

NSRC Meteorological and Navigation (MetNav) User Guide

Ryan Bennett

Version: 0

2020-07-04

Table of Contents

- I. Introduction
- II. Supported Instrumentation

I. Introduction

The National Suborbital Research Center (NSRC) is a cooperative agreement between the NASA AMES Research Center Cooperative agreement for Research in Earth Science and Technology. NSRC supports mission science mission operations and aircraft deployments for Earth science research campaigns conducted by the NASA Airborne Science Program. NSRC provides payload integration engineering, data display and networking, and facility instrumentation for NASA's fleet of research aircraft. NSRC is also responsible for outreach activities for the Airborne Science Program, including the Student Airborne Research Program (SARP).

NSRC provides direct support for a suite of instrumentation across the Airborne Science research aircraft. Navigation and position, aircraft orientation, air data parameters, atmospheric meteorological state measurements, and 4K high definition video cameras are maintained on each of the platforms, with other instrument setups available upon request.

II. Supported Instrumentation

Instrument Name	Measurement Type	Parameter
Litton 251 Landmark-20*	Navigation	Latitude Longitude GPS Altitude Ground Speed
Litton 251	Orientation	True Heading Track Angle Roll Angle Pitch Angle
Aircraft Data Computer	Air Data Parameter	True Air Speed Indicated Air Speed Mach Number Static Pressure
Rosemount 102 fast	Atmospheric State	Total Air Temperature
Edgetech Vigilant A3	Atmospheric State	Dew Point
Heitronics KT-19.85II	Radiometric	IR Surface Temperature
MKS Baratron	Aircraft	Cabin Pressure
Samsung 4K camera	Video	Visual referencing

III. Instrument Data Sheets

- **Litton-251 (Landmark-20*)**
- **Aircraft Data Computer**
- **Rosemount 102-E4AL non-deiced (fast)**
- **Edgetech Vigilant A3**
- **Heitronics KT-19.85II**
- **MKS Baratron**
- **Samsung 4K cameras**

A. Litton-251 (Landmark-20/LaseRef IMU)

The Northrup-Grumman Litton 251 is a “completely integrated... navigation system with an embedded... GPS unit” that offers “superior navigation performance relative to other embedded Inertial Navigation System/Global Positioning System (INS/GPS) systems. GPS aided position quotes a measured accuracy of within 4 m spherical error probable, velocity accuracy to 0.015 m/sec, and attitude accuracy to 0.02 degrees. Aircraft maneuvers have been used to quantify and remove mounting biases present in attitude (true heading, pitch, roll angle) data. When data from the Litton-251 is not available, the aircraft GPS/IMU system is used.



B. Aircraft Data Computer

The NASA P3 aircraft data computer interfaces with the flight necessary instrumentation and produces output of air data parameters. The Sperry ADC unit provides measurements of air data parameters, such as static pressure, true air speed, indicated air speed, and mach number. NSRC does not currently have a native measurement or calibration for the aircraft static pressure measurement.

C. Rosemount 102-E4AL non-deiced (fast)

The Rosemount 102 type non-deiced probe is a platinum resistance to temperature detector (RTD) and is ideal for use during flight testing and meteorological studies where very fast temperature time response is critical. These probes physically sample the aircraft boundary layer. To account for the dynamic compression along the aircraft skin, this measurement must be reduced, using a function of aircraft mach number) to properly reflect the ambient air temperature. Noted weaknesses: liquid water ingestion during cumulus penetration, potential for ice accretion to block the sensor chassis.



102 Type Non-Deiced

MODEL 102 TYPE NON-DEICED

Total Temperature -70°C to +350°C

Speed To Mach 3

Altitude 0 to 100,000 feet

Open wire removable platinum resistance element with ice point resistance of 50Ω.

Inertial particle separation to minimize foreign object damage.

Designed for use during flight testing and meteorological studies where very fast time response is critical.

D. Edgetech Vigilant A3

The Edgetech Vigilant uses an optical (three-stage) chilled mirror to derive an ambient dew point from immersion sampling along the aircraft boundary layer. The A3 sensor allows for a depression of 65 deg C from an ambient temperature of 25 deg C. Both analog and serial RS232 outputs are available. Internal studies have determined that uncertainties in derived RH vary from 2% RH to greater than 5% RH, depending on environmental conditions (e.g. higher uncertainties where the dew point is decreasing quickly, and when the absolute dew point measurement is below a tolerance). This is due to intrinsic limits on the ability of the chilled mirror to cool quickly enough to match environmental conditions.



E. Heitronics KT-19.85II

The KT-19.85II infrared radiation thermometer unit is a nadir facing optical measuring unit with a spectral response in the 9.6-11.5 micrometer range, with a temperature retrieval range of -100 to 200 deg C. A single emissivity value ($\epsilon = 0.97$) is programmed in the derivation of surface temperature. Both analog and serial RS232 outputs are available.



E. MKS Baratron

The MKS Baratron is an absolute capacitance manometer consisting of a thin diaphragm that flexes as pressure changes, thus changing the capacitance between two electrodes. The 220D model is rated for an accuracy of 0.15% of the reading (over the full 1000 Torr scale) provided a warm up time of 4 hours.

