

# USAF F-16 ASIP Data Collection

## ASIP 2007

### December 6, 2007



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- **F-16 introduction**
- **Database background**
- **Database discussion**
  - **Data collection for analysis**
  - **Database population**
- **Future plans**
- **Conclusions**

- The F-16 is a compact, multi-role fighter aircraft
  - First flown in December 1976
  - Operated by many countries
- Several aircraft blocks manufactured:
  - 10/15
  - 25/30/32
  - 40/42
  - 50/52
- Most of the block 10/15 aircraft have been retired
  - Exact retirement dates for remaining aircraft blocks are unknown
- Aircraft structural integrity must be maintained throughout the remaining life



<http://www.af.mil/photos/index.asp?galleryID=3&page=5>

# Introduction



- **The Health of the Fleet (HOTF) analysis is an aircraft structural integrity program (ASIP) support tool designed to summarize and analyze fatigue cracking data obtained from various sources**
- **Fatigue cracking trends are identified, and predictions for problematic areas of future cracking are made**
- **HOTF is important due to the extended service life requirements of the F-16**



- **HOTF requires significant amounts of aircraft data to allow for accurate fleet assessment**
- **These data types are collected from varying sources, substantiating the need for several databases**
- **The databases cover a range of data inputs, including special inspection reporting and individual aircraft tracking**
- **HOTF was presented at ASIP 2006 (“Current Health of the USAF F-16 Fleet”)**

# ***Background: F-16 Structural Inspections***

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- **Individual Aircraft Tracking (IAT) Program**
  - **Tracks potential structural damage growth**
  - **Adjusts average maintenance schedule based on individual aircraft usage**
  - **Projects flight hours and dates of maintenance requirements**
- **Phase Inspections**
  - **Based on crack findings**
- **Analytical Condition Inspection (ACI)**
  - **Sampling of critical structural components during depot modification or repair**

# *Why perform a health of the fleet study?*

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- **The F-16's mission has changed from that originally designed**
  - **Significant cracking has occurred**
  - **Many problem areas have been repaired and/or have had structure replaced**
  - **Future areas of fatigue related cracking need to be identified**
  - **Data must be collected to support HOTF efforts**
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# Health of the Fleet Analysis Purpose

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- **Determine cost of:**
    - **Current inspections**
    - **Future modifications**
  - **Data collection to support:**
    - **Aircraft attrition**
    - **Risk analysis**
- 
- A semi-transparent image of an F-35 fighter jet in flight is overlaid on the slide, positioned behind the text. The jet is shown from a side-on, slightly elevated perspective, flying towards the right.





## INPUT

Engineering  
Disposition  
Requests



F-16 Fleet  
Cracking  
Database



Fleet Structural  
Maintenance Plan



F-16 Preventive and  
Scheduled Maintenance  
Technical Orders



Major Modification  
Programs/Time  
Compliance Technical Orders



Health  
of the  
Fleet  
(HOTF)  
Analysis

## OUTPUT

Future crack occurrence  
prediction by analyzing  
historical and current  
cracking trends



Crack summarization by  
block, area of fuselage,  
and part number



Flight hours at reported  
cracking charted against  
percentage of the fleet  
reporting a crack



Predictive maintenance cost  
and associated downtime  
interactive website





- **Common Inspection Reporting Engine (CIRE)**
  - **Various inspections currently in the system, input by field units – benefits include ease of reporting and instant results visibility**
    - Upper wing skin
    - Lower FS 341 bulkhead: cannon plug satellite holes
    - FS 357 bulkhead inspection: strap area
    - FS 479 bulkhead: vertical tail attach pads
  - **Analytical Condition Inspection (ACI)**
- **Individual Aircraft Tracking (IAT)**
  - Inspections reported online by field units
  - Interim Operational Supplements (IOS) reported via the web
- **Fatigue Cracking Database (FCD)**
  - Maintained by engineers through requests for engineering disposition (107T/202) database

# Common Inspection Reporting Engine (CIRE)

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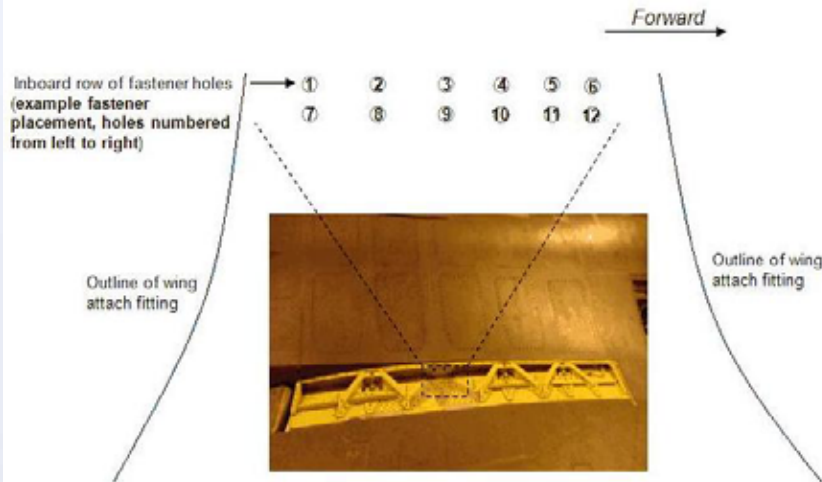
- CIRE is used for tracking various inspection reporting requirements
  - Current inspections include:
    - Upper wing skin fastener holes along the inboard edge
    - Lower FS 341 bulkhead: cannon plug satellite holes
    - FS 357 bulkhead inspection: strap area
    - FS 479 bulkhead: vertical tail attach pads
    - Analytical Condition Inspections (ACI)
  - New inspections can be easily added
  - Online capability allows users to access data immediately
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# CIRE Examples

## Upper wing skin fastener holes



Submit Inspection



### General Information

Wing Serial Number:

Part Number:

Select Wing:  Left Wing  Right Wing

Action Taken:  Upper Wing Skin Replaced  Repair Performed (preventative or oversize bushing)  No Action Taken

Under Wing Attach Fitting:  1  2  3  4

### Crack Lengths

Please enter surface crack length(s) in inches, fore and aft, in decimal form (example: 0.125)

Example crack measurement

#1 Fore:  Aft:

#2 Fore:  Aft:

#3 Fore:  Aft:

#4 Fore:  Aft:

#5 Fore:  Aft:

# CIRE Examples

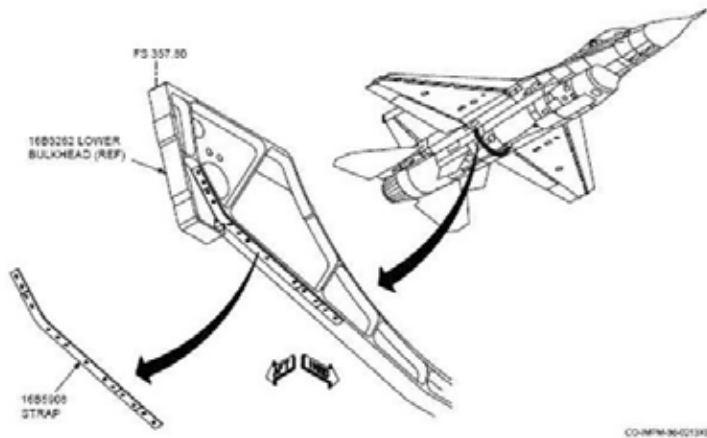
## FS 357 bulkhead -- strap area



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INSPECTION [DETAIL](#) [Edit](#)

Inspection	Visual Inspection of FS 357.8 Lower Bulkhead Strap Fitting Attachment Area	Control Number	07-000000-00074	Date	09/19/20
Aircraft S/N		Flight Hours	4321.00	Base Depot	
Inspector	Kimberli Jones	Phone			



### Inspection Results

Crack Found?	<input checked="" type="radio"/> Yes <input type="radio"/> No
Crack Length	<input type="text" value="0.5"/>
Crack Location	<input type="text"/>
Comments	<input type="text" value="Crack found during IAT inspection."/>

# CIRE Examples

## FS 479 bulkhead -- vertical tail attach pads



ENTER A NEW INSPECTION

Inspection	Upper Bulkhead Vertical Stabilizer Attach Pad Eddy Current Crack Detection		Date	09/19/2007	(MM/DD/YYYY)
Aircraft S/N	N/A	Flight Hours	5432	Base	Depot
Inspector	Kimberli Jones		Phone		

Submit Inspection

Dimensions

Crack Dimensions (+/- 1/16 Inch)

Gain Setting: Angle  H  V

**LEFT SIDE**

a =

b =

c =

**RIGHT SIDE**

a =

b =

c =

Numbers must be in the form of a whole number or fraction.

**Examples:**

- 1 inch would be entered as **1**
- 1 and 1 quarter inch would be entered as **1.1/4**
- 3 sixteenths inch would be **3/16**

a = aft edge of pad to end of crack    b = total crack length  
c = forward edge of pad to end of crack

Current Response

**Eddy Current Response (+/- 5%):** Take 4 equally spaced readings as shown. Readings 1 and 4 shall be largest responses measured in region of crack ends. For cracks not extending full width of attach pad, crack end region is defined as 1/8 inch from crack tip +/- 1/16 inch. For cracks extending full width of attach pad, crack end region is defined as 1/8 inch from FWD/AFT edges of pad +/- 1/16 inch. In addition to readings 1 through 4, scan entire length of the crack to identify magnitude and location of maximum crack response.

# CIRE Examples

## ACI – upper FS 341 bulkhead



Submit Inspection

<< First < Prev Next > Last >> Page 3 of 7

### 1038 Upper FS 341.8 Bulkhead, Outboard FSJ Attach Bolt Holes (Post-ECP 1910)

Defect Found  Yes  No

**Action Taken**

Repair Performed   
No Action Taken

Hole	Crack Size	Direction
Left Hand Side		
1		
2		
Right Hand Side		
1		
2		
Additional Information/Comments		



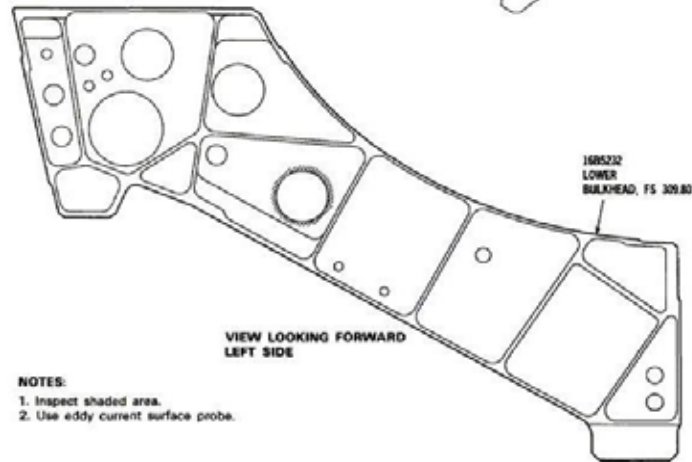
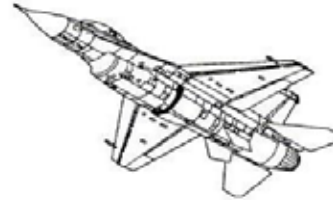


- **Inspection Reports**
  - **Control points vary by block**
  - **Webpage lists only the applicable control points for a given aircraft (block dependent)**
- **Interim Operational Supplement (IOS)**
  - **Released every 6 months to notify of upcoming inspections by individual tail number**



# IAT Example

## Control point inspection



Control Point B5232AC: FS 309 BLKHD LH PANEL F

Defect Found	<input type="radio"/> Yes <input checked="" type="radio"/> No
Crack Length (inches)	<input type="text"/>
Origination	<input type="text"/>
Orientation	<input type="text"/>
Repaired	<input type="radio"/> Yes <input checked="" type="radio"/> No
Repair Method	-- Select a Repair Method --

# IAT Example

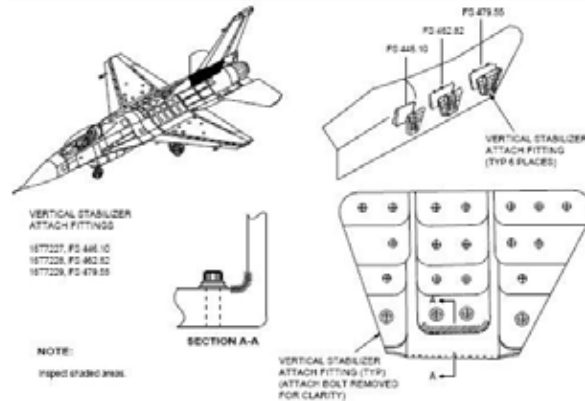
## Control point inspection



ENTER A NEW INSPECTION

Control Point	T7228BA	Date	10/02/2007 (MM/DD/YYYY)
Aircraft S/N		Flight Hours	5432
Inspector	Kimberli Jones	Base	Depot - Depot
Image Upload	<input type="text"/> Browse...	Phone	<input type="text"/>

Submit Inspection



Control Point T7228BA: VERTICAL TAIL CENTER ATTACH FITTING (INCLUDE ALL 3 ATTACH PADS)

16T7227 FS 446.10 LEFT

Defect Found	<input checked="" type="radio"/> Yes <input type="radio"/> No
Crack Length (inches)	-- Select a Repair Method -- No Action Taken Replaced Part
Origination	Submitted 107 Request
Orientation	Stop Drilled Crack Rout/Ream Hole Installed Doubler Machined Fitting
Repaired	Other (enter comments)
Repair Method	-- Select a Repair Method --
Comments	<input type="text"/>

16T7228 FS 462.82 LEFT

Defect Found	<input type="radio"/> Yes <input checked="" type="radio"/> No
Crack Length (inches)	<input type="text"/>
Origination	<input type="text"/>
Orientation	<input type="text"/>
Repaired	<input type="radio"/> Yes <input checked="" type="radio"/> No
Repair Method	-- Select a Repair Method --
Comments	<input type="text"/>

16T7229 FS 479.55 LEFT

Defect Found	<input type="radio"/> Yes <input checked="" type="radio"/> No
Crack Length (inches)	<input type="text"/>
Origination	<input type="text"/>
Orientation	<input type="text"/>
Repaired	<input type="radio"/> Yes <input checked="" type="radio"/> No
Repair Method	-- Select a Repair Method --
Comments	<input type="text"/>

# IAT Example

## Interim Operational Supplement



### F-16 IAT INSPECTIONS

AIRCRAFT STRUCTURAL INTEGRITY PROGRAM

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You are logged in as Kimberly Jones

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#### SELECT A UNIT

Unit	Unit Contact Email	Last Notification Sent
<input type="text" value=""/>	none	Never
<a href="#">PRINT VERSION</a>		
Tail Number	Control Point	Due At
<input type="text" value=""/>	B5251BA	5173
<input type="text" value=""/>	D6135AA	5904
<input type="text" value=""/>	W102GA	5626
<input type="text" value=""/>	No Inspection(s) Required	
<input type="text" value=""/>	B1103BA	5169
<input type="text" value=""/>	B6135AA	5448
<input type="text" value=""/>	W102GA	5099
<input type="text" value=""/>	B1103BA	4907
<input type="text" value=""/>	B1103BA	4850
<input type="text" value=""/>	B5251BA	4328
<input type="text" value=""/>	B6135AA	4929
<input type="text" value=""/>	W102GA	4017
<input type="text" value=""/>	B1103BA	5479
<input type="text" value=""/>	B1103BA	5693
<input type="text" value=""/>	B6135AA	5628
<input type="text" value=""/>	B6215BB	5442
<input type="text" value=""/>	D1103BA	6375
<input type="text" value=""/>	B6215BB	6571
<input type="text" value=""/>	B1103BA	5791
<input type="text" value=""/>	D6040AC	6136



- **Inputs come from requests for engineering disposition (107T/202)**
  - **Engineers fill out the information for the fatigue cracking database as they answer the disposition**
  - **Cracking information can be added, edited, or deleted later as needed**
-

# Engineering Disposition Request Fatigue Crack Database



- YPVS Chief Structural Engineer: Tim Sorensen
- Engineering Main
- View NCR and Status
- Assign NCRs
- Answer NCRs
- Edit a NCR
- Add / Delete NCR Files
- Approve NCRs
- Field User Login
- Review NCR Database
- Member Management
- Rescind or Delete a NCR
- Reassign NCR for Approval

## Fatigue Crack Database

This page displays a list of all NCRs. This page can also be used to add existing NCRs to the Fatigue Crack Database.

[Add to Fatigue Crack Database](#)    [Search Fatigue Crack Database](#)

Total Records Found:   
Records Shown: 1 - 50

[First Page](#)   [Previous Page](#)   [Next Page](#)   [Last Page](#)

Control Number	Submittal Date	Location	Block	Part Number	Crack Length
<a href="#">[Link]</a>	01/11/2010	...	0	...	0.266
<a href="#">[Link]</a>	01/11/2010	...	0	...	
<a href="#">[Link]</a>	01/11/2010	...	0	...	At least 5"
<a href="#">[Link]</a>	01/11/2010	...	0	...	
<a href="#">[Link]</a>	01/11/2010	...	0	...	0.3125'
<a href="#">[Link]</a>	01/11/2010	...	0	...	5"
<a href="#">[Link]</a>	01/11/2010	...	0	...	0.125
<a href="#">[Link]</a>	01/11/2010	...	0	...	0.75
<a href="#">[Link]</a>	01/11/2010	...	0	...	0.625
<a href="#">[Link]</a>	01/11/2010	...	0	...	unk
<a href="#">[Link]</a>	01/11/2010	...	0	...	1.062
<a href="#">[Link]</a>	01/11/2010	...	0	...	0.5"
<a href="#">[Link]</a>	01/11/2010	...	0	...	6.75
<a href="#">[Link]</a>	01/11/2010	...	0	...	1.1875'
<a href="#">[Link]</a>	01/11/2010	...	0	...	75
<a href="#">[Link]</a>	01/11/2010	...	0	...	85
<a href="#">[Link]</a>	01/11/2010	...	0	...	0.25

# Engineering Disposition Request Fatigue Crack Data



- YPVS Chief Structural Engineers  
Tim Sorensen
- Engineering Main
- View NCR and Status
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- Answer NCRs
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## Fatigue Crack Information

This page displays the information stored in Fatigue Crack Database.

CONTROL NUMBER:	DATE:	BLOCK:	PART NUMBER:	AIRCRAFT S/N:
LENGTH: 1.1875"	ORIENTATION: forward - aft	REPAIR DESCRIPTION: Replace Part	ORIGIN: Edge	MULTIPLE CRACKS: No
COMMENTS Temporary repair given; replace no later than next phase.				<a href="#">Edit Crack</a>

[Add Fatigue Crack for this NCR](#)    [View Complete Fatigue Crack List](#)

Registered in Fatigue Crack Database

107-T NONCONFORMING TECHNICAL ASSISTANCE REQUEST AND REPLY				
PART A				
1. TO	2. FROM	3. DATE	4. CONTROL NUMBER	
5. NOUN	6. PART NUMBER	7. NATIONAL STOCK NUMBER	8. SERIAL/TAIL NUMBER	
9. UNIT AIRCRAFT ASSIGNED TO	10. T.O./DWG NUMBER	11. WORK STOPPAGE	12. ORGANICALLY CAUSED	13. QUALITY ASSURANCE NOTIFIED
A/C DEFICIENCY REGION	A/C BLOCK	A/C FLYING HOURS	PROBLEM POC	
14. DEFICIENCY AND RECOMMENDATIONS				
15. INITIATOR (Signature/Office Symbol/Phone)			16. IND. ENGR. TECH/PLANNER (Signature/Office Symbol/Phone)	
PART B				
17. TO	18. FROM	19. DATE	20. ENGINEER/ES (Name/Office Symbol/Phone)	
21. DISPOSITION INSTRUCTIONS				
REPAIR	REWORK	USE AS IS	CONDEMN X	OTHER
22. REPAIR INSTRUCTIONS				



- **Collected information is used within the Health of the Fleet Analysis to:**
  - **Project future cracking trends**
  - **Assess risk**
  - **Review current fleet state**
  - **Discover underlying causes of fatigue cracking**
  - **Predict potential aircraft modification needs**



- **Continue to collect data, including reported fatigue cracks, inspection results, etc.**
- **Add various standard technical order repairs to CIRE to increase visibility of the actual number of repairs performed**
- **Improve data reporting procedures and databases**
- **Create a corrosion specific database to facilitate easier tracking**
  - **Recently added a specific place in the 107T/202 system to indicate if the request is maintenance induced or corrosion related**



# Conclusions



- **The Health of the Fleet analysis is an important part of sustaining the F-16 until retirement**
- **Data collection is a very important part of aircraft sustainment**
- **New data may be introduced easily into the Health of the Fleet analysis**
- **New databases/inspections continue to be introduced for useful ASIP data capture**

# Acknowledgments

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- Work performed by SAIC under USAF Contract F09603-01-D0208-QP23
- Thanks to Rob McCowin, former F-16 ASIP manager, currently with ES3



# Questions?



[http://www.f-16.net/gallery\\_item30738.html](http://www.f-16.net/gallery_item30738.html)