ATT-67/2022, PERCENT COMPACTION, Asphalt Concrete Pavement

1.0 SCOPE

This method describes the procedure for calculating the percent compaction of asphalt concrete pavement core densities for each Lot and Segment, as related to either:

1) The average Dry Density of the field formed Marshall specimens compacted for the lot.
2) The average Theoretical Maximum Specific Gravity (G_{mm}) of loose mix specimens tested for the lot.

2.0 EQUIPMENT

Calculator

Data Sheets: Mix Moisture Content and Marshall Density Data,
Theoretical Maximum Specific Gravity (ASTM D2041, AASHTO T209),
Core Density, Extraction and Sieve Analysis,
Ignition Asphalt Content,
ACP Density and Void Contents,
Lot Paving Report.

3.0 PROCEDURE

3.1 Lot Marshall Density

1. Use the moisture content of the mix sample to calculate the dry weight of each of the two field formed Marshall specimens, as per ATT-7.

2. Calculate the dry density of each of the two field formed Marshall specimens using the formula:

$$\textit{Marshall Dry Density (kg/m}^3\textit{)} = \frac{\textit{Dry Sample Weight (g)}}{\textit{Volume of Sample (cm}^3\textit{)}} \times 1000$$

3. Determine the average dry density of the two Marshall specimens. Enter the Average Marshall Density of each mix sample, in the order of testing.

4. Calculate the average Marshall density of the mix samples obtained for the lot. Record as Lot Average Formed Marshall Specimen Density.

3.2 Theoretical Maximum Specific Gravity (Gmm)

1. The following is a brief description of the Maximum Specific Gravity Test. A complete description can be found in ASTM D2041 (AASHTO T209).

2. A representative sample of Hot Mix Asphalt is broken down and separated (taking care not to fracture the aggregate). Follow the procedure for the bowl or flask container type to calculate the G_{mm} (kg/m^3). Calculate the G_{mm} to 3 decimal places.

3.3 Segment Percent Compaction

1. Calculate the dry density (kg/m^3) of the core obtained for the segment using the formula:

$$\textit{Segment Core Dry Density (kg/m}^3\textit{)} = \frac{\textit{Oven Dry Wt. of Core (g)}}{\textit{Volume of Core (cm}^3\textit{)}} \times 1000$$

2. Determine the percent compaction for the segment as follows:

   a) by using Marshall Density
   b) by using Theoretical Maximum Specific Gravity (G_{mm})

$$\textit{Segment \% Compaction} = \frac{\textit{Segment Core Dry Density (kg/m}^3\textit{)}}{\textit{Lot Avg Marshall Density (kg/m}^3\textit{)}} \times 100\%$$

or

$$\textit{Segment \% Compaction} = \frac{\textit{Segment Core Dry Density (kg/m}^3\textit{)}}{\textit{Lot Avg Loose Mix G}_{mm}} \times 100\%$$

3.4 Lot Percent Compaction

1. Average the segment core dry densities obtained for the lot.

2. Calculate the Lot Average Percent Compaction as follows:

   a) by using Marshall Density
   b) by using Theoretical Maximum Specific Gravity (G_{mm})

$$\textit{LOT \% Compaction} = \frac{\textit{Lot Avg Core Dry Density } (kg/m^3)}{\textit{Lot Avg Marshall Density } (kg/m^3)} \times 100\%$$

or

$$\textit{LOT \% Compaction} = \frac{\textit{Lot Avg Core Dry Density } (kg/m^3)}{\textit{Lot Avg Loose Mix } G_{mm}} \times 100\%$$

Example Lot Paving Report

LOT PAVING REPORT - QA Testing using Maximum Specific Gravities

Alberta Transportation — MAT 6-78/19

CONTRACT NO.	PROJECT NO.				PROJECT FROM	LOT NO.	MST DESIGN NO.	DESIGN DENSITY (kg/m^3)	2344	DESIGN AIR VOIDS (%)	3.7	BSG of AGGREGATE	2.587
123456						1							
WEEK ENDING YY MM DD	CL	NO.	A	CS	PROJECT TO	MIX TYPE	PIT NAME	DESIGN AC (%)	5.5	DESIGN VMA (%)	14.1	Gmm at Design AC	2.435
	HW	222		10	PAVING CONTRACTOR: Black Ops	H2	QA CONSULTANT	TARGET AC (%)	5.5	DESIGN LIFT THICKNESS (mm)	50		

DATE LAID	LOT AGGREGATE PROPORTIONS					FORMED MARSHALL SPECIMENS						ASPHALT CONTENT			LOT PAVEMENT AND COMPACTION DATA												
	COARSE AGGREGATE %	MF %	BS %	RAP %		DENSITY	Max Spec Gravity (G_{mm})	* AIR VOIDS by Gmm		* AIR VOIDS using Airvoid Table		SAMPLE SOURCE	SEGMENT CORRECTED ASPHALT CONTENT	TEST METHOD	SEGMENT #	STATION	+ OR -	LOCATION	LANE	LIFT	CORE THICKNESS	CORE DENSITY	AIR VOIDS		** COMPACTION		CORE MOISTURE
(dd-mm-yyyy)						(kg/m^3)	(kg/m^3)	(% by G_{mm})	VMA	AV	VMA (%)		(%)			(00+000)					(mm)	(kg/m^3)	(% by G_{mm})	using AV Table	% by G_{mm}	by Marshall Density	(%)
1-May-2018	27	28	8	30		2384	2435	2.1	10.9	1.8	12.8	CO	5.56	IG	1					B	60	2201	9.8	9.4	90.2	93.7	
LOT PAVING LIMITS (km)						2364	2417	2.2	11.6	2.7	13.5	CO	5.63	IG	2					B	61	2278	6.7	6.2	93.3	97.0	
FROM	TO	LANE		MAT		2304	2462	6.4	9.9	5.1	15.7	CO	5.53	IG	3					B	63	2302	5.7	5.2	94.3	98.0	
						2339	2451	4.6	10.3	3.7	14.4	CO	5.79	IG	4					B	60	2305	5.6	5.1	94.4	98.2	
												CO	5.88	IG	5					B	62	2294	6.0	5.6	94.0	97.7	
						2348	2441	3.8	10.7	3.3	14.1		5.68		LOT MEAN						61	2276	6.8	6.3	93.2	96.9	
						For QC Lots: Calculate air voids using Target AC				3.6	14.0	* Use Lot Mean Corrected asphalt content to calculate Marshall Air Voids & V.M.A. Marshall AV by Gmm = ((Gmm-Marshall Density)/ Gmm)) x 100												6.5		

ADDITIVE: RA Reclaim — MAT: R Right

4.0 HINTS AND PRECAUTIONS

1. ***DO NOT*** round-off the actual segment percent compaction numbers when calculating the lot percent compaction. Rounding errors could result in an error in the compaction Lot Mean calculations for the contractor payment bonus/penalties.

   A rounding error, or round-off error, is a mathematical miscalculation error caused by altering a number to an integer, or one with fewer decimals.

   When a sequence of calculations with an input involving any roundoff error are made, errors may accumulate, sometimes dominating the calculation.