

Spherical Near Field Radome Test Facility for Nose-Mounted Radomes of Commercial Traffic Aircraft

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This is not about football



This is about maintenance of nose-mounted radomes

Radomes typically get damaged by moisture entry, rain erosion, hail, bird and other impacts, lightning, static electricity, etc. etc.

Many aircraft maintenance facilities have a repair workshop for such damage

In many cases after-repair electromagnetic testing is required

This presentation describes an electromagnetic test facility for nose-mounted radomes



The big bird was stronger....



RTCA, Inc. is a private, not-for-profit corporation that develops consensus-based recommendations regarding communications, navigation, surveillance, and air traffic management (CNS/ATM) system issues. RTCA functions as a Federal Advisory Committee.

www.rtca.org

„after repair“ electromagnetic test requirements
are defined in

RTCA/DO-213
Component Maintenance Manuals

Test facility is based on Spherical Near Field antenna measurement technology

- Indoor, environmentally controlled
- Compact chamber (5.7 m x 5.2 m x 3.9 + 0.7 m)
- RF and positioner instrumentation inside chamber
- 200 mm pyramidal absorbers

Elevation Arm over Azimuth positioner system

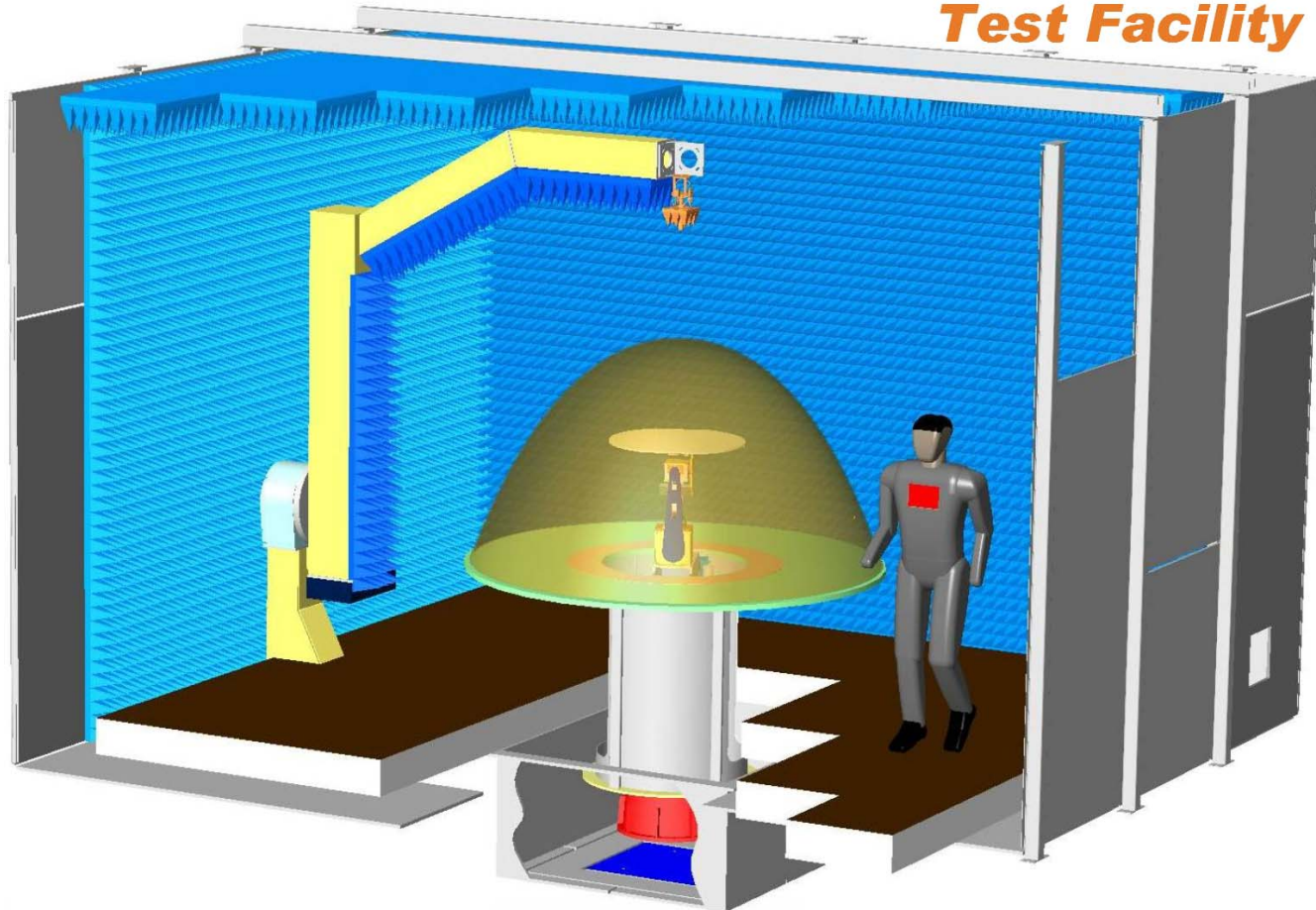
Azimuth: 30 rpm

Elevation: 2 sec / step

Electromagnetic Test Facility for Nose-mounted Radomes



Radom Transmission Test Facility



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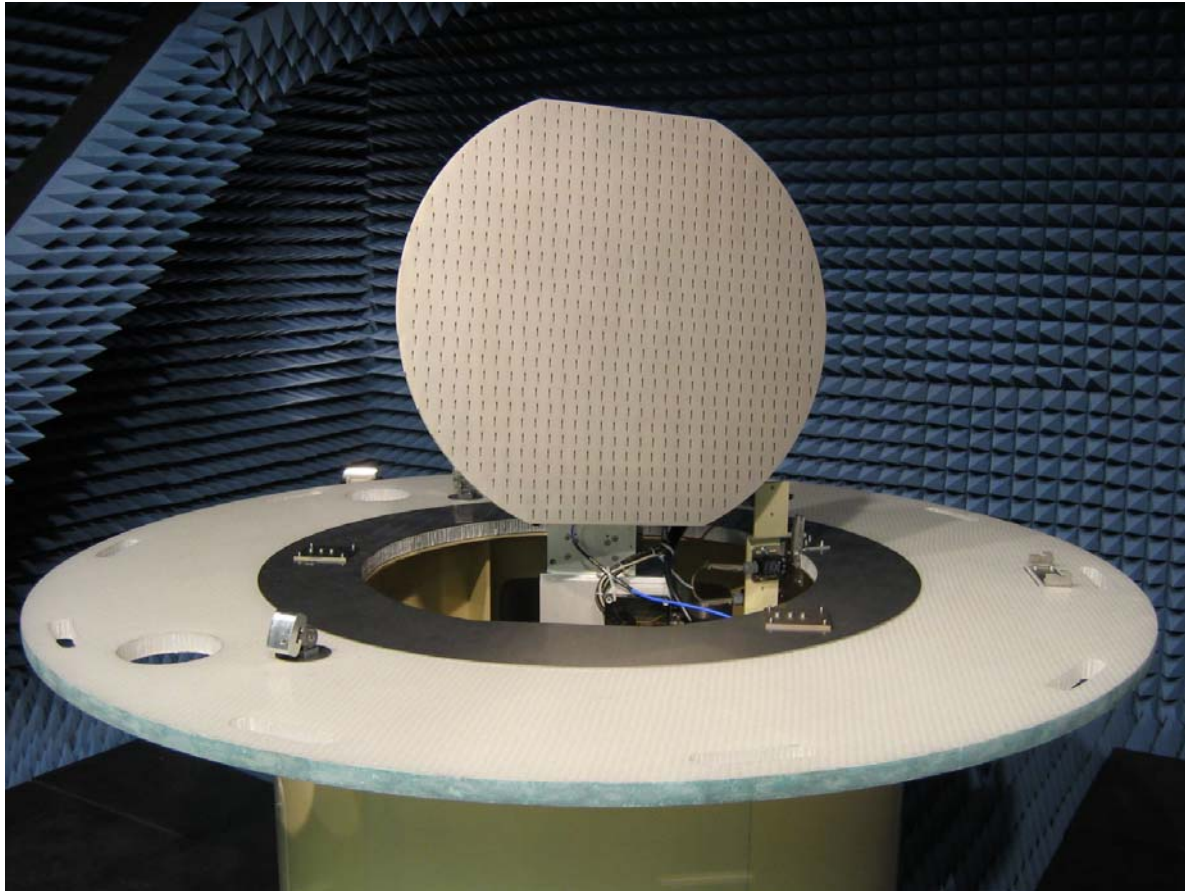
On Azimuth positioner (on / inside drum):

- Gimbal on vertical slide
- Azimuth ± 88 deg
- Elevation ± 33 deg
- $\frac{1}{4} \lambda$ slide in propagation direction

Radome dedicated mounting plate



Electromagnetic Test Facility for Nose-mounted Radomes



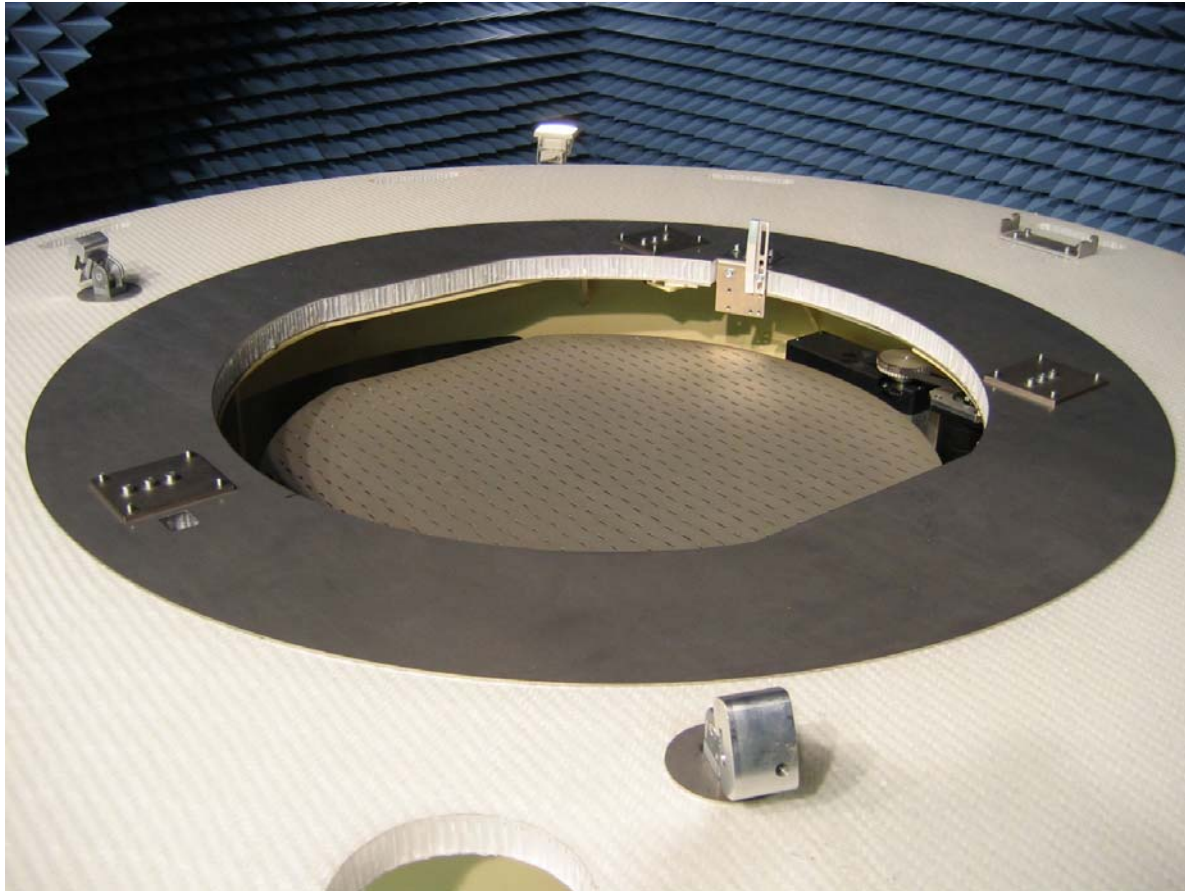
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Two antenna sizes: 30 inch and 12 inch

Each Radome type has its own mounting plate

Antenna lowered below radome interface
for easy installation

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Facility Test Capabilities

- a. Fully automated RTCA/DO-213 and CMM compliant measurements
- b. Customer specified sub-sets or angles

Test Sequence

- Power on facility
- Temperature stabilization
- Mount proper radar antenna
 - Enter test radome data



Test Sequence

- Select measurement type (RTCA or customer)
 - Execute reference measurement
 - Mount radome
 - Execute all radome measurements
(typically 2 x 45, runs unattended)
 - Dismount radome
 - Execute reference measurement



Test Results

► Transmission Efficiency Check:

Trans-mission [%]	Azimuth Angle [°]									
	-80	-60	-40	-20	0	20	40	60	80	
Elevation Angle [°]	-25	87,6	84,9	85,0	87,4	87,5	86,3	84,1	83,7	87,0
	-10	84,9	83,1	83,9	86,5	88,2	86,5	83,6	82,8	83,8
	0	85,7	84,4	85,0	86,6	88,5	86,2	84,8	84,4	85,0
	10	86,6	85,1	85,1	87,0	87,3	86,2	84,6	84,4	86,8
	25	85,8	84,5	85,3	86,7	86,0	86,6	83,9	84,2	86,8

Average Transmission [%]: 85,56
 Minimum Transmission [%]: 82,81
 Class: C

Test Results

► Transmission Efficiency Check:

Trans-mission [%]	Azimuth Angle [°]									
	-80	-60	-40	-20	0	20	40	60	80	
Elevation Angle [°]	-20	87,7	90,7	92,4	94,1	95,5	93,7	93,2	89,5	87,6
	-10	89,2	90,4	93,7	94,8	95,5	94,8	92,4	91,7	90,1
	0	91,3	91,7	93,4	94,7	95,4	94,1	92,7	92,2	92,0
	10	91,2	92,5	93,8	95,9	96,6	94,7	93,5	92,6	92,2
	20	89,6	91,2	92,9	94,5	96,4	95,5	94,1	91,9	89,7

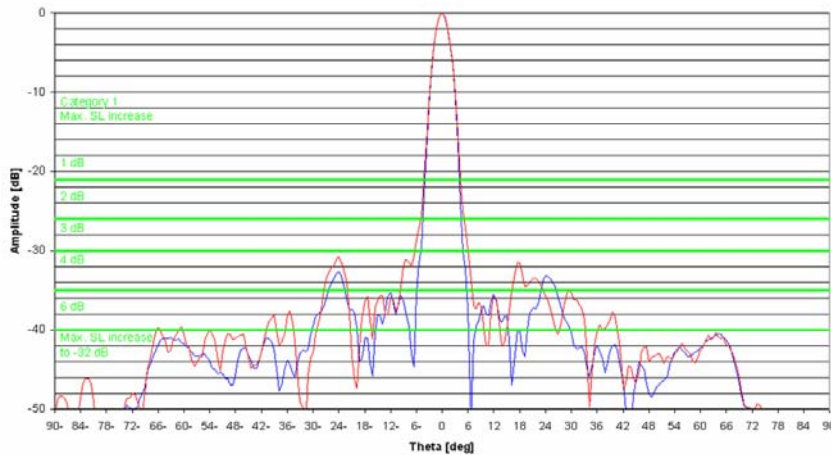
Average Transmission [%]: 92,73
 Minimum Transmission [%]: 87,56
 Class: A

Transmission Loss

Typical Kevlar radome

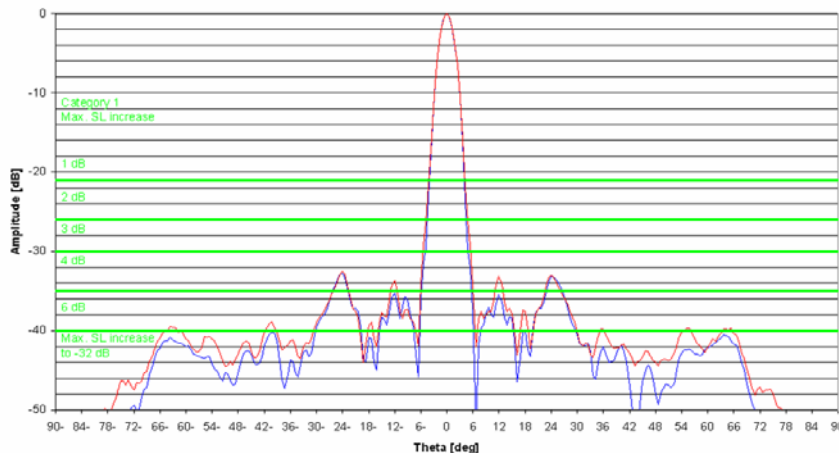
Typical quartz glass radome





Sidelobe Increase

Typical Kevlar radome



Typical quartz glass radome



Equipment Safety

Radar antenna lowered below
radome interface during mounting

Arm and probe at zenith during installation

Coded radome interface plates
controls gimbal height limit switch
„snap-in“ interface eliminates alignment

Radar antenna (30 or 12 inch) is only test equipment
which need to be changed



Personnel Safety

When door is opened, system stops automatically (30 rpm positioner!)

3 Emergency stop buttons

Very low door step

Shielded control window and web-video camera

Low RF power in shielded chamber

Equipment Repeatability and Stability

Gimbal angle

better ± 0.1 deg (± 0.02 dB or ± 0.5 %)

RF stability over full measurement

better ± 0.05 dB or ± 1 %

Test times

14 hours for B 747 radome

8 hours for DASH radome

Includes transmission loss and sidelobes increase test

Multiple probes will reduce test times

$1/n$



Conclusions

A very compact RTCA/DO-213 compliant „after repair“ RF test facility has been build and qualified.

The facility also allows Qualification and Production testing

Can be installed in repair workshop, and operated by workshop personnel

Allows for in-house immediate testing and thus reduces repair times significantly

