1
00:00:27,670 --> 00:00:26,170
welcome to future path I'm a Mariko for

2
00:00:29,950 --> 00:00:27,680
Astari the director of External Affairs

3
00:00:32,170 --> 00:00:29,960
at the NASA Lewis Research Center in

4
00:00:34,180 --> 00:00:32,180
this series we are exploring research

5
00:00:36,910 --> 00:00:34,190
and technology programs that may affect

6
00:00:38,979 --> 00:00:36,920
our lives this show deals with the

7
00:00:40,990 --> 00:00:38,989
present and the future in a little while

8
00:00:43,300 --> 00:00:41,000
we'll see how an advanced propeller

9
00:00:46,270 --> 00:00:43,310
aircraft engine now under test may

10
00:00:48,190 --> 00:00:46,280
replace conventional jet engines but

11
00:00:50,590 --> 00:00:48,200
first let's take a look at the space

12
00:00:53,110 --> 00:00:50,600
station here at Lois we have had an

13
00:00:55,480 --> 00:00:53,120

ongoing program to design power systems

14
00:00:57,340 --> 00:00:55,490
for future spacecraft before Lewis began

15
00:00:59,350 --> 00:00:57,350
to work on a power system for the space

16
00:01:19,270 --> 00:00:59,360
station however many years of research

17
00:01:21,490 --> 00:01:19,280
went by throughout the 30-year history

18
00:01:24,010 --> 00:01:21,500
of space exploration there has been an

19
00:01:24,580 --> 00:01:24,020
evolution in our understanding and use

20
00:01:28,570 --> 00:01:24,590
of space

21
00:01:31,510 --> 00:01:28,580
we began with exploration pioneering

22
00:01:34,030 --> 00:01:31,520
kind of missions we've demonstrated some

23
00:01:36,280 --> 00:01:34,040
initial space operational capability

24
00:01:38,770 --> 00:01:36,290
with the shuttle we now want to make

25
00:01:42,790 --> 00:01:38,780
space a place where we live and work

26
00:01:44,590 --> 00:01:42,800
permanently so space station we believe

27
00:01:49,600 --> 00:01:44,600
is the next logical step in that

28
00:01:53,110 --> 00:01:49,610
evolutionary process the next logical

29
00:01:55,810 --> 00:01:53,120
step we have visited space for short

30
00:01:58,030 --> 00:01:55,820
periods we now have the capability and

31
00:02:00,700 --> 00:01:58,040
resources to make it a place to go to

32
00:02:03,550 --> 00:02:00,710
stay permanently a place where we go to

33
00:02:05,620 --> 00:02:03,560
work and to do useful tasks a space

34
00:02:06,130 --> 00:02:05,630
station is a logical place in which to

35
00:02:09,219 --> 00:02:06,140
do this

36
00:02:11,259 --> 00:02:09,229
the main horizontal keel will have solar

37
00:02:13,750 --> 00:02:11,269
powered electrical generating systems

38
00:02:16,509 --> 00:02:13,760

and pressurize crew and laboratory

39
00:02:19,089 --> 00:02:16,519
modules the space station is being

40
00:02:23,290 --> 00:02:19,099
designed to serve a variety of users

41
00:02:25,780 --> 00:02:23,300
many experimenters have been identified

42
00:02:28,810 --> 00:02:25,790
these will be earth viewing space

43
00:02:32,320 --> 00:02:28,820
viewing experiments many microgravity

44
00:02:36,540 --> 00:02:32,330
experiments Space Station will be used

45
00:02:38,590 --> 00:02:36,550
for assembly of large structures

46
00:02:42,400 --> 00:02:38,600
servicing of satellites and other

47
00:02:44,860 --> 00:02:42,410
payloads and as a transportation node in

48
00:02:47,530 --> 00:02:44,870
the sense that payloads would be taken

49
00:02:49,660 --> 00:02:47,540
off of the space shuttle and put on to

50
00:02:52,300 --> 00:02:49,670
some other rocket to go into

51
00:02:55,990 --> 00:02:52,310
interplanetary space or to high Earth

52
00:02:58,510 --> 00:02:56,000
orbit space station will be a research

53
00:03:01,210 --> 00:02:58,520
laboratory to conduct science and to

54
00:03:03,490 --> 00:03:01,220
develop new technologies a permanent

55
00:03:06,010 --> 00:03:03,500
Observatory enabling us to look down at

56
00:03:08,530 --> 00:03:06,020
earth and up at the stars the station

57
00:03:11,140 --> 00:03:08,540
will be a servicing manufacturing and

58
00:03:13,960 --> 00:03:11,150
assembly plant as well as a storage

59
00:03:16,960 --> 00:03:13,970
depot and a staging base there are many

60
00:03:19,410 --> 00:03:16,970
other uses the bottom line is that space

61
00:03:22,210 --> 00:03:19,420
station will be a multi-purpose facility

62
00:03:24,700 --> 00:03:22,220
very much unlike the spacecraft that

63
00:03:26,880 --> 00:03:24,710

nASA has designed in the past which were

64
00:03:29,320 --> 00:03:26,890
designed for essentially one mission

65
00:03:31,210 --> 00:03:29,330
space station will be very different it

66
00:03:34,270 --> 00:03:31,220
will be multi-purpose and it will be

67
00:03:38,050 --> 00:03:34,280
very long-lived compared with previous

68
00:03:40,390 --> 00:03:38,060
spacecraft in the sense that space

69
00:03:43,449 --> 00:03:40,400
station is designed for approximately a

70
00:03:45,880 --> 00:03:43,459
30-year lifetime you contrast that with

71
00:03:50,410 --> 00:03:45,890
single purpose satellites which might be

72
00:03:52,210 --> 00:03:50,420
designed for a few years at most the

73
00:03:54,729 --> 00:03:52,220
role of Lewis Research Center in the

74
00:03:57,070 --> 00:03:54,739
space station program is to design the

75
00:04:00,850 --> 00:03:57,080
electrical power generating conditioning

76
00:04:04,720 --> 00:04:00,860
and storage systems power the use of

77
00:04:08,320 --> 00:04:04,730
power for civilization is a measure of

78
00:04:11,229 --> 00:04:08,330
its development if you chart the usage

79
00:04:13,510 --> 00:04:11,239
of power on earth you find that the more

80
00:04:16,479 --> 00:04:13,520
advanced societies use more and more

81
00:04:20,140 --> 00:04:16,489
electric power the less advanced you are

82
00:04:23,170 --> 00:04:20,150
the less you use in space we've been

83
00:04:25,780 --> 00:04:23,180
absolutely primitive in the first 25

84
00:04:29,620 --> 00:04:25,790
years of the space program scarcely

85
00:04:31,900 --> 00:04:29,630
using more than 10 kilowatts put that in

86
00:04:35,170 --> 00:04:31,910
perspective your house uses about 25

87
00:04:36,100 --> 00:04:35,180
kilowatts so we're limited in what we

88
00:04:39,159 --> 00:04:36,110

can do

89
00:04:43,629 --> 00:04:39,169
and that means we can't really flex our

90
00:04:46,059 --> 00:04:43,639
muscles in space we can't utilize it we

91
00:04:49,990 --> 00:04:46,069
can't understand it well so we're power

92
00:04:52,390 --> 00:04:50,000
poor and so we can't explore power is

93
00:04:56,080 --> 00:04:52,400
vital the space station without power

94
00:04:58,480 --> 00:04:56,090
the station could not work other space

95
00:05:00,959 --> 00:04:58,490
missions use a small amount of power in

96
00:05:03,459 --> 00:05:00,969
comparison to space stations needs

97
00:05:07,839 --> 00:05:03,469
communication satellites use up to about

98
00:05:10,990 --> 00:05:07,849
10 kilowatts of power previously the

99
00:05:14,200 --> 00:05:11,000
largest user of power in near space was

100
00:05:17,230 --> 00:05:14,210
Skylab it used about 15 kilowatts of

101
00:05:20,320 --> 00:05:17,240
electricity space station may use more

102
00:05:23,459 --> 00:05:20,330
than 20 times that or nearly 300

103
00:05:26,050 --> 00:05:23,469
kilowatts to make that much electricity

104
00:05:28,839 --> 00:05:26,060
space station will eventually rely on

105
00:05:31,930 --> 00:05:28,849
hybrid or combination of both solar

106
00:05:34,570 --> 00:05:31,940
cells and a solar dynamic system the

107
00:05:37,899 --> 00:05:34,580
system to be used first is a solar cell

108
00:05:40,719 --> 00:05:37,909
system solar cells in large panels or

109
00:05:43,719 --> 00:05:40,729
solar arrays collect sunshine and

110
00:05:45,339 --> 00:05:43,729
convert it directly into electricity the

111
00:05:48,969 --> 00:05:45,349
hardware to be launched first by the

112
00:05:51,010 --> 00:05:48,979
shuttle will be solar panels they've

113
00:05:52,930 --> 00:05:51,020

been used to power spacecraft now

114
00:05:55,329 --> 00:05:52,940
throughout the history of the space

115
00:05:57,579 --> 00:05:55,339
program and we have great confidence

116
00:06:00,219 --> 00:05:57,589
that they will work that we will be able

117
00:06:03,640 --> 00:06:00,229
to manufacture test and verify their

118
00:06:07,059 --> 00:06:03,650
performance to a very high level of

119
00:06:10,360 --> 00:06:07,069
confidence early solar array panels are

120
00:06:13,680 --> 00:06:10,370
about 7% efficient but now new improved

121
00:06:17,079 --> 00:06:13,690
solar arrays run at about 10% efficiency

122
00:06:20,769 --> 00:06:17,089
solar panels have a drawback to produce

123
00:06:23,320 --> 00:06:20,779
about 300 kilowatts 30,000 square feet

124
00:06:26,529 --> 00:06:23,330
of panels are needed that's a lot at

125
00:06:29,230 --> 00:06:26,539
first to complete solar panels will be

126
00:06:32,680 --> 00:06:29,240
orbited for Space Station each unit will

127
00:06:34,899 --> 00:06:32,690
be about 110 feet long by 33 feet wide

128
00:06:36,279 --> 00:06:34,909
another problem created by the large

129
00:06:39,519 --> 00:06:36,289
size of the panel's

130
00:06:42,040 --> 00:06:39,529
is atmospheric drag even though space

131
00:06:45,040 --> 00:06:42,050
station will orbit at about 250 miles

132
00:06:47,559 --> 00:06:45,050
there are enough atoms of air at that

133
00:06:50,020 --> 00:06:47,569
altitude to impact on the panel's and

134
00:06:52,300 --> 00:06:50,030
cause the station to slow down ever

135
00:06:54,460 --> 00:06:52,310
so slightly so the station must be

136
00:06:57,850 --> 00:06:54,470
periodically boosted back into its

137
00:06:59,860 --> 00:06:57,860
original orbit NASA is designing a

138
00:07:02,920 --> 00:06:59,870

system with a smaller area to reduce

139
00:07:05,830 --> 00:07:02,930
atmospheric drag this system is the

140
00:07:10,630 --> 00:07:05,840
solar dynamic system solar dynamic

141
00:07:14,110 --> 00:07:10,640
system uses a concentrating mirror to

142
00:07:17,950 --> 00:07:14,120
collect and focus the sun's energy into

143
00:07:20,230 --> 00:07:17,960
a receiver that accepts that energy in

144
00:07:22,780 --> 00:07:20,240
the form of heat that's very different

145
00:07:26,050 --> 00:07:22,790
than solar cells which converts sunlight

146
00:07:29,920 --> 00:07:26,060
directly into electricity solar dynamic

147
00:07:34,080 --> 00:07:29,930
systems operate on heat use that heat to

148
00:07:37,300 --> 00:07:34,090
heat a fluid that runs through a turbine

149
00:07:39,100 --> 00:07:37,310
causing it to rotate the turbine of

150
00:07:41,530 --> 00:07:39,110
course is attached to a generator which

151
00:07:45,270 --> 00:07:41,540
actually converts the mechanical energy

152
00:07:49,000 --> 00:07:45,280
of rotation into electrical energy and

153
00:07:52,480 --> 00:07:49,010
that circulating fluid is then reused in

154
00:07:56,710 --> 00:07:52,490
a closed system so solar dynamic systems

155
00:07:58,900 --> 00:07:56,720
take sunlight convert it to heat that is

156
00:08:01,840 --> 00:07:58,910
transformed into mechanical energy and

157
00:08:04,300 --> 00:08:01,850
then finally into electrical energy that

158
00:08:06,310 --> 00:08:04,310
sounds like a complex process but the

159
00:08:08,230 --> 00:08:06,320
overall system efficiency there is

160
00:08:11,410 --> 00:08:08,240
greater than it is for photovoltaic

161
00:08:14,200 --> 00:08:11,420
devices besides having a smaller drag

162
00:08:16,990 --> 00:08:14,210
area the solar dynamic system is more

163
00:08:19,030 --> 00:08:17,000

than 15 percent efficient and NASA is

164
00:08:21,370 --> 00:08:19,040
looking at other systems which are more

165
00:08:23,640 --> 00:08:21,380
than 30 percent efficient they use

166
00:08:25,840 --> 00:08:23,650
different engines to drive generators

167
00:08:29,080 --> 00:08:25,850
but what do you do if there's no

168
00:08:32,470 --> 00:08:29,090
sunlight communication satellites orbit

169
00:08:34,990 --> 00:08:32,480
at an altitude of 22,000 miles these

170
00:08:37,690 --> 00:08:35,000
satellites rely on solar cells and

171
00:08:39,790 --> 00:08:37,700
storage batteries for power batteries

172
00:08:42,970 --> 00:08:39,800
supply electricity to the craft when it

173
00:08:45,430 --> 00:08:42,980
is in Earth's shadow at 22,000 miles

174
00:08:48,760 --> 00:08:45,440
those satellites rarely pass into the

175
00:08:50,470 --> 00:08:48,770
shadow of Earth in low-earth orbit space

176
00:08:53,340 --> 00:08:50,480
station will be in the shadow of earth

177
00:08:56,290 --> 00:08:53,350
for about half of each 90-minute orbit

178
00:08:59,350 --> 00:08:56,300
the initial space station relying

179
00:09:01,390 --> 00:08:59,360
exclusively on solar cells will require

180
00:09:04,210 --> 00:09:01,400
much larger batteries than previously

181
00:09:06,280 --> 00:09:04,220
used in space but as solar

182
00:09:08,140 --> 00:09:06,290
amic power systems are added energy

183
00:09:09,180 --> 00:09:08,150
storage will be a different matter

184
00:09:12,010 --> 00:09:09,190
altogether

185
00:09:14,380 --> 00:09:12,020
in the case of the solar dynamic system

186
00:09:18,370 --> 00:09:14,390
that energy is stored in the form of

187
00:09:21,280 --> 00:09:18,380
heat the leading contender for storing

188
00:09:25,420 --> 00:09:21,290

that energy that heat energy now is some

189
00:09:27,870 --> 00:09:25,430
type of salt a phase change material

190
00:09:31,570 --> 00:09:27,880
that converts from a solid to a liquid

191
00:09:33,390 --> 00:09:31,580
and by virtue of doing that is able to

192
00:09:37,120 --> 00:09:33,400
store much greater amounts of energy

193
00:09:39,970 --> 00:09:37,130
these salts or phase change materials

194
00:09:42,040 --> 00:09:39,980
are not like common table salt the

195
00:09:44,590 --> 00:09:42,050
special salts melt at a very high

196
00:09:46,960 --> 00:09:44,600
temperature when space station passes

197
00:09:48,760 --> 00:09:46,970
into the Earth's shadow sunlight will no

198
00:09:51,460 --> 00:09:48,770
longer be focused on to the receiving

199
00:09:53,770 --> 00:09:51,470
cavity of the solar mirror the salts

200
00:09:56,110 --> 00:09:53,780
will slowly cool and change from a

201
00:10:00,030 --> 00:09:56,120
liquid to a solid giving off large

202
00:10:05,920 --> 00:10:02,710
space station power systems will make a

203
00:10:09,940 --> 00:10:05,930
lot of electricity initially more than

204
00:10:12,640 --> 00:10:09,950
75 kilowatts and more later how will all

205
00:10:14,950 --> 00:10:12,650
this electricity be used probably the

206
00:10:17,230 --> 00:10:14,960
users will be the largest consumers of

207
00:10:20,260 --> 00:10:17,240
power there is a class of experiments

208
00:10:22,780 --> 00:10:20,270
called materials processing that are

209
00:10:26,110 --> 00:10:22,790
estimating their needs and the tens of

210
00:10:29,200 --> 00:10:26,120
kilowatts by far in a way that will be

211
00:10:32,680 --> 00:10:29,210
the single largest user of power

212
00:10:36,580 --> 00:10:32,690
we also lump power into another category

213
00:10:38,890 --> 00:10:36,590

called housekeeping by this we mean

214
00:10:41,110 --> 00:10:38,900
electrical energy required to operate

215
00:10:43,330 --> 00:10:41,120
the environmental control and life

216
00:10:45,210 --> 00:10:43,340
support system for regenerating the air

217
00:10:48,990 --> 00:10:45,220
and water on board the space station

218
00:10:52,800 --> 00:10:49,000
housekeeping also includes lights

219
00:10:54,840 --> 00:10:52,810
preparing food in the galley

220
00:10:57,100 --> 00:10:54,850
entertainment devices and so forth

221
00:11:00,670 --> 00:10:57,110
personal care devices that the

222
00:11:03,400 --> 00:11:00,680
astronauts might use and communications

223
00:11:06,750 --> 00:11:03,410
and computer systems all of that we lump

224
00:11:09,550 --> 00:11:06,760
into housekeeping power and it will be

225
00:11:11,980 --> 00:11:09,560
not as large a user of electrical energy

226
00:11:14,020 --> 00:11:11,990
but it since we lump so much into that

227
00:11:16,630 --> 00:11:14,030
single category it looks like a big

228
00:11:18,160 --> 00:11:16,640
number the shuttle will first launch

229
00:11:21,460 --> 00:11:18,170
space station elements

230
00:11:23,110 --> 00:11:21,470
the mid-1990s shuttle will be used in

231
00:11:25,750 --> 00:11:23,120
the assembly and check out of the

232
00:11:27,819 --> 00:11:25,760
station a number of launches will be

233
00:11:29,920 --> 00:11:27,829
needed and there will be various phases

234
00:11:32,440 --> 00:11:29,930
of capability that the station will go

235
00:11:35,439 --> 00:11:32,450
through it will be unmanned at first

236
00:11:37,810 --> 00:11:35,449
then mant ended within a year and a half

237
00:11:43,090 --> 00:11:37,820
beyond that the station is to be

238
00:11:45,160 --> 00:11:43,100

permanently manned the ultimate benefit

239
00:11:47,680 --> 00:11:45,170
of space station to mankind will be to

240
00:11:49,960 --> 00:11:47,690
extend man's capability to explore the

241
00:11:52,420 --> 00:11:49,970
solar system space station will provide

242
00:11:55,810 --> 00:11:52,430
the necessary first step for future

243
00:12:01,050 --> 00:11:55,820
manned missions in space a permanent

244
00:12:06,069 --> 00:12:01,060
lunar base a manned mission to Mars a

245
00:12:07,720 --> 00:12:06,079
manned survey of the asteroids space

246
00:12:09,550 --> 00:12:07,730
station will enable the staging of

247
00:12:12,900 --> 00:12:09,560
future unmanned missions to the planets

248
00:12:16,449 --> 00:12:12,910
with the possibility of sample returns

249
00:12:23,710 --> 00:12:16,459
but most importantly Space Station will

250
00:12:27,640 --> 00:12:25,780
now let's turn from the space station to

251
00:12:30,190 --> 00:12:27,650
a story about how propellers may again

252
00:12:32,650 --> 00:12:30,200
be back on passenger planes in the late

253
00:12:34,090 --> 00:12:32,660
1950s jet aircraft entered into

254
00:12:35,800 --> 00:12:34,100
commercial service and essentially

255
00:12:38,200 --> 00:12:35,810
replaced the slower but more efficient

256
00:12:41,890 --> 00:12:38,210
propeller driven aircraft then in the

257
00:12:43,840 --> 00:12:41,900
late 1973 the oil embargo hit NASA was

258
00:12:45,160 --> 00:12:43,850
mandated to explore all technologies

259
00:12:48,010 --> 00:12:45,170
that could significantly reduce

260
00:12:49,780 --> 00:12:48,020
commercial aircraft fuel consumption the

261
00:12:57,100 --> 00:12:49,790
Lewis Research Center responded with the

262
00:12:59,770 --> 00:12:57,110
advanced turboprop program what might

263
00:13:03,280 --> 00:12:59,780

look like a step backwards is actually

264
00:13:10,330 --> 00:13:03,290
two giant steps forward on the future

265
00:13:15,970 --> 00:13:14,260
since 1941 the Lewis Research Center has

266
00:13:18,280 --> 00:13:15,980
developed an international reputation

267
00:13:23,019 --> 00:13:18,290
for its research on jet propulsion

268
00:13:25,450 --> 00:13:23,029
systems however in 1977 the researchers

269
00:13:28,210 --> 00:13:25,460
at Louis began to take a new look at the

270
00:13:30,579 --> 00:13:28,220
propeller their challenge was to combine

271
00:13:33,100 --> 00:13:30,589
the efficiency of the propeller with the

272
00:13:36,850 --> 00:13:33,110
power of the turbine engine what has

273
00:13:40,510 --> 00:13:36,860
evolved is ATP the advanced turboprop

274
00:13:43,150 --> 00:13:40,520
project Keith severs manager of the NASA

275
00:13:45,640 --> 00:13:43,160
advanced turboprop project office at the

276
00:13:48,760 --> 00:13:45,650
Lewis Research Center back after World

277
00:13:50,980 --> 00:13:48,770
War two jets for the thing the coming

278
00:13:53,590 --> 00:13:50,990
thing her powers were very efficient in

279
00:13:56,590 --> 00:13:53,600
those days but they couldn't go fast it

280
00:13:59,200 --> 00:13:56,600
couldn't go to high altitudes and quite

281
00:14:01,120 --> 00:13:59,210
frankly they were not jazzy like jet

282
00:14:03,190 --> 00:14:01,130
engines and which gave way then to

283
00:14:06,100 --> 00:14:03,200
turbofan engines and high bypass ratio

284
00:14:08,050 --> 00:14:06,110
engines and when fuel was chief people

285
00:14:10,660 --> 00:14:08,060
didn't worry much about it ten cents a

286
00:14:13,060 --> 00:14:10,670
gallon as long as they get speed high

287
00:14:15,520 --> 00:14:13,070
altitude capability which the air

288
00:14:18,400 --> 00:14:15,530

transport system required propellers

289
00:14:21,670 --> 00:14:18,410
just kind of withered on the vine for 20

290
00:14:23,980 --> 00:14:21,680
or 30 years the Arab oil embargo of the

291
00:14:26,470 --> 00:14:23,990
early 70s not only hit American

292
00:14:28,780 --> 00:14:26,480
consumers at the corner gas station but

293
00:14:31,180 --> 00:14:28,790
was also reflected at the airline ticket

294
00:14:35,710 --> 00:14:31,190
counter due to the soaring price of jet

295
00:14:38,530 --> 00:14:35,720
fuel in 1973 the price of a gallon of

296
00:14:40,750 --> 00:14:38,540
jet fuel was 12 cents and represented

297
00:14:44,470 --> 00:14:40,760
one-quarter of the direct operating cost

298
00:14:46,980 --> 00:14:44,480
of the jet in 1981 the cost of jet fuel

299
00:14:50,350 --> 00:14:46,990
was over a dollar eight cents a gallon

300
00:14:52,750 --> 00:14:50,360
with the rising fuel prices a fuel

301
00:14:55,090 --> 00:14:52,760
efficient propeller engine again became

302
00:14:56,140 --> 00:14:55,100
the object of an aeronautical propulsion

303
00:14:59,020 --> 00:14:56,150
research effort

304
00:15:02,380 --> 00:14:59,030
the researchers objectives were to

305
00:15:07,980 --> 00:15:02,390
develop a powerplant that would be fuel

306
00:15:12,519 --> 00:15:07,990
efficient dew point eight mach cruise at

307
00:15:14,860 --> 00:15:12,529
35,000 feet operate at a reduced noise

308
00:15:16,390 --> 00:15:14,870
level well these propellers look a lot

309
00:15:17,860 --> 00:15:16,400
different there are very highly swept

310
00:15:18,920 --> 00:15:17,870
they're very thin compared to old

311
00:15:20,210 --> 00:15:18,930
propellers

312
00:15:23,600 --> 00:15:20,220
and the thing that hits you first is

313
00:15:25,460 --> 00:15:23,610

their eight to ten blades on these would

314
00:15:28,310 --> 00:15:25,470
rather than three or four is that you've

315
00:15:30,350 --> 00:15:28,320
been accustomed to in the past and what

316
00:15:32,840 --> 00:15:30,360
the sweep doesn't in the propeller and a

317
00:15:34,700 --> 00:15:32,850
fitness is is to reduce the drag losses

318
00:15:37,040 --> 00:15:34,710
at the higher tip speeds and higher Mach

319
00:15:40,220 --> 00:15:37,050
numbers also helps to reduce the source

320
00:15:41,870 --> 00:15:40,230
noise of the propellers the higher

321
00:15:43,910 --> 00:15:41,880
blade count and we've loaded these

322
00:15:46,100 --> 00:15:43,920
blades up much higher than old fellers

323
00:15:48,829 --> 00:15:46,110
so we get a lot more power at a lot

324
00:15:50,540 --> 00:15:48,839
smaller diameter and this saves weight

325
00:15:53,090 --> 00:15:50,550
on the propeller and I say it's weight

326
00:15:55,760 --> 00:15:53,100
on the engine and it also packages

327
00:15:58,519 --> 00:15:55,770
better on the aircraft earlier two turbo

328
00:16:03,170 --> 00:15:58,529
props were limited both in horsepower

329
00:16:05,990 --> 00:16:03,180
and in flight speed mainly because of

330
00:16:11,720 --> 00:16:06,000
the compressibility effects that occur

331
00:16:14,269 --> 00:16:11,730
at the propeller tips with the recent

332
00:16:16,790 --> 00:16:14,279
advances in computer design technology

333
00:16:19,790 --> 00:16:16,800
we are now able to optimize the blade

334
00:16:22,100 --> 00:16:19,800
shape to minimize the compressibility

335
00:16:25,519 --> 00:16:22,110
effects occurring at the blade tips

336
00:16:28,670 --> 00:16:25,529
allowing the planes to fly faster up to

337
00:16:30,920 --> 00:16:28,680
six hundred miles an hour and at higher

338
00:16:34,690 --> 00:16:30,930

altitudes up to thirty five thousand

339
00:16:37,730 --> 00:16:34,700
feet as you approach the speed of sound

340
00:16:40,519 --> 00:16:37,740
you run into a problem where the

341
00:16:43,100 --> 00:16:40,529
apparent pressure that you're trying to

342
00:16:47,870 --> 00:16:43,110
push through suddenly takes a quantum

343
00:16:50,240 --> 00:16:47,880
leap and because the blades are very

344
00:16:56,329 --> 00:16:50,250
large in diameter to thirteen feet in

345
00:17:00,560 --> 00:16:56,339
diameter the tip speed is upwards of 800

346
00:17:04,010 --> 00:17:00,570
feet per second which is just under Mach

347
00:17:08,240 --> 00:17:04,020
1 or the speed of sound as you try to

348
00:17:10,250 --> 00:17:08,250
push through that Mach 1 range you run

349
00:17:11,870 --> 00:17:10,260
into this compressibility factor it's

350
00:17:14,840 --> 00:17:11,880
almost like running into a brick wall

351
00:17:17,000 --> 00:17:14,850
with the blade blade construction is now

352
00:17:19,400 --> 00:17:17,010
a composite type arrangement where you

353
00:17:22,280 --> 00:17:19,410
have a metallic leading edge such as

354
00:17:24,559 --> 00:17:22,290
aluminum and a graphite epoxy resign'd

355
00:17:26,240 --> 00:17:24,569
internal construction that allows the

356
00:17:29,150 --> 00:17:26,250
blades to be very lightweight and

357
00:17:31,220 --> 00:17:29,160
because they're lighter weight minimizes

358
00:17:32,570 --> 00:17:31,230
the centrifugal stresses that occur when

359
00:17:35,330 --> 00:17:32,580
the propeller system is

360
00:17:38,690 --> 00:17:35,340
dated at 12,000 rpm ultimate goal is to

361
00:17:41,180 --> 00:17:38,700
save fuel commercial aircraft and also

362
00:17:43,759 --> 00:17:41,190
military aircraft were it can be applied

363
00:17:46,430 --> 00:17:43,769

and this fuel saving is very dramatic

364
00:17:50,779 --> 00:17:46,440
compared to the fuel burn that aircraft

365
00:17:54,200 --> 00:17:50,789
have today such as a 727 737 that type

366
00:17:56,029 --> 00:17:54,210
of air cream aircraft a prop van driven

367
00:17:59,060 --> 00:17:56,039
airplane can do the same mission that

368
00:18:01,850 --> 00:17:59,070
like forty to fifty percent of the fuel

369
00:18:05,840 --> 00:18:01,860
that they use today if you look at just

370
00:18:08,769 --> 00:18:05,850
the u.s. fleet existing today for medium

371
00:18:13,190 --> 00:18:08,779
to short range aircraft I'm talking 727

372
00:18:15,230 --> 00:18:13,200
737s dc9 md-80s those aircraft in a

373
00:18:18,649 --> 00:18:15,240
typical year burn about five billion

374
00:18:21,799 --> 00:18:18,659
gallons of fuel if these aircraft were

375
00:18:23,210 --> 00:18:21,809
equipped with pop fans they could do the

376
00:18:25,279 --> 00:18:23,220
same mission they're dirty today and

377
00:18:37,419 --> 00:18:25,289
save two to two and a half billion

378
00:18:41,750 --> 00:18:39,500
propeller-driven airplanes have

379
00:18:44,270 --> 00:18:41,760
traditionally been noisy advanced

380
00:18:46,039 --> 00:18:44,280
turboprop researchers are tackling the

381
00:18:48,620 --> 00:18:46,049
problem of trying to build a turboprop

382
00:18:51,770 --> 00:18:48,630
to rival the relative quiet and

383
00:18:53,780 --> 00:18:51,780
smoothness of the jet well we've had to

384
00:18:55,490 --> 00:18:53,790
look at the entire aircraft as a system

385
00:18:58,039 --> 00:18:55,500
we didn't look just at sticking a new

386
00:18:59,840 --> 00:18:58,049
widget call of profiting on them better

387
00:19:01,820 --> 00:18:59,850
look at what to do to do to the rest of

388
00:19:04,070 --> 00:19:01,830

the aircraft and particularly we're

389
00:19:05,840 --> 00:19:04,080
concern about passenger comfort it

390
00:19:08,390 --> 00:19:05,850
doesn't matter how much fuel was saved

391
00:19:14,450 --> 00:19:08,400
if the people don't like it or they're

392
00:19:17,150 --> 00:19:14,460
uncomfortable sound vibration so part of

393
00:19:18,650 --> 00:19:17,160
our project goal is to to make sure that

394
00:19:20,150 --> 00:19:18,660
people have the same comfort that

395
00:19:23,419 --> 00:19:20,160
they're used to on today's wide-body

396
00:19:25,100 --> 00:19:23,429
aircraft in addition we're concerned

397
00:19:26,480 --> 00:19:25,110
about community noise these things are

398
00:19:28,530 --> 00:19:26,490
allowed and we have to provide the

399
00:19:33,570 --> 00:19:28,540
technology so we think it will

400
00:19:33,570 --> 00:19:33,580
listing for 37 states we regulate

401
00:19:33,580 --> 00:19:47,490
by around airports and communities

402
00:19:50,620 --> 00:19:49,510
most of the time we really don't even

403
00:19:54,070 --> 00:19:50,630
know what's running inside the cockpit

404
00:19:56,380 --> 00:19:54,080
it's that quiet and we're only what 15

405
00:19:58,720 --> 00:19:56,390
feet away from after several years of

406
00:20:00,880 --> 00:19:58,730
wind tunnel and static engine testing a

407
00:20:04,630 --> 00:20:00,890
full flight test of the advanced

408
00:20:07,659 --> 00:20:04,640
propeller system was held on May 19 1987

409
00:20:10,419 --> 00:20:07,669
at Lockheed Georgia company in Marietta

410
00:20:13,510 --> 00:20:10,429
Georgia so far operation has been very

411
00:20:16,110 --> 00:20:13,520
good everything is about as predicted

412
00:20:17,760 --> 00:20:16,120
that the engineers had predicted

413
00:20:20,610 --> 00:20:17,770

from their initial assessment of the

414
00:20:24,330 --> 00:20:20,620
program we haven't really had any big

415
00:20:27,360 --> 00:20:24,340
surprises I should say when you pull the

416
00:20:29,519 --> 00:20:27,370
prop fan in and add power to it the

417
00:20:31,019 --> 00:20:29,529
pilot really knows it but there again

418
00:20:32,940 --> 00:20:31,029
this airplane wasn't really designed to

419
00:20:34,080 --> 00:20:32,950
fly with an engine out on a on the left

420
00:20:37,169 --> 00:20:34,090
wing

421
00:20:38,760 --> 00:20:37,179
but again what our engineers predicted

422
00:20:40,860 --> 00:20:38,770
is pretty much what's happening with the

423
00:20:42,960 --> 00:20:40,870
airplane so I'd have to say so far it

424
00:20:45,810 --> 00:20:42,970
looks good so far it looks very good if

425
00:20:48,180 --> 00:20:45,820
all goes to plan prop fans will probably

426
00:20:51,810 --> 00:20:48,190
be fitted on short to medium range

427
00:20:54,120 --> 00:20:51,820
aircraft we hope to have as a part of

428
00:20:57,810 --> 00:20:54,130
the project goal to have the technology

429
00:21:00,570 --> 00:20:57,820
in hand by the end of 1980s so that

430
00:21:02,820 --> 00:21:00,580
industry the engine people the aircraft

431
00:21:05,340 --> 00:21:02,830
people can make marketing decisions

432
00:21:07,590 --> 00:21:05,350
because it's a involves a lot of private

433
00:21:10,320 --> 00:21:07,600
capital that's a make sure breaks

434
00:21:13,100 --> 00:21:10,330
they're companies so the way things are

435
00:21:16,320 --> 00:21:13,110
proceeding right now it looks like

436
00:21:18,120 --> 00:21:16,330
Boeing and McDonnell Douglas are aiming

437
00:21:21,480 --> 00:21:18,130
for new aircraft injuries or with the

438
00:21:27,540 --> 00:21:21,490

prop fans and say the 1991 92 93

439
00:21:32,020 --> 00:21:30,190
the advanced turboprop program that you

440
00:21:33,790 --> 00:21:32,030
just saw will help maintain the US

441
00:21:36,220 --> 00:21:33,800
aircraft industry in a dominant world

442
00:21:38,230 --> 00:21:36,230
leadership position well we've nearly

443
00:21:40,330 --> 00:21:38,240
come to the end of our show but before

444
00:21:43,060 --> 00:21:40,340
we go let's watch this NASA Lewis

445
00:21:44,170 --> 00:21:43,070
Research Center overview this segment

446
00:21:45,850 --> 00:21:44,180
will show you some of the high-tech

447
00:21:47,890 --> 00:21:45,860
facilities and people who make it

448
00:21:50,560 --> 00:21:47,900
possible for Louis to accomplish its

449
00:24:33,009 --> 00:21:50,570
mission to develop advanced technology

450
00:24:37,369 --> 00:24:35,149
thank you for spending some time with us

451
00:24:39,019 --> 00:24:37,379
please stop by and see the many displays

452
00:24:41,450 --> 00:24:39,029
and programs at the Visitor Center here

453
00:24:43,489 --> 00:24:41,460
at Lois we are located near Hopkins

454
00:24:45,409 --> 00:24:43,499
International Airport in Cleveland Ohio

455
00:24:48,440 --> 00:24:45,419
admission is free and we are open every