



Designation: D 2035 – 80 (Reapproved 1999)

Standard Practice for Coagulation-Flocculation Jar Test of Water¹

This standard is issued under the fixed designation D 2035; 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.

1. Scope

1.1 This practice covers a general procedure for the evaluation of a treatment to reduce dissolved, suspended, colloidal, and nonsettling matter from water by chemical coagulation-flocculation, followed by gravity settling. The procedure may be used to evaluate color, turbidity, and hardness reduction.

1.2 The practice provides a systematic evaluation of the variables normally encountered in the coagulation-flocculation process.

1.3 *This standard does not purport to address 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 ASTM Standards:

- D 1129 Terminology Relating to Water²
- D 1192 Specification for Equipment for Sampling Water and Steam²
- D 1193 Specification for Reagent Water²
- D 1293 Test Methods for pH of Water²
- D 1889 Test Method for Turbidity of Water²
- D 3370 Practices for Sampling Water²

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminology D 1129.

4. Summary of Practice

4.1 The coagulation-flocculation test is carried out to determine the chemicals, dosages, and conditions required to achieve optimum results. The primary variables to be investigated using the recommended practice include, but are not limited to:

- 4.1.1 Chemical additives,
- 4.1.2 pH,

4.1.3 Temperature, and

4.1.4 Order of addition and mixing conditions.

5. Significance and Use

5.1 This practice permits the evaluation of various coagulants and coagulant aids used in the treatment of water and waste water for the same water and the same experimental conditions.

5.2 The effects of concentration of the coagulants and coagulant aids and their order of addition can also be evaluated by this practice.

6. Interferences

6.1 There are some possible interferences that may make the determination of optimum jar test conditions difficult. These include the following:

6.1.1 *Temperature Change (During Test)*—Thermal or convection currents may occur, interfering with the settling of coagulated particles. This can be prevented by temperature control.

6.1.2 *Gas Release (During Test)*—Flotation of coagulated floc may occur due to gas bubble formation caused by mechanical agitator, temperature increase or chemical reaction.

6.1.3 *Testing-Period*—Biological activity or other factors may alter the coagulation characteristics of water upon prolonged standing. For this reason the period between sampling and testing should be kept to a minimum, with the time being recorded.

7. Apparatus

7.1 *Multiple Stirrer*—A multiposition stirrer with continuous speed variation from about 20 to 150 rpm should be used. The stirring paddles should be of light gage corrosion-resistant material all of the same configuration and size. An illuminated base is useful to observe the floc formation. Precautionary measures should be taken to avoid heat being imparted by the illumination system which may counteract normal settling.

7.2 *Jars (or Beakers)*, all of the same size and shape; 1500-mL Griffin beakers may be used (1000-mL recommended minimum size).

¹ This practice is under the jurisdiction of ASTM Committee D-19 on Water and is the direct responsibility of Subcommittee D19.03 on Sampling of Water and Water-Formed Deposits, and Surveillance of Water.

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² *Annual Book of ASTM Standards*, Vol 11.01.

7.3 *Reagent Racks*— A means of introducing each test solution to all jars simultaneously. There should be at least one rack for each test solution or suspension. The racks should be similar to that shown in Fig. 1.

8. Reagents

8.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.³ Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

8.2 *Purity of Water*— Unless otherwise indicated, reference to water for reagent preparation shall be understood to mean Type IV reagent water conforming to Specification D 1193.

8.3 The following chemicals and additives are typical of those used for test solutions and suspensions. The latter, with the exception of coagulant aids, may be prepared daily by mixing chemicals with water to a concentration of 10 (± 0.1) g/L (1.0 mL of test solution or suspension when added to 1 L of sample is equivalent to 10 mg/L):

Prime Coagulants
 Alum [$\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$]
 Ferric sulfate [$\text{Fe}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$]
 Ferric chloride ($\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$)
 Ferrous sulfate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$)
 Magnesium carbonate ($\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$)
 Sodium aluminate (NaAlO_2)
 Coagulant Aids
 Activated silica
 Anionic (polyelectrolyte)
 Cationic (polyelectrolyte)
 Nonionic Polymer
 Oxidizing Agents
 Chlorine (Cl_2)
 Chlorine dioxide (ClO_2)
 Potassium permanganate (KMnO_4)
 Calcium hypochlorite [$\text{CaCl}(\text{ClO}) \cdot 4\text{H}_2\text{O}$]
 Sodium hypochlorite (NaClO)
 Alkalis
 Calcium carbonate (CaCO_3)
 Dolomitic lime
 (58 % CaO , 40 % MgO)
 Lime, hydrated [$\text{Ca}(\text{OH})_2$]
 Magnesium oxide (MgO)
 Sodium carbonate (Na_2CO_3)
 Sodium hydroxide (NaOH)
 Weighting Agents
 Bentonite
 Kaolin
 Other clays and minerals
 Miscellaneous
 Activated carbon (powdered)

8.4 *Coagulant Aids*— There are numerous commercially available coagulant aids or polyelectrolytes. All polyelectrolytes are classified anionic, cationic or nonionic, depending upon their composition. These aids may have the ability to produce large, tough, easily-settled floc when used alone or in conjunction with inorganic coagulants. A small dosage (under 1 mg/L) may permit a reduction in the dosage of, or complete

³ *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

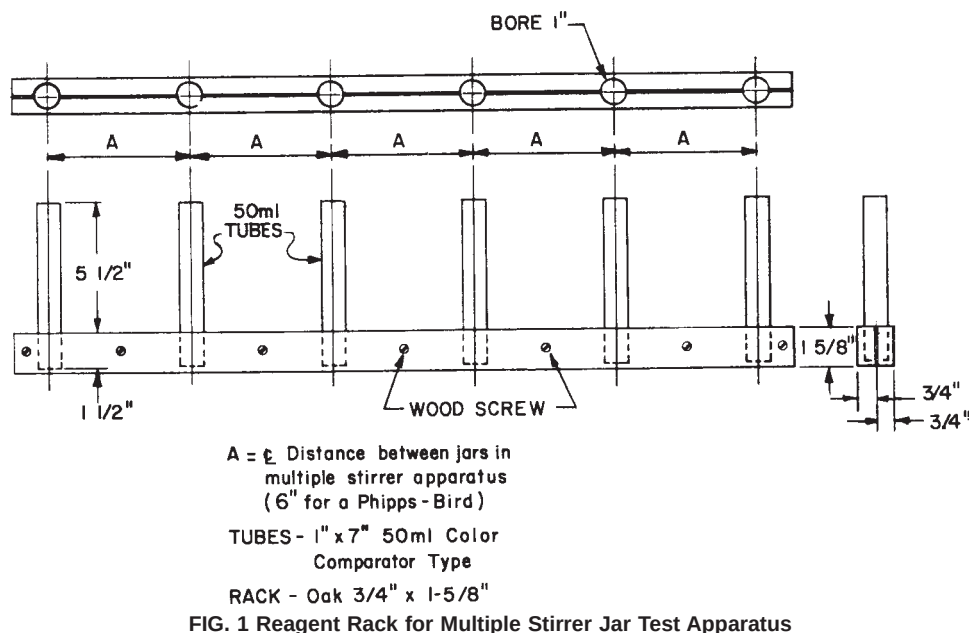


FIG. 1 Reagent Rack for Multiple Stirrer Jar Test Apparatus