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Division of Administrative Services
 Office of Administration
 Mail Stop T6-D59
 U.S. Regulatory Commission
 Washington, D.C. 20555-0001

RECEIVED

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71FR 1776

A

Attn: Chief Rules and Directives Branch

Re: *RSPS-TF*

NRC Representatives

I am replying in regards to the news bulletin dated 12 January 2006, requesting public comment on "Radiation Source Protection and Security." (Copy Attached) My company has a number of Nuclear Density Gauges spread throughout the United States and I being the Director of that program I have faced numerous security challenges and issues in the past couple of years to prevent these "gauges" from being stolen and misused. My main concern has always been the misconception that the gauges receive from the media when these gauges are involved in an incident where they are either damaged or stolen. Security must be the central factor when devising and implementing a solid safety program.

My responses will be numbered in the order the topics are listed in the January bulletin. I will direct them towards the use of Nuclear Density Gauges as I feel they do not receive the right amount of attention.

1) **"Sources Requiring Security"**

Most Density Gauges use a combination of CS-137 and AM-241:BE for their main function. The amounts of these materials used in these gauges would not normally warrant concern for a "Terrorist Threat", but the growing number of gauges being stolen each year is of concern. A current theory is that the gauges are being sold via black-markets to South American Countries that do not have the current licensing requirements that the United States requires before these gauges are placed on construction sites. Whether this is true or not, the safety and security of these gauges needs to be increased from its current standing and stricter penalties need to be in place for those who are found guilty for the theft of one of these.

*SIS Review Complete**Template =
ADM-013*

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*E-RIDS = ADM-03
Call = M. Ham (MLHI)*

2) "National System of Recovery for Lost or Stolen Sources"

A National Tracking System should be in place for all radioactive sources. (Excluding those currently exempt) Companies should be required to maintain a current serial number list of all sources in their current possession, and fined for any deviation/exclusions to that list. Accountability for all sources ensures that in the event that something is presumed lost or stolen, an inventory list can be referenced and exact knowledge of what went missing (serial and source number) will help aid in the manner of the recovery of that item. As the Director of this program for my company, all gauges are accounted for by serial number, and source number.

3) "Safe and Secure Storage of Radiation Sources when not in use."

One of the best measures that can be taken is the use of secondary containment boxes in order to prevent the theft of any gauge. All gauges should be required to be locked in either a job type "Gang Box" or through the use of a site "Conex" box. Both of these methods employ the use of a multiple locking system and when used together (Gang box mounted inside a Conex) the probability of theft is greatly reduced. The preferred method should be to have the gang box mounted within the conex box (to avoid the gang box from being readily removed) and gauges placed there while not in use. When in use the gauges should also be transported within an unmarked secondary container as to avoid any unwanted attention. Every gauge has its own shipping container and should be secured in the vehicle (i.e. truck bed) to prevent theft. A secondary container mounted in the vehicle would aid in the prevention of theft of these gauges. (Photo)

4) "National Source Tracking System"

Again as noted I agree with this, it should be done. Now with reference to Nuclear Gauges, the manufacturers should maintain a copy all source numbers, and submit these numbers to a government agency anytime a gauge is purchased along with the appropriate information of the purchasing body. The company or organization that purchases one of these gauges should also register these gauges as an affirmation that they are in possession of these sources. (See attached spreadsheet from my program as to how we track our gauges)

5) "National System for the Proper Disposal of Radiation Sources"

With reference to gauges the same procedure as stated in #4 should be applied but in reverse order. The organization or company needing to dispose of a gauge should notify the government agency in writing that that source is to be turned back to the manufacturer. The manufacturer shall then in turn notify the agency when that source was received. The manufacturer should have the ability to reuse the source or have the facilities at their disposal to discard that source.

7) "Procedures for Improving Security and Control"

No real comment

8) "Procedures for Improving the Security of Transportation of Sources"

As every gauge and source should be accounted for, so should the movement of every gauge. When transporting a gauge from one point to another over long distances, the preferred method is a registered ground transportation company. This ensures the path of the gauge's departure and arrival via that company's internal tracking system. Over short distances or when being transported via a company vehicle, the gauge should be secured via a secondary containment device, and steps should be taken as to avoid unnecessary stoppages. All the appropriate information on the gauge must be with the driver. This is already a DOT Procedure.

9) **"Background Checks for Individuals"**

Background checks in this day and age have not become so uncommon as to think that this area of (Gauge use) application should not warrant an individuals background examined. We are dealing with sources that can potentially harm someone, therefore it should not be out of the mainstream to consider this application eligible for a background screen and/or a condition of license.

10) **"Alternative Technologies"**

There is some research into the field of Laser Density Measuring Devices that could prove very useful to the work that these gauges are enlisted for. Further work and approval by the USDOT/FHWA to utilize these devices on roadway construction projects would eliminate the use of Nuclear Density Gauges all together and thus eliminate the issues surrounding these gauges.

Sincerely,



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I HAVE ALSO INCLUDED
A COPY OF OUR PROGRAM

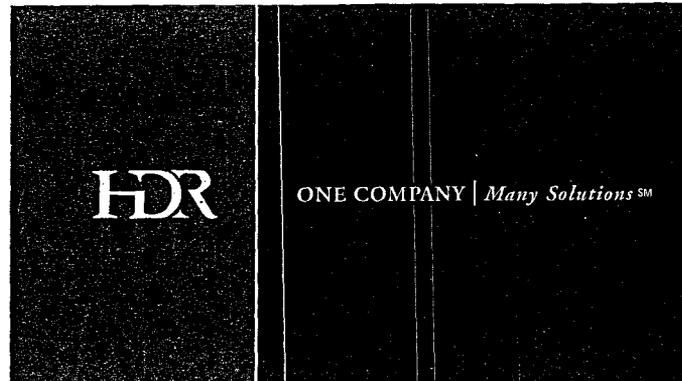
Jeff

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HDR OFFICE NAME	DEPT. #	Radioactive License Date on License or No License	Expiration Date for License	Radiation Gauge Type & Serial Number	Sealed Sources: Types & Serial #s & Current Activity	Gauge's Physical Location (storage area)	Radiation Gauge Leak Test Certificated	Next Radiation Gauge Leak Test	EMPLOYEE Last, First	Radiation Safety Officer Certificate: Date Expires	Radiation Safety & Use of Nuclear Gauges Date Issued	Radiation Safety & Use of Nuclear Gauges Expiration Date	Radiation Dosimetry Report, Badge Comp., Status
Tampa-CCC	196	2763-1	1/31/07	CPN MC3, Serial #M340602090	CS-137, 0.37GBq (10 mCi), #W-362; AM- 241:BE, 1.85 GBq (50 mCi) #2248NK	2950 64th St SW, Bldg 2, Naples, FL 24105	4/27/2005	4/27/2006	Vieth, Karl/ Rummons, Wesley/ Hammett, Jonathan		1/13/05/ 9/05 1/10/03	1/13/08/ 9/08 1/10/06	Landauer - Okay
Tampa-CCC	196	2763-1	1/31/07	Humboldt 5001EZ, Serial #3857	CS-137, 0.37GBq (10 mCi), #0673cx; AM- 241:BE, 1.48 GBq (50 mCi) #nj00131	2950 64th St SW, Bldg 2, Naples, FL 24105	7/15/2005	1/15/2006	Lofton, James/ Buller, Len/ Woosley, Tommy		1/13/05/ 2/11/04/ 6/17/04	1/13/08/ 2/11/07/ 6/17/07	
Tampa-CCC	196	2763-1	1/31/07	CPN MC1-DR, Serial #MD20801024	CS-137, 0.37GBq (10 mCi), #5061GH; AM- 241:BE, 1.85 GBq (50 mCi) #2136NK	Dale Mabry & Waters Unit F176, Tampa, FL	10/28/2005	10/28/2006	Available				
Tampa-CCC	196	2763-1	1/31/07	CPN MC3, Serial #M380304194	CS-137, 0.37GBq (10 mCi), #5320GQ; AM- 241:BE, 1.48 GBq (50 mCi) #7081NK	Dale Mabry & Waters Unit F176, Tampa, FL	3/22/2005	3/22/2006	Available				
Tampa-CCC	196	2763-1	1/31/07	Humboldt 5001EZ, Serial #4246	CS-137, 0.37GBq (10 mCi), #1077cx; AM- 241:BE, 1.48 GBq (50 mCi) #nj04594	1985 Erving Cir, Unit 8- 102, Ocoee, FL 34761	9/28/2005	3/28/2006	Oset, Dan				
Tampa-CCC	196	2763-1	1/31/07	Humboldt 5001EZ, Serial #4247	CS-137, 0.37GBq (10 mCi), #1088cx; AM- 241:BE, 1.48 GBq (50 mCi) #nj04517	Dale Mabry & Waters Unit F176, Tampa, FL	At Atlantic for Calib & Leak Test		Available				
Tampa-CCC	196	2763-1	1/31/07	Humboldt 5001EZ, Serial #4289	CS-137, 0.37GBq (10 mCi), #02900m; AM- 241:BE, 1.48 GBq (50 mCi) #nj04617	37248 Florida Ave., Dade City, FL 33525	3/29/2005	In Progress	Frederick, Shaun		06/25/03	06/25/06	
Tampa-CCC	196	2763-1	1/31/07	Humboldt 5001EZ, Serial 4305	CS-137, 0.37GBq (10 mCi), #12180m; AM- 241:BE, 1.48 GBq (50 mCi) #nj04664	Pensacola, FL	6/8/2005	12/8/2005	White, Ed/ Capps, Melvin/ Geiger, Jerry		4/16/04/ 6/10/04/ 1/27/03	4/16/07 / 6/10/07/ 1/27/06	
Tampa-CCC	196	2763-1	1/31/07	Humboldt 5001EZ, Serial #4339	CS-137, 0.37GBq (10 mCi), #0156cm; AM- 241:BE, 1.48 GBq (50 mCi) #nj04717	Franklin & Division St., City of Oviedo, FL	5/9/2005	11/9/2005	Stacks, Randy Kline, Tom		4/15/04 4/15/04	4/15/07 4/15/07	
Tampa-CCC	196	2763-1	1/31/07	Humboldt 5001EZ, Serial #4360	CS-137, 0.37GBq (10 mCi), #1360cm; AM- 241:BE, 1.48 GBq (50 mCi) #nm0003	10 N. Atlantic Ave., Daytona Bch, FL	5/23/2005	11/23/2005	Marietta, Jason		06/17/04	06/17/07	

<u>HDR OFFICE NAME</u>	<u>DEPT. #</u>	<u>Radioactive Material License Date on License or No License</u>	<u>Expiration Date for License</u>	<u>Radiation Gauge Type & Serial Number</u>	<u>Sealed Sources: Types & Serial #s & Current Activity</u>	<u>Gauge's Physical Location (storage area)</u>	<u>Radiation Gauge Leak Test Certificated</u>	<u>Next Radiation Gauge Leak Test</u>	<u>EMPLOYEE Last, First</u>	<u>Radiation Safety Officer Certificate: Date Expires</u>	<u>Radiation Safety & Use of Nuclear Gauges Date Issued</u>	<u>Radiation Safety & Use of Nuclear Gauges Expiration Date</u>	<u>Radiation Dosimetry Report, Badge Comp., Status</u>
Tampa-CCC	196	2763-1	1/31/07	CPN MC3, Serial # M390404959	CS-137, 0.37GBq (10 mCi), #7505GQ; AM- 241:BE, 1.85 GBq (50 mCi) #8066NK	Dale Mabry & Waters Unit F176, Tampa, FL	6/22/2005	6/22/2006	Available				
Tampa-CCC	196	2763-1	1/31/07	CPN MC3, Serial #M311006374	CS-137, 0.37GBq (10 mCi), #0446GC; AM- 241:BE, 1.85 GBq (50 mCi) #AM39Y	Dale Mabry & Waters Unit F176, Tampa, FL	6/8/2005	6/8/2006	Available				
Tampa-CCC	196	2763-1	1/31/07	N/A					White, Sandra		02/11/05	02/11/08	
Tampa-CCC	196	2763-1	1/31/07	N/A					Keefer, Paul D.		05/20/04	05/20/07	
Tampa-CCC	196	2763-1	1/31/07	N/A					Stevens, Ed		12/16/04	12/16/07	
Tampa-CCC	196	2763-1	1/31/07	N/A					McIntosh, Brian		11/14/02	11/14/05	
Tampa-CCC	196	2763-1	1/31/07	N/A					Pulles, Rafael		04/19/05	04/19/08	
Tampa-CCC	196	2763-1	1/31/07	N/A					Christian, Don		5/20/04	05/20/07	
Tampa-CCC	196	2763-1	1/31/07	N/A					McVay, Barry		2/9/05	02/09/08	
Tampa-CCC	196	2763-1	1/31/07	N/A					Blackwell, Kathy		10/16/03	10/16/06	

1.0 OBJECTIVE

Nuclear Moisture/Density Gauges ("Gauges"), used to determine density and moisture in field substrates, contain a radioactive source material. This radioactive source can be hazardous to workers if radiation exposure exceeds acceptable levels or if the radioactive source inside the Gauge is damaged. Therefore, the use of Gauges is a potentially dangerous activity, and shall be performed in accordance with this Procedure. It is the objective of HDR to prevent injuries while using Gauges through recognition of the potential hazards associated with their use, and the implementation of safe working practices and conditions.

This Procedure presents the requirements, actions, training and acceptable working conditions necessary for the safe use and/or storage of Gauges, whenever project tasks mandate their use.

2.0 PURPOSE

This Procedure addresses the elements of the HDR Nuclear Moisture/Density Gauge Safety Program and conforms to the requirements of 23 CFR Part 637, Subpart B – Quality Assurance Procedures for Construction as mandated by the Federal Highway Administration (FHWA), effective June 29, 2000. The safety guidelines presented herein also comply with the Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1926.53 – Ionizing Radiation, as well as pertinent provisions of the Nuclear Regulatory Commission's Standards for Protection against Radiation, contained in 10 CFR Part 20. Other additional HDR requirements are also addressed, as applicable.

Special Note: Activities in each state are regulated by a State Radiation Protection Program, which may have requirements that differ, and are more stringent than the federal requirements presented here. When any HDR office has employees that use a Gauge, a Radiation Safety Officer shall be designated within that office. It is the responsibility of the local Radiation Safety Officer to assure that State Radiation Protection Program regulations, in the state(s) where that office uses the Gauge, are followed.

3.0 APPLICABILITY

This Procedure is applicable to all HDR employees that use a Gauge. HDR field professionals are responsible for evaluating project/contract requirements to determine whether the use of Gauges is necessary or not. All HDR subcontractors are responsible for developing their own Gauge

Safety Programs; this Procedure is not intended to apply to, or direct, the activities of outside employers. Direct HDR subcontractors using Gauges shall be contractually required to comply with all federal and state requirements, including (but not limited to) those specified in this Procedure.

If a client's requirements differ from those specified herein, the more stringent requirements shall apply.

4.0 PROGRAM IMPLEMENTATION

This program will be administered nationally by the National Director of the HDR Nuclear Gauge Program.

CCC Field Health and Safety Manager Shall:

- Provide guidance to Radiation Safety Officers (RSOs) and Office Safety Coordinators (OSCs) and other HDR professionals concerning issues regarding Gauges.
- Assist RSOs and OSCs in acquiring equipment, PPE and other necessary items to allow employees to work safely with Gauges.

National Gauge Program Director. The National Gauge Program Director (*Jeffrey Berger CHST - Omaha*) shall:

- Develop this Procedure in cooperation with the CCC President (Laurie Roden).
- Review, at least annually, the effectiveness of this Program, identify any deficiencies, and work with the National Director of Safety to ensure they are corrected.
- Compile and maintain records relating to employee radiation exposure.
- Obtain Federal Licensing for future projects
- Serve as the main contact point for matters relating to the safety, training and regulatory aspects of Gauge use.
- Provide guidance to OSCs and HDR professionals concerning issues regarding Gauge safety.
- Assist OSCs in acquiring equipment, PPE and other necessary items to allow employees to work safely with Gauges.
- Provide Gauge safety training to HDR professionals as necessary.

Office Safety Coordinators. The OSC(s) (or their field designee) will:

- Interface with the National Gauge Program Director on Gauge questions, and when guidance is necessary.
- Provide office technical assistance to project personnel, as qualified.

Radiation Safety Officer. The Radiation Safety Officer(s) will:

- Be responsible for the State Radioactive Material License needed for a HDR Gauge maintained or used within the state.
- Be responsible for the safe usage and storage of HDR-controlled Gauges within the state.
- Determine any additional state-specific Radiation Protection Program requirements, and relay this information to their impacted staff, as well as the National Gauge Program Director.
- Monitor the amount of radiation exposure an employee has received from working with Gauges.
- Maintain certification by the Gauge manufacturer (i.e., Troxler Corp. and/or Seaman Corp.).
- Provide evaluation assistance to Project Managers during project planning and proposal preparation.

Impacted Project Personnel. All project personnel working with, or in close proximity to Gauges shall:

- **Sign off that they have read, understood and will follow the contents of this Procedure when required to use a Nuclear Gauge.**
- Make sure they have received site-specific Gauge training and instruction, as detailed herein.
- Wear a Personal Exposure Measurement Device before any usage is made of any Gauge (this includes working within six (6) feet of contractor operated Gauges).

5.0 GAUGE OVERVIEW

Gauges are small portable field devices (Figure 1) used on construction project sites to determine (a) the percent of soil moisture, and (b) the density of the soil. To perform this analysis, Gauges employ a radioactive "source" - a small quantity of radioactive material. The source cannot be turned on or off, but continuously emits radiation (when not in use, this radiation is shielded from escape, although the shielding is not 100 percent effective). While this

radiation is the vehicle by which the Gauge performs its functions, it is also a potential health hazard to humans in close proximity.

Gauges are simple devices to operate. The Gauge is placed on the substrate (soil, concrete) to be tested, turned on, and the radioactive source material is exposed. The instrument collects the data and generates output within about two minutes. During this time the operator remains at a safe distance, generally at least six (6) feet away. An expanded discussion of Gauge operation is included in Appendix A.

There are four common models of Gauges currently used in the United States. Troxler Corp. manufactures the most common types, producing approximately 80% of the Gauges used today. The other frequently encountered Gauge is manufactured by Seaman Corp. Figure 1 shows the most common Gauge models by these manufacturers. A third type, manufactured by CPN International, (Camel Pacific) and a fourth one by Humboldt may be occasionally encountered on construction projects.

Figure 1 – Most Common Gauges in Use Today



**Troxler Model 3411-B
on Reference Count Stand**



**Seaman Model C-200
on Reference Count Stand**

6.0 DEFINITIONS

- **ALARA** – Acronym meaning “As Low As Reasonably Achievable”. This is the goal for maximum employee exposure to any ionizing radiation – all exposures should be reduced to as low a level as possible, irrespective of permissible limits set by law.
- **Radionuclide** – These are species of atoms characterized by radioactive nuclei.
- **Radiation**. – Radiation results from the spontaneous, uncontrollable breakdown of unstable atomic nuclei, generating a random release of energy (radiation). This energy is emitted in the form of waves or particles. We are concerned when the radiation has enough energy to strip electrons away from atoms within body tissue - this is called “ionizing radiation”. Radiation exposure can occur through two pathways - external and internal. External radiation exposure results from proximity to a source located outside the body. Internal exposure results from radiation materials inhaled or ingested into the body. Precautions against one type of exposure hazard will not be helpful in protecting against the other type of hazard. There are four different types of ionizing radiation being emitted by Gauge radioactive source(s):
 - **Alpha Particles** – These are large and slow moving particles emitted from the nucleus of very heavy atoms, and do not travel far. Alpha particles are the least penetrating of all radiation forms - a few centimeters of air provides adequate shielding. They cannot pass through a Gauge’s source encapsulating material, nor can they penetrate paper or outer human skin layers. Therefore, under normal Gauge use, alpha particles do not present a hazard. Alpha particles in Gauges are used to bombard beryllium to produce neutron radiation for use in moisture detection.
 - **Beta Particles**. – These are electrons ejected from an atom during radioactive decay. Beta particles cannot pass through a Gauge’s source encapsulating material, so do not present a hazard to the worker under normal Gauge operation. Beta particles can penetrate outer skin layers, but cannot penetrate as far as the vital organs. In air, beta particles travel several hundred times the distance of alpha particles.
 - **Neutron Particles**. – Neutron particles do not have an electrical charge, but have a very high kinetic or momentum energy, and are very penetrating in human tissue. In order to lose their energy, they must collide with the nucleus of another atom and be absorbed or slowed down. In Gauge operation, neutron particles are generated in

order to determine substrate moisture concentration. Not occurring naturally, neutron particles readily penetrate most materials, and they need to be shielded with materials containing hydrogen (i.e., water, paraffin, polyethylene, concrete).

- **Gamma Rays (Electromagnetic or Photons)**. Gamma is "wave" energy, emitted always in combination with alpha or beta particles. They are photons that are emitted from the nucleus of an atom. Possessing infinite range, this form of radiation is extremely penetrating and can easily pass through the human body. The Gauge emits gamma radiation to determine the density of a substrate, and therefore is designed to release gamma radiation into the work area. Exposure to Gamma Radiation is the primary safety concern when in proximity to a Gauge. Very dense materials, such as lead, are required to effectively shield gamma rays.

7.0 HEALTH EFFECTS OF IONIZING RADIATION

Radiation effects on living tissue vary in relation to: (a) the energy of the radiation, (b) the absorbed dose, (c) the time span over which the dose was received, and (d) the particular body area exposed to the radiation. Some body areas, such as eyes and reproductive organs are more susceptible to damage from radiation than other areas.

The energy contained in radiation is a function of the form (alpha, beta, gamma, neutron). Radiation dose is universally reported in units called RADs, but since radiation comes in different forms (alpha, beta, gamma, etc.), with different energy levels, a qualifying factor (specific to the form) is multiplied with the RAD value to get a useful human exposure value regardless of the form source - **REM (R)**; small doses of radiation are measured in milliREM's (mR). One REM = 1000 milliREM.

Every human on earth is exposed to radiation. The average person in the United States receives a dose of about 360 mR of radiation per year. Eighty percent of that exposure comes from natural sources, such as radon gas (55%), the human body (11%), the ground (8%), and cosmic radiation (from space, 8%). The remaining twenty percent comes from man-made sources, primarily diagnostic x-rays by doctors and dentists. This radiation "load" is considered background for modern life, and is unavoidable. The radiation we are concerned about in this Procedure is generated as a result of occupational employment, and is an exposure we can control.

In gaining an understanding of radiation health hazards, the following terms need to be understood:

- **Curie** (kur'e) (Ci). Is the strength or activity of a source, defined as the number of atoms that disintegrate in one second. One (1) Ci = 3.7×10^{10} disintegrations per second.
- **Quality Factor**. A corrective value to account for the difference in the biological effect of different types of radiation, as compared to X-rays. Presented in Table 1.
- **Roentgen** (rent'gen, rent'jen). A measure of the ionizing effect of radiation in air at some specific location. Approximately equal to one RAD.
- **RAD**. Acronym for "**R**adiation **A**bsorbed **D**ose", a RAD is a measurement of exposure – the absorbed dose per unit mass of biological tissue. One RAD is defined as 100 erg/gm of body tissue.
- **REM**. Acronym for "**R**oentgen **E**quivalent **M**an", it represents the equivalent biological effect of various types of radiation. It is calculated by multiplying the absorbed dose (RAD) by an assigned quality factor of the particular form of radiation. This is the exposure unit we are concerned with, since it self-corrects for the various forms and levels of radiation, length of exposure, and body part exposed.

Table 1 – Assigned Quality Factors
RAD x QF = Dose (REM)

Type of Radiation	RAD (Dose)	Quality Factor (QF)*	REM
x-ray, gamma or beta	1	1	1
slow (thermal) neutron	1	5	5
fast neutron or high energy proton	1	10	10
alpha (with the energy to reach the lens of the eye)	1	20	20
* The Quality factor is a permanently assigned value (constant), specific to the type of radiation, and does not change.			

The biological effects of radiation further depend not only on the form and total amount absorbed (REM), but also on the rate at which it is absorbed (dose rate). For example, a 600 REM dose would be fatal to a person if it were absorbed by the whole body within a period of one day, but would probably not have any noticeable effect if absorbed over a period of 30 years. Damaged body tissue is able to repair itself when the dose rate is low. Dose rates of less than 24 hours are termed "Acute Exposure", while dose rates in excess of 24 hours are termed "Chronic Exposure".

Additionally, health effects of radiation exposure that appear within approximately a month following exposure are termed "Acute Effects". "Chronic Effects" would include those that result in persistent health effects, such as radiation dermatitis, and long-term effects (appearing after one year), such as tumor growth, cataract formation, etc.

8.0 METHODS OF PROTECTION

Due to the detrimental effects of ionizing radiation on living cells, exposure levels must be kept As Low As Reasonably Achievable (ALARA). There are **three principles for protection** from all forms of ionizing radiation. They are:

- **Time** – The less time a person spends in an area of radiation, the smaller the dose received.
- **Distance** – Distance is very effective in reducing the amount of radiation exposure to the body. The decrease in radiation intensity is proportional to the square of the distance from the source (Inverse Square Law). Thus, moving a short distance away from a source can lessen exposure (dose) significantly (e.g., if a radioactive source emits 16 REM, moving only 4 feet away will lessen the dose received to 1 REM).
- **Shielding** – This is the placement of suitable deflecting or absorbing material between a radiation source and the worker. For example, a piece of paper will shield an alpha source, two centimeters (~1 inch) of aluminum will shield a beta source, two and one-half inches of lead will effectively shield a gamma source, and four inches of polyethylene will shield a neutron source.

When working with radioactive sources such as Gauges, all three principles must be employed at all times to ensure that your dose received is as low as reasonably achievable!

REGULATORY DOSE LIMITS

Per 29 CFR 1926.53 – *Ionizing Radiation*, no HDR employee working with Gauges may be exposed to radiation, during any calendar quarter, in excess of 1.25 REMs (based on exposure to the whole body). Personnel monitoring records shall be maintained by the National Gauge Program Director to ensure this limit is not exceeded.

9.0 GAUGE RADIATION SOURCES

The most common radiation source materials currently used in Gauges are listed in Table 2. Most Gauges have only one source, but may have two.

Check your Gauge Manual to verify what kind and size of radiation sources your Gauge is using.

Table 2 – Gauge Radioactive Source Materials

Source Type	Max. Size of Source
Cesium-137 (Cs-137)	8 mCi
Americium-241: beryllium (Am-241:Be)	40 mCi
Californium-241 (Cf-252)	50 mCi
Americium-241 (Am-241)	10mCi

10.0 RADIATION EXPOSURE SAMPLING

There are four basic methods used to detect radiation:

- **Gas Ionization Instrument** - These instruments are the most commonly employed field radiation detection instruments. The instrument utilizes an ionization chamber with a fixed anode running the length of the center of the chamber and electrically insulated from the chamber walls. The walls of the chamber represent the cathode. A positive charge is applied to the anode, and a negative voltage applied to the cathode. The chamber is filled with air and an absorbing gas medium. As radiation passes within the chamber, the air and gas molecules are ionized. A consistent voltage is applied across the anode and cathode so that the ion pairs produced do not recombine, but rather migrate to the oppositely charged poles of the anode and cathode. The number of ion pairs produced is directly proportional to the radiation received. A quenching gas is also present which discharges the ionization occurring within the chamber. At the instant the molecules of quenching gas break down, a small amount of electricity is discharged, referred to as a "pulse." The pulse rate, given as counts-per-unit time, indicates the speed of ionization occurring within the chamber. (This detection method is utilized in most nuclear moisture/density Gauges.)
- **Photographic Emulsions** - This method employs film, coated with a photographic emulsion that is affected when exposed to radiation. As each particle or ray of radiation strikes the emulsion surface, the exposed point of light is visible on the film. These points can be correlated to the amount of radiation. This concept is used in personnel radiation monitoring in the form of film badges. Film badges detect x-ray, beta and gamma radiation.
- **Scintillation Media** - Certain substances, such as lithium fluoride, store energy when subjected to radiation exposure. Upon analysis, the stored energy can then be released in the form of measurable visible light and

correlated to the received radiation dose. This concept is used in personnel monitoring in the form of Thermo-Luminescence Dosimeter (TLD) badges. One significant problem with this monitoring device is that it is permanently destroyed during lab analysis, so there is no way of repeating the analysis if needed. These badges detect x-ray, beta and gamma radiation.

- **Optically Stimulated Luminescence (OSL)** - OSL personal monitoring badges are the current standard, and will be the preferred method employed by HDR personal. Employing a combination of film and TLD technology, radiation passes through a thin layer of aluminum oxide. After exposure, and submission of the badge for analysis, a laser light is used to stimulate the aluminum, causing it to become luminescent in proportion to the amount of radiation exposure. They have a large dynamic measurement range, high sensitivity, and excellent long-term stability. Their sensitivity is good for employees working in low-radiation environments, such as with Gauges. This badge detects x-ray, beta and gamma radiation.

All personal monitoring badges should be worn between the waist and the shoulders, positioned face forward, to ensure an accurate record of exposure to the trunk of the body (where vital organs are contained). The badges can be monitored on a weekly, biweekly, monthly, bimonthly or a quarterly basis, depending on the length of the project. Generally, the employee will wear the same assigned badge daily when Gauge operation is occurring, for up to the length of Gauge use or quarterly, whichever is less.

11.0 GENERAL SAFETY REQUIREMENTS

When using a Gauge, HDR employees shall perform the following:

- Each operator shall wear a personal **OSL (primary choice) or TLD** exposure badge to monitor the amount of radiation exposure received during the use of the Gauge. Badge selection/acquisition is the responsibility of the Radiation Safety Officer assigned to the project, and will be based on the type of radiation expected and the preference of the analytical lab used.
- In addition to the personal exposure badge, a **control badge** is used to establish a background exposure level (i.e., the control badge monitors normal environmental radiation when an operator is not using the Gauge). The difference between the personnel badge and the control badge is the amount of Gauge-generated radiation exposure that the operator has received. In order to obtain accurate radiation exposure measurements,

the use of the control badge in lieu of an operator's assigned personal "exposure" badge is strictly prohibited.

- The control badge shall be placed and remain in the office, away from the source or pathway to/from storage area. **The control badge is never worn!**
- All badges not being worn (i.e., personal exposure badges removed at end of workday, fresh badges, control badges) must be stored away from the Gauges radiation source. This includes the Gauge storage area and the path used to move the Gauges to and from the storage area.

Obligations of the Operator:

- No HDR employee shall attempt to operate a Gauge unless he/she has successfully completed an approved training course accepted by the State Radiation Control Bureau for that state. **Additionally, the employee must have been designated as an operator, in writing, by both the local RSO and National Gauge Program Director.**
- The operator shall have read the Gauge operating manual, be completely familiar with the particular equipment and have operated the Gauge under the observed supervision of a qualified operator before he/she attempts to operate the Gauge. **The operator shall always strictly comply with the Gauge operating manual.**
- Any malfunctions related to the radioactive control mechanism(s) shall be reported immediately to the operator's Supervisor and their RSO. **Operators shall never attempt to force the mechanism closed, or try to locate the cause of equipment failure.**
- When not in actual use, the radioactive "source" shall be kept in the shielded position. **The source lock shall be in place and locked, and the Gauge shall be locked into its transport/storage container. Keys shall be removed from the locks and retained by the operator.**
- As previously indicated, **the wearing of an employee's "control" badge, or another operator's monitoring badge, in lieu of an operator's assigned exposure badge is strictly prohibited.**
- When the Gauge is not locked in its storage area or transport container, the operator shall always have the Gauge under visual immediate surveillance.
- Once the Gauge is in operation, the operator shall assure he/she is no closer than three (3) feet to the source during the operation cycle.

- An area six (6) feet in radius around the Gauge, in all directions, is considered the "Restricted Area." Unauthorized personnel and all persons not wearing a personal radiation badge shall be kept outside this six (6) foot restricted area at all times that the source is present.
- The operator shall update the utilization log with the appropriate information and correct entries as actions are taking place. The law clearly places the responsibility for public safety upon the user and the log is a legal document for personal and licensee protection.
- Persons under eighteen (18) years of age shall not be allowed to use a Gauge containing a radioactive source.
- A female operator shall inform her supervisor as soon as she has reason to believe that she is pregnant, and she must decide whether she wishes to continue operating the Gauge. If so, she must sign a statement indicating that she understands the hazards involved to the fetus and is knowledgeable of the possible consequences. Exposure to the fetus, as measured by the mother's personal exposure badge results, shall not exceed five tenths (0.5) of a REM during the entire term of the pregnancy.
- It is extremely important that the operator never look at the source when operating in the direct transmission method of testing, with a Gauge whose radiation leaves the body of the Gauge.
- Use of the Gauge for any purposes other than those specified in the manufacturers operating manual is strictly prohibited.

12.0 TRANSPORTATION OF GAUGES

Anytime a Gauge is transported, HDR personnel shall comply with applicable portions of the following regulations:

- The State Environmental Department
- The State Department of Transportation
- The United States Department of Transportation (USDOT)
- The United States Environmental Protection Agency (EPA)
- The International Atomic Energy Agency (IAEA)
- Title 49 of the United States Code of Federal Regulations (49 CFR) pertaining to the transportation of portable nuclear Gauges
- Notify the HDR Nuclear Gauge Program Director prior to its transport (see Appendix B)

See Appendix B for a complete list of State Radiation Contact Agencies.

The following paragraphs provide guidance on the requirements for transport of Gauge(s); however, additional more stringent state-specific requirements may also need to be implemented.

- 1) Any employee transporting by public conveyance (common carrier), or preparing a Gauge for transport, must have completed an accredited Hazardous Material Transportation Training course. This course must be repeated at three (3) year intervals, in accordance with 49 CFR Part 172.
- 2) A copy of the IAEA Certificate(s) of Competent Authority is REQUIRED by 49 CFR 173.476(a). (Numbers USA/0632/S & USA/0614/S) The Gauge manufacturer should supply this form. If you do not have this form, contact the manufacturer, or the Director for HDR's Nuclear Gauge Program, and provide your Gauge model and serial number; and they will supply it. Important: this is not the same form as a Gauge certificate issued by the manufacturer. The Gauge certificate provides relevant information and is useful when being inspected, but it is not required and it does not serve as a replacement for the IAEA form.
- 3) A Leak Test Certificate is REQUIRED for all Gauges. HDR operators can perform this test, consisting of the thorough wiping off of manufacturer-specified areas inside the Gauge, with submission of the wipe samples to an approved lab. The lab issues the certificate. The purpose of a leak test is to ensure the integrity of the source encapsulation, and verify that no radioactive materials are escaping. While radiation is always being emitted by the source, no radioactive materials should be escaping. The certification is good for a period of six months from the date the Gauge was wiped for the leak test. A Gauge must have a current leak test certificate to be removed from its storage area. Because of the sensitive nature of the Gauge shielding components, they must be treated with care. If a Gauge is hit or impacted, even lightly (i.e., it falls off a tailgate), the Gauge will require a new leak test. A copy of this must be sent to the National Gauge Director – Omaha.

While performing the leak test, you must wear your personnel monitoring badge.

- 4) The transport container for the Gauge must meet the requirements of 49 CFR 173.415(a) for a "Specification 7A, Type A" package. The shipping boxes made by the Gauge manufacturers already meet these requirements, and the documentation for the container is furnished with the Gauge. Save boxes and transport in these containers only!
- 5) All transport containers carried in private vehicles must be carried on the passenger side of the vehicle and located as far to the rear of the bed/cargo compartment as possible. The lid/door must be secured with a lock that is not readily breakable to prevent unauthorized access to the Gauge. When a manufacturer's shipping containers are being utilized as transport containers, they must also be secured to the vehicle to prevent shifting, moving, sliding, etc. during normal transport. All locks shall be locked when the operator is not in direct/immediate attendance. The keys or combinations to the transport container are to be retained by the driver of the vehicle at all times. Before leaving the transport vehicle unattended, the vehicle is to be locked, the keys retained by the driver, and the "Bill of Lading" placed in the drivers seat.
- 6) A "Bill of Lading" must accompany the driver of the vehicle and be within his/her reach when the seat belt shoulder strap is in place. NRC Regulations, State Law and State Regulations require this. It is the responsibility of the Radiation Safety Officer to supply the Bill of Lading to the operator. It is the operator's responsibility to ensure they received the Bill, and that it is the proper one for the Gauge being transported. The Bill of Lading must contain the following information:
- Name of shipper
 - Description of the shipment (proper shipping name, Hazard class, UN material identification number, type of package, name and activity of each nuclide, category of labeling and transport index)
 - Emergency response telephone number - Check with your Gauge manufacturer, they may offer this service to their customers (some have in the past). If not, it is the responsibility of the Licensee to supply this service.
 - Shipper's certification
 - Shipper's signature

The Bill of Lading is created in-house (no specific form); it is good practice to use company letterhead for this document.

This documentation is ONLY for transporting a Gauge to and from the job site by private vehicle. For shipment by common carrier (i.e., Federal Express, Air, International shipment) there are different forms that must accompany the shipment. Check with your Radiation Safety Officer for this information.

- 7) **Radiation Yellow II labels** (see Figure 2) are required on two opposite sides (not including the bottom) of the transport container. One label must be positioned so that it is visible to a person who is opening or attempting to open the transport container. **The labels must indicate the radionuclide name, its activity level in megabecquerels, and the transport index.** The container must also be marked with the proper shipping name of the radioactive material, such as "RQ, Radioactive Material, Special Form, NOS, 7 UN2974" for certain Americium/Cesium sources and "Radioactive Material, NOS. 7, UN2982" for certain Radium sources. **These labels are for the transport container only. Do not placard your vehicle.**



**Figure 2
Radiation Yellow II Sign**

- 8) Should a container be damaged sufficiently to require its disposal, all labels **must be removed or rendered illegible** prior to container disposal.
- 9) **Emergency Response Information must accompany the shipment of a Gauge. As with the Bill of Lading, this document must be within reach of the driver when the seat and shoulder belts are in place.** Check with your manufacturer, they should supply a comprehensive form for this purpose. It should include the Proper Shipping Name, Potential Hazards (both Health and Fire or Explosion), and Emergency Actions, Precautions, Response to Fire, Spill or Leakage, and First Aid.

As an addendum to this information, a **Telephone Listing** of your emergency contact personnel must also be present (i.e., immediate

supervisor, the Radiation Safety Officer, the State Police, USDOT, or State Environmental Department).

Summary list of items needed when transporting a Gauge:

1. A copy of HDR's current Gauge license (See Section 14.0)
2. Gauge operating procedures
3. Copy of current leak test certificate
4. Emergency response information (must remain within reach of the driver)
5. Emergency telephone numbers (to cover all personnel requiring contact)
6. Bill of Lading (must remain within reach of the driver)
7. Proper signs
8. Utilization logs
9. State regulations
10. Copy of Operator's Radiological Training Certificate or Card
11. Personnel monitoring device worn (OSL or TLD badge)
12. Any other records that may be required by your company license

13.0 EMERGENCY PROCEDURES

An emergency situation may require the transporting employee to take immediate action to safeguard the health and safety of those nearby who could be exposed to radiation. Such emergency situations could include the Gauge being lost, stolen, or the source being stuck in the "open" or "use" position, or the Gauge being damaged either on the job or during the course of a vehicular accident. **In any event, do not overreact! Assess the situation and proceed accordingly.**

If an accident does occur, your first obligation is to assist the injured.

****REMEMBER: People First, Then Radiological Concerns! ****

Medical problems take priority over radiological concerns. Do not delay assistance to, and/or rescue or transport of, a seriously injured or possibly contaminated person.

Then, if radioactive contamination is a possibility, take the following steps:

1. Secure the area (for 35' radius)
2. Notify your immediate supervisor (reference your emergency contact list)
3. Notify the HDR Nuclear Gauge Program Director (See Appendix B)
4. Notify your Radiation Safety Officer

5. Notify the State Police
6. Notify the State Environmental Department
7. Try to keep involved persons at the site until authorities arrive to interview them
8. Do not leave the site until relieved by proper authorities
9. The USDOT must be notified at the earliest practical time of an accident that occurs during the course of transportation (including loading, unloading and temporary storage) in which fire, breakage, spillage, or suspected contamination occurs involving shipment of radioactive materials, including Gauge sources.
10. Written notification to the State Environmental Department and the National Gauge Program Director within 24 hours. You may use a FAX for notification.

14.0 NUCLEAR-GAUGE OWNERSHIP REQUIREMENTS

If HDR owns a Gauge, the following requirements are applicable:

A State Radioactive Materials License issued to HDR is needed from the state that the Gauge will be used in. That state issues the license and authorizes the use of specific radioactive sources, as well as the manner in which they shall be used. The use of radioactive materials in any manner NOT covered by the language of the license is strictly prohibited. The license may be revoked, suspended or modified, in whole or in part, for any false information stated. The state has the authority to perform unannounced inspections at any time. A license is issued to the owner of the Gauge (HDR), not to individual operators. A Gauge may not be transported across state lines unless prior arrangements have been made with the other state's licensing agency.

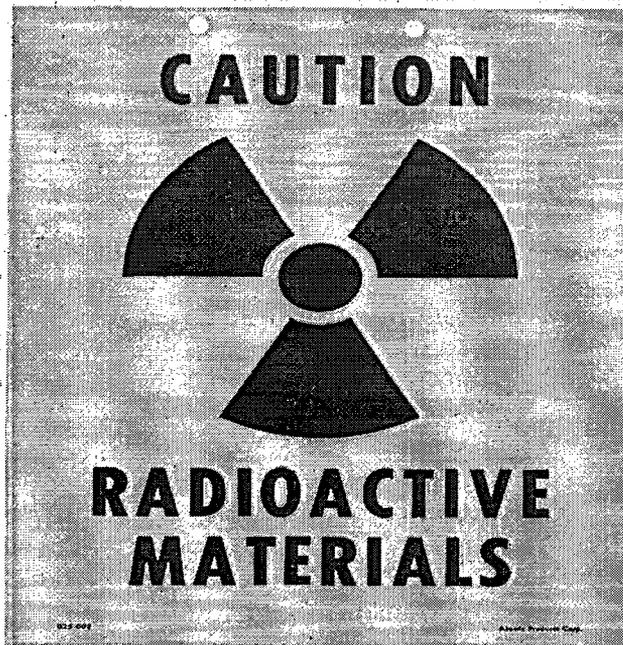
Storage of Gauge: When the Gauge is not in use, it **must** be stored in an approved (by the Program Director) storage area, meeting the storage requirements directed by the state and/or federal mandates. The storage area, if possible, should be capable of preventing exposures to persons to a radiation field of more than 2 mR/hr, at the external surface of the storage area, and must be capable of being secured (i.e., a securable door - locked). If the room has windows or skylights, they must be secured to significantly retard forced entry. Persons working next to a storage room wall, and/or within a 2 mR/hr radiation field outside the storage room, must have their radiation exposure documented, either by assigning them a personnel monitoring badge or by calculating their radiation exposure. In the event a calculated exposure exceeds 100 mR/yr, the individual must have radiological training and be assigned a personnel monitoring badge, or be relocated out of the area. All Gauge accessories should be stored with

that Gauge (i.e., standard count stand, leveling plate, Gauge log book, shipping container, drill rod, hammer).

Three signs are required to be posted on the door to the storage area:

1. **“CAUTION: RADIOACTIVE MATERIAL”** Radiation signs shall be posted to notify personnel of the existence of the source material. The signs must measure no less than eight (8) inches on the side, and additionally display the magenta on yellow radiation symbol. The statement “CAUTION RADIOACTIVE MATERIALS” shall be on the sign (Figure 3).

Figure 3 – Storage Door Sign (1/3)



2. **“NOTICE TO EMPLOYEE”** This notice will present the following information (Figure 4):
 - a) Your employer's responsibility
 - b) Your responsibility as a worker
 - c) Reports on your radiation exposure history
 - d) Record of inspections
 - e) Phone numbers for contacting the radiation control bureau



STATE OF NEW MEXICO
ENVIRONMENT
DEPARTMENT

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION
NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS: INSPECTIONS

Part 4 of the New Mexico Radiation Protection Regulations establishes standards for your protection against radiation hazards. Part 10 establishes options for radiation workers and related matters.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to -

1. Apply these regulations to work involving sources of radiation.
2. Post or otherwise make available to you a copy of the Radiation Protection Regulations, licenses and operating procedures that apply to work you are engaged in, and explain their provisions to you; post Notices of Violation involving radiological working conditions and orders.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the Radiation Protection Regulations and the operating procedures that apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas.
2. Measures to be taken after accidental exposure.
3. Personnel monitoring, surveys and equipment.
4. Caution signs, labels and safety interlock equipment.
5. Exposure records and reports.
6. Options for workers regarding division inspection.
7. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The Radiation Protection Regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Part 4 of the Radiation Protection Regulations. These sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air and water.
 2. If you work where personnel monitoring is required, and if you request in-
- NMED 845 Revised 3/92

formation on your radiation exposures:

- (a) your employer must give you a written report, upon termination of your employment, of your radiation exposures, and
- (b) your employer must advise you annually of your exposure to radiation.

INSPECTIONS

All licensed or registered activities are subject to inspection by representatives of the Environmental Improvement Division. In addition, any worker or representative of workers who believes a violation of the Act, Radiation Protection Regulations or license condition exists or has occurred in work under a license or registration with regard to radiological working conditions on which the worker is engaged may request an inspection by sending a notice of the alleged violation to the address below. The request must set forth the specific grounds for the notice and must be signed by the worker or the representative of workers. During inspections, division inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation.

INQUIRIES

Inquiries dealing with the matters outlined above can be sent to:

New Mexico Environment Department
H
R Community Services Bureau
Radiation Licensing & Registration
2052-B Galisteo St., P.O. Box 26110
Santa Fe, New Mexico 87502

POSTING REQUIREMENT

Copies of this notice must be posted in a sufficient number of places in every establishment where employees are employed in activities licensed or registered, pursuant to Parts 2 and 3 of the Radiation Protection Regulations, to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their places of employment.

Figure 4 - Storage Door Sign (2/3)

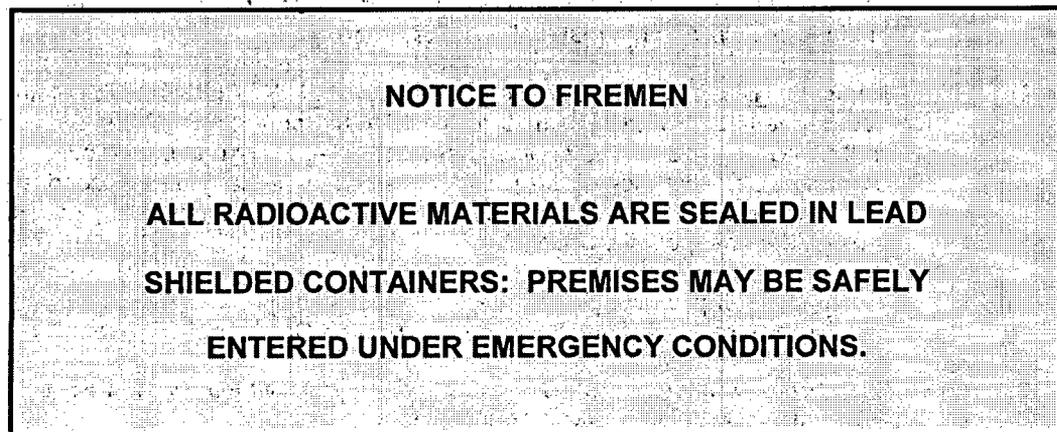
HDR

NUCLEAR MOISTURE/DENSITY
GAUGE SAFETY
H&S PROCEDURE #40

3. **"NOTICE TO FIREMEN"** The notice will state the following (Figure 5):

"NOTICE TO FIREMEN: ALL RADIOACTIVE MATERIALS ARE SEALED IN LEAD SHIELDED CONTAINERS: PREMISES MAY BE SAFELY ENTERED UNDER EMERGENCY CONDITIONS."

Figure 5 – Storage Door Sign (3/3)



The local fire department must be notified, in writing of the storage location and sources, when sources change, and when Gauges will no longer be stored at that location. The names and phone numbers of the Radiation Safety Officer and other emergency personnel shall be posted. A log must be kept at the storage location tracking the Gauge location anytime it is removed from the storage site. This log must include the operators name, signature, date, time in/out of storage, source serial number, Gauge model number and manufacturer, and where the Gauge will be while it is out of its storage area (location, project number, etc.).

15.0 Operator Training Requirements

The operator needs a basic understanding of radiation fundamental concepts, health/safety concerns and requirements, and Gauge operational training and procedures as per the most current rules and regulations of your state and the Nuclear Regulatory Commission (NRC). This is usually required as a provision of your radioactive materials license. Your state will have their own training requirements for Nuclear Gauge Operators, which will specify what certifications and number of hours of on-the-job experience are needed. Alternatively, formal training can be taken from the Gauge manufacturer, such as Troxler; check their website for training locations/dates. (www.troxlerlabs.com).

**SAFE & OPERATIONAL STEPS FOR TAKING NUCLEAR
MOISTURE/DENSITY TESTS**

Gauges may be used in performing three different operational testing methods:

1. **Backscatter** - In backscatter testing, the source is lowered onto the surface of the material being tested, and radiation is directed down into the material itself. The radiation is "scattered" through collisions with the atoms of the material and deflected "back" to the detector tubes. The Gauge compares this reading to a "daily standard count" taken in the area and arrives at a reading for the density of the material being tested.
2. **Backscatter/Air-Gap Ratio** - Commonly referred to as the Air-Gap Ratio Method, it uses the backscatter method to determine material density, but additionally yields a "chemical" reading. To get this reading, the Gauge is placed into the "air-gap" operational mode, which raises the source exactly one and one-quarter inches above the material, and a second reading is taken. Due to the large air-space under the Gauge, a "chemical" reading is yielded. The Gauge then performs the following computation:

$$\frac{(\text{Air-Gap Reading})}{(\text{Backscatter Reading})} = \frac{\text{Chemical}}{(\text{Density} * \text{Chemical})} = \frac{1}{\text{Density}}$$

* Use of this operational method effectively cancels out the chemical and/or radiological effects of the material being tested

3. **Direct Transmission** - In operating in the direct transmission method, a small hole (not to exceed the diameter of the source rod by more than 3mm or the depth to be tested by more than 51 mm) is drilled into the material to be tested. The source rod (or a detector tube) is then inserted to the desired test depth within the predrilled hole. The Gauge electronics are set for the selected test depth (some Gauges have sensors which automatically set this depth for the operator). The radiation emitted by the source, while still being scattered thru collisions with atoms of the material, then travels in a somewhat more "direct" line from the source to the detector tube.

OPERATIONAL STEPS IN PERFORMING A BACKSCATTER TEST, USING A TROXLER 3411-B AS AN EXAMPLE

- 1) Attach your nuclear exposure badge to your shirt, facing forward, between your neck and belt line.
- 2) Go to the Gauge storage area, do a physical check of the Gauge, transport container and equipment. Fill out the Gauge utilization log, detailing where the Gauge will be used today (normally the project site). Leave the utilization log in the Gauge storage area.
4. The Gauge must be locked up, at all times, when not in use. The keys should be either in the transport container in the Gauge storage area, or on the operator when being used in the field. Remove Gauge and reference count stand from storage. Place stand on selected location (always the same pre-selected location for reference counts), at least 6 feet from other objects and 30 feet from any other Gauge. After cleaning off the top of the stand and the bottom of the Gauge, set the Gauge on the stand in the required orientation and turn on the Gauge. Allow the Gauge to warm up in accordance with the manufacturer's requirements (Check the

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operator's manual for the time requirements for your Gauge - Troxler 3411-B models require a 10 minute warm-up.)

5. The source rod remains in the shielded position when testing with a Troxler or CPN Gauge on the stand. If the Gauge does not perform an automatic standardization test when turned on (Troxler 3411-B models do not), perform the standardization test in accordance with the American Association of State Highway and Transportation Officials (AASHTO, www.aashto.org) T-310. To perform, four 1-minute counts must be taken, recording the density and moisture counts for each test. Average each set of 4 counts and record. Using the formula in AASHTO, ascertain whether or not the meter has passed the standardization test. If passed, the Gauge is ready for use. If it does not pass, run another complete standardization test. If passed on the second try, the Gauge is ready for use. If it does not pass the second test, you may run one or two more standardization tests (no more than 4). After a failure on the 2nd, 3rd, or 4th test, contact your Radiation Safety Officer (RSO) in charge of the Gauges, explain what is happening and proceed as instructed. The Gauge may need to be replaced.
6. Using the pad-lock provided, lock the Gauge in the safe shielded position. Leaving the Gauge electronics on, properly load the Gauge in the transport container for transport into the field. Secure the storage case in the back of the vehicle furthest from the driver (normally rear right side of car/trunk-passenger car; right rear of bed-pickup. Use seat belts, bicycle lock cables to secure). Take all required accessories, paperwork and signs (no radiation signs are needed outside on vehicle) and proceed to the work site. While in transit, if a stop is required, lock car; if in truckbed, ensure that it is secured in place and locked.
7. Transport Gauge/stand to an acceptable site location close to the area that will be tested today. Perform a Daily Standard Count (a method of calibrating the Gauge to the substrate – this only has to be performed once daily, unless the Gauge is moved to a different elevation [trench sidewalls are now present, etc.]; then repeated) on the Gauge using the stand. This will give the Gauge a standard radiation count for moisture content in that general area. To perform, clean the top of the stand and the bottom of the Gauge and set the Gauge on the stand. Take one, four minute Daily Standard Count test with the source rod remaining in the shielded position. Some of the Gauges will automatically set the time when the Daily Standard Count function is activated (Troxler 3411-B model will not).
8. You are now ready to begin field testing, called Acceptance Tests. If taking an Acceptance Test, locate a randomly selected test location or, if taking a Courtesy Test (follow up test requested by the contractor to find out how close they are to acceptance parameters – not an official acceptance test), choose a representative area as the test location.
9. Prepare the surface as required. This must include leveling, as necessary, on untreated material, tamping (if on untreated material), the use of fines (acceptable conditions -native or natural fines, minus No. 8 or 10 sieve size, maximum allowable depth of any void to be filled is 1/8 inch, and the total voids filled cannot exceed 10% of the test area of the base of the Gauge) to fill small surface voids, tamping fines into place (glazing if on treated material) and finally checking the plate for rocking. The plate is the last piece of equipment used to actually level the surface. Never use the Gauge as a leveling device!
10. Place the Gauge on the prepared surface. Check the Gauge for rocking by alternating pressure on opposing corners of the main body of the Gauge. The Gauge is the final piece of equipment used to verify a level test surface. Check around the sides of the Gauge with a piece of paper to ensure no concave areas exist under the edge of the Gauge.

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11. Set or check to ensure that the test time is set for at least one minute for Acceptance Tests, and that the Gauge electronics are set for the backscatter mode. Some Gauges have sensors that will automatically set the test mode based on the location of the source rod (Troxler 3411-B Gauges do not have these sensors).
12. Enter the laboratory density (proctor maximum dry density) or asphalt treated material maximum density (Gmm X 62.4 lbs/ft³ in the English system). Depending on the amount of rock in the soil, the operator may need to make a rock correction, per AASHTO T-224.
13. Ensure persons with a badge are at least three feet from the Gauge, and all persons without a badge are never closer than six feet. Make sure all equipment and accessories are moved back at least six feet (any other Gauge at least thirty feet) from the Gauge.
14. Move the handle down into the second notch (backscatter test position) from the first (top notch) that is the shielded position. Do this by pressing the trigger mechanism, pushing the handle out of the shielded notch, release the trigger mechanism, and firmly press the handle down until it locks into the second notch. Holding the trigger mechanism, moving down past the second notch, and then coming back up into the second notch is strictly forbidden! This action could leave a dimple in the test surface directly below the source, and result in excess radiation exposure!
15. Press the measure/test/count key and step back away from the Gauge a minimum of three (3) feet.
16. Once the Gauge has completed the test count, step up and shield the source (return the handle to the shielded position).
17. Record all applicable readings for the material being tested (Daily Standard Counts must be viewed and recorded for each test).
18. Repeat Acceptance Test procedures #13 through #16 above, to get a second reading.
19. Compare the two Acceptance Test results. If the two test results are within 1 lb/ft³ of each other, report the average of the two tests as the final test result. If the two test results differ by more than 1 lb/ft³, run a third test. If the third test is within 1 lb/ft³ of either of the first two tests, average those two tests and report the average as the final test result (if within 1 lb/ft³ of both previous tests, average the two closest results). If the third test is not within 1 lb/ft³ of either of the first two tests, immediately run two (2) more tests (you now have a total of five tests at this location). Disregard the high and low tests and average the three remaining tests and report that average as the final test.
20. Lock the source in the shielded position, but do not turn off the Gauge electronics (most Gauge electronics will erase the Daily Standard Count).
21. Place the meter into the transport container, close and lock the transport container. As described in Step #6, secure the Gauge transport container prior to transit.
22. Record the number of tests performed at this location with the Gauge in the Gauge utilization log.

SHIPPING AND RECEIVING PROCEDURE

TRANSPORTATION OF GAUGE FOR LOCAL AREA

Anytime a Gauge is transported, HDR personnel shall comply with applicable portions of the following regulations:

- The State Environmental Department,
- The State Department of Transportation,
- The United States Department of Transportation (USDOT),
- The United States Environmental Protection Agency (EPA),
- The International Atomic Energy Agency (IAEA), and
- Title 49 of the United States Code of Federal Regulations (49 CFR) pertaining to the transportation of portable nuclear Gauges.

The following paragraphs provide guidance on the requirements for transport of Gauge(s); however, additional more stringent state-specific requirements may also need to be implemented.

Hazardous Material Transportation Training of employers/employees who transport Nuclear Gauges must be repeated at three (3) year intervals for any employee transporting by public conveyance (common carrier), or preparing a Gauge for transport, in accordance with 49 CFR Part 172.

A copy of the IAEA Certificate(s) of Competent Authority is required by 49 CFR 173.476(a). The Gauge manufacturer should supply this form. If you do not have this form, contact the manufacturer with your Gauge model and serial number; and they will supply it. This is not the same form as a Gauge certificate issued by the manufacturer. The Gauge certificate provides relevant information and is useful when being inspected, but it is not required and it does not serve as a replacement for the IAEA form.

A Leak Test Certificate is required for all Gauges. The purpose of a leak test is to ensure the integrity of the source encapsulation, and verify that no radioactive materials are escaping from the source encapsulation. While radiation is always being emitted by the source, no radioactive materials should be escaping. The certification is good for a period of six months from the date the Gauge was wiped for the leak test. A Gauge must have a current leak test certificate to be removed from its storage area. Because of the sensitive nature of the Gauge shielding components, they must be treated with care. If a Gauge is hit or impacted, even lightly (e.g., it falls off a tailgate), the Gauge will require a new leak test. While performing the test, you must wear your personal monitoring equipment.

HDR, Inc. JJB CHST	Approved By: JWoolcott/RO'Gara Initials:	H&S Pro #40 Rev. 0 Initial Date: 07/11/05
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The transport container for the Gauge must meet the requirements of 49 CFR 173.415(a) for a "Specification 7A, Type A" package. The shipping boxes made by the Gauge manufacturers already meet these requirements, and the documentation for the container is furnished with the Gauge. Transport in these containers only.

All transport containers carried in private vehicles must be carried on the passenger side of the vehicle and located as far to the rear of the bed/cargo compartment as possible. The lid/door must be secured with a lock that is not readily breakable to prevent unauthorized access to the Gauge. When manufacturer's shipping containers are being utilized as transport containers, they must also be secured to the vehicle to prevent shifting, moving, sliding, etc., during normal transport and be secured with a lock to prevent unauthorized removal of the container. All locks shall be locked when the operator is not in direct/immediate attendance. The keys or combinations to the transport container are to be retained by the driver of the vehicle at all times. The vehicle is to be locked, the keys retained by the driver, and the "Bill of Lading" placed in the drivers seat when the driver is not in direct/immediate attendance to the vehicle.

A 'Bill of Lading' (see Appendix C1 or C2) must accompany the driver of the vehicle and be within his/her reach with the seat belt shoulder strap in place. This is required by NRC Regulations, State Law and State Regulations. It is the responsibility of the Radiation Safety Officer (RSO) to supply the Bill of Lading to the operator. It is the operator's responsibility to ensure they received the Bill, and that it is the proper one for the Gauge being transported. The Bill of Lading must contain the following information:

- Name of shipper
- Description of the shipment (proper shipping name, Hazard class, UN material identification number, type of package, name and activity of each nuclide, category of labeling and transport index)
- Emergency response telephone number
- Shippers certification
- Shippers signature

It is a good practice to use company letterhead for this document. Note that it has no date on it, as that is not required. "Knowledge of the hazards and characteristics of the hazardous material being shipped, has comprehensive emergency response and accident mitigation information for that material or has immediate access to a person who possesses such knowledge and information." Check with your Gauge manufacturer, they may offer this service to their customers (some have in the past). If not, it is the responsibility of the Licensee to supply this service. This documentation is ONLY for transporting a Gauge to and from the job site by private vehicle. For shipment by common carrier (e.g., Federal Express, Air, International Shipment, etc.) there are different forms that must accompany the shipment. Check with your Radiation Safety Officer for this information.

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Radiation Yellow II labels are required on two opposite sides (not including the bottom) of the transport container. One label must be positioned so that it is visible to a person who is opening or attempting to open the transport container. The labels must indicate the radionuclide name, its activity level in megabecquerels, and the transport index. The container must also be marked with the proper shipping name of the radioactive material, such as "RQ, Radioactive Material, Special Form, UN2974" for certain Americium/Cesium sources and "Radioactive Material, UN2982" for certain Radium sources. These signs are for the transport container only. Do not placard your vehicle.

Should a container be damaged sufficiently to require its disposal, all labels must be removed or rendered illegible prior to container disposal.

Emergency Response Information must accompany the shipment of a Gauge. As with the Bill of Lading, this document must be within reach of the driver when the seat and shoulder belts are in place. Check with your manufacturer, they may supply a comprehensive form for this purpose. It should include the Proper Shipping Name, Potential Hazards (both Health and Fire or Explosion), and Emergency Actions, Precautions, Response to Fire, Spill or Leakage, and First Aid.

A Telephone Listing of your emergency contact personnel must also be present (i.e., immediate supervisor, the Radiation Safety Officer, the State Police, USDOT or State Environmental Department).

Summary List of Items needed when transporting a Gauge:

- A copy of HDR's current license
- Gauge operating procedures
- Copy of current leak test certificate
- Emergency response information (must remain within reach of the driver)
- Bill of Lading (must remain within reach of the driver)
- Emergency telephone numbers (to cover all personnel requiring contact)
- Proper signs
- Utilization logs
- State regulations
- Copy of Operator's Radiological Training Certificate or Card
- Personal monitoring device worn (OSL or TLD badge)
- Any other records that may be required by your company license.

TRANSPORTATION OF GAUGE FROM STATE TO STATE

The same rules for the TRANSPORTATION OF GAUGE FOR LOCAL AREA apply plus the following rules and regulations. Before any Gauge can be bought or

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transferred in or out of state the 'HDR Nuclear Gauge Program Director' needs to be notified in writing and received approval of the intent to buy or transfer a Gauge. The Director needs to validate that the new location has a current state nuclear license with a certificated RSO at the new location.

The local Radiation Safety Officer is responsible for the shipping and receiving of any Gauge coming or going from his or her area. The local RSO needs to validate that the new mailing address and the RSO's name that the Gauge is being transported to or from as per the HDR Nuclear Gauge Program Director.

Sending Nuclear Gauge:

1. Secure the Gauge in the safe position inside the shipping case.
2. The package must be marked with the proper shipping name and labeled on opposite sides. The shipping case requires the Yellow II label which must denote the radionuclide, activity and transport index. In addition, Type A packages must be labeled "US DOT 7A Type A."
3. Whenever a nuclear Gauge is shipped or transported it must be accompanied by properly completed shipping papers. Check FedEx web site for copies of the forms.
 - FedEx – Dangerous Goods shipping form
 - Shippers Declaration for Dangerous Goods
 - Common Carrier 'Bill of Lading'
4. Sealing of Package: Each Type 'A' package must contain a seal that is not readily breakable and provides evidence the package has not been opened in transit. This seal is required when shipping a Gauge by a common carrier (e.g., FedEx).
5. Inspection prior to shipment: before transporting a nuclear Gauge, the shipper must inspect the package (shipping case) to ensure it is in good physical condition other than superficial marks and that all closure devices are in good working order and secured.
6. Subtract the Gauge to your inventory. Notify the Director that the Gauge was sent.
7. Notify the State Radioactive Materials Bureau using Section #14 – Nuclear-Gauge Ownership Requirements of the 'Nuclear Moisture/Density Gauge Safety H&S Procedure #40' for a revision to your license.

Receiving Nuclear Gauge:

1. Check and compare the shipping papers. See who it came from and where it was sent from. You should know beforehand about the shipment. If you do not know about the shipment beforehand. Call 'HDR Nuclear Gauge Program Director' as

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- soon as possible. If the shipment is unknown to the Director or yourself then use Section #13 Emergency Procedures of the 'Nuclear Moisture/Density Gauge Safety H&S Procedure #40'. Is the paperwork okay?
2. Check the shipping box and/or case for any sign of damage (wetness, crushed, etc.). Is the shipping box okay?
 3. Check the tamper-evident security seal and seal number. Is the seal okay?
 4. Open the shipping box to check the condition of the nuclear Gauge. Is the Gauge okay?
 5. Add the Gauge to your inventory. Notify the Director the Gauge received in good condition.
 6. Notify the State Radioactive Materials Bureau using Section #14 – Nuclear-Gauge Ownership Requirements of the 'Nuclear Moisture/Density Gauge Safety H&S Procedure #40' for a revision to your license.

HDR, Inc.
JJB CHST

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Initials:

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RADIATION AGENCY CONTACTS

NRC REGIONAL OFFICES

Region 1

(Connecticut, Delaware, District of Columbia, Maine, New Jersey, Pennsylvania, and Vermont)

Nuclear Regulatory Commission Phone: (610) 337-5000
 475 Allendale Road Toll Free: 1-800-432-1415
 King of Prussia, PA 19406-1415 Fax: (610) 337-5241
 Website: <http://www.nrc.gov/>

Region 2

(Virginia, West Virginia, Puerto Rico, and U.S. Virgin Islands)

Nuclear Regulatory Commission Phone: (404) 562-4400
 Sam Nun Atlanta Federal Center Toll Free: 1-800-577-8510
 61 Forsyth Street, SW, Suite 23T85 Fax: (404) 562-4410
 Atlanta, GA 30303-8931
 Website: <http://www.nrc.gov/>

Region 3

(Indiana, Michigan, Minnesota, Missouri, and Wisconsin)

Nuclear Regulatory Commission Phone: (630) 829-9500
 801 Warrenville Road Toll Free: 1-800-522-3025
 Lisle, IL 60532-4351 Fax: (630) 515-1078
 Website: <http://www.nrc.gov/>

Region 4

(Alaska, Hawaii, Guam, Idaho, Montana, Oklahoma, South Dakota, and Wyoming)

Nuclear Regulatory Commission Phone: (817) 860-8100
 Texas Health Resource Tower Toll Free: 1-800-952-9677
 611 Ryan Plaza, Suite 1000 Fax: (817) 860-8210
 Arlington, TX 76011-8064
 Website: <http://www.nrc.gov/>



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AGREEMENT STATES

Alabama Phone: (334) 206-5391
 Division of Radiation Control Fax: (334) 206-5387
 State Department of Public Health
 RSA Tower, Suite 700
 201 Monroe Street
 Montgomery, Alabama 36104
 Website: <http://www.adph.org/radiation>

Arizona Phone: (602) 255-4845
 Arizona Radiation Regulatory Agency Fax: (602) 437-0705
 4814 South 40th Street
 Phoenix, Arizona 85040
 Website: <http://www.arra.state.az.us/>

Arkansas Phone: (501) 661-2301
 Division of Radiation Control and Fax: (501) 661-2468
 Emergency Management
 Department of Health
 4815 West Markham Street, Slot 30
 Little Rock, Arkansas 72205-3867
 Website: <http://www.healtharkansas.com>

California Phone: (916) 445-0931
 Radiological Health Branch Fax: (916) 324-3610
 Food, Drugs, & Radiation Safety Division
 P.O. Box 942732
 Sacramento, California 94234-7320
 Website: <http://www.dhs.ca.gov/rhb/>

Colorado Phone: (303) 692-3030
 Laboratory and Radiation Services Division Fax: (303) 343-3697
 Colorado Department of Public Health & Environment
 8100 Lowry Blvd
 Denver, Colorado 80220-6928
 Website: <http://www.cdphe.state.co.us/lr/lrhom.asp>

Florida Phone: (850) 245-4266
 Bureau of Radiation Control Fax: (850) 487-0435
 Department of Health
 4052 Bald Cypress Way, Bin C21
 Tallahassee, Florida 32399
 Website: <http://www9.myflorida.com/environment/radiation/index.html>

Georgia Phone: (404) 362-2675
 Radioactive Materials Program Fax: (404) 362-2653
 Department of Natural Resources
 4244 International Parkway, Suite 114
 Atlanta, Georgia 30354
 Website: http://www.ganet.org/dnr/envirom/aboutepd_files/branches_files/rmprogram/default.htm

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AGREEMENT STATES

Illinois Phone: (217) 785-9900
Department of Nuclear Safety Fax: (217) 782-1328
1035 Outer Park Drive
Springfield, Illinois 62704
Website: <http://www.state.il.us/idns/>

Iowa Phone: (515) 281-5787
Bureau of Radiological Health Fax: (515) 242-6284
Iowa Department of Public Health
Lucas State Office Building
Des Moines, Iowa 50319
Website: <http://www.idph.state.ia.us/pa/rh.htm>

Kansas Phone: (785) 296-1593
Department of Health and Environment Fax: (785) 291-3953
Bureau of Air and Radiation
Forbes Field, Bldg. 283
1000 SW Jackson St, Suite 310
Topeka, Kansas 66612
Website: <http://www.kdhe.state.ks.us/radiation/>

Kentucky Phone: (502) 564-3700
Radiation Health and Toxic Agents Branch Fax: (502) 564-6533
Cabinet for Health Services
275 East Main Street, Mail Stop HS 2E-D
Frankfort, Kentucky 4060
Website: <http://chs.state.ky.us/publichealth/radiation.htm>

Louisiana Phone: (225) 765-0160
Radiation Protection Division Fax: (225) 765-0220
Office of Air Quality and Radiation Protection
7220 Bluebonnet Road
P.O. Box 82135
Baton Rouge, Louisiana 70810
Website: <http://www.deq.state.la.us/>

Maine Phone: (207) 287-5698
Radiation Control Program Fax: (207) 287-4172
Division of Health Engineering
10 State House Station
Augusta, Maine 043300010
Website: <http://www.state.me.us/dhs/eng/rad/index.html>

Maryland Phone: (410) 631-3300
Maryland Department of the Environment Fax: (410) 631-3198
Air and Radiation Management Agency
2500 Broening Highway
Baltimore, Maryland 21224
Website: <http://www.mde.state.md.us/arma/Programs/Radiolog/radiolog.html>

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Massachusetts..... Phone: (617) 727-6214
Radiation Control Program..... Fax: (617) 727-2098
Department of Public Health
174 Portland Street, 5th Floor
Boston, Massachusetts 02114
Website: <http://www.state.ma.us/dph/rcp/radia.htm>

Mississippi..... Phone: (601) 987-6893
Division of Radiological Health..... Fax: (601) 987-6887
State Department of Health
3150 Lawson Street
P.O. Box 1700
Jackson, Mississippi 39215-1700
Website: <http://www.msdh.state.ms.us/msdhsite/index.cfm/11,0,102.html>

Nebraska..... Phone: (402) 471-2079
Department of Health and Human Services..... Fax: (402) 471-0169
Regulation and Licensure
301 Centennial Mall South
P.O. Box 95007
Lincoln, Nebraska 68509-5007
Website: <http://www.hhs.state.ne.us/rad/radindex.htm>

Nevada..... Phone: (775) 687-5394
Radiological Health Section..... Fax: (775) 687-5751
Nevada State Health Division
1179 Fairview Drive, Suite 102
Carson City, Nevada 89701-5405
Website: <http://www.state.nv.us/health/bhps/>

New Hampshire..... Phone: (603) 271-4625
Radiological Health Bureau..... Fax: (603) 225-2325
Health and Welfare Building
6 Hazen Drive
Concord, New Hampshire 03301-6527
Website: <http://www.state.nh.us/>

New Mexico..... Phone: (505) 827-1557
Bureau of Hazardous and Radioactive Materials..... Fax: (505) 827-1544
Department of Environment
1190 Francis Drive
Santa Fe, New Mexico 87502
Website: <http://www.nmenv.state.nm.us/nmrcb/home.html>

New York..... Phone: (518) 402-7550
Bureau of Environmental Radiation Protection..... Fax: (518) 402-7554
Center for Environmental Health
547 River Street
Troy, New York 12180
Website: <http://www.health.state.ny.us/nysdoh/radon/radonhom.htm>

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North Carolina Phone: (919) 571-4141
 NC Department of Environmental Fax: (919) 571-4148
 Division of Radiation Protection
 3825 Barrett Dr.
 Raleigh, North Carolina 27609
 Website: <http://www.drp.enr.state.nc.us/>

North Dakota Phone: (701) 328-5188
 North Dakota Department of Health Fax: (701) 328-5200
 Environmental Health Section
 1200 Missouri Ave., Box 5520
 Bismarck, North Dakota 58506-5520
 Website: <http://www.health.state.nd.us/ndhd/environ/ee/RAD/rad.htm>

Ohio Phone: (614) 644-2727
 Bureau of Radiation Protection Fax: (614) 466-0381
 Ohio Department of Health
 246 North High Street
 P.O. Box 118
 Columbus, Ohio 43216-0118
 Website: <http://www.odh.state.oh.us/ODHPrograms/ENVRAD/envrاد1.htm>

Oregon Phone: (503) 731-4014
 Radiation Protection Services Fax: (503) 731-4081
 Oregon State Health Division
 800 NE Oregon Street, Suite 260
 P.O. Box 14450
 Portland, Oregon 97232
 Website: <http://www.odh.hr.state.or.us/rps/welcome.htm>

Rhode Island Phone: (401) 222-2438
 Division of Occupational and Radiological Health Fax: (401) 222-6953
 3 Capitol Hill, Room 206
 Providence, Rhode Island 02908-5097
 Website: <http://www.health.state.ri.us>

South Carolina Phone: (803) 545-4400
 Bureau of Radiological Health Fax: (803) 545-4359
 2600 Bull Street
 Columbia, South Carolina 29201
 Website: <http://www.scdhec.net/hr/radhlt/>

Tennessee Phone: (615) 532-0364
 Division of Radiological Health Fax: (615) 532-7938
 L & C Annex, 3rd Floor
 401 Church St.
 Nashville, Tennessee 37243-1532
 Website: <http://www.state.tn.us/environment/rad/index.html>

HDR, Inc.	Approved By: J Woolcott/JSuttle Initials: <i>JW</i> <i>JS</i>	H&S Pro #40 Rev. 0
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Texas Phone: (512) 532-6688
Bureau of Radiation Control Fax: (512) 834-6690
Texas Department of Health
1100 West 49th Street
Austin, Texas 78756-3189
Website: <http://www.tdh.state.tx.us/ech/rad/pages/brc.htm>

Utah Phone: (801) 536-4250
Division of Radiation Safety Control Fax: (801) 533-4097
168 North 1950 West
P.O. Box 144850
Salt Lake City, Utah 84114-4850
Website: http://www.eq.state.ut.us/EQRAD/drc_hmpg.htm

Washington Phone: (360) 236-3300
Washington State Department of Health Fax: (360) 239-2255
Division of Radiation Protection
7171 Clean Water Lane, Bldg. 5
P.O. Box 47827
Olympia, Washington 98504-7827
Website: <http://www.doh.wa.gov/ehp/rp/>

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BILL OF LADING

Shipper: Name
Address
City, State, Zip Code

**(RQ), RADIOACTIVE MATERIAL, SPECIAL FORM, NOS, 7, UN3332,
TYPE "A" PACKAGE, CONTAINING:**

**Cs-137, 0.3 GBq (8 mCi)
Am-241:Be, 1.48 GBq (40 mCi0)**

RADIOACTIVE YELLOW II LABEL, TI = 0.5

****** EMERGENCY CONTACT ******

(Name)
(Telephone Number)

These is to certify that the above-named materials, are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

SHIPPER: _____ (Signature) _____ (Date)



BILL OF LADING

Shipper: _____
(Name)

(Address)

(City, State, Zip Code)

**(RQ), RADIOACTIVE MATERIAL, SPECIAL FORM, NOS, 7, UN2974,
TYPE "A" PACKAGE, CONTAINING:**

**Cs-137, 0.3 GBq (8 mCi)
Am-241:Be, 1.48 GBq (40 mCi)**

RADIOACTIVE YELLOW II LABEL, TI = 0.5

****** EMERGENCY CONTACT ******

(Name)

(Telephone Number)

These is to certify that the above-named materials, are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

SHIPPER: _____
(Signature) (Date)





Quality and Safety Assurance

Information regarding Special Form Certificate USA/0632/S for Capsule Codes AX1, X1 & X1/2

Special Form certificate GB/7/S-85 for the X1 & X1/2 capsules lapsed at the end of June 2003. All products that were previously approved as Special Form Radioactive Material by certificate GB/7/S-85 are now approved by Special Form certificate USA/0632/S.

Special Form certificate GB/403/S-85 for the AX1 capsule will lapse at the end of October 2006. All products that were previously approved as Special Form Radioactive Material by certificate GB/403/S-85 are now approved by Special Form certificate USA/0632/S.

Important note:

ONLY X1 and X1/2 capsules that were manufactured on or after 17th May 1977 and conform to the requirements of the Special Form Material certificate USA/0632/S are approved as Special Form Radioactive Material.

Mark Shepperson

17th December 2003



U.S. Department
of Transportation
**Research and
Special Programs
Administration**

APPENDIX D1

400 Seventh St., S.W.
Washington, D.C. 20590

**IAEA CERTIFICATE OF COMPETENT AUTHORITY
SPECIAL FORM RADIOACTIVE MATERIALS
CERTIFICATE NUMBER USA/0632/S, REVISION 0**

This certifies that the sources described have been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in the regulations of the International Atomic Energy Agency¹ and the United States of America² for the transport of radioactive materials.

1. Source Identification - AEA Technology QSA, Inc. Model Numbers X.1 and X.1/2.
2. Source Description - Both models are a cylindrical double encapsulation made of stainless steel and tungsten inert gas or laser seal welded. Approximate outer dimensions of both models are 7.9 mm (0.31 in.) in diameter and 10.1 mm (0.4 in.) in length. The Model No. X.1/2 contains an aluminum spacer within the inner encapsulation. Construction shall be in accordance with attached AEA Technology QSA, Inc. Drawing Number RBA10880, Rev. A.
3. Radioactive Contents - No more than either 3.7 GBq (100 mCi) Americium-241 or 13 GBq (351 mCi) Californium-252. The Americium-241 is in oxide form and mixed with Beryllium powder and pressed into a solid pellet. The Californium-252 is in the form of a metal wire or an oxide solid ceramic.
4. Quality Assurance - Records of Quality Assurance activities required by Paragraph 310 of the IAEA regulations¹ shall be maintained and made available to the authorized officials for at least three years after the last shipment authorized by this certificate. Consignors and consignees in the United States exporting or importing shipments under this certificate shall satisfy the requirements of Subpart H of 10 CFR 71.
5. Expiration Date - This certificate expires June 15, 2008.

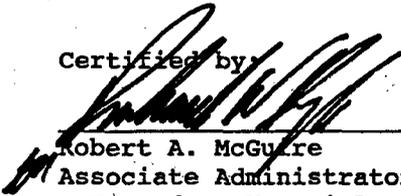
1 "Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised), No. TS-R-1 (ST-1, Revised)," published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

2 Title 49, Code of Federal Regulations, Parts 100 - 199, United States of America.

CERTIFICATE USA/0632/S, REVISION 0

This certificate is issued in accordance with paragraph 804 of the IAEA Regulations and Section 173.476 of Title 49 of the Code of Federal Regulations, in response to the petition and information dated April 16, 2003 submitted by AEA Technology QSA, Inc., Burlington, MA, and in consideration of other information on file in this Office.

Certified by:



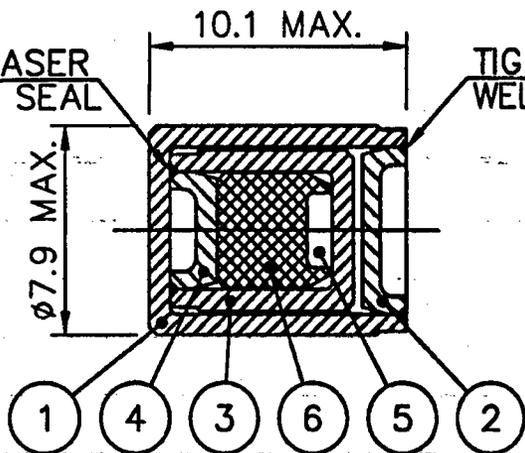
Robert A. McGuire
Associate Administrator for
Hazardous Materials Safety

JUN 12 2003

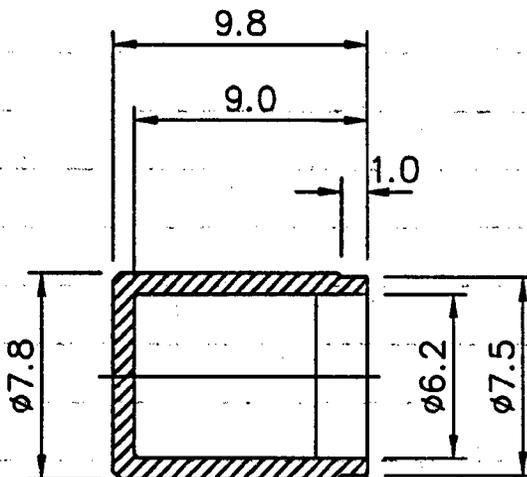
(DATE)

Revision 0 - Original issue.

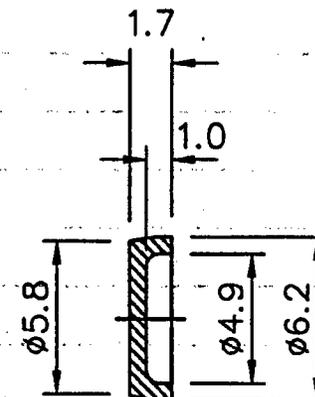
TIG OR LASER WELD TO SEAL



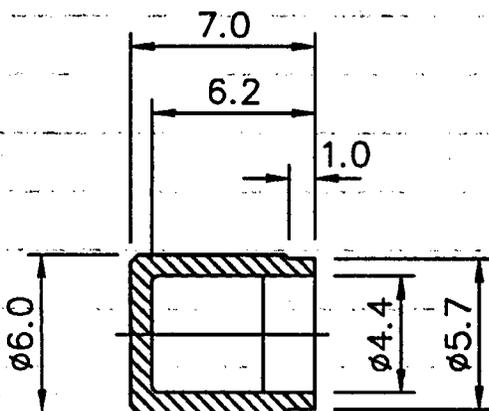
ITEM No.	DESCRIPTION	QTY.
1	SHEATH BODY STAIN.STL	1
2	SHEATH LID STAIN.STL	1
3	CELL BODY STAIN.STL	1
4	CELL LID STAIN.STL	1
5	ACTIVE MATERIAL	1
6	SPACER (MODEL X1/2 ONLY) ALUM.	AR



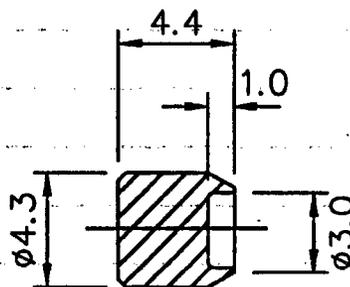
ITEM 1



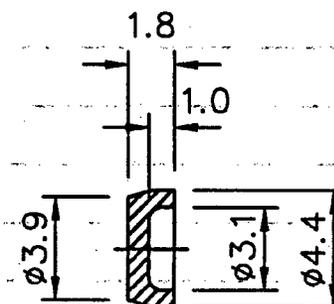
ITEM 2



ITEM 3



ITEM 6



ITEM 4

APPROVALS
[Signature] 16 APR 03
[Signature] 16 APR 03



DESCRIPTIVE DRAWING

APPENDIX D

DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED TOLERANCES:

X ±0.5
 XX ±0.1
 XXX ±0.05
 ANGULAR ±5°

INTERNAL
 EXTERNAL

TITLE X1 & X1/2 CAPSULE ASSY

SIZE DWG. NO. RBA10880

SCALE: NONE SHEET 1 OF 1

REV A

ERF # 476



TO: _____

SITE: _____

DATE: _____

FROM: Jeffrey Berger CHST – Director, HDR Nuclear Gauge Program

This acknowledgement is to verify that you have received, read and understand the copy of the updated HDR Procedure 40 Nuclear Moisture Density Gauge Program and its attachments. The following revisions are to be followed on all HDR projects where we are utilizing Nuclear Gauges. Any further revisions that you will receive after this point will be for your copy which you must maintain as an operator. If you need any further assistance please call Jeff Berger at the Omaha Office.

Thank You.

=====

I have read and understand the updated HDR Procedure 40 Nuclear Moisture Density Gauge Program and its attachments.

Operators Signature: _____

Date: _____

Date Receipt Received in Omaha: _____

Initials: _____

TROXLER TRANSPORTATION GUIDE

The following information is applicable to all users of nuclear gauges in the United States.

**Revision 21
(May 2004)**



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PN 106978
May 2004
Revision 21

TRANSPORTATION GUIDE

OVERVIEW AND APPLICABILITY

This guide is designed to assist Troxler nuclear gauge users in complying with U.S. Department of Transportation (DOT) hazardous material (hazmat) regulations and International Air Transport Association (IATA) Dangerous Goods Regulations. It highlights and explains the major requirements for shipping and transporting portable nuclear gauges.

Throughout this guide, you will see references to the applicable sections of the U.S. DOT regulations given in brackets, such as [49 CFR 173.410]. Troxler recommends that persons shipping and transporting nuclear gauges obtain and read the applicable DOT and IATA regulations. The U.S. DOT regulations are published in Title 49 of the Code of Federal Regulations, Parts 100-185 (49 CFR 100-185), which can be viewed online at the U.S. DOT hazmat web site: <http://hazmat.dot.gov>. IATA Dangerous Goods Regulations may be purchased from the IATA online store at: <http://www.iata.org>. The U.S. DOT hazmat regulations apply to all U.S. domestic shipments by all modes of transport. IATA regulations apply to all shipments by air, both international and domestic. When shipping a nuclear gauge by Federal Express®, the gauge must be prepared in accordance with IATA regulations for shipment by air.

The focus of this guide is on preparing nuclear gauges for shipment via common carriers and on transporting gauges as a private carrier. Private carriers generally own the goods (nuclear gauge) being transported and the transportation of the goods is incidental to their regular business activity. A company that owns a nuclear gauge and transports it to and from job sites in the course of business is considered a private carrier. Common and contract carriers, on the other hand, are "for hire" carriers whose primary business is transportation of goods for others.

The major requirements that apply to shipping a gauge via common carrier or transporting a gauge as private carrier include:

- ◆ A current copy of the International Atomic Energy Agency (IAEA) Certificate of Competent Authority (special form certificate) for each source in the gauge must be on file.
- ◆ The gauge must be in a TYPE A package and a copy of the TYPE A package testing results must be on file.
- ◆ The package must be properly marked, labeled, sealed, and inspected prior to each shipment.
- ◆ The package must be properly loaded and secured in the vehicle.
- ◆ Properly completed shipping papers (bill of lading) must be in the transport vehicle and immediately accessible to the driver
- ◆ An Emergency Response Information document must be in the transport vehicle with the shipping papers and immediately accessible to the driver
- ◆ An emergency response phone number must be manned continuously while the gauge is in transit (this service is provided free of charge by Troxler)
- ◆ A certificate of training must be on file for each hazmat employee involved in the shipment, essentially any individual involved in packaging, preparing shipping papers, or transporting a nuclear gauge (training classes are offered by Troxler)

TRAINING

If you own portable nuclear gauges, hazmat training is critical to your business. According to the U.S. DOT Office of Hazardous Material Safety:

"More than one-third of the Department's enforcement actions pertaining to violations of the hazardous materials transportation regulations involve the failure of hazmat employers to provide training or maintain test records. In most cases, violations are attributed to failure to provide function specific training. For example, an investigator questions incorrect entries on a shipping paper prepared by a hazmat employee who responds that he was not instructed, nor tested, by his hazmat employer regarding the preparation of shipping papers."

The regulations define a *hazmat employee* as a person (including a self-employed person) who is employed by a hazmat employer and who:

- ◆ Loads, unloads, or handles hazmat (e.g., a nuclear gauge);
- ◆ Tests, reconditions, repairs, modifies, marks, or otherwise represents packagings as qualified for use in the transportation of hazmat;
- ◆ Prepares hazmat for transportation;
- ◆ Is responsible for safety of transporting hazmat; or
- ◆ Operates a vehicle used to transport hazardous materials.

Each hazmat employer must train and test, certify, and develop and retain records of current training for each hazmat employee (during the period of employment and 90 days thereafter).

Initial hazmat training must be completed within 90 days of employment or change in job function. Before completing training, an employee may only perform hazmat functions under the direct supervision of a properly trained and knowledgeable hazmat employee.

Recurrent training is required at least once every three years per U.S. DOT rules. If gauges are shipped by air (e.g., Federal Express), retraining is required every two years per IATA rules.

Relevant training received from a previous employer or source may be used to satisfy the requirements provided a current record of training is obtained from the previous employer or source.

Hazmat employee training must include the following:

- ◆ General awareness/familiarization training
- ◆ Function-specific training
- ◆ Safety training
- ◆ Security awareness training

Training Records must include:

- ◆ Hazmat employee's name;
- ◆ Completion date of most recent training;
- ◆ Training Materials (copy, description, or location);
- ◆ Name and address of hazmat trainer; and
- ◆ Certification that the hazmat employee has been trained and tested.

To assist you in meeting these training requirements, Troxler offers both initial and refresher hazmat training courses, including testing and certification. For further information about Troxler training opportunities, please consult our website: <http://www.troxlerlabs.com>.

CERTIFICATE OF COMPETENT AUTHORITY

The sealed sources in Troxler gauges meet the U.S. DOT requirements for classification as Special Form Radioactive Material. "Special Form" materials are designed and constructed to maintain their physical integrity even under severe accident conditions. For all practical purposes, such materials cannot produce radioactive contamination. The testing requirements that "special form" materials must meet are described in 49 CFR 173.469. Sources meeting these requirements are issued a Certificate of Competent Authority by the International Atomic Energy Agency (IAEA).

A shipper must keep a copy of the IAEA Certificate of Competent Authority (also known as Special Form Certificate) for at least one year after the latest shipment of special form radioactive material. [49 CFR 173.476(a)] An example of a special form certificate is shown in Appendix G. Please note that these certificates have expiration dates. You must have a current copy in your possession before you can legally ship special form radioactive materials. If shipping a gauge by air, a copy of the special form certificate must be included with the shipment.

Current copies of the certificates can be downloaded from the Troxler web site (www.troxlerlabs.com) or requested by calling Troxler. When requesting a special form certificate, please provide your gauge model number and serial number or the special form certificate number. You can determine the applicable special form certificate numbers (for example, GB/7/S-85) by referring to the Troxler gauge certificate.

NOTE

Troxler issues a "gauge certificate" with each gauge. This certificate is sometimes confused with the special form certificate described above. The Troxler gauge certificate gives the gauge model and serial number, owner name and address, and information about the sources in the gauge, including the special form certificate number (e.g., GB/7/S-85). The Troxler gauge certificate is not a legally required document for purposes of shipment. However, it is useful when being inspected by either your licensing agency or U.S. DOT, since it provides relevant gauge information.

TYPE A PACKAGE

The type, form, and quantity of radioactive material in Troxler nuclear gauges requires the use of Type A packaging during transportation. The Troxler gauge shipping case meets all Type A package standards. [49 CFR 173.410 and 173.412]

Each shipper of a (Specification 7A) Type A package must maintain on file for at least one year after the latest shipment, documentation of the Type A package testing methods and results. This documentation is provided in Appendix A for all Troxler gauges/cases currently manufactured. [49 CFR 173.415(a)]

MARKING PACKAGES

Each Specification 7A package (Troxler shipping case) must be marked on the outside "U.S.A. DOT 7A TYPE A" and "RADIOACTIVE MATERIAL." [49 CFR 178.350(b)]

Each package must be marked with the proper shipping name and United Nations identification number (UN ID). [172.301(a) and (c)]

The U.S. Environmental Protection Agency (EPA) requires notification of serious accidents involving certain quantities of hazardous substances. These "Reportable Quantities" must be identified by the abbreviation "RQ". For Troxler gauges containing 10 mCi or more of Americium-241 or Americium-241:Beryllium, the letters "RQ" must be marked on the package next to the proper shipping name. [49 CFR 172.324(b)]

All of the above marking requirements are incorporated into a single label on each Troxler shipping case.

Each package offered for shipment by air transport (e.g., FedEx) must be marked as air eligible. The purpose of the marking is to indicate that the shipper has determined that the package meets all applicable requirements for air transport. The marking symbol is an airplane within a circle and may include the words "air eligible." The marking must be placed adjacent to the proper shipping name and UN ID markings, and be durable, legible, and of a size so as to be readily visible. [49 CFR 172.321]

U.S. DOT requires the consignee's (receiver) or consignor's (transferor) name and address to be marked on the package, except when the package is transported by highway only and will not be transferred from one motor carrier to another. Therefore, when transporting a gauge to and from a job site by highway, name and address marking is not required. However, if a gauge is transported by a common carrier, name and address marking is required. [49 CFR 172.301(d)]

LABELING PACKAGES

Packages containing nuclear gauges are required to have radioactive hazard labels affixed to opposite sides (not top or bottom) near the proper shipping name marking. The nuclear gauge shipping case as received from Troxler will have the appropriate labels (White-I or Yellow-II).

The following information must be entered on the labels in legible printing with a durable weather-resistant means of marking [49 CFR 172.403(g)]:

- ◆ **Contents** – the name of the radionuclide(s) in the package (e.g., Cs-137 and Am-241:Be)
- ◆ **Activity** – the activity of the radioactive materials expressed in appropriate SI units, e.g., megabecquerels (MBq), gigabecquerels (GBq).
- ◆ **Transport Index** (for YELLOW-II or YELLOW-III labels only) – the maximum radiation level at one meter from the surface of the package in millirem/hour. See Appendix H for a list of TI values for Troxler gauges.

CARGO AIRCRAFT ONLY LABELING

Nuclear gauges are not allowed on passenger-carrying aircraft. When offered for transport by air, including Federal Express, nuclear gauge packages must bear a "CARGO AIRCRAFT ONLY" label. [49 CFR 173.448(f), 49 CFR 172.402(c)]

TYPE A PACKAGE MARKING AND LABELING SUMMARY

In summary, packages containing Troxler gauges need the following marking and labeling:

- ◆ Consignor or consignee's name and address, except highway shipments that will not be transferred from one motor carrier to another
- ◆ "U.S. DOT 7A Type A" package marking
- ◆ Proper shipping name
- ◆ UN identification number
- ◆ "RQ" designation if the gauge contains 10 or more mCi of Am-241 or Am-241:Be
- ◆ Radioactive labels on opposite sides of the package.
- ◆ "CARGO AIRCRAFT ONLY" label, if shipped by air

SECURITY SEALS

Each Type A package must incorporate a feature, such as a seal, that is not readily breakable, and that, while intact, is evidence that the package has not been opened. The seal is required when transporting a gauge to or from a work site, as well as when shipping a gauge via common carrier. You should also lock the gauge before placing it in the case. [49 CFR 173.412]

INSPECTING PACKAGE BEFORE SHIPMENT

The shipper must inspect each package (gauge shipping case) before each shipment to ensure it is in unimpaired physical condition, except for superficial marks, and that each closure device (hinge, hasp, latch, etc.) is properly installed, secured, and free of defects. [49 CFR 173.475]

SECURING PACKAGES IN VEHICLE

Any package of radioactive material must be secured against movement within the transport vehicle under conditions normally incident to transportation. [49 CFR 177.834(a) and 173.448]

MINIMUM SEPARATION BETWEEN PACKAGES AND PEOPLE

Packages bearing RADIOACTIVE YELLOW-II or YELLOW-III labels are not to be carried in compartments occupied by passengers. These packages must be kept a minimum distance away from vehicle occupants, based on the transport index, as shown in the table below. If more than one package is present, the distance (measured from the nearest point on any package) must be based on the total transport index for all of the packages. [49 CFR 177.842(b)]

Total Transport Index	Minimum Distance (Feet)
0.1 to 1.0	1
1.1 to 5.0	2
5.1 to 10.0	3
10.1 to 20.0	4
20.1 to 30.0	5
30.1 to 40.0	6
40.1 to 50.0	7

For example, a Troxler 3440 gauge with a TI of 0.6 must be kept at least 1 foot away from the driver or passengers. Two Troxler 3440s with a combined TI of 1.2 must be kept at least 2 feet from the driver or passengers.

SHIPPING PAPER PREPARATION AND RETENTION

Shipping paper examples are shown in Appendices B, C, D, and E. Shipping papers must include:

- ◆ The letters "RQ" for reportable quantities of material (e.g., 10 mCi or greater of either Am-241 or Am-241:Be)
- ◆ Proper shipping name (e.g., Radioactive material, Type A package, special form)
- ◆ Hazard class (7)
- ◆ UN identification number (e.g., UN3332)
- ◆ Radionuclide names (e.g., Cs-137, Am-241:Be)
- ◆ Activity contained in the package in SI units (e.g., megabecquerel, gigabecquerel, etc.) or in SI units followed by customary units (e.g., millicuries, microcuries, etc.)
- ◆ Label category: Radioactive Yellow-II or White-I, as applicable.
- ◆ Transport index (dose rate in mrem per hour at 1 meter)
- ◆ The words "Cargo Aircraft Only" if the package is offered for transport by air
- ◆ Emergency telephone number
- ◆ Date of acceptance by carrier (i.e., the shipment date)

Shippers and carriers must retain a copy of the shipping papers, or an electronic image thereof, for a period of 375 days after the date the hazardous material (e.g., a portable nuclear gauge) is accepted by a carrier. An electronic image includes an image transmitted by fax machine, an image on the screen of a computer, or an image generated by an optical imaging machine. The copy (paper or electronic) must be accessible at or through the principal place of business and immediately available upon request by an authorized official of federal, state, or local government. [49 CFR 172.201(e)]

Private carriers who use the same shipping paper for multiple shipments of the same hazardous material (e.g., a portable nuclear gauge) may retain a single copy of the permanent shipping paper, instead of a copy for each shipment made, if the carrier also retains a separate record of each shipment made, including:

- ◆ Shipping name (proper shipping name)
- ◆ Identification number (UN identification number)
- ◆ Quantity transported (activity in the shipment)
- ◆ Date of shipment

SHIPPER'S CERTIFICATION

For any shipment offered for transport by common carrier, the shipping papers must include a signed and dated shipper's certification statement. No certification is required for a hazardous material transported by motor vehicle by a private carrier if the material will not be reshipped or transferred to another carrier (i.e., no certification is required when a gauge is transferred to and from a job site in a Company vehicle). [177.204]

SHIPPING PAPER ACCESSIBILITY

When transporting hazmat by motor vehicle, the driver must ensure that the shipping papers are readily available to, and recognizable by, authorities in the event of an accident or inspection. The shipping paper must be clearly distinguished, if it is carried with any other papers, by either tabbing it or by having it appear first in the stack of papers.

When the driver is at the vehicle's controls, the shipping paper must be within immediate reach while the driver is restrained by the lap belt. The paper must be either readily visible to a person entering the driver's compartment (e.g., on the seat next to the driver) or in a holder which is mounted to the inside of the door on the driver's side of the vehicle.

When the driver is not at the controls of the vehicle, the shipping papers must be on the driver's seat or in a holder which is mounted to the inside of the door on the driver's side of the vehicle. [49 CFR 177.817(e)]

EMERGENCY RESPONSE INFORMATION

An emergency response information sheet must accompany the shipment of a nuclear gauge. This document must be in the transport vehicle and immediately accessible to the driver during transportation on a public highway. Troxler includes a copy of this document with each gauge. An example of an emergency response information sheet is shown in Appendix F. [49 CFR 172, Subpart G]

EMERGENCY RESPONSE PHONE NUMBER

A 24-hour emergency response telephone number must be provided on the shipping paper. This number must be manned continuously, while the gauge is in transit, by someone who is knowledgeable of the hazards and characteristics of the hazardous material being shipped, has comprehensive emergency response and accident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information. Troxler currently provides this service to Troxler gauge users at no charge (919-549-9539). [49 CFR 172, Subpart G]

ACCIDENT NOTIFICATION REQUIREMENTS

Notify your licensing agency as soon as practical after a reportable incident. You are also required by 49 CFR 171.15 to notify, at the earliest practical moment, the U.S. DOT at 1-800-424-8802 of an accident that occurs during the course of transportation (including loading, unloading, and temporary storage) in which fire, breakage, spillage, or suspected contamination occurs involving shipment of radioactive material.

APPENDIX A

TESTING RESULTS FOR TYPE A PACKAGES FOR TROXLER GAUGES/CASES

INSTRUCTIONS FOR FINDING YOUR 7A TYPE A TESTING RESULTS:

1. Determine your shipping case type by using the drawing below.
2. Find your gauge model number in the first column of the table on the next page.
3. Find the corresponding case in the second column of this row.
4. Gauges that are no longer in production may not be listed. Please contact your Troxler representative or the Troxler corporate headquarters if you need assistance.

TESTING PERFORMED & RESULTS (unless otherwise indicated in footnotes):

Water Spray: Subjected the package to a water spray simulating rainfall of approximately two inches per hour for one continuous hour.

Results: No physical damage to the package was observed, unless otherwise noted in footnotes.

Vibration: The package was vibrated with a displacement of 0.1" at approximately 12 Hz for a period of 24 continuous hours.

Results: No physical damage to the package was observed, unless otherwise noted in footnotes.

Free Drop: The package was dropped from a height of four feet onto a non-yielding surface from a position to cause maximum damage to the package.

Results: The case was scratched due to the abrasiveness of the concrete, but no other physical damage to the package was observed, unless otherwise noted in footnotes.

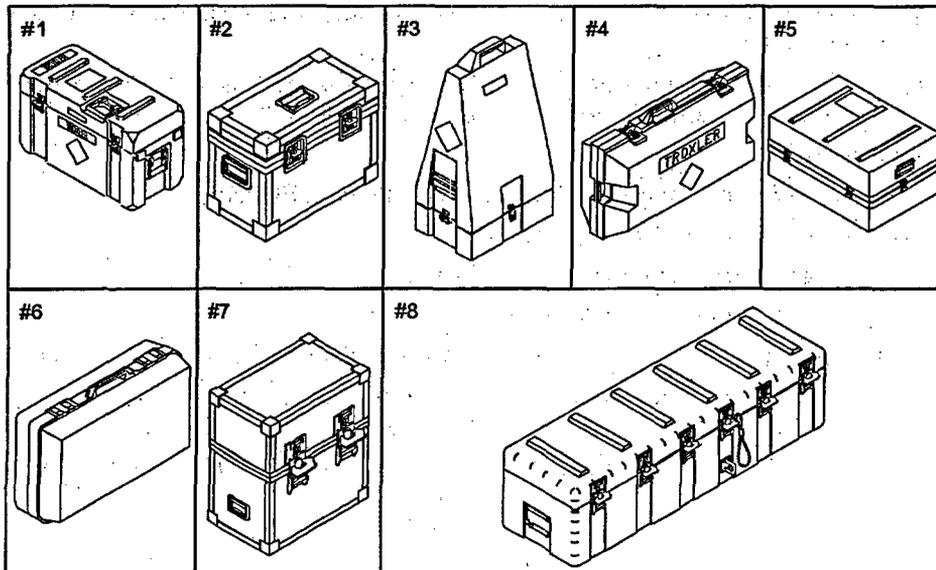
Penetration: The package was placed on a non-yielding surface. A 1-1/4" diameter, 13-pound steel cylinder with a hemispherical end was dropped in the vertical position from a height of 40" onto the package to a point to cause maximum damage to the package.

Results: No physical damage to the package was observed, unless otherwise noted in footnotes.

Compression: Package was placed on a non-yielding surface and subjected to a compressive load of at least 13 kilopascals multiplied by the vertically projected area of the package, in square feet, for 24 continuous hours.

Results: No physical damage to the package was observed, unless otherwise noted in footnotes.

PACKAGE DRAWINGS:



RESULTS OF TESTING

Consult the table below for applicable testing results, as described in the instructions on the previous page. A [✓] in the table below indicates that the applicable test was performed. The results are on the previous page of this document unless otherwise stated in the referenced footnotes.

GAUGE MODEL	CASE/DRAWING #	WATER SPRAY	VIBRATION	FREE DROP	PENETRATION	COMPRESSION	PACKAGE WEIGHT (lbs)	DATE TEST COMPLETED
3241 SERIES- 3241-A, 3241-B 3241-C, 3241-M 3242	WATER RES#1	(1)	✓	✓	✓	✓	103, (5)	9/91
	GAUGE ONLY	(1)	✓	✓, (3)	✓, (3)	✓, (2)	55	1/83
3216, 3217, 3218, 3221, 3222	PYRAMID#3	(1)	✓	✓	✓	✓, (7)	93, (5)	9/91
	PLASTIC#6	(1)	✓	✓	✓	✓	70, (5)	6/91
3400 SERIES- 3401, 3401-B 3411, 3411-B 3430, 3430-M 3440, 3440-M	WATER RES#1	(1)	✓	✓	✓	✓	110, (5)	9/91
	TRUNK#2	(1)	✓	✓	✓	✓	115, (5)	9/91
	PYRAMID#3	(1)	✓	✓	✓	✓, (7)	93, (5)	9/91
	BLOWMOLD#4	(1)	✓	✓	✓	✓, (2)	81	5/85
	ABS#5	(1)	✓	✓	✓	✓	105, (5)	9/91
3450, 3451	WATER RES#1	(1)	✓	✓	✓	✓	96	7/96
4232	WATER RES#1	(1)	✓, (8)	✓	✓	✓	70, (9)	1/95
4301 & 4302	PLASTIC#6	(1)	✓	✓	✓	✓	70, (5)	6/91
4350	WATER RES#8	(1)	✓	✓	✓	✓	122	3/92
4430	TRUNK#7	(1)	✓	✓, (3)	✓	✓	107	12/92
4440 SERIES	WATER RES#1	(1)	✓	✓	✓	✓	120, (5)	9/91
4640	WATER RES#1	(1)	✓	✓	✓	✓	110, (5)	8/96
	TRUNK#2	(1)	✓	✓	✓	✓, (2)	93	6/84

Notes:

1. Engineering Evaluation - Water exposure of the magnitude required by regulations would not affect the shielding or containment integrity.
2. Compressive load at date of test was specified as being derived using the "maximum horizontal cross-section of the package," in place of the "vertically projected area of the package."
3. Cosmetic damage was observed.
4. Package material was exempt from this test per regulations at the time of testing.
5. Package tested with full weight plus 20 pounds added.
6. Package weight not available (case is no longer in production).
7. Engineering Evaluation - Test not practical due to case geometry.
8. The case was vibrated with a displacement of 1/8" at 15 Hz for a period of 24 continuous hours.
9. The weight of the case and dummy contents as tested was 74 lbs.

Test results were obtained from the most current Type A package testing and evaluation documentation.

APPENDIX B

PRIVATE CARRIER BILL OF LADING FOR A 3400 SERIES GAUGE

This example shows a bill of lading for a 3400 Series gauge transported by private carrier. This document is NOT required to be dated.

NOTE

Your source type, source activity, and TI may differ from this example. The "RQ" requirement applies only to sources containing americium-241.

Your Company's Letterhead	
BILL OF LADING	
Shipper:	ABC Paving Company 0000 Road Drive Anywhere, U.S.A.
RQ, Radioactive material, Type A package, Special Form, 7, UN3332	
Cs-137 0.30 GBq (8.0 mCi) Am-241:Be 1.48 GBq (40.0 mCi)	
Radioactive Yellow II Label, TI = 0.3	
**** EMERGENCY CONTACT: (919) 549-9539 ****	
<u>(signature)</u> SHIPPER	

APPENDIX C

COMMON CARRIER BILL OF LADING EXAMPLE FOR A 3400 SERIES GAUGE

This is an example of a bill of lading for a 3400 Series nuclear gauge being shipped by a common carrier.

NOTE

Your source type, source activity, TI, and certificate of competent authority numbers may differ from this example. The "RQ" requirement applies only to sources containing americium-241.

SB Freightways
BILL OF LADING

		DATE SHIP DATE	P.O. NO.	SHIPPER NO.	
CONSIGNEE (TO) RED E. WAITING		SHIPPER/CONSIGNOR (FROM) ABC PAVING COMPANY			
DEF PAVING INTERNATIONAL		456 MAIN STREET			
123 DIRT ROAD		ANY OTHER TOWN, U.S.A. 67890			
ANYTOWN, U.S.A. 12345					
PHONE NO.	EMERGENCY RESPONSE NUMBER* (REQUIRED IF HM COLUMN MARKED) 919-549-9539	ROUTE			
(SUBJECT TO CORRECTION)					
Number of Packages	HM	Kind of Packaging, Description of Articles, Special Marks and Exceptions	Weight (lb)	Class or Rate Ref	Cube (Optional)
1	x	RQ, Radioactive Material, Type A package,			
		Special Form, 7, UN3332			
		Cs-137 0.30 GBq (8.0 mCi)			
		Am-241:Be 1.48 GBq (40 mCi)			
		Radioactive Yellow II label, TI = 0.3			
		Dim 35 x 45 x 78 cm			
		Emergency Contact: (919) 549-9539			
THIS IS TO CERTIFY THAT THE ABOVE NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED, AND LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION.					
SHIPPER/CONSIGNOR WANDA SHIPPITT			CARRIER SB FREIGHTWAYS		
AUTHORIZED SIGNATURE			AUTHORIZED SIGNATURE		
DATE					

APPENDIX D

SHIPPER'S DECLARATION FOR DANGEROUS GOODS
EXAMPLE FOR A 3400 SERIES GAUGE

This is an example of a Shipper's Declaration for Dangerous Goods for shipping a 3400 Series nuclear gauge by air.

NOTE

Your source type, source activity, TI, and certificate of competent authority numbers may differ from this example. The "RQ" requirement applies only to sources containing americium-241.

SHIPPER'S DECLARATION FOR DANGEROUS GOODS						
Shipper ABC PAVING COMPANY 123 DIRT ROAD ANYTOWN, U.S.A. 12345			Air Waybill No. Page of Pages Shipper's Reference Number <i>(optional)</i>			
Consignee DEF PAVING INTERNATIONAL 456 MAIN STREET ANY OTHER TOWN, U.S.A. 67890						
<i>Two completed and signed copies of this Declaration must be handed to the operator.</i>			WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.			
TRANSPORT DETAILS						
This shipment is within the limitations prescribed for: <i>(delete non-applicable)</i>		Airport of Departure:				
<input checked="" type="checkbox"/> CARGO <input checked="" type="checkbox"/> AIRCRAFT ONLY						
Airport of Destination:		Shipment type: <i>(delete non-applicable)</i> <input checked="" type="checkbox"/> RADIOACTIVE				
NATURE AND QUANTITY OF DANGEROUS GOODS						
Dangerous Good Identification						
Proper Shipping Name	Class or Division	UN or ID No.	Subsidiary Risk	Quantity and type of packing	Packing Inst.	Authorization
RQ, Radioactive Material Type A package, Special Form	7	UN3332		Cesium-137, 0.30 GBq (8 mCi) Americium-241:Beryllium 1.48 GBq (40 mCi) All packed in one Type A package Dim 35 x 45 x 78 cm	Yellow II TI=0.3	SPECIAL FORM CERT USA/0614/S USA/0632/S
Additional Handling Information This shipment may be carried on passenger aircraft outside U.S. Jurisdiction. Special Form Approval certification is attached to dangerous goods declaration. EMERGENCY CONTACT: (01) 1-919-549-9539						
I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations				Name/Title of Signatory Wanda Shippitt, Shipping Coordinator Place and Date ANYTOWN, U.S.A. Ship Date Signature <i>(see warning above)</i>		

APPENDIX E

FEDERAL EXPRESS® FORM EXAMPLE FOR A 3400 SERIES GAUGE

This is an example of the Federal Express version of a Shipper's Declaration for Dangerous Goods.

NOTE

Your source type, source activity, TI, and certificate of competent authority numbers may differ from this example. The "RQ" requirement applies only to sources containing americium-241.

FedEx. Dangerous Goods Airbill **Sender's Copy**
 RETAIN FOR 1 YEAR
 RETAIN THIS COPY FOR YOUR RECORDS

The World On Time.

1 From Please print and press hard.
 Shipper's Name: **WANDA SHIPPITT** Phone: **(444) 444-4444**
 Company: **ABC PAVING COMPANY**
 Address: **123 DIRT ROAD**
 City: **ANYTOWN** State: **U.S.A.** Zip: **12345**

2 Your Intended (Shipping Reference)
 Recipient's Name: **RED E. WAITING** Phone: **(555) 555-5555**
 Company: **DEF PAVING INTERNATIONAL**
 Address: **456 MAIN STREET**
 City: **ANY OTHER TOWN** State: **U.S.A.** Zip: **67890**

3 To
 Recipient's Name: **RED E. WAITING** Phone: **(555) 555-5555**
 Company: **DEF PAVING INTERNATIONAL**
 Address: **456 MAIN STREET**
 City: **ANY OTHER TOWN** State: **U.S.A.** Zip: **67890**

4 Express Package Service Package up to 70 lbs.
 FedEx Priority Overnight
 FedEx Standard Overnight
 FedEx 2Day
 FedEx International Priority
 FedEx International Economy

5 Express Freight Service Package over 70 lbs.
 FedEx Heavy Freight®
 FedEx 3Day Freight
 FedEx 2Day Freight

6 Packaging
 Other Packaging
 Special Handling
 Fragile Goods
 Hazardous Materials

7 Payment
 Sender
 Receiver
 Third Party
 Credit Card
 Cash

8 Signature Release Unavailable

974

811508706847 0204

Page 1 of 1 Pages

TRANSPORT DETAILS
 Report of Shipper:
 Report of Recipient:
 Shipment type: RADIOACTIVE

NATURE AND QUANTITY OF DANGEROUS GOODS

Proper Shipping Name	Class or Division	UN or LD. No.	Packing Group	Subsidiary Risk	Quantity and Type of Packaging	Packing Inst.	Authorization
RQ, Radioactive Material, Type A package, Special Form,	7	JN3332			Cesium-137 0.30 GBq (8.0 mCi) Americium-241/Beryllium 1.48 GBq (40.0 mCi) All Packed in One Type A Package Dim 35 x 45 x 78 cm	Yellow II TI = 0.3	SPECIAL FORM CERT. USA/0614/S USA/0632/S

NOTE

Prepared for AIR TRANSPORT according to:
 ICAO IATA/IMD

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked, and labeled/recorded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Emergency Telephone Number (Required for U.S. Origin or Destination Shipments) **919-649-8539**

Name/Title of Shipper: **Wanda Shippitt, Shipping Coordinator**
 Place and Date: **ANYTOWN, U.S.A.** Ship Date: _____

Signature: _____
 Title: _____

ACCEPTABLE FOR PASSENGER AIRCRAFT THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT



APPENDIX F

EMERGENCY RESPONSE INFORMATION EXAMPLE

TROXLER NUCLEAR GAUGE EMERGENCY RESPONSE INFORMATION REQUIRED FOR TRANSPORTATION

Call Troxler Electronic Laboratories, Inc. at (919) 549-9539 for Emergency Assistance.

1. PROPER SHIPPING NAME:

- ◆ Radioactive material, Type A package, Special Form, UN3332

POTENTIAL HAZARDS

2. HEALTH HAZARDS

- ◆ Radiation presents minimal risk to lives of persons during transportation accidents.
- ◆ Undamaged packages are safe; damaged packages or materials released from packages can cause external radiation hazards. Contamination is not suspected.
- ◆ Packages (cartons, boxes, drums, articles, etc.) identified as "Type A" by marking on packages or by shipping papers contain non-life endangering amounts. Radioactive sources may be released if packages are damaged in moderately severe accidents.
- ◆ Packages (large and small, usually metal) identified as "Type B" by marking on packages or by shipping papers contain potentially life-endangering amounts. Because of design, evaluation, and testing of packages, life-endangering releases are not expected in accidents except those of utmost severity.
- ◆ Commonly available instruments can detect most of these materials.
- ◆ Water from cargo fire control is not expected to cause pollution.

3. FIRE OR EXPLOSION

- ◆ Packagings can be consumed without content loss from sealed source capsule.
- ◆ Radioactive source capsules and Type B packages are designed to withstand temperatures of 1475 °F (800 °C).

EMERGENCY ACTION

4. IMMEDIATE PRECAUTIONS

- ◆ Priority response actions may be performed before taking radiation measurements.
- ◆ Priorities are life saving, control of fire and other hazards, and first aid.
- ◆ Isolate hazard area and deny entry. Notify Radiation Authority of accident conditions.
- ◆ Delay final cleanup until instruction or advice of Radiation Authority.
- ◆ Positive pressure self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing will provide adequate protection against internal radiation exposure, but not external radiation exposure.

5. FIRE

- ◆ Do not move damaged packages; move undamaged packages out of fire zone.
- ◆ Small Fires: Dry chemical, CO₂ water spray or regular foam.
- ◆ Large Fires: Water spray, fog (flooding amounts)

6. SPILL OR LEAK

- ◆ Do not touch damaged packages or spilled material.
- ◆ Slightly damaged or damp outer surfaces seldom indicate failure of inner container.
- ◆ If source is identified as being out of package, stay away and await advice from Radiation Authority.

7. FIRST AID

- ◆ Use first aid treatment according to the nature of the injury.
- ◆ Persons exposed to special form sources are not likely to be contaminated with radioactive material.

APPENDIX G

SPECIAL FORM CERTIFICATE EXAMPLE



Reference GB/353/S-85
Certificate Issue 5

**Certificate of Approval
of
Design for Special Form Radioactive Material**

Title	
Capsule X.1218	
Drawing Nos and Specification References	
Assembly: A 62269 Issue C Details: A 62268 Issue C Special Form Drawing List: SFDL/353 Issue 3 dated 18 October 1999 SM/GB/353/S-85 dated 21 February 1991; QA/MS/353/1199 Issue 1 dated 22 November 1999	
Q.A. Programme Ref: Nycomed -Amersham's & AEA(T)'s IPD QAM	
Radioactive Material	Maximum Activity
Caesium 137	555MBq

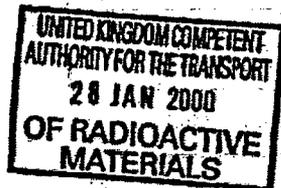
THIS IS TO CERTIFY that the Secretary of State for the Environment Transport and the Regions being, for the purposes of the Regulations of the International Atomic Energy Agency, the Competent Authority of Great Britain in respect of inland surface transport and of the United Kingdom of Great Britain and Northern Ireland in respect of sea and air transport and the Department of the Environment for Northern Ireland being the Competent Authority of Northern Ireland in respect of inland surface transport, have approved the above mentioned Special Form Design. Radioactive material manufactured to the above-mentioned design qualifies as special form radioactive material and as such will meet the requirements of the regulations overleaf.

This Certificate of Approval applies only to the design as set out in the above named drawings and specifications submitted by AEA Technology plc

In the event of any alteration in the composition of the package, the package design or in any of the facts stated in the application for approval, this certificate will cease to have effect unless the Competent Authority is notified of the alteration and the Competent Authority confirms the certificate notwithstanding the alteration.

This Certificate Cancels all Previous Issues and is valid until 31 January 2003
COMPETENT AUTHORITY IDENTIFICATION MARK: GB/353/S-85

Transport Radiological Adviser
Department of the Environment
Transport and the Regions
Great Minster House
76 Marsham Street
London SW1P 4DR



On behalf of the Secretary of State
for the Environment Transport and the
Regions and the Department of the
Environment for Northern Ireland

APPENDIX H

TRANSPORT INDEXES (TI) FOR TROXLER GAUGES

The TI for a nuclear gauge is defined as the dose rate (mrem/h) one meter from the shipping case.

1. Determine your case type using the case drawings (see page 11).
2. Find your gauge model number in the first column of the table below.
3. Find the corresponding case in the second column of this row.
4. If the gauge was manufactured with different source activities or sources, find this information in the third column of this row.
5. The fourth column provides the TI for each gauge, case, and source combination.
6. Gauges that are no longer in production may not be listed. Please contact your Troxler representative or the Troxler corporate headquarters if you need any assistance.

GAUGE MODEL	CASE/ DRAWING #	SOURCE INFO	TRANSPORT INDEX (TI)
1351, 1352, 2376	TRUNK/#2	—	0.2
3241-C	WATER RES/#1	100 mCi	0.1
		300 mCi	0.5
3241-M	WATER RES/#1	—	0.1
3216, 3217, 3218	PLASTIC/#6	—	0.1
	PYRAMID/#3	—	0.1
3242	WATER RES/#1	—	0.4
3401	WATER RES/#1 or BLOWMOLD/#4	—	0.4
	TRUNK/#2, PYRAMID/#3, or ABS/#5	—	0.1
3411	WATER RES/#1	—	0.5
	TRUNK/#2, PYRAMID/#3, or ABS/#5	—	0.1
	BLOWMOLD/#4	—	0.4
3430	WATER RES/#1	Cs-137/Am-241:Be	0.3
		Cs-137/Cf-252	0.5
3440, 3440-M, 3440-CM	WATER RES/#1	—	0.6
	TRUNK/#2	—	0.5
3450, 3451	WATER RES/#1	—	0.3
4232	WATER RES/#1	—	0.4
4300, 4301, 4302	PLASTIC/#6	—	*
4350	WATER RES/#8	—	0.2
4430	TRUNK/#7	—	0.1
4440 SERIES	WATER RES/#1	—	0.1
4545	TRUNK/#2	—	0.2
4640 SERIES	WATER RES/#1 or TRUNK/#2	—	0.2

* White I labels require no TI.

NOTES

DISCLAIMER

Proper training is required under federal and/or state regulations to handle dangerous goods and/ or hazardous materials. All persons and entities must comply with all federal regulations, including but not limited to the specific training requirements of 49 C.F.R. (172.700 – 172.704)

FedEx Express provides these materials as a service, to be used as guidelines to assist properly trained shippers. The materials provided by FedEx Express in no way alter, satisfy, or influence any federal or state requirements. The attached information provided does not meet the training requirements as required in DOT 49 CFR.

The study and/or use of these FedEx Express materials does not qualify an individual to prepare, package, transport, or otherwise handle dangerous goods or hazardous materials.

The information contained in this document is subject to change or update due to changing government regulations. The user of this document assumes responsibility for complying with all applicable laws and regulations regarding the shipment of Dangerous Goods.

FedEx shall not be held responsible for any loss, injury and/or damage caused by errors, omissions, misprints or misrepresentations of the contents of this document or for any unauthorized or inappropriate use.

INSTRUCTIONS

FOR COMPLETING THE SHIPPER'S DECLARATION

Step #1:

Open the Attached Shipper's Declaration with Adobe Acrobat Reader.
(Adobe Acrobat Reader is available as a free download from the Adobe.com web site.)

Step #2:

Save a blank copy of the Shipper's Declaration form for future use.

Step #3:

Begin by placing the cursor in the "Shipper" block in the upper left corner of the Shipper's Declaration and keying information as appropriate. Using the TAB key to move from one field to another, complete all required fields.

For a detailed explanation of information required on a Shipper's Declaration, refer to **IATA Section 8 - Documentation (Paragraph 8.1.6)**. Using the sequence the TAB key will follow, a general explanation of how to complete the attached form is provided below:

- **Shipper** - Full name and address of the shipper
- **AirWaybill Number** - The number of the Air Waybill to which the declaration form will be attached
- **Page of pages** - The page number and the total number of pages (For a single page Shipper's Declaration, enter "Page 1 of 1 pages").
- **Shipper's Reference Number** - Optional field providing the shipper with an opportunity to enter an internal organization reference number
- **Consignee** - Full name and address of the consignee
- **Transport Details** - Tab to the appropriate field, and using the capital letter "X," enter X's to block out "Passenger and Cargo Aircraft" (*for shipments which must travel on Cargo Aircraft Only*) or to block out "Cargo Aircraft Only" (*for shipments which may travel on either Passenger or Cargo aircraft*).
- **Airport of Departure** - Enter the full name of the airport or city of departure. (For a package being shipped out of Chicago using Ohare Airport, this field may be completed as: "Ohare," "Ohare Airport," "Ohare International Airport," "Chicago," "Chicago, IL," etc.).
- **Airport of Destination** - Enter the full name of the airport or city of destination. (For a package being shipped to Chicago using Ohare Airport, this field may be completed as: "Ohare," "Ohare Airport," "Ohare International Airport," "Chicago," "Chicago, IL," etc.).

- **Shipment Type** - Tab to the appropriate field, and using the capital letter "X," enter X's to block out "NON-RADIOACTIVE" (for shipments which contain radioactive material) or to block out "RADIOACTIVE" (for shipments which do not contain radioactive material).

- **Nature and Quantity of Dangerous Goods** - Enter the required information strictly in accordance with IATA 8.1.6.9.

Begin by entering the UN or ID Number. Use the **SPACE BAR** to move from one column to another as you enter information across the page.

Per IATA 8.1.6.10 (b), the information in this field "*must* be entered in sequence within the columns provided." If your information will not fit without going over the lines separating the columns, use the **ENTER** key and enter text on another line.

- **Additional Handling Information** - Enter any special handling information relevant to the shipment in accordance with IATA 8.1.6.11.

- **Emergency Telephone Number** - All dangerous goods shipments to, from, within, or transiting through the U.S. must include 24-hour emergency response information as described in IATA 2.9.2, USG-12.

- **Name and Title of Signatory** - Enter the name and title of the person actually signing the Shipper's Declaration.

- **Place and Date** - Enter the place and date to indicate where and when the form is actually signed.

Step #4:

Print and sign the form. Per IATA 8.1.4.1, a typewritten signature is not acceptable.

Step #5:

Provide at least three (3) signed copies of the completed Shipper's Declaration (with diagonal hatchings printed in red) to FedEx Express for shipping. (Refer to FedEx Express IATA Variation FX-14).

A color printer must be used to ensure the diagonal hatchings on the completed Shipper's Declaration form appear in red.

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

(Provide at least three copies to the airline.)

Shipper

Air Waybill No.
Page of Pages
Shipper's Reference Number

Consignee



Two completed and signed copies of this Declaration must be handed to the operator

WARNING

TRANSPORT DETAILS

This shipment is within the limitations prescribed for:
(delete non applicable)

Airport of Departure

<input type="checkbox"/> PASSENGER AND CARGO AIRCRAFT	<input type="checkbox"/> CARGO AIRCRAFT ONLY
---	--

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

Airport of Destination:

Shipment type: *(delete non-applicable)*

<input type="checkbox"/> NON-RADIOACTIVE	<input type="checkbox"/> RADIOACTIVE
--	--------------------------------------

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification				Quantity and type of packaging	Packing Inst.	Authorization
UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Pack- ing Group			

Additional Handling Information

Emergency Telephone Number

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable International and National Governmental Regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory

Place and Date

Signature
(see warning above)

FOR RADIOACTIVE MATERIAL SHIPMENT ACCEPTABLE FOR PASSENGER AIRCRAFT, THE SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN OR INCIDENT TO RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.