17025·HAA 1043 TEST

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Working order: 82012985

Zagreb, 2017-08-29

# TEST REPORT No. 72563-2545/17

| | |
|---|---|
| Construction product: | **Bituminous mixture** |
| Tested property: | **Composition and physical-mechanical properties** |

## GENERAL DATA

| | | | | |
|---|---|---|---|---|
| Client: | **BECHTEL ENKA GP** | | | |
| Producer: | **BECHTEL ENKA GP** | | | |
| Construction site: | - | | | |
| Sampled by: | **Client** | | | |
| Type of asphalt: | **SMA 16** | | | Laboratory designation: **17-2450** |
| Date of sampling: | - | Date of receiving the sample: | 2017-08-17 | |
| Date of test beginning: | 2017-08-28 | Date of test ending: | 2017-08-29 | |

## TEST RESULTS

### COMPOSITION OF THE ASPHALT MIXTURE

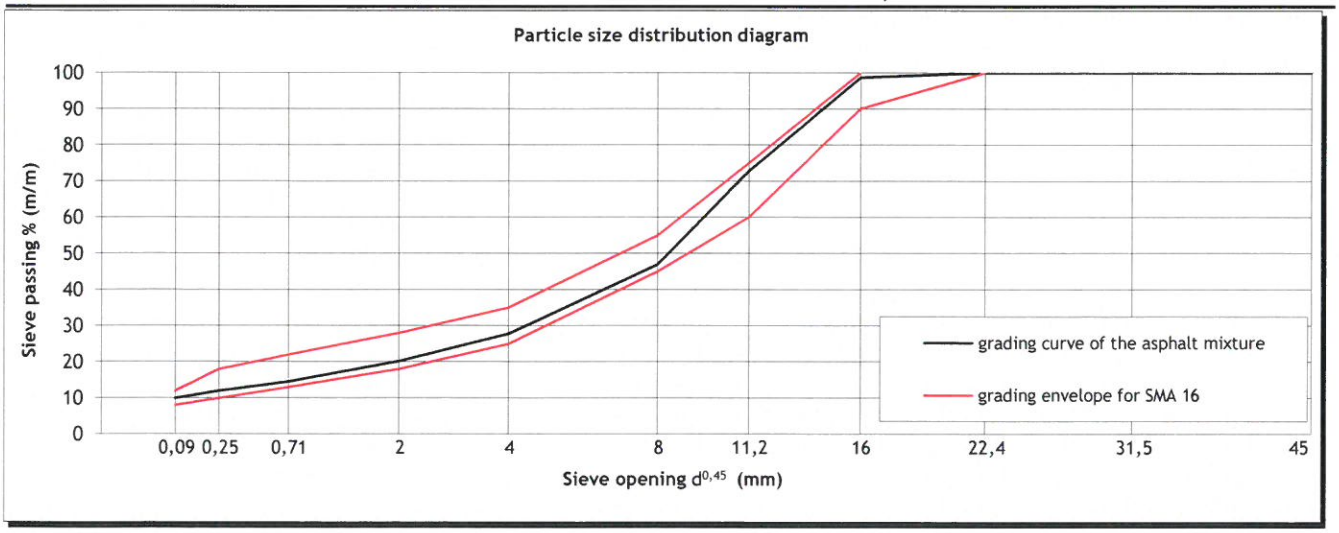
**Bitumen content (EN 12697-1; asphaltanalyzer)** % (m/m) **4,3** Date of testing: 2017-08-28

**Particle size distribution (EN 12697-2)** Date of testing: 2017-08-28

| Sieve opening [mm] | 0,063 | 0,09 | 0,125 | 0,25 | 0,5 | 0,71 | 1 | 2 | 4 | 5,6 | 8 | 11,2 | 16 | 22,4 | 31,5 | 45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Σ passing % (m/m) | **9,7** | **9,9** | **10,5** | **11,9** | **13,5** | **14,5** | **15,6** | **20,1** | **27,7** | **34,2** | **46,9** | **72,8** | **98,7** | **100,0** | **100,0** | **100,0** |

### PHYSICAL-MECHANICAL PROPERTIES OF THE ASPHALT MIXTURE

| | | | | |
|---|---|---|---|---|
| **Bulk density (EN 12697-6; clause. 9.3)** | kg/m³ | **2,738** | Mass of the dry specimen | g 1238,2 |
| **Maximum density (EN 12697-5; clause. 9.2 - otapalom)** | Mg/m³ | **2,845** | Test temperature | °C 25,4 |
| **Air voids content (EN 12697-8)** | % (v/v) | **3,8** | | |
| **Voids content in the mineral aggregate (EN 12697-8)** | % (v/v) | **15,3** | | |
| **Voids in the mineral aggregate filled with bitumen (EN 12697-8)** | % (v/v) | **75,4** | | |
| **Stability (EN 12697-34:2008)** | kN | **13,6** | | |
| **Tangential flow (HRN EN 12697-34:2008)** | mm | **1,1** | | |
| **Flow (HRN EN 12697-34:2008)** | mm | **2,2** | | |
| **Marshall quotient (HRN EN 12697-34:2008)** | kN/mm | **6,2** | | |




**Note:** **The samples were taken by Clinet**

**Test Overseer:**

Jasna Putrić Brkić, B.Sc.

**Head of Laboratory for Asphalt and Bitumen:**

Klaudije Simić, B.Sc.

Test results refer only to the tested specimens.

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Working order 82012985

# TEST REPORT No. 72563-2872/17

| | |
|---|---|
| Client: | **BECHTEL ENKA GP** |
| Contract/purchase order: | 2-2153-1-12985/14 |
| Construction product: | Asphalt |
| Type of asphalt: | SMA 16 (Mim Golesh + PmB 45/80-65) |
| Traffic load: | Highways |
| Tested property: | resistance to rutting |
| Date of test report: | 2017-09-25 |

**Test Overseer:**
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**Head of Laboratory for Asphalt and Bitumen:**
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Total number of pages: 4; Annexes: 0.
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Test Report No.: 72563-2872/17

## 1. ASPHALT MIX DATA

| | |
|---|---|
| Laboratory designation: | 17-2450 |
| Mixture composition: | **sample taken from Gencor Asphalt Plant** |
| Used mixing method: | - |
| Type of mixer: | - |
| Date of manufacture of the mixture: | - |
| Temperature/duration of mixing: | - |

## 2. TEST SAMPLES DATA

| | |
|---|---|
| Compaction method used: | **EN 12697-33:2003+A1:2007 Bituminous mixtures - Test methods for hot mix asphalt - Part 33: Specimen prepared by roller compactor; clause 5.2 Methods using a smooth steel roller; clause 7.2.4.2 Compaction with controlled compaction energy*** |
| Type of compactor: | CRT-RC2SV |
| Dimensions of the mould: | (305 x 400) mm |
| Nominal thickness of the specimens: | 50 mm |
| Number of specimens: | 2 |
| Date of compaction of specimen No. 1: | 11.09.2017. |
| Date of compaction of specimen No. 2: | 11.09.2017. |
| Compaction temperature: | 165 °C |
| Storage of test specimen: | 23 °C |

## 3. TEST DATA

| | |
|---|---|
| Standard test method: | **EN 12697-22:2003+A1:2007 Bituminous mixtures - Test methods for hot mix asphalt - Part 22: Wheel tracking*** |
| Test procedure: | method B in air |
| Date of testing of specimen no.1: | 21.09.2017. |
| Date of testing of specimen no.2: | 22.09.2017. |
| Test temperature: | 60 °C |
| Type of testing device: | small device |
| Any deviation from the standard: | none |

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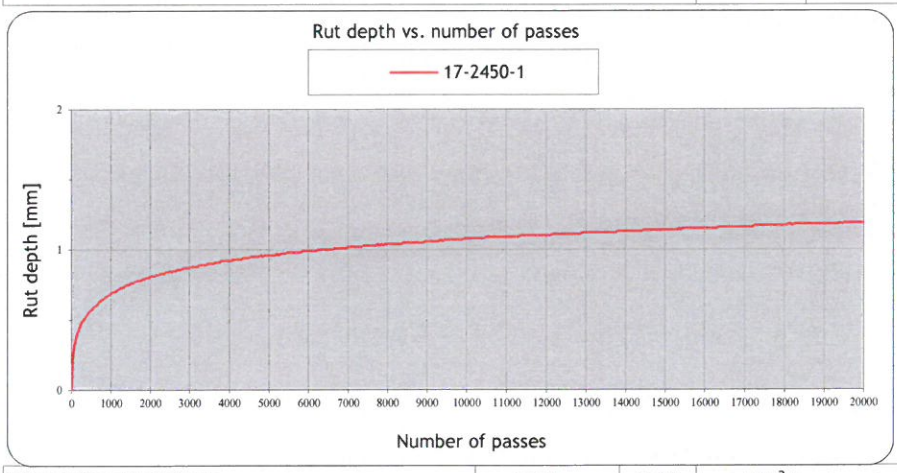
## 5. TEST RESULTS OF LABORATORY MADE SPECIMEN

### TEST SPECIMEN 1

| Number of passes N | Rut depth [mm] |
|---|---|
| 0 | 0,00 |
| 2000 | 0,81 |
| 4000 | 0,92 |
| 6000 | 0,99 |
| 8000 | 1,04 |
| 10000 | 1,08 |
| 12000 | 1,10 |
| 14000 | 1,13 |
| 16000 | 1,15 |
| 18000 | 1,17 |
| 20000 | 1,19 |

| | | |
|---|---|---|
| Bulk density of specimen (EN 12697-6:2008; clause 9.3)* | 2,790 | Mg/m$^3$ |
| Height of specimen (EN 12697-29:2003; clause 3.1)* | 40,2 | mm |

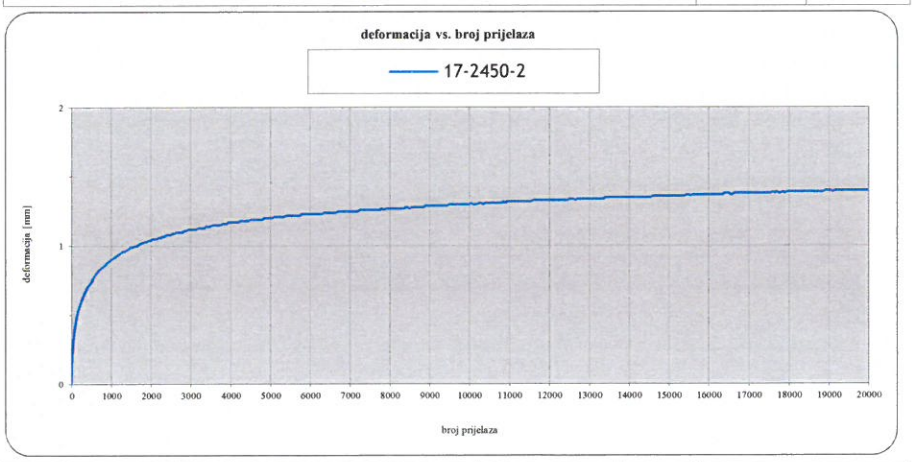



| | | | |
|---|---|---|---|
| Wheel-tracking slope | $WTS_{AIR}$ | 0,02 | mm/10$^3$ load cycles |
| Proportional rut depth | $PRD_{AIR}$ | 3,0 | % |
| Rut depth | $RD_{AIR}$ | 1,2 | mm |

### TEST SPECIMEN 2

| Number of passes N | Rut depth [mm] |
|---|---|
| 0 | 0,00 |
| 2000 | 1,04 |
| 4000 | 1,17 |
| 6000 | 1,23 |
| 8000 | 1,27 |
| 10000 | 1,30 |
| 12000 | 1,33 |
| 14000 | 1,35 |
| 16000 | 1,37 |
| 18000 | 1,39 |
| 20000 | 1,40 |

| | | |
|---|---|---|
| Bulk density of specimen (EN 12697-6:2008; clause 9.3)* | 2,795 | Mg/m$^3$ |
| Height of specimen (EN 12697-29:2003; clause 3.1)* | 40,3 | mm |




| | | | |
|---|---|---|---|
| Wheel-tracking slope | $WTS_{AIR}$ | 0,02 | mm/10$^3$ load cycles |
| Proportional rut depth | $PRD_{AIR}$ | 3,5 | % |
| Rut depth | $RD_{AIR}$ | 1,4 | mm |

Test results are relevant only for tested samples. *ACCREDITED TEST METHOD

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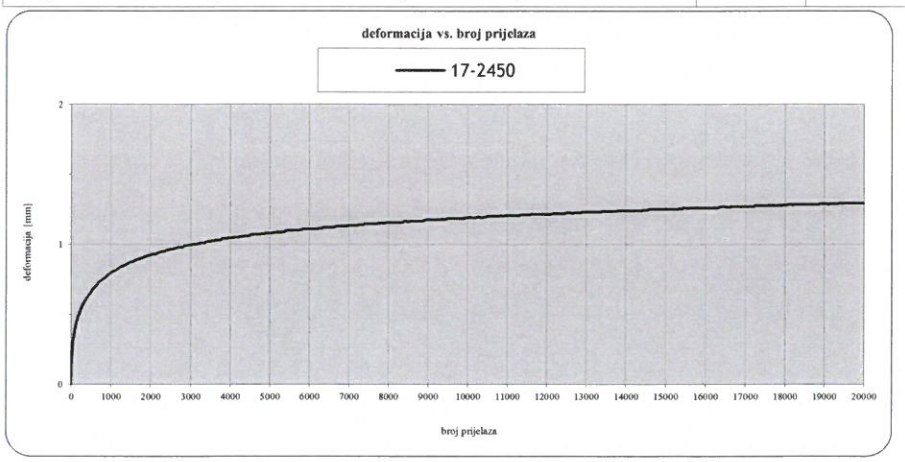
Test Report No.: 72563-2872/17

## MEAN VALUES

| Number of passes *N* | Rut depth [mm] |
|---|---|
| 0 | 0,0 |
| 2000 | 0,9 |
| 4000 | 1,0 |
| 6000 | 1,1 |
| 8000 | 1,2 |
| 10000 | 1,2 |
| 12000 | 1,2 |
| 14000 | 1,2 |
| 16000 | 1,3 |
| 18000 | 1,3 |
| 20000 | 1,3 |

| | | |
|---|---|---|
| Bulk density of specimen (EN 12697-6:2008; clause 9.3)* | 2,793 | $Mg/m^3$ |
| Height of specimen (EN 12697-29:2003; clause 3.1)* | 40 | mm |




| | | | |
|---|---|---|---|
| Mean wheel-tracking slope | $WTS_{AIR}$ | 0,02 | $mm/10^3$ load cycles |
| Mean proportional rut depth | $PRD_{AIR}$ | 3,2 | % |
| Mean ruth depth | $RD_{AIR}$ | 1,3 | mm |

**NOTE:**

Test results are relevant only for tested samples. *ACCREDITED TEST METHOD

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RN 82012985

# TEST REPORT No. 72563-2594/17

| | |
|---|---|
| Client: | **BECHTEL ENKA GP** |
| Contract/ purchase order: | 2-2153-1-12985/14 |
| Construction product: | Asphalt |
| Type of asphalt: | SMA 16 PmB 45/80-65 |
| Traffic load: | Highways |
| Tested property: | water sensitivity |
| Date of test report: | 2017-08-31 |

**Test Overseer:**

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Test report No.: 72563-2594/17

## 1. ASPHALT MIX DATA

| | |
|---|---|
| Laboratory designation: | 17-2450 |
| Mixture composition: | samples taken from Asphalt Plant |
| Material specifications standard: | **EN 13108-5:2006 + AC:2008 Bituminous mixtures - Material specifications - Part 1: Stone Mastic Asphalt** |
| Used mixing method: | **EN 12697-35:2016 Bituminous mixtures - Test methods for hot mix asphalt - Part 35: Laboratory mixing*** |
| Type of mixer: | GZM-30+ producer "Josef Freundl Maschinen" |
| Date of manufacture of the mixture: | - |
| Temperature/duration of mixing: | 175 °C / 3 min |

## 2. TEST SAMPLES DATA

| | |
|---|---|
| Method of manufacture of specimens: | **EN 12697-30:2012 Bituminous mixtures - Test methods for hot mix asphalt - Part 30: Specimen preparation by impact compactor*** |
| Type of impact compactor: | impact compactor with steel anvil "InfraTest" |
| Date of compaction of the specimens: | 2017-08-25 |
| Number and type of test specimens: | 8 laboratory made specimens |
| Compaction temp./number of blows: | 165 °C / 2 x 35 |

## 3. TEST DATA

| | |
|---|---|
| Standard test method: | **EN 12697-12:2008 Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens; method A*** |
| Test temperature: | 15 °C |
| Beginning of the test: | 2017-08-28 |
| Ending of the test: | 2017-08-31 |
| Any deviation from the standard: | none |

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## 4. TEST RESULTS

### 4.1 Determination of the dimensions of test specimens (EN 12697-29:2002*) and bulk density of test specimens (EN 12697-6:2012; clause 9.3*)

*Table 1. Results of dimensions and bulk densities of dry specimens before conditioning*

| SUBSET OF DRY SPECIMENS | | | | |
|---|---|---|---|---|
| Laboratory designation | Specimen height [mm] | Specimen diameter [mm] | Mass of dry specimen [g] | Bulk density [Mg/m$^3$] |
| 17-2450/01 | 58,9 | 101,5 | 1223,9 | 2,706 |
| 17-2450/02 | 57,9 | 101,5 | 1227,0 | 2,704 |
| 17-2450/03 | 58,7 | 101,4 | 1225,9 | 2,696 |
| 17-2450/04 | 58,1 | 101,4 | 1226,8 | 2,709 |
| **Average** | **58,4** | **101,5** | **1225,9** | **2,704** |

*Table 2. Results of dimensions and bulk densities of wet specimens before conditioning*

| SUBSET OF WET SPECIMENS | | | | | |
|---|---|---|---|---|---|
| Oznaka uzorka | Specimen height [mm] | Specimen diameter [mm] | Specimen volume [cm$^3$] | Mass of dry specimen | Bulk density [Mg/m3] |
| 17-2450/05 | 59,1 | 101,4 | 477,3 | 1226,1 | 2,696 |
| 17-2450/06 | 59,2 | 101,4 | 478,1 | 1223,4 | 2,708 |
| 17-2450/07 | 58,9 | 101,4 | 475,6 | 1223,0 | 2,706 |
| 17-2450/08 | 58,8 | 101,4 | 474,8 | 1225,1 | 2,704 |
| **Average** | **59,0** | **101,4** | **476,5** | **1224,4** | **2,704** |

*Table 3. Results of dimensions of wet specimens after vacuum conditioning*

| SUBSET OF WET SPECIMENS after vacuum conditioning | | | | |
|---|---|---|---|---|
| Oznaka uzorka | Specimen height [mm] | Specimen diameter [mm] | Specimen volume [cm3] | Change in volume[1)] [%] |
| 17-2450/05 | 59,1 | 101,4 | 477,3 | 0,0 |
| 17-2450/06 | 59,2 | 101,4 | 478,1 | 0,0 |
| 17-2450/07 | 58,9 | 101,4 | 475,6 | 0,0 |
| 17-2450/08 | 58,8 | 101,4 | 474,8 | 0,0 |
| **Average** | **59,0** | **101,4** | **476,5** | **0,0** |

**Note:**

[1)] volume shall not increased by more than 2 % according to clause 6.1.2.2.5 of EN 12697-12

Test results are relevant only for tested samples. *Test methods for which laboratory is accredited by Croatian Accreditation Agency (Accreditation No. 1043)

Test report No.: 72563-2594/17

### 4.2 Determination of the indirect tensile strength (EN 12697-23:2003*)

*Table 4. Results of determination of the indirect tensile strength on dry specimens*

| SUBSET OF DRY SPECIMENS | | | | | |
|---|---|---|---|---|---|
| Laboratory designation | Maximum load [kN] | Indirect tensile strenght [GPa] | Deviation from mean value[2)] [%] | Type of failure[3)] | Observation on aggregate after testing |
| 17-2450/01 | 20,7 | 0,00220 | 7 | c-combination | no crushed aggregate |
| 17-2450/02 | 24,2 | 0,00262 | 11 | c-combination | no crushed aggregate |
| 17-2450/03 | 20,9 | 0,00224 | 5 | c-combination | no crushed aggregate |
| 17-2450/04 | 22,1 | 0,00239 | 1 | c-combination | no crushed aggregate |
| **Srednja vrijednost** | **22,0** | **0,00236** | | | |

*Table 5. Results of determination of the indirect tensile strength on wet specimens after vacuum conditioning*

| SUBSET OF WET SPECIMENS after vacuum conditioning | | | | | |
|---|---|---|---|---|---|
| Laboratory designation | Maximum load [kN] | Indirect tensile strenght [GPa] | Deviation from mean value[2)] [%] | Type of failure[3)] | Observation on aggregate after testing |
| 17-2450/05 | 20,1 | 0,00214 | 4 | c-combination | no crushed aggregate |
| 17-2450/06 | 21,9 | 0,00232 | 4 | c-combination | no crushed aggregate |
| 17-2450/07 | 20,7 | 0,00221 | 1 | c-combination | no crushed aggregate |
| 17-2450/08 | 21,2 | 0,00226 | 1 | c-combination | no crushed aggregate |
| **Srednja vrijednost** | **21,0** | **0,00223** | | | |

**Note:**

[2)] results must not differ by more than 17 % of the mean value according to clause 11.1 of EN 12697-23

[3)] a - clear break line; b - deformation failure; c - combination according to clause 8.4 and figure.2 of EN 12697-23

### 4.3 Determination of the water sensitivity of bituminous specimens (EN 12697-12:2008, method A*)

*Table 6. Results of determination of the water sensitivity*

| Indirect tensile strength - subset of wet specimens | Indirect tensile strength - subset of dry specimens | Indirect tensile strength ratio |
|---|---|---|
| $ITS_w$ [GPa] | $ITS_d$ [GPa] | *ITSR* [%] |
| **0,00223** | **0,00236** | **94,5** |

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Working order 82012985

Zagreb, 2017-08-29

# TEST REPORT No. 72563-2546/17

| | |
|---|---|
| **Client:** | **BECHTEL ENKA GP** |
| **Contract:** | **2-2153-1-12985/14** |
| **Tested property:** | **BINDER DRAINAGE** |
| Date of testing: | 2017-08-29 |
| Type of asphalt mixture: | **SMA 16** |
| Type of bitumen: | **PmB 45/80-65** |
| Additives: | Cellulose fibers |
| **Identification of the samples:** | **17-2450** |
| Composition of asphalt mix: | According to Asphalt Mix Design **MD(BEGP)_15-04** |
| Test method: | EN 12697-18:2004 Bituminous mixtures - Test methods for hot mix asphalt - Part 18: Binder drainage (Schellenberg method)* |
| Target test temperature, °C | 190 |

**TEST RESULTS:**

| Temperature in the mixture after 60 min of heat storage in the oven | [°C] | 188 |
|---|---|---|

| Test sample No. | Drained material, $D_i$ [%(m/m)] | Residue on the 1 mm sieve, $R_i$ [%(m/m)] |
|---|---|---|
| 17-2450/01 | 0,3 | - |
| 17-2450/02 | 0,3 | - |
| 17-2450/03 | 0,3 | - |

| **Average binder drainage, *D*** | **[%(m/m)]** | **0,3** |
|---|---|---|

NOTE: -

Test Supervisor:

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Head of Laboratory for Asphalt and Bitumen:

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Test results are relevant only for tested samples.
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