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30 June 1970

Materiel Test Procedure 10-2-185
General Equipment Test Activity

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U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

VECTOR CONTROL EQUIPMENT

1970

AD 873575

1. OBJECTIVE*

This document provides test methods and techniques necessary to determine the technical performance and safety characteristics of vector control equipment and associated tools and equipment as described in Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), and Technical Characteristics (TC's), and to determine the item's suitability for service tests.

2. BACKGROUND

The U. S. Army has requirements for materials and devices which can provide for the control of vectors. As used here, the term vector implies an organism (as an insect) which transmits a pathogen- or disease-causing virus. It is due to this ability to transmit disease that vectors represent a hazard to the health and environment of military personnel. Control over vectors can, depending upon the circumstances and the method used, be classed as either shielding, repulsion, or extermination and all vector control equipment will provide one or more of the types of control when utilized. There are within the subject of vector control equipment (4) subdivisions, these being:

- I. Insecticides - Personal repellent and non-personal
- II. Insecticide dispensers
- III. Personal equipment
- IV. Auxiliary equipment

Insecticides are chemicals usually in powder, liquid, or water soluble form used primarily for extermination, but in some cases, providing only repulsion as with the personal repellent types.

To facilitate handling and usage of chemicals, dispensers, usually referred to as sprayers, foggers or dusters are used. There is a wide range in the design of dispensers for such characteristics as capacity, expulsion rate and mode of transportation. Sizes also range from trailer mounted gasoline engine driven units to manually operated and manually carried types. The principle of operation of sprayers and foggers is basically the same for liquid dispensing. Chemical insecticides in a reservoir are forced through supply lines to output nozzles either by the application of sufficient pressure at the air-material interface or by continuous acting in line pumps in the larger systems. The output nozzles are usually adjustable allowing for a stream or spray discharge. Dusters usually dispense powdered insecticides

*This MTP is intended to be used as a basic guide in preparing actual test plans for the subject equipment. Specific criteria and test procedures must be determined only after careful appraisal of pertinent QMR's, SDR's, TC's and any other applicable documents.

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by blower action on an air-powder mixture produced by agitation.

Personal equipment encompasses those items which are affixed about the body in some manner so as to provide protection against the vector and also to provide protection for personnel involved in the discharging of chemicals. Face nets and masks are examples of this category.

Finally, auxiliary equipment would be those remaining items which though in a strict sense are non-personal are closely related to personal protection by their usage. Screening type guards or bed nets would be an example of this category.

This document is intended to provide for the complete evaluation of all vector control equipment through procedures for testing and methods and criteria for inspection.

3. REQUIRED EQUIPMENT

- a. EMI Testing Facility - shielded room or open area
- b. Shock Test Facility
- c. Mechanical Shaker Assembly
- d. Sound Anechoic Chamber
- e. Field Intensity Meter
- f. Rod, Biconical, and Conical Log-Spiral Antennas
- g. Miscellaneous Sieves per Federal Specification RR-S-366
- h. Glass Stoppered Graduated Cylinder - 100 ml.
- i. Thermometers - liquid in glass - °F and °C.
- j. Miscellaneous Chemical Laboratory Glassware
- k. pH Electrometer
- l. Ohmmeter
- m. 500 VDC megohmmeter or bridge
- n. Dielectric Strength Tester 0-3000VRMS, 25-60Hz
- o. Wheatstone Bridge
- p. Ammeters, Voltmeters, Wattmeters - AC and DC
- q. Scales
- r. Rulers
- s. Sound Level Meter per ASA S1.4-1961
- t. Octave Band Analyzer per ASA S1.6-1960
- u. Miscellaneous Chemicals
- v. Distilled and Hard Water

4. REFERENCES

- A. USATECOM Regulation 70-23, Equipment Performance Report.
- B. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- C. USATECOM Regulation 700-1, Value Analysis in Materiel Testing.
- D. Federal Test Method Standard No. 141, Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing.
- E. Federal Test Method Standard No. 601, Rubber: Sampling and

Testing.

- F. Federal Test Method Standard No. 791, Lubricants, Liquid Fuels and Related Products, Methods of Testing.
- G. Federal Standard 102, Preservation, Packaging and Packing Levels.
- H. Federal Specification RR-S-366, Sieves, Standard for Testing Purposes.
- I. Federal Specification ZZ-G-381, Gloves.
- J. Federal Specification GGG-M-131, Masks.
- K. Federal Specification GGG-G-521, Goggles.
- L. MIL-STD-129, Marking for Shipment and Storage.
- M. MIL-STD-130, Identification Marking of U. S. Military Property.
- N. MIL-STD-282, Filter Units, Protective Clothing Gas Mask Components and Related Products, Performance Test Methods.
- O. MIL-STD-461, Electromagnetic Interference Requirements for Equipment.
- P. MIL-STD-462, Electromagnetic Interference Characteristics, Measurement of.
- Q. MIL-STD-463, Definitions and Systems of Units Electromagnetic Interference Technology.
- R. MIL-STD-707, Air Permeability Fineness.
- S. MIL-STD-810, Method 516 Shock Tests.
- T. TMS-632, Military Entomology Operational Handbook, Headquarters Department of the Army 1965.
- U. MIL-P-116, Preservation, Methods of.
- V. MIL-S-1837, Spray Gun, Insecticide Dusting Powder.
- W. MIL-C-3395, Cloth, Netting, Nylon.
- X. MIL-E-11275, Engines, Gasoline, Industrial Type General Specification for.
- Y. MIL-I-11489, Face Nets.
- Z. MIL-B-11757, Boxes: Fiber, Corrugated.
- AA. MIL-S-12651, Sprayers, Packaging of.
- AB. MIL-B-43291, Boxes: Fiberboard, Corrugated, Double-Wall, Water-Resistant.
- AC. HEL Standard S-1-63B, Maximum Noise Level for Army Materiel Command Equipment June 1965.
- AD. USAGETA Document (HEDGE), Human Factors Evaluation Data For General Equipment November 1967.
- AE. NEMA National Electrical Manufacturer's Association, Tests and Performance AC and DC Fractional and Integral Horsepower Motors Part 12 1966.
- AF. ANSI S1.2-1962, Physical Measurement of Sound.
- AG. ANSI S1.4-1961, General Purpose Sound Level Meters.
- AH. Air Moving and Conditioning Association AMCA Standard 210-67, Test Code for Air Moving Devices.
- AI. MTP 10-2-500, Physical Characteristics.
- AJ. MTP 10-2-501, Operator Training and Familiarization.
- AK. MTP 10-2-502, Durability.
- AL. MTP 10-2-503, Surface Transportability (General Supplies and Equipment).
- AM. MTP 10-2-505, Human Factors.
- AN. MTP 10-2-507, Maintenance Evaluation.

- AO. MTP 10-2-508, Safety.
- AP. MTP 10-2-511, Quality Assurance.
- AQ. MTP 10-2-512, Reliability.

5. SCOPE

5.1 SUMMARY

The contents of these procedures are intended to provide for the complete evaluation of vector control materials and devices. Due to the wide variation between the subdivisions of this commodity class and in order to present a complete testing document, the tests are presented so as to include considerations, where applicable, of the appropriate requirements of each subdivision. Following the title of each test is a bracketed list containing those subdivisions (as represented by their corresponding Roman numeral of section 2.) which have requirements listed in that particular test. Where there is doubt as to which subdivision a particular item belongs, the brief descriptions of each subdivision in section 2. may also be used. Since not all tests nor all procedures in a given test are required or applicable in the evaluation of a particular item the test director should determine those procedures which will be used prior to the start of testing.

- a. Preparation for Test (I, II, III, IV) - A determination of the condition of the test item upon arrival, its physical characteristics, pre-operational checks and operator training and familiarization requirements.
- b. Chemical Analysis (I) - An evaluation of the chemical properties of the finished insecticide. The finished insecticide contains the primary technical chemical plus any added solvents or emulsifiers.
- c. Hydrostatic and Pneumatic Tests (II) - An evaluation designed to reveal leakage and to determine mechanical strength of components through the use of controlled water and air pressures. The resistance to solvents of other components will also be determined.
- d. Preliminary Electrical Measurements (II) - A determination of the condition of the electrical circuits of the test item prior to the application of normal operating power.
- e. Operation and Performance (II) - An evaluation to determine the degree to which the test item performs its primary function. In particular, the rate and coverage of material delivery are determined in the performance test and test item controls and indicators are evaluated.
- f. Electromagnetic Interference (II) - An evaluation to determine the extent to which the test item produces radiated or line conducted interference.
- g. Durability (IV) - An evaluation of the test item's capability to retain original performance and physical characteristics after extended operation.
- h. Balance (I) - An evaluation to determine the extent of undesirable motion which the test item exterior housing exhibits due to the moving components of the test item.
- i. Transportability (I, II, III, IV) - An evaluation to determine the capability of the test item to withstand the forces which it will experience during normal handling and transporting.

j. Maintenance (II) - An evaluation to determine and appraise the test item's maintenance characteristics and requirements, a verification and appraisal of its malfunctions, an evaluation of the test item's associated publications and other common and special support elements (maintenance test package), an appraisal of the test item's design for maintainability (AMCP 706-134: accessibility, ease of maintenance, standardization, and interchangeability), an evaluation of component and system durability and reliability, and the calculation of indicators which express the effects of appropriate preceding aspects.

k. Safety (I, II, III, IV) - An evaluation to determine the safety characteristics and possible hazards of the test item.

l. Human Factors Evaluation (I, II, III, IV) - An evaluation to determine the adequacy of the design and performance characteristics of the test item and associated equipment in terms of conformance to accepted human factors engineering design criteria. Where applicable the sound noise level of the test item will be measured.

m. Value Analyses (I, II, III, IV) - An evaluation directed at analyzing the primary function and features of the test item for the purpose or reducing the cost of the test item without compromising performance and safety characteristics.

n. Quality Assurance (I, II, III, IV) - A study to determine the quality of the test item.

5.2 LIMITATIONS

Any material or device which can be assigned to either of the (4) major subdivisions listed in paragraph 2. can be tested by procedures given in this document. Support apparatus such as carriers (sleds, push carts, trailers) will not be tested by this MTP. Refer to Volume I of USATECOM Materiel Test Procedures for the appropriate MTP.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Initial Inspection

The test item shall be subjected to the following on arrival at the test site.

6.1.1.1 Packaging Inspection

a. Verify the marking on all containers for conformance with MIL-STD-129.

b. Remove the test item from the container(s) and record deviations from the following:

- 1) Preservation in accordance with MIL-P-116
- 2) Class packaging in accordance with the following:

- a) Class I - Federal STD-102

- b) Class II - MIL-S-12651
- c) Class III - MIL-B-43291
- d) Class IV - MIL-B-11757

3) Packages contain the following printed material:

- a) Class I - Handling and dispensing instructions.
- b) Class II - Mechanical and electrical drawings and manuals containing installation, operation and maintenance data.
- c) Class III - Instructions for usage.
- d) Class IV - Installation and/or usage instructions.

6.1.1.2 Inventory Check

Verify completeness of the test item and agreement between the contents of the packages and the basic issue items list (BIIL).

6.1.1.3 Test Item Inspection

130. a. Verify that the test item is marked in accordance with MIL-STD-

b. Visually inspect the test item and record the following:

1) Evidence of defects:

- a) Manufacturing
- b) Material
- c) Workmanship

2) Evidence of damage.

3) Evidence of wear.

4) Correlation of data on accompanying printed material with test item markings.

c. Examine the test item for verification of the following:

1) Class I material containers are clearly marked for handling and dispensing. Where the material is toxic in nature safety precautions are given. Labeling is in accordance with the Federal Insecticide Fungicide and Rodenticide Act.

2) Class II devices and materials are in accordance with the following:

- a) Exterior surfaces are treated and printed in accordance with MIL-T-704.
- b) Fans and blowers, if used, are rated and tested in accordance with the requirements of the AMCA Standard Test Code for air moving devices.
- c) All electrical wiring and safety devices shall conform to the National Electrical Code.
- d) All motors, are constructed and rated in accordance with

the applicable provisions of the NEMA Standards for Motors and Generators.

- e) Gasoline engines where used are in accordance with MIL-E-11275.
 - f) Powder dispensing units, spray gains in accordance with MIL-S-1837.
- 3) Class III devices and materials are in accordance with the following:
- a) Goggles - Federal Specification GGG-G-521
 - b) Masks - Federal Specification GGG-M-131
 - c) Gloves - Federal Specification ZZ-G-381
 - d) Face Nets - MIL-I-11489C
- 4) Class IV devices and materials are in accordance with MIL-C-3395.

6.1.2 Physical Characteristics

Physical characteristics of the test item shall be determined by performing the applicable sections of MTP 10-2-500 and in addition, for the individual subclasses denoted, the following will be performed:

6.1.2.1 Class III - (Personal Equipment)

Evaluate the physical characteristics of the items in this class in accordance with the requirements of MIL-STD-282 and, as applicable, the following:

- a. Masks - Bureau of Mines Schedule 14
- b. Gloves - Federal Test Method Standard 601
- c. Face Nets - Federal Specification CCC-T-191 Textile test methods
- d. Goggles - Federal Specifications GGG-G-521

6.1.2.2 Class IV - Auxiliary Equipment

Evaluate the item in this class in accordance with Federal Specification CCC-T-191.

6.1.3 Operator Training and Familiarization

a. Orient test personnel as described in applicable sections of MTP 10-2-501 and the following:

- 1) Familiarize test personnel with the objectives and procedures of the tests to be performed.
 - 2) Instruct test personnel in the safety, installation, operation and maintenance of the test item using the technical manuals.
- b. Determine the adequacy of the supplied manuals for training

MgCL ₂ 6H ₂ O	0.1388g
Distilled water to make	1 liter

c. Emulsifier water content - The water content shall be determined by titration with Karl Fischer reagent in accordance with Method 4082 of Federal Test Method Standard No. 141.

6.2.1.2 Non Personal Insecticides (Chlorinated hydrocarbons and phosphorous compounds in concentrate water emulsifiable, liquid and powder form).

Subject a sample of the insecticide to the tests which are applicable from the following:

a. Powders:

- 1) Appearance - The powder shall be a free flowing, clean material without foreign material and uniform. (no cakes, lumps or agglomerates).
- 2) Particle Size - Screen a dry 20 gm. sample through a U. S. Standard sieve of the designated mesh size conforming to RR-S-366 using a single eccentric type mechanical shaker which imparts to the sieve a rotary motion and tapping action. Use 300 ± 15 gyrations and 150 ± 10 taps as the shaker rates. Weigh the residue and calculate the percentage passing through the sieve.
- 3) Surface Mean Particle Diameter - The surface mean particle diameter will be determined by the air permeation method. The apparatus will be an approved air permeation device in accordance with MIL-STD-707 and will be properly calibrated. The solid density of the powder which must be known prior to the permeation test shall be determined by Method 4181 of Federal Test Method Standard No. 141 substituting a 1% solution of a suitable wetting agent in distilled water as the immersion medium and omitting the oven drying of the sample.
- 4) pH Measurement - Shake a suspension of 20 grams of the finished insecticide and 80 milliliters of distilled water in a glass stoppered Erlenmeyer flask at intermittent intervals during the course of one hour. Filter the suspension through a quantitative filter paper and determine the pH of the filtrate by any suitable method such as a calibrated pH electrometer.

b. Concentrate-Water Emulsifiable:

- 1) Appearance at 80°F - With the sample at $80^\circ \pm 10^\circ\text{F}$ the sample shall be homogeneous solution without traces of sediment.
- 2) Appearance at 32°F - Fill a 50ml glass stoppered cylinder and store for 168 hours at $32^\circ \pm 1^\circ\text{F}$. Examine the sample by transmitted light for clarity, phase formation, sediment and deposition.

- 3) Flash Point - Determine the flash point by the tag closed cup tester in accordance with Method 1101 of the Federal Test Method No. 791.
- 4) Emulsion Stability - Place 98 ml. of hard water (as described in section 6.1.2) at $80^{\circ} \pm 5^{\circ}\text{F}$ into a 250 ml. beaker. Use a power driven stirrer to stir at 1000 revolutions per minute. Add 2 ml. of the concentrate from a pipette and continue stirring for one minute. Pour the emulsion into a 100 ml. glass stoppered graduated cylinder and after one hour examine under strong transmitted light for phase formation and sediment.
- 5) pH Measurement - Place 98 ml. of distilled water in a glass stoppered cylinder and add 2 ml. of concentrate and mix by vigorous shaking. Determine immediately the pH by any standard method such as with a calibrated pH electrometer.
- 6) Water Content - The water content of the concentrate shall be determined by the distillation procedure outlined in Method 3001 of Federal Test Method Standard No. 791.
- 7) Compatibility with Hydrocarbons - With ingredients at $80^{\circ} \pm 5^{\circ} - 0^{\circ}\text{F}$ add 5 ml. of concentrate to 95 ml. of diesel oil conforming to VV-F-800 type DF-2 contained in a 100 ml. mixing cylinder. Stopper the cylinder and mix the contents thoroughly by inverting and righting the cylinder 30 times. Wait 10 minutes and examine the diluted concentrate for phase separation and sedimentation. Store at the test temperature for 24 hours and re-examine.

c. Liquids:

- 1) Appearance - The insecticide shall be a clear homogeneous liquid without sediment.
- 2) Staining Properties - Immerse a 6 inch square of bleached cotton sheeting in the insecticide. Thoroughly wet the sheeting, wring out excessive liquid and hang up to dry for 48 hours in a well ventilated room.
- 3) Water Content - The water content shall be determined in accordance with Method 4082 of the Federal Test Method Standard No. 141.
- 4) Flash Point - The flash point shall be determined by the tag closed cup tested in accordance with Method 1101 of the Federal Test Method No. 791.
- 5) Residual Odor - Dip uniform strips of filter paper into the insecticide and allow to evaporate for 24 hours at $75^{\circ}\text{F} \pm 5^{\circ}$. Examine the exposed paper for strong and offensive odors.
- 6) pH - Phase 25 ml. of the insecticide together with 100 ml. of distilled water in a 250 ml. separatory funnel and shake vigorously. Allow phase separation for several minutes and determine the pH of the aqueous portion by any acceptable method such as a pH electrometer.

6.2.2 Hydrostatic and Pneumatic Tests

6.2.2.1 Sprayers

a. For manually carried (capacity rated at several gallons) units perform the following:

- 1) Tank (fluid container) hydrostatic - Subject the tank to an internal hydrostatic pressure of 100 psi. Examine the unit for leaking or deformation.
- 2) Tank Pneumatic - Subject the tank to an internal air pressure 60 psi, submerge the tank in water and check for air leakage.
- 3) Solvent resistance of hose. Immerse hoses for not less than 48 hours in a test solution, (see Table I) at a temperature of (70 - 80)°F. After the immersion period, wash the hose with clear water, dry it and test item for hydraulic bursting pressure and swelling. Test limits will be a minimum of 150 psi and 30% swelling.

TABLE I: TEST SOLUTION

	% by weight
Kerosene	60
Benzene	5
Toluene	20
Xylene	15

b. For manually carried units capacity rated at approximately one quart, perform the following:

- 1) Pump seam and joints tightness - Seal the nozzle of the unit and immerse the sprayer in water. Examine the test item for seam leakage or rapid loss of air past the plunger valve during the compression stroke of the sprayer.
- 2) Container seam tightness - Fill the container with kerosene, allow it to stand for 4 hours and examine for leakage.

c. For carrier mounted gasoline engine driven units perform the following:

- 1) Solvent resistance of hose - High pressure (discharge) and suction hose shall be tested as in section 6.1.2.1.1.a.
- 2) Discharge hose hydrostatic - Subject this hose to a hydrostatic pressure of 800 psi and examine for leakage and swelling.
- 3) Suction hose - Subject this hose to a vacuum pressure of -30.5 ft. water or -26.81 inches mercury. Examine the hose for signs of collapse.

6.2.2.2 Dusters

Operate the test item and allow a buildup in air pressure of 30 psig. Subject all connections and lines to air leakage checks by the application of water containing a 20% solution of soap.

6.2.3 Preliminary Electrical Measurements

Perform the following on Class II devices requiring the application of external electrical power:

- a. Without power leads connected to the test item, set the power control to the "on" position.
- b. Using an ohmmeter, check that each power lead is ungrounded and that the earth or building ground lead is connected to the test item housing. Where multiple power input locations exist, repeat the test at each location.
- c. If the test item is equipped with a motor, determine the direct current resistance of each motor winding of each motor by performing the following:
 - 1) Isolate the motor loads.
 - 2) Using a Wheatstone bridge, measure and record the resistance of each winding.
 - 3) Measure and record the ambient room temperature.
- d. Reconnect the motor(s) power leads.
- e. Using the megohmmeter, measure and record the insulation resistance between each winding with its associated circuit and the test item case with all other circuits connected to the test item case. Repeat the test for each motor.
- f. Using the dielectric strength tester, test each electrical circuit by applying the test voltage between the circuit and ground with all other circuits connected to ground. The procedure and voltage used will depend on the motor found in the circuit. See Appendix A. for the applicable requirements.

NOTE: For steps c. and f. where there are shunt components with lower voltage ratings than the test voltage these may be disconnected.

6.2.4 Operation and Performance

Class II devices shall be subjected to the following in the evaluation of their performance characteristics.

6.2.4.1 Sprayers

6.2.4.1.1 Manually Carried - Perform the following:

- a. For manually pumped units:

- 1) Fill the sprayer with insecticide and record volume.
- 2) Check for leakage by holding the sprayer at various angles and inverting.
- 3) Operate the sprayer by successive pump strokes during which the nozzle will be tested. The spray should range from a fine mist to a solid pin stream.
- 4) Operate the sprayer directing the spray into a graduated measuring container and record the number of operating strokes, N, and the accumulated insecticide M in the container, in liquid volume units.
- 5) Record any binding or sticking of the pumping mechanism.
- 6) Operate the sprayer until the spraying ceases and measure the residue, R, remaining in the container.

b. For power driven, hand operated, - continuous units:

- 1) Fill the sprayer with insecticide and record volume, V.
- 2) Check for leakage.
- 3) Operate the sprayer by applying power and record the starting time, T₁.
- 4) Continue operating until the spray container is empty and record the finishing time and the container residue, R.
- 5) Refill the insecticide container, operate the test item and evaluate the adjustment range of each type nozzle provided.
- 6) Measure and record the electric power consumption of the sprayer.

6.2.4.1.2 Carrier Mounted - Gasoline Engine Driven Units - Perform the following:

- a. Using as a test liquid, diesel fuel No. 2, load the supply tank with test fluid, start the gasoline engine and adjust spray for normal operating output.
- b. Test each nozzle and/or flow control disk provided for adjustment range and effectiveness of delivery.
- c. Determine the capability for a change of spray pattern from solid stream to mist.
- d. Vary the pump through its pressure range and check for a continued smooth delivery.
- e. Check the pump to verify that it is self priming.
- f. Bring the pump to maximum pressure with the spray gun shut off. Check entire system for leakage.
- g. Operate the spray gun in sequential on-off cycles to determine the effects of abrupt pressure changes.
- h. Determine the discharge rate of the unit by performing a timed filling of a drum type container of known volume, and record the length of time required to fill the drum.

6.2.4.2 Dusters, Gasoline Engine Driven Air Compressor

- a. Load the insecticide dust in the container.
- b. Bring the engine to operating level.

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- c. Measure the delivery rate by expelling a known quantity of dust. Record the elapsed time and quantity of dust expelled.
- d. Verify the proper operation of all valves, controls and indicators.

6.2.4.3 Fog Generator, Manual, Pulse Jet Engine

- a. Load the insecticide tank with diesel oil No. 2.
- b. Start the engine with the control valve off.
- c. Open the valve and attain a steady discharge.
- d. Spray the discharge onto a target where an estimate can be made of the particle size caused by fractionalization.
- e. Reload the tank and run the fogger until the insecticide supply is exhausted. Record the elapsed time.

6.2.5 Electromagnetic Interference

This test is applicable for devices which either require external electrical power or are powered by gasoline engines utilizing electrical ignition systems. The test will be conducted in accordance with the requirements of MIL-STD-461 and MIL-STD-462, using the definitions of MIL-STD-463, as denoted in Table II.

The radiated and conducted interference tests will be conducted according to the procedures of MIL-STD-462 in an area where ambient interference is at least 6 db below the allowable specified limit. Ground planes or their equivalent shall be used. The measuring set should be calibrated, the proper antenna used and the measuring distance observed.

The following antennas shall be used as applicable:

- a. 14 KHz to 25 MHz - 41 inch rod antenna (electrical length = 0.5 meters) and appropriate matching network with a square counterpoise whose sides measure at least 60 cm.
- b. (20-200) MHz biconical antenna.
- c. (200-1000) MHz conical log spiral antenna.

6.2.6 Balance Test

Determine the balance characteristics of engine or motor driven Class II test items both manually and not manually carried, in their normal operating mode dispensing insecticide or test fluid as follows:

- a. For stationary test items measure and record the vibration of the test item housing at various locations to obtain a measure of balance.
- b. For manually carried test items determine a measure of the design balance through discomfort, due to forces, which the user experiences and record discomfort experienced.

6.2.7 Durability

Subject test items from Class II which are equipped with electric motors or are driven by fuel burning engines to the procedures in MTP 10-2-502, and the following:

TABLE II: ELECTROMAGNETIC INTERFERENCE TESTS

<u>DEVICE DESCRIPTION</u>	<u>CLASS OF MIL-STD-461</u>	<u>REQUIRED TESTS</u>	<u>DESCRIPTION</u>
EXTERNALLY POWERED	IIB	CE03	0.02 - 50MHZ POWER LEADS
		CE05	30Hz - 50MHZ INVERSE FILTER METHOD
		RE01	0.03 - 30KHz MAGNETIC FIELD
		RE02	14KHz - 10GHZ ELECTRIC FIELD
		RE04	0.02 TO 50MHZ MAGNETIC FIELD
ENGINE DRIVEN	IIIC	RE05	150KHz TO 400MHZ RADIATED EMISSIONS

a. With the test item in its normal operating mode, running at rated pressure and discharge rate operate it for a time period in accordance with the following:

- 1) Sprayer, Manually Carried, - Electric - 0.5 hour.
- 2) Sprayer, Gasoline Engine Driven - 8 hours.
- 3) Fog Generator - Portable - Pulse - Jet Engine - 4 hours.
- 4) Duster, Gasoline Engine Driven Compressor - 200 hours (not continuously but not less than 20 hours/day).

- NOTES:
1. For classes, 2, 3, and 4, the insecticide may be recirculated back to the supply tank in order to conserve material.
 2. Portable items may be unmanned but must be rigidly mounted in a test stand.

b. During the run, monitor fuel and electrical power consumption and read all gauges provided to determine gross changes in operating conditions.

c. Determine if overheating occurs at any location on the test item.

d. At the completion of the test, test all motor windings for resistance and dielectric strength to determine heat effects and test each electrical circuit for insulation resistance. Use the procedures described in paragraph 6.2.3 steps c through f.

e. Measure and record winding resistances for all motors.

f. Examine the test item for signs of accelerated wear and record such conditions where they exist.

NOTE: Steps d. and e. shall be performed immediately at the completion of the run while components are still at their operating temperature.

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6.2.8 Transportability

- a. Determine the transportability characteristics of the test item as described in the applicable sections of MTP 10-2-503.
- b. Determine the effect of transportation on the test item by operating the test item under normal conditions and see if there has been any change in its operating efficiency.

6.2.9 Maintenance

Evaluate the maintenance-related factors of the test item as described in MTP 10-2-507 and MTP 10-2-512, with emphasis on the following:

- a. Organizational (O), Direct Support (F), and General Support (H) Maintenance Requirements.
- b. Operator through General Support Maintenance Literature.
- c. Repair parts.
- d. Tools.
- e. Test and handling equipment.
- f. Calibration and maintenance facilities.
- g. Personnel skill requirements.
- h. Maintainability.
- i. Reliability.
- j. Availability.

6.2.10 Safety

- NOTE:
1. During testing, issue a Safety Release recommendation in accordance with USATECOM Regulation 385-6.
 2. During conduct of all tests, test personnel shall observe the proper safety precautions and, in particular, shall adhere closely to the manufacturer's instructions for the handling and use of the test item.
 3. The procedures for all tests and the test item shall be examined and any condition which might constitute a safety hazard shall be recorded.

Determine the safety characteristics of the test item, using the applicable procedures of MTP 10-2-508, and by considering the following specific safety factors for the individual subclasses of vector control equipment:

- a. Class I, Insecticides - Where toxic insecticides are handled or dispensed, the proper personal safety equipment shall be utilized by personnel.
- b. Class II, Dispensers:

- 1) Prepare a list of all safety devices used on the test item. For each device listed, a minimum of two cycles of operation will be caused by simulating the type failure which the device is to detect. Record the following:
 - a) Device
 - b) Failure for which device was provided
 - c) Proper operation of device
 - d) Absence of or suggestions for additional safety devices

- 2) General Safety Considerations - the test item will be examined for the following and any discrepancies noted:
 - a) Electrical parts shall be so located or enclosed so that suitable protection against accidental contact with un-insulated energized circuits is provided.
 - b) All internal wiring shall be protected against heat and contact with moving parts.
 - c) Where connections are made to internal wiring a barrier type terminal board or equivalent shall be used for secure lead attachment and protection against accidental contact of leads attached adjacent to each other.
 - d) Where line cords are used they shall be of sufficient current carrying capacity, shall be protected against rubbing at access ports by insulated bushings and shall be sufficiently strain relieved to withstand approximately five pounds of pull.
 - e) Where line fuses are used they shall be of a value consistent with the requirements of the test item.
 - f) Where switches are used they shall be of sufficient current capacity and mounted so as not to allow movement.
 - g) All metal parts shall be electrically bonded and grounded to prevent static electrical buildup.
 - h) The materials used in the motors and engines shall be inherently nonflammable and nonexplosive.
 - i) Where the normal operating temperature of the motor(s) shall be sufficient to cause a burn the motor shall have a plate attached stating this fact.
 - j) All moving parts of the set shall be enclosed to avoid accidental contact when the test item is in its operating position.
 - k) All propellers or impellers shall be securely attached to the motor shafts.
 - l) All external surfaces and internal surfaces (those exposed during maintenance) shall have no sharp edges.
 - m) Where a thermal overload is provided for a motor it shall be tested for operation and the method of reset (manual or automatic) verified.
 - n) The blades or impellers and shafting shall be sufficiently strong and designed with adequate clearance to prevent contact with casings or prevent distortion under conditions

- of deposit loading or other factors.
- o) Where capacitors are used they shall be housed in a suitable enclosure which will provide protection and also prevent the emission of flame or molten material in the event of a failure.

6.2.11 Human Factors Evaluation

6.2.11.1 General Evaluation

Determine the degree to which the design and performance of the test item satisfy accepted standards for human factors as described in applicable sections of MTP 10-2-505 and the following:

- a. Use the requirements of Human Factors Evaluation Data for General Equipment (HEDGE) and prepare checklists for human factors considerations of the test item for functional areas according to Table III.

Table III: Vector Control Equipment Test Functions.

<u>Vector Control Equipment Class</u>	<u>Material Type</u>	<u>HEDGE Class</u>	<u>Test Functions</u>
I	Insecticides	IV B	Transportability Portability/Usability Operability
II	Dispensers	III C	Maintainability Transportability Operability
III	Personal Equipment	IV D	Portability/ Usability
IV	Auxiliary Equipment	IV D	Portability/ Usability

- b. Perform the following tasks for the test functions specified:
 - 1) Transportability:
 - a) Prepare for transport
 - b) Load/Unload
 - c) Secure/Unfasten
 - 2) Maintainability:
 - a) Malfunction indication and determination of cause
 - b) Access to defective component
 - c) Adjustments and routine maintenance of test item

3) Operability:

a) VCE Class I:

- (1) Unpackaging
- (2) Preparation for use
- (3) Consumption

b) VCE Class II:

- (1) Assembly and set up
- (2) Preparation for use
- (3) Activation and performance
- (4) Portability/Usability

c) VCE Class III and Class IV as applicable:

- (1) Don and doff
- (2) Carrying
- (3) Preparation for and use
- (4) Fit and adjustment

c. Evaluation of the tasks of step b shall include but not be limited to the following:

- 1) Task performed
- 2) Adequacy of instructions and tools to perform the task
- 3) Ease of performing the task
- 4) Design of test item as it affects the task
- 5) Time and personnel required for the task
- 6) Safety

6.2.11.2 Noise Evaluation

6.2.11.2.1 Preparation for Test - Perform the following:

Prepare the test item for noise evaluation utilizing a sound level meter and an octave band filter set to evaluate the noise characteristics of the test item in its normal operating mode. Where size permits and the facility is available, the test will be conducted in a sound anechoic chamber. There should be no obstructions between the measuring microphone and the test item. Measuring locations for the microphone shall be along a circular path whose radius is approximately ten feet measured to the approximate geometric center of the test item. No measurements should be taken at plus or minus 30° with respect to the center line of an open inlet or outlet. Use measuring locations approximately every 20° apart with the microphone encased in a sound absorbing enclosure which is open only on the side facing the test item to minimize indirect reflections to the detective device.

6.2.11.2.2 Test Procedures - Perform the following:

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- a. Calibrate the sound level meter and set the weighting network switch to the "flat response" or C position.
- b. Operate the test item at its rated output.
- c. Determine the highest sound pressure level in each band over all of the bands at each location (see Table IV).

Table IV: Series 2 Frequency Analysis

BAND	FROM	TO	MAX. STEADY STATE NOISE LEVEL	CENTER FREQUENCY*
1	45	90	119	63
2	90	180	114	125
3	180	355	107	250
4	355	710	99	500
5	710	1400	91	1000
6	1400	2800	89	2000
7	2800	5600	89	4000
8	5600	11,200	91	8000

*Defined as geometric mean of cut-off frequencies.

d. For the point of highest sound pressure in each band determine also the ambient noise level (test item inoperative).

6.2.12 Value Analysis

a. During the conduct of all tests the test personnel will examine the materials, design and construction of the test item from a value standpoint in an effort to affect cost reduction of the test item. In particular the following possibilities should be considered:

- 1) Deletion of ineffective or unnecessary features or components.
- 2) Substitution of less expensive but comparable component or material.
- 3) Changes in design of the test item in order to reduce the cost of manufacturing.

b. The proposals resulting from the test should not result in a lowering of the performance and safety characteristics of the test item.

c. Record the following for each item being considered:

- 1) Component or feature involved
- 2) Suggested change
- 3) Reasons for suggestion

6.2.13 Quality Assurance

Determine the quality of the test item as described in applicable

sections of MTP 10-2-511.

6.3 TEST DATA

NOTE: In compiling the Test Data section, test personnel should expound upon those data procedures which are other than quantitative in nature by recording narrative descriptions which will provide full details of conditions and/or events occurring during the conduct of the test.

6.3.1 Preparation for Test

6.3.1.1 Arrival Inspection

6.3.1.1.1 Packaging Inspection -

Record the following:

- a. Noncompliance with requirements of standards for marking, preservation and packaging.
- b. Absence of required printed matter.

6.3.1.1.2 Inventory Check -

Record any missing items

6.3.1.1.3 Test Item Inspection -

Record the following:

- a. Noncompliance with the marking requirements of MIL-STD-130.
- b. Evidence of defects, damage or wear.
- c. Improper accompanying printed matter.
- d. Noncompliance with the referenced standards for components materials and construction.

6.3.1.2 Physical Characteristics

Record the data required by MTP 10-2-500 and any features of the test item not in accordance with the referenced standards.

6.3.1.3 Operator Training and Familiarization

Record the following:

- a. Data collected as described in applicable sections of MTP 10-2-501
- b. Adequacy of manuals for training purposes

6.3.1.4 Pre-Operational Inspection

Record the following:

- a. Difficulties encountered
- b. Any lubrication procedures required
- c. Any valves, controls, or adjustables which do not move freely

6.3.2 Test Conduct

6.3.2.1 Chemical Analysis:

Record, for the insecticide types, the following:

6.3.2.1.1 Personal application repellent -

- a. Appearance not as required
- b. Improper emulsification
- c. Water content

6.3.2.1.2 Non-Personal Insecticides -

a. Powders:

- 1) Appearance not as required
- 2) Particle size in microns
- 3) Particle diameter in cm
- 4) pH

b. Concentrate-Water Emulsifiable:

- 1) Appearance not as required at 80°F
- 2) Appearance not as required at 32°F
- 3) Flash point in °F
- 4) Improper emulsion stability
- 5) pH
- 6) Water content
- 7) Incompatibility with hydrocarbons

c. Liquids:

- 1) Appearance not as required
- 2) Any staining exhibited
- 3) Water content
- 4) Flash point in °F
- 5) Any strong or offensive odor
- 6) pH

6.3.2.2 Hydrostatic and Pneumatic Tests

Record for the test items denoted the following:

6.3.2.2.1 Sprayers -

- a. Manually carried (gallon capacity):
 - 1) Evidence of leakage or deformation during the hydrostatic test.
 - 2) Evidence of leakage during the air pressure test.
 - 3) Hose ability, after immersion, to withstand 150 psi and not exhibit more than 30% swelling.
- b. Manually carried (quart capacity):
 - 1) Any evidence of leakage or rapid air loss during compression stroke (pump seam and joints).
 - 2) Evidence of leakage from container.
- c. Carrier mounted-gasoline engine driven:
 - 1) Hoses withstand 150 psi and do not exhibit excessive swelling after solvent test.
 - 2) Discharge hose withstands 800 psi and does not leak or swell.
 - 3) Suction hose withstands - 26.81 in. Hg. and exhibits no sign of collapse.

6.3.2.3 Preliminary Electrical Measurements

Record the following:

- a. Improperly wired power leads.
- b. For each motor winding:
 - 1) Identification of motor
 - 2) Identification of winding
 - 3) Resistance in ohms
 - 4) Winding temperature in °F
- c. Insulation resistance in megohms for each circuit.
- d. Identification of any circuits which fail the dielectric strength test.

6.3.2.4 Operation and Performance

Record the following for different classes of dispensers:

6.3.2.4.1 Sprayers -

- a. Manually carried-manually pumped:
 - 1) The volume of the sprayer, in liquid measure.
 - 2) For any leakage, the location on the sprayer.
 - 3) The relative range of spray variation for the nozzle.

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- 4) The number of strokes used from the dispensing rate test.
- 5) The accumulated spray in the measuring container, in liquid measure.
- 6) Signs of binding or sticking and its frequency.
- 7) The residue in the container when spraying ceases.

b. Power driven, hand operated, continuous:

- 1) The sprayer volume, in liquid measure.
- 2) For any leakage, the location on the sprayer.
- 3) The time interval for the dispensing rate test.
- 4) The time when the container is empty and the sprayer residue in liquid measure.
- 5) The relative range of spray variation for each nozzle.
- 6) Record the rate of power consumption, in watts.

c. Carrier mounted - gasoline engine driven:

- 1) The supply tank volume, in liquid measure.
- 2) The relative range of spray variation for each nozzle.
- 3) The range of pump pressures used, in psi and evidence of ineffective delivery.
- 4) Any difficulties experienced in priming the pump.
- 5) Any leaking exhibited, with the spray gun off, and pump at maximum pressure. Give locations.
- 6) Any failures experienced during sequential on-off spray gun cycles.
- 7) The volume of the test drum used, V, in liquid measure, and the time, T, required to fill the drum, in minutes.

6.3.2.4.2 Dusters - Gasoline Engine Driven, Air Compressor -

- a. The container volume, in lbs.
- b. The amount of dust, M, expelled in lbs, and time required, T, in minutes.
- c. Any difficulties in the operation of valves or controls.

6.3.2.4.3 Fog Generator, Manual, Pulse Jet Engine -

- a. The container volume, in liquid measure, V
- b. The relative quality of the spray generated
- c. The elapsed time, T, in minutes to exhaust a filled tank

6.3.2.5 Electromagnetic Interference

- a. Record for each test and its frequency band, the frequency and its corresponding highest in-band interference reading.
- b. Prepare a diagrammatic layout of the test site showing the test item and locations at which measurements were made. Use a distance scale.

6.3.2.6 Balance Test

Record the following:

- a. For stationary test items record the vibration (in inches of displacement) and locations, for the points of greatest vibration.
- b. For manually carried test items record any discomfort which the user feels with test item in operation as opposed to that experienced with the test item being carried but not in operation.

6.3.2.7 Durability

Record the following:

- a. Data collected as described in MTP 10-2-502.
- b. The type of dispenser and the length of the test in hours.
- c. The consumption rate of fuel or electrical power in gpm or watts.
- d. Any gross changes in test item indicators during the test.
- e. Location and degree of overheating on test item housing.
- f. Insulation resistance in megohms for each circuit.
- g. Identification of any circuit which fails the dielectric strength test.
- h. The resistance, R_t , in ohms for each winding, for all motors.
- i. Any evidence of accelerated wear. Give condition and location.

6.3.2.8 Transportability

Record the following:

- a. Data required by MTP 10-2-503 and the following:
- b. Any damage to the test item or impairment of its operating efficiency. Include details as to location and nature of the fault.

6.3.2.9 Maintenance

Record the data collected as described in applicable sections of MTP 10-2-507 and MTP 10-2-512.

6.3.2.10 Safety

Record the following:

- a. Data collected as described in the applicable sections of MTP 10-2-508.
- b. For Class II equipment:
 - 1) A list of all safety devices used on the test item.
 - 2) The type of failure each device is to detect.
 - 3) Indication that the device has successfully passed two cycles of operation.
 - 4) Missing device or unsafe conditions.
 - 5) Suggested additions to the test item's safety features.

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6.3.2.11 Human Factors Evaluation

6.3.2.11.1 General Evaluation -

- a. Record the data collected as described in the applicable sections of MTP 10-2-505.
- b. Retain completed checklists.

6.3.2.11.2 Noise Evaluation -

Record the following:

- a. A diagrammatic layout of the test site indicating the test item position and points at which measurements were made.
- b. The highest noise level in each band over all bands at each measuring location and the corresponding ambient noise level, at each of these frequencies with the test item inoperative.

6.3.2.12 Value Analysis

Record the following:

- a. The component or feature involved
- b. Suggested change
- c. Reasons for the suggested change

6.3.2.13 Quality Assurance

Record the data collected as described in the applicable section of MTP 10-2-511.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Chemical Analysis

Present the results of the test in tabular form to indicate the test parameter and results obtained for each. Use narrative as applicable to amplify or express qualitative results in summary form.

6.4.2 Hydrostatic and Pneumatic Tests

Summarize test results using tabular form to indicate test pressure, swelling etc. as appropriate.

6.4.3 Preliminary Electrical Tests

Present the results of the test in tabular form indicating for each motor, its windings, resistance, insulation resistance and dielectric strength test completion. Show results of insulation resistance and dielectric strength tests for all other circuits.

6.4.4 Operation and Performance

6.4.4.1 Sprayers

Determine the following quantities for the types denoted:

a. Manually carried-manually pumped:

- 1) The discharge rate per stroke, D

$$D = \frac{M}{N}, \left(\frac{\text{cm}^3}{\text{stroke}} \right)$$

- 2) Display the residue, R, (cm³)

b. Power Driven, Hand Operated, Continuous

- 1) Display the residue, R, volume liquid measure
2) The discharge rate, D

$$D = \frac{V-R}{T_2-T_1}, \left(\frac{\text{volume liquid measure}}{\text{unit time}} \right)$$

c. Carrier mounted, gasoline engine driven

The discharge rate, D

$$D = V/T \left(\frac{\text{gallons}}{\text{unit time}} \right)$$

6.4.4.2 Dusters

The discharge rate, D

$$D = M/T, \left(\frac{\text{lbs}}{\text{unit time}} \right)$$

6.4.4.3 Fog generator, manual, pulse jet engine

The discharge rate, D

$$D = V/T \left(\frac{\text{volume liquid measure}}{\text{unit time}} \right)$$

6.4.5 Electromagnetic Interference

Prepare a table showing the type of interference test, out of limit readings, or the highest reading in the band and corresponding frequencies. Consult the graphs of MIL-STD-461 for maximum allowable readings.

6.4.6 Balance Test

Summarize the results of the balance test in narrative form.

6.4.7 Durability

- a. Analyze all abrupt changes in test item indicators for a possible malfunction.
- b. Record any failures in the post-test dielectric strength and insulation resistance checks.
- c. Calculate the final temperature of each motor by using the initial and final resistance values of the motor windings as follows:

$$t_f = \frac{R_{t_l}}{R_l} (C + t_r) - C$$

where: t_f = final temperature of the winding ($^{\circ}$ C).

t_r = room temperature of the winding in $^{\circ}$ C.

R_{t_l} = the final resistance value of the winding, in ohms.

R_l = the initial resistance value of the winding, in ohms.

C = 243.5 for copper windings and 221 for aluminum windings.

- d. Compare the temperature rise with the insulation class to determine an excessive temperature change.

Class A insulation - not more than 40° C rise

Class B insulation - not more than 60° C rise

Class C insulation - not more than 15° C rise

- e. List any indications of accelerated wear of the test item as determined by visual inspection.

6.4.8 Transportability

Present the results of the transportability test as prescribed in MTP 10-2-503.

6.4.9 Maintenance

Present the results of the maintenance test as prescribed in MTP 10-2-507.

6.4.10 Safety

Present the results of the safety test as prescribed in MTP 10-2-508.

A Safety Release Recommendation shall be submitted in accordance with USATECOM Regulation 385-6 based on the data collected related to safety.

6.4.11 Human Factors Evaluation

Prepare a table showing measurement locations, the highest noise readings in each band and the ambient noise. Include a column for corrected noise readings with the new readings to be determined in the following manner:

- a. If the difference between the noise reading and the ambient reading is 3 decibels or less mark corrected reading "indeterminate".
- b. If the difference is between 4 and 10 decibels consult Table V.

TABLE V: CORRECTIONS FOR AMBIENT SOUND PRESSURE LEVELS

Difference in decibels between sound pressure level measured with sound source operating and ambient sound pressure level alone.	4	5	6	7	8	9	10
Correction, in decibels, to be subtracted from sound pressure level measured with sound source operating to obtain sound pressure level due to sound source alone.	2.2	1.7	1.3	1.0	0.8	0.6	0.4

- c. If the difference is greater than 10 decibels no corrections necessary.
- d. Circle those readings which are out of limit by consulting Table 2 of HEL Standard S-1-63B, Maximum Noise Level for Army Material Command Equipment, June 1965.

Tabulate and summarize the remaining data as appropriate. All data shall be compared with the technical performance characteristics specified in the QMR's, SDR's, or other specifications.

6.4.12 Value Analysis

Summarize the results of the analysis in narrative form and list recommendations for changes.

6.4.13 Quality Assurance

Present the results of the test as prescribed in MTP 10-2-511.

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APPENDIX A

MOTOR DIELECTRIC STRENGTH TESTS

General Requirements: This specification is applicable before and after a prolonged run period. The frequency of the test voltage shall be 25-60 Hz and the peak value shall be the specified test voltage multiplied by 2. The test voltage shall be applied for (1) minute except that an equivalent test can be conducted for (1) second if the test voltage is 1.2 times that voltage used for the (1) minute test.

Motor Types

- A. Universal Motors - The high potential test for all motors regardless of horsepower and for operation upon circuits not exceeding 250 volts shall be made by applying 900 VRMS.
- B. Direct Current and Induction Motors -
 - 1. Motors rated 1/2 horsepower and larger.
 - a. Apply 1000 VRMS plus twice the rated voltage of the motor windings.
 - b. For motors with armatures or rotors with insulated windings not connected to the line apply 1000 VRMS.

Exception: The standard test voltage for secondary windings of wound rotors of induction motors shall be 1000 VRMS plus twice the maximum voltage induced between slip rings on open circuit at standstill (or running if under this condition the voltage is greater) with primary voltage applied to the stator terminals as in service. Since the voltage induced in the rotor is a function of both the speed of the rotor and the voltage impressed on the stator, the test voltage applied to the rotor shall be determined from that combination of those two conditions which give the highest voltage induced in the rotor.

For reversing motors the test voltage shall be 1000 VRMS plus four times the maximum voltage induced between slip rings on open circuit at standstill with rated primary voltage applied to the stator terminals.

- 2. Motors Rated at Less than 1/2 Horsepower
 - a. For motors rated less than 1/2 horsepower and operated by circuits of less than 250 volts the test voltage shall be 900 VRMS. Above 250 volt operation the test voltage shall be 1000 VRMS plus twice the motor rated voltage.
 - b. For motors rated less than 1/2 horsepower where armatures or rotors

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have insulated windings not connected to the line the test voltage shall be 900 VRMS.

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