

SEMI PV54-0514

SPECIFICATION FOR SILVER PASTE, USED TO CONTACT WITH N+ DIFFUSION LAYER OF CRYSTALLINE SILICON SOLAR CELLS

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1 Purpose

1.1 This Specification covers the requirements for silver paste (hereafter referred to as Ag paste), used to contact with N+ diffusion layer of crystalline silicon solar cells.

1.2 This Specification provides common characteristics of Ag paste based on currently widely used for photovoltaic applications. And this Specification also includes requirements for Ag paste after firing.

2 Scope

2.1 This Specification covers the requirements of Ag paste, including but not limited to appearance, granularity, solids percentage and viscosity, silver layer adhesion and solder ability after firing.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Upon agreement between user and supplier, other additional Ag paste property tests than those stated in this Standard can be added into incoming quality test.

3.2 In case of nonconformance of the requirement stated in this SEMI Standard or supply agreement, user shall feedback to supplier within 30 days after receiving paste.

4 Referenced Standards and Documents

4.1 *ASTM Standards*¹

ASTM B678-86(2011) — Standard Test Method for Solderability of Metallic-Coated Products

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Refer to the SEMI Standards Compilation of Terms (COTs) for a list of the current Abbreviations, Acronyms, Definitions, and Symbols.

5.2 *Abbreviations and Acronyms*

5.2.1 *FOG* — fineness of grind (same as granularity)

5.3 *Definitions*

5.3.1 *solids percentage* — weight of sample after firing divided by weight of sample.

5.3.2 *adhesion* — silver layer adhesion with silicon bulk after firing.

¹ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA; Telephone: +1.610.832.9585, Fax: +1.610.832.9555, <http://www.astm.org>

6 Test Methods

6.1 Appearance

6.1.1 This Test Method is visual inspection of Ag paste. Ag paste to be checked is stirred properly in as received container by using a spatula for 2 minutes. Then do the visual inspection.

6.2 Solids Percentage

6.2.1 This Test Method is measurement of the weight percentage of solid in Ag paste by determine of mass difference between before and after firing at suitable temperature and time, which is selected based on the Ag paste firing condition.

6.2.2 Test Procedure

6.2.2.1 After mixing the paste properly, place 0.5 to 2 g Ag paste uniformly on a tared Al_2O_3 substrate or in a tared crucible. Measure the Ag paste weight using analytical weighing scale, and record Ag paste weight W_0 rounded to 0.001 g.

6.2.2.2 Firing Condition

6.2.2.2.1 *Condition 1* — Place Ag paste sample and the substrate to first box oven at temperature of $150^\circ\text{C} \pm 5^\circ\text{C}$ for 10 minutes, and then move this sample to second box oven, which has been preheated to temperature of $850^\circ\text{C} \pm 5^\circ\text{C}$, for another 10 minutes.

6.2.2.2.2 *Condition 2* — Introduce Ag paste sample and the crucible into the box oven at temperature of $750^\circ\text{C} \pm 5^\circ\text{C}$ gradually to allow the removal of low boiling components without spattering, and then leave the crucible in the hottest zone of the box oven for 20 minutes with the door closed.

NOTE 1: Condition 1 or 2 is carried out according to agreement between users and suppliers.

6.2.2.3 Remove sample out of box oven and cool the sample temperature down to room temperature in a desiccator.

6.2.2.4 Measure the Ag paste weight using analytical weighing scale again, and record Ag paste weight W_t accurate to 0.001 g.

6.2.3 Calculation

6.2.3.1 Solids percentage $X\%$ is calculated using equation below:

$$X\% = W_t / W_0 \times 100\% \quad (1)$$

where:

W_t = Ag paste weight after firing, and

W_0 = Ag paste weight before firing.

6.2.3.2 Determine the Ag paste solids percentage according to above equation, round to 0.01%. Report the solid content using average of two parallel sample results. The absolute difference value between solids percentage of two parallel samples shall be less than 0.3%.

6.3 FOG Test

6.3.1 This Test Method covers measurement of the FOG of Ag paste. Ag paste to be checked is spread uniformly by drawing a straight-edged scraper from the deep end to the shallow end of the gage. Particles or agglomerates too large to pass between the moving scraper and the gage path are revealed as 'scratches' or 'points', where these occur is read directly on the calibrated gage shoulder. This Test Method is applicable to any dispersion that is fine enough to fall within the 0 to 25 μm range of the specified grind gauge.

6.3.2 Test Procedures

6.3.2.1 Place the material to be tested in the deep end of the path, so that it overflows the path slightly. When using the double-path gage, place material in both paths.

6.3.2.2 Holding the scraper in both hands, nearly vertical but inclined slightly toward the operator, draw the material down the length of the path toward the shallow end of the gage with a uniform, brisk motion in approximately 1 to