



# Standard Test Method for Determination of Reactivity of Unsaturated Polyesters and Vinyl Esters at 180.0°F (82.2°C)<sup>1</sup>

This standard is issued under the fixed designation D7029; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This standard provides a standardized test method for determining the gelation and exotherm curve of unsaturated polyester and vinyl ester resins. This method provides guidance for measurement of the “Standard 180°F (82.2°C) Exotherm Curve” along with information on variances of the measurement which may be required for special resins. This test method provides information concerning the reactivity of unsaturated polyester and vinyl ester resins as they go through polymerization after mixing with the initiator.

NOTE 1—There is no known ISO equivalent to this standard, although ISO 584 is similar.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.3 *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 appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *Society of Plastics Industry, Inc.:*

*Handbook of Reinforced Plastics “Procedure for Running Exotherm Curves Using the Block Test Method”*

2.2 *ISO Standard:*

*ISO 584 Reinforced Plastics Based on Unsaturated Polyester Resins—Determination of Reactivity at 80°C<sup>2</sup>*

## 3. Terminology

### 3.1 Definitions:

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.18 on Reinforced Thermosetting Plastics.

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<sup>2</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

3.1.1 *gel time*—the period of time in minutes and seconds required for the recording pyrometer to go from a temperature below (usually 10 to 30°F or 5.5 to 16°C) bath temperature to 10°F (5.55°C) above the bath temperature, typically 150°F (65.5°C) to 190°F (78.8°C) for a bath at 180°F (82.2°C).

3.1.2 *cure time*—the period of time in minutes and seconds required for the recording pyrometer to go from a temperature below (usually 10 to 30°F or 5.5 to 16°C) bath temperature to the maximum temperature reading, typically 150°F (65.5°C) to the maximum temperature for a bath at 180°F (82.2°C).

3.1.3 *interval time*—the period of time in minutes and seconds required for the recording pyrometer to go from 10°F (5.5°C) above the bath temperature to the maximum temperature reading, typically 190°F (78.8°C) to the maximum temperature. Thus, interval time is cure time minus gel time.

3.1.4 *peak exotherm*—the maximum temperature reached during the testing.

3.1.5 *recording pyrometer*—a broad class of temperature measuring devices including thermocouples with the ability for continuous temperature recording.

3.1.6 *initiator*—a compound that generates free radicals to start the free radical polymerization of the unsaturated polyester and vinyl ester resins. It is typically a single peroxide, but a combination of initiators could be used.

## 4. Summary of Test Method

4.1 Polyester or vinyl ester resin is mixed with the initiator(s) in a beaker causing a polymerization of the resin to occur. Heat will accelerate the polymerization reaction. The exotherm generated by the resin as it cures is measured using a thermocouple. The curve is plotted and the time to reach various temperatures along with the peak temperature obtained (peak exotherm) is determined. The initiator normally employed to generate the test results is benzoyl peroxide, although the method may be used with other initiator systems.

4.2 The test method is useful in providing information about the heat generated during cure of the resin and the length of time the resin remains in the liquid state prior to polymerization into solid form.