T 21 ORGANIC IMPURITIES IN CONCRETE SAND

1. Which of the following best describes the sample as prepared for testing?
   a. The sample shall consist of approximately 450 grams of material that has first been washed, then air-dried to a condition where it will be free-flowing so that it can be added to the bottle of solution.
   b. The sample is first air-dried, then wetted with a 3% solution of NaOH prior to adding to the bottle and shaking.
   c. The sample as obtained and reduced by AASHTO T 2 and T 248 shall consist of approximately 450 grams of the sand to be tested. If drying is necessary, only air-drying shall be permitted.
   d. None of the choices.

2. According to this FOP, which of the following statements is true?
   a. When making the color comparison of the supernatant solution with a color standard, only the glass color plate is permitted due to the danger associated with dissolving potassium dichromate in sulfuric acid.
   b. After making the color comparison, it is noticed that the color of the supernatant solution is darker than that of the standard. This indicates that the fine aggregate may not be used under any circumstances because it contains injurious amounts of organic material.
   c. A clear, graduated glass bottle of 12 fl. oz. capacity having an outside diameter of 2.0 inches may be used for the test. The bottle is first filled with 3% NaOH solution to the 4½ ounce mark and the test sample is then introduced into the bottle.
   d. A clear, graduated glass bottle of 12 fl. oz. capacity having an outside diameter of 2.0 inches may be used for the test. The bottle is first filled with fine aggregate to the 4½ ounce mark and then with a 3% NaOH solution to the 7 ounce mark.
   e. All of the above.

3. When making the color comparison using a Standard Color Solution…
   a. make the solution by dissolving potassium dichromate in sulfuric acid such that the color of the solution is equal to Organic Color 3. The solution must be freshly made (within 2 hours of use).
   b. record whether the supernatant liquid is lighter, darker, or equal to the Standard Color Solution.
   c. record the organic plate number that is nearest the color of the Standard Color Solution.
   d. a & b
   e. b & c

T 104 SOUNDNESS OF AGGREGATE

4. Which of the following statements is correct?
   a. Suitable glassware and a scale may be used to check the specific gravity of the solution used for this test.
   b. Sample containers shall be 8-inch diameter sieves (No. 8 size for coarse aggregate, No. 60 for fine aggregate). Alternate containers may be used for comparison testing providing they provide free access of solution to the aggregate and draining of the solution from the samples without loss of aggregate.
   c. When immersed in the solution, the sample temperatures must be regulated within the range of 68.5 to 71.5 ˚F.
   d. a & c
   e. b & c

5. For reliable drying of the samples after immersion in the appropriate solution, the oven must demonstrate an acceptable evaporation rate. Which of the following statements about evaporation rate is true?
   a. Evaporation rate is acceptable provided that no moist solution is noted on the samples after at least four hours of drying at 230 ±9˚F.
   b. When evaluating evaporation rate, after four hours in the oven regulated at 230 ±9˚F, each beaker of water installed in the oven must have lost at least 100 grams of water.
   c. Evaporation rate is determined in only one location in the oven. The location is selected such that it represents the area in the oven having the slowest evaporation rate.
   d. None of the above.

6. Based on the table on the following page, what is the reported total weighted percentage loss for the coarse aggregate; for the fine aggregate?
   a. 4.7% - - 5.6%
   b. 4% - - 5%
   c. 5% - - 6%
   d. 19.8% - - 28.8%
   e. None of the above.

Date: _____ Project: _____

Material: _____

Solution: _____ No. of Cycles: _____

Source: _____

Tested By: _____

Quantitative Examination					
Sieve Size	**Grading of Sample, %**	**Fraction Mass, g**		**Percent Loss**	**Weighted % Loss**
		Before	**After**		
Minus No. 100	8	---	---	---	---
No. 50 to No. 100	11	---	---	---	---
No. 30 to No. 50	22	100.0	95.5		
No. 16 to No. 30	27	100.0	93.6		
No. 8 to No. 16	13	99.9	92.3		
No. 4 to No. 8	16	100.0	89.7		
3/8" to No. 4	3	---	---		
Totals (Fine Agg)	100	---	---	---	
2½" to 1½" 2½" – 2" (3014 g.) 2" – 1½" (1983 g.) Total:	16	4997	4822		
1½" to ¾" 1½" – 1" (1002 g.) 1" – ¾" (509 g.) Total:	47	1511	1463		
¾" to ⅜" ¾" – ½" (664 g.) ½" – ⅜" (332 g.) Total:	31	996	922		
⅜" to No. 4 296 g.	6	296	279		
Totals (Coarse Agg)	100	---	---	---	

Qualitative Examination of Coarse Particles											
Sieve Size	Disinteg.		Splitting		Crumbling		Cracking		Flaking		No. of Particles in Fraction
	No.	%	No.	%	No.	%	No.	%	No.	%	
2½" - 1½"	---	---	1	3	1	3	2	6	---	---	31
1½" - ¾"	---	---	3	6	2	4	5	10	---	---	48

T 112 CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATE

7. Which of the following statements regarding this FOP is **not true**?
   a. Containers must be manufactured of rust resistant material sufficiently large to permit spreading the sample in a thin layer.
   b. For Superpave Hot-Mix Asphalt, this test is considered to be source-specific rather than a consensus property. The governing agency is responsible for setting limits for evaluating the results of this test.
   c. The coarse aggregate sample, as prepared, must be separated into individual sizes with minimum mass of each size fraction conforming to the requirements of the FOP.
   d. After initially washing (T 11 procedure) and drying to constant mass, the sample fractions are spread out in their respective pans in a thin layer and covered with distilled water. The material is soaked for 24 ±4 hours.
   e. None of the choices.

8. Which of the following best describes the testing procedure after the soaking period?
   a. Attempt to break each particle by rolling and squeezing the particles between thumb and forefinger. Do not use the fingernail or press against a hard surface. Then subject the sample fractions to wet sieving using the appropriate sieve size. Dry the sample to constant mass, allow samples to cool, and determine the mass of each fraction to the nearest 0.1% of sample mass. After calculating, report percent clay lumps and friable particles to the nearest 1% (coarse aggregate reported as the weighted average of the fractions tested).
   b. Attempt to break each particle by rolling and squeezing the particles between thumb and forefinger. Wash the samples over the same sieve size used for separating the fractions during sample preparation. Dry to constant mass, cool, weigh, and calculate the percentage clay lumps and friable particles. Report results to the nearest 0.1%
   c. Roll and squeeze each particle between thumb and forefinger without using the fingernail or by pressing against a hard surface. After all clay lumps and friable particles have been broken up, subject the sample fractions to wet sieving using the appropriate sieve size designated by the FOP.
   d. Attempt to break each particle by rolling and squeezing the particles between thumb and forefinger. Do not use the fingernail or press against a hard surface. Dry the sample to constant mass, allow samples to cool, and determine the mass of each fraction to the nearest 0.1% of sample mass. After calculating, report the weighted average of percent clay lumps and friable particles of coarse aggregate to the nearest 1% and that of the fine aggregate to the nearest 0.1%

9. According to this FOP, it is permissible to use tap water rather than distilled water if it can be shown that there is no impact on testing accuracy.
   a. True
   b. False

T 193 CALIFORNIA BEARING RATIO

10. According to this FOP, when preparations are made to perform a CBR test, the maximum dry density and optimum moisture content of the soil must first be determined. Which of the following statements is true?
    a. For maximum dry density and optimum moisture determination, the appropriate test method is used according to the soil classification (T99 or T180). Correction for oversize particles is conducted according to AASHTO T224 (correction based on percentage and specific gravity of oversize particles).
    b. For maximum dry density and optimum moisture determination, the test method specified by the agency is used (T99 or T180). Adjustment for oversize particle content in the sample is made by replacing the mass of particles coarser than ¾-inch with an equal mass of particles ¾-inch to Number 4 in size.
    c. For maximum dry density and optimum moisture determination, the appropriate test method is used according to the soil classification (T99 or T180). No correction for oversize particles is necessary because the CBR method does not require any adjustment to the sample for the proctor or CBR specimens.
    d. If oversize particles (coarser than ¾-inch) are present, the sample is first prepared by removing all particles larger than 2 inches. For both proctor and CBR specimens, the 12-inch diameter molds must then be used. In this way, correction for coarse particles is unnecessary since they are incorporated in the sample being tested.

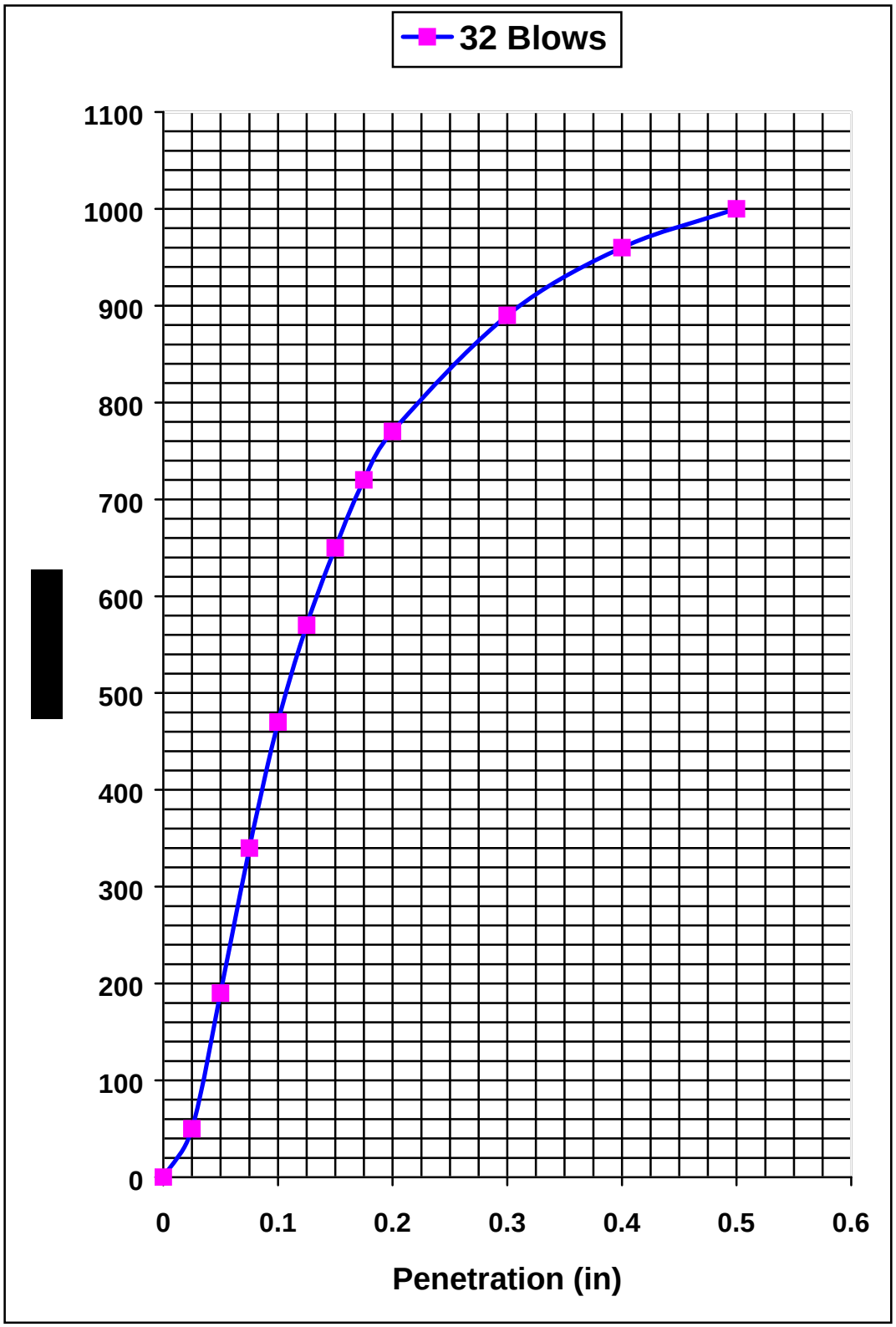
11. According to this FOP, which of the following statements is true?
    a. Surcharge weights consisting of at least one annular weight and as many slotted weights as necessary must be applied to the top of the molded specimen prior to soaking. The number of weights must produce a surcharge within 5 lb of the anticipated mass of the base course and pavement (at least 10 lb must be applied).
    b. The standard test method requires a soaking period of 96 hours after which the final swell reading is taken. Remove free water from the top of the specimen and allow draining downward for 15 minutes taking care not to disturb the specimen surface.
    c. In preparation for the penetration procedure, the surcharge weights and swell plate must be removed and one surcharge weight reinstalled. The penetration piston is then seated with a 10-lb load followed by installation of the remaining surcharge weights. The stress and strain gages are then set to zero.
    d. Penetration is conducted at a uniform rate of 0.05 inch per minute. Load readings are taken to the nearest 10 pounds at all required penetrations.
    e. All of the above.

12. Based on the curve on the following page, no correction to the zero point is required.
    a. True
    b. False

$$\text{CBR} = \frac{\text{Corrected Load Value}}{\text{Standard Load Value}} \times 100$$

What is the CBR value at 0.2 inch penetration? _____

Penetration Values at 32 blows/layer



T 288 DETERMINING MINIMUM LABORATORY SOIL RESISTIVITY

13. For this test method, the sample is prepared by initially screening over a No. 4 sieve. Approximately 1500 grams of the minus No. 4 material is selected for further sample preparation.
    a. True
    b. False

14. According to this FOP, which of the following statements is true?
    a. In alternate sample preparation Method B, the fraction of material remaining on the No. 4 sieve should be ground then separated again using the No. 4 sieve.
    b. Resistors used for calibration of the resistivity meter must be accurate within a 10 percent tolerance.
    c. The zero point calibration of the resistivity meter is conducted according to manufacturer's instructions, usually by clamping the two leads together and adjusting the meter as necessary.
    d. a & b
    e. a & c
    f. None of the above.

15. Using the information below, which of the choices most closely represents the minimum soil resistivity.

R = Minimum Reading (Ω) x Multiplying Constant

$$\textbf{Multiplying Constant} = \frac{\text{Surface Area of One Electrode (cm}^2\text{)}}{\text{Measured Avg. Distance Between Electrodes (cm)}}$$

Electrode length: 4.428 cm
Electrode width: 15.22 cm
Average measured distance between electrodes: 10.18 cm
Measured Resistance Values: 2510 Ω, 1790 Ω, 930 Ω, 440 Ω, 720 Ω

    a. 4766 (ohm) x (cm)
    b. 3498 (ohm) x (mm)
    c. 2913 (ohm) x (cm)
    d. 5411 (ohm) x (mm)
    e. None of the above, more data is required.

T 289 DETERMINING THE PH OF SOILS

16. Initial sample preparation for this test method (drying, splitting, pulverizing and screening) is identical to that of the soil resistivity test. From the prepared soil, a representative portion of approximately 100 grams is obtained.
    a. True
    b. False

17. According to this FOP, which of the following statements is **not true**?
    a. 30 ±1.0 g of material and 30 ±1.0 g of distilled water are added and mixed to obtain a slurry for the pH reading.
    b. After mixing the sample with distilled water it is allowed to stand for a minimum of two hours, stirring the sample every 30 minutes.
    c. Prior to making the pH determination, the meter must be standardized according to manufacturer's instructions. The temperature of the soil slurry must be determined and the pH meter's temperature controller adjusted accordingly (if the meter does not have automatic temperature adjustment capability).
    d. After the electrodes are placed in the slurry gently turn the beaker to make good contact between the solution and the electrodes. After allowing the meter to stabilize for at least 30 seconds, read and record the pH value of the soil to the nearest 0.1.

18. According to this FOP, which of the following statements is true?
    a. The results of this test are used to supplement determinations made according to AASHTO T 288 (resistivity test), helping to identify soil conditions that may accentuate the corrosion of embedded metal items.
    b. The original sample as reduced by AASHTO T 248 must be of sufficient size to yield at least 1000 grams of dry material passing the No. 10 sieve.
    c. After adding distilled water to the appropriate sample, the slurry is mixed thoroughly. It is then allowed to stand for any convenient period of time to allow complete saturation of the sample.
    d. Electrodes of the pH meter should be kept dry while the meter is not in use. After removal from the soil slurry, they should be cleaned by wiping thoroughly using a soft tissue.

T 19 DENSITY ("UNIT WEIGHT") AND VOID CONTENT IN AGGREGATES

19. According to this FOP, which of the following statements is true?
    a. The jigging procedure is the appropriate method of compacting aggregate in the measure for material having a nominal maximum size larger than 1½ inch.
    b. During sample preparation it is always necessary to wash the sample, then dry it to constant mass prior to performing the test.
    c. The shoveling procedure for loose bulk density shall only be permitted when the governing agency requires it.
    d. a & c
    e. b & c

20. Which of the following is required by this FOP when determining density and void content of aggregates?
    a. The measure must be calibrated so the volume is known.
    b. The dry bulk specific gravity (G_{sb}) of the aggregate must be known to allow calculation of void content.
    c. The rodding procedure should always be used to compact aggregate in the measure unless some other method is specified.
    d. a & b
    e. b & c.

21. Given the following, which values should be reported for bulk density and void content of the aggregate.

$$\mathbf{M} = \frac{\mathbf{(G - T)}}{\mathbf{V}} \qquad \mathbf{Voids,\%} = \frac{\mathbf{100[(S \times W) - M]}}{\mathbf{S \times W}}$$

known:

Aggregate Nominal Maximum Size: 2-inch

G =	70.97 lbs	S =	2.628
T =	15.45 lbs	W =	62.3 lb/ft^3
V =	0.491 ft^3		

    a. 113.1 lb/ft^3 -- 30.9%
    b. 144.5 lb/ft^3 -- 11.7%
    c. 113 lb/ft^3 -- 31%
    d. 145 lb/ft^3 -- 12%.

T 96, C 535 RESISTANCE TO DEGRADATION BY THE L.A. WEAR MACHINE

22. Describe the differences between the T 96 and C 535 test methods; describe the similarities.

Differences: _____

_____

_____

_____

Similarities: _____

_____

_____

_____

23. At what rate does the cylinder rotate?
    a. 30 ±5 rpm.
    b. 33 ±3 rpm.
    c. 30 to 33 rpm.
    d. 30 to 35 rpm.

24. Degradation of the sample occurs because, with each revolution of the cylinder, the charge and the sample are dropped from the center of the cylinder onto the shelf.
    a. True
    b. False

T 113 LIGHTWEIGHT PIECES IN AGGREGATE

25. According to this FOP, which of the following statements is **incorrect**?
    a. Either hydrometers or suitable balance and glassware may be used to check the specific gravity of the heavy liquids used for this test.
    b. When conducting this test using heavy solutions made from zinc bromide or zinc chloride, final sample drying must be conducted out of doors or under a vent hood.
    c. Coal & lignite particles are those having a specific gravity less than 2.00.
    d. For the coarse aggregate procedure, the skimmer (manufactured of No. 50 screen cloth) is used to remove the floating particles from the surface of the heavy solution.
    e. None of the above.

26. According to this FOP…
    a. after appropriate sample preparation, introduce the aggregate into the heavy liquid. Agitate the sample in the liquid to permit lightweight particles to float.
    b. heavy liquid specific gravities must be maintained within ± 0.001 of the required value at all times during the testing procedure.
    c. it is permissible to test coarse aggregate in the oven-dry condition provided that water absorption does not exceed 0.5 percent.
    d. no special precautions need be taken in mixing or handling heavy solutions.
    e. All of the above.

27. Percentage of lightweight pieces is reported to the nearest 0.1%.
    a. True
    b. False

T 84 Specific Gravity and Absorption of Fine Aggregate

28. The standard method of sample preparation and testing requires which of the following?
    a. Remove oversize particles (larger than #8) from the sample and submerge in water for 15 to 19 hours.
    b. After reducing to approximately 1000 gram sample size, immediately expose the sample to a gently moving current of warm air until the material approaches a free flowing condition.
    c. Dry the as-received sample to constant mass and submerge in water for 20± 4 hours.
    d. None of the above.

Calculations

Bulk Specific Gravity (G_{sb}) $= \dfrac{A}{(B + S - C)}$

Bulk Specific Gravity (G_{sb} SSD) $= \dfrac{S}{(B + S - C)}$

Apparent Specific Gravity (G_{sa}) $= \dfrac{A}{(B + A - C)}$

Absorption $= \dfrac{S - A}{A} \times 100$

A Mass, g	B Mass, g	C Mass, g	S Mass, g
502.4	669.4	979.1	501.5

29. Perform calculations and determine the values requested using the appropriate formulas above.

    a. The reported G_{sb} is _____

    b. The reported G_{sb}(SSD) is _____

    c. The reported G_{sa} is _____

    d. Do the test results make sense (Yes/No)? _____

    e. If results don't make sense, why?

    _____

    _____

    _____

T 85 SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE

30. Apparent specific gravity (G_{sa}) is a determination of specific gravity that takes into account the permeable and impermeable voids within aggregate particles, but not the voids between particles.

    a. True
    b. False

31. The correct sequence of mass or weight determinations for this test method is…
    a. 1- Dry Mass; 2- Submerged Weight; 3- SSD Mass
    b. 1- Submerged Weight; 2- SSD Mass; 3- Dry Mass
    c. 1- SSD Mass; 2- Submerged Weight; 3- Dry Mass
    d. Any of the above. Masses / weights may be performed in any convenient sequence.

T 304 Uncompacted Void Content of Fine Aggregate

32. For Method C (as-received sample), sample preparation includes which of the following?
    a. First wash the sample and dry to constant mass. Remove particles larger than the No. 4 sieve.
    b. Dry the sample to constant mass, then remove particles larger than the No. 4 sieve.
    c. Use 190±1 grams of material for the uncompacted void determination.
    d. b & c
    e. None of the above.

33. Calculation of uncompacted void content.

$$U = \frac{V - \left(\frac{F}{G}\right)}{V} \times 100$$

where:

Volume of the measure (V)	= 100.1 mL
Mass of measure + aggregate	= 335.7 g.
Mass of empty measure	= 189.4 g.
Mass of aggregate (F)	= _____ g.
Bulk Specific Gravity (G)	= 2.687

Given the information presented above, what is the reported uncompacted void content?

a. 45.6%
b. 46%
c. 29.6%
d. 54.4%
e. None of the above.