



Light industrial gas turbines Service Offer

Independent Maintenance Center

Cost and quality control

Flexibility



**SATURN 10 & 20
CENTAUR 40 & 50
TAURUS 60**



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Introduction

Since 1980's, ANTONI International's service facility is dedicated to turbo machinery maintenance (compressors, gas and steam turbines) and fully independent from the OEM's.

We offer :

- ❖ Engine repair & overhaul
- ❖ Parts manufacturing & refurbishments
- ❖ Engine upgrade & retrofits
- ❖ Package relocation & maintenance engineering
- ❖ Preventive & corrective maintenance services
- ❖ Maintenance training

Based in Europe and North America we offer our services worldwide, such as in Indonesia, Saudi Arabia, Malaysia, Argentina, Morocco, Congo, Gabon ... and in different industrial sectors such as oil & gas, power generation, paper industry, sugar industry, refineries, steel industry, waste treatment...

Focused on providing its customers services and products of the highest quality standard, ANTONI's service facility is ISO 9002 certified since 1993 (ISO9001 version 2000 pending).

Throughout the years, ANTONI has proven its capability in assisting its customers in various aspects of their SOLAR® engine fleets maintenance such as:

- ❖ Field services
- ❖ Engine repairs and overhaul
- ❖ Parts procurement
- ❖ Retrofits and upgrades





Service offer summary

Summary

		Saturn 10	Saturn 20	Centaur 40	Centaur 50	Taurus 60
FIELD SERVICE	<i>Preventive maintenance & bore scope inspection</i>	X	X	X	X	X
	<i>Corrective maintenance</i>	X	X	X	X	X
	<i>Vibration survey & Performance test</i>	X	X	X	X	X
OVERHAUL & REPAIR	<i>Standard Overhaul</i>	X	X	X	X	X
	<i>Engine repair</i>	X	X	X	X	X
	<i>Test cell (liquid fuel test only)</i>	X	-	X	X (not full load)	-
RETROFIT & UPGRADES	<i>Package</i>	X	X	X	X	-
	<i>Auxiliaries</i>	X	X	X	X	-
	<i>Control system</i>	X	X	X	X	-
	<i>Engine</i>	X	-	X	-	-
PARTS SUPPLY	<i>Engine parts</i>	X	X	X	-	-
	<i>Control system parts</i>	X	X	X	X	X
	<i>Package parts</i>	X	X	X	X	X



Field Service

Field Service

Preventive maintenance

A preventive maintenance program ensures the optimal availability of the equipment and minimizes the occurrence of failures, and even worse, breakdowns.

The preventive maintenance interventions are scheduled based on the operating hours and the operating profile (engine usage).

Maintenance is carried out according to detailed inspection procedures and shall ensure a smooth operation until the next scheduled inspection.

The services are offered around the world through skilled specialists.

The field service staff is composed of :

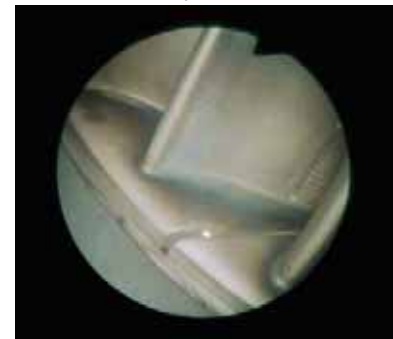
- ❖ 4 field service engineers
- ❖ 6 field service representatives dedicated to gas turbines



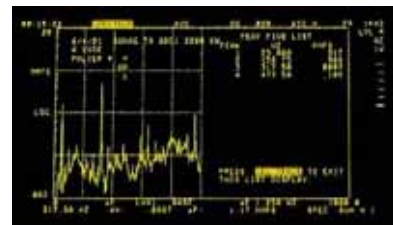
C40 packages in the African



C50 GenSet on platform



Bore scope inspection



Vibration spectral analysis



C40 engine being removed from package after breakdown

Corrective maintenance

In the event of an unscheduled shutdown, ANTONI offers its assistance for :

- ❖ Troubleshooting failure and issue a precise diagnostic to help the operator in how to resume operation
- ❖ Mobilizing a specialized team for repairs and for special surveys within 48 hours
- ❖ "Rush" procurement of needed spare parts



Overhaul



Saturn hoisted out of its package

Engine removal

After shutdown, the engine is removed from its package and is prepared for shipment to the workshop.

Inspection

Once arrived at the workshop, the engine goes through :

- Visual inspection to check transportation and equipment integrity
- Dismantling of the modules into components
- Chemical cleaning or sand blasting of the components
- Dimensional and geometrical checks
- Non Destructive Inspection (NDI) with dye penetrant or eddy current inspection on the critical parts
- Issuance of inspection report (“Engine Condition Report”) and final overhaul scope of work and pricing.



Different parts on dimensional and dye penetrant inspections

Repair process

- Repair or parts replacement based on the inspection report and customer decisions.
- Parts modification or replacement for turbine upgrades in accordance with customer specification.
- Reassembly of the components to modules.
- Reassembly and adjustments of compressor and turbine rotors
- Protective coating according to OEM’s and shops recommendations.
- Balancing of each rotor

Reassembly of the complete unit

- Reassembly of the modules into a complete unit
- Final balancing



Reassembly of a Centaur compressor



Centaur compressor being balanced



C40 reassembled upright



Mechanical test at in-house test cell

For single and twin shaft applications.

- Run-in procedure
- Full speed test
- Vibration survey
- Full load test up to 5 MW with an hydraulic brake



C40 being full load tested



Delivery in accordance with customer's specifications

The packing of the engines is done to client requirements, ocean freight, air freight or long term storage.



On site commissioning

Once the engine is delivered at the customer site, installation, commissioning and startup tests are performed through the field service engineers.



C40 engine under commissioning



Repair & quality control

Repair capabilities

ANTONI's service facility is focused on providing the latest repair technology on hand :

The repair processes used are :

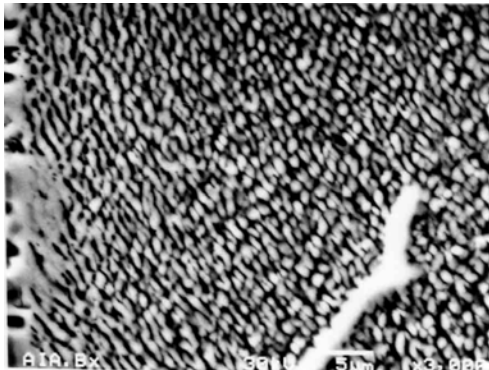
- ❖ Welding (TIG, electron beam & laser)
- ❖ Brazing of any alloy
- ❖ Special coatings of any kind (Sermetel, Sermalloy, CODEP, etc)
- ❖ Electro-erosion cutting
- ❖ Heat treatments (hardening, detensioning)
- ❖ Shot penning



TIG welding



New C50 combustor splash plate repair by brazing



Inconel structure on a blade at 32000 hours

Metrology capabilities

In order to control the quality of the repairs or the procured parts, the service facility has developed different means of metrology:

- ❖ In-house metrology laboratory for parts up to 2000x1000mm
- ❖ Hardness test
- ❖ X-ray control
- ❖ Dye penetrant, ultrasonic and eddy current inspection performed by COFREN certified personnel
- ❖ Tomography
- ❖ Metallurgical analysis



Fluorescent penetrant inspection on heavy duty turbine compressor



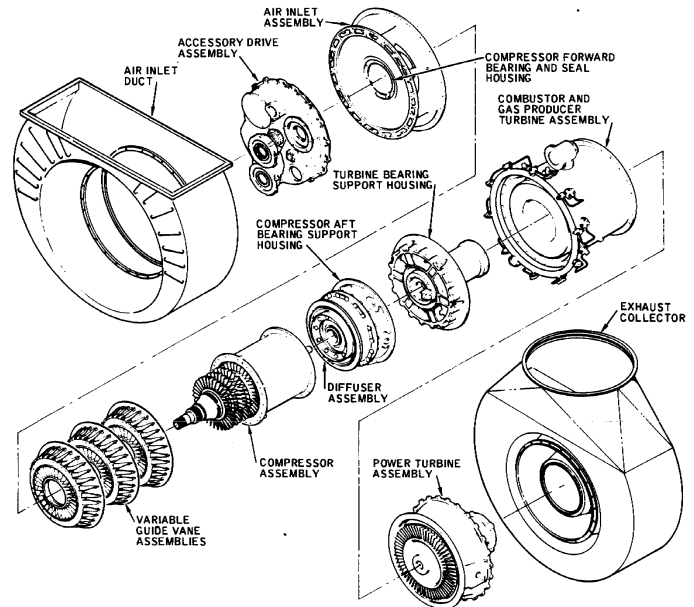
Part internals check by tomography



Component repair

Through developed repair processes for SOLAR® engines, incorporating the latest technologies (like laser welding and tomography). ANTONI provides opportunities to refurbish a wide range of components that were no longer repairable several years ago.

Below shown table is an example of the major repair achievements of the service facility for the CENTAUR 40 and 50.



Section	Part	Repair type	T4x01	T4x02	T5x01	T5x02
Accessory drive assembly	Shafts (all)	Bearing journal reloading	N/A	X	N/A	X
	Bearings (all)	Ball bearing housing restauration	N/A	X	N/A	X
Compressor forward bearing housing	Bearing #1	Bearing housing restauration	X	X	X	X
VGV & Compressor assembly	Blades (all stages)	SERMETEL™ coating	X	X	X	X
	Compressor casing	Geometrical restoration by plasma spray	X	X	X	X
	Shafts	Bearing journal reloading	X	X	X	X
		Seals repair	X	X	X	X
	Vanes (all stages)	SERMETEL™ coating	X	X	X	X
Diffuser assembly	Diffuser	Geometrical restoration by reloading	X	X	X	X
Combustor assembly	Combustor liner	Replacement of spacing baffles	N/A	N/A	X	X
		Combustor liner distortion repair	X	X	X	X
		Patching by brazing-diffusion	X	X	X	X
		Crack welding	X	X	X	X
		Air tubes replacement	X	X	X	X
		Splash plate erosion & corrosion replacement	N/A	N/A	X	X
	Injectors	Tip refurbishment	-	-	X	X
		Fuel and air flow test	X	X	X	X
Compressor aft bearing housing	Bearing #2	Bearing housing restauration	X	X	X	X
	Shaft	Bearing journal reloading	X	X	X	X
		Seals repair	X	X	X	X
Turbine bearing support	Bearing #3	Bearing housing restauration	X	X	X	X
	Turbine shaft	Bearing journal reloading	X	N/A	X	N/A
		Seals repair	X	N/A	X	N/A
Turbine assembly	1st & 2nd stage blades	SERMALLOY™ coating	X	X	X	X
	2nd stage nozzles	Crack, dent or mutilation repairs	X	X	X	X
		CODEP™ coating	X	X	X	X
	3rd stage blades	SERMALLOY™ coating	X	N/A	X	N/A
	3rd stage nozzles	Crack, dent or mutilation repairs	X	N/A	X	N/A
		CODEP™ coating	X	N/A	X	N/A
	Turbine disks (all stages)	Fir tree slots shot penning	X	X	X	X
Power turbine	3rd stage blades	SERMALLOY™ coating	N/A	X	N/A	X
	3rd stage nozzles	Crack, dent or mutilation repairs	N/A	X	N/A	X
		CODEP™ coating	N/A	X	N/A	X
	Bearing #4	Bearing housing restauration	N/A	X	N/A	X
	PT Shaft	Bearing journal reloading	N/A	X	N/A	X
		Seals repair	N/A	X	N/A	X
Accessory gearbox	Shafts (all)	Bearing journal reloading	X	X	X	X
	Bearings (all)	Ball bearing housing restauration	X	X	X	X



Upgrades & retrofits

Engine upgrades

The engine upgrading kits can be implemented during an overhaul :

- SATURN Mark 1 to Mark 1.5
- CENTAUR T400x to T450x
- CENTAUR T450x to T470x

Control system and ancillaries retrofit

Conversion of any control system to a Programmable Logic Controller (PLC) :

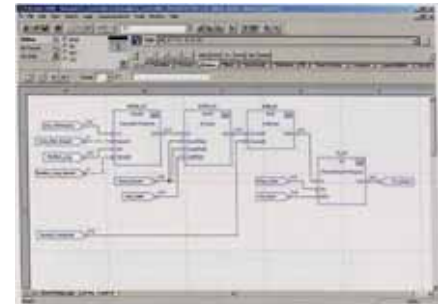
- Allen Bradley® : PLC5, Micrologix™ or FlexIO™
- Siemens : S7
- GE Fanuc® : VersaMax™, Series 90 or Genius™
- Télémécanique® : TSX

Control system enhancement:

- Vibration monitoring system
- Performance controller system
- Electrically gas controlled throttle valve

Instrumentation & actuators retrofit for gensets or turbocompressors to latest technologies like :

- Smart™ instrumentation
- Intrinsically safe technology
- Conversion of gas starters to hydraulic starters
- Fire & gas system
- Battery system



Package refurbishment and relocation

- Transfer from North America to an offshore platform in west Africa of a complete C50 GENSET package
- Engineering and erection of a new installation on an offshore platform
- Modification of process control system



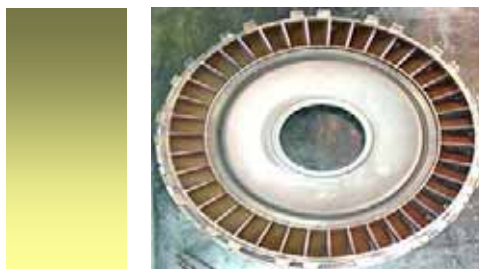
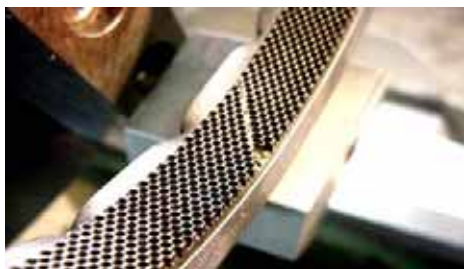


Parts supply

PARTS SUPPLY



Section	Part	Saturn 10	Saturn 20	Centaur 40	Centaur 50	Taurus 60
Compressor forward bearing housing VGV & Compressor assembly	Bearing #1	X	X	X	X	X
	Blades (all stages)	X	X	X	X	-
	Compressor casing	X	X	X	X	X
	Shaft	X	X	X	X	X
	Vanes (all stages)	X	X	X	X	-
Diffuser assembly	Diffuser	X	X	X	X	X
Combustor assembly	Combustor casing	X	X	X	X	-
	Injectors	X	X	X	X	X
Compressor aft bearing housing	Aft & forward thrust washers / tilt pads	X	X	X	X	X
	Bearing #2	X	X	X	X	-
	Shaft	X	X	X	X	X
Turbine bearing support	Bearing #3	X	X	X	X	-
	Turbine shaft	X	X	X	X	X
Turbine assembly	1st & 2nd stage blades	X	X	X	X	X
	2nd stage nozzles	X	X	X	X	X
	3rd stage blades	X	X	X	X	X
	3rd stage nozzles	X	X	X	X	X
	Turbine disks (all stages)	X	X	X	X	X
Power turbine	3rd stage blades	X	X	X	X	X
	3rd stage nozzles	X	X	X	X	X
	Aft & forward thrust washers / tilt pads	X	X	X	X	X
	Bearing #3	X	X	X	X	X
	PT Shaft	X	X	X	X	X
Accessory gearbox	Thrust bearing	X	X	X	X	X
	Shaft (all)	X	X	X	X	X
	Bearing (all)	X	X	X	X	X





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