

SEMI P9-88

GUIDELINE FOR FUNCTIONAL TESTING OF MICROELECTRONIC RESISTS

1 Purpose

1.1 The purpose of this guideline is to provide a baseline program of test procedures needed to functionally test liquid-developed resists, resist developers, and rinses for microelectronic applications. It can also be used as a guide to evaluate process modifications to such systems. This guideline is intended to be applicable for photo, DUV, X-ray, and electron beam processes.

2 Background

2.1 Release of the information in this document was approved by the SEMI Photolithographic Chemicals Committee (Resist Committee) in May 1987. This committee plans to complete and revise the guideline as appropriate. Comments will be welcomed.

3 Scope

3.1 Virtually all lithographic fabrication processes vary in some way from location to location, even for the same type of resist. Consequently, it is impossible to provide a stringent evaluation program acceptable to most users. It is, therefore, the aim of this guideline to provide a program of tests and methods that allows variable, but controlled, process differences. In order to maintain a proper baseline control for each process, all tests should be run relative to some internal standard product whose functional characteristics are known and characterized. It is understood that each product is to be run at its own preferred or recommended conditions and that different products may be evaluated under different conditions. It should also be understood that some properties, variables, or conditions, such as normality, are specific to resist type, such as positive photoresist, and are to be used only where applicable. Further, since this guide is directed to functional testing, it is assumed that any products to be evaluated have passed all relevant chemical and physical testing before such functional testing.

4 Priorities

4.1 This guideline has been divided into two separate groups. The first group, called "Sustaining Tests," includes tests that are necessary for timely adjustments to coating and exposure conditions in order to maintain consistent image dimensions (Tables 1 through 3). The second group, called "Extended Testing," includes tests that are required for full evaluation of the resist system (Tables 4 through 6). These tests may, or may not, be necessary for evaluation of each lot of product, depending on the individual requirements of the user.

5 Definitions

5.1 *characteristic* — the functional test parameter to be observed.

5.2 *measured property* — the function or property actually measured or derived during the test to define the characteristic. This is the value that is experimentally determined in response to changes in the variable(s).

5.3 *variable condition* — the parameter(s) or property(ies) that is(are) varied to generate the response curve. These are the major factors that influence the property to be measured. These variables must either be held constant or varied in a predetermined manner.

5.4 *fixed conditions* — process parameters that must be fixed at some known value in order to generate reproducible response surfaces for the measured property with respect to the variable condition(s). It is further understood that under experimental design or indepth testing, one or more of these fixed conditions may become a variable condition at the user's discretion. Fixed conditions are the general facility process conditions that must be maintained constant at some known value in order to obtain a controlled process. These conditions are independently predetermined and equipment, and materials are assumed to be selected before testing.

5.5 *test methods* — these are applicable published test methods. Local in-house procedures or other methods may be substituted in place of published methods, if desired. These are the tests used to determine or to evaluate the measured property. Test methods may vary considerably depending on the type of resist evaluated.

6 Glossary

6.1 A glossary of terms for each characteristic, measured property, variable and fixed condition is affixed for easy reference.

7 Addenda

7.1 Additional references and procedures of relevance to this guideline are attached.

Table 1 Sustaining Tests – Resist Coating

<i>Characteristic</i>	<i>Measured Property</i>	<i>Variable</i>	<i>Fixed Conditions</i>	<i>Test Methods</i>
Thickness curve	Film thickness	Spin speed	Viscosity/Solids Substrate Measurement method Softbake Coating program Acceleration Dispense volume Exhaust rate Environment	ASTM F804
Film uniformity	Film thickness	Across Wafer to wafer	As above	
Striations	Fringes Film thickness variation		As above Before and after developing	
Cleanliness	Particles	In/On coating On substrate after removal	Filtration Housekeeping External sources Defect size Test method	ASTM F863
Film integrity	Pin holes	Film thickness	As above	ASTM F890

Table 2 Sustaining Tests – Characteristic Information

<i>Characteristic</i>	<i>Measured Property</i>	<i>Variable</i>	<i>Fixed Conditions</i>	<i>Test Methods</i>
Threshold energy	Film thickness	Exposure energy	Measurement method Calculation method Exposure conditions Developer type Developer normality Development time Development method Rinse type(s) Agitation/Spray	