
NASA
SPACESTATION
LIVE

1
00:00:11,749 --> 00:00:09,430
the more recent soyuz crews have been

2
00:00:13,910 --> 00:00:11,759
taking six hour trips um to the

3
00:00:15,509 --> 00:00:13,920
international space station this one's

4
00:00:19,269 --> 00:00:15,519
taking two days and that's to test out

5
00:00:21,189 --> 00:00:19,279
the variety of upgrades that have been

6
00:00:23,349 --> 00:00:21,199
added to the newly modified soyuz

7
00:00:26,070 --> 00:00:23,359
vehicle this includes thrusters debris

8
00:00:28,230 --> 00:00:26,080
shielding power and digital video

9
00:00:30,390 --> 00:00:28,240
as well as many other things

10
00:00:33,350 --> 00:00:30,400
but what makes this soyuz so different

11
00:00:34,630 --> 00:00:33,360
from uh other previous models

12
00:00:38,950 --> 00:00:34,640
a few

13
00:00:40,389 --> 00:00:38,960

sat down with mark bowman the chief

14
00:00:41,990 --> 00:00:40,399
engineer of the soyuz branch of the

15
00:00:45,110 --> 00:00:42,000
astronaut office here at the johnson

16
00:00:47,350 --> 00:00:45,120
space center to find out and he asked

17
00:00:49,510 --> 00:00:47,360
bowman to begin by explaining the goals

18
00:00:51,189 --> 00:00:49,520
of the russian designers had in mind

19
00:00:55,990 --> 00:00:51,199
when they set out to improve this

20
00:00:59,910 --> 00:00:58,310
they stated two major reasons for

21
00:01:01,590 --> 00:00:59,920
performing the modifications the first

22
00:01:03,910 --> 00:01:01,600
is to increase the reliability of the

23
00:01:06,870 --> 00:01:03,920
spacecraft and the second is to enhance

24
00:01:09,109 --> 00:01:06,880
performance and technical specifications

25
00:01:11,030 --> 00:01:09,119
there were a lot of changes the first is

26
00:01:13,109 --> 00:01:11,040
a structural change they added

27
00:01:15,429 --> 00:01:13,119
additional shielding for micro meteorite

28
00:01:17,190 --> 00:01:15,439
and orbital debris to the habitation

29
00:01:19,749 --> 00:01:17,200
module and the intent of this is to

30
00:01:22,630 --> 00:01:19,759
increase what we in space parlance call

31
00:01:24,550 --> 00:01:22,640
the probability of non-penetration in

32
00:01:26,310 --> 00:01:24,560
other words to reduce the chance that a

33
00:01:28,149 --> 00:01:26,320
micro meteorite or some piece of orbital

34
00:01:30,069 --> 00:01:28,159
debris would actually punch a hole

35
00:01:32,149 --> 00:01:30,079
through the spacecraft

36
00:01:34,149 --> 00:01:32,159
the second change is a modification to

37
00:01:37,429 --> 00:01:34,159
the electrical power system

38
00:01:39,030 --> 00:01:37,439

to increase the the reserves of power

39
00:01:42,149 --> 00:01:39,040
the first thing they did was to add a

40
00:01:43,749 --> 00:01:42,159
fifth battery assembly to the spacecraft

41
00:01:45,590 --> 00:01:43,759
each battery assembly consists of a

42
00:01:48,469 --> 00:01:45,600
prime battery and a backup battery so by

43
00:01:50,389 --> 00:01:48,479
adding a fifth unit that's a 20 increase

44
00:01:53,190 --> 00:01:50,399
in the energy storage capacity on the

45
00:01:54,789 --> 00:01:53,200
spacecraft and to provide the power that

46
00:01:57,030 --> 00:01:54,799
go into those batteries there are solar

47
00:01:59,270 --> 00:01:57,040
arrays on the spacecraft and they added

48
00:02:01,350 --> 00:01:59,280
some additional surface area of the

49
00:02:03,429 --> 00:02:01,360
photoelectric cells on the solar arrays

50
00:02:06,069 --> 00:02:03,439
which increased surface area by a little

51
00:02:08,309 --> 00:02:06,079
over a square meter of area and they

52
00:02:10,229 --> 00:02:08,319
used additional or modern photoelectric

53
00:02:12,550 --> 00:02:10,239
cells on those arrays to increase the

54
00:02:15,190 --> 00:02:12,560
efficiency by about two percent so that

55
00:02:16,550 --> 00:02:15,200
helps to increase the power reserves on

56
00:02:18,949 --> 00:02:16,560
the spacecraft

57
00:02:20,710 --> 00:02:18,959
in addition they change the telemetry

58
00:02:22,630 --> 00:02:20,720
system the radio system that sends

59
00:02:24,790 --> 00:02:22,640
telemetry down to the ground and

60
00:02:26,790 --> 00:02:24,800
receives commands from the ground in the

61
00:02:28,710 --> 00:02:26,800
spacecraft to go to a much more modern

62
00:02:29,830 --> 00:02:28,720
system what they're calling an

63
00:02:32,630 --> 00:02:29,840

integrated

64
00:02:35,270 --> 00:02:32,640
command and telemetry system this makes

65
00:02:36,869 --> 00:02:35,280
use of the new russian looch satellites

66
00:02:39,430 --> 00:02:36,879
which are analogous to our tracking and

67
00:02:41,750 --> 00:02:39,440
data relay satellites and will greatly

68
00:02:43,750 --> 00:02:41,760
increase the amount of coverage that the

69
00:02:45,670 --> 00:02:43,760
communications systems on the spacecraft

70
00:02:47,430 --> 00:02:45,680
so ground controllers would be able to

71
00:02:49,990 --> 00:02:47,440
send commands as you know now they can

72
00:02:52,470 --> 00:02:50,000
only command to the spacecraft for about

73
00:02:53,910 --> 00:02:52,480
a maximum of 20 minutes per orbit and

74
00:02:55,430 --> 00:02:53,920
that's when they happen to be in an

75
00:02:56,390 --> 00:02:55,440
orbit that goes over a russian ground

76
00:02:58,070 --> 00:02:56,400
station

77
00:03:00,229 --> 00:02:58,080
once this system is fully up and running

78
00:03:03,030 --> 00:03:00,239
and tested they'll be able to send

79
00:03:05,430 --> 00:03:03,040
commands for at least 45 percent to

80
00:03:06,710 --> 00:03:05,440
perhaps 80 or 90 percent of an orbital

81
00:03:08,790 --> 00:03:06,720
coverage

82
00:03:11,670 --> 00:03:08,800
as also as part of that yakitaya system

83
00:03:13,509 --> 00:03:11,680
they've transitioned to an s-band system

84
00:03:16,229 --> 00:03:13,519
they removed the old antennas that

85
00:03:17,910 --> 00:03:16,239
supported the the old radio system and

86
00:03:20,790 --> 00:03:17,920
replaced those with four

87
00:03:22,390 --> 00:03:20,800
omni-directional antennas that provide

88
00:03:24,630 --> 00:03:22,400

access to the spacecraft from all of the

89
00:03:27,270 --> 00:03:24,640
russian ground sites and additionally

90
00:03:29,670 --> 00:03:27,280
they added a phased array antenna that

91
00:03:31,750 --> 00:03:29,680
will point at the looch satellites which

92
00:03:33,910 --> 00:03:31,760
are in geosynchronous orbit so phase

93
00:03:35,750 --> 00:03:33,920
deray antenna allows them to point more

94
00:03:38,229 --> 00:03:35,760
precisely to

95
00:03:40,070 --> 00:03:38,239
get communication with those satellites

96
00:03:42,470 --> 00:03:40,080
they also improve the communication

97
00:03:44,470 --> 00:03:42,480
system the vhf communications radios in

98
00:03:46,390 --> 00:03:44,480
the descent module which the crew

99
00:03:48,949 --> 00:03:46,400
members used for voice communications

100
00:03:50,789 --> 00:03:48,959
with the ground um the yakata system

101
00:03:53,270 --> 00:03:50,799
includes a backup capability that will

102
00:03:56,309 --> 00:03:53,280
eventually enable them to have ground

103
00:03:58,070 --> 00:03:56,319
voice command voice communications

104
00:04:00,470 --> 00:03:58,080
in addition to vhf but that's not

105
00:04:02,949 --> 00:04:00,480
functional yet on this first spacecraft

106
00:04:05,190 --> 00:04:02,959
but the improvements to the vhf radios

107
00:04:07,190 --> 00:04:05,200
in the descent module provide provide a

108
00:04:09,990 --> 00:04:07,200
lot of additional safety to the crew

109
00:04:12,470 --> 00:04:10,000
members because they've added a global

110
00:04:14,789 --> 00:04:12,480
positioning satellite receiver on the

111
00:04:16,710 --> 00:04:14,799
hatch of the spacecraft so once the

112
00:04:18,949 --> 00:04:16,720
parachutes have opened during re-entry

113
00:04:21,189 --> 00:04:18,959

they start taking data from a gps which

114
00:04:23,590 --> 00:04:21,199
tells the spacecraft where it's located

115
00:04:25,590 --> 00:04:23,600
then the radio system also has a new

116
00:04:27,110 --> 00:04:25,600
transponder that sends then that

117
00:04:29,830 --> 00:04:27,120
location to

118
00:04:31,590 --> 00:04:29,840
the coast bar and sarsat rescue

119
00:04:33,350 --> 00:04:31,600
satellite systems it's a universal

120
00:04:34,710 --> 00:04:33,360
system that's used all over the world

121
00:04:36,550 --> 00:04:34,720
and this will allow the search and

122
00:04:38,710 --> 00:04:36,560
rescue crews to quickly locate a

123
00:04:41,030 --> 00:04:38,720
spacecraft in the event say of bad

124
00:04:43,510 --> 00:04:41,040
weather or a ballistic entry so it

125
00:04:45,030 --> 00:04:43,520
greatly improves the the reliability the

126
00:04:47,189 --> 00:04:45,040
other thing they did was change the

127
00:04:49,590 --> 00:04:47,199
coors rendezvous radar system which has

128
00:04:52,390 --> 00:04:49,600
been used for many years on the soyuz

129
00:04:55,430 --> 00:04:52,400
the new coors includes much upgraded

130
00:04:57,510 --> 00:04:55,440
avionics modernized electronic systems

131
00:04:59,909 --> 00:04:57,520
new antennas they have actually had

132
00:05:01,830 --> 00:04:59,919
reduced the the antenna footprint on the

133
00:05:03,830 --> 00:05:01,840
spacecraft as you know

134
00:05:05,590 --> 00:05:03,840
you've seen the the iconic photo looking

135
00:05:08,230 --> 00:05:05,600
out of the blister of the soyuz as they

136
00:05:10,230 --> 00:05:08,240
approach the the iss and you can see an

137
00:05:12,629 --> 00:05:10,240
antenna that's rotating in the field of

138
00:05:14,790 --> 00:05:12,639

view that is a coors antenna that is no

139
00:05:16,870 --> 00:05:14,800
longer needed it was very complicated

140
00:05:19,189 --> 00:05:16,880
mechanically and also it had to be

141
00:05:20,629 --> 00:05:19,199
retracted prior to docking with the

142
00:05:22,790 --> 00:05:20,639
space station so that it didn't come in

143
00:05:24,710 --> 00:05:22,800
contact with station structure the new

144
00:05:27,110 --> 00:05:24,720
coors allows them to put a small phased

145
00:05:29,110 --> 00:05:27,120
array antenna on a fixed bracket that

146
00:05:30,870 --> 00:05:29,120
doesn't have to be retracted it weighs

147
00:05:33,590 --> 00:05:30,880
less uses less power it's much less

148
00:05:35,670 --> 00:05:33,600
complicated also you might recollect a

149
00:05:38,230 --> 00:05:35,680
boom on the aft end of the spacecraft

150
00:05:39,990 --> 00:05:38,240
that had two coors antennas that boom

151
00:05:41,749 --> 00:05:40,000
has been removed and the antenna has

152
00:05:43,830 --> 00:05:41,759
been placed on fixed locations on the

153
00:05:46,070 --> 00:05:43,840
spacecraft body so that simplifies the

154
00:05:48,230 --> 00:05:46,080
spacecraft and reduces weight all in all

155
00:05:50,870 --> 00:05:48,240
the the coors modifications

156
00:05:53,590 --> 00:05:50,880
reduced the weight of the the cool

157
00:05:57,029 --> 00:05:53,600
system by about 25 kilograms and takes

158
00:05:59,749 --> 00:05:57,039
about 30 less volume and it uses about

159
00:06:01,510 --> 00:05:59,759
24 less power so plus is all the way

160
00:06:02,710 --> 00:06:01,520
around

161
00:06:04,950 --> 00:06:02,720
another thing that they did to this

162
00:06:07,430 --> 00:06:04,960
spacecraft is change the

163
00:06:09,909 --> 00:06:07,440

approach and attitude control thrusters

164
00:06:11,909 --> 00:06:09,919
which in russian we call the depeo

165
00:06:14,790 --> 00:06:11,919
thrusters that are used to maneuver the

166
00:06:16,870 --> 00:06:14,800
spacecraft and change its orientation

167
00:06:18,870 --> 00:06:16,880
the previous depaol thrusters there were

168
00:06:21,270 --> 00:06:18,880
28 of them 16 of them were large

169
00:06:23,830 --> 00:06:21,280
thrusters of about 13 kilograms of

170
00:06:26,070 --> 00:06:23,840
thrust and 12 of them were small

171
00:06:29,029 --> 00:06:26,080
thrusters about 3 kilograms in thrust

172
00:06:31,189 --> 00:06:29,039
the new configuration uses 28 all large

173
00:06:33,830 --> 00:06:31,199
thrusters and it provides a lot of

174
00:06:35,990 --> 00:06:33,840
redundancy now by by

175
00:06:38,070 --> 00:06:36,000
uh 14 pairs of thrusters around the

176
00:06:40,309 --> 00:06:38,080
spacecraft so that there's a redundant

177
00:06:42,070 --> 00:06:40,319
thruster for every other thruster and

178
00:06:44,870 --> 00:06:42,080
they're operated on separate completely

179
00:06:46,870 --> 00:06:44,880
redundant manifolds for propellant so if

180
00:06:48,710 --> 00:06:46,880
one thruster fails the other thruster

181
00:06:51,510 --> 00:06:48,720
immediately in its pair immediately

182
00:06:53,909 --> 00:06:51,520
picks up and assumes control you recall

183
00:06:55,589 --> 00:06:53,919
in december when the 45 soyuz approached

184
00:06:57,670 --> 00:06:55,599
and they had a false indication of a

185
00:06:59,909 --> 00:06:57,680
thruster failing that required the crew

186
00:07:01,749 --> 00:06:59,919
members to manually take over and dock

187
00:07:03,189 --> 00:07:01,759
to the space station with the new

188
00:07:04,710 --> 00:07:03,199

thruster configuration that would not

189
00:07:06,950 --> 00:07:04,720
have been a problem a threat failure of

190
00:07:09,029 --> 00:07:06,960
one thruster just transitions to the

191
00:07:10,710 --> 00:07:09,039
thruster on the backup manifold

192
00:07:12,710 --> 00:07:10,720
the other advantage of the new thruster

193
00:07:15,029 --> 00:07:12,720
configuration is that on the aft end of

194
00:07:18,230 --> 00:07:15,039
the spacecraft there are eight thrusters

195
00:07:20,550 --> 00:07:18,240
instead of four so if during say a

196
00:07:23,189 --> 00:07:20,560
deorbit burn for example if the main

197
00:07:25,430 --> 00:07:23,199
engine were to fail now you have four

198
00:07:27,670 --> 00:07:25,440
large thrusters to be able to perform

199
00:07:29,350 --> 00:07:27,680
your deorbit burn instead of only four

200
00:07:31,189 --> 00:07:29,360
and so that provides additional level of

201
00:07:33,110 --> 00:07:31,199
redundancy as well

202
00:07:34,390 --> 00:07:33,120
how have all these modifications been

203
00:07:36,469 --> 00:07:34,400
tested mark

204
00:07:38,309 --> 00:07:36,479
well the testing has been comprehensive

205
00:07:41,189 --> 00:07:38,319
and extensive most or many of the

206
00:07:43,589 --> 00:07:41,199
modifications have already flown

207
00:07:46,230 --> 00:07:43,599
on previous versions of the soyuz even

208
00:07:48,070 --> 00:07:46,240
though they were tmam vehicles they one

209
00:07:50,629 --> 00:07:48,080
by one implemented some of the

210
00:07:52,710 --> 00:07:50,639
modifications they tested the redundant

211
00:07:54,309 --> 00:07:52,720
drive motors on the docking system they

212
00:07:56,070 --> 00:07:54,319
tested the core system so they've been

213
00:07:58,230 --> 00:07:56,080

tested on both progress and soyuz

214
00:08:00,469 --> 00:07:58,240
vehicles and then finally the last two

215
00:08:02,550 --> 00:08:00,479
progresses 62.63p

216
00:08:05,510 --> 00:08:02,560
have included all of the modifications

217
00:08:07,270 --> 00:08:05,520
comprehensively so that they'll have two

218
00:08:09,830 --> 00:08:07,280
positive flights and positive test

219
00:08:11,510 --> 00:08:09,840
results on progress vehicles giving them

220
00:08:12,950 --> 00:08:11,520
great confidence that the soyuz will be

221
00:08:15,029 --> 00:08:12,960
fine

222
00:08:17,510 --> 00:08:15,039
this launch will send kate rubins and

223
00:08:19,670 --> 00:08:17,520
her crewmates on a deliberate two-day

224
00:08:21,430 --> 00:08:19,680
rendezvous instead of the more common

225
00:08:23,189 --> 00:08:21,440
four-orbit six-hour rendezvous that

226
00:08:24,070 --> 00:08:23,199
we've become accustomed to

227
00:08:26,070 --> 00:08:24,080
why

228
00:08:28,230 --> 00:08:26,080
well the main reason for going to a 34

229
00:08:30,469 --> 00:08:28,240
orbit rendezvous on this flight is to

230
00:08:32,790 --> 00:08:30,479
provide additional time to test the new

231
00:08:35,110 --> 00:08:32,800
systems going to 34 orbit gives them

232
00:08:37,750 --> 00:08:35,120
lots of time to test the new unified or

233
00:08:39,509 --> 00:08:37,760
integrated command and telemetry system

234
00:08:40,949 --> 00:08:39,519
it gives them a chance to do some flying

235
00:08:43,670 --> 00:08:40,959
quality assessments with the new

236
00:08:45,750 --> 00:08:43,680
thruster configuration and it gives them

237
00:08:47,750 --> 00:08:45,760
a chance to test communications using

238
00:08:49,670 --> 00:08:47,760

the new luch satellites as well as the