

TEST PROCEDURE-Ballistic Gelatin Blocks-1.0 Background

- 1.1 The use of gelatin solution as a medium to replicate soft biological tissue has been employed for years in conjunction with wound ballistic studies.
- 1.2 Solution concentration is most simply defined on a weight percentage basis. Some authorities, however, improperly specify this concentration as the ratio of weight of solute (gelatin) to weight of solvent (water). To properly specify concentration on a weight percentage basis, the ratio of weight of solute to weight of solution (gelatin plus water) is specified. Thus, authorities ignorant of this fact are producing gelatin whose concentrations are, by convention, less than those intended.
- 1.3 Over a period of years, there has developed a school of thought claiming that a 10 percent weight concentration gelatin solution is more representative of human flesh tissue than a 20 percent weight concentration solution. As of this writing, this issue has not been conclusively resolved.
- 1.4 Evidence does exist that methods employing water temperatures exceeding 104 degrees Fahrenheit (40 degrees Centigrade) reduce both the gel strength (stiffness) and viscosity of a gelatin solution from that which would otherwise have been produced using relatively cooler water preparation temperatures.

2.0 Objective

- 2.1 The objective of this procedure is to promulgate a method which, when used, produces a gelatin solution representative of the character of human flesh tissue specified by authoritative literature.

3.0 Discussion

- 3.1 This procedure specifies the use of Ordnance Type 250A gelatin. This is a Type A gelatin manufactured expressly for ballistic testing usage, and possesses a nominal Bloom rating (gel strength) of 250 grams.
- 3.2 The characterization of the gelatin solution concentration on a weight percentage basis is based on the ratio of the weight of granulated gelatin to the combined weight of granulated gelatin and water.
- 3.3 The method specified herein is for formulation of 10 percent weight concentration (1 part solute to 9 parts solvent) gelatin solution only. Formulation of 20 percent weight concentration gelatin solution at these relatively cooler water temperatures precludes

adequate hydration of all of the gelatin granules during the hydration period of formulation (see formulation below).

4.0 Formulation Procedure

- 4.1 Table I provides a work sheet to calculate the correct quantities of granulated gelatin and water for any volume of container. Use of biological mold inhibitors, such as propionic acid or cinnamon oil, is optional.

TABLE I. FORMULATION WORK SHEET

1. Weight of mold	:	_____	grams
2. Fill mold with water.			
3. Weight of mold + water	:	_____	grams
4. Weight of water	:	_____	grams
5. Weight of gelatin	:	_____	grams (a)

(a) To determine the weight of gelatin for a 10 percent concentration, divide the weight of water by 9.

- 4.2 Rigid adherence to the following procedure is important:
- 4.2.1 Begin the mixing process with water at 45-50°F (7-10°C).
 - 4.2.2 Add 5 ml of propionic acid or cinnamon oil (optional).
 - 4.2.3 Add gelatin to water - never add water to gelatin.
 - 4.2.3.1 Stir gently to avoid entrapping air.
 - 4.2.3.2 Stir only until all particles of gelatin are wetted.
 - 4.2.4 Let stand (hydrate) at 45-50°F (7-10°C) for two hours.
 - 4.2.5 Heat solution to 100°F (38°C). **DO NOT HEAT OVER 104°F (40°C).**
 - 4.2.6 Pour into mold and store at 45-50°F (7-10°C) for a minimum of twenty hours.
 - 4.2.7 Remove gelatin from mold. Application of hot water to outside of mold will ease removal.
 - 4.2.8 Conduct testing within twenty minutes of removal from storage temperature (45-50°F).

4.2.9 For improved optical quality, minor surface irregularities may be eliminated by smoothing with warm water.

5.0 Reconstituted Blocks

5.1 In the interest of economy, gelatin blocks may be reused to make new blocks by heating to--and maintaining at--100 degrees Fahrenheit. Once the gelatin block dissolves into solution again, the above procedure may then be repeated.

6.0 Long Term Storage

6.1 Remove from mold, seal in airtight bag, and store at 39°F (4°C).

7.0 Materials

7.1 The following materials are to be used:

7.1.1 Ordnance Type 250A gelatin; Kind and Knox Gelatin, Inc.; Sioux City, Iowa.

7.1.2 Water; potable.

7.1.3 Propionic acid; Fisher Scientific; Pittsburgh, Pennsylvania.

7.1.4 Cinnamon oil; Lorann Oils, Inc.; Lansing, Michigan.