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(71) Applicant (for all designated States except US): **SIKO-RSKY AIRCRAFT CORPORATION** [US/US]; 6900 Main Street, P.O. Box 9729, Stratford, CT 06615-9129 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **SUTTON, Charles, C.** [US/US]; 16 Beechtree Lane, Monroe, CT 06487 (US). **STATHIS, George, L.** [US/US]; 136 Bender Road, Hamden, CT 06518 (US). **HARRINGTON, Daniel, F.** [US/US]; 111 Jockey Hollow Rd., Monroe, CT 06468 (US).(74) Agent: **WISZ, David, L.**; 400 West Maple Road, Suite 350, Birmingham, MI 48009 (US).

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(54) Title: RELIABILITY ESTIMATION METHODOLOGY FOR PERFORMANCE BASED LOGISTICS

Quarterly Data

Slope 14.4000

			I-LEVEL BCM RATE					
			All Failures			I-Level BCM Failures		
Quarters	SAC Upper Limit	MA-total number of maintenance actions I level+beyond I level	I-LEVEL BCM-beyond caple maintenance (depot)	FH	MFHBF	F/100000 FH	MFHBF	F/100000 FH
FY104	979.75	220	213	26349.30	119.77	834.94	123.71	808.37
FY204	979.75	192	186	31340.40	163.23	612.63	168.50	593.48
FY304	979.75	316	311	25958.10	82.15	1217.35	83.47	1198.08
FY404	979.75	277	272	33040.50	119.28	838.37	121.47	823.23
FY105	979.75	210	189	29467.90	140.32	712.64	155.91	641.38
FY205	979.75	225	190	34074.20	151.44	660.32	179.34	557.61
FY305	979.75	290	264	32068.20	110.58	904.32	121.47	823.25
FY405	979.75	282	237	31640.30	112.20	891.27	133.50	749.04
2012			1862	243938.90	121.24	824.80	131.01	763.31

(57) Abstract: A method of reliability estimation to track component performance within a population that has an inconsistent number of installations through a moving average of a predetermined time period such as four quarters which is plotted relative to a MAX removal rate upper limit. If the moving average exceeds the MAX removal rate upper limit, then a recovery plan with Proposed Corrective Actions may then be implemented.

RELIABILITY ESTIMATION METHODOLOGY FOR PERFORMANCE BASED LOGISTICS

BACKGROUND OF THE INVENTION

5 This invention was made with government support under Contract No.:
N00383-04-D-028N, awarded by the United States Navy. The government therefore
has certain rights in this invention.

 The present invention relates to a component reliability method and more
particularly to a method used to track reliability of a component which is utilized in
10 a multiple of locations in a multiple of systems within a fleet of systems to
determine non-reliable components.

 Currently, information pertaining to a component removal or failure that
caused an unscheduled maintenance event is tracked versus time of operation of the
system within which the component is installed. However, this is only valid when
15 there is a direct correlation between system and component operating time.
Oftentimes, a multiple of components may be utilized in a number of different
locations within a varying number of systems such that the total component
operating time is actually a multiple of system operating time. Thus, using the above
method, the down-time of the system could be attributed to the failure of a single
20 component as if only one of the components were installed in the system. Such
conventional tracking methodology may improperly calculate the reliability of the
component.

 Accordingly, it is desirable to provide a reliability estimation system to track
component performance within a population that has an inconsistent (varying)
25 number of installations to facilitate failure analysis over a fleet of systems.

SUMMARY OF THE INVENTION

 A method of reliability estimation to track component performance within a
population that has an inconsistent number of installations according to the present
30 invention determines a reliability metric through a moving average of a
predetermined time period such as four quarters which is plotted relative to a MAX

metric upper limit. If the moving average exceeds the MAX upper limit, then a recovery plan with Proposed Corrective Actions may then be implemented.

The present invention therefore provides a reliability estimation system to track component performance within a population that has an inconsistent (varying)
5 number of installations to facilitate monitoring of fleet performance.

BRIEF DESCRIPTION OF THE DRAWINGS

The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently
10 preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows:

Figure 1 is a chart of reliability trend data;

Figure 2 is a graph of reliability trend data;

Figure 3 is a chart of an example: Inlet Assembly utilized in a multiple of
15 locations on a multiple of aircraft which define a fleet of aircraft; and

Figure 4 is a chart of maintenance performed with regard to the example Inlet Assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 provides a chart of reliability trend data (graphically represented in
20 Figure 2) for a component which is utilized on a fleet of aircraft. Typically, the component is utilized in a multiple of locations on a multiple of aircraft models which define the fleet of aircraft (Figure 3). It should be understood that although aircraft are utilized herein as the system which defines a fleet, it should be
25 understood that any system which utilizes components in which reliability concerns need be tracked to assure availability of the systems will likewise benefit from the present invention. In the disclosed embodiment, an Inlet Assembly is the example component. The Inlet Assembly is utilized on many aircraft models such that the number installed is dependant upon the specific aircraft model.(Figure 3).

30 The measure of reliability is defined as "repairs" per 100,000 Flight Hours at the Intermediate Maintenance Level... Reliability is preferably tracked by Family in

which a Family is defined as all National Item Identification Numbers (NIIN) with the same Family Group Code (FGC). NIIN's with no FGC ("Bachelors") are treated as a single NIIN Family. Removals are preferably computed based on particular Intermediate level maintenance Action Taken Codes (ATC; Appendix); however, any consistent definition will likewise be usable. For a maintenance action to be counted as a "removal" in the disclosed embodiment, the ATC must be B, C, Z, or 1 through 9. Typically, there are three levels of maintenance:

1. Organizational level (standard maintenance);
2. Intermediate level (the component was removed from the aircraft and required repair); and.

3. Intermediate level BCM (Beyond Capable Maintenance), Also known as. Depot level - the component was removed from the aircraft and could/should not be repaired at the Intermediate Maintenance Level. (E.g. Component repaired at the Original Equipment Supplier.)

Tracking of Intermediate level (I-Level) and Intermediate level BCM (I-Level BCM) is preferred as such levels typically result in the component being considered "failed" under such Action Taken Codes. A consistent definition of "failure" for Performance Based Logistics (PBL) purposes is necessary for the determination of a component reliability metric. That is, failure rate is essentially the inverse of reliability but "high time" removals (successful components at scheduled removals) may be classified as "failures." Determination of "true reliability" may alternatively be considered and measured as a "contract metric" should such "high time" removals be included in the definition. In either case, a method for determining the expected demand rate of PBL components needs to be defined (see Appendix - "End Item Demand Estimation for Performance Based Logistics (PBL)"). More specifically, the Appendix also defines the time period in which the "failure" is to be counted and that Action Taken Codes 1-9, B, C, & Z are herein preferably defined as "failures."

The reliability metric is the sum of all component removals (including family members) over a predetermined time period such as the most recent nine quarters, per 100,000 flying hours. The reliability metric is generally utilized as a ceiling to prevent component demand from outstripping what is required by the fleet. The

reliability metric is computed using the sum of past Intermediate level maintenance actions divided by the applicable aircraft flight hours. The basic formula to be used is (as represented by the "Upper Limit" line in Figure 2):

$$[(\text{Sum of I-Level Actions}) / (\text{Aircraft Flight Hours})] \times [100,000]$$

5 Referring to Figure 2, the "reliability" trend chart includes the MAX removal rate upper limit, which may also be referred to as the "Reliability Baseline." The MAX removal rate for each NIIN / Family Group identified is determined from historical data (Figure 4) collected from each aircraft in the fleet. The MAX removal rate upper limit is fixed but may be adjusted for subsequent data submittals
10 by projecting it on a slope established by the linear regression of the quarterly data trend line. That is, the MAX removal rate upper limit may not be horizontal but may alternatively have a slope. An exception is those NIIN's / FGC's (typical of electronic components) that do not have a sufficient number of removals recorded during the stated time period to create a valid regression equation.

15 The MAX removal rate upper limit is based upon the component historical MFHBR +1 standard deviation. The regression equation may be adjusted (at the Y-intercept +/- one standard deviation of the previous 27-month MFHBR data.)

Reliability as novelly determined herein is tracked through a moving average over a predetermined time period such as four quarters which is plotted relative to
20 the MAX removal rate upper limit. The "all failures" line provides tracking of component reliability when compared to the MAX removal rate upper limit to provide a reliability estimation system to track component performance within a fleet that has an inconsistent (varying) number of installations to facilitate failure analysis. If the "4 quarters moving average (All Failures) line exceeds the MAX
25 removal rate upper limit, then a recovery plan with Proposed Corrective Actions may then be implemented.

Separate tracking of just the Intermediate level BCM further defines severity. That is, the closer the Intermediate level BCM line is to the "All Failures" line, further attention will be drawn to the tracked component.

30 Although particular step sequences are shown, described, and claimed, it should be understood that steps may be performed in any order, separated or

combined unless otherwise indicated and will still benefit from the present invention.

The foregoing description is exemplary rather than defined by the limitations within. Many modifications and variations of the present invention are possible in
5 light of the above teachings. The preferred embodiments of this invention have been disclosed, however, one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. For that reason the following
10 claims should be studied to determine the true scope and content of this invention.

RELIABILITY DEFINITIONS

- NIIN** - National Item Identification Number.
- Nomenclature** - Description of the NIIN.
- 5 **Component** - Initial identification of the grouping to which the NIIN belongs.
- COG** - Cognizant code.
- FGC** - Family Group Code.
- FRC** - Family Relationship Code.
- 10 **AAC** - Acquisition Advice Code.
- WUC** - Work Unit Code with the highest frequency.
- CAGE** - Manufacturing Identification Code.
- Part #** - Part number with the highest frequency.
- Flt Hrs** - Sum of the flight hours. This sample report incorporated the
- 15 sum of the flight hours for the Type/Model/Series (TMS) on which a failure was counted. (The final report will incorporate the flight hours for all TMS on which the NIIN was installed as determined by the government.)
- MFHBR** - Mean Flight Hours Between Removals. The value is computed from the product of the average Unit Per Application (UPA) times the
- 20 flight hours divided by the number of failures.
- MA** - Number of maintenance actions reported at the I-level.
- Fail** - Number of failures reported on the above maintenance actions. A failure is defined as having the Action Taken Code (ATC) of 'B', 'C', 'Z', or '1 through 9'. SEE BELOW.
- 25 **BCM** - Number of actions reported at the I-level as being Beyond Capability of Maintenance.
- BCM9** - Number of actions reported with ATC of '9', (condemnation).
- UPA** - Average UPA for the NIIN for the TMS as computed from P2300 data.

- APPENDIX -

Action Taken Codes (from Volume III of OPNAVINST 4790.2H)

AT Codes 1 through 9 are restricted to those repairable items of material which have been administratively or technically screened and found to be non-repairable at an IMA (by designated I-level personnel authorized to make these determinations). In keeping with the philosophy of repair at the lowest practicable level, the IMA is authorized to perform any and all functions for which it has or can be granted authority and the capability to perform and meet performance specifications. If more than one BCM code applies, the code reflecting the most serious logistic support deficiency will be used.

BCM 1 - Repair Not Authorized. This code is entered only when the activity is specifically not authorized to repair the item in applicable directives, for example, required maintenance function not assigned by SM&R code, MIM, maintenance plan, other technical decision, peculiar item from an aircraft not supported by an activity, and SM&R coded XXXXD.

BCM 2 - Lack of Equipment, Tools, or Facilities. This code is entered when the repair is authorized but cannot be performed because of a lack of equipment, tools, or facilities, for example, required equipment is on IMRL but authorized quantity is zero, receipt of authorized IMRL equipment not expected within 30 days (zero quantity on hand), return of required equipment from repair or calibration not expected within 30 days, non-IMRL tools and equipment not on-hand, lack of permanently installed facilities, specifically directed by ACC/TYCOM.

BCM 3 - Lack of Technical Skills. This code is entered when repair is authorized but cannot be performed because of a lack of technical skills, for example, permanent billet will be vacant for more than 30 days; TAD billet will be vacant for more than 30 days; billet incumbent absent, for example, TAD or leave; formal technical training is nonexistent; formal technical training exists but cannot be used due to lack of quota or funds; rating, NEC, or MOS required is not reflected on manpower authorization; rating, NEC, or MOS is on board but billet not assigned to IMA.

BCM 4 - Lack of Parts. This code is entered when repair is authorized but cannot be performed because required parts will not be available within guidelines established by applicable directives.

5 BCM 5 - Fails Check and Test. This code is entered when the activity's authorized level of maintenance is limited to check and test only and repair is required.

10 BCM 6 - Lack of Technical Data. This code is entered when repair is authorized but cannot be performed because of a lack of technical data, for example, maintenance manuals or test program sets exist but cannot be obtained within 30 days, maintenance manuals or test program sets do not exist or cannot be identified within 30 days, applicable manuals or test program sets are available but do not provide adequate technical information.

15 BCM 7 - Beyond Authorized Repair Depth. This code is entered when some level of repair beyond check and test is authorized but the maintenance function required to return the item to a RFI condition is not assigned by SM&R code, MIMs, maintenance plan, or other technical decision.

20 BCM 8 - Administrative. This code is entered when repair is authorized and feasible but not attempted due to an EI exhibit, SRC data unknown and cannot be determined, item under warranty, excessive backlog, budgetary limitations, materials in excess of requirements, or specifically directed by the ACC/TYCOM. The determination to use BCM 8 for excessive backlog will be made jointly by the maintenance and supply officers. BCM 8 for materials in excess of requirements and budgetary limitations require ACC/TYCOM approval.

25 BCM 9 - Condemned. This code is entered when a repairable item is so severely worn or damaged that repair is not feasible, as determined by local maintenance personnel, or specifically directed by ACC/TYCOM. The item is locally condemned and returned to the Supply Department for survey, retrograde, or scrap (as appropriate) per applicable directives.

30 All codes listed below may be used for either on-equipment or off-equipment work unless otherwise noted.

A. Items of Repairable Material or Weapon/Support System Discrepancy Checked No Repair Required. This code is used for all discrepancies which are

checked and found that either the reported deficiency cannot be duplicated, or the equipment is operating within allowable tolerances. Adjustments may be made under this code if the purpose of the adjustment is to peak or optimize performance. When adjustments are made, the malfunction code should reflect the reason for the adjustment, for example, A-127, A-281, A-282. If the purpose of the adjustment is to bring the equipment within allowable tolerances, Action Taken Code C should be used, for example, C-127, C-281, C-282. Additionally, this code will be used on all MAF work requests for documenting local manufacture/fabrication.

B. Repair or replacement of items, such as attaching units, seals, gaskets, packing, tubing, hose, and fittings, that are not integral parts of work unit coded items or components. These parts are not identified by WUCs and are normally a connecting or attaching link between two or more components that do have WUCs assigned. Therefore, when items of this nature are repaired or replaced, this action taken code is used. In case of doubt regarding which component to identify, the WUC of the component serviced will be used.

C. Repair. This code is entered when a repairable item of material which is identified by WUC is repaired. Repair includes cleaning, disassembly, inspection, reassembly, lubrication, and replacement of integral parts; adjustments are included in this definition if the purpose of the adjustment is to bring the equipment within allowable tolerances (see Action Taken Code A). This code also applies to the correction of a discrepancy on a weapon/support system (when appropriate).

D. Work Stoppage, Post and Pre-deployment, and Inter-IMA Support. This code is entered to closeout MAF Copy 1 when component repair is to be performed at another facility.

F. Failure of Items Undergoing Check and Test. (Work Request and I-level Assisting Work Center MAFs only.)

J. Calibrated - No Adjustment Required. This code is used when an item is calibrated and found serviceable without need for adjustment. If the item requires adjustment to meet calibration standards, use code K. This code applies to PME only.

K. Calibrated - Adjustment Required. This code is used when an item must be adjusted to meet calibration standards. If the item needs repair in addition to

calibration and adjustment, use another code indicating the proper maintenance action. This code applies to PME only.

5 L. Work Stoppage - Awaiting Parts. This code is entered when a maintenance action must be stopped or delayed while awaiting parts which are not available locally and a component goes into an awaiting parts status. Use of this code is restricted to the I-level, no entries will be made in the (H-Z) Failed/Required Material block of the close out MAF.

10 N. Work In Progress - Close out. This code is entered by an organizational activity when it becomes necessary to close out a maintenance action during or at the end of a reporting period for any reason. This code will be entered by an IMA to close out for any reason except awaiting parts (see AT Code L).

P. Removed. This code is entered when an item of material is removed and only the removal is to be accounted for. In this instance delayed or additional actions are accounted for separately (see also codes R, S, and T).

15 Q. Installed. This code is entered when an item is installed and only the installation action is to be accounted for.

R. Remove and Replace. This code is entered when an item of material is removed due to a suspected malfunction and the same or a like item is reinstalled.

20 S. Remove and Reinstall. This code is entered when an item of material is removed to facilitate other maintenance and the same item is reinstalled. Action Taken Code S is limited to Malfunction Codes 800, 804, and 811.

T. Removed and Replaced for Cannibalization. This code is used when an item of material is removed and replaced as a cannibalization action.

25 Y. Troubleshooting. This code is used when the time expended in locating a discrepancy is great enough to warrant separating troubleshooting time from repair time. Use of this code necessitates completion of two separate documents, one for the troubleshooting phase and one for the repair phase. When recording the troubleshooting time separately from the repair time, the total time taken to isolate the primary cause of the discrepancy is recorded on a separate MAF, using the
30 system, subsystem, or assembly WUC (as appropriate).

Z. Corrosion Treatment. Includes cleaning, treatment, priming, and painting of corroded items that require no other repair. This code is always used when actually treating corroded items, either on equipment or in the shop.

- 5 0. The numeric 0 will be used in the Action Taken block on all source documents recording look phase man-hours for acceptance, transfer, special, conditional, major aircraft and combined airframe and engine special inspections; and corrosion, preservation, and depreservation including the close out of man-hours on the look phase of those inspections at the end of the reporting period.

CLAIMS

What is claimed is:

- 5 1. A method of reliability estimation to track component performance within a population that has an inconsistent number of installations comprising the steps of:
- (A) determining a MAX removal rate upper limit of a component;
- (B) comparing a moving average of a sum of failures for the component
10 over a predetermined time period to the MAX removal rate upper limit; and
- (C) identifying if the moving average exceeds the MAX removal rate upper limit.
- 15 2. A method as recited in claim 1, wherein said step (A) further comprises the step of:
- (a) summing a number of predefined failures;
- (b) dividing the number of predefined failures by flight hours; and
- (c) multiplying the result of step (b) by a predetermined time period.
- 20 3. A method as recited in claim 2, wherein said step (c) further comprises:
- (i) summing a number of component removals from a system within which the component is installed.
- 25 4. A method as recited in claim 3, wherein said step (i) further comprises:

- (1) classifying the removals according to severity of repair; and
- (2) summing only a removal of predetermined severity.

5. A method as recited in claim 2, wherein said step (c) further
5 comprises:

- (i) multiplying the result of step (b) by a 100,000 hours.

6. A method of reliability estimation to track component performance within a population that has an inconsistent number of installations comprising the steps of:

- (A) summing a number of predefined failures of a component;
- 5 (B) dividing the number of predefined failures by a predetermined number of flight hours;
- (C) multiplying the result of said step (B) by a predetermined time period to determine a MAX removal rate upper limit of a component;
- 10 (D) determining a sum of failures for the component over a predetermined time period;
- (E) determining a moving average from said step (D);
- (F) comparing the moving average to the MAX removal rate upper limit; and
- 15 (G) identifying if the moving average exceeds the MAX removal rate upper limit.

7. A method as recited in claim 6, wherein said step (B) further comprises:

- (i) multiplying the result of step (b) by a 100,000 hours.
- 20

8. A method as recited in claim 6, wherein said step (D) further comprises:

- (a) classifying the removals according to severity of repair; and
 - (b) summing only a removal of predetermined severity.
- 25

9. A method as recited in claim 6, wherein said step (D) further comprises:

(a) classifying the removals according to an action taken codes; and

(b) summing only a removal of the component when the system is
5 considered “down” under particular action taken codes.

Quarterly Data

Slope 14.4000

		I-LEVEL BCM RATE		I-Level BCM Failures	
		All Failures			
		MFHBF	F/100000 FH	MFHBF	F/100000 FH
		I-LEVEL BCM-beyond caple maintenance (depot)			
		FH			
		MA-total number of maintenance actions I level+beyond I level			
		SAC			
		Upper Limit			
Quarters					
FY104	979.75	220	26349.30	119.77	834.94
FY204	979.75	192	31340.40	163.23	612.63
FY304	979.75	316	25958.10	82.15	1217.35
FY404	979.75	277	33040.50	119.28	838.37
FY105	979.75	210	29467.90	140.32	712.64
FY205	979.75	225	34074.20	151.44	660.32
FY305	979.75	290	32068.20	110.58	904.32
FY405	979.75	282	31640.30	112.20	891.27
		2012	1862 243938.90	121.24	824.80
				131.01	763.31

FIG. 1

2/4

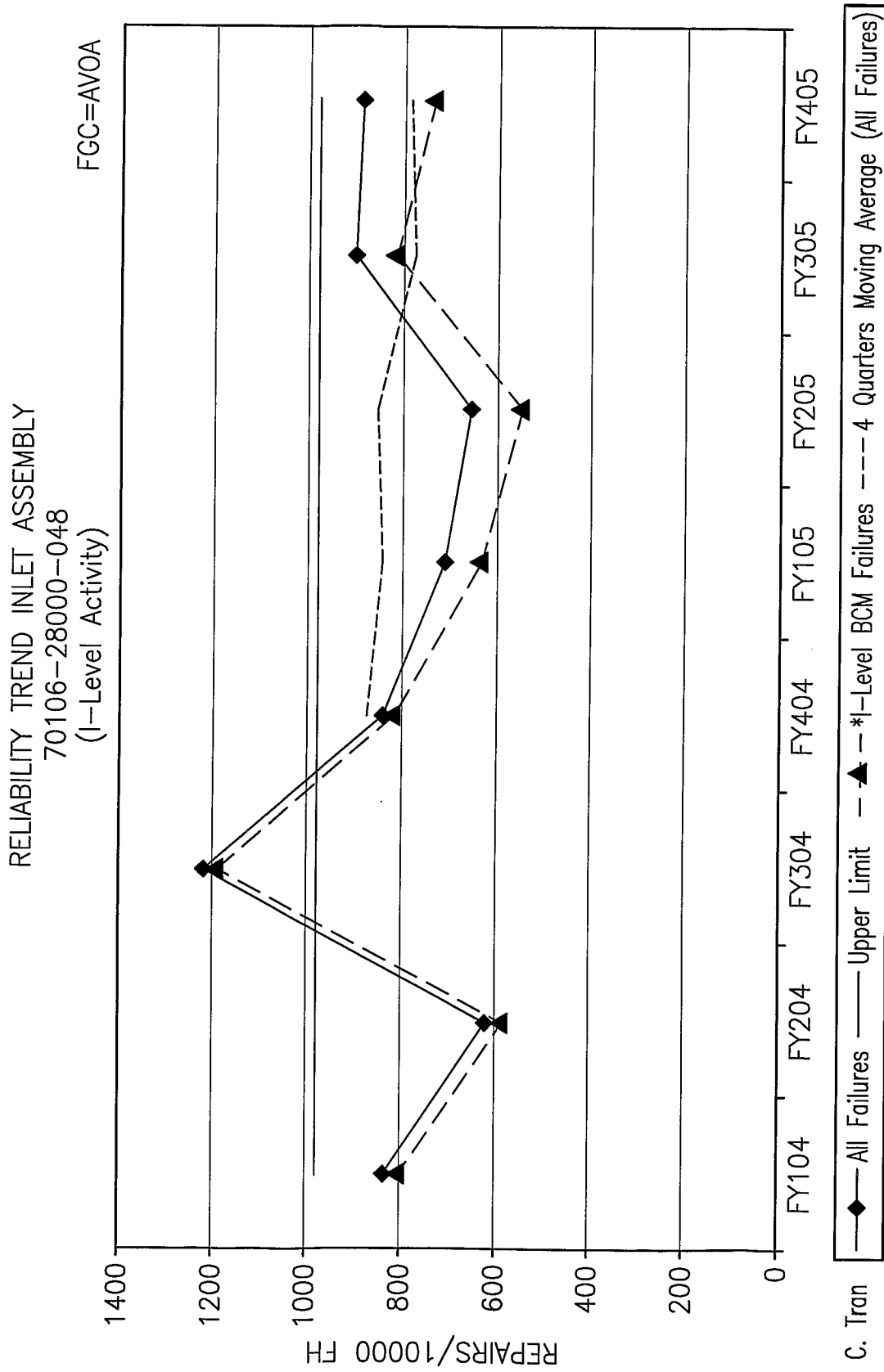


FIG. 2

3/4

**INLET ASSEMBLY
MTBUR**

FY104 Thru FY405				
Aircraft Model	QTY of Removals	Inlets/ Aircraft	Flight Hours	MTBUR
HH-60H	1	2	23,501	23,501
HH-60R	0	1	2,396	0
HH-60S	0	2	61,619	0
HH-60B	55	3	106,211	1,931
HH-60F	14	3	50,213	3,587
All Models	70		243,939	3,485

FIG. 3

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FY Quarters	Removed Part No.	Removed Part Serial No.	Completion Datetime	Maintenance Long Desc	Maintenance Code	Type Maintenance Code	Type Maintenance Desc	Maintenance Desc	Action Taken Desc	Action Taken Code	Usage Flight Hours	Removal Date	Malfunction Desc	When Discovered Desc	Maintenance Level	Organization Code	Work Unit Code	Work Unit Code Level	Work Unit Code Desc	Aircraft Model	Aircraft Serial Number
4FY104	70106-28000-448	AZ2102347	10/12/2003 10:09	WORN, STRIPPED, CHAFED, FRAYED - except electrical wiring	20	B	UNSCHEDULED MAINT	H-Level BCM	BCM-BEYOND REPAIR	7		10/12/2003	WORMSTRIPIC HAFFRAY	BTWN FLTS-GRND CREW	3	A9C	1513500	5	MAIN INlet ASSEMBLY	HH60H	165715
4FY104	70106-28000-448	AZ2104453	10/12/2003 11:30	LEAKING - internal or external	381	B	UNSCHEDULED MAINT	H-Level BCM	BCM-BEYOND REPAIR	7		9/28/2003	LEAKING	IN-FLIGHT - ABORT	3	P8R	1513500	5	ASSEMBLY	SH80B	162109
4FY104	70106-28000-448	AZ2101845	10/12/2003 12:00	NO DEFECT - removed and installed due to scheduled maintenance, modification, or flight time	804	B	UNSCHEDULED MAINT	H-Level BCM	BCM-BEYOND REPAIR	7		9/28/2003	NO DEF-MOD/HI TIME	ADMINISTRATIVE	3	P8R	1513500	5	ASSEMBLY	SH80B	163594
4FY104	70106-28000-448	AZ2102108	10/22/2003 4:00	WORN, STRIPPED, CHAFED, FRAYED - except electrical wiring	20	B	UNSCHEDULED MAINT	H-Level BCM	BCM-BEYOND REPAIR	7		10/22/2003	WORMSTRIPIC HAFFRAY	ADMINISTRATIVE	3	P8A	1513500	5	ASSEMBLY	MH60S	165756
4FY104	70106-28000-448	AZ2100864	10/22/2003 4:00	WORN, STRIPPED, CHAFED, FRAYED - except electrical wiring	20	B	UNSCHEDULED MAINT	H-Level BCM	BCM-BEYOND REPAIR	7		10/22/2003	WORMSTRIPIC HAFFRAY	ADMINISTRATIVE	3	P8A	1513500	5	ASSEMBLY	MH60S	165756
4FY104	70106-28000-448	AZ2100382	10/22/2003 4:30	WORN, STRIPPED, CHAFED, FRAYED - except electrical wiring	20	B	UNSCHEDULED MAINT	H-Level BCM	BCM-BEYOND REPAIR	7		10/22/2003	WORMSTRIPIC HAFFRAY	ADMINISTRATIVE	3	P8A	1513500	5	ASSEMBLY	MH60S	165756
4FY104	70106-28000-448	AZ2103150	10/22/2003 6:27	NO DEFECT - removed and installed due to scheduled maintenance, modification, or flight time	804	B	UNSCHEDULED MAINT	H-Level BCM	BCM-BEYOND REPAIR	7		10/22/2003	NO DEF-MOD/HI TIME	ADMINISTRATIVE	3	A9B	1513500	5	ASSEMBLY	MH60S	165764
4FY104	70106-28000-448	AZ2103143	10/22/2003 6:27	NO DEFECT - removed and installed due to scheduled maintenance, modification, or flight time	804	B	UNSCHEDULED MAINT	H-Level BCM	BCM-BEYOND REPAIR	7		10/22/2003	NO DEF-MOD/HI TIME	ADMINISTRATIVE	3	A9B	1513500	5	ASSEMBLY	MH60S	165764
4FY104	70106-28000-448	AZ2103145	10/22/2003 6:27	NO DEFECT - removed and installed due to scheduled maintenance, modification, or flight time	804	B	UNSCHEDULED MAINT	H-Level BCM	BCM-BEYOND REPAIR	7		10/22/2003	NO DEF-MOD/HI TIME	ADMINISTRATIVE	3	A9B	1513500	5	ASSEMBLY	MH60S	165764

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US06/30556

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **G01B 11/14**(2006.01)

USPC: 356/614;256/22;700/90

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 356/614; 256/22; 700/90

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7031941 B2 (GARROW et al.) 18 August 2006 (18.04.2006), Whole Document.	1
A	US 6,665,822 B1 (CONWAY) 16 December 2003 (14.12.2003), Whole Document.	2-9
A	US 2004/0254764 a1 (WETZER et al.) 16 December 2004 (16.12.2004), Whole Document.	2-9



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search

18 August 2007 (18.08.2007)

Date of mailing of the international search report

21 SEP 2007

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Facsimile No. (571) 273-3201

Authorized officer

Kidest Bahta

Jacqueline A. Whitfield

Telephone No. 571-272-3201 Special Project Asst.