

Thermal Protection System Facility



Thermal Protection Systems Facility (TPSF)

- Primary function is manufacture of flight hardware used in the orbiter Thermal Protection System (TPS) and Thermal Control System (TCS)
- Government Owned Contractor Operated on site at KSC
- TPS Facility provided real time support to orbiter processing and is the primary supplier of orbiter thermal protection system and thermal control system spare parts.
- Encompasses the widest range of TPS manufacturing and repair capabilities ever to exist within a single facility.



Milestones in TPSF History

- 1979- TPSF was established in to provide on site manufacturing and processing capability at KSC in support of early program TPS work. Facility occupied 2500 ft² in what is now OPF bay 2
- 1981- Additional fabrication tasks assumed based on efficiency of performing the work at the launch site. Facility relocated to Building K6-1095 (16,000 ft²)
- 1987- Facility relocated to K6-794 (45,000 ft²) to accommodate growth
- 1991- Logistics responsibility for all TPS and TCS spare and replacement parts transitioned from Palmdale to TPSF and contract responsibility from JSC to KSC
- 1995- Transition complete. All orbiter OEM vendor parts (Rockwell, McDonnell Douglas, Fairchild, LMSC, Hughes) manufacture and repair transitioned and certified at TPSF
- 1996- Rockwell operations transitioned to United Space Alliance
- 1997-1999 - TPSF supports X-38 TPS manufacture from raw materials to delivered product
- 2004- Completion of OV-103 orbiter OMM at KSC fully supported by TPSF
- 2013- Transitioned to the TOSC contract
- 2013-Began first commercial work

TPSF Products and Services



- Thermal Protection System Facility TPSF Products and Services (Flight and Ground certified hardware)
 - Tile Production and Installation
 - Tile Production Unit (PU) Manufacturing (Billets)
 - Tile Computer Numerical Control (CNC) 5 axis Machining
 - Application and Repair of Ceramic Coatings
 - Strain Isolator Pad (SIP) Bonding and Installation
 - Ceramic Waterproofing
 - Ceramic Densification
 - Tooling manufacturing
 - Shop Aids Design and Fabrication
 - Setter Fabrication
 - Soft good tooling
 - CNC Machining
 - Soft good Ground Support Equipment GSE
 - Bond Verification Tooling
 - Pressure Pad manufacturing and calibration

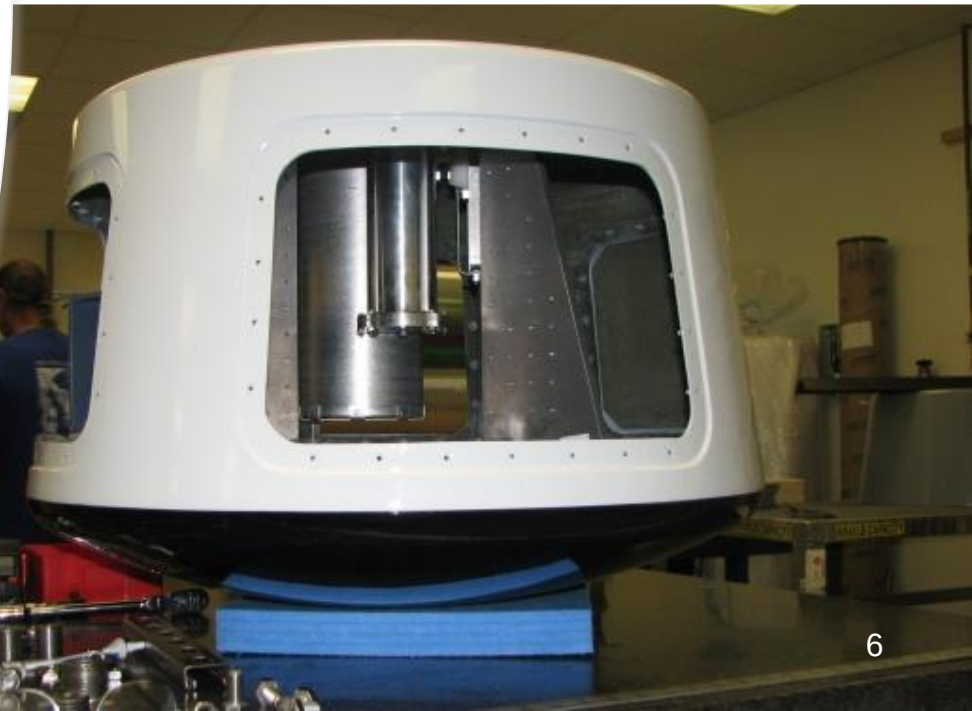
TPSF Products and Services

- TPSF Products and Services (cont..)
 - Flexible Insulation Blankets (FIB) Fabrication
 - Waterproofing
 - High Temperature Heat Cleaning
 - Application and Repair of Coatings
 - Multi Layer Insulation (MLI) Fabrication
 - Mix Crib/Pharmacy for chemical products
 - Dry film lube refurbishment
 - Thermal Testing part manufacturing:
 - Installation of Instrumentation for Arc Jet and radiant heat testing.
 - Thermal Barrier Manufacturing

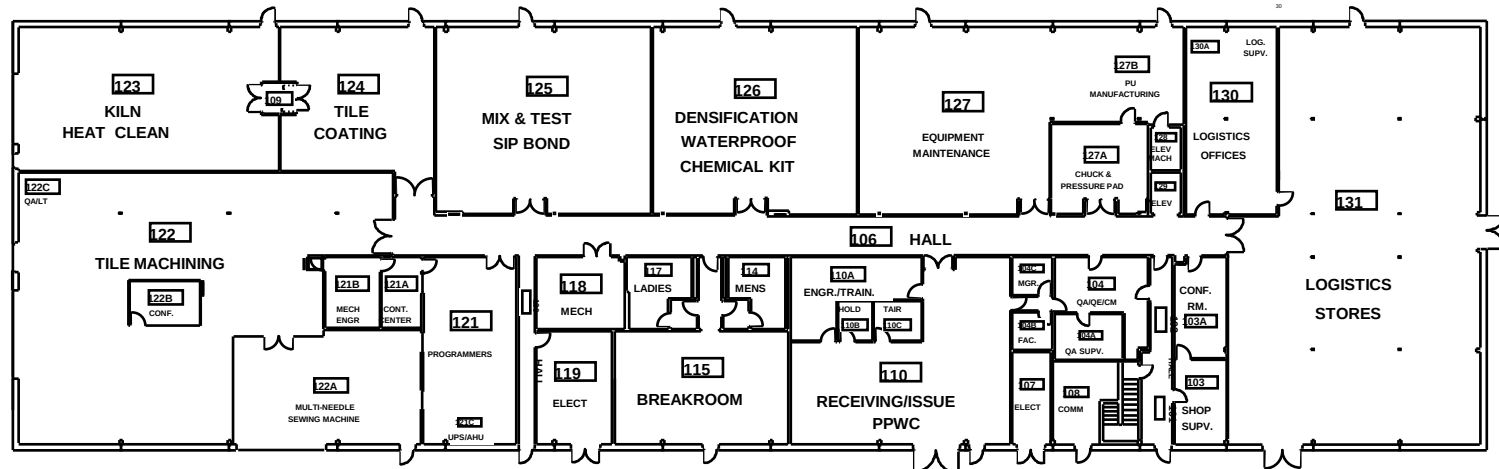


TPSF Products and Services

- TPSF Products and Services (cont.)
 - Airframe & Powerplant A&P support services
 - Mechanical systems repair and fabrication
 - Composite Manufacturing and Repair
 - Bonding Services
 - Tile Installation and Strain Isolator Pad
 - Advanced Flexible Reusable Surface Insulation (AFRSI)
 - Felt Reusable Surface Insulation (FRIS)
 - Thermal Barriers/Gap Fillers
 - Engineering:
 - Cad modeling, machine coding
 - Reverse Engineering, 3D Scanning
 - CAD Designing Engineering
 - Product Development
 - Tool Design
 - Operations:
 - Planning
 - Integrated Scheduling



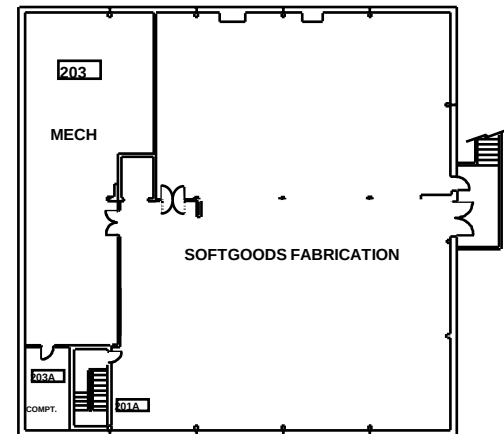
TPSF Facility K6-794



Government owned, contractor operated

TPSF encompasses of 45,000 ft²

- 31,000 ft² of manufacturing space
- 9,000 ft² warehouse
- 2,000 ft² office and administration
- 3,000 ft² engineering and work control



Capabilities - Tile Production Unit Fabrication

- Core Competencies
 - Fabrication of ceramic billets (FRCI-12 (not flight certified), AETB-8 (X-38, Orion), LI-2200 (Orbiter), HTP-6 (Hughes))
- Tools
 - Multiple casting towers
 - Vee blenders (2ft³ and 1ft³)
 - Fiber Mixer/extractor
 - Wet Vacuum system



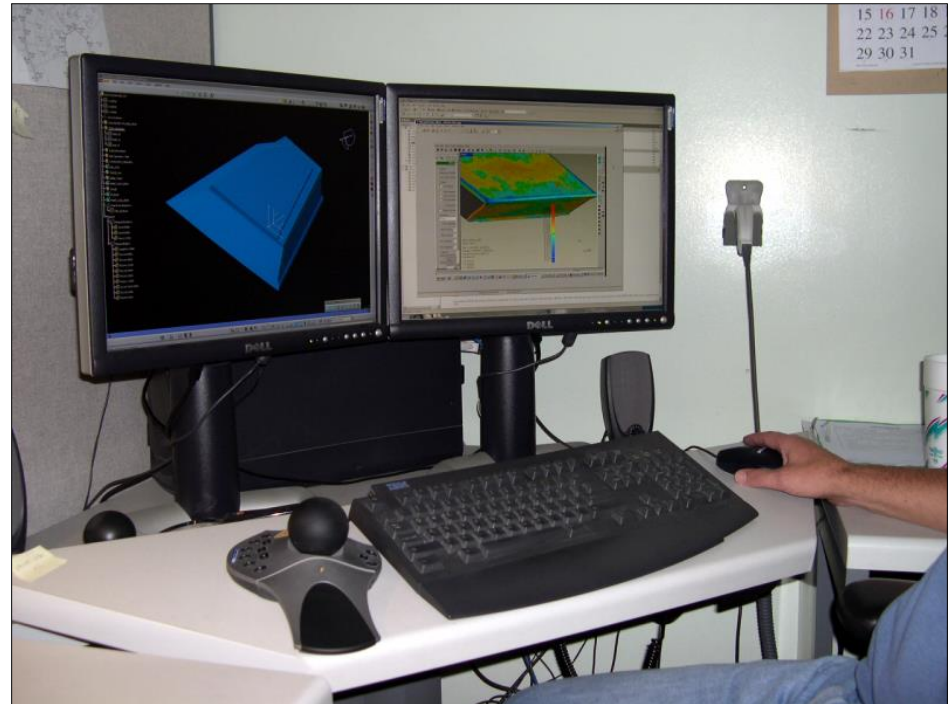
Capabilities - Machining

- Core competencies
 - Machinists skilled in working with non metallic materials and composites.
 - Skills include both NC machine operation as well as traditional machining methods
- Tools
 - Machines are all adapted to machine ceramics and composites with appropriate OSHA required environmental controls



Capabilities - CAD/CAM

- Core competencies
 - Four NC programmers adept at a wide range of CAD/CAM tasks
 - Lofting
 - Modelling
 - Reverse engineering of free form parts
 - Machine programming
- Primary Tools
 - CATIA
 - PRO-E
 - Vericut
 - 3D Scanning



Capabilities – High temperature processing

- Core Competencies

- Preparation and application of ceramic and epoxy coatings
- Surface preparation
- Application by spraying
- Firing
- Thermal processing

- Tools

- Roller mill and jar mills
- Spray booths
- Spray equipment
- Masking
- Five high purity 2500 F Kilns
- One high purity 2650 F Kiln
- Two 50 cubic foot 1250 F Class A ovens
- One 2 cubic foot class A oven
- Two forced air 600F ovens



Capabilities – Waterproofing & Densification

- Core Competencies
 - Operation of ceramic waterproofing ovens
 - Application of coatings
 - Heat curing
- Tools
 - Four chemical vapor deposition ceramic waterproofing ovens
 - One 37 ft³, three 7.5 ft³
 - Four explosion proof vent hoods
 - One Class A and three conventional 600 F Ovens



Capabilities – Materials and Chemical Preparation

- Core Competencies
 - Compounding, processing and packaging of material products to support manufacturing and operations
- Tools
 - Roller mills
 - Precision scales
 - Particle size analysis
 - pH
 - General purpose laboratory equipment



Capabilities - Bond Room

- Core Competencies
 - Molding manufacturing
 - Molding of polyurethane Kydex, lexan and polyethylene foam
 - Engraving
- Tools
 - Temperature and humidity controls
 - Vacuum tables
 - General purpose laboratory equipment



Capabilities – TPS/TCS Softgoods Manufacture

- Core Competencies
 - 2D CAD drafting
 - Hand fabrication of TPS seals
 - Fabrication of Thermal Control System Blankets
 - Molding & Stiffening
- Tools
 - 16 customized sewing machines adapted to sew with ceramic polymer and metallic threads



Leveraging Capabilities

- TPSF core skills have been used with great effectiveness to support shuttle and other programs

- X-38 thermal protection system tiles and thermal seals
- Hughes Satellite dielectric spacers
- SSME MPS Liquid Air Insulators
- Hold Down Post Blast Covers
- Nose gear door silicone boots
- Crew module debris nets
- Pad GN2 vent line covers
- NASCAR thermal insulators
- GOX vent seals
- Root cause investigation of Artemis umbilical leak

