CHAPTER 4

PAYLOAD FAIRING

4.1 Fairing Introduction

4.1.1 Summary

The spacecraft is protected by a fairing that shields it from various interference by the atmosphere, which includes high-speed air-stream, aerodynamic loads, aerodynamic heating and acoustic noises, etc. The fairing provides the payload with acceptable environments.

The aerodynamic heating is absorbed or isolated by the fairing. The temperature inside the fairing is controlled under the allowable range. The acoustic noises generated by air-stream and LV engines are declined to the allowable level for the Payload by the fairing.

The fairing is jettisoned when LM-2C launch vehicle flies out of the atmosphere. The specific time of fairing jettisoning is determined by the requirement that aerodynamic heating flux at fairing jettisoning is lower than 1135 W/m^2.

See **Figure 4.1** for LM-2C Fairing Configuration.

A series of tests have been performed during LM-2C fairing development, including fairing wind-tunnel test, thermal test, acoustic test, separation test, model survey test and strength test, etc.

The typical LM-2C fairing is 3.35 m in diameter, and 8.368 m in length. The length of the fairing can be adjusted according to different mission requirements.

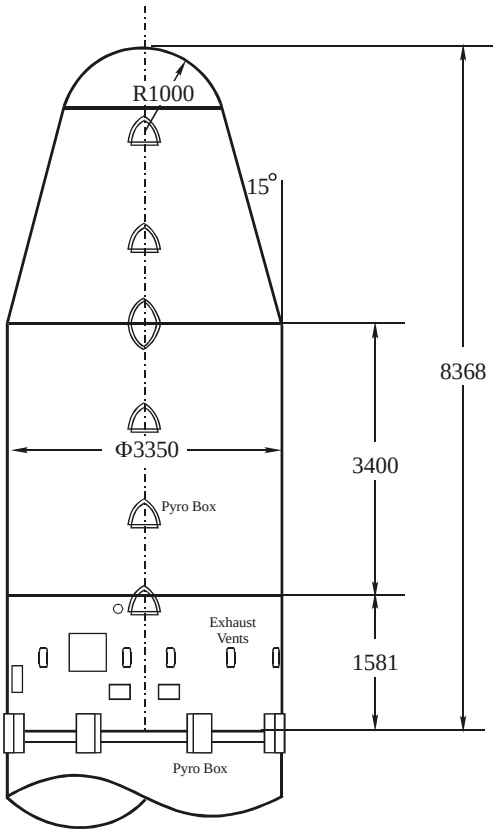

Figure 4-1 Fairing Configuration

4.1.2 Fairing Static Envelope

The static envelope of the fairing is the limitation to the maximum dimensions of SC configuration. The static envelope is determined by consideration of estimated dynamic and static deformation of the fairing/payload stack generated by a variety of interference during flight. The envelopes vary with different fairing and different types of payload adapters.

It is allowed that a few extrusions of SC can exceed the maximum static envelope (Φ3000mm) in the fairing cylindrical section. However, the extrusion issue shall be resolved by technical coordination between SC side and CALT.
The typical fairing static envelopes for Two-stage LM-2C are shown in **Figure 4-2a**, and **Figure 4-2b**. The typical fairing static envelope for LM-2C/CTS is shown in **Figure 4-2c**.

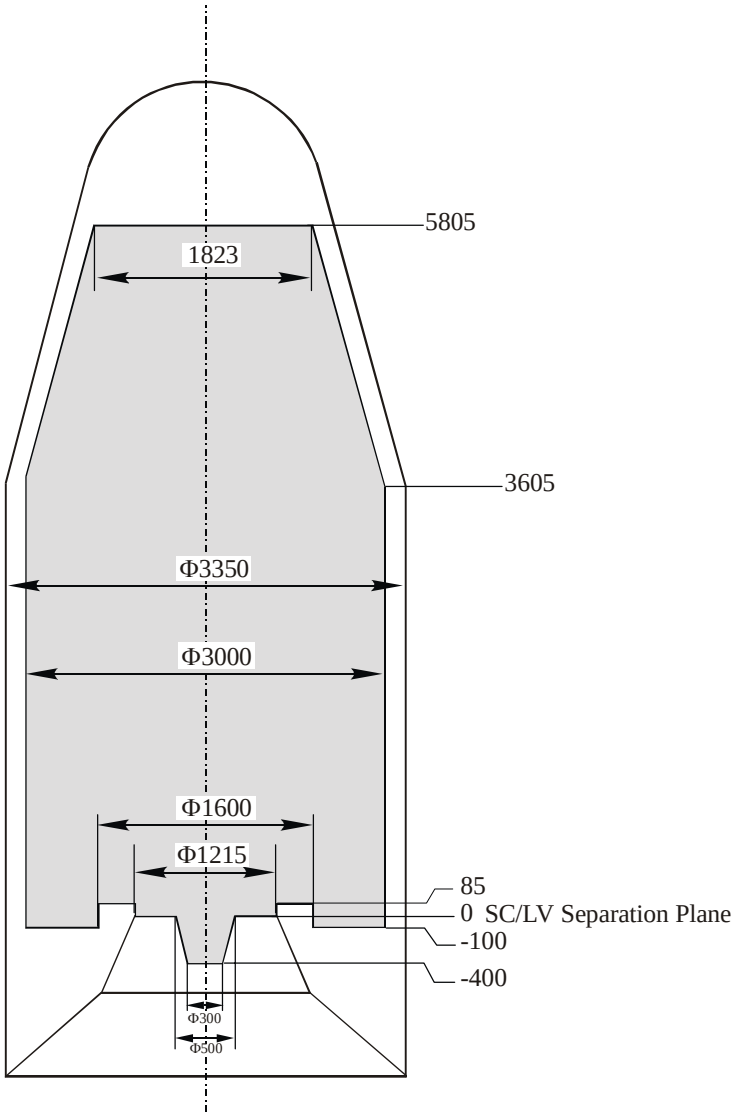

Figure 4-2a Two-stage LM-2C Fairing Static Envelope (1194A Interface)

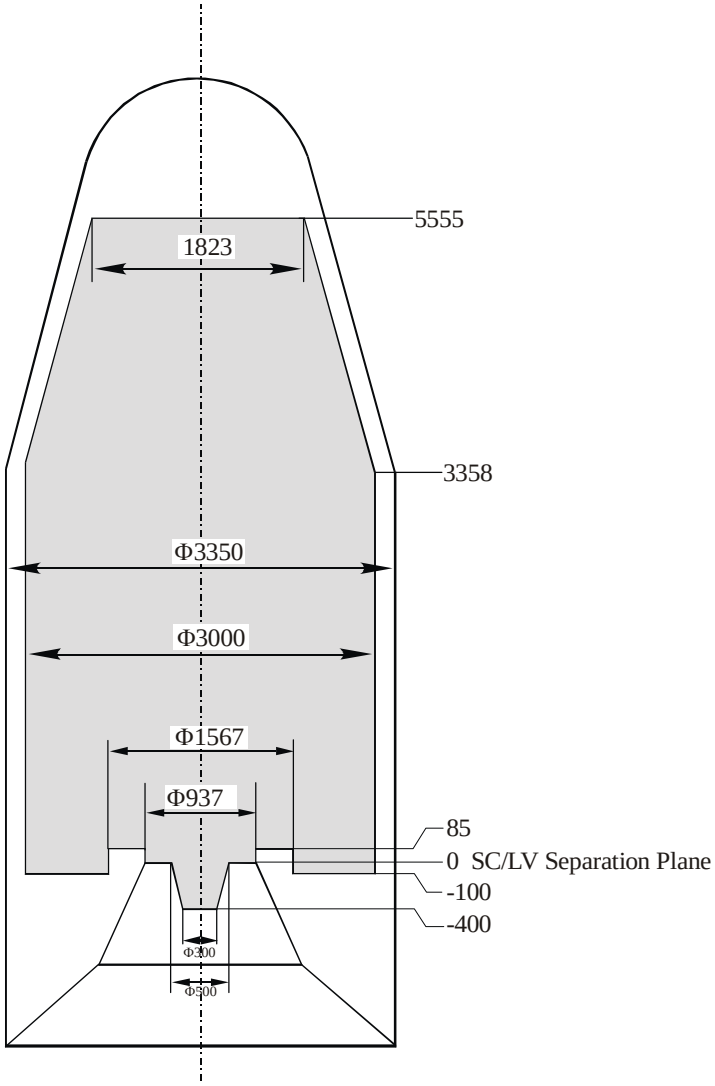

Figure 4-2b Two-stage LM-2C Fairing Static Envelope (937B Interface)

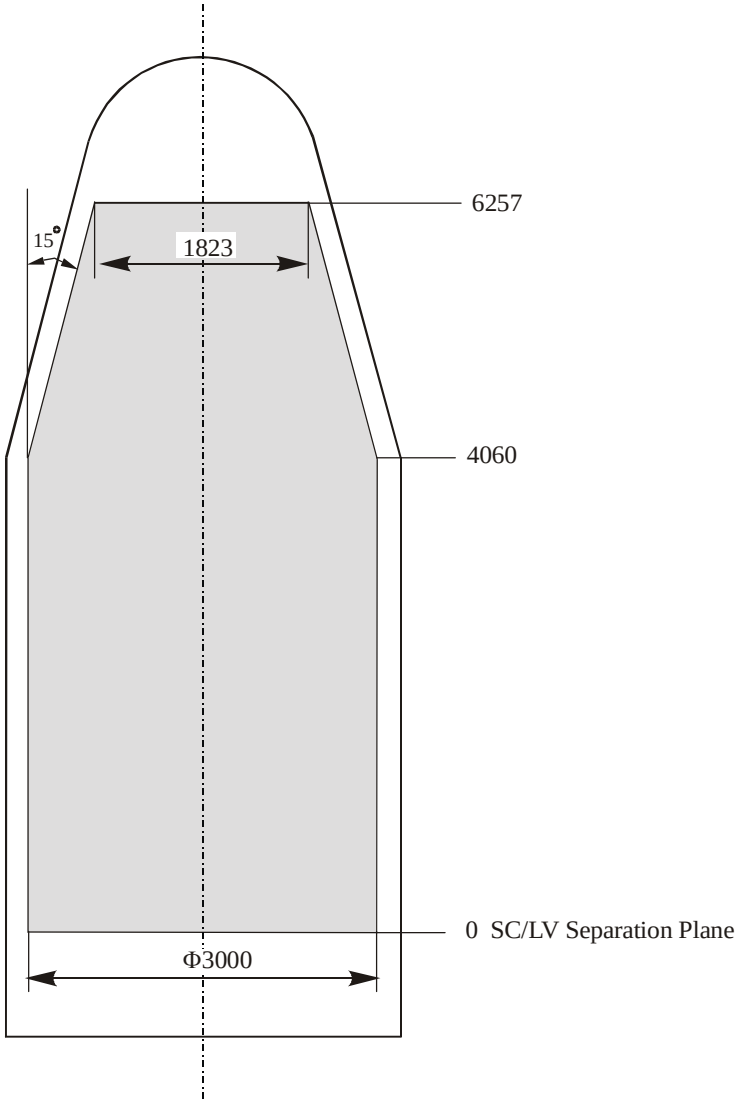

Figure 4-2c LM-2C/CTS Fairing Static Envelope (Explosive Bolt Interface)

4.2 Fairing Structure

The fairing consists of dome, forward cone section, and cylindrical section. The cylindrical section consists of two parts: honey-comb cylindrical section and chemical-milled cylindrical section. Refer to **Figure 4-3.**

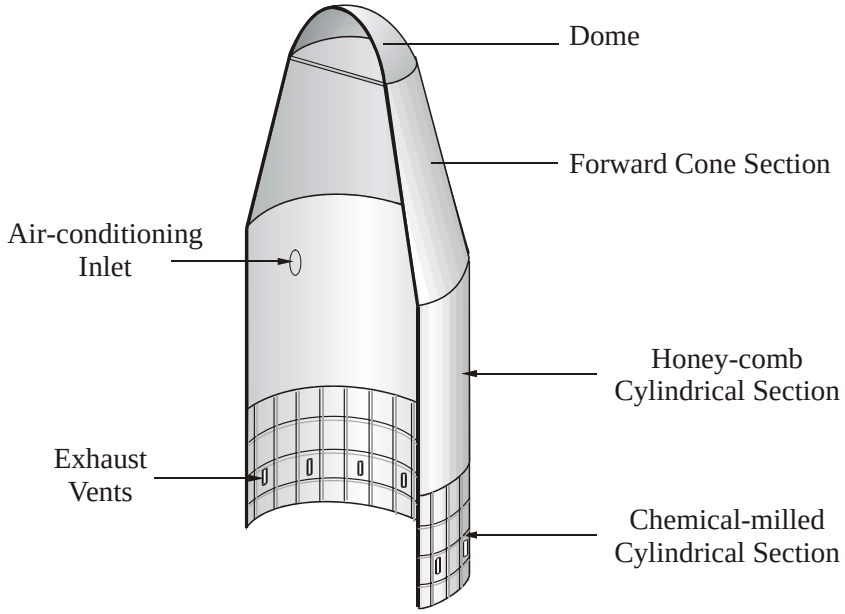

Figure 4-3 Fairing Structure

4.2.1 Dome

The dome is a semi-sphere body with radius of 1000 mm, height of 740 mm and base ring diameter of ϕ1930mm. It consists of dome shell, base ring, encapsulation ring and stiffeners. Refer to **Figure 4-4**.

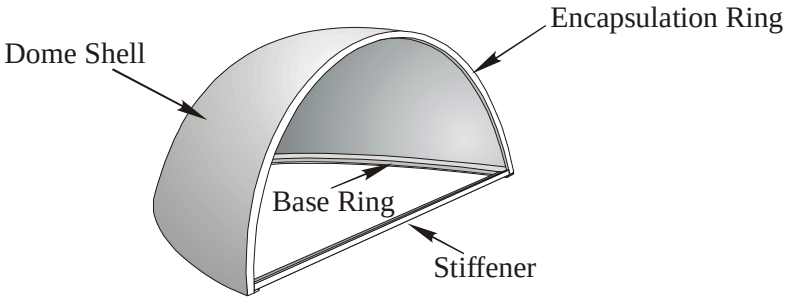

Figure 4-4 Structure of the Fairing Dome

The dome shell is made of fiberglass structure. The base ring, encapsulation ring and stiffener are made of high-strength aluminum alloys. A silica-rubber wind-belt covers on the outside of the split line, and a rubber sealing belt is compressed between the two halves. The outer and inner sealing belts keep air-stream from entering the fairing during flight.

4.2.2 Forward Cone Section

The forward cone section is a 15°-cone with height of 2647 mm. The diameter of the top ring is ϕ1930 mm, and diameter of the base ring is ϕ1930 mm. The section is made of aluminum honeycomb sandwich structure.

4.2.3 Cylindrical Section

The cylindrical section is composed of two parts. The lower part is made of chemical-milled aluminum structure with height of 1581 mm, and the upper part is made of aluminum honeycomb sandwich structure with height of 3400 mm. Almost all the access doors are opened in the chemical-milled lower part. 12 exhaust vents with total area of 350 cm^2 on the lower part. The length of the cylindrical section can be adjusted according to different mission requirements. Refer to **Figure 4-1**.

4.3 Heating-proof Function of the Fairing

The outer surface of the fairing, especially the surface of the dome and forward cone section, is heated by high-speed air-stream during LV flight. Therefore, heating-proof measures are adopted to assure the temperature of the inner surface be appropriate.

The fiberglass dome is of excellent heating-proof function. The outer surface of the forward cone section and cylindrical section is covered by special cork panel. The cork panel also functions to damp noise.

4.4 Fairing Jettisoning Mechanism

The fairing jettisoning mechanism consists of lateral unlocking mechanism and longitudinal unlocking mechanism and separation mechanism. See **Figure 4-5a,b&c**.

4.4.1 Lateral Unlocking Mechanism

The base ring of the fairing is connected with the LV second stage by 8 non-contamination explosive bolts. See **Figure 4-5a&b**.

4.4.2 Longitudinal Unlocking Mechanism

The longitudinal separation plane of the fairing is II-IV quadrant. The longitudinal unlocking mechanism consists of 12 non-contamination explosive bolts. See **Figure 4-5a**.

4.4.3 Fairing Separation Mechanism

The fairing separation mechanism is composed of two pairs of hinges and 12 springs. See **Figure 4-5b**. Each half of the fairing is supported by two hinges, which locate at quadrant I and III. There are 6 separation springs mounted on each half of the fairing, the maximum acting force of each spring is 4 kN. After fairing unlocking, each half of the fairing turns around the hinge. When the roll-over rate of the fairing half is larger than 15°/s, the fairing is jettisoned. Refer to **Figure 4-5c**.

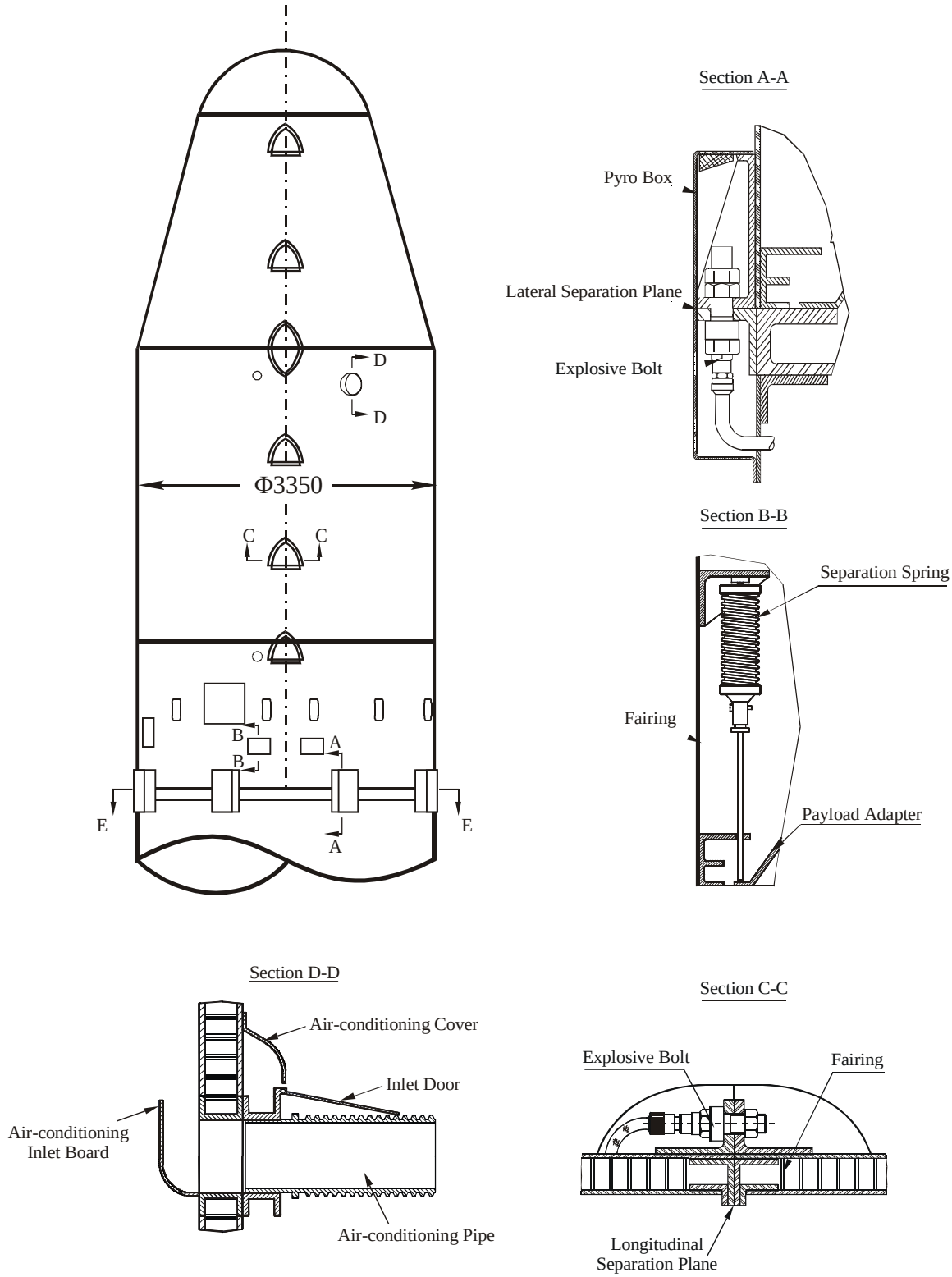

Figure 4-5a Fairing Jettisoning Mechanism (1)

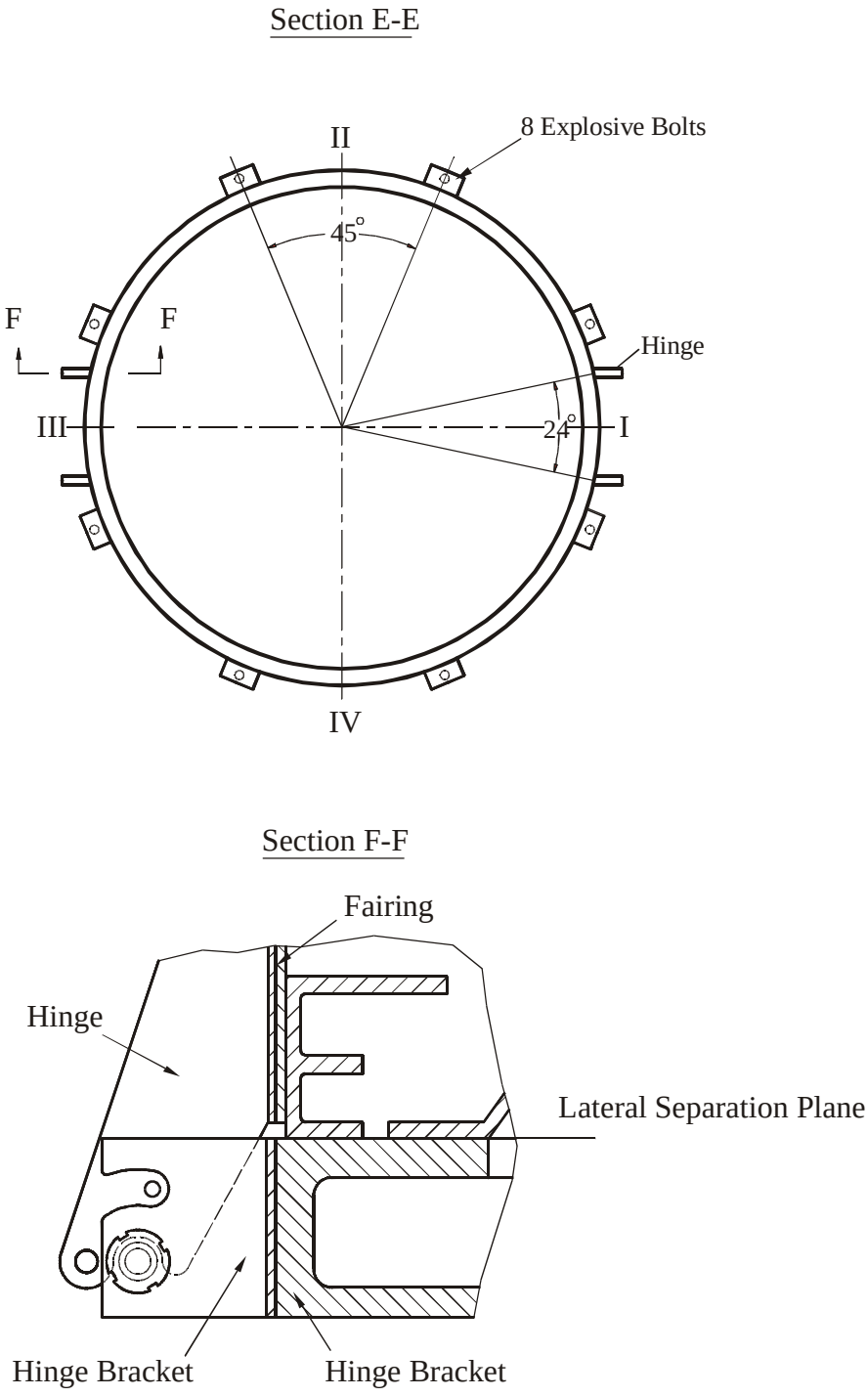

Figure 4-5b Fairing Jettisoning Mechanism (2)

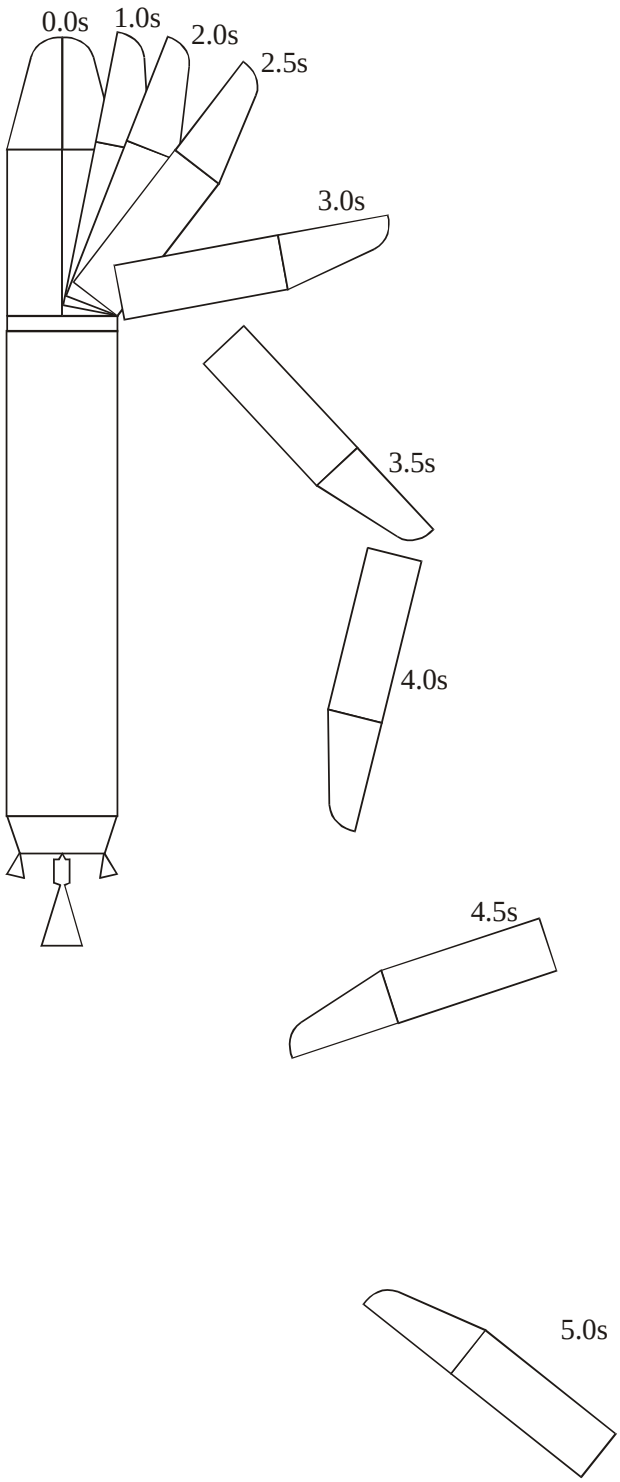

Figure 4-5c Fairing Separation Dynamic Process

4.5 RF Windows and Access Doors

The Radio Frequency (RF) transparent windows can be incorporated into the fairing forward cone section and cylindrical section to provide SC with RF transmission through the fairing, according to the user's need. The RF transparent windows are made of fiberglass, of which the RF transparency rate is larger than 85%.

Some area on the fairing can not be selected as the locations of access door or RF window, see **Figure 4-6**. The user can propose the requirements on access doors and RF windows to CALT. However, such requirements should be finalized 8 months prior to launch.

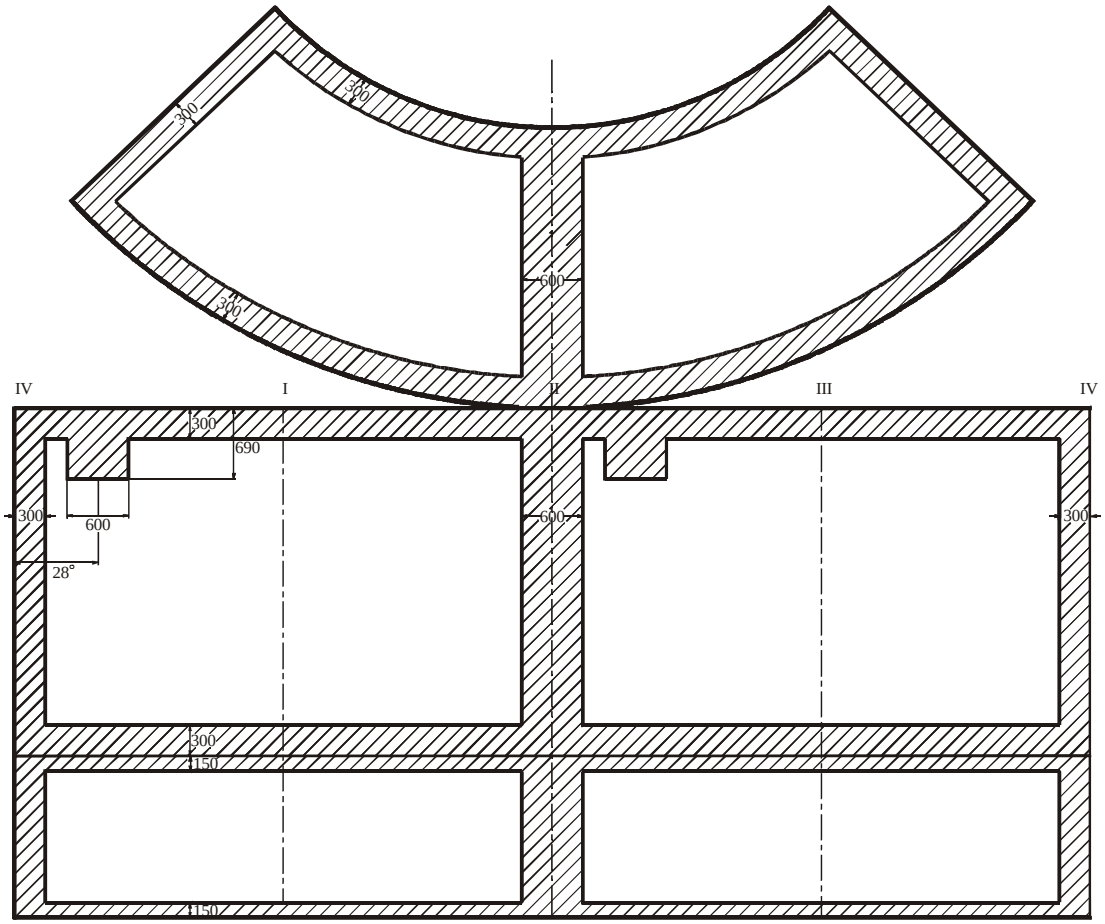

Figure 4-6 Prohibited Area for Access Doors