November 11, 1994

SENTINEL

Oak Ridge National Laboratory
Office of Environmental Compliance and Documentation
Environmental Surveillance and Protection
Exposure Assessment Group
Building 4500-s, MS-6102
P.O. Box 2008
Oak Ridge, Tennessee 37831-6012

Amersham Corporation
40 North Avenue
Burlington, MA 01803

tel (617) 272-2000
tel (800) 225-1383
fax (617) 273-2216

Amersham

Dear Ms. Scofield,

Please find enclosed any information I have been able to gather regarding the exposure to Depleted Uranium (D.U.) and the associated devices containing Depleted Uranium. I assume you have already received a fax from me containing the table of the devices and their pertinent information. Included in this packet are the certificates of compliance for the majority of our currently certified cameras and changers, as well as a copy of our manual for the model 660 camera. I have also included brief answers to some of the questions you posed in the fax sent to me on October 20th.

Regarding the data on exposure. The data which I have already sent you is the only source of data we have concerning exposure to Depleted Uranium only. This is due to the fact that the devices are usually "loaded" with a radioactive source which obscures the exposure due to the Depleted Uranium. I can tell you that to determine exposure to empty containers you can just multiply the time spent handling the empty containers by the dose rates which are present at the surface and at a meter from the device. Fortunately the properties of Depleted Uranium allow that, regardless of size, the shields will always give the same exposure rate. As far as the workers at SENTINEL are concerned, the receiving staff and two of our radiation technicians handle loaded (and a few empty) devices for 8 hours a day. However they are handled behind shielding and are not kept at close proximity for the entire 8 hours. Our receivers transfer the devices to transporters whose exposure we are not responsible for tracking. But for arguments sake, if one of our workers were to work with an empty D.U. container for 8 hours a day and 50 weeks a year. The daily whole body exposure (based on the 1 meter exposure rate) would be .8 mRem and the yearly exposure would be 200 mRem. This is an absolute worst case scenario, under normal conditions these exposure levels would not be reached.

I hope this is all the information you need. If anything else is necessary please call me at (617) 272-2000 extension *230.

Sincerely,

Erik Okvist

Erik Okvist
Health Physicist

Radiography Devices

Device Model #	Number Manufactured, (In Use)	Isotope	Maximum Activity (Ci)	DU Shield Weight (lbs)	Shield Dimensions Radius, Length (inches)
460	0 (0)			22	1.38, 7.44
AI 520		IR-192	120		
660	4138	IR-192	Varies	35	1.64, 8.5
683		IR-192	120	28	
702	(28)	IR-192	10000		
865		IR-192	240	40	
900	36 (0)	IR-192	120	28	
920	49 (0)	IR-192	240	31	
680	181	CO-60	110	284	3.9, 13.40
664		CO-60			3.7, 12.63
741	74	CO-60 IR-192	33 240	200	3.25, 11.44
676	33	CO-60	330	370	
684	104	CO-60 IR-192	11 240	150	
616	329	Ir-192	240	29	
533	750 (25)	IR-192	100	37	
Changers					
C-8	(1)	CO-60	200		
AI 500SU	(132)	IR-192	120	39	
650	(333)	IR-192	240	40	
C-1	(0)	IR-192	240		
771	(5)	CO-60	110	213	

# Max (In Use	Isotope	Max Act, Ci	DU shield weight, lb	
820	(8)	IR-192	1000	120	
770	(1)	CO-60	550	355	
855	(3)	IR-192	1000	125	
864	(9)	IR-192	360		
850	(16)	IR-192	240	48	
C-10	(66)	IR-192		65	
U-110	(29)	IR-192		60	

Comments:

1. Each shield will have approximately the same dose rate readings at the surface and at 1 meter from the surface. This is due to the DU's specific activity and other characteristics.

2. Each container is used until it cannot be repaired. Most of the time, the camera's and changers are sent out "loaded" with a source. These sources are usually about 100 Ci in activity and the resulting dose rates coming off the device can be attributed entirely to the source contained within.

3. Each of these devices are either a type B shipping container themselves or they are shipped in a container which satisfies the type B certification. In order to be classified as a type B container the devices undergo a series of tests including crash tests, drop tests, fire tests, and water immersion tests. Therefore the possibility of a radioactive incident occuring is almost zero and there are actual examples of damaged devices which maintained their integrity throughout the accident.

NEW

Radiography Devices

Device Model #	Number Manufactured, (In Use)	Isotope	Maximum Activity (Ci)	DU Shield Weight (lbs)	Shield Dimensions Radius, Length (inches)
460	0 (0)			22	1.38, 7.44
AI 520		IR-192	120		
660	4138	IR-192	Varies	35	1.64, 8.5
683		IR-192	120	28	
702	(28)	IR-192	10000		
865		IR-192	240	40	
900	36 (0)	IR 192	120	28	
920	49 (0)	IR-192	240	31	
680	181	CO-60	110	284	3.9, 13.40
664		CO-60			3.7, 12.63
741	74	CO-60 IR-192	33 240	200	3.25, 11.44
676	33	CO-60	330	370	
684	104	CO-60 IR-192	11 240	150	
616	329	Ir-192	240	29	
533	750 (25)	IR-192	100	37	
Changers					
C-8	(1)	CO-60	200		
AI 500SU	(132)	IR-192	120	39	
650	(333)	IR-192	240	40	
C-1	(0)	IR-192	240		
771	(5)	CO-60	110	213	

* Bob Thompson, Marketing

Q #manufactured per year?

Q #Taken out of service?

	Total manufactured	Total In Use
Ir-192:	6100	5294

Total [illegible] Device 4519

NEW

820	(8)	IR-192	1000	120	
770	(1)	CO-60	550	355	
855	(3)	IR-192	1000	125	
864	(9)	IR-192	360		
850	(16)	IR-192	240	48	
C-10	(66)	IR-192		65	
U-110	(29)	IR-192		60	

Comments: TOTAL In use 4819 ~ TOTAL Ir-192 (Manufactured) 6000± In use (Include ( ) ± # w/o Chove 5294

1. Each shield will have approximately the same dose rate readings at the surface and at 1 meter from the surface. This is due to the DU's specific activity and other characteristics.

2. Each container is used until it cannot be repaired. Most of the time, the camera's and changers are sent out "loaded" with a source. These sources are usually about 100 Ci in activity and the resulting dose rates coming off the device can be attributed entirely to the source contained within.

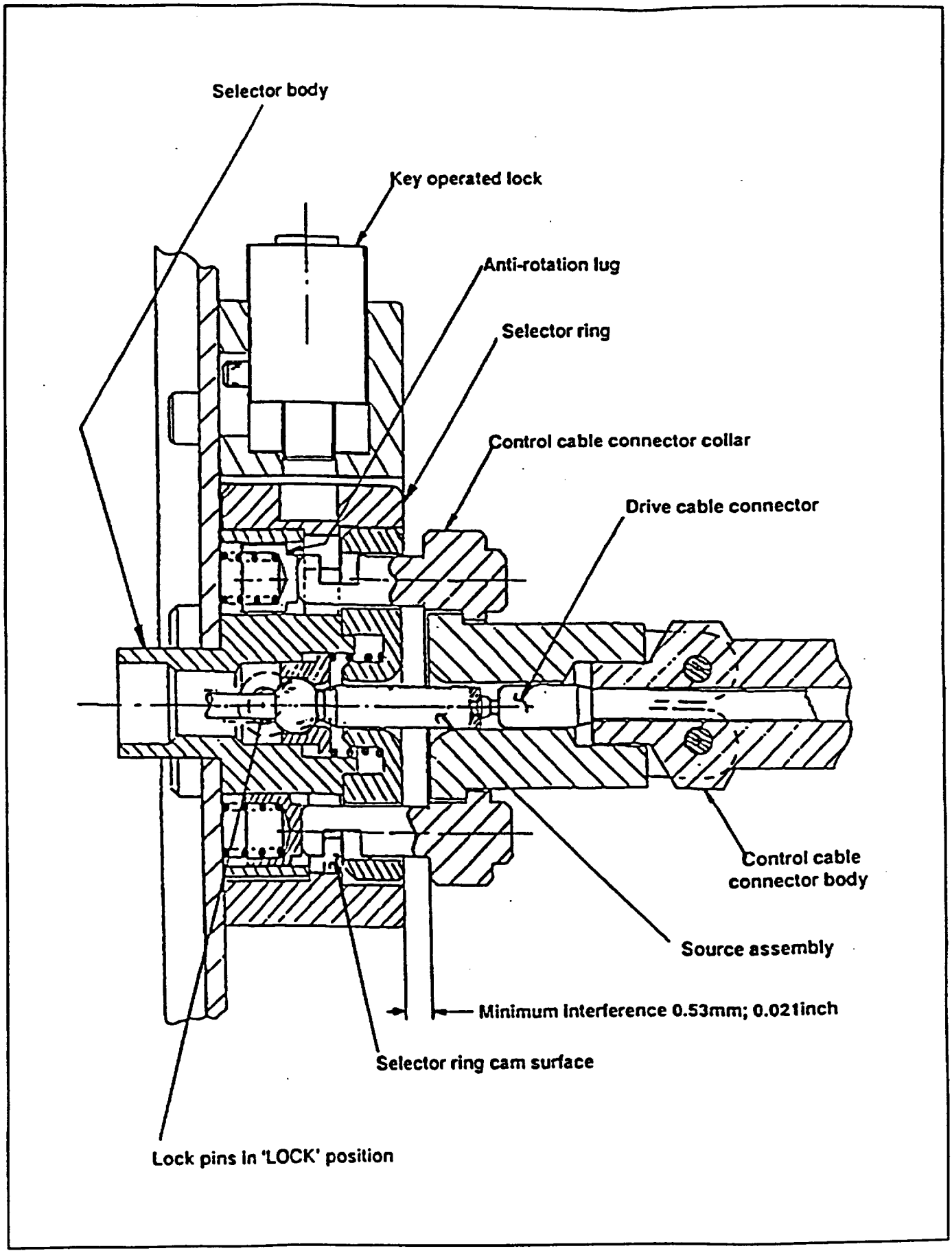
3. Each of these devices are either a type B shipping container themselves or they are shipped in a container which satisfies the type B certification. In order to be classified as a type B container the devices undergo a series of tests including crash tests, drop tests, fire tests, and water immersion tests. Therefore the possibility of a radioactive incident occuring is almost zero and there are actual examples of damaged devices which maintained their integrity throughout the accident.

Amertest™
gamma radiography products

Model 660
gamma ray projector

Amersham

Figure 5.9 Selector mechanism in misconnect mode



5.11 Specifications

Application: Used for industrial gamma radiography, mainly with Ir-192, for various materials in the thickness range:

Steel from 12 to 65mm (0.5 to 2.5 inches)

Light alloy 40 to 190mm (1.5 to 7.5 inches)

Source assembly:

Iridium-192 metal is encapsulated in welded stainless steel capsules.

The source is swaged to one end of a short flexible steel cable which has the female half of a swivel connector at the other end, used for coupling to a drive cable.

The source meets the IAEA and USNRC requirements for "Special form".

Operating distance:

The distance between the drive cable control unit and the source stop is determined by the length of the total control housing plus the guide tubes, and normally should not exceed 22 m (72 ft.).

Standard control housings: 7.6m (25ft), 10.7m (35ft), 15m (50ft).

Standard guide tubes: 2.1m (7ft). Set of 3 tubes: 6.4m (21ft).

Certification: The projector meets the requirements for Type B packaging: Certificate of compliance number 9033 for USA shipments. IAEA certificate number USA/9033/B(U) for international shipments.

Radioisotopes used:

Radioisotope	Gamma energy range	Projector/source maximum capacity		Half-life
Iridium-192	206 to 612 keV	5.2 TBq	140 Ci	74 days
Ytterbium-169	8 to 308 keV	185 GBq	5 Ci*	32 days
Thulium-170	52 to 84 keV	1.9 TBq	50 Ci*	128 days
Cobalt-60	1.17 to 1.33 MeV	4.4 GBq	120 mCi	5.27 years
*Capacity is limited by the physical size of the source for Yb-169 and Tm-170.				

Source Output at 1 Meter/C			
Ir-192	0.48 R/hr	1.16 µGy/s	4.19 mSv/hr
Yb-169	0.125 R/hr	0.303 µGy/s	1.091 mSv/hr
Tm-170	0.0025 R/hr	0.00607 µGy/s	0.0218 mSv/hr
Co-60	1.30 R/hr	3.15 µGy/s	11.4 mSv/hr

Dimensions:

Model	Length	Width	Height	Weight	Uranium shield
660	330 mm 13 in	133 mm 5.25 in	248 mm 9.75 in	24 kg 53 lb	16.8 kg 36 lb