

Compass Rose Surveying, Inc.

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Compass Rose Survey Report

Magnetic Surveys
For a new Compass Rose
At Bremerton National Airport
Bremerton, Washington

April 2-9, 2018

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Certificate of Compass Calibration Pad

This report certifies that the new Compass Rose (CCP) at Bremerton National Airport **CONDITIONALLY** meets the requirements of the FAA AC 150/5300-13A, Appendix 6, dated 9/28/2012. The declination of the CCP was 15° 22' east on 9 April 2018. The range of declination over the pad is 16 minutes of arc. An FAA certified compass rose must have a maximum range of 30 minutes of arc (0.5 degree). Re-certification is required after construction or other changes near the CCP that may affect the magnetic properties of the site. The area marked 'NO CAL' must not be used for compass calibrations.

CCB LOCATION	BREMERTON NATIONAL AIRPORT
CCB SIZE	50-FOOT DIAMETER
CLASS OF CERTIFICATION	CONDITIONAL, No calibrations in area marked 'NO CAL'
DATE OF SURVEY	9 APRIL 2018
EXPIRATION DATE	9 APRIL 2023

Certified By:	Mr. Alan Berarducci
Title:	President and Geophysicist, Compass Rose Surveying, Inc.
Date:	13 April 2018

The instruments used for this certification are calibrated at the IAGA (International Association of Geomagnetism and Aeronomy) Instruments Workshop to US, International and IAGA standards. 5 and IAGA standards.

Magnetic Surveys for a new Compass Rose At Bremerton National Airport Bremerton, Washington April 2-9, 2018

Introduction

Bremerton national Airport contracted with Compass Rose Surveying, Inc. (CRS) to make magnetic surveys to find a location for a new compass rose. Several sites were checked. Once a good site was found, CRS certified, permanently marked and provided markings to indicate where to paint a new compass rose (compass calibration pad or CCP) at Bremerton national Airport. All work was done to the requirements of the FAA Advisory Circular (AC) 150/5300-13A, Appendix 6 dated 9/28/2012. Mr. Tim Mensonides, the Airport Manager, coordinated the survey and provided access to the site.

The airport chose four possible sites; Site 1, a small ramp pad near the south end of the main taxiway; Site 2, a run-up pad for Runway 2; Site 3, a run-up pad for Runway 20 and Site 4, an abandoned taxiway north of Runway 20. Compass Rose Surveying, Inc. visually evaluated the four sites and made preliminary magnetic surveys of all four sites. Sites 1 and 2 had numerous magnetic anomalies and were deemed not usable. Sites 3 and 4 had some buried magnetic materials but they were in limited areas and a compass rose could be sited at either location. The Airport preferred Site 3 so long as it could be near the south end of the pad. A comprehensive magnetic cleanliness survey and a declination survey were made of Site 3. **The remainder of this report is exclusively about Site 3.**

Equipment

- DI Flux magnetometers with Zeiss Jena 020 non-magnetic theodolites and DTU Model G fluxgate magnetometers. Absolute accuracy 6" of arc (0.1').
- GEM Systems GSM-19 total field magnetometer. Accuracy 0.1nT (nanoTesla).

Methods

- A Preliminary Magnetic Survey or Magnetic Cleanliness Survey is a total field magnetic survey made of the proposed compass rose site and surrounding area with a GEM Systems GSM-19. Measurements were made with the sensor 5.3 feet above the ground on 2.5-foot spacing over a 160-foot by 160-foot area. Further measurements were made on the cardinal headings every 5 feet out to 150 feet from the center and in other selected areas. Approximately 4400 total field measurements were made. The purpose of a preliminary survey is to be sure the area on, around and under the compass rose is magnetically clean. This survey can locate hidden or buried ferrous material.

- Declination Survey - A magnetic declination survey of the proposed compass rose and surrounding area was made with a calibrated DI Flux magnetometer. A grid pattern with 29 test points was laid out to cover the compass rose. Magnetic declination was measured at all 29 test points 57 inches above the ground and at several points at 36 inches above the ground. The measured values have been corrected by applying adjustments to eliminate effects of diurnal and irregular magnetic field variations. The purpose of this survey is to determine the average declination of the new compass rose and to be sure the magnetic declination meets the FAA AC requirement that declination not vary by more 30 minutes of arc over the compass rose. The DI Flux magnetometer is an absolute magnetometer and is certified every 2 years at the IAGA (International Association of Geomagnetism and Aeronomy) Instruments Workshop. IAGA is the World standard for magnetometers. The last instrument certification was September 2016 at Dourbes Magnetic Observatory in Belgium.

Results

- Preliminary Survey – The results of the total field magnetic survey show that within 25-feet of the center of the new compass rose the range of total field is 31nT (nanoTesla). The range within 80-feet of the center is 254nT. It is generally considered that if the range on a compass rose (painted area) is less than 150nT (FAA) and within 250nT in the area of a compass rose; the site is magnetically clean and will meet the FAA requirements. **This site meets the FAA requirements with the painted compass rose 25-foot radius (50-foot diameter). There is a point 30 feet east of the center of the CCP that makes the range 236nT. Extra declination measurements will be made in that area to determine the exact effect.**
- Declination Survey - **The results of the magnetic declination survey show that the range of magnetic declination within 25-feet of the center of the compass rose is 16 minutes of arc. At a point 30 feet east of the center, the site DOES NOT meet the FAA requirements for declination. Declination at that point creates a 41-minute range of declination, outside the 30 minute FAA requirement.**
- **However, if the CCP is limited to a 25-foot radius and clearly delineates and labels a “NO CAL” area on the east side of the CCP (as described to Ed Draper), the site will meet FAA requirements. The limitations listed above must be adhered to. The certification is conditional due to the proximity to an area that does not meet the requirements.** CRS carefully measured declination at 25 feet and 30 feet from the center and at lower heights above the ground (per the FAA AC) to know exactly where the CCP can be painted and still meet the FAA requirements. The measured value of magnetic declination over the painted CCP is 15° 22' East and is changing 9 minutes west per year. With the conditions described above, the new compass rose meets all FAA requirements for a certified compass rose.
- Details of the test grid layout and individual values of the corrected magnetic declination at the test and auxiliary stations are shown on the magnetic survey drawing included with this report.

Location

- The compass rose is located at coordinates 47° 29' 50.1" North and 122° 45' 35.1" West. It is on a run-up pad near the threshold of Runway 20. Compass Rose Surveying, Inc. measured the location with a hand-held GPS. An aluminum survey marker stamped "COMPASS ROSE" marks the center of the compass rose.
- Bronze 1" survey markers stamped "True North" and "True South" are located approximately 70 feet from the center point and should be marked with paint as NT and ST.
- Compass Rose Surveying, Inc. determined the true azimuth of the objects given below from the center of the compass rose by making solar observations. The true azimuths are measured from north around by east.

True North marker	0° 0.0'
Temporary C stake	213° 03.8'
True South marker	180° 0.0'

Compass Rose Radial Lines

The FAA AC recommends that a compass rose be marked with 12 magnetic calibration stripes radiating from the center of the compass rose and that each be marked with its magnetic heading. The magnetic calibration stripes are marked to be painted at 15° 22' East, the current value of declination. The marks are a small drill hole in the pavement approximately 29 feet from the center of the CCP. The holes are ringed in red paint and have the magnetic heading labeled above them. We recommend that the radials begin approximately 12-18 inches from the center point to avoid a mass of paint at the center. **The radials can extend only 25 feet from the center point.**

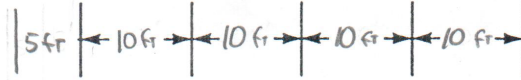
Conditional Certification

A magnetically anomalous area beginning 30 feet east of the center will have a north-south line and angled lines marked as 'NO CAL'. The site meets the FAA requirements so long as the compass is NOT IN the area marked 'NO CAL'.

Magnetic Survey and report by:

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MAGNETIC SURVEY OF COMPASS SWING AREA

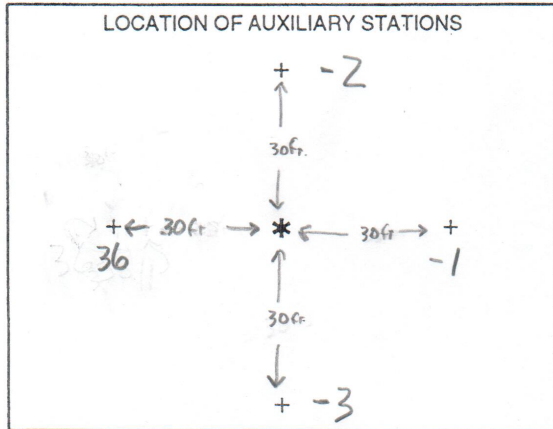


↑ 10 ft	+	+	+	+	+
+	5	-2	-3	-1	-2
↓ 10 ft	+	+	+	+	+
+	3	0	-2	0	-2
↓ 10 ft	+	+	*	+	+
+	3	-1	-2	-1	-2
↑ 10 ft	+	+	+	+	+
+	2	-1	-5	0	-1
↓ 10 ft	+	+	+	+	+
+	1	0	-4	-1	-2

↻ 11
at 25 ft



Bremerton National Airport
Bremerton, WA



Declination = 15° 22' east
plus/minus minute values shown

DECLINATION within 25 ft.
Maximum 15° 33' east
Minimum 15° 17' east
Mean 15° 22' east
Annual Change 9 min. west

* = Center of Rose

Date 9 April 2018