STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY

DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
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METHOD FOR DETERMINING OPTIMUM BITUMEN CONTENT (OBC)

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read "SAFETY AND HEALTH" in Section F of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

A. SCOPE

This is the procedure to be used to analyze data from specimens fabricated and tested in accordance with the following test methods:

1. Compaction — California Test 304
2. Stability — California Test 366
3. Specific Gravity — California Test 308, Method A

B. VOID CONTENT OF SPECIMEN

1. Calculate the void content of each specimen as follows:

% voids = 100 - Relative Density (Figure 1)

Where:

Relative Density = Specific Gravity (Sp. Gr.) Briquette/Maximum Specific Gravity

and

$$\text{Max Sp. Gr.} = \frac{100 + \%\ \text{Asphalt}}{\frac{\%\ \text{Fines}}{\text{Sp. Gr. Fines*}} + \frac{\%\ \text{Coarse}}{\text{Sp. Gr. Coarse*}} + \frac{\%\ \text{Asphalt}}{\text{Sp. Gr. Asphalt}}}$$

* Coarse Aggregate - CT 206, Bulk Specific Gravity (oven-dry basis)

Fine Aggregate - CT 208, Apparent Specific Gravity

C. OPTIMUM BITUMEN CONTENT

1. Using Form TL-3158 (Figure 2), record in Step 1 of the pyramid the asphalt content of the four specimens with the maximum asphalt content used in the square farthest to the right.
2. Plot the asphalt content versus the void content for each specimen on Form TL-306 (Figure 3), and the connect adjacent points with straight lines.
3. Inspect the compacted surface of each specimen. Classify the surface according to the degree of flushing or bleeding. See Note 1. From Step 1 of the pyramid, select the three highest asphalt contents that do not exhibit moderate or heavy surface flushing. Record these asphalt contents in Step 2.
4. From Step 2 of the pyramid, select the two highest asphalt contents that provide the specified minimum stabilometer value, and record them in Step 3. See Note 2.
5. Using the void content data (Figure 3), select the theoretical asphalt content that has 4.0 % or more voids and is within the asphalt range listed in Step 3

of the pyramid. **Always stay as close to 4.0 % voids as possible.**

a. For asphalt rubber hot mix-gap graded (ARHM-G), select the percent asphalt content established by the plot at the specified percent air voids. Record this amount in Step 4 of the pyramid. See Note 2.

b. For asphalt rubber hot mix-dense graded (ARHM-D), select the percent asphalt content established by the plot that has the specified percent or more voids and is within the range of asphalt are listed in Step 2 of the pyramid.

6. Record the asphalt content in Step 4 as the Optimum Bitumen Content (OBC).

7. To establish a recommended range, use the Optimum Bitumen Content (OBC) as the high value and 0.3 % less as the low value where the OBC is 7.9 % or less. When the OBC is between 8.0 % and 8.6 %, use it as the high value of the range and use 7.6 % as the low value. When the OBC is greater than 8.6 %, use it as the high value and 1.0 % less as the low value.

D. REPORTING OF RESULTS

Use Form TL-3158 for recording test data and Form TL-302 for reporting the recommended range for the bitumen content. A copy of TL-3158 should accompany the report.

E. NOTES

1. Surface flushing or bleeding is considered "Slight" if the surface has a slight sheen. It is considered "Moderate" if sufficient free asphalt is apparent to cause paper to stick to the surface but no distortion is noted. "Heavy" surface flushing is assigned to specimens with sufficient free asphalt to cause surface puddling and/or specimen distortion after compaction.

   For recommending asphalt content, slight flushing will be considered as "no flushing."

2. For bituminous mixtures other than ARHM, stabilometer values less than 35 generally indicate a mixture that may be unstable if the thickness exceeds 52 mm. Mixes with stabilities less than 25 should be avoided regardless of thickness. Specimens with low stabilometer values may contain an excess amount of asphalt and/or the aggregate may tend to be round or smooth.

3. The specified air void content of each ARHM is project specific. It is based on the ambient temperature and the projected traffic conditions for the roadway. Consult the Special Provisions for the minimum value allowed.

4. The optimum bitumen content for open-graded mixtures is determined as indicated in California Test 368.

F. SAFETY AND HEALTH

Prior to handling, testing or disposing of any materials, testers are required to read Part C (Section 1.2) of Caltrans Laboratory Safety Manual. Users of this method do so at their own risk.

REFERENCES

California Tests 206, 208, 304, 308, and 366

End of Text (California Test 367 contains 5 pages)

AIR VOIDS DETERMINATION
(CALCULATION SHEET)

Asphalt Grade _____

Test Card No. _____ Plant _____

BRIQUETTE 1.

STEP A : $\dfrac{100\% + \%\ \text{Asphalt in Briq. (\ )}}{\dfrac{\%\ \text{Fines (\ )}}{\text{Fine Sp. Gr. (\ )}} + \dfrac{\%\ \text{Coarse (\ )}}{\text{Coarse Sp. Gr. (\ )}} + \dfrac{\%\ \text{Asphalt (\ )}}{\text{Asphalt Sp. Gr. (\ )}}} = \dfrac{\text{X (\ )}}{\text{Y * (\ )}} = \text{MSG}$ _____

STEP B : RD = $\left(\dfrac{\text{Sp. Gr. Briq. No. 1 (\ )}}{\text{MSG (\ )}}\right) \times 100 =$ _____ %

STEP C : V = 100 – RD (\ ) = ¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾→

% VOIDS

BRIQUETTE 2.

STEP A : MSG = $\dfrac{100 + \%\ \text{Asphalt (\ )}}{\text{Y} + 0.49\ (\ )} =$ _____

STEP B : RD = $\left(\dfrac{\text{Sp. Gr. Briq. No. 2 (\ )}}{\text{MSG (\ )}}\right) \times 100 =$ _____ %

STEP C : V = 100 – RD (\ ) = ¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾→

% VOIDS

BRIQUETTE 3.

STEP A : MSG = $\dfrac{100 + \%\ \text{Asphalt (\ )}}{\text{Y} + 0.98\ (\ )} =$ _____

STEP B : RD = $\left(\dfrac{\text{Sp. Gr. Briq. No. 3 (\ )}}{\text{MSG (\ )}}\right) \times 100 =$ _____ %

STEP C : V = 100 – RD (\ ) = ¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾→

% VOIDS

BRIQUETTE 4.

STEP A : MSG = $\dfrac{100 + \%\ \text{Asphalt (\ )}}{\text{Y} + 1.47\ (\ )} =$ _____

STEP B : RD = $\left(\dfrac{\text{Sp. Gr. Briq. No. 4 (\ )}}{\text{MSG (\ )}}\right) \times 100 =$ _____ %

STEP C : V = 100 – RD (\ ) = ¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾¾→

% VOIDS

NOTE: MSG = Maximum Specific Gravity
RD = Relative Density
V = Voids
Sp. Gr. Asphalt = 1.02 for Paving Grades AR 1000, 2000, 4000, 8000, 1.04 for Asphalt Rubber Binder
0.96 for Liquid Grades MC, SC, 70, 250, 800
*Value of the Denominator to be Increased by: 0.49 with each 0.5% of Paving Asphalt or,
0.52 with each 0.5% of Liquid Asphalt or,
0.48 with each 0.5% of Asphalt Rubber Binder.

FIGURE 1

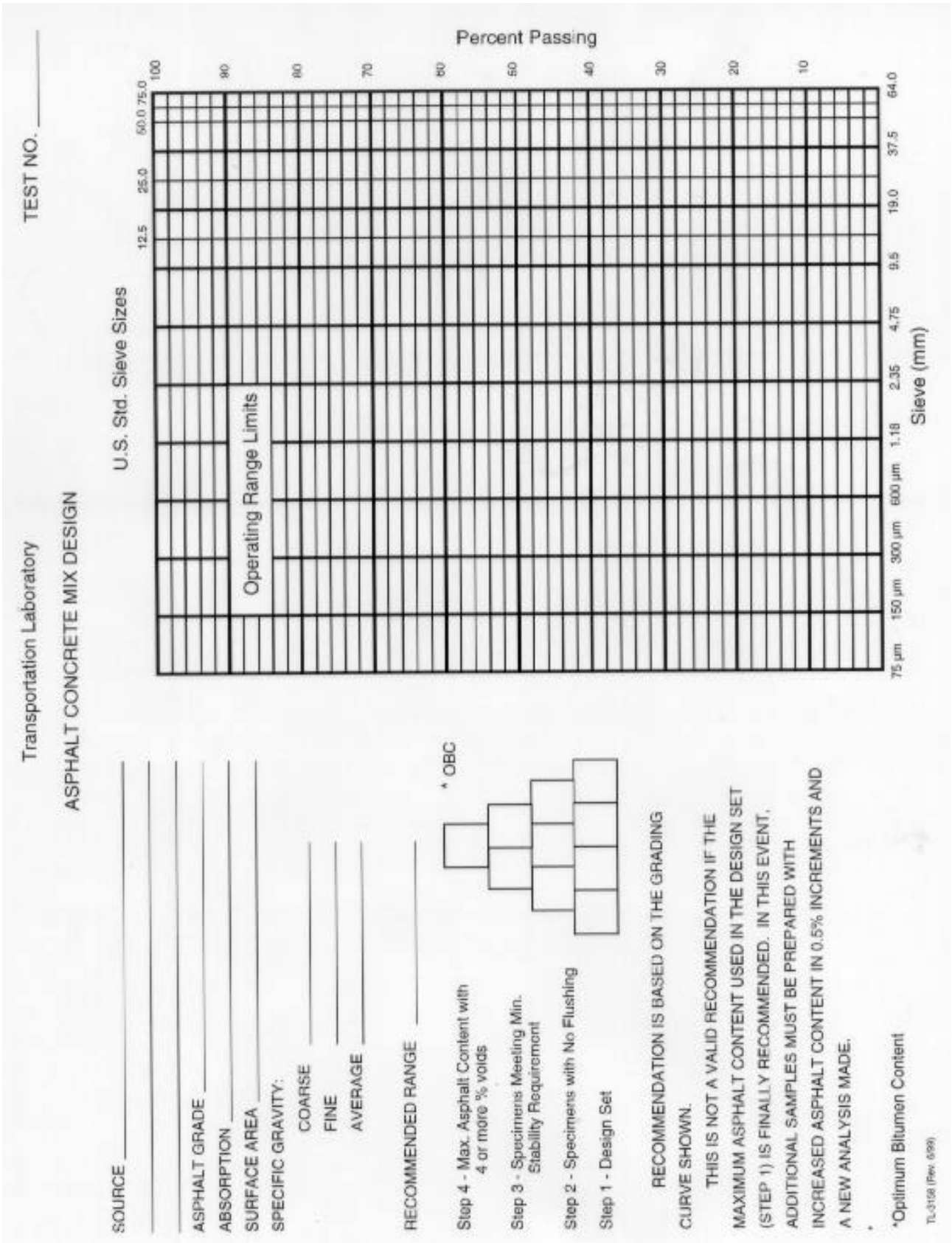
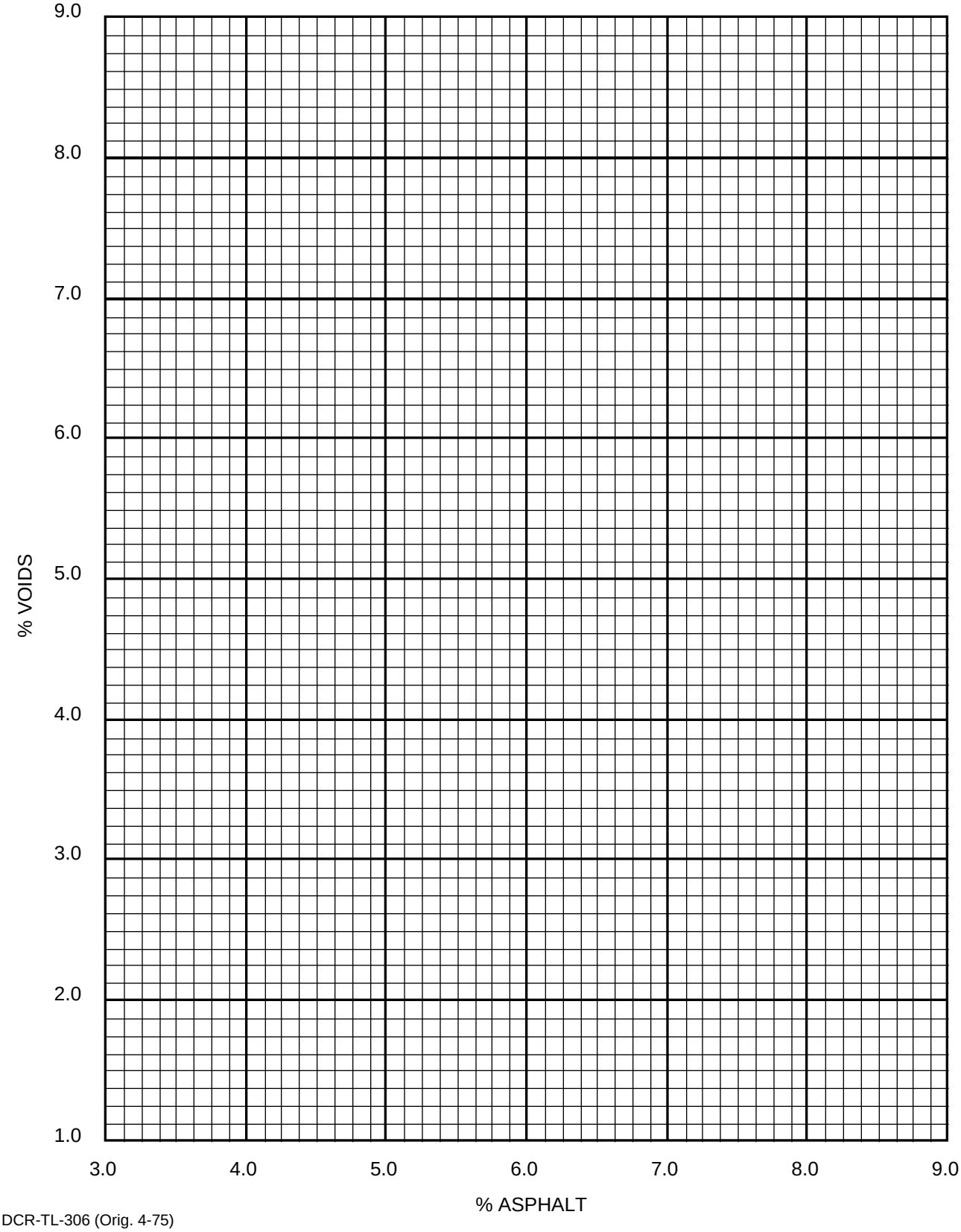

Transportation Laboratory
TEST NO. _____
ASPHALT CONCRETE MIX DESIGN
SOURCE _____
ASPHALT GRADE _____
ABSORPTION _____
SURFACE AREA _____
SPECIFIC GRAVITY:
COARSE _____
FINE _____
AVERAGE _____
RECOMMENDED RANGE _____
Step 4 - Max. Asphalt Content with 4 or more % voids
Step 3 - Specimens Meeting Min. Stability Requirement
Step 2 - Specimens with No Flushing
Step 1 - Design Set
* OBC
RECOMMENDATION IS BASED ON THE GRADING CURVE SHOWN.
THIS IS NOT A VALID RECOMMENDATION IF THE MAXIMUM ASPHALT CONTENT USED IN THE DESIGN SET (STEP 1) IS FINALLY RECOMMENDED. IN THIS EVENT, ADDITIONAL SAMPLES MUST BE PREPARED WITH INCREASED ASPHALT CONTENT IN 0.5% INCREMENTS AND A NEW ANALYSIS MADE.
*Optimum Bitumen Content
TL-3158 (Rev. 6/99)
U.S. Std. Sieve Sizes
Operating Range Limits
Percent Passing
100
90
80
70
60
50
40
30
20
10
75 µm
150 µm
300 µm
600 µm
1.18
2.35
4.75
9.5
12.5
19.0
25.0
37.5
50.0 75.0
64.0
Sieve (mm)

FIGURE 2

TRANSPORTATION LABORATORY
ASPHALT CONCRETE MIX DESIGN



DCR-TL-306 (Orig. 4-75)

FIGURE 3