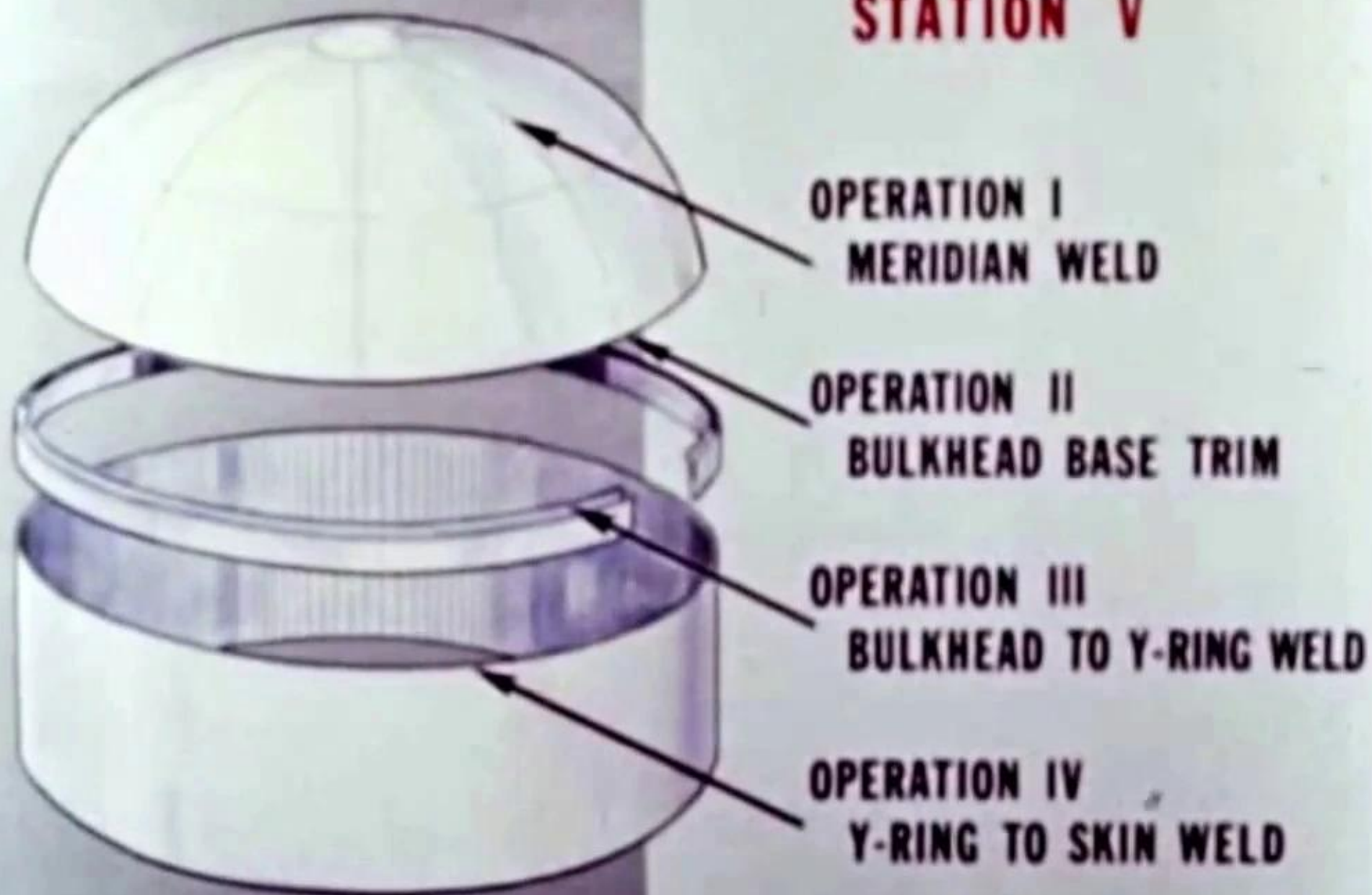


## STATION V



1  
00:00:24,330 --> 00:00:20,490  
this was yesterday this is happening

2  
00:00:29,700 --> 00:00:24,340  
today saturn s 1c has moved from drawing

3  
00:00:31,560 --> 00:00:29,710  
board design to pilot fabrication nasa's

4  
00:00:34,200 --> 00:00:31,570  
marshall center is responsible for

5  
00:00:36,720 --> 00:00:34,210  
development of the s 1c booster stage of

6  
00:00:40,130 --> 00:00:36,730  
the saturn v vehicle the boeing company

7  
00:00:42,540 --> 00:00:40,140  
is the contractor for the booster

8  
00:00:44,690 --> 00:00:42,550  
development of manufacturing techniques

9  
00:00:46,680 --> 00:00:44,700  
consistent with reliability requirements

10  
00:00:49,380 --> 00:00:46,690  
state-of-the-art advancements and

11  
00:00:53,090 --> 00:00:49,390  
feasible production capabilities is a

12  
00:00:59,880 --> 00:00:56,100  
basically the s 1c booster is a tandem

13  
00:01:02,700 --> 00:00:59,890

tank configuration with the oxidizer

14

00:01:06,120 --> 00:01:02,710

tank on top and enter tank structure

15

00:01:09,859 --> 00:01:06,130

next then the fuel tank assembly above

16

00:01:12,899 --> 00:01:09,869

and attached to the thrust structure

17

00:01:16,230 --> 00:01:12,909

which supports the fens based structures

18

00:01:18,149 --> 00:01:16,240

and the v f1 engines the first static

19

00:01:22,139 --> 00:01:18,159

test of the booster is scheduled for

20

00:01:25,620 --> 00:01:22,149

october 1964 pilot fabrication of the

21

00:01:27,419 --> 00:01:25,630

huge tank bulkheads is now underway six

22

00:01:29,239 --> 00:01:27,429

basic jigs are stations have been

23

00:01:31,830 --> 00:01:29,249

developed to perform this operation

24

00:01:35,520 --> 00:01:31,840

openings required for fittings are first

25

00:01:37,469 --> 00:01:35,530

cut and fittings installed then the apex

26  
00:01:41,699 --> 00:01:37,479  
and base parts of each core section are

27  
00:01:43,289 --> 00:01:41,709  
trimmed next the apex and base sections

28  
00:01:47,039 --> 00:01:43,299  
are welded together to form a gore

29  
00:01:48,300 --> 00:01:47,049  
segment the core is then trimmed and

30  
00:01:51,410 --> 00:01:48,310  
routed are grooved

31  
00:01:53,999 --> 00:01:51,420  
on each side for well two other sections

32  
00:01:55,889 --> 00:01:54,009  
next all four sections are welded

33  
00:02:00,179 --> 00:01:55,899  
together trimmed and the bulkhead

34  
00:02:04,410 --> 00:02:00,189  
assembly completed next operation is

35  
00:02:06,449 --> 00:02:04,420  
closure of the bulkhead utilizing this

36  
00:02:08,160 --> 00:02:06,459  
tooling the manufacturing engineering

37  
00:02:11,220 --> 00:02:08,170  
division at Marshall is presently

38  
00:02:13,140 --> 00:02:11,230

performing pilot fabrication advantage

39

00:02:15,059 --> 00:02:13,150

of this manufacturing process can be

40

00:02:16,980 --> 00:02:15,069

depicted by following a bulkhead

41

00:02:20,790 --> 00:02:16,990

fabrication sequence through the six

42

00:02:22,890 --> 00:02:20,800

stations previous bulkhead fabrication

43

00:02:25,619 --> 00:02:22,900

techniques on smaller tank components

44

00:02:27,440 --> 00:02:25,629

utilized a moveable jig which traveled

45

00:02:29,300 --> 00:02:27,450

under a stationary weld head

46

00:02:31,990 --> 00:02:29,310

this approach was impractical for

47

00:02:34,790 --> 00:02:32,000

elliptical bulkheads of large diameters

48

00:02:36,770 --> 00:02:34,800

here we see an apex segment of Evora

49

00:02:39,020 --> 00:02:36,780

section being positioned on the station

50

00:02:41,240 --> 00:02:39,030

one fixture both tooling and bulkhead

51  
00:02:45,740 --> 00:02:41,250  
segments are fabricated by Boeing at

52  
00:02:47,780 --> 00:02:45,750  
Wichita the first operation is

53  
00:02:50,000 --> 00:02:47,790  
installation of various propellant line

54  
00:02:54,320 --> 00:02:50,010  
fittings as required here we see a

55  
00:02:56,630 --> 00:02:54,330  
cutout for a fixture these fittings

56  
00:02:58,729 --> 00:02:56,640  
short conical sleeves are used for

57  
00:03:01,009 --> 00:02:58,739  
structural support of propellant suction

58  
00:03:02,900 --> 00:03:01,019  
tunnels the bulkhead components are

59  
00:03:06,550 --> 00:03:02,910  
handled by overhead cranes which

60  
00:03:09,289 --> 00:03:06,560  
traverse the area over all jig stations

61  
00:03:11,660 --> 00:03:09,299  
the fixtures were designed by Marshall

62  
00:03:15,020 --> 00:03:11,670  
Center and fabricated to MSFC

63  
00:03:17,210 --> 00:03:15,030

specifications by Boeing this fixture

64

00:03:19,190 --> 00:03:17,220

consists of a gantry under dolly the

65

00:03:21,470 --> 00:03:19,200

gantry suspends a rotating carriage over

66

00:03:23,240 --> 00:03:21,480

the weld area this carriage is being

67

00:03:25,520 --> 00:03:23,250

positioned in preparation for trimming

68

00:03:29,839 --> 00:03:25,530

and routing the cutout and preparation

69

00:03:32,390 --> 00:03:29,849

for welding operations the carriage

70

00:03:34,789 --> 00:03:32,400

supports both cutting and welded which

71

00:03:38,509 --> 00:03:34,799

may be attached without removal of the

72

00:03:40,400 --> 00:03:38,519

carriage the bulkhead section is

73

00:03:44,930 --> 00:03:40,410

anchored to the fixture by a hydraulic

74

00:03:47,330 --> 00:03:44,940

pull down system in accordance with the

75

00:03:48,890 --> 00:03:47,340

original manufacturing plan initial

76

00:03:51,379 --> 00:03:48,900

operations will be accomplished at

77

00:03:53,690 --> 00:03:51,389

Marshall with pilot operations followed

78

00:03:57,770 --> 00:03:53,700

by fabrication of ground test stages and

79

00:03:59,960 --> 00:03:57,780

the first flight vehicle this effort

80

00:04:02,990 --> 00:03:59,970

will include partial fabrication and

81

00:04:07,039 --> 00:04:03,000

assembly of the s-1 CT the first static

82

00:04:10,819 --> 00:04:07,049

firing stage s1 CD a dynamic test stage

83

00:04:12,229 --> 00:04:10,829

and one light beer all machine and

84

00:04:14,509 --> 00:04:12,239

fabrication techniques and procedures

85

00:04:17,300 --> 00:04:14,519

developed and proved feasible and

86

00:04:19,729 --> 00:04:17,310

reliable at Marshall will be utilized at

87

00:04:24,379 --> 00:04:19,739

masu and production fabrication of the

88

00:04:27,050 --> 00:04:24,389

s-1 sea all jigs and equipment will be

89

00:04:29,390 --> 00:04:27,060

transferred to miss Yu for use by Boeing

90

00:04:32,240 --> 00:04:29,400

and the production phase of the program

91

00:04:37,810 --> 00:04:32,250

after Marshall phases out of the s-1 C

92

00:04:41,840 --> 00:04:40,010

fusion welding of the structural

93

00:04:43,730 --> 00:04:41,850

components that comprise the propellant

94

00:04:45,680 --> 00:04:43,740

containers is accomplished automatically

95

00:04:46,400 --> 00:04:45,690

by both mechanical and electronic

96

00:04:48,890 --> 00:04:46,410

controls

97

00:04:51,320 --> 00:04:48,900

well thickness are fitting locations

98

00:04:53,450 --> 00:04:51,330

vary from two tenths to eight tenths of

99

00:04:56,450 --> 00:04:53,460

an edge depending upon the size of the

100

00:04:58,909 --> 00:04:56,460

fitting after welding is completed on

101  
00:05:01,249 --> 00:04:58,919  
each section the segment is removed and

102  
00:05:03,740 --> 00:05:01,259  
subjected to x-ray inspection then

103  
00:05:05,659 --> 00:05:03,750  
transported to the cleaning facility the

104  
00:05:08,689 --> 00:05:05,669  
part is aged formed where the well

105  
00:05:10,999 --> 00:05:08,699  
distortion is corrected the apex core

106  
00:05:14,510 --> 00:05:11,009  
segment is then cleaned and according of

107  
00:05:16,909 --> 00:05:14,520  
erudite 14 to our Aladin 1200 is applied

108  
00:05:18,890 --> 00:05:16,919  
next the apex segment and the base

109  
00:05:21,230 --> 00:05:18,900  
segment of a gore section are prepared

110  
00:05:23,270 --> 00:05:21,240  
for welding this operation is

111  
00:05:26,570 --> 00:05:23,280  
accomplished on the station to fixture

112  
00:05:28,909 --> 00:05:26,580  
which actually comprises two jigs one

113  
00:05:33,230 --> 00:05:28,919

for the apex segment as shown here and

114

00:05:35,210 --> 00:05:33,240

one for the base segment in this view

115

00:05:37,490 --> 00:05:35,220

the depressions on the jig can be noted

116

00:05:39,980 --> 00:05:37,500

clearly vacuum affected at each of these

117

00:05:41,990 --> 00:05:39,990

points holds the material in place but

118

00:05:44,390 --> 00:05:42,000

does not bind the material to the jig as

119

00:05:46,879 --> 00:05:44,400

tightly as hold down clamps and allows

120

00:05:51,170 --> 00:05:46,889

the weld area to move thus the terms of

121

00:05:53,089 --> 00:05:51,180

tooling is applied this section the

122

00:05:56,180 --> 00:05:53,099

bottom of the apex segment is being

123

00:05:59,000 --> 00:05:56,190

trimmed the edges apex and base segments

124

00:06:01,370 --> 00:05:59,010

are cut into a concave or a convex shape

125

00:06:04,490 --> 00:06:01,380

to allow a tongue-and-groove type joint

126  
00:06:08,600 --> 00:06:04,500  
the concave section is approximately six

127  
00:06:10,580 --> 00:06:08,610  
hundredths of an inch deep this fixture

128  
00:06:13,100 --> 00:06:10,590  
is used with the base segment of the

129  
00:06:16,070 --> 00:06:13,110  
gore section vacuum locations are

130  
00:06:18,379 --> 00:06:16,080  
evident here in the base segment is

131  
00:06:21,969 --> 00:06:18,389  
being positioned on the jig preparatory

132  
00:06:24,290 --> 00:06:21,979  
to final trimming of the base line

133  
00:06:26,149 --> 00:06:24,300  
trimming and routing operations are

134  
00:06:28,219 --> 00:06:26,159  
performed by tooling that travels on a

135  
00:06:31,040 --> 00:06:28,229  
fixed track which is a part of the

136  
00:06:33,920 --> 00:06:31,050  
fixture assuring the same cut or routing

137  
00:06:35,779 --> 00:06:33,930  
on each segment next the apex and base

138  
00:06:40,879 --> 00:06:35,789

segments will be welded into a course

139

00:06:43,100 --> 00:06:40,889

section assembly this operation is

140

00:06:46,519 --> 00:06:43,110

accomplished on the apex two base weld

141

00:06:48,800 --> 00:06:46,529

fixture our station number three this

142

00:06:51,110 --> 00:06:48,810

fixture consists of three sections and

143

00:06:53,090 --> 00:06:51,120

overhead support holds the well

144

00:06:55,610 --> 00:06:53,100

head and track for the unit to travel

145

00:06:57,890 --> 00:06:55,620

over a two-part Dalek type fixture

146

00:07:00,830 --> 00:06:57,900

utilizing vacuum pulldown Positioning

147

00:07:03,890 --> 00:07:00,840

Systems holds the gore segments this

148

00:07:06,620 --> 00:07:03,900

approach extensively used at MSFC called

149

00:07:09,439 --> 00:07:06,630

soft tooling will be utilized at masu

150

00:07:11,960 --> 00:07:09,449

wherever practical the apex segment is

151  
00:07:14,050 --> 00:07:11,970  
being positioned for welding after

152  
00:07:16,820 --> 00:07:14,060  
positioning the fixture is locked

153  
00:07:19,100 --> 00:07:16,830  
next the base segment is positioned and

154  
00:07:21,260 --> 00:07:19,110  
locked the two parts of the Dalek

155  
00:07:26,210 --> 00:07:21,270  
platform are attached forming an

156  
00:07:28,909 --> 00:07:26,220  
integral unit this platform is tilted

157  
00:07:31,790 --> 00:07:28,919  
allowing the immediate weld area to

158  
00:07:34,189 --> 00:07:31,800  
remain in an uphill position this method

159  
00:07:37,850 --> 00:07:34,199  
precludes running our fooling of the

160  
00:07:40,279 --> 00:07:37,860  
weld material wells are made with single

161  
00:07:42,250 --> 00:07:40,289  
passes of the head the well track

162  
00:07:45,020 --> 00:07:42,260  
follows the contour of the head assembly

163  
00:07:47,750 --> 00:07:45,030

but the proximity of the head to work

164

00:07:50,420 --> 00:07:47,760

surface does not depend on the accuracy

165

00:07:52,430 --> 00:07:50,430

of the track this is accomplished by an

166

00:07:54,740 --> 00:07:52,440

electronic sensing device which

167

00:07:57,950 --> 00:07:54,750

compensates for variations in curvature

168

00:08:00,710 --> 00:07:57,960

of the work surface and proximity of the

169

00:08:03,500 --> 00:08:00,720

weld head to the part rate of travel of

170

00:08:05,900 --> 00:08:03,510

the weld head angle of attack and other

171

00:08:09,110 --> 00:08:05,910

control aspects are programmed and

172

00:08:11,150 --> 00:08:09,120

monitored electronically this provides a

173

00:08:13,190 --> 00:08:11,160

system that effectively reduces human

174

00:08:16,730 --> 00:08:13,200

error and provides a high degree of

175

00:08:19,100 --> 00:08:16,740

reliability next the gore sections are

176  
00:08:22,270 --> 00:08:19,110  
positioned on the bulkhead Gore trim and

177  
00:08:24,920 --> 00:08:22,280  
route fixture this is station number 4

178  
00:08:28,370 --> 00:08:24,930  
here the section is trimmed to Meridian

179  
00:08:30,589 --> 00:08:28,380  
trim lines then routed on both sides one

180  
00:08:33,199 --> 00:08:30,599  
side of the section is routed concave

181  
00:08:34,070 --> 00:08:33,209  
and the other convex which allows a

182  
00:08:36,500 --> 00:08:34,080  
tongue-and-groove

183  
00:08:38,959 --> 00:08:36,510  
fitting between sections the gore

184  
00:08:42,769 --> 00:08:38,969  
sections used in this pilot fabrication

185  
00:08:44,960 --> 00:08:42,779  
are of 2219 aluminum the same material

186  
00:08:48,110 --> 00:08:44,970  
which will be used in all test and

187  
00:08:50,870 --> 00:08:48,120  
production boosters the entire portion

188  
00:08:53,570 --> 00:08:50,880

of the gore is held down by vacuum there

189

00:08:56,449 --> 00:08:53,580

by holding the part in position until

190

00:08:59,300 --> 00:08:56,459

the operation is complete after trimming

191

00:09:01,910 --> 00:08:59,310

the gore is removed and placed on the

192

00:09:04,190 --> 00:09:01,920

bulkhead assembly jig station number

193

00:09:05,150 --> 00:09:04,200

five where the eight core sections are

194

00:09:07,370 --> 00:09:05,160

joined together

195

00:09:10,490 --> 00:09:07,380

to form the bulkhead this fixture

196

00:09:13,940 --> 00:09:10,500

consists of a 396 inch diameter

197

00:09:17,000 --> 00:09:13,950

turntable clamping device a 17 foot tall

198

00:09:20,030 --> 00:09:17,010

Center pedestal and a vacuum Chuck the

199

00:09:22,640 --> 00:09:20,040

size of two side-by-side Gore's joining

200

00:09:25,130 --> 00:09:22,650

the pedestal to the ring assembly of a

201  
00:09:27,020 --> 00:09:25,140  
bulkhead begins with two four sections

202  
00:09:29,930 --> 00:09:27,030  
being positioned to form the vacuum

203  
00:09:32,270 --> 00:09:29,940  
Chuck the sections fit together with a

204  
00:09:34,880 --> 00:09:32,280  
tongue and groove joint the weld head

205  
00:09:37,010 --> 00:09:34,890  
suspended from a curved arm makes a

206  
00:09:39,860 --> 00:09:37,020  
Meridian but weld along the joint of the

207  
00:09:43,250 --> 00:09:39,870  
two wars starting at the base and moving

208  
00:09:45,530 --> 00:09:43,260  
up and on an elliptical path the head

209  
00:09:47,990 --> 00:09:45,540  
makes a single pass to weld the two bars

210  
00:09:51,560 --> 00:09:48,000  
together and well thickness will vary

211  
00:09:54,020 --> 00:09:51,570  
between 2/10 and 8/10 of an edge after a

212  
00:09:56,780 --> 00:09:54,030  
pass the head will be swung out of the

213  
00:09:58,910 --> 00:09:56,790

way and the welded seam x-rayed the

214

00:10:01,190 --> 00:09:58,920

world head travels on an overhead track

215

00:10:03,950 --> 00:10:01,200

and is controlled by a similar system

216

00:10:06,980 --> 00:10:03,960

used at station number three where the

217

00:10:08,840 --> 00:10:06,990

segments are welded together after one

218

00:10:11,470 --> 00:10:08,850

well joint is completed and x-ray

219

00:10:14,030 --> 00:10:11,480

accepted that turntable is rotated

220

00:10:17,270 --> 00:10:14,040

positioning the next core section joint

221

00:10:19,070 --> 00:10:17,280

and the well process repeated until all

222

00:10:22,040 --> 00:10:19,080

eight drawers have been welded together

223

00:10:24,380 --> 00:10:22,050

to form the bulkhead the base of the

224

00:10:27,110 --> 00:10:24,390

bulkhead will be trimmed and the entire

225

00:10:30,470 --> 00:10:27,120

section moved to station number six the

226

00:10:32,680 --> 00:10:30,480

center piece trim and well fixture this

227

00:10:36,590 --> 00:10:32,690

center piece fixture performs cutout

228

00:10:39,440 --> 00:10:36,600

final trim and weld operations to

229

00:10:42,920 --> 00:10:39,450

install the 54 inch disc of aluminum

230

00:10:46,100 --> 00:10:42,930

alloy in the bulkhead center the center

231

00:10:48,620 --> 00:10:46,110

disc closes the top of the bulkhead this

232

00:10:51,410 --> 00:10:48,630

jig consists of a Center pedestal and

233

00:10:54,640 --> 00:10:51,420

eight support arms the bulkhead is

234

00:10:57,410 --> 00:10:54,650

lowered over the pedestal onto the arms

235

00:11:00,140 --> 00:10:57,420

after this operation the bulkhead has

236

00:11:02,810 --> 00:11:00,150

returned to station 5 where the wiring

237

00:11:06,440 --> 00:11:02,820

is welded to the base section of the

238

00:11:09,770 --> 00:11:06,450

bulkhead tooling has felt the influence

239

00:11:12,770 --> 00:11:09,780

of a team effort in design fabrication

240

00:11:14,960 --> 00:11:12,780

and installation since Marshall Space

241

00:11:18,140 --> 00:11:14,970

Flight Center had several month lead on

242

00:11:19,010 --> 00:11:18,150

Boeing and tool development ma division

243

00:11:21,829 --> 00:11:19,020

tool designer

244

00:11:24,470 --> 00:11:21,839

laid ground rules and development then

245

00:11:27,710 --> 00:11:24,480

worked out the major design concepts in

246

00:11:30,170 --> 00:11:27,720

the area of bulkhead fabrication joint

247

00:11:33,260 --> 00:11:30,180

effort is not an abstract term in the

248

00:11:37,070 --> 00:11:33,270

relationship between MSFC and the boeing

249

00:11:39,440 --> 00:11:37,080

company it is an evident truth the s1c