DE HAVILLAND AIRCRAFT OF CANADA LIMITED

DHC – 8 SERIES 400

AIRCRAFT RECOVERY MANUAL

PSM 1-84-9

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The following Temporary Revisions are effective in your manual at Revision 7 dated Mar 05, 2022

TR NO.	Chapter/Section/Subject	DATE

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TRANSMITTAL LETTER

REVISION 7

This package contains Revision 7 to the Dash 8 Series 400 Aircraft Recovery Manual (ARM), PSM 1–84–9, dated Mar 05/2022.

This revisions is a full issue of the manual in its entirety, due to the word “Master” being removed from all pages of the Manual.

It is recommended this Transmittal Letter be retained in the front of the manual for record purposes.

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DE HAVILLAND AIRCRAFT
OF CANADA LIMITED

DHC–8 Series 400

AIRCRAFT RECOVERY MANUAL

PSM 1–84–9

DE HAVILLAND AIRCRAFT OF CANADA LIMITED

123 GARRATT BLVD., TORONTO, ONTARIO
CANADA M3K 1Y5

Initial Issue: Apr 30/1999
Revision 7: Mar 05/2022

AIRCRAFT RECOVERY MANUAL

IMPORTANT MESSAGE TO USERS OF THIS DOCUMENT

The generalized recovery techniques and methods described in this document are intended only for general planning purposes and to illustrate the use of special recovery equipment and procedures for the Dash–8, Series 400 aircraft.

The data presented in this document was calculated for hypothetical aircraft conditions or for specific conditions which have occurred in the past. Because every situation that requires recovery is unique, the recovery method appropriate to a particular situation will depend on the circumstances and the available recovery equipment.

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Publication Information

*Aircraft Type:		*Aircraft Model:	*PSM:
*Publication Name/Revision:	*Media Type: ☐Paper ☐DVD ☐CD–ROM ☐Web	*Chapter/Section/Subject/Task (or) Page Block/Page Number:	
Originator's reference number:		Impact on other programs:	

*Description of Change Request:

Reason for change:

Reference data provided: ☐ Yes ☐ No Description:

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Revision No.	Issue Date	Date Inserted	Inserted By
Initial Issue	Apr 30/1999	Apr 30/1999	BCSG
1	Jul 17/2000	Jul 17/2000	BCSG
2	Apr 05, 2005	Apr 05, 2005	BCSG
3	Nov 05/2014	Nov 04/2014	BCSG
4	Dec 05/2016	Dec 05/2016	BCSG
5	Apr 05/2019	Apr 05/2019	BCSG
6	Mar 05/2021	Mar 05/2021	DHTP
7	Mar 05/2022	Mar 05/2022	DHTP

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AIRCRAFT RECOVERY MANUAL

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AIRCRAFT RECOVERY MANUAL

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AIRCRAFT RECOVERY MANUAL

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DE HAVILLAND AIRCRAFT
OF CANADA LIMITED

AIRCRAFT RECOVERY MANUAL

TABLE OF CONTENTS

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Introduction

Organization

1. This manual conforms in general to ATA Specification No. 100, Revision 34, dated Feb. 15/96.

Content

2. The Aircraft Recovery Manual describes the aircraft recovery procedures for the Dash–8 Series 400 aircraft and contains the items that follow:

   – Equipment and tooling requirements

   – Procedures to lift, shore and recover the aircraft from the most abnormal conditions to which it may be subjected.

3. This manual contains information, in sufficient detail, to recover an aircraft in the most expeditious manner, while maintaining consideration of recovery personnel safety and the prevention of additional damage to the aircraft.

   NOTE: It is recommended that before any recovery operation begins the In–Service Structures Engineering Group of De Havilland Aircraft of Canada Limited be contacted through the Technical Help Desk at (416) 375–4000.

Using this Manual

4. Organization of Chapters

   a. The chapters are allocated in accordance with ATA Specification No. 100.

5. Chapter Breakdown

   a. Each Chapter is divided into sections and, where necessary, each section into subjects. These three elements (Chapter – Section – Subject) are allocated numbers which are located on the lower right–hand corner of each page. An example of a three–element number is shown in Figure 1.

6. Page Number

   a. Page numbers start with number one for each new Chapter/Section/Subject breakdown and the pages are numbered consecutively thereafter through the material written on the subject.

7. List of Effective Pages

   a. In order that users can establish that a Chapter is complete, and whether it contains the latest issue of all pages, a List of Effective Pages (LOEP) is located at the front of each Chapter (immediately following the chapter divider card). On each List, the date against each page number should correspond with the date on the relevant page.

Associated Manuals

8. Throughout this manual, cross references are made to other publications. The table that follows shows the associated manuals.

DASH–8 SERIES 400 PUBLICATIONS

MANUAL	PSM #
FLIGHT CREW OPERATING MANUAL (FCOM)	1–84–1
AIRPLANE FLIGHT MANUAL (AFM)	1–84–1A
AIRCRAFT MAINTENANCE MANUAL (AMM) (INCLUDES PWC MAINT. MANUAL)	1–84–2
RAMP SERVICING MANUAL (RSM)	1–84–2S
ILLUSTRATED TOOL AND EQUIPMENT MANUAL (ITEM)	1–84–2T
WIRING DIAGRAM MANUAL (WDM)	1–84–2W
STRUCTURAL REPAIR MANUAL (SRM)	1–84–3
COMPONENT MAINTENCE MANUAL (CMM)	1–84–6
MAINTENANCE REQUIREMENTS MANUAL (MRM)	1–84–7
NON–DESTRUCTIVE TEST MANUAL (NDT)	1–84–7A
WEIGHT AND BALANCE MANUAL (WBM)	1–84–8
CARGO LOADING MANUAL (CLM)	1–84–8A
POWER PLANT BUILD–UP MANUAL (PPBM)	1–84–10
MODS AND OPTIONS MANUAL	1–813–12

Revisions

9. Normal Revisions

   a. Revisions are made to this manual when new data is developed or when industry experience dictates revisions to the content. Qualified holders will receive copies without request.

10. Temporary Revisions

    a. Temporary Revisions are issued at the earliest opportunity to notify the operator of important changes that affect recovery procedures for the aircraft. These revisions are printed on yellow paper for instant identification when inserted in the manual.

Reference Information

11. Throughout this manual, Metric equivalents are assigned to numerical values that are in English units. Metric equivalents are shown in parentheses located next to or below the English unit. Where none are shown, but are desired by the user, charts and equivalents are provided in this Introduction.

12. Body coordinates (ie. body stations, buttock and water lines) are maintained in their original form. These are in inches and are referenced as such in this manual. However, for measurement purposes, dimension lines are extensively provided with the corresponding Metric equivalents.

English–Metric Conversions

13. Refer to Figure 2.

Other Useful Conversion Factors

14. Some conversion factors and equivalents which are useful, but not included, in the English–Metric Conversion illustrations, are shown in the tables that follows.

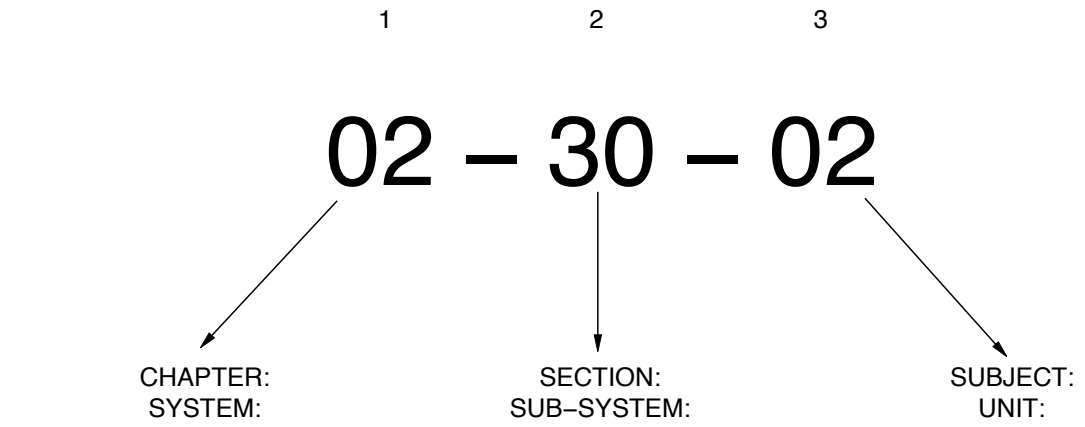
OTHER USEFUL CONVERSION FACTORS

FACTOR	MULTIPLY BY	TO OBTAIN
7.48	CUBIC FEET	GALLONS (U.S.)
3.785	GALLONS (U.S.)	LITERS
28.317	CUBIC FOOT/MIN.	LITERS/MIN.
1.15	KNOTS	MILES PER HOUR
3415	KW–HR.	BTU PER HOUR

EQUIVALENTS

ITEM	WEIGHT
FUEL, JET A	6.74 LBS/U.S. GALLON
FUEL, JP–4	6.55 LBS/U.S. GALLON
WATER	8.345 LBS/U.S. GALLON AT 62° F
	62.35 LBS/CU. FT. AT 62° F

ELEMENTS



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CHAPTER BREAKDOWN

Figure 1

LIQUID MEASURE:

U.S. Quarts / Liters	U.S. Gallons / Liters
1 qt = 0.9463 liters	1 gal = 3.785 liters
1 liter = 1.057 qts.	1 liter = 0.2642 gals

VELOCITY:

Miles/Hour / Kilometers/Hr.	Knots / Kilometers/Hr.
1 m.p.h. = 1.609 km/hr.	1 Kn. = 1.8532 Km/hr.
1 km/hr = 0.6214 m.p.h.	1 Kn/hr = 0.5396 Km.

PRESSURE:

Pounds/inch^2 / Kilogms/Centmtr^2	Pounds/foot^2 / Kilograms/meter^2
1 p.s.i. = 0.0703 kg/cm^2	1 p.s.f. = 4.882 kg/m^2
1 kg/cm^2 = 14.22 p.s.i.	1 kg/m^2 = 0.2048 p.s.f.

RATE:

Pounds/minute / Kilogram/minute	Gallons/minute / Liters/minute
1 lb/min = 0.4536 kg/min	1 g.p.m = 3.785 l/min.
1 kg/min = 2.204 lb/min	1 l/min = 0.2642 g.p.m.

TEMP:

Fahrenheit / Centigrade

$^\circ C = 5/9 (^\circ F - 32^\circ)$

$^\circ F = 9/5\ ^\circ C + 32^\circ$

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ENGLISH – METRIC CONVERSIONS (Sheet 1 of 2)

Figure 2

LINEAR MEASURE:

Inches / Centimeters	Feet / Meters
1 in = 2.54 cm	1 ft = 0.3048 m
1 cm = 0.3937 in	1 m = 3.281 ft.

Miles / Kilometers	Nautical Miles / Kilometers
1 mi = 1.609 km.	1 N.mi = 1.8532 km.
1 km = 0.6214 mi.	1 km = 0.5396 N.mi.

AREA:

$Inches^2$ / $Centimeters^2$	$Feet^2$ / $Meters^2$
$1\ in^2 = 6.452\ cm^2$	$1\ ft^2 = 0.0929\ m^2$
$1\ cm^2 = 0.155\ in^2$	$1\ m^2 = 10.76\ ft^2$

VOLUME:

$Inches^3$ / $Centimeters^3$	$Feet^3$ / $Meters^3$
$1\ in^3 = 16.39\ cm^3$	$1\ ft^3 = 0.0283\ m^3$
$1\ cm^3 = 0.061\ in^3$	$1\ m^3 = 35.31\ ft^3$

WEIGHT:

Pounds / Kilograms	Tons / Metric Tons
1 lb = 0.4536 kgs.	1T = 0.907 metric ton
1 kg = 2.205 lb.	1 metric ton = 1.102 T

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ENGLISH – METRIC CONVERSIONS (Sheet 2 of 2)

Figure 2

Technical Publications
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DE HAVILLAND AIRCRAFT
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AIRCRAFT RECOVERY MANUAL

CHAPTER 01

GENERAL

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AIRCRAFT RECOVERY MANUAL

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AIRCRAFT GENERAL

1. General

A. The Dash−8 Series 400 aircraft is a metal high−wing monoplane with these features:

- Fully cantilevered wings and horizontal stabilizer surfaces
- A semi−monocoque fuselage
- Fully retractable tricycle landing−gear.

B. The Series 400 is powered by two Pratt and Whitney PW150A turboprop engines. Large diameter, constant speed, variable and reversible six−bladed Dowty R408 propellers provide high thrust efficiency and low noise.

C. This aircraft is designed for short and medium−range passenger transportation, under day or night all−weather conditions. The Dash−8 Series 400 is air conditioned and pressurized for passenger flights up to 25,000 ft (7620 m) or 27,000 ft (optional) (8300 m) and is equipped with airframe and propeller deicing. The required flight crew is a pilot, a copilot and two flight attendants to service up to 90 passengers. The maximum structural weight limits are shown in the table below.

MAXIMUM STRUCTURAL WEIGHTS			
Weight	**Basic Gross Weight MS 4−201539**	**Intermediate Gross Weight MS 4−308807**	**High Gross Weight MS 4−308907**
Max. Ramp Weight	61,900 lb (28,077 kg)	64,130 lb (29,089 kg)	64,700 lb (29,347 kg)
Max Take−off Weight	61,700 lb (27,987 kg)	63,930 lb (28,998 kg)	64,500 lb (29,257 kg)
Max Landing Weight	60,500 lb (27,442 kg)	61,750 lb (28,009 kg)	61,750 lb (28,009 kg)
Max Zero Fuel Weight	55,500 lb (25,174 kg)	57,000 lb (25,855 kg)	57,000 lb (25,855 kg)

D. The following definitions and terms are used in the table above.

(1) Maximum Ramp (Taxi) Weight

(a) This is the maximum weight at which an aircraft can safely move on the ground.

(Maximum Ramp Weight = Maximum Takeoff Weight + Fuel allowance for taxi)

(2) Maximum Takeoff Weight (Gross Weight)

(a) This is the maximum allowable weight for the aircraft at the start of a takeoff run. The takeoff weight for a particular flight may be reduced by factors such as field altitude and/or temperature, and available runway length or obstacle clearance requirements (refer to the appropriate AFM).

(Maximum Take−off Weight = Operational Weight Empty + Payload + Fuel)

(3) Maximum Landing Weight

(a) This is the maximum allowable weight at which the aircraft can land. The landing weight may be reduced by factors such as available landing–runway length, etc. (refer to the appropriate Aircraft Flight Manual (AFM)).

(4) Maximum Zero Fuel Weight

(a) This is the maximum weight permitted for the aircraft before the fuel load is added.

(Maximum Zero Fuel Weight = Operational Weight Empty + Payload)

2. Fuselage

A. The fuselage consists of four main sections: Nose, Forward Center, Middle Center and Aft Center. The basic structure is of conventional all–metal construction that uses high–strength aluminum alloy (2024 and 7075) frames, stringers, doublers and chemical milled skin.

(1) Nose Section

(a) The nose section extends rearward to the fuselage forward center section, from Sta. X –155.000 to X –19.850. It contains the flight compartment, which is separated from the main cabin by a bulkhead with a lockable door. An emergency exit is provided in the canopy roof of the flight compartment by means of a removable hatch. This hatch also provides ventilation when on the ground.

(b) The forward pressure bulkhead is located between Sta. X –111.000 and X –98.000. The area forward of the bulkhead contains the unpressurized equipment compartment and supports the nose cone and radar unit. The nose landing gear and the nosewheel well are located below the equipment compartment.

(2) Forward Center Section

(a) The forward center section extends from the nose section (Sta. X –18.425) to the mid–center section (Sta. X 234.475). The forward center section is a constant circular cross–section of 106 in. (2.69 m) outside diameter, with a flattened bottom of larger radius. Floor loads are supported by the seat rails and frames.

(b) The forward passenger (airstair) door is 30.0 in. (0.76 m) wide and 69.7 in. (1.65 m) high and is located on the forward left–hand side of the fuselage.

(c) The forward baggage compartment has a capacity of approximately 91 cubic feet (2.58 cubic meters) (or 51 cubic feet (1.44 cubic meters) and 135 cubic feet (3.82 cubic meters) optional) and is located immediately aft of the lavatory, on the right hand side. It is accessible through a lockable door in the cabin and from an external door 24.0 in. (0.61 m) wide by 54.0 in. (1.37 m) high. The weight capacity of this compartment is approximately 910 lb (413 kg) for the 91 cubic foot version.

NOTE: The forward baggage compartment is removed to accommodate the

additional passenger seats for the extra capacity and cargo combi configurations.

NOTE: The forward Type I emergency exit door is installed in lieu of forward baggage door for the extra capacity and cargo combi configurations.

(d) A Type I emergency exit door is 24.0 in. (0.61 m) wide and 65.0 in. (1.65 m) high and is located on the forward right–hand side of the fuselage of the passenger compartment for the extra capacity configuration aircraft.

(e) A Type II/III emergency exit is located on the right–hand side of the fuselage, opposite the airstair door. The emergency exit door is constructed of an upper and lower door. In the event of an emergency ditching procedure, the lower door is kept closed during passenger evacuation.

NOTE: A Type II/III emergency exit door is de–activated for the extra capacity and cargo combi configurations.

(f) A Type III emergency exit door is 21.00 in. (0.53 m) wide and 46.59 in. (1.18 m) high and is located one on each side of the fuselage, at Sta. X479.70 of the passenger compartment for the cargo combi configuration aircraft.

(3) Middle Center Fuselage

(a) The middle center section extends from the forward center section (Sta. X 234.475) to the aft center section (Sta. X 566.025). The middle center section is a constant circular cross–section of 106 in. (2.69 m) outside diameter, with a flattened bottom of larger radius.

(b) The wing structure is attached to fittings on the middle center section with tension bolts. Floor loads are supported by the seat rails and frames.

(c) Ice shields are installed on the left and right side of the middle center fuselage. These ice shields are installed on the plane of the propellers, to protect the fuselage pressure shell from damage due to the impact of ice thrown from the propellers.

(4) Aft Center Fuselage

(a) The aft center section extends from the middle center section (Sta. X 566.025) to the aft (tail) fuselage section (Sta. X 829.548/836.452). Floor loads are supported by the seat rails and frames.

(b) The aft passenger door is 24.0 in. (0.61 m) wide and 65.0 in. (1.65 m) high and is located on the left–hand side of the rear fuselage. A service door 24.0 in. (0.61 m) wide and 54.0 in. (1.37 m) high is located on the right–hand side of the rear fuselage, opposite the aft passenger door.

NOTE: The aft passenger door is de–activated for the aircraft with cargo combi configuration.

NOTE: The forward baggage door is installed in lieu of a aft service door and de–activated permanently for the cargo combi configuration aircraft.

(c) The aft baggage compartment is located at the rear of this section and has a capacity of approximately 411 cubic feet (11.64 cubic meters) (or 365 cubic feet (10.34 cubic meters) optional). This compartment is accessible through an external door 53.2 in. (1.35 m) wide by 56.4 in. (1.43 m) high on the left–hand side. The weight capacity of this compartment is approximately 3500 lb (1588 kg) for the 411 cubic foot version.

NOTE: For the cargo combi configuration, the aft baggage compartment is extended up to the station X586.00. The volume of the aft cargo compartment is increased to 828 cubic feet (23.45 cubic meters).

(5) Aft (Tail) Fuselage

(a) The aft fuselage section extends from the rear pressure bulkhead (Sta. 829.548/836.452) to the trailing edge of the horizontal stabilizer (Sta. X 1114.557). This section consists of the integral vertical stabilizer and dorsal fin. The lower portions of the three stabilizer spars extend downwards to form the main frames of the rear fuselage. The area between the front and center frame serves as an equipment bay for the air cycle machine. Access is provided by an access panel in the bottom of the fuselage, aft of the center frame.

(6) Floor Panels

(a) The cabin floor panels are removable. Each panel is a sandwich construction that consists of five laminates of epoxy–impregnated organic–fiber (carbon fiber) cloth with a phenolic–coated, fibrous–nylon honeycomb core.

(b) The baggage–compartment floor panels (from the bulkhead to the step) are approximately 0.60 in. (15.2 mm) thick and are constructed of aluminum–alloy top and bottom skins, with a balsa core.

(c) The floor aft of the step is a composite construction with three laminates on the upper surface and two on the lower surface.

3. Landing Gear

A. The retractable landing gear consists of two main gear assemblies, one installed in each nacelle, and a nose gear assembly installed in a well in the nose section. Both main and nose gear assemblies incorporate shock struts and dual wheels, and are fully enclosed by doors when retracted.

B. On both main and nose gear assemblies the doors close after extension of the gear to give protection against debris. Disc brakes at each main wheel are hydraulically operated through anti–skid units. The nose wheels are steered hydraulically.

C. The main gear assemblies retract rearward and the nose gear assembly retract forward. Normal extension and retraction are hydraulically actuated by the No. 2 main hydraulic system (refer to the Aircraft Maintenance Manual, PSM 1–84–2, Ch. 32).

4. Wings

   A. The wing is a single, high–aspect ratio, cantilevered unit, attached at its center to the center middle fuselage. The wing incorporates integral fuel tanks, nacelle mounting structures, ailerons, flaps and spoilers. The sections of the wing that are outboard of the engine nacelles are tapered and have a dihedral angle of 2.5°.

5. Fuel

   A. Fuel is contained in two integral fuel tanks which extend from Sta. YW 42 to Sta. YW 407 (surge bay extends from Sta. YW 407 to Sta. YW 425) spanwise, and from front to rear spar (chordwise). Each tank supplies fuel to its individual engine. The fuel level in the tanks is balanced through inter–tank transfer.

   B. Fuel from each tank is fed to its engine by an engine–feed pumping system contained in a collector bay at the inner end of the tank. A collector–bay pumping system maintains the level of fuel in the collector bay and provides engine feed regardless of aircraft attitude. Each tank is vented to independent surge bays in the outboard wing by a vent line and a vent float valve.

   C. Pressure refueling and defueling is accomplished through a single–point refuel/defuel adapter. It is located in the right nacelle and is controlled from an adjacent refuel/defuel control panel. Each tank can also be filled through an overwing filler point. Refer to AMM Ch. 12 for more information on refuel/defuel procedures.

   D. Each tank has its own capacitance–type fuel–quantity indicating system, which provides an input to help control fuel levels during pressure refueling/defueling. Low–level warnings are also provided for each fuel tank.

   E. Drain valves are located at the low points of the collector and surge tanks and allow any collected sediment and water to be drained. Refer to AMM Ch. 28 for more information about the fuel system.

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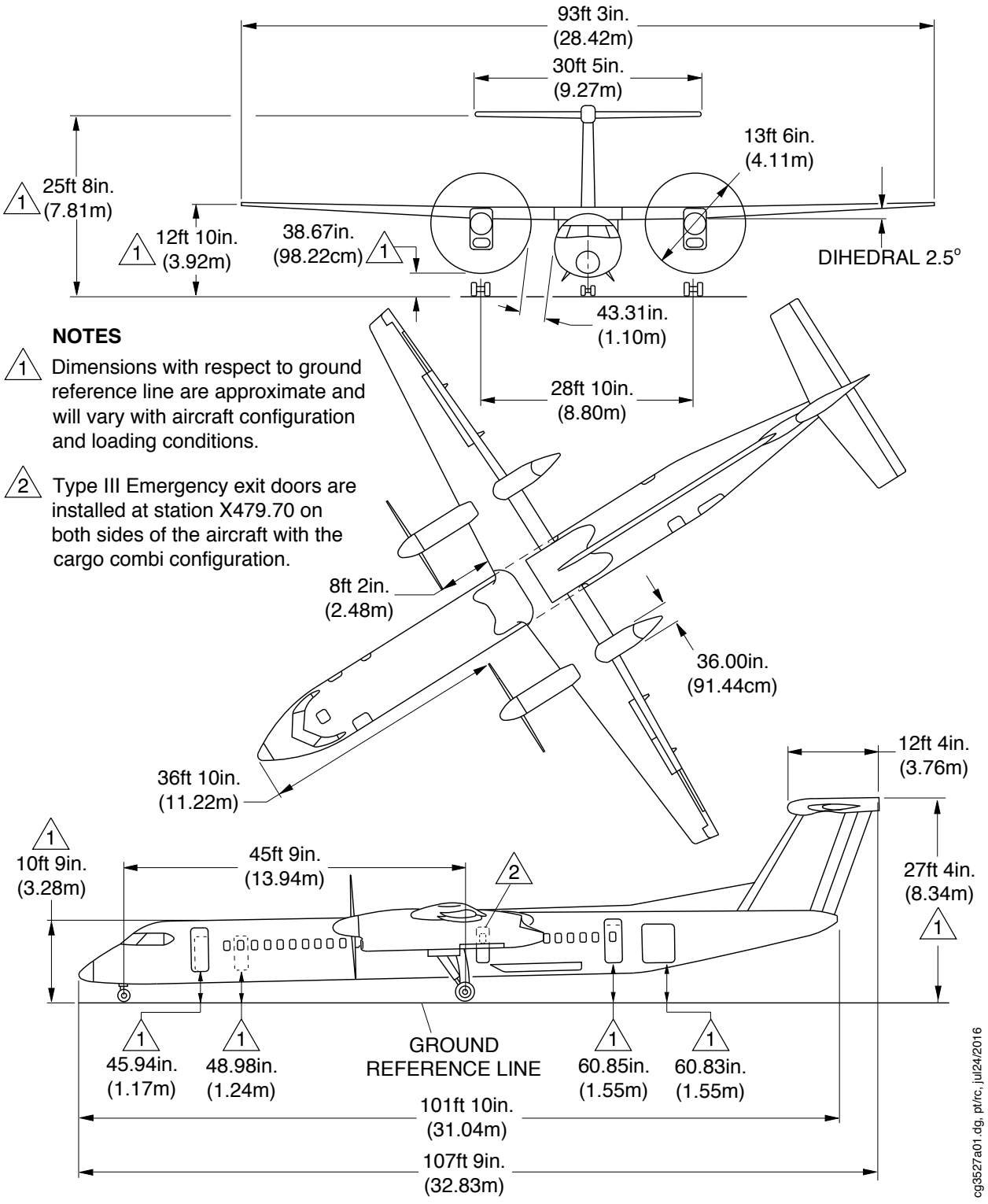
AIRCRAFT DIMENSIONS

1. Dimensions and Areas

   A. Refer to Figure 01–1 and Figure 01–2.

DIMENSIONS AND AREAS OF THE DASH–8, SERIES 400

Wing Area (Nominal)	679 sq. ft (63.1 sq. m)
Root Chord (Basic)	10 ft 1.258 in. (3080 mm)
Tip Chord	3 ft 10.591 in. (1183 mm)
Taper Ratio	0.38
Incidence –Root –Tip	 +2° –1°
Dihedral (Outboard of Nacelles)	2.5°
1/4 Chord Sweepback –Inner Wing –Outer Wing	 3.36° 3.03°
Aspect Ratio	12.806
Control Surfaces –Horizontal Tail Area (Total) –Vertical Tail Area (Total)	 180 sq. ft (16.73 sq. m) 152 sq. ft (14.13 sq. m)

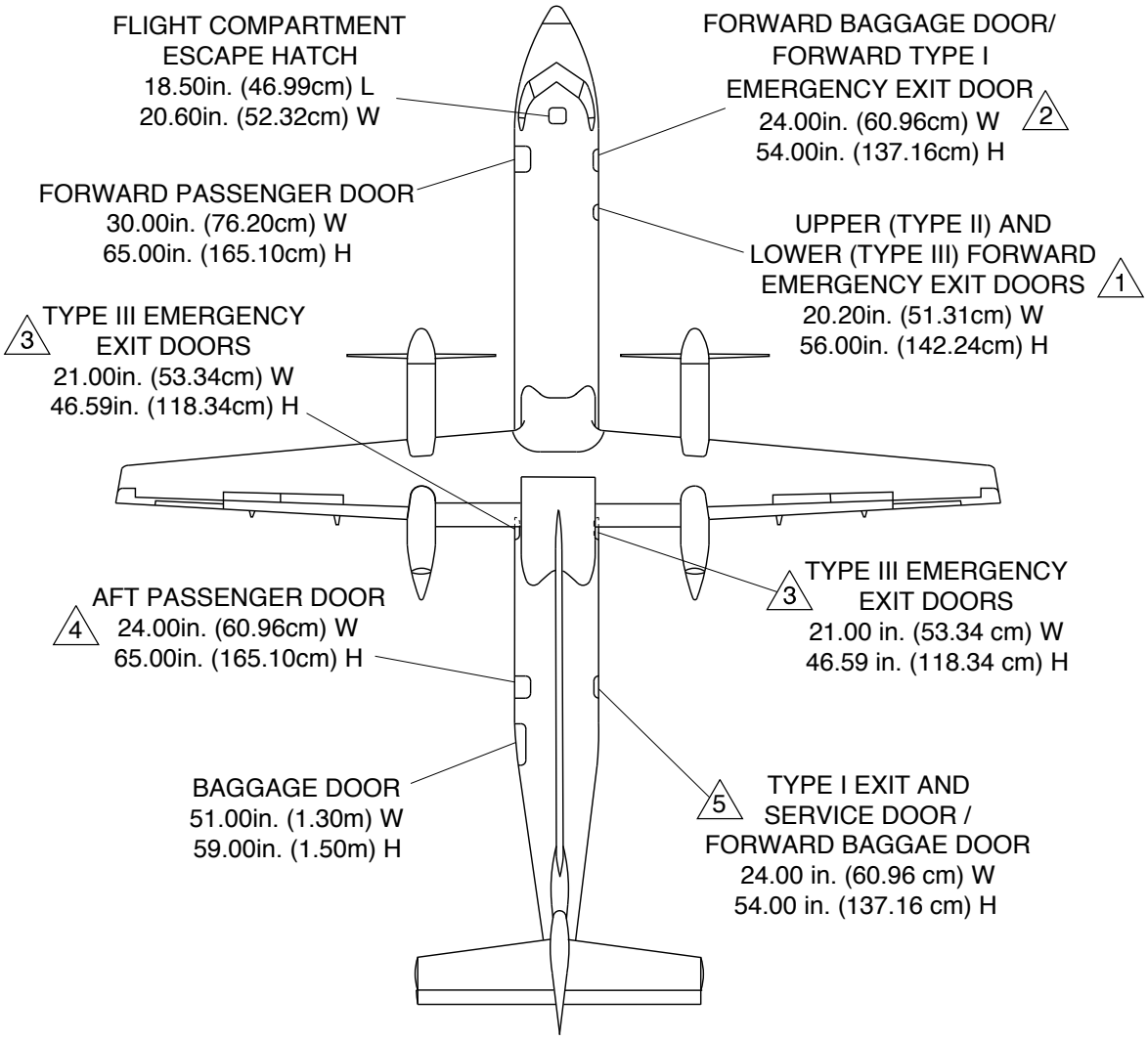


NOTES

1. Dimensions with respect to ground reference line are approximate and will vary with aircraft configuration and loading conditions.
2. Type III Emergency exit doors are installed at station X479.70 on both sides of the aircraft with the cargo combi configuration.

AIRCRAFT DIMENSIONS (Sheet 1 of 2)

Figure 01 – 1



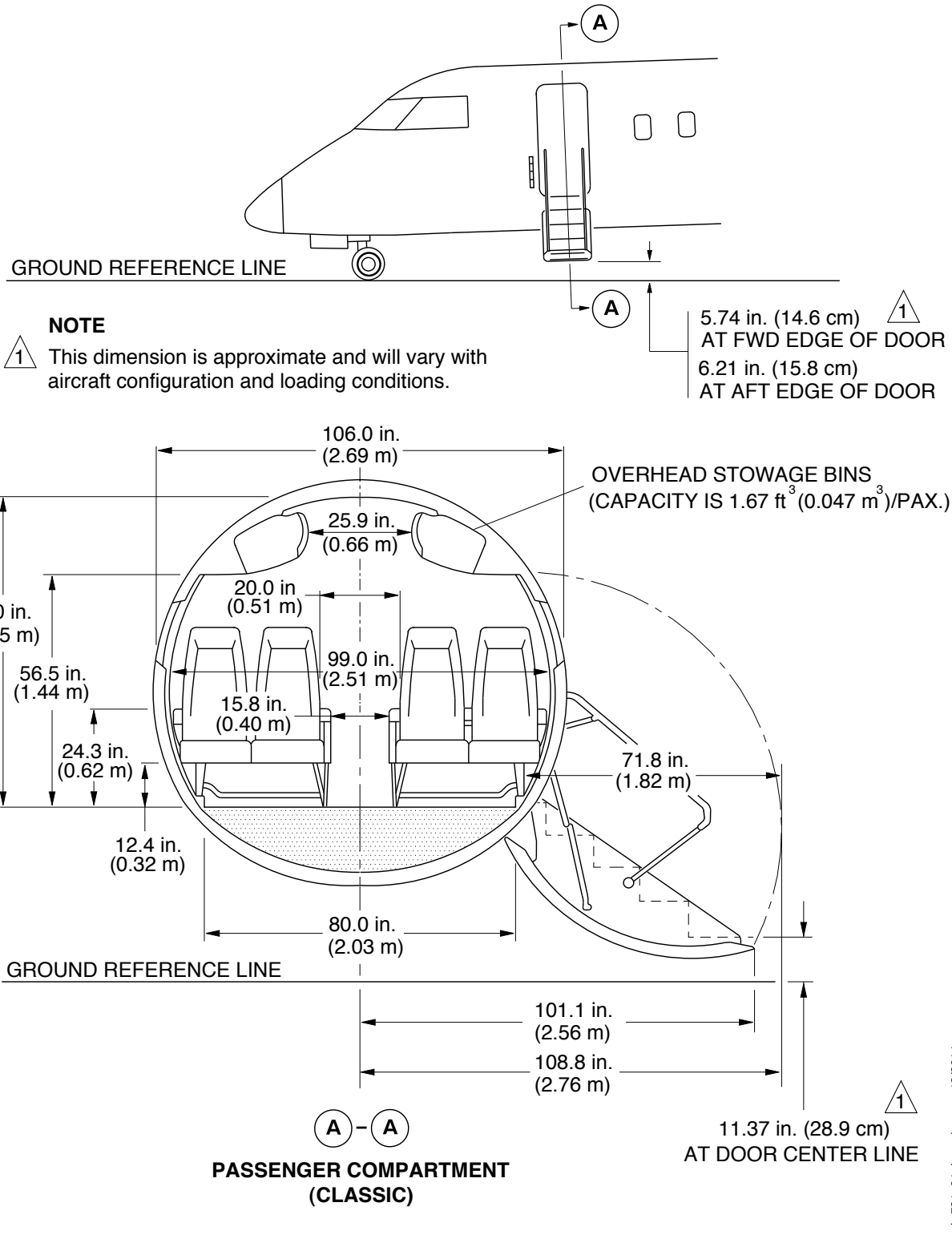
NOTES

1. Type II/III emergency exit door is de−activated for the extra capacity and cargo combi configuration.
2. Forward type I emergency exit door is installed only on aircraft with extra capacity and cargo combi configuration.
3. Type III emergency exit door is installed only on aircraft with cargo combi configuration.
4. The aft passenger door is de−activated for the aircraft with cargo combi configuration.
5. FWD baggage door is installed in lieu of aft service door and de−activated permanently for the cargo combi configuration.

cg3527a02.dg, cs/rc, jul24/2016

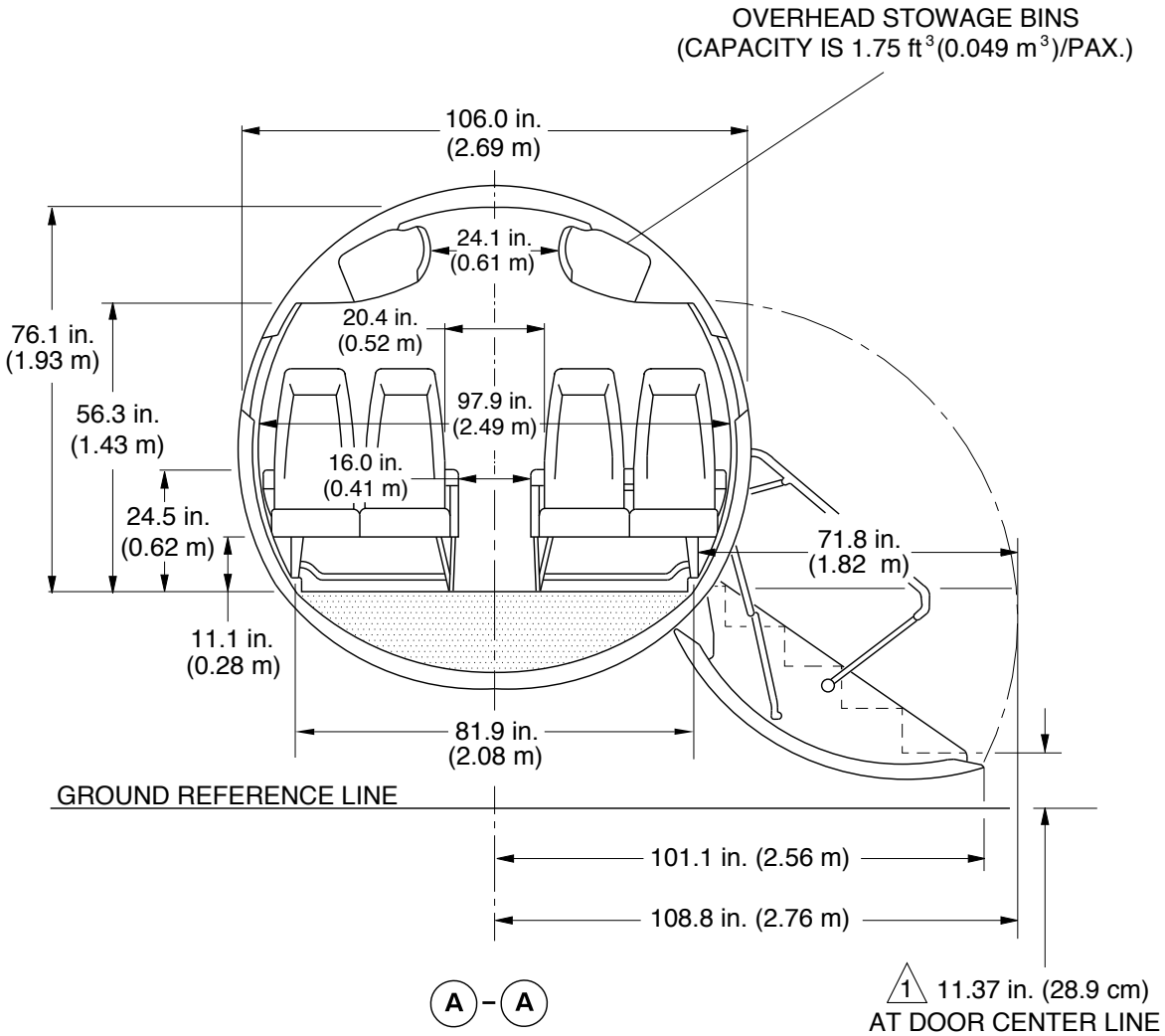
AIRCRAFT DIMENSIONS (Sheet 2 of 2)

Figure 01 – 1



PASSENGER COMPARTMENT CROSS SECTION (Sheet 1 of 2)

Figure 01 – 2



PASSENGER COMPARTMENT
(NEXT GEN)

NOTE

1 This dimension is approximate and will vary with aircraft configuration and loading conditions.

br721a02.dg, gw, nov13/2014

PASSENGER COMPARTMENT CROSS SECTION (Sheet 2 of 2)

Figure 01 – 2

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AIRCRAFT STATIONS

1. General

   A. The aircraft stations and major structural components of the aircraft are located by a coordinate system that uses three main reference axes.

2. Aircraft Coordinate System

   A. General

      (1) The three main reference axes are designated X, Y and Z. Ordinates are located along these axes from a point of origin (datum). This datum point is aft of the nose and below the ground static line, on the aircraft centerline (refer to Figure 01–1). Identification of the ordinates is by the dimension in inches from the datum point, prefixed by a letter denoting the axis. For example, Sta. X 182.00 represents a position 182.00 inches (462.28 cm) aft of the datum, along the longitudinal axis (refer to Figure 01–2).

   B. Major Assembly Datum Points

      (1) Within the X, Y and Z axis system, additional points of origin are available in the aircraft as datum points for locating major assemblies (wings, horizontal stabilizer and nacelles) (refer to Figure 01–1). The ordinates in these areas are identified by the letter for the major axis with a suffix letter that indicates the assembly, followed by a dimension in inches from the assembly point of origin. For example, Sta. XN 55.00 represents a position 55.00 inches (139.7 cm) aft of the point of origin for the engine nacelle. This point of origin coincides with the basic aircraft ordinate Sta. X 257.00 (refer to Figure 01–11).

   C. Fuselage

      (1) The fuselage components are located by dimensions along the X, Y and Z axis from the datum point as previously described (refer to Figure 01–3, Figure 01–4, Figure 01–5 and Figure 01–6).

   D. Vertical Stabilizer

      (1) The vertical stabilizer is included in the fuselage coordinate system (refer to Figure 01–7).

   E. Horizontal Stabilizer

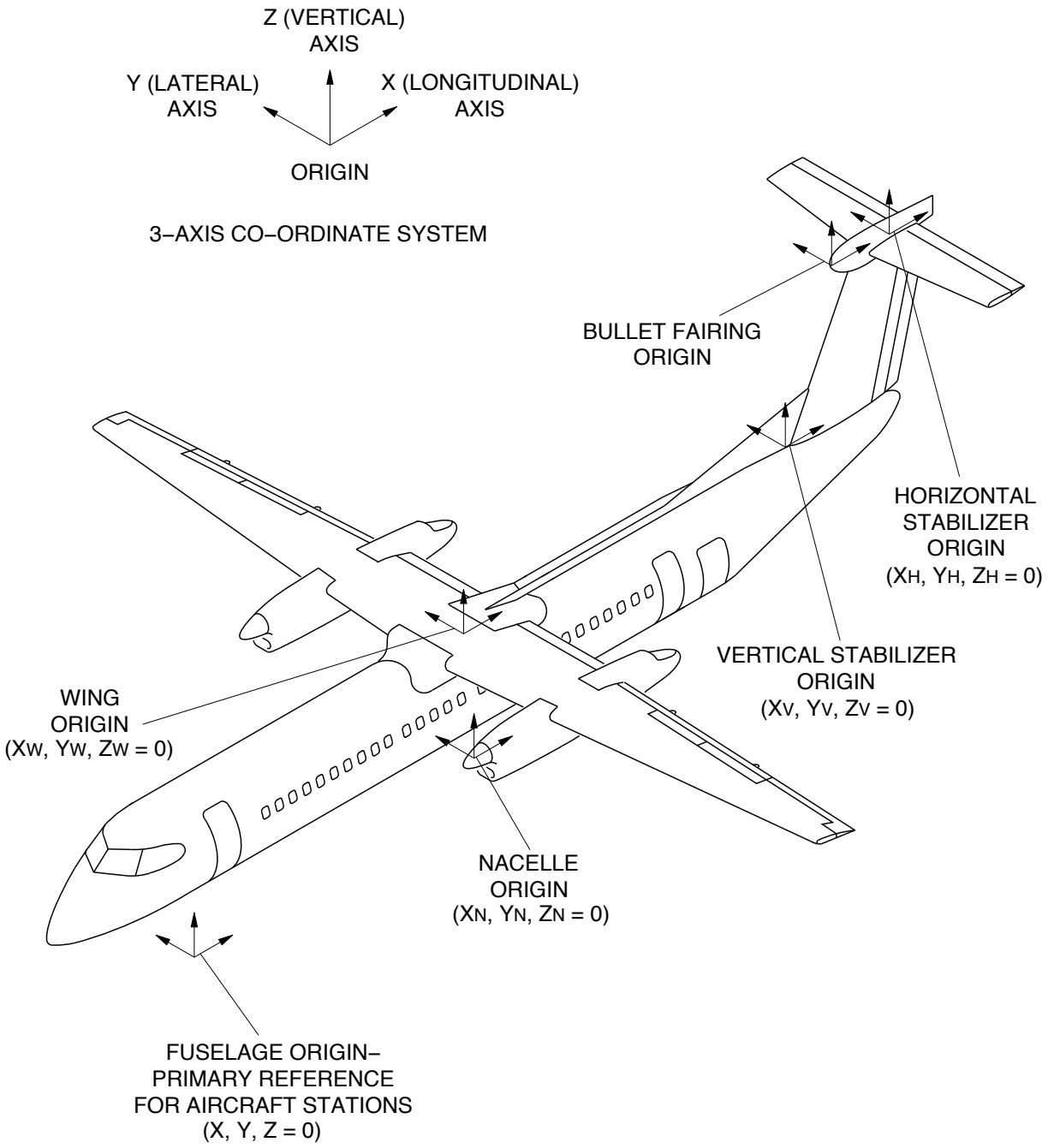
      (1) The horizontal stabilizer assembly components are located by dimensions along the X axis from a point of origin XH 0.00 (aircraft ordinate Sta. X 1049.409). Dimensions forward of XH 0.00 are negative. Along the Y axis, dimensions are prefixed YH for identification, although YH 0.00 is coincident with Sta. Y 0.00 on the aircraft centerline (refer to Figure 01–8).

F. Wings

(1) The wing components are located by dimensions along the X axis from a point of origin XW 0.00 (aircraft ordinate Sta. X 426.974). Along the Y axis, dimensions are prefixed YW for identification although YW 0.00 is coincident with Y 0.00 on the aircraft centerline (refer to Figure 01–9 and Figure 01–10).

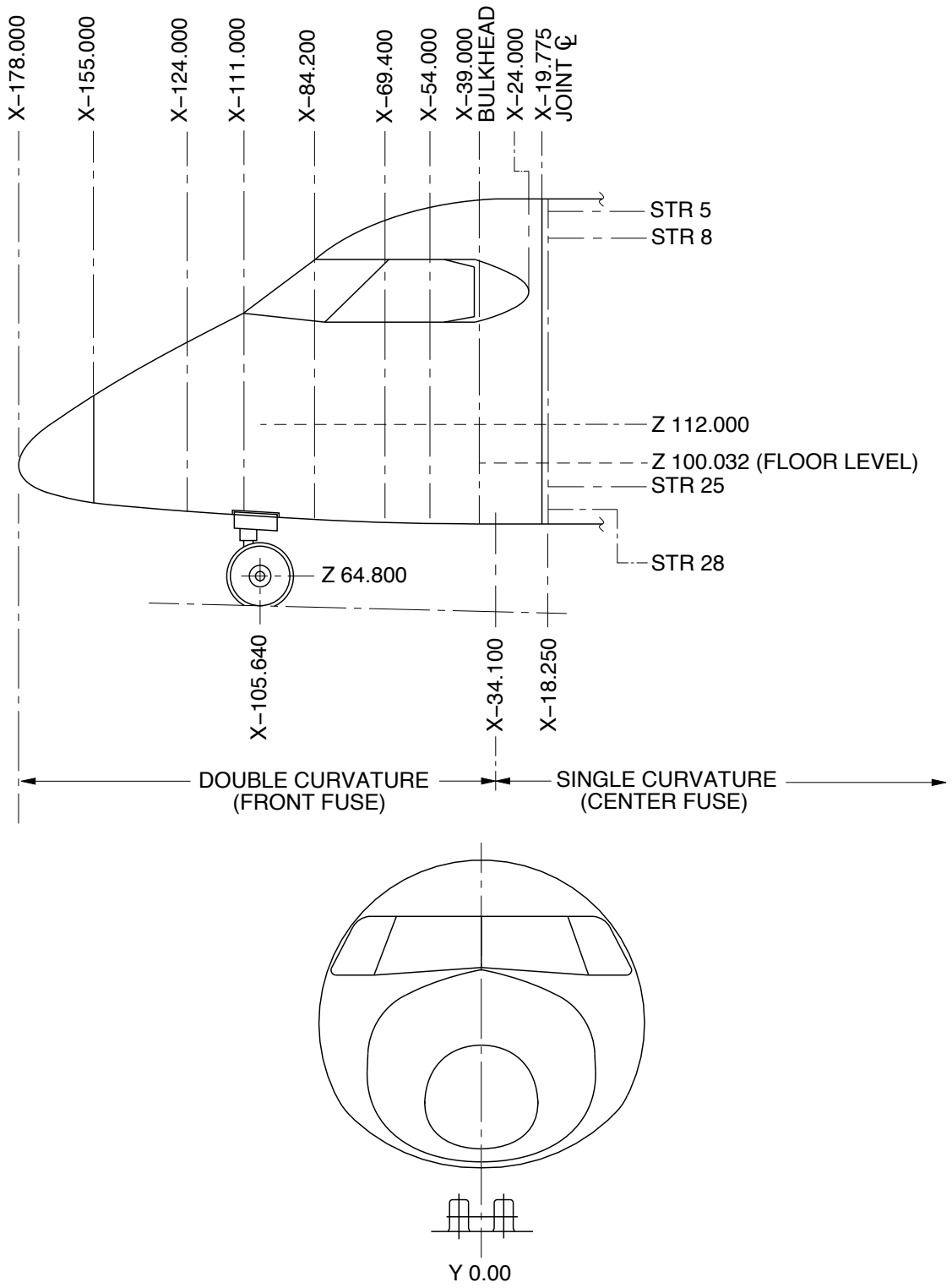
G. Nacelles

(1) The nacelle components are located by dimensions along the X axis from a point of origin XN 0.00 (aircraft ordinate Sta. X 257.000). This is located 12.907 inches (32. 784 cm) forward of the spinner tip. It is also located along the Z axis from a point of origin ZN 0.00 (engine centerline), which is aircraft ordinate Z 171.900. Dimensions below ZN 0.00 are negative (refer to Figure 01–11).



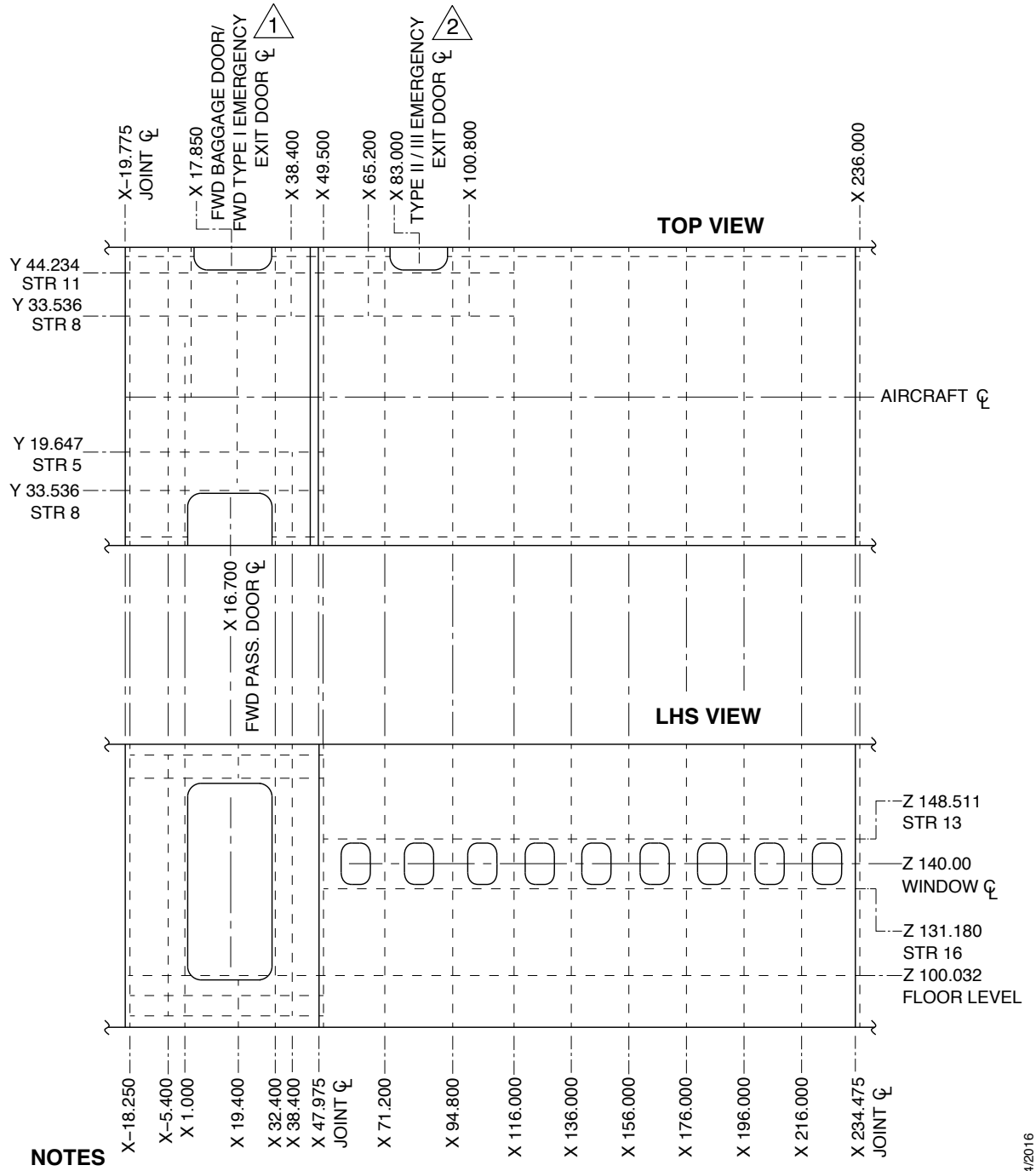
AIRCRAFT CO–ORDINATE SYSTEM

Figure 01 – 1



AIRCRAFT STATIONS – NOSE SECTION

Figure 01 – 2



NOTES

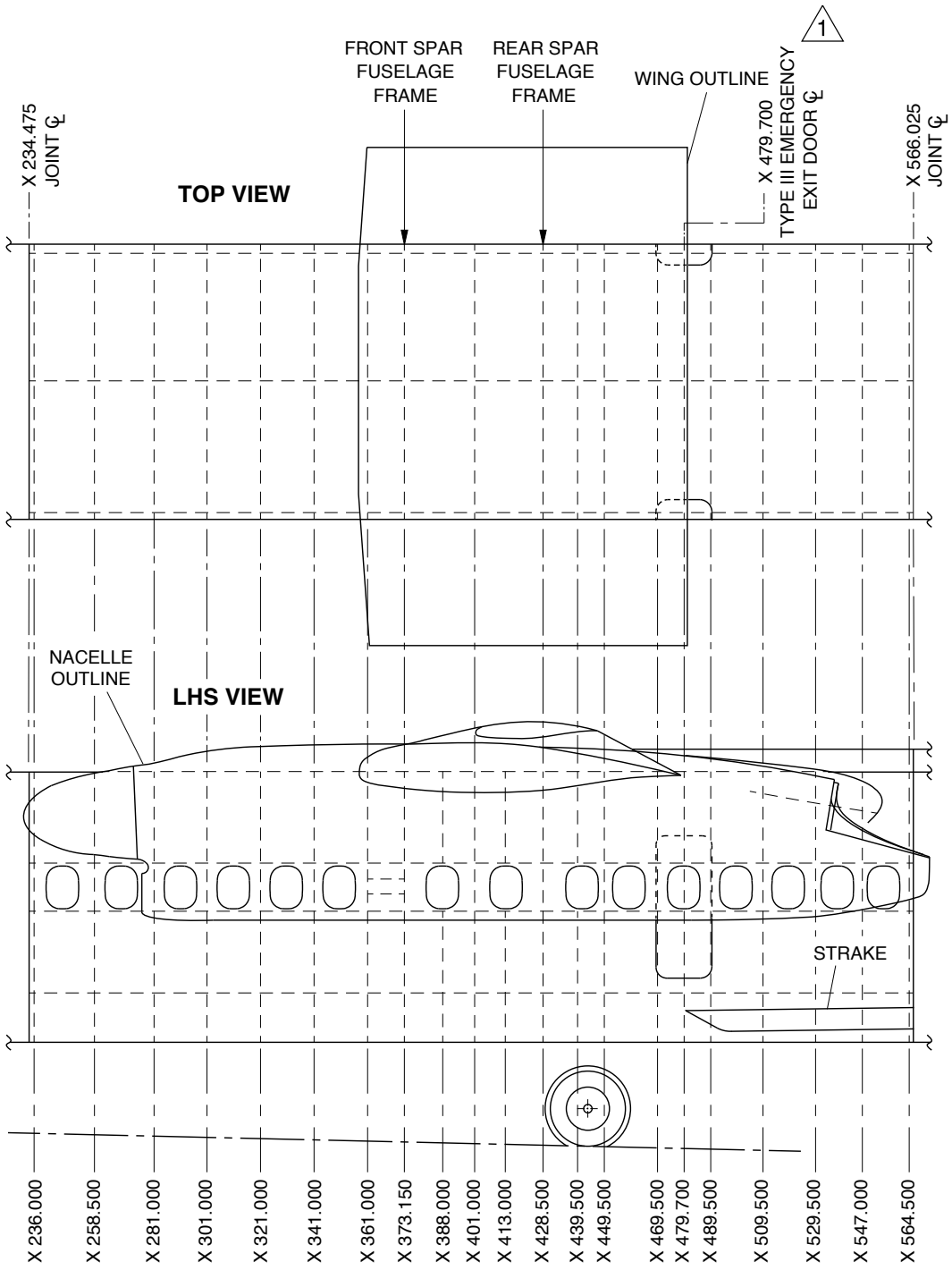
1. Forward type I emergency exit door is installed only on aircraft with the extra capacity and cargo combi configuration.

2. Type II/III emergency exit door is de–activated for the extra capacity and cargo combi configuration.

cg4819a01.dg, rc, jul24/2016

AIRCRAFT STATIONS – CENTER FUSELAGE (FORWARD)

Figure 01 – 3



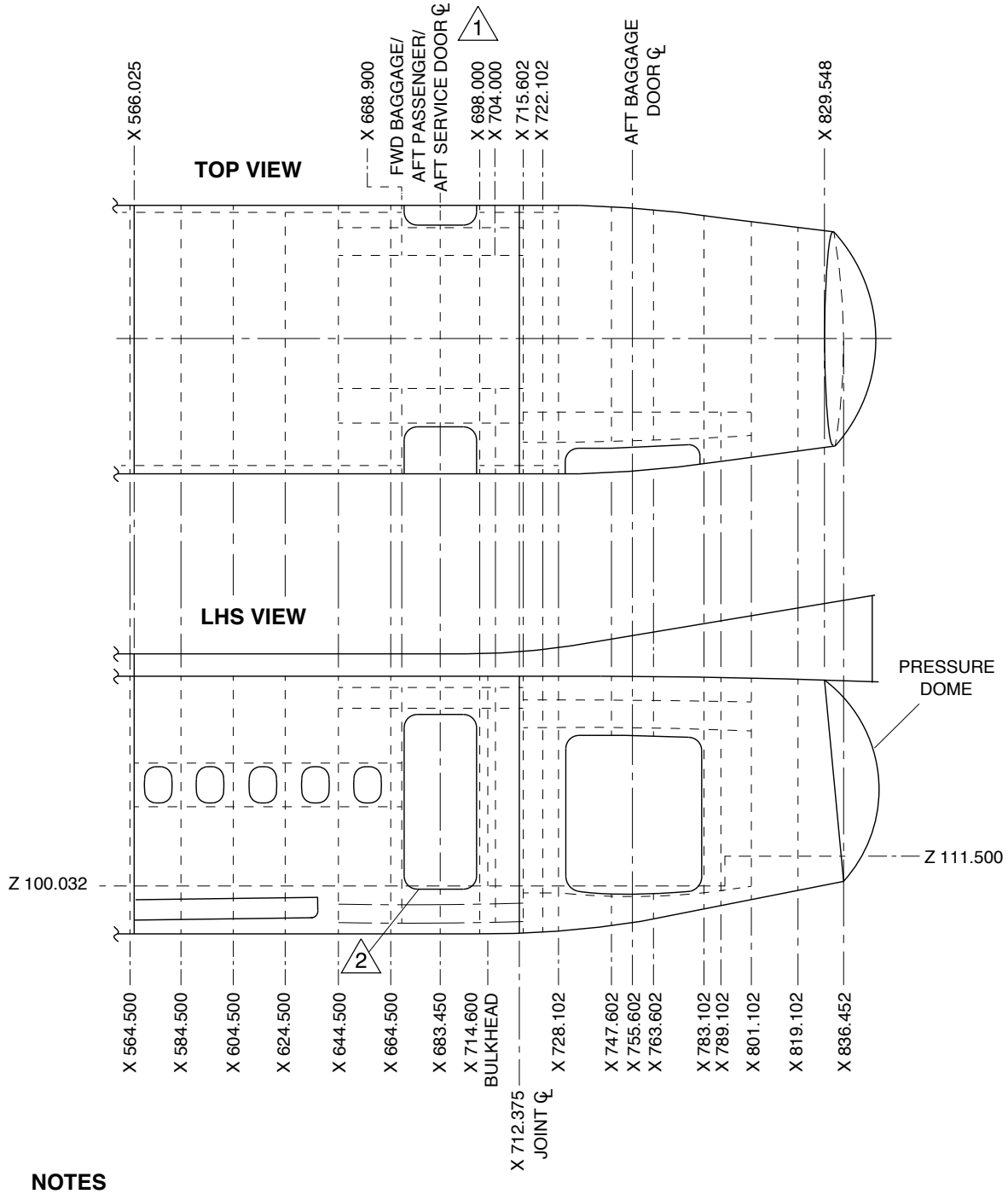
cg4820a01.dg, rc, jul24/2016

NOTE

1 Type III emergency exit doors are installed at station X479.70 on both the sides of the aircraft with the cargo combi configuration.

AIRCRAFT STATIONS – CENTER FUSELAGE (MIDDLE)

Figure 01 – 4



NOTES

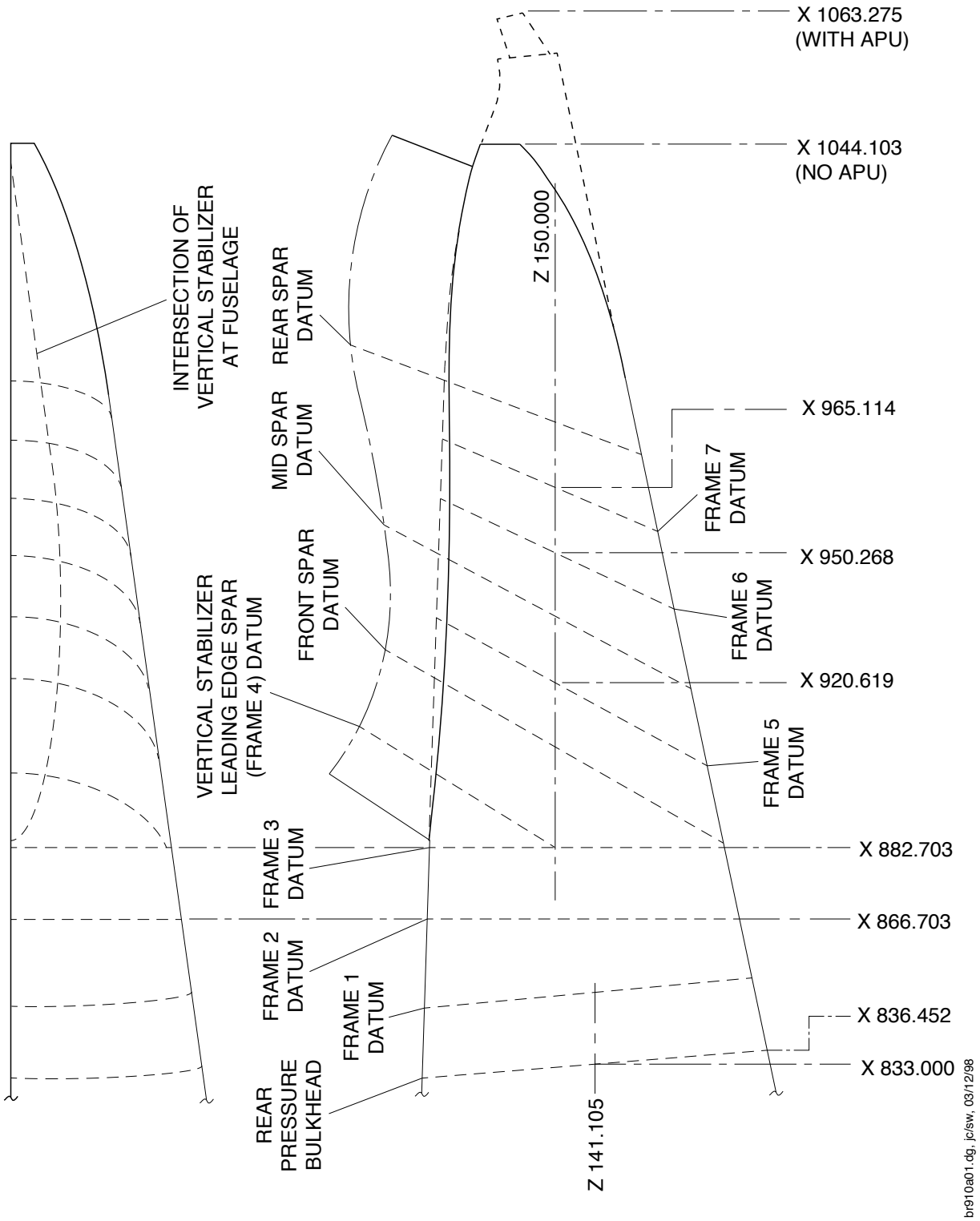
1. Forward baggage door is installed in lieu of the aft service door and de–activated for the cargo combi configuration.

2. Aft passenger door is de–activated for the cargo combi configuration.

cg4818a01.dg, rc, jul24/2016

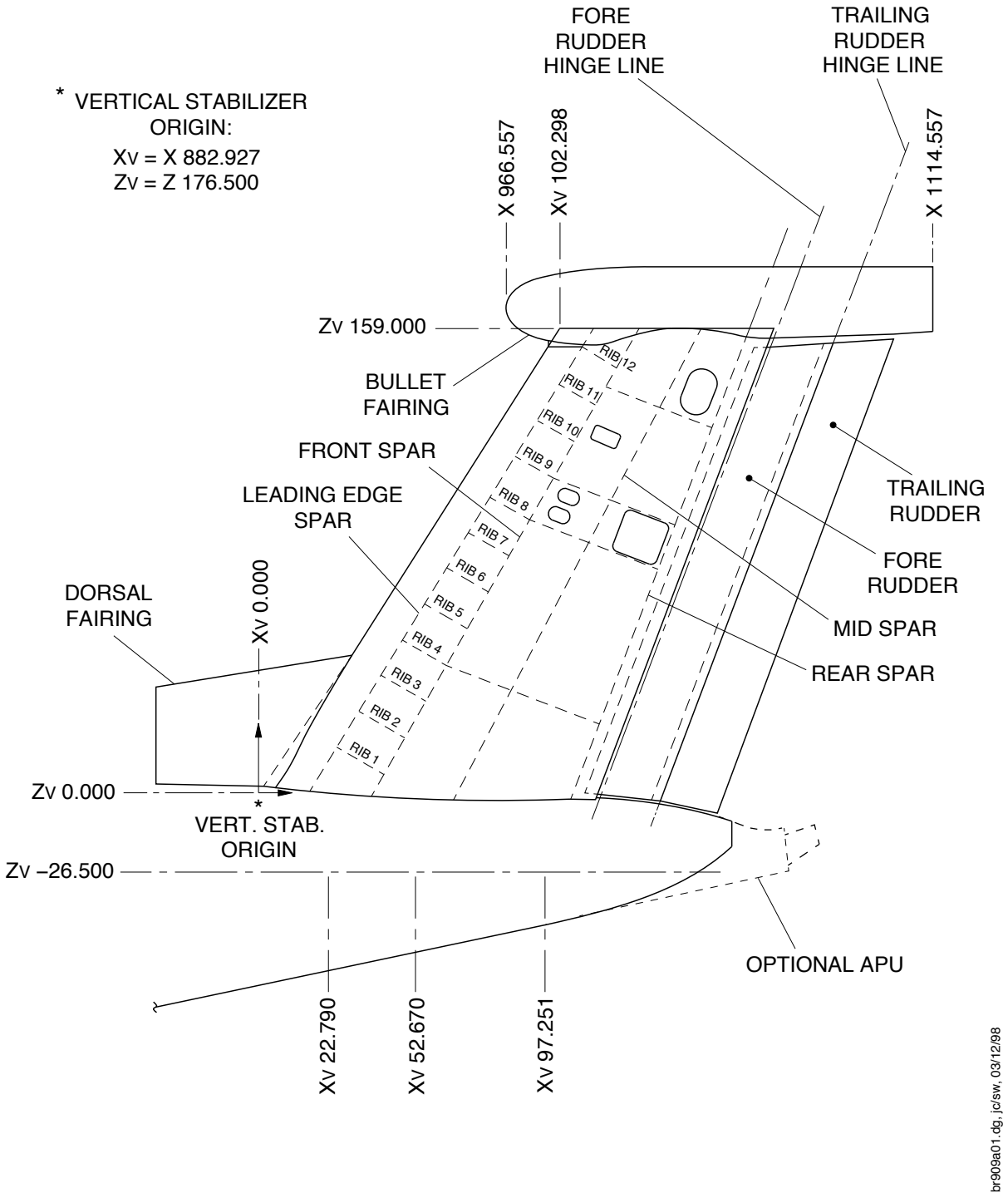
AIRCRAFT STATIONS – CENTER FUSELAGE (AFT)

Figure 01 – 5



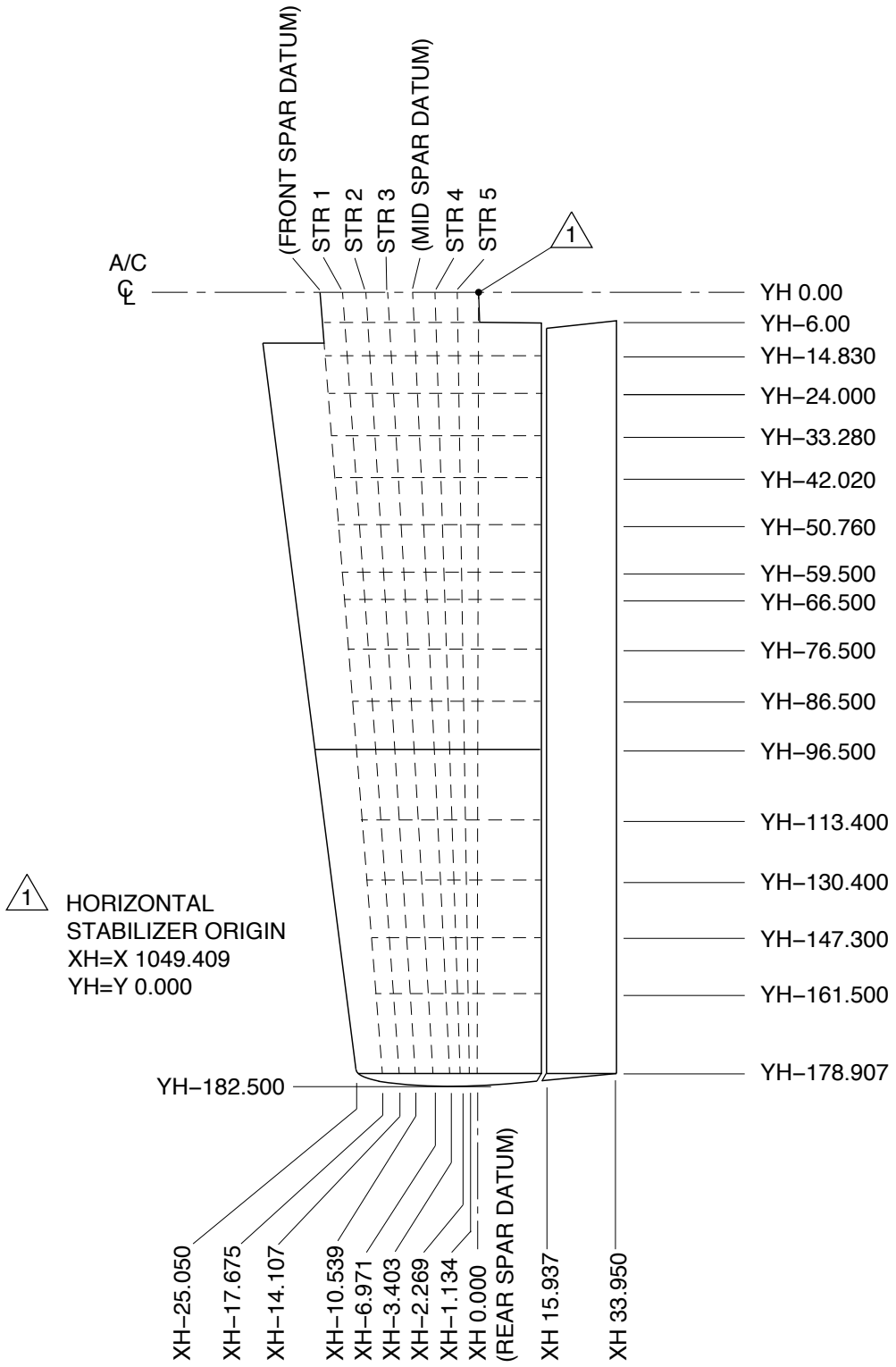
AIRCRAFT STATIONS – AFT FUSELAGE

Figure 01 – 6



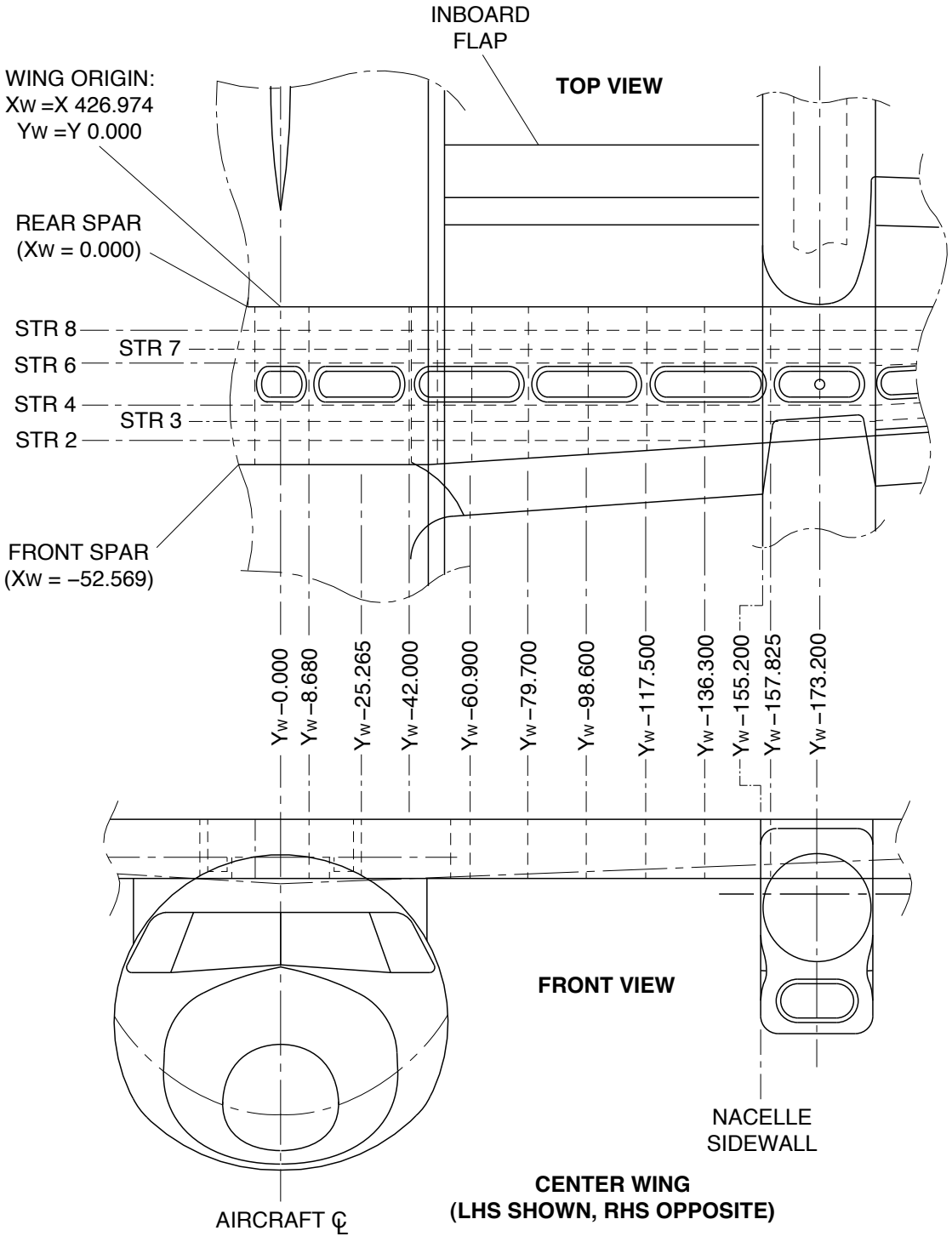
AIRCRAFT STATIONS – VERTICAL STABILIZER

Figure 01 – 7



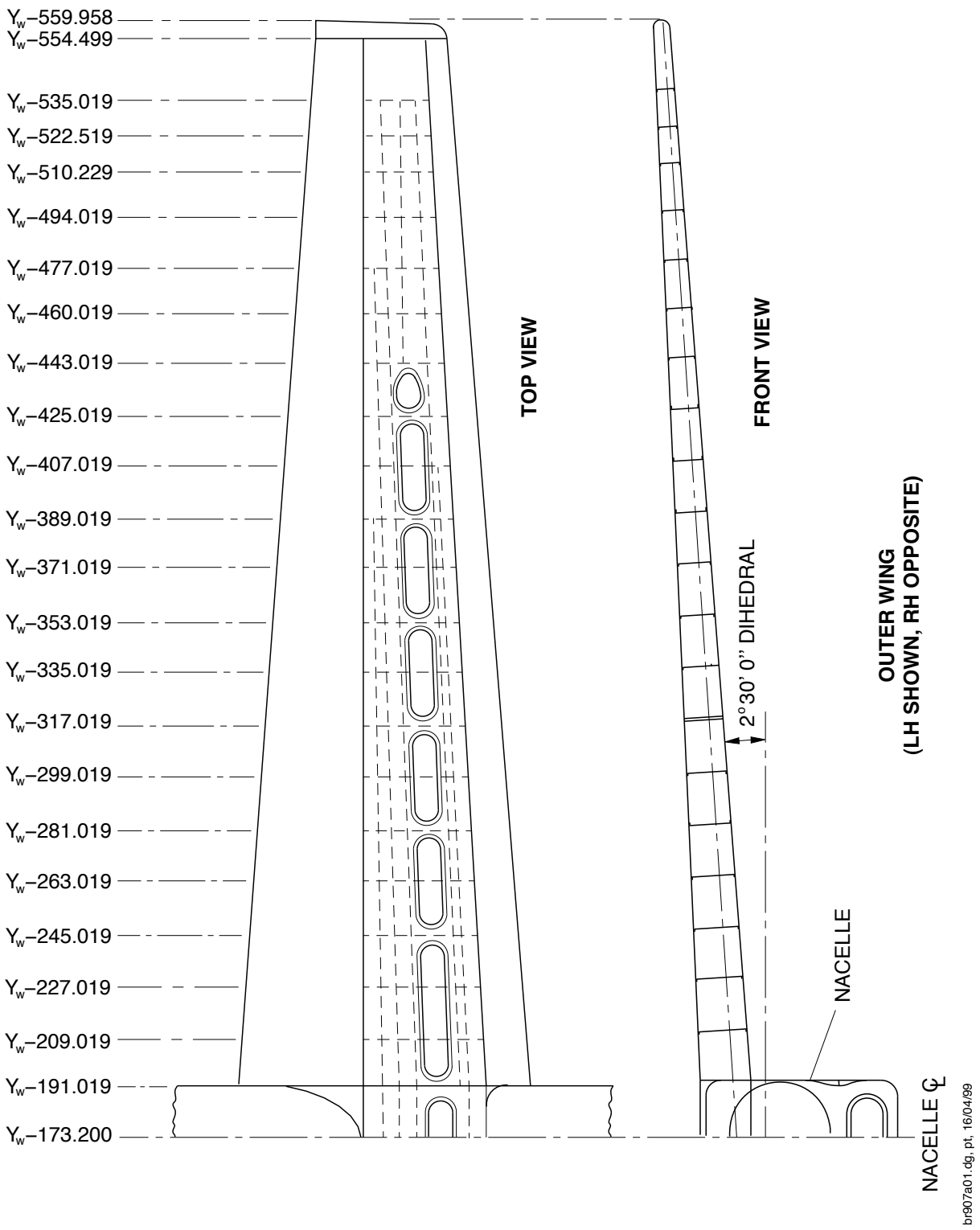
AIRCRAFT STATIONS – HORIZONTAL STABILIZER

Figure 01 – 8



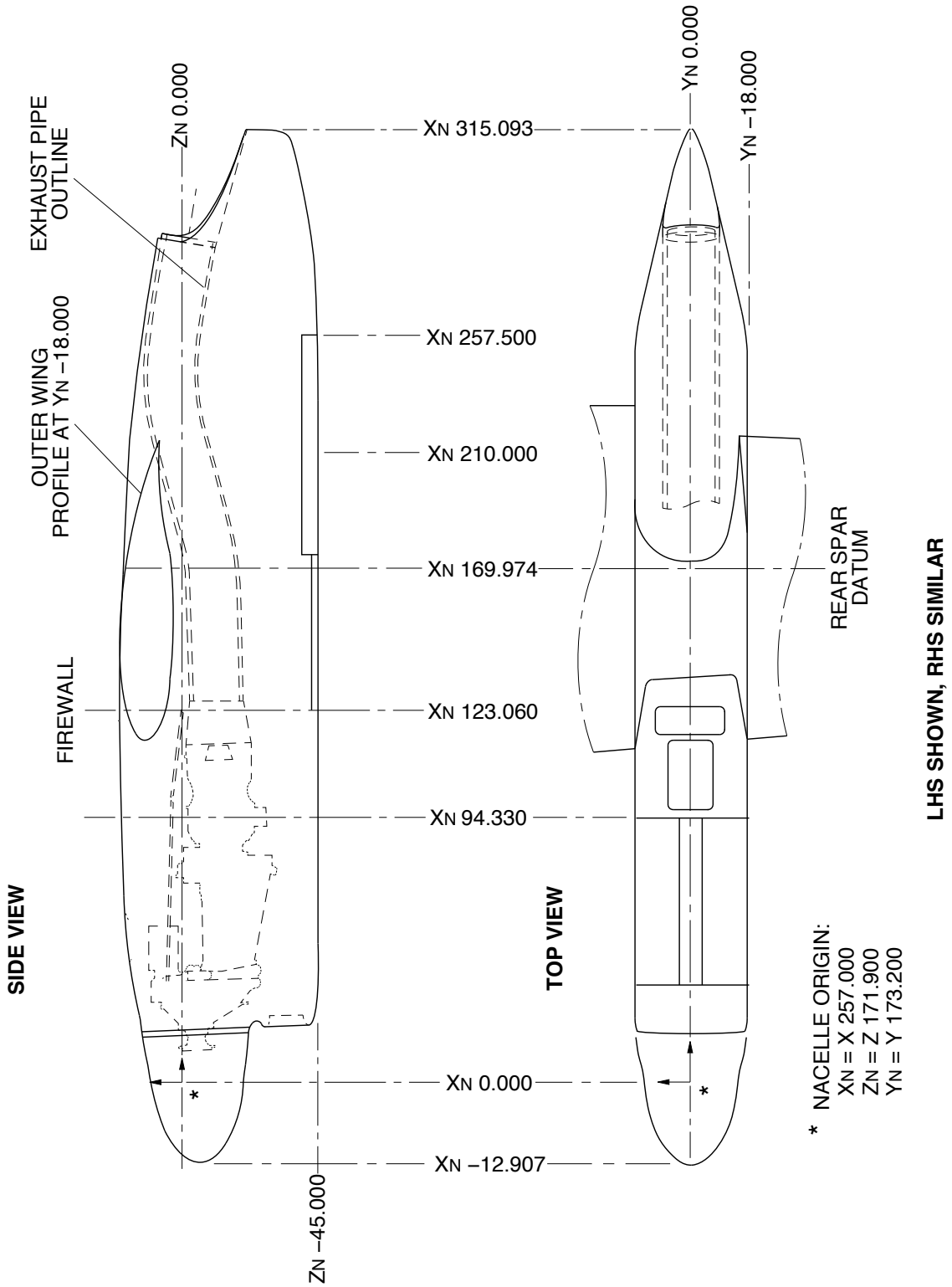
AIRCRAFT STATIONS – WING (INNER)

Figure 01 – 9



AIRCRAFT STATIONS – WING (OUTER)

Figure 01 – 10



AIRCRAFT STATIONS – NACELLE

Figure 01 – 11

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AIRCRAFT SERVICING POINTS

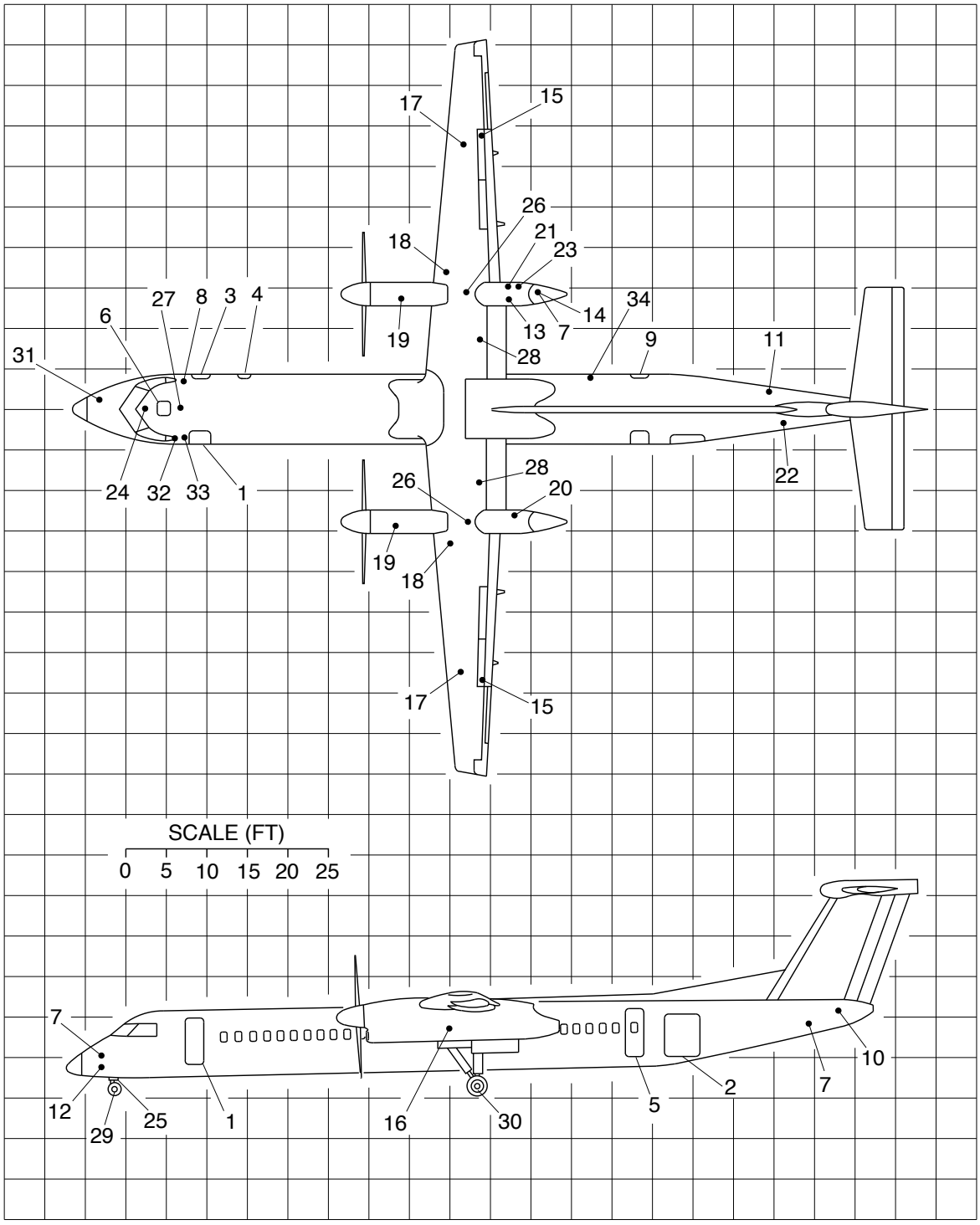
1. General

   A. This section provides descriptions and illustrations to help locate system or component service points. For additional information, please refer to the publications that follow:

   - Chapter 12 of the Aircraft Maintenance Manual (AMM), PSM 1–84–2
   - Chapter 4 of the Ramp Servicing Manual (RSM), PSM 1–84–2S.

   B. For the locations of ground servicing points, refer to Figure 01–1.

   C. For views of each ground servicing point, refer to Figure 01–2.



GROUND SERVICING POINT LOCATIONS (STANDARD CONFIGURATION)

GROUND SERVICING POINT LOCATIONS (Sheet 1 of 6)

Figure 01 – 1

LEGEND

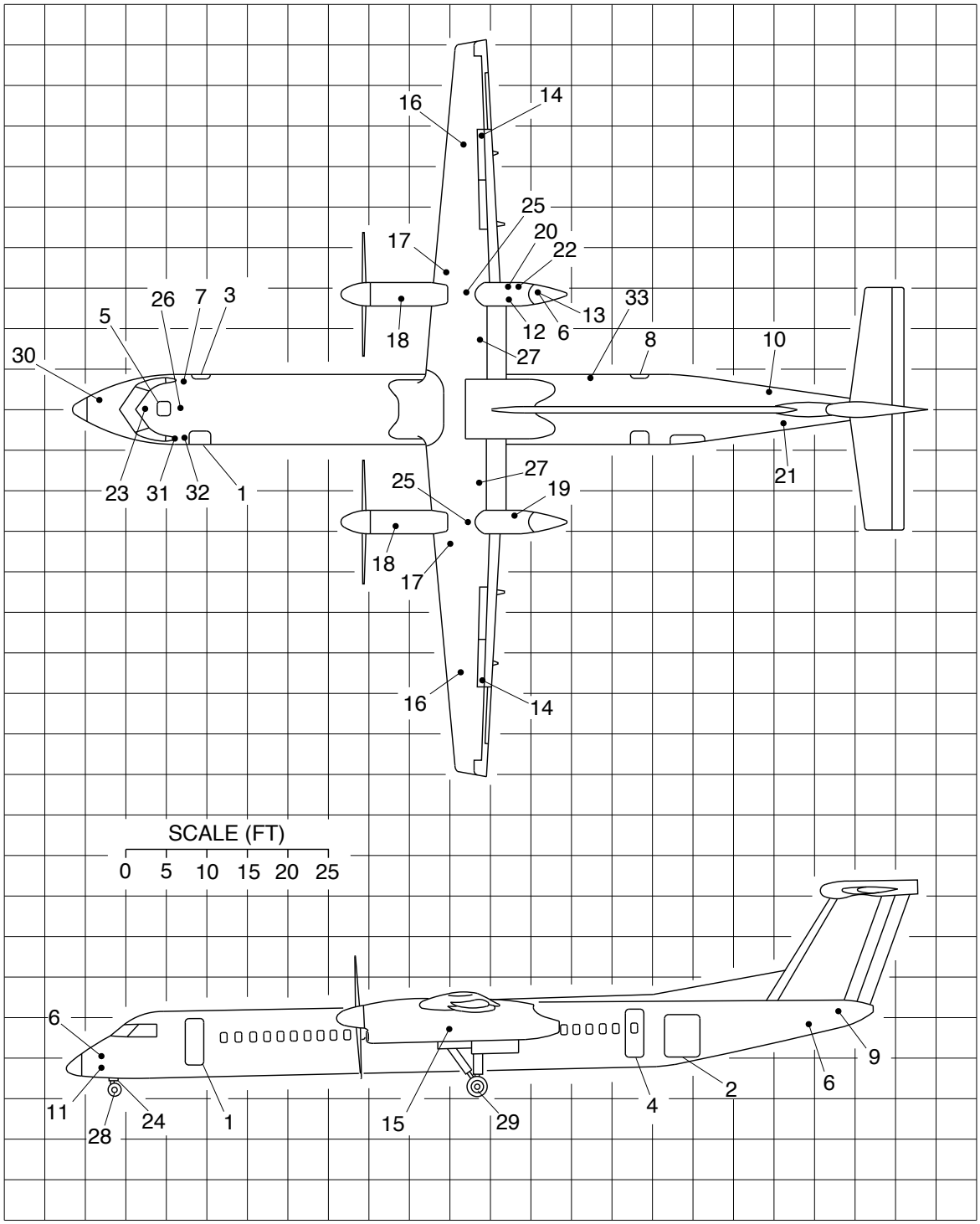
1. Forward passenger door.
2. Aft baggage door.
3. Forward baggage door.
4. Type II/III emergency exit.
5. Aft passenger door.
6. Flight compartment emergency exit.
7. Interphone connectors (3).
8. Lavatory service/optional wash water service.
9. Galley service door/type I emergency exit.
10. Optional auxiliary power unit (APU).
11. Optional conditioned air connection.
12. Electrical DC power receptacle.
13. Electrical AC power receptacle (optional installation on right nose fuselage).
14. Pressure refueling panel and ground point.
15. Ground point (overwing–both sides).
16. Aircraft ground point (on undercarriage–both sides).
17. Gravity fuel filler (over wing–both sides).
18. Magnastick (fuel quantity–underwing–both sides).
19. Engine oil filler panel.
20. No.1 Hydraulic system.
21. No.2 Hydraulic system.
22. No.3 Hydraulic system.
23. Brake accumulator and hydraulic hand pump.
24. Emergency landing gear hydraulic reservoir and hand pump.
25. Nose landing gear shock strut charging point.
26. Main landing gear shock strut charging point (under nacelle–both sides).
27. Nose jacking point.
28. Wing jacking point (underwing–both sides).
29. Nose landing gear jacking point.
30. Main landing gear jacking point (both sides).
31. Crew oxygen supply.
32. Avionics bay.
33. Wardrobe.
34. Optional galley water service.

cg4860a02.dg, rc, aug24/2016

GROUND SERVICING POINT LOCATIONS (STANDARD CONFIGURATION)

GROUND SERVICING POINT LOCATIONS (Sheet 2 of 6)

Figure 01 – 1



GROUND SERVICING POINT LOCATIONS (EXTRA CAPACITY CONFIGURATION)

GROUND SERVICING POINT LOCATIONS (Sheet 3 of 6)

Figure 01 – 1

LEGEND

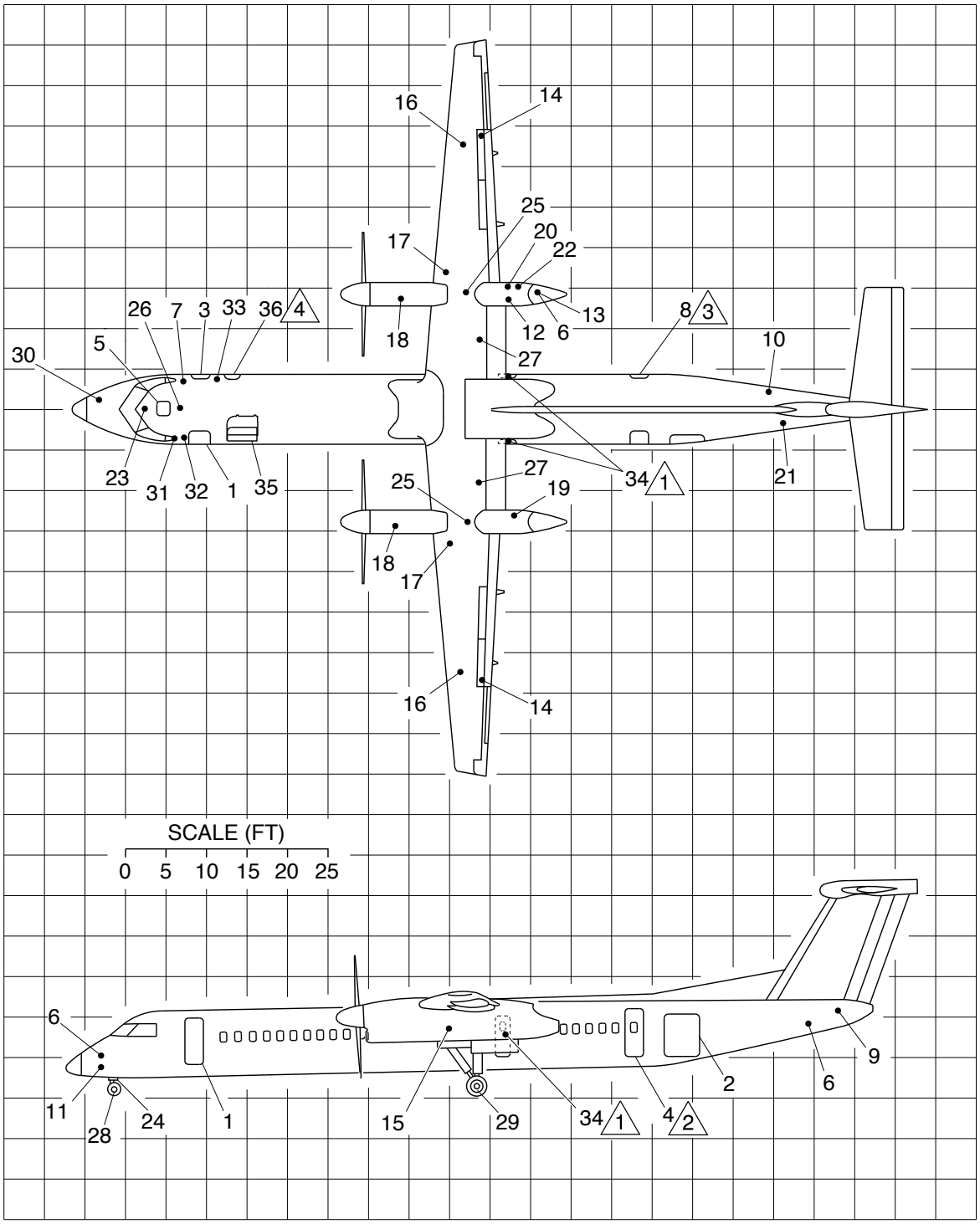
1. Forward passenger door.
2. Aft baggage door.
3. Forward type I emergency exit door.
4. Aft passenger door.
5. Flight compartment emergency exit.
6. Interphone connectors (3).
7. Lavatory service/optional wash water service.
8. Galley service door/type I emergency exit.
9. Optional auxiliary power unit (APU).
10. Optional conditioned air connection.
11. Electrical DC power receptacle.
12. Electrical AC power receptacle (optional installation on right nose fuselage).
13. Pressure refueling panel and ground point.
14. Ground point (overwing–both sides).
15. Aircraft ground point (on undercarriage–both sides).
16. Gravity fuel filler (over wing–both sides).
17. Magnastick (fuel quantity–underwing–both sides).
18. Engine oil filler panel.
19. No.1 Hydraulic system.
20. No.2 Hydraulic system.
21. No.3 Hydraulic system.
22. Brake accumulator and hydraulic hand pump.
23. Emergency landing gear hydraulic reservoir and hand pump.
24. Nose landing gear shock strut charging point.
25. Main landing gear shock strut charging point (under nacelle–both sides).
26. Nose jacking point.
27. Wing jacking point (underwing–both sides).
28. Nose landing gear jacking point.
29. Main landing gear jacking point (both sides).
30. Crew oxygen supply.
31. Avionics bay.
32. Wardrobe.
33. Optional galley water service.

cg4860a04.dg, rc, aug24/2016

GROUND SERVICING POINT LOCATIONS (EXTRA CAPACITY CONFIGURATION)

GROUND SERVICING POINT LOCATIONS (Sheet 4 of 6)

Figure 01 – 1



cg4860a05.dg, rc, aug24/2016

GROUND SERVICING POINT LOCATIONS (CARGO COMBI CONFIGURATION)

GROUND SERVICING POINT LOCATIONS (Sheet 5 of 6)

Figure 01 – 1

LEGEND

1. Forward passenger door.
2. Aft baggage door.
3. Forward type I emergency exit door.
4. Aft passenger door.
5. Flight compartment emergency exit.
6. Interphone connectors (3).
7. Lavatory service/optional wash water service.
8. Type I exit/aft service door.
9. Optional auxiliary power unit (APU).
10. Optional conditioned air connection.
11. Electrical DC power receptacle.
12. Electrical AC power receptacle (optional installation on right nose fuselage).
13. Pressure refueling panel and ground point.
14. Ground point (overwing–both sides).
15. Aircraft ground point (on undercarriage–both sides).
16. Gravity fuel filler (over wing–both sides).
17. Magnastick (fuel quantity–underwing–both sides).
18. Engine oil filler panel.
19. No.1 Hydraulic system.
20. No.2 Hydraulic system.
21. No.3 Hydraulic system.
22. Brake accumulator and hydraulic hand pump.
23. Emergency landing gear hydraulic reservoir and hand pump.
24. Nose landing gear shock strut charging point.
25. Main landing gear shock strut charging point (under nacelle–both sides).
26. Nose jacking point.
27. Wing jacking point (underwing–both sides).
28. Nose landing gear jacking point.
29. Main landing gear jacking point (both sides).
30. Crew oxygen supply.
31. Avionics bay.
32. Wardrobe.
33. Optional galley water service.
34. Type III emergency exit door.
35. C1A wardrobe.
36. Type II/III emergency exit door.

NOTES

1. Type III emergency exit doors are installed at station X479.70 on both the sides of the aircraft with the cargo combi configuration.

2. The aft passenger door is de–activated for aircraft with the cargo combi configuration.

3. Forward baggage door is installed in lieu of aft service door and de–activated permanently for the cargo combi configuration.

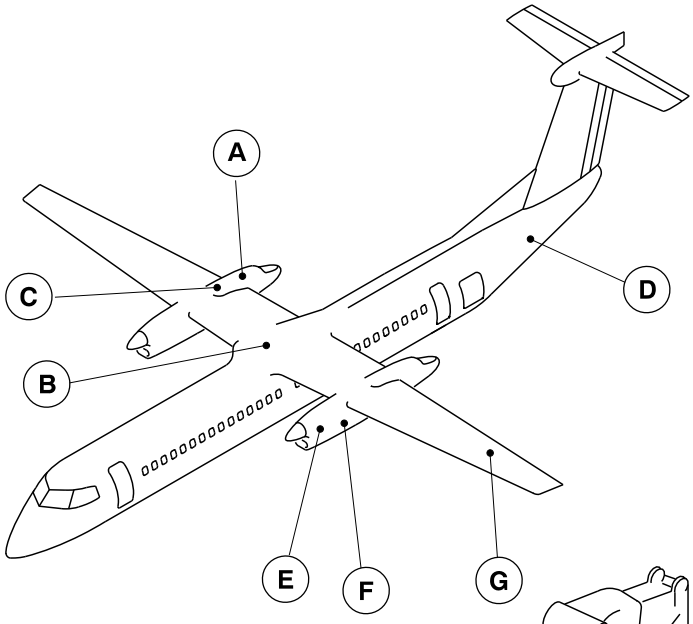
4. Type II/III emergency exit door is de–activated for the cargo combi configuration.

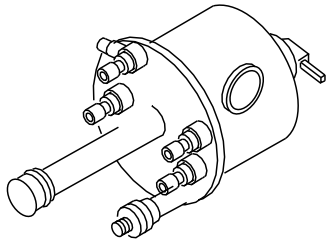
GROUND SERVICING POINT LOCATIONS (CARGO COMBI CONFIGURATION)

cg4860a06.dg, rc, aug24/2016

GROUND SERVICING POINT LOCATIONS (Sheet 6 of 6)

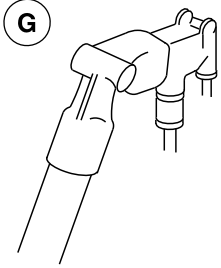
Figure 01 – 1





HYDRAULIC RESERVOIR
(No. 1 AND No. 2 NACELLES)

A

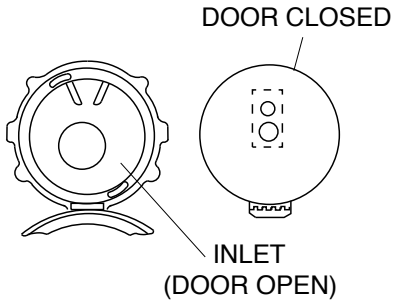


HANDLE–STOWED
ON NACELLE INBOARD
SIDEWALL

BRAKE SYSTEM HANDPUMP

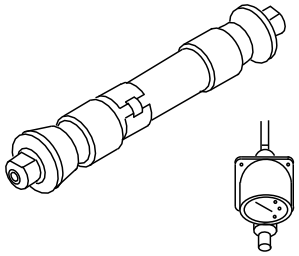
C

NOTE
ON RIGHT SIDE OF FUSELAGE



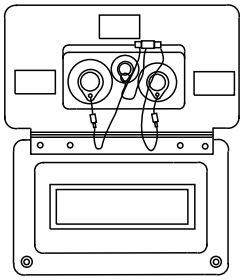
GROUND CONDITIONED
AIR CONNECTION

D



PARKING BRAKE SYSTEM
ACCUMULATOR

B

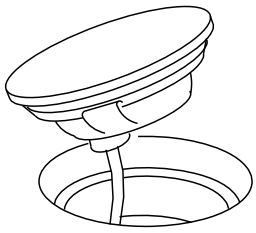


HYDRAULIC GROUND
SERVICING PANEL
(No.1 AND No. 2 NACELLES)

F

ENGINE OIL FILTER
(2 PLACES)

E



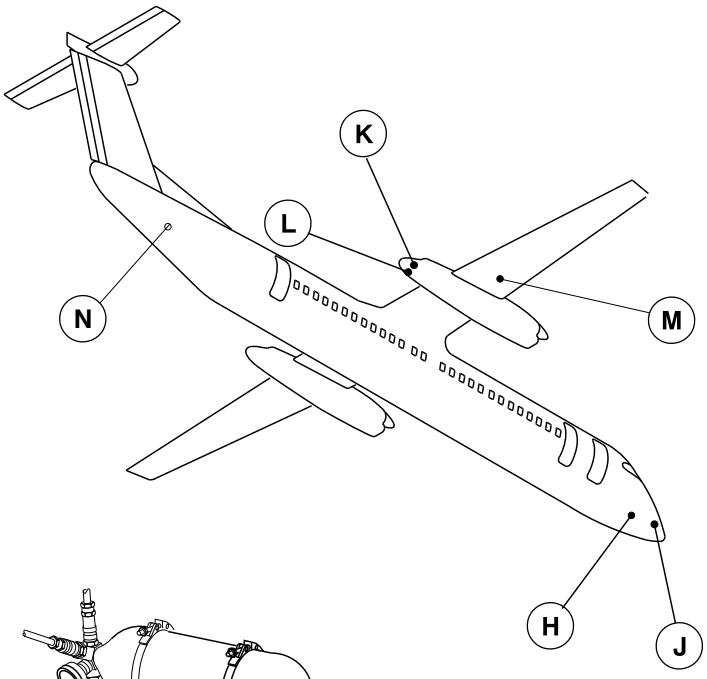
OVERWING FUEL FILLERS
(2 PLACES)

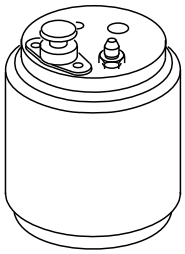
G

brb29a01.dg, sw, 25/08/98

GROUND SERVICING POINTS (Sheet 1 of 5)

Figure 01 – 2



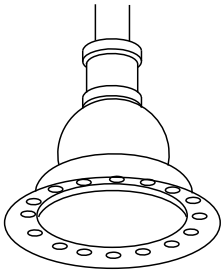


H

HYDRAULIC RESERVOIR
(MAIN GEAR ALTERNATE EXTENSION)

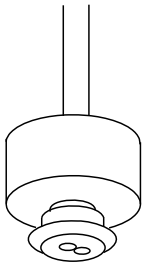
J

CREW OXYGEN BOTTLE



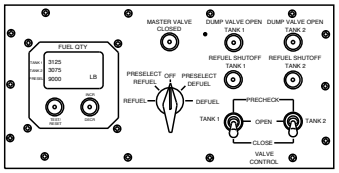
K

PRESSURE REFUEL/DEFUEL
ADAPTER



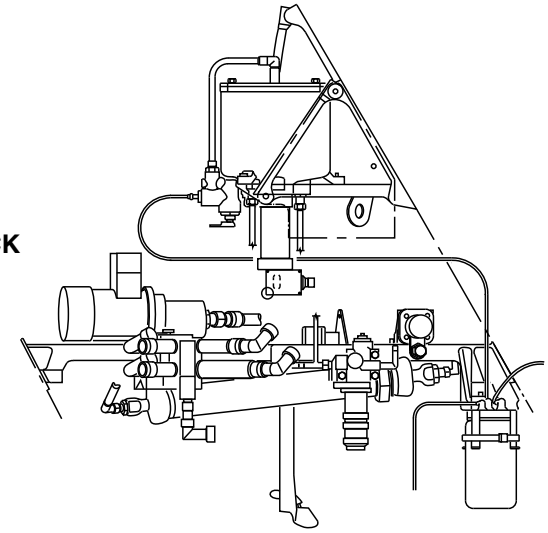
M

MAGNETIC DIPSTICK
(2 PLACES)



L

PRESSURE REFUEL/DEFUEL
PANEL



N

NO. 3 HYDRAULIC RESERVOIR
AND ACCUMULATOR

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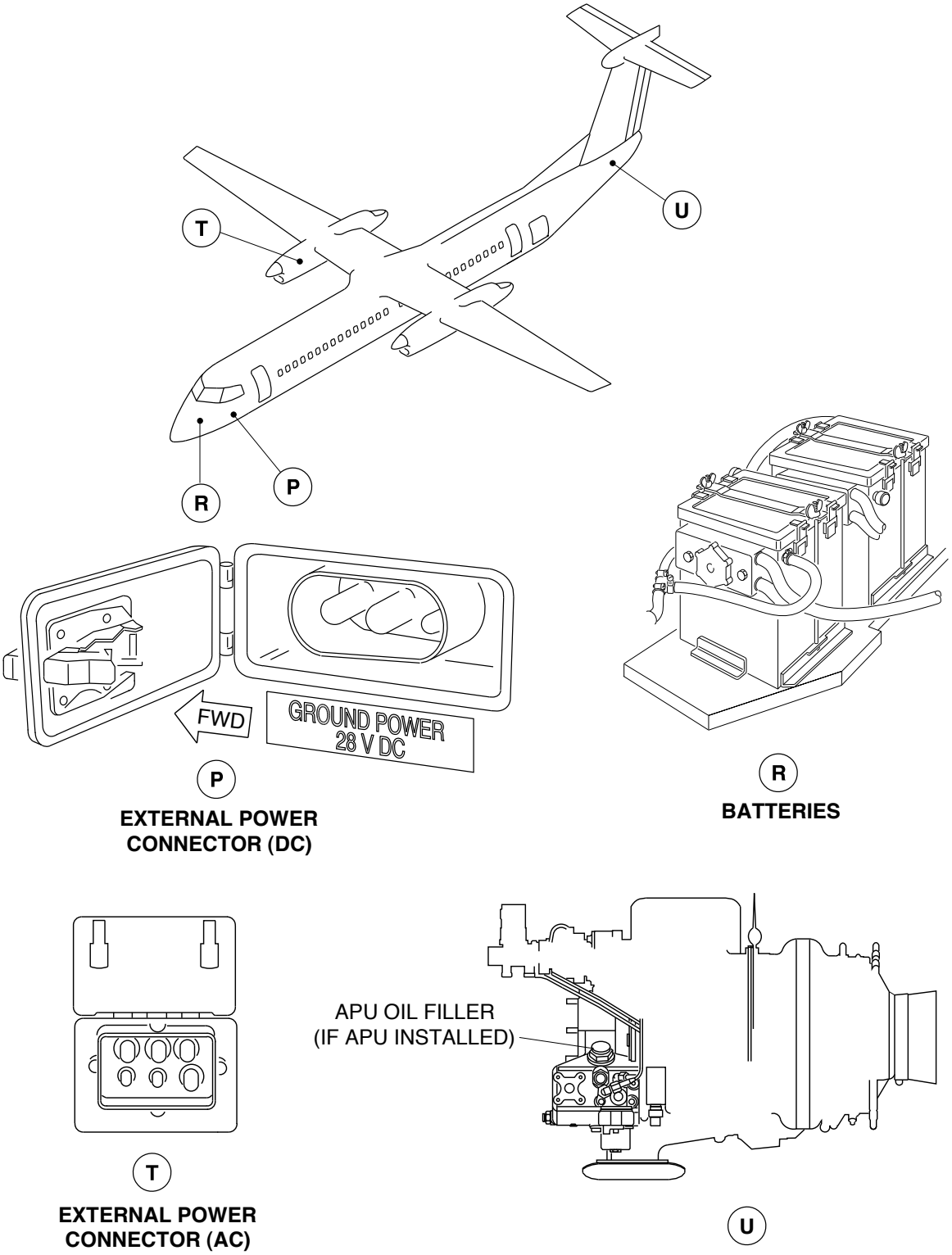
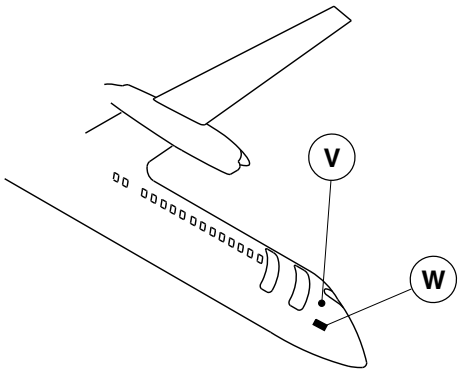
GROUND SERVICING POINTS (Sheet 2 of 5)

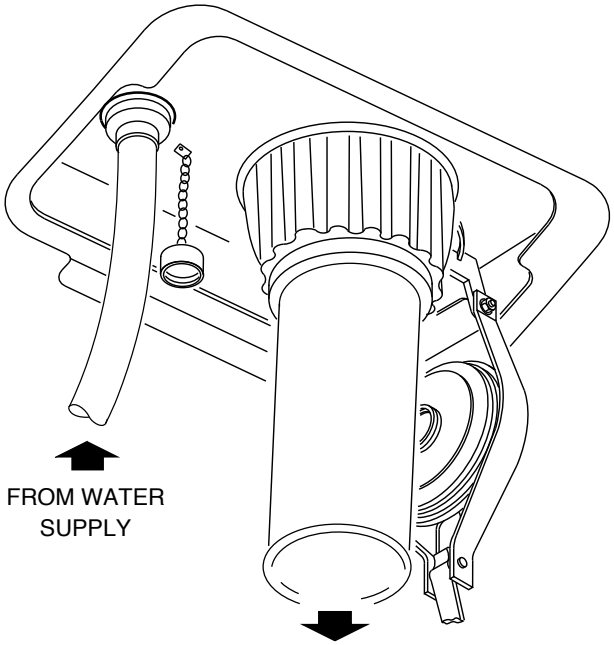
Figure 01 – 2



GROUND SERVICING POINTS (Sheet 3 of 5)

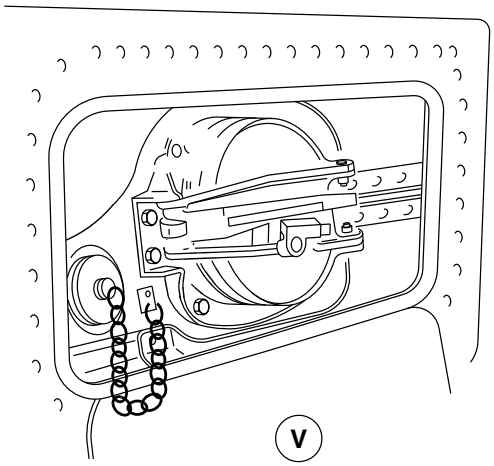
Figure 01 – 2





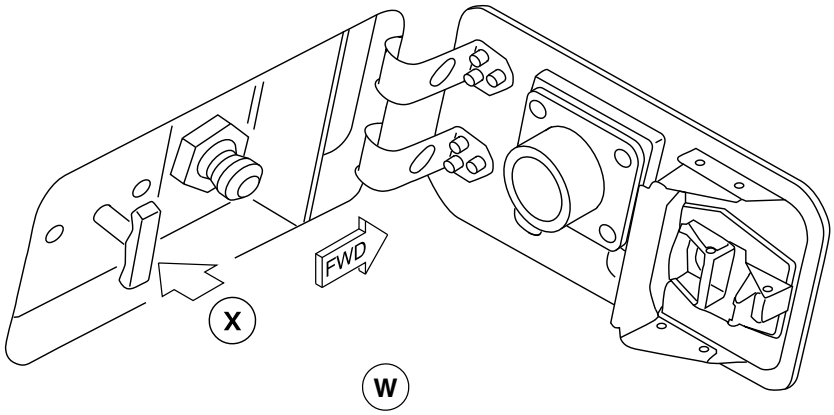
V

CONNECTOR COUPLED FOR DRAINING AND FLUSHING OPERATIONS AT LAVATORY SERVICING PANEL



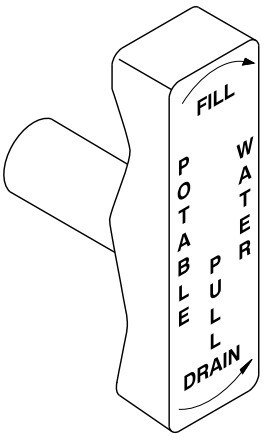
V

LAVATORY SERVICING PANEL



W

LAVATORY POTABLE WATER GROUND SERVICING PANEL



X

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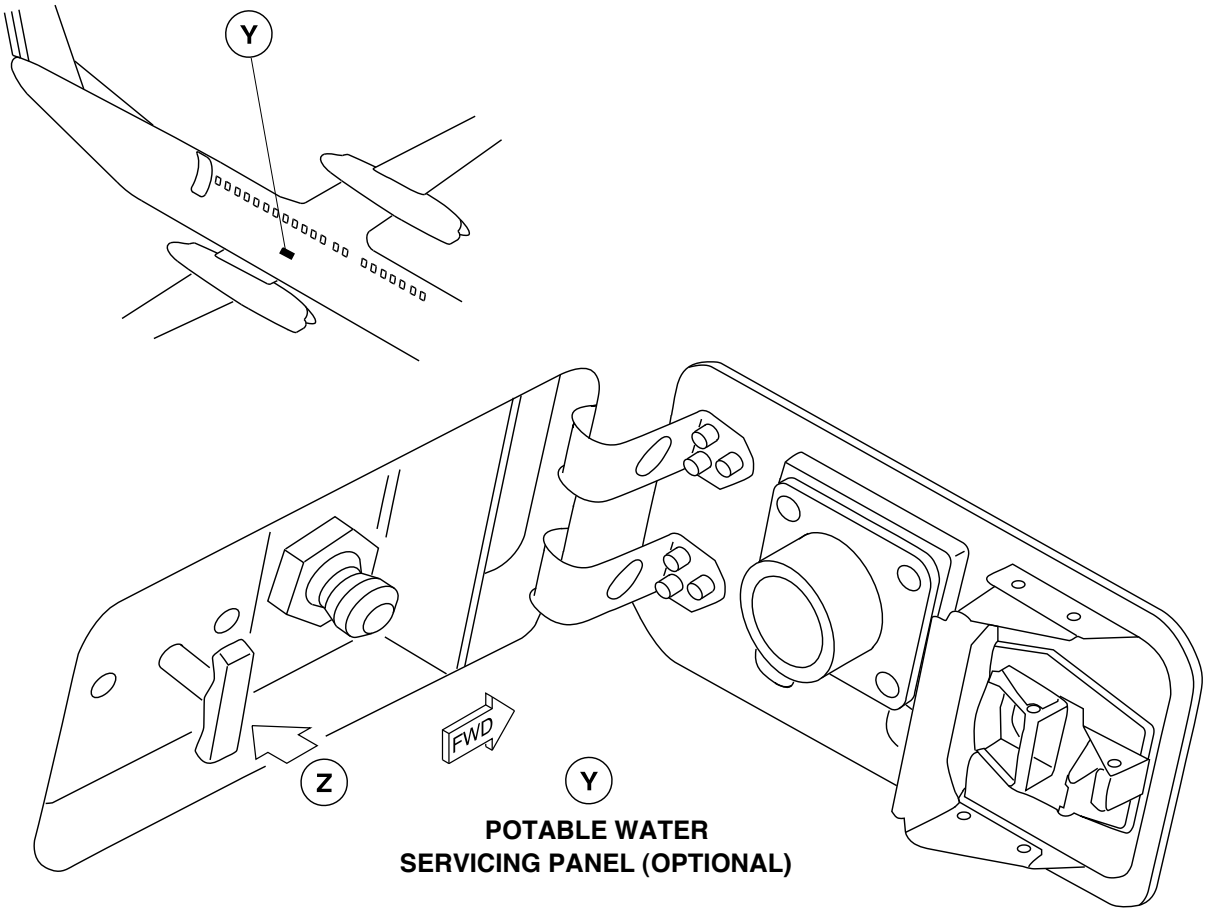
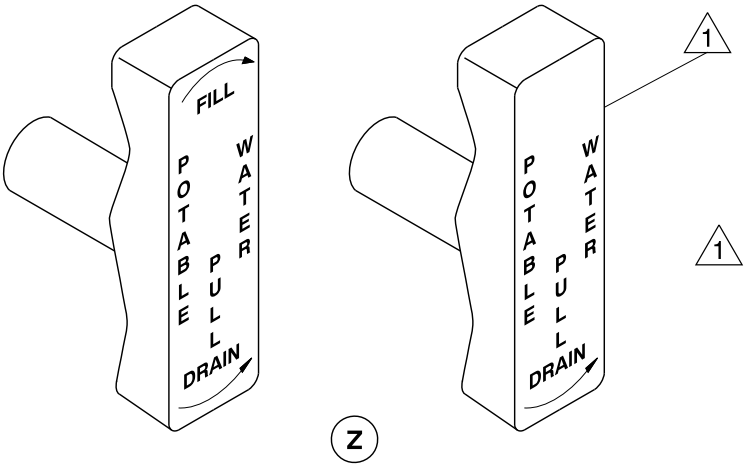
GROUND SERVICING POINTS (Sheet 4 of 5)

Figure 01 – 2



**POTABLE WATER
SERVICING PANEL (OPTIONAL)**



**T–HANDLE
MODIFIED G1 GALLEY**

NOTE

1 Do not turn T–handle of the valve control unit assembly clockwise when it is in the vertical position. If you do, it can cause damage.

brb29a05.dg, jp/gw, jul9/2010

GROUND SERVICING POINTS (Sheet 5 of 5)

Figure 01 – 2

DOORS

1. General

   A. The descriptions that follow provide details about the various doors on the Dash–8, Series 400 aircraft (refer to Figure 01–1).

   B. Flight Compartment Escape Hatch

      (1) An escape–hatch door for the flight crew is located in the canopy roof of the flight compartment. A door located in the forward bulkhead of the passenger–compartment provides access to the flight compartment (refer to Figure 01–2).

   C. Forward Passenger Door

      (1) The forward passenger (airstair) door is located on the left–hand side of the fuselage, at the front of the passenger compartment. This door provides the primary access to and from the aircraft for passengers and crew during normal use. The airstair door incorporates stairs and an inflatable seal that is installed on the fuselage structure around the edge of the door opening. A ditching dam is also located above the airstair door. The ditching dam (when not in use) forms the ceiling panel above the door and when deployed prevents water from entering the passenger compartment (refer to Figure 01–3 and Figure 01–4).

   D. Emergency Exit

      (1) A Type II/III emergency exit is located on the right–hand side of the fuselage, opposite the forward passenger door. The emergency exit is constructed of an upper and lower door (ditching dam). The lower door can be locked in place by an internal handle located on the lower part of the door (refer to Figure 01–5).

      NOTE: The Type II/III emergency exit door is de–activated for the extra capacity and cargo combi configurations.

      (2) A Type I emergency exit is located on the right–hand side of the fuselage, opposite the forward passenger door. This is constructed of an upper and lower door (ditching dam). The lower door can be locked in place by an internal handle located on the lower part of the door (refer to Figure 01–6 and Figure 01–7).

      NOTE: The Type I emergency exit door is installed on the extra capacity and cargo combi configurations in lieu of the forward baggage door.

      (3) Type III emergency exit doors supply an exit for emergency evacuation of the passenger compartment. There are two type III emergency exit doors, one on each side of the fuselage at station X479.70. The doors are plug type which have to be removed completely for opening. The door is unlocked by the operation of the internal or external handle (refer to Figure 01–13).

      NOTE: Type III emergency exit doors are installed at station X479.70 on both the sides of the aircraft with the cargo combi configuration.

E. Forward Baggage Compartment Door

(1) The exterior door for the forward baggage compartment is located immediately aft of the lavatory, on the right–hand side of the fuselage. The forward baggage compartment is accessible from the cabin interior through a separate lockable door. There is no access to this lock from the forward baggage compartment which can prevent exterior access if it is locked (refer to Figure 01–6).

NOTE: The forward baggage compartment is removed and the forward Type I emergency exit door is installed in lieu of forward baggage door for the extra capacity and cargo combi configurations.

F. Aft Passenger and Service Doors

(1) The aft passenger door is located on the left–hand side of the rear fuselage (refer to Figure 01–8 and Figure 01–9). A service door is located on the right–hand side of the rear fuselage, opposite the aft passenger door (refer to Figure 01–10 and Figure 01–11).

NOTE: The aft passenger door is de–activated for the aircraft with cargo combi configuration.

NOTE: Forward baggage door is installed in lieu of the aft service door and de–activated permanently for the cargo combi configuration.

G. Aft Baggage Compartment Door

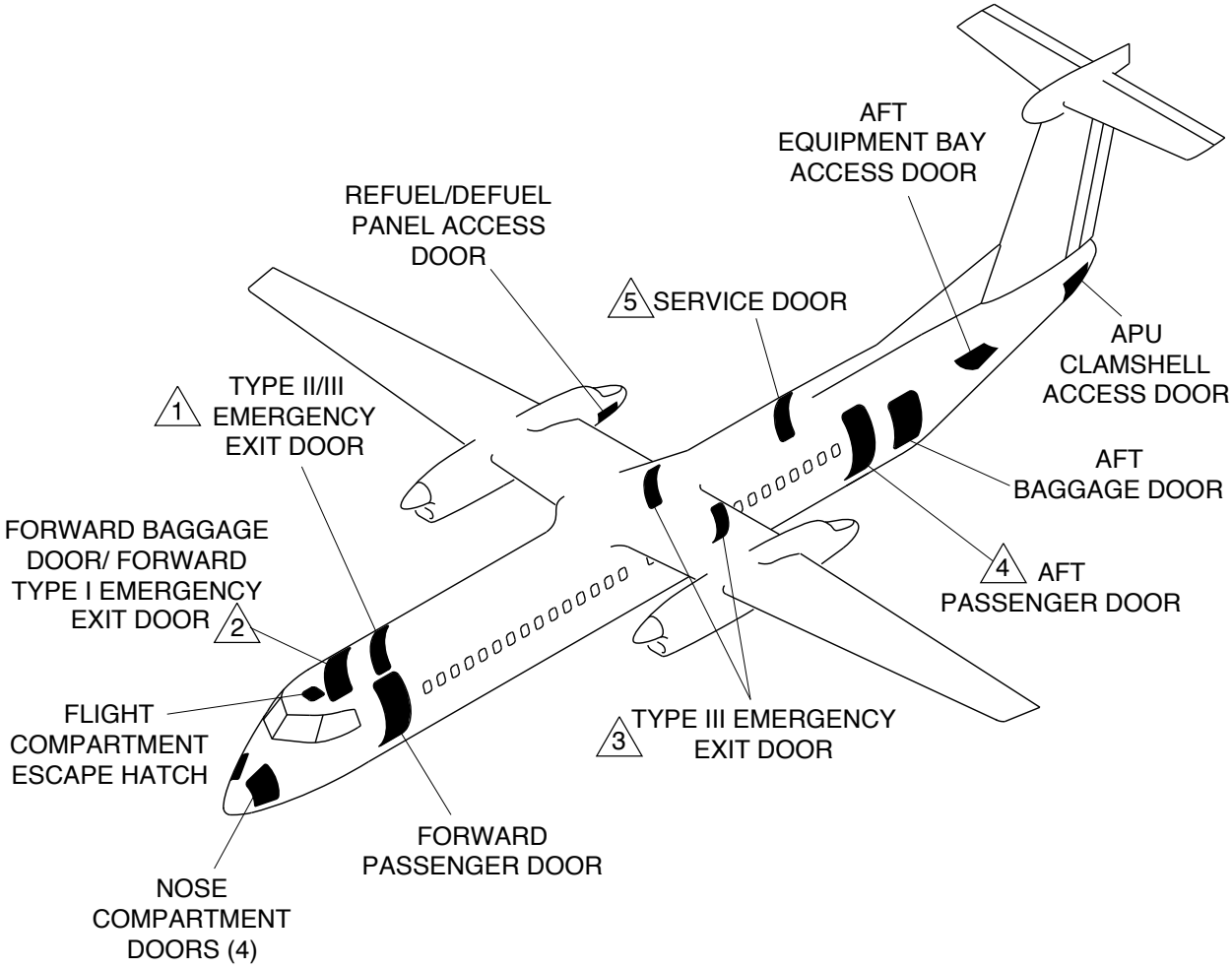
(1) The door to the aft baggage compartment is located on the left–hand side of the aft center–fuselage section (refer to Figure 01–12).

H. Access Doors

(1) For maintenance purposes, access doors are installed at various locations on the aircraft. A rear–fuselage access door is located on the underside of the rear fuselage. Access to the refuel/defuel panel is by a door in the rear of the No. 2 engine nacelle. A lavatory service door is located in the right–hand side of the forward fuselage. Four doors, two on each side of the fuselage forward of the flight compartment, provide access to the nose compartment.

I. Door Warning System

(1) A warning indication system provides a visual indication (in the flight compartment) when the passenger, emergency exit, service, or cargo doors are not in a closed and locked condition.



NOTES

1. Type II/III emergency exit door is de−activated for the extra capacity and cargo combi configuration.
2. Forward type I emergency exit door is installed only on aircraft with extra capacity and corgo combi configuration.
3. Type III emergency exit doors are installed at the station X479.70 on both the sides of the aircraft with the cargo combi configuration.
4. The aft passenger door is de−activated for the aircraft with cargo combi configuration.
5. Forward baggage door is installed in lieu of aft service door and de−activated permanently for the cargo combi configuration.

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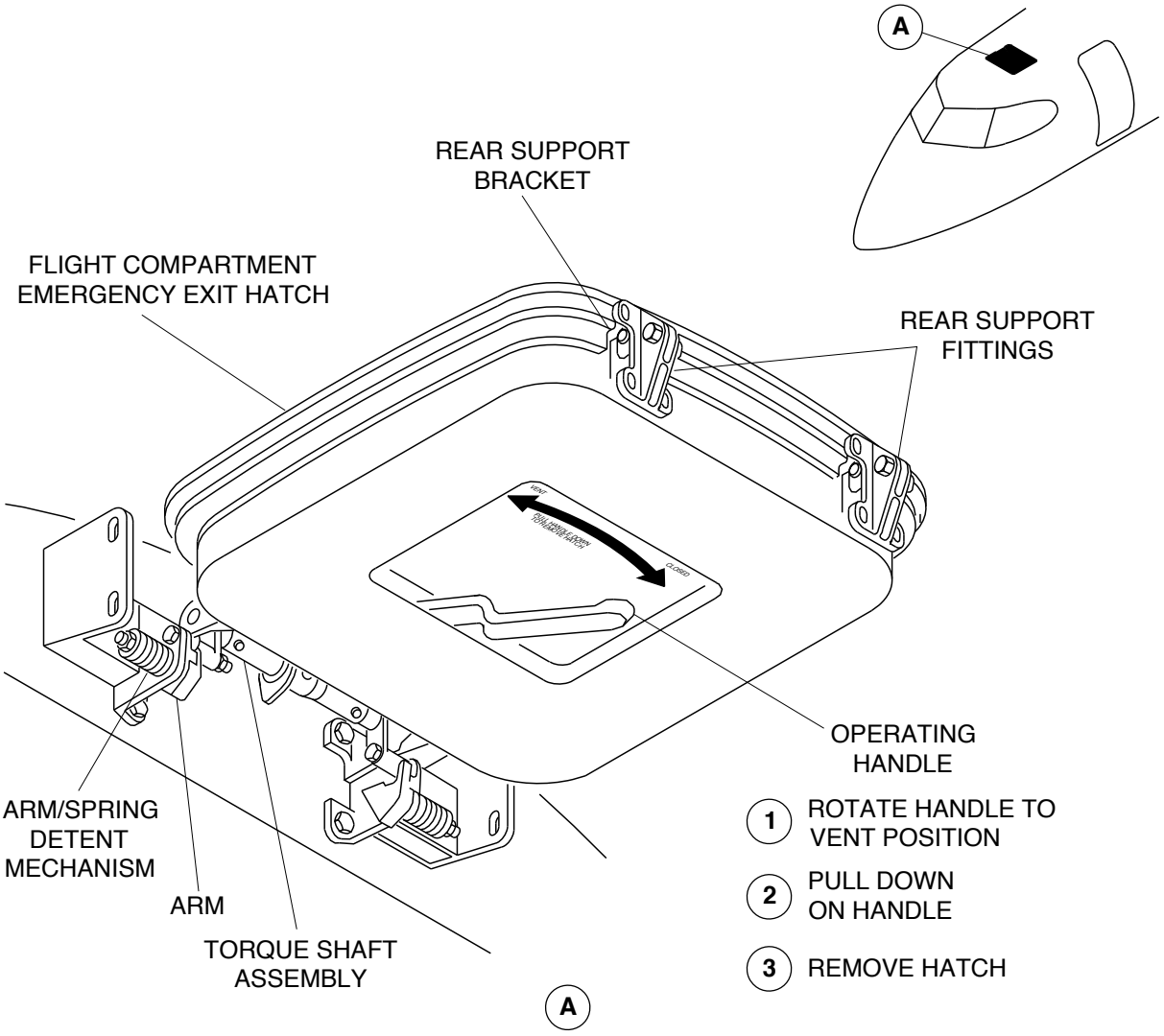
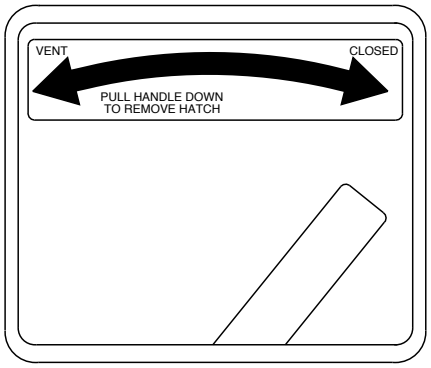
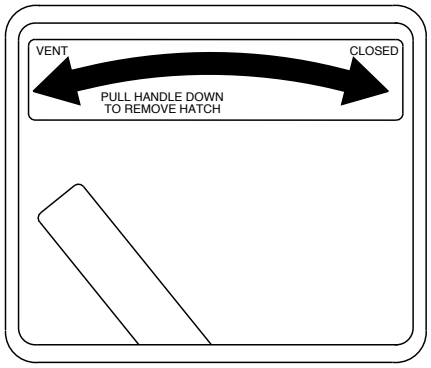
AIRCRAFT DOORS

Figure 01 – 1





OPERATING HANDLE



OPERATING HANDLE

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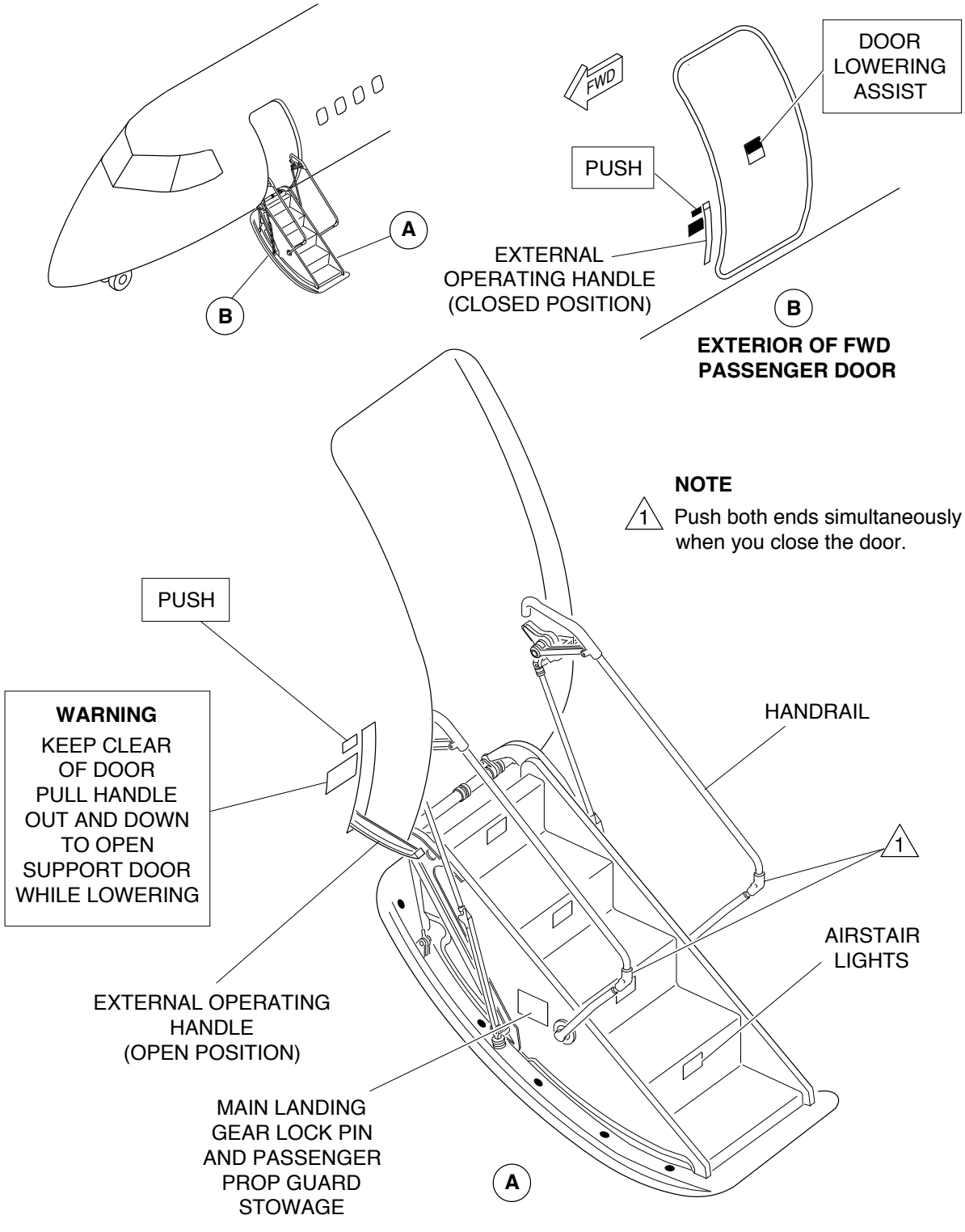
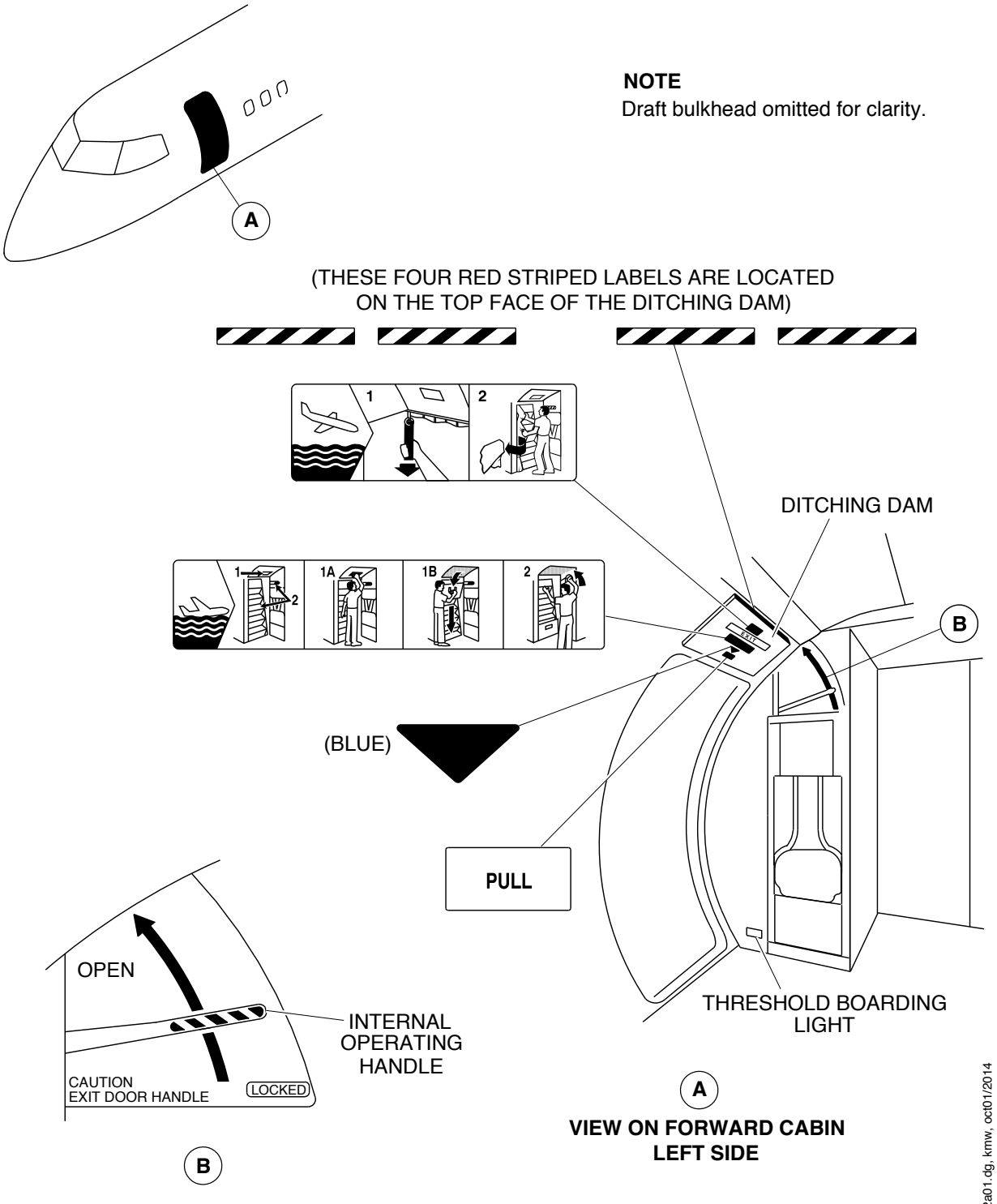
FLIGHT COMPARTMENT ESCAPE HATCH OPERATION

Figure 01 – 2



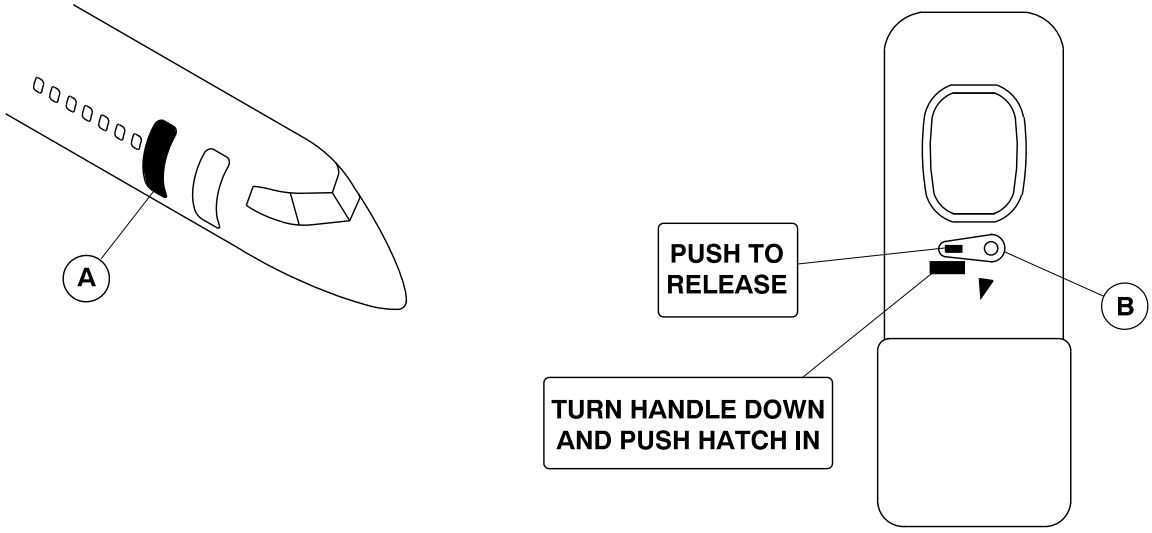
FORWARD PASSENGER DOOR OPERATION (EXTERIOR)

Figure 01 – 3



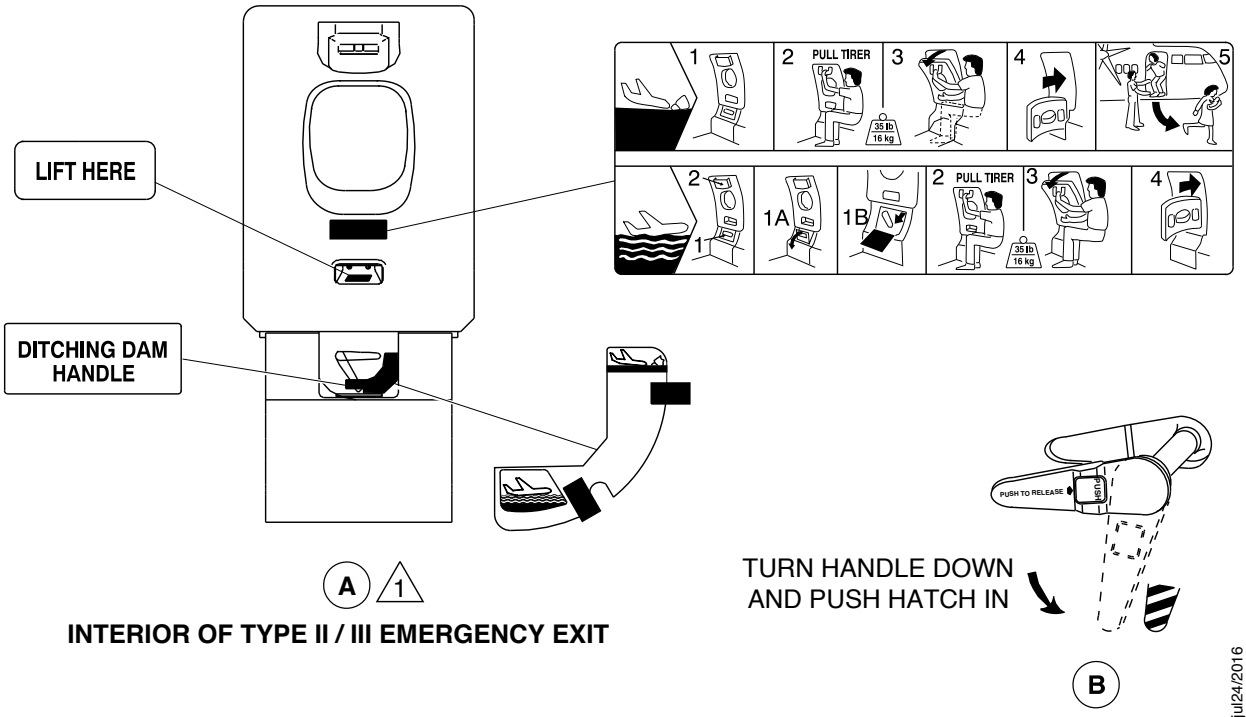
FORWARD PASSENGER DOOR OPERATION (INTERIOR)

Figure 01 – 4



A 1

EXTERIOR OF TYPE II / III EMERGENCY EXIT



A 1

INTERIOR OF TYPE II / III EMERGENCY EXIT

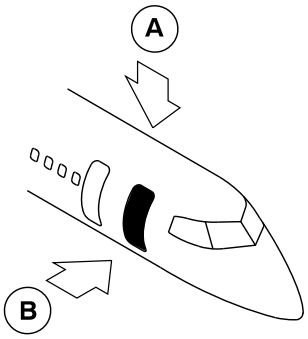
brf29a01.dg, pt/rc, jul24/2016

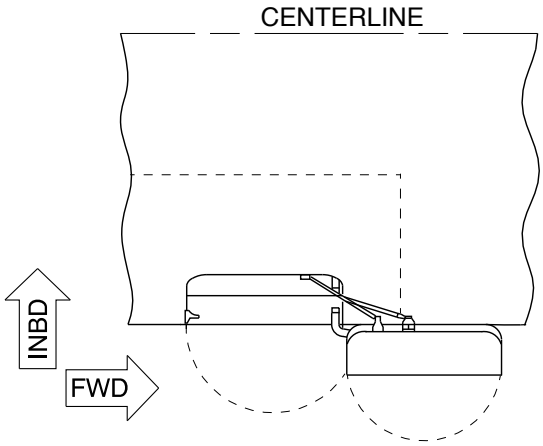
NOTE

1 Type II/III emergency exit door is de–activated for the extra capacity and cargo combi configuration.

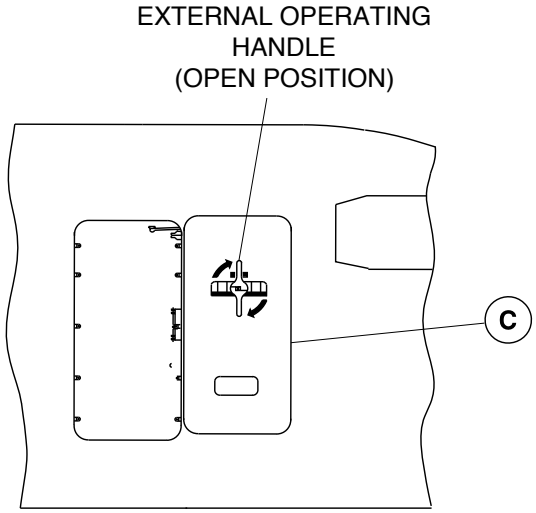
EMERGENCY EXIT DOOR (TYPE II/III) OPERATION

Figure 01 – 5

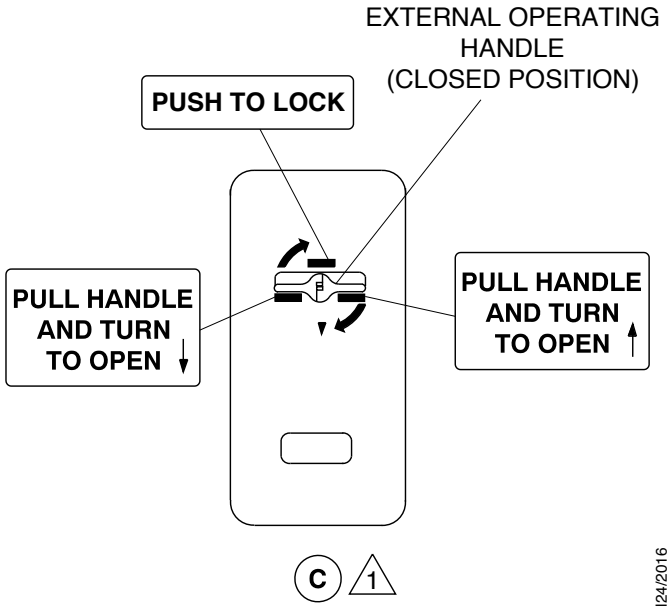




VIEW LOOKING DOWN ON R/H SIDE FORWARD BAGGAGE DOOR/ FORWARD TYPE I EMEMERGENCY EXIT DOOR (OPEN POSITION)



VIEW LOOKING INBOARD ON R/H SIDE



EXTERIOR OF FORWARD BAGGAGE DOOR/ FORWARD TYPE I EMERGENCY EXIT DOOR

NOTES

1. Forward type I emergency exit door is installed only on aircraft with extra capacity and cargo combi configuration.
2. No access to passenger cabin from exterior of aircraft if forward baggage door is installed.

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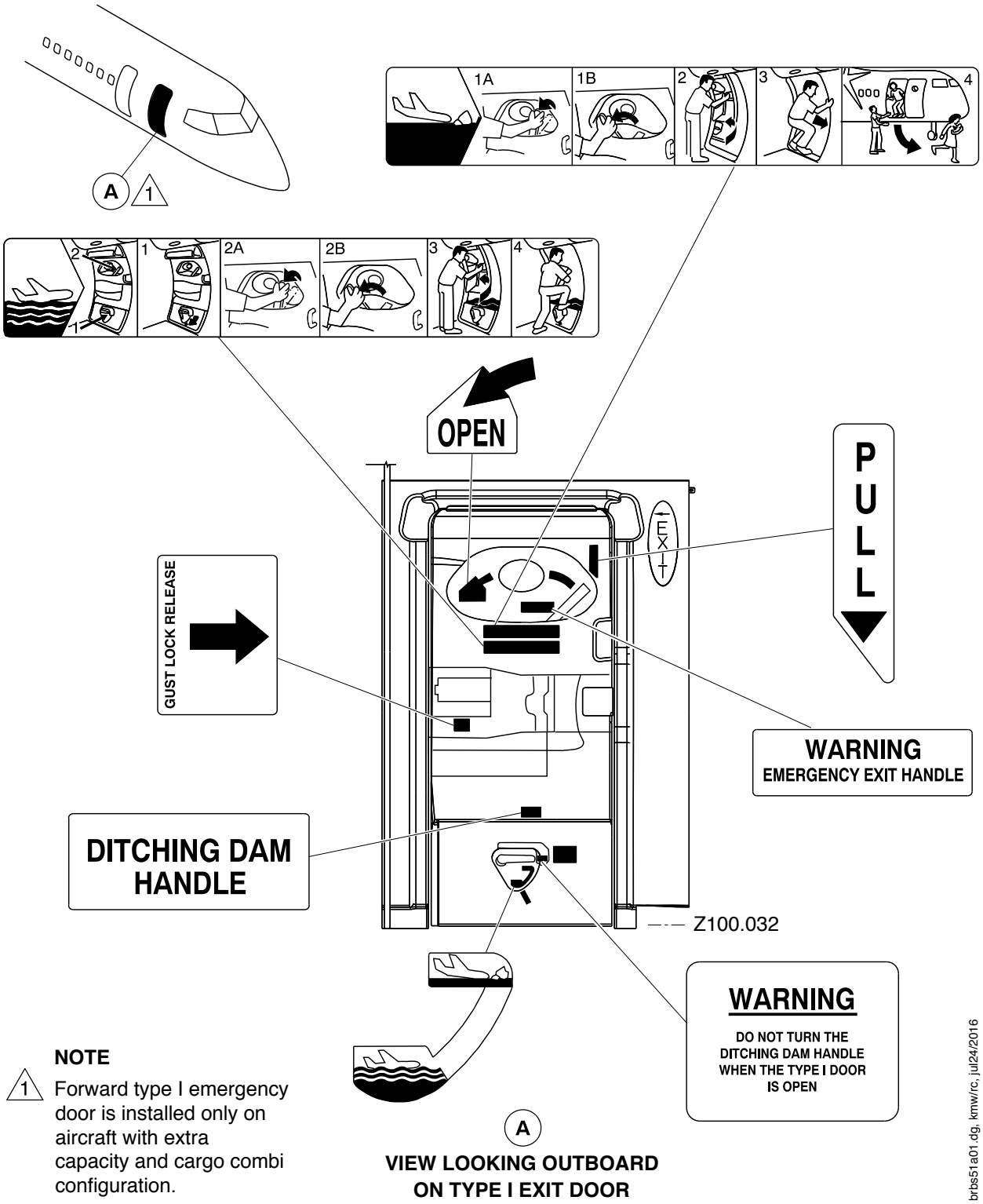
FORWARD BAGGAGE DOOR/FORWARD TYPE I EMERGENCY DOOR OPERATION (EXTERIOR)
Figure 01 – 6

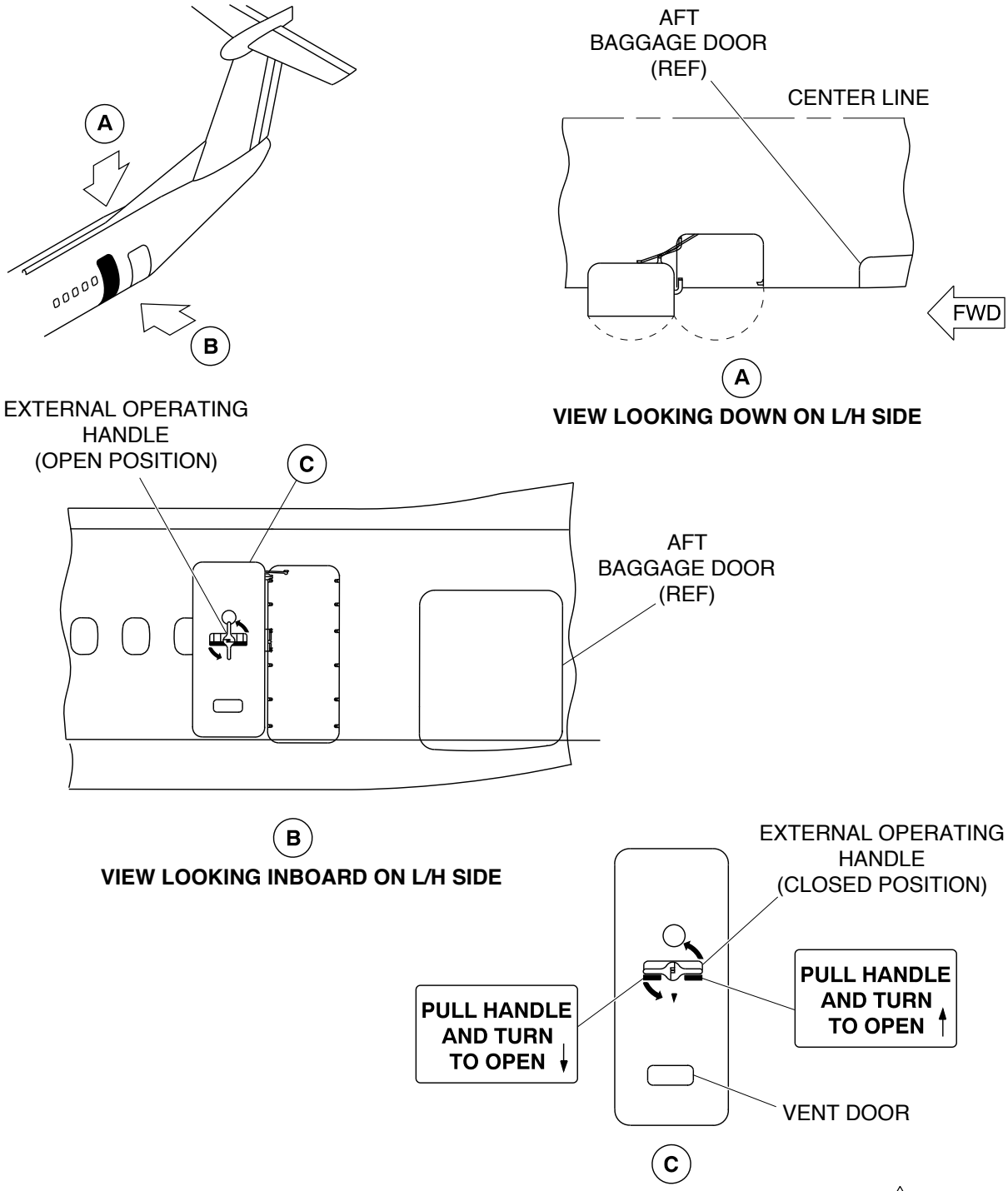


NOTE

1 Forward type I emergency door is installed only on aircraft with extra capacity and cargo combi configuration.

FORWARD TYPE I EMERGENCY DOOR OPERATION (INTERIOR)

Figure 01 – 7



NOTE

1 Aft passenger door is de–activated for the cargo combi configuration.

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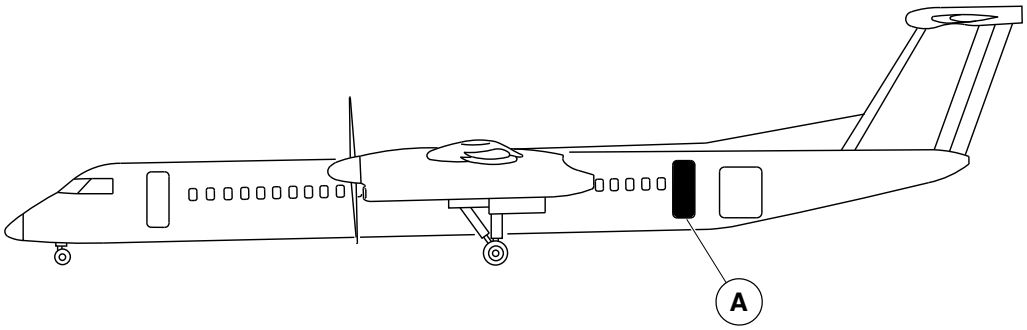
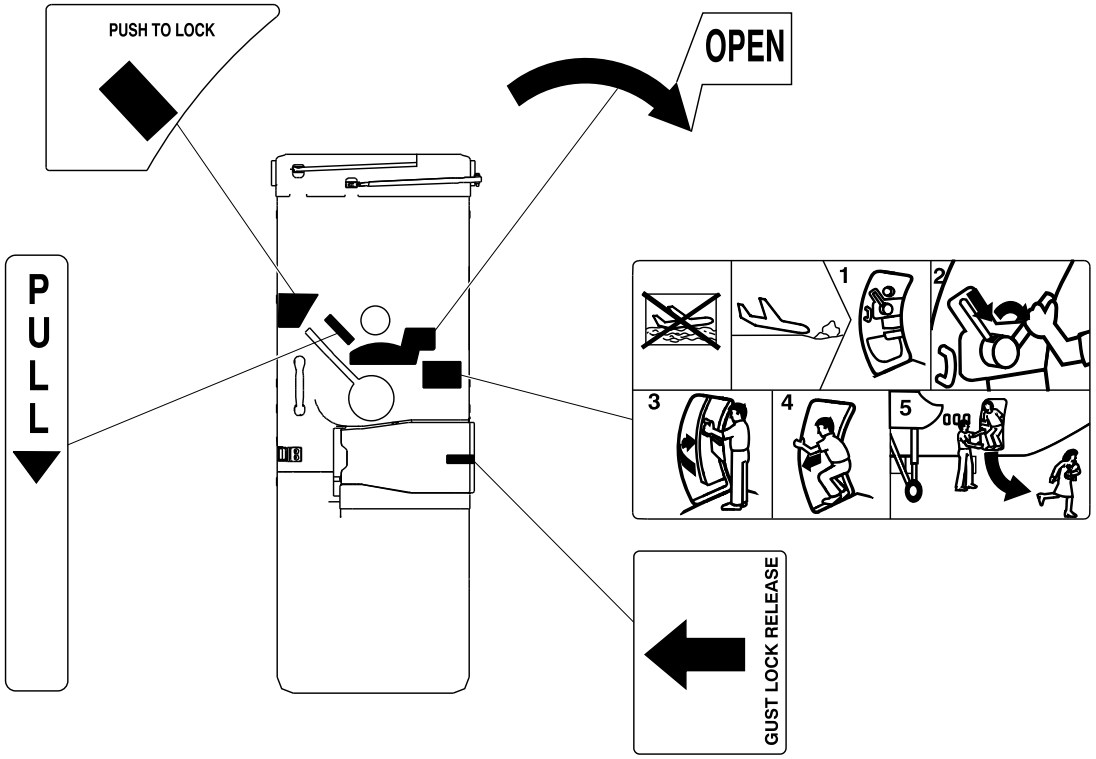
AFT PASSENGER DOOR OPERATION (EXTERIOR)

Figure 01 – 8





INTERIOR OF AFT PASSENGER DOOR 1

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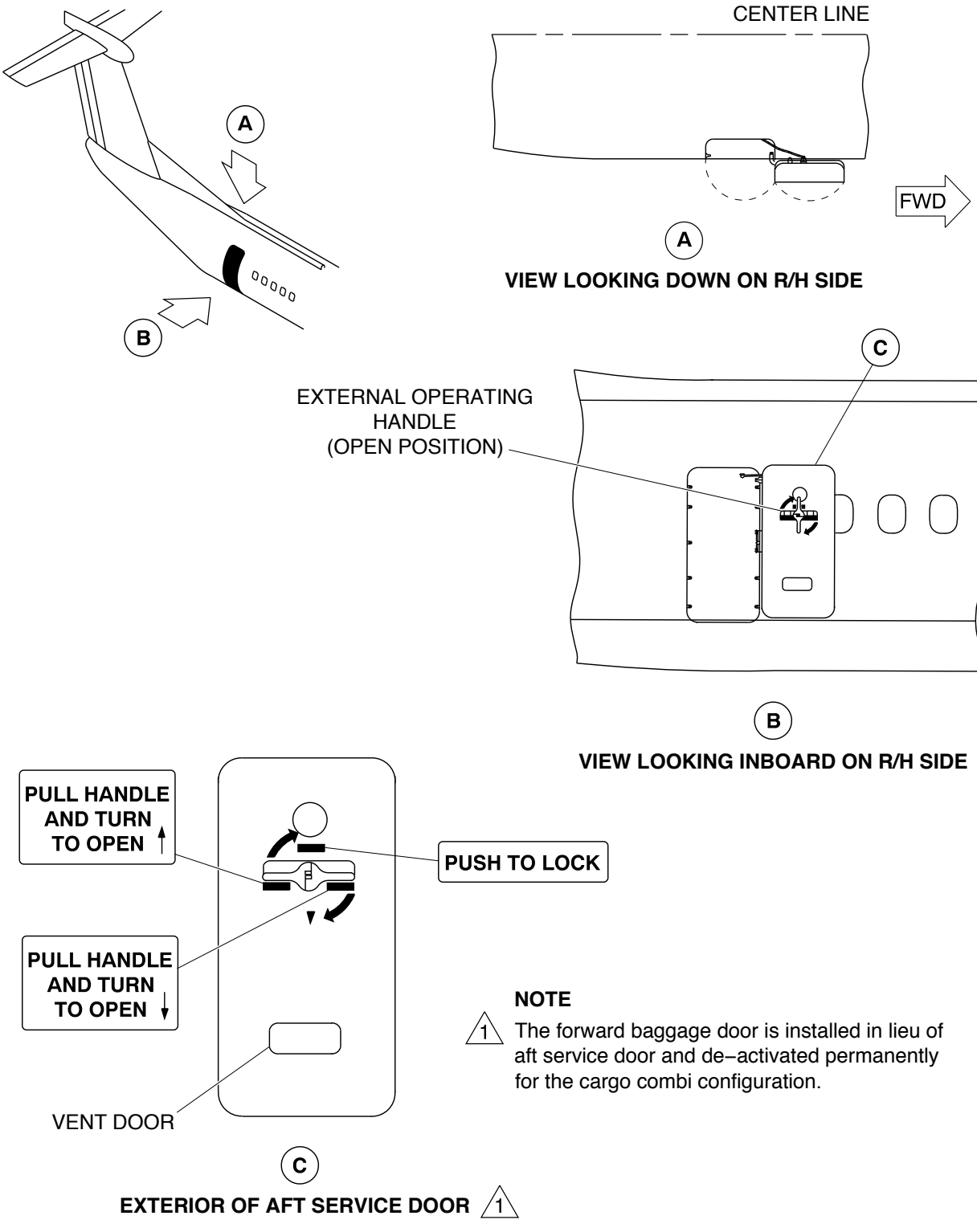
NOTE

1 Aft passenger door is de–activated for the cargo combi configuration.

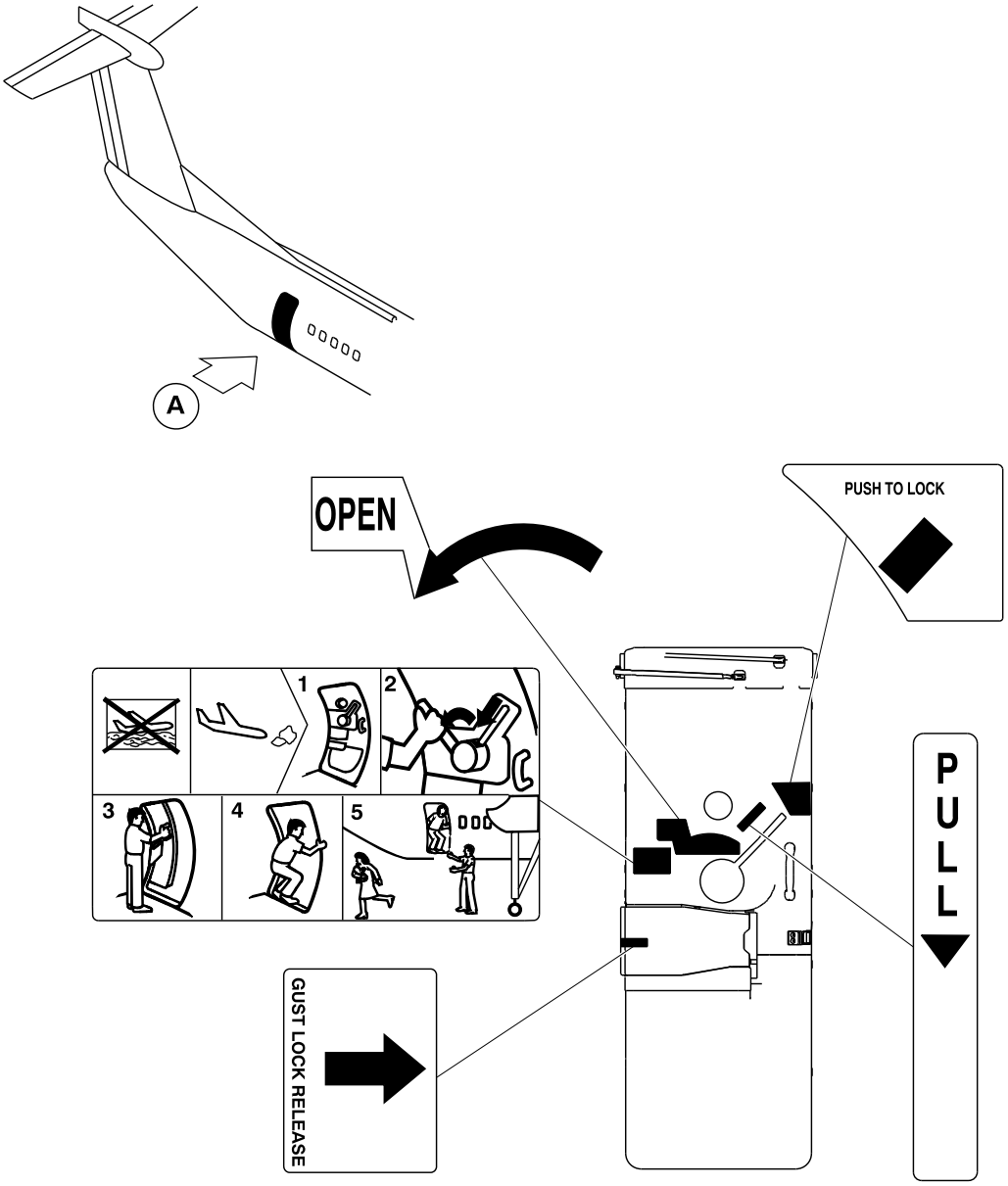
AFT PASSENGER DOOR OPERATION (INTERIOR)

Figure 01 – 9



SERVICE DOOR OPERATION (EXTERIOR)

Figure 01 – 10



INTERIOR OF SERVICE DOOR 1

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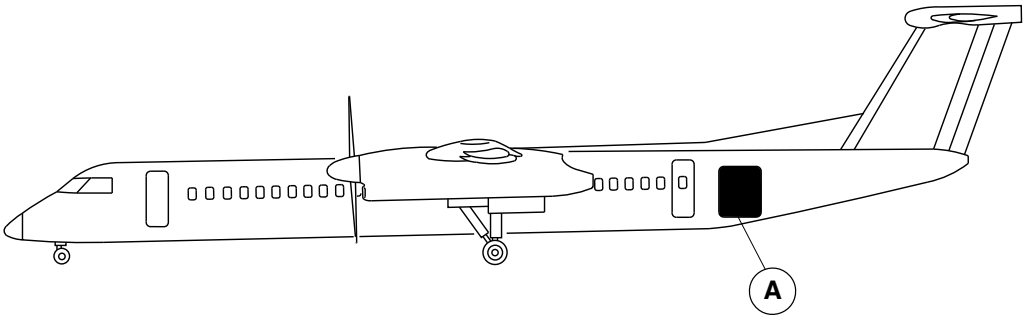
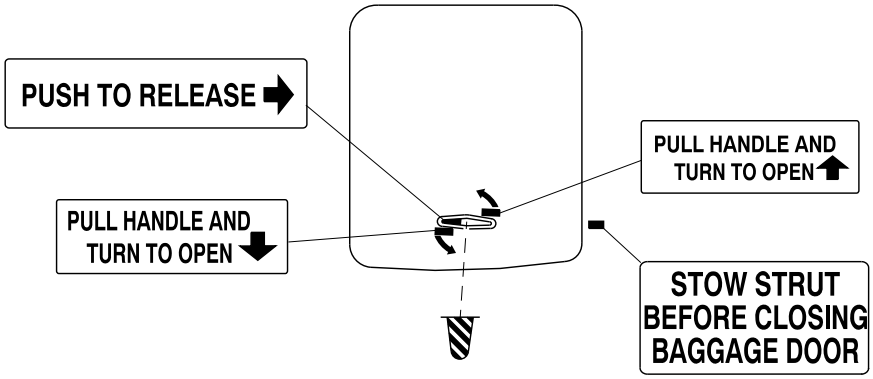
NOTE

1 The forward baggage door is installed in lieu of aft service door and de−activated permanently for the cargo combi configuration.

SERVICE DOOR OPERATION (INTERIOR)

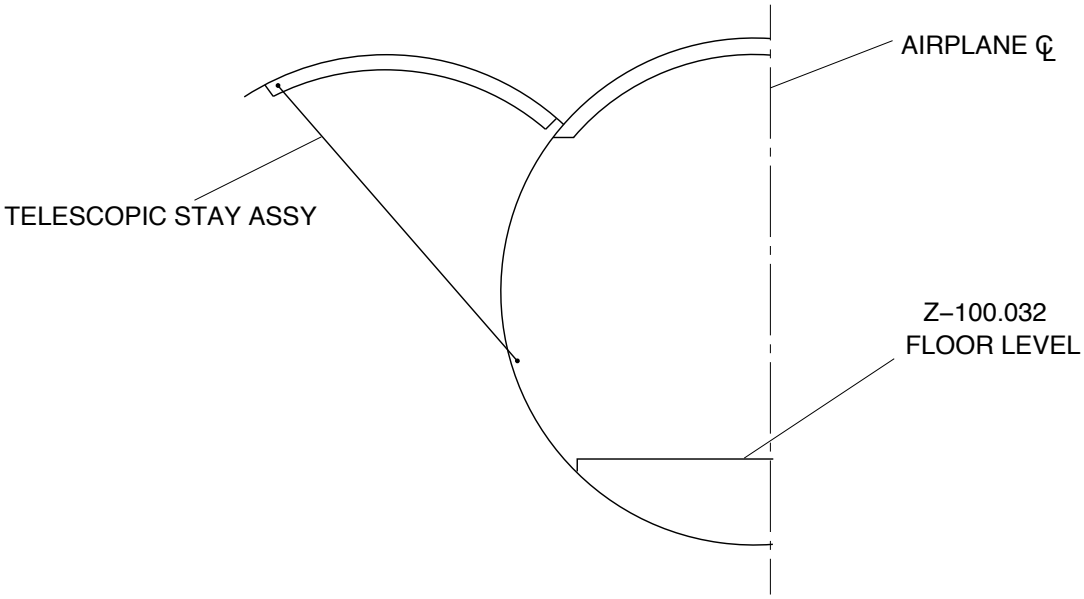
Figure 01 − 11





A

EXTERIOR OF AFT BAGGAGE DOOR (CLOSED POSITION)



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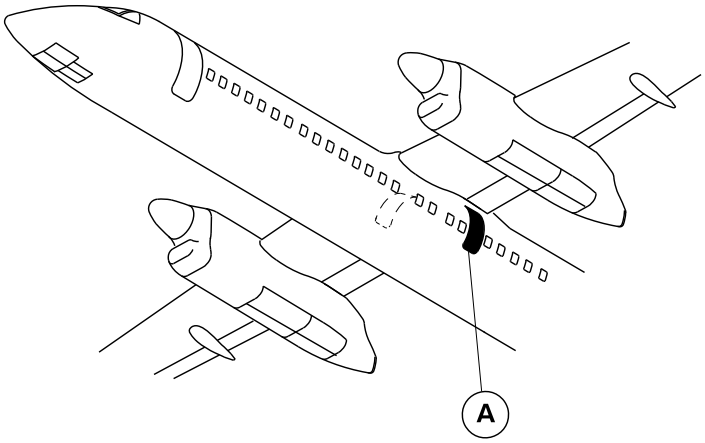
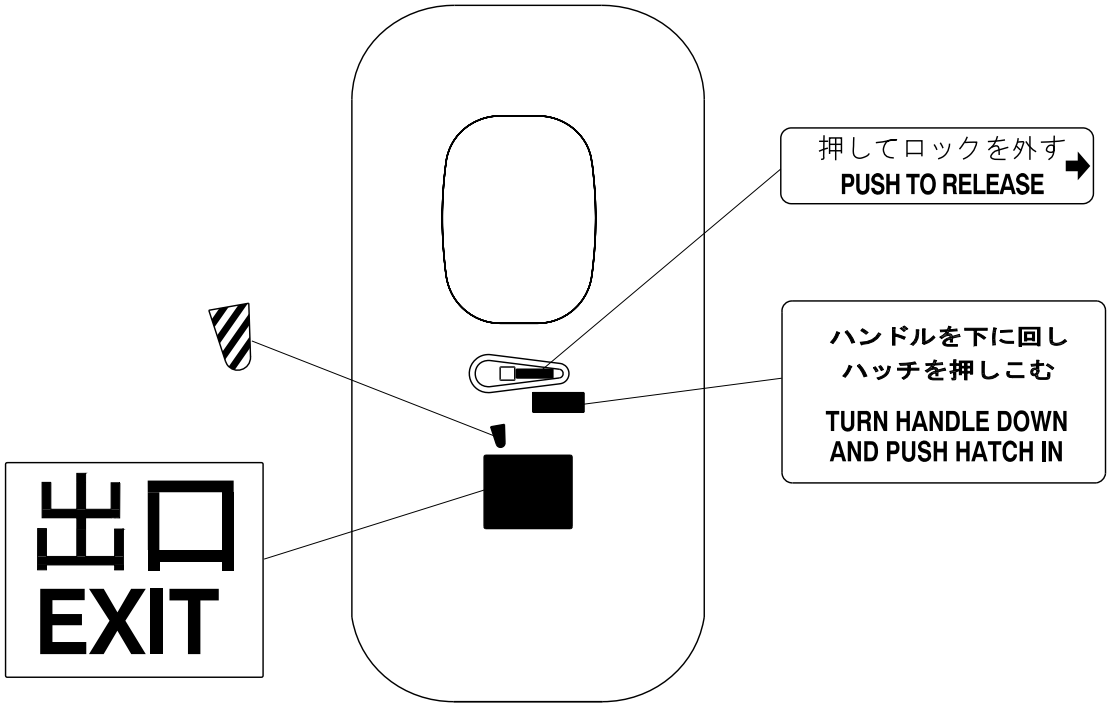
SIDE VIEW OF DOOR IN OPEN POSITION

AFT BAGGAGE COMPARTMENT DOOR OPERATION

Figure 01 – 12





**VIEW LOOKING INBOARD
ON TYPE III EMERGENCY EXIT DOOR
LEFT SIDE SHOWN, RIGHT SIDE SIMILAR**

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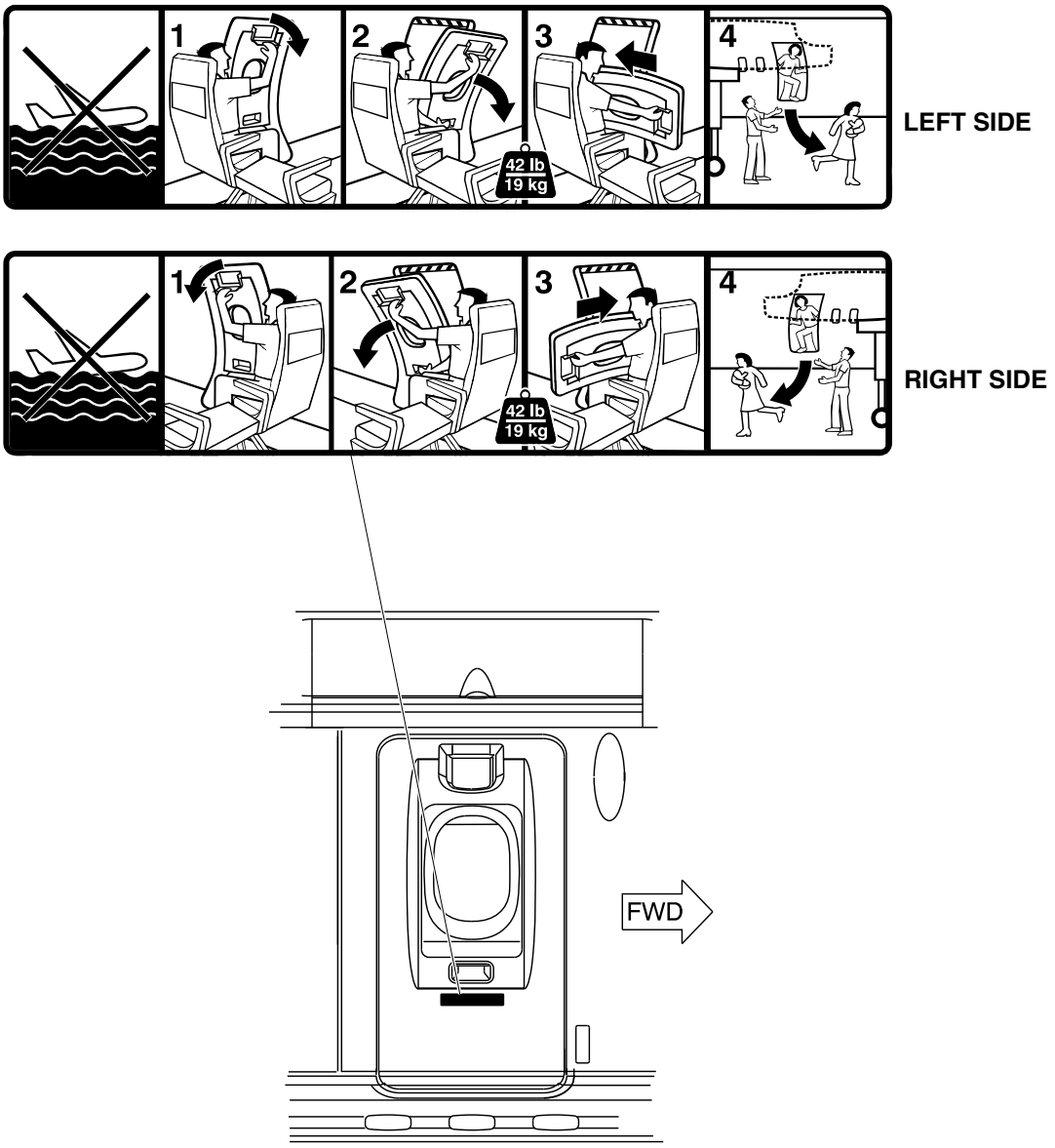
TYPE III EMERGENCY EXIT DOOR OPERATION (Sheet 1 of 2)

Figure 01 – 13



VIEW LOOKING OUTBOARD
ON TYPE III EMERGENCY EXIT DOOR
LEFT SIDE SHOWN, RIGHT SIDE SIMILAR

cg4664a02.dg, rc, jul24/2016

TYPE III EMERGENCY EXIT DOOR OPERATION (Sheet 2 of 2)

Figure 01 – 13

DE HAVILLAND AIRCRAFT
OF CANADA LIMITED

AIRCRAFT RECOVERY MANUAL

CHAPTER 02

SURVEY AND PREPARATION

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DE HAVILLAND AIRCRAFT OF CANADA LIMITED

AIRCRAFT RECOVERY MANUAL

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AIRCRAFT RECOVERY MANUAL

TABLE OF CONTENTS

SURVEY AND PREPARATION

1. General

   A. This chapter describes the preparatory planning and precautionary procedures required before an aircraft is lifted or moved. These procedures are meant to prevent accidents, minimize further damage and to accelerate the recovery process.

   B. Problems such as an engine failure, a blown tire or a brake malfunction should be handled with a minimum amount of delay. However, if the aircraft is substantially damaged in a landing, take–off or taxiing accident, an investigation will be required. In these cases, the aircraft or its parts must not be moved until approval is given by a representative of the applicable Transportation Accident Investigation Safety Board (or equivalent).

   C. Accident investigation takes precedence over aircraft recovery. The objective of investigation is to determine the cause of the accident, liability and the extent of damage. Such an investigation may be on–going throughout the recovery process.

2. Advance Planning

   A. The need for sound planning and preparation cannot be over–emphasized. Secondary damage caused during the recovery operation can sometimes be as great as the initial damage incurred. Security should be established at the site at the earliest possible time in order to:

      – Reduce fire hazards
      – Prevent theft
      – Prevent the destruction of information needed for accident investigation
      – Control unauthorized personnel from access to the site.

   B. Advance planning is required to make sure that the necessary equipment and skills will be available and can be put to use quickly when they are needed. Using this manual (PSM 1–84–9) as a guide, prepare a detailed “Aircraft Recovery Plan” for each airport where this aircraft may operate. This plan should be ready to be put into motion as soon as an accident occurs or when any required investigation permits. Consider the necessary emergency actions and assign specific responsibilities for carrying them out. The complexities involved in removing a disabled aircraft make it imperative that this plan designate a specific person to take charge of the overall operation.

   C. A trained crew of specialists can expedite the recovery operation and successfully utilize the aid of untrained personnel who may be assigned to help. Make sure that everyone concerned understands the preparations, capabilities and policies regarding the removal of disabled aircraft.

D. Representatives of local airlines should have a clear definition of their responsibilities and authority to enter into contracts for removal services. It is vital that airport authorities are aware of these arrangements.

E. Include in the Aircraft Recovery Plan, among other things:

(1) The type and location of heavy equipment or specialized units that might be needed and the average time required to get it to the airport. It is important to have aircraft defueling equipment that can move into any area or location. Due to the relatively smaller size of the Series 400, cranes and slings can easily be used to lift the aircraft. However, airbags are normally the best type of equipment to use as they will minimize damage to the aircraft.

(2) Detailed grid maps of the type referred to in the FAA Advisory Circular 150/5200–10, for use during aircraft recovery operations. These maps should show the topography of the airport site, approaches and surroundings. Road, ditches, gates, soil conditions and any other factors that could have an effect on the recovery operations should be indicated on these maps. Re–evaluation and inspection of all sites should be done periodically to keep the maps current.

(3) Access routes to all parts of the airport, especially any special routes needed for heavy equipment such as cranes. Access routes that pass under or are adjacent to bridges and overhead power lines should be clearly marked on grid maps.

(4) Manufacturer's data for aircraft recovery operations on the Dash–8 Series 400.

(5) The economic reasons to plan for the quick removal of disabled aircraft from airport operational areas, in order to maintain uninterrupted flight operations.

F. Make advance plans to obtain the services of aircraft removal equipment and crews, through agreements with other airport sponsors, with military airfields, or with aerospace industries in the vicinity of civil airports. An inventory of locally available salvage equipment should be kept current. This should include, in addition to equipment located at the airport, equipment that construction contractors and other operators of heavy machinery have nearby and will agree to make available

G. When arranging for equipment, anticipate that a primary source of equipment or operators may not be available, and that a second or even a third source for these services must be considered in the plans. Mere plans to call for heavy equipment are not enough. An operator must have commitments from companies to provide the equipment and services when they are needed.

H. It must be recognized that it will be necessary to deal with complex mechanical problems. These include hull inspection, planning of the operation, and the determination of the methods to use for lifting and removal operations.

I. The conditions of the aircraft must be determined, as most of the work associated with removal will depend on these findings. Other major considerations include weather, terrain, and the type of special removal equipment (i.e. cranes and winches) available on the airport or through local rental companies and contractor.

J. The table that follows shows some of the more common situations that occur which result in an aircraft becoming disabled, along with typical methods of removal.

CONDITIONS	TYPICAL METHODS OF REMOVAL
COLLAPSED NOSE GEAR	JACKING AND USE OF PNEUMATIC LIFTING BAGS; HOISTING WITH CRANES AND SLINGS.
COLLAPSED OR RETRACTED MAIN GEAR, BUT NOSE GEAR INTACT AND EXTENDED	JACKS, PNEUMATIC LIFTING BAGS, OR CRANES.
COLLAPSED MAIN GEAR, ONE SIDE ONLY	JACKS, PNEUMATIC LIFTING BAGS, OR CRANES.
COLLAPSE OF ALL LANDING GEARS	JACKS, PNEUMATIC LIFTING BAGS, AND CRANES.
ONE OR MORE MAIN GEAR OFF PAVEMENT, NO AIRCRAFT DAMAGE	IF THE GEAR IS BOGGED DOWN IN SOFT SOIL OR MUD, A TOWING KIT (REFER TO 04–20–00) OR THE USE OF PNEUMATIC LIFTING BAGS WILL USUALLY BE SUFFICIENT FOR THIS TYPE OF REMOVAL. IT MAY BE NECESSARY TO CONSTRUCT A TEMPORARY RAMP OF TIMBERS, MATTING, ETC..
NOSE GEAR FAILURE AND ONE SIDE OF MAIN GEAR FAILURE	JACKS, PNEUMATIC LIFTING BAGS, OR CRANES.
TIRE FAILURES AND/OR DAMAGED WHEELS	JACKS AND PARTS REPLACEMENTS.

(1) In addition to lifting an aircraft, plans are required for equipment to remove an aircraft whose gear cannot be lowered. Equipment which has been most frequently used for this purpose includes flatbed trailers and various types of dollies.

(2) Other equipment or systems, such as that offered by companies who specialize in this business, are also available. While these companies use special equipment to move an aircraft, they also complement conventional equipment, such as jacks or cranes.

K. The manufacturer of pneumatic lifting bags is listed below:

L. The field representatives of aviation insurance–underwriting companies can usually provide information about firms or individuals who are experienced in aircraft recovery operations. This assumes that the insurance firms are notified of the accident occurrence promptly. De Havilland Aircraft of Canada Limited (In–Service Structures Engineering Group) may also be contacted by telephone on a 24 hour basis at (416) 375–4000 for recovery assistance.

M. Aircraft with part or all of their landing gear off the runway will probably require defueling before other operations. It is therefore essential that arrangements are made to obtain defueling equipment.

N. In exceptional cases where the aircraft is broken up and is determined to be beyond salvage, plans and arrangements are required to obtain bulldozers, etc. These are emergency situations where secondary damage to the aircraft is not a limiting consideration. The required plans should include methods for dragging an aircraft off a runway in a emergency situation with cables and towing equipment.

O. Due to the infrequent use of removal equipment (such as pneumatic lifting bags), there can be special problems associated with storage, inventory and periodic inspection/testing. Proper maintenance and storage procedures are essential to ensure that removal equipment is serviceable and available at all times.

DAMAGE AND TERRAIN

WARNING: OBEY THE SAFETY PRECAUTIONS THAT FOLLOW BEFORE YOU START THE DAMAGE SURVEY:

FLUSH THE AIRCRAFT AND GROUND SURFACES WITH WATER TO NEUTRALIZE SPILLED FLAMMABLE LIQUIDS.

DISCONNECT AND REMOVE THE BATTERIES.

IF THE LANDING GEAR IS EXTENDED, ENGAGE THE GROUND LOCK AND INSTALL THE LOCKPINS.

GROUND THE AIRCRAFT TO A COPPER–COATED STEEL ROD AND CABLE.

REMOVE PRESSURE FROM THE HYDRAULIC SYSTEMS.

REMOVE THE OXYGEN BOTTLES.

IF YOU DO NOT FOLLOW THESE PRECAUTIONS, YOU CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

1. General

   A. The sections that follow cover these topics:

      (1) The initial survey of damage, an initial examination of structural condition, and an examination of the influence of structural condition on the recovery.

      (2) The necessity for soil analysis for load bearing and tethering capability.

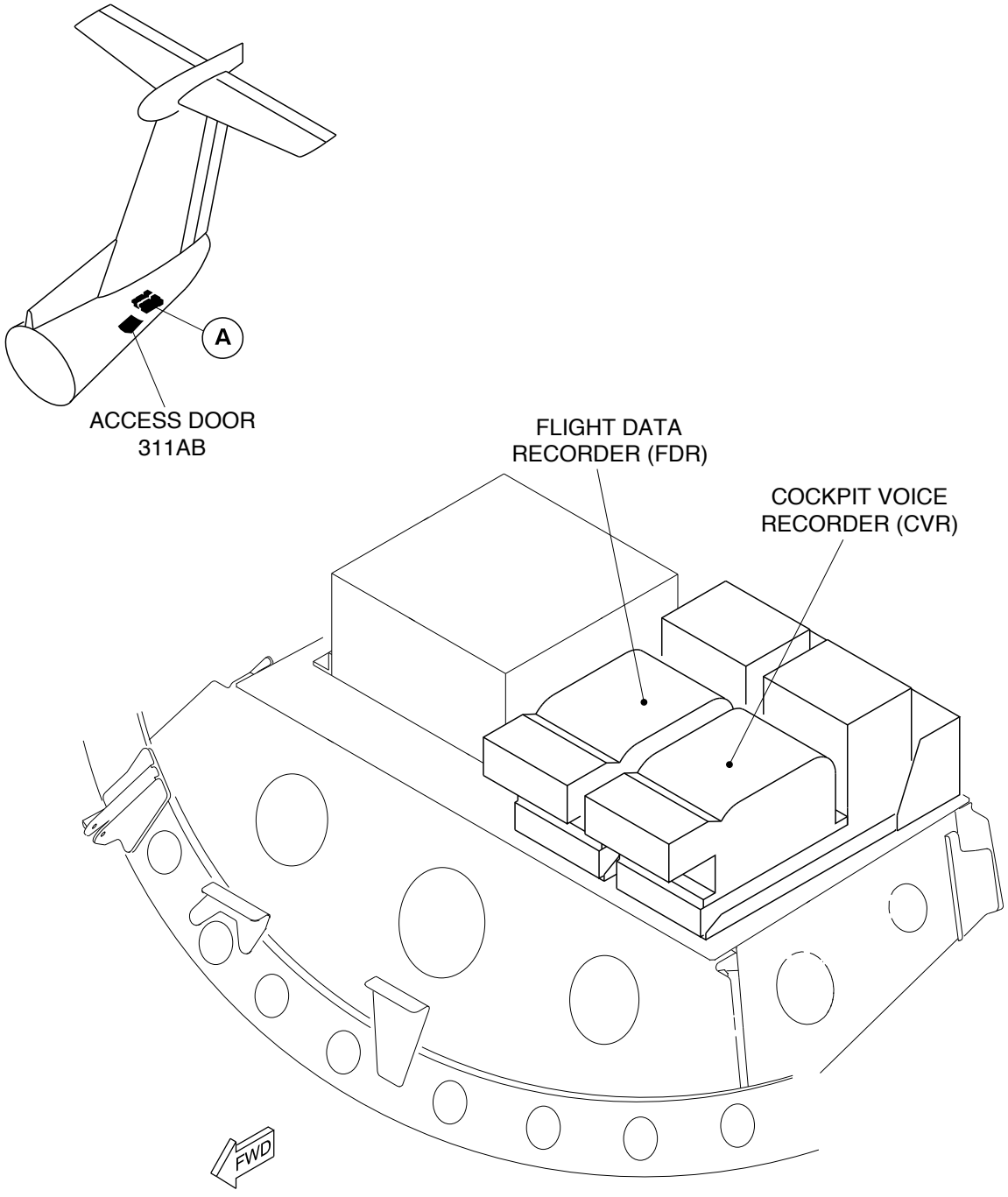
      (3) Terrain features, access and site preparation.

   B. Cockpit Voice and Flight Recorders

      (1) Remove the cockpit voice and flight recorders. They are located together in the aft fuselage. Access to the recorders is through access panel 311AB on the underside of the fuselage (refer to Figure 02–1).

   C. Before Inspection for Damage

      (1) It may be necessary to clean the aircraft of ground residue before you can inspect the aircraft for damage.



COCKPIT VOICE AND FLIGHT DATA RECORDERS

Figure 02 – 1

AIRCRAFT DAMAGE REPORTS

1. General

   A. Determine the condition of the aircraft as early as possible. Refer to flight–crew log sheets, insurance carrier's report and operator's incident report.

   B. The preliminary report is to be followed by one or more detail reports that provide a more explicit description of the damage and the existing conditions. These reports give direction to repair activities and/or removal of the aircraft from the scene of the incident. Photographic coverage of the damage is to be provided as soon as practical. Digital cameras are recommended for their ability to transmit photos by electronic mail.

   C. Determine how the impact of the accident may have affected the other structural members. Rivets, bolts or fasteners of any kind that are tipped, sheared or loose may serve as clues to damaged internal structure. Whenever buckling, cracks or elongation is observed, the structural member is considered to have failed and should not be depended upon to carry the load for which it was designed.

   D. Since it is the intent to first try and tow the aircraft by the use of its landing gear, the gear and its supporting structure must be carefully inspected. Check the stabilizer strut, shock strut, drag strut, frame assembly as well as the yoke assembly.

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CONDITION OF SOIL

1. General

   A. In order to determine the proper method of recovery, the strength and condition of the soil around the aircraft and along the recovery path to a hard surface will need to be determined.

   B. The condition of the soil, the extent of structural damage to the aircraft and weather conditions all have an influence on the selection of the procedures that will be required to move the aircraft.

   C. Soil strength characteristics are required to determine the type of jacking, shoring, towing and ground anchor operations which will be used (refer to Figure 02–1).

   D. The services of a civil engineer or soil analyst may be contracted to study the surface bearing ability of the local ground.

   E. Check the forecasted weather reports as it may affect the terrain.

      (1) Heavy rains may turn the soil to mud. Drainage ditches may have to be dug in order to remove excess water.

      (2) Snow, ice and high winds will adversely affect the recovery operation.

APPROX. CBR RANGE (1)	SURFACE MATERIAL	SHORING (CRIBBING) REQUIRED FOR ROLLING LOADS				SHORING (CRIBBING) REQUIRED FOR ROLLING LOADS			
		MAXIMUM ALLOWABLE CONTACT PRESSURE		MINIMUM CONTACT AREA REQUIRED PER 2,000 LBS	1,000 KG	MAXIMUM ALLOWABLE CONTACT PRESSURE		MINIMUM CONTACT AREA REQUIRED PER	
		PSI	KG/CM^2	(IN^2)	(CM^2)	PSI	KG/CM^2	(FT^2)	(M^2)
2–6	SOFT WET CLAY OR WET ORGANIC SOIL	18	1.25	1,100	8,000	8	.55	130	12.7
8–20	LOOSE SAND OR SANDY SOIL	65	4.5	300	2,200	35	2.4	30	3.0
15–30	SAND AND CLAY	100	6.9	200	1,450	50	3.5	21	2.0
20–60	WELL GRADED SAND AND MEDIUM CLAY	180	12.4	110	800	85	5.9	12.5	1.2
20–60	SANDY GRAVEL OR CLAYEY GRAVEL OR DRY CLAY	300	20.7	65	480	165	11.4	6.3	.6
50 AND ABOVE	COMPACTED SANDY CLAYEY GRAVELS	N/A	N/A	N/A	N/A	200	13.8	5.2	.5

(1) CBR Data is given for reference only. The load carrying capability of surface soil can be stated in terms of CBR, but a wet material having a CBR of 4 or 5 can be equal in bearing strength to a CBR of 40 or 50 material, when dry.

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SOIL SURFACE CONDITIONS FOR SHORING (CRIBBING)

Figure 02 – 1

TERRAIN FEATURES

1. General

   A. In order to determine the most practical method of lifting and moving the aircraft, these factors must be considered:

   - The firmness, condition and the slope of the terrain around the aircraft accident site
   - The extent of damage to the aircraft
   - The weather conditions.

   B. In addition to the physical features, it should be determined whether the site and access roads are on private or public property. Arrangements should be made to survey the site and access roads as part of the legal requirements. Photographs should be taken before and after the recovery process as a part of the planning function and for records. Towing or winching operations will require the grading of high and low spots to smooth out the path of the aircraft and tow vehicles.

   C. Observe surface hardness, smoothness and drainage for possible effects of rainfall on the load–carrying capability of the ground. Determine the safe bearing load and surface area of the ground. The soil strength should have the same California Bearing Rating (C.B.R.) for a depth of 8 inches (20.35 cm). The force to tow an aircraft increases as a function of the softness of the ground. Rain and snow can further complicate the recovery operation. Irrigation pumps will be required or drainage ditches will have to be dug to divert standing water.

   D. If the jacking points are buried, it will be necessary to dig down to hard ground to expose enough hard surface area for shoring (cribbing).

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ACCESS AND SITE PREPARATION

1. General

   A. It is advantageous to start defueling operations as soon as possible after passenger evacuation. It would probably save time and expedite the defueling and unloading operations if material (such as fiberglass matting, or various types of airfield landing mat, or other ramp construction materials) is kept at the airport to make a temporary vehicle roadway to the aircraft. Consider using material that can be reused (such as matting), rather than constructing a temporary roadway from crushed stone or gravel (which can be turn out to be costly). There are obvious advantages to any planning that calls for a single means of access to the aircraft and to bring the aircraft out.

   B. Depending on the local conditions, steps should be taken to:

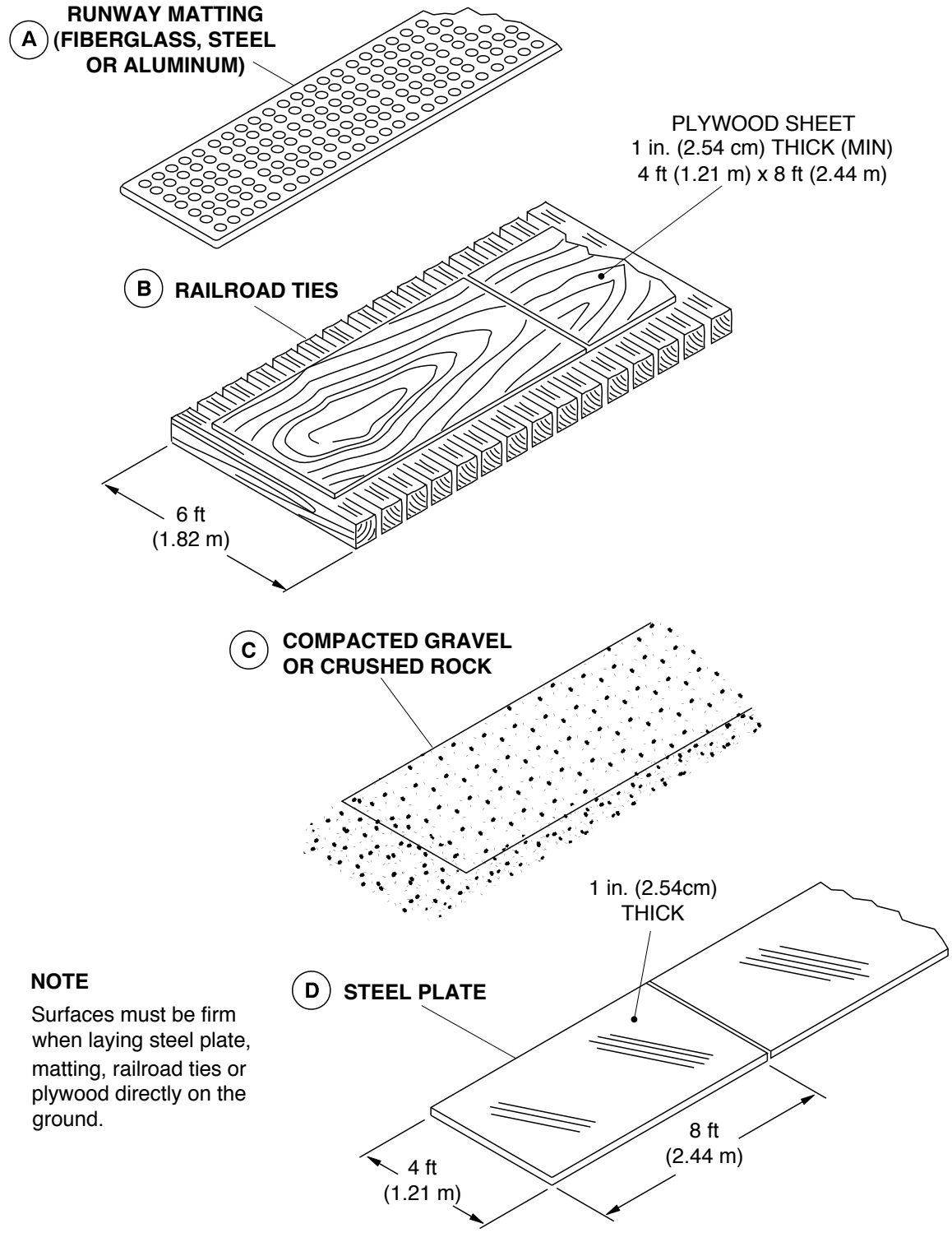
      – Clear shrubs and trees
      – Fill ditches
      – Level the immediate site area
      – Prepare access roads.

2. Manufactured and Prepared Surfaces

   A. Sometimes it will be necessary to prepare a path from the aircraft to the runway. A ramp or treadway over soft ground will facilitate the towing of the aircraft. Several methods are available for stabilizing the surface (refer to Figure 02–1).

   B. Drain or evacuate any standing water. Pour gravel or crushed rock in the affected area and pack it down. Use a power tamper to obtain sufficient bearing strength (some soft mud will probably be displaced with this action). Next, steel matting, railroad ties, plywood, steel plate or any of these combinations may be laid over the compacted gravel.

   C. Most available railroad ties are usually reclaimed and are thus uneven when laid crosswise to the desired path. In these cases heavy timbers can be used instead of railroad ties. Steel plate or plywood will smooth out the rough surface. Plywood, when laid in layers, must be arranged so that the joints are staggered.



NOTE

Surfaces must be firm when laying steel plate, matting, railroad ties or plywood directly on the ground.

TYPICAL PREPARED SURFACES

Figure 02 – 1

DAMAGE CONTROL AND SAFETY

WARNING: IF YOU THINK THERE WILL BE HIGH WINDS, OBEY THE SAFETY PRECAUTIONS THAT FOLLOW:

TETHER THE AIRCRAFT AS NECESSARY.

DO NOT TRY TO LIFT THE AIRCRAFT ON JACKS OR MOVE THE AIRCRAFT IF THE WIND SPEEDS ARE 20 MPH (32 KM/H) OR MORE.

IF NECESSARY, USE FACE MASKS AND SAFETY GOGGLES FOR PROTECTION AGAINST AIRBORNE DUST AND SAND.

IF YOU DO NOT FOLLOW THESE PRECAUTIONS, INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT CAN OCCUR.

WARNING: DO NOT START A RECOVERY OPERATION IF THE AIRCRAFT IS ON FIRE OR THE AIRCRAFT HAD A FIRE.
STAY A SAFE DISTANCE AWAY FROM THE SITE UNTIL PERSONNEL CLEAN IT UP AND THE AUTHORITIES DECLARE IT SAFE.
IF YOU DO NOT DO THIS, THE POISONOUS SMOKE AND CONTAMINATION FROM BURNING COMPOSITE MATERIALS CAN CAUSE DAMAGE TO SKIN, EYES, AND LUNGS.

1. General

   A. To prevent additional damage to the aircraft or injuries to personnel during recovery procedures, observe the safety precautions that follow:

      (1) Tether (tie down, or moor) the aircraft as necessary.

      (2) Do not lift the aircraft or move it when the wind speeds are forecasted to be 20 mph (32 km/h) or more.

      (3) Wear face masks and safety goggles if sand or loose soil are present and the wind speeds will be higher than 20 mph (32 km/h).

      (4) Do not start a recovery operation if the aircraft is on fire or if there has been a fire. Stay a safe distance away from the accident site until it has been cleaned up and is declared safe by the appropriate authorities. The Dash–8 Series 400 contains many composite materials. When these are burned, the smoke and residue can cause serious damage to eyes, skin and lungs.

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DAMAGE CONTROL

1. General

   A. If the site of the incident and extent of damage prevents immediate movement of aircraft to a location where it can remain for an extended period of time, then damage control is required. To secure the aircraft against additional damage, do the steps that follow:

   NOTE: The aircraft attitude, damage or location may prevent completion of all the items that follow. The basic goal is to secure the aircraft as much as possible to prevent further damage.

   (1) Make sure that the nose gear ground–lock and main landing–gear lockpins are installed, where possible.

   (2) Install wheel chocks and secure them with sandbags, where possible.

   (3) Tether (tie down) the aircraft, as necessary (refer to Figure 02–1).

   (4) Install nose and wing jacks and extend them so that they are snug at jack points (without lifting the aircraft). Install railway ties, plywood panels or steel plates beneath the jacks to prevent sinking.

   (5) If the nose gear has collapsed and the tail is elevated, brace the nose section with sandbags on each side. Secure the tail section with a tethering line attached to ground anchors. Repeat this procedure (if possible) to secure a wing tip if a main landing gear has collapsed.

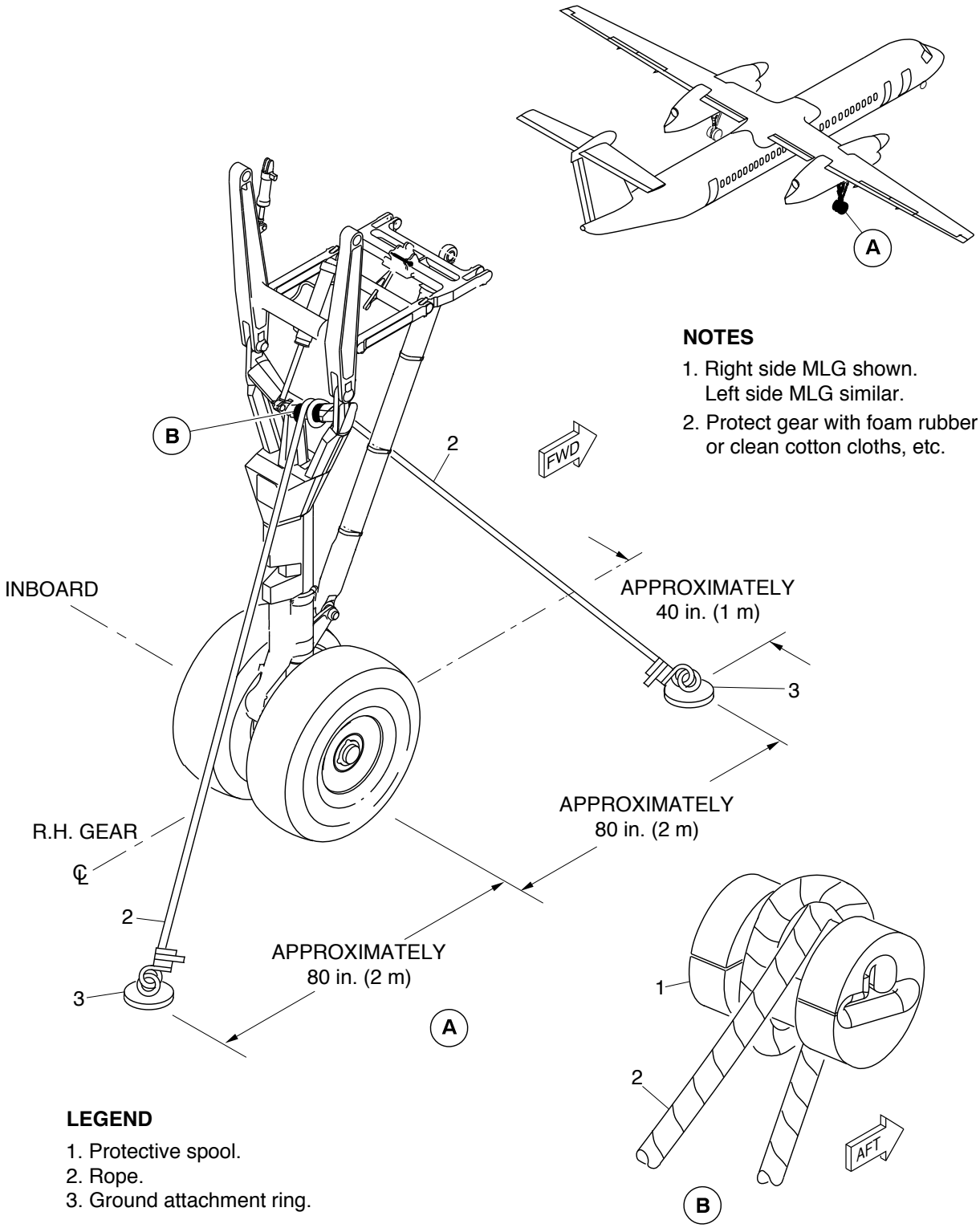
   (6) Make sure that aircraft batteries have been removed.

   (7) Remove baggage and cargo.

   (8) Install propeller restraints and install engine and other protective covers (refer to Figure 02–2).

   (9) Close all doors, emergency exits, escape hatches and access panels.

   (10) Remove any spilled fuel from the ground. Make sure that all applicable environmental regulations are followed.



NOTES

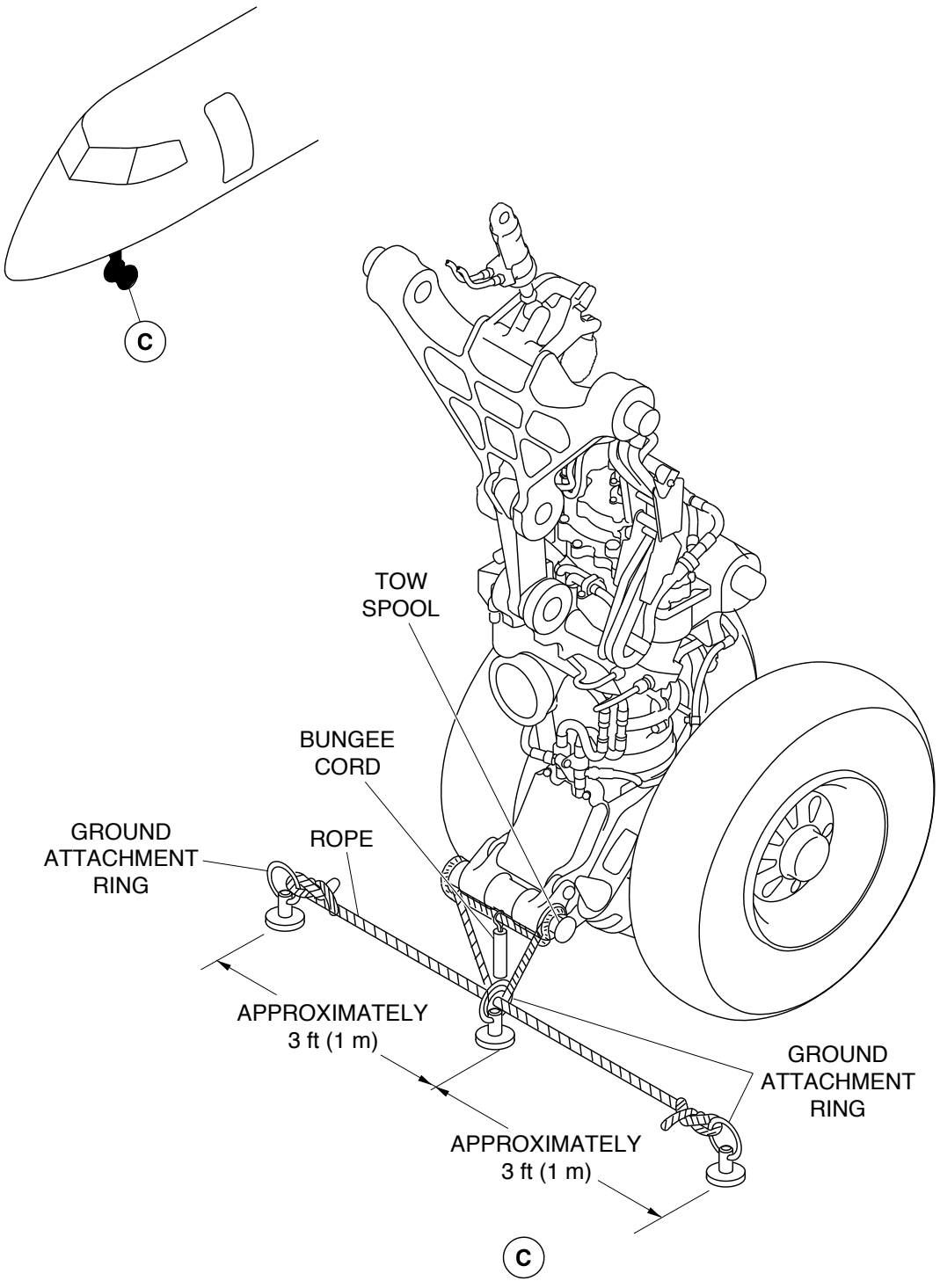
1. Right side MLG shown. Left side MLG similar.
2. Protect gear with foam rubber or clean cotton cloths, etc.

LEGEND

1. Protective spool.
2. Rope.
3. Ground attachment ring.

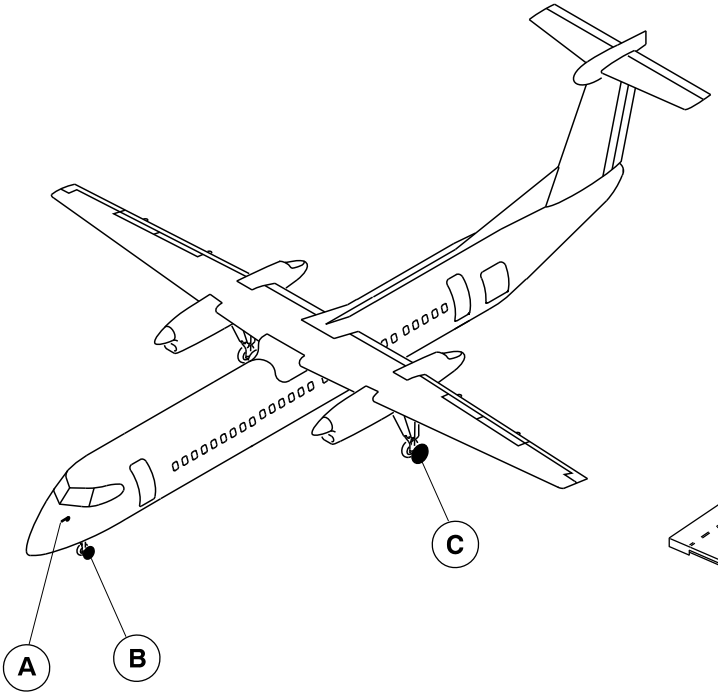
AIRCRAFT TIE DOWN PROVISIONS (Sheet 1 of 2)

Figure 02 – 1



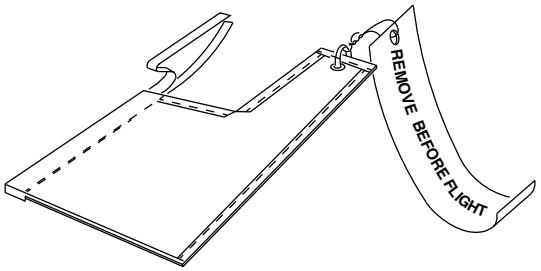
AIRCRAFT TIE DOWN PROVISIONS (Sheet 2 of 2)

Figure 02 – 1



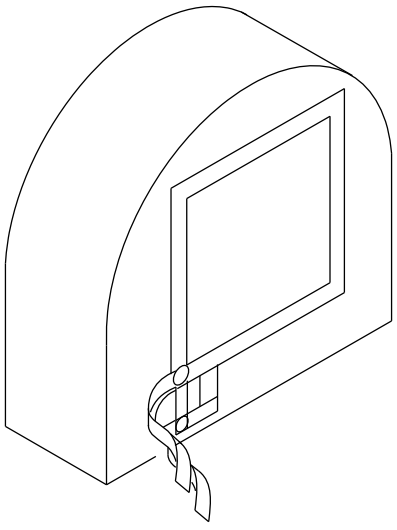
NOTE

This is not an exhaustive list.
For further detail, consult the ITEM, PSM 1–84–2T.



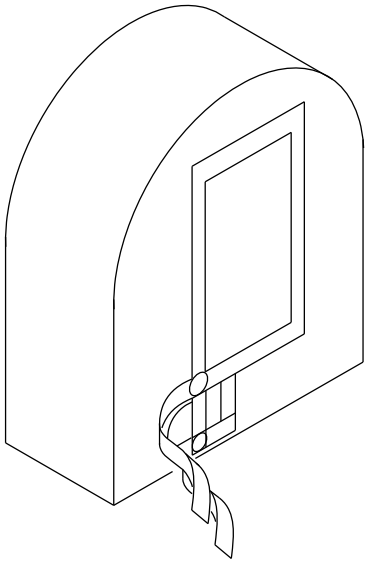
PITOT HEAD COVER

(A)



NLG WHEEL COVER

(B)



MLG WHEEL COVER

(C)

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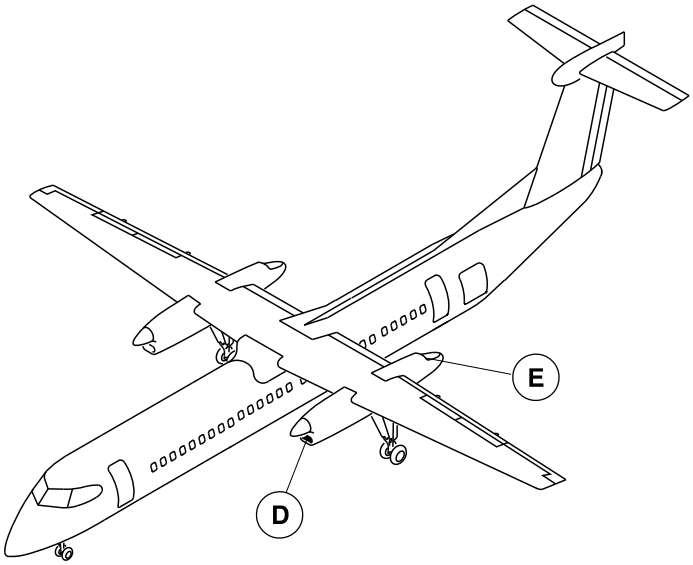
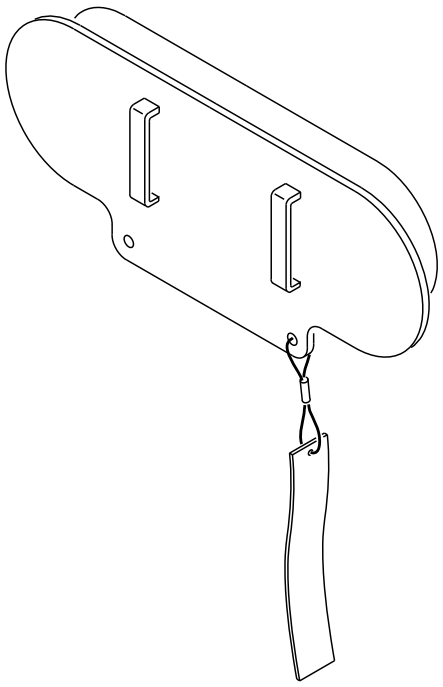
AIRCRAFT COVERS (Sheet 1 of 2)

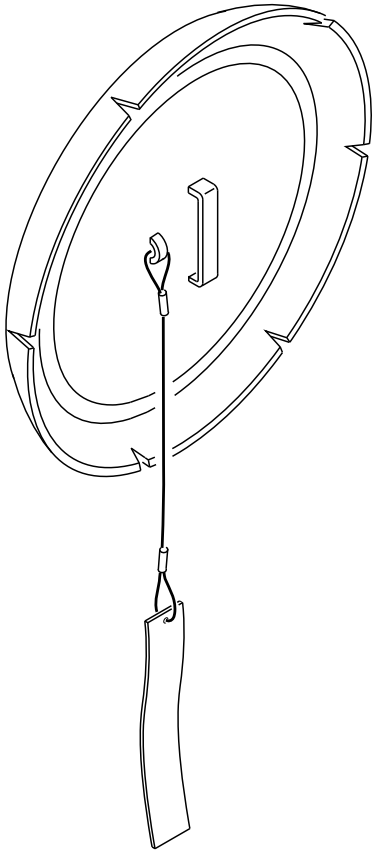
Figure 02 – 2





D

ENGINE AIR INTAKE COVER



E

ENGINE EXHAUST COVER

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AIRCRAFT COVERS (Sheet 2 of 2)

Figure 02 – 2

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SITE RECLAMATION

1. General

   A. The site area is to be cleaned up after all aircraft removal operations are completed. Make sure that all applicable environmental regulations are followed.

   B. The damaged terrain at the site and along any temporary roadways is to be restored to near original conditions. All debris, equipment and materials are to be removed.

   C. Prior to reopening an operational area, make a safety inspection to determine that no hazardous pavement or shoulder conditions exist and that facilities such as lighting are operational.

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PERSONNEL SAFETY

1. General

   A. Steps must be taken to ensure the safety of personnel at the incident site. Depending on the extent of the damage, the working conditions and the length of time that workers will be on the site, these items should be considered:

      (1) Provide standby aircraft fire–fighting and rescue vehicles.

      (2) Eliminate or reduce the hazards of spilled fuel by the use of blanketing–type fire extinguishing agents or by flushing with water.

      (3) Shore or support the aircraft to prevent inadvertent movements. Clear the area of unnecessary personnel during actual lifting or other aircraft movements.

      (4) Provide first–aid kits and medical support.

      (5) Provide fire extinguishers on the site. Refer to Figure 02–1 and figure 02–2 for the location of the portable fire extinguishers and Figure 02–3 for the locations of the fire extinguishing systems. Refer to AMM Ch. 26 for information about the fire extinguishing systems.

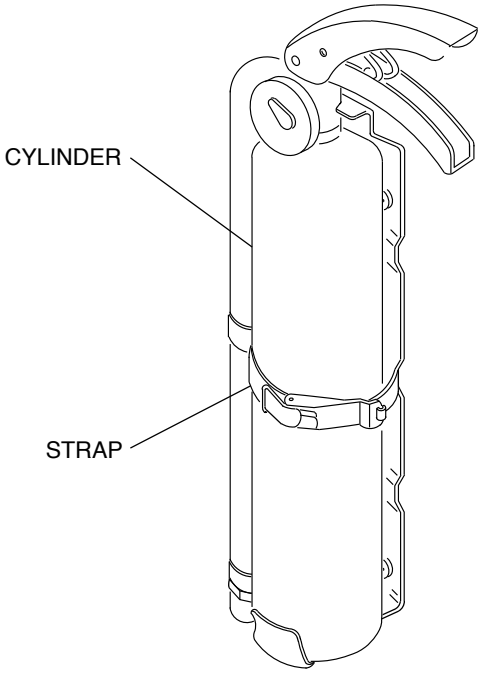
      (6) Arrange for site security and communication with local police so as to restrict unauthorized access.

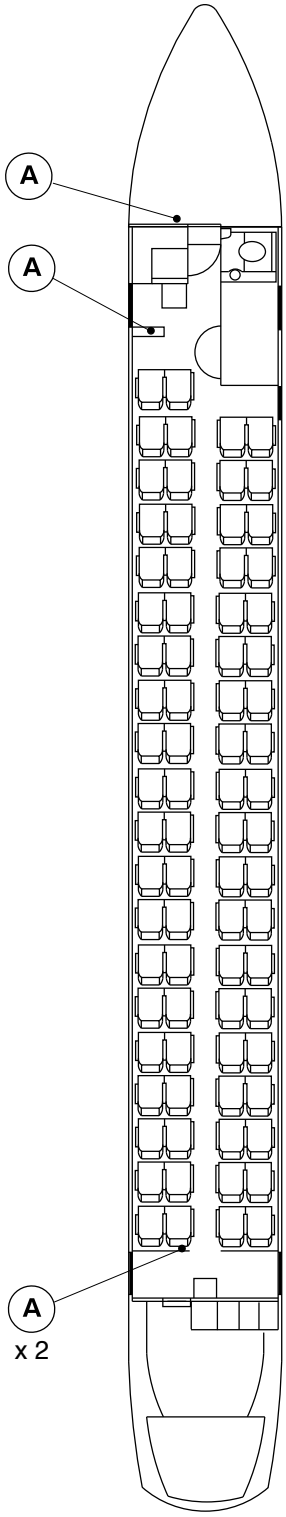
      (7) Establish a “No Smoking” perimeter.

      (8) Provide shelter and eating facilities.

      (9) Provide tools and equipment that are suited to the job.

      (10) Provide floods lights for any nighttime recovery work.





A **PORTABLE FIRE EXTINGUISHER (4 LOCATIONS)**

NOTE

Each fire extinguisher contains Halon 1211 extinguishant and can be used on electrical fires or fires involving fuel or oil.
Halon 1211 is nontoxic and noncorrosive.

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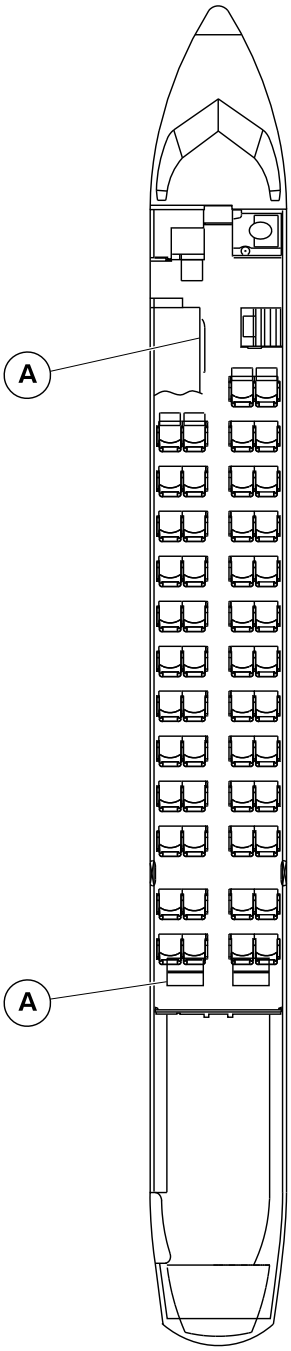
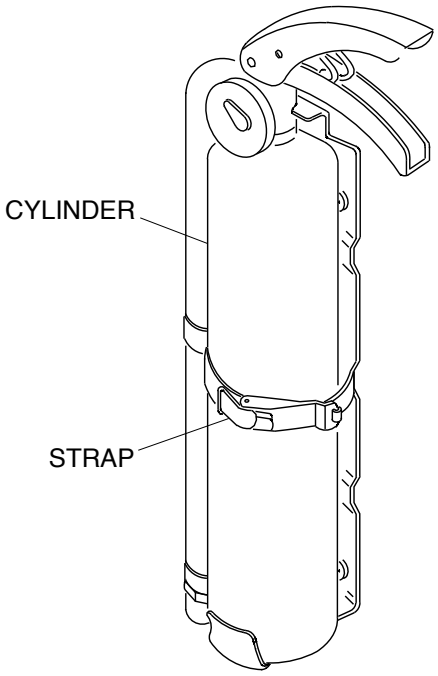
PORTABLE FIRE EXTINGUISHERS

Figure 02 – 1





**PORTABLE FIRE EXTINGUISHER
(2 LOCATIONS)**

NOTE

Each fire extinguisher contains Halon 1211 extinguishant and can be used on electrical fires or fires involving fuel or oil.
Halon 1211 is nontoxic and noncorrosive.

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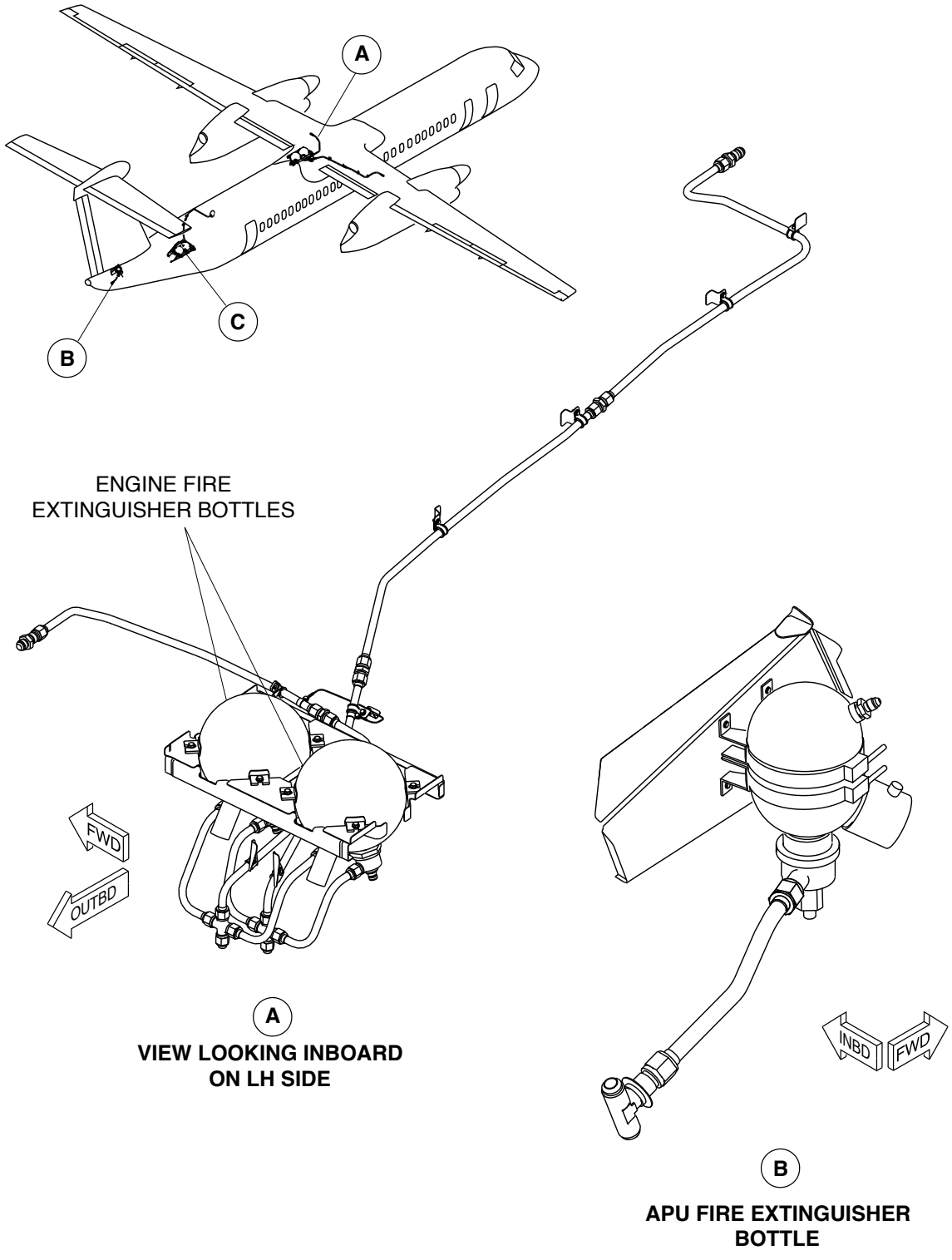
PORTABLE FIRE EXTINGUISHERS – (CARGO COMBI CONFIGURATION)

Figure 02 – 2



A
VIEW LOOKING INBOARD ON LH SIDE

B
APU FIRE EXTINGUISHER BOTTLE

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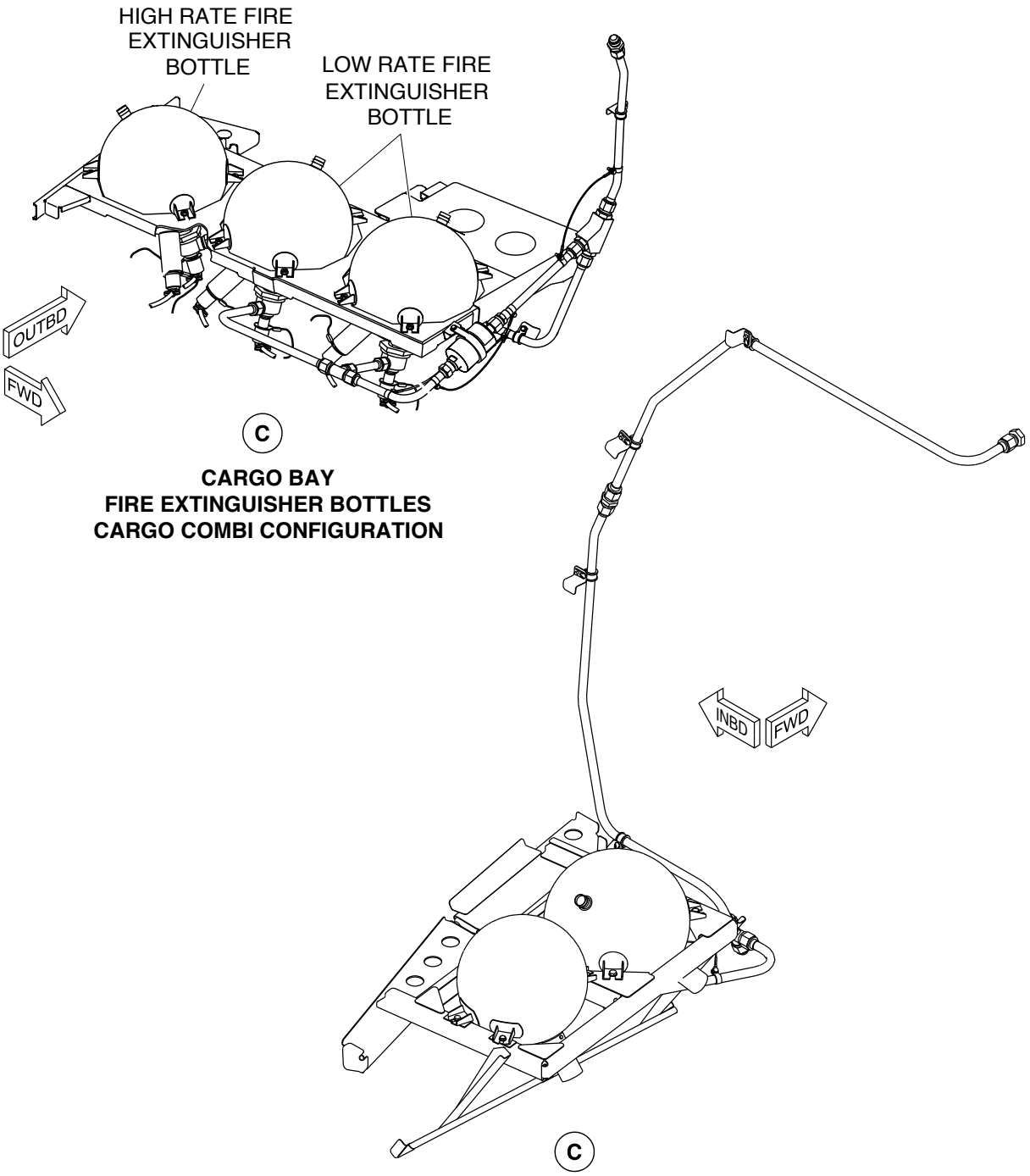
FIRE EXTINGUISHING SYSTEMS LOCATIONS (Sheet 1 of 2)

Figure 02 – 3



FIRE EXTINGUISHING SYSTEMS LOCATIONS (Sheet 2 of 2)

Figure 02 – 3

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WEIGHT AND C.G. MANAGEMENT

1. General

   A. An accurate determination of the aircraft configuration is essential for the recovery operation. This information is required to determine the type and capacity of equipment for lifting and towing, such as aircraft jacks, cranes, cribbing base area and lift cable size.

      Every effort should be made to reduce the total weight of the aircraft to the minimum possible by the removal of fuel, cargo, water and major components.

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WEIGHT MANAGEMENT

1. General

   A. Weight reduction of the aircraft is necessary before aircraft recovery. As weight is removed the aircraft will be easier to lift and tow. The final weight of the aircraft will be significantly reduced when payload (such as passengers, luggage and cargo) and aircraft components (such as damaged power plants, fuel, etc.) are removed.

2. Determine the Recoverable Empty Weight (R.E.W.)

   A. Determine the R.E.W. as follows (refer to Figure 02–1):

      (1) After the flight crew, cabin attendants and passengers have vacated the aircraft, remove the galley supplies (i.e. all O.W.E. items), passenger baggage and cargo.

      (2) Defuel the aircraft, if this is possible.

      NOTE: De Havilland Aircraft of Canada Limited strongly recommends that you defuel the aircraft, if this is possible, before any recovery operation takes place. This will reduce the weight of the aircraft and help prevent damage to the structure.

      NOTE: When the defueling is complete, the aircraft fuel tanks will contain a certain amount of unrecoverable (trapped) fuel.

      (3) Determine the Basic Weight and Center of Gravity Station (C.G. Sta.) from the Ch. 2 of the applicable Weight and Balance Manual, (PSM 1–84–8/8M).

      (4) Enter the Basic Weight and C.G. Sta. in LINE 1 of the R.E.W. Worksheet (refer to Figure 02–1). Multiply the Basic Weight by the C.G Sta. to obtain the moment and enter it in LINE 1.

      (5) In LINE 2 of the worksheet enter the weights of those items removed or lost during the aircraft accident, and also those items removed as part of the recovery procedures (such as aircraft components, cabin equipment, etc.). Add up the weights of these removed/lost items and enter the subtotal in LINE 3.

      (6) From the Basic Weight, subtract the subtotal of weights from LINE 3 and enter the result in LINE 4. This is the Recovery Empty Weight (R.E.W).

      (7) Calculate the moments for each removed/lost item by multiplying its weight times its C.G. Sta. and then divide by 1000 for each item. Enter each result in the LINE 2 area of the worksheet. Add up these moments in LINE 2 and enter the subtotal in LINE 3.

      (8) Add the moment from the Basic Weight (LINE 1) to the subtotal of moments (LINE 3). Enter the sum of the moments in LINE 4.

      (9) Determine the C.G. Sta. for the Recoverable Aircraft as follows:

(a) C.G. STA. = [BASIC WEIGHT (LINE 1) x C.G. STA. BASIC WEIGHT (LINE 1) – SUM OF MOMENTS (LINE 4)]/R.E.W.

(b) Enter the C.G. Sta. on LINE 4 of the worksheet (refer to Figure 02–1).

3. Determine the Net Recoverable Weight (N.R.W.)

A. Enter the R.E.W., the C.G. Sta., and the Sum of the Moments (from Figure 02–1, obtained in previous step) in LINE 1 of the N.R.W. Worksheet (refer to Figure 02–2).

B. In the event that the landing gears are retracted or the flaps are fully extended during the recovery operation, moment corrections can be determined from Figure 02–3. Enter these moment corrections, if required, in LINE 2 and 3 of the N.R.W. worksheet (refer to Figure 02–2).

C. Determine the quantity of fuel in each tank after defueling in order to get the weight and C.G. of residual fuel. From the Weight and Balance Manual (01–20–00), obtain the C.G. of the fuel in each tank (the values shown in the Weight and Balance Manual are for an aircraft in a level position). Enter the weight and C.G. data of the fuel in LINE 4 of the worksheet (refer to Figure 02–2) as applicable.

NOTE: The weight of oil in the engines and in closed systems has been included in the R.E.W.. Any loss of engine oil will have no significant effect on the aircraft C.G. and may be disregarded.

D. Repeat the above step for Other Fluids (as applicable) and enter the weight and C.G. data in LINE 5 of the worksheet.

E. Add up the weights and enter the total in LINE 6 of the worksheet. This is the Net Recoverable Weight (N.R.W.)

F. Add up the moments and enter the total (Sum of Moments) in LINE 6 of the worksheet.

G. Determine the C.G. station for the Net Recoverable Weight (N.R.W.) of the aircraft as follows:

C.G. STA. = SUM OF MOMENTS/N.R.W.

H. Enter the C.G. Sta. on LINE 6 of the worksheet.

I. Use the N.R.W. and C.G. Sta. shown above to determine the jacking loads (refer to Figure 02–4).

4. Location of Center of Gravity (C.G.) in Percent M.A.C.

A. To calculate the location of the C.G. in relation to the Mean Aerodynamic Chord (M.A.C.), refer to Figure 02–4.

5. Determination of Load at Wing–Jack Point

A. Use the chart shown in Figure 02–5 and the previously calculated Net Recoverable Weight (N.R.W.) and C.G. location (from Figure 02–2) to determine the loads at the wing jack points A, B, and C.

B. The chart can also be used to determine the jack loads in any aircraft attitude at rest (when one of the landing gear has collapsed).

C. Some criteria for using the chart are:

(1) Left wing jack–load at Point B are shown. These loads are higher than the right wing jack–load at Point C.

(2) The right wing jack–load at Point C can be calculated as follows:

POINT C LOAD = N.R.W. – POINT B LOAD – POINT A LOAD

(3) Aircraft jack–point locations are shown in the table below:

JACK POINT LOCATIONS

ITEM	STA. X	STA. Y	STA. Z
FWD. FUSELAGE	–39.7	12.4	82.8
LEFT WING	427.57	–108.17	175.36
RIGHT WING	427.57	108.17	175.36

D. To illustrate the use of the chart, an example is given below.

AIRCRAFT N.R.W. = 48,000 LB (21,772 KG)

C.G. STATION = 30 % MAC

AIRCRAFT IN HORIZONTAL ATTITUDE

DETERMINE: LOAD AT JACK POINT C

E. First, determine left wing jack–load at Point B.

(1) Enter the chart from the bottom, at 48,000 lb (21,772 kg) N.W.R.

(2) Move up vertically until you intersect the 30 % C.G. line. Identify this point as Point X.

(3) Trace this point along a line to the right–hand scale and the forward–fuselage jack load is found to be 2650 lb (1202 kg).

(4) At Point X, trace this point to the top scale and read 23,000 lb (10,433 kg) for the left wing jack–load at Point B.

(5) The right wing jack–load at Point C can now be calculated, as:

POINT C LOAD = 48,000 – 23,000 – 2650

= 22,350 LB (10,138 KG).

LINE	SUBJECT	WEIGHT (LB)	C.G.STA. (INCHES)	MOMENT (LB–IN.)/1000
1	BASIC WEIGHT			
2	–MINUS ITEMS REMOVED DURING RECOVERY			
3	SUBTOTAL OF ITEMS			
4	RECOVERABLE EMPTY WEIGHT (R.E.W.)			

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R.E.W. WORKSHEET

Figure 02 – 1

LINE	SUBJECT	WEIGHT (LB)	C.G. STA. (INCHES)	MOMENT (LB–IN.)/1000
1	RECOVERABLE EMPTY WEIGHT (R.E.W.)			
2	LANDING GEAR (FROM FIGURE 02–3)			
3	FLAPS (FROM FIGURE 02–3)			
4	RESIDUAL FUEL			
5	OTHER FLUIDS			
6	NET RECOVERABLE WEIGHT (N.R.W.)			

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N.R.W. WORKSHEET

Figure 02 – 2

ITEM	3 MOMENT (LB–IN.)/1000
NOSE LANDING GEAR (NLG)	– 3.1
MAIN LANDING GEAR (MLG)	+ 37
TOTAL ALL GEAR 1	+ 33.9
INBOARD AND OUTBOARD FLAPS	– 12.4
TOTAL ALL FLAPS 2	– 12.4

NOTES

1 Gear from full down to full up.

2 Flaps from full down to full up.

3 (+) C.G. Moved aff.
(–) C.G. Moved forward.

Do not use these correction figures if the landing gear are in the down position or if the flaps are in the full up position for recovery.

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MOMENT CORRECTIONS FOR LANDING GEAR AND FLAPS

Figure 02 – 3

The location of the C.G. in relation to the Mean Aerodynamic Chord (M.A.C.) can be calculated as follows:

To convert C.G. ARM in Inches to C.G. % M.A.C:

$$\% \text{ M.A.C.} = \frac{(\text{ARM} - 374.116)}{94.512} \times 100$$

To convert C.G. % M.A.C. to C.G. ARM in Inches:

$$\text{ARM} = \frac{94.512 \times \% \text{ M.A.C.}}{100} + 374.116$$

WHERE: PERCENT M.A.C. = Location of C.G. in percent of the M.A.C.

C.G. STATION = Station location of C.G. (inches).

94.512 = Width of M.A.C. (inches).

374.116 = Distance of M.A.C. leading edge to STA. x 0.00.

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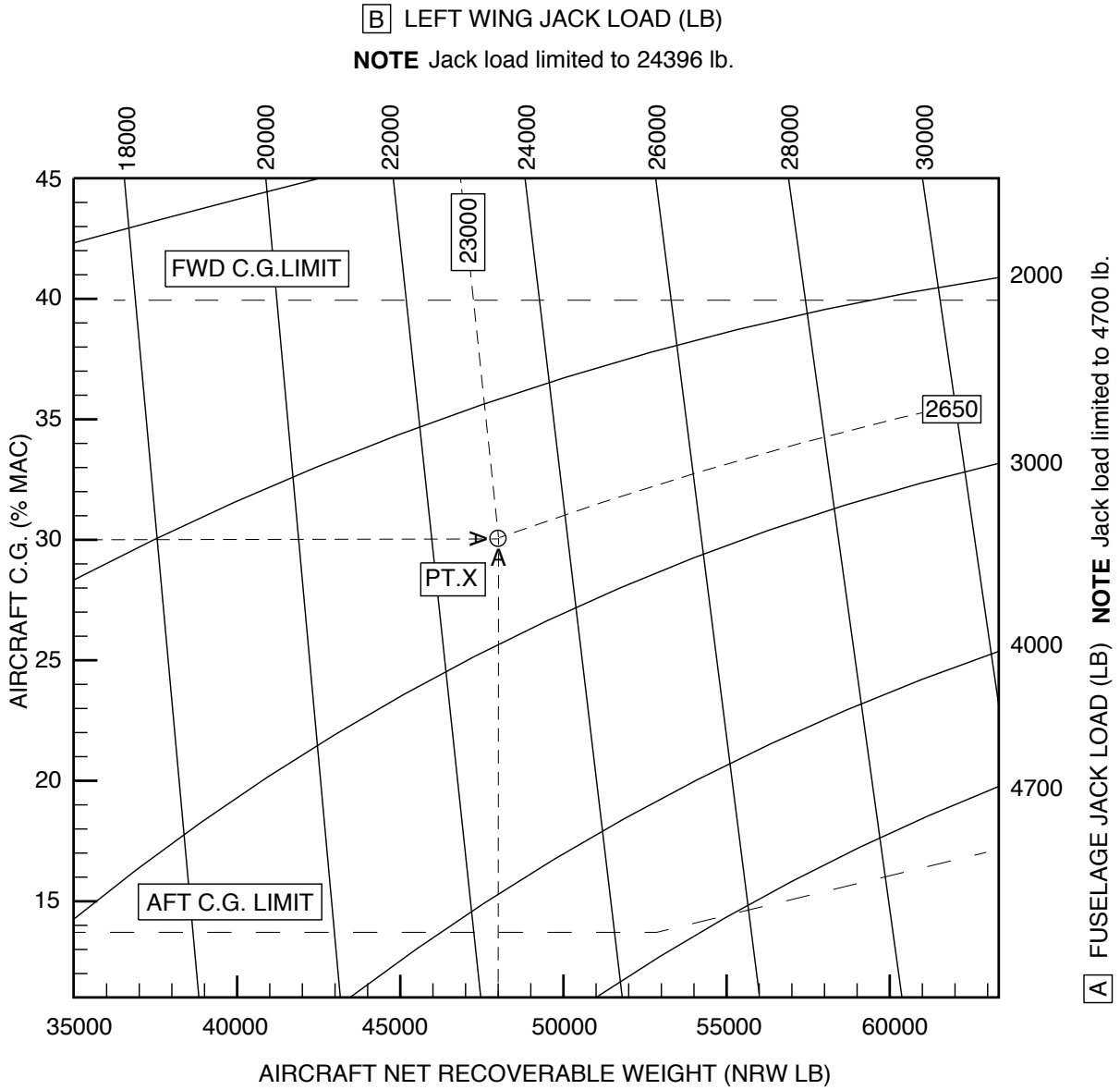
CALCULATIONS FOR C.G. AND M.A.C.

Figure 02 – 4



RIGHT WING JACK LOAD

C = NRW – B – A

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JACKLOAD / NET RECOVERY WEIGHT DETERMINATION

Figure 02 – 5

REMOVAL OF PAYLOAD

1. General

   A. The removal of payload is necessary as a means to reduce aircraft weight prior to recovery. It is assumed that at this stage the passengers and their carry–on baggage have been deplaned.

   B. If the aircraft has come to rest on an unpaved surface, the ordinary loaded units that are normally used at airport terminals may not be useful because of their small wheels and low ground clearances. Vehicles with large tires will probably be required.

   C. When removing cargo, be aware of the effect on the Center of Gravity (C.G.) of the aircraft, as any shift in C.G. could rotate the aircraft.

2. Baggage Compartments

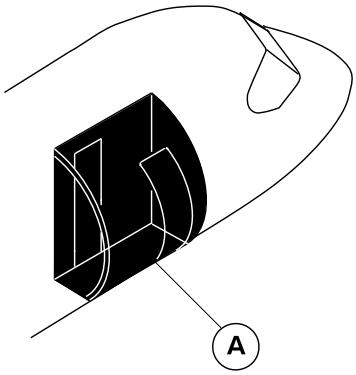
   A. The forward and aft baggage compartments may be configured to carry several combinations of baggage/cargo.

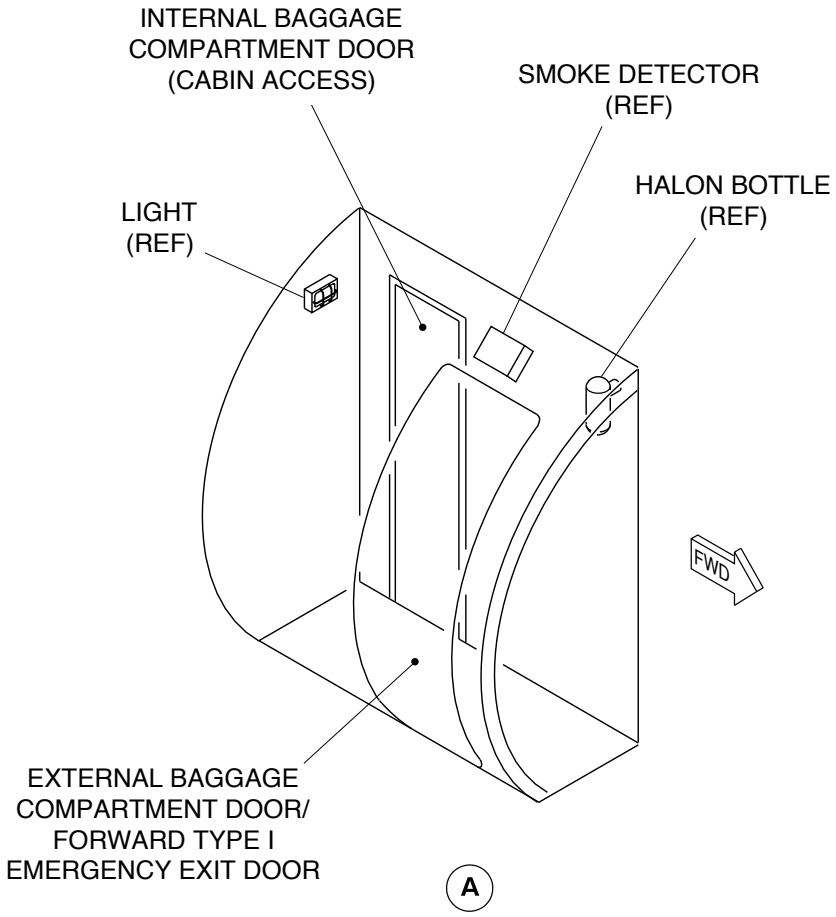
   B. A door on the forward right–hand side of the fuselage provides access to the forward baggage compartment (for all configurations). An interior access door is located immediately aft of the lavatory (refer to Figure 02–1 and Figure 02–2 for a typical forward baggage compartment).

   NOTE: The forward baggage compartment is removed and forward Type I emergency exit door is installed in lieu of forward baggage door for the extra capacity and cargo combi configurations.

   C. A door on the aft left–hand side of the fuselage provides access to all configurations of the aft baggage compartment (refer to Figure 02–3, Figure 02–04, Figure 02–5, Figure 02–6 and Figure 02–7). This baggage compartment is divided by various configurations of cargo nets and posts (refer to Figure 02–8, Figure 02–9, Figure 02–10 and Figure 02–11).

   NOTE: The aft cargo compartment is extended up to the station X586.00 for the cargo combi configuration.





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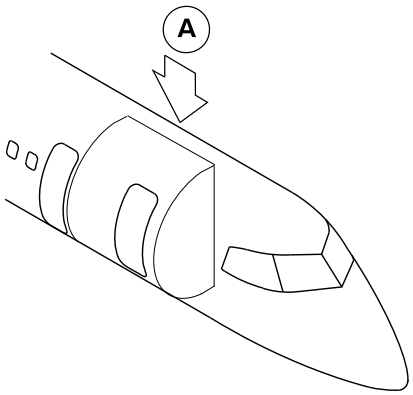
NOTE

Forward baggage compartment and forward baggage door is removed for the extra capacity and cargo combi configuration.

FORWARD BAGGAGE COMPARTMENT DOORS – LOCATION (91 CUBIC FT)

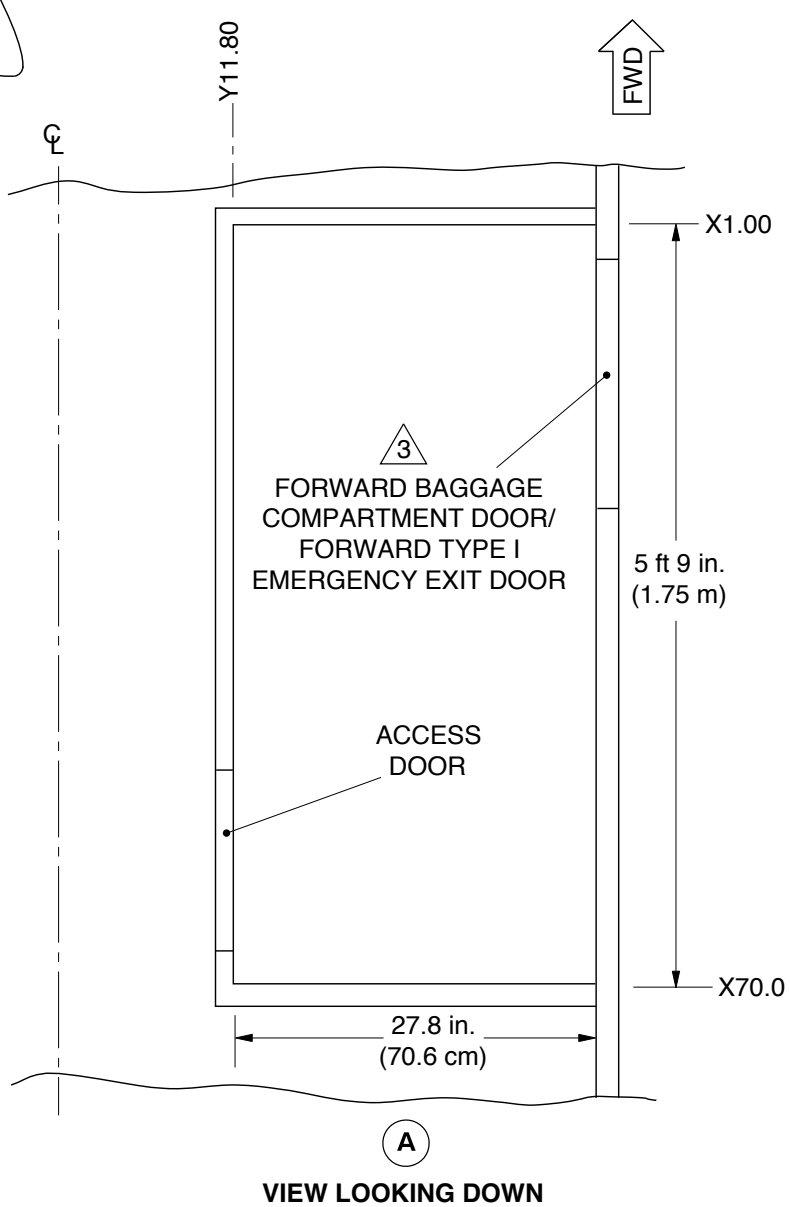
Figure 02 – 1



NOTES

1. The dimensions shown are measured at floor level.
2. Forward baggage compartment and forward baggage door is removed for the extra capacity and cargo combi configuration.

△3 Type I emergency exit door is installed in forward RH side for the extra capacity and cargo combi configuration.



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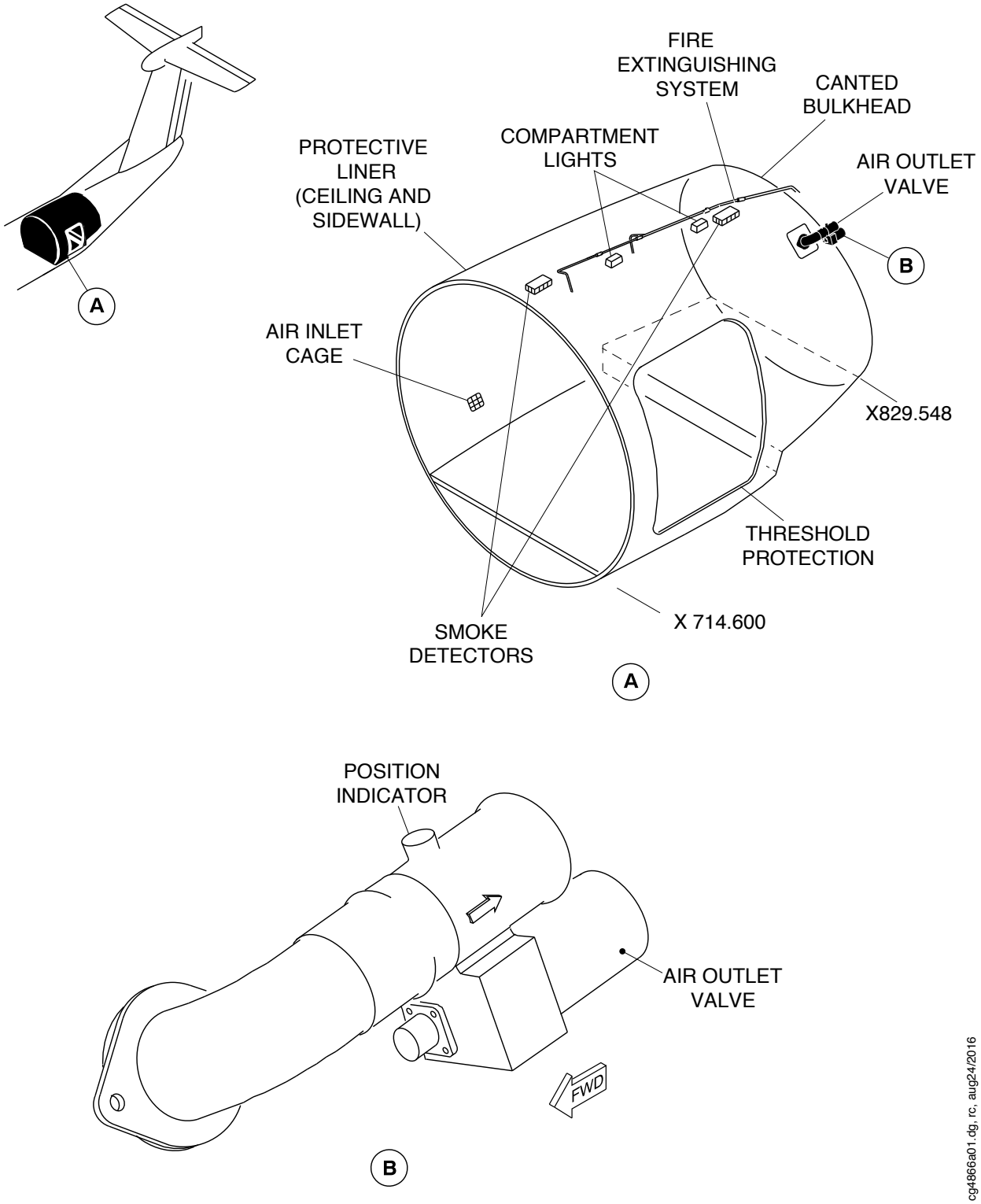
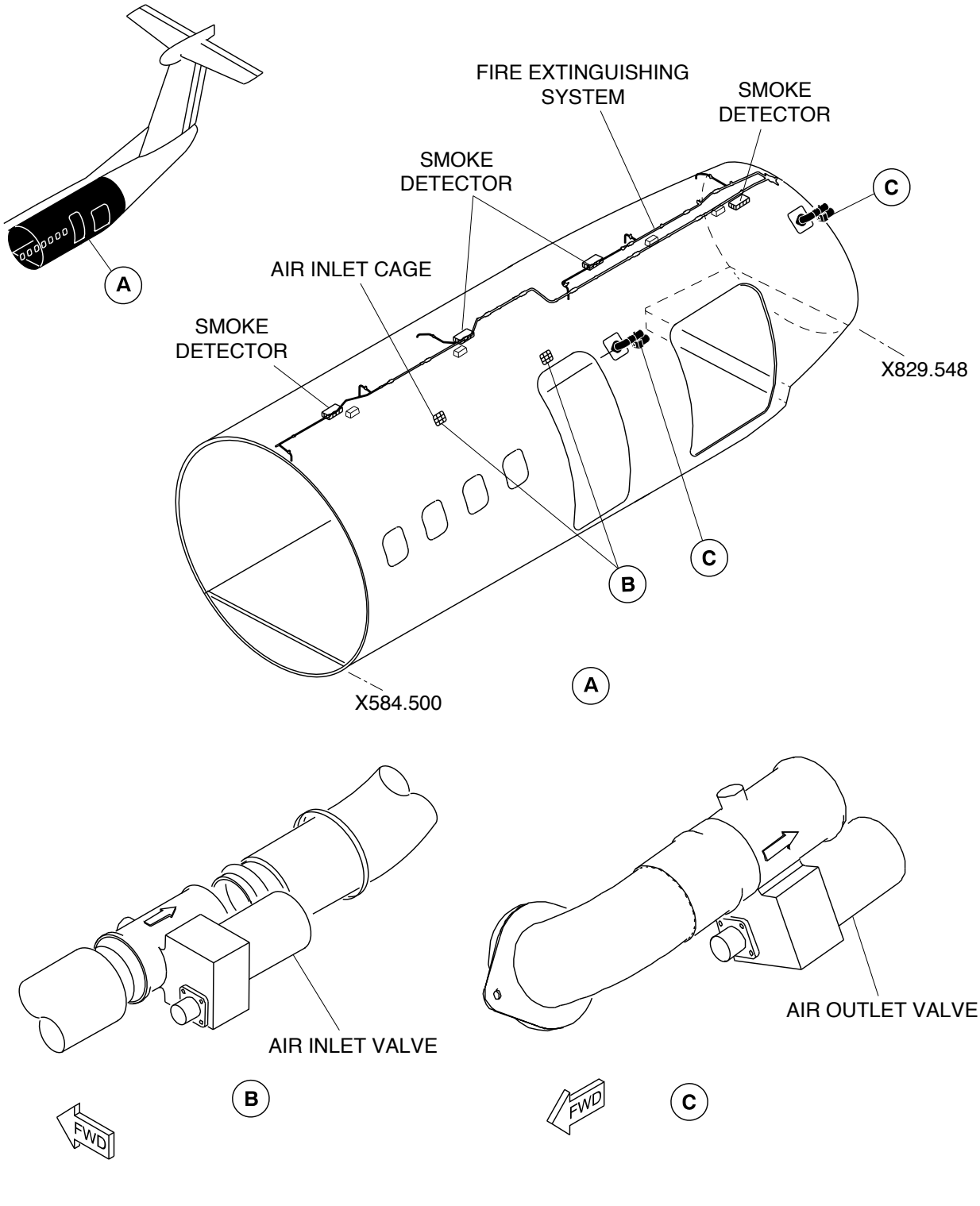
FORWARD BAGGAGE – COMPARTMENT DIMENSIONS (STANDARD INTERIOR CONFIGURATION)
Figure 02 – 2



AFT BAGGAGE COMPARTMENT (STANDARD INTERIOR CONFIGURATION)

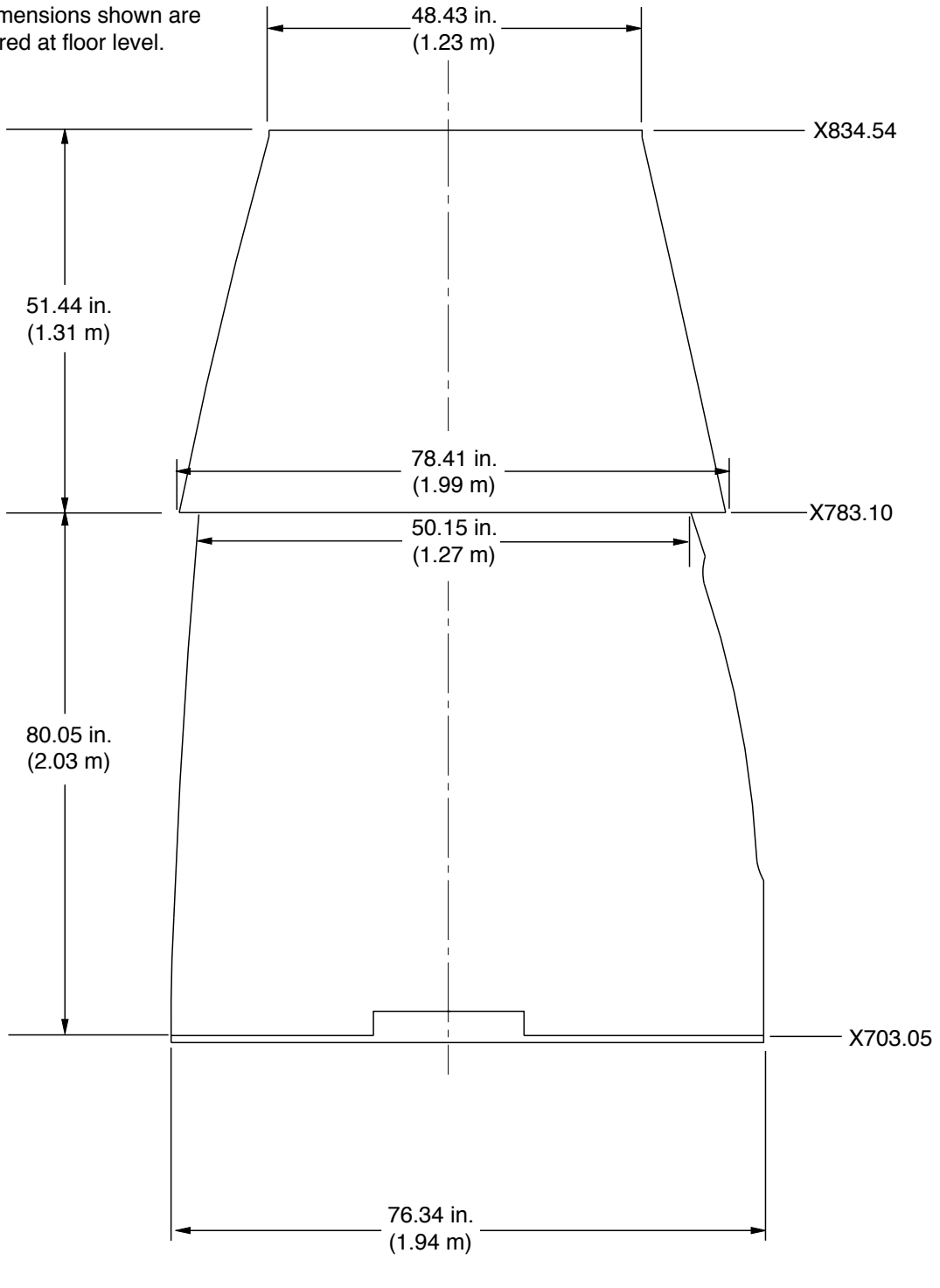
Figure 02 – 3



AFT BAGGAGE COMPARTMENT – (CARGO COMBI CONFIGURATION)

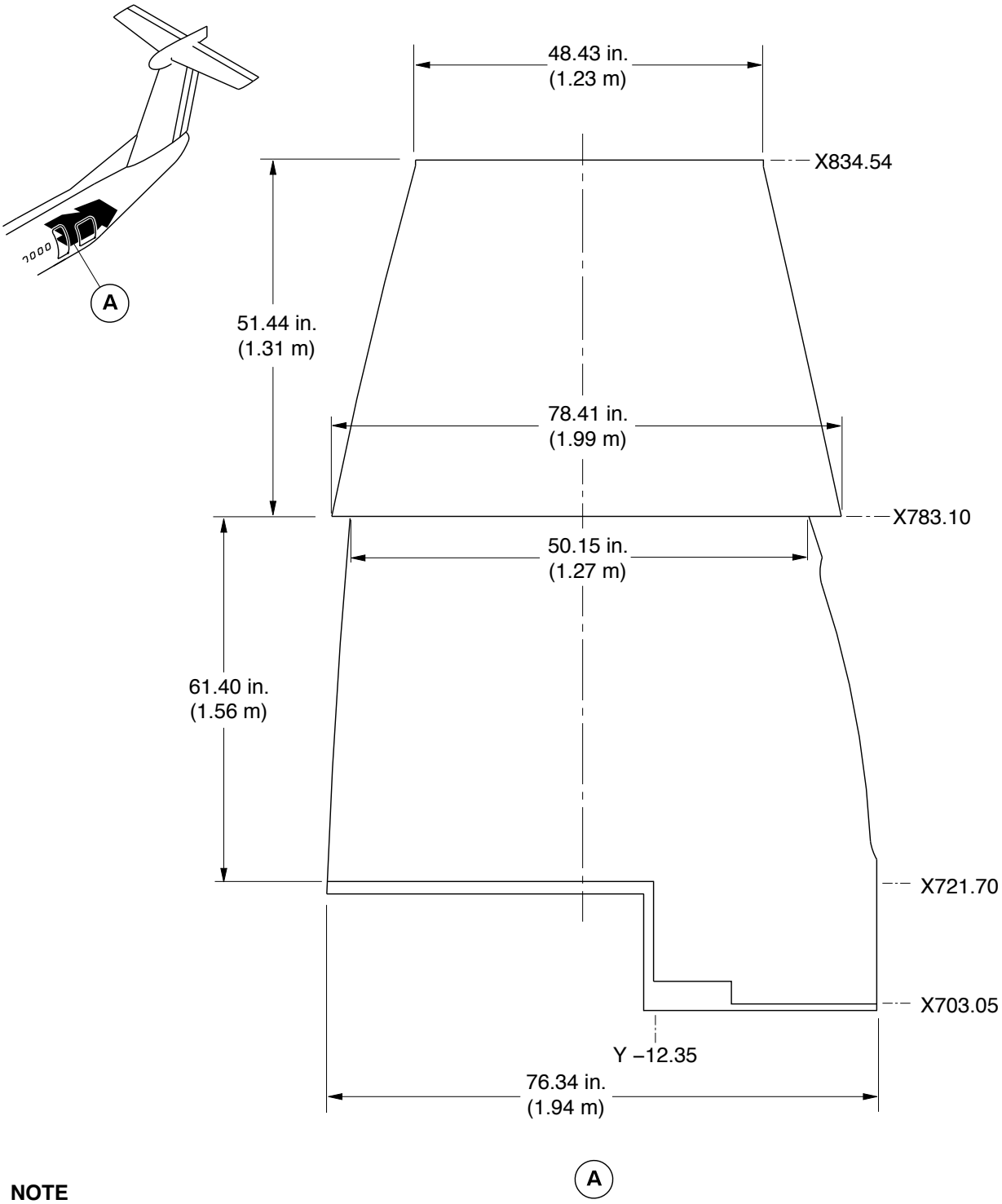
Figure 02 – 4

NOTE
The dimensions shown are measured at floor level.



AFT BAGGAGE COMPARTMENT DIMENSIONS (STANDARD INTERIOR CONFIGURATION)

Figure 02 – 5

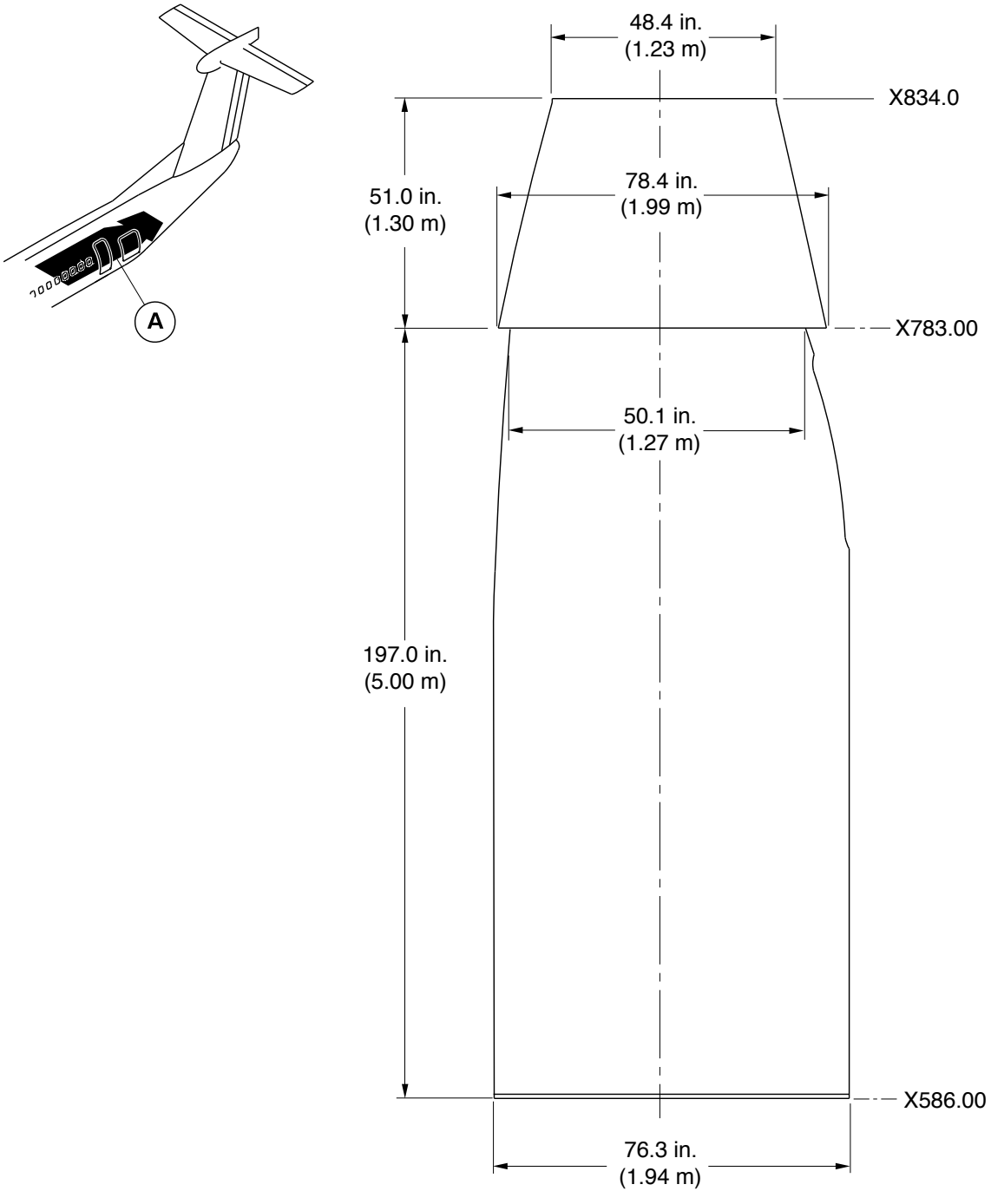


NOTE

The dimensions shown are measured at floor level.

AFT BAGGAGE COMPARTMENT DIMENSIONS (OPTIONAL INTERIOR CONFIGURATION)

Figure 02 – 6

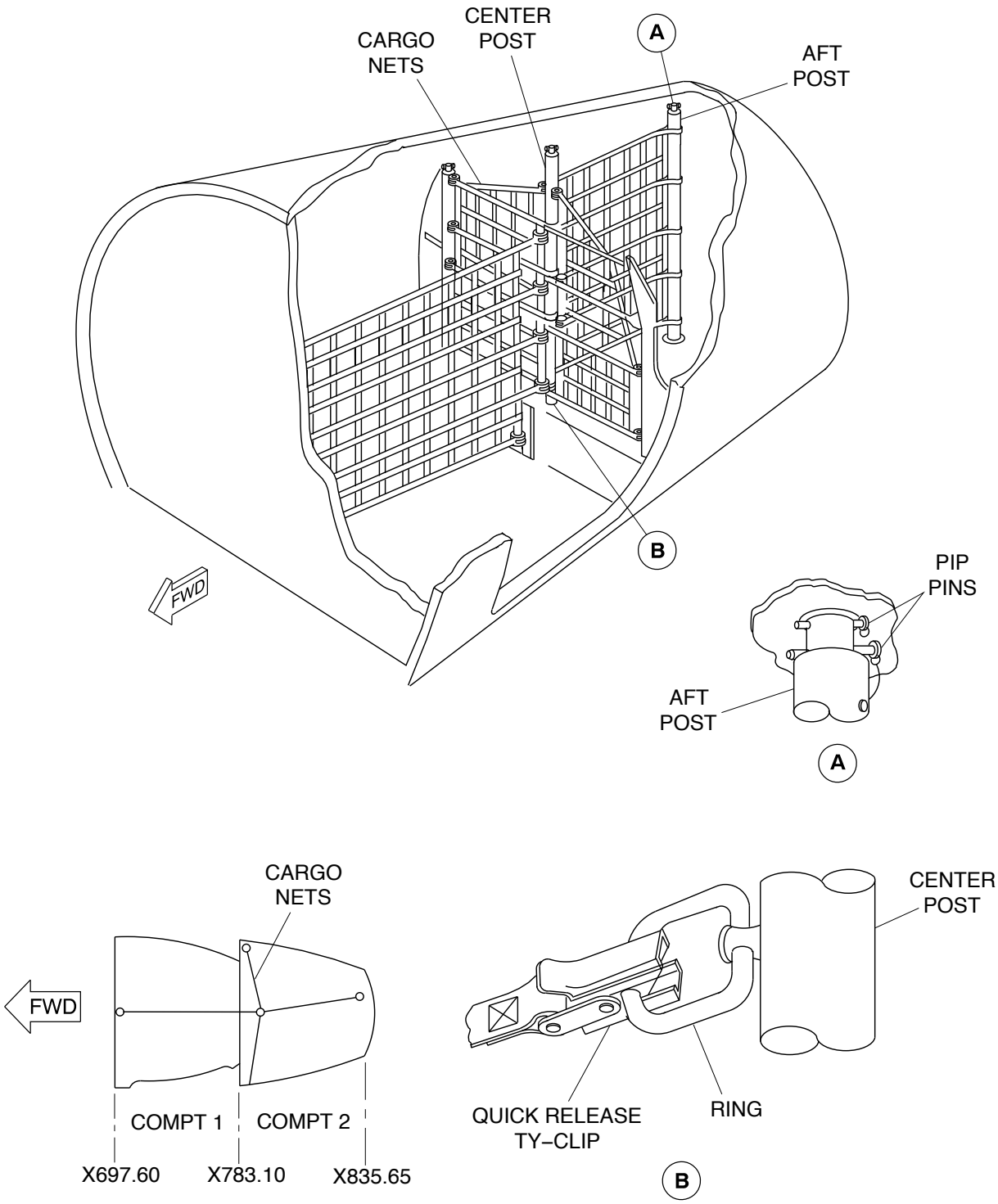


NOTE

The dimensions shown are measured at floor level.

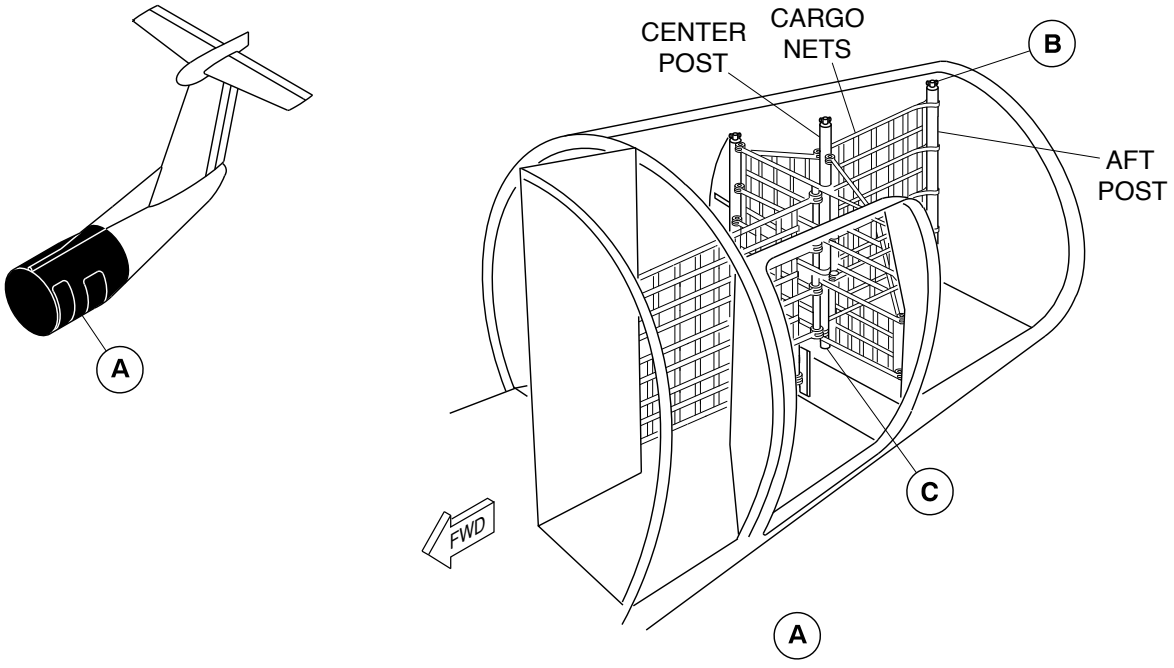
AFT BAGGAGE COMPARTMENT DIMENSIONS – (CARGO COMBI CONFIGURATION)

Figure 02 – 7

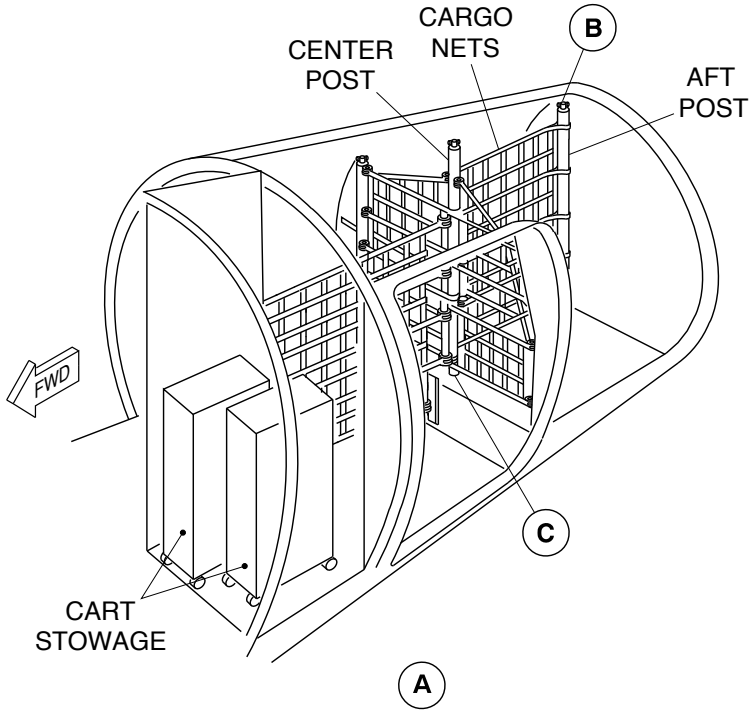


BAGGAGE DIVIDER NETS (STANDARD INTERIOR CONFIGURATION)

Figure 02 – 8



G3 GALLEY



EXTENDED G3 GALLEY

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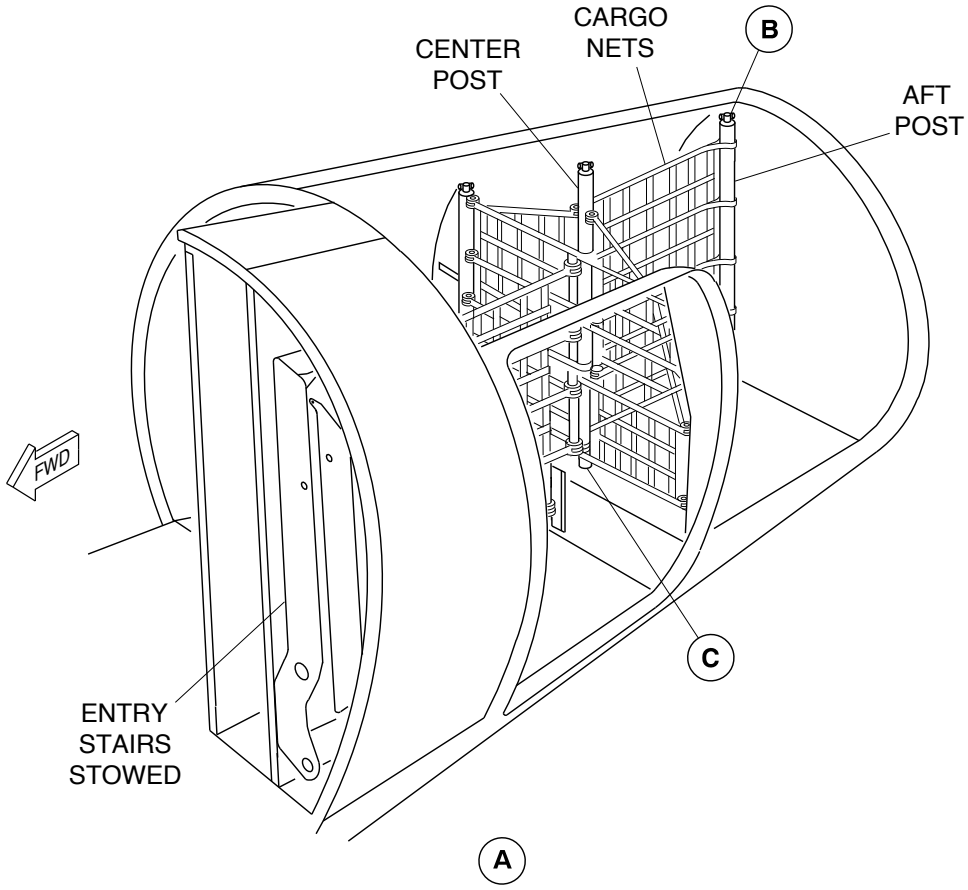
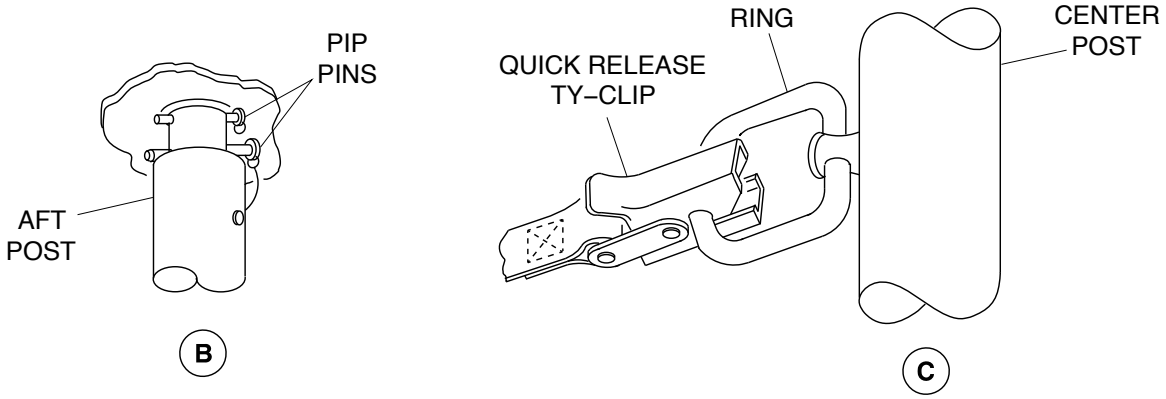
BAGGAGE DIVIDER NETS (OPTIONAL INTERIOR CONFIGURATIONS) (Sheet 1 of 3)

Figure 02 – 9



EXTENDED G3 GALLEY WITH STAIRS



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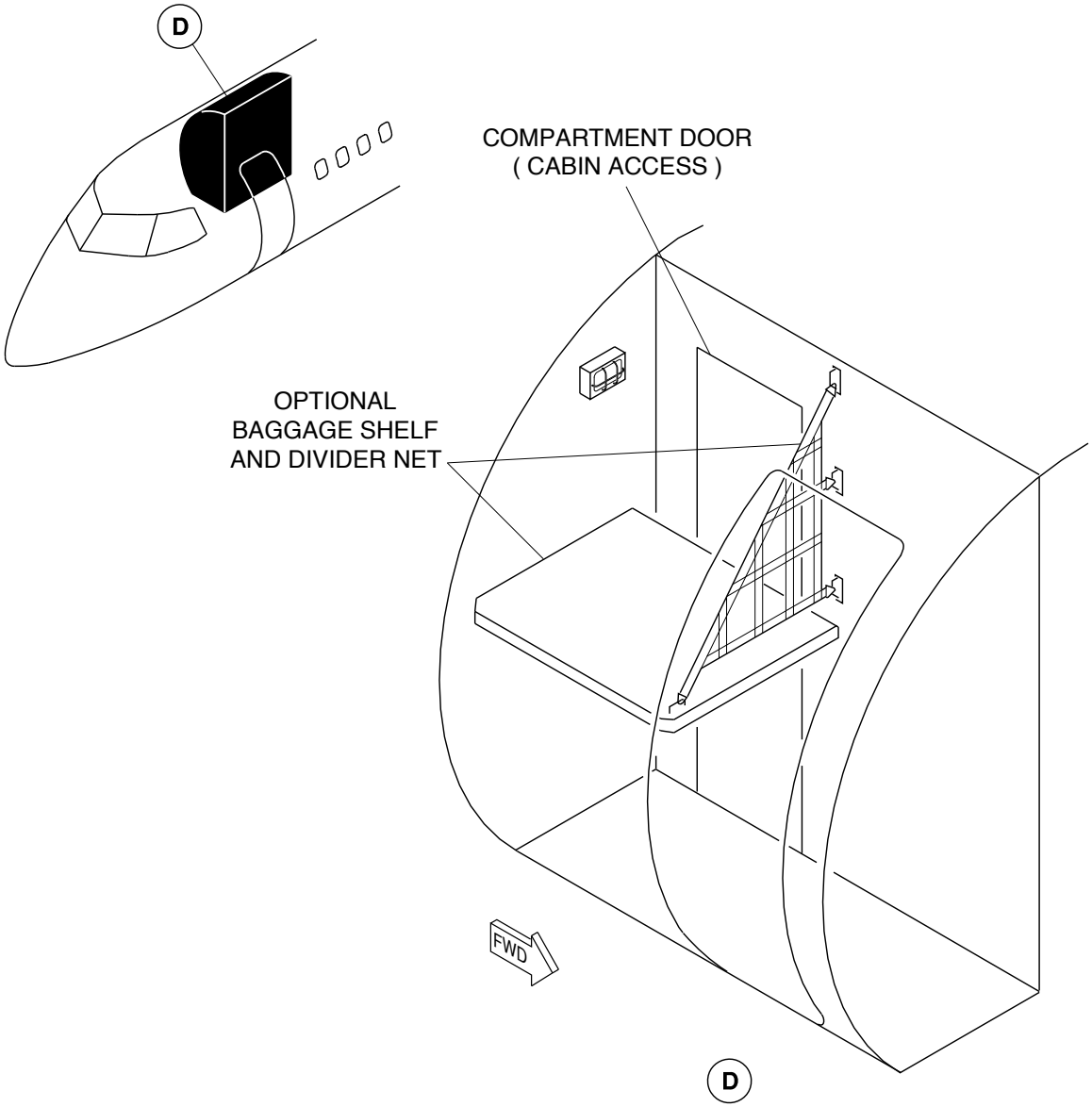
BAGGAGE DIVIDER NETS (OPTIONAL INTERIOR CONFIGURATIONS) (Sheet 2 of 3)

Figure 02 – 9



FORWARD BAGGAGE COMPARTMENT WITH OPTIONAL BAGGAGE SHELF AND NET

NOTE

1. Divider net is intended to assist in baggage organization only. The net does not provide any structural baggage restraint and is not required for flight.
2. Forward baggage compartment and forward baggage door is removed for the extra capacity configuration and cargo combi configuration.

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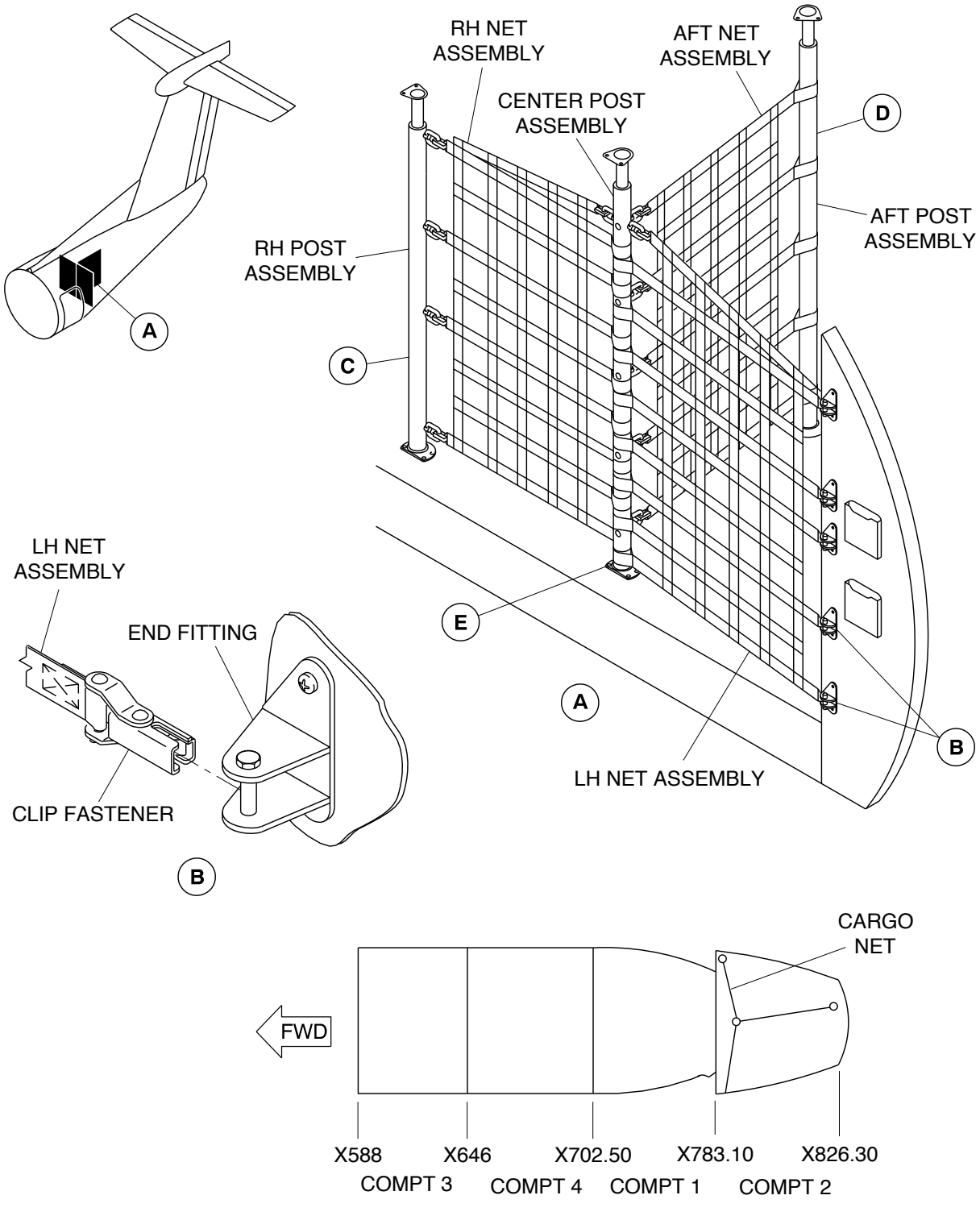
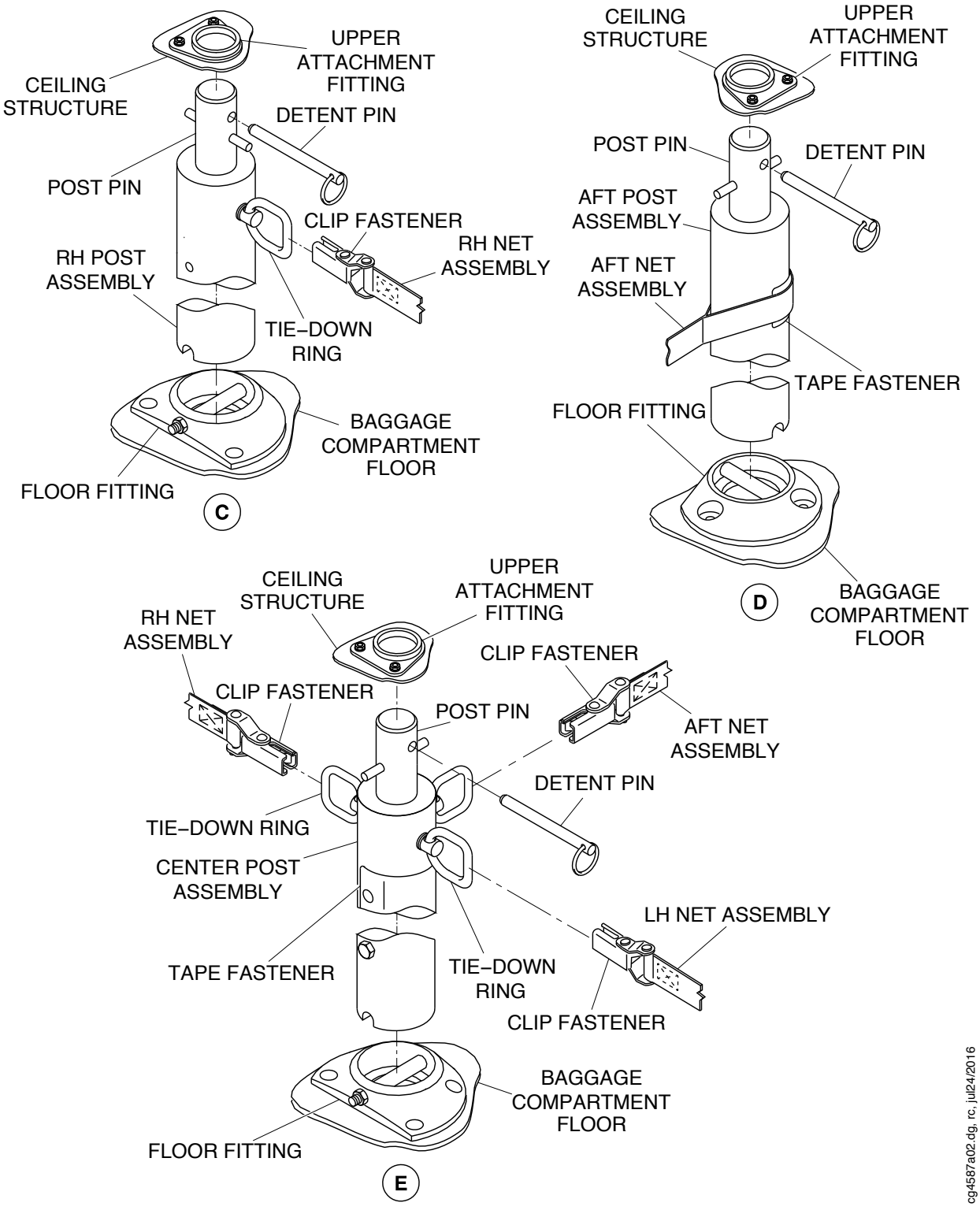
BAGGAGE DIVIDER NETS (OPTIONAL INTERIOR CONFIGURATIONS) (Sheet 3 of 3)

Figure 02 – 9



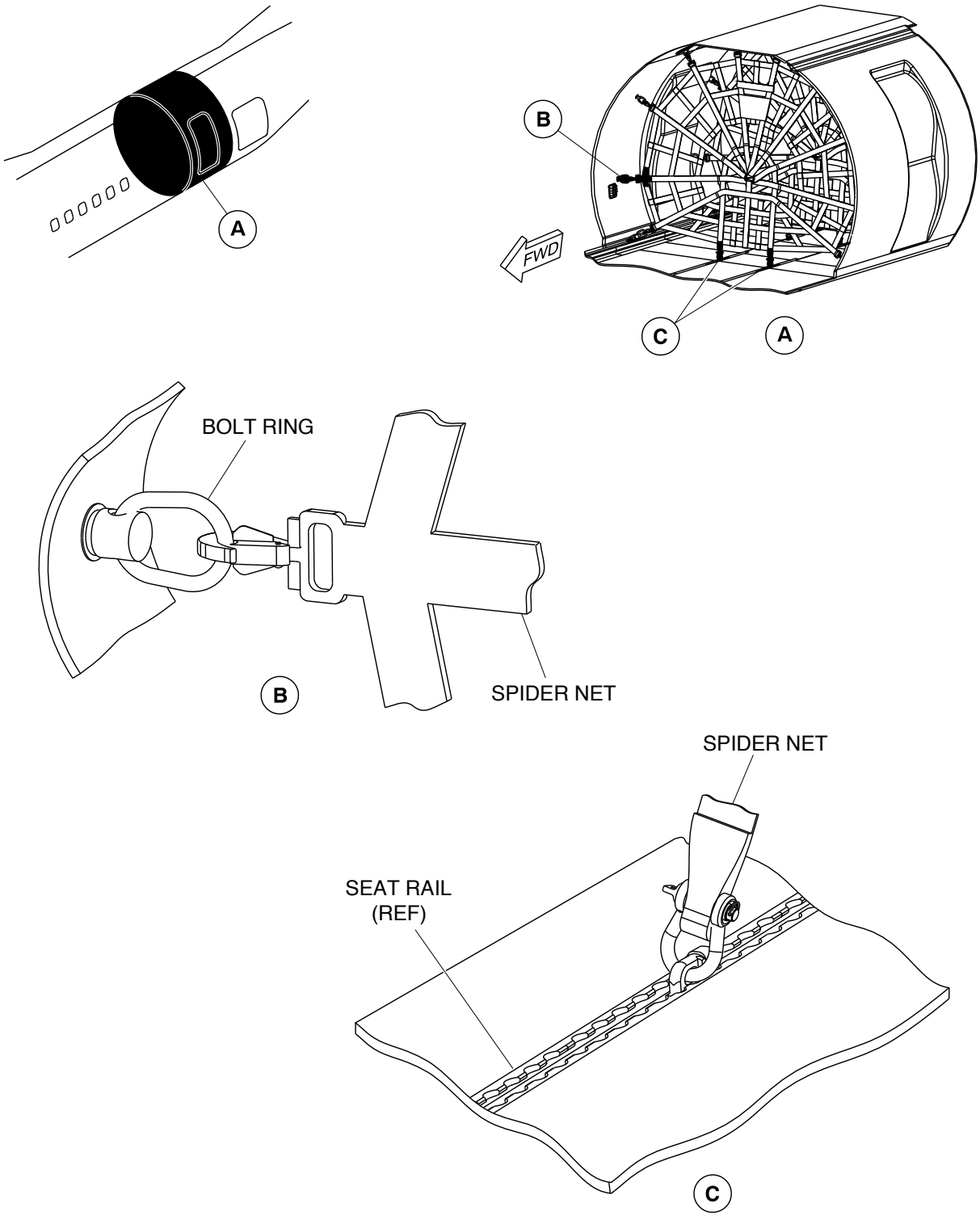
BAGGAGE DIVIDER NET INSTALLATION – (CARGO COMBI CONFIGURATION) (Sheet 1 of 2)

Figure 02 – 10



BAGGAGE DIVIDER NET INSTALLATION – (CARGO COMBI CONFIGURATION) (Sheet 2 of 2)

Figure 02 – 10



SPIDER NET INSTALLATION – (CARGO COMBI CONFIGURATION)

Figure 02 – 11

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REMOVABLE COMPONENTS

1. General

A. In order to reduce aircraft weight, payload and some aircraft components may have to be removed. Components that can be removed are:

- Unused fuel
- Engines
- Propellers
- Passenger and crew seats
- Interior furnishing items.

B. The tables that follow provide weight and moment information for specific items. Certain items are not listed because of optional configurations. For these optional items, refer to Chapter 2 (Aircraft Reports, specific to that airplane serial number) of the applicable Weight and Balance Manual (PSM 1–84–8/8M). Eight typical passenger–compartment diagrams are shown in "Passenger Compartment Diagram – 70 Passengers at 32/33 Inch Pitch" Figure 02–1, "Passenger Compartment Diagram – 72 Passengers at 32 Inch Pitch" Figure 02–2, "Passenger Compartment Diagram – 74 Passengers at 32/30 Inch Pitch" Figure 02–3, "Passenger Compartment Diagram – 76 Passengers at 32/30/29 Inch Pitch" Figure 02–4, "Passenger Compartment Diagram – 78 Passengers at 32/30 Inch Pitch" Figure 02–5, "Passenger Compartment Diagram – 67 Passengers at 30/52/29 Inch Pitch" Figure 02–6, "Passenger Compartment Diagram – 86 Passengers at 29 Inch Pitch" Figure 02–7, Passenger Compartment Diagram – 50 Passengers at 35 Inch Pitch" Figure 02–8 and "Passenger Compartment Diagram – 90 Passengers at 28 Inch Pitch" Figure 02–9.

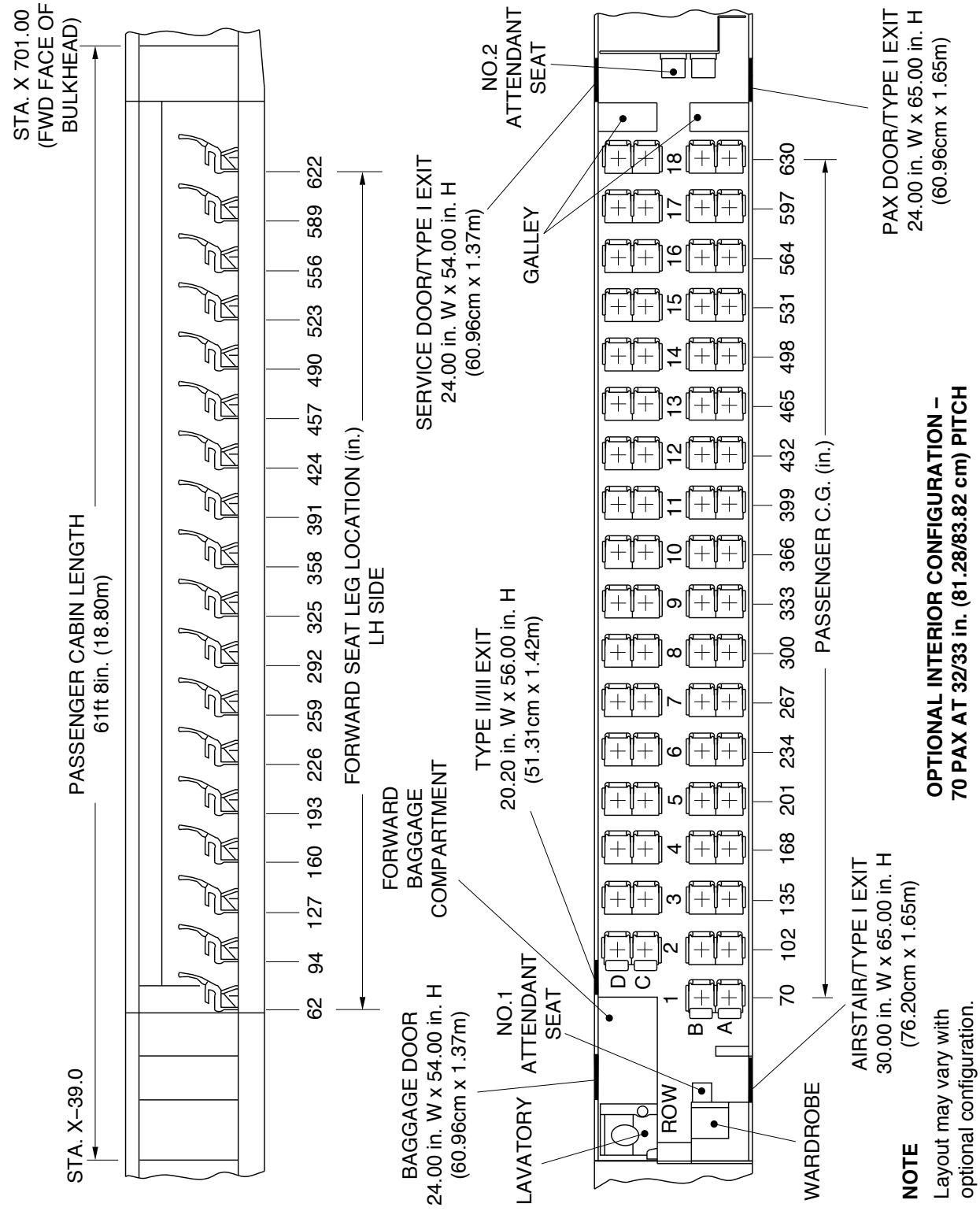
NOTE: The weights and C.G.s shown in the table below are based on a “Type Spec” configured aircraft

STANDARD EQUIPMENT

COMPONENTS	WEIGHT (LB) (PER SIDE)	ARM (IN.)	MOMENT (LB–IN.)/1000
ENGINE (PWC 150A, DRESSED, INCLUDES EXHAUST NOZZLE)	1924.6	317.0	610.0
EXHAUST ONLY (JETPIPE)	169.5	441.0	74.7
PROPELLERS (DOWTY R408, SIX BLADE, INCLUDES BETA TUBE UNIT AND SPINNER)	555.4	263.9	146.5
BATTERIES (3)	187.0	71.1	13.3
APU (OPTIONAL) AND OIL	139.0	1012.5	140.7
APU STARTER/GENERATOR	40.4	1016.0	41.0
USABLE FUEL (EST.)	11 960	405.5	4849.8
UNUSABLE (DRAINABLE) FUEL	134	398.6	53.4
WATER WASH SYSTEM (EST. WT.)	46.0	–3.3	–0.2

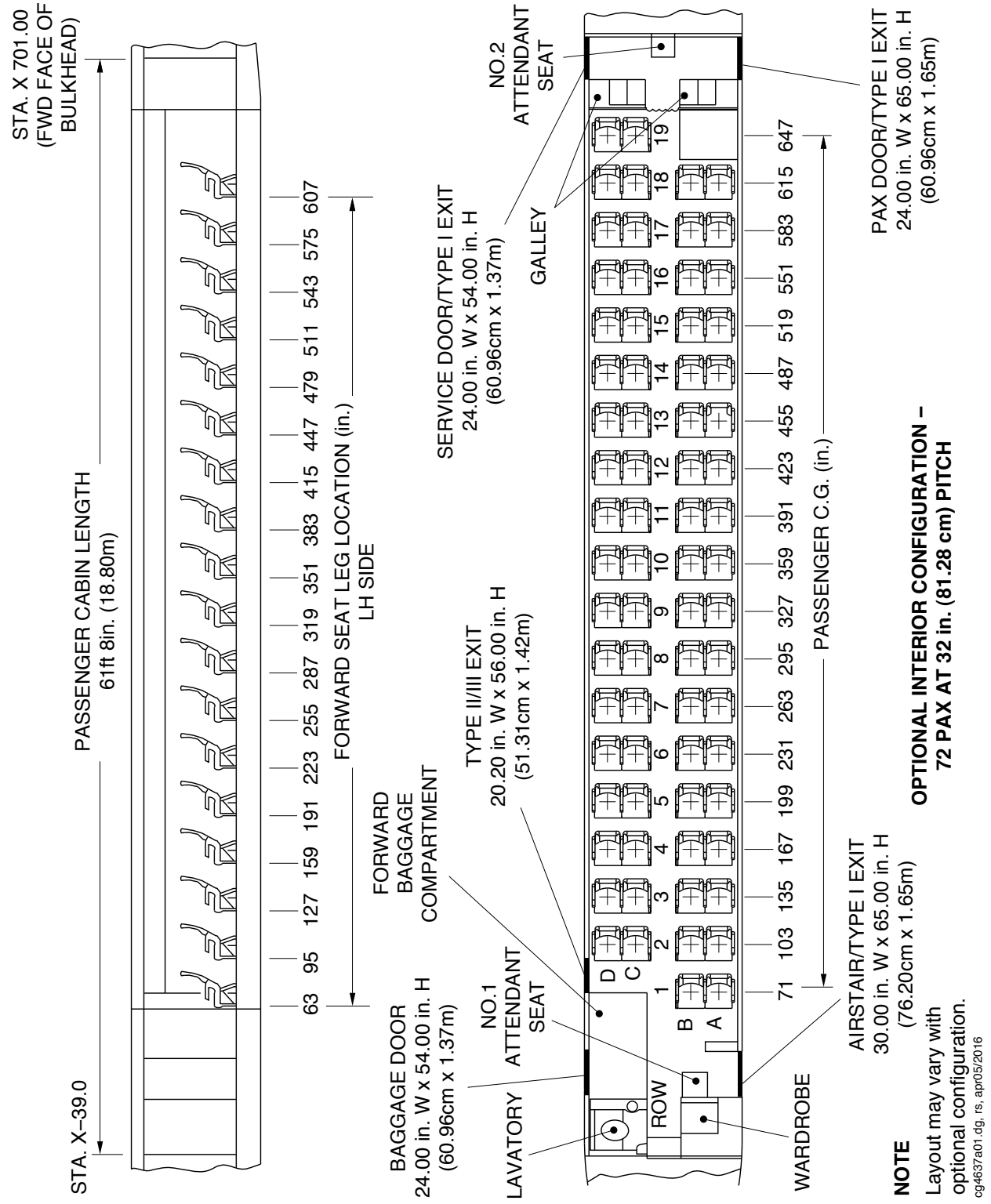
COMPONENTS	WEIGHT (LB) (PER SIDE)	ARM (IN.)	MOMENT (LB–IN.)/1000
FLIGHT CREW SEATS AND HARNESSES (2)	90.0	–56.6	–5.1
FLIGHT ATTENDANT'S SEAT INSTALLATION (2)	64.6	238.7	15.4
WARDROBE (WITHOUT PANELS)	31.0	–11.6	–0.4
WARDROBE PANELS (INCL. WING BLKHD.)	56.0	–10.5	–0.6
FORWARD DRAFT BULKHEAD	29.0	33.9	1.0
COCKPIT FIRE AXE	2.0	–39.7	–0.1
COCKPIT DOOR	27.0	–24.8	–0.7
LAVATORY (DRY)	144.0	–17.0	–2.4
LAVATORY PRE–CHARGE	22.0	–20.1	–0.4
OVERHEAD BIN INSTALLATION	726.0	350.6	254.5
SIDEWALL INSTALLATION (INCL. DOOR LINERS)	295.1	388.8	114.7
CABIN & BAGGAGE COMPARTMENT FLOOR PANELS	290.0	452.4	131.2
PORTABLE OXYGEN CYLINDERS & PBEs	36.0	377.9	13.6
TYPE II/III EMERGENCY EXIT (TOP PORTION)	32.0	83.0	2.7
FWD PAX (AIRSTAIR) DOOR	154.0	16.1	2.5
GALLEY, 2 (G1 & G2)	204.0	223.9	45.7
CABIN SEATS	1430.0	355.9	508.9
FLOOR CARPET	145.0	360.5	52.3
SEAT TRACK COVERS	22.0	361.2	7.9
AVIONICS	356.2	87.8	31.3
DADO PANELS	82.0	363.4	29.8
P.S.U.	134.9	351.3	47.4
CEILING PANELS	99.8	389.2	38.8
EMERG. EQUIPMENT (FLIGHT DECK)	16.0	–40.6	–0.6
EMERG. EQUIPMENT (CABIN)	34.0	396.3	13.5
FWD. BAGGAGE COMPARTMENT	172.0	32.9	5.7
AFT CABIN BAGGAGE BLKHD.	159.0	701.8	111.6
NOTE: WEIGHTS AND MOMENT OF THESE ITEMS VARY CONSIDERABLY DUE TO OPTIONAL INSTALLATIONS. REFER TO CH. 2 IN THE APPLICABLE WEIGHT AND BALANCE MANUAL (PSM 1–84–8/8M).			

NOTE: The forward baggage compartment is removed to accommodate the additional passenger seats for the extra capacity and cargo combi configurations.



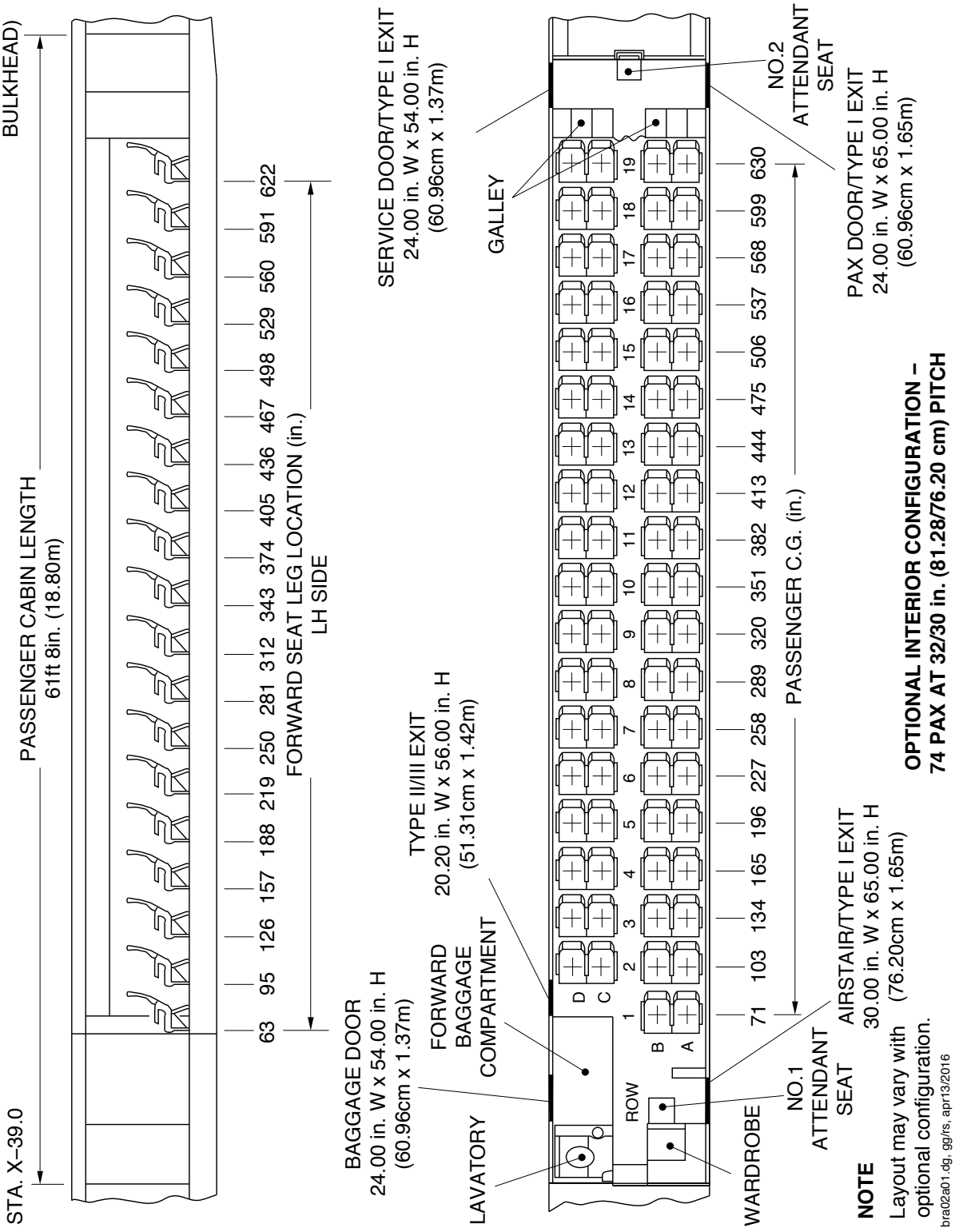
PASSENGER COMPARTMENT DIAGRAM – 70 PASSENGERS AT 32/33 INCH PITCH

Figure 02 – 1



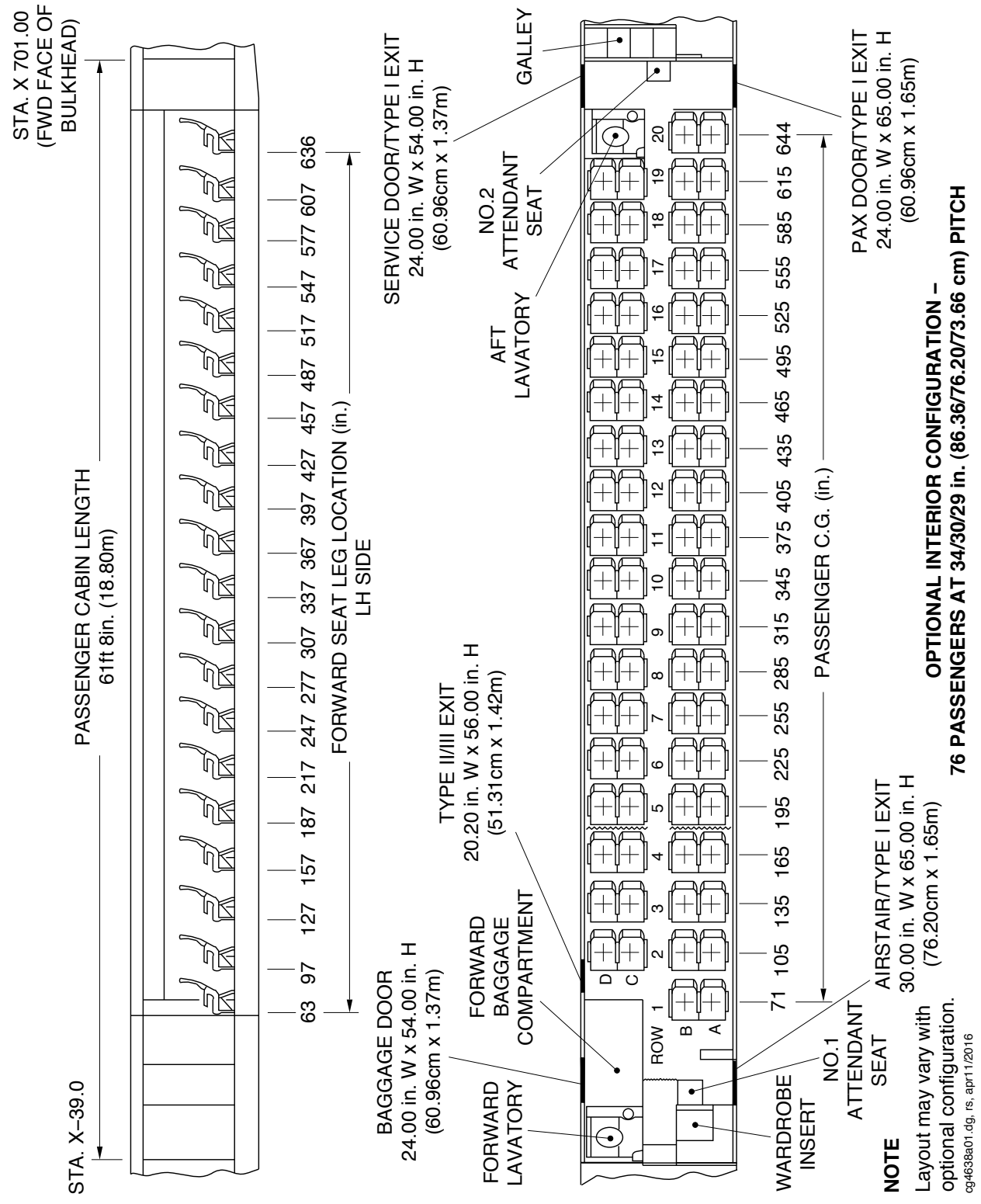
PASSENGER COMPARTMENT DIAGRAM – 72 PASSENGERS AT 32 INCH PITCH

Figure 02 – 2



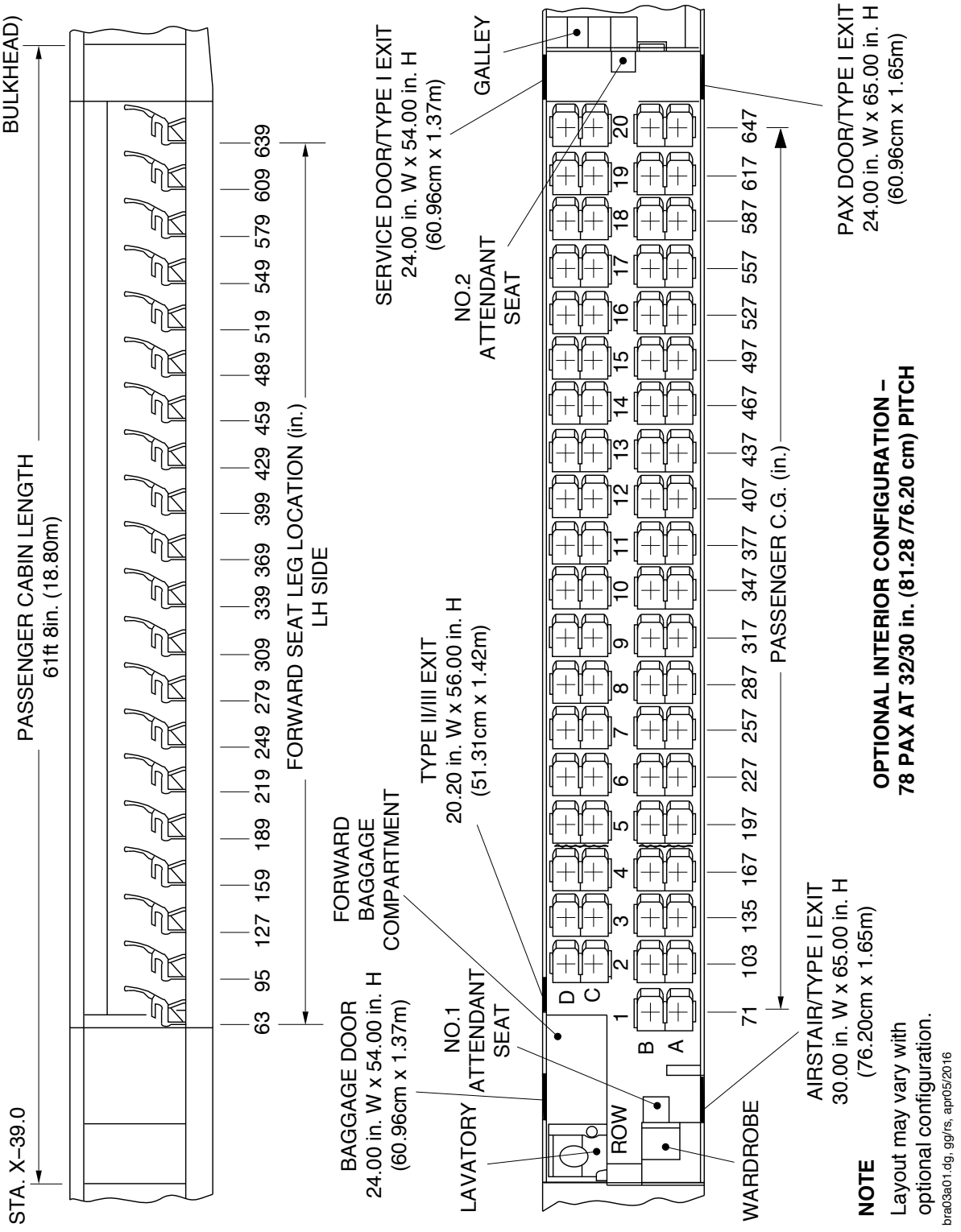
PASSENGER COMPARTMENT DIAGRAM – 74 PASSENGERS AT 32/30 INCH PITCH

Figure 02 – 3



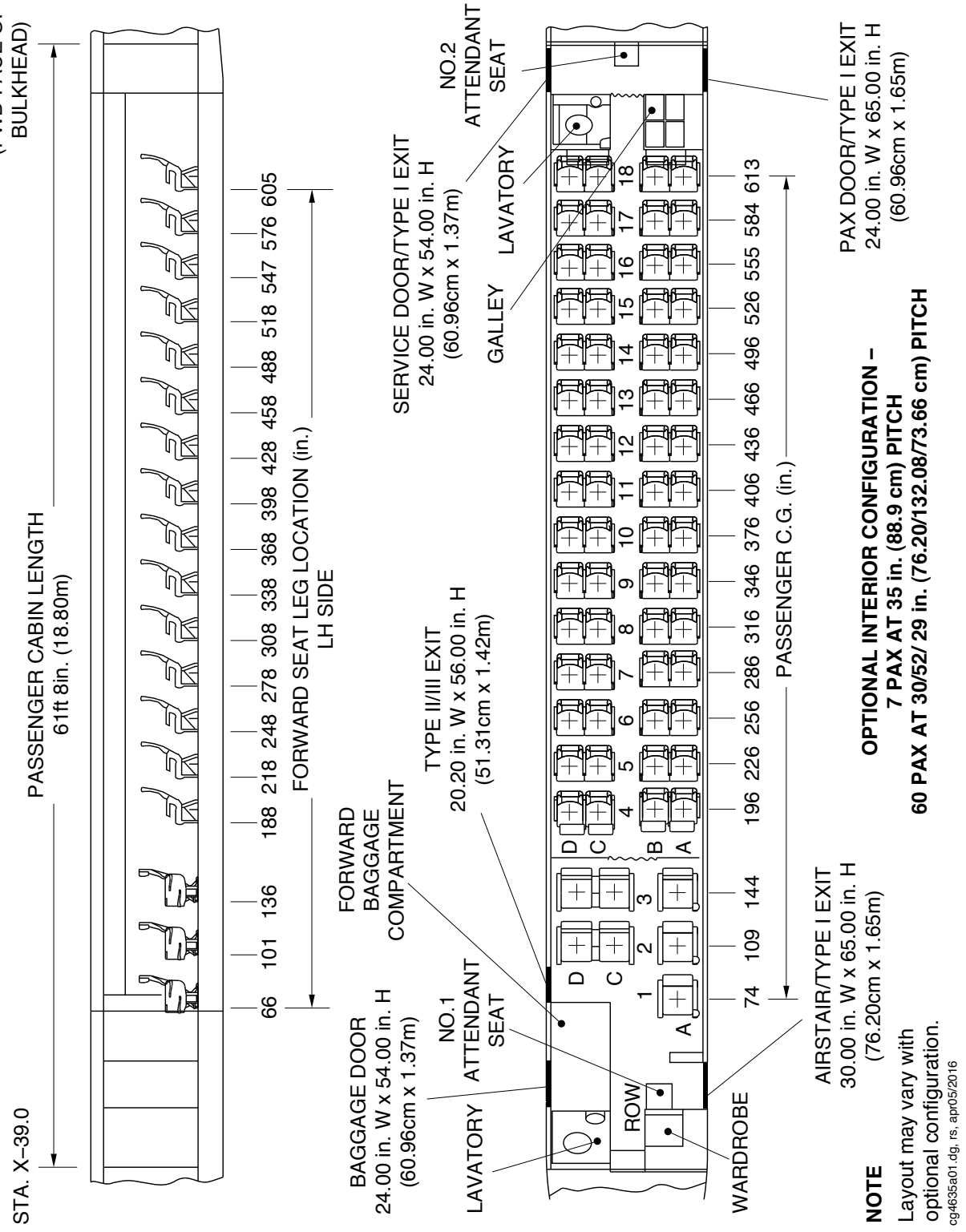
PASSENGER COMPARTMENT DIAGRAM – 76 PASSENGERS AT 34/30/29 INCH PITCH

Figure 02 – 4



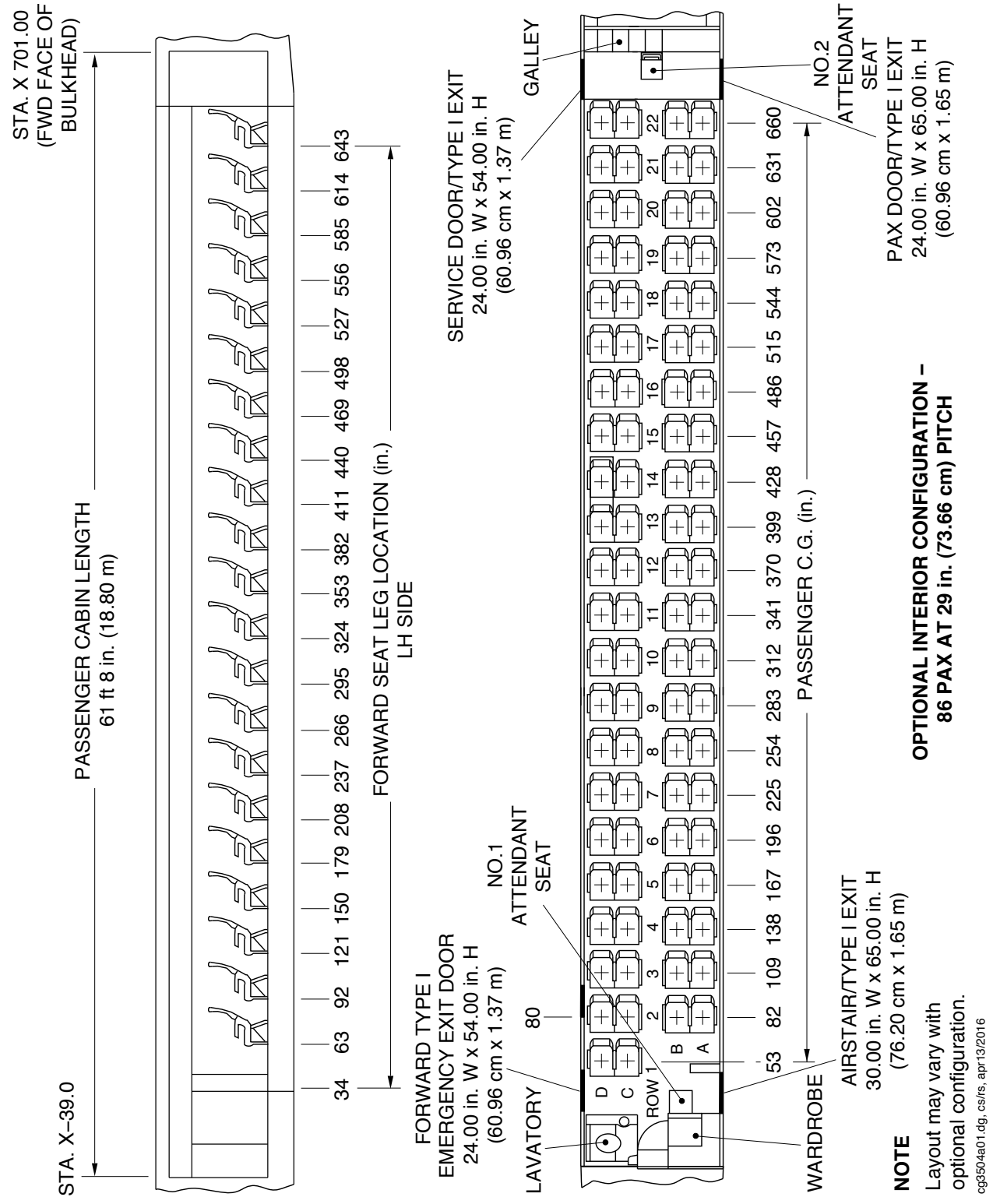
PASSENGER COMPARTMENT DIAGRAM – 78 PASSENGERS AT 32/30 INCH PITCH

Figure 02 – 5



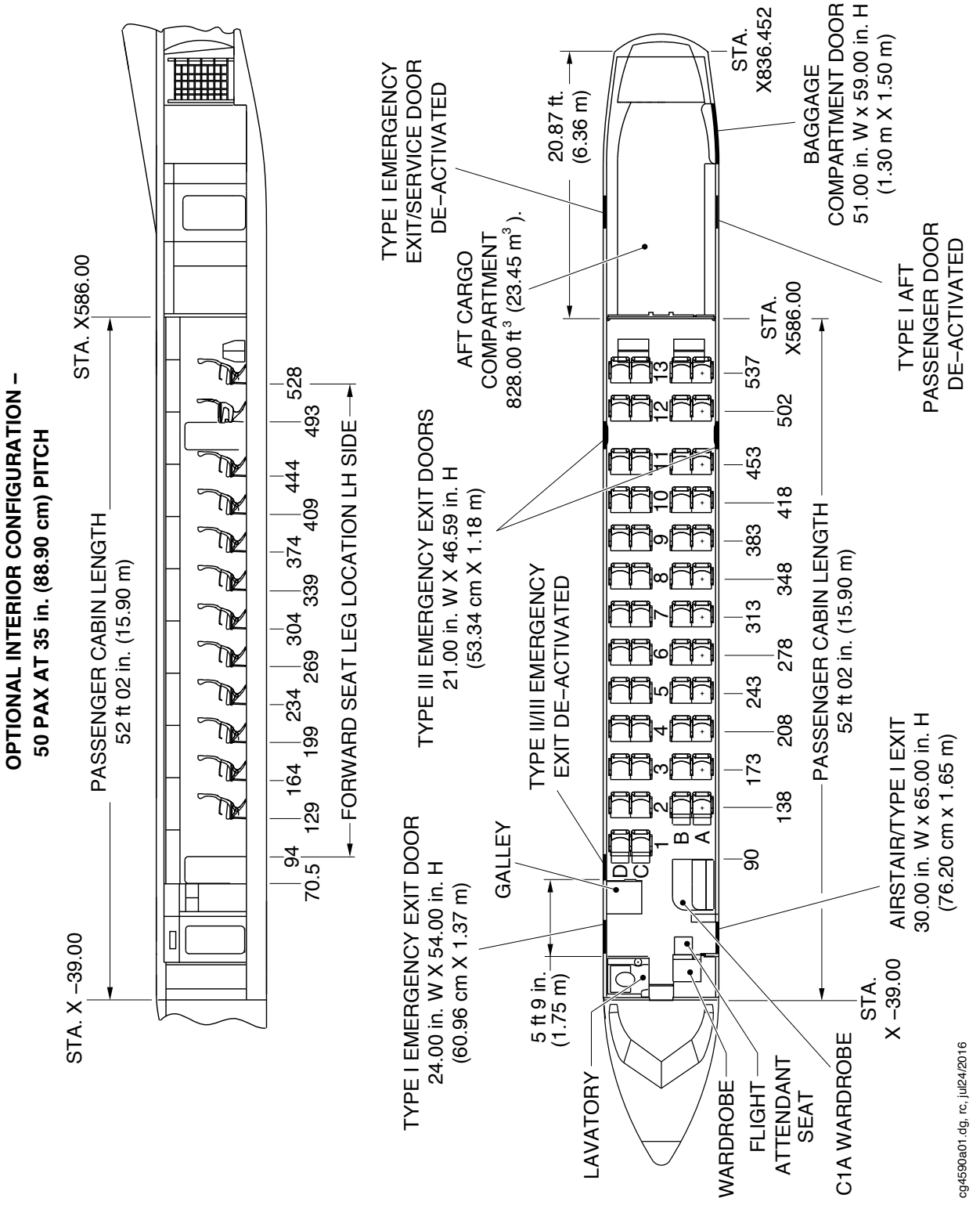
PASSENGER COMPARTMENT DIAGRAM – 67 PASSENGERS AT 30/52/29 INCH PITCH

Figure 02 – 6



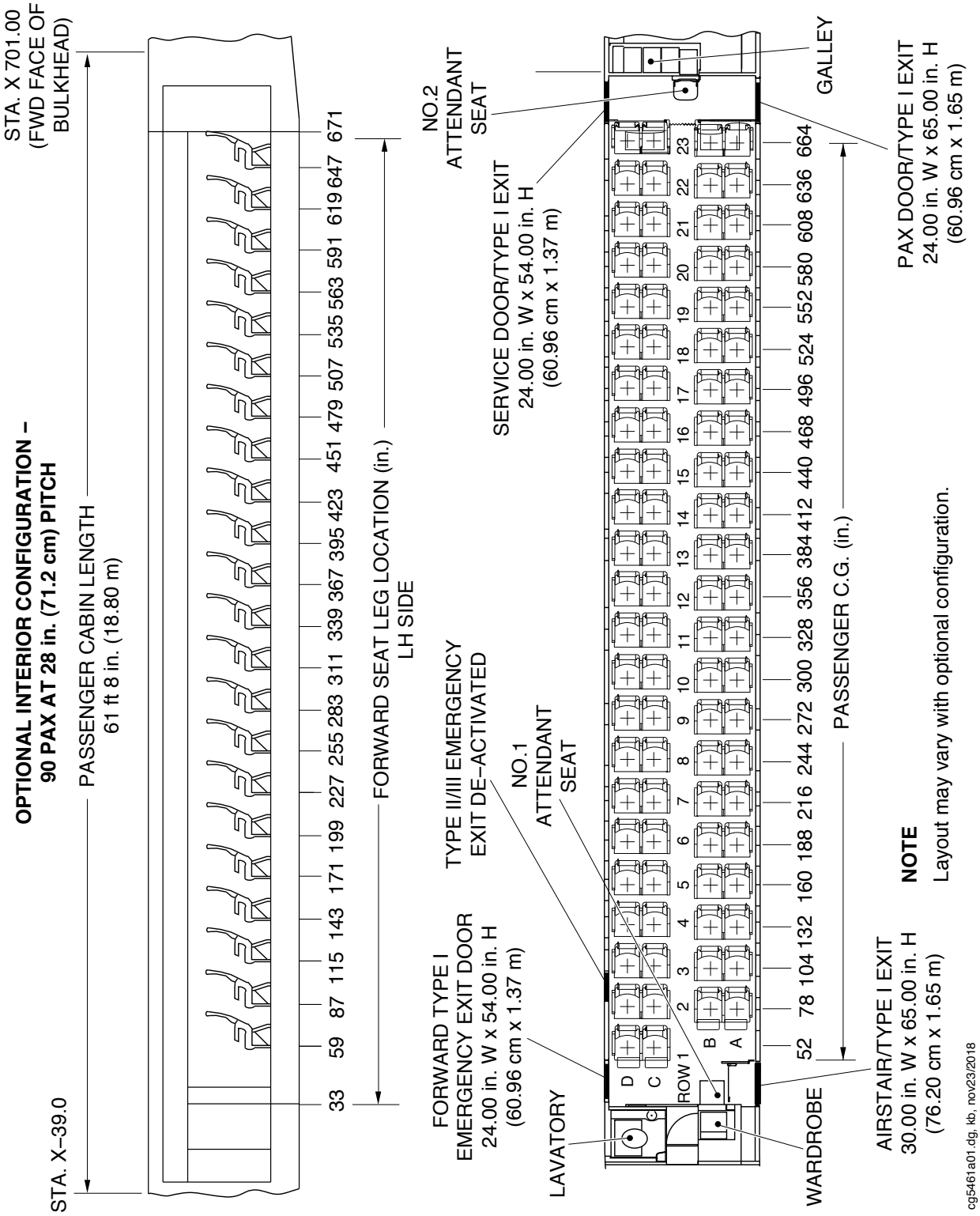
PASSENGER COMPARTMENT DIAGRAM – 86 PASSENGER AT 29 INCH PITCH

Figure 02 – 7



PASSENGER COMPARTMENT DIAGRAM – 50 PASSENGERS AT 35 INCH PITCH

Figure 02 – 8



PASSENGER COMPARTMENT DIAGRAM – 90 PASSENGERS AT 28 INCH PITCH

Figure 02 – 9

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DEFUELING

WARNING: OBEY THE FUEL SAFETY PRECAUTIONS WHEN YOU DO WORK ON THE FUEL SYSTEM OR A FUEL SYSTEM COMPONENT. IF YOU DO NOT DO THIS, YOU CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO THE EQUIPMENT.

WARNING: MAKE SURE THAT THE FUEL TENDER AND THE FUEL NOZZLE ARE ELECTRICALLY BONDED TO THE AIRCRAFT BEFORE YOU DEFUEL OR REFUEL THE AIRCRAFT. AN ELECTROSTATIC SPARK DURING REFUELING/DEFUELING CAN CAUSE AN EXPLOSION OR A FIRE.

WARNING: DO NOT LET THE FUEL TOUCH YOUR EYES AND/OR SKIN. DO NOT BREATHE THE FUMES OR ABSORB THE FUEL. THIS CAN CAUSE INJURIES.

CAUTION: DRAIN THE FUEL TANK BEFORE YOU REMOVE THE ACCESS PANELS. IF YOU DO NOT DO THIS, YOU CAN CAUSE DAMAGE TO THE WING STRUCTURE.

1. General

   A. Description and Operation

      (1) Fuel is contained in two integral wing tanks. Fuel from each main tank is fed to its associated engine by an engine–feed pumping system that is contained in a collector bay at the inner end of each tank. A collector–bay pumping system maintains the level of fuel in the collector bay and provides engine feed regardless of aircraft attitude. Each tank is vented to independent surge bay in the outboard wing by a vent line and a vent float valve (refer to Figure 02–1).

      (2) Pressure refueling and defueling is accomplished through a single–point refuel/defuel adapter. It is located in the right nacelle and is controlled from an adjacent refuel/defuel control panel. Each tank can also be filled through an overwing filler point.

      (3) Each tank has its own capacitance–type fuel–quantity indicating system, which provides an input to help control fuel levels during refueling/defueling. Low–level warnings are also provided for each fuel tank.

      (4) Defueling is highly recommended (if possible) before lifting the aircraft so that the weight of the aircraft is reduced and potential fire hazard is minimized. While some recovery operations do not need defueling operations, the decision to do so or not must be determined only after a study of the effects of such action on jacking loads, C. G. shift, towing loads and safety considerations. In particular the factors that follow may effect the decision to defuel:

         – The urgency to move the aircraft from a runway or taxiway (time available for recovery)

- Whether electrical power can safely be applied
- Whether ground conditions and aircraft attitude permit the use of refueling equipment (bowsers, etc.).

(5) The amount of fuel in the aircraft may be significant enough to shift the center of gravity when the aircraft is righted from an abnormal attitude. Due to this abnormal attitude, the defueling procedure may be different from normal and may require more time. Before any defueling is attempted, determine from Weight and Balance calculations (refer to 02–30–01) how the amount or quantity of fuel you want to remove will affect the Center of Gravity (C.G.) location.

B. Safety Precautions

(1) Do not smoke in or around the aircraft and keep all sources or fire or sparks away from the aircraft.

(2) Do not park fuel trucks or other vehicles less than 20 feet from the fuel vents.

(3) Do not do maintenance on the aircraft until the fuel tanks are completely drained, purged of fuel vapors and determined to be safe.

(4) Make sure that adequate fire–extinguishing equipment and personnel familiar with its use are immediately available and on standby at all times.

(5) Make sure that the aircraft, fuel tender and fuel nozzle are correctly grounded.

(6) Make sure that all electrical power is off except when suction defueling is in progress. During suction defueling, all electrical services must be off except for those required to monitor the operation.

(7) Avoid any fuel spillage as this will greatly increase the risk of fire. If fuel is spilled, all operations must cease in the vicinity until the spill is cleaned up and the area is determined to be safe by fire personnel.

(8) Use only vapor/explosion–proof lamps with good electrical connections and serviceable extensions cords when inside or in the vicinity of open fuel tanks.

(9) Avoid fuel contact with eyes and skin, or inhalation of vapors or accidental swallowing of fuel. Anyone who has been exposed to fuel must wash contacted areas thoroughly with water and get medical attention immediately.

(10) Do not enter fuel tanks until they are completely drained, purged of fuel vapors, and determined to be safe. All access panels must be open or removed.

(11) Make sure that a continuous flow of ventilating air is maintained through the fuel tanks when work is being done inside.

C. Fuel Tank Data

(1) The table that follows shows the capacities and the fuel weights for the fuel tanks:

TANK CAPACITIES

FUEL TANK CAPACITIES AND FUEL WEIGHTS (USABLE)					
LOCATION	TANK CAPACITY (APPROX.)			BASED ON: 6.8 LB/U.S. GAL. (0.775 KG/L)	
TANKS	U.S. GAL.	IMP. GAL	L	LB	KG
NO. 1 TANK (LEFT WING)	862	718	3263	5862	2659
NO. 2 TANK (RIGHT WING)	862	718	3263	5862	2659
TOTAL	1724	1436	6526	11724	5318

(2) The list that follows shows the permitted fuel types:

PERMITTED FUEL TYPES

CANADIAN	U.S.
KEROSENE TYPE	
CAN 2–3.23–M81	ASTM D1655 JET A
	ASTM D1655 JET A1
	MIL–T–5624 JP–5
	MIL–T–5624 JP–8
WIDE CUT TYPE	
CAN 2–3.22–M80	ASTM D1655 JET B
	MIL–T–5624 JP–4

(3) System requirements for pressure refueling/defueling are shown in the table that follows:

SYSTEM REQUIREMENTS FOR REFUELING/DEFUELING

TYPE	REQUIREMENTS
ELECTRICAL POWER	28 VOLTS DC, FROM INTERNAL OR EXTERNAL SOURCE. MAKE SURE THAT ALL INVERTER CIRCUIT BREAKERS ARE CLOSED.
FUELING PRESSURE	50 PSI (350 KPA) MAXIMUM
FUELING FLOW RATE	125 U.S. GALL./MIN. (473 L/MIN.) AT 50 PSI MAX.
AIRCRAFT CONNECTOR	ADAPTER – 2810070–101 PARKER HANNIFIN (MS2448–4–2)
MATING GROUND CONNECTOR	ANY STANDARD FUELING NOZZLE CONFORMING TO MS29520–1
GROUNDING PROVISION	AIRCRAFT CONNECTOR – MS90298–2, MATING GROUND CONNECTOR – MS3493

D. Pressure (Suction) Defueling

(1) Observe the safety precautions previously listed.

(2) Make sure that the aircraft is grounded (refer to Figure 02–2) (Refer to AMM TASK 10–11–00–869–801).

(3) Connect the external DC electrical power to the aircraft (Refer to AMM TASK 12–00–06–861–801). Connect the external AC electrical power to the aircraft (Refer to AMM TASK 12–00–06–861–803).

(4) Open the Refuel/Defuel Control–Panel access door (424AB) (refer to Figure 02–3).

(5) Pressure defuel the aircraft as follows:

(a) Make sure the floodlight and the MASTER VALVE CLOSED light come on when you open the refuel/defuel panel door (1).

(b) Make sure that the rotary selector knob on the refuel/defuel panel is in the OFF position.

(c) Make sure that the VALVE CONTROL switches are in the CLOSE position.

(d) Ground the refuel unit and the fuel nozzle. Ground the refuel unit to the ground before you ground it to the aircraft.

(e) Remove the cap from the refuel/defuel adapter and connect the fuel nozzle to the adapter. Push the tab to unlock and vent, then turn the cap counterclockwise.

(f) Turn the rotary selector knob on the refuel/defuel panel (2) to the PRESELECT DEFUEL or the DEFUEL position. Make sure that you see the indications that follow:

1 The MASTER VALVE CLOSED light is off.

2 The REFUEL SHUTOFF lights are on.

3 The FUELING ON light on the caution/warning panel in the flight compartment comes on.

(g) Make sure that the refuel/defuel indicator (referred to as the RDI (3) in these procedures) comes on. It will show the tank quantities and preselect value.

(h) Apply suction to the refuel manifold.

(i) If you use the PRESELECT DEFUEL procedure, use the INCR/DECR pushbutton on the refuel/defuel indicator to set the necessary fuel quantity.

NOTE: If you use the PRESELECT DEFUEL procedure, defuel flow starts four seconds after you release the INCR/DECR switch. If you use the DEFUEL procedure, defuel flow will start immediately when you move the VALVE CONTROL switches to the REFUEL position.

(j) Make sure that the REFUEL SHUTOFF (TANK 1 and TANK 2) lights go off.

(k) Set the applicable VALVE CONTROL switch or switches to the OPEN position.

(l) If you use the DEFUEL procedure, you can control the flow from each fuel tank with the VALVE CONTROL switches.

(m) To stop the defuel flow from tank 1, tank 2, or the two tanks, set the applicable VALVE CONTROL switch to the CLOSE position.

NOTE: With the PRESELECT DEFUEL procedure, the defuel flow stops automatically when each tank contains one half the value set on the RDI.

(n) When you complete the defuel operation, make sure the RDI fuel quantity agrees with the FUEL page (4) on the flight compartment MFD.

(o) At the refuel unit, remove the suction from the refuel manifold.

(p) Set the rotary selector knob on the refuel/defuel panel to the OFF position. Monitor the indications that follow:

1 The MASTER VALVE CLOSED light come on.

2 The REFUEL SHUTOFF lights are on.

(q) Disconnect the fuel nozzle from the refuel/defuel adapter. Install the cap on the refuel/defuel adapter and turn the cap clockwise. Make sure that the tab is flush with the cap.

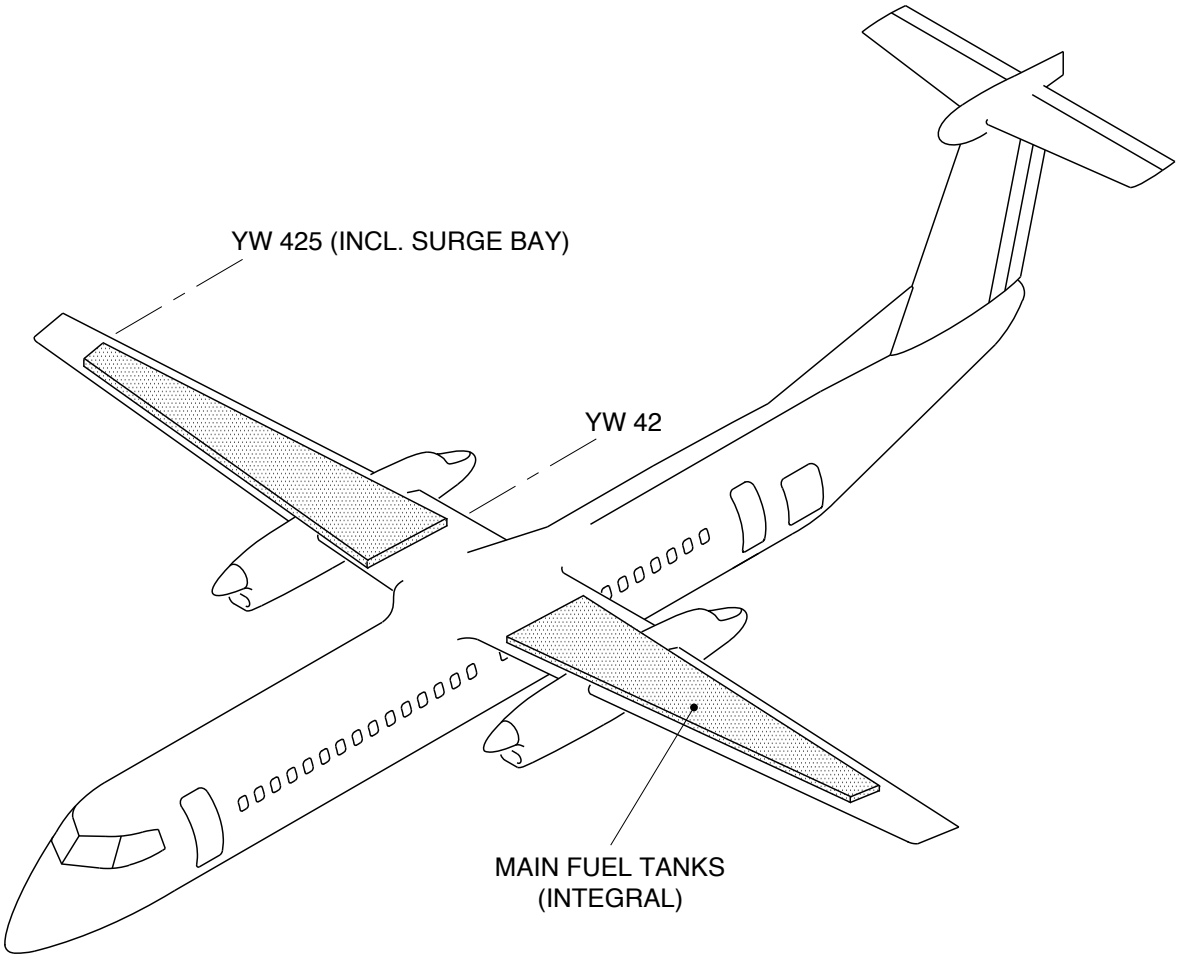
(r) Remove the ground cable of the fuel unit and the nozzle from the aircraft.

(s) Make sure the rotary selector knob is in the OFF position and the VALVE CONTROL switches are in the CLOSE position.

(t) Close the Refuel/Defuel Control–Panel access door (424AB).

(u) Make sure that the FUELING ON light on the caution/warning panel in the flight compartment goes off.

(v) Remove the external DC electrical power from the aircraft (Refer to AMM TASK 12–00–06–861–802). Remove the external AC electrical power from the aircraft (Refer to AMM TASK 12–00–06–861–804).



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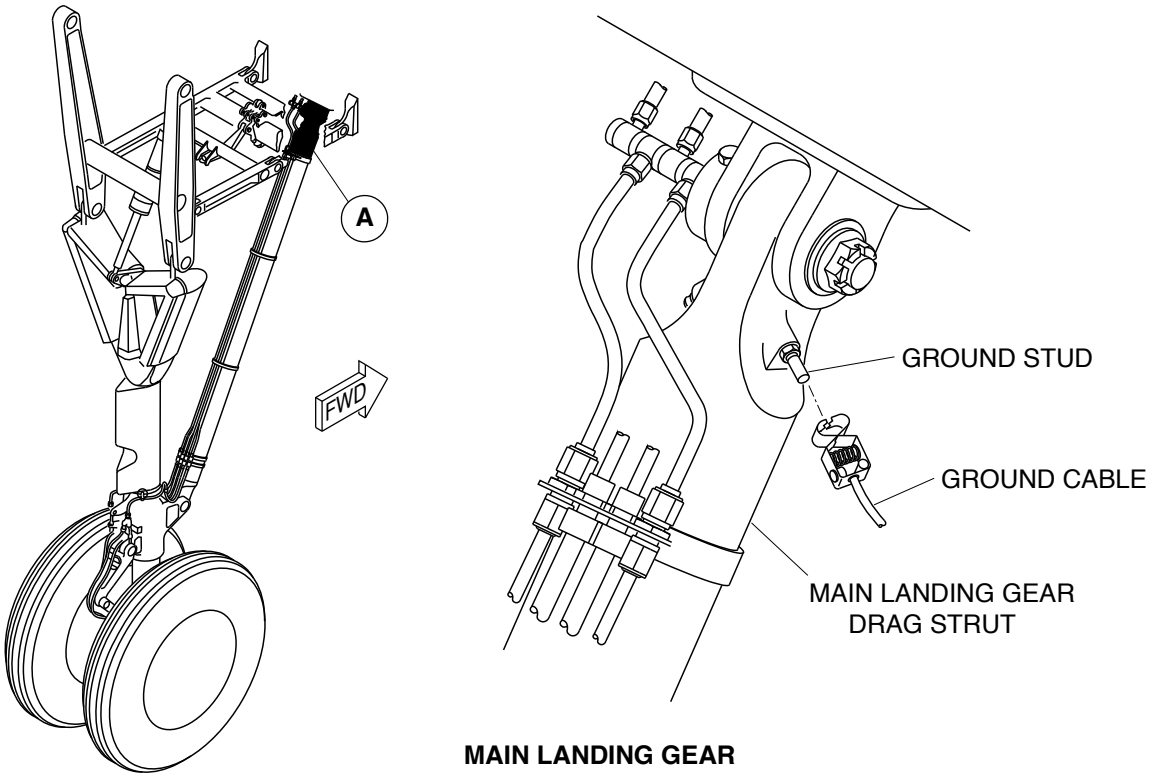
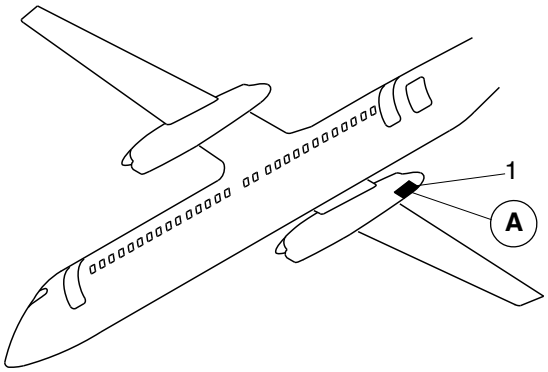
FUEL TANKS

Figure 02 – 1



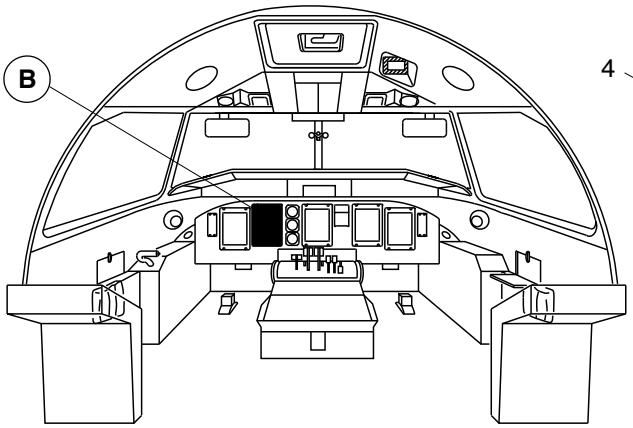
STATIC GROUNDING POINTS

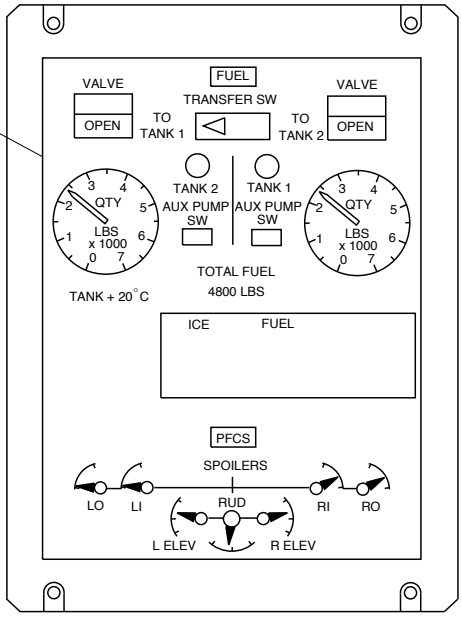
Figure 02 – 2

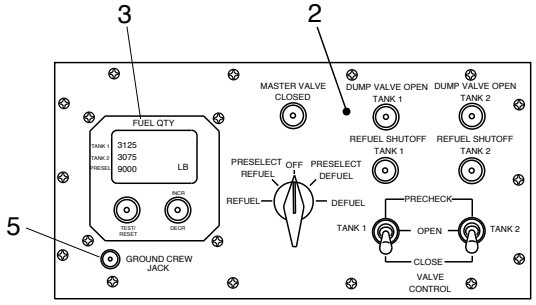


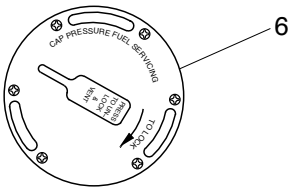
LEGEND

1. Refuel / Defuel panel door.
2. Refuel / Defuel panel.
3. Refuel / Defuel indicator.
4. Fuel System readout (typical).
5. Ground crew jack.
6. Cap.









NOTE

Refuel / Defuel panel visible with door open.

REFUEL/DEFUEL PANEL

A

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PRESSURE REFUELING / DEFUELING OF THE AIRCRAFT

Figure 02 – 3

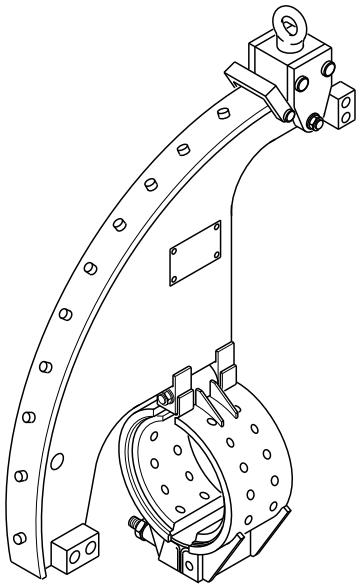
POWER PLANT

1. General

   A. The aircraft is powered by two Pratt and Whitney PW150A turboprop engines. Six–bladed, constant speed, variable and reversible pitch Dowty R408 propellers are installed.

2. Removal

   A. To remove the engines and propellers, refer to Ch. 71, Aircraft Maintenance Manual (PSM 1–84–82). Refer to Figure 02–1 and Figure 02–2.

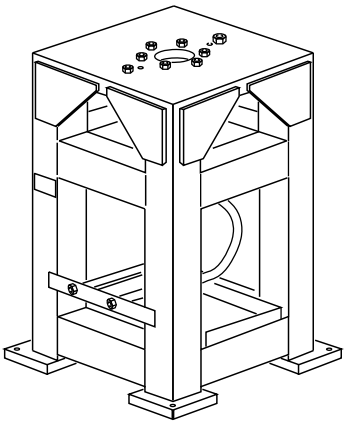


PROPELLER LIFTING EQUIPMENT

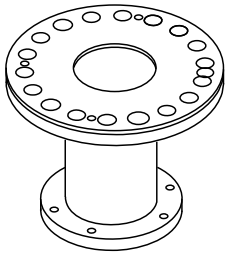
NOTE

This is not a complete list.
For further information, consult
the Tools and Equipment Manual,
PSM 1–84–2T.

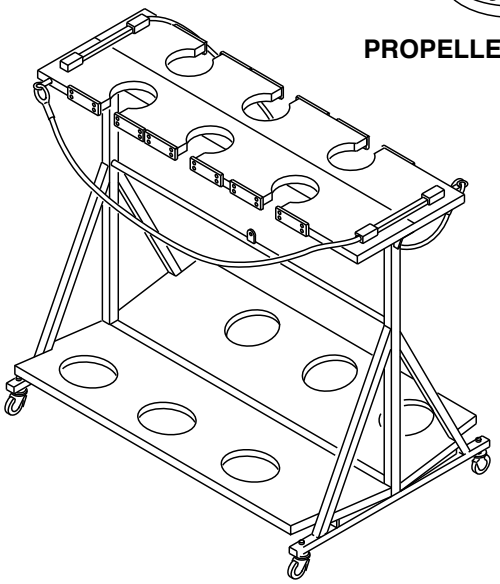
Equipment may not be exactly as shown.



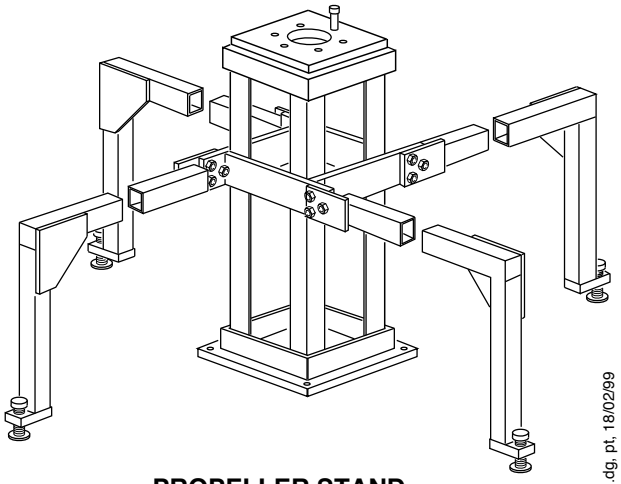
PROPELLER STAND
(HORIZONTAL FIXED)



PROPELLER MANDREL



BLADE STORAGE DOLLY



PROPELLER STAND
(HORIZONTAL PORTABLE)

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PROPELLER MAINTENANCE EQUIPMENT

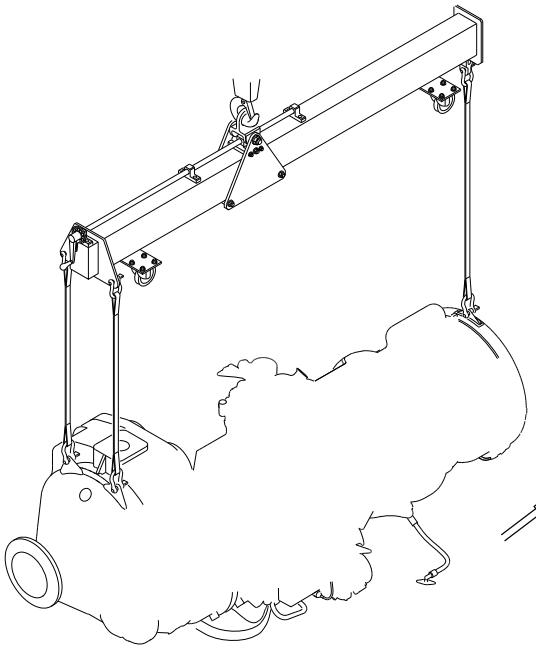
Figure 02 – 1

NOTE

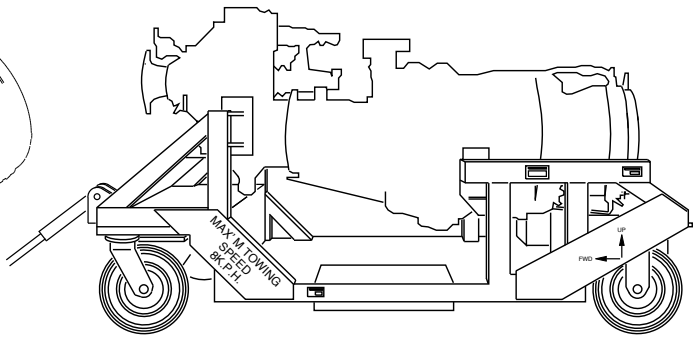
This is not a complete list.

For further information, consult the Illustrated Tool and Equipment Manual, PSM 1–84–2T.

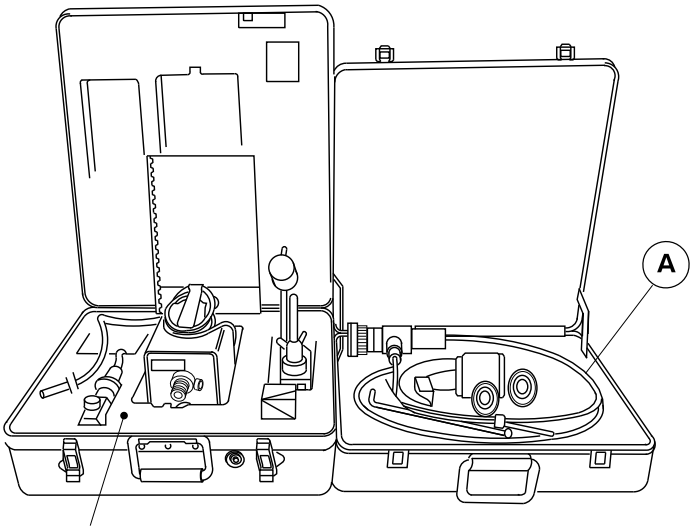
Equipment may not be exactly as shown.

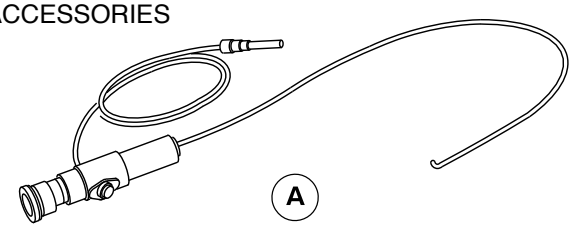


ENGINE SLING

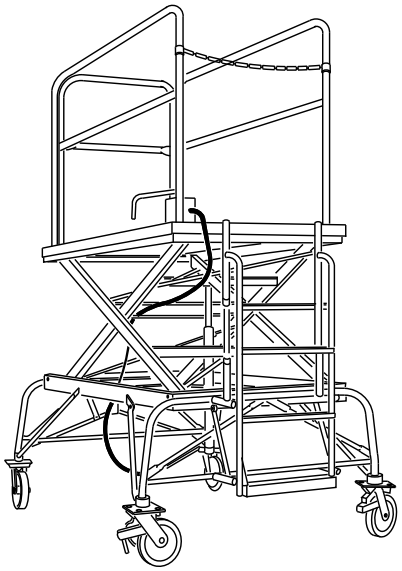


ENGINE TRANSPORT STAND





BORESCOPE KIT



ENGINE WORK STAND

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ENGINE MAINTENANCE EQUIPMENT

Figure 02 – 2

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DE HAVILLAND AIRCRAFT
OF CANADA LIMITED

AIRCRAFT RECOVERY MANUAL

CHAPTER 03

STABILIZE AIRCRAFT

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AIRCRAFT RECOVERY MANUAL

LIST OF EFFECTIVE PAGES

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03–20–01	1 *	Mar 05/2022
	2 *	Mar 05/2022
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The asterisk (*) indicates pages revised, added or deleted by current revision.

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AIRCRAFT RECOVERY MANUAL

TABLE OF CONTENTS

STABILIZE AIRCRAFT

1. General

   A. This Chapter covers methods and devices for stabilizing and lifting the aircraft. Close all doors and access panels to protect the aircraft against inclement weather.

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TETHERING

WARNING: BE CAREFUL WHEN YOU USE MANILA ROPE IN WET WEATHER CONDITIONS. IT WILL SHRINK AND CAUSE DAMAGE TO THE AIRCRAFT STRUCTURES. WET MANILA ROPE CAN ALSO FREEZE. THEN IT CAN BREAK EASILY. IF YOU DO NOT OBEY THESE PRECAUTIONS, YOU CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE AIRCRAFT.

WARNING: DO NOT USE ROPES OR STEEL CABLES WITH WORN, CUT, OR BROKEN STRANDS, KINKS, OR RUST. IF YOU DO THIS, YOU CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

1. General

   A. Whether or not the aircraft needs to be tethered for a safe recovery depends on the factors that follow:

      – The type of incident
      – The recovery method
      – The equipment used
      – Terrain and wind conditions.

   NOTE: In this manual the terms tethering and mooring have the same meaning and are used interchangeably. The term tie–down refers to the conventional method to secure an aircraft to the ground surface with ropes or cables

2. Tethering Lines

   A. The tethering points of the Dash–8, Series 400 are located at the nose and main landing gears. There are no other tether points.

   B. For a 65 knot (120 km/h) steady wind at the most critical angle, it has been determined that the Series 400 tethering lines must be rated for a 5000 lb (2268 kg) minimum working load (refer to Figure 03–1).

   C. Use only tethering lines with a safety factor of greater than five times (25,000 lb (11,340 kg)) of the working load of the line. Examples are:

      – 1 in. (25 mm) diameter nylon
      – 0.75 in. (19 mm) diameter high strength polypropylene.

   D. Do not use ropes or steel cables with damaged strands. Manila rope must be used with caution if wet weather is forecast.

E. Each tethering line must have some means of adjustment to allow for changes in cable length.

F. Tether the Nose Landing Gear as follows:

(1) Make a double loop with the rope. Put one loop around the right side of the tow spool and the other loop around the left side of the tow spool. Then pass the rope through the middle ground attachment ring.

(2) While you keep tension in the rope, secure the ends of the rope to the outer ground attachment rings. Make sure the rope stays tight.

(3) Install a bungee cord between the rope and the middle ground attachment ring. Make sure that the bungee cord has tension.

G. Tether the Main Landing Gear as follows:

(1) Install the protective spool (1) on each of the main landing gear shock strut outer web.

(2) Make a double loop around the protective spool (1) installed on the main landing gear shock strut outer web with the rope (2).

(3) While you keep tension in the rope (2), secure the ends of the rope (2) to the ground attachment rings (3). Make sure the rope (2) stays tight.

H. Install a dynamometer on each line and assign one lineman for each tether line to monitor the dynamometer as the aircraft is lifted. This person must make sure that excessive force is not transmitted to the tethering point. If this happens, the tensioning device must be released to ease the load (refer to Figure 03–2).

NOMINAL DIAMETER IN INCHES (CM)	BREAKING STRENGTH IN LB (KG)				
	(ABACA) MANILA FED. SPEC. TR 605	DUPONT DACRON	NYLON	DOUBLE NYLON BRAID	STEEL CABLE (6X19 WITH FIBRE CORE)
3/16 (.48)	–	–	–	–	3100 (1406)
1/4 (.64)	–	–	–	–	5480 (2486)
5/16 (.79)	–	–	–	–	8520 (3856)
3/8 (.925)	–	–	–	–	12200 (5534)
7/16 (1.11)	–	–	–	–	16540 (7503)
1/2 (1.27)	2650 (1202)	6100 (2767)	6650 (3016)	7500 (3402)	21400 (9707)
5/8 (1.58)	4400 (1996)	9500 (4309)	10000 (4536)	12000 (5443)	33400 (15150)
3/4 (1.91)	5400 (2449)	13200 (5988)	14600 (6623)	17000 (7711)	47600 (21591)
7/8 (2.22)	7700 (3493)	17500 (7938)	19600 (8891)	23700 (10750)	64400 (29212)
1 (2.54)	9000 (4082)	22000 (9979)	25000 (11340)	28500 (12927)	83600 (37921)
1–1/4 (3.175)	13500 (6124)	30500 (13835)	37800 (17146)	44000 (19958)	129200 (58605)

NOTE

The ratio of safe working load to breaking strength should be 1:5 or greater.

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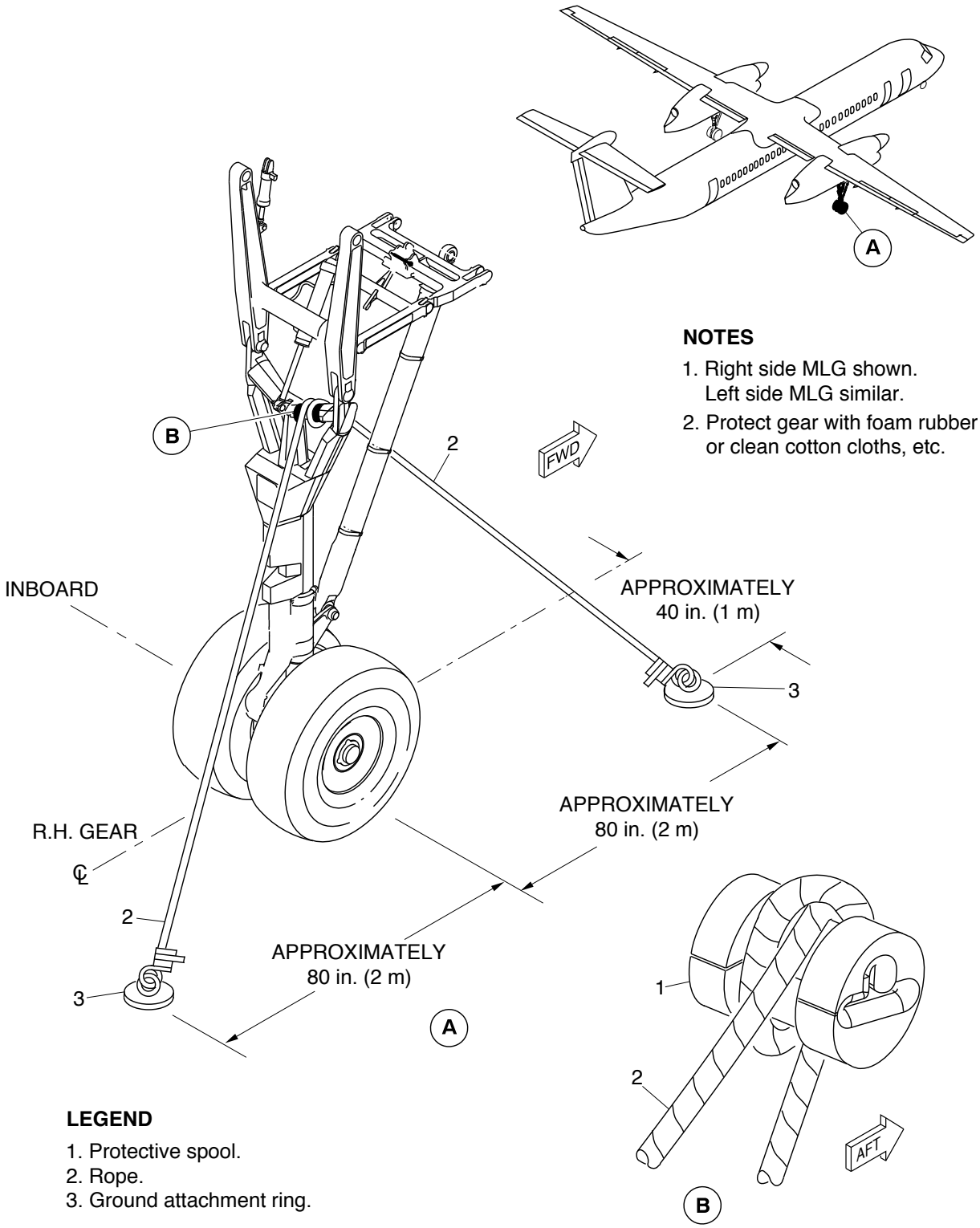
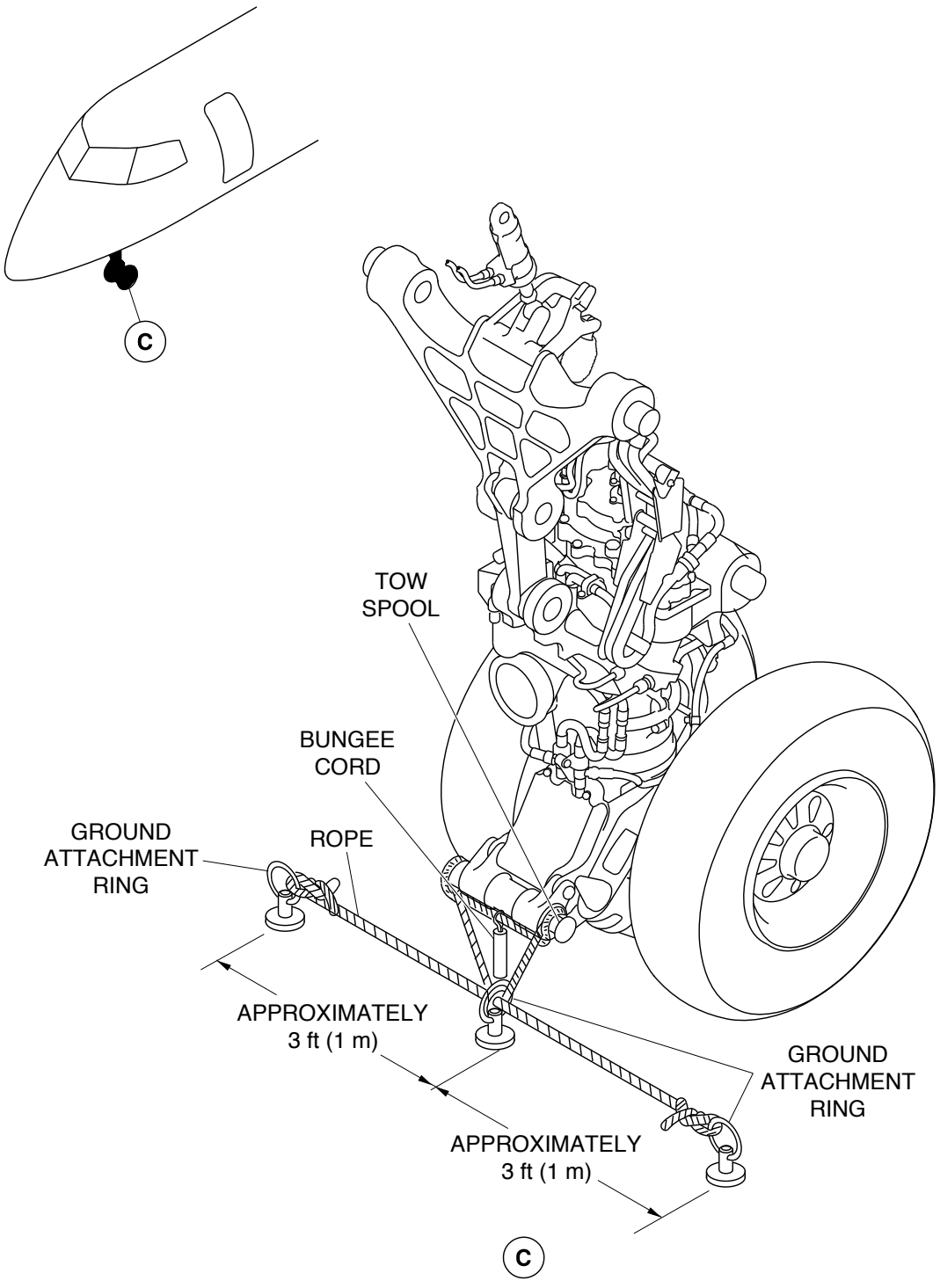
MINIMUM BREAKING STRENGTH OF TETHERING LINE MATERIALS

Figure 03 – 1



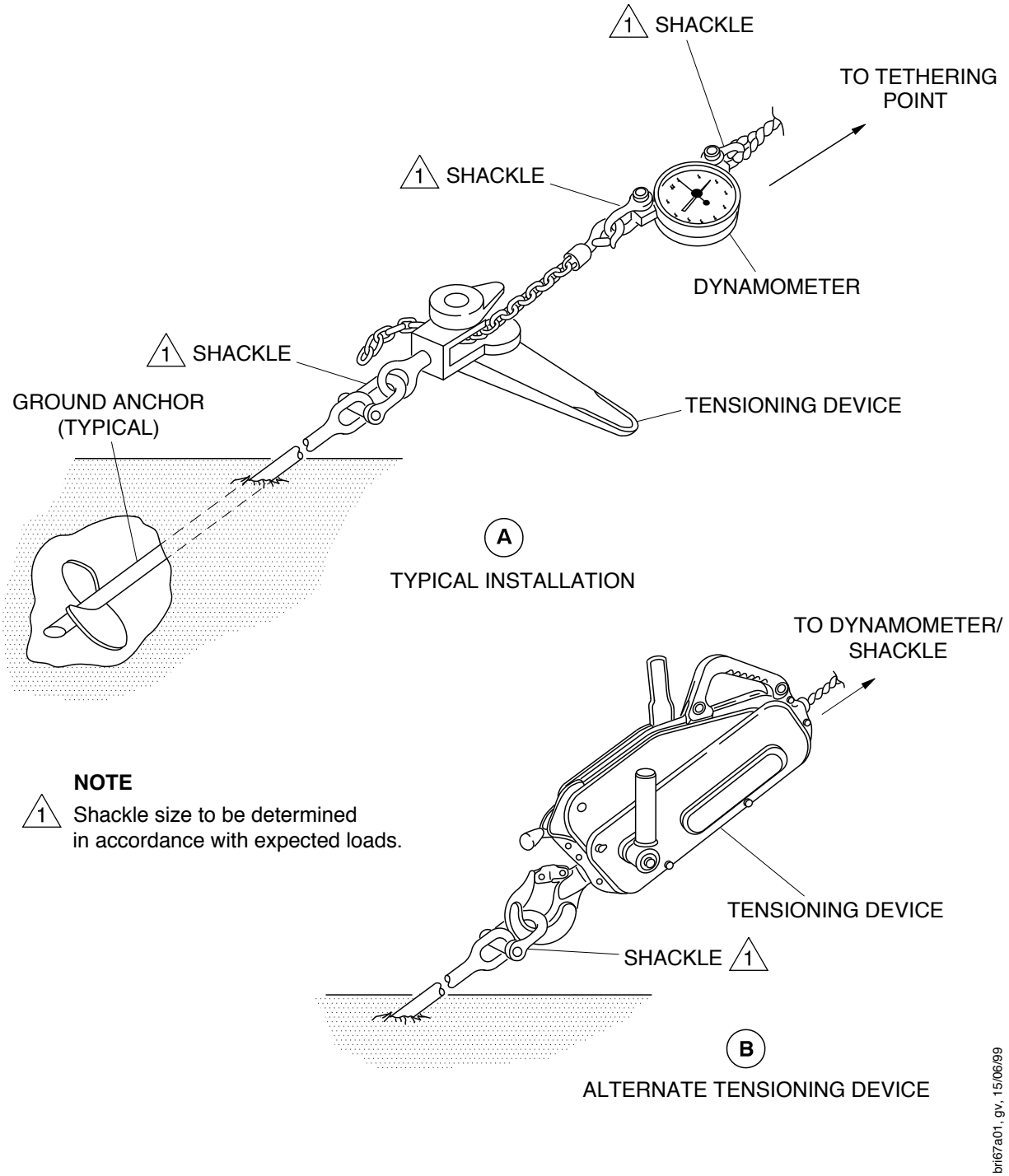
AIRCRAFT TIE DOWN PROVISIONS (Sheet 1 of 2)

Figure 03 – 2



AIRCRAFT TIE DOWN PROVISIONS (Sheet 2 of 2)

Figure 03 – 2



TYPICAL TETHERING – LINE INSTALLATION

Figure 03 – 3

GROUND ANCHORS

1. General

   A. Tethering or mooring lines are held steady by attaching them to heavy vehicles, buried timber (deadman), ground anchors or other structures. Various types of ground anchors are available for specific ground conditions (refer to Figure 03–1).

   B. Ground anchors are manufactured from malleable iron, aluminum or steel and vary in weight, size and holding power.

   C. Most types of ground anchors are inserted by hand with a manual impact tool, a driving rod and a handle.

   D. Follow the manufacturer's instructions when you install anchors.

   E. Preload the anchor to take in any slack or settling before you attach the tether line.

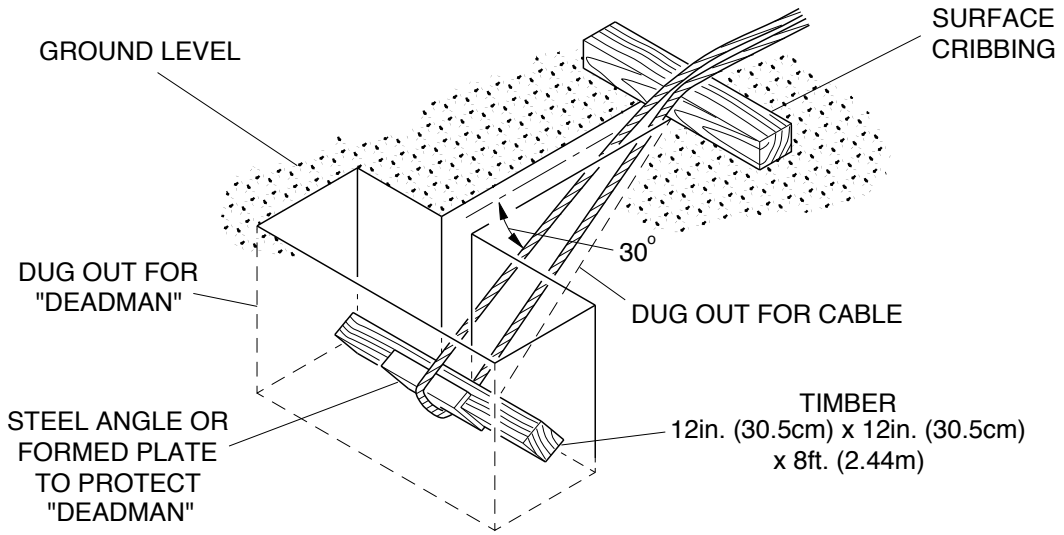
2. Types of Anchors

   A. Screw–Type Anchors

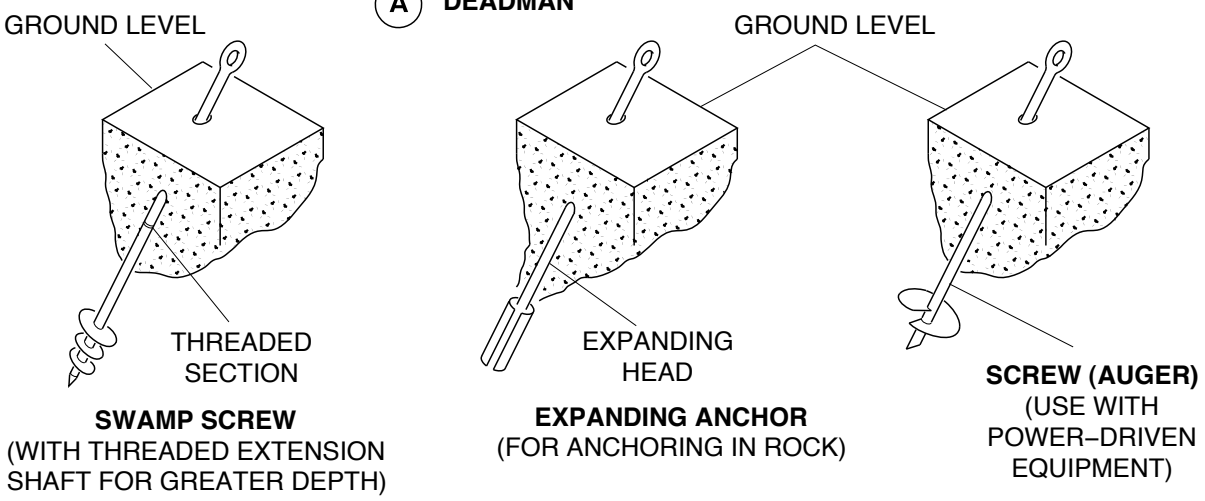
      (1) These are installed with the use of a power driving machine.

   B. Expanding–Type Anchors

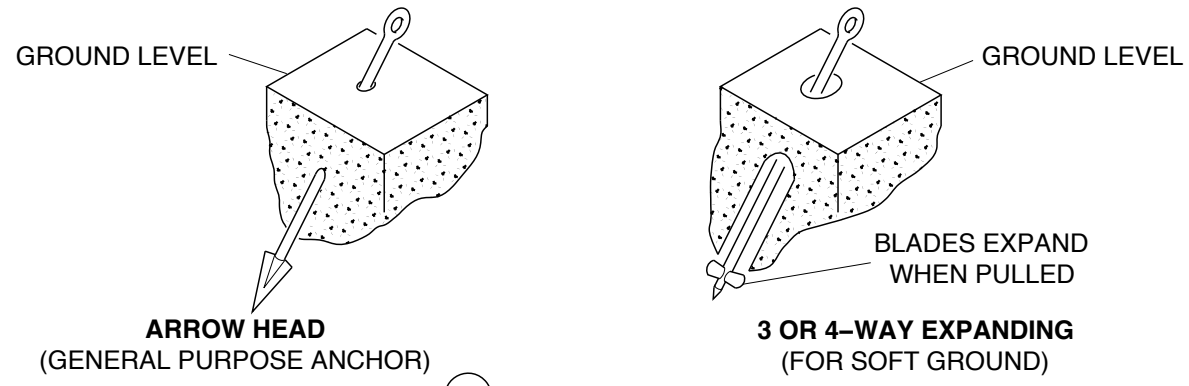
      (1) To install an expanding–type anchor, a hole is first drilled, then the anchor is pushed into the hole. When the anchor rod is turned, the blades expand and dig into the soil. The clearance around the rod is then filled in with tamped soil or fast–setting concrete.



A "DEADMAN"



B SCREW–TYPE ANCHORS



C OTHER ANCHORS

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TYPICAL ANCHOR INSTALLATION

Figure 03 – 1

LIFTING DAMAGED AIRCRAFT

WARNING: BEFORE YOU MOVE THE AIRCRAFT OR LIFT IT FROM THE GROUND, OBEY THE SAFETY PRECAUTIONS THAT FOLLOW:

DO NOT LIFT THE AIRCRAFT IF THE WIND SPEEDS ARE 20 MPH (32 KM/H) OR MORE.

TETHER THE AIRCRAFT AS NECESSARY.

REMOVE PAYLOAD TO REDUCE THE AIRCRAFT WEIGHT.

MAKE SURE THAT NO PERSON IS IN/ON THE AIRCRAFT WHEN YOU LIFT IT.

MAKE SURE THAT AN APPROVED PERSON IS AVAILABLE TO MONITOR THE OPERATION TO MAKE SURE NO FUEL SPILLS.

DAMAGED STRUCTURES THAT ARE COMPRESSED CAN MOVE SUDDENLY DURING THE RELEASE OF ENERGY WHEN YOU START TO LIFT THE AIRCRAFT.

IF YOU DO NOT FOLLOW THESE PRECAUTIONS, YOU CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

CAUTION: IF IT IS POSSIBLE, DEFUEL THE AIRCRAFT TO DECREASE THE WEIGHT. THIS WILL HELP TO PREVENT DAMAGE TO THE AIRCRAFT STRUCTURE.

1. General

   A. Almost every aircraft recovery situation is unique. Each situation must be analyzed with respect to the specific conditions.

   B. The use of jacks, pneumatic lifting bags (airbags), cranes and slings are proven and effective ways to lift aircraft. While the time–honoured method to lift an aircraft from the belly position is to use a series of airbags, this method requires extra caution (because of the unstable nature of inflated airbags). It is often simpler and safer to lift the aircraft in smaller increments with axle jacks and cribbing.

   C. As outlined in Ch. 2 of this manual, reduce the aircraft weight as much as possible to make the lift operation easier and safer. In particular, defuel the aircraft, if this is possible. When only one wing has to be lifted, it may be helpful to leave fuel in the opposite wing tanks or to transfer it there. Ballast may also be required in the forward or aft baggage compartments in order to correct C.G. problems.

   NOTE: De Havilland Aircraft of Canada Limited strongly recommends that you defuel the aircraft, if this is possible, before any lifting operation takes place. This will reduce the weight of the aircraft and help prevent damage to the structure.

D. Raise the aircraft so that it is kept in a level attitude as much as possible as this will help to reduce side loads on the jacks and to minimize the shift of airbags. Monitor the aircraft's attitude during the lift with a carpenter's level (the use of a spirit level will allow the attitude of the aircraft to be monitored from a safe distance). Make sure that the aircraft remains in a level attitude so that it does not shift.

E. It is essential that the operation is properly planned and that procedures are followed. This will make sure that injuries to personnel and the possibility of additional damage to the aircraft during the lift operation are eliminated or reduced.

2. Basic Preparations to Lift the Aircraft

A. Review the Aircraft Recovery Plan outlined in 02–00–00 (Survey and Preparation).

B. Do a survey of the terrain.

C. Do an inspection of the aircraft structures in the lift point areas as soon as possible to determine their structural integrity. The condition of the ground and the damaged areas of the aircraft may have an effect on the method of lift that is chosen.

D. Engage the ground lock in the nose gear and install the lockpins in the main landing gear as soon as they are in the extended position. This is an important safety precaution to prevent injuries to personnel and damage to the aircraft.

E. Determine the location of the Center of Gravity (C.G.) as outlined in 02–30–01 (Weight Management). When the aircraft is defueled completely (if accomplished) and all payload is removed, the Basic Weight condition and C.G. location that results should cause no problems to the recovery operation. If a substantial amount of payload or fuel is still on board or if a major component has been broken off, then a Net Recoverable Weight (N.R.W.) and a C.G. location must be calculated. If the N.R.W. is high and the C.G. moves too far forward or aft, then the loads on the lift points must be determined to prevent the jack pads and skin surfaces from being overloaded.

NOTE: After you determine the final configuration, the weight and the C.G., it may be helpful to mark the C.G. position on both sides of the fuselage with an permanent marker.

F. Remove all payload and defuel the aircraft as much as possible to reduce the weight of the aircraft to a minimum (refer to Ch. 2).

G. Tether the aircraft as necessary before you start the lift operation.

NOTE: The Dash–8 Series 400 aircraft can only be tethered at the nose landing–gear towing–spool and also at the main landing gear trunnions. In many recovery situations these points may not be accessible.

H. Reduce the pressure in the oleos as necessary if the landing gear are to be locked in the collapsed position.

3. Post–Recovery Inspections

A. Any lifting/recovery operation may cause additional damage to the aircraft structure. For this reason you must do these inspections once the aircraft has been moved to a maintenance facility:

(1) Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–801).

(a) If airbags are used to lift the aircraft, do a detailed visual inspection of the wing joint area just outboard of the nacelle (in addition to the procedures of the Inspection After a Hard Landing (above)). Carefully check the spars and stringers for signs of deformation (i.e. twisting, bending, buckling). Remove overwing access panels on the outer wing (refer to AMM TASK 57–21–01–000–801) as required for internal inspections.

(2) Engine Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–802).

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JACKING AIRCRAFT

WARNING: BEFORE YOU MOVE THE AIRCRAFT OR LIFT IT FROM THE GROUND, OBEY THE SAFETY PRECAUTIONS THAT FOLLOW:

DO NOT LIFT THE AIRCRAFT IF THE WIND SPEEDS ARE 20 MPH (32 KM/H) OR MORE.

TETHER THE AIRCRAFT AS NECESSARY.

REMOVE PAYLOAD TO REDUCE THE AIRCRAFT WEIGHT.

MAKE SURE THAT NO PERSON IS IN/ON THE AIRCRAFT WHEN YOU LIFT IT.

MAKE SURE THAT AN APPROVED PERSON IS AVAILABLE TO MONITOR THE OPERATION TO MAKE SURE NO FUEL SPILLS.

DAMAGED STRUCTURES THAT ARE COMPRESSED CAN MOVE SUDDENLY DURING THE RELEASE OF ENERGY WHEN YOU START TO LIFT THE AIRCRAFT.

IF YOU DO NOT FOLLOW THESE PRECAUTIONS, YOU CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

WARNING: DO NOT LIFT THE AIRCRAFT AT THE JACKING POINTS OF THE WING AND THE NOSE FUSELAGE IF THE WEIGHT IS MORE THAN 48,792 LB (22,132 KG). IF YOU DO THIS, YOU CAN CAUSE DAMAGE TO THE AIRCRAFT STRUCTURE. THIS CAN CAUSE INJURY TO PERSONS AND DAMAGE TO THE AIRCRAFT.

WARNING: DO NOT LIFT THE AIRCRAFT ON JACKS IF YOU THINK THE LOAD AT THE NOSE–FUSELAGE JACKING POINT WILL BE 4700 LB (2132 KG) OR MORE. IF YOU DO, YOU CAN CAUSE DAMAGE TO THE AIRCRAFT STRUCTURE. THIS CAN CAUSE INJURY TO PERSONS AND DAMAGE TO THE AIRCRAFT.

WARNING: BE CAREFUL WHEN YOU MAKE THE AIRCRAFT LEVEL. THE CENTER OF GRAVITY CAN MOVE IF THE FUEL TANKS ARE PARTIALLY FULL. THE AIRCRAFT CAN BECOME UNSTABLE AND FALL OFF THE JACKS. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

WARNING: ENGAGE THE NLG GROUND LOCK AND INSTALL THE MLG LOCKPINS IMMEDIATELY WHEN YOU LOWER THE AIRCRAFT ON ITS LANDING GEAR. IF YOU DO NOT DO THIS, THE LANDING GEAR IS NOT SAFE AND CAN COLLAPSE. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

1. General

   A. Three jacking points are provided for jacking the aircraft. One is located on the forward fuselage aft of the nose landing gear, and the other two are on each rear spar in the center wing area. The aircraft can also be lifted at an individual axle of the nose or main landing gear in order to change wheels. Jack pads at the base of the main–gear shock struts and on the nose–gear suspension lever are used in this case.

2. Preparation

   A. It is very probable that during the aircraft recovery operation the jacks will rest on terrain other than hard surfaces. In this case the bearing strength of the jack base area must be determined. If the consistency of the base area is such that it will not support the expected jacking load, then preparations must be made to strengthen the area. Extremely soft terrain may require excavation and a crushed rock fill to provide the necessary bearing strength (refer to Figure 03–1).

   B. Make sure that:

      (1) The area at the base of the jack is flat and level so that the jack will be vertical.

      (2) The jack pads are installed on the aircraft.

      (3) The jacks have been compressed to minimum height.

      (4) The required airbags, cribbing or jacks are present and that tethering (mooring) is complete.

   C. During the lifting operation the primary goal is to make the aircraft level and maintain it in that attitude during subsequent lifting. The attitude of the aircraft can be monitored by the use of a carpenter's spirit level, which can be put on the floor of the aircraft or attached temporarily to the outside of the fuselage. The main advantage of the carpenter's level is that it can be monitored from a safe distance from the aircraft.

   D. Review the recovery procedures and the overall plan with the recovery crew members before the aircraft is jacked. Each person must understand their role and the entire operation so that they can anticipate any problems that may occur. This will help to prevent injuries to personnel and damage to the aircraft.

3. Jacking Aircraft at Nose Fuselage and Wing Jacking Points

   A. General

      (1) Jack the aircraft at the nose fuselage and wing jacking points until the planned height is reached to either lower collapsed landing gear, replace gear or put a flatbed trailer below the aircraft.

      (2) Once the aircraft has been made level, any additional lifting operations are to be done so as to maintain a level attitude. Unlevel attitudes must be avoided as they put large side loads on the jacks. Monitor the carpenter's level to make sure that the aircraft is still in a level attitude.

      NOTE: During the lifting operation, you may have to support the aircraft in its partially lifted position with cribbing (preferably airbags) while the jacks are readjusted or additional cribbing is moved under the jack position. This is because there are

no alternate wing jacking–points.

B. Jacking Procedure

(1) Equipment Required:

- 3 Jack Adapters (GSB0700007)
- 2 Wing Jacks (GSB0700019)
- Front Fuselage Jack (GSB0700020)
- Carpenter's Spirit Level.

(2) Lift the aircraft as follows (refer to Figure 03–2).

(a) Put the carpenter's level on the floor of the aircraft or attach it to the outside of the fuselage. Make sure that there is no personnel in/on the aircraft during the jacking procedure.

(b) Put a nose fuselage jack at the jacking point (3) of the nose fuselage.

(c) Put the jack adapter (2) in the nose fuselage receptacle and hold it there. Increase the jack height until the jack correctly engages the adapter.

NOTE: Two crew members must set up each jack. One person operates the jack while the other holds the jack adapter in the receptacle until the jack touches the adapter.

(d) Lift the aircraft at the jacking point of the nose fuselage. Continuously move the lock collar (1) down while you lift the aircraft.

(e) Stop when the aircraft is shown to be approximately level on the carpenter's level.

(f) Put a wing jack at each wing jacking point (5).

(g) Put the jack adapter (2) in the right wing receptacle and hold it there. Increase the jack height until the jack touches the adapter.

(h) Put the jack adapter (2) in the left wing receptacle and hold it there. Increase the jack height until the jack touches the adapter.

(i) Lift the aircraft on the jacks at the three positions, at the same time. Continue until the aircraft is at the desired height. Continuously move the lock collars (1, 6) down while you lift the aircraft.

NOTE: Three crew members must lift the aircraft on jacks at the same time. One person is necessary to operate each jack.

NOTE: A crew member must monitor the carpenter's level to make sure that the longitudinal axis of the aircraft stays level.

(j) Tighten the lock collar (1, 6) on each jack to lock the jack extensions.

(3) To lower the aircraft, do the steps that follow:

(a) Loosen the lock collar (1, 6) on each jack to unlock the jack extension. Make sure that you move the lock collars up a sufficient distance on the jack extension.

(b) Lower the three jacks gradually and at the same time. Have a crew member monitor the carpenter's level to make sure that the longitudinal axis of the aircraft stays level.

NOTE: Three crew members must lower the aircraft on jacks at the same time. One person is necessary to operate each jack.

(c) After the lowering operation is finished (i.e. when the weight has been removed from the jacks) remove the jack adapters (2) from the nose and wing receptacles.

(d) Move the jacks clear of the aircraft.

4. Jacking at Nose Fuselage and Wing Jacking Points (Aircraft Not Level)

A. General

(1) If the aircraft is not level, lift the low point first. Because of the rotational effect, the low jack point will move in an arc during the lift. Inward movements can be 10 to 15 inches (25.4 to 38.1 cm) in the worst case. This movement can cause excessive side loads on the jacks.

(2) Therefore, small, incremental vertical lifts of approximately 6 to 8 inches (15.2 to 20.3 cm) are to be made, and the wing or fuselage near the jack point is to be supported with cribbing (preferably airbags). This will hold the aircraft in this partially lifted position while the jack(s) are readjusted and additional cribbing is moved under the jack(s). Repeat this lift–crib–lift method until the aircraft has been made level.

NOTE: It may be useful to deflate the oleos and tires of any gear. This can help to put the aircraft in a level attitude more quickly.

5. Jacking at Nose and Main Landing Gear Axles

A. General

(1) The procedure that follows provides instructions to lift the aircraft at an axle of the nose landing gear (NLG) or main landing gear (MLG) in order to change wheels. Refer to AMM Ch. 7 for more information.

B. Jacking Procedure

(1) Equipment required:

- Jack – axle nose landing gear (GSB0700016)
- Jack – axle main landing gear (GSB0700023)

– NLG castor lockpin (Menasco AT31955).

NOTE: This procedure is for the jacking of the NLG. The procedures for the NLG and MLG are almost the same. The differences are identified.

(a) Lift the aircraft on a jack at the NLG or an MLG axle as follows (refer to Figure 03–3):

1 Apply the parking brake.

2 If possible, engage the ground lock on the nose landing gear and install the lockpins on the main landing gear.

3 If you lift the aircraft at the NLG axle, do the steps that follow before you continue:

a Center the nosewheel.

b Make sure that the nosewheel STEERING switch is in the OFF position.

c Install the NLG castor lockpin in its hole (1).

4 Put the NLG jack (2) or the MLG jack (3) at the related jack pad (4 or 5).

5 Put chocks at the tires of the other two landing gear units.

6 Increase the jack height until the jack correctly engages the related jack pad.

7 Lift the aircraft on the applicable axle jack until the related wheel is approximately 2 in. (5.1 cm) clear of the ground. Continuously move the lock collar down while you lift the aircraft.

(b) To lower the aircraft, do the steps that follow:

1 Lower the jack until the applicable landing gear has weight on wheels.

2 Move the jack clear of the aircraft.

3 If you lifted the aircraft at the NLG axle, do the steps that follow:

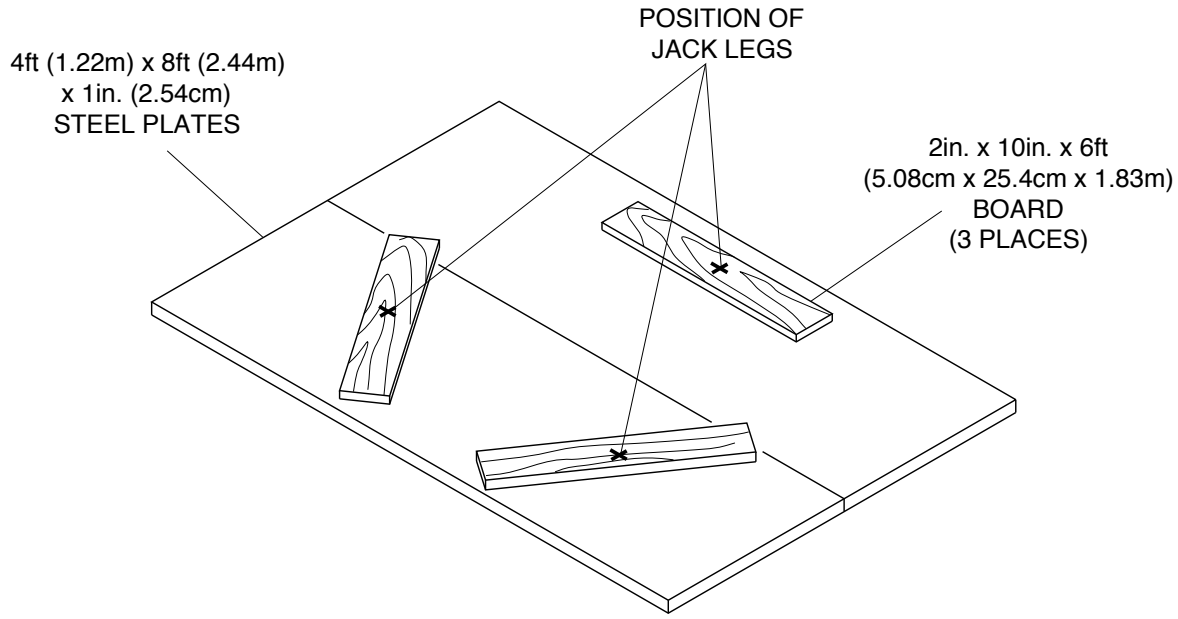
a Make sure that the nosewheel is centered and nosewheel STEERING switch is in the OFF position.

b Remove the castor lockpin from its hole (1).

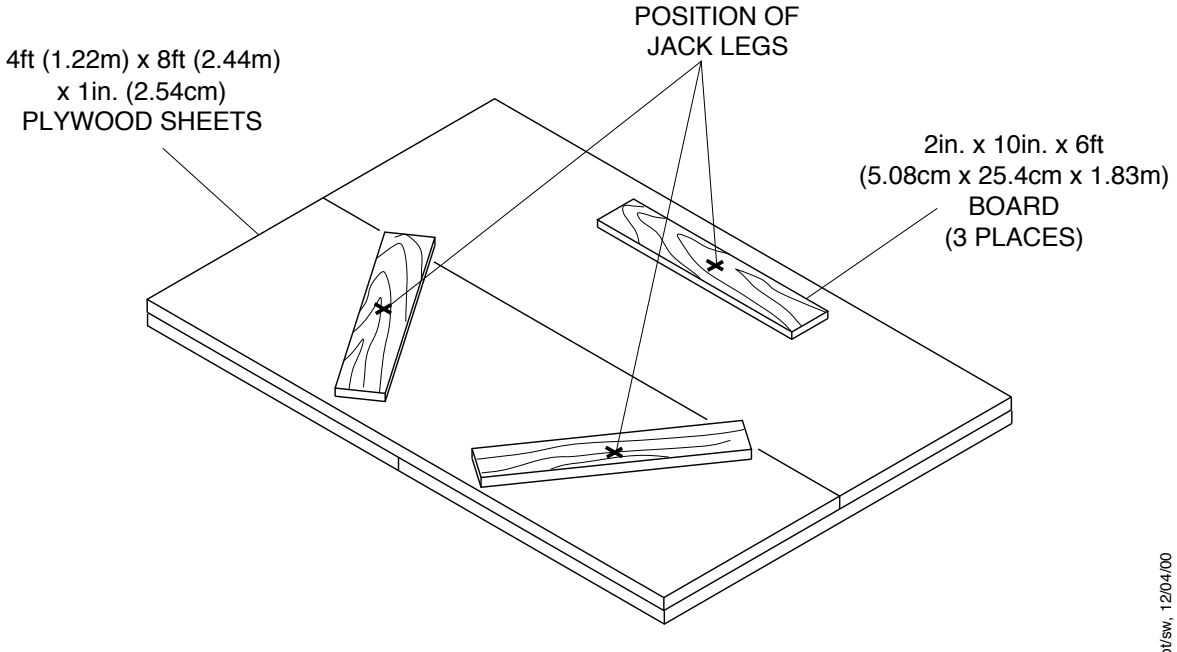
c Make sure that the castor lock is disengaged.

4 Remove the chocks from the landing gear tires.

5 Release the parking brake when the aircraft is to be moved.



PREFERRED BASE (STEEL PLATES)



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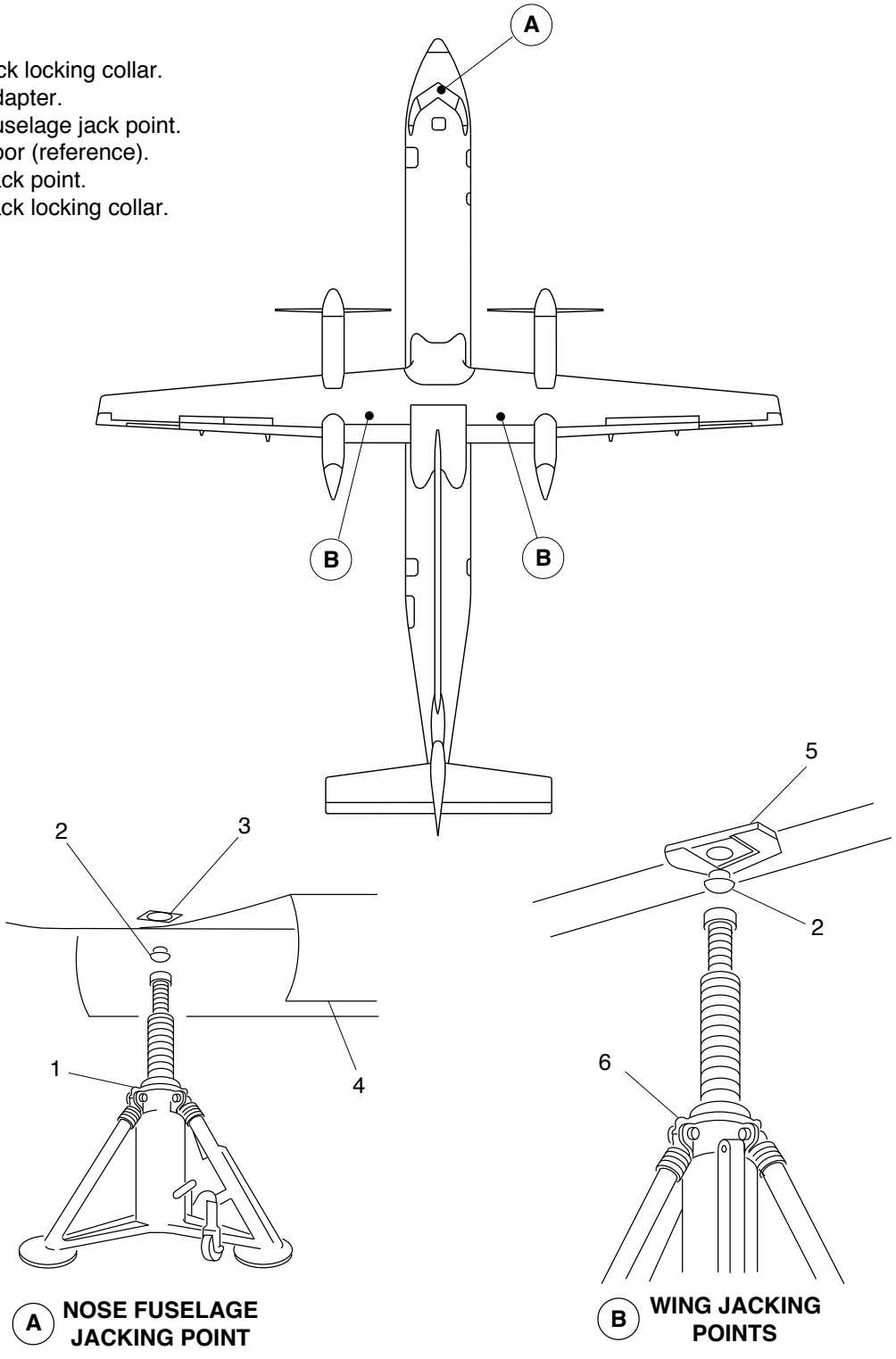
ALTERNATIVE BASE (PLYWOOD SHEETS)

LIFT BASES FOR JACKS

Figure 03 – 1

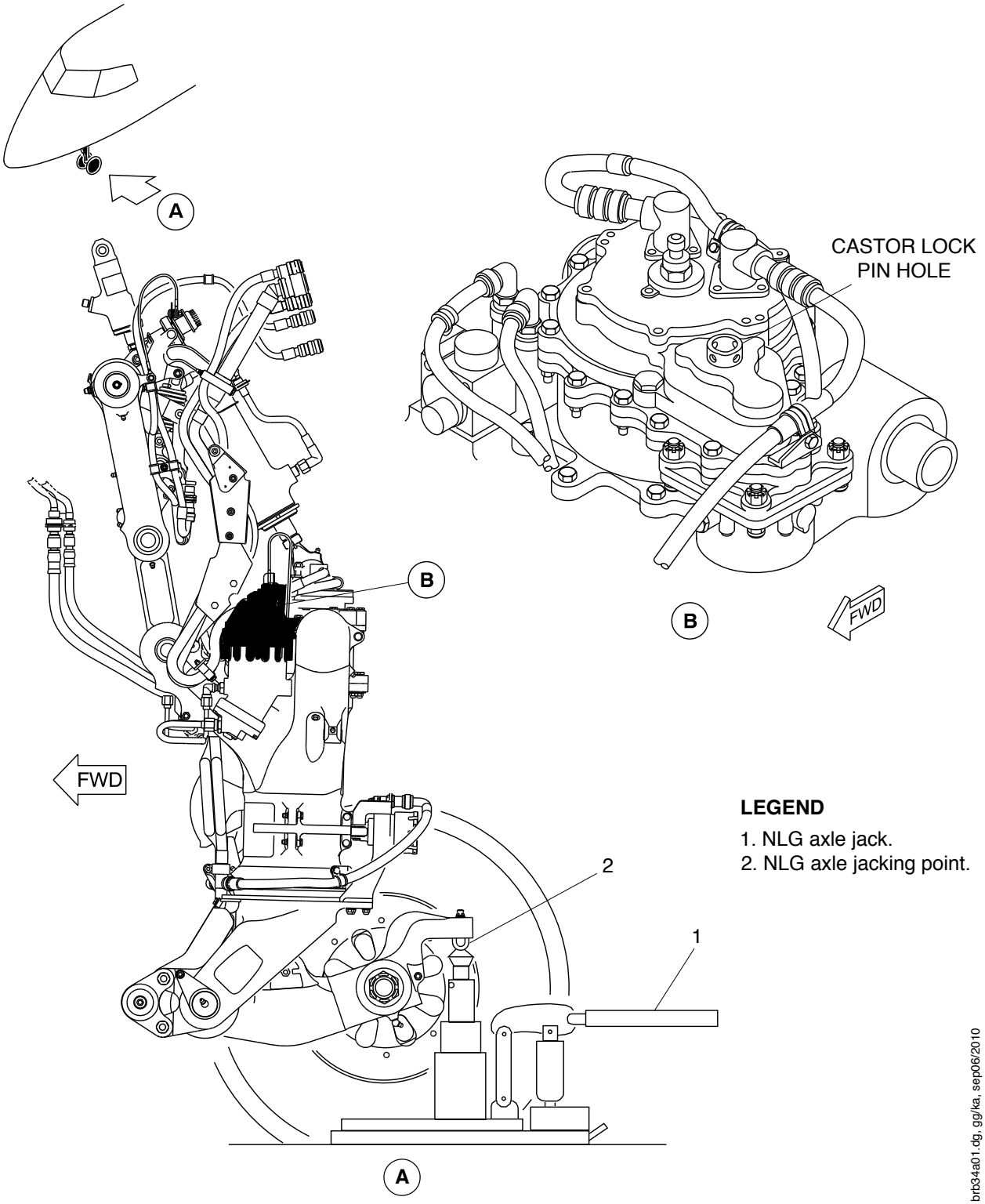
LEGEND

1. NLG jack locking collar.
2. Jack adapter.
3. Nose fuselage jack point.
4. NLG door (reference).
5. Wing jack point.
6. Wing jack locking collar.



JACKING OF THE AIRCRAFT AT THE NOSE AND WINGS

Figure 03 – 2



JACKING OF THE AIRCRAFT AT THE NOSE LANDING GEAR AXLE

Figure 03 – 3

PNEUMATIC BAGS

WARNING: OBEY THE SAFETY PRECAUTIONS THAT FOLLOW BEFORE YOU LIFT THE AIRCRAFT WITH AIRBAGS:

DO NOT LIFT THE AIRCRAFT IF THE WIND SPEEDS ARE 20 MPH (32 KM/H) OR MORE.

TETHER THE AIRCRAFT AS NECESSARY.

REMOVE PAYLOAD TO REDUCE THE AIRCRAFT WEIGHT.

INSTALL AIRBAGS BELOW THE WINGS AND OUTBOARD OF THE NACELLES.

MAKE SURE THAT NO PERSON IS IN/ON THE AIRCRAFT WHEN YOU LIFT IT.

FOLLOW THE MANUFACTURER'S INFLATION INSTRUCTIONS TO MAKE SURE THAT YOU LIFT THE AIRCRAFT EVENLY AND GRADUALLY.

IF YOU DO NOT FOLLOW THESE PRECAUTIONS, THE AIRCRAFT CAN BECOME UNSTABLE WHEN YOU LIFT IT. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

CAUTION: DO NOT INFLATE THE TOP TWO ELEMENTS OF THE HIGH–STABILITY AIRBAGS TO MORE THAN 3.5 PSI. THIS CAN CAUSE DAMAGE TO THE AIRCRAFT STRUCTURES.

CAUTION: IF IT IS POSSIBLE, DEFUEL THE AIRCRAFT TO DECREASE THE WEIGHT. THIS WILL HELP TO PREVENT DAMAGE TO THE AIRCRAFT STRUCTURE.

1. General

   A. The use of multi–element (high–stability) lifting bags is recommended for the Dash–8 Series 400. These bags have a compartmented design and are much more stable than single–compartment types.

   B. In the construction of multi–element bags, each element or chamber is attached to another and are stacked vertically. Drop threads are woven between the surfaces of the individual elements to restrict expansion of the elements. This helps to produce a flat slab shape of uniform thickness (refer to Figure 03–1).

   C. Pneumatic lifting bags (also referred to as airbags in this manual) must be positioned so that the center of lift for the system coincides with, or is as near as possible to, the center of gravity of the aircraft. It is also important to make sure that each of the bags will have approximately the same extension potential during the lift.

   D. A high degree of lateral instability is inherent in the design of any pneumatic lifting bag. For this reason do not use lifting bags when wind speeds are more than 20 mph (32 km/h).

E. Lifting bags must be periodically pressure tested and inspected for deterioration according to the manufacturer's instructions.

2. Preparations for Using Pneumatic Lifting Bags

A. Reduce the weight of the aircraft as much as possible (remove baggage and cargo, refer to Ch. 2). Defuel the aircraft, if this is possible.

NOTE: De Havilland Aircraft of Canada Limited strongly recommends that you defuel the aircraft, if this is possible, before any lifting operation takes place. This will reduce the weight of the aircraft and help prevent damage to the structure.

B. Clear the area where the bag is to be located of sharp objects for approximately 12 square feet (4 sq. m).

C. If necessary, prepare the ground surface according to the type of terrain. Use steel plates or plywood sheets as required (refer to Figure 03–2 and Figure 03–3).

D. Construct a base of suitable height from timbers. Make sure that the upper surface area of the base is larger than that of the lifting bag. The base must also, as much as possible, match the angle of the aircraft contact surface in order to minimize the shift due to the rotational effect.

E. After the basic preparations are completed, determine the number of bags that will be required and the location of the bags. Although the number and location of the bags will depend on each recovery situation, it is recommended to use as many as possible to distribute the load.

NOTE: Put the bags into position so that they will not cover the nose– fuselage jacking point. This will allow the jack to support the aircraft when it has been lifted to a sufficient height by the bags.

NOTE: To lift the aircraft at the wings, install the pneumatic bags outboard of the nacelles, between the nacelle and the No. 4 flap fairing (refer to Figure 03–4). To lift the nose of the aircraft, install the bags under the fuselage, as far forward as possible (keep the nose–fuselage jacking point clear). Refer to Figure 03–5.

F. Put a mattress or blankets between the aircraft and the bag surface. If padding is not available, remove or tape over any sharp edges or protuberances on the aircraft which may cause damage to the bag.

3. Lifting with Pneumatic Bags

A. Before you start to lift the aircraft, review the procedures and the overall recovery plan with crew members. Each person must understand their role and the entire operation so that they can anticipate any problems that may occur. This will help to prevent injuries to personnel and damage to the aircraft.

B. Make sure that the required cribbing, jacks, etc. are present and the aircraft is tethered (if required and physically possible). The goal of all initial lifting operations must be to make the aircraft level. The attitude of the aircraft can be monitored by the use of a carpenter's spirit level, which can be placed on the floor of the aircraft or temporarily attached to the outside surface of the fuselage.

C. Lift the aircraft with pneumatic bags as follows:

(1) Start the compressor and inflate all the bags at the same rate (to distribute the loads). Do not inflate the bags to more than the manufacturer's maximum recommended pressure. Make sure that you regulate the air supply so that a controlled lift is achieved.

(2) Follow the manufacturer's instructions so that you inflate the bags in the proper sequence.

(3) Do not inflate the top two bags (that come into contact with the aircraft surface) to more than 3.5 psi (0.2461 kg/sq. cm).

(4) Once the aircraft has been made level, any additional lifting operations are to be done so as to maintain a level attitude. Unlevel attitudes must be avoided as they put large side loads on the jacks and can cause a serious shift of the aircraft. Monitor the carpenter's level to make sure that the aircraft remains in a level attitude.

(5) Put cribbing into appropriate places as soon as possible. For safety, move the cribbing towards the fuselage as it is lifted in case the bag or a hose ruptures.

(6) Continue to lift and move the cribbing as described above until the fuselage is at a sufficient height to install jacks.

(7) Lift the aircraft with jacks until the planned height is reached to either lower collapsed landing gear, replace gear or put a flatbed trailer below the aircraft. Refer to section 03–20–01 (Jacking Aircraft) of this manual for normal jacking procedures.

(8) When the aircraft is secure, follow the manufacturer's instructions to deflate the multi–element bags.

(9) Remove the inflation hose(s), replace the inflation/deflation valve cap(s) and move the bag to a quiet area for repacking.

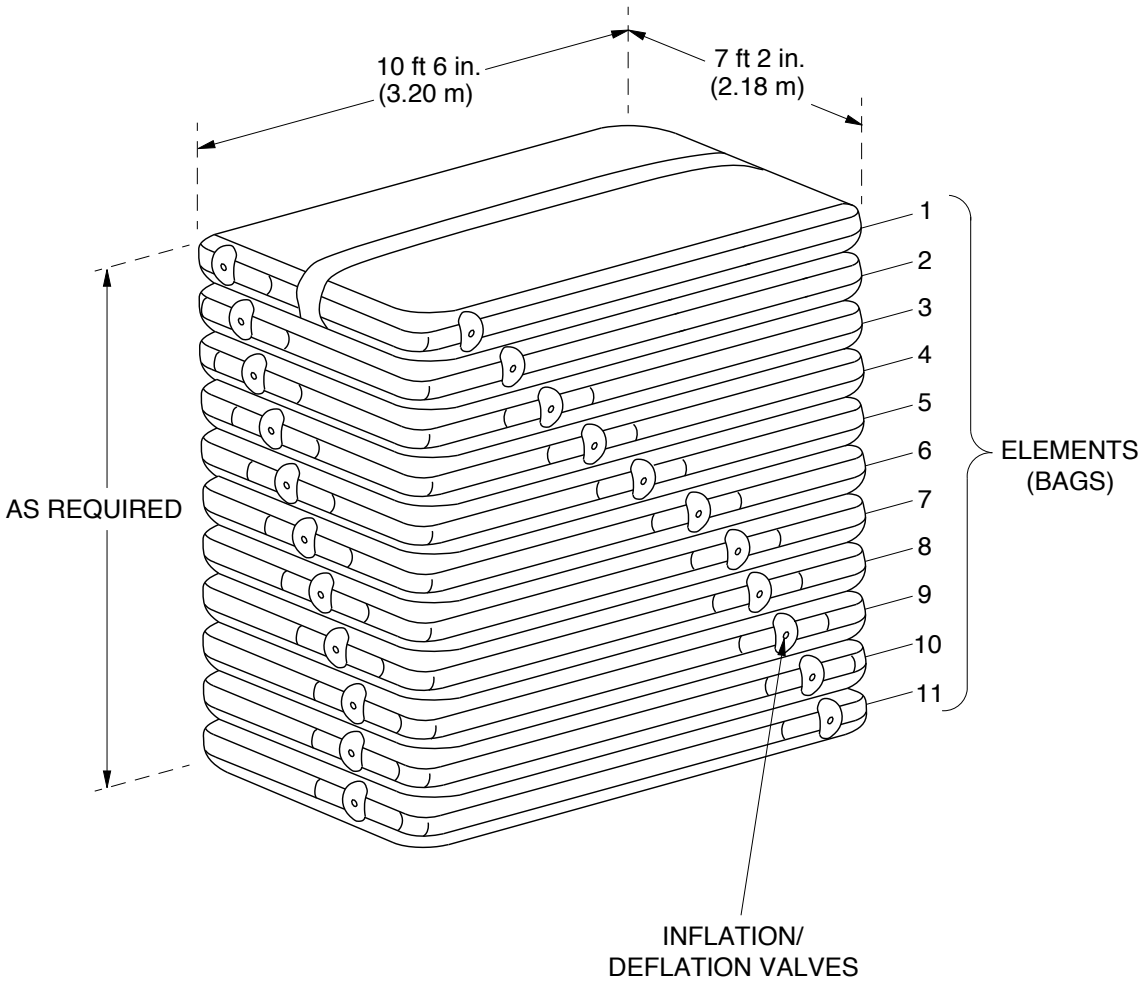
4. Post–Recovery Inspections

A. Any lifting/recovery operation may cause additional damage to the aircraft structure. For this reason you must do these inspections once the aircraft has been moved to a maintenance facility:

(1) Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–801).

(a) In addition to the procedures of the Inspection After a Hard Landing (above), do a detailed visual inspection of the wing joint area just outboard of the nacelle. Carefully check the spars and stringers for signs of deformation (i.e. twisting, bending, buckling). Remove overwing access panels on the outer wing (refer to AMM TASK 57–21–01–000–801) as required for internal inspections.

(2) Engine Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–802).



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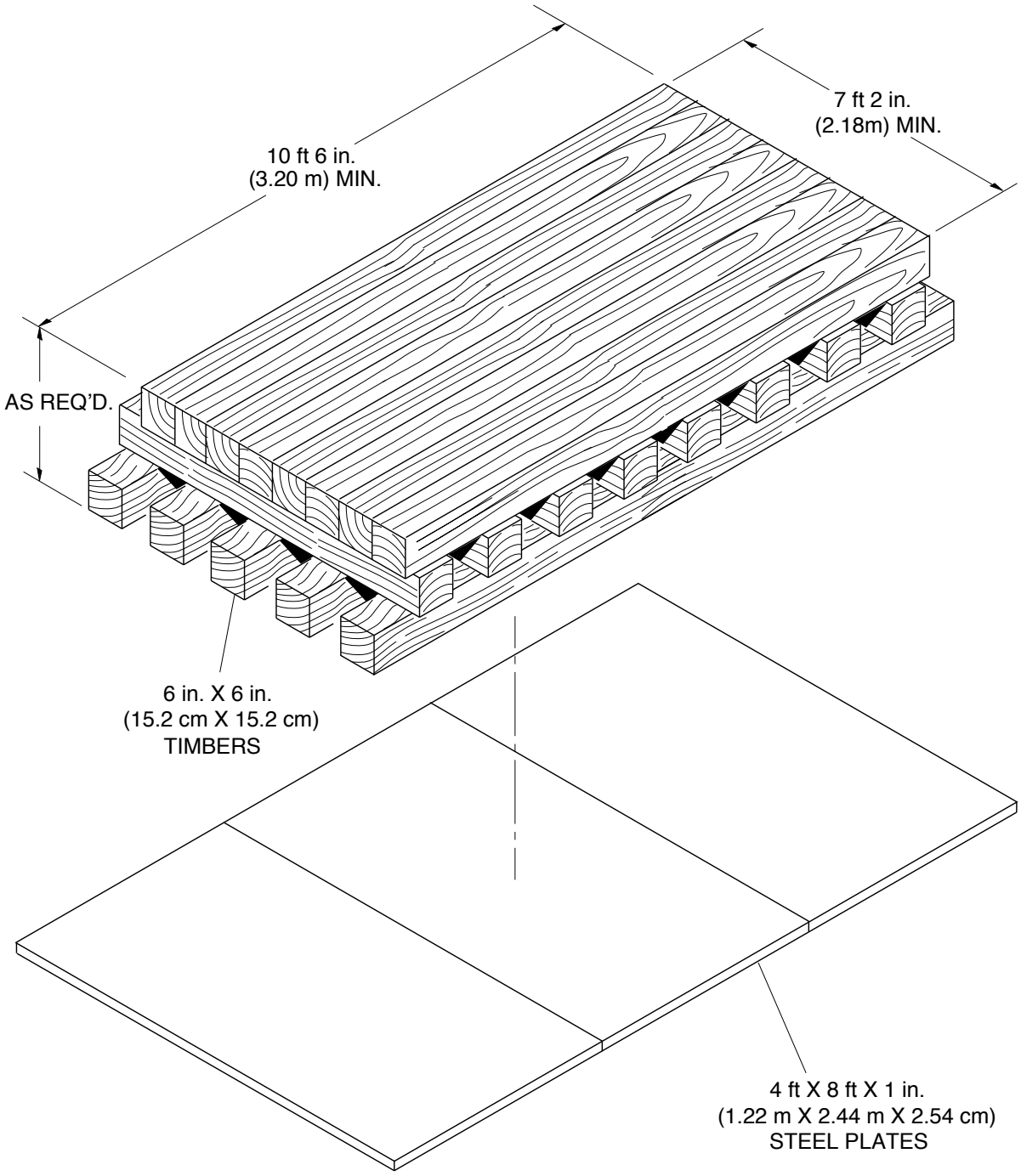
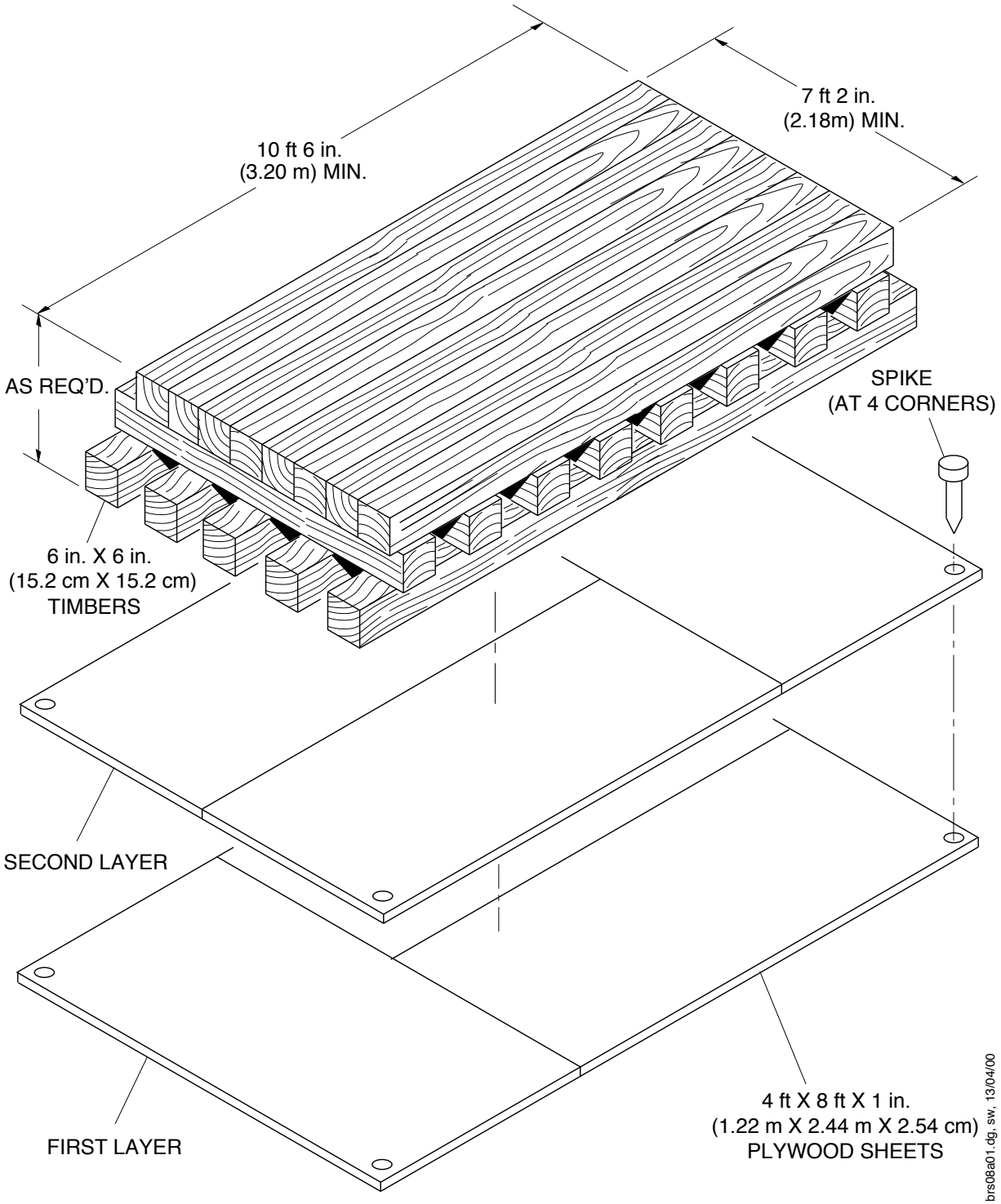
TYPICAL AIRBAGS

Figure 03 – 1



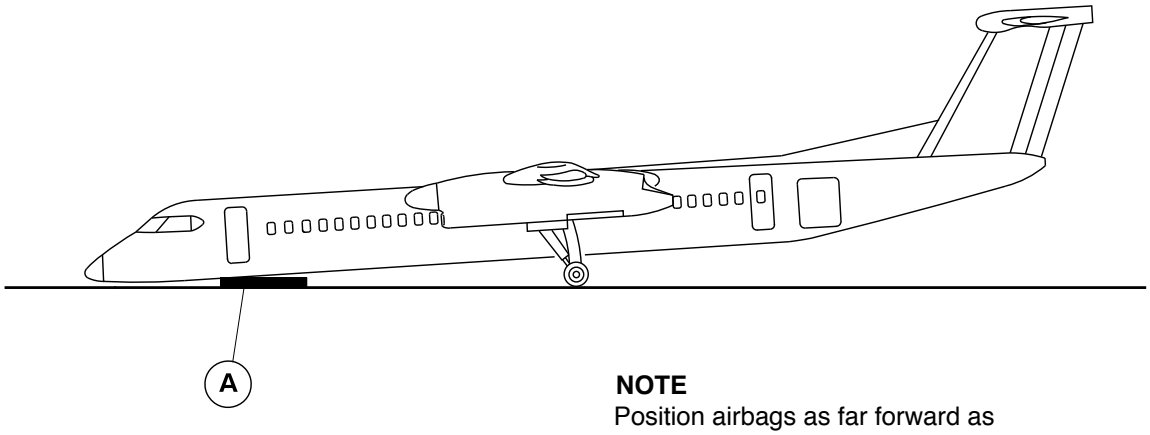
AIRBAG BASE WITH STEEL PLATES (PREFERRED)

Figure 03 – 2

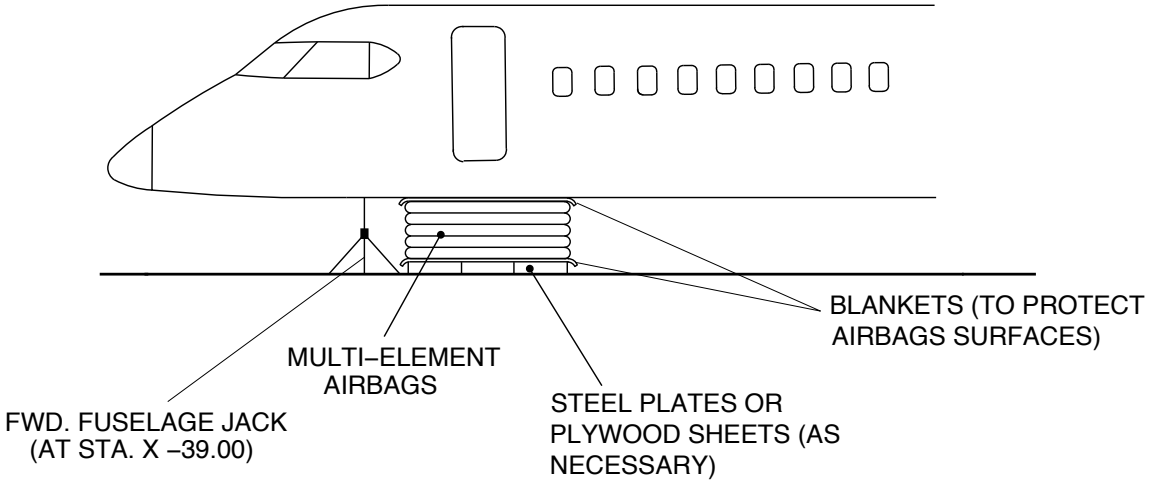


AIRBAG BASE WITH PLYWOOD SHEETS (ALTERNATIVE)

Figure 03 – 3



NOTE
Position airbags as far forward as possible but allow space to install fwd. fuselage jack.



AIRBAGS AT FORWARD FUSELAGE

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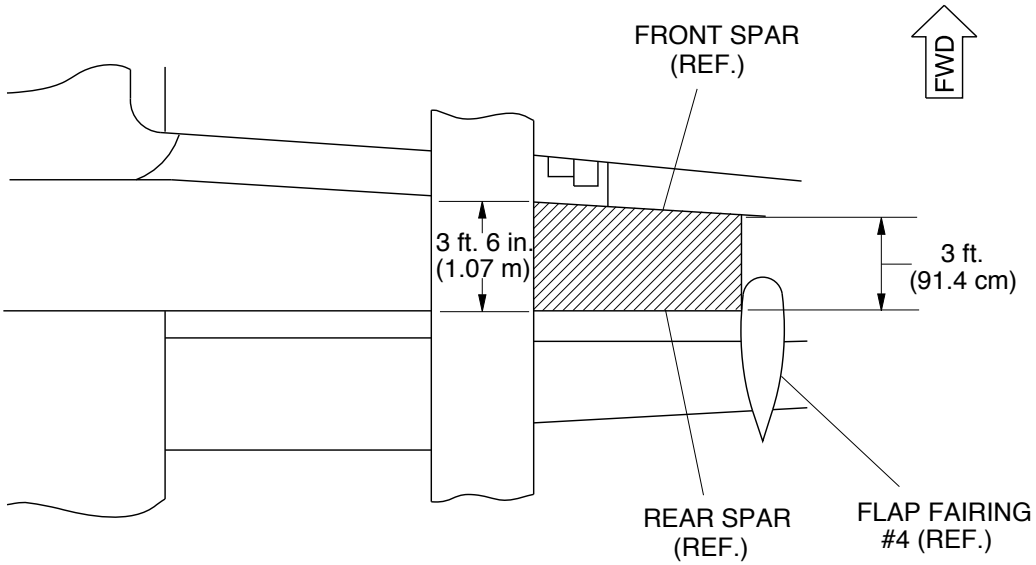
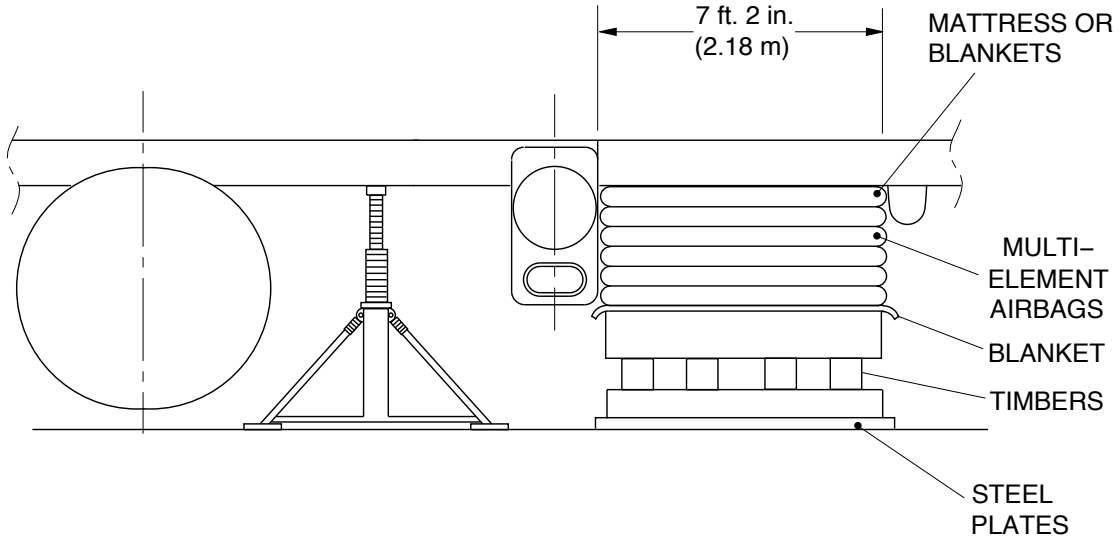
DETAILS OF TYPICAL AIRBAG INSTALLATION AT NOSE

Figure 03 – 4



VIEW LOOKING UP ON LEFT WING



VIEW LOOKING AFT ON LEFT WIMG

NOTE

1. Jack to be installed after lifting.
2. Damage may occur to leading edge and flap – inspect after recovery.

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DETAILS OF TYPICAL AIRBAG INSTALLATION AT WINGS

Figure 03 – 5

LIFTING AIRCRAFT WITH MOBILE CRANE

WARNING: OBEY THE SAFETY PRECAUTIONS THAT FOLLOW BEFORE YOU LIFT THE AIRCRAFT WITH MOBILE CRANES AND SLINGS:

DO NOT LIFT THE AIRCRAFT IF THE WIND SPEEDS ARE 20 MPH (32 KM/H) OR MORE.

TETHER THE AIRCRAFT AS NECESSARY.

REMOVE PAYLOAD TO REDUCE THE AIRCRAFT WEIGHT.

MAKE SURE THAT NO PERSON IS IN/ON THE AIRCRAFT WHEN YOU LIFT IT.

MAKE SURE THAT AN APPROVED PERSON IS AVAILABLE TO DIRECT THE LIFT OPERATION.

USE ONLY EXPERIENCED CRANE OPERATORS AND GROUND PERSONNEL.

DO NOT TRY TO LIFT MORE THAN THE MAXIMUM RATED LOAD OF THE MOBILE CRANE(S).

IF YOU DO NOT FOLLOW THESE PRECAUTIONS, THE AIRCRAFT CAN BECOME UNSTABLE AND FALL WHEN YOU LIFT IT. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

WARNING: MAKE SURE THAT AN APPROVED PERSON IS AVAILABLE TO DIRECT THE LIFT OPERATION WHEN YOU USE TWO OR MORE MOBILE CRANES. IF YOU DO NOT DO THIS, THE AIRCRAFT CAN BECOME UNSTABLE AND FALL TO THE GROUND. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

CAUTION: YOU MUST USE A SPREADER BAR IF YOU LIFT THE AIRCRAFT WITH ONLY ONE MOBILE CRANE. THIS WILL PREVENT DAMAGE TO THE AIRCRAFT STRUCTURE.

CAUTION: IF IT IS POSSIBLE, DEFUEL THE AIRCRAFT TO DECREASE THE WEIGHT. THIS WILL HELP TO PREVENT DAMAGE TO THE AIRCRAFT STRUCTURE.

1. General

   A. Make sure that the ground surface near the recovery area is capable of supporting large mobile cranes before you attempt to start the recovery operation (refer to Ch. 2 of this manual).

   B. Reduce the weight of the aircraft as much as possible (refer to 02–30–01, Weight Management). In particular, defuel the aircraft, if this is possible.

   NOTE: De Havilland Aircraft of Canada Limited strongly recommends that you defuel the aircraft, if this is possible, before any lifting operation takes place. This will reduce the weight of the aircraft and help prevent damage to the structure.

C. For lifting at the nose, one 5 ton (4536 kg) crane is required. For lifting at the nose and wings, one 5 ton (4536 kg) and two 15 ton (13,608 kg) mobile cranes are required.

D. Use slings that:

- Are as wide as practical
- Are rated at 5000 lb (2268 kg) or greater when used to lift the nose of the aircraft
- Are rated at 30,000 lb (13,608 kg) or greater when used to lift at the wings
- Have a safety factor of 5 times the working load of the sling or greater.

2. Preparations for Using Mobile Crane

A. Put the mobile cranes into position to lift the aircraft. Refer to Figure 03–1.

B. Do not use jibs to increase operating radius. They are only to be used to increase lifting height (for reference information about slings, refer to Figure 03–5 and Figure 03–6).

NOTE: To obtain the net lifting capacity of a boom at a specific boom angle, subtract the weight of all suspended load–handling devices (such as hooks, hookblocks, slings, boom extension, jib, etc.) from the load rating.

C. A spreader bar must be used if only one crane is used to lift the aircraft. This will help prevent damage to the fuselage (refer to Figure 03–2).

D. If two cranes are used, make sure that you lift the aircraft evenly. This will help to prevent movement of the sling against the fuselage and subsequent damage from abrasion (refer to Figure 03–3).

E. Do a visual check of all slings for signs of damage. Do not use a damaged sling.

F. Review the procedures and the overall recovery plan with crew members. Each person must understand their role and the entire operation so that they can anticipate any problems that may occur. This will help to prevent injuries to personnel and damage to the aircraft.

3. Lifting at the Forward Fuselage

A. This method is normally used when the nose landing gear has collapsed and the aircraft rests on its forward fuselage.

B. Remove the standby pitot–static probe on the right side of the fuselage (refer to AMM TASK 34–11–06–000–801). Cover the hole with tape to prevent the entry of foreign objects into the fuselage.

C. Install the sling at STA. X –39.00 (which corresponds to the frame at the pilot's bulkhead). Refer to Figure 01–3.

NOTE: Do not cover the nose–fuselage jacking point.

D. Lift the nose slowly and take the slack out of the sling. Once the sling is tight, continue to raise the nose slowly.

E. Once the planned height has been reached, transfer the weight of the forward fuselage to extended nose landing gear, a jack or a flatbed trailer, etc.

NOTE: If necessary, the aircraft can be moved while supported by mobile crane(s).

F. Remove the sling and the mobile crane(s) after the aircraft has been securely supported.

4. Three Point Lifting of the Aircraft

A. The aircraft can be lifted by cranes and slings at the pilot's bulkhead (STA. X –39.00) and at the wings, inboard of the nacelles (STA. YW 117.50). Refer to Figure 03–4.

B. Construct or obtain wing support beams (contour boards) to fit under the wing. These support beams must have the same contour as the lower surface of the wing, and must be padded. The use of contour boards will prevent damage to the leading and trailing edges of the wing.

NOTE: Put the sling over the contour boards.

C. Remove the standby pitot–static probe on the right side of the fuselage (refer to AMM TASK 34–11–06–000–801). Cover the hole with tape to prevent the entry of foreign objects into the fuselage.

D. If the flaps are in the extended position, there will be interference between the inboard flap panels and the slings. To avoid this situation, remove the inboard flap panels before the slings are installed (refer to AMM TASK 27–54–01–000–801).

E. Install the slings as follows (refer to Figure 03–4):

(1) Forward fuselage: At STA. X –39.00 (the pilot's bulkhead).

(2) Left wing: STA. YW –117.50 (just outboard of the wing jacking point, which is at STA. YW –108.17).

(3) Right wing: STA. YW 117.50 (just outboard of the wing jacking point).

NOTE: Do not cover the wing jacking point.

F. Slowly take the slack out of the slings to begin the lifting operation. When all the slings are tight, start to lift the aircraft very slowly.

G. Stop the lift operation occasionally to inspect the slings and to make sure that the aircraft is still in a level attitude. Make the aircraft level again, if necessary.

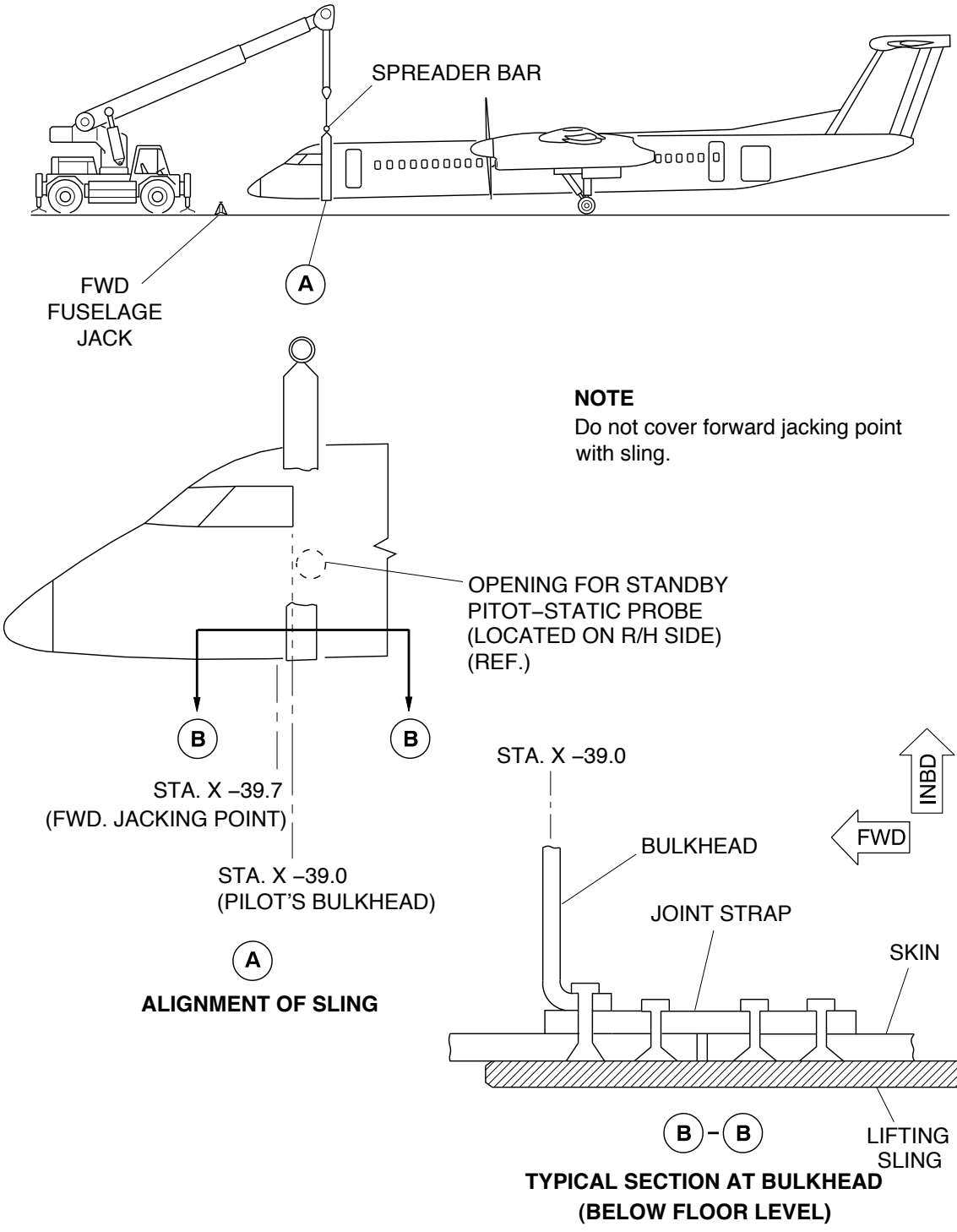
H. Once the aircraft has been lifted to the planned height, put cribbing (preferably airbags) into place as necessary and lower the aircraft onto the landing gear, jacks or flatbed trailer(s).

5. Post–Recovery Inspections

A. Any lifting/recovery operation may cause additional damage to the aircraft structure. For this reason you must do these inspections once the aircraft has been moved to a maintenance facility:

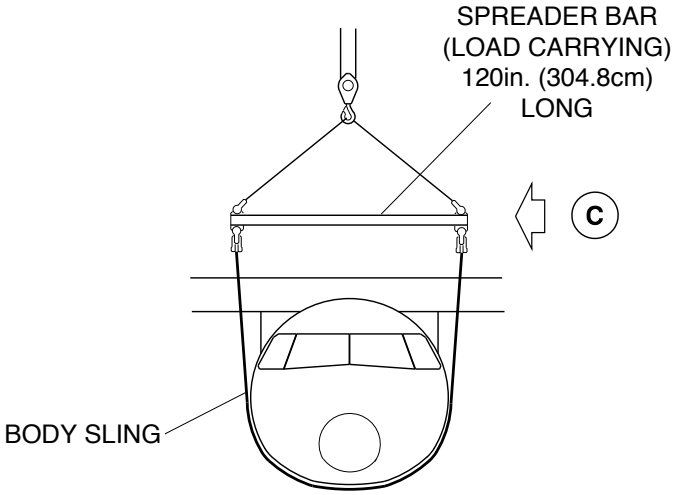
(1) Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–801).

(2) Engine Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–802).

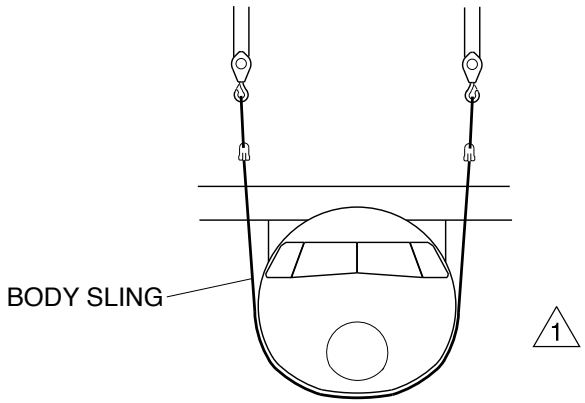


HOW TO LIFT NOSE WITH ONE MOBILE CRANE

Figure 03 – 1



A SINGLE CRANE METHOD



B TWO CRANE METHOD (WITHOUT SPREADER BAR)

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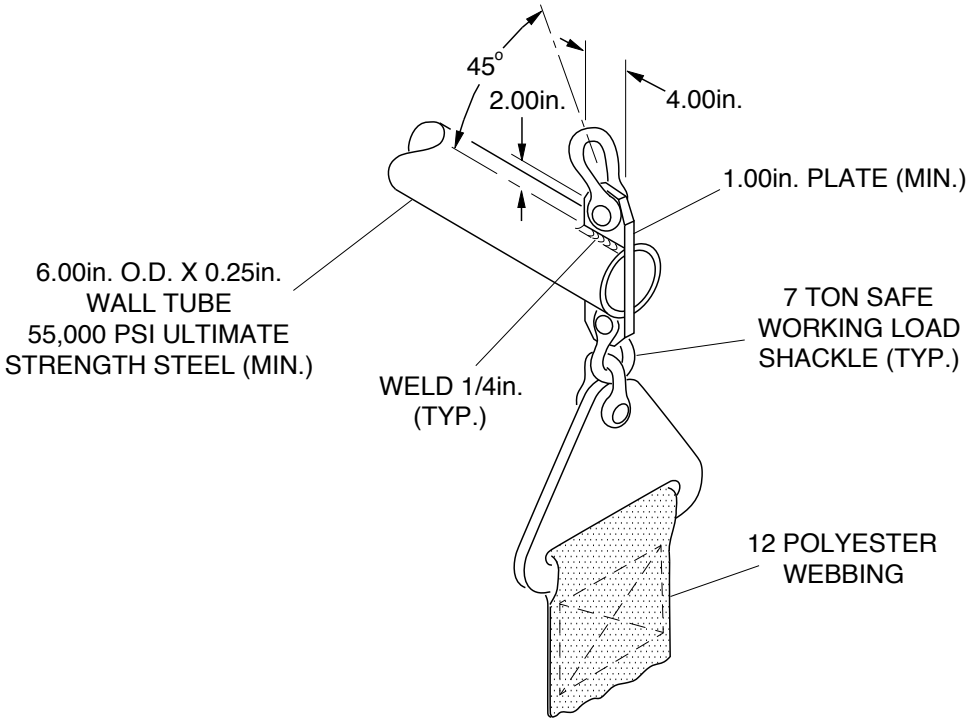
NOTE

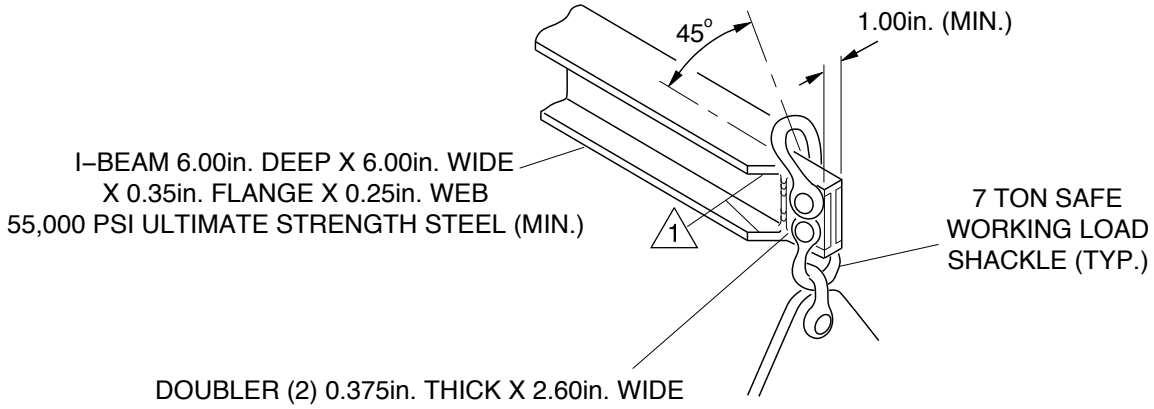
1 Make sure that you lift the aircraft evenly (This prevents abrasion of the skin surfaces by the sling).

SPREADER BAR DATA (Sheet 1 of 2)

Figure 03 – 2



C TUBULAR SPREADER BAR



NOTE

1 Trim at 45 ° degree angle to clear shackle.

D I–BEAM SPREADER BAR

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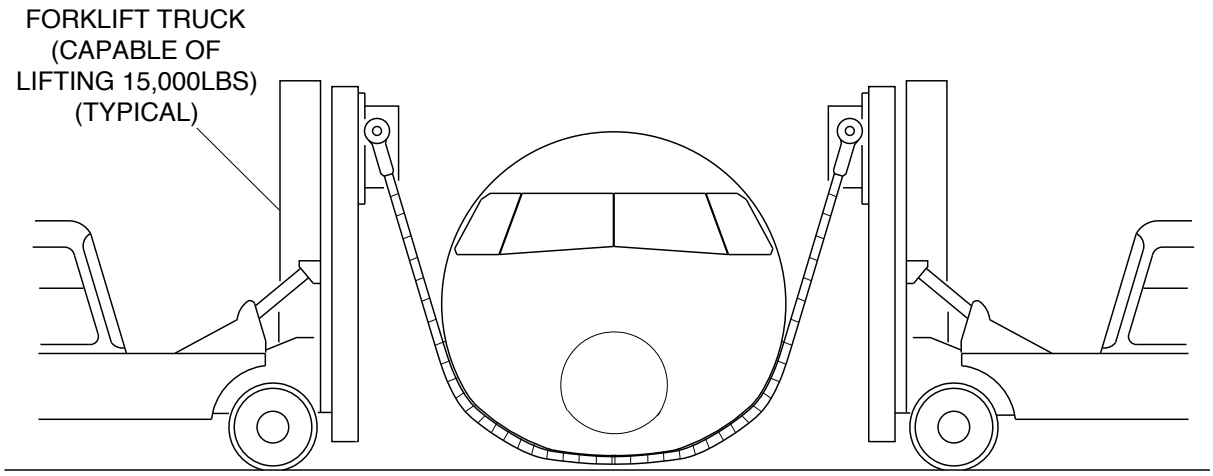
SPREADER BAR DATA (Sheet 2 of 2)

Figure 03 – 2



NOTES

Remove forklift blades and attach sling to the lifting fittings of the forklift vehicles.

Keep FWD fuselage jacking–point clear to allow installation of FWD jack.

Lift aircraft evenly to prevent abrasion of skin surfaces by sling.

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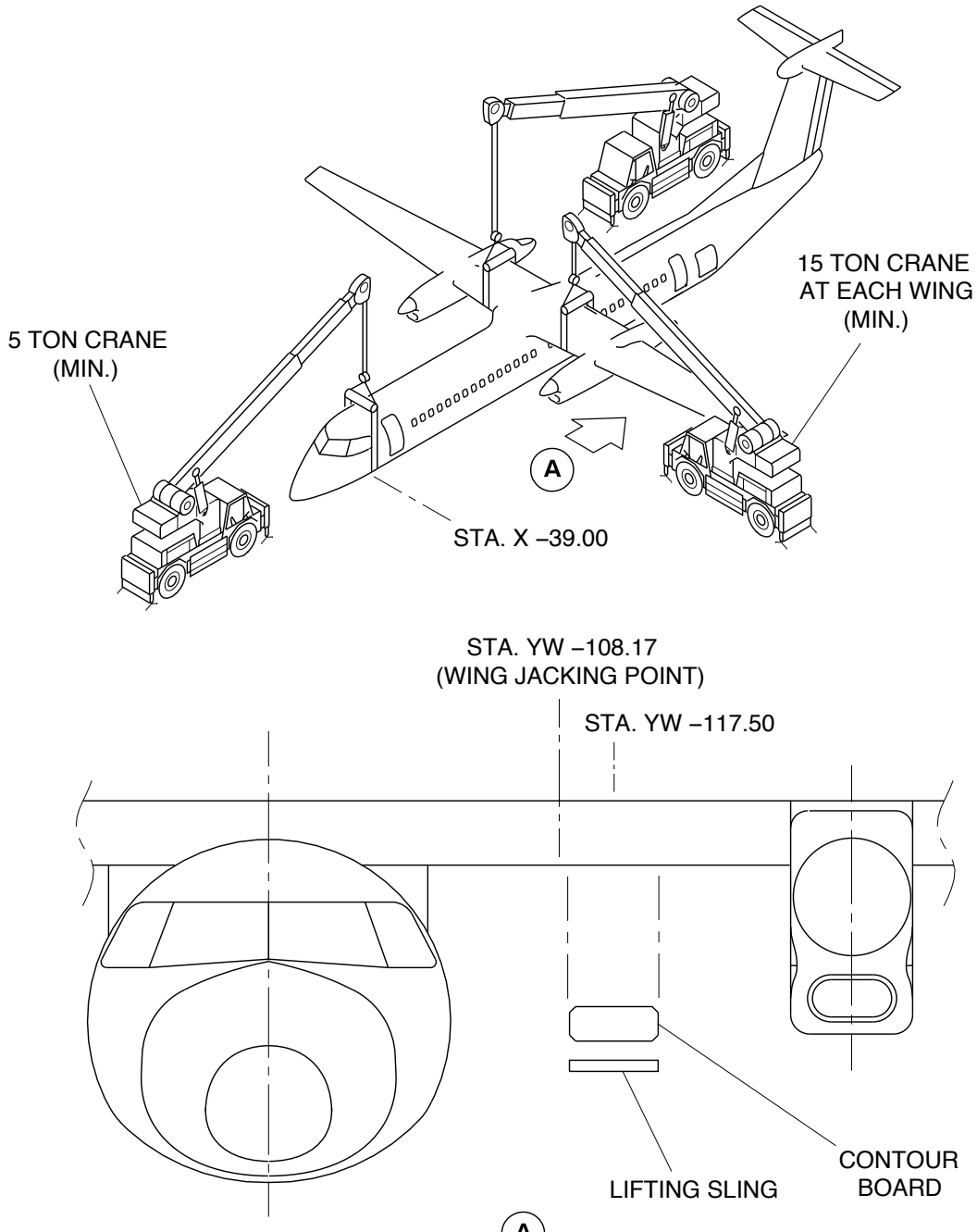
HOW TO LIFT NOSE WITH TWO FORKLIFTS AND A SLING

Figure 03 – 3



LIFTING AT WINGS (TYPICAL)
(LEFT WING SHOWN)

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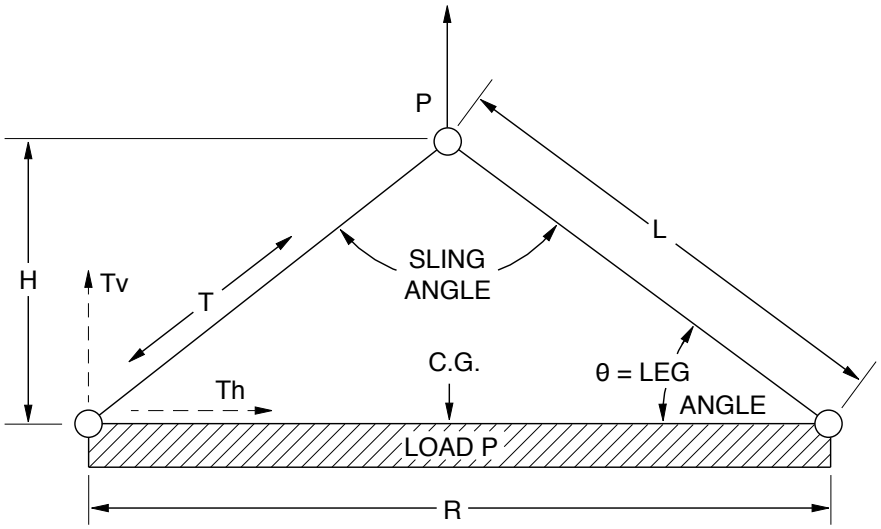
NOTE
Do not cover wing jacking point.

THREE – POINT LIFTING OF THE AIRCRAFT

Figure 03 – 4



LEGEND

T = Tension or pull in one leg of sling – To find "T" multiply the total load "P" by multiplier "A"..... T = P x A

W = Load capacity of sling – To find "W" multiply the safe working strength of the sling material "S" by the multiplier "B"..... W = S x B

H = Height of sling – To find "H" multiply the reach "R" by multiplier "C"..... H = R x C

L = Length of sling leg – To find "L" multiply the reach "R" by mulitiplier "D"..... L = R x D

R = Reach of sling – To find "R" multiply the length of the sling leg "L" by multiplier "E"..... R = L x E

S = Safe working strength of the sling material – To find "S" divide the breaking strength of the sling material by a suitable factor of safety.

Tv = 1/2 P = T Sin θ.

Th = T Cos θ.

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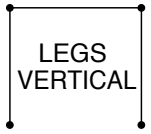
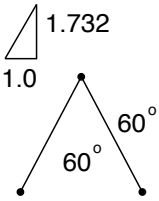
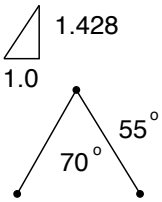
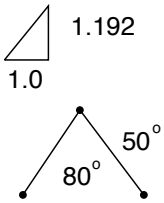
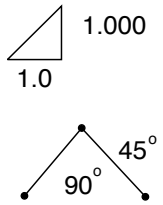
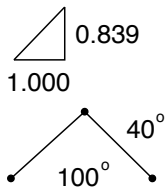
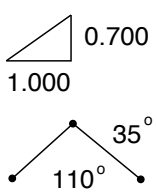
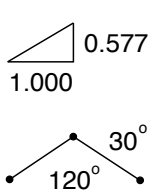
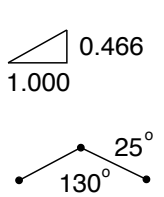
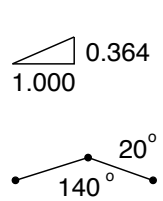
MULTIPLIERS FOR SLING CAPACITY CALCULATIONS (Sheet 1 of 2)

Figure 03 – 5

2 LEGGED SLINGS AT VARIOUS ANGLES					
MULTIPLIERS					
A	0.500	0.577	0.610	0.653	0.707
B	2.000	1.732	1.638	1.532	1.414
C	–	0.866	0.714	0.596	0.500
D	–	1.000	0.872	0.778	0.707
E	–	1.000	1.147	1.286	1.414
MULTIPLIERS					
A	0.778	0.872	1.000	1.183	1.462
B	1.286	1.147	1.000	0.845	0.684
C	0.420	0.350	0.289	0.233	0.182
D	0.653	0.610	0.577	0.552	0.532
E	1.532	1.638	1.732	1.813	1.879

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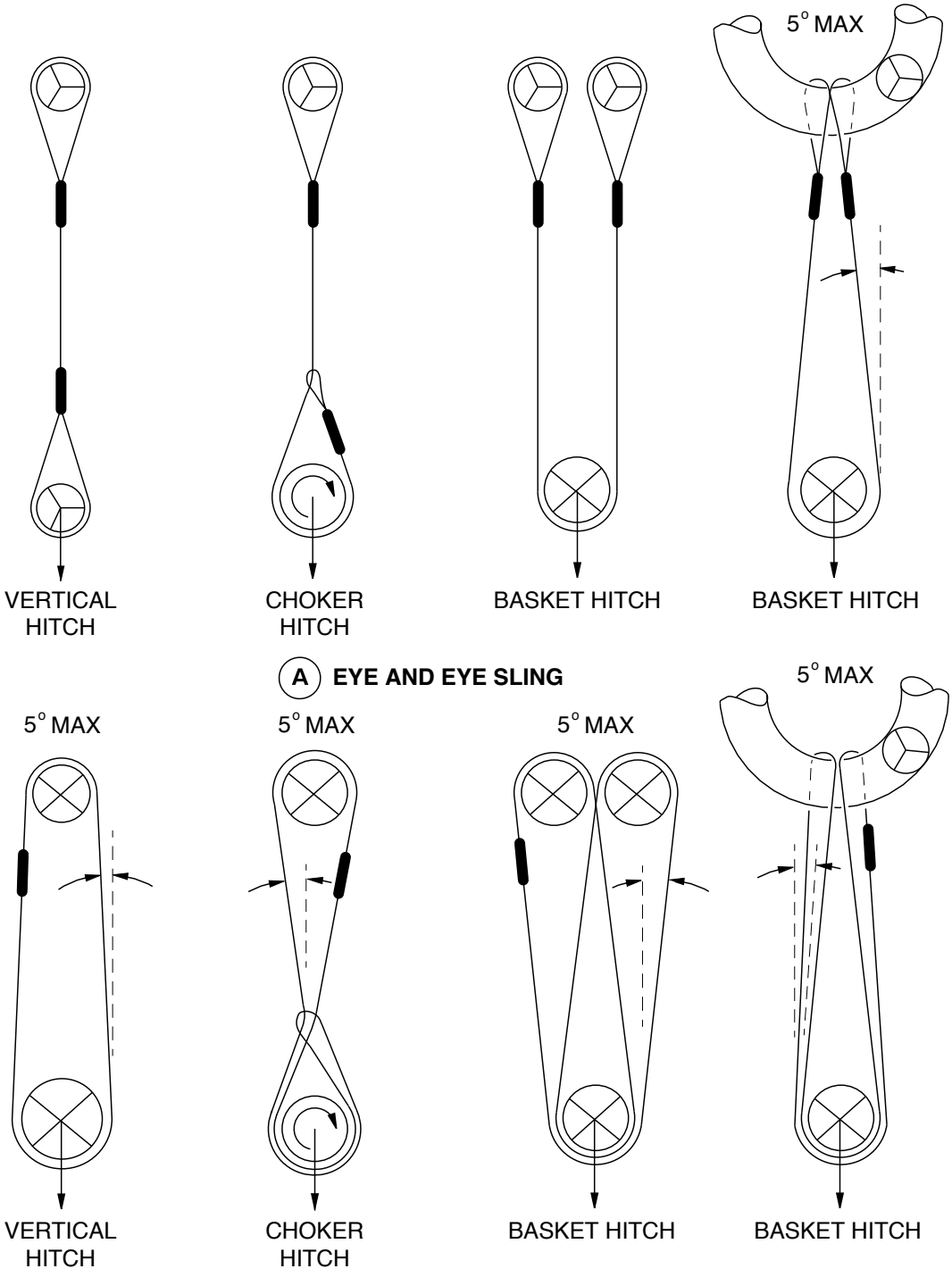
MULTIPLIERS FOR SLING CAPACITY CALCULATIONS (Sheet 2 of 2)

Figure 03 – 5



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NOTE: Legs that are 5° or less from vertical may be considered vertical.

BASE SLING CONFIGURATIONS

Figure 03 – 6

LIFTING

WARNING: OBEY THE SAFETY PRECAUTIONS THAT FOLLOW WHEN YOU LIFT AN AIRCRAFT WITH COLLAPSED NOSE AND/OR MAIN LANDING GEAR:

DO NOT LIFT THE AIRCRAFT IF THE WIND SPEEDS ARE 20 MPH (32 KM/H) OR MORE.

TETHER THE AIRCRAFT AS NECESSARY.

INSTALL CHOCKS AT THE NOSE LANDING GEAR AND/OR MAIN LANDING–GEAR WHEELS AS NECESSARY.

REMOVE PAYLOAD TO REDUCE THE AIRCRAFT WEIGHT.

MAKE SURE THAT NO PERSON IS IN/ON THE AIRCRAFT WHEN YOU LIFT IT.

IF YOU DO NOT FOLLOW THESE PRECAUTIONS, YOU CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

WARNING: MAKE SURE THAT AN APPROVED PERSON IS AVAILABLE TO DIRECT THE LIFT OPERATION WHEN YOU USE TWO OR MORE MOBILE CRANES. IF YOU DO NOT DO THIS, THE AIRCRAFT CAN BECOME UNSTABLE AND FALL TO THE GROUND. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

WARNING: LOWER THE AIRCRAFT ON TO CRIBBING OR JACKS IMMEDIATELY WHEN THE AIRCRAFT HAS BEEN LIFTED TO A SUFFICIENT HEIGHT BY THE AIRBAGS. THE AIRCRAFT IS NOT IN A SAFE CONDITION WHEN YOU SUPPORT IT ONLY BY THE AIRBAGS. THE AIRCRAFT CAN FALL OFF THE AIRBAGS AND CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

CAUTION: YOU MUST USE A SPREADER BAR IF YOU LIFT THE AIRCRAFT WITH ONLY ONE MOBILE CRANE. THIS WILL PREVENT DAMAGE TO THE AIRCRAFT STRUCTURE.

CAUTION: IF IT IS POSSIBLE, DEFUEL THE AIRCRAFT TO DECREASE THE WEIGHT. THIS WILL HELP TO PREVENT DAMAGE TO THE AIRCRAFT STRUCTURE.

1. General

   A. This section describes the recommended methods used to lift an aircraft from the ground in various conditions. These conditions are:

   - Nose gear collapsed (both main gear extended)
   - Main gear collapsed (both sides)
   - Main gear collapsed (on one side)
   - Nose gear and one main gear collapsed

– All landing gear collapsed.

B. For the recovery operations that follow, make sure that:

– One qualified person is in charge of the overall operation

– Payload and components are removed to reduce weight (refer to Ch. 2 of this manual)

– Aircraft is defueled, if this is possible

– Chocks are installed at the wheels whenever possible

– Airbags are inflated according to the manufacturer's instructions.

NOTE: De Havilland Aircraft of Canada Limited strongly recommends that you defuel the aircraft, if this is possible, before any lifting operation takes place. This will reduce the weight of the aircraft and help prevent damage to the structure.

2. Nose Gear Collapsed (Both Main Gear Extended)

A. Configuration (refer to Figure 03–1):

– Nose down, wings level, nose area damaged.

(1) The fastest way to lift the aircraft in this condition is to use a mobile crane and sling (if available and ground conditions allow). Install the sling at STA. X –39.00 (the frame at the pilot's bulkhead).

(2) If airbags are used, install them under the fuselage as far forward as possible and follow the manufacturer's instructions for recommended pressure and the inflation sequence. Make sure that you keep the nose–fuselage jacking point clear.

(3) Use jacks, airbags or slings simultaneously to help lift and support the forward fuselage.

(4) Extend the nose landing gear and engage the nose–gear down lock (if the damaged structure will permit this). If not, support the nose section on a flatbed or similar mobile unit.

(5) Tow the aircraft by the main landing gear to a repair area (refer to 04–10–00, Returning Undamaged Aircraft to a Hard Surface for information about how to tow the aircraft from the main gear with tow straps).

3. Main Gear Collapsed (Both Sides)

A. Configuration (refer to Figure 03–2):

– Tail down, extensive to moderate damage to mid–fuselage, wings are level or one wing down with wing tip damage

– Propeller damage, possible damage to main gear and nacelle.

B. Install chocks at the wheels of the nose landing gear.

C. Support the aft fuselage with an airbag.

D. Install jacks at the wing jacking points, and airbags outboard of the nacelles on both wings. Use cribbing where required.

E. Lift the aircraft and make it level by the coordinated use of jacks and airbags.

NOTE: As an alternative to jacks and airbags, mobile cranes and slings can be used, if soil conditions permit. The nose–fuselage sling point is at STA X –39.00 (the frame at the pilot's bulkhead). The wing sling points are STA. YW 117.50 (just outboard of the wing jacking point, which is at STA. X 108.17) and STA. YW –117.50.

F. Lift and support the tail section with airbags.

G. If possible, extend the main landing gear and install the lockpins. If not, support the aircraft on a flatbed or similar mobile unit.

H. If the aircraft is now on its gear, remove the chocks from the wheels and tow it from the nose and main landing gear.

4. Main Gear Collapsed (On One Side)

A. Configuration (refer to Figure 03–3):

- Nose gear and one main gear are extended, ground lock is engaged and lockpin installed (wheels chocks are installed)
- Tail down, damage to mid–fuselage
- One wing is down to wing tip, outer wing panel and propeller.

B. Install chocks the wheels of the nose landing gear and the extended main landing gear.

C. Support the forward and aft sections of the aircraft with airbags.

D. Install airbags under the high wing, outboard of the nacelle. Inflate the bags to support the high wing.

E. Install a jack at the wing jacking point of the low wing and airbags outboard of the nacelle.

F. Lift the aircraft and make it level laterally through the coordinated operation of the wing jack and airbags.

NOTE: As an alternative to jacks and airbags, mobile cranes and slings can be used, if soil conditions permit. The nose–fuselage sling point is at STA X –39.00 (the frame at the pilot's bulkhead). The wing sling points are STA. YW 117.5 (just outboard of the wing jacking point, which is at STA. X 108.17) and STA. YW –117.5.

G. Lift and support the tail section with airbags.

H. If possible, extend the collapsed main landing gear and install the lockpin. If not, support the aircraft on a flatbed or similar mobile unit.

I. Remove the chocks from the wheels and tow the aircraft from the nose and main landing gears.

5. Nose Gear and One Main Gear Collapsed

A. Configuration (refer to Figure 03–4):

- One main landing gear is extended and the lockpin is installed
- Aircraft is resting on its fuselage with one wing down
- Damage to lower fuselage, wing tip, outer wing panel, propeller and possibly nacelle and landing gear.

B. Install chocks at the extended main gear, if possible.

C. Support the aft fuselage with airbags, jacks or cranes and slings.

D. Put sandbags temporarily on both sides of the nose section.

E. Install jacks at the wing jacking points on both wings.

F. Install airbags under both wings, outboard of the nacelles. Cranes and slings can also be used if the soil conditions permit.

G. Install airbags or slings under the fuselage as far forward as possible.

H. Lift the aircraft and make it level laterally through the coordinated operation of the jacks, airbags or cranes and slings.

I. If possible, extend the collapsed nose and main landing gear. Engage the ground lock and install the lockpin. If one or both of the gear cannot be extended then support the aircraft on a flatbed or similar mobile unit.

J. Remove the chocks from the wheels and tow the aircraft from the nose and main landing gear.

6. All Landing Gear Collapsed

A. Configuration (refer to Figure 03–5):

- Aircraft is resting on fuselage, probably with one wing down
- Damage to full length of lower fuselage, one wing tip and outer wing panel with possible damage to opposite wing
- Damage to one or both propellers, possible damage to nacelles and landing gears.

B. Reduce the weight of the aircraft as follows:

- Remove payload and components
- Defuel the aircraft, if this is possible.

NOTE: De Havilland Aircraft of Canada Limited strongly recommends that you defuel the aircraft, if this is possible, before any lifting operation takes place. This will reduce the weight of the aircraft and help prevent damage to the structure.

C. Put sandbags temporarily on both sides of the nose section.

D. Install airbags under both wings, outboard of the nacelles. Cranes and slings can also be used if the soil conditions permit.

E. Install airbags or slings under the fuselage as far forward as possible.

F. Lift the aircraft and make it level through the coordinated operation of the jacks, airbags or cranes and slings.

G. Once the aircraft is completely raised, install jacks and attempt to extend the landing gear. Make sure that you engage the ground lock and install the lockpin. If any of the gear cannot be extended then support the aircraft on a flatbed or similar mobile unit.

H. Tow the aircraft by the nose and main landing gear to a repair area.

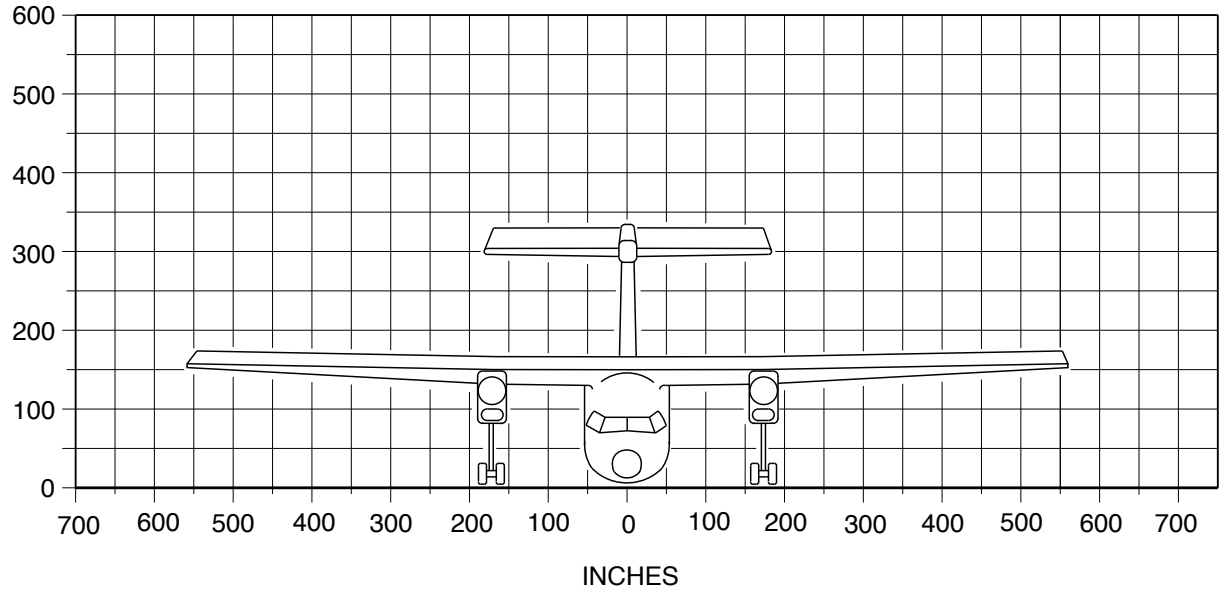
7. Post–Recovery Inspections

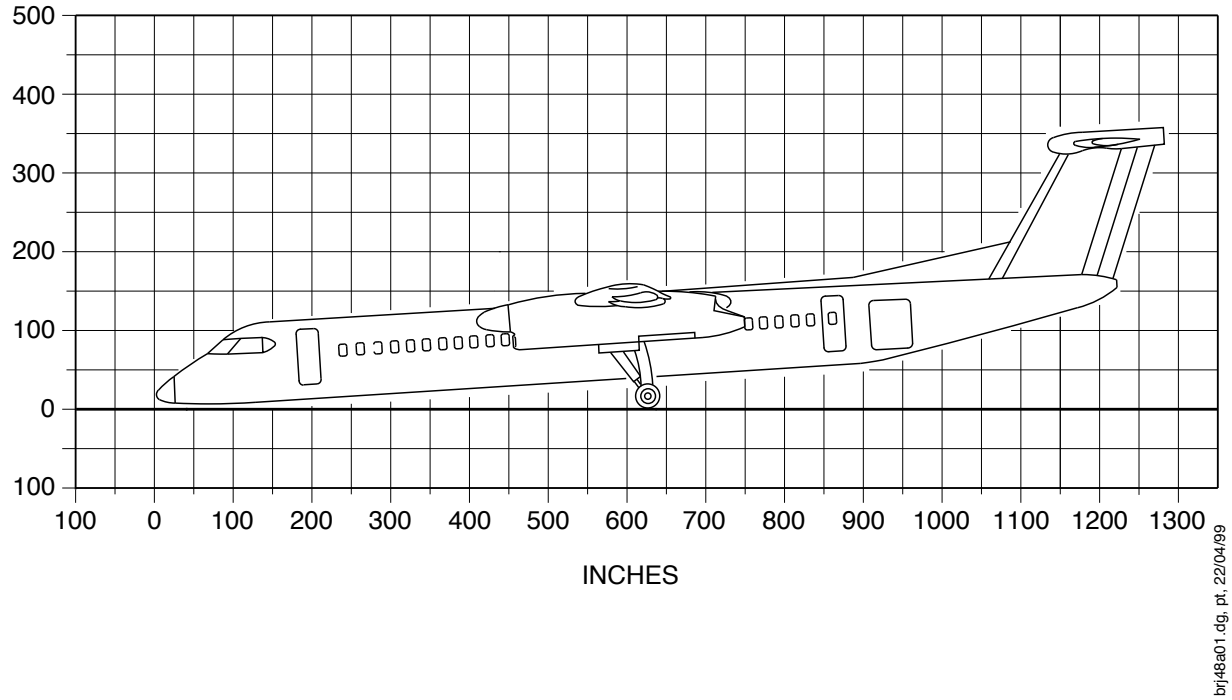
A. Any lifting/recovery operation may cause additional damage to the aircraft structure. For this reason you must do these inspections once the aircraft has been moved to a maintenance facility:

(1) Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–801).

(a) If airbags were used to lift the aircraft, do a detailed visual inspection of the wing joint area just outboard of the nacelle (in addition to the procedures of the Inspection After a Hard Landing (above)). Carefully check the spars and stringers for signs of deformation (i.e. twisting, bending, buckling). Remove overwing access panels on the outer wing (refer to AMM TASK 57–21–01–000–801) as required for internal inspections.

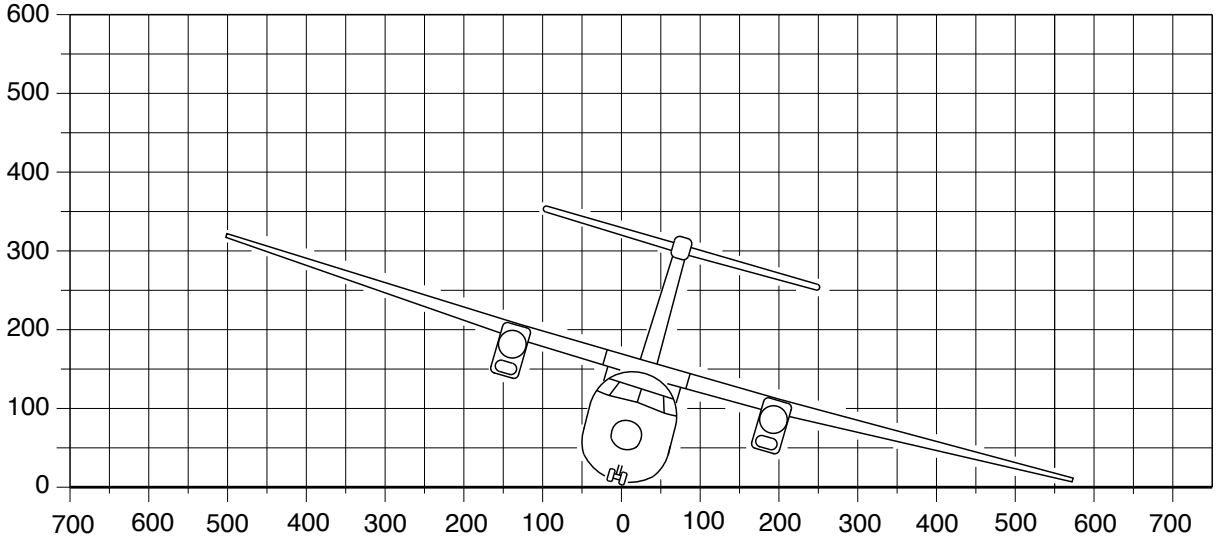
(2) Engine Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–802).

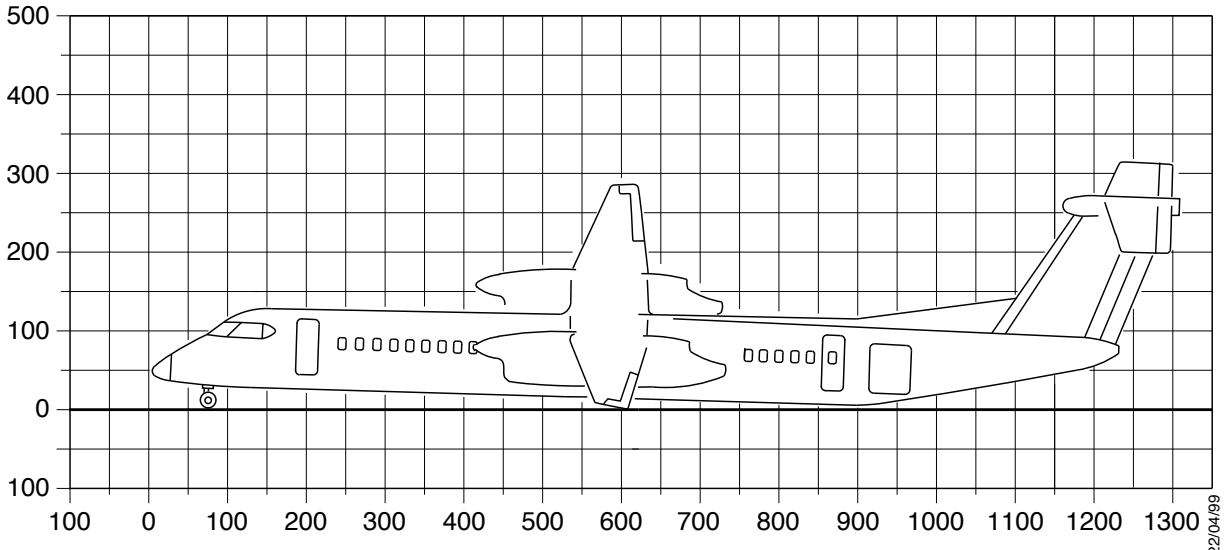




COLLAPSED NLG (BOTH MAIN GEAR EXTENDED)

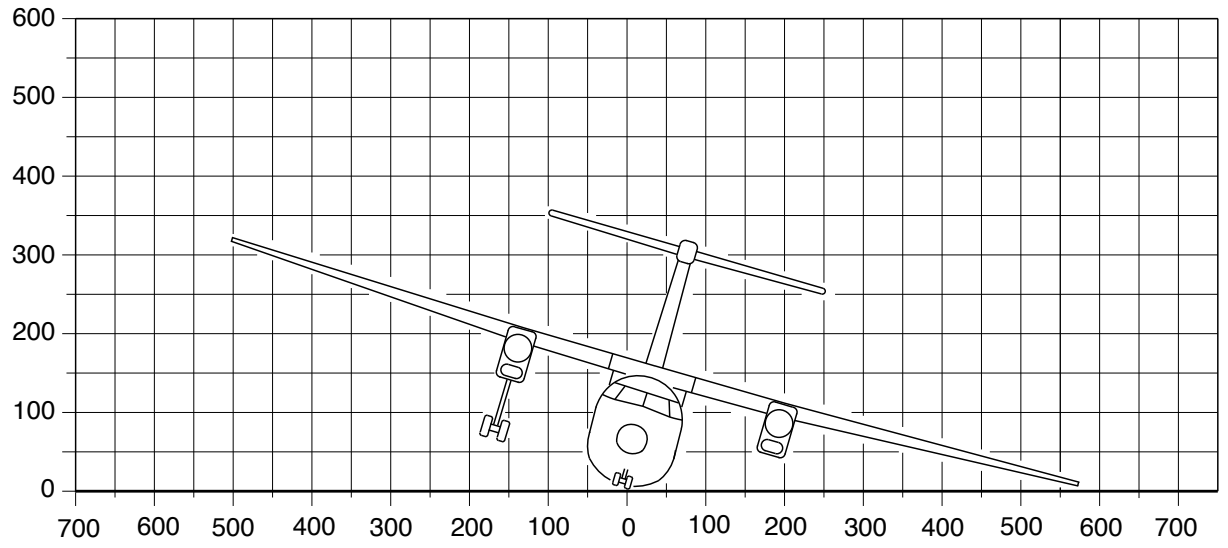
Figure 03 – 1

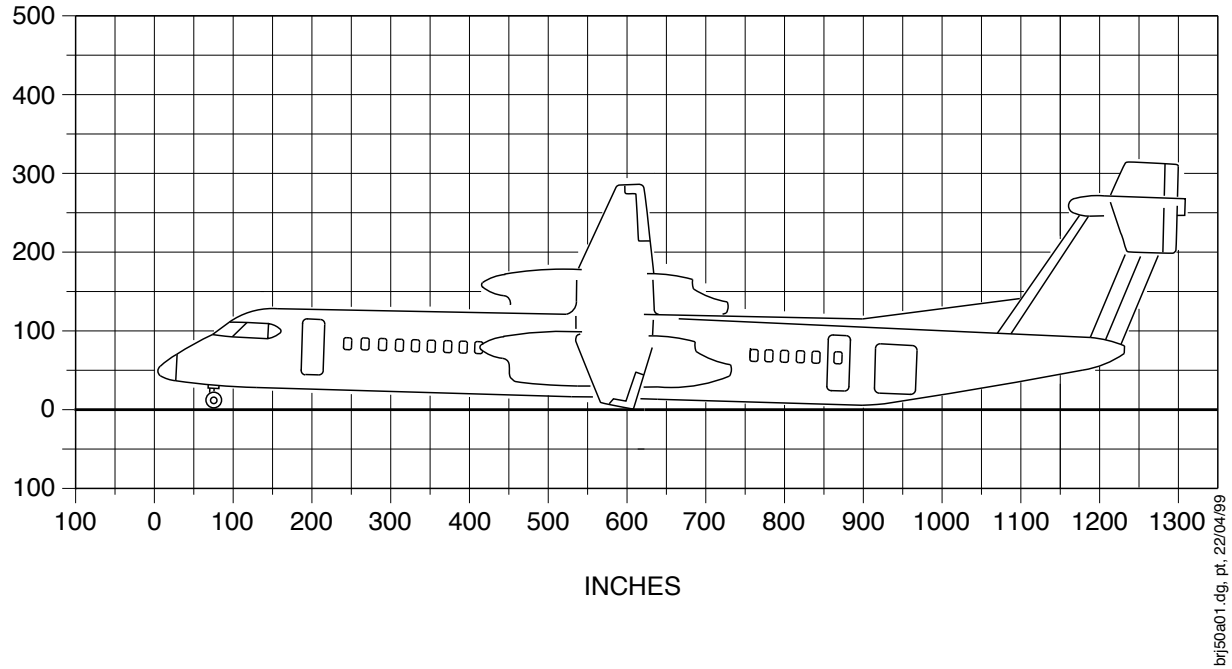




COLLAPSED MLG (BOTH SIDES)

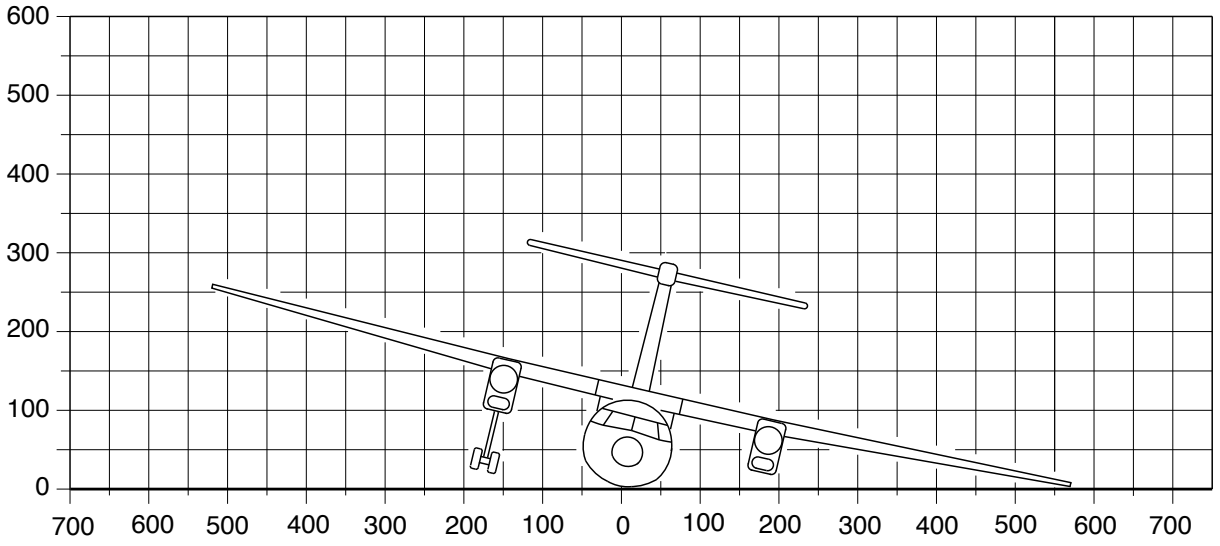
Figure 03 – 2

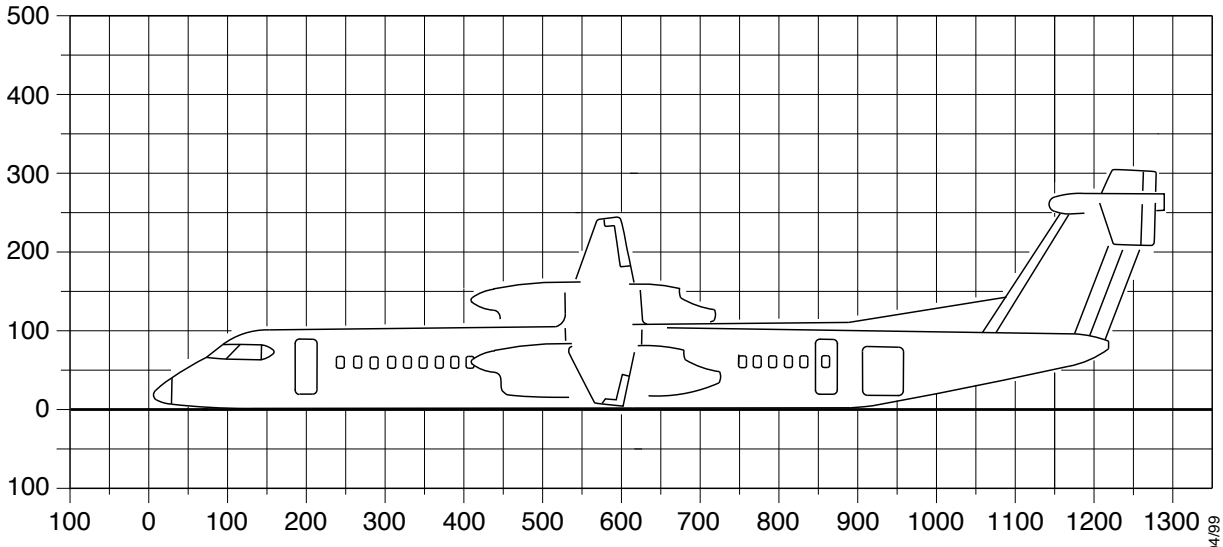




COLLAPSED MLG (ONE SIDE)

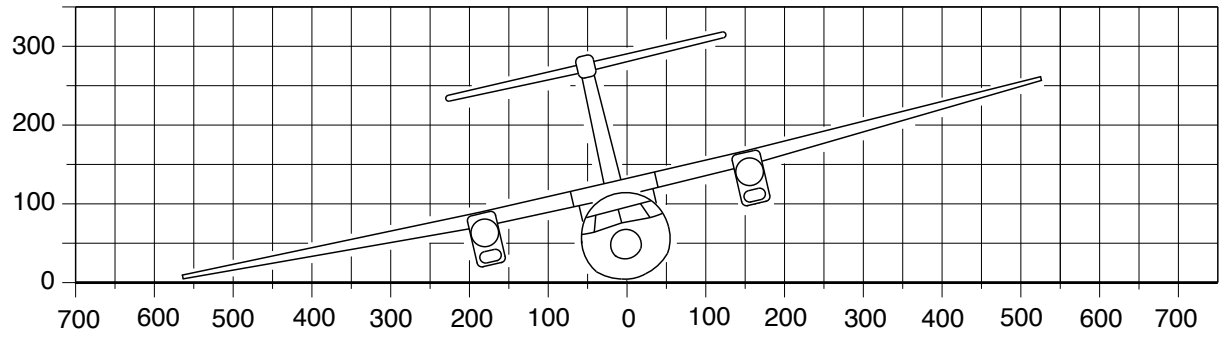
Figure 03 – 3



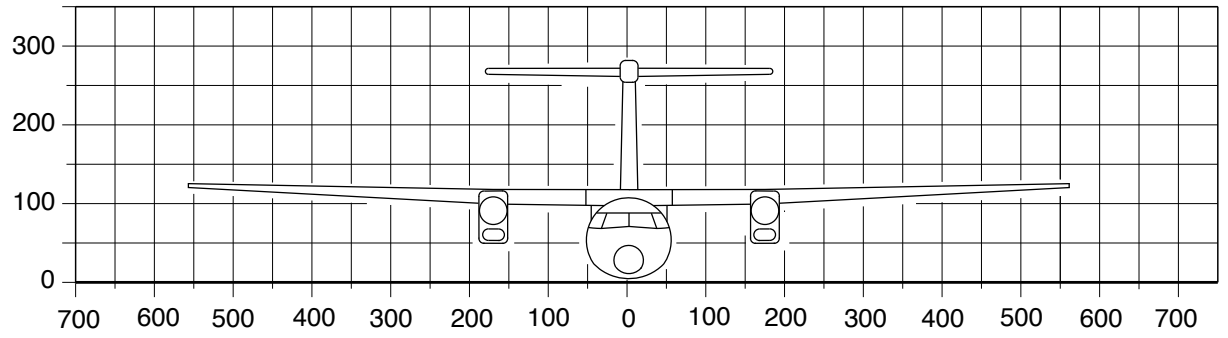


COLLAPSED NLG AND MLG ON ONE SIDE

Figure 03 – 4



INCHES



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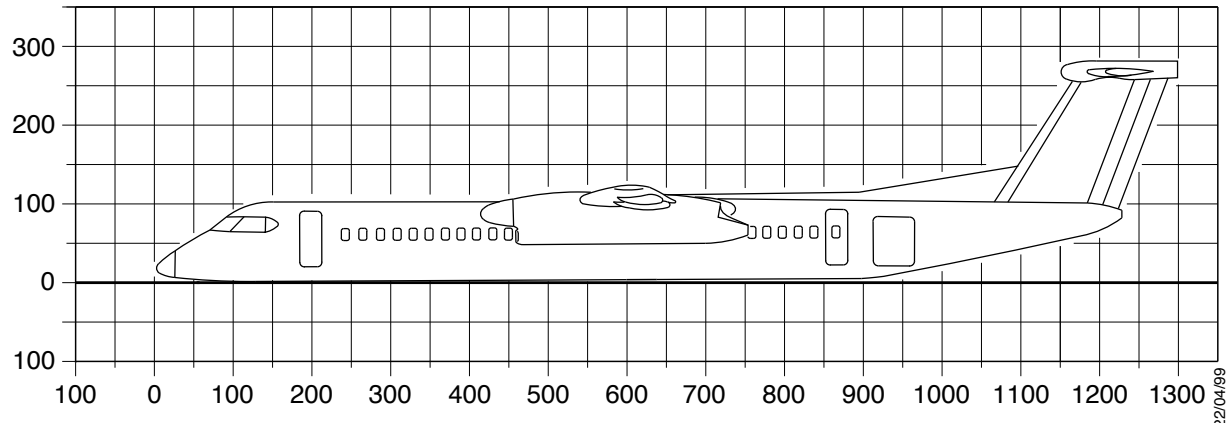

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COLLAPSED LANDING GEAR (ALL)

Figure 03 – 5

DE HAVILLAND AIRCRAFT
OF CANADA LIMITED

AIRCRAFT RECOVERY MANUAL

CHAPTER 04

MOVING AIRCRAFT

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DE HAVILLAND AIRCRAFT
OF CANADA LIMITED

AIRCRAFT RECOVERY MANUAL

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AIRCRAFT RECOVERY MANUAL

TABLE OF CONTENTS

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GENERAL PREPARATION

1. General

   A. This section provides details about the general preparations and special equipment required to move the aircraft.

2. Preparation

   A. General

      (1) Before you can move the aircraft from the incident site to a permanent repair facility, several activities may have to occur. These are:

      - To get approval from the authorities to move the aircraft
      - To prepare the recovery site
      - To remove payload
      - To defuel the aircraft, if this is possible
      - To remove propellers and engines.

      (2) During the recovery of an aircraft, consideration must be given to move the aircraft on its extended landing gear. This requires an early examination of the landing gear so that it can be determined if the gear can be extended, repaired or if it needs to be replaced.

   B. Special Equipment Required

      (1) A tow kit is required to return the aircraft from a soft surface to a runway or hard surface. This kit consists of slings, ropes and a lunette assembly and is described in 04–10–00, Returning Undamaged Aircraft to a Hard Surface.

      (2) A low–profile flatbed trailer with spreader beam (for the wings) is required to move the aircraft when all its landing gear are unserviceable. This trailer must be equipped with padded cradles to support the fuselage and the wings. Wide tie–down straps or slings are required to secure the aircraft to the trailer during transport from the incident site to a maintenance facility. The use of the trailer is described in 04–30–00, Moving Damaged Aircraft.

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RETURNING UNDAMAGED AIRCRAFT TO A HARD SURFACE

1. General

   A. When an aircraft leaves the runway and becomes bogged down in soft soil, mud or sand, special procedures are required to return it to a hard surface (the runway). In this case a special towing kit (GSB 0910008) that consists of straps and ropes is required. The use of this kit is the only way to move the aircraft from the main gear. For more information about this kit contact the Ground Support Equipment group of De Havilland Aircraft of Canada Limited, through the Technical Help Desk at (416) 375–4000.

   NOTE: Plan the entire operation before you start any action. This will help to prevent further damage to the aircraft, will save valuable time and will allow the runway, if blocked, to be opened more quickly.

2. Pre–Recovery Inspection

   A. Before the aircraft is moved, do a visual inspection of the landing gear attachment points, wheels, tires and brakes. Make sure that the wheels can rotate freely. The purpose of this visual inspection is to make sure that the aircraft can be moved safely and that it has not received any structural damage that could be aggravated by towing.

3. Aircraft Recovery Planning

   A. Plan the entire operation before you start any action.

   B. Consider the condition of the terrain and the firmness of the ground.

   C. Select the type of platform (ramp and boardwalk) to use and determine the construction materials required to bring the aircraft to a hard surface.

   D. Determine the direction that the aircraft will be moved (either tail or nose first)

   E. Provide an adequate capacity tow vehicle.

   F. Obtain the Tow Sling Kit (GSB 0910008).

4. Prepare the Aircraft for Movement

   A. Make sure that the ground lock is engaged and lock pins are installed in all landing gear.

   B. Remove baggage and cargo as necessary. Defuel the aircraft, if this is possible.

   NOTE: De Havilland Aircraft of Canada Limited strongly recommends that you defuel the aircraft, if this is possible, before any recovery operation takes place. This will reduce the weight of the aircraft and help prevent damage to the structure.

   C. Make sure that the Pre–Recovery Inspection of the landing gear, tires and brakes has been done.

D. Lock the nosewheel in a centered position as follows:

(1) Center the nosewheel.

(2) Make sure that the nosewheel STEERING switch is in the OFF position.

(3) Install the nose landing–gear (NLG) castor lockpin (Menasco AT31955) in its hole in the top of the steering gearbox (refer to AMM Ch. 7).

E. Lift the aircraft to allow the construction of a boardwalk, or build a ramp to the boardwalk (refer to Figure 04–1 and Figure 04–2).

5. Return the Aircraft to a Hard Surface

A. Tail–First Towing With Slings and Ropes

(1) Make sure that the NLG castor lockpin has been installed.

(2) Attach (loop) the slings around the lower shock–strut of the main gears. Make sure that you route each sling between the inboard tire and torque links (refer to Figure 04–3).

(3) Position the tow vehicle in order to obtain maximum traction.

(4) Slowly pull the aircraft up the ramp and onto the boardwalk to the hard surface.

B. Nose–First Towing With Slings and Ropes

(1) Make sure that the NLG castor lockpin has been installed.

(2) Loop the slings around the lower shock struts so that the slings point forward (refer to Figure 04–4).

(3) Position the tow vehicle in order to obtain maximum traction.

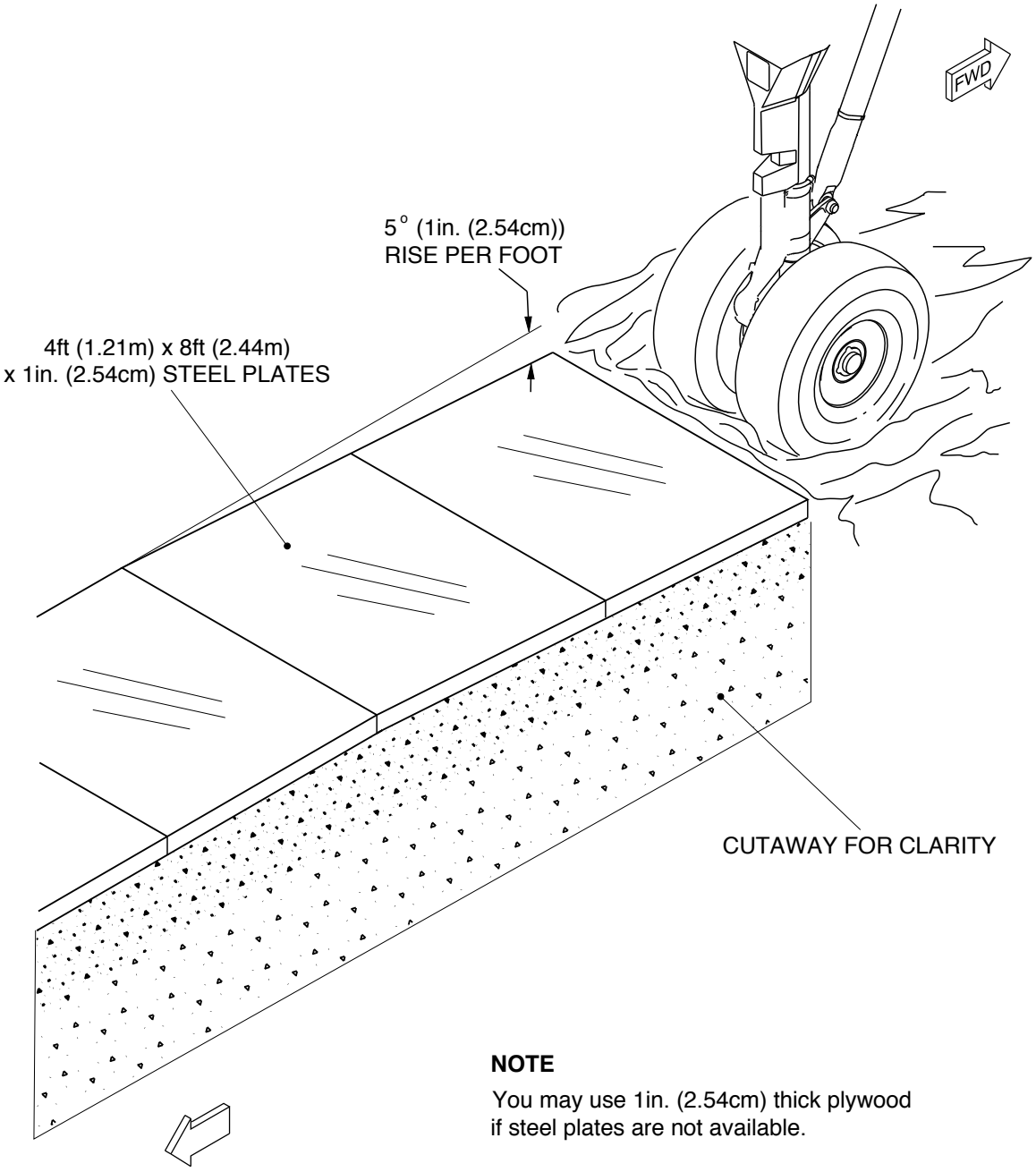
(4) Slowly pull the aircraft up the ramp and onto the boardwalk to the hard surface.

6. Post–Recovery Inspections

A. Any lifting/recovery operation may cause additional damage to the aircraft structure. For this reason you must do these inspections once the aircraft has been moved to a maintenance facility:

(1) Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–801).

(2) Engine Inspection After a Hard Landing (refer to AMM TASK 05–50–06–210–802).



NOTE

You may use 1in. (2.54cm) thick plywood if steel plates are not available.

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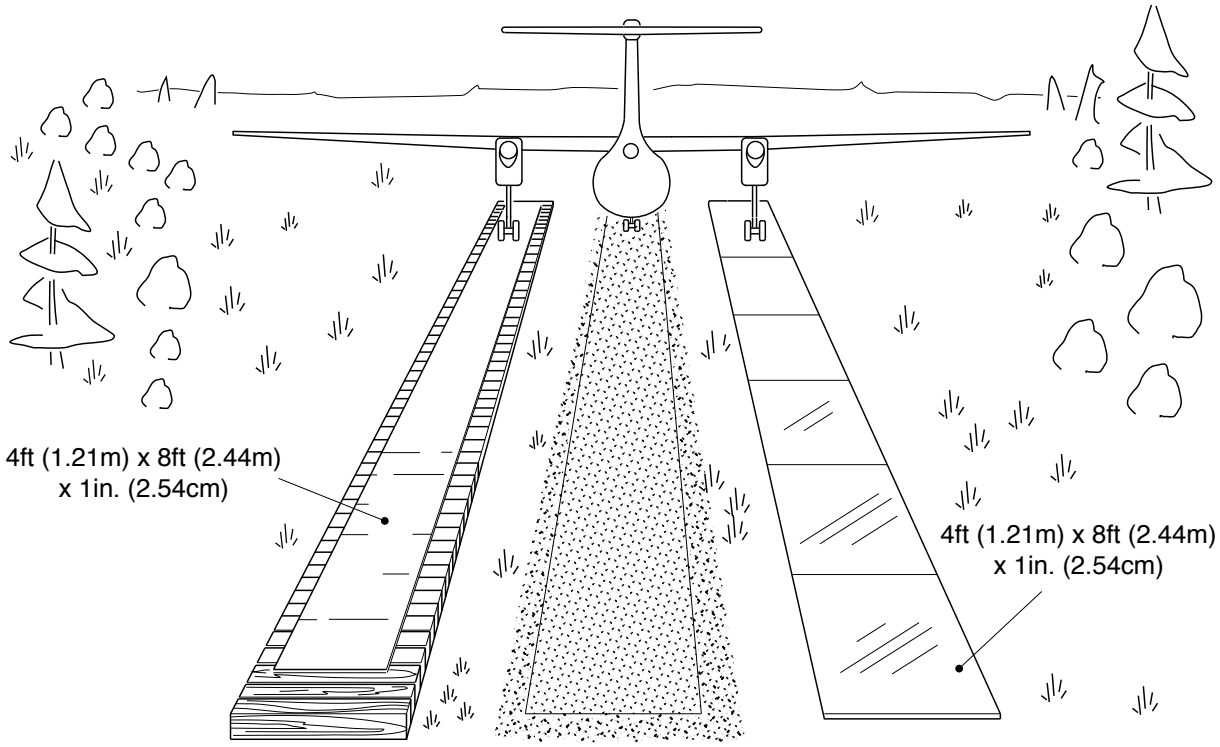
RAMP CONSTRUCTION DETAILS

Figure 04 – 1



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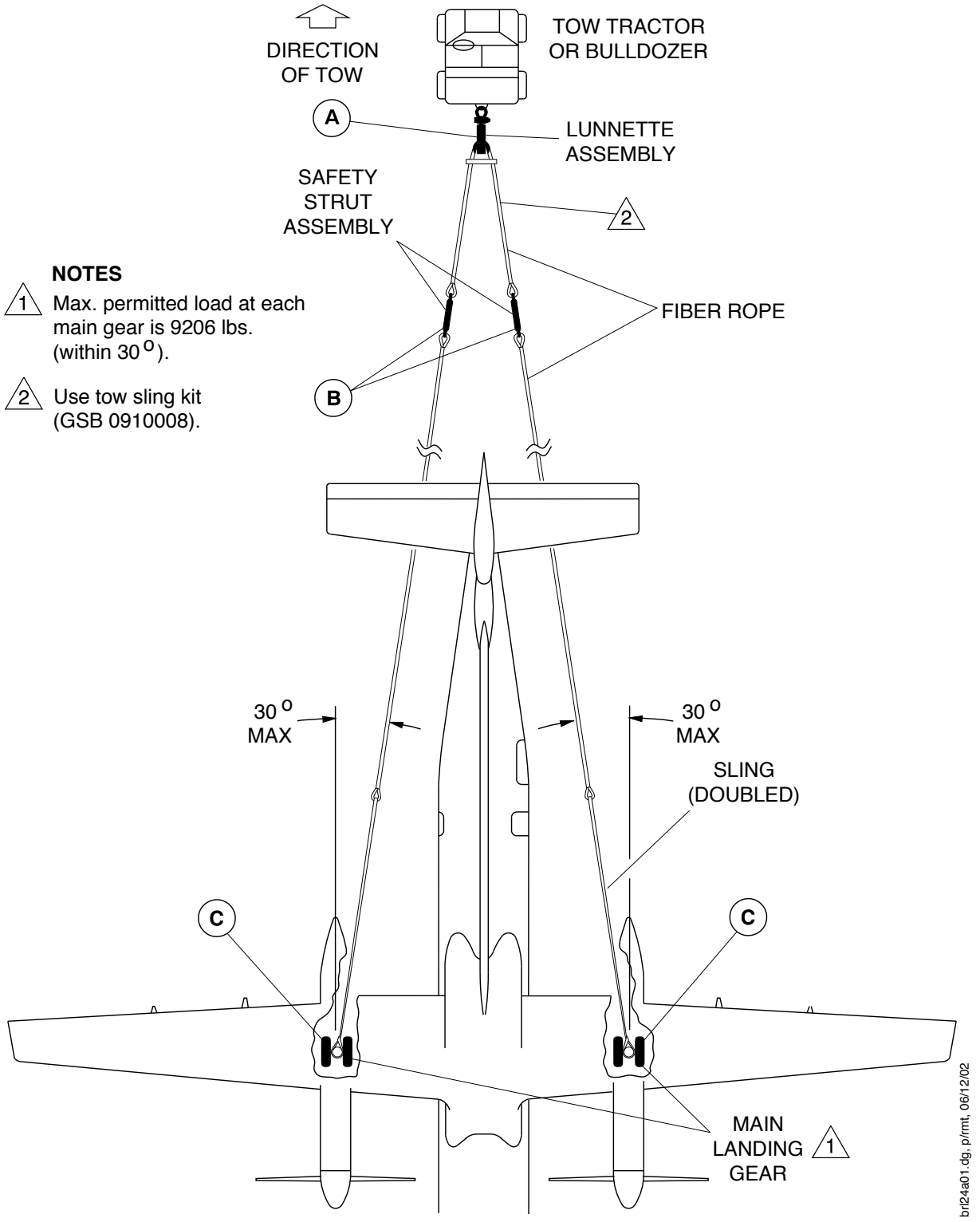
VARIOUS PREPARED SURFACES

Figure 04 – 2

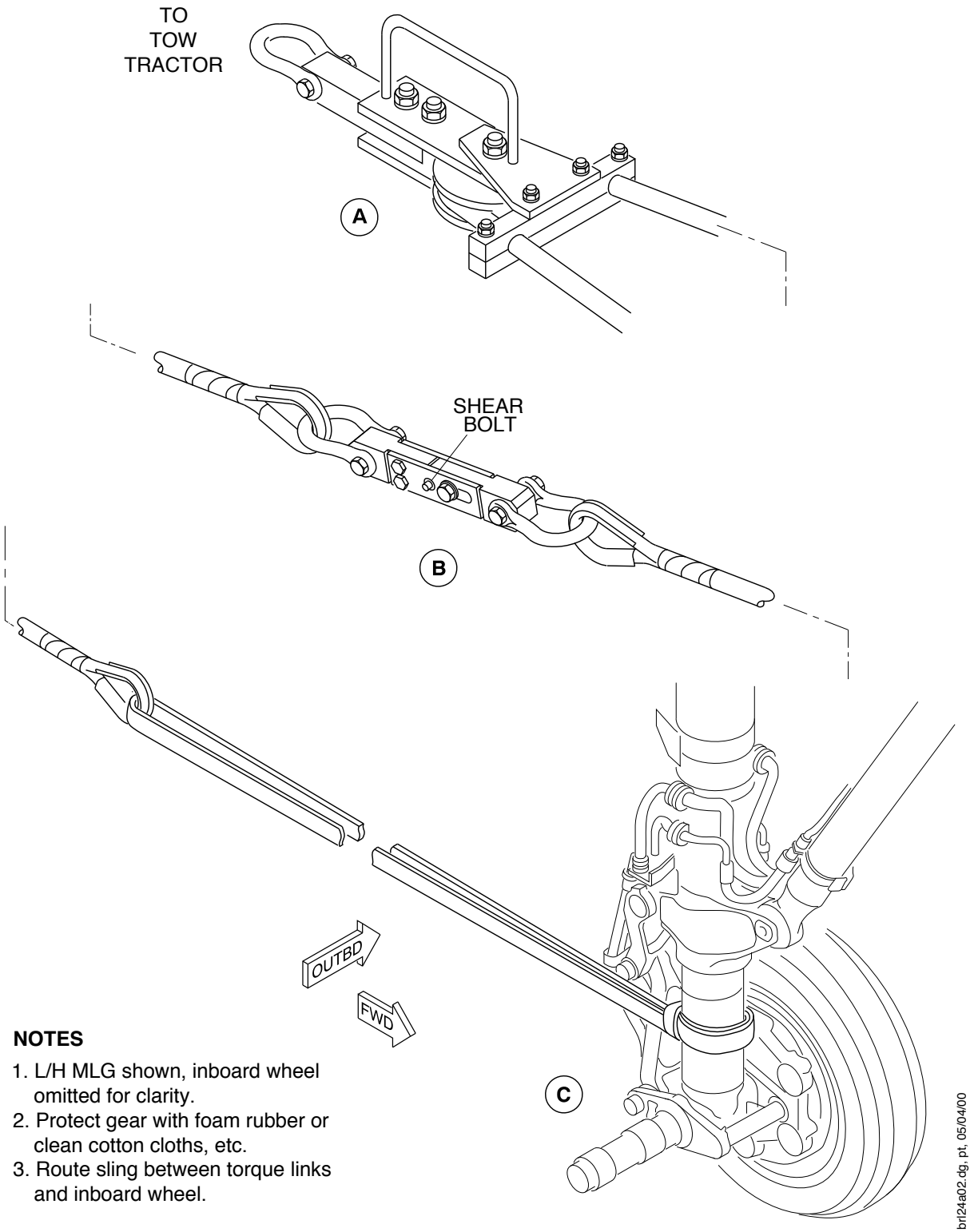


NOTES

1. Max. permitted load at each main gear is 9206 lbs. (within 30 O).
2. Use tow sling kit (GSB 0910008).

HOW TO USE KIT FOR TAIL – FIRST TOWING (Sheet 1 of 2)

Figure 04 – 3

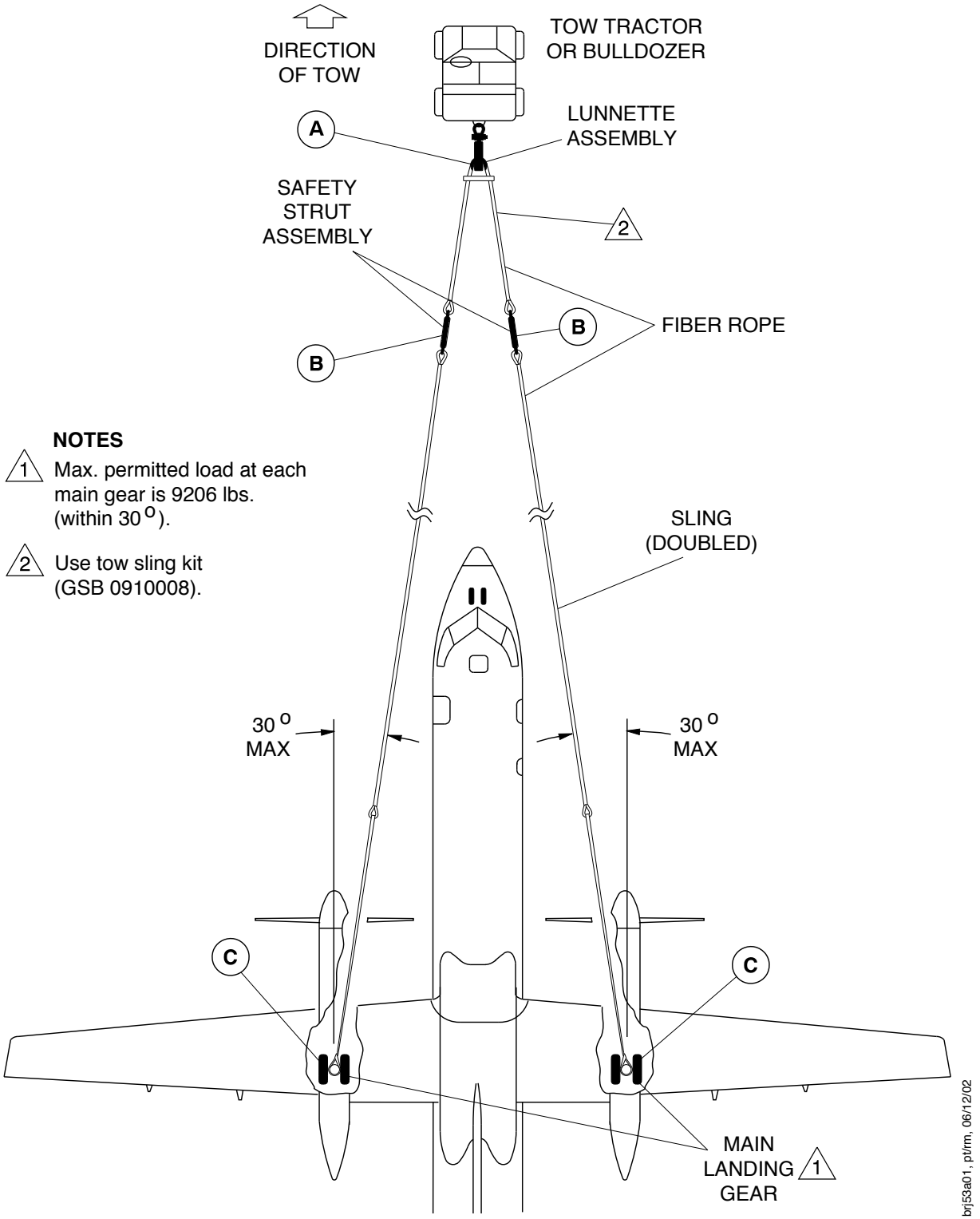


NOTES

1. L/H MLG shown, inboard wheel omitted for clarity.
2. Protect gear with foam rubber or clean cotton cloths, etc.
3. Route sling between torque links and inboard wheel.

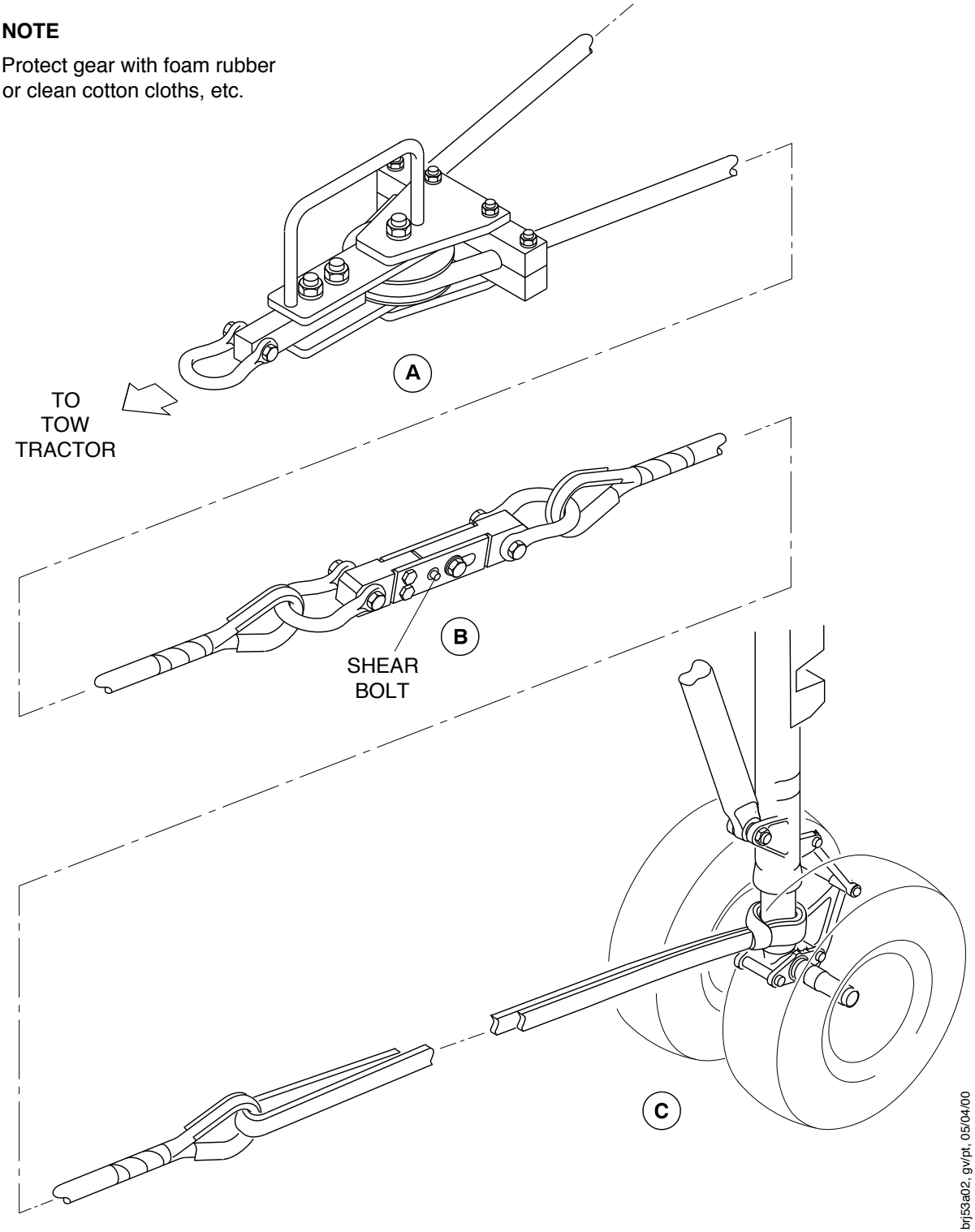
HOW TO USE KIT FOR TAIL – FIRST TOWING (Sheet 2 of 2)

Figure 04 – 3



HOW TO USE KIT FOR NOSE – FIRST TOWING (Sheet 1 of 2)

Figure 04 – 4



HOW TO USE KIT FOR NOSE – FIRST TOWING (Sheet 2 of 2)

Figure 04 – 4

TOWING AND WINCHING

1. General

   A. This section provides information about towing and winching procedures for the Dash–8, Series 400. Towing is the most common way to move the aircraft in a recovery situation, but winching may be used to pull the aircraft using the towing kit.

2. Methods of Towing

   A. Towbar and Tractor

      (1) In some recovery situations the Series 400 can be towed from the nose landing gear (NLG) with a towbar and a tractor or tug. This can be done once the aircraft is on a hard surface and the landing gear has been determined to be serviceable (refer to Figure 04–1, Figure 04–2, Figure 04–3, Figure 04–4 and Figure 04–5).

      (2) The maximum permitted towing loads on the NLG are as follows:

      – 11,867 lb (5382 kg) for the nose gear at approx. 0° steer angle

      – 5,933 lb (2691 kg) for the nose gear at approx. 45° and 120° steer angles

      – The maximum torque limit is 42,056 lbf/in (4752.4 Nm).

      NOTE: These loads are applicable for both NLG tires inflated. In the case of one tire flat, maximum loads are 60% of those shown above.

   B. Towing Kit and Tractor

      (1) The tow kit consists of slings, fiber ropes, safety struts and a lunette assembly (this is described in 04–10–00, Returning Undamaged Aircraft to a Hard Surface). This kit can be used to pull the aircraft (either tail–first or nose–first) from soft ground to a hard surface. The kit can also be used to move the aircraft on hard surfaces when it is not possible to tow the aircraft conventionally from the nose landing gear.

3. Towing Aircraft with Flat Tires

   A. An aircraft with a flat tire or combination of flat tires on the runway, taxiway or apron may be towed using a tractor and towbar or Towing Sling Kit (GSB 0910008). The maximum combination of flat tires is defined in Figure 04–6. Ensure the wheel rims of any flat tire are not damaged and that the aircraft is still supported by its own main and nose landing gear. The following procedures and guidelines must be followed:

      (1) Engage nose landing gear ground lock.

      (2) Install main landing gear lock pins.

      (3) Obey the following precautions when towing an aircraft with two flat tires on one or more axles:

(a) Limit towing speed to 2 mph (3 km/h).

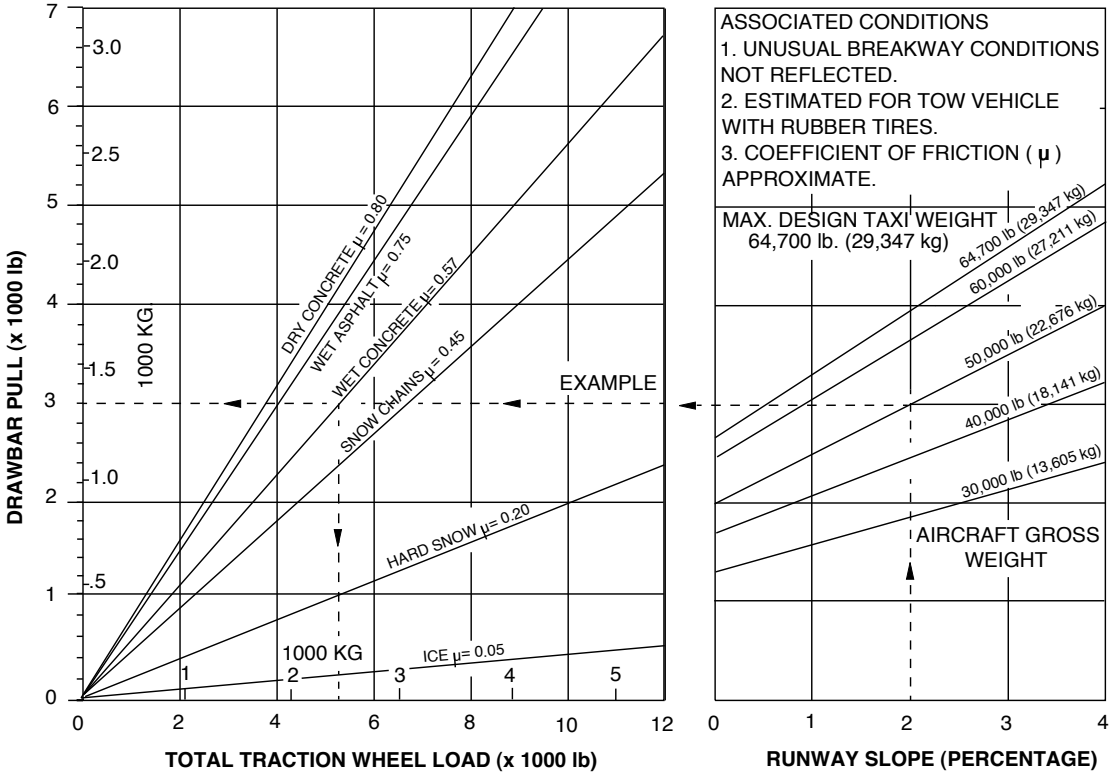
(b) Minimize towing distance with flat tires.

(c) Avoid sharp turns, abrupt starts and stops.

(4) Maximum Allowable Towing Loads:

- one flat tire – 7,185 lb.
- two flat tires – 5,987 lb.

NOTE: Maximum Allowable Towing Load is the force applied on the towbar during the towing operation. The Maximum Allowable Towing Load is reduced from normal when towing with flat tires.



EXAMPLE :

At an aircraft gross weight of 50,000 lb (22,676 kg), an uphill slope of 2 % and with a wet concrete surface, the coresponding draw bar pull or push required is 3,000 lb (1,360 kg) and the total traction wheel load is 5,250 lb (2,381 kg).

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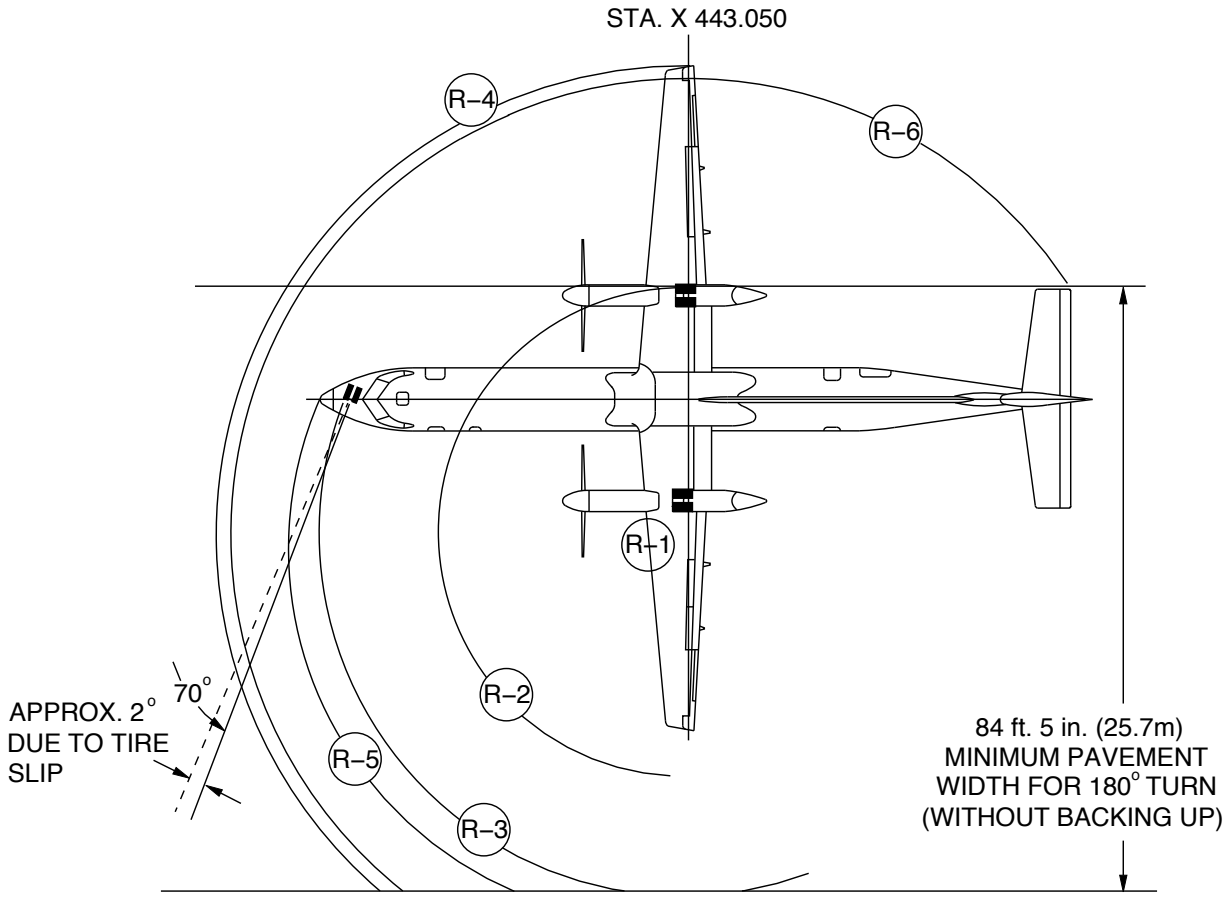
GROUND TOWING REQUIREMENTS

Figure 04 – 1

MINIMUM TURNING CENTER ON MAIN–AXLE GEAR PROJECTION



ITEM	RADIUS
R–1 INNER GEAR	4 ft. 9 in. (1.52 m)
R–2 OUTER GEAR	33 ft. 10 in. (10.32 m)
R–3 NOSE GEAR	50 ft. 7 in. (15.41 m)
R–4 WING TIP	64 ft. 9 in. (19.74 m)
R–5 NOSE	54 ft. 10 in. (16.73 m)
R–6 ELEVATOR TIP	62 ft. 9 in. (19.13 m)

NOTES

1. Dimensions noted are for dry, hard, level surfaces at these tire pressures : 227 psi (loaded), 32 x 8.8–16 standard main–wheel tires, and 89 psi (loaded) for 22 x 6.50–10 standard nose–wheel tires.
2. Nose gear steering limit is approximately 70° left and right.
3. Slip angle of 2° is approximate only and may vary with aircraft configuration, loading and tire wear.
4. Dimensions given for maneuvering clearance and turning radii are minimum recommended limits.
5. Tire pressures shown are for calculation purposes only. Refer to AMM Ch. 12 for service pressures.

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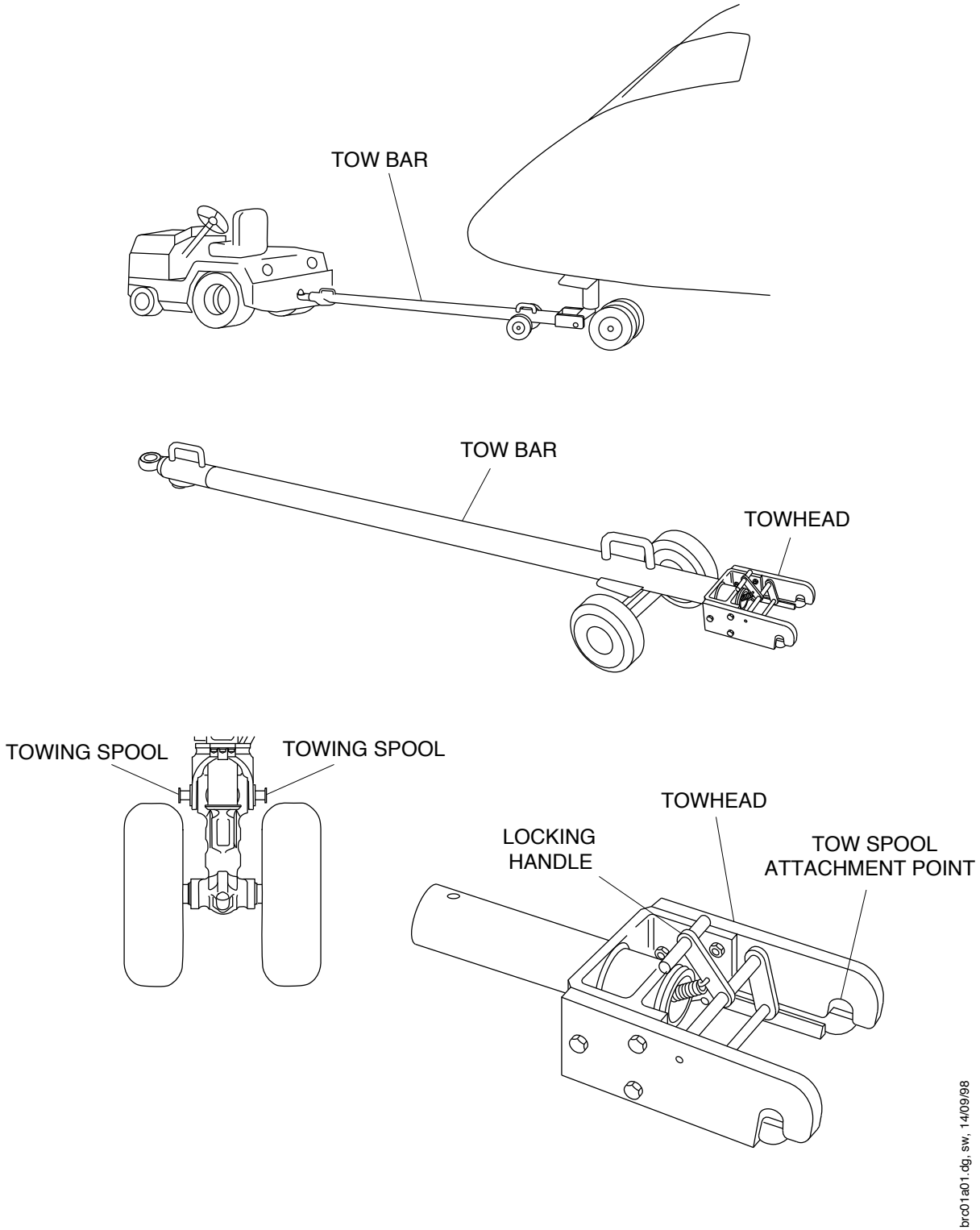
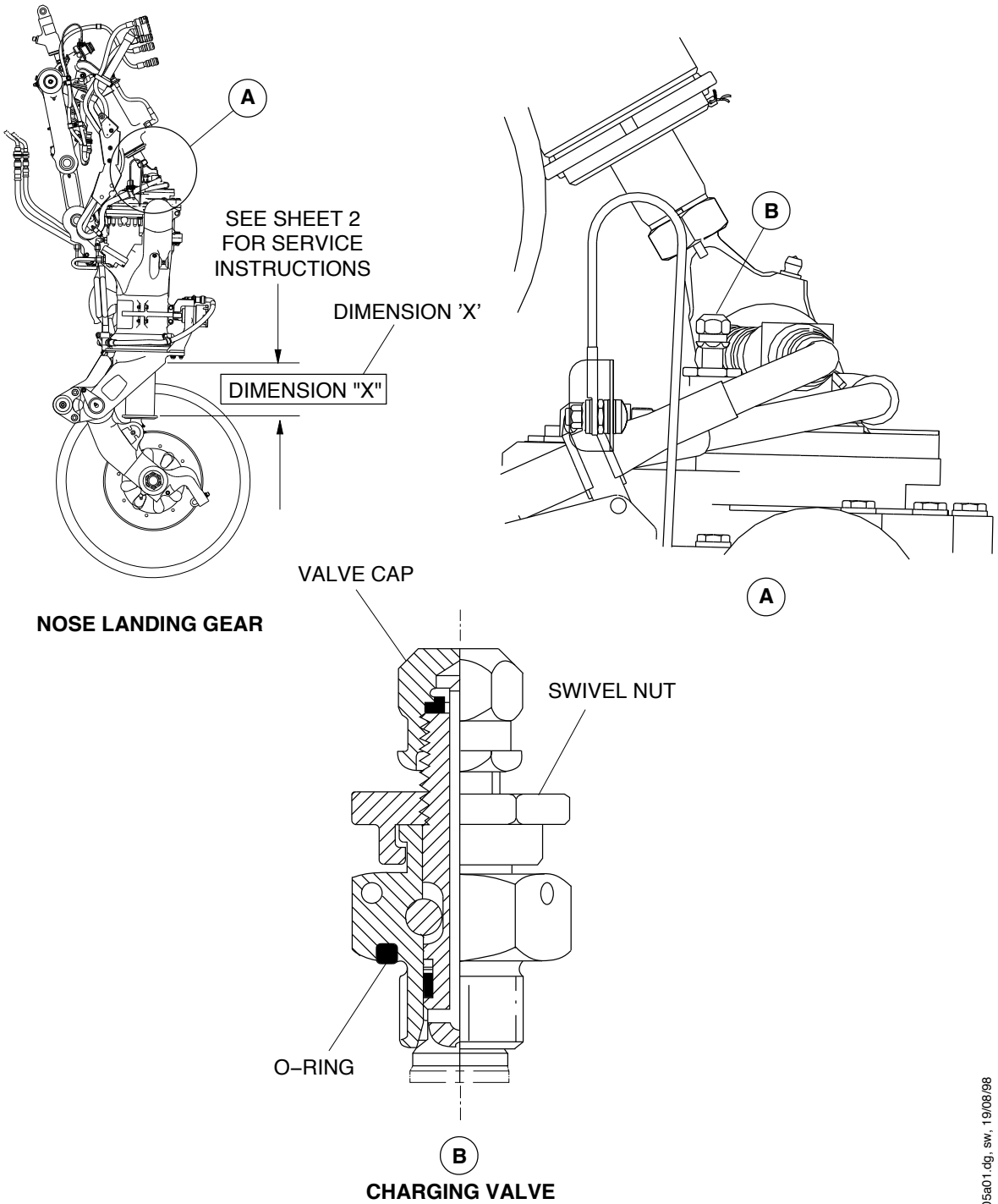
TURNING RADIUS AT MINIMUM POWER

Figure 04 – 2



AIRCRAFT TOWING

Figure 04 – 3



NOSE LANDING GEAR

CHARGING VALVE

NOSE LANDING GEAR SERVICING (Sheet 1 of 2)

Figure 04 – 4

NOTE
PLACARD LOCATED
ON AFT LEFT
NLG DOOR

FOR CURVE DETAIL
SEE TABLE "A"

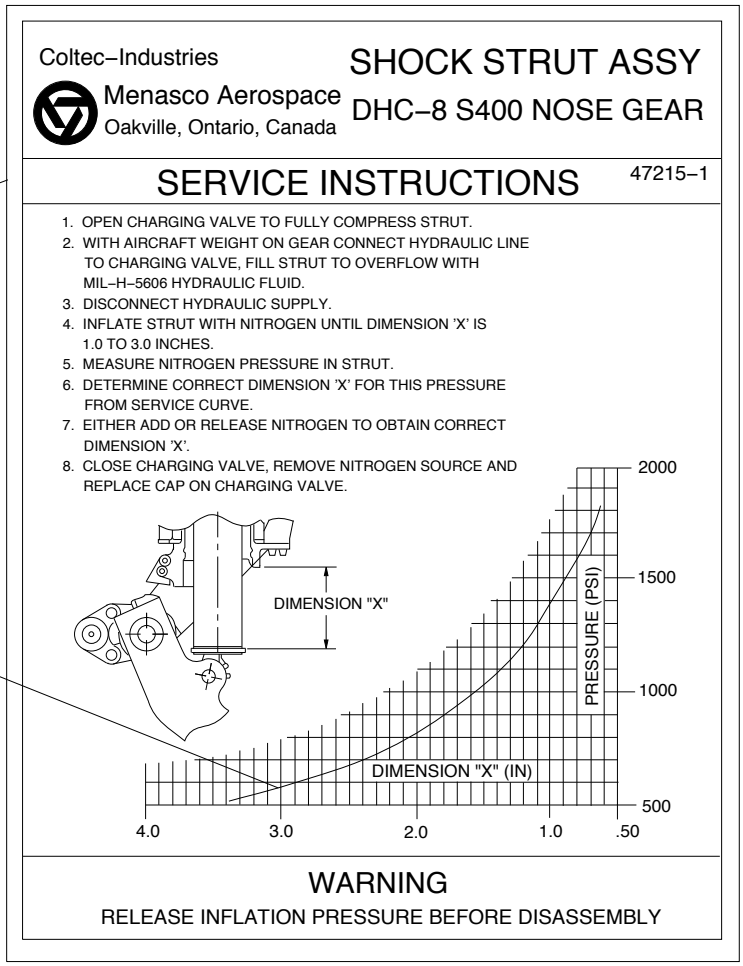


TABLE "A"

DIMENSION "X"	PRESSURE (PSI)
.63	1833
.88	1505
1.13	1272
1.38	1100
1.63	967
1.88	862
2.13	777
2.38	707
2.63	648
2.88	598
3.13	555
3.38	518

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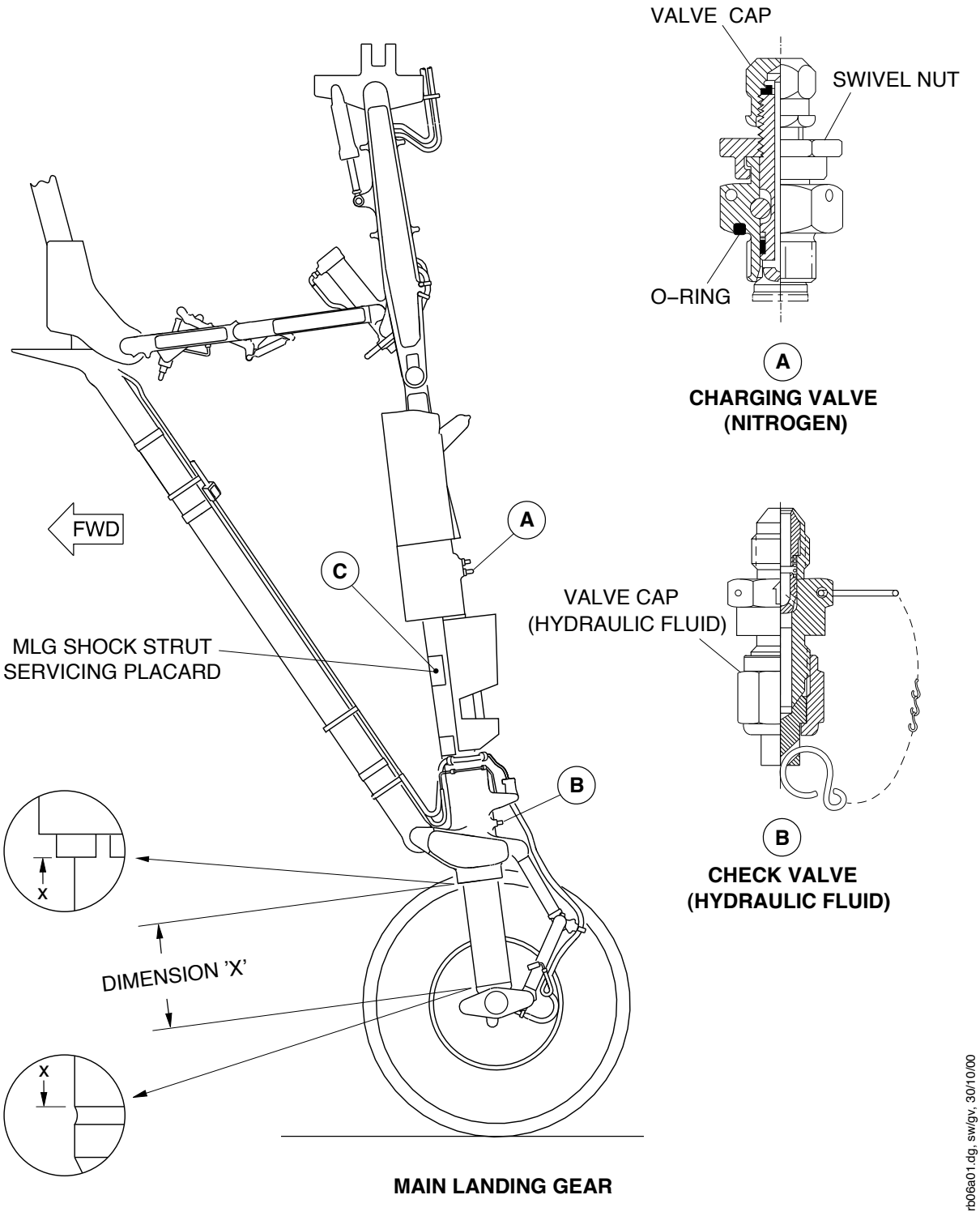
NOSE LANDING GEAR SERVICING (Sheet 2 of 2)

Figure 04 – 4



MAIN LANDING GEAR SERVICING (Sheet 1 of 2)

Figure 04 – 5

SHOCK STRUT ASSY, MAIN LANDING GEAR

DESIGNED AND MANUFACTURED BY
Coltec–Industries

MENASCO AEROSPACE
OAKVILLE, ONTARIO, CANADA
CAGE CODE 02121

FOR DHC–8 S400

PART NO: 46250–7

SERIAL NO: MA

ASSEMBLY DATE:

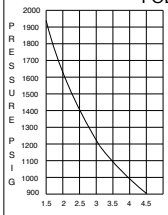
ENGINEERING SPEC: D–432 FLUID: MIL–H–5606

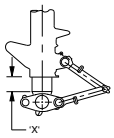
MOD. STATUS			
S. B. NO.	DATE	S. B. NO.	DATE

WARNING

RELEASE NITROGEN PRESSURE IN STRUT THROUGH CHARGING VALVE BEFORE DISASSEMBLY

MAINTENANCE: WITH AIRCRAFT ON THE GROUND THE ACCEPTABLE PRESSURES ARE AS FOLLOWS:





'X'=MEASUREMENT FROM FACE OF GLAND NUT TO TOP OF CHROME RUNNOUT GROOVE.

DIM 'X' INCHES	PRESSURE ± 25 PSIG
4.5	911
4.0	1001
3.5	1110
3.0	1245
2.5	1416
2.0	1638
1.5	1938

NOTE: FULLY EXTENDED THE PRESSURE IS 337 PSIG

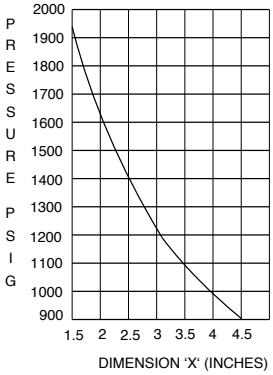
INSTRUCTIONS FOR SERVICING

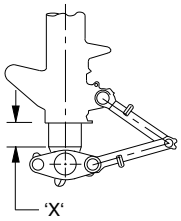
1. REMOVE NITROGEN CHARGING VALVE FAIRING COVER. ATTACH OVERFLOW LINE TO CHARGE VALVE MS28889–2, AND OPEN CHARGE VALVE TO FULLY COMPRESS SHOCK STRUT.
2. CONNECT MIL–H–5606 FLUID SUPPLY TO CHECK VALVE 1C1010 AND FILL STRUT WITH HYDRAULIC FLUID UNTIL NO BUBBLES ARE OBSERVED IN OVERFLOW LINE.
3. REMOVE FLUID SUPPLY AND REPLACE BLANKING CAP ON CHECK VALVE.
4. CONNECT NITROGEN SOURCE TO CHARGING VALVE AND PRESSURIZE STRUT TO OBTAIN VALUES SHOWN ON TABLE/GRAPH.
5. CLOSE CHARGING VALVE, REMOVE NITROGEN SOURCE AND REPLACE CAP ON CHARGING VALVE.

C

NAMEPLATE, INSTRUCTION

MAINTENANCE: WITH AIRCRAFT ON THE GROUND THE ACCEPTABLE PRESSURES ARE AS FOLLOWS:





DIM 'X' INCHES	PRESSURE ± 25 PSIG
4.5	911
4.0	1001
3.5	1110
3.0	1245
2.5	1416
2.0	1638
1.5	1938

'X'=MEASUREMENT FROM FACE OF GLAND NUT TO TOP OF CHROME RUNNOUT GROOVE.

NOTE: FULLY EXTENDED THE PRESSURE IS 337 PSIG.

brb06a02.dg, sw/lk, 21/02/00

MAIN LANDING GEAR SERVICING (Sheet 2 of 2)

Figure 04 – 5

ITEM NO.	MAIN GEAR CONDITION	TIRE FOOTPRINT EXAMPLES	IS TAXIING ALLOWED?	IS TOWING ALLOWED?	DISTANCE ALLOWED (TAXIING & TOWING)	NOSE WHEEL ANGLE OF TURN	REMARKS
1	ONLY ONE FLAT TIRE (ANY TIRE)		YES	YES	UNLIMITED	NORMAL	SEE NOTES 1., 2., 6., 8.
2	TWO FLAT TIRES (ONE ON EACH AXLE)		YES	YES	UNLIMITED	NORMAL	SEE NOTES 1., 3., 4., 6., 8.
3	TWO FLAT TIRES (ON ONE AXLE)		YES	YES	MINIMUM TO CLEAR RUNWAY	10° MAXIMUM	SEE NOTES 1., 3., 4., 5., 6., 7., 9.
4	THREE FLAT TIRES (ANY COMBINATION)		YES	YES	MINIMUM TO CLEAR RUNWAY	10° MAXIMUM	SEE NOTES 1., 3., 4., 5., 6., 7., 9.
5	FOUR FLAT TIRES		YES	YES	MINIMUM TO CLEAR RUNWAY	10° MAXIMUM	SEE NOTES 1., 3., 4., 5., 6., 7., 9.
	NOSE GEAR CONDITION						
6	ONE FLAT TIRE		YES	YES	UNLIMITED	NORMAL	SEE NOTES 1., 2., 4., 8.
7	TWO FLAT TIRES		YES	YES	MINIMUM TO CLEAR RUNWAY	10° MAXIMUM	SEE NOTES 1., 3., 4., 5., 6., 7., 8. or 9.

 = FLAT TIRE

NOTES

1. Avoid sharp turns, abrupt starts and stops.
2. Maximum taxiing or towing speed = 5 mph (8 kmh).
3. Maximum taxiing or towing speed = 2 mph (3 kmh).
4. After clearing runway, or if additional tire fails, aircraft should be stopped and serviceable wheel/tire assembly(ies) installed to satisfy conditions in Item No. 2 or 6.
5. Taxiing or towing with two flat tires on same gear can result in wheel damage.
6. After any tire failure or excessive heat condition, the affected wheel assembly must be inspected per applicable Vendor Manual prior to further use.
7. Under multiple failed tire condition, the affected landing gear assemblies and linkages must be inspected for possible structural damage.
8. Towbar required.
9. Use of rope on both main landing gear required.

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TOWING OF THE AIRCRAFT (FLAT TIRE CONDITIONS)

Figure 04 – 6

MOVING DAMAGED AIRCRAFT

1. General

   A. This section provides methods and recommendations to transport the aircraft if all three of the landing gear are unserviceable.

   NOTE: If all three landing gear are damaged, it is also likely that the airframe is extensively damaged as well. In this case economic recovery may not be feasible.

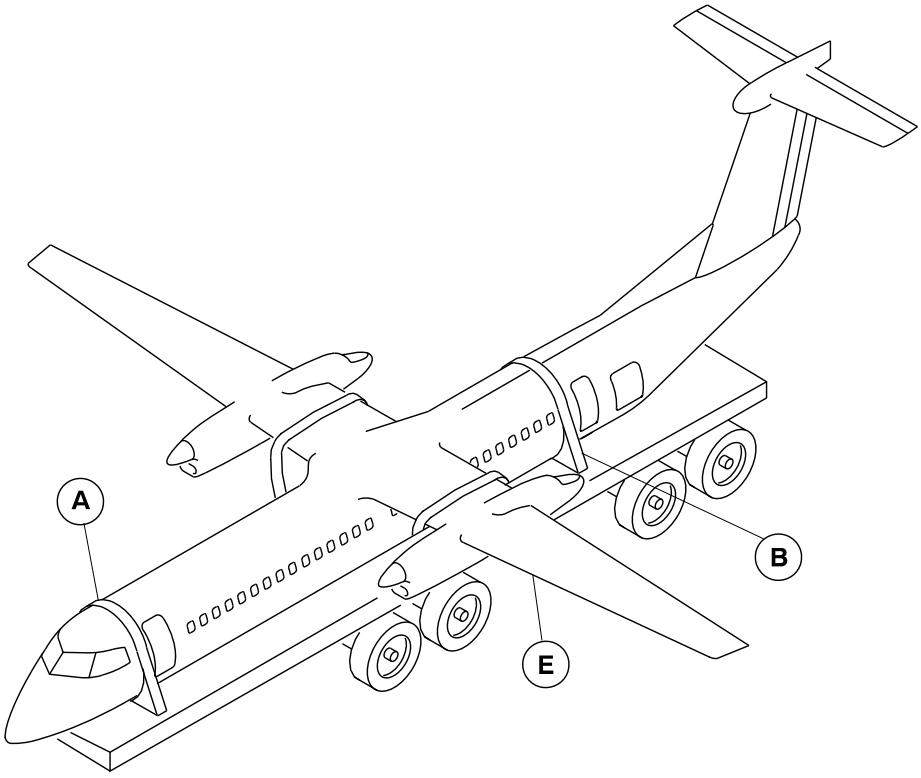
2. Methods and Equipment

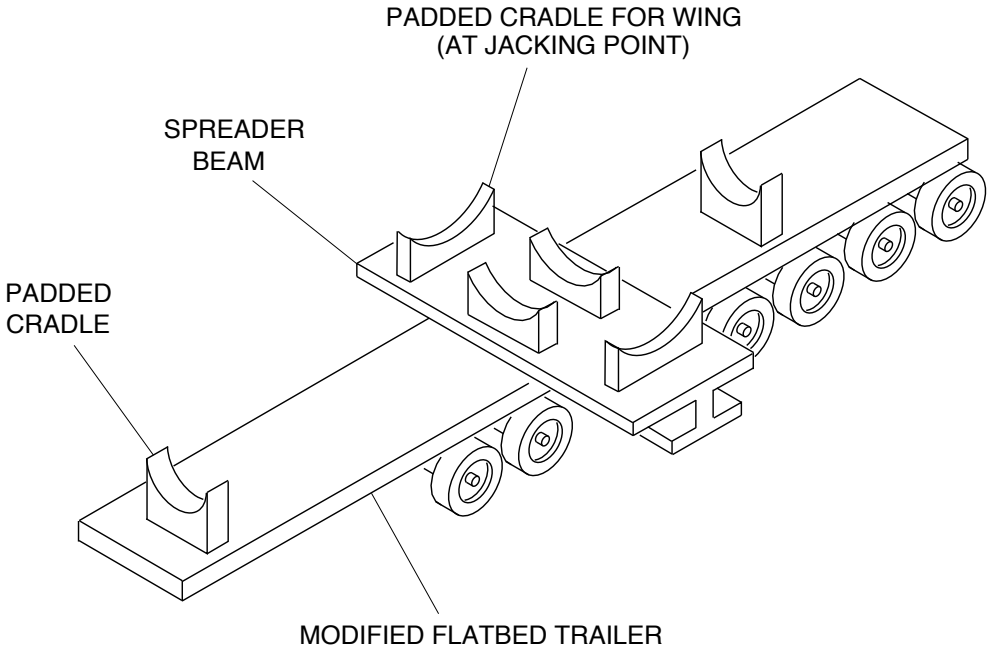
   A. Flatbed Trailers

      If all of the landing gear are unserviceable and mobile cranes can be used at the incident site, then the complete aircraft can be lifted onto specially constructed, padded cradles on a flatbed trailer. Lift the aircraft according to the methods described in 03–20–03, Lifting Aircraft with Mobile Crane. Make sure that all the cradles are well padded and that the aircraft is secured with wide fabric straps. Refer to Figure 04–1.

3. Dummy Landing Gear

   A. If only one of the landing gear is unserviceable, then it may be possible to remove it and install a complete fabricated replacement landing gear. Replacement gear are generally manufactured by an agency that specializes in aircraft recovery. This gear can be kept ready as part of the detailed Aircraft Recovery Plan (refer to 02–00–00, Survey and Preparation).





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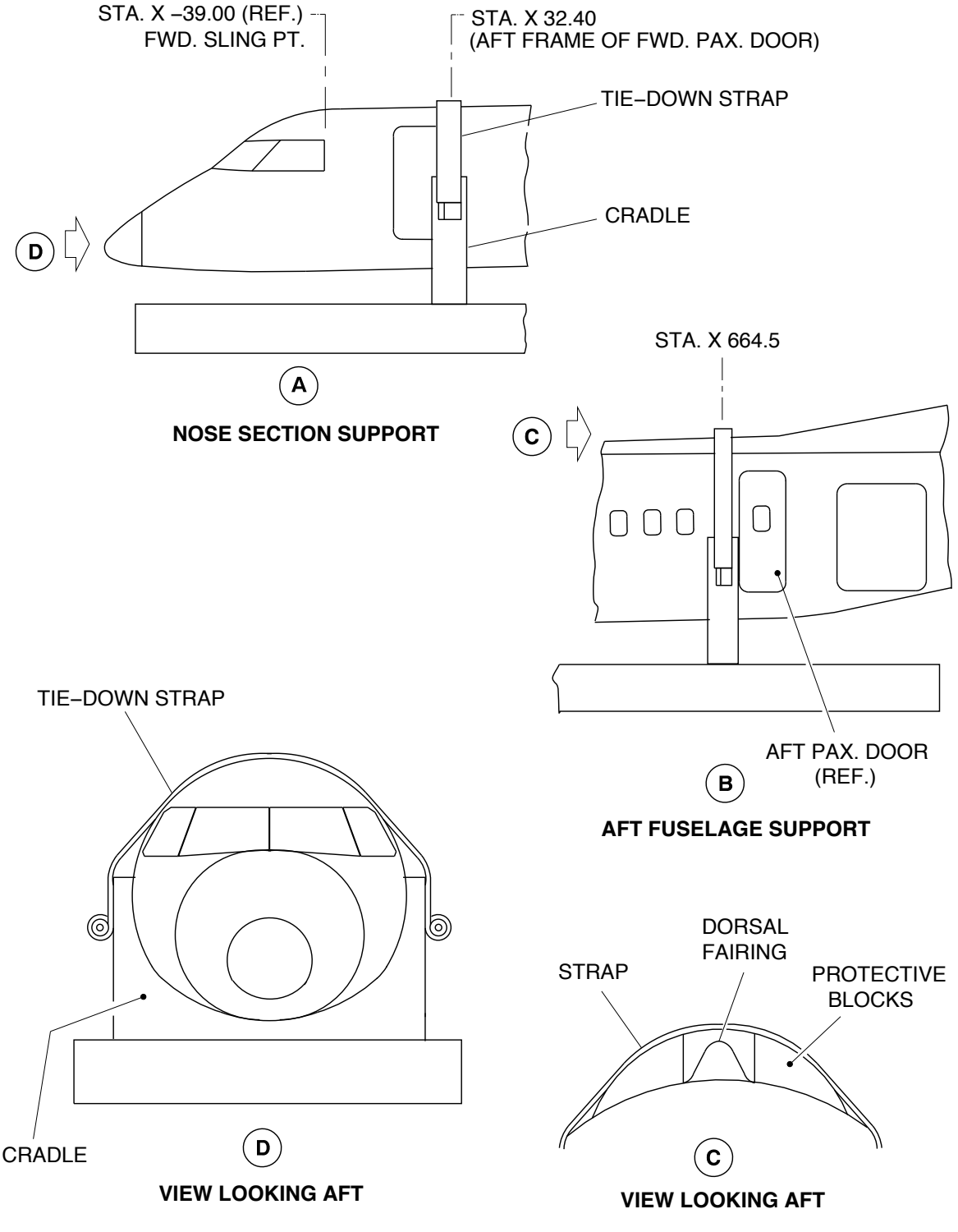
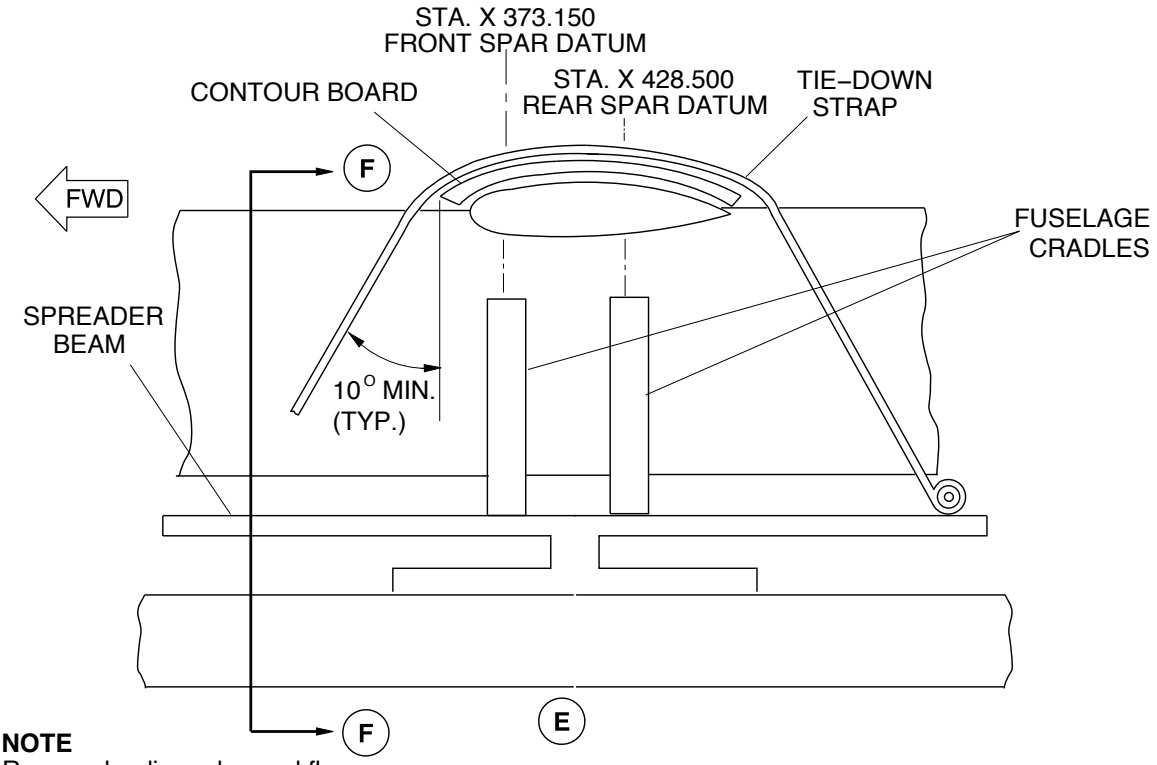
HOW TO MOVE DAMAGED AIRCRAFT ON FLATBED TRAILER (Sheet 1 of 3)

Figure 04 – 1



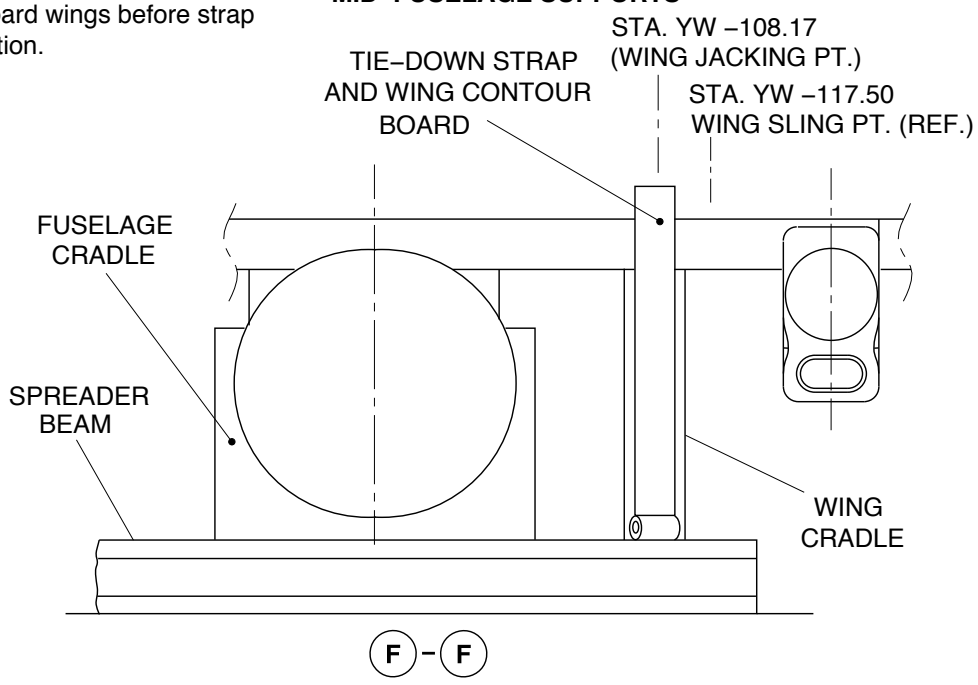
HOW TO MOVE DAMAGED AIRCRAFT ON FLATBED TRAILER (Sheet 2 of 3)

Figure 04 – 1



NOTE
Remove leading edge and flap on inboard wings before strap installation.

MID–FUSELAGE SUPPORTS



VIEW LOOKING AFT

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HOW TO MOVE DAMAGED AIRCRAFT ON FLATBED TRAILER (Sheet 3 of 3)

Figure 04 – 1

DE HAVILLAND AIRCRAFT
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AIRCRAFT RECOVERY MANUAL

CHAPTER 05

TOOLING AND EQUIPMENT

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AIRCRAFT RECOVERY MANUAL

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DE HAVILLAND AIRCRAFT
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AIRCRAFT RECOVERY MANUAL

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TOOLING AND EQUIPMENT

1. General

   A. This chapter provides information about the recovery tools and equipment applicable to the Dash–8, Series 400.

   B. The suggested materials, common tools and heavy equipment most likely used in aircraft recovery are listed in 05–10–00, General Recovery Equipment. This equipment is probably available from local sources.

   C. Special recovery tools and equipment for the Series 400 are listed in 05–20–00, Specialized Recovery Equipment.

   D. The International Airline Technical Pool (IATP) provides aircraft recovery services worldwide for its members (non members for a fee). At this time, the IATP does not list any recovery equipment specific to regional aircraft. The IATP believes that their standard recovery kits (suitable for a narrowbody aircraft) are more than adequate for regional aircraft. However, it should be noted that regional operators will be charged the same for the kit as operators of larger aircraft, such as the Boeing 737 or 757.

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GENERAL RECOVERY EQUIPMENT

1. General

   A. This section provides details about the materials, common tools and heavy equipment normally required during recovery operations and likely to be available from local sources.

   NOTE: It is important that arrangements for heavy equipment such as cranes be made in advance.

2. General Purpose Equipment

   A. Refer to the table that follows for suggested materials and equipment.

SUGGESTED RECOVERY MATERIALS AND EQUIPMENT

ITEM	DESCRIPTION	QTY.
1	BALLAST BAGS, 50 LB (25 KG) CAPACITY, MADE OF STRONG WOVEN FIBER (TO BE USED AS PLATFORMS TO LEVEL EQUIPMENT AND FOR STABILIZING AIRCRAFT)	40
2	STEEL PLATES 1/2 X 36 X 36 INCHES (1.27 X 91.44 X 91.44 CM) 1 X 48 X 96 INCHES (2.54 X 121.92 X 243.84 CM) (FOR GROUND REINFORCEMENT UNDER JACKS TO INCREASE BEARING AREA. SUBSURFACE PREPARATION MAY BE REQUIRED ON SOFT EARTH)	6 4
3	PLYWOOD SHEETS 1 X 48 X 96 INCHES (2.54 X 121.9 X 244 CM) (TO BE USED TO MOVE AIRCRAFT OR EQUIPMENT OVER SOFT EARTH)	20
4	CRIBBING TIMBERS 4 X 9 1/2 X 96 INCHES (10.16 X 24.13 X 244 CM) 4 X 9 1/2 X 126 INCHES (10.16 X 24.13 X 320 CM) (FOR PLATFORMS TO SUPPORT PNEUMATIC BAGS)	AS REQ'D.
5	STEEL SPIKES (NAILS)	200
6	GROUND REINFORCEMENT MATS, 150 – 300 FEET (50 – 100 M) LONG. MAY BE METAL, PLASTIC OR FIBERGLASS MATERIAL. (PROVIDES A ROLLING SURFACE OVER THE EARTH TO PERMIT AIRCRAFT TOWING)	AS REQ'D.
7	GROUND ANCHORS, 10 – 15 TON (9072 – 13,608 KG) (CAPACITY (FOR TETHERING)	10 – 20
8	CRUSHED ROCK OR GRAVEL (TO FILL AND LEVEL AREAS TO ALLOW EQUIPMENT ACCESS)	13 CUBIC YARDS (10 CUBIC M)
9	QUICK–SET CONCRETE (TO PROVIDE SUBSURFACE, PREPARATION TO SUPPORT JACKS, ETC.)	13 CUBIC YARDS (10 CUBIC M)

ITEM	DESCRIPTION	QTY.
10	DRAINAGE PUMP (SELF–POWERED TO REMOVE WATER), 50 – 100 GPM (2 INCH DIA. PUMP, PUMP POWER SUPPLY, 100 FT. OF 3 INCH DIA. SUCTION HOSE)	2
11	CRANE 10 TON (9072 KG) WORKING LOAD (OR 2 X 5 TON (4536 KG)) WITH A 20 FT. (6 M) REACH AND A 26 – 33 FT. (8–10 M) HOOK HEIGHT TO REMOVE ENGINE(S). THIS EQUIPMENT IS NOT REQUIRED IF THE NACELLE–MOUNTED ENGINE HOIST IS USED.	1
12	MULTIWHEEL FLATBED TRAILER, 35 TON (31,752 KG) TO MOVE AIRCRAFT IF LANDING GEAR IS UNUSABLE	1
13	STEEL CABLE ASSEMBLY, 1 INCH (25.4 MM) MIN. DIA., 100 – 150 FT. (30 – 50 M) WITH EYES AND SHEAR LINKS AT EACH END	1
14	ROPE 1–1/4 IN. (3.175 CM) DIAMETER 2 IN. (5.08 CM) DIAMETER	 500 FT. (152 M)
15	ELECTRIC GENERATOR, 5 KVA OR LARGER	2
16	FLOODLIGHTS WITH CABLES AND STANDS (FOR ILLUMINATION OF THE RECOVERY SITE)	6
17	MEGAPHONES WITH SELF–CONTAINED AMPLIFIERS (HAND–HELD RADIOS CAN ALSO BE USED)	3 OR AS REQ'D.
18	AREA ELEVATION MAP (FOR PLANNING METHODS OF TOWING)	1
19	WORKSHOP TRAILER OR TENT (FOR FIELD OFFICE, STORAGE SHELTER AND EATING FACILITIES)	1
20	GROUNDING ROD, 10 FT. (3.048 M) COPPER–COATED STEEL WITH A 60 FT. (18.29 M) CABLE AND CLIP (TO PROVIDE GROUNDING OF THE AIRCRAFT WHILE DEFUELING)	1
21	FUEL BOWSER OR DISPOSAL TANKS FOR DEFUELING	1
22	FENCING MATERIAL AND APPROPRIATE WARNING SIGNS (TO RESTRICT THE WORK AREA TO AUTHORIZED PERSONNEL)	AS REQ'D.
23	EARTH MOVING EQUIPMENT (BULLDOZER OR EQUIVALENT)	2
24	GASOLINE POWERED COMPRESSOR (TO OPERATE PNEUMATIC TOOLS)	1
25	AIR POWERED ROTARY METAL CUTTING SAW (FOR CLEARING OF WRECKAGE)	1
26	BOLT CUTTERS, SHEET METAL SHEARS	AS REQ'D.
27	BASIC TOOLS, PICKS, SHOVELS, CROWBARS, SLEDGE HAMMERS, HANDSAW, ETC.	AS REQ'D.
28	LADDERS (LIGHTWEIGHT EXTENSION TYPE) 20 FT. (6.09 M) 30 FT. (9.14 M)	 2 2
29	TOW TRACTOR	1
30	HEATER UNITS (FOR COLD WEATHER OPERATION)	2

ITEM	DESCRIPTION	QTY.
31	TARPAULINS, 8 X 12 FT. (2.44 X 3.66 M)	4
32	RAILROAD TIES	AS REQ'D.
33	FLASHLIGHTS (HAND–HELD)	AS REQ'D.
34	USED RUBBER TIRES	30
35	FELT PADDING (OR EQUIVALENT)	200 SQ. FT. (18.6 SQ. M)
36	MATTRESSES (HOUSEHOLD TYPE)	8

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SPECIALIZED RECOVERY EQUIPMENT

1. General

   A. This section provides a list of recovery equipment that is particular to the Dash–8, Series 400.

   NOTE: This list contains only those items that could realistically be used to efficiently remove the aircraft from the incident site to a maintenance area.

SPECIALIZED RECOVERY EQUIPMENT

DESCRIPTION	QTY. REQ'D.	PART NUMBER
ENGINE TRANSPORT STAND	2	PWC 55921
ENGINE SLING	1	PWC 55453
NACELLE–MOUNTED ENGINE HOIST	1	GSB 7100021 (TRONAIR)
PROPELLER SLING	1	DAPT 70–0021–01 (DOWTY)
PROPELLER NUT ADAPTER	1	DAPT 61–0015–00 (DOWTY)
TOWHEAD ASSEMBLY	1	GSB 0900004 (TRONAIR)
TOWBAR	1	GSB 0900005 (TRONAIR)
TOW SLING KIT	1	GSB 0910008 (DE HAVILLAND AIRCRAFT OF CANADA LIMITED)

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SPECIALIZED TRANSPORTABLE EQUIPMENT

1. Air Transportable Equipment

   A. Several airlines have joined together to form the International Airline Technical Pool (IATP). Its purpose is to make some essential aircraft recovery equipment available for shipment to any place in the world at short notice. This organization has identified the minimum equipment required on most aircraft recovery operations. In kit form, these items are air transportable and are stored in strategic locations around the world for quick delivery.

   B. This equipment is owned by the member airlines and is shared through the organization. Non–member airlines can also avail themselves of the equipment on a rental fee basis.

   C. These kits are maintained, kept in a state of readiness and ready for shipment by the custodian airline in each location.

   D. Similar equipment may be kept in some military installations.

   NOTE: For further information on the IATP, contact them directly on the Internet at: https://www.iatpool.com

2. Air Transportable Recovery Kit

   A. The recovery kit contains the necessary equipment to raise an aircraft which has made a landing with one or more of its landing gear retracted and/or may have run off the runway.

   B. A typical kit consists of the following:

AIR TRANSPORTABLE RECOVERY KIT

DESCRIPTION	QTY.
12 ton (1220 Kg) pneumatic lift bags and repair kit	8
Portable air compressor, 50 CFM (1415 liters per min.) 1 to 4 psi (.28 Kg/sq. cm.), manifold and hoses	3
Mattresses (or similar material for padding)	8
Earth screw anchors	10
Plywood, 1/4 x 48 x 96 inches (0.635 x 121.92 x 243.84 cm)	24 Shts
1 inch (2.54 cm) diameter rope	500 Ft
Come–along or ratchet hoist, 2–ton (2032 Kg) capacity	4
Short–stroke aircraft axle or screw type jacks – 30 to 50 ton (30482 Kg to 50803 Kg) capacity	3
Steel plates 1/2 x 24 x 24 inch (1.27 x 60.96 x 60.96 cm)	6
light alloy access ladder, 15 foot (4.572 m)	1
Electric power unit for emergency lighting – 5 Kw or larger	1
Floodlights, lamp stands, leads and junction boxes and 50 foot (15.24 m) extension	4

Plus other specialized equipment the custodian airline may provide.

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CHAPTER 06

PREVIOUS AIRCRAFT RECOVERY EXPERIENCE

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PREVIOUS AIRCRAFT RECOVERY

1. General

   A. This chapter provides previous recovery experiences with similar type of aircraft (the Dash–8, Series 100/200/300). The incidents and the recovery operations described are typical of the situations that could occur with the Series 400.

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AIRCRAFT INCIDENTS

1. General

   A. The descriptions that follow are typical aircraft incidents and the recovery operations that have occurred.

2. Right–Hand Main–Gear Retracted During Take–Off Roll

   A. As the aircraft was rolling down the runway at the start of the take–off, the pilot observed a red light come on the landing gear panel. At the same time the aircraft settled in a right wing down attitude and the belly struck the runway. The right–hand main gear retracted and the aircraft pivoted around the other two gear. The right–hand outboard wheel of the retracted gear then became jammed against the aft wheel door and began to skid along the runway. This swung the aircraft further to the right. The right wing dropped and made contact with the ground at the wing tip and propeller. The aircraft slid to a stop at an approximate 40 degree angle to the right of the runway center line.

      The damage to the wing was limited to minor distortion of the wing tip.

      There was no injuries and also no fire.

   B. The removal operation started on the next day with airbags, once the damaged propeller was removed. Further damage to the aircraft occurred during recovery. The failure of an airbag that was supporting the right wing allowed the wing to fall off a jack and onto the airbag support platform. Damage occurred to the lower surface of the wing box, between the nacelle and the fuselage, to the inboard leading edge and to the outer end of the flap.

3. Right–Hand Main–Gear Retracted as Aircraft Taxied From Ramp

   A. The aircraft had just straightened up from a right–hand turn when the nose wheel crossed over a drainage grate that was built into the tarmac. Shortly after the nose crossed the grate, the right–hand main gear inadvertently retracted, which caused the right–hand propeller (number two) and right wing tip to strike the surface of the tarmac. The aircraft settled on the right–hand wing tip, the right undercarriage doors and nacelle, a single blade from the number two propeller, and the rear fuselage.

      The passengers and crew were evacuated from the aircraft without any injuries. There was no fire.

   B. The aircraft was lifted the next morning with aircraft jacks and a wide–body aircraft cargo lift. The landing gear was lowered by means of the emergency hydraulic system and the ground lock pin installed. The aircraft was then moved approximately one–quarter mile from the ramp area and jacked again for inspections.

4. Aircraft Executed Very Heavy Landing on Runway Threshold, Left Main Landing–Gear Pivot Pin Sheared.

A. During the landing the left–hand main gear collapsed and the aircraft slid off the runway, coming to a stop on the grass between parallel runways. The left–hand propeller (number one) contacted the surface of the runway and one blade was shed. Damaged areas of the aircraft included the belly, nacelle, fuselage side panels, number one engine and propeller.

B. Preliminary reports indicated that the yoke pivot pin for the landing gear shock strut sheared on touch–down because of the heavy landing on the left–hand main gear.

C. Shortly after the touch–down, the crew became aware the left main landing–gear had begun to collapse. The aircraft continued down the runway veering slightly to the left, rotating 90 degrees in a southerly direction.

There were no injuries and the crew exited by the airstair door. There was no fire.

D. The runway was closed for approximately four hours. The aircraft incurred more damage during recovery. A lifting sling was placed around the left wing outboard of the nacelle and a crane was used to raise the aircraft. Both the leading edge D nose and the trailing edge flap shroud sustained damage.

5. Aircraft Landed with Retracted Nose Landing Gear

A. The aircraft landed with the nose gear retracted. Cockpit indication reported all gear were down and locked. The absence of the nose gear only became evident after touch–down. The nose was held clear of the ground as long as possible to minimize structural damage.

B. As the nose was lowered at a speed of approximately 40 to 45 knots (74.13 to 83.4 km/h) the pilot heard scraping noises coming from below the flight compartment and instructed the first officer to hold the aircraft's nose clear of the runway for as long as possible. The aircraft slowed with the lower surface of the nose gear doors in contact with the runway and then slid in a straight line to a stop.

Passengers and crew evacuated the aircraft through the main airstair door, which still cleared the ground. There were no injuries and also no fire.

C. The aircraft was recovered from the runway using a crane and a sling. The nose was lifted and the nose landing gear was extended using the alternate extension system to lock the gear down (ground lock pins were installed in all landing gear) prior to its relocation to the maintenance facility.

D. Impact forces were concurrent with those felt during a normal landing and as such caused no major airframe, system or structural damage.