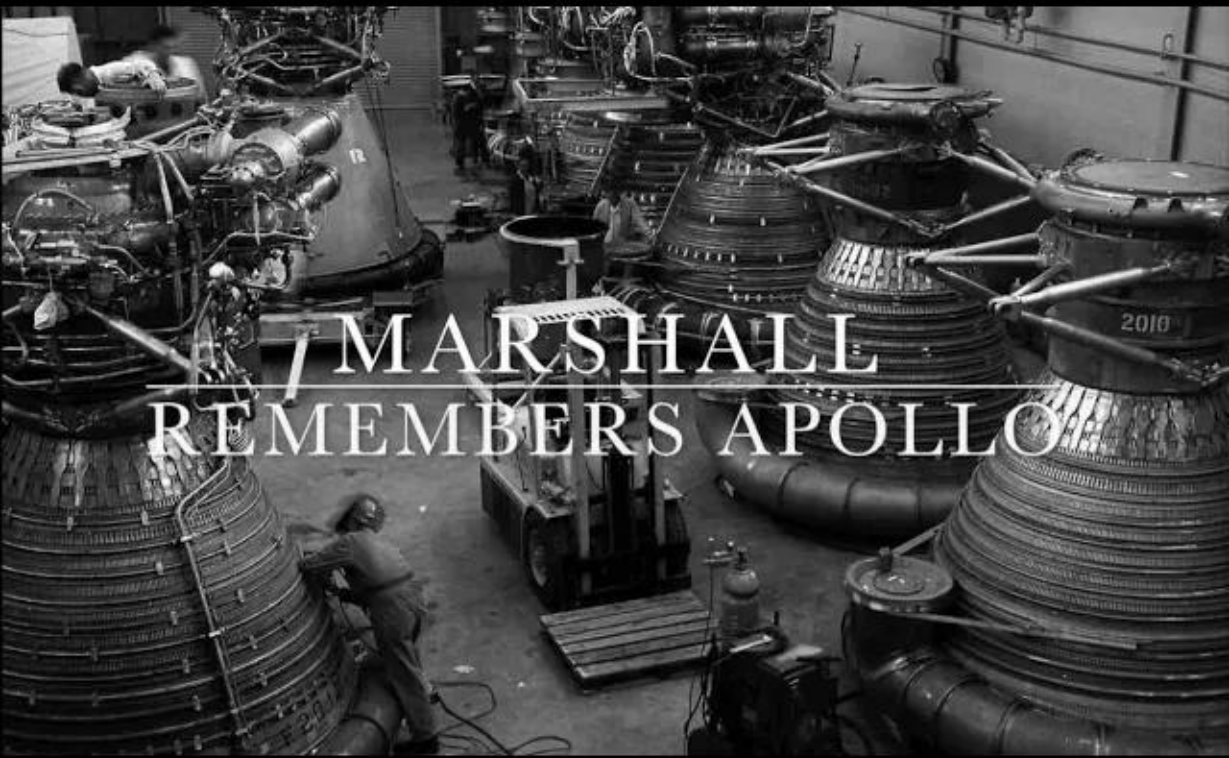
MARSHALL
REMEMBERS APOLLO

1
00:00:01,130 --> 00:00:14,390
[Music]

2
00:00:23,080 --> 00:00:20,750
I was interviewed by NASA at LSU where I

3
00:00:26,749 --> 00:00:23,090
was getting ready to graduate

4
00:00:28,760 --> 00:00:26,759
Marshall offered a job and a friend of

5
00:00:29,420 --> 00:00:28,770
mine it was actually the best man at my

6
00:00:31,880 --> 00:00:29,430
wedding

7
00:00:36,979 --> 00:00:31,890
used to co-op here so he was very high

8
00:00:48,670 --> 00:00:36,989
so I accepted and the first thing I know

9
00:00:52,540 --> 00:00:50,890
well the main thing for Apollo where

10
00:00:56,230 --> 00:00:52,550
they were is the early days of the

11
00:00:59,350 --> 00:00:56,240
Saturn 5 but the Saturn one and one base

12
00:01:03,160 --> 00:00:59,360
were active one of the first jobs I had

13
00:01:08,860 --> 00:01:03,170

was with the in the test laboratory was

14
00:01:13,180 --> 00:01:08,870
the caretaking the s1b that we had in a

15
00:01:18,400 --> 00:01:13,190
dynamic test and and we do mobile

16
00:01:21,670 --> 00:01:18,410
testing whatever and our job was the 24

17
00:01:25,780 --> 00:01:21,680
hours is a lot of treat and make sure if

18
00:01:29,440 --> 00:01:25,790
it got cold nothing froze next activity

19
00:01:32,800 --> 00:01:29,450
I got involved in was testing the turbo

20
00:01:38,710 --> 00:01:32,810
pump that was on the h1 engine for the

21
00:01:42,969 --> 00:01:38,720
Saturn 1b and following that our section

22
00:01:46,900 --> 00:01:42,979
was chosen to test the f1 engine which

23
00:01:49,150 --> 00:01:46,910
goes on the first stage of s1 C so

24
00:01:51,460 --> 00:01:49,160
spending a lot of time getting test

25
00:01:55,480 --> 00:01:51,470
stands ready we've modified one of the

26
00:02:00,370 --> 00:01:55,490
old Saturn stands to start testing early

27
00:02:07,900 --> 00:02:00,380
and plus built a new sample at Rome so I

28
00:02:13,160 --> 00:02:10,279
your first attempt deaf woman is

29
00:02:18,380 --> 00:02:13,170
basically scale-up components from the

30
00:02:21,260 --> 00:02:18,390
h1 and the first injector that goes in

31
00:02:25,010 --> 00:02:21,270
the main chamber for the f1 turned out

32
00:02:27,100 --> 00:02:25,020
to be very unstable you want to test

33
00:02:29,710 --> 00:02:27,110
that me running I'm thinking you were

34
00:02:32,450 --> 00:02:29,720
doing fine and all of a sudden it was

35
00:02:36,620 --> 00:02:32,460
combustion instability was set in and

36
00:02:40,730 --> 00:02:36,630
they tear the engine apart so they even

37
00:02:44,960 --> 00:02:40,740
it created that team to go out to

38
00:02:48,800 --> 00:02:44,970

California and I think Jerry Thompson

39
00:02:51,770 --> 00:02:48,810
had it is up to look at different

40
00:02:55,040 --> 00:02:51,780
concepts getting wealthy problems

41
00:02:58,820 --> 00:02:55,050
settled and they finally then after they

42
00:03:01,520 --> 00:02:58,830
got the our first engine was very stable

43
00:03:04,760 --> 00:03:01,530
and we never never had an instability

44
00:03:07,690 --> 00:03:04,770
problem I worked on the s-1 see when we

45
00:03:11,840 --> 00:03:07,700
put it in the test and and tested the

46
00:03:16,430 --> 00:03:11,850
test vehicle as well as the first couple

47
00:03:20,030 --> 00:03:16,440
of flight stages and they're in metal

48
00:03:24,289 --> 00:03:20,040
the latter stages of that period the we

49
00:03:27,289 --> 00:03:24,299
took the old s1 CT the test vehicle to

50
00:03:30,020 --> 00:03:27,299
Stennis to activate the B facility

51
00:03:32,630 --> 00:03:30,030
incentives so I went to sentence for

52
00:03:35,660 --> 00:03:32,640
that and activation and installers work

53
00:03:40,340 --> 00:03:35,670
in the s2 stage which was being an

54
00:03:42,500 --> 00:03:40,350
exception tested at Stennis and they

55
00:03:45,530 --> 00:03:42,510
therefore it was like seven or eight

56
00:03:48,380 --> 00:03:45,540
months I was at Stennis because it was

57
00:03:51,080 --> 00:03:48,390
Mississippi test facility back then the

58
00:03:55,190 --> 00:03:51,090
vehicle I was on was second stage of

59
00:03:59,840 --> 00:03:55,200
Apollo six which was the second flight

60
00:04:01,430 --> 00:03:59,850
vehicle and so I was there for four or

61
00:04:04,789 --> 00:04:01,440
five months while we were prepping the

62
00:04:06,890 --> 00:04:04,799
stage and getting it ready launch and

63
00:04:12,750 --> 00:04:06,900

that happened to be the stage that also

64
00:04:15,600 --> 00:04:12,760
had some problems I was in

65
00:04:18,120 --> 00:04:15,610
the sensual instrumentation of selfie it

66
00:04:20,129 --> 00:04:18,130
was collars were all the restrictions

67
00:04:22,320 --> 00:04:20,139
and the recorders were so I didn't get

68
00:04:24,870 --> 00:04:22,330
to see a thing my my wife watched the

69
00:04:26,640 --> 00:04:24,880
launch from a parking lot of Titusville

70
00:04:30,240 --> 00:04:26,650
band you had a much better view than I

71
00:04:32,960 --> 00:04:30,250
did I remember looking at the strip

72
00:04:37,050 --> 00:04:32,970
chart that showed the chamber pressures

73
00:04:41,480 --> 00:04:37,060
well the s2 was fine and all of a sudden

74
00:04:45,540 --> 00:04:41,490
made Engine 2 and in his in three quit

75
00:04:49,800 --> 00:04:45,550
which was kind of shocking and wasn't

76
00:04:53,370 --> 00:04:49,810
not expected that staged that flight

77
00:04:57,060 --> 00:04:53,380
also experienced Pogo now Pogo was a

78
00:05:01,560 --> 00:04:57,070
problem we were for me with it occurred

79
00:05:03,420 --> 00:05:01,570
in a Titan it's real subtle you can make

80
00:05:06,390 --> 00:05:03,430
some there weren't that many changes

81
00:05:08,909 --> 00:05:06,400
between the first saturn v launch

82
00:05:11,580 --> 00:05:08,919
centers at the second one but it was

83
00:05:14,430 --> 00:05:11,590
enough to change some dynamic

84
00:05:17,820 --> 00:05:14,440
characteristics and the Pogo came in and

85
00:05:21,450 --> 00:05:17,830
and really rattle that stage with a low

86
00:05:23,640 --> 00:05:21,460
friction to the oscillation after it

87
00:05:27,210 --> 00:05:23,650
splashed down and we finally completed a

88
00:05:29,190 --> 00:05:27,220

mission the we went back to hospital and

89
00:05:31,140 --> 00:05:29,200
started working

90
00:05:34,070 --> 00:05:31,150
what were those problems and the big

91
00:05:36,990 --> 00:05:34,080
problem we I was involved with was the

92
00:05:41,430 --> 00:05:37,000
taking care of the Pogo problem our

93
00:05:43,950 --> 00:05:41,440
tests and that we were using had a lot

94
00:05:46,800 --> 00:05:43,960
of vehicles Hardware in it from the

95
00:05:49,050 --> 00:05:46,810
bottom of propellant tanks all the way

96
00:05:52,850 --> 00:05:49,060
down to the unit of interface were all

97
00:05:56,130 --> 00:05:52,860
vehicle Hardware so we were able to

98
00:05:59,730 --> 00:05:56,140
assimilate all the conditions that it

99
00:06:02,090 --> 00:05:59,740
would say and they we were fortunate

100
00:06:06,629 --> 00:06:02,100
that the prevail we have which is a

101
00:06:09,140 --> 00:06:06,639
valve just in front of the engine that

102
00:06:12,270 --> 00:06:09,150
you use an emergency's one of you to

103
00:06:15,300 --> 00:06:12,280
terminate the propellant flow I had a

104
00:06:17,659 --> 00:06:15,310
lot of cavity space in it which worked

105
00:06:20,790 --> 00:06:17,669
out to be perfect to be an accumulator

106
00:06:23,399 --> 00:06:20,800
so that worked up a design for an

107
00:06:25,559 --> 00:06:23,409
accumulator and we put it in the f1

108
00:06:28,999 --> 00:06:25,569
stand to test it and we ran a lot of

109
00:06:32,839 --> 00:06:29,009
tests on that pulse the engine and

110
00:06:36,269 --> 00:06:32,849
verify that it worked at dampened the

111
00:06:39,589 --> 00:06:36,279
oscillation significantly the rest of

112
00:06:42,689 --> 00:06:39,599
the time with the Saturn 5 it was almost

113
00:06:44,550 --> 00:06:42,699

well I wouldn't say boring because we

114
00:06:46,499 --> 00:06:44,560
need firing engines in that bed and it's

115
00:06:50,100 --> 00:06:46,509
rattling the building you're standing in

116
00:06:57,030 --> 00:06:50,110
it's not boring but we didn't have any

117
00:07:03,940 --> 00:07:00,430
one memory of that that really stands

118
00:07:06,310 --> 00:07:03,950
out for me was the news people were all

119
00:07:10,570 --> 00:07:06,320
over the world and they were in Paris

120
00:07:14,650 --> 00:07:10,580
and they were interviewed some citizens

121
00:07:18,520 --> 00:07:14,660
in Paris and one guy made a statement

122
00:07:22,300 --> 00:07:18,530
it must be proud to be an American right

123
00:07:27,719 --> 00:07:22,310
now I'll always remember that that

124
00:07:33,300 --> 00:07:30,990
the first thing we had a mission the

125
00:07:36,089 --> 00:07:33,310
President Kennedy made the statement

126
00:07:38,939 --> 00:07:36,099
that we want to send men to the moon and

127
00:07:41,189 --> 00:07:38,949
bring them back safely so that was

128
00:07:43,469 --> 00:07:41,199
that's the thing that programs that have

129
00:07:46,469 --> 00:07:43,479
followed it really suffered from the

130
00:07:49,020 --> 00:07:46,479
lack of a mission we just continued the

131
00:07:52,830 --> 00:07:49,030
testing and and did what we could to

132
00:07:56,100 --> 00:07:52,840
make sure every flight was successful I

133
00:07:59,820 --> 00:07:56,110
work for some very good people then

134
00:08:02,580 --> 00:07:59,830
Driscoll was our division chief Carl

135
00:08:06,119 --> 00:08:02,590
Hamburg was a laboratory chief we

136
00:08:08,429 --> 00:08:06,129
started transitioning and working then

137
00:08:11,040 --> 00:08:08,439
follow-on which was going to be the

138
00:08:14,249 --> 00:08:11,050

shuttle we thought the way to get costs

139
00:08:16,619 --> 00:08:14,259
down was to reused something I started

140
00:08:20,580 --> 00:08:16,629
working the Space Shuttle main engine

141
00:08:24,360 --> 00:08:20,590
and those early days we did trade

142
00:08:27,959 --> 00:08:24,370
studies and we even had versions that

143
00:08:30,689 --> 00:08:27,969
were modifying the Saturn 5 first stage

144
00:08:33,389 --> 00:08:30,699
to make it a fly back booster we

145
00:08:37,259 --> 00:08:33,399
couldn't do what SpaceX - there because

146
00:08:39,240 --> 00:08:37,269
it was very large and I think we're a

147
00:08:42,480 --> 00:08:39,250
bit further down range when it burned

148
00:08:45,300 --> 00:08:42,490
out so it wasn't as easy to to fly it

149
00:08:50,570 --> 00:08:45,310
fire it up and fly it back to the long

150
00:08:57,880 --> 00:08:52,760
being in the blockhouse when we were

151
00:09:02,720 --> 00:08:57,890
testing the s1c i mean that was a big

152
00:09:05,540 --> 00:09:02,730
loud booster during one test I was on

153
00:09:11,449 --> 00:09:05,550
the periscope so watch for something

154
00:09:15,740 --> 00:09:11,459
going wrong and we had we used water to

155
00:09:19,070 --> 00:09:15,750
cool the exhaust a little bit protect

156
00:09:22,130 --> 00:09:19,080
the vehicle in the facility and one of

157
00:09:24,500 --> 00:09:22,140
them had a flange that was about in the

158
00:09:28,490 --> 00:09:24,510
middle of engine and during the testing

159
00:09:30,920 --> 00:09:28,500
its sprung a weight and we was sitting

160
00:09:34,190 --> 00:09:30,930
there with a cut button but very quickly

161
00:09:40,840 --> 00:09:34,200
realized what it was and and we

162
00:09:45,240 --> 00:09:42,990
and we had a lot of criticism

163
00:09:46,530 --> 00:09:45,250

was spending so much money and a lot of

164
00:09:49,140 --> 00:09:46,540
people thought it could be better spent

165
00:09:52,290 --> 00:09:49,150
in other areas yeah it was just

166
00:09:54,570 --> 00:09:52,300
something you put up with we couldn't do

167
00:09:58,140 --> 00:09:54,580
anything about it we just make sure that

168
00:10:05,120 --> 00:09:58,150
we didn't provide them with any

169
00:10:11,970 --> 00:10:06,900
social issues can

170
00:10:14,970 --> 00:10:11,980
very alarming you couldn't watch

171
00:10:16,800 --> 00:10:14,980
television without seeing something

172
00:10:20,070 --> 00:10:16,810
going on where somebody did something

173
00:10:24,870 --> 00:10:20,080
they shouldn't have and we've had

174
00:10:27,570 --> 00:10:24,880
protests and marches and but we were

175
00:10:29,490 --> 00:10:27,580
still concentrating on getting the man

176
00:10:36,310 --> 00:10:29,500
to the moon and make sure he came back

177
00:10:47,000 --> 00:10:42,290
the German crew that was here they were

178
00:10:49,579 --> 00:10:47,010
amazing they argue like gangbusters over

179
00:10:52,010 --> 00:10:49,589
a subject whatever but they had one

180
00:10:54,860 --> 00:10:52,020
characteristics I wish we all had is

181
00:10:57,769 --> 00:10:54,870
once the decision was made they all

182
00:10:59,990 --> 00:10:57,779
lined up and marched together I recall

183
00:11:04,340 --> 00:11:00,000
one time I was in a review that dr. von

184
00:11:07,730 --> 00:11:04,350
Braun was in and it was an engine review

185
00:11:10,820 --> 00:11:07,740
and they put a schematic I think it was

186
00:11:12,920 --> 00:11:10,830
a j2 up on the screen and he studied it

187
00:11:16,150 --> 00:11:12,930
for a while and all of a sudden he

188
00:11:19,639 --> 00:11:16,160

stopped the percenter and pointed out a

189
00:11:22,550 --> 00:11:19,649
valve on the engine that was backwards

190
00:11:25,610 --> 00:11:22,560
in the schematic there's a check valve

191
00:11:29,510 --> 00:11:25,620
but he said in that well the wrong

192
00:11:32,269 --> 00:11:29,520
way and yeah it was a an artist made a

193
00:11:35,449 --> 00:11:32,279
mistake and put the chicken in the wrong

194
00:11:39,590 --> 00:11:35,459
direction but he was a sneak picked it

195
00:11:42,199 --> 00:11:39,600
out after the first full duration s1c

196
00:11:45,980 --> 00:11:42,209
fire and he invited a bunch of us to his

197
00:11:48,740 --> 00:11:45,990
house and we sat around and just talked

198
00:11:52,420 --> 00:11:48,750
and he wouldn't know about all the Pogo

199
00:11:55,579 --> 00:11:52,430
stuff but we did and verified that the

200
00:11:58,730 --> 00:11:55,589
method of recirculating propellants to

201
00:12:02,150 --> 00:11:58,740
keep geysers from occurring

202
00:12:06,110 --> 00:12:02,160
geysers estranged currency you have a

203
00:12:09,410 --> 00:12:06,120
tall column of cryogenic particular

204
00:12:13,370 --> 00:12:09,420
locks and then you have a heat source at

205
00:12:14,990 --> 00:12:13,380
the bottom like an engine it'll if you

206
00:12:19,250 --> 00:12:15,000
don't keep it cold enough it'll

207
00:12:22,910 --> 00:12:19,260
ultimately saturate and then turn it

208
00:12:25,430 --> 00:12:22,920
into a gas and then you get enough gas

209
00:12:29,140 --> 00:12:25,440
it goes up the line and when it goes up

210
00:12:31,550 --> 00:12:29,150
the line it empties everything above it

211
00:12:33,290 --> 00:12:31,560
until it gets over the bottom of thank

212
00:12:37,850 --> 00:12:33,300
you vent filled back up and you've got

213
00:12:41,720 --> 00:12:37,860

this 50 something foot column of oxygen

214
00:12:44,120 --> 00:12:41,730
moving in fact 1g it can damage stuff

215
00:12:45,890 --> 00:12:44,130
yes once he had a problem with that

216
00:12:48,890 --> 00:12:45,900
during one of the acceptance tests

217
00:12:52,310 --> 00:12:48,900
somebody made an error and did it

218
00:12:53,630 --> 00:12:52,320
replace a seal and he had a fuel and it

219
00:12:56,660 --> 00:12:53,640
caught on fire

220
00:12:58,610 --> 00:12:56,670
and while the tester was trying to

221
00:13:02,720 --> 00:12:58,620
figure out what to do they neglected to

222
00:13:05,060 --> 00:13:02,730
reestablish the recirculation so they

223
00:13:09,949 --> 00:13:05,070
got a geyser that ruptured one of the

224
00:13:12,560 --> 00:13:09,959
locks lines and they dumped locks on a

225
00:13:17,500 --> 00:13:12,570
kerosene fire you learn from your

226
00:13:22,060 --> 00:13:20,140
well everybody likes to say you guys had

227
00:13:23,710 --> 00:13:22,070
plenty of money cuz you can do what you

228
00:13:26,950 --> 00:13:23,720
wanted to do and to a certain degree

229
00:13:30,160 --> 00:13:26,960
that was true there were some budget

230
00:13:32,650 --> 00:13:30,170
constraints but we still had the money

231
00:13:35,170 --> 00:13:32,660
to do what we felt it was necessary to

232
00:13:37,690 --> 00:13:35,180
do the center was very young not a lot

233
00:13:41,770 --> 00:13:37,700
of young engineers like myself at that

234
00:13:44,050 --> 00:13:41,780
time and you know we didn't know that we

235
00:13:46,090 --> 00:13:44,060
couldn't do things you know somebody

236
00:13:50,020 --> 00:13:46,100
come up with an idea well we try it and

237
00:13:53,410 --> 00:13:50,030
see what happens where we go that's very

238
00:13:55,090 --> 00:13:53,420

beneficial I was working on a system to

239
00:13:57,400 --> 00:13:55,100
put people on the moon

240
00:14:00,640 --> 00:13:57,410
you know people not too many people have

241
00:14:03,850 --> 00:14:00,650
done that before in their lives there

242
00:14:05,620 --> 00:14:03,860
was exciting times everybody was kind of

243
00:14:08,980 --> 00:14:05,630
excited about the fact that we were

244
00:14:11,620 --> 00:14:08,990
going to send them you know a crew to

245
00:14:13,360 --> 00:14:11,630
the moon and bring them back it made you

246
00:14:17,140 --> 00:14:13,370
kind of look at things a little more

247
00:14:19,900 --> 00:14:17,150
critical to be sure you didn't have any

248
00:14:22,840 --> 00:14:19,910
problem since most of the flights were

249
00:14:24,460 --> 00:14:22,850
pretty much except for the the one I was

250
00:14:30,070 --> 00:14:24,470
at the Cape Foyle were pretty successful

251
00:14:33,970 --> 00:14:30,080
there they had no major problems so that

252
00:14:37,600 --> 00:14:33,980
paid off but being part of an effort to