

Environmental, Health, and Safety Guidelines for Airlines

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)¹. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-

¹ Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

Applicability

The EHS Guidelines for Airlines apply to activities typically conducted by passenger and cargo airline operators. The document is organized into two main areas, namely, flight operations, including loading and unloading of passengers and cargo, and aircraft maintenance, including engine services, accessory parts overhaul, aircraft washing, aircraft repainting, and testing.

This document is organized according to the following sections:

- Section 1.0 — Industry-Specific Impacts and Management
- Section 2.0 — Performance Indicators and Monitoring
- Section 3.0 — References
- Annex A — General Description of Industry Activities

1.0 Industry-Specific Impacts and Management

The following section provides a summary of EHS issues associated with airlines operation, along with recommendations for their management. Recommendations for the management of EHS issues common to most large industrial facilities during the construction and decommissioning phases are provided in the **General EHS Guidelines**.

1.1 Environment

1.1.1 Flight Operations

Environmental issues associated with flight operations include:

- Noise and air emissions from aircraft engines
- Dangerous cargo handling

Noise and Air Emissions

The principal sources of noise and air emissions from flight operations include aircraft engines during flight, landing, takeoff, and taxiing, and the operation of Auxiliary Power Units (APUs) during aircraft ground operation and startup. Other sources of air emissions include dumping of non-combusted jet fuel in emergency situations.

Noise

Recommended noise management strategies, which greatly depend on the landing and takeoff requirements of the particular airport^{2,3}, include:

² Additional information on noise abatement procedures is available in Annex 16 — Environmental Protection, Volume I — Aircraft Noise of the Convention on International Civil Aviation (also known as the Chicago Convention) and International Civil Aviation Organization (ICAO) Procedures for Air Navigation Services - Aircraft Operations (Document 8168). Volume I - Flight Procedures.

³ Many of the recommendations applicable to reduced noise emissions are also applicable to air emissions. Additional information on noise reduction strategies

- Modification of aircraft operation through the use of descent profiles which may include use of “continuous descent approach” and “Low Power / Low Drag” (LPLD) procedures to fly the aircraft in a “clean” condition (e.g. with no flap or wheels deployed) as long as possible to minimize airframe noise, and instructions on minimizing reverse thrust on landing;
- Use of departure procedures that allow the aircraft to reduce power after reaching an altitude of 800 feet, gradually resuming full thrust after reaching 3,000 feet;⁴
- In coordination with airport and air traffic control authorities, avoidance of noise-sensitive areas through the use of “noise preferential routes” achievable through Standard Instrument Departure (SID) procedures, or alternatively using multiple flight tracks to spread and reduce the frequency of noise impacts;
- Minimizing use of APUs during idling and taxiing operations, and using Ground Power Units (GPUs), where available;
- Fleet upgrades in favor of newer, quieter aircraft which comply with applicable international certification requirements for their year of manufacture.⁵

Air Emissions

Emissions prevention and reduction strategies are primarily linked to fuel consumption, which depends on a number of factors included in the following recommendations^{6,7}:

is provided in International Air Transport Association (IATA), Flight Path to Environmental Excellence (2001).

⁴ IATA (2001)

⁵ For several decades, manufacturers of commercial aircraft have been required to meet increasingly strict engine noise certification standards. See Annex 16 — Environmental Protection, Volume I — Aircraft Noise of the Convention on International Civil Aviation.

⁶ These recommendations are largely based on the Template and Guidance on Voluntary Measures prepared by ICAO according to ICAO Assembly Resolution A33-7 to limit or reduce emissions of carbon dioxide, also applicable to a reduction in overall emissions. Additional information is available in ICAO

- Fuel consumption should be optimized through careful planning of the flight route (including selection of flight altitude and speed), expected demand from passenger and cargo services (maximizing occupancy and load), and type of flight equipment available. Wherever possible, operators should select the combination that results in the lowest specific fuel consumption;
- During individual pre-flight planning, loads should be distributed to reduce aerodynamic drag, loading the appropriate amount of fuel to reduce unnecessary weight;
- During idling and taxing activities, operators should consider opportunities for reduced engine operation (e.g. towing of aircrafts to runways, last minute start-up, taxing and idling with the minimum number of engines, minimizing or avoiding the use of APUs during engine startup and pushback, and minimizing holding times). Use of GPUs should be considered where they are provided by airports;
- Airframe and engines should be kept clean and aerodynamically efficient. Examples of maintenance opportunities include the correction of surface mismatches along doors and windows, correcting misrigging of flight control surfaces, identifying and removing dents, blisters or other sources of increased roughness of the airframe surface, in addition to following the aircraft manufacturer's maintenance recommendations applicable to fuel conservation;
- Aircraft modifications to improve aerodynamic and fuel efficiency should be considered, including the installation of winglets, engine retrofits or upgrades, and polishing rather than painting exterior surfaces;
- Operators should consider fleet upgrades in favor of newer, more fuel efficient aircraft which comply with applicable

international certification requirements for their year of manufacture;⁸

- Intentional release of non-combusted fuel should be avoided, and this practice limited to emergency situations;⁹
- Use of non-essential or non-revenue generating flights should be limited (e.g. by using flight simulators instead of aircraft for flight crew training activities).

Dangerous Cargo Handling

Airlines should implement a system for the proper screening, acceptance, and transport of dangerous cargo according to the requirements of international regulations. The system should be based on internationally accepted standards and include the following elements¹⁰:

- Training staff in relevant aspects of dangerous goods management including screening and acceptance of dangerous goods in passenger and cargo airplanes;
- Procedures for screening of packages and cargo to be admitted into the aircraft, including instructions on shipping documentation, restrictions (e.g. quantity, loading, segregation), labeling, packaging, and other handling requirements;

Circular 303, AN/176 – Operational Opportunities to Minimize Fuel Use and Reduce Emissions.

⁷ Additional information on emissions reduction strategies is provided in IATA Guidance Material and Best Practices for Fuel and Environmental Management (2004) and IATA (2001)

⁸ See Annex 16 – Environmental Protection, Volume II – Aircraft Engine Emissions of the Convention on International Civil Aviation.

⁹ According to Volume II of Annex 16, intentional venting of fuel is prohibited for turbine engine powered aircraft manufactured after February 18, 1982.

¹⁰ The principal standards include: IATA Dangerous Goods Regulations Manual (2007), ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air (Document 9284), and Annex 18 to the Convention on International Civil Aviation—The Safe Transport of Dangerous Goods by Air. Additional requirements may include host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal (<http://www.basel.int/>) and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (<http://www.pic.int/>).

- Emergency response procedures specific to dangerous goods, and inclusion of these procedures in the flight operations manual.¹¹

1.1.2 Airplane Maintenance

Routine maintenance activities may be limited to engine oil changes and other minor work. Heavy maintenance activities may include repairs and overhauls of engines and other mechanical parts; washing, stripping and painting of parts or airplane fuselages; and use of numerous toxic substances. Environmental issues associated with airplane maintenance activities include:

- Air emissions
- Wastewater
- Wastes
- Noise

Air emissions

The main sources of air emissions in heavy maintenance activities include metal finishing and cleaning activities associated with engine overhauls (e.g. dust from grinding, blasting and shot peening, acid from surface treatment, chromic acid from hard chromium plating, and volatile organic compounds [VOCs] from technical washing), airplane exterior cleaning and painting operations (e.g. VOCs from cleaning and paint mixing and application), and engine test runs (e.g. fuel combustion exhaust gases). Recommended prevention and control strategies include¹²:

¹¹ For further information, refer to ICAO Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods (ICAO Document 9481).

¹² All air emissions sources should be directed to appropriate ventilation systems to maintain the concentrations of pollutants in work areas at safe levels (see Occupational Health and Safety guidance in the **General EHS Guidelines** and additional recommendations applicable to aircraft maintenance activities below).

- Collection of dust emissions from blasting, grinding, and peening operations through extraction and ventilation systems, removing dust with bagfilters or other dust control techniques. Recovered cadmium-containing dust should be managed as a hazardous or non-hazardous waste, depending on its characteristics, as described in the **General EHS Guidelines**:
- Prevention or minimizing the generation of acid emissions, particularly acid-containing aerosols, and aerosols with entrained heavy metals such as chromium. These types of emissions, which can be generated from pickling and some electrolytic plating processes, should be prevented or minimized through the use of surfactants and, if required, wet scrubbers. Removed chromic acid from the exhaust gas should be returned to the plating baths or else managed as required by local regulations;
- Emission of VOCs should be minimized in cleaning and painting processes. Cleaning agents containing VOCs should be replaced with water-based, alkaline, cleansing agents. Use of VOC containing paints, solvents, and pigments should be avoided in airplane painting operations or operators should select airplane exterior designs that favor polishing, rather than painting, to minimize the amount of paints used. Use of water-based paints should be encouraged, whenever possible, avoiding the use of paint strippers based on methylene chloride or the use of chromate primers;
- Potential impacts of exhaust gases from engine test runs should be minimized by locating the testing area away from urban areas, limiting testing times depending on seasonal ambient air quality, or other management actions necessary to address potential impact to ambient air quality. Additional guidance on ambient air quality considerations is presented in the **General EHS Guidelines**.

Wastewater

Release of hazardous substances to water may occur from workshops, metal finishing shops, and exterior and technical washes. The main types of pollutants may include toxic metals, petroleum products (e.g. oil, white spirit, fuel), complexing agents and surfactants, heavy metals (e.g. cyanide, hexavalent chromium), and organic solvents. Cadmium may be present as it is still frequently used for surface treatment of certain parts of aircraft (e.g. landing gear, wings). Recommendations to prevent, minimize, and control wastewater effluents include:

- Segregating highly toxic waste streams, principally those containing cyanide, hexavalent chromium (Cr⁶⁺), cadmium and other toxic metals. Other examples of wastewater streams that should be segregated include concentrated pre-treatment and plating solutions; degreasing baths; pickling baths; electroless plating baths (from chemical coating); electroplating baths (electrolytes); rinsing waters containing cyanide, hexavalent chromium (Cr⁶⁺), hypophosphite (from electroless nickel plating), and airplane washing and paint stripping operations;
- Selected or combined wastewater streams should be pre-treated prior to discharge to local sewer systems including use of coagulation, flocculation, and precipitation methods and other relevant industrial process wastewater management guidance. Additional guidance on the management of wastewater streams, such as those generated from metal finishing operations, is presented in the **EHS Guidelines for Metal, Plastic, and Rubber Products Manufacturing**.

Wastes

Hazardous or potentially hazardous wastes generated during airplane overhaul and repair activities may include waste oil and oil emulsions and fuel residuals; organic solvents and glycols;

metal hydroxide sludge; lead batteries; nickel-cadmium and nickel-metal hydride batteries; spent surface treatment solutions (from degreasing, pickling, passivating, electroplating, and chemical coating) containing cyanides, hexavalent chromium and cadmium; solid and semisolid cyanide residuals; paint sludge and spray box water; isocyanates; and mercury-containing fluorescent lamps and tubes. Wastes, including hazardous wastes, should be managed according to the applicable recommendations provided in the **General EHS Guidelines**.

Noise

The main source of noise in airplane maintenance activities is associated with engine test runs. Test runs should be conducted in designated areas preferably located away from urban areas or in locations equipped with noise suppression or deflection equipment. Additional noise management strategies may include daytime and nighttime restrictions. Noise levels at the nearest point of reception should not exceed the guideline values provided in the **General EHS Guidelines**.

1.2 Occupational Health and Safety

1.2.1 Flight Operations

Occupational health and safety issues in airline operations primarily include the following:

- Flight operations safety and security
- Physical hazards
- Biological hazards
- Chemical hazards
- Fatigue

Flight operations safety and security

The most significant safety issue potentially affecting both crew and passengers is the threat of serious injury or the potential loss of life due to flight-related hazards, including aircraft exposure to turbulence, or mechanical or other types of failures and crashes. Airlines should implement accident prevention and control plans as part of the airline's overall safety management program. The safety management program should be:

- Equivalent to internationally recognized airline safety programs;¹³
- Auditable under internationally recognized systems such as the IATA Operational Safety Audit (IOSA) program;¹⁴
- Inclusive of a continuous and recurrent pilot and crew training component such as Controlled Flight into Terrain and Approach (CFIT-ALAR) and Crew Resource Management (CRM);
- Inclusive of an incident and accident research, recordkeeping, in addition to a responsive corrective action program.¹⁵

In addition to flight operational safety issues, airline operators may also have certain key responsibilities related to ground operations necessary for the safety of passengers against the consequences of unlawful acts. Airline operators should prepare and implement a Security Plan consistent with internationally recognized standards and procedures,¹⁶ collaborating with the airport administrators or other competent public authorities as required to prevent and respond to security concerns.

¹³ Examples include the flight safety and accident prevention program requirements established by the US Federal Aviation Administration (FAA), European Aviation Safety Agency (EASA), and ICAO.

¹⁴ IATA Operational Safety Audit Programme Manual, 2nd Edition (2004)

¹⁵ Examples of specific flight safety assessment methods include the Threat and Error Management (TEM) programs and the Line Operations Safety Audit (LOSA) programs.

¹⁶ As noted in Annex 17 of ICAO and the Annex's Security Manual for Safeguarding Civil Aviation Against Acts of Unlawful Interference (Doc. 8973)

Strategic collaboration or partnering with established carriers experienced in the implementation of the above safety and security programs may prove an effective strategy in their successful implementation in smaller, or less experienced, airlines.

Physical Hazards

Airline employees may be exposed to physical hazards depending on their particular work functions. Injuries are typically associated with vehicle and cargo movement in ground operations, ergonomic issues in baggage handling (including handling by customer service staff at passenger check-in stations), and ergonomic issues of in-flight crew associated with baggage stowing assistance and catering functions. Airline employees may also be exposed to physical threats from violent acts of customers at service desks or in-flight. Recommended physical hazard management strategies include:

- All workers involved in luggage and larger cargo handling, whether as a regular or incidental aspect of their work function, should be trained in the use of proper lifting, bending, and turning techniques to avoid injury to the back or extremities;
- Customer service stations and luggage conveyance systems should be designed based on the results of an ergonomics assessment, eliminating the need for customer service agents to lift or handle baggage, where possible;
- Operators should evaluate whether to implement individual luggage weight restrictions in coordination with airlines, applying weight limits on individual luggage packages according to local regulations or, in their absence, limiting the weight for individual luggage packages to 32 kilograms (70 pounds);¹⁷

¹⁷ The International Air Transport Association (IATA) has established a weight limit of 32 kilograms (70 pounds) for an individual luggage package.

- At-risk personnel should be trained to identify and manage potentially violent situations. Training should include methods for appraising and solving potentially violent situations.¹⁸

Biological Hazards

Flight crew members may be potentially exposed to communicable diseases arising from close contact with large numbers of passengers and the confined nature of the work environment. Examples of communicable diseases include respiratory illnesses such as Severe Acute Respiratory Syndrome (SARS) or influenza viruses (including Pandemic Flu). Recommended management practices include:

- As part of the standard occupational hazard communication program, airline employees should be provided with updated information on disease outbreaks and appropriate methods of transmission prevention;¹⁹
- Airline operators should institute a policy to manage passengers who have evidence of illnesses and who are departing or arriving from areas with a known disease outbreak;²⁰
- Operators should consider retrofitting aircraft cabin ventilation systems with High Efficiency Particulate Air (HEPA) filters or other methods for reducing the recirculation of contaminated air.

¹⁸ Additional information is available in the International Labour Organisation's (ILO) Code of Practice on Workplace Violence in Services Sectors and Measures to Combat this Phenomenon (2003).

¹⁹ Examples of sources of up to date information include the web sites from the World Health Organization (<http://www.who.int/en/>) and the US Centers for Disease Control and Prevention (CDC) (<http://www.cdc.gov/>).

²⁰ Examples of procedures applicable to Avian Influenza are available in the US CDC Guidelines and Recommendations: Interim Guidance for Airline Flight Crews and Persons Meeting Passengers Arriving from Areas with Avian Influenza, and Interim Guidance for Airline Cleaning Crew, Maintenance Crew, and Baggage / Package and Cargo Handlers for Airlines Returning from Areas Affected by Avian Influenza A (H5N1) (2006)

Chemical hazards

Aircraft crew may be frequently exposed to hazardous chemicals, particularly insecticides used for aircraft disinsection to reduce the international spread of disease carrying insects or agricultural pests. Insecticides used may include phenothin (a pyrethroid) and permethrin. Many countries require the practice of disinsection in all in-bound flights. Insecticides can be applied in aerosol form with or without the presence of cabin crew and passengers, or sprayed on cabin surfaces while the aircraft is empty. Recommended strategies to reduce occupational exposure to these chemicals include:

- Preparation of a Pesticide Management Plan detailing the method for their selection and application procedures (including length, frequency, and timing of application);
- Avoiding the use of pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Classes 1a and 1b;
- Avoiding the use of pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Class II except under conditions as noted in IFC's Performance Standard 3 — Pollution Prevention and Control;²¹
- Avoiding the use of pesticides listed in Annexes A and B of the Stockholm Convention, except under the conditions noted in the convention;²²
- Using only pesticides that are manufactured under license and registered and approved by the appropriate authority and in accordance with the Food and Agriculture Organization's (FAO's) International Code of Conduct on the Distribution and Use of Pesticides²³;
- Using only pesticides that are labeled in accordance with international standards and norms, such as the FAO's

²¹ IFC Performance Standard 3. Available at www.ifc.org/envsocstandards

²² The Stockholm Convention on Persistent Organic Pollutants (2001).

²³ FAO (2002c)

Revised Guidelines for Good Labeling Practice for Pesticides²⁴;

- Store pesticides in their original packaging and in a dedicated location that can be locked and properly identified with signs, limiting access to authorized persons. No human or animal food should be stored in this location;
- Mixing and transfer of pesticides should be undertaken by trained personnel in ventilated and well lit areas, using containers designed and dedicated for this purpose;
- Used pesticide containers should not be used for any other purpose (e.g. drinking water) and should be managed as a hazardous waste as described in the **General EHS Guidelines**;
- Educating and training aviation crews in the risks and hazards of airplane disinfection;
- Reducing or eliminating repeated treatment of bunk room (cabin crew rest area) to address potential health effects from increased residual substance levels;²⁵
- Ensuring sufficient ventilation of cabins after treatment with insecticides;
- Delaying entry of cabin crew to the aircraft after disinsection.

Fatigue

Fatigue among flight crew members is a hazard to aviation safety due to impaired alertness and performance. The principal recommended management strategy is to provide airline employees with the necessary level of rest periods to allow the maintenance of workload and work functions, in compliance with applicable regulations.²⁶

²⁴ FAO (2002c)

²⁵ Additional information on residual levels of insecticides in aircraft cabin surfaces is provided in California Department of Health Services (CDHS). 2003.

²⁶ Examples include the US Federal Aviation Administration (FAA) 14 CFR Part 121 – Flight Crew Member Flighttime Limitations and Rest Requirements.

1.2.2 Airplane Maintenance

Although aircraft maintenance activities may pose numerous physical and chemical hazards to workers, the most significant hazards are related to the use of hazardous chemicals which may result in potential exposures to cadmium containing dust; organic solvents; hexavalent chromium; cyanides and cyanogen chloride; and isocyanates, mainly via inhalation and dermal contact routes. Recommended strategies for the management of chemical occupational hazards are presented in the **General EHS Guidelines**.

1.3 Community Health and Safety

In addition to environmental issues applicable to airline operation and maintenance activities that may have an impact on communities if not properly managed, other significant community health and safety impacts relate to aircraft operational safety. Catastrophic operational failure of aircraft has the potential to harm members of the general public either as passengers or as by-standers.

In addition to the flight safety recommendations presented under the occupational health and safety section, airline operators should implement Emergency Preparedness and Response procedures to respond to catastrophic accidents. These procedures should be tailored to the availability of institutional support to respond to emergencies in the countries where the airline operates, including communications and coordination of response with public agencies, and communications with the families of potentially affected passengers.

Community health and safety impacts during the operation of service activities (repair and maintenance of aircrafts and vehicles) connected to airlines are common to those of most

large industrial facilities, and are discussed in the **General EHS Guidelines**.

2.0 Performance Indicators and Monitoring

2.1 Environment

Emissions and Effluent Guidelines

Aircraft air emissions and noise levels should meet the certification requirements established by International Civil Aviation Organization (ICAO) for their year of manufacture. Guideline values for process emissions and effluents in this sector are indicative of good international industry practice as reflected in relevant standards of countries with recognized regulatory frameworks.

Emission and effluents from heavy maintenance facilities should be treated to a level consistent to the requirements of local sewer network operation or, if discharged into surface waters, according to the guideline values provided in the **EHS**

Guidelines for Metal, Plastic, and Rubber Products

Manufacturing which provide treated effluent guideline values applicable to metals machining, cleaning, and plating and finishing processes, including painting. Site-specific discharge levels may be established based on the requirements of publicly operated sewage collection and treatment systems or, if discharged directly to surface waters, on the receiving water use classification as described in the **General EHS Guidelines**.

Combustion source emissions guidelines associated with steam- and power-generation activities from sources with a capacity equal to or lower than 50 MWth are addressed in the **General EHS Guidelines** with larger power source emissions addressed in the **EHS Guidelines for Thermal Power**.

Guidance on ambient considerations based on the total load of emissions is provided in the **General EHS Guidelines**.

Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular activity. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the **General EHS Guidelines**.

2.2 Occupational Health and Safety

Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),²⁷ the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),²⁸ Permissible Exposure Limits (PELs) published by the

²⁷ Available at: <http://www.acgih.org/TLV/> and <http://www.acgih.org/store/>

²⁸ Available at: <http://www.cdc.gov/niosh/hpg/>

Occupational Safety and Health Administration of the United States (OSHA),²⁹ Indicative Occupational Exposure Limit Values published by European Union member states,³⁰ or other similar sources.

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)³¹.

Occupational Health and Safety Monitoring

The working environment should be monitored according to occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals³² as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

²⁹ Available at:
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992

³⁰ Available at: http://europe.osha.eu.int/good_practice/risks/ds/oe/

³¹ Available at: <http://www.bls.gov/iif/> and
<http://www.hse.gov.uk/statistics/index.htm>

³² Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.

3.0 References and Additional Sources

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Annex A: General Description of Industry Activities

Flight Operations

The main activities associated with airlines are the operation of aircraft for the purpose of transporting passengers and cargo.

The size of aircraft fleet and the types of equipment used depend on the nature of the airline business, including the number of passengers, amount of cargo, routes, and distances involved. As a general rule, airlines primarily dedicated to passenger service and operating at the regional level use smaller aircraft, while larger aircraft are favored for longer routes between the main regional or international passenger airports, also referred to as "hubs." Different principles may apply to airlines primarily or solely dedicated to cargo transport where the fleet makeup may be established by a combination of the type of cargo and the primary routes.

Airline operations depend on ground infrastructure and services, some of which are provided by the airline itself, but most of which may be provided by airports or ground services providers. Examples of these services include air traffic control (also applicable to taxiing), passenger screening for security purposes, baggage / cargo handling, fueling, catering, cleaning, waste management, and mechanical maintenance services. In cold climates, ground services may also include de-icing and anti-icing of aircraft, taxiway, and runway surfaces. Passenger airlines typically require ground personnel to manage passenger and baggage check-in activities. Airlines are also responsible for crew and passenger safety during flight and are required to implement national and international operational safety requirements while in flight.

Aircraft operations consume significant quantities of fuel, mainly associated with flight operations. The majority of the fuel consumed is during cruising and during the landing and take-off (LTO) cycle. Smaller proportions of fuel are used in taxiing and

during ramp operations where aircraft may use their Auxiliary Power Unit (APU), to provide electricity during parking. Aircraft operations also result in the generation of noise which is perceived to be greatest during the LTO cycle due to potential exposure of noise sensitive receptors near airports.

Airplane Maintenance

Airlines may either contract or conduct their own mechanical maintenance activities typically in locations adjacent to airports. Maintenance activities may consist of routine servicing or heavy mechanical maintenance activities (e.g. engine overhauls, landing gear maintenance and repairs, and airframe cleaning and painting).

Routine maintenance activities may include lubricating oil changes and mechanical safety inspections. Engine services associated with heavy maintenance mainly comprise dismantling of the engines followed by a thorough washing and cleaning, removal of metal plated layers and oxides, penetrant checks, and mechanical tests and adjustments. When the motor parts are accepted the reverse process starts, which means electroplating, painting and assembling. The service procedure ends with test runs, followed by packing and returning of the engine to the overhaul hangar.

In aircraft engines, low and high alloyed steel parts may be found. The low alloyed parts are electroplated and / or electroless plated (chemical methods). Aluminum and light alloy parts are common. All parts are regularly subject to crack tests with penetrants and / or inspections, measurements and other tests. Stripping of coatings can be electroless or electrochemical depending on the type of coating.

Removal of superficial oxide layers is carried out in alkaline solutions, hydrogen sulfate solutions, and in phosphoric acid. To be able to remove the inner oxide layers the engine parts are submerged in alkaline potassium permanganate solution followed by phosphoric acid and the oxide layers are removed with water. Subsequently, crack tests, measurements and visual checks are undertaken. When the inspections are finished, the parts are again electroless or electrochemically plated. To protect low alloyed parts, located before the combustion chamber, from corrosion, solutions based on sodium nitrite are used.

The surface of the turbine blades typically becomes rough during flights through contact with objects in the air. Tumbling is used to maintain an even and smooth surface. A near-perfect surface finish of the blades and vanes is important to minimize fuel consumption.

In addition to the engines, a modern aircraft has many parts that are electroless plated, electroplated, and / or painted (e.g. landing gears, wheel rims, and steering devices for ailerons and side rudders, among others). These components are subject to wear and corrosion. The outer parts of the aircraft are also subject to damage from objects. If the damage covers a substantial part of the fuselage or other parts (e.g. undercarriages), the painted and plated layers are typically removed for repairs. Metal plating is carried out locally through brush electroplating (cadmium plating, nickel plating, chromium plating). Painting is then carried out in-situ.

Washing and cleaning of exterior aircraft parts, as well as the entire airframe including wings, is typically undertaken in the overhaul hangar. Other vehicles and accessories subject to exterior washing regimes include airport vehicles and other equipment (e.g. ladders).

In general, alkaline cleaning agents are used. However, for special purposes other types of cleaning agents could be utilized such as petroleum based degreasing agents. As a supplement to wet wash, a dry wash and polishing are performed. Dry wash agents are applied with spray devices or cloths and removed by dry mopping or wiping with clean dry cloths.

Touch-up painting of aircrafts is performed, when needed, as a part of the regular overhaul program. In certain cases the entire aircraft is repainted. The latter is typically carried out by larger maintenance companies specialized in aircraft repainting. Typical solvents include toluene, xylene, methyl ethyl ketone, acetone, n-butyl alcohol. Many different kinds of paints and varnishes are used (e.g. washing and self etching primers [epoxy based], cellulose top coats, alkyd coatings, polyurethane coatings, and epoxy coatings).

Following engine services, the motor performance is tested at an in-house engine test facility. The test facility is normally located within the airport area in connection with the maintenance shops. Less extensive engine test runs are also performed after smaller overhaul and services operations which may not include dismounting of the engines from the fuselage or wings.