GOVERNMENT OF INDIA
**OFFICE OF THE DIRECTOR GENERAL OF CIVIL AVIATION**
TECHNICAL CENTRE, OPP. SAFDURJUNG AIRPORT, NEW DELHI

**CIVIL AVIATION REQUIREMENTS**
**SECTION 10 – AVIATION ENVIRONMENTAL PROTECTION**
**SERIES 'B' PART I**
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Subject: **Climate Change Initiatives and Local Air Quality Monitoring in Civil Aviation**

## 1. INTRODUCTION

1.1 Human induced climate change is now recognized by the global community as the greatest environmental threat of the 21st century. The most important greenhouse gas produced by human activities is carbon dioxide ($CO_2$). While international aviation's contribution to global emissions of greenhouse gases remains relatively small, in the order of 2-3%, aviation's share is likely to increase as the industry continues to grow rapidly on a global basis.

1.2 Emissions from aviation are being addressed within the framework of the United Nations Framework Convention on Climate Change (UNFCCC). Specifically, emissions from international aviation (i.e. bunker fuels) are addressed through the International Civil Aviation Organization (ICAO), while emissions from domestic aviation are included in national greenhouse gas inventories.

1.3 Apart from climate change issue, air quality at and in the vicinity of airports, often referred as Local Air Quality (LAQ), is an important environmental aspect that airport operators must take into account in order to achieve sustainable green aviation. Aircraft emissions contains various pollutants which in turn can involve broader environmental issues related to ground level ozone ($O_3$), acid rain and climate change and cause potential risks to public health and the environment. Unlike most transportation modes, aircraft travel longer distances at varied altitudes producing

emissions that have an adverse impact on air quality in the local, regional and global levels.

1.4 Aircraft engines produce emissions that contain oxides of nitrogen (NOx), carbon monoxide (CO), unburnt hydrocarbons (UHC), sulphur dioxide ($SO_2$), particulate matter ($PM_{10}$ and $PM_{2.5}$), etc. Stationary sources such as power-plants, generators, air conditioning & heating units, auxiliary power units, apron vehicles, de-icing and apron spillages of fuel and chemicals also emit these pollutants.

1.5 Emissions from aircraft up to 1,000 feet above the ground (typically around 3 km from departure or, for arrivals, around 6 km from touchdown) mainly influence the local air quality and are dispersed with the wind and blend with emissions from other sources such as emissions from domestic, industries and surface transport.

1.6 ICAO has recognized that airport-related sources of emissions have the ability to emit pollutants leading to degradation of air quality in the local community. As such, national and international air quality programmes and standards require airport authorities and government bodies to address air quality issues in the vicinity of airports.

1.7 This Civil Aviation Requirements (CAR) is issued in compliance to Section 5A sub-section 1 of the Aircraft Act, 1934 in conjunction with rule 29C of the Aircraft Rules 1937.

1.8 This CAR stipulates the general requirements, procedures and practices to be adhered to by all stakeholders/organizations that are engaged in activities that directly or indirectly impact climate change and local air quality around airports. The objective of this CAR is to manage the adverse impact of aviation activities on the atmosphere leading to sustainable growth of the industry.

## 2. DEFINITIONS

**Scope 1 Emissions** - GHG emissions from sources that are owned or controlled by the stakeholder. This can include emissions from fuel combustion in boilers, airport power generation facilities, airport fleet vehicles, aircraft emissions, etc.

**Scope 2 Emissions** - GHG emissions from the off-site generation of electricity (and heating or cooling), purchased and consumed by the airport or airline operators.

## 3. APPLICABILITY

3.1 The provisions of this CAR shall be applicable to the following:

3.1.1 Indian airports having more than 50,000 aircraft movements per calendar year (where a single movement is a take-off or a landing); and

3.1.2 All Indian scheduled and non-scheduled passenger and cargo airline operators except those meeting the criteria mentioned in Para 3.2 of the CAR.

3.2 The provisions of this CAR are not applicable to the following categories of aircraft operations:

a) Flights of all small aircraft with MTOW < 5,700 kg,
b) Flights engaged in Search & Rescue, Patrolling or fire-fighting purposes,
c) Flights engaged in humanitarian grounds and emergency medical service,
d) Flights engaged in carrying VVIP, Head of States and other eminent personalities, and
e) All foreign registered airlines operating to/from India.

## 4. REQUIREMENTS

4.1 Airport operators and airline operators shall develop an annual emission management report on the following:

i) Carbon footprint for Scope 1 and Scope 2 emissions (as applicable) to monitor the emission trends of their respective organizations.
ii) Voluntary measures taken to reduce $CO_2$ emissions in their respective organizations, especially in relation to fuel efficiency, reduction of emissions, etc.
iii) Certifications in accordance to ISO standards (e.g. ISO-14001, ISO 14064), participation in Airport Carbon Accreditation or any other similar initiatives.

4.2 Airport operators shall submit the following data to DGCA on annual basis in the prescribed format given at Annexure I to this CAR:

i) Fuel consumption data from owned power generators,
ii) Fuel consumption data for airport-owned vehicles and equipment,
iii) Electricity consumption for the entire airport (inclusive of the electricity consumed by the tenants functioning inside the airport), and
iv) Electricity consumption for the airport operator only.

4.3 Airline operators shall submit Aviation Turbine Fuel (ATF) consumption data for aircraft main engines and APUs for both domestic and international operations on annual basis in the prescribed format given at Annexure II to this CAR.

4.4 Operators shall use appropriate emission factors as published from time to time. An indicative emission factors are given in Annexure III to this CAR for reference purpose.

## 5. Local Air Quality Monitoring

5.1 Airport operators shall establish one continuous (preferably mobile) monitoring station for determining pollutants indicated in Annexure IV to assess local air quality. Where possible, the airport operator shall use mobile station both inside and outside the airport as per guidance contained in ICAO Doc 9889. The monitoring station shall be capable of monitoring basic meteorological parameters including temperature, wind speed, wind direction, relative humidity, etc.

5.2 Airport operators shall collect air quality data for their airport(s) for pollutants as indicated in Para 5.1 of this CAR in a format as given in Annexure V.

5.3 All requirements contained in this CAR are supplementary to those laid down by other agencies, such as Central Pollution Control Board, State Pollution Control Boards, local municipal authorities, etc. and do not annul any other requirement regarding air pollution monitoring and reporting.

## 6. Fuel Management by Airline Operators

Airline operators shall develop following fuel management procedures for compliance without compromising with the safety of aircraft and its occupants:

a) For efficient flight planning management, a flight-planned route should include the planned take-off runway, departure and arrival procedures and landing runway.

b) To avoid additional fuel burn on account of unwanted extra weight, proper weight management shall be ensured on the aircraft. Carriage of items like old magazines and newspapers, excess duty free material, extra water in the tanks not required for the flight, pillows and blankets, excessive crew baggage, extra airline magazines, empty baggage and cargo containers, etc. shall be avoided on board the aircraft. Moisture accumulation in the aircraft insulation, accumulation of dirt both inside and outside the aircraft shall also be avoided.

c) Airline operators shall develop a system to track APU usage and ensure reducing the use of APUs when the aircraft are being prepared on stand for departure or following arrival.

d) To minimize departure delays and ramp congestion, engine start-up and push-back procedures shall be streamlined and coordinated.

e) Before using engine-out procedures, it shall be ensured that the SOPs regarding engine-out taxi are well established and flight crew properly trained.

f) Under normal conditions, single engine-out taxi-in shall be used as a standard procedure. Before using the engine-out taxi-in procedure, the flight crew shall undergo training and familiarization.

g) For initial climb-out profile management, proper speed and flap management shall be ensured for optimum fuel consumption and flight time.

h) For cruise management, flight crew shall use FMS suggested optimum altitudes. In this regard, flight crew shall ensure accurate feeding of wind fields (including winds above and below planned altitudes) and temperatures at the planned waypoints into the FMS.

i) Whenever practicable, the flight crew shall follow an uninterrupted descent profile from cruise altitude without the use of thrust or speed brakes until reaching the final approach stabilization altitude. The flight crew shall also adhere to the computed descent speeds and monitor the descent profile for any adjustments, if any.

## 7. Emissions Management by Airports

Airport operators shall manage their emissions by considering the adoption of appropriate best practices, as applicable including:

a) Emissions inventories and modeling.
b) Technical measures (i.e. reduction of emissions by implementing technical solutions).
c) Operational measures (i.e. reduction of emissions by changing operating times or procedures).
d) Indicative measures for reduction of aircraft taxiing and queuing;
e) Provision of electrical power (400Hz) and pre-conditioned air (PCA) to aircraft;
f) Use of renewable energy, such as solar energy;

g) Assessment of ground service equipment, ground vehicles and land transport infrastructure for emissions reduction opportunities and modernization of such equipment;

h) Use of alternative fuels;

i) Encouragement of public transport/mass transit;

j) Avoidance of engine idling.

8. The report/data as envisaged in Para 4.2 and 5.2 of this CAR shall be submitted to DGCA by March 31st of every year for the preceding calendar year.

(M. Sathyavathi)
Director General of Civil Aviation

**Annexure I**

**FORMAT FOR ANNUAL CARBON FOOTPRINT DATA (AIRPORT OPERATORS)**

| | | |
|---|---|---|
| Name of the Airport Operator | | |
| Calendar Year | | |
| Aircraft Movements* | Domestic | |
| | International | |
| | Total | |
| Number of Passengers | Domestic | |
| | International | |
| | Total | |
| Cargo (Tonnes) | Domestic | |
| | International | |
| | Total | |
| Scope 1: Fuel consumed by power generators, airport vehicles/equipment (e.g. GPU) moving inside or outside airport boundary owned by the airport company**<br><br>*Report fuel quantity & unit (e.g. liters, $m^3$, kgs, tonnes)* | Petrolfor Generators | |
| | Petrol for Vehicles/Equipment | |
| | Dieselfor Generators | |
| | Diesel for Vehicles/Equipment | |
| | CNGfor Generators | |
| | CNG for Vehicles/Equipment | |
| | LPGfor Generators | |
| | LPG for Vehicles/Equipment | |
| | Other | |
| Scope 2: Total electricity (MWh) purchased for heating, cooling, lighting of terminal building, runways, offices, etc. for all users, including the airport operator's company, third parties, etc.*** | Electricity | |
| Scope 2: Total electricity (MWh) purchased for heating, cooling, lighting of terminal building, runways, etc. only for the airport operator's company | Electricity | |
| Short description of data collection and quality control methodology (i.e. explain the source of the data, responsible department, checks done, correction process, etc.) | | |
| Authorized person | | |
| Designation | | |
| Telephone number | | |
| Email address | | |
| | Signature | Date |

* Aircraft movement is defined as aircraft take-off or landing at an airport. One arrival and one departure represent two movements.

** Vehicles, equipment, etc. that are sub-contracted should not be part of the calculations.

*** One number needs to be reported. In most of the cases this number will be based on the main electricity bills paid by the airport operator for the whole airport consumption.

## Annexure II

### FORMAT FOR ANNUAL CARBON FOOTPRINT DATA (AIRLINE OPERATORS)

| | | |
|---|---|---|
| Name of the Airline Operator | | |
| Calendar Year | | |
| Types of aircraft | | |
| Number of Aircraft Movements* | Domestic | |
| | International | |
| | Total | |
| Number of Passengers | Domestic | |
| | International | |
| | Total | |
| Cargo (tonnes) | Domestic | |
| | International | |
| | Total | |
| Revenue Tonne Kilometers (RTK)** | Domestic | |
| | International | |
| | Total | |
| Scope 1: ATF consumed by aircraft engines, APUs, maintenance etc. (tonnes)**** | Domestic operations*** | |
| | International operations*** | |
| | Total | |
| Short description of ATF data collection and quality control methodology (i.e., explain the source of the data, responsible department, checks done, correction process, etc.). | | |
| Authorized person | | |
| Designation | | |
| Telephone number | | |
| Email address | | |
| | Signature | Date |

* Aircraft movement is defined as aircraft take-off or landing at an airport. One arrival and one departure represent two movements.

** RTK = Distance × Payload,Where:

- Distance means the actual distance flown by the aircraft. In case of non-availability of this information, the great circle distance between the aerodrome of departure and the aerodrome of arrival plus an additional fixed factor of 95 km may be used.
- Payload means the total mass of revenue-based freight, mail and passengers carried. The number of passengers shall be the number of persons on-board excluding crew members. An aircraft operator may choose to apply either the actual or standard mass for passengers and checked baggage contained in its mass and balance documentation for the relevant flights. Alternatively a default value of 100 kg for each passenger and their checked baggage may be used.

*** Domestic flights are those that depart and arrive in India. International flights are those that depart from India and arrive in another country or those that depart from another country and arrive in India. ATF consumption from flights departing from another country and arriving to another country by an Indian airline (e.g. a flight from Brussels to Toronto) should also be reported as international flights. The airline should state the amount of fuel consumed for domestic and international flights separately. For flights that combine both a domestic and international leg, airlines should report the domestic leg at the domestic operations section and international leg at the international operations section by using a justified methodology. ATF consumption information may be calculated based on the summation of fuel consumption from each individual flight or on other appropriately documented and accepted methodology.

**** In case conversion from litres to kgs is required and there is no information on the specific density factor value, then the value of 0.8 kg/litre may be used.

## Annexure III

### INDICATIVE EMISSIONS FACTORS

The information below is provided for the benefit of airlines and airports that are developing carbon footprints. The emissions factors are based on the specific references and are updated periodically. Airport and airline operators shall use the latest value always while calculating emissions and may use other emission factors in accordance to best practice with proper justification/documentation.

| Source | Emission Factor | Reference |
|---|---|---|
| ATF | 3.157 tonnes of $CO_2$/tonne | ICAO (2011), Guidance Material for the Development of States' Action Plans, P. 19 |
| Petrol | 3.15 tonnes of $CO_2$/tonne | DEFRA: 2011 Guidelines to DEFRA/DECC's GHG Conversion Factors for Company Reporting, Annex 1, Tables 1a & 1b |
| Diesel | 3.16 tonnes of $CO_2$/tonne | |
| CNG | 2.70 tonnes of $CO_2$/tonne | |
| LPG | 1.49 tonners of $CO_2/m^3$ | |
| Electricity NEWNE* | 0.82 tonnes of $CO_2$/MWh | Ministry of Power (2012), Central Electricity Authority, $CO_2$ Baseline Database for the Indian Power Sector, Table S-1 |
| Electricity South* | 0.85 tonnes of $CO_2$/MWh | |
| * Two emission factors are available depending on the location of service provision (NEWNE: Integrated North Eastern Western & North-Eastern regional grids and South: Southern Grid) | | |

## Annexure IV

### POLLUTANTS TO BE MONITORED FOR LOCAL AIR QUALITY

| No. | Pollutant |
|---|---|
| 1. | Carbon monoxide (CO) $mg/m^3$ |
| 2. | Sulphur dioxide ($SO_2$) $\mu g/m^3$ |
| 3. | Nitrogen dioxide ($NO_2$) $\mu g/m^3$ |
| 4. | Ozone ($O_3$) $\mu g/m^3$ |
| 5. | Particulate Matter ($PM_{10}$) $\mu g/m^3$ |
| 6. | Particulate Matter ($PM_{2.5}$) $\mu g/m^3$ |
| 7. | Hydrocarbons (HCs) |

**Annexure - V**

**TABLE 1: MONTHLY MEAN VALUES (TO BE SUBMITTED EVERY 12 MONTHS)**

| Airport | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station Location | | | | | | | | | | | | | |
| Reporting Period | | | | | | | | | | | | | |
| **Month** | **NO** | **$NO_2$** | **$NO_x$** | **CO** | **$O_3$** | **$SO_2$** | **$PM_{10}$** | **$PM_{2.5}$** | **HCs** | **Temp** | **RH%** | **WS** | **WD*** |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Prevailing (i.e. most common) wind direction should be reported. | | | | | | | | | | | | | |

**TABLE 2: ANNUAL MEAN VALUES (TO BE SUBMITTED EVERY 12 MONTHS)**

| Airport | | | | |
|---|---|---|---|---|
| Station Location | | | | |
| Reporting Period | | | | |
| **Pollutant** | **Minimum**** | **Mean**** | **Maximum**** | **Data Capture %***** |
| NO | | | | |
| $NO_2$ | | | | |
| $NO_x$ | | | | |
| CO | | | | |
| $O_3$ | | | | |
| $SO_2$ | | | | |
| $PM_{10}$ | | | | |
| $PM_{2.5}$ | | | | |
| HCs | | | | |
| Temp | | | | |
| RH% | | | | |
| WS | | | | |
| WD* | | | | |

* Prevailing (i.e. most common) wind direction should be reported for the mean, while no minimum or maximum value should be reported for this parameter.

** Calculation for minimum, mean and maximum values shall be based on hourly values recorded throughout the entire reporting period.

*** **Data Capture (%)**: This is calculated by dividing the total number of valid measurements (e.g. hourly average values stored by the equipment) by the total possible number of valid measurements (e.g. 8760 hours in one calendar year) and converting the result into a percentage (by multiplying by 100).

Note: Periods where the equipment is being periodically serviced or calibrated are not taken into account. For example, in a 30-day month (e.g. June), 670 valid hourly measurements are obtained while the analyser calibrated during a 5-hour period at the end of the month and the analyser malfunctioned for a total of 45 hours. In that case, the Data Capture (%) would be 670 / (670 + 45) = 93.7%.