WOODWARD

INVESTIGATION/8D REPORT

Class 1 Published: 03-APR-2014 (D8)

CUSTOMER: HONEYWELL ENGINES & SYSTEMS			INVESTIGATION NO: [redacted]
CUSTOMER ORDER: NONE	WOODWARD SALES ORDER: [redacted]		WOODWARD WORK ORDER: [redacted]
CUSTOMER REJECTION DOCUMENT (CAR,QN,RFA,DMR,ETC.): N/A	WARRANTY DISPOSITION: N/A		PRODUCT STATUS: N/A
PROGRAM/ENGINE TYPE: GARRETT		ITEM RECEIVED: 8070-604	ENGINE MFR MODEL RECEIVED: N/A
PROGRAM CODE: 82228	SERIAL NUMBER: 1451780	ITEM SHIPPED: 8070-604	ENGINE MFR MODEL SHIPPED: 897800-4
PARENT ITEM NUMBER: 8070-604	PARENT ITEM SERIAL NUMBER: 1451780	FIRST SHIPPED: 26-MAR-1993	LAST SHIPPED: 01-NOV-1999
CUSTOMER SERIAL NUMBER: 306	APPLICATION: TPE331	VESSEL TYPE & VESSEL NUMBER: MU-2B-25, N856JT	SITE & LOCATION GRID ID: N/A
TIME/CYCLES SINCE NEW, OVERHAUL, OR REPAIR: N/A			
DATE REPORT OPENED: 24-JAN-2014	DATE PART REMOVED: N/A		DATE RECEIVED: 14-JAN-2014

TEAM MEMBERS (D1)

[redacted]

PROBLEM DESCRIPTION (D2)

UNIT WAS REPORTEDLY INVOLVED IN AN INCIDENT IN OWASSA, OK ON NOVEMBER 10, 2013

INVESTIGATION SUMMARY (D4)

Confirmation Text: NO REPORTED PROBLEM

The unit was inspected upon removal from the shipping container. The investigation was under the oversight of the NTSB and FAA. Unit had impact and fire damage. The unit had lock wire which indicate the unit was not last worked on by Woodward as the lock wire did not have Woodward marked seals on it.

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Initial Testing

The unit was installed on a test stand and the acceptance test was run. The test run 2 results are shown in Appendix 1 (this was the first run that was done on the unit and labeled run 2 due to a computer mislabel). Packings from under the cover were replaced as the packings which are a fluorosilicone material were severely heat damaged. The packings were disintegrated to the point of crumbling when touched which indicates the cover had seen heat in excess of 500 degrees F.

Acceleration schedule

The data showed the sea level acceleration schedule had a Pt2 bias. (This was later determined due to the Pt2 bellows having a longer position at ambient pressure which was caused by the reflow of the solder joint due to the fire exposure). The altitude acceleration test points showed the same effect. The hot and cold day acceleration schedules were run and the results showed the acceleration schedule was biased by the same Pt2 pressure shift due to the sense bellows. The flows matched a shift of 6.5 psi in the bellows.

Decel Schedule

The decel schedule was slightly below the overhaul test point limits throughout the schedule up to 3 pph.

Underspeed Governor Schedule

The unit was run at 65% and 96% governor settings. Both of these settings tested above overhaul test point limits. The 65% underspeed governor point appears to have been set at 65.5% when the unit was set at a speed that corresponded to the 108 pph set point. The 96% governor setting was run and also was higher than the test point limit. The 96% underspeed governor speed to obtain 180 pph was 4369 CRPM. This corresponds to a set point of 96.3%.

Overspeed Governor

The overspeed governor test was set to 4706 rpm to meet the 218 pph required for test point 10.3 This is low by 0.25% speed of the 104% set point. This variation in set point would not have been identified or observed during normal operation of the unit.

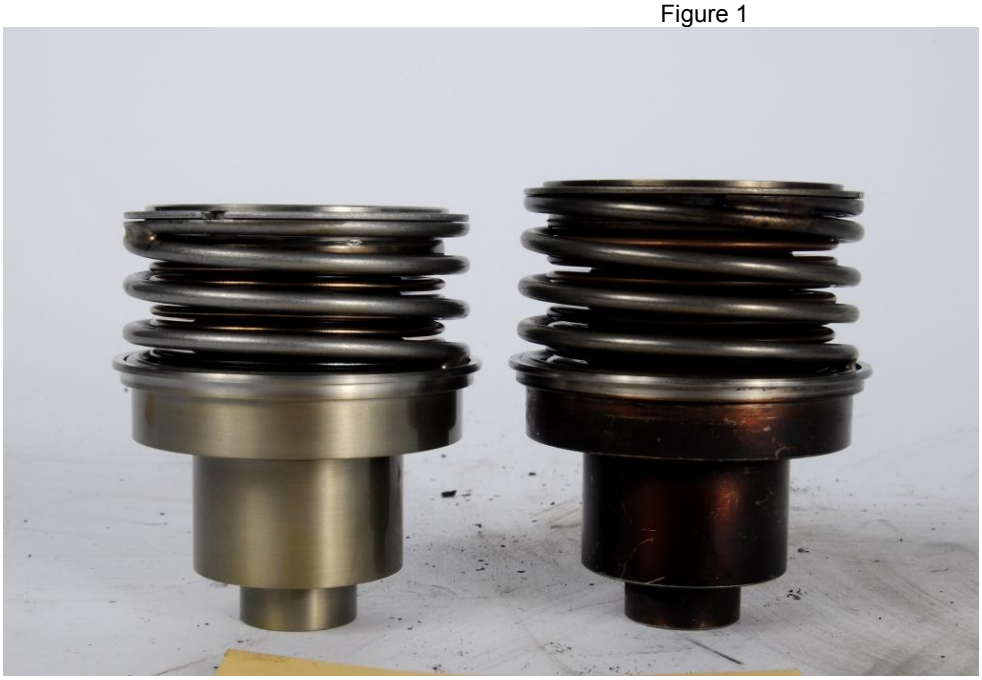
Power lever schedule

The power lever schedule was run and found to be below overhaul test point limits at most test points. This is due to the Pt2 bias caused mostly by the leak in the Pt2 sense bellows. This reduction matches the output of the unit with the bias shift of the Pt2 bellows. Power lever schedules with correction for altitude were run and exhibited the same characteristics.

Partial Disassembly

The unit was removed from the test cell and the Pt2 bellows removed. It was determined the unit would be retested with a new bellows assembly (as it was determined by inspection the bellows was longer than it should be at a near sea level condition). The bellows of the unit is shown in the figure 1 below compared to a new stock bellows. The bellows on the right from the investigation unit is longer as shown in this photo.

Figure 1



Pt2 Sense Bellows Disassembly and Inspection

The bellows was machined to allow the insert of a capillary tube into the cap of the assembly. A capillary tube was epoxied into cap. The capillary tube was pressurized with helium and put in a tank of MIL-PRF-7024 fluid to inspect for leaks. There was a leak observed at the joint between the cap and the end of the bellows. (The bellows is attached to the end cap using solder whose eutectic temperature is 430 degrees F.)

The bellows is shown in figure 2. The arrow indicates the location where the unit was leaking. The location could not be seen with bellows end piece in place.

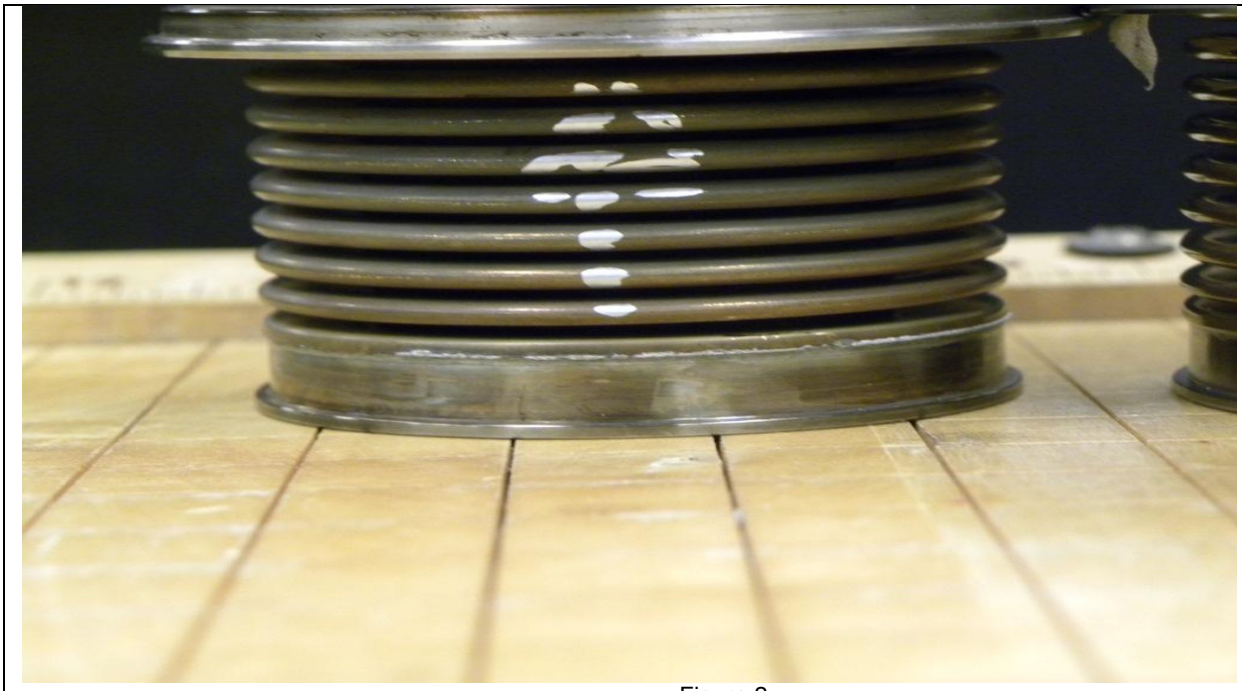


Figure 2

Photos were taken of the solder joint in the area of the leak. See Figure 3. The figure clearly shows the solder joint had reflowed after assembly.

Figure 3.

It is concluded the solder joint degraded in the post crash fire. (Normally the solder joint is brushed to clean the joint. There are brush marks above the joint (to the right in the photo) which are not visible in the area of the reflow. There would be brush marks if the part had been in this condition before the brushing occurred)

Retesting of the unit with New Pt2 Sense Bellows

The test results for the unit are in appendix 2 as run 4

Acceleration schedule

The results showed the acceleration test points section 3.0 were within 8 pph of overhaul test point limits except for 3.11 which was 26 pph low. This shows the acceleration schedule was functionally acceptable with the new bellows assembly. The 3.11 test point appear to be low due to the low setting of Maximum flow stop on the unit but this was not verified as it was not pertinent to the investigation.

The unit could still not be unpressurized to meet the altitude conditions. The unit was refitted with a new cover assembly.

Retesting of the unit with New Pt2 Sense Bellows and Cover

The test results for the unit are in appendix 3 as run 5.

Acceleration schedule

The results showed the acceleration test points section 3.0 were within 8 pph of overhaul test point limits except for 3.11 which was 27 pph low. This shows the acceleration schedule was functionally acceptable with the new bellows assembly. The accel schedules with altitude and temperature bias were within 9 pph of a overhaul acceptance limits except for test point 7.5. This test point was 27 pph low. This point and test point 3.11 may have been influenced by the maximum flow stop.

Decel Schedule

The decel schedule was within 2 pph of the test point limits.

Underspeed Governor Schedule

The schedules were run and very close to the number of the initial run.

Overspeed Governor Schedule

The schedules were run and very close to the number of the initial run.

Power Lever Schedule

The power lever schedule improved from the initial run however the schedule did not come into overhaul test point limits. It was determined the unit still had a Pt2 bias of the power lever schedule. The control linkage which sets the multiplication for the Pt2 bias had shifted. The unit was disassembled to determine the amount of shift of the power lever shaft bias. An indicator WT-68705 S/N 3 was installed on the unit. It was determined the required dimension (L2) which determines position of the lever had shifted .051 in. (C-A dimension was .484, requirement is .530-.540.) This will happen during operation of the bellows in a lower than intended condition due to the partial pressurization which occurred during the reflow of the solder. In the partially pressurized condition the Pt2 bellows amplifier overpowers a torqued adjustment in the unit and changes this set point. This can also happen due to impact loads on the unit. This was the cause of the shift in the power lever test points.

Conclusions

The unit was damaged by fire and impact but functioned normally when the bellows and cover were replaced. The shift in the power lever schedule was caused by operating the Pt2 bias in an out of specification condition caused by the leak in the Pt2 bellows or due to impact. Resetting the 0.535 inch setting would cause the power lever schedule points to be close to overhaul test point limits. No other anomalies were observed on the unit which would have prevented proper operation.

WOODWARD GOVERNOR COMPANY
ROCKFORD, IL
CAGE 66503

TSP-8858
ECL: B
PAGE : 1 OF 1

Desc: TSP - HONEYWELL T22331 FCU ACCEPTANCE TEST
Date: 27-MAR-2014
IMTPC - TEST SPECIFICATION RESULTS PRINT REPORT

Serial No: 1451780 Run No: 2 Work Order: 9239524 Item No: 8070-604
Current Status: A Run Status: F Test Type: AR Test Date: 14-JAN-2014

Test Point		Record	Units	Formula Tag	Min	Value	Max	Pass Fail
1.0	CASE SERIAL NUMBER	Case SN				3055		P
2.0	USG AND PL MIN AND MAX SETTINGS							
2.1	USG Min	USG	deg	USG_MIN	1	4	6	P
2.2	USG Max	USG	deg	USG_MAX	39	41	41	P
2.3	PL Min	PL	deg	PL_MIN	0	0	0	P
2.4	PL Max	PL	deg	PL_MAX	101	101	102	P
3.0	STANDARD ACCELERATION SCHEDULE							
3.1	Standard Accel	Wf	pph		44.0	38.0	48.0	FAIL
3.2	Standard Accel - Sea level start flow.	Wf	pph		44.0	38.0	48.0	FAIL
3.3	Standard Accel	Wf	pph		110.0	92.0	120.0	FAIL
3.4	Standard Accel	Wf	pph		195.0	177.0	211.0	FAIL
3.5	Standard Accel	Wf	pph		260.0	219.0	282.0	FAIL
3.6	Standard Accel							
3.6.1	Standard Accel	Wf	pph	WF_1	306.0	288.0	332.0	FAIL
3.6.2	Standard Accel	Wf	pph	WF_2	283.0 (Calc)	291.0	293.0 (Calc)	P
3.7	Standard Accel Hysteresis	=WF_1-WF_2			-5.0	-3.0	5.0	P
3.8	Standard Accel							
3.8.1	Standard Accel	Wf	pph	WF_3	392.0	463.0	424.0	FAIL
3.8.2	Standard Accel	Wf	pph	WF_4	453.0 (Calc)	468.0	473.0 (Calc)	P
3.9	Standard Accel Hysteresis	=WF_3-WF_4			-10.0	-5.0	10.0	P
3.10	Standard Accel	Wf	pph		437.0	521.0	473.0	FAIL
3.11	Standard Accel	Wf	pph		543.0	530.0	589.0	FAIL
4.0	15,000 FOOT ACCEL SCHEDULE							
4.1	15,000 Foot Accel	Wf	pph		40.0	37.0	52.0	FAIL
4.2	15,000 Foot Accel	Wf	pph		117.0	110.0	127.0	FAIL
4.3	15,000 Foot Accel	Wf	pph		195.0	203.0	211.0	P
4.4	15,000 Foot Accel	Wf	pph		250.0	228.0	270.0	FAIL
4.5	15,000 Foot Accel	Wf	pph		325.0	289.0	353.0	FAIL
5.0	30,000 FOOT ACCEL SCHEDULE							
5.1	30,000 Foot Accel	Wf	pph		87.0	87.0	95.0	P
5.2	30,000 Foot Accel	Wf	pph		113.0	112.0	123.0	FAIL
5.3	30,000 Foot Accel	Wf	pph		199.0	167.0	215.0	FAIL
6.0	HOT DAY ACCEL SCHEDULE							
6.1	Hot Day Accel	Wf	pph		42.0	37.0	54.0	FAIL
6.2	Hot Day Accel	Wf	pph		206.0	187.0	224.0	FAIL
6.3	Hot Day Accel	Wf	pph		319.0	295.0	345.0	FAIL
6.4	Hot Day Accel	Wf	pph		455.0	521.0	493.0	FAIL
7.0	COLD DAY ACCEL SCHEDULE							
7.1	Cold Day Accel	Wf	pph		38.0	34.0	50.0	FAIL
7.2	Cold Day Accel	Wf	pph		174.0	146.0	188.0	FAIL
7.3	Cold Day Accel	Wf	pph		269.0	242.0	291.0	FAIL
7.4	Cold Day Accel	Wf	pph		402.0	479.0	436.0	FAIL
7.5	Cold Day Accel	Wf	pph		531.0	514.0	575.0	FAIL
8.0	UNDERSPEED GOVERNOR 65% SPEED							
8.1	Underspeed Governor 65% Speed	Wf	pph		160.0	155.0	725.0	FAIL
8.2	Underspeed Governor 65% Speed	Wf	pph	WF_5	103.0	132.0	113.0	FAIL
8.3	Underspeed Governor 65% Speed	Wf	pph	WF_24	50.0	112.0	127.0 (Calc)	P

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8.4	Underspeed Governor 65% Speed	Wf	pph		124.0 (Calc)	131.0	140.0 (Calc)	P
9.0	UNDERSPEED GOVERNOR 96.0% SPEED							
9.1	Underspeed Governor 96.0% Speed	Wf	pph		252.0	288.0	725.0	P
9.2	Underspeed Governor 96.0% Speed	Wf	pph	WF_6	175.0	198.0	185.0	FAIL
9.3	Underspeed Governor 96.0% Speed	Wf	pph		50.0	126.0	193.0 (Calc)	P
9.4	Underspeed Governor 96.0% Speed	Wf	pph		188.0 (Calc)	202.0	208.0 (Calc)	P
9.5	Underspeed Governor 75.0% Speed	USG	deg		13	11	15	FAIL
10.0	OVERSPEED GOVERNOR							
10.1	Overspeed Governor - Initial Speed	Wf	pph	WF_7	50.0	456.0	725.0	P
10.2	Overspeed Governor - Final Speed	Wf	pph	WF_23	444.0 (Calc)	451.0	468.0 (Calc)	P
10.3	Overspeed Governor - Increasing Speed	Wf	pph	WF_8	210.0	166.0	230.0	FAIL
10.4	Overspeed Governor	Wf	pph		104.0	82.0	114.0	FAIL
10.5	Overspeed Governor - Decreasing Speed	Wf	pph	WF_9	156.0 (Calc)	165.0	176.0 (Calc)	P
11.0	DECEL SCHEDULE							
11.1	Decel Schedule	Wf	pph		145.0	142.0	159.0	FAIL
11.2	Decel Schedule	Wf	pph		86.0	83.0	100.0	FAIL
11.3	Decel Schedule	Wf	pph		66.0	65.0	80.0	FAIL
12.0	POWER LEVER SCHEDULE - TT2 CORRECTION							
12.1	Power Lever Schedule	Wf	pph	WF_12	463.0	394.0	483.0	FAIL
12.2	Power Lever Schedule - Increasing Tt2	Wf	pph	WF_10	525.0	445.0	545.0	FAIL
12.3	Power Lever Schedule - Decreasing Tt2	Wf	pph	WF_11	431.0 (Calc)	456.0	459.0 (Calc)	P
12.4	Tt2 Hysteresis	=WF_10-WF_11			-14.0	-11.0	14.0	P
12.5	Power Lever Schedule	Wf	pph		477.0 (Calc)	472.0	493.0 (Calc)	FAIL
12.6	Power Lever Schedule	Wf	pph		171.0	137.0	181.0	FAIL
12.7	Power Lever Schedule - Increasing Tt2	Wf	pph	WF_13	180.0	147.0	190.0	FAIL
12.8	Power Lever Schedule - Decreasing Tt2	Wf	pph	WF_14	143.0 (Calc)	149.0	151.0 (Calc)	P
12.9	Tt2 Hysteresis	=WF_13-WF_14			-4.0	-2.0	4.0	P
12.10	Power Lever Schedule	Wf	pph		199.0	176.0	219.0	FAIL
13.0	POWER LEVER SCHEDULE - Tt2 CORRECTION - 10,000 ft.							
13.1	Fuel Flow - Standard Day	Wf	pph	WF_20	315.0	258.0	325.0	FAIL
13.2	Fuel Flow - Hot Day	Wf	pph	WF_21	206.0 (Calc)	226.0	236.0 (Calc)	P
13.3	Delta Flow	=WF_20-WF_21			22.0	32.0	52.0	P
13.4	Fuel Flow - Cold Day	Wf	pph	WF_22	362.0 (Calc)	355.0	392.0 (Calc)	FAIL
13.5	Delta Flow	=WF_22-WF_20			104.0	97.0	134.0	FAIL
14.0	POWER LEVER SCHEDULE - PT2 CORRECTION							
14.1	Fuel Flow	Wf	pph		154.0	185.0	166.0	FAIL
14.2	Fuel Flow - Increasing Pt2	Wf	pph	WF_15	568.0	302.0	596.0	FAIL
14.3	Fuel Flow - Decreasing Pt2	Wf	pph	WF_16	292.0 (Calc)	304.0	312.0 (Calc)	P
14.4	Pt2 Hysteresis	=WF_15-WF_16			-10.0	-2.0	10.0	P
14.5	Fuel Flow	Wf	pph		106.0	89.0	116.0	FAIL
14.6	Fuel Flow - Increasing Pt2	Wf	pph	WF_17	216.0	176.0	226.0	FAIL
14.7	Fuel Flow - Decreasing Pt2	Wf	pph	WF_18	172.0 (Calc)	175.0	180.0 (Calc)	P
14.8	Pt2 Hysteresis	=WF_17-WF_18			-4.0	1.0	4.0	P
15.0	LEVER SHAFT TORQUE	PLT	lb_in		0	4	7	P
16.0	LEVER SHAFT TORQUE	USGT	lb_in		0	6	10	P
17.0	POWER LEVER ANGULAR TRAVELS							
17.1	Flight Idle Max	PL	deg		43	44	45	P
17.2	Flight Idle Min	PL	deg		35	36	37	P
17.3	Max Power Min	PL	deg		93	94	97	P
17.4	Power Lever Max Stop	PL	deg		101	101	102	P
17.5	Power Lever Ground Idle (Min Point)	PL	deg		0	0	0	P

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18.0	MAX FUEL FLOW LIMIT	Wf	pph		545.0	523.0	555.0	FAIL
19.0	MAX POWER ADJUSTMENT CHECK							
19.1	Max. Power Adjustment	Wf	pph	WF_19	315.0	Skip	325.0	S
19.2	Max. Power Adjustment Upward	Wf	pph		UNAVAILABLE	Skip	725.0	S
19.3	Max. Power Adjustment Downward	Wf	pph		50.0	Skip	UNAVAILABLE	S
20.0	FINAL SPECIFIC GRAVITY ADJUSTER SETTING	SpGr Adj				PASS		P
21.0	T2 Linkage Check	T2 Link	inches		0.890	0.980	1.000	P

AUDIT SCHEDULE

2.1	USG Min	USG	deg		1		6	
2.2	USG Max	USG	deg		39		41	
2.3	PL Min	PL	deg		0		0	
2.4	PL Max	PL	deg		101		102	
3.1	Standard Accel	Wf	pph		44.0		48.0	
3.10	Standard Accel	Wf	pph		437.0		473.0	
5.3	30,000 Foot Accel	Wf	pph		199.0		215.0	
6.4	Hot Day Accel	Wf	pph		455.0		493.0	
8.2	Underspeed Governor 65% Speed	Wf	pph		103.0		113.0	
9.2	Underspeed Governor 96.0% Speed	Wf	pph		175.0		185.0	
10.3	Overspeed Governor - Increasing Speed	Wf	pph		210.0		230.0	
11.1	Decel Schedule	Wf	pph		145.0		159.0	
11.2	Decel Schedule	Wf	pph		86.0		100.0	
12.2	Power Lever Schedule - Increasing Tt2	Wf	pph		525.0		545.0	
12.7	Power Lever Schedule - Increasing Tt2	Wf	pph		180.0		190.0	
13.1	Fuel Flow - Standard Day	Wf	pph		315.0		325.0	
13.2	Fuel Flow - Hot Day	Wf	pph		206.0 (Calc)		236.0 (Calc)	
13.3	Delta Flow	=WF_20-WF_21			22.0		52.0	
13.4	Fuel Flow - Cold Day	Wf	pph		362.0 (Calc)		392.0 (Calc)	
13.5	Delta Flow	=WF_22-WF_20			104.0		134.0	
14.1	Fuel Flow	Wf	pph		154.0		166.0	
17.1	Flight Idle Max	PL	deg		43		45	
18.0	MAX FUEL FLOW LIMIT	Wf	pph		545.0		555.0	
20.0	FINAL SPECIFIC GRAVITY ADJUSTER SETTING	SpGr Adj						
21.0	T2 Linkage Check	T2 Link	inches		0.890		1.000	
22.0	OVERSPEED LOW FLOW CHECK	Wf	pph		160.0	163.0	200.0	P

The following criteria were used to run this report:

Serial No:	1451780
Run Number:	2
Status:	A
Run Type:	AR
Order By:	1

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* End of IMTPC *
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WOODWARD GOVERNOR COMPANY
ROCKFORD, IL
CAGE 66503

TSP-8858
ECL: B
PAGE : 1 OF 1

Desc: TSP - HONEYWELL TPE331 PCU ACCEPTANCE TEST
Date: 27-MAR-2014
IMTPC - TEST SPECIFICATION RESULTS PRINT REPORT

Serial No: 1451780 Run No: 4 Work Order: 9239524 Item No: 8070-604
Current Status: A Run Status: F Test Type: AR Test Date: 15-JAN-2014

Test Point		Record	Units	Formula Tag	Min	Value	Max	Pass Fail
1.0	CASE SERIAL NUMBER	Case SN						
2.0	USG AND PL MIN AND MAX SETTINGS							
2.1	USG Min	USG	deg	USG_MIN	1	4	6	P
2.2	USG Max	USG	deg	USG_MAX	39	40	41	P
2.3	PL Min	PL	deg	PL_MIN	0	0	0	P
2.4	PL Max	PL	deg	PL_MAX	101		102	
3.0	STANDARD ACCELERATION SCHEDULE							
3.1	Standard Accel	Wf	pph		44.0	37.0	48.0	FAIL
3.2	Standard Accel - Sea level start flow.	Wf	pph		44.0	36.0	48.0	FAIL
3.3	Standard Accel	Wf	pph		110.0	112.0	120.0	P
3.4	Standard Accel	Wf	pph		195.0	202.0	211.0	P
3.5	Standard Accel	Wf	pph		260.0	266.0	282.0	P
3.6	Standard Accel							
3.6.1	Standard Accel	Wf	pph	WF_1	306.0	320.0	332.0	P
3.6.2	Standard Accel	Wf	pph	WF_2	315.0 (Calc)	322.0	325.0 (Calc)	P
3.7	Standard Accel Hysteresis	=WF_1-WF_2			-5.0	-2.0	5.0	P
3.8	Standard Accel							
3.8.1	Standard Accel	Wf	pph	WF_3	392.0	385.0	424.0	FAIL
3.8.2	Standard Accel	Wf	pph	WF_4	375.0 (Calc)	388.0	395.0 (Calc)	P
3.9	Standard Accel Hysteresis	=WF_3-WF_4			-10.0	-3.0	10.0	P
3.10	Standard Accel	Wf	pph		437.0	429.0	473.0	FAIL
3.11	Standard Accel	Wf	pph		543.0	517.0	589.0	FAIL
4.0	15,000 FOOT ACCEL SCHEDULE							
4.1	15,000 Foot Accel	Wf	pph		40.0		52.0	
4.2	15,000 Foot Accel	Wf	pph		117.0		127.0	
4.3	15,000 Foot Accel	Wf	pph		195.0		211.0	
4.4	15,000 Foot Accel	Wf	pph		250.0		270.0	
4.5	15,000 Foot Accel	Wf	pph		325.0		353.0	
5.0	30,000 FOOT ACCEL SCHEDULE							
5.1	30,000 Foot Accel	Wf	pph		87.0		95.0	
5.2	30,000 Foot Accel	Wf	pph		113.0		123.0	
5.3	30,000 Foot Accel	Wf	pph		199.0		215.0	
6.0	HOT DAY ACCEL SCHEDULE							
6.1	Hot Day Accel	Wf	pph		42.0		54.0	
6.2	Hot Day Accel	Wf	pph		206.0		224.0	
6.3	Hot Day Accel	Wf	pph		319.0		345.0	
6.4	Hot Day Accel	Wf	pph		455.0		493.0	
7.0	COLD DAY ACCEL SCHEDULE							
7.1	Cold Day Accel	Wf	pph		38.0		50.0	
7.2	Cold Day Accel	Wf	pph		174.0		188.0	
7.3	Cold Day Accel	Wf	pph		269.0		291.0	
7.4	Cold Day Accel	Wf	pph		402.0		436.0	
7.5	Cold Day Accel	Wf	pph		531.0		575.0	
8.0	UNDERSPEED GOVERNOR 65% SPEED							
8.1	Underspeed Governor 65% Speed	Wf	pph		160.0		725.0	
8.2	Underspeed Governor 65% Speed	Wf	pph	WF_5	103.0		113.0	
8.3	Underspeed Governor 65% Speed	Wf	pph	WF_24	50.0		UNAVAILABLE	

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8.4	Underspeed Governor 65% Speed	Wf	pph		UNAVAILABLE	UNAVAILABLE
9.0	UNDERSPEED GOVERNOR 96.0% SPEED					
9.1	Underspeed Governor 96.0% Speed	Wf	pph		252.0	725.0
9.2	Underspeed Governor 96.0% Speed	Wf	pph	WF_6	175.0	185.0
9.3	Underspeed Governor 96.0% Speed	Wf	pph		50.0	UNAVAILABLE
9.4	Underspeed Governor 96.0% Speed	Wf	pph		UNAVAILABLE	UNAVAILABLE
9.5	Underspeed Governor 75.0% Speed	USG	deg		13	15
10.0	OVERSPEED GOVERNOR					
10.1	Overspeed Governor - Initial Speed	Wf	pph	WF_7	50.0	725.0
10.2	Overspeed Governor - Final Speed	Wf	pph	WF_23	UNAVAILABLE	UNAVAILABLE
10.3	Overspeed Governor - Increasing Speed	Wf	pph	WF_8	210.0	230.0
10.4	Overspeed Governor	Wf	pph		104.0	114.0
10.5	Overspeed Governor - Decreasing Speed	Wf	pph	WF_9	UNAVAILABLE	UNAVAILABLE
11.0	DECEL SCHEDULE					
11.1	Decel Schedule	Wf	pph		145.0	159.0
11.2	Decel Schedule	Wf	pph		86.0	100.0
11.3	Decel Schedule	Wf	pph		66.0	80.0
12.0	POWER LEVER SCHEDULE - TT2 CORRECTION					
12.1	Power Lever Schedule	Wf	pph	WF_12	463.0	483.0
12.2	Power Lever Schedule - Increasing Tt2	Wf	pph	WF_10	525.0	545.0
12.3	Power Lever Schedule - Decreasing Tt2	Wf	pph	WF_11	UNAVAILABLE	UNAVAILABLE
12.4	Tt2 Hysteresis	=WF_10-WF_11			-14.0	14.0
12.5	Power Lever Schedule	Wf	pph		UNAVAILABLE	UNAVAILABLE
12.6	Power Lever Schedule	Wf	pph		171.0	181.0
12.7	Power Lever Schedule - Increasing Tt2	Wf	pph	WF_13	180.0	190.0
12.8	Power Lever Schedule - Decreasing Tt2	Wf	pph	WF_14	UNAVAILABLE	UNAVAILABLE
12.9	Tt2 Hysteresis	=WF_13-WF_14			-4.0	4.0
12.10	Power Lever Schedule	Wf	pph		199.0	219.0
13.0	POWER LEVER SCHEDULE - Tt2 CORRECTION - 10,000 ft.					
13.1	Fuel Flow - Standard Day	Wf	pph	WF_20	315.0	325.0
13.2	Fuel Flow - Hot Day	Wf	pph	WF_21	UNAVAILABLE	UNAVAILABLE
13.3	Delta Flow	=WF_20-WF_21			22.0	52.0
13.4	Fuel Flow - Cold Day	Wf	pph	WF_22	UNAVAILABLE	UNAVAILABLE
13.5	Delta Flow	=WF_22-WF_20			104.0	134.0
14.0	POWER LEVER SCHEDULE - PT2 CORRECTION					
14.1	Fuel Flow	Wf	pph		154.0	166.0
14.2	Fuel Flow - Increasing Pt2	Wf	pph	WF_15	568.0	596.0
14.3	Fuel Flow - Decreasing Pt2	Wf	pph	WF_16	UNAVAILABLE	UNAVAILABLE
14.4	Pt2 Hysteresis	=WF_15-WF_16			-10.0	10.0
14.5	Fuel Flow	Wf	pph		106.0	116.0
14.6	Fuel Flow - Increasing Pt2	Wf	pph	WF_17	216.0	226.0
14.7	Fuel Flow - Decreasing Pt2	Wf	pph	WF_18	UNAVAILABLE	UNAVAILABLE
14.8	Pt2 Hysteresis	=WF_17-WF_18			-4.0	4.0
15.0	LEVER SHAFT TORQUE	PLT	lb_in		0	7
16.0	LEVER SHAFT TORQUE	USGT	lb_in		0	10
17.0	POWER LEVER ANGULAR TRAVELS					
17.1	Flight Idle Max	PL	deg		43	45
17.2	Flight Idle Min	PL	deg		35	37
17.3	Max Power Min	PL	deg		93	97
17.4	Power Lever Max Stop	PL	deg		101	102
17.5	Power Lever Ground Idle (Min Point)	PL	deg		0	0

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18.0	MAX FUEL FLOW LIMIT	Wf	pph		545.0	555.0
19.0	MAX POWER ADJUSTMENT CHECK					
19.1	Max. Power Adjustment	Wf	pph	WF_19	315.0	325.0
19.2	Max. Power Adjustment Upward	Wf	pph		UNAVAILABLE	725.0
19.3	Max. Power Adjustment Downward	Wf	pph		50.0	UNAVAILABLE
20.0	FINAL SPECIFIC GRAVITY ADJUSTER SETTING	SpGr Adj				
21.0	T2 Linkage Check	T2 Link	inches		0.890	1.000

AUDIT SCHEDULE

2.1	USG Min	USG	deg	1	6
2.2	USG Max	USG	deg	39	41
2.3	PL Min	PL	deg	0	0
2.4	PL Max	PL	deg	101	102
3.1	Standard Accel	Wf	pph	44.0	48.0
3.10	Standard Accel	Wf	pph	437.0	473.0
5.3	30,000 Foot Accel	Wf	pph	199.0	215.0
6.4	Hot Day Accel	Wf	pph	455.0	493.0
8.2	Underspeed Governor 65% Speed	Wf	pph	103.0	113.0
9.2	Underspeed Governor 96.0% Speed	Wf	pph	175.0	185.0
10.3	Overspeed Governor - Increasing Speed	Wf	pph	210.0	230.0
11.1	Decel Schedule	Wf	pph	145.0	159.0
11.2	Decel Schedule	Wf	pph	86.0	100.0
12.2	Power Lever Schedule - Increasing Tt2	Wf	pph	525.0	545.0
12.7	Power Lever Schedule - Increasing Tt2	Wf	pph	180.0	190.0
13.1	Fuel Flow - Standard Day	Wf	pph	315.0	325.0
13.2	Fuel Flow - Hot Day	Wf	pph	UNAVAILABLE	UNAVAILABLE
13.3	Delta Flow	=WF_20-WF_21		22.0	52.0
13.4	Fuel Flow - Cold Day	Wf	pph	UNAVAILABLE	UNAVAILABLE
13.5	Delta Flow	=WF_22-WF_20		104.0	134.0
14.1	Fuel Flow	Wf	pph	154.0	166.0
17.1	Flight Idle Max	PL	deg	43	45
18.0	MAX FUEL FLOW LIMIT	Wf	pph	545.0	555.0
20.0	FINAL SPECIFIC GRAVITY ADJUSTER SETTING	SpGr Adj			
21.0	T2 Linkage Check	T2 Link	inches	0.890	1.000
22.0	OVERSPEED LOW FLOW CHECK	Wf	pph	160.0	200.0

The following criteria were used to run this report:

Serial No: 1451780
Run Number: 4
Status: A
Run Type: AR
Order By: 1

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* End of IMTPC *
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3/27/2014

WOODWARD GOVERNOR COMPANY
ROCKFORD, IL
CAGE 66503

TSP-8858
ECL: B
PAGE : 1 OF 1

Desc: TSP - HONEYWELL TPE331 FCU ACCEPTANCE TEST
Date: 27-MAR-2014
IMTPC - TEST SPECIFICATION RESULTS PRINT REPORT

Serial No: 1451780 Run No: 5 Work Order: 9239524 Item No: 8070-604
Current Status: A Run Status: F Test Type: AR Test Date: 15-JAN-2014

Test Point		Record	Units	Formula Tag	Min	Value	Max	Pass Fail
1.0	CASE SERIAL NUMBER	Case SN				3055		P
2.0	USG AND PL MIN AND MAX SETTINGS							
2.1	USG Min	USG	deg	USG_MIN	1	4	6	P
2.2	USG Max	USG	deg	USG_MAX	39	40	41	P
2.3	PL Min	PL	deg	PL_MIN	0	0	0	P
2.4	PL Max	PL	deg	PL_MAX	101	101	102	P
3.0	STANDARD ACCELERATION SCHEDULE							
3.1	Standard Accel	Wf	pph		44.0	37.0	48.0	FAIL
3.2	Standard Accel - Sea level start flow.	Wf	pph		44.0	36.0	48.0	FAIL
3.3	Standard Accel	Wf	pph		110.0	112.0	120.0	P
3.4	Standard Accel	Wf	pph		195.0	205.0	211.0	P
3.5	Standard Accel	Wf	pph		260.0	268.0	282.0	P
3.6	Standard Accel							
3.6.1	Standard Accel	Wf	pph	WF_1	306.0	322.0	332.0	P
3.6.2	Standard Accel	Wf	pph	WF_2	317.0 (Calc)	322.0	327.0 (Calc)	P
3.7	Standard Accel Hysteresis	=WF_1-WF_2			-5.0	0.0	5.0	P
3.8	Standard Accel							
3.8.1	Standard Accel	Wf	pph	WF_3	392.0	387.0	424.0	FAIL
3.8.2	Standard Accel	Wf	pph	WF_4	377.0 (Calc)	388.0	397.0 (Calc)	P
3.9	Standard Accel Hysteresis	=WF_3-WF_4			-10.0	-1.0	10.0	P
3.10	Standard Accel	Wf	pph		437.0	430.0	473.0	FAIL
3.11	Standard Accel	Wf	pph		543.0	518.0	589.0	FAIL
4.0	15,000 FOOT ACCEL SCHEDULE							
4.1	15,000 Foot Accel	Wf	pph		40.0	37.0	52.0	FAIL
4.2	15,000 Foot Accel	Wf	pph		117.0	127.0	127.0	P
4.3	15,000 Foot Accel	Wf	pph		195.0	207.0	211.0	P
4.4	15,000 Foot Accel	Wf	pph		250.0	250.0	270.0	P
4.5	15,000 Foot Accel	Wf	pph		325.0	325.0	353.0	P
5.0	30,000 FOOT ACCEL SCHEDULE							
5.1	30,000 Foot Accel	Wf	pph		87.0	101.0	95.0	FAIL
5.2	30,000 Foot Accel	Wf	pph		113.0	120.0	123.0	P
5.3	30,000 Foot Accel	Wf	pph		199.0	191.0	215.0	FAIL
6.0	HOT DAY ACCEL SCHEDULE							
6.1	Hot Day Accel	Wf	pph		42.0	37.0	54.0	FAIL
6.2	Hot Day Accel	Wf	pph		206.0	217.0	224.0	P
6.3	Hot Day Accel	Wf	pph		319.0	337.0	345.0	P
6.4	Hot Day Accel	Wf	pph		455.0	448.0	493.0	FAIL
7.0	COLD DAY ACCEL SCHEDULE							
7.1	Cold Day Accel	Wf	pph		38.0	34.0	50.0	FAIL
7.2	Cold Day Accel	Wf	pph		174.0	174.0	188.0	P
7.3	Cold Day Accel	Wf	pph		269.0	277.0	291.0	P
7.4	Cold Day Accel	Wf	pph		402.0	393.0	436.0	FAIL
7.5	Cold Day Accel	Wf	pph		531.0	504.0	575.0	FAIL
8.0	UNDERSPEED GOVERNOR 65% SPEED							
8.1	Underspeed Governor 65% Speed	Wf	pph		160.0	187.0	725.0	P
8.2	Underspeed Governor 65% Speed	Wf	pph	WF_5	103.0	133.0	113.0	FAIL
8.3	Underspeed Governor 65% Speed	Wf	pph	WF_24	50.0	114.0	128.0 (Calc)	P

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8.4	Underspeed Governor 65% Speed	Wf	pph		125.0 (Calc)	134.0	141.0 (Calc)	P
9.0	UNDERSPEED GOVERNOR 96.0% SPEED							
9.1	Underspeed Governor 96.0% Speed	Wf	pph		252.0	299.0	725.0	P
9.2	Underspeed Governor 96.0% Speed	Wf	pph	WF_6	175.0	216.0	185.0	FAIL
9.3	Underspeed Governor 96.0% Speed	Wf	pph		50.0	128.0	211.0 (Calc)	P
9.4	Underspeed Governor 96.0% Speed	Wf	pph		206.0 (Calc)	217.0	226.0 (Calc)	P
9.5	Underspeed Governor 75.0% Speed	USG	deg		13	13	15	P
10.0	OVERSPEED GOVERNOR							
10.1	Overspeed Governor - Initial Speed	Wf	pph	WF_7	50.0	525.0	725.0	P
10.2	Overspeed Governor - Final Speed	Wf	pph	WF_23	513.0 (Calc)	516.0	537.0 (Calc)	P
10.3	Overspeed Governor - Increasing Speed	Wf	pph	WF_8	210.0	167.0	230.0	FAIL
10.4	Overspeed Governor	Wf	pph		104.0	83.0	114.0	FAIL
10.5	Overspeed Governor - Decreasing Speed	Wf	pph	WF_9	157.0 (Calc)	171.0	177.0 (Calc)	P
11.0	DECEL SCHEDULE							
11.1	Decel Schedule	Wf	pph		145.0	143.0	159.0	FAIL
11.2	Decel Schedule	Wf	pph		86.0	85.0	100.0	FAIL
11.3	Decel Schedule	Wf	pph		66.0	67.0	80.0	P
12.0	POWER LEVER SCHEDULE - TT2 CORRECTION							
12.1	Power Lever Schedule	Wf	pph	WF_12	463.0	529.0	483.0	FAIL
12.2	Power Lever Schedule - Increasing Tt2	Wf	pph	WF_10	525.0	528.0	545.0	P
12.3	Power Lever Schedule - Decreasing Tt2	Wf	pph	WF_11	514.0 (Calc)	527.0	542.0 (Calc)	P
12.4	Tt2 Hysteresis	=WF_10-WF_11			-14.0	1.0	14.0	P
12.5	Power Lever Schedule	Wf	pph		612.0 (Calc)	530.0	628.0 (Calc)	FAIL
12.6	Power Lever Schedule	Wf	pph		171.0	205.0	181.0	FAIL
12.7	Power Lever Schedule - Increasing Tt2	Wf	pph	WF_13	180.0	221.0	190.0	FAIL
12.8	Power Lever Schedule - Decreasing Tt2	Wf	pph	WF_14	217.0 (Calc)	226.0	225.0 (Calc)	FAIL
12.9	Tt2 Hysteresis	=WF_13-WF_14			-4.0	-5.0	4.0	FAIL
12.10	Power Lever Schedule	Wf	pph		199.0	263.0	219.0	FAIL
13.0	POWER LEVER SCHEDULE - Tt2 CORRECTION - 10,000 ft.							
13.1	Fuel Flow - Standard Day	Wf	pph	WF_20	315.0	429.0	325.0	FAIL
13.2	Fuel Flow - Hot Day	Wf	pph	WF_21	377.0 (Calc)	381.0	407.0 (Calc)	P
13.3	Delta Flow	=WF_20-WF_21			22.0	48.0	52.0	P
13.4	Fuel Flow - Cold Day	Wf	pph	WF_22	533.0 (Calc)	447.0	563.0 (Calc)	FAIL
13.5	Delta Flow	=WF_22-WF_20			104.0	18.0	134.0	FAIL
14.0	POWER LEVER SCHEDULE - PT2 CORRECTION							
14.1	Fuel Flow	Wf	pph		154.0	192.0	166.0	FAIL
14.2	Fuel Flow - Increasing Pt2	Wf	pph	WF_15	568.0	318.0	596.0	FAIL
14.3	Fuel Flow - Decreasing Pt2	Wf	pph	WF_16	308.0 (Calc)	318.0	328.0 (Calc)	P
14.4	Pt2 Hysteresis	=WF_15-WF_16			-10.0	0.0	10.0	P
14.5	Fuel Flow	Wf	pph		106.0	141.0	116.0	FAIL
14.6	Fuel Flow - Increasing Pt2	Wf	pph	WF_17	216.0	259.0	226.0	FAIL
14.7	Fuel Flow - Decreasing Pt2	Wf	pph	WF_18	255.0 (Calc)	259.0	263.0 (Calc)	P
14.8	Pt2 Hysteresis	=WF_17-WF_18			-4.0	0.0	4.0	P
15.0	LEVER SHAFT TORQUE	PLT	lb_in		0	3	7	P
16.0	LEVER SHAFT TORQUE	USGT	lb_in		0	6	10	P
17.0	POWER LEVER ANGULAR TRAVELS							
17.1	Flight Idle Max	PL	deg		43	45	45	P
17.2	Flight Idle Min	PL	deg		35	37	37	P
17.3	Max Power Min	PL	deg		93	96	97	P
17.4	Power Lever Max Stop	PL	deg		101	102	102	P
17.5	Power Lever Ground Idle (Min Point)	PL	deg		0	2	0	FAIL

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18.0	MAX FUEL FLOW LIMIT	Wf	pph	545.0	528.0	555.0	FAIL
19.0	MAX POWER ADJUSTMENT CHECK						
19.1	Max. Power Adjustment	Wf	pph WF_19	315.0	Skip	325.0	S
19.2	Max. Power Adjustment Upward	Wf	pph	UNAVAILABLE	Skip	725.0	S
19.3	Max. Power Adjustment Downward	Wf	pph	50.0	Skip	UNAVAILABLE	S
20.0	FINAL SPECIFIC GRAVITY ADJUSTER SETTING	SpGr Adj			PASS		P
21.0	T2 Linkage Check	T2 Link	inches	0.890	0.980	1.000	P

AUDIT SCHEDULE

2.1	USG Min	USG	deg	1	6
2.2	USG Max	USG	deg	39	41
2.3	PL Min	PL	deg	0	0
2.4	PL Max	PL	deg	101	102
3.1	Standard Accel	Wf	pph	44.0	48.0
3.10	Standard Accel	Wf	pph	437.0	473.0
5.3	30,000 Foot Accel	Wf	pph	199.0	215.0
6.4	Hot Day Accel	Wf	pph	455.0	493.0
8.2	Underspeed Governor 65% Speed	Wf	pph	103.0	113.0
9.2	Underspeed Governor 96.0% Speed	Wf	pph	175.0	185.0
10.3	Overspeed Governor - Increasing Speed	Wf	pph	210.0	230.0
11.1	Decel Schedule	Wf	pph	145.0	159.0
11.2	Decel Schedule	Wf	pph	86.0	100.0
12.2	Power Lever Schedule - Increasing Tt2	Wf	pph	525.0	545.0
12.7	Power Lever Schedule - Increasing Tt2	Wf	pph	180.0	190.0
13.1	Fuel Flow - Standard Day	Wf	pph	315.0	325.0
13.2	Fuel Flow - Hot Day	Wf	pph	377.0 (Calc)	407.0 (Calc)
13.3	Delta Flow	=WF_20-WF_21		22.0	52.0
13.4	Fuel Flow - Cold Day	Wf	pph	533.0 (Calc)	563.0 (Calc)
13.5	Delta Flow	=WF_22-WF_20		104.0	134.0
14.1	Fuel Flow	Wf	pph	154.0	166.0
17.1	Flight Idle Max	PL	deg	43	45
18.0	MAX FUEL FLOW LIMIT	Wf	pph	545.0	555.0
20.0	FINAL SPECIFIC GRAVITY ADJUSTER SETTING	SpGr Adj			
21.0	T2 Linkage Check	T2 Link	inches	0.890	1.000
22.0	OVERSPEED LOW FLOW CHECK	Wf	pph	160.0 165.5	200.0 P

The following criteria were used to run this report:
Serial No: 1451780
Run Number: 5
Status: A
Run Type: AR
Order By: 1

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* End of IMTPC *
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[redacted]

3/27/2014

ROOT CAUSE (D4)

Investigation Type: Product Return
General Cause: No Cause Found
Cause: Cause Not Isolated or Determined

CORRECTIVE ACTION IMPLEMENTATION (D6)

Corrective Action Status: NO ACTION