Assembly Fixture for 78 Section 11, Heavy Composite Assembly

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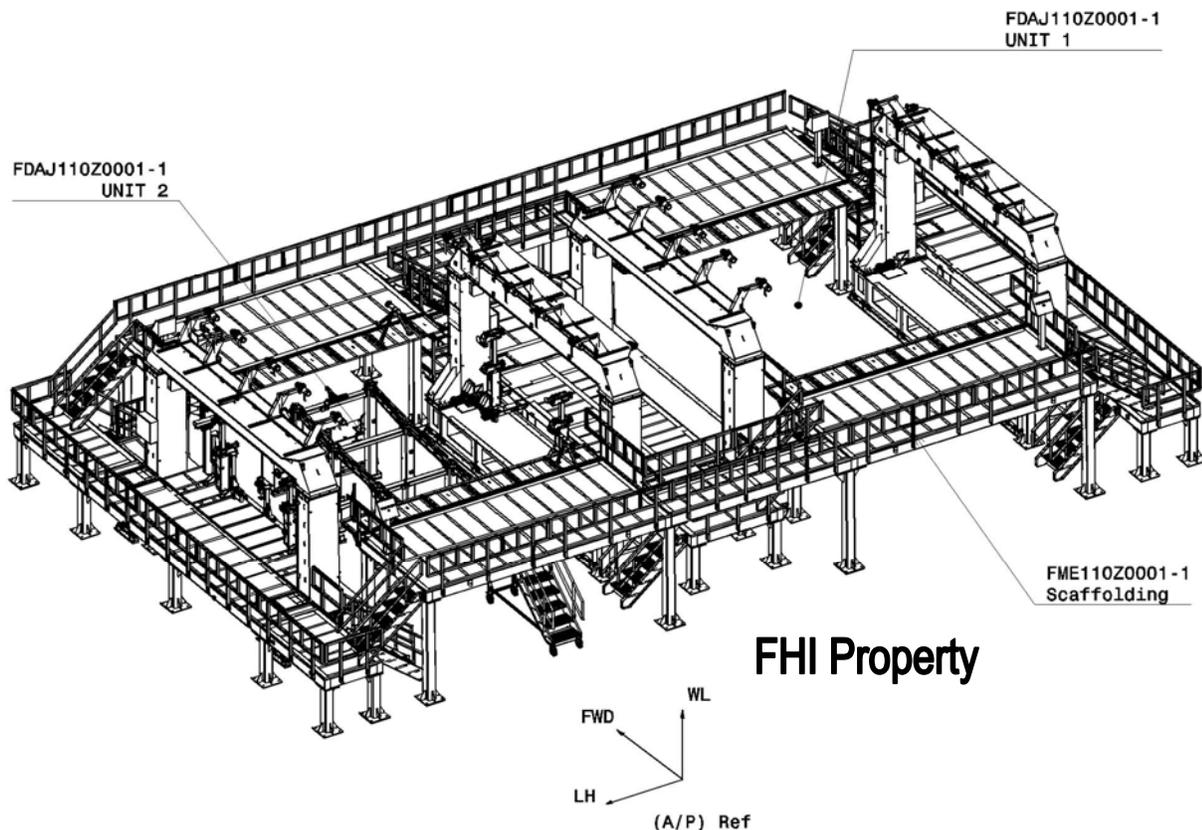**Masatomo Nakada**
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ABSTRACT

The 787 Section 11 Assembly Cell is a combination fixed post and moving frame holding and indexing system, designed to determinately build the 787 Section 11 Wing box. The retractable overhead frame allows maximum clearance for safer and faster loading and unloading of component parts, as well as completed wingbody sections. Additionally, each index is also retractable allowing maximum fastener access inside the jig.

INTRODUCTION

The 787 Section 11 is primarily CRFP (spars, spanwise beams, panels, etc), and Titanium (SOB Chords, Terminal Fittings, etc) with some smaller portions made of aluminum alloys. The completed assembly weighs 5 Tonne.

The Concept, Design, and Build of this Cell was subcontracted to Electroimpact, as FHI wanted an "Outside the Box" approach for the new cell. Section 11 cells from previous projects were slow to load/unload, ergonomically unfriendly, and uncomfortable to work around. FHI wanted a cell that had quick load/unload capability and better access. This cell is one of several "Lean" cells at the Handa, Japan Factory for final assembling the Section 11/45.

CELL DESCRIPTION

The purpose of the cell is to provide rigid, accurate positioning for each of the major external Section 11 components, while allowing the indexes to individually retract for offset measurement verification, drilling access, and deburring/washdown. Additional design aspects include:

    Open Wide frame design for quick part load/unload.
    Removable indexes for multiple aircraft variants.
    Power Retracting and Locking Frames and Scaffold.
    Unparalleled Ergonomics and Safety.
    Ease of use. Self explanatory.

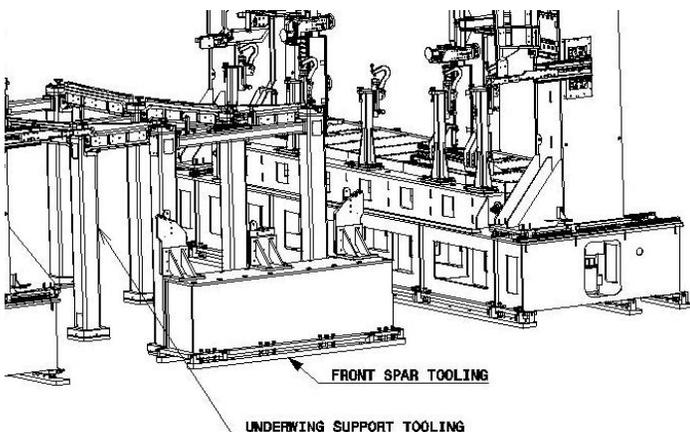There are 88 direct contact and offset indexes in the Section 11 Jig, all captured and non-removable. There are 2 jigs in the cell sharing a common overhead crane.

Cell Fixtures and Tooling

The cell is comprised of 4 tooling modules as well as integrated scaffolding and facilities: Underwing Support, Front Spar, and the Port and Stbd SOB Stationary Base and Moving Frames.

UWS Module

The Underwing support module is the primary structural support that carries the majority of the weight of the Section 11. It also indexes the Lower panel, Keel chords, and portions of the Front spar. The UWS is a post design to maximize mechanic access underneath the panel and allow for future use of a flex track style automated drilling machine.

FRONT SPAR TOOLING

UNDERWING SUPPORT TOOLING

The UWS supports the OML of the lower panel with profiled contour boards. The lower panel first is set down on compliant lifting jacks while jacking screws position the panel to receive Indexing pins through

coordination holes in the panel. The jacks are lowered and the panel rests indexed on the contour boards. Retractable Keel Chord Locators are used to verify Keel Chord position, and then moved out of the way. Also, a set of retractable Auxiliary FS locators are used to verify the position of the midline FS in Station.
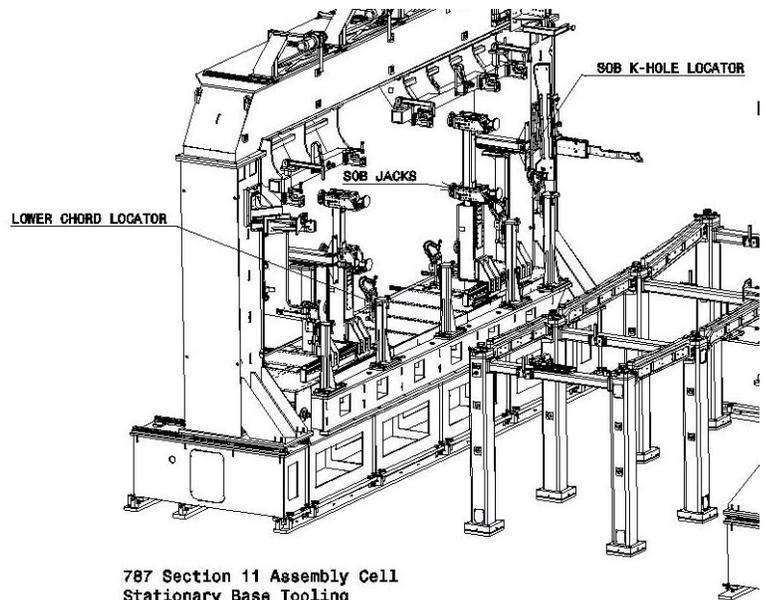
Front Spar Tooling Module

The Front Spar tooling module offset indexes allow for verification inspection of the lower portion of the Front spar in station and WL, temporary jacks are used to adjust the FS in Station

Stationary SOB Base Module

The Stationary portion of the SOB Base Module indexes the Lower SOB Chords and the SOB Ribs.
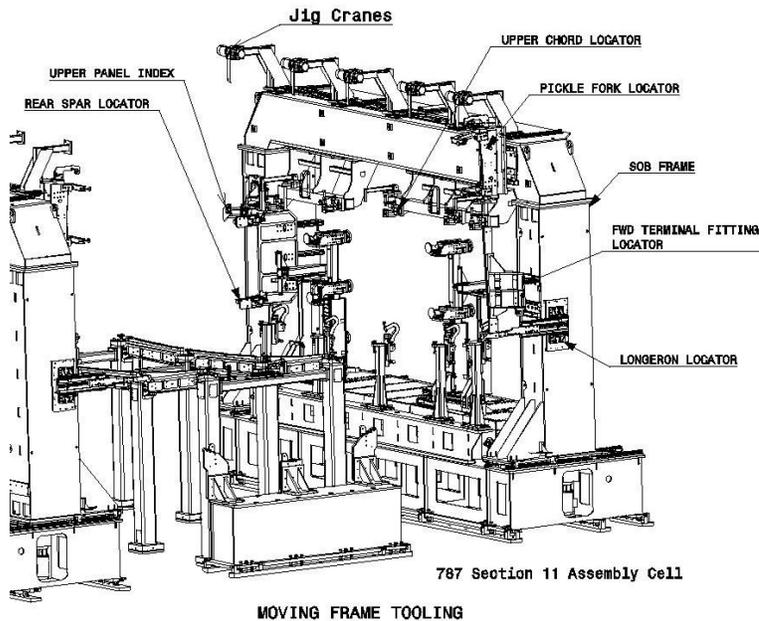
SOB K-HOLE LOCATOR

SOB JACKS

LOWER CHORD LOCATOR

787 Section 11 Assembly Cell
Stationary Base Tooling

The Lower Chord tooling indexes and clamps the Lower SOB chord in position, while allowing each individual index to be either dropped for access, or indexed at an offset for inspection measurement. The SOB Ribs are indexed using an air powered jacking system and aligned with pins through the coordination holes. The stationary base also provides access at an optimum work height for technicians, as well as easy access to the inside of the Section 11.

Moving SOB Frame Module

The Moving SOB Frame Module indexes the Upper SOB Chord, Rear Spar, Pickle Fork, Forward Terminal Fitting, Longeron, and Upper Panel. It also serves as a mounting for the fishing pole jig cranes. The Frame moves under plc control and can be easily moved into either the indexed and locked or retracted positions.

UPPER PANEL INDEX
REAR SPAR LOCATOR
Jig Cranes
UPPER CHORD LOCATOR
PICKLE FORK LOCATOR
SOB FRAME
FWD TERMINAL FITTING LOCATOR
LONGERON LOCATOR

787 Section 11 Assembly Cell

MOVING FRAME TOOLING

FHI Property

The Upper Chord tooling indexes and clamps the upper SOB chord. Chord indexes can be positioned between the hard index position, an indexed offset position for inspection measurement, and can be dropped down for drill access or part loading/unloading.

Rear spar indexes index and clamp the rear spar. The rear spar also has temporary jacks to position it in Station. The rear spar tooling can be retracted for drill access or unloading.

The Picklefork tooling indexes and clamps the Picklefork Assembly. The tooling also has positions for loading and unloading allowing the mechanics to drill off then remove the Picklefork.

The Forward Terminal Fitting and Longeron Terminal are offset measured and verified only. Both tooling can be retracted for drilling access or unloading.

The Upper Panel tooling hard indexes or offset indexes the upper panel in Station, and can be retracted.

The in-Jig Cranes are controlled by wireless pendant or fixed Operator Station and can be operated in pairs, all at once, or individually. They also extend and retract as needed over the work zone.

Scaffolding

Flip Floors on either end of the jig are pneumatically operated to raise or lower individually or as a group. This allows for safe access to the Sec 11 for mechanics, and also allows for safe and easy loading and unloading. Lighting, electrical, compressed air, and vacuum have been integrated into the jig and are available at branch locations located around the jig.

CONCLUSION

The new 787 Section 11 Assembly jig delivers excellent access and ergonomics, fast part loading and unloading. It also provides rigid physical contact Indexes making for accurate positioning, while built-in offset position make inspection verification fast and precise. All these factors contribute to the manufacture of a quality Section 11 Wingbox.