Oklahoma Gas & Electric

ESN:675497

Shop Report

10/02/2023

Model: GG4A-9

Sulzer Job Number: P203351

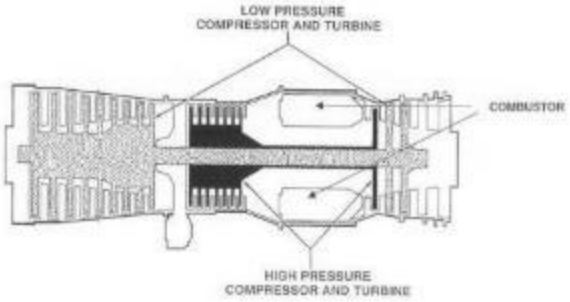
Initial Details:

Gas Generator ESN 675497 was received at Sulzer Turbo Services on May 9th, 2023. The Engine was sent to Sulzer Turbo Services for Tower Shaft Failure. The engine was disassembled for inspection and repair.

Initial Workscope:

The engine was sent to TSF to return to service:

- Disassemble engine to inspect and determine scope of repairs.



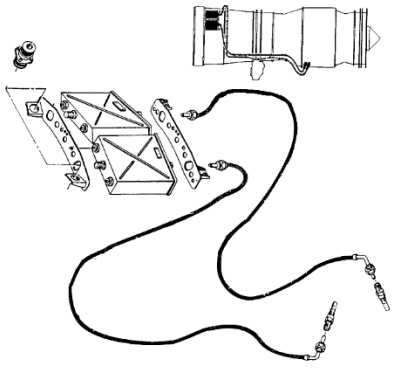
Findings:

Ignition System **2-1-5 & 2-1-6 fig. 1**

Initial Scope: Test igniter boxes, cables and igniter plugs.

Findings: Performed function test to ignition system. All parts functioned properly.

Conducted: Reinstalled igniter parts on the engine.

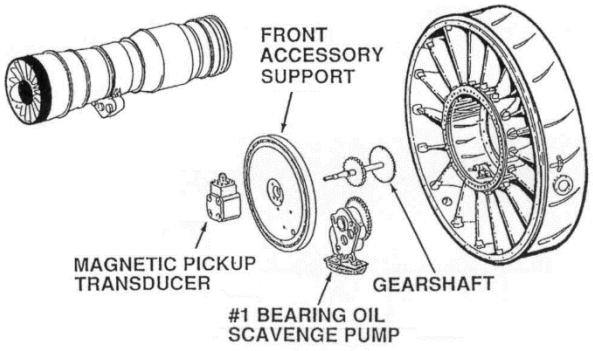


Inlet Case & #1 Housing Area **2-2-1 fig. 1**

Initial Scope: Inspect and report findings.

Findings: Visually inspected with no findings.

Conducted: No repairs were performed. Reassembled #1 oil pump and tested transducer.

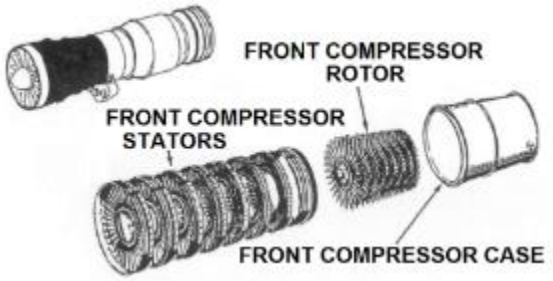


Low Pressure Compressor Rotor Package **2-2-3 fig 1 / 2-2-4 fig 1 / 2-2-5 fig 1**

Initial Scope: Inspect and report findings.

Findings: Visually inspected with no findings.

Conducted: Performed no repairs

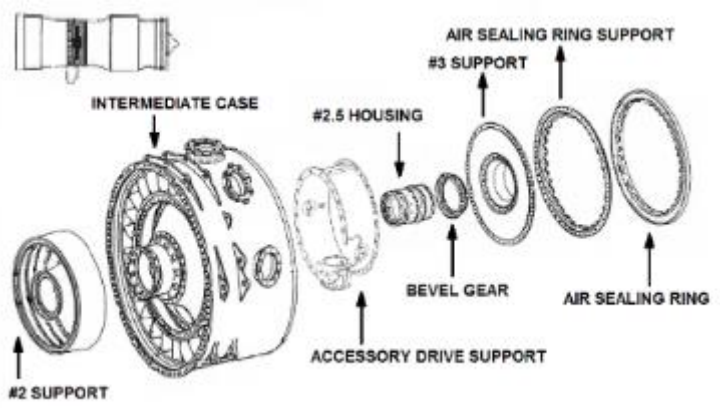


Intermediate Case & #2 Support **2-2-7 fig 1**

Initial Scope: Inspect and report findings.

Findings: Intermediate case strut ruptured during failure. Case is Beyond Economical Repair.

Conducted: Intermediate case was exchanged. #2 support was Cleaned and installed in replacement case. #2.5 Housing and bevel gear were cleaned and installed in replacement case. #3 support and air sealing rings were cleaned and inspected then installed into the replacement case.

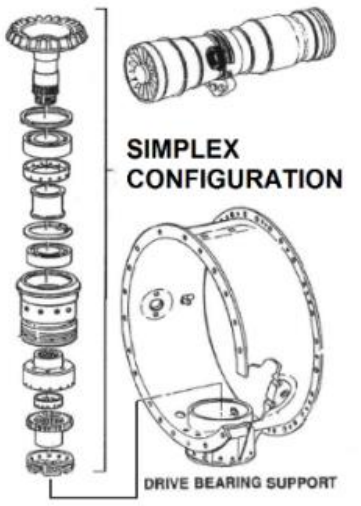


Accessory Drive Area **2-2-8 fig. 1**

Initial Scope: Simplex configuration: inspect and report findings.

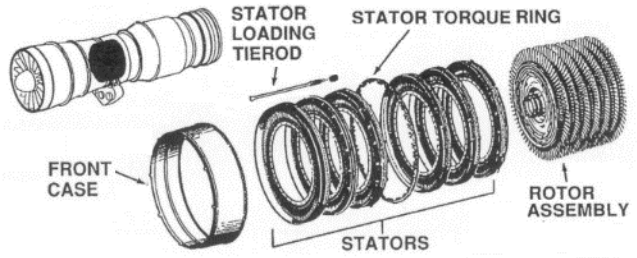
Findings: Accessory drive was disassembled. Bushing was dimensionally inspected for fit to housing. Bearing roller and ball are scrap. The remaining parts were cleaned and inspected with no findings. Faulty nut plate.

Conducted: Accessory drive was dimensionally inspected prior to assembly. Replaced both tower shaft bearings and reassemble using inspected parts. Replace nut plate on accessory drive support.



High Pressure Compressor Rotor Package **2-3-1 fig 1 / 2-3-2 fig 1**

Initial Scope: Inspect and report findings.

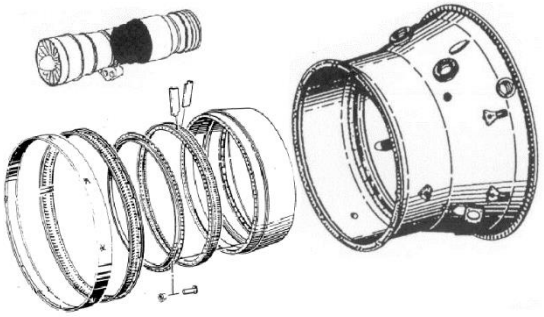


Findings: HPC case – inspected and no Domestic Object Damage observed.
Stators – C-9 to C-13 stators had light DOD on stator vanes. Stators – C-14 had heavy impact on vanes.
Spacers – 9-10 and 11-12 had coating loss.
Spacer – 10-11 was bent. Spacers 12-13 to 14-15 were inspected with no damage.
Blades – C-9 blades had heavy DOD damage.
Blades – C-10 – C-15 blades also had impact damage.
Disks – C-9 – C-12 Disks had coating loss. C-13 to C-15 Disk 15 disk along with rear hub and center tube had no damage.

Conducted: HPC case – Stripped and coated.
Stators – C-9 to C-13 stators, blended, stripped, NDT inspected and coated. Stators – C-14 was replaced.
Spacers – 9-10 and 11-12 – Stripped and coated. Spacer – 10-11 was replaced. Spacers 12-13 to 14-15 were blasted to clean.
Blades – C-9 blades were replaced.
Blades – C-10 blades were replaced.
Blades – C-11 – C-15 were replaced.
Disks – C-9 – C-12 Disks, stripped, NDT inspected and coated. C-13 to C-15 disk along with rear hub and center tube were cleaned and NDT inspected.

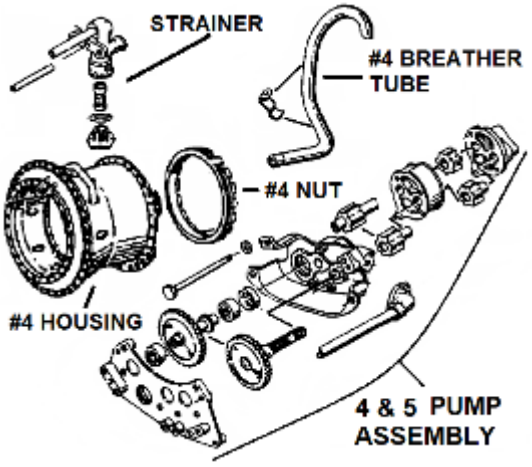
Diffuser Case, 15th stator, #4 Sump Area **2-3-3 fig 1 / 2-3-5 fig 1 / 2-3-6 fig 1**

Initial Scope: Inspect and report findings.



Findings: Visually inspected with no findings.

Conducted: Reassembled.

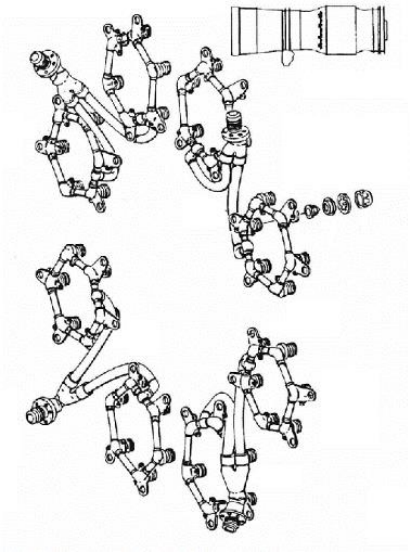


Fuel Manifolds **2-4-8 fig 3**

Initial Scope: Inspect and report findings.

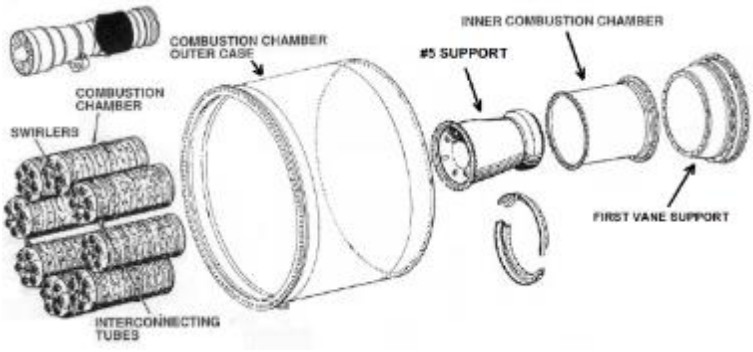
Findings: Visually inspected with no findings.

Conducted: Reassembled



Combustion Outer Case **2-3-10 fig. 1** **Combustion Chambers** **2-3-7 fig 1**

Initial Scope: Inspect and report findings.



Findings: Outer combustion case was deemed serviceable. The number 1 combustion chamber was cracked on the outer liner. The number 5 combustion chamber had burnt inner dome heatshield. The remaining combustion chambers all require cleaning. Combustion chamber clamps were inspected and needed to be cleaned. Inner combustion case was inspected with no findings. #5 support passed pressure test and visual inspection.

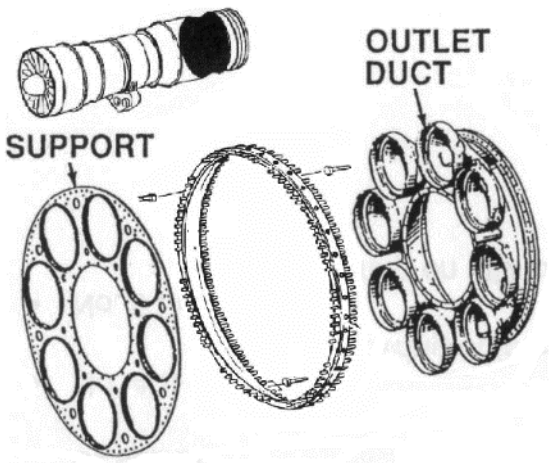
Conducted: Weld repaired the damage on the combustion chambers. Grit blasted to clean the remaining six combustion chambers. Grit blasted to clean combustion chamber clamps. #5 support was cleaned, and pressure tested.

Transition Ducts 2-3-9 fig 1

Initial Scope: Inspect and report findings.

Findings: Visually inspected with no findings.

Conducted: Reassembled

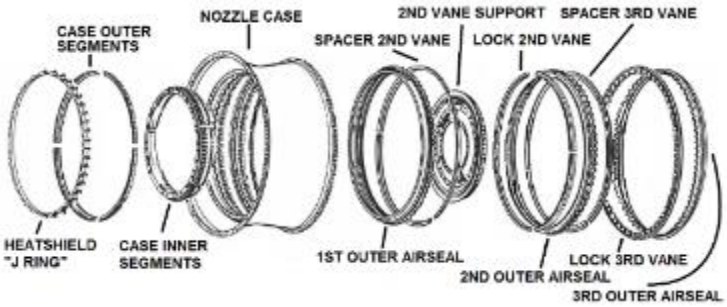


Nozzle Case and Supports 2-3-11 fig 1

Initial Scope: Inspect and report findings.

Findings: Visually inspected with no findings. T-1 Outer airseal had damage to the knife edges

Conducted: No repairs were performed to nozzle case of vane support. Replaced T-1 Outer airseal. T-2 and T-3 outer airseals had no repairs performed.

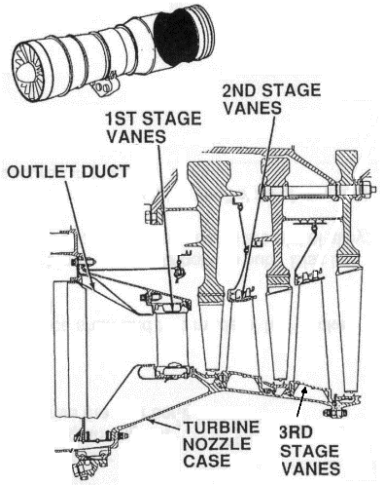


Nozzle Guide Vanes 2-3-11 fig 1

Initial Scope: Inspect and report findings.

Findings: (15) 1st stage vanes had heavy DOD from the broken T-1 blade. (1) 1st stage vanes had over temp. (3) 2nd stage vanes had DOD. (5) 3rd stage vanes had DOD.

Conducted: (16) 1st stage vanes were replaced with overhauled parts. Replaced 2nd and 3rd stage vanes with overhauled parts.

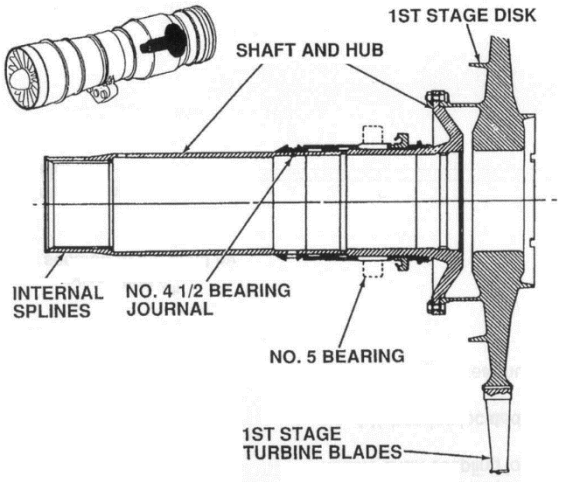


High Pressure Turbine Rotor **2-3-12 fig 1**

Initial Scope: Inspect and report findings.

Findings: Disk and shaft were inspected with no findings.
T-1 blade was cracked in half and missing. Additional quantity of 15 T-1 blades have DOD.

Conducted: Replaced fractured blade with and overhauled blade. Replaced DOD blades with overhauled blades. Overhauled the remaining 92 blades.
Rebuilt rotor and check balance.
See appendix A for balance results.

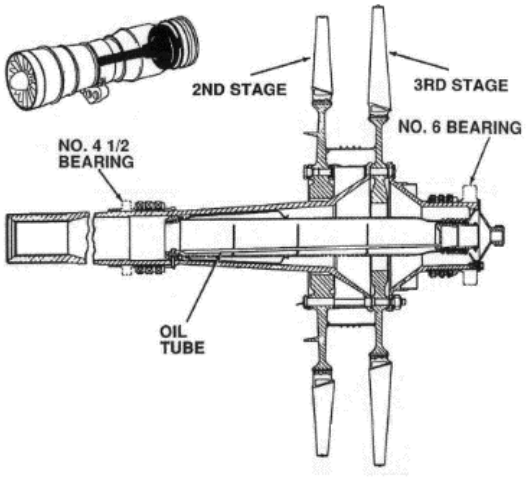


Low Pressure Turbine Rotor **2-3-13 fig 1**

Initial Scope: Inspect and report findings.

Findings: T-2 blades were inspected, and (11) had DOD. T-3 blades were inspected, and (2) had DOD.

Conducted: Damaged T-2 and T-3 blades were replaced.
Rebuilt rotor and check balance.
See appendix A for balance results.

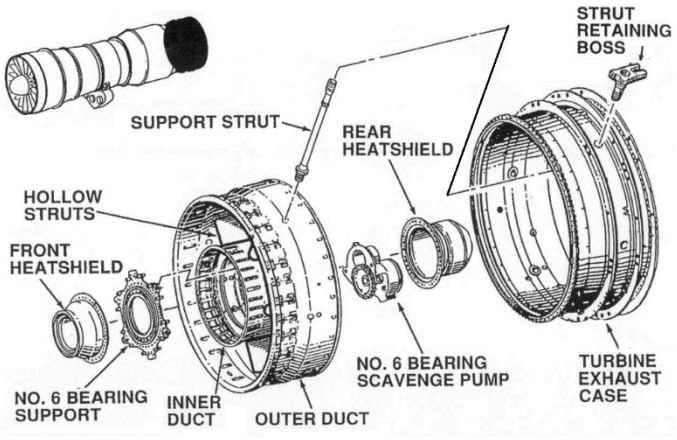


Exhaust Case and #6 bearing Housing **2-3-11 fig 1**

Initial Scope: Inspect and report findings.

Findings: Visually inspected with no findings.

Conducted: Reassembled

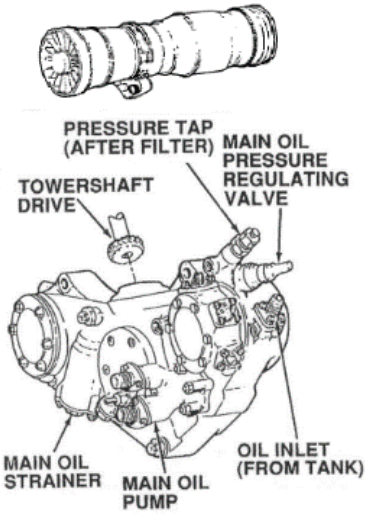


N2 Gearbox & Main Oil Pump Assy **2-4-1 through 2-4-6**

Initial Scope: Clean & flush case and inspect.

Findings: Gearbox assembly was split, and gears and bearings were inspected. Ingested upstream Tower Shaft Bearing material resulting in compromised oil ingestion into downstream gearbox bearings.

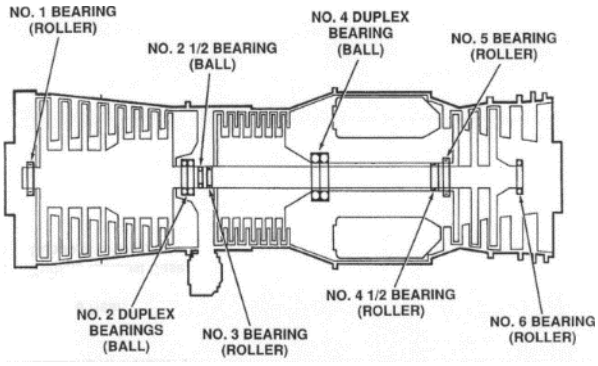
Conducted: Exchanged gearbox.



Main Line Bearings

Initial Scope: Inspect and report findings.

Findings:
#1 Bearing was inspected with no findings.
#2 Bearing inner and outer races were hazed as a result of downstream oil contamination from the tower shaft failure.
#2.5 Bearing was inspected with no findings.
#3 Bearing outer race and rollers were hazed as a result of downstream oil contamination from the failure tower shaft.
#4 Bearing inspected with no findings.
#4.5 Bearing was inspected with no findings.
#5 Bearing was inspected with no findings.
#6 Bearing was inspected with no findings.



Conducted:
#1 Bearing was reinstalled back in engine.
#2 Bearing was replaced.
#2.5 Bearing was reinstalled in the engine.
#3 Bearing was replaced.
#4 Bearing was reinstalled in the engine.
#4.5 Bearing reinstalled in the engine.
#5 Bearing was reinstalled in the engine.
#6 Bearing was reinstalled in the engine.

Main Line Seal Assemblies
Initial Scope: Inspect and report findings.

Findings:
#2 Seal plate was worn.
#3 Seal plate was inspected with no findings.
#4 Seal plate was inspected with no findings.
#4.5 Seal Liner had wear mark on sealing surface.
#5 Seal plate was inspected with no findings.
#6 Carbon rings replace with new.
#6 Seal plates (flat) worn.
#6 Seal plate (large) worn.

Conducted:
#2 Seal plate was overhauled.
#3 Seal plate was reinstalled in the engine.
#4 Seal plate was reinstalled in the engine.
#4.5 Seal Liner was repaired by Grind Plate Grind.
#4.5 Carbon rings was replaced with new.
#5 Seal plate was reinstalled in the engine.
#6 Carbon rings was replaced with new.
#6 Seal plates (flat) was overhauled.
#6 Seal plate (large) was overhauled.

Initial		Final		% of limit	Runouts	
Rear	Front	Rear	Front			
HPC Balance						
24 gr	28.8 gr	.612 gr	.887 gr	% of limit	front	back
2.33gr @ 351°	**16.43gr @ 240°**	**.179gr @ 332°**	**.748gr @ 80°**	**57%**	**.001"**	**.001"**
HPT Balance						
		.900 gr		% of limit	rivets	shaft
22.41gr @ 312°		**.237gr @ 239°**		**26%**	**.005"**	**.001"**
LPT Balance						
22.6 gr		1.134 gr		% of limit		
19.70gr @ 196°		**.050gr @ 265°**		**4%**		

spacer flatness	spline concentricity	#4.5	#6	T-2	T-3
.001"	**.004"**	**.001"**	**.001"**	**.003"**	**.003"**

Compartment Flow Checks					
#1	2 & 3	#4	4 & 5	#6	final
1.5 - 4pph	**37 - 52pph**		**60 - 80pph**	**15 - 21pph**	
3pph	**46pph**		**55pph**	**18pph**	
Compartment Pressure Tests					
6pph max	**14pph max**	**6.5pph max**	**12pph max**	**0pph max**	**56pph max**
6pph	**11pph**	**3.4pph**	**8.5pph**	**0pph**	**40pph**
Exhaust Case Runouts					
concentricity	flatness				
.001"	**.002"**				

Appendix A