



Standard Specification for Natural Block Mica and Mica Films Suitable for Use in Fixed Mica-Dielectric Capacitors¹

This standard is issued under the fixed designation D 748; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers natural block mica² and mica films (cut and uncut) suitable for use in the manufacture of fixed mica-dielectric capacitors, based on electrical, visual, and physical properties as determined by tests specified herein.

1.2 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 ASTM Standards:

D 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies³

D 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials³

D 351 Classification for Natural Muscovite Block Mica and Thins Based on Visual Quality³

D 1082 Test Method for Power Factor and Dielectric Constant of Mica³

3. Terminology

3.1 For definitions pertaining to this specification see Classification D 351.

4. Significance and Use

4.1 The properties included in this specification are those required to identify the types of natural block mica and mica films (cut and uncut) suitable for use in the manufacture of fixed mica-dielectric capacitors. There may be other requirements necessary to identify particular characteristics. These will be added to the specification as their inclusion becomes generally desirable, and the necessary test data and methods become available. Natural block mica and mica films that do

not conform to the requirements of this specification for capacitor use may well be capable of meeting the requirements for other critical electrical insulation purposes.

4.2 The system of classifying electrical quality of natural block and mica films (cut and uncut) covered by this specification is based on a combination of electrical and physical properties, and visual qualities specified herein, which the mica must possess. This system differs radically from past practices and previous concepts of mica quality for capacitor use. The electrical classification system does not discriminate against the presence of spots and stains in even first quality electrically selected mica, provided the mica conforms to specific and physical requirements. Appreciable amounts of air inclusions and waviness also are permitted in all electrical quality classes, provided the mica meets specific electrical and physical requirements. Mica meeting these requirements is acceptable without regard to color or origin. However, mica meeting these electrical and physical requirements but having lower visual quality than that meeting the requirements for the visual quality classification is not considered generally as desirable.

4.3 In capacitor fabrication, one or more pieces of cut film or block mica having lower than required electrical and physical properties may prevent meeting the end requirements of the capacitor. It is therefore required that each piece of block (cut) or film (cut or uncut), or both, be tested for the electrical requirements and inspected for the visual requirements listed in this specification.

5. Forms

5.1 This specification covers the following three forms of natural mica, suitable for use in the manufacture of mica-dielectric capacitors:

5.1.1 *Form 1*—Full-knife trimmed natural block mica 0.007 to 0.035 in. (0.18 to 0.89 mm) in thickness.

NOTE 1—A certain percentage of block mica thinner than 0.007 in. may be accepted under this specification, upon agreement between the purchaser and the manufacturer.

5.1.2 *Form 2*—Half-knife trimmed natural block mica 0.007 to 0.035 in. in thickness.

¹ This specification is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.19 on Dielectric Sheet and Roll Products.

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² Coutlee, K. G., "Electrical Quality Classification of Raw Mica by a Rapid, Direct-Reading Test Method," *Proceedings, ASTM*, Vol 46, 1946, p. 1486.

³ *Annual Book of ASTM Standards*, Vol. 10.01.

5.1.3 *Form 3*—Films (cut or uncut) split or manufactured from natural block mica in any range from 0.0008 up to and including 0.006 in. (0.020 to 0.15 mm).

6. Grades (Sizes)

6.1 For grades see Classification D 351.

7. Classes

7.1 This specification covers the following four classes and subdivisions of natural block mica or mica films. The class of mica desired shall be specified by the purchaser. Block mica or mica films shall conform to all of the requirements of its respective class, unless otherwise specified by the purchaser.

7.1.1 *Class C-1 Special*—Class C-1 special mica films, in addition to having the highest Q obtainable for mica in the megacycle range also have the highest Q generally obtainable for mica in the audio frequency range (1000 min at 1 kHz). Such mica therefore is particularly suitable for capacitors which must meet highest Q requirements at both high and low frequencies.

7.1.2 *Class C-1*—Class C-1 block mica or mica films have the highest Q value obtainable for mica (2500 min at 1 MHz in capacitors) and is suitable for use in all sizes and types of silver and foil electrode, molded and clamped unit capacitors, including the most critical types, for use in high stability tuned circuits, as well as high current radio frequency capacitors used in radio transmitter circuits.

NOTE 2—Based⁴ on commercial experience Class C-1 block mica or mica films are satisfactory for the manufacture of all of these types of mica capacitors. However, it has been found that “medium to heavy” air-stained mica may produce a slightly lower yield of highest stability and high current radio frequency types of capacitors as well as a somewhat lower yield of satisfactory silver electrode mica laminations. Likewise, “medium to heavy” wavy mica may also adversely influence the application of silver electrodes. In addition, there is some possibility that excessive waviness may cause cracked laminations in molded capacitors due to the high molding pressures employed and it may be less suitable from a stacking standpoint. Similarly, some reduction in unit volume capacitance of foil electrode capacitors may result from excessive amounts of either air inclusions or waviness.

7.1.3 *Class C-2*—Class C-2 block mica and mica films have a high order of Q value (1500 min at 1 MHz in capacitors) and are suitable for use in all sizes and types of silver and foil electrode molded and clamped unit capacitors similar to those specified for Class C-1 mica. However, a certain percentage of capacitors made with Class C-2 block mica and films may show a somewhat higher temperature rise in transmitter types than capacitors made with Class C-1 block mica or mica films.

7.1.4 *Class C-3*—Class C-3 block mica and mica films have the lowest Q value (200 min at 1 MHz in capacitors) of the three classes covered by this specification. Such Q value, however, is sufficiently high to permit this mica to be classed as a low-loss insulating material. This mica is particularly suitable for use in foil electrode molded and clamped type capacitors (Note 3) used in less critical circuits for blocking

and coupling purposes where high Q value, high stability, and low temperature coefficient are not required.

NOTE 3—Experience has shown that silver electrode molded capacitors made with Class C-3 mica which contained slightly conducting spots and stains but contained “very slight” air inclusions and “nearly flat” waves, had temperature coefficient and capacitance stability characteristics just as good as that obtained with capacitors made with the best Class C-1 mica.

8. Electrical and Physical Properties, and Visual Qualities

8.1 Natural block mica and mica films shall conform to the requirements as to electrical and physical properties and visual qualities as prescribed in Table 1. Visual qualities not covered in this specification are permitted provided mica meets the electrical and physical requirements.

9. Test Methods

9.1 The properties enumerated in this specification shall be determined in accordance with the following:

9.2 *Grading According to Size*—Classification D 351.

9.3 *Electrical Conductivity*—See Annex A1.

NOTE 4—For the purpose of this specification, electrical conductivity in spotted and stained areas of block mica is revealed when visible sparking or glowing takes place inside or on the surface of the mica in the vicinity of the test probe and not by actual puncture of the mica by the high-potential current. If actual puncture of the test specimen does take place this indicates the presence of mechanical faults, such as pinholes, tears, or cracks which extend completely through the mica. While this test method had been found suitable for controlling conductivity in spots and stains and dielectric weakness due to mechanical faults in block mica, an even greater factor of safety will be realized if this flash test is applied directly to capacitor films. In this instance the purpose of the test is to detect dielectric weakness due to any cause.

9.4 *Q Value or Dissipation Factor*—Test Method D 1082 at 1 MHz, or by the rapid, direct-reading method described in Appendix X1.

NOTE 5—In cases of dispute arising from borderline cases of Q value or dissipation factor and dielectric strength, the test specimens shall be baked for a minimum period of 2 h at a temperature of 121°C (250°F), and tested immediately upon cooling to room temperature.

9.5 *Dielectric Strength*—Test Method D 149, using the short-time test with ¼-in. (6.4-mm) diameter electrodes in oil.

9.6 *Weight Loss on Heating*—Preheat the test specimens in an oven at 121°C (250°F) for a minimum time of 2 h and then weigh. Then heat the specimens in the oven at 600°C (1110°F) for 5 min and reweigh. Calculate the percentage loss in weight after heating based on the weight of the specimen at the end of the 2-h preheating period.

9.7 *Thickness [Uniformity (Films)]*—Judge splitting quality by the uniformity of thickness of films split from mica by viewing between crossed polaroids.

9.8 *Visual Qualities*—See Classification D 351.

9.8.1 *Air Inclusions*—Reflected daylight or equivalent.

9.8.2 *Waves, Buckles, Ridges, etc.*—Reflected daylight or its equivalent where distortion of parallel and vertical lines of reflected image, such as a window frame, can be judged.

9.8.3 *Cracks, Tears, Pinholes, and Stones*—Determine the presence of such mechanical defects as cracks, tears, pinholes,

⁴ Coutlee, K. G., “Judging Mica Quality Electrically,” *Transactions, Am. Inst. Electrical Engrs.*, Vol 64, 1945.

TABLE 1 Electrical, Physical, and Visual Quality Requirements of Natural Block Mica and Mica Films for Use in Capacitors

		Class C-1	Class C-2	Class C-3
<i>Electrical Properties:</i>				
Conducting paths ^A		none	none	none
Q value or dissipation factor at 1 MHz		E-1 ^B	E-2 ^B	E-3 ^B
Dielectric strength, min	{ average single	1000	1000	1000
V/mil at 60 Hz		850	850	850
Dielectric constant		C	C	C
<i>Physical Properties:</i>				
Weight loss on heating (5 min at 600°C), max %		0.2	0.2	0.2
Thickness uniformity (mica films) ^D		best	best E	intermediate E
Temperature coefficient of capacitance and retrace				
<i>Visual Qualities:^F</i>				
Air inclusions ^G	{ A B C	very slight ^H	very slight ^H	very slight ^H
		slight ^I	slight ^F	slight ^I
		medium ^J	medium ^J	medium ^J
Waves ^K	{ A B C D	nearly flatslight	nearly flatslight	nearly flatslight
		medium	medium	medium
		heavy	heavy	heavy
Cracks		none	none	none
Tears		none	none	none
Pin holes		none	none	none
Stones		none	none	none
Buckles		none	none	none
Ridges		none	none	none

^A This applies to the conductivity of visible spots and stains only and excludes air stains or air inclusions.

^B The Q values or dissipation factor $Q = \left(\frac{1}{\text{dissipation factor}} \right)$ of block mica or mica films suitable for use in capacitors shall fall within specified electrical quality groups, based on end-use requirements, designated E-1 Special, E-1, E-2, or E-3. These quality groups shall conform to the Q or dissipation factor values prescribed in Table 2 or the corresponding scale readings of the vacuum-tube voltmeter when tested by the rapid, direct-reading method described in Appendix X1.

^C As the dielectric constant of natural block mica suitable for use in capacitors is fairly uniform, no value is specified.

^D Until definite values can be specified, the permissible amounts of such defects shall be agreed upon between the purchaser and the manufacturer.

^E It has been found that the temperature coefficient of capacitance and retrace of capacitors made with Classes C-1, C-2, and C-3 mica are more dependent on such factors as electrical and mechanical design and manufacturing technique than on any differences in the mica itself.

^F See Classification D 351.

^G The amount of air inclusions shall not exceed the specified limits for each subclass. The permissible amount of air inclusions shall be stated by suffixing the letter A, B, C, or D as the case may be, to the required electrical quality class.

^H Few and tiny in one fourth of usable area (must not contain air chains, etc.).

^I In one half of usable area (must not contain air chains, etc.).

^J In two thirds of usable areas.

^K The waviness shall not exceed the specified limits for each subclass. The permissible amount of waves shall be stated by suffixing the letter A, B, C or D, as the case may be, to the letter denoting the amount of permissible air inclusions. For example, Class C-1 B A block mica or mica films denotes:

C-1	B	A
Best electrical quality	slight air inclusion in one half usable area	nearly flat waves

and stones by the spark coil test as prescribed in Annex A1, or by visual inspection as judged by transmitted daylight or its equivalent.

10. Precision and Bias

10.1 This test method has been in use for many years, but no information has been presented to ASTM upon which to base

a statement of precision or bias. No activity has been planned to develop such information.

11. Keywords

11.1 block mica; capacitor; classes; dielectric strength; electrical conductivity; form; grades; mica; mica films; Q value; visual quality; weight loss

TABLE 2 Q and Dissipation Factor Values for Electrical Quality Group E-1 Special, E-1, E-2, and E-3

		Rapid Meter Reading					
Electrical Quality Designation	Mica Form	Q Requirements, ^A		Perpendicular Method ^B			Parallel Method ^C
		1 MHz	1 kHz	0.010 in. ^D (0.007 to 0.015 in.) [0.25 mm ^D (0.18 to 0.38 mm)]	0.020 in. ^D (0.015 to 0.025 in.) [0.51 mm ^D (0.38 to 0.64 mm)]	0.030 in. ^D (0.025 to 0.035 in.) [0.76 mm (0.64 to 0.89 mm)]	0.0008 to 0.004 in. ^E (0.033 to 0.10 mm) ^E
E-1 Special	Film	2500 min ^F	1000 min ^F	...	...	...	95 to 100
E-1	{Block}	2500 min ^G	...	95 to 100	95 to 100	95 to 100	...
	{Film}	2500 min ^F	500 min ^F	...	...	...	90 to 100
E-2	{Block}	1500 min ^G	...	87 to 95	77 to 95	71 to 95	...
	{Film}	1500 min ^F	200 min ^F	...	...	...	71 to 90
E-3	{Block}	200 min ^G	...	50 to 87	32 to 77	24 to 71	...
	{Film}	200 min ^F	100 min ^F	...	...	...	24 to 71

^A Conversion Table follows Footnote^G.

^B Method A, see Appendix X1.

^C Method B, see Appendix X1.

^D Thickness of block mica specimens (use corresponding meter calibration).

^E Thickness range of single mica film specimens.

^F Minimum Q values for mica purchased as film. These values apply to minimum Q values of individual mica films with fired-on silver, parallel-plate, or mercury electrodes when tested at ≈ 50 % relative humidity at 1 MHz, and at ≤ 10 % relative humidity at 1 kHz.

^G Extensive commercial tests have verified the validity of the 1 MHz Q values of molded type, 1000 pF stacked-foil and silvered capacitors made with films from electrically selected E-1, E-2, and E-3 block mica. These will apply when all factors which would adversely influence the Q values, such as entrapped moisture, dielectric loss of other insulations used in the capacitor, as well as electrode and contact resistance, are under control.

Q Value	Dissipation Factor (tan δ)
2500	0.00040
1500	0.00067
1000	0.00100
500	0.00200
200	0.00500
100	0.01000

ANNEX

(Mandatory Information)

A1. METHOD OF TEST FOR CONDUCTING PATHS IN MICA

A1.1 *General*—This Appendix contains a description of a method of testing for conducting paths in mica.

A1.2 The tests shall be made in subdued light as follows:

A1.2.1 *Spark Coil*— A spark coil of the vibrator type capable of giving a spark from $\frac{1}{8}$ to 1 in. (9.6 to 25.4 mm) in length between needle points. (Ignition-type spark coil is satisfactory.)

A1.2.2 *Current Source*— Six volts direct current.

A1.2.3 *Electrodes*— One electrode consisting of a sharp pointed No. 8 (AWG) bare copper wire, or equivalent, about 4 in. (100 mm) in length mounted on the end of a suitable insulated handle shall be connected to the high-tension side of the spark coil with high-grade automobile ignition wire, or

equivalent. The other electrode shall be a sheet of metal of suitable size connected to the grounded side of the spark coil.

A1.3 *Procedure*—With both electrodes connected to the current source, bring the electrodes together within the sparking distance at which point a continuous spark discharge should take place. Insert the mica specimen to be tested on the grounded electrode and bring the pointed electrode to within approximately $\frac{1}{4}$ in. (6 mm) of the sample surface. A slight bluish brush discharge will be noted. Then carefully explore the stained areas of the sample holding the point approximately $\frac{1}{4}$ in. above the mica surface. When a conducting area is located, sparks will jump and scatter to it in lightning-like forks.

APPENDIX

(Nonmandatory Information)

X1. RAPID DIRECT-READING RESONANT-CIRCUIT METHODS FOR DETERMINING Q VALUE OR DISSIPATION FACTOR OF NATURAL BLOCK MICA OR MICA FILMS

METHOD A

(Perpendicular to Laminations)

X1.1 *General*—This Appendix contains a description of a rapid, direct-reading, resonant-circuit method for measuring dissipation factor or Q value of sheet insulating materials perpendicular to laminations at a frequency of 1 MHz. It has been found equally suitable for such purpose over a frequency range from 50 kHz up to 100 MHz. It is not intended as a precision method. Its chief virtues are the speed and simplicity with which a useful dissipation factor or Q value indication can be obtained. No special preparation of the test specimen is necessarily (other than conditioning, prior to or during testing, where necessary), such as the application of tin-foil electrodes. Likewise, no calculations are necessary.

X1.2 *Theory of Operation*—This method makes use of a comparison between the maximum resonant voltage measured across a low-loss capacitor in parallel with an inductance and the maximum resonant voltage across the same circuit when a piece of block mica is introduced in series with the low-loss capacitor. To accomplish this, resonance is re-established each time a test specimen is placed in series with the low-loss capacitor by adding capacitance to duplicate the initial capacitance of the resonant circuit, by means of a variable vernier air capacitor in parallel with the coil. This provides a test method requiring but a single dial adjustment and this, combined with a direct-reading meter, greatly facilitates rapid testing. Greater testing speed can be realized by adapting this method to full automatic means.

X1.3 *Calibration*—It is possible to calibrate the indicating scale of the vacuum-tube voltmeter directly in terms of dissipation factor or Q value by using test specimens of block mica of known dissipation factor.⁵ The resulting scale then can be used to give a direct indication of dissipation factor or Q value over a useful range. As the meter indication is a function of both the dissipation factor and the thickness of the test specimen, the latter also shall be taken into consideration in the calibration. It has been found that if the inductance coil used in such a test circuit has a Q value of approximately 300, the Q range will extend from somewhere in the vicinity of 10,000 at full scale to about 50 at quarter scale of the indicating meter. It further has been found that using inductances with Q 's of 300 or more, the calibration is fairly independent of frequency and a frequency range from 50 kHz to 50 MHz can be covered by merely changing the inductances and the oscillator test frequency. Even without a true Q value calibration this method is

capable of giving relative values of Q on an arbitrary scale where such indications are all that might be required. It has been found feasible to use an arbitrary scale in the measurement of the Q value of block mica.

X1.4 *Test Circuit*—A diagram of connections of the test circuit is shown in Fig. X1.1 (a).

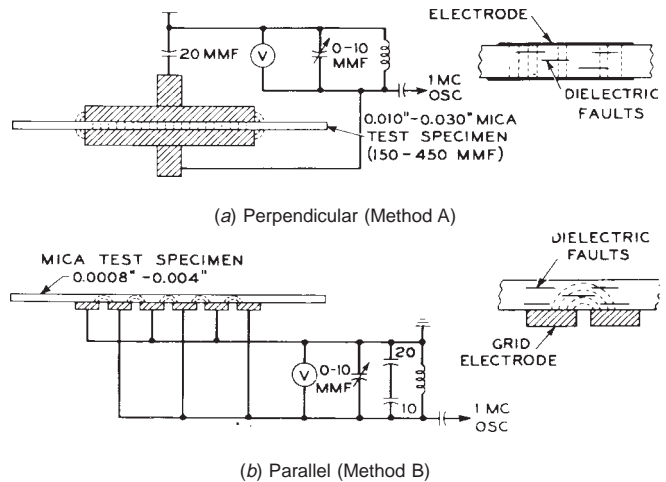


FIG. X1.1 Schematic Arrangement of Test Circuits

X1.5 *Sensitivity*—High sensitivity in the low dissipation factor of high Q value range is a function of high circuit Q value. To obtain this, particular care is necessary in the choice of components and insulating materials. For test frequencies of 1 MHz and lower, C_v (Fig. X1.1) may be a high quality conventional type variable air capacitor with a single movable plate. For frequencies above 1 MHz the vernier capacitor should preferably form an integral part of the test electrodes so as to keep series resistance and inductance effects at a minimum.

X1.6 *Test Electrodes*—The test electrodes⁶ found satisfactory for the perpendicular test method are shown in Fig. X1.2. These test electrodes have been designed with a view of adapting them to standard commercial testing equipment incorporating an oscillator and a vacuum-tube voltmeter.

⁵ Electrical Quality Mica Standards for use in Calibration in Method B, Perpendicular to Lamination (X1.3), are available for use from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

⁶ Blueprints of detailed drawings for the construction of these test electrodes are available at a nominal cost from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Request Adjunct No. ADJD074801 for test electrodes and ADJD074802 for grid test electrodes.

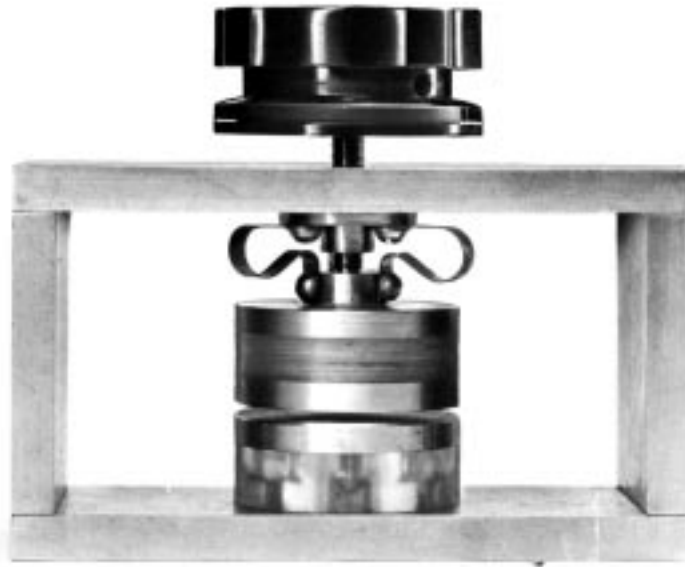


FIG. X1.2 Test Electrodes

X1.7 *Meter Scale*—The calibration of the meter scale (Fig. X1.3) for block mica is based fundamentally on the probable Q values of capacitors when made from splittings from block mica. Group E-1 corresponds to capacitors having Q values of 2500, minimum. The range for group E-2 corresponds to capacitors having Q values of 1500 to 2500, and the E-3 range to capacitors with Q values up to 1500 at a frequency of 1 MHz. The minimum Q value for the E-3 range that capacitors may have appears to be in the neighborhood of 200. The

divergence of the Q value of block mica from capacitor Q values is an interesting phenomenon. A depreciation from the value for block mica in the high Q range and an improvement over block mica in the low Q range when made into molded capacitors has been established. A possible explanation is the contributing losses in the molded casing and the resistance of foil and leads in the first case and the release of imprisoned moisture on splitting and baking in the second case.

METHOD B
(Parallel to Cleavage Plane)

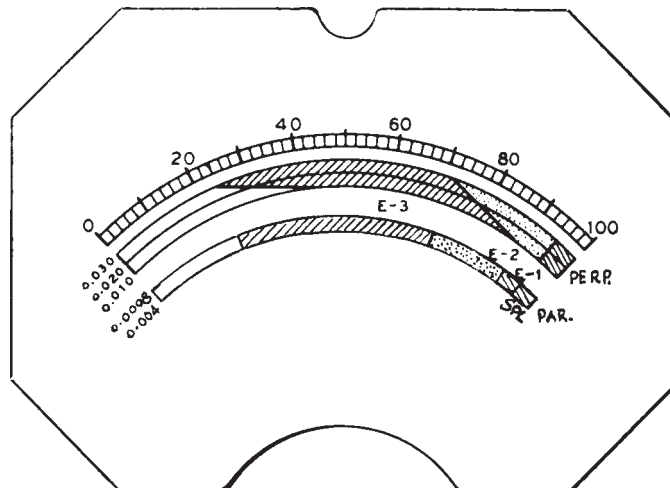


FIG. X1.3 Meter Scale of the Mica Q Test Set

X1.8 *General*⁷—It has been established that the dielectric loss of muscovite mica is highly anisotropic. The dielectric loss parallel to the cleavage plane even in lowest loss, clear ruby mica usually is many times greater than in the perpendicular direction. The parallel loss is particularly sensitive to further degradation by nonmicaceous dielectric impurities situated between the laminae such as entrapped water in internal voids of clear mica or thin plate-like semi-conducting, mineral inclusions of spotted mica. Abnormal parallel loss also results from absorbed moisture on the surface of mica but such adverse effects are practically eliminated at 1 MHz by testing in a low relative humidity of 50 % or less. Parallel loss is reflected in the perpendicular direction but to a lesser degree. Of significant importance is the consistent evidence that when abnormal loss is not found in the parallel direction it does not exist in the perpendicular direction. However, the converse usually is not true. Parallel loss, therefore, appears to be more significant dielectric loss criterion of mica and due to its greater magnitude is more readily detected and measured. Abnormal parallel loss does not appear to be directly related to the amount of air inclusion as some mica containing appreciable quantities does not show abnormal parallel loss. Mica containing visible mineral inclusions, such as stains and spots, may not show abnormal parallel loss. However, the method is particularly sensitive in detecting the presence of semi-conducting stains, which increase both the parallel dielectric loss and dielectric constant. The parallel test, therefore, also is suitable for selecting stained and spotted mica for use as insulation in vacuum tubes and terminal plates where both uniform low loss and dielectric constant in the parallel direction are desirable.

X1.9 *Theory of Operation*—Method B employs the same test equipment used in Method A except that a multiple-grid electrode with all electrode surfaces in the same plane is substituted for the 2-in. (51-mm) parallel plate electrodes of Method A. The grid electrode is connected in parallel with the inductance, variable air capacitor and vacuum-tube voltmeter of the resonant circuit as shown in Fig. X1.1 (b). Alternate grids are connected to opposite sides of the test circuit. This applies the electric field parallel to the cleavage plane of a mica specimen in contact with the grids. The resonant voltage first is adjusted to full scale, without a test specimen resting on the grid, with the vernier air capacitor set near maximum. A mica test specimen is then placed on the grid and resonance re-established by decreasing the capacitance of the vernier capacitor. The resonant voltage for the second condition is then read. The greater the deviation from the initial full-scale reading the greater the loss.

X1.10 *Typical Calibration Curves*—The meter can be calibrated in (1) terms of equivalent perpendicular dielectric loss based on parallel meter readings of mica films versus their Q as silvered films, or (2) parallel 1-MHz conductance for such

applications as vacuum-tube insulators and high-frequency terminal plates where dielectric loss is parallel to the laminae (see Fig. X1.4).

X1.11 *Test Electrodes*—A variety of electrode arrangements are possible for applying the electric field parallel to cleavage plane of sheet mica. An electrode⁶ which has been found suitable and which has approximately the same area as the circular 2-in. (51-mm) perpendicular electrodes of Method A is shown in Fig. X1.5. This grid electrode consists of 18 square metal studs 1/4 by 1/4 by 1/16-in. (6.4 by 6.4 by 1.6-mm) thick with 1/16-in. spacing between all adjacent stud edges. The circular studs are connected to the ungrounded side of the test circuit. The surfaces of the square and circular studs shall be in the same plane and ground flat, after assembly. The grounded electrodes shall be provided with centrally located 0.035-in. (0.89-mm) (No. 65 drill) holes which extend from one end to the other. The threaded ends of these hollow electrode shafts shall be connected by suitable means to a vacuum line of about 27 in. (686 mm) min Hg. This vacuum provides sufficient suction to flatten out curly and wavy mica films and maintain satisfactory intimate contact with the face of the grid electrode during test. The use of a vacuum grip is generally recommended, particularly in cases of dispute. The total capacitance of the grid electrode assembly shall be between 15 and 17 pF. The special design features and type of insulation specified in the construction of the grid electrode automatically ensure satisfactory, low dielectric loss.

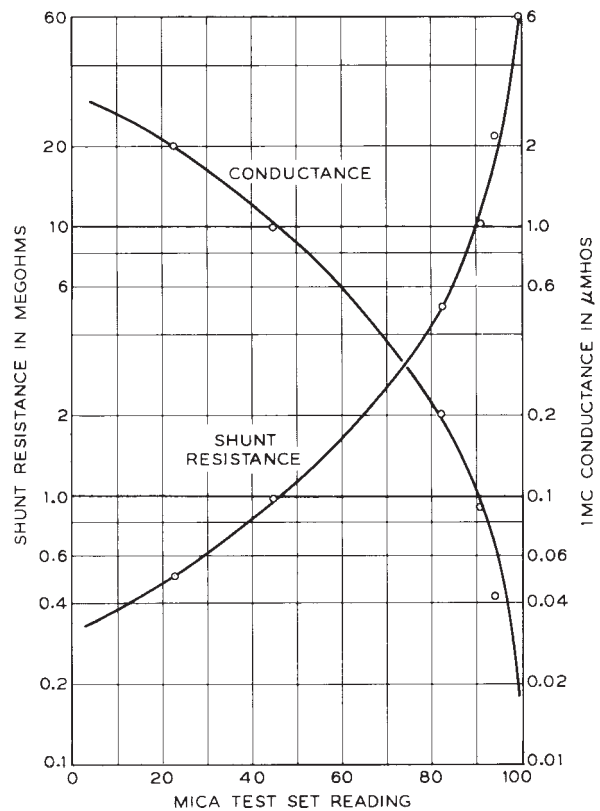


FIG. X1.4 MHz Conductance versus Mica Test Set Readings

⁷ Coutlee, K. G., "Electrical Properties of Mica," *Annual Report 1950*, presented at the Conference on Electrical Insulation, March 15, 1951, National Research Council.



FIG. X1.5 Grid Electrode

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