



## Advanced Composites Center

Manufacturing Advanced Composite Structures

THE VALUE OF PERFORMANCE.  
**NORTHROP GRUMMAN**

### Facts at a Glance

#### Lamination Areas

- Positive pressured, temperature- & humidity-controlled laminating area
- Cutting tables with nesting
- Laser ply locating lean work stations
- Fiber placement machines
- Resin transfer molding presses
- Z-Fiber® insertion process
- Complex structural bond process
- Aqueous core cleaning
- Bond primer application

#### Paperless Factory System

- On-line work instructions
- Direct access to drawings and process specifications
- Daily performance metrics and report generation

#### Autoclaves and Ovens

- Computer-controlled autoclaves capable of 900 degrees Fahrenheit and 250 PSI
- Spike oven capable of 1400 degrees Fahrenheit
- Computer-controlled walk-in ovens capable of 900 degrees Fahrenheit

#### Numerically Controlled Automated Trimming

- Conventional 5-axis, high speed profiler and routers w/probe capability
- Non-abrasive waterjet trimming machines

#### Non-Destructive Inspection

- Automated ultrasonic scanning systems
- Computerized x-ray machine w/booth
- Conventional x-ray machines w/booths
- Penetrant and eddy current inspection

### Automatic Ply Cutting

#### Equipment

- Three cutting machines
- 50,000 cu. ft. sub zero raw material storage



#### Capabilities

- Automated nesting and cutting of impregnated plies
- Automated labeling

#### Benefits

- Just-in-time ply cutting
- Reduced raw materials, scrap and work-in-process inventory
- High yield, defect-free plies

### Laser Ply Locating System

#### Equipment

- Laser ply locating stations

#### Capabilities

- Automated ply location
- Parts up to 12' x 20' with concavity up to 180 degrees

#### Benefits

- Reduced labor hours
- Elimination of all ply location hard tooling



### Automatic Fiber Placement

#### Equipment

- Fiber placement machines

#### Capabilities

- Automated application of graphite fiber on large complex tools
- Automated labeling

#### Benefits

- Eliminates ply cutting and storage requirements
- Increases production efficiency and reduces costs by eliminating debulks



### Numerically Controlled (N/C) Automated Trimming

#### Equipment

- 5-axis high speed profiler, router and probes
- 5-axis precision milling machines. Each machine includes a high speed profiler, a router and a probe.

#### Capabilities

- N/C 5-axis automated machining of large complex contoured parts

#### Benefits

- Increased accuracy and variability reduction



### Non-Destructive Inspection

#### Equipment

- Automated ultrasonic scanning systems
- Conventional x-ray machines
- Computerized x-ray machine

#### Capabilities

- Non-destructive inspection (NDI) of composites parts using high frequency sound waves in a water medium
- X-ray for fine detail and focused inspection

#### Benefits

- Provides data to aid in process control
- NDI guarantees 100% quality to customers



### Laminate Thickness Measurement

#### Equipment

- Laser displacement sensor
- Conventional x-ray machines
- Computerized x-ray machine

#### Capabilities

- Validation of laminate thickness using laser technology

#### Benefits

- Increased measurement accuracy
- Improved process cycle time



### About the Center

Located in Southern California, the Advanced Composites Center produces state-of-the-art composite structures. Lean manufacturing techniques, just-in-time manufacturing, and the Six Sigma approach maintain the Center's competitive edge.

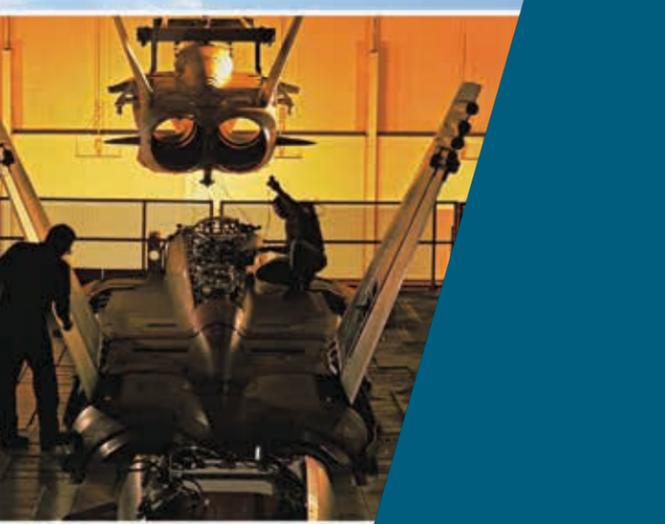
The Composites Center can produce precision composite products from the raw materials stage through the finished product.

Our self-Inspection system gives each mechanic the tools necessary to maintain first-time quality throughout the fabrication process.

The Center currently fabricates parts in support of the F/A-18C/D, F/A-18E/F, EA-18G, F-35, E-2D and B-2 aircraft programs.

THE VALUE OF PERFORMANCE.  
**NORTHROP GRUMMAN**

www.northropgrumman.com  
© 2016 Northrop Grumman Systems Corporation  
Printed in USA  
Marcom El Segundo  
16-0615 • 8/16 • 78364  
Approved for Public Release  
Distribution is unlimited: SPR 2016-600, BPR-2016-33, 09 August 2016

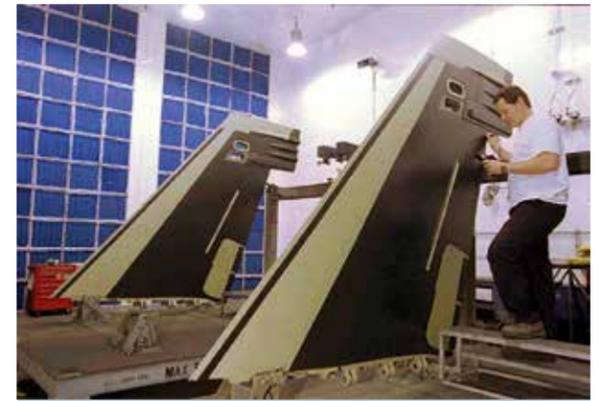


## F/A-18 Assembly Line

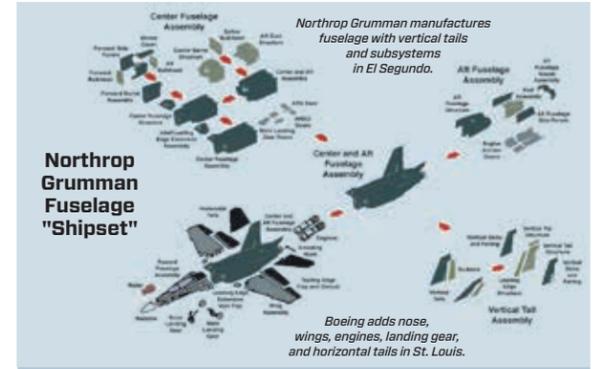
F/A-18E/F Super Hornet  
EA-18G Growler

THE VALUE OF PERFORMANCE.  
**NORTHROP GRUMMAN**

**H**oused in an historic one-million-square foot facility originally built in 1942 from redwood, later this plant produced nearly 12,000 aircraft representing 14 different types. Northrop Grumman's F/A-18 Assembly Line is the focal point of the company's work on the F/A-18 and EA-18G aircraft programs. The line produces major structural assemblies for both aircraft and integrates many of the associated subsystems.



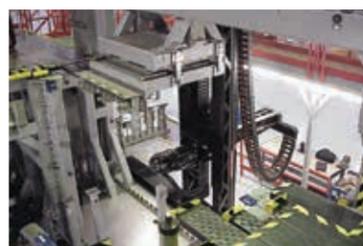
Northrop Grumman's Advanced Paint and Coatings Center supports its F/A-18 Assembly Line.



F/A-18E/F & E/A-18G Airframe Structure Breakdown.

### Mechanized Hole Drilling Lowers Costs, Raises Quality, Increases Safety

We use six different gantry-type drilling machines (with a total of nine spindles) on the F/A-18 assembly line to improve quality and affordability.



TriGADS

**TriGADS (3)**  
for the Aft Center Fuselage

**MoGADS (1)**  
for the Aft Fuselage Side Panel, Aft Engine Bay Door

**LexGADS (1)**  
for the Leading Edge Assembly



LexGADS

**InletGADS (1)**  
for the Inlet Duct

**SideGADS (1)**  
for the Forward Fuselage Keel Assembly



VADS

**VADS (two-spindle)**  
for the Vertical Stabilizer Assembly

### Lean Manufacturing Process

#### Positionalized Workcenter Toolbox

- Tools shadowed for visual use
- Data matrix for accountability
- Company-owned tools
- Manufacturing Execution System (MES)-based setup



#### Electronic Toolboxes (ETB)

- ETB setup per process by MES
- Tools scanned out using data matrix for accountability
- Company-owned tools



#### Direct Line Feed to Assembly

- Delivers parts, standard tooling and hardware to the point of use in a just-in-time kitting system.
- Web-based electronic daily triggering system using MES production and quality notifications
- Pull system from technicians

#### Global Supply Chain

- Mistake-proof kitting using bar-coding



#### Sub-Assembly Center

- Optimizes work-in-process flow
- Reduces kitting and de-kitting using shadow boards and visual aids
- Reduces technician and material movement and reduces costs by eliminating debulks

#### Common Distribution System

- A day's kit for a day's work
- Provides consumable carts for kitting and distribution
- Vendor tool distribution machines supply and account for standard tools



### Statistical Process Control

- Reduces process variability
- Leads to acceptance sampling
- Promotes factory of the future



### Six Sigma

- Focuses on process performance critical to maintaining customer satisfaction
- Improves the first time yield of process
- Unmasks the hidden factory using statistical tools
- Drives results to the bottom line



### Quality Policy

Northrop Grumman employees are dedicated to relentless pursuit of internal and external customer satisfaction; integrating total quality into every aspect of our operations to satisfy all stakeholder requirements; and continuous improvement in our people, processes, technology and products.

### Our Values

Northrop Grumman employees are guided by the following values:

- We take responsibility for our quality.*
- We deliver customer satisfaction.*
- We provide leadership as a company and as individuals.*
- We act with integrity in all we do.*
- We value Northrop Grumman people.*
- We regard our suppliers as essential team members.*

### About the F/A-18 Assembly Line

Located near Los Angeles International Airport, Northrop Grumman's F/A-18 Assembly Line produces major structural assemblies for the F/A-18E/F Super Hornet and EA-18G Growler aircraft. Northrop Grumman is the principal subcontractor on both aircraft to The Boeing Company, the U.S. Navy's F/A-18 and EA-18G prime contractor.

The F/A-18 Assembly Line features state-of-the-art manufacturing processes that include Six Sigma and Just-in-Time manufacturing. Coupled with advanced manufacturing equipment and a disciplined, highly skilled work force, these processes allow us to consistently deliver high precision, high reliability military aircraft products on schedule and on budget.

Our manufacturing staff works collaboratively with Northrop Grumman specialists in engineering design, manufacturing engineering, industrial engineer, tooling, global supply chain, quality assurance and transportation to ensure that we continue to fulfill critical customer requirements with innovation and affordability.

John P Murnane  
F/A-18 & F-5 Program Manager  
and El Segundo Site Manager  
[john.murnane@ngc.com](mailto:john.murnane@ngc.com)

THE VALUE OF PERFORMANCE.  
**NORTHROP GRUMMAN**

[www.northropgrumman.com/aerospacesystems](http://www.northropgrumman.com/aerospacesystems)  
© 2016 Northrop Grumman Systems Corporation  
Printed in USA  
Marcom El Segundo  
16-0615 • 8/16 • 78364  
Approved for Public Release  
Distribution is unlimited: SPR 2016-600, BPR-2016-33, 09 August 2016