

Patrick Results. The print outs below are from a C-H 8500C Balancer*. The aircraft: US Air Force Sikorsky HH-60 Pavehawk. The print outs were done after a Phase Inspection.

After the 8500C had measured, collected and then calculated a balancing solution, as illustrated on each print out below, IVT then utilized that data. IVT's patented technology was used to analyze the data. **NOTE: Only IVT's calculated solutions were used to solve the problem.**

1st flight print out:

1st Run

HH-60 Main Rotor 428MTL (Direct, w/ Track)
 Smart Chart #12955-7
 Revision Date: 31 Apr 99
 Tail Number: 6232
 Run Number:
 Data Acquired: 23:51:06 3 Apr 2000
 Frequency: 289 RPM

100% Ground Roll: 0.438 IPR @ 5:25
 Hover Roll: 0.337 IPR @ 5:27
 130 KIAS Roll: 0.292 IPR @ 5:16
 130 KIAS Vertical: 0.888 IPR @ 8:09

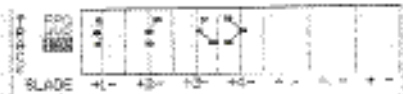
Damper check not performed.

Current Solution Options:
 Use P/L: YES Tab: YES Weight: YES
 Solve for: WTB + TRACK

Iterations: 1
 Excellent improvement predicted
 Ground Goal: 0.981 IPR
 Flight Goal: 0.891 IPR

Current weights (GRM) and tab (MILS) configuration for each blade:

BLADE	1	2	3	4
WTB	+088	+028	+088	+088
WEIGHT	2.68	2.68	2.68	2.68



Track Measurements (INCHES):

Blade	1	2	3	4
FPG	+0.28	-0.48	-2.57	+0.71
HVR	+0.47	-0.22	+0.18	-0.15
130	+0.44	-1.84	-1.20	+0.51

Link/Tab Measurements (MILLIMETERS):

Blade	1	2	3	4
FPG	+11	-4	-18	+0
HVR	-5	+8	+2	+11
130	+5	-4	-7	-4

Measurements are relative to blade

8500C Firmware Version: 4.114
 8520/8528C Firmware Version: 8.1
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23:52:27 3 APR 2000

	1	2	3	4
P/L (notches)	1.8	1.4	1.7	1.4
TAB (mils)	+1.42	0.00	0.00	0.00

MAKE ALL CHANGES!

↑ means make blade fly higher with pitch link or tab.
 (UP tab makes blade fly higher.)

All changes made from present settings.
 NOT from zero!

TAB MEASUREMENT STATION

	1	2	3	4	5	6

Norm's Adj.
 #1 ↓ 8 mil
 #3 ↑ 12 mil
 #4 ↓ 8 mil

The solution is handwritten on the print outs – it is shown as “Norm’s Adj.”

Solutions:

8500C solution: 3 Pitch Link; 3 Tab; 2 Hub Weight Adjustments

IVT solution: 3 Tab Adjustments

*The C-H 8500C Balancer is the approved balancing equipment utilized by the US Air Force.

2nd flight print out:

2nd Run

07:23:07 5 APR 2009

	1	2	3	4
Hub InnerRadius:	-1.0	1.0	-1.0	-1.0
Tab Length (mm):	+0.00	0.00	0.00	+0.00

MAKE ALL CHANGES!

↑ means make blade fly higher with pitch link or tab.
(Use tab makes blade fly higher.)

All changes made from present settings.
ME from zero!

TAB MEASUREMENT SECTION

	1	2	3	4	5	6

Norm's Adj.

#3 ↓ 6 mil

#4 ↓ 4 mil

MR-50 Main Rotor (LSAP), Smart, w/ Track
Smart Chart #12759-7

Revision Date: 01 Apr 99

Teil Number: 6282

Run Number: 1

Date Acquired: 07:00:00 5 APR 2009

Frequency: 250 RPM

100% Ground Roll: 0.285 IPS @ 7:36

Hover Roll: 0.154 IPS @ 1:28

130 KIAS Roll: 0.074 IPS @ 1:43

130 KIAS Vertical: 0.088 IPS @ 1:34

Damper check not performed. *0.08 @ 1:34*

Current Solution Options:

Use P/L: YES Tab: YES Weight: YES

Solve for: VIB + TRACK

Iterations: 2

Excellent improvement predicted

Ground Goal: 0.062 IPS

Flight Goal: 0.052 IPS

Current weight (LBS) and tab (MILS)
configuration for each blade:

BLADE	1	2	3	4
TAB	+300	+300	+300	+300
WEIGHT	0.20	0.20	0.20	0.20



Track Measurements (INCHES):

Blade	1	2	3	4
FPG	+0.05	-0.05	-0.05	+0.05
HVR	+0.05	-0.05	+0.05	-0.05
130	-0.05	-0.05	-0.05	+0.15

Lead(+)/Lag(-) in MILLIMETERS:

Blade	1	2	3	4
FPG	+9	-7	-4	+2
HVR	+18	-1	-20	+11
130	+13	+0	-23	+7

Measurements are relative to blade MEAN

8500C Firmware Version: 4.11+

8520/8530C Firmware Version: 0.24

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Solutions:

8500C solution: 2 Pitch Link; 2 Tab; 2 Hub Weight Adjustments

IVT Solution: 2 Tab Adjustments

3rd flight print out:

8500C Flight Data Summary
 Beant Chart #18755-7
 Revision Date: 01 Apr 98
 Tail Number: 6292
 Run Number: 1
 Date Acquired: 08:35:15 5 Apr 2000
 Procedure: 250 RPM

100% Ground Roll: 0.171 IPR @ 2:04
 Hover Roll: 0.272 IPR @ 2:25
 130 KIAS Roll: 0.198 IPR @ 2:08
 130 KIAS Vertical: 0.092 IPR @ 2:57

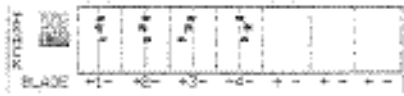
Dancey check not performed.

Current Solution Options:
 Use P/L: YES Tab: YES Weight: YES
 Solve for: VIB + TRACK

Iterations: 2
 Excellent performance predicted
 Ground Goal: 0.062 IPR
 Flight Goal: 0.062 IPR

Current weight (LBS) and tab (MILS)
 configuration for each blade:

BLADE	1	2	3	4
TAB	+0.00	+0.00	+0.00	+0.00
WEIGHT	0.00	0.00	0.00	0.00



Track Measurements ((INCHES)):
 Blade 1 2 3 4
 FPG -0.05 -0.05 +0.05 +0.00
 HVR 0.30 +0.21 +0.20 -0.42
 130 -0.24 -0.09 +0.67 -0.35

Lead(+)/Lag(-) in MILLIMETERS:
 Blade 1 2 3 4
 FPG +0 -4 -5 +1
 HVR -11 -10 -25 +20
 130 -12 2 -24 -11

Measurements are relative to blade #FAX

8500C Flight Data Ver. 1
 8500/8520C F1-
 (c) 1998

3rd Run

12:35:01 5 APR 2000

	1	2	3	4
Ed. (inches)	+0	-	-0.1	-0.3
WGT (LBS)	+0.10	+0.10	-	-
WEIGHT (LBS)	+0.10	-	-	+0.00

MAKE ALL CHANGES!

1 means make blade fly higher with
 pitch link or tab.
 (Use tab makes blade fly higher.)

All changes made from present settings.
 NOT from zero!

TAB MEASUREMENT STATION

	1	2	3	4	5	6

1 mil = 0.001"
 Norm's Adj
 #4 ↑ 4 cc.

Solutions:

8500C solution: 3 Pitch Link; 2 Tab; 2 Hub Weight Adjustments

IVT solution: 1 Pitch Link Adjustment

4th flight print out:

MH-60 Main Rotor (LRAF), Smart, w/ Track
 Smart Chart #12755-7
 Revision Date: 01 Apr 98
 Tail Number: 6232
 Run Number: 1
 Date Acquired: 10:18:58 5 APR 2009
 Frequency: 250 RPM

100% Ground Roll: 0.224 IPS @ 7:49
 Hover Roll: 0.299 IPS @ 2:16
 100 KIA@ Roll: 0.918 IPS @ 2:29
 100 KIA@ Vertical: 0.899 IPS @ 8:37

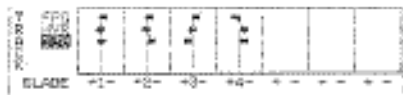
Damper check not performed.

Current Solution Options:
 Use P/L: YES Tab: YES Weight: YES
 Solve for: VIB + TRACK

Iterations: 5
 Good Improvement Predicted
 Ground Goal: 0.134 IPS
 Flight Goal: 0.059 IPS

Current weight (LBS) and tab (MILG)
 configuration for each blade:

BLADE	1	2	3	4
TAB	+088	+082	+082	+083
WEIGHT	0.00	0.02	0.02	0.00



Track Measurements (INCHES):

Blade	1	2	3	4
PPG	-0.39	-0.07	-0.12	+0.28
HVR	+0.14	+0.18	+0.27	-0.02
100	+0.04	-0.15	+0.42	-0.27

Lead(+)/Lag(-) in MILLIMETERS:

Blade	1	2	3	4
PPG	+8	5	-4	-4
HVR	+9	-2	-10	+8
100	+9	+5	-14	-1

Measurements are relative to blade YEAH.

358004 Firmware Version: 4.114
 8500/85000 Firmware Version: 3.04
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10:11:29 5 APR 2009



MAKE ALL CHANGES!

↑ means make blade fly higher with
 pitch link or tab.
 (↑ tab makes blade fly higher.)

All changes made from present settings,
 MXI from zero!

TAB MEASUREMENT STATION

	1	2	3	4	5	6

Final Run.

Less Rotor Adjustments with Better Results

The Air Force's C-H 8500C balancer calculated on average 7 separate adjustments per balance session.

IVT averaged 2 adjustments per session.

Over 70% fewer adjustments to smooth the main rotor system down to 0.0 ips in all flight regimes. **The aircraft was released by lunch time.**