4. CONTAINMENT

4.1 Description of the Containment System

The first principal boundary for the containment of radioactivity is the stainless-steel encapsulation of the cobalt-60 or cesium-137 source. Figure 4.1 shows a typical teletherapy source capsule in cross section. The source is enclosed within a cylindrical tungsten alloy shield which is open at one end. The source and shield are, in turn, doubly encapsulated in cylindrical stainless-steel capsules, each of which is successively sealed by a completely welded stainless steel end cap. The source capsule design meets the qualifications and tests for special form radioactive material as set forth in 10 CFR 71.75 and 49 CFR 173.469. An exploded view of a teletherapy source capsule, along with an International source holder, one of many into which the source may be fitted, is shown in Figure 4.2. Other types of sources, such as pencil sources, may also be shipped in the 9215 package. However, the teletherapy type source is depicted because the highest activity sources (those that would approach the 15,000 Ci limit for cobalt-60), would necessarily have to be dimensionally small (like a teletherapy source) in order for the package to meet DOT dose rate limits.

The S/TC provides the second containment barrier of the shipping package. The containment boundary follows the inside diameter of the S/TC Shell Assembly liner and the inside surface of the two shielded End Covers. The cavity defined by the boundary contains the Drum Assembly, which in turn carries the sources. The drum, sources and their holders, if any, and associated shield plugs are secured in the container by the shielded End Covers which are bolted to the S/TC Shell Assembly at both ends of the chamber containing drum. Silicone rubber gaskets provide the seal between the End Covers and the S/TC Shell Assembly. This arrangement is shown in Figure 4.3. There are no welds in the containment boundary.

Since the source capsule meets special form requirements, reference in the remainder of this section is to the S/TC containment.

4.1.1 Containment Vessel

The containment vessel is comprised of the S/TC Shell Assembly, gasketing, and the two End Cover Assemblies. There are no valves or pressure relief devices.

4.1.2 Containment Penetrations

There are no containment penetrations.

4.1.3 Seals and Welds

There is no weld as part of the containment boundary; however, there are strength welds which join the liner, S/TC Shell, and the flange to which the End Cover bolts are fastened.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCES

NO.: MD 474S109S DATE:

SEALED SOURCE TYPE: Medical Teletherapy Source

DIAGRAM:

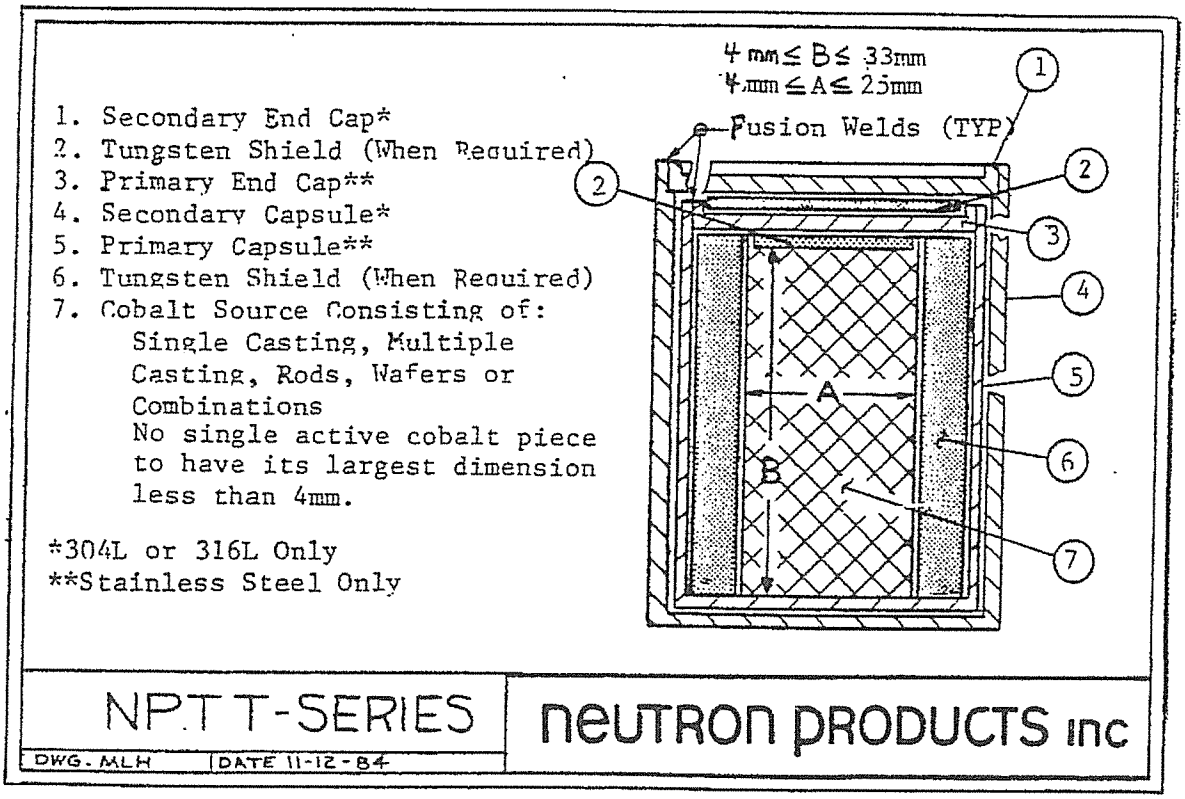

FIGURE 4.1
MEDICAL TELETHERAPY SOURCE

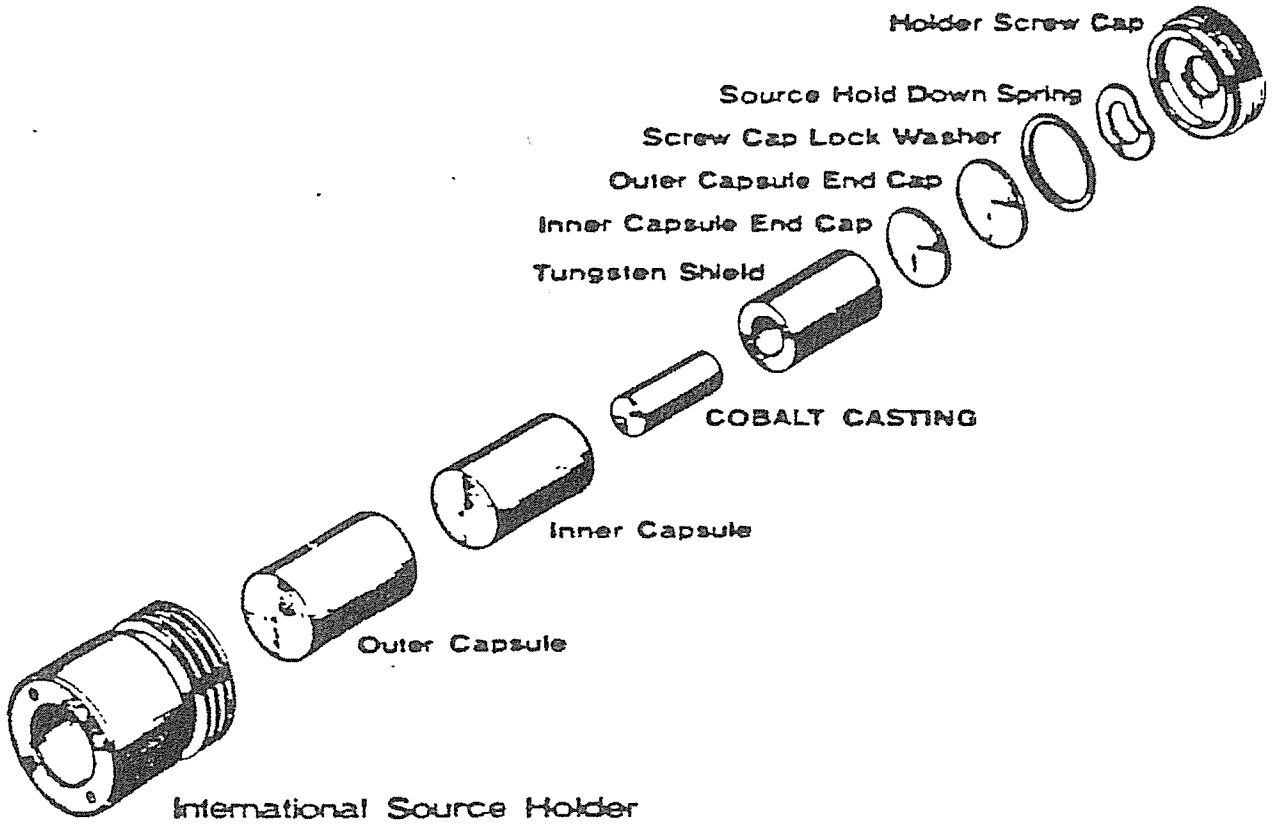

Figure 4.2

TELETHERAPY SOURCE

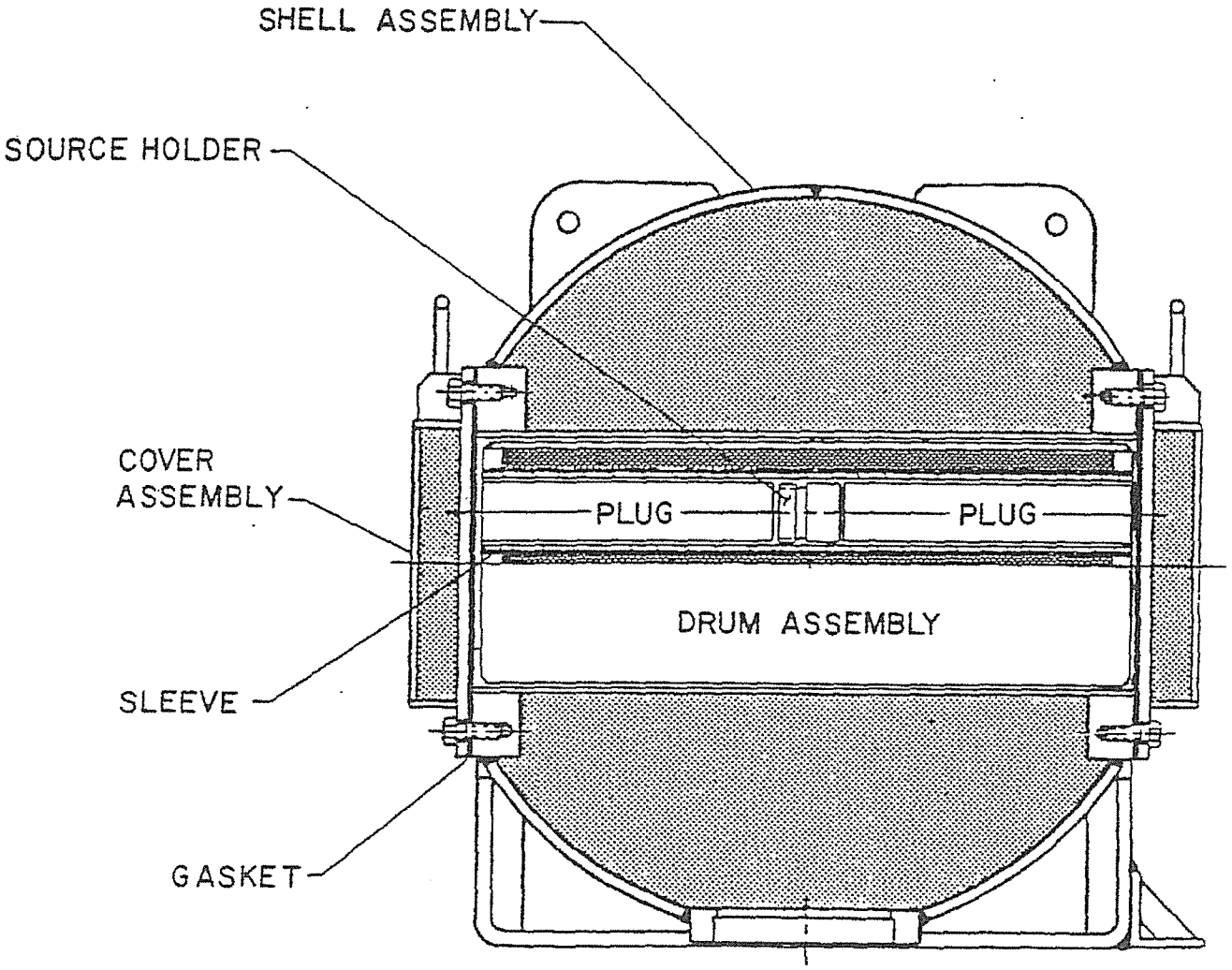

FIGURE 4.3

INTERNATIONAL SOURCE HOLDER
INSTALLED IN S/TC INNER CONTAINER

The gasket between the S/TC Shell Assembly flange and the End Cover is of silicone rubber and meets the ASTM Standard D-2000 requirements.

Specifications for welds and seals are included in the purchase documentation and on Drawing 240122. As discussed in Chapters 2 and 3, the internal pressure under normal transport is essentially atmospheric. Postulating extreme circumstances under hypothetical accident conditions results in a calculated pressure of 16.6 psig (see section 3.4.4).

4.1.4 Closure

The closure is mechanical, using eight - ½ inch bolts on an 11¼ inch bolt circle. The End Cover is bolted to the S/TC Shell Assembly and the closure seal is provided by a flat, full diameter, 1/16-inch-thick silicone rubber gasket. The bolts are tightened to firmly compress the gasket with a torque of 100 – 125 inch–pounds.

The overpack provides two additional closures, but these are not gasketed and are not intended to provide a gas tight seal.

4.2 Containment under Normal Conditions of Transport

The source capsule qualifies as special form material. The evaluation in Chapters 2 and 3 indicates that the S/TC will provide a secondary seal under normal transport conditions. One of the principal functions of the seal is to prevent any external contaminants, such as liquids or particulates, from reaching the source chamber.

4.2.1 Release of Radioactive Material

None

4.2.2 Pressurization of Containment Vessel

There are no gases that can form and/or explode in the containment chamber. There has been no evidence of pressure build up in the sealed drum chamber in practice. Any foreseeable change in chamber pressure will not reduce package effectiveness.

4.2.3 Coolant

Not applicable

4.2.4 Coolant Loss

Not applicable

4.3 Containment under Hypothetical Accident Conditions

The evaluation of test information and associated analysis presented in Chapters 2 and 3 show that the package could experience the sequence of conditions postulated in 10 CFR 71.73 without release of radioactive material or significant change in shielding capability. In addition, the encapsulated source meets special form requirements, which are at least as stringent as the accident conditions for the package.

4.3.1 Fission Gas Products

Not Applicable

4.3.2 Release of Contents

In summary, from the standpoint of containment (as opposed to shielding), the source capsule by itself can meet all of the hypothetical accident conditions imposed on the package. In addition, evaluation of the S/TC as a secondary containment, enclosed within the Wooden Protective Jacket and the Steel Shell overpack, will meet the requirements of the hypothetical accident sequence of conditions.

4.4 Leakage Rate Tests for Type B Packages

10 CFR 71.51 provides limits for the loss or dispersal of radioactive contents from the package during both normal conditions of transport (10^{-6} A_2 per hour) and hypothetical accident conditions (A_2 per week). As the authorized contents of the package are limited to special form sources, there is no appreciable level of unsealed radioactive material within the package to be released. The sources are checked for contamination prior to being loaded into the S/TC, and the empty S/TC's are checked periodically for the presence of contamination. The standard source leak test would fail if the contamination level were to exceed 0.005 µCi, which is orders of magnitude less than the limits in 10 CFR 71.51 (11 µCi/hour for cobalt-60 and 16 µCi/hour for cesium-137).

In addition, the analysis performed for chapters 2 and 3 demonstrate the ability of the package to maintain both its containment and shielding properties under conditions of normal transport and under hypothetical accident conditions.

No filters or mechanical cooling systems are used in this package.

The authorized contents of the package do not exceed 10^5 A_2, so 10 CFR 71.61 is not applicable.

4.5 Appendix

Supporting evaluations and analysis for statements in this chapter are provided in the body and appendices of Chapters 2 and 3.