1
00:00:44,869 --> 00:00:42,470
since the first airplane flight in 1903

2
00:00:47,190 --> 00:00:44,879
flying in winter has been a problem

3
00:00:50,549 --> 00:00:47,200
because of dangerous situations created

4
00:00:53,750 --> 00:00:50,559
by ice formations on aircraft

5
00:00:56,630 --> 00:00:53,760
during the 1920s and 30s when aviation

6
00:00:59,189 --> 00:00:56,640
was still in its infancy the limitations

7
00:01:01,510 --> 00:00:59,199
of winter flying were very apparent

8
00:01:03,590 --> 00:01:01,520
one example was the attempt to establish

9
00:01:05,270 --> 00:01:03,600
transatlantic routes between the united

10
00:01:07,670 --> 00:01:05,280
states and europe over the north

11
00:01:09,910 --> 00:01:07,680
atlantic which were considered much too

12
00:01:12,149 --> 00:01:09,920
dangerous to fly

13
00:01:15,990 --> 00:01:12,159

during the second world war more than

14
00:01:18,230 --> 00:01:16,000
100 c-46 aircraft were lost while flying

15
00:01:19,350 --> 00:01:18,240
over the himalayas between india and

16
00:01:21,990 --> 00:01:19,360
china

17
00:01:23,910 --> 00:01:22,000
this route was known as the hump

18
00:01:27,670 --> 00:01:23,920
responding to this need the national

19
00:01:30,550 --> 00:01:27,680
advisory committee for aeronautics naca

20
00:01:32,950 --> 00:01:30,560
directed that an icing research tunnel

21
00:01:35,590 --> 00:01:32,960
be constructed at the aircraft engine

22
00:01:38,469 --> 00:01:35,600
research laboratory which was the former

23
00:01:40,950 --> 00:01:38,479
name of the lewis research center

24
00:01:43,749 --> 00:01:40,960
the icing research tunnel was designed

25
00:01:47,109 --> 00:01:43,759
and constructed from 1942

26
00:01:48,469 --> 00:01:47,119
to 1944 for six hundred seventy thousand

27
00:01:51,630 --> 00:01:48,479
dollars

28
00:01:53,510 --> 00:01:51,640
the first icing test was run on june 9th

29
00:01:56,469 --> 00:01:53,520
1944

30
00:01:59,749 --> 00:01:56,479
the icing research within naca first

31
00:02:01,910 --> 00:01:59,759
started in the 1920s at langley research

32
00:02:04,149 --> 00:02:01,920
center in virginia

33
00:02:07,350 --> 00:02:04,159
icing research was also conducted at

34
00:02:10,229 --> 00:02:07,360
ames research center in california prior

35
00:02:12,630 --> 00:02:10,239
to the research at lewis research center

36
00:02:15,990 --> 00:02:12,640
in the 1940s

37
00:02:18,790 --> 00:02:16,000
soon naca turned to nasa

38
00:02:20,070 --> 00:02:18,800

and their attention from aeronautics to

39
00:02:22,150 --> 00:02:20,080
space

40
00:02:26,150 --> 00:02:22,160
the icing technology developed through

41
00:02:28,869 --> 00:02:26,160
the 40s and 50s at naca nasa formed the

42
00:02:32,949 --> 00:02:28,879
basis of what the u.s aircraft industry

43
00:02:35,830 --> 00:02:32,959
used to solve various icing problems

44
00:02:38,229 --> 00:02:35,840
dr joe shaw deputy chief for applied

45
00:02:39,190 --> 00:02:38,239
dynamics at the nasa lewis research

46
00:02:43,430 --> 00:02:39,200
center

47
00:02:46,229 --> 00:02:43,440
explains the icing research program

48
00:02:49,350 --> 00:02:46,239
the icing research program at lewis was

49
00:02:51,190 --> 00:02:49,360
begun in the early forties it was felt

50
00:02:52,390 --> 00:02:51,200
that an icing research activity

51
00:02:54,550 --> 00:02:52,400
including

52
00:02:56,470 --> 00:02:54,560
the construction of a ground icing test

53
00:02:59,430 --> 00:02:56,480
facility or the icing research tunnel

54
00:03:01,350 --> 00:02:59,440
was needed to address the wartime icing

55
00:03:03,910 --> 00:03:01,360
problems that that the military was

56
00:03:06,550 --> 00:03:03,920
having there was expressed a need for an

57
00:03:08,390 --> 00:03:06,560
icing test facility ground test facility

58
00:03:11,190 --> 00:03:08,400
that would accurately and adequately

59
00:03:13,750 --> 00:03:11,200
duplicate natural icing conditions

60
00:03:16,630 --> 00:03:13,760
and you need to generate a cloud in that

61
00:03:18,869 --> 00:03:16,640
tunnel an icing cloud that simulates the

62
00:03:21,110 --> 00:03:18,879
right amount of liquid water content and

63
00:03:23,270 --> 00:03:21,120

droplet size distribution to be typical

64
00:03:24,790 --> 00:03:23,280
of those you might find in natural icing

65
00:03:27,190 --> 00:03:24,800
as well as you need to control the

66
00:03:28,710 --> 00:03:27,200
temperature of the airflow in the tunnel

67
00:03:30,789 --> 00:03:28,720
so again that you would be able to

68
00:03:33,110 --> 00:03:30,799
simulate accurate conditions that you

69
00:03:35,110 --> 00:03:33,120
would expect to see in flight it is not

70
00:03:37,030 --> 00:03:35,120
the weight of the ice on the various

71
00:03:38,070 --> 00:03:37,040
parts of the aircraft that causes the

72
00:03:40,949 --> 00:03:38,080
problem

73
00:03:43,750 --> 00:03:40,959
but the altered aerodynamics that change

74
00:03:46,550 --> 00:03:43,760
the performance stability and control

75
00:03:49,030 --> 00:03:46,560
characteristics of the airplane

76
00:03:50,789 --> 00:03:49,040
the ice forms may be small but they do

77
00:03:53,350 --> 00:03:50,799
have a significant effect on the

78
00:03:56,470 --> 00:03:53,360
airplane and its actions when ice

79
00:04:00,070 --> 00:03:56,480
secretes or grows on the surfaces of the

80
00:04:00,949 --> 00:04:00,080
airplane wings tails fuselage whatever

81
00:04:12,830 --> 00:04:00,959
the

82
00:04:14,789 --> 00:04:12,840
become severe enough

83
00:04:17,830 --> 00:04:14,799
the stability and control of the

84
00:04:19,830 --> 00:04:17,840
aircraft can be completely lost and your

85
00:04:22,790 --> 00:04:19,840
craft cannot be controlled

86
00:04:25,590 --> 00:04:22,800
the irt is similar to other subsonic

87
00:04:28,070 --> 00:04:25,600
wind tunnels in that a wing or other

88
00:04:30,870 --> 00:04:28,080

aircraft component when placed in the

89
00:04:32,310 --> 00:04:30,880
test section may be subjected to various

90
00:04:34,390 --> 00:04:32,320
air speeds

91
00:04:36,310 --> 00:04:34,400
the airflow being created by a motor

92
00:04:38,710 --> 00:04:36,320
driven fan

93
00:04:41,270 --> 00:04:38,720
the irt has several unique features to

94
00:04:43,830 --> 00:04:41,280
simulate icing conditions a heat

95
00:04:46,230 --> 00:04:43,840
exchanger and a refrigeration plant to

96
00:04:48,469 --> 00:04:46,240
achieve the desired temperature and a

97
00:04:50,870 --> 00:04:48,479
unique spray system to generate a cloud

98
00:04:52,230 --> 00:04:50,880
of microscopic droplets of unfrozen

99
00:04:54,150 --> 00:04:52,240
water

100
00:04:56,710 --> 00:04:54,160
this makes the irt capable of

101
00:04:59,430 --> 00:04:56,720
duplicating the icing conditions that an

102
00:05:02,550 --> 00:04:59,440
aircraft might encounter

103
00:05:05,030 --> 00:05:02,560
all aircraft whatever their size can be

104
00:05:07,189 --> 00:05:05,040
susceptible to icing

105
00:05:09,670 --> 00:05:07,199
general aviation aircraft can be more

106
00:05:11,749 --> 00:05:09,680
susceptible to icing because they have

107
00:05:16,550 --> 00:05:11,759
smaller wing sections

108
00:05:18,230 --> 00:05:16,560
ice at a faster rate than larger wing

109
00:05:20,950 --> 00:05:18,240
sections

110
00:05:23,670 --> 00:05:20,960
helicopters also have icing problems

111
00:05:25,990 --> 00:05:23,680
because helicopter rotors are small and

112
00:05:27,909 --> 00:05:26,000
are spinning at high speeds

113
00:05:30,469 --> 00:05:27,919

they therefore tend to build up ice

114
00:05:33,029 --> 00:05:30,479
quickly and it does not take long before

115
00:05:35,670 --> 00:05:33,039
you get some severe icing conditions on

116
00:05:37,830 --> 00:05:35,680
the helicopter rotor

117
00:05:39,270 --> 00:05:37,840
now dr shaw will tell us about

118
00:05:43,830 --> 00:05:39,280
anti-icing

119
00:05:45,590 --> 00:05:43,840
using some technique which prevents the

120
00:05:47,430 --> 00:05:45,600
buildup of ice that is when the water

121
00:05:49,270 --> 00:05:47,440
droplets hit the surface and

122
00:05:50,790 --> 00:05:49,280
of the airplane of course they're in the

123
00:05:53,909 --> 00:05:50,800
liquid state and they remain in the

124
00:05:55,830 --> 00:05:53,919
liquid state de-icing means that you

125
00:05:57,830 --> 00:05:55,840
allow the ice to grow that is you form

126
00:06:00,310 --> 00:05:57,840
an ice accretion or an ice growth and

127
00:06:02,710 --> 00:06:00,320
then you get rid of or de-ice

128
00:06:05,510 --> 00:06:02,720
that ice accretion before it it reaches

129
00:06:07,350 --> 00:06:05,520
a size that can significantly impact the

130
00:06:09,749 --> 00:06:07,360
aerodynamic performance and stability

131
00:06:12,550 --> 00:06:09,759
and control performance of that airplane

132
00:06:14,790 --> 00:06:12,560
in the 1970s the aircraft industry

133
00:06:17,590 --> 00:06:14,800
realized that there was a need for

134
00:06:21,270 --> 00:06:17,600
additional icing technology

135
00:06:24,230 --> 00:06:21,280
and nasa reinstituted an icing research

136
00:06:26,710 --> 00:06:24,240
program to meet the new icing technology

137
00:06:29,990 --> 00:06:26,720
needs which occur as a result of the

138
00:06:33,510 --> 00:06:30,000

ever-changing aircraft design problems

139
00:06:36,550 --> 00:06:33,520
from basically 1950 through 1957 when

140
00:06:39,110 --> 00:06:36,560
the knack or nasa program was concluded

141
00:06:41,350 --> 00:06:39,120
a tremendous icing technology database

142
00:06:42,710 --> 00:06:41,360
was developed and the technology being

143
00:06:44,870 --> 00:06:42,720
used today

144
00:06:47,350 --> 00:06:44,880
on today's aircraft came from largely

145
00:06:50,230 --> 00:06:47,360
from that program examples of that would

146
00:06:52,950 --> 00:06:50,240
be the hot gas anti-icing system that is

147
00:06:54,309 --> 00:06:52,960
used by all transports today for ice

148
00:06:56,710 --> 00:06:54,319
protection

149
00:06:59,510 --> 00:06:56,720
today about 90 percent of the smaller

150
00:07:02,710 --> 00:06:59,520
general aviation aircraft certified for

151
00:07:05,350 --> 00:07:02,720
flight into forecast icing conditions

152
00:07:06,950 --> 00:07:05,360
are using the pneumatic boot system for

153
00:07:09,589 --> 00:07:06,960
de-icing

154
00:07:11,350 --> 00:07:09,599
it was developed in the 1930s by the bf

155
00:07:13,510 --> 00:07:11,360
goodrich company

156
00:07:15,510 --> 00:07:13,520
the pneumatic boot is a rubber boot

157
00:07:16,950 --> 00:07:15,520
placed over the leading edge of the wing

158
00:07:19,510 --> 00:07:16,960
or tail

159
00:07:21,990 --> 00:07:19,520
when the ice secretes or grows a

160
00:07:25,350 --> 00:07:22,000
pneumatic air source is used to inflate

161
00:07:28,390 --> 00:07:25,360
the boot which destroys the ice aircraft

162
00:07:30,230 --> 00:07:28,400
surface bond to clean the surface of the

163
00:07:32,710 --> 00:07:30,240

craft

164
00:07:35,110 --> 00:07:32,720
the nasa lewis icing research tunnel was

165
00:07:39,589 --> 00:07:35,120
named an international historic

166
00:07:41,430 --> 00:07:39,599
mechanical engineering landmark in 1987.

167
00:07:43,589 --> 00:07:41,440
it is the oldest and largest

168
00:07:45,589 --> 00:07:43,599
refrigerated icing wind tunnel in the

169
00:07:47,110 --> 00:07:45,599
world

170
00:07:48,790 --> 00:07:47,120
two major achievements of this

171
00:07:51,189 --> 00:07:48,800
installation are the unique heat

172
00:07:54,230 --> 00:07:51,199
exchanger and the spray system that

173
00:07:55,430 --> 00:07:54,240
simulates a natural icing cloud of tiny

174
00:07:57,670 --> 00:07:55,440
droplets

175
00:08:00,230 --> 00:07:57,680
icing is no longer a major problem for

176
00:08:02,950 --> 00:08:00,240
many of today's aircraft because of the

177
00:08:04,950 --> 00:08:02,960
ice protection systems technology

178
00:08:08,070 --> 00:08:04,960
largely developed in the nasa lewis

179
00:08:10,390 --> 00:08:08,080
research center icing research tunnel

180
00:08:13,029 --> 00:08:10,400
as new aircraft are developed and

181
00:08:16,390 --> 00:08:13,039
operating practices are changed the

182
00:08:17,670 --> 00:08:16,400
recently modernized irt will continue to

183
00:08:20,230 --> 00:08:17,680
lead the way