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SALLOYTECH

SALLOYTECH

CONSUMABLES FOR SPECIAL PROCESSES AND AEROSPACE LABS

05.09.2024 v1

SCOPE OF BUSSINES ACTIVITIES

Salloytech specializes in the manufacture of Spare Parts Details and consumable materials used in special processes such as thermal spraying, hardfacing, brazing, welding, chemical processing, and others. We produce tooling for testing the properties of aerospace materials and coatings. Our main customers are factories producing new engine parts and MROs worldwide. Our production facility is certified to AS9100 standard, and we have a military license.

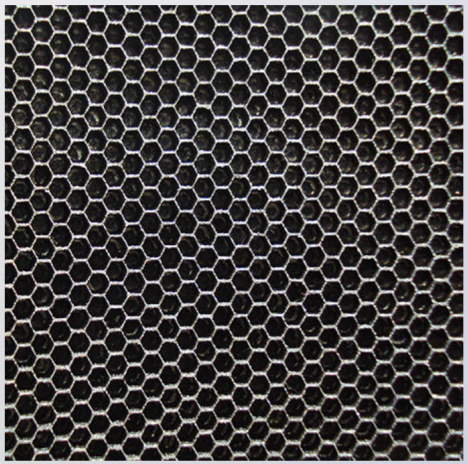
In the field of Spare Parts Details, we can supply:

Parts used for engine production and repair, such as patches, metal spares, pre-sintered preforms for Brazing (PSP), metal honeycomb seals for blades

Consumables for special processes:

Test panels, coupons, strips, substrates and samples made of nickel and cobalt superalloys, titanium, hardened steel to aerospace standards. Used for example in thermal spraying, welding, chemical processing.

Reusable silicone masking for thermal spraying, shot blasting, sandblasting, chemical processing, and vibratory finishing.



SCOPE OF BUSSINES ACTIVITIES

Tooling for testing materials used in aircraft engines:

Custom accessories and high-temperature equipment: such as pull rods, couplings, fixtures, made of MAR M247 or other cast nickel superalloys, for creep and tensile testing at elevated temperatures up to 1300°C;

Services dedicated to the aerospace industry:

Processing of difficult-to-machine materials such as nickel superalloys and titanium alloys, particularly by unconventional methods (WEDM).

Research and development work focused on technological projects aimed at improving repair/production processes of gas turbines

Our experience in research and development of technology has resulted in contracts from companies producing aircraft engines (GE, Pratt & Whitney, GKN, Honeywell, MTU). We also collaborate with the Space Technology Department of the Institute of Aviation and the National Center for Nuclear Research.

CUSTOMERS

- Avio Bielsko - GE Aerospace (Poland)
- MTU Aero Engines (Poland, Germany)
- Pratt&Whitney Rzeszów (Poland)
- Honeywell Aerospace (Czech Republic)
- GKN (Sweden, Malaysia)
- Tawazun Precision Industries Lic (United Arab Emirates)
- MB Aerospace Technologies (Poland – Kalisz, Rzeszów)
- Institute of Aviation in Warsaw (Poland)
- Treibacher Industrie AG (Austria)
- Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS. (Germany)
- Conseil National de Recherches (Canada)
- Ionbond (USA)
- Lincotek (Italy)
- and others

CONSUMABLES FOR SPECIAL PROCESSES

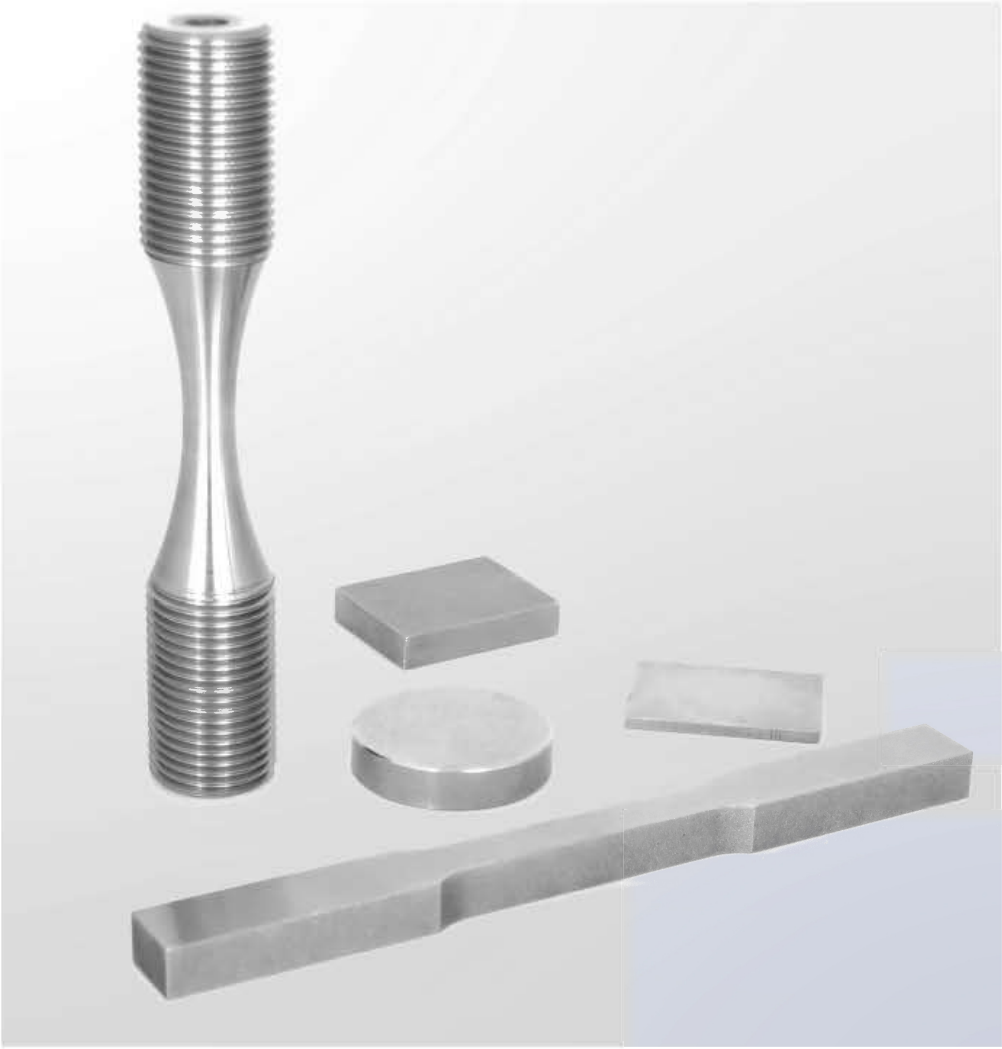
COUPONS, SUBSTRATE AND SAMPLE MACHINING

Salloytech manufactures high quality test coupons, substrates, specimens, samples, buttons, panels, discs, and strips for thermal Spray, Cold Spray, Chemical Processing, (EB) Welding facilities in the aviation industry. We specialize in cutting difficult-to-machine aerospace grade materials such as: nickel and cobalt base superalloys, titanium, and hardened steel and single crystals.

Aerospace grade materials we work with:

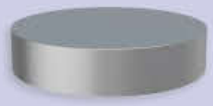
- René 77
- Inconel 718
- Inconel 625
- Haynes 188
- Haynes 282
- Hastelloy X
- Ti-6Al-4V
- 300M steel
- Alu 2014-T6
- Alu 7050 T7451
- Alu 7075-T6511
- 410 stainless steel
- Rene N5
- CMSX 4
- N515

(Rene N5, CMSX 4, N515: single crystal superalloys)



TEST COUPONS AND PANELS MACHINING

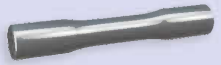
Our experience includes but not limited to the manufacturing of the following substrate types:



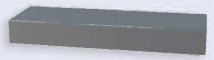
Button for Adhesion, cohesion & bond strength test of coating

Panel for Microstructure evaluation

Panel for Hardness test



Round Specimen for Fatigue Test



Flat specimen for Tensile test

Panel for Lap Shear Test

Panel for Bend Test

Panel for Erosion Test

C-shape specimen for Stress Corrosion

Panel for Hoffman Scratch Test

Button for Cyclic Furnace Oxidation Test

Bond Cap External Thread

Specimen for Fatigue test

Bond Cap Internal Thread for Bond Strength

REUSABLE SILICONE AND HARD MASKING

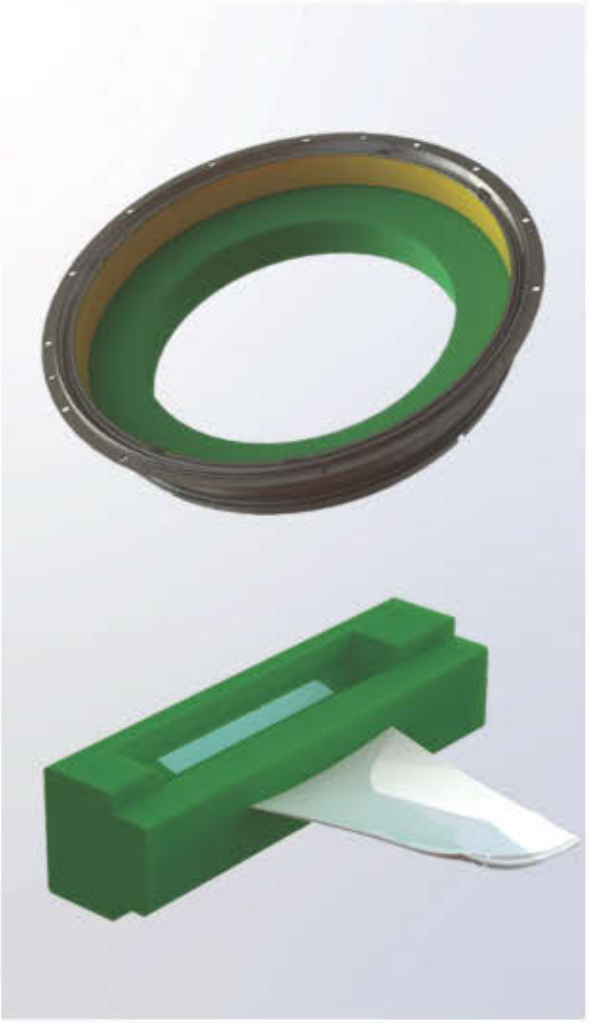
Salloytech designs and manufactures silicone masking to protect aero and gas turbine engines parts during production through a special process. These masking products enhance productivity, lower costs and process stability.

Advantages:

- Rapid design
- Tight masking tolerances
- Cost reduction comparing to the traditional tape masking due to multiple process cycles and significant assembly time reduction
- Design, validation and engineering support
- Proven Results with Major OEMs
- Global sales agents network

Applicable for processes:

- Thermal spray (plasma, HVOF, flame, and other)
- Grit blasting
- Shot peening
- Chemical processing



PRE-SINTERED DIFFUSION BRAZING PREFORMS (PSP)

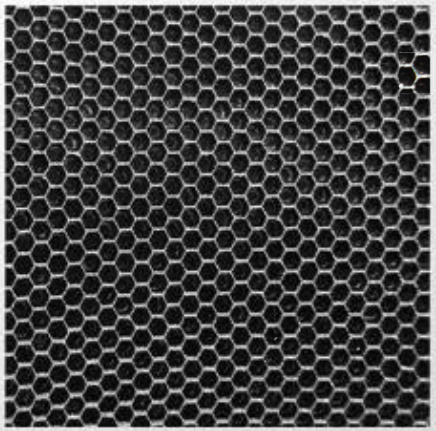
Metallurgy products composed of superalloy and brazing powders from a customized blend. They are ideal for dimensional restoration as well as crack repair of blades and vanes subjected up to 1300°C in aero engines. Available in various compositions and shapes – e.g. plates, from 0.25 to 5 mm thickness can be cut to required dimensions. For difficult-to-reach areas it can be produce as a paste and paint. Thanks to low porosity (less than 2%), shrinkage is minimized thus only small allowance is needed for grinding/machining after brazing.

FAN BLADE LEADING EDGE PATCHES, CUSTOM SPARE METAL PARTS

Salloytech, a supplier in the aerospace industry, offers a range of locally produced components and spare parts. Essential for the maintenance and repair of turbine engines, as well as for the construction of new assemblies. Salloytech is equipped to provide any number of these components, which are produced from various materials such as sheet metal, bar stock, plate, castings, or forgings, catering to all major engine models. Additionally, they provide the service of applying PSP to these components, which enhances the efficiency of the assembly process.

HONEYCOMB

Honeycomb structures with or without brazing material embedded into the cells, tailoring to each customer's specific requirements. Honeycomb with tape offers an advantage over powder application by reducing assembly time. These honeycomb structures can be supplied according to specific designs in various forms like segments, rings, and an array of contours and geometries to match the end-use and optimize brazing size. Additionally, Salloytech also offers any kind of additional surface treatment to the honeycomb as a value-added service



CONSUMABLES FOR AEROSPACE LABS

SALLOYTECH

HIGH-TEMPERATURE COUPLINGS AND PULL RODS FOR:

- ✓ CREEP, STRESS RUPTURE,
- ✓ HOT TENSILE TESTING,
- ✓ OTHER APPLICATIONS

HIGH-TEMPERATURE PULL RODS

Custom-Made Connecting Rods, Couplings, Grips, and Fixtures made of Cast and Wrought Superalloys

- MAR M246/247, 713C,
- CSMX-4plus SLS
- Waspaloy, Inconels
- Other materials upon request

Threaded Pull Rods

- Custom thread on both ends, imperial or metric
- Custom lengths up to 40” / 1 meter
- Materials: cast and wrought superalloys or other upon request

Threaded Couplings

- Custom thread on both ends, imperial or metric
- Materials: cast and wrought

HIGH-TEMPERATURE COUPLINGS

Intended use:

- Creep, Stress Rupture
- Hot Tensile Testing
- Other Applications

Clevis Couplings

- Custom threaded, imperial or metric
- Custom slot sizes, imperial or metric
- Materials: cast and wrought superalloys or other upon request

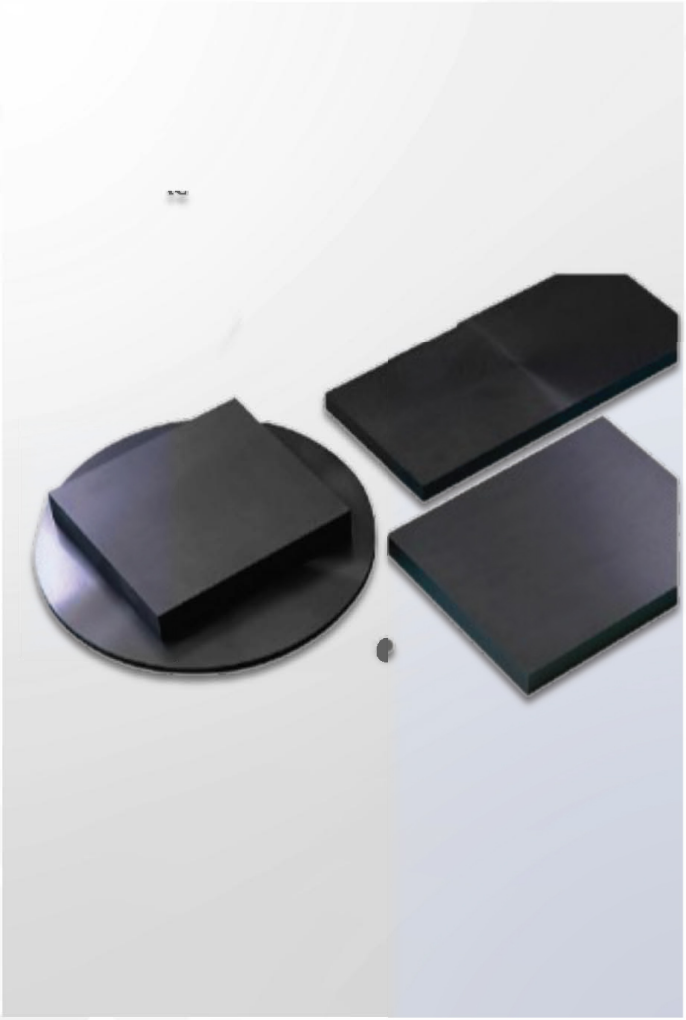
Other Customized Couplings (e.g., Button Head, Wedge)

- Custom Buttonhead seat
- Custom specimen Thickness
- Custom threaded, imperial or metric
- Materials: cast and wrought superalloys or other upon request

MODERN AVIATION MATERIALS

CERAMIC COMPOSITES (Sic-SiC CMC)

The replacement of metal alloys with ceramic matrix composites (CMCs) in high-temperature engine components has increased worldwide interest in this type of material. Salloytech is a comprehensive source of CMC SiC-SiC material, as well as test samples and other elements for both the aerospace industry and research and development.



AEROSPACE NICKEL AND COBALT BASE SUPERALLOYS, TITANIUM, STEEL, ALUMINIUM ALLOYS

Salloytech offers a comprehensive range of aerospace raw materials (wrought and cast). Including Inconel, Rene, MAR, GTD, PWA, CSMX (Single Crystals), Haynes and many others. We are able to supply difficult to find raw materials in required shapes and dimensions.

Examples of available raw materials:

Nickel Base Equiaxed	Nickel Base Directionally Solidified	Nickel Base Single Crystal	Cobalt Base
IN 713 LC, Mar M 246, Rene 77	Mar M247, Rene 80 H, GTD 111 M	CMSX-4, PWA 1480, Rene N5	Mar-M-918, Haynes 188

SERVICES

SALLOYTECH

WIRE EDM CUTTING

Our experience in WEDM cutting give us possibility to find innovative approach to manufacturing metal parts, giving cost reduction and meeting all requirements.

Adventages:

- Cost reduction over waterjet + machining
- Thick cuts up to 700 mm of height
- No heat impact on part comparing to laser cutting
- Tight tolerances
- Nine (9) WEDM on site gives ultimate cutting speed

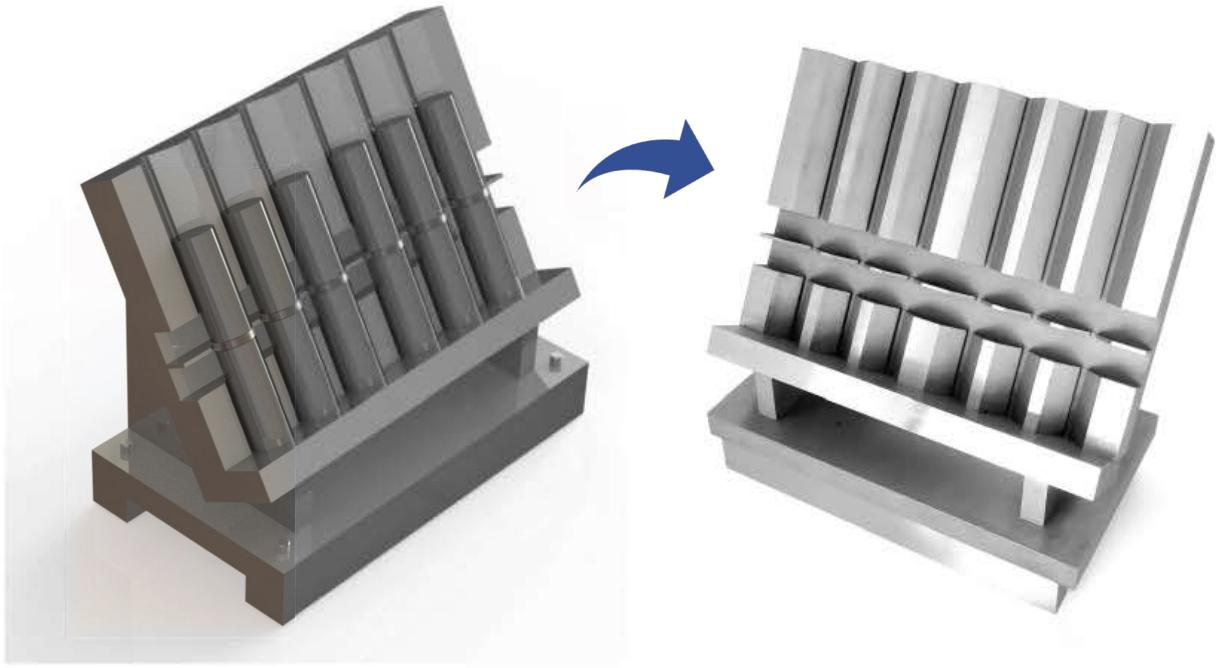
Suitable for:

- Replacing waterjet + machining
- Cutting hard-to-machine materials such as superalloys, titanium, hardened steel
- Tight tolerance flat parts made of all metal alloys
- Cutting

PART, FIXTURE DESIGN AND MANUFACTURING

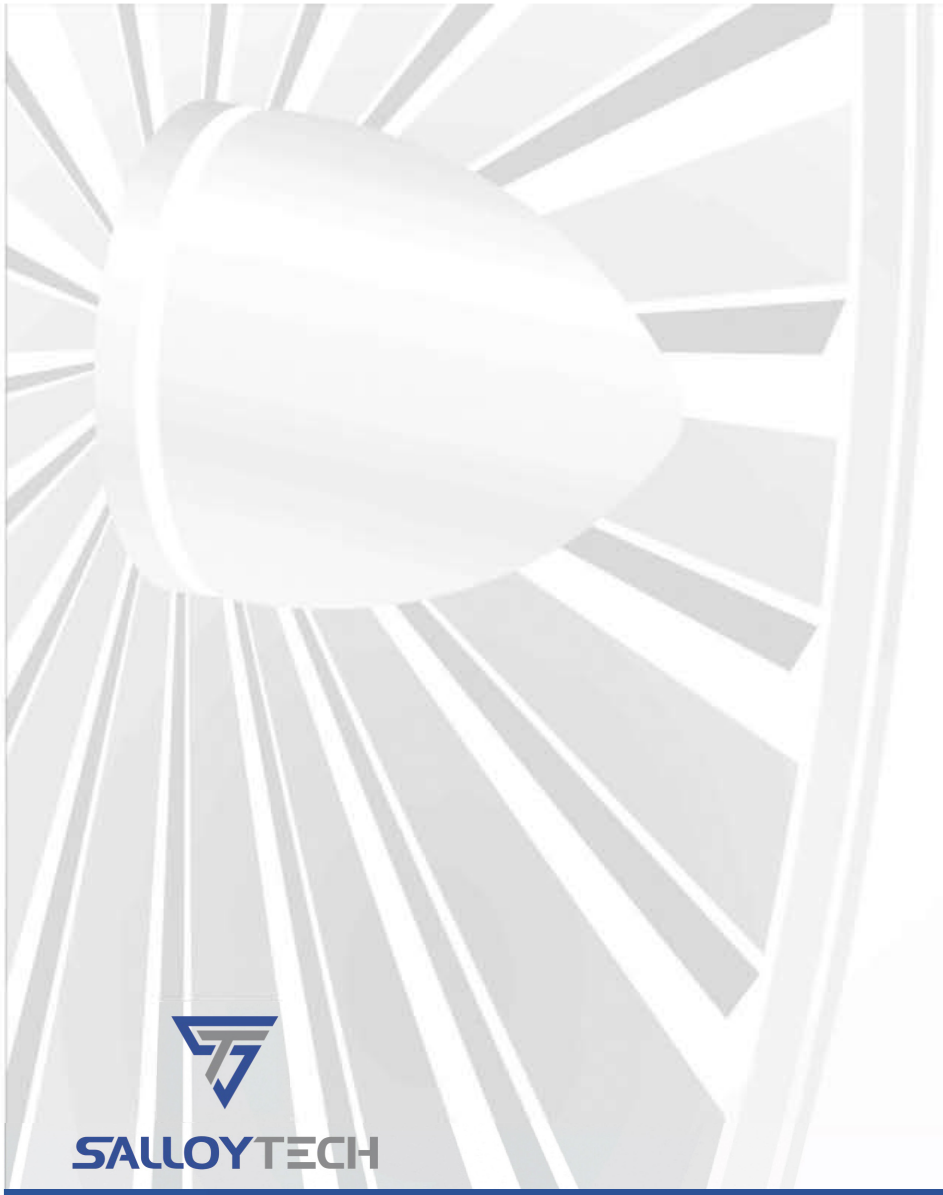
Machining of custom laboratory accessories:

- Gravity or pressure type V-grooved curing fixture for Tensile Bond Strength test of coating
- Loading fixture
- And more...



Design stage

Manufactured part



WORK ON TECHNOLOGICAL PROJECTS
AIMED AT IMPROVING REPAIR / MANUFACTURING PROCESSES

Current project: Repair of Rene 77 airfoils

One of our customers from aerospace industry is looking for the solution to repair airfoils at the production process. Our contribution is to support our customer in order to find a technological solution that would allow to reduce number of scrapped parts.

SALLOYTECH

THERMAL SPRAY / PLASMA SPRAY
PROBLEM SOLVING SERVICES

Our experience in thermal processes, mainly in Plasma Spraying allows for comprehensive optimization from the side of:

- design of technological equipment i.e., fixtures,
- masking, as an aid in the selection of the most favorable solutions to protect the part from overspray and sandblasting,
- coating quality assurance solutions, consultations for control and technical plans, conducting the first article inspection (FAI) and pre-audit for NADCAP accreditation.

SALLOYTECH

SERVICES RELATED TO QUALITY MANAGEMENT

Consulting, audits, preparation for certification, training for implementation and maintenance of:

- Technological processes requiring NADCAP accreditation (including, but no limited to Coatings PRI AC7109 - thermal spray, Coating Evaluation Laboratory, Stripping of Coatings)
- First article inspection (FAI) according to AS9102
- Quality Management System compliant with ISO9001 / AS9100 and PRI AC7004 (NADCAP Aerospace Quality System)
- Control and technical plans for special processes

SALLOYTECH

QUALITY ASSURANCE
ACCORDING TO AS9100

- Working with technological standards/specifications describing:
  - production requirements regarding the equipment, staff and the process itself,
  - raw material properties
- CMM measurements
- First Article Inspection (FAI) according to AS9102
- Control and technical plans for special processes
- Technological Validation for each manufacturing process
- NADCAP best practices implemented in manufacturing processes
- Materials and coatings properties testing
- Statistical Process Control for production

SPACE APPLICATION

SALLOYTECH

HYBRID MANUFACTURING

Hybrid manufacturing: additive + subtractive

Our capabilities:

- Concept Laser DMLM printer
- 5 axis milling machine
- small diameter (~0,1 mm) holes drilling
- 3D printing according to the ECSS Space Product Assurance procedure:

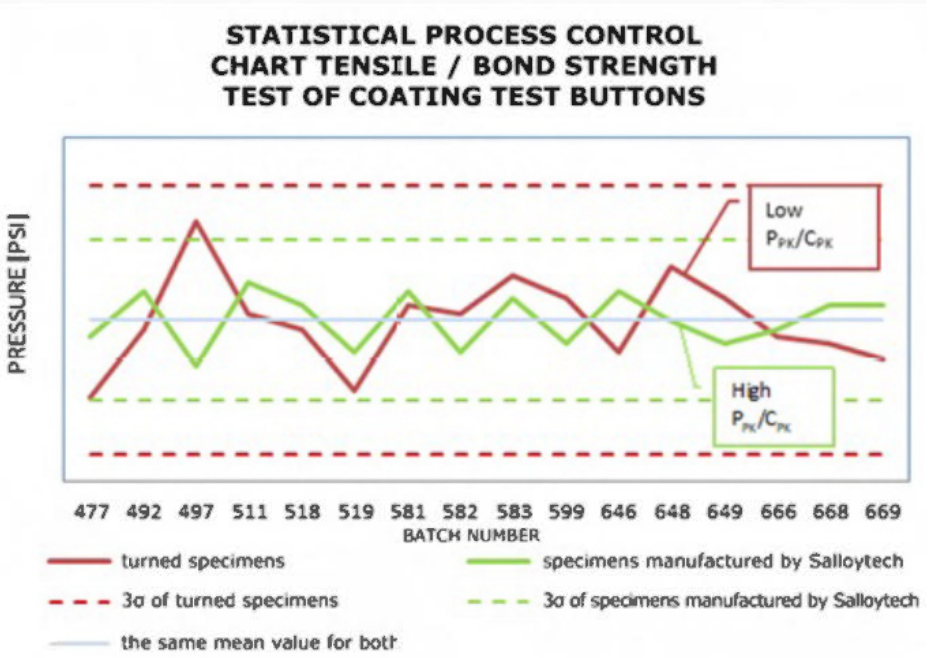
‚Processing and quality assurance requirements for metallic powder bed fusion technologies for space applications'

CASE STUDIES

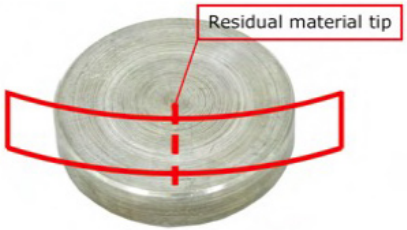
SALLOYTECH

Improve quality of test coupons

- To obtain approval for the coating as part of the qualification process,
- To continuously monitor the consistency of the coating,
- To reduce the frequency of testing in accordance with the Reduced Testing / Sampling procedure.
- Achieve better test results for coating qualification,
- Improve reduced tests and keep them at a high level. (You can see this a in the graph below.)



TENSILE / BOND STRENGTH OF COATING TEST COUPON / BUTTON



Conventional machining by turning

Manufactured by Salloytech

COMPLEX MACHINING OF ROCKET PROPULSION PARTS

In cooperation with Space Technologies Center,
Institute of Aviation (Łukasiewicz Research Network)

Project challenges:

- Tight tolerances
- Complex structures
- Material residual stresses
- Supervision over outsourced special processes

Quality assurance tools like:

- Technological validations
- FAI
- CMM

SILICON MASKING FOR PLASMA SPRAY PROCESS
for the LPT nozzle segments

Project goals:

- Elimination of the masking tape as disposable material
- Reduction of hazardous use of scalpel
- Process cost reduction – masking tape and labor

SILICON MASKING FOR HVOF-PROCESS

JP 5000, Tungsten Carbide

- ✓ gun travel speed: 400 [mm/s]
- ✓ shift: 6 [mm]
- ✓ distance: 360 [mm]
- ✓ cycles: 8 (+1 preheat)

R&D by Ralf Schuefer - Salloytech

SILICON MASKING FOR HVOF-PROCESS

JP 5000, Tungsten Carbide

- ✓ gun travel speed: 400 [mm/s]
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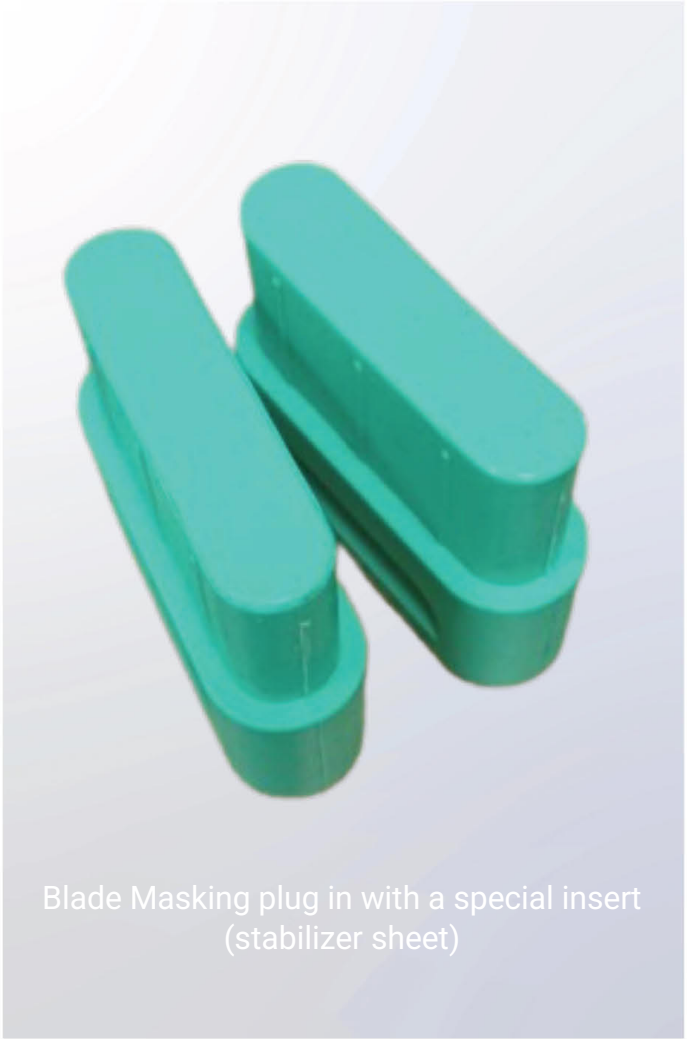


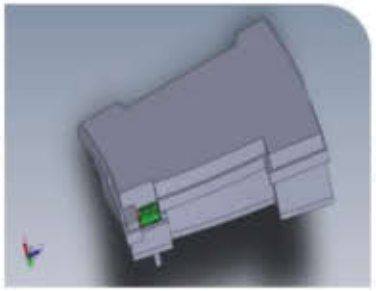
Blade Masking plug in with a special insert (stabilizer sheet)

R&D by Ralf Schuefer - Salloytech

SILICON MASKING FOR PLASMA SPRAY PROCESS
for the LPT nozzle segments

DESIGN EVOLUTION

TAPE MASKING



"BOX" TYPE MASKING DESIGN

"BOX" TYPE MASKING - TEST

"GLOVE 1.0" TYPE MASKING DESIGN

FURTHER TESTING
(NEXT SLIDE)

"GLOVE 2.0" TYPE MASKING TESTS

"GLOVE 2.0" TYPE MASKING DESIGN

"GLOVE 1.0" TYPE MASKING TESTS

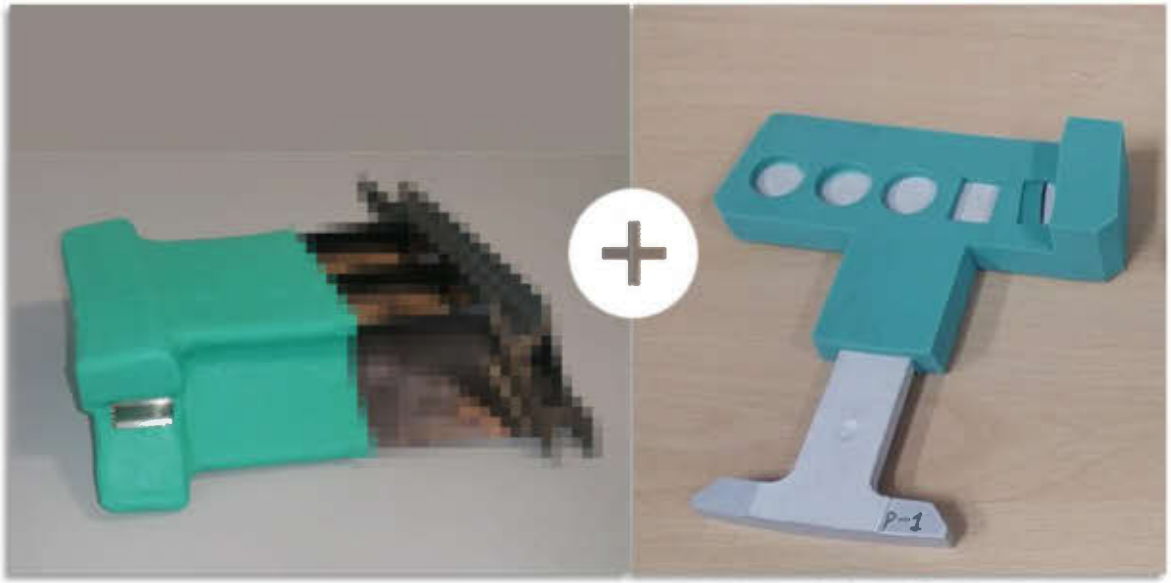
SILICON MASKING FOR PLASMA SPRAY PROCESS
for the LPT nozzle segments

FURTHER DEVELOPMENT PLANS:

01 Implementation of silicon masking for specimen holder

02 Coating qualification on the nozzle segment with silicon masking

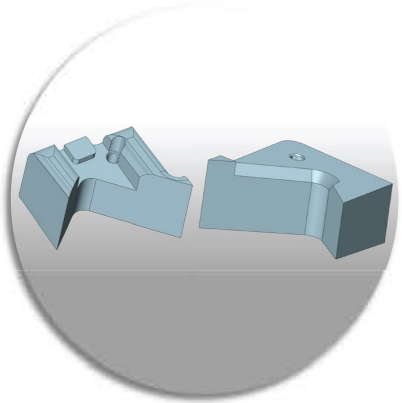
03 Implementation and acceptance of changes in plasma spray process technical plans



NOZZLE SEGMENT WITH SILICON MASKING

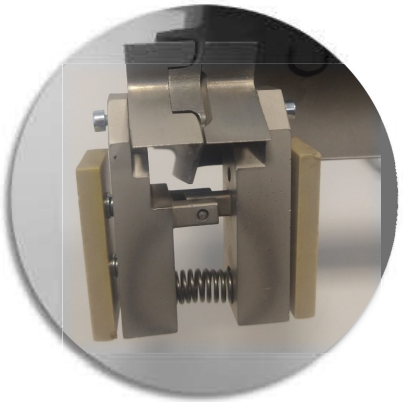
SPECIMEN HOLDER WITH SILICON MASKING

CLAMPING TOOL NICKEL PLATED COPPER BLOCKS FOR COOLING BLADES/VANES DURING THE WELDING PROCESS



DESIGN

Rapid prototyping (3D print from plastic)



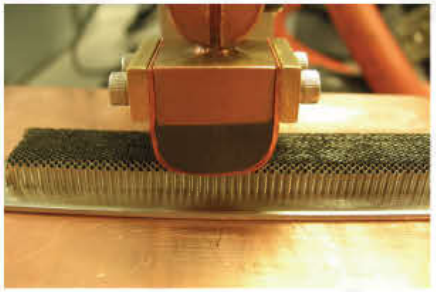
Manufactured parts

FURTHER DEVELOPEMENT: NICKEL COATING REGENERATION

Requirements:

- Material: Electrolytic Copper with nickel plating
- During the welding process: airfoil cooling and joint forming
- 0,2 ÷ 0,4 mm (~8-16 mils) of clearance on the circumference of the contact

HONEYCOMB TACK WELDING
PROCESS IMPROVEMENT

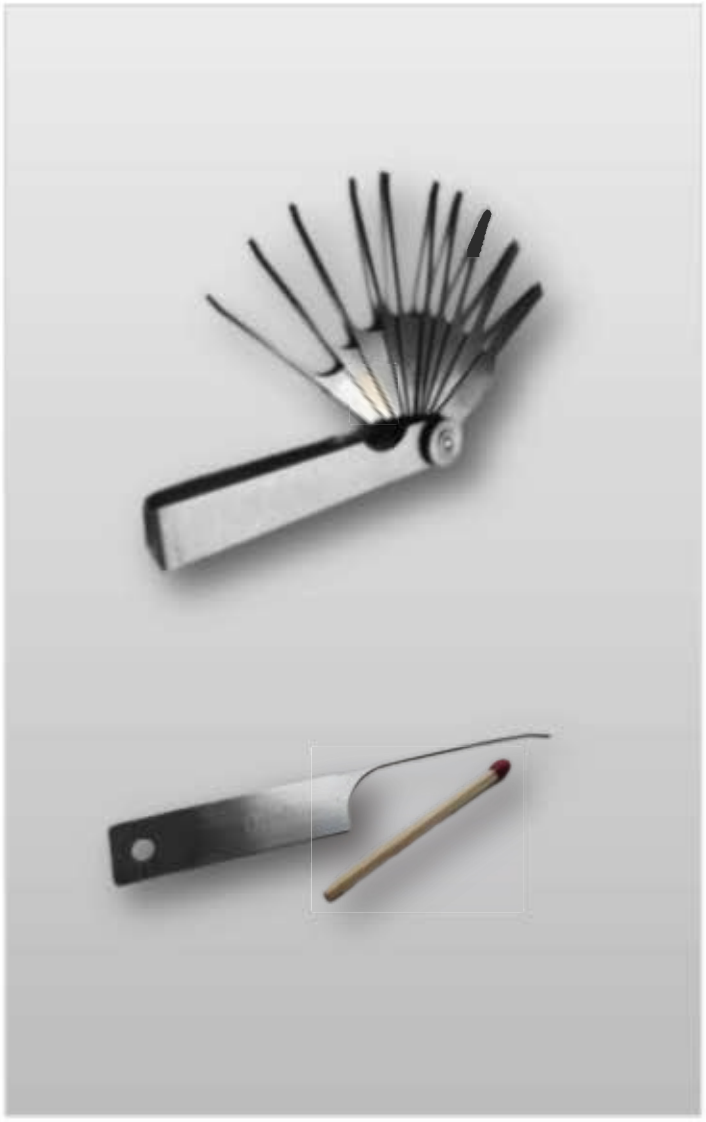


- Our client reported a problem regarding the convex edges on very thin (0,1 mm) copper tack welding shims
- The problem caused local scorch on the shim contact edges and honeycomb

Using our resources, we managed to manufacture a plate with no convex and sharp edges and so the technological problem has been eliminated.

CUSTOM FEELER GAUGES
MANUFACTURING

- Thanks to our WEDM capabilities we can manufacture precise tooling used to measure thickness, gaps, and spacing used in blades/vanes assembly and manufacturing
- Example in the photo shows feeler gauge that is as small as 0,2 mm in width.



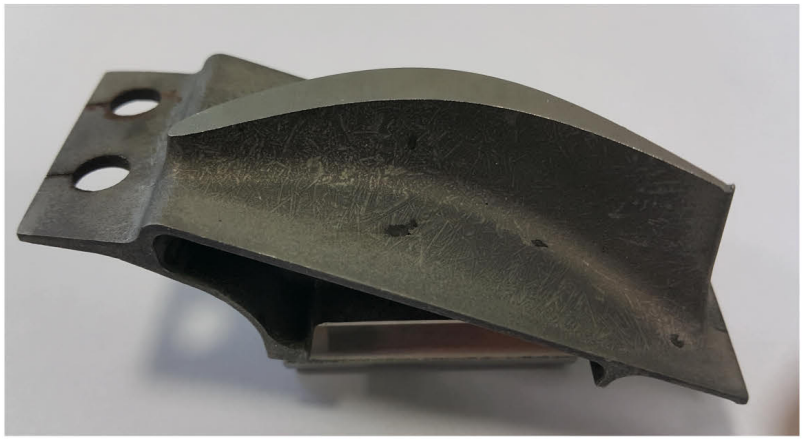
PREPARATION OF TEST SAMPLES FOR ABRASIVE CORROSION STUDIES - INTRODUCTION

The customer's order involved the manufacture of a sample for the study of abrasive corrosion according to the following general assumptions and requirements:

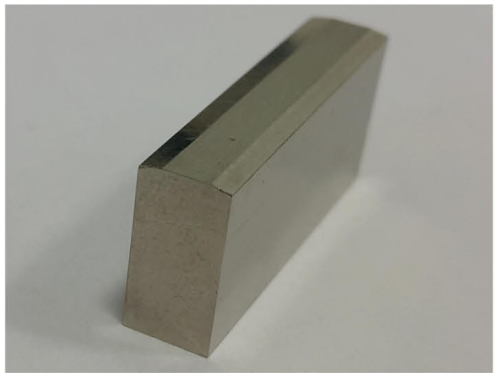
- Material: cast nickel superalloy used for the production of low-pressure turbine blades in aircraft engines
- The samples were to be made from entrusted material in the form of scrapped elements – cut-off dovetails of low-pressure turbine blades
- Required geometric tolerance values such as parallelism and perpendicularity of the order of 0.02 mm
- Absence of a recast layer typical for WEDM processing

Preparation of test samples for abrasive corrosion testing - implementation

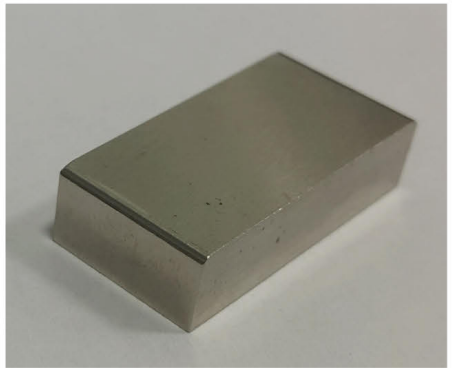
- The preparation of samples included a range of mechanical processing types, for example unconventional ones.



Entrusted scrapped nickel superalloy components



Sample no. 1



Sample no. 2

- The quality control process for the manufactured samples included measurements on a coordinate measuring machine and, finally, tests at the customer's facility.

The use of technologies employed at Salloytech, which made it possible to manufacture the ordered components from the entrusted material (difficult to machine and of irregular shape), will allow for a significant reduction in the unit costs of the samples made in the future.

CURRENT STATUS

- AS9100 certification
- Qualified supplier of aircraft engine manufacturers
- Military concession
- Aviation Valley (Polish Aviation cluster) member

Thank you for your time and we kindly invite you to ask questions.

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