WEBVTT

1
00:00:01.545 --> 00:00:02.765
All right, next up this morning.

2
00:00:03.345 --> 00:00:06.165
It was a, a very interesting way of thinking at it.

3
00:00:06.165 --> 00:00:09.005
For somebody who's looked at 2D matrices for about 14 years,

4
00:00:09.025 --> 00:00:10.765
the Navy, certainly Naval Aviation, loves

5
00:00:10.765 --> 00:00:12.245
to use those 2D matrices.

6
00:00:12.545 --> 00:00:13.725
And Jeff, I'm glad you mentioned that.

7
00:00:13.845 --> 00:00:15.285
'cause I was thinking of that the presentation we had

8
00:00:15.285 --> 00:00:16.965
yesterday, you know, there's been three

9
00:00:16.965 --> 00:00:20.245
or four different, uh, ways of looking at risk management,

10
00:00:20.645 --> 00:00:22.805
ORM, you know, pre-flight risk analysis

11
00:00:22.805 --> 00:00:24.405
that we've seen here over the last couple days.

12
00:00:24.405 --> 00:00:26.525
So it's definitely something I think that we can all take

13
00:00:26.545 --> 00:00:28.125
and kind of ask ourselves,

14
00:00:28.125 --> 00:00:30.685
have we been focused on looking at this from one angle?

15
00:00:31.065 --> 00:00:33.205
And do we have the mental capacity to kind of think

16
00:00:33.205 --> 00:00:35.005
outside the box and approach it from a different angle

17
00:00:35.005 --> 00:00:36.205
and maybe use a different tool?

18
00:00:37.105 --> 00:00:38.605
So as we roll along this morning,

19
00:00:38.605 --> 00:00:40.765
next step is Mr. Brian Lee from the Boeing Company.

20
00:00:40.945 --> 00:00:42.605
Uh, Brian has more than 38 years

21
00:00:42.605 --> 00:00:44.765
of experience in aerodynamics stability

22
00:00:44.865 --> 00:00:46.085
and control and flight test.

23
00:00:46.515 --> 00:00:48.725
He's currently the chair of SAE standards

24
00:00:48.825 --> 00:00:51.445
and, uh, excuse me, the SAE standards committee, uh,

25
00:00:51.645 --> 00:00:53.285
S seven, which focuses on flight deck

26
00:00:53.285 --> 00:00:55.885
and handling quality standards for transport aircraft.

27
00:00:56.265 --> 00:00:57.925

And he's also the US co-chair

28
00:00:57.945 --> 00:01:00.565
for the FA a's Flight Test Harmonization working group

29
00:01:00.985 --> 00:01:02.645
and chair of the Aerospace Control

30
00:01:02.665 --> 00:01:03.805
and Guidance System Committee.

31
00:01:04.275 --> 00:01:06.205
He's got a variety of, uh, certifications

32
00:01:06.225 --> 00:01:07.485
and instructor certificates

33
00:01:07.505 --> 00:01:10.165
and more than 3,800 hours experience in nearly a

34
00:01:10.165 --> 00:01:11.245
hundred different types of aircraft.

35
00:01:11.545 --> 00:01:13.525
So, without further ado, Mr. Brian Lee.

36
00:01:22.815 --> 00:01:24.555
And now for something just a little bit different.

37
00:01:25.285 --> 00:01:27.995
First I wanna say I'm honored and privileged to be here.

38
00:01:28.455 --> 00:01:31.195
Uh, given the expertise in this room, I'm really humbled

39
00:01:31.215 --> 00:01:33.315
to be able to tell you this story about flight testing.

40
00:01:33.855 --> 00:01:35.755
And this story really begins with

41
00:01:37.535 --> 00:01:38.875
my good friend Bill Rig.

42
00:01:39.305 --> 00:01:42.755
Bill is a, a high school industrial arts teacher.

43
00:01:42.975 --> 00:01:44.195
He, he taught shop class

44
00:01:44.695 --> 00:01:46.355
and in 1983, he endeavored

45
00:01:46.355 --> 00:01:47.995
to build this airplane called a Falco.

46
00:01:48.855 --> 00:01:50.595
Uh, he told me he wanted to do it

47
00:01:50.595 --> 00:01:53.035
because he wanted to prove to himself that he could build

48
00:01:53.735 --> 00:01:55.715
all of the airplane by himself.

49
00:01:55.775 --> 00:01:58.675
And he shunned any, uh, offers of assistance.

50
00:01:59.015 --> 00:02:00.635
He wanted to do it all by himself.

51
00:02:00.655 --> 00:02:03.875
And I'm here to tell you, he built every piece

52
00:02:03.895 --> 00:02:05.675
of the airplane by himself.

53
00:02:06.375 --> 00:02:07.995
He made his own oleo struts.

54
00:02:08.135 --> 00:02:10.355

He, he stitched the upholstery himself.

55
00:02:10.495 --> 00:02:12.515
He did everything all by himself.

56
00:02:12.975 --> 00:02:14.835
He started the project in 1982.

57
00:02:15.755 --> 00:02:18.835
I first met him in 1986 when I went to Oshkosh to volunteer

58
00:02:19.295 --> 00:02:21.355
to be an instructor in the Air Academy there.

59
00:02:22.015 --> 00:02:24.635
Uh, every year after that, we would make a pilgrimage

60
00:02:24.635 --> 00:02:27.355
to Appleton, Wisconsin to look at the project, to watch

61
00:02:27.855 --> 00:02:28.915
how it was going together.

62
00:02:29.675 --> 00:02:31.915
I got to see the airplane go together over a period

63
00:02:31.935 --> 00:02:36.155
of 29 years and really understood the airplane.

64
00:02:36.255 --> 00:02:38.755
If you're not familiar with the Falco, it's a product

65
00:02:38.775 --> 00:02:40.275
of Fratti in Italy.

66
00:02:40.825 --> 00:02:43.195
It's, uh, side by side, two place, low wing,

67
00:02:43.205 --> 00:02:45.355
fully aerobatic, and it's all wood.

68
00:02:46.295 --> 00:02:48.755
It was certified in Italy in the 1950s.

69
00:02:49.335 --> 00:02:52.155
It came to the US in the 1970s as a home built.

70
00:02:52.665 --> 00:02:56.715
It's known to be a sophisticated project, very difficult

71
00:02:56.715 --> 00:02:58.915
to build, and even more difficult to build.

72
00:02:59.035 --> 00:03:03.045
Well. Bill's manifestation

73
00:03:03.045 --> 00:03:05.365
of this airplane is absolutely exquisite.

74
00:03:05.955 --> 00:03:08.125
Look how he cut out around the aileron hinges.

75
00:03:09.225 --> 00:03:10.685
The gear doors fit perfectly.

76
00:03:11.585 --> 00:03:13.125
The skin was all sanded by hand.

77
00:03:14.225 --> 00:03:15.925
The mechanisms sequence very nicely.

78
00:03:17.435 --> 00:03:20.165
Look at the aluminum weldings, absolutely spectacular.

79
00:03:21.435 --> 00:03:23.845
This is under the pilot's knees, under the floorboard.

80
00:03:24.115 --> 00:03:27.085
That trim, uh, knob in the middle was hogged out

81
00:03:27.085 --> 00:03:28.445

of a single piece block of aluminum.

82
00:03:28.865 --> 00:03:30.245
And he narrowed it himself.

83
00:03:30.785 --> 00:03:33.165
The landing gear actuation is, uh, lead screw.

84
00:03:33.505 --> 00:03:37.925
And he cut the acme threads himself with dyes.

85
00:03:38.065 --> 00:03:42.245
He made himself On the right hand side.

86
00:03:42.245 --> 00:03:43.325
The stick is removable

87
00:03:43.325 --> 00:03:45.245
and you can see that neural, uh, nut

88
00:03:45.275 --> 00:03:47.165
that you can at the base of the stick.

89
00:03:47.505 --> 00:03:49.845
He made that from the same stuff you make cake out of.

90
00:03:50.065 --> 00:03:54.805
He made it from scratch. Every tube

91
00:03:55.045 --> 00:03:57.085
in the, in the engine mount and the nose gear mount.

92
00:03:57.085 --> 00:03:59.005
Like I said, he made his own oleo struts.

93
00:03:59.105 --> 00:04:00.685
He cut those and, and fitted them

94
00:04:00.685 --> 00:04:02.405
and welded them all himself.

95
00:04:03.145 --> 00:04:04.485
He made his own fuel tanks.

96
00:04:04.745 --> 00:04:07.365
Now, he didn't have access to a 20 ton drop hammer to,

97
00:04:07.465 --> 00:04:10.205
to press the stiffening beads in, in those,

98
00:04:10.465 --> 00:04:12.125
uh, in that fuel tank.

99
00:04:12.785 --> 00:04:16.445
So he made blocks out of, uh, maple, took it in his basement

100
00:04:16.445 --> 00:04:18.005
and jacked up the house on top of it

101
00:04:18.105 --> 00:04:20.765
to force the aluminum into those stiffening beads.

102
00:04:22.395 --> 00:04:25.125
Look how he carved the logo into the stainless steel rudder

103
00:04:25.125 --> 00:04:26.205
pedals with a file going

104
00:04:28.705 --> 00:04:29.705
Really Nice.

105
00:04:30.985 --> 00:04:33.845
He even built the jacks custom out of wood.

106
00:04:36.505 --> 00:04:37.725
The inside of the wheel well looks

107
00:04:37.725 --> 00:04:38.885
like the inside of a guitar.

108
00:04:39.795 --> 00:04:41.005

It's just really nice.

109
00:04:42.225 --> 00:04:44.485
He spent 32 years building this airplane.

110
00:04:45.665 --> 00:04:48.285
And when Ray Peterson came up from the Fido in Milwaukee

111
00:04:48.285 --> 00:04:51.045
to look at it, he said, I was so impressed with the detail.

112
00:04:51.165 --> 00:04:52.645
I almost didn't see the airplane.

113
00:04:54.435 --> 00:04:56.245
This was in February of 2015.

114
00:04:57.025 --> 00:04:58.965
By the middle of March, bill passed away.

115
00:04:59.625 --> 00:05:01.005
He never got to fly the airplane.

116
00:05:01.005 --> 00:05:02.165
He never got to see it fly.

117
00:05:02.785 --> 00:05:05.965
The airplane building project itself is what kept him alive.

118
00:05:07.185 --> 00:05:09.605
And this of course left his family in the lurch.

119
00:05:10.305 --> 00:05:11.685
Uh, his sons Al

120
00:05:11.685 --> 00:05:15.765
and Mike there, This was dad's project.

121
00:05:16.395 --> 00:05:18.725
They knew it was complicated. They knew it was fragile.

122
00:05:18.755 --> 00:05:20.725
They knew it was probably pretty expensive,

123
00:05:21.065 --> 00:05:22.205
but they're not airplane people.

124
00:05:22.205 --> 00:05:23.645
Nobody else in the family flies.

125
00:05:23.835 --> 00:05:25.325
They don't understand airplanes.

126
00:05:25.835 --> 00:05:27.965
They are mechanically quite adept.

127
00:05:29.135 --> 00:05:33.685
Their thing is that 7,000 horsepower top fuel dragster.

128
00:05:34.385 --> 00:05:36.005
So they understand mechanical things,

129
00:05:36.425 --> 00:05:37.845
but airplanes are not that thing.

130
00:05:38.745 --> 00:05:41.885
So they asked me if I would help 'em out by doing the, the,

131
00:05:41.905 --> 00:05:44.885
uh, phase one testing so that they could sell the airplane

132
00:05:45.225 --> 00:05:46.725
and get their dad's estate closed.

133
00:05:47.105 --> 00:05:50.165
And I told 'em I'd do that. And I made 'em two promises.

134
00:05:50.425 --> 00:05:51.485
One is I would do it safely.

135
00:05:52.345 --> 00:05:54.725

And the second one is I would make sure the airplane is safe

136
00:05:55.065 --> 00:05:57.485
for whoever got to, uh, to own it later.

137
00:05:59.335 --> 00:06:01.115
So how do we prepare for something like this?

138
00:06:02.115 --> 00:06:03.995
I was gonna use a checklist for inspections

139
00:06:04.235 --> 00:06:05.395
'cause I didn't build the airplane,

140
00:06:05.395 --> 00:06:06.475
but I watched it go together.

141
00:06:07.395 --> 00:06:08.915
I wanted to understand the weight and balance.

142
00:06:10.195 --> 00:06:12.075
I concluded that I would have all the test cards ready

143
00:06:12.075 --> 00:06:13.235
before we started this thing.

144
00:06:13.775 --> 00:06:15.795
And for me, this was the biggest challenge

145
00:06:16.105 --> 00:06:17.795
because in our professional lives,

146
00:06:18.375 --> 00:06:20.955
we have consummate professionals who will take care

147
00:06:20.955 --> 00:06:23.515
of all those details in each of their disciplines.

148
00:06:24.055 --> 00:06:26.475
In the home built world, it's all up to one guy.

149
00:06:27.695 --> 00:06:29.715
And, and so the hard part for me was

150
00:06:29.715 --> 00:06:31.995
to get a mental model ready for each flight.

151
00:06:32.315 --> 00:06:35.115
I needed to understand the boundaries, the sequence,

152
00:06:35.695 --> 00:06:38.755
and every place I went in that flight, I needed

153
00:06:38.755 --> 00:06:42.595
to know the closest path to safer, whatever that is.

154
00:06:43.035 --> 00:06:44.555
I needed to have a mental model ready.

155
00:06:45.095 --> 00:06:47.195
And that took me a while, but I figured it out.

156
00:06:47.535 --> 00:06:49.475
And of course, you understand the adage at the bottom,

157
00:06:49.825 --> 00:06:51.515
plan the flight and fly the plan.

158
00:06:52.695 --> 00:06:54.395
And that's what I tried to adhere to.

159
00:06:55.175 --> 00:06:57.715
So in preparation, there's a really nice advisory circular

160
00:06:57.825 --> 00:07:00.515
that the FAA publishes for how to do, uh, flight testing,

161
00:07:00.585 --> 00:07:01.595
home build airplanes.

162
00:07:01.895 --> 00:07:02.995

In the case of the Falco,

163
00:07:02.995 --> 00:07:05.555
those are even nicer flight test guide already published.

164
00:07:06.015 --> 00:07:07.515
So I went and availed myself of that.

165
00:07:07.845 --> 00:07:09.515
There are serious textbooks available

166
00:07:09.535 --> 00:07:12.355
and these two are in my library and I made use of those.

167
00:07:12.855 --> 00:07:15.475
And most everybody in this room is, uh, well familiar

168
00:07:15.475 --> 00:07:17.035
with these documents and they're available.

169
00:07:17.635 --> 00:07:19.155
I also have referenced those.

170
00:07:21.065 --> 00:07:22.315
This is a stock airplane,

171
00:07:22.335 --> 00:07:24.195
so it doesn't have any fancy instrumentation.

172
00:07:24.455 --> 00:07:26.195
So here was my solution to instrumentation.

173
00:07:26.235 --> 00:07:30.715
I had an MP three player recorder with a,

174
00:07:30.715 --> 00:07:32.035
uh, exterior microphone.

175
00:07:32.635 --> 00:07:34.435
I put the microphone in the ear cup in the headset,

176
00:07:35.175 --> 00:07:37.675
and I would, uh, get all the voice communications,

177
00:07:37.675 --> 00:07:40.075
all the radio calls, and importantly the engine noises.

178
00:07:40.075 --> 00:07:42.835
That was really helpful when I was transcribing this,

179
00:07:43.135 --> 00:07:44.995
as long as I would remember to talk to myself,

180
00:07:45.675 --> 00:07:49.395
I could record anything I needed a whole lot easier than,

181
00:07:49.415 --> 00:07:51.515
uh, making notes on a, on an e-board.

182
00:07:52.835 --> 00:07:53.995
Personal safety considerations.

183
00:07:53.995 --> 00:07:55.915
Of course, I, I did wear Nomex.

184
00:07:56.375 --> 00:07:58.875
It is after all a wooden airplane with fuel on board.

185
00:07:59.855 --> 00:08:02.395
Um, the helmet and parachute, uh, turned out

186
00:08:02.395 --> 00:08:05.195
to be not very compatible because all I had was available

187
00:08:05.195 --> 00:08:06.915
was a seat pack for a parachute.

188
00:08:07.295 --> 00:08:09.315
And with a helmet on, I couldn't close the canopy.

189
00:08:09.975 --> 00:08:12.515

In the end, I decided that the helmet would protect me from

190
00:08:12.515 --> 00:08:13.955
more things than the parachute would.

191
00:08:14.375 --> 00:08:15.555
So I deleted the parachute.

192
00:08:15.555 --> 00:08:17.635
And even with that, I had to take the seat cushion out.

193
00:08:18.015 --> 00:08:19.915
So I flew most of the flights just sitting on the

194
00:08:19.915 --> 00:08:20.955
plywood seat pan and it worked.

195
00:08:21.615 --> 00:08:24.035
Now, the consequence of making that decision though,

196
00:08:24.535 --> 00:08:28.035
was I didn't do spins and I didn't do flutter at VNE.

197
00:08:28.975 --> 00:08:30.475
I'm not gonna do those without a parachute.

198
00:08:30.535 --> 00:08:31.995
And it didn't work.

199
00:08:32.215 --> 00:08:33.435
Now having said that, though,

200
00:08:33.745 --> 00:08:35.315
that very nice flight test guide

201
00:08:35.315 --> 00:08:37.235
and the knowledge that the airplane was certified,

202
00:08:37.295 --> 00:08:40.795
the design was certified in, in Italy, tells me

203
00:08:40.795 --> 00:08:42.955
that the spin characteristics of the airplane are okay.

204
00:08:43.495 --> 00:08:45.075
And I knew that Bill had, uh,

205
00:08:45.265 --> 00:08:47.475
mass balanced all the control surfaces because he

206
00:08:47.475 --> 00:08:50.075
and I talked about that during that period of 30 years

207
00:08:50.445 --> 00:08:51.675
where I watched it go together.

208
00:08:53.615 --> 00:08:55.730
So I took a week off of work and went to Wisconsin.

209
00:08:56.845 --> 00:08:58.365
I showed up with a 30 page checklist.

210
00:08:58.545 --> 00:09:01.565
It was a read and do checklist for how

211
00:09:01.565 --> 00:09:02.605
to inspect this airplane.

212
00:09:02.605 --> 00:09:04.005
We found one cotter pin missing.

213
00:09:04.545 --> 00:09:06.205
It was on a gear door, and we were gonna take those

214
00:09:06.205 --> 00:09:07.365
off for the first flight anyway.

215
00:09:08.025 --> 00:09:09.045
We had to bleed the brakes.

216
00:09:09.385 --> 00:09:10.805

The rudder cable tensions were wrong.

217
00:09:10.805 --> 00:09:13.365
So we had to re rig the rudder and then realign everything.

218
00:09:14.225 --> 00:09:16.165
Uh, we had to swing the gear several times

219
00:09:16.955 --> 00:09:19.885
because as a pilot in command, I needed to know

220
00:09:21.035 --> 00:09:23.445
what does it really mean when the red light goes off

221
00:09:23.465 --> 00:09:24.605
and the green light goes on?

222
00:09:25.145 --> 00:09:27.285
So we chased the wiring and figured it out

223
00:09:27.405 --> 00:09:28.725
'cause the builder wasn't available to ask.

224
00:09:29.945 --> 00:09:31.605
Um, I cranked the gear up

225
00:09:31.605 --> 00:09:32.885
and down by hand a couple of times

226
00:09:32.945 --> 00:09:34.445
to make sure I understood how that worked.

227
00:09:34.905 --> 00:09:36.445
We had to increase the strut pressures

228
00:09:36.565 --> 00:09:37.605
'cause it was a little saggy.

229
00:09:38.105 --> 00:09:39.885
And we had to reset the landing gear warning,

230
00:09:39.885 --> 00:09:41.765
throttle switch, which is a block of phenolic

231
00:09:41.765 --> 00:09:44.005
that rubs against the thro, uh, against the micro switch

232
00:09:44.425 --> 00:09:45.645
inside the throttle assembly.

233
00:09:46.265 --> 00:09:48.925
Um, it was going, the horn was going off at 18 inches

234
00:09:48.925 --> 00:09:50.645
of manifold pressure, which is way too high.

235
00:09:51.745 --> 00:09:53.965
So here we are adjusting the rudder cable pensions.

236
00:09:54.595 --> 00:09:56.125
Here you can see the AF fuel tank.

237
00:09:56.125 --> 00:09:57.405
We had to take the, the airplane

238
00:09:57.405 --> 00:09:58.765
basically apart to get to it.

239
00:09:59.545 --> 00:10:01.005
Um, then it was off to the fuel farm.

240
00:10:01.005 --> 00:10:03.845
To calibrate the fuel system, the pilot really needs

241
00:10:03.845 --> 00:10:06.365
to understand when the gauge points at

242
00:10:06.565 --> 00:10:07.765
excellent, what does that really mean?

243
00:10:08.625 --> 00:10:09.645

And in the front tank,

244
00:10:09.645 --> 00:10:11.325
that means I still had two gallons left.

245
00:10:11.985 --> 00:10:14.925
The back tank was actually pretty good At the same time I

246
00:10:14.925 --> 00:10:17.285
went to, uh, went to the hardware store

247
00:10:17.285 --> 00:10:19.485
and I got a, a piece of doll rod and some paint,

248
00:10:19.485 --> 00:10:21.405
and we made ourselves a custom dipstick.

249
00:10:21.945 --> 00:10:23.885
We put in two gallons at a time and marked the stick.

250
00:10:24.745 --> 00:10:27.485
So we knew exactly how much fuel we had in each tank.

251
00:10:28.185 --> 00:10:30.165
The gear doors had to come off for the first flight.

252
00:10:30.745 --> 00:10:32.885
Uh, and each of those gear doors is held on

253
00:10:32.885 --> 00:10:34.805
by 30 number six screws.

254
00:10:36.225 --> 00:10:38.205
So, uh, Mike and Al grumbled a little bit,

255
00:10:38.205 --> 00:10:39.405
but they were happy to help out.

256
00:10:41.395 --> 00:10:44.605
Initial engine runs the, uh, exhaust gas temperature

257
00:10:44.605 --> 00:10:47.125
and cylinder head temperature gauges were stone cold dead.

258
00:10:47.705 --> 00:10:50.365
Uh, alternator didn't work the first time or the second time

259
00:10:50.385 --> 00:10:52.405
or the third time, but it came online the fourth time.

260
00:10:53.225 --> 00:10:55.685
Uh, we discovered an oil leak in the top of the case,

261
00:10:55.685 --> 00:10:58.045
which is a really weird place to have an oil leak.

262
00:10:58.825 --> 00:11:00.365
Um, and the intercom didn't work.

263
00:11:00.365 --> 00:11:01.685
So that was my instrumentation system.

264
00:11:01.745 --> 00:11:03.765
So I needed to get all those things fixed

265
00:11:03.765 --> 00:11:05.365
before I was gonna fly the airplane.

266
00:11:06.625 --> 00:11:09.285
So just to prove I can cl crawl under the instrument panel,

267
00:11:11.545 --> 00:11:14.325
the, the engine gauge problem was a wiring issue

268
00:11:14.325 --> 00:11:17.165
and we fixed that, uh, to test the engine.

269
00:11:17.205 --> 00:11:18.845
I wanted to see full power for three minutes

270
00:11:18.845 --> 00:11:21.685

because I have a good friend who had one quit at 2 45 once.

271
00:11:22.705 --> 00:11:25.685
And you think about where would you be in the pattern at two

272
00:11:25.685 --> 00:11:27.645
minutes and 45 seconds after engine start.

273
00:11:27.945 --> 00:11:29.285
That's probably not a good place

274
00:11:29.285 --> 00:11:30.525
to be when the engine quits.

275
00:11:31.385 --> 00:11:33.125
Um, now these brakes are really wimpy.

276
00:11:33.125 --> 00:11:34.205
They won't hold full power.

277
00:11:34.745 --> 00:11:37.805
So we tied the airplane to Al's car blue gravel all over it.

278
00:11:38.465 --> 00:11:40.365
Um, and I deleted this shocks

279
00:11:41.115 --> 00:11:44.645
because if the, I know the brakes won't hold,

280
00:11:44.985 --> 00:11:46.325
if the right rope brakes

281
00:11:46.425 --> 00:11:47.685
and the airplane starts moving,

282
00:11:47.885 --> 00:11:50.725
I did not want a big dynamic kerfluffle going on while I was

283
00:11:50.725 --> 00:11:52.285
trying to get the power off and get the airplane

284
00:11:52.285 --> 00:11:53.365
pointed away from the hangar.

285
00:11:54.435 --> 00:11:56.965
That went very well. Appleton,

286
00:11:56.965 --> 00:11:59.045
Wisconsin is a really nice place to do flight testing.

287
00:11:59.055 --> 00:12:00.285
We've got two long runways

288
00:12:00.285 --> 00:12:01.525
and they're 90 degrees to each other.

289
00:12:02.305 --> 00:12:04.285
You can see bill's hangar and the fuel farm there.

290
00:12:04.915 --> 00:12:08.165
Most important to me was the fire station is right here.

291
00:12:09.405 --> 00:12:10.765
I wanted to know where that was. Us.

292
00:12:12.825 --> 00:12:14.885
Low speed taxi testing proved that even

293
00:12:14.885 --> 00:12:17.645
with proper coordination with a TC airport,

294
00:12:17.965 --> 00:12:19.605
security was not always well coordinated.

295
00:12:19.605 --> 00:12:21.325
And my buddy Dave only got arrested once.

296
00:12:22.145 --> 00:12:24.085
Uh, the nose wheel steering is really sensitive,

297
00:12:24.085 --> 00:12:25.925

but it's just a hard rod between the pedal and the,

298
00:12:26.105 --> 00:12:27.525
and the, uh, nose wheel.

299
00:12:28.385 --> 00:12:31.085
It takes really large pedal deflections for high power.

300
00:12:31.825 --> 00:12:33.405
And the brakes hadn't been conditioned.

301
00:12:33.405 --> 00:12:35.045
Of course, the airplane hadn't moved

302
00:12:35.045 --> 00:12:36.805
before, so we had to condition the brakes.

303
00:12:37.345 --> 00:12:39.405
Uh, even then, they still wouldn't hold full power,

304
00:12:39.425 --> 00:12:41.085
but at least we got a good glaze on 'em.

305
00:12:41.465 --> 00:12:44.925
So they would grab something onto high speed taxiing

306
00:12:45.205 --> 00:12:46.525
required more coordination with a TC.

307
00:12:46.525 --> 00:12:48.445
I finally talked 'em into letting me get on the runway.

308
00:12:49.265 --> 00:12:51.325
Uh, the rudder becomes effective at, well,

309
00:12:51.385 --> 00:12:53.125
we don't really know 'cause we have nose wheel steering.

310
00:12:54.085 --> 00:12:55.405
Elevator becomes effective at 40

311
00:12:56.035 --> 00:12:57.725
lateral controls effective at 60.

312
00:12:58.045 --> 00:12:59.245
I was, by this time, I was getting

313
00:12:59.245 --> 00:13:00.325
used to the nose wheel steering.

314
00:13:00.985 --> 00:13:02.925
And at that point, frankly, it was about six 30 in the

315
00:13:02.925 --> 00:13:05.445
evening and I was ready to fly the airplane.

316
00:13:05.445 --> 00:13:07.845
But I said to myself, I'm gonna do one more walk around.

317
00:13:08.465 --> 00:13:09.765
And I took it back to the hangar

318
00:13:09.765 --> 00:13:10.765
and we got outta the airplane

319
00:13:11.185 --> 00:13:12.565
and I pushed on the vertical tail

320
00:13:12.585 --> 00:13:14.845
and something in the airplane went clunk, clunk, clunk,

321
00:13:14.845 --> 00:13:16.405
clunk, clunk, clunk, clunk, clunk.

322
00:13:17.385 --> 00:13:20.205
We discovered, uh, some looseness in the nose wheel.

323
00:13:21.025 --> 00:13:22.405
Here's a detail of the nose gear.

324
00:13:22.405 --> 00:13:24.925

This is a, a custom axle nut arrangement.

325
00:13:25.695 --> 00:13:28.205
There are custom shims between the, uh,

326
00:13:28.205 --> 00:13:29.445
wheel bearings and the fork.

327
00:13:30.305 --> 00:13:31.885
And this nut is screwed on.

328
00:13:31.885 --> 00:13:34.525
And then it's secured with a set screw in that notch.

329
00:13:34.945 --> 00:13:36.405
And you see, we had to tighten it.

330
00:13:36.785 --> 00:13:38.885
Oh, not quite a quarter of a turn.

331
00:13:39.725 --> 00:13:41.405
I figured if the thing became loose

332
00:13:41.405 --> 00:13:43.205
because I was up at 50 miles an hour,

333
00:13:43.325 --> 00:13:45.005
I don't really wanna touch down at 90

334
00:13:45.345 --> 00:13:47.125
and have those breaks start to chatter

335
00:13:47.505 --> 00:13:49.525
or those, those bearings start to chatter.

336
00:13:51.085 --> 00:13:53.645
I also gotta spend some me time in the cockpit.

337
00:13:54.205 --> 00:13:56.485
I made prodigious use of sticky notes, as you see,

338
00:13:56.485 --> 00:13:58.285
because there were no range gauges on

339
00:13:58.425 --> 00:14:00.525
or range marks on any of the instruments.

340
00:14:01.035 --> 00:14:03.045
I've got all the V speeds up there in the middle,

341
00:14:03.665 --> 00:14:06.885
and I did two other things on the first flight.

342
00:14:07.045 --> 00:14:09.205
I was gonna restrict myself to, uh, VLE,

343
00:14:09.205 --> 00:14:11.245
the landing gear speed, even though I took the doors off.

344
00:14:11.705 --> 00:14:13.845
So I put a sticky note on the airspeed indicator,

345
00:14:14.185 --> 00:14:16.005
so if the needle goes behind the sticky note,

346
00:14:16.005 --> 00:14:17.085
I went, I know I went too fast.

347
00:14:17.785 --> 00:14:19.245
And the other thing I did is I put a piece

348
00:14:19.245 --> 00:14:20.565
of tape over the landing gear handle,

349
00:14:20.585 --> 00:14:22.405
so I wouldn't even be tempted to touch it.

350
00:14:23.485 --> 00:14:24.765
I I just taped it down.

351
00:14:28.145 --> 00:14:29.565

The purpose of the first flight is

352
00:14:29.565 --> 00:14:30.565
to make sure the engine runs,

353
00:14:30.995 --> 00:14:32.605
make sure the controls work properly,

354
00:14:32.995 --> 00:14:34.485
make sure you do a safe landing

355
00:14:34.485 --> 00:14:35.885
so you can inspect the airplane again.

356
00:14:36.385 --> 00:14:39.125
And, you know, everybody on the on the crew has a job

357
00:14:39.485 --> 00:14:40.885
to do there.

358
00:14:40.885 --> 00:14:43.325
Mike has the radio. AL'S got the fire extinguisher.

359
00:14:43.755 --> 00:14:46.045
This is, uh, a guy named Jim Keenan who helped

360
00:14:46.045 --> 00:14:47.245
with the engine installation

361
00:14:48.625 --> 00:14:50.005
and we're all set to do the first flight,

362
00:14:50.025 --> 00:14:51.885
but the whole family wanted to come out and watch.

363
00:14:52.545 --> 00:14:55.245
So you see the chairs set up and that was fine.

364
00:14:57.845 --> 00:14:59.325
I needed to understand the weight and balance.

365
00:15:00.265 --> 00:15:01.525
So we went through Bill's records

366
00:15:01.585 --> 00:15:04.965
and we found two different weighings and they're different.

367
00:15:05.985 --> 00:15:07.845
We can't ask the builder why they're different

368
00:15:07.845 --> 00:15:08.845
or what's different about them.

369
00:15:09.665 --> 00:15:11.965
Uh, you can see it's dated there the 2nd of February.

370
00:15:12.905 --> 00:15:15.645
Um, so I had to devise a sanity check

371
00:15:15.665 --> 00:15:18.605
to make sure I understood where the CG really was.

372
00:15:19.065 --> 00:15:20.365
And what we discovered was

373
00:15:20.905 --> 00:15:25.365
92-year-old bill had transposed two digits when he wrote

374
00:15:25.385 --> 00:15:27.645
the, the wait and balance on the form.

375
00:15:28.585 --> 00:15:29.885
So we got that straightened out.

376
00:15:30.845 --> 00:15:34.005
I wanted the CG to be in the forward, uh, portion

377
00:15:34.025 --> 00:15:35.805
of the envelope because of uncertainty

378
00:15:35.805 --> 00:15:38.085

and measurements, uncertainty and characteristics

379
00:15:38.085 --> 00:15:39.445
and forward is better than aft.

380
00:15:40.105 --> 00:15:41.645
So here's the empty weight in cg.

381
00:15:42.305 --> 00:15:44.845
Here's me and eight gallons of fuel in the back tank,

382
00:15:45.635 --> 00:15:47.045
full fuel in the forward tank,

383
00:15:47.045 --> 00:15:48.965
and that represents one hour of fuel burn.

384
00:15:49.465 --> 00:15:52.205
Now, the reason I wanted fuel in the back tank is

385
00:15:52.205 --> 00:15:54.405
because if for any reason there was a blockage from

386
00:15:54.405 --> 00:15:56.285
that front tank, I want access to more fuel.

387
00:15:57.585 --> 00:15:59.765
So I made sure I put the eight gallons in the back tank,

388
00:16:00.495 --> 00:16:02.285
everything was checked and rechecked.

389
00:16:02.285 --> 00:16:03.885
Now, Mike

390
00:16:03.885 --> 00:16:06.045
and Al might not have understood a lot about airplanes,

391
00:16:06.045 --> 00:16:08.285
but they did understand the concept of a pit crew

392
00:16:08.965 --> 00:16:10.165
I get in front of the hangar.

393
00:16:10.275 --> 00:16:12.005
They were there with a screwdriver in one hand

394
00:16:12.005 --> 00:16:13.645
and a rag in the other, and they had the cow open

395
00:16:13.645 --> 00:16:14.925
before I got the seat belts off.

396
00:16:15.915 --> 00:16:17.725
That was very nice to work with those guys.

397
00:16:18.575 --> 00:16:20.525
First flight qualitatively longitudinal.

398
00:16:20.525 --> 00:16:23.365
The controls are very smooth, trim is quite effective.

399
00:16:23.385 --> 00:16:25.005
No bad habits between AD

400
00:16:25.005 --> 00:16:26.725
and VLE, which is, uh, I think one 20.

401
00:16:27.745 --> 00:16:29.645
Uh, good positive stability throughout

402
00:16:30.275 --> 00:16:31.845
lateral directional characteristics.

403
00:16:32.015 --> 00:16:33.445
Again, very smooth controls.

404
00:16:33.865 --> 00:16:36.245
The roll mode time constant is incredibly short,

405
00:16:36.715 --> 00:16:38.045

very precise, but I couldn't find

406
00:16:38.045 --> 00:16:39.205
any roll ratchet tendencies.

407
00:16:39.205 --> 00:16:40.645
Of course, all the fuels in the fuselage,

408
00:16:41.105 --> 00:16:44.085
so the wings have no inertia, basically, uh,

409
00:16:44.145 --> 00:16:45.325
it required right rudder

410
00:16:45.325 --> 00:16:47.365
to maintain a straight and level flight.

411
00:16:47.945 --> 00:16:49.405
The left wing was heavy with about a

412
00:16:49.405 --> 00:16:50.525
10 degree per second roll rate.

413
00:16:50.525 --> 00:16:53.005
If you let go, I could hold it with rudder,

414
00:16:53.005 --> 00:16:54.165
but frankly, it was easier just

415
00:16:54.165 --> 00:16:55.445
to hold a couple pounds on the stick.

416
00:16:56.065 --> 00:16:57.165
It really wasn't an issue.

417
00:16:58.545 --> 00:17:00.045
The purpose of the second flight was

418
00:17:00.045 --> 00:17:02.445
to make sure the first flight wasn't a fluke.

419
00:17:03.385 --> 00:17:05.125
So I repeated the same weight

420
00:17:05.125 --> 00:17:07.005
and balance, same test card, same profile,

421
00:17:07.535 --> 00:17:08.885
everything worked out fine.

422
00:17:08.885 --> 00:17:10.645
Flight three, we did the first gear retraction.

423
00:17:11.265 --> 00:17:13.285
We used a local Grumman Yankee for Chase,

424
00:17:13.295 --> 00:17:15.885
which had mismatched air speeds and it wasn't very good.

425
00:17:15.885 --> 00:17:17.245
But still, I wanted somebody

426
00:17:17.245 --> 00:17:18.565
who could look up into the wheel well

427
00:17:18.565 --> 00:17:20.045
and make sure nothing was fouled.

428
00:17:20.545 --> 00:17:22.525
And I wanted to be able to make sure they could see the down

429
00:17:22.575 --> 00:17:25.485
locks when the gear came down the first time in flight.

430
00:17:26.335 --> 00:17:29.925
Looks pretty nice with the gear up, no doors yet.

431
00:17:30.705 --> 00:17:32.285
So then we put the doors back on and,

432
00:17:32.905 --> 00:17:34.885

and Mike announced, said, well first he wants the doors off.

433
00:17:34.885 --> 00:17:37.165
Now he wants them back on. What's up with this engineer?

434
00:17:37.545 --> 00:17:39.725
We don't quite understand, but they helped me out.

435
00:17:41.745 --> 00:17:45.365
Here's what we did. Uh, flight one.

436
00:17:45.365 --> 00:17:46.685
Of course flight two was a repeat.

437
00:17:46.685 --> 00:17:48.245
Flight three was the first gear retraction.

438
00:17:49.185 --> 00:17:51.325
At that point, I took it out to, uh, VNO.

439
00:17:52.305 --> 00:17:55.745
Uh, flight four. We put the gear doors on.

440
00:17:56.465 --> 00:17:57.905
I stayed at VNO because we had

441
00:17:57.905 --> 00:17:59.025
rough air in the late afternoon.

442
00:17:59.685 --> 00:18:02.545
Flight five the next morning I went to v uh, VNE,

443
00:18:02.545 --> 00:18:03.705
240 miles an hour.

444
00:18:04.245 --> 00:18:05.865
Flight six I did stalls.

445
00:18:06.325 --> 00:18:09.185
At forward CG flight seven, we did some more stalls.

446
00:18:09.725 --> 00:18:11.825
Flight eight, we measured the CG.

447
00:18:12.925 --> 00:18:15.945
At forward, uh, the forward CG condition,

448
00:18:15.945 --> 00:18:16.945
we measured the stability.

449
00:18:17.495 --> 00:18:20.785
Nine, we started moving the CG AFT with Fred,

450
00:18:20.785 --> 00:18:22.385
and I'll talk about who Fred is in just a minute.

451
00:18:23.085 --> 00:18:26.425
Uh, flight 10, we got AF CG stability measurements

452
00:18:26.645 --> 00:18:30.545
and started doing stalls at the FCG flight 11 I did stalls

453
00:18:30.545 --> 00:18:31.585
with Fred Autopilot.

454
00:18:31.825 --> 00:18:33.745
Functional check, some performance maneuvers.

455
00:18:33.745 --> 00:18:35.705
That's a euphemism for gentleman's

456
00:18:36.075 --> 00:18:37.905
aerobatics loops and rolls.

457
00:18:38.845 --> 00:18:42.975
Um, where am I?

458
00:18:44.255 --> 00:18:46.095
Airspeed, calibration. Were up next.

459
00:18:46.315 --> 00:18:48.615

But the, the, uh, we had rough air in the late afternoon,

460
00:18:48.615 --> 00:18:50.175
so I did redid it in the next morning.

461
00:18:50.955 --> 00:18:54.695
Uh, by flight 14, we had the rudder, uh, trim tab in place.

462
00:18:55.195 --> 00:18:56.295
Put it on with duct tape first

463
00:18:56.295 --> 00:18:57.535
to make sure things were all working.

464
00:18:57.635 --> 00:19:01.055
All right. Uh, flight 15, I adjusted the prop Governor

465
00:19:01.675 --> 00:19:04.495
flight 16, we had the rudder block and the prop governor

466
00:19:04.495 --> 00:19:06.575
and I redid the stalls to make sure that, uh,

467
00:19:06.575 --> 00:19:09.055
the rudder block, uh, didn't cause any trouble.

468
00:19:09.635 --> 00:19:10.655
And by flight 17,

469
00:19:10.655 --> 00:19:13.415
we put a trim tab on the lower surface of the right aileron.

470
00:19:13.745 --> 00:19:16.695
Three days, 17 flights, 19 hours on the tack,

471
00:19:16.695 --> 00:19:17.855
and 21 hours on the clock.

472
00:19:17.995 --> 00:19:19.015
And then I had to go back to work.

473
00:19:20.275 --> 00:19:21.815
At that point, I felt pretty good.

474
00:19:21.895 --> 00:19:24.175
I had cleared the handling qualities of the airplane

475
00:19:24.725 --> 00:19:28.735
from stall speed to VNE and from forward to FCG.

476
00:19:29.185 --> 00:19:30.815
We'll talk a little more of the details here.

477
00:19:32.065 --> 00:19:34.975
Stall speed is about 59 miles an hour, and VNE is two 40.

478
00:19:35.245 --> 00:19:38.095
This is a speed range of four. That's very impressive.

479
00:19:38.095 --> 00:19:40.655
I don't think Boeing transports have a speed range of four.

480
00:19:41.755 --> 00:19:46.015
Um, for envelope expansion, I started at flaps 15,

481
00:19:46.925 --> 00:19:48.575
then I went to flaps 20.

482
00:19:48.965 --> 00:19:51.175
Then if all goes well, I'm gonna go to flaps up.

483
00:19:52.055 --> 00:19:53.775
I wanna be able to land the airplane again if

484
00:19:53.775 --> 00:19:54.935
something, uh, happens.

485
00:19:56.075 --> 00:19:59.455
The initial envelope, I evaluated 80 miles an hour to 1 25,

486
00:20:00.045 --> 00:20:02.535

then out to 180 5 and then to two 40.

487
00:20:03.355 --> 00:20:06.535
At each of those points, I did pitch hat captures,

488
00:20:06.565 --> 00:20:08.375
roll captures, heading captures

489
00:20:08.735 --> 00:20:10.255
doublets to look at the dynamics.

490
00:20:10.845 --> 00:20:12.015
Side slips left and right.

491
00:20:12.365 --> 00:20:13.575
Then I varied the speed plus

492
00:20:13.575 --> 00:20:15.575
or minus 10 knots just with the elevator alone.

493
00:20:16.125 --> 00:20:19.335
Then I did some general roller rollercoasters, uh, half a G

494
00:20:19.835 --> 00:20:21.015
and a two G level turn.

495
00:20:21.015 --> 00:20:22.255
And then I went to the next air speed

496
00:20:22.395 --> 00:20:23.655
and did it all over again.

497
00:20:24.085 --> 00:20:25.375
Then I went to the next air speed

498
00:20:25.375 --> 00:20:29.935
and did it all over again, at least on the first flight.

499
00:20:30.465 --> 00:20:31.975
Based on those characteristics,

500
00:20:32.575 --> 00:20:34.775
I multiplied my minimum speed by 1.3

501
00:20:34.775 --> 00:20:35.815
to get the first approach.

502
00:20:35.815 --> 00:20:38.615
Speed turned out to be about 90, which is about right.

503
00:20:38.615 --> 00:20:41.495
Anyway, um, and everything went well.

504
00:20:43.635 --> 00:20:46.295
The results of that speed envelope expansion were

505
00:20:46.295 --> 00:20:48.765
that the control system is really nice in this airplane.

506
00:20:48.885 --> 00:20:51.005
I could not measure the friction with my four gauges.

507
00:20:51.775 --> 00:20:53.125
Pitch stability is really good

508
00:20:53.125 --> 00:20:56.365
and crisp at all speeds above 70, below 70,

509
00:20:56.385 --> 00:20:58.645
the stick gets really mushy in a really big hurry.

510
00:20:59.475 --> 00:21:00.645
Trim characteristics are good.

511
00:21:00.685 --> 00:21:02.845
I ran outta trim between 85 and 90 with flaps.

512
00:21:02.845 --> 00:21:05.685
20 lat dirt characteristics.

513
00:21:05.765 --> 00:21:07.965

Good crisp response to the pedal at all speeds.

514
00:21:08.385 --> 00:21:10.645
All flaps, lateral control force,

515
00:21:10.645 --> 00:21:12.485
the aileron control forces get really stiff,

516
00:21:12.485 --> 00:21:13.965
especially above 180.

517
00:21:14.825 --> 00:21:16.685
Uh, exceptionally crisp roll response

518
00:21:16.685 --> 00:21:19.845
with very short time constant, not much roll due

519
00:21:19.845 --> 00:21:22.005
to side slip until you get beyond about a half a pedal.

520
00:21:23.305 --> 00:21:26.965
Uh, large side slips were asymmetric. This was a curiosity.

521
00:21:28.105 --> 00:21:32.645
Uh, when I went to the left, I got a very severe airframe,

522
00:21:32.645 --> 00:21:35.125
buffeting bump, bump bump, bump, bump to the right.

523
00:21:35.205 --> 00:21:37.125
I could go to full pedal and the airplane just ya out

524
00:21:37.125 --> 00:21:40.125
and didn't do any, have any problem, mark that well,

525
00:21:40.125 --> 00:21:41.685
coming back and investigate it in a bit.

526
00:21:42.785 --> 00:21:45.965
Stalls pitch characteristics were good at forward cg

527
00:21:46.075 --> 00:21:47.085
good positive forces.

528
00:21:47.745 --> 00:21:49.085
Uh, got to full aft stick.

529
00:21:49.135 --> 00:21:53.285
Flaps up, flaps down the airplane dropped against a aft

530
00:21:53.285 --> 00:21:56.045
moving stick, uh, at aft cg.

531
00:21:56.215 --> 00:21:58.845
Again, positive forces. What I did at aft CG is I took my

532
00:21:58.845 --> 00:21:59.965
thumb off the back of the stick

533
00:22:00.465 --> 00:22:02.085
and just pulled the stick aft.

534
00:22:02.275 --> 00:22:04.765
When the stall broke, I let go and the stick fell forward

535
00:22:04.825 --> 00:22:05.845
and the airplane recovered.

536
00:22:06.865 --> 00:22:10.445
Uh, lateral directional stall characteristics, uh, flaps up.

537
00:22:10.825 --> 00:22:13.005
It broke straight ahead, flaps down.

538
00:22:13.005 --> 00:22:14.805
It broke, left all the time.

539
00:22:14.825 --> 00:22:15.885
And we suspected that's

540
00:22:15.885 --> 00:22:16.925

because I was by myself in

541
00:22:16.925 --> 00:22:18.165
the airplane sitting on the left side.

542
00:22:19.865 --> 00:22:23.885
Um, at the deeper flaps, the stick would snatch left as well

543
00:22:23.885 --> 00:22:25.765
as it would roll so it would roll

544
00:22:25.765 --> 00:22:27.525
and the stick would go left, which just tells me the

545
00:22:27.525 --> 00:22:29.445
separation got to the ailerons

546
00:22:29.505 --> 00:22:30.645
and messed with the hinge moments.

547
00:22:31.615 --> 00:22:33.365
Other systems, the lights worked really well

548
00:22:33.365 --> 00:22:36.005
and the, the heat and defrosters worked better than any

549
00:22:36.005 --> 00:22:39.245
other airplane I've ever flown onto.

550
00:22:39.245 --> 00:22:40.285
Airspeed calibrations.

551
00:22:40.385 --> 00:22:42.725
Rob Freeland at Boeing says there are only two pressures.

552
00:22:42.725 --> 00:22:47.405
How tough can it be? So pretty

553
00:22:47.605 --> 00:22:48.685
standard PTO under the wing

554
00:22:48.705 --> 00:22:50.725
and, uh, static ports in the fuselage.

555
00:22:51.545 --> 00:22:54.125
Now how do you do airspeed? Calibration without a boom?

556
00:22:54.185 --> 00:22:57.005
Bomber a cone? Well, you can fly a certified speed course,

557
00:22:57.545 --> 00:22:59.005
but then you have to have no wind.

558
00:22:59.585 --> 00:23:01.405
You could do a fly tower fly by,

559
00:23:01.545 --> 00:23:04.085
but then you need a tower and no wind.

560
00:23:04.705 --> 00:23:06.365
If you know, if you know which way the wind's blowing,

561
00:23:06.425 --> 00:23:08.205
you can fly reciprocal headings.

562
00:23:08.505 --> 00:23:09.645
But you know, if you got one

563
00:23:09.645 --> 00:23:11.445
of these gizmos, it's real easy.

564
00:23:11.555 --> 00:23:15.445
With Kevin Horton's software, all you need to do is, uh,

565
00:23:15.895 --> 00:23:17.925
three courses at least 60 degrees apart,

566
00:23:17.985 --> 00:23:19.565
and it gives you the answer right away.

567
00:23:20.425 --> 00:23:21.965

Uh, it is kind of intense flying.

568
00:23:21.965 --> 00:23:24.285
You're trying to fly one knot of airspeed, five knot,

569
00:23:24.285 --> 00:23:25.325
five feet of altitude,

570
00:23:25.325 --> 00:23:27.325
and one degree heading long enough

571
00:23:27.745 --> 00:23:29.325
for the GPS to get a solution.

572
00:23:29.625 --> 00:23:31.725
And then I did that at every 10 knots air speeded.

573
00:23:32.505 --> 00:23:34.685
For the record, that's what the answer looks like.

574
00:23:34.865 --> 00:23:36.565
The airspeed indicates a little bit fast.

575
00:23:38.995 --> 00:23:40.645
What about that buffeting inside slip?

576
00:23:41.305 --> 00:23:43.965
It was present at all flaps only with the gear down

577
00:23:43.965 --> 00:23:45.005
and only with left pedal.

578
00:23:46.755 --> 00:23:49.005
Well, could it be awake from the gear door?

579
00:23:49.005 --> 00:23:49.965
Well, I got it on the first

580
00:23:49.965 --> 00:23:51.205
flight when we didn't have any doors.

581
00:23:51.695 --> 00:23:55.445
Could it be awake from the strut? Well, only from the left.

582
00:23:56.065 --> 00:23:58.805
And besides that, it requires a really big side slip angle,

583
00:23:58.935 --> 00:24:01.085
which sort of equivalent somewhere between 22

584
00:24:01.105 --> 00:24:04.245
and 25 knots of, of crosswind.

585
00:24:04.745 --> 00:24:06.045
So maybe there's an interaction

586
00:24:06.045 --> 00:24:08.125
between the propeller slipstream and the vertical tail.

587
00:24:08.455 --> 00:24:10.125
Let's put Tufts on and go find out.

588
00:24:11.625 --> 00:24:12.885
So here, full left rudder.

589
00:24:12.905 --> 00:24:15.565
So the, the rudder is away from you in this picture.

590
00:24:16.075 --> 00:24:18.365
This is a suction side of the vertical tail.

591
00:24:18.365 --> 00:24:22.925
Everything looks nice. The other side

592
00:24:22.945 --> 00:24:24.005
is completely stalled.

593
00:24:25.215 --> 00:24:28.525
There was, uh, again, this big buffet, no tendency

594
00:24:28.525 --> 00:24:29.325

to depart though the

595
00:24:29.445 --> 00:24:30.565
airplane would just hang there in buffet.

596
00:24:30.865 --> 00:24:34.125
The chase pilot said the hor the ver horizontal tail was

597
00:24:34.125 --> 00:24:35.725
going up and down, plus or minus two inches.

598
00:24:36.185 --> 00:24:38.245
It was shaking the back end of the airplane hard enough.

599
00:24:38.985 --> 00:24:41.685
Uh, not at 2.8 hertz though.

600
00:24:43.065 --> 00:24:45.685
Um, our solution was pretty straightforward.

601
00:24:46.785 --> 00:24:48.405
We just put a shim on the rudder stop.

602
00:24:48.945 --> 00:24:52.005
So to keep you from going there, the airplane has plenty

603
00:24:52.005 --> 00:24:53.965
of side slip capability that I'll talk about it in a minute.

604
00:24:54.265 --> 00:24:57.165
And it worked really well as I'd started

605
00:24:57.165 --> 00:24:58.365
to move the CG around.

606
00:24:58.715 --> 00:24:59.725
What did I have to work with?

607
00:24:59.805 --> 00:25:01.645
I had forward fuel, I had the seats,

608
00:25:02.285 --> 00:25:03.285
I had a baggage compartment,

609
00:25:03.385 --> 00:25:05.565
but Bill never got to put tie downs in the back.

610
00:25:05.585 --> 00:25:08.325
So I was really unwilling to put anything heavy back there.

611
00:25:08.705 --> 00:25:10.805
And I had an afu tank that I could adjust.

612
00:25:12.985 --> 00:25:15.365
So while I was doing stalls, I sent the boys out to, uh,

613
00:25:15.365 --> 00:25:18.845
find me some ballast and a way to, to weigh it.

614
00:25:19.545 --> 00:25:22.685
So they came back with this river rock. We weighed each bag.

615
00:25:22.685 --> 00:25:24.565
You see the one on the left weighs 46 pounds.

616
00:25:25.105 --> 00:25:26.925
So we knew how much we had.

617
00:25:28.145 --> 00:25:29.525
We loaded that into the front seat

618
00:25:29.525 --> 00:25:30.525
and tied it down real tight.

619
00:25:30.605 --> 00:25:32.325
I wanted to make sure it wouldn't foul the controls.

620
00:25:32.945 --> 00:25:35.485
So there's my first passenger in the airplane,

621
00:25:35.715 --> 00:25:40.205

Fred Flintstone, he didn't complain at all.

622
00:25:41.785 --> 00:25:42.805
Now, because I'm an s

623
00:25:42.805 --> 00:25:45.845
and C guy, I understand that stick force per g changes

624
00:25:45.915 --> 00:25:47.125
with CG linearly

625
00:25:47.465 --> 00:25:49.725
and where it goes to zero down in the lower right there

626
00:25:49.915 --> 00:25:51.005
defines a maneuver point

627
00:25:51.005 --> 00:25:52.405
where maneuver stability goes to zero.

628
00:25:53.285 --> 00:25:55.245
I also know that stick force per v

629
00:25:55.905 --> 00:25:58.925
static stability changes linearly with airspeed.

630
00:25:59.185 --> 00:26:01.765
And where it goes to zero is defined as the neutral point.

631
00:26:02.025 --> 00:26:04.005
And that's where the static stability goes to zero.

632
00:26:04.065 --> 00:26:08.925
So that's the critical one. So I measured those.

633
00:26:10.085 --> 00:26:12.165
I measured the stick force away from trim. Pretty simple.

634
00:26:12.165 --> 00:26:14.205
You trim the airplane, change the speed,

635
00:26:15.065 --> 00:26:16.885
put the gauge on the stick, see what it says.

636
00:26:17.985 --> 00:26:19.565
Uh, load factor was pretty easy.

637
00:26:21.105 --> 00:26:23.685
Two G turn 60 degrees level flight.

638
00:26:23.995 --> 00:26:25.205
Sometimes it took me four

639
00:26:25.205 --> 00:26:27.005
or five times around to get things all stable

640
00:26:27.005 --> 00:26:28.565
and make sure there was no traffic in the area.

641
00:26:29.025 --> 00:26:31.645
Put the gauge on the stick, measure the force.

642
00:26:33.465 --> 00:26:34.605
Here's what the answer was.

643
00:26:35.035 --> 00:26:39.485
Four pounds per G at 22%, uh, CG

644
00:26:40.465 --> 00:26:42.125
and about a pound and three quarters

645
00:26:42.125 --> 00:26:43.645
for 30 knot change in airspeed.

646
00:26:44.305 --> 00:26:45.365
Now that actually, I think

647
00:26:45.365 --> 00:26:47.205
that actually meets the part 23 standard,

648
00:26:48.185 --> 00:26:49.725

you guys from Wichita can tell me.

649
00:26:50.665 --> 00:26:53.645
Um, but at that point, all I knew was that one data point

650
00:26:53.645 --> 00:26:54.925
and I didn't know what the slopes were.

651
00:26:54.925 --> 00:26:57.045
So I moved the CG back two more inches.

652
00:26:57.505 --> 00:27:00.845
Uh, those poor auto mechanics didn't understand what

653
00:27:00.845 --> 00:27:02.645
that engineer was doing at 10 o'clock at night,

654
00:27:02.645 --> 00:27:03.805
drawing lines on graph paper.

655
00:27:04.505 --> 00:27:06.165
But, uh, next thing they knew, I told 'em

656
00:27:06.165 --> 00:27:07.525
how much fuel I needed in the back tank.

657
00:27:07.525 --> 00:27:08.845
They were happy to help me with that.

658
00:27:10.345 --> 00:27:12.725
So I moved the CG back based on the

659
00:27:12.725 --> 00:27:13.965
four data points on the left.

660
00:27:14.485 --> 00:27:16.605
I drew the lines extrapolated down to zero

661
00:27:16.605 --> 00:27:18.445
and I said, you know, I'm not sure I want

662
00:27:18.445 --> 00:27:19.885
to go all the way in one step.

663
00:27:20.345 --> 00:27:22.325
So I moved the CG back two more percent

664
00:27:22.705 --> 00:27:24.045
and found out that that initial

665
00:27:24.045 --> 00:27:25.285
fairing was a little conservative.

666
00:27:27.255 --> 00:27:29.605
Other characteristics, I demonstrated the crosswinds.

667
00:27:29.865 --> 00:27:31.405
That's what's neat about having, uh,

668
00:27:31.405 --> 00:27:32.885
90 degree runways at the airport.

669
00:27:33.315 --> 00:27:35.845
Takeoff, I, I did 20 knots gusting to 27

670
00:27:36.885 --> 00:27:39.525
demonstrated landings in 11 gusting to 16, which is plenty

671
00:27:39.545 --> 00:27:40.685
for this class of airplane.

672
00:27:41.345 --> 00:27:42.885
And then I had to go back to work, of course.

673
00:27:43.305 --> 00:27:45.165
So yet to do was the performance stuff.

674
00:27:46.905 --> 00:27:51.445
So two months later I went back to Appleton, measured the,

675
00:27:51.465 --> 00:27:55.885

uh, time to climb or climb rate data to get the best speed

676
00:27:55.885 --> 00:27:58.405
and angle, uh, of climb

677
00:27:59.485 --> 00:28:01.285
reciprocal headings perpendicular to the wind.

678
00:28:02.035 --> 00:28:03.645
Similar for the glide speeds.

679
00:28:06.075 --> 00:28:09.405
Best glides about min sink is about 80 best glides about 95.

680
00:28:10.465 --> 00:28:13.005
And then we got Fred Flintstone's, older sister Freda.

681
00:28:13.385 --> 00:28:16.085
And we put 300 pounds of rocks in the right seat,

682
00:28:16.915 --> 00:28:18.285
full fuel me in the left seat.

683
00:28:18.285 --> 00:28:19.565
The airplane's pretty squatty.

684
00:28:19.855 --> 00:28:22.365
Those little 505 tires are working pretty hard.

685
00:28:23.575 --> 00:28:26.405
Again, I was most worried about, uh, not fouling the stick,

686
00:28:26.785 --> 00:28:29.205
but I took the airplane direct to 12,500 feet

687
00:28:29.205 --> 00:28:30.965
and the engine temperatures stayed in check.

688
00:28:31.425 --> 00:28:32.685
So I was pretty happy with that.

689
00:28:34.395 --> 00:28:36.245
That left takeoff and landing performance.

690
00:28:36.245 --> 00:28:39.205
So five 30 in the morning, we're out there with no wind, uh,

691
00:28:39.345 --> 00:28:41.845
runway two niner, uh, tax away.

692
00:28:41.895 --> 00:28:44.645
Alpha three gives me 1800 feet tax away.

693
00:28:44.695 --> 00:28:46.645
Bravo gives me 3, 301 feet

694
00:28:46.645 --> 00:28:48.365
and the runway lights are 200 feet apart.

695
00:28:49.225 --> 00:28:52.565
So I was able to measure my own landing distances.

696
00:28:53.585 --> 00:28:56.165
Um, this airplane's pretty good at 2000 feet,

697
00:28:56.165 --> 00:28:57.525
but I wouldn't go much shorter than that.

698
00:28:57.845 --> 00:29:00.445
Takeoffs were always about 12 or 1300 feet.

699
00:29:01.385 --> 00:29:03.405
Now if you take an airplane to Oshkosh, you really

700
00:29:09.015 --> 00:29:10.015
Good morning. Uh, hopefully

701
00:29:10.015 --> 00:29:11.025
you guys have a charge.

702
00:29:11.045 --> 00:29:13.425

Couple coffee because I'm about

703
00:29:13.425 --> 00:29:15.705
to make a best attempt to put you to sleep.

704
00:29:17.045 --> 00:29:18.305
Um, let's see.

705
00:29:18.365 --> 00:29:19.745
Uh, thank you for the opportunity to come

706
00:29:19.745 --> 00:29:22.665
and tell you, tell you all about our strategies

707
00:29:22.725 --> 00:29:23.745
for test planning.

708
00:29:24.085 --> 00:29:25.705
I'm, uh, I go by animal.

709
00:29:26.005 --> 00:29:27.065
Uh, this is flash

710
00:29:27.325 --> 00:29:31.425
and uh, we are gonna start with, uh,

711
00:29:31.585 --> 00:29:32.625
a quick instruct

712
00:29:32.625 --> 00:29:34.185
or a quick, quick introduction

713
00:29:34.245 --> 00:29:35.665
of our proposed methodologies.

714
00:29:36.005 --> 00:29:39.105
And we'll really show you how these are applied

715
00:29:39.285 --> 00:29:41.645
by considering two different, uh, case studies.

716
00:29:42.345 --> 00:29:46.245
The first of those will be the integration of an, uh,

717
00:29:46.245 --> 00:29:49.285
active electronically scanned array radar on the 16.

718
00:29:49.945 --> 00:29:52.125
Uh, in that particular case study, we'll be able

719
00:29:52.125 --> 00:29:54.605
to highlight, uh, one of our, our changes

720
00:29:54.865 --> 00:29:57.365
to the current planning methodology by

721
00:29:58.005 --> 00:29:59.805
applying the flood test to build a flow chart.

722
00:30:00.385 --> 00:30:03.405
And secondly, we're gonna, we will take the opportunity

723
00:30:03.405 --> 00:30:06.125
to use, uh, the F three five harassment code example

724
00:30:06.125 --> 00:30:07.965
that I heard you saw a video of yesterday.

725
00:30:08.585 --> 00:30:11.445
Um, to show you how our output based risk method,

726
00:30:11.555 --> 00:30:14.005
risk risk assessment method might be employed.

727
00:30:16.065 --> 00:30:19.645
One helpful way to conceptualize, uh, why we are trying

728
00:30:19.645 --> 00:30:23.045
to do this and why we wanna modernize our safety and test

729
00:30:23.205 --> 00:30:26.055

Planning, consider trying to do envelope expansion

730
00:30:26.285 --> 00:30:29.455
with two types of, uh, two very different types of aircraft.

731
00:30:29.865 --> 00:30:31.695
First, the P 38 lightning

732
00:30:32.075 --> 00:30:35.695
and, uh, second the F 35 Lightning two,

733
00:30:35.785 --> 00:30:37.495
which we wrapped Raptor guys like

734
00:30:37.495 --> 00:30:39.455
to affectionately call the Deuce.

735
00:30:40.715 --> 00:30:43.415
Um, anyway, flash.

736
00:30:43.415 --> 00:30:45.855
Didn't know I was gonna say that season F 35 guy.

737
00:30:46.235 --> 00:30:49.615
Uh, anyway, when you look at the, the testing

738
00:30:49.635 --> 00:30:52.135
of these two particular systems, the, uh,

739
00:30:52.455 --> 00:30:54.255
P 38 is relatively straightforward.