

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 1 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

DEVICE MODEL: C-1

SEALED SOURCE MODELS: T-5, T-1, T-1F, T-6, G-60, G-1, G-1F, G-1T, G-3, G-3F, G-40F, G-40T, G-41F, G-41T, B-16F, B-16T, and equivalent sources of other manufacturers

MANUFACTURER/DISTRIBUTOR:

Source Production and Equipment Co., Inc. (SPEC)
113 Teal Street
St. Rose, Louisiana 70087-9691

ISOTOPE: Iridium-192
Depleted Uranium
Selenium-75
Ytterbium-169

MAXIMUM ACTIVITY: 300 Curies
Shielding, 17 kilograms

LEAK TEST FREQUENCY: Not Required

PRINCIPAL USE: Industrial Radiography

CUSTOM DEVICE: No

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 2 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

DESCRIPTION:

The C-1 device consists of an outer housing and an inner changer unit (See Appendix A, Drawing D322010). The outer housing is a nominal twelve (12) gallon open head, twenty (20) or twenty two (22) gauge steel drum with a snap ring or bolt ring closure, and is manufactured in accordance with the National Motor Freight Classification Item 260, 100-H or succeeding issues. This outer housing is partially filled with polyurethane foam to position the changer unit in the center of the housing and limit movement during normal conditions of transport. The top of the outer housing is secured by a snap ring or bolt ring closure (See Appendix A, Drawing No. D322000, pages 1-2).

The changer unit consists of a depleted uranium shield inside of a rectangular steel box. The following design features protect the integrity of the depleted uranium shield by preventing movement of the shield within the rectangular steel box: the changer unit provides direct contact between the depleted uranium and the adjacent panels on all sides, and the shield's hot top is secured in place by a hot top ring welded to the wall of the steel box (that houses the depleted uranium shield).

Outlet nipples are affixed to the outer end of the changer unit J-tubes for attachment of the source transfer tubes when making source exchanges (See Appendix A, Drawing No. D311000, pages 1-5)

One half of the changer unit is painted red and the other half is painted blue. When the unit is used for one new source and one old source, this color system provides an indication of the side in which the new source is contained (the new source is on the red side).

The maximum gross weight of the device is one hundred (100) pounds.

Materials of Construction

The changer unit is constructed of commercial ASTM A-569 grade carbon steel, 1/8 inch (0.03 cm) nominal thick plates welded together to form a rectangular box approximately 9 ³/₁₆ inches, (23.3 cm) high, 7 ¹/₂ inches (19.1 cm) wide and 7 inches (17.8 cm) deep which contains and supports a depleted uranium shield. Carbon steel is used for the door brackets. The hot top ring and components of the lock housing are stainless steel. Brass is used in the outlet nipples. The radiation shield is a depleted uranium casting with two titanium or zircalloy J-tubes inside. The carrying handle is made of stainless steel and PVC, although according to the manufacturer, the handle is not a structural part of this

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 3 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

Materials of Construction (continued)

device. The identification plate is stainless steel. Fabrication and examination methods used in the construction and inspection of the inner changer unit are described on Drawing No. D311000, pages 1-5, in Appendix A.

Protection from radiation is provided by approximately two (2) inches of depleted uranium which is cast around a titanium or zircalloy U-tube with a septum in the middle forming two (2) J-tubes (See Appendix A, Drawing No. D311001).

These construction materials are stable, common metals which are not known to present chemical, galvanic or other reactions between the various metals. All of the materials are inert to reaction with water, except for slow corrosion. An iron-uranium eutectic has been shown not to exist.

The outer housing is constructed of twenty (20) or twenty two (22) gauge steel and polyurethane foam.

Source(s) Securement and Locking

The source assembly(s) are not mounted in the device. They are held in the secured position by the following features:

- Each source assembly is contained within the changer unit by a locking plunger which restricts rear movement of the source capsule,
- and by the permanent septum in the U-tube which forms two (2) J-tubes and which prohibits forward movement.

The operation of the locking plungers is not affected by the source assembly length, connector, and locking ball. Each locking plunger is spring loaded to prevent inadvertent retraction of the locking plungers due to reasonable foreseeable vibration, impact, or temperature. The lock plungers must be engaged in order for the front door to fully close.

These lock plungers ensure that the source will not be accidentally withdrawn from the changer when connecting or disconnecting the drive cable to or from a source assembly in accordance with CFR 34.20.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 4 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

Source(s) Securement and Locking (continued)

Additional security of the source assemblies in the changer unit is provided by closing both doors together. Lock hasps are attached to the top and front doors. The lock hasps are designed to keep both doors in close contact regardless of the size or design of the padlock. This design feature prohibits partial opening of the front door which provides a redundant safety feature to keep the lock plungers in the secure position. The padlock and design of the lock hasps prevents unauthorized or accidental removal of the sealed source(s) from its shielded position.

C-1 Source Changer Device – Overall Operation

- Only trained radiography personnel, authorized by the licensee, may open the C-1 device.
- The top of the outer housing is removed from the outer housing and changer unit.
- The changer unit is lifted out of the outer housing. The padlock is removed. Both doors are opened and the source transfer tube is connected between the outlet end of the exposure device and the changer unit's outlet nipple.
- To insert or remove a source assembly, the lock plunger is pulled out against spring tension and rotated ¼ turn, retracting the plunger. Source transfer with remote control assembly may then be accomplished.
- Once the source exchange is done, the lock plunger is rotated until it snaps into its engaged position, then the changer unit is replaced into the outer housing, and the outer housing top is secured in place with the bolt/snap ring.

LABELING:

C-1 Source Changer Nameplate

The nameplate is marked with SPEC's name address, device gross weight, proper shipping name and Certificate of Competent Authority number. It is constructed of permanently marked stainless steel and is approximately 8.0" wide by 5.0" high. The nameplate has black letters written on a yellow background with a magenta trefoil. This label is attached to the side of the device with stainless steel rivets. See Appendix A Drawing No. D322000.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 5 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

The C-1 Source Changer Caution Label

The caution label is marked with "Caution Radioactive Material" and "Do Not Handle", "Notify civil authorities if found". It is made of permanently marked, etched or embossed stainless steel. The label is yellow with magenta trefoil and black lettering and measures 4¼ " wide X 2½ " high and is attached to the side of the device outer housing with stainless steel rivets. See Appendix A, Drawing No. D322000.

The Source Tag

A source tag is provided with each source shipped which identifies the isotope, source model, serial number, activity, manufacturer, and date of manufacture. The source tag meets the requirements of 10 CFR 34.20(b)(1) and ANSI N432-1980. It measures approximately 2 5/8" wide X 3/4" high.

Changer Unit Nameplate

The nameplate is marked with SPEC's name, address, device model, serial number, and mass of depleted uranium. It is made of permanently marked, embossed or etched stainless steel and measures approximately 6½ " wide X 7 ½ " high. The nameplate had black lettering on a yellow background and is attached to the front door of the changer unit with stainless steel rivets. See Appendix A, Drawing No. D311002.

C-1 Changer Unit Caution Label

The caution decal is marked with "Caution Radioactive Material" and "Notify civil authorities or SPEC" and with SPEC's address. The decal is yellow with black lettering and a magenta trefoil. It measures 3 1/3 " wide X 2 ¼" high and is attached to three (3) sides of the changer unit. See Appendix A, drawing D311002.

DIAGRAMS:

- See Appendix A, Drawing D322010
- See Appendix A, Drawing No. D322000, pages 1-2
- See Appendix A, Drawing No. D311000, pages 1-5
- Appendix A, Drawing No. D311001
- Appendix A, Drawing No. D311002

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 6 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

CONDITIONS OF NORMAL USE:

Intended Use

The C-1 source changer is intended to be used to transfer sealed Iridium-192, **Selenium-75**, **Ytterbium-169** sources to and from industrial radiography licensees and authorized distributors for exchange of sources.

Intended Users

Users of the device are required to be specifically licensed by the U.S. Nuclear Regulatory Commission (NRC) or an agreement state to perform industrial radiography. The individual users of the device must be specifically authorized persons who have been formally trained in the use of this device, the proper use of survey instruments and radiation safety. This device must be used in strict compliance with the licensee's operating and emergency procedures and applicable regulations.

Locations of Use

The source changer is intended to be used where industrial radiography is performed, regardless of the industry or locations. Common industrial locations are associated with oil field, petrochemical, marine, construction (such as bridges and buildings), and the aerospace industries. It is expected that sources may be exchanged at offshore locations, piping and structural fabrication yards, petrochemical plants and refineries, shipyards, foundries, building sites, utility companies and airline inspection/maintenance locations.

Use of the C-1 is not limited to these locations.

Occasions and Frequency for Persons to be Near the Device

Only trained radiography personnel, authorized by the licensee, should be near the device while exchanging sources. It is expected that other persons, such as shipping, receiving, and transport personnel will be near the device once it is prepared for transport. The device is not intended to be near unmonitored members of the public who are not involved with transport, storage, or other authorized use of the device.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 7 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

Environmental and Operational Conditions

The SPEC, C-1 source exchanger is designed to perform source exchanges at field sites and permanent facilities with a broad range of environmental conditions. It will operate properly within a temperature range of -40 degrees F to +180 degrees F and all levels of relative humidity. It is resistant to corrosion from typical industrial and environmental atmospheres. It is not intended for use under water. Vibration encountered as a result of normal use, handling, storage, and transportation will have no impact on the device or its safety features.

Useful Life

The inner changer unit has been approved for use since June 26, 1975, and most units are still in use today. Currently, there are approximately two hundred (200) C-1 source changer devices in use and the estimated working life of the changer unit is fifty (50) years or more.

PROTOTYPE TESTING:

Locking Effectiveness

The capability of the lock plungers to ensure that the source(s) will not be accidentally withdrawn from the changer when connecting or disconnecting the drive cable from a source assembly (in accordance with 10 CFR 34.20) is tested by applying a tensile load of fifty (50) pounds to the source assembly (in the locked position). The integrity of this locking system is verified during fabrication and prior to use.

Device Integrity

The C-1 source changer passed the 30' free drop test required for Type B packages. This test simulates the most reasonably foreseeable and most rigorous likely accidental condition. The test resulted in no release of the source assembly, and the radiation levels remained well below the test criteria for the hypothetical accidental conditions.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
 SAFETY EVALUATION OF SEALED SOURCE
 (AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 8 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

EXTERNAL RADIATION LEVELS:

Surface Radiation Profile

The radiation dose rates (dose rates extrapolated to 300 curies of iridium-192) contained in the table below demonstrate that radiation levels for the C-1 source changer do not exceed 200 mrem/hr at any exterior surface with the source(s) in the shielded position in accordance with 10 CFR 34.21.

RADIATION DOSE RATES AT THE SURFACE Extrapolated for a 300 curie iridium-192 source (mrem/hr)		
Position	Average	Maximum
Sides	51.1	124.4
Top	12.6	17.5
Bottom	89.9	121.9

Radiation Profile at 1 Meter

The radiation dose rates (extrapolated to 300 curies of iridium-192) contained in the table below demonstrate that radiation levels for the C-1 source changer do not exceed 10 mrem/hr at one (1) meter with the source(s) in the shielded position in accordance with 10 CFR 34.21.

RADIATION DOSE RATES AT ONE (1) METER Extrapolated for a 300 curie iridium-192 source (mrem/hr)		
Position	Average	Maximum
Sides	2.25	3.25
Top	0.36	0.87
Bottom	4.87	5.87

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 9 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

Radiation Profile Levels for ⁷⁵Selenium

	At Surface	At 1 meter from Surface
Calculated (36 mm Uranium)	0.063 mR/hr	0.0014 mR/hr

Radiation Profile Levels for ¹⁶⁹Ytterbium

	At Surface	At 1 meter from Surface
Calculated (36 mm Uranium)	3.25×10^{-9} mR/hr	1.43×10^{-10} mR/hr

QUALITY ASSURANCE AND CONTROL:

The C-1 source changer is manufactured under the control of the SPEC Quality Assurance Program, which has received a Quality Assurance Program Approval for Radioactive Material Packages (Number 0102) by the U.S. NRC. The Quality Assurance Program encompasses the design, fabrication, assembly, testing, use, repair, and maintenance of radioactive material packages, exposure devices, source changers, sources, and associated equipment.

Each C-1 source changer is provided with a QA Final Inspection Certificate. The certificate records the maximum radiation profiles of the device at the surface and at one (1) meter. It certifies the results of the device operation inspection, performed in accordance with the operational checklist. Final inspections include an audit for all fabrication and QA inspection records, and a visual inspection of marking and labeling.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

- A. The C-1 source changer shall be distributed (in the U.S.) only to specific licensees of the U.S. Nuclear Regulatory Commission or Agreement States.
- B. Only personnel trained in the Operating Procedures by the licensee or the manufacturer may open the outer package and perform source exchanges.
- C. The manufacturer is required to furnish all users with revised and detailed Operating and Emergency Procedures (in accordance with the "Written Notification Plan" submitted to LDEQ) including safety precautions designed to assure doses as low as reasonably achievable (ALARA). All user licensees of the C-1 should adopt these new Operating and Emergency Procedures immediately.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 10 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE CONTINUED:

- D. The SPEC C-1 is suitable for shipment and storage of the following SPEC sources: G-1, G-1F, G-1T, G-3, G-3F, G-60, G-41F, G-41T, G-40, G-40T, B-16F, B-16T, T-5, T-5F, T-1, T-1F, T-6, and equivalent sources of other manufacturers.
- E. The inner unit of the device shall only be stored while inside of the outer housing.
- F. The inner unit of the device is *only* to be removed from the outer housing to perform source exchanges.

SAFETY ANALYSIS

According to SPEC, the model C-1 source changer meets the requirements specified in 10 CFR Subpart C "Equipment". Compliance with these requirements was determined by documented prototype testing.

SPEC has submitted sufficient information to provide reasonable assurance that under ordinary conditions of handling, storage, and use of the device, the radioactive material contained in the device will not be released or inadvertently removed from the source housing.

Based on the review of the Model C-1, and the information and test data submitted, we continue to conclude that the device is acceptable for licensing purposes.

Furthermore, we continue to conclude that the device would be expected to maintain its integrity for normal and accidental conditions of use.

REFERENCES:

Source Production and Equipment Company, Inc. submitted 10 CFR Part 71 Test Report, Supplement No. 6, dated July 1, 1997.

Source Production and Equipment Company, Inc. Quality Assurance Program, Revision 5, dated August 20, 2001.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 11 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

REFERENCES (continued)

Source Production and Equipment Company, Inc. Revised Operating Instructions for SPEC Model C-1 Source Changer, dated September 27, 2001.

Source Production and Equipment Company, Inc. letter (not dated but received by the Department November 13, 2001) and application to amend this Sealed Source and Device Registration Certificate, with enclosures thereto.

Louisiana Department of Environmental Quality (LDEQ) email sent to Michele Burgess of the U.S. NRC dated February 27, 2002.

Source Production and Equipment Company, Inc. letter dated March 7, 2002 to LDEQ submitting additional information requested by the Department.

LDEQ letter to SPEC dated March 12, 2002, requesting additional information.

Source Production and Equipment Company, Inc. letter dated March 19, 2002 responding to the Department's letter dated March 12, 2002.

LDEQ email dated April 18, 2002, from Mary Haik to Dr. John Jankovich, of the U.S. NRC dated April 18, 2002.

Source Production and Equipment Company, Inc. letter dated April 25, 2002 to LDEQ.

U.S. NRC email dated August 5, 2002 from Bruce Carrico to Mary Haik at LDEQ.

LDEQ email dated September 13, 2002 from Michael Vince to Michael Henry and Jodi Miller.

LDEQ email dated September 17, 2002, from Michael E. Henry to Jodi Miller, Ann Troxler, and Mary Haik dated September 17, 2002.

LDEQ email dated September 27, 2002 from Mike Henry to Jodi Miller.

Source Production and Equipment Company, Inc. fax dated September 30, 2002.

Source Production and Equipment Company, Inc. email from Kelley Richardt dated October 24, 2002.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO. LA-612-D-102-U

DATE: May 5, 2008

PAGE 12 OF 12

DEVICE TYPE: Industrial Radiography Source Changer

REFERENCES (continued)

Source Production and Equipment Company, Inc. "Written Notification Plan" dated November 12, 2002.

LDEQ fax to SPEC dated November 15, 2002 requesting information regarding the "Written Notification Plan".

Source Production and Equipment Company, Inc. fax to LDEQ dated November 15, 2002.

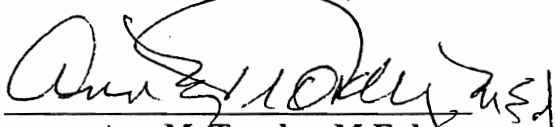
Source Production and Equipment Company, Inc. letter dated December 7, 2007 to LDEQ.

Source Production and Equipment Company, Inc. email dated April 23, 2008 to LDEQ.

ISSUING AGENCY:

State of Louisiana, Department of Environmental Quality, Office of Environmental Services,
Permits Division

Date: May 5, 2008 Prepared By: 
James M. Pate III, M.S.

Date: May 5, 2008 Concurrence: 
Ann M. Troxler, M.E.d.

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