



SIEMENS

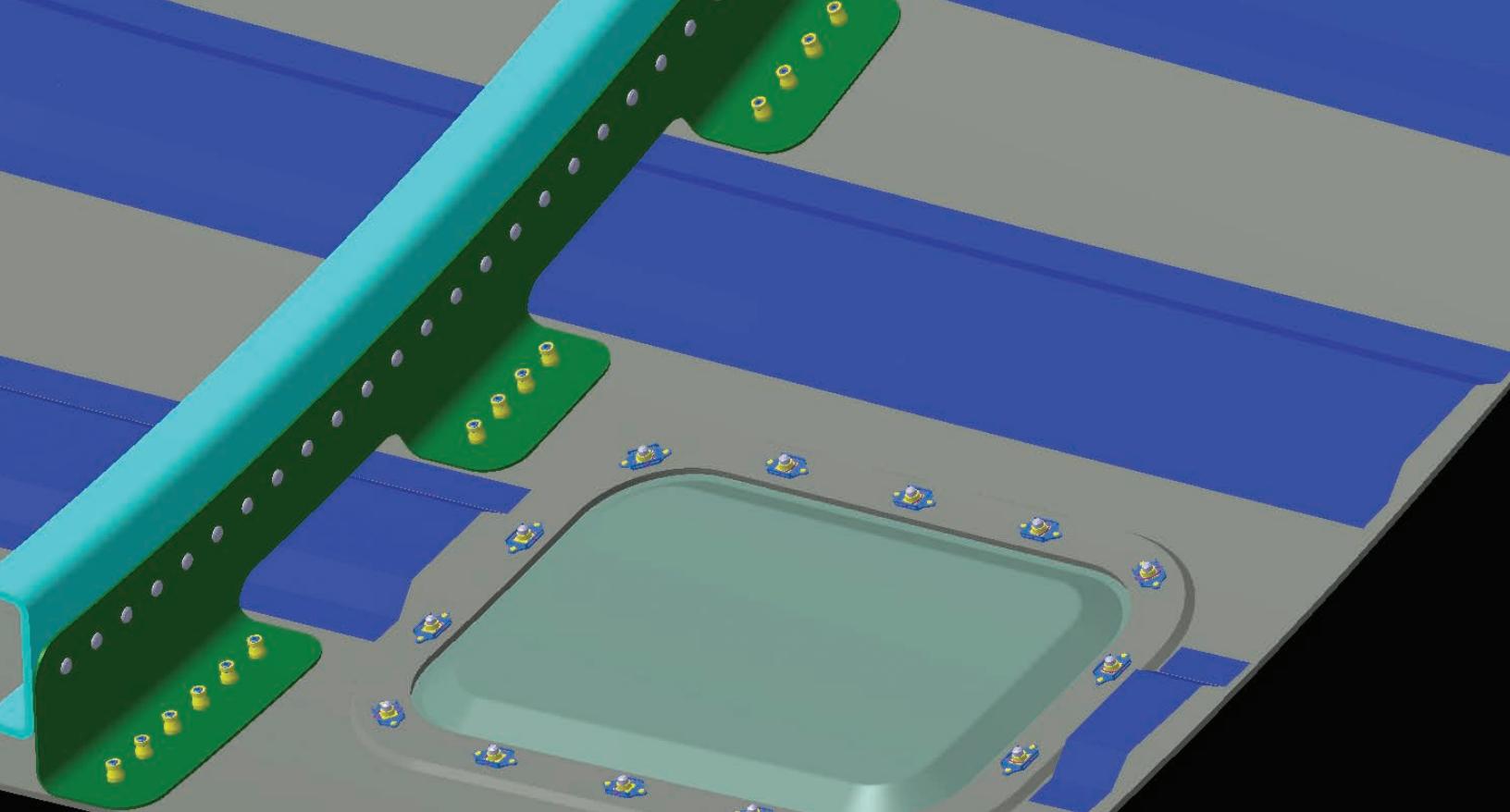
Ingenuity for life

Siemens PLM Software

Syncrofit

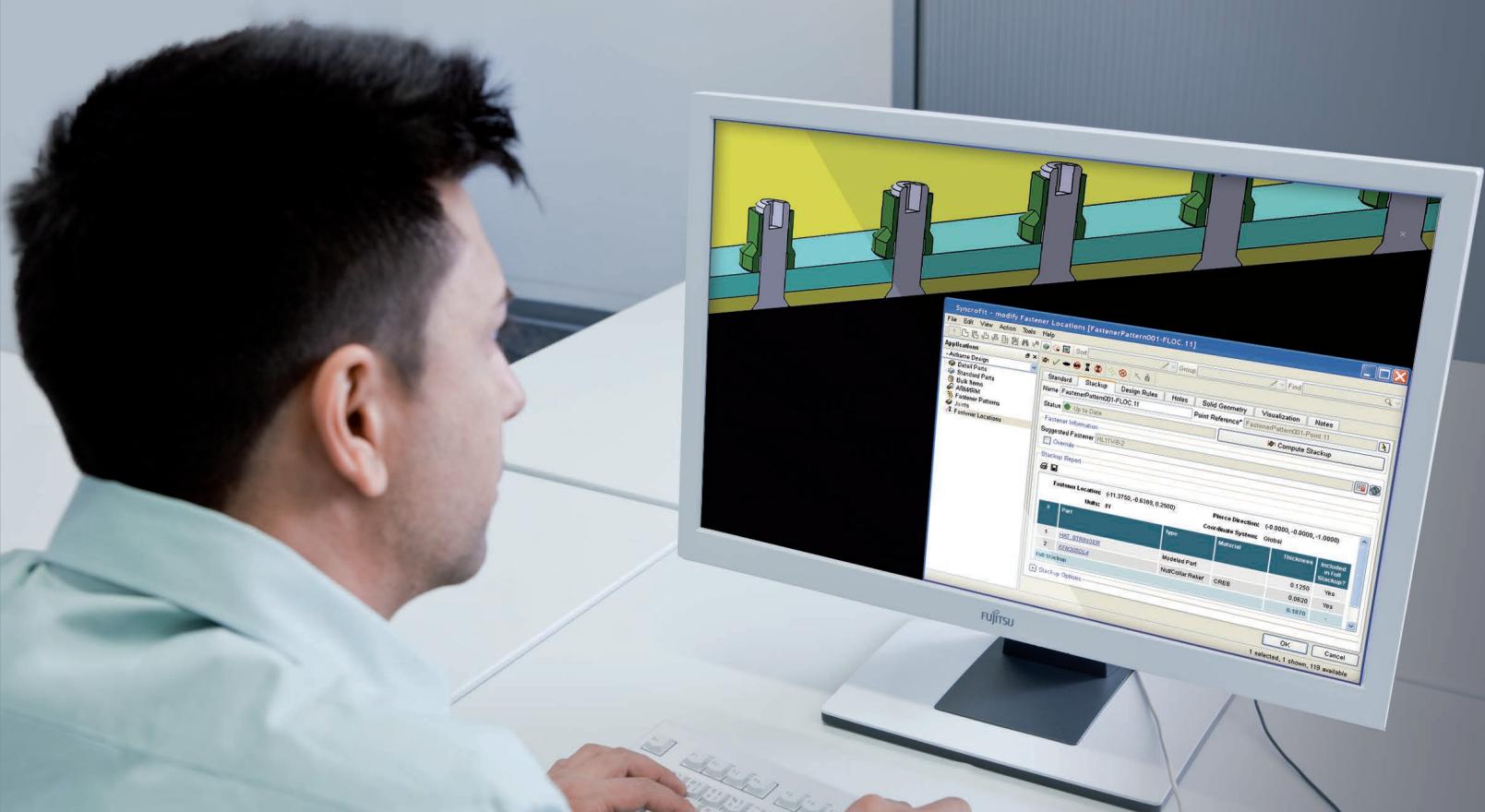
Propelling world-class
development of airframe
assemblies

siemens.com/plm/syncrofit



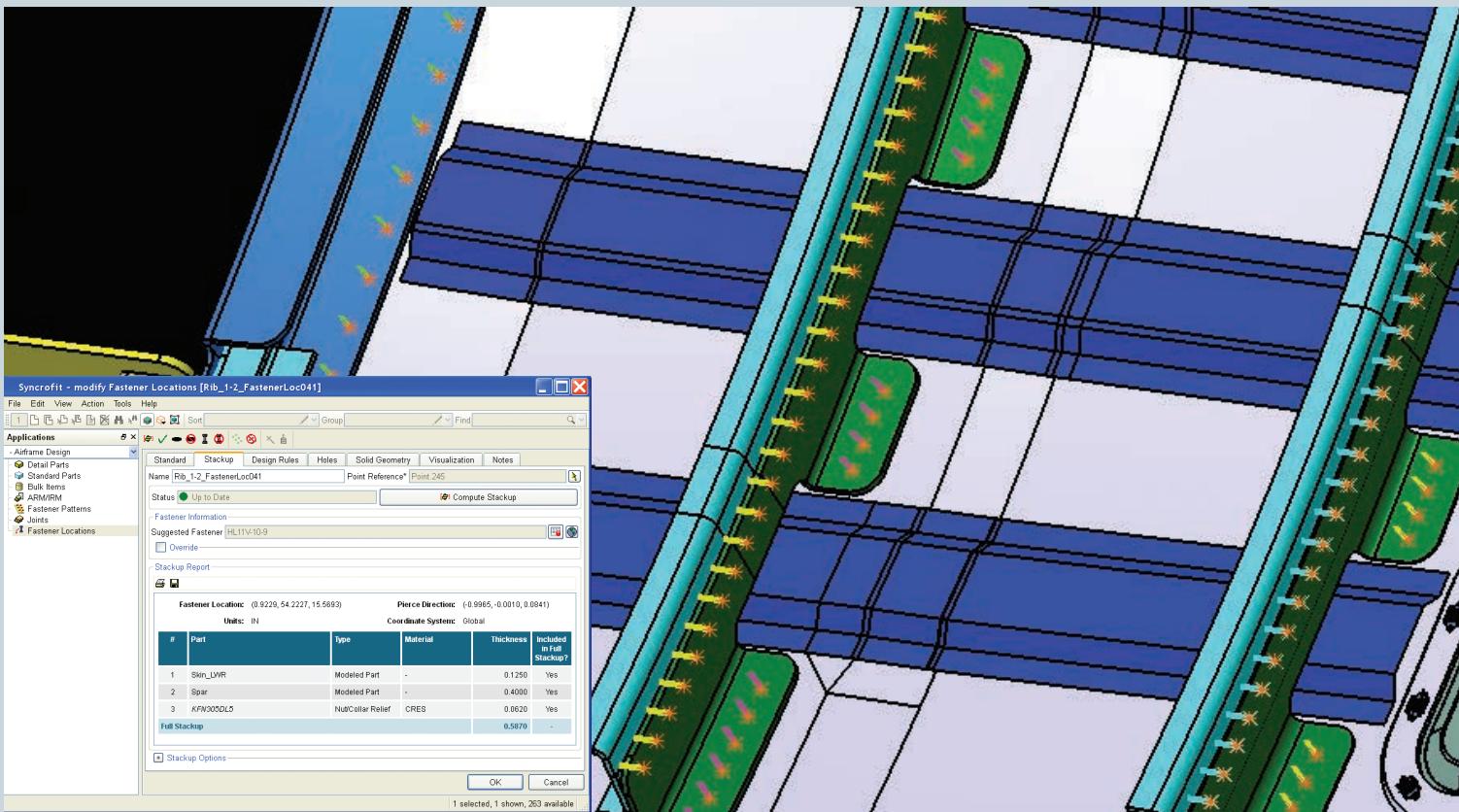
Syncrofit software

- *Improves engineering productivity for fastened assemblies by 65 percent*
- *Reduces engineering change orders by 40 percent*
- *Creates a complete digital definition of an airframe assembly to accurately feed downstream systems*



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Thousands of pieces of unstructured information are generated in the airframe design-to-manufacturing process that must be communicated accurately and completely through multiple design revisions. The tasks necessary to define and share this information are both tedious and complex. Such tasks are often not automated or well supported by commercial 3D CAD systems. You must accurately and unambiguously capture specifications and verify that requirements are met, efficiently define the stages of the manufacturing process and ensure that the end product meets certification criteria. This complexity, along

with increasing pressure to deliver products to market faster, puts enormous demands on you and your software systems. Specialized tools that reflect the unique terminology and process used for airframe design are critical to efficiently meet these requirements.

That's exactly what Syncrofit™ software from Siemens PLM Software provides: specialized solutions for developing high-quality airframes profitably and on schedule.

A specialized problem requires specialized tools

(Below) Several years of data collected by major aerospace manufacturers regarding the source of engineering change orders (ECOs) shows that more than 40 percent of them can be attributed to assembly definition issues. Syncrofit has proven to help significantly reduce these design errors by eliminating manual data entry, automating tedious calculations and validating design rules prior to engineering release.

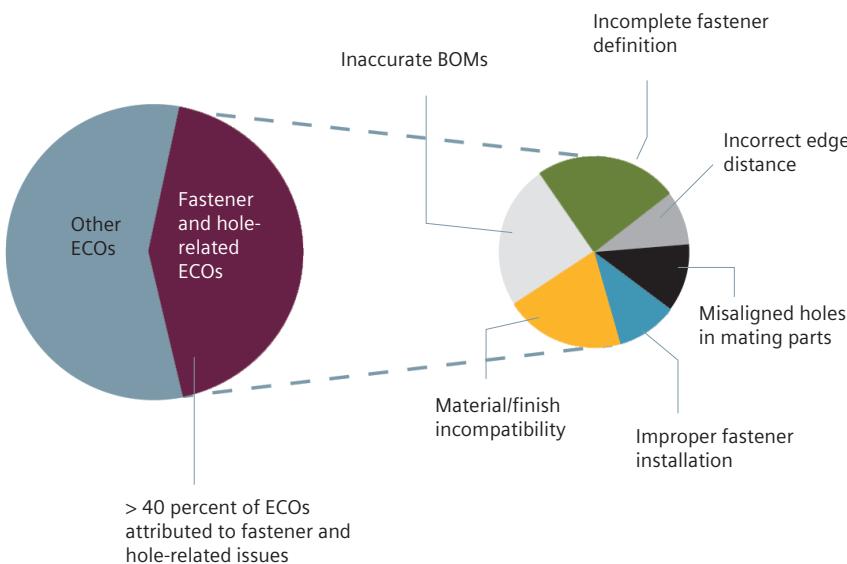
Airframe design is very specialized work, which can be better supported if your tools allow you to work how you think – in terms of joints, fastener types, grip lengths and sealant specifications, for example. For this unique, non-geometric information to be useful in the product development process, it must be associated with geometry. Otherwise, reduced quality designs and extended schedules may result from manually entering specifications and callouts for thousands of fasteners.

Airframe manufacturing is also very specialized. It demands accurate and fast consumption of engineering requirements. You need an automated link between design and manufacturing systems to quickly and precisely consume engineering requirements. If forced to use generic tools, you are

required to manually consume specifications for myriad fasteners, joints and detail parts – which can be tedious, error-prone and time-consuming.

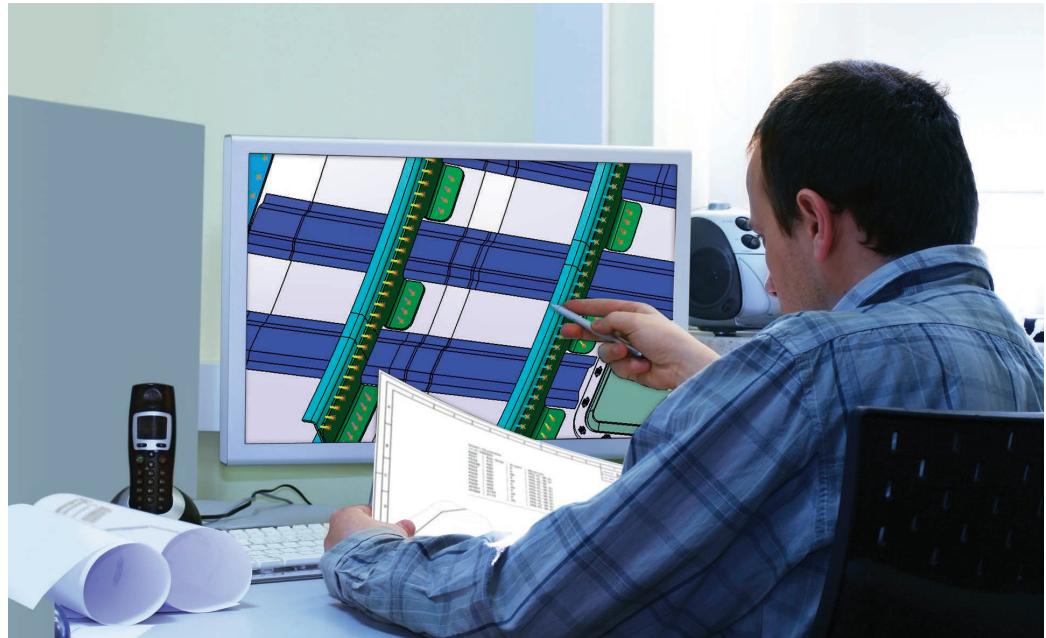
Consider this example: Airframe assembly frequently uses unique manufacturing processes (such as match drilling), which require definition of the intermediate states the assembly progresses through to achieve the final product. The effort to document these individual states is complex and can be hard to manage, especially during design changes. These challenges often cause schedule delays due to errors or unanticipated changes required by the design team.

Syncrofit software from Siemens PLM Software addresses these challenges by providing a complete solution integrated into commercial 3D CAD systems specifically for designing and manufacturing airframe assemblies and large aerostructures. It creates digital, model-based definitions that minimize monotonous, lengthy design tasks while taking into account new manufacturing technologies and globally distributed design approaches.



Addressing the unique needs of assembly design and manufacturing engineers

Syncrofit is an essential tool for both design and manufacturing engineers.

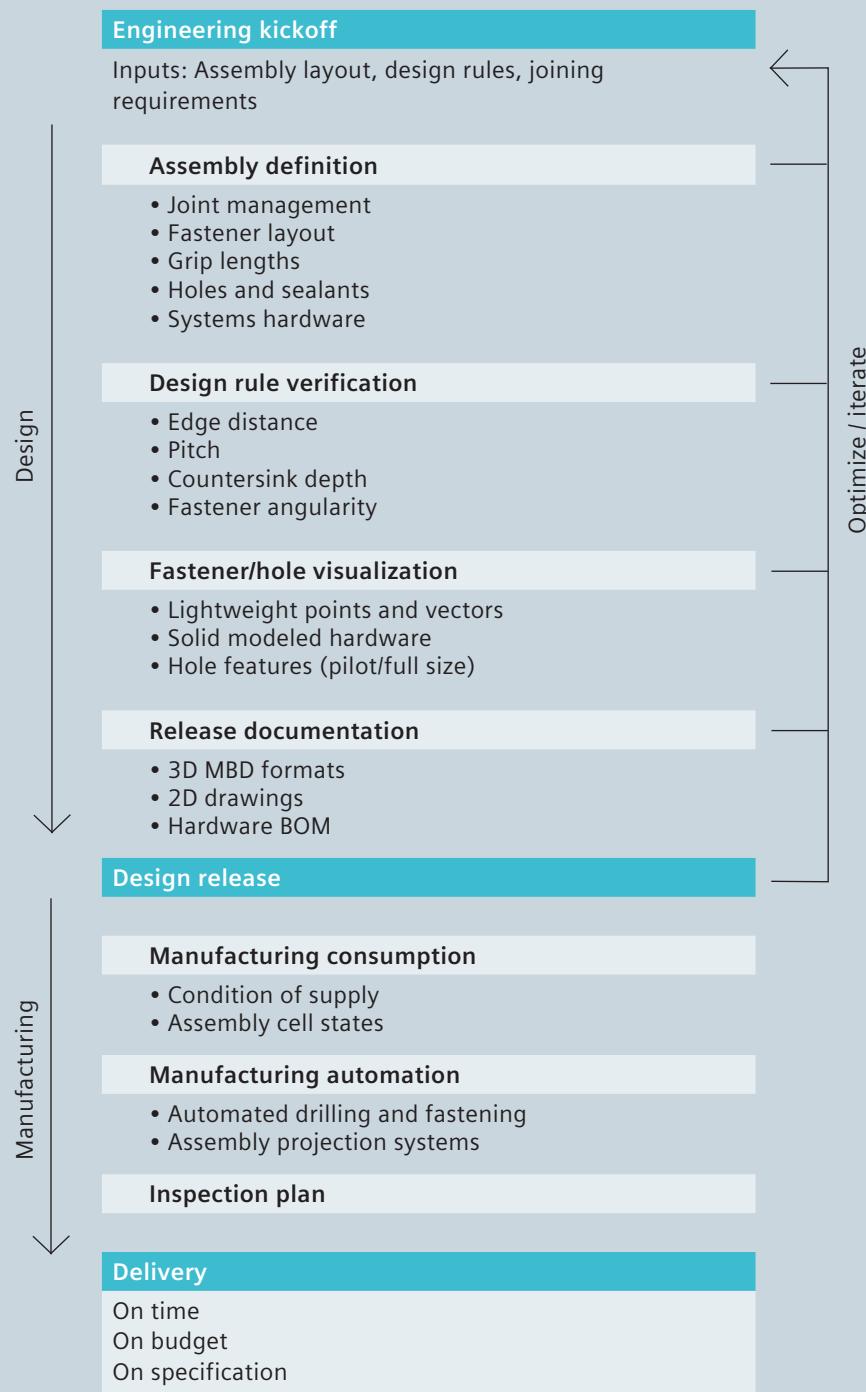


For design engineers, Syncrofit facilitates authoring design data for joints, fasteners and holes to create complete 3D product definitions. The software stores the design data, linked to the associated geometry, directly inside the 3D CAD model. It provides powerful tools for automating repetitive design tasks such as calculating fastener grip lengths and edge distances. It also helps engineers generate deliverables such as model-based definition formats and bill of material (BOM) reports for assembly hardware.

For manufacturing engineers, Syncrofit facilitates creation, management and communication of multiple manufacturing states required for assembling airframes. It enables you to easily consume requirements into assembly states – including the condition of supply – to support process planning. It also aids in tracking fastener consumption and delivers key information for programming automated drilling and fastening equipment.

The result? A highly efficient process for delivering world-class aircraft on schedule, at reduced cost.

Supporting the entire aerostructures development process



Assembly definition

Establish a consistent, repeatable process for developing airframes in 3D

Key functionality

- Joint management
- Fastener layout
- Grip lengths
- Holes and sealants
- Systems hardware

Benefits

- Reduces fastener definition time by as much as 70 percent
- Provides for rapid design updates based on structural changes driven by analysts
- Ensures adherence to company design rules and standards
- Eliminates interpretation problems and errors related to data entry

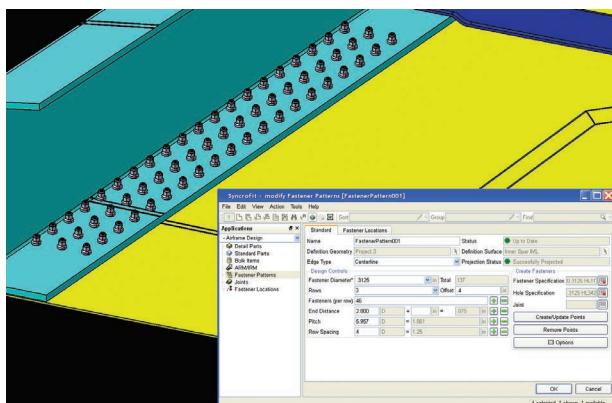
Syncrofit enables you to organize the airframe into a series of joint definitions that capture essential information such as part stackup, bonding, sealing and fastening requirements.

To enable earlier and more accurate assembly definition, Syncrofit incorporates fastener pattern development capability that embeds company design rules and standards into the definition while promoting consistency between designers.

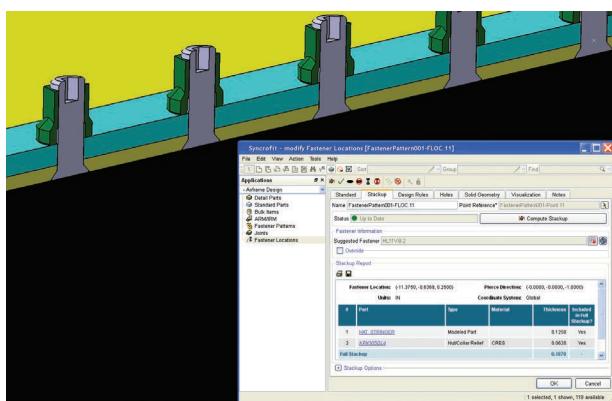
Positioning fasteners to secure a joint is just the start. You must provide a complete definition at each fastener location and determine the required grip length. The grip length is based on thickness of the stack of components and hardware at a given location. In the past, calculating the fastener grip

length required you to manually take measurements at each location to properly size the fastener.

Syncrofit automates this process and handles all details that impact the grip length, such as the amount of relief in the nut or collar and whether a sealant or coating is applied to components in the stackup.



The fastener pattern capability in Syncrofit incorporates design rules to position fasteners to satisfy edge distance, pitch and tangent edge requirements while enabling a concurrent approach to part and assembly development.



Syncrofit assigns the appropriate grip length to airframe fasteners by automating the manual and tedious process of calculating part stackup thickness.

Design rule verification

Verify that specifications are met, and understand the impact of design changes

Key functionality

Push-button verification with instantaneous feed-back on status of key design rules for:

- Part edge distance
- Tangent edge distance
- Pitch
- Grip length validation
- Length-to-diameter ratio
- Countersink depth-to-part thickness ratio
- Angularity

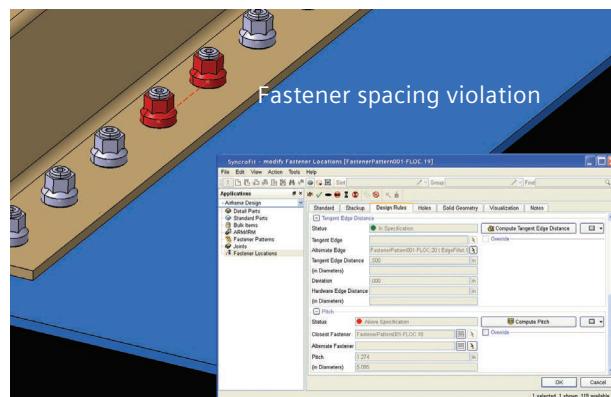
Based on 20 years of experience working with OEMs and Tier 1 suppliers on a variety of aerostructure programs, it has been calculated that, on average, more than 40 percent of engineering change orders and rework on the manufacturing floor are related to assembly interfaces, holes and fasteners. In fact, many of these issues are violations of design rules related to holes and fasteners.

Syncrofit provides capabilities to avoid design rule violations, including dedicated functionality specifically targeted at validating critical fastener- and hole-related design requirements.

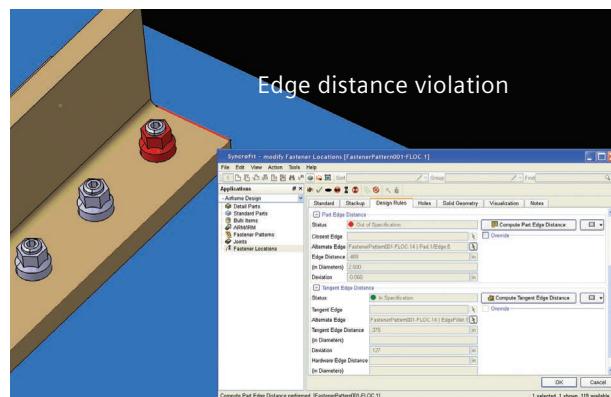
The Syncrofit intuitive user interface provides a panel that acts like a dashboard that automatically computes all design rules for each of the fastener locations in an assembly. This provides a quick view of the design rule adherence. As a result, you can be confident that designs will be released within specification and that you will not be facing costly engineering change orders and potential rework or scrapped parts on the manufacturing floor.

Benefits

- Reduces engineering change orders resulting from design rule violations
- Continuously monitors design rule adherence during the iterative change process



Syncrofit automatically detects and calculates the spacing between fasteners to ensure pitch requirements have been satisfied.



Syncrofit automatically detects the closest part edge and tangent edge for each fastener location and warns you when design rule limits have been exceeded.

Fastener and hole visualization

Visualize fasteners and holes at various levels of granularity

Key functionality

Unique ability to toggle between required visualization state for holes and fasteners, including:

- Lightweight points and vectors
- Solid modeled hardware
- Hole features (pilot/full size)

Benefits

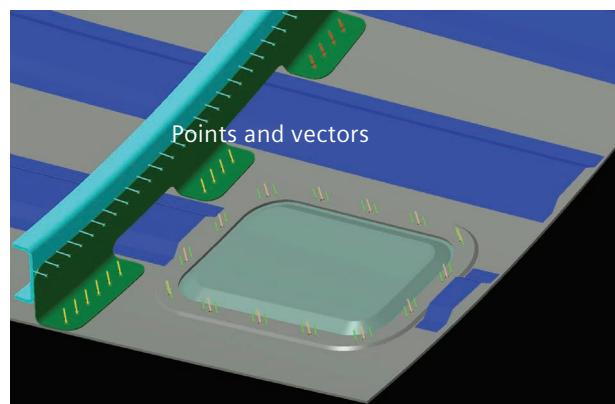
- Reduces time to create fastener representations by as much as 90 percent
- Enables visualization of multiple representations of fasteners and holes
- Eliminates hole and fastener misalignment problems and errors related to data entry

You need to visualize airframe assemblies differently throughout the development process depending on the task. Syncrofit provides several options to do this, resulting in an unprecedented level of flexibility and efficiency throughout the entire process.

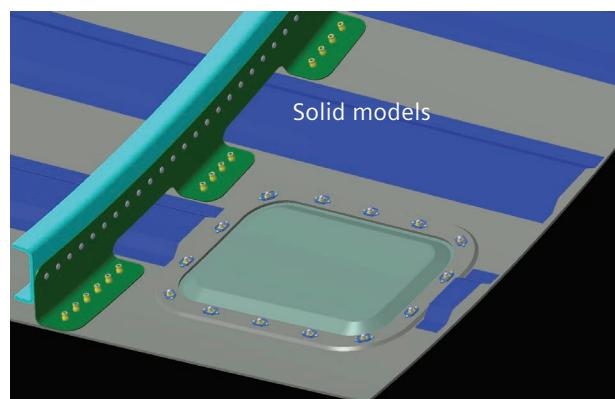
During the assembly design and fastener layout phase, simple point and vector representations of fasteners are sufficient to communicate key information quickly – such as fastener location, head side, spacing or distance to edge – while minimizing model size.

At other times, cylindrical representations of fasteners are necessary for you to easily visualize fastener lengths and rough interferences without bogging down computing power.

But if the task is to perform complete clash/interference detection, maintenance studies or installation studies, or if it is a required supplier deliverable to the OEM, it is necessary to load fasteners into the model. This ensures that all the hardware at every location can be seen – including nuts, washers, nutplates and the like. With the unique ability to toggle between the design and manufacturing state of the hole, Syncrofit helps you visualize detail parts with any of these representations.



Syncrofit provides multiple levels of visualization for the representation of fasteners including lightweight, color-coded points and vectors as shown.



Loading and positioning fastener hardware models is a push-button operation in Syncrofit, which provides you with the ability to check for interferences and meet engineering deliverable requirements.

Release documentation

Avoid errors and manual re-entry of data

Key functionality

Defines airframe assembly data using a model-based design approach for:

- Notes and specifications
- Standard parts
- Joint definitions
- Fastener and hole callouts
- Hardware bills of material

Benefits

- Establishes model-based definition standard for airframe assembly data
- Ensures consistency between designers
- Reduces documentation requirements and need to develop design guide
- Improves communication between airframe OEMs and the supply chain

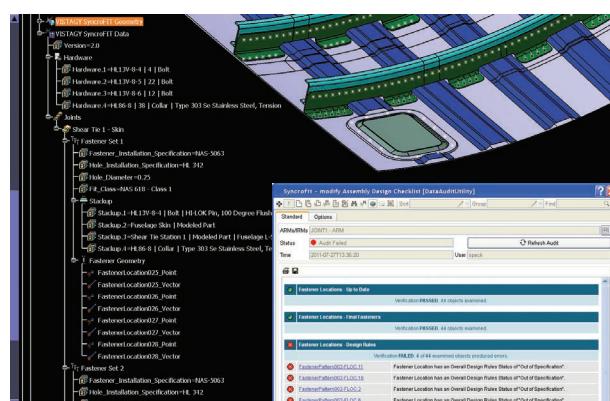
As part of the release process, you must create various documentation that defines the airframe assembly. This may include 2D drawings, 3D model-based definition (MBD) data or specialized reports.

To meet the demands of the aerospace industry as it transitions from a 2D drawing-based process to a 3D model-centric environment, Siemens PLM Software has established an industry standard 3D MBD approach for capturing and communicating detail part and assembly data.

The Syncrofit MBD functionality organizes critical detail part and assembly data in the native CAD model in a structured format. Alternatively, it can be navigated within the Syncrofit viewing application. This ensures

consistency between designers and reduces documentation requirements to develop design guides and model format standards. It also provides a consistent way for downstream users to access the data.

Data from Syncrofit can also be exported into other formats such as Excel spreadsheets, text files, PDF documents or HTML pages. Syncrofit utilizes an open XML data format, which enables seamless data transfer into other downstream systems with the push of a button.



Syncrofit is the only off-the-shelf solution for capturing and communicating model-based definitions of airframe assemblies and installations.

Syncrofit fastener hardware report				
Part Number	Quantity	Type	Material	Description
HL11V-12-6	15	Bolt	6AL-4V Titanium	HI-LOK Pin, 100 Degree Flush Shear Head, Titanium
HL11V-6-7	60	Bolt	6AL-4V Titanium	HI-LOK Pin, 100 Degree Flush Shear Head, Titanium
HL11V-8-5	44	Bolt	6AL-4V Titanium	HI-LOK Pin, 100 Degree Flush Shear Head, Titanium
KFN305DL3	60	Nut	CRES	6 Point Deep C'Bore Nut
KFN305DL4	44	Nut	CRES	6 Point Deep C'Bore Nut
KFN305DL6	15	Nut	CRES	6 Point Deep C'Bore Nut
NAS1149D0332K	60	Washer	2024-T3 Aluminum	Washer, flat
NAS1149D0432K	44	Washer	2024-T3 Aluminum	Washer, flat
NAS1149D0632K	15	Washer	2024-T3 Aluminum	Washer, flat

Generating a bill of material for assembly hardware is accomplished with the click of a button and can be updated instantaneously throughout the design process.

Manufacturing consumption

Enabling lifecycle definitions and traceability from design to manufacturing

Key functionality

Model-based approach for consuming engineering data to develop manufacturing definitions for airframe assemblies:

- Condition of supply
- Intermediate assembly states

Benefits

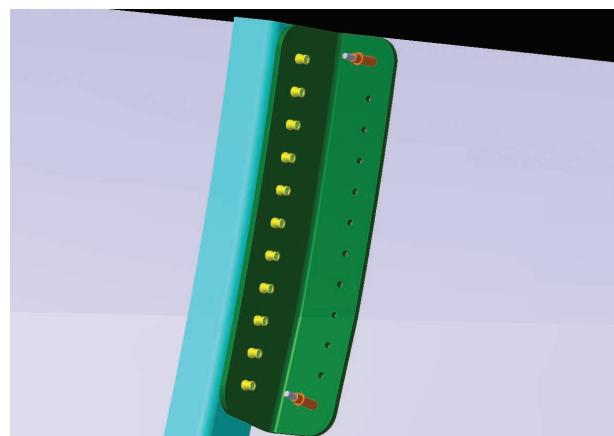
- Fully traces hole and fastener requirements from design to manufacturing
- Eliminates manual methods for consuming engineering data to support manufacturing process planning
- Prevents scrapping of parts due to manufacturing errors that result from poorly documented conditions of supply

Unique manufacturing processes used frequently for airframe assembly (such as match drilling) require the definition of intermediate states that the details and subassemblies progress through to achieve the final assembly. You have a significant challenge consuming the engineering definitions and documenting the individual assembly states, especially when there are changes to the design. These challenges often cause schedule delays due to errors or unanticipated changes required by the design team.

Traditional manual and uncontrolled processes for conveying deliverable requirements to suppliers often result in components being incorrectly drilled.

Syncrofit creates, manages and communicates the multiple manufacturing states required for assembling airframes. You can easily consume engineering requirements into

assembly states, including the condition of supply, and support process planning activities by authoring detailed, fine-grain manufacturing data within the software. Syncrofit easily accommodates design changes, tracks fastener consumption and shares all that information with manufacturing and quality planning applications. This enables the delivery of essential data to the entire integrated product development and manufacturing team.



Manufacturing engineers consume engineering data within Syncrofit to define the states that the airframe assembly progresses through during the build process.



Syncrofit provides clear and concise information on the initial fabrication state for airframe components by generating condition of supply models.

Manufacturing automation

Automatically deliver design data to the manufacturing floor

Key functionality

Automatically generates data for advanced manufacturing systems:

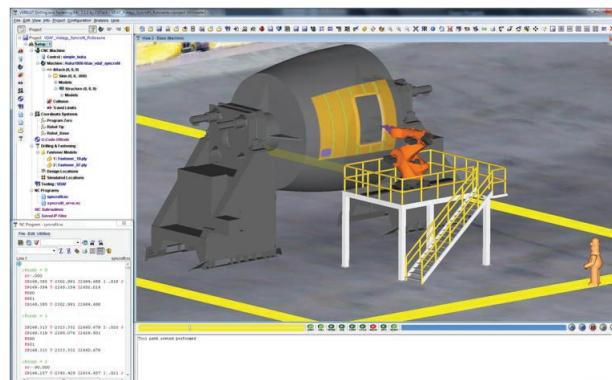
- Fastener and hardware specifications
- Hole sizes
- Drilling requirements (pilot/full size)
- Fastener positions and installation vectors
- Material stackups
- Sealing requirements

Benefits

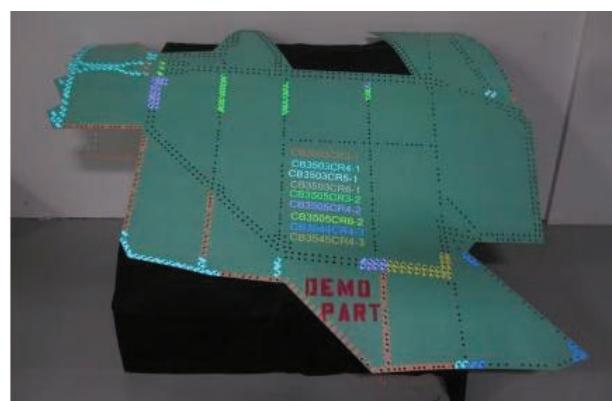
- Seamlessly transfers data from design to the manufacturing floor
- Eliminates manual interrogation of design data and errors caused by re-entry into manufacturing systems

To reduce touch labor costs, improve repeatability and improve quality, airframes are increasingly assembled with automated drilling and fastening equipment. The NC programming systems require detailed information about each fastener location. This data includes position information, approach vectors, drill vectors, operation codes, hole diameter and countersink sizing, part thicknesses and material stackup, sealing requirements and an understanding of the existing state at the location (e.g., temporary fastener in position). With a full definition of the hole and fastening requirements captured with Syncrofit, you can export the required data to various NC programming environments to drive cycle statements for multi-material stack drilling.

In addition to supporting automated manufacturing processes, Syncrofit also provides interfaces to support manual assembly operations that utilize projection-guided assembly methods such as Delta Sigma Corporation's ProjectionWorks system. ProjectionWorks puts all the available information – perhaps more than you have ever supplied to your assembly technicians – right where they need it, when they need it, presented in an optimized format.



Interfaces with NC programming systems such as CGTech's Vericut Drilling and Fastening (VDAF) solution enable a direct feed of engineering data to drive state-of-the-art automated manufacturing equipment.



The Syncrofit interface with Delta Sigma Corporation's ProjectionWorks system enables manufacturers to transform the way aircraft are built using new projection-guided assembly methods.

Inspection plan

Avoid quality escapes and improve efficiency of the quality planning process

Key functionality

Automatically generates engineering data for AS9102 form packages to support first article inspection processes, including:

- Part accountability
- Notes and specifications
- Joint definitions
- Fastener and hole requirements
- Dimensions

Benefits

- Reduces time to generate quality plans for airframe assemblies and installations by as much as 90 percent compared to manual processes
- Delivers more thorough and accurate quality reports resulting in less rework of documentation

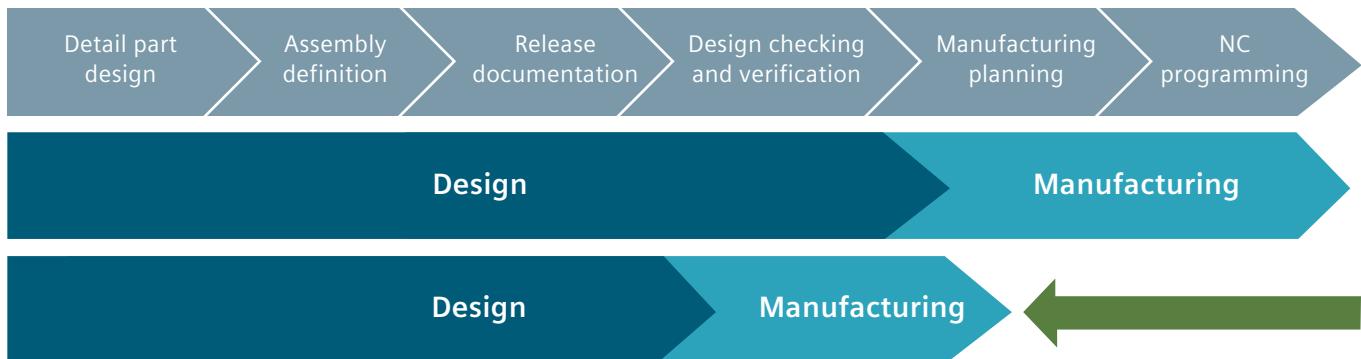
The first article inspection process is a critical step toward certifying an aircraft. Verifying that a design has been manufactured according to specification is accomplished by satisfying all requirements identified on an inspection plan. The development of first article inspection plans from model-based designs is a very manual and error-prone process. Syncrofit, in conjunction with Quality Planning Environment (QPE), helps consume the engineering definition into the quality plan.

As the product data is imported into QPE from Syncrofit, it is formatted into a standard inspection format. QPE is then used to complete the inspection plan by creating the additional portions of the quality plan such as dimensions, notes, joint definitions, fastener and hole requirements and balloons on inspectable items. Once the plan is complete,

QPE stores the plan in an associated quality model. When it is ready for execution, it is exported from QPE to a standard AS9102 format in Excel or Adobe Acrobat (PDF). Alternatively, it may be exported into an XML file, which may be imported into computer-aided process planning (CAPP) systems or other types of downstream software.

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Integrate the entire airframe development process



Syncrofit compresses the design-to-manufacturing process for airframe assemblies up to 25 percent.

Syncrofit delivers:

Achieves productivity improvements and time savings as high as 90 percent for managing joints, fasteners and holes in airframe assemblies

Reduces engineering change orders caused by design rule violations and common errors by as much as 90 percent

Provides early visibility and continuous BOM updates to prevent fastener procurement problems

Enables a smooth transition of engineering data to manufacturing to support advanced assembly processes

Improves communication both internally and with suppliers

Implements a concurrent detail part and assembly design process, capturing critical design information to effectively manage change throughout multiple design iterations

Syncrofit is transforming the airframe development process by allowing for earlier assembly definition to achieve a concurrent detail part and assembly design approach. By automating tedious design tasks and continuously verifying design rules, engineering release schedules are being compressed and engineering change orders are diminishing. And with a smooth hand-off of data from design to manufacturing, accurate designs are hitting the shop floor more quickly than ever.

"Syncrofit enables us to easily author and capture complete digital representations of composite airframe assemblies and share critical design and manufacturing detail more efficiently. The software and service offerings will enable us to take an integrated approach to airframe assembly design and will help us meet our goals."

Justin Elliott, GKN Aerospace chief engineer on the CSeries aircraft winglet program

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Siemens PLM Software, a business unit of the Siemens Digital Factory Division, is a leading global provider of software solutions to drive the digital transformation of industry, creating new opportunities for manufacturers to realize innovation. With headquarters in Plano, Texas, and over 140,000 customers worldwide, Siemens PLM Software works with companies of all sizes to transform the way ideas come to life, the way products are realized, and the way products and assets in operation are used and understood. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

Headquarters: +1 972 987 3000
Americas: +1 314 264 8499
Europe: +44 (0) 1276 413200
Asia-Pacific: +852 2230 3308

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