

Presented by:
Mr. Paul Sampson

Army Materiel Command



NCMS/CTMA
*Working Symposium On
Sustainment: Strengthening
America's Military Readiness*



Universal Static Balance Fixture



Universal Static Balance Fixture



Overview

- ◆ **Project Status**
 - **USBF Quad Chart**
 - **Project Team**
 - **Challenge**
 - **System Specifications**
 - **Technical Approach**
 - **Schedule**
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Universal Static Balance Fixture



Solution/Approach

- Develop and demonstrate a prototype universal computer controlled static balance fixture that can balance any DoD main rotor blade through the use of strategically placed load cells
- The system will calculate and correlate span and chord wise centers of gravity, static and dynamic centers of gravity, and overall weight

Benefits

- New industry standard for static and dynamic balancing
- Estimated cost savings of over \$1.0M per year at CCAD
- Potential reduction of cycle time of 15% for dynamic testing on existing Whirl Tower by balancing blades to a tighter tolerance
- Estimated cost savings of \$20.0M @ 20 years

Problem/Objective

Main rotor blade repair procedures vary throughout industry and require both static and dynamic balancing. Current balance procedures require a different static fixture per blade type and a dynamic Whirl Tower for some blades. Capability per blade is constrained by the flexibility of existing equipment, production space, and a tremendous Whirl Tower expense for operation and maintenance to accommodate current, transitioned, and new workloads.

FUNDING

<u>FY97</u>	<u>FY98</u>	<u>FY99</u>	
125K	225K	125K	Army ManTech/RM&S
0	0	0	Other Gov't
0	0	0	Industry/Acad.

Completion: Oct 00

Status

Project status is as follows:

- Completed Oct 00
- All blades have been certified:

CH-47	AH-1W	CH-53E	CH-46
UH-60	OH-58D	H-3	UH-1H/N
AH-1S	SH-60		

- Implemented at CCAD



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Project Team



Organization	Name	Responsibility
CCAD	De Havel	Government Project Leader
GRC International Inc. an AT&T Company	Mike Cummings Paul Sampson	Prime contractor Customer Liaison Program Mgmt & Integration Program Documentation
Avion Inc.	Norman Beachum Joseph Buckel Dennis Dunaway Charles Clark	Program Plan Design/Specification Analysis USBF Concept Demonstration Final Demonstration/Review

Challenge

- ◆ **Develop and demonstrate a prototype universal computer controlled static balance fixture that can balance DoD main rotor blades through the use of strategically placed load cells**
 - **Main rotor blade repair procedures vary throughout industry**
 - **Current balance system requires a different static fixture for each blade type**
 - **Throughput constrained by the flexibility of existing equipment and production space at CCAD**
 - **Subsequent Whirl Tower testing costs increasing**



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System Specifications

- ◆ **System utilizes load cells, with feedback to an integral PC control system**
- ◆ **Self calibrating system/automated diagnostics**
- ◆ **Integral printer for hardcopy of test results**
- ◆ **User friendly alpha numeric keyboard interface with PC controller**
- ◆ **Mobile system, can be disassembled into two ten foot sections for storage**



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System Specifications - Continued

- ◆ **Blade can be positioned by one person**
- ◆ **Load cell location varies by blade type**
- ◆ **Unique software algorithms for each blade type**
- ◆ **USBF balances blades for: span-wise moment, chord-wise center of gravity or moment, and overall weight**



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Technical Approach

- ◆ **For Each Blade to be Balanced:**
 - **Collect Drawings and DMWRs**
 - **Develop Control Software**
 - **Determine Required Load Cell Size and Location**
 - **Design and Fabricate Mechanical Attachments**
 - **Develop Users Manual**
 - **System Demonstration**
 - **Operation and Maintenance Training**

Technical Approach - Continued

◆ Avion - USBF

➤ Structural Table

- 20 ft. long
- Full swivel/adjustable height
- Breaks down into two 10 ft. sections
- T-bar substantially improves repeatability

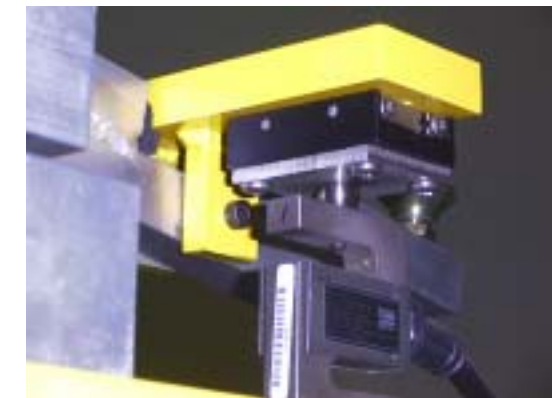


➤ Blade Lift Subsystem

- Allows one person to position blade

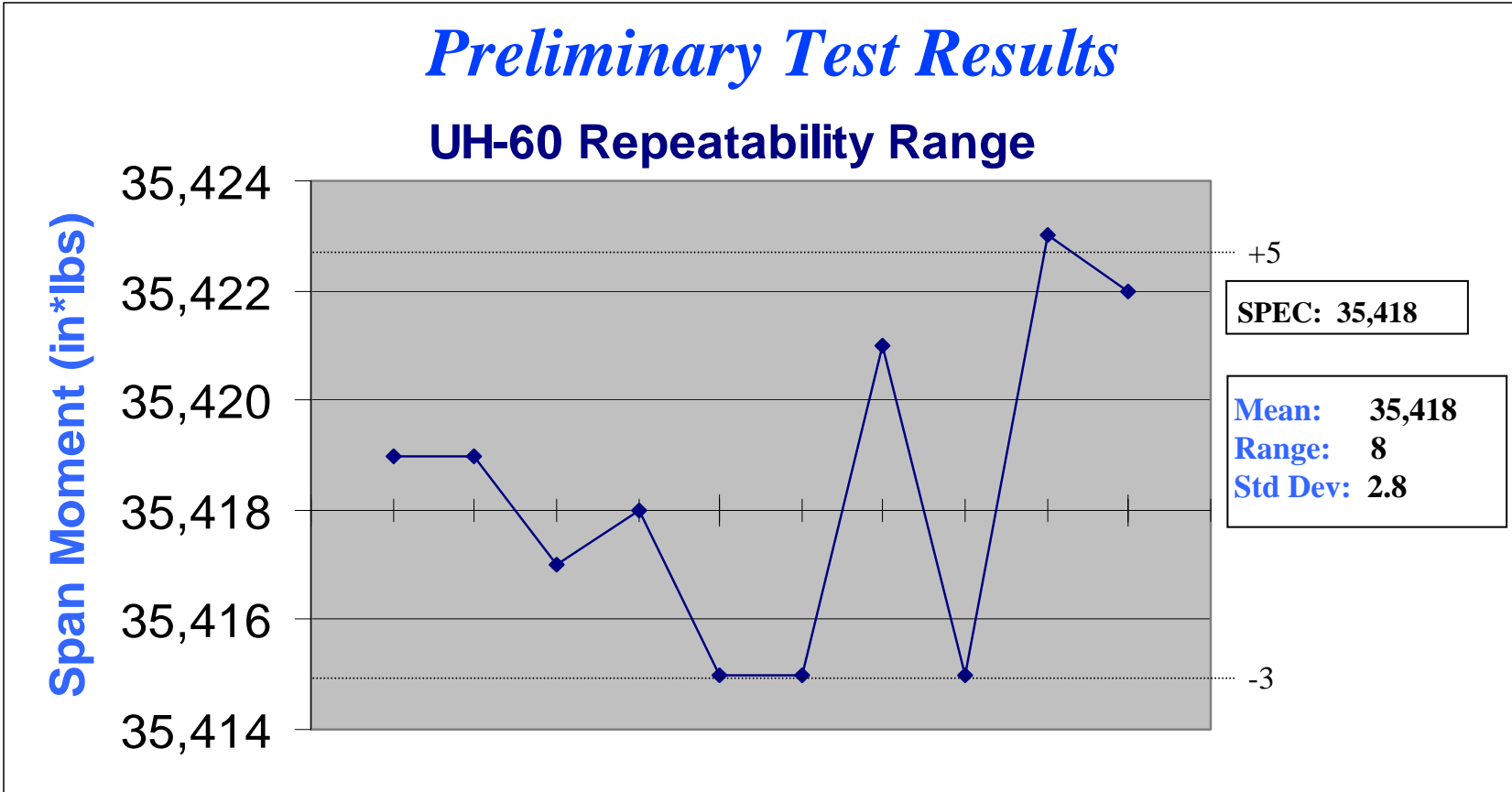
➤ Electronic Subsystem

- Intel 486 processor
- Integral printer
- Alpha numeric keyboard
- Highly reliable load cells



Status/Results

- ◆ Example: Data Collected at Ft Rucker (AH-64), Boeing, CCAD (Bell Blades), and Sikorsky



Implementation

- ◆ Completed development of prototype USBF
- ◆ Successfully demonstrated on various main rotor blades at CCAD
- ◆ Several USBFs have been sold/delivered to various field organizations for maintenance
 - National Guard
 - Army Reserves
 - Commercial aviation facilities
- ◆ Technology transitioned to balance tail rotors
- ◆ Potential to transition technology to balance C-130 propellers





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Summary

- ◆ **USBF technology is extremely cost-effective for balancing rotor blades**
 - **50% reduction in static balancing time through use of single vs. multiple fixture process**
 - **Static balancing blades to a higher tolerance**
 - **15% reduction in cycle time for dynamic testing on Whirl Tower**
 - **Estimated cost savings of \$1M per year at CCAD for static balancing**
- ◆ **Impacted systems**
 - **AH-1 Cobra, AH-1W Super Cobra, AH-64 Apache, CH-46 Sea Knight, CH-47 Chinook, CH-53 Sea Stallion, OH-58D Kiowa Warrior, UH-60A Black Hawk, MH-60 Pave Hawk, SH-60 Sea Hawk, UH-1 Huey, UH-1N Huey**