

# ANALYSIS OF CASING CHANGES: STYROFOAM VS PLASTIC CASING OF THE RS41

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DAN BREWER & JENNIFER DOVER

NWS STERLING FIELD SUPPORT CENTER

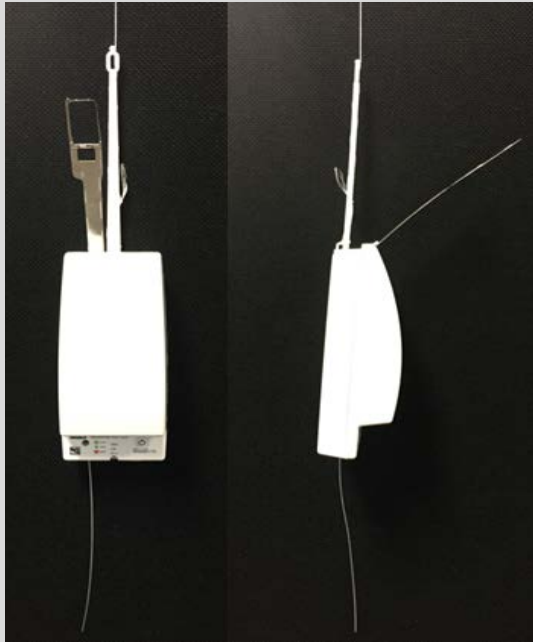




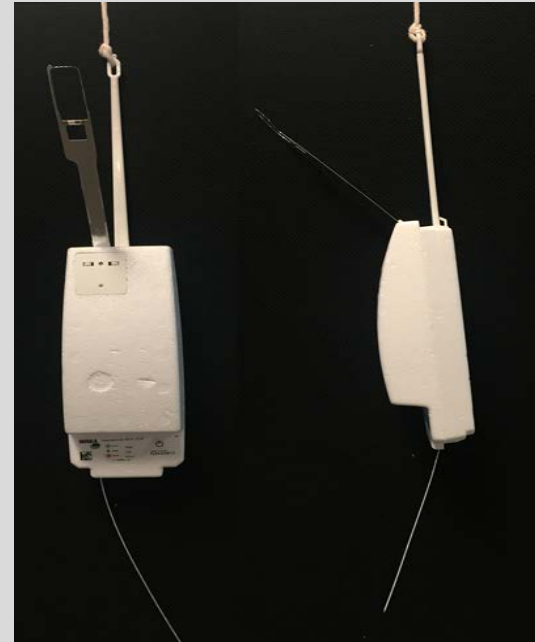
# OVERVIEW

- Motivation for Evaluation
- Evaluation Limitations
- Evaluation Areas
- Methodology
- Results

# PLASTIC & STYROFOAM RS41

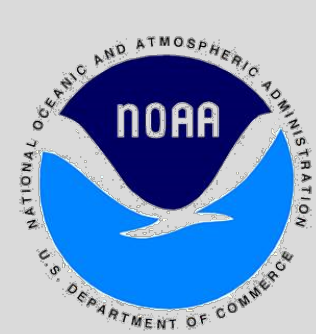


RS41 Plastic  
Weight ~100g



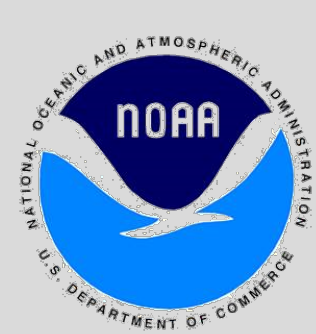
RS41 Soft and Light  
Expanded Polystyrene  
Weight ~80g

# MOTIVATION FOR EVALUATION



- **If an operational observing system is changed in part or in whole, the change must be tested**
- **Vaisala Autosonde with MW41 is being deployed to Alaska**
- **Autosonde was previously evaluated**
- **RS41 with plastic case analyzed by NWS in during short-term assessment in February 2017**
  - After assessment, Vaisala makes change to casing from plastic to Styrofoam for a lighter package. Changes limited to casing material.

# EVALUATION LIMITATIONS



- **Limited supplies of RS41 Soft & Light – Considerations for test:**
  - 2 vaisala ground systems (including Autosonde)
  - 70 Soft and Light radiosondes
    - Priority 1- Precision of measurement
    - Priority 2- Integration with Autosonde
    - Priority 3- Quality/Durability of casing
  - Sensors did not change
- **While RS41 was anticipated to go “operational”, it was not operational at time of test planning.**
  - Did not go through typical old vs. new testing

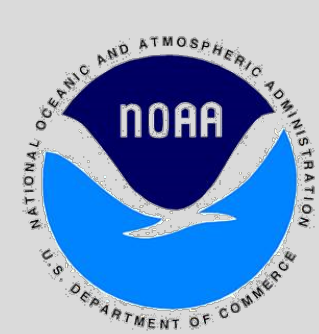


# EVALUATION AREAS

- **Quality of Manufacturing**
- **Simulated Environment Performance**
  - Environmental Spray Testing
- **In-flight Performance**
  - Precision
  - Intercomparison of Precision (plastic 41 vs. Styrofoam 41)
  - Intercomparison with operational radiosonde LMS6 (data not shown)
- **Performance with Autosonde**

# TEST OVERVIEW

1 OF 2



**Spray Test**

**Location: Sterling, Va**  
**# of Sondes: 9**

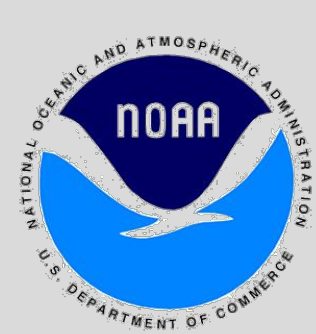


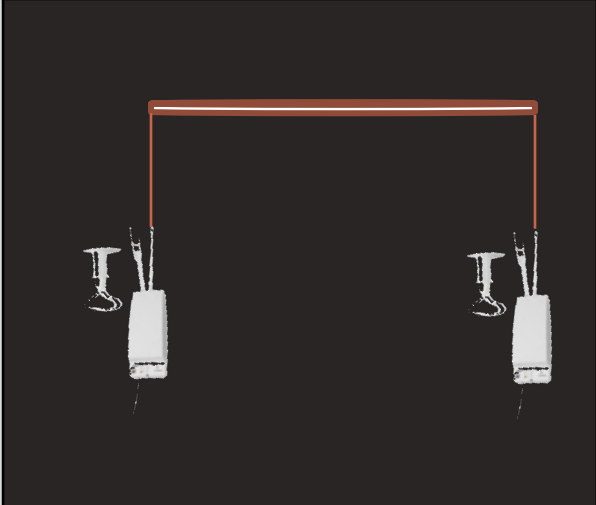
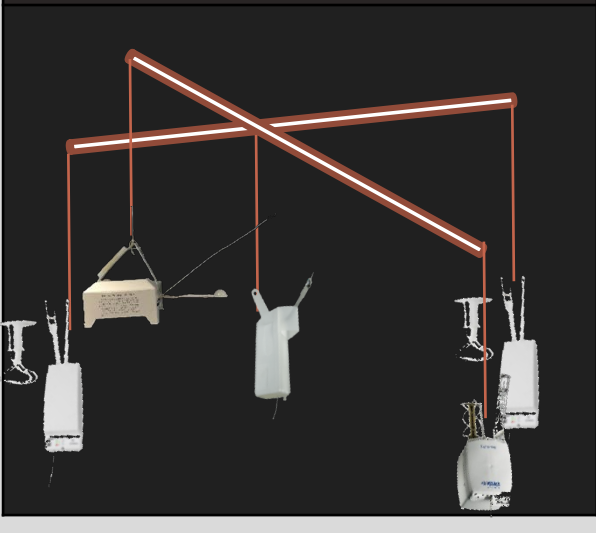
**Autosonde  
Integration  
Test**

**Vaisala AS15/MW41**  
**Location: Sterling, Va**  
**# of Sondes: 30**

# TEST OVERVIEW

2 OF 2



 A diagram showing a horizontal orange line representing a flight path. Two white sondes are suspended from the line by thin wires, positioned symmetrically on either side of the center.	<p><b>Precision Test</b></p>	<p><b>Precision of Soft &amp; Light</b> <b>Location: Sterling, Va</b> <b># of Sondes: 20 (Soft &amp; Light)</b> <b># of Flights: 10</b></p>
 A diagram showing a complex orange structure representing a flight path. It consists of multiple intersecting lines. Several white sondes and one white plastic RS41 are suspended from the structure at various points.	<p><b>Precision Inter-comparison Test</b></p>	<p><b>Precision of Soft &amp; Light (above) compared to precision of Plastic RS41</b> <b>Location: Wallops Island, Va (Plastic)</b> <b># of Sondes: 66 (Plastic)</b></p>

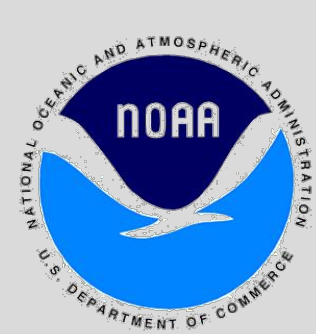


# QUALITY OF MANUFACTURING



- **No issues were found when considering the following:**
  - Proper packaging
  - Arrival in tact
  - Visual inspection before use
  - Lifting device (force of balloon pulling on radiosonde – 11kg)

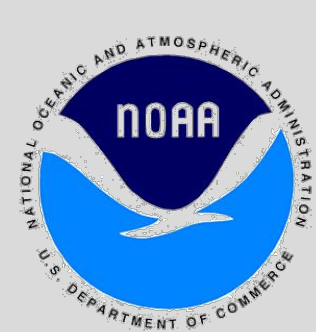
# ENVIRONMENTAL SPRAY TESTING



Test Type	“Flights”	RS41s Used
Spray-test	9	9

- **Purpose**
  - Moisture Intrusion
  - Performance of Temperature and Humidity Sensors
- **Spray Rate**
  - 10mm to 30mm per hour
- **Process**
  - Baselined
  - Placed in chamber after spray turned on
  - Radiosonde “released”
- **Test Completed when:**
  - RF stops transmitting for extended period of time
  - Software terminates flight due to missing data
  - Test duration >4 hours

# ENVIRONMENTAL SPRAY TESTING

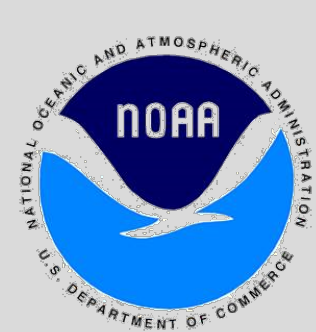


Test Type	“Flights”	RS41s Used
Spray-test	9	9

Profile (°F)	Date/Time	RH Sensor Failure	Unit Failure	Time On (s)
40° Steady	10/27 13Z	Y	N	63725
40° Steady	10/27 16Z	N	N	16332
40° Steady	10/31 12Z	Y	N	3450
60° Steady	11/13 19Z	N	N	14427
60° Steady	11/14 7Z	N	N	14605
40°↓20°	11/14 20Z	Y	N	14265
40°↓20°	11/15 12Z	Y	N	12186
30°↓20°	11/15 19Z	Y	N	16571
30°↓20°	11/16 11Z	Y	N	14432



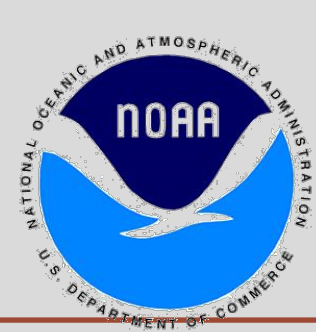
# IN-FLIGHT PERFORMANCE: PRECISION SOFT & LIGHT



Test Type	Flights	RS41s Used
Precision	10	20

Parameter	N	Minimum	Maximum	Mean	Std. Dev.	RMSD
Pressure	51664	-0.8	0.8	0.00	0.21	0.21
Temperature	51664	-1.9	1.1	-0.01	0.1	0.1
R.H.	25291	-15	25	0.05	0.74	0.74
Wind u/v	51664	-1.6/-3.3	3.9/2.8	0.01/0.0	0.13/0.15	0.14/0.15

# IN-FLIGHT PERFORMANCE: STYROFOAM VS PLASTIC PRECISION



Test Type	Flights	RS41s Used
Soft & Light	10	20
Plastic Case	33	66

Styrofoam

Parameter	N	Minimum	Maximum	Mean	Std. Dev.	RMSD
Pressure	51664	-0.8	0.8	0.00	0.21	0.21
Temperature	51664	-1.9	1.1	-0.01	0.1	0.1
R.H.	25291	-15	25	0.05	0.74	0.74
Wind u/v	51664	-1.6/-3.3	3.9/2.8	0.01/0.0	0.13/0.15	0.14/0.15

Plastic

Parameter	N	Minimum	Maximum	Mean	Std. Dev.	RMSD
Pressure	190608	-1.7	1.5	-0.05	0.27	0.27
Temperature	190608	-1.3	1	-0.01	0.12	0.12
R.H.	82294	-14	13	-0.12	0.91	0.91
Wind u/v	190608	-4.7/-2.6	3/3.7	0.01/-0.02	0.15/0.15	0.015/0.16

# IN-FLIGHT PERFORMANCE: PRECISION DAY VS NIGHT



Test Type	Flights	RS41s Used
Precision	10	20
Day	8	16
Night	2	4

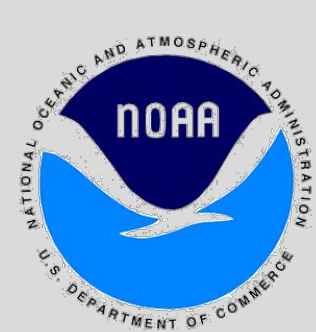
Styrofoam

Parameter	N	Minimum	Maximum	Mean	Std. Dev.	RMSD
Temp. Night	9364	-0.6	0.4	-0.03	0.10	0.11
Temp. Day	42300	-1.9	1.1	0.00	0.10	0.10

Plastic

Parameter	N	Minimum	Maximum	Mean	Std. Dev.	RMSD
Temp. Night	89068	-0.9	1	0.01	0.07	0.07
Temp. Day	101540	-1.3	0.9	-0.02	0.14	0.46

# PERFORMANCE WITH AUTOSONDE



Test Type	Flights	RS41s Used
Autosonde	30	30

- **29 Successful, 1 invalid flight**
- **Soft and Light: For a 600g balloon, average term height 33.6 km, average ascent rate: 314 m/min**
- **Plastic Case: For a 600g balloon, average term height: 29.1 km average ascent rate: 301 m/min**
- **No Gas Difference between plastic casing and Soft and Light flights**



# FUTURE PLANS

- **Direct Comparison of Soft & Light vs. Plastic Case (supply dependent)**
- **Spray testing with controlled aspiration**

**Thank you!**

**Questions:**

- [jennifer.dover@noaa.gov](mailto:jennifer.dover@noaa.gov)
- [james.fitzgibbon@noaa.gov](mailto:james.fitzgibbon@noaa.gov)
- [daniel.brewer@noaa.gov](mailto:daniel.brewer@noaa.gov)