UNITED NATIONS
ECONOMIC
AND
SOCIAL COUNCIL

Distr.
LIMITED
E/CN.14/CART/137
30 June 1965
Original: ENGLISH

ECONOMIC COMMISSION FOR AFRICA
Meeting of Experts on Joint Centres
For Specialized Services in Surveying
and Mapping
Addis Ababa. 30 June - 10 July 1965

CHECKING, CALIBRATION AND MAINTENANCE OF PHOTOGRAMMETRIC INSTRUMENTS

Contribution from the Government of the United States of America

(Technical paper for information)

65-2360

E/CN.14/CART/137

CHECKING, CALIBRATION AND MAINTENANCE OF PHOTOGRAMMETRIC INSTRUMENTS

by

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The coastal mapping program of the U.S. Coast and Geodetic Survey requires the use of the most modern photogrammetric cameras, photographic printers, stereoscopic plotters, comparators, and stereoscopic compilation instrumentation. Requirements for infrared and color as well as panchoromatic aerial photography and super-wide (120°) as well as conventional wide-angle photography are only attainable through the use of high precision cameras and direct viewing stereoplotters which require factory trained personnel for the replacement of worn parts. In order to keep costly and time-consuming maintenance by factory experts at a minimum, the Bureau has installed suitable environmental control, adopted routine instrument cleaning and oiling procedures, and devised calibration tests for each type of instrument.

The photographic and photogrammetric laboratories and work areas are temperature controlled at 72 degrees Fahrenheit $\pm$ 2 degrees through the use of forced-air cooling and heating systems equipped with filters for removing dust. The relative humidity is held at 50 percent $\pm$ 5 percent to maintain the metric stability of plastic materials and to prevent corrosion and rust of the photogrammetric instruments. The temperature control is required for adequate control of humidity, metric stability of photogrammetric instruments, and reducing failure of electronic coordinate readout equipment components.

In addition to dust control through air filtration, the floors of all work areas are frequently vacuum cleaned. Cleaning is done by the photogrammetric instrument operators to eliminate the need for janitorial service by people who cannot appreciate the delicacy of these instruments. The instrument operators also clean and lubricate the

working parts of their stereoscopic plotters every two weeks according to the manufacturer's instructions. The micron measuring precision comparator screws are flushed with new clean oil daily before measuring begins.

Tests and calibration procedures for all instrumentation have been devised in such a way that the regular operating personnel can perform them routinely without the aid of specialists.

Aerial cameras are checked before each new roll of film is placed in the magazine to see that the film transport and vacuum lines are free. The camera intervalometer and shutter mechanisms are operated and visually checked before each flight, and the cameras are thoroughly cleaned and lubricated each winter between photographic seasons.

The laboratory processing equipment is continuously tested by making controlled exposures of density and color step wedges at the ends of each roll of film and measuring the processed step wedges with a densitometer after the film is dried. These same step wedges provide a similar check on the operation of electronic dodging photographic printers as well as assist in color compensation during printing. In addition, the photographic resolution of the cameras and printers are monitored continuously by examining both negatives and prints under magnification. An aerial camera vacuum failure is detected immediately after a roll of aerial film is processed by making glass diapositives of sample negatives at both ends and center of the roll, and measuring the positions of the camera fiducial mark images. This problem rarely occurs, but the consequences are so serious that this test procedure was developed in order that a camera magazine, which is not functioning properly, can be repaired or taken out of service before it is used again.

The stereoscopic plotting instruments are checked by the operating personnel every six months through the use of precise glass grid plates. Both the aerotriangulation and compilation-type instruments are checked for rectangularity of horizontal plotting and vertical deformation of

the stereomodel formed by a pair of grids. The well known Zeiss 23-point deformation test is used for the latter. In addition, stereoplotters used for aerotriangulation are tested for abnormal screw and bearing error propagation by making a six-model strip aerotriangulation using the same pair of glass grid plates.

The precision micron measuring comparators, used for computational or analytic aerotriangulation, are tested and calibrated for mathematical compensation with more precisely calibrated grid plates measured in each of four rotational positions by three different operators. A least squares orientation and determination of the parameters for comparator error compensation is made by computation with electronic computers. These tests are also made every six months by the regular operators of the comparators.

The Coast and Geodetic Survey trains each instrument operator to perform all phases of instrument operation. The test and calibration procedures are designed to be performed using standard instrument operation procedures, and quality control is attained through experience with each type of instrument. The supervisor or chief operator of each type of instrument is also ableto check the quality of the product through the numerical analysis of photogrammetric coordinate and ground control data.

These testing, calibration, and maintenance functions together with routine quality control have been developed through many years of experience with the problems which arise in the operation of photogrammetric mapping facility. The effort required to test the quality of the basic aerial photography is less than six man-hours per roll of film. The extra effort required to test and control the quality of photographic print and diapositive production amounts to about one man-hour per day for the whole photographic laboratory. The semi-annual grid tests of stereoscopic plotters require about one and one-half man-days for each aerotriangualtion instrument and one man-day for each compilation instrument. The calibration of each precision

comparator requires about four man-days semiannually. It is believed that this is a minimum and adequate effort for insuring agains instrumentation degradation or failure.

Through the careful attention to environmental control of instrument areas and periodic testing of each instrument, as outined above, the Coast and Geodetic Survey maintains a highly reliable photogrammetric mapping facility with a minimum amount of instrument repair by factory trained technicians.