Guide to Dual Flight Operations
Preparing & Releasing a Dual Flight Bar

Vaisala RS92-NGP® Sippican B2®

Upper Air Data Continuity Study

-DRAFT-

Prepared by
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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service/Office of Operational Systems
Field Systems Operations Center/Observing Systems Branch

ACRONYMS AND ABBREVIATIONS

TERMS	DEFINITION
BILS	Balloon Inflation Launch Shelter
CDU	Control Display Unit:
GPS	Global Positioning System
hPa.	Hectopascal
IF	Intermediate Frequency
KHz	Kilohertz
LOS	Line-Of-Sight
Mb	Millibar
PSI	Pounds Per Square Inch
IB	Inflation Building
MHz	Megahertz
MSL	Mean Sea Level
NCDC	National Climatic Data Center
NEC	National Electrical Code
NFPA	National Fire Protection Association
NOTAM	Notice to Airman
PITS	Protocol Interface Tests Suite
RF	Radio Frequency
RRS	Radiosonde Replacement System
RSOIS	Radiosonde Surface Observing Instrument System
RWS	RRS Workstation
SDM	Station Duty Manual
SPS	Signal Processing System
SPSS	Statistical Package for the Social Sciences
TRS	Telemetry Receiving System
UHF	Ultra High Frequency
UPS	Uninterruptible Power Source
UTC	Universal Time Code
WMO	World Meteorological Organization

1.0 Introduction

The Upper Air Data Continuity Study (DCS) is useful for investigating the relationship between climate variation and change due to measurement error. To replace the antiquated Microcomputer Automatic Radio-theodolite (MicroART), a system that has been in operation since the late 1980s, new Global Positioning System (GPS) radiosondes are being introduced. The NWS upper air network has witnessed a significant impact on operations from the implementation of these new GPS radiosondes due to sensor changes for temperature, pressure and relative humidity measurements. Because these have differing characteristics than other current radiosondes, the Data Continuity Study is pertinent in assessing the sensors in a variety of climatic and meteorological conditions.

The Data Continuity Study flight configuration will consist of flying two radiosondes on the same balloon during the 00z and 12z synoptic windows one day a week. The day that flights will occur will be left up to the site's discretion; however, once DCS flights begin, the site will continue with that scheduled day. These flights must be conducted as precisely as possible in order to accurately assess the sensors' behavior. The purpose of this document is therefore to guide observers through the steps to properly assemble and release a dual flight bar in order to complete an accurate and successful flight using the Vaisala RS92-NGP and Sippican B2 radiosondes.

2.0 Procedures

The following procedures detail the prescribed order of operations to be conducted when performing a dual flight. More specific instructions can be found in the *Guide to Dual Flight Operations Performance Checklist*.

1.) **Equipment Warm-Up**
Powering on UPS and other hardware to allow for warm-up operations
2.) **Balloon Inflation and Train Assembly**
Preparing balloon and train assembly for flight
3.) **Radiosonde Preparation**
Preparing radiosondes according to vendor documentation
4.) **Ground Equipment Preparation Procedures**
Completing hardware status checks, pre-observation information, instrument baseline and antenna positioning
5.) **Release Site Processes**
Final train preparations, obtaining launch approval, and possible repositioning of antenna
6.) **In-Flight Procedures**
Ensuring release was detected, monitoring the flight using displays and plots, transmitting messages
7.) **Archiving Flights**
Uploading compressed flight data to FTP site for NCDC

3.0 Instructions for Balloon Inflation and Train Assembly

Pre-observation procedures are an important component in successful upper-air operations. The care taken in preparing for an observation decreases the likelihood of having an unsuccessful or missed observation due defective parts or from using improper procedures. The observer should be aware of changing weather conditions that may affect the decision on train components used for the flight, the amount of gas, and release obstacles that may result from such conditions.

- Begin inflating an HM-32 Balloon
- Determine the additional weight needed for the dual flight depending on the present weather conditions and those expected at the time of release. The following chart can assist in determining this weight based on the prevailing weather type and intensity:

Precipitation		**Frozen Precipitation**	
Intensity	**Additional Weight (g)**	**Intensity**	**Additional Weight (g)**
Light Rain	1100-1300 g	Light Frozen	1200-1400 g
Moderate Rain	1300-1500 g	Moderate Frozen	1400-1500 g
Heavy Rain	1500-1800 g	Heavy Frozen	1700-1900 g
No Precipitation: 800-1000 g			

*** Use this table as a guideline for applying additional weight since ranges are heavily dependent upon location, temperature variations, and balloon manufacturing procedures. It is important to monitor the flight to ensure SFC-Term ascent rates of 250-350 m/min are being achieved.***

- To prepare the train using two parachutes, first tie a 7 foot length of double strand cord to the top of the first parachute, leaving free the other end. Repeat this step again, except tying the cord to the top of the second parachute. This cord should then be knotted securely to the bottom of the first parachute.

Figure 1. Tying parachutes together

Figure 2. Knot joining two parachutes

- Based on the wind conditions at release, adjust the remainder of the train so the total length meets standards as indicated below, securing the flight train to the bottom of the second parachute:

Wind Speed (knots)	Train Length (meters)	Train Length (feet)
0-5	37	120
5-10	27	90
>10	23	75

Note: The total train length (70-120 feet) is the distance extending from the balloon neck to the top of the flight bar. It does not describe the length from the bottom of the second parachute to the top of the flight bar.

***Trains less than the prescribed length should never be used since this increases the risk of the radiosonde being too close to the radiation environment of the balloon or of encountering the balloon's wake as it ascends. Erroneous data may result from these occurrences. ***

- Position and secure the flight bar on the RTS and tie the train assembly to the end of the string extending from the top of the bar.

Figure 3. Tying flight train to flight bar

Figure 4. Knot connecting flight train and flight bar

- **When Applicable:** Because the flight train is longer and larger in mass, two light sticks should be used for a dual release. Attach one light stick to the end of the second parachute with the small strings that extend from the knot. The second light stick should be tied to the bottom of the flight train where it is connected to the flight bar.

- Once the balloon has finished filling, complete the flight train and inspect tie points to ensure cord connections are tight.

Figure 5. Completed flight train

***Warning: Because some inflation bays are lower than others and additional weights increase its size, be mindful when filling the balloon and preparing it for release so that it does not touch the ceiling. This can puncture the balloon, creating a leak, or pop the balloon completely. ***

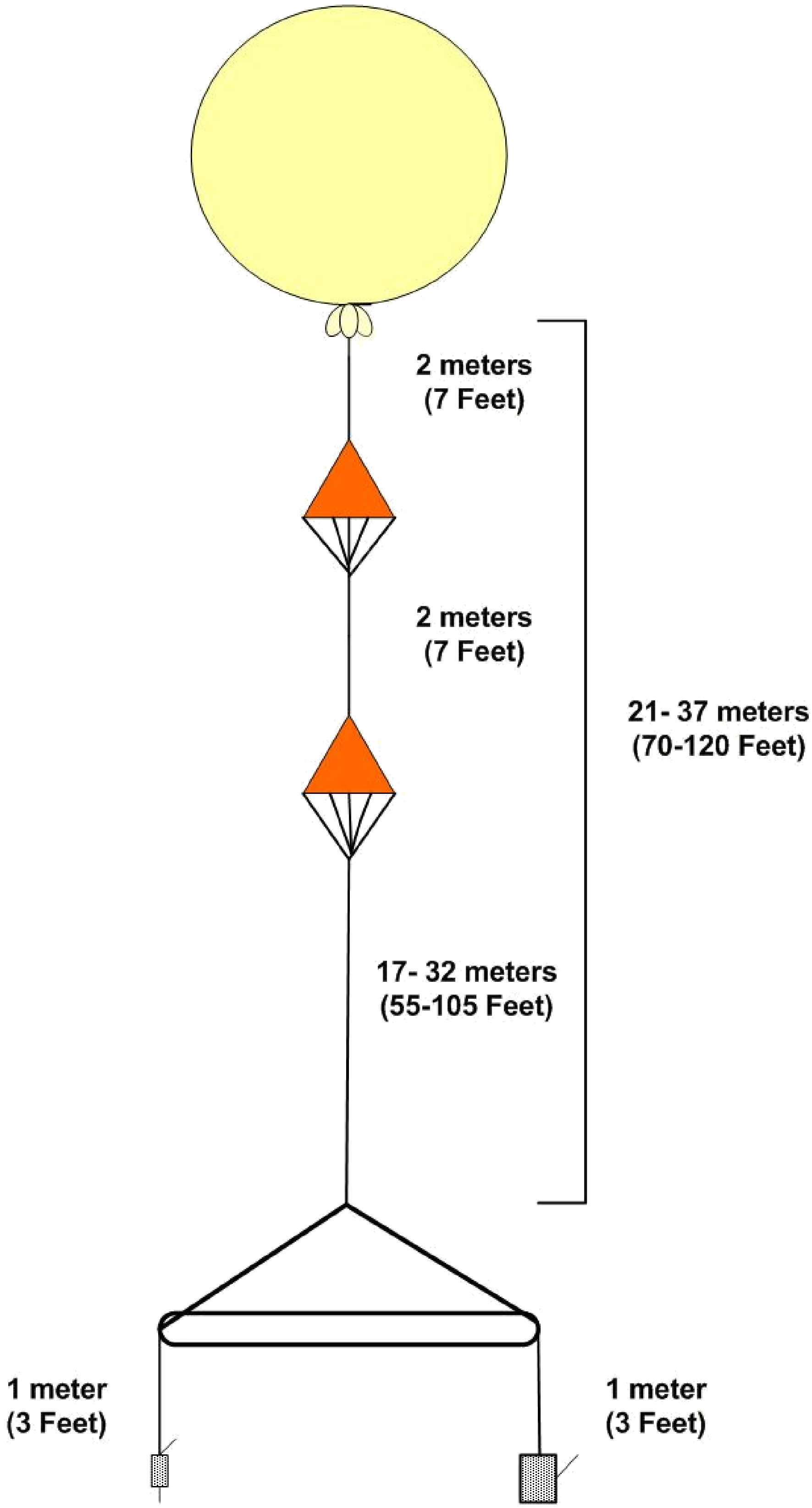

Figure 6. Schematic of flight train

3.1 Release Site Processes

- Upon arriving at the release site, tie the radiosondes to the assembled flight bar, first attaching the Vaisala RS92-NGP radiosonde to the string that has a knotted loop. The loop should be slipped through the gaps in the eyelet. Following this, the B2 radiosonde should be tied on to ensure that it hangs at the same height as the RS92-NGP. This enables the radiosondes to collect data at the same points and time, yielding a more reliable data comparison.

Figure 7. RS92-NGP on knotted loop on flight bar

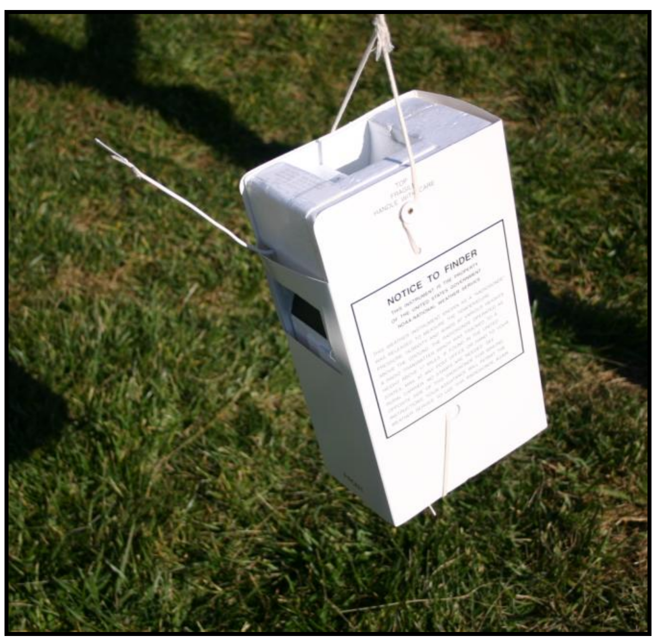

Figure 8. Sippican B2 tied to assembled flight bar

Figure 9. Flight bar with RS92-NGP and Sippican B2 radiosondes

- Visually inspect the release zone and the anticipated path of flight for any obstacles or dangers. Check the flight train's integrity and ensure radiosondes are secure on the flight bar.
- If within 5 nautical miles of an airport, call the airport control tower and request approval to release the balloon.
- While one observer releases the balloon, another observer should keep a loose grip on the flight bar, holding it above and away from their body. The bar will be lifted by the balloon out of the observer's hands. To prepare for release, the observer with the balloon should be facing the observer holding the bar. This will allow for better control of the flight bar when the balloon is released depending on dominant wind conditions.

Figure 10. Preparing for balloon release with flight bar

Figure 11. Release of flight bar

- After release, the observer can use the RCDU to verify the frequency has not shifted for the Vaisala RS92-NGP. Double check to ensure the antenna is positioned to the appropriate azimuth and elevation and that AFC is on. For the Sippican B2, open the remote release panel and turn up the speaker volume to check for a clean signal.

NWS Direct Field Support

The NWS Direct Field Support Help Desk serves to provide operational assistance to National Weather Service field personnel with questions that pertain with the operation of a new RWS system, including pre-flight and flight assistance during synoptic soundings. The Radiosonde Replacement System (RRS) Help Line assists users in order to ensure continuity in understanding of the RWS system and quality data collection among all operating deployment sites.

Hours of Operation
M-F 10:00-02:00 UTC

Contact
(301) 713-9800   (703) 661-1293