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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practice for Specifying Thick-Film Pastes [1]

This standard is issued under the fixed designation F 508; 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.

ε[1] NOTE—Keywords were added editorially in December l997.

1. Scope

1.1 This practice covers the writing of specifications for thick-film pastes for electronics.

1.2 The practice provides a guide for the routine procedure to be followed in specifying for procurement thick-film pastes for use in manufactured circuits. Specific requirements, intended applications, and test methods should be included or identified in each paste specification. In addition, each specification should include basic information to facilitate procurement, preparation, quality control, lot shipment identifications, and shipping of such pastes.

1.3 The practice covers the development of specifications for fireable, thick-film pastes, including resistor, conductor, dielectric, and overglaze pastes.

2. Specification Form and Content

2.1 *Form*—Each specification should be prepared in conformance with *Form and Style for ASTM Standards.* [2]

2.2 *Procurement Information*—Information pertinent to procurement should include the procuring organization's name, location, address, telephone number, and the name of the procurement agent, or anyone else involved in procurement or with the technical details of the specifications.

2.3 *Technical Information*—Each specification should cover the specific technical details, the performance requirements, and the precision or accuracy of measurements necessary for the producer to supply the thick-film paste specified.

2.3.1 *Processing Characteristics*:

2.3.1.1 *Screen Selection*—The particular paste specifications should identify the required screen by the mesh count, the wire size, and the emulsion thickness. Where metal masks are to be used, the cavity thickness and the cavity-aperture tolerances should be specified. The specification should also state the recommended nominal deposit thickness.

2.3.1.2 *Drying and Leveling Characteristics*—The specification should state the range of drying time, the range of drying temperature, and the dried film (leveling) characteristics. The dried film characteristics may be specified by visual examination, for such defects as lifting or pinholes, and by a thickness profile across the surface of the dried film.

2.3.1.3 *Firing Profile*—The specification profile for each specific style of paste.

2.3.1.4 *Firing Atmosphere*—For each style of paste and firing profile, the specification should define the firing atmosphere.

2.3.1.5 *Test Substrate*—The specification should specify and identify the composition of the test substrate and the surface on which the paste is to be deposited.

2.3.2 *Test Pattern*—Where applicable, the specification should include a layout and description of a suitable test pattern for evaluating printed and fired pastes. The specification should also include a list and functions of other materials required to perform the specified tests, that is, terminations, leads, etc. Consideration should be given to compatibility requirements for all materials used.

2.4 *Quality Control*—The specification should identify the quality control procedures to be employed. Such procedures should include: a sampling plan, a sequence for each examination and test specified, and corresponding requirements for each method of examination or test.

2.5 *Handling and Storing*—Each specification should include the method of handling and storing the pastes.

2.6 *Performance Tests*:

2.6.1 Individual procurement specifications should include requirements for each selected applicable test, inspection, and examination listed in Table 1 and Table 2 for the given type of thick-film paste. The specification should include any other pertinent tests and inspections to cover special or specific applications.

2.6.1.1 The test and inspection equipment specified should be of sufficient accuracy and quality to permit the required tests and inspections to be carried out.

2.6.1.2 The types of visual inspection equipment to be used should be specified, including magnification (to be given separately for the objective and eyepiece if both are used), the type of light, the intensity, and the direction of the light source.

2.6.1.3 For fired materials, the inspection criteria should specify the general surface appearance. The number, location, and maximum size of permissible significant defects such as pinholes, projections, scratches, and surface contamination should be specified for the entire fired area. Whenever possible, the inspection criteria should be specific for the intended application of the paste.

[1] This practice is under the jurisdiction of ASTM Committee F-1 on Electronics, and is the direct responsibility of Subcommittee F01.03 on Metallic Materials.
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[2] Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, Pa. 19428.

TABLE 1 Paste Characterization

Test and Examination	Test Applies to [A]			
	Resistor Paste	Conductor Paste	Dielectric Paste	Overglaze Plaste
Paste properties—Prior to Drying:				
Printability	X	X	X	X
Viscosity	X	X	X	X
Particle size	X	X	X	X
Storage stability	X	X	X	X
Leveling and wettability	X	X	X	X
Paste properties—Dry:				
Edge definition	X	X	X	X
Dry adhesion	X	X	X	X
Shelf life	X	X	X	X
Paste properties—Fired (Initial and Aged [B]):				
Visual examination:				
Edge movement (flow-off)	X	X	X	X
Line resolution	X	X	X	X
Surface defects	X	X	X	X
Adhesion to substrate	X	X		
Adhesion to conductor	X		X	X
Adhesion to dielectric		X		
Adhesion to resistors		X		X
Solderability		X		
Leach resistance		X		
Bondability:				
Beam leads		X		
TC bond		X		
Ultrasonic		X		
Die		X		
Brazing		X		
Compatibility	X	X	X	X
Bond strength:				
Wire		X		
Beam lead		X		
Trimming characteristics	X		X	X
Thermal resistance		X	X	X

[A] An "X" in a column position indicates that a specific test applies to the paste type listed at the head of that column.
[B] The term "aged" refers to pastes that have been reworked, refired, etc.

TABLE 2 Electrical and Environmental Characterization

Test and Examination	Test Applies to [A]			
	Resistor Paste	Conductor Paste	Dielectric Paste	Overglaze Paste
Electrical properties:				
Dielectric constant			X	
Contact resistance		X		
Dissipation factor			X	X
Dielectric withstanding voltage	X		X	
Insulation resistance	X	X	X	X
Noise	X			
Power	X	X		
Resistivity	X	X		
Short-time overload	X	X		
Stability after trimming	X		X	
Voltage coefficient of resistance	X			
Electrostatic discharge characteristics		X	X	X
Environmental behavior:				
Humidity	X	X	X	X
Load life-high temperature	X	X	X	X
Temperature coefficient	X		X	X
Tracking	X	X		
Thermal shock	X	X	X	X
Ambient stability	X	X	X	X
Thermal stability (no load)	X	X	X	X

[A] An "X" in a column position indicates that a specific test applies to the paste type listed at the head of that column.

2.6.1.4 As the fired, electrical, and environmental characterization parameters of Table 1 and Table 2 are process sensitive, when specified, these parameters should take into account the specified permissible process variations and tolerances.

2.6.2 *Test Routine*—Each specification should establish a sequence for performing the tests, inspections, and examinations. The specifications should also identify the quantity of fired test specimens to be subjected to each test or group of tests.

2.6.3 *Test Failures*—Each specification should identify the maximum number of defects or failures (those not meeting specified requirements) that can be tolerated. Sample pastes exceeding the maximum specified failure rate shall be considered as having failed to meet the requirements of the applicable specification. Each paste specification should have a provision for action on failed samples or lots.

2.7 *Qualification Tests*:

2.7.1 The purpose of qualification is to identify those materials that have initially met all technical requirements of an applicable procurement document and may be expected to continue to do so, subject to repeated testing at specified intervals.

2.7.2 If required for purposes of qualification, the specification should include:

2.7.2.1 Identification of qualification tests,

2.7.2.2 Sequence of such tests,

2.7.2.3 Description and number of test specimens required for each test or group of tests, with sampling instructions,

2.7.2.4 Pass-fail criteria for each test,

2.7.2.5 Overall pass-fail criterion, and

2.7.2.6 Frequency of qualification testing.

2.8 *Marking*—Each specification should provide the necessary instructions for the supplier to identify the quantity, paste material type and number, lot identification, and date of manufacture.

2.9 *Shipping and Packing*—Each specification should (*1*) identify the method of shipment and specify the packaging to be used to provide protection during shipment, handling, and storage, and (*2*) specify, as an alternative, agreement between the supplier and the purchaser.

3. Keywords

3.1 hybrid microcircuits; reliability; solderability; thick films