



7F Product Offering

Additional Services and Product Offerings: GE 7F, 7EA, SW 501F, MHI 501F, GE 6B, 9E, 9F

Field Services & Outage Management including on-staff bladers and supply of labor for gas turbines, steam turbines and generators worldwide for GE B,E & F-class, SW & MHI F-class.
Reconditioning & Repair of all turbine airfoils and combustion system components, including fuel nozzle overhaul for GE 7F, SW & MHI 501F, GE 6B & 7E/EA (Standard and DLN-1).
Combustion System Engine Tuning including Monitoring & Diagnostics Support for all rotating equipment (e.g. remote monitoring) of gas turbines worldwide.
Rotor Rebuild & Inspection including disk repairs, low speed or high speed vacuum balance and rotor life extension/assessment.
R&D, Engineering Assessments, Root Cause Analysis and system technical support for gas turbines.
Flexible Long-Term Parts and Service Agreements (LTSA) combine all of PSM's products and services for a custom solution that meets your needs.
Power Plant Solutions provide integrated services and upgrades for all your critical power plant components and systems. PSM provides a single point of contact for maximizing your plant's performance potential, increasing operational flexibility, and outage management.
AutoTune offers autonomous, real-time combustion system control tuning packages for optimizing combustion dynamics/pulsations, emissions and output on the GE 7F gas turbines.
GTOP Upgrade Packages for the 7F increase output and reduce heat rate, while extending component lifetime and inspection intervals.



The Preferred Partner for Service and Innovation

Contact your PSM Sales Representative for more information.
Call: **561.354.1100** or email: **sales@psm.ansaldoenergia.com**

+ Americas

Company Headquarters and
Sales for Gas Turbines
1440 West Indiantown Road
Jupiter, Florida 33458 USA
Phone: +1 561 354 1100

+ Europe/Africa

Sales for Gas Turbines
Phone : +41 585 058 593

+ Middle East

Sales for Gas Turbines
Phone : +31 26 497 5941

+ Asia Pacific

Sales for Gas Turbines
Phone : +886-963-765-952



www.psm.com

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PSM 7F PRODUCTS

- Complete Compressor, Combustor, and Turbine flow path offering
- Sole Source for Aftermarket 7F GT Performance Upgrades
- Full Product Line Capability to Support Long Term Agreements including Rotor Replacement and Lifetime Extension
- Independent Technical & Manufacturing Capability to Address Product Issues
- Operational Flexibility Solutions for Integration with Renewables

Since 2002, PSM has built a complete 7F compressor, combustor, and turbine flow path product line that offers robust and proven design solutions and improvements. The product line has expanded from the flagship turbine offering to include reliability enhanced, in-kind replacement combustion, compressor, and rotor hardware as well as upgrade packages that deliver performance enhancements and extended lifetimes.

PSM is the only aftermarket supplier of 7F GT performance upgrades, a capability enabled by a staff of 100+ R&D engineers focused on introducing innovations for the installed F-Class power base, to maintain the relevancy of these assets. PSM is continuously improving our current offerings, and expanding into new products.

Combining technical expertise, speed to market, flexible solutions, tools, and multiple OEM cross-platform experience, PSM is the industry-leading 7F alternative products and services supplier.

LONG TERM AGREEMENTS

Summary of Offerings

As a leading parts provider in the industry, PSM is offering comprehensive and flexible Long Term Agreements for 7F & 501F (SGT6-5000F) aimed at decreasing lifecycle costs to the end user. Our PSM engineered part design enables us to increase the component life and extend the program intervals, eliminating inspections and providing the customer with significant price reduction over the life of the contract.

In addition, through our experience with component performance, PSM is able to reduce the fallout of hot gas parts due to the improvements made to the OEM design and reconditioning process. PSM has also assembled a highly skilled and experienced field service organization capable of industry leading outage performance.

Flexible Agreements — to fit the customer needs

Types of PSM Service Agreement Offerings			
Included Product Offerings	Long Term Agreement (LTA)	Long Term Maintenance Agreement (LTMA)	Frame Agreement
Parts Supply	✓	✓	✓
Reconditioning	✓	✓	✓
Field Services	✓	✓	Optional
Monitoring & Diagnostics (Remote Monitoring)	✓	Optional	Optional
Contract Manager	✓	Optional	Optional
Inventory Management	✓	✓	Optional

PSM can further customize offerings by adding Monitoring & Diagnostics or Field Services to any agreement as required.

PSM has designed a flexible concept for the Long Term Agreements focused on your requirements. We understand the frequent change in market conditions, and PSM is willing to accommodate the changing conditions based on your needs. The intention of each agreement is to provide the customer with competitive pricing while taking advantage of the entire PSM portfolio of offerings. Our agreements can be structured to not only include the gas turbine, but also the generator, steam turbine, and respective auxiliaries.

Innovative. Agile. Responsive. Global.



In summary, the various agreement offerings are structured to optimize your maintenance budget by offering competitive parts life guarantees, minimal parts fallout, coverage during unscheduled inspections, control of inventory, and proactive contract management to ensure total coverage.

Scope of Supply — based on the customer requirements

The customer determines the level of scope for the Long Term Agreements, ranging from full service offerings to a pricing agreement. Service offered by PSM within a Long Term Agreement include, but are not limited to, the following:

- + Parts Supply
- + Reconditioning
- + Field Services — including craft labor
- + Monitoring & Diagnostics (e.g. Remote Monitoring)
- + Contract Management
- + Inventory Management
- + Parts Tracking
- + Engineering Assessments
- + System Technical Support



DIGITAL TECHNOLOGIES

We continue to focus on the timely market introduction of our own innovative, targeted, high quality design solutions to emerging 7F fleet issues.

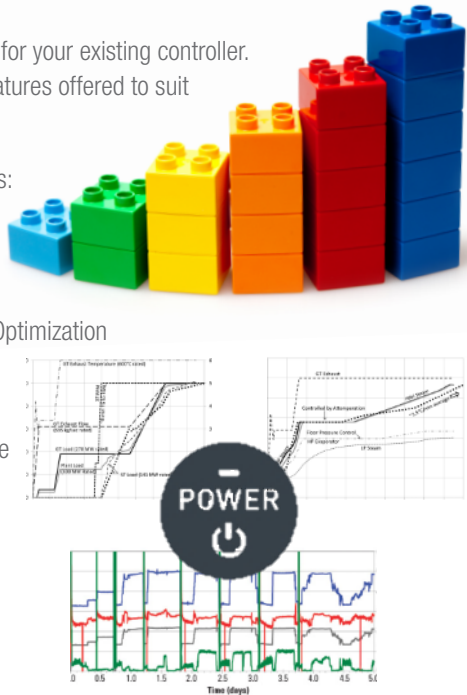


FlexSuite™

Portfolio of applications for your existing controller. Multiple optimization features offered to suit individual needs.

FlexSuite building blocks:

- + Combustion Optimization
- + Start-up/Shut-down Optimization
- + Enlarged Load Range
- + Efficiency and Lifetime
- + Fuel Flexibility
- + Grid Support
- + Service Flexibility

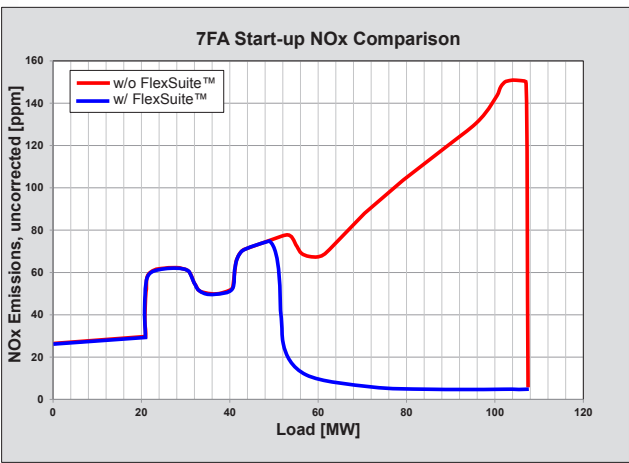


FlexSuite Example: Start-Up Optimization

- + Modified logic utilizes a modified fuel schedule that eliminates modes 4 and 5

End Result:

- + Reduced NOx
- + Shorter ramp to Mode 6Q



FlexSuite™: AutoTune

Enables automated GT combustion tuning to maintain emissions and combustion dynamics compliance

Self Learning Algorithm

- + AutoTune's patented learning algorithm captures information from successful and unsuccessful tunes to quickly provide a tuned engine all year long
- + Fuel Fractions stored across varying CTIM and other parameters

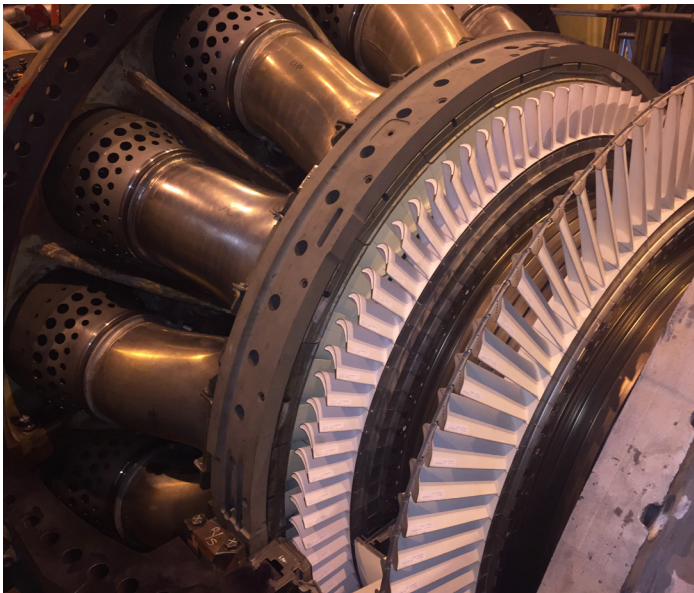
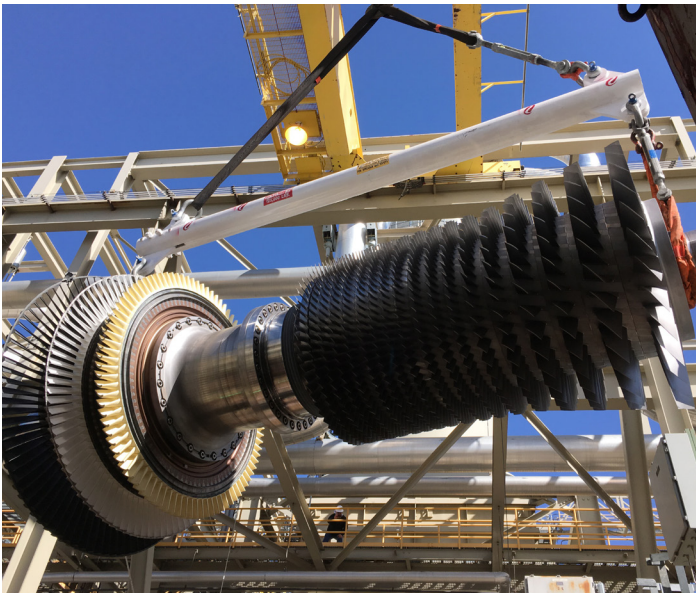


AutoTune Box Features

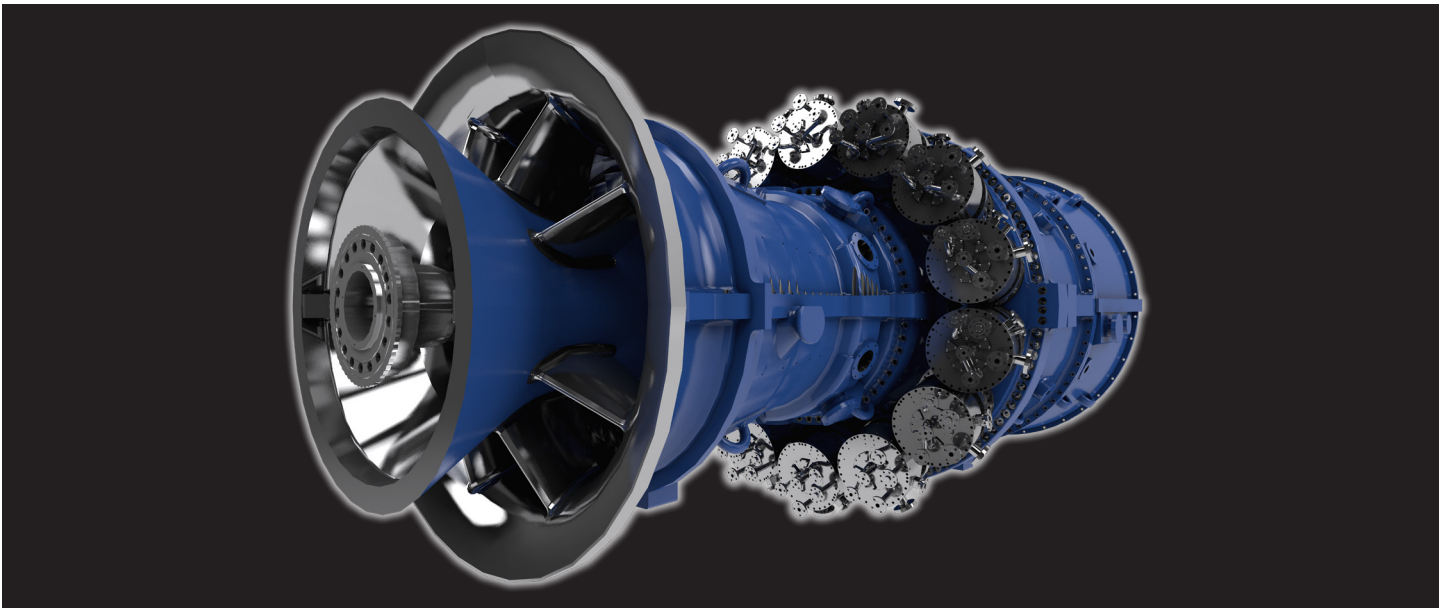
- + Compact, rack-mounted system
- + Logic external to control system
- + HMI screen seamlessly integrated
- + Highly customizable to each GT
- + Self learning tuning logic / highly adaptable
- + Contains fully functional CDMS
- + Industrial grade electronics (Non-PC)
- + Back-up safety logic

AutoTune Optional Features:

- + Power+ and Peak+ for increased output
- + Extended Turndown to reduce load up to 5%
- + Fuel Flex to increase DLN2.6 MWI from +/-5% to +/-7%



With the resources and expertise to meet your needs 24/7.



7F COMPRESSOR RELIABILITY SOLUTIONS

Providing Proven Compressor Solutions for More Than a Decade

PSM offers a complete compressor flowpath product line for flared and unflared 7F units, with reliability upgrades to solve common compressor durability issues. The product line was developed using PSM's proven compressor design approach.



Finite Element Analysis

+ Customer Need Identification – From stator wear to R0 HCF failures, chronic compressor issues have limited the ability of operators to reliably and profitably operate their machines.

+ Problem Identification – Understanding the root cause is critical to ensuring design solutions implemented will solve known issues. Using detailed analytical models, parts are analyzed to predict field issue drivers. When possible, engine testing is used, including stator strain gauging and rotor blade vibration monitoring, to understand root cause and calibrate analytical models. Failed component metallurgical evaluations are also completed to diagnose failure modes.



Design Solution

+ Design Solution Implementation – Once root cause is understood, design enhancements are implemented. These design solutions are rigorously evaluated with PSM's internal gate review process, to ensure design targets are achieved.

+ Validation – When feasible, engine instrumentation is used to validate that actual performance of PSM's design solutions is consistent with the predicted performance. Fleet leader components are tracked and monitored to ensure that reliability is as expected.

PSM's compressor design approach is proven to provide timely, high quality design solutions.

ROTOR MANAGEMENT SOLUTIONS

Capitalizing on a portfolio of rotor and blading design upgrades and full 3D steady state and transient analysis models enables PSM to offer customers a proven rotor management alternative.

Capabilities

- + Unstack and deblade
- + Reblade and tip grind new blades
- + R0 retention plug modification
- + Compressor clocking optimization
- + Patch ring repairs
- + Complete rotor structural analysis to support repairs
- + Own design flared and unflared compressor blading with reliability improvements
- + Seed rotor to support rotor exchange program

Example Design Solutions Available

- + Developed in response to the emerging fleet Compressor Wheel O (CWO) dovetail slot cracking issue, PSM's CWO incorporates a new dovetail profile to reduce stresses in the known crack location.



PSM seed rotor installed with new row 9-17 compressor wheels

- + PSM replacement Compressor Wheels 9-17 (CW9-17) feature the latest 7F.03 / 7F.04 upgraded geometries
- Round bottom dovetail geometry (CW12-17) to eliminate cracking associated with the original flat bottom dovetail geometry
- Robust Back End (RBE) CW14-17 disk geometry
- CW9-17 wheels feature the latest conical flowpath, enabling 7F.01 compressor rotor upgrades from the original cylindrical flowpath
- In-Situ Blend / Polish / Peen of first turbine disk cooling slot, with additional life-enhancing solutions available upon full destack

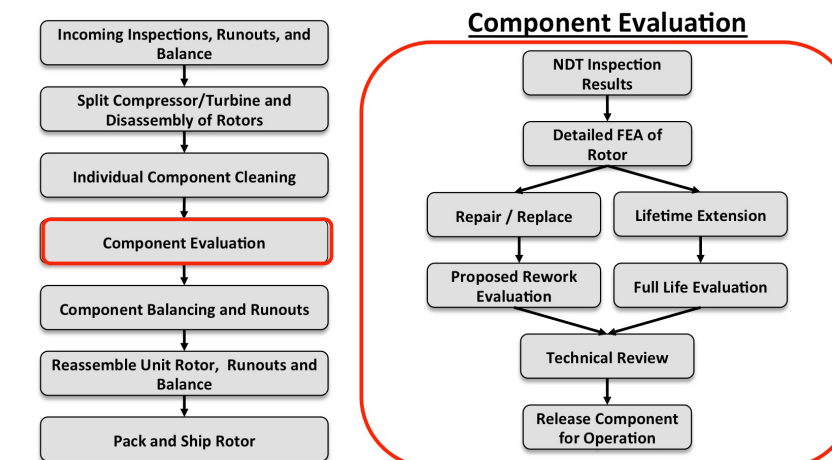
Rotor Lifetime Extension (LTE)

PSM's Rotor LTE program can extend the useful lifetime of your rotor. With the advancements in computing power, material properties, fracture mechanic methodologies, and inspection techniques, it is now possible to assess the potential to run rotors beyond their original published limits. Rotor LTE is enabled by:

- + Advanced non-destructive inspection techniques, utilized to detect surface and volume flaws
- + Full rotor material characterization
- + Full 3D Finite Element Analysis (FEA) models for thermal & structural analysis
- + Inspection results and operational history fed back to the FEA Model

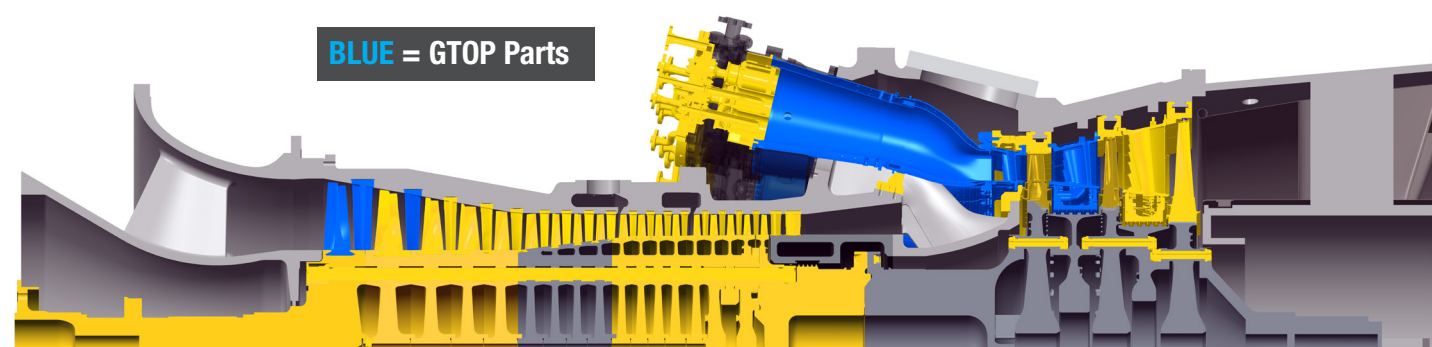
Any problematic flaws identified are analyzed, and a report detailing the predicted remaining rotor capability is generated, empowering owners to make informed decisions about their

rotor assets. Optional rotor modifications can be applied, that are designed to extend rotor lifetime in known life limiting locations.



GTOP - GAS TURBINE OPTIMIZATION

PSM's 7F Upgrade Packages provide flexibility, enabling users to **optimize performance and maintenance schedules** to their individual requirements.



Key Features: GTOP3.0

GTOP3.0: Installed during a standard hot gas path (HGP) outage, the package consists of PSM's low pressure drop combustion system and redesigned 1st and 2nd stage turbine nozzles. Turbine nozzles incorporate alloy and cooling technology improvements to enable TCLA reductions.

- Utilizes enhanced transition piece and flowsleeve designs that reduce combustor pressure drop
- Incorporates upgraded alloys, TBC enhancements, and improved efficiency cooling features
- PSM AutoTune System
- Maintains NOx emissions ≤ 9 ppm
- Maintains set-wise interchangeability with standard 7F hardware
- Firing temperature increase within 7F experience
- Incorporation of upgraded 1st & 2nd stage buckets is optional for durability

Key Features: GTOP3.1

Includes GTOP3.0 features plus the following:

GTOP3.1: Builds on the GTOP3.0 upgrade package, incorporating aerodynamically redesigned front stage compressor airfoils that provide increased compressor inlet flow at constant compressor efficiency for additional performance gains at a constant IGV position.

- Aerodynamically redesigned R0, S0, and S1 rows for increased compressor inlet flow at constant efficiency
- GTOP3.1 components designed for equivalent mechanical integrity characteristics with PSM proven R0, S0, and S1 design methods

GTOP 3.0 & 3.1 Options include:

- Extended component life cycles: Increasing the hot gas path inspection interval (HGPI) from 24,000FH to 32,000FH while operating in Maintenance Mode
- Additional performance at standard life cycle while operating in Performance Mode
- The ability to switch between the two operating modes as desired

Standard GTOP Packages deliver significant output and heat rate benefits* versus the baseline 7F.03.

- + Simple cycle output increases up to 14MW
- + Simple cycle heat rate reductions up to 2.4%
- + Combined cycle output increases up to 35MW
- + Combined cycle heat rate reductions up to 1.5%
- + Demonstrated low load operating capability down to 40% load

*Quoted benefits are for ISO day operation. Combined cycle benefits assume 2X1 plant configuration.

7F COMPRESSOR BLADE RELIABILITY SOLUTIONS

Common fleet rotor blade issues include:

- + **R0 HCF failures** that can cause significant downstream damage
- + **Attachment fretting and crack initiation**
- + **Tip rubs** that cause material degradation that can result in tip crack initiation and material liberation, leading to downstream compressor hardware impact damage

To address these fleet issues, enhanced rotor blade reliability design features are incorporated as standard for our R0 thru R17 product offering:

- + **Squealer tips standard**, to minimize the potential for tip cracks and blade material liberation due to rubs against the case during operation
- + **Shotpeen**, for enhanced material capability
- + **Passivation**, for corrosion resistance
- + **Attachment undercuts** to avoid fretting and potential cracks
- + **All required spacers available**
- + **Interchangeable** with OEM design by sets
- + **In-situ blade tip grinding capability** to ensure tip clearance requirements are achieved
- + **Complete offering** for flared and unflared compressor flowpaths available



1st to Market with a Proven R0 Design Solution

Since its introduction, the 7F.03 R0 compressor blade has been a major maintenance issue for end users. PSM completely redesigned this component, delivering a design solution to the customer that met design requirements in only 10 months. This solution has been operational since 2008.

- + Erosion and corrosion tolerant design
- + Material upgraded to a higher strength alloy
- + Compound variable conical fillet introduced to reduce stresses
- + Airfoil restacked to reduce steady stresses along the leading edge
- + Retuned airfoil to reduce vibratory stress response
- + PSM has a patented R0 Blade retention design that replaces the OEM "Biscuit Mod" retention feature and does not rely on staking to retain R0
- + No IGV modifications required for install
- + No requirements for replicas or extraordinary inspections



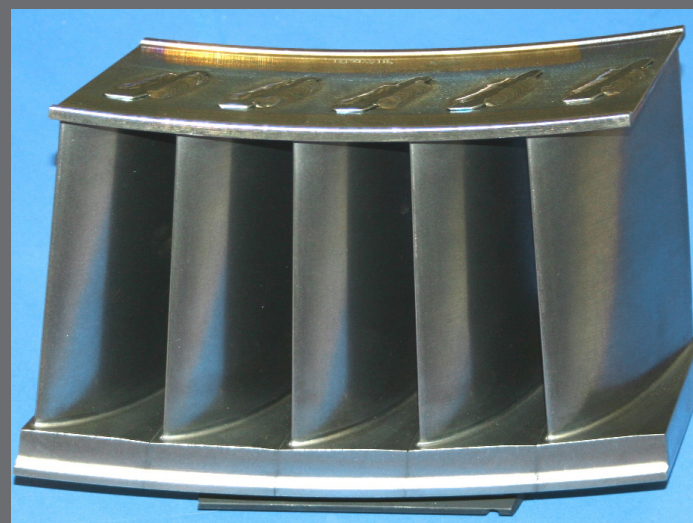
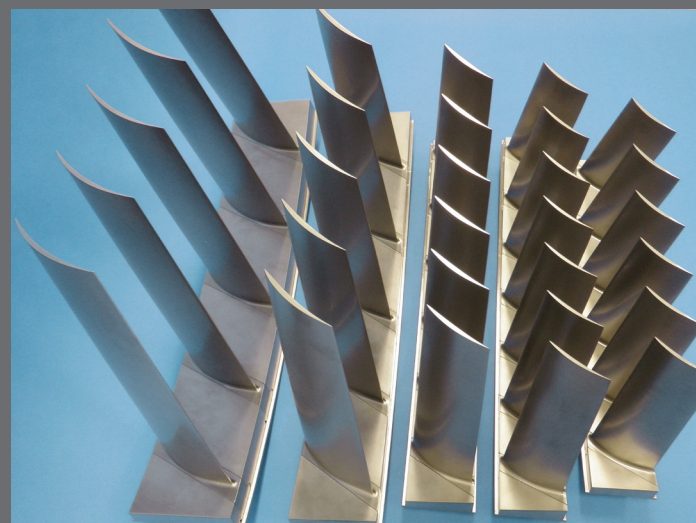
7F COMPRESSOR STATOR RELIABILITY SOLUTIONS

Common fleet stator issues include:

- + **Shim migration and liberation** that can result in significant downstream compressor hardware impact damage
- + **S0-S4 carrier ring corrosion and lock-up** that can cause high cycle fatigue (HCF) failures. Maintainability is also negatively impacted, since the corroded carriers can be very difficult to remove, sometimes requiring a rotor lift and destructive removal.
- + **Excessive case hook fit wear** that can result in stator rock or stepping that can lead to forced outages. Wear issues are most pronounced in the aft compressor stages.
- + **Tip rubs** can cause tip crack initiation and pieces of stator tips to liberate, that can cause compressor hardware impact damage.

To address these fleet issues, enhanced stator reliability design features are incorporated as standard across the S0 thru EGV product offering:

- + **100% Shimless**, to eliminate shim liberation risk
- + **Squealer tips standard**, to minimize the potential for tip cracks and stator material liberation due to rubs against the rotor during operation
- + **Full radial machining geometry**, for optimum part damping
- + **Shotpeen**, for enhanced material capability
- + **Passivation**, for corrosion resistance
- + **Interchangeable** with OEM design by sets
- + **Complete offering** for flared and unflared compressor flowpaths available



7F TURBINE BUCKETS AND SHROUDS

Turbine Buckets

1st Stage Bucket

- + Directionally Solidified (DS) casting for improved capability
- + Latest design features cast-in, TBC coated tip plate for enhanced reliability and reduced repair scope
- + Advanced cooling technology to address tip and platform durability issues
- + Full platform TE (trailing edge) undercut to eliminate TE cracking
- + Includes attachment relief cuts to address turbine wheel cooling air slot and lockwire tab cracking
- + Externally coated with durable Strain Tolerant Micro Cracked Thermal Barrier Coating STMC-TBC® and internally aluminide coated

2nd Stage Bucket

- + Conventionally cast from patented PSM 116 material for improved durability and repairability
- + Improved cooling scheme with fully turbulated cooling holes
- + Tip shrouds feature several design upgrades to eliminate shroud lifting and localized creep cracking
- + Buckets are externally TBC coated and internally aluminide coated
- + Includes attachment relief cuts to address turbine wheel cooling air slot and lockwire tab cracking

3rd Stage Bucket

- + Conventionally cast from patented PSM 116 material for improved durability and repairability
- + Features scalloped shrouds to counteract shroud lifting. Z-Notch features larger hard face surface area to reduce wear and fretting
- + Externally MCrAlY coated

Turbine Shrouds

Standard Features

- + Segment to segment seals are PSM's patented flexible seals, a pliable design that provides superior intersegment gap sealing and in turn improved efficiency. PSM flexible seals have proven reusability post repair.

1st Stage Shroud Block

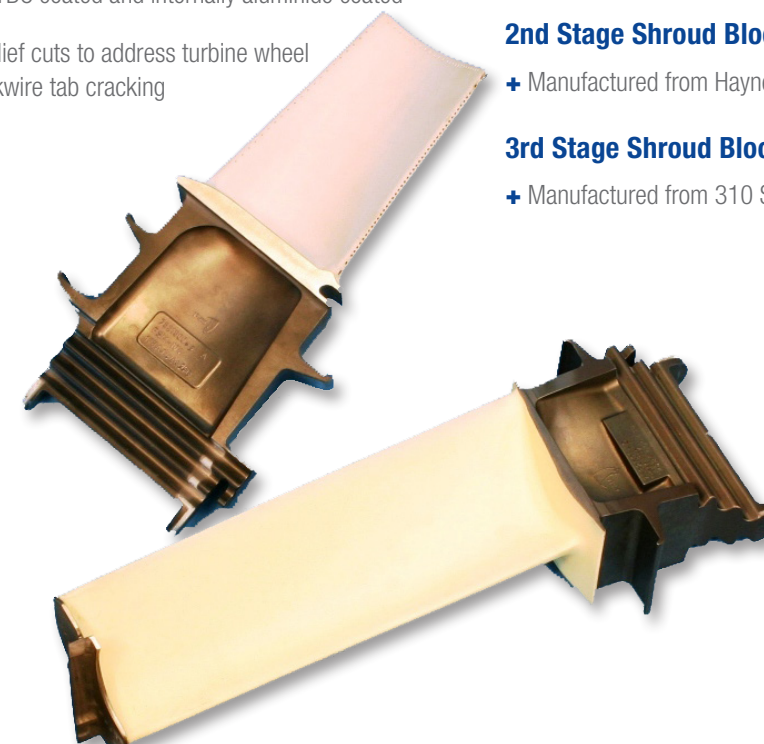
- + Shroud tiles are externally coated with durable Strain Tolerant Micro Cracked Thermal Barrier Coating STMC-TBC®.
- + Improved cooling design that provides positive cooling outflow margins, eliminating hot gas ingestion issues

2nd Stage Shroud Block

- + Manufactured from Haynes® HR 120® alloy

3rd Stage Shroud Block

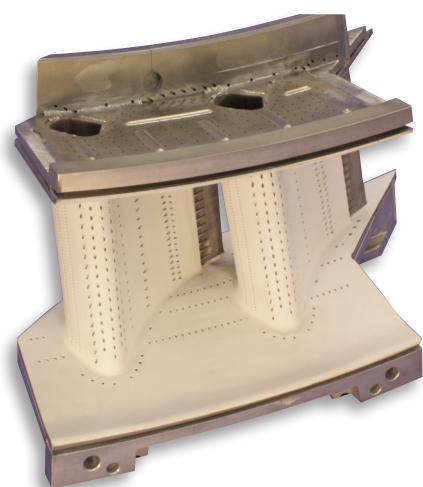
- + Manufactured from 310 SS alloy



7F TURBINE NOZZLES

Standard Features

- + Nozzles are conventionally cast from PSM 109, a nickel based material, with superior mechanical integrity, and creep properties relative to cobalt based alloys, providing reduced life cycle cost. PSM 109 has proven weldability at repair.
- + Segment to segment seals are PSM's patented flexible seals, a pliable design that provides superior intersegment gap sealing and in turn improved efficiency. PSM flexible seals have proven reusability post repair.



1st Stage Nozzle and Outer Retaining Ring

- + Fully externally coated with MCrAlY metallic bond and TBC for oxidation resistance and reduced metal temperatures
- + Cooling air is redistributed to the platform and sidewalls for improved durability
- + ID rail redesigned to reduce stiffness that contributes to high airfoil stresses and cracking
- + Parallel chordal hinge to seal between nozzle ID and support ring
- + PSM109 alloy provides a proven reduction in Thermo-Mechanical Fatigue (TMF) cracking when compared to cobalt based alloys

2nd Stage Nozzle

- + Fully externally coated with MCrAlY metallic bond coat and TBC for oxidation resistance and reduced metal temperatures
- + Upgraded trailing edge cooling design
- + Furnished with attached diaphragms made from 310 SS, an upgraded alloy, to address field oxidation issues

3rd Stage Nozzle

- + Furnished with attached diaphragms



In addition to the standard design features, additional design enhancements are incorporated for S0-S4 and S13-EGV designs to address the reliability issues specific to those rows.

S0 – S4 Carrier Ring Row Solution

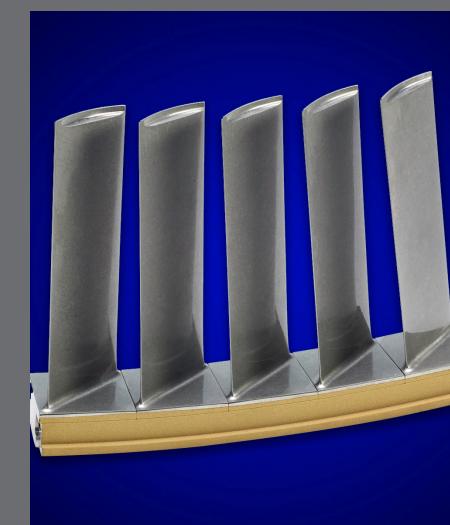
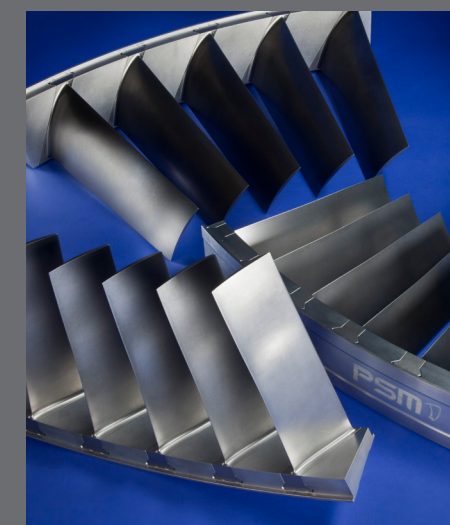
- + Carriers rings are forged from an upgraded, corrosion resistant alloy, to address corrosion and prevent carrier/case "lock-up" that can lead to stator HCF failures
- + Increased number of carrier ring segments for improved installation and removal process
- + Asymmetric vane spacing on S0 & S1 is utilized to reduce vibratory driver strength on R0 & R1 blades
- + Redesigned S3 to prevent HCF failures
- + Added a groove to attach tooling to ease disassembly
- + Flared and Unflared variants available

S13 – S16 Hook Ring Solution

- + S13 - S16 stators are joined together at the OD using a patented Hook Ring design that creates packs of 4 or 5 Vanes, eliminating wear issues experienced with the OEM single airfoil design
- + Patented Hook Rings include an aluminum bronze coating for anti-galling prevention
- + No case modification required for installation

S17 and EGV Welded Pack Solution

- + Design incorporates stators into tip shrouded packs of 5 joined together at both the OD and ID
- + Shrouds are joined utilizing a PSM patented design
- + Eliminates the vibratory failures and wear issues experienced with the OEM single airfoil design stators
- + Eliminates damage to EGV's, the R17 blade, Compressor Wheel 17, and the inner barrel associated with OEM shrouded S17 bolt failures
- + Design options available for standard and "FB-Style" inner barrel configurations
- + Designs do not use a V-seal



7F HOT SECTION RELIABILITY SOLUTIONS

Designed to Reduce Life Cycle Cost

Maximizing part durability and reliability provides better availability and profitability in the marketplace. PSM's complete line of GE 7F compatible parts have been redesigned where necessary to address the life-limiting elements of existing designs. PSM's hot gas path components utilize advanced materials, coatings, cooling schemes, and design features to maximize durability and reliability. Components are upgraded following a proven design approach:

- + Identify the current component issues/failures
- + Use state-of-the-art analytical tools, metallurgical evaluations, and engine test data where possible to determine the root cause of the issues/failures
- + Use the same analytical tools to design and fabricate new hardware with design features to maximize durability and reliability

By co-locating R&D engineering with the PSM repair workshop, PSM design engineers collect continuous feedback on the performance of PSM and competitor designs and proactively address emerging fleet issues. With these capabilities PSM has introduced designs that can align combustion and hot gas path inspections and reduce repair scopes, providing customers with reduced lifecycle costs.

Hot Section Components Offer

- + Interchangeability with OEM hardware (contact PSM for specifics)
- + ≤ 9 ppm NOx & CO emissions over normal premix operating load range
- + All parts are designed to deliver 24,000 Factored Hours (FH) and 900 Factored Starts (FS) inspection intervals or better.

DLN2.6 COMBUSTION HARDWARE

"Brazeless" Combustion Cover

- + All machined and welded design – no brazed inserts, eliminating recurrent braze joint failures in brazed designs
- + Available for gas only and dual fuel applications
- + Compatible with PSM and OEM fuel nozzles

Fuel Nozzles

- + PSM nozzles are internally purged. PSM nozzles on OEM covers mitigate the typical NOx increase when OEM cover brazed joints fail.



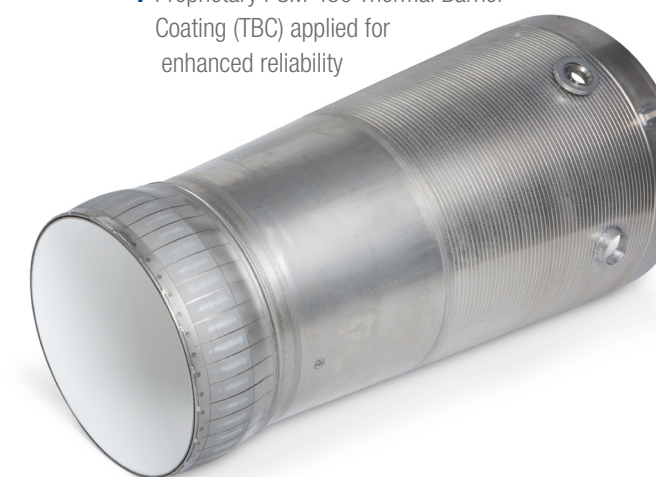
Liner Cap Assembly

- + Caps redesigned with improved cooling to reduce thermal gradients
- + Effusion plate manufactured from higher strength Haynes® 282® material
- + Improved manufacturing technique for cooling holes reduces propensity for cracks
- + Addresses cracking and durability issues experienced with OEM cap



Combustion Liner

- + Manufactured from proven NIMONIC® 263 material
- + Enhanced cooling design at liner aft end for improved durability
- + Proprietary PSM 450 Thermal Barrier Coating (TBC) applied for enhanced reliability



Transition Piece

- + Thermally free mount to 1st stage nozzle to address impingement duct cracking
- + Tighter fit between impingement sleeve and duct body improves cooling effectiveness
- + Manufactured from proven NIMONIC® 263 material
- + Aft attachment moved to exit frame to eliminate cracking in that region of the component
- + Patented cooling features to reduce metal temperature by up to 100 °F
- + Hard coat on all mating surfaces reduces wear

