Doc 9137
AN/898

Airport Services Manual

Part 5
Removal of Disabled Aircraft

Approved by the Secretary General and published under his authority

Fourth Edition — 2009

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Published in separate English, French, Russian and Spanish editions by the
INTERNATIONAL CIVIL AVIATION ORGANIZATION
999 University Street, Montréal, Quebec, Canada H3C 5H7

For ordering information and for a complete listing of sales agents
and booksellers, please go to the ICAO website at www.icao.int

Fourth edition 2009

Doc 9137, *Airport Services Manual,* Part 5 — *Removal of Disabled Aircraft*
Order Number: 9137P5
ISBN 978-92-9231-409-5

AMENDMENTS

Amendments are announced in the supplements to the *Catalogue of ICAO Publications;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
No.	Date	Entered by

CORRIGENDA		
No.	Date	Entered by
1	5/2/10	ICAO

FOREWORD

The specifications in Annex 14 — *Aerodromes*, Volume I — *Aerodrome Design and Operations*, recommend that States establish a plan for the removal of an aircraft disabled on or adjacent to the movement area of an airport. The plan is based on the characteristics of the aircraft normally expected to operate at the airport. In addition, the Annex recommends that a coordinator be designated to implement the plan when necessary.

As newer generations of aircraft commence operation at airports, the problem of removal of a disabled aircraft becomes increasingly serious. Most airports find it economically impossible to store all the equipment necessary for the removal of a disabled aircraft. It has been generally agreed that the most feasible approach to the problem is for States, in consultation with operators, to prepare a plan for each airport for the removal of a disabled aircraft and to make arrangements with other States and airports for pooling the required specialized equipment. To this end, airlines have made arrangements so as to make specialized equipment available on short notice on a worldwide basis, and kits have been strategically placed around the world.

This manual contains updated guidance on the removal of disabled aircraft and is intended to be used by airport and aircraft operators planning for the processes required to recover an aircraft. It has been expanded to include guidance material relating to the removal of new larger aircraft, categorized under the new ICAO aerodrome reference code F, such as the Airbus A380 and Boeing 747- 8. This manual is to be used in conjunction with the aircraft recovery manual published by the respective aircraft manufacturer. The information in this document is not intended to be used for any commercial purposes.

In developing this manual, ICAO wishes to acknowledge the assistance of the International Air Transport Association (IATA).

It is intended that this manual be kept current. Future editions will improve on this edition on the basis of experience gained and of comments and suggestions received from users of the manual. Readers are therefore invited to send their views, comments and suggestions on this edition, in writing, to:

The Secretary General of ICAO
International Civil Aviation Organization
999 University Street
Montréal, Quebec H3C 5H7
Canada

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ACRONYMS AND ABBREVIATIONS

ACN/PCN	Aircraft classification number/pavement classification number
ARM	Aircraft recovery manual
ATC	Air traffic control
CBR	California bearing ratio
HAZ-MAT	Hazardous material
HBV	Hepatitis B virus
IATA	International Air Transport Association
IATP	International Airline Technical Pool
MAC	Mean aerodynamic chord
MEW	Manufacturer’s empty weight
MZFW	Manufacturer’s zero fuel weight
NLA	New larger aeroplane
NOTAM	Notice to all airmen
NRW	Net recoverable weight
OEW	Operating empty weight
PSI	Pounds per square inch
RAT	Ram air turbine
RC	Reference chord
REW	Recoverable empty weight
VHF	Very high frequency

Chapter 1

INTRODUCTION

1.1 PURPOSE

1.1.1 The purpose of this manual is to assist States, aerodrome and aircraft operators in addressing the issues related to immobilized and disabled aircraft in an aerodrome environment. In the past, minor incidents have been handled with relative ease. As the size and mass of aircraft increase, the complexities of the removal process have increased proportionately. With the advent of the new larger aeroplane (NLA), categorized under a new aerodrome reference code letter F, additional, larger and more complex recovery equipment is required. This manual is designed to assist both aerodrome and aircraft operators in identifying the relevant problems, then preparing and implementing an adequate plan of action to remove the disabled aircraft.

1.1.2 Although information regarding the removal of larger aircraft will dominate in this manual, recovery of smaller aircraft such as regional jets, due to their increasing numbers, will also be addressed.

1.2 GENERAL

1.2.1 Disabled aircraft that interfere with normal activity of an aerodrome require prompt removal actions. The travelling public, other aircraft operators, the aerodrome operator and the operator of the incident aircraft are all affected to varying degrees. In addition, runway and taxiway closures can substantially reduce the number of arrivals and departures and restrict movement around the aerodrome, resulting in loss of revenue to the airport as well as to the aircraft operator.

1.2.2 Annex 14 — *Aerodromes,* Volume I — *Aerodrome Design and Operations*, 9.3.1, specifies that each aerodrome must draw up a comprehensive plan for the removal of a disabled aircraft on, or adjacent to, the movement area and a coordinator designated to implement the plan, when necessary. In addition, the removal plan should include the following:

a) a list of equipment and personnel available on or in the vicinity of the aerodrome;

b) a list of additional equipment available from other aerodromes on request;

c) a list of nominated agents acting on behalf of each operator at the aerodrome;

d) a statement of the airlines arrangements for the use of pooled specialist equipment; and

e) a list of local contractors (with names and telephone numbers) able to supply heavy removal equipment on hire.

1.2.3 The information described in 1.2.2 will be contained in the relevant aerodrome disabled aircraft removal plan. Furthermore, in accordance with Annex 14, Volume I, section 2.10, aerodrome authorities are required to make available to the appropriate aeronautical information service units information on the capability to remove a disabled aircraft on or adjacent to the movement area. This may be expressed in terms of the largest type of aircraft that the aerodrome is equipped to remove. For instance, an Airbus A380 or a Boeing B747 can be reported as being the largest type of aircraft that the aerodrome is equipped to remove. This capability should be based on the equipment available at the aerodrome and on equipment which, according to the disabled aircraft removal plan, can be available at short notice. Should the plan take into account an airline pooling arrangement, the determination of the capability to remove a disabled aircraft should also take into consideration the specialized aircraft recovery kits available from the aerodromes mentioned in Appendix 9.

1.2.4 In addition, there is a requirement that contact information concerning the office of the aerodrome coordinator of operations for the removal of a disabled aircraft be made available, on request, to aircraft operators.

1.2.5 It is also recommended that aircraft operators have a plan for the removal of disabled aircraft. The suggested form is an internal aircraft removal process document containing all relevant company information and required contact information regarding the removal of disabled aircraft (see Appendix 5).

1.3 OBJECTIVE

The objective of this document is to identify the issues involved in removing immobilized or disabled aircraft. The processes and procedures required to return the aircraft to a hard surface are described. The aircraft recovery process is dependent on a number of variables. Even so, there are five generally accepted major steps identified with the removal process, that will be covered in detail:

- survey
- planning
- preparation
- recovery
- reporting processes

1.4 IMPORTANT NOTES

1.4.1 Aircraft should not be moved without the approval of the accident investigation authority. Except as specified in Annex 13 — *Aircraft Accident and Incident Investigation*, wreckage of aircraft should be left undisturbed until the arrival of the Investigator-in-Charge of the accident investigation. Detailed guidance on the initial action at the scene of the accident, preservation of the evidence, etc., may be found in the *Manual of Aircraft Accident Investigation* (Doc 6920).

1.4.2 In exceptional circumstances, where safety of other aircraft is imperilled, the disabled aircraft should be removed as quickly as possible. If the aircraft or parts thereof must be moved prior to completion of the investigation, it is important that such an operation not be carried out until:

a) photographs are taken;

b) the location and position of all major components are marked on the ground; and

c) a diagram of the accident site including ground scars is drawn.

1.4.3 The photographs should include general views of the aircraft from four directions. Photographs of the flight deck showing the position of all switches and controls should also be included. The location and position of the aircraft and its separated parts should be indicated by driving stakes into the ground or by markings on the surface, as appropriate. The diagram of the accident site, preferably prepared on squared paper, should record the location of all major components and their relative position with respect to a reference point or line. Detailed information on photographs to be taken and preparation of diagrams is contained in Doc 6920. If, in the removal operation, the aircraft or any part thereof is further damaged, such damage, referred to as secondary damage, should be recorded so that it can be distinguished from impact damage.

1.4.4 Other notes:

a) This document provides only general aircraft removal information; it is imperative therefore that the aircraft manufacturers' Aircraft Recovery Manual (ARM) be consulted prior to initiating the aircraft recovery process (see 2.7);

b) This document follows the format and general guidelines of the ATA iSpec 2200 specification, which provides the industry-wide standard of numbering aircraft systems;

c) Only experienced people must manage the removal process; and

d) Safety precautions must predominate and take precedence over all other parameters and removal pressures.

1.5 TYPES OF OCCURRENCES

An aircraft removal incident can occur at any time and in any weather conditions with varying degrees of magnitude. These removal incidents can range from minor debogging to major events including damaged or missing landing gear. The recovery process may take from a few hours to many days depending on the severity. While recovery incidents cannot be predicted, they can be anticipated and prepared for.

1.6 RESPONSE

The removal of some disabled aircraft can be a complex scenario involving a number of specific procedures including multipart levelling and lifting actions. These procedures can be dangerous, and safety precautions must take precedence over all other constraints. Prevention of secondary damage must also be a priority (see 4.3). In some cases, the removal process cannot begin until a lengthy investigation by the on-site investigative authority has been completed, and the aircraft is formally released. Because of these issues, it is not always possible for the aerodrome to be cleared as quickly as desired by the aerodrome operator.

1.7 COST TEMPLATE

The direct costs associated with a removal incident are fairly easy to assess and record, but the indirect costs are much more difficult to appraise. Attempts should be made to capture these costs and make them available for further study. An Aircraft Removal Cost Template is provided in Appendix 8.

1.8 GENERAL REMOVAL TERMS AND DEFINITIONS

There are three general terms used in the removal of disabled aircraft: aircraft debogging, aircraft recovery and aircraft salvage. These terms are defined as follows:

a) *Aircraft debogging.* The removal of an aircraft from a runway or taxiway excursion where the aircraft has become bogged down but has relatively little or no damage is considered a “debogg”.

b) *Aircraft recovery.* Any aircraft that is unable to move under its own power or through the normal use of an appropriate tow tractor and tow bar will be considered an “aircraft recovery”, examples are:

— one or more landing gear off the hard surface of a runway, taxiway or apron;

— aircraft bogged down in mud or snow;

— one or more landing gear collapsed or damaged;

— an aircraft that is considered to be economically repairable; and

c) *Aircraft salvage.* An accident or incident in which the aircraft sustains substantial damage and the insurer considers the hull a constructive loss will be considered “aircraft salvage”.

1.9 RESPONSIBILITIES

1.9.1 Responsibilities for the removal of a disabled aircraft lie not only with the aircraft operator, but also with the State and the aerodrome operator. For an aircraft removal operation to begin and be completed as quickly as possible, all parties must be expeditiously facilitated and already have the proper procedures in place. An efficient removal operation requires sufficient planning and readily accessible recovery equipment.

State

1.9.2 Annex 9 — *Facilitation*, Chapter 8, section B, contains international Standards and Recommended Practices (SARPs) to facilitate, inter alia, the removal of damaged aircraft, as follows:

a) States shall make arrangements to ensure without delay into their territories on a temporary basis of qualified personnel required for, among others, salvage in connection with a damaged aircraft; and

b) States shall facilitate the temporary entry into its territory of all aircraft, tools, spare parts and equipment required in the, among others, repair or salvage of the damaged aircraft of another State.

Aerodrome operator

1.9.3 The aerodrome operator must have an officer designated to coordinate the aircraft recovery operation and a disabled aircraft removal plan available (see Appendix 1). In addition, a copy of the aircraft operator’s removal plan should be on file for every regular user of the aerodrome.

1.9.4 The aircraft must be removed in a timely and efficient manner. If the aircraft operator fails to take responsibility for the removal operation, the aerodrome operator may take over the responsibility and contract the removal to a third party. It is suggested that the aerodrome operator, in conjunction with the aircraft operators, hold regular tabletop exercises in order to anticipate various aircraft removal scenarios and their projected outcomes.

1.9.5 When aircraft recovery operations are carried out at an operating aerodrome, the recovery devices such as large mobile cranes may penetrate the obstacle limitation surfaces or interfere with radio navigational aids, etc. Therefore, consideration should be given to mitigating risks associated with the recovery operations to ensure the aerodrome's operational safety.

Aircraft operator

1.9.6 It is imperative that the aircraft operator notify the relevant investigative authority of the incident as quickly as possible. Annex 13 contains international SARPs on the mandatory reporting of certain types of accidents/incidents and the responsibilities of the various parties involved.

1.9.7 The registered owner or aircraft operator retains complete responsibility for the removal. Notification of the accident or incident must also be transmitted to the operator's insurance representative. The aircraft operator must have an aircraft recovery process document available for review. Information within the document must be filed with the aerodrome operator and include all relevant contact numbers as well as information on who the aircraft operator will use to remove the aircraft.

Investigation authority

1.9.8 The investigation authority must be notified of the incident as soon as possible to ensure that the investigation of the accident or incident is concluded, and the aircraft is released in a timely matter. In some cases, the aerodrome operator or the local air traffic control (ATC) unit advises the investigation authority. It is important to remember that even though it may impede the removal operation, the regulations of the investigation authority of the State of Occurrence must be complied with at all times.

1.9.9 The investigation authority may request the aircraft operator to carry out a number of initial tasks such as removal of the flight data recorder and removal of the cockpit voice recorder. These tasks may be requested and can be completed even though the aircraft has not been released. Under no circumstances can the aircraft removal process begin until this authority has given formal release.

Insurance underwriter

1.9.10 The aircraft operator is ultimately responsible for his aircraft, which includes its removal after an accident. The insurance underwriter generally, through a representative, will be involved in the aircraft removal process. The aircraft operator, with the assistance of the underwriter will arrange for removal of the aircraft and, in the case where the aircraft operator possesses the necessary qualifications, the operator will perform the aircraft removal. Every effort must be made during the recovery operation to avoid further damage to the aircraft as well as the accident site.

1.10 RUNWAY EXCURSIONS

There are numerous factors contributing to aircraft recovery events arising from runway excursions, and these can be generalized as follows:

a) flight control system failures;

b) power plant such as actual engine failure or failure of the thrust reverse system;

c) landing gear such as hydraulics, brakes, tires, steering;

d) weather such as rain, snow, ice, crosswinds, visibility, runway friction;

e) maintenance, weight and balance; and

f) Human Factors such as flight crew.

Most runway excursions are minor in context but can still cause significant damage to the aircraft resulting in major recovery initiatives to be taken.

1.11 NEW LARGER AEROPLANES (NLAs)

1.11.1 In the late 1990s, plans were announced by the two major aircraft manufacturers that they were planning to develop aircraft larger than the B747-400, which was then the largest commercial civil passenger aircraft. In response, ICAO undertook a study of these NLAs, and the results of this study led to Amendment 3 to Annex 14, Volume I, which became applicable in November 1999. Consequently, a new aerodrome reference code letter F was established. This new code included aircraft with wingspans from 65 metres up to but not including 80 metres, with an outer main gear wheel span from 14 metres up to but not including 16 metres. The Airbus A380 and the B747-8 fall into this new category. However, other aircraft such as the Airbus A340-600 and Boeing B777-300, which belong to code letter E, are very close in length to the new code letter F aircraft. (See the aerodrome reference code system in Appendix 2). Additionally, a detailed list of aeroplane classification by code number and letter, available in *Aerodrome Design Manual,* Part 1 — *Runways* (Doc 9157), is also reproduced in Appendix 2.

1.11.2 It should be noted that aircraft in the upper area of code letter E and code letter F may cause greater logistical problems in expediting their removal and also impose longer operational constraints at major aerodromes. Two examples of these constraints are: the blocking of more than one access route to the apron areas and the use of the runway and taxiway where their separation distances are minimal.

Removal of NLAs

1.11.3 The added restrictions relating to the size and weight of the NLA increases the pressure for the speedy removal of the aircraft. With the advent of these NLAs, many new requirements were needed in the area of aircraft removal. As a result, aircraft removal equipment manufacturers have responded with the following:

— higher capacity pneumatic lifting devices

— higher capacity aircraft removal jacks with arc movement control capabilities

— new technology designs in lifting equipment

— higher capacity lifting and towing equipment

— larger temporary fuel storage equipment

1.11.4 Some of the major issues relevant to aircraft removal concerning the new code letter F aeroplanes will be identified in Chapters 2 and 5 of this document. For details on the operation of NLAs at existing aerodromes, see *Operation of New Larger Aeroplanes at Existing Aerodromes* (Cir 305).

1.12 SMALLER AIRCRAFT

1.12.1 The advent of the regional jet has a number of implications regarding aircraft removal. Although these aircrafts are relatively small when compared to NLAs, the removal problems are similar. These aircraft types generally fall into the aerodrome reference code letters B and C. Aircraft in the aerodrome reference code letter A usually present fewer aircraft removal problems.

Recovery of smaller aircraft

1.12.2 Due to the smaller size, weight and minimal wing height above the ground, regional jets present unique aircraft removal problems that must be addressed, such as the requirement for smaller aircraft removal jacks and smaller pneumatic lifting device as well as lack of information in the ARM for lifting with cranes.

1.13 RELATED DATA

The following documents must be reviewed for additional information on removal of disabled aircraft:

— Annex 14 — *Aerodromes*, Volume I — *Aerodrome Design and Operations*

— Annex 13 — *Aircraft Accident and Incident Investigation*

— Annex 9 — *Facilitation;*

— *Airport Services Manual* (Doc 9137):

Part 1 — *Rescue and Fire Fighting*

Part 7 — *Airport Emergency Planning*

Part 8 — *Airport Operational Services*

— *Manual of Aircraft Accident Investigation* (Doc 6920)

— *Operation of New Larger Aeroplanes at Existing Aerodromes* (Circ 305)

— Regulations of the State of Occurrence of the accident/incident

— Local airport operator disabled aircraft removal plan and related emergency plans

— United States Federal Aviation Administration Advisory Circular 150/5200-31A

— Specific ARM of the manufacturer

— Specific Weight and Balance Manual

— Aircraft removal process document of the aircraft operator

1.14 RELATED WEBSITES

The following websites are suggested for additional information:

— International Civil Aviation Organization (ICAO): http://www.icao.int

— International Air Transport Association (IATA): http://www.iata.org/workgroups/emg

— International Airlines Technical Pool (IATP): http://www.iatp.com

Chapter 2

SITE SURVEY

2.1 INTRODUCTION

The objective of this chapter is to clearly identify the major steps involved in the aircraft removal process and to assist in developing and implementing an appropriate removal plan. It must be noted that if initial conditions and parameters change during the process, each step of the implemented plan may have to be revised, which could be a continual process.

2.2 PRIOR TO RELEASE OF THE AIRCRAFT BY THE INVESTIGATION AUTHORITY

There is a time period between notification of the accident/incident to the aircraft accident investigation authority and release by the investigation authority to allow access to the aircraft. During this time a number of preliminary tasks can be completed in preparation for removal; some of these tasks include the following:

a) Recording of the initial accident/incident data;

b) Preparations for site security including fire, theft and access control;

c) Confirmation of the availability of the removal team members;

d) Arrangement for delivery of local recovery equipment;

e) Preparations for movement of specific removal equipment such as IATP kits from other sources (see Appendix 9);

f) Establishment of communication with the aerodrome operator and the investigative authorities;

g) Identification of what types of dangerous goods were being carried on board as cargo;

h) Obtaining current drawings/maps of the aerodrome to asses access routes to the site;

i) Transportation of the required personnel to and from the removal site;

j) Confirmation of shipping details for the required recovery equipment;

k) Visas, passports, vaccinations and related certificates; and

l) Hotel accommodations and local transportation.

2.3 RELEASE BY THE INVESTIGATION AUTHORITY

Once the investigation authority has formally released the aircraft, an initial survey can be carried out. A report on the general condition of the aircraft and its systems must be completed as soon as possible (see 2.4).

2.4 INITIAL AIRCRAFT SURVEY

2.4.1 As mentioned in 2.3, an aircraft survey can only be carried out once the investigation authority has released or granted access to the aircraft. Items to be recorded can include the following:

a) the integrity of the aircraft structure and landing gear;

b) an appraisal of the soil conditions;

c) forecast of current and future weather conditions;

d) relevant health and safety issues of personnel; and

e) expected environmental concerns.

2.4.2 In a minor incident where no injuries have occurred, the investigative authorities may not respond to the notice of the accident/incident but will give verbal approval to commence the removal process. In this case the investigation authorities will usually require a detailed report on the removal once completed.

2.4.3 Before allowing personnel to carry out the initial inspection of the aircraft or to enter or move under the aircraft, the aircraft must be properly stabilized. Once stabilized, a general visual inspection must be carried out paying particular attention to the condition of the fuselage, wings, engines and landing gear. Any visible damage or fluid leaks must be recorded. This documentation, which forms part of the recovery records, can be in the form of photographs, sketches, measurements and notes, etc.

2.4.4 If the accident/incident is major, the aircraft operator, pending the investigation, may lockout any computer-based aircraft technical documentation. In this case the fuel and cargo loads will be unknown, and it will be necessary to wait until the aircraft is properly stabilized to establish these factors.

2.4.5 This initial survey is important when carrying out preliminary discussions with the investigative authorities, the insurance adjusters, the aircraft manufacturer's representatives and, ultimately, the repair facility. As these discussions would normally take place by telephone; having access to this initial survey material is invaluable.

2.4.6 Usually the investigation of the accident/incident generates much more activity than the removal process itself. Because the objective of the investigation is to determine the cause of the accident/incident and provide details to prevent a reoccurrence of the event. The investigation authority may ask the aircraft operator's engineers to remove the flight data and voice recorders from the aircraft and release them to the investigative authorities who will issue a receipt for them, including the aircraft registration and the serial numbers of the units.

2.5 INSPECTION

2.5.1 Visual inspection of the aircraft without climbing on, entering or moving under the aircraft, a visual inspection of the aircraft must be carried out, taking note of any obvious and visible damage. Such damage must be recorded using stringer and fuselage frame or station numbers as references. Possible types of damage observed can include:

a) cracked, creased, buckled, distorted or torn fuselage and wing skin panels;

b) broken and missing fasteners; and

c) signs of overheating of any fuselage or wing panels or other components.

2.5.2 Any of the preceding types of damage are signs of failed structural components that must be considered questionable since failed structural components cannot be relied on to carry their designed loads. Prior to any levelling or lifting, a more detailed inspection of these areas is required.

2.5.3 If any damaged or loose components that will interfere with the removal process have been identified, plans must be made to either remove or secure them in place. These components may include:

— landing gear

— flap sections

— engine cowlings

— other non-structural parts such as damaged fairings, which can be a sign of hidden damage to other structural components

Electrical system

2.5.4 Further inspection of the electrical system is warranted if structural damage to the aircraft is evident. The decision to disconnect the aircraft's main batteries must not be taken lightly as it can greatly affect the recovery process. The ability to defuel the aircraft in a timely manner is greatly improved with aircraft power available.

Fluid leaks

2.5.5 Fluid leaks must be identified during this initial inspection. These leaks may include fuel, hydraulic fluid, wastewater, potable water or leaking cargo. Fuel leaks of any kind would mandate the defuelling of the aircraft as a primary task. Other than potable water, fluid leaks must be immediately reported in order for a quick response by the hazardous materials clean-up crew. In the mean time, attempts can be made to cap lines, temporarily plug any leaks and contain the fluids with the use of absorbent materials or containers.

Landing gear

2.5.6 When inspecting the landing gear, identify any landing gear that appears serviceable. Landing gear in the extended position must be secured, by installing landing gear down-lock pins. Once the aircraft has been levelled and lifted, it is sometimes possible to extend the landing gear and secure it by installing landing gear down-lock pins. It is also sometimes possible to perform temporary repairs on failed, folded or retracted landing gear or to replace a damaged landing gear assembly if spares are available. In certain cases, repairs or replacement will take less time than attempts to move the aircraft using trailers, which will increase the chance of inflicting secondary damage to the aircraft.

2.6 INITIAL SITE SURVEY

2.6.1 A thorough inspection the area surrounding the incident/accident site must be carried out. The path of the aircraft from where it left the hard surface to where it came to rest will be quite clear. Using this information, the direction the aircraft will be moved needs to be considered, keeping in mind the shortest distance to a hard surface may not always be the best choice. A current aerodrome topographical site map will help when making these decisions.

Terrain

2.6.2 The removal process will be more straightforward where the ground is reasonably flat. In an area where the ground consists of hills, slopes, streams and/or drainage ditches, the difficulty and complexity of the recovery process will increase. The aerodrome site map can be used to note any irregularities or conflicting information. Buried electrical conduits, drainage pipes and culverts must be discussed with the aerodrome field maintenance department and will be important when planning the extraction route of the aircraft. Any type of animal life, including rodents and snakes, must be investigated and reported accordingly.

Soil characteristics

2.6.3 One method used to evaluate soil conditions and load-bearing capability is the California Bearing Ratio or CBR. The CBR test measures the load necessary to force a plunger or penetrometre into a soil sample, thus identifying the inherent strength of the soil. Certain factors can affect the load-bearing capacity such as:

— type of soil and substrate

— any signs of recent excavations

— disturbed ground

— excessive rain

— drainage problems

2.6.4 Ruts left by the landing gear can be used to determine the load-bearing capacity of the soil. Some ARMs correlate these rut depths to the load-bearing capacity of the soil. There are many factors that are dependent on the load-bearing capacity of the soil. The strength of the soil will determine the choice of:

— materials when building temporary roadways capable of supporting the aircraft's weight

— earth anchors for tethering purposes

Aerodrome map

2.6.5 It is preferable to use an aerodrome topographical site map to identify obstacles such as fences, concrete footings, streams, drainage ditches, both surface and underground, culverts and buried electrical conduits. These obstacles must be considered when preparing the removal plan. The aerodrome field maintenance department can assist in identifying on the map any recent excavations near the incident/accident site and also use the map to plan a detailed removal route for the aircraft.

Access routes

2.6.6 Access routes to and from the incident site will normally be a concern and must be planned with the help of the local ATC unit and aerodrome map. The local ATC unit will provide direction and in some cases the aerodrome operator will provide escort vehicles, eliminating the requirement for radio contact. When choosing the removal route for the aircraft, it is necessary to evaluate the distance to the closest hard surface that can support the aircraft, the type of soil in the area, rut depth and physical obstacles.

2.6.7 Actual pavement specifications must be taken into account for code letter E aircraft and especially for new code letter F aircraft. For example, a taxiway in proximity to the disabled aircraft that is not rated for the aircraft's weight cannot be used without causing possible damage to the pavement. The bearing strength of pavements rated for various aircraft loads are reported using the aircraft classification number/pavement classification number (ACN/PCN) system. Information on the ACN/PCN system can be found in Annex 14, Volume I; and the *Aerodrome Design Manual,* Part 3 — *Pavements* (Doc 9157). Further consideration is required when one or more of the landing gear is missing, causing uneven distribution of the aircraft's weight. Further information on aircraft weight and footprint loads can be found in each specific ARM.

Weather

2.6.8 General weather conditions play a major part in the recovery process. Current and forecast weather conditions must be considered in properly planning the recovery process. These weather conditions include the following:

a) *Precipitation:* in any form will have major consequences on surface grading, soil load-bearing capacity and general recovery operations.

b) *Temperature:* both extreme heat and cold will determine the type of clothing and shelter required.

c) *Wind:* wind speed must be monitored to ensure that ARM limits on levelling/lifting operations are not exceeded. Wind will also determine the types and amounts of tethers to be used.

2.7 NLAs

Due to their size and weight, disabled aircraft that are classified under the code letters E and F require further evaluation and consideration when planning the removal process. Factors influencing the removal process of NLAs are:

a) increased fuselage length and wingspan;

b) increased weight;

c) substantial increases in volume of fuel and cargo;

d) access height for various components including engines, doors, wings and tail surfaces may be compounded by unusual aircraft attitudes;

e) general accessibility to the aircraft, which may require large areas of soil to be prepared and stabilized in order to move removal equipment and equipment for offloading cargo and fuel; and

f) the need to substantially increase the load-bearing capability of any roads being built.

2.8 ARM

2.8.1 The specific ARM produced by the aircraft manufacturer provides detailed information regarding the specific aircraft, which can include:

— weight and balance information

— maximum loads for lifting and towing operations

— locations for lifting bags and associated skin pressures

— the location and numbering of fuselage frames and stringers

— the location and type of composite materials

— the size and location of all doors and openings

— ground clearances

— ground connections

— grounding points

2.8.2 It is imperative that an ARM for the specific aircraft be consulted for required information during the removal process. Failure to access and properly use the required information can result in secondary damage to the aircraft and resultant delays in returning the aircraft to service. It is suggested that access to an ARM for all aircraft normally operating into an aerodrome be made available. This availability can be through the aircraft operator, the aircraft manufacturer, the contracted recovery company or a copy held by the aerodrome operator.

2.9 HEALTH AND SAFETY ISSUES

2.9.1 During any aircraft recovery operation, emphasis must be placed on the safety of all personnel involved. All necessary steps must be taken to avoid personal injury and to ensure that these personnel are not subjected to any unnecessary dangers.

Protective equipment for personnel

2.9.2 Appropriate personal protective equipment must be made available for aircraft removal personnel. The type of equipment will vary according to the severity of the incident/accident and the existing and anticipated weather conditions. All aircraft removal personnel need to be aware of the various types of equipment available and to use it to the required degree. Protective equipment can include hard hats, safety boots, protective gloves, coveralls such as Tyvek or equivalent, particulate dust masks, respirators, parkas and rain-suits, etc. Other factors that must be considered in providing the appropriate protective equipment are local poisonous plants, insects and snakes.

Contracted equipment operators

2.9.3 All contracted personnel and equipment operators must be included in the safety approach of the aircraft removal team including all safety briefings. Since most heavy equipment operators will have little experience working closely around aircraft, many basic aircraft safety issues may have to be explained or discussed, including concerns of overloading equipment and the subsequent dangers involved as they relate to aircraft. These safety discussions must also include subjects such as maximum lifting loads during crane lifts, and the need to follow the instructions of a clearly identified authority.

Removal equipment

2.9.4 The aircraft removal manager must ensure that all aircraft removal equipment is appropriately rated for the anticipated loads. All aircraft removal equipment must be visually inspected prior to use and attached tags attesting to appropriate load ratings and test dates should be examined.

Hazardous materials

2.9.5 Hazardous materials at an accident/incident site can include various aircraft parts made from composite materials and dangerous goods being carried as cargo. Another example of hazardous material is depleted uranium, which is sometimes used for balance weights. Cracked, broken and torn metals also present significant hazards from their sharp and jagged edges. In most cases these materials present no dangers to the removal team in their serviceable state. However, composite aircraft materials must be approached with caution when they are broken, torn or burned. Most manufacturers' ARMs will identify the location of any composite materials on the aircraft.

Biohazards

2.9.6 The dangers of blood-borne pathogens at an accident/incident site can vary in accordance with the severity of the incident. In an increasing number of jurisdictions, access to an accident/incident site can be restricted to individuals with a current blood borne pathogen training certificate. It is suggested that aircraft removal personnel familiarize themselves with local regulations and the regulations of States or areas where they may be required to recover aircraft. Blood borne pathogen training should be considered for all aircraft recovery personnel. Important areas of this training include:

a) biohazard risks associated with aircraft accident/incident investigation and the subsequent recovery operation;

b) recognition of biohazards:

c) exposure control plan, including procedures used to control exposure to blood-borne pathogens;

d) modes of blood-borne pathogen transmission;

e) Hepatitis B virus (HBV) vaccination information; and

f) personal protective equipment.

Oxygen system

2.9.7 Only experienced personnel must be involved when handling or working with the onboard oxygen system, and all applicable safety precautions must be taken with this system.

2.9.8 Once the aircraft has been stabilized, any oxygen bottles on board the aircraft must have their valves manually closed and, if possible, the bottles should be removed from the aircraft. Cabin oxygen generators must be either secured or removed depending on the condition of the aircraft, the anticipated dangers and the time required to remove them, as it is both a time-consuming and labor-intensive job.

Electrical system

2.9.9 Only experienced personnel must be involved when working on the electrical system, and all applicable safety precautions must be taken with this system.

2.9.10 Once the aircraft has been stabilized, and prior to energizing the electrical system, a comprehensive check of the electrical system must be carried out. First, a cockpit check must be carried out to confirm that all relevant switches and selectors are in the appropriate position and that the aircraft electrical system is serviceable and secure. If changes are made to switches or selectors, they must be properly documented. All applicable cautions and warnings pertaining to the specific aircraft must be adhered to.

2.9.11 The main aircraft batteries must be disconnected if the aircraft electrical system is found to be unserviceable. Fire extinguishers in remote locations are activated by explosive “squibs”. If there is any doubt about the integrity of the aircraft electrical systems, these systems should be disconnected or removed. For safety reasons, whether the electrical system is serviceable or not, the aircraft must still be properly grounded. Emergency power ram air turbines (RAT) systems are often heavy and have substantial deployment mechanisms, usually utilizing springs. These systems should be fitted with specific safety-retaining devices.

Fuel system

2.9.12 Only experienced personnel must be involved when handling or working with the onboard oxygen system, and all applicable safety precautions must be taken with this system.

2.9.13 On the initial aircraft survey, specific inspections will indicate whether there are any fuel leaks from the wings, fuselage or engines. All leaks must be identified and reported to the appropriate aerodrome personnel concerned for immediate action. In some cases minor leaks can be temporarily plugged or repaired. Any evidence of fuel leaks will only escalate the importance of defueling the aircraft.

2.9.14 Once the aircraft is stabilized and if no leaks are evident, a detailed review of the fuel system can be carried out. After being declared serviceable, the fuel can be removed or used for stability control. If the electrical system is considered to be serviceable, the components of the fuel system can be used either for defuelling purposes or for fuel movement between tanks.

Dangerous goods crew

2.9.15 Due to the widespread concern for environmental issues, especially around aerodromes, a dangerous goods clean-up crew, sometimes also known as a hazardous material (HAZ-MAT) crew, must be available to contain any fluid spills or leaks. In most cases, aerodromes require all spills or leaks to be contained and properly cleaned up. Dangerous goods clean-up crews must be equipped with the required materials for various fluid spills and leaks, including fuel, hydraulic fluid and waste systems. Aerodrome operators usually have standing contracts with companies to provide these services. In most cases the aerodrome operator, at the first sign of a spill or leak, alerts the dangerous goods clean-up crews. Aircraft operators must include dangerous goods clean-up crews in their contact information or aircraft recovery process document.

Fire safety

2.9.16 Aerodrome rescue and fire fighting service personnel and vehicles must be in place at the incident site during any defuel or levelling/lifting operations. During this time no smoking zones must be adhered to at all times.

Other safety-related issues

2.9.17 Another important safety issue is the inspection of aircraft wheels. Aircraft wheels must be inspected by qualified persons to ensure the wheels, particularly the rims, have not been damaged. The pressure and volume of gas in the tires could pose serious risks if the wheels/wheel rims fail.

Chapter 3

WEIGHT AND CENTRE OF GRAVITY MANAGEMENT

3.1 GENERAL

3.1.1 An accurate determination of the weight and centre of gravity location of the aircraft is essential in determining:

a) the levelling/lifting technique to be used;

b) the type and capacity of the selected equipment;

c) the expected loads;

d) any anticipated changes to the stability of the aircraft; and

e) that the lateral and longitudinal balance limits not be exceeded during the recovery operation.

3.1.2 It is necessary to calculate the weight of the aircraft and its centre of gravity location in order to anticipate changes in the stability of the aircraft. Both weight and centre of gravity location are also used to calculate the expected loads and to assist in the selection of the appropriate removal technique. Most ARMs provide worksheets to assist in calculating the net recoverable weight (NRW) and/or recoverable empty weight (REW) and the associated moments.

3.1.3 The actual weight of every aircraft will vary according to specific equipment and options; therefore, in most cases it will be necessary to obtain weights for the specific aircraft from the relevant weight and balance manuals. Without this information, the use of generic weights will be necessary, and only approximate calculation results will be obtained.

3.1.4 In cases involving a serious accident/incident, the aircraft operator is required to freeze or lockout all computerized information and quarantine all hard copy material or other data related to the specific aircraft involved. This will cause difficulties in obtaining load figures and weights for the flight involved. In this case estimated and generic weights will need to be used, and the recovery manager must take this into consideration when carrying out centre of gravity calculations, as these figures will only be approximate. Accurate calculations require data based on the serial number of the specific aircraft, information from the weight and balance manual and the operator's load sheets for the flight.

3.1.5 If the aircraft electrical system is serviceable, the onboard computers may be used to obtain flight information such as the amount and location of fuel on board and in some cases, the actual centre of gravity location available as a percentage of the reference chord (RC). Information from other areas of the airline's operation, such as weight and balance or flight dispatch departments, will most likely provide figures expressed in terms of percentage of reference chord (% RC) or percentage of mean aerodynamic chord (% MAC), which may also be available from the aircraft's onboard computers.

3.1.6 The ARM will provide details on how to convert from percentage RC or percentage MAC to a centre of gravity location measured from the aircraft datum point. The aircraft's datum point is usually located forward of the aircraft's nose and is normally measured in metres moving aft from the datum. Fuselage frames and fuselage stations are recorded using the distance from the datum. Information related to the datum, fuselage frames and station numbers are all detailed in the applicable ARM.

3.2 CENTRE OF GRAVITY TERMS AND DEFINITIONS

Centre of gravity. The balance point of the aircraft. It is the imaginary point about which the nose heavy and tail-heavy moments are exactly equal in magnitude.

Manufacturer's empty weight (MEW). The basic dry weight of a specific aircraft model that includes those fluids contained within closed systems.

Manufacturer's zero fuel weight (MZFW). The maximum weight permitted before fuel is boarded.

Mean aerodynamic chord or reference chord (MAC or RC). Distance from the leading edge to the trailing edge of a wing.

Net recoverable weight (NRW). The recoverable empty weight (REW) including some adjustments which comprise of:

- subtraction of the crew weight and crew baggage
- the effect of missing equipment and components
- the effect of fuel and cargo on the aircraft
- the effect of the position of the landing gear and flaps

Operating empty weight (OEW). The MEW plus the weight of standard and operational items. Standard items include:

- unusable fuel
- engine oil
- oxygen
- fixed galley structure
- miscellaneous equipment

Operational items include:

- crew and their baggage
- removable galley and cabin service items
- food and beverages
- potable water
- emergency equipment
- waste tank pre-charge
- cargo containers

Recoverable empty weight (REW). The MEW plus the weight of various items of operational equipment that are an integral part of the aircraft.

3.3 MANAGING AIRCRAFT WEIGHT AND CENTRE OF GRAVITY

3.3.1 Managing the aircraft weight and related centre of gravity is the key to a successful removal plan as it has a direct impact on aircraft stability and the calculation of expected loads. Every aircraft removal operation is different, and how much weight must be removed will first depend on the actual ability to carry out the task and various other factors such as time, accessibility and cost. Every effort must be made to reduce the weight of the aircraft to the minimum possible. Fuel and cargo are generally the easiest way to remove large amounts of weight quickly.

3.3.2 After choosing which levelling/lifting procedure is to be used, the next step is to calculate the aircraft NRW and centre of gravity in order to calculate the expected loads. These expected loads must be within both the aircraft allowable limits and the tooling capabilities. If the expected loads are not within these limits, it will be necessary to:

a) find an alternate levelling/lifting procedure to ensure that aircraft and tooling loads are within their stated limits;

b) adjust the aircraft weight to allow the loads to fall into allowable limits; and

c) reduce the weight of the aircraft.

3.3.3 Changes in weight and centre of gravity can be achieved by removing fuel and cargo, moving fuel from tank to tank or by adding ballast.

3.3.4 Damaged aircraft components such as stabilizers, wing and flap sections, large fairings, landing gear and landing gear door assemblies that are likely to interfere with the recovery process must be removed or secured in place. All removed components must be recorded, as their weights and moments will need to be subtracted when carrying out weight and centre of gravity calculations.

3.3.5 Galley catering units and trolleys can also have a significant influence on the centre of gravity. The weights and moments involved can be substantial, especially with aft-mounted galleys. The decision to remove galleys during a lengthy recovery may become a priority due to health concerns. Consideration must also be given to the removal of escape slides and slide rafts, as well as potable water and lavatory waste, as all are of significant weight.

3.4 FUEL AND CENTRE OF GRAVITY CONTROL

3.4.1 In order to find the weight and associated centre of gravity of the fuel remaining on board, the quantity how to determine these figures; however, depending on the attitude of the aircraft, this may be quite difficult to determine accurately. In most cases manual magnetic sticks can be used to measure fuel, but the results will only be accurate if the aircraft is level.

3.4.2 An alternate means for calculating the remaining fuel on board is provided by some manufacturers in their ARMs; however, in some cases, it may be necessary to estimate these figures. If the aircraft records are available, a good estimate of the expected fuel on board at landing will be available. In cases where the electrical system is serviceable, the onboard computer can also provide these details.

Chapter 4

PREPARATION

4.1 AIRCRAFT REMOVAL PREPARATION

4.1.1 The main issues associated with the preparation phase of the removal operation are the following:

a) stabilizing of the aircraft with tethers and shoring;

b) removal of any damaged components that will hinder the process;

c) wind and other adverse weather conditions, such as heavy snow;

d) testing and stabilizing of the soil;

e) removal of any large components for weight reduction or other specific considerations; and

f) preparation of the required levelling and lifting and general recovery equipment.

Stability

4.1.2 Prior to any weight reduction and levelling/lifting operations, the aircraft must be properly stabilized. Stability is defined as the resistance of the aircraft to uncontrolled movement caused by destabilizing forces. These destabilizing forces are usually loads imposed during the weight removal process when fuel and cargo are removed and the weight reduction causes a sudden shift in the centre of gravity of the aircraft.

4.1.3 Stabilizing of the aircraft is carried out not only for safety reasons but also to assist in containing secondary damage, which may be caused by any unexpected movement. The levelling/lifting equipment may add to the destabilizing affects. One other common factor on destabilizing the aircraft is the velocity and direction of the wind. The use of tethers and shoring is the most common way of stabilizing an aircraft (see 4.1.5 to 4.1.10).

Stabilizing the aircraft

4.1.4 Depending on the specific aircraft removal conditions, various steps can be taken to help with the stabilizing process as follows:

a) review safety procedures (see section 2.9) and ensure that all relevant and specific data is available;

b) tethers must be installed as soon as practicable depending on the aircraft stability;

c) shoring with timbers can be used to stabilize the aircraft;

d) calculate the NRW and centre of gravity position;

e) mark the centre of gravity position on the fuselage with paint or a marker. This mark can then be used as reference for future centre of gravity changes. The reference mark can be changed as fuel and cargo are removed or ballast added;

f) ensure the aircraft is properly grounded;

g) install landing gear down-lock pins in any extended gear;

h) move fuel from the low wing to high wing if possible;

i) inflate the landing gear strut of the low wing and deflate the landing gear strut of the high wing;

j) extend wing spoiler panels in strong wind conditions;

k) position horizontal stabilizer to a nose down position if aircraft power is available;

l) try to maintain a forward centre of gravity position;

m) test the soil and, if necessary, stabilize the soil around the aircraft for movement of equipment and eventual movement of the aircraft; and

n) reduce the aircraft weight to a minimum as soon as feasible once the aircraft is stabilized.

Tethers

4.1.5 General removal practice dictates that in many circumstances tethering and shoring are required. It will be necessary to evaluate the necessity and advantages for each removal event. During all levelling/lifting and weight reduction operations, careful monitoring is required to ensure that the aircraft remains stable and that uncontrolled movement of the aircraft is prevented.

4.1.6 Tethers must be firmly attached to the aircraft using either special attachment fittings provided by the aircraft manufacturer or through various other means such as wooden fixtures attached to doorways and window cutouts, and cables or straps attached to various wing strong points, which are described in the specific ARM.

4.1.7 The number of tethers used will be determined by the amount of instability, the specific removal process and the wind speed and direction. The specific ARM will provide precise details on where to attach the tethers, at what angles they must be installed and the maximum loads that can be exerted at each position.

4.1.8 Tethers must be securely attached to some form of ground anchor and equipped with load-tensioning devices. They should also protected with load-measuring equipment, such as scales or dynamometers, which will allow the loads to be properly monitored and adjusted. As the aircraft is levelled/lifted or the centre of gravity moved, these tethers must be constantly adjusted to maintain a consistent restraining force.

Shoring

4.1.9 Shoring of the aircraft may be necessary to make the aircraft stable prior to the removal of fuel or cargo. Shoring can also be used to hold the aircraft in position while levelling and lifting equipment is repositioned. It is possible to use large timbers to support the forward or aft fuselage and/or the lower wing surfaces. The timbers and supports must be placed in the correct load-bearing areas and properly padded to prevent secondary damage. Protective padding can consist of heavy felt, rubber sheets, mattresses, sandbags and, in some cases, rubber tires. Fuselage supports or cradles can also be fabricated to match the contours of the fuselage frames and must also be suitably padded.

4.1.10 As with tethering, the shoring loads must be evaluated and meet the allowable limits stated in the ARM.

Ground anchors

4.1.11 Some form of ground anchoring device is required when using tethers. The selection of the appropriate anchor is dependent on the required holding capacity of the tether lines. There are three basic forms of anchors:

a) *Commercial type ground anchors.* Numerous manufacturers of ground anchors provide a wide range of anchors according to their suggested holding capacities. The manufacturer's instructions must be followed when using any type of ground anchor. Generally, ground anchors are impacted or turned to a specified depth depending on the soil stability with longer models required for loose soils and shorter ones for compacted soils.

b) *Dead man anchors.* This type of anchor is generally fabricated on site from available materials using, for example, car or truck wheels complete with tires, heavy timbers or railroad ties. Usually a hole is excavated, and the anchor materials are buried after being attached to cables. The hole is then backfilled with the cables forming an angle of approximately 30 degrees between the anchor and the ground. Caution must be taken when using this type of anchor, and experience is required to ensure adequate holding capacity.

c) *Heavy vehicles.* If heavy vehicles are available, they can be used as ground anchors. However, their use must be carefully evaluated as once the vehicle is used as an anchor, it cannot be used for its original intended purpose.

Anchor-holding ability

4.1.12 The soil stability must first be tested to select the type of anchor to be used and to determine its holding capacity in various soil types. The holding capacity of the anchor is dependent on these variables:

— the type of soil and the depth of the anchor

— the moisture content of the soil (as it increases the holding capacity of the anchor decreases)

Soil stability testing

4.1.13 To ensure the ground around the incident site is capable of supporting the required equipment and the weight of the aircraft, soil stability testing must be performed. To do this the type of soil and substrate must be identified, usually by using a portable soil test probe. If the load-bearing capacity is too low, the ground must be properly stabilized. One of the methods used to evaluate different soil conditions is called the California Bearing Ratio (CBR), which consists of dropping a plunger or cone of a specified area and weight from a predetermined height. The measured penetration of the plunger or cone into the soil is plotted on a graph providing a CBR reading by putting a figure on the inherent strength of the soil.

Wind loads

4.1.14 Depending on the velocity and direction, wind loads impacted on the fuselage and vertical fin can cause serious implications on both longitudinal and lateral stability and have a large impact on attempts to stabilize the aircraft. The specific ARM will provide wind velocity limits for various levelling and lifting operations that will include maximums for lifting with jacks, cranes and pneumatic lifting devices. Forces imposed on the vertical fin by the wind can have a large destabilizing affect, and the amount of the destabilizing force is dependent on the wind speed and direction. Any decision to remove the vertical fin must be approached with caution since fin removal is considered to be a lengthy, labor-intensive job, and any advantages must be carefully evaluated. Obstacle clearance of the runway or a runway in close proximity could also be a factor in deciding whether to remove the vertical fin.

Damaged components

4.1.15 The initial damage survey will have identified any damaged or unsecured components. Consideration must be given to removing any of these items that will interfere with the recovery process or pose safety concerns during the levelling/lifting or moving process. Adequately securing any loose component is also an option to removal.

Equipment preparation

4.1.16 At this stage, a preliminary removal plan must be formulated. All available local equipment must now be available; this includes general aircraft removal materials along with any required heavy equipment listed in the Appendix 7. Additional removal equipment that is required, such as IATP kits from other aerodromes, must be identified and a request for its shipping underway.

4.2 COMMUNICATION EQUIPMENT

4.2.1 It is necessary to ensure that clear lines of communication between all relevant groups at the site are established. These groups may include aerodrome rescue and fire fighting service, investigative authorities, police, aerodrome personnel and any contracted assistance. It is therefore important to ensure that adequate and reliable communication equipment, such as two-way radios, cell phones and very high frequency (VHF) radios, is available at the accident/incident site. Voice activated two-way radios are ideal for aircraft removal operations. Extra batteries along with a power supply are also required for this equipment.

4.2.2 With the requirement to cross active runways, direct links with the local ATC unit by means of VHF radio will be necessary. The radio traffic and delays associated with the need to cross active runways can impede the removal operation. Therefore, the ATC unit will usually do everything possible to provide alternate routes to limit these crossings. In some cases the aerodrome authority will provide escort vehicles eliminating the requirement for VHF equipment in any removal vehicles.

4.2.3 Short briefing sessions must be held regularly to keep all groups involved in the removal operation aware of these procedures and to alert them to any anticipated hazards and dangers.

4.3 PREVENTING SECONDARY DAMAGE

4.3.1 Secondary damage is considered to be damage caused to the aircraft during the removal operation. The goal of a successful aircraft removal operation is to stabilize, offload fuel and cargo, level, lift and move the aircraft to a repair facility without causing any further damage. Every step of the removal process is prone to secondary damage and, as such, must be continually monitored, and all the necessary steps must be taken to prevent it. The availability and use of the specific ARM for the aircraft involved will assist in averting any additional damage.

4.3.2 Secondary damage can add significantly to the repair costs and substantially increase repair time. The significant reduction of aircraft weight by the removal of fuel, cargo and other items is the single, most important factor assisting in the minimizing of secondary damage. In unusual circumstances, however, secondary damage may have to be justified. Such circumstances could include cases where the accident/incident causes the complete closure of the aerodrome for a lengthy period of time and, consequently, pressure to move the aircraft could include negotiations on secondary cost absorption if significant time reduction is realized. Any discussions on accepting secondary damage must include the insurance underwriters, as they will vehemently oppose any risk of secondary damage.

Chapter 5

WEIGHT REDUCTION

5.1 GENERAL

The importance of weight reduction relates not only to actual removal of weight from the aircraft but also to control the centre of gravity. Caution must always be exercised during any weight reduction operation, as a significant shift in the centre of gravity can take place when fuel and cargo are removed. The main issues associated with the weight reduction phase of the operation are:

a) requirement for weight reduction;

b) removal of fuel and cargo;

c) removal of other large weight components;

d) use of fuel on board for centre of gravity control;

e) various defuelling procedures; and

f) fuel storage.

5.2 REQUIREMENT FOR WEIGHT REDUCTION

5.2.1 The reduction of aircraft weight during an aircraft removal operation is accepted as a general removal principle and incorporates many benefits that include:

— a lower NRW

— a lower load imposed on the aircraft

— a lower load placed on the recovery equipment

— a more straightforward soil stabilization, when necessary

— the ability to use equipment of lower ratings such as cables, slings, etc.

5.2.2 In some cases, the necessity to remove fuel and cargo can be eliminated completely or in other cases, reduced significantly. When making this decision, the following questions are to be considered:

a) Is there only minimal fuel remaining on board?

b) Is there only minimal passenger baggage and cargo on board?

c) Will it be necessary to use fuel and cargo weight for stability control?

d) How much time, material and labour will be required to excavate and prepare roads for fuel trucks and cargo loaders?

e) What are the expected fuel and cargo removal times versus the urgency in removing the aircraft?

f) How much time is required to obtain adequate fuel storage?

g) Are the allowable maximum loads within limits?

h) What is the capacity of the available levelling/lifting equipment?

i) Is it necessary to reduce the aircraft weight only to the point where maximum levelling/lifting loads will not be exceeded?

5.2.3 The decision not to reduce aircraft weight or to only partially reduce it must not be taken lightly; moreover, it is not the recommended approach. All possible repercussions must be thoroughly investigated prior to making these decisions, as there is great potential for secondary damage when the proper removal procedures are not implemented.

5.3 FUEL AND CARGO REMOVAL

5.3.1 Important considerations to keep in mind during the fuel and cargo removal process include the following:

a) fuel and cargo removal must only take place once the damage survey has been completed and stability and centre of gravity considerations have been taken into account;

b) a proper defuelling procedure be chosen only after a thorough damage survey of the aircraft to determine the functional status and serviceability of the fuel system;

c) in most cases, fuel is the largest removable weight component followed closely by cargo;

d) aircraft weight change will affect centre of gravity, aircraft stability and expected loads;

e) be prepared for and anticipate sudden attitude changes as fuel or cargo is removed. The changes can affect both the longitudinal and lateral axis of the aircraft;

f) unusual attitudes caused by collapsed, missing or heavily bogged landing gear will increase the difficulty of removing both fuel and cargo;

g) once the aircraft is stabilized, and before any levelling/lifting operations are performed, it is usual to remove baggage and cargo from compartments in the following order:

   1) the aft bulk compartments;

   2) the forward compartments; and

   3) the centre section cargo compartments.

Once baggage and cargo are removed, the fuel removal process can begin.

The use of onboard fuel for centre of gravity and stability control

5.3.2 There are cases where it may be prudent to leave all or some of the onboard fuel in place as it can be used to help stabilize the aircraft. For example, in a situation where the low wing landing gear is missing, retracted or bogged in mud, the fuel can be pumped from the low wing to the high wing to help reduce the weight on the low wing. Another reason for moving fuel from the low wing to the high wing is to help prevent the damage of engines from contacting the ground.

5.3.3 In the case of a nose gear collapse, fuel could be moved from the forward fuselage tanks to aft mounted tanks to decrease weight on the nose.

5.4 FUEL REMOVAL

5.4.1 All defuelling procedures must be carried out by appropriately trained and qualified personnel, and all safety procedures related to fuel must be complied with. Annex 14, Volume I, specifies, inter alia, that fire extinguishing equipment suitable for at least initial intervention in the event of a fuel fire and personnel trained in its use shall be readily available during ground servicing of an aircraft. The *Airport Services Manual*, Part 1 — *Rescue and Fire Fighting* (Doc 9137), provides guidance on aircraft defuelling practices.

5.4.2 When choosing the defuelling procedure, it is important to note that the information from the initial aircraft survey can be used to confirm: aircraft attitude and serviceability of the aircraft electrical system to accept external electrical power and to use the aircraft batteries. Lack of electrical power is the most common source of problems associated with fuel removal, as in most cases, fuel valves will have to be accessed and operated manually.

5.4.3 Serious consideration must be given to the fuel removal process when the aircraft comes to rest on soft or unprepared surfaces. In this case, roadways will need to be prepared not only for the aircraft removal but also for the equipment required for the defuelling process. Depending on the size of the tank trucks, roadways may require substantial preparation, and the soil may need to be stabilized with gravel, plywood or steel sheets. Alternate temporary and portable roadway systems may also be available commercially. Details on roadway preparation may be available in some ARMs.

Defuelling methods

5.4.4 There are a number of generally accepted defuelling methods including the following:

a) normal pressure defuelling, with all applicable aircraft systems serviceable;

b) suction defuelling, with all applicable systems serviceable and battery power available;

c) suction defuelling, with no electrical power available;

d) pressure defuelling, using an external boost pump harness to supply power to the aircraft fuel pumps;

e) suction defuelling, through over-wing fuelling ports; and

f) gravity or suction defuelling, using water drain valves.

The total quantity of fuel removed must be recorded, and it is suggested that actual quantities removed from each “tank” be recorded.

The defuelling process

5.4.5 Generally the aircraft defuelling system uses the same valves and fuel lines as the aircraft's refuelling, engine feed and fuel transfer systems. The quantity of fuel removed and the time required vary greatly depending on the aircraft type. Major defuelling factors are: aircraft attitude, serviceability of the electrical system and the method used.

Preparation for fuel removal

5.4.6 Prior to beginning the defuelling process, ensure that the following applicable safety precautions related to defuelling operations have been strictly adhered to:

a) aerodrome rescue and fire fighting service vehicles are on standby;

b) no smoking or open flames are within the safety zone;

c) portable fire fighting equipment with qualified operators are in position;

d) a generally accepted 15-metre perimeter safety zone around the aircraft must be clearly identified;

e) a clear exit route for fuel tankers in an emergency is provided;

f) a qualified hazardous material clean-up crew must be available for any fuel spills;

g) the aircraft and fuel trucks must be properly grounded;

h) only properly qualified people must be involved with the defuelling process; and

i) only equipment required for the defuelling process is permitted within the safety zone.

Other defuelling considerations

5.4.7 There are other considerations to take into account when defuelling an aircraft, including the following:

a) remove as much fuel as possible;

b) large quantities of fuel can be trapped in the wings due to abnormal aircraft attitudes. In some cases this fuel cannot be removed until the levelling process has been completed;

c) the defuelling process may have to be carried out in several steps as the aircraft is levelled; and

d) when one main landing gear is collapsed, missing or heavily bogged in mud, the transfer of fuel from the low wing to the high wing will reduce the weight on the low wing. This reduction in weight on the low wing will shift the centre of gravity outboard on the high wing. This process is only valid if the fuel system is serviceable and the various fuel pumps and valves can be powered.

Fuel storage

5.4.8 Defuelling is one of the most important tasks to be carried out during an aircraft removal operation. A major problem with any defuelling procedure is that of storage. There are many considerations and options for storage of removed fuel such as:

a) sufficient storage capacity for the removed fuel must be available. For example, a take-off incident involving a code letter “D” aircraft (Boeing B767 or Airbus A330) can require storage for 75 000 to 100 000 litres of fuel; and

b) if the aircraft was involved in an incident where fuel contamination is suspected, the investigative authorities will require that the removed fuel be quarantined. This is necessary to confirm the quality and specification of any uplifted fuel and to eliminate fuel as the incident/accident cause.

5.4.9 Fuel storage for aircraft involved in any type of aircraft removal incident can be designated as short term or long term. Some considerations of both storage requirements are:

a) removed fuel can be transferred to a fuel tank truck and then reused in a different aircraft of the operator’s fleet. This will depend on a variety of regulations including national, local and those of the operator;

b) fuel removal is dependent on the fuelling contractor’s ability to provide empty tank trucks;

c) defuelling could be a lengthy process if only one tank truck is available; and

d) long-term storage may occur when removed fuel is quarantined or the removed fuel quantity exceeds the aircraft operator’s need for re-use in other aircraft.

5.4.10 The following options are available for storage of removed fuel:

a) *Leasing of empty tank trucks.* This is an inexpensive way to provide storage for large quantities of stored fuel. The aerodrome and airline operators would need to discuss this option with the fuelling contractor and have made contract arrangements.

b) *Leasing of empty rail tank cars.* This option can only be considered if the aerodrome has a rail line within its boundaries or within close proximity.

c) *Tanks.* The possibility of fuel storage in tanks that are not clean or have been used for other products. Removed fuel can sometimes be returned to the supplier for re-refining of the product; and

d) *Portable fuel tank bladders.* These are available in various capacities. Some aerodromes will accept this storage option as long as it is a short-term solution and can be set up in a safe area of the aerodrome.

5.4.11 The issue of responsibility for removed fuel is dependent on a number of issues, including contractual and local requirements. It is suggested that each local aerodrome operator, aircraft operator and fueling contractor come to an agreement on this issue.

NLAs and fuel storage

5.4.12 Removal of code letter F aircraft, in particular those involved in a take-off accident/incident, may require fuel storage capacities of up to 300 000 litres. These large capacities further compound the requirement for temporary fuel storage.

5.5 CARGO REMOVAL

5.5.1 In addition to passenger baggage, modern aircraft are capable of carrying substantial volumes of air cargo in a variety of ways. On passenger aircraft there are two basic types of belly cargo compartments — bulk loaded and those equipped with cargo-loading systems.

5.5.2 Bulk loaded compartments are loaded manually, and in an aircraft in an unusual attitude, cargo can still be unloaded once the cargo door is open. However, automated cargo-loading systems require a relatively level aircraft attitude when cargo-loading vehicles are used. Problems associated with unloading containers with the aircraft in an unusual attitude are:

— the need for construction of roadways

— the necessity to level the aircraft prior to unloading

5.5.3 Although it is possible to remove cargo prior to levelling, it will be a time-consuming process and may require the following procedures:

a) cargo doors will have to be manually opened if electrical power to the aircraft is not available;

b) the side panels of the containers will have to be cut in order to gain access;

c) empty containers will have to be dismantled and removed to gain access to other full containers; and

d) containers will have to be secured to prevent unwanted movement.

5.5.4 Full freight aircraft in an unusual attitude, including a tail tip, will require a similar means to those described in 5.5.3 a) to d) to unload. Removal of cargo using these methods is always time-consuming and labour-intensive.

5.6 REMOVAL OF OTHER LARGE WEIGHT COMPONENTS

5.6.1 If extensive damage to any major components is recorded during the aircraft survey, it will be necessary to ensure that these components are either removed or secured to prevent a safety threat. These components could include the following:

— landing gear and gear doors

— ailerons, flaps and other wing components

— elevator and rudder components

— engines

— damaged fuselage or wing structure

5.6.2 Components that are either badly damaged, hanging loosely in place or torn from their attachments will require investigation. It is essential that these units be completely removed or securely attached in place to prevent unwanted movement during the levelling/lifting process since the risk of heavy components moving unnoticed can cause a shift in the centre of gravity.

5.6.3 Large components such as landing gear and engines present difficulty in any attempts to temporarily secure them in place due to the weights involved. In these cases it may be easier to remove them completely. Ailerons, flaps, elevators and rudders can usually be secured in place. Damaged or jagged sections of fuselage or wing structure that are loose can be cut away to prevent injury. Any removed components or structure must be recorded and their weights and moments properly subtracted from the aircraft weight.

Chapter 6

LEVELLING AND LIFTING

6.1 GENERAL

6.1.1 This chapter outlines the methods and processes required when levelling/lifting disabled aircraft. Each aircraft recovery incident is unique and must be thoroughly evaluated prior to any levelling/lifting operations being initiated. The basic requirement is to level and lift the aircraft to a height where maintenance jacks can be installed, allowing the landing gear to be extended, repaired, replaced or allowing for a recovery trailer to be installed. An overview of the required steps is as follows:

a) ensure the aircraft has been officially released by the investigative authorities;

b) resolve all related health and safety issues;

c) calculate the aircraft weight and centre of gravity;

d) ensure the aircraft has been properly stabilized;

e) resolve all weight reduction issues; and

f) ensure all required equipment and personnel are available.

In all circumstances, the aircraft must be levelled first and then lifted.

6.1.2 There are a number of different circumstances that will leave the aircraft sitting at an unusual attitude after an accident/incident. These scenarios may include the following:

a) nose landing gear collapsed, missing or retracted;

b) nose landing gear collapsed missing or retracted along with one main landing gear collapsed missing of retracted;

c) one main landing gear collapsed, missing or retracted;

d) two or more main landing gear collapsed, missing or retracted;

e) all landing gear collapsed, missing or retracted;

f) the aircraft is in a tail tipped attitude; and

g) the aircraft is in an unusual attitude due to one or more landing gear deeply bogged or buried in soft ground.

Solutions to these and other conditions will be found in most specific ARMs.

Levelling

6.1.3 Prior to lifting the aircraft, it is first necessary to establish the level attitude about the lateral and longitudinal axis. Different aircraft types will each provide a different means of confirming these pitch and roll angles. Examples of some of these are:

a) onboard computers of most modern aircraft can provide information on level attitude when electrical power is available;

b) the ARAM will specify longitudinal and lateral points on the aircraft, such as floor beams and seat tracks, where a spirit level can be placed; and

c) plumb bobs can be attached at grid points in wheel well areas to indicate the aircraft attitude.

6.1.4 These levelling points can be used during the levelling and lifting process to confirm when a proper aircraft attitude is reached and then monitored to maintain the level attitude. When the level attitude is reached, the levelling process may begin and is generally carried out in two distinct steps: levelling about the lateral axis (wings); and levelling about the longitudinal axis (fuselage). Sometimes it is only necessary to use one of the lifting points during the levelling process. In this case, the aircraft will pivot about a fixed point such as one of the landing gear.

Lifting

6.1.5 Once the aircraft has been properly levelled, it can be raised to the required height. Height requirements must include sufficient room to:

a) extend and lock a retracted landing gear;

b) place hanger or maintenance type jacks in position while further work is carried out on the landing gear, including landing gear replacement; and

c) place special aircraft recovery trailers or trucks under the wings and/or fuselage.

6.1.6 If the lifting equipment being used is not capable of lifting to the required height in a single step, it may be necessary to lift the aircraft in stages. In this case, extra support from shoring or cradles will be necessary while the lifting equipment is repositioned. For additional lift, it may be necessary to build a platform under a jack or pneumatic lifting device. Shoring may also be required when maximum arc movement is reached during lifting with jacks, and repositioning of the jacks is required. During any shoring operations, allowable shoring loads must always be calculated and monitored (see Chapter 4). There are various devices used to level and lift disabled aircraft. The generally accepted devices include: jacks, pneumatic lifting devices, and cranes and slings. In some cases it will be necessary to use a combination of these devices to successfully level and lift a disabled aircraft.

6.2 JACKS

6.2.1 Aircraft are generally lifted with jacks from reinforced hard points on the wings and fuselage. There is usually one jack point under each wing and another jack point on either the forward or aft fuselage. Other jack points on the aircraft may not be capable of supporting a normal jacking load and are intended to be used strictly for stabilizing purposes. The ARM will identify the specific locations of all jacking and stabilizing points. In all cases, jacks must be placed on a flat, stable, base such as steel plates, and the ground may have to be stabilized. During the levelling or lifting process, it may be possible to use only one of the jack lifting points to level the aircraft, which will then pivot around a fixed point such as the main landing gear. An example of such would be the case of a nose gear collapse where only a single lifting point at the forward fuselage would be available, and the aircraft would pivot around the main landing gear.

Type of jack

6.2.2 The various types of jacks used to lift an aircraft are as follow:

a) *Specialized aircraft recovery jacks.* These are capable of freely following the arc movement within specified limits and must be operated according to applicable operating instructions. Two different designs are available:

1) monopole design: consisting of a single cylinder attached to a large flexible base plate; and

2) tripod design: consisting of three multi-stage legs that are individually controlled and operated. Pressure gauges are installed on each leg allowing independent operation and control of the loads on the individual leg. This allows the operator to ensure that the arc movement is kept within the specified limits.

Note.— Standard maintenance tripod jacks are not capable of any arc movement and are not recommended for use during recovery operations.

b) *Bottle or wheel type jacks.* These can be useful for initial levelling and lifting in constricted areas. They have the same limitations as the standard maintenance jacks.

c) *Recovery jacks for NLAs.* These can provide continuous measuring and recording of loads during the entire jacking process and can automatically control side loads as they extend.

Jacking loads

6.2.3 Jacking loads must be calculated prior to any lifting operation. The specific ARM will provide details on how to calculate the expected vertical loads during a levelling and lifting operation. The structure near the jack points must be undamaged and capable of carrying the anticipated loads.

Side loads and arc movement

6.2.4 Side loads can be imposed as a result of the arc through which the jack pad will travel as the aircraft is raised from an unusual attitude. Misalignment will induce side loads that may cause secondary damage and possibly force the jack to topple. This movement or lateral translation of the jack head is known as arc movement and must be controlled during all jacking operations. Structural damage can occur if side loads are imposed that are greater than allowable limits. Special aircraft recovery jack heads move and follow this arc movement so there are no related side loads.

Jack stability

6.2.5 When jacks are used to lift aircraft from unprepared surfaces, the area on which the jack rests must be properly stabilized. This may include requirements to excavate and prepare the area with a gravel base, steel plates and plywood in order to support the anticipated loads. The base must also be large enough to allow for repositioning of the jack if necessary.

Lifting with jacks

6.2.6 Before the lifting process can begin, the aircraft must be levelled. The levelling process must always start laterally then longitudinally from the lowest point.

6.2.7 As with other lifting devices, there are general preparations and precautions to take prior to any lifting operation with jacks, such as:

a) ensure that all safety instructions are complied with;

b) monitor and ensure that wind speeds are not exceeded;

c) ensure that the aircraft is tethered if required;

d) ensure that all weights and loads have been calculated;

e) ensure that the platform area for the jack is large enough to change jack position as the aircraft is lifted, if necessary;

f) determine the type of jack to be used and ensure that it is capable of supporting the required load;

g) ensure that all the manufacturer's operating instructions are complied with;

h) install fittings or jack pad adapters at the jack points;

i) ensure that landing gear down-lock pins are installed in any serviceable landing gear;

j) discuss with the jack operators and other personnel what is expected to happen as the aircraft is raised and what is expected of each operator;

k) ensure that no unnecessary personnel are in the safety zone;

l) ensure that adequate communication is available between the jack operators, the recovery manager and the lifting coordinator;

m) attach plumb bobs to various fuselage and wing locations to assist with monitoring the relative attitude of the aircraft as it is lifted;

n) ensure that personnel are available to monitor and adjust the tension loads as the aircraft is lifted, if tethers are being used;

o) provide tail tip protection;

p) follow the aircraft manufacturer's recommendations regarding whether the parking brakes must be set, wheel chocks installed and whether it is necessary to deflate the landing gear shock struts;

q) if the required lifting height is greater than the jack extension height, shoring will be required while a platform is fabricated to provide additional lift;

r) jack operators must monitor the jacking loads at all times during the jacking operation;

s) the jacking operation must be carried out in a controlled and steady movement; and

t) install landing gear down-lock pins in any landing gear that is serviceable .

6.2.8 When the aircraft is lifted to the required height, the jacks must be left in place as a safety precaution in the following circumstances:

a) when attempting to extend any landing gear that is capable of supporting the aircraft's weight;

b) when work on the landing gear is carried out; and

c) when repairs or replacement of any damaged landing gear is undertaken.

If it is not possible to make the landing gear serviceable, removal trailers or trucks will be required to move the aircraft.

Other jacking requirements

6.2.9 Initial lifting of the aircraft may be necessary to gain clearance for positioning aircraft removal jacks or to make room for positioning lifting bags or lifting straps. In cases where the landing gear is collapsed, missing or retracted, or engines are missing, the aircraft will provide very little clearance for positioning lifting devices. In this case, wheel change axle jacks or bottle jacks can be used to lift the aircraft to a sufficient height. Again, all loads must be properly calculated and complied with (see Chapter 3).

6.2.10 In the event the aircraft comes to rest with landing gear extended but with multiple tire failures, special lifting requirements will be necessary. With more than one tire failure on the same axle, it will be difficult to place normal axle jacks due to the limited clearance. However, there are a number of special purpose jacks, jacking adapters and ramps available for this purpose. The specific ARM will provide details on this subject.

6.3 PNEUMATIC LIFTING DEVICES

6.3.1 Different designs of pneumatic lifting devices are available to achieve the desired lift during aircraft removal operations. Depending on the design, different methods are used to control lateral stability and arc movement during the lift.

6.3.2 The most common pneumatic lifting devices use bags with a multi-element or multi-compartment design for aircraft removal operations. Multi-element pneumatic lifting bags are designed to restrict the expansion of the individual element providing a flat slab shape of uniform thickness. Some degree of lateral instability is inherent in the design, although there are features that allow upper elements to more easily conform to the wing profile.

Pneumatic lifting device capacity

6.3.3 Pneumatic lifting bags are generally rated in terms of lifting capacity in tons and metric tonnes. Lifting bags are usually manufactured in approximate standard capacities of 15, 25 and 40 tons. Some manufacturers have developed pneumatic lifting devices with a higher capacity for the NLA.

Pneumatic lifting device placement

6.3.4 Pneumatic lifting bags and other pneumatic lifting devices are normally placed under the wings, the forward fuselage and the aft fuselage. The ARM will provide specific details on where the lifting bags should be placed and the maximum allowable skin pressure in these areas.

6.3.5 When pneumatic lifting bags are used to lift aircraft from unprepared surfaces, the area that the lifting bags rest on must be properly stabilized and able to support the anticipated loads. As with jacks, this may include requirements to excavate the area and prepare it with a gravel base and/or steel plates and plywood. The base should also be large enough to allow for repositioning of the lifting bags and in some cases the repositioning of any constructed cribbing platforms.

6.3.6 It is important not to place lifting bags under any damaged area of the fuselage or wings. Where damage exists, lifting bags generally should be placed a minimum of one fuselage frame or wing rib away from the damaged area. On some aircraft the wing dihedral in the area of air bag placement is considerable, and caution must be taken to prevent the bags from sliding outboard under the wing.

Calculating lift capacity

6.3.7 A major limitation with the use of lifting bags is their rated lifting capacity. For example, a lifting bag rated at 25 tons may not lift this load in all recovery events. The actual lifting load is dependent on the following few key factors:

a) the specified lifting capacity of the bag;

b) the maximum acceptable skin pressure in the area the lifting bag will be inflated; and

c) the measured surface area of the wing or fuselage that the lifting bag is actually in contact with.

6.3.8 If the lifting capacity required is greater than the capacity of the bag lifting, a different method of lifting will be required, or the weight of the aircraft will have to be reduced. In some cases, additional lifting capacity can be gained by pressurizing the aircraft cabin. Any increase in cabin pressure will, in most cases, add to the allowable fuselage skin pressure, thereby increasing the lifting capacity.

Platform cribbing

6.3.9 The inflated height of the lifting bag may not be sufficient to lift the aircraft to the required height. In this case a platform can be built to increase the height of the lift, however, this is a very time-consuming and labor-intensive job. The platform it must be made large enough to adapt to any minor position changes of the lifting bags, otherwise it will be necessary to dismantle it and rebuild it in a more accurate position.

6.3.10 There are alternatives to a wood platform or wood cribbing available from various companies in the form of inflatable cribbing and cribbing manufactured from composite and other man-made materials.

Lifting with pneumatic devices

6.3.11 Before the lifting process can begin, the aircraft must be levelled. The levelling process must always start laterally then longitudinally from the lowest point.

6.3.12 As with other lifting devices, there are general preparations and precautions to take prior to any lifting operations with pneumatic devices such as:

a) ensure that all safety instructions are complied with;

b) monitor and ensure that wind speeds are not exceeded;

c) ensure that the aircraft is tethered if required;

d) ensure that all weights and loads have been calculated;

e) ensure that all the manufacturer's operating instructions are complied with;

f) ensure that landing gear down-lock pins are installed in any serviceable landing gear;

g) determine the necessary lifting capacity and the number of bags required;

h) confirm the placement of the lifting bags on the ground and provide protection from sharp objects with rubber mats or tarpaulins, keeping in mind that ground preparation may be required;

i) protect the lower wing or fuselage from minor protrusions using rubber mats; however, it may be necessary to completely remove antennas and drain masts;

j) ensure that the area around the wing jack point is not encroached upon, as failure to provide an area for the jacks may require the aircraft to be shored once the lifting process is complete, to allow for the removal of the lifting devices and positioning of wing jacks;

k) place the lifting bags with the inflation fittings facing the inflation console if possible;

l) position the inflation console with a good view of the lifting bags;

m) discuss with the console operators and other personnel what may occur as the aircraft is raised and what is expected of each operator;

n) ensure adequate communication is available between the console operators, the recovery manager and the lift coordinator;

o) ensure that unnecessary personnel are not in the safety zone;

p) ensure that the compressor and console have adequate moisture traps;

q) unroll the inflation hoses and connect them to the console;

r) after purging, connect the hoses to the appropriate lifting bag inflation fitting and confirm the correct hose sequence;

s) attach plumb bobs to various fuselage and wing locations to assist in monitoring the relative attitude of the aircraft as it is lifted;

t) if tethers are being used, ensure that personnel are available to monitor and adjust the tension loads as the aircraft is lifted;

u) provide tail tip protection; and

v) follow the aircraft manufacturer's recommendations as to whether the parking brakes are to be set, wheel chocks installed and whether it is necessary to deflate the landing gear shock struts.

6.3.13 It may be necessary to lift the aircraft in stages if the lifting equipment being used is not capable of lifting to the required height in a single step. This will require the aircraft to be supported on some form of shoring or cradles while the lifting equipment is being repositioned, replaced or while a platform is being built to provide additional lift. If an adequate area is left available, jacks could be installed at this point.

Note.— During any shoring operations, allowable shoring loads must be calculated and monitored.

6.3.14 When the aircraft is lifted to the required height, jacks must be installed or shoring fabricated as a safety precaution under the following circumstances:

a) when attempting to extend any landing gear that is capable of supporting the aircraft's weight;

b) when work on the landing gear is carried out; and

c) when repairs or replacement of any damaged landing gear is undertaken.

If it is not possible to make the landing gear serviceable, removal trailers or trucks will be required to move the aircraft.

Inspections

6.3.15 Generally inspections include a visual inspection in the area the lifting bags made contact with the aircraft to ensure that there are no deep scratches or gouges caused by debris, stones or sand trapped between the lifting bag and the aircraft.

6.4 CRANES

6.4.1 Large mobile cranes, used in combination with various sling assemblies can be used in the recovery of disabled aircraft and are possibly the easiest way to lift the forward fuselage, for example, after a nose gear collapse. Whether to use cranes in the recovery operation depends on their availability. In some areas cranes are available with many choices in lifting capacity. In other areas cranes can be in short supply with limited lifting capacity, unknown serviceability and incomplete or non-existent records of safety inspections. When it is necessary to use equipment that are suspect, extreme caution must be exercised.

6.4.2 Prior to any crane operation, a reassessment of the initial aircraft survey must take place to confirm details of any structural damage. Careful examination of any damaged areas must be made prior to placing any lifting straps. Normally the strongest locations for placing lifting straps are near jack points, fuselage frames, bulkheads, fuselage production joints and doorframes. The ARM will identify these locations.

Note.— Tethering is important in any crane lift operation as even slight winds can cause large swinging forces.

Crane types

6.4.3 The types of cranes that can be used are:

a) *Mobile cranes.* Mobile cranes require a prepared surface called a pad to operate from. Depending on the size and lifting capacity of the crane, the requirements for the pad and access road can be substantial.

b) *All terrain cranes.* All terrain cranes with high flotation tires provide good site access with less of a requirement for prepared surfaces, although lifting capacity is limited.

c) *Crawler cranes.* Crawler cranes are available with substantial lifting capacities but require a prepared pad to operate from. The major problem with crawler cranes is the time required for transport and set-up.

Slings

6.4.4 A sling assembly is comprised of cables, hooks, fittings, spreader bars and straps. Some sling assemblies can be quite complicated featuring elaborate pulley systems to distribute the load evenly through a number of straps as the aircraft is raised from an unusual attitude. Other slings can be quite simple consisting of a single strap and spreader bar.

6.4.5 The number of lifting straps needed is dependent on the anticipated loads. It is recommended that the strap width be not less than 200 mm and fabricated from nylon or some form of carbon fiber weave. The ARM will identify placement of the straps around specific frames of the fuselage. Straps must not be placed near a damaged frame, stringer or damaged area of skin. Generally straps are placed a minimum of one frame away from any damage. Lifting straps must be used with an appropriate spreader bar, or secondary damage may result from the crushing action of the straps. One alternative is the use of a crane on each side of the fuselage, each lifting one end of the strap vertically.

Note.— All straps must be inspected prior to use and should have the load rating and inspection date tags attached.

Crane-lifting combinations

6.4.6 Cranes can be used as an integral part of the aircraft recovery operation assuming the crane has adequate lifting capacity. Generally, cranes of greater capacity than required offer much more flexibility in their positioning. Larger capacity cranes can be placed further away allowing for a greater operating radius around the aircraft. Jibs or jib extensions provide increased lifting height but do not increase the operating radius. As the boom angle of the crane decreases, the load capacity of the crane also decreases.

6.4.7 The required lifting height must be calculated to ensure sufficient lift height and boom travel range is available. The length of the lifting straps used must be determined to ensure that the maximum crane hook height is not reached before the required lift height of the aircraft is reached.

6.4.8 Following a nose gear collapse, the forward fuselage of most aircraft can easily be lifted with a proper sling and straps. In some cases, the nose landing gear is still serviceable, and once extended, the aircraft can be towed away.

6.4.9 Some aircraft are capable of being lifted from the main landing gear support beam, landing gear trunnion or some form of lifting adapter attached to the landing gear. Access is gained through removable panels on the upper surface of the wing above the landing gear attachments. Most aircraft without removable upper wing panels are incapable of being lifted with cranes from the main landing gear.

6.4.10 In some cases, cranes are able to lift the entire aircraft when it is possible to lift from the main landing gear. In this case, the aircraft can be lifted using the landing gear attachments and straps placed around either the forward or aft fuselage. To accomplish this three-point lift, several cranes may be used. Three-point single crane lifts may not be feasible for larger aircraft but are useful on smaller aircraft where cranes of adequate capacity are available.

6.4.11 When using a single crane, the three lifting points can be tied together with a combination of lateral and longitudinal spreader bars forming a single lift point. This same principle can be carried out using multiple cranes, where each crane lifts from a single lifting point. When using three separate cranes, a spreader bar is only required at the fuselage lifting point.

6.4.12 Whenever cranes are used, adequate roadways and crane pads must be constructed. The crane pad must be large enough to cope with repositioning of the crane. Lifting loads must be calculated to include the weight of the sling assembly and any associated shackles and cables. The lifting loads must continually be monitored and recorded. Most modern cranes are equipped with not only load indication devices but also systems that will stop crane movement if a preset crane load is exceeded.

Lifting with cranes

6.4.13 Before the lifting process can begin, the aircraft must be levelled. The levelling process must always start laterally then longitudinally from the lowest point.

6.4.14 As with other lifting devices, there are general preparations and precautions to take prior to any lifting operations with cranes, such as:

a) ensure that all safety instructions are complied with;

b) monitor and ensure that wind speeds are not exceeded;

c) ensure that the aircraft is tethered if required;

d) ensure that all weights and loads have been calculated;

e) ensure that landing gear down lock pins are installed in any serviceable landing gear;

f) determine the necessary lifting capacity and the number of sling straps required;

g) ensure that the prepared roadway and crane pad can support the anticipated loads;

h) ensure that cranes are placed as close to the aircraft as possible;

i) confirm the placement of lifting straps and provide protection from sharp objects with rubber mats;

j) protect the lower fuselage from minor protusions using rubber mats; however, it may be necessary to remove antennas and drain masts;

k) discuss with the crane operators and other personnel what will occur as the aircraft is raised and what is expected of each operator;

l) ensure adequate communication is available between the crane operators, the recovery manager and the lift coordinator;

m) ensure that unnecessary personnel are not in the safety zone;

n) attach plumb bobs to various fuselage and wing locations to assist in monitoring the relative attitude of the aircraft as it is lifted;

o) if tethers are being used, ensure that personnel are available to monitor and adjust the tension loads as the aircraft is lifted;

p) provide tail tip protection; and

q) follow the aircraft manufacturer's recommendations as to whether the parking brakes are to be set, wheel chocks installed and whether it is necessary to deflate the landing gear shock struts.

6.4.15 When the aircraft is lifted to the required height, jacks must be installed or shoring fabricated as a safety precaution under the following circumstances:

a) when attempting to extend any landing gear that is capable of supporting the aircraft's weight;

b) when work on the landing gear is carried out; and

c) when repairs or replacement of any damaged landing gear is undertaken.

If it is not possible to make the landing gear serviceable, removal trailers or trucks must be used to move the aircraft.

Crane operators

6.4.16 Crane operators, although skilled, may have little experience dealing with aircraft. Therefore, the removal manager must ensure that the crane operator is provided with as much information as possible, such as the basic weights and centre of gravity position of the aircraft, as well as any ideas on how the aircraft will respond as it is lifted. Crane operators usually work with at least one other assistant or rigger who is responsible for giving the crane operator instructions for crane movement and lifting directions. The removal manager must communicate with this assistant or rigger and not attempt to direct the crane operator himself.

Inspections

6.4.17 Generally this will include a visual inspection in the area the straps were placed to ensure that there are no deep scratches or gouges caused by debris, stones or sand trapped between the straps and the aircraft.

Chapter 7

MOVING THE AIRCRAFT

7.1 GENERAL

7.1.1 Once the aircraft has been stabilized, levelled and/or lifted, it will be necessary to move it back onto a hard surface and possibly to a repair facility. It is preferable to move a damaged aircraft supported on its own landing gear. If an aircraft has left the hard surface, a temporary roadway of some kind is usually required (see 7.2).

7.1.2 Prior to any type of movement of the aircraft, the removal manager will need to determine:

a) whether the weight and centre of gravity location have changed due to shifting of fuel that was unable to be removed during the defuelling operation;

b) further weight reduction operations after the levelling process or the removal of any large components;

c) the serviceability of the landing gear by:

   1) carrying out a detailed inspection of the landing gear to confirm its structural integrity;

   2) ensuring that the landing gear is capable of supporting the weight of the aircraft during any winching or towing operations;

   3) making certain the landing gear down-lock pins are installed in any serviceable gear;

   4) completing a thorough investigation to determine why it is not possible to install down lock pins. Repairs must be carried out and the landing gear secured by other means prior to supporting the aircraft on that particular landing gear; and

d) the direction the aircraft will be moved, depending on:

   1) the distance to a suitable hard surface;

   2) any obstacles that are present in the direction of movement; and

e) the requirement for construction of a temporary roadway. This will depend on the outcome of the soil stability tests during the site survey. In most cases, a temporary roadway will be required whether the aircraft is damaged or not.

7.2 ROADWAY CONSTRUCTION

7.2.1 Local contractors or construction companies can provide assistance in roadway construction details. However, the basic requirements for a constructed roadway are that generally it must be capable of supporting the weight of the aircraft and the recovery vehicles used to extract it. The roadway must also be wide enough to turn the aircraft if required. The interface between the constructed roadway and the hard surface is important, and the incline or ramp must consist of the smallest gradient possible.

7.2.2 In cases where the soil load-bearing capacity is high, and the ruts left by the aircraft tires are not deep, it may be possible to fill the ruts with gravel and move the aircraft backwards along these same tracks. Some ARMs provide charts that relate rut depth to aircraft weight and specify the depth of rut the aircraft can be moved in without preparing a roadway.

7.2.3 In cases where the soil is of a low load-bearing capacity, it will be necessary to excavate the unstable soil and prepare a proper base. The depth of the excavation will vary according to the soil stability. Large gravel is normally used to provide a sturdy base. Plywood sheets or steel plates can be placed over the gravel bed as a roadway. Where the soil is very soft, railroad ties can be placed laterally over the gravel and then covered with plywood or steel sheets, which must be overlapped in a shiplap manner. In situations where distances are long or if there is an insufficient amount of material to form a complete roadway, the plywood sheets or steel plates can be reused by constantly moving them ahead of the wheels in the direction of aircraft movement.

7.2.4 When large timbers or railroad ties are used in the construction of a roadway, they must be covered with a layer of sheet material, such as plywood or steel, to prevent the loads of individual aircraft wheels from pushing the timbers into the ground or against the wheel behind it and stopping movement.

7.2.5 In some cases only a prepared track and not a full width roadway will be required for each of the main landing gear. A roadway or track may not be necessary for the nose gear; however, this depends on soil stability, how the nose wheels will be steered and how the aircraft will be pulled or winched. If aircraft systems are serviceable, a qualified person can operate the nose wheel steering system, and, in this case, communication is mandatory. Tow bars can be attached to the nose gear and physically manoeuvred to provide steering. However, the level of difficulty for this type of operation increases with the size of the aircraft, soil type and depth of ruts. In cases where manual operation is not viable, a small tractor can be used with a prepared roadway or track.

7.2.6 Most aerodromes will have various types of crushed stone, gravel or broken up asphalt available that can also be used as a base for the roadway. In wet areas or inclement weather, drainage pumps may be required to remove standing water and to provide adequate drainage for the site. It is necessary to ensure that all materials used in the recovery operation are safe, able to cope with varying weather conditions and are capable of withstanding the loads imposed by the aircraft and the recovery equipment.

7.2.7 Aerodrome operators and/or major aircraft operators at each aerodrome must provide a “General Aircraft Removal Materials and Equipment” list that must include the location and availability of every item. (see Appendix 7 for a complete list).

7.3 COMMERCIAL TEMPORARY ROADWAY SYSTEMS

There are a number of commercially available temporary roadway systems on the market. Various types consist of aluminum or composite sections that can be fitted or bolted together. Fiberglass and carbon fiber matting are also available for this purpose.

7.4 MOVING AIRCRAFT WITH SERVICABLE LANDING GEAR

In cases where the aircraft has left a hard surface but has sustained little or no damage to the landing gear, and the soil load-bearing capacity is adequate, the retrieval process is fairly straightforward. For example, frozen ground in extremely cold temperatures will usually provide a good solid surface. When no roadway preparation is required, the aircraft can be pulled or winched directly onto a hard surface after taking maximum towing loads into consideration, keeping in mind that all loads must be monitored and recorded. However, in cases where roadway construction is required, an aircraft with serviceable landing gear can be moved once the roadway is built.

7.5 MOVING AIRCRAFT WITH UNSERVICABLE LANDING GEAR

7.5.1 Unserviceable landing gear generally refers to aircraft with damaged landing gear that either cannot be made serviceable or that have one or more landing gear missing. First, every attempt must be made to make as many landing gear serviceable as possible. In most cases it will take more time to move an aircraft with unserviceable landing gear on to some form of trailer system, which will cause the aircraft to be more susceptible to secondary damage, than it would be to use one of the following alternatives:

a) install a dummy landing gear (one which can support the weight of the aircraft but does not contain all the accessories such as brakes and hydraulic systems);

b) make repairs or install temporary bracing to a damaged landing gear; or

c) install a replacement landing gear assembly.

7.5.2 When repairs or replacement of the landing gear is not possible and all other methods have been investigated, there are a number of ways of moving and supporting the aircraft, using one or more of the following equipment types:

— flat bed trailers

— general purpose multi-wheel trailers

— specialized aircraft recovery transport systems

— moveable cranes (only in certain cases)

Flatbed trailers

7.5.3 When only the nose gear is missing, a flatbed trailer can be installed under the forward fuselage. It is preferable that this trailer has some form of turntable to allow for the turning of the tow vehicle and trailer. Adequate protection must be installed to prevent secondary damage to the aircraft.

7.5.4 With one or more main landing gear missing, the aircraft can be moved using one or more trailers of sufficient capacity. Shoring or cribbing with adequate padding will be necessary as an interface between the lower wing surface and the trailer deck and must be properly secured to the trailer and rigid enough to support the loads imposed during movement. An assessment of the structural condition of the trailer must be made to ensure that it is capable of supporting the weight of the aircraft on the trailer. The pulling speed must be kept to a minimum, and any turns must be carried out using the maximum turning radius possible.

General purpose multi-wheel trailers

7.5.5 Multi-wheel trailers are similar to standard flatbed trailers except they are usually self-propelled and fully steerable. Multi-wheel trailers have a large load-carrying capacity and are prevalent in seaport areas and locations associated with heavy industry.

Specialized aircraft recovery transport systems

7.5.6 Specialized aircraft recovery transport equipment usually consists of a series of self-propelled, hydraulically operated, multi-wheeled trailers with adjustable supports that can closely conform to the fuselage and wing contours. The platforms or supports are independently operated and are adjusted through an integral hydraulic system. To prevent secondary damage to the aircraft, heavy padding is integrated into the support structure of the trailer. These specialized recovery trailers can be linked together with beams or cables and can provide good stability and turning ability. Another piece of specialized equipment is the forward fuselage turntable which, when attached to a trailer, allows turns to be made during the moving operation.

7.6 MOVEABLE CRANES

When the entire aircraft is capable of being lifted with cranes, it can also be moved with them. Moving an aircraft will most likely require the use of large crawler-type cranes, which must remain close to the aircraft not only for maximum stability, but also to provide maximum load-carrying ability. Carefully planned roadways will be necessary to provide a pathway back to the hard surface for each crane being used. One crane lifting the forward fuselage and one or two supporting the wings can simultaneously be used to move the aircraft to a hard surface where jacks can then be installed to support the aircraft. Manoeuvres of this kind must be very closely controlled, and communication between each crane operator and their guides is essential. Due to the complexities involved, moving aircraft with cranes must be a last resort when all other options have been investigated.

7.7 WINCHING AND TOWING

7.7.1 Winching is the preferred option over towing, especially when moving an aircraft up a sloping surface, as it is more controllable, exerts a greater stable force and is not subject to surface conditions. Towing, however, offers the advantages of maneuverability, flexibility and uninterrupted movement over greater distances.

7.7.2 When the aircraft is off a hard surface, both towing and winching operations must be made from the main landing gear, keeping in mind that cables must never be wrapped directly around a landing gear piston or cylinder, as this will cause severe damage. Integral tow lugs are part of some landing gear assemblies; other landing gear can be fitted with specialized towing adapters. Nylon straps or carbon fiber loops wrapped around the landing gear cylinder and then attached to a steel cable with shackles is generally the accepted method when tow lugs are not installed. Any landing gear used to pull the aircraft must be serviceable with down-lock pins installed.

7.7.3 Load-limiting or load-indicating devices must be used for all towing operations. These load-limiting devices can be in the form of shear pins, but load-indicating devices are preferable. It is suggested to place winch or tow vehicles on a hard surface when initiating the pull. Wheel chocks must be moved continuously as a precaution to prevent the aircraft from rolling backwards. A vehicle with a restraint cable attached to the landing gear can be used for braking action.

Towing from the main landing gear

7.7.4 The main landing gear must be used for all towing and winching operations. Most aircraft have provisions for attaching towing cables to the main landing gear assemblies enabling the aircraft to be pulled either forwards or backwards. These provisions may consist of the following:

a) towing lugs that are an integral part of the landing gear assembly;

b) removable lugs that can be interchanged to either a forward or aft position;

c) adapters that can be installed to the forward or aft positions; and

d) straps or loops of nylon or carbon fiber can be looped around the landing gear cylinder on aircraft without towing lugs or adapters.

Towing from the nose gear

7.7.5 Towing from the nose gear is to be avoided for all recovery operations unless absolutely necessary as nose gear towing is intended only for pushing or pulling operations on a hard surface. Prior to any attempts to tow from the nose gear, a thorough inspection of the gear must be carried out. Any sign of damage to the gear will render it unusable for towing purposes. If the nose gear is used to move the aircraft, a load-indicating device must be incorporated to ensure that maximum loads are not exceeded. Pulling loads and towing angles must be carefully monitored.

Towing with deflated tires

7.7.6 In some cases it may be necessary to move the aircraft that has deflated tires. The ARM will give the allowable flat tire towing configurations. If possible, all deflated tires must be replaced before moving the aircraft. Extreme difficulty may be encountered during attempts to change tires on bogged gear. For example, deflated or damaged tires will create a dam effect when the aircraft is pulled, and the resistance may be so great that the tires will have to be changed. Deflated tires will also tend to wallow from side to side on a flat surface. Load-indicating devices must be used and monitored when pulling an aircraft with flat tires to prevent exceeding maximum towing loads.

Towing load limits and towing angles

7.7.7 When pulling an aircraft, the allowable towing load will vary with the towing angle. The ARM will provide the:

— maximum towing loads for both pulling and pushing on the nose gear including maximum towing angles

— maximum towing loads for both forward and aft pulling from the main landing gear, including the maximum towing angles

Towing turning radius

7.7.8 The ARM will provide the necessary information on turning radii, steering angles and other manoeuvring data. It is important that the aircraft not be turned in a tighter radius than allowable in order to prevent exceeding maximum loads on the landing gear.

7.8 DEBOGGING

7.8.1 An aircraft that has left the hard surface can get bogged down in sand, mud or snow and not sustain any significant damage. The removal of an aircraft in this condition is referred to as "debogging". The aircraft will be unable to move under its own power or through normal towing procedures using a standard tow bar and tractor; however, it can be moved on its own landing gear. Every debogging incident is different with many varying conditions and circumstances. General considerations involved in the initial debogging process are as follows:

a) confirm the weight and centre of gravity location;

b) confirm the aircraft is in a stable condition;

c) install landing gear down-lock pins;

d) carry out a thorough inspection of the landing gear to ensure its serviceability and ability to support the weight of the aircraft;

e) ensure the wheels are chocked;

f) if one landing gear is bogged down more than another, fuel can be moved from the low wing to reduce the weight on that gear;

g) reduce the aircraft weight as much as possible;

h) confirm the soil stability and prepare a roadway if required; and

i) excavate as much material as possible from around any bogged down landing gear.

Moving a bogged aircraft

7.8.2 In most cases the bogged aircraft will be extracted in the opposite direction of its entry. Preparations for moving a bogged aircraft include:

a) following the manufacturer's instructions when using specialized equipment;

b) attaching shackles and cables to the landing gear tow lugs if specialized aircraft debogging equipment is not available;

c) using a pulley between the main landing gear and the cables is suggested to equalize the loads on each landing gear;

d) using a load-indicating device to monitor the loads imposed;

e) connecting bridging ropes or cables between the towing cables every five metres to reduce uncontrolled cable movement in case of cable failure;

f) connecting pulling cables to a heavy tow tractor or winch truck and, if possible having the pulling vehicle positioned on a hard surface;

g) reducing tire pressure to give a higher surface area and therefore a lower footprint load as suggested by some aircraft manufacturers;

h) steering the aircraft by using a qualified person to steer the nose wheels from the cockpit or using a standard tow bar and tractor for steering purposes only;

i) having wheel chocks available to stop the aircraft if necessary;

j) ensuring the aircraft is moved at a constant speed with no jerky movements;

k) stopping the pull, if necessary, in order to reposition the following:

1) pulling vehicles and cable system; and

2) plywood, steel sheets or other commercial roadway systems when there is an insufficient amount to form a continuous roadway.

7.8.3 Once the aircraft is back on the hard surface install wheel chocks. The aerodrome authority will, at this point, wash the landing gear and fuselage so that no mud or debris will contaminate the hard surfaces as the aircraft is towed.

Chapter 8

POST-RECOVERY CORRECTIVE ACTIONS

8.1 DATA RECORDING

Once the aircraft has been recovered and moved to a repair or inspection facility, the details of the recovery must be recorded. These details include but are not limited to the following:

a) the initial survey and inspection report, including diagrams and photographs;

b) initial calculations of the aircraft weight, anticipated loads and centre of gravity calculations;

c) information on the weight reduction procedures;

d) the technique used to level and lift the aircraft, i.e, jacks, cranes, lifting bags or combination thereof;

e) the loads imposed during levelling and lifting;

f) the loads imposed on tethers;

g) the loads imposed on the landing gear during the movement of the aircraft to a hard surface; and

h) details on any resultant secondary damage.

8.2 CORRECTIVE ACTIONS

8.2.1 In some instances it will be difficult to obtain certain load figures, but every effort must be made to monitor and record them. If monitoring equipment is not available, the recovery manager must justify and accept the risks involved. This information is necessary so that the proper inspections and corrective actions can be carried out prior to the release of the aircraft back into service. By providing the actual loads imposed, the aircraft manufacturer will be in a better position to provide comprehensive and detailed repair schemes for damaged aircraft following any accident/incident. Some ARMs may include information on what inspections are required following an accident/incident where the aircraft leaves the hard surface. Once completed, the entire package of data and information related to the accident/incident and any repairs required or performed become part of the aircraft technical history.

8.2.2 The above-mentioned inspections of the removal process, when carried out, will confirm that the removal was properly completed with no excess loads applied. This will be important if, at a later date, questions arise regarding the recovery by the operator, the manufacturer or the insurance underwriter.

8.2.3 The importance of using load-indicating devices cannot be overly emphasized (see section 7.7). Load-indicating devices are becoming a standard in aircraft recovery events, and most IATP aircraft recovery kits now include them.

8.3 INCIDENT REPORTING

Annex 13 contains specifications for the mandatory reporting of all “international accidents” and certain “domestic accidents”. Further guidance is available in the *Manual of Aircraft Accident Investigation* (Doc 6920).

Appendix 1

OUTLINE OF A DISABLED AIRCRAFT REMOVAL PLAN

An outline of a disabled aircraft removal plan is given below. This material is intended as a guide for basic matters to be covered in the plan as well as on action to be taken by the main parties responsible for the overall aircraft removal operation. In general, the disabled aircraft removal plan should be structured to take into account the principal functions, as shown in Appendix 3.

1. RESPONSIBILITIES

1.1 *Removal of a disabled aircraft or parts thereof.* Identify the person or agency (normally the aircraft owner or operator) responsible for the removal of the aircraft and define the procedures to follow in the event of failure to comply with such directions.

1.2 *Notification of the aircraft accident to the aircraft accident investigation authority.* Identify person or agency (normally the aircraft owner or operator or, when this is not possible, the appropriate authority) responsible for notifying the accident to the aircraft accident investigation authority. Give the telephone number of the aircraft accident investigation authority. List the details to be notified, such as the aircraft operator, time, route stage, passengers and fatalities.

1.3 *Preservation of aircraft, mail, cargo and records.* Identify the person or agency (normally the aircraft owner or operator) responsible for preserving, to the extent possible, the aircraft and parts thereof, cargo, mail and all records. Define the procedures to be followed when it is necessary to disturb or move the aircraft or parts thereof (i.e. photographs, marks on the ground and a diagram of the accident site).

2. ACTION REQUIRED BY MAIN RESPONSIBLE PARTIES

2.1 *Aerodrome authority.* List the actions to be taken by the aerodrome authority when implementing the plan. The aerodrome authority should, among other things:

a) issue the required notice to airmen (NOTAM) as may be appropriate;

b) coordinate all aerodrome operations with the air traffic services units for continuation of aircraft operations, when possible;

c) determine any obstacles in accordance with clearance criteria found in Annex 14 — *Aerodromes*, Volume I, *Aerodrome Design and Operations*, and, as a result, consider whether any section of the movement area should be closed;

d) provide for security of the accident site and coordinate with the aircraft accident investigation authority on measures to be taken before the aircraft removal operation is initiated;

e) provide advance vehicles and personnel to escort airline equipment to the site;

f) establish a removal command post at the site, if considered necessary;

g) inspect all areas prior to resumption of normal aircraft operations;

h) convene a removal operation debriefing of all interested parties. The debriefing may include a review of aircraft accident investigation authority requirements, the coordinator's chronological report, and a discussion of the procedures and equipment used during the recovery operation. It may be desirable that all aircraft operators, especially those operating the same type of equipment, be invited to attend; and

i) amend the disabled aircraft removal plan to overcome problems identified under 2.1 h).

2.2 *Aerodrome coordinator of disabled aircraft removal operations.* List the action that is expected to be taken by the aerodrome coordinator when implementing the plan. The aerodrome coordinator should, among other things:

a) convene a meeting with the aircraft operator representative, aircraft accident investigation authority, representatives of resident oil companies, heavy equipment contractors and other parties, as necessary, to discuss the most appropriate removal operation and agree upon a broad plan of action. This should cover the following points:

   1) escort routes between the aircraft operator's area and the accident site;

   2) defuelling to lighten the mass of the aircraft;

   3) requirements and availability of equipment for the removal of the aircraft;

   4) use of the aerodrome and aircraft operator's equipment;

   5) dispatch of aircraft operator ancillary support devices to the scene;

   6) weather conditions, particularly when a crane-lifting or pneumatic lifting-bag operation is necessary;

   7) lighting of the site;

   8) a contingency plan, should difficulties develop in the initial plan; and

b) provide for a rescue and fire fighting vehicle, when necessary;

c) supervise the aerodrome personnel and equipment assigned to the removal operation;

d) make decisions on behalf of the aerodrome authority, as necessary, to expedite the removal of the disabled aircraft;

e) report further penetrations of the obstacle limitation surfaces due to the manoeuvring of cranes or other equipment during the lifting of the aircraft;

f) monitor weather forecasts;

g) maintain a chronological summary of the removal operation;

h) have photographs of the removal operation taken where possible;

i) where excavations are necessary, check with the appropriate aerodrome maintenance services for underground utilities;

j) keep the aerodrome authority and other aircraft operators informed of the progress of the aircraft removal operations; and

k) participate in the removal operation debriefing.

2.3 *Aircraft operator.* List the action which is expected to be taken by the aircraft operator when implementing the plan. The aircraft operator should, among other things:

a) arrange for portable stairs and removal of mail, baggage and cargo; it being understood that authority to remove these items must be secured from the aircraft accident investigation authority;

b) designate one representative with the authority to make all technical and financial decisions necessary to remove the aircraft. The representative should have the use of company facilities, personnel and equipment required for the removal operation;

c) consider designating of a representative to answer any questions from the press and to issue press releases as may be appropriate; and

d) participate in the removal operation debriefing.

2.4 *Aircraft operator's representative.* List the action to be taken by the aircraft operator's representative when implementing the plan. The aircraft operator's representative should, among other things:

a) implement the aircraft operator's removal plan for such an emergency;

b) meet with the aerodrome coordinator, aircraft accident investigation authority and other parties, as necessary, to develop a comprehensive plan for the removal of the aircraft;

c) decide on the need for consultation with aircraft airframe and engine manufacturers or other aircraft operator representatives experienced in such accidents; and

d) participate in the removal operation debriefing.

3. EQUIPMENT, PERSONNEL AND FACILITIES

3.1 *Equipment and personnel available.* List equipment and personnel on or in the vicinity of the airport that would be available for the removal operation (see Appendix 7). The list of equipment should include information on the type and location of heavy equipment or special units needed and the average time it will take to get them to the airport. The list of personnel should also contain information on the availability of human resources for road-making and other duties. Names, addresses and telephone numbers of personnel and equipment representatives should be given.

3.2 *Access routes.* Include information on access routes to any part of the airport including, if required, special routes for cranes to avoid power lines. A grid map of the type referred to in Annex 14, Volume I, Attachment A, Section 17, may be useful for this purpose.

3.3 *Security.* Define a means of maintaining security for the aircraft removal operation.

3.4 *Aircraft removal equipment kits.* Describe arrangements for the rapid receipt of aircraft removal equipment kits available from other airports. This should be coordinated with the airlines operating at the aerodrome.

3.5 *Aircraft data.* Describe arrangements to make available, at the aerodrome, manufacturer's data pertaining to aircraft removal for the various types of aircraft that normally use the aerodrome.

3.6 *Aircraft defuelling.* Describe arrangements with the resident oil companies to ensure that the defuelling, storage and disposal of the aircraft fuel, including contaminated fuel, can be done at short notice.

3.7 *Responsible representatives.* List names, addresses and telephone numbers of responsible representatives of each aircraft operator, as well as of the nearest representatives of aircraft and engine manufacturers.

Appendix 2

AERODROME REFERENCE CODE

1. The following table provides information on the aerodrome reference code system used in Annex 14, Volume I, to categorize the various sizes of aeroplanes. The intent of the reference code is to provide a simple method for interrelating the numerous specifications concerning the characteristics of aerodromes so as to provide a series of aerodrome facilities that are suitable for the aeroplanes that are intended to operate at the aerodrome.

2. .The generation of new larger aeroplanes (NLAs), such as the Airbus A380 and Boeing 747-8, belongs to the code letter "F" category of aeroplanes. In Table 2-1, code element 2, which is based on the aeroplane wing span and outer main gear wheel span, is of particular interest to aircraft removal personnel. Additionally, a detailed list of aeroplane classification by code number and letter is reproduced in Table 2-2.

Table 2-1. Aerodrome reference code
(extract of Table 1-1, Annex 14, Volume I)

Code element 1		Code element 2		
Code number (1)	Aeroplane reference field length (2)	Code letter (3)	Wing span (4)	Outer main gear wheel span[a] (5)
1	Less than 800 m	A	Up to but not including 15 m	Up to but not including 4.5 m
2	800 m up to but not including 1 200 m	B	15 m up to but not including 24 m	4.5 m up to but not including 6 m
3	1 200 m up to but not including 1 800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1 800 m and over	D	36 m up to but not including 52 m	9 m up to but not including 14 m
		E	52 m up to but not including 65 m	9 m up to but not including 14 m
		F	65 m up to but not including 80 m	14 m up to but not including 16 m

a. Distance between the outside edges of the main gear wheels.

AEROPLANE CLASSIFICATION BY CODE NUMBER AND LETTER

(taken from the *Aerodrome Design Manual*, Part I — *Runways* (Doc 9157))

Aircraft make	*Model*	*Code*	*Aeroplane reference field length (m)*	*Wing span (m)*	*Outer main gear wheel span (m)*
de Havilland Canada	DHC2	1A	381	14.6	3.3
	DHC2T	1A	427	14.6	3.3
Britten-Norman	BN2A	1A	353	14.93	3.61
	BN2B-20	1A	355	14.93	3.61
	BN2-26	1A	371	14.93	3.61
	BN2T	1A	381	14.93	3.61
Cessna	152	1A	408	10.0	—
	172 S	1A	381	11.0	2.7
	180	1A	367	10.9	—
	182 S	1A	462	11.0	2.9
	Stationair 6	1A	543	11.0	2.9
	Turbo 6	1A	500	11.0	2.9
	Stationair 7	1A	600	10.9	—
	Turbo 7	1A	567	10.9	—
	Skylane	1A	479	10.9	—
	Turbo Skylane	1A	470	10.9	—
	310	1A	518	11.3	—
	310 Turbo	1A	507	11.3	—
	Golden Eagle 421 C	1A	708	12.5	—
	Titan 404	1A	721	14.1	—
Fuji	FA-200-160	1A	345	9.42	2.63
	FA-200-180	1A	350	9.42	2.63
Mitsubishi	MU-2B	1A	460[2]	11.95	2.36
	MU-2B-10	1A	490[2]	11.95	2.36
	MU-2B-15	1A	455[2]	11.95	2.36
	MU-2B-20/25	1A	520[2]	11.95	2.36
	MU-2B-26/26A	1A	550[2]	11.95	2.36
	MU-2B-30	1A	576[2]	11.95	2.4
	MU-2B-35	1A	570[2]	11.95	2.4
	MU-2B-36/36A	1A	660[2]	11.95	2.4
	MU-2B-40	1A	550[2]	11.95	2.36
	MU-2B-60	1A	660[2]	11.95	2.4
Piper	PA28-161	1A	494[2]	10.7	3.2
	PA28-181	1A	490[2]	10.8	3.2
	PA28R-201	1A	487[2]	10.8	3.4
	PA32R-301	1A	539[2]	11.0	3.5

Aircraft make	*Model*	*Code*	*Aeroplane reference field length (m)*	*Wing span (m)*	*Outer main gear wheel span (m)*
	PA32R-301T	1A	756[2]	11.0	3.5
	PA34-220T	1A	520[2]	11.9	3.5
	PA44-180	1A	671[2]	11.8	3.2
	PA46-350P	1A	637[2]	13.1	3.9
Raytheon Beechcraft	A24R	1A	603	10.0	3.9
	A36	1A	670	10.2	2.9
	76	1A	430	11.6	3.3
	B55	1A	457	11.5	2.9
	B60	1A	793	12.0	3.4
	B100	1A	579	14.0	4.3
Antonov	AN2	1B	500	18.18	3.36
	AN3	1B	390	18.18	3.45
	AN28	1B	585	22.06	3.41
Britten-Norman	BN2T-4S	1B	565	16.2	3.61
Cessna	525	1B	939	14.3	4.1
de Havilland Canada	DHC3	1B	497	17.7	3.7
	DHC6	1B	695	19.8	4.1
Embraer	EMB-110	1B	1400	15.3	4.9
LET	L410 UPV	1B	740	19.5	4.0
Pilatus	PC-12	1B	452	16.2	4.5
Raytheon Beechcraft	E18S	1B	753	15.0	3.9
	B80	1B	427	15.3	4.3
	C90	1B	488	15.3	4.3
	200	1B	579	16.6	5.6
Short	SC7-3/SC7-3A	1B	616	19.8	4.6
de Havilland Canada	DHC7	1C	689	28.4	7.8
Learjet	24F	2A	1 005	10.9	2.5
	28/29	2A	912	13.4	2.5
Antonov	AN38-100	2B	965	22.06	3.43
	AN38-200	2B	1 125	22.06	3.43

Aircraft make	*Model*	*Code*	*Aeroplane reference field length (m)*	*Wing span (m)*	*Outer main gear wheel span (m)*
Dornier	320-100MOD10/20	2B	1 088	20.98	3.22
	320-100MOD30	2B	1 044	20.98	3.22
LET	L410 UPV-E	2B	920	20.0[1]	4.0
	L410 UPV-E9	2B	952	20.0[1]	4.0
	L410 UPV-E20	2B	1 050	20.0[1]	4.0
	L420	2B	920	20.0[1]	4.0
Shorts	SD3-30	2B	1 106	22.8	4.6
Avions de Transport Régional (ATR)	ATR42-500	2C	1 165	24.57	4.1
Fokker	F27 Mk050	2C	1 167	29.0	8.0
Mitsubishi	YS-11-100	2C	970	32.00	8.60
	YS-11A-200/300	2C	1 110	32.00	8.60
Dassault Aviation	Falcon 10	3A	1 615	13.1	3.0
	Falcon 10	3A	1 480[4]	13.1	3.27
Hawker Siddley	HS 125-400/600	3A	1 646	14.3	3.3
	HS 125-700	3A	1 768	14.3	3.3
Learjet	24D	3A	1 200	10.9	2.5
	35A	3A	1 287	12.0	2.5
	36A	3A	1 458	12.0	2.5
	54	3A	1 217	13.4	2.5
	55	3A	1 292	13.4	2.5
Bombardier Aerospace	CRJ 100	3B	1 470	21.2	4.0
	CRJ 100ER	3B	1 720	21.2	4.0
	CRJ 200	3B	1 440	21.2	4.0
	CRJ 200ER	3B	1 700	21.2	4.0
Dassault Aviation	Falcon 20	3B	1 463	16.3	3.7
	Falcon 200	3B	1 700	16.3	3.5
	F50/F50EX	3B	1 586	18.9	4.5
	Falcon 900	3B	1 504	19.3	4.6
	Falcon 900EX	3B	1 590	19.3	4.6
	F2000	3B	1 658	19.3	5.0
	F2000EX	3B	1 700	19.3	5.0
	Falcon 20F	3B	1 495[4]	16.3	3.95[4]
	Falcon 20-5F	3B	1 740[4]	16.3	3.95[4]
	Falcon 200	3B	1 600[4]	16.3	3.95[4]
	Falcon 50/50	3B	1 586	18.9	4.52

Aircraft make	*Model*	*Code*	*Aeroplane reference field length (m)*	*Wing span (m)*	*Outer main gear wheel span (m)*
	Falcon 900	3B	1 586[4]	19.3	5.02[4]
	Falcon 900DX	3B	1 490	19.3	5.02
	Falcon 900EX	3B	1 634[4]	19.3	5.02[4]
	Falcon 2000	3B	1 768[4]	19.3	5.01
	Falcon 2000DX	3B	1 615	19.3	5.01
	Falcon 2000EX	3B	1 708[4]	19.3	5.01
	Falcon 2000LX	3B	1 708	21.4	5.01
Dornier	320-300MOD00	3B	1 297	20.98	3.22
	320-300MOD10	3B	1 367	20.98	3.22
Embraer	EMB-135 LR	3B	1 745	20.0	4.1
	EMB-145 BJ	3B	1 650	21.2	4.1
Fokker	F28-1000/2000	3B	1 646	23.6	5.8
	F28 Mk1000/2000	3B	1 759	23.6	5.8
Israel Aircraft Industries (IAI)	SPX	3B	1 644	16.6	—
	Galaxy	3B	1 798	17.7	—
Gulfstream Aerospace	G IV-SP	3B	1 661	23.7	4.8
Nord	262	3B	1 260	21.9	3.4
Airbus	A318-100	3C	1 789	34.1	8.9
Antonov	AN24	3C	1 600	29.20	8.8
	AN24	3C	1 350	29.20	7.90
	AN24PB	3C	1 600	29.20	7.90
	AN30	3C	1 550	29.20	7.90
	AN32	3C	1 600	29.20	7.90
	AN72	3C	1 250	31.89	4.09
	AN148-100A	3C	1 740	28.91	4.58
Dassault Aviation	Falcon 7X	3C	1 750	26.2	5.04
Embraer	EMB-120 RT	3C	1 420	19.8	6.6
	EMB-120 ER	3C	1 550	19.8	6.6
	ERJ-170 LR	3C	1 550	26.0	5.2
	ERJ-175 LR	3C	1 530	26.0	5.2
	ERJ-190 AR	3C	1 700	28.7	5.9
ATR	ATR72-212A	3C	1 290	27.05	4.1
Boeing	B717-200	3C	1 670	28.4	5.9

Aircraft make	*Model*	*Code*	*Aeroplane reference field length (m)*	*Wing span (m)*	*Outer main gear wheel span (m)*
	B737-600	3C	1 690	34.3	7.0
	B737-600[4]	3C	1 640	35.8	7.0
	B737-700	3C	1 610	34.3	7.0
	B737-700[4]	3C	1 600	35.8	7.0
Convair	240	3C	1 301	28.0	8.4
	440	3C	1 564	32.1	8.6
	580	3C	1 341	32.1	8.6
	600	3C	1 378	28.0	8.4
	640	3C	1 570	32.1	8.6
Douglas	DC3	3C	1 204	28.8	5.8
	DC4	3C	1 542	35.8	8.5
	DC6A/6B	3C	1 375	35.8	8.5
	DC9-20	3C	1 560	28.4	6.0
Embraer	EMB-120 ER	3C	1 481	19.8	6.6
Fokker	F27-500/600	3C	1 670	29.0	7.9
	F28-3000/4000	3C	1 640	25.1	5.8
	F28-6000	3C	1 400	25.1	5.8
	F50	3C	1 355	29.0	8.0
	F27 Mk500/600	3C	1 755	29.0	7.9
	F27 Mk050	3C	1 355	29.0	8.0
	F28 Mk3000/4000	3C	1 684	25.1	5.8
	F28 Mk0070	3C	1 673	28.1	6.0
McDonnell Douglas	MD-90	3C	1 800	32.9	6.2
	YS-11A-500/600	3C	1 310	32.00	8.60
SAAB	340A	3C	1 220	21.4	7.3
	340B	3C	1 220	22.8[3]	7.3
	SAAB 2000	3C	1 340	24.8	8.9
Antonov	AN70	3D	1 610	44.06	5.93
British Aerospace (BAe)	ATP	3D	1 540	30.6	9.3
de Havilland Canada	DHC5D	3D	1 471	29.3	10.2
Airbus	A300 B2	3D	1 676	44.8	10.9
Bombardier Aerospace	CRJ 100LR	4B	1 880	21.2	4.0
	CRJ 200LR	4B	1 850	21.2	4.0

Aircraft make	*Model*	*Code*	*Aeroplane reference field length (m)*	*Wing span (m)*	*Outer main gear wheel span (m)*
Dassault Aviation	Falcon 20-5 (Retrofit)	4B	1 859	16.3	3.7
	Falcon 20 Basic/D/E	4B	1 890[4]	16.3	3.95[4]
	Falcon 20-5 C/D/E	4B	1 920[4]	16.3	3.95[4]
Embraer	EMB-145 XR	4B	2 050	21.0	4.1
	EMB-145 LR	4B	2 269	20.0	4.1
Airbus	A319-100	4C	1 800	34.1	8.9
	A320-200	4C	2 025	34.1	8.9
	A321-200	4C	2 533	34.1	8.9
Antonov	AN26	4C	1 850	29.20	7.90
	AN26B	4C	2 200	29.20	7.90
	AN32B-100	4C	2 080	29.20	7.90
	AN74	4C	1 920	31.89	4.09
	AN74TK-100	4C	1 920	31.89	4.09
	AN74T-200	4C	2 130	31.89	4.09
	AN74TK-300	4C	2 200	31.89	4.09
	AN140	4C	1 880	24.51	3.68
	AN140-100	4C	1 970	25.51	3.68
	AN148-100B	4C	2 020	28.91	4.58
	AN148-100E	4C	2 060	28.91	4.58
	AN158[5]	4C	2 060	28.56	4.58
	AN168[5]	4C	2 060	28.91	4.58
British Aircraft Corp. (BAC)	1-11-200	4C	1 884	27.0	5.2
	1-11-300	4C	2 484	27.0	5.2
	1-11-400	4C	2 420	27.0	5.2
	1-11-475	4C	2 286	28.5	5.4
	1-11-500	4C	2 408	28.5	5.2
Boeing	B727-100	4C	2 502	32.9	6.9
	B727-200	4C	3 176	32.9	6.9
	B737-100	4C	2 499	28.4	6.4
	B737-200	4C	2 295	28.4	6.4
	B737-300	4C	2 170	28.9	6.4
	B737-400	4C	2 550	28.9	6.4
	B737-500	4C	2 470	28.9	6.4
	B737-700	4C	1 980	34.3	7.0
	B737-700[4]	4C	1 960	35.8	7.0
	B737-800	4C	2 090	34.3	7.0
	B737-800[4]	4C	2 010	35.8	7.0
	B737-900	4C	2 240	34.3	7.0
	B737-900ER[4]	4C	2 470	35.8	7.0

Aircraft make	*Model*	*Code*	*Aeroplane reference field length (m)*	*Wing span (m)*	*Outer main gear wheel span (m)*
Fokker	F100	4C	1 840	28.1	6.0
	F28 Mk0100	4C	1 977	28.1	6.0
	F28 Mk0100	4C	1 825	28.1	6.0
Gulfstream Aerospace	G V	4C	1 863	28.5	5.1
Douglas	DC9-10	4C	1 975	27.2	5.9
	DC9-15	4C	1 990	27.3	6.0
	DC9-20	4C	1 560	28.4	6.0
	DC9-30	4C	2 134	28.5	5.9
	DC9-40	4C	2 091	28.5	5.9
	DC9-50	4C	2 451	28.5	5.9
McDonnell Douglas	MD-81	4C	2 290	32.9	6.2
	MD-82	4C	2 280	32.9	6.2
	MD-83	4C	2 470	32.9	6.2
	MD-87	4C	2 260	32.9	6.2
	MD-88	4C	2 470	32.9	6.2
Airbus	A300B4-200	4D	2 727	44.8	11.1
	A300-600R	4D	2 279	44.8	11.1
	A310-300	4D	2 350	43.9	11.0
	A300 B4	4D	2 605	44.8	10.9
	A300-600	4D	2 332	44.8	10.9
	A310	4D	1 845	44.8	10.9
Antonov	AN12	4D	1 900	38.01	5.41
Boeing	B707-300	4D	3 088	44.4	7.9
	B707-400	4D	3 277	44.4	7.9
	B720	4D	1 981	39.9	7.5
	B767-200	4D	1 981	47.6	10.8
	B757-200	4D	1 980	38.0	8.6
	B757-300	4D	2 400	38.0	8.6
	B767-300ER	4D	2 540	47.6	10.9
	B767-400ER	4D	3 140	51.9	11.0
Canadair	CL44D-4	4D	2 240	43.4	10.5
Ilyushin	18V	4D	1 980	37.4	9.9
	62M	4D	3 280	43.2	8.0
Lockheed	L100-20	4D	1 829	40.8	4.9
	L100-30	4D	1 829	40.4	4.9
	L188	4D	2 066	30.2	10.5

Aircraft make	*Model*	*Code*	*Aeroplane reference field length (m)*	*Wing span (m)*	*Outer main gear wheel span (m)*
	L1011-1	4D	2 426	47.3	12.8
	L1011-100/200	4D	2 469	47.3	12.8
	L1011-500	4D	2 844	47.3	12.8
Douglas	DC8-61	4D	3 048	43.4	7.5
	DC8-62	4D	3 100	45.2	7.6
	DC8-63	4D	3 179	45.2	7.6
	DC8-71	4D	2 770	43.4	7.5
McDonnell Douglas	DC8-72	4D	2 980	45.2	7.6
	DC8-73	4D	3 050	45.2	7.6
	DC10-10	4D	3 200	47.4	12.6
	DC10-30	4D	3 170	50.4	12.6
	DC10-40	4D	3 124	50.4	12.6
Tupolev	TU134A	4D	2 400	29.0	10.3
	TU154	4D	2 160	37.6	12.4
Airbus	A330-200	4E	2 479	60.3	12.6
	A330-300	4E	2 490	60.3	12.6
	A340-200	4E	2 906	60.3	12.6
	A340-300	4E	2 993	60.3	12.6
	A340-500	4E	3 023	63.4	12.6
	A340-600	4E	2 864	63.4	12.6
Antonov	AN22	4E	3 120	64.41	7.43
Boeing	B747-100	4E	3 060	59.6	12.4
	B747-200	4E	3 150	59.6	12.4
	B747-300	4E	3 292	59.6	12.4
	B747-400	4E	2 890	64.9[4]	12.6
	B747-SR	4E	1 860	59.6	12.4
	B747-SP	4E	2 710	59.6	12.4
	B777-200	4E	2 390	61.0	12.9
	B777-200ER	4E	3 110	61.0	12.9
	B777-300	4E	3 140	60.9	12.9
	B777-300ER	4E	3 120	64.8	12.9
	B777-200	4E	2 380	60.9	12.9
	B777-200ER	4E	2 890	60.9	12.9
	B777-200LR	4E	3 390	64.8	12.9
	B777-300	4E	3 140	60.9	12.9
	B777-300ER	4E	3 060	64.8	12.9
	B787-8	4E	2 660	60.1	11.6
McDonnell Douglas	MD11	4E	3 130	52.0[4]	12. 6

Aircraft make	*Model*	*Code*	*Aeroplane reference field length (m)*	*Wing span (m)*	*Outer main gear wheel span (m)*
Airbus	A380	4F	3 350	79.8	14.3
	A380-800	4F	2 779	79.8	14.3
Antonov	AN124-100	4F	3 000	73.30	9.01
	AN124-100M-150	4F	3 200	73.30	9.01
	AN225	4F	3 430	88.40	9.01
Boeing	747-8/8F	4F	3 070	68.4	12.7

1. With wing tip tanks installed.
2. Over a 15-m obstacle.
3. With extended wing tips.
4. Winglets.
5. Preliminary data.

Note.— The values for aeroplane reference field lengths indicated in the fourth column of the table are not necessarily the maximum values arising from any combination of model/engine configurations.

Appendix 3

PLANNING CHART

The chart in Table A3-1 is intended to be used as a general review and guide to assist in the aircraft removal process. It is not anticipated to be used as step-by-step instructions in dealing with a removal event.

Table A3-1. Planning chart

Basic Recovery Steps				
1. Survey	*2. Plan*	*3. Prepare*	*4. Recover*	*5. Report*
Aircraft condition: – Recover or salvage – Attitude – Landing gear – Structure – Damaged components – Missing components – Unserviceable components – Cargo and fuel Site: – Terrain – Soil – Access routes Weather: – Current – Forecast Equipment availability: – Preparation – Levelling – Lifting – Moving – Stabilizing Manpower availability: – Number – Skills Environmental issues: – Fluid spills – Hazardous materials	Rapid recovery: – Important – Not important Weight and balance: – Calculate weight of fuel and cargo – Calculate centre of gravity Weight reduction: – Unload cargo – Defuel – Remove major components Recovery: – Reduce weight – Prepare site – Level – Lift – Stabilize – Move Schedule equipment and manpower required: – Confirm delivery plan Secondary damage: – Prevent or – Accept to reduce recovery time	Monitor and record: – Loads – Actions performed Assemble equipment and manpower: – Confirm arrival dates Weight reduction: – Unload cargo – Defuel – Remove major components Prepare site: – Clear – Excavate – Fill – Stabilize Roadway: – Clear – Excavate – Fill – Stabilize – Manufactured temporary roadway	Monitor and record: – Loads – Actions performed Stabilize: – Tether – Ground anchors – Jacks – Shoring Level/lift: – Jacks – Airbags – Cranes – New technology equipment Debogging: – Confirm a lifting method Move: – Tow on gear – Move on suitable trailer	Report: Include in aircraft technical history: – recovery details – repair details – record of loads

Appendix 4

THE AIRCRAFT REMOVAL TEAM

1. COMPOSITION OF THE AIRCRAFT REMOVAL TEAM

It is suggested that each aircraft operator develop a core group of personnel who will become responsible for any aircraft removal events related to the operator. The general recommendations for the team are:

a) that it be made up of volunteers from the aircraft maintenance department;

b) that each individual should possess a good technical background and have a strong interest in the aircraft removal process; and

c) those individuals that remain part of the removal team, even if they are promoted or moved to other internal departments, so that any experience gained is not lost.

2. THE REMOVAL TEAM MANAGER

Each removal team should have one member assigned as the manager to control the activities of the removal team and to oversee any recovery events. The manager should have clear lines of responsibility and decision-making authority. It is suggested that the manager meet the following requirements:

a) have experience as an aircraft maintenance production manager;

b) have experience and knowledge related to aircraft removal;

c) organize regular meetings and training sessions for the aircraft removal team; and

d) act as the interface between senior management, the aerodrome operator and the local and State authorities responsible for aircraft removal.

3. TEAM LEADERS

Depending on the size of the airline and the area to be covered, more than one team leader may be required. It is suggested that team leaders meet the following requirements:

a) have experience as an aircraft maintenance production team leader or foreman;

b) have good technical and leadership qualities;

c) have experience and knowledge of aircraft recovery;

d) have knowledge of equipment such as jacks, pneumatic lifting bags, cranes and their general operation;

e) report to the aircraft recovery manager regarding aircraft recovery events and issues;

f) control airline owned aircraft recovery equipment and ensure its serviceability;

f) make recommendations and suggestions related to the purchase of aircraft recovery equipment; and

h) supervise any on-site recovery processes.

4. STRUCTURES AND SYSTEMS ENGINEERS

Although engineers may not be included as part of the actual aircraft removal team, contact information should be available to the team. Structures and systems engineers will be able to assist as follows:

a) analyse aircraft damage;

b) prepare the drawings necessary for temporary repairs; and

c) assist the recovery manager and team leader with recovery-related decisions.

5. PLANNER OR PURCHASING AGENT

Although planning and purchasing agents may not be included as part of the actual aircraft removal team, contact information should be available to the team. Planner or purchasing agent will be able to assist as follows:

a) contract the required heavy equipment operators;

b) arrange shipment of the required recovery equipment whether available locally or with requirement to transport; and

c) organize leasing of other required equipment, hotels, transport, etc.

6. LICENSED AIRCRAFT TECHNICIANS

Although licensed aircraft technicians may not be included as part of the actual aircraft removal team, contact information should be available to the team. Licensed aircraft technicians will:

a) have a good technical background;

b) hold a valid aircraft maintenance licence for the specific aircraft types;

c) report to and assist the removal team leader; and

d) carry out specific maintenance tasks assigned by the team leader.

Appendix 5

AIRCRAFT REMOVAL PROCESS DOCUMENT

1. Aircraft operators should consider the preparation of an internal Aircraft Removal Process Document. This document would assist the airline by preparing them for any aircraft removal event, as it would contain full instructions on how to prepare for, organize and carry out a successful removal event.

2. The aircraft removal process document should provide detailed steps, beginning from the time of notification of the accident/incident to the aircraft's inspection at a repair facility. Suggested contents include the following:

a) an up-to-date list of the removal team manager, team leaders and other team members should include name, address, office, telephone, fax, pager and/or cell or mobile numbers. A process should be in place to ensure the list remains up to date;

b) a list of applicable aircraft that the team is responsible for may include aircraft owned or leased by the operator, aircraft from subsidiary airlines or other contracted aircraft;

c) clear procedures to follow when notified of an incident, including the requirement to record all relevant data;

d) a current list of applicable government agencies with contact names and telephone numbers;

e) recommendations on logistical preparations, including passport requirements, vaccinations and visas along with suggested contents of a personal "Go Kit";

f) a full list of the operator's support staff and contact numbers for assistance with different removal scenarios which may involve flight dispatch and weight and balance departments;

g) a current detailed list of all operator-owned removal equipment including location, container size and weight;

h) a current copy of the IATP equipment pools list showing the contents and location of their available removal kits, available at www.iatp.com (for registered users only);

i) a list of any recovery equipment owned by the various aerodrome operators that the airline operates out of and their storage locations;

j) a list of locally available general aircraft removal materials and equipment. In some cases, the aerodrome operator will maintain and update this listing (see Appendix 7 for a detailed list);

k) the ARMs for each fleet type the operator maintains; most ARMs are available in digital formats;

l) the sizes of all cargo compartment doors in the operator's fleet. This information will be helpful when it is necessary to transport equipment from one aerodrome to another; and

m) a list of relevant company-owned equipment for use during a removal event that may include the location, capacities and extended and compressed heights of lifting bags, slings and jacks;

Appendix 6

AIRCRAFT REMOVAL REPORT FORM

1. One of the most important tasks of aircraft removal incidents is the recording of data; therefore, it is suggested that some proforma be used for this purpose. An aircraft removal report form, with suggested contents, is shown below.

2. This form is designed for use by the aerodrome and/or aircraft operator to record information arising from the removal of a disabled aircraft. It does not replace any forms required by national regulations pertaining to the notification of an aircraft accident/incident in accordance with Annex 13 — *Aircraft Accident and Incident Investigation*.

Aircraft Removal Report Form

Operator: ____

Date of accident/incident: _____________________________ Time: ______________________________

Aerodrome: ____

Aircraft type including dash number: ____

Aircraft registration: ____

Part 1

a) Provide pictorial description of accident/incident showing plan view of aerodrome, buildings, runways and positions of all obstacles encountered during the incident.

b) Provide approximate location, trajectory of aircraft and final attitude of aircraft following incident.

c) Provide supporting photos, diagrams, etc.

Part 2

Provide a detailed written description of the accident/incident. Provide additional photos and diagrams, where necessary.

Part 3

Provide information on ground conditions and depths of wheel ruts. Provide supporting photos, diagrams, etc.

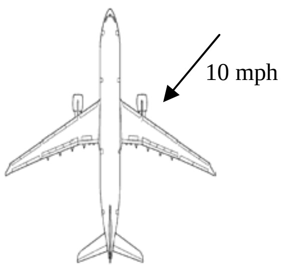
Part 4

Provide a diagram or photo of all nose-gear and main gear wheels. Identify which wheels are off the hard surface by circling the wheel.

Part 5

Provide wind direction and speed at time of accident/incident and at various intervals during the recovery process.

Example:



Part 6

a) Approximate aircraft weight: ____

b) Aircraft centre of gravity: __________ distance from datum *or* __________ per cent of mean aerodynamic chord (MAC)

c) Flight phase of aircraft at time of accident/incident (check appropriate phase): ____________________

☐ taxiing/manoeuvring ☐ take-off ☐ landing ☐ towing

d) Distance traversed off runway: ____

e) Runway/taxiway surface condition (check box or specify as appropriate):

☐ dry ☐ wet ☐ snow ☐ ice ☐ other: ___________________

f) Off-runway surface nature and conditions (check box or specify as appropriate):

i) Type of ground:

☐ sand ☐ clay ☐ stone ☐ other: ___________________

ii) Nature of surface: ☐ flat ☐ sloped

iii) Condition of ground:

☐ dry ☐ wet ☐ snow ☐ ice

☐ hard ☐ soft ☐ other: ___________________

iv) Provide details of weather conditions at time of accident/incident :

____

____

____

____

v) Visibility: ☐ day ☐ night ☐ clear ☐ reduced

vi) List obstacles traversed:

____

____

____

____

g) Resting attitude of aircraft off runway (check appropriate box):

Roll______ (degrees) ☐ to port ☐ to starboard

Roll______ (degrees) ☐ nose down ☐ nose up

Part 7

Provide full details of the recovery or debogging including all loads imposed.

____

Appendix 7

GENERAL AIRCRAFT REMOVAL MATERIALS AND EQUIPMENT

1. GENERAL

1.1 Based on past aircraft removal experiences, a list and description of materials and equipment has been compiled. These materials and equipment should be adjusted based on the largest aircraft in the fleet or, in the case of aerodrome operator, the t aircraft that may normally be expected to operate at the aerodrome. In general, NLA will require greater numbers of some types of materials and equipment, and load rated capacities will require higher limits.

1.2 This equipment should be readily available but not necessarily stored at the aerodrome. Contractors tend to have most of the required material stored in their equipment yards and assuming agreements have been made in advance, these items should be quite easily accessible. Usually, aerodrome operators have a large quantity of construction equipment and materials available for road building.

2. AIRCRAFT REMOVAL EQUIPMENT

The following list is intended as a guide for what may be required during a removal event. Various items may be substituted for locally available materials. The general types of equipment required include:

- removal equipment (weight reduction)
- levelling and supporting equipment
- tethering equipment
- ground reinforcement equipment
- lifting equipment
- moving equipment
- communication equipment
- shelter for personnel

3. AIRCRAFT REMOVAL MATERIALS AND EQUIPMENT DESCRIPTION AND USE

A short description of the materials and equipment and how they are used in a removal operation has follows:

Ballast bag:

— usually made of strong woven fiber (to be filled with sand or earth) for the purpose of providing a manageable receptacle for the contents;

— used to provide mass in situations where counterbalance is needed;

— can be used in many other ways, such as building a platform for levelling equipment; and

— if laid in brick-fashion, a stable but non-rigid structure can be built.

Plywood sheets (6 mm thick):

— versatile material with many uses, such as for protecting pneumatic lifting bags from damaged aircraft skin, minor protuberances and other areas with sharp and jagged edges;

— for use between aircraft skin and lifting or tethering cables to protect aircraft; and

— heavy woven matting or light gauge sheet metal might be considered as a substitute.

Plywood sheets (25 mm thick):

— thicker plywood used primarily for placement over soft earth to facilitate movement of aircraft or equipment.

Steel plates:

— intended for placement under jacks to increase bearing area;

— plate sizes of approximately 1.2 m × 2.4 m suitable for use on only very firm earth or thin pavement; and

— subsurface preparation may be required when jacking on soft earth.

Cribbing material:

— for the purpose of building platforms on which to place the pneumatic lifting bags. Essentially, a platform is constructed for each bag under the aircraft's wing to a height of within about 1 m of the lower wing skin. The exact dimensions depend on several factors such as the type of bag, type of aircraft, attitude and terrain;

— most versatile material that is widely available in most areas; and

— if not available in sufficient quantity at the aerodrome, other materials may be substituted such as concrete piles, concrete blocks, bricks, ballast bags filled with earth or any structure of sufficient strength and stability to serve as cribbing material.

Metal, plastic and fiberglass products:

— ground reinforcement;

— intended to provide a rolling surface over earth to permit the towing of aircraft; and

— reinforcing very soft terrain may require more elaborate preparations.

Note.— Plywood sheets and steel plates may perform the same purpose but will require additional quantities.

Crushed rock:

— used for filling and levelling areas for equipment access, jack or pneumatic bag placement, etc.

Concrete (quick set):

— intended for subsurface preparation for jacking or other concentrated earth load situations.

Note.— Ordinary concrete can be made to set quickly with the addition of calcium chloride or appropriate commercial preparations.

Drainage pump:

— for removal of water when excavation is required to prepare rolling or jacking surface.

Note.— May not be required in arid climates.

Earth anchors:

— provide stability and allow tethering of aircraft during the lifting process.

Note.— Adequate anchors can be made on site by using a bulldozer to bury a bundle of timbers attached with a tethering cable.

Cranes:

— in sufficient quantities and capacities to lift all or part of the affected aircraft; and

— may be self-propelled on crawler tracks or wheels.

Mobile multi-wheel flatbeds:

— usually procured from industrial movers of heavy equipment, such as transformers, turbines, bridges and buildings.

Steel cables:

— for towing or winching aircraft by attaching the cable to the main landing gear; and

— frequently used to tow undamaged aircraft from soft earth to pavement.

Carbon fiber loops:

— available in many lengths and strengths; and

— more widely used than steel cables for towing and winching.

Rope:

— for many miscellaneous uses.

Block and tackle:

— used as an alternative to winching or towing to move aircraft or to handle major detached pieces of aircraft.

Pulling/winching units:

— better control is obtained by winching from a stationary point or vehicle than conventional towing in an aircraft removal operation, which is usually not effective.

Tank:

— proper tank, if available, is ideal as a storage and disposal facility for offloaded fuel; and

— safety and ecological considerations may be involved in other temporary methods such as pumping into collapsible tanks.

Floodlights and generators:

— for illumination of aircraft removal site during night operations.

Communication equipment:

— telephone, two-way radio, cell/mobile phone, megaphones, etc., for communicating during actual aircraft lifting and movement between the several interrelated workstations; and

— hand-held radio transceivers or cell/mobile telephones may be a better alternative than megaphones.

Note.— Aerodrome complexity tends to determine the extent to which this must be provided and organized.

Area and terrain map:

— to indicate grades for the purpose of planning the towing of aircraft;

— to indicate subsurface structures such as buried pipes, soft unstable ground, recently excavated ground and electrical installations, which may be disturbed by excavation or towing.

Workshop trailer or tent:

— for use as on site workshop, field office, etc.

Note.— Some aerodromes have outfitted a large van with electrical power, desk and communication centre for immediate location at the site of a removal operation or similar emergency. Leased coaches can also be used for the same objective.

Grounding rod:

— provides an earthing/grounding point for the aircraft while defuelling and/or when other flammable hazards exist.

Fencing materials and signs:

— to demarcate and restrict the work area to those who are involved in the aircraft removal operation.

Tractor or bulldozer (or other earth-moving equipment):

— for uses such as moving earth and levelling terrain to make temporary roadways; and

— towing, tethering, etc.

Compressor:

— with manifold and connections to fit appropriate tools for drilling, sawing and other operations necessary to the removal operation.

Rotary or demolition saw:

— metal-cutting saw for clearing or removal of wreckage; and

— hydraulic, pneumatic, electric or engine driven.

Chain saws:

— useful for cutting timber.

Note.— Fire hazards are associated with the cutting operation as well as with the power source when using saws.

Bolt cutters, metal shearers, ladders and other basic tools:

— for miscellaneous uses.

4. QUANTITY AND DESCRIPTION OF OTHER RECOVERY EQUIPMENT AND MATERIALS

The suggested quantity and description of materials/equipment that may be required is as follows:

Quantity	*Description*
5 000 kg	ballast bags, maximum mass/bag should not exceed 25 kg
10	plywood sheets for padding 6 × 1 250 × 2 500 mm
50	plywood sheets for padding and ground reinforcement 20 or 25 ×1 250 × 2 500 mm
	steel plates for ground reinforcement
12	13 × 1 250 × 2 500 mm
12	26 × 1 250 × 2 500 mm
	cribbing material — compatible with two 40-tonne bags, five 25-tonne bags or equivalent
325	100 × 240 × 2 500 mm
130	100 × 240 × 3 500 mm
	cribbing material — compatible with six 25-tonne bags or equivalent
350	100 × 240 × 2 500 mm
150	100 × 240 × 3 500 mm
200	steel spikes (nails) for crib assembly
—	ground reinforcement mats or plates to lay five tracks, each a minimum 3-m wide and each 50- to 100-m long
10 m^3	crushed rock or gravel
10 m^3	concrete, quickset, for use in water environment
—	self-powered drainage pumps for water
5	earth anchors (dead weight), 9- to 13.5-tonne capacity (or heavy-duty sand-loaded trucks)
—	cranes, sufficient to lift part or all of affected aircraft, with personnel bucket, if available, for nose or tail lifting
—	mobile, multi-wheel, heavy-load flatbeds or special aircraft recovery trailers for moving aircraft without landing gear; number of units required depends on aircraft weight
4	steel cable assembly, 25 mm minimum diameter, complete with eyes and pear links at each end, 30–50 m (shackles to be provided by aircraft owner); heavier cable should be available for larger aircraft

Quantity	*Description*
300 m	rope, 25 mm in diameter
300 m	rope, 50 mm in diameter
2	multiple-strand block and tackle, 50-tonne pulling capacity
2	pulling/winching units, each 10-tonne minimum capacity (e.g. tractors category 2 or 3, winch-trucks, army tanks)
200 000 litres	storage capacity for offloaded fuel
1	self-powered floodlight generator, 10 kVA
10	floodlights with associated cables and stands
—	communication equipment for inter-aerodrome and base facilities and for city telephone network, as required
3	megaphones with self-contained amplifiers or similar
1	area elevation map with underground installations, showing soft, unstable ground/recently excavated ground
1	workshop trailer or tent providing storage facilities and shelter
1	3-m copper coated steel grounding rod with 20-m cable with clip
1 kit	fencing material and “Danger Keep Out” and “Smoking Prohibited” signs
1	equipment to move earth, e.g. bulldozer or equivalent (large)
1	equipment to move earth, e.g. bulldozer or equivalent (small)
1	self-powered compressor for operating tools of 6.9 kPa and 38 dm^3/s
1	air powered rotary saw
1 kit	bolt cutters, sheet metal shears
1 kit	basic tools, such as picks, shovels, crowbars, sledge hammers, hand-saws, etc.
2	ladders, lightweight, 6-m long
2	ladders, lightweight, 9-m long

5. QUANTITY AND DESCRIPTION OF SPECIALIZED AIRCRAFT REMOVAL EQUIPMENT

Quantity	*Description*
To be established on site	Various types of lifting devices of adequate capacities to lift aircraft that normally use the aerodrome. Other associated equipment necessary for their operations, such as compressors, air distribution equipment, hoses and protective pads, should be included.
1 kit	Lifting device of adequate capacity to lift aircraft that normally use the aerodrome (see Appendix 9).
1 set	Tethering equipment

Appendix 8

AIRCRAFT REMOVAL COST TEMPLATE

1. Increasingly, costs of certain operations are being requested. In an attempt to help capture the costs associated with an aircraft recovery event, an Aircraft Removal Cost Template has been developed. This template has been designed strictly as a guide.

2. The information required to capture direct costs includes:

a) labour man-hours involved in the recovery operation for the aircraft operator and any contracted assistance;

b) manager man-hours the aircraft operator has engaged in the recovery operation;

c) specific recovery equipment rentals, including either flat rate charges or the cost per day of leased or rented equipment such as IATP kits;

d) the cost of shipping or transporting any rented recovery kits;

e) emergency response clean-up, including outside emergency response clean-up companies contracted to contain or clean up fluid spills, or handle hazardous materials; and

f) returning the site to normal, including the cost of a general clean-up of the area, grading of the site and possible removal of materials used to build crane pads or roadways.

3. The information required to capture indirect costs includes:

a) environmental assessment, including inspections, core samples and assessment of the site for contamination due to fuel and hydraulic leaks and other related hazardous materials;

b) environmental clean-up, including the removal of any contaminated materials from the site; and

c) loss of aircraft use, cancellation of flights and diversion of flights due to runway closures, etc. Although this is difficult to obtain, it can be estimated.

4. The information required to capture aerodrome costs includes: loss of tenant revenue and landing fees due to passenger reductions during restrictive operations. See the following Aircraft Removal Cost Template to calculate the total costs.

AIRCRAFT REMOVAL COST TEMPLATE

Airline direct costs	*Man-hours*	*Cost $*	*Totals $*
Removal costs:			
Labour man-hours			
Manager man-hours			
Specific recovery equipment rental:			
– Flat rate			
– Per day			
– Shipping costs			
Heavy equipment rental:			
– Flat rate			
– Per day			
Emergency response clean-up, fuel spills			
Return incident site to normal			
Total direct costs			
Airline indirect costs			
Environmental assessment			
Environmental clean-up			
Loss of use of aircraft			
Cost of diversion of flights			
Reduction in flights due to runway closures			
Total indirect costs			
TOTAL AIRLINE REMOVAL COSTS			

Airport costs	*Cost $*
Flight reduction revenue loss	
Additional manpower costs	
Additional equipment costs	
TOTAL AIRPORT COSTS	

———————————

Appendix 9

INTERNATIONAL AIRLINE TECHNICAL POOL (IATP) RECOVERY KITS

1. Local airline representatives should have a clear definition of their responsibility and authority to enter into contracts for removal services, and aerodrome authorities should be made aware of these arrangements. General recovery equipment, such as hand tools, cranes and tugs, is usually available locally, and the vitally needed specialized lifting equipment is found at some locations around the world. With the advent of wide-body aircraft, IATA found it necessary to take preparatory measures to make such lifting equipment available on short notice on a worldwide basis. Because of the comparatively high cost of this equipment, attention was given to solving the problem of its provision at the least cost to the industry, consistent with adequate availability.

2. The IATP provides a number of aircraft recovery kits at strategic locations around the world. Currently there are ten of these kits, and they are maintained by provider airlines. These kits are funded by a fee charged to each airline per landing at each specific aerodrome. Initial incorporation of these kits at certain aerodromes was based on the large initial cost required to purchase the equipment and reluctance by individual airlines to purchase their own. This pool format allows the cost to be shared by a large group of operators. Current locations of the kits and their providers are given below:

City/country	*3-letter airport code*	*Airline*
London, England	LHR	British Airways
Paris, France	ORY	Air France
Johannesburg, South Africa	JNB	South African Airways
Tokyo, Japan	NRT	Japan Airlines
New York, USA	JFK	Delta Airlines
Chicago, USA	ORD	American Airlines
Los Angeles, USA	LAX	American Airlines
Honolulu, USA	HNL	United Airlines
Sydney, Australia	SYD	Qantas Airlines
Mumbai, India	BOM	Air India

3. These kits are available not only to the pool member airlines but also to any other suffering party upon request, on a fee-paying basis. If the suffering operator is not a member of IATP, there will be a substantial charge for the user of the kit. The responsibility for transporting a kit from its pool location to where it is required lies with the suffering aircraft operator.

4. Experience indicates that the time spent after an accident for government investigation, obtaining permission from the insurance company (almost all insurance policies contain a clause indicating that, in the case of an aircraft incident or accident, the airline must inform the insurance company who will then give permission to proceed further), defuelling of the aircraft, mass reducing, providing access roads to the accident site, collecting general recovery equipment from local sources, etc., may easily amount to 20 hours or more, particularly in the case of larger aircraft types. All the recovery kits are kept in a state of preparedness for immediate shipment, and, in most cases, it should be possible to transport a kit by air from the nearest location to the accident/incident site in time for commencement of the lifting operation.

5. A kit from one of the pool locations can be transported to any airport in the world where it may be required, within five or six hours to a maximum of ten hours. Since it may take up to 20 hours, as described in paragraph 4, before the kit can be used, it would appear that the operation of the airport will not be hindered by the unavailability of this specialized equipment.

6. Where airline pooling arrangements exist at an airport, it is desirable that the disabled aircraft removal plan for that airport include a list of the contact points for the IATP pool.

7. Further information on IATP recovery kits is available at http://www.iatp.com.

Appendix 10

QUALIFICATIONS OF RECOVERY PERSONNEL

In today's industry, the requirement for personnel managing aircraft removal accidents/incidents to possess a level of experience, training and proficiency that allows them to control a successful aircraft removal operation without causing secondary damage to the aircraft is of increasing importance. Aircraft leasing companies and insurance underwriters now request that only qualified managers direct and control the removal process. Personnel qualifications may consist of experience and/or training in the field of aircraft removal/recovery. As this is a very complicated issue, it is suggested that individual operators develop their own qualification process.

Appendix 11

UNITS OF MEASURE — CONVERSION TABLE

	Multiply	By	To obtain
Length	Metres (m)	39.37008	Inches (in)
	Metres (m)	3.280840	Feet (ft)
	Millimetres (mm)	0.03937008	Inches (in)
	Millimetres (mm)	0.00328084	Feet (ft)
	Inches (in)	0.0254	Metres (m)
	Inches (in)	25.4	Millimetres (mm)
	Feet (ft)	0.3048	Metres (m)
	Feet (ft)	304.8	Millimetres (mm)
Area	Square metres (m^2)	10.763910	Square feet (ft^2)
	Square feet (ft^2)	0.09290304	Square metres (m^2)
Volume	Cubic metres (m^3)	35.31466	Cubic feet (ft^3)
	Cubic feet (ft^3)	0.02831685	Cubic metres (m^3)
Weight	Kilograms (kg)	2.204622	Pounds (lb)
	Pounds (lb)	0.4535924	Kilograms (kg)
Pressure	Pascals (Pa)	0.000145037	Pounds per square inch (psi)
	Bars (bar)	14.50377	Pounds per square inch (psi)
	Pounds per square inch (psi)	6894.757	Pascals (pa)
	Pounds per square inch (psi)	0.06894757	Bars (bar)
Velocity	Metres per second (m/s)	3.2808399	Feet per second (ft/s)
	Metres per second (m/s)	2.2369	Miles per hour (mph)
	Kilometres per hour (km/h)	0.9113	Feet per second (ft/s)
	Kilometres per hour (km/h)	0.6214	Miles per hour (mph)
	Feet per second (ft/s)	0.3048	Metres per second (m/s)
	Feet per second (ft/s)	1.0973	Kilometres per hour (km/h)
	Miles per hour (mph)	0.4470	Metres per second (m/s)
	Miles per hour (mph)	1.6093	Kilometres per hour (km/h)
Capacity	Litres (l)	0.264172	US gallons (gal)
Quantity	US gallons (gal)	3.785412	Litres (l)
Temperature conversion	Degrees Celsius (C)	1.8 x C + 32	degrees Fahrenheit (F)
	Degrees Fahrenheit (F)	0.5555 x (F – 32)	degrees Celsius (C)

— END —