Driver & Vehicle Standards Agency

Title	Diesel Smoke Meter Equipment Specification
Equipment purpose	Emissions Testing - Diesel
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Issue date	14/07/2023
Revision history	Issued October 2001 1st Revision: April 2002 2nd Revision May 2003 3rd Revision January 2007 4th Revision December 2020 5th Revision April 2023

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1. Introduction

1.1. This specification outlines the requirements for diesel opacity smoke meters (DSMs) used in the statutory testing schemes for HGV, PSV, MOT and IVA. It also includes the additional requirements for meters used during Low Emissions Vehicle testing and by the Driver & Vehicle Standards Agency (DVSA) Roadside Enforcement and Testing Divisions.

1.2. New DSM approvals will also need to meet the requirements for connectivity and data transfer set out in Test Equipment Interface Specification.

2. Purpose

2.1. Smoke meters are used to measure diesel vehicle exhaust smoke opacity during a Free Acceleration Smoke (FAS) test taken over the whole speed range of an engine, where the engine is accelerated against its own inertia.

2.2. There are two categories of meter, these relate to the type of vehicle to be tested. Meters can be assessed and approved for testing one or both categories:-

2.3. Category A - Cars and light commercial vehicles (including MOT Class 4, 7 and Individual Vehicle Approval Scheme (IVA) vehicles).

2.4. Category B - Public Service Vehicles and private buses (including MOT Class 5) and Heavy Goods Vehicles.

2.5. All meter types to be used for statutory testing shall conform and be shown to continue to conform to the requirements in this document, and the additional optional requirements in Annexes 4 & 5 as necessary.

2.6. Meters must be calibrated according to the requirements found in this document.

3. Requirements

3.1. General

Meters shall:

a. measure accurately the Free Acceleration Smoke (FAS) output over the whole speed range of an engine (no load from idle up to cut-off speed), where the engine is accelerated against its own inertia.

b. record, display and retain the peak value of the smoke output measured during each FAS test.

c. maintain a fixed effective optical path length irrespective of exhaust tailpipe size or shape.

d. correlate with the reference smoke meter whilst measuring FAS from the range of vehicles likely to be tested. For details of how this is assessed, see Annex 2, Section 2, FAS Correlation.

e. maintain correct sampling and purge air pressures at all times to ensure consistent measurement chamber filling with no variation in effective optical path length.

f. provide adequate safeguards against the possibility of condensation influencing the measurement with all sample pipe size and extension variants supplied with the meter.

g. produce accurate results without the need for precise or specific alignment of the sampling chamber or probe with the exhaust tailpipe.

h. maintain accuracy to meet all specific requirements under the rated operating conditions in Section 4.11 and Pattern Approval Procedures in Section 8.

i. for FAS correlation purposes (Approval testing), perform an uninterrupted sequence of 10 FAS and display each value, regardless of smoke level.

j. for MOT and HGV&PSV testing purposes, a Fail result must not be issued unless a full uninterrupted sequence of 6 FAS has been completed.

k. operate reliably in all conditions likely to be encountered within the vehicle testing environment and meet with all appropriate environmental performance standards as detailed in Annex 2 Section 3, Environmental Testing.

l. meet the requirements for connectivity and data transfer set out in the Test Equipment Interface Specification.

3.2. Technical

Meters shall:

a. declare their Effective Optical Path Length (EOPL).

b. include a real time clock and a four year calendar which operates even when the electrical supply is disconnected. The time may be adjustable by the operator. Seasonal time adjustment may be automatic. However, adjustment of the day and date shall only be accessible to UKAS approved operators.

NOTE: Where the meter may be used with a hand-held device or other similar accessory there shall be no adjustment of the meter day nor date possible via any such device.

c. have a light source which shall be an incandescent lamp with a colour temperature in the range of 2,800K to 3,250K (conforming to CIE S 001) or a green light emitting diode (LED) with a spectral peak 560nm ±10nm.

d. have a receiver that shall be a photocell or a photo diode (with filter if necessary) which in the case when the light source is an incandescent lamp shall have a spectral response similar to the photopic curve of the human eye (maximum response) in the range 560nm ±10nm, to less than 4% of that maximum response below 430nm and above 680nm.

3.3. Operational

Meters shall:

a. automatically prevent measurement of smoke and prompt the user when the meter is due for any calibration.

b. perform a zero check automatically immediately before each series of FAS tests and reset zero as necessary. This should take no longer than 10 seconds.

c. remind the operator before the start of the FAS cycles to fully depress the accelerator in under one second, quickly and continuously, but not violently.

d. enable the operator to anticipate the prompt to depress the accelerator by a countdown or similar visual aid, for example by using red, amber and green indicators.

e. schedule a sequence of up to 6 accelerations (including fast pass), leaving a gap of at least 10 seconds between the release of the accelerator pedal and the prompt to carry out the next acceleration.

NOTE: the engine, and any turbocharger fitted, should be at idle before the start of each FAS cycle; this may mean leaving a gap in excess of 10 seconds between the release of the accelerator pedal and the prompt to carry out the next acceleration. The operator may be invited to confirm that the engine has returned to idle 10 seconds after the prompt to release the accelerator.

f. recognise that a FAS test is in progress. This may be done by monitoring any effective combination of the following: engine speed, exhaust gas temperature, exhaust gas pressure rise, smoke level. Proposals for other systems will be considered on their merits.

g. ensure that the smoke meter sees the complete pulse produced as a result of accelerating the engine. Calculate after each acceleration, and automatically, the arithmetic mean of the latest 3 readings. If any of the 3 readings is less than 75% of the mean smoke level, then that individual reading shall be rejected (for the purpose of this average only) and no mean value shall be displayed.

NOTE: The total number of accelerations never exceeds 6. Also if one or more of the last 3 readings is rejected, then the meter shall take the mean of the valid readings contained in the last 3 (see Annex 1 for worked examples). Where no valid mean has been achieved a ‘void’ result will be returned.

h. provide a prompt to the operator based on FAS being in progress to “release the accelerator pedal as soon as the engine reaches cut-off speed”.

i. check, simply and quickly, for any zero drift which may have occurred during a complete test of up to 6 accelerations.

j. Zero drift shall not be more than $\pm 0.1 m^{-1}$ or ±5% of the arithmetic mean result, whichever is the greater. For values in excess of these the meter shall show an error message and not display or produce a result.

k. If the drift is either equal to or less than $0.1 m^{-1}$ or ±5% of the arithmetic mean, and positive, subtract it from the mean of the last valid readings

NOTE: only applicable if a complete sequence of 6 accelerations has been carried out. If the resulting value is negative, then this should be recorded and displayed as zero.

l. clear the meter peak-hold and reset for the next acceleration in a single operation which is either automatic or such that it can be carried out by a tester sat in the driving seat of the vehicle under test.

m. when required in the specification, calculate with the smoke output measured in light absorption coefficient units (‘K’ values). Calculations are not to be rounded beyond that which is practical for device functionality.

n. display output results to 2dp (e.g. n.nn);

o. have standard pass/fail values built into the equipment. These must be easily changed.

3.4. Engine Temperature Measurement (Category A meters)

Meters shall:

a. incorporate a device or devices for measuring engine temperature of Class 4, 7 and IVA diesel engined vehicles.

b. display the recommended and measured engine test temperature (according to the requirements in section 3.9 Display).

c. record the measured engine temperature, at the point when the test proceeds, on the test output and printout.

d. record the method of capture used i.e., OBD/Probe/Other on the test output and printout.

Temperature measuring devices shall:

e. be capable of measuring engine temperature with an accuracy of ±5% relative and equivalent to an indicated oil temperature of up to at least 90°C.

f. be suitable for all MOT Class 4, 7 and IVA diesel engined vehicles.

g. Where oil temperature probes are used must be capable of being inserted via the dipstick tube and be adjustable in length to match the length of the dipstick of all MOT Class 4 and 7 and IVA diesel engined vehicles.

NOTE: It is accepted that this device may not cater for a minority of vehicles/engines which can be identified as not intended for the GB marketplace.

3.5. Engine Temperature sensing

Requirements for Category A (Class 4, 7 and IVA) meters:

a. Allow the operator to proceed with the test at any time when the minimum oil temperature of 60^{o}C has been reached. This process will not inhibit the operator's ability to warm the engine further before proceeding. The operator will not be able to proceed to the smoke test procedure until the engine temperature has reached the minimum requirement. The temperature at which the test proceeded shall be shown in the results (it will not default to show 60^{o}C).

b. if an oil temperature probe is used, prompt the operator to remove the oil temperature probe before raising the engine speed for any purpose and confirm by the press of a button that the probe has been removed.

c. if OBD is used, prompt the operator to remove the device after the test and confirm by the press of a button that the OBD device has been removed.

d. where an alternative temperature sensing is used, prompt the operator to work with care and be aware of hot and rotating components in the engine bay. The test method used must be shown in the results (ref MOT manual).

e. allow the operator to by-pass engine temperature and impose a time penalty of 40 seconds (showing the operator a clear count down) if the operator does choose to by-pass engine temperature measurement. 'No engine temperature taken' shall be clearly shown on any results;

f. allow a pass result at any temperature ≥ 60^{o}C oil (or equivalent), to be issued for any test option or process.

g. in the event of a fail result from a first full set of 6 FAS at any temperature greater than 60^{o}C but less than 80^{o}C oil (or equivalent) the meter will not offer to produce a

fail result. The operator will be informed that the engine temperature should be raised to at least 80ºC oil (or equivalent) or as close to this as may be considered normal for that engine and a second test cycle offered.

h. in the event of a fail from a first full set of 6 FAS at any temperature greater than or equal to 80ºC oil (or equivalent) the meter must offer to produce and output a fail result.

i. in the event of a fail following two full sets of 6 FAS at any temperature which is less than 80ºC oil (or equivalent) the meter must produce and output a fail result and include advice that the test was conducted at less than 80ºC oil temperature (or equivalent).

3.6. Sample probe

Sample probes shall:

a. attach securely to, and sample from, exhaust pipes of various shapes, sizes, outlet angles and positions, positioning the sample probe effectively central to the flow of exhaust gas in straight tailpipes and those with bends close to the tailpipe outlet.

b. Category B Meters must also make provision for reaching vertical stack or central exit exhausts and adapt prompts and timings to suit sample pipe lengths.

3.7. Test limits and procedures

Meters shall meet all the procedural requirements and limits contained in the current DVSA testing manuals.

Additionally meters shall:

a. Allow for the manual entry of a test limit value (manufactures plate value). Any value entered will be validated against the appropriate default value for the age of vehicle selected (see flow chart).

b. Automatically stop the test sequence if the measured value of the first acceleration is 40% below the Fast Pass smoke limit and produce a pass result appropriate for Test Type - Fast Pass. Important: For any other value continue with the test sequence of up to 6 FAS cycles;

NOTE: This facility shall be automatically disabled when any Low Emissions Vehicle (LEV) test option is selected by the operator.

3.8. Low Emissions Vehicle Tests (LEV test)

a. Meters to be used within Category B shall also offer Low Emission Vehicle (LEV) tests. The definition of which is ‘A vehicle that may need to operate in a Low Emission Zone (LEZ) or Clean Air Zone (CAZ). The respective standard can be found in the latest edition of the HGV/PSV Inspection Manual.

b. A meter in Category B shall meet all the general requirements above and in addition shall:

c. Allow the operator to select the LEV process. The selection of this process will disable the 'Fast pass' process;

d. Impose the LEV limit and sequence a test cycle of up to 6 FAS as per Section 3.3;

e. Calculate, display and produce results in respect of both the LEV and ‘standard’ smoke limits;

f. Provide result outputs which include a Pass/Fail for the standard test limits for the vehicle under test, and the LEV Pass/Fail.

NOTE: It is acceptable that results may show a Pass at the standard turbo or non-turbo limits and a LEV Fail at the same time.

NOTE: RPC is no longer used and references to RPC must be removed from existing software.

3.9. Display

a. All displays will be digital with figures at least 12mm high (unless the display is hand-held, in which case figures 4mm high will be acceptable);

b. The display shall be easily readable both in poor light conditions and bright sunlight;

c. The display shall be clearly visible to a tester sat in the driving seat of the vehicle under test.

d. The minimum scale range is K = $0m^{-1}$ to at least $9.99m^{-1}$;

e. The least significant figure of the display shall provide a resolution equal to or better than $0.01m^{-1}$

3.10. Results Output

Devices must:

a. meet the requirements for MTS connectivity and data transfer set out in Test Equipment Interface Specification.

b. be capable of recording and retaining the test result outputs for a minimum of three months.

c. store test data in a readily retrievable and usable format with an option to print via the device printer and/or a networked printer;

d. ensure the result of a completed test must be saved even when not printed.

e. ensure Data transmission from the instrument to the printer shall be designed so that the results cannot be falsified.

f. ensure printouts clearly show a minimum of the following:

i. Vehicle Testing Station (VTS) name and address

ii. VTS number

iii. Date and time of test in the format DD/MM/YYYY

iv. Engine temperature, or the words ‘No engine temperature taken’

v. The words ‘Tested at below 80^{o}C oil temperature (or an acceptable equivalent)’ where appropriate

vi. The test limit applied e.g. $2.5m^{-1}$ or $3.0m^{-1}$

vii. Plate or LEV value applied (where selected by operator) as n.nn

viii. fast pass Smoke Limit applied (where appropriate value achieved on test)

ix. result of each acceleration as n.nn

x. drift at the end of the test as n.nn

xi. mean of the final valid accelerations undertaken as n.nn

xii. the test type applied followed by the words ‘Test result’ followed by ‘Fail’, ‘Pass’, ‘Void’ or ‘Aborted’ as appropriate.

Examples: Test types currently include non-turbo engine, turbo engine, fast pass, low emissions vehicle and <2008. A void result may occur when no valid mean has been achieved. An aborted result may occur when the tester aborts a test once in progress.

NOTE: It is acceptable for test result and/or printouts not to show (i) and (ii) above at the time of installation. These can be added when the meter receives its first full on-site calibration. In this case a space for the Vehicle Testing Station to stamp or emboss the printout must be provided.

g. No malfunction of the printer or the print function shall affect the measuring ability of the meter.

h. The smoke meter will always give the tester (by prompt) the option of at least one printout at the end of each completed test sequence.

i. The meter must always offer to produce a second or further printouts.

3.11. Marking

The meter shall be fitted with a permanent and easily read label giving the:

a. make,

b. model,

c. category of vehicles for which it is approved (all as shown on the certificate of acceptance),

d. serial number,

e. EIN Number (issued by the GEA on application for approval).

These marking shall be clearly visible on at least one of the photographs submitted to the GEA under the requirements of Section 6, Evidential requirements.

3.12. Environmental Requirements

Reference conditions,

a. For Correlation Tests,

Stable ambient conditions.

b. For Environmental Testing

temperature	20^{o}C $\pm$4^{o}C

relative humidity	60% ±10%
atmospheric pressure	stable ambient
mains voltage	nominal voltage ±2% nominal frequency ±1%

3.13. Rated Operating Conditions

temperature:	2°C to 40°C (any part of the instrument which is taken to the vehicle must be suitable for intermittent use down to 2°C)
relative humidity	up to 90%
atmospheric pressure variation:	ambient ±2,500 Pa
mains voltage variation	-15% to +10% of the nominal voltage and ±2% of the nominal frequency

See Annex 2 Section 3 for details of tests to these requirements.

The power source need not be mains. In the case of a meter which runs on more than one power source, then either: -

a. type approval testing is carried out with the machine running on each power source, or
b. a large clear durable notice shall be permanently displayed on the unit saying, for example, ‘For statutory testing, use mains power only’ or similar as appropriate.

3.14. Special Requirements for Category B Meters

a. The power supply to any part of the meter which will be handled by the vehicle tester during a test must not be greater than 24v. Additionally, those parts of the meter which would normally be used when testing a vehicle outside must effectively be sealed against the ingress of rain (see Annex 2, 3.8.)
b. Alternatives to using 24v power which can be demonstrated to be as safe will be considered.

3.15. Disturbances

The meter shall maintain accuracy to within $\pm 0.05 m^{-1}$, or shall indicate a fault or not register a result, when subject to the following disturbances (as set out in Annex 2):

a. mechanical shock
b. short time power reduction
c. bursts from the mains (transients)

d. electrostatic discharges

e. radiated, radio frequency, electromagnetic fields

3.16. Validation/Calibration

a. The meter shall be supplied with a stable neutral density filter which has a value in the region 1.6 to 2.0m^{-1} based on the smoke meter's declared Effective Optical Path Length (EOPL). This value shall be programmed into the smoke meter. Only UKAS approved operators shall have access to re-program this value.

b. Meters shall prompt a verification check at least once every seven and a half days, using the filter specified in 3.16.a (above). No further testing shall be permitted unless the meter reads the value of that filter to within $\pm$0.1m^{-1}. This check shall be simple and quick to perform and within the capability of a vehicle tester.

c. Only UKAS approved operators shall have access to correct for non-linearity.

d. Provision shall be made for a more comprehensive check at 3 points in the range as specified in Annex 6. This check will be carried out by a UKAS approved operator at a frequency as specified in Annex 6.

NOTE: Methods of calibrating using other than optical filters will be considered on their merits.

e. Details of periodic calibration procedures can be found in Annex 6

3.17. Calibration Manual

a. A calibration manual shall be provided with each meter supplied for pattern approval testing and its adequacy and completeness shall be checked by the laboratory carrying out the Environmental testing.

b. The manual shall contain all the information necessary to carry out a full annual calibration as specified by DVSA.

c. Before the GEA issues a Certificate of Acceptance for a meter, the meter manufacturer (or UK importer) shall provide a written declaration stating whether or not a copyright publication of this manual, and any additional software required for calibration purposes, will be made available to any third parties, at a reasonable price, requiring the information to gain UKAS accreditation.

d. GEA will make it clear what manufacturers (or UK importers) have declared for each meter when it publishes lists of acceptable smoke meters.

3.18. Operation Instructions

Each meter shall be supplied with comprehensive user manual(s) in English including, in simple step-by-step terms: -

a. using the meter to carry out FAS testing according to the relevant Inspection Manual(s)

b. the use of the engine temperature device (including the appropriate temperature values required when not using an oil temperature probe)

c. an explanation of the types of vehicles for which the meter is 'Approved'

d. how to carry out a calibration verification check

e. routine maintenance

f. contact address (in the UK) for service and spare parts (including the neutral density filters referred to in 3.16).

g. A sample of each manual shall be provided to GEA.

h. Any subsequent manual updates shall also be provided to GEA at the time of their issue.

i. In addition, a quick reference card, preferably laminated or plasticised, shall be attached to each meter and shall include the information necessary for daily use.

3.19. Method of Inspection – Vehicle Testing

Statutory Test Procedures

Full details of the Diesel Exhaust Emission Test procedures can be found in the current DVSA's Inspection Manuals for:

a. Private Passenger and Light Commercial Vehicle Testing (Class 3, 4, 5 and 7)

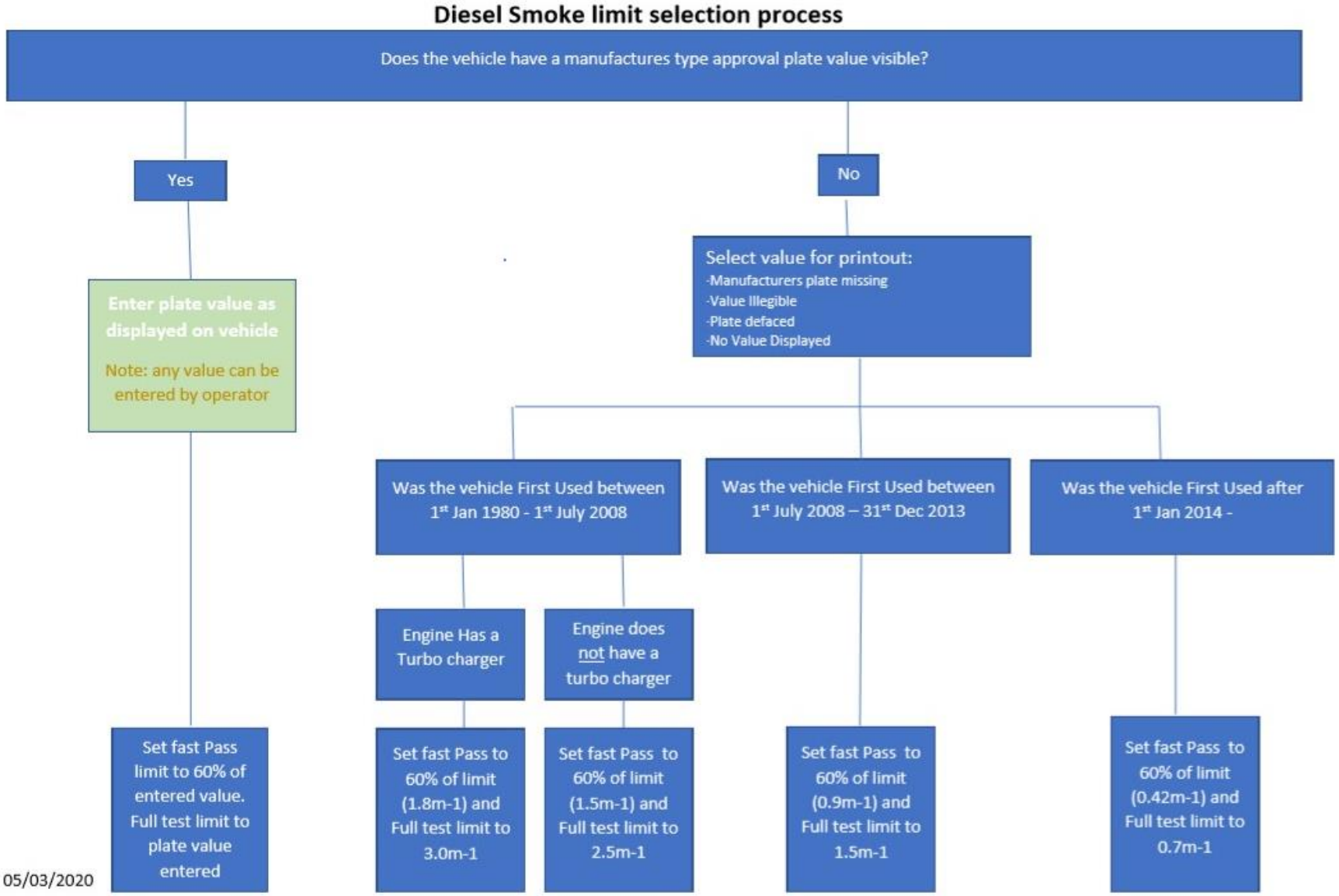
b. Public Service Vehicle (Class 6)

c. Heavy Goods Vehicle

d. Individual Vehicle Approval (Category M1, M2 & M3, N1 and N2 & N3)

NOTE: Meters must test according to the current Inspection Manuals at the time of sale

3.20. Diesel Smoke Limit Process Chart



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4. Approval Process

4.1. Pattern Approval Procedure

a. Meters must undergo a pattern approval process before consideration for final approval and before being added to the DVSA approved equipment list.

b. This is a two-part process consisting of Correlation testing against a reference meter, and Environmental testing.

c. Further details can be found in Annex 2

4.2. Badge engineering

Where a meter is to be released by the original certification holder for the issue of a second or further certificate for marketing or other purposes these original reports will continue to be acceptable.

4.3. Submitting an application

All documents shall be presented in English or accompanied by a full technical translation to English.

When both sets of tests have successfully been completed, application for inclusion on the List of Acceptable Equipment should be made to:

Garage Equipment Association

2/3 Church Walk

DAVENTRY

Northants

NN11 4BL

4.4. Applications for new meters should include the following as necessary:

a. a copy of the test reports showing that all the required criteria have been satisfied

b. a copy of the user manual(s) to meet the requirements made under paragraph 3.18 (Operating Instructions)

c. photographs of the meter

d. clear identification of the power source during the test process e.g., battery or mains

e. any declaration made under paragraph 3.17 (Calibration Manual)

f. a declaration of the categories of vehicle to be tested

g. a declaration that any changes, as listed in the pattern approval report, which were required to obtain approval will be made to all production models

h. a declaration that any future design modifications will be notified to the original test house

i. a declaration that no changes have been made to meter software which will affect the equipment function for the purposes of MOT Testing

4.5. Applications for badge engineered meters should include the following as necessary:

a. a copy of the user manual(s) to meet the requirements made under paragraph 3.1.8 (Operating Instructions)

b. photographs of the meter clearly showing new identifying features – colour, badging, etc.

c. any declaration made under paragraph 3.17 (Calibration Manual)

d. a declaration that any changes, as listed in the pattern approval report, which were required to obtain approval will continue to be made to all production models

e. a declaration that any future design modifications will be notified to the original test house

f. a declaration from the original certification holder to advise that the meter has been released to be sold an alternative trim format

g. a request for the issue of alternative certification giving details from original certification and new identifying information

h. a declaration that no changes have been made to meter software which will affect the equipment function for the purposes of MOT Testing

5. Scope

The requirements in this document may be subject to change in-line with legislative amendments and changes in testing procedure.

5.1. This document must be referenced against the requirements of the latest relevant MOT testing inspection manuals.

5.2. All new devices submitted for approval must meet the requirements of the most recent iteration of the MOT testing inspection manual.

5.3. All meters to be used for statutory testing shall conform and be shown to continue to conform to these requirements, existing devices will need to be updated accordingly to retain their approved status throughout their lifecycle.

6. Evidential Requirements

6.1. Conformity of production

a. The meter will be subject to annual conformity of production testing according to the requirements set out below.

6.2. Annual Conformity of Production Checks

a. The conformity of production checks will be performed by a test house which is either a member of the European Accreditation Multi Lateral Agreement (MLA) or other International Laboratory Accreditation (ILAC), or in certain cases (see 6.4) by an accredited ISO 9000 certification body.

b. The manufacturer/importer will nominate the test house or the ISO 9000 certification body, at the time of approval, which will be carrying out the conformity of production checks and will notify the GEA of the contact’s name and address.

c. This body may be changed at any time during the meter life by notifying GEA of the new conformity of production contact details.

6.3. Conformity of Production by Test House

a. The test house will nominate a suitably qualified auditor who will visit the manufacturer/importer at any point between their manufacturing premises and point of sale.

b. Starting from one calendar year after the date when the meter was accepted by GEA as meeting the requirements of the Specification for Diesel Smoke Meters the auditor will visit the manufacturer/importer and provide GEA with appropriate reports annually

c. In exceptional circumstances the test house and manufacturer may apply to the GEA to make alternative arrangements.

d. The manufacturer/importer will be required to provide a minimum of 2 sets of the following at the time of approval (see Annex 2)

e. Documents as listed in Annex 2 at items 1.2 a - g of this specification (MOT/05/05/01) must bear unique references, information about the issue status, and a validation stamp from the test house.

f. Quality colour photographs (digital or 10” x 8” if printed) showing the following:

Item	Number of photographs	
Meter	External	At least 2 - (taken from opposite corners such that all sides of the meter including identification markings are clearly visible).
	Internal	At least 1 – (showing all circuit boards)
Probes	External	1

g. The above sets will be distributed as follows after approval:

- GEA
- test house or ISO 9000 certification body (whichever applicable)
- importer or distributor (where this is not the body seeking approval)

h. The manufacturer/importer will also be required to maintain a file of any modifications to the meter since it was first approved. The onus lies with the manufacturer/importer to decide in consultation with their nominated test house or certification body whether each modification requires re-approval.

i. Where a modification has not been re-approved, the file shall include a statement explaining why the modification does not affect the original approval.

j. A copy of this document must be made available to the test house at the time of the conformity of production check. A copy must also be made available to the GEA on request.

k. GEA reserve the right to request supporting information, or documentation to any modification related file statement.

l. At the annual inspection, the test house auditor will compare the original set of photographs, technical drawings and specifications to the meter currently being manufactured or offered for sale. Should there be any discrepancies, the test house auditor should advise appropriate action. The GEA will require evidence from the test house of satisfactory audit reports, along with copies of any associated supporting information or documentation where requested.

NOTE: If any discrepancies arise which cannot be resolved between the test house auditor and the manufacturer/importer, they should be referred to the GEA. A decision will be made, and the meter may then need to be submitted for full or partial approval testing to check whether it still meets the requirements of the specification.

b. If the auditor finds that the meter no longer meets the requirements of the specification, or where the GEA have not received appropriate periodic evidence of conformity of production checks, the certificate of acceptance holder will be notified and shall provide clear evidence that the meter continues to meet the requirements of the specification, for consideration by the GEA.

c. A warning will be given prior to the removal of the meter from the List of Acceptable Equipment. The meter will not be reinstated until it can be shown the required modifications have been made to both current production of the meter and to all identical models already being used for MOT purposes to the satisfaction of the test house auditor and GEA.

6.4. ISO 9000 Conformity of Production

a. Where the meter manufacturer holds certification from a UKAS accredited Certifying Body (or certification from any other accreditation body which is a member of the European Accreditation MLA or other International Laboratory Accreditation ILAC) to BS EN ISO 9000 covering the products concerned, then the annual test house conformity of production check can be replaced by providing the following to GEA:

b. An annual written declaration, based on items 6.3.h and 6.3.l (COP by test house), from the manufacturer, endorsed by the Certification Body auditor to further the assurance, that no unauthorised changes have been made to the approved product.

c. Declarations shall be retained by the manufacturer’s representative in the UK.

d. Copies of Conformity of Production reports or declarations must be submitted to the GEA on an annual basis.

Annex 1 – Example Results Calculations

Example 1

Acceleration 1	3.0
Acceleration 2	2.0
Acceleration 3	1.5
Acceleration 4	1.5

The mean after the first 3 accelerations

$$is \quad \frac{3.0 \ + \ 2.0 \ + \ 1.5}{3} = \frac{6.5}{3} = \ 2.167$$

For this result to be valid, no reading may be lower than 75% of this value

75% of the mean is

$$(0.75 \ x \ 2.167) \quad = \quad 1.625$$

The reading from acceleration 3 is below this value, so the result is not valid, and another acceleration is necessary.

After 4 accelerations the mean of the last three is 1.67, and no reading is less than 75% of this value so the result is valid.

Example 2

Acceleration 1	4.2
Acceleration 2	4.1
Acceleration 3	4.2
Acceleration 4	4.0
Acceleration 5	1.6
Acceleration 6	4.2

We need consider only the last 3 accelerations,

The mean is,

$$\frac{4.0 \ + \ 1.6 \ + \ 4.2}{3} = \frac{9.8}{3} = 3.267$$

25% of the mean is:

$$0.25 \ x \ 3.267 \ = \ 0.817$$

So, for the mean to be valid, no reading can be less than

$$3.267 - 0.817 = 2.45$$

The reading from Acceleration 5 is clearly below this value and is not valid. The result of this test is the mean of accelerations 4 and 6, i.e.

$$\frac{4.0 + 4.2}{2} = 4.1$$

Annex 2 – Approval and Pattern Approval Procedures

1. General

Correlation testing shall be carried out on 2 units and environmental testing shall be carried out on at least one unit, all of which, in the opinion of the testing bodies, represent the definitive pattern.

Test houses will normally expect meters to be provided complete with:

a) a description of the general principle of measurement

b) a list of essential components with their characteristics

c) a description of the essential components with drawings and diagrams that are necessary for testing and maintenance

d) general information on the software required for a microprocessor equipped measuring meter

e) the operating instructions that shall be provided to the user

f) details of how calculations are performed

g) a fully documented calibration procedure and a set of calibration filters.

The pattern tests fall into 2 parts:

Part 1: Verify correlation with the reference meter, taking the form of back-to-back FAS testing over a range of vehicles representative of those likely to be tested. This is to be conducted by an organisation having a proven ability in FAS testing to Type Approval standards using the reference meter, and which can demonstrate independence from any smoke meter manufacturer.

The suitability of a particular test house should be confirmed with the DVSA before testing begins.

The organisation conducting this aspect of the approval process is also responsible for verifying that the operational requirements of this specification (Section 4.4) are met.

Part 2:

Environmental testing using a neutral density filter to simulate smoke measurement. This can be done only by a test house having a UKAS accreditation which specifically covers the relevant tests on smoke meters.

Reports from other European Accreditation Multi Lateral Agreement (MLA), or other International Laboratory Accreditation (ILAC) test houses will be considered on their merits.

2. FAS Correlation testing

2.1 Range of vehicles/engines

Correlation testing against the reference meter, must be carried out on a range of vehicles representative of those on which the meter will be used in-service.

The selection will be made by the Approving Engineer appointed by the Approval body and include the extremes of the current in-service vehicle fleet.

For each category of meter (A or B) one vehicle of each of the following types for Euro Emission standards groups listed must be tested.

Category A Meters

Light duty diesel emission standards, vehicle types M1, M2, N1, N2; one of each from Euro 1, 2, 3 and Euro 4, 5

Category B Meters

Heavy duty diesel emissions standards, vehicle types M2, M3, N2, N3; one of each from Euro 1, 2, 3 and Euro 4, 5

2.2 Test reports

EU correlation test reports such as PTB / NMI will be verified by the Approving engineer by testing at least one vehicle in each of the classes above.

2.3 Correlation Test Procedure

The correlation tests shall be performed using complete vehicles. Test engines shall be at normal operating temperature as specified by the vehicle manufacturer.

The reference meter shall be properly calibrated using a neutral density filter, the value of which is known to better than 0.025m^{-1} and is traceable to National or International Standards according to UKAS requirements.

The reference meter shall indicate this value to within $\pm$0.05m^{-1}.

The following series of tests, each consisting of 10 FAS, will be performed on each vehicle with the meter indicated:

Test 1 - Reference meter installed on its own and in accordance with Directive 72/306/EEC and as agreed with the GEA

Test 2 - Subject meter installed on its own in the vehicle tailpipe and calibrated

according to manufacturer's instructions using a neutral density filter the value of which is known to better than 0.025m^{-1} and is traceable to National or International Standards according to UKAS requirements.

Test 3 - As Test 2

Test 4 - As Test 1

Having performed Tests 1 to 4 on all engines, this will then be repeated on one engine selected at random from the appropriate category as a further check on the subject meter's repeatability.

2.4 Analysis of Results

Based on the mean of Free Accelerations 7, 8, 9 and 10 in each test:

A test sequence is valid only if Test 4 does not vary from Test 1 by more than $\pm$0.05m^{-1} or $\pm$5% of the arithmetic mean result, whichever is the greater.

On 2 vehicles, the mean of Tests 2 and 3 must lie within $\pm 0.05 m^{-1}$ or $\pm 5\%$ of the arithmetic mean result, whichever is the greater, of Tests 1 and 4. On the remaining vehicle, the mean of Tests 2 and 3 must lie within $\pm 0.1 m^{-1}$ or $\pm 10\%$ of the arithmetic mean result, whichever is the greater, of Tests 1 and 4

The results of tests 2 and 3 must lie within $\pm 0.1 m^{-1}$ or $\pm 10\%$ of the arithmetic mean, whichever is the greater, mean of the 2 tests.

For each of the 4 tests, the scatter of results of the last 4 FAS (i.e. 7, 8, 9 and 10) expressed in units of m^{-1} shall not exceed 15% coefficient of variation, where the coefficient of variation is defined as

$$\frac{\text{Standard Deviation} \times 100}{\text{Mean}} \quad \%$$

2.5 Environmental Testing

The tests in this section are to be performed applying a randomly selected filter from one of two stable neutral density optical filters in the region of 0.7 to $1.5 m^{-1}$ and 2.5 to $3.0 m^{-1}$ to simulate a measurement situation. These filters are to be supplied by the meter manufacturer and may or may not be part of the set of calibration filters. Their values need not be traceable to National standards. Once selected the same filter may be used for each of the environmental checks conducted.

Tests should normally be carried out on a complete unit, including the printer. If the size or configuration of the meter is such that this is not practicable or if only a particular component or device of the meter is concerned, a test may be carried out on the component or device separately, but a simulated measurement set-up must be achieved.

It is not intended that meters be dismantled for testing.

Before each test, the unit shall be calibrated according to Section 5

The neutral density filters are to be kept with the meter during the climatic tests to prevent problems such as condensation or poor fit due to differential heating.

Not all tests are applicable to all meter power supply configurations. A schedule of tests relevant to each configuration is given at the end of this section.

Tests should be conducted in accordance with relevant IEC & BSI standards.

2.5.1 Safety Checks

Part 1 Earth Continuity

The resistance from the earth pin of the mains supply plug to the meter chassis should be less than 0.5Ω. The point of measurement on the chassis should normally be that which is physically the farthest accessible point from the mains cable entry position of the meter enclosure.

Part 2 Dielectric Strength and Insulation Resistance

The test voltage of 2.1kV dc is applied between the live and neutral terminals (strapped together) and mains earth for at least one minute, followed by a measurement of the insulation resistance at 500V dc (applied across the same points). This resistance shall not be less than 20MΩ. Note that during this test, the equipment should not be powered up, but the mains switch should be in the 'on' position.

2.5.2 Repeatability

Carry out the manufacturers calibration procedure and verify that it effectively and properly calibrates the meter. Repeat the calibration procedure 4 more times and confirm that calibration is repeatable to within $\pm 0.05 m^{-1}$.

2.5.3 Drift Stability

This test shall be conducted for a period of 4 hours following the warmup time. Measurements shall be performed every half hour. The meter shall maintain accuracy to within $\pm 0.05 m^{-1}$ (or not indicate a result if the meter is battery powered and the battery has become discharged). For meters which are intended to run on batteries for only a short period (such as for the duration of a FAS test), this test shall be done twice, once without the unit being returned to the charger, and one with the unit alternating between being 'on charge' for 15 minutes and 'in use' for 15 minutes.

2.5.4 Dry Heat

The test consists of exposure of the meter to a temperature of 40°C under 'free air' condition for 2 hours. The time duration specified beginning after the meter has reached temperature stability. During the test, the change in temperature shall not exceed 1°C/min during heating up and cooling down, and the relative humidity in the testing atmosphere shall not exceed 50%.

2.5.5 Cold

Part 1 - This test consists of exposure of the meter to a temperature of 2°C under 'free air' condition for 2 hours. The time duration specified beginning after the meter has reached temperature stability. During the heating up and cooling down of the meter, the change in temperature shall not exceed 1°C/min.

Part 2 - Immediately after Part 1, any part of the meter which would normally be attached to a vehicle's exhaust pipe shall be placed in an ambient temperature of below –2°C. It is accepted that cabinet doors may have to be left ajar during this test to allow for interconnecting cables, and the main body of the meter need not be kept critically at 2°C.

2.5.6 Damp Heat, Steady State

This test consists of exposure of the meter to a constant temperature of 40°C and a constant relative humidity of 90% for 4 days. The exposure shall be such that water does not condense on the meter. The temperature is deemed to be steady when the difference between the extreme temperatures does not exceed 5°C, and the rate of change does not exceed 5°C per hour.

2.5.7 Power Supply Variation

Part 1 - For meters which are directly connected to the mains while measurements are taken.

Mains voltage V (v)	upper limit lower limit	V_{nom} + 10% V_{nom} - 15%
Mains frequency f (Hz)	upper limit lower limit	f_{nom} + 2% f_{nom} - 2%

This test consists of exposing the meter to extreme values from the nominal power supply voltage, V_{nom}, and the nominal frequency, $f_{nom,}$ for a period long enough to perform the required measurement. A measurement shall be taken while the meter is exposed separately to each of the following conditions:

Part 2 - For meters with a battery power supply

This test consists of exposing the meter to extreme values from the nominal power supply voltage, for a period long enough to perform a measurement. A DC power supply is to be used to simulate a battery, and a measurement shall be taken with the meter exposed to V_{nom} +10% and V_{nom} –25%. This latter figure may be reduced to coincide with voltage at which a 'battery low' or similar warning device operates.

2.5.8 Ingress Protection – Category B Meters only

This test applies to those parts of the meter which would normally be used outside when testing a vehicle outside. It consists of placing each unit under test equipment to prove protection against drops of water.

The rate of discharge shall be reasonably uniform over the area of the apparatus, with a rainfall of approximately between 3mm and 5mm of water per minute. The base of the dripping equipment shall be larger than the equipment under test. The component shall be tested in 4 fixed positions of tilt. These positions are 15° either side of the vertical in 2 mutually perpendicular planes. The total test duration will be 10 minutes with the equipment tested for 2.5 minutes in each position of tilt. On components which attach to exhaust pipes, the test will be carried out twice, once with the exhaust probe pointing vertically down and once with the exhaust probe horizontal. In each case, the exhaust probe will be effectively sealed against the ingress of water prior to the test.

The meter shall be switched on during the test, and a measurement shall be taken before and after. At the end of the test the components shall be examined to confirm that there has been no ingress of water.

2.5.9 Mechanical Shock

Part 1 - For mechanical shock testing, the meter shall be placed in its normal position of use on a rigid surface. It shall be tilted on one bottom edge and then shall be allowed to fall freely onto the test surface. The following conditions shall be applied

Height of fall……. 50 mm

Number of falls……. 2 on each bottom edge

A measurement shall be taken before and after the test.

Part 2 - This part applies only to those parts of the meter which contain electrical or electronic components, and which are carried by the vehicle tester during normal use, for example any part which attaches to the vehicle exhaust or a remote control unit etc.

The test consists of subjecting the relevant component to two falls from a height of 0.5m onto a smooth hard rigid surface of either concrete or steel. A measurement shall be performed after the test and the component shall be examined to confirm that structural integrity has been maintained.

2.5.10 Short Time Power Reduction

A test generator shall be used to reduce the amplitude of the AC mains voltage as specified in the table below. It shall be adjusted before being connected to the meter. The mains voltage interruptions and reductions shall be repeated 10 times with an interval of at least 10 seconds between successive disturbances.

The following conditions shall be applied:

Reduction	100%	50%
Duration	10 ms	20 ms

2.5.11 Bursts from the mains (transients)

The test consists of exposure of the meter to bursts of 1.0 kV voltage spikes and having a double exponential waveform. Each spike shall have a rise time of 5ns and a half amplitude duration of 50ns. The burst length shall be 15 ms, the burst period (repetition time interval) shall be 300ms. Repetition frequency of the impulses and peak values of the output voltage on 50Ω load: 5.0kHz ±20%.

The transient generator shall have an output impedance of 50Ω and shall be adjusted before connecting to the meter. At least 10 positive and 10 negative bursts randomly phased shall be applied. Insertion of blocking filters in the cables to the meter may be necessary to prevent the burst energy being dissipated in the mains.

2.5.12 Electrostatic discharges

A capacitor of 150pF shall be charged by a suitable DC voltage source of 6kV in contact mode and 8kV in air mode. Then it shall be discharged through the meter by connecting one terminal to the meter's ground chassis and the other through a 330Ω resistance to the meter's surfaces that are normally accessible to the user.

At least 10 successive discharges shall be applied with a time interval between discharges of at least 10s. A meter not equipped with a grounding terminal shall be placed on a grounded plane surface that projects beyond the meter by at least 0.1m on all sides. The associated grounded connection to the capacitor shall be as short as possible. In the contact discharge mode, to be carried out on conductive surfaces, the electrode shall be in contact with the meter and the discharge shall be actuated by the discharge switch of the generator. In the air

discharge mode, on insulating surfaces, the electrode is approached to the meter and the discharge occurs by spark.

2.5.13 Radiated, radio frequency, electromagnetic fields

The meter shall be exposed to an electromagnetic field strength as follows:

Frequency Range	26 – 1000MHz
Field Strength	3 V/m
Modulation	80% AM, 1kHz sine wave

The field strength may be generated in the following ways:

- a strip line for low frequencies for small meters from DC to 150MHz
- a TEM cell (Transverse Electromagnetic Mode cell) for higher frequencies, up to 1GHz
- a biconical antenna (26MHz – 300MHz)
- a log periodic antenna (100MHz – 1,000MHz)

The specified field strength shall be established prior to the actual testing (without the meter in the field).

When the test is carried out in a shielded enclosure to comply with international laws prohibiting interference to radio communications, care needs to be taken to handle reflections from walls. Anechoic shielding may be necessary.

SCHEDULE OF TESTS

The following table gives guidance on which tests to carry out on meters with various power supplies.

Power Test	Mains only	Mains/short life[1] Battery	Long Life[2] Battery	Dual power option
2.5.1	Yes	Yes	On charger	Yes
2.5.2	Yes	Yes	Yes	Battery
2.5.3	Yes	Yes, twice	Yes	Battery
2.5.4	Yes	Yes	Yes	Either
2.5.5	Yes	Yes	Yes	Either
2.5.6	Yes	Yes	Yes	Either
2.5.7 (1)	Yes	No	No	Yes

2.5.7 (2)	No	Yes	Yes	Yes
2.5.8	N/A	Yes	Yes	Yes
2.5.9	Yes	Yes	Yes	Yes
2.5.10	Yes	No	No	Mains
2.5.11	Yes	No	No	Mains
2.5.12	Yes	Yes	Yes	Both[3]
2.5.13	Yes	Yes	Yes	Both[3]

NOTES:

1) ‘Short life battery’ means meters where the measuring unit is normally recharged between tests.
2) ‘Long life battery’ means meters which would be expected to run all day without recharging.
3) These tests must be repeated on each configuration due to different earthing arrangements etc.
4) Allowance should be made for the inclusion of the read/write device where the 12v supply for this is sourced from the meter.

Additional Checks

Engine Temperature Measurement Approval

(Required for category A meters used in Class 4, 7 and IVA testing)

Verify that the meter meets the operational and accuracy requirements for measuring engine temperature as specified in Sections 4.4.

Disconnect the probe from the meter and check that no reading is displayed and that the words ‘No engine temperature taken’ are recorded on the test output data and the printout.

Check that OBD access meets the requirements in Section 3.5. Engine Temperature sensing.

Annex 3 - Reference Meter

The reference meter for correlation testing purposes will be a dedicated system consisting of:

i. the Bosch RTM 430 smoke tube,
ii. probe of internal diameter 10mm and length 1m for exhaust diameters to less than70mm

iii. probe of internal diameter 16mm and length 1m for exhaust diameters from 70mm

iv. dedicated correlation software for use with this device.

Damping

The damping filter to be used with the reference smoke tube consists of two parts. An initial, physical response correction filter is applied to correct smoke output of the reference device to that of a smoke meter with a 400ms response time (EC 72/306 maximum allowable response time). A second, one second electrical filter is then applied.

NOTE 1: This two-stage filtering is recommended in ISO 11614, and also provides compliance with EC 72/306.

NOTE 2: Response time is largely dependent upon exhaust gas velocity. Exhaust gas velocity is not measured during FAS tests, therefore the physical response correction to 400ms is based around a specific point. The point chosen for the physical correction filter relates to an exhaust gas velocity of 20m/s with a corresponding response time of the reference meter of 150ms. Both the correction and the main electrical filters are based around a simple first order recursive filter.

These filters are applied in sequence to the raw output of the reference smoke tube.

Correction Filter

$Y_n = (0.9304 * Y_n^{-1}) + (0.0696 * X_n)$

Electrical filter

$Y_n = (0.9772 * Y_n^{-1}) + (0.0228 * X_n)$

Where;

Y_n new calculated (filtered) value

Y_n^{-1} previous calculated (filtered) smoke value

X_n input raw (prior to filter) smoke value

All filtering is conducted on opacity values, with conversion to light absorption coefficient (k) occurring after the filters. Finally a temperature correction is applied.

Correlation software

Correlation software to enable manufacturers to conduct tests and trials prior to seeking correlation testing for acceptance certification is available from the GEA.

Annex 4 - DVSA Vehicle Testing Division Requirements

The equipment shall be capable of functioning or meeting the following:

1.1 The meter must appear as a Category B meter on the current List of Acceptable Equipment for statutory testing purposes;

1.2 Operational Life
The minimum operational life of the equipment, without need of major overhaul, shall be 5 years;

1.3 Environment
The test environment in which goods vehicle inspections are normally conducted is particularly hostile, for health and safety reasons most smoke testing is done outdoors and to meet this requirement smoke meters have to be capable of operating outdoors at all times, therefore the environmental conditions are those ambient conditions existing throughout the UK all year round;

1.4 Be suitable for testing all vehicle types, for example by the lengths of cables, probe and pipework , temperature probe design, etc;

1.5 Be designed such that 100% of all diesel powered vehicles can be tested having a multitude of possible exhaust outlets, varying from low mounted under vehicle to vertical stacks up to 4.9 meters high;

1.6 Be provided with detailed maintenance/operating instructions and calibration certificate;

1.7 Be capable of subsequent integration with Management Information Systems. The minimum information to be transferred will be: Vehicle identity, test results, date of test, time of test and overall assessment result. Manufacturers shall be required to supply full detail of data transfer capabilities;

1.8 Take a minimum of time to become operational after initial switching on from cold; information regarding typical time to be provided related to an ambient temperature of -10^{o}C;

1.9 Be ‘CE’ or UKCA approved and marked accordingly;

1.10 Have an automatic self test function, irrespective however there should be a user operable calibration feature;

1.11 Operate correctly in an ambient temperature range of -15 to +30^{o}C, atmosphere of relative humidity of 90% (non condensing) and any other conditions identified elsewhere in the specifications;

1.12 Comply with all relevant British and International Standards and Health & Safety Regulations being in force at the time of commissioning. This shall include the Health & Safety at Work Act 1974, Supply of Machinery (Safety) Regulations 1992, Electrical

Equipment (Safety) Regulations 1994, and other relevant supporting Regulation identified at the time of commissioning;

NOTE: Equipment in service will be maintained according to the requirements found within PUWER for all Vehicle & Operator Services Agency use;

1.13 If supplied with a trolley this shall be of robust design and suitable for high frequency use within the intended environment. The wheels of any such trolley will be:

i) lockable, or include wheel or other type of brakes to prevent unintended movement
ii) not less than 75 mm diameter
iii) of a design to minimise problems caused by small stones and surface imperfections
iv) be constructed to reduce vibration;

1.14 Although there are no installation risks anticipated manufacturers must supply details of any unusual risks associated with the normal usage/storage of the equipment.

Annex 5 - DVSA Roadside Enforcement Requirements

The meter must appear on the current List of Acceptable Equipment for statutory testing purposes.

The meter will be ‘CE’ or UKCA approved and marked accordingly.

The meter will be portable and ideally weigh less than 10kg. Heavier units may be considered acceptable if supported by a trolley. The wheels of any such trolley will be lockable and of a design to minimise problems caused by small stones and surface imperfections.

The existence of trailing cables for power and/or printer operation will be minimised.

Any display will be capable of being read in daylight.

The equipment should be capable of being powered by a single low voltage power supply.

The measuring probe will be of a design to offer the potential of gaining access to the greatest possible positional range of exhaust outlets.

The equipment will be supplied in a robust carrying case **containing all parts and accessories** (excluding the trolley if applicable).

Annex 6 - (MOT/08/19/1) Diesel Smoke Meter Calibration Requirements

1. INTRODUCTION

The requirements detailed in this document relate to all smoke meter calibrations, which are carried out on meters to be used for statutory purposes after they are commissioned.

At the time of the first 'in-service' calibration, the opportunity should be taken to enter printout details such as VTS name and number etc.

2. INITIAL PERIOD OF CALIBRATION

A smoke meter may be calibrated before it is supplied as part of the in-house quality system at manufacture by a BSi/ISO registered company. Such meters will be issued with a dated Certificate of Conformity which carries the BSi and/or ISO logos at the time of the calibration.

This calibration will remain valid for 6 months from the date of issue.

3. FREQUENCY

Smoke meters are to be calibrated every 12 months.

Calibration certificates are normally valid for 12 months from the date of issue. However, if the certificate is issued no more than one month before the expiry of an existing certificate then the expiry date may be twelve months from the expiry of the old certificate.

Only UKAS approved operators can carry out annual smoke meter calibrations.

Meters must also be calibrated whenever they have been subject to a major repair, which is normally defined as a repair which the user would not normally be expected to carry out in the course of normal use.

4. CALIBRATION FILTERS

1. Calibration shall be carried out using 3 neutral density filters.

The value of these must lie in the ranges 0.5 to 1.0m^{-1}, 1.6 to 2m^{-1} and 3.0 to 3.5m^{-1}, and be known to better than $\pm$0.05m^{-1}.

2. Filters shall be calibrated using a light source of wavelength 565nm $\pm$5nm.

Calibration shall be traceable to National or International standards according to UKAS requirements.

5. ACCURACY REQUIREMENTS

1. Smoke meters shall indicate the value of the 3 calibration filters to at least $\pm 0.1 m^{-1}$.

2. Check oil temperature sensing device accuracy manually by correlation to a traceable calibrated device to at least one point in the range 50-90^{0}C.

The device shall indicate the temperature to an accuracy of at least $\pm 5^0$C.

3. Any temperature measuring device sensing an equivalent to an indicated oil temperature shall indicate the equivalent temperature to an accuracy of at least $\pm 5^0$C.

6. ANALYSIS OF RESULTS

Calibration results must be made available, on request, to the Driver & Vehicle Standards Agency to verify the adequacy of the calibration periods.

Details of the form of the data to be given to the Driver & Vehicle Standards Agency will be agreed with individual accredited laboratories.

7. CALIBRATION PROCEDURE

The items detailed below must, where relevant, be included in the periodic calibration checks of smoke meters used for statutory testing. The order in which they are performed may vary according to the equipment type.

1. Measure and record ambient temperature.

2. When the meter has completed any warm-up phase, insert the calibration filters and record the results.

3. Check that:
    a. The unit has the correct level of software & or limits to ensure it maintains requirements for testing to the current DVSA tester manual.
    b. the exhaust probe can be inserted into an exhaust pipe, and will clamp securely to it
    c. the hole(s) at the end of the probe are clear
    d. any sample hose, including any extension hose and pipework, is not chafed to the extent that failure is imminent
    e. any sample hose, including any extension hose and pipework, is not collapsed or kinked

f. internal pipes are secure and not damaged or deteriorated to the extent that collapse or leakage is imminent
g. the pump /fans fitted are operating correctly
h. the heating system for the optical chamber is functional
i. any sample period adjustments for extension hoses and pipework are correct
j. internal voltages are within tolerance
k. the purge air system is working correctly
l. engine temperature devices are functional and within tolerance
m. visual displays are readable and function correctly
n. the casing is complete and there is electrical continuity between the earth on the input socket and all parts of the steel case
o. all seals are complete and undamaged
p. the printer is working correctly and the printout details are correct

4. Calibrate the meter to within the limits given in Sections 4 and 5 using the neutral density filters.

5. Program the meter with the value of the weekly check filter.

6. Complete and affix calibration seals and next due date.

7. Wherever possible, carry out a Statutory smoke test to confirm that the meter is working properly.

8. Complete and issue a calibration certificate of a type approved for the purpose by UKAS and the Driver & Vehicle Standards Agency.

Change Log

Amendment	Page	Revision	Date
Amended section 3.8 to clarify LEV procedure. Added note on removal of RPC.	7	5.4	14.07.2023
Added Change log	36	5.4	14.07.2023