

QSA GLOBAL.



OPERATING MANUAL & MAINTENANCE GUIDE.

MAN-058, DECEMBER 2018



Model G1. Instrument Calibrator

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DANGER - IMPORTANT WARNINGS

The Model G1 calibrator contains a Cesium-137 gamma radiation source. It must be kept secured and used only by operators, who are qualified and licensed in compliance with local and national safety regulations and properly trained in the use of radiation sources for instrument calibration. Such operators must first read and fully understand this manual before handling or using the device. Never leave the calibrator unlocked or unattended whenever it's removed from the designated storage area.

WARNING: The use of this device by unqualified personnel or when safety procedures are not fully met could create hazardous radiation conditions.

This device is designed to emit a radiation beam when required for the calibration of radiation detection instruments. No person should be exposed to the radiation beam because irradiation at close range can cause serious injury. An unshielded radiation source at close range can cause **injury, sickness, or death** to anyone who is exposed to it even for a short period of time.

Since gamma radiation cannot be detected by the human senses, strict operating and emergency procedures must be followed. The proper use of calibrated and operable survey meters must be employed to avoid potentially dangerous levels of radiation exposure.

Proper dosimetry including film badges, optically stimulated luminescent dosimeter (OSL) or thermoluminescent dosimeters, direct reading pocket dosimeters and audible alarm rate meters must be worn during all calibration operations.

During use of this calibrator, **never** assume the position of the radiation source. **Always** conduct a thorough confirmatory survey using a calibrated and operable survey meter to verify the location of the radiation source. Be reminded that a multitude of overexposure incidents which include injuries are directly attributed to a failure of the operator to perform or supervise an adequate confirmatory survey.

It is very important and required by national and international regulations to prevent access by unauthorized persons to radiation sources/devices and to the areas where these sources/devices are used and stored.

Take advantage of the three basic radiation protection methods to minimize radiation exposure:

Time: Spend less time near the radiation source.

Distance: Increase your distance in a direction away from the radiation source.

Shielding: When possible, always apply the use of effective shielding between you and the radiation source.

Do not perform any unauthorized modifications or repairs to the Model G1 calibrator.

QSA Global, Inc. shall not be liable for any errors or omissions contained herein and the provision by QSA Global, Inc. of the information set out in this manual does not in itself constitute acceptance or any liability or responsibility on the part of QSA Global, Inc.

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NOTICE.

The Model G1 instrument calibrator is designed, manufactured and approved for radiation instrumentation calibrations. It is not intended for other applications that utilize ionizing radiation sources. The Model G1 calibrator is also a Type A approved shipping package for the Cs-137 sealed source contained within the device. The purpose of this manual is to provide information that will assist authorized and qualified users to ensure all safety and regulatory requirements are met when using the Model G1 instrument calibrator. ***The user should become thoroughly familiar with this instruction manual before attempting operation of the equipment.***

Users of this equipment must comply with the regulatory requirements and licensing and transportation regulations as they apply in their respective countries. Modifications to the calibrator without advance written authorization from the manufacturer will nullify the product warranty and the USDOT Type A transport package status.

To obtain authorization to use this equipment, users within the USA and Canada must be specifically licensed for possession and calibration. Applications for a license must be filed with the Materials Licensing Section of the appropriate U.S. Nuclear Regulatory regional office, or Agreement State. It is the responsibility of users to comply with all local, national, and international regulatory licensing and transportation rules as they apply in their respective countries.

For additional information or assistance regarding use of the Model G1 instrument calibrator, contact QSA Global, Inc. and/or one of our authorized distributor service centers by contacting:

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1. GENERAL DESCRIPTION & APPLICATION.

The Model G1 device is a portable instrument calibrator specifically intended for calibration of radiation survey and radiation detection instruments. The main calibrator body is manufactured using a cylindrical steel tube with metallic lead as the primary shielding material. A stainless-steel tube through which the source rod travels is centered within the shield and the metal cylinder. This device contains a special-form sealed Cesium-137 gamma source contained within a movable source rod which is installed in the lead shielded calibrator housing. The source can be exposed when required by manually raising the source rod which positions the source at the apex of a 36° x 20° collimated beam port providing an external and directional radiation beam. This is illustrated in Figures 1 and 2.

The source rod is held in the exposed position via spring plungers and is designed to shield the source when being raised or lowered by an operator. The source rod is held in the fully shielded and secured position by spring plungers, gravity, and a padlock when not in use.

The calibrator is equipped with a beam flattening attenuator at the collimator port to produce a radiation field whose intensity is uniform in any plane perpendicular to the beam axis.

The Model G1 calibrator includes three movable attenuators (X4, X10, X10) with transmissions of 0.25 (75% attenuation / 25% transmitted), 0.10 (90% attenuation / 10% transmitted) and 0.10 (90% attenuation / 10% transmitted). The movable attenuators permit a survey meter with three ranges to be calibrated at 20% and 80% of each range without changing the position of the survey instrument.

The unit is equipped with carrying handles and is lockable with a padlocked security cross-pin when the source rod is in the fully shielded (stored) position. The padlock must be engaged and the key removed to prevent unauthorized use of the calibrator. A steel shipping cover secured over the source rod in the stored position provides a secondary means of securement during shipment of the USDOT Type A transport package.

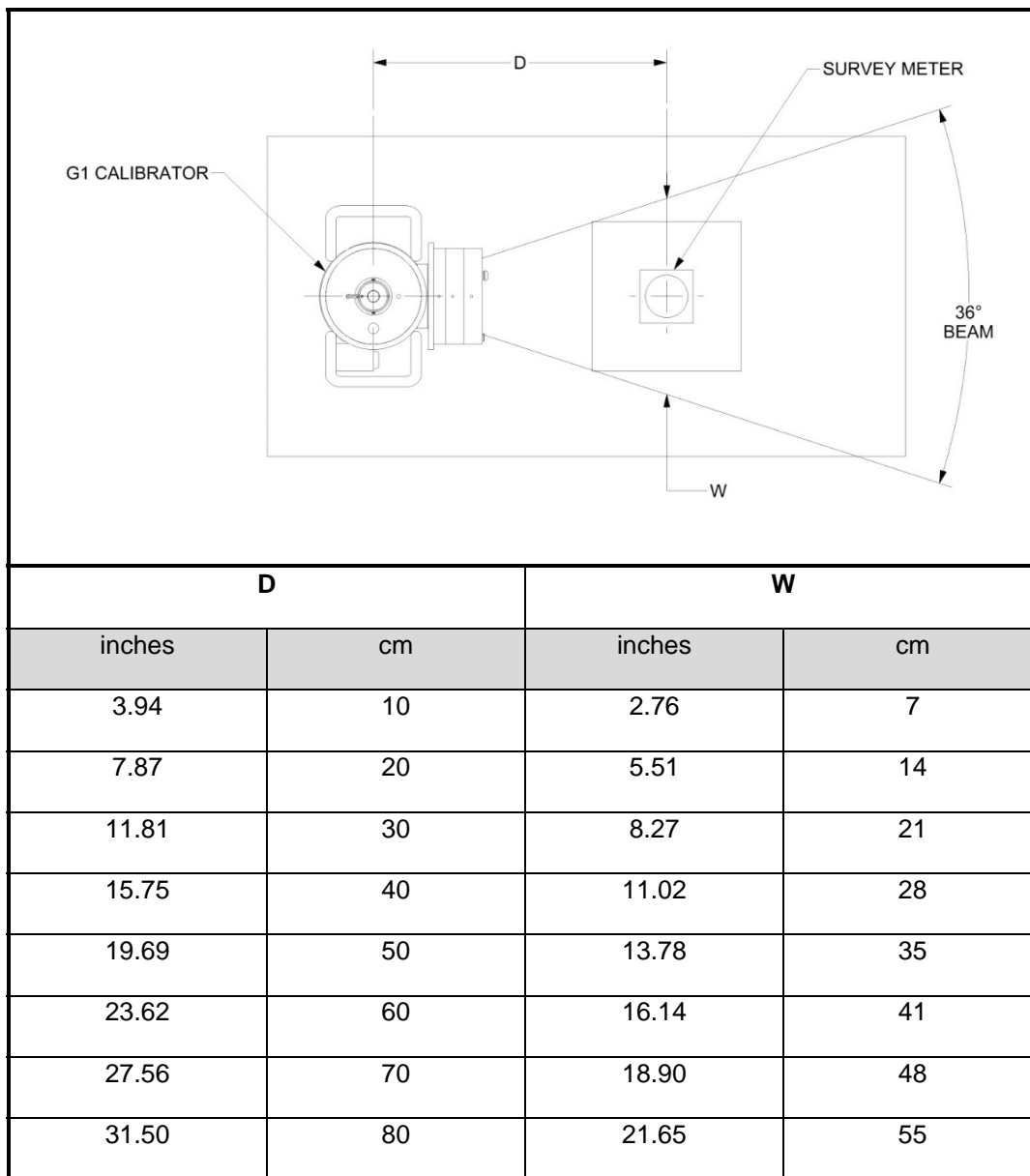


Figure 1 Horizontal beam dispersion (primary radiation beam excluding scatter radiation)

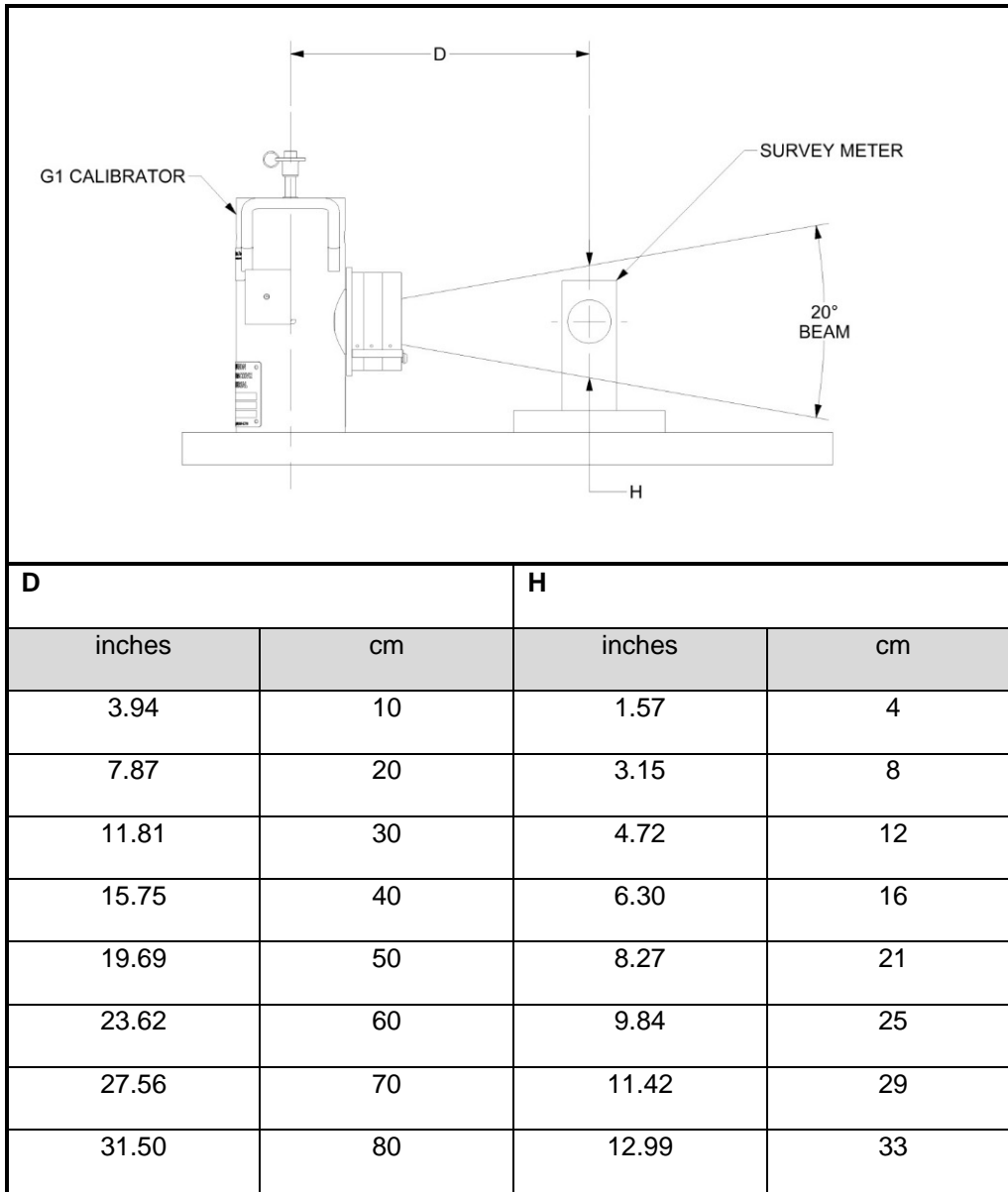


Figure 2 Vertical beam dispersion (primary radiation beam excluding scatter radiation)

2. TECHNICAL SPECIFICATIONS.

Model G1 Gamma Calibrator	
Manufacturer:	Hopewell Designs Inc. 5940 Gateway Drive Alpharetta, GA 30004
Size:	Base diameter: 5 in. (12.7 cm) Height: 10.8 in. (27.4 cm) Width: 8 ½ in. (21.6 cm) Handles welded to the top side of the calibrator make the overall width 8.5 inches (21.6 cm) handle to handle. The security cross pin and padlock make the overall width 6.4 inches (16.3cm) without attenuators attached and 8.9 inches (22.6 cm) with attenuators attached.
Weight (G1):	G1 calibrator: 70 lbs max. (32 kg) Attenuators: 15 lbs max. (6.8 kg) combined Combined weight: 85 lbs max (38.6 kg)
USNRC SDDR number:	NR-1138-D-110-S
Sealed source:	Isotope: Cesium-137 QSA Global, Inc. Model CDC.700 Nominal activity: 200 mCi. (7.4 GBq) +/- 20% Maximum activity: 240 mCi. (8.9 GBq) Emission determinations for the calibrator are traceable to NIST or its international equivalents.
Attenuators (G1):	Three movable attenuators that reduce the applied radiation intensity by a factor of 4, 10, and 10.
Uncertainty:	<5% in accordance with ANSI N323A (1997).
Shipping:	U.S. DOT Specification 7A Type A package.
Shielding:	Lead metal in welded steel body. Lead metal attenuators in aluminum.

Table 1 Technical Specifications

Each source capsule is seal welded and meets the requirements of Special Form radioactive material in accordance with IAEA Safety Series TS-R-1 (1996 Edition Revised) under USA special form certificate USA/0703/S-96. Additionally, the sealed sources have been designed and tested to comply with the requirements of International Standard ISO 2919:2012(E) and American National Standard N43.6:2007 and have achieved an ANSI/ISO classification of C66646.

The source rod assembly and sealed source capsule in the Model G1 calibrator may only be changed or removed by QSA Global, Inc. or one of its authorized service centers. Source changing and replacement or any change in the source for this device requires the use of a shielded cell, specially designed tools, and

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calibration of the emission after servicing. Therefore, all calibrators must be returned to QSA Global, Inc. or one of its authorized service centers for source replacement and/or for source disposition.

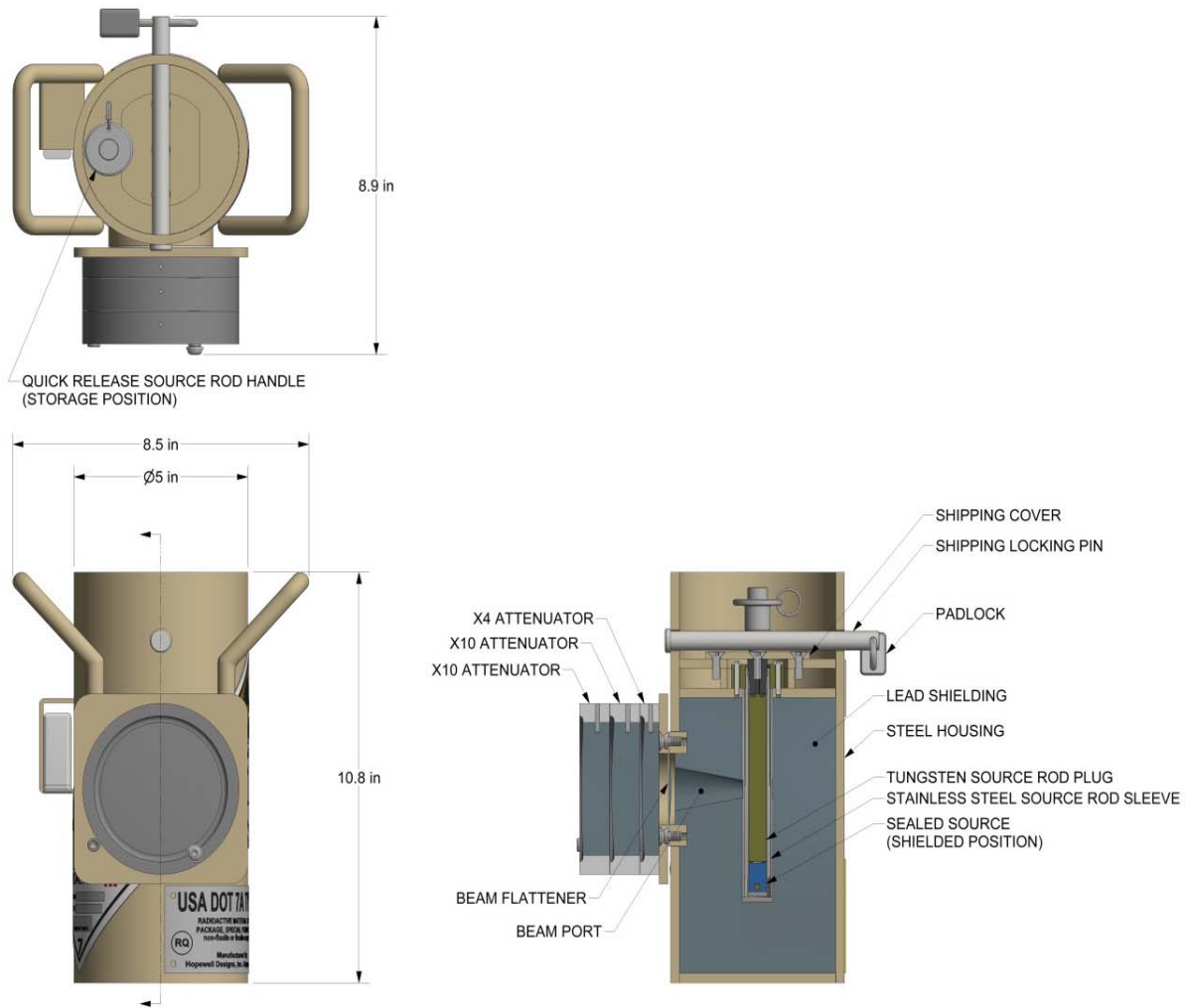


Figure 3 Key elements of the Model G1 calibrator

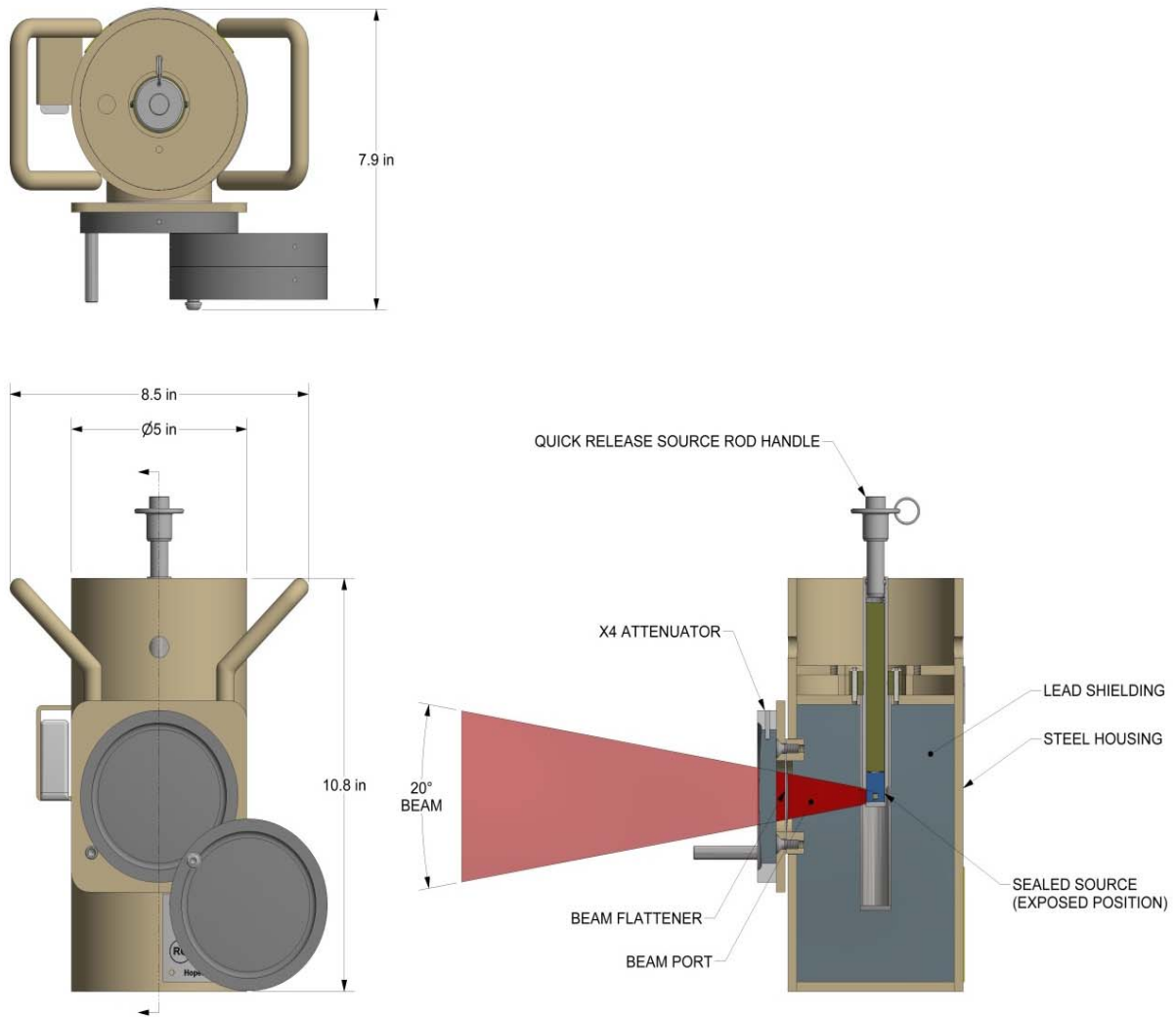


Figure 4 Key elements of the Model G1 calibrator during use

3. RECEIVING.

Inspect the package on receipt for signs of physical damage. If damage is evident, QSA Global, Inc. should be informed and the carrier should be present while unpacking. Upon receipt of a package of radioactive material, the package shall be placed in a restricted area. Ensure the appropriate personnel are notified.

A radioactive material package must be accepted from the carrier at the time it is delivered. If a radioactive material package is to be held at the carrier's terminal for pickup, arrangements must be made to receive notification from the carrier of the arrival of the package at the time of arrival. The package must be picked up expeditiously upon receipt of notification (within three hours if practicable).

A radiation survey of the package must be performed as soon as practicable but at least within three hours if received during normal working hours or within three hours of the next work day if received after normal working hours.

Survey the entire exterior surface of the package at the time of receipt and ensure that the maximum radiation level does not exceed 2 mSv/hr (200 mrem/hr). Survey all sides of the package at one meter from the exterior surfaces of the packages and ensure that the maximum radiation level does not exceed 0.1 mSv/hr (10 mrem/hr). If either of these limits are exceeded, notify the Radiation Safety Officer immediately. Record the maximum radiation levels measured at the package surface and at one meter from the package surface on the Receiving Report. Also record on the Receiving Report the date, the name of the individual making the record, the source model number and serial number, radionuclide, activity, transport package model number, and package serial number.

Ensure that the Model G1 calibrator is locked by installing the security cross-pin and the padlock when not in use. A steel shipping cap is placed over the locked source rod during all shipments of the calibrator or during long term storage. Further, the calibrator must be stored in a security storage area to prevent access by unauthorized personnel.

Keep a copy of the current Operating Manual and the Type A evaluation for the Model G1 transport package on file to ensure you have the proper opening and handling instructions. Ensure that the instructions are followed and any noted special precautions are performed.

4. SHIPMENT OF RADIOACTIVE MATERIAL.

Pre-shipment training requirements:

Prior to shipping hazardous materials, personnel must be trained in accordance with 49 CFR 172, Subpart H and be retrained every three years.

If shipment involves use of a Declaration of Dangerous Goods form, all personnel involved with the shipment must be trained in IATA/ICAO/IAEA requirements every two years. Documentation should be kept in one file. All radiation safety related training used as part of the Hazmat training and IATA/ICAO/IAEA training should be included.

Package and Contents:

Prior to shipment ensure the package and its contents meet the following requirements:

1. The contents are authorized for use in the package.
2. The package is in good physical condition for transport.
3. All locks or required shipping covers, padlocks are properly installed and padlock installed with the key removed.
4. All conditions of the Type A package approval are met.

Maintain copies of the most current Type A package and special form certifications and related drawings on file.

Preparing for shipping:

1. Ensure that the source is secured in the proper shielded position in the shipping package as described in this operations manual. Perform a pre-shipment inspection of the package to verify the package is not damaged and is assembled as described in the Type A package certification.
2. Install the shipping cover and secure the source rod in the stored position by installing the Security Cross Pin and installing the padlock and removing the key. The padlock serves as a tamper indicator.
3. If the shipping package is to be packaged inside a crate or other outer packaging, the outer packaging must be strong enough to withstand the normal conditions of transport and must not reduce the safety of the package. The shipping package must be placed within the outer package or mounted to a shipping pallet with sufficient blocking/bracing to prevent shifting during transportation.
4. Survey the exterior surfaces of the package and ensure that the maximum radiation level does not exceed 200 mrem/hr. Survey the package and ensure that the maximum radiation level does not

exceed 10 mrem/hr at one meter from the exterior surfaces. Determine the proper shipping labels to be applied to the package using the criteria of Table 2.

NOTE: If shipping the Type A container is inside an overpack or convenience box, survey and label both the inner Type A package and the overpack. Placarding the vehicle is dependent on the category of label applied to the overpack if used.

For a package, both the transport index (TI) and the surface radiation level conditions shall be considered in determining which is the appropriate category of radioactive material label. Where the TI satisfies the condition for one category but the surface radiation level satisfies the condition for a different category, the package shall be assigned to the higher category of the two. For this purpose, category White-I shall be regarded as the lowest category.

The TI is the maximum radiation level measured in mrem/hr at a distance of one meter from the external surfaces of the package. When recording the TI, the dose rate units of mrem/hr are not listed. For example, a reading of 2 mrem/hr would indicate a TI = 2.0. (Note that the TI is rounded to the nearest tenth value.)

5. Properly complete two Class 7 shipping labels indicating the contents (Cesium-137), the activity of the source in becquerels or multiples of becquerels (e.g., 200 mCi is equal to 7.4 GBq), and the transport index. The transport index is used only on II Yellow and III Yellow labels and is defined as the maximum radiation level in mrem/hr at one meter from the package surface (see Table 2)
6. Ensure that any old shipping labels have been removed from the package. Apply two properly completed labels to two opposite sides of the package (excluding the bottom surface).




	Maximum Radiation Level at Surface	Maximum Radiation Level at 1 Meter
Radioactive White I 	0.5 mrem/hr (0.005 mSv/hr)	None
Radioactive Yellow II 	50 mrem/hr (0.5 mSv/hr)	1.0 mrem/hr (0.01 mSv/hr)
Radioactive Yellow III 	200 mrem/hr (2 mSv/hr)	10 mrem/hr (0.1 mSv/hr)

Table 2

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7. For air shipments in the USA, the package must be labeled with, "**CARGO AIRCRAFT ONLY**" labels. Ensure that these labels do not cover any other package markings or labels.
8. Mark the outside of the package with the proper shipping name and identification number as shown below if not already marked.

Description	Proper Shipping Name
Type A package containing special form source	Radioactive Material, Type A Package Special Form UN 3332

9. If the shipping package is inside a crate or other outer packaging, mark the outside package with the "**UN identification number**" followed by the "**proper shipping name**". The word "**OVERPACK**" must be marked on the outside package. The required markings must be in letters a minimum of ½ inch high.
10. Ensure that the levels of removable radioactive contamination on the outside surface of the outer package do not exceed 0.0001 microcurie per square centimeters. [49CFR173.443]
11. If the package gross weight exceeds 110 pounds, mark the outside of the package with the permissible gross weight.
12. Properly complete the shipping papers, indicating:
 - a. United Nations number, Proper shipping name, Class Number "7", (i.e., Radioactive Material, Type A Package, Special Form, Class 7, UN 3332).
 - b. Name of the radionuclide (i.e., Cesium-137).
 - c. Physical or Chemical form (i.e., special form).
 - d. Activity of the source in becquerels (or other appropriate multiples of becquerels) on the DOT label and the shipping papers. Note: number of millicuries X 0.037 = number of gigabecquerels (GBq).
 - e. Category of label applied (i.e. Radioactive II Yellow).
 - f. Transport Index.
 - g. USDOT Type A Specification 7A for a Type A shipment.
 - h. Shipper's Certification:

"This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport according to the applicable regulations of the Department of Transportation."

For air shipments, the following shipper's certification may be used:

"I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable transport requirements have been met."

For air shipments within the USA, the following statement:

"THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR CARGO AIRCRAFT ONLY."

NOTE: For shipments in company vehicles to and from job sites, the shipper's certification is not required.

- i. The shipping papers must indicate your company's emergency phone number. This phone number must have 24-hour coverage in case of an emergency concerning your shipment. The phone number must be clearly visible on the shipping paper and must be answered by a person that can provide immediate emergency response information. Beepers, pagers and callbacks are not acceptable.
13. For air shipments, the shipping papers must meet the requirements specified in IATA for a Shipper's Declaration for Dangerous Goods. In addition to the information listed in Section 12 of this part, the following information needs to be specified:
- a. Air Waybill Number: Enter the number of the air waybill to which the declaration form will be attached. (This may be amended by the carrier).
 - b. Aircraft Limitations: Specify that the shipment is within the limitations for "Cargo aircraft only." A notation can be added in the handling information box of the Shipper's Declaration which states "This shipment may be carried on passenger aircraft outside U.S. jurisdiction."
 - c. Airport of Departure: Enter the full name of the airport of city of departure, which may be amended by the Carrier.
 - d. Airport of Destination: Enter the full name of the airport or city of destination, which may be amended by the Carrier.
 - e. Shipment Type: Specify the shipment type as "Radioactive."
 - f. Under Nature and Quantity of Dangerous Goods, specify the number of packages (of same type and content), their type of package, and activity in becquerels or multiples thereof (units used must be clearly indicated) in each package, including packages in overpacks.

(If relevant) Indication of use of overpack and dimensions of the overpack (including dimensional units). When an overpack is used, the wording "overpack used" must be inserted on the declaration form immediately after all the relevant entries relating to the packages within the overpack. In such cases, packages within overpacks must be listed first. Dimension units must be in multiples of meters.
 - g. The 24-hour emergency number required by Step 12.i. of this part, must appear in the "Additional Handling Information" section of the Declaration for Dangerous Goods.
 - h. For shipment of special form radioactive material, the USDOT Special Form Certificate of Competent Authority for the radioactive source must be included (i.e., USA/0703/S-96).

For shipment of Type A packages, maintain a copy of the Type A package justification on file for at least one year after the date of the latest shipment.

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The information on the Declaration for Dangerous Goods must be entered strictly in accordance with the order specified in the latest edition of the International Air Transport Association, Dangerous Goods Regulations. Questions regarding completion of a Shipper's Declaration for Dangerous Goods should be directed to the Radiation Safety Officer.

If you are shipping a source to another licensee, you must track the shipment to ensure the intended recipient received the shipment within the expected timeframe. If they do not receive the shipment within the “not later than” time established, regulatory agencies must be notified immediately by the shipper.

5. SAFETY PRECAUTIONS AND MAINTENANCE.

The Model G1 calibrator contains a radioactive source which emits penetrating gamma radiation. This radiation can cause injury if the unit is improperly used.

In general, routine maintenance on the Model G1 calibrator is not required, but a daily visual inspection and simple operability checks should be conducted before and during use. The verifications would include checking the legibility of the calibrator warning label identifying "Radioactive Material", the trefoil, the make and model number, isotope, and maximum activity. The calibrator must also have a legible metal source identification tag with information for the source manufacturer, model number, serial number, isotope and a date the activity of the source was measured. The security cross pin and padlock must be installed and engaged whenever not being used by authorized personnel.

Any service requiring disassembly of the device or removal of the source must only be performed by QSA Global, Inc. or one of its authorized service centers. Never remove the security screws which secure the source rod retaining collar. Only the manufacturer or authorized service center is authorized to remove the security screws.

Although the Model G1 calibrator (with the source stored) has radiation levels which are well below the maximum permitted for transportation, $<800\mu\text{Sv/hr}$ ($<80\text{ mR/hr}$), on the surface, personnel should not remain close to the calibrator any longer than necessary. For lengthy or repeated measurements, additional shielding should be placed between the calibrator and the operator to minimize their radiation exposure.

The calibrator must only be used in the upright position. During use do not put any part of your body in the radiation beam. Check that the source rod holding the source moves to the stored position when the source rod is pushed down to the stored position. If the source fails to return to the stored position when pushed down, notify the site Radiation Safety Officer for assistance. Do not leave the calibrator unattended with the source in the exposed position.

 **DANGER - IMPORTANT WARNING** 

Personnel should not enter the area of the radiation beam or expose any part of the body to the radiation beam. Failure to comply will expose them to the risk of potential radiation injury.

6. SELECTING LOCATION OF USE AND CALIBRATOR SET-UP.

Locate the calibrator in a restricted area in such a way that the radiation beam will be aimed horizontally towards an area from which all personnel can be excluded.

To minimize the effects of scattered radiation, the unit must be placed so that the primary beam does not strike a wall, floor, or ceiling for at least ~16.5 feet (5 meters).

Place an instrument support in front of the calibrator to locate instruments undergoing calibration at the correct position in the primary beam (see Figure 1 and Figure 2). The supports used to elevate the instrument detector in the centerline of the primary beam should be made of low "Z" materials, such as Styrofoam or wood. The detector of the instrument being calibrated should be aligned perpendicular to the axis of the beam and the distance measured from the centerline of the sealed source to the centerline of the detector.

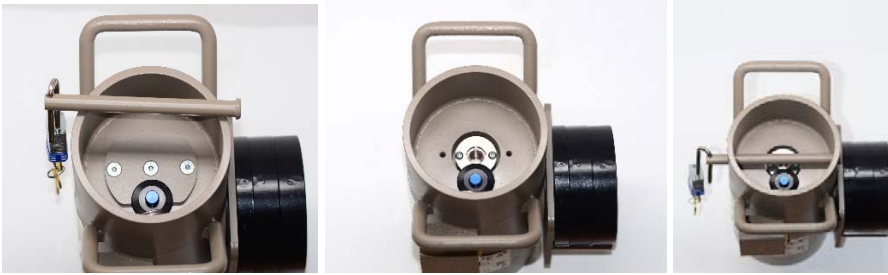
Preparing the calibrator for use and/or storage:

1. Remove the four screws holding the beam flattener in place.



2. Attach the manual attenuator set to the calibrator with the beam flattener placed between the mounting plates using the flat head screws provided. The beam flattener is a component of the emission calibration and must always be used during calibrations. Do not use the calibrator if the beam-port beam flattener is missing or damaged.
3. Use the key to unlock the padlock and remove the security cross pin.

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4. Remove the shipping cap and store for later usage and shipments. Please note the shipping cover is part of the Type A transport package. You cannot ship the calibrator without the shipping cap installed.
5. Press and hold the button on the quick release pin and place it in the holder next to the source rod.
6. Replace the security cross pin and padlock until the calibrator will be used. Ensure the key is kept in a secure location to prevent unauthorized use. Store the calibrator in a clean, dry, security designated storage area. The storage area is the designated area listed on the radioactive materials license that prevents access by unauthorized personnel and will minimize any threat from theft, fire, explosion, or security related issues. If the calibrator is used infrequently it is recommended to place the device in the shipping configuration to prevent dirt, dust, and debris from collecting around the source rod.

7. SEALED SOURCE ACTIVITY AND DISTANCE CALCULATIONS.

For proper calibration of a linear scaled survey instrument, its response must be determined for two applied intensities on each of its ranges. These intensities should be separated by at least 50% of the full-scale reading. Instrument reading must agree with the actual radiation intensity within $\pm 20\%$ for use in industrial radiography applications to be in satisfactory calibration. Other applications, including medical uses, may require a tighter calibration accuracy of $\pm 10\%$. Consult your license regulations and approvals as applicable for your operations.

Determine the current source activity from a source certificate decay chart or use the following formula:

$$A = A_0 e^{-kt}$$

Where:

A = the present activity of the source

A_0 = the activity at the original date when the source was calibrated

t = the number of months elapsed since source calibration

k = the decay constant = $\ln(2) / T_{1/2}$. $K = 0.00192 \text{ month}^{-1}$ for Cs-137

To establish the distance "D" at which a given unattenuated intensity will occur, use the following formula:

$$D (cm) = 0.929\sqrt{A \div I}$$

where:

A = the present activity of the source in MBq

I = desired unattenuated intensity in mSv/hr (usually 80% of full scale)

or

$$D (in) = 22.2\sqrt{A \div I}$$

where:

A = the present activity of the source in mCi

I = desired unattenuated intensity in mR/hr (usually 80% of full scale).

For example: If the decayed source activity is 5,402 MBq (146 mCi) and the desired intensity is 8 mSv/hr (800 mR/hr), the distance according to the formula would be:

$$D (cm) = 0.929\sqrt{5402 \div 8} = 24.1 \text{ cm}$$

or

$$D (in) = 22.2\sqrt{146 \div 800} = 9.5 \text{ in}$$

8. CALIBRATION.

The typical procedure described below assumes that a survey meter with three linear ranges is to be calibrated. The ranges in this example are:

X100 scale:	measures 0 to 1,000 mR/hr (0 to 10 mSv/hr)
X10 scale:	measures 0 to 100 mR/hr (0 to 1 mSv/hr)
X1 scale:	measures 0 to 10 mR/hr (0 to 0.1 mSv/hr)

1. Before calibration, clean and inspect the survey meter for damage or defects that may qualify the instrument as unsuitable for calibration until repairs are accomplished. Damage could include broken glass on the meter movement, a loose knob used to change scales, missing screws or gaskets, battery check function that doesn't work or falls below acceptable voltage requirements, fails an operability check, cracks or perforations in the instrument housing, loose handles, etc. As required, ensure new batteries are installed before calibration. Record the results of the pre-calibration inspection and operability checks including details of any repairs, damage found, replacement of missing parts or adjustments performed.
2. Turn on the survey meter and allow it to "warm up" for five to ten minutes.
3. Determine the activity of the source on the date of use as described in Section 7.
4. Calculate the distance from the source at which the radiation intensity would be 80% of full scale deflection (fsd) (i.e., 800 mR/hr) on the high range from Section 7. The calibration distance is measured from the centerline of the source rod to the centerline of instrument detector that has been positioned perpendicular to the central axis of the beam.
5. Use Figure 1 and Figure 2 to check that the beam height and width at the calculated distance are sufficient to irradiate the survey meter's detector fully. If not, a lower intensity must be chosen, but the intensity must be at least 50% of fsd. If less than 50%, contact QSA Global, Inc.
6. Using the tape measure attached to the Model G1 calibrator, place the center of the survey meter's detector at the distance determined in Sections 7. Align the centerline of the detector with the beam axis (5.1 in. / 13 cm above the base of the Model G1). The detector centerline is often indicated by markings on the survey meter case.
7. Use the key to unlock the padlock and remove the security cross pin. **Gently rotate** all the attenuators out of the radiation beam path. Set the survey meter on high range (X100 scale). Attach the source rod handle to the source rod.



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8. Stand away from the radiation beam and expose the source by raising the source rod until it reaches its internal stop. Observe the survey meter reading without entering the radiation beam.



- a. Note and record the survey meter reading. Release the source rod and ensure that it returns to the stored position.
- b. The meter reading should be 80% ($\pm 20\%$) of fsd. The percent error is calculated by taking the ratio of the instrument's response over the applied radiation intensity (i.e.: 820 mR/hr / 800 mR/hr = 1.025 or +2.5%). If the instrument falls outside of the acceptable error, release the source rod to store the source, adjust the meter sensitivity, and repeat the calibration.

⚠ IMPORTANT WARNING ⚠

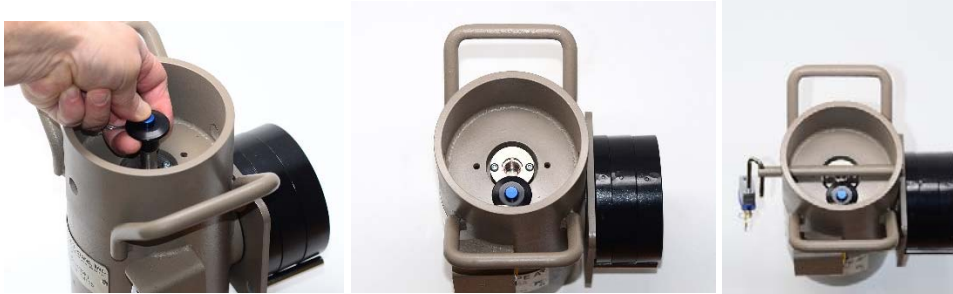
Warning: always return the source rod to the fully stored and shielded position whenever moving attenuators into place during calibration procedures. Also, never place extremities or any portion of the body into the primary beam if adjustments are needed for the instrument being calibrated. Always store the source rod first. Unnecessary exposure to radiation is excessive exposure.

9. Shift the 0.25 attenuator into the beam and repeat step 8.a. The reading should be 20% ($\pm 20\%$) of fsd (i.e. 0.25 x 80%). Adjust the sensitivity if necessary after releasing the source rod to store the source.
10. Set the meter on its middle range (X10 scale). Remove the 0.25 attenuator and place a 0.10 attenuator in the beam. Repeat step 8; the reading should be 80% ($\pm 20\%$) of fsd.
11. Add the 0.25 attenuator to the 0.10 attenuator in the beam and repeat step 8.a. The reading should be 20% ($\pm 20\%$) of fsd.
12. Set the meter on its low range (X1 scale). Remove the 0.25 and place both of the 0.10 attenuators in the beam. Repeat step 8; the reading should be 80% ($\pm 20\%$) of fsd.
13. Place all three attenuators in the beam and repeat step 8.a. The reading should be 20% ($\pm 20\%$) of fsd.

NOTE: Should the desired reading not be attainable by adjustment of the sensitivity control, the survey meter should be repaired by a qualified technician and recalibrated before use.

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14. After calibration is complete, disconnect the source rod handle from the source rod, install (shipping cap for long term storage or shipments) the security cross-pin, and padlock to prevent unauthorized use.



15. Attach a new calibration sticker onto the calibrated instrument and complete the required documentation for the results of the calibration.

9. LEAK TESTING.

The source assembly used in the Model G1 must be leak tested for removable radioactive contamination at intervals not to exceed six months or at intervals specified by local Regulatory Authority requirements. This can be accomplished using QSA Global, Inc. Model 518 Leak Test Kit or equivalent test kit.

This test must be performed in a properly secured Controlled Area. The individual performing this test should wear a direct reading pocket dosimeter and either a film badge or thermoluminescent dosimeter. The individual should also use a properly calibrated and operable radiation survey instrument.

1. Set a survey meter on its most sensitive range in a low background area away from the calibrator to establish the ambient background radiation level.
2. Unlock the padlock and remove the security cross pin.
3. Dampen the wipe test swab with EDTA solution or alcohol. Wipe around the top of the source rod located in the center of the shield.
4. Place the wipe test swab in the plastic envelope.
5. Take the swab, in its plastic envelope, to the survey meter and note the reading when the envelope is in contact with the meter.
6. If there was no measurable increase above the background radiation level, proceed with the next test by attaching the quick release source rod handle to the source rod.
7. Standing away from the beam port, raise the source rod to the expose position and wipe the exposed source rod thoroughly. Release the source rod to store the sealed source, then secure with the security cross pin and padlock.
8. Place the swab in the plastic envelope and take it to the survey meter. Note the reading when the envelope is in contact with the meter. If there was no measurable increase above the background radiation level, the swab may be taken to a sensitive radiation instrumentation capable of detecting less than 0.005 μCi ($< 185 \text{ Bq}$). The leak test can be sent by mail for radio-assay to QSA Global, Inc. Be sure to complete and return the wipe test identification form.

DO NOT MAIL OR SEND THE WIPE TEST PATCH if the meter reading of the swab indicates any increase above the background radiation level, contact QSA Global, Inc. for further instructions.

10. ROUTINE MAINTENANCE – INSPECTIONS.

The calibrator has been designed and built using the finest components available to ensure maximum performance with minimum maintenance. All components have life cycles that should last beyond the expected useful life of the source and calibrator. The following items should be checked periodically:

Description	Inspection Frequency	Action
Leak testing	6 months	Check sealed source for radioactive material leakage.
Source movement	6 months	Verify movement is smooth and the spring plungers can support the source rod in the exposed position.
Inspection	6 months	Physical inspection for corrosion prevention and legibility of the required warning, make, model and source identification labels.
Lubrication	None	<u>Do not</u> use any lubricants on this device.

Table 3 Maintenance Schedule

The Model G1 device cannot be repaired, disassembled, or modified at all by the end user. If any problems arise with the shield or source, place the device in a safe configuration and contact QSA Global, Inc. immediately.

11. DISPOSAL.

When the calibrator and/or the sealed source have reached the end of their working life, they shall be dispositioned by transfer to a licensed recipient in accordance with applicable regulatory requirements.

Authorized recipients will provide any specific conditions to the shipper as required by regulatory authorities. As a minimum, sources that are transferred for a final disposition must be within a current 6-month leak test and properly secured within an authorized package before shipment.

Damaged, modified or contaminated source assemblies may require special handling and special transport containers. Notify the authorized recipient for specific instructions in these circumstances.

12. WARRANTY AND LIMITATION OF LIABILITY.

In accordance with QSA Global, Inc.'s Terms and Conditions of Sale available at www.qsa-global.com.

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