TECHNICAL MEMORANDUM

NOTICE: This document is version controlled and was produced as a part of the GEX Information Program which requires that all Series 100 documents be reviewed periodically to maintain currency and continuity of information. Appropriate Technical Memorandum are used to provide information detail in support of the Product Data Sheets as well as GEX Recommended Procedures and to provide technical information in support of GEX Marketing documents.

REVISION HISTORY: Sept. 1, 2010 *Recommended 552nm for absorbance measurement.*

GENESYS 20 – GENERAL PRACTICES AND INFORMATION

Release Date: September 1, 2010

The Genesys 20 spectrophotometer serves as the centerpiece of the B3 WINdose Dosimetry System and this document summarizes important recommendations for optimum performance of the Genesys 20 with B3 film dosimeters. A Technical Appendix is included describing key functionality with recommended methods for evaluating and monitoring the performance stability of the Genesys 20 over time.

INSTALLATION OF THE GENESYS 20

Locate the Genesys 20 spectrophotometer(s) in an access controlled environment with stable temperatures maintained between 15-30°C. Use an Un-Interrupted Power Supply (UPS) with sufficient protection for line current protection to avoid current spikes and drop-outs.

USING B3 DOSIMETERS AS REFERENCES FOR DAILY PERFORMANCE TESTING

It is important to have verification confirmation that the Genesys 20 spectrophotometers used to measure B3 dosimeters produce constant and accurate results over the life of a B3 batch calibration. A major advantage of using B3 radiochromic film is its post irradiation stability after heat treatment. B3 dosimeters are completely shelf stable before and after irradiation.

GEX has demonstrated a simple means of monitoring the performance level of the Genesys 20 spectrophotometer on a daily basis using B3 dosimeters as references. This approach uses the actual batch calibration B3 dosimeter replicates themselves to verify that the instrumentation is able to return the same B3 response values that it did at the time of the batch calibration. A baseline is established for each Genesys 20 instrument to establish the acceptance limits for the daily checks test of the spectrophotometers and allows the application of trend analysis to detect even a small change over time.

These same B3 dosimeter references can also be used to validate new replacement Genesys 20 instruments or to re-validate a returning Genesys 20 that has been sent to the manufacturer for cleaning and recertification. GEX has demonstrated that these same B3 dosimeters from the calibration can be used as references in a daily checks program.

IMPLENTING AND USING A DAILY CHECKS PROGRAM

1. On a daily basis, power down and then restart the Genesys 20 so the “self-test” functions embedded in the Genesys 20 can execute its internal instrument functionality testing routine.

   CAUTION: Failure to turn the Genesys 20 on and off daily creates a risk that a key function could fail and not be detected until the next instrument start-up cycle.

2. Remove the entire cuvette cup assembly and close the cover (lid) to the measurement compartment during the “re-start” or initial start-up and warm up period.

   CAUTION: Do not leave the removable B3 WINdose dosimeter holder in the cup during the start up cycle. The WINdose holder will cut off a portion of the light beam from

reaching the detector that will in turn lead to significant instrument drift and the need to re-zero often until the Genesys 20 is re-started with the holder removed.

3. Once the Genesys 20 has completed all internal tests (takes approximately 3 minutes to complete all internal checks) during its start up cycle, verify that there were no error messages.

4. Allow the full 30 minutes of Genesys 20 manufacturer recommended warm up time before use.

5. Use the Genesys 20 'Utilities' menu to check and record the number of hours on the Tungsten Halogen lamp since last change out as apart of an instrument "daily checks" program. Pro-actively replace the Tungsten Halogen lamp every 800 hours of total elapsed operating time.

   CAUTION: Use powder free gloves or lint free tissue while handling the replacement lamps making sure to insert the lamp so the filament is positioned directly in front of the entrance slit. Use only Genesys 20 replacement lamps sourced by Thermo Electron and supplied by GEX. Avoid lamp substitutes from any other source as the unit was designed specifically for this specific lamp and its exact specifications.

6. Establish and use a performance baseline test daily for each Genesys 20 being used. Predictable performance of a dosimetry system depends on assurance that the instruments used for the dose measurements are stable and perform within their specified limits.

   IMPORTANT: **Perform daily performance checks of the photometric scale and wavelength accuracy by using B3 films that have been established as references. Refer to the section "Long term monitoring of the photometric scale using B3 film references and neutral density filters" in the Technical Information Appendix for detail.**

GENESYS 20 CALIBRATION AND MAINTENANCE PROGRAM

See GEX Doc# 100-254, Genesys 20 Calibration and Maintenance, to periodically perform appropriate instrument calibration verification (approximately monthly) using the Spectronic Standards Set or equivalent. The verification should test at a minimum:

a. Photometric scale performance using 10% and 50% neutral density filters.
b. Wavelength performance test at the middle point of the wavelength scale using the Spectronic Standards wavelength filter or equivalent. The glass filter included in the set has a traceable absorbance peak at about 525nm.
c. B3 Wavelength testing should be conducted to verify that the Genesys 20 is responding uniformly and predictably over the important 545-559 wavelength peak range of B3. This is performed using any single irradiated B3 film dosimeter to verify the instrument is able to provide peak values at the 550-554 nm settings. See the Technical Appendix for detail.
d. Stray light energy test at 340nm and 400nm using notch filters.
e. Test of instrument electronic zero light level with the light path completely blocked (0%T).
f. Consult the Spectronic Standards Set manual for acceptance levels that are specific to Genesys 20 if using Spectronic Standards (see also the 100-254 procedure cited above).

CAUTION: The Genesys 20 cannot be field calibrated. Never attempt to open the Genesys 20 outer cover or attempt to perform any form of service of the instrument. The Genesys 20 must be returned to Thermo Spectronic for service or internal cleaning with calibration re-certification. Outside calibration service companies should not attempt to re-calibrate and certify the Genesys 20. Contact GEX for Thermo Electron service contact information or to locate an approved supplier in your area.

COMMONLY REPORTED CONDITIONS

The Genesys 20 responds to internally detected malfunctions by audible and visual signal. The audio signal consists of single or multiple beeps and the visual signal consists of the Error Message displayed on the two line LCD display. Some error messages do not remain permanently on the screen. It is important for an operator to properly interpret error codes per their definitions as listed in the instrument manual.

OTHER ATYPICAL MALFUNCTIONS

- WINdose holder not properly seated in the cuvette cup; absorbance value displayed will be unstable.
- Power supply electronics failing. Instrument shuts down unexpectedly. After restart, instrument should perform normally unless there is an actual internal failure condition.
- Instrument does not enter the sequence of initial tests upon powering up; the display reports software version on the display and audio alarm beeps persistently. This is the indication of major failure on the main circuit board.
- Light bulb filament not properly positioned in front of the entrance slit (optical alignment). See procedure 100-254 cited previously for detail.
- Never use the Genesys 20 above the 2.5 Absorbance Units maximum value. The display of the instrument will blink indicating an over range value

If the instrument fails to perform within its established daily checks performance limits or displays a malfunction condition that cannot be cleared by a simple re-start process, contact GEX to discuss appropriate actions.

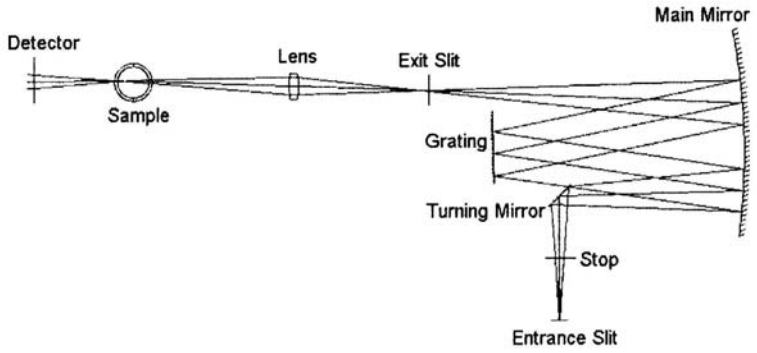
The most common failure reported for Genesys 20s is related to stray light alarms. This is often an indication that the instrument has accumulated particulate that is interfering with its operation and that the unit should be returned to the factory for cleaning and recertification by Thermo Spectronic.

TECHNICAL INFORMATION APPENDIX

1. General instrument design philosophy.

- Optical component design of Genesys 20

  The Genesys 20 spectrophotometer is classified in optical terms as a single beam and single mirror, Czerny-Turner type monochromator unit. The monochromator uses a 1200 line/mm reflective grating as a wavelength dispersing element.
  The monochromator has fixed slit width optics and a fixed value of Spectral Band Width specified as not greater then 8nm. The entire optical system excluding the light source and the detector is sealed in a single compartment and immune to infiltration and accumulation of contaminants. The sealed optical system is not end user or field serviceable. The simplified schematic diagram of the system layout is shown in the figure below. (*From GENESYS 20 Service Manual)*



Lamp:	The Tungsten-Halogen lamp provides continuous energy output. There is no illumination optics between the lamp and the entrance slit. Instead, the lamp is mounted very close to the entrance slit.
Stop:	An optical stop reduces the amount of stray light in the instrument.
Turning Mirror:	The turning mirror directs the diverging beam to the main mirror.
Main Mirror:	The main mirror converts the diverging beam to parallel light and directs it to the grating.
Grating:	The planar grating, whose orientation is controlled by a micro-stepping motor, sends a horizontally dispersed spectrum of collimated light back to the main mirror.
Main Mirror:	The beam hits the main mirror a second time and is focused onto the exit slit.

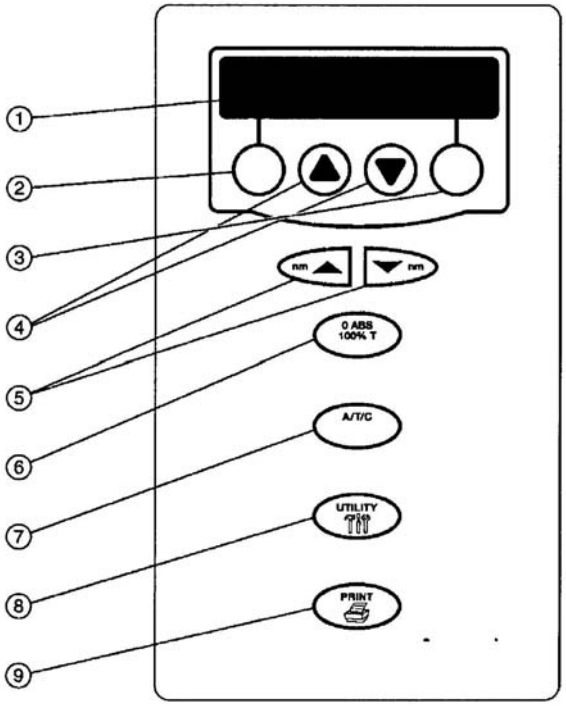
General instrument design philosophy (CONTINUED).

- **Detector component design of Genesys 20**
  The light detector of the Genesys 20 spectrophotometer is a solid state photodiode array located in the front section of the instrument immediately following the sample compartment. The mounting plane of the detector is angled with respect to the incoming light beam in order to minimize back reflections into the sample compartment.

- **VIS part of the spectrum as the wavelength operating range of Genesys 20.**
  The Genesys 20 spectrophotometer is designed to operate only in the visible (VIS) part of electromagnetic spectrum specified by the manufacturer in the range from 320nm to 1100nm. This instrument specification is wider then commonly used boundaries for the visible spectrum portion typically defined in the range from about 340 nm to 800 nm. The optical subcomponents of the instrument are not designed, nor are they specified to operate in the ultra violet (UV) or the infra red (IR) part of the spectrum. It appears that the wider than typical wavelength specification refers to the spectral output of the light source (tungsten – halogen type) and spectral sensitivity of the solid state detector employed in the design of Genesys 20.

- **Photometric scale of Genesys 20 appropriate for B3 dose range**
  The instrument specification for its photometric range is said to extend from 0% to 125% on the Transmittance scale or equivalently from -0.1 to 2.5 on the Absorbance scale. This range is very well matched with the dynamic range in which the B3 film dosimeter is designed to perform (i.e. < 1.0 kGy to >100 kGy). The absorbed dose levels at which the colored dye development in B3 dosimeters show slow but progressive saturation effects are well below the maximum measurable Absorbance and without effects of stray light interference on the measured value. The B3 saturation absorbance due to radiation exposure occurs at approximately 1.6 Absorbance Units. It is worth noting that at an absorbance value of 2.5 the initial light beam has been attenuated to about 0.3% of its initial intensity.

- **Embedded Genesys 20 programmed operating and performance verification functions**
  The Genesys 20 instrument uses embedded programming at instrument start-up to provide built-in instrument diagnostics and performance functionality verification. It takes approximately 3 minutes for the Genesys 20 to complete its self-diagnostics each time the unit is re-started. The results of these internal self-tests are reported to the operator on an LCD display. This display is limited to two lines. The operator can use several membrane switches controlling all user accessible functions and options of the instrument (see figure on following page).



1. Display - 20-character, 2-line LCD
2. Soft key 1 - Function varies depending on screen; generally Escape, Back Up, or Clear
3. Soft key 2 - Function varies depending on screen; generally Enter, Accept, or Continue
4. Scroll keys - Used to scroll through menus and enter numeric values
5. Wavelength controls - Increase and decrease the wavelength settings
6. 0 Abs/100%T - Automatically sets the instrument to zero absorbance (100%T)
7. A/T/C - Switches between absorbance, %transmittance, and concentration modes
8. Utility - Accesses instrument set-up, diagnostics, and other functions
9. Print - Sends currently displayed data to selected printer

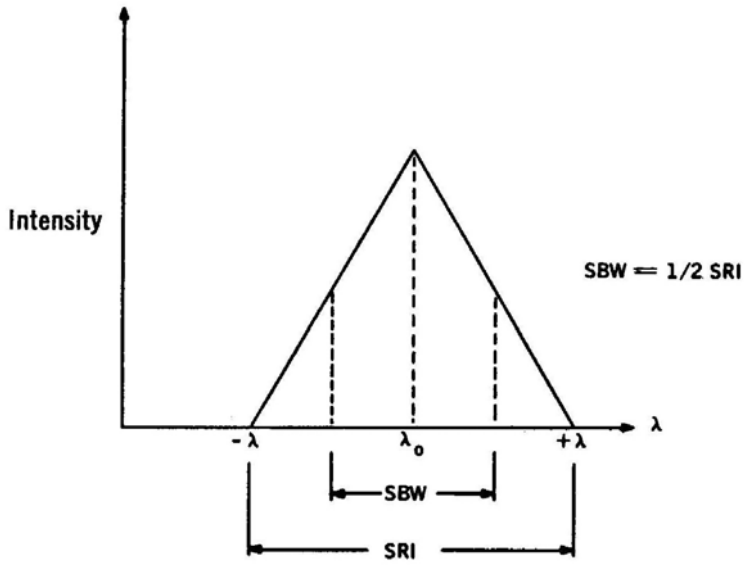
- **Wavelength calibrating and wavelength access look up tables (instrument specific).**
  The access to any desired wavelength on the Genesys 20 wavelength scale is accomplished by the micro stepper motor driving the angular orientation of the diffraction grating (wavelength dispersing element) by the number of steps called upon from the micro stepper look up table. The use of the stepper motor provides accurate and repetitive access to any wavelength on the wavelength scale. In addition to the instrument specific micro stepper motor look up table, the Genesys 20 is also pre-loaded with the instrument specific wavelength calibration look up table. Both tables reside in the EPROM (Erasable Programmable Read Only Memory) on the main controller board. In very seldom instances, numerical data in either table may get lost from EPROM chip. In such a situation, the Genesys 20 defaults to the embedded Default Wavelength Calibration Table. The default table is considered fairly accurate but it may not be accurate enough to comply with the wavelength accuracy specification for Genesys 20 stated at ±2nm over the entire range of wavelengths.

  In addition to the look up table, the other anchoring point of the wavelength scale is the null position of the diffraction grating. The null position defines the “zeroth order” intensity peak while the diffraction grating is positioned perpendicular to the light beam and optically acting as a mirror. The null position is verified every time during the Genesys 20 start up and is reported as “Monochromator Init” on the Genesys 20 LCD display.
  In a majority of dosimetric applications, the users of Genesys 20 employ the Spectronic Standards Set together with the applicable procedure to verify the wavelength accuracy specification of the instrument at one wavelength only. The glass filter included in the set is used for this purpose and has a traceable and certified wavelength centered in the proximity of 525nm. This peak is traceable directly to the Thermo Electron reference spectrophotometer standardized to be within ±0.1nm of deuterium and mercury emission lines (primary standard wavelengths). The Standards Set filter has two other peaks bracketing the 525nm peak at 400nm and 780nm. These two peaks are neither traceable nor certifiable, but may however be used to check Genesys 20 repeatability over the wider range of wavelengths.

2. Critical instrument specifications and their significance in thin film application.

- **Slit width**
  The slit width is the physical width of the monochromator exit slit opening in millimeters. It is the exit slit of the monochromator that defines the band of wavelengths directed at the sample. The Genesys 20 spectrophotometer uses an optical system having a fixed width of the exit slit. The exit slit width of the monochromator according to the manufacturer is fixed at 1.0mm.

- **Spectral Band Width (SBW) of the instrument (or spectral bandpass of the instrument)**
  The light directed at the sample is not strictly monochromatic. It contains added wavelengths (colors) present on both sides of the nominally selected wavelength and the band is defined by the slit width. This band is referred to as Spectral Region Isolated (SRI) and a fraction of its span is occupied by the Spectral Band Width (SBW). In an idealized description, the radiant intensities of side wavelengths would decrease linearly to an arbitrary level of 0.1% of the maximum intensity. The radiant intensity transfer function would then have the shape of an isosceles triangle.



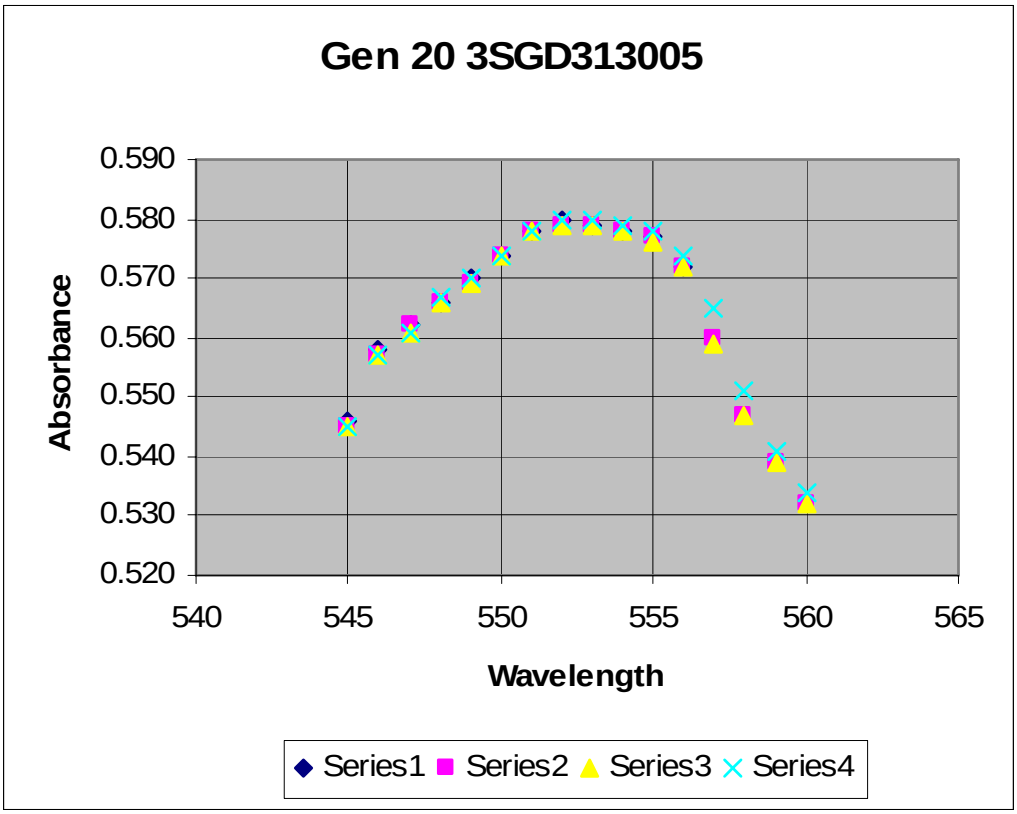
Intensity Distribution of Energy
Emerging from Exit Slit as a Function of Wavelength

The Spectral Region Isolated (SRI) can be well approximated by an isosceles triangle with the Full Width at Half Maximum (FWHM) of its height defining the Spectral Band Width (SBW) and it is expressed in nanometers. In terms of radiant energy emerging from the slit, the portion occupied by the SBW contains ¾ or 75% of all the radiant energy and in terms of range of wavelengths it is ½ or 50% as wide as the Spectral Region Isolated. The parameter of high importance (without getting into precise definition of this quantity) in the description of the optical system discussed here is the dispersion function **D** and its reciprocal $\mathbf{D^{-1}}$. The product of slit width in millimeters by the reciprocal of dispersion $\mathbf{D^{-1}}$ gives the numerical value of Spectral Band Width (SBW).

- **Wavelength accuracy.**
  The Genesys 20 instrument can access a specifically selected wavelength between 320nm and 1100 nm with a manufacturer specified wavelength accuracy of ±2nm over the entire range. Due to additional uncertainties in measurement, ±4nm is the acceptance criteria for the Spectronic Standards wavelength accuracy verification test.

- **Wavelength reproducibility specification**
  The periodic use of the Spectronic Standards Set requires setting and accessing the different wavelengths associated with different filters in the set. The wavelength reproducibility specification assures that the repetitive process of access to the same wavelength is always not worse then 0.5nm between repetitions.

  NOTE: GEX suggests the use of post irradiation heat treated B3 dosimeters as internal references to verify that each Genesys 20 spectrophotometer used to measure B3 film will faithfully reproduce the B3 measurement peak of 550-554 nm. The example below is a 1nm incremental plot of the absorbances of a single B3 dosimeter measured over this specified range. These results reflect acceptable wavelength selection reproducibility and also evidence the reproducibility of the photometric scale within expected limits over the peak wavelengths.



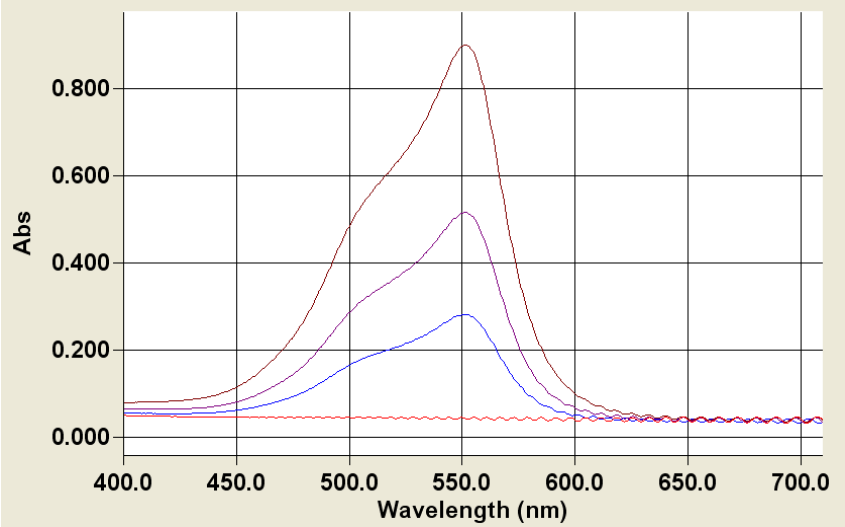
Reproducibility plot of 4 separate measurement sets of the same B3 dosimeter over 2 days.

- **Stray light influence**
  Any radiant energy reaching the detector that originates outside of the SBW of energies available from the slit of the monochromator is considered spurious and contaminating. The presence of stray radiant energy artificially creates a departure from linearity according to Beer-Lambert's law and depresses the high absorbance end (low transmittance end) of the photometric scale of the instrument. Stray light error messages reported by the Genesys 20 following its initial internal checks performed during start-up of the instrument may be an indication that the unit needs to be returned to the factory for cleaning and recertification.

3. Application specific performance aspects.

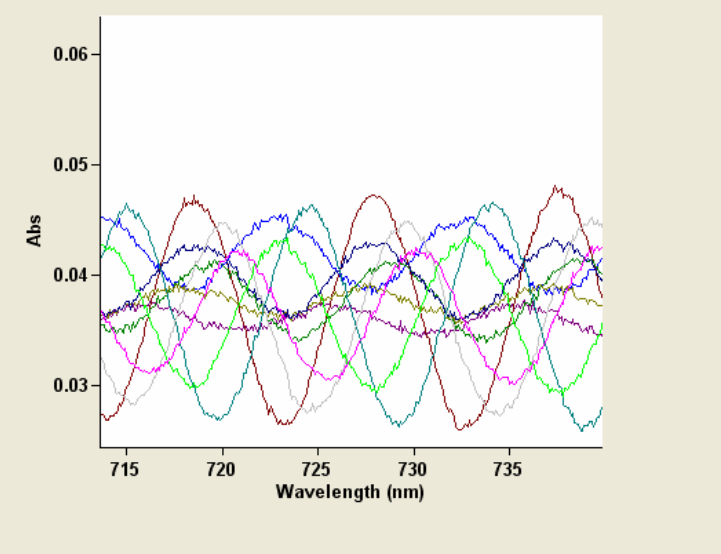
- **The wide 8nm bandpass of Genesys 20 is highly beneficial in the context of avoiding optical interference fringes.**
  In order for the instrument to properly resolve separate but closely adjacent absorbance peaks (or inversely, not to detect the presence of interference fringes), the SBW of a monochromator must be only a fraction of the natural spectral width of the peak (or inversely comparable to or greater then the FWHM of an interference fringe).

  Either of these conditions is met by the Genesys 20 with the SBW specified to be not greater then 8nm while the observed bandwidth of irradiated B3 absorbance peak is about 9nm. (The full spectrum in the illustration below has been acquired using the Cary 300 scanning spectrophotometer).



The chart above shows wavelength scans of low medium and high dose B3 DoseStix dosimeters performed using the GEX Cary / Varian 300 instrument to show the constancy of the central B3 peak found over the 550-555 nm range.

Interference fringes (oscillations) in the thin film are easily detectable by the Cary 300 spectrophotometer at the longer wavelengths to the right of the main absorbance peak. The Genesys 20 spectrophotometer is however totally immune to detection of the oscillations having the SBW comparable or greater then the FWHM of the oscillation.



The chart above shows multiple Interference Fringes in B3 film at a 3.0nm SBW setting used on the Cary 300. Each trace is a scan of a separate B3 film. The image captures the details of differences in amplitude and the out of phase condition between different B3 film samples. The Genesys 20 instrument on the other hand does not see these fringes because of its 8 nm SBW which is the equivalent of averaging the Cary 300 absorbance data over an 8 nm range that eliminates optical fringe interference.

- **Selection of the wavelength of the measurement**.
  In typical dosimetric applications using thin radiochromic films, the Genesys 20 spectrophotometer is used most of the time at the "center" wavelength of absorbance peak. The 554nm wavelength for B3 radiochromic film has historically been accepted and used by the majority of users as the peak wavelength of B3 film. GEX has identified a broad stable peak that reproducibly occurs over full dose range of B3 in a region from 550nm to 554nm. Therefore, GEX Corporation continues to approve use of the historically accepted 554nm wavelength but recommends 552nm for absorbance measurement of B3 film. A user may determine the peak wavelength of B3 dosimeters using their Genesys 20 instruments by performing the single nm incremental scan over the range from 545nm-559nm.

  NOTE: GEX Corporation has also demonstrated scanning absorbance data over the peak of B3 film from 545nm to 559nm and using the median or mean absorbance value over that range can mitigate the fringe problem introduced with high quality narrow band SBW spectrophotometers such as the Cary 100/300.

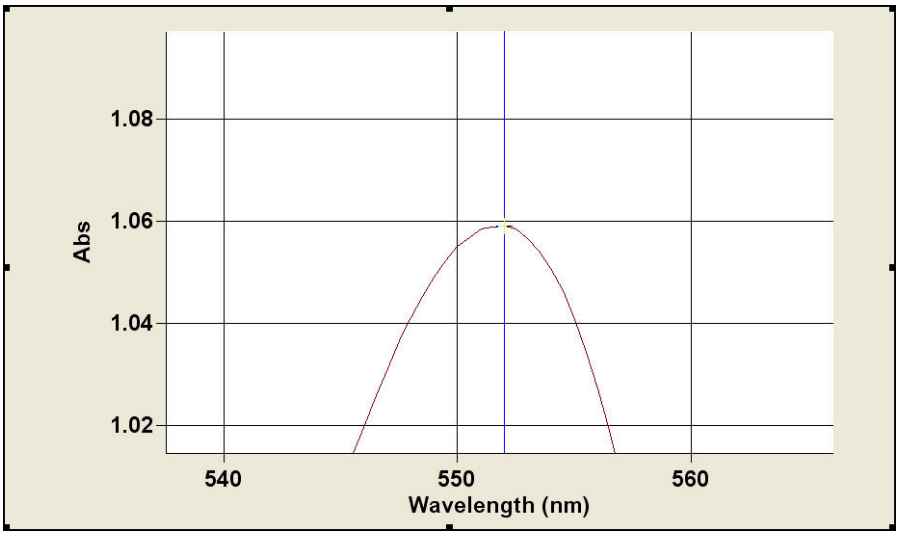


  Image of the peak of a high dose (120 kGy) B3 film dosimeter. The vertical line intercepting the peak is positioned at 552.0nm. The scan was acquired using the Cary 300 spectrophotometer.

- **Small aperture B3 WINdose dosimeter holder**.
  In the WINdose dosimeter format the B3 film occupies only the circular section of the paper overlay. The design of the B3 WINdose dosimeter holder (GEX part # P4502) employs both a conical shaped aperture and then the annular shaped aperture. The diameter of the annular section of the aperture reduces the dimensions of the beam spot as it proceeds through the holder. The resultant geometry is such that the size of the beam spot intercepted by the B3 film present in the holder is always smaller than the diameter of the film area. The probability of the light beam striking the paper overlay of a dosimeter is greatly reduced by this design. However, this geometry reduces the light energy flux reaching the detector and necessitates down-rating of the long term stability of the instrument from the value stated in the manufacturer's specifications. The manufacturer specification of drift being less then 0.003 Absorbance Units / hour is therefore down rated to instrument drift being less or equal than 0.001 Absorbance Units for at least one half of an hour.

- **Drift in displayed absorbance caused by the start up process with the restrictive aperture of the P4502 holder.**

  CAUTION: Always verify that the Genesys 20 sample compartment does not have a dosimeter holder or anything else than could interfere with the light beam path in any way during start up. For example, leaving a P4502 WINdose dosimeter holder in the sample compartment cuvette holder of a Genesys 20 during instrument start-up will result in considerable and unwanted instrument drift during measurement use after warm-up. The dosimeter holder designed for the WINdose format dosimeters has a restrictive aperture that reduces a portion light beam that would have reached the detector if the holder was not present. This loss of light striking the detector was not considered nor expected during the design of the Genesys 20 and must be avoided to obtain optimum performance of the Genesys 20.

- **Periodic instrument restarts for POST (Power-On Self Tests).**
  The control and supervision of the internal workings of the Genesys 20 instrument is vested with embedded programmed sequences of the main controller. In order for these sequences to be executed, the controller must be initialized which occurs when the Genesys 20 is restarted or turned on initially. The consequence of this approach is the need for the user to initiate periodic restarts of the Genesys 20. A Genesys 20 re-start permits the instrument to undergo a full Power-On Self Test (POST) and execute all internally built-in microprocessor actions. The failure of a sub-component of the Genesys 20 is readily detected by simply restarting the Genesys 20 at a minimum of once over every 24 hour period of use.

- **Lamp replacement and alignment.**

  CAUTION: Always use Thermo or GEX supplied lamp replacements.

  The tungsten – halogen lamp used in the Genesys 20 spectrophotometer has manufacturer recommended replacement period of 1000 hours. It is our recommendation that the lamp is replaced at the period of not more then 800 hours. Proactive replacement of the lamp eliminates possible darkening of the glass envelope toward the end of the life time or having possible instability (flickering) in the filament and reduction in luminous energy output. We have no recorded observations pertinent to these events but the additional security is prudent and speaks in favor of the preventative measure. The detailed lamp replacement procedure is included in the Genesys 20 manual.

  In addition to recommendations outlined in the procedure, there is an additional recommendation that can optimize positioning of replacement lamp.

  > While inserting replacement tungsten-halogen lamp bulb, attention should be paid to position the lamp filament directly in front of the entrance slit. The pins on the light bulb are relatively long and permit insertion the bulb either not far enough into the bulb socket or just past the optimum location in front of the entrance slit. See GEX Doc# 100-254 for detail.

- **<u>Long term monitoring of the photometric scale using B3 film references and neutral density filters.</u>**

  As outlined in the main document section, GEX recommends use of a simple daily instrument performance checks program to monitor and verify stability of the photometric scale of the Genesys 20 spectrophotometer. The following is a suggested method for implementing such a program.

  Accumulated data regarding long term stability of post irradiation heat treated B3 dosimeters indicates that B3 dosimeters are completely stable over the period of many months with a measured change in absorbance being typically less than 1.0% in a year. This unique stability quality of post irradiation heat treated B3 dosimeters makes them ideal for use as reference controls.

  While any post irradiation B3 dosimeter can be established and used as a reference, B3 replicates from dose sets used in a batch calibration provide a simple and direct means of traceability back to the calibration itself. Selected B3 dosimeters are established as references by simply measuring and recording their absorbances 32 consecutive times for each at the established B3 measurement wavelength on each instrument. The average of these 32 measurements serves as the baseline data for each B3 reference dosimeter for use as a daily check of the photometric response prior to performing dosimetry measurements.

  The use of a simple daily check of the Genesys 20 instrument using established B3 dosimeter references provides verification the instrument is performing correctly. This simple test also provides ongoing data that can be compared to identify a performance trend. Although GEX uses low medium and high dose B3 references, use of a single B3 reference at a middle dose range is considered sufficient following a daily instrument restart to verify the photometric scale performance of the Genesys 20.

  Our experience at GEX in using these internal B3 dosimeters as references in daily monitoring instrument checks revealed a slight growth in the B3 references over time that is on the order of approximately one percent per year. This gradual signal growth is shown to be consistent for the low, medium and high dose references. We have also shown that a typical reference dosimeter sample can be expected to have a six month or more useful life when used on a daily basis if proper measurement handling and storage care is used. When handling and caring for these B3 dosimeter references, please keep in mind that these dosimeters are designed and manufactured as a single use item.

  Dosimeter replicates retained from the initial B3 dosimeter batch calibration dose point sets provide an excellent source of dosimeter sets for use as internal instrument references.
  In addition to the use of highly stable B3 dosimeters as references, GEX recommends including use of the 10% Transmittance and/or 50% Transmittanceneutral density filters from the Spectronic Standard Set for monitoring of the photometric scale stability of the Genesys 20 instruments during a batch calibration life cycle. This approach provides two independent reference sources to help verify a change in the photometric scale performance reproducibility of the Genesys 20, with the B3 reference also confirming the wavelength accuracy reproducibility of the Genesys 20 on a daily basis.

  NOTE: A number of users have reported that simply using the baseline of a single B3 dosimeter with acceptance at ±0.05% is sufficiently effective for daily checks testing.

NOTE: Verification of WINdose for Excel dose output is discussed in GEX Doc# 100-255

An example of a daily checks worksheet is found on the following page which contains results for a single month. GEX experience with the use of B3 references indicates that one should expect to be able to maintain absorbance CVs at 0.4% for the low dose, 0.2% for the middle dose and 0.15% for the high dose B3 references (reduced instrument noise influence at higher dose). The example worksheet also shows the ability to maintain multiple Genesys 20 instrument within limits of 1.0% or better that provides verification of their interchangeability or the ability to combine calibration data sets for use in single combined B3 batch calibrations.

Daily Instrument Checks Example

Title:	Daily checks of spectrophotometer performance
Purpose:	Verify expected performance of spectrophotometer stability and reproducibility using Standard's Set photometric filters and DoseStix references at three dose levels
SOP in Use:	None
Instructions:	
1	Start all instruments subjected to test from "cold" start and at the same time
2	Allow for the warm-up period as specified by separate procedure
3	At 552nm record transmittance of 10% and 50% filters on Genesys 20
4	Enter into the data table
5	Repeat on any other Genesys 20 involved in test
6	Go to absorbance mode changing cup holder to accommodate DoseStix films
7	At 552nm record absorbance of LOW MID HI dosimeters on all Genesys 20s
8	Repeat #7 with Cary 300 at 552nm , 4nm SBW, 0.5 sec averaging time.
Conditions of the Test:	
Date	Daily
Operator	Marian Strzelczyk
Instrument	Two Genesys 20
Dosimeter Type	Single DoseStix at three dose levels
Wavelength	552 nm
SN	3SGD313005 and 3SG347012
Last calibration	7/31/2006
Calibration due date	8/30/2006

Mean	1.007	1.007	0.297	0.296	0.116	0.117	0.330	0.330	0.553	0.554
St Dev	0.0004	0.0004	0.0003	0.0005	0.0004	0.0004	0.0005	0.0006	0.0009	0.0008
CV	0.04%	0.04%	0.10%	0.17%	0.33%	0.31%	0.15%	0.18%	0.16%	0.14%
	10% standard	10% T standard	50% standard	50% T standard	Gen20 #1 low	Gen20 #2 low	Gen20 #1 mid	Gen20 #2 mid	Gen20 #1 high	Gen20 #2 high
Aug-06	3SGD313005	3SG347012	3SGD313005	3SG347012	8229122B	8229122B	8228929A	8228929A	8347153B	8347153B
1-Aug	1.006	1.006	0.297	0.297	0.116	0.116	0.330	0.331	0.553	0.554
2-Aug	1.007	1.007	0.297	0.297	0.116	0.117	0.331	0.331	0.553	0.554
3-Aug	1.007	1.007	0.297	0.297	0.116	0.117	0.331	0.331	0.554	0.555
4-Aug	1.006	1.007	0.297	0.297	0.116	0.117	0.330	0.331	0.554	0.555
7-Aug	1.007	1.006	0.297	0.297	0.116	0.118	0.330	0.329	0.555	0.552
8-Aug	1.007	1.007	0.297	0.297	0.117	0.118	0.330	0.330	0.553	0.554
9-Aug	1.007	1.007	0.297	0.297	0.116	0.117	0.330	0.331	0.553	0.553
10-Aug	1.007	1.006	0.297	0.296	0.116	0.117	0.331	0.331	0.553	0.554
11-Aug	1.007	1.007	0.297	0.297	0.116	0.117	0.330	0.330	0.552	0.554
14-Aug	1.007	1.007	0.297	0.297	0.117	0.117	0.330	0.331	0.554	0.554
15-Aug	1.006	1.007	0.297	0.296	0.116	0.117	0.330	0.331	0.554	0.554
16-Aug	1.007	1.006	0.297	0.296	0.116	0.117	0.330	0.330	0.553	0.553
17-Aug	1.007	1.007	0.297	0.297	0.116	0.117	0.331	0.330	0.554	0.554
18-Aug	1.007	1.007	0.297	0.296	0.116	0.117	0.330	0.330	0.553	0.553
21-Aug	1.007	1.007	0.297	0.296	0.117	0.117	0.331	0.331	0.554	0.555
22-Aug	1.007	1.007	0.297	0.297	0.116	0.117	0.331	0.330	0.554	0.554
23-Aug	1.006	1.007	0.297	0.296	0.117	0.117	0.331	0.331	0.554	0.554
24-Aug	1.006	1.006	0.296	0.296	0.116	0.117	0.330	0.330	0.552	0.553
25-Aug	1.006	1.007	0.296	0.296	0.116	0.117	0.330	0.330	0.551	0.553
28-Aug	1.007	1.006	0.297	0.296	0.116	0.117	0.331	0.330	0.552	0.554
29-Aug	1.007	1.007	0.297	0.296	0.116	0.117	0.331	0.331	0.553	0.553
30-Aug	1.007	1.007	0.297	0.296	0.116	0.117	0.331	0.330	0.553	0.553
31-Aug	1.007	1.007	0.297	0.296	0.116	0.117	0.331	0.330	0.553	0.553