INVESTIGATION AND AERODYNAMIC SMOOTHNESS - REPAIR

1. Aerodynamic Smoothness

A. Modern aircraft specifications require that the aircraft exterior surfaces be of extremely smooth construction to obtain design performance. The structural repair person must keep this in mind when making repairs or changes. Figure 201 shows the areas that are most critical aerodynamically, however, smoothness of the entire aircraft surface area is a critical requirement from the performance standpoint. The seriousness of this condition is proportional to the airflow disturbance created. For classification of zone and fastener smoothness requirements (Refer to 51-40-04.).

B. The prime considerations of aerodynamic smoothness are parasite drag (drag caused by skin friction and nonlifting surfaces of an aircraft) and the aerodynamic load distribution on the surface. Any repair or change that increases parasite drag will reduce the top speed of the aircraft. Also range will be reduced, since more power and thus more fuel, is required to maintain cruising speed.

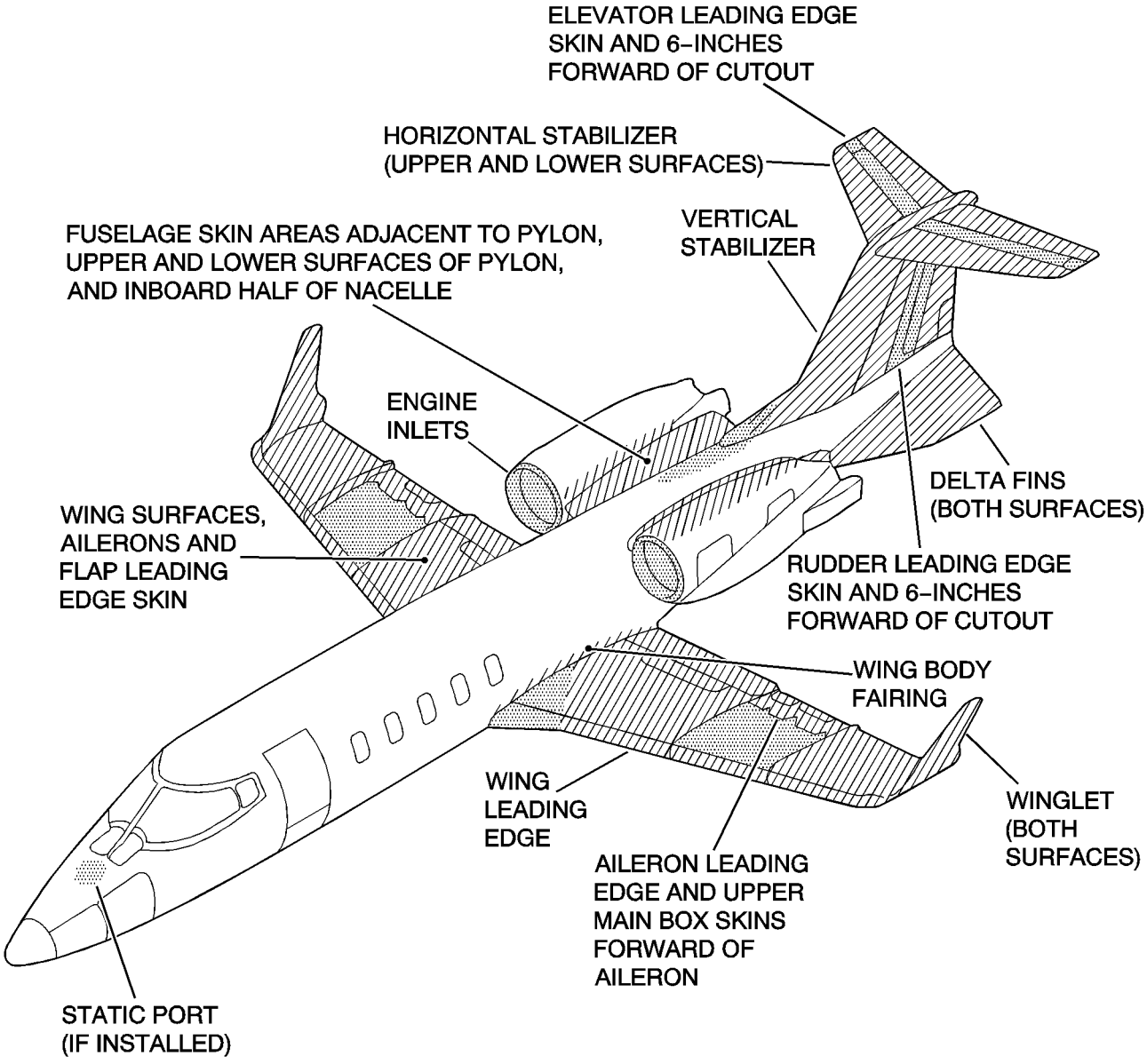
C. Any change that disturbs the smooth flow of air over a critical surface will change the load on that surface, as well as increase the drag.

D. Any change in the airflow around the control surfaces is critical, since the control effectiveness may be affected.

E. Another problem that may arise is buffeting. Buffeting can be caused by airflow separation around an abrupt change, such as a nonflush patch, in the mold line.

F. Temporary (Nonflush) repairs are permitted in some areas designated as critical. (See Figure 201.) Temporary repairs must be replaced by permanent repairs at the earliest possible time.

G. Paste-type fillers that cure to a hard-rubber-like consistency are used to fill skin and door gaps and to blend overlapping surfaces. They are also used in similar conditions to achieve a satisfactory degree of aerodynamic smoothness. (Refer to 51-70-01.)



CRITICAL AREAS

Temporary (nonflush) repairs are not permitted in these areas.

Flight characteristics could be affected by temporary (nonflush) repairs in these areas. If temporary repairs are made, a review by Learjet Customer Service Engineering is mandatory and a flight test may be required.

Temporary (nonflush) repairs are permitted in these areas.

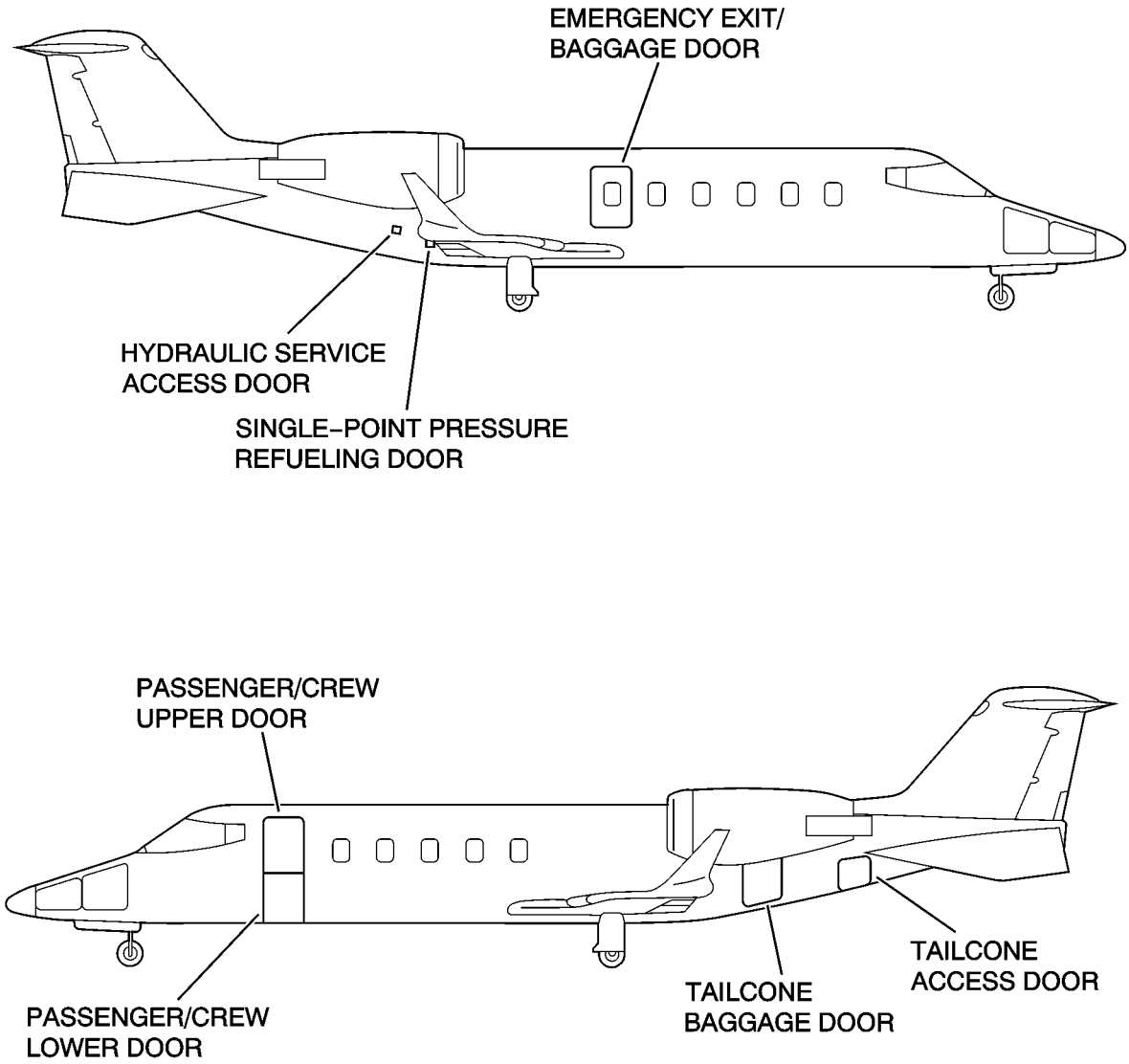
S60–511000–201–01

Aerodynamically Critical Areas
Figure 201

ACCESS DOORS AND PANELS - STRUCTURAL IDENTIFICATION

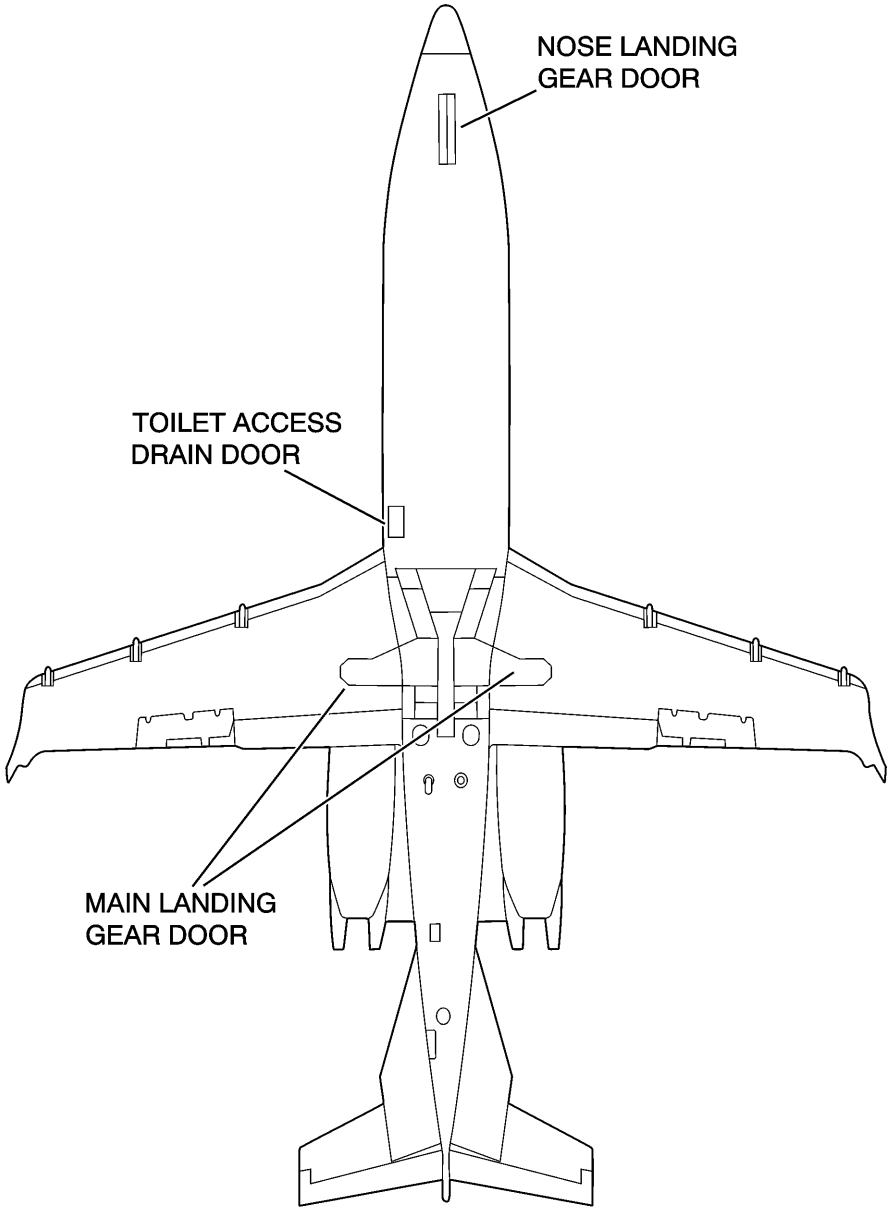
1. Access Doors and Panels Description

A. For access doors and panels locations (See Figure 1.).



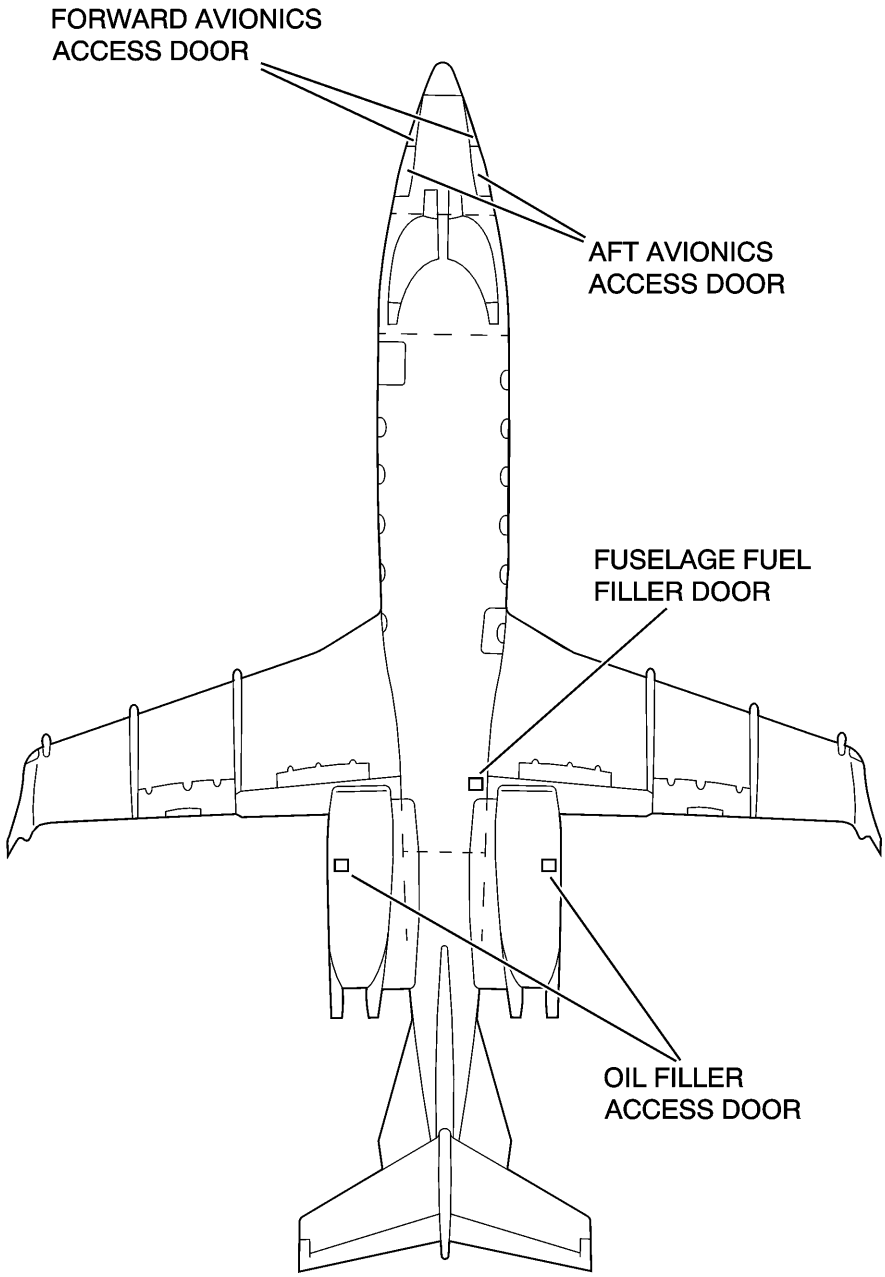
S60–510003–001–01

Access Doors and Panels - Fuselage, Empennage & Stabilizers
Figure 1 (Sheet 1 of 5)



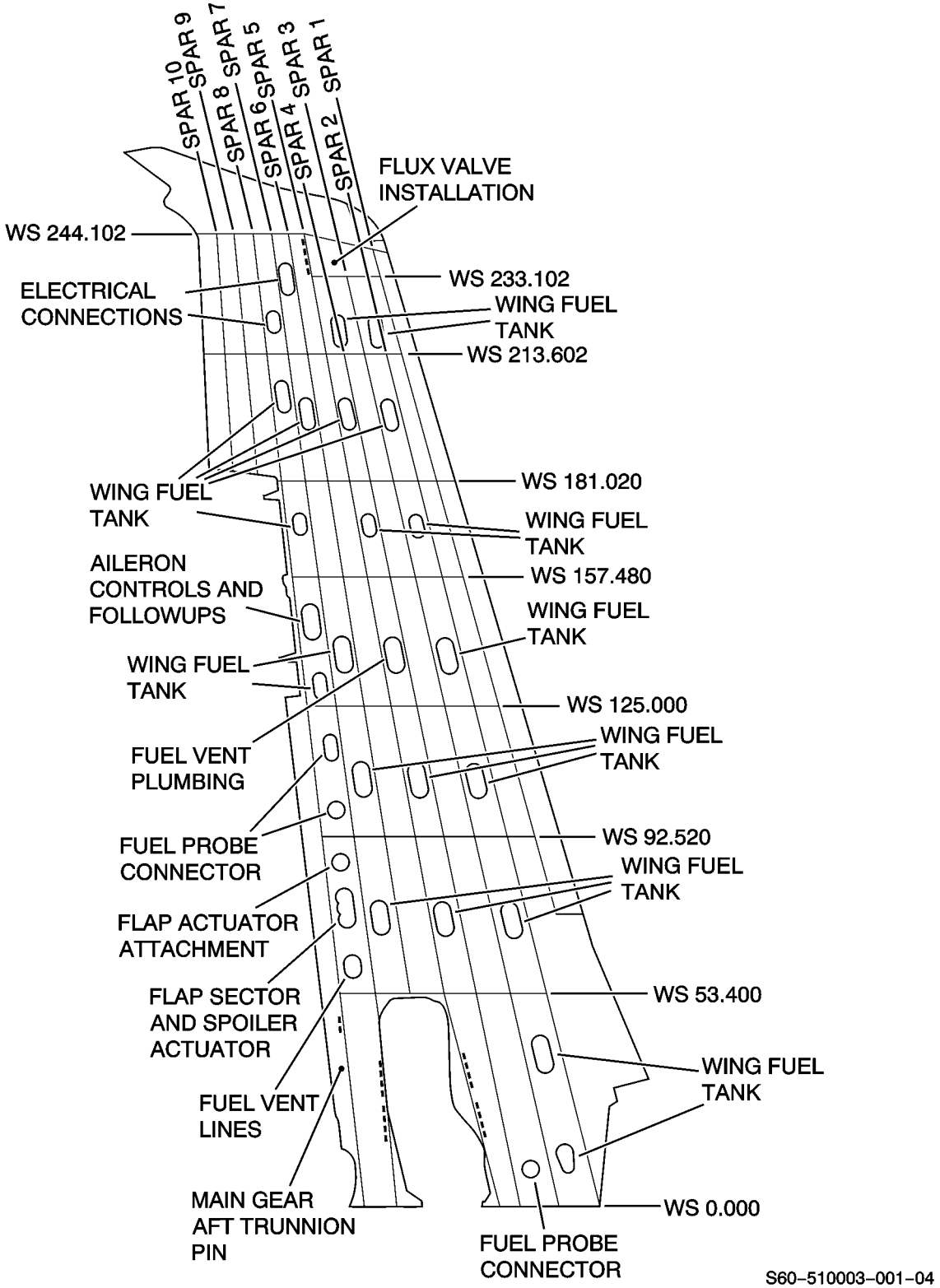
S60–510003–001–02

Access Doors and Panels - Fuselage, Empennage & Stabilizers
Figure 1 (Sheet 2 of 5)

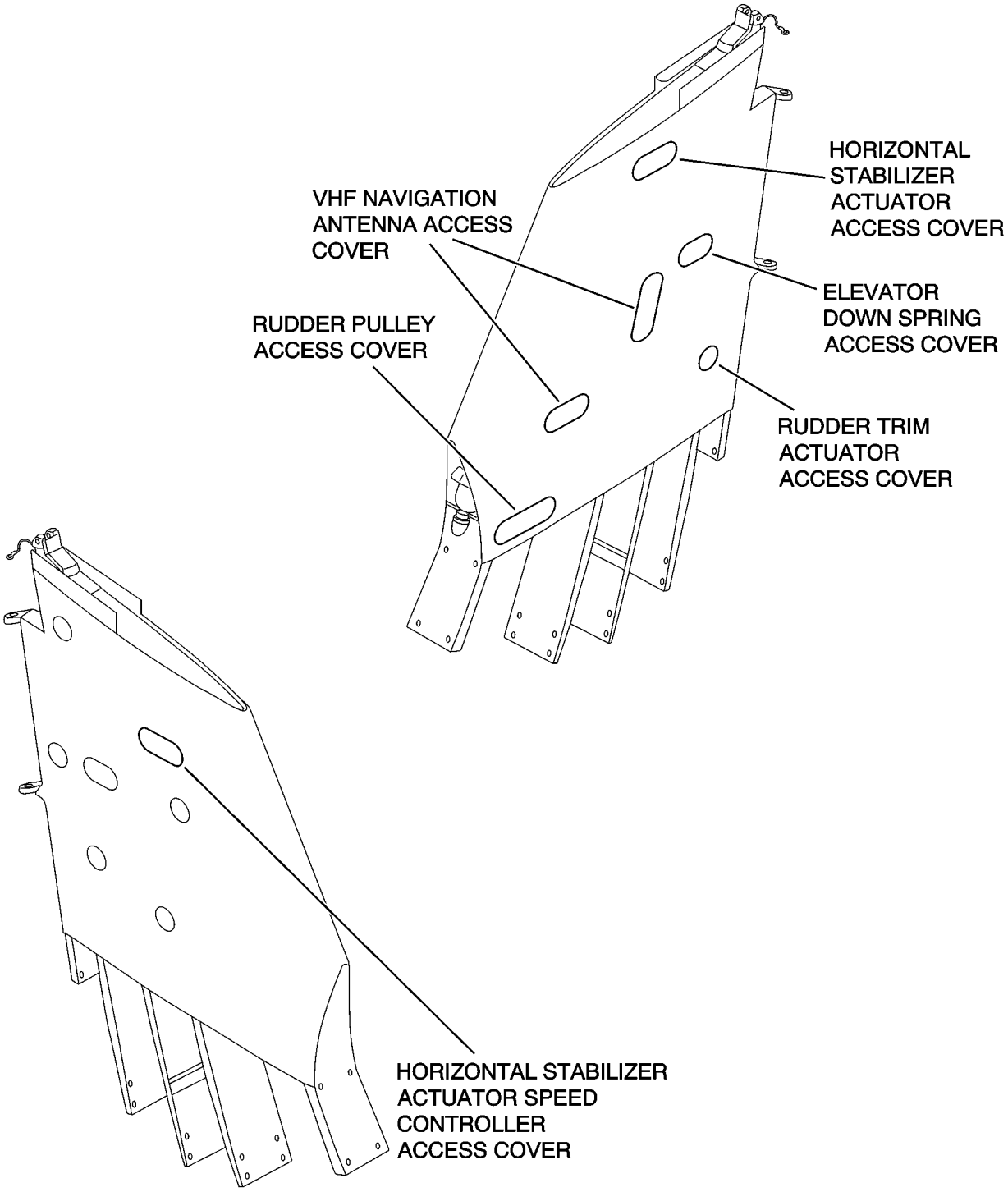


S60–510003–001–03

Access Doors and Panels - Fuselage, Empennage & Stabilizers
Figure 1 (Sheet 3 of 5)



Access Doors and Panels - Wing Access Covers
Figure 1 (Sheet 4 of 5)



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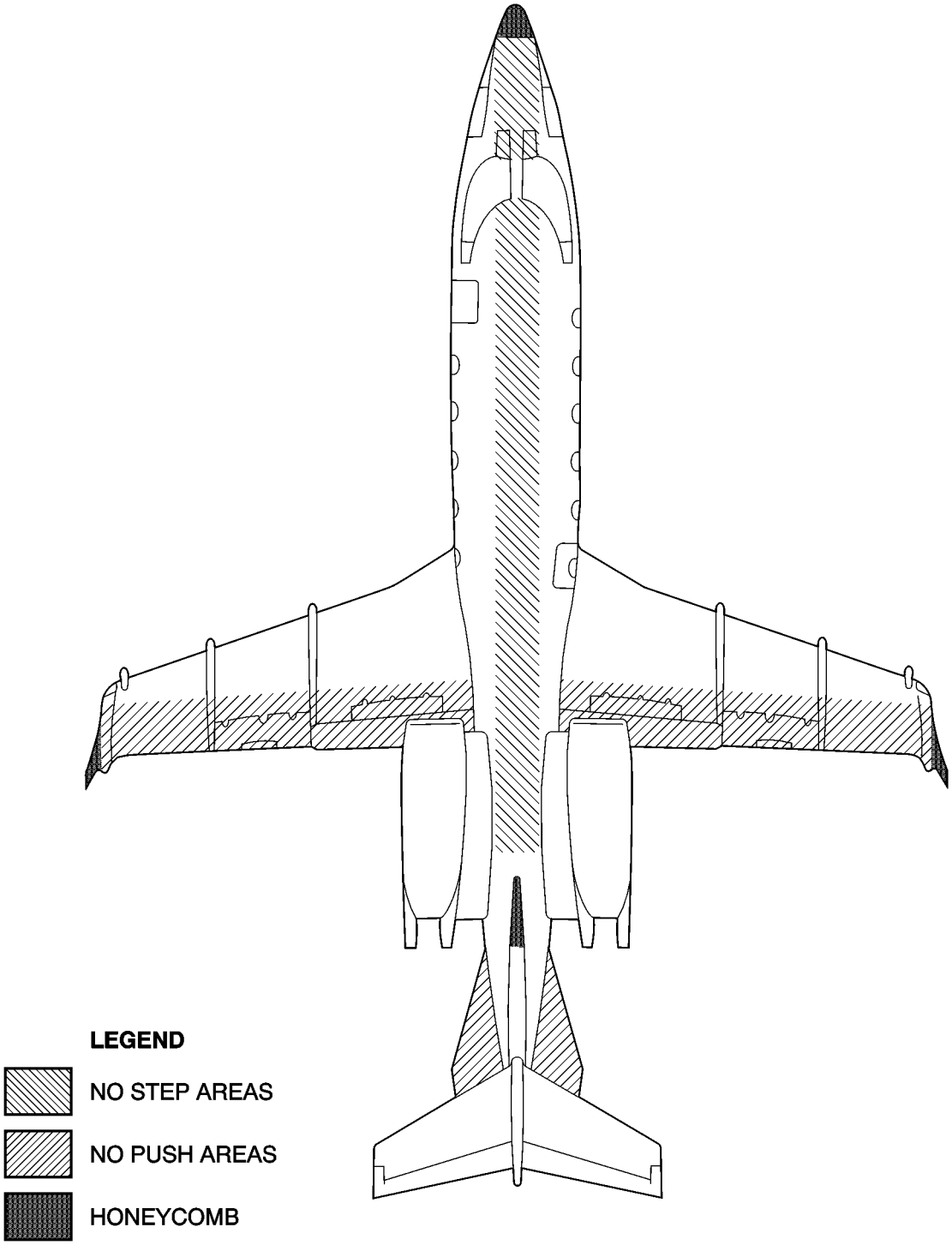
Access Doors and Panels - Stabilizer
Figure 1 (Sheet 5 of 5)

RESTRICTED AREAS - STRUCTURAL IDENTIFICATION

1. Restricted Areas Description

A. For restricted area locations (See Figure 1.).



S60-510002-001-01

Restricted Area Diagram
Figure 1

AIRCRAFT MEASUREMENT SYSTEM - STRUCTURAL IDENTIFICATION

1. Aircraft Measurement System Description

A. This section presents the aircraft dimensions, control surface areas, water lines, buttock lines, and station designations.

B. The dimensions of the aircraft and the areas of the control surfaces are carried to the nearest full inch. These dimensions are for reference only and are not for inspection purposes.

C. The aircraft is divided into reference points along three axes. The reference points are measured in inches. These reference points provide a means of quickly identifying the location of a bulkhead, component, etc.
   (1) Fuselage station, water line, and buttock line measurements used in this manual are rounded to the nearest inch.

D. All reference points may be converted to metric measurement (millimeters) by multiplying the reference point (in inches) by 25.4.

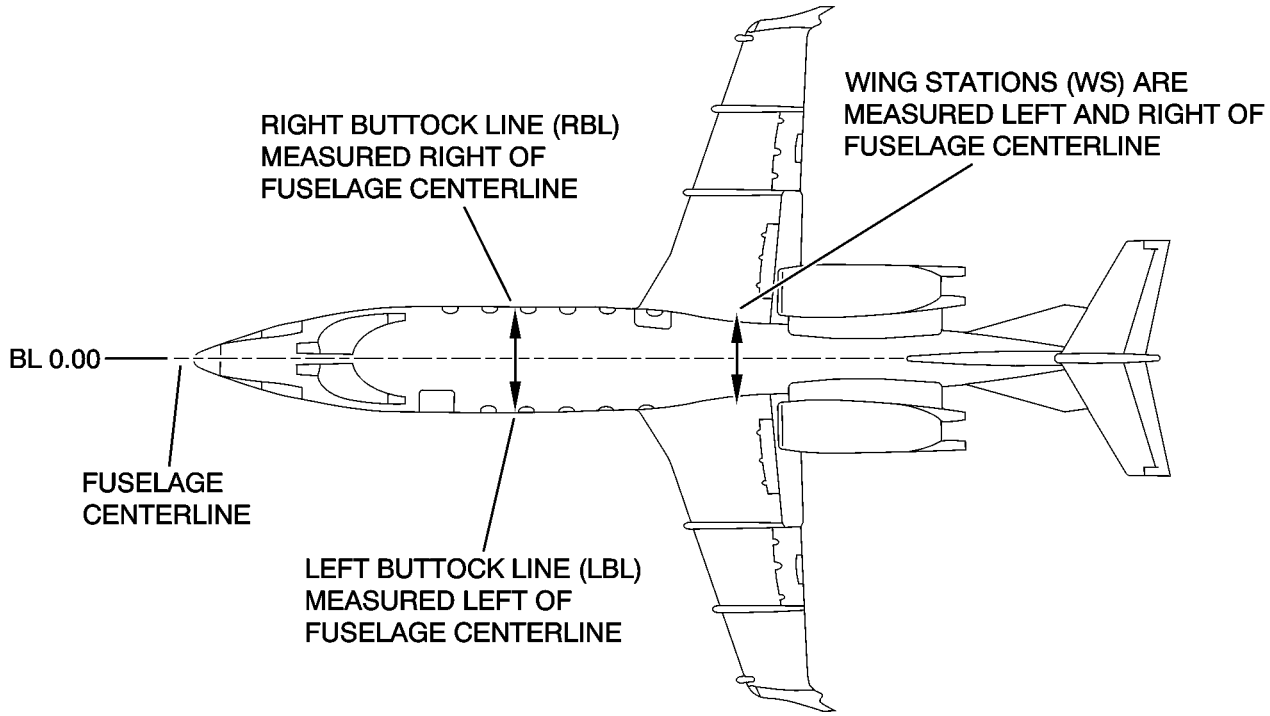
E. The following terms are used for reference points.

FS	Fuselage station is a vertical reference plane measured horizontally from a vertical reference line on or near the nose of the aircraft.
WL	Water line is a horizontal reference plane measured vertically from the horizontal reference line of the aircraft.
BL	Buttock line is a vertical reference plane measured horizontally from the aircraft centerline. Right or left is added to indicate the direction from aircraft centerline (RBL & LBL).
WS	Wing station is a vertical reference plane measured horizontally from the wing centerline and perpendicularly along wing datum.
CL	Centerline is the center reference point of the aircraft or component.
NAC STA NAC WL NAC BL	Reference points that apply to the engine nacelle.
WINGLET STA	Reference points that apply to the winglet.
OML	Outside Mold line is that line corresponding to the outside contour of a fuselage skin or formed part.
IML	Inside Mold line is that line corresponding to the inside contour of a fuselage skin or formed part.

F. The following charts and figures give the dimensions of the aircraft and the areas of the control surfaces. These dimensions are for reference only and are not meant for inspection purposes.

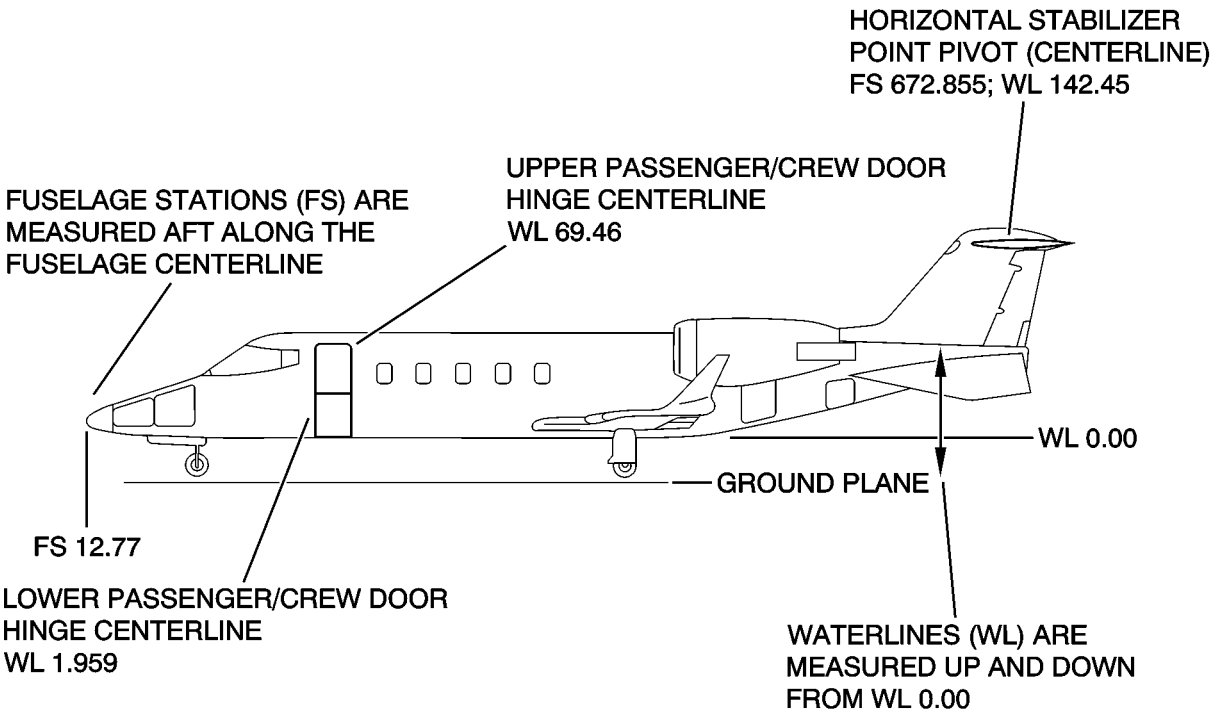
Aircraft Measurement System - Dimensions

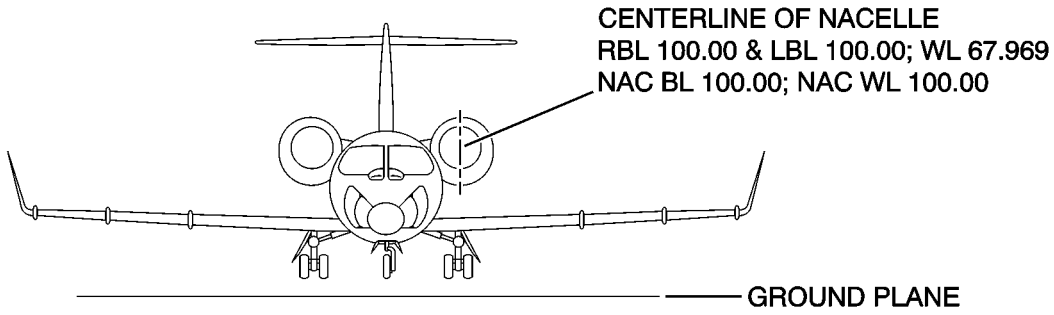
SUBJECT	DIMENSIONS
Aircraft	
Span (overall)	43 ft 10 in [13.36 m]
Length (overall)	58 ft 8.5 in [17.89 m]
Height (overall)	14 ft 7 in [4.44 m]
Wing	
Root Chord (@ fuselage centerline)	9 ft 0 in [2.74 m]
Chord (@ WS 181)	5 ft 1 in [1.55 m]
Dihedral	2° 30’
Sweepback (c/4)	13°
Incidence	+1°
Aileron	
Span (nominal)	4 ft 9 in [1.45 m]
Trim Tap Span (LH only)	1 ft 2.75 in [0.37 m]
Balance Tap Span (RH & LH)	1 ft 9 in [0.53 m]
Flaps	
Type	Single Slotted
Span (nominal)	8 ft 9.25 in [2.67 m]
Root Chord	2 ft 3 in [0.69 m]
Horizontal Stabilizer	
Span	14 ft 8 in [4.47 m]
Sweepback (of 25% chord)	25°
Dihedral	0°
Elevators	
Span (per side)	7 ft 4 in [2.24 m]
Vertical Stabilizer	
Sweepback (@ leading edge)	35° 36’
Fuselage	
Fuselage Constant Section	
Outside diameter	6 ft 5 in [1.96 m]
Inside diameter	6 ft 0 in [1.83 m]
Length of passenger area	14 ft 8 in [4.47 m]
Height (floor to ceiling)	5 ft 8 in [1.73 m]



S60-510001-001-01

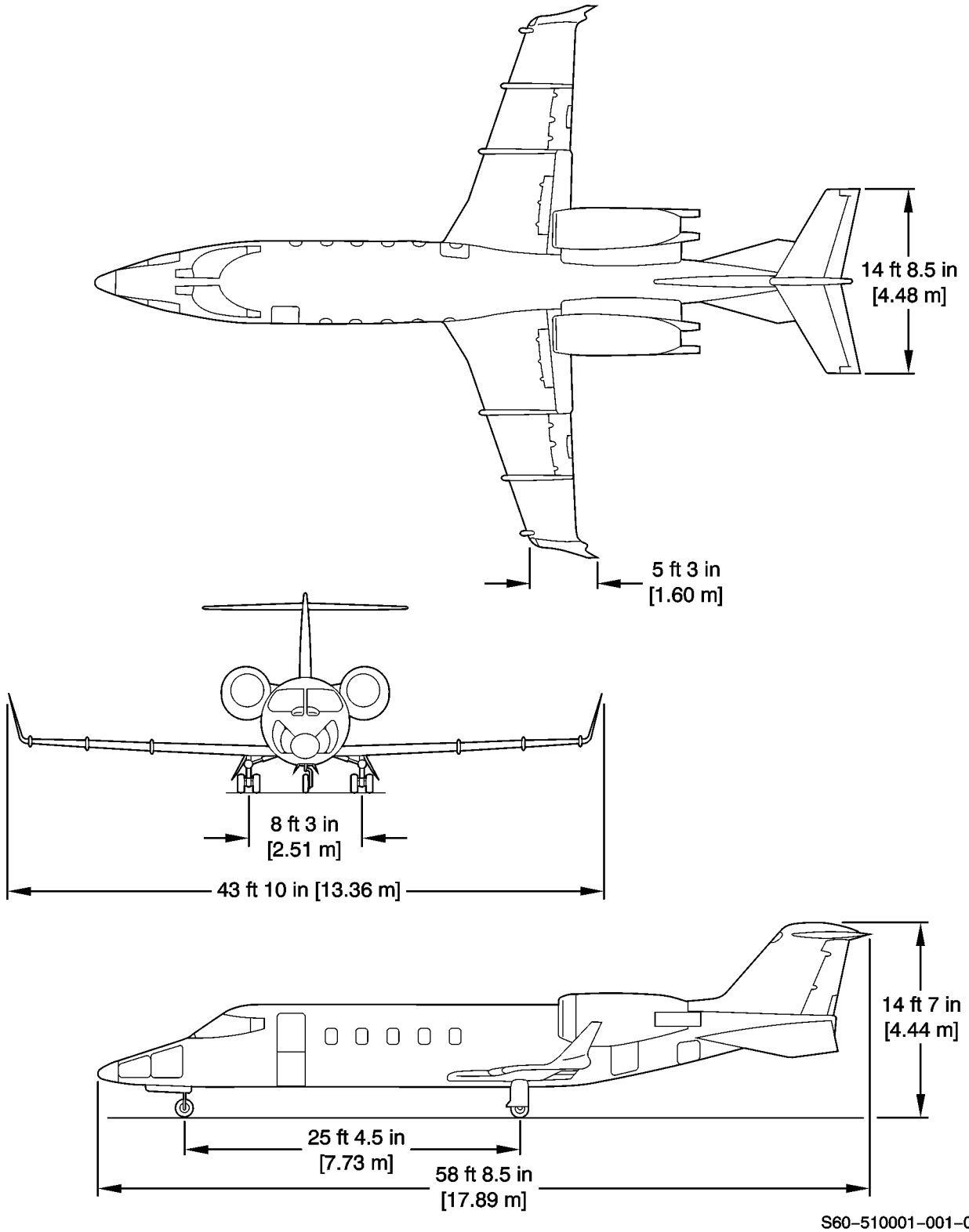
Aircraft Measurement System - Reference Points
Figure 1 (Sheet 1 of 12)





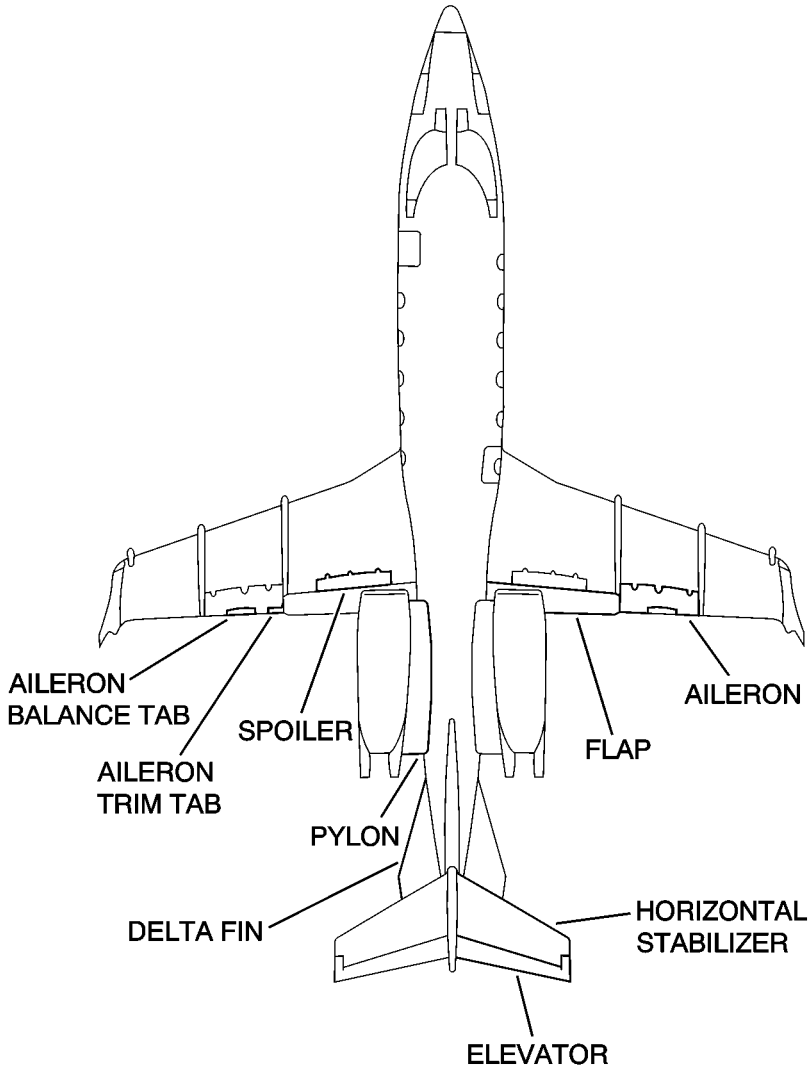
S60–510001–001–02

Aircraft Measurement System - Reference Points
Figure 1 (Sheet 2 of 12)



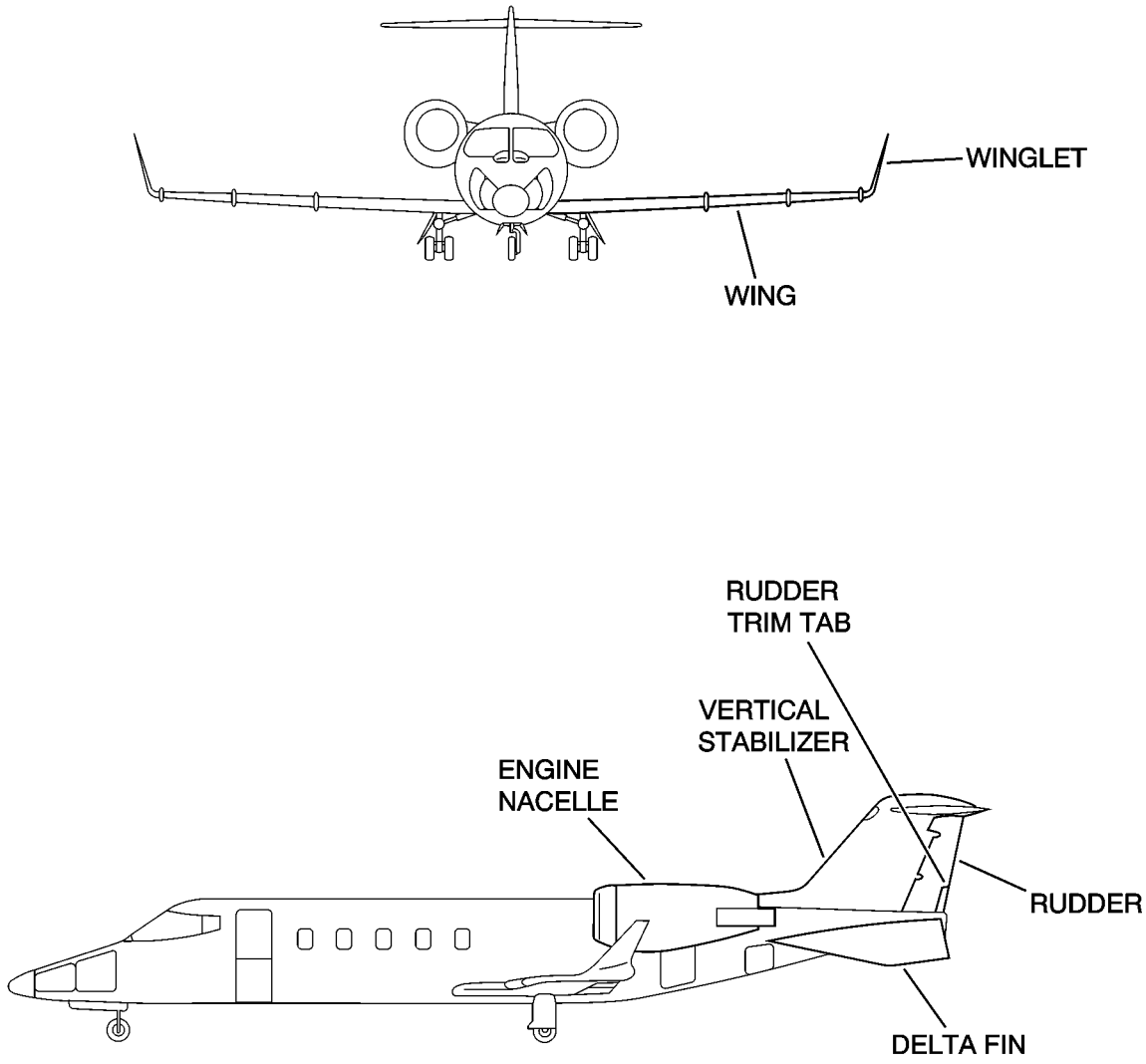
Aircraft Measurement System - Dimensions
Figure 1 (Sheet 3 of 12)

Miscellaneous Areas	
Wing (WS 0.00 to WS 181.10)	264.51 ft² [24.574 m²]
Winglet	12.00 ft² [1.115 m²]
Aileron (per side)	5.854 ft² [0.544 m²]
Flaps (total)	39.49 ft² [3.669 m²]
Horizontal Stabilizer (total)	54.00 ft² [5.017 m²]
Elevator	14.13 ft² [1.313 m²]
Vertical Stabilizer (total)	51.53 ft² [4.788 m²]
Rudder	9.86 ft² [0.916 m²]
Delta Fin	44.45 ft² [4.129 m²]



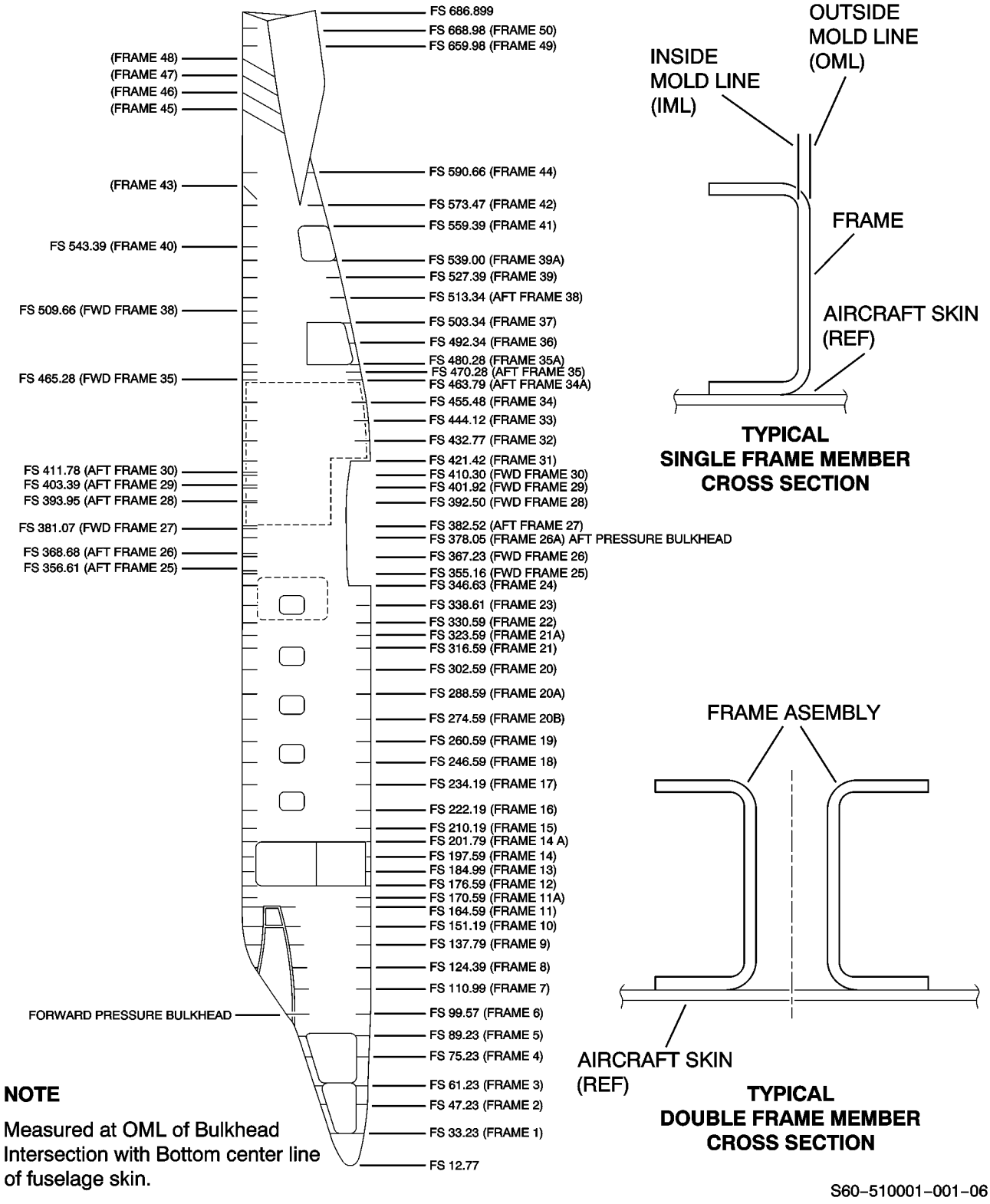
S60–510001–001–04

Aircraft Measurement System - Dimensions
Figure 1 (Sheet 4 of 12)

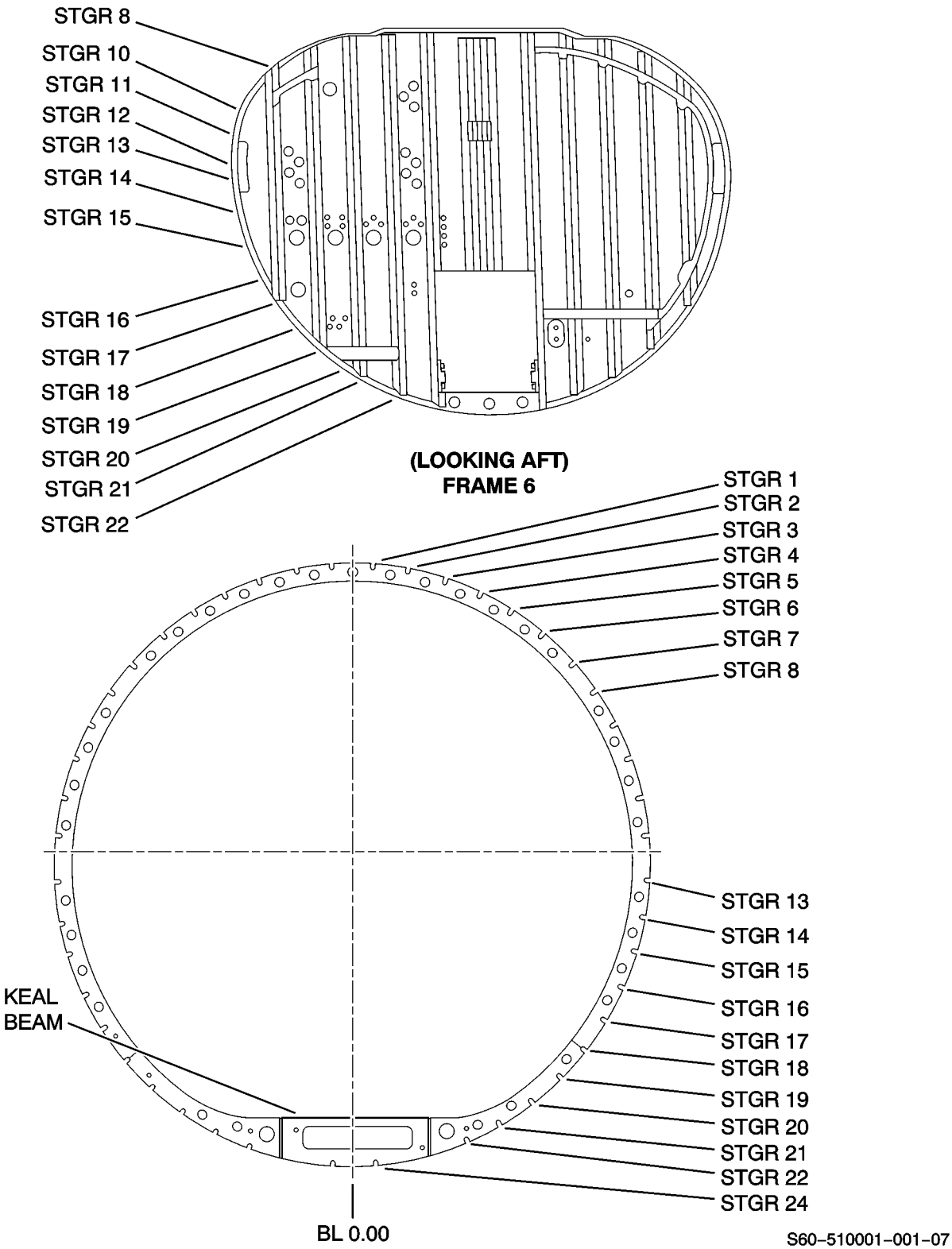


S60–510001–001–05

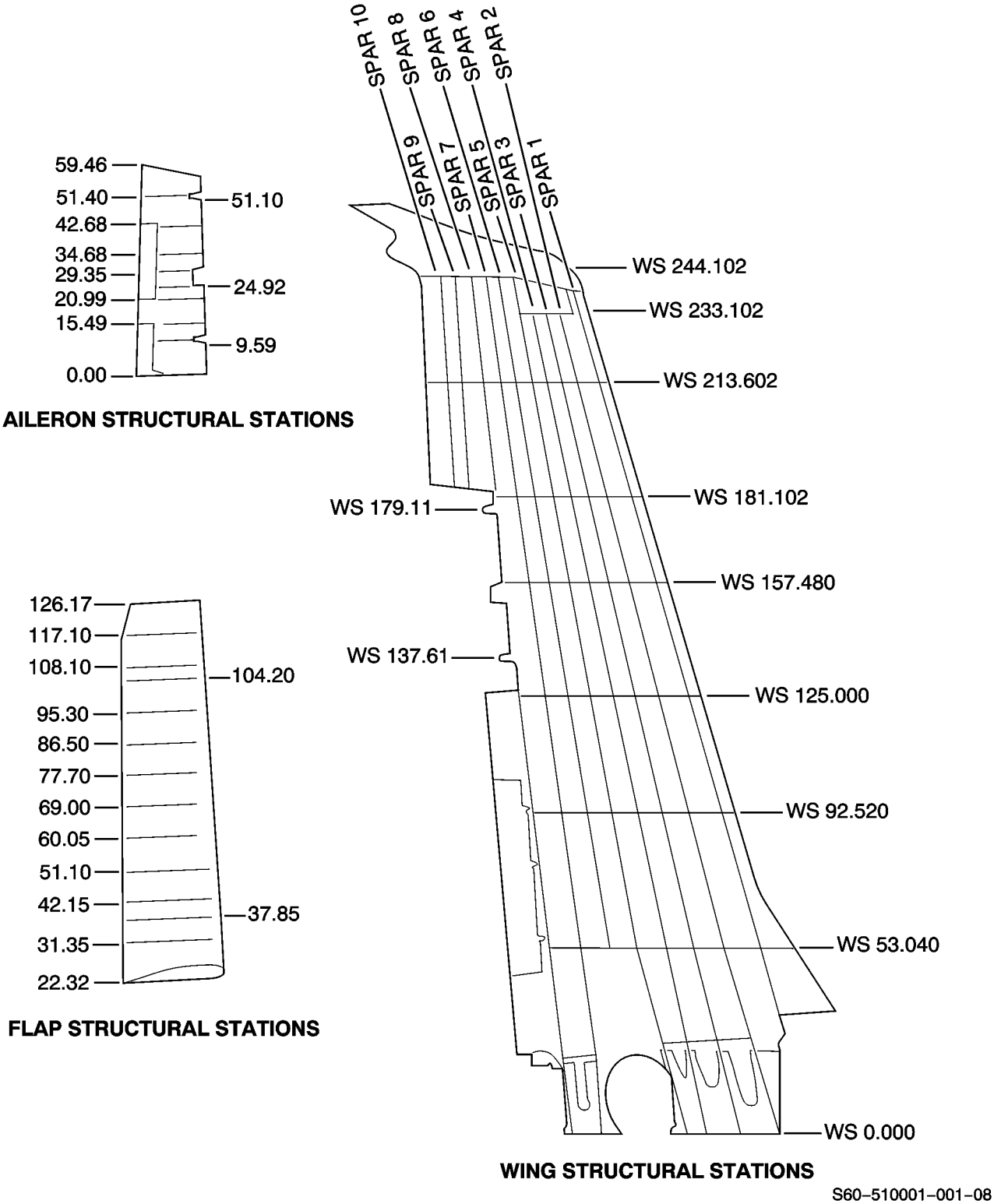
Aircraft Measurement System - Reference Points
Figure 1 (Sheet 5 of 12)



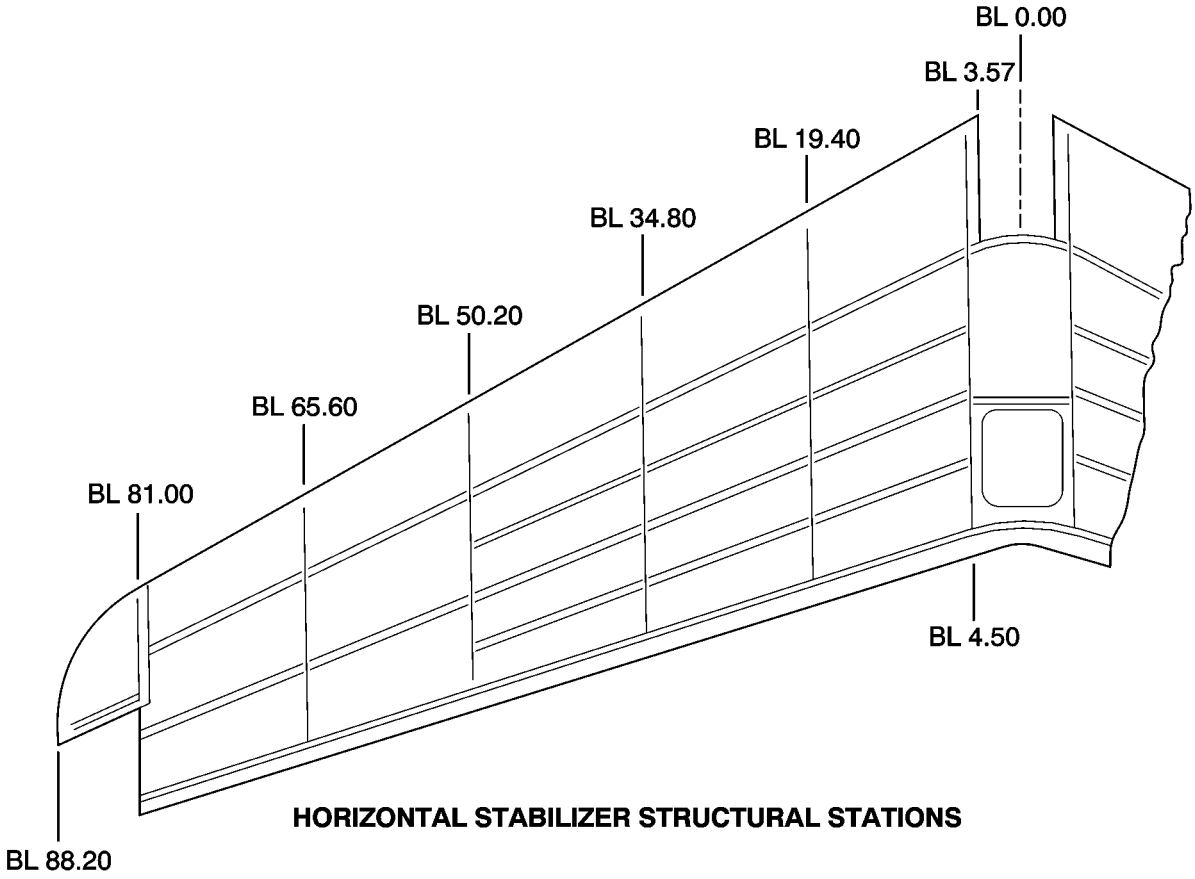
Aircraft Measurement System - Fuselage Stations
Figure 1 (Sheet 6 of 12)

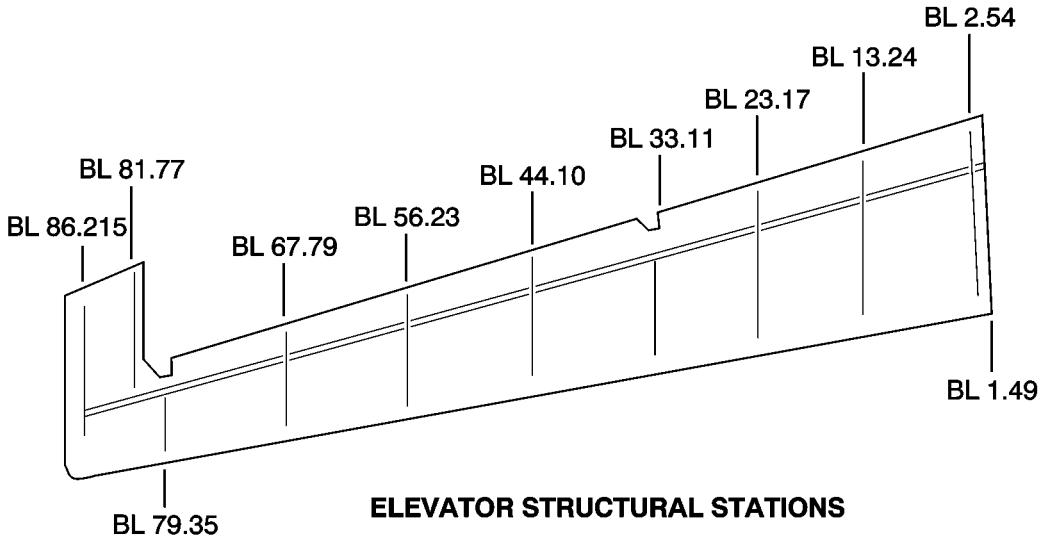


Aircraft Measurement System - Fuselage Assembly
Figure 1 (Sheet 7 of 12)



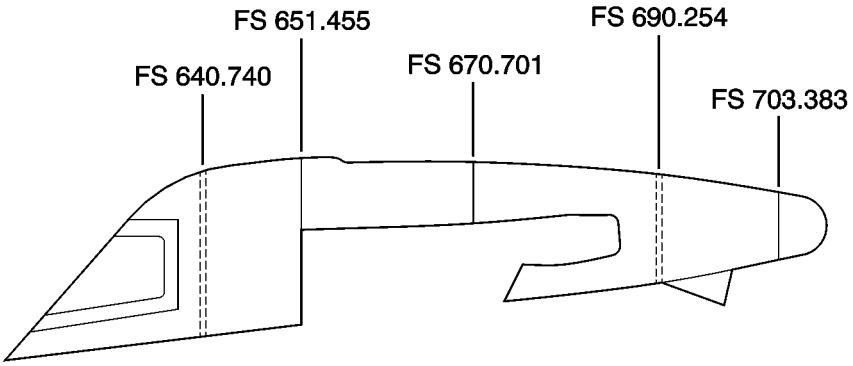
Aircraft Measurement System - Wing, Aileron and Flap Structural Stations
Figure 1 (Sheet 8 of 12)



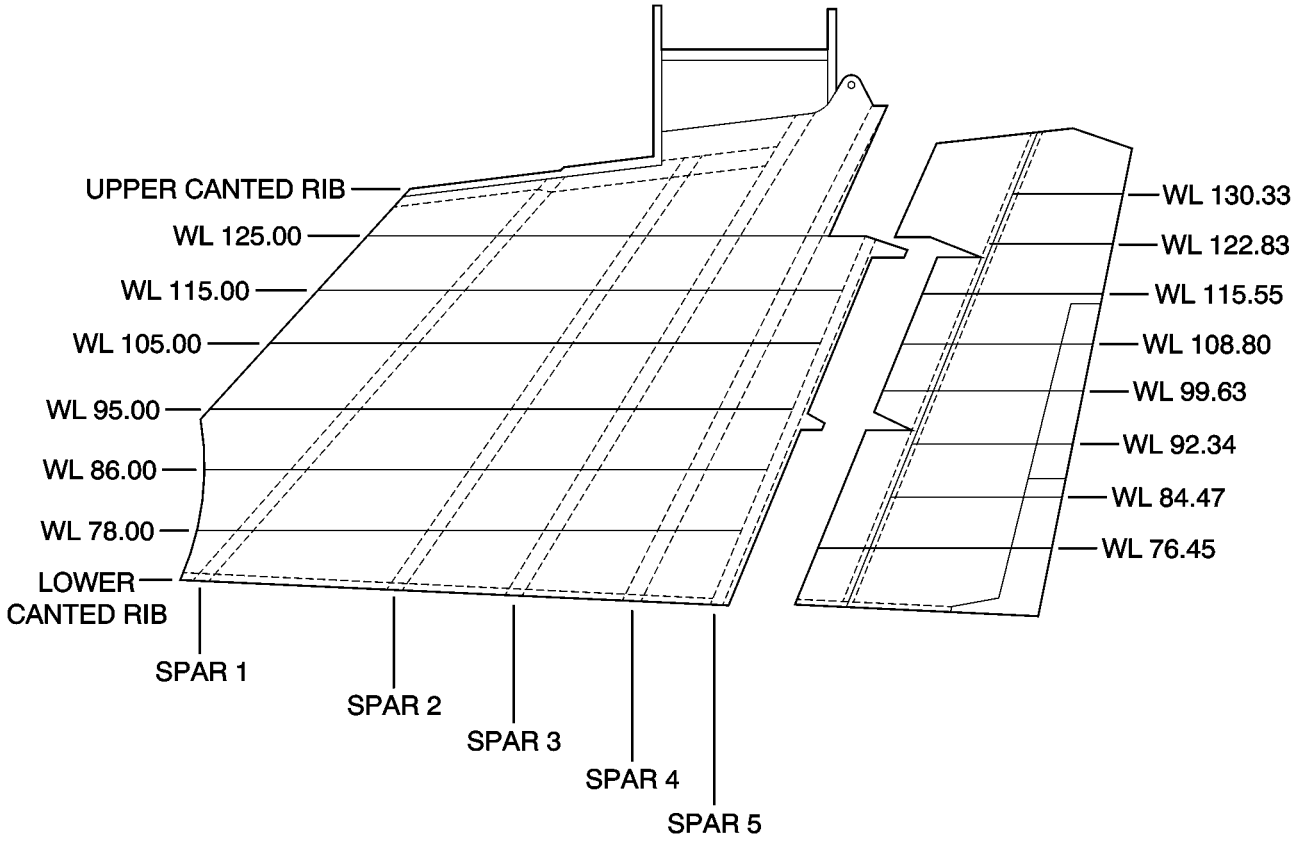


S60–510001–001–09

Aircraft Measurement System - Horizontal Stabilizer and Elevator Structural Stations
Figure 1 (Sheet 9 of 12)



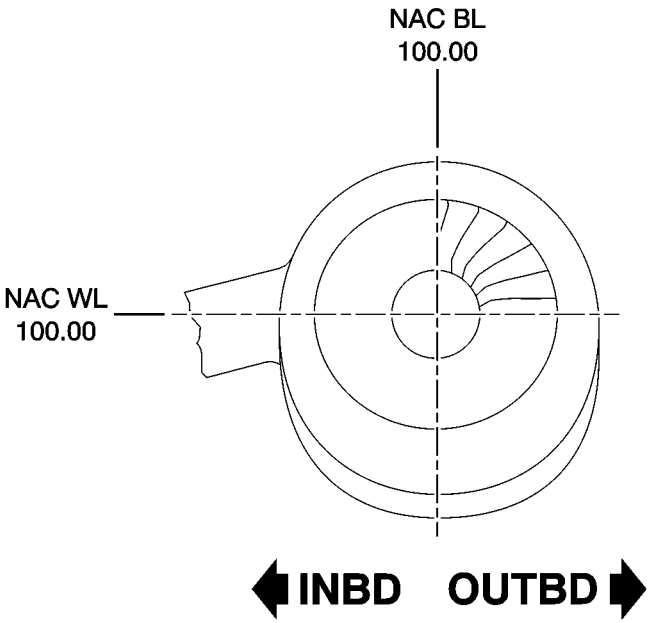
VERTICAL STABILIZER STRUCTURAL STATIONS

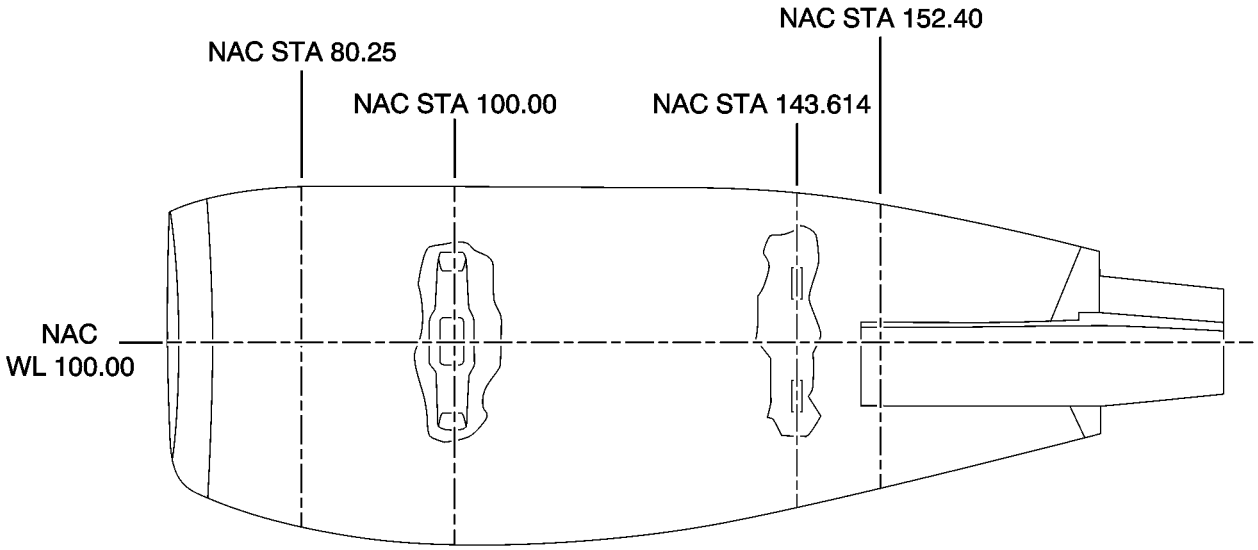


RUDDER STRUCTURAL STATIONS

S60–510001–001–10

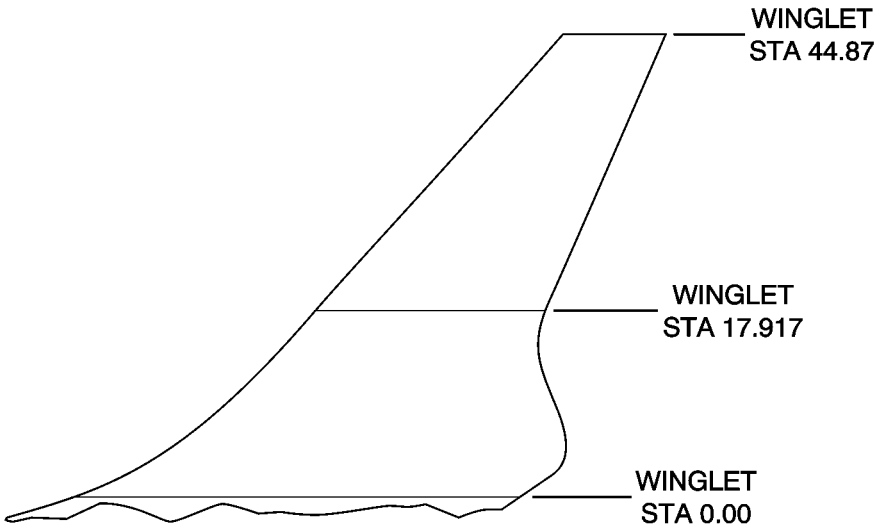
Aircraft Measurement System - Vertical Stabilizer and Rudder Structural Stations
Figure 1 (Sheet 10 of 12)



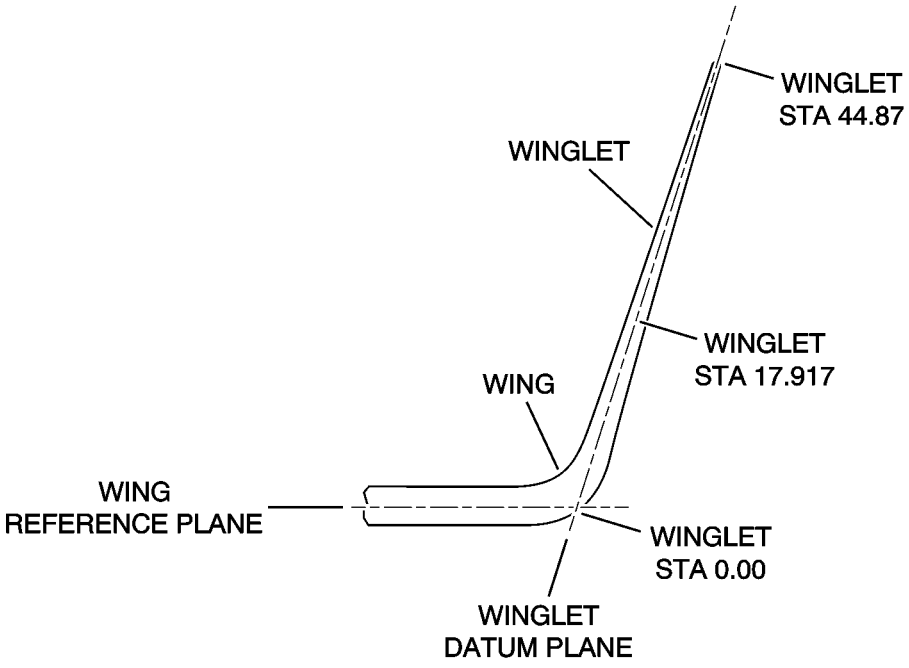


S60-510001-001-11

Aircraft Measurement System - Nacelle Stations
Figure 1 (Sheet 11 of 12)



(VIEW LOOKING INBOARD)



(VIEW LOOKING AFT)
(LH WINGLET SHOWN, RH TYPICAL)

S60–510001–001–12

Aircraft Measurement System - Winglet Stations
Figure 1 (Sheet 12 of 12)

AIRCRAFT - STRUCTURAL IDENTIFICATION

1. Aircraft Structural Description

WARNING: DRILLING, MODIFICATIONS, OR ANY TYPE OF WORK THAT CREATES A BREAK IN THE PRESSURE SECTION IS THE RESPONSIBILITY OF THE OWNER OR FACILITY PERFORMING THE WORK. OBTAINING APPROVAL OF THE WORK IS, THEREFORE, THEIR RESPONSIBILITY.

A. Major Structural Groups

(1) The major structural groups of the aircraft are the doors, fuselage, nacelles/pylons, stabilizers, windows, and wings.

B. Major Structural Members

(1) The major structural members of the aircraft are the forward and aft pressure bulkheads, floorboards, forward and aft engine beams, baggage compartment floor, under wing keel beam, fuselage keel beam, and the landing gear.

C. Type of Construction

(1) This is an all-metal aircraft with full cantilever wing and horizontal stabilizer. The fuselage is of semimonocoque construction and supports an engine nacelle on each side in the area above and aft of the wing.

(2) A two-piece passenger/crew door (upper and lower) is located on the fuselage left side. The doors are hinged to the fuselage by piano-type hinges. The lower door incorporates the steps for entering and exiting the aircraft. Additionally, there is an emergency exit, several service doors, and the landing gear doors.

(3) The fuselage basic structure consists of a stressed skin structure with transverse frames and longerons. The fuselage is comprised of four basic sections: the nose section, the pressurized section (cockpit and cabin), the fuel section, and the tailcone section.

(4) The pressurized section houses the crew, passenger, and baggage areas. Drilling, modifications, or any type of work that creates a break in the pressure section is the responsibility of the owner or facility performing the work. Obtaining approval of the work is, therefore, their responsibility.

(5) The principle structure of the engine nacelles consists of the nose section, upper and lower cowls and the aft section. The complete nacelle assembly is cantilevered from the pylon by engine support fittings, and structural carry-through fittings that extend inboard from the nacelle, through the pylon, and attach to the fuselage assembly.

(6) The horizontal stabilizer is a fully cantilevered one-piece construction consisting of a forward and aft spar, transverse ribs, stringers, and skins.

(7) The vertical stabilizer is a fully cantilevered structure consisting of spars, transverse ribs, and skins.

(8) The elevator and rudder consist of a forward spar and transverse ribs and skins.

(9) The flight compartment windows consist of the pilot's and copilot's windshield halves and crew windows.

The windshield is made up of three laminated layers of acrylic plastic. Both outer layers are made of stretched acrylic 0.475 (±0.010) inch [12.07 (±0.25 mm)] thick. The middle layer is cast in place acrylic 0.1(±0.03) inch [(2.54 (±0.76 mm)] thick.

The two piece impact-resistant plexiglass windshield is secured to the fuselage with screws and retainers.

The pilot's and copilot's crew windows.

(a) *On Aircraft 60-001 thru 60-235*, the pilot's window is located just aft of the windshield on the left side and can be opened. It is secured to the aircraft structure by latches, hinges, and attaching screws. The pilot's window assembly is made of two 0.475 inch [12.07mm] plexiglass window panels laminated with one 0.1 inch [2.54 mm] cast in place acrylic inner layer.

(b) *On Aircraft 60-236 and subsequent*, the pilot's window is located just aft of the windshield on the left side. The pilot's window can not be opened. It is secured to the aircraft structure by screws and retainers. The pilot's side window assembly is made of two 0.33 inch [8.38 mm] plexiglass window panels laminated with one 0.075 inch [1.91 mm] cast in place with an acrylic inner layer.

(c) The copilot's window is located just aft of the windshield on the right side. The copilot's window can not be opened. It is secured to the aircraft structure by screws and retainers. The copilot's side window assembly is made of two 0.33 inch [8.38 mm] plexiglass window panels laminated with one 0.075 inch [1.91 mm] cast in place with an acrylic inner layer.

(10) The cabin windows consist of two panes of stretched acrylic with dead air space between them. The cabin windows are secured to the fuselage structure. The right rear window is removable and serves as the emergency exit.

(11) The wing is a fully cantilevered single unit consisting of the leading edge, wing box section, ailerons, flaps, spoilers and winglets. The multicellular-type wing structure consists of spars and ribs in each wing half. The upper and lower wing skins are taper-milled so the trailing edge is thinner than the leading edge. Splice plates join the wing skin halves at the aircraft centerline. The winglets are built in two sections. The inboard section is conventional built-up construction and the outboard section is a bonded assembly consisting of aluminum skins and a full-depth aluminum honeycomb core. The flaps, ailerons, and spoilers are constructed primarily of spars, transverse ribs, and skins.

2. Structural Design Concept

A. Basic Design Approach

(1) There are two basic design approaches for ensuring the structural integrity of an aircraft during its service life: the "safe-life" and "fail-safe" concepts. The design of the Learjet incorporates both concepts. To clarify the differences in the two basic approaches, definitions are presented in the following paragraphs.

B. Safe-Life Concept

(1) A safe-life aircraft structure is defined as being capable of withstanding, without failure, the repeated loads of variable magnitudes expected during the defined service life of the aircraft. Safelife is proved by either analysis or tests that include all scatter factors on material and load spectrums. Because of the proof of safe-life, alternate load paths are not necessarily deliberately provided.

C. Fail-Safe Concept

(1) The concept of fail-safe design differs in that alternate load paths are specifically provided and methods for limiting crack propagation are employed.

3. Repairing Safe-life Structure

A. Safe-life Structure Repair

(1) Since safe-life structure does not provide for alternate load paths or methods of limiting crack propagation, it is mandatory that all damage to primary and secondary structure (other than allowable damage) be repaired upon discovery.

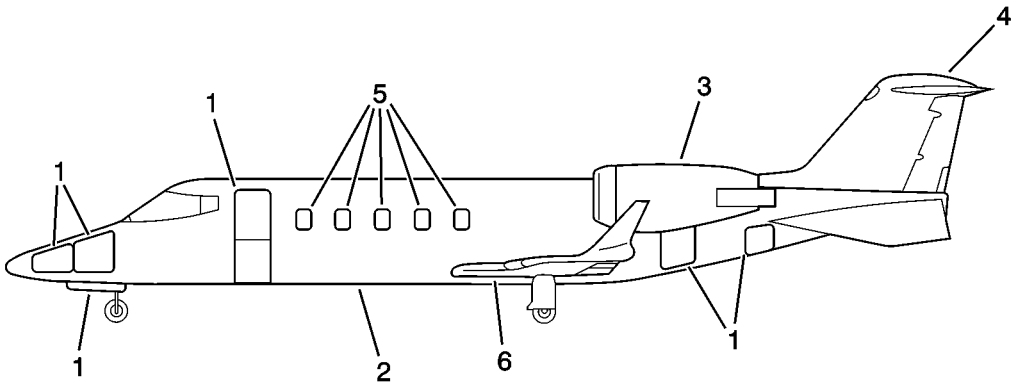
(2) Repairs in this manual are designed to restore the capability of the material in order to ensure the safe-life characteristics of the structure. It is emphasized that other repairs, designed for a specific "fix," must follow the same concept, i.e., that the ultimate allowable strength must be maintained, to maintain structural integrity for the life of the aircraft.

4. Primary and Secondary Structure

A. Primary structure is considered to be that structure that is essential to continued safe flight and landing. Examples of this would be wing (spars, skins, ribs, fittings, etc.), fuselage, empennage, control structure systems/support and mechanisms, engine mounts and pylon structure, landing gear and actuator including attachment fittings, main cabin door and attachments, windshield, cabin windows, escape hatch, and underwing keel beam.

B. Secondary structure is that not considered essential for continued safe flight and landing. Examples of this would include fairings (wing-to-body etc.), gear doors, nose access doors, dorsal fin, upper vertical fin mailbox fairing, tailcone access door, horizontal-to-vertical tail fairing, parts of pylon fairing and nacelle covers.

ITEM NO.	SECTION TITLE	CHAPTER
1	Doors	52
2	Fuselage	53
3	Nacelles/Pylons	54
4	Stabilizers	55
5	Windows	56
6	Wings	57



(TYPICAL)

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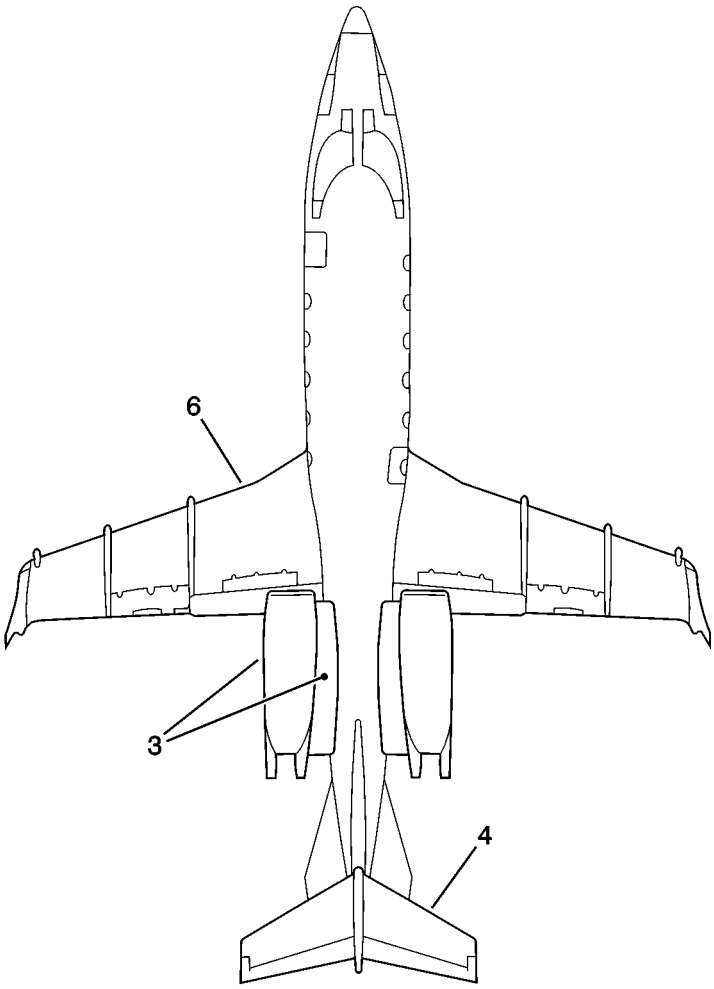
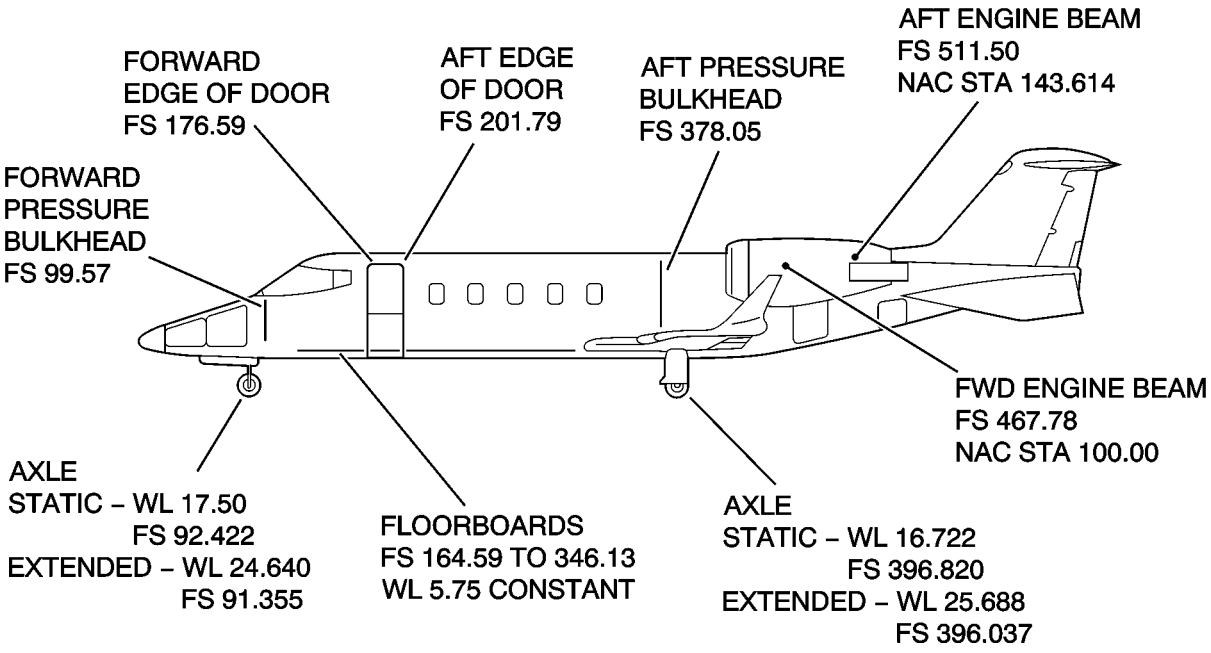
Aircraft Master Repair Index
Figure 1 (Sheet 1 of 2)

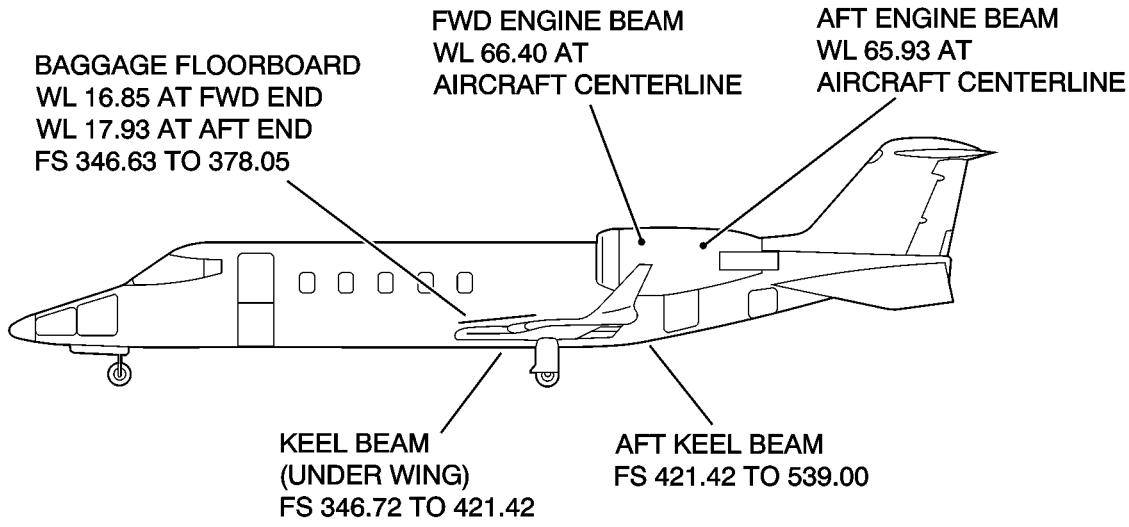


(TYPICAL)

S60–510000–001–02

Aircraft Master Repair Index
Figure 1 (Sheet 2 of 2)





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Major Structural Member Locations
Figure 2