

Solutions Flash

Easy-to-Implement Thermal Spray MRO Solutions for the World's Largest and Most Powerful Turbofan Engine

SF-0022.1 – June 2015



Today's Situation

With a fan diameter of 3.25 m (128 in) and a certified thrust of 513 kN (115,300 lbf), the General Electric's GE90-115B is the world's largest and most powerful turbofan engine.

The GE90-115B is the sole power plant for the popular Boeing 777-200LR and -300ER wide-body passenger aircraft and the Boeing 777F freighter. As of the date of this publication there are 1,200 GE90-115B engines in service and new production adds 190 engines per year to the fleet.

The market success of the GE90-115B engine leads to an increased demand for robust and cost-effective thermal spray repair solutions that have the required approvals and are easily implemented at the repair station. A total of 44 repairs are listed for GE90-115B engine components that require thermal spray, 10 of which require a Technical License Agreement from GE (not listed here).



GE90-115B turbofan engines power the Boeing 777-200LR aircraft

The Oerlikon Metco Solution

We have developed thermal spray MRO solutions covering the full range of listed repairs for the various GE90-115B engine components. The integrated coating solutions cover the equipment for approved thermal spray processes and consumable materials to meet the coating requirements as specified by the OEM in the engine repair manual.

- Our turnkey spray cell accommodates four approved thermal spray application processes along with part and gun manipulation equipment. In a typical configuration, the main thermal spray processes — atmospheric plasma spray, HVOF (liquid- and gas-fueled) and powder combustion spray — are controlled from a single MultiCoat™ controller.
- We supply all of the required 15 thermal spray coating materials with optimized spray parameters. Together with the tailored equipment, these OEM-approved materials provide integral, economical coating repair solutions that are also easily installed at the MRO site.
- As a result, three out of three MRO providers that recently installed GE90-115B repair capabilities have selected our integrated solution consisting of tailored equipment and materials.



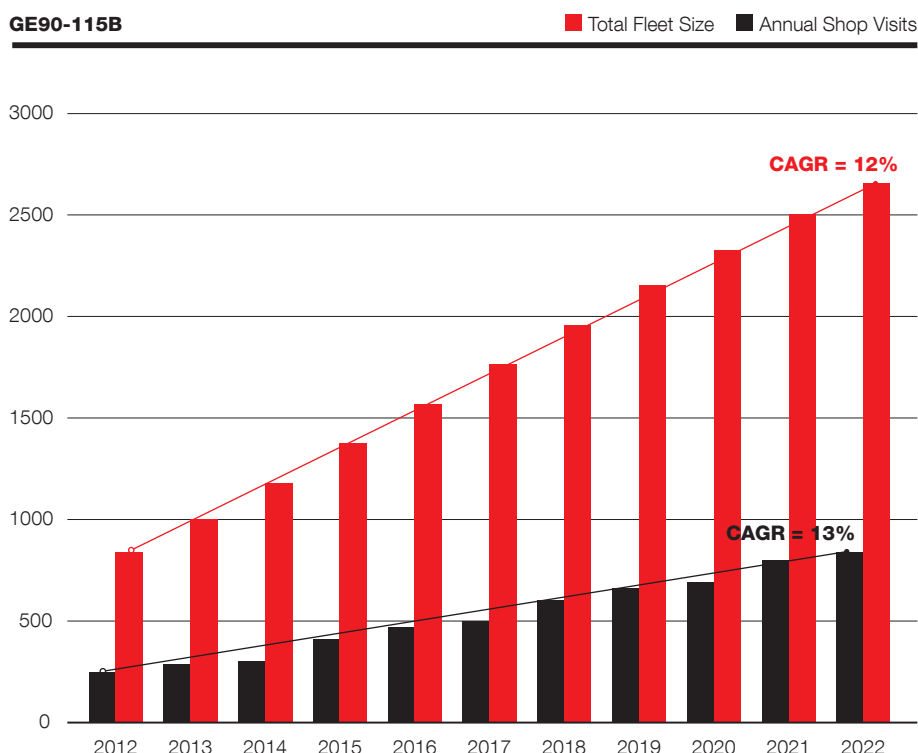
Fan section of the GE90-115B turbine engine. Source: Wikimedia Commons, Photographer: David Monniaux

Solution Description And Validation

GE90-115B Growth

The size of the GE90-115B fleet is growing at the rate of 12% annually.

The rate of MRO growth is 13% annually, based on engine shop visits.



GE90-115B Thermal Spray Repairs

EM Chapter / Repair No.	Description	Scope of Repair	Spray Process	Material (Generic Description)
72-22-02 / 002	No. 1 Bearing Support	Diameter E Thermal Spray Repair	APS; EAW	NiCr/Al Composite Powder; NiCr/Al Wire
72-31-01 / 002	HPC Stage 1 Blisk	Thermal Spraying the Centering Diameter	APS	NiCr/Al Composite Powder
72-31-02 / 001	HPC Rotor Stages 2 Thru 5 Blades	HPC Rotor Blades Stages 2 thru 5 Dovetails Repair	APS	CuNiIn Powder; CuAlFe Powder
72-31-05 / 001	HPC Rotor Cone Shaft	No. 3 Bearing Journal Plasma Coating Repair	HVOF	WC/17Co Powder
72-31-05 / 003	HPC Rotor Cone Shaft	Oil Distributor Journal Plasma Coating Repair	HVOF	WC/17Co Powder
72-31-05 / 004	HPC Rotor Cone Shaft	Bearing Journal Plasma Coating Repair	HVOF	WC/17Co Powder
72-31-05 / 005	HPC Rotor Cone Shaft	Inlet Gearbox Journal Plasma Coating Repair	HVOF	WC/17Co Powder
72-31-05 / 006	HPC Rotor Cone Shaft	Diameter P Plasma Coating Repair	HVOF	WC/17Co Powder
72-31-08 / 001	HPC Rotor Stage 7 – 9 Spool	Spool Seal Tooth Thermal Spray Repair	APS	Ni/Al Composite Powder; Al ₂ O ₃ Powder
72-31-08 / 005	HPC Rotor Stage 7 – 9 Spool	Forward Outer and Forward Inner Rabbet Diameters Repair	HVOF	High Density Inconel 718 Coating
72-31-09 / 002	Compressor Discharge Pressure Rotating Seal	Seal Teeth Thermal Spray Coating Repair	APS	Ni/Al Composite Powder; Al ₂ O ₃ Powder

^a **APS:** Atmospheric Plasma Spray, **HVOF:** High Velocity Oxygen Fuel Spray, **EAW:** Electric Arc Wire Spray, **CPS:** Combustion Powder Spray

GE90-115B Thermal Spray Repairs (continued)

EM Chapter / Repair No.	Description	Scope of Repair	Spray Process	Material (Generic Description)
72-32-02 / 004	HPC Stages 1 thru 3 Variable Stator Vanes	Stages 1-3 VSV Tungsten Carbide Coating Repair	HVOF	WC/17Co Powder
72-32-04 / 001	HPC Stage 1 Interstage Seal	Aluminum Silicon Polyester Coating Replacement	APS	AlSi/Polyester Powder; NiAl Powder
72-32-04 / 002	HPC Stage 2 Interstage Seal	Aluminum Silicon Polyester Coating Replacement	APS	AlSi/Polyester Powder; NiAl Powder
72-52-01 / 002	HPT Stator Case	Thermal Barrier Coating Replacement	APS	ZrO ₂ 8Y ₂ O ₃ Powder over NiCrAlY Bond coat Powder
72-52-01 / 004	HPT Stator Case	Dimensional Restoration by Metal Spray	APS; EAW	NiCr/Al Wire; Inconel 718 Wire; NiCr/Al Composite Powder; Inconel 718 Powder
72-52-12 / 007	HPT Stage 2 Nozzle Assembly	Aft-W Seal Interface Wear Repair	HVOF	Co-Mo-Cr-Si Powder
72-53-02 / 007	HPT Rotor Stage 1 Disk	Inner Bayonet Tab Thermal Spray Repair	APS	Inconel 718 Powder
72-53-03 / 002	HPT Rotor Interstage Seal	Seal Teeth Thermal Spray Repair	APS	Al ₂ O ₃ Powder
72-53-03 / 009	HPT Rotor Interstage Seal	Seal Teeth Thermal Spray Repair	APS	ZrO ₂ 8Y ₂ O ₃ Powder over NiCrAlY Bond Coat Powder; Al ₂ O ₃ Powder
72-53-05 / 002	HPT Rotor Aft Seal	Seal Teeth Coating Repair	APS	Ni/Al Composite Powder; Al ₂ O ₃ Powder
72-53-07 / 002	HPT Inner Sump Seal	Inner Sump Seal Forward Flange Repair	APS	NiCr/Al Composite Powder
72-54-01 / 005	Turbine Center Frame	Case and Hub Dimensional Restoration	APS; EAW	Inconel 718 Powder or Inconel 718 Wire
72-54-01 / 012	Turbine Center Frame	Inner Case Wall Thermal Spray Wear Repair	APS	Inconel 718 Powder
72-54-01 / 022	Turbine Center Frame	LPT Stage 1 Nozzle Support Rail Thermal Spray Repair	APS; EAW	Ni/Al Composite Powder or NiCr/Al Wire
72-54-04 / 001	No. 4 Bearing Housing	Dimensional Restoration	APS	Inconel 718 Powder; NiCr/Al Composite Powder
72-54-05 / 001	No. 4 Bearing After Stationary Air Seal	Nickel Graphite Coating Replacement	APS; CPS	Ni/Al Composite Powder; 85/15 Ni-Graphite Powder
72-54-05 / 003	No. 4 Bearing After Stationary Air Seal	Dimensional Restoration by Thermal Spray	APS; EAW	Inconel 718 Powder or Inconel 718 Wire
72-54-08 / 003	HPT Stationary Seal	Outer Flange Corrosion Removal	HVOF	Rene 80 Powder
72-54-08 / 004	HPT Stationary Seal	Diameter B Dimensional Restoration	APS; EAW	NiCrAl Wire; Inconel 718 Powder
72-54-11 / 003	Transition Duct Seal Support	Dimension B Restoration Repair	APS	NiCr/Al Composite Powder
72-54-12 / 001	TCF Hanger	Dimensional Restoration	APS	NiCr/Al Composite Powder
72-54-13 / 001	Aft Outer Hanger	Restoration of the Mating Surfaces	APS; EAW	CoMoCrSi Powder (Tribaloy 800); NiCr/Al Wire; Inconel 718 Powder
72-54-20 / 003	LPT Forward Seal Support	Aft Flange Dimensional Restoration	APS	NiCr/Al Composite Powder

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Oerlikon Metco Approved Materials

Oerlikon Metco offers OEM-approved materials for all of the thermal spray repairs on the GE90-115B engine.

In fact, Oerlikon Metco has more OEM-approved materials for use on gas turbine engines, whether for new production

or repair, than any other company. We were instrumental in the original development of many of the materials in this table through our own in-house research and/or in partnership with turbine engine OEMs.

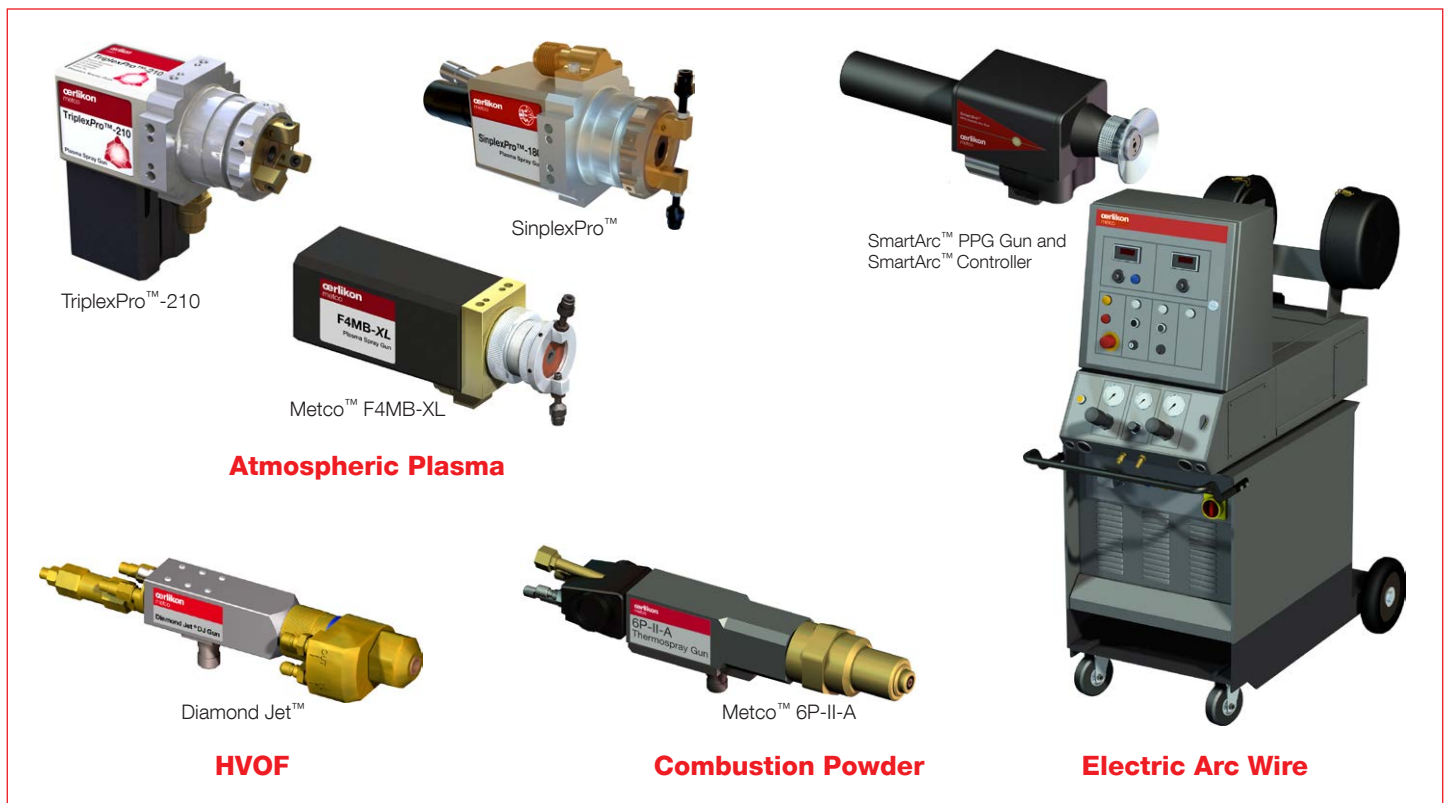
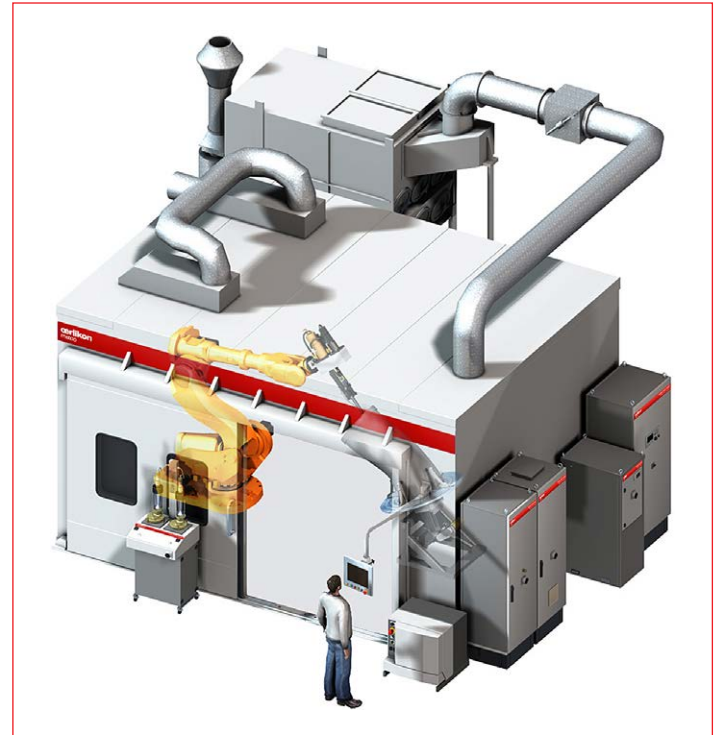
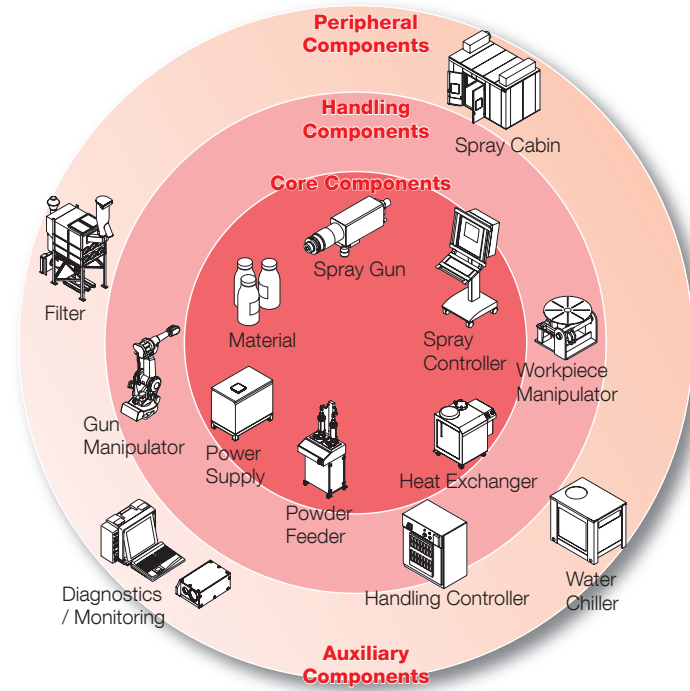
EM Chapter / Repair No.	Description	Approved Process^a	Approved Oerlikon Metco Material	Oerlikon Metco Datasheet No(s)
72-22-02 / 002	No. 1 Bearing Support	APS; EAW	Metco 443NS; Metco 8443	DSMTS-0091; DSMTS-0052
72-31-01 / 002	HPC Stage 1 Blisk	APS	Metco 443NS	DSMTS-0091
72-31-02 / 001	HPC Rotor Stages 2 Thru 5 Blades	APS	Metco 58NS; Metco 51F-NS	DSMTS-0061; DSMTS-0103
72-31-05 / 001	HPC Rotor Cone Shaft	HVOF	Diamalloy 2005	DSMTS-0030
72-31-05 / 003	HPC Rotor Cone Shaft	HVOF	Diamalloy 2005	DSMTS-0030
72-31-05 / 004	HPC Rotor Cone Shaft	HVOF	Diamalloy 2005	DSMTS-0030
72-31-05 / 005	HPC Rotor Cone Shaft	HVOF	Diamalloy 2005	DSMTS-0030
72-31-05 / 006	HPC Rotor Cone Shaft	HVOF	Diamalloy 2005	DSMTS-0030
72-31-08 / 001	HPC Rotor Stage 7 – 9 Spool	APS	Metco 450NS; Metco 101B-NS	DSMTS-0043; DSMTS-0006
72-31-08 / 005	HPC Rotor Stage 7 – 9 Spool	HVOF	Amdry 1718	DSMTS-0085
72-31-09 / 002	Compressor Discharge Pressure Rotating Seal	APS	Metco 450NS; Metco 101B-NS	DSMTS-0043; DSMTS-0006
72-32-02 / 004	HPC Stages 1 thru 3 Variable Stator Vanes	HVOF	Diamalloy 2005	DSMTS-0030
72-32-04 / 001	HPC Stage 1 Interstage Seal	APS	Metco 450NS; Metco 601NS	DSMTS-0043; DSMTS-0016
72-32-04 / 002	HPC Stage 2 Interstage Seal	APS	Metco 450NS; Metco 601NS	DSMTS-0043; DSMTS-0016
72-52-01 / 002	HPT Stator Case	APS	Amdry 962; Metco 204NS	DSMTS-0102; DSMTS-0001
72-52-01 / 004	HPT Stator Case	APS; EAW	Metco 8443; Metco 443NS; Amdry 718	DSMTS-0052; DSMTS-0091; DSMTS-0085
72-52-12 / 007	HPT Stage 2 Nozzle Assembly	HVOF	Diamalloy 3001	DSMTS-0079
72-53-02 / 007	HPT Rotor Stage 1 Disk	APS	Amdry 718; Amdry 1718	DSMTS-0085
72-53-03 / 002	HPT Rotor Interstage Seal	APS	Metco 101B-NS	DSMTS-0006
72-53-03 / 009	HPT Rotor Interstage Seal	APS	Amdry 962; Metco 204NS	DSMTS-0102; DSMTS-0001
72-53-05 / 002	HPT Rotor Aft Seal	APS	Metco 450NS; Metco 101B-NS	DSMTS-0043; DSMTS-0006
72-53-07 / 002	HPT Inner Sump Seal	APS	Metco 443NS	DSMTS-0091
72-54-01 / 005	Turbine Center Frame	APS; EAW	Amdry 718; Amdry 1718	DSMTS-0085
72-54-01 / 012	Turbine Center Frame	APS	Amdry 718; Amdry 1718	DSMTS-0085
72-54-01 / 022	Turbine Center Frame	APS; EAW	Metco 450NS; Metco 8443	DSMTS-0043; DSMTS-0052
72-54-04 / 001	No. 4 Bearing Housing	APS	Amdry 718; Metco 443NS	DSMTS-0085; DSMTS-0091
72-54-05 / 001	No. 4 Bearing After Stationary Air Seal	APS; CPS	Metco 450NS; Metco 308NS-3	DSMTS-0043; DSMTS-0021
72-54-05 / 003	No. 4 Bearing After Stationary Air Seal	APS; EAW	Amdry 718; Amdry 1718	DSMTS-0085
72-54-08 / 003	HPT Stationary Seal	HVOF	Diamalloy 4004NS	DSMTS-0110
72-54-08 / 004	HPT Stationary Seal	APS; EAW	Metco 8443; Amdry 718	DSMTS-0052; DSMTS-0085
72-54-11 / 003	Transition Duct Seal Support	APS	Metco 443NS	DSMTS-0091
72-54-12 / 001	TCF Hanger	APS	Metco 443NS	DSMTS-0091
72-54-13 / 001	Aft Outer Hanger	APS; EAW	Metco 68F-NS-1; Metco 8443; Amdry 718	DSMTS-0079; DSMTS-0052; DSMTS-0085
72-54-20 / 003	LPT Forward Seal Support	APS	Metco 443NS	DSMTS-0091

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Thermal Spray Systems Technology

As a manufacturer of core thermal spray equipment with a worldwide sales and logistics network, Oerlikon Metco is able to offer our customers, regardless of their location, all of the necessary processing equipment to apply the MRO thermal spray coatings for the GE90-115B engine. In addition, we are a highly experienced system integrator; thus, we are

able to provide a complete thermal spray system that includes gun and part handling equipment, as well as ancillary safety equipment such as exhausts, acoustical rooms. Our systems can be designed to handle all four thermal spray processes used for MRO repairs, maximizing system utility and minimizing investment costs.



Supporting Documentation

For more information on the Oerlikon Metco products discussed in this document, please contact your Oerlikon Metco Account Representative, or visit our web site to download the information at www.oerlikon.com/metco.



Thermal Spray Guides

Process Brochures

Material and Equipment Data Sheets

Customer Benefits

- Oerlikon Metco thermal spray solutions for the GE90-115B comply with overhaul manual requirements
- Oerlikon Metco thermal spray materials are OEM approved
- Oerlikon Metco thermal spray processes are OEM approved
- Oerlikon Metco's system integration team can provide turnkey thermal spray systems to apply MRO coatings for the GE90-115B, and other engine types
- Turnkey MultiCoat systems can be designed with multiple thermal spray process capability, saving valuable shop floor space, maximizing system utility and minimizing investment cost
- Oerlikon Metco spray systems are designed with the latest safety standards
- MultiCoat systems include sophisticated trending and reporting for quality control
- Global logistics allow Oerlikon Metco to deliver and support our customers, wherever their location
- Oerlikon Metco after-sales support allow customers to process thermal spray coatings efficiently and minimize downtime:
 - Field Service
 - Technical Support
 - Coating Solutions Services
 - Worldwide spare part support
 - Training

GE90-115B is a product of General Electric Company (GE);
Boeing 777 and its derivatives are products of Boeing Company;
Inconel is a registered trademark of Huntington Alloys Corp.;
Rene is a registered trademark of Teledyne Industries, Inc.;
Tribaloy is a registered trademark of Deloro Stellite Holdings Corporation

Information is subject to change without prior notice.

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