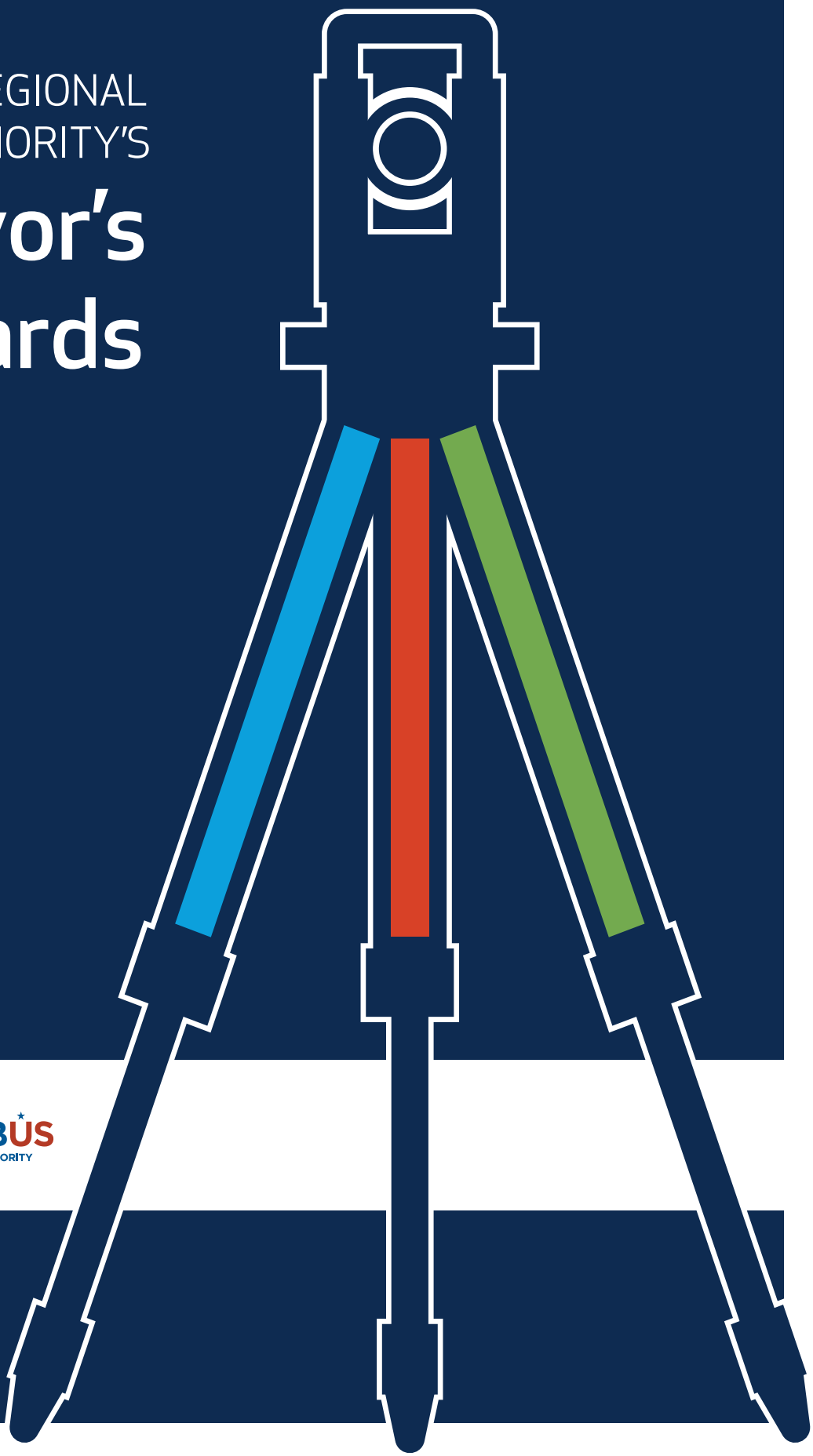
COLUMBUS REGIONAL AIRPORT AUTHORITY'S

Surveyor's Standards



COLUMBUS
REGIONAL AIRPORT AUTHORITY

FEBRUARY 2018

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SECTION 1: INTRODUCTION

This section is designed to aid in navigating the vast information that is needed and must be utilized by the contractor when performing general surveying tasks for the Columbus Regional Airport Authority (CRAA). The procedures developed by CRAA should be employed to the greatest extent possible and are mandatory for all airside AIP funded survey activities.

Definitions

There are many acronyms and terms that are specific to the airport environment. Having a working knowledge or access to a tabulated reference that can be accessed in the field of these terms and definitions will assist in providing a safe and confusion free airside survey mission. It is highly advised that the contractor review and have a hard copy of FAA Advisory Circular 150/5300-18B (or the most recent published version) readily available, found in the Appendix is a complete Glossary and Acronym and Word Phrase list that encompasses most situations that will be encountered on the airfield. Refer to the "Reference Documentation" below to locate the Advisory Circular.

Points of Contact (POC)

The contractor shall review the proposed work plan with the Project Manager in charge of the project and verify the points of contact for the work effort. Contacts may vary depending upon the location and type of work performed.

For questions related to the CRAA survey program, contact:

Raymond Fridley, P.E.
4600 International Gateway
Columbus, OH 43219
614.239.3040-office
330.240.5144-mobile
rfridley@ColumbusAirports.com

Contacts for work at each airport will be identified at the project kick-off meeting.

Reference Documentation

All work on the CRAA airports must be related to the following documentation; accuracies and specifications were methodically documented to ensure a systematic, repeatable and precise survey:

- Federal Aviation Administration. *Advisory Circular:* General Guidance and Specifications for Aeronautical Surveys: Establishment of Geodetic Control and Submission to the National Geodetic Survey. AC No. 150/5300-16A (or the most recent published version). Washington: February 13, 2006. **Herein referred to as AC-16A.**

- Federal Aviation Administration. *Advisory Circular:* General Guidance and Specifications for Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System (GIS) Standards. AC No. 150/5300-18B (or the most recent published version). Washington: May 21, 2009 with Change 1 on February 2, 2014. **Herein referred to as AC-18B, Change 1.**

- Federal Geodetic Control Committee: Standards and Specifications for Geodetic Control Networks. Rockville, Maryland: September 1984. **Herein referred to as FGCC Specifications.**

- The State of Ohio: Ohio Revised Code. Effective date through December 31, 2008. **Herein referred to as ORC.**

- The State of Ohio: Ohio Administrative Code. Effective date through May, 1 2009. **Herein referred to as OAC.**

These sources above change without notice please access these websites periodically to ensure that the latest specifications are being met.

FAA Advisory Circulars

https://airports-gis.faa.gov/airportsgis/public/surveyors_intro.jsp

FGCC Specifications

http://www.ngs.noaa.gov/FGCS/tech_pub/1984-stds-specs-geodetic-control-networks.htm

Ohio Codes

http://codes.ohio.gov/

SECTION 2: SURVEY REFERENCES

The consultant shall furnish all labor, supervision, materials, transportation, and equipment necessary for the completion of the requested survey services. CRAA may specify the order of accuracy required for each individual project if different from those required under the referenced standards. Unless CRAA specifies specific equipment or survey type, the consultant shall choose the proper equipment and procedures to meet the required accuracy.

These specifications are intended to insure the precision and accuracy necessary to obtain orders of accuracy and levels of certainty proposed by CRAA. In special circumstances, specific requirements may be modified to accommodate control networks other than the existing Airport control. These modifications will be done in conjunction with CRAA and using appropriate network design techniques.

Survey Datums **(Updated February 2018)

For all engineering and construction surveys at the CRAA airports the surveys must be referenced to the following datums:

Horizontal**

Horizontal datum is defined to the North American Datum of 1983 refined to the 2011 adjustment, most commonly known as NAD83(2011), Epoch 2010.00.

Vertical

Vertical datum is defined to the North American Vertical Datum of 1988, most commonly referred to as NAVD88.

Geoid**

The nationally recognized geoid for the conus North America is Geoid 2012B, most commonly referred to as Geoid12B.

Reference Control

At all three CRAA airports (CMH, LCK and TZR) there are a large number of existing survey control marks established through previous surveying and engineering projects. These existing control marks are classified as **valueless** unless there is a direct survey tie (current or historical) to the Primary and Secondary Airport Control Stations (PACS and SACS respectively). Procedures for meeting this requirement are found in detail in Section 3 of this procedure manual. The PACS and SACS are NGS published National Spatial Reference System (NSRS) control marks that were established following AC-16A (or the most recent published version) specifications.

All surveying projects for the benefit of the CRAA must initiate from the PACS and SACS. As stated above, any existing control marks are deemed inaccurate and valueless unless positioned directly from the PACS and SACS. If uncertain about a monument, check with the CRAA CAD/GIS Department for clarification.

To assist the survey, construction and engineering community the CRAA engineering group has implemented a Real-Time Kinematic (RTK) GPS Reference Station (RS) at CMH to help facilitate RTK GPS surveys at CMH. The RS was established following AC-16A (or the most recent published version) guidelines with a direct GPS tie to the PACS and SACS at CMH. For a concise list of NSRS geodetic control at any of the CRAA airports please reference the NGS datasheet retrieval site at https://geodesy.noaa.gov/AERO/aero.html. For access to the CRAA GPS Reference Station, contact the CRAA Project Manager.

In addition to the NSRS control at CMH there also exists resurveyed control marks scattered airside and landside. The resurvey of these marks was commissioned by the CRAA engineering department for the benefit of the surveying, construction and engineering community associated with projects related to CMH. For a complete list of coordinates and sketches please contact the POC at CMH.

SECTION 3: SURVEY EQUIPMENT

Survey work at any of the CRAA airports is not equipment specific. Virtually all survey equipment manufactures equipment can be utilized. With respect to receiving the CRAA GPS RS corrections, Trimble Navigation (of Sunnyvale California) RTK GPS rover must be coupled to a cellular modem equipped to accept CDMA cellular GPS corrections.

Equipment Maintenance

All equipment that is to be used on a CRAA project must have the corresponding maintenance logs which have the documented routine maintenance of the electronic and optical equipment. Following the best practices of a competent surveyor, reports of periodic equipment calibration verification must also be readily available. Requests for this information are at the discretion of the CRAA POC or other CRAA personnel.

To ensure that total stations are meeting angular and distance accuracies stated by the equipment manufacturer it is recommended to periodically validate the equipment at the NGS designated Calibration Base Line (CBL). Sites can be identified at the following internet link http://www.ngs.noaa.gov/CBLINES/calibration.shtml where public access has been made to aid in the ease of use of these CBL locations. All other equipment maintenance recommended by each manufacture should be followed.

Equipment Type

RTK GPS

RTK GPS receivers with data controller capable of receiving corrections from a known base station should be utilized when access to the CRAA RS is not feasible or equipment constraints restrict data access. The RTK GPS base station should be erected over a PACS, SACS or other control mark established from said PACS/SACS and broadcast the GPS correction based on the known coordinate of the control mark being utilized. Once initialization is made, whether from the CRAA RS or other ground based RTK GPS base station, a known geodetic control station must be observed with the RTK Rover and the position must be verified within a nominal tolerance to confirm a successful initialization. RTK GPS surveys should be utilized when horizontal and vertical positions of 0.05 of a foot or less accuracy are required and horizontal obstructions are at a minimum.

Note: Prior to any survey execution, the survey contractor will check the identified airport reference monuments to ensure that the monuments are correct. If the reference control monuments do not comply with CRAA accuracy requirements, then the survey contractor will stop survey execution, and notify the CRAA project representative to resolve the discrepancy.

Static GPS Receiver

For Static GPS surveys, only Static GPS receiver of geodetic quality capable of receiving multiple frequency GPS data will be utilized. The minimum session observation will be 15 minutes or more of continuous data. This time is dependent on the relative distance between corresponding static GPS receivers. The trivial and non-trivial baselines need to be processed and a least-squares adjusted must be performed in accordance with FGCS Specifications using the manufacturers corresponding GPS vector processing software. This survey type is commonly required when surveys of higher accuracy or surveys generating long GPS vectors are required. Data from the CMH reference station may be made available for use during static surveys. Contractor should contact the CRAA CAD/GIS Department at least 48 hours prior to commencing observations to request that data files be preserved for use in the project.

Electronic Total Station

An Electronic Total Station of an angular accuracy of 5-arcseconds or better will be utilized for surveys requiring traditional methods to achieve an accuracy of 0.03 of a foot or better. During each setup the reference geodetic control station distance (backsight) must be checked and verified and if possible a second reference geodetic control station should be observed to verify that the backsight observation had been successfully performed on the correct geodetic control stations.

Differential Level

An automatic differential level of 0.1-mm accuracy or better will be utilized when accuracies of greater that 0.02 of a foot is needed to be performed for construction staking or geodetic control point establishment. The level circuit must start on a PACS, SACS or CRAA published geodetic control station, attention should be paid to balancing the foresights and backsights leading back to the original geodetic control station or an additional PACS, SACS or CRAA published geodetic control station.

SECTION 4: SURVEY ACCURACIES AND STANDARDS

Prior to any field activities, the Surveyor shall coordinate all field work through the airport POC responsible for the project where work will be performed. Prior to any work beginning, the Surveyor shall meet with the CRAA site representative(s) responsible for the site where work will be performed to review and resolve any issues (safety, work authorizations, badges, escorts, etc.), and review the execution plan.

All survey activities performed for geodetic control and engineering purposes must meet the accuracies listed below.

Boundary Surveys

The Surveyor shall perform a legal boundary survey, locate existing property corners if necessary, and produce a survey plat in compliance with any applicable governmental codes or requirements. The Surveyor shall perform the necessary research to provide location for all easements and right-of-ways within the property being surveyed.

All boundary survey performed on the airport properties will follow, at a minimum, the Minimum Standards for Boundary Surveys in the State of Ohio as defined in Ohio Administrative Code Chapter 4733-37 and the conveyance requirements for the county that the property is located in.

Topographic and As-Built Surveys

The Surveyor shall develop complete topographic information within the limits shown on the design drawings. Complete topographic information includes, but is not limited to, the horizontal and vertical location and description of all surface features. Unless a specific grid interval is called for on the design drawings or in the contract documents, a 50 foot spacing with high points, low points and ground break points will be the minimum requirements to develop sufficient ground surface elevations to create the specified contours.

The Surveyor shall meet the following tolerances for all topographic survey measurements unless otherwise specified in other standards/specifications as listed:

- Ground feature – Accuracy of 0.10’ and displayed at 0.05’
- Hard surface features and structures – Accuracy of 0.02’ and displayed at 0.01’
- Utility rim and invert – Accuracy of 0.02’ and displayed at 0.01’
- Contour interval of 1.0’
- ASCM/ASTM SUE Level C - Utility locations are a minimum requirement, Level B and Level A information may be required for specific situations

Horizontal Control Points Surveys

The accuracy of horizontal measurements for the purpose of establishing horizontal control shall meet the requirements of a Second-order, Class 1 classification, as defined by "Standards and Specifications for Geodetic Control Networks" (FGCC Table 2.1). Otherwise if a more precise survey is required, NGS Standard Guidelines will be followed for geodetic and control surveys.

Vertical Control Points Surveys

The accuracy of vertical measurements for the purpose of establishing vertical control shall meet the requirements of a Third-order classification, as defined by "Standards and Specifications for Geodetic Control Networks" (FGCC Table 2.2). For a typical project, a vertical control survey must be referenced to at least two published vertical control stations and have a differential level circuit closure of 0.05' or better.

Construction Surveys

All site features will be staked with the following accuracies

- Ground feature – Accuracy of 0.10' and displayed at 0.05'
- Hard surface features and structures – Accuracy of 0.02' and displayed at 0.01'
- Utility rim and invert – Accuracy of 0.02' and displayed at 0.01'

SECTION 5: QUALITY CONTROL/QUALITY ASSURANCE

To ensure that all surveys are consistent and meet the accuracy requirements described in AC-18B, ORC and OAC the following requirements must be met.

Quality Control

All RTK GPS surveys must show a quality check into a PACS, SACS or other CRAA published geodetic control station. Multiple observations throughout the day should be made and documented. A tabular result should be documented to ensure that all survey coordinates collected for the day meet the accuracy requirements for all RTK GPS survey operations.

When collecting static GPS data it is recommended that the data is either validated or checked for integrity reasons through either the NGS Online Positioning User Service (OPUS) or through the UNAVCO free pre-processing GNSS data toolkit. Both options are easily accessible at the following internet websites.

OPUS – http://www.ngs.noaa.gov/OPUS/
Teqc – http://www.unavco.org/software/data-processing/teqc/teqc.html

Quality Assurance

All surveys performed at the airport facilities will be performed under the direct supervision of a Licensed Professional Surveyor registered in the State of Ohio.

All surveys performed at the airport facilities will list the horizontal and vertical control stations that the surveys are reference to. All topographic surveys will establish, at a minimum two horizontal control stations, that meet the standards for monuments OAC 4733-37-03, and two temporary benchmarks and will have their positions published to 0.01' accuracy.

Topographic and boundary surveys will be signed and sealed by a Licensed Professional Surveyor registered in the State of Ohio.

SECTION 6: SURVEY MARK MAINTENANCE

To assist the CRAA with maintaining the current geodetic control mark network and database and to help the surveying community, mark maintenance is an essential component to preserving our localized control network.

If applicable, the Surveyor shall install new temporary and permanent bench marks and monuments for further densification to be used for horizontal and vertical control at the airport as required. The locations of bench marks and monuments to be installed shall be specified on the contract documents. The surveyor shall submit a drawing outlining their proposed bench mark(s) and monument(s) construction with the layout plan. Permanent and temporary benchmarks and monuments will have a permanent reference point that has been centered punch on the bench mark and monument to indicate the precise coordinate location. The Surveyor shall furnish the following information for each bench mark and monument installed:

- Date of survey
- Identification number
- CAD Sketch of surrounding features
- Reference ties
- Horizontal location established on state plane grid system
- Elevation relative to the airport datum

Below is a list of tasks that should be completed and delivered to the CRAA in the final report as described in the deliverable section, see next section.

- FAA Control Station Recovery Form as described in AC-16A.
- Removal of debris around control station, including weeds and tall grass.
- Notification of CRAA of control point discrepancies, including destroyed control stations and coordinate confliction
- System messages broadcasted from the CRAA RS.
- Impending destruction or impact of existing control marks. (A new structure that impact the GPS quality of a monument as an example)
- Updating the NSRS control station database for all NGS published control stations, the Mark Recovery Entry can be done via the NGS recommended "DSWorld" free software or at this internet website https://www.ngs.noaa.gov/cgi-bin/recvy_entry_www.prl

SECTION 7: DELIVERABLES

There are many different types of deliverables that the CRAA may expect. The deliverable type is dependent on the type of survey project that is being performed. This section describes each type of deliverable and the required data and metadata that must be delivered and how this information is to be assembled. The majority will be delivered in both "hard copy" and AutoCAD format. Confirm with the CRAA CAD/GIS Department on version of AutoCAD to use for submission.

Airport Improvement Program (AIP)

All AIP projects must follow the deliverable standards that are stated in AC-18B (or the most recent published version). The comprehensive chart found on page 24 -25 will assist with the type of project, data types and what information is needed.

The delivery system for information collected for an AIP funded project must be through the FAA Airport's GIS (AGIS) system. All information that is delivered to the AGIS system must meet FAA and NGS expectations, complete validated data, clear photographs, thorough sketches and complete observation log sheets are but a few of the many items that must be completed and delivered. Please access the AGIS site for the complete list forms that have been derived for AIP projects.

Engineering Project

Survey drawings and documents such as property line surveys, boundary surveys, and easement surveys that will be filed with appropriate government agencies shall be certified with the seal and signature of the licensed surveyor responsible. All topographical surveys will also be signed by a licensed professional surveyor and submitted to the engineering project manager responsible for the design project.

Geodetic Control Project

If performing a geodetic control project for the CRAA the contractor should follow the specifications and deliverables outlined in AC-16A (or the most recent published version). At a minimum a final report that contains the following should be included:

- Summary of project, listing location and general scope of work completed
- List of all field personnel and data processor involved with the project
- List of equipment and data processing software used
- Final coordinate listing
- Final sketch of survey control station, including station witness ties and final adjusted coordinates
- Photographs of survey control station, meeting guidelines listed in AC-16A
- Data processing and adjustment results; showing fixed survey control used, residual values and a narrative of problems or issues with outlying results
- Quality Assurance and Quality Control data results

The CRAA will request that a complete station sketch be completed using the template that has been derived for all geodetic control survey projects, this form is available upon request from the CMH POC.