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भारतीय मानक *मसौदा*

# खाद्य संपर्क अनुप्रयोगों के लिए पॉली (एथिलीन टेरेफ्थेलेट) (पीईटी) के उपभोक्ता पैकेजिंग अपशिष्ट से पुनर्चक्रण

*Draft Indian Standard*

# RECYCLATES FROM POST CONSUMER PACKAGING WASTE OF POLY (ETHYLENE TEREPHTHALATE) (PET) FOR FOOD CONTACT APPLICATIONS

ICS NO. 83.080.20

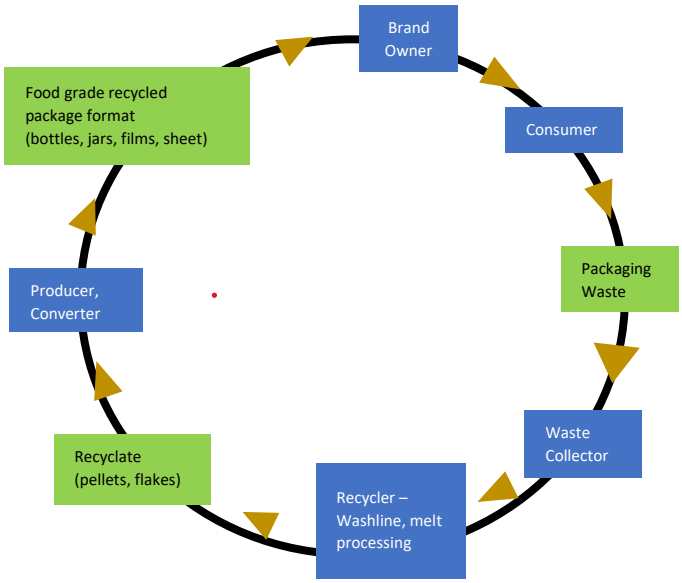
| | |
|---|---|
| Plastics Sectional Committee,<br>PCD 12 | Last date for receipt of<br>comment is **02 April 2025** |

## FOREWORD

(Formal clause will be added later)

This Indian Standard is for making PET recyclates for Food Contact packaging from post-consumer waste (PCW) in line with agenda for sustainable development, Plastic Waste Management (PWM) Rules, 2016, Extended Producers Responsibility (EPR) Rule 2022, FSSAI guidelines for recycling of post-consumer PET for food contact applications, 18 January 2022, as amended from time to time. To reduce dependency on primary raw materials and to build a circular economy for plastics, the market for recycled plastics in food packaging also needs to be facilitated.

This Standard reflects the actual recycling capabilities and safety standards to be followed. The scope of this Standard uses a systematic approach to circular flow of resources by recovering and redesigning to add value and to reduce the burden on the environment.
The supply chain is indicated as circled below:




NOTE: Converter means the first entity that transforms the recyclate into an intermediate packaging format. Producer then transforms the intermediate packaging format into the final packaging format such as of bottle, jar, film, food trays, etc. In some instances, the converter transforms the recyclate into the final packaging format for supplying it to the final purchaser (e.g. brand-owner).

This Standard establishes specifications for PET recyclates made from PCW, to ensure product safety as intended for food packaging applications.

For the purpose of deciding whether a particular requirement of this Standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2: 2022 'Rules for rounding off numerical values (*second revision*)'.

## 1 SCOPE

**1.1** This Standard prescribes criteria for qualifications and testing for recyclates produced from post-consumer poly (ethylene terephthalate) (PET) bottles and jars (PCW) previously used for packaging foodstuff such as drinking water, aerated drinks and other food products.

**1.2** This Standard is applicable to recyclates (flakes and pellets) obtained from Super Clean mechanical recycling processes that are meant for food contact packaging such as bottles, jars, trays, films, etc.

**1.3** This Standard provides guidelines to ensure an efficient decontamination process for the production of all grades/types of recyclates.

a) These recyclates can be converted into various food packaging formats as permitted under extant PWM Rules and any other applicable national regulations.

b) However, the process for transforming the recyclates into different end products would need separate assessment.

## 2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All Standards are subject to revisions and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

## 3 TERMINOLOGY

**3.1 Lot :** definite quantity of a commodity produced in a manufacturing facility having a unique number or identification.

**3.2 Feedstock :** Post consumer waste (PCW) of PET packaging that is used for the recycling process.

**3.3 Qualified Feedstock :** Screened / sorted PCW to ensure PET packaging previously used only for foodstuff, which is used for the recycling process.

**3.4 Recyclate:** Plastics material resulting from the recycling of plastics waste (*see* IS 14534).

**3.5 Food-Grade Recycled PET (FG rPET) :** Post-consumer PET that has undergone a FSSAI approved decontamination and recycling process to attain suitable purity to be used as a safe food packaging.

**3.6 Super-Clean Mechanical Recycling:** A conventional recycling process enhanced with an integrated decontamination step [as per EU/US approved recycling process] to remove absorbed contaminants through a combination of surface treatment, high heat, and/or high vacuum in a controlled environment such that the output can be used for direct food contact.

**3.7 Source / Sourcing :** Supplier of aggregated feedstock collected from formal and informal channels.

**3.8 Input traceability :** Ability to track the source of the feedstock and trace its previous application.

**3.9 Recycler :** An entity that is engaged in the process of recycling which involves sourcing, processing and converting post-consumer PET waste into recyclates.

## 4 GENERAL OUTLINE FOR FOOD GRADE (FG) RECYCLED POLY (ETHYLENE TEREPHTHALATE) (PET) PRODUCTION PROCESS

**4.1** To ensure the production of food grade (FG) recycled PET (rPET), the following processes are to be followed:

a) Sourcing and screening of the PCW input material to make it the qualified feedstock.

b) The qualified feedstock is subjected to a series of preparatory processes (sorting, cleaning) followed by grinding/shredding in a wash line to yield washed flakes.
c) The washed and dried flakes are subjected to a decontamination process as approved by FSSAI ("Guidelines for recycling of post-consumer PET for food contact applications, 18 January 2022"), as amended from time to time.
d) Additives used, if any, during the super-clean recycling processes:
   i) shall be compliant with the positive list of IS 12252
   ii) shall not compromise the overall migration limit and the specific migration limit in the finished articles, as indicated in **6.2.2.1[ii) and iii)]**.
   iii) depending on its nature, shall also be in compliance with:
      - IS 9833; and
      - the relevant US FDA guidelines or EU 10/2011.

**4.2** The typical operations in the decontamination process are depicted in Figure 1.

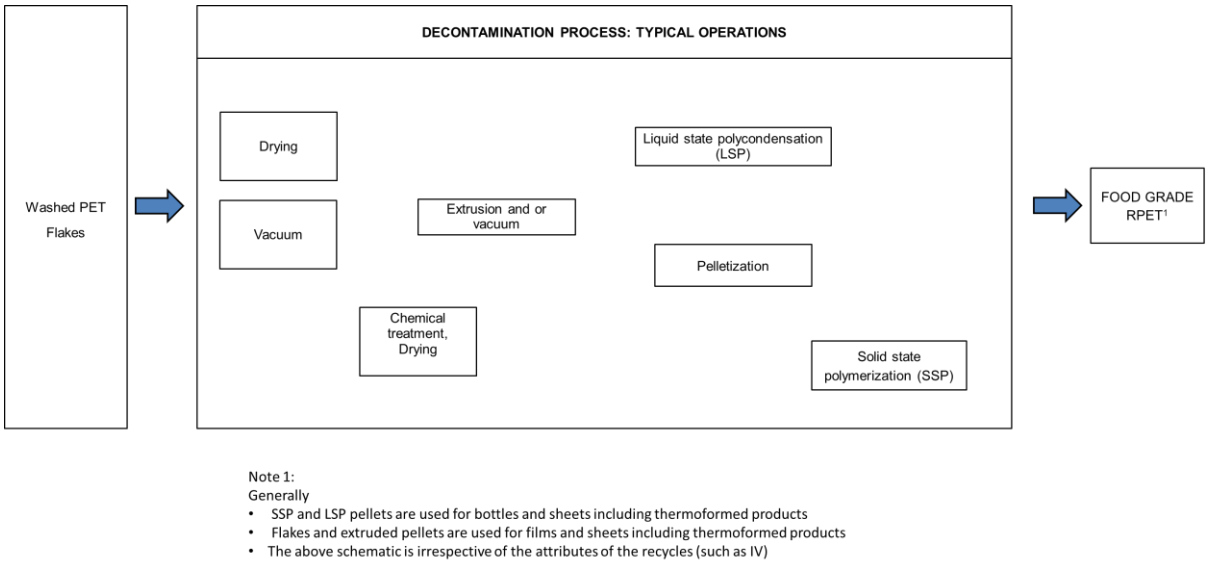



**Figure 1 Schematic representation of typical elements in the Super Clean process for the production of decontaminated recyclates.**

## 5 TRACEABILITY

Traceability is an important feature of any good manufacturing process. The need for traceability is further accentuated by the fact that the output needs to be food grade. Traceability ensures that the input material, production, testing and user experience can all be linked together.

### 5.1 Input Materials

**5.1.1** As per **1.1**, a control over the feedstock needs to be exercised through traceable sourcing. To achieve this, an independent third-party audit shall be undertaken annually by the recycler to verify that only post-consumer PET waste, previously used for food-packaging applications, is used for making FG rPET. The recycler shall maintain records of these audits.

**5.1.2** Since the PCW is a heterogeneous and variable input, its traceability can be established only up to the supplier. Hence, batchwise traceability of the input and the output materials

shall be maintained through appropriate documentation.

**5.1.3** Systems such as AI-based or block-chain based logging, and any other innovative technologies may also be deployed for ensuring traceability.

### 5.2 Washline Operations

**5.2.1**The washline operations are an intermediate process yielding flakes that are subjected to further decontamination process (*see* **4**).

**5.2.2** Recyclers shall maintain records to establish correlation between washed flakes and the recyclates.

### 5.3 Segregation of Recyclate Production

The washed flakes are subjected to decontamination process (*see* **4**) to yield food grade rPET (recyclates). To enable traceability, this production needs to be discretely identified as follows.

**a)** *Lot size*

The recyclates produced shall be segregated in lots as follows:

i. After every 24 hrs or after 25 MT production, whichever is sooner.
ii. Whenever there is a change in the process parameters or process chemicals.

**b)** *Lot identification*

Each lot shall be numbered to enable the identification of:

i. Date of production (DD-MM-YYYY)
ii. Site of production
iii. Line of production

### 5.4 Test Samples

To ensure quality control, samples of recyclates – linked to lot sizes – shall be subjected to appropriate testing at a frequency given in Table 4 (*see* Annex B).
Recyclers shall maintain records to establish correlation between recyclates and the sample testing.

## 6 QUALITY ASSURANCE IN THE SUPER-CLEAN MECHANICAL RECYCLING TO QUALIFY FOR FG RPET

### 6.1 Quality Control of the Feedstock

To ensure the quality of the input to the recycling process at the very beginning:

i. The recycler shall test each incoming truck/vehicle of PCW bales/bags.
ii. For recyclers having pre-sorting facility outside of the washline premises:
    a. Entire consignment shall be subjected to scrutiny and only the feedstock (used-PET) that was used for food packaging shall be used for washline and further

processes.

iii. For recyclers who do not have pre-sorting facility:
   a. The test shall comprise visual examination to eliminate non-food PET packaging. For this, the following shall be adopted:
   b. Sampling:

      For a statistically reliable reflection of the quality of the input PCW, a random minimum of 3percent by weight* or 2 bales (whichever is higher) of each incoming truck/vehicle load shall be tested.

      * Reference: Glass HJ & Dominy, "Plastics recycling and sampling", 8th World Conference on sampling and blending, Perth, WA, 9-11 May 2017.

   c. Acceptance / Rejection criteria:
      If the average result of non-compliant PCW from the above samples
      1. is less than 2% (by weight), the entire consignment shall be examined, and non-food PET packaging removed before proceeding towards the first grinder/crusher,
      2. is more than 2% (by weight), the entire truck load shall be rejected for FG rPET.

iv. Recyclers shall maintain records (physical or digital) of the above tests along with batchwise traceability of the input and the output materials for atleast one year.

### 6.2 Quality Control of the Recyclates

For the recyclates to be qualified as food grade, following components of the quality control protocols shall be complied with:

Group A: Decontamination efficiency of the super clean process
Group B: Quality parameters of the recyclate

#### 6.2.1 Group A : Decontamination efficiency of the super clean process

**6.2.1.1** The super clean process can be operated through various technologies that are certified by USFDA and/or EFSA for meeting the requirements for food grade recyclates. These certifications are provided based on Challenge Tests at the time of introduction of the technology.

#### 6.2.1.2 Records of process parameters

Subsequent to the adoption of the certified technology, records of the following tests /controls shall be maintained by the recycler to assure the decontamination efficiency:

i. Quality of input flakes of each batch is in compliance with the prescription of technology supplier (see 5.1).
ii. Batchwise recyclate production is within the certified process tramlines.

#### 6.2.1.3 Evaluation of decontamination process efficiency

Following tests shall be done:

i. Determination of volatiles (residual representative markers namely limonene, benzene, and BPA) as per Table 1.

**Table 1**
[Clause 6.2.1.3 (i)]
**Analysis of recyclates for ensuring decontamination efficiency**

| Sl No. | Analytes | UOM | Limits* | Method |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| 1. | Benzene | mg/kg (ppm) | 0.03 | Annex C |
| 2. | Limonene | ppb | 20 | Annex C |
| 3. | Bisphenol A | ppb | Absence | BS EN 14372-2:2004 |

**NOTES**:

1. The limits are as measured on GC-MS.
2. Test to be done in-house once a day by the recycler followed by testing at an NABL / FSSAI notified Lab once a month. Records to be maintained.
3. In addition to the tests mentioned in table above, any specific chemical test at a frequency specified by the certifying agency shall be performed.
4. For any analyte other than the ones listed in Table-1, their test methods and limits may be decided between the recycler and the purchaser.

ii. Any specific chemical test at a frequency specified by the agency that has certified the technology.

**NOTE —** Since the above tests involve long turnaround times, they only represent the robustness of the decontamination process and not on the quality of ongoing production.

### 6.2.2 Group B: Testing for quality control of the recyclates

**6.2.2.1** Following testing shall be done

i. No perceptible difference in the odour and flavour of the recyclates shall be observed when tested as per the Paired comparison test of ISO 13302.
ii. Presence of metals listed in Table 2.

**Table 2**
[*Clause* 6.2.2.1 (ii)]
**Determination of metals in the recyclates**

| Sl No. | Analytes<br>Metals | Limits<br>mg/kg (ppm) | Test method |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 1 | Antimony | 300 | IS 3025 (Part 2) |
| 2 | Calcium | 100 | IS 3025 (Part 40) |
| 3 | Cobalt | 125 | IS 3025 (Part 2) |
| 4 | Lithium | 130 | IS 3025 (Part 2) |
| 5 | Manganese | 80 | IS 3025 (Part 2) |
| 6 | Tin | 30 | IS 3025 (Part 2) |
| 7 | Titanium | 120 | IS 3025 (Part 2) |
| 8 | Zinc | 80 | IS 3025 (Part 2) |

iii. Migration propensity shall be determined after converting the recyclates into articles namely bottles / sheets / pouches / containers as appropriate for the final application:

a. **Overall migration tested as per IS 9845** — The maximum extraction values shall not exceed 10 mg/dm$^2$ or 60 mg/l.

b. **Specific migration of metals, phthalates and BPA** — The sample/simulants shall be prepared using the procedure described in IS 9845. The testing for detection of regulated substances shall be carried out as per method given in Table 3.

**Table 3**
[*Clause* 6.2.2.1 (iii)]
**Specific Migration**

| Sl No. | Substances | Maximum Migration Limit (mg/kg) | Test Method |
|---|---|---|---|
| | (2) | (3) | (4) |
| 1 | Barium | 1.00 | IS 3025 (Part 2) |
| 2 | Cobalt | 0.05 | -do- |
| 3 | Copper | 5.00 | -do- |
| 4 | Iron | 48.00 | -do- |
| 5 | Lithium | 0.60 | -do- |
| 6 | Manganese | 0.60 | -do- |
| 7 | Zinc | 25.00 | -do- |
| 8 | Antimony | 0.04 | -do- |
| 9 | Phthalic acid, bis(2-ethylhexyl) ester (DEHP) | 1.50 | ISO 18856 |

**6.3 Common Stipulations for Quality Control:**

The recycler shall ensure the following.

i. The results of all the tests (as per Table 1, Table 2, Table 3) shall be within the limits prescribed in the respective tables.
ii. These tests may be done in-house or in external laboratories.
iii. Testing shall be done as per frequency indicated in Table 4 (*see* Annex B).
iv. The records (physical or digital) of the production details and the tests results shall be preserved as indicated in Table 4 (*see* Annex B).

**6.4 Sampling and Storage:**

i. Samples shall not be taken in an exposed place.
ii. The sampling instrument shall be of stainless steel or any other suitable material on which the material shall have no action. The instrument shall be clean and dry.
iii. Precautions shall be taken to protect the samples, the sampling instrument and the containers for samples from adventitious contamination.

iv. The samples shall be placed in a suitable clean, dry, air-tight, water-tight transparent PET container. The sample container shall be of such a size that it is almost completely filled by the sample.

v. Each sample container shall be labeled with details such as lot number, grade, etc. that will enable traceability between the purchaser, test results and the production details.

vi. All samples shall be stored in a separate, designated, clean, cool (less than 27 deg C) and dry room. This storeroom shall be maintained clean, dust-free and pest-free. This storeroom shall enable easy depositing and retrieval of the sample containers.

vii. In essence, sampling and storing shall be such that they ensure that the samples meaningfully serve their intended purpose.

viii. For the purpose of dispute resolution and any other learning, the recycler shall retain 100 g reference sample of each lot of each recyclate type. Common guidelines related to samples and sampling shall be followed as per Table 4.

ix. After the expiry of the sampling period, the sample shall be disposed in a appropriate recycling stream.

## 7 PACKING AND MARKING

### 7.1 Packing

The recyclate (FG rPET) shall be packed in suitable form of packing, as agreed to between the purchaser and the supplier.

### 7.2 Marking

**7.2.1** Each bag and/or unit package whichever is smallest in size that is being delivered to the customer shall be clearly marked with the following:

a) Name and address of the recycler;
b) Trade mark; if any;
c) Name and grade of the material: “FG rPET” or “FG RPET”;
d) Form of recyclate;
e) Net quantity;
f) Lot number; (see 5.3)
g) FSSAI licence number; and
h) Any other statutory requirements.

### 7.2.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and *the Rules and Regulations* framed thereunder, and the products may be marked with the Standard Mark.

**Annex A**
(*Clause* 2)

## LIST OF REFERRED STANDARDS

| *IS No.* | *Title* |
|---|---|
| IS 7019 : 1998 | Glossary of terms in plastics and flexible packaging, excluding paper (*second revision*) |
| IS 7328 : 2020 | Specification for polyethylene material for moulding and extrusion (*second revision*) |
| IS 10171 : 1999 | Guide on suitability of plastics for food packaging (*second revision*) |
| IS 12252: 2017 | Polyalkylene terephthalates (PET and PBT), their copolymers and list of constituents in raw materials and end products for their safe use in contact with foodstuffs pharmaceuticals (*first revision*) |
| IS 13193 : 1992 | Polyalkylene terephthalate (PET and PBT) for moulding and extrusion — Specification |
| IS 14534 : 2023 | Plastics — Recovery and recycling of plastics waste — Guidelines (*second revision*) |
| IS 14535 : 2023 | Recycled plastics for the manufacturing of products — Designation |
| IS 16630 (Part 2) : 2024 | Plastics — Recyclates from post- consumer bottles and other forms of poly (ethylene terephthalate) (PET) : Part 2 Preparation of test specimens and determination of properties (*first revision*) |

# ANNEX B

## Table 4
(*Clause* 5.4, 6.3 *and* 6.4)
**Quality assurance**

| | | | | QUALITY ASSURANCE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Testing (QC) | | | | | Records | Sample preservation | |
| | Objective of testing | Section # | Parameters | Sample type/ target analytes | Sample size | Testing Frequency | Acceptance criteria | Nature of results | | Counter sample | Production sample |
| **INPUTS** | Quality of feedstock | 6.1 | Elimination of non-food packaging | Bottles | 3% by weight* or 2 bales/bags (whichever is higher) | each incoming truck/vehicle load | less than 2% (by weight) | real-time | 3 years | NA | NA |
| | | | | | | | | | | | |
| **OUTPUT (RECYCLATES)** | Process fidelity | 6.2 (A1) | Process tramlines | Digital settings from technology licencer for production of food grade recyclates | Screen shots of parameters for entire system (all unit operations) | Continous monitoring of control panel along with daily screen shots of console OR Physical printout of the process parameters data (inclusive of date & time) | No deviation | real-time | 3 Years | NA | NA |
| | | 6.2 (A2, i) | Residual organics | limonene, benzene, and BPA | As required by the analytical procedure | Once in a quarter (to be collected in the lot within 24 hrs prior of the dispatch to laboratory) | Table 2, ANNEX B | post-facto | 3 Years | 1 year, 100g | 1 year, 100g every lot |
| | | | | | | | | | | | |
| | Quality of recylates | 6.2 (B, i) | Organoleptic properties | Recyclates (chips / powder) | As required by the analytical procedure | Once in a quarter (to be collected in the lot within 24 hrs prior of the dispatch to laboratory) | ISO 13302-2003 | post-facto | 3 Years | 1 year, 100g | 1 year, 100g every lot |
| | | 6.2 (B, ii) | Metals | 12 Metals | As required by the analytical procedure | Once in a quarter from a random lot | Table 3, ANNEX B | post-facto | 3 Years | 1 year, 100g | 1 year, 100g every lot |
| | | 6.2 (B, iii) | Phthalate | DEHP | As required by the analytical procedure | Once in a quarter from a random lot | ISO 18856 | post-facto | 3 Years | 1 year, 100g | 1 year, 100g every lot |
| | | 6.2 (B, iv) | Migration | a) Overall<br>b) Specific | Converted into articles (bottles OR sheets OR pouches OR containers) | Once in a quarter from a random lot | a) IS-9845<br>b) As per special note in any of the Standards for PET (e.g. IS 15410, A6) | post-facto | 3 Years | 1 year, 5 articles | NA |

**Note:**
1) All the samples sent to external laboratories shall be coded with lot number
2) Sample size for all tests shall be as required by the analytical procedure

## ANNEX C

Benzene and limonene in PET recyclates shall be determined using headspace (HS) gas chromatography (GC) as detailed below.

### C1) Sample Preparation

Custom-made Standards for this application can be obtained in whatever concentration is needed. For example, following standards can be utilized:

### C2) Standards

Appropriate Standards in Toluene of benzene (CAS# 71-43-2) and of d-Limonene (CAS# 5989-27-5).

### C3) Conditions for setting up HS-GC

The instrument may be set up for analysis as per conditions given in Table C-1.

**Table C-1**

| | |
|---|---|
| Capillary Injector | @ 250°C |
| Flame Ionization Detector | @ 335°C |
| Carrier Gas | Helium @ 100 kPa |
| Split | 10 mL/minute |
| Column | 30 m x 0.25 mm x 0.25 µm or similar |
| Temperature Program | · 50°C hold for 4 minutes<br>· 20°C/minute to 320°C<br>· 320°C hold for 5 minutes |

### C4) Procedure

For the determination of benzene and limonene, the following procedure shall be used:

- Weigh 1.00 g of PET recyclate material into an appropriately sized HS crimp vial.
- To this, add 5 µL standard solutions with a suitable microlitre syringe.
- The benzene and limonene standard solution to be directly injected using a suitable microlitre syringe into an empty appropriately sized HS crimp vial.
- Additionally, a second vial to be analyzed that contains 1.00 g of PET with a known concentration of benzene and limonene.
- These two data sets allow the calculation of benzene and limonene concentration in the samples.
- To calculate concentration of benzene, the software available from the HS-GC supplier may be used and to calculate the concentration of limonene an external calibration to be used.
- The conditions for determining the two analytes are given in table C-2 below:

**Table C-2**

| Instrument conditions | Benzene | Limonene |
|---|---|---|
| Headspace Mode | Multiple Headspace Extraction (MHE) at least 6 times | Standard Headspace Mode |
| Oven Temperature | 200°C | 200°C |
| Needle Temperature | 210°C | 210°C |
| Transfer Line Temperature | 210°C | 210°C |
| Thermostat. Time | 60 minutes | 60 minutes |
| Vial Pressurization Time | 3 minutes | 3 minutes |
| Withdraw Time | 0.5 minutes | 0.5 minutes |
| Injection Time | 0.02 minutes to 0.04 minutes, depending upon HS-needle used | 0.02 minutes to 0.04 minutes, depending upon HS-needle used |
| Column Pressure | 145 kPa | 145 kPa |
| Vial Vent | On | On |
| Transfer Line | Fused Silica uncoated, 0.32 mm | Fused Silica uncoated, 0.32 mm |