**HOS/15/002: Vapour Permeation Measurements**

**Background**

The Home Office Centre for Applied Science and Technology (CAST) is seeking to appoint one or more organisations who are able to carry out investigative studies on vapour permeation as detailed in the specification below.

**Specification**

**1.1** CAST are looking to obtain information on the permeation of the vapours of the following ‘permeants of interest’ through the described ‘packaging materials’.

**1.2** Permeants of interest;

* DMNB – 2, 3- Dimethyl 2, 3-Dinitrobutane (CAS No. 3964-18-9)
* 2,4 DNT – 2,4 Dinitrotoluene (CAS No. 121-14-2)
* NH3 - Ammonia (CAS No. 7664-41-7)

**1.3** All permeants of interest should be supplied by the bidder. These materials are readily available from commercial chemical suppliers and require no special handling or storage licences. If the bidder is unable to work with any of the permeants of interest this must be declared.

**1.4** Packaging materials;

* Poly Vinyl Chloride (PVC -SPI Code 3) or Low Density Polyethylene (LDPE - SPI Code 4), 0.01 – 1 mm thickness
* Polypropylene (PP - SPI Code 5), 0.01 – 1 mm thickness
* Polyethylene terephthalate (PET – SPI Code 1) coated with Aluminium film (0.5 µm), 0.01 – 1 mm thickness

**1.5** CAST will supply the nominated bidder with the required packaging materials. However, the bidder should indicate whether they would prefer to source their own packaging materials of similar type to those listed above, in order to perform the experiment. The bidder must estimate the thicknesses and specific material of packaging where a measurement of the permeation can be made. It is the expectation of CAST that the thickness would approach that of commonly encountered packaging materials (listed above). If a measurement is made within the desired thickness range CAST would like to understand the possibility of extrapolating the information across the full thickness range commonly encountered specified for each material.

**1.6** CAST are interested in understanding the permeation of the vapours in a temperature range from -10 °C to 40 °C. Two different temperature measurements are preferred in this temperature range. If a measurement is required to be made by the bidder at temperatures outside of this range, CAST require that it should be possible to extrapolate the data obtained to both lower and higher temperature ranges and information on this extrapolation must be presented. The bidder should estimate the additional characterisation work required and assumptions made to provide this extrapolated information with estimated uncertainty. If a measurement is made within the temperature range CAST would like to understand the possibility of extrapolating the information across the full temperature range specified.

**1.7** CAST are interested in a humidity range from 0 – 100 % RH with measurements made at two different relative humidity values. The bidder must stipulate the specific relative humidity range and values that can be achieved. At a minimum a measurement at 0% RH would be expected.

**1.8** CAST would like to understand any changes in the permeation rate, over a minimum 2 hour time period, in order to understand potential saturation effects. In addition, CAST would like to know the time taken to reach a steady state condition for the permeation rate, for each permeant and packaging material of interest. If steady-state conditions are not reached within a reasonable time frame (bidders should indicate what they consider to be a reasonable time-frame for their experimental set-up), CAST would like to know whether it is possible to extrapolate the data to obtain this information and what assumptions this makes. In addition, CAST would like to know whether measurements are taken in real-time and an estimate of how many measurements could be achieved in a 2 hour time period and whether obtaining a measurement interrupts the continuity of the 2 hour time period (i.e. is the experiment required to be started again after each measurement point?).

**1.9** CAST are interested in the effect of the vapour concentration on the permeation rate and whether the permeation rate is expected to scale linearly with the vapour concentration. CAST would like measurements to be undertaken at a minimum of two known vapour concentrations for each permeant of interest and packaging material combination, bidders must state whether this is possible. Errors on the vapour concentration measurement should be known and described in advance.

**1.10** Bidders must detail the method of vapour generation to be used in their experimental set-up. Where ‘bulk’ samples are used to generate the vapour, CAST require that the distance of the permeant to the packaging material during measurement to be known. In this set-up CAST would like the permeation measurement to be possible with and without direct contact between the permeant and packaging material. The maximum distance between the permeant and packaging material must be provided by the bidder.

**1.11** CAST would like measurements to be made in low (to very low) air flow conditions. Bidders must state if this is possible and at what air flow rates measurements can be performed, including details on the errors associated with this.

**1.12** Bidders must detail what units the permeation rate / permeation coefficient will be presented in. CAST require that this data be easily comparable to other permeation data and would prefer permeation rates to be reported in units of mass per unit time and area. It is CAST preference that any permeation measurement is performed at atmospheric pressure.

**1.13** CAST seeks to understand how the various experimental parameters described above affects the overall time to perform the experiment. The bidder should identify time consuming aspects of the experimental measurement to allow CAST to prioritise the most useful parameters.

**1.14** CAST seeks to understand how the data may be extrapolated from the experiments performed to give calculated values with estimates of uncertainty against the various parameters of interest; i.e. temperature, humidity, time, thickness of packaging material, vapour concentration, air flow, distance of permeant to packaging material and quantity of permeant?. Details of assumptions made to support the extrapolation and sources of error / uncertainty of the extrapolation must be given. If possible, CAST would like bidders to detail an appropriate permeation model, to enable an understanding of the various contributing processes, for each of the permeants of interest.

**Requirements from bidder’s response**

Bidders must address the following questions in their tender.

1. Full details of how the permeation is measured, including details of vapour generation
2. Full details on the validity / accuracy / reliability/ limitations of the above technique
3. Can the data from the measurements at two temperatures be extrapolated to higher and lower temperatures? What are the assumptions / limitations for this extrapolation? (See Para 1.6.)
4. Are there any limitations with the associated measurement parameters?
5. What level of control / measurements are achievable on the temperature and humidity?
6. Please indicate how the proposed experimental design considers each of the following parameters: temperature, humidity, time, thickness of packaging material, vapour concentration, air flow, distance of permeant to packaging material and quantity of permeant?
7. Consideration of additional parameters not listed at (6)
8. Responses to the specific questions raised in the outline experimental plan. Detailed below for ease of reference, with the applicable paragraph number given in brackets at the start.
   1. **(Para 1.3)** Can you work with all of the permeants of interest? If not, which permeants are excluded?
   2. **(Para 1.5)** Please specify if you would prefer to source your own packaging materials as detailed in Para 1.4?
   3. **(Para 1.5)** Please estimate the thicknesses and specific packaging material for which permeation measurements can be made?
   4. **(Para 1.5)** If a measurement is made within the desired thickness range is it possible to extrapolate the data across the full thickness range specified for each material?
   5. **(Para 1.7)** What specific relative humidity range and values can be achieved within the bidders experimental set-up?
   6. **(Para 1.8)** Please indicate what you would consider to be a reasonable time frame to reach steady state conditions for the permeation rate for your experimental set-up. If steady-state conditions are not reached within this time frame, please state whether it is possible to extrapolate the data to obtain this information and what assumptions are made?
   7. **(Para 1.8)** Please specify whether measurements are made in real-time and give an estimate of how many measurements could be achieved in a 2 hour time period. Does obtaining a measurement interrupt the continuity of the 2 hour time period (i.e. is the experiment required to be started again after each measurement point?)?
   8. **(Para 1.9)** Please specify whether it is possible to obtain measurements at known vapour concentrations? Errors on the vapour concentration measurement should be known and described.
   9. **(Para 1.10)** Please detail the method of vapour generation to be used in the proposed experimental set-up.
   10. **(Para 1.11)** Please specify whether it is possible to undertake measurements in low (to very low) air flow conditions? At what air flow rates can measurements be performed (include details on the errors associated with this)?
   11. **(Para 1.12)** In what units will the permeation rate / permeation coefficient will be presented?
   12. **(Para 1.13)** Please identify time consuming aspects of the experimental measurement to allow CAST to prioritise the most useful parameters.
   13. **(Para 1.14)** Please give details on whether and how the data may be extrapolated from the experiments performed to give further information on the impact of changing the various parameters of interest. What assumptions would be made to support this extrapolation and what are the associated sources of error / uncertainty?
   14. **(Para 1.14)** Please specify whether you can provide an appropriate permeation model to enable an understanding of the various contributing processes, for each of the permeants of interest?

**Key Criteria**

Prospective organisations must:

* Be able to work with at least one of the permeants of interest and packaging materials as detailed in the specification.
* Evidence that they have the required skills to investigate vapour permeation, as described in the specification, including necessary personnel and equipment.
* Provide full details of the experimental capabilities as described in the Bidders Response section above.

## **Submitting an Expression of Interest**

To Express an Interest in this advertisement, organisations must send their response to [HOSProcurement@homeoffice.gsi.gov.uk](mailto:HOSProcurement@homeoffice.gsi.gov.uk) by 1st May 2015, if they wish to attend the supplier information day, quoting (HOS/15/002) Vapour Permeation Measurements in the subject line.

## To register your intention to bid, please provide the following information:

### Confirmation of your Expression of Interest

### Organisation details

### Names, titles and full contact details for the representatives who would like to be invited to the supplier information day

### A brief overview of the organisations ability to perform vapour permeation measurements and relevant data analysis and extrapolation. The overview should be supplied as a Word document, limited to two sides of A4.

## The Home Office reserves the right not to invite suppliers who have not fulfilled the

## above criteria to the information day.

**Information Day**

## Organisations who have submitted an Expression of Interest and have met the criteria as listed above will be invited to attend a supplier information day at CAST, Sandridge on **7th May 2015**, where further briefing on the project will be provided. The information day will also provide an opportunity for bidders to raise queries. Bidders will be asked to sign a Non-Disclosure Agreement (NDA) in order to attend the supplier information day, receive further briefing on the project and questions and answers from the information day.

## Organisations who have not expressed an interest to attend the supplier

## information day by 1st May, **are still eligible to submit a tender before the closing**

## **date of 25th May 2015.**

## Organisations who have not expressed an interest by 1st May, but would like to

## receive further briefing on the project and to receive a copy of questions and

## answers from the supplier information day, must send a request to

## [HOSProcurement@homeoffice.gsi.gov.uk](mailto:HOSProcurement@homeoffice.gsi.gov.uk) by **18th May 2015 and sign a Non-**

## **Disclosuure Agreement**.

**Timetable**

* The contract will start June 2015
* The following timetable for selecting the successful contractor(s) will be followed.

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| **Timetable** | **Stage** |
| 1st May 2015 | Deadline for submission of Expression of Interest |
| 7th May 2015 | Information Day |
| 25th May 2015 | Deadline for submission of tenders. |
| 12th June 2015 | Anticipated contract award |

## **Submitting a Tender**

## The contract will be awarded using Home Office standard terms and conditions. To receive a copy of the Home Office standard terms and conditions, bidders must email a request to [HOSProcurement@homeoffice.gsi.gov.uk](mailto:HOSProcurement@homeoffice.gsi.gov.uk) by **25th May 2015,** quoting HOS/15/002 Vapour Permeation Measurements in the subject line

## Tenders must be submitted on a Word document to [HOSProcurement@homeoffice.gsi.gov.uk](mailto:HOSProcurement@homeoffice.gsi.gov.uk) by **25th May 2015,** quoting HOS/15/002 Vapour Permeation Measurements in the subject line. Responses are not to exceed 10 pages, exclusive of Annexes.