

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



CEN23LA232

POWERPLANTS

Group Chair's Factual Report - Attachment #2

Component Exam Test Results

January 8, 2024

Appendix A

FCU Test Report

WOODWARD GOVERNOR COMPANY
Rockford, Illinois
CAGE 66503

TSP-5516
Page 2 of 10
Rev. NEW

Case No. _____

W.G.C. Order _____

Date 12-05-2023

Customer Allied Signal

By _____

Prod. Order _____

Allied Signal P/N 869199-14, -18, -19, -21, -25, -29

T2 Simulator _____

W.G.C. S/N 923051

Test Stand No. _____

REF. DOCUMENTS:

Allied Signal PSC No. 869199-N

W.G.C. Acceptance Test Spec. TSP-1629

For Model 8070-081, -086, -087, -116, -166

W.G.C. Acceptance Test Spec. TSP-1569

For Model 8070-170

All input settings should consistently be made while approaching set points as follows:

- PT2 Approach all inlet pressure settings from a lower pressure setting.
- TT2 Approach all inlet temperature settings from a higher temperature setting.
- PS3 Approach all compressor pressure settings from a lower pressure setting except when checking deceleration schedules or hysteresis.
- MFL Approach all manual fuel lever angular settings from a lower setting.

PRESSURE TEST

Operate unit at the underspeed governor minimum set point. Actuate fuel discharge shutoff valve. Do not shut off discharge flow for more than 2 seconds.

Checked By _____

1 STANDARD ACCELERATION SCHEDULE

Sea level start flow checking procedure: (Test pt. 1.2 only)

Start flow is to be accomplished in the following sequence:

CAUTION: At no time in this calibration procedure is PT2 to be set above PS3.

- A. Preset speed, TT2. Underspeed governor lever, main metering valve lever as specified on data sheet.
- B. Set PS3 at 20 psia Min.
- C. Set PT2 from a low pressure to the required set point without overshoot.
- D. Reset PS3 to 15 psia without undershoot.
- E. Read start fuel flow.

Hold Constant: TT2 = 59 deg. F PT2 = 14.7 psia											
Test Point	Inlet Flow pph Ref.	Req'd Lever Positions (deg.)		Input Speed RPM ± 25	PS3 psia	Pfn psig	Wf - pph			Hysteresis	
		USG	MFL				Req'd	Actual↓	Actual↑	Spec.	Act.
1.1	150	Min.	0	450	15	85	Record	5	---	---	---
1.2	350	Min.	0	1000	15	85	46 $\pm$ 2	60	---	---	---
1.3	350	Max.	0	1000	15	85	46 $\pm$ 2	60	---	---	---
1.4 **	350	Min.	0	1000	18.2 $\pm$ 1	85	46 $\pm$ 2	73	---	---	---
1.5 ***	350	Min.	0	1000	20.1 $\pm$ 1	200	70	81	---	---	---
1.6	800	Max.	0	2200	25	215	104 $\pm$ 3	102	---	---	---
1.7	1150	Max.	0	3000	45	250	189 $\pm$ 7	170	---	---	---
1.8	1400	Max.	0	3600	65	290	256 $\pm$ 10	229	---	---	---
1.9	1550	Max.	0	4000	85	335	307 $\pm$ 12	311	320	3	---
1.10	1550	Max.	0	4000	105	410	379 $\pm$ 14	460	487	6	---
1.11	1550	Max.	0	4000	116	500	452 $\pm$ 18	549	---	---	---
1.12	1550	Max.	101	4000	130	610	515 $\pm$ 10	561	---	---	---

REMARKS: ** With Wf as specified, increase PS3 until Wf starts to increase. Record PS3.

*** Adjust PS3 from a lower setting to a higher setting for exact Wf of 70 pph. Record PS3.

TEST DATA SHEET
ALTITUDE ACCELERATION SCHEDULES

2 15,000 FOOT ACCEL SCHEDULE

Hold Constant: TT2 = 59 deg. F PT2 = 8.8 psia								
Test Point	Inlet Flow	Req'd Lever Positions (deg.)		Input Speed	PS3 psia	Pfn psig	Wf = pph	
	Ref.	USG	MFL	Req'd	Req'd	Req'd	Req'd	Actual
2.1	350	Min.	0	1000	8.8	80	44 ± 6	36
2.2	1200	Max.	0	3100	30	230	126 ± 5	124
2.3	1550	Max.	0	4000	60	280	215 ± 9	216
2.4	1550	Max.	0	4000	70	310	275 ± 11	277
2.5	1550	Max.	Max.	4000	75	335	313 ± 13	322

3 30,000 FOOT ACCEL SCHEDULE

Hold Constant: TT2 = 59 deg. F PT2 = 4.4 psia								
Test Point	Inlet Flow	Req'd Lever Positions (deg.)		Input Speed	PS3 psia	Pfn psig	Wf = pph	
	Ref.	USG	MFL	Req'd	Req'd	Req'd	Req'd	Actual
3.1	1550	Max.	0	4000	25	225	87 ± 4	86
3.2	1550	Max.	0	4000	35	240	138 ± 5	133
3.3	1550	Max.	0	4000	40	255	179 ± 7	173

4 HOT DAY ACCEL SCHEDULE

Hold Constant: TT2 = 103 deg. F PT2 = 14.7 psia								
Test Point	Inlet Flow	Req'd Lever Positions (deg.)		Input Speed	PS3 psia	Pfn psig	Wf = pph	
	Ref.	USG	MFL	Req'd	Req'd	Req'd	Req'd	Actual
4.1	350	Min.	0	1000	15	95	48 ± 6	44
4.2	1300	Max.	0	3400	55	275	235 ± 10	213
4.3	1550	Max.	0	4000	85	345	319 ± 13	320
4.4	1550	Max.	0	4000	116	525	470 ± 18	570

5 COLD DAY ACCEL SCHEDULE

Hold Constant: TT2 = -60 deg. F PT2 = 14.7 psia								
Test Point	Inlet Flow Ref.	Req'd Lever Positions (deg.)		Input Speed	PS3 psia	Pfn psig	Wf = pph	
		USG	MFL	Req'd	Req'd	Req'd	Req'd	Actual
5.1	350	Min.	0	1000	15	80	44 ± 6	36
5.2	1150	Max.	0	3000	45	245	166 ± 6	152
5.3	1450	Max.	0	3800	75	300	249 ± 10	229
5.4	1550	Max.	0	4000	105	370	334 ± 13	402
5.5	1550	Max.	0	4000	116	435	396 ± 16	487

6 UNDERSPEED GOVERNOR 65% SPEED

Hold Constant: MFL = 0 deg. TT2 = 59 deg. F PT2 = 14.7 psia								
Test Point	USG Lever Positions		Input Speed ± 5	Inlet Flow	PS3 psia	Pfn psig	Wf = pph	
	Req'd deg.	Actual	Req'd	Ref.	Req'd	Req'd	Req'd	Actual
6.1	3 ± 3	3	2847 Min.	1100	45	235	145 Min.	171
6.2	3 ± 3	"	2948	1100	42	235	95 ± 5	137
6.3	3 ± 3	"	2970	1100	42	235	*	116
6.4	3 ± 3	"	2948	1100	42	235		138

REMARKS: * A Min. of 5 pph less than the fuel flow at data point 6.2.

7 UNDERSPEED GOVERNOR - 97% SPEED

Hold Constant: MFL = 0 deg. TT2 = 59 deg. F PT2 = 14.7 psia								
Test Point	USG Lever Positions		Input Speed ± 5	Inlet Flow	PS3 psia	Pfn psig	Wf = pph	
	Req'd deg.	Actual	Req'd	Ref.	Req'd	Req'd	Req'd	Actual
7.1	40 ± .25	41	4287 Min.	1650	110	400	340 Min.	332
7.2	40 ± .25	"	4400	1700	102	305	170 ± 5	153
7.3	40 ± .25	"	4420	1700	102	305		148
7.4	40 ± .25	"	4400	1700	102	305		151
7.5	14 ± 1	13	3400**	1300	55	250	110 ± 3	110

REMARKS: ** Set speed and fuel flow. Record speed lever angle. Req.: 14 ± 1 deg.

8 OVERSPEED GOVERNOR

Hold Constant: MFL = Max. TT2 = 59 deg. F PT2 = 14.7 psia							
Test Point	USG Lever Positions	Input Speed ± 5	Inlet Flow Ref.	PS3 psia	Pfn psig	Wf = pph	
	Req'd	Req'd	Req'd	Req'd	Req'd	Req'd	Actual
8.1	Max.	4536	1800	118	510		404
8.2	Max.	4581	1800	118	510	*	399
8.3	Max.	4695	1800	118	330	200 $\pm$ 10	184
8.4	Max.	4800	1800	118	310	109 $\pm$ 5	100
8.5	Max.	4800	1800	118	310	**	87
8.6	Max.	4695	1800	118	330	Record	188

REMARKS: *10 pph Max. drop from the actual flow of preceding data point 8.1.

** Record fuel flow with MFL at Min. position.

9 DECELERATING SCHEDULE

Hold Constant: MFL = 0 TT2 = 59 deg. F Inlet Flow = 1800 Ref. Speed = 4536 RPM USG = Min.					
Test Point	PT2 psia	PS3 psia	Pfn psig	Wf = pph	
	Req'd	Req'd	Req'd	Req'd	Actual
9.1	14.7	117	315	160 $\pm$ 5	159
9.2	14.7	75	270	108 $\pm$ 5	98
9.3	4.4	25	170	Record	46

10 MAIN METERING VALVE SCHEDULE - TT2 CORRECTION

Hold Constant: Inlet Flow = 1800 pph Ref. Speed = 4536 RPM PT2 = 14.7 psia USG = Max. NOTE: Approach all MMV settings from a lower lever setting.										
Test Point	MFL Position ± .5 deg.	TT2 deg. F	TT2 Mike	PS3 psia	Pfn psig	Wf = pph				
						Req'd	Act. ↓	Act. ↑	Hysteresis	
									Spec.	Actual
10.1	101	130	.839	140	435	370 ± 10	329	—	—	—
10.2	101	103	.823	140	480	405 ± 10	351	353	8	2
10.3	101	59	.800	140	535	460 ± 10	383	—	—	—
10.4	101	59	.800	140	535	*	381	—	—	—
10.5	40	103	.823	75	275	164 ± 6	123	—	—	—
10.6	40	59	.800	75	280	175 ± 5	127	128	3	1
10.7	40	-60	.735	75	285	218 ± 8	168	—	—	—

REMARKS: * Record flow change when USG lever is changed from the Max. speed stop to the Min. speed stop. The change in flow must not exceed 10 pph.

11 MAIN METERING VALVE SCHEDULE - PT2 CORRECTION

Hold Constant: Inlet Flow = 1800 Ref. Speed = 4536 RPM TT2 = 59 deg. USG = Max. NOTE: Approach all MMV settings from a lower lever setting.									
Test Point	MFL Position ± .5 deg.	PT2 psia	PS3	Pfn psig	Wf = pph				
					Req'd	Actual ↓	Actual ↑	Hysteresis	
								Spec.	Actual
11.1	101	4.4	55	280	137 ± 6	177	—	—	—
11.2	101	8.8	140	380	275 ± 10	306	—	—	—
11.3	101	14.7	140	535	460 ± 10	370	370	7	6
11.4	40	6.8	22	220	Record	85	—	—	—
11.5	40	8.8	30	230	105 ± 5	105	—	—	—
11.6 *	40	14.7	75	280	175 ± 5	125	125	3	0
11.7	40	17.6	75	280	208 ± 5	125	—	—	—

REMARKS: * Adjustability range approximately ± 10 pph Actual + _____ - _____.

12 LEVER SHAFT TORQUE

Test Point		Req'd Torque In.lbs.	Act. Torque Range
12.1	MMV	7 Max.	4
12.2	USG	10 Max.	9

13 MMV ANGULAR TRAVELS

Test Point	Flat		Angle, deg.	
			Req'd deg.	Actual
13.1	GI		0	0
13.2	FI	Min.	35 - 37	37
		Max.	43 - 45	44
13.3	Max.		101 - 0 + .5	102

14 ACCELERATION SCHEDULE - TT2 HYSTERESIS

Hold Constant: MMV = Max. PT2 = 14.7 psia Inlet Flow = 1550 pph Ref. N = 4000 ± 10 RPM USG = Max.								
Test Point	TT2 deg. F	Sensor Sim. Setting	PS3 psia	Pfn psig	Fuel Flow - pph			
					Actual	Actual	Hysteresis	
							Req'd	Actual
14.1	135	.843	113	510 ± 26	---	---	---	---
14.2	103	.823	113	490 ± 25	570	570	3	0
14.3	-60	.735	113	410 ± 21	487	489	3	2
14.4	-75	.727	113	410 ± 21	---	---	---	---

15 MAX. MFV WF ADJ. CHECK

Test Point

15.1 Record Wf at test point 10.3.

Record: _____

15.2 Adjust MFV Max. flow CCW
Must be 30 pph less than 10.3

Record: _____

NOTE: Reset adjustment to level of T.P. 10.3.

Appendix B
Propeller Governor
Test Report

WOODWARD GOVERNOR COMPANY
Rockford, Illinois
CAGE 66503
VENDOR CODE 23245

AS RECEIVED

TSP-325
Page 9 of 15
Rev. AH

CONSTANT SPEED PROP GOVERNOR - TEST REPORT
Use with Governors 210560 (869120-1), 210563 (893615-3) (See Below)

OIL INLET TEMP. 140 $\pm$ 5 DEG. F. OIL INLET PRESSURE 95 $\pm$ 10 PSIG

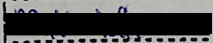
S/N 1113178

P/N 210734

PT.	TSP PARAGRAPH NUMBER	SPEED (RPM)		OIL PRESSURE (PSIG)		OIL FLOW (QTS./MIN)	ACTUAL
		REQUIRED	ACTUAL	REQUIRED	ACTUAL	REQUIRED	
1	C1	CHECK VALVE PRESS. CHECK	0	0	15 Max.	START FLOW	START FLOW
2	C2	TOTAL LEAK CHECK	0	0	200 $\pm$ 10	.5 MAX.	.2
3	C3	RELIEF VALVE CHECK a.	3500 $\pm$ 15	3500	465 $\pm$ 20	0	0
4	C4	PUMP CASE PRESSURE b.	3500 $\pm$ 15	3500	525 PSI MAX.	460	
5	C4	PUMP CAPACITY CHECK	3500 $\pm$ 15	3500	150 $\pm$ 5	150	9.9
6	C5	EXTERNAL LEAK	3500 $\pm$ 15	3500	RELIEF VALVE	0	NONE
7	C6	OVERSPEED SETTING	3942 $\pm$ 10	N/A	150 $\pm$ 5	N/A	Max 100
8	C7	MAXIMUM RPM	3754 $\pm$ 10	3845	150 $\pm$ 5	150	Min 80
9	C8	MINIMUM RPM	2815 $\pm$ 10	3560	150 $\pm$ 5	150	
10	C9	ARM TRAVEL - MAX. TO MIN.	55 DEG.-65 DEG.	20			
11	C10	INCREASE SPEED TO OBTAIN		3853	200 $\pm$ 5	200	
12	C10	INCREASE SPEED TO OBTAIN		3890	50 $\pm$ 5	50	
13	C10	PRESSURE GAIN = PT12-PT11 20-40 RPM		37			
14	C11	DECREASE SPEED TO OBTAIN		3849	200 $\pm$ 5 PSI	200	
15	C11	SPEED HYSTERESIS = PT11-PT 14 -15 TO +40 RPM		4			
16	C12	INTERNAL LEAK	AS REQUIRED	3893	150 $\pm$ 5	150	NEW 1.40 MAX. O'HAUL 1.7 MAX. 0.4
17	C13	MAGNETIC PICKUP VOLTAGE	3700 $\pm$ 10	N/A	Adjust pickup to 4.5V $\pm$.2 peak-to-peak		
18	C13	PICKUP INDICATED RPM	925 $\pm$ 3*	N/A			
19	C16	ELECTRICAL SPEED CHANGE	50 $\pm$ 5	N/A	28 VDC APPLIED TO COIL		

Use with Governors:
210736 (869120-6,-7,-8,-9) 8210-260 (893615-13)
210738 (893615-7,-12) 8210-100 (893615-17)
210743 (897382-1) 8210-266 (893615-18)
REMARKS: If governor is shipped without a lever, test
with P/N 210039

*Applied to 210743 prior to "D" change only.
Indicated pickup RPM (62)

SIGNATURE		DATE
TECHNICIAN		12/05/2023
GARRETT PURCHASE ORDER #		
W.G. SALES ORDER #		3907447