This document was formerly published as *GEX Doc. No. 100-208 Calibration Analysis: Determining the Integrity of Measurement Data When Calibrating Dosimeters*

This document discusses one portion of the analysis of a calibration as currently practiced by GEX Corporation. Discussions of other analysis areas, techniques, biases and/or actions and their relation to the topics discussed are outside the scope of this memo.

When a calibration of routine dosimeters is performed, the variance of the dosimeter responses of each dose point calibrated should be examined by calculating the mean, standard deviation, and coefficient of variance *(CV)* of each set of measurements *(see ISO/ASTM 51261, Selection and Calibration of Dosimetry Systems for Radiation Processing, section 8.10.1 and 8.10.2)*. The calculation and subsequent review of these statistical values can help determine if a bias has been introduced into the calibration by the measurements, the irradiation process, the irradiation geometry, or other factors.

Note 14 of the aforementioned reference document states 'if any CV values are greater than a value prescribed for a specific dosimetry system and application', then that data should be evaluated for errors and dealt with appropriately. In order to help our customers apply this referenced document, GEX offers the following prescribed values to be used during the portion of calibration analysis to which the scope of this memo pertains:

- For dose measurements of B3 radiochromic film products at doses of 10 kGy and above, a CV of 2.0% or better should be expected, a CV of 2.0% to 3.0% accepted, and data set CV's higher than 3.0% should be investigated.
- For doses from 1.0 to 10 kGy, a CV of 3.0% or better should be expected, 3.0% to 4.0% accepted, and any CV's above 4.0% should be investigated.
- For doses below 1.0 kGy, user discretion should be applied.

Therefore, in examining calibration results, dosimeter measurement sets of a particular dose should be investigated if they do not meet the expected criteria above. For investigation, GEX offers the following suggestion:

> *Dosimeter investigations should begin following GEX Technical Report - Investigation of Dosimeter Measurements or contact GEX support. More than ¾ of all calibration problems in the past have been corrected by investigation, applying the proper corrective action, and re-measuring the data set. As part of the investigation, the dosimeter thickness in many cases should be measured. GEX can provide certified traceable thickness measurements for clients.*

Should the above steps fail to yield a re-measurement CV that meets the criteria, the following steps should be taken to resolve the issue:

1. It should be determined if one of the following is true:
    a. One or more measurements are statistical outliers, and removal of those measurements results in a CV that meets the manufacturer's criteria for acceptance. To determine an outlier measurement, GEX or the user should follow ASTM E178, Standard Practice for Dealing with Outlying Observations, to determine if some data can be removed to reduce the CV to a value which meets the GEX manufacturer recommendations. A minimum of four

dosimeter measurements must remain after elimination of an outlying measurement(s) in order to retain the dose point in the calibration curve *(per ISO/ASTM 51261, section 8.10.5)*. *Or,*

b. There is sufficient data *(per ISO/ASTM 51261, section 8.3.1)* to define the calibration curve without using the dose measurements in question. If there is sufficient data, then the measurements may be removed from the curve *(per ISO/ASTM 51261, section 8.10.5)*.

2. If neither of the above approaches can be successfully applied then the dose point irradiations should be repeated to the extent necessary *(per ISO/ASTM 51261, section 8.10.5)*.