

## ASPHALT-RUBBER ASPHALT CONCRETE

**717.1 DESCRIPTION:**

The work under this section shall consist of furnishing, proportioning and mixing all the ingredients necessary to produce an Asphalt-Rubber Asphalt Concrete (ARAC) material. ARAC mixes may be used for low or high traffic conditions, as determined by the agency. Low traffic conditions are conditions where the asphalt mix will be subject to low volume and low weight vehicle usage. Examples of this condition are residential streets, most parking lots and residential minor collector streets. High traffic conditions are conditions where the asphalt mix will be subject to high volume and/or heavy weight vehicle usage as found on major collector, arterial and commercial streets. Street classifications (i.e. minor collector and major collector) shall be determined by the specifying agency.

**717.2 MATERIALS:**

**717.2.1 Asphalt-Rubber Binder (ARB):** The blended ARB shall meet the criteria list below. The ARB may be blended in a dedicated blending and storage unit connected to the hot plant or at the asphalt binder supplier's facility.

**717.2.1.1 Asphalt Cement:** Asphalt cement shall conform to the requirements of Section [711](#).

**717.2.1.2 Crumb Rubber:** Crumb Rubber shall meet the gradation requirements as shown in Table [717-1](#) below when tested in accordance with Arizona Test Method 714.

TABLE 717-1	
GRADATION REQUIREMENTS OF CRUMB RUBBER	
Sieve Size	Percent Passing
2.00 mm (#10)	100
1.18 mm (#16)	65 - 100
600 µm (#30)	20 - 100
300 µm (#50)	0 - 45
75 µm (#200)	0 - 5

The crumb rubber shall have a specific gravity of  $1.15 \pm 0.05$  and shall be free of wire or other contaminating materials, and shall contain not more than 0.5 percent fabric. Calcium carbonate, up to four percent by weight of the crumb rubber, may be added to prevent the particles from sticking together.

Certificates of Compliance conforming to Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted. In addition, the Certificates shall confirm that the rubber is a crumb rubber, derived from processing at ambient temperature, whole scrap tires or shredded tire materials; and the tires from which the crumb rubber is produced is taken from automobiles, trucks, or other equipment owned and operated in the United States. The Certificates shall also verify that the processing does not produce, as a waste product, casings or other round tire material that can hold water when stored or disposed of above the ground. The crumb rubber to be used in ARB shall be the type produced through a process of mechanical grinding at ambient temperature. Use of crumb rubber granules produced from a cryogenic process is prohibited.

**717.2.1.3 ARB Proportions and Properties:** Ground crumb rubber in ARB shall be a minimum of 18 percent by weight of total binder.

ARB shall be Type 1 unless otherwise specified and conform to the requirements of Table [717-2](#).

TABLE 717-2			
PHYSICAL PROPERTIES OF ARB			
Property	Requirement		
	Type 1	Type 2	Type 3
<b>Grade of base asphalt cement</b>	<b>PG 64-16</b>	<b>PG 58-22</b>	<b>PG 52-28</b>
Rotational Viscosity*; 350° F, Pascal seconds	1.5-4.0	1.5-4.0	1.5-4.0
Penetration; 39° F (4° C), 200g, 60 sec. (ASTM <a href="#">D5</a> ); dmm, min	10	15	25
Softening Point; (ASTM <a href="#">D36</a> ); °F, min.	135	130	125
Resilience; 77°F (ASTM <a href="#">D5329</a> ); %, min	25	20	15
* The Viscometer used must be a hand held rotational viscometer, such as a Rion (formerly Haake) Model VT – 04, or an equivalent, using Rotor No. 1. The rotor, while in the off position, shall be completely immersed in the binder at a temperature from 350° to 355° F for a minimum heat equilibrium period of 60 seconds, and an average viscosity determined from three separate constant readings ( $\pm 0.5$ pascal-seconds) taken within a 30 second time frame with the viscotester level during testing and turned off between readings. Continuous rotation of the rotor may cause thinning of the material immediately in contact with the rotor, resulting in erroneous results.			

**717.2.1.4 ARB Design:** At least two weeks prior to paving, the Contractor shall submit an ARB design prepared by an ADOT approved laboratory. Such design shall meet the requirements specified herein. The design shall show the values obtained from the required tests, along with the following information: percent, grade and source of the asphalt cement used; and percent, gradation and source(s) of the crumb rubber used, as well as the ARB blending location: on-site or at the asphalt binder supplier's facility.

**717.2.2 Aggregate:** Coarse and fine aggregates shall conform to the applicable requirements of Tables [717-3](#) and [717-4](#) below. Coarse mineral aggregate shall consist of crushed gravel, crushed rock, or other approved inert material with similar characteristics, or a combination thereof, conforming to the requirements of these specifications.

Coarse aggregate is material retained above the Number 8 sieve and fine aggregate is material passing the Number 8 sieve. Aggregates shall be free of deleterious materials, clay balls, and adhering films or other material that prevent thorough coating with the asphalt cement. Mineral aggregate shall conform to the following requirements when tested in accordance with the applicable test methods.

TABLE 717-3		
MIX DESIGN GRADATION REQUIREMENTS WITH MINERAL ADMIXTURE		
Overlay Thickness	1" & 1- 1/2"	2"
Sieve Size	Percent Passing	Percent Passing
1" (25 mm)	100	100
3/4" (19 mm)	100	95-100
1/2" (12.5 mm)	95-100	78-92
3/8" (9.5 mm)	78-92	61-75
No. 4 (4.75 mm)	28-45	30-40
No. 8 (2.36 mm)	15-25	15-25
No. 30 (600 $\mu$ m)	5-15	5-15
No. 200 (75 $\mu$ m)	3.0-7.0	2.0-6.0

The combined aggregate properties shall conform to the requirements of Table [717-4](#).

TABLE 717-4		
COARSE/FINE AGGREGATE REQUIREMENTS		
Characteristics	Test Method	Requirements
Fractured Faces, % (Plus No. 8)	ARIZ-212	85, 1 fracture 80, 2 or more
Uncompacted Voids, %	ARIZ-247	45.0 (High Traffic Volume) 42.0 (Low Traffic Volume)
Sand Equivalent (Minus No. 4)	AASHTO T-176	65 minimum
Plasticity Index	AASHTO T-89 & T-90	Non Plastic
L.A. Abrasion, % Loss	AASHTO T-96	9 max. @ 100 Rev. 40 max. @ 500 Rev.
Combined Bulk Specific Gravity	AI MS-2	2.35-2.85
Combined Water Absorption, %	AI MS-2	0-2.5

**717.2.3 Mineral Admixture:** Mineral admixture used in ARAC shall be dry hydrated lime conforming to the requirements of ASTM [C1097](#) or Portland cement conforming to ASTM [C150](#) for Type II, or ASTM [C595](#) for Type IP. The minimum mineral admixture content will be 1.0percent, by weight of total aggregate.

### 717.3 MIX DESIGN REQUIREMENT:

**717.3.1 General:** The mix design for ARAC shall be prepared by a laboratory that is accredited through the AASHTO Accreditation Program (AAP) in Hot Mix Asphalt Aggregates and Hot Mix Asphalt. The laboratory shall be under the direct supervision of a Civil Engineer, registered by the State of Arizona, and who is listed by ADOT as a “Qualified Asphalt Concrete Mix Design Engineer” within ADOT’s list of approved laboratories.

The date of the design shall not be older than two years from the date of submittal, unless supportive documentation is provided and approved by the Engineer.

The mix design method used shall be in accordance with the Marshall Mix procedure, 75 blows, as described in Arizona Test Method 832 “Marshall Mix Design Method for Asphaltic Concrete (Asphalt Rubber) [AR-AC]” with the exceptions that:

- (1) Mineral admixture shall be considered part of the total weight of aggregate and all combined specific gravity and combined absorption calculations for aggregates and mineral admixture will be done in accordance with Asphalt Institute’s Manual MS-2.
- (2) Course aggregate shall be separated from the fine aggregate on the #8 sieve.

Mix designs are subject to approval by the Engineer.

**717.3.2 Mix Design Criteria:** The mix shall comply with the criteria in Table [717-5](#).

TABLE 717-5		
MARSHALL MIX DESIGN CRITERIA		
Criteria	Low Volume Traffic	High Volume Traffic
ARB Content		
1” and 1-1/2” Overlay Thickness	8.4% minimum	8.0% minimum
2” Overlay Thickness	N/A	7.0% minimum
Mixture Air Voids, %	3.5-4.5	4.5-5.5
Voids in Mineral Aggregate, %	19.0 min	19.0 min
Tensile Strength Ratio, <a href="#">ASTM D 4867/AASHTO T 283</a>	65% minimum	65% minimum
Marshall Stability, pounds minimum	800	800
Marshall Flow, 0.01 inch minimum	16	16

The mix design report shall include the following elements as a minimum.

- (1) The name and address of the testing organization and the person responsible for the mix design report.

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- (2) The mix plant identification and/or location, as well as the supplier or producer name.
- (3) The traffic condition (low or high traffic) and lift thickness.
- (4) A description of all products that are incorporated in the ARAC along with the sources of all products, including the base asphalt cement, crumb rubber, mineral aggregate, and admixtures.
- (5) The results of all testing, determinations, etc., such as: specific gravity and gradation, water absorption, sand equivalent, loss on abrasion, fractured coarse aggregate particles, Tensile Strength Ratio ([ASTM D 4867/AASHTO T-283](#)), Marshall bulk density, stability and flow, asphalt absorption, percent air voids, voids in mineral aggregate, and mineral admixture content. Historical abrasion values may be supplied on existing sources. The submittal should include a plot of the gradation on the Federal Highway Administration's 0.45 Power Gradation Chart and plots of the compaction curves.
- (6) The laboratory mixing and compaction temperature ranges for the ARB used within the mix design.
- (7) A specific recommendation for design ARB content and any limiting conditions that may be associated with the use of the design, such as minimum percentages of crushed or washed fine aggregate.
- (8) The supplier's product code, the laboratory Engineer's seal (signed and dated), and the date the design was completed.
- (9) The ARB design.

The mix design shall be submitted to the Agency or Engineer by the Contractor/Supplier for which it was developed as part of his project submittals. Once the mix design has been approved by the agency or Engineer, the Contractor and/or his supplier shall not change plants nor utilize additional mixing plants without prior approval of the Engineer. Any changes in the plant operation, the producer's pit, the ARB, or any other item that will cause an adjustment in the mix, shall be justification for a new mix design to be submitted.

**- End of Section**