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SECTION 12 – ASPHALTIC CONCRETE PAVING SPECIFICATIONS

12.20 SCOPE

- .1 This specification outlines the requirements for the production, placing and compaction of hot mix, hot laid asphalt concrete for pavement construction and other uses.
- .2 For the definition of terms used within the Manual, refer to Section 2.01 – Defined Terms [\[1\]](#). (REVISE? TBD 2025)
- .3 For the list of products acceptable for the design within the scope of the Manual, refer to the City of Nanaimo Approved Products List [\[1\]](#). (REVISE? TBD 2025)

12.21 SPECIAL MIXES

- .1 For general purposes, such as ~~road~~-asphalt pavement, the requirements of this specification, and the 19 mm aggregate gradation shall apply unless otherwise approved by the City Engineer. (REVISE? TBD 2025)
- .2 For special purposes, such as patching, the paving of shoulders, boulevards walkways and sidewalks, and the construction of curb, gutter or combination curb and gutter, the requirements of this specification, particularly in respect to the mix design aggregate requirements, and the level of testing, shall be subject to amendment by the ~~Engineer~~-Professional of Record. (REVISE? TBD 2025)

12.22 -NOT USED-

12.23 AGGREGATE

- .1 Aggregate for asphaltic concrete shall be composed of hard, angular, durable, crushed gravel free from silt or clay lumps, cementation, organic material, frozen material and other deleterious materials.
- .2 The aggregate gradation shall fall within the following limits when tested in accordance with *ASTM C136 and ASTM C117*.

Gradation Limits (% by Passing Weight)				
Size	19 mm	12 mm	10 mm	12.5 mm Superpave
19 mm	100	100	100	100
12.5 mm	70-100	90-100	100	90-100
9.5 mm	55-90	75-95	90-100	
4.75 mm	35-70	45-75	55-85	
2.36 mm	25-57	30-60	35-70	28-58
1.18 mm	18-45	20-45	25-55	
0.60 mm	13-34	15-35	15-40	
0.30 mm	8-26	6-20	8-25	
0.15 mm	5-17	4-15	5-18	
0.075 mm	2-8	2-10	2-10	2-10

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- .3 Recycled Asphalt Pavement (RAP):
- (a) RAP is sourced for asphalt millings or excavated road mix. Suitable RAP shall not contain any other additives including, but not limited to, sulphur, crumb rubber, asphalt rubber, asbestos, produced sand, paving fabrics and reinforcement grids. Crush and screen so that 100% of the reclaimed asphalt pavement materials passes the 19 mm screen before mixing.
 - (b) RAP must be fed to the plant by separate feed systems capable of being sampled and metering at the design rate.
- .4 All sample gradations shall fall within the gradation limits, and any deviations between the samples and the project gradation curve, based on the mix design, shall not exceed the following limits:

Sieve Size (mm)	Maximum Permissible Tolerance % by Weight Passing
4.75 - 19.0	± 4.5
1.18 - 2.36	± 4.0
0.60	± 3.5
0.30	± 3.0
0.15	± 2.0
0.075	± 1.0

- .5 A minimum 75% of the material retained on a 4.75 sieve shall have at least 2 fractured faces. Percentages shall be determined by particle mass.
- .6 **Composition** (REVISE? TBD 2025)
- (a) Deleterious material (clay lumps, soft shale, coal wood or mica) by weight shall not exceed 3% in the lower course nor 1.5% in the surface course.
 - (b) The maximum percentage of flat and elongated particles shall be 10% by mass for coarse aggregates.
 - (i) Flat particles are defined as those particles with a ratio of width to thickness greater than three (3).
 - (ii) Elongated particles are defined as those particles with a ratio of length to width greater than three (3).
- .7 Aggregate deficient of material passing the 0.075 mm sieve shall have approved mineral filler added. Mineral filler shall be only material passing the 0.075 mm sieve and shall be finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic materials when tested in accordance with **ASTM D4318**.
- .8 The moisture content of the aggregate after leaving the drier and before mixing shall not be more than 0.5% by weight.

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- .9 The following tests may be required to confirm the gravel source is suitable for use in the production of aggregate for asphaltic concrete:
- (a) Soundness of Aggregates to *ASTM C88*
 - (i) Maximum loss by mass after 5 cycles with $MgSO_4$
 - 1. Coarse aggregate = 15%
 - 2. Fine aggregate = 18%
 - (b) Micro-Deval Abrasion to *ASTM D6928*
 - (i) Maximum loss factor = 18%
 - (c) Sand equivalent to *ASTM D2419*
 - (i) Minimum = 40
 - (d) Absorption of Aggregate to *ASTM C127*
 - (i) Maximum absorption by mass = 2%
 - (e) Petrographic Examination to *ASTM C295*.
- .10 Additional Requirements for Superpave Aggregates:
- (a) Aggregates for Superpave mixes shall have properties and the gradation limits as specified below and in accordance with the latest version of the Asphalt Institute's *Superpave Series Publication – Superpave Mix Design (current version)*. Changes and/or variation from these limits shall be outlined within the Contract Special Provisions.
 - (i) 90% fractured aggregate with a 12.5 mm nominal maximum size, including sufficient manufactured fines to provide fine aggregate angularity.
 - (ii) The aggregates must meet all the requirements for angularity, toughness deleterious materials, clay content, and flat and elongated particles.
 - (iii) Design ESAL's will be 10 – 30 million.

12.24 ASPHALT CEMENT

- .1 Performance grade 64-22 or penetration grade 80-100 asphalt cement shall be in accordance with *MOTI SS 952*. Asphalt cement shall be prepared from the refining of petroleum oils and be homogeneous, free from water and shall not foam when heated to 175°C. Vacuum Tower Asphalt Extender (VTAE) shall not be incorporated into the binder. ~~—(REVISE? TBD 2025)~~
- .2 The Contractor shall inform the Engineer-Professional of Record of the name of his ~~his~~ their asphalt supplier and shall ensure that each load of asphalt is accompanied with a flow sheet showing compliance with the preceding requirements. Such flow sheets shall be submitted to the Engineer-Professional of Record. ~~(REVISE? TBD 2025)~~

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12.25 ASPHALTIC CONCRETE MIX DESIGN CRITERIA

.1 Marshall Mixes:

- (a) The asphalt mix design for pavements shall be carried out under Marshall design criteria using the designated equipment and procedures as contained in the Asphalt Institute's *Mix Design Methods for Asphaltic Concrete MS-2*, latest edition.
- (b) If requested by the ~~Engineer~~ Professional of Record, the Contractor shall supply an asphaltic concrete mix design conforming to the following specifications as based on the Marshall method of design *Asphalt Institute Manual series No. 2 (MS-2)* for approval: (REVISE? TBD 2025)

		Local	Collector	Arterial	Special Mixes
(a)	Number of blows each face of test specimen	75	75	75	50
(b)	Minimum % voids in Mineral aggregate (VMA), based on Bulk SG				
	25 mm Aggregate	-	-	-	-
	19 mm Aggregate	13	13	13	13
	12 mm Aggregate	14	14	14	14
	10 mm Aggregate	16	16	16	16
(c)	% air voids in compacted mixture, surface and lower course	3-5	3-5	3-5	3-5
(d)	Minimum modified Marshall load, N @ 60°C	5000	7000	7000	4500
(e)	Flow index, (mm)	2-4	2-4	2-4	2-4
(f)	Minimum asphalt film thickness (µm)	8	8	8	
(g)	Minimum index of retained stability after immersion in water @ 60°C for 24 hours	75%	75%	75%	75%
(h)	Asphalt content in the mix shall be as specified in the mix design ±0.3%				

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.2 Superpave Mixes:

- (a) The Superpave asphalt mix design shall be carried out in accordance with the latest edition of the Asphalt Institute's *Superpave Mix Design, Superpave Series No. 2* (current version) and these Standard Specifications.
- (b) If requested by the ~~Engineer~~ Professional of Record, the Contractor shall supply an asphaltic concrete mix design conforming to the following specification for approval: (REVISE? TBD 2025)

CRITERIA PROPERTY OF LABORATORY COMPACTED PAVING MIXTURE	SUPERPAVE nominal 12.5 mm
For Design ESAL's = 10-30 million, at $N_{Design} = 100$ gyrations	
% voids in the Mineral Aggregate, minimum	14
Required density:	
% of Theoretical Maximum Specific Gravity in a Laboratory compacted mix:	
at $N_{max} = 160$ gyrations	98 maximum
at $N_{Design} = 100$ gyrations	95-97
at $N_{Initial} = 8$ gyrations	89 maximum
% voids filled with Asphalt Cement	65-75
Dust to Binder ratio ¹	0.6-1.2

.3 Reclaimed Asphalt Product (RAP):

- (a) The maximum RAP allowed in the asphalt mix shall be determined by the contribution of the RAP Asphalt Cement (AC) towards the total AC content in the mix by weight as per the percentages shall be 15%. Contractor shall notify the City Representative, 14 days in advance of Paving if RAP will be used in the project.
- (b) The amount of the total AC replaced by the AC in the RAP will be calculated as follows:

% AC Replacement = (a x b)/c
Where:
a = AC content of RAP
b = RAP percent in mixture by total weight of mix
c = Total percent AC content in mixture

¹ Consideration shall be given to increasing the dust to binder ratio to 0.8 – 1.6

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12.26 JOB MIX AND PLANT CALIBRATION

- .1 If requested by the ~~Engineer~~ Professional of Record, a job mix formula shall be provided by the Contractor and shall contain the following information: (REVISE? TBD 2025)
 - (a) Sieve analysis of combined aggregate in mix.
 - (b) Aggregate size range in each bin separation to be used.
 - (c) Weight of aggregate to be used from each bin for one batch of mix.
 - (d) Weight of asphalt cement to be used for one batch of mix.
 - (e) Optimum mixing and compacting temperatures.
- .2 If requested by the Engineer, a plant calibration for continuous mix plants shall be provided by the Contractor.

12.27 TACK COAT

- .1 Bituminous tack coat shall be Grade SS-1 or SS-1h asphalt emulsion, in accordance with *MOTI SS 952* (or the latest *AASHTO M140-13* or the latest *ASTM D977*) or as approved. Manufacturer's laboratory analysis of each tack coat shipment shall be submitted to the ~~Engineer~~ Professional of Record for approval. (REVISE? TBD 2025)

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12.40 RESPONSIBILITY FOR ALIGNMENT, GRADE AND BASE

- .1 The **Contractor** shall examine the base, existing surface and tack coat to ensure they conform to the specifications, and the grade and alignment conform to the construction drawings, prior to commencing paving operations. The **Contractor** shall be satisfied that the base is properly prepared for the placement of asphaltic concrete and shall notify the **Engineer-Professional of Record** of any observed deficiencies prior to paving. The **Contractor's** responsibility for pavement failures shall include those caused by base failure, misalignment or incorrect grade. *(REVISE? TBD 2025)*
- .2 Prior to delivery of the asphaltic concrete to the job site, the prepared base shall be cleaned of all loose or foreign material.

12.41 TRAFFIC CONTROL

- .1 The **Contractor** shall be responsible for traffic control during all operations in accordance with Section ~~3.61~~ 3.60 – Control of Public Traffic – General **[]**. *(REVISE? TBD 2025)*
- .2 Traffic shall not be permitted on the finished pavement until it has cooled to atmospheric temperature.

12.42 CUTTING AND REMOVAL OF EXISTING PAVEMENT

- .1 The **Contractor** shall cut, remove and dispose of existing pavement as directed by the **Engineer-Professional of Record**. Pavement cutting shall be in accordance with Section 4.28 – Final Cutting Paved Surfaces **[]**. *(REVISE? TBD 2025)* ~~(REVISED MAY 2020)~~

12.43 ADJUSTMENT OF SERVICES

- .1 The **Contractor** shall adjust manholes, catch basins, valves, etc. to the proper finished grade at least 48 hours prior to paving in accordance with Section 6.53 – Frames and Covers and Section 6.54 – Manhole ~~Steps~~ Rungs **[]**. *(REVISE? TBD 2025)*

12.44 TESTING

- .1 The **Engineer-Professional of Record** will arrange for a testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates non compliance with the specification, additional testing shall be required at the **Contractor's** expense. *(REVISE? TBD 2025)*
- .2 The **Contractor** as directed by the **Engineer-Professional of Record** shall supply specimens or samples for testing. *(REVISE? TBD 2025)*

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- .3 The test programs listed below are the minimum testing requirements. The ~~Engineer~~ **Professional of Record** shall determine if additional testing is required. (*REVISE? TBD 2025*)
- (a) Aggregates:
- (i) One aggregate gradation test shall be carried out either for each 300 tonnes of production or a minimum of once per day (*ASTM C136 and ASTM C117*).
 - (ii) Additional testing as outline in Section 12.23 [→] as required by the ~~Engineer~~ **Professional of Record**. (*REVISE? TBD 2025*)
- (b) Asphaltic Concrete:
- (i) One Marshall test consisting of three briquettes for every three hundred tonnes of production, or a minimum of one test per day shall be performed to determine the following:
 - (ii) Marshall stability
 - (iii) Specific gravity
 - (iv) Air voids and voids in mineral aggregate (VMA)
 - (v) Flow index
 - (vi) Asphalt content extraction
 - (vii) Gradation of Asphalt aggregate
 - 1. Testing shall use the 75 Blow Marshall test method. The 50 Blow Marshall test method may be used for walkways, sidewalks, driveways or other **City Engineer** approved locations.
- (c) Compaction:
- (i) Upon completion of the asphalt paving operation, one core from each 400 m² of pavement with a minimum of three (3) cores shall be obtained at locations determined by the ~~Engineer~~ **Professional of Record** for the purpose of determining the asphaltic concrete density in accordance with *ASTM D2723*, and the asphaltic concrete thickness (*see Section 12.51 – Asphaltic Concrete Acceptance Requirements [→]*). (*REVISE? TBD 2025*)
 - (ii) Final compaction results shall be expressed as a percentage compacted density which is defined as follows:

$$\text{Percentage compacted density} = \frac{\text{Density of sample} \times 100}{\text{Marshall density}}$$
 - (iii) Test result data will be subjected to statistical analysis and the final compaction shall not be considered satisfactory unless the mean and the standard deviation of the test result data is in accordance with Section 12.51 – Asphaltic Concrete Acceptance Requirements [→].
- (d) Other testing as may be required to confirm conformance of materials and workmanship to the specifications.

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- .4 The test programs outlined above are minimum requirements and may be modified by the ~~Engineer~~ Professional of Record. Full testing may be required during the first few days of paving to determine quality control and construction procedures. As paving progresses sufficient tests to maintain uniformity will be required. (REVISE? TBD 2025)
- .5 Inspection and testing by the ~~Engineer~~ Professional of Record shall not relieve the Contractor of ~~his~~ their responsibility for quality control. (REVISE? TBD 2025)
- .6 Asphaltic concrete found to be in non-compliance with the specifications shall be repaired or replaced by the Contractor. The Contractor shall submit to the ~~Engineer~~ Professional of Record for approval, the proposed method to correct the noted deficiencies and work schedule, prior to commencing the work. (REVISE? TBD 2025)

12.45 TACK COAT

- .1 The existing asphaltic concrete surface shall be thoroughly cleaned by a power driven sweeper immediately prior to applying the tack coat.
- .2 Tack coat shall be applied to all existing asphaltic concrete which is to be overlaid. Tack coat shall be applied to the edge of existing asphaltic concrete, curbs and structures where these surfaces will be in contact with the new asphaltic concrete pavement.
- .3 Tack coat ~~shall~~ must be applied only when the surface is dry and clean, and the air temperature is over 10°C. (REVISE? TBD 2025)
- .4 Tack coat shall not be diluted unless directed by the ~~Engineer~~ Professional of Record. (REVISE? TBD 2025)
- .5 Tack coat shall be uniformly applied with an approved pressure distributor at a rate of 0.25 litres per square metre. The temperature of the material shall be maintained between 32°C and 38°C.
- .6 Traffic shall, where possible, be kept off tack coat areas. Where traffic has been allowed on the tack coat, these areas shall be thoroughly cleaned by a power-driven sweeper immediately prior to laying asphaltic concrete.
- .7 No hot mix shall be placed upon the tack coat until it has dried to a proper condition of tackiness, as determined by the ~~Engineer~~ Professional of Record. (REVISE? TBD 2025)
- .8 Tack coat shall be placed only on the area being paved. Work shall be planned so that no more tack coat than is necessary for the days operation is placed on the surface.
- .9 Any damage to persons, vehicles or private property during the application and curing of the tack coat is the Contractor's responsibility.

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12.46 TRANSPORTATION OF HOT PLANT MIX

- .1 Trucks used for the transport of hot mix shall be equipped with tarpaulins and, where required, with insulated boxes. Trucks shall not leak fuel, lubrication oils or hydraulic oil.
- .2 Inside surface of truck boxes shall be free of all deleterious materials and lubricated with suitable thin soap, but excessive use of lubricant will not be permitted.
- .3 The mixture shall be transported from the paving plant to the job site utilizing City of Nanaimo designated truck routes where possible, and shall use local streets only to obtain local access. (REVISE? TBD 2025)
- .4 Loads shall be delivered continuously in covered trucks to provide a uniform, non-stop paving operation.
- .5 Delivery of the mix shall be scheduled to permit completion of the paving operation in daylight hours unless otherwise approved by the Engineer-Professional of Record. (REVISE? TBD 2025)

12.47 PLACEMENT

- .1 Surfaces onto which asphaltic concrete pavement is placed shall-must be dry, above 5°C, and cleaned of all loose and foreign materials. Mixtures shall-are normally not be laid when the atmospheric temperature is less than 5°C and falling. (REVISE? TBD 2025)
 - (a) Bottom lift shall-must be placed onto surfaces above 5°C and rising. (REVISE? TBD 2025)
 - (b) Top lift shall-must be placed onto surfaces above 10°C and rising. (REVISE? TBD 2025)
- .2 The mixture at time of placing shall be not less than 120°C or greater than 160°C or as required by the mix design and requires approval by the City Engineer.
- .3 An approved, self-propelled mechanical paver shall be used to spread the mixture to the specified thickness. The paver speed shall be adjusted to correspond to the rate of delivery to provide a uniform, non-stop paving operation.
- .4 The Contractor may use such methods as approved by the Engineer-Professional of Record in narrow areas, irregular sections, intersections, turnouts or driveways, where it is impractical to spread with a paver. (REVISE? TBD 2025)
- .5 Minor inequalities in spreading and shaping the paved surface adjacent to existing structures such as manholes, catch basins or valves shall be performed to a condition satisfactory to the City Engineer.

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12.48 COMPACTION

.1 Equipment:

- (a) Unless otherwise directed by the ~~Engineer~~ Professional of Record, the Contractor shall furnish a minimum of two (2) self-propelled rollers to roll and compact the asphaltic concrete mixture. All rollers shall be in good condition and capable of reversing without backlash. (REVISE? TBD 2025)

.2 General:

- (a) Compaction shall commence immediately after the bearing capacity of the asphalt mat is adequate to support compaction equipment without undesirable displacement or cracking.
- (b) Maximum speed for initial rolling shall not exceed 5 km/hr, and subsequent rolling, 8 km/hr. Speeds shall be maintained at all times such that displacement of asphaltic concrete does not occur.
- (c) During the rolling operation, roller wheels shall be kept moist with only enough water to avoid picking up material. Fuel oil, lubricating oil, or kerosene shall not be permitted as lubricants for the surface of the roller wheels.
- (d) The line of rolling shall not be suddenly changed nor the direction of rolling suddenly reversed. Pronounced changes in direction shall be made on stable material.
- (e) Heavy equipment including rollers shall not be permitted to stand on the finished surface.
- (f) Where rolling causes displacement of material, loosen affected areas immediately with lutes or shovels and restore to original grade of loose material before re-rolling.
- (g) Should the testing results or the Contractor's quality control indicate compaction requirements are not being met, the Contractor shall immediately modify ~~his~~ ~~their~~ compaction procedure to satisfy the compaction requirements. (REVISE? TBD 2025)

.3 Breakdown Rolling:

Breakdown rolling shall immediately follow the rolling of transverse and longitudinal joint and edges. Rollers shall be operated as close to the paver as necessary to obtain adequate density without causing undue displacement. Initial rolling shall be performed by steel wheel rollers with the drive roll or wheel forward in the direction of paving. Rolling shall commence on the low side of the mat and progress to the high side.

.4 Secondary Rolling:

Secondary rolling shall follow the initial rolling as closely as possible, and shall be continuous until the mix has been thoroughly compacted.

.5 Finish Rolling:

Finish rolling shall be by steel wheel roller to remove all marks left by pneumatic rolling. Finish rolling shall be accomplished with the minimum number of passes required to produce a satisfactory surface.

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12.49 JOINTS

.1 General:

- (a) All transverse and longitudinal joints shall be painted with a thin tack coat immediately prior to paving. Application of tack coat to longitudinal joints may be omitted if the previously laid pavement has not cooled to less than 50°C.
- (b) Transverse joints in succeeding courses shall be offset a minimum of 600 mm. In adjacent lanes they shall be offset a minimum of 3.0 m.
- (c) Longitudinal joints in succeeding courses shall be offset 150 – 200 mm.
- (d) Wherever possible, longitudinal joints shall be offset 100 mm from future traffic markings (paint lines).
- (e) Work shall be sequenced to avoid the number of cold joints. (REVISE? TBD 2025)

.2 Transverse Joints:

Transverse joints shall have a vertical face and shall be carefully constructed and thoroughly compacted to provide a smooth riding surface over the joint. Horizontal alignment of joints shall be straight-edged to ensure smoothness. Rolling of transverse joints shall be performed immediately after raking is completed.

.3 Longitudinal Joints:

Longitudinal joints shall have a vertical face and shall be rolled directly behind the paving operation. Joints shall be rolled by passing the roller on the previously compacted lane letting one wheel project 100 mm to 150 mm on the new lane. A minimum of 2 passes shall be required to thoroughly compact this narrow strip down to and even with the existing lane.

.4 Edges:

Pavement edges shall be rolled concurrently with the longitudinal joints and shall not be exposed more than 15 minutes before rolling. After longitudinal joints and edges have been compacted, longitudinal rolling shall start at the edge and progress to the centre of the pavement, overlapping at least one-half the width of the roller with each successive pass. On super-elevated curves, rolling shall begin on the low side and progress to the high side.

12.50 CLEANING

- .1 The Contractor shall thoroughly remove from all culvert, catch basins, curbs, gutters and other structures such contamination by asphaltic or other materials as may have occurred during the performance of the work.

12.51 ASPHALTIC CONCRETE ACCEPTANCE REQUIREMENTS

- .1 The finished grade surface shall-must be free from bumps, depressions or other irregularities and shall-must be within 6 mm of the design grade and cross-section, but not uniformly high or low, when measured with a 3.0 m straight edge in any direction. (REVISE? TBD 2025)

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- .2 The finished elevation of the compacted asphaltic concrete shall be 0 - 6 mm above the finish elevation of structures, including but not limited to curbs, gutters, manhole lids, catch basins, valve boxes and survey monuments.
- .3 The finished surface of the asphaltic concrete shall be homogenous, free from segregation and consistently uniform in surface texture.
- .4 Asphaltic concrete shall be compacted to 97% mean compacted density when tested in accordance with Section 12.44 – Testing [→]. Maximum acceptable standard deviation of test data shall be 1.5%, with no individual test results less than 95% compacted density.
- .5 Asphaltic concrete thickness, as measured in accordance with **ASTM D3549**, shall not be less than the specified thickness for all test cores. (REVISE? TBD 2025)