DOCKET NO.: SA-515
EXHIBIT NO. 8J

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

JTSD-200 SERIES FAN HUB INDUSTRY MEETING

(92 PAGES)

JT8D-200 FAN HUB INDUSTRY MEETING AGENDA
BRADLEY SHERATON AUG. 22,1996

7:30	Registration, Coffee
8:00	Welcome, Opening Remarks, Purpose of Meeting
8:15	Background / History of Event
9:00	Results of Technical Investigation
10:00	Break
11:30	P&W Recommendations
12:00	Lunch
1:00	Discussion / Establishment of ATA Position
2:45	Break
4:30	Eddy Current Demonstration
5:00	Adjourn

TABLE OF CONTENTS

BACKGROUND / HISTORY OF EVENT

JT8D-219 FAN HUB FRACTURE
JULY 6,1996

- McDonnell Douglas MD-88 aircraft
- Uncontained fracture in No. 1 position engine during takeoff roll
- Takeoff was aborted
- Hub fractured into two pieces

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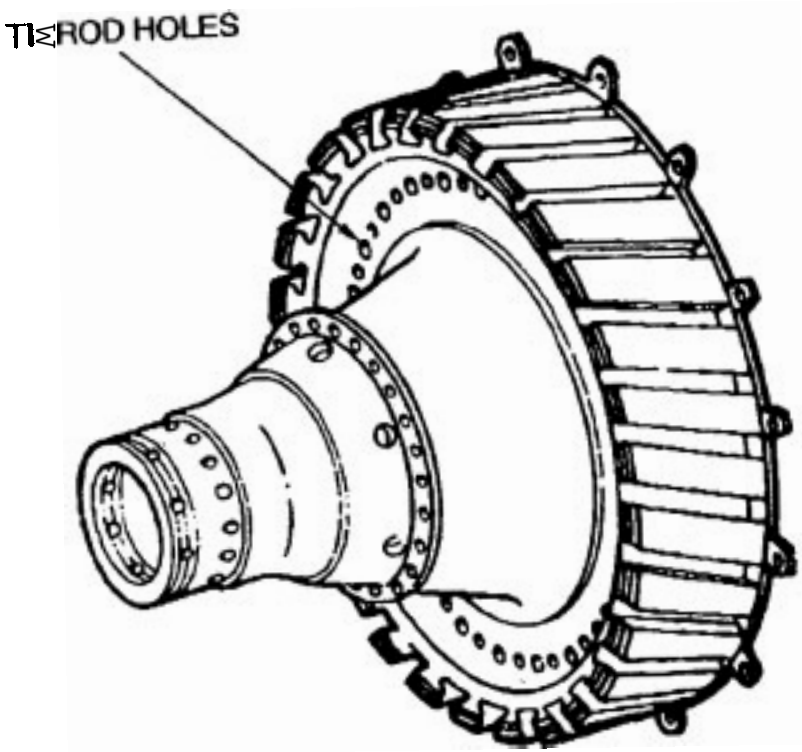
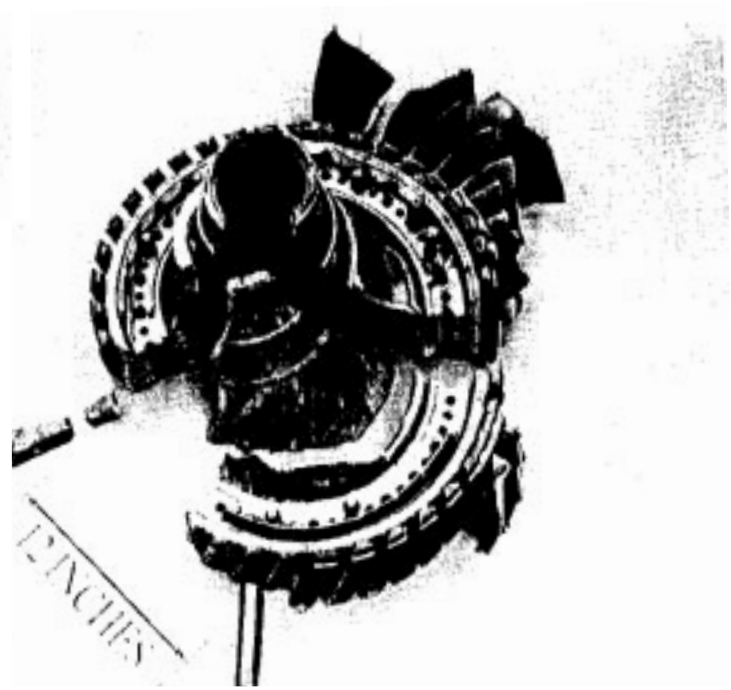
JT8D-219 FAN HUB FRACTURE
JULY 6,1996

- Multiple fan blade liberations
- Fan blades penetrated the fuselage
- Two fatalities
- Orderly evacuation

RESULTANT AIRCRAFT DAMAGE

JT8D-200 1ST STAGE FAN HUB





JT8D-200 FAN HUB SERVICE EXPERIENCE

- JT8D-200 certified in 1979
- McDonnell Douglas MD-80 aircraft
- 2,620 engines delivered
  - 47.4 Million hours of service
  - 32.5 Million cycles of service
  - Never a reported fan hub related problem
- No reports of any cracks in fan hubs

HISTORY OF FRACTURED HUB

- P/N 5000501-01, S/N R32971
- Manufactured June 1989 by Volvo Flygmotor in Trollhattan, Sweden

- Total Hours: 16,542
- Total Cycles: 13,835

HISTORY OF FRACTURED HUB (Continued)

- Delivered in engine P-725528 11/89

- Removed and Installed in engine P-725627 6/92
  - Total Hours: 5,020
  - Total Cycles: 4,456

HISTORY OF FRACTURED HUB (Continued)

- Removed from P-725627 9/95
  - Total Hours: 15,013
  - Total Cycles: 12,693
  - FPI and visual inspections performed
- Installed in engine P-726984 1/96
- Date of fracture 7/96
  - TSLSV: 1,529
  - CSLSV: 1,142

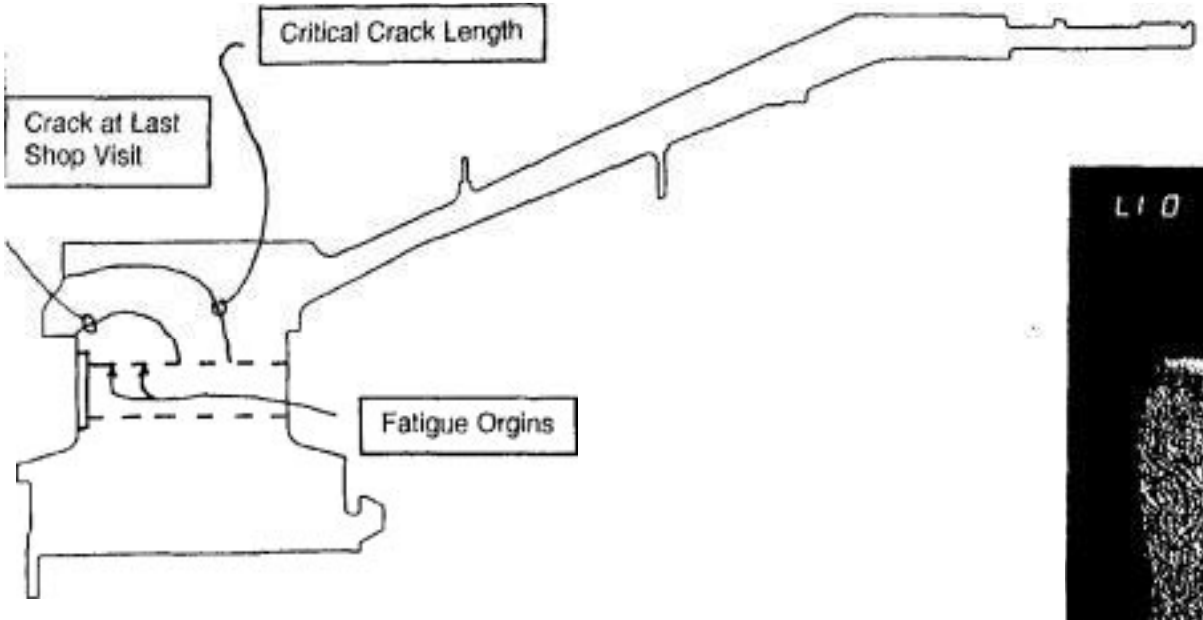
RESULTS OF
TECHNICAL INVESTIGATION

FRACTURED FAN HUB METALLURGICAL ANALYSIS

- Low cycle fatigue
- Originated from a localized area of work hardened / deformed material
  - Located 1/2 inch inboard of the aft face in the tierod hole
- Striation count shows crack had been present for 12,000 to 13,000 cycles

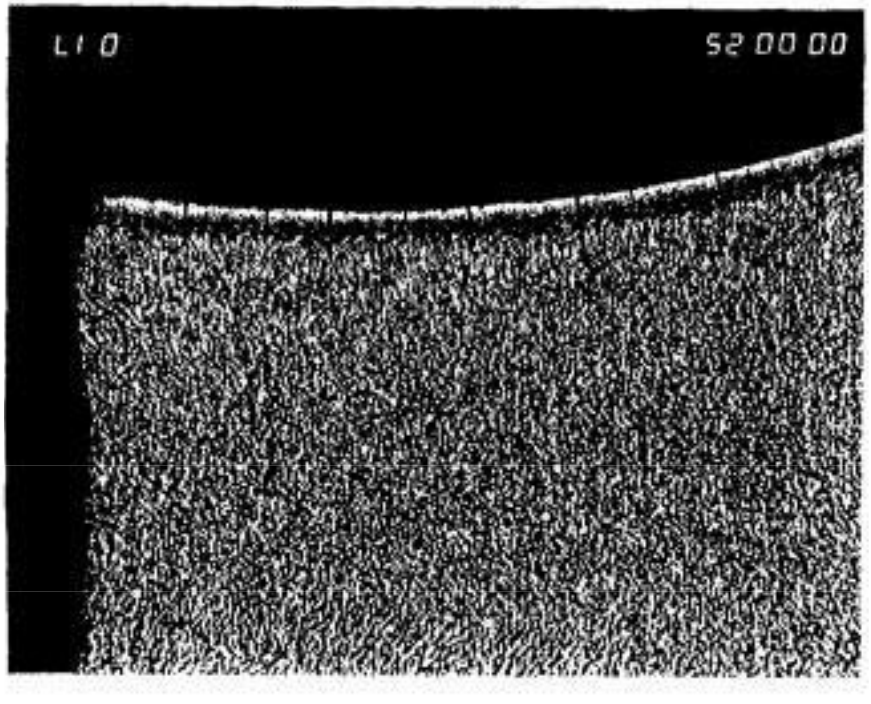
Revised Aug. 29, 1996

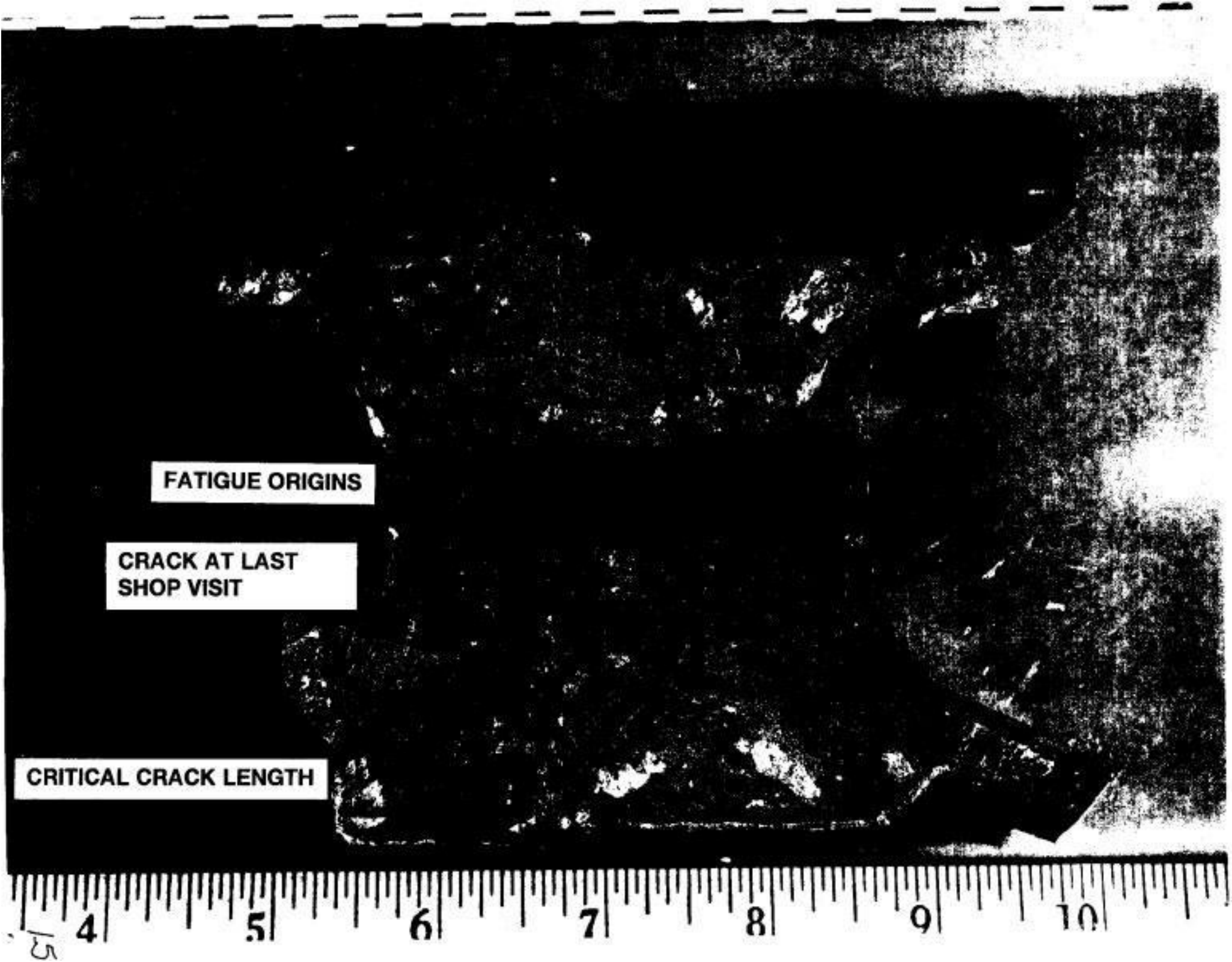
FRACTURED FAN HUB METALLURGICAL ANALYSIS



JT8D-200 FAN HUB CROSS SECTION

WORK HARDENED LAYER




FATIGUE ORIGINS
CRACK AT LAST SHOP VISIT
CRITICAL CRACK LENGTH
4
5
6
7
8
9
10

CRACK LENGTH AT LAST SHOP VISIT

- Hub was in the shop 9/95 and underwent a Fluorescent Penetrant Inspection
  - Total Time: 15,013
  - Total Cycles: 12,693
- Crack was approximately 0.9 inch along the length of the hole
- Crack had extended to aft side of the hub approximately 0.46 inch long

INITIAL P&W ACTION

- Review of fractured hub's manufacturing records
  - Unusual surface condition noted in tierod hole during Blue Etch Anodize (BEA) inspection

    Condition was considered acceptable
  - No other deviations were noted in tierod holes

BLUE ETCH ANODIZE (BEA)

- Part is etched in an acid salt solution
- Used to inspect for microstructure abnormalities such as grain separation and alpha case, forging laps
- A surface abnormality turns area a different shade of blue
- BEA is a required inspection in the manufacturing process

RESULTS OF INITIAL MANUFACTURING REVIEW

- Manufacturing records of all JT8D-200 fan hubs reviewed

Pratt & Whitney	91
Atlantic Machining	580
Volvo	2379
TOTAL	3050

RESULTS OF INITIAL MANUFACTURING REVIEW (continued)

- No indications were noted on the P&W or Atlantic hubs

- 8 Volvo hubs had inspection notations
  - 7 were noted during BEA inspection
  - 1 was noted during FPI inspection

RESULTS OF INITIAL MANUFACTURING REVIEW (continued)

- 2 of the 8 hubs had been scrapped at manufacturer

- Remaining 6 hubs were identified, located and immediately removed from service

P&W INVESTIGATION OF SUSPECT HUBS

- All **six** hubs received at P&W
- All hubs have been inspected:
  - Fluorescent Penetrant Inspection (FPI) - SPOP 84
  - Blue Etch Anodize (BEA)
  - Eddy Current Inspection (ECI)
- 5 of 6 hubs were sectioned for metallurgical analysis

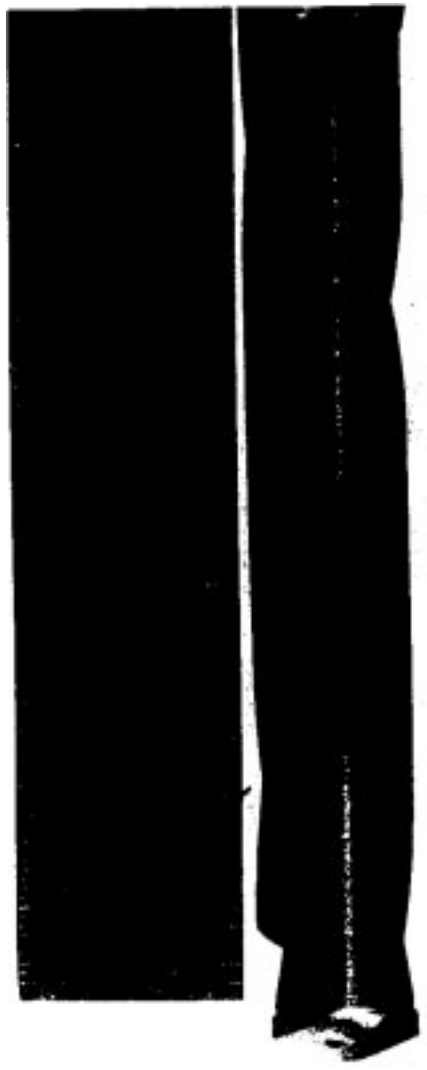
MANY AREAS WERE HIGHLIGHTED USING THREE INSPECTION TECHNIQUES

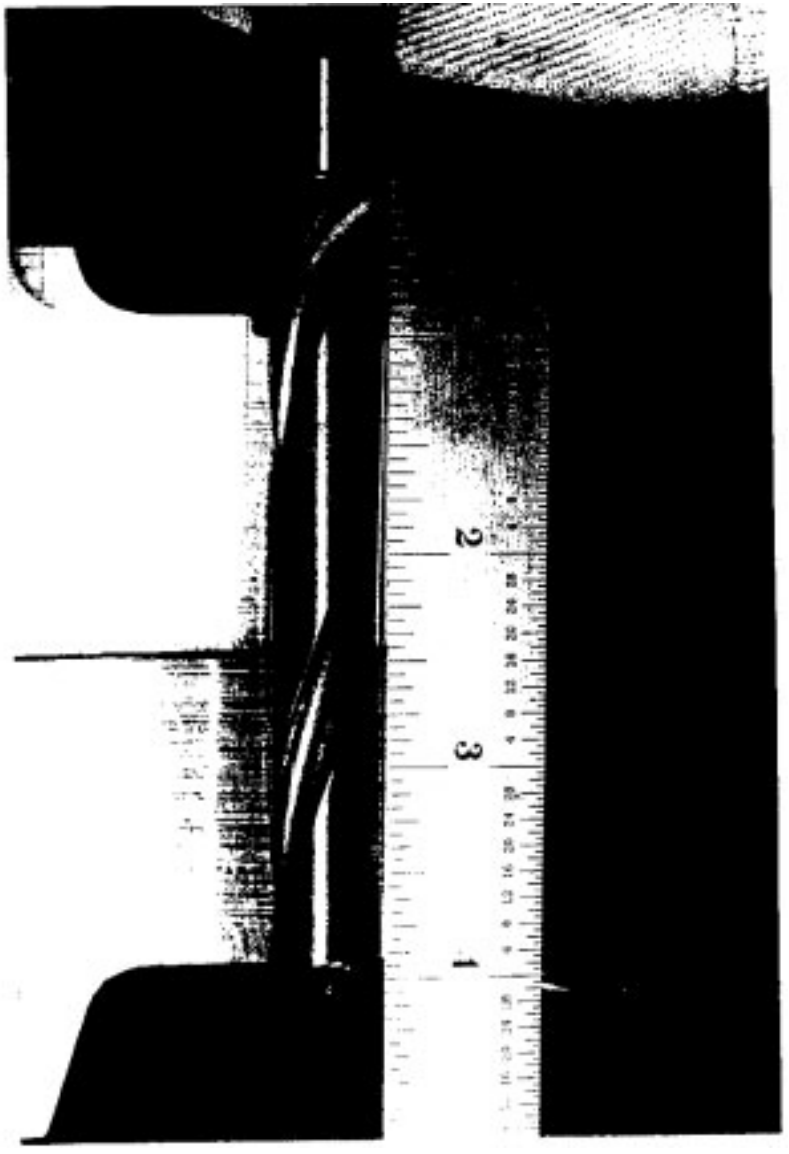
- Inspection indications were caused by service use
- Difficult to identify those marks noted during manufacturing inspection
- Metallurgical analysis performed on those indications considered to be most suspect
  - No cracks were present
  - No work hardened material was present

STATUS OF NINE SUSPECT HUBS

Serial Number	Total Hours	Total Cycles	Status	Inspection Results
T50827	9,615	7,807	Removed From Service	No cracks or work hardened material
R32926	18,789	15,988	Removed From Service	No cracks or work hardened material
R32960	17,348	14,593	Removed From Service	No cracks or work hardened material
T50823	5,374	2,595	Removed From Service	No cracks or work hardened material
T50693	10,766	6,181	Removed From Service	No cracks or work hardened material
P66756	10,806	5,959	Removed From Service	No cracks or work hardened material
R32971	16,542	13,835	Fractured Hub	***
T50574	0	0	Scrapped at Manufacturer	***
S25443	0	0	Scrapped at Manufacturer	***

COOLANT CHANNEL DRILL (COD)





IDENTIFICATION OF ROOT CAUSE OF WORK HARDENED MATERIAL

- Work hardened material was caused by a coolant channel drill (CCD)
  - CCD has holes which carry coolant to the tip of the drill
- CCD Timeline
  - First used 2/11/89 to 9/14/90
  - Reintroduced 2/26/91 to 3/31/91
- Total CCD population = 719 hubs

Revised Aua. 29,1996

COOLANT CHANNEL DRILL (CCD)

- CCD discontinued due to high incidence of tool burning, tool breaking, dimensional deviations, etc.
- CCD is a one-step plunge process
- Standard drill utilizes a multiple step procedure

PRATT & WHITNEY FAN HUB FLEET MANAGEMENT PROCESS

- Pratt & Whitney's procedure for developing inspection recommendations is based on the following:
  - Assign a risk management "hazard ratio" to the event
  - Define the suspect population
  - Model predicted number of future events
  - Develop a plan to ensure that the risk of any further event is consistent with the risk management hazard ratio

CONTINUED AIRWORTHINESS ASSESSMENT METHODOLOGY (CAAM)

CAAM HAZARD LEVEL DEFINITIONS

CAAM hazard levels are based on consequences to aircraft:

- Level 4: Severe consequences (fatalities, hull loss, forced landings)
- Level 3: Serious consequences (reduction in A/C capability - substantial damage, uncontrolled fires, rapid depressurization, loss of thrust greater than one engine)
- Level 2: Significant consequences (nicks, dents, and small penetrations in A/C primary structure, slow depressurization, controlled fires)
- Level 1: Minor consequences (uncontained nacelle damage, uncommanded power increase or decrease above v l and below 3000 feet altitude)

GOALS FOR CAAM LEVEL 3+4 EVENTS

- Level 3+4
  - Risk factor of 0.5 or less
- Level4
  - Risk factor of 0.1 or less
- Level 3+4 events per aircraft flight
  - 4×10^{-6} or less

RISK ANALYSIS

RISK ANALYSIS - INPUT / ASSUMPTIONS

- 1 fan hub fracture on 7/6/96 (TPT/TPC 16,542/13,835)
- Suspect population consists of hubs manufactured with coolant channel drill (719)
- Assume that only 2 hubs with work hardened layer defect have ever entered service, of which 1 has fractured and 1 is currently in operation
- Assume hubs are routinely available for inspection at an average rate of every 7,000 cycles (distribution used)

RISK ANALYSIS - INPUT / ASSUMPTIONS (continued)

- Assume that any hub manufactured with work hardened layer would have the following:
  - Defect equivalent to 0.010" crack depth
  - Crack propagation beginning at initial entry into service
  - Crack propagation lives from 0.010 crack to fracture are calculated so that the risk model is calibrated to 1 hub fracture and to the assumption that **1** cracked hub is currently operating:

Model	B50 Life (cycles)	BO.l Life (cycles)
-219	7,860	3,570
-217A / 217C	8,540	3,880
-209 / 217	9,290	4,220

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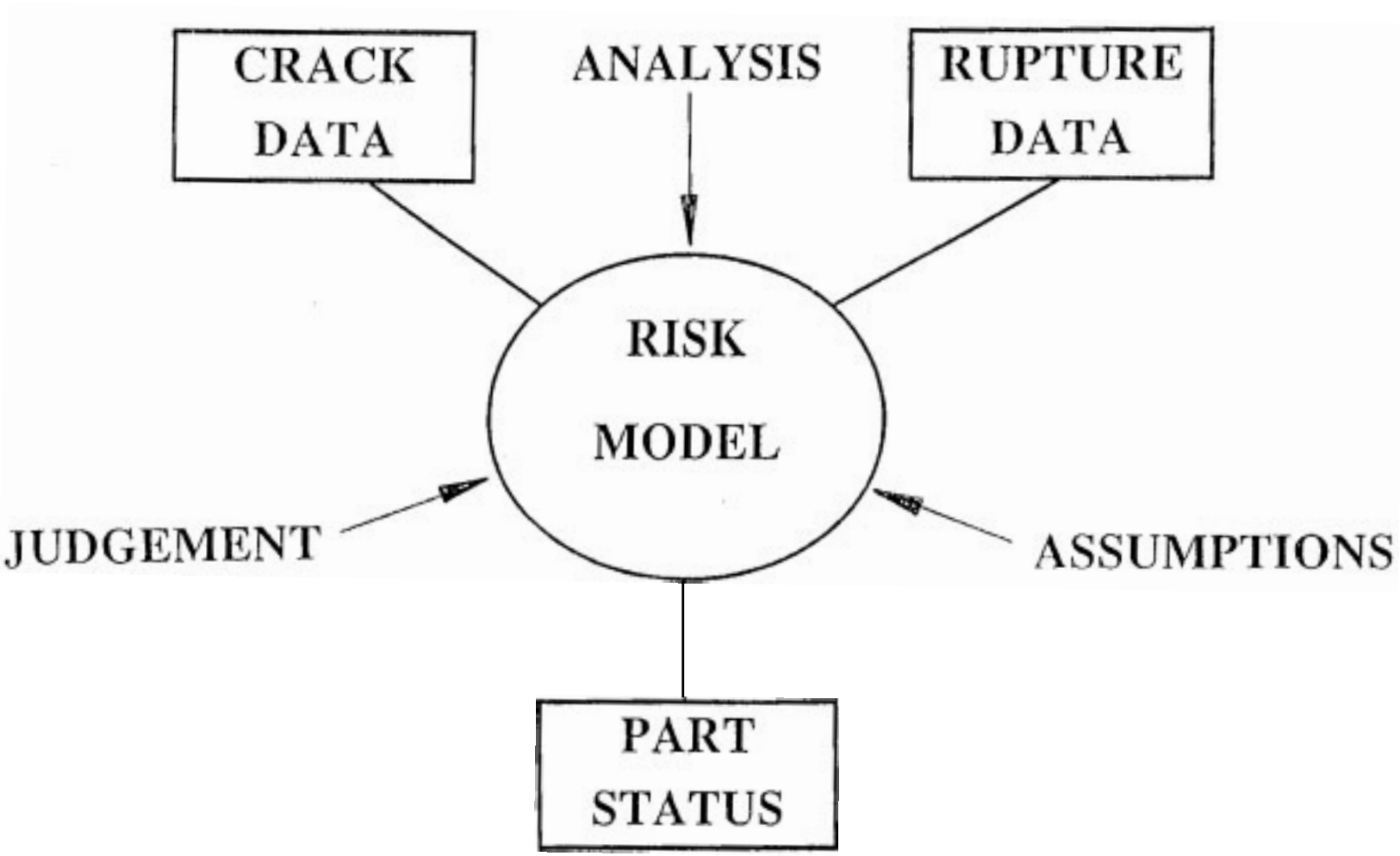
RISK ANALYSIS - INPUT / ASSUMPTIONS

- Assume future hub inspections (combined FPI and ECI) will have an inspection reliability of 97.5% for a crack depth >0.015”
- Engine shop visit Weibull distribution with characteristic life = 4,800 cycles
-
- No credit is taken for any prior FPI inspections performed

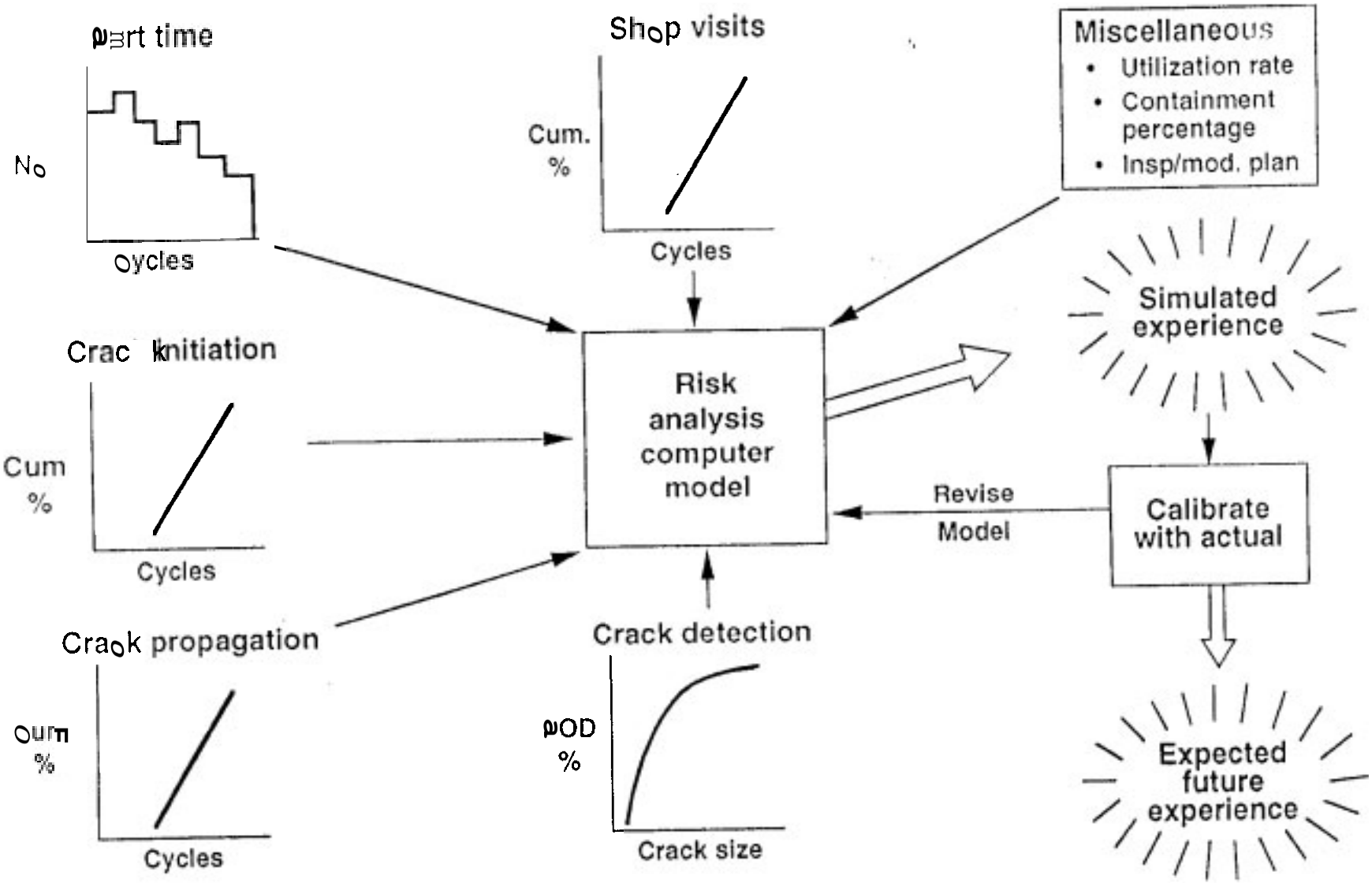
RISK ANALYSIS - INPUT / ASSUMPTIONS

- Probability of a CAAM Level 3+4 event given a hub fracture = 1.0
- Probability of a CAAM Level 4 event given a level 3+4 event = 1.0
- Problem management plan must meet a hub fracture risk goal of 0.10 (applies from 10/1/96 until all currently installed suspect hubs are retired)

ANCHOR MODEL TO KNOWN FACTS



RISK ANALYSIS FLOWCHART

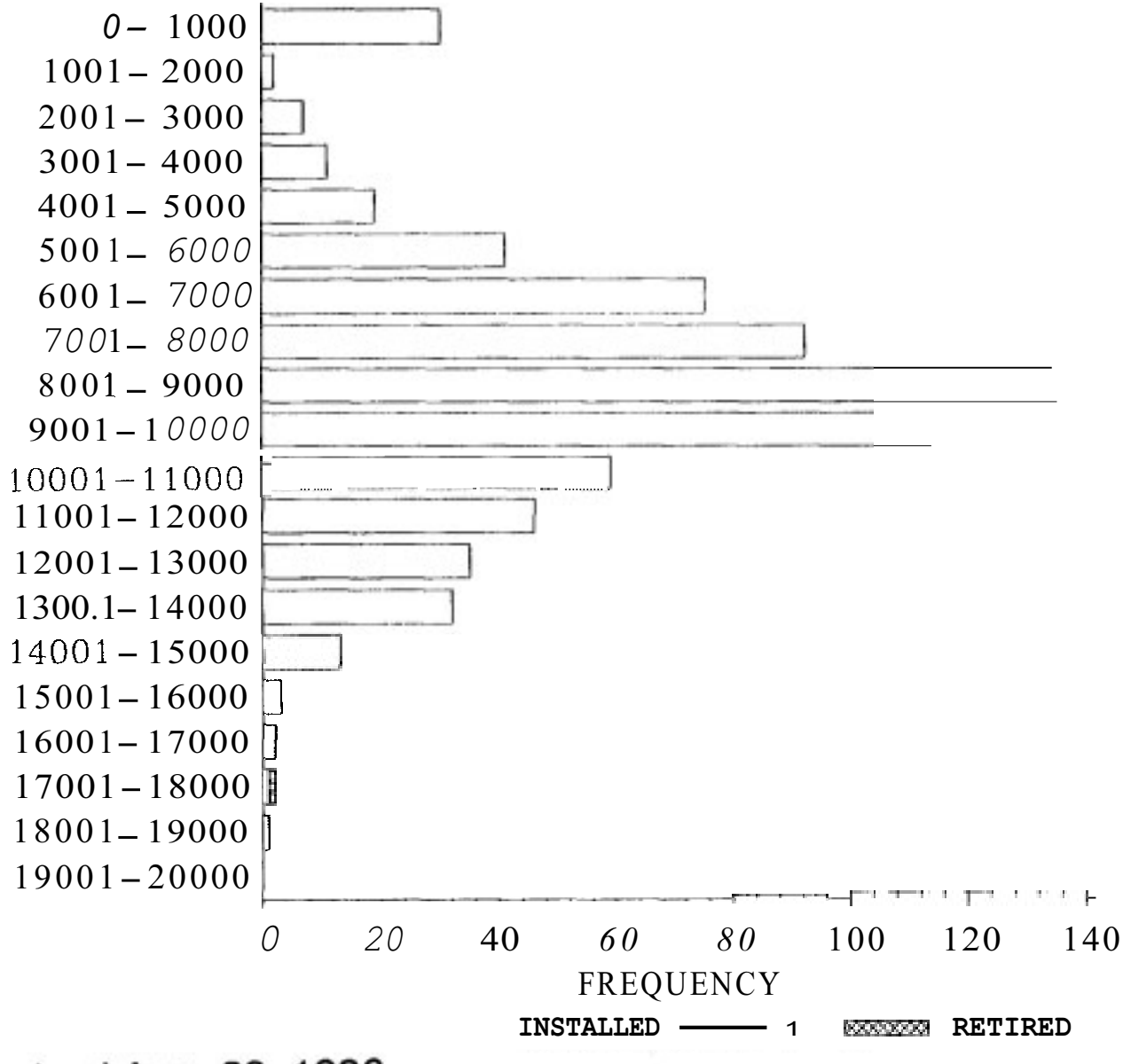


M44685-5
920511

JT8D-200 FAN HUB EST. CYCLES HISTOGRAM

FAN HUBS MANUFACTURED WITH COOLANT CHANNEL DRILL

(AS OF 6/30/96)



	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0 - 1000	30	30	4.17	4.17
1001 - 2000	2	32	0.28	4.45
2001 - 3000	7	39	0.97	5.42
3001 - 4000	11	50	1.53	6.95
4001 - 5000	19	69	2.64	9.60
5001 - 6000	41	110	5.70	15.30
6001 - 7000	75	185	10.43	25.73
7001 - 8000	92	277	12.80	38.53
8001 - 9000	135	412	18.78	57.30
9001 - 10000	114	526	15.86	73.16
10001 - 11000	59	585	0.21	81.36
11001 - 12000	46	6?1	6.40	87.76
12001 - 13000	35	666	4.87	92.63
1300.1 - 14000	32	698	4.45	97.08
14001 - 15000	13	711	1.81	98.09
15001 - 16000	3	714	0.42	99.30
16001 - 17000	2	716	0.28	99.58
17001 - 18000	2	718	0.28	99.86
18001 - 19000	1	719	0.14	100.00
19001 - 20000	0	719	0.00	100.00

Revised Aug 29 1996

JT8D-200 FAN HUB FRACTURE RISK ANALYSIS

- RESULTS -

- Inspection Threshold = 4000 cycles

Initial Inspection	Reinspection Interval	Hub Fracture Risk Factor	Level 3+4 Event Risk Factor	Level 4 Event Risk Factor	Level 4 Event Prob. per A/C Flight
1) Current Inspection Frequency	Current Inspection Frequency	0.50	0.50	0.50	1.39×10^{-7}
2) Next Shop Visit	Next availability	0.39	0.39	0.39	1.08×10^{-7}
3) Within 1050 cycles	Next availability not to exceed 6000 cycles	0.10		10.10	2.77×10^{-8}
4) Within 990 cycles	Next availability not to exceed 8000 cycles	0.10	0.10	0.10	2.77×10^{-8}
5) Within 965 cycles	Next availability not to exceed 10,000 cycles	0.10	0.10	0.10	2.77×10^{-8}

☐ - Meets Risk Factor Goal Level

Revised **Aua.** 29,1996

JT8D-200 FAN HUB FRACTURE RISK ANALYSIS

- RESULTS (cont)-

Initial Inspection	Reinspection Interval	Hub Fracture Risk Factor	Level 3+4 Event Risk Factor	Level 4 Event Risk Factor	Level 4 Event Prob. per A/C Flight
6) Within 500 cycles (4000 Thresh.)	Next availability not to exceed 6000 cycles	0.07	0.07	0.07	1.94×10^{-8}
7) Within 500 cycles (10,000 Thresh.)	Next availability	0.28	0.28	0.28	7.76×10^{-8}

☐ - Meets Risk Factor Goal Level

Revised Aug. 29, 1996

NTSB RECOMMENDATIONS

NTSB RECOMMENDATIONS

- For fan hubs with more than 10,000 cycles
  - Eddy current inspect (ECI) tierod holes within 500 cycles
  - Concentrate on hubs between 10,000 and 15,000 cycles
- Periodically inspect all counterweight and tierod holes via FPI and ECI

PRATT & WHITNEY RECOMMENDATIONS

INSPECTION RECOMMENDATIONS

- **For Coolant Channel Drill hubs (719), choose one *of* the following inspection intervals:**

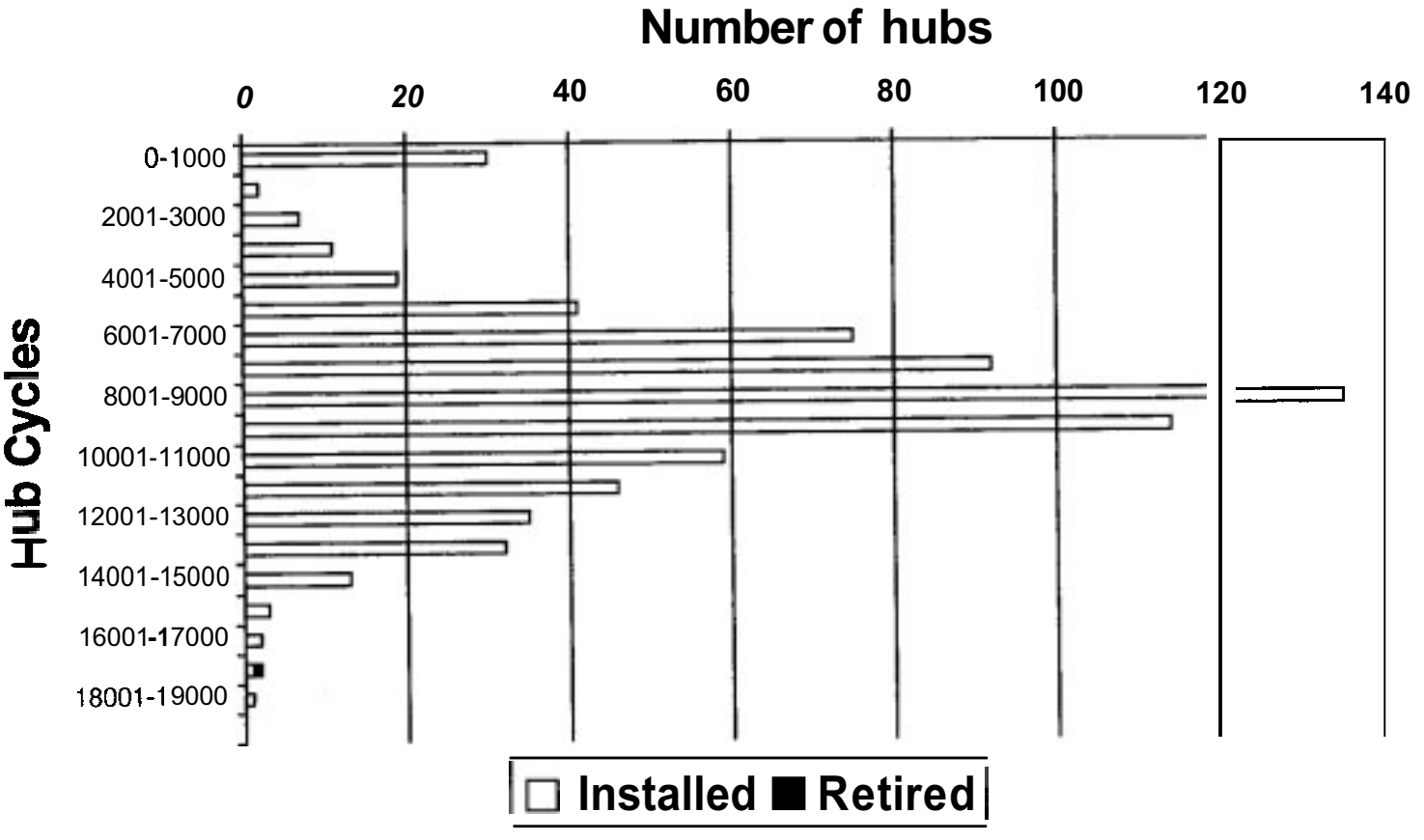
Initial ECI and FPI Inspection	Reinspection Interval
Within 1,050 cycles	Next availability not to exceed 6,000 cycles
Within 990 cycles	Next availability not to exceed 8,000 cycles
Within 965 cycles	Next availability not to exceed 10,000 cycles

- **For all other hubs: FPI and ECI required when the detail part is in the shop**

45

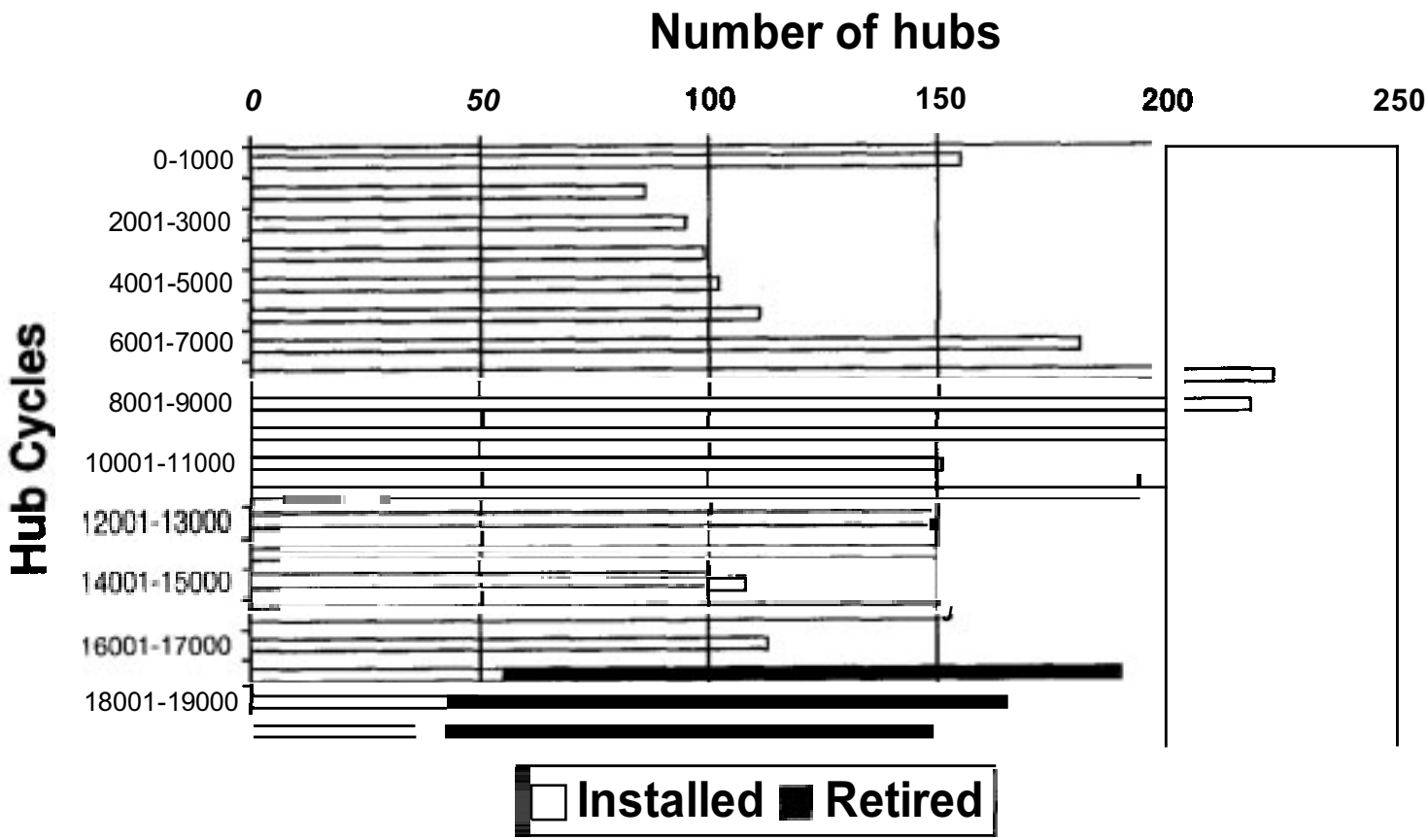
Revised Aug. 29, 1996

Histogram - Coolant Channel Drill Population Estimated Cycles (as of 6/30/96)



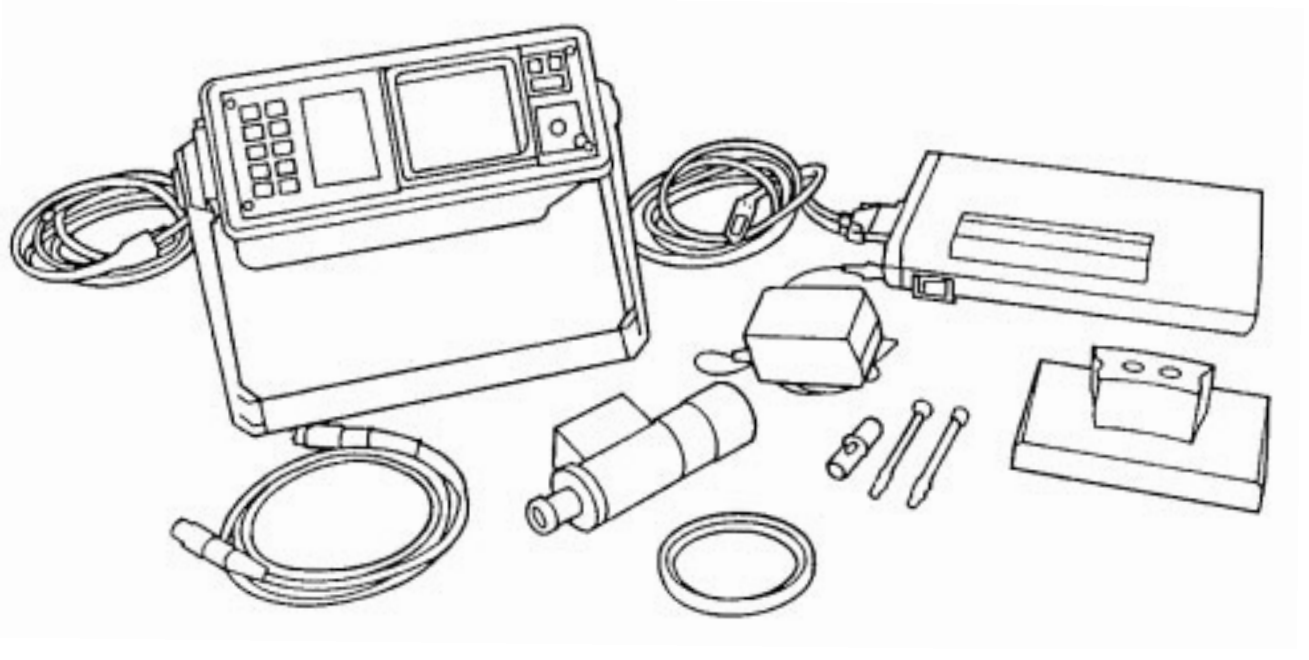
Revised **Aug.** 29,1996

Histogram - Entire JT8D-200 Population Estimated Cycles (as of 6/30/96)



EDDY CURRENT INSPECTION

EDDY CURRENT EQUIPMENT

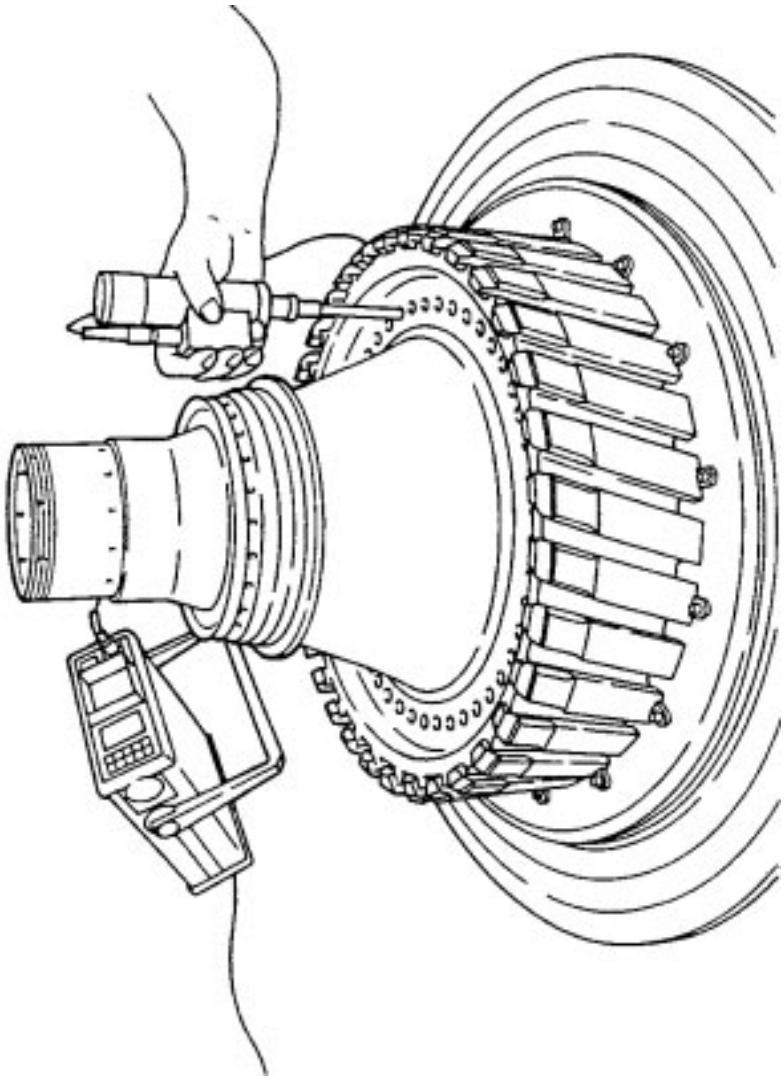


EDDY CURRENT EQUIPMENT

- Rotating eddy current inspection system
  - Eddy current instrument
  - Rotary scanner
  - Rotating eddy current probes
- PWA 102133 sensitivity setting standard
- Standards and one set of probes to be provided at no cost
  - Available Sept. 15, 1996

INFORMATION REQUIRED FOR EDDY CURRENT PROBES

- Provide the following information through your local field rep regarding your rotating ECI instrumentation
  - Instrument manufacturer and model number
    - Frequency capability
  - Rotary scanner model
    - Rotary speed
    - Frequency capability
- Information on how to obtain equipment will be provided in advance of ASB



EDDY CURRENT INSPECTION PROCEDURE

- Clean hub per SPOP 218
- Calibrate rotating eddy current inspection system
- Inspect holes

EDDY CURRENT CONCERNS

- Copper residue in counterweight holes
  - Nitric acid solution (PS 11) cleaning procedure
- Service damage
- Bushed holes

DAMAGE LIMITS

- Damage limits being reviewed for acceptability
- Holes with damage beyond allowable limits
  - Butterfly polish per SPOP TBD and hone if necessary to remove damage
- Use of oversized holes being considered

BUSHED HOLES

- Bushings must be removed prior to inspection
  - Machine bushing to 0.010" or less thickness and drift or peel the bushing out
- If surface damage exists - follow procedures for damaged holes
- Inspect the hole via ECI and FPI
- Rebush holes
  - Bushing repair being reviewed

ONGOING ACTIVITIES

• Review P&W / ATA recommendations with FAA	8/23
• Crack standards and probes available	9/15
• Alert Service Bulletin	9/15
• FAA Airworthiness Directive	TBD

SUPPORTING DOCUMENTS

SUPPORTING DOCUMENTS

COMMERCIAL ENGINE BUSINESS

Attn:	CS/ALL FIELD REPRS	Airline:	ALL
Author:	CRENSHAW	Status:	F
Number:	C036 G 960716 XFR	Ref:	C020 G 960708 XFR
		Reply-Due:	
Actionee:	JT8D CRENSHAW	Priority:	
Eng/Acft:	8D-219/MD88	Eng-S/N:	
ATA:	72-33-31		
Subject:	ALL OPERATOR WIRE	960716	11:16

Please Distribute this A.O.W to your cognizant airline personnel

To: All JT8D-200 Operators

Applicability: JT8D-200 Series

Subject: Accident Update

Date: July 16, 1996

Reference: All Operator Wire JT8D/72-00/AIR:MLY:6-7-8-1

This is: JT8D/72-00/TS:CRC:6-7-16-1

The purpose of this wire is to provide an update on the MD88 No.1 JT8D-219 engine position first stage fan hub fracture and uncontainment that occurred on July 6, 1996 during take off roll at Pensacola. Florida.

The hub, P/N 5000501-01, is undergoing metallurgical examination at the National Transportation Safety Board (NTSB) laboratory with the assistance from P&W, the operator, Douglas Aircraft Company and the FAA. The examination has confirmed the presence of fatigue originating from a tie bolt hole and progressing radially towards the bore of the hub. The NTSB will release their findings at the conclusion of their investigation.

The investigation has identified processing anomalies, not related to raw material deficiencies, which we have been able to trace to six other hubs which were in service. The owners of these hubs have been notified and the hubs have now been removed from service. No immediate action is required from other operators at this time.

The Event is still under investigation. However, final recommendations / corrective actions will be released by the NTSB and the Federal Aviation Administration (FAA) in the near future.

We are reviewing the inspection recommendation and procedures currently in the Engine manual. Based on this review, we may require additional inspections of hubs when they are available in the shop.

Please note. The protocol associated with the participation in NTSB investigations dictates the nature and timing of release of information related to the event investigation. We may be unable to fulfill all requests for information concerning the details of this investigation. It is our intention however, to provide appropriate airworthiness related information at the earliest opportunity by follow on all operators correspondence.

Regards,

Charlns R. Crenshaw
Mid Thrust Technical Support

[redacted]

COMMERCIAL ENGINE BUSINESS

Attn:	CS/ALL FIELD REPS	Airline:	ALL
Author:	CRENSHAW	Status:	F
Number:	C054 Q 960725 XFR	Ref:	R067 A 960731 BOG
		Reply-Due:	960802
Actionee:	NDI CRENSHAW	Priority:	
Eng/Acft:	8D-200/MD80	Eng-S/N:	
ATA:	72-33-31		
Subject:	ECI EQUIPMENT		960725 09:43

ALL FIELD REPRESENTATIVES WIRE

To: All JT8D Field Representatives

Applicability: JT8D-200 Engines

Subject: Eddy Current inspection Equipment

Date: July 25, 1996

Reference: C030 G 960711 XFR

We are in the process of developing an in shop Eddy Current Inspection (ECI) procedure for JT8D-200 1st stage fan hub tierod and balance weight holes.

As we do this, we need to know what type of ECI equipment is being used at the various operator and overhaul facilities. For those Of you who are located at facilities capable of performing ECI, please provide the following information regarding all rotating ECI instrumentation available at your location.

1. Instrument Manufacturer and model

   1.a. Frequency capability

2. Rotary Scanner Model

   2.a. Rotary speed

   2.b. Frequency capability

Please respond via CACTUS using NDI actionee code, NOT JT8D Crenshaw, no later than August 2, 1996.

REGARDS,

CHARLES R. CRENSHAW
MID THRUST TECHNICAL SUPPORT

[redacted]

COMMERCIAL ENGINE BUSINESS

Attn: CS/ALL FIELD REPRS
Author: DUKE
Airline: ALL
Status: F

Number: C063 G 960730 XFR
Ref: C036 G 960716 XFR
Reply-Due:

Actionee: JT8D SUMNER
Eng/Acft: 8D-219/MD88
ATA: 72-33-31
Priority:
Eng-S/N:

Subject: 1ST STAGE FAN HUB FRACTURE UPDATE 960730 13:33

PLEASE DISTRIBUTE THIS AOW TO YOUR COGNIZANT AIRLINE PERSONNEL

To: All JT8D-200 Operators

Applicability: JT8D-200 Series Engines

Subject: 1st Stage Fan Hub Fracture Update

Date: July 30, 1996

Reference: All Operators Wire JT8/72-00/TS:CRC:6-7-16-1

This is: JT8D/72-33/TS:CRC:6-7-30-1

The purpose of this wire is to provide an update on the 1st stage fan hub fracture which occurred on July 6, 1996. and to explain some of the Pratt & Whitney actions which are being proposed.

Status Of Fractured Hub Investigation

As stated in the referenced wire, the cause of this fracture has been traced to a processing anomaly. This occurred during the machining of the tie rod hole which had the primary fracture. This fracture is not related to a material anomaly such as an inclusion or forging lap, therefore we are not focusing on any particular heat code or material melt. An anomaly was noted during the blue etch anodize (BEA) inspection of the hub. After being noted, the area received a close inspection for surface condition. It was concluded that the area did not violate the surface inspection requirements, and the hub was determined to be acceptable by the inspection standards in place at that time.

A search of BEA records revealed eight other hubs which had

similar notes following BEA inspection. Two of the eight were scrapped at manufacture, and the other six had been delivered to operators. Those operators were contacted and all six hubs have now been removed from service. Four of these hubs have been delivered to us, and the other two are being shipped to us.

Our plans for the six returned hubs are to: 1. fluorescent penetrant inspect (FPI), 2. eddy current inspect (ECI) the tie rod and balance weight holes, 3. BEA the entire hub. and 4. make micro sections through whatever indications are noted.

In addition to removing and analyzing the six hubs, we are continuing the review of manufacturing records of all hubs produced to determine if there is any other indication of any anomalies. If additional hubs are identified, the appropriate operators will be immediately contacted.

On Going Activity

Currently, FPI and visual inspection is required for hubs being refurbished. We feel that an additional inspection of the tie rod and balance weight holes is necessary.

We are currently developing an ECI probe and procedure for an in-shop inspection of tie rod and balance weight holes. We expect these probes and procedure to be available by mid August, 1996.

At this point, we have not concluded that additional hubs will require inspection, other than at normal shop visit. This evaluation is expected to be completed by mid August, 1996, about the same time the ECI probes will be available. Until this evaluation is completed, Pratt & Whitney is making no recommendation to prematurely remove any hubs from service.

What To Do Prior To Mid August

Prior to mid August, when the evaluation is completed and ECI probes are available, our recommendation is that hubs going through overhaul shops be FPI with very close attention paid to the interior of the tie rod and balance weight holes. Also, close visual inspection of these holes should be accomplished to determine if unacceptable surface damage is present.

As our evaluation continues, more specific recommendations

will be provided.

As stated in prior correspondence, the National Transportation Safety Board (NTSB) is still conducting and controlling this investigation. It is expected that recommendations and corrective actions will be released by the NTSB and The Federal Aviation Administration (FAA) in the near future. It is not known if these recommendations and actions will be issued before or after we have completed our evaluation.

Further updates will be issued as new information is made available.

Douglas Duke for:

[redacted]

Charles R. Crenshaw
Technical Support
Mature Engines

[redacted]

Jack Sumner, Manager
Technical Support
Mature Engines

[redacted]

COMMERCIAL ENGINE BUSINESS

ATTN: CS/ALL FIELD REPS
AUTHOR: MIKE YOUNG
AIRLINE: ALL
STATUS: F

NUMBER: C020 G 960708 XFR
REF:
REPLY-DUE:

ACTIONEE: AIRW YOUNG
ENG/ACFT: 8D-219/MD88
ATA: 72-00-00
PRIORITY:
ENG-SIN:

SUBJECT: AIRCRAFT ACCIDENT 960708 16:04

Please distribute this AOW to your cognizant airline personnel

To: All JT8D-200 Operators Applicability:

JT8D-200 Series

This is: JT8D/72-00/AIRW:MLY:6-7-8-1

The purpose of this wire is to inform you of an accident that occurred on July 6, 1996 involving a JT8D-219 powered MD88 Aircraft at Pensacola, Florida.

The aircraft was into its takeoff roll when a No. 1 position engine uncontainment occurred. The takeoff was aborted and the aircraft stopped on the runway.

It was found that the 1st stage fan hub, PIN 5005601-01, had fractured in two pieces and separated from the engine. Engine debris penetrated the fuselage. Two fatalities occurred.

This is the first fracture event of this nature ever experienced by JT8D-200 series engine. The 1st stage fan hub that fractured is a configuration unique to the JT8D-200 series engine.

The National Transportation Safety Board (NTSB) is conducting the investigation of this accident. P&W is assisting the NTSB along with the operator, the FAA, and Douglas Aircraft Company

Please note. The protocol associated with the participation in NTSB investigations dictates the nature and timing of release of information related to the event. It is our intention to work within this protocol. In this regard, we may be unable to immediately fulfill requests for information concerning the status of engine related issues, should any develop. It is our intention however, to provide appropriate engine related information at the earliest opportunity by follow on all operator correspondence.

Mike Young
Airworthiness

COMMERCIAL ENGINE BUSINESS

ATTN: CS/ALL FIELD REPS
AUTHOR: CRENSHAW
AIRLINE: ALL
STATUS: F

NUMBER: C030 G 960711 XFR
REF: C020 G 960708 XFR
REPLY-DUE:

ACTIONEE: JT8D CRENSHAW
ENG/ACFT: 8D-219/MD80
ATA: 72-33-31
PRIORITY:
ENG-S/N:

SUBJECT: HUB FRACTURE UPDATE 960711 16:06

All Field Representatives Wire

To: All JT8D Field Representatives

Applicability: JT8D-200 Engines

Subject: Additional Fan Hub Fracture Information

Date: July 11, 1996

Reference: All Operator Wire JT8D/72-00/AIR:MLY:6-7-8-1

This is to provide additional information to the reference wire.

At this point in the investigation of the fractured No. 1 hub, a fatigue crack has been identified originating in a tie rod hole and progressing toward the bore of the hub. The cause for this fatigue crack has not been identified. The National Transportation Safety Board (NTSB) plans to continue the investigation of this fatigue area at their Washington, D. C. lab.

This hub design, which is unique to the JT8D-200 series, was first introduced in the JTBD-209 engine. The design is now used in all JT8D-200 engines and has not been revised since first incorporated. Other than what is in the Engine Manual, there are no unique or specific maintenance, refurbishment, or service bulletin requirements for this hub. There have been no reports of any problems with this hub.

The factual information available at this time is the following:

Engine Model: JT8D-219

Hub part number: 5000501-01

Hub total time: 16,542 hours

Hub total cycles: **13,835** cycles

The hub had been in the shop for inspection and refurbishment **1529** hours and **1142** cycles prior to this fracture. Among other things, a fluorescent penetrant inspection was accomplished at that time.

The review of the history of this hub is continuing, and additional information regarding this fracture and the investigation will be supplied as appropriate. At this point in the investigation. there is no specific recommended action to be taken on hubs of similar part numbers or part times.

REGARDS,

CHARLES R. CRENSHAW
MID THRUST TECHNICAL SUPPORT

[redacted]

COMMERCIAL ENGINE BUSINESS

Attn: CS/ALL JT8D-200 FIELD REP Airline: ALL
Author: ROSS H A Status: F

Number: C092 G 960808 XFR Ref:
Reply-Due:

Actionee: JT8D ROSS Priority:
Eng/Acft: 8D-200/MD80 Eng-S/N:
ATA: 72-33-00

Subject: JT8D-200 FAN HUB FRACTURE MEETING 960808 15:18

PLEASE DISTRIBUTE THIS WIRE TO YOUR AIRLINE COGNIZANT PERSONNEL.

THIS IS: JT8D/72-33/TS:HAR:6-8-8-1

TO: All JT8D-200 Field Reps

ATA: 72-33-00

SUBJECT: JT8D-200 Fan Hub Fracture Meeting

REFERENCE: C020 G 960708 XFR

IN REPLY PLEASE REFER TO: JT8D-200/72-33-00/HAR:6-08-08-96

Please pass the following invitation to appropriate operator personnel at the airlines covered by your office.

Operators of JT8D-200 engines are invited to participate in a meeting to review the results of P&W's investigation into the cause of the July 6, 1996 Fan hub fracture accident and to assess recommendations to prevent future events of this kind. The meeting is scheduled for August 22, 1996 at the Bradley International Airport Sheraton Hotel in Windsor Locks CT, USA.

The meeting will be co hosted by representatives of the ATA and will assist in formulating inspection and closing action recommendations to the FAA.

A preliminary agenda follows:

0800	Opening Remarks	ATA/P&W
	History/Background	P&W
	Technical Investigation	P&W
	Metallurgical Review	P&W
	Statistical Risk Analysis	P&W

Noon Lunch

1300	P&W Recommendations	P&W
	Inspection Demonstration	P&W
	Open Discussion/ATA Position	ATA
	Action Plan	All

1600 Adjourn

Those wishing to register for the meeting should call Ms. Carolyn Roy, P&W's coordinator for this meeting, at 860-565-2527 or Mr. Jon Greene at 860-565-3946. Attendees may also fax registration to 860-565-1167. Please provide your name, address, company name, telephone number, date of arrival and departure date.

If you require hotel accommodations for this meeting, please contact the Sheraton Hotel directly at 860-627-5311. We have reserved a limited block of rooms until August 15, 1996 at a meeting price of $88.00. Please advise the hotel that you will be attending the P&W technical meeting. Reservations made after August 15 will be on a space available basis and at standard room rates.

We regret the interruption to your busy schedules but we believe all operators should be informed of the fracture event investigation and participate in the recommendations going forward to the regulatory authorities.

H.A. Ross
Mature Engines
Customer Support

COMMERCIAL ENGINE BUSINESS

Attn: CS/ALL FIELD REPS
Author: CRENSHAW
Airline: ALL
Status: F

Number: C11O G 960816 XFR
Ref:
Reply-Due:

Actionee: JT8D CRENSHAW
Eng/Acft: 8D-200/MD80
ATA: 72-33-21
Priority:
Eng-S/N:

Subject: FAN HUB FRACTURE UPDATE 960816 15:13

PLEASE DISTRIBUTE THIS AOW TO YOUR COGNIZANT AIRLINE PERSONNEL

To: All JT8D-200 Operators

Applicability: JT8D-200 Series Engines

Subject: 1st Stage Fan Hub Fracture Update

Date: August 16, 1996

Reference: All Operators Wire JT8/72-33/TS:CRC:6-7-30-1
(CACTUS wire C063 G 960730 XFR)

In reply refer to: JT8/72-33/TS:CRC:6-8-16-1

The purpose of this wire is to provide an update into the investigation of the JT8D-200 fan hub fracture and to provide some preliminary information regarding the all JT8D-200 operators meeting which will take place August 22, 1996.

Description of Material Anomaly

The referenced wire mentioned that the cause of the fracture has been determined to be a processing anomaly which occurred during the machining of the tie rod hole. Since the release of this information. we have received numerous requests for a description of this processing anomaly. The anomaly at the fracture origin is an area of work hardened re-crystallized material. This condition occurred during the machining of the hole. This condition resulted in an abnormal microstructure which is not necessarily detected by visual inspection. The blue etch anodize (BEA) inspection is not specifically in place to detect work hardened areas: however, the BEA inspector noted an unusual surface condition during his BEA inspection. Subsequent review of the condition concluded that the condition did not violate the surface inspection requirements.

We are reviewing the capability of BEA to determine if this method can detect work hardened areas. At this time, we have no other effective non-destructive inspection to determine the presence of a work hardened area. It can only be determined by sectioning the hub. Fluorescent penetrant inspection (FPI) or eddy current inspection (ECI) is only effective if detectable cracks are present in the work hardened area.

Status of Six Returned Hubs

The referenced wire also mentioned that six other hubs having similar notations by the BEA inspector had been identified and removed from service. All six hubs are now in East Hartford. At this point, four hubs have been thoroughly inspected by BEA, FPI, and ECI. Although some "indications" were noted, metallurgical sections through the most suspect areas revealed no metallurgical discrepancies. None of these hubs exhibited any cracking in any areas.

The last two hubs just arrived, and the inspection process has just begun. The inspection results of these hubs will be presented in the next status report.

NTSB Recommendations

On July 29, 1996, the National Transportation Safety Board (NTSB) issued a safety recommendation to the Federal Aviation Administration (FAA). This recommendation is the action the NTSB feels should be taken to prevent future JT8D- 200 hub fractures, and is based on their assessment of the cause of this fracture. The FAA will now work with Pratt & Whitney and the operators to determine if this recommendation can be implemented, or if alternate action is more appropriate, but as effective.

In summary, the NTSB recommendation is as follows:

Quote

.....the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that, within 500 cycles of FAA approval of an engine "On wing" eddy current inspection process for Pratt & Whitney JT8D-200 series engine fan hub tie rod holes, this inspection be performed on those hubs that have accumulated more than 10,000 cycles since new.....

Require an inspection of all Pratt & Whitney JT8D-200 series engine fan hub tie rod and stress reduction (counterweight) holes by means

of FPI and eddy current by a fixed number of flight cycles based on the risk of crack propagation from manufacturing flaws.....

Unquote

The NTSB is calling the ECI an "on wing" inspection because the engine does not have to be removed. The 1st fan rotor can be removed while leaving the engine installed. The 1st fan rotor can then be inspected in the appropriate location. Therefore, the ECI of the hub is not actually being done "on wing".

All Operators Meeting - August 22, 1996

As a result of strong operator interest regarding the cause of this fracture and the concerns that many operators have regarding their inability to accomplish these inspections within the time of the NTSB recommendations, an all operators meeting was announced via All Operator Wire JT8D-200/72-33-00/HAR:6-08-96 (CACTUS wire C092 G 960808 XFR). All JT8D-200 operators are invited to attend this meeting which will be held at the Bradley Sheraton Hotel in Windsor Locks, Ct., USA. The date of the meeting is Thursday, August 22, 1996. Refer to the all operators wire mentioned in this paragraph for registration and hotel accommodation details. This meeting will be hosted by the Air Transport Association and we urge you to attend, if at all possible.

During this meeting, we plan to present as much information as we can regarding our investigation of this hub fracture, and we will provide Pratt & Whitney's recommendations for actions which should be taken to prevent additional fractures. Our recommendations will be different than those of the NTSB. At this time, our recommendations have not been finalized as we are still evaluating the entire situation.

Although the specific agenda for this meeting has not been fully established, the following are the topics which we plan to cover in detail:

1. Background and history of the event

2. Metallurgical analysis of the fractured hub

3. Details of the technical investigation

4. Discussion of the NTSB recommendations

5. Statistical analysis used to establish Pratt & Whitney recommendations

6. Pratt & Whitney recommendations

7. Availability, description, and demonstration of ECI equipment

8. Open discussion on all items

9. Establishment of ATA position

After the meeting, a wire will be issued within a short period of time summarizing the results of the meeting. Also, a copy of the presentation book will be mailed to all JT8D- 200 operators. Hence, if you can not attend, you will at least have a copy of the material which was presented.

Status of ECI Equipment

Although it was stated in the referenced wire that the ECI equipment and procedure would be available by mid August, unexpected delays in the development program have caused this date to slip to mid September. It is our plan to offer ECI probes and sensitivity setting standards on a no charge basis at that time.

One of the problems encountered is that we do not know what type Of ECI equipment is available at those facilities which will be doing the ECI. This information is crucial and needed immediately. For those of you who will be requesting the ECI probes and standards, please supply, through your local field representative, the following information on your rotating ECI instrumentation:

1. Instrument manufacturer and model number

1.a. Frequency capability

2. Rotary scanner model

2.a. Rotary speed

2.b. Frequency capability

This information is needed before any orders can be processed because different instruments may require specific connectors and this information has to be given to the suppliers making the probes.

Those of you who have already supplied this information (Reference All Field Reps CACTUS wire C054 Q 960725 XFR) do not have to re-submit your information.

We are looking forward to seeing many of you on August 22, 1996.

REGARDS,

CHARLES R. CRENSHAW
MID THRUST TECHNICAL SUPPORT

[redacted]

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 29, 1996
In reply refer to: A-96-74 through -77

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On July 6, 1996, Delta Air Lines flight 1288, a McDonnell-Douglas MD-88 airplane, experienced an uncontained failure of the No. 1 (left) engine front compressor front hub (fan hub) during takeoff at the Pensacola Regional Airport, Pensacola, Florida. Flight 1288 was a regularly scheduled passenger flight from Pensacola to Atlanta, Georgia, operating under the provisions of Title 14 Code of Federal Regulations (CFR) Part 121. On board the airplane were the 2 pilots, 3 flight attendants, and 142 passengers. The airplane was equipped with Pran & Whitney JT8D-219 engines, which are part of the JT8D-200 engine series.

The captain rejected the takeoff following the engine failure and stopped the airplane on the departure runway. Engine fragments penetrated the aft fuselage, killing two passengers and seriously injuring one passenger. An engine fire ensued; however, it self-extinguished within moments. The investigation of this accident is continuing; however, information gathered thus far raises serious concerns for which immediate action is needed by the Federal Aviation Administration (FAA).

The investigation has determined that during the initial part of the takeoff roll, just as the engines were reaching peak thrust, the fan hub on the No. 1 engine separated into two large pieces; one was about 2/3 of the hub (containing 20 complete fan blade slots) and the other was about 1/3 of the hub (containing 12 fan blade slots). Other pieces of the fan hub, fan blades, and/or other engine debris penetrated the aft cabin area.

The fan hub design for the JT8D-200 series engine is different from other JTSD engines. According to Pratt & Whitney officials, about 2,600 JT8D-200 series fan hubs have been produced and are operating worldwide on about 1,200 MD-80 series airplanes.

Maintenance records at Delta Air Lines indicate that the fractured fan hub was inspected in December 1995, after accruing 12,693 flight cycles,[1] and was installed on the accident engine on December 29, 1995. The hub was inspected at Delta Air Lines using a florescent dye

[1] One flight cycle is equivalent to one takeoff and landing.

penetrant inspection (FPI) procedure.[2] The hub failed at 13,835 cycles, which was 1.142 cycles since the last inspection. Maintenance records indicate that all work on the hub after delivery of the engine was performed by Delta

Metallurgical examination of the fan hub, part number 5000501-01, serial number R32971, at the *Safety* Board's Materials Laboratory revealed that the fracture originated in one of the 24 tierod holes in the hub. The tierod holes, which are aligned parallel to the engine shaft, are located around the circumference of the hub bore and alternate with 24 smaller diameter stress redistribution (SR) holes.[3] The tierod and SR holes cannot be inspected without disassembling the fan hub from the engine; however, an inspection technique (eddy current) being developed by Delta Air Lines will permit inspection of the fan hub tierod holes "on-wing" without moving the fan hub into an engine shop.[4]

The metallurgical examination showed that the hub separation stemmed from low cycle fatigue (LCF) cracking that originated from abusive machining[5] that created a localized area of ladder cracking and cold working of the underlying material in the microstructure inside one of the tierod holes about ½ inch from the aft face. A fatigue striation count using the scanning electron microscope disclosed a number of striations roughly equivalent to the total number of flight cycles for the fan hub. The number of striations and the appearance of the fracture surface suggest tha: the crack was present on the *aft* face of the hub for a distance of 0.46 inch at the time of the last FPI. The length of the crack along the wall ofthe hole was about 0.9 inch at the time of the FF'I.

The investigation has revealed that the failed hub was manufactured in 1989in Trollhattan, Sweden, by Volvo Flygmotor, which is the current manufacturer of Pratt & Whitney JT8D-200 series fan hubs. A review of Volvo's records for the accident hub indicates that following manufacture, a blue etch anodize (BEA)[6] inspection and an FPI were performed on June 14, 1989. During BEA, mechanical marks were detected inside the tierod hole where the fatigue crack originated and were referred to a visual inspection process where the marks were accepted because the part satisfied all Pratt & Whitney BEA and visual inspection criteria. The part was subsequently forwarded to Pratt & Whitney for installation into a production engine.

The Safety Board believes that the FAA should conduct a review of *the* processes used by Volvo and Pratt & Whitney that allowed a fan hub to be placed in service with anomalies that led to the failure *of* the hub on Delta flight 1288. Based on the review, the FAA should require as

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[2]FPI refers to the submersion afthc hub infolow viscosity floracent dye bath, followed by washing with high viscosity solution. Thc florescent dyc, which is rctained by cracks or other surface defects, luminesces under black tight inspection.

[3]"Stress rodistribution holes" are sometimes referred to as balance weight holes, cooling holes, lightening holes, or shielding boles.

[4]The hub would be removed from the engine, although the engine would not be removed from the airplane.

[5]Local surface hardening and cracking created during the drilling of the holes.

[6]BEA is an inspection process intcndcd to detect microstructure anomalies on the surface of a titanium component. *It* is no! intended lo detect marks left by the machining process.

necessary that Pratt & Whitney modify its quality assurance standards and practices for inspection of the JT8D-200 series engine fan hubs.

The fact that the hub failed from fatigue cracking at the location of a BEA indication raises immediate concerns about other fan hubs that also had BEA indications during inspection and entered into airline service. However, on July 15, 1996. Pratt & Whitney advised the Safety Board that a review of the production records had identified six additional fan hubs in service that had exhibited similar BEA indications after manufacture. Pratt & Whitney immediately contacted the affected airlines and strongly urged them to remove those hubs from service before further flight. The airlines voluntarily complied with the request on July IS, 1996. On July 16, 1996, the FAA formalized this action by issuing Airworthiness Directive (AD) 96-IS-06 mandating removal of the six fan hubs from service. The six hubs are being forwarded to Pratt & Whitney for a detailed inspection and analyses to determine what corrective actions *are* required. The Safety Board is pleased that immediate actions to reduce the safety hazards associated with those hubs were taken.

Nonetheless, the Safety Board remains concerned about the potential for cracking in tierod holes in other JT8D-200 series fan hubs that may have been exposed to abusive machining or other damage that occurred during production or subsequent overhaul or rework that has nor been detected by BEA and/or FPI inspections. Further. the Safety Board is concerned that fatigue cracking could also occur in the SR holes. Although the SR holes are smaller in diameter, and the related stresses should be less than in the tierod holes, the potential for catastrophic failure of the fan hub from undetected cracking in those holes should be addressed. The Safety Board is aware that inspection of the SR holes is complicated by the placement of balance weights in some of the holes and that the removal of the weights leaves copper residue that makes eddy current inspection unreliable. Regardless, the Safety Board believes that the need to identify any fatigue cracking that may exist in the SR holes warrants cleaning and inspecting the SR holes.

The Safety Board is concerned that enhanced visual inspection techniques, including the FF'I technique currently used for JT8D-200 series engine fan hubs, may not be adequately performed to detect cracking that *can* lead to catastrophic failure of the hub. The FPI method used at the Delta *Air* Lines engine repair station should have readily detected the crack on the surface of the *aft* face of the hub; however, there are mitigating circumstances that may have prevented the detection of the existing crack. For example, FF'I relies on an inspector visually detecting surface cracks in units that are typically crack free. According to Pratt & Whitney, there has never been a crack found on a JT8D-200 series fan hub during its service Life. Consequently, the expectation of finding a crack is reduced. Moreover, the Safety Board is concerned that the procedures used by inspectors may make it difficult to view cracking in the tierod holes. Further, the training provided to the inspectors, which includes the syllabi and any visual aids, may not be sufficiently specific with regard to the most likely locations of cracks, orientation of a crack in a disk, the difficulty of detecting a crack in a hole (particularly high aspect ratio holes), and the appearance of cracks in rotating parts.

This accident. as well as past accident experience,[7] has shown that existing cracks have been missed during other visual inspections using FPI. As a result, the Safety Board is concerned that procedures and inspector training and supervision may not be fully adequate to ensure reliable FPI of critical rotating engine parts. The Safety Board appreciates the important role of FPI in the inspection of critical aircraft parts, including the JT8D-200 series fan hub. Therefore, pending the development and implementation of a more definitive and reliable non-destructive inspection procedure. the FAA should review and revise. in conjunction with engine manufacturers and air carriers, the published guidance, inspection procedures, inspector (raining including any visual aids, and supervision currently in place for performing FPI and other non-destructive testing of high energy rotating engine parts. Particular emphasis should be placed on the FPI procedures for detecting cracks on JT8D-200 series fan hubs.

The Safety Board is aware that Pran & Whitney is currently developing an eddy current inspection procedure for the JT8D-200 series fin hub tierod and SR holes to supplement the existing FPI technique being used by operators. Pran & Whitney officials report that development and implementation of the eddy current inspection procedure to inspect the tierod and SR holes, may take "weeks or months" to complete. They also report that they intend for the newly developed procedure to be implemented as a "soft time" inspection whenever the engines are removed for other scheduled maintenance. The Safety Board believes that the eddy current inspection procedure in development at Delta Air Lines, in cooperation with Pratf & Whitney, that will permit "on-wing" inspection of fan hub tierod holes offers an opportunity to detect cracks in these holes in a relatively short time (reportedly 14 hours per engine) before a method involving inspection of all SR holes may be developed and implemented by Pratt & Whitney. Delta reportedly plans to begin this inspection as soon as it is fully developed and approved by Pran & Whitney and the FAA. Such an "on-wing" inspection may be the only means to inspect tierod holes in *the* fan hubs without substantial grounding of MD-80 airplanes because of the very limited number of spare hubs to replace hubs removed and taken into an engine shop.

Review of JT8D-200 engine fleet size, fan hub life cycle data, the crack propagation rate of the accident engine fan hub, and consultation with industry indicate that the proposed on-wing tierod hole eddy current inspection could be accomplished within the next 500 flight cycles with minimal impact on airline revenue service operations. Some data suggest that hubs that have between 10.000 and 15,000 cycles may be at greater risk than those with more than 15,000 cycles, the latter having passed the point where cracks caused by manufacturing flaws would be expected to cause failure of the hub. The Safety Board believes that inspection of all hubs with more than 10,000 cycles should be an FAA priority but that inspections should be prioritized to ensure that the fan hubs most at risk are inspected first.

Based on the evidence and data available at this time, the Safety Board believes that the FAA should require inspection of the tierod and SR bolt hole cracking potential in two stages. First, the FAA should require, on a schedule that would give priority to fan hubs presenting the highest risk, as an interim measure, within 500 cycles of the approval of a validated inspection

[7]Previous accidents in which inspectors failed to identify detectable fatigue cracks using FPI techniques: United Airlines DC-10, Sioux City, Iowa. GEAE CF6-6. July 19, 1989; Egypt Air A-300B4, GEAE CF6-50C2, April 10. 1995; and ValuJet DC-9. Atlanta, Georgia, Pratt & Whitney JT8D-9A, June 8. 1995.

process that *can* be accomplished without having to send the fan hub to an engine shop, an eddy current inspection of the tierod holes *of JT8D-200* series fan hubs that have accumulated over 10,000 cycles. Secondly, the **FAA should** require, as a terminating action. both an FPI and eddy current inspection of all fan hub tierod and SR holes. The scheduling **of the** redundant inspections should be commensurate with the risk associated with propagation of a fatigue crack from a manufacturing defect in the holes.

Therefore, as a result of its ongoing investigation **of** this accident. the National 'Transportation Safety Board recommends that the Federal Aviation Administration:

Require that, within 500 cycles of FAA approval of an engine "on wing" eddy current inspection process for Pratt & Whitney JT8D-200 series engine fan hub tierod holes. this inspection be performed on those hubs that have accumulated more than 10,000 cycles since new; prioritize the inspections to ensure that the fan hubs most at risk (data suggest those hubs with 10,000 to 15,000 cycles since new) are inspected first. This inspection *can* be superseded by the redundant inspection urged in safety recommendation A-96-75. **(Class** I, Urgent Action) **(A-96-74)**

Require an inspection of all Pratt & Whitney JT8D-200 *series* engine fan hub tierod and stress redistribution holes by means of FPI and eddy current by a fixed number of flight cycles based on the risk of crack propagation from manufacturing flaws. **(Class** II, *Priority Action*) (A-96-75)

Review and modify the processes as necessary by which Volvo and Pratt & Whitney permitted JT8D-200 series fan hubs to be placed in airline service following indications of mechanical damage in the tierod holes based on a blue etch anodize inspection. (Class II, Priority Action) (A-96-76)

Review and revise. in conjunction with the engine manufacturers and air carriers, the procedures, **training** that includes the syllabi and visual aids, and supervision provided to inspectors for performing FF'I and other non-destructive testing of **high** *energy* rotating engine **pans,** with **particular** emphasis on the JT8D-200 series tierod and stress redistribution holes. **(Class** I. Urgent Action) **(A-96-77)**

Chairman **HALL**, Vice Chairman **FRANCIS**, and Members HAMMERSCHMIDT, GOGLIA, and **BLACK** concurred in **these** recommendations.

By: Jim Hall
Chairman

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COMMERCIAL ENGINE BUSINESS

C129 G 960829 XFR CACTUS 08/29/96 PAGE 1 OF 5

Attn: CS/ALL FIELD REPS
Author: CRENSHAW
Airline: ALL
Status: F

Number: C129 G 960829 XFR
Ref: C11O G 960816 XFR
Reply-Due:

Actionee: JT8D CRENSHAW
Eng/Acft: 8D-200/MD80
ATA: 72-33-31
Priority:
Eng-S/N:

Subject: ALL OP WIRE - HUB FRACTURE UPDATE 960829 17:48

PLEASE DISTRIBUTE THIS AOW TO YOUR COGNIZANT AIRLINE PERSONNEL

JT8D-200 All Operator Wire

To: All JT8D-200 Operators

Applicability: JTED-200 Series Engines

This is: JT8/72-33/TS:CRC:6-8-29-1

Subject: 1st Stage Fan Hub Meeting Summary

Date: August 29. 1996

Reference: All Operators Wire JT8/72-33/TS:CRC:6-8-16-1 (CACTUS C11O G 960816 XFR)

In reply refer to: JT8/72-33/TS:CRC:6-8-29-1

The purpose of this wire is to provide a summary of the all operators meeting held August 22. 1996 to discuss the JT8D- 200 fan hub fracture. On the following day, August 23, 1996. the operators' position was presented to the Federal Aviation Administration (FAA) by Pratt & Whitney and the Airline Transport Association (ATA). Results of that meeting will also be presented.

The meeting was attended by representatives from seventeen airlines, three overhaul shops, the airframer, and the Director of the ATA. The meeting was co-chaired by the ATA.

Cause of Fracture Origin

Based on the investigation conducted by us at the hub vendor's plant and a review of manufacturing records, we were able to

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Revised Aug. 29, 1996

determine that the work hardened material at the fracture origin was the result of the use of a coolant channel drill and a continuous plunge drilling process. This type of drill and procedure was used for about two years. During this time period, 719 hubs were delivered to operators, This type of drill and procedure is no longer used because of the high number of nonconforming hubs identified during the time the coolant channel drill was used to drill tie rod and counterweight holes.

Photographs of this drill are contained in the presentation book distributed during the meeting. However, a brief description of this type of drill is that it is a drill having two holes, or channels, drilled through the shank. Cooling liquid is flowed throug!. these channels during the drilling process. The coolant and drilled chips continuously flow up through the drill flutes and exit at the top of the part. This continuous flow of coolant and chips allows a hole to be drilled with one continuous procedure. By comparison, when drilling with a standard drill, 0.250 inch of material is drilled, then the drill is removed, and the hole is flushed of drilling chips. The drill is re-inserted and another 0.250 inch of material is drilled and the drill is again removed for flushing of the hole. This process continues until the hole is drill completely through the part. The coolant channel drill was used to reduce the amount of time the standard drill takes to produce a hole.

Our conclusion, after reviewing the process and finding evidence of titanium transfer on several coolant channel drills, is that the continuous flow of coolant fluid and drilled chips was periodically interrupted, possibly due to jamming of material in the drill flutes. This jammed material could cause local overheating which could lead to a work hardened area.

We are very confident that the condition which resulted in this fracture was caused by a work hardened area resulting from the use of the coolant channel drill and the continuous plunge drilling process.

Background for Pratt & Whitney Recommendations

Based on our conclusions, the population of suspect hubs is limited to 719 hubs delivered during the time the coolant channel drill was used. After inspecting the six hubs immediately recalled (see status of returned hubs later in this wire), we feel strongly that there are no cracked hubs from this suspect group in operation. However, due to the serious consequences of a hub fracture, we have completed an analysis assuming the possibility of a cracked hub in operation. Our recommendations for the inspection of the suspect population is based on this assumption.

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An initial recommendation was presented during the meeting. However, the operators present asked for several alternate inspection choices. We were able to provide three inspection scenarios which the operators agreed upon. Our plan is to have each operator choose the scenario which best fits his operation.

Therefore, at the end of the meeting, it was agreed that the following three inspection scenarios will be P&W's recommendation for inspection of the 719 suspect hubs.

Pratt & Whitney Recommendations

For P/N 5000501-01 hubs having more than 4000 total part cycles, choose one of the following inspection/re-inspection programs for your fleet:

1. Perform the initial inspection of the tierod and counterweight holes within 1050 cycles; perform a re-inspection at the next hub availability not to exceed 6000 cycles since initial inspection.

2. Perform the initial inspection of the tierod and counterweight holes within 990 cycles; perform a re-inspection at the next hub availability not to exceed 8000 cycles since initial inspection.

3. Perform the initial inspection of the tierod and counterweight holes within 965 cycles; perform a re-inspection at the next hub availability not to exceed 10,000 cycles since initial inspection.

Inspection Methods

It will be recommended that two inspections be performed on the hubs. One will be fluorescent penetrant inspection (FPI) using SPOP 84. the other will be an eddy current inspection (ECI).

At the suggestion of the operators present at the meeting, we are considering only requiring an ECI at the initial inspection of the hub if the ECI is to be done with the blades installed. This is being reviewed because of the time consuming need to remove blades, strip the anti-gallant, clean, and essentially refurbish the hub in order to perform FPI. A decision on this is expected the first week of September.

Status of ECI Equipment

As stated in the reference wire, ECI equipment is scheduled to be available in mid September. Information will be provided before that date giving the details on how to obtain equipment at no charge.

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Results of FAA Meeting

On August 23, 1996 the Director of the ATA and two ATA members met with the FAA, Pratt & Whitney, and Douglas Aircraft Company in East Hartford. The purpose of this meeting was to present to the FAA. the Pratt & Whitney findings, the rationale for our recommendations. and our recommendations.

The FAA has now reviewed and accepted our recommendations. At this time, they plan to issue a Notice Of Proposed Rule Making (NPRM) concurrent with the issuance of the Pratt & Whitney Alert Service Bulletin. The response time to the NPRM will be short.

Issuance of Alert Service Bulletin (ASB)

The Pratt & Whitney recommendations will be issued through an ASB which is scheduled for release by mid September. The ASB will provide the instructions for ECI , how to address holes which have bushings installed in them, and repairs for damaged holes. The list of suspect serial numbers will also be included in the ASB.

Status of Six Returned Hubs

As mentioned in previous correspondence, six suspect hubs were immediately removed from service once it was determined that these hubs had inspection notations recorded during the blue etch anodize (BEA) inspection. All six hubs have received FPI, ECI. and BEA inspection at Pratt & Whitney. Metallurgical sections were made through the most suspect indications. Analysis of these areas determined that no cracks or work hardened areas were present. Even with these positive findings, Pratt & Whitney feels that it is prudent to inspect the rest of the hubs manufactured with coolant channel drills.

Copies of Presentation Book

The presentation book used during the August 22, 1996 meeting is being revised to reflect the final number of hubs affected (719). and the final recommendations which Pratt & Whitney and the ATA agreed upon. The revised book will also have the list of the serial numbers for the 719 hubs requiring inspection. This revised book will be mailed out to all JT8D field representatives for distribution to our customers. Additional copies may be requested through you local field representative.

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REGARDS,

CHARLES R. CRENSHAW
MID THRUST TECHNICAL SUPPORT

[redacted]

POPULATION OF COOLANT CHANNEL DRILL HUBS

S/N		R32781		R32866		R32923	
P66733		R32782		R32867		R32924	
P66744		R32783		R32868		R32925	
P66747		R32784		R32869		R32926	
P66749		R32785		R32870		R32927	
P66756		R32786		R32871		R32928	
P66760		R32787		R32872		R32929	
P66797		R32788		R32873		R32930	
P66798		R32789		R32874		R32931	
P66799		R32790		R32875		R32932	
P66800		R32791		R32876		R32933	
P66801		R32792		R32877		R32934	
P66802		R32793		R32878		R32935	
P66803		R32794		R32879		R32936	
P66804		R32795		R32880		R32937	
P66805		R32796		R32881		R32938	
P66806		R32797		R32882		R32939	
P66807		R32799		R32883		R32940	
P66808	scrap	R32800		R32884		R32941	
P66809		R32801		R32885		R32942	
P66810		R32803		R32886		R32943	
P66811	scrap	R32804		R32887		R32944	
P66812		R32805		R32888		R32945	
P66813		R32806		R32889	scrap	R32946	
P66814		R32807		R32890		R32947	
P66815		R32808		R32891		R32948	
P66816		R32815		R32892		R32949	
P66817		R32816		R32893		R32950	scrap
P66818		R32823		R32894		R32951	
P66819		R32825		R32895		R32952	
P66820		R32827		R32896		R32953	
P66821		R32828		R32897		R32954	
P66822		R32829		R32898		R32955	
P66823		R32830		R32899		R32956	
P66824		R32832		R32900		R32957	
P66825		R32833		R32901		R32958	
P66826		R32834		R32902		R32959	
P66827		R32835		R32903	scrap	R32960	
P66828		R32836		R32904		R32961	
P66829		R32837		R32905		R32962	
P66830		R32838		R32906		R32963	
P66831		R32839		R32907		R32964	
P66832		R32845		R32908		R32965	
P66833		R32852	scrap	R32909		R32966	
P66834		R32853		R32910		R32967	
P66851		R32854		R32911		R32968	
P66852		R32855		R32912		R32969	
P66853		R32856		R32913		R32970	
P66854		R32857		R32914		R32971	
P66856		R32858		R32915		R32972	
P66858		R32859		R32916		R32973	
R32767		R32860		R32917		R32974	scrap
R32768		R32861		R32918		R32975	
R32771		R32862		R32919		R32976	
R32777		R32863		R32920		R32977	
R32779		R32864		R32921		R32976	
R32780		R32865		R32922		R32979	

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POPULATION OF COOLANT CHANNEL DRILL HUBS (CON'T)

R32980		R33038		R33096		R33154	
R32981		R33039		R33097	scrap	R33155	
R32982		R33040		R33098		R33156	
R32983		R33041		R33099		R33157	
R32984		R33042		R33100		R33158	
R32985		R33043		R33101		R33159	
R32986		R33044		R33102		R33160	
R32987		R33045		R33103		R33161	
R32988		R33046		R33104		R33162	
R32989		R33047		R33105		R33163	
R32990		R33048		R33106		R33164	
R32991		R33049		R33107		R33165	
R32992		R33050		R33108		R33166	
R32993		R33051		R33109		R33167	
R32994		R33052		R33110		R33168	
R32995		R33053	scrap	R33111	scrap	R33169	
R32996	scrap	R33054	scrap	R33112		R33170	
R32997		R33055		R33113		R33171	
R32998		R33056	scrap	R33114		R33172	
R32999		R33057		R33115		R33173	
R33000		R33058		R33116		R33174	
R33001		R33059		R33117		R33175	
R33002		R33060		R33118		R33176	
R33003		R33061		R33119		R33177	
R33004		R33062		R33120		R33178	
R33005		R33063		R33121		R33179	
R33006	scrap	R33064		R33122		R33180	
R33007		R33065		R33123		R33181	
R33008		R33066		R33124		R33182	
R33009	scrap	R33067		R33125	scrap	R33183	
R33010	scrap	R33068		R33126		R33184	
R33011	scrap	R33069		R33127		R33185	
R33012		R33070		R33128		R33186	scrap
R33013	scrap	R33071		R33129		R33187	
R33014		R33072		R33130		R33188	scrap
R33015		R33073		R33131		R33189	
R33016		R33074	scrap	R33132		R33190	scrap
R33017		R33075		R33133		R33191	
R33018		R33076		R33134		R33192	
R33019		R33077		R33135		R33193	
R33020		R33078		R33136		R33194	
R33021		R33079		R33137		R33195	scrap
R33022		R33080		R33138		R33196	
R33023		R33081		R33139		R33197	
R33024		R33082		R33140		R33198	
R33025		R33083		R33141		R33199	
R33026		R33084		R33142		R33200	
R33027	scrap	R33085		R33143		R33201	
R33028		R33086		R33144		R33202	
R33029		R33087		R33145		R33203	
R33030		R33088		R33146	scrap	R33204	
R33031		R33089		R33147		R33205	
R33032		R33090		R33148		R33206	
R33033		R33091	scrap	R33149		R33207	
R33034		R33092	scrap	R33150		R33208	
R33035		R33093		R33151		R33209	
R33036		R33094		R33152		R33210	
R33037		R33095		R33153		R33211	

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R33212	scrap	S25229		S25287		S25345	
R33213		S25230	scrap	S25288		S25346	scrap
R33214		S25231		S25289	scrap	S25347	
R33215		S25232		S25290		S25348	
R33216		S25233	scrap	S25291	scrap	S25349	
R33217		S25234		S25292		S25350	
R33218		S25235		S25293		S25351	
R33219	scrap	S25236	scrap	S25294		S25352	
R33220		S25237		S25295		S25353	
R33221		S25238		S25296		S25354	
R33222		S25239		S25297		S25355	
R33223		S25240		S25298		S25356	
R33224		S25241	scrap	S25299		S25357	
R33225		S25242		S25300		S25358	
R33226	scrap	S25243		S25301		S25359	
R33227		S25244		S25302		S25360	
R33228		S25245		S25303		S25361	scrap
R33229	scrap	S25246		S25304		S25362	
R33230		S25247		S25305		S25363	
S25190		S25248		S25306		S25364	scrap
S25191		S25249		S25307	scrap	S25365	
S25192		S25250		S25308		S25366	
S25193		S25251		S25309	scrap	S25367	
S25194		S25252		S25310		S25368	
S25195		S25253		S25311	scrap	S25369	
S25196		S25254		S25312		S25370	
S25197		S25255		S25313		S25371	
S25198		S25256		S25314		S25372	
S25199		S25257		S25315		S25373	
S25200		S25258		S25316		S25374	
S25201	scrap	S25259		S25317		S25375	
S25202		S25260		S25318		S25376	
S25203		S25261		S25319		S25377	
S25204		S25262		S25320		S25378	
S25205		S25263	scrap	S25321		S25379	
S25206		S25264		S25322		S25380	
S25207		S25265		S25323		S25381	
S25208		S25266		S25324	scrap	S25382	
S25209		S25267		S25325		S25383	
S25210		S25268		S25326		S25384	
S25211		S25269		S25327		S25385	
S25212		S25270		S25328		S25386	
S25213		625271		S25329		S25387	
S25214	scrap	S25272		S25330		S25388	
S25215		S25273		S25331		S25389	
S25216		S25274		S25332		S25390	
S25217		S25275		S25333		S25391	scrap
S25218		S25276		S25334		S25392	scrap
S25219		S25277		S25335		S25393	scrap
S25220		S25278		S25336		S25394	
S25221		S25279		S25337		S25395	
S25222		S25280		S25338		S25396	
S25223		S25281		S25339		S25397	scrap
S25224		S25282		S25340		S25398	
S25225		S25283		S25341		S25399	
S25226		S25284		S25342		S25400	
S25227		S25285		S25343		S25401	
S25228		S25286		S25344		S25402	

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S25403	scrap	S25665					
S25404	scrap	S25667					
S25405		S25668					
S25406		S25670					
S25407		S25672					
S25408		S25675					
S25409		S25676					
S25410		S25677					
S25411		S25678					
S25412	scrap	S25679					
S25413		S25680					
S25414		S25684					
S25415		S25685					
S25416		S25686					
S25417		S25688					
S25418		S25689					
S25419		T50556					
S25420		T50559					
S25421		T50868					
S25422		T50870					
S25423		T50873					
S25424		T50876					
S25425		T50877					
S25426		T50878					
S25427		T50879					
S25428		T50880					
S25429	scrap	T50881					
S25430		T50882					
S25431	scrap	T50885					
S25432							
S25433							
S25434							
S25435							
S26496							
S25437							
S25438							
S25439							
S25440							
S25441							
S25442							
S25444							
S25446							
S25449							
S25450							
S25451	scrap						
S25452							
S25457	scrap						
S25462	scrap						
S25645							
S25646							
S25647							
S25649							
S25651							
S25654							
S25657							
S25661							
S25662							
S25664							

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HUBS BUSHED AT MANUFACTURER

Manufacturer	Hub Serial Number	Heat Code Suffix
Pratt & Whitney	J13945	CFUL 2021
Pratt & Whitney	J14647	CHHY 2017
Pratt & Whitney	J14681	CHTC 2026
Pratt & Whitney	J13488	CFUL 2012
Pratt & Whitney	J79141	CJWS 201 1
Atlantic	K72481	CKDU 2009
Atlantic	M90852	CUBJ 2001
Atlantic	K41835	CKJL 2016
Atlantic	L41729	CSWR 2004
Volvo	M67671	CTFZ 2001
Volvo	M67722	CTJF 2023
Volvo	M67725	CTJF 2005
Volvo	M67726	CUNR 2013
Volvo	M67746	CTJF 2012
Volvo	M67784	CUBL 2010
Volvo	M67826	CUZR 2007
Volvo	N71771	CWRR 2020
Volvo	N71875	CWYH 2007
Volvo	N72062	CYYW 2012
Volvo	N72207	CZJB 2026
Volvo	N72242	CZJB 2015
Volvo	P66753	CZRK 2020
VOlVO	P66831	LAFJ 4005
Volvo	P66880	LCHK 4018
Volvo	P66885	LCRW 4014
Volvo	R32735	LCNU 4015
Volvo	R32792	LCHK 4021
Volvo	R32800	LCRW 4021
Volvo	R32807	LCAA 4013
Volvo	R32810	LCAA 4023
Volvo	R32849	LCLY 4007
Volvo	R32870	LCCB 4015
Volvo	R32905	LCCB 4010
Volvo	R32952	LCYB 4005
Volvo	R32964	LCWD 4026
Volvo	R32966	LCST 4022
Volvo	R32981	LCST 4017
Volvo	R33004	LCZR 4007
Volvo	R33059	LCWD 4010
Volvo	R33136	LCHS 4014

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