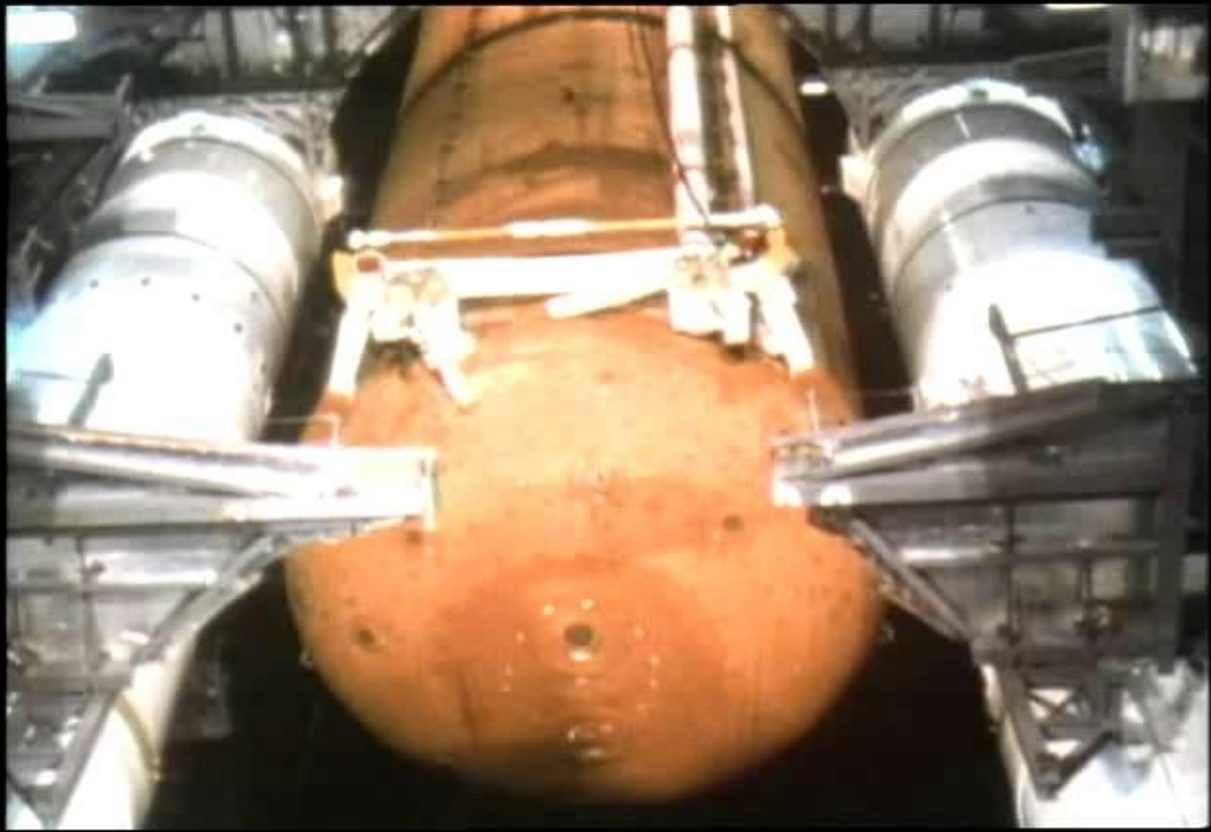

1
00:00:22,150 --> 00:00:20,230
satellite from now on McNair pilot Mike

2
00:00:23,580 --> 00:00:22,160
Smith followed by Christa McAuliffe

3
00:00:26,560 --> 00:00:23,590
featuring faith

4
00:00:32,170 --> 00:00:26,570
Ellison Onizuka and payload specialist

5
00:00:35,079 --> 00:00:32,180
Greg Jarvis big smiles today confidently

6
00:00:38,369 --> 00:00:35,089
getting into the van we're going to go

7
00:00:41,819 --> 00:00:38,379
to that pad and attempt a second try

8
00:00:44,110 --> 00:00:41,829
second loss second try at launch today

9
00:00:50,310 --> 00:00:44,120
it will take a few minutes for the

10
00:00:57,279 --> 00:00:54,490
the orbiter and the first crew member

11
00:01:01,180 --> 00:00:57,289
commander dick Scobee now in the white

12
00:01:09,070 --> 00:01:01,190
room taking off his jacket along with

13
00:01:13,960 --> 00:01:09,080

Mike Smith who is the the pilot dick

14
00:01:18,160 --> 00:01:13,970
Scobee became a military pilot and later

15
00:01:21,070 --> 00:01:18,170
a test pilot the hard way the he

16
00:01:23,649 --> 00:01:21,080
enlisted in the Air Force in 1957 and

17
00:01:27,070 --> 00:01:23,659
was trained as a reciprocating engine

18
00:01:32,529 --> 00:01:27,080
mechanic however he went to night school

19
00:01:35,290 --> 00:01:32,539
during the time he was down at Kelly Air

20
00:01:37,570 --> 00:01:35,300
Force Base and earned two years of

21
00:01:40,419 --> 00:01:37,580
college credit which helped lead to his

22
00:01:43,029 --> 00:01:40,429
selection as for the Airman's education

23
00:01:45,340 --> 00:01:43,039
and commissioning program he graduated

24
00:01:47,949 --> 00:01:45,350
from the University of Arizona with a

25
00:01:51,180 --> 00:01:47,959
degree in aerospace engineering received

26
00:01:54,700 --> 00:01:51,190
his commission in 1965 and his wings in

27
00:01:57,910 --> 00:01:54,710
1966 eyes completed a number of

28
00:02:02,649 --> 00:01:57,920
assignments for the Air Force including

29
00:02:06,069 --> 00:02:02,659
becoming an Air Force test pilot he was

30
00:02:08,169 --> 00:02:06,079
the pilot of the 41 C mission which

31
00:02:10,630 --> 00:02:08,179
deployed the long-duration exposure

32
00:02:12,970 --> 00:02:10,640
facility which is still in orbit and

33
00:02:15,970 --> 00:02:12,980
captured and repaired the solar maximum

34
00:02:18,569 --> 00:02:15,980
mission satellite and placed it in orbit

35
00:02:22,180 --> 00:02:18,579
where it is functioning better than ever

36
00:02:24,759 --> 00:02:22,190
Mike Smith putting on his egress harness

37
00:02:27,370 --> 00:02:24,769
to they're going to be going very fast

38
00:02:30,759 --> 00:02:27,380

two days to get out of the cold and into

39
00:02:32,650 --> 00:02:30,769
the cabin he was one of the Mike Smith

40
00:02:34,870 --> 00:02:32,660
is one of the few rookies on board this

41
00:02:37,360 --> 00:02:34,880
flight he's a graduate of the US Naval

42
00:02:41,410 --> 00:02:37,370
Academy in Annapolis and received his

43
00:02:45,009 --> 00:02:41,420
naval aviator wings in 1969 he had a

44
00:02:46,780 --> 00:02:45,019
two-year tour of duty in Vietnam and as

45
00:02:49,420 --> 00:02:46,790
a graduate of the Navy test pilot school

46
00:02:51,750 --> 00:02:49,430
where he also served as an instructor

47
00:02:54,729 --> 00:02:51,760
for 18 months

48
00:02:57,300 --> 00:02:54,739
altogether he's flown about 28 different

49
00:03:02,000 --> 00:02:57,310
types of civilian and military aircraft

50
00:03:05,250 --> 00:03:02,010
logging over 43 hundred hours

51
00:03:08,040 --> 00:03:05,260
he's taken on a number of tasks while

52
00:03:10,110 --> 00:03:08,050
he's been in the astronaut corps he

53
00:03:12,450 --> 00:03:10,120
served as commander in the shuttle

54
00:03:14,640 --> 00:03:12,460
avionics integration laboratory in

55
00:03:16,470 --> 00:03:14,650
Houston which tests all of the

56
00:03:19,110 --> 00:03:16,480
instrumentation and computers and

57
00:03:21,560 --> 00:03:19,120
software for the shuttle he also was

58
00:03:24,090 --> 00:03:21,570
deputy chief of aircraft operations and

59
00:03:27,330 --> 00:03:24,100
technical assistant to the director of

60
00:03:29,100 --> 00:03:27,340
flight operations George Abby he also

61
00:03:35,970 --> 00:03:29,110
served in the astronaut office

62
00:03:39,270 --> 00:03:35,980
development and test group after the

63
00:03:42,150 --> 00:03:39,280

scrub yesterday the crew went back to

64
00:03:44,010 --> 00:03:42,160
the crew quarters where they relaxed for

65
00:03:47,940 --> 00:03:44,020
a while and were able to have dinner

66
00:03:51,900 --> 00:03:47,950
with their spouses in the crew quarters

67
00:03:54,840 --> 00:03:51,910
dining room but they had to be in bed by

68
00:04:00,510 --> 00:03:54,850
about 7 o'clock so they could be up and

69
00:04:02,430 --> 00:04:00,520
on their way this morning Mike Smith

70
00:04:04,920 --> 00:04:02,440
shaking hands with the closeout crew

71
00:04:10,140 --> 00:04:04,930
which has assisted him in in getting

72
00:04:11,850 --> 00:04:10,150
ready they take a look at his feet and

73
00:04:14,910 --> 00:04:11,860
then wipe those out to make sure he's

74
00:04:28,980 --> 00:04:14,920
not carrying any debris into the cabin

75
00:04:34,770 --> 00:04:31,500
this is shuttle launch control at one

76
00:04:39,150 --> 00:04:34,780
hour 58 minutes 57 seconds in counting

77
00:04:41,880 --> 00:04:39,160
and dr. Judy Resnik who was mission

78
00:04:44,220 --> 00:04:41,890
specialist for the st 41 D mission on

79
00:04:46,350 --> 00:04:44,230
her first flight is in the white room

80
00:04:48,750 --> 00:04:46,360
now preparing to put on her egress

81
00:04:52,920 --> 00:04:48,760
harness and get ready for her entrance

82
00:04:56,430 --> 00:04:52,930
into the orbiter on her first flight

83
00:05:00,240 --> 00:04:56,440
three satellites were deployed and she

84
00:05:02,550 --> 00:05:00,250
was responsible for operating the remote

85
00:05:04,980 --> 00:05:02,560
manipulator arm on that particular

86
00:05:07,410 --> 00:05:04,990
flight she's also responsible for

87
00:05:09,870 --> 00:05:07,420
operating the arm for placing the

88
00:05:12,480 --> 00:05:09,880

Spartan Halley's spacecraft in orbit and

89
00:05:16,110 --> 00:05:12,490
then recovering it later in flight that

90
00:05:18,390 --> 00:05:16,120
will be put in orbit over the side of on

91
00:05:20,940 --> 00:05:18,400
the second day the orbiter will move

92
00:05:24,240 --> 00:05:20,950
about five miles away and allow it to

93
00:05:27,150 --> 00:05:24,250
function and look at Halley's Comet for

94
00:05:29,970 --> 00:05:27,160
40 hours and then go back and pick it up

95
00:05:32,610 --> 00:05:29,980
and bring it back to earth her

96
00:05:35,670 --> 00:05:32,620
undergraduate degree was from Carnegie

97
00:05:38,130 --> 00:05:35,680
Mellon University and she earned her PhD

98
00:05:42,680 --> 00:05:38,140
in electrical engineering from the

99
00:05:49,830 --> 00:05:46,830
prior to joining NASA in 1978 as a

100
00:05:51,810 --> 00:05:49,840
mission specialist Judy Resnik worked as

101
00:05:54,240 --> 00:05:51,820
a senior systems engineer in product

102
00:05:57,680 --> 00:05:54,250
development for the Xerox Corporation in

103
00:06:00,870 --> 00:05:57,690
California she's a native of Akron Ohio

104
00:06:03,770 --> 00:06:00,880
and also a classical pianist and enjoys

105
00:06:07,290 --> 00:06:03,780
flying and bicycling in their spare time

106
00:06:09,150 --> 00:06:07,300
Ellison Onizuka also in the white room

107
00:06:14,450 --> 00:06:09,160
actually everybody is going to be in

108
00:06:19,020 --> 00:06:14,460
there shortly as they get ready the

109
00:06:22,800 --> 00:06:19,030
teacher observer of Christa McAuliffe

110
00:06:27,510 --> 00:06:22,810
has been handed an apple by the closeout

111
00:06:30,300 --> 00:06:27,520
crew Ellison Onizuka Nell getting his

112
00:06:33,840 --> 00:06:30,310
egress harness on

113
00:06:37,020 --> 00:06:33,850

the native of Hawaii is a graduate of

114
00:06:39,060 --> 00:06:37,030
our Konawaena high school and earn both

115
00:06:41,129 --> 00:06:39,070
a bachelor and Master of Science degree

116
00:06:44,670 --> 00:06:41,139
in aerospace engineering from the

117
00:06:46,619 --> 00:06:44,680
versity of colorado after receiving his

118
00:06:49,529 --> 00:06:46,629
commission in the Air Force he served as

119
00:06:52,679 --> 00:06:49,539
a flight test engineer and participated

120
00:06:55,110 --> 00:06:52,689
in the flight programs and system safety

121
00:06:58,260 --> 00:06:55,120
engineering for a wide variety of

122
00:07:00,689 --> 00:06:58,270
aircraft he graduated from the Air Force

123
00:07:04,050 --> 00:07:00,699
test pilot school and then served on the

124
00:07:06,239 --> 00:07:04,060
staff on azúcar is one of the astronauts

125
00:07:09,390 --> 00:07:06,249
known as the Cape Crusaders who were

126
00:07:11,939 --> 00:07:09,400
assigned to KSC for a period of time of

127
00:07:14,100 --> 00:07:11,949
several launches and work with the

128
00:07:18,300 --> 00:07:14,110
orbiter test and check-out teams and the

129
00:07:22,230 --> 00:07:18,310
launch support crews the astronaut

130
00:07:25,230 --> 00:07:22,240
support person on board are Sonny Billy

131
00:07:49,720 --> 00:07:25,240
Bob Carter is also one of the Cape

132
00:07:49,730 --> 00:07:53,440
right up here

133
00:07:53,450 --> 00:08:17,720
go ahead up here

134
00:08:55,949 --> 00:08:22,830
Buhler curricula to a social position

135
00:08:55,959 --> 00:09:41,060
okay terrific

136
00:09:47,870 --> 00:09:45,860
I'll be Sufi LCCC okay apparently one of

137
00:09:48,439 --> 00:09:47,880
the crew left their gloves in the

138
00:09:52,220 --> 00:09:48,449

astro-man

139
00:09:56,590 --> 00:09:52,230
now between the orbiter the firing room

140
00:10:00,639 --> 00:09:56,600
here at Kennedy Space Center in Houston

141
00:10:11,269 --> 00:10:00,649
the booster engine gimbal now underway

142
00:10:15,019 --> 00:10:11,279
t-minus 15 seconds t-minus 10 9 8 7 6 we

143
00:10:20,150 --> 00:10:15,029
have main engine start four three two

144
00:10:22,249 --> 00:10:20,160
one and liftoff liftoff of the 25th

145
00:10:31,180 --> 00:10:22,259
space shuttle mission and it has cleared

146
00:10:44,280 --> 00:10:35,180
good roll program confirmed challenger

147
00:10:50,950 --> 00:10:47,320
engines beginning throttling down now at

148
00:10:56,400 --> 00:10:50,960
94% normal titles for most of the flight

149
00:11:03,190 --> 00:10:56,410
104 percent will travel down to 65%

150
00:11:05,110 --> 00:11:03,200
shortly engines at 65% three engines

151
00:11:11,560 --> 00:11:05,120
running normally karika fuel cells

152
00:11:13,720 --> 00:11:11,570
triggered ap use velocity 2257 feet per

153
00:11:20,220 --> 00:11:13,730
second altitude 4.3 nautical miles

154
00:11:31,170 --> 00:11:22,480
engines throttling up 3 engines and out

155
00:11:36,190 --> 00:11:34,330
1 minute 15 seconds velocity 2,900 feet

156
00:12:07,540 --> 00:11:36,200
per second altitude nautical miles

157
00:12:13,130 --> 00:12:09,470
my controllers here looking very

158
00:12:19,180 --> 00:12:13,140
carefully at the situation obviously a

159
00:12:19,190 --> 00:12:59,560
we have no down Lee

160
00:13:03,129 --> 00:13:01,480
we have a report from the flight

161
00:13:05,530 --> 00:13:03,139
dynamics officer that the vehicle has

162
00:13:08,199 --> 00:13:05,540
exploded flight director confirms that

163
00:13:10,210 --> 00:13:08,209

we are looking at checking with the

164
00:13:20,680 --> 00:13:10,220
recovery forces to see what can be done

165
00:13:29,720 --> 00:13:20,690
at this point contingency procedures are

166
00:13:36,289 --> 00:13:32,599
we will report more as we have

167
00:13:38,689 --> 00:13:36,299
information available again or repeat we

168
00:13:41,239 --> 00:13:38,699
have a report relayed through the flight

169
00:13:45,679 --> 00:13:41,249
dynamics officer that the vehicle has

170
00:13:48,409 --> 00:13:45,689
exploded we are now looking at all the

171
00:13:51,079 --> 00:13:48,419
contingency operations and waiting the

172
00:15:55,170 --> 00:13:51,089
report from any recovery of horses in

173
00:16:00,939 --> 00:15:57,189
flight of the space shuttle Challenger

174
00:16:03,550 --> 00:16:00,949
on mission 51 L the 25th flight of the

175
00:16:06,939 --> 00:16:03,560
space shuttle program began at 11:38

176
00:16:11,470 --> 00:16:06,949
a.m. Eastern Standard Time on January 28

177
00:16:13,569 --> 00:16:11,480
1986 it ended 73 seconds later in a

178
00:16:15,549 --> 00:16:13,579
structural breakup of the external tank

179
00:16:18,939 --> 00:16:15,559
and orbiter in which the seven crew

180
00:16:21,340 --> 00:16:18,949
members perished the solid rocket

181
00:16:23,249 --> 00:16:21,350
boosters continued in flight and were

182
00:16:38,410 --> 00:16:23,259
destroyed by the Range Safety Officer

183
00:16:43,630 --> 00:16:41,380
the delivery and assembly of 51l launch

184
00:16:45,270 --> 00:16:43,640
vehicle components began months prior to

185
00:16:48,070 --> 00:16:45,280
launch

186
00:16:50,110 --> 00:16:48,080
the solid rocket booster segments were

187
00:16:59,230 --> 00:16:50,120
transported by rail to the Kennedy Space

188
00:17:01,020 --> 00:16:59,240

Center the SRBs were inspected and

189
00:17:10,300 --> 00:17:01,030
partially assembled at the rotation

190
00:17:12,100 --> 00:17:10,310
processing and storage facility the

191
00:17:14,590 --> 00:17:12,110
segments were then moved to the Vehicle

192
00:17:26,590 --> 00:17:14,600
Assembly Building or VAB where they were

193
00:17:32,529 --> 00:17:29,259
the external tank arrived at KSC by

194
00:17:34,480 --> 00:17:32,539
barge and was moved into the VAB where

195
00:17:45,519 --> 00:17:34,490
it was checked out and made it to the

196
00:17:47,769 --> 00:17:45,529
stacked solid rocket boosters after

197
00:17:52,210 --> 00:17:47,779
orbiter check out challenger was rolled

198
00:18:00,930 --> 00:17:52,220
into the VAB and mated with the

199
00:18:06,810 --> 00:18:04,440
the STS 51l vehicle was transported from

200
00:18:10,799 --> 00:18:06,820
the VAB to the launch pad on December

201
00:18:13,080 --> 00:18:10,809
22nd 1985 at a crawler speed of

202
00:18:19,169 --> 00:18:13,090
approximately one mile per hour the

203
00:18:21,690 --> 00:18:19,179
journey takes about six hours the launch

204
00:18:24,149 --> 00:18:21,700
was rescheduled several times resulting

205
00:18:27,960 --> 00:18:24,159
in the final countdown on January 28

206
00:18:29,549 --> 00:18:27,970
1986 the weather was forecast to be

207
00:18:33,960 --> 00:18:29,559
clear and cold with temperatures

208
00:18:35,969 --> 00:18:33,970
dropping into the low 20s overnight the

209
00:18:41,070 --> 00:18:35,979
fueling of the external tank began at

210
00:18:43,529 --> 00:18:41,080
1:25 a.m. I said accumulated on the

211
00:18:45,570 --> 00:18:43,539
launch pad during the night several

212
00:18:48,330 --> 00:18:45,580
water systems were opened slightly and

213
00:18:51,629 --> 00:18:48,340

allowed to flow into drains the drains

214
00:18:53,879 --> 00:18:51,639
froze and caused overflows high wind

215
00:18:59,999 --> 00:18:53,889
gusts spread the water over large areas

216
00:19:03,089 --> 00:19:00,009
and ice formed the air temperature at

217
00:19:05,489 --> 00:19:03,099
launch was 36 degrees Fahrenheit this

218
00:19:15,690 --> 00:19:05,499
was 15 degrees colder than any previous

219
00:19:17,279 --> 00:19:15,700
launch at t-minus 7 minutes and 30

220
00:19:20,759 --> 00:19:17,289
seconds the ground launch sequencer

221
00:19:23,009 --> 00:19:20,769
began retracting the crew access arm the

222
00:19:25,710 --> 00:19:23,019
arm can be put back in place within 15

223
00:19:29,479 --> 00:19:25,720
to 20 seconds if an emergency arises and

224
00:19:33,089 --> 00:19:29,489
the crew must evacuate the pad at

225
00:19:34,919 --> 00:19:33,099
t-minus 3 minutes and 15 seconds gimble

226
00:19:37,710 --> 00:19:34,929
checks of the orbiter main engines were

227
00:19:40,019 --> 00:19:37,720
performed all three engines move in a

228
00:19:43,200 --> 00:19:40,029
pre-programmed pattern to verify a sent

229
00:19:44,609 --> 00:19:43,210
flight control the gimbal sequence ends

230
00:19:52,049 --> 00:19:44,619
with the engines in their start

231
00:19:54,419 --> 00:19:52,059
positions at t-minus 2 minutes and 55

232
00:19:56,789 --> 00:19:54,429
seconds external tank liquid oxygen

233
00:19:59,669 --> 00:19:56,799
pressurization began and main engine

234
00:20:01,799 --> 00:19:59,679
purging was completed at t-minus 2

235
00:20:05,219 --> 00:20:01,809
minutes and 50 seconds retraction of the

236
00:20:07,169 --> 00:20:05,229
gaseous oxygen vent hood began the

237
00:20:14,280 --> 00:20:07,179
ground launch sequencer verified its

238
00:20:24,190 --> 00:20:17,080

sound suppression water was started at t

239
00:20:26,410 --> 00:20:24,200
minus 16 seconds at t minus 8 seconds

240
00:20:32,920 --> 00:20:26,420
hydrogen igniters were turned on to burn

241
00:20:35,260 --> 00:20:32,930
off any free hydrogen six point six

242
00:20:37,090 --> 00:20:35,270
seconds before launch challengers liquid

243
00:20:47,100 --> 00:20:37,100
fueled main engines were ignited in

244
00:20:52,030 --> 00:20:49,690
thrust from the main engines bends the

245
00:20:54,010 --> 00:20:52,040
shuttle stack when it returned to

246
00:20:57,790 --> 00:20:54,020
vertical the solid rocket boosters

247
00:21:01,480 --> 00:20:57,800
ignited at t zero the hold-down bolts

248
00:21:03,430 --> 00:21:01,490
were explosively released after the

249
00:21:05,530 --> 00:21:03,440
initial pre release twang motion

250
00:21:07,600 --> 00:21:05,540
structural forces on the assembly are

251
00:21:09,550 --> 00:21:07,610
dissipated through vibration at a rate

252
00:21:17,260 --> 00:21:09,560
of three cycles per second during the

253
00:21:19,390 --> 00:21:17,270
first few seconds of flight roll

254
00:21:24,280 --> 00:21:19,400
maneuver was initiated at seven point

255
00:21:26,230 --> 00:21:24,290
seven to four seconds the maneuver was

256
00:21:30,070 --> 00:21:26,240
completed at twenty-one point one to

257
00:21:34,200 --> 00:21:30,080
four seconds most of the plane hundred

258
00:21:36,820 --> 00:21:34,210
and four percent will throttle down to

259
00:21:39,820 --> 00:21:36,830
the main engines were throttled back to

260
00:21:43,000 --> 00:21:39,830
65 percent at 35 point three seven nine

261
00:21:45,070 --> 00:21:43,010
seconds for about 16 seconds in order to

262
00:21:50,800 --> 00:21:45,080
alleviate loads during maximum dynamic

263
00:21:52,540 --> 00:21:50,810

pressure velocity 2257 feet per second

264
00:21:54,430 --> 00:21:52,550
altitude four point three nautical miles

265
00:21:57,190 --> 00:21:54,440
downrange distance the engines were then

266
00:22:03,580 --> 00:21:57,200
throttled up to 104 percent at fifty one

267
00:22:05,560 --> 00:22:03,590
point nine one nine seconds during the

268
00:22:10,880 --> 00:22:05,570
flight telemetry data gave no indication

269
00:22:15,660 --> 00:22:13,800
minute 15 seconds velocity 2,900 feet

270
00:22:35,810 --> 00:22:15,670
per second altitude nautical miles

271
00:22:40,769 --> 00:22:38,760
the solid rocket boosters continued in

272
00:22:49,669 --> 00:22:40,779
flight and were destroyed by the Range

273
00:22:55,110 --> 00:22:52,529
data from nearly 200 cameras were

274
00:22:57,210 --> 00:22:55,120
analyzed during the investigation the

275
00:22:59,549 --> 00:22:57,220
following sequence of events is based on

276
00:23:04,830 --> 00:22:59,559
the evaluation of film video and

277
00:23:07,110 --> 00:23:04,840
telemetry data this graphic indicates

278
00:23:09,480 --> 00:23:07,120
viewing angles for three cameras in the

279
00:23:12,360 --> 00:23:09,490
vicinity of the launch site the first

280
00:23:16,200 --> 00:23:12,370
view shown is from camera East 63 at the

281
00:23:18,029 --> 00:23:16,210
lower right of the chart at point six

282
00:23:20,220 --> 00:23:18,039
seven eight seconds into the flight a

283
00:23:22,169 --> 00:23:20,230
strong puff of grey smoke can be seen

284
00:23:24,210 --> 00:23:22,179
spurting from the vicinity of the aft

285
00:23:27,600 --> 00:23:24,220
field joint on the right solid rocket

286
00:23:29,220 --> 00:23:27,610
booster the vaporized material streaming

287
00:23:32,600 --> 00:23:29,230
from the joint indicates there was not

288
00:23:36,510 --> 00:23:32,610

complete sealing action within the joint

289
00:23:38,760 --> 00:23:36,520
this second view is from camera e60 the

290
00:23:40,980 --> 00:23:38,770
smoke can be seen between the right SRB

291
00:23:43,799 --> 00:23:40,990
and the external tank and initially

292
00:23:46,110 --> 00:23:43,809
moves in the upward direction the angle

293
00:23:56,190 --> 00:23:46,120
between this view and a 63 is

294
00:23:59,340 --> 00:23:56,200
approximately 100 degrees with a 60 and

295
00:24:02,100 --> 00:23:59,350
e63 side-by-side it is clear that when

296
00:24:06,000 --> 00:24:02,110
smoke is first visible to camera e60 it

297
00:24:08,909 --> 00:24:06,010
is not yet visible to e63 point two

298
00:24:11,730 --> 00:24:08,919
seconds later it becomes visible to e63

299
00:24:14,880 --> 00:24:11,740
and is seen in multiple lobes or puffs

300
00:24:19,169 --> 00:24:14,890
reaching maximum visibility at about 1.9

301
00:24:22,350 --> 00:24:19,179
seconds a third higher resolution camera

302
00:24:25,889 --> 00:24:22,360
D 67 was located east of the launch pad

303
00:24:27,990 --> 00:24:25,899
D 67 recorded this view of the smoke at

304
00:24:30,779 --> 00:24:28,000
approximately the same time of maximum

305
00:24:33,539 --> 00:24:30,789
development smoke appears to the right

306
00:24:37,190 --> 00:24:33,549
side of the SRB only while normal water

307
00:24:40,080 --> 00:24:37,200
condensation vapors appear to the left

308
00:24:41,850 --> 00:24:40,090
this plan shows that none of the cameras

309
00:24:45,110 --> 00:24:41,860
directly view the surface of the right

310
00:24:47,460 --> 00:24:45,120
SRB in the shaded region of the graphic

311
00:24:49,380 --> 00:24:47,470
analysis of film from several pad

312
00:24:52,890 --> 00:24:49,390
cameras indicated that the smoke

313
00:24:59,660 --> 00:24:52,900

from between 270 and 310 degrees on the

314
00:25:04,560 --> 00:25:02,460
indicated on these preflight photos the

315
00:25:07,799 --> 00:25:04,570
smoke emerged from just above the strut

316
00:25:10,320 --> 00:25:07,809
between the SRB and ET at a point along

317
00:25:19,020 --> 00:25:10,330
the longitudinal axis near the aft field

318
00:25:21,140 --> 00:25:19,030
joint the multiple smoke puffs occurred

319
00:25:23,070 --> 00:25:21,150
at a rate of about 4 times per second

320
00:25:25,230 --> 00:25:23,080
approximating the frequency of the

321
00:25:29,610 --> 00:25:25,240
structural load dynamics and resultant

322
00:25:31,799 --> 00:25:29,620
joint flexing this greatly exaggerated

323
00:25:35,610 --> 00:25:31,809
computer animation depicts the flexing

324
00:25:37,770 --> 00:25:35,620
of the SRB joint this flexing increased

325
00:25:41,930 --> 00:25:37,780
the gap between the tang and clevis at

326
00:25:44,580 --> 00:25:41,940
the location of two rubber o-ring seals

327
00:25:47,789 --> 00:25:44,590
last evidence of smoke above the aft

328
00:25:50,610 --> 00:25:47,799
attached ring appears at 2.7 3 3 seconds

329
00:25:53,669 --> 00:25:50,620
the last indication of smoke dispersing

330
00:25:56,090 --> 00:25:53,679
below the F don't appear zat 3.37 5

331
00:25:58,590 --> 00:25:56,100
seconds

332
00:26:00,659 --> 00:25:58,600
film records of the Assembly of the

333
00:26:02,610 --> 00:26:00,669
solid rocket booster were reviewed to

334
00:26:07,289 --> 00:26:02,620
determine any evidence of cause for the

335
00:26:09,000 --> 00:26:07,299
smoke photographs taken just prior to

336
00:26:10,830 --> 00:26:09,010
mating of the booster segments at the

337
00:26:13,190 --> 00:26:10,840
aft field joint show the o-rings

338
00:26:15,900 --> 00:26:13,200

installed in the grease clevis grooves a

339
00:26:17,430 --> 00:26:15,910
subtle variation was detected but

340
00:26:19,169 --> 00:26:17,440
through computer enhancement was

341
00:26:22,200 --> 00:26:19,179
determined to be a shadow caused by

342
00:26:24,630 --> 00:26:22,210
irregularities in the grease no evidence

343
00:26:28,080 --> 00:26:24,640
of oring defects was observed in any of

344
00:26:30,060 --> 00:26:28,090
the stacking photography the facility

345
00:26:33,000 --> 00:26:30,070
gaseous hydrogen vent arm was not

346
00:26:34,860 --> 00:26:33,010
captured after retraction at launch film

347
00:26:37,230 --> 00:26:34,870
analysis however showed that it did not

348
00:26:42,960 --> 00:26:37,240
rebound and contact the vehicle or

349
00:26:44,370 --> 00:26:42,970
contribute to the accident post launch

350
00:26:46,620 --> 00:26:44,380
inspection of the hold-down posts

351
00:26:51,020 --> 00:26:46,630
revealed that the kick spring assemblies

352
00:26:54,780 --> 00:26:53,490
detailed analysis determined that the

353
00:26:58,200 --> 00:26:54,790
assemblies could not have become

354
00:27:00,030 --> 00:26:58,210
detached prior to t + 850 milliseconds

355
00:27:03,120 --> 00:27:00,040
and were not a contributing factor to

356
00:27:05,580 --> 00:27:03,130
the smoke observed at liftoff

357
00:27:07,529 --> 00:27:05,590
the next significant event was the

358
00:27:15,960 --> 00:27:07,539
development of the SRB burned through

359
00:27:18,000 --> 00:27:15,970
plume camera E 2 O 7 located about 6

360
00:27:25,919 --> 00:27:18,010
miles north of the launch pad shows the

361
00:27:27,870 --> 00:27:25,929
growth of this plume the first evidence

362
00:27:29,640 --> 00:27:27,880
of flame appeared on the right solid

363
00:27:32,340 --> 00:27:29,650

rocket booster at fifty eight point

364
00:27:34,080 --> 00:27:32,350
seven eight eight seconds this occurred

365
00:27:36,870 --> 00:27:34,090
as the main engines had been throttled

366
00:27:41,430 --> 00:27:36,880
up to 104 percent thrust and the SRBs

367
00:27:43,200 --> 00:27:41,440
were increasing thrust camera e 203 was

368
00:27:46,409 --> 00:27:43,210
located west of the launch site and

369
00:27:52,409 --> 00:27:46,419
gives an aft view the exposure was set

370
00:27:54,330 --> 00:27:52,419
for the booster nozzle plumes this

371
00:27:58,770 --> 00:27:54,340
graphic illustrates the location of the

372
00:28:01,430 --> 00:27:58,780
flare the flare was located near the aft

373
00:28:03,600 --> 00:28:01,440
field joint approximately 300 degrees

374
00:28:05,340 --> 00:28:03,610
circumferentially which is consistent

375
00:28:12,750 --> 00:28:05,350
with the location of the smoke emissions

376
00:28:14,640 --> 00:28:12,760
at liftoff within half a second the

377
00:28:17,279 --> 00:28:14,650
flame had grown into a continuous and

378
00:28:19,560 --> 00:28:17,289
well-defined plume at about the same

379
00:28:21,120 --> 00:28:19,570
time telemetry showed a divergence and

380
00:28:24,390 --> 00:28:21,130
chamber pressures between the right and

381
00:28:26,340 --> 00:28:24,400
left SRBs pressure in the right SRB

382
00:28:30,180 --> 00:28:26,350
chamber was lower as a result of the

383
00:28:32,070 --> 00:28:30,190
growing leak the plume is seen here in

384
00:28:33,840 --> 00:28:32,080
pinching directly onto the surface of

385
00:28:35,970 --> 00:28:33,850
the external tank and the lower aft

386
00:28:39,840 --> 00:28:35,980
strut at sixty point two four eight

387
00:28:42,149 --> 00:28:39,850
seconds at about sixty two seconds the

388
00:28:48,200 --> 00:28:42,159

control system elements began to respond

389
00:28:53,909 --> 00:28:52,020
recorded on e 207 and E 204 the first

390
00:28:56,039 --> 00:28:53,919
visual indication that the anomalous

391
00:28:58,560 --> 00:28:56,049
plume penetrated the external tank was

392
00:29:00,360 --> 00:28:58,570
seen at sixty four point six six seconds

393
00:29:03,390 --> 00:29:00,370
as an abrupt change in the shape and

394
00:29:05,310 --> 00:29:03,400
color of the plume this is an indication

395
00:29:09,610 --> 00:29:05,320
of hydrogen leaking from the external

396
00:29:14,560 --> 00:29:12,520
at sixty four point seven oh five

397
00:29:16,420 --> 00:29:14,570
seconds a bright sustained glow

398
00:29:21,790 --> 00:29:16,430
developed between the orbiter and the

399
00:29:23,620 --> 00:29:21,800
external tank slight changes in the

400
00:29:25,930 --> 00:29:23,630
hydrogen tank pressure telemetry data

401
00:29:28,210 --> 00:29:25,940
confirmed the leak two point two seconds

402
00:29:29,950 --> 00:29:28,220
later at sixty six point eight seconds

403
00:29:32,200 --> 00:29:29,960
when the LH two tank pressurization

404
00:29:34,870 --> 00:29:32,210
system could no longer maintain its

405
00:29:37,210 --> 00:29:34,880
normal repressurization rate at seventy

406
00:29:39,030 --> 00:29:37,220
two point six seconds the LH to tank

407
00:29:40,960 --> 00:29:39,040
pressure could no longer be maintained

408
00:29:42,940 --> 00:29:40,970
indicating that the leak path had

409
00:29:47,320 --> 00:29:42,950
significantly increased and was growing

410
00:29:49,150 --> 00:29:47,330
rapidly at seventy two point two seconds

411
00:29:51,640 --> 00:29:49,160
the guidance system showed that right

412
00:29:54,520 --> 00:29:51,650
SRB motion diverged from the orbiter and

413
00:29:59,580 --> 00:29:54,530

left SRB indicating that the lower ET

414
00:30:04,299 --> 00:30:02,500
during this timeframe exaggerated

415
00:30:06,250 --> 00:30:04,309
steering commands and control system

416
00:30:11,200 --> 00:30:06,260
responses registered in telemetry data

417
00:30:13,270 --> 00:30:11,210
and approximately 73 seconds both liquid

418
00:30:15,220 --> 00:30:13,280
hydrogen and liquid oxygen pressure to

419
00:30:18,280 --> 00:30:15,230
the main engines showed a significant

420
00:30:20,169 --> 00:30:18,290
drop this was followed at seventy three

421
00:30:22,090 --> 00:30:20,179
point one to four seconds by the

422
00:30:24,030 --> 00:30:22,100
appearance of a circumferential white

423
00:30:28,290 --> 00:30:24,040
pattern around the ET aft region

424
00:30:31,450 --> 00:30:28,300
suggesting LH to tank structural failure

425
00:30:33,820 --> 00:30:31,460
13 milliseconds later at seventy three

426
00:30:36,130 --> 00:30:33,830
point one three seven seconds vapor was

427
00:30:38,890 --> 00:30:36,140
observed at the inner tank indicative of

428
00:30:40,570 --> 00:30:38,900
the liquid oxygen tank failing this can

429
00:30:43,240 --> 00:30:40,580
be attributed to have normal loads

430
00:30:45,340 --> 00:30:43,250
induced by either the right SRB rotation

431
00:30:47,650 --> 00:30:45,350
at the forward attach point or the

432
00:30:52,830 --> 00:30:47,660
propulsive forces created by the yell h2

433
00:30:57,850 --> 00:30:55,960
within milliseconds liquid oxygen was

434
00:31:03,040 --> 00:30:57,860
observed streaming along the external

435
00:31:05,890 --> 00:31:03,050
tank at seventy three point one nine one

436
00:31:07,960 --> 00:31:05,900
seconds a flash was observed between the

437
00:31:10,120 --> 00:31:07,970
ET and orbiter that was immediately

438
00:31:12,340 --> 00:31:10,130

followed by the start of total vehicle

439
00:31:16,450 --> 00:31:12,350
breakup at seventy three point two one

440
00:31:19,000 --> 00:31:16,460
three seconds during the next 100

441
00:31:22,960 --> 00:31:19,010
milliseconds additional flashes occur in

442
00:31:23,379 --> 00:31:22,970
the SRB forward attach area as the ET

443
00:31:25,899 --> 00:31:23,389
broke

444
00:31:28,239 --> 00:31:25,909
the released fluids vaporized rapidly

445
00:31:31,119 --> 00:31:28,249
producing an expanding cloud of gases

446
00:31:33,459 --> 00:31:31,129
vapors and cryogenic fluid with embedded

447
00:31:36,940 --> 00:31:33,469
debris and localized combustion of mixed

448
00:31:38,949 --> 00:31:36,950
gases no shockwave or other evidence of

449
00:31:41,680 --> 00:31:38,959
a violent explosion was detected in the

450
00:31:44,619 --> 00:31:41,690
imagery illumination from a combination

451
00:31:46,869 --> 00:31:44,629
of SRB plume radiance reflected sunlight

452
00:31:49,589 --> 00:31:46,879
and peripheral burning of gases gives

453
00:31:52,690 --> 00:31:49,599
the cloud the appearance of a fireball

454
00:31:54,489 --> 00:31:52,700
by seventy three point six seconds the

455
00:31:56,680 --> 00:31:54,499
main engines were in automatic shutdown

456
00:31:59,440 --> 00:31:56,690
mode as a result of reduced propellant

457
00:32:01,419 --> 00:31:59,450
pressures the last telemetry from

458
00:32:06,119 --> 00:32:01,429
challenger was received seventy three

459
00:32:10,629 --> 00:32:08,709
the actual vehicle breakup was

460
00:32:12,940 --> 00:32:10,639
essentially obscured from view by the

461
00:32:15,789 --> 00:32:12,950
vapor cloud which abruptly enveloped the

462
00:32:19,209 --> 00:32:15,799
vehicle hundreds of fragments were noted

463
00:32:21,219 --> 00:32:19,219

exiting the et cloud those identified

464
00:32:26,699 --> 00:32:21,229
included the shuttle main engines the

465
00:32:31,239 --> 00:32:29,049
approximately one second after initial

466
00:32:33,879 --> 00:32:31,249
breakup film showed the front segment of

467
00:32:36,369 --> 00:32:33,889
the orbiter emerging from the cloud the

468
00:32:38,440 --> 00:32:36,379
nose crew cabin and a portion of the

469
00:32:42,940 --> 00:32:38,450
cargo bay make up the orbiter in this

470
00:32:44,799 --> 00:32:42,950
view nitrogen tetroxide oxidizer from

471
00:32:46,599 --> 00:32:44,809
the forward reaction control system

472
00:32:51,219 --> 00:32:46,609
provided a distinctive orange brown

473
00:32:53,379 --> 00:32:51,229
color to the cloud by seventy four point

474
00:32:55,599 --> 00:32:53,389
five seven eight seconds a yellow cloud

475
00:32:58,180 --> 00:32:55,609
or flash was visible near the orbiter

476
00:32:59,739 --> 00:32:58,190
nose segment this is believed to be

477
00:33:06,489 --> 00:32:59,749
caused by burning monomethylhydrazine

478
00:33:08,289 --> 00:33:06,499
from the forward RCS the flash reaction

479
00:33:10,479 --> 00:33:08,299
from the RCS propellant sub aided

480
00:33:13,149 --> 00:33:10,489
revealing separation of the nose section

481
00:33:15,009 --> 00:33:13,159
from the crew cabin less than a quarter

482
00:33:18,089 --> 00:33:15,019
of a second later the crew cabin was

483
00:33:20,199 --> 00:33:18,099
noted to be severed from the cargo bay

484
00:33:21,819 --> 00:33:20,209
igniting a propellant discharge

485
00:33:32,320 --> 00:33:21,829
continued to be observed from the

486
00:33:36,970 --> 00:33:34,600
a camera south of the launch pad

487
00:33:44,259 --> 00:33:36,980
recorded a wider array of debris exiting

488
00:33:46,210 --> 00:33:44,269

the vapor cloud the initial emergence of

489
00:33:48,100 --> 00:33:46,220
the crew cabin from this perspective was

490
00:33:55,930 --> 00:33:48,110
at seventy five point two three seven

491
00:33:57,759 --> 00:33:55,940
seconds the initial path of the crew

492
00:33:59,889 --> 00:33:57,769
cabin from the vapor cloud carried it

493
00:34:02,440 --> 00:33:59,899
across the path of an adjacent contrail

494
00:34:09,820 --> 00:34:02,450
clearly revealing its truncated form and

495
00:34:11,290 --> 00:34:09,830
attitude the left wing became visible at

496
00:34:15,159 --> 00:34:11,300
seventy eight point five three one

497
00:34:19,389 --> 00:34:15,169
seconds the main engines and crew cabin

498
00:34:21,399 --> 00:34:19,399
are also identifiable after ten seconds

499
00:34:23,589 --> 00:34:21,409
the crew cabin was seen again with the

500
00:34:27,369 --> 00:34:23,599
front end and top of the cabin visible

501
00:34:29,710 --> 00:34:27,379
as the subject moved further away and

502
00:34:31,480 --> 00:34:29,720
dropped lower on the horizon the quality

503
00:34:37,690 --> 00:34:31,490
of the image for visual analysis

504
00:34:40,060 --> 00:34:37,700
deteriorated rapidly long-range tracking

505
00:34:43,389 --> 00:34:40,070
cameras followed the SRBs through Range

506
00:34:45,730 --> 00:34:43,399
Safety destruct at approximately seventy

507
00:34:49,329 --> 00:34:45,740
five point eight seconds the right SRB

508
00:34:51,669 --> 00:34:49,339
was seen exiting the cloud camera E to O

509
00:34:53,470 --> 00:34:51,679
seven shows the right SRB after the

510
00:34:58,890 --> 00:34:53,480
breakup and the joints are clearly

511
00:35:07,320 --> 00:35:01,630
this confirmed the location of the plume

512
00:35:11,890 --> 00:35:10,060
the separated nose cap and deployed

513
00:35:13,839 --> 00:35:11,900

drogue parachute are identified at

514
00:35:23,370 --> 00:35:13,849
approximately seventy six point four

515
00:35:27,750 --> 00:35:25,680
the shockwave from the detonation of the

516
00:35:34,350 --> 00:35:27,760
linear shaped charge on the right SRB

517
00:35:42,210 --> 00:35:34,360
can be seen clearly simultaneously the

518
00:35:44,760 --> 00:35:42,220
left SRB was destroyed at approximately

519
00:35:46,590 --> 00:35:44,770
37 seconds challenger had encountered

520
00:35:48,780 --> 00:35:46,600
the first of several expected high

521
00:35:53,460 --> 00:35:48,790
altitude wind shear conditions which

522
00:35:55,110 --> 00:35:53,470
lasted until about 64 seconds these wind

523
00:35:58,530 --> 00:35:55,120
shears are best illustrated by the

524
00:36:00,540 --> 00:35:58,540
effect on the booster exhaust trails the

525
00:36:02,250 --> 00:36:00,550
effect of wind shear was immediately

526
00:36:06,120 --> 00:36:02,260
sensed and countered by the guidance

527
00:36:08,280 --> 00:36:06,130
navigation and control system wind

528
00:36:10,140 --> 00:36:08,290
reconstructions were aided by comparing

529
00:36:13,050 --> 00:36:10,150
predicted exhaust trail shapes with

530
00:36:15,150 --> 00:36:13,060
acquired photography the reconstructed

531
00:36:17,550 --> 00:36:15,160
winds were used in trajectory and flight

532
00:36:22,370 --> 00:36:17,560
loads analyses which verified that the

533
00:36:29,760 --> 00:36:25,470
several flashes and yes any plumes were

534
00:36:32,610 --> 00:36:29,770
observed during the flight as similar

535
00:36:34,380 --> 00:36:32,620
life is a mysterious light these are

536
00:36:37,980 --> 00:36:34,390
considered NASA to have not tribute into

537
00:36:40,050 --> 00:36:37,990
the acts of the accident the visible

538
00:36:42,300 --> 00:36:40,060

condensation that appears in this frame

539
00:36:44,130 --> 00:36:42,310
is created by shockwaves which develop

540
00:36:53,280 --> 00:36:44,140
as the vehicle passes through the speed

541
00:36:57,600 --> 00:36:55,620
a large-scale search effort was

542
00:37:02,130 --> 00:36:57,610
initiated to recover the space shuttle

543
00:37:06,090 --> 00:37:02,140
debris 22 ships six underwater search

544
00:37:11,070 --> 00:37:06,100
vessels and 33 aircraft participated in

545
00:37:12,930 --> 00:37:11,080
the operation the pieces recovered

546
00:37:20,370 --> 00:37:12,940
initially were those found floating on

547
00:37:24,650 --> 00:37:20,380
the surface the submarine fleet was used

548
00:37:37,470 --> 00:37:27,360
objects identified as being important to

549
00:37:39,420 --> 00:37:37,480
the investigation were retrieved 50% of

550
00:37:45,600 --> 00:37:39,430
the entire vehicle was recovered in the

551
00:37:47,910 --> 00:37:45,610
effort the ocean search area was located

552
00:37:51,420 --> 00:37:47,920
at the edge of the Gulf Stream at depths

553
00:37:53,340 --> 00:37:51,430
up to 1,200 feet approximately 93

554
00:37:58,170 --> 00:37:53,350
thousand square miles of ocean were

555
00:38:00,180 --> 00:37:58,180
searched the recovered hardware was

556
00:38:02,340 --> 00:38:00,190
brought to the recovery facility where

557
00:38:06,620 --> 00:38:02,350
root construction to verify the

558
00:38:12,420 --> 00:38:06,630
investigation team's findings as well as

559
00:38:14,880 --> 00:38:12,430
an order été and the survey's inside the

560
00:38:16,830 --> 00:38:14,890
recovery facility parts were rows of

561
00:38:24,330 --> 00:38:16,840
floral recorder to the duration of the

562
00:38:27,450 --> 00:38:24,340
vehicle 45 percent of the orbiter itself

563
00:38:29,190 --> 00:38:27,460

was recovered the debris confirmed that

564
00:38:30,600 --> 00:38:29,200
the orbiter and its payloads did not

565
00:38:32,820 --> 00:38:30,610
contribute to the cause of the accident

566
00:38:34,980 --> 00:38:32,830
and that the orbiter breakup was a

567
00:38:40,110 --> 00:38:34,990
result of aerodynamic effects rather

568
00:38:42,060 --> 00:38:40,120
than explosive effects shown here are

569
00:38:51,150 --> 00:38:42,070
parts of the orbiter forward fuselage

570
00:38:55,240 --> 00:38:53,320
extensive heating and erosion was

571
00:38:59,290 --> 00:38:55,250
detected on the right aft section of the

572
00:39:00,880 --> 00:38:59,300
orbiter the paint was scorched and

573
00:39:07,540 --> 00:39:00,890
blackened on the right side of the aft

574
00:39:10,870 --> 00:39:07,550
fuselage thermal distress was apparent

575
00:39:17,200 --> 00:39:10,880
on the right rudder speed brake while

576
00:39:25,730 --> 00:39:17,210
the left showed little effect thermal

577
00:39:35,660 --> 00:39:28,160
the aft left side of the orbiter showed

578
00:39:37,609 --> 00:39:35,670
no apparent sign of heat damage the

579
00:39:39,859 --> 00:39:37,619
remaining recovered parts of the orbiter

580
00:39:45,440 --> 00:39:39,869
showed no evidence of fire or explosion

581
00:39:47,329 --> 00:39:45,450
from within the vehicle all three main

582
00:39:49,190 --> 00:39:47,339
engines were recovered and helped to

583
00:39:57,440 --> 00:39:49,200
verify that they did not contribute to

584
00:40:04,609 --> 00:39:57,450
the cause of the accident the external

585
00:40:07,070 --> 00:40:04,619
tank was similarly reconstructed 25% of

586
00:40:09,620 --> 00:40:07,080
the liquid hydrogen tank 80% of the

587
00:40:17,120 --> 00:40:09,630
inner tank and 5% of the liquid oxygen

588
00:40:25,700 --> 00:40:17,130

tank was recovered most of the external

589
00:40:33,440 --> 00:40:28,010
the nose cap sustained very little

590
00:40:34,819 --> 00:40:33,450
damage in general the recovered pieces

591
00:40:37,400 --> 00:40:34,829
were quite large

592
00:40:39,530 --> 00:40:37,410
the spray-on foam insulation exhibited

593
00:40:41,750 --> 00:40:39,540
varying degrees of thermal effects from

594
00:40:49,040 --> 00:40:41,760
extreme charring to practically no

595
00:40:51,290 --> 00:40:49,050
effect the external tank range safety

596
00:40:52,819 --> 00:40:51,300
destruct explosive charges housed in

597
00:40:55,670 --> 00:40:52,829
this cable tray were recovered

598
00:40:59,349 --> 00:40:55,680
undetonated eliminating them as a

599
00:41:02,180 --> 00:40:59,359
possible factor an external tank breakup

600
00:41:04,220 --> 00:41:02,190
the inter tank region showed signs of

601
00:41:06,410 --> 00:41:04,230
buckling in the fore and aft direction

602
00:41:08,299 --> 00:41:06,420
this would be consistent with the

603
00:41:10,099 --> 00:41:08,309
impulsive thrust that resulted from the

604
00:41:15,380 --> 00:41:10,109
sudden loss of liquid hydrogen from the

605
00:41:16,790 --> 00:41:15,390
aft section of the tank this sharing

606
00:41:19,309 --> 00:41:16,800
failure of the forward attachment

607
00:41:21,140 --> 00:41:19,319
fitting with the right SRB was caused by

608
00:41:30,250 --> 00:41:21,150
the boosters rotation after the aft

609
00:41:33,849 --> 00:41:32,140
the stiffener stringers on the

610
00:41:36,040 --> 00:41:33,859
right-hand side of the inner tank show

611
00:41:44,700 --> 00:41:36,050
evidence of contact which match marks on

612
00:41:48,880 --> 00:41:47,230
section of the ring frame and a section

613
00:41:50,800 --> 00:41:48,890

of the a film from the lower strut

614
00:41:53,440 --> 00:41:50,810
attachment area was recovered in one

615
00:41:58,599 --> 00:41:53,450
piece the lower strut attachment fitting

616
00:42:00,940 --> 00:41:58,609
had been pulled away the effects of the

617
00:42:03,099 --> 00:42:00,950
anomalous SRB plume can be seen on the

618
00:42:05,170 --> 00:42:03,109
external tank excluding an area which

619
00:42:10,960 --> 00:42:05,180
was shielded by the strut and attachment

620
00:42:13,060 --> 00:42:10,970
fitting approximately 50% of solid

621
00:42:15,700 --> 00:42:13,070
rocket booster Hardware was recovered an

622
00:42:17,920 --> 00:42:15,710
ordnance storage facility was used to

623
00:42:23,590 --> 00:42:17,930
house the motor case pieces as some

624
00:42:25,720 --> 00:42:23,600
contained unburned propellant marks seen

625
00:42:28,180 --> 00:42:25,730
on the right SRB frustum matched the

626
00:42:36,670 --> 00:42:28,190
contact area shown previously on the et

627
00:42:38,170 --> 00:42:36,680
inter tank stringers the size and

628
00:42:40,450 --> 00:42:38,180
location of the burn through as

629
00:42:45,210 --> 00:42:40,460
indicated by the recovered SRB debris

630
00:42:50,380 --> 00:42:47,859
the aft center section of the joint

631
00:42:52,960 --> 00:42:50,390
shows a large hole centered at the 307

632
00:42:54,940 --> 00:42:52,970
degrees circumferential position the

633
00:43:04,660 --> 00:42:54,950
irregular hole is roughly rectangular

634
00:43:06,730 --> 00:43:04,670
and is about 27 by 15 inches the

635
00:43:09,099 --> 00:43:06,740
Steelcase material showed evidence of

636
00:43:14,349 --> 00:43:09,109
hot gas erosion caused by combustion

637
00:43:16,420 --> 00:43:14,359
products flowing through the opening the

638
00:43:22,240 --> 00:43:16,430

aft section of the right SRB showed a

639
00:43:24,130 --> 00:43:22,250
hole approximately 33 by 21 inches the

640
00:43:29,590 --> 00:43:24,140
burned surface extended into the aft

641
00:43:31,750 --> 00:43:29,600
attached strut region the exterior

642
00:43:34,210 --> 00:43:31,760
surface of the aft case featured a large

643
00:43:36,340 --> 00:43:34,220
heat affected area the shape and

644
00:43:40,980 --> 00:43:36,350
location of this heat spot indicates an

645
00:43:44,170 --> 00:43:43,450
there was a small burn through in the

646
00:43:45,730 --> 00:43:44,180
case wall

647
00:43:48,370 --> 00:43:45,740
which appeared to have penetrated from

648
00:43:49,990 --> 00:43:48,380
the outside in this was due to the

649
00:43:55,630 --> 00:43:50,000
impingement of hot gases from the

650
00:43:57,490 --> 00:43:55,640
anomalous plume the hole and the solid

651
00:43:59,109 --> 00:43:57,500
rocket booster segments was the result

652
00:44:01,540 --> 00:43:59,119
of the joint leakage on the right hand

653
00:44:09,520 --> 00:44:01,550
SRB which was determined to be the cause

654
00:44:11,109 --> 00:44:09,530
of the accident the presidential

655
00:44:13,030 --> 00:44:11,119
commission concluded that the cause of

656
00:44:15,040 --> 00:44:13,040
the Challenger accident was the failure

657
00:44:16,870 --> 00:44:15,050
of the pressure seal in the aft filled

658
00:44:19,530 --> 00:44:16,880
joint of the right solid rocket motor

659
00:44:21,700 --> 00:44:19,540
the failure was due to a faulty design

660
00:44:25,540 --> 00:44:21,710
rendering the seal unacceptably

661
00:44:27,040 --> 00:44:25,550
sensitive to a number of factors those

662
00:44:29,710 --> 00:44:27,050
factors include the effects of

663
00:44:32,020 --> 00:44:29,720

temperature physical dimensions the

664
00:44:34,599 --> 00:44:32,030
character of materials the effects of

665
00:44:40,000 --> 00:44:34,609
reuse and processing and the reaction of

666
00:44:42,010 --> 00:44:40,010
the joint to dynamic loading more

667
00:44:43,660 --> 00:44:42,020
detailed analyses are contained in

668
00:44:45,400 --> 00:44:43,670
volume 3 of the report of the