

Third
Edition

Environmental Technology Verification Project
In the field of simplified VOC measurement technologies

Protocol for the verification tests on simplified VOC measurement technologies

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The Japan Environmental Technology Association
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technologies in the Advisory Committee on the ETV Project エラー! ブックマークが定義されていません。

[Main section]

I. Introduction

1. Target technologies

Simplified VOC measurement technologies covered by this verification test are technologies that are characterized by simple operation and maintenance and expedited quantification, and can be applied to voluntary efforts of VOC emission reduction such as management of process, machinery, VOC treatment equipment, and work environment at enterprises using VOCs.

A target technology, which especially should be measured within the enterprises, shall satisfy the following requirements:

- A technology which can simultaneously^{*1} measure multiple components relating to VOCs described in this protocol for the verification (“this Protocol”)
- Easy to operate and maintain
- Commercially available

As for target technologies covered by this verification test, it is not requisite to determine VOC quantity inclusively (that is, to represent measurement results with the ppmC unit), which is required in the official method of VOC measurement,^{*2} so that the methods can be used in voluntary efforts corresponding to the actual situation of each enterprise, e.g., the type of solvent used. In principle, there is no limitation on measurement principles.

- * 1: “Simultaneously” here means that a technology will be acceptable as long as multiple components can be measured after the introduction of a single sample gas. The technology may be acceptable even if measurements cannot be obtained simultaneously in terms of time.
- * 2: Although the measuring range example prescribed in the official method is 0 - 500/1,000/2,000/5,000 ppmC, it is not requisite to have this measuring range, either.

2. Basic policies of verification tests

(1) Types of verification tests

In this verification test, the following points shall be verified for a target verification product presented by a verification applicant. A verification test will provide information that helps to determine whether or not the target verification product can be used for voluntary efforts to reduce VOC emission.

- Reliability of product performance
- Practicability in measurement of target VOCs at the enterprises using VOCs
- Convenience of product operation and similar actions

(2) Outline of verification tests

The verification test will primarily be conducted according to the steps specified below:

① Application for verification

A verification applicant shall clearly state an outline of the proposed technology in an application for a verification test and submit it to the Verification Organizations. Verification Organizations will examine the proposed technologies from the perspective of adequacy for purport of this verification test.

② Test Plan

The plan for the verification test (the “Test Plan”) shall be developed prior to the conduct of verification test. The Test Plan will be prepared by the Verification Organizations in cooperation with a verification applicant.

In the Test Plan, the following shall be specified:

- Verification test system
- General and technology-specific objectives of the verification test
- Verification test items
- Specific work items in the verification test (analysis techniques, measurement methods, and calculation methods)
- Schedule of the verification test

③ Verification test

A verification test will be conducted according to the Test Plan described above. Verification Organizations may, if necessary, subcontract part of the verification test to an external test organization.

④ Data assessment and reporting

Based on the results of the verification test, collected data will be analyzed and examined for verification, and a verification test result report will be compiled. Verification Organizations are responsible for evaluation of the data and reporting.

To accelerate the above process, the Verification Organizations may subcontract an external organization to prepare a draft of the verification test result report.

Verification test result report will be submitted to the Verification Management Organization, and the suitability of the verification test will be discussed by the working group on the simplified VOC measurement technologies in the Advisory Committee on the Environmental Technology Verification Project (the “ETV Project”) (the “working group”). The Ministry of the Environment (MOE) will approve the report based on the review results and similar factors compiled by the working group, and shall issue the verified number and logo-mark to the verification applicant. The approved verification test result report will then be issued by the Verification Organization to the verification applicant and simultaneously disclosed to the public via the website and similar media of the ETV Project by the MOE.

3. Definitions of terms and phrases

The definitions of the major terms and phrases are in accordance with those of the Japanese Industrial Standards (the “JIS”). The standard in JIS particularly relevant to this Protocol is as follows:

JIS B 7989 Measuring method for volatile organic compounds (VOCs) in flue gas by analyzers

JIS K 0055 General rules for calibration method of gas analyzer

JIS K 0095 Methods for sampling of flue gas

JIS K 0211 Technical terms for analytical chemistry (General part)

JIS K 0212 Technical terms for analytical chemistry (Optical part)

JIS K 0213 Technical terms for analytical chemistry (Electrochemistry part)

JIS K 0215 Technical terms for analytical chemistry (Analytical instrument part)

JIS Z 8103 Glossary of terms used in measurement

In addition, the terms and phrases used in this Protocol are defined as set forth in Table 1.

Table 1 Definitions of terms and phrases used in this Protocol

| Term/Phrase | Definition |
|-----------------------------------|--|
| Target verification technology | Theoretical concept or performance of a technology under verification test (“Simplified VOC measurement technology” in this Protocol) |
| Target verification product | A product to be used in the verification test among the apparatus/equipment representing the embodiments of the target verification technology (To be more specific, “XX analyzers” manufactured by “Company X,” etc.) |
| Verification item | Item to be analyzed for determination of the performance of a target verification product (To be more specific, “Sensitivity,” “90% response time,” etc.) |
| VOCs (Volatile Organic Compounds) | Organic compound which is in a gaseous state when emitted or scattered in the air (excluding any substance prescribed by the laws or regulations as a substance which would not cause the generation of airborne particulate, and/or an oxidant), as defined by the Article 2, Paragraph 4 of the Air Pollution Control Law. However, the addition, if necessary, of any similar substance in terms of chemical properties, considering the actuation situation of enterprises using VOCs, is not precluded. |
| Verification category test | A category for selecting a simulant gas to be measured by this verification test, classified by unique types of VOCs emitted by each enterprise. To be more specific, it is classified into Facilities subject to general regulations (coating/adhesive bonding/printing), Enterprises using chlorinated VOCs in considerable quantity (washing, etc.), and Others. |

| | |
|--------------|---|
| Simulant gas | The test gas which is the target for measurement in this verification test. A gas consisting of multiple mixed VOCs, simulating the unique VOCs emitted from enterprises using VOCs. A mix of gasses and VOC components will vary depending on verification test category. |
|--------------|---|

II. Verification test system

1. Ministry of the Environment (MOE)

- Comprehensively administer the entire ETV Project
- Comprehensively review the verification test system
- Select target verification technology fields for the verification test
- Establish and administer the Advisory Committee on ETV Project
- Create a protocol for the verification test
- Select Verification Organizations
- Approve verification test result reports
- Create a website for the ETV Project for its dissemination and provide information
- Issue a logo-mark for verified technology

2. Advisory Committee on ETV Project

- Offer advice on management of the entire ETV Project
- Offer advice on the comprehensive evaluation of verification test results

3. Verification Management Organization

- Prepare a protocol for a verification test and obtain approval of the MOE
- Select Verification Organizations and obtain approval of the MOE
- Approve target verification technologies
- Determine the items of the fee associated with the verification test and collect the fee
- Subcontract operation of verification test to the Verification Organizations
- Check verification test result reports and obtain approval of the MOE
- Establish and manage the working group

4. Working group on the simplified VOC measurement technologies in the Advisory Committee on the ETV Project

- Offer advice on management of the entire ETV Project in the field of simplified VOC measurement technologies
- Offer advice on creating a protocol for the verification test
- Offer advice on selection of Verification Organizations
- Offer advice on approval of verification test result reports

5. Verification Organizations

- Administer all processes of the verification test under the auspices of the MOE and Verification Management Organization
- Establish the quality management system shown in Appendix 0
- Invite the public to register the technologies and products that are suitable as the target of the verification test
- Establish and manage respective Technology Panel
- Develop the Test Plan in cooperation with verification applicant
- Calculate all fees related to verification test
- Conduct and manage the target verification test based on the Test Plan
- Operate target verification products according to their specifications presented by the respective verification applicant
- Restrict entry to the site of verification test during the test period
- Ensure the health and safety of all persons involved in the verification test
- Set and adjust the test schedule by assuring the means of communication among all participants in the verification test, and providing technical assistance as necessary
- When the verification test is subcontracted to an external organization, ensure that the quality management system which is required in this Protocol is indeed functioning properly at the subcontractor
- Audit the procedures for the verification test
- Manage the data/information obtained in the verification test
- Prepare verification test result reports based on analysis/evaluation of the data on the verification test

6. Technology Panel

- Offer advice on the Test Plan
- Offer advice on the problems occurred during the verification test as appropriate
- Offer advice on preparation of verification test result reports
- Offer advice on dissemination of the technologies verified in the verification test

7. Verification applicants

- Cooperate with Verification Organizations in development of the Test Plan, such as by providing information required for the verification test
- Prepare as many sets of the target verification product as required for the verification test

- Bear the costs and responsibility for the transportation, installation, removal, and others of the target verification products as necessary
- Prepare existing performance data related to target verification technologies
- Provide technical information required in a verification test, such as operating and measuring methods of the target verification products
- Cooperate with the Verification Organizations in preparing verification test result reports

III. Call for submissions of target verification technologies

1. Application

A verification applicant may apply to a Verification Organization for verification of the applicant's proprietary technology/product.

Items to be specified in the application form are described below. The verification applicant should fill in the necessary information in the "Verification application form" set forth in Appendix 1, and submit the application form together with the designated documents to the Verification Organization.

- Company name, address, division of person in charge, name of person in charge, etc.
- Principle of technology
- Characteristics/advantages/selling points, etc.
- Product data
- Measuring ability for each substance (quantity range, precision, etc.)
- Desired application category, desire for implementation of optional verification items
- Delivery status
- Technological novelty, application/acquisition of patent/utility model, presented papers, award won, etc.
- Other relevant or unique features (if any)
- <Document>¹ Company profile, etc.
- <Document> Instructions
- <Document> Technical specifications, brochures, etc.
- <Document> In-house or external organization's performance test results²
- <Document> Other reference materials (patents, presented papers, etc.)

¹ Items which require existing documents to be attached

² Attach references to confirm performance test methods and validity of interpretation of results

2. Selection of target verification technologies

Based on the description of the application and the advice from the Technology Panel and others from a comprehensive viewpoint, a Verification Organization selects target verification technologies and obtains approval from the Verification Management Organization. The selection criteria are as follows:

(1) Formal requirements:

- The proposed technology falls under the target verification technology field
- The application form is properly filled in
- The technology is at a commercialization stage
- The technology has not undergone similar verification or other testing using public funds in the past

(2) Prior confirmation of target verification products:

- It is possible to scientifically explain the principle and mechanism of the technology
- The technology must not result in secondary adverse effects upon the environment
- There is potential of use for voluntary efforts of VOC reduction
- It is an innovative technology

(3) Examination of verification methods:

- It is possible to complete the verification from cost and organizational standpoints
- It is possible to develop a suitable Test Plan (It is possible to develop a Test Plan which includes items in accordance with the methods described in “IV. Preparation for the verification tests” and “V. Verification test method”)

A verification applicant shall be allowed to apply for up to three technologies at one time.

* A product which has an identical specification and is sold by different enterprises under different names:

When a verification applicant applies for verification of a product which has identical performance to one sold by different enterprises under different names due to a manufacturing subcontract or similar situation, the applicant shall liaise with interested parties (such as manufacturers or sales business operators) and submit a document which proves that the applicable products have identical specifications, in order to be approved as an identical technology. On verification test result reports, multiple names of verification applicants and products shall be all stated. The verification logo-mark shall be separately granted for each applicable product.

IV. Preparation for the verification tests

1. Viewpoints of verification test

The following viewpoints shall be checked in a verification test: reliability, practicability, and convenience of product operation.

Table 2 Viewpoints of verification test

| Viewpoint | Description |
|----------------------------------|--|
| Reliability | Determine whether or not the target technology provides reliable measurement of VOCs described in this Protocol within the precision range required for usage of each target verification technology |
| Practicability | Examine the product specifications or measurement performance to determine whether or not the use of target verification product is appropriate at the VOC emission sites such as worksites |
| Convenience of product operation | Examine whether or not the product specifications or operational procedures are simple and easy |

2. Development of the Test Plan

Verification Organizations shall develop the Test Plan based on information provided by the verification applicant and the advice of the Technology Panel. If a verification applicant does not give approval for the Test Plan, the Verification Organizations will consult as required with the Verification Management Organization to determine the necessary actions.

The items to be included in the Test Plan are listed in Appendix 2.

3. Verification test sites

As described below (see V. Verification test method), a verification test will be conducted by a test organization. The test organization which conducts a verification test shall be selected by the Verification Organizations in accordance with the Test Plan.

Actual gas may be collected at the target enterprise (optional verification items) under the following conditions: a verification applicant desires to measure gas emissions at a worksite (process) using VOCs; collection of sample gas can be done at the worksite; and the Verification Organization judges that it would contribute to the improvement of verification test. As for the worksite at which the actual gas is to be collected, the Verification Organization shall discuss with applicable verification applicant, obtain advice from the Technology Panel as needed, and

make a decision.

4. Distribution of test expenses

A verification applicant shall acquire as many sets of the target verification product as required for the verification test.

In the Fee-based System, in principle, the verification applicant shall bear the costs entailing transportation of target technology products into the Test Site, installation of the products, operation of the target technology when the on-site verification test is carried out, dismantling and transportation of the target technology products after the completion of the test.

The applicant shall bear the costs associated with the implementation of the verification test (i.e., costs of measurement and analysis, labor cost, expendables, and traveling costs which arise at the Verification Organizations) as a test fee, and the MOE shall bear the remainder (administration of the Advisory Committee, working groups for applicable fields, the Technology Panel, and others).

5. Disclaimer

Participants involved in this verification project disclaim legal responsibility as follows:

- The verification applicant shall be held liable for any losses or damage incurred by a third party resulting from defects in the product, except in cases of intentional wrongdoing or gross negligence by the third party. The MOE, the Verification Organizations, and other parties participating in the project shall not be held liable
- The MOE, the Verification Organizations, and other parties participating in the verification project shall not be held liable for any disputes arising between the verification applicant and a third party as a result of the public release of verification test result reports
- If changes are made to the specifications of the product based on the target technology, data contained in verification test result reports does no longer apply to the product after such changes

V. Verification test method

1. Outline of verification test method

In a verification test, the practical performance of a target verification product using simplified VOC measurement technologies shall be examined.

Details of items to be verified in this verification test are described below:

(1) Selection of verification test category

A verification applicant shall select the applicable verification test category (see Appendix 1) prior to this verification test, and measure simulant gas as required for the applicable category. An applicant can select more than one verification test category. It should be noted that the verification test category selected at this time is only selected to set the category for convenience, in order to conduct the verification test under conditions as close as possible to those of the actual site, and shall not limit the enterprises which can use the target verification products.

(2) Measurement of individual gas

In this verification test, basic performance elements such as repeatability and effect of interference components will be tested using one type of typical gas (individual gas such as propane, toluene, or dichloromethane) which can be measured by a target verification product.

The type of gas to be used for the test shall be determined based on the specification information submitted in advance by the applicable verification applicant for the target verification product (see Appendix 1). In addition, the measuring ability for each VOC (relative sensitivity) may be conducted separately, at the discretion of the Verification Organizations, if each VOC substance needs to be measured due to a lack of application data or other reasons.

(3) Measurement of simulant gas

This verification test will measure a sample gas (simulant gas), in which multiple gas components which are assumed to be emitted at an actual site (process) will be mixed. At least one kind of simulant gas shall be measured for each verification test category described above.

(4) Measurement of actual gas in work environment and/or at an exhaust port (Optional verification items)

Any items related to the measurement of actual gas which is emitted from the enterprises shall be optional verification items. These measurements will be conducted only on occasions where the following conditions apply: a verification applicant desires a measurement of gas emission;

actual gas that would serve as sample gas can be collected; and the Verification Organization judges that it would contribute to the improvement of verification test. As for the worksite at which the actual gas is to be collected, the Verification Organization shall discuss with applicable verification applicant, obtain advice from the Technology Panel as needed, and make a decision.

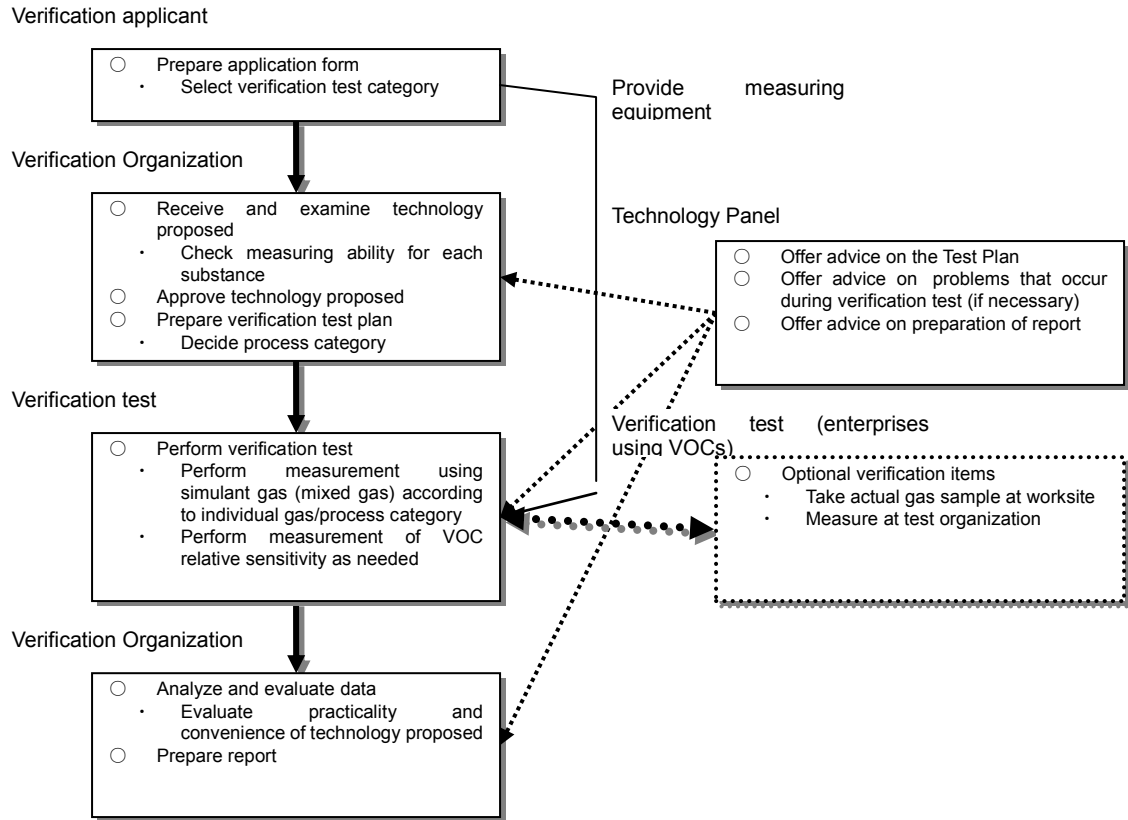


Figure 1 Flow of Verification Test

2. Selection of verification test category

The following substances are target VOC candidates. However, a target verification product is not required to be able to measure all of the following substances. Technology which can measure typical VOCs at target enterprises will also be covered.

Table 3 VOC emission amount of each substance

| Substance group | Substance code | Name of substance | Target enterprise | | | | | | Emissions (t/year) FY2007 |
|----------------------------------|----------------|--|---------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--|---------------------------------|------------------------------|
| | | | C o a t i n g | A d h e s i v e | P r i n t i n g | C h e m i c a l | I n d u s t r i a l | S t o r a g e | |
| Hydrocarbon series | 1001 | Toluene | ○ | ○ | ○ | ○ | ○ | ○ | 151,185 |
| | 1002 | Xylene | ○ | ○ | ○ | ○ | ○ | ○ | 113,512 |
| | 1003 | Ethylbenzene | ○ | | ○ | ○ | ○ | ○ | 26,945 |
| | 1004 | 1,3,5-trimethylbenzene | | | | ○ | ○ | ○ | 57 |
| | 1005 | n-hexane | | ○ | | ○ | | ○ | 19,987 |
| | 1006 | Isohexane | | | | | | | 148 |
| | 1007 | Cyclohexane | | ○ | | ○ | | ○ | 7,231 |
| | 1008 | n-heptane | | | | | | ○ | 234 |
| | 1100 | Other (Hydrocarbon series) | | | | ○ | ○ | ○ | 161,586 |
| | Alcohol series | 2001 | Methyl alcohol | | ○ | ○ | ○ | | |
| 2002 | | Ethyl alcohol | | | ○ | ○ | | | 32,835 |
| 2003 | | Isopropyl alcohol | ○ | | ○ | ○ | | | 31,780 |
| 2004 | | n-butyl alcohol | | | | | | | 125 |
| 2005 | | Isobutyl alcohol | | | | | | | 389 |
| 2100 | | Other (Alcohol series) | ○ | | ○ | ○ | | | 14,183 |
| Ketone series | 3001 | Acetone | | ○ | | ○ | | | 10,032 |
| | 3002 | Methyl ethyl ketone | ○ | ○ | ○ | ○ | | | 29,984 |
| | 3003 | Methyl isobutyl ketone | ○ | | ○ | ○ | | | 13,471 |
| | 3100 | Other (Ketone series) | | | | ○ | ○ | | 964 |
| | 4001 | Ethyl acetate | ○ | ○ | ○ | ○ | | | 125,760 |
| Ester series | 4002 | Butyl acetate | ○ | | ○ | ○ | | | 22,517 |
| | 4100 | Other (Ester series) | | | ○ | ○ | | | 5,474 |
| Glycol series | 5001 | Ethylene glycol | | | ○ | ○ | | | 349 |
| Ether/glycol ether series | 6001 | Ethylene glycol monomethyl ether | | | | | | | 19 |
| | 6003 | Ethylene glycol monobutyl ether | | | | ○ | ○ | | 357 |
| | 6004 | Propylene glycol monomethyl ether | | | | ○ | ○ | | 1,028 |
| | 6005 | Dimethyl ether | | | | | | | 14 |
| | 6100 | Other (Ether/glycol ether series) | | | | | | | 514 |
| | Halogen series | 8001 | Dichloromethane | | | | | ○ | ○ |
| 8002 | | Chloroform | | | | | | | 64 |
| 8003 | | Trichloroethylene | | | | | | ○ | 12,835 |
| 8004 | | Tetrachloroethylene | | | | | | ○ | 4,592 |
| 8100 | | Other (Halogen series) | | | | | ○ | ○ | 5,318 |
| Other simple solvents | 9004 | N,N-dimethylformamide | | | | | ○ | | 5,744 |
| | 9100 | Other (Simple solvents other than the ones stated elsewhere) | | | | | ○ | | 5,868 |
| Petroleum-derived mixed solvents | 10002 | No. 2 industrial gasoline (Rubber solvent) | | ○ | | ○ | | | 10,157 |
| | 10004 | No. 4 industrial gasoline (Mineral spirit) | | | | | | | 1,773 |
| | 10005 | No. 5 industrial gasoline (Cleaning solvent) | | | | | | | 33,375 |
| | 10009 | Solvent naphtha (Coal tar naphtha) | | | | | | | 47 |
| | 10100 | Other (Petroleum-derived mixed solvents) | | | | ○ | ○ | | 19,775 |
| | 11100 | Uncategorized petroleum-derived mixed | ○ | | | | ○ | ○ | ○ |
| Unidentified substances | 99100 | Unidentified substances | ○ | | ○ | ○ | ○ | ○ | 124,063 |

The above table was prepared based on Volatile Organic Compounds (VOC) Emissions Inventory Report (March, 2009)

Note: Notation of substance name was adopted from the reference report.

A **verification** applicant shall select the verification test category (see Appendix 1) in advance based on the data relating to the performance of the target verification products (Appendix 1). The simulant gas handled in the verification test will vary according to the verification test category. It is acceptable to select more than one verification test category. If the verification applicant wishes, verification tests in multiple verification test categories can be conducted, within the range of budget borne by the MOE. Details of the verification test categories are described below:

(1) Facilities subject to general regulations (coating, adhesive bonding, and/or printing related enterprises)

This verification test category measures simulant gas composed of VOCs emitted from enterprises related to coating, adhesive bonding, and/or printing. Target verification VOCs include oxygenated compounds such as hydrocarbon series, alcohol series, ketone series, and ester series. The simulant gas handled in the verification test within this category shall be a mixture of typical components of the VOCs indicated in Table 4.

Table 4 VOCs emitted in the process of coating, adhesive bonding, and/or printing

| Substance group | Substance code | Name of substance | Target enterprise | |
|----------------------------------|----------------|--|-------------------|-----------------|
| | | | C o a t i n g | P r i n t i n g |
| Hydrocarbon series | 1001 | Toluene | ○ | ○ |
| | 1002 | Xylene | ○ | ○ |
| | 1003 | Ethylbenzene | ○ | ○ |
| | 1005 | n-hexane | ○ | ○ |
| | 1007 | Cyclohexane | ○ | ○ |
| | 1100 | Other (Hydrocarbon series) | ○ | ○ |
| Alcohol series | 2001 | Methyl alcohol | ○ | ○ |
| | 2002 | Ethyl alcohol | ○ | ○ |
| | 2003 | Isopropyl alcohol | ○ | ○ |
| | 2100 | Other (Alcohol series) | ○ | ○ |
| Ketone series | 3001 | Acetone | ○ | ○ |
| | 3002 | Methyl ethyl ketone | ○ | ○ |
| | 3003 | Methyl isobutyl ketone | ○ | ○ |
| | 3100 | Other (Ketone series) | ○ | ○ |
| Ester series | 4001 | Ethyl acetate | ○ | ○ |
| | 4002 | Butyl acetate | ○ | ○ |
| | 4100 | Other (Ester series) | ○ | ○ |
| Glycol series | 5001 | Ethylene glycol | ○ | ○ |
| Ether/glycol ether series | 6003 | Ethylene glycol monobutyl ether | ○ | ○ |
| | 6004 | Propylene glycol monomethyl ether | ○ | ○ |
| Petroleum-derived mixed solvents | 10002 | No. 2 industrial gasoline (Rubber solvent) | ○ | ○ |
| | 10100 | Other (Petroleum-derived mixed solvents) | ○ | ○ |
| | 11100 | Uncategorized petroleum-derived mixed | ○ | ○ |
| Unidentified substances | 99100 | Unidentified substances | ○ | ○ |
| No. of target substances | | | 11 | 9 |

The above table was prepared based on Volatile Organic Compounds (VOC) Emissions Inventory Report (March, 2009)

Note: Notation of substance name was adopted from the reference report.

(2) Worksites where halogen series VOC is used in considerable quantity (such as industrial washing related enterprises)

This verification test category measures simulant gas composed of VOCs emitted from enterprises related to industrial washing. Target verification VOCs are primarily halogen series. The simulant gas handled in the verification test within this category shall be a mixture of typical components of the VOCs indicated in Table 5.

Table 5 VOCs emitted in the process of industrial washing

| Substance group | Name of substance | Industrial washing |
|----------------------------------|---|--------------------|
| Halogen series | Dichloromethane | ○ |
| | Trichloroethylene | ○ |
| | Tetrachloroethylene | ○ |
| | Chlorinated solvents other than dichloromethane, trichloroethylene, or tetrachloroethylene | ○ |
| | HFC series industrial cleaner | ○ |
| | Other fluorine series industrial cleaning solvents | ○ |
| Petroleum-derived mixed solvents | N-bromopropane | ○ |
| | n-paraffin series | ○ |
| | iso-paraffin series | ○ |
| | Naphthene series | ○ |
| Unidentified substances | Hydrocarbon series solvents other than n-paraffin series, iso-paraffin series, naphthene series | ○ |
| | Unidentified substances | ○ |
| No. of substances | | 12 |

The above table was prepared based on Volatile Organic Compounds (VOC) Emissions Inventory Report (March, 2009)

Note: Notation of substance name was adopted from the reference report.

(3) Others

VOCs are also heavily used at enterprises other than those which are the targets of (1) or (2). If the applicable target technology is intended to be used at enterprises which primarily handle VOCs other than the ones described above, or at enterprises which handle VOCs with high reactivity of photochemical oxidant formation potential, or high hazardousness to the human body even at low emission amounts, the Verification Organizations shall select the target substances in the Test Plan in light of advice from the Technology Panel, based on information and similar materials provided from the applicable verification applicant.

3. Details of verification test

(1) Creation of simulant gas

Simulant gas (VOC mixed gas) to be measured in verification test will be, in principle, composed of the substances described in the table of each verification test category (see “2. Selection of verification test category”). At least one type of simulant gas shall be created for each verification test category. Verification Organizations shall determine details such as selection of target substances and their composition ratio, concentration, and the number of types of simulant gas, in light of advice from the Technology Panel, based on the verification applicant’s data regarding the target verification product (the one which has been already applied).

For reference, the following are the types of simulant gas used for verification tests in FY2010 (Simulant gas described below was split/prepared by a standard gas splitter (five-way splitter) for use in the test).

(1) Simulant gas (five component VOCs): 426 ppm as total VOCs (1,860 ppmC)
Toluene: 53 ppm (371 ppmC) + isopropyl alcohol: 125 ppm (374 ppmC) +
n-hexane: 62 ppm (371 ppmC) + ethyl acetate: 93 ppm (371 ppmC) + methylethyl:
Ketone: 93 ppm (371 ppmC)

(2) Simulant gas (three component VOCs): 604 ppm as total VOCs (906 ppmC)
dichloromethane: 302 ppm (302 ppmC) + trichloroethylene: 151ppm (302 ppmC)
+ tetrachloroethylene: 151ppm (302 ppmC)

(2) Details of verification items

In this verification test, basic performance elements such as repeatability and effect of interference components will be tested using one type of typical gas (individual gas) which can be measured by a target verification product. Relative sensitivity measurements may be conducted separately at the discretion of the Verification Organizations, if each substance in the VOC gas needs to be measured individually due to a lack of application data or other reasons.

In general, several kinds of VOCs exist at the same time at a worksite (process) using VOCs. Therefore, a mixed gas (simulant gas) simulating such VOCs will be measured by this verification test.

Table 6 Example of viewpoints and methods by verification item

| Item | Index | Viewpoint | | | Method | |
|---|-------------------|-------------|----------------|-------------|----------|------|
| | | Reliability | Practicability | Convenience | Document | Test |
| 1. Evaluation items concerning measurement for each substance (checked based on document and actual measurement) | | | | | | |
| (1) Measuring range | | ○ | | | ○ | — |
| (2) Repeatability | Deviation, etc. | ○ | | | ○ | ◎ |
| (3) Linearity | Correlation, etc. | ○ | | | ○ | ◎ |
| (4) Interference effect test | Ratio, etc. | ○ | | | ○ | ◎ |
| (5) Response time | Time | ○ | | | ○ | ◎ |
| (6) Relative sensitivity | Ratio, etc. | ○ | | | ○ | — |
| (7) Reproducibility | Deviation, etc. | ○ | | | — | ◎ |
| 2. Evaluation items concerning measurement for a mixed substance (actual measurement) | | | | | | |
| (1) Measuring range | | ○ | ○ | | ○ | — |
| (2) Repeatability | Deviation, etc. | ○ | ○ | | ○ | ◎ |
| (3) Linearity | Correlation, etc. | ○ | ○ | | ○ | ◎ |
| (4) Interference effect test | Ratio, etc. | ○ | ○ | | ○ | — |
| (5) Response time | Time | ○ | ○ | | ○ | ◎ |
| (6) ppmC equivalent | | ○ | ○ | | ○ | ◎ |
| 3. Evaluation items concerning measurement for actual gas sampled at an enterprise (option) | | | | | | |
| (1) Repeatability | Deviation, etc. | ○ | ○ | | — | ◎ |
| (2) Comparison with other analysis methods | Correlation, etc. | ○ | ○ | | — | ◎ |

| | | | | | | |
|-----------------------------------|--|--|--|--|--|--|
| (official method, GC-MS, etc.) | | | | | | |
|-----------------------------------|--|--|--|--|--|--|

Note: ☉ marks in the method field mean items considered to be important in verification. Data shall be obtained by actual measurement, etc.

For 1 and 2, measurement shall be performed using a gas prepared with analysis-target substances or commercial standard substances similar to them. For 3, it shall be done using a gas actually taken at an enterprise.

Table 7 Description of verification items

| Item | Description (Outline) |
|--|--|
| 1. Items to be evaluated for each substance | |
| (1) Measuring range | Review numerical appropriateness based on details of submitted document, variations of measurements using test gas (known concentration), etc. |
| (2) Repeatability | Measure a zero test gas and span test gas three times using identical target verification product, calculate average of each span indication, and calculate difference from each measurement and average, with respect to the maximum value of the meter, as a percentage. |
| (3) Linearity | Split concentration of test gas into several types, and review correlation between each concentration and indication. (Sample split: zero gas, 25%, 50%, 75%, 100% (span gas)) |
| (4) Interference effect test | Review variation patterns of sensitivity, influenced by temperature, humidity, oxygen concentration, carbon dioxide concentration, etc., at the time of measurement. |
| (5) Response time | Time which combines lag time and rise time required for the indication of analyzer to reach the value equivalent to 90% of final indication after introducing test gas. |
| (6) Relative sensitivity | When setting the sensitivity of standard substance (such as propane and toluene) as 1 for the target verification product, calculate the ratio between sensitivity of other substances and standard substance. |
| (7) Reproducibility | Measure a span test gas using identical target verification product during test period, and calculate difference between each measurement and average, with respect to the maximum value of the meter, as a percentage. |
| 2. Evaluation items concerning measurement for a mixed substance | |
| (1) Measuring range | Same as 1. above |
| (2) Repeatability | Same as 1. above |
| (3) Linearity | Same as 1. above |
| (4) Interference effect test | Same as 1. above |
| (5) Response time | Same as 1. above |
| (6) ppmC equivalent (when it is impossible to measure in ppmC) | Calculate ppmC equivalent value by unique method designated for target verification technology, and compare the value with ppmC value of simulant gas (theoretical value). |
| 3. Evaluation items concerning measurement for actual gas sampled at an enterprise (option) | |
| (1) Repeatability | Same as 1. above |
| (2) Comparison with other analysis methods (official method, GC-MS, etc.) | Review correlation with the measurement by existing analysis methods (official method, GC-MS, etc.) which have already established their reliability and appropriateness. |

Although the verification test items described above are standards, the Verification

Organizations may add or change test items as needed, considering principles, technical specifications, and similar factors regarding the target verification product.

(3) Evaluation of verification test results

The following points shall be checked in verification test results: reliability, practicability, and convenience of product operation.

Details of items to be evaluated by viewpoint are described below:

① Reliability

- Evaluate whether or not the target technology provides reliable measurement of VOCs emitted at a worksite (process) using VOCs within a precision range required by usage of each target verification technology
 - Measurement results of individual gas (reliability of measurement results such as repeatability and effect of interference components)
 - Measurement results of simulant gas (mixed gas of VOCs) which is assumed to be emitted in each verification test category of conducted verification test (reliability of measurement results such as repeatability and linearity)

② Practicability

- Evaluate the product specifications or measurement performance to determine whether or not the use of target verification product is appropriate at VOC emission sites such as worksites
 - Review practicability (usage examples) based on measurement results of simulant gas (mixed gas of VOCs) which is assumed to be emitted in each verification test category of conducted verification test
 - Check and evaluate whether or not normal operation/calibration can be done as described in technical specifications and/or instructions

③ Convenience of product operation

- Evaluate whether or not the product specifications and/or operational procedures are simple and easy

VI. Preparation of verification test result reports

Verification Organizations shall report the results of verification test in a verification test result report. In verification test result reports, all details including the results of the verification test and any problems that occur during verification test must be reported.

Verification test result reports shall include the details described below:

- Outline
- Outline and objectives of verification test
- Target verification technology and its outline
 - Principles
 - Characteristics and explanation (including performance) of target verification technology and/or target verification product
- Manufacturer (name, address, and phone number) and model number
- Implementation system of verification test (Verification Organization(s) and verification test site(s))
- Test method for each verification item
- Test result for each verification item (data must be compiled as graphs and tables)
- Review and observation of verification test results
 - Practicability of target verification product including the “Example of assumed usage” shall be compiled in light of advice from the Technology Panel based on the performance test results submitted by the verification applicant as well as the measurement results of the applicable test
- Other reference materials (Test Plan)

Verification Organizations shall develop a draft of the verification test result report, check any errors or similar matters with the applicable verification applicant, review the results with the Technology Panel, and compile a verification test result report.

A verification test result report submitted to the Verification Management Organization will be reviewed by the working group, and an approval shall be obtained from the MOE. In addition, the Verification Organizations shall prepare a summary of the verification test results using Appendix 3 as a reference.

VII. Remarks in conducting verification tests

In conducting a verification test, the matters described below shall be noted:

- Related equipment used in a verification test shall have the adequacy of its measurement precision confirmed by the implementation of regular calibration, etc.
- Verification Organizations shall create a Test Plan taking into the account the latest information
- Verification Organizations shall keep in mind that the absolute requirements for data related to verification items are accuracy and high reliability, and give considerable attention to precision control of data related to verification items from sampling and analytical procedures to the rounding up of the results without introducing any error or variation due to various factors such as the individual who conducts measurement, the sample storage condition, the reagents used, and the analytical environment