

Democratic Socialist Republic of Sri Lanka



Civil Aviation Authority of Sri Lanka

Implementing Standards

(Issued under Sec. 120, Civil Aviation Act No. 14 of 2010)

Title: Aircraft Engine Emissions

Reference No. : IS-16-(ii)-all

SLCAIS : 082

Date: 01st January 2018

Pursuant to Sec.120 of the Civil Aviation Act No.14 of 2010 which is hereinafter referred to as the CA Act, Director General of Civil Aviation shall have the power to issue, whenever he considers it necessary or appropriate to do so, such Implementing Standards for the purpose of giving effect to any provision in the CA Act, Regulations or Rules made thereunder including the Articles of the Convention on International Civil Aviation specified in the Schedule to the CA Act.

Accordingly, I, being the Director General of Civil Aviation do hereby issue the Implementing Standards on **Aircraft Engine Emissions** as mentioned in the Attachment hereto (Ref: Attachment No. IS-16-(ii)-all-Att.), elaborating the requirements to be satisfied for the effective implementation of the International Standards and Recommended Practices on 'Aircraft Engine Emissions' contained in Volume II, of the Annex-16 in particular to the Convention and the Air Navigation Regulations of 1955.

This Implementing Standard shall be applicable to all Aircraft Operators holding Air Operator Certificate or special authorization issued by Director General of Civil Aviation of Sri Lanka and shall come in to force with immediate effect and remain in force unless revoked.

The IS-082 shall be effective on 01st January 2018 and will be applicable on 01st January 2018. It will supersede the requirement in Aviation Safety Notice (ASN) 79.

Attention is also drawn to Sec. 103 of the Act, which states inter alia that failure to comply with Implementing Standard is an offence.

H.M.C. Nimalsiri
Director General of Civil Aviation and
Chief Executive Officer

Civil Aviation Authority of Sri Lanka
04, Hunupitiya Road
Colombo 02.

Enclosure: Attachment No. IS-16-(ii)-all-Att.

Table of Contents

APPLICABILITY.....	2
PART I. DEFINITIONS AND SYMBOLS.....	2
CHAPTER 1. Definitions.....	2
CHAPTER 2. Symbols.....	3
PART II. VENTED FUEL	3
CHAPTER 1. Administration	3
CHAPTER 2. Prevention of Intentional Fuel Venting.....	4
PART III. EMISSION CERTIFICATION	4
CHAPTER 1. Administration	4
CHAPTER 2. Turbojet and Turbo Fan Engines Intended for Propulsion only at Subsonic Speed. ...	5
2.1 General	5
2.2 Smoke.....	7
2.3 Gaseous Emissions.....	7
2.4 Information Required	9
CHAPTER 3 Turbojet and Turbofan Engines Intended for Propulsion at Supersonic Speeds	10
3.1 General	10
3.2 Smoke.....	12
3.3 Gaseous Emissions.....	12
3.4 Information Required	13

Implementing Standards

SLCAIS-082: Aircraft Engine Emissions

APPLICABILITY

Requirements contained in this document are based on the ICAO Annex – 16 “Environmental Protection” Volume II “Aircraft Engine Emissions”. Aircraft Engine Emissions or certification procedures apply to all such aircraft that are specified in Annex 16 Volume II and registered in Sri Lanka. These procedures are also applicable to foreign registered aircraft operated under AOC issued by the Director General of Civil Aviation of Sri Lanka. In respect of foreign aircraft conducting flight operations into and out of Sri Lanka, the requirement for Aircraft Engine Emissions shall be as approved by the state of the Operator. Nevertheless such requirements shall not be less than that are specified in the Annex-16 part II to the Convention on International Civil Aviation in writing.

PART I. DEFINITIONS AND SYMBOLS

CHAPTER 1. Definitions

Where the following expressions are used in this IS, they have the meanings ascribed to them below:

Afterburning. A mode of engine operation wherein a combustion system fed (in whole or part) by vitiated air is used.

Approach phase. The operating phase defined by the time during which the engine is operated in the approach operating mode.

Climb phase. The operating phase defined by the time during which the engine is operated in the climb operating mode.

Date of manufacture. The date of issue of the document attesting that the individual aircraft or engine as appropriate conforms to the requirements of the type or the date of an analogous document.

Derivative version. An aircraft gas turbine engine of the same generic family as an originally type certificated engine and having features which retain the basic core engine and combustor design of the original model or for which other factors, as judged by the Director General of Civil Aviation, have not changed.

Oxides of nitrogen. The sum of the amounts of the nitric oxide and nitrogen dioxide contained in a gas sample calculated as if the nitric oxide were in the form of nitrogen dioxide.

Rated thrust. For engine emissions purposes, the maximum take-off thrust approved by the certifying authority for use under normal operating conditions at ISA sea level static conditions, and without the use of water injection. Thrust is expressed in kilo Newton.

Reference pressure ratio. The ratio of the mean total pressure at the last compressor discharge plane of the compressor to the mean total pressure at the compressor entry plane when the engine is developing take-off thrust rating in ISA sea level static conditions.

Smoke. The carbonaceous materials in exhaust emissions which obscure the transmission of light.

Smoke Number. The dimensionless term quantifying smoke emissions (see 3 of Appendix 2 of Annex 16 Part II)

Take-off phase. The operating phase defined by the time during which the engine is operated at the rated thrust.

Taxi/ground idle. The operating phase involving taxi and idle between the initial starting of the propulsion engine(s) and the initiation of the take-of roll and between the time of runway turn-off and final shutdown of all propulsion engine(s).

Unburned hydrocarbons. The total hydrocarbon compounds of all classes and molecular weight contained in a gas sample, calculated as if they were in the form of methane.

CHAPTER 2. Symbols.

Where the following symbols are used in this IS, they have the meanings ascribed to them below:

CO	Carbon monoxide
Dp	The mass of any gaseous pollutant emitted during the reference emissions landing and take-off cycle
F_n	Thrust in international Standard Atmosphere (ISA), sea level conditions, for the given operating mode.
F_{oo}	Rated thrust
F^*_{oo}	Rated thrust with afterburning applied
HC	Unburned hydrocarbons (see definition)
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen (see definition)
SN	Smoke Number (see definition)
π_{oo}	Reference pressure ratio (see definition)

PART II. VENTED FUEL

CHAPTER 1. Administration

- 1.1 The provision of this Part shall apply to all turbine engine powered aircraft intended for operation in international air navigation manufactured after 18 February 1982.
- 1.2 Certification related to the prevention of intentional fuel venting shall be granted by the certifying authority on the basis of satisfactory evidence that either the aircraft or the aircraft engines comply with requirements of Chapter 2.

- 1.3 Director General of Civil Aviation shall recognize as valid a certification relating to fuel venting granted by the certificating authority of another Contracting State provided the requirements under which such certification was granted are not less stringent than provision of this IS.

CHAPTER 2. Prevention of Intentional Fuel Venting

Aircraft shall be so designed and constructed as to prevent the intentional discharge into the atmosphere of liquid fuel from the fuel nozzle manifolds resulting from the process of engine shutdown following normal flight or ground operations.

PART III. EMISSION CERTIFICATION

CHAPTER 1. Administration

- 1.1 The provisions of paragraph 1.2 to 1.4 below shall apply to all engines included in the classifications defined for emission certification purposes in Chapters 2 and 3 where such engines are fitted to aircraft engaged in international air navigation.
- 1.2 Emission certification shall be granted by the certifying authority on the basis of satisfactory evidence that the engine complies with requirements which are at least equal to the stringency of the provisions of this IS. Compliance with the emissions levels of Chapter 2 and 3 shall be demonstrated using the procedure described in Appendix 6 of Annex 16 part II.

Note: - The document attesting emissions certification may take the form of a separate emissions certificate or a suitable statement contained in another document approved by the certifying authority.

- 1.3 The document attesting emissions certification for each individual engine shall include at least the following information which is applicable to the engine type:
 - a) name of the certifying authority
 - b) manufacturer's type and model designation;
 - c) statement of any additional modifications incorporated for the propose of compliance with the applicable emissions certification requirements;
 - d) rated thrust;
 - e) reference pressure ratio;
 - f) a statement indicating compliance with Smoke Number requirements;
 - g) A statement indicating compliance with gaseous pollutant requirements.
- 1.4 Director General of Civil Aviation shall recognize as valid emissions certification granted by the certificating authority of another Contracting State provided that the requirements under which such certification was granted are not less stringent than the provisions of this IS.

CHAPTER 2. Turbojet and Turbo Fan Engines Intended for Propulsion only at Subsonic Speed.

2.1 General

2.1.1 Applicability

2.1.1.1 The provisions of this chapter shall apply to all turbojet and turbofan engines, as further specified in paragraph 2.2 and 2.3 below, intended for propulsion only at subsonic speeds, except when certifying Authority make exemptions for:

- a) Specific engine types and derivative versions of such engines for which the type certificate of the first basic type was issued or other equivalent prescribed procedure was carried out before 01 January 1965: and
- b) A limited number of engines beyond the dates of applicability specified in 2.2 and 2.3 for the manufacture of the individual engine.

2.1.1.2 In such cases, an exemption document shall be issued by the certifying authority, the identification plates on the engines shall be marked “EXEMPT NEW” or “EXEMPT SPARE” and the grant of exemption shall be noted in the permanent engine record. Exemptions shall be reported by engine serial number and made available via an official public register.

2.1.1.3 The provisions of this chapter shall also apply to engines designed for applications that otherwise would have been fulfilled by turbojet and turbofan engines.

Note:- In considering exemptions, certifying authorities should take into account the probable numbers of such engines that will be produced and their impact on the environment. When such an exemption is granted, the certifying authority should consider imposing a time limit on the production of such engines for installation on new aircraft. Further guidance on issuing exemptions is provided in the Environmental Technical Manual (Doc 9501), Volume II — Procedures for the Emissions Certification of Aircraft Engines.

2.1.2 Emissions Involved

The following emissions shall be controlled for certification of aircraft engines

Smoke

Gaseous emissions

Unburned hydrocarbons (HC)

Carbon monoxide (CO)

Oxides of nitrogen (NO_x).

2.1.3 Units of Measurement

2.1.3.1 The smoke emission shall be measured and reported in terms of smoke Number (SN)

2.1.3.2 The mass (D_p) of the gaseous pollutant HC, CO, or NO_x emitted during the reference emissions landing and take-off (LTO) cycle, defined in paragraph 2.1.4.2 and 2.1.4.3 below, shall be measured and reported in grams.

2.1.4 Reference Conditions

2.1.4.1 Atmospheric Conditions

The reference atmospheric conditions shall be ISA at sea level exempt that the reference absolute humidity shall be 0.00634 kg water/kg dry air.

2.1.4.2 Thrust Settings

The engine shall be tested at sufficient thrust settings to define the gaseous and smoke emissions of the engine so that mass emission rates and Smoke Numbers can be determined at the following specific percentages of rated thrust as agreed by the certifying authority;

LTO operating mode	Thrust setting
Take-off	100 per cent F_{oo}
Climb	85 per cent F_{oo}
Approach	30 per cent F_{oo}
Taxi/ ground idle	7 per cent F_{oo}

2.1.4.3 Reference Emissions Landing and Take-Off (LTO) Cycle

The reference emissions LTO cycle for the calculation and reporting of gaseous emissions shall be represented by the following time in each operating mode;

Phase	Time in operating Mode, minutes
Take-off	0.7
Climb	2.2
Approach	4.0
Taxi/ ground idle	26.0

2.1.4.4. Fuel Specifications

The fuel used during tests shall meet the specifications of Appendix 4 of Annex 16 part II, unless a deviation and any necessary corrections have been agreed by the certifying authority. Additives used for the purpose of smoke suppression (such as organometallic compounds) shall not be present.

2.1.5 Test Conditions

2.1.5.1 The test shall be made with the engine on its test bed.

2.1.5.2 The engine shall be representative of certificated configuration (see Appendix 6 of Annex 16 part II) off-take bleeds and accessory loads other than those necessary for the engine's basic operation shall not be simulated.

2.1.5.3 When test conditions differ from the reference atmospheric conditions in 2.1.4.1, the gaseous emissions test results shall be corrected to the reference atmospheric conditions by the methods given in Appendix 3 of Annex 16 part II.

2.2 Smoke

2.2.1. Applicability

The provisions of paragraph 2.2.2. shall apply to engines whose date of manufacture is on or after 01 January 1983.

2.2.2. Regulatory Smoke Number

The Smoke Number at any of the four LTO operating mode thrust settings when measured and computed in accordance with the procedures in Appendix 2 of Annex 16 part II and converted to a characteristic level by the procedures in Appendix 6 Annex 16 part II shall not exceed the level determined from the following formula:

$$\text{Regulatory Smoke Number} = 83.6 (F_{oo})^{-0.274}$$

or a value of 50, whichever is lower.

2.3 Gaseous Emissions

2.3.1 Applicability

The provisions of paragraph 2.3.2. below shall apply to engines whose rated thrust is greater than 26.7 kN and whose date of manufacture is on or after 01 January 1986 and as further specified for oxides of nitrogen.

2.3.2. Regulatory Levels

Gaseous emission levels when measured and computed in accordance with the procedures in Appendix 03 of Annex 16 part II and converted to characteristic levels by the procedures in Appendix 6 of Annex 16 part II shall not exceed the regulatory levels determined from the following formulas:

$$\text{Hydrocarbons (HC): } D_p / F_{oo} = 19.6$$

$$\text{Carbon monoxide (CO): } D_p / F_{oo} = 118.0$$

Oxides of nitrogen (NO_x):

- a) For engines of a type or model for which the date of manufacture of the first individual production model was before 1 January 1996 and for which the date of manufacture of the individual engine was before 1 January 2000.

$$D_p / F_{oo} = 40 + 2\pi_{oo}$$

- b) For engines of a type or model for which the date of manufacture of the first individual production model was on or after 1 January 1996 or for which the date of manufacture of the individual engine was on or after 1 January 2000.

$$D_p / F_{oo} = 32 + 1.6\pi_{oo}$$

c) For engines of a type or model for which the date of manufacture of the first individual production model was on or after 1 January 2004:

1) For engines with a pressure ratio of 30 or less:

i) For engines with a maximum rated thrust of more than 89.0 kN

$$D_p / F_{oo} = 19 + 1.6\pi_{oo}$$

ii) For engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN:

$$D_p / F_{oo} = 37.572 + 1.6\pi_{oo} - 0.2087F_{oo}$$

2) For engines with a pressure ratio of more than 30 but less than 62.5:

i) For engines with a maximum rated thrust of more than 89.0 kN

$$D_p / F_{oo} = 7 + 2.0\pi_{oo}$$

ii) For engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN

$$D_p / F_{oo} = 42.71 + 1.4286\pi_{oo} - 0.4013F_{oo} + 0.00642\pi_{oo} \times F_{oo}$$

3) For engines with a pressure ratio of 62.5 or more:

$$D_p / F_{oo} = 32 + 1.6\pi_{oo}$$

d) For engines of a type or model for which the date of manufacture of the first individual production model was on or after 1 January 2008 or for which the date of manufacture of the individual engine was on or after 1 January 2013:

1) For engines with a pressure ratio of 30 or less:

i) For engines with a maximum rated thrust of more than 89.0 kN

$$D_p / F_{oo} = 16.72 + (1.4080 * \pi_{oo})$$

ii) For engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN

$$D_p / F_{oo} = 38.5486 + (1.6823 * \pi_{oo}) - (0.2453 * F_{oo}) - (0.00308 * \pi_{oo} * F_{oo})$$

2) For engines with a pressure ratio of more than 30 but less than 82.6

i) For engines with a maximum rated thrust of more than 89.0 kN

$$D_p / F_{oo} = -1.04 + (2.0 * \pi_{oo})$$

ii) For engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN

$$D_p / F_{oo} = 46.1600 + (1.4286 * \pi_{oo}) - (0.5303 * F_{oo}) + (0.00642 * \pi_{oo} * F_{oo})$$

3) For engines with a pressure ratio of 82.6 or more:

$$D_p / F_{oo} = 32 + (1.6 * \pi_{oo})$$

e) For engines of a type or model for which the date of manufacture of the first individual production model was on or after 1 January 2014:

1) For engines with a pressure ratio of 30 or less:

i) For engines with a maximum rated thrust of more than 89.0 kN

$$D_p / F_{oo} = 7.88 + 1.4080\pi_{oo}$$

ii) For engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN

$$D_p / F_{oo} = 40.052 + 1.5681\pi_{oo} - 0.3615F_{oo} - 0.0018\pi_{oo}F_{oo}$$

2) For engines with a pressure ratio of more than 30 but less than 104.7:

i) For engines with a maximum rated thrust of more than 89.0 kN

$$D_p / F_{oo} = -9.88 + 2.0\pi_{oo}$$

ii) For engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN

$$D_p / F_{oo} = 41.9435 + 1.505\pi_{oo} - 0.5823F_{oo} + 0.005562\pi_{oo}F_{oo}$$

3) For engines with a pressure ratio of 104.7 or more:

$$D_p / F_{oo} = 32 + 1.6\pi_{oo}$$

2.4 Information Required

Note: - The information required is divided into three groups: 1) general information to identify the engine characteristics, the fuel used and the methods of data analysis; 2) the data obtained from the engine test(s); and 3) the results derived from the test data.

2.4.1 General Information

The following information shall be provided for each engine type for which emissions certification is sought:

- a) Engine identification;
- b) Rated thrust (in kilonewtons);
- c) Reference pressure ratio;
- d) Fuel specification reference;
- e) Fuel hydrogen/ carbon ratio;
- f) The methods of data acquisition;
- g) The method of making corrections for ambient conditions; and
- h) The method of data analysis.

2.4.2. Test Information

The following information shall be provided for each engine tested for certification purposes at each of the thrust settings specified in 2.1.4.2. The information shall be provided after correction to the reference ambient conditions where applicable:

- a) Fuel flow (kilograms/ second)
- b) Emission index (grams/ kilogram) for each gaseous pollutant; and
- c) Measured smoke number.

2.4.3 Derived Information

2.4.3.1 The following derived information shall be provided for each engine tested for certification purpose:

- a) Emission rate, i.e. Emission index \times fuel flow, (grams/second) for each gaseous pollutant;
- b) Total gross emission of each gaseous pollutant measured over the LTO cycle (grams);
- c) Values of D_p / F_{oo} for each gaseous pollutant (grams/ kilo newton); and
- d) Maximum smoke number.

2.4.3.2 The characteristic Smoke Number and gaseous pollutant emission levels shall be provided for each engine type for which emissions certification is sought.

CHAPTER 3 Turbojet and Turbofan Engines Intended for Propulsion at Supersonic Speeds

3.1 General

3.1.1 Applicability

The provisions of this IS shall apply to all turbojet and turbofan engines intended for propulsion at supersonic speeds whose date of manufacture is on or after 18 February 1982.

3.1.2 Emissions Involved

The following emissions shall be controlled for certification of aircraft engines:

Smoke

Gaseous emissions

- Unburned hydrocarbons (HC);
- Carbon monoxide (CO): and
- Oxides of nitrogen (NO_x).

3.1.3 Units of Measurement

3.1.3.1 The smoke emission shall be measured and reported in terms of Smoke Number (SN)

3.1.3.2 The mass (D_p) of the gaseous pollutants HC, CO or NO_x emitted during the reference emissions landing and take-off (LTO) cycle, defined in paragraph 3.1.5.2 and 3.1.5.3 below shall be measured and reported in grams.

3.1.4 Nomenclature

Throughout this chapter, where the expression F^*_{oo} is used, it shall be replaced by F_{oo} for engines which do not employ afterburning. For taxi/ground idle thrust setting, F_{oo} shall be used in all cases.

3.1.5 Reference Conditions

3.1.5.1 Atmospheric Conditions

The reference atmospheric conditions shall be ISA at sea level except that the reference absolute humidity shall be 0.00634 kg water/kg dry air.

3.1.5.2 Thrust Settings

The engine shall be tested at sufficient power settings to define the gaseous and smoke emissions of the engine so that mass emission rates and Smoke Numbers corrected to the reference ambient conditions can be determined at the following specific percentages of rated output as agreed by the certifying authority.

<i>Operating mode</i>	<i>Thrust setting</i>
Take-off	100 per cent F^*_{oo}
Climb	65 per cent F^*_{oo}
Descent	15 per cent F^*_{oo}
Approach	34 per cent F^*_{oo}
Taxi/ ground idle	5.8 per cent F_{oo}

3.1.5.3 Reference Emissions Landing and Take-Off (LTO) Cycle

The Reference emissions LTO cycle for the calculation and reporting of gaseous emissions shall be represented by the following time in each operating mode.

<i>Phase</i>	<i>Time in operating mode, minutes</i>
Take-off	1.2
Climb	2.0
Descent	1.2

Approach	2.3
Taxi/ ground idle	26.0

3.1.5.4 Fuel Specifications

The fuel used during test shall meet the specifications in Appendix 4 of Annex 16 part II. Additives used for the purpose of smoke suppression (such as organometallic compounds) shall not be present.

3.1.6 Test Conditions

3.1.6.1 The tests shall be made with the engine on its test bed.

3.1.6.2 The engine shall be representative of the certificated configuration; (see Appendix 6 of Annex 16 part II) off-take bleeds and accessory loads other than those necessary for the engine's basic operation shall not be simulated.

3.1.6.3 Measurements made for determination of emission levels at the thrusts specified in 3.1.5.2 shall be made with the afterburner operating at the level normally used, as applicable.

3.1.7 When test conditions differ from the reference conditions in paragraph 3.1.5, the test results shall be corrected to the reference conditions by the methods given in Appendix 5 of Annex 16 part II.

3.2 Smoke

3.2.1 Regulatory Smoke Number

The Smoke Number at any thrust setting when measured and computed in accordance with the procedures in Appendix 2 of Annex 16 part II and converted to a characteristic level by the procedures in Appendix 6 of Annex 16 part II shall not exceed the regulatory level determined from the following formula:

$$\text{Regulatory Smoke Number} = 83.6 (F^*_{oo})^{-0.274}$$

or a value of 50, whichever is lower

3.3 Gaseous Emissions

3.3.1 Regulatory Levels

Gaseous emission levels when measured and computed in accordance with the procedures in Appendix 3 or Appendix 5 as applicable of Annex 16 part II, and converted to characteristic levels by the procedures in Appendix 6 of Annex 16 part II shall not exceed the regulatory levels determined from the following formulas:

$$\text{Hydrocarbons (HC): } D_p / F^*_{oo} = 140(0.92)^{\pi_{oo}}$$

$$\text{Carbon monoxide (CO): } D_p / F^*_{oo} = 4\,550(\pi_{oo})^{-1.03}$$

$$\text{Oxides of nitrogen (NO}_x\text{): } D_p / F^*_{oo} = 36 + 2.42\pi_{oo}$$

Note:- The characteristic level of the Smoke Number or gaseous pollutant emissions is the mean of the values of all the engines tested, measured and corrected to the reference standard engine and reference ambient conditions, divided by the coefficient corresponding to the number of engines tested, as shown in Appendix 6 of Annex 16 part II.

3.4 Information Required

Note: - The information required is divided into three groups: 1) general information to identify the engine characteristic, the fuel used and the method of data analysis; 2) the data obtained from the engine test(s); and 3) the results derived from the test data.

3.4.1 The following information shall be provided for each engine type for which emissions certification is sought:

- a) Engine identification;
- b) Rated output (in kilonewtons);
- c) Rated output with afterburning applied, if applicable (in kilonewtons)
- d) Reference pressure ratio;
- e) Fuel specification reference;
- f) Fuel hydrogen/ carbon ratio;
- g) The methods of data acquisition;
- h) The methods of making corrections for ambient conditions; and
- i) The method of data analysis.

3.4.2 Test Information

The following information shall be provided for each engine tested for certification purposes at each of the thrust settings specified in paragraph 3.1.5.2. The information shall be provided after correction to the reference ambient conditions where applicable:

- a) Fuel flow (kilograms/ second)
- b) Emission index (grams/ kilogram) for each gaseous pollutant;
- c) Percentage of thrust contributed by afterburning; and
- d) Measured Smoke Number.

3.4.3 Derived Information

3.4.3.1 the following derived information shall be provided for each engine tested for certification purposes:

- a) Emission rate, i.e. Emission index \times fuel flow, (grams/second), for each gaseous pollutant;
- b) Total gross emission of each gaseous pollutant measured over the LTO cycle (grams)
- c) Values of d_p/f^*_{oo} for each gaseous pollutant (grams/ kilo newton); and
- d) Maximum Smoke Number.

3.4.3.2 The characteristic Smoke Number and gaseous pollutant emission levels shall be provided for each engine type for which emissions certification is sought.

Note:- *The characteristic level of the Smoke Number or gaseous is the mean of the values of all the engines tested, measured and corrected to the reference standard engine and reference ambient conditions, divided by the coefficient corresponding to the number of engines tested, as shown in Appendix 6 of Annex 16 part II.*