

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE
(corrected page
address change only
10/23/92)

NO. : NR-112-D-103-B

DATE : 10/18/91

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DEVICE TYPE: Level Measuring Device

MODEL : LB 7400 L Series (LB 7440, LB 7442, LB 7444)

DISTRIBUTOR:

Apgee Corporation
Hopewell Business & Industrial Park
103 Corporation Drive
Alliquippa, PA 15001

MANUFACTURER :

W&G Barthold
Calmbacher Strasse 22 Postfach 160
D 7547 Wildbad 1
Germany

SEALED SOURCE MODEL DESIGNATION:

Barthold Drawing No. P2602-100
(Cobalt-60). Barthold Drawing
No. P-2623-100 (Cesium 137 up
to 500 mCi). Barthold Drawing
No. 2645-100.000. (Cesium 137
up to 3000 mCi)

ISOTOPE:

MAXIMUM ACTIVITY:

Cobalt-60
Cesium-137

500 millicuries (18.5 GBq)
3000 millicuries (111 GBq)

LEAK TEST FREQUENCY: 3 years

PRINCIPAL USE: (D) Gamma Gauge

CUSTOM DEVICE:

YES

X

NO

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DEVICE TYPE: Level Measuring Device

DESCRIPTION:

A Model LB 7400 L Series level measuring device will use either a cobalt-60 or a cesium-137 source and the device will use one of three source housings. The source housings all have the safety features showed in Fig. (b), Attachment 1, and described below. The source housings differ in physical dimensions: ranging in external dimensions from about 18 cm in height and 20 cm in length to about 32 cm in height and 38 cm in length (see Fig. (b)). The housing range in weight from about 31 Kg to 170 Kg. The selection of a housing for a particular facility depends on the radioisotope and curies quantity of the source required for a particular application. The manufacturer/distributor has indicated the following quantities for the three source housings:

LB 7440 D - 10 mCi Co-60 or 500 mCi Cs-137
LB 7442 D - 100 mCi Co-60 or 3,000 mCi Cs-137
LB 7444 D - 500 mCi Co-60

The source housing has a heavy cast iron outer shell. This shell is lead filled in such a way as to provide shielding of the radiation source in all directions when the shutter is closed. Within the heavy cast iron outer shell is a rotating shutter. There is a cylindrical hole in the shutter's lead shielding. When the shutter is "open", the cylindrical hole is in line with the fixed position shown in Fig (b) and a collimated primary beam of radiation emerges through the thin front steel plate. The steel plate is sealed to the cast iron outer shell and provides protection to the source against dust and other air contaminants.

Shown in Fig. (c) is an LB 7400 L Series device installed on a closed tank. When the shutter is in the "open" position, the primary beam from the source housing traverses the tank and contents at that level and strikes the NaI(Tl) detector crystal of the scintillation counter. Installed devices for use by general licensees will have a wire and lead seal security connection across the mounting bolts for the housing to discourage unauthorized removal of the device.

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DESCRIPTION (Cent'd)

Markings, showing the "open" and "closed" positions of the shutter, are on the back of the source housing. Operation of the manual shutter is controlled by a key lock. The shutter can be locked in either the "open" or the "closed" position. The handle for operating the shutter is pinned to the rod that rotates the shutter. The distributor has stated that there should be no need to remove the handle from that rod after it is attached by the manufacturer.

Access to the source for replacement purposes is accomplished by placing the shutter in a position midway between "open" and "closed", thus exposing the head of the threaded source holder which is epoxy filled to discourage unauthorized removal.

The cobalt-60 source has a stainless steel capsule with external dimensions of approximately 9 mm diameter and 23 mm length. The capsule has a minimum wall thickness of 1 mm and is sealed by argon gas arc welding. The cobalt-60 is in the form of a piece of wire made of a cobalt-nickel alloy (see Fig. (a), Attachment 2).

The cesium-137 source has an inner stainless steel capsule and an outer stainless steel capsule. The minimum window thickness on each capsule is 0.5 mm. Each capsule is sealed by argon gas arc welding. The cesium-137 is in the form of a single cesium glass or ceramic bead and, depending on the quantity of activity, ranges in diameter from about 4 mm to 6 mm. The maximum external dimensions of the cesium-137 sources are approximately 8 mm diameter and 16 mm length. (See Fig. (b) and (c), Attachment 2).

LABELING:

The manufacturer/distributor states that each source housing will be labeled in accordance with the requirements of 10 CFR 20.203.

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DEVICE TYPE: Level Measuring Device

LABELING: (Cont'd)

Devices intended for distribution to persons generally licensed will be labeled in accordance with the requirements of 10 CFR 32.51.

These labels are made of aluminum or stainless steel and are riveted in place or are made of mylar and secured in place with an adhesive.

Additionally, with regard to installation on vessels or tanks where there is accessibility into the vessel or tank, a caution sign with the statement "Radiation Area - Check to insure that the shutter is closed before entering" to be placed at all logical access point.

DIAGRAMS:

See Attachment 1 for pictures of housing, cross section sketch of housing, and sketch of installed device. See Attachment 2 for drawing of sources.

CONDITIONS OF NORMAL USE:

The system is designed for the measurement of the level of the contents of vessels.

The device might encounter a variety of industrial environments; however, because of characteristics inherent to scintillation detector systems, particularly with respect to temperature and vibration, environmental stresses on radiological protection features of the device should be well within the protective capabilities of those features. The manufacturer's operating instructions that accompany the device state -20° to 50°C for the scintillation counter.

Multiple barriers (seals) between the radioactive material and the exterior of the device provide protection against corrosive or abrasive airborne material.

As related by the manufacturer, European experience has shown that the design of the Berthold equipment has been such as to be unaffected by normal use in industrial environments.

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PROTOTYPE TESTING:

Apgee did not supply prototype test results regarding mechanical operation (e.g. , no specific data on life cycle testing of the shutter mechanism). In lieu of such submission, Apgee states "the continued use of these devices in Europe in the past 10 years in industrial environmental 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."

The cobalt-60 source and the cesium-137 sources have been evaluated and each has achieved classification of ISO/C65444 (same as ANSI N542-1977) and "special form" approval according to IAEA transport standards.

EXTERNAL RADIATION LEVELS:

Apgee submitted information indicating radiation levels to be less than 0.75 mR/hr at 1 m from accessible surfaces of the device. Submitted isodose curves indicate that radiation levels at 12" from accessible surfaces are less than 5 mR/hr with the shutter closed.

In the primary beam exiting the front steel plate the maximum calculated radiation level is approximately 60 R/hr. This level is at a distance of about 13 cm from a 3,000 mCi Cs-137 source. The level at 1 meter from the housing with the 3,000 mCi source would be about 750 mR/hr in the primary beam.

The calculated radiation level at 1 meter from the housing that contain a 500 mCi Co-60 source would be about 450 mR/hr in the primary beam.

The angle (width) of the primary beam ranges from 10° for the smallest housing to 6° for the largest housing in the Berthold Model LB 7400 L Series.

When the device is "on" in an installed position, the primary beam would be accessible only if an individual were to enter the vessel (perhaps for the purpose of cleaning). Such entry is unlikely because of the warning signs posted at entrances to the vessel.

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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 Medical, Academic, and Commercial Use Safety Branch.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

- ° Devices intended for distribution to persons specifically license by the NRC or an Agreement State shall be labeled in accordance with Section 20.203(f).
- ° Devices intended for distribution to persons generally licensed pursuant to Section 31.5 shall be labeled in accordance with Section 32.51(a)(3).
- ° Devices intended for use under general license shall be installed and initially tested for external radiation levels, and leakage/contamination of radioactive material by Berthold System, Inc., or other persons specifically licensed by NRC or an Agreement State.
- ° Handling, storage, use, transfer and disposal: For devices used under specific license to be determined by the licensing authority. For devices used under general license to be covered by the requirements of 10 CFR 31.5.
- ° The device shall be leak tested at 3 year intervals using techniques capable of detecting 0.005 microcurie of removable contamination. The test shall be performed by specifically licensed persons.
- ° This registration sheet and the information contained within the references shall not be changed without written consent of the NRC.

SAFETY ANALYSIS SUMMARY:

The LB 7400 L Series Measuring Device is used to determine the level of the contents of containers by use of gamma radiation from a cobalt-60 source or a cesium-137 source. The radioactive source is contained in a lead-filled, cast iron housing. A manually operated shutter controls the narrow, collimated primary beam of radiation. When the shutter is "open" the primary beam exits the housing, is reduced in intensity by the material undergoing measurement, and strikes the sodium iodide crystal of the scintillation detector measuring system. The output of the measuring system is used for material evaluation/control.

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SAFETY ANALYSIS SUMMARY: (Cent 'd)

The gamma sources used in the LB 7400 L Series devices have an ISO (ANSI) classification of C-65444. This indicates that temperatures, pressure, impact, vibration and puncture stresses imposed during use are highly unlikely to cause breach of the containment integrity of the capsule. During use, the source is sealed within the housing such that the source is protected against possible airborne corrosive and other types of contaminants. Even if the source capsule developed a defect (hole or crack), leakage of radioactive material would be highly unlikely because of cobalt-60 and cesium-137 are in the non-dispersible forms, respectively, of cobalt-nickel alloy wire and solid ceramic or glass.

The LB 7400 L Series source housings, when loaded with the maximum designated quantity of cobalt-60 or cesium-137, have external radiation levels of less than 0.75 mR/hr at 1 meter and less than 5 mR/hr at 12" from the housing with the device in the "off" position. When the device is "on" in an installed position, the primary beam will be accessible only if an individual were to enter a container (perhaps for purposes of cleaning). Such an entry is unlikely because of warning signs posted at entrances to the container. Radiation levels in the vicinity of the scintillation detector system are expected to be low because proper operation of the system requires that radiation levels at the detector crystal not exceed 1 mR/hr.

Operation of the shutter is controlled by a key lock. This same locking system and epoxy filling of screw heads and bolt head recesses discourage unauthorized access to the source.

Wire and lead seals across mounting bolts will discourage unauthorized movement of the source housing after installation of the device by the distributor or other specific licensee.

The device will be used in industrial environments; however, these environments are not expected to be severe because of the need to protect the scintillation detection system.

In the event of fire, breach of containment integrity of the radioactive source is unlikely. Prototype evaluation of the source shows it to be adequate to withstand a 1 hour, 800°C fire. Protection provided by the device housing further assures radioactive material containment in the event of an accident.

A number of these units are in operation throughout the world. Berthold's experience shows that the units provide adequate radiation protection.

Apgee has submitted sufficient information to provide reasonable assurance that:

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SAFETY ANALYSIS SUMMARY: (Cent 'd)

- ° The device can be safely operated by persons not having training in radiological protection.
- ° Under ordinary conditions of handling, storage, and use of the device, the byproduct material contained in the device will not be released or inadvertently removed for the device, and it is unlikely that any person will receive in any period of one calendar quarter a dose in excess of 10 percent of the limits specified in the table in Section 20.101(a), 10 CFR Part 20.
- ° Under accident conditions (such as fire and explosion) associated with handling, storage, and use of the device, it is unlikely that any person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in the following chart:

<u>Part of Body</u>	<u>rem</u>
Whole body; head and trunk; active blood-forming organs; gonads; or lens of eye	15
Hands and forearms; feet and ankles; localized areas of skin averaged over areas no larger than 1 square centimeter	200
Other organs	50

Based on the above and the information referenced below, we conclude that the Model LB 7400 L Series Level Measuring Device is acceptable for distribution to specific licensees and to general licensees. Further, we conclude that the source housing can be expected to maintain its containment integrity adequately for normal conditions of use and for accidental conditions that might occur during use.

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REFERENCE:

The following supporting documents for the Model LB 7400 L Series Level Measuring Device are hereby incorporated by reference and are made a part of this registration document:

- ° Berthold Systems, Inc. application dated May 24, 1984, as revised June 20, 1984.
- ° Berthold Systems, Inc. letters dated September 27, 1984; October 29, 1984; November 15, 1984; and November 23, 1984; with attachments thereto.
- ° Berthold Systems, Inc. letters dated February 13, 1985; February 28, 1985, March 20, 1985; with attachments thereto.
- ° Berthold Systems, Inc., letters dated March 4, 1985, with transmittal letter dated March 22, 1985.
- ° Berthold System, Inc. letters dated March 4, 1985, and March 22, 1985, with enclosure thereto.
- ° Berthold Systems, Inc. letter dated June 27, 1988 with attachments thereto
- ° Apgee Corporation letters dated August 8, 1991, September 28, 1991 and October 2, 1991 with enclosures thereto.


ISSUING AGENCY:

u. s. NUCLEAR REGULATORY COMMISSION

DATE : OCT 18 1991

REVIEWER: 

DATE : OCT 18 1991

CONCURRENCE: 

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ATTACHMENT 1

Fig. (b)

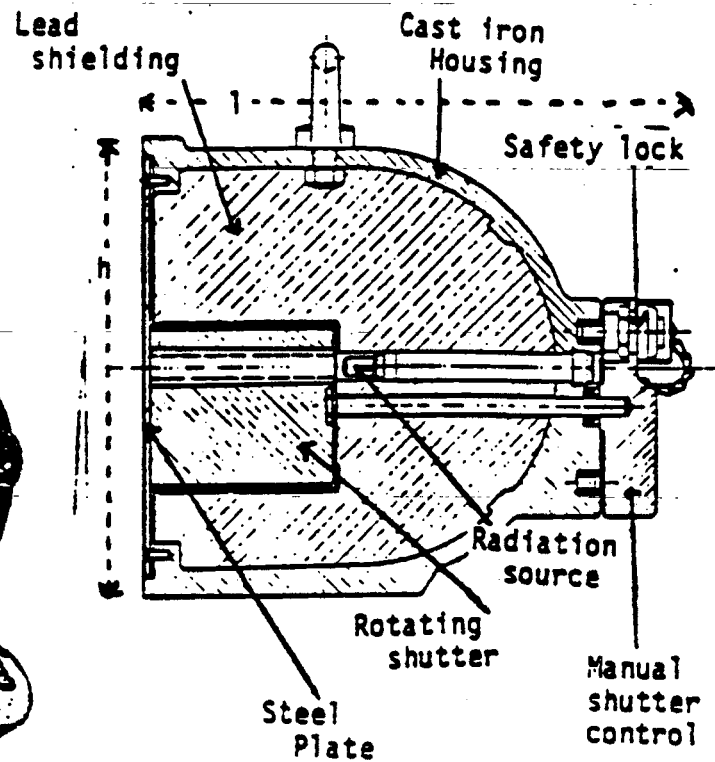
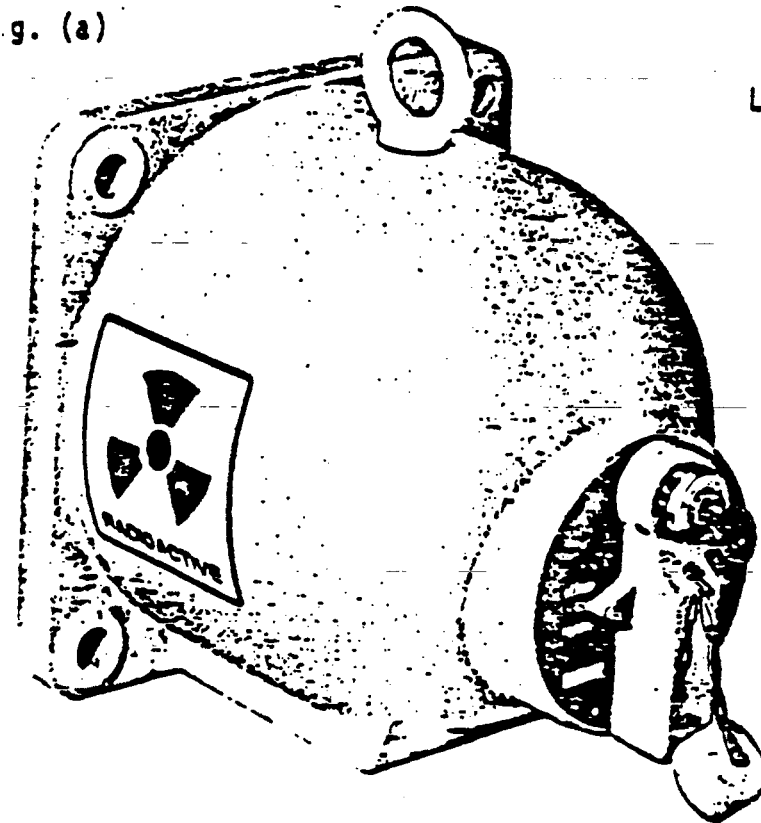
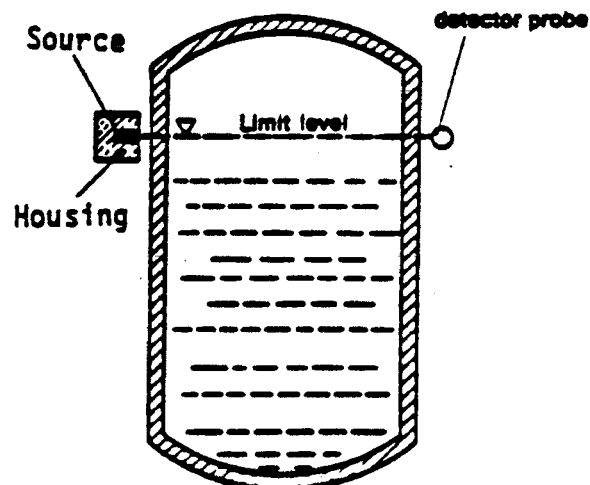


Fig. (c)



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ATTACHMENT 2

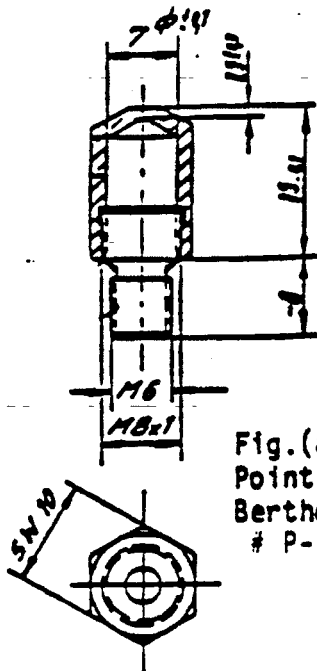
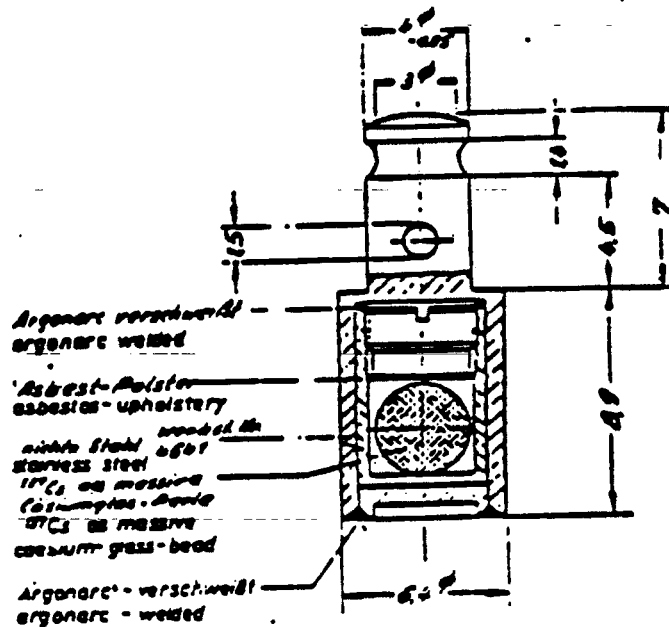


Fig.(a): Cobalt-60
Point Source. From
Berthold Drawing
P-2602-100.



Beschreibung der KÜlle:
Innen- und Außenkapsel: doppel verschlossen
Material: Innenkapsel: 0,3 mm
Außenkapsel: 0,63 mm
Art der Abdichtung: Argonarc verschweißt

Fig. (b): Cesium-137
Point Source. From
Berthold Drawing #
P-2623-100. Max. 500 mCi.

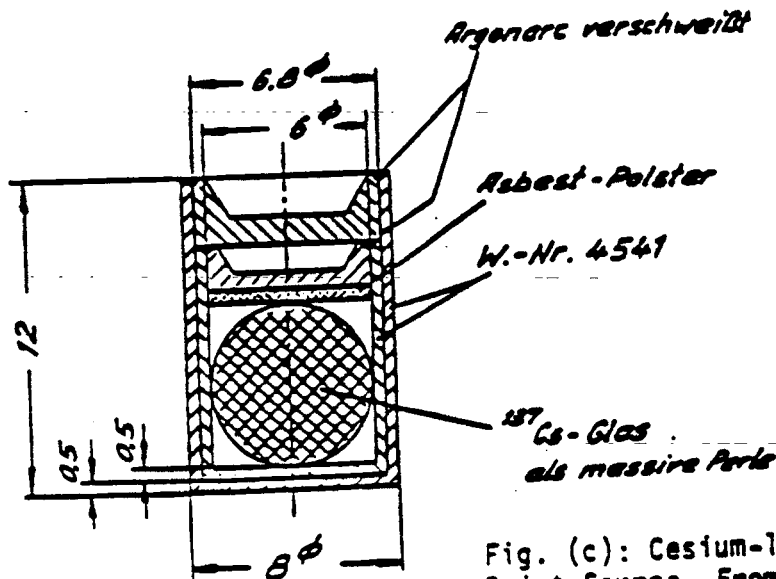


Fig. (c): Cesium-137
Point Source. From
Berthold Drawing #
2645.100-000. Max. 3 Ci.