Standard Test Method for
Gel Time of Thermosetting Coating Powder

This standard is issued under the fixed designation D 4217; 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 (e) indicates an editorial change since the last revision or reapproval.

1. Scope *

1.1 This test method determines the length of time a thermosetting coating powder takes to gel on a polished metal surface
at a specified temperature, such as 204°C (400°F). The determination of the gel time is a very simple method for the
characterization and quality control of coating powders. However, the gel time determined by this method is not directly
related to the time for the coating powder to cure in practical applications.

1.2 This standard does not purport to address all of the
safety concerns, if any, associated with its use. It is the
responsibility of the user of this standard to establish appro-
priate safety and health practices and determine the applica-
bility of regulatory limitations prior to use.

2. Referenced Documents

2.1 ISO Standards:
of gel time of thermosetting coating powders at a given
temperature

3. Terminology

3.1 Definitions:
3.1.1 coating powder, n—finely divided particles of resin,
either thermoplastic or thermosetting, generally incorporating
pigments, fillers, and additives and remaining finely divided
during storage under suitable conditions, which, after fusing
and possibly curing, give a continuous film.

3.1.2 cure time of a coating powder—the time required for
a thermosetting coating powder to sufficiently chemically
crosslink at a given temperature to provide the required coating
properties.

3.1.3 gel time of a coating powder—the interval required at
a given temperature for a coating powder to be transformed
from a dry solid to a gel-like state.

3.1.4 powder coating, n—coatings which are protective or
decorative, or both, formed by the application of a coating
powder to a substrate and fused in a continuous film by the
application of heat or radiant energy.

3.1.5 thermosetting, adj—describing a material that, when
heated per a minimum recommended cure condition, under-
goes a chemical reaction and a permanent change to a more
durable state capable of specific properties as designed for
substrate protection or decoration, or both.

4. Significance and Use

4.1 This test method is useful for selecting coating powders
that gel in the desired time at the specified temperature. The
method is not useful for determination of cure time.

5. Apparatus

5.1 Hot Plate,3 having an electrically heated metal block
with a polished surface capable of being maintained at tem-
peratures between range 130-230°C (266-466°F) to within
±2°C (±4°F). The temperature should be controlled by means
of a thermoregulator.

Note 1—There are expected differences in results between this method
and ISO 8130-6 which requires a heating block with small depressions.

5.2 Stopwatch or Timer, accurate to at least 1 s.

5.3 Stirrer, of very low heat capacity and of suitable size.
Wooden stirrers with dimensions of 2 mm by 6 mm by 130 mm
or (1/16 in. by 1/4 in. by 5 in.) have been found suitable.

5.4 Surface Contact Thermocouple, suitable for use at
150–250°C (300–480°F) and reading no greater than 1°C
(2°F).

5.5 Measuring Spoon, of 1.25 cc (1/4 tsp) capacity.

5.6 Scraper, made of material softer than that of the heating
block, for removing the test material from the heating block
without scratching its surface.

6. Selection of Specimens

6.1 Obtain a representative sample of the coating powder.

6.2 Store the sample of coating powder in accordance with
the manufacturer’s recommendations, after sampling and prior
to testing.

6.3 A specimen shall consist of approximately 1.25 ml (1/4
tsp) of coating powder.

* A Summary of Changes section appears at the end of this standard.

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7. Calibration

7.1 Place the hot plate in a draft-free location or use a three-sided draft shield constructed to eliminate drafts.

7.2 Allow a minimum of 30 min for the hot plate to stabilize after reaching the temperature at which calibration is to be made.

7.3 Calibrate the hot plate with the surface contact thermocouple to ±2°C (±4°F). The temperature of the hot plate will likely vary slightly over the hot plate surface. Thus the calibration is only valid for the immediate location tested. Gel times should only be measured at the location that was calibrated.

8. Procedure

8.1 Carry out the determination in duplicate.

8.2 Place the hot plate in a draft-free location or use a three-sided draft shield constructed to eliminate drafts.

8.3 Allow a minimum of 30 min for the hot plate to stabilize after reaching the temperature at which the measurement is to be made.

8.4 Using the measuring spoon, transfer 1.25 ml (¼ tsp) of the material under test onto the calibrated area of the hot plate.

8.5 As soon as the powder hits the plate, start the stop watch and begin stirring.

8.6 Stir the molten material in small circular movements with the stirrer. When thickening starts, maintain the overall stirring action, and periodically lift the stirrer approximately 25 to 50 mm (1 to 2 in.) above the molten material to produce a filament of molten material. When filaments break and can no longer be drawn from the then gelled material, stop the timer and record the time to the nearest second. This is the gel time.

8.7 Clean the gelled material from the surface of the hot plate with the scraper. If the plate surface becomes pitted or scratched, polish it smooth or replace it.

8.8 Repeat the determination with a fresh sample. If the two results differ by less than 5% of the lower value, calculate and report the arithmetic mean. If the difference between the two results exceeds 5%, carry out a third determination and calculate and report the arithmetic mean of all three results to the nearest second. If the difference between the result of the third determination and those of the other two determinations is also greater than 5%, state this and the individual results in the test report.

9. Report

9.1 Report the following information:

9.1.1 All details necessary to identify the product tested,

9.1.2 A reference to this standard,

9.1.3 The test temperature,

9.1.4 The amount of powder used if other than the default amount,

9.1.5 The result of the test as indicated in section 8.8,

9.1.6 Any deviation from the test method specified, and

9.1.7 The date of the test.

10. Precision and Bias

10.1 Precision—It is not possible to specify the precision of the procedure in Test Method D 4217 for measuring gel time because adequate data has not been established. No activity is planned to develop such data.

10.2 Bias—This test method has no bias because the value for gel time is defined solely in terms of this test method.

11. Keywords

11.1 coating powder; gel time of coating powder; hot plate; powder coating; thermosetting

SUMMARY OF CHANGES

Committee D01 has identified the location of selected changes to this standard since the last issue (D 4217 - 91 (1995)) that may impact the use of this standard. Minor changes to:

(1) Scope clarified and expanded in Section 1.
(2) Reference to ISO 8130–6 added in Section 2.
(3) Coating powder, cure time, powder coating, and thermosetting definitions added in Section 3.
(4) Apparatus details clarified and expanded in Section 5.
(5) Sample details simplified in Section 6.
(6) Calibration clarified and expanded in Section 7.
(7) Procedure clarified and expanded in Section 8.
(9) Precision statement revised.