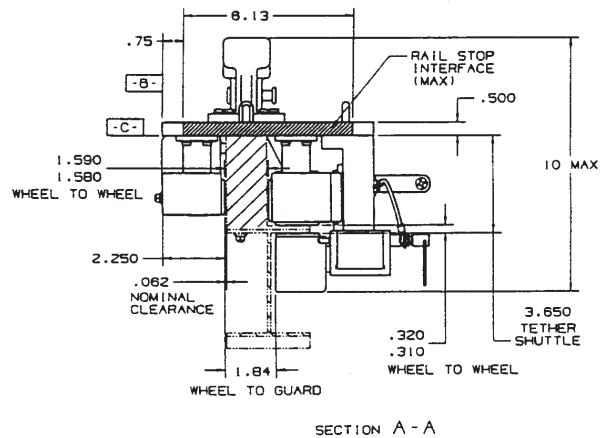
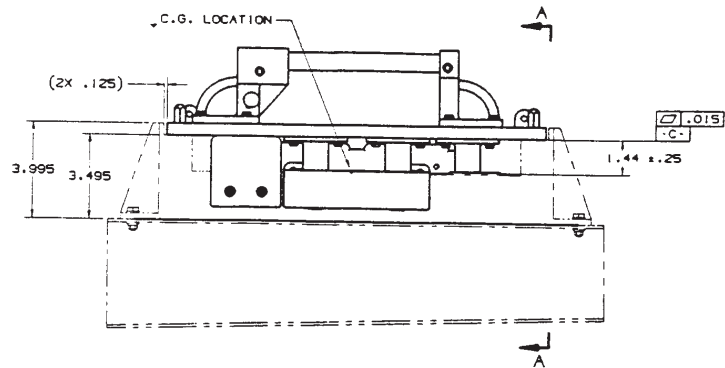
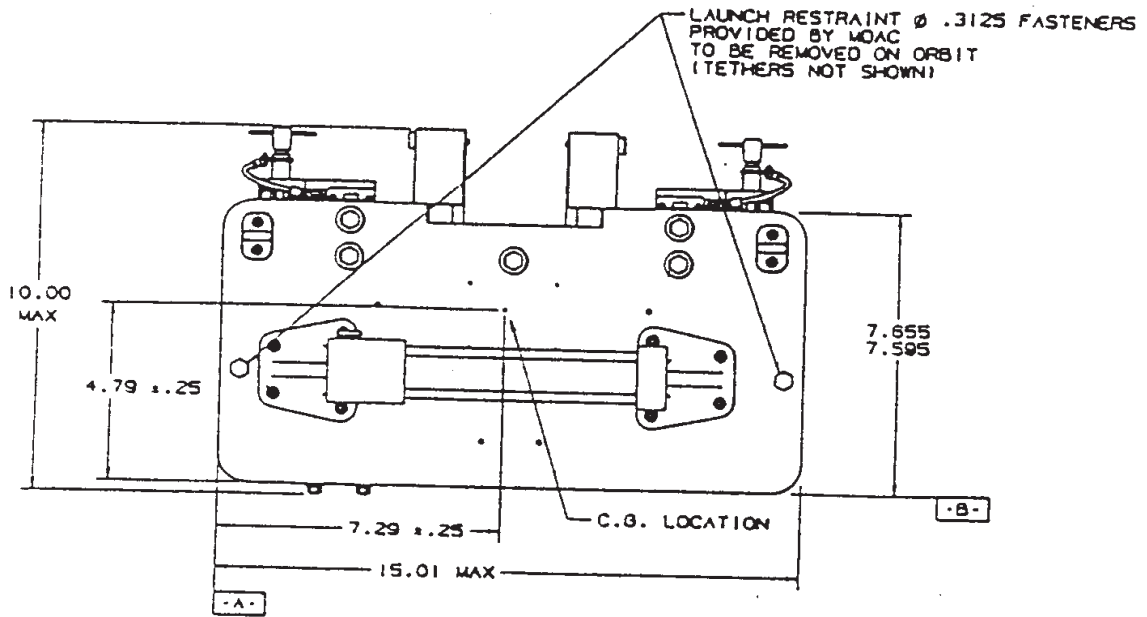


FIGURE 3.4.1.1-1 TETHER SHUTTLE TO LAUNCH AND STOWAGE INTERFACE – LAUNCH BRACKET

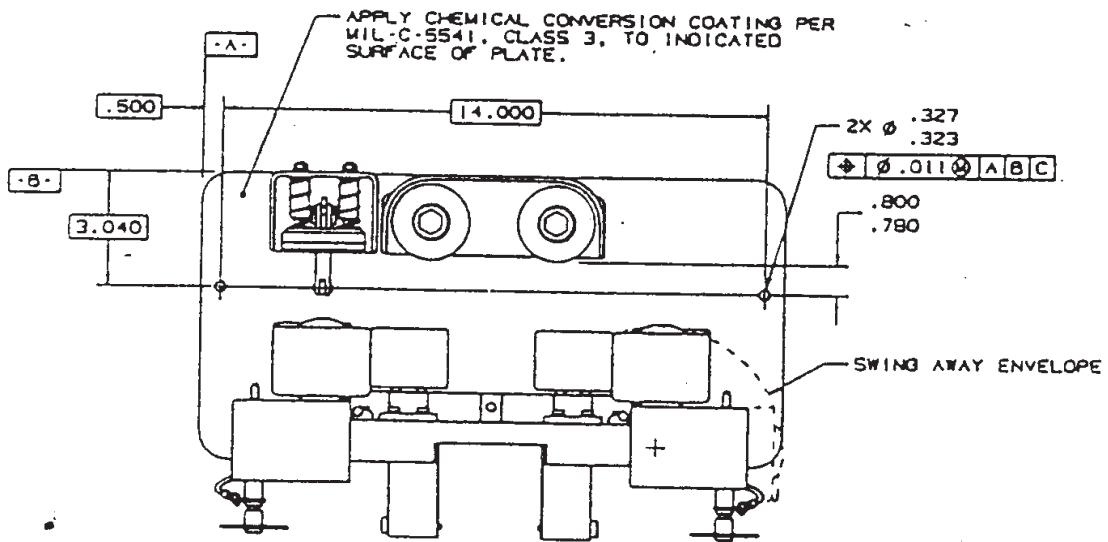


DIMENSIONAL TOLERANCES: .0 +/- .1
 (UNLESS OTHERWISE NOTED) .00 +/- .03
 .000 +/- .010

FIGURE 3.4.1.1-2 TETHER SHUTTLE TO LAUNCH AND STOWAGE INTERFACE – TETHER SHUTTLE



LAUNCH STRUCTURE OMITTED FOR CLARITY



LAUNCH STRUCTURE OMITTED FOR CLARITY

FIGURE 3.4.1.1-3 TETHER SHUTTLE TO LAUNCH AND STOWAGE INTERFACE – TETHER SHUTTLE (CONCLUDED)

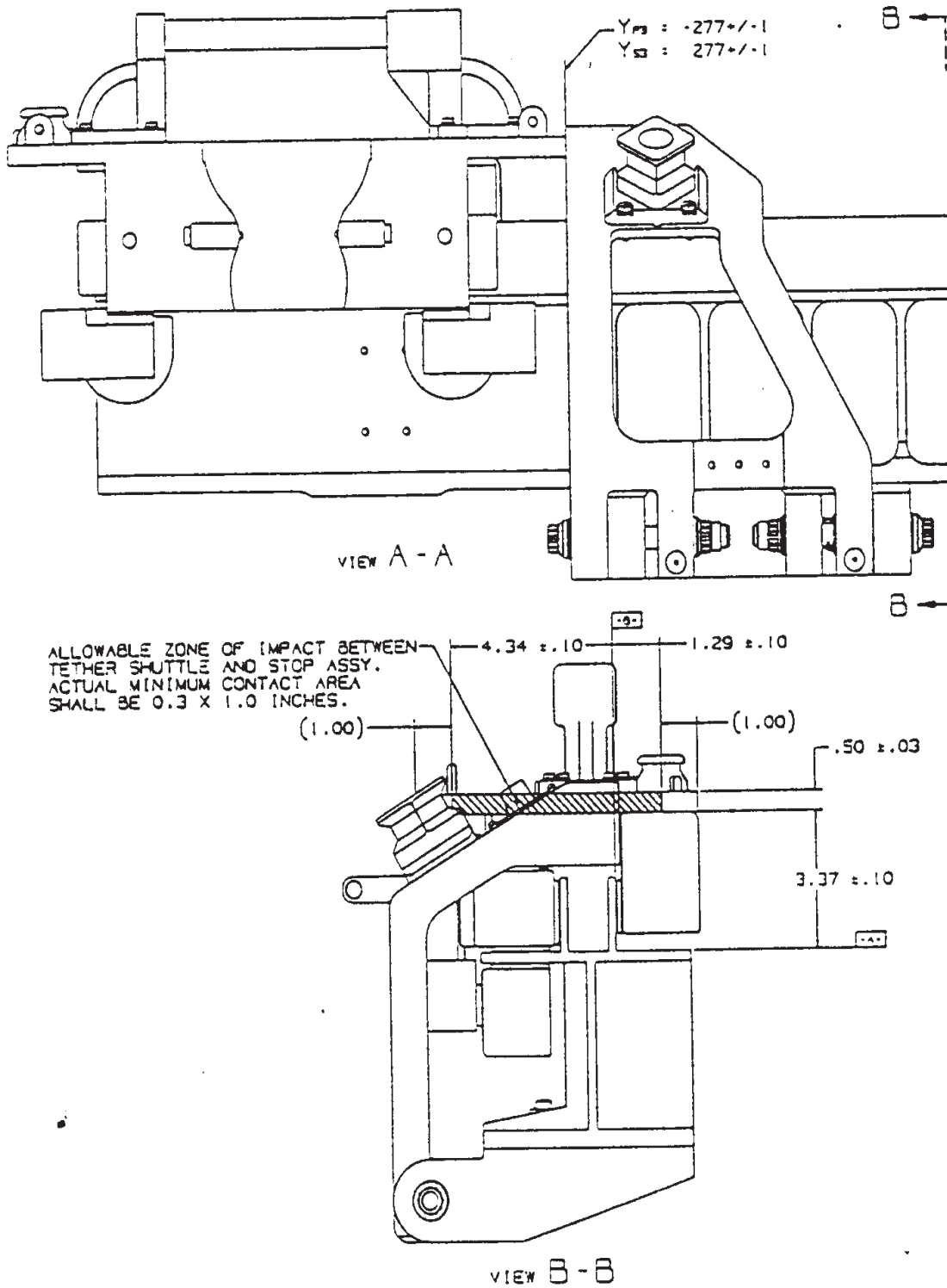


FIGURE 3.4.1.1-4 TETHER SHUTTLE STOP INTERFACE

stops is shown in Figure 3.4.1.1–4 and the location on the MT that the Tether Shuttle may impact against is shown in Figure 3.4.1.1–5.

3.4.1.2 ENVELOPE

3.4.1.2.1 HARDWARE

The maximum hardware launch envelope dimensions of each Tether Shuttle is 15.1 in. x 10 in. x 10 in. See Figure 3.4.1.2.1–1 for details. The maximum on-orbit volume envelope dimensions for each Tether Shuttle, including the Extended Range Crewmember (ECRM) Safety Tether Reel, is 15.1 in. x 10 in. x 10 in.

3.4.1.2.2 EVA

The access envelope for stowage, installation and removal of the Tether Shuttle is shown in Figure 3.4.1.2.2–1. The Tether Shuttle operates within the CETA Cart translation corridor.

3.4.1.3 STRUCTURAL

3.4.1.3.1 STIFFNESS

A first mode of 25 Hz is sufficient. The natural frequency of the Tether Shuttle final design will be greater than 40 Hz.

3.4.1.3.2 LOADING

There shall be no separation or gapping at the Tether Shuttle to launch restraint structure interface during launch or landing. Load factors are 13 g's in any one direction with 3.25 g's in the other two directions.

The on-orbit loads transmitted by the Tether Shuttle onto the nadir MT/CETA rail shall be governed by a 200 lb tether load and shall not exceed a line contact load of 300 lbs. between a wheel bogie roller and the MT/CETA rail.

The Tether Shuttle and the PG–1 Tether Shuttle rail stops inboard of the SARJ shall be capable of withstanding a compressive load of 1500 lbs (limit) due to impact of the Tether Shuttle onto the Tether Shuttle rail stop. The compressive load shall be applied over a minimum impact area of 0.3 inches by 1.0 inch and restricted to the impact areas specified in Figure 3.4.1.1–3 and Figure 3.4.1.1–4. Note that the compressive load of 1500 lbs is an equivalent static load that

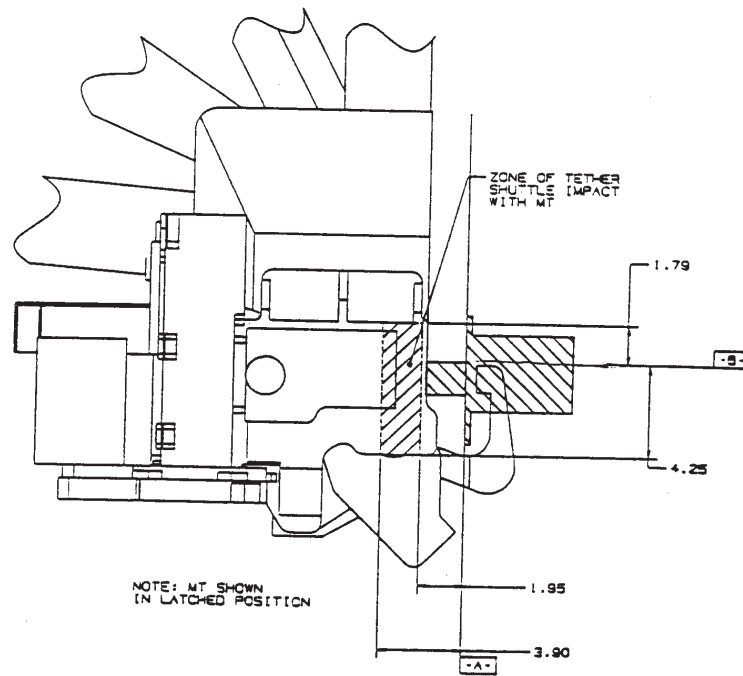


FIGURE 3.4.1.1-5 TETHER SHUTTLE TO MOBILE TRANSPORTER INTERFACE – MOBILE TRANSPORTER

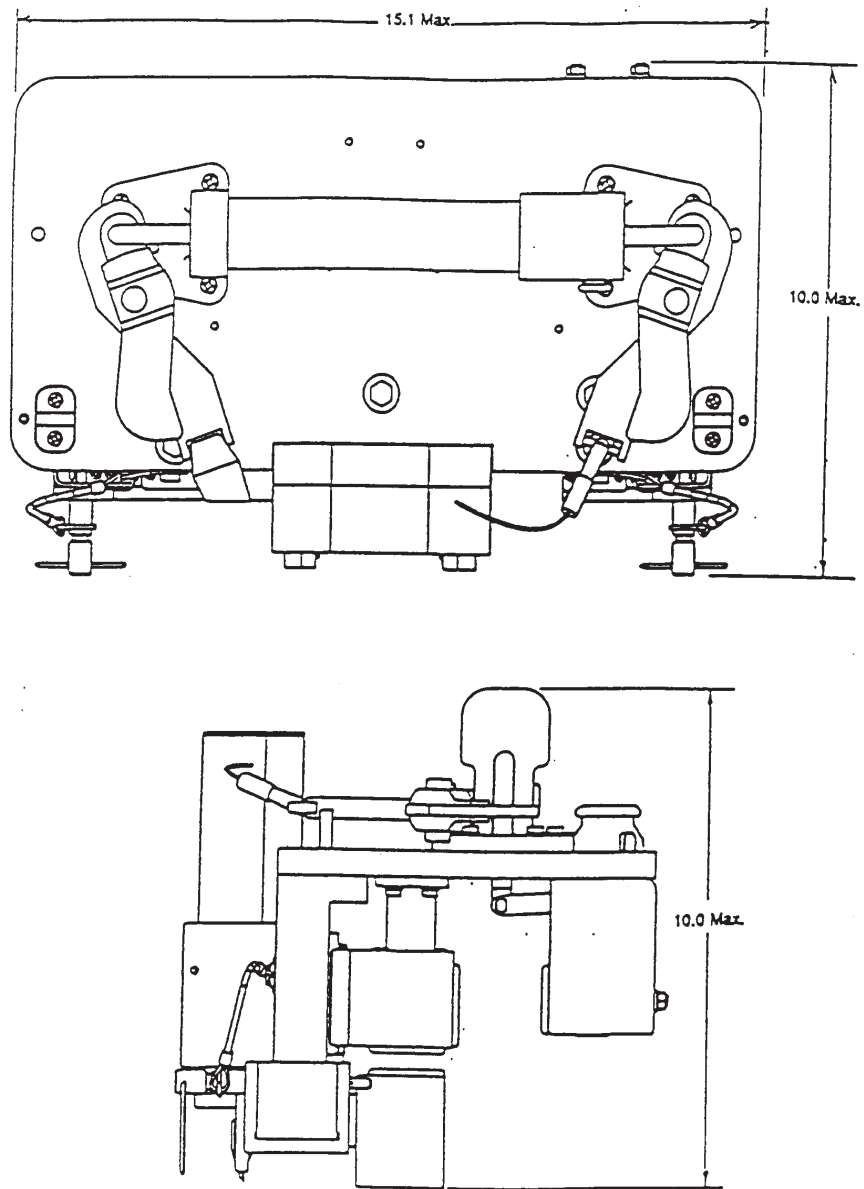


FIGURE 3.4.1.2.1-1 TETHER SHUTTLE STOWAGE ENVELOPE

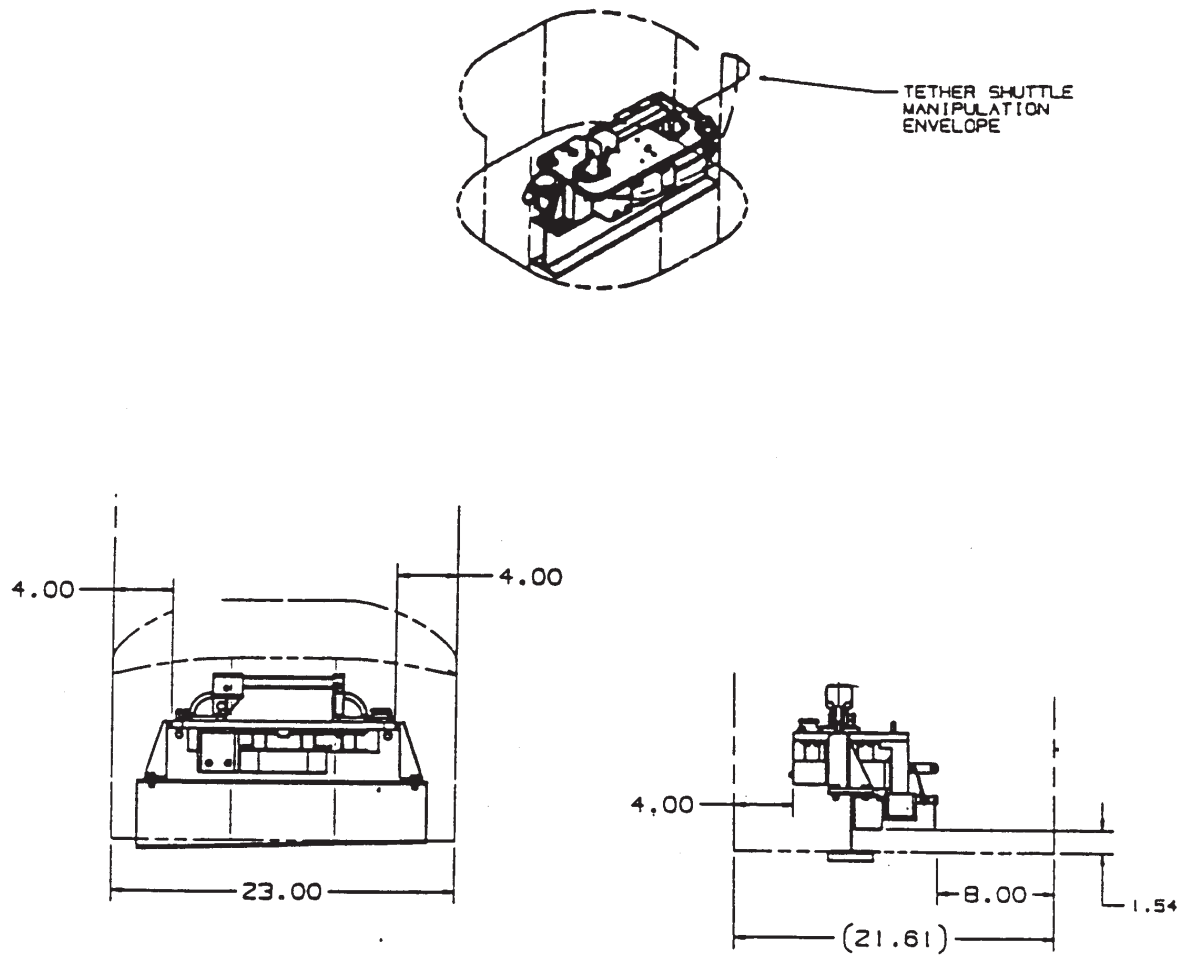


FIGURE 3.4.1.2.2-1 TETHER SHUTTLE EVA ACCESS ENVELOPE

corresponds to the Tether Shuttle moving at 3 ft/sec with a total mass of 25 lbm at impact to a Tether Shuttle rail stop.

3.4.1.3.3 MASS PROPERTIES

The maximum weight of the Tether Shuttle is 25 lbs. without the Extended Range Crewmember (ERCM) safety tether reel. The location of the Tether Shuttle center-of-gravity (CG) is shown in Figure 3.4.1.1-2 and Figure 3.4.1.1-3.

3.4.1.4 MECHANICAL

3.4.1.4.1 MATERIALS

Tether Shuttle materials meet the requirements of SSP 30233, Space Station Requirements for Materials and Processes.

3.4.1.4.2 SURFACE FINISH

Tether Shuttle surface finishes meet the requirements of SSP 30233, Space Station Requirements for Materials and Processes.

3.4.1.5 THERMAL

The Tether Shuttle is designated as "unlimited contact" EVA interface. Thermal control of this hardware is achieved by passive techniques. Contacting MT rail surfaces are calculated to be within the range between -85° F and +185° F.

3.4.1.6 ELECTRICAL BONDING

The Tether Shuttle launch restraint contact surfaces, as indicated in Figure 3.4.1.1-2 and Figure 3.4.1.1-3, will satisfy a Class S bond per SSP 30245, Space Station Electrical Bonding Specification, in its entirety.

3.4.2 CETA CART

This section defines CETA Cart to Integrated Truss Segment (ITS) interfaces inboard of the Solar Alpha Rotary Joints (SARJ).

The CETA Cart provides for restrained and controlled translation of the crew, EVA equipment, and cargo (ORUs) along the MT-CETA rails. The CETA Cart provides the capability to be used as an EVA work platform at worksites in proximity to the Integrated Truss Segment (ITS) structure. To translate the CETA Cart along the MT rail, the EVA crewmember is provided the

CETA handrails located along side the Nadir MT-CETA rail on Face 1. The CETA Handrails are the responsibility of the ITS providers. The CETA Cart launch and on-orbit configurations are shown in Figures 3.4.2-1 and 3.4.2-2, respectively.

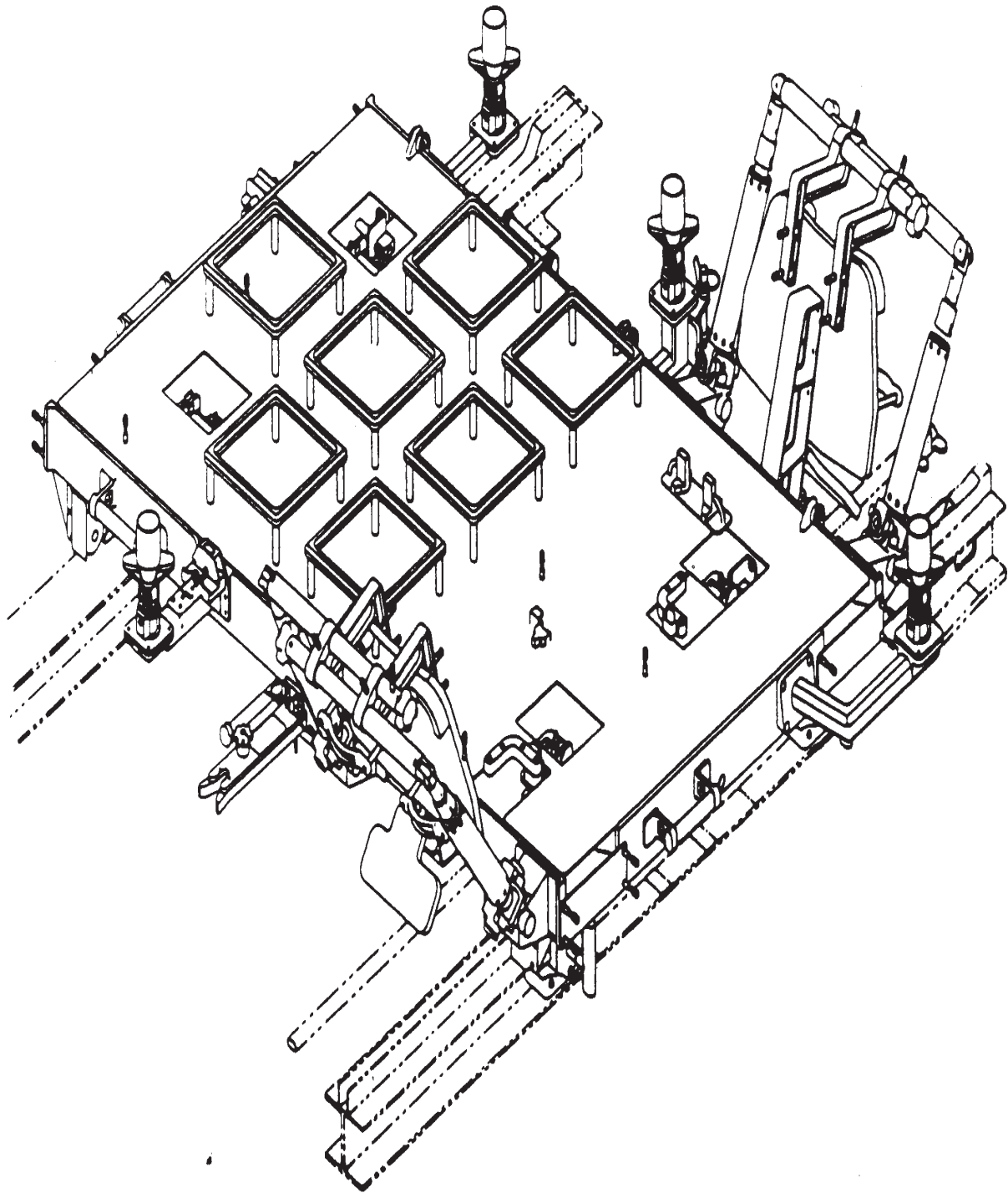


FIGURE 3.4.2-1 CETA CART LAUNCH CONFIGURATION

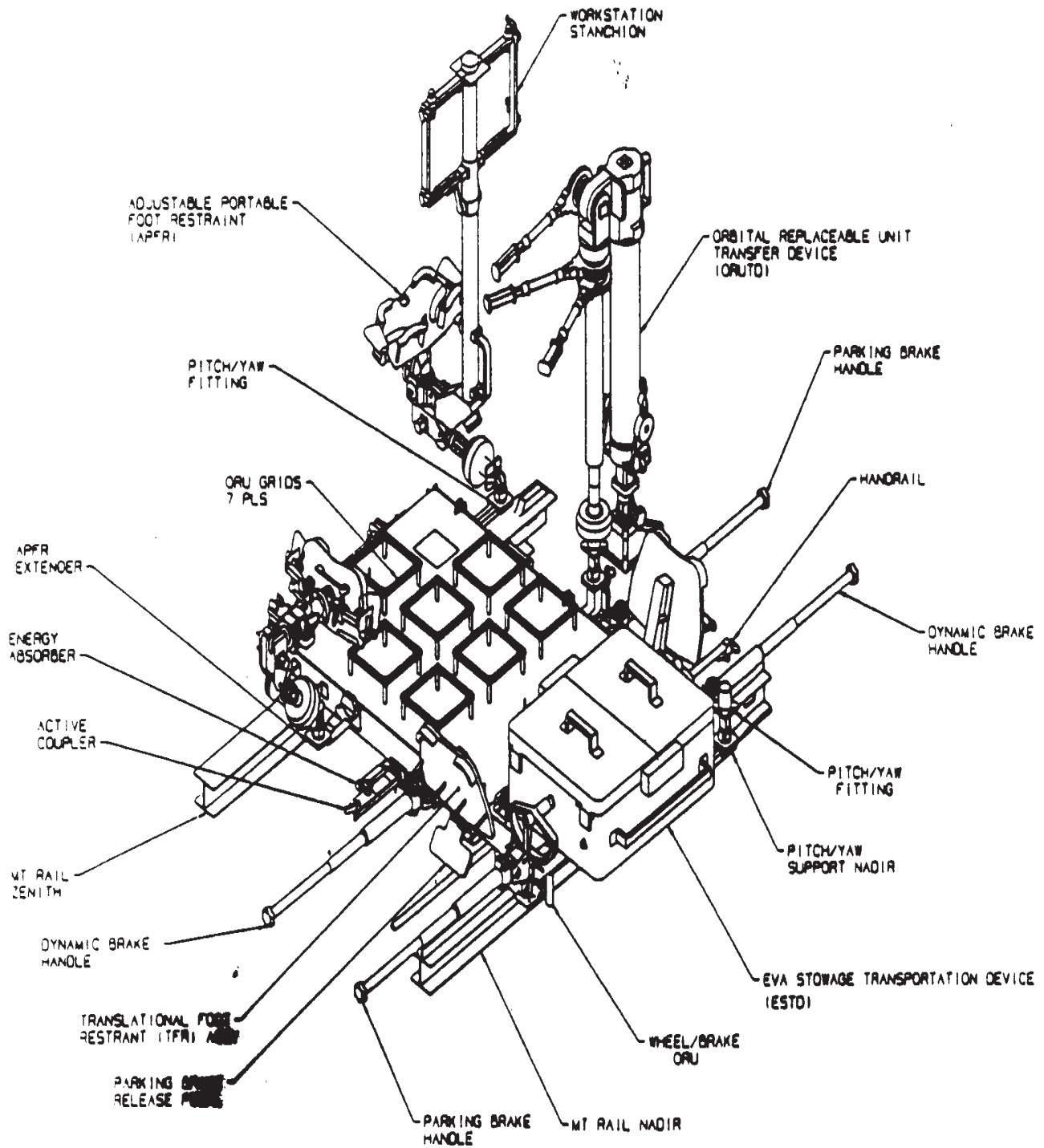


FIGURE 3.4.2-2 CETA CART ON-ORBIT TRANSLATION CONFIGURATION

3.4.2.1 INTERFACE DESCRIPTION

The CETA Cart interfaces with several ISS elements. The first is with ITS segments S1 and P1 for launch. The second is with the MT–CETA rails. The third is with the ITS structure. The fourth is with the Mobile Transporter (MT). And the final CETA Cart interface is with cargo (ORU or ORU(s) on CHIA subcarriers/cargo pallet). Note that any dimension that is shown as a maximum (Max) or a minimum (Min) and that is a CETA Cart controlled dimensions, area, etc. shall not be impinged upon by the opposing interfacing element.

Maximum: the highest that that value can be without affecting the CETA Cart design

Minimum: the lowest that that value can be without affecting the CETA Cart design

If a Max or Min value is an ISS element controlled value, it shall not be impinged upon by the CETA Cart.

3.4.2.1.1 CETA CART LAUNCH INTERFACE

The first CETA Cart interface is with ITS S1 and P1 and is used for launching the CETA Carts to orbit. One CETA Cart is launched on ITS S1 and the other is launched on ITS P1. The CETA Cart launch configuration is shown in Figure 3.4.2–1. The launch restraint locations of the CETA Cart on S1 and P1 is defined by the integrator those Truss Segments. Those locations are specified in Figure 3.4.2.1.1–1 ($Y = +149.750$ on Segment S1 and $Y = -149.750$ on Segment P1). These two values are relative to the ITS S1/P1 coordinate system and defines the location of the center of the launch restraint hole pattern (in Y axis). Figure 3.4.2.1.1–1 also shows the ITS structure (S1 and P1) bolt hole pattern and hole size to be supplied by Segments S1 and P1 for the CETA Cart launch restraint system and are dimensioned relative to the MT–CETA Rail datums. Figure 3.4.2.1.1–2 shows the floating nut that is provided by the S1/P1 provider onto which the CETA Cart launch restraint bolts will attach.

The CETA Cart provider is responsible for providing the launch restraints (fasteners/bolts) that attach the CETA Carts to ITS S1 and P1. The CETA Cart bolt pattern interfaces supplied by the CETA Carts are shown in Figure 3.4.2.1.1–3 and are dimensioned relative to the CETA Cart datums. Figure 3.4.2.1.1–3 shows the CETA Cart bolt hole pattern and bolt size relative to the CETA Cart datums and also shows the flatness requirements for both the CETA Cart and the MT–CETA rail at the launch location on S1 and P1.

The launch restraint bolt pattern on the CETA Cart and the bolt hole pattern on Segments S1 and P1 shall be located by a Support Fixture (drill template) that is to be provided by the ITS S1 and P1 provider (MDA–Huntington Beach). The Support Fixture shall then be used to locate the four (4) hole pattern onto ITS S1 and P1 within the tolerance specified in Figure 3.4.2.1.1–1 and Figure 3.4.2.1.1–3. The Support Fixture shall then be used to locate the same four (4) bolt hole pattern onto the two CETA Carts. This will assure that the 4 bolt hole pattern is the same on both the CETA Carts and on the ITS launch locations.

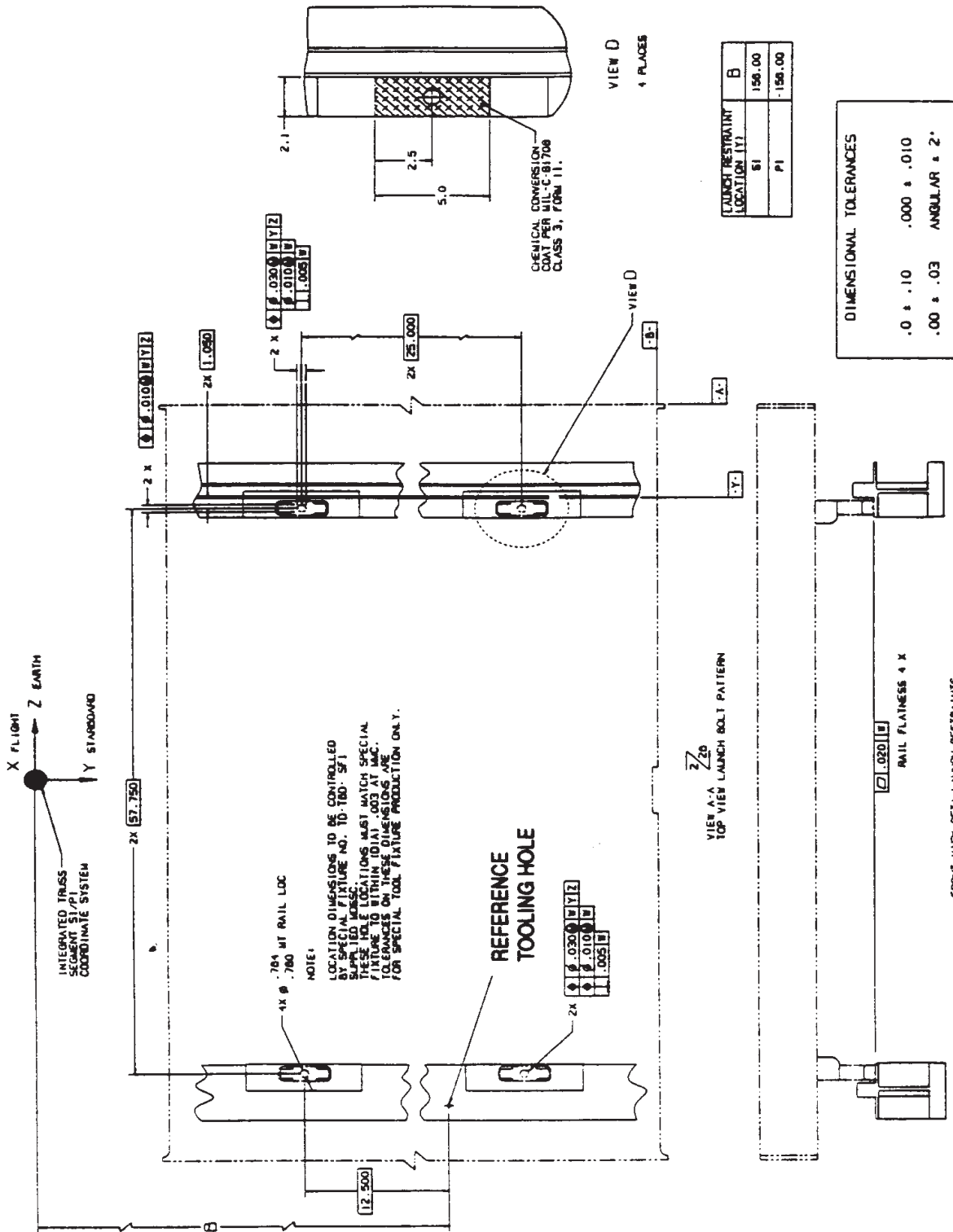


FIGURE 3.4.2.1.1-1 CETA CART LAUNCH RESTRAINT FOOT PRINT AND BOLT PATTERN

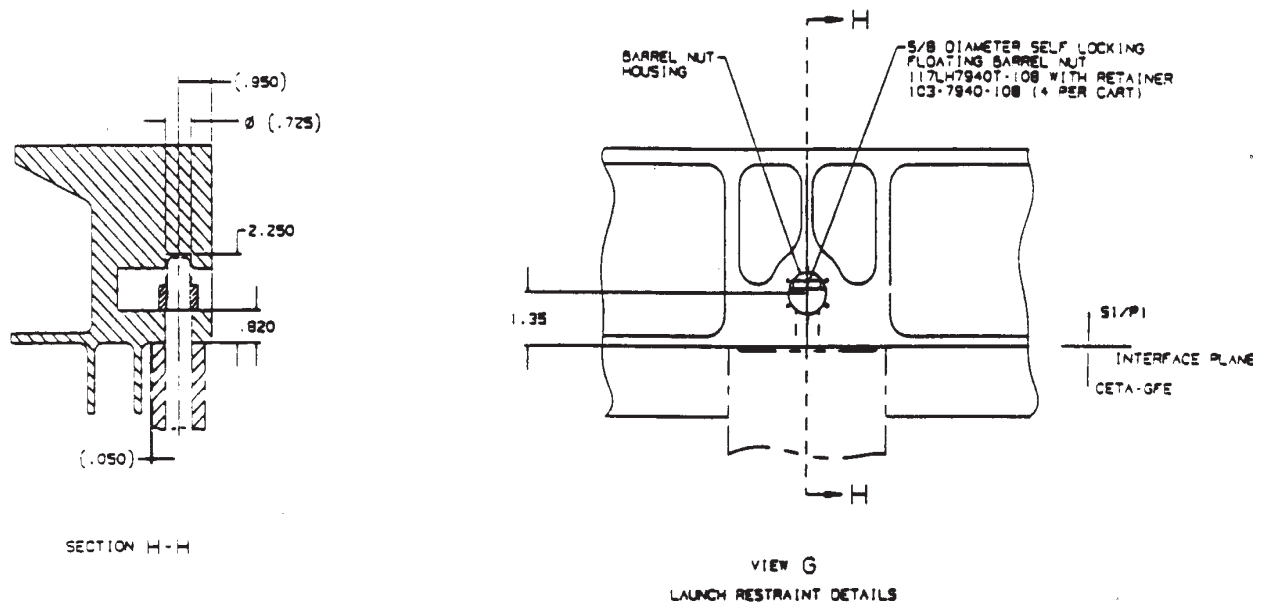


FIGURE 3.4.2.1.1-2 CETA CART LAUNCH RESTRAINT DETAILS

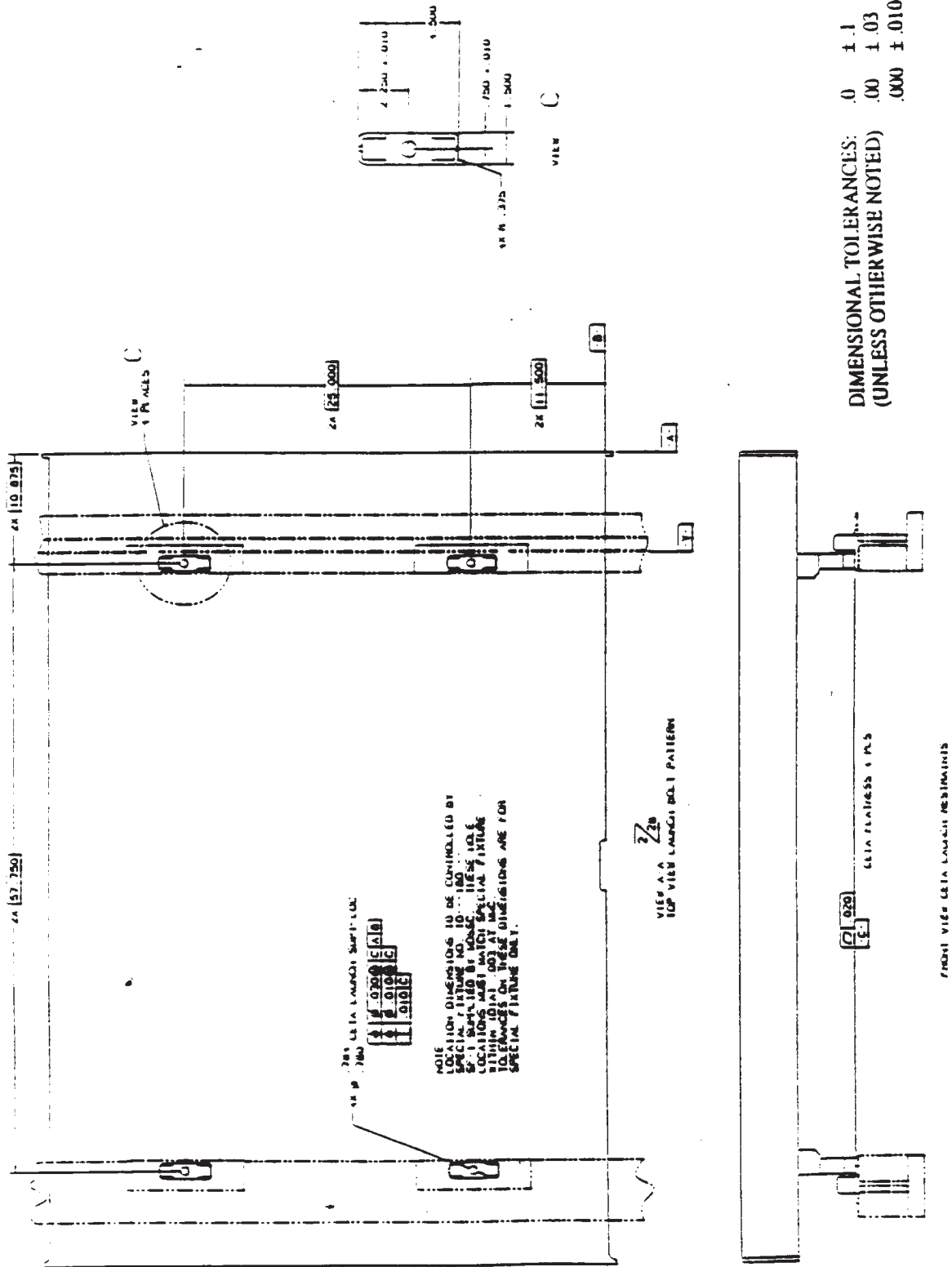


FIGURE 3.4.2.1.1-3 CETA CART TO ITS SEGMENTS S1 AND P1 INTERFACES

Figure 3.4.2.1.1–1 shows the footprint envelope that the CETA Cart launch restraint must stay within and also shows the footprint relative to the 4 bolt hole pattern set on the MT–CETA rails. Figure 3.4.2.1.1–3 (View C) shows the CETA Cart launch restraint footprint relative to the bolt centerline. Figure 3.4.2.1.1–4 (View B) shows the CETA Cart wheel bogie spacing requirements while on the MT–CETA rail at the launch location on S1 and P1.

In order to support the attachment of the CETA Cart(s) to ITS S1 and P1, the CETA Cart provides four lift points. The lift points locations and the hole diameter and thread size are defined in Figure 3.4.2.1.1–4. Note that the CETA Cart will be delivered with lifting eyelets on each of the lifting points. Two stay out zones are also defined in Figure 3.4.2.1.1–4. These stay out zones are required only during installation of the CETA Cart onto the ITS and are required for the attachment of the four CETA Cart launch restraints. The lifting point locations and the stay out zones are dimensioned relative to CETA Cart datums –A– and –B–.

Figure 3.4.2.1.1–4 also shows a top view of the CETA Cart in its Launch configuration. Figure 3.4.2.1.1–5 shows an end view of the CETA Cart (while on the MT–CETA rail launch location). This view shows the envelope dimensions in the “Z” and “X” directions (relative to the ISS coordinate system).

3.4.2.1.2 CETA CART TO MT–CETA RAIL INTERFACE

The second CETA Cart interface is with the MT–CETA rails (on Face 1 of the ITS from S3 to P3). The MT–CETA rails allow the CETA Carts to attach to the ISS and allow the crew to translate EVA equipment and cargo along Face 1 of the ITS. The MT–CETA rails are placed such that one is on the Nadir side of Face 1 and one on the Zenith side of Face 1. This interface consists ITS joints and profiles. Figure 3.4.2.1.2–1 (View Y and View DE) show the profile views of the Nadir and Zenith rails. Figure 3.4.2.1.2–1 also defines the relationship that must be maintained between the two rails (nadir & zenith). Even though Figure 3.4.2.1.2–1 gives a nominal nadir and zenith height for the vertical flange of $1.80 \pm .06$, the maximum possible vertical interference is defined by the MT worksite tie down points as $2.475 \pm .003$ inches above Datum –W–. As stated before, the MT–CETA rails have gaps and misalignments at the various segment–to–segment connections and also at the junctions at each SARJ. Figure 3.4.2.1.2–2 shows the maximum ITS to ITS joint gaps and misalignments. Figure 3.4.2.1.2–3 shows the tapers at the end of each rail at the ITS to ITS connections.

The SARJ consists of three segments of rail that when aligned allow the MT and the CETA Carts to cross the SARJ connection. Figures 3.4.2.1.2–4, 3.4.2.1.2–5, and 3.4.2.1.2–6 show the relationship between the three segments of rail. Figures 3.4.2.1.2–7 and 3.4.2.1.2–8 show the maximum SARJ gaps and misalignments at the two joints that make up the SARJ connection. Figures 3.4.2.1.2–9 and 3.4.2.1.2–10 show the tapers at the end of each rail segment at the two SARJ gaps. Figure 3.4.2.1.2–11 shows periodic indentations created by tie down sensors for the MT that are located on the MT–CETA rails.

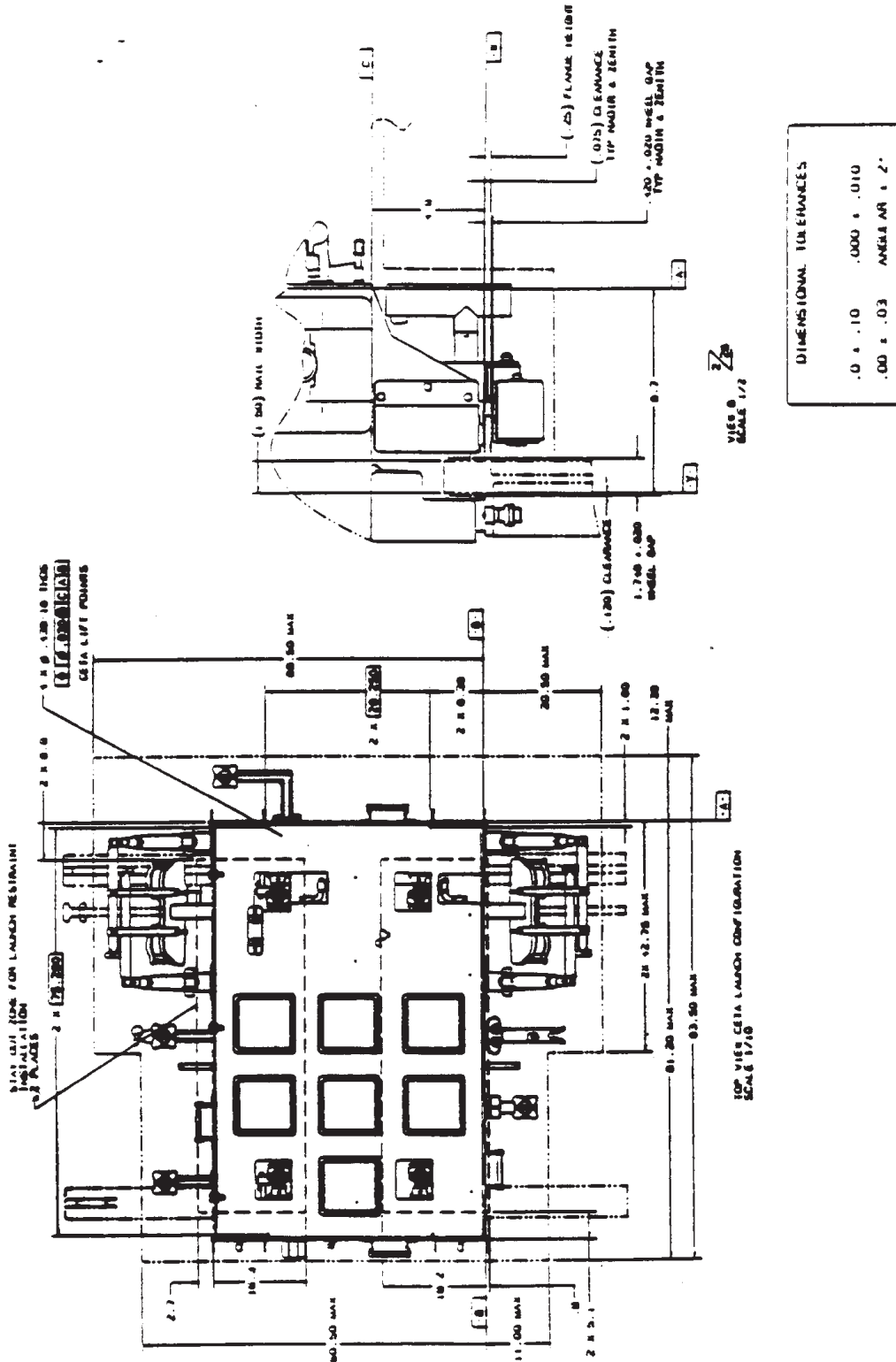


FIGURE 3.4.2.1.1-4 CETA CART LAUNCH RESTRAINT WHEEL BOGIE SPACING AND LIFTING POINT LOCATIONS

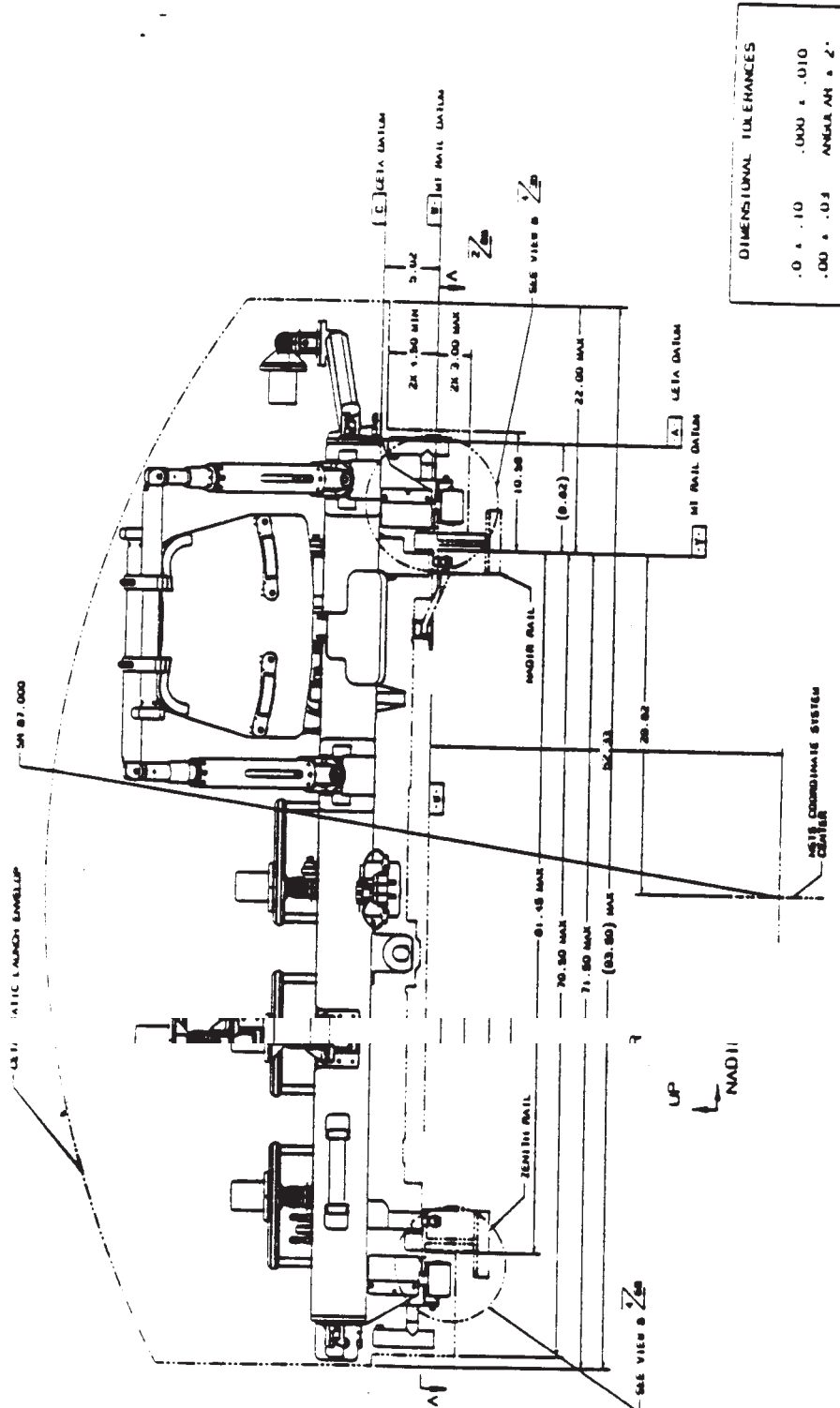


FIGURE 3.4.2.1.1-5 CETA CART LAUNCH ENVELOPE - FRONT VIEW

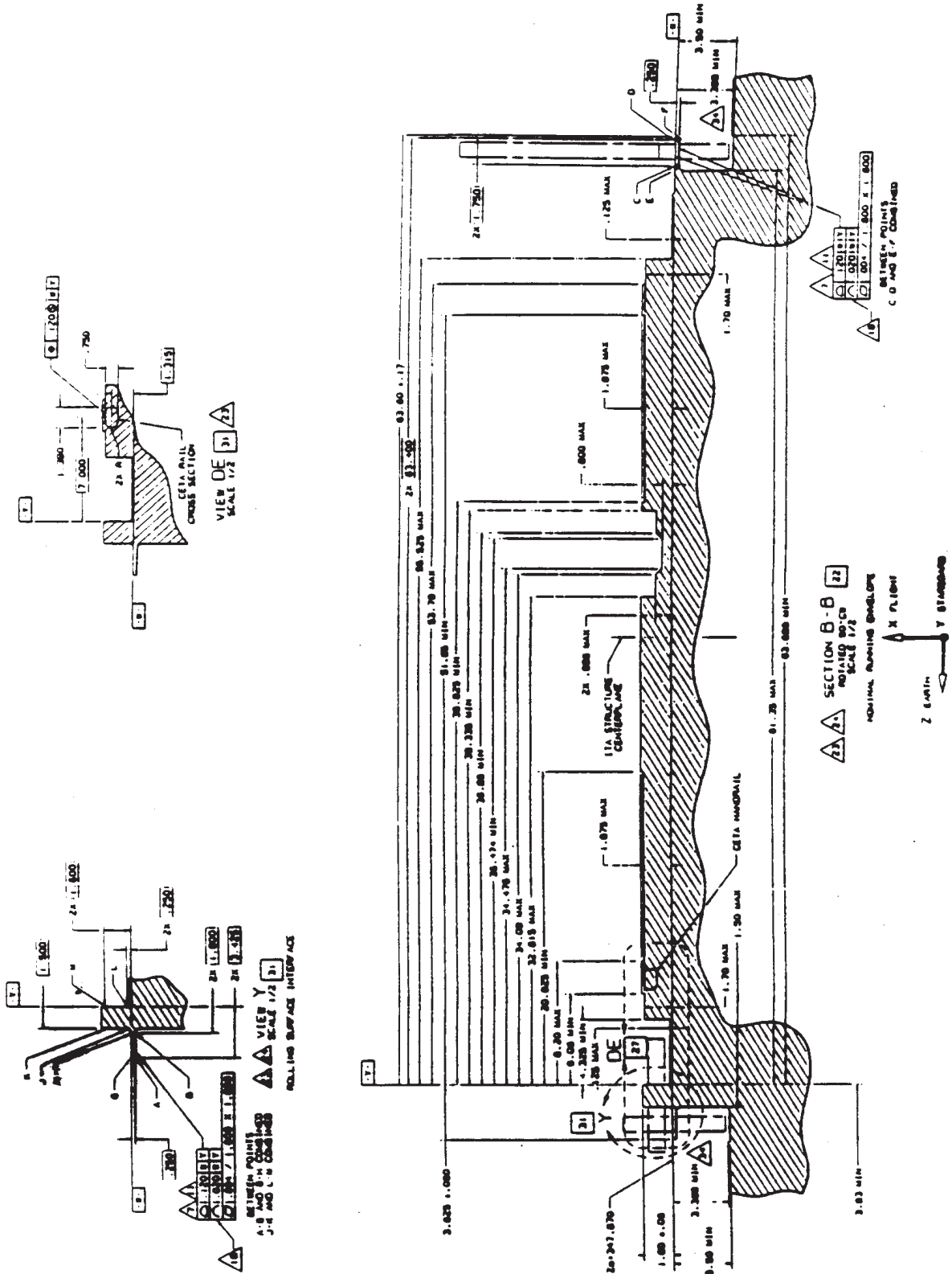


FIGURE 3.4.2.1.2-1 MT-CETA RAIL PROFILE AND INTERFACE DIMENSIONS

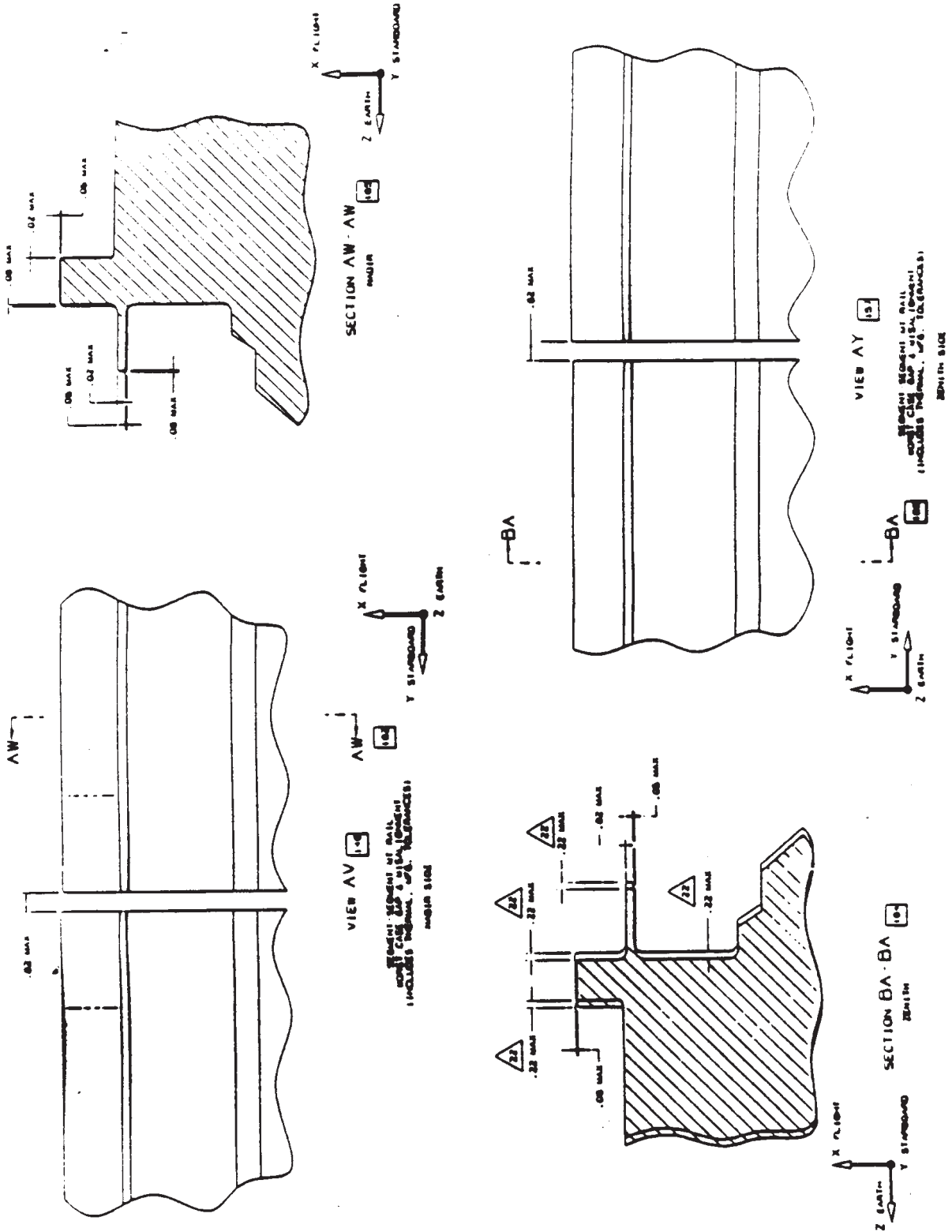


FIGURE 3.4.2.1.2-2 MT-CETA RAIL ITS SEGMENT TO ITS SEGMENT GAPS AND MISALIGNMENTS

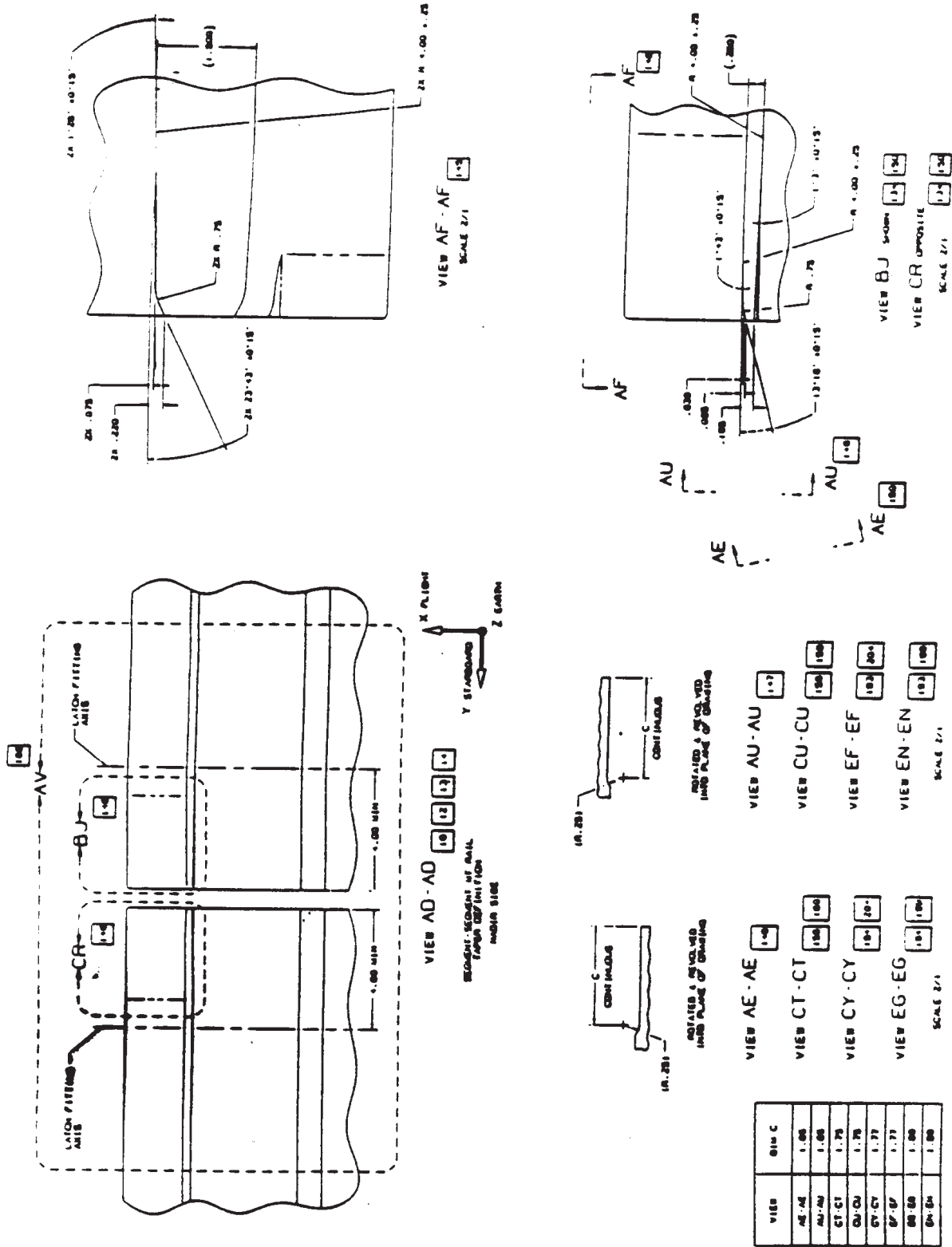


FIGURE 3.4.2.1.2-3 MT-CETA ITS SEGMENT RAIL END TAPERS

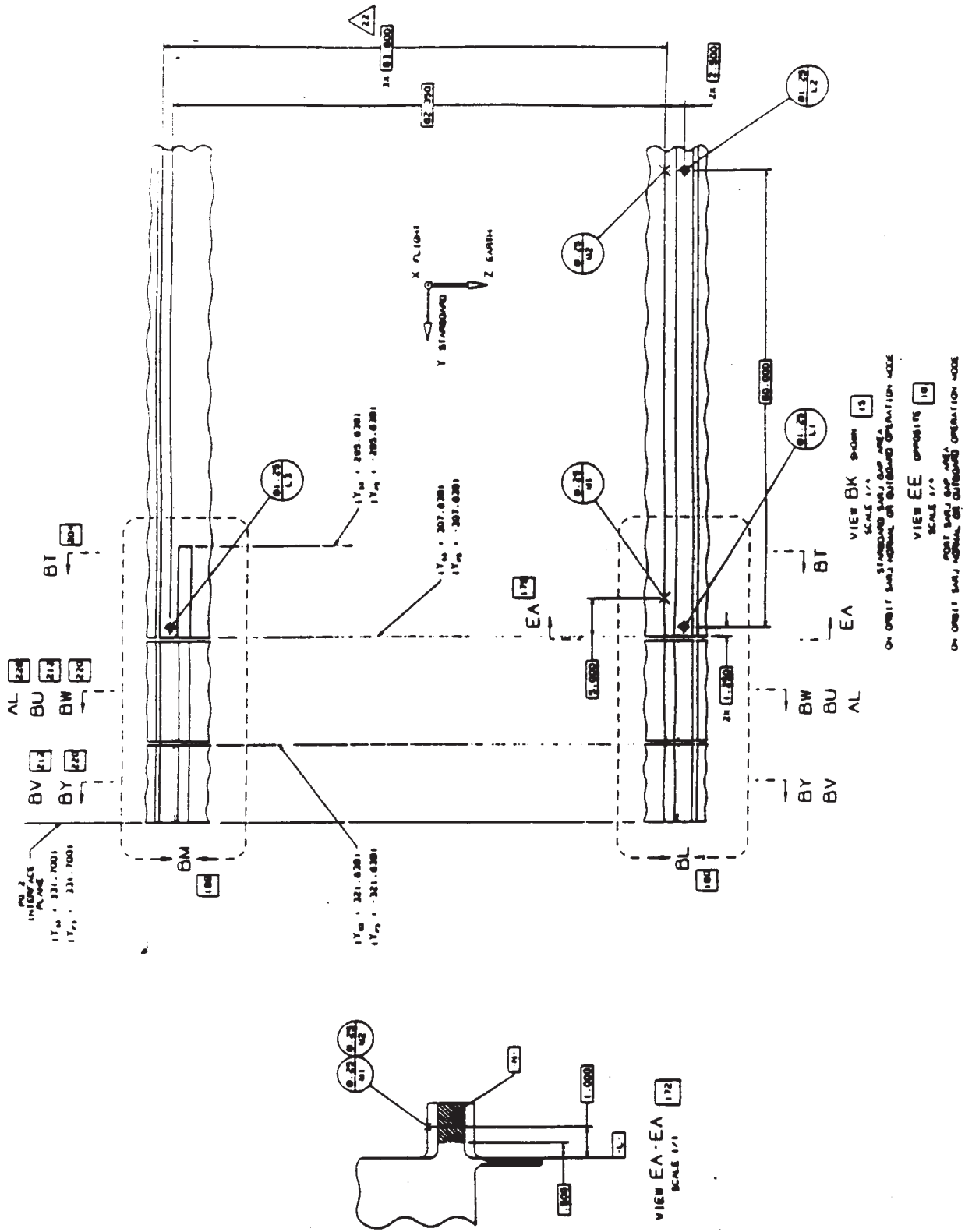


FIGURE 3.4.2.1.2-4 SOLAR ARRAY ROTARY JOINT SEGMENT RELATIONSHIPS

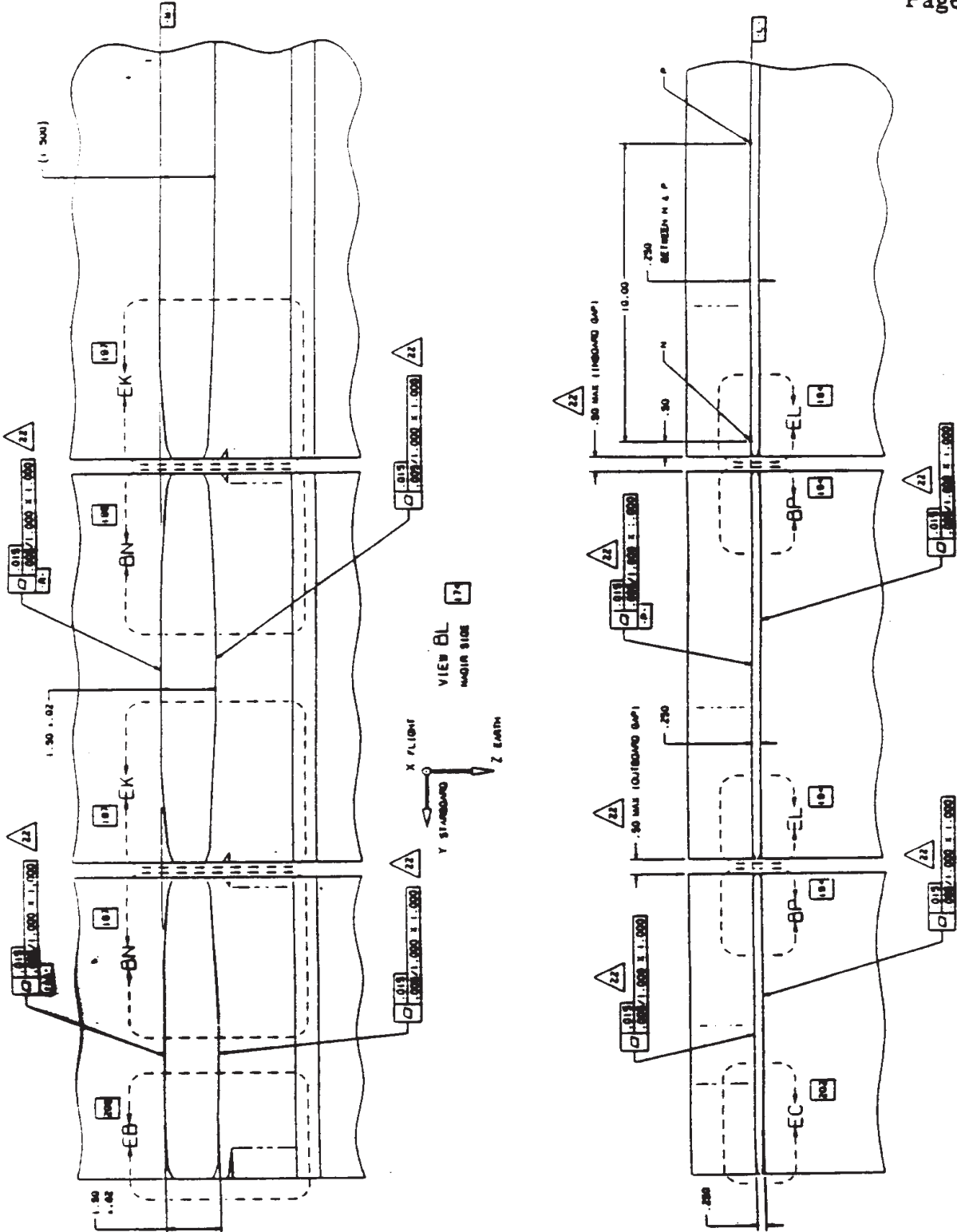


FIGURE 3.4.2.1.2-5 SOLAR ARRAY ROTARY JOINT SEGMENT RELATIONSHIPS – NADIR DETAIL

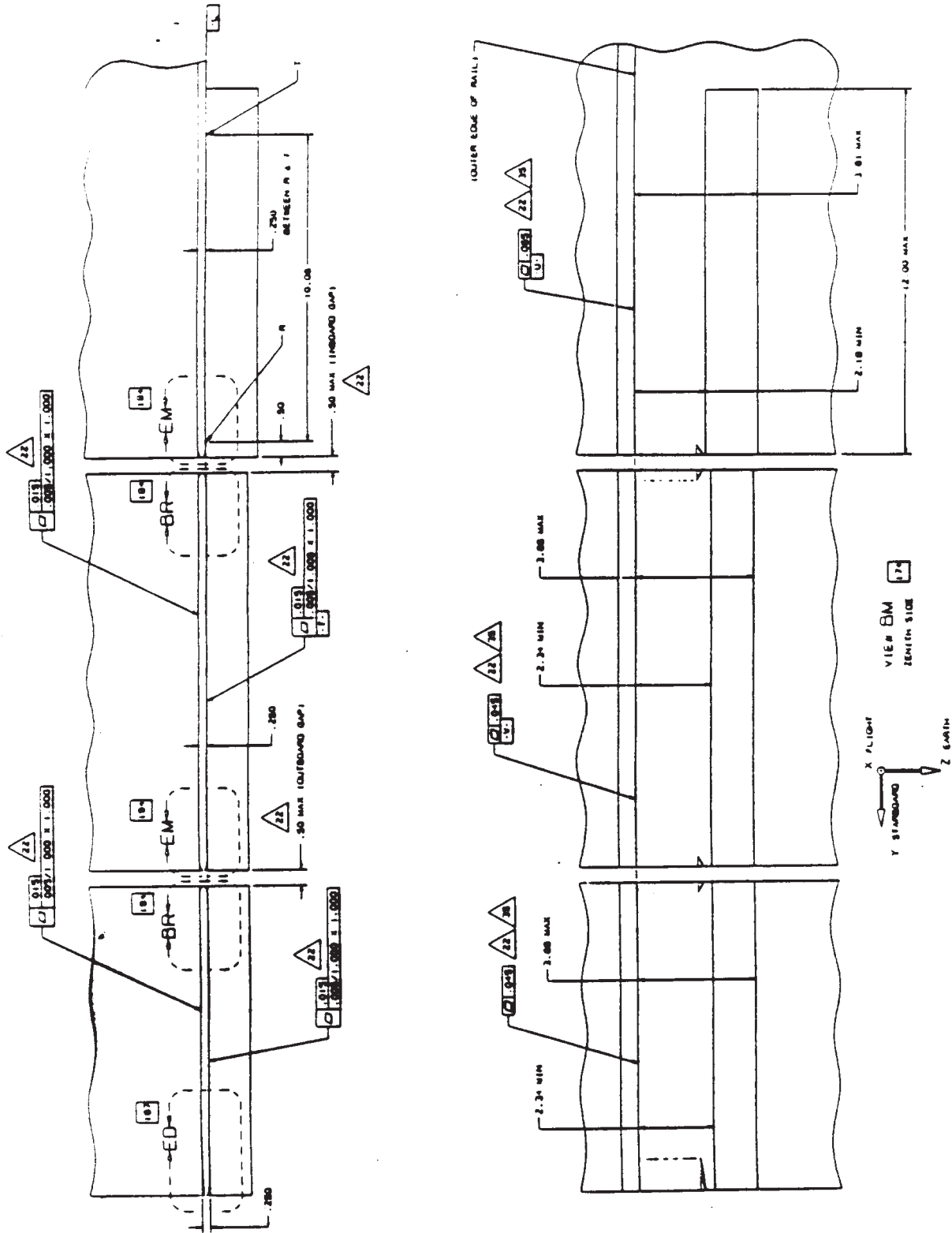


FIGURE 3.4.2.1.2-6 SOLAR ARRAY ROTARY JOINT SEGMENT RELATIONSHIPS – ZENITH DETAIL

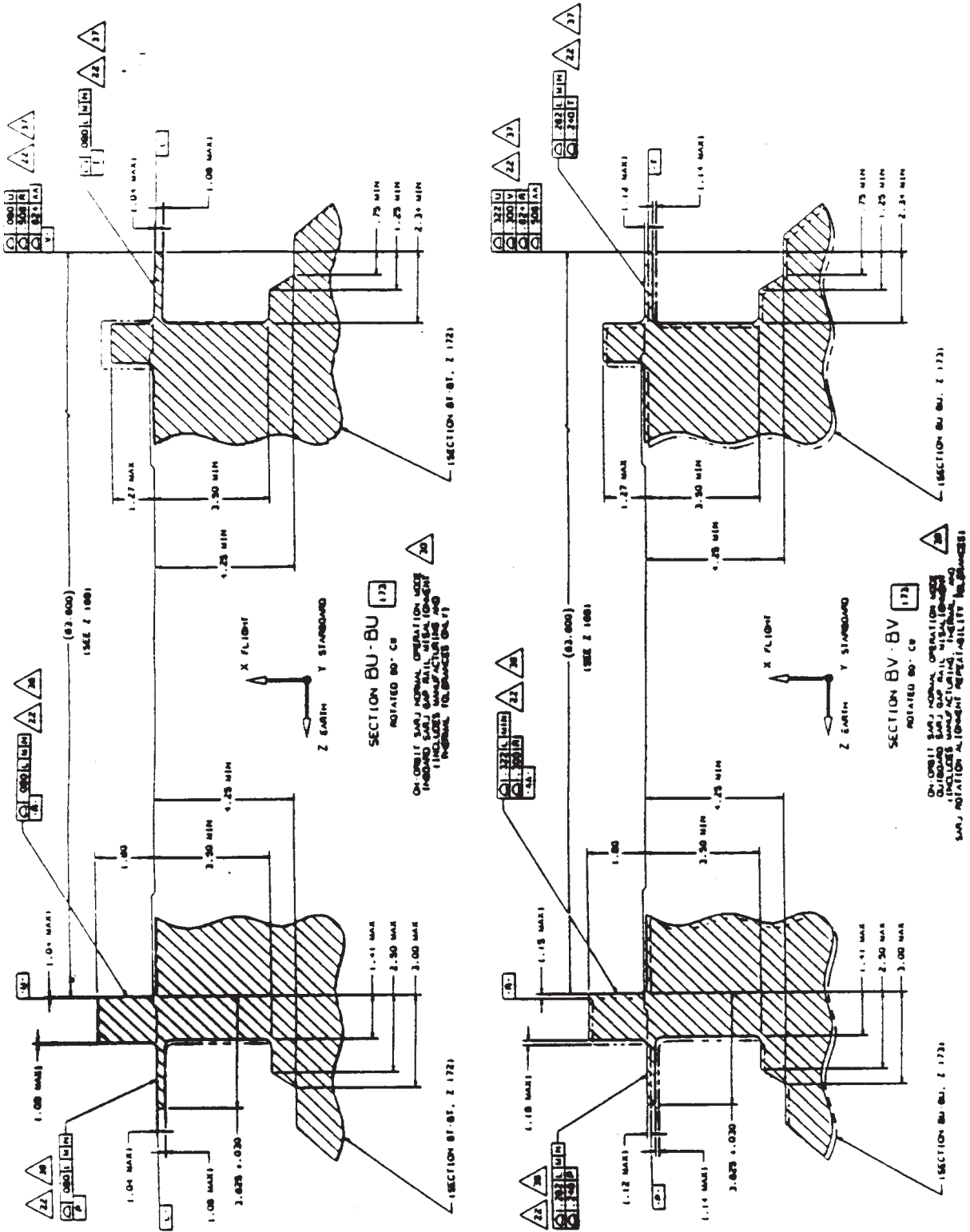


FIGURE 3.4.2.1.2-7 SOLAR ARRAY ROTARY JOINT RAIL GAPS AND MISALIGNMENTS

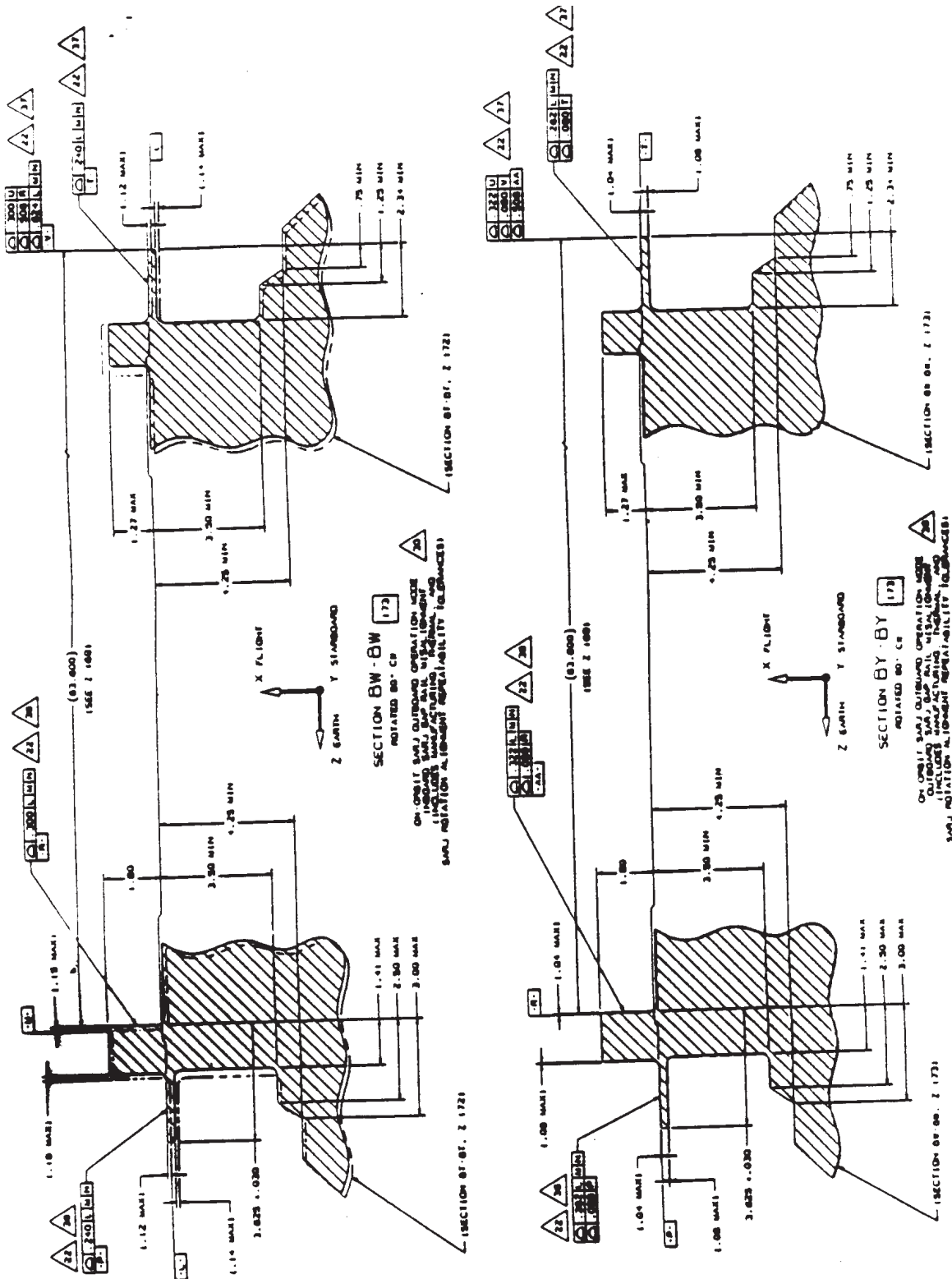


FIGURE 3.4.2.1.2-8 SOLAR ARRAY ROTARY JOINT RAIL GAPS AND MISALIGNMENTS (CONT'D)

During on-orbit usage, the CETA cart dynamic brakes, parking brakes, and the CETA cart wheel bogies will physically interface with the MT-CETA rails. The CETA Cart nominal wheel bogies spacings are shown in Figure 3.4.2.1.1-4 and the removal envelope in Figure 3.4.2.1.2-12.

3.4.2.1.3 CETA CART TO ITS STRUCTURE INTERFACE

The third interface, CETA Cart to ITS structure, encompasses three interfaces; worksite setup locations from the CETA cart, CETA Cart translation envelope relative to the ITS structure, and the CETA Cart energy absorbers to the MT-CETA Stops interface. A nominal on-orbit configuration of the CETA Cart is shown in Figure 3.4.2-2 which is used in determining these interfaces. Figure 3.4.2.1.3-1 defines the interface between the MT-CETA rails and the CETA.

The CETA Cart worksite locations are shown in Figure 3.4.2.1.3-2. Figure 3.4.2.1.3-2 also shows the WIF Pitch/Yaw fitting locations and the handhold locations on the CETA Cart. Note that one of the WIF Pitch/Yaw fittings is located on an extender that can be moved from 7 inches to 36 inches from the edge of the CETA Cart at 3.25 inch increments. To allow greater flexibility in setting up the APFRs to the necessary orientations, the CETA Cart provides Pitch/Yaw fittings underneath each WIF. Figure 3.4.2.1.3-3 shows pitch/yaw fitting articulation travel and the increment spacings.

The CETA Cart energy absorbers interface with the MT-CETA rail stops located on Face 1 at the ends of each ITS (located between the MT-CETA rails). Figures 3.4.2.1.3-4 and Figure 3.4.2.1.3-5 show details of the CETA Cart to MT-CETA rail stop. The CETA Energy Absorber misalignment envelope is defined by the rectangle with the dimensions .475 by .357 as shown in Figure 3.4.2.1.3-4 and is dimensioned relative to Datums -W- and -Y- (MT-CETA rail Datums).

3.4.2.1.4 CETA CART TO MOBILE TRANSPORTER (MT) INTERFACE

The fourth CETA Cart interface is with the Mobile Transporter (MT). This CETA Cart interface encompasses the location and the supplied elements (provided by the CETA Cart provider) of the system that couples the CETA Cart(s) to the MT. The coupling system elements is provided by the CETA Cart provider. The CETA Carts attach to the Mobile Transporter while on the MT-CETA rail or to the second CETA cart that is attached to the MT to CETA coupler engaged during on-orbit stowage. These are unique MT stowage sites. In addition, once the CETA Cart(s) are coupled to the MT, the relationship between these two elements creates a larger system that must be controlled by the Prime Integrator to other ISS elements.

The active and passive coupler as shown in Figures 3.4.2.1.4-1 and 3.4.2.1.4-2 are provided by the CETA Cart to the MT integrator/provider. Figures 3.4.2.1.4-1 and 3.4.2.1.4-2 also show the maximum allowable envelope dimensions for the active and passive couplers. The MT integrator/provider shall assure that the active and passive coupler attachment points are

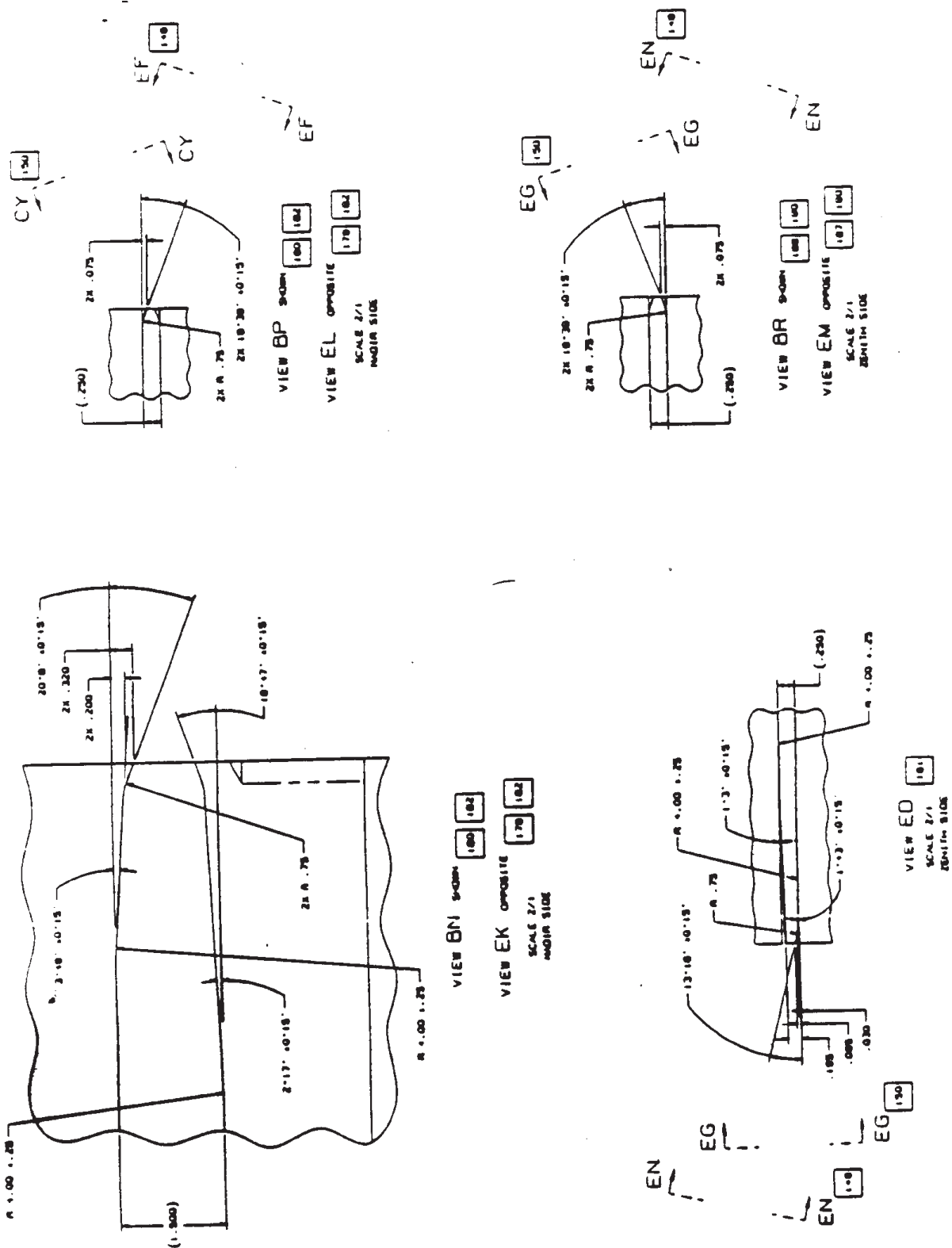


FIGURE 3.4.2.1.2-9 SOLAR ARRAY ROTARY JOINT RAIL END TAPERS

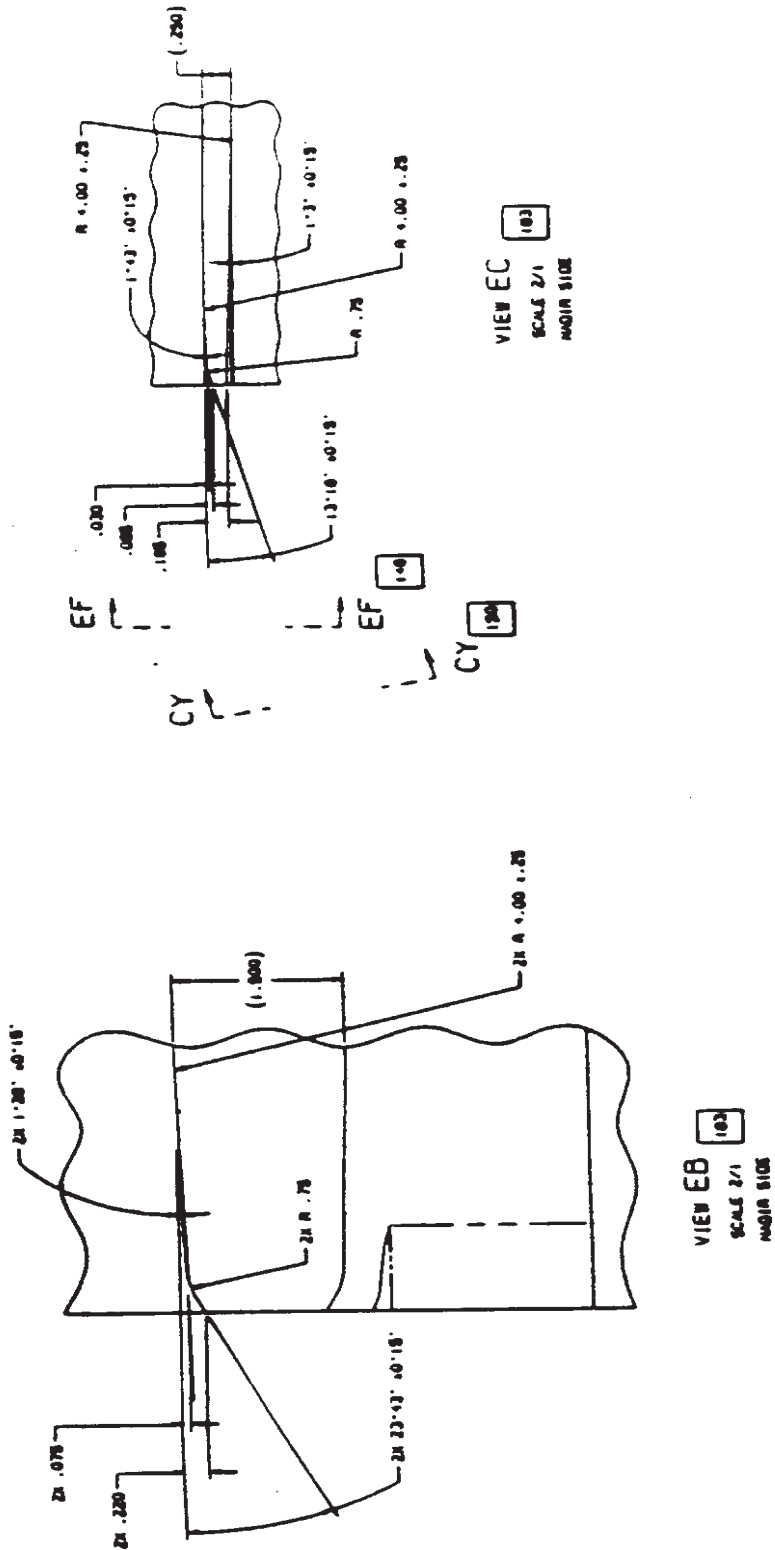


FIGURE 3.4.2.1.2-10 SOLAR ARRAY ROTARY JOINT RAIL END TAPERS (CONT'D)

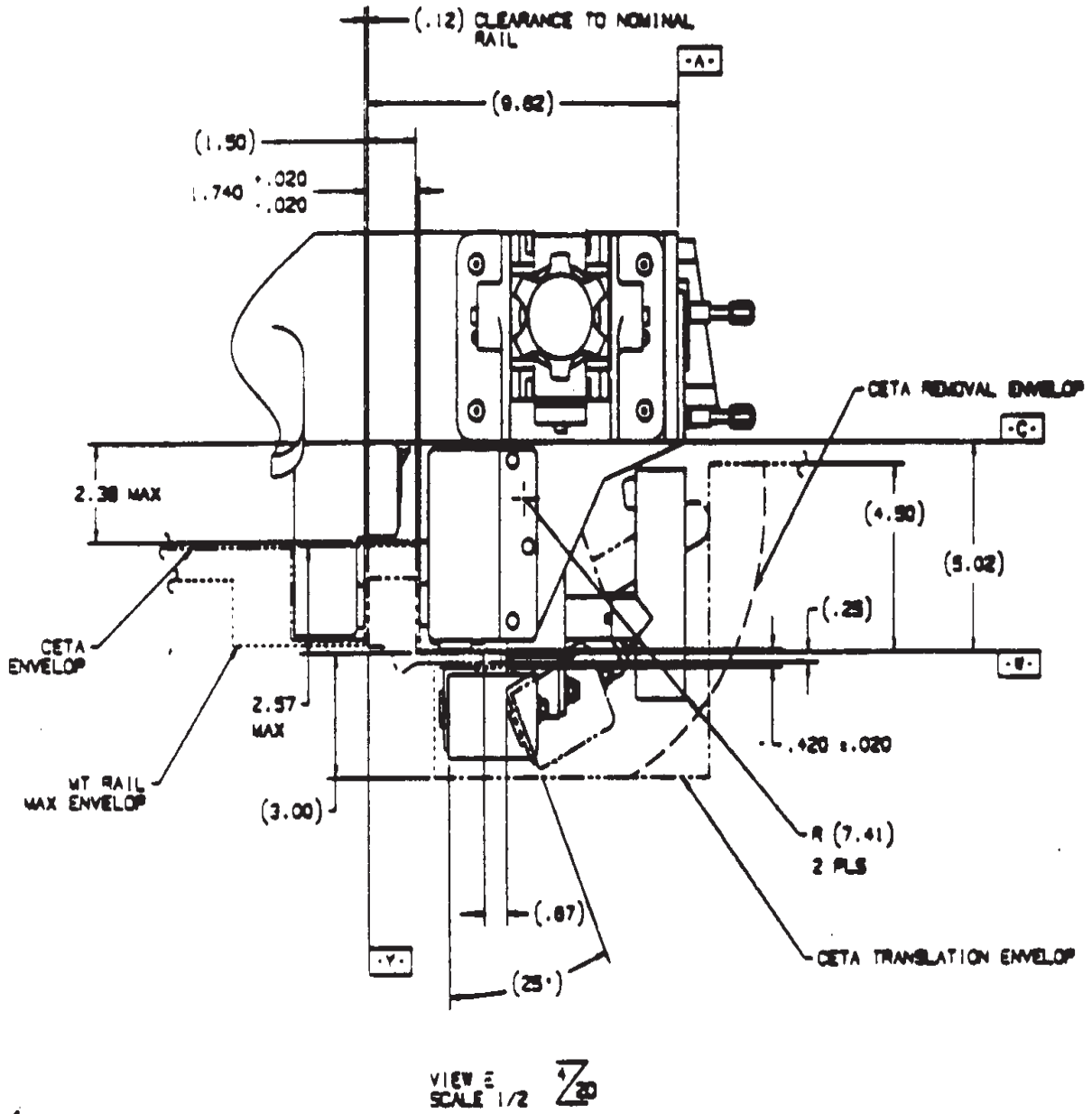
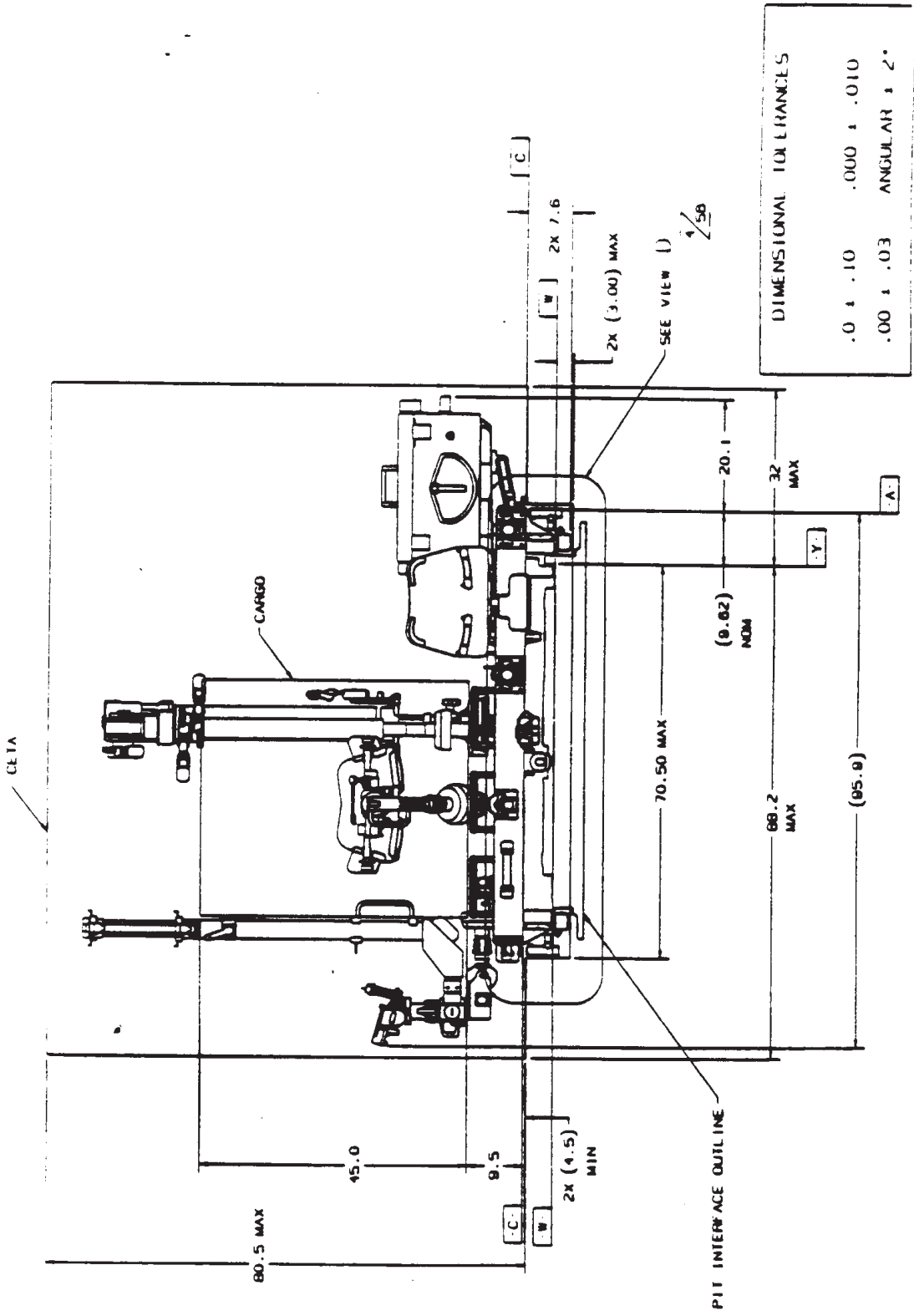
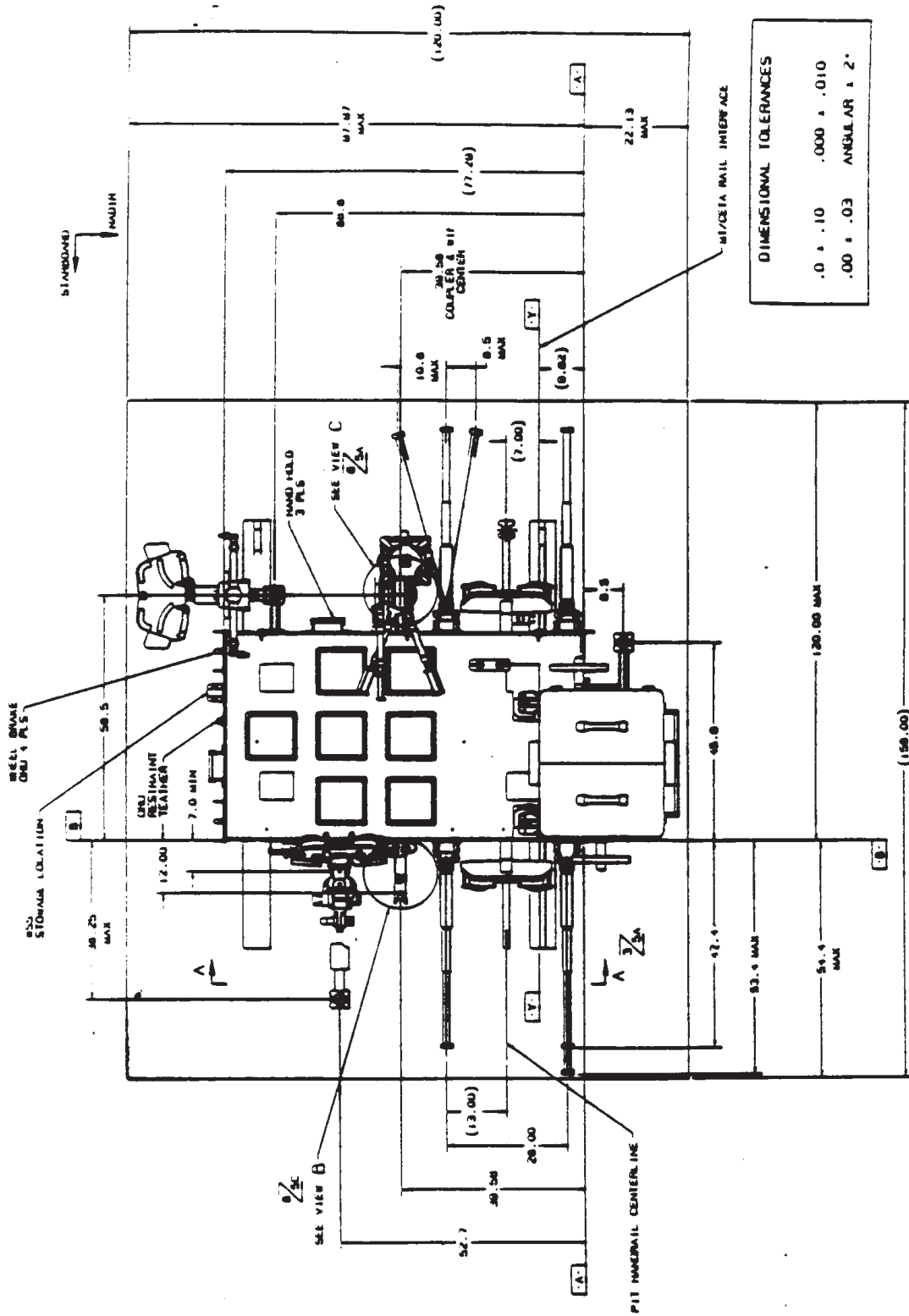


FIGURE 3.4.2.1.2-12 CETA WHEEL BOGIE REMOVAL ENVELOPE



VIEW A-A $\frac{2}{30}$
 CETA ON ORBIT TRANSLATION ENVELOP

FIGURE 3.4.2.1.3-1 CETA CART FRAME TO MT-CETA RAIL INTERFACE



CETA OR ORBIT TRANSLATION ENVELOPE

FIGURE 3.4.2.1.3-2 CETA CART WORKSITE LOCATIONS

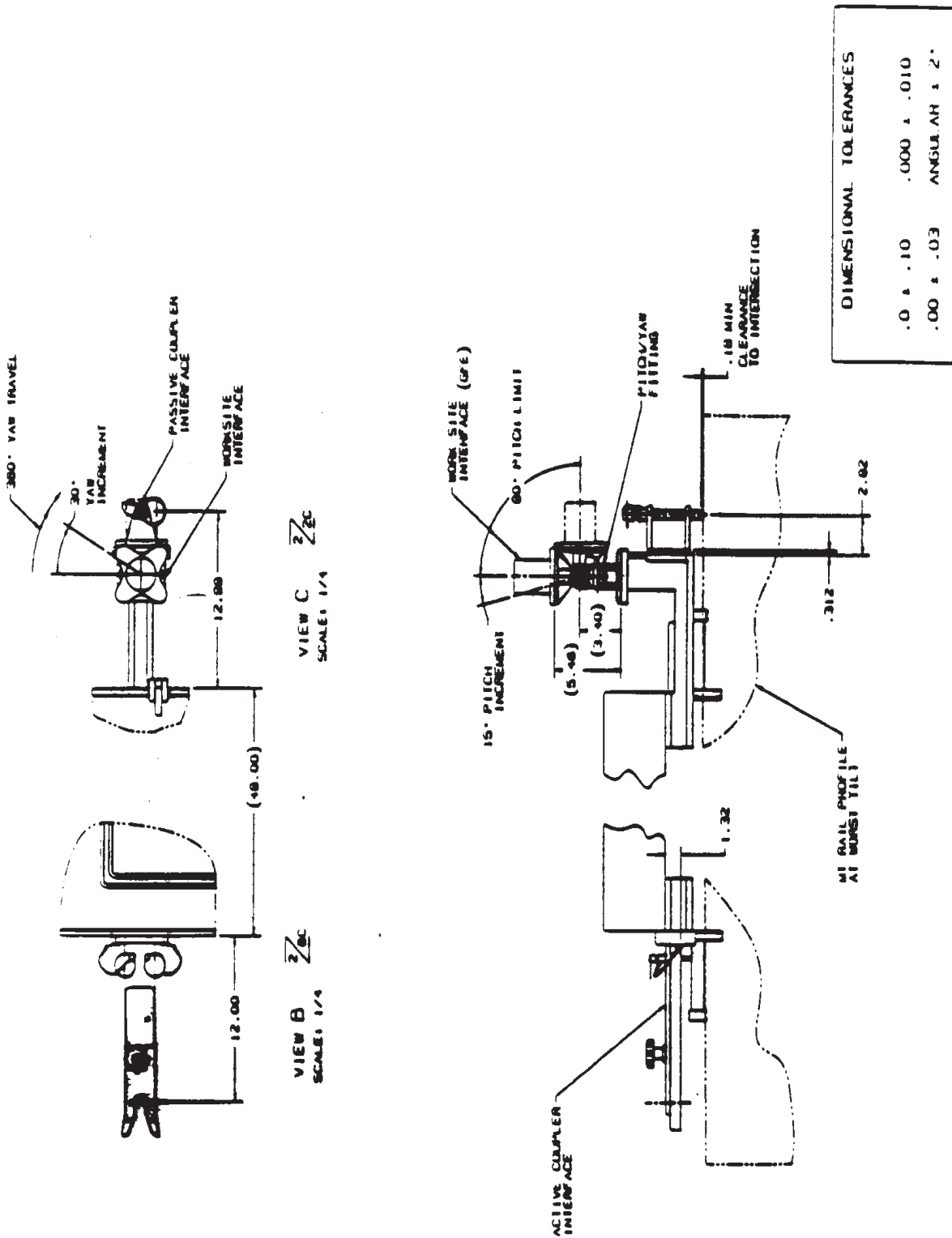


FIGURE 3.4.2.1.3-3 CETA PITCH/YAW FITTING ARTICULATION RANGE AND INCREMENTAL SETTINGS

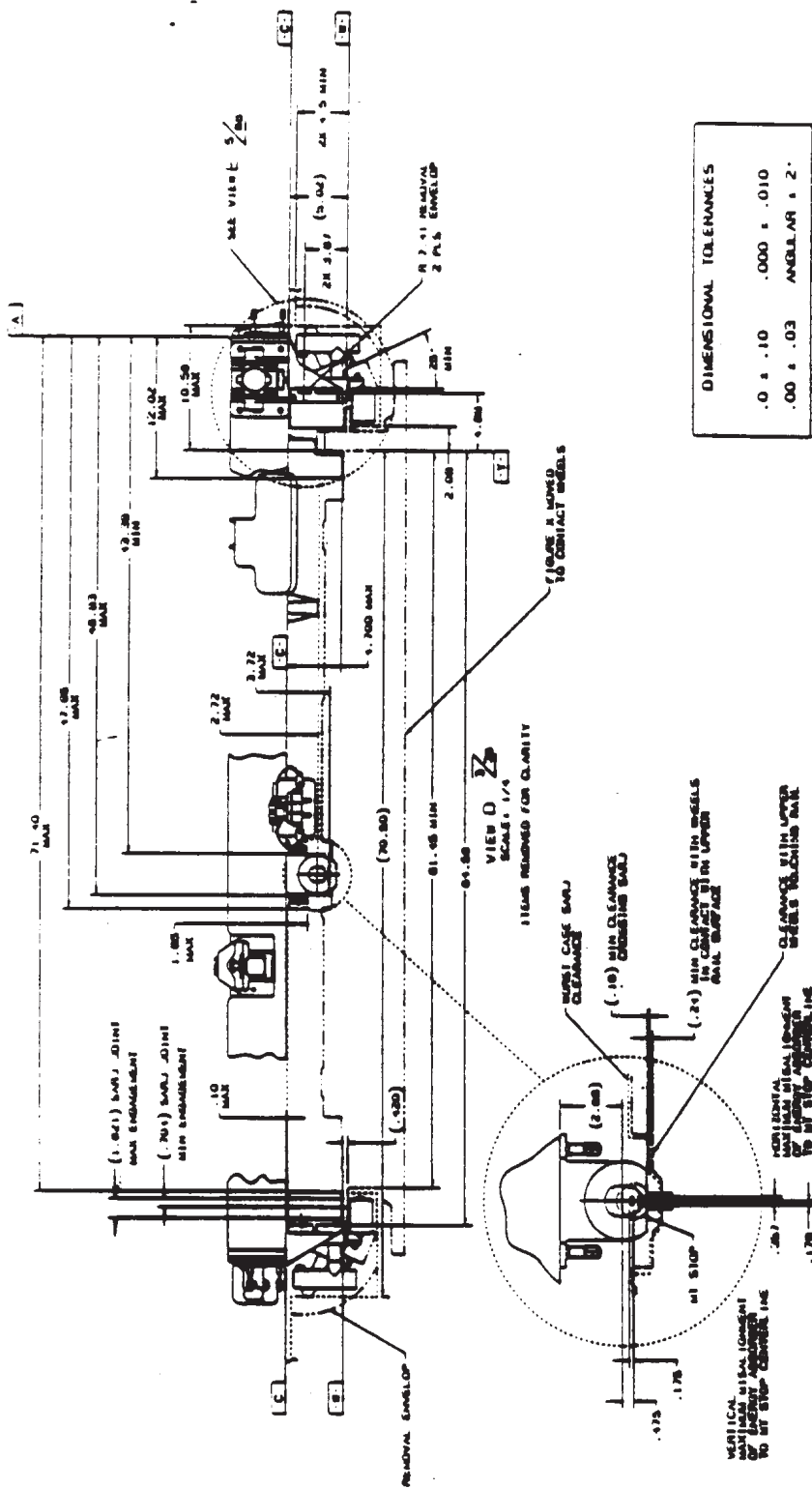


FIGURE 3.4.2.1.3-4 CETA CART TO MT-CETA RAIL STOP INTERFACE DETAILS AND MISALIGNMENT ENVELOPE

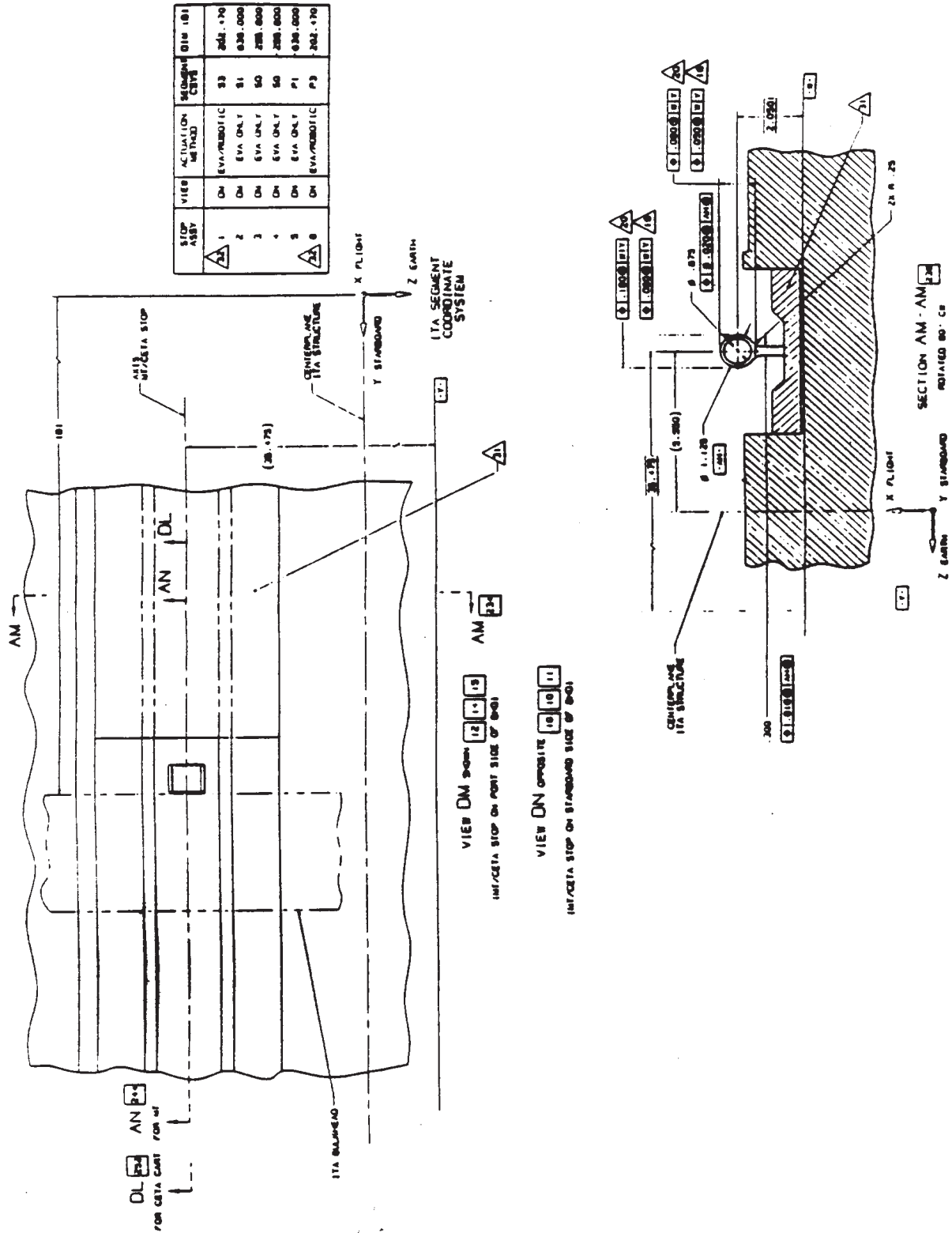


FIGURE 3.4.2.1.3-5 MT/CETA RAIL STOP DETAIL

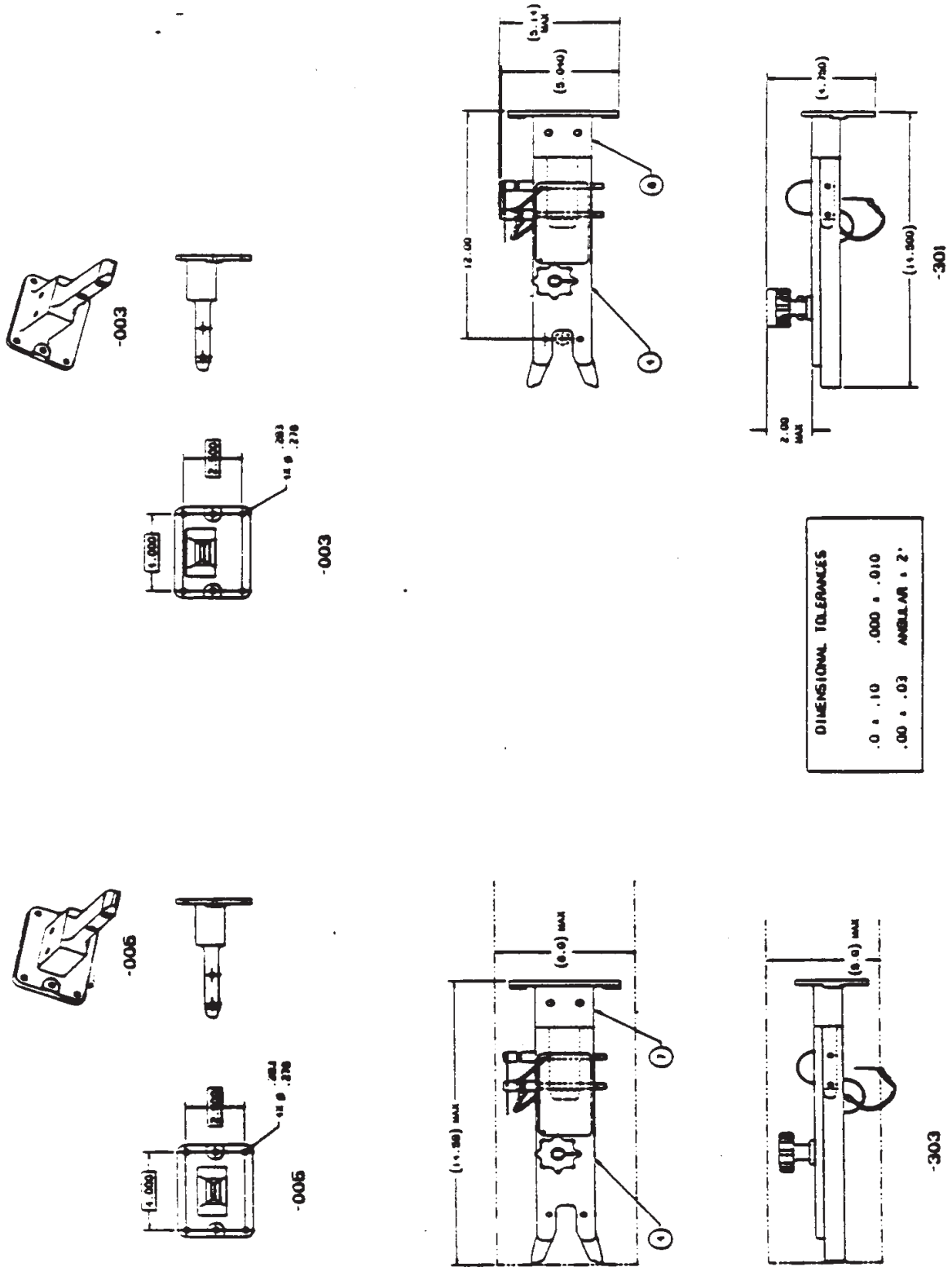


FIGURE 3.4.2.1.4-1 CETA CART ACTIVE COUPLER

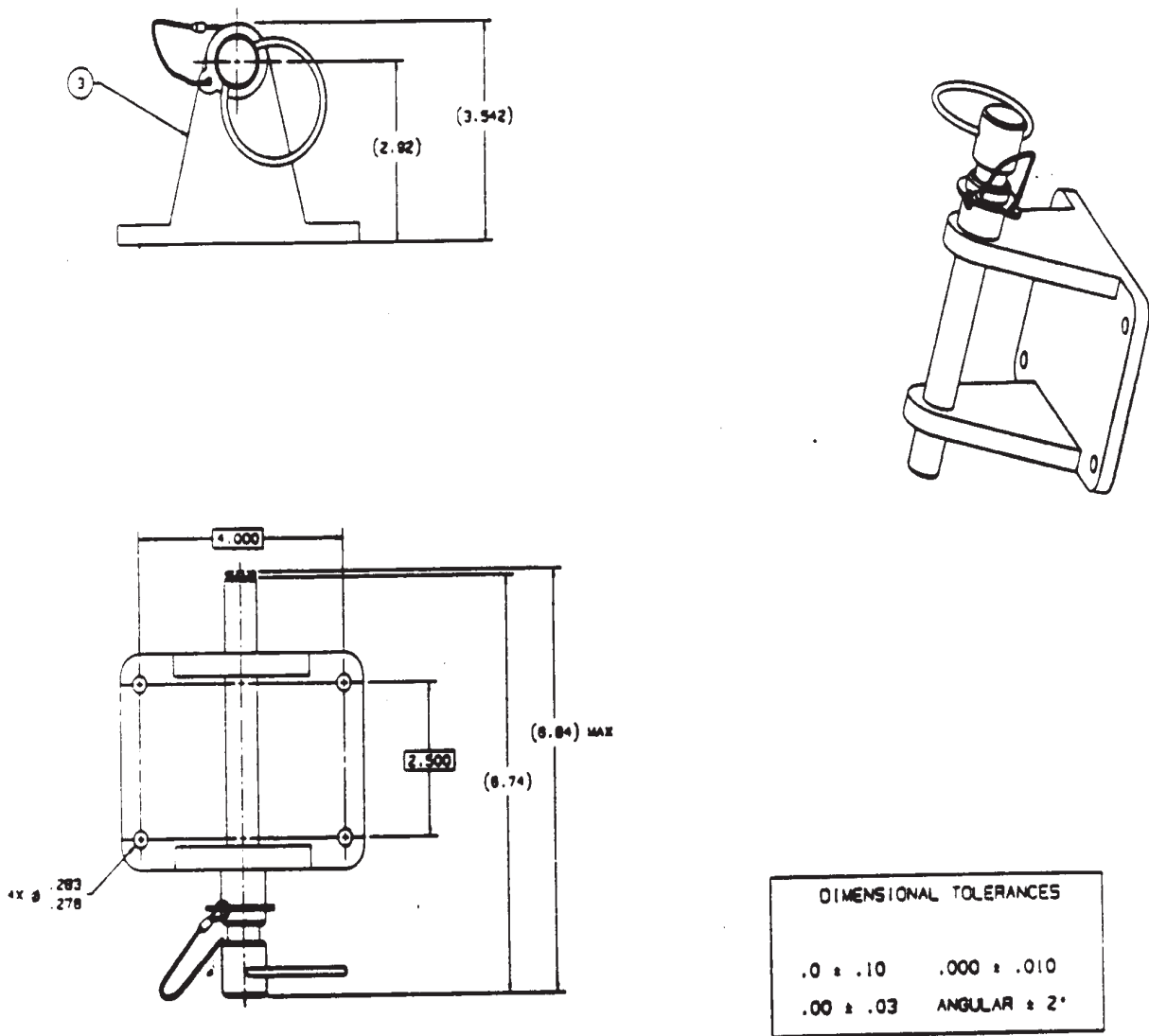


FIGURE 3.4.2.1.4-2 CETA CART PASSIVE COUPLER

located within the envelope and by the hole pattern specified in Figures 3.4.2.1.4–1, 3.4.2.1.3–2, and 3.4.2.1.3–3.

3.4.2.1.5 CETA CART TO CARGO INTERFACE

The final CETA Cart interface is with cargo. Cargo is defined as a CHIA subcarrier/cargo pallet that includes an Active Common Structural Interface (CSI) latching mechanism and attached ORUs. In order to support attachment of cargo onto the CETA Cart, several Passive Common Structural Interfaces (CSIs) Grids are supplied by the CETA Cart per Figure 3.4.2.1.5–1. In addition, the CETA Cart allows a maximum footprint for cargo per Figure 3.4.2.1.5–1.

3.4.2.2 ENVELOPE

3.4.2.2.1 HARDWARE

The maximum envelope of each CETA cart for launch is 89 in. (brake handles retracted and stowed for launch) longitudinally x 93.5 in. laterally x 32 in. in height above Datum W of the rail. Figures 3.4.2.1.1–4 and 3.4.2.1.1–5 reflect the CETA launch envelope.

The maximum on-orbit envelope of each CETA cart includes the EVA Tool Stowage Device, the ORU Transfer Device, and the Articulating Portable Foot Restraint with Tool Stanchion, as well as the maximum volume of cargo. Figures 3.4.2.1.3–1 and 3.4.2.1.3–2 show the CETA on-orbit envelope.

The CETA will operate within the MT/MBS translation envelope. The minimum translation envelope required for CETA along the entire rail length is described by a 136 in. lateral x 133 in. high (above the truss stay out envelope) rectangle.

3.4.2.2.2 EVA

In order to limit loads onto the MT/CETA rail, the CETA Cart shall only be utilized by a single crewmember at an EVA worksite. EVA crewmembers shall perform only translation operations from the Translation Foot Restraint (TFR).

3.4.2.3 STRUCTURAL

3.4.2.3.1 STIFFNESS

The natural frequency of the CETA final design shall be greater than 35 Hz.

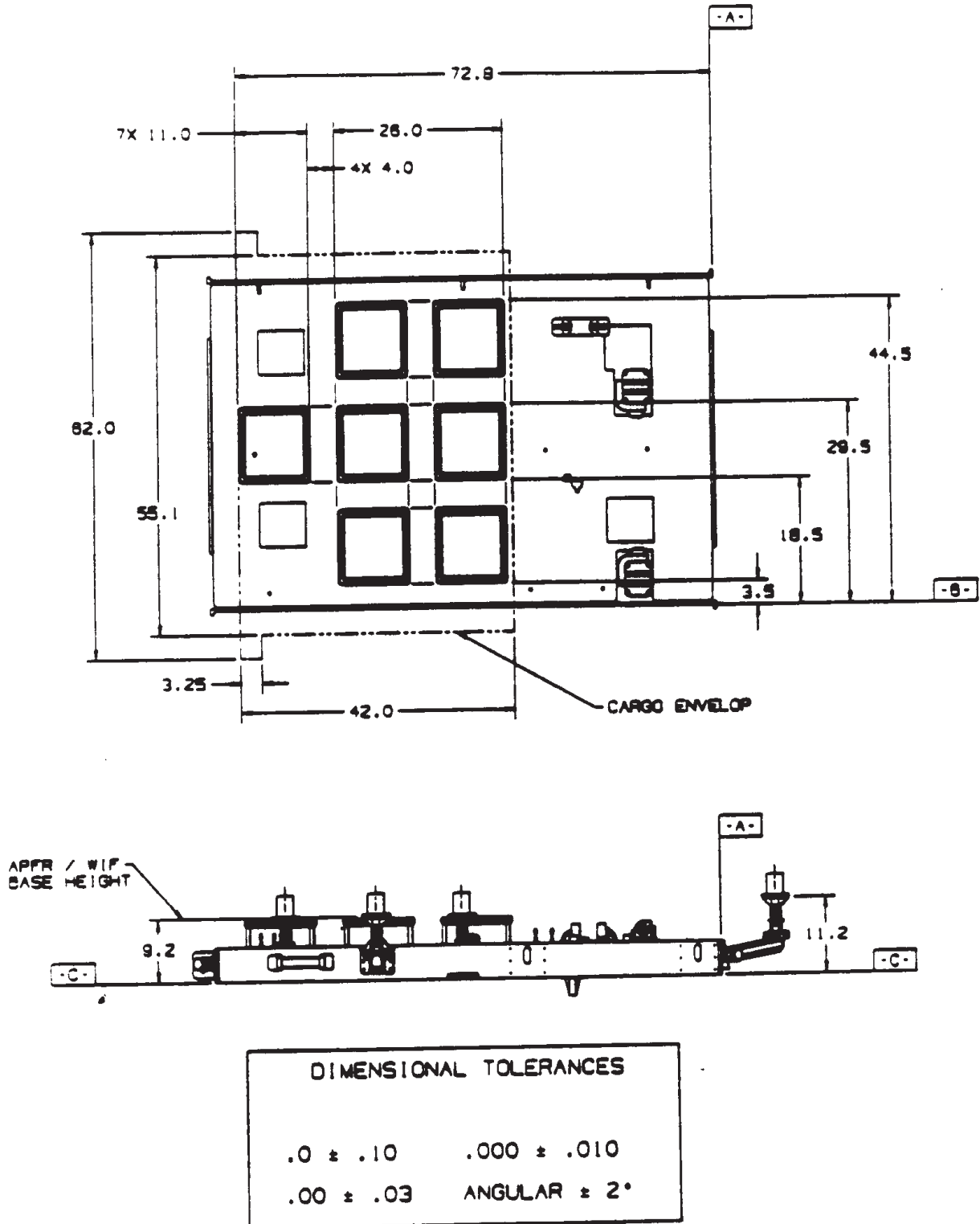


FIGURE 3.4.2.1.5-1 CETA CART CARGO INTERFACE AND MAXIMUM CARGO FOOTPRINT

3.4.2.3.2 LOADING

There will be no separation or gapping at the CETA Cart to ITS S1 or P1 launch interfaces. The launch loads and load factors shall not exceed those shown in Tables 3.4.2.3.2–1 and 3.4.2.3.2–2 below. The CETA Cart shall be designed to no less than these limit loads. These launch loads are derived from coupled loads analysis conducted by the ITS S1 and P1 integrators.

TABLE 3.4.2.3.2–1 CETA CART INTERFACE PEAK LAUNCH LOADS

Fx (lbf)	Fy (lbf)	Fz (lbf)	Mx (lbf)	My (lbf)	Mz (lbf)
+/- 2312	+/- 1178	+/- 2262	+/- 5154	+/- 6708	0

TABLE 3.4.2.3.2–2 CETA CART NSTS MAXIMUM FLIGHT LOAD FACTORS

Nx (G)	Ny (G)	Nz (G)
+ 2.37 / - 5.60	+ 2.86 / - 2.93	+ 6.81 / - 5.66

The CETA energy absorbers shall not induce loads greater than 400 lbs onto the MT–CETA rail stops and the MT–CETA rail stops shall be capable of withstanding loads up to 400 lbs.

The interface between the CETA Carts (wheel bogies and brakes) and the MT–CETA rail shall be capable of withstanding loads up to 300 lbs. between the CETA Cart interface to MT–CETA rails. Note that the CETA Carts are to cross the SARJs at no greater than 1 ft/sec in order to avoid exceeding the 300 lb. rail impact load.

The interface between the CETA Carts couplers and the MT shall be capable of withstanding loads up to 250 lbs. between the CETA Cart coupler interface to MT/MT Energy absorbers.

The interface between the CETA Cart CSI grids and Cargo shall be capable of withstanding loads of up to 125 lbs. in shear and 5625 in–lbs (125 lb x 45 inches) in bending and torsion. These loads are at the attachment between the CETA Cart CSI grid interface(s) and the stored cargo (via an active latching mechanism on the CHIA subcarrier/cargo pallet).

3.4.2.3.3 MASS PROPERTIES

The launch weight of the CETA cart shall not exceed 632 lbs. The maximum mass of a loaded CETA cart, including crew and EVA removable CETA ancillary equipment, i.e., ETSD, OTD, PFRWS, and APFRs will be operationally maintained to a mass not to exceed 2200 lbm. The launch weight of the active portion of the CETA coupler, launched mounted to a Mobile Transporter energy absorber, shall not exceed 5.5 lbs. The launch weight of the passive portion of the CETA coupler, launched mounted to a Mobile Transporter energy absorber, shall not exceed 2.0 lbs.

3.4.2.4 MECHANICAL

3.4.2.4.1 MATERIALS

CETA cart materials meet the requirements of SSP 30233, Space Station Requirements for Materials and Processes.

3.4.2.4.2 SURFACE FINISH

CETA cart surface finishes meet the requirements of SSP 30233, Space Station Requirements for Materials and Processes.

3.4.2.5 THERMAL

The CETA cart is designated as “unlimited contact” EVA interface. Thermal control of this hardware is achieved by passive techniques. Contacting Mobile Transporter rail surface temperatures are calculated to be within the range between -85° and $+185^{\circ}$ F.

3.4.2.6 ELECTRICAL BONDING

The CETA cart launch restraint contact surfaces, as indicated in Figure 3.4.2.1.1–1, will satisfy a class S bond per SSP 30245, Space Station Electrical Bonding Requirements, in its entirety.

3.5 ORBITAL REPLACEABLE UNIT TRANSFER DEVICE (OTD)

The OTD is a crane-like device with an extending/retracting boom mechanism that is to be used to restrain and translate cargo and ORUs of up to 600 lb. mass, and EVA equipment. Figure 3.5–1 shows the OTD.

The OTD is primarily operated from the CETA cart (see figure 3.5–2) in support of on-orbit maintenance operations conducted by an EVA crewmember from the CETA Cart. The OTD can also be used from specific passive WIF(s) on Truss Segment P3 in order to support retrieval of cargo (ORUs and cargo pallets) from the ULCs that are attached to Truss Segment P3. This will only occur when the SSRMS, Mobile Transporter, or the SPDM are not operational.

3.5.1 INTERFACE DESCRIPTION

There are three interfaces between the OTD and ISS elements. The first is with cargo. The second is with structures from which the OTD will be operated. These structures must have passive WIFs on which to attach the OTD and the structure must be able to support the loads produced by the OTD. The third is the interfaces between the OTD and launch FSE.

The OTD interfaces with cargo via the OTD common structural interface (CSI) passive grid. The CSI passive grid design is the same as the TERA grid shown in Figure 3.3.2.1-1, TERA ORU Adapter Plate Interface.

The OTD is primarily operated from the CETA Carts. The OTD can be installed on any of the passive WIFs on the CETA Carts. Two locations on Truss Segment P3 have been identified as OTD installation locations to support transport of cargo from the ULCs on P3 to the CETA Carts. Any OTD stowage location or on-orbit operating location must meet the loads specified in paragraph 3.5.3.1. Two passive WIFs have been identified that can support the OTD loads on Truss Segment P3. Passive WIF #1 on Face 3, shown in Figure 3.5.1-1, and a corresponding Passive WIF on Face 5.

To support the launch of the OTD, OTD grasp areas, their cross sections and the directions of restraint are given in Figures 3.5.1-2 through 3.5.1-6. Figure 3.5.1-2 shows where the OTD may be grasped (grasp areas) by the launch FSE. Figures 3.5.1-3, through 3.5.1-6 show the cross sections at each of the OTD launch grasp areas.

3.5.2 ENVELOPE

The maximum launch and on-orbit stowage envelope dimensions for the OTD are 72 in. x 24in. x 16 in. (see Figure 3.5.2-1). The volume required for removal of the OTD from the launch support equipment is 72 in. x 24 in. x 35 in. as shown in Figure 3.5.2-1.

3.5.3 STRUCTURAL

3.5.3.1 LOADING

The OTD is capable of producing bending and torsional moments of 5780 in-lb and a shear load of 125 lbf, simultaneously, at the interfacing between the Passive WIF and support structure. Table 3.3.3.1-2, design loads for the PFRWS, TERA, and OTD, shows the OTD launch design loads.

3.5.3.2 MASS PROPERTIES

The maximum weight of the OTD is 231 lbs.

3.5.4 ELECTRICAL BONDING

The OTD will satisfy the class S bond per SSP 30245, Space Station Electrical Bonding Specification, in its entirety, when installed onto the OTD FSE and any passive WIF during on-orbit usage or stowage.

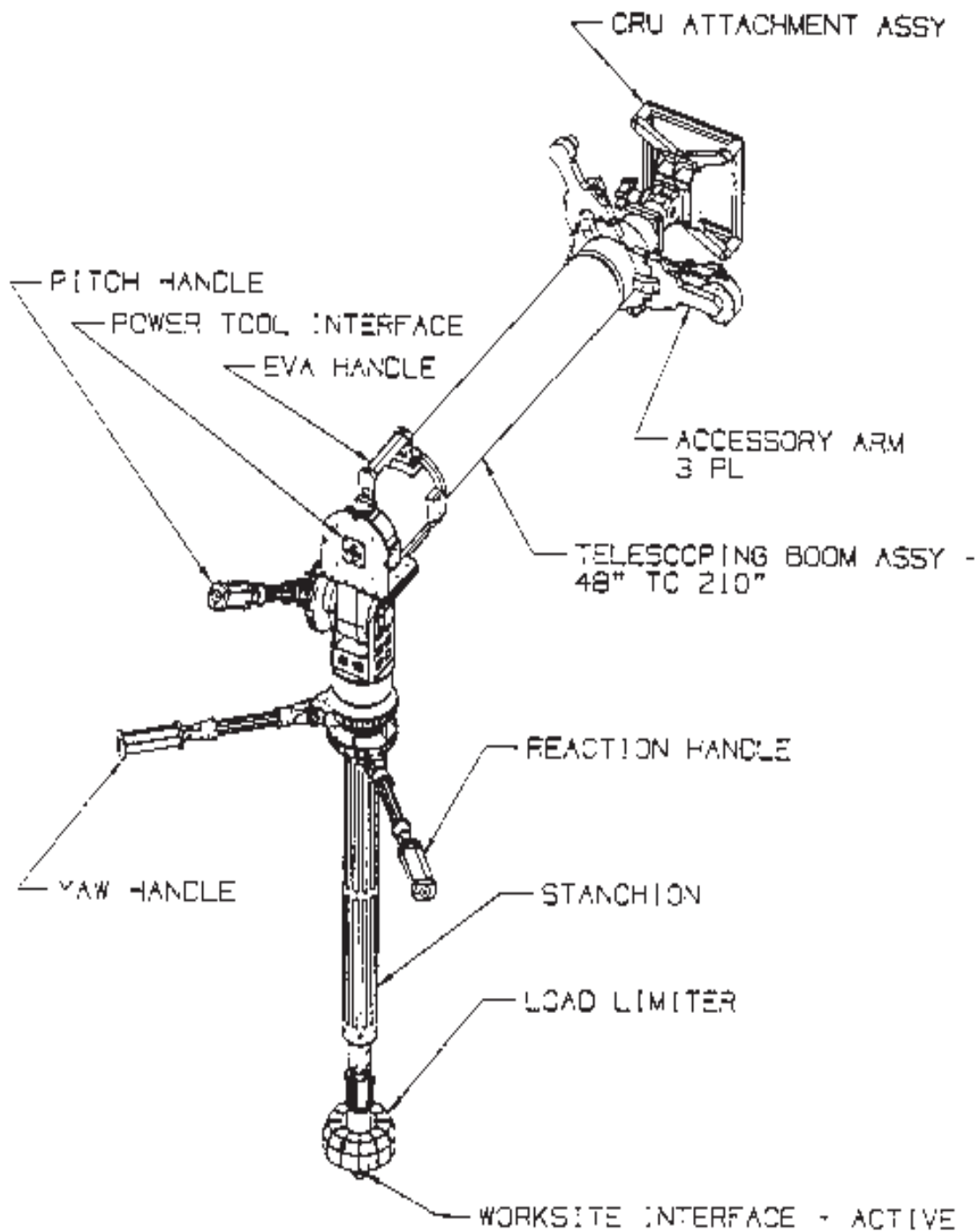


FIGURE 3.5-1 ORU TRANSFER DEVICE

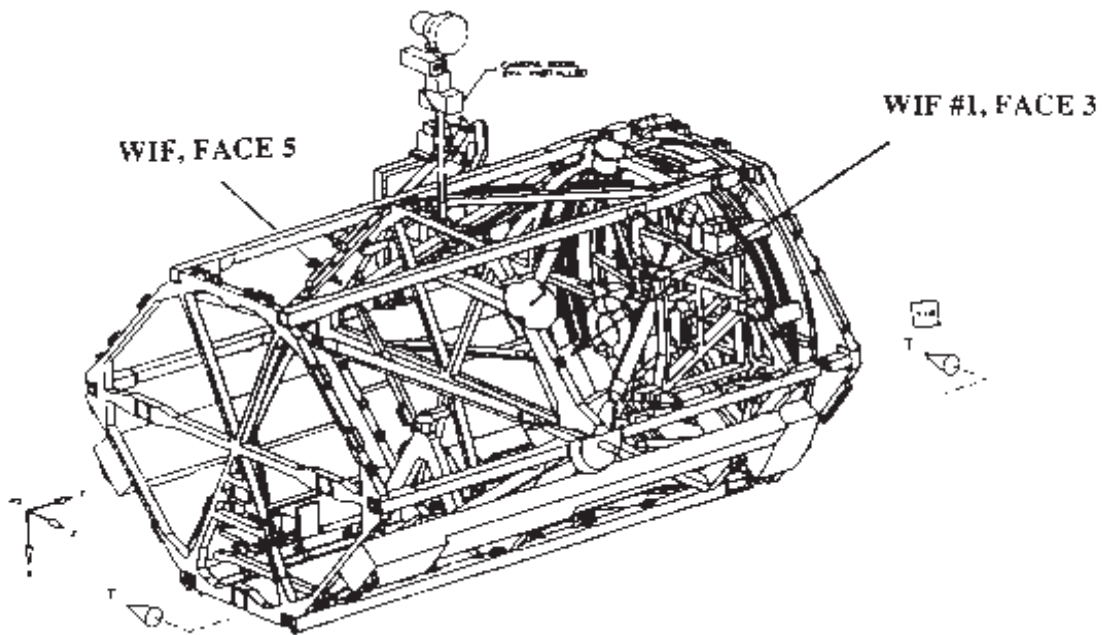
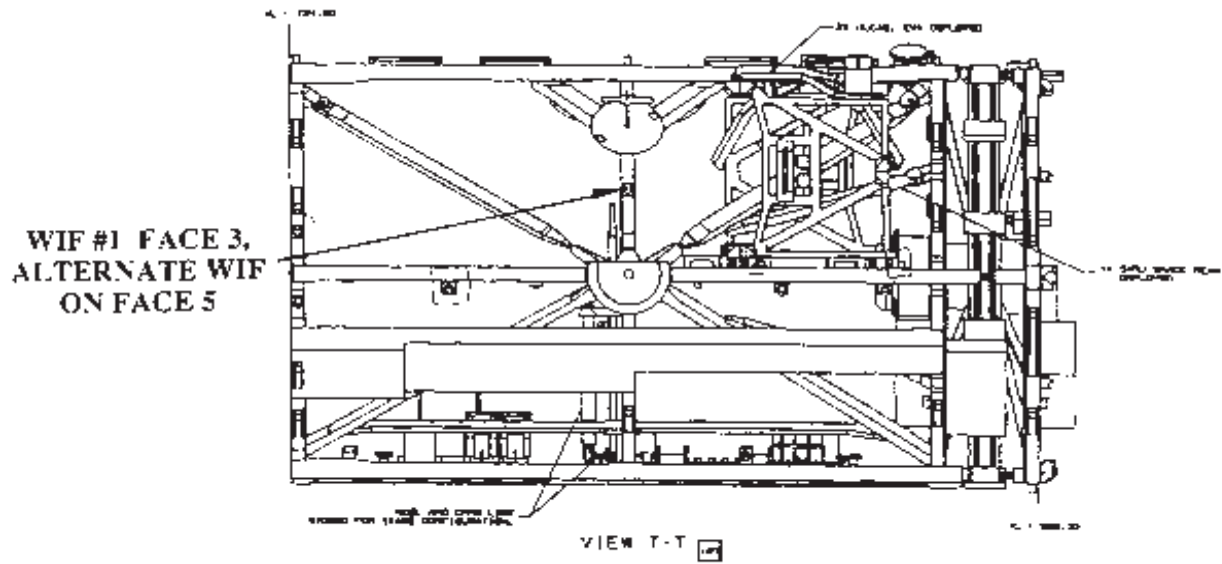


FIGURE 3.5.1-1 OTD USE LOCATIONS ON TRUSS SEGMENT P3

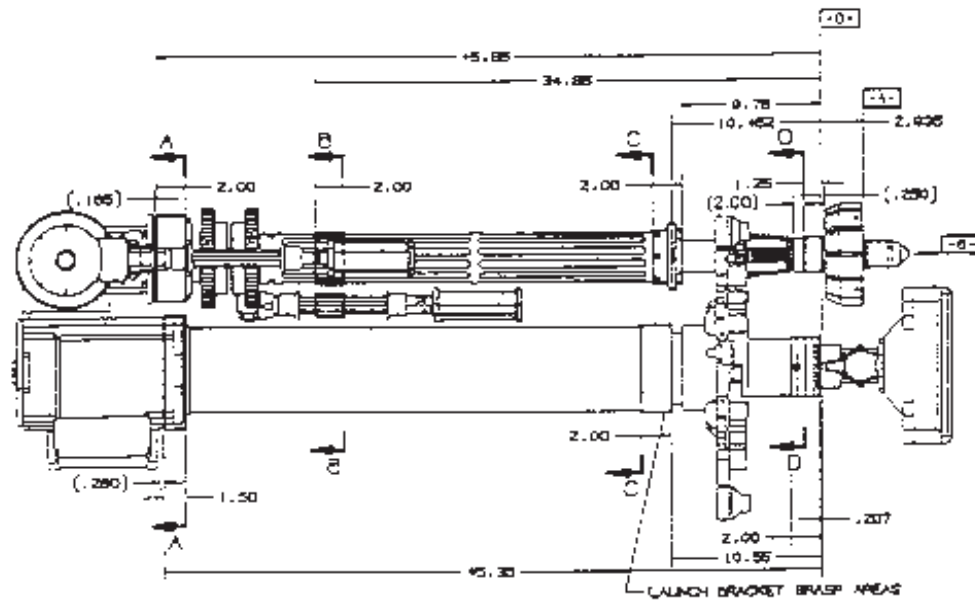


FIGURE 3.5.1-2 ORU TRANSFER DEVICE LAUNCH BRACKET RESTRAINT LOCATIONS

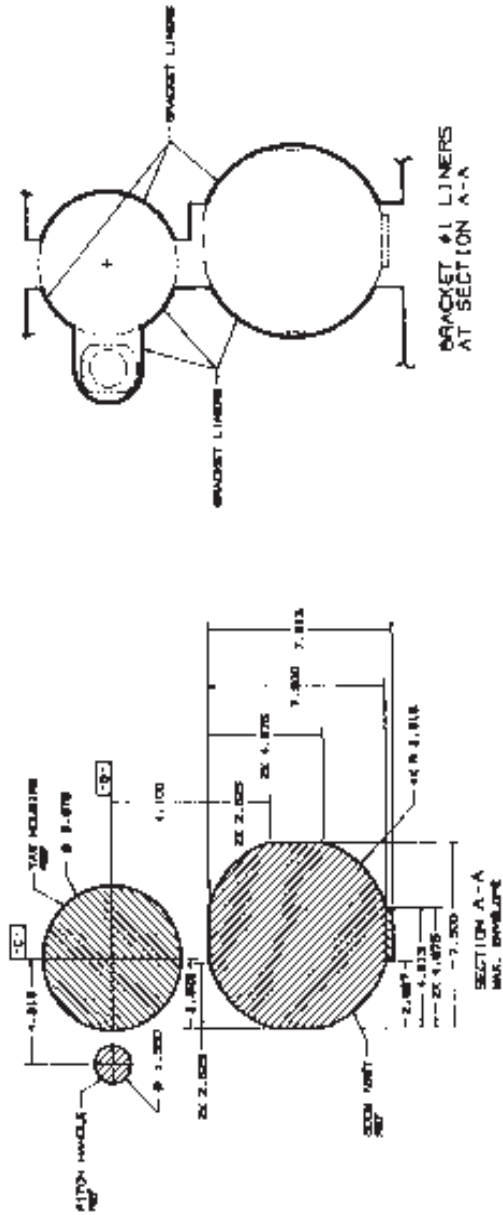


FIGURE 3.5.1-3 ORU TRANSFER DEVICE LAUNCH BRACKET 1 INTERFACE

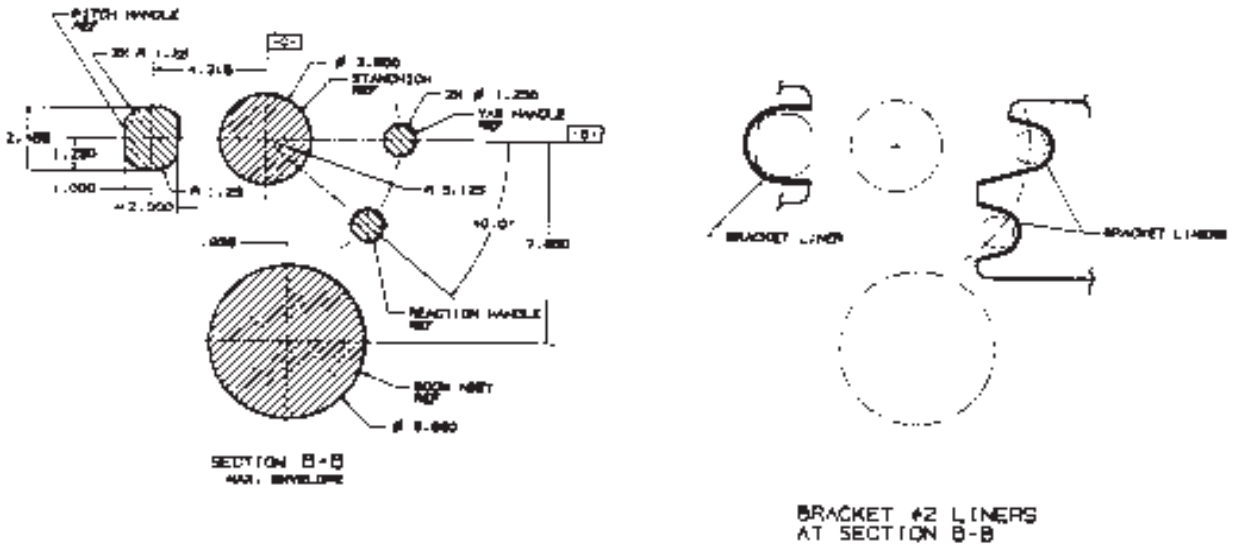


FIGURE 3.5.1-4 ORU TRANSFER DEVICE LAUNCH BRACKET 2 INTERFACE

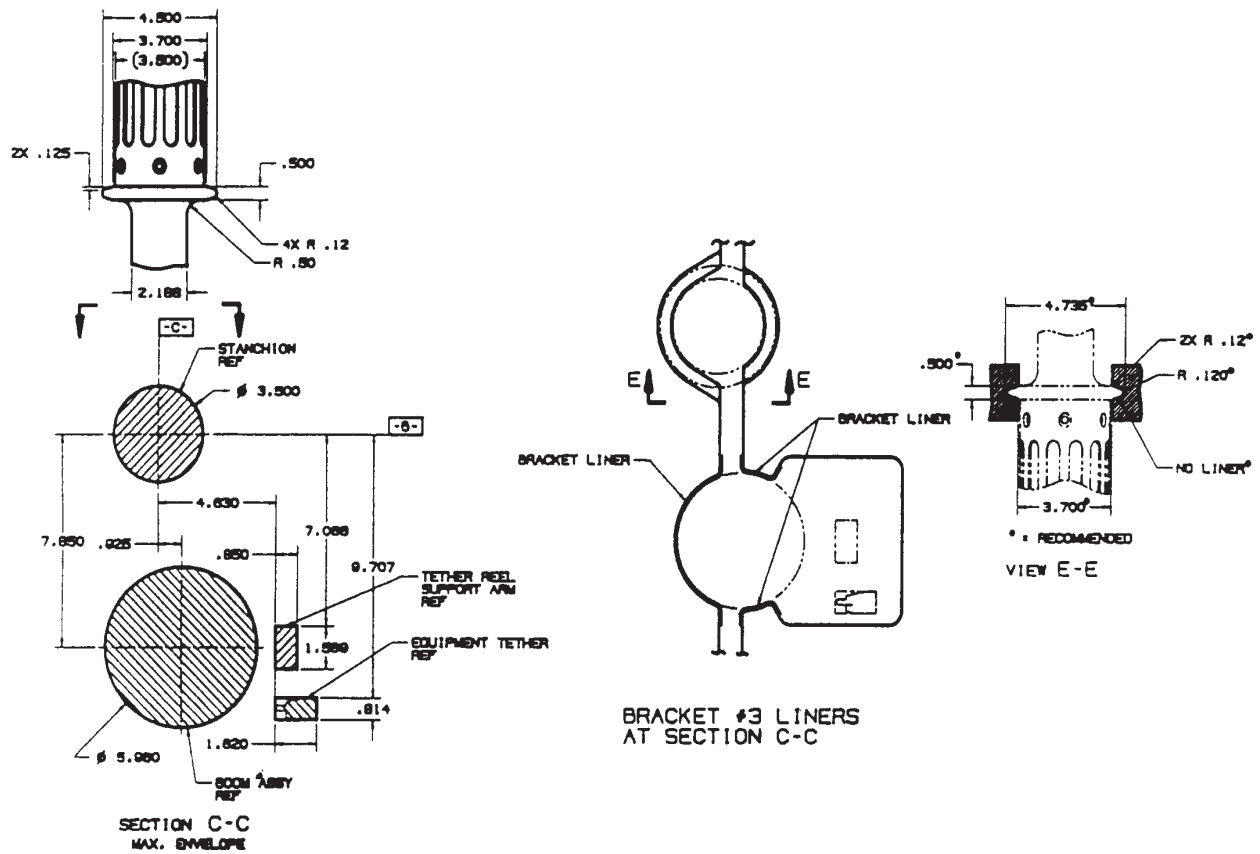


FIGURE 3.5.1-5 ORU TRANSFER DEVICE LAUNCH BRACKET 3 INTERFACE

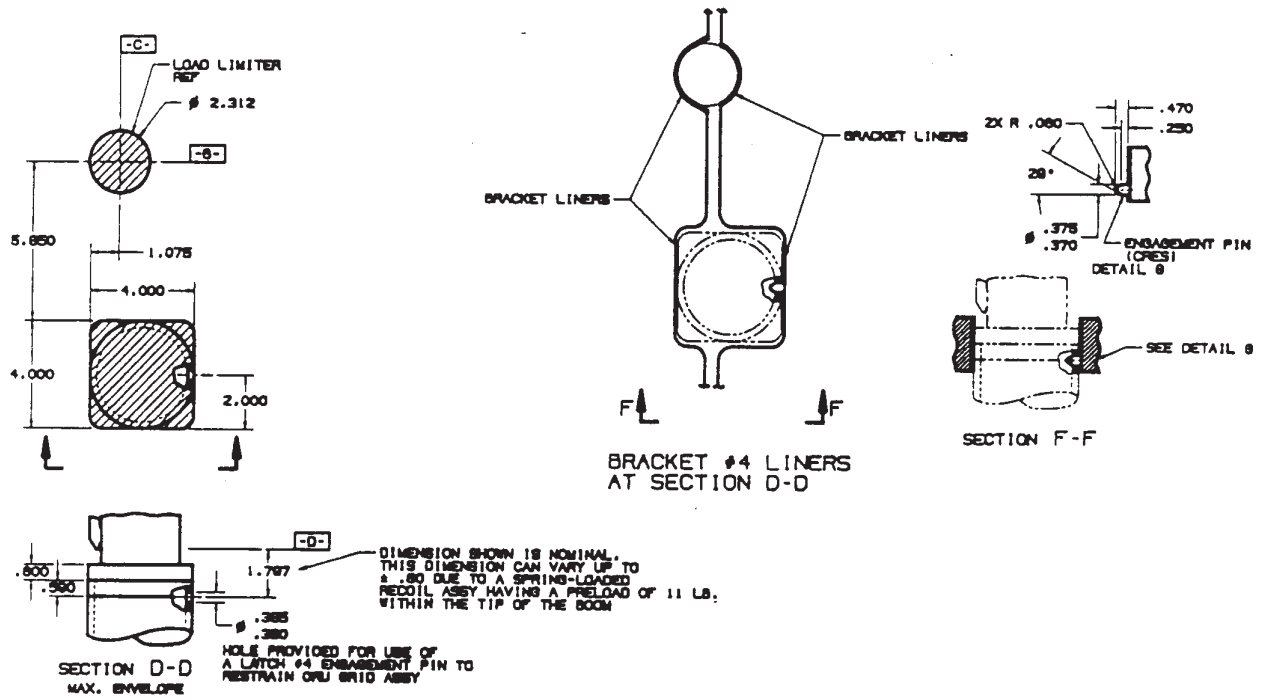


FIGURE 3.5.1-6 ORU TRANSFER DEVICE LAUNCH BRACKET 4 INTERFACE

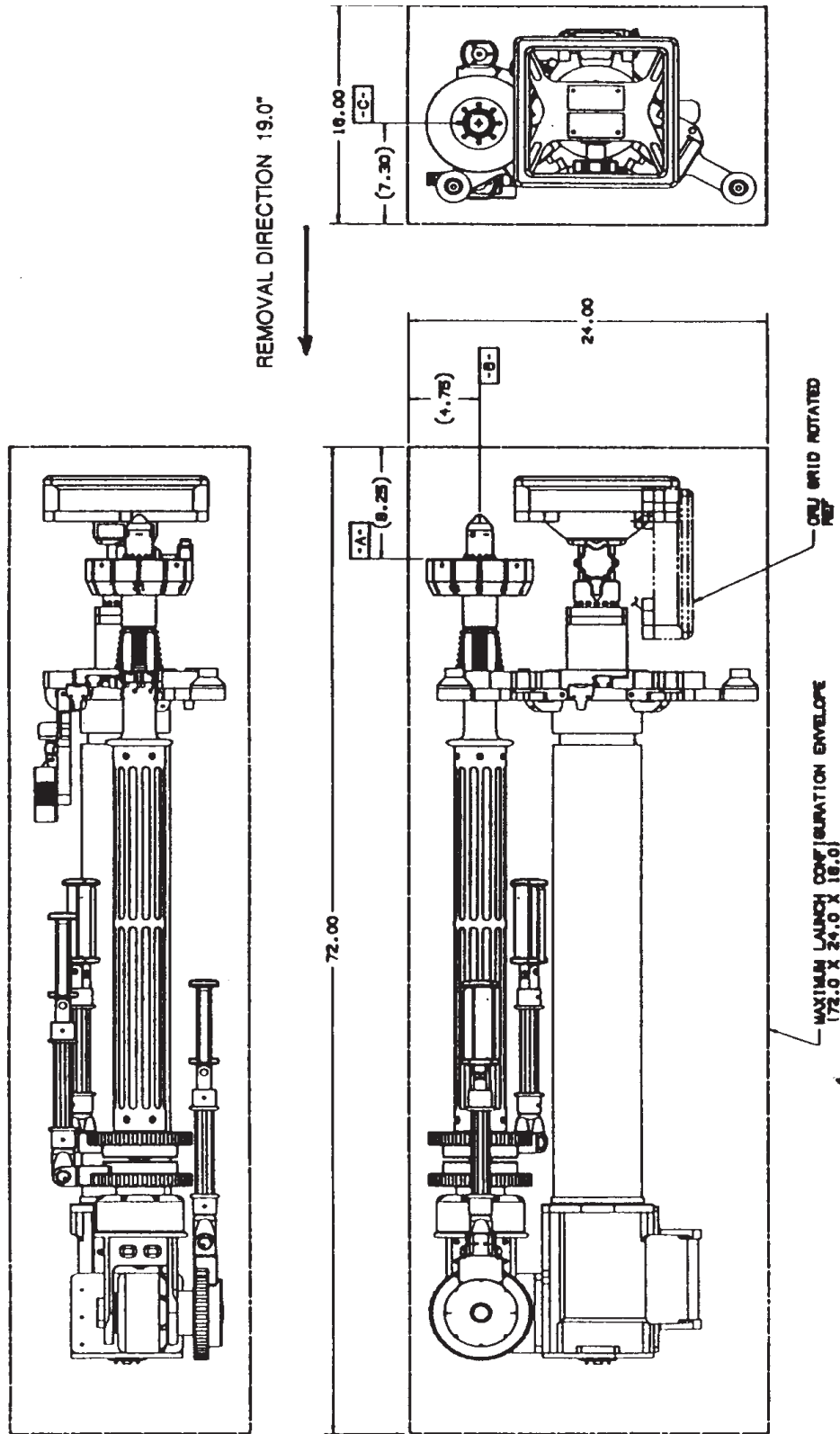


FIGURE 3.5.2-1 ORU TRANSFER DEVICE LAUNCH AND STORAGE ENVELOPE

3.5.5 THERMAL

The OTD is designated as an “unlimited contact” EVA interface. Thermal control of this component is achieved by passive techniques. Responsibility for maintaining the heat transfer rates within specified limits is the responsibility of the ISS Prime.

3.6 TRANSLATION AIDS AND ATTACHMENTS (TA&A)

3.6.1 HANDRAIL / HANDHOLD (GROUND INSTALLED)

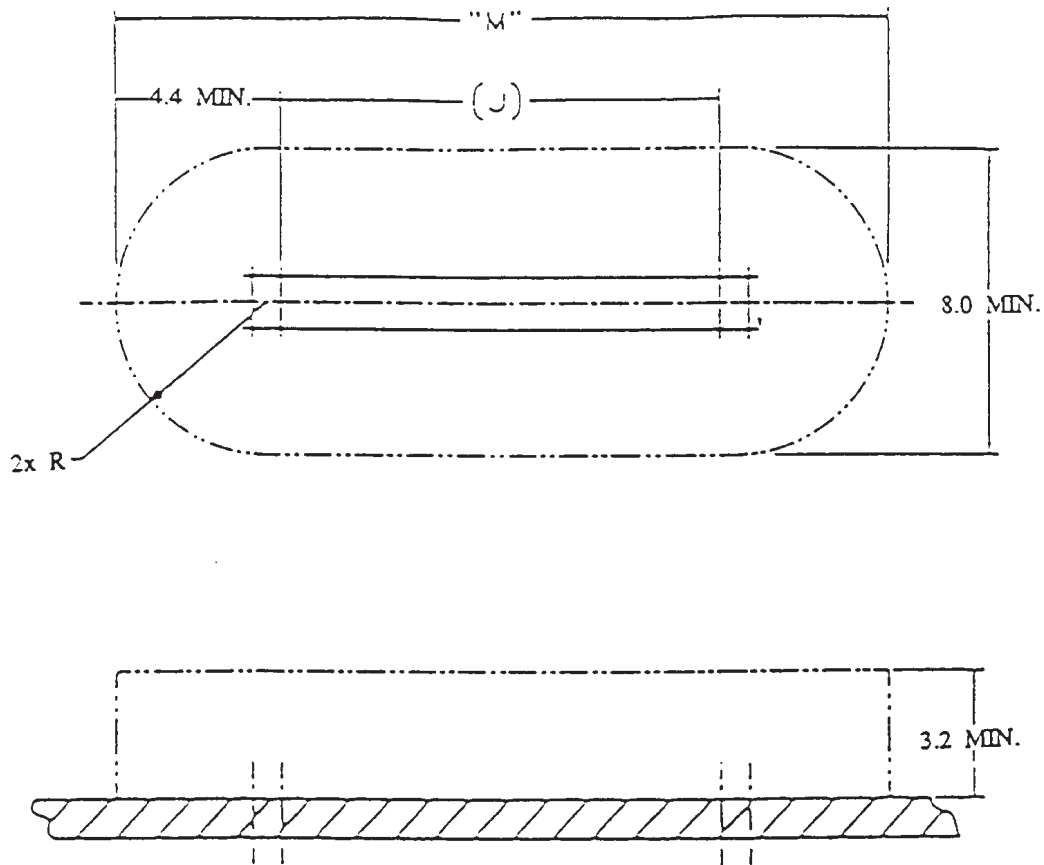
3.6.1.1 INTERFACE DESCRIPTION

EVA handrails/handholds will be supplied to facilitate translation or provide restraint for a crewmember in a space suit on the exterior surface of the Space Station elements. These handrails/handholds will accommodate EVA tether hooks by having tether points designed into the standoffs to restrain the crewmember or loose equipment. This section describes the interface information for three styles of handrails/handholds that will be installed on the ground. Interface requirements for presently defined customized lengths are included. For on-orbit installed handrails, see section 3.6.5

3.6.1.2 ENVELOPE

3.6.1.2.1 HARDWARE

The ground installed handrail/handhold has three different style stand-offs; one for top mounting and a tall and a short stand-off for side mounting. The standard length of the handrails is nominally 24 in. between the stand-offs, and handholds, 6 in. between stand-offs. Customized handrail lengths are provided where required. Hardware dimensions are shown in figures 3.6.1.2.1-1 through 3.6.1.2.1-6 and Figures 3.6.1.4.1-1 through 3.6.1.4.1-4.



Part Number	Description	J (Ref)	M (Min)
SEG33106347-801 (Ref. 5835754-501)	Handrail, Top Mounted	25.530	34.3
SEG33106347-811	Handrail, Custom, 15.441 in.	15.441	24.2
SEG33106347-803	Handrail, Custom, 21.941 in.	21.941	30.7
SEG33106347-805	Handrail, Custom, 22.625 in.	22.625	31.4
SEG33106347-843	Handrail, Custom, 25.606 in.	25.606	34.4
SEG33106347-807 (Ref. 5835755-501)	Handhold, Top Mounted	8.530	17.3
SEG33106347-809	Handhold Custom, 8.626	8.626	17.4

**FIGURE 3.6.1.2.1-1 TOP MOUNTED HANDRAIL/HANDHOLD ACCESS ENVELOP
(GROUND INSTALLED)**

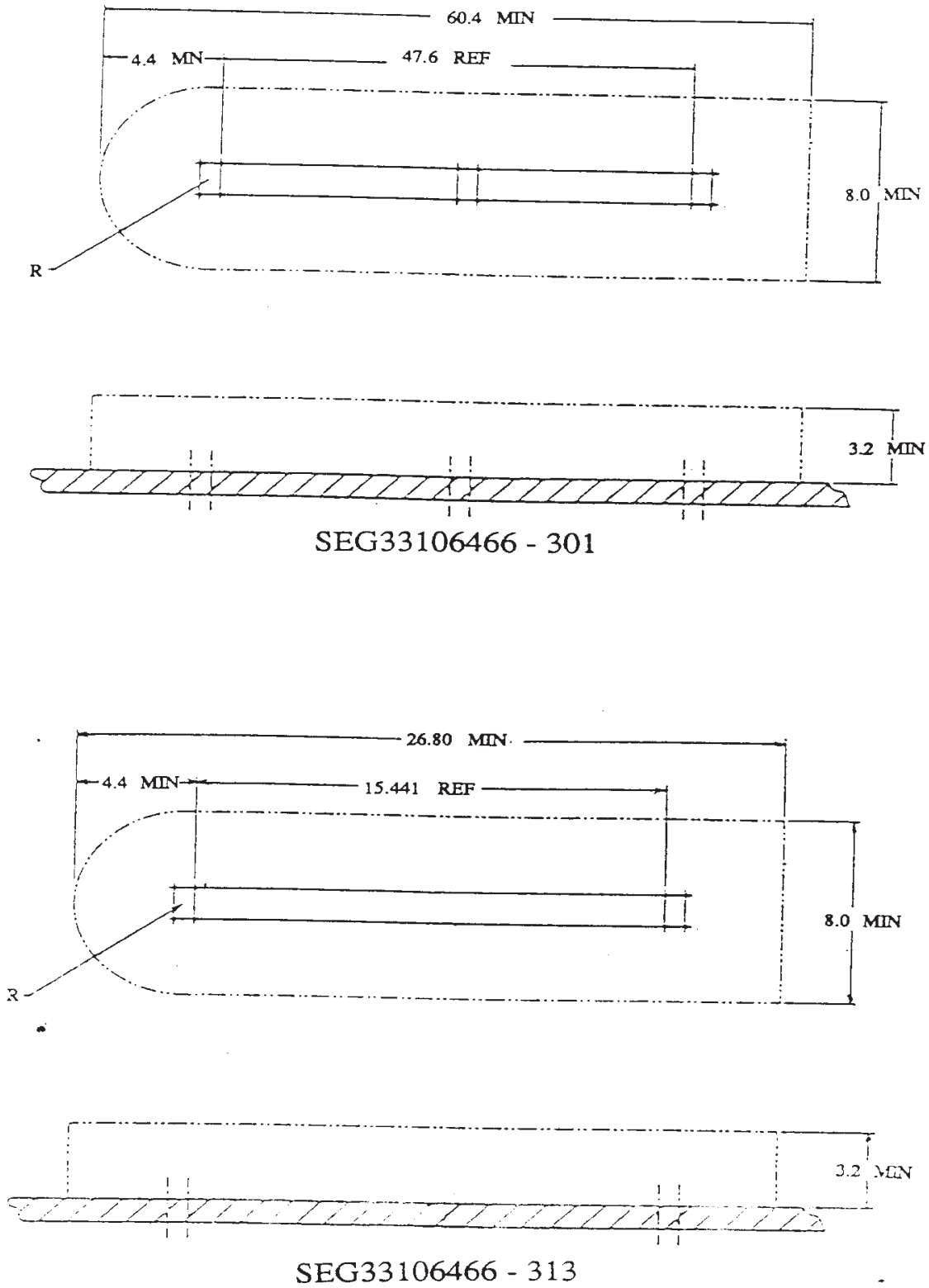


FIGURE 3.6.1.2.1-2 TOP MOUNTED CUSTOM LENGTH HANDRAIL ACCESS ENVELOPE (GROUND INSTALLED)

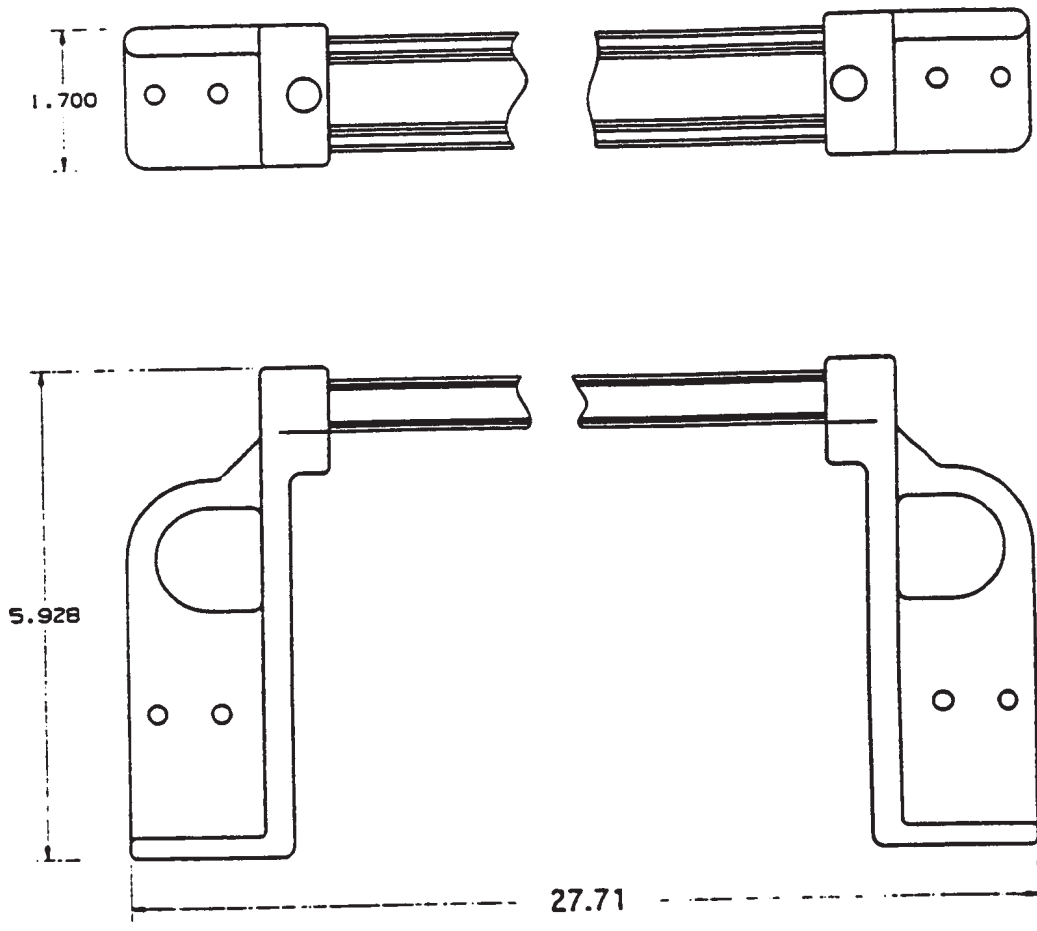


FIGURE 3.6.1.2.1-3 TALL SIDE MOUNTED HANDRAIL ENVELOPE (GROUND INSTALLED)

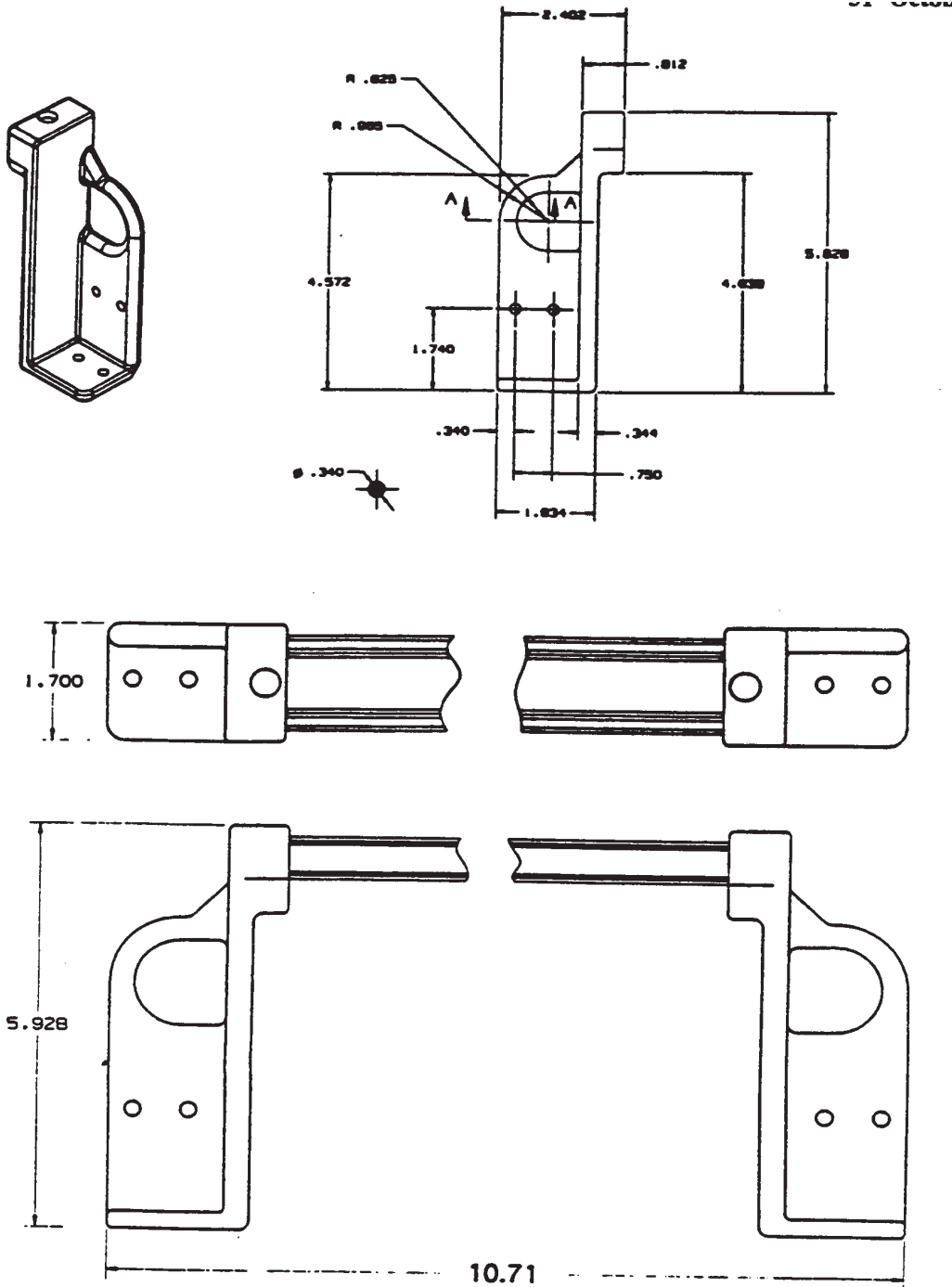


FIGURE 3.6.1.2.1-4 TALL SIDE MOUNTED HANDHOLD ENVELOPE (GROUND INSTALLED)

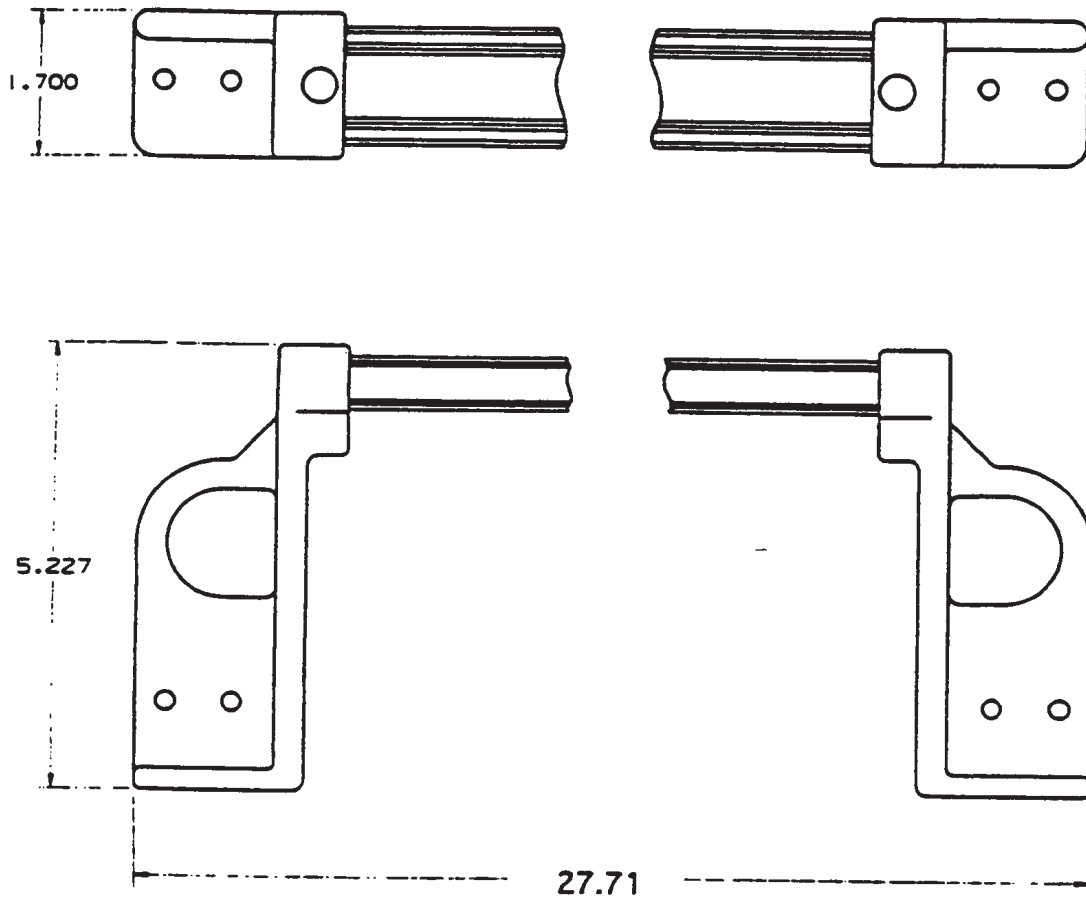


FIGURE 3.6.1.2.1-5 SHORT SIDE MOUNTED HANDRAIL ENVELOPE (GROUND INSTALLED)

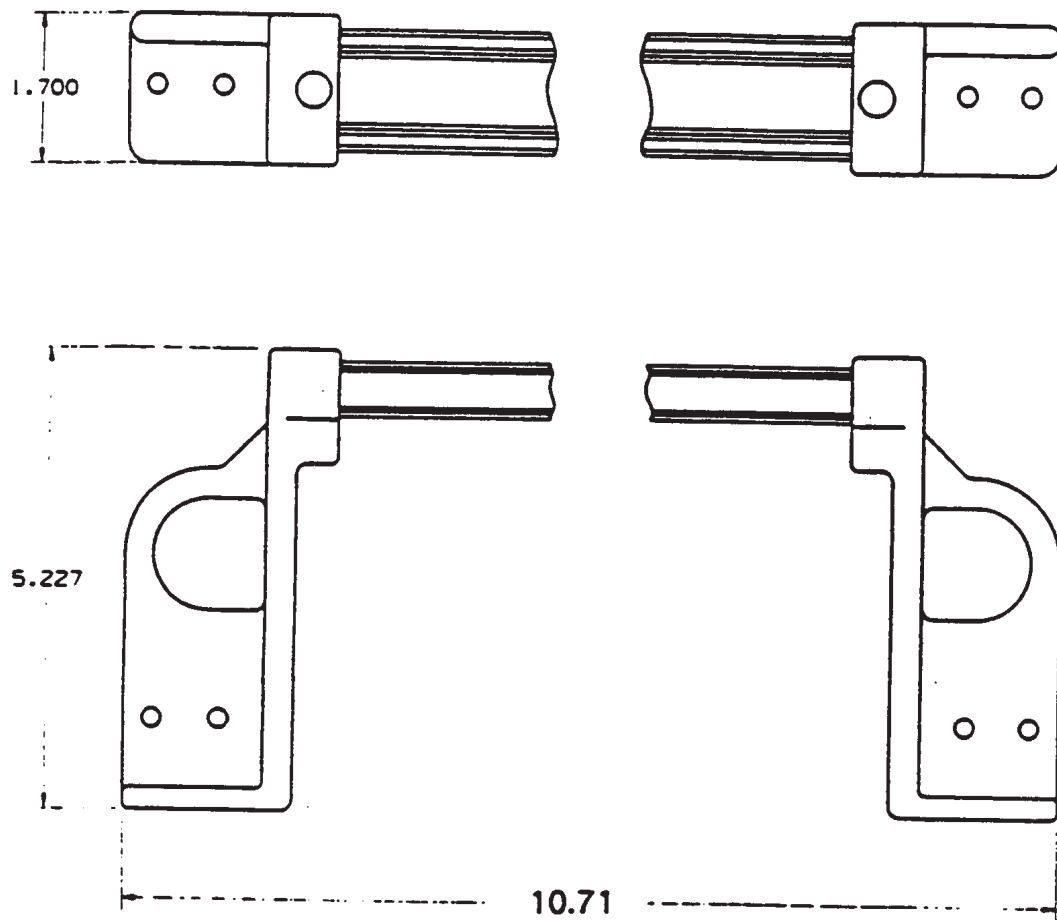


FIGURE 3.6.1.2.1-6 SHORT SIDE MOUNTED HANDHOLD ENVELOPE (GROUND INSTALLED)

3.6.1.4.2 SURFACE FINISH

The ground installed handrails/handholds meet the finish requirements found in SSP 30233, Space Station Requirements for Materials and Processes. The surface finish color will be yellow. The faying surface is chemical conversion coated per MIL-C-5541, Class 3, for electrical bonding.

3.6.1.4.3 FASTENERS

The user will provide #10 (0.190 in. dia) bolts and associated fastener hardware that is compatible with the material and protective finish on the handrail/handhold stand-offs.

3.6.1.4.4 MATERIALS

The handrail/handhold stand-off material is 7075-T7351 aluminum alloy.

3.6.1.5 THERMAL

The handrails/handholds are designated “unlimited contact” EVA crew interfaces. Thermal control of these components is achieved by passive techniques.

3.6.1.6 ELECTRICAL BONDING

The handrail/handhold to user interface shall satisfy a Class S bond per SSP 30245, Space Station Electrical Bonding Specification, as specified in Figures 3.6.1.4.1-1 through 3.6.1.4.1-8. Note that Figure 3.6.1.4.1-2 shows an alternate bonding surface for top mounted handrails and handholds.

3.6.2 RESERVED

3.6.3 SLIDEWIRE

3.6.3.1 INTERFACE DESCRIPTION

EVA installable slidewires with sliders to facilitate translation of the two crewmembers in space suits on the exterior surface of Space Station elements and ground installed structural adapter plates will be supplied. The slidewire has standard standoffs and the cable length is sized for each specific element. This item can be installed on-orbit, is classified as an ORU and meets the requirements for EVA compatibility.

3.6.3.2 ENVELOPE

3.6.3.2.1 HARDWARE

Hardware envelope dimensions are shown in Figure 3.6.3.2.1-1

3.6.3.2.2 EVA

Figures 3.6.3.2.2-1, -2, and -3 define the EVA clearance envelope around the slidewire necessary to use the slidewire as a translation aid.

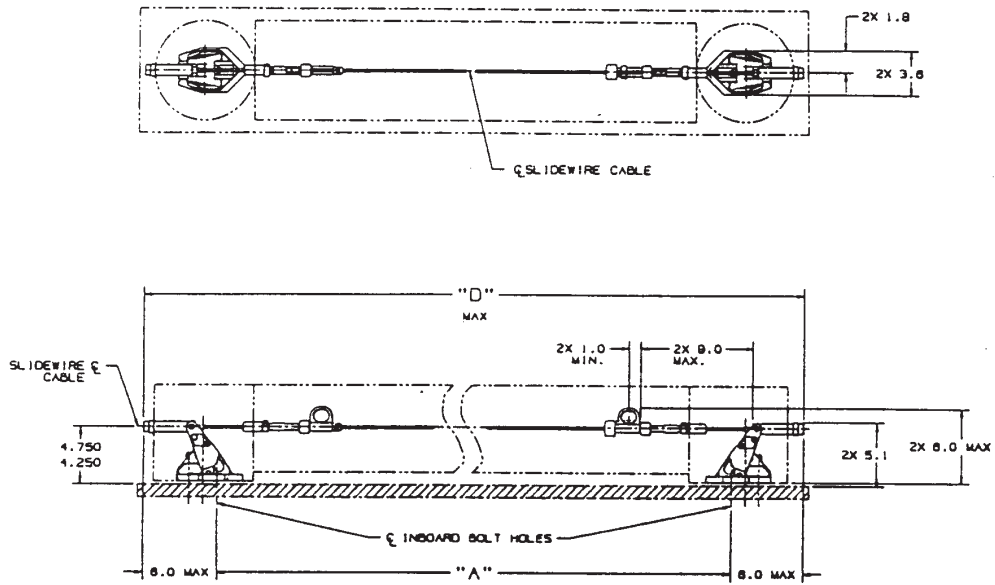
3.6.3.3 STRUCTURAL

3.6.3.3.1 LOADING

The slidewire will support EVA tether tension limit loads of 200 lbs in any direction, and will always have a positive pre-load. The slidewire will exert a maximum shear load of 1150 lbs and a maximum bending moment of 5000 in-lbs at the standoff interface.

3.6.3.3.2 MASS PROPERTIES

The maximum weight of the slidewire, including the ground installed adapter plates, is 14.3 lbs. The maximum weight of the slidewire assembly, consisting of two standoffs and a cable assembly, is 13.5 lbs. The maximum weight of each of the two ground installed adapter plates is 0.8 lbs each.



PART NUMBER	DESCRIPTION	USE LOCATION	A	D
SEG33106344-301	SLIDEWIRE -13FT	NODE	156.085 155.835	168.1
SEG33106344-303	SLIDEWIRE -24FT	HAB & LAB	289.815 289.565	301.9

FIGURE 3.6.3.2.1-1 SLIDEWIRE HARDWARE ENVELOPE

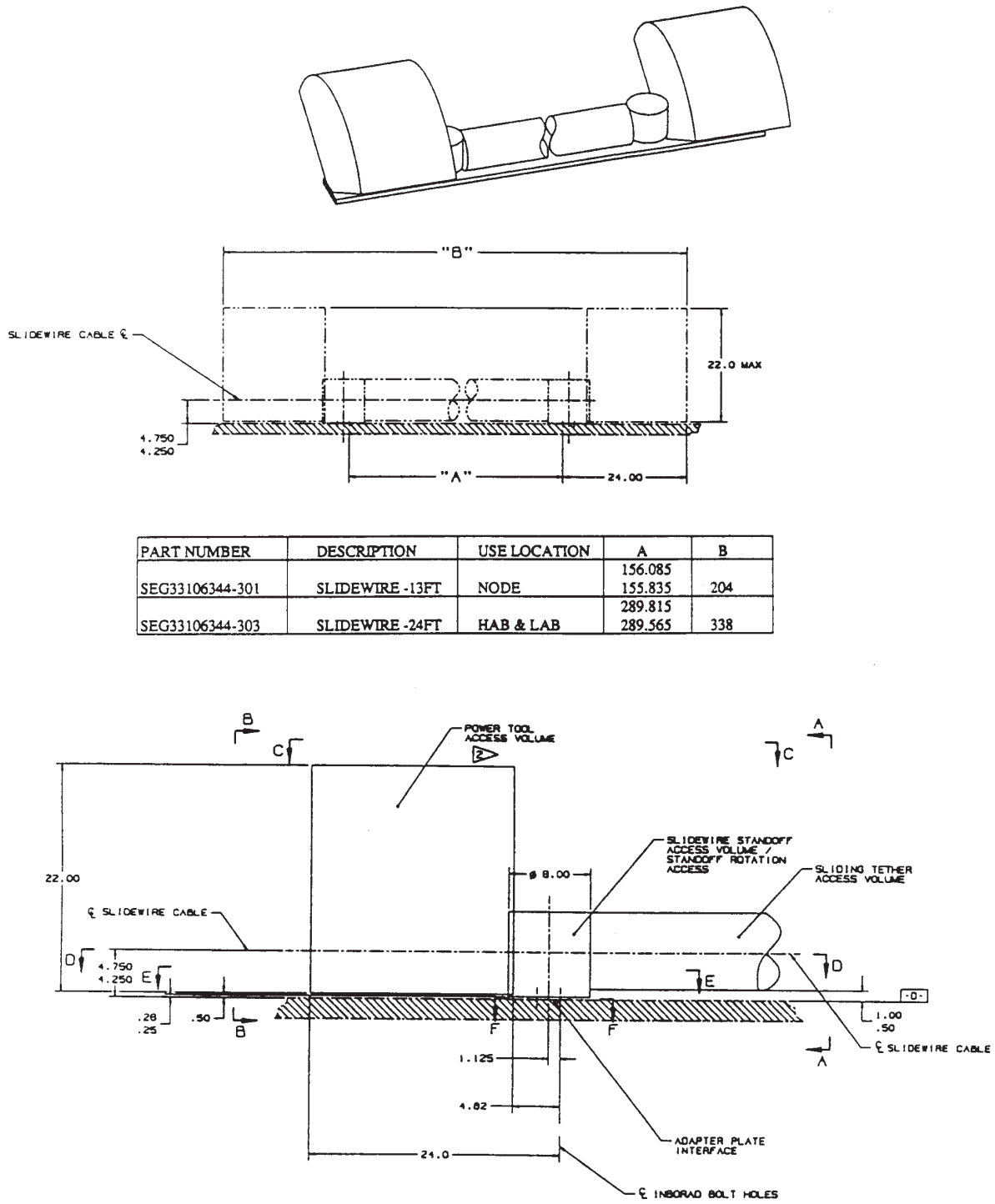


FIGURE 3.6.3.2.2-1 SLIDEWIRE EVA CLEARANCE ENVELOPE (SIDE VIEWS)

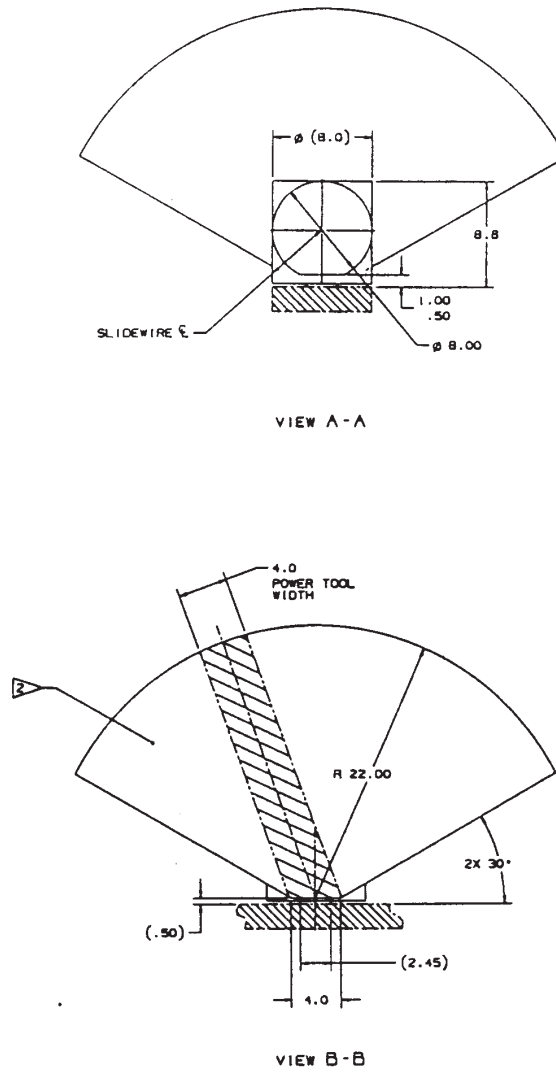
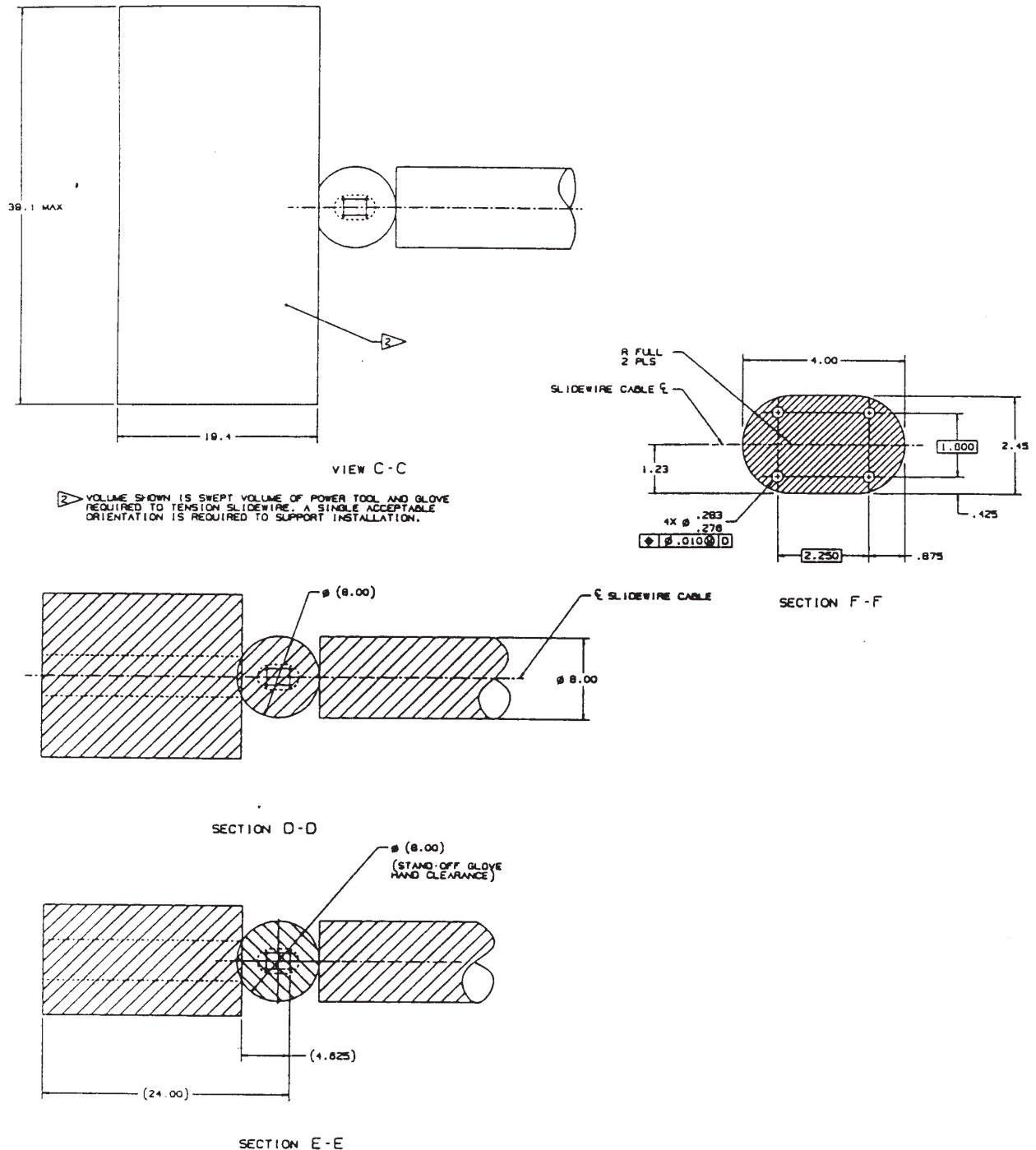


FIGURE 3.6.3.2.2-2 SLIDEWIRE EVA CLEARANCE ENVELOPE (END VIEWS)



3.6.3.4 MECHANICAL

3.6.3.4.1 MOUNTING AND INSTALLATIONS

The slidewire standoffs mount to slidewire adapter plates. The adapter plates interface with the Space Station structure. Figure 3.6.3.4.1-1 shows the user side interface bolthole pattern and clearance volume required for slidewire bracket installation.

3.6.3.4.2 SURFACE FINISH

The slidewire standoffs meet the finish requirements found in SSP 30233, Space Station Requirements for Materials and Processes. The faying surface is chemical conversion coated per MIL-C-5541, Class 3, for electrical bonding.

3.6.3.4.3 FASTENERS

Captive fasteners will be provided with the slidewire stand-off. The captive bolts are .2500-28 UNJF-3A with a maximum engagement depth of 0.87 in.

3.6.3.4.4 MATERIALS

The slidewire stand-off interface material is 7075-T7351 aluminum alloy.

3.6.3.5 THERMAL

The slidewire standoffs are designated “incidental contact” EVA crew interfaces. Thermal control of this hardware is achieved by passive techniques. The installation design activity is responsible for maintaining the heat transfer rates within the specified limits.

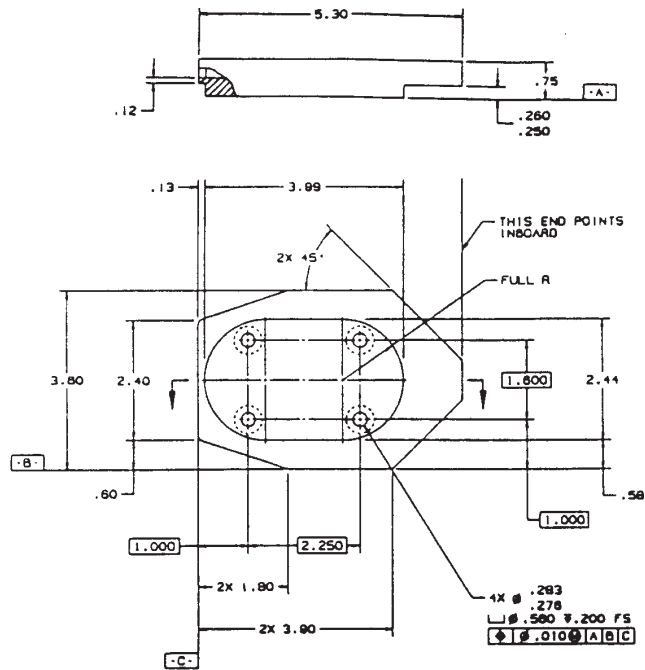
3.6.3.6 ELECTRICAL BONDING

The slidewire (docking plate) to user hardware interface will satisfy a class S bond per SSP 30245, Space Station Electrical Bonding Specification, in its entirety.

3.6.4 WORKSITE INTERFACE (WIF) – PASSIVE HALF

3.6.4.1 WORKSITE INTERFACE – PASSIVE HALF

The WIF is comprised of a passive half, which generally resides on the structure, and an active half, which generally resides on the EVA hardware itself. The active half, while replaceable,



PART NUMBER	DESCRIPTION	USE LOCATION	C
SEG33106344-301	SLIDEWIRE -13FT	NODE	156.085 155.835
SEG33106344-303	SLIDEWIRE -24FT	HAB & LAB	289.815 289.565

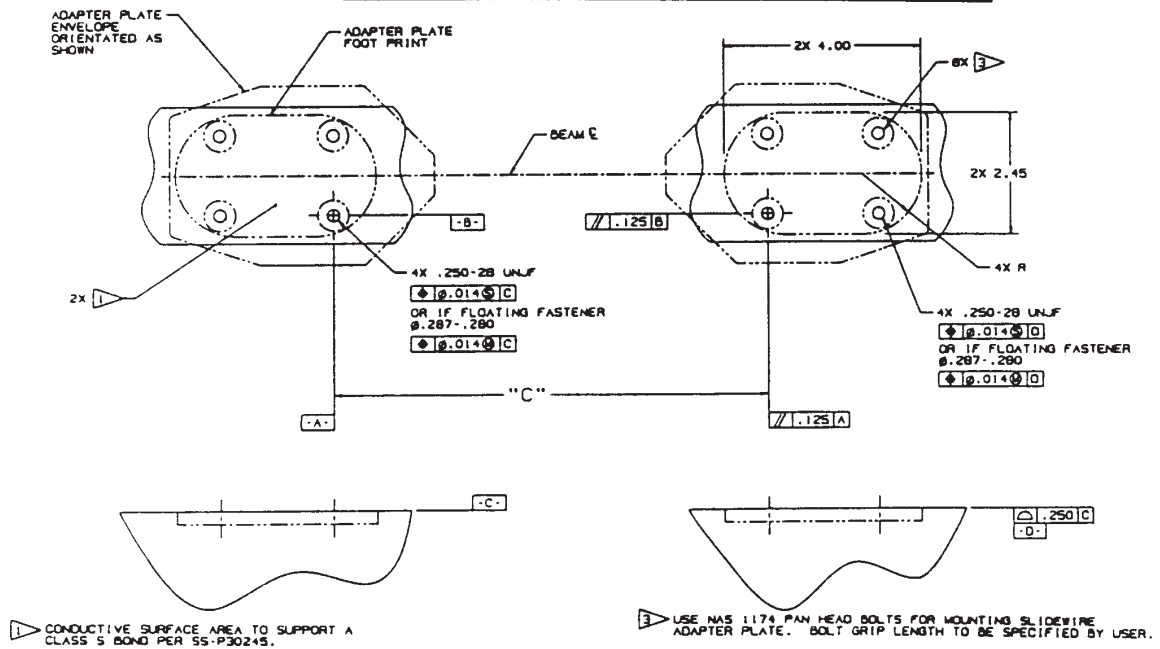


FIGURE 3.6.3.4.1-1 SLIDEWIRE ADAPTER PLATE ENVELOPE AND INTERFACE

will be integrated into the design of the hardware. The discussion of the active half of the WIF will reside in the section which covers the hardware onto which it is installed.

Only the passive half of the WIF will be discussed in this section. The passive half of the WIF will provide a means to interface structure, the CETA, or the TERA with EVA hardware such as the APFR, the OTD, and the TERA.

There are four different types of WIFs. The top mounted and side mounted, part number (P/N) SEG33106859-301 and SEG33106860-301, respectively, which are ground installed, an on-orbit installed top mounted type, P/N SEG33106861-301, with a ground installed adapter plate, P/N SEG33106862-701, and a passive adapter, P/N SEG33106863-301, which will interface between the Shuttle-style PFR socket and the active WIF.

3.6.4.2 ENVELOPE

3.6.4.2.1 HARDWARE

Hardware envelope dimensions for each WIF are referenced in Figures 3.6.4.2.1-1 through 3.6.4.2.1-3. The hardware envelope dimensions for the on-orbit installed WIF Adapter Plate are referenced in Figure 3.6.4.2.1-4. Figure 3.6.4.2.1-5 provides the overall hardware envelope once the on-orbit installed WIF is mounted on the Adapter Plate. Figure 3.6.4.2.1-6 shows the current Shuttle-style PFR socket to WIF adapter.

3.6.4.2.2 EVA CLEARANCE

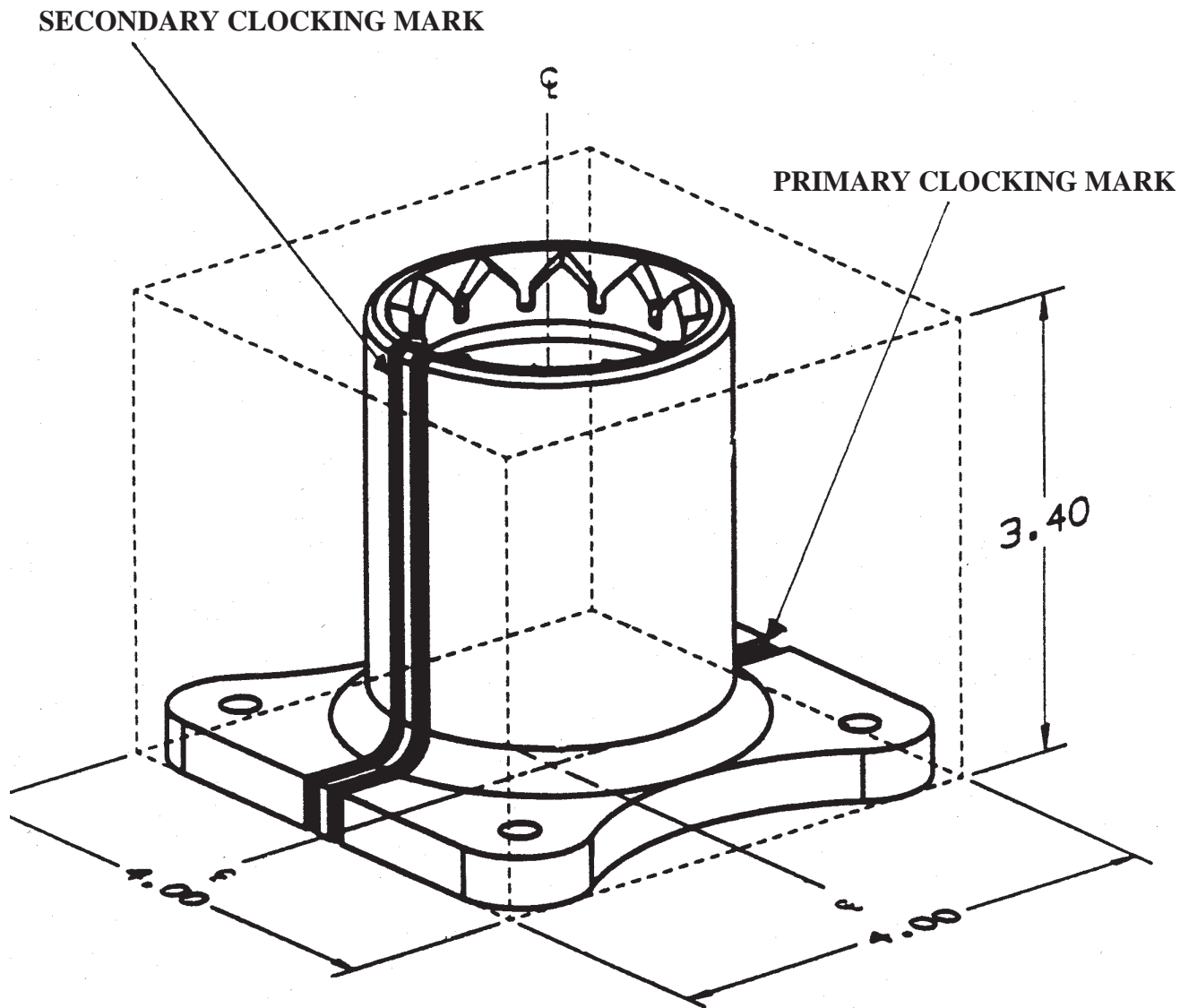
Figures 3.6.4.2.2-1 through 3.6.4.2.2-4 define the EVA clearance envelope around the WIF necessary for a crewmember to install and remove the APFR. Similar clearance envelopes are necessary for the installation and removal of each unique piece of EVA hardware outfitted with an active WIF. The hardware specific envelopes are included in the sections describing the respective hardware items. Figure 3.6.4.2.2-5 defines the EVA clearance envelope around the on-orbit installed WIF adapter plate necessary for the crewmember to install the on-orbit installed WIF socket. Figure 3.6.4.2.2-6 defines the EVA clearance envelope around the Shuttle-type PFR socket necessary to install and remove the passive WIF Adapter.

3.6.4.3 STRUCTURAL

3.6.4.3.1 RESERVED

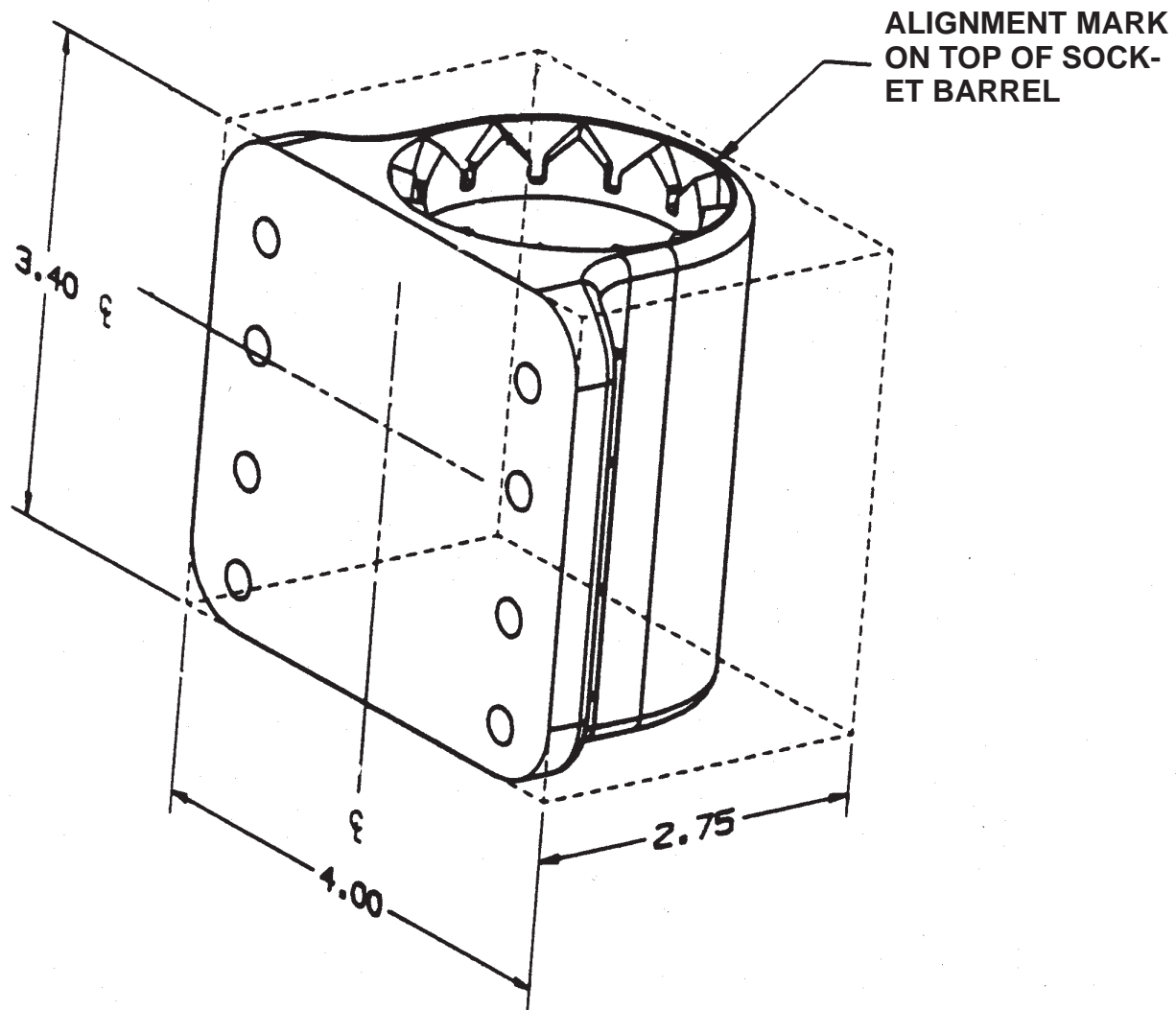
3.6.4.3.2 LOADING

The load limit at the WIF to structure interface is 274 lbs force in any direction and a moment of 4200 in-lbs in any direction, simultaneously. Figures 3.6.4.3.2-1 and 3.6.4.3.2-2 give additional information.



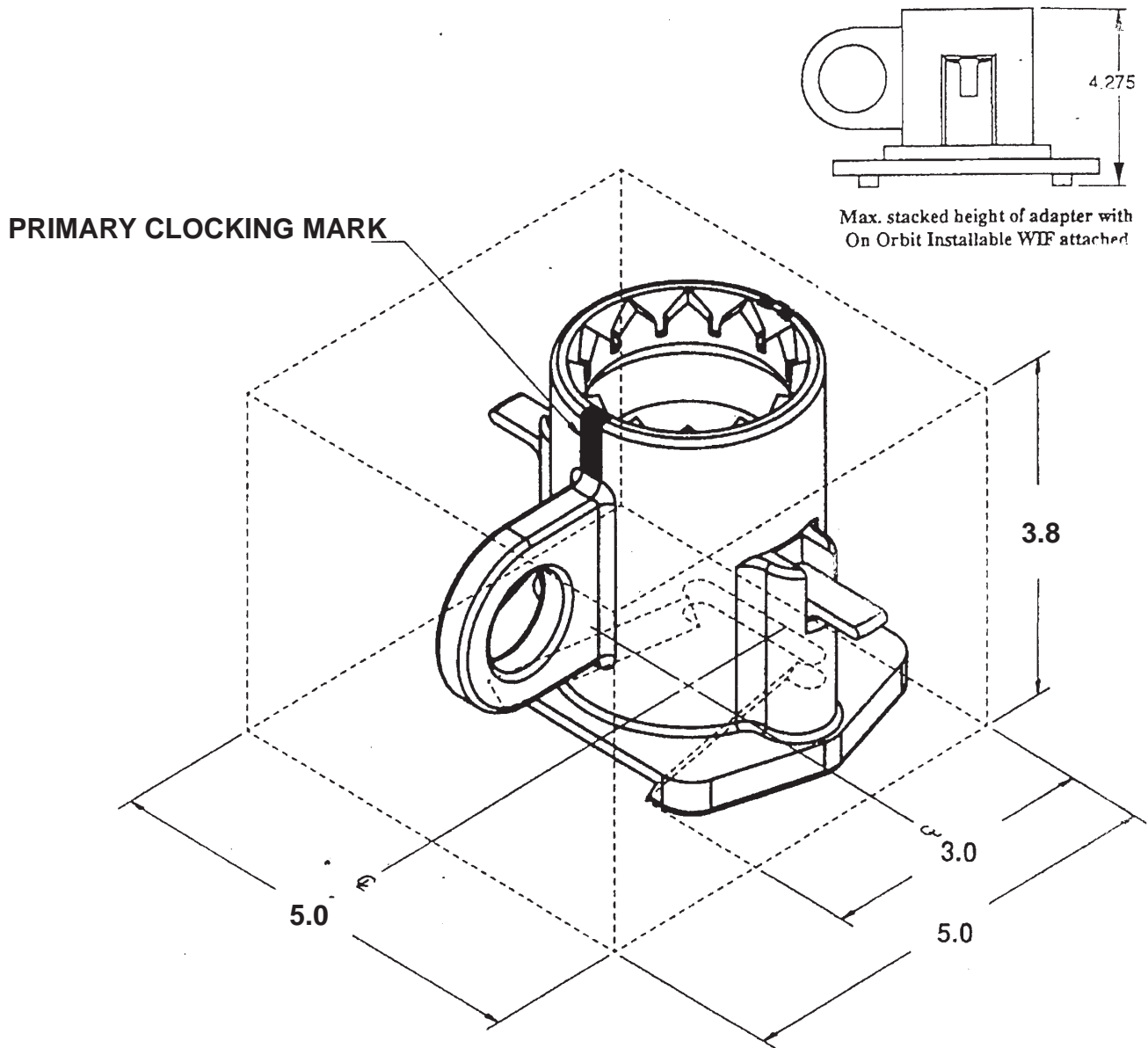
ALL DIMENSIONS ARE MAXIMUM MATERIAL DIMENSIONS UNLESS OTHERWISE NOTED.

FIGURE 3.6.4.2.1-1 TOP MOUNTED WORKSITE INTERFACE PASSIVE HALF HARDWARE ENVELOPE WITH CLOCKING MARK INDICATED



ALL DIMENSIONS ARE MAXIMUM MATERIAL DIMENSIONS UNLESS OTHERWISE NOTED.

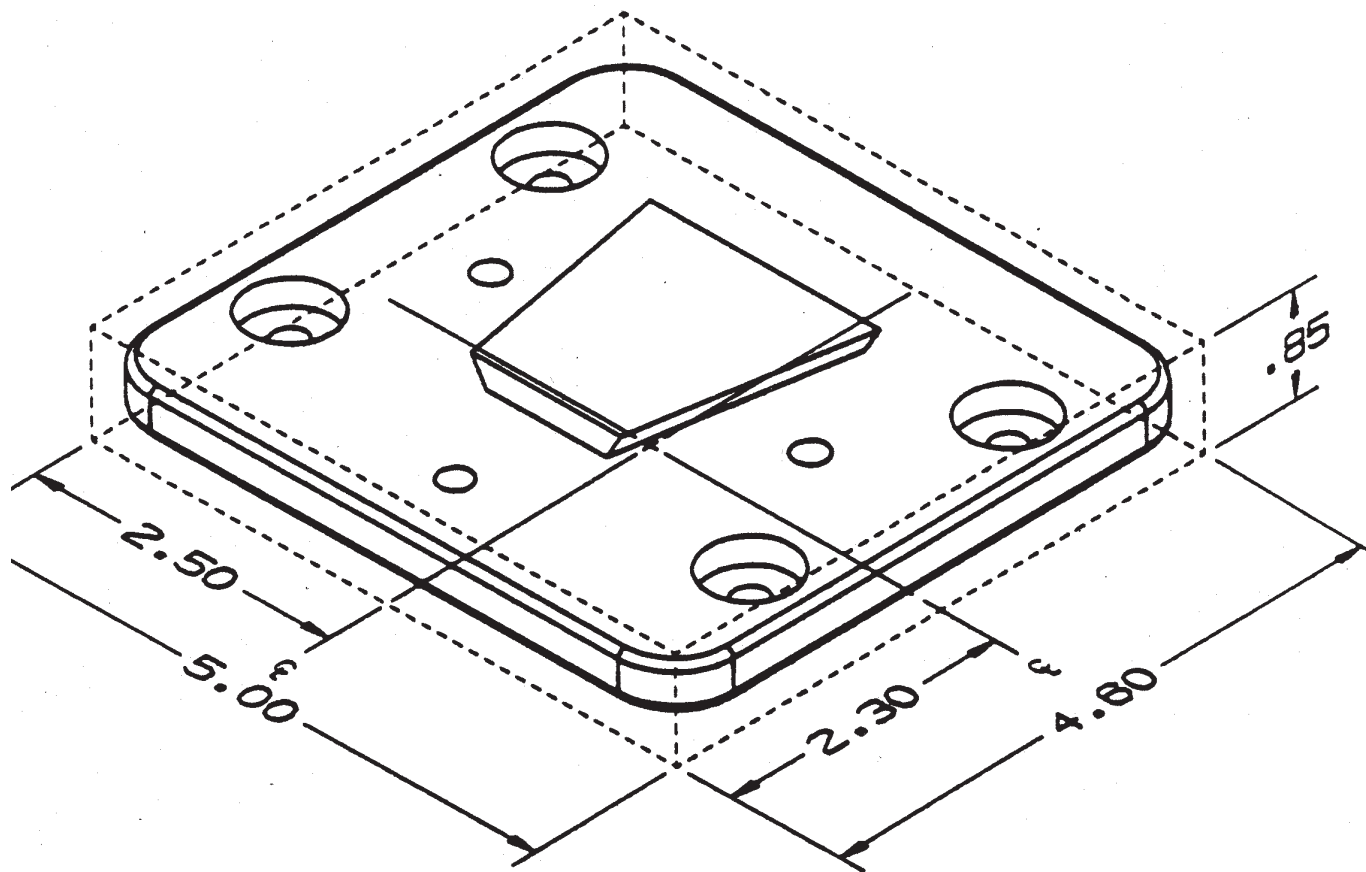
FIGURE 3.6.4.2.1-2 SIDE MOUNTED WORKSITE INTERFACE PASSIVE HALF HARDWARE ENVELOPE WITH CLOCKING MARK INDICATED



ALL DIMENSIONS ARE MAXIMUM
MATERIAL DIMENSIONS UNLESS
OTHERWISE NOTED.

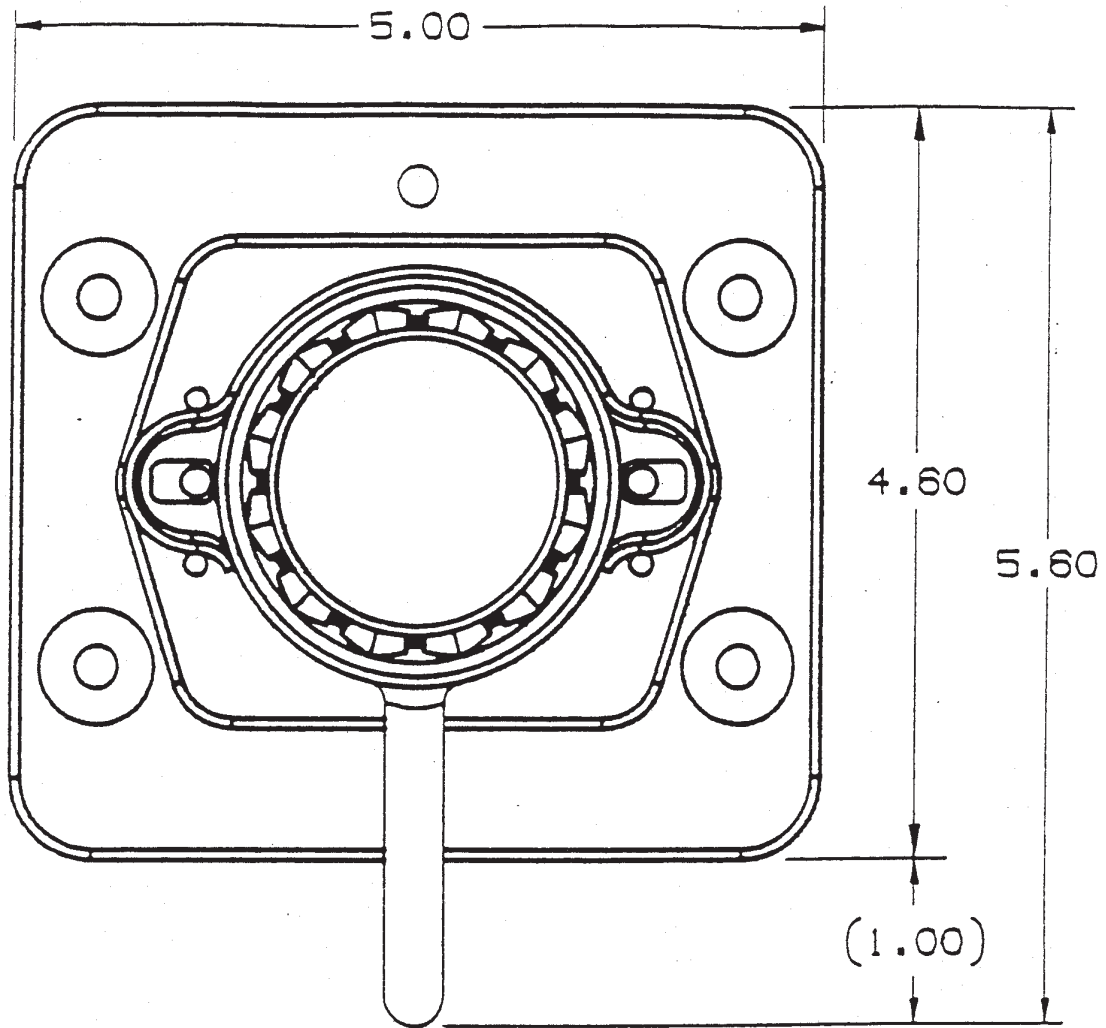
**FIGURE 3.6.4.2.1-3 ON-ORBIT INSTALLED WORKSITE INTERFACE PASSIVE HALF
HARDWARE ENVELOPE WITH CLOCKING MARK INDICATED**

4 EACH SPACERS ARE INCLUDED IN THE ENVELOPE BUT ARE NOT SHOWN. SEE FIGURE 3.6.4.4.1-3 FOR SPACER LOCATION.



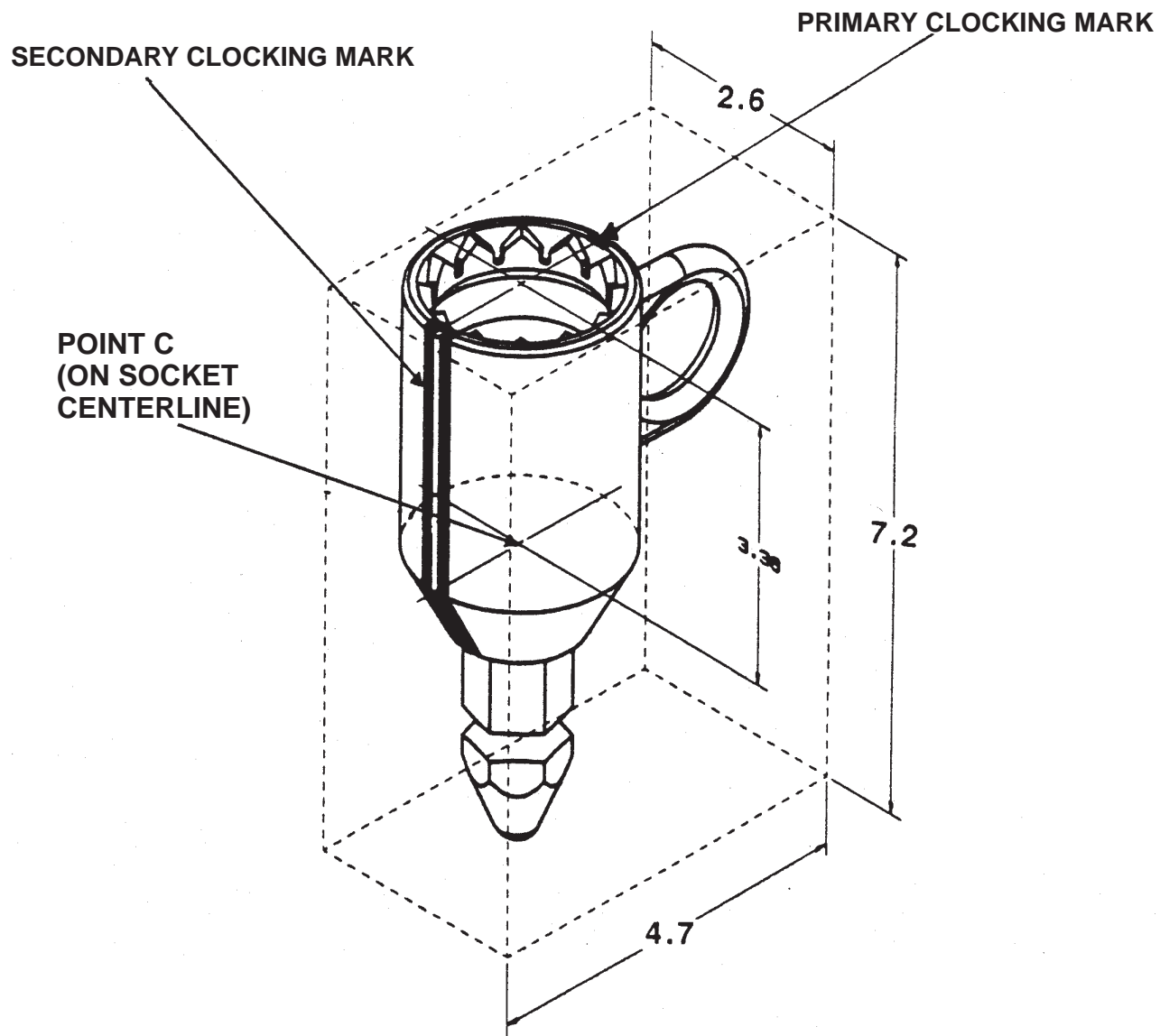
ALL DIMENSIONS ARE MAXIMUM MATERIAL DIMENSIONS UNLESS OTHERWISE NOTED.

FIGURE 3.6.4.2.1-4 ON-ORBIT INSTALLED WORKSITE INTERFACE ADAPTER PLATE HARDWARE ENVELOPE



NOTE: DIMENSIONAL TOLERANCES ARE +/- .01

FIGURE 3.6.4.2.1-5 AS INSTALLED ON-ORBIT INSTALLED WORKSITE INTERFACE FOOTPRINT



ALL DIMENSIONS ARE MAXIMUM MATERIAL DIMENSIONS UNLESS OTHERWISE NOTED.

FIGURE 3.6.4.2.1-6 WORKSITE INTERFACE PASSIVE ADAPTER ENVELOPE WITH CLOCKING MARK INDICATED