CEMS CERTIFICATION SYSTEM IN INDIA

CSE Proposal

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ABBREVIATIONS

AMS: Automated monitoring system

CAMD: Clean Air Markets Division

CEMS: Continuous emission monitoring system

CEN: European Committee for Standardization

CSA: Canadian Standards Association

CSIR-NPL: Council of Scientific and Industrial Research–National Physical Laboratory

ECPMS: Emission Collection and Monitoring Plan System

FTIR: Fourier Transform Infra-Red

MCERTS: Monitoring Certification Scheme

PESO: Petroleum and Explosive Safety Organization

QAL: Quality Assurance Level

RATA: Relative Accuracy Test Audits

SCS: Sira Certification Service

TUV: Technischer Überwachungs-Verein

UBA: Umweltbundesamt (the German Environment Agency)

UKAS: United Kingdom Accreditation Service

USEPA: United States Environmental Protection Agency

NORMATIVE REFERENCES

ISO-17025: General requirements for the competence of testing and calibration laboratories

ISO 17065: General requirements for the competence of certification body

EN 15259: Stationary source emissions requirements for the measurement sections and sites and for the measurement objective, plan and report. This standard describes how to achieve accurate and reliable results in emission testing, including in relation to sampling position.

EN 15267-1: General requirements for bodies operating product certification systems

EN 15267-2: Air quality certification of automated measuring systems—minimum requirements for product quality assurance, initial assessment and ongoing surveillance

EN 15267-3: Air quality certification of automated measuring systems—performance criteria and test procedures for automated measuring systems for monitoring emissions from stationary sources

EN 14181: Stationary source emissions—quality assurance of automated measuring systems

EN ISO 14956: Air quality evaluation of the suitability of a measurement method by comparison with a stated measurement uncertainty

1. Why is CEMS certification required in India?

Continuous Emission Monitoring System (CEMS) is a tool for accurate and credible pollution monitoring and reporting. However, the accuracy and credibility assurance comes from the quality of equipment, correct installation, proper operation and maintenance, and calibration. CEMS installed in industries generates huge quantities of data everyday but the quality of data poses a major challenge as its reliability needs to be ascertained. To this end, the roles of instrument and its calibration and certification needs to be addressed.

CEMS is a vital part of emission monitoring in developed countries such as member states of the European Union (EU), USA and Japan. It has been extensively utilized to regulate emissions of gases and particulate matter in the atmosphere for the last 25–30 years. One of the most crucial factors behind the success of CEMS in these countries is the requirement of assured systems for certification or quality assurance of devices, extensive testing and verification of devices by independent agencies, defining roles and responsibilities and guidelines. Therefore, CEMS data in these countries is used for regulatory and compliance purposes.

In India, on the other hand, there is no CEMS certification system. The National Physical Laboratory (NPL) was appointed by the Ministry of Environment, Forest and Climate Change (MOEF&CC) as a certification body in August 2019, but the certification system is still in the developing phase. In 2014, the Central Pollution Control Board (CPCB) mandated installation of CEMS in 17 categories of industries and common pollution control facilities. In 2016, CPCB put out technical guidelines that elaborated technology selection for various parameters, site requirement and preparation for mounting; it referred to EU practices for calibration and performance evaluation. However, no system is in place to verify CEMS instruments on the basis of which certification will be done. Other than certification, no system in place to verify installation and calibration/performance evaluation and the quality or credibility of data. Currently, industry is buying CEMS from different vendors and installing it as per the CPCB guidelines,

There is a big question mark over the quality of calibration and performance evaluation exercise by industry or vendors. Therefore, a certification system is required in the country for a proper mechanism from technology selection to

installation and calibration or performance evaluation. This will also ensure the technology to work at national and international standards.

Calibration and performance evaluation is a technical job that requires both technical manpower and sophisticated instruments along with accreditation of the laboratory. Currently, there is no system in place; no vendors nor the industry carries out evaluation exercises and data credibility remains a big issue. There should be a protocol for laboratories to follow for data quality, with a well-structured certification system in the country. Such a system will open avenues for laboratories to upscale and create jobs in the market.

Manufacturers are also coming up with different combinations to measure different parameters that do not fall under the technology guidelines suggested by CPCB. To obtain reliable CEMS data from the industry, it is essential that the CEMS should be capable of accurately measuring respective parameters (composition of the flue gas), must work only on approved technology principles, must be tested and certified by a competent authority, and must have inbuilt zero and span calibration for quality assurance. In India, however, legacy CEMS installation does not comply with product certification nor with the auto calibration, zero check and span check and hence not meet the drift rates and linearity etc. Old analysers installed in industries do not have the facility for zero and span check and are thus not complying with CPCB directions. New CEMS analysers being pushed by vendors are sensor-based technologies that are not the approved technology by CPCB. Local vendors in India are currently misguiding and selling their sensor-based CEMS instruments to industries. To address this, there is a need to create local certification laboratories that comply with the requirements of ISO-17025 and benchmark with EU EN 15267 (discussed in detail in Chapter 2.1) testing procedure.

CEMS CERTIFICATION—NEED OF THE HOUR

- Ensures that the product manufactured is reliable and works as per the relevant national or international standards.
- As certification is carried out by a competent authority, it will approve and ensure the quality and functioning of the product.
- Legacy installation: Old analysers installed do not comply with product certification or with auto calibration and/or zero or span checks. They do not meet the drift rates, linearity, etc. either. A certification system will help verify the product as per the guidelines.
- Ensures CEMS data quality and makes use of CEMS for legal and compliance purposes.
- Certifies CEMS as per India's climatic conditions.

For quality assurance, until an indigenous certification system is in place, CPCB has given direction in their guidelines that CEMS will have to be tested for suitability by use of the procedure equivalent to the United States Environmental Protection Agency (USEPA) and European standards and recommends use of TUV-, MCERTS- and USEPA-certified and approved analysers. Other than this, CPCB also recommends following EN 15259 for selection of a measuring point and/or port locations on stack as sampling location has a major impact on the representativeness and accuracy of sample collected. Suitable measurement site and measurement section are necessary to obtain reliable and comparable emission measurements results.

Most of the CEMS instruments used are imported and come with certification from agencies such as USEPA, TUV or MCERTS. The certificate issued to instruments is based on environmental and climatic conditions of the certificate-issuing country. There is high variability in the temperature and humidity in India and the countries certifying CEMS, which affects the quality of measurements by instruments operating for long periods of time in Indian conditions. Further, there is a difference in the operation and maintenance methods and modalities too. There is currently no certification system available for CEMS equipment with Indian climatic conditions taken into consideration.

Countries such as China and Indonesia have developed their standards based on European standards. MOEF&CC has designated CSIR-NPL (Council of Scientific and Industrial Research-National Physical Laboratory) as the national certification agency for instruments and equipment for monitoring emissions and ambient air in India over three years ago, but the certification system is still in the developing phase. It will take at least another one to two years to become active. Until the local certification is created, an agency for validation of international certification such as Quality Assurance Level 1 (QAL 1) should be verified by a government agency. For example, the Government of India's Petroleum and Explosives Safety Organization (PESO) Chief Controller of Explosives (CCOE) issues approvals to products for hazardous environments that conform to Indian standards. ATEX (Atmosphere Explosives) certification is given to equipment that has gone through rigorous testing outlines by European Union directives. Products that are ATEX-compliant have been proven safe to use in specific environments with explosive atmospheres, according to the zone/s they are certified to be used in. Similarly, IECEx (International Electrotechnical Commission Explosive) is a global certification scheme for equipment used in potentially explosive atmospheres such as petrol stations, oil refineries etc. Even after the European and global ATEX and IECEx certifications of product, PESO India validates their certificates with Indian standards.

CEMS has been in India for more than seven years. However, the data cannot be used for legal and compliance purposes. The reason it is not considered admissible evidence under the Air Act 1981. Once there is a certified system in place, the Air Act 1981 can be amended to allow use of CEMS data for legal and compliance purposes.

The CPCB CEMS technical guidelines focus on technology selection, installation and calibration but it will not serve the purpose of getting credible CEMS data until CEMS installed in industries is certified by concerned authorities. Certified CEMS confirms that it can work as per the laid-down standards and can perform all the tests (such as span and zero test) as specified in CPCB guidelines. Hence, CEMS certification is the initial and key requirement for ensuring CEMS data quality. The NPL has appointed as a certified body for CEMS, but it's been more than two years and nothing has been come of it.

The best way to develop CEMS certification is to look at how systems have been set up in countries in Europe and USA. Accordingly, India needs to develop a certification and quality assurance system to check the performance of CEMS so that CEMS data can be used for legal and compliance purposes.

This report is an attempt in this direction. It identifies systems available in countries such as USA and Europe and recommends a similar system for India.

2. CEMS certification protocol in Europe and USA

The certification process assures recognition of quality and accuracy of equipment by relevant stakeholders. Certification ensures that the manufactured instruments are reliable and work as per the standards laid and will produce reliable data. Certification is carried out by a competent authority or agency authorized to evaluate and approve the quality and functioning of the product as per the relevant national or international standards. Once the device passes all the tests specified in such standards, it gets certified by a competent authority. Certification gives the product recognition and quality assurance across different markets where it is recognized.

CEMS is used to collect credible and accurate data monitored at the source. This is the basis of self-monitoring and control practices such as emissions trading. Countries such as Germany, the UK and USA have well established their CEMS frameworks. Europe has a system of CEMS certification while USA has adopted a similar system of CEMS performance check during installation.

India has adopted CEMS recently but has no indigenous CEMS certification system and therefore imports CEMS equipment. The success of the CEMS initiative demands the development of an indigenous certification system that considers all the environmental and test conditions in India influencing the system and assures credible data quality for the purpose of compliance.

2.1 CEMS certification system in Europe

The European certification schemes include both type approval of the product (technology performance verified against minimum performance requirements, with product meeting a minimum set of regulatory, technical and safety requirements for a particular type of process), and factory audits carried out regularly to ensure that the product being made and sold is still identical to that which was tested.[1] The certification is often regulation-driven.

In Europe CEMS is known as automated monitoring system (AMS hereafter written as CEMS). European countries initially had their individual set of standards to which devices had to be accredited. This was unfavourable to all parties involved in international trading as it required a fresh accreditation each time a product met a new market. It also made international trade difficult. To solve this problem,

a single accreditation system that would be considered acceptable to all countries and effective in terms of quality across Europe was required. Hence, the standard BS EN 15267 (standards for CEMS certification, *see Box 1: EN 15267—Type approval and certification of AMS*) was structured to certify CEMS devices and to give them international recognition.

UK's MCERTS certification system

The UK's Environment Agency (EA) launched the Monitoring Certification Scheme of the Environment Agency (MCERTS) in 1998 to improve the quality and consistency of environmental data as the foundation for regulatory monitoring and to deliver quality environmental measurements. The MCERTS product certification scheme provides the certification of products according to the Environment Agency's performance standards, based on relevant CEN (European Committee for Standardization), ISO and national standards. The agency has appointed Sira Certification Service (SCS) under the Canadian Standards Association (CSA) Group Testing UK Ltd as a certification body to operate the MCERTS scheme in the UK. The purpose of the scheme is to ensure that operators, regulators and the public can have confidence in the data reported, for the purpose of compliance, on both industrial emissions and the environment receiving those emissions.

The CSA Group is accredited by the United Kingdom Accreditation Service (UKAS) according to the ISO/IEC 17000 series of conformity assessment standards. All devices testing under MCERTs is carried out by laboratories or agencies accredited to ISO 17025 (accreditation for testing and calibration). CSA examines the results of the laboratory tests and field tests using a group of independent experts (Certification Committee). The requirements for certification of CEMS under MCERTS are covered in BS EN 15267-1, the requirements for the manufacturer's quality management system for manufacturing and design control are covered in BS EN 15267-2. BS EN 15267-3 covers the performance testing processes to be carried out in laboratories and field tests.

TUV: Germany—UBA-type approval system

The *Umweltbundesamt* (UBA) (the German Federal Environment Agency) approval system for CEMS, launched in 1975, verifies the performance of the product and checks that the data provided by the monitoring system meets the minimum requirements defined to be in line with the German regulations. In Germany, TÜV (*Technischer Überwachungs-Verein*, or Technical Inspection Association) is authorized by UBA to carry out the testing and certification of CEMS devices. The laboratories entitled by UBA to perform the performance tests must be accredited by the National Accreditation Institute.

Table 1: European systems for CEMS certification or type approval[2]

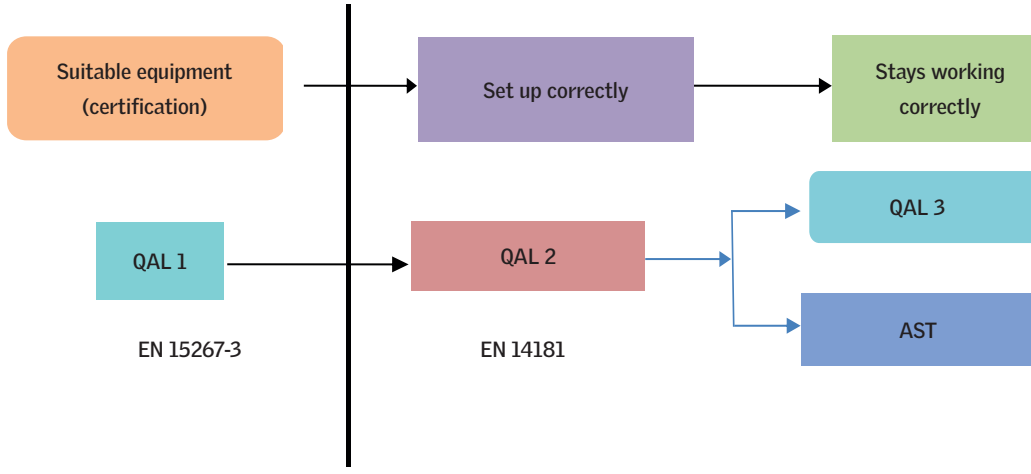
Country	Certification scheme	Starting date	Features
Germany	UBA (Umweltbundesamt)-type approval scheme (TUV)	1975	· Verifies the performance of the device, i.e. its suitability to meet minimum requirements defined in line with the German and EU regulations. · The scheme is also referred to as the TUV scheme since most testing is performed by TUV; however, testing may also be performed by other test institutes across Europe.
UK	The Environment Agency of England's (EA's) Monitoring Certification Scheme (MCERTS)	1998	· Verifies the compliance of the CEMS with European Norms (EN) performance standards and audits the production process of the CEMS. · The scheme is administered by Sira and an independent certification body on behalf of the EA. · The scheme initially focused only on the UK but since 2003, when it adopted EN standards as the basis for certification, is now applicable to other EU countries.
European Union	CEN (European Committee for Standardization) standard: Certification scheme	2004	· CEMS are certified according to EN 15267-3 and these are mandatory in all processes requiring installation of CEMS in all EU member states. · MCERTS and UBA (TUV) are the two European certification schemes, either of which may be applied in other EU countries since they use the same performance standards (EN 15267-3).

Source: L. Sophie et al.., JRC Scientific and Technical Reports, 2007, Environmental Technologies Verification Systems, p. 57.

European Committee for Standardization (CEN): The aligned scheme between the UK and Germany has become the basis for European standards for the testing and approval of analysers for stack emissions. A specific working group (WG22, Technical committee 264) was established within CEN (the European committee for standardization) aiming for mutual acceptance of certification procedures for CEMS within the EU. Further, instead of proposing new standards, these schemes promote the mutual acceptance of existing standards.

CEN Technical Committee (CEN-TC 264) produced the EN-14181 stationary source emissions for quality assurance of CEMS in 2004. It includes three quality assurance levels (QAL) QAL 1, QAL 2, QAL 3 and Annual Surveillance Test (AST)

Figure 1: Quality Assurance Levels



for CEMS. Quality assurance is closely connected to EU standards EN 15267 (QAL 1) and EN 14181. The two key issues of quality and fitness, and the calibration of the system has led the EU to develop the standard EN-15267 as the basis for a pan European CEMS type approval scheme (QAL 1 approval) and EN14181 as a basis for the selection, quality assurance and calibration of CEMS.

2.1.1 Certification process in Europe

CEMS devices are certified only if certification is performed according to standard BS EN 15267- 1. The manufacturer adheres to the requirements of BS EN 15267-2 and the measuring system has been tested as per the standards mentioned in BS EN 15267-3 (see *Box 1: EN 15267—Type approval and certification of AMS*).

Table 2: Overview of Quality Assurance Levels

	QAL 1	QAL 2	QAL 3	AST
When?	Product certification before installation of CEMS	Installation and calibration	During operation	Starting one year after QAL 2
Who	Manufacturer/ operator	Accredited laboratory/ manufacturer	Operator	Accredited laboratory
Frequency	Once	At least every five years	Continuously	Annually
Relevant standards	EN-14181, EN ISO 14956, EN 15267-3	EN-14181, EN 15259	EN-14181	EN-14181, EN 15259

BOX 1: EN 15267—TYPE APPROVAL AND CERTIFICATION OF AMS

Certification for CEMS is accomplished on the basis of EN 15267 Part 1–3 and is divided into the following work procedures:

BS EN 15267: Part 1—General principles
This specifies the general principles for product certification of CEMS for monitoring emissions from stationary sources and ambient air quality. The product certification comprises the sequential steps of performance testing of a CEMS, initial assessment of the CEMS manufacturer's quality, certification and surveillance. Part 1 outlines the roles of all parties required to participate in the accreditation process, including the manufacturer, testing laboratory where devices will be evaluated, competent authorities, and certification bodies, together referred to as "relevant bodies". Following certification, the relevant agencies ensure that ongoing manufacturing and performance of certified CEMS are monitored on a regular basis.

BS EN 15267: Part 2—Quality management (QM) and audit scope
This standard specifies the requirements for quality management system of the manufacturer and post certification surveillance for manufacturing process. Since CEMS may undergo design changes during product life, it is important to ensure the changes don't alter its performance beyond standards. These design changes may be of **type 0** (changes that have no measurable influence on the performance of the CEMS), type 1 (changes that have a possible influence, but which can be proved by a test that the influence is not significant) and **type 2** (changes that have significant influence to the CEMS). Additional tests are always required if **type 2** changes are implemented. The manufacturer must keep records and evaluations on any modification of the certified CEMS.

In order to control the changes, EN-15267-2 specifies the requirement of manufacturer's quality management system, initial assessment of manufacturer's production control and continuous surveillance of the effect of CEMS' design changes on its performance.

BS EN 15267: Part 3—Performance standards and test procedures
This European Standard defines performance standards and test procedures for CEMS that measure gases, particulate matter and flow of waste gases from stationary sources. It provides detailed procedures that cover QAL 1 requirements of the quality assurance standard EN 14181. These procedures are a combination of laboratory tests and field tests. Laboratory tests last four to eight weeks while field tests are carried out for a minimum duration of three months.

QAL 1—Measuring procedure check

Quality assurance level 1 (QAL 1) procedure is used to demonstrate the potential suitability of the CEMS based upon a set of laboratory test, field test and auditing the manufacturer's quality management system (as set out in EN 15267-3) before it is installed. These testing must be carried out by an approved laboratory accredited to EN ISO/IEC 17025 (such as TÜV or Sira/CSA) by a national body. The instrument must be appropriately tested in accordance with EN 15267-3 standards.

A QAL 1 certificate is granted by SIRA (for MCERTS in the UK) and/or UBA/TÜV in Germany. The suitability evaluation of CEMS and its measuring procedures are described in EN ISO 14956 which subsequently became EN 15267-1.

EN-14181 specifies procedures for establishing quality assurance levels QAL 2, QAL 3 and AST for a CEMS installed on industrial plants for the determination of the flue gas components and other flue gas parameters.

After certification of CEMS device it is important to properly install, calibrate and do the functional testing of CEMS in order to get reliable data which is covered under QAL 2.

QAL 2—Proper installation, functional testing and calibration

Quality assurance level 2 (QAL 2) procedure comprises post-certification processes such as installation, functional test(s), parallel measurements with the Standard Reference Method (SRM) for each parameter, data evaluation etc. QAL 2 tests have to be performed on suitable CEMS that have passed QAL 1 testing and been correctly installed and commissioned. This stage of quality assurance specifies the procedures to ensure that the CEMS has been correctly installed, calibrated by comparison measurement, and independently verified.

The correct positioning of the CEMS on stack is of utmost importance to obtain representative values for the concentration and flue gas flow. The selection of measurement site and measurement section for CEMS installation is described in EN 15259. All measurements, calibrations and relevant equipment assessments for CEMS to be performed by laboratories accredited in accordance with EN ISO/IEC 17025. After installation, the calibration function is established from the results of a number of parallel measurements performed with a standard reference method (SRM).

Typically, QAL 2 tests are undertaken every five years or more frequently if required by legislation or the competent authority. Further, a QAL 2 procedure is performed if there are any major changes made to the plant or process being measured that might affect the emissions or the ability of the CEMS to measure a parameter, an operator must have the CEMS evaluated and conduct another QAL 2 assessment. A major change means for example a change in fuel type, an alteration to combustion or the incarceration process or anything that might radically change the emissions.

QAL 3—Ongoing device check during operation

After acceptance of QAL 1 certification and QAL 2 calibration of CEMS, QAL 3 procedure is described as ongoing monitoring and quality control of CEMS. Its objective is to demonstrate that CEMS is stable and does not drift significantly and it is therefore under control during its operations. With QAL 3 monitoring, industrial plants are able to spot any drift in the zero/span levels and point out if the system has any needs for maintenance. In QAL 3, use of control charts like Shewart and CUSUM (or cumulative sum control chart) will provide an ongoing analysis of instrument zero and span calibration checks to ensure correct instrument operation and to ensure that any drift of measurement is within the specified drift allowable for the instrument.

Process operators and CEM owners are responsible for carrying out the QAL 3 procedures. Usually, QAL 3 is carried out by feeding the zero gas (typically nitrogen) and span gas through the entire emissions monitoring system and monitoring the measuring results of zero and the span gas. This gives us valid and reliable information on the drift and precision and confirms proper operation of the CEMS.

AST—Annual Surveillance Test

The annual surveillance test checks the variability and the validity of the calibration function annually. Its purpose is for the CEMS to demonstrate:

- that it functions correctly and its performance remains valid, and
- that its calibration function and variability remain as previously determined.

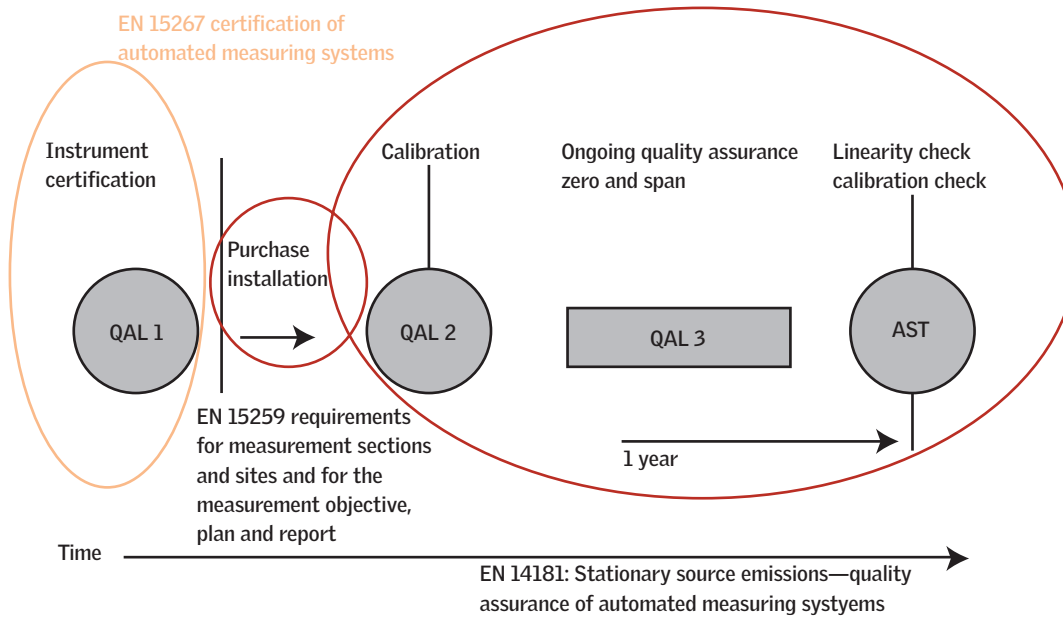
This procedure is similar to that of QAL 2. AST is conducted to check the calibration function of CEMS by functionality checks such as check for linearity, interferences and zero and span drift. The AST check of the validity of the calibration function has to involve at least five parallel measurements between the CEMS and SRM.

How the process works in the UK

SCS (Sira Certification Service) operates the MCERTS scheme on behalf of the Environment Agency. SCS is accredited for these activities by the United Kingdom Accreditation Service (UKAS) and is appointed as a "notified body" by the UK Government under European Directives.

Application for certification: The application pack is available from SCS (Sira Certification Service), which includes information on the certification process, including an application form and check sheet. The applicant will need to submit

Figure 2: Overview of certification and quality assurance system



a completed application form to proceed. And applications are accepted from product manufacturers. The applicant specifies the measurement ranges for which the product is to be certified, in line with the performance standards published by the Environment Agency. The applicant is required to provide evidence that an appropriate quality management system controls manufacture of the product. If the manufacturer has an ISO 9001 certificate from an accredited certification body, details should be supplied with the application. Once an application form is received, SCS will supply a quotation for the cost of certification which excludes the cost of testing.

Certification testing committee: The certification committee comprises independent experts that offer technical support for certification projects. If existing test data is available, it is advisable for a certification committee meeting to be held. The data should be sent through to SCS at least two weeks prior to the meeting to enable the certification committee time to review it.

At the meeting a test programme is generated by working through the performance standard, and the committee decides the plan for the test.

Testing: Existing test data may consist of third-party test reports, or in-house test data. The applicant can also submit existing test reports, which normally have to be from a suitably accredited laboratory.

If the product clearly fails a performance test, the programme will be halted and the applicant asked to comment. The instrument may need to be removed and/or the test period may require to be extended to compensate. The applicant can comment on the reports from both the laboratory and field tests before the Certification Committee considers them. The duration of this stage of the certification process will depend on the acceptability of existing test data and the availability of the laboratory to conduct testing.

Laboratory test: The applicant will place an order for the test work direct with the test laboratory and will supply the product direct. The product will be operated according to its instruction manual. If the product should fail any performance test, the programme is halted and the applicant asked to comment.

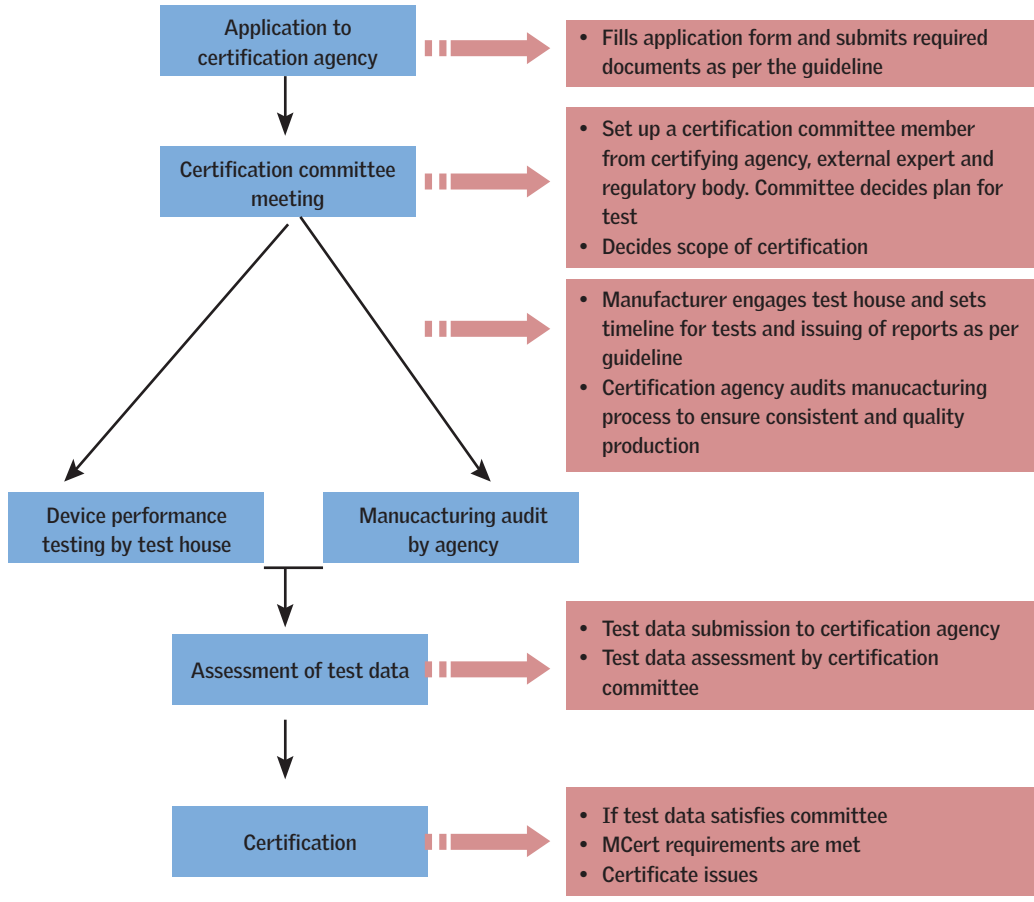
Field test: The applicant will place an order for the test work direct with the test laboratory. Alternatively, an existing installation could be used if acceptable to the Certification Committee. The requirements for the field trial is at least three months on site

Initial audit of the manufacturing process: The MCERTS product certification scheme requires that an audit of the manufacturing process is undertaken by the certification body to confirm that the manufacturer has implemented procedures to ensure manufacturing reproducibility and control of any design changes so that they do not degrade performance below the MCERTS standard. The audit is conducted according to EN15267-2. SCS conducts an initial audit of the manufacturing process prior to the certification of the product. Certification cannot be granted until the initial audit has been successfully completed.

Assessment of test data: The laboratory and field test data is reviewed by the Certification Committee and assessed against the MCERTS performance standard. The estimated time taken to assess test reports and make the certification decision will be set out in the quotation and will vary depending on the complexity of the product certification.

Granting of a certificate: SCS, with technical support from the Certification Committee, will recommend whether a certificate should after assessment of the

Figure 3: CEMS certification system in Europe



test data and successful completion of an initial audit be granted. The Certification Committee will specify the wording on the certificate and any special conditions.

2.2 CEMS certification system in USA

In USA, the United States Environmental Protection Agency's (USEPA's) Clean Air Markets Division (CAMD)[3] runs programmes to reduce air pollution. CAMD regulates industries and other (emission) sources and follows the monitoring regulations Volume 40 of the Code of Federal Regulations (CFR) Part 75 which requires continuous monitoring and reporting. The title 40 of USEPA's code federal regulation deals with environment regulation.

Part 75 consists of eight subparts A–H, followed by a series of 10 Appendices, A–J. Subpart C of Part 75, 40 CFR, describes the process for certification and re-certification of CEMS, its quality assurance and quality control (QA/QC)

requirements. Its Appendix A[4] describes CEMS installation and certification test procedures and provides performance specifications for the CEMS and explains how to set the span and range of CEMS. Appendix B describes the required ongoing CEMS quality assurance tests and procedures for CEMS and includes rules for data validation.[5]

USA does not have a CEMS device certification process similar to Europe's. It has a device check system for performance assurance during installation at the site. It is the responsibility of owner or operator to get the CEMS device certified. The US approach to the adoption of CEMS on industrial stacks is to implement quality control to ensure the results of the CEMS can be used for legal compliance.

USEPA's emission monitoring and reporting requirements

Register unit with CAMD: In the US, each industry must be registered first with EPA's Clean Air Market Division (CAMD) before reporting any emission data. Registration can be done electronically through the CAMD Business System.

Select a monitoring methodology: After registration, select monitoring methods depending on unit classification (coal-fired unit, non-peaking oil fired-gas fired, oil-fired or gas-fired peaking unit, combust low-sulphur fuel). Part 75 provides several monitoring options that depend upon the unit classification.

Install and certify CEMS: Install CEMS. Before operating CEMS, it must be approved through a certification process. The selected monitoring methodology for each unit must be approved by USEPA through a certification process. Once the methodology has been approved and the required monitoring systems are certified, the recording and reporting of emissions data begins.

Monitor emission and use missing data substitution: Monitoring and reporting of emissions begins as soon as certification testing is successfully complete. Emissions data has to be reported for every hour that an affected unit is operating, including periods of start-up, shutdown and malfunction. If one of the required monitoring systems is not working or is out of control (e.g. if it fails one of its required quality assurance tests), data from an approved backup monitor or from an EPA reference method may be reported. If quality-assured data from a back-up monitor or reference method are not available, Part 75 missing data substitution procedures must be used to estimate emissions.

Conduct quality assurance/quality control procedures: After certification, periodic performance evaluations of all monitoring systems must be conducted to ensure the continued accuracy of the emissions data. CEMS are required to undergo periodic quality-assurance testing to ensure that the systems continue to provide accurate data (see *Table 3: Ongoing quality assurance test requirements*). Table 3 shows that routine QA testing of CEMS is required at three basic frequencies: daily, quarterly and monthly.

Calibration error checks of all monitors and interference checks of flow monitors are required daily. Linearity checks of gas monitors, flow-to-load ratio tests, and leak checks of DP-type flow monitors are required quarterly. RATAs are required either semiannually or annually, depending on the results of test.

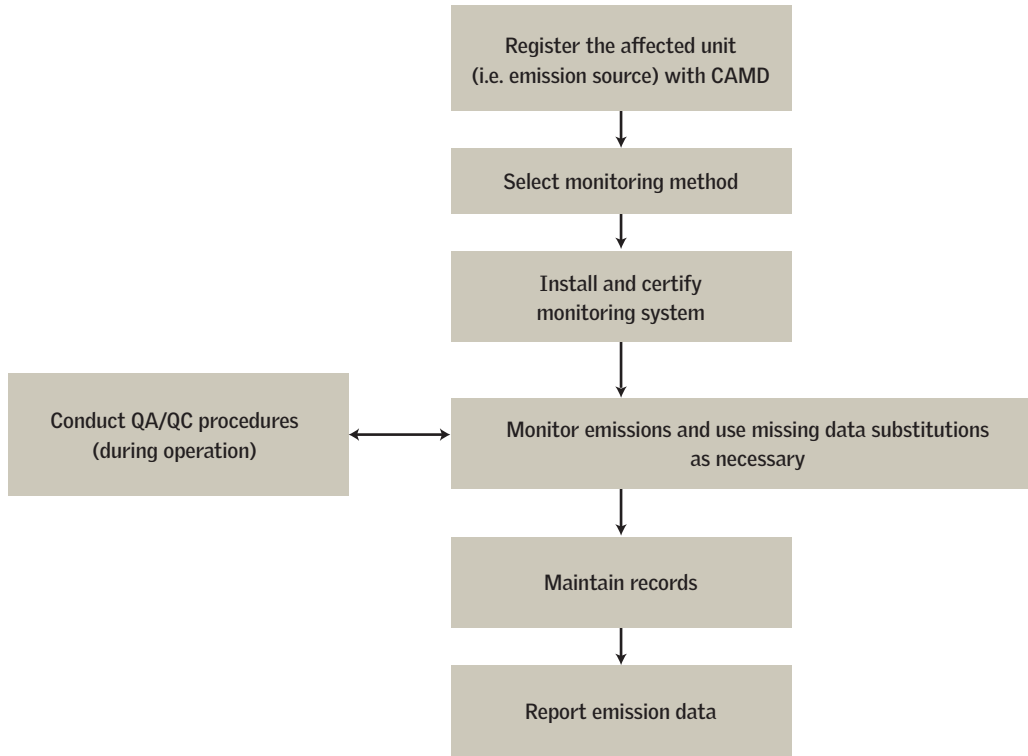
Table 3: Ongoing quality assurance test requirements[6]

Type of test	On these CEMS	Frequency
Calibration error test	Gas and flow monitors	Daily
Interference check	Flow monitors	Daily
Linearity check	Gas monitors	Quarterly
Flow-to-load ratio	Flow monitors	Quarterly
Leak check	Differential pressure-type flow monitors	Quarterly
RATA and bias test	Gas and flow monitors	Semiannual or annual
Flowmeter accuracy test	Flowmeter accuracy test	Once every four "fuel flowmeter QA operating quarters"
Primary element visual inspection	Orifice, nozzle and venturi fuel flowmeters	Once every three years

Maintain records: Data recorded during monitoring are kept for a minimum of three years (electronically), using a data acquisition and handling system (DAHS), although some monitoring plan information and quality assurance (QA) test support data is kept in hard copy. The DAHS records all data from the monitoring systems translates it into the required units of measure and stores the data. When emissions data is missing, the DAHS automatically performs missing data substitution.

Report emissions: Data must be submitted electronically and for the same USEPA provides a standard electronic data reporting format that must be used and requires the use of a special software tool that performs quality control checks on the data prior to submittal.

Figure 4: Overview of Part 75 monitoring and reporting requirements



2.2.1 Certification process in USA

Data generated from CEMS cannot be reported as quality-assured until the systems pass a series of certification tests to demonstrate that they are capable of providing accurate emissions data. The overall monitoring system certification process consists of several steps, as shown in *Figure 5: CEMS certification process in USA*.

Step 1—Submit initial monitoring plan

The applicant submits an initial monitoring plan to USEPA and the state at least 21 days prior to the start of the certification testing of the monitoring systems. The plan must contain sufficient information about the monitoring systems to demonstrate that all of the regulated emissions from the unit will be measured and reported. The monitoring plan consists of two parts: electronic and hard copy. The electronic copy includes information such as type of unit, operating range of unit (in terms of megawatts or steam load), type of fuel combusted and emission

control system installed, stack configuration information, and CEMS information, e.g. the pollutant or parameter monitored by the system, the make, model and serial number of each analyser, and analyser span and range information.

The source/applicant must use the Emissions Collection and Monitoring Plan System (ECMPS) Client Tool to evaluate the electronic monitoring plan before submitting it to CAMD. Once the electronic monitoring plan has been received and added to the CAMD database, an evaluation report is sent to the source, with copies to the State and EPA Region. The State and EPA Regional Offices then review the hard copy piece of the monitoring plan, together with the feedback from CAMD on the electronic portion. The reviewing agencies communicate their findings to the source and help resolve any issues or deficiencies identified during the review process.

Step 2—Submit certification test notice
Certification test notices must be sent to CAMD, to the EPA Regional Office and to the appropriate state or local air agency, at least 21 days prior to conducting the required certification testing.

Step 3—Conduct certification testing
The certification testing is carried as per the procedures specified in 40 CFR 75 Section 6 of Appendix A.

The tests include:

- Seven days calibration error tests: Evaluates the accuracy and stability of a gas or flow monitor's calibration over an extended period of unit operation.

- Linearity check: Determines whether the response of a gas monitor is linear across its range.

- RATA (Relative Accuracy Test Audits): Compares emissions data recorded by a CEMS to data collected concurrently with an EPA emission test method.

- Bias test: Determines whether a monitoring system is biased low with respect to the reference method, based on the RATA results. If a low bias is found, a bias adjustment factor (BAF) must be calculated and applied to the subsequent hourly emissions data. This test is required only for SO_2, NOx, and flow monitoring systems.

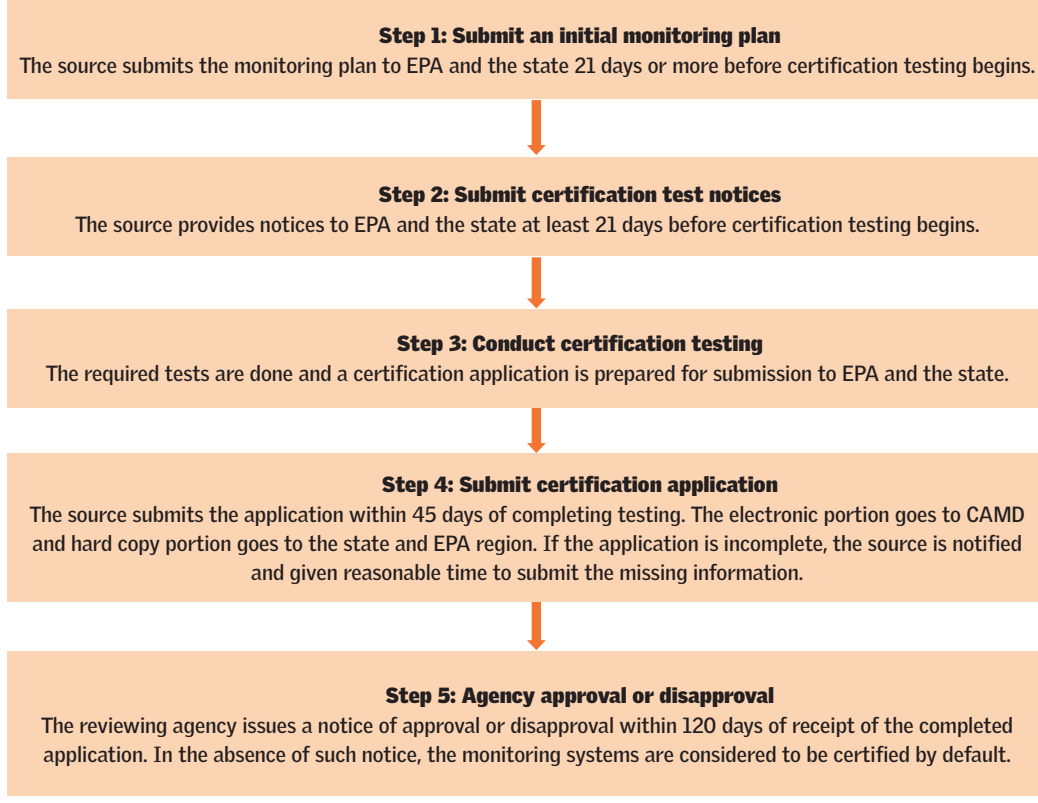
- Cycle time test: Determines whether a gas monitoring system is capable of completing at least one cycle of sampling, analysing and data recording every 15 minutes.
- Flow meter accuracy test: Demonstrates that a fuel flowmeter can accurately measure the fuel flow rate over the normal operating range of the unit.

- Four load NOx emission testing and heat input measurement: Provides data for a correlation curve of NOx emission rate versus heat input rate for an Appendix E peaking unit.

- NOx emission testing at one or more unit loads: Determines fuel- and unit-specific NOx emission factors for LME (low mass emission) units.

- DAHS verification: Ensures that all emissions calculations are being performed correctly and that the missing data routines are being applied properly.

Figure 5: CEMS certification process in USA



Step 4: Submit certification application
After completing the required certification testing, the application for certification with updated monitoring plan and the results of certification testing sent to CAMD, using ECMPS client tool and the documents that are incompatible to electronic tools such as the hard copy piece of the application consists of a cover letter from the Designated Representative, the hard copy certification test report, and any changes made to the hard copy portion of the monitoring plan as a result of the testing goes as hard copy to state or local agency and USEPA Regional office within 45 days.

If the certification application is incomplete or is missing any information, the reviewing agencies will notify the source, and a reasonable amount of time will be given to submit the required information. A 120-day review period begins when a complete certification application has been received. An appropriate reviewing agency issue a notice of approval or disapproval in 120 days. If no such notice is issued, the device is deemed certified by default.

Step 5: Receive agency approval or disapproval
The reviewing agency will issue a notice of approval/disapproval of the certification application within 120 days of receiving the complete application. If no such notice is issued, the device is deemed certified by default.

3. CEMS certification for India—CSE proposal

Developed countries that have adopted CEMS have also set up systems for device quality assurance or performance check. The above-discussed system in the US and Europe has well-drafted guidelines and working methods that ensure recognition of the certified product.

This report highlights European and US quality assurance systems for CEMS. Europe has a well-established certification and quality assurance system while USA has devices performance check systems during installation. By reviewing both the quality assurance system in Europe and the US, a system similar to the European system for India, which involves both certification of product and quality assurance, is recommended.

CSE suggests a process similar to Europe's as it includes as a first and vital step the certification of product, which is very important for India as several local vendors misguide and sell their products to industries, results in generation of poor-quality data. In the US, on the other hand, there is no particular system for CEMS product certification—it has a device performance check system after installation.

In the USEPA quality assurance system, CEMS have to be first installed, and then they conduct a series of tests such as Relative Accuracy Test Audits (RATA) to check the performance of device, which is an expensive process. In some cases, the instrument installed may not be fit for the purpose or has failed in performance check tests and then whole process needs to be repeated. And in these cases, cost of installation and certification overruns the cost of instrument. In the European system, on the other hand, the CEMS is first certified and then installed and calibrated, which saves money and time as compared with the USEPA system as there is less chance of device unsuitability or malfunction since the CEMS is already certified.

In August 2019, MOEF&CC issued a notification under Section 3 of the Environment (Protection) Act, 1986 (29 of 1986), in which the Central government designates the Council of Scientific and Industrial Research-National Physical Laboratory (CSIR-NPL) as the national certification agency for certifying instruments and equipment for monitoring emission and ambient air in India. CSIR-NPL will also develop infrastructure, management systems, and testing and certification

Table 4: Certification system in India, USA and Europe

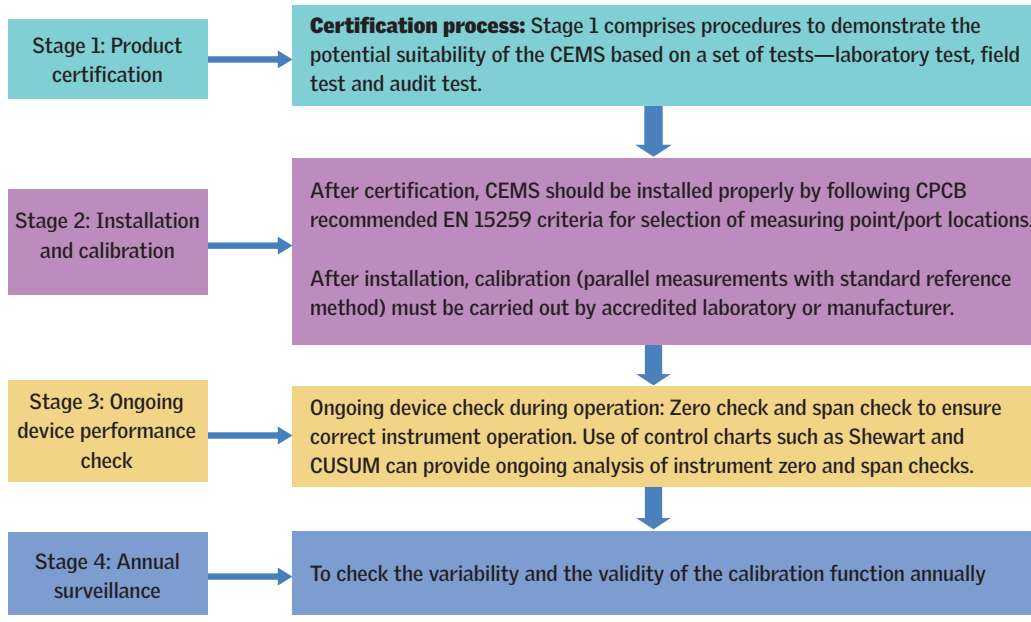
S. no.	Gaps	India	UK	USA
1	Specific guidelines for CEMS testing and calibration laboratories	Nil	Yes	Yes
2	Suitability of CEMS	Nil	QAL 1 EN14181	EPA
3	Certifying body for CEMS device	NPL, but certification system is in developing phase	CSA	

facilities conforming to international standards like ISO 17605 and ISO 17025 for both continuous ambient air quality monitoring stations (CAQMS) and continuous emission monitoring systems (CEMS). CSIR-NPL shall also be responsible for the preparation of all documentation and protocol for measurements in consultation with CPCB.

CSIR-NPL is the National Metrology Institute (NMI) of India. It is a member of the Bureau International des Poids et Mesures (BIPM) and a signatory to the International Committee for Weights and Measures-Mutual Recognition Arrangement (CIPM-MRA). Since it is a signatory to CIPM-MRA, the certificates issued by CSIR-NPL are accepted worldwide.

CSE suggests a process in line with the European certification and quality assurance system (see *Figure 6: Proposed quality assurance process to ensure CEMS data credibility*). India should develop a well-framed process for CEMS certification and quality assurance. It needs to initially focus on **product certification**, which involves the process of getting the CEMS device certified. Certification of CEMS will be done based upon the results of tests such as field tests, laboratory tests and audit tests.

Figure 6: Proposed quality assurance process to ensure CEMS data credibility

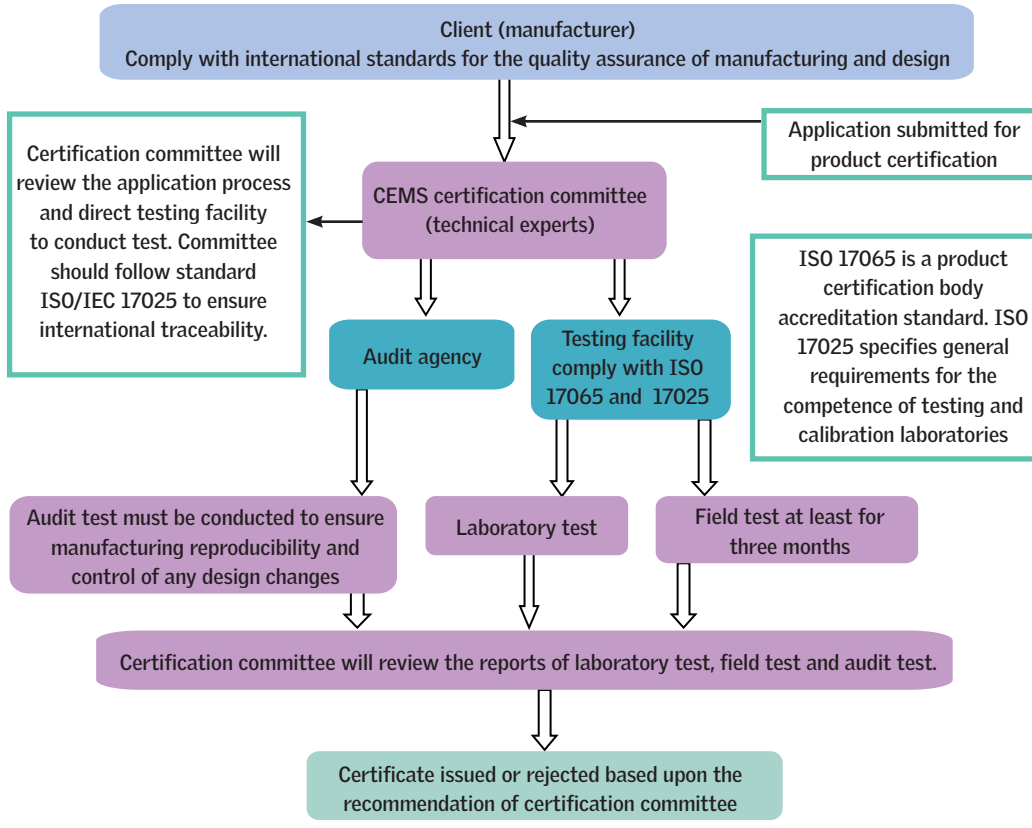


3.1 Certification process

For certifying any CEMS device, a **certification committee** under the supervision of which all the certification processes will occur is required. The certification committee must comprise independent experts who offer technical support for certification projects. The certification committee will be required to obtain international accreditation and follow established standards such as ISO/IEC 17025 to ensure international traceability (see *Figure 7: Proposed CEMS certification process*).

To perform the tests directed by the certification committee, there must be a **testing facility**. Like MCERTS has entitled five accredited labs—two UK labs (NPL and AEA Technology), INERIS France, TUV Germany, and CESI Italy—and UBA has entitled five accredited labs—four TUV labs and one Regional Government Laboratory. Similarly, NPL should also entitle some laboratories to perform the performance test, which must have accreditation by an authorized accredited body. The testing facility must comply with the requirements of ISO 17065 and ISO 17025 (ISO 17065 is a product certification body Accreditation standard, a requirement for bodies, certifying products, processes and services; ISO 17025 specifies general requirements for the competence of testing and calibration laboratories). The facility should be equipped and capable of testing and calibration extractive, in situ, and cross-stack measurement to allow more

Figure 7: Proposed CEMS certification process



than one system to test at a time. The testing facility will be capable to perform two identical tests, in the laboratory and in the field. The testing facility will be capable of conducting three months' field testing on-site as per the requirement of international norms. To perform the tasks related to CEMS, a laboratory needs to be equipped with basic infrastructure and skilled manpower (see *Box 2: Equipment required for laboratory test*).

There is also a need of performance standards to be developed for certification against which the CEMS will be tested. For instance, standards for different tests can be developed in line with what exists in Europe. These performance standards have been well established for decades in Europe and are followed in many countries. It is also important to ensure that changes in environmental conditions will not have a significant influence on the test performance characteristics. After performing the tests, the testing facility needs to prepare a test report and submit it to the certification committee for its review.

BOX 2: EQUIPMENT REQUIRED FOR LABORATORY TEST

1. Climatic chamber large enough to test two whole analyser cabinets;
2. Controlled transformer to examine the influence of power voltage fluctuations;
3. Vibration simulations stand;
4. Data collecting system;
5. **Requirement for testing gaseous CEMS:** Different calibration and test gas cylinders/ bottles, system for production of test gas mixtures with precise mass flow controller, sample gas pressure and flow measuring unit; and
6. **Requirement for testing PM CEMS:** Dust emissions simulation facility.

Equipment required for field test

1. Component specific equipment for Stage 2 test;
2. Equipment for lack of fit test (for example: mass flow controller, gray filter for dust etc.); and
3. Data collecting system.

Skilled manpower requirement: The laboratory must have skilled manpower with practice in CEMS calibration and maintenance.

Certification requirement: For recognition and traceability, the laboratory needs relevant certification. For international accreditation, the laboratory may need ISO 17025 certification.

Aside from the certification committee, calibration and testing facility, there should be an **audit team** that will undertake audit of the manufacturing process to confirm that the manufacturer has implemented procedures to ensure manufacturing reproducibility and control of any design changes so that they do not degrade performance below the standards. And certificate must not be awarded without conducting audit of the facility.

The audit team and testing team submit the respective reports to the certification committee for review. The certification committee should evaluate all the audit reports and ensure that the product/system meets the requirements in accordance with ISO 9001, ISO 17025 and ISO 17065. Attention should be given on product specification and range of parameters as requested by manufacturer for certification and ensure that the measurement system fulfills the requirements of the guideline notified by regulatory body. The committee evaluates both the reports and issues or rejects the certificate. In case of rejection, the committee should also provide scope of improvement if required.

After certification of the product, it is also important to monitor the performance of CEMS. Currently India does not have any quality assurance system for CEMS;

there is a need to develop a comprehensive system for CEMS quality assurance so that CEMS data can be used for legal and compliance purposes. CEMS performance can be tested by conducting three stages of quality assurance steps.

After certification, **Stage 2** should involve installation and calibration of CEMS. Correct installation of CEMS is important to obtain reliable CEMS data, so the selection of measurement site and measurement section for CEMS installation should be in accordance with CPCB recommended EN 15259 standard. After installation, the calibration function should be established from the results of number of parallel measurements performed with a standard reference method (SRM). Stage 2 test should be undertaken every three years or more if required by legislation.

Stage 3 should be ongoing monitoring and quality control of CEMS to check the stability of CEMS. In this stage, industrial plants are able to spot any drift in the zero/span levels and point out if the system has any needs for maintenance. In stage 3, Shewart and CUSUM control charts can be used which will provide an ongoing analysis of instrument zero and span calibration checks to ensure correct instrument operation. Operators are responsible for carrying out stage 3 procedures. Stage 3 is carried out by feeding the zero gas (typically nitrogen) and span gas through entire emissions monitoring system and monitoring the measuring results of zero and the span gas. This gives us valid and reliable information on the drift and precision and confirms proper operation of the CEMs.

Stage 4: An annual surveillance test needs to be done to check the variability and the validity of the calibration function annually. Its purpose is to demonstrate that CEMS functions correctly and its performance remains valid. It is conducted by functionality checks such as check for linearity, interferences and zero and span drift etc. The AST check of the validity of the calibration function must involve at least five parallel measurements between the CEMS and the SRM.

References

1. L. Sophie et al., JRC Scientific and Technical Reports, 2007, Environmental Technologies Verification; https://ec.europa.eu/environment/archives/ecoinnovation2007/2nd_forum/pdf/publication.pdf (last accessed on 2 January 2022).

2. Ibid.

3. USEPA website, Clean Air Market – Emission Monitoring; https://www.epa.gov/airmarkets (last accessed on 28 December 2021).

4. https://www.epa.gov/sites/default/files/2015-05/documents/plain_english_guide_to_the_part_75_rule.pdf (last accessed on 28 December 2021).

5. Legal information Institute, 40 CFR Part 75 - Continuous Emission Monitoring https://www.law.cornell.edu/cfr/text/40/appendix-A_to_part_75 (last accessed on 28 December 2021).

6. https://www.epa.gov/sites/default/files/2015-05/documents/plain_english_guide_to_the_part_75_rule.pdf (last accessed on 28 December 2021).

Continuous Emission Monitoring System (CEMS) is an indispensable part of pollution monitoring in developed countries such as EU members, USA and Japan. It is successful in these countries because it provides assured systems required for certification and quality assurance of devices, extensive testing and verification of devices by independent agencies, and defined roles, responsibilities and guidelines. CEMS has also been extensively utilized to regulate emission of gases and particulate matter in the atmosphere for the last 25–30 years.

The Central Pollution Control Board (CPCB) mandated installation of CEMS in major industries and common pollution control facilities in 2014. Implementation of this initiative requires well-framed certification systems, lab empanelment systems and their respective guidelines and protocols. A certification and quality assurance system similar to that in Europe and USA is required for India so that CEMS data can be used for regulatory and legal compliance purposes.

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