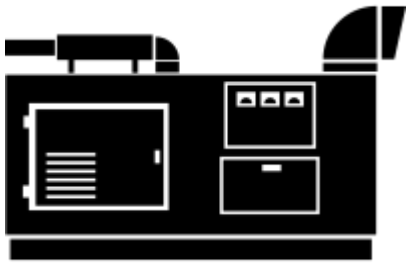
Pollution Control Series

PCLS/12/2021-22



System and Procedure

For

Emission Compliance Testing of Retro-fit Emission Control Devices (RECD) For Diesel Power Generating Set Engines Up to Gross Mechanical Power 800 kW

01/02/2022

CENTRAL POLLUTION CONTROL BOARD, NEW DELHI
(Ministry of Environment, Forests and Climate Change, Govt. of India)

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FOREWARD

National Green Tribunal (NGT) , in the matter of O.A. No. 681/2018 vide order dated 6.08.2019 , had directed for reduction of Particulate Matter (PM) emitted by in-use diesel operated power generating sets. Accordingly, Central Pollution Control Board (CPCB as 'the Nodal Agency' was mandated to prepare compliance and testing procedure in this regard following which "System & Procedure for Testing of Retrofit Emission Control Devices" has been prepared.

This document has accordingly been prepared in relevant sections to comprehensively cover compliance requirements. The document is divided in two parts. Part-I deals with Certification Systems and Procedure. This part is the illustrative part and deals with regulating of the PM limits of in-use diesel operated power generating sets. Upon compliance as per the specified limits, Type Approval (TA) Certificate is to be issued by the Certification Agency (as specified in NGT notification) to an Industry/Importer/Retrofitter for its complied family / model of Genset Engine/ Retrofit Emission Control Device. After obtaining TA, the manufacturer/importer shall obtain Conformity of Production Certificate (CoP) during every CoP year (1st July of current year to 30th June of the subsequent year).

Part-II of the document deals with the description of equipment and testing procedures to be adopted in compliance testing process. This part is to be executed by the certification agencies. The document has been prepared jointly by CPCB and the certification agency ARAI in consultation with ICAT, IOCL, IIP, Indian Diesel Engine Manufacturer's Association (IDEMA) and Standing Committee on Emissions (SCoE).

I hope that the document will help all the engine manufacturers/retro fitment kit suppliers and certification agencies /monitoring authorities in emission compliance testing in a systematic and scientific manner and in obtaining and / or issue of TA certificates.

1/2/22
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Date : 01.02.2022

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INTRODUCTION

National Green Tribunal (NGT) had issued an order/report for the remedial measures to be adopted to enforce the Ambient Air Quality Standards with reference to the provisions of the Air (Prevention and Control of Pollution) Act, 1981 (the Air Act) and the Environment (Protection) Act, 1986 (the EPA Act) in cities classified as 'Non-Attainment Cities' (NACs) based on monitoring of the ambient air quality. Further question is compliance of Noise Pollution (Regulation and Control) Rules, 2000 (Noise Rules) framed under the provisions of the EPA Act.

Central Pollution Control Board under direction of Ministry of Environment, Forest, and climate Change (MoEF & CC) has been directed by National Green Tribunal (NGT) to develop & evolve the standard and norms for use of retrofitted emission control equipment or devices (RECD) having a minimum specified PM capturing efficiency of 70% for in-use DG sets below 800 kW gross power category vide order/report "Report filed in O.A. No. 681/2018 dated 6.08.2019". To prescribe test methods for the above norms a task was entrusted to ARAI. This standard CPCB–PCLS/12/2021-22 prescribes Test Method, Testing Equipment and related Procedures for Type Approval testing of retrofitted emission control equipment used for Particulate control measure of Gensets up to 800 kW Mechanical Gross Power.

While preparing this standard, considerable assistance has been taken from following regulations/documents

ISO 8178- Part 1, ISO 8178-Part 3, ISO 8178-Part 4, ISO 8178-Part 7, ISO 8178-Part 9

E/ECE/324/Rev.2/Add.131/Rev.1/Amend.1−E/ECE/TRANS/505/Rev.2/Add.131/Rev.1/Amend.1 dated 3 February 2015. "Uniform provisions concerning the approval of Retrofit Emission Control devices (RECD) for heavy duty vehicles, agricultural and forestry tractors and non-road mobile machinery equipped with compression ignition engines".

GSR 371 dated 17th May 2002 & "The System & Procedure for Compliance to Emission Limits for Diesel Engines (Up to 800 kW Mechanical Power) for Genset Applications.

GSR 771(E) dated 11th Dec 2013 and its amendment vide GSR 232(E) dated 31-Mar-2014 & "The System & Procedure for Compliance to Emission Limits for Diesel Engines (Up to 800 kW Mechanical Power) for Genset Applications dated 4.07.2014

40 CFR 1065.680

After approval of the standard by SCOE, The Central Pollution Control Board being a Nodal Agency has published this standard. For better dissemination of this information, CPCB may publish this standard on their web site.

The Committee Composition for formulation of this standard has been given in Annexure 11

OVERALL SCOPE

This document lays down the applicability and requirements of system & procedure for compliance of the NGT order dated 06.08.2019 in the matter of "Report filed in O.A. No. 681/2018 . This is with the objective for PM reduction by using retrofitted emission control devices (RECD) for in-use diesel operated internal combustion engines up to 800 kW gross mechanical power for generator set (Genset) application.

The details are covered in following parts:

- Exhaust PM limits, applicability & other requirement
- Certification system and procedure
- Test equipment & Test procedure

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1. SCOPE

This document lays down the applicability and requirements of system & procedure for compliance of the NGT order dated 06.08.2019 in the matter of "Report filed in O.A. No. 681/2018. This is with the objective for PM reduction by using retrofitted emission control devices (RECD) for in-use diesel operated internal combustion engines up to 800 kW gross mechanical power for generator set (Genset) application.

The details are covered in following parts:

- Exhaust PM limits, applicability & other requirement
- Certification system and procedure
- Test equipment & Test procedure

Following ISO 8178 Standards shall be referred wherever stated.

Sr No.	Standard	Title
1	ISO 8178-1	Reciprocating internal combustion engines — Exhaust emission measurement — Part 1: Test-bed measurement systems of gaseous and particulate emission
2	ISO 8178-3	Exhaust emission measurement — Part 3: Test procedure for measurement of exhaust gas smoke emissions from compression ignition engines using a filter type smoke meter
3	ISO 8178-4	Reciprocating internal combustion engines — Exhaust emission measurement — Part 4: Steady-state and transient test cycles for different engine application
4	ISO 8178-9: 2019	Reciprocating internal combustion engines — Exhaust emission measurement — Part 9: Test cycles and test procedures for measurement of exhaust gas smoke emissions from compression ignition engines using an opacimeter

2. DEFINITION & ABBREVIATTIONS

DEFINITIONS

1.1.1 **"*Active regeneration*"** means any additional measure to initiate regeneration either on a periodic or continuously regenerating RECD.

1.1.2 ***"Adjustment factors"*** means additive upward adjustment factor and downward adjustment factor or multiplicative factors to be considered during periodic regeneration**.**

1.1.3 ***"Ageing cycle"*** means the machine or engine operation (speed, load, power) to be executed during the service accumulation period.

1.1.4 ***"Applicable emission limit"*** means an emission limit to which an engine is subject to for approval.

1.1.5 ***"Application range"*** means the range of engines to which a retrofit emission control device (RECD) approved in accordance with this Regulation can be applied.

1.1.6 ***"Applicable PM limit"*** means the Particulate Matter (PM) limit; absolute or percentage to which a RECD is subject to for approval.

1.1.7 ***"Approval of an engine (engine family)"*** means the approval of an engine type with regards to the level of the emission of gaseous, particulate and smoke pollutants.

1.1.8 ***"Approval of a retro-fitment Emission Control Device (RECD)"*** means the approval of a retro fitment device type or its family with regard to the level of particulate pollutants reduced by the device.

1.1.9 ***"Class I retrofit emission control device (RECD)"*** means a retrofit emission control device which is intended to control particulate matter emissions only, and which does not increase the direct NO_2 emissions.

1.1.10 ***"Class II retrofit emission control device (RECD)"*** means a retrofit emission control device which is intended to control particulate matter emissions only, and which does not increase the direct tailpipe NO_2 emissions by more than the percentage specified in paragraph 4.8.3 based on the engine baseline emission NO_2 level.

1.1.11 *Reserved*

1.1.12 ***"Constant speed engine"*** means an engine whose type approval or certification is limited to constant-speed operation. Engines whose constant-speed governor function is removed, or disabled are no longer constant-speed engines.

1.1.13 ***"Continuous regeneration"*** means the regeneration process of an exhaust after-treatment system or RECD that occurs permanently or at least once per applicable test cycle.

1.1.14 ***"Critical emission related components"*** means the components which are designed primarily for emission control, that is but not limited to, any exhaust after-treatment system including it's controls and diagnostics system, the electronic engine control unit and its associated sensors and actuators, fuel injection equipment, turbocharger and it's integral control actuators and the EGR system including all related filters, coolers, control valves and tubings.

1.1.15 ***"Declared power (kWm,)"*** means rated gross mechanical power declared by manufacturer for type approval at declared rated speed.

1.1.16 *"**Emissions-related defect"*** means a deviation from normal production tolerances in design, materials, system or assembly that affects any parameter, specification or component belonging to the emission control system. A missing component may be considered to be an emission-related defect.

1.1.17 **"*Engine baseline emission*"** means the emissions of a given engine or engine system without any retrofit emission control device. For engines without after-treatment, the engine baseline emissions are equal to the engine out raw emissions. For engines with after-treatment, the engine baseline emissions are equal to the tailpipe emissions downstream of the after-treatment system.

1.1.18 ***"Engine family"*** means a manufacturer's grouping of engine systems, which, through their design have

similar exhaust emission characteristics, all members of the family must comply with the applicable emission limit values. Also refer ISO 8178-7.

1.1.19 ***"Electronic control unit (ECU)"*** means an engine's electronic device that uses data from engine sensors to control engine parameters as primary function. ECU may contain more functionality than stated above of interest.

1.1.20 ***"Exhaust after treatment system"*** means 'a catalyst (oxidation or 3-way), a particulate filter, a de-NOx system, a combined de-NOx particulate filter' or any other emission-reducing device that is installed downstream of the engine. This definition excludes exhaust gas recirculation, which, where fitted is considered an integral part of the engine system.

1.1.21 ***"Emission related maintenance"*** means maintenance which substantially affects emissions, or which is likely to affect emissions performance deterioration of the engine and Exhaust after treatment system during normal in-use operation.

1.1.22 ***"Non-emission related maintenance"*** means maintenance which does not substantially affect emissions, and which does not have a lasting effect on the emissions performance deterioration of the machine or the engine during normal in-use operation once the maintenance is performed.

1.1.23 ***"Engine system"*** means the engine, the emission control system and the communication interface (hardware and messages) between the engine system electronic control unit(s) (ECU) and any other DG control unit.

1.1.24 **"*Engine Type*"** means a category of engines, which do not differ in such essential respects as engine characteristics as defined in paragraphs 4.0 of this Regulation and ISO 8178 – 4.

1.1.25 ***"Internal combustion engine (ICE)"*** means an engine, which works on the either compression-ignition principle or positive ignition principle utilising liquid, gaseous or combination of both fuels.

1.1.26 ***"Installer"*** means a person or body who is responsible for the correct and safe installation of the approved RECD.

1.1.27 ***"Manufacturer/Importer/Retrofitter"*** means the person or body who is responsible to the Nodal Agency & Test Agency for all aspects of the type-approval and can demonstrate that it possesses the features required and the necessary means to achieve quality assessment and conformity of production. It is not essential that the person or body be directly involved in all stages of the construction of the DG set, system, component or separate technical unit, which is the subject of the approval process.

1.1.28 ***"On-board operator warning system"*** means a device that detects incorrect operation or removal of the RECD.

1.1.29 **"*Particulate matter (PM)"*** means the mass of any material collected on a specified filter medium which is defined in the relevant series ISO 8178 standards.

1.1.30 Reserved.

1.1.31 *Reserved*

1.1.32 ***"Periodical regeneration"*** means the regeneration process of an emission control device that occurs periodically in typically less than 100 hours of normal engine operation. During cycles where regeneration

occurs, emission standards can be exceeded.

1.1.33 ***"Reduction efficiency"*** means the ratio between the emissions downstream of the RECD system (E_{REC}) and the engine baseline emissions (E_{Base}) and both measured in accordance with the procedures defined in this Regulation and calculated as defined in paragraph 4.8.2.2.

1.1.34 ***"Reduction level"*** means a reduction efficiency in percent to be met by the retrofit emission control device (RECD) in order to be certified as meeting the reduction level specified in paragraph 4.8.2.

1.1.35 ***"Retrofit emission control device (RECD)"*** means Retrofit Emission Control Device (RECD) that has a particulate mass emission reduction efficiency, which qualifies it to be certified as meeting the classification class as defined in this Regulation. The regeneration system and strategy are part of the RECD. This includes any sensors, controller and software essential to the operation of the device. Systems that only modify the existing engine system controls are not considered to be RECDs.

1.1.36 ***"Retro-fitment Device Family"*** means OEM/Retrofitter system, which through their design have similar exhaust emission characteristics, all members of the family must comply with the applicable emission limit values as per paragraph 4.1.2.

1.1.37 ***"Scan-tool"*** means an external test equipment used for off-board communication with the RECD System

1.1.38 ***"Generic scan-tool"*** means a scan-tool, which is publicly available, and which shall be capable to read failure messages.

1.1.39 ***"Proprietary scan-tool"*** means a scan-tool, which is used only by the RECD manufacturer and its authorized dealership, and which shall be capable to read failure messages and to enable an engine start after activation of the operator inducement system.

1.1.40 ***"Parent engine"*** means an engine selected from an engine family in such a way that its emissions characteristics will be representative for that engine family and that it complies with the requirements set out in Annex 1B to this Regulation. Refer also ISO 8178-7.

1.1.41 ***"Percent load"*** means the fraction of available torque at a rated engine speed. Also refer ISO 8178-4.

1.1.42 ***"Power generating set or Genset"*** means any equipment which is used for electric power generation in absence or failure of grid power utilizing engine system defined in this document as prime mover.

1.1.43 ***"Smoke"*** means particles suspended in the exhaust stream of a diesel engine, which absorb, reflect, or refract light. Also refer ISO 8178-3.

1.1.44 ***"Test Cycle"*** means a sequence of test points each with a defined speed and torque to be followed by the engine during standardised emission assessment test. Also refer ISO 8178-4.

1.1.45 For domestic products, Date of Manufacture means the date on which the engine is invoiced.

1.1.46 For Imported products, Date of Import means the date of payment of custom duties applicable to the engine or Genset.

1.1.47 **"Useful life"** means the relevant period of distance/operating hours and/or time over which compliance with the relevant particulate emission limits has to be assured.

Part- 1

3 Exhaust Emission Limits, Applicability and Requirement

3.1 Exhaust Emission Limits

3.1.1. The emissions of the particulate matter (PM) during emission test/s conducted as mentioned in GSR 771(E) dated 11th Dec 2013 and its amendment vide GSR 232(E) dated 31st Mar 2014 where the PM limits shall not exceed the as specified in the NGT order / report "Report filed in O.A. No. 681/2018 dated 6.08.2019", also tabulated in 4.8.2.

3.1.2. The engines/generating sets manufactured & installed before 1.7.2004 or the engines which are not complying either Stage-I and/or Stage-II emission limits, such engines are to be scrapped. No one shall sell/use/run the above engines/generating sets.

This rule is applicable to Retrofit Emission Control Devises (RECD) to be installed on all the Phase-I & Phase-II engines/engine families as mentioned in clause 3.1.3, which have completed five years from the date/month of engine manufacturing.

3.1.3. **Phase-I Engines:** The engines complying to emission limits as specified in CPCB Stage-1 /GSR 371 dated 17th May 2002 and the diesel genset engines manufactured/imported on or after 1.7.2004 till 1.7.2014 shall establish the compliance of minimum 70% reduction of Particulate Matter by using the retrofitted after treatment device/s without adversely affecting any other emission parameters.

Phase II Engines: The engines complying to emission limits as specified in CPCB Stage-2 / GSR 771(E) dated 11th Dec 2013 and its amendment vide GSR 232(E) dated 31-Mar-2014, and the diesel genset engines manufactured/imported on or after 1.7.2014 shall establish the compliance of minimum 70% reduction of Particulate Matter by using the retro-fitted after treatment device/s without adversely affecting any other emission parameters.

Test Cycle

Speed operation	Emission Test Cycle
Constant speed engine	5-mode Constant Speed Cycle (D2 Steady-state discrete mode test cycle specified in ISO-8178-Part 4)

Notes:

(a) The above test cycle and PM reduction limits are applicable for constant speed engines.

(b) Gaseous emissions other than PM shall not be applicable. However, other gaseous emissions & smoke should not increase than the base values.

(c) The testing shall be done as per test procedures mentioned in CPCB Stage-1 /GSR 371 dated 17th May 2002 and CPCB Stage-2 / GSR 771(E) dated 11th Dec 2013 and its amendment vide GSR 232(E) dated 31-Mar-2014 as applicable.

(d) Every manufacturer, importer or retrofitter of RECD Supplier for genset application manufactured or imported into India shall obtain Type Approval and comply with Conformity of Production (CoP) requirements of their RECD(s) for PM emission reduction limits, which shall be valid for next CoP year.

(e) RECD system when used and maintained according to the manufacturer's instructions will comply with the applicable provisions during normal operation over a useful life.

(f) The above-mentioned limit shall be applicable to Type approval and Conformity of Production (CoP) carried out by authorized test agencies.

The term 'CoP year' means the period from 1st July of a calendar year to 30th June of the following year.

3.2 Rounding off

The final test result shall be rounded in one step to the number of places to the right of the decimal point indicated by the applicable emission standard plus two additional significant figures, in accordance with IS:2-1960. No rounding of intermediate values leading to the final brake-specific emission result is permitted.

3.3 In addition, the following requirements shall apply:

3.3.1. **Durability Period and Fixed Deterioration Factor Requirements:**

Durability requirement shall be applicable to the retrofitted emission control devices (RECD) as per following power category.

The applicant shall declare that the RECD system when used and maintained according to the manufacturer's instructions will comply with the applicable provisions during normal operation over a useful life of:

i) RECD Durability Period fitted on the DG engines manufactured/imported between 01.07.2007 to 01.07.2014.

Category (Power Band)	Emission durability period (hours)
Up to 800 kW	4000 or 6 years whichever is earlier.

ii) RECD Durability Period fitted on the DG engines manufactured/imported after 1.07.2014

Category (Power Band)	Emission durability period (hours)
Up to 75 kW	4000 or 6 years whichever is earlier.
> 75 kW≤ 800 kW	6000 or 6 years whichever is earlier.

iii) The applicant shall conduct 500 hours for phase –I & 1000 hours for phase –II engines durability test on an engine and RECD combination. This test shall be either a field test on a typical DG set agreed between the Test Agency and the applicant or a test on an engine test bed. In the case of testing on an engine test bed, the ISO-8178 D2-5 mode test cycle shall be used.

The engine for the durability run may be different from the test engine used for tests to establish the reduction level of the RECD, but shall be an engine within the declared application range of the particular RECD.

iv) The content of the durability test is as follows:

Phase 1: For phase -1 engines, 500 hours service accumulation of the RECD with recording of all relevant operating data of the engine concerned including type and consumption of fuel and lubricating oil, and continuous second-by-second data logging of exhaust temperature before the RECD and pressure

loss over the RECD. In the case of a field test, the RECD shall be sealed by the Technical Service and the data logging shall be carried out by the RECD manufacturer or by the operator of the DG Set on which the endurance test is performed.

After completion of the durability run, the RECD system used to demonstrate durability should be used for any further evaluation testing with the original test engine.

In the event that the original test engine is no longer functional, an engine of the same type may be used with the prior agreement of the Test Agency. The RECD system shall meet the requirements of clause 3.1 after completion of the service accumulation/after completion of durability period.

Phase 2: For Phase-2 engines, 1000 hours service accumulation of the RECD with recording of all relevant operating data of the engine concerned including type and consumption of fuel and lubricating oil, and continuous second-by-second data logging of exhaust temperature before the REC and pressure loss over the REC. In the case of a field test, the Technical Service shall seal the RECD and the data logging shall be carried out by the RECD manufacturer or by the operator of the-DG Set on which the endurance test is performed.

After completion of the durability run, the RECD system used to demonstrate durability should be used for any further evaluation testing with the original test engine.

In the event that the original test engine is no longer functional, an engine of the same type may be used with the prior agreement of the Test Agency. The RECD system shall meet the requirements of clause 3.1 after completion of the service accumulation/after completion of durability period.

v**) Fixed deterioration factors**

As an alternative to durability method, RECD manufacturers may select to use the fixed deterioration factor of 1.05 for the Particulate Matter reduction efficiency.

If fixed DF method is used, the DF shall be demonstrated for the RECD after the durability of 100 hours running of engine with subjective RECD for Phase -1 & Phase-II engine categories.

Fixed DF:

(Calculated cycle PM efficiency) / DF ≥ PM Reduction Efficiency Limit (70%)

Type approval agency reserves rights for allowing manufacturer to opt for fixed DF option based on technology evaluation.

Note: When opted for fixed DF, above clauses (i-iv) are not applicable.

a) Particulate control measures: Engines which rely on the use RECD to reduce Particulate Matter emissions, shall ensure the correct operation of PM control measures, as set out in details in Annexure 8 of this Regulation in details.

b) Gross Power & Speed tolerance: While carrying out the required test on the engine for the compliance of the retro fitment after-treatment devices, the gross declared power of the engine shall be measured on the test bench at rated speed of engine. The measured power and speed may differ from the power and speed declared by manufactured as specified below.

#	Gross Power Tolerance	Speed Tolerance

Type Approval (TA) & Conformity of Production (CoP)	± 6% at rated for single cylinder engines ± 5% at rated for other engines	± 1% at rated

4 Type Approval Administrative Procedure

4.1 Retro-Fit Emission Control Devices (RECD) type and family

4.1.1. Retro-Fit Emission Control Devices type

The technical features of RECD type shall be those defined in its information document drafted in accordance with the template set out in Annexure 1.

The RECD devices shall be developed, optimised, and certified for an already certified DG engine family/s.

4.1.2. Retro-Fit Emission Control Devices family criteria

4.1.2.1. General

For the purpose of type approval & the durability/DF, the RECD shall be divided into model families certified suitably for the respective engine families consisting of parent RECDs and its variant(s).

RECD family(s) shall be grouped into families similar to that of engines, which through their design are expected to have similar exhaust emission characteristic where member of the family shall comply with the applicable emission values.

The Type Approval range describes the power range of engines or engine families to which the RECD family may be applied.

RECD/RECD family(ies) shall be fitted on an already certified engine/family of engines of different make & model, which shall have identical technical characteristics as mentioned in 4.1.2.2 (b).

The Type Approval range is limited to the engine family to which the test engine as defined in clause 4.1.2.3.

Parent RECD shall be the RECD selected from the family, in such a way that it will incorporate those features, which will adversely affect the emission level of the relevant exhaust emission.

4.1.2.2. Retro-fitment Emission Control Device (RECD) family formation & choice of the parent device.

Essential characteristic of the retro-fitment family:

The parameters defining the retro-fitment device family, the determination of retro fitment device family and the criteria for choosing the parent device shall be as mentioned below. However, the decision of selection of parent device and family classification by the authorized test agency shall be final.

For the purpose of identification, the Manufacturer/Importer/Retrofitter shall designate the families as R1, R2, R3…. Rn.

The Manufacturer/Importer/Retrofitter shall provide to the type approval authority the appropriate information relating to the emissions reduction levels of the members of the retro fitment device family

The RECD /RECD family is limited applicable to the engine/family(ies) of engines/group of families of engines to which the test engine as defined in clause 4.1.2.3.

The Type Approval range may be extended to:

(a) Other engines/engine families produced by the same engine manufacturer; and
(b) Engines/engine families of other engine manufacturers.

if the applicant can demonstrate that the following criteria features of the engines concerned are the same as those in the test engine:

i) Exhaust mass flow at the rated speed and power is equal or lower
ii) Method of aspiration (turbocharged or naturally aspirated engine)
iii) With or without EGR
iv) Whether a constant speed
v) Engine baseline emission stage and
vi) With or without an after-treatment system.

4.1.2.3. Choice of the test engines and RECD combination:

(a) The test engines shall originate from an engine emissions family corresponding to the subsequent application range of the RECD.

A duly overhauled/serviced DG engine as per the engine manufacturer's recommendation having below working performance parameters.

i. Phase I Engine: Emission, Smoke & PM values should not exceed 1.5 times of the CPCB Stage-1 /GSR GSR 371 dated 17th May 2002 and

ii. Phase II Engine: Emission, Smoke & PM values should not exceed 1.25 times of the CPCB Stage-2 / GSR 771(E) dated 11th Dec 2013 and its amendment vide GSR 232(E) dated 31-Mar-2014.

(b) The parent engine of respective family of specific engine manufacturer/importer shall be selected for the emissions & PM measurement.

(c) For Class I and Class II RECD, when combined with the selected test engine the RECD shall have the highest space velocity or exhaust mass flow rate, as may be applicable within the application range of the RECD family.

(d) The RECD shall have the minimum volumetric concentration of catalytically active materials specified by the manufacturer for the RECD family.

When the requirements of sub-paragraph c) and sub-paragraph d), above, are mutually incompatible, the requirements of sub-paragraph c) shall take priority.

(e) The selected test engine shall comply in both series production condition and in retrofitted condition

with all of the pollutant emissions limits associated with the stage or standard to which it was originally type-approved. Where DG sets are fitted with on-board diagnostic systems, those systems shall not be affected with respect to their monitoring function after the retrofit system has been installed. The characteristics of the electronic engine control unit (as regards, for example, injection timing, air-mass flow metering, or exhaust emissions reduction strategies) shall not be altered by the retrofitting. Any modification of the test engine that changes the original emission behaviour (for example alternation of the injection timing) is not permitted.

(f) Engines certified with exhaust mufflers (with or without containing aftertreatment element) shall be represented during type approval testing as an actual component or through back-pressure setting and such element cannot be removed from installations for actual RECD application owing to their contribution and compliance to noise certification.

4.2 Selection of Certifying Agency

4.2.1. Following test agencies are currently approved by the Nodal Agency Central Pollution Control Board (CPCB) for purpose of type approval and subsequently conformity of production verification compliance process and may be revised from time to time.

(a) Automotive Research Association of India (ARAI, Pune)

(b) International Centre for Automotive Testing (ICAT, Manesar)

(c) Indian Institute of Petroleum (IIP, Dehradun)

(d) Vehicle Research Development Establishment (VRDE, Ahmednagar)

4.2.2. One OEM or importer shall submit application for Type Approval to any one of the certification agencies for its families/models out of those approved by central pollution control board (CPCB).

4.2.3. For a new OEM or importer, selection of technical agencies for type approval certification and subsequently conformity of production shall be applicant's choice among the technical agencies published by central pollution control board (CPCB) in paragraph 4.2.1 and as amended from time to time.

4.2.4. If any manufacturer wants to change the certification agency, he shall seek No Objection Certificate (NOC) from the existing Certification Agency before approaching another agency. However, in case of any dispute, the applicant may approach Nodal Agency (CPCB) well in advance with justifiable reason. The nodal agency, after consultation with the existing certification agency/ standing committee, may approve the change, if found justified. If approved, the nodal agency shall inform to the parties concerned.

4.2.5. On receipt of information for change in certification agency from the nodal agency, the previous certification agency shall authenticate all the relevant document of the model (type approval as well as CoP verification) and forward the same to the new certification agency. The certification agency shall be responsible for carrying out the type approval testing and CoP verification for the manufacturer in the future.

4.3 Application of type approval

4.3.1 The application shall be made in the format prescribed in Appendix 1 and must be complete in all respect. Appendix 1 be submitted to Nodal Agency and on its written acceptance, RECD specification related documents to be submitted to the test agency as per Annexure –1.

4.3.2 The application for approval of a RECD or a RECD family with regard to the level of particulate pollutants shall be submitted by the Manufacturer/Importer/Retro-fitter or by a duly accredited representative.

4.3.3 For each RECD family, the Manufacturer/Importer/Retro-fitter must submit an application to the certification agency, selected as above.

4.3.4 The application must be signed by the authorized representative of the manufacturer.

4.3.5 It shall be accompanied by the undermentioned documents and the following particulars:

4.3.6 A description of the RECD type comprising the particulars referred to in clause 4.1. of this Regulation and if applicable the particulars of the RECD family as referred to in paragraph 4.3.1 to this Regulation. For the purpose of identification, the manufacturer shall designate the engines families as R1, R2, R3 …. Rn in consultation with technical agency.

4.3.7 Testing of the parent RECD model, shall, normally, be sufficient for type approval of the family. The Testing agency has the option to carry out the testing of more than one model in the family to satisfy itself, subject to parent engine-concept as per Annexure 1.

4.3.8 A RECD conforming to the RECD type characteristics described in clause 4.1. shall be submitted to the Test Agency responsible for conducting the approval test. Test Agency determines that the submitted engine does not fully represent the engine family described in clause 4.1., an alternative and, if necessary, an additional RECD shall be submitted for test.

4.3.9 During Type Approval test, the manufacturer shall submit the qualified emission test data of all the remaining variant RECD if any, other than the parent RECD, which is chosen for emission test by the test agency of the family along with all other documents.

4.3.10 At later stage if the manufacturer submits the application for type approval of a model, the Testing agency shall ascertain whether the model can be classified as belonging to a RECD family of model(s) already certified. If the model does not belong to a RECD family already certified, the Testing agency shall proceed with the testing of the model for type approval with issuance of new and unique RECD emissions family certification upon qualification.

4.3.11 If the model belongs to a RECD family already certified, the Testing agency shall decide whether the specific testing of the model is required. In case the specific testing of the model is not required, the type approval certificate for the RECD family may be extended to include the model. In such case qualified emissions data shall be submitted to agency by manufacturer during application.

4.3.12 The Testing agency shall intimate its decision to the applicant within a fortnight of receipt of the application, indicating need and plan (schedule) of testing for type approval.

4.3.13 Each RECD shall be accompanied by the following information:

(a) The manufacturer's name and/or trademark.
(b) the make and identifying part number of the RECD as recorded in the information document issued in accordance with the model set out in Annex 1.
(c) The RECD family as defined in clause 4.1.2.2. including year of manufacture, for which the RECD is approved, including, where applicable, a marking to identify if the RECD is suitable for fitting to an engine & family that is equipped with an on-board diagnostic (OBD) system.
(d) The instruction manual for the retrofit installation.
(e) The end-user service manual including maintenance instructions.

4.4 Type Approval

4.4.1. No person or agency shall sale, import, install or use a RECD for in-use Genset application in India without valid Type Approval Certificate referred to in Clause 4.5. and 5.4 of this Regulation.

4.4.2. In order to receive a type approval of a RECD type or RECD family, the manufacturer/importer/retrofitter shall demonstrate compliance, of the RECD type or RECD family with the provisions of this Regulation.

4.4.3. All the type approval tests shall be conducted in the technical agency laboratory. In case the required test facilities are accredited by the technical agency, the type approval tests can be carried out at OEM/Retrofitter laboratory also if reasons call for. In case the test is to be carried out at any overseas test facilities, the same shall be informed to the Nodal Agency by technical agency. The technical agency will submit a copy of accreditation letter highlighting the details of test facilities available in the manufacture's laboratory to the Nodal Agency.

4.4.5. Reserved.

4.4.6 In case, the manufacturer/ importer/ retrofitter allows the use of commercial fuels set out in Annexure - 6 provided to be declared in the information document.

4.4.7. Additionally, in order to receive type approval of a RECD on a Genset with an approved engine with regard to emissions or a type approval of a Genset with regard to emissions the manufacturer/importer/ Retro-fitter shall ensure compliance with the installation requirements set out in clause 4.14.

4.4.8. The Type Approval Authority shall put together an information package consisting of the information folder accompanied by the test report and all other documents added by the technical service or by the Type Approval Authority to the information folder in the course of carrying out their functions ('the information package'). The information package shall include an index listing its contents, suitably numbered or otherwise marked so as to clearly identify all the pages and the format of each document, in order to present a record of the successive steps in the management of the type approval, in particular the dates of revisions and updating.

4.4.9. The approval authority shall ensure that the information contained in the information package is available for a period of at least 5 years following the end of the validity of the type approval concerned.

4.5. Certificate of Type Approval and Validity

4.5.1. After verification of RECD on an already certified engine(s) for the type approval, the technical agency shall issue a type approval report to manufacturer/importer/retro-fitter within one month from date of testing completion indicating acceptance or rejection decision and reason thereof.

4.5.2. If the RECD(s) submitted for approval pursuant to paragraph 4.3. of this Regulation meets the requirements, approval of that RECD on engine type(s) or engine family(s) shall be granted by the technical agency through issue of Type Approval Certificate as per format prescribed in Annexure 2 along with report. Copy of the certificate and report shall be forwarded to Nodal Agency by technical agency involved.

4.5.3. For the purposes of clarity and easing access to relevant data, the communication includes an addendum containing the most relevant information related with the type-approved RECD & engine type or engine family.

4.5.4. The certificate shall be deemed to be valid for the model(s) included herein, unless explicitly withdrawn by separate written order by the Nodal Agency.

4.5.5. Validity of Type Approval Certificate issued by type approval authority shall remain valid further as long as following conditions are met:

i) Till the RECD specifications change as mentioned in Annexure 1 and modification related clauses described in clause 4.6 below;

ii) Till the further amendments to the notification.

iii) Till CoP is not missed / Till CoP procedure compliance per clause 5.2. is obtained within prescribed timeframe as listed in clause 5.3.10.

4.6. Modification and Extensions of RECD

4.6.1. If a RECD type or RECD family is type approved and valid, manufacturer/importer//retrofitter may approach type approval certificate issuing technical agency for modifications pertaining to parent or any RECD type in the certified RECD family. Such modifications shall be ascertained by manufacturer/retrofitter utilizing guidelines described in clause 4.6.6.

4.6.2. Manufacturer/importer/retrofitter shall submit technical document in line with type approval procedure prescribed in this Regulation.

4.6.3. Subjected to scrutiny of manufacture's application, technical agency shall approve or seek more data pertaining but not limited to RECD architecture, parameters, similarity with existing RECD type from emissions and performance perspective along with evidences. Decision of technical agency will remain finally binding for allowing such amendments to existing type approval certificate of an RECD family through extension(s) vs asking manufacturer/retrofitter to type approve as new RECD family or RECD type.

4.6.4. Technical agency retains all rights to ask manufacture/retrofitter to demonstrate modified RECD type for emissions conformity through applicable type approval test procedures.

4.6.5. Where the Approval Authority approves the modification, a reference to the formal notification of that approval shall be included in the installation manual for the RECD.

4.6.6. Following generic rules may be utilized as example for extensions of type approval certificate:

4.6.6.1. **No emission test requirements necessary:**

(a) change to part numbers declared through type approval documentation that is not emission affecting.

(b) part number change of emission affecting component that is just an administrative change supported with due declarations (proto to production Part number change as an example).

4.6.6.2. **Emission test compliance required:**

(a) Performance or specification or source change of a component declared through type approval documentation that is emissions affecting. This applies to any such component in RECD and including software.

(b) Addition of alternate source component that is emission affecting with or without part number change.

4.6.6.3. Particulate Control Diagnostics compliance required:

(a) In addition to paragraph 4.6.6.2 at discretion of technical agency, if changes to Particulate control diagnostics limits, strategy, or software is carried out.

(b) Particulate control diagnostics demonstration method through failed part has been changed.

4.6.6.4. In the event of an extension, the Test Agency shall establish an updated communication denoted by an extension number that shall be incremental in accordance with the number of successive extensions previously granted. That communication shall clearly show the reason for the extension and the date of extension.

4.7. General Requirements:

4.7.1. A RECD approved in accordance with this Regulation shall be designed, constructed and capable of being mounted so as to enable the application to comply with the rules set out in this Regulation throughout the normal life of the RECD under normal conditions of use.

4.7.2. A RECD approved in accordance with this Regulation shall be durable. That is, it shall be designed, constructed and capable of being mounted so that reasonable resistance is obtained to phenomena such as the corrosion, oxidation, vibration and mechanical stress to which it will be exposed under normal conditions of use. Specific durability requirements are in clause 3.3.1.

4.7.3. The RECD manufacturer/importer/retrofitter shall provide installation documents that will ensure that the RECD, when installed on the DG set, will operate, in conjunction with the necessary machinery parts, in a manner that will comply with the requirements this regulation. This documentation shall include the detailed technical requirements and the provisions of the RECD (software, hardware, and communication) needed for the correct installation of the RECD on the DG set.

4.7.4. Devices that by-pass or reduce the efficiency of the RECD are not permitted and shall be considered defeat device or strategy.

4.7.5. A RECD approved in accordance with this Regulation shall be fitted with an on-board diagnostics and operator warning system that signals to the operator/control room the presence of a failure affecting the efficiency of the RECD.

4.7.6. A particulate reduction RECD shall be equipped with a monitoring device that detects incorrect operation or removal of the RECD and that triggers an audible and/or visual alarm to the operator. For reagent based particulate reduction, RECD the monitoring device may interrupt the input of any reagent or additive, if necessary. The warning system can be based for example, on the continuous measurement of the engine exhaust backpressure.

4.7.6.1. **Maintenance requirements**

4.7.6.1.1. The RECD manufacturer shall furnish written instructions about the RECD system and its correct operation to be provided to all operators /control room of DG sets.

These instructions shall state that if the RECD system is not functioning correctly, the operators /control room will be informed of a problem by the operator warning system and that activation of the operator inducement system as a consequence of ignoring this warning will result in DG set being unable to re-start.

4.7.6.1.2. The instructions shall indicate requirements for the proper use and maintenance of the RECD in order to maintain its emissions performance, including the proper use of consumable reagents where applicable.

4.7.6.1.3. The instructions shall be written in a clear and non-technical manner using the same language as is used in the operator's manual on the DG set.

4.7.6.1.4. The instructions shall specify if consumable reagents have to be refilled by the operator by control room staff between normal maintenance intervals. The instructions shall also specify the required chemical solution/reagent quality. They shall indicate how the operator/control room should refill the chemical solution/reagent tank. The information shall also indicate a likely rate of chemical solution /reagent consumption and how often it should be replenished.

4.7.6.1.5. The instructions shall specify that use of, and refilling of, a required chemical solvent/liquid/reagent of the correct specifications is essential in order for the DG set to comply with the requirements for the issuing of the approval of the RECD for that DG set.

4.7.6.1.6. The instructions shall state that it may be a criminal offence to use a DG set that does not consume any chemical solution/reagent if the chemical solution/reagent is required for the reduction of emissions.

4.7.6.1.7. The instructions shall explain how the operator warning and inducement systems work. In addition, the consequences, in terms of performance and fault logging, of ignoring the warning system and not replenishing the reagent or rectifying the problem shall be explained.

4.7.6.1.8. The approval shall be conditional upon the following:

The manufacturer providing written maintenance instructions to be given by the manufacturer/importer/retrofitter/installer to the operator.

The manufacturer/importer/retrofitter/installer providing installation documents for the RECD.

The manufacturer providing a written statement to the manufacturer/importer/retrofitter/installer, to be given to the operator/control room, on the normal operating conditions (temperature range, environmental conditions,) within which the RECD will operate correctly.

4.7.6.1.9. A written instruction & guidelines of handling/disposal of any secondary non-regulated pollutants generating out of the process shall provide to the operator. The pertinent mandatory clauses are applicable to the regulated & nonregulated generated secondary emission coming out of the RCED process. Retrofitter/Owner/Operator shall be responsible for the timely disposal of the hazardous and non-hazardous generated out of the RECD process as per the appropriate disposal laws

4.8. Performance Requirements:

4.8.1. RECD approved under this regulation shall meet all of the following criteria

- the particulate matter emission reduction limit values as specified in paragraph 4.8.2.1 and paragraph 4.8.2.3
- the NO_2 emission requirements as specified in paragraph 4.8.3
- the secondary emissions requirements as specified in paragraph 4.8.3.4

4.8.2. Emissions Limit values

4.8.2.1. The retrofitted engine system shall be governed by the minimum reduction PM limits as specified in the NGT order / report “Report filed in O.A. No. 681/2018 dated 6.08.2019”.

4.8.2.2. Reduction levels and reduction efficiency

4.8.2.3. The reduction level of a RECD system is characterised by means of its reduction efficiency as specified in Table 4.8.2:

Table 4.8.2

Reduction levels

	Minimum reduction efficiency (%)
	PM mass
Reduction level	70

4.8.2.4. The reduction efficiency shall be determined by comparison of the emissions measured over the weighted specified test cycle for RECDs to be applied to DG set engines. The reduction efficiency shall be calculated as defined in 4.8.2.5.

4.8.2.5. The reduction efficiency shall be calculated from the measured emissions of the relevant pollutant downstream of the RECD (E_{REC}) and the engine system emissions measured before fitment of the RECD (E_{Base}) for that pollutant, both measured in accordance with the procedures defined in this Regulation:

If two particle measurement systems are used in parallel for measurement of the particle reduction efficiency, they shall give measurements within 5 per cent of each other when measuring simultaneously from the same sample point.

4.8.2.6. Reduction efficiency (percent) = $(1 - (E_{REC} \div E_{Base})) \times 100$.

4.8.2.7. Further factors pertaining to tested or fixed Deterioration factor, regeneration factor shall apply as per respective clauses beyond minimum performance limit prescribed.

4.8.3. NO_2 emissions requirements

4.8.3.1. For a Class I REC, there shall be no increase in NO_2 emissions above the NO_2 baseline emissions if any, measured as defined in Annex 8. For eliminating emissions test measurement accuracy and repeatability related decision bias, variation of 5% is assumed 'no increase' of NO_2 emissions.

4.8.3.2. If applicable, for a Class II RECD, the NO_2 incremental increase shall not be more than 20 percentage points greater than the level recorded when no REC is fitted (baseline). As an example, if baseline NO_2 is 10 percent of NO_X, the maximum permitted NO_2 emission with the REC is 30 percent of NO_X measured as defined in Annex 8.

4.8.3.3. For Class I and II additionally the control of secondary emissions shall be as per paragraph 4.8.3.4.

4.8.3.4. Secondary emissions requirements

4.8.3.5. The manufacturer of the RECD system shall provide documentary evidence to show that materials and processes used in the RECD do not present any additional hazard to health and the environment.

4.8.3.6. The RECD shall not increase secondary emissions to concentrations known to be hazardous to health.

4.8.3.7. The applicant for approval shall provide an assessment of the performance of the RECD with respect to secondary emissions. The assessment shall address all likely secondary emissions from the RECD having regard to its working principle, its design, its method of construction, and the materials employed.

4.8.3.8. The assessment shall, in particular,

a) In cases where the RECD contains copper or copper compounds, address the possible formation of dioxins.

b) In cases where the RECD makes use of a fuel-borne catalyst, consider the impact upon the production of secondary emissions of

i) the absence of that catalyst and

ii) its presence at up to twice the recommended or intended concentration.

4.8.3.9. The assessment shall name each of the species of secondary emissions considered.

4.8.3.9.1. The assessment may be based upon sound engineering analysis and judgement, upon the results of tests or simulations, upon the results of analysis or tests of similar systems or technologies, or upon any combination of these elements.

4.8.3.9.2. For the purposes of this Regulation secondary emissions produced at concentrations not significantly higher than the concentrations produced by original equipment engine systems shall be considered not to be hazardous to health.

4.8.3.9.3. The applicant may be required to perform tests for secondary emissions as a prerequisite for approval in cases where the assessment of the performance of the RECD with respect to secondary emissions produces a reasonable expectation that the requirements of paragraph 4.8.3.6 will not be met.

4.9. Modifications to the engine baseline emissions:

4.9.1. Any modifications of engine operation parameters which might affect the engine baseline emissions must be kept within the limits specified by the original engine manufacturer (for example maximum allowable exhaust gas back pressure or limits set for impact of external devices upon the electrical or data handling systems).

4.9.2. In cases where additional measures with respect to emission-relevant components or system components, such as modifications to the exhaust gas recirculation (EGR) control, are necessary in order to ensure proper functioning of the engine and exhaust after-treatment systems in conjunction with the RECD, the applicant shall provide a detailed description of the design modification along with an explanation of how the modification will change the operation and performance of the emission control strategy. To support its claims, the applicant shall submit additional test data, engineering justification and analysis, or any other information deemed necessary by the Approval Authority or Technical Service to address the differences between the modified and original designs.

4.9.3. The emission control system of the original engine manufacturer shall not be modified, except for:

a) Modifications allowed by written permission of the original engine manufacturer or

b) In the case of a Class I or Class II RECD, replacement of an existing diesel oxidation

catalyst providing that

i) The requirements of clause 4.8.3. are met and that

ii) The retrofitted engine system meets at least the limits for the stage to which the base engine was approved for each of the other controlled pollutants relevant to that stage.

4.9.4. Subject to the requirements of paragraph 4.9.1. being met, modifications downstream of an original after treatment system are permitted.

4.10. Particulate Reduction RECD family:

4.10.1. The approval of a particulate reduction RECD will continue to be valid for a nominally similar system in a different configuration or application provided that it does not deviate from the tested system with respect to the following features:

a) Type of retention of the active element (for example, adhesive or mechanical fixing), and functioning;

b) Working principle of the active element (for example, metallic or ceramic material, barrier filtration or aerodynamic separation).

c) Design and characteristics of the filter or other active material (for example, whether it consists of sheets or plates, or is braided or wound, the cell, material, or non-woven density, the porosity and pore diameter of barrier filter media, the number of pockets, blades or balls in aerodynamic separators, the surface roughness of critical components, and the diameters of wires, balls, or fibres).

d) Minimum volumetric concentration of catalytically active materials of the particulate reduction system including upstream catalysts (if fitted) (grams/m^3).

e) Maximum volumetric concentration of catalytically active materials of the particulate reduction system including upstream catalysts (if fitted) (grams/m^3).

f) The design characteristics of the canning or packaging (for example, the storage or retention of the carrier of the active elements).

g) Volume of each active component (e.g. DOC, filter substrate) which shall be within ± 40 percent of the volume of the tested device;

h) Space velocity and/or exhaust flow rates as maximum value and tested as parent RECD

i) Type of regeneration (whether periodic or continuous).

j) Regeneration principle (for example, catalytic, thermal, electro thermal, any other means) and regeneration strategy (for example passive, active, forced).

k) Method and control strategy for introducing additives or reagents (if used).

l) Type of additive or chemical solution/reagent (if used).

m) Type of any catalytically active material.

n) With or without an upstream oxidation catalyst.

o) Where the tested device was tested in association with other pollution control devices:

   i) the retention of the same arrangement of devices for the RECD under consideration and

   ii) the other pollution control devices being similar in design and principle of operation to those used during testing

p) A good engineering judgement & scientific method shall be adapted by the test agencies to classify the other methodologies of RECDs.

4.11. Fuel & Specific Fuel Consumption:

4.11.1. The testing of the RECD shall be conducted with commercially available fuel. The Fuel Specification as per the Annexure-6.

4.11.2. The specific fuel consumption of the engine fitted with the RECD during the applicable test cycles shall be not more than 4 percent greater in the retrofitted condition than the mean specific consumption in the non-retrofitted condition.

4.12. Operating behaviour and Safety hazard:

4.12.1. The RECD shall be so designed that it can be used in its intended applications, when fitted in accordance with the supplied instructions, without exposing operators or bystanders to any safety hazard either directly or as result of modifications to the DG set or its operating characteristics.

4.12.2. The RECD shall be so designed that it can be used in its intended applications, when fitted in accordance with the supplied instructions, without impairment of the operating behaviour of the DG set unless,

a) The impairment does not cause a safety hazard;

b) The impairment does not increase the fuel consumption beyond the level set Clause 4.11

c) The nature and extent of the impairment is clearly stated in the instructions and information that will be passed to the retrofitter and to the operator and owner.

4.12.3. In order to ensure that the requirements of paragraph 4.14 and Annex 9 with respect to installation and the provision of information are properly complied with, the RECD manufacturer/importer/retrofitter shall make an assessment of the safety hazards that might arise from installation of the RECD on the DG set. In performing this assessment, he shall take as the baseline the level of safety provided by the DG set when it was first placed on the market.

4.13. Nosie Emissions:

The applicant shall provide evidence that the retrofitting of a RECD in accordance with the supplied fitting instructions will not lead to an increase of the DG set's noise emissions. Evidence that the RECD is intended only to be fitted in addition to the original equipment manufacturers' standard production silencer system on a DG set will be considered to fulfil this requirement.

Increase in Noise emission value as specified in the certified original DG set is not permitted. Declaration supported by the valid documents by the manufacturer showing there is no increase in the noise emissions shall be submitted.

4.14. Installation of a RECD:

4.14.1. The RECD manufacturer shall provide written installation guidelines and operation and maintenance instructions in accordance with the requirements of Annex 9.

4.14.2. The attention of the RECD manufacturer/importer/retrofitter is drawn, in particular, to the requirement in Annex 9 for the guidelines and instructions.

a) to be written in English and preferably additionally local language in which region RECD is sold or in which the RECD is expected to be used, and to be in clear language appropriate to the intended readership.

b) to remind the manufacturer/importer/retrofitter/installer of his or her potential legal responsibilities.

c) to indicate to the end user any requirements for the proper maintenance of the RECD, including, where relevant, the use of consumable chemical solutions, reagents or additives.

d) to indicate any requirements or limitations on the use of the DG Set that are necessary in order to ensure safety and correct functioning of the RECD.

e) to specify whether any chemical solutions/reagents/fluids need to be refilled by the DG set operator between normal maintenance intervals, and to indicate a likely rate of consumption.

f) to specify the type and quality of any consumable chemical solutions/reagents/fluids or additives used.

g) to remind the owner and operator of the DG set that, where the fitting of the RECD is a condition for its operation in a particular area, or where fitting of the RECD entitles the DG sets owner to incentives or privileges, the failure to maintain the RECD in proper working order (including the failure to ensure a proper supply of any reagent or additive), may be a breach of contract or constitute a criminal offence.

4.14.3. The RECD manufacturer/importer/retrofitter shall demonstrate to the Approval Authority. The existence of adequate procedures to select, train and monitor authorised RECD installers.

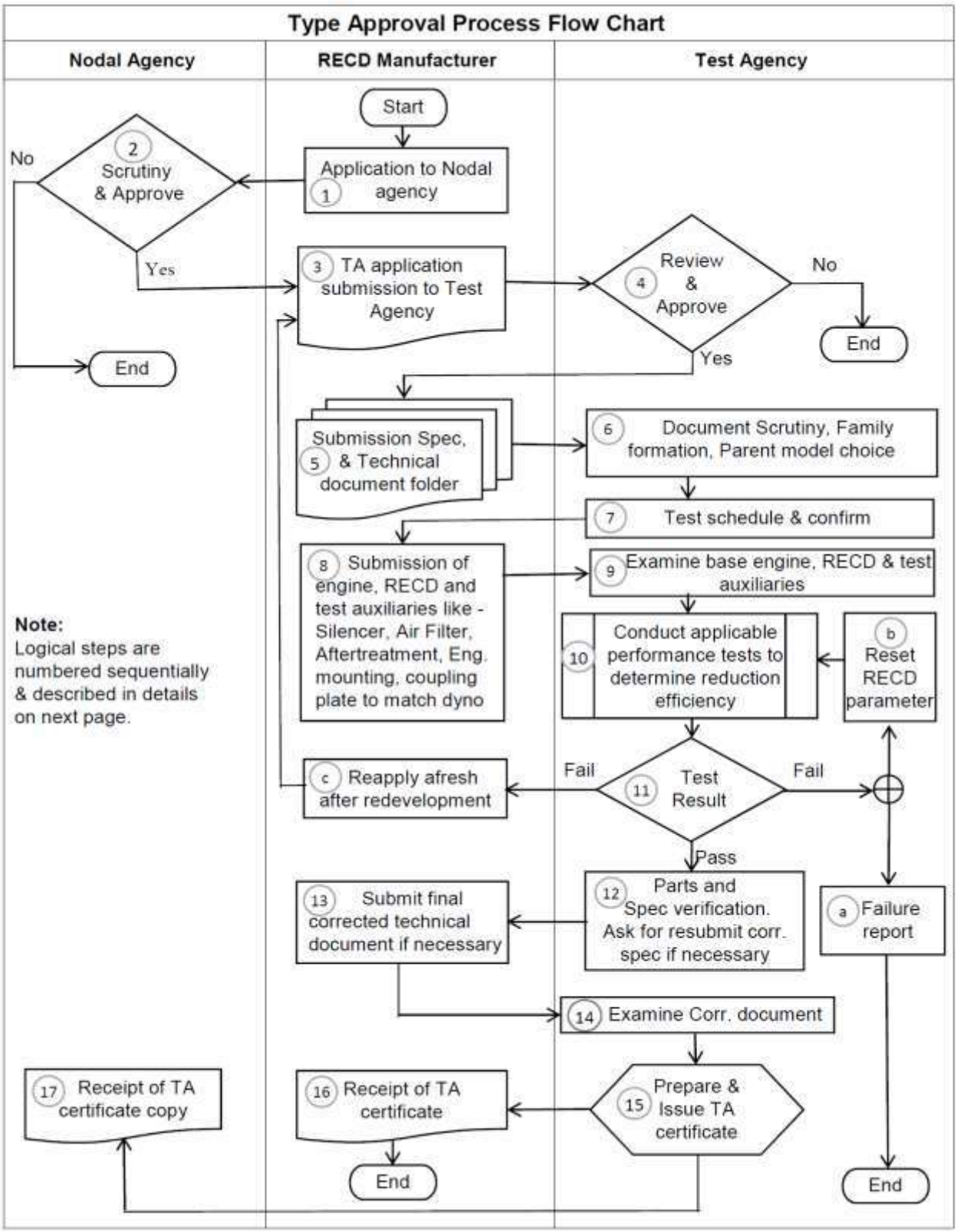
4.14.4. Any change in the lay out DG set canopy/enclosure arising-out of the fitment of RECD shall be approved by the test agency.

4.14.5. Retro fitter without any additional cost should make good provision for a porthole/suitable arrangement just after tail pipe for emission monitoring at a later stage. In case of noncompliance of this, COP may be denied by the Certification Agency.

4.15. Labelling Requirement:

4.15.1. All DG sets fitted with duly certified RECDs shall be marked with the trade name or mark of the retrofit manufacturer that is indicated in Annex 3, and the identifying part number as recorded in the information document issued in accordance with the model set out in Annex 3.

4.16. Type Approval Process Flow-Chart:



Following are the logical steps for the type approval process flow chart described in brief stepwise

1. Application to nodal agency (CPCB) in the form of affidavit seeking permission for type approval of RECD family, submission provided as draft specimen in Appendix 1.
2. Upon written approval of nodal agency to manufacturer and chosen technical agency; (This could be decision-making node with "Yes" / "No" loop).
3. Manufacture contact to selected test agency seeking for type approval of RECD, discuss in brief the process & formalities. Submit type approval certification application to test agency. Based on provisions such application can be written or online through their secured portal.
4. Obtain technical agency approval (*This could be decision making node with "Yes" / "No" loop with NO means, provide additional data*)
5. Upon agencies application scrutiny and negotiations, submit detailed technical documentation as per requirements described in Annexure 1.
6. Obtain documentation approval from technical agency, family formation, choice of parent retro fitment device, provide additional data.
7. Obtain test plan / schedule from technical agency.
8. Upon approval from technical agency plan for providing base engine, RECD, test auxiliaries like - Silencer, air filter, after treatment systems, engine mounting, coupling plate to match dyno, components for PCD demonstration etc. In cases the base engine critical component makes, ID nos, part numbers are mismatched to engine original type approved specification, another engine duly verified by the RECD supplier shall be submitted for the test.
9. Upon receipt of engine along with auxiliaries, technical agency examines the adaptability in test cell, make necessary modification in exhaust line, mounts, etc., if required.
10. Conduct performance test for PM reduction to qualify *(This could be decision making node with "Pass" / "Fail" loop. "Fail" means, a) current TA application is closed out with failure report b) adjust. reset engine parameter for retest or c) further manufacturer may re-apply afresh after redevelopment)*

    10.1 Durability testing- service accumulation run (100hr for Fixed DF option)/500hr/1000 hr.

    10.2 Engine baseline emission.

    10.3 Emission test with RECD.

    10.4 Secondary emission requirement.

    10.5 NO_2 emission requirement.

    10.6 Specific fuel consumption requirement.

    10.7 Test of RECD for regeneration strategy- Continuous or periodic.

    10.8 Test of RECD regeneration characteristic.

    10.9 Assessment criteria for periodic regenerating RECD.

    10.10 Determination of Particulate reduction level/efficiency.

    10.11 Conduct PCD demonstration tests to comply (This could be decision making node with "Pass" / "Fail" loop. "Fail" means, a) current TA application is closed out with failure report b) adjust., reset engine parameter for retest or c) further manufacturer may re-apply afresh after redevelopment)

11. Review of PM test results with manufactures and decision about compliance, in case of failure manufacture have three options to proceed a, b, & c, act accordingly.
12. Technical agency carries out part verification of REC in compliance with document submission, take final review of technical document and ask manufacture to resubmit if necessary. Engine critical components shall match with engine type approved document.
13. Manufacturer submit the corrected technical document if found necessary.
14. Examine corrected document submitted in line with the requirement.
15. Technical agency prepares technical report based on tests.
16. Technical agency issues type approval certificate to manufacturer.
17. Technical agency forwards a copy of type approval certificate to nodal agency.

End

Appendix - 1

Application to Nodal Agency. Specimen for Submission of Affidavit & Profile details of Retrofit Emission Control Device (RECD) manufacturer

Part - A

NOTARISED AFFIDAVIT ON NON-JUDICIAL STAMP PAPER OF Rs.10/-

[To be submitted to the Nodal Agency by a supplier approaching for the first time for TA]

I, ……., Chairman / President / Managing Director / Partner / CEO / COO / Proprietor of M/s ……, having Registered Office at …… engaged in manufacturing /Retrofitting/ import of Retrofit Emission Control Device (RECD) with manufacturing facilities / ware house at:

i) …….

ii) …….

am authorized to swear this affidavit for and on behalf of the above named Company. I do hereby solemnly affirm and declare as under:

1. That the deponent is well conversant with the facts and competent to swear this affidavit.
2. That the deponent declares that M/s …… are manufacturer /Retrofitter/ importer of Retrofit Emission Control Device (RECD) in the brand name

i) ……..

ii) ……..

(Strike out if not applicable)

3. That the deponent declares that M/s ……. are importer of retrofitting devices from M/s i) ….……..…. (ii) M/s ……. (Complete address)
(Strike out if not applicable)

4. That the deponent declares that M/s ……. will obtain Type Approval / Conformity of Production verification only from (Name of the Certification Agency) …… and will not approach any other Certification Agency for Type Approval / Conformity of Production verification for any of their Retrofit Emission Control Device (RECD) models, without prior permission from the nodal agency.
5. That the deponent declares that M/s ……. will manufacture / import and sell only compliant Retrofit Emission Control Device (RECD) on the brand name ……..

(Name & signature with Co. stamp)

(DEPONENT)

VERIFICATION

Verified at ……. on this ……of ……20…… that the contents of the above affidavit are true and correct to the best of my knowledge and belief and nothing has been concealed therein.

Place: ……
Date……

(Name & Signature with Co. Seal)

(DEPONENT)

Part - B

FORMAT FOR SUBMISSION OF PROFILE AND DETAILS OF THE SUPPLIER

A. Company details

- Name of the Company
- Type of Company: Proprietor / Partnership / Private Ltd / Public Ltd
- Name of the Proprietor / Partners / Directors (submit relevant documents)
- Importer / manufacturer/Retrofitter
- Registered Office Address with phone number
- Contact Address with phone number, fax number, email etc.
- Name and designation of the authorized person for submission of documents and to deal with the certification agency
- Plant addresses and contact details, in case of manufacturer
- Ware house address, in case of importer (This cannot be changed without prior intimation to Nodal Agency and Certification Agency)
- Name of the company from whom to import and its contact details, in case of importer
- Plant details, from where to import
- Authenticated Copies of following documents to be submitted
    - i) Manufacturing License from Directorate of Industries / Department of Industry (in case of Manufacturer), IEC Code (in case of importer)
    - ii) GST Registration
    - iii) Consent from State Pollution Control Board/ Pollution Committee
- No. of employees
- Engineers (if any)
- Last year Turn-over
- Any other business

B. Details of Retrofit Emission Control Device (RECD)(Proposed) manufactured / Retrofitted / imported

Sr No	Model Names	Nos. produced /imported in current year	Nos. expected to be produced / imported in the next year
A			
B			
C			
D			

C. Details of Infrastructure

D. Land: Owned / Rented

Area (m2):

E. Covered Area

F. Machinery for manufacture

a)

b)

c)

d)

G. Testing facility equipment's

a) Load bank type and capacity

b) Measuring Instruments

c) Any other

H. Quality Control

1. Quality Control In charge
2. Quality Procedure:

   ISO Certified since when (Enclose a Copy of Operating Procedure)
3. Pre-delivery Inspection Procedure on Gensets (including records maintained)
4. System of serial numbering and marking on Genset and their sub-systems – e.g. all Enclosures, etc.)
5. Any other

Date: .....
Place: .....

SIGNATURE OF THE
(Chairman /President / Managing Director
/ Partner / CEO / COO / Proprietor)

SEAL OF THE COMPANY

---End---

5 Conformity of Production (CoP) Administrative Procedure

5.1 General

5.1.1. Conformity of Production (CoP) compliance is designed to ensure manufacture's/importer's/retrofitter's compliance and control towards a type approved RECD family to statistically ensure engines sold under such emission certification does meet required emissions and other requirements including Particulate diagnostics provisioned by this Regulation.

5.1.2. CoP process compliance also ensures type approval certificate validity and hence right to produce and sale RECD by a manufacturer/importer/retrofitter owing such type approval certification for the next CoP-year. Such provision is administratively provided by issuing Conformity of Production Certificate.

5.1.3. Each manufacture shall subject its RECD model range as mentioned in the clause 4.1.2.3 (a) to the verification of CoP, every year. For this, the year shall mean the period from 1st July of the calendar year to 30th June of the succeeding calendar year.

5.1.4. Each manufacturer/retrofitter, as applicable, shall subject RECD model(s) for or Particulate Control Diagnostics (PCD) compliance test representative of its PCD family as declared during type approval certification for its entire RECD model range. Depending on RECD types certified, a manufacturer/importer/retrofitter may need to submit apt and separate representation of engine & RECD types representing PCD families. Such demonstration and compliance shall be required once per CoP-year per PCD family. For this, the year shall mean the period from 1st July of the calendar year to 30th June of the succeeding calendar year.

5.2 Verification of Conformity of Production (CoP)

5.2.1. **CoP of RECD families:**

RECDs fitted on engines of all ratings shall be subjected to the verification of CoP once for every 500 units per family or once a year, whichever is earlier; -

5.2.2. Wherever applicable, RECDs fitted on engines of all ratings of engines shall be subjected to the verification of PCD once every CoP-year by PCD family(ies) representative RECD(s). Such demonstration is PCD family dependant and irrespective of combined volumes produced and sold under such family(ies).

5.3 Sample size, Decision and Other Criteria for verification of CoP

5.3.1. Testing of RECDs shall be done on sample(s) randomly selected by certification agency from the production line/import warehouse.

5.3.2. In case of RECDs defined in clauses 5.2. above, testing shall be done on sample(s) randomly selected by certification agency from the production line/import warehouse for PCD compliance if applicable.

5.3.3. A minimum one-day's average production volume of the RECD model selected by technical agency, shall be made available for random selection subject to minimum quantity of 3.

5.3.4. The manufacturer/importer/retrofitter shall request the certification agency when they would like to make random selection of RECD(s) and to seek their schedule/availability for completing the CoP test.

5.3.5. CoP verification shall be carried out for each plant of the domestic manufacturer. For imported RECD(s), the CoP testing shall be carried out on the RECD manufactured for each country of origin irrespective of engine family being same.

5.3.6. The certification agency shall intimate to the manufacturer/retrofitter the schedule (month) of sampling/testing. The manufacturer shall inform the production/ import plan for the month in which the technical agency wants to carry out the CoP, to the technical agency. If the manufacturer/retrofitter has a problem due to particular reasons such as the particular model is not likely to be scheduled for production/import at that time, or enough number of RECD(s) may not be available for random selection; the time schedule may be modified based on mutual convenience of the manufacturer/retrofitter and the technical agency.

5.3.7. The manufacturer/retrofitter shall complete all CoP activities (such as random selection, initial running in, emission testing, Particulate Diagnostics testing and documentation) at least one month before the end of CoP-year. The CoP certificate shall not be issued in case of non-adherence to above schedule unless such schedule attainment is due to unavoidable reasons such as but not limited to test facility downtime, extended CoP process encountered.

5.3.8. Following 'Table 2' gives the deadlines for the respective CoP-year for the CoP activities. However, manufacturer can take early action on each activity to ensure compliance.

5.3.9. Manufacturer must take early action on each activity for the families exceeding 500 units of production to ensure the compliance of clause 5.2.

5.3.10. CoP Activity Timelines

Table 2

Sr No	Activity Description	Last Date
1	Submission of production/import plan/actual details to technical agency	1st March
2	Random Selection	1st April
3	Submission of RCEDs & engines and subsequent testing (Including extended CoP if any)	31st May
4	Completion of documentation and CoP Certificate issuance	30th June

5.3.11. The manufacturer/retrofitter shall inform the technical agency regarding the stoppage of production of a specific model, in case this has not been anticipated at the start of the CoP period. This shall be intimated well in advance so that CoP selection of the RECD can be completed by the technical agency before stoppage of production. Manufacturer/retrofitter is held accountable for ensuring CoP is conducted and samples are made available per requirements of this Regulation.

5.3.12. The manufacturer/importer/retrofitter shall provide all the assistance required by the technical agency for completing the tests.

5.3.13. The latest updated technical specifications, procedure of pre-delivery inspection (PDI), running-in, shall also be submitted before the RECD selection, if there have been revisions after the previous CoP/type approval.

5.3.14. Pre-delivery inspection as per owner's instruction manual/service manual will be carried out by the manufacturer as per procedure declared at the time of type approval and as amended and intimated to concern technical agency from time to time for the selected engine(s), under the control of technical agency.

5.3.15. The running if applicable of the RCED and the engine(s) shall be carried out as per the manufacturer's/importer/retrofitter's recommendation submitted during the type approval and as amended and intimated to the concern technical agency from time to time, for RCED & engine(s) under control of the technical agency. Running in if applicable may also be carried out at manufacturer's/importer's/retrofitter's place under the control of technical agency provided adequate facilities are available. After such running-in procedure, manufacturer will be permitted to carry out all the adjustments recommended in their owner's/service manual and as amended and intimated the

concern technical agency from time to time published with technical agency, under the control of the technical agency.

5.3.16. In case of failure of any major component during the running in or testing, the technical agency may permit to replace component only once, which has failed and which does not affect the performance and emission of the RECD. Such decision discretion is entirely with technical agency. In case of failure of emission affecting component, random selection of RECD at manufacturer's plant or warehouse shall be done afresh. If for such randomly selected RECD (second time) or a replaced component fails again, it shall be reported to the nodal agency by the concern technical agency and agency shall await instructions from the nodal agency for further action.

5.3.17. The manufacturer/importer/retrofitter shall submit the randomly selected RECD(s) & the representative engines to technical agency within four weeks (8 weeks in case of import subjected to last date as mentioned in clause 5.3.10. – Table 2) of completion of running-in for emission compliance test and Particulate diagnostics test where applicable. Manufacturer/retrofitter also shall supply appropriate 'failed' parts for PCD demonstration in line with agreement with technical agency during type approval certification and documentation.

5.3.18. The technical agency should endeavour to complete the required testing of selected RECD(s) within four weeks after submission of engine(s).

5.3.19. The testing shall be done as per applicable procedures and specifications described in Annexure 7 with test facility compliant to requirements specified Annexure 4 while utilizing data evaluation and result calculation procedures described in Annexure 5 of this Regulation.

5.4 Sampling plan for CoP

5.4.1. **Sampling Plan :**

5.4.1.1. One RECD sample selected randomly shall be tested as per procedure described in Annex 7 of this Regulation;

5.4.1.2. If the RECD sample as tested fails to comply with the emisison limits, the manufacturer may ask for measures to be performed on a sample of RECDs taken from the production series and including the RECD orignally tested. The manufacturer/retrofitter shall specify the size 'n' of the sample subject to 'n' being minimum of 3 and maximum of 10 inclusive of sample originally tested.

5.4.1.3. The production or import units of all models in the family shall be deemed to compy with emission limits if following condition is met for each criteria pollutant except for Smoke limits:

$\overline{x} + k. S < L$

Where,

$\overline{x}$ = arithmetic mean of the results of the tests conducted on 'n' number of samples, for a particular specie

S = Standard deviation of the results of the tests conducted on 'n' number of samples, for the specie = $[\Sigma (x - \overline{x})^2 / (n - 1)]^{1/2}$

x = results of the tests conducted on 'n' number of samples, for the specie.

L= E_{Base}- (E_{Base} x (PM Reduction Efficiency/100))

k = a statistical factor dependent on 'n' number of samples and as given in below table.

Table 4

Values of Statistical Factor 'k' with respect to parameter 'n'

N	2	3	4	5	6	7	8	9	10
K	0.973	0.613	0.489	0.421	0.376	0.342	0.317	0.296	0.279

5.4.2. **Miscellaneous failure during CoP**

5.4.2.1. **Gross Power failure & Emission :** For verifing the conformity of production, if the selected engine does not meet the gross rated power, rated speed & emissions limit as applicable, Another engine shall be submitted by the RECD supplier & subjected to the emission test for the conformance of production.

5.4.2.2. **PCD demostration failure** : For verifing the conformity of production, if the selected RECD does not meet the compliance requirement with respect to PCD demostration as applicable, the another two RECDs will be taken from the series at random and be tested as per this part. This selected RECD should meet the limit values specified.

5.4.2.3. If further same failure noted in any of the additionally selected samples of clause 5.4.2.2 , the production shall be considered as non-compliance and the provision of clause 5.9 shall be put into effect.

5.5 Certificate of Conformity of Production (CoP) and It's Validity

5.5.1. After verification for CoP, the certification agency shall issue a CoP verification report to the manufacturer/retrofitter within one month of the date of testing completion , indicating compliace or non-compliance. In case of compliance, the technical agency shall issue a CoP certificate to the manufacturer as per format prescibed in Annex 2 along with report. At the end of CoP year, detalis of CoP & the copies of certificate as well as report shall also be forwarded to the Nodal Agency.

5.5.2. Certificate of conformity of production is required to commence the production and sale of RECD(s) immediately next CoP-year. Validity of current CoP certificate shall be till successful compliance of first CoP test in next CoP-year.

5.5.3. In given CoP-year for engine type(s) described in clause 5.2.2., successful compliance of CoP for every 500 RECD(s) invoiced by the manufacturer/retrofitter shall enable further production of 500 RECD(s) and thereafter, in case engine(s) volumes for a particualr RECD family exceed 500 units annually ;

5.5.4. The CoP certificate will be issued at the end once all the numbers of RECD samples demanded as per the production plan submitted become tested successfully. Intermediate CoP certificate i.e at each sample tested shall not be issued, However the test data report will be issued at every test sample.

5.5.5. The COP certificate shall be issued on compliance of the prescribed norms and RECD supplier shall provide a copy of this certificate to the user and obtain a acknoledgmnet for the same from the user.

5.6 CoP Discontinuity

5.6.1. If there is no production or import of model(s) of a particular RECD family for two consecutive years immediately after obtaining type approval or immediately after obtaining CoP certificate, the type approval certificate for that particular RECD family becomes invalid. In case the manufacturer wants to maufacture or import RECD model(s) of such particular engine family, then the manufacture shall approach Test Agency to obtain a new Type Approval certificate afresh following stated procedure.

5.6.2. If there is no production or import of model(s) of a particular RECD family for two consecutive years immediately after obtaining type approval and if the CoP test is requested for the third year, then the supplier shall approach Test Agency to obtain approval for the extention of validity of Type Approval.

5.7 Exemption from CoP

In the following cases, RECD family(ies) shall be exempted from CoP process.

5.7.1. In case of no production or import, the manufacturer shall submit a declaration to technical agency for 'No production or import' of a particular family models for every CoP-year.

5.7.2. CoP test shall be conducted by technical agency for the next CoP-year, upon receipt of declaration by the manaufacturer that there was no production or import during current CoP-year.

5.7.3. Declaration in this regard should be submitted before 31st March the current CoP-year.

5.7.4. Any RECD(s) manufactured for purpose of export outside India. CoP exemption shall apply for such volumes and CoP test exemption shall apply if all such RECD(s) produced are exported.

5.7.5. Any domestically manufactured/retrofitted RECD(s) intended for the purpose of sample (Maximum number of 4 units per engine family) only and not for sale in India.

5.7.6. Any RECD(s) imported for the purpose of sample testing, bench making and not intended for any commercial sale (Maximum nuber of 4 units per year).

5.7.7. Any RECD imported for the round robin or laboratory correlation tests. Such RECDs along with engines if any, shall be exported back within 12 months from the date of import. Appropriate permissions as applicable for used engines import if any shall be obtained by manufacturer/importer.

5.7.8. For obtaining exemptions regarding clauses 5.7.5, 5.7.6 and 5.7.7, the manufacturer shall obtain written approval from Nodal Agency.

5.7.9. Test Agency shall update quarterly compliance status to the Nodal Agency .

5.7.10. In case of any dispute, matter shall be refered to the Nodal Agency.

5.8 Production Definitely Discontinued

5.8.1. If manufacturer decides to discontinue production/withdraw type approval certificate of a specific RECD(s) family or multiple families from a specific plant or all plants, the manufacturer shall so inform to Test Agency involved in type approvals and CoP compliance at least three month before the stoppage of production.

5.8.2. In such case, the manufacturer shall ensure CoP compliance for the RECD family(ies) from every manufacturing plant before the production of the RECD family(ies) is discontinued following CoP compliance process described in clauses 5.1.1., 5.1.2, 5.1.3 and 5.1.4 of this Regulation.

5.8.3. Upon receiving the relevant communication, the Test Agency shall inform the manufacturer/retrofitter the acceptance of the communication and provide an acceptance letter.

5.9 Consequances of non compliance

5.9.1. If the CoP vertification report of the technical agency for a model family indicates non-compliance, the manufacturer must stop manufacturing/retrofitting with immediate effect all models within the said emissions family.

5.9.2. Further, the manufacturer/retrofitter must analyze the reasons for non-compliance, plan to take corrective actions in design, production line and units already produced and submit a report to the nodal agency with a copy to concern technical agency withing four weeks of the receipt of the CoP verification report.

5.9.3. If the manufacturer is unable to diagnose the reasons for non-compliance within stipulated time, this shall be clearly stated in the report.

5.9.4. Based on the diagnostics and corrective action plan submitted by the manufacturer.

5.9.5. The Nodal Agency in consultation with technical agency and if both decide to, in consultation with standing committee, may take any of the following actions:

1) Allow continuation of production or import of all models in the family if it is satisfied with the corrective actions planned or taken by the manufacturer and ability to meet emission norms.

2) Allow continuation of production or import of some or all other models of the RECD family if it determines that the reasons for non-conformance of the tested model are not relevant to these models; with or without additional verification of CoP in due course.

3) Stop production or import of some or all other models of the RECD family till compliance is demonstrated by the supplier, through a re-verification of CoP. In case of imported model(s), the non-compliant RECD(s) should be sent back to the original destination.

5.9.6. The manufacturer/importer shall be given an opportunity to explain it's views before taking final decision.

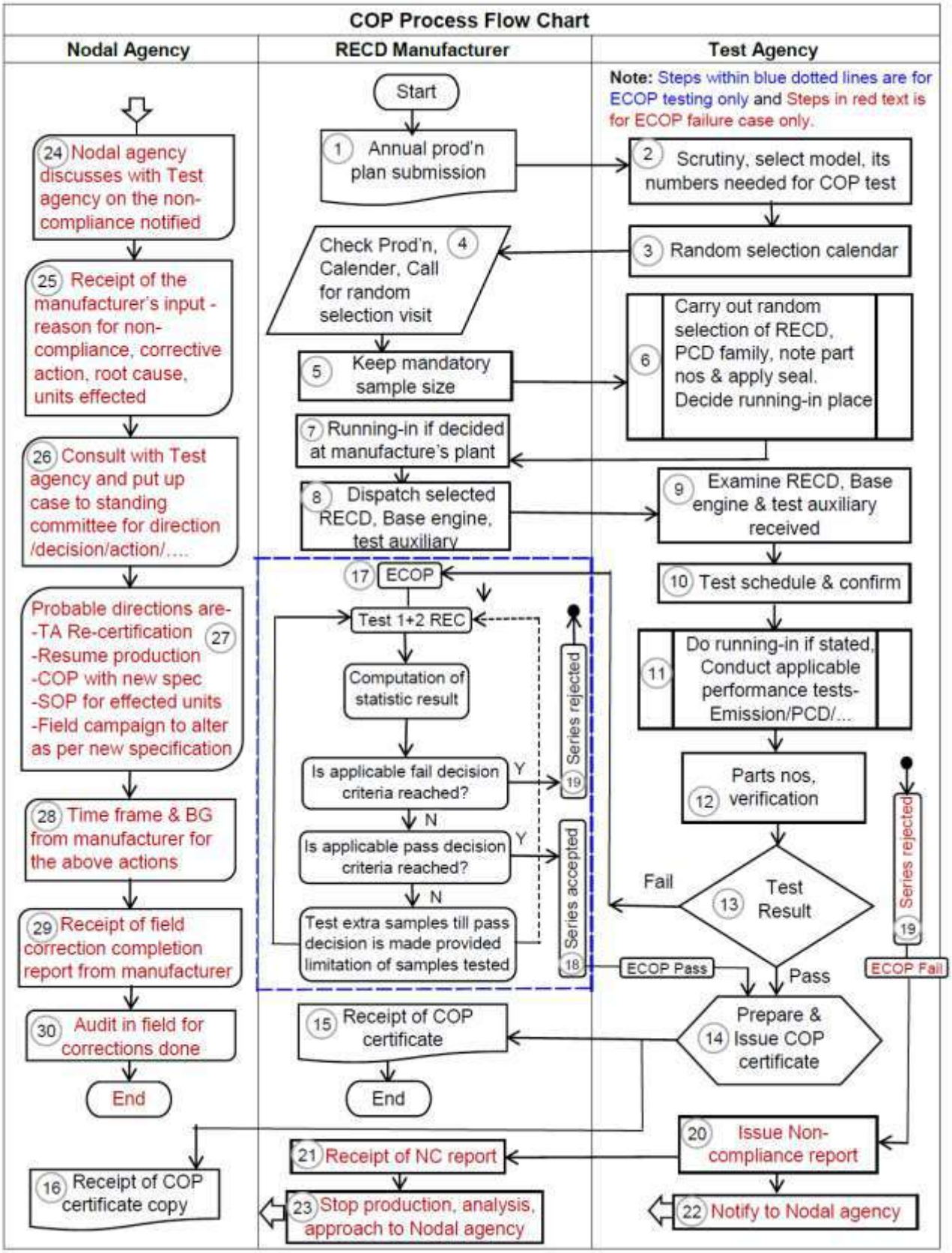
5.9.7. It is responsibility of the manufacturer/retrofitter to ensure at his cost that the modifications are carried out such as field retro fitment campaigns within period specified by the Nodal Agency on all products produced as well as sold / dispatched in the period between the dates from which the CoP became due and re-verification of CoP or as decided by the Nodal Agency, in consultation with standing committee.

5.9.8. Nodal Agency with help from Technical agency shall audits compliance in field on random basis for corrections done and issues closure letter to manufacturer.

5.9.9. Further, to avoid such non-compliances again in future, following precautionary measures shall be initiated to strengthen the process which will be followed for next two CoP year after re-certification & resuming the production with new modified spec.

a) CoP compliance shall be established once for every 250 units of production.
b) First CoP compliance to be established before crossing 50 units of production once production resume with modified spec.
c) CoP activities to be completed in all by 31st March every CoP year for the next three year.

5.10 CoP Process Flow Chart



Following are the logical steps for the CoP process flow chart described in brief stepwise-

CoP cycle shall end with either -

I. CoP compliance with regular sample testing (Steps 1-16)
II. CoP compliance with extended samples testing (Steps 17-18)
III. CoP non-compliance after extended testing (Steps 19-30)

CASE I:

1. Manufacturer with valid Type Approval and CoP certification submits annual estimated production volume data to technical agency involved in the format provided within two months of start of new CoP-year.
2. Technical agency communicates to manufacturer RECD type chosen and the number of samples needed for CoP compliance test for all RECD families of that manufacturer within one month of submission of above production volume data.
3. Technical agency also communicates to the manufacturer plan for CoP of RECD random selection based on manufacture's input above;
4. Manufacturer coordinates adhering to technical agency provided or negotiated plan and coordinates for engine random selection at manufacturing plants.
5. At plant, manufacturer provides with minimum required sample size for random selection.
6. Technical agency representative carries out random selection and does note RECD critical component part and serial numbers. Provides with appropriate seal for avoiding tampering of assembly parameters further.

   Technical agency representative randomly selects base engine.

   Technical agency representative can also carry out random selection of an PCD family if from chosen representative RECD family for PCD compliance utilizing the same pool of RECD offered.
7. Decision if running –in is carried out at manufacturer's location or technical agency location.

   If running in is agreed to be carried out at manufacture's facility, running-in shall be started in presence of technical agency representative.
8. RECD along with base engine shall be transported to technical agency test location.
9. Upon receipt of RECD & base engine along with auxiliary technical agency examine the adaptability in test cell, make necessary modification in exhaust line, mounts, etc., if required.
10. Technical agency communicates the test schedule to manufacture for his witness.
11. Technical agency carries out performance test and emissions test per applicable procedure and shares results with manufacturer.
12. Technical agency carries out critical component type/part numbers, injection timing verification and match with type approved document, in case any change noted, manufacturer to provide the declaration in this regard, till time CoP certificate will be on hold.
13. Review of test result & decision on compliance.
14. If CoP compliance is obtained, the technical agency shall prepare the compliance certificate within 4 weeks from the date of testing. Base engine, RECD & test auxiliary is returned to the manufacturer.
15. Technical agency issue compliance certificate to manufacturer.
16. Technical agency forwards a copy of compliance certificate to Nodal agency.

CASE II:

17. **ECoP:** If non-compliance observed after testing (at Stage No 13), process begins from extended random selection of RECD(s) as per preferred options prescribed in this regulation.

    17.1 Initially test 2 more RECDs

    17.2 Computation of the test statistic result of 3 RECD (1-originally tested + 2 new)

    a) According to the appropriate clause, does the test statistic result agree with the criteria for failing the series

    b) According to the appropriate clause, does the test statistic result agree with the criteria for passing the series

    17.3 If, answers of a & b are NO, then; continue the testing on additional samples till pass decision is made provided limitation of samples tested as applicable (10 numbers)

18. If during testing if the pass decision criteria is reached, the series is deemed to be compliance and CoP certificate is issued (then continue from Stage14-16)

CASE III:

19. If during testing if they fail decision criteria is reached, the series is deemed to be non-compliance;

    Or if Manufacturer opts to declare non-compliance without availing total number of samples allowed to be tested, the series is deemed to be non-compliance

20. Technical agency prepares the CoP failure report

21. Technical agency issue CoP failure report to manufacturer

22. Technical agency informs nodal agency about CoP non-compliance of said RECD family

23. Manufacturer stops production or import of the said non-compliant RECD family;

    Manufacturer informs nodal agency about non-conformity, stoppage of production and dispatch and their plan for failure investigation within 4 weeks of receipt of CoP verification report

24. Nodal agency discusses with test agency in details on the non-compliance notified.

25. Nodal agency replies to the manufacturer about their inputs on timelines by which compliance shall be obtained as well as failure root cause and corrective action plan submission. Nodal agency also informs about any financial penalty or assurance required from the manufacturer;

26. Manufacturer submits root cause analysis and corrective action plans to nodal agency in consultation with technical agency.

27. Nodal agency in consultation with technical agency reviews manufacture's submissions and decides if such case shall be put forth for standing committee review and guidance.

    If decided to represent at standing committee, nodal agency brings this issue to standing committee and allows manufacture to represent their submissions. If standing committee agrees / approves manufacturer's submission and plan then;

28. If nodal agency decides on their own, then;

    28.1. Nodal agency gives written permission to technical agency to proceed with re-verification of CoP with improvements implemented by manufacturer and also type approval re-certification as the case may be.

28.2. Manufacturer offers RECD sample and technical documentation to technical agency and complies with CoP.

28.3. Technical agency issues compliance certificate or type approval certificate if newly approved as an option.

28.4. Manufacture begins production after obtaining new Type Approval or CoP compliance certificate.

28.5. Manufacturer completes corrective actions on RECD(s) dispatched during period of CoP and CoP failure date.

29. Manufacturer complies with 'financial assurance related' documents asked by Nodal Agency;

30. Manufacturer submits corrective action/campaign report with adequate evidences to the Nodal Agency

31. The Nodal Agency with help from the technical agency audits compliance in field for corrections done and issues closure letter to manufacturer.

End

Annexure 1

Information document

Information Document No - PCLS/12/2021-22 relating of Pollution Control Series to the type-approval of Retrofit Emission Control Devices (RECD) for In-Use DG sets equipped with compression ignition engines.

A list of the main components has to be attached to describe the range of validity of the type-approval. Any drawings and part lists shall be supplied in appropriate scale and sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, shall show sufficient detail.

Upon request of the Approval Authority, further information may be needed for REC family members to demonstrate compliance with paragraphs 4.10. of this Regulation, as appropriate.

If the system, components or separate technical units have electronic controls, information concerning their performance shall be supplied.

Appendix 1: Brief Technical Data & Specifications of RECD Used for Genset Application

S. No	Item Description	Parent RECD Type	RECD types within the RECD family (if applicable)		
		Type 1	Type 2	Type 3	Type n
1	**GENERAL INFORMATION**				
1.1	Make (trade name of manufacturer)				
1.2	Name and address of manufacturer (Type approval Certificate Owner)				
1.3	Name and address of manufacturer's authorised representative with contact telephone number and email address				
1.4	Name(s) and address(es) of assembly/manufacture plant(s)				
1.5	RECD family designation				
1.6	RECD type/model designation				
1.7	RECD Category (Domestic/Imported)				
1.8	Location and method of affixing of the approval mark				

2	**DESCRIPTION OF THE DEVICE**				
2.1	Class of RECD				
2.2	Make(s) (Commercial name), and manufacturer's type identification of the RECD				
2.3	Identifying part number(s) of the RECD				
2.4	Engine/ Engine Family for which the RECD is intended (application range)				
2.5	Number(s) and/or character(s) characterising the engine baseline emission(s) performanc**e**				
2.6	Number(s) and/or character(s) characterising the achieved engine emission(s) performanc**e**				
2.7	PM Reduction level of the RECD claimed				
2.8	Is the RECD intended to be compatible with OBD requirements: Yes / No				
2.9	Description and drawings showing the position of the RECD relative to the engine exhaust manifold(s)				
2.10	Maximum design exhaust flow rate of the RECD in kg/s				
2.11	Maximum allowable exhaust back pressure of the RECD in kPa @ maximum design flow rate stated above				
3	**CHARACTERISTICS OF THE PARTICULATE REDUCTION REC AND PARTICULATE REDUCTION REC FAMILY**				
3.1	Dimensions, shape and active volume of the particulate matter reduction system				
3.2	Maximum distance to the RECD inlet permissible from the outlet of the turbocharger (turbine) or the outlet plane of the exhaust manifold where no turbocharger is fitted.				
3.3	Description drawings and part lists of the Particulate Matter (PM) reduction RECD				

	(The description shall include a list of the main components (stating the part numbers) that are assembled to a RECD for each application. Furthermore, the description shall provide all information necessary to permit decisions relating to the RECD family to be made				
3.4	Type of retention of the active element (for example, adhesive or mechanical fixing)				
3.5	Working principle of the PM reduction active element (for example metallic or ceramic material including material type, barrier filtration or aerodynamic separation or any other)				
3.6	Design and characteristics of the filter or other active material				
3.7	Type(s) of catalytically active material(s) (if any)				
3.8	Physical design of the substrate				
3.9	Cell density, porosity, mean pore size and pore size distribution				
3.10	Location (upstream/downstream), function and working principle (e.g. oxidation) of any supplementary catalyst(s):				
3.11	Type(s) of catalytically active material (s):				
3.12	Physical design of the substrate				
3.13	Cell density				
3.14	Minimum volumetric concentration of catalytically active materials of each element of the particulate reduction system including supplementary catalysts (if fitted) (grams/m^3):				
3.15	Maximum volumetric concentration of catalytically active materials of each element of the particulate reduction system including supplementary catalysts (if fitted) (grams/m^3)				
3.16	The design characteristics of the canning or packaging				

3.17	Volume of each active component				
3.18	Method or system of regeneration (comprehensive description through separate document and/or drawing)				
3.19	Type of regeneration (for example periodic or continuous)				
3.20	Regeneration principle, frequency and strategy				
3.21	Method and control strategy for introducing additives or reagents (if used):				
3.22	Type and concentration of reagent(s) or additive(s)				
3.23	Frequency of reagent or additive refill				
3.24	Description of PM reduction system monitoring				
3.25	Description of any modifications to the original engine or emissions control system				
3.26	Normal operating temperature (Deg. C) and pressure range(kPa)				
3.27	Use of insulation (yes/no)				
3.28	Design and characteristics of the insulation				
4	**ANY ADDITIONAL INFORMATION**				
4.1	Please specify				
4.2	Please specify				
4.3	Please specify				
4.4	Please specify				
4.5	Please specify				
5	**ENGINE TYPE (S) FOR WHICH THE REC DEVICE IS QUALIFIED (APPLICABLE RANGE)**				
4.1	Engine manufacturer				
4.2	Engine Type Approval certificate number (Refer engine compliance name plate)				
4.3	Model year from/to				
4.4	Engine type/Model				
4.5	Rated Power kW @ RPM				

4.6	Capacity/displacement (Litre)				
4.7	Bore x Stroke (mm)				
4.8	No of cylinder				
4.9	Capacity / cylinder (Litre)				
4.10	Engine Baseline emissions				
4.11	Is silencer replaced? Explain alternate noise compliance means if Yes				
4.12	Type identification of the RECD				
4.13	REC Type/model				
4.14	PM Reduction Level/Efficiency				
4.15	Any other, Please specify				
4.16	Any other, Please specify				
6	**ATTACHMENT ENCLOSED- DOCUMENTS/ DRAWINGS/ LAYOUT ETC.**				
6.1	Please specify				
6.2	Please specify				
6.3	Please specify				
6.4	Please specify				
6.5	Please specify				
7	**MANUFACTURER'S SIGNATURE AND SEAL/ STAMP**				

Manufacturer		Document No	
Name		Revision status	
Signature/Seal			
Designation		Revision date	
Date		Sheet No.	

ANNEXURE 2

Certificate – Type Approval and CoP Template to be attached here by Test Agencies

TA/CoP Certificate No.		Cert. issued Date:

Cert	Report	Spec	Total
1	4		pgs.

CERTIFICATE
OF
TYPE APPROVAL/EXTENSION/CONFORMITY OF PRODUCTION FOR THE YEAR…
for
Retro-fit Emission Control Devices (RECD) Compliance to Diesel Power Generating Set Engines Up to Gross Mechanical Power 800 kWm, as Per NGT Order in reference to OA No 681; 6th August 2018; order issued on 06th August 2019.

M/s. Manufacturer's Name & Address.

Based on the verification of documents & trials conducted on RECD Type/model "XXXX" (Family R…) manufactured/imported by M/s. XXXX XXXX XXX/ and randomly selected from their XXX plant,/it is certified that the following RECD models of family R… complies with the provisions of Type Approval/Type Approval Extension/Verification of the Conformity of Production (CoP) as per para XX of CPCB System Procedure number CPCBXXXX (Retro-fit Emission Control Devices (RECD) Compliance to Diesel Power Generating Set Engines Up to Gross Mechanical Power 800 kW, as Per NGT Order/report "Report filed in O.A. No. 681/2018 dated 6.08.2019".

S No	Item Description	Parent RECD Type	RECD types within the RECD family (if applicable)		
		Type 1	Type 2	Type 3	Type n
1	Manufacturing Plant address				
2	Manufacturer's trade name or mark				
3	RECD family designation				
4	RECD type/model designation				
5	RECD Category (Domestic/Imported)				
6	Class of RECD				
7	Type Identification of the RECD				
8	Location of type ID marking				
9	Identifying part number(s) of the RECD				
10	Engine/ Engine Family for which the RECD is intended (application range)				
11	PM Reduction Efficiency of the RECD				
12	Designed for fitment to an engine meeting the emissions requirements of (Regulation and Stage):				
13	Manufacturing period in of CoP				

Validity of the Certificate: This Certificate is valid upto dd/mm/yyyy subject to conducting COP by dd/mm/yyyy. In case of proposed closure/ discontinuation of this activity, it is to be informed just after conducting COP.

Disclaimer: As appropriate

Authorized Signatory - 1

Test Agency Seal/Stamp

Authorized Signatory- 2

Head of the test executed department

Head of the Test agency/ Technical agency

Reference: Report No. XXX/XXXXX/XXX, Dated dd-mm-yyyy

Place of Issue:

TYPE APPROVAL/ EXTENSION/ CONFORMITY OF PRODUCTION (CoP) TEST REPORT

Annexure to Certificate Number					
Report No.		**Report date**			
Date of Test		**Test Site**			
Date of application		**CoP Period *(incase of COP)***		**CoP Year**	
Objective	Performance test on RECD for Type Approval / CoP for the year…./ as per para XX of CPCB System Procedure number CPCBXXXX (Retro-fit Emission Control Devices (RECD) Compliance to Diesel Power Generating Set Engines Up to Gross Mechanical Power 800 kWm, as Per NGT Order/ report "Report filed in O.A. No. 681/2018 dated 6.08.2019".				
Manufacturer					
Manufacturing Plant					

Brief Specification of Base Engine on which RECD has been tested							
Base engine Type Approval Certificate No.				Eng Sr No		Date of Mfg.	
Engine Manufacturer		NA / TC / TC-IC		WC / AC			
Engine Model		No.of Valves/Cyl		Bore x Stroke mm			
DI / IDI		No. of Cylinders		Swept Volume Litre			
INLINE / V		Rated Power		Rated Speed			
Any Specific	Mechanical governor/ Electronic governor / FIP Inline, Rotary,CRDI, PT, Unit Injector / EGR / DOC etc						

Brief Specification of RECD Type/ Model tested			
RECD Family		RECD Type /Model	
Identifying Part number(s)		Type Identification of the RECD	
Class of REC		RECD Sr No tested	
Any Specific			

Test Procedure Reference	a) "System Procedure number CPCBXXXX" on Retro-fit Emission Control Devices (RECD), published by CPCB
	b) Measurement of CO, HC, NOx & PM as per D2-5 Mode Cycle of ISO-8178 (Part 1)
	c) Measurement of exhaust gas smoke (m^{-1}) as per ISO-8178(Part 3)
	d) Test diesel fuel as per the specifications given in the System Procedure number CPCBXXXX

Test Equipment Used	**Make**	**Model**
Dynamometer		
Exhaust gas analysis system		
Particulate measurement system		
Air flow meter		
Fuel consumption meter		
Smokemeter		
Intake air conditioning system		
Weighing micro balance		

Summary of Performance Test Results

Emissions	NOx	HC	NOx+HC	CO	PM	Smoke	Corr. Power	SFC	NO_2
	g/kWh	g/kWh	g/kWh	g/kWh	g/kWh	m^{-1}	KW	g/kWh	g/kWh
Baseline emission									
RECD fitted emission									

Regeneration adjustment factor for PM		Application method : Addititive/ mutiplicative/ upward/ downward
Final PM result with Regeneration adjustment factor		

S No	**Requirement**	**Result / Impression/ Remark**
1	Performance of an endurance run	
2	Verification of the engine baseline emissions	
3	Determination of emissions with the REC fitted	
4	Results of the reduction efficiency	
5	Secondary emission requirement	
6	Determination of the NO_2 emissions and other regulated pollutants	
7	Specific fuel consumption requirement	
8	Test of REC for regeneration strategy	
9	Test of REC regeneration characteristic	
10	REC to demonstration compatibility with OBD/PCD requirements	
11	Exhaust back pressure requirement	
12	Engine gross power, rated speed & smoke requirment	
13	Declaration on Noise emissions	
14	Any other please specify	

Conclusion	The engine + RECD system meet the requirement in force from dd-mm-yy (Power range upto 800 kW) as per System Procedure number CPCBXXXX (Retro-fit Emission Control Devices (RECD) Compliance to Diesel Power Generating Set Engines Up to Gross Mechanical Power 800 kWm, as Per NGT Order/ report "Report filed in O.A. No. 681/2018 dated 6.08.2019".

Test Enginer	**Reviewer**	**Approved by**	**Authorized Signatory-1**

Enclosures	1) Annexure I - Baseline emissions test data sheet
	2) Annexure II - REC fited Emissions test data sheet
	3) Annexure III - Engine type(s) for which the REC device is qualified (application range)

ANNEXURE - I
BASE LINE EMISSION PERFORMANCE RESULTS

ANNEXURE TO REPORT NO: **REF. SHEET NO : XXXX**

TEST DATE		TEST SITE		TEST STANDARD	
RECD MANUFACTURE		BORE X STROKE(mm)		DYNAMOMETER	
BASE ENGINE MANUFACTURER		NO OF CYLINDERS		DYNO CONSTANT	
BASE ENGINE MODEL		CUBIC CAPACITY		F.C. METER	
BASE ENGINE SERIAL NO		RATED_SPEED		EMISSION ANALYZER	
RECD TYPE/ MODEL		FUEL		COND. AIR SYSTEM	
RECD IDENTIFICATION NO		SULPHUR CONTENT OF FUEL		AIR FLOW METER	
RECD SR NO		SMOKE METER		P.M. EQUIPMENT	

Sr No	Speed	Torque	Fuel Flow Rate	Power obs.	BSFC obs	Fuelling	T_Air In	RH	P_Baro	Air Flow Rate	Air Fule Ratio	Fa	P_AID	P_Exh Back	P_Man	T_Man	Smoke	Power Corr. Factor
--	*(rpm)*	*(N-m)*	*(Kg/hr)*	*(kW)*	*(g/kWh)*	*(mm³/str/cyl)*	*(°C)*	*(%)*	*(kPa)*	*(Kg/hr)*	*(-)*	*(-)*	*(mmH2O)*	*(mmHg)*	*(bar)*	*(°C)*	*(m^{-1})*	*(-)*
1																		
2																		
3																		
4																		
5																		

Sr No	NOx (Wet)	CO (Dry)	HC (WET)	CO_2 (Dry)	O_2	NO_2	Dry-Wet Corr. Factor	Humidity Corr. Factor	NOx Corr.	CO Corr.	HC Corr.	NO_2	WF	NOx* WF	CO * WF	HC *WF	NO_2 *WF	Power *WF	Power Corr.
--	*(ppm)*	*(ppm)*	*(ppm)*	*(%)*	*(%)*	*(ppm)*	*(-)*	*(-)*	*(g/h)*	*(g/h)*	*(g/h)*	*(g/h)*	*(-)*	*(-)*	*(-)*	*(-)*	*(-)*	*(-)*	*(-)*
1																			
2																			
3																			
4																			
5																			

WEIGHTED SUM					

WEIGHTED MASS EMISSIONS AS PER 5-MODE CYCLE

NOx :		(g/kwh)	CO		(g/kwh)	HC		(g/kwh)	PM		(g/kwh)	NO_2		(g/kwh)

Max Smoke		m-1

MAX. ALLOWABLE INTAKE DEPRESSION DECLARED BY MANUFACTURER : kPa
MAX. ALLOWABLE EXHAUST BACK PRESSURE DECLARED BY MANUFACTURER : kPa
MAX. ALLOWABLE INTAKE MANIFOLD TEMPERATURE DECLARED BY MANUFACTURER (IN CASE OF TC-IC) : Deg C

PARTICULATE MEASUREMENT :
(a) PARTICULATE MASS (mg)
(b) Msam TOTAL (gm)
(c) Gedf WEIGHTED AVERAGE (kg/h)
(d) PM correction factor Humidity (kp)

Test Agency Seal/Stamp

Test Remark : **1) BASE LINE EMISSION TEST**

TEST ENGINEER **REVIEWER** **AUTHORISED SIGNATORY 1**

ANNEXURE - I

RECD FITTED EMISSION PERFORMANCE RESULTS

ANNEXURE TO REPORT NO: **REF. SHEET NO : XXXX**

TEST DATE		TEST SITE		TEST STANDARD	
RECD MANUFACTURE		BORE X STROKE(mm)		DYNAMOMETER	
BASE ENGINE MANUFACTURER		NO OF CYLINDERS		DYNO CONSTANT	
BASE ENGINE MODEL		CUBIC CAPACITY		F.C. METER	
BASE ENGINE SERIAL NO		RATED_SPEED		EMISSION ANALYZER	
RECD TYPE/ MODEL		FUEL		COND. AIR SYSTEM	
RECD IDENTIFICATION NO		SULPHUR CONTENT OF FUEL		AIR FLOW METER	
RECD SR NO		SMOKE METER		P.M. EQUIPMENT	

Sr No	Speed	Torque	Fuel Flow Rate	Power obs.	BSFC obs	Fuelling	T_Air In	RH	P_Baro	Air Flow Rate	Air Fule Ratio	Fa	P_AID	P_Exh Back	P_Man	T_Man	Smoke	Power Corr. Factor
--	*(rpm)*	*(N-m)*	*(Kg/hr)*	*(kW)*	*(g/kWh)*	*(mm³/str/cyl)*	*(°C)*	*(%)*	*(kPa)*	*(Kg/hr)*	*(-)*	*(-)*	*(mmH2O)*	*(mmHg)*	*(bar)*	*(°C)*	*(m^{-1})*	*(-)*
1																		
2																		
3																		
4																		
5																		

Sr No	NOx (Wet)	CO (Dry)	HC (WET)	CO_2 (Dry)	O_2	NO_2	Dry-Wet Corr. Factor	Humidity Corr. Factor	NOx Corr.	CO Corr.	HC Corr.	NO_2	WF	NOx* WF	CO * WF	HC *WF	NO_2 *WF	Power *WF	Power Corr.
--	*(ppm)*	*(ppm)*	*(ppm)*	*(%)*	*(%)*	*(ppm)*	*(-)*	*(-)*	*(g/h)*	*(g/h)*	*(g/h)*	*(g/h)*	*(-)*	*(-)*	*(-)*	*(-)*	*(-)*	*(-)*	*(-)*
1																			
2																			
3																			
4																			
5																			

WEIGHTED SUM					

WEIGHTED MASS EMISSIONS AS PER 5-MODE CYCLE

NOx :		(g/kwh)	CO		(g/kwh)	HC		(g/kwh)	PM		(g/kwh)	NO_2		(g/kwh)

Max Smoke		m-1

MAX. ALLOWABLE INTAKE DEPRESSION DECLARED BY MANUFACTURER : kPa
MAX. ALLOWABLE EXHAUST BACK PRESSURE DECLARED BY MANUFACTURER : kPa
MAX. ALLOWABLE INTAKE MANIFOLD TEMPERATURE DECLARED BY MANUFACTURER (IN CASE OF TC-IC) : Deg C

PARTICULATE MEASUREMENT :
(a) PARTICULATE MASS (mg)
(b) Msam TOTAL (gm)
(c) Gedf WEIGHTED AVERAGE (kg/h)
(d) PM correction factor Humidity (kp)

Test Agency Seal/Stamp

Test Remark : **1) RECD FITED EMISSION TEST**

TEST ENGINEER **REVIEWER** **AUTHORISED SIGNATORY 1**

ANNEXURE - III

ENGINE TYPE (S) FOR WHICH THE REC DEVICE IS QULALIFIED (APPLICABLE RANGE)

S. No	Item Description	RECD types within the RECD family			
		Type 1	Type 2	Type 3	Type n
1	Engine manufacturer				
2	Engine Type Approval certificate number (Refer engine compliance name plate)				
3	Model year from/to				
4	Engine type/Model				
5	Rated Power kW				
6	Capacity/displacement (Litre)				
7	Bore x Stroke (mm)				
8	No of cylinder				
9	Capacity / cylinder (Litre)				
10	Engine Baseline emissions				
11	Silencer replaced				
12	Type identification of the REC				
13	REC Type				
14	PM Reduction Level				
15	Designed for fitment to an engine meeting the emissions requirements of (Regulation and Stage):				
16	Any other, Please specify				
17	Any other, Please specify				
					Test Agency Seal/Stamp
TEST ENGINEER		**REVIEWER**	**AUTHORISED SIGNATORY 1**		

ANNEXURE 3

Labelling Requirements

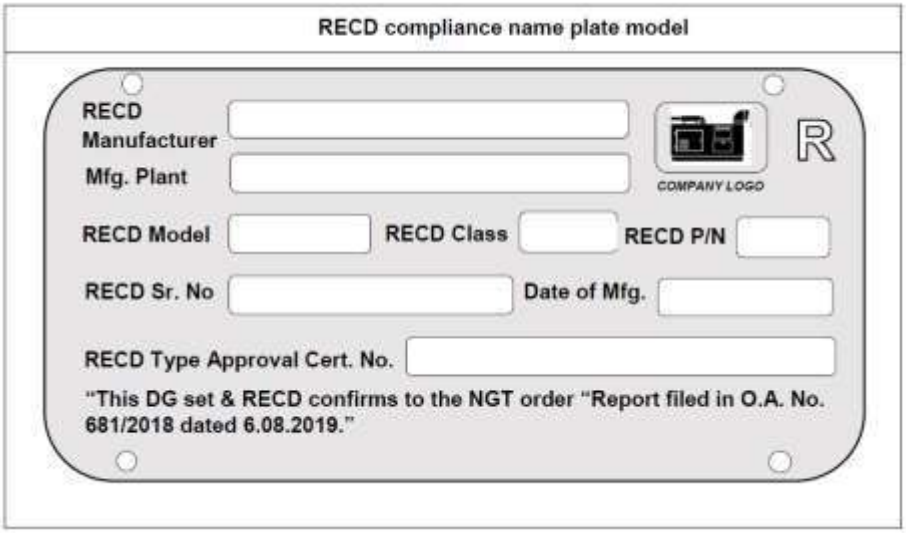
A3.1. The RECD set or the product must be affixed with a conformance label meeting the following requirements.

A3.1.1. General Requirement

a. The label shall be durable and legible;
b. The label shall be affixed on a part necessary for normal operation of the RECD or the product and not normally requiring replacement during the life of the RECD or the product;
c. This label has to be permanently fixed to the RECD, and shall be clearly readable after installation of the RECD and the labels cannot be removed without destroying or defacing them.
d. To ensure visibility of such a label in an installed system, the manufacturer may provide a duplicate label for fitment by the RECD installer. Such label shall clearly include the word "duplicate" and shall be fixed on genset canopy
e. All the information mentioned in the conformance label must be in English language;

A3.1.2. RECD Conformance Labelling Content Requirement

a. Name the RECD manufacturer or the importer or the retrofitter (Type approval certificate holder)
b. Manufacturing plant address from where RECD is manufactured
c. RECD Model name;
d. Class of RECD (I, II,);
e. RECD identifying part number as recorded in the information document issued in accordance with the model set out;
f. RECD Unique Identification Number (Serial Number, etc.);
g. Date of manufacturing and in case of import, date of import of RECD;
h. Type Approval certificate number;
i. Statement that ‘this DG set & RECD confirms to the NGT order “Report filed in O.A. No. 681/2018 dated 6.08.2019.”
j. Retrofitted date
k. Letter ‘R’ to denote that the DG set is retrofitted as per the NGT order. The Letter ‘R’ shall be engraved on the conformance label. The letter(s) should have a minimum size of 7 mm.



Part- 2

ANNEXURE 4

Test equipment, test bed measurement system and test facility

A4.1 Requirement

A4.1.1 **Test facility**: The test facility to be used shall be of the certification agencies or any other facility approved by these certification agencies. The test shall be carried out under the control of the certification agencies.

A4.1.2 **Test bed measurement system and equipment:** Test bed measurement system and equipment's of gaseous and particulate shall be as per the guideline given in the applicable ISO-8178-1: Reciprocating internal combustion engines — Exhaust emission measurement — Part 1: Test-bed measurement systems of gaseous and particulate emission.

Smoke measurement equipment shall be as per the guideline given in the applicable ISO-8178-3 Reciprocating internal combustion engines — Exhaust emission measurement — Part 3: Test procedure for measurement of exhaust gas smoke emissions from compression ignition engines using a filter type smoke meter

Method of smoke equipment shall be the guideline given in the ISO 8178-9:2019 Reciprocating internal combustion engines — Exhaust emission measurement — Part 9: Test cycles and test procedures for measurement of exhaust gas smoke emissions from compression ignition engines using an opacimeter

ANNEXURE 5

Data evaluation, test result calculation of gaseous & particulate emission, test execution and measurement procedures

A5.1 Requirement

A5.1.1 **Method of test execution, measurement procedures, data evaluation and calculation of gaseous and particulate emission** shall be as per the guideline given in the applicable ISO-8178-4: Reciprocating internal combustion engines — Exhaust emission measurement — Part 4: Steady-state test cycles for different engine applications.

A5.1.2 **Method of smoke measurement** shall be as per the guideline given in the applicable ISO-8178-3: Reciprocating internal combustion engines — Exhaust emission measurement — Part 3: Test procedure for measurement of exhaust gas smoke emissions from compression ignition engines using a filter type smoke meter.

Method of smoke measurement shall be the guideline given in the ISO 8178-9: Reciprocating internal combustion engines — Exhaust emission measurement — Part 9: Test cycles and test procedures for measurement of exhaust gas smoke emissions from compression ignition engines using an opacimeter.

Selection of smoke measurement method shall be at the discretion of the test agency and decision shall remain final.

ANNEXURE 6

Technical characteristics of fuels prescribed for approval tests and to verify conformity of production tests

1. Technical data on fuels for testing compression-ignition engines

1.1. Type: Diesel

For Type approval and Conformity of Production (CoP) test, fuel shall be commercial fuel as prescribed in Table 1

Appendix 2

Commercial diesel fuel characteristics

Table 1

Commercial Diesel Fuel		
Characteristics	**Unit**	**Requirements**
Ash, max	% mass	0.01
Carbon Residue (Ramsbottom) on 10 % residue, max	% mass	0.3 without additives
Cetane number (CN), min		51
Cetane Index (CI), min		46
Distillation :		
95% vol. recovery at ^{0}C, max	^{0}C	360
Flash point :		
a) Abel, min	^{0}C	35
Kinematic Viscosity @ 40 ^{0}C	Cst	2.0-4.5
Density @15 ^{0}C	kg/m^3	845
Total Sulphur, max.	mg/kg	10
Water content, max	mg/kg	200
Cold filter Plugging point (CFPP)		
a) Summer, max	^{0}C	18
b) Winter, max	^{0}C	6
Total contaminations, max	mg/kg	24
Oxidation stability, max	g/m^3	25
Polycyclic Aromatic Hydrocarbon (PAH), max	% mass	11
Lubricity, corrected wear scar diameter @ 60 ^{0}C, max	µm (microns)	460
Copper strip corrosion for 3 hrs @ 50^{0}C	Rating	Class – 1
FAME content max.	% v/v	7.0

Note :

- Test methods and other provisions / details along with the requirements as given above shall be issued by Bureau of Indian Standards. * FAME content shall apply as per current specification limits amended/enforced time to time.
- The Cetane number (CN), (min) shall be permitted up to 48 in North Eastern States till 01.04.2023

ANNEXURE 7

Tests and Test Procedures

7.1. General

Engines and RECDs shall be designed, constructed and assembled so as to enable them to comply with the provisions of this Regulation.

7.1.1. The technical measures taken by the manufacturer shall be such as to ensure that the gaseous and particulate pollutant is effectively limited, as set out in Regulation throughout the emission durability period and under normal conditions of use.

7.1.1.1. For this purpose, the engine final emission test result calculated according to the requirements shall not exceed the PM emission limits set out in clause 4.8.2.3 & table 4.8.2 when:

(a) tested in accordance with the test conditions and detailed technical procedures set out in Annexure 5 to this Regulation.

(b) using the fuel(s) specified in Annexure – 8

(c) using the test cycles specified in Appendix 1 A, 1B and Appendix 8 to Annexure 7 of this Regulation.

7.1.2 Reserved

7.1.3 In accordance with Appendix 1 and Annexure 8 and Annexure 7 of this Regulation, the testing of an engine & RECD type or engine & RECD family to determine whether it meets the PM emission limits set out in this Regulation shall be carried out by using the commercial fuel.

7.1.4 As regards the conduct of measurements and tests, the technical requirements shall be met in respect of:

(a) apparatus and procedures for the conduct of tests.

(b) apparatus and procedures for emission measurement and sampling.

(c) methods for data evaluation and calculations.

(d) methods for determining and taking account of continuous or infrequent regeneration of exhaust after-treatment systems.

7.3. The technical requirements relating to emission control strategies as set out in Annexure 8 to this regulation shall apply.

7.4. The use of defeat strategies shall be prohibited.

7.5. RECD types and RECD families shall be designed and fitted with emission control strategies in such a way as to prevent tampering to the extent possible.

Appendix 1 A

Emission Test Cycles Introduction

A1A.1. Test cycles

The type-approval test shall be conducted using D2 5 mode constant speed cycle for constant speed application.

A1A.1.1 Steady-state test cycles

Steady-state test cycles are specified in Appendix 1 B of this Annexure as a list of discrete modes (operating points), where each operating point has one value of speed and one value of torque. A steady-state test cycle shall be measured with a warmed up and running engine according to manufacturer's specifications.

A1A.1.1.1. Steady-state discrete mode test cycles

The steady-state discrete mode test cycles are hot running cycles where emissions shall be started to be measured after the engine is started, warmed up and running as per specified boundary conditions. Each cycle consists of a number of speed and load modes (with the respective weighing factor for each mode) which cover the typical operating range of the specified engine category.

Appendix 1 B

Characteristics of the steady-state test cycles

A1B.1. Test cycles applicable to Genset engine categories are set out in Tables A1B-1

Table A1B-1

Test cycles for Genset engine categories			
Category	**Speed operation**	**Purpose**	**Test Cycle**
Genset	Constand speed engine	Constant speed engine upto 800 kW	5-mode Constant Speed Cycle (D2 Steady-state discrete mode test cycle specified in ISO-8178-Part 4)

A1B.2. Steady-state constant speed test cycles:

The detailed description of the test modes and weighting factors for the steady-state discrete-mode test cycles for constant speed genset engines are set out in tables A1B-2.

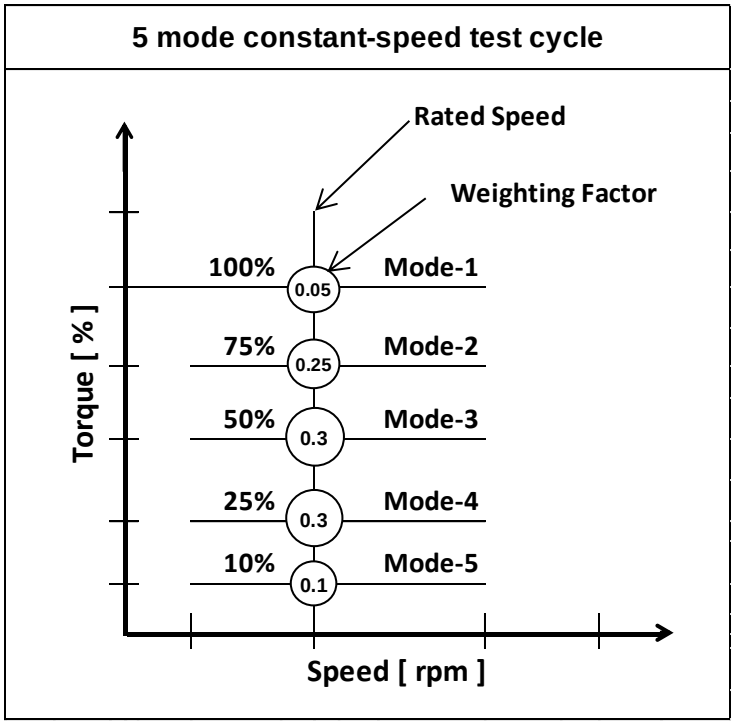
i) Constant Speed Test Cycle

Table A1B-2

Test modes and weighting factors					
Mode number (cycle D2)	**1**	**2**	**3**	**4**	**5**
Speed (a)	100%				
Torque (b) (%)	100	75	50	25	10
Weighting factor	0.05	0.25	0.3	0.3	0.1
Mode length (Second)	600	600	600	600	600
(a) Rated speeds as declared by manufactured (b) Per cent torque is relative to the torque corresponding to the rated gross power declared by the manufacturer.					

Note: Reference applicable ISO 8178-4:

Reciprocating internal combustion engines — Exhaust emission measurement — Part 4: Steady-state and transient test cycles for different engine applications.


5 mode constant-speed test cycle
Rated Speed
Weighting Factor
100%
Mode-1
0.05
75%
Mode-2
0.25
50%
Mode-3
0.3
25%
Mode-4
0.3
10%
Mode-5
0.1
Torque [%]
Speed [rpm]

APPENDIX 2

Method for measuring Smoke

A2.1 **Method of smoke measurement** shall be as per the guideline given in the applicable ISO-8178-3: Reciprocating internal combustion engines — Exhaust emission measurement — Part 3: Test procedure for measurement of exhaust gas smoke emissions from compression ignition engines using a filter type smoke meter**.**

Method of smoke measurement shall be the guideline given in the ISO 8178-9:2019 Reciprocating internal combustion engines — Exhaust emission measurement — Part 9: Test cycles and test procedures for measurement of exhaust gas smoke emissions from compression ignition engines using an opacimeter.

A2.2 Smoke limit is applicable to type approval and as well as conformity of production as set out in clause 4.1.2.3 & 4.8.2.

A2.3 If the measurement of smoke is in different unit, then to be convert it in m^{-1} unit with acceptable conversion formula.

A2.4 For verifing the conformity of production, if the selected engine does not meet the smoke limit as applicable, another engine be tested as per this part. This selected engine should meet the limit values as specified.

APPENDIX 3

Gross Rated Power Measurement Procedure

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1.0 Declared rated power (kWm) means rated gross mechanical power declared by manufacturer for type approval.

2.0 Gross observed power shall be the criteria for adjusting dynamometer load as well as calculating the specific emission values.

3.0 The declared rated gross power shall be verified and corrected as mentioned below.

4.0 Power observed in the emission test cycle for all test mode points shall be corrected as per mentioned below formula and 1st mode corrected power is the corrected rated gross power.

5.0 Power Corrections Factors:

Definition: The power correction factor is the coefficient by which the measured power must be multiplied to determine the engine power under the reference atmospheric conditions specified as below

$$P_{corr} = \alpha P_{obs}$$

Where,

P_{corr} is the corrected power (i.e. power under reference atmospheric conditions)
α is the correction factor
P_{obs} is the measured power (test power)

Reference atmospheric conditions:

- Temperature (T): 298 K
- Dry pressure (Ps): 99 kPa

Note: The dry pressure is based on a total pressure of 100 kPa and a water vapour pressure of 1 kPa.

Test atmospheric conditions:

The atmospheric conditions during the test shall be the following:

- Temperature (T): Between 283 K and 313 K
- Pressure (P): Between 80 kPa and 110 kPa

Determination of correction factor:
(The tests may be carried out in air-conditioned tests rooms where the atmospheric conditions may be controlled.)
The power correction factor α for diesel engines at constant fuel delivery is obtained by applying the formula:

$$\alpha = fa^{fm}$$

where,

fa – the atmospheric factor
fm- the characteristic parameter for each type of engine and adjustment

Atmospheric factor (fa):
This factor indicates effect of environmental conditions (pressure, temperature and humidity) on the air drawn in by the engine. The atmospheric factor differs according to the type of the engines.

- Naturally aspirated and mechanically pressure charged engines:
  $fa = (99/Ps) \times (T/298)^{0.7}$
- Turbocharged engines with or without cooling of charge air:
  $fa = (99/Ps)^{0.7} \times (T/298)^{1.5}$

Engine Factor (fm):
fm is a function of Qc (fuel flow corrected) as follows,

$fm = 0.036\ Qc - 1.14$

where, Qc is Q/r and

- Q – the fuel delivery in milligrams/cycle per litre of engine swept volume (mg/1.cycle)
- r is the pressure ratio of compressor outlet and compressor inlet (r = 1for naturally aspired engines)

Note:
a. This formula is valid when Qc is $40 \leq Qc \leq 65$
b. For Qc values lower than 40, a constant value of fm equal to 0.3 (fm=0.3) will be taken
c. For Qc values higher than 65, a constant value of fm equal to 1.2 (fm=1.2) will be taken

6.0 The gross declared corrected power of the engine shall be measured on a test bench at rated speed of the engine. The measured power and speed may differ from the power and speed specified by the manufacturer as specified below**:**

Declared rated corrected gross Power & speed tolerance

➢ **For Constant speed engine**

(i) For Type Approval & Conformity of Production:

- For single cylinder engines, at rated power point, ± 6% of the type approved figure
- For all other engines, at rated power point, ± 5% of the type approved figure

Declared rated Speed at rated power point shall vary within ± 1%

7.0 For verifying the conformity of production, for the selected engine, if the gross power and rated speed does not meet the limits, another engine shall be submitted for the testing.

8.0 The fuel temperature shall be maintained at 38 ±5 deg C throughout the test.

9.0 Single & two-cylinder engines shall be tested with the engine intake system. All the other engines shall be tested with either air intake system of applying maximum declared air intake depression of clean air intake.

10.0 The engine shall be tested with the maximum exhaust backpressure values declared by the manufacturer. In case of the engines fitted with exhaust after treatment device and external EGR system, the manufacturer shall declare exhaust backpressure values at all five test points. The engine will be tested with the declared exhaust backpressure values set at laboratory condition with a tolerance of ±10% at rated load. At part load points the tolerance shall be as low as possible in the test laboratory conditions.

11.0 The no-load speed or high idle speed and overload speed shall be verified and documented against value specified by the manufacturer.

Annexure 8

Requirements with regard to emission control strategies for Particulate control measures (for Class I or Class II)

Appendix A.1

Testing of a particulate reduction RECD is performed in the following series of stages, including an assessment of the emissions of secondary pollutants and determination of the NO_2 emissions:

1. Performance of a service accumulation run.

   The service accumulation run shall be performed in accordance with the requirements of paragraph 3.3 of this Regulation.

2. Measurement of engine baseline emissions and specific fuel consumption without RECD fitted.

2.1. The engine baseline emissions shall be measured by performance of an emissions test on the engine system without the RECD in accordance with the requirements of Regulation CPCB Stage-1 /GSR 371 dated 17th May 2002 & CPCB Stage-2 / GSR 771(E) dated 11th Dec 2013 and its amendment vide GSR 232(E) dated 31-Mar-2014 as appropriate to the application and Type Approval level of the base engine. The smoke limits established as per the clause 4.1.2.3/4.8.2.

2.2. To enable the determination of reduction efficiency the emissions are measured by performance of an emissions test in accordance with the requirements of clause 4.8.2.2. of this Regulation.

2.3. The specific fuel consumption (g/kWh) shall be measured by performance of the emissions test in paragraph 2.2. of this Annex.

3. Determination of PM emissions, fuel consumption and reduction efficiency with the RECD fitted after service accumulation run.

3.1. The emissions measured by performance of an emissions test on the engine system in accordance with the requirements of Regulation CPCB Stage-1 /GSR 371 dated 17th May 2002 & CPCB Stage-2 / GSR 771(E) dated 11th Dec 2013 and its amendment vide GSR 232(E) dated 31-Mar-2014 as appropriate to the application and intended emission level of the candidate RECD with the RECD fitted in accordance with the requirements of this Regulation.

3.2. For determination of reduction efficiency, the PM emissions are additionally established by performance of an emissions test with the RECD fitted in accordance with the requirements of paragraph 4.8.2.2. of this Regulation.

3.3. The increase in the gaseous emissions measured after fitment of RECD should not increase by more than 5% of the base value measured as per paragraph 2 of this Annex.

3.4. The specific fuel consumption (g/kWh) shall be established by performance of the emissions test in paragraph 3.2. of this Annex.

4. **Determination of particulate reduction RECD regeneration strategy and regeneration characteristics**

4.1. The particulate reduction RECD regeneration strategy (periodically or continuously) and the regeneration characteristics are established by use of the following procedure.

4.2. Considering within technical merits, RECD manufacturer's assessment and declaration of type of PM regeneration including protective regeneration event that is being used.

4.3. In order to assess the regeneration performance of a particulate reduction RECD at least 25 test cycles shall be carried out. The test cycle used shall be a cycle appropriate to the emissions stage or standard that the RECD system is intended to permit the DG Set to meet.

The gaseous emissions and the particulate mass, when appropriate, shall be measured during at least each fifth test cycle.

A separate test of the particulate reduction system is carried out for each family or application range defined in the type approval procedure for the engine with which the RECD system is intended to be used. That is, one system test takes place for each application area.

Above regeneration performance test can be combined along with the DF assessment test cycle with scrutiny and prior approval from the technical agency concerned.

4.4. A particulate reduction RECD is considered to have been proved to have a continuously operating regeneration process if a suitable assessment variable can be regarded as constant over at least 25 applicable test cycles. The average particulate emission and the average exhaust gas backpressure or differential pressure across PM capture element of RECD are regarded as suitable assessment variables for this purpose.

If an applicant wishes to use one or more different assessment variables, he shall present a robust technical case to the Approval Authority in support of his request to do so.

Where a continuously regenerating system as defined above also contains provision for active regeneration, then the assessment criteria defined in paragraph 4.7. of this Annex shall be applied.

The PM mass emission and the exhaust gas backpressure are considered constant within the meaning of this regulation where there is a coefficient of variance of less than 25 percent over 25 test cycles. The exhaust gas backpressure is measured continuously for the purposes of this assessment and the particulate emissions are measured during at least every fifth test cycle.

The coefficient of variance (CoV) is calculated as follows.

$$\text{Coefficient of Variance} = \frac{\text{Standard deviation X (n)}}{\text{Average value X (n)}}$$

with:

$$\text{Standard deviation} = \sqrt{\frac{n \sum x^2 - (\sum x)^2}{n(n-1)}}$$

and:

$$\text{Average value} = (x_1 + x_2 + \ldots + x_n) / n$$

where:

n = number of measured values

x = respective single measured value

4.5. Test of the regeneration characteristic of a particulate reduction RECD

This testing is carried out by loading the system with particulate matter until a constant exhaust gas backpressure is reached or over a time period of a maximum of 100 hours if no constant value for the backpressure has been achieved before that time. The exhaust gas backpressure is considered constant if, when measured after a period of at least 50 hours, the exhaust gas backpressure does not vary by more than plus or minus 4 mbar within a period of 30 min. The test points of the cycle used for loading the system are to be selected so that a maximum exhaust gas temperature of 180°C at the inlet of the particulate reduction system is not exceeded.

After the RECD has been loaded with particulate matter until the backpressure is constant, or after a maximum of 100 hours of running to load the system as defined above, regeneration is activated. This can, for example, be activated by running the engine at a higher load mode step so as to increase the exhaust temperature. After completion of the regeneration, exhaust gas measurements are to be taken during at least three iterations of the appropriate test cycle (D2-5 mode cycle.) The measured exhaust gas pollutant values shall not deviate from the measured exhaust gas pollutant values before the RECD loading procedure by more than 15 percent for the gaseous emissions or more than 20 percent for the particulate mass.

The manufacturer shall confirm in writing that the maximum temperatures occurring during the regeneration process will not damage or significantly shorten the effective life of the RECD.

As an alternative to using the loading procedure described above, the manufacturer may provide a particulate reduction RECD already loaded to the limit for the regeneration test.

4.6. Assessment criteria for continuously regenerating particulate reduction RECD

The RECD system test of the particulate reduction RECD is considered satisfactory if the particulate emissions measured as defined in paragraph 4.8 of the Regulation are met.

4.6.1. Regulated pollutants

The emissions of the regulated pollutants & PM measurements are determined by measurements taken immediately after the tests to establish the regeneration characteristics.

The emissions of the regulated pollutants (CO, HC, PM and NO_X) in the initial condition and in the retrofitted condition shall be within the limit as mentioned in the paragraph 4.1.2.3 & 4.8.2. The NO_2 to NO_X ratio for the initial condition and the retrofitted condition is to be recorded and shown in the test report.

The determination of the NO_2 and NO_X mass emissions is to be determined by simultaneous measurements.

4.7. Assessment criteria for periodically regenerating particulate reduction RECD

This provision only applies to RECDs, which utilise active regeneration.

The emissions shall be measured during at least three appropriate test cycles, one of the cycles from which measurements are taken should include a regeneration event on a stabilized RECD system. The other two

cycles from which measurements are taken should be cycles in which regeneration does not occur. If regeneration takes longer than one test cycle, consecutive test cycles shall be run until regeneration is complete.

The RECD manufacturer shall declare the conditions under which the regeneration process normally occurs (the particulate loading, temperature, exhaust backpressure, or other relevant parameters.). The manufacturer shall also provide the frequency of the regeneration event in terms of the fraction of tests during which the regeneration occurs. The exact procedure used to determine this fraction should be agreed with the manufacturer by the Approval Authority on the basis of good engineering judgement. (This frequency fraction is the factor F in the procedure for calculation of nominal particulate emissions set out below),

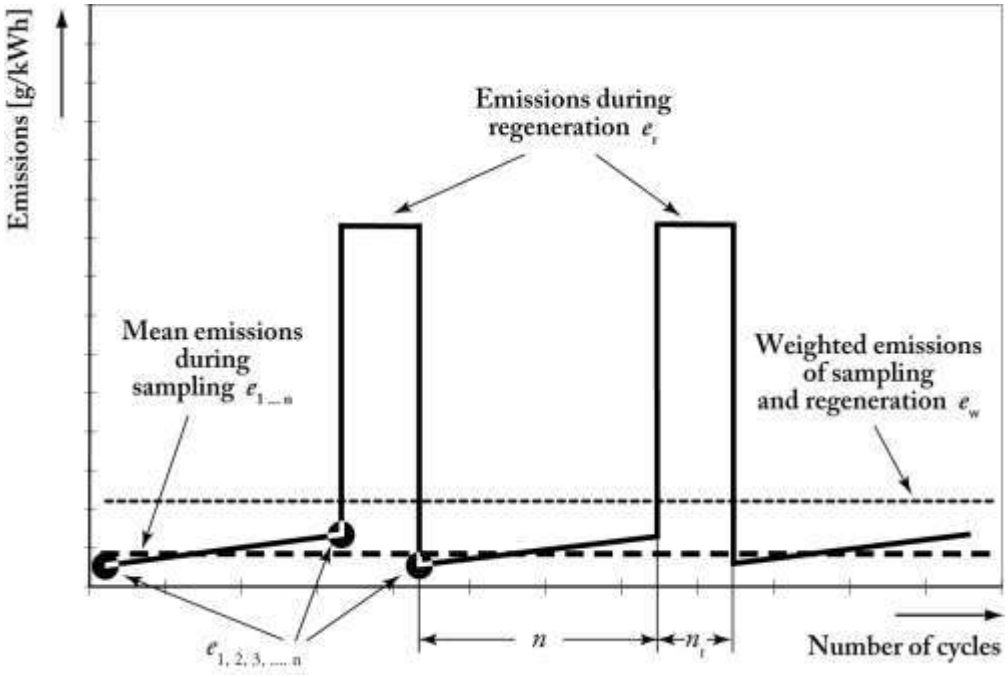
For a regeneration test, the manufacturer shall provide a particulate reduction RECD system that has been loaded with particulate matter. As an option, the manufacturer may run consecutive test cycles as set out in paragraph 4.4. until the particulate reduction RECD is loaded. Emissions measurement is not required on cycles run for the purposes of loading the RECD with particulate matter.

Average emissions between regeneration phases shall be determined from the arithmetic mean of several tests approximately equidistant in terms of the number of unmeasured test cycles between them. As a minimum, at least one test cycle as close as possible prior to a regeneration test and one test cycle immediately after a regeneration test shall be included in the calculation of the arithmetic mean.

During the regeneration test, all the data needed to detect regeneration shall be recorded (CO or NO_X emissions, temperature before and after the RECD, exhaust backpressure, and any other relevant parameters). It is permissible for the applicable emission limits to be exceeded during the regeneration process. The test procedure is shown schematically in figure 1.1.

Figure 1.1.:

Scheme of periodic regeneration



The system test of a periodically regenerating particulate reduction RECD is considered passed if the [nominal] particulate emissions calculated using the procedure set out below are within the limit set for the reduction level for which the applicant wishes the RECD to be approved.

4.7.1. Regulated pollutants

The emissions of regulated pollutants (CO, HC, PM and NO_X) shall not increase by 5% when tested for both in the initial condition and in the retrofitted condition. The NO_2 / NO_X ratio for both the initial condition and the retrofitted condition are to be recorded and shown in the test report.

The determination of the NO_2 and NO_X-mass emissions is to be determined by simultaneous measurement in accordance with paragraph 4.7.2. of this annex and paragraph13. of this Regulation.

4.7.1.1. Weighted particulate emissions

The particulate emissions PM mass (g/kWh) for periodically regenerating systems are determined as follows.

$PM\ mass = PM\ mass_r \times F + (1-F) \times PM\ mass_{wor}$

Where:

F = frequency of the regeneration event in terms of fraction of tests during which the regeneration occurs [-]

$PM\ mass_{wor}$ = average specific emission from a test in which the regeneration does not occur [g/kWh]

$PM\ mass_r$ = average specific emission from a test in which the regeneration occurs [g/kWh]

The manufacturer may choose, on the basis of good engineering analysis, to calculate either a multiplicative or an additive regeneration adjustment factor k_r, expressing the average emission rate, as follows:

$k_r = PM\ mass / PM\ mass_{wor}$ (multiplicative adjustment factor)

or

$k_{Ur} = PM\ mass - PM\ mass_{wor}$ (upward adjustment factor)

or

$k_{Dr} = PM\ mass - PM\ mass_r$ (downward adjustment factor)

If more than two measurements between the regeneration phases are used to determine the emissions, these further measurements shall be taken at equal intervals and an arithmetical average taken.

4.7.1.2. Weighted gaseous emissions

The emission of gaseous components Mgas (g/kWh) for periodically regenerating systems is determined as follows.

$Mgas = Mgas_r \times F + (1-F) \times Mgas_{wor}$

where:

F = frequency of the regeneration event in terms of the fraction of tests during which the regeneration occurs

$Mgas_{wor}$ = average specific emission from a test in which the regeneration does not occur [g/kWh]

$Mgas_r$ = average specific emission from a test in which the regeneration occurs [g/kWh]

The manufacturer may choose, on the basis of good engineering analysis, to calculate either a multiplicative or an additive the regeneration adjustment factor kr, expressing the average emission rate, as follows:

$k_r = Mgas / Mgas_{wor}$ (multiplicative adjustment factor)

or

k_{Ur} = Mgas - $Mgas_{wor}$ (upward adjustment factor)

or

k_{Dr} = Mgas - $Mgas_{r}$ (downward adjustment factor)

4.8. Determination of NO_2 emissions

The testing shall be performed on the test engine selected by the criteria described in paragraph 4.1.2.3 of this Regulation.

4.8.1. Selection of the particulate reduction RECD for NO_2 determination.

The RECD used for testing may be different from the RECD used in paragraph 4.5. of this Annex. The particulate reduction RECD to be tested shall be

A particulate reduction RECD with the largest active volume and, if a diesel oxidation catalyst (DOC) is used upstream, the catalytic converter with the largest active surface area and

The particulate reduction RECD containing the maximum charge of platinum with the maximum total charge of catalytically active material within the defined RECD family.

The chosen particulate reduction RECD shall be fitted in such a way that the shortest distance between the engine and the particulate reduction RECD as specified in the application range for the particulate reduction RECD, is achieved.

The particulate reduction RECD shall be unloaded and shall not have been run in for longer than 125 hours.

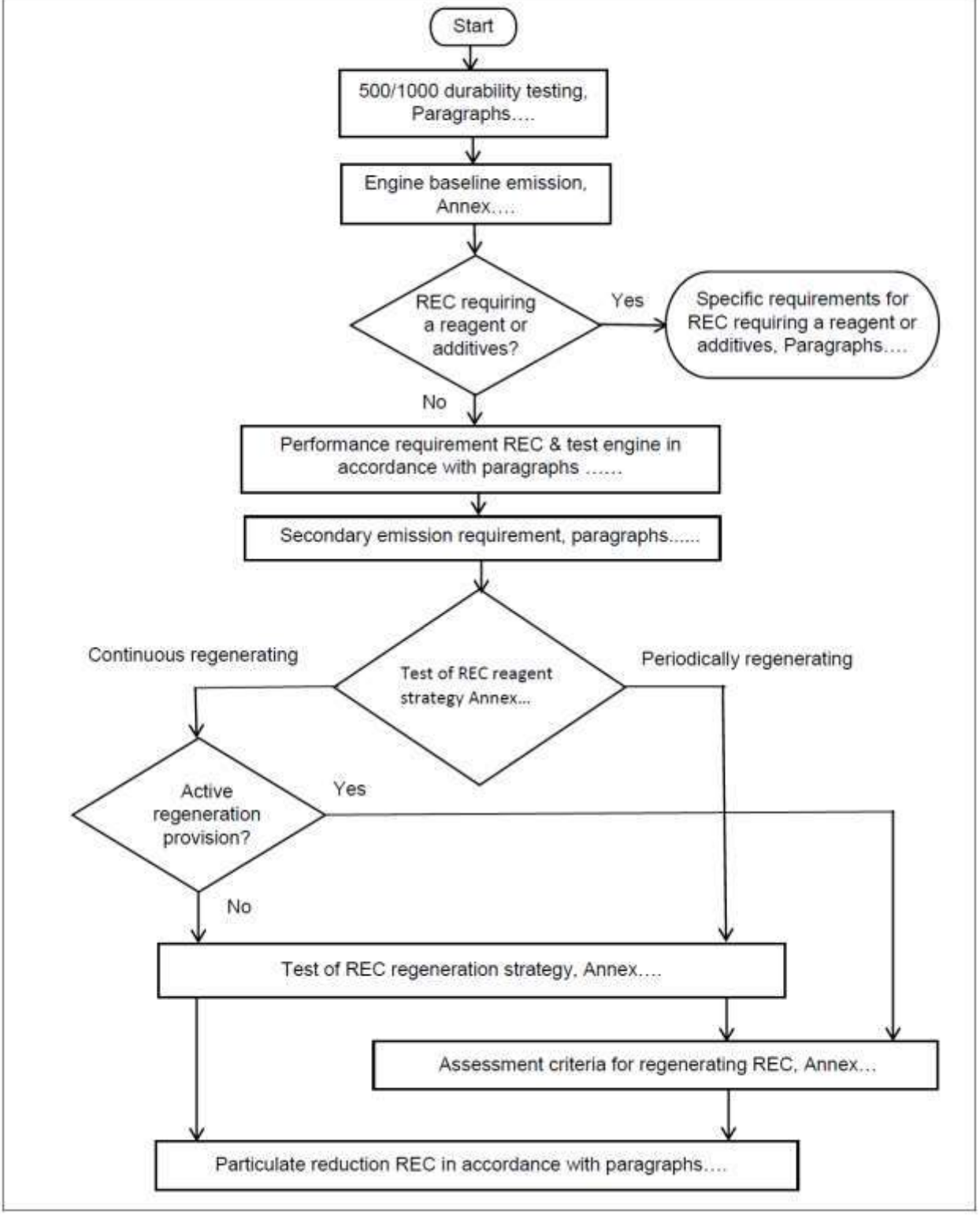
4.8.2. Determination of NO_2 emissions

Three successive D2-5Mode emission test cycles, as appropriate to the application, shall be conducted. The emissions shall be determined over all three cycles and averaged. If the range of these results is greater than ±15 percent of the mean, then an additional test cycle should be run.

5. Test Cycles.

The emission PM tests as per clause 4.0, before & after fitment of RECD shall be tested and accepted or rejected as per this document. The tests as per 40 CFR 1065.680 applicable to steady state or discrete–mode type tests shall be adopted.

Test Sequence of Particulate reduction REC



Appendix A. 2

Technical details for prevention of tampering

A.2.1. For RECD types and RECD families that use an Electronic Control Unit (ECU) of any sort as part of the PM emission control system the manufacturer shall provide to the approval authority a description of the provisions taken to prevent tampering with and modification of the ECU including the facility for updating using a manufacturer-approved program or the calibration.

A.2.2. For RECD types and RECD families that use mechanical and/or electrical devices as part of the PM emission control system the manufacturer shall provide to the approval authority a description of the provisions taken to prevent tampering with and modification of the adjustable parameters of the emission control system.

A.2.2.1. The manufacturer shall demonstrate to the Test Authority that the adjustable parameters of the PM emission control system cannot be easily tampered by applying reasonable forces, either:

(a) using the tools supplied together with the engine; or,

(b) using ordinary tools such as screwdriver, pliers (including cutting pliers) or wrenches.

Ordinary tools do not include most cutting or grinding tools, drills and rotary cutters, or tools that generate excessive heat or flame.

A.2.3. For the purpose of this Appendix, RECDs from different RECD families may be further combined into families based upon the type and design of tamper prevention measures utilized. In order to place RECDs from different RECD families into the same tamper prevention RECD family the manufacturer shall provide confirmation to the approval authority that the measures used to prevent tampering are similar.

A.2.4. Manufacturers shall provide a warning in the operator's manual stating that tampering with the engine voids the type-approval of that particular RECD.

Appendix A.3

Technical Requirements for Particulate Control Diagnostics including the method to demonstrate these measures

A 3.1 The RECD shall be fitted with particulate control diagnostics with ability to diagnose and trigger operator warning system when confirmed fault/s is detected as per stated requirements below. Any RECD fitted on the engine covered by this clause shall be designed & constructed so as to be capable of meeting these requirements throughout the normal life of the engine under normal condition of use.

a) complete loss of particulate capture function.
b) Removal of the RECD system
c) Failure of the RECD system.
d) detection of exhaust bypass, temporary or permanently as part of a field/operator tampering or as a design architectural requirement.

A.3.2. The RECD manufacturer or importer is required to demonstrate all the above particulate diagnostics conditions during certification process utilizing failed parts or simulation in consultation and approval by the test agency.

Required information

Detailed written information fully describing the functional operation characteristics of the operator warning system shall be provided to the Type Approval Authority at the time of type-approval.

The RECD manufacturer shall provide installation documents that, when used, will ensure that the engine, inclusive of the emission control system that is part of the approved engine type or engine family, when installed in the genset, will operate, in conjunction with the necessary machinery parts, in a manner that will comply with the requirements of this Annexure. This documentation shall include the detailed technical requirements and the provisions of the engine (software, hardware, and communication) needed for the correct installation of the RECD on the engine in the genset.

A.3.3. Particulate diagnostics system shall register self-healing and non-erasable fault codes in its on-board memory or any capable alternative such as but not limited to connected cloud based storage along with a time counter to track fault code active period. Such fault code active period shall be utilized for operator inducement.

A.3.4. Method and conditions to confirm all the fault code/s shall be shared with test agency as a declaration for approval.

A.3.5. **Operator Warning system:**

A.3.5.1. Operator warning system shall activate once confirmed fault code is registered.

A.3.5.2. Typically owing to low proximity of gensets at the actual installation sites, audible operator warning shall be mandatory.

A.3.5.3. Intensity of the audible warning system shall be at 100 dB sound pressure measured at 1 meter level at least at the location external to RECD where audible alarm device is mounted. RECD manufacturer may opt for alternate arrangements complying to minimal stated requirements.

A.3.5.4. It is also recommended to have visual warning in the form of 'flashing RED light' on the RECD control panel if such control panel provision is made.

A.3.5.5. RECDs installed with provision of audible and visual operator warning system both, can provide audible warning temporary 'snooze' function with snooze timer not more than 12 hrs. duration.

A.3.5.6. Appropriate declarations and at least preliminary fault tree suggestions shall be provided to the operator through the owner's manual.

A.3.5.7. Indication to be provided in the owner's manual that active fault if not corrected within specified timelines will lead to genset inducement.

Appendix A.4

Operator Inducement System

A.4.1. The RECD shall be fitted with operator inducement system that will disable genset operation with following requirements,

A.4.1.1. If fault with full functional failure of the RECD is confirmed, and if not corrected/repaired within 100 hrs. duration since the confirmation of the fault code, genset operation shall be effectively disabled post the operational cycle in which active fault code has crossed the said threshold.

A.4.1.2. If fault with partial functional impairment of the RECD is confirmed, if not corrected/repaired within 150 hrs. duration since the confirmation of the fault code, genset operation shall be effectively disabled post operational cycle in which active fault code has crossed the said threshold.

A.4.1.3. If fault detecting exhaust bypass of the RECD is confirmed, RECD shall immediately trigger operator inducement action however genset disability can trigger post current operational cycle.

A.4.1.4. If fault detecting low or no reagent, where applicable is confirmed, RECD shall immediately trigger operator inducement action however genset disability can trigger post current operational cycle.

Appendix A.5

Declarations by RECD manufacturer/importer during Certification Process

A.5.1. The RECD manufacturer/importer shall submit declarations to the test agency with documents addressed to the nodal agency those are signed by responsible position holder in the company such as MD, CEO, COO, CTO as per the guidelines below,

a) Declaration that RECD technology utilized will function consistently during in-field use and with various genset operating conditions without significant reduction in the particulate capture efficiency.

b) Due diligence is done by the RECD manufacturer/importer to ensure that the RECD device/s has been designs along with quality control, material, service schedule to ensure RECDs will perform till emissions useful life prescribed in this procedure. Test agency reserves right to interpret such claim and may scrutinize the product with help from the manufacturer.

c) Document declaration along with possible licenses, if applicable for RECDs requiring secondary regulated or unregulated material disposal.

ANNEXURE 9

Installation and Operation instructions

1. The RECD manufacturer/importers/retrofitters shall provide written information and installation instructions for use by retrofitters/installers, and operation and maintenance instructions for use by owners and operators. These instructions shall,

   a) Address the safety hazards identified in the course of the assessment undertaken in accordance with paragraph 4.12.3. of this Regulation so that, to the greatest extent possible, fitting of the RECD in accordance with the instructions will eliminate those hazards and will

      i) maintain the level of safety provided by the DG set when it was first placed on the market,
      ii) maintain the DG set in a state of conformity with all legal health and safety requirements,

   b) Explicitly list and describe any identified safety hazards that will not be fully eliminated by following the fitting instructions and that will have to be addressed by the application of appropriate skills and good engineering judgement on the part of the retrofitter.

   c) Clearly address each of the points in paragraphs 3. and 4. of this annex.

2. Preparation and demonstration requirements;

2.1. The instructions and guidelines shall be written in the language of the country in which the RECD is sold or in which the RECD is expected to be used, and shall be in clear language appropriate to the intended readership.

2.2. The RECD manufacturer shall be able to demonstrate to the Approval Authority where each of the relevant points in this annex is addressed, but may address these points in any way that meets the requirement for clarity. There is no requirement for the wording or layout of this annex to be reproduced.

2.3. Technical or legal language should not be used in documents intended for readers, such as end users, who are unlikely to be familiar with it. Where the use of such language is considered essential in such documents, it should be accompanied by a clear explanation of its intent.

2.4. The RECD manufacturer is encouraged to consider, in the interests of clarity, the use of local idioms and usages where a language is used in more than one region, and the use of industry-specific terms where a RECD is intended for use on DG Set specific to that industry

3. Instructions for the retrofitter/installer:

3.1. The instructions for the retrofitter/installer should include

   a) specific instructions related to any specific DG Set application for which the RECD is intended.

   b) general instructions and guidelines, when appropriate, which will permit the RECD to be properly fitted to any DG set in the range for which it is approved.

   c) a clear indication of the range of applications for which the RECD is approved, and of the range of DG sets for which it may be safely used if that is different.

   d) an indication of the level of skill and education required in order to perform the fitting operation.

   e) a level of detail at least sufficient to permit an appropriately skilled and educated person to perform the work.

3.2. The instruction shall state that retrofitting with a RECD shall be performed in accordance with the installation instructions provided by the RECD manufacturer/importer/retrofitter, and that any additional instructions provided by the DG set /engine manufacturer, public authorities, or other competent parties shall also be taken into consideration.

3.3. The Instruction shall state that the DG set to be retrofitted shall be in a properly maintained condition, and that defects that could prevent achievement of the PM emission reduction level for which the RECD is approved or could adversely affect its endurance are to be rectified as necessary before the retrofitting.

3.4. The instructions shall state that all necessary care shall be taken in order to ensure that the safety in use of the DG set is not impaired by the fitting of the RECD, and that it remains conformant with local laws and regulations. The instructions shall, in particular,

a) Draw attention to any additional safety hazards to operators or bystanders, such as high surface temperatures or electrical voltages that are associated with the RECD, and propose measures for reducing the risks associated with them.

b) Warn against the installation of the RECD, or any systems associated with it, in such a way as to interfere with the field of vision of the operator of a DG set, or with the visibility of any gauges or indicators, or with access to any controls.

c) warn that the extent of the liability of the person or company fitting the RECD for any subsequent accident or failure will depend upon local laws and customs, and may extend beyond liability for failures of or directly attributable to the RECD.

3.5. The Instruction shall draw attention to the fact that any modification made to a DG sets/engine enclosure or access panel may increase the noise emitted by the DG set that local laws may forbid increases in noise, and that increases in noise may have implications for the health and safety of operators and bystanders.

4. Instructions to the owner and operator;

4.1. The instructions for the owner and operator should include both specific instructions related to any DG sets for which the RECD is intended and, when appropriate, general instructions related to its use with any DG Set in the range for which it is approved.

4.2. The instructions shall indicate any requirements or limitations on the use of the DG set that are necessary in order to ensure correct functioning of the RECD.

4.3. The instructions shall specify whether any chemical solutions, reagents or additives need to be refilled by the DG set operator between normal maintenance intervals, and to indicate a likely rate of consumption.

4.4. The instructions shall specify the type and quality of any consumables, chemical solutions, reagents or additives used. The instruction shall specify clearly the handling and disposal of the secondary regulated/non-regulated pollutants generated during the process.

4.5. The instructions shall remind the owner and operator of the DG set that, where the fitting of the RECD is a condition for its operation in a particular area, or where fitting of the RECD entitles the DG set owner to incentives or privileges, the failure to maintain the RECD in proper working order (including the failure to ensure a proper supply of any consumables, reagent or additive), may constitute a breach of contract or be a criminal offence.

ANNEXURE 10

Site Monitoring

In order to ensure the correct installation, function and effectiveness of the RECD as per approved specification, the site monitoring shall be performed by the respective State Pollution Control Board or the Relevant Competent Authority. The RECD manufacturer/retrofitter and the DG set owner/operator shall extend their support to check/inspect the below points. The RECD manufacturer/retrofitter shall make available the approved technical specification/information documents/installation document to review upon the request of the visiting officer. A copy of the site monitoring report to be forward to nodal agency and to test agency to review and update.

Sr No	Parameter	Observation
1	**Engine verification** The engine on which RECD fitted shall be from the approved applicable range. Check the engine emission compliance labelling details. a) Engine manufacturer b) Engine Type Approval certificate c) Engine Family d) Model year from/to. / Date of Mfg. e) Engine type/Model f) Rated Power kW	
2	**RECD verification** RECD shall be as per approved document. Check the compliance labelling details. a) RECD Manufacturer's name b) Type identification of the RECD c) REC Type/model d) RECD family e) RECD part number f) Class of RECD	
3	**Site verification** a) Layout of the RECD as per TA approved drawing/layout/installation documents b) Stack (Chimney) height as specified c) Overall Noise during running d) Any exposing operators or bystanders to any safety hazard e) Visual smoke f) Stack Height as per specifications g) Provision of Pothole/Opening for future measurements. h) Nosie Status.	

4	**Maintenance verification** a) Scheduled maintenance Records of RECD including any scheduled exchange of RECD related components b) Use of specified lubrication oil specifications necessary to maintain the performance of the RECD system;	
5	**On-board diagnostics Systems verification** a) Warning system: Proper functioning of on-board operator warning system, audible and/or visual alarm to the operator when possible malfunctions/failure detected in RECD system /components which affecting the efficiency of the RECD b) Proper functioning On Board Diagnostic tool or method to detect the functioning/bypassing/removal of RECD c) Inducement system: Proper functioning of the operator inducement system as a consequence of ignoring the warning alarm will result in DG set being unable to re-start	
6	**Tampering** a) Any deliberate tampering or misuse of the engine RECD control system; in particular, with regard to deactivating or not maintaining an exhaust gas recirculation (EGR) or a reagent dosing system b) Presence of any defeat devices that by-pass or reduce the efficiency of the RECD	
7	**Regeneration verification** a) In case RECD system requires a reagent for regeneration, check specified characteristics of that reagent, including the type of reagent being used b) Proper functioning of Regenerations methodology adapted to bring the efficiency of the RECD c) Proper dispose of Soot/PM collected during regeneration	
8	Any other Remarks.	

ANNEXURE 11

COMPOSITION OF COMMITTEE FOR FORMULATION OF THIS SYSTEM & PROCEDURE

Planning & Co-coordinators	
Mr N.K Gupta Mr Kedarnath Dash	Central Pollution Control Board, CPCB, New Delhi,
Co-ordinator	
Dr Prasanna G. Bhat	The Automotive Research Association of India (ARAI), Pune
Members	**Representing**
Representative from	The Automotive Research Association of India (ARAI), Pune
Representative from	International Centre for Automotive Technology (iCAT), Manesar, Gurgaon
Representative from	Indian Diesel Engine Manufacturers' Association (IDEMA), New Delhi
Representative from	Automotive Component Manufacturers Association of India (ACMA), New Delhi
Representative from	Indian Institute of Petroleum (IIP), Dehra Dun
Representative from	Emission Control Manufacturers Association (ECMA), New Delhi
Representative from	Indian Oil Corporation Research and Development Centre, IOCL R&D, Faridabad