

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE

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DEVICE TYPE: Moisture Detector - Bunker Probe

MODEL: LB 6600 (Series)

DISTRIBUTOR: Apgee Corporation
Hopewell Business & Industrial Park
103 Corporation Drive
Aliquippa, PA 15001

MANUFACTURER: EG&G Berthold
Calmbacher Strasse 22- Postfach 160
D-7547 Wildbad 1
Germany

SEALED SOURCE MODEL DESIGNATION: Amersham Radiochemical Centre
Model X2 (Drawing No. 3A11001)

ISOTOPE: MAXIMUM ACTIVITY:
Americium-241:Be 100 millicuries (3.7 GBq)

LEAK TEST FREQUENCY: 6 months

PRINCIPAL USE: (G) Portable Moisture Density Gauge

CUSTOM DEVICE: _____ YES _____ X _____ NO

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DESCRIPTION:

The Model LB 6600(Series) Moisture Detector Bunker Probe is used for measuring the moisture or hydrogen content of materials in containers. See Attachment 1(B)

The probe consists of a stainless steel tube (casing) of about 36 mm (1.42") or 70 mm (2.76") diameter, about 500 to 600 mm (19.69 to 23.62") length, and wall thickness of at least 1.5 mm (0.06"). Within the tube are a doubly encapsulated (stainless steel) 100 mCi (3.7 GBq) Am-241/Be neutron source and either of two neutron detection systems.

The distributor marketed the device with a source designated as Model X2 (Drawing No. 3A11001). The device had been originally registered as containing a source designated in Apgee (formerly Berthold) Drawing No. P-2611-100. According to the manufacturer, all units sold were equipped with Model X2 sources. The two sources are essentially identical.

The tube is completely sealed at one end, either by single piece cup-like construction or by welding an end cap onto the tube. At the other end of the tube is a 12 mm (0.47") diameter opening through which a connector cable extends from the detection system to accessory electronics (main amplifier and readout) which may be several meters from the probe.

The two neutron detection systems used in the Model LB 6600 (Series) Bunker Probes use either (1) a scintillation detector with a lithium crystal or (2) a helium-3 counter tube. A Bunker Probe using the scintillation detector is shown in Attachment 1(A). Within the tube are: (1) at the upper end, the neutron source, (2) directly below the source is a 30 mm (1.18") diameter by 55 mm (2.17") length cylinder lead shield with source actually mounted in the upper end of this shield, (3) directly below the lead shield is the scintillation detector with the lithium crystal, and (4) directly below the detector is mounted the preamplifier.

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DESCRIPTION (Cont'd):

All internal components, including source and lead shield are loaded into the probe through the lower end which is closed by a screw-in-cover surrounding the connector cable. According to the manufacturer, the electronics, including the photomultiplier tube, must be removed through the lower end to gain access to the source. The source and lead shield can then be removed by removing an internal screw which requires a special long screw-driver inserted through the lower uncapped end of the probe.

A Bunker Probe that uses a helium-3 counter tube is quite similar in construction and assembly to a probe that uses a scintillation detector.

Minor differences include: (1) locating the source about 10 or 12 mm (0.39 to 0.47") from the end of the casing where it is near the center point and adjacent to the counter tube, (2) enclosing the source in a source holder with 2 mm (0.08") thick lead walls, and (3) mounting the counter tube in shock absorbent materials.

The accessory electronics (main amplifier and readout) are mounted in a separate aluminum dust and splash proof housing and can be located at some distance from the probe. Interconnection is by a special cable, 5 meters (16.4 ft) of PVC-cable mounted to the probe, connected to the accessory electronics.

When in use, the probe is mounted in the outlet of a bunker or other materials container in such a way that the built-in source is sufficiently surrounded by material corresponding to its efficiency range. The probe is housed either in a tube socket extending through the container wall at an angle of 30 - 40° to the horizontal plane, or in a protective tube extending through both walls of the container. See Attachment 1(B)

When not in use, the probe can be placed in shielded, carbon steel storage/transport container, Model LB 7400(Series). See Attachment 1(C). This cylindrical container is about 200 to 270 mm (7.87 to 10.63") in diameter and 200 to 375 mm (7.87 to 14.76") in height and has an additional circular steel support tube of about 37 to 80 mm (1.46 to 3.15") diameter mounted in the center of the shield and extending above the shield for a total height of about 540 to 700 mm (21.26 to 27.56").

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DESCRIPTION (Cont'd):

Surrounding the lower (about 200 to 270 mm [7.87 to 10.63"]) portion of this inner tube are shielding rings of borated polyethylene. When the bunker probe is placed in this shielded container, the neutron source is centered within the shield. A hole in the upper end of the support tube wall provides a means for placement of a locking bolt or padlock which would prevent removal of the probe when placed in this shielded container. Container weights for the LB 7400 (Series) range from 13 kg (28.66 lb) to 55 kg (121.25 lb).

LABELING:

The distributor states that the probe containing the source will be labeled in accordance with the requirements of 10 CFR 20.1901.

The labels are placed as follows: (1) A mylar label with the information required by 10 CFR 20.1901 is placed around the probe at the cable end, and (2) an additional mylar warning label is placed on the source end of the probe. This label contains the radiation symbol and an instruction not to handle this source end of the probe.

DIAGRAM:

See Attachment 1

CONDITIONS OF NORMAL USE:

The Model LB 6600 (Series) bunker probe is used to measure moisture or hydrogen content in materials such as glass sand in a bunker, weighing container or similar passage container. When measurements are made, the probe is placed in a tube socker that is closed at one end and extends into the material volume or the probe is placed in a protective tube which extends through both container walls in such a manner that the built in neutron source is sufficiently surrounded by the material to be measured. The probe itself does not come in contact with the material to be measured.

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CONDITIONS OF NORMAL USE (Cont'd):

The probe may be used in a variety of industrial environments, but because of the requirements imposed by the radiation detection system mounted in the probe, the probe would not normally be used in high temperature environments or in areas of high vibration. The manufacturer's established temperature range of operation is -20°C (-4°F) up to 50°C (122°F). The manufacturer also states that if temperatures in a container might rise to more than 50°C (122°F), air must be blown through the protective tube in the bunker which surrounds the probe to lower operating temperatures.

When not in use the probe would normally be stored in the lockable shielded storage/transport container that is provided.

PROTOTYPE TESTING:

- A. The 100 mCi (3.7 GBq) americium-241/Be source (Berthold Drawing No. P-2611-100) is a doubly encapsulated (stainless steel) source. The radioactive material consists of americium oxide-beryllium powder which is compressed into tablet form and placed in the inner capsule. Both stainless steel capsules are sealed by argon arc welding. Apgee's (formerly Berthold) vendor for the source, illustrated on Berthold Drawing No. P-2611-100, provided evidence of an ISO classification of C64544 and an IAEA special form designation.
- B. For the device containing the source, Apgee Corp. did not provide prototype test results of the mechanical operation of the device, such as source support/retention within the bunker probe's stainless steel casing or support/retention of the end closure plug of the probe, when subjected to vibration or drop. In lieu of such submission, the manufacturer states "[t]he continued use of these devices in Europe in the past 10 years in industrial environments without operational problems causing radiation exposures in excess of acceptable levels indicates to us that prototype testing at this time is not necessary - units are considered field tested."

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PROTOTYPE TESTING (Cont'd):

Apgee Corp. states that the Model LB 7400 (Series) storage/transport containers comply with transportation standards of the IAEA Safety Series 6. The containers are marked with "Type A" and "Made in West Germany." Accordingly, they are authorized Type A packages under the U.S. Department of Transportation's regulation 49 CFR 173.415(d).

EXTERNAL RADIATION LEVELS:

Information provided by the distributor and calculations indicate the following radiation levels from the source, source in the probe, and probe in the storage shield or installed:

- Unshielded 100 mCi (3.7 GBq) Am-241/Be source: (2.5 x 10⁵ n/sec.)
By neutrons: ≈ 0.30 mrem (3.0 μSv)/hr at 1 m (39")
By gamma rays: ≈ 0.25 mrem (2.5 μSv)/hr at 1 m (39")
- Source in probe: calculated to be about 850 mrem (8.5 mSv)/hr at surface directly over source due to neutrons.
- Source in storage shield:
 Surface of shield: 2.5 mrem/hr (25 μSv/hr).
- Probe installed for use:
 Accessible surfaces: Generally < 0.75 mrem (7.5 μSv)/hr.

QUALITY ASSURANCE AND CONTROL:

The manufacturer/distributor performs inspection and testing on each device to assure that labeling and other radiation protection features are in accordance with specifications and drawings. Each source prior to installation is also tested for leakage/contamination and assayed for source strength. A copy of the "Quality Assurance and Control Program" is on file with the NRC.

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LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

- This device shall be distributed only to persons specifically licensed by the NRC or an Agreement State.
- The device shall be leak tested at six month intervals using techniques capable of detecting 0.005 microcurie (185 Bq) of removal contamination.
- Handling, storage, use, transfer and disposal: To be determined by the licensing authority.
- This registration sheet and the information contained within the references shall not be changed without the written consent of the NRC.
- REVIEWER NOTE: Apgee stated that Model LB 6600 has been inactive since mid-1998.
- REVIEWER NOTE: The hole size for the source holder was increased from 26.2 mm (1.03") (Drawing No. 19201.200-005) to 26.6 mm (1.05") (Drawing No. 19201.400-002) to make room for the thickness of the paint and radiation warning sign on the source holder (Drawing No. 19201.200-006) which is slid into the hole.
- REVIEWER NOTE: New stainless steel labeling material might also have been used on some units, instead of mylar as previously specified.
- REVIEWER NOTE: The distributor changed its name from Berthold Systems, Inc. to Apgee Corp. in 1992.

SAFETY ANALYSIS SUMMARY:

Based on our review of the information and test data contained in the references cited below, we conclude that the Model LB 6600 (Series) device is acceptable for specific licensing purposes.

Date: December 15, 2000 Concurrence: /RA/
John P. Jankovich

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No.: NR-0112-D-810-S DATE: December 15, 2000 ATTACHMENT 1