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Shipping Explosives Offsite

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Shipping Explosives Offsite*

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Shipping Explosives Offsite

1.0 Introduction

This document provides requirements and guidance for properly preparing explosives for shipment offsite on public roads. This document also provides requirements on how to classify new explosive materials and explosive devices for shipment (see Appendix A). The word "shipment" or "shipping," as used in this document, refers to the movement of explosives, including explosives waste, on public roads. The movement of explosives between Livermore and Site 300 and between LLNL and Sandia National Laboratories/California is treated as a shipment. Department of Energy (DOE) orders, the *DOE Explosives Safety Manual*, and the DOE Explosive Classification and Shipment Program Management Plan prescribe that all packaging, labeling, applicable shipping documents, placarding, and transportation requirements for the offsite shipment of explosives shall be in accordance with Department of Transportation (DOT) regulations contained in 49 CFR 100–179. Such shipments are monitored by the California Highway Patrol.

The packaging and transportation of explosives onsite (i.e., within the geographically contiguous private property owned by or under the control of LLNL) is not addressed in this document. Such operations are covered in Document 21.2, "Onsite Hazardous Materials Packaging and Transportation Safety (HMPTS) Manual," in the *Environment, Safety, and Health (ES&H) Manual*.

This document applies to all LLNL operations involving the shipment of explosives offsite from the Livermore site or Site 300. Operations involving the transport or shipment of explosives within the Nevada Test Site (NTS) are contained in NTS-specific safety procedures.

For assistance in preparing a specific explosive for shipment, contact the Materials Management Section (MMS) Site 300 Controlled Materials Group (CMG) or the ES&H Team explosives safety engineer.

2.0 Hazards

The major hazards associated with the transport or shipment of explosives are personal injury and property damage caused by an explosive reaction, which can occur in the event of a vehicle accident or if a packaged explosive were dropped during vehicle loading or unloading. Injuries can range from minor to fatal, including trauma,

lacerations, eye injury, hearing impairment, and burns. Property damage can also range from minor to major.

Properly packaged explosives can withstand the normal rigors of transportation without incident. Nonetheless, exposure of personnel to hazardous materials or an unintentional explosion can potentially occur if packaging is broken or exposed to fire. As examples of the consequence of such accidents, the potential bounding impacts of truck accidents involving up to 29.1 lb of TNT-equivalent high explosives (HE) between LLNL's main site and Site 300 and aircraft accidents involving shipments of 2910 lb of TNT-equivalent HE through Tracy airport bound for Site 300 or NTS can be found in Appendix D.4 of the 1992 *Final Environmental Impact Statement and Environmental Impact Report (EIS/EIR) for Continued Operation of Lawrence Livermore National Laboratory, and Sandia National Laboratories, Livermore*.

3.0 Controls

3.1 Receipt of Explosives Shipments

3.1.1 Non-LLNL Shipments

A Responsible Individual shall ensure that all explosives shipments from offsite locations are delivered for processing to Building 832, MMS Site 300 CMG. In special cases, CMG personnel may determine that the nature of an explosives shipment (e.g., destination and weight) is such that processing should be handled at another facility.

3.1.2 Intersite Shipments

The main area at the Livermore site for receiving and dispatching intersite explosives shipments is Building 191, the High Explosives Applications Facility (HEAF). At Site 300, the proper area is Building 832, MMS Site 300 CMG, unless otherwise designated.

3.2 Preparation for Shipment

3.2.1 DOT Classification

All explosives and explosive devices to be shipped on public roads shall be approved as described in Appendix A of this document, and shall possess a DOT shipping classification. The six DOT shipping classifications for explosives are:

- Hazard Class/Division 1.1 Mass explosion.
- Hazard Class/Division 1.2 Nonmass explosion with fragments.

- Hazard Class/Division 1.3 Mass fire with minor blast or fragments.
- Hazard Class/Division 1.4 Moderate fire with no blast or fragments.
- Hazard Class/Division 1.5 Very insensitive explosive substance (with a mass explosion hazard).
- Hazard Class/Division 1.6 Extremely insensitive explosive article.

A "new" explosive can be shipped on public roads only if the explosive is not a forbidden explosive and has been approved and classified as described in Appendix A. Appendix B provides additional information concerning lab-scale sensitivity and stability tests performed at LLNL and typical test data for some of the more common explosives.

3.2.2 Packaging

Explosives to be shipped offsite (to other than an LLNL location) shall be transported for packaging to Building 832, MMS Site 300 CMG, unless CMG determines that the classification or weight of the material makes it more feasible to package and pick up the shipment at another facility. All explosives destined for offsite shipment shall be packaged in containers specified in 49 CFR. When a specified container cannot be used, a DOT exemption may be granted for a special packaging scheme. An exemption request shall be submitted by MMS to DOT (through DOE) with the information specified in 49 CFR, Part 107, Subpart B. Upon approval, DOT will issue a DOT Exemption (DOT-E) number to identify the approved exemption. The MMS maintains a list of packaging configurations for which LLNL has DOT exemptions.

3.2.3 Labeling

Primary containers used for shipping explosives shall be tagged with an explosives identification label (LL-4299 or LL-3936) specifying the material's name, hazard class/division, storage compatibility group, weight, process review date, and stability review date (if applicable). DOT shipping containers shall have the appropriate DOT labels affixed. Unlabeled or incorrectly labeled containers shall not be transported or shipped.

All empty shipping containers shall be verified as being empty prior to disposal, transport to another facility, or shipment offsite. The LLNL Empty tag shall be affixed to all empty explosives shipping containers to signify that the containers are in fact empty. Empty explosives shipping containers being transported to another facility shall be tagged with a completed LLNL Empty tag (see Figure 1) and an LLNL Delivery tag (LL-1158-1).

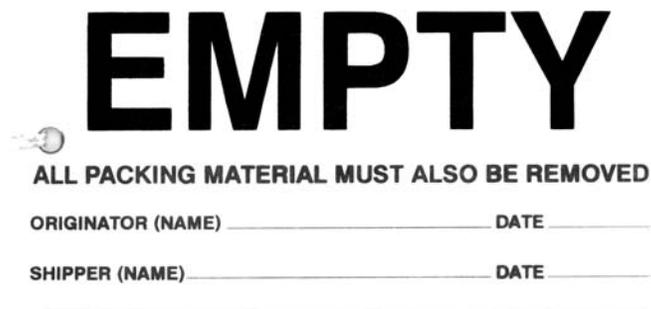


Figure 1. LLNL Empty tag.

3.2.4 Documentation

A Controlled Material ID tag (LL-3076) is required when shipping explosives (including waste) between Livermore and Site 300. The tag shall be completed properly and in legible print. Personnel intending to ship an explosive to a non-LLNL addressee shall submit a shipping document (LL 1095-3) to MMS for approval. This shipping document is not required when shipping explosives between Livermore and Site 300. For shipments of explosives (with the exception of waste explosives; see below), a Straight Bill of Lading is the primary shipping document, and shall be completed properly, including the correct DOT shipping name, DOT Hazard Class/Division, storage compatibility group, and identification number. MMS Site 300 CMG is responsible for completing the Straight Bill of Lading. For waste explosives, the Hazardous Waste Management (HWM) Division is responsible for completing a Hazardous Waste Shipping Manifest, which serves as the shipping document.

3.3 Explosives Shipments

3.3.1 Administrative Controls

All shipments of DOT Hazard Class/Division 1.1, 1.2, 1.3, 1.5, and 1.6 explosives to LLNL or between the Livermore site and Site 300 are transported by Material Distribution Division (MDD) Site 300 Transportation. DOT Hazard Class/Division 1.4 explosives may be transported on public roads by MDD Site 300 Transportation or Site 300 CMG.

Before a motor vehicle loaded with explosive materials can leave the Livermore site or Site 300, the driver shall be informed of the nature of the cargo and the methods to use in fighting fires involving the vehicle or its cargo (see Appendix C). MMS Site 300 CMG is responsible for providing emergency-response information to the driver. This information is to be carried by the driver of every explosives shipment.

For information on vehicle inspections, see Section 3.3.5.

3.3.2 Driver Training

Only personnel who hold a current commercial driver's license, are authorized to operate an LLNL commercial vehicle, and meet the qualification procedures listed below are permitted to transport explosives. Driver selection and training for operation of LLNL vehicles on public roads shall be in accordance with pertinent requirements of 49 CFR 390–397. All drivers of explosives-carrying vehicles shall have received proper training in the general safety precautions for explosives handling and specialized training for explosives transportation (i.e., course HS2120, "Explosives Transportation Safety").

In addition, drivers shall receive special training that emphasizes caution, road courtesy, and defensive driving. The computer-based training course "Defensive Driving" (HS5600-CBT) satisfies this requirement. Registration procedures for such courses are described in Document 40.2, "Environment, Safety, and Health Training and Education," in the *ES&H Manual*. The Explosives Handlers Training Qualification Record (LLNL RL-2999-9 or its equivalent) shall reflect the individual's explosives-transport duties in the "Qualification Details" section and satisfactory completion of the required drivers training in the "Training Summary" section of the form. Explosives Handlers Training Qualification Records are maintained by a driver's work supervisor.

The procedure for qualifying explosives users is described in Document 17.1, "Explosives," in the *ES&H Manual*.

3.3.3 Vehicle Controls

Explosives shall be transported only in vehicles that have been properly equipped, approved, maintained, and inspected. Any vehicle failing to meet these requirements shall not be permitted to transport explosives. The following equipment is required for all vehicles carrying explosives:

- Explosives placarding that is plainly visible from all directions. Placarding is not required for vehicles transporting DOT Hazard Class/Division 1.4 explosives, unless the aggregate gross weight of all hazardous cargo exceeds 1000 lb (in which case DANGEROUS placards are required).
- Two fire extinguishers, each with a minimum rating of 2A:10BC. One fire extinguisher shall be mounted inside the cab, the other outside of the vehicle, on the driver's side. Only one fire extinguisher is required for vehicles transporting Hazard Class/Division 1.4 explosives.
- Emergency four-way flasher.
- Backup light.

- Chock block.
- Tie-down mechanism for securing containers.
- Rear-view mirror on each side of the vehicle.
- Quick-disconnect switch on the battery if explosives are to remain on the vehicle overnight.
- Covered cargo area or a fire- and water-resistant tarpaulin.
- Cargo area with no sharp projections.

In addition to the preceding general equipment requirements, all vehicles transporting explosives offsite are required to have the following equipment:

- A sign on the rear of the vehicle indicating that it stops at railroad crossings (applies to DOT Hazard Class/Division 1.1, 1.2, and 1.3).
- Portable emergency reflectors (three per vehicle).
- Flashlight.
- Kit containing replacement sealed-beam lights, light bulbs, and fuses (one spare for each type and size of light on the vehicle).
- LLNL two-way radio.

3.3.4 Operational Controls

All drivers of explosives-carrying vehicles shall observe the following controls:

- Obey the posted speed limit, but do not exceed 25 mph onsite or 55 mph on public roads, even if the posted speed limit is higher.
- Do not load a vehicle in excess of its rated weight limit.
- Do not smoke or permit an open flame within 50 ft of a vehicle carrying explosives.
- Do not leave the cab without first stopping the motor and setting the parking brake.
- If the vehicle is stopped on a grade, one wheel shall be chocked.
- Do not transport explosives if bad weather limits the safe control of the vehicle.
- Do not allow more than two people in a vehicle transporting explosives.
- Ride only in the cab of the vehicle.

- Do not operate motor vehicles within 25 ft of an open magazine.
- Be familiar with the Offsite Emergency Plan (Appendix C).

3.3.5 Vehicle Inspection and Maintenance

All LLNL vehicles used to transport explosives shall be equipped properly and inspected by the responsible operator once each day prior to use. If the inspection reveals any defect or deficiency that could affect the safe operation of a vehicle, that vehicle shall not be operated until the necessary service or repair has been made. During inspection, the vehicle's operator is responsible for seeing that:

- Fire extinguishers are full, sealed, and inspection-current.
- Electrical wiring is in good condition.
- Fuel tank and lines are not leaking.
- Brakes, lights, horn, steering, and other operating equipment (such as a lift gate) are functioning properly.
- Tires are in good condition and properly inflated.
- Chassis and engine are reasonably clean and free of excess oil and grease.
- Exhaust system, including tail pipe, is in good condition.
- Windows and mirrors are clean and rear-view-mirror alignment is good.

All drivers who are assigned vehicles for transporting explosives shall be responsible for obtaining an inspection by Fleet Management every 90 days to ensure that the vehicle is properly equipped and maintained. Fleet Management shall correct vehicle defects as required and perform routine service and inspection. Such inspection shall be documented on the LLNL Safety Inspection Report—Vehicles Used to Transport Explosives form (RL-2653, shown in Appendix D). The completed inspection report shall be mailed to the appropriate supervisor, with a copy sent to the Site 300 ES&H Team explosives safety engineer.

Each day, before a properly equipped (see Section 3.3.3) motor vehicle may be loaded with explosives for transport over public roads, the vehicle shall be inspected for compliance and approved by a qualified inspector with the LLNL Commercial Motor Vehicle Inspection Report form (LL6335, shown in Appendix E) and the California Highway Patrol Inspection Record—Explosives Transportation form (CHP Form 148A, shown in Appendix F), as appropriate. The Motor Vehicle Inspection form (LL6170, shown in Appendix G) is also required when explosives shipments are made to other DOE or Department of Defense (DoD) facilities. After loading, the inspection form(s) shall be reviewed and approved by the driver.

Fleet Management shall perform a thorough steam cleaning of the engine, chassis, and underbody of all explosives-carrying vehicles at least every four months (more often if needed). If the cargo compartment requires cleaning, contact the Site 300 process area supervisor for explosives decontamination. When a vehicle is removed from service as an explosives-transport vehicle, the vehicle shall be decontaminated. The ES&H Team explosives safety engineer then performs an inspection to verify that the vehicle is free of explosives.

3.3.6 Material Compatibility

Explosives and other hazardous materials being transported together in a single vehicle shall be compatible. The loading chart in 49 CFR 177.848 shall be followed whenever explosives are to be transported.

3.3.7 Approved Routes

When transporting explosives, travel should be by the most direct, least congested route. Transportation of explosives on public roads is monitored by the California Highway Patrol. Approved routes, stopping places, and rules of the road are outlined in the California Highway Patrol publication HPH 84.3, *Explosives Routes and Stopping Places*.

There are currently two approved explosives routes between the Livermore site and Site 300. The first is by way of Corral Hollow Road (west), Tesla Road, and Greenville Road. The second is by way of Corral Hollow Road (east), Interstate 580, and Greenville Road. The first route is preferred because it presents less exposure to the general public. There are no approved stopping places on either route.

3.3.8 Emergencies

In the event of a breakdown, fire, or accident involving a vehicle carrying explosives offsite, follow the Offsite Emergency Plan, presented in Appendix C .

4.0 Responsibilities

General responsibilities for all workers are described in Document 2.1, "Laboratory and ES&H Policies, General Worker Responsibilities, and Integrated Safety Management," in the *ES&H Manual*. Each organization at the Laboratory shall ensure that personnel assigned to handle explosive materials perform the applicable responsibilities listed below and are adequately trained and equipped to perform their work safely and in accordance with LLNL and DOE requirements.

4.1 Responsible Individuals

A Responsible Individual is a supervisor who has direct responsibility for the safety of an explosives shipping activity or operation, including the condition of explosives-transport vehicles.

Responsible Individuals supervising workers who ship, handle, or store explosives shall ensure that:

- Workers adhere to the requirements of the *ES&H Manual* and applicable Work Smart Standards.
- Workers are trained as applicable and in accordance with safety plans and procedures that cover how to receive, handle, and ship explosive materials and explosive-waste materials.
- Explosive materials shipped offsite are properly classified.
- Drivers hold a current commercial driver's license and are authorized to operate LLNL commercial vehicles.

4.2 Workers

Programmatic personnel, researchers, waste generators, HWM technicians, and others who request the procurement or shipment of an explosive material or generate explosives waste shall:

- Follow applicable controls when obtaining, using, storing, shipping, or disposing of a hazardous material.
- Contact the organization responsible for packaging and shipping such materials.
- Prepare written requests for approval and shipment by analogy and requests for interim hazard classification, as appropriate. (For a definition of shipment by analogy, see Section A.3.2, "Acceptable Explosives Requiring Approval by Analogy.")

4.3 Qualified Explosives Handlers

A qualified explosives handler is responsible for the following:

- Providing primary packaging and labeling.
- Completing the Controlled Material ID tag (LL-3076).
- Notifying MDD Site 300 Transportation to arrange for material movement.

- Addressing explosives to an authorized facility and an approved explosives handler.

4.4 Drivers of Vehicles Transporting Explosives

Drivers of vehicles transporting explosives are responsible for the daily inspection of explosives-carrying vehicles prior to use and for the transport of explosives in a manner in compliance with DOT, DOE, and LLNL standards.

4.5 Materials Management Section

With respect to explosive materials (excluding explosive-waste materials), the MMS Site 300 CMG shall:

- Provide for the safe and secure receipt and distribution of explosive materials in accordance with LLNL and DOE requirements.
- Ensure that all explosives shipments leaving Site 300 and the Livermore site are properly packaged and labeled and have the correct shipping documents, including emergency response information, in place.
- Obtain DOE interim hazard classification and DOT hazard classification for new explosives or new explosive articles.
- Determine the need for DOT exemptions and obtain such exemptions when needed.
- Provide emergency-response information to drivers of vehicles loaded with explosive materials.

4.6 Hazardous Waste Management Division

The HWM Division shall:

- Prepare and sign shipping documents and manifests before explosives waste materials are shipped offsite.
- Provide technical assistance, through the ES&H Teams, to Laboratory personnel on how to package explosives waste materials.
- Ensure that explosives waste materials are packaged, marked, and transported offsite in accordance with applicable requirements.

4.7 Hazards Control Department's Explosives Safety Personnel

The Hazards Control Department's explosives safety personnel shall:

- Interpret applicable codes, standards, and regulations.
- Approve vehicles for explosives transport.
- Review and concur with the qualifications of explosives-transport drivers.
- Review requests for
 - DOE interim hazard classification or DOT hazard classification for a new explosive or explosive article.
 - Exemptions to DOT explosives-transportation requirements.
- Respond to emergency situations and incidents involving explosive materials.
- Provide liaison, safety guidance, and safety services to personnel who package or ship explosive materials.

4.8 Automotive Fleet Management Group

The Automotive Fleet Management Group shall:

- Inspect LLNL explosives-transport vehicles every 90 days, and provide routine maintenance and repair as required.
- Inspect non-LLNL commercial vehicles (e.g., common carriers and DOE and DoD trucks) that transport explosives.
- Steam clean explosives-transport vehicles at least every four months.

5.0 Work Standards

49 CFR, 100-179, "Research and Special Programs Administration, Department of Transportation."

49 CFR 382, "Controlled Substances and Alcohol Use and Testing."

DOE Order 440.1A, "Worker Protection Management for DOE Federal and Contractor Employees," Attachment 2, "Contractor Requirements Document," Sections 1–11, 13–18 (delete item 18.a), 19 (delete item 19.d.3) and 22.

DOE M 440.1-1, *DOE Explosives Safety Manual*.

6.0 Resources for More Information

6.1 Contacts

Contact the following, as appropriate, for further guidance or additional information:

- ES&H Team explosives safety engineer.
- Hazard Control Department explosives safety technical leader.
- MMS Site 300 CMG.
- HWM Division.

6.2 Lessons Learned

For lessons learned applicable to the offsite transport of explosive materials, refer to the following Internet address:

http://www-r.llnl.gov/es_and_h/lessons/lessons.shtml

6.3 Other Sources

DOE Explosive Classification and Shipment Program Management Plan, DOE National Transportation Program, DOE-AL, (1999).

DoD TB 700-2, "Department of Defense Ammunition and Explosives Hazard Classification Procedures."

Explosive Materials Shipments: Routes, Safe Stopping Places and Safe Parking Places, California Highway Patrol (HPH 84.3).

United Nations Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria, (ST/SG/AC.10/11/Rev.2).

Appendix A

Requirements for Shipping an Explosive

A.1 Introduction

This appendix describes the steps that shall be taken before an explosive (i.e., material or device) may be shipped from LLNL. Explosives can be categorized as "forbidden," "acceptable," or "new." Forbidden explosives may not be shipped (Section A.2). All other explosives may be shipped as acceptable explosives (Section A.3) or as new explosives (Section A.4). An explosive may need to undergo laboratory-scale tests (as described in Appendix B) before a final decision can be made with regards to shipping. Additional information concerning the DOE program for classifying new explosives can be found in the DOE Explosive Classification and Shipment Program Management Plan.

High-explosive shipments of quantities greater than 29.1 lb of TNT equivalent by truck (between the Livermore Site and Site 300) or greater than 2910 lb of TNT equivalent by aircraft (to or from offsite points or Site 300 through the Tracy airport) are outside the scope of impact analyses noted in the 1992 EIS/EIR (Appendix D.4) and require a DOE review under the National Environmental Policy Act (NEPA); see Document 3.6, "Environmental Planning," in the *ES&H Manual*.

A.2 Forbidden Explosives

The explosives listed below are generally forbidden for shipment on public roads. Contact the ES&H Team explosives safety engineer for additional information.

- An explosive that has not been approved in accordance with 49 CFR Section 173.56.
- An explosive mixture or device containing a chlorate and either (1) an ammonium salt, including a substituted ammonium or quaternary ammonium salt or (2) an acidic substance, including the salt of a weak base or strong acid.
- A propellant that is unstable, condemned, or deteriorated.
- An initiating explosive that is dry.
- Nitroglycerine, diethylene glycol dinitrate, or other liquid explosive, except as authorized by DOT.
- Any type of explosive in a leaking or damaged package.

A.3 Shipping Acceptable Explosives by Commercial or DOE Vehicle

An acceptable explosive is any explosive that either (1) has already been approved by DOE/DOT for shipment or (2) requires approval only by analogy because the explosive is similar in composition and hazard characteristics to an already-approved, acceptable explosive.

A.3.1 Acceptable Explosives Already Approved by DOE/DOT

If an explosive has already been classed and approved by DOE/DOT for shipment by commercial carrier, the explosive may be shipped by commercial or DOE vehicle using the same classification and shipping description, without additional tests or authorizations. For assistance, contact the MMS Site 300 CMG or the Hazards Control Department explosives safety technical leader.

A.3.2 Acceptable Explosives Requiring Approval by Analogy

An explosive that is similar in composition and hazard characteristics to an already-approved explosive may also be approved for shipment by preparing a written request (i.e., a memo) for approval for shipment by analogy. The requester is to address the memo to MMS, with a request to forward to the DOE/OAK Hazardous Materials Transportation Program manager for approval. Copies of the memo are to be sent to the Hazards Control Department's explosive safety technical leader (L-384) and to the MMS Site 300 CMG (L-832).

A memo to request approval for shipment by analogy shall:

- Describe the desired mode of transportation.
- State that the explosive under consideration is similar in composition to, and has hazard characteristics that are less than or equal to, an explosive that has already been classed and approved and therefore is not a new explosive.
- Conclude with a statement that the explosive is at least as safe as the previously approved explosive. Include results from tests conducted for both explosives and any other information that would be helpful in reaching a final decision.

The Hazards Control Department explosives safety technical leader (or designee) reviews the request memo and, if he or she agrees, submits a memo to MMS that includes the following:

- The proposed classification, marking, labeling, and mode of transportation.
- The results of any testing, with a statement that the material does not significantly exceed the previously classed explosive's energy output or

sensitivity to heat or shock and therefore is at least as safe as the previously approved explosive material or device.

- A description of the DOT-specified packaging or approved exemption.
- A statement that there is
 - No significant change in configuration with respect to directional energy output or shaping effect, and an equal or lower length-to-diameter ratio, in comparison with the previously classed item (for devices only).
 - No reduction in the containment characteristics of the outer package, including the container, its latches, banding, and sharp edges (for Hazard Class/Division 1.4 items only).
 - No significant decrease in the integrity of the packing material, baffles or separations, orientation, or separation distance, if more than one item is contained in a package (for Hazard Class/Division 1.4 items only).

The memo from the explosives safety technical leader and the test results are forwarded to the DOE/OAK Hazardous Materials Transportation Program manager by MMS in the manner described in the latest version of the controlling DOE/OAK directive. If all parties are in concurrence, DOE/OAK issues approval memos. Contact MMS Site 300 CMG or the Hazards Control Department explosives safety technical leader for assistance.

A.4 Shipping New Explosives

By definition, a new explosive is not similar to any already-approved explosive and may be shipped only:

- By DOE vehicle to a testing facility.
- By commercial carrier or DOE vehicle to a laboratory for examination prior to classification and approval.

Test criteria for classifying a new explosive material or device that cannot be classified by analogy are contained in the DoD Explosives Hazard Classification Procedures (TB 700-2).

A.4.1 Shipping By DOE Vehicle

A new explosive may be shipped from the place of production to an explosives testing facility (e.g., between the Livermore site and Site 300 or the Nevada Test Site), provided that the new explosive is:

- Not a primary initiating explosive or a forbidden explosive.

- Accompanied by a second person, in addition to the operator of the motor vehicle, who is qualified, by training and experience, to handle the explosive.
- Appropriately described on the shipping papers as a Hazard Class Division 1.1 explosive (i.e., substance or article).
- Packaged, marked, and labeled as required by DOT.

A.4.2 Shipping By Commercial Carrier/DOE Vehicle to a Laboratory for Examination

Before a new explosive can be shipped to a laboratory for examination, the following conditions shall be fulfilled:

- DOE has assigned the new explosive a tentative shipping description and class in writing.
- The sample is packaged as required by DOT, unless otherwise specified in writing by DOE.
- The package is labeled as required by DOT. The words SAMPLE FOR LABORATORY EXAMINATION, the net weight, and the tentative shipping name and identification number are to be marked on the package.

A request for a tentative shipping description and class is made to MMS in the same manner as described in Section A.3. The Hazards Control Department explosives safety technical leader provides an evaluation of the explosive and recommends a tentative shipping class and description before a request is forwarded to DOE/OAK for approval.

A.4.3 DOE Interim Hazard Classification

Interim hazard classification is assigned for a variety of reasons. For example, in a program to acquire a new explosive or explosive device, the need arises to transport an explosive substance or device from the place of manufacture or assembly to a testing facility. Typically, such shipments are made at times during the development cycle when hardware configurations are subject to frequent, significant changes. Furthermore, extensive testing may not be economically justifiable to support one or a few shipments of such developmental configurations.

Consequently, it is frequently necessary to hazard-classify explosive items on an interim basis, with less information than is usually available for production items. Information concerning the procedural requirements for obtaining a DOE interim hazard classification is found in DoD Explosives Hazard Classification Procedures (TB 700-2), Chapter 7.

Appendix B

Lab-Scale Sensitivity and Stability Tests

B.1 Introduction

The lab-scale screening tests described in this appendix are available at LLNL to develop data on the sensitivity and stability of an explosive. When test results are evaluated, an explosive's hazard characteristics for shipping purposes can reasonably be determined. Lab-scale tests are valid only for explosive materials, not for explosive devices.

Lab-scale tests cannot be substituted for the full-scale tests that are prescribed by the DOT regulations for the full and final classification of a new explosive. Full-scale tests are described in DoD TB 700-2 (Explosives Hazard Classification Procedure). Table B-1 lists general comparisons between TB 700-2 (i.e., full-scale) tests and LLNL lab-scale tests.

Table B-1. General comparisons of TB 700-2 tests and LLNL lab-scale tests.

	TB 700-2 tests	LLNL lab-scale tests
Impact sensitivity	Bureau of Explosives impact test. 3.6-kg weight on 10-mg sample. Ten trials each at 9.5- and 24.5-cm drop height determination.	Drop-hammer impact test. 2.5-kg weight on 35-mg sample. Type- 12 tooling (sandpaper). Probability of explosion is 50%.
Thermal stability	75°C/48 hr. 5-cm cube.	120°C/22 hr. 0.25 g. Gas-evolution (CRT) ^a test. DTA ^b at 10°C/min and 2°C/min for 20 mg. Plot of endothermic and exothermic reactions.
Detonation	No. 8 blasting cap on a 5-cm cube (five tests).	None.
Shock sensitivity	NOL ^c card gap, 3.8-cm diameter × 13.9-cm long, confined in steel tube. Three test minimum, 12 test maximum to obtain 50% probability of explosion for gap (shock attenuation).	Small-scale gap test. 12.7-mm diameter × 38.1-mm long confined in Lucite. Minimum tests to determine gap range.
Ignition and unconfined burning	5-cm cube on kerosene-soaked sawdust. Burning time or explosion recorded. Two tests on single cube and one test on four cubes placed end to end.	Same.
Friction sensitivity	BAM ^d friction apparatus.	Same.

^a CRT = Chemical reactivity test.

^b DTA = Differential thermal analysis.

^c NOL = Naval Ordnance Laboratory.

^d BAM = Bundesanstalt für Material Prüfung (Germany's Federal Institute for Materials Research and Testing).

B.2 Evaluation of Test Data

The data obtained from a lab-scale test is evaluated to determine if an explosive has sensitivity or stability characteristics that make the material DOT-forbidden. In addition, lab-scale tests can be used with other information to determine Hazard Class/Division classifications.

B.3 Forbidden Explosives

An explosive may be designated a forbidden explosive because of composition or if the explosive can undergo marked decomposition when subjected to a temperature of 75°C for 48 consecutive hours. (For a list of forbidden explosives, see Section A.2.) The LLNL chemical reactivity test (CRT) is normally run at 120°C for 22 consecutive hours; gas-evolution measurements are also made and analyzed. Nitrate ester-based explosives, because of their volatility, are normally run at 80°C for 22 consecutive hours. Materials that undergo marked decomposition at 75°C can readily be identified by CRT results. Differential thermal analysis (DTA) and the one-dimensional time-to-explosion (ODTX) test can also help in characterizing thermal stability.

An explosive compound or mixture with an impact sensitivity that is less than or equal to that of dry cyclotrimethylene trinitramine (RDX) is to be considered too dangerous for transport in the form in which it was tested, and shall be desensitized before shipment. Any explosive that, during the LLNL drop-hammer test, exhibits an impact sensitivity that is equal to or greater than that of PETN is to be considered an initiating explosive.

B.4 DOT Hazard Class/Division 1.1 or 1.3

Testing and evaluation is required only when a tentative description and class (as DOT Hazard Class/Division 1.3) needs to be assigned to an explosive sample to be sent to a laboratory for examination.

If any of the following tests yields the results indicated, the sample is to be listed as a tentative DOT Hazard Class/Division 1.1 explosive:

- Impact-sensitivity test produces an explosion with a drop-height of 10 cm or more but not more than 25 cm.
- Thermal-stability test results in an explosion, burning, or marked decomposition only at a temperature greater than 75°C.
- Sensitivity-to-shock-initiation test indicates a sensitivity of 70 cards or less.

If all of the following tests yield the results indicated, the sample is to be listed as a tentative DOT Hazard Class/Division 1.3 explosive:

- Impact-sensitivity test does not result in an explosion at a drop-height of 25 cm or less.
- Thermal-stability test does not result in an explosion, burning, or marked decomposition.
- Sensitivity-to-shock-initiation test indicates a sensitivity of less than 70 cards or no reaction at zero cards.

A major test to differentiate between Hazard Class/Division 1.1 and Hazard Class/Division 1.3 explosives in the full-scale examination program (see Table B-1) is shock-sensitivity threshold as determined by the Naval Ordnance Laboratory (NOL) card-gap test. Because no direct correlation exists between the LLNL lab-scale gap test and the NOL test, any recommendation to DOE for a tentative designation other than Hazard Class/ Division 1.1 should include a comparison with similar materials previously classed.

B.5 Impact-Sensitivity Tests

An impact-sensitivity test determines the impact sensitivity of an explosive or other energetic material by impacting the material with a 2.5-kg weight falling freely from a predetermined height. When performing the test, place a 35-mg sample pellet on a piece of sandpaper (Type 12 tooling) or on a roughened steel surface (Type 12B tooling). Summarize the test results as the height (in centimeters) at which the probability of explosion is 50%, as calculated using the standard Bruceton method. An "explosion" is defined as an arbitrarily set level of sound produced by the explosive upon impact. Measure the sound with a transducer set to give a zero reading when the hammer strikes the anvil after falling from the highest point (177 cm). Composition B, which is used as a standard, produces a sound level of 100 when exploded by a hammer dropped from its highest point. Always report the drop-hammer numbers relative to standard explosives, such as HMX, RDX, TNT, or PETN. Table B-2 shows typical data for impact-sensitivity tests.

B.6 Thermal-Stability Tests

Determine the thermal stability of an explosive by performing two separate tests: a standard DTA and a CRT. In the standard DTA, set up two identical containers (one containing the sample and the other containing a standard reference substance) in identical thermal geometries. Arrange the temperature sensors to indicate both the temperature of each container and the difference in temperature between the containers.

Table B-2. Typical data for impact-sensitivity tests.

Plastic-bonded explosives (PBX)	Type 12 tooling drop height (cm)
LX-04	41
LX-07	38
LX-09	32
LX-10	35
LX-11	59
LX-14	53
LX-17	>177
PBX-9404	34
Castable	
Composition B	45
TNT	80
Powders	
HMX	33
RDX	28
PETN	11
	(initiating explosive)

The data are displayed as a DTA thermogram plotting the temperature difference against the temperature of the sample. If the sample has no rapidly changing thermal behavior, the thermogram will be a roughly straight line. Excursions below and above the baseline indicate endothermic or exothermic changes. DTA analysis permits the interpretation of phase change, decomposition, and melting point, from which kinetic and thermal-stability information are also derived.

Sample size is roughly 20 mg. Because the temperature of a thermal event is determined to some extent by the rate of heating, various heating rates are used. The standard rates are 10°C/min and 2°C/min.

In a CRT, heat a sample weighing approximately 0.25 g under a helium blanket at 120°C for 22 hours. Use a two-stage chromatography unit to measure the individual volumes of N₂, NO, CO, N₂O, and CO₂. The CRT is used principally to determine the reactivity of explosives with other materials. Although the standard temperature is 120°C, explosives are frequently investigated at other temperatures and for other durations. Table B-3 lists typical data for DTA and CRT.

Table B-3. Typical data for DTA and CRT.

PBXs	Gas (cm ³) evolved from 0.25 g sample
LX-04	0.01–0.04
LX-07	0.01–0.04
LX-09	0.03–0.07
LX-10	0.02–0.06
LX-11	0.01–0.04
LX-14	0.02
LX-17	0.02
PBX-9404	0.36–0.40
Castable	
Comp B	0.05
TNT	0.0–0.01
Powders	
HMX	0.01
RDX	0.02
PETN	0.10–0.14

DTA—Graphic plot showing endothermic and exothermic reactions. Temperatures of onset of first exotherm can be identified.

CRT—Gas (cm³) evolved from 0.25 g after 22 hr/120°C.

B.7 Sensitivity-to-Shock-Initiation Tests

The shock-initiation sensitivity of an explosive is measured by a sensitivity-to-shock-initiation test (also referred to as a gap test). In a gap test, a new explosive is subjected to a shock wave generated from a standard donor material and attenuated through a thickness of inert spacer materials. Express the data as the number of cards, or the thickness of spacer material, that will attenuate the shock enough to decrease the probability of detonation to 50%. In general, the larger the gap is, the more shock-sensitive is the explosive. The actual number, however, depends on test size and geometry (as well as on the particular lot, method of preparation, and density of the explosive) and is therefore only an indicator of relative shock sensitivity. LLNL has previously used the LANL-generated small-scale gap test. In this test, the explosive samples are pellets 12.7 mm in diameter and 38.1 mm long. The gap spacers are brass shims in 0.254-mm increments. The donors are modified SE-1 detonators with PBX-9407 pellets 7.62 mm in diameter and 5.26 mm long. Detonation of the samples is ascertained by a dent produced in a 152-mm-square, 102-mm-thick, steel witness plate. Values are expressed in millimeters or in mils of brass. Table B-4 shows typical data for sensitivity-to-shock-initiation tests.

Table B-4. Typical data for shock-sensitivity test.

PBXs	Gap thickness for cast or pressed pellets (mm)
LX-04	1.0–1.5
LX-07	1.8– 2.3
LX-09	1.9–2.7
LX-10	2.0–2.5
LX-11	1.1–1.7
LX-14	1.5–2.0
LX-17	1.3–2.3
PBX-9404	2.2–2.7
Castable	
Composition B	1.1–1.4
TNT	0.2–0.4
Pressed powder	
RDX	4.8–5.6 (shipped wet)
PETN	4.8–5.6 (shipped wet)
TATB	0.05–0.41 (shipped dry)

Appendix C

Offsite Emergency Plan

Drivers transporting Class/Division 1.1, 1.2, or 1.3 explosives offsite are to follow the following emergency procedures in the event of an accident or delay.

C.1 Emergencies

In the event of a fire or accident involving a vehicle carrying explosives, notify the nearest police officer, or call 911 and the LLNL emergency response number [(925) 447-6880].

In the event of a delay in delivering explosives, call LLNL CMG [(925) 423-5334] or the Traffic Office [(925) 422-7492].

C.2 Nature of Explosives

Explosives can explode and throw fragments 1600 meters (1 mile) or more if fire reaches the cargo. Fire may produce irritating, corrosive, and/or toxic gases.

Division 1.1— Explosives that have a mass-explosion hazard. A mass explosion is one that affects almost the entire load instantaneously.

Division 1.2— Explosives that pose a projection hazard but not a mass-explosion hazard.

Division 1.3—Explosives that pose a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass-explosion hazard.

C.3 General Precautions

- Protect the public from the hazards of the cargo.
- Do not allow smoking or the use of matches or lighters in or near the vehicle.
- Do not move the vehicle following an incident if doing so would spread contamination.
- Isolate a leak area immediately.
- Do not clean up or dispose of explosives, except under the direction of a specialist.
- Avoid tunnels, heavily populated areas, and bridges.

- Avoid unnecessary delays.
- Do not park within 5 ft of the traveled portion of a road.
- Stop at all railroad crossings when transporting a placarded load.
- Do not exceed posted speed limits or the maximum allowable speed for explosives shipments (55 mph).
- Keep at least 300 ft from other vehicles loaded with explosives.
- Use designated routes. Select approved, safe parking places.
- Do not permit unauthorized persons to ride on vehicles.
- When transporting blasting caps, do not operate radio transmitters.
- Stay upwind.

C.4 Specific Procedures

C.4.1 Vehicle Fire or Accident with Fire

- Take prompt action to extinguish an electrical fire in the motor compartment if such action can be taken with minimum risk.
- If a fire is outside the motor compartment, involves fuel or tires, or is threatening the explosives cargo, evacuate all personnel to the distance specified by written procedures or the distance stated below. If you do not know the applicable distance, evacuate to a distance of 2500 feet. **DO NOT ATTEMPT TO EXTINGUISH THIS TYPE OF FIRE.**

Class/Division 1.1	2500 feet
Class/Division 1.2	2500 feet
Class/Division 1.3	600 feet

- Keep shipping papers with you.
- Stop all traffic at the above-stated distances.
- Give warning of the danger of explosion to habitants in the vicinity (i.e., at least within the applicable distance specified above) and other users of the road.
- Stay upwind.
- Give all available information concerning the weight and type of explosives to emergency response personnel.

C.4.2 Vehicle Accident with Spilled Explosives and No Fire

- Shut off the ignition and the quick-disconnect switch.
- Set the brake and block the vehicle to prevent movement.
- Place red emergency reflectors as warning devices.
- Do not smoke or use highway flares within 50 feet of vehicle or explosives (i.e., keep all sources of fire away).
- Do not leave the vehicle unattended.
- Prevent people and vehicles from moving through spilled explosives.
- Prevent individuals from congregating in the vicinity (i.e., keep people away).
- Give aid and assistance to injured personnel.
- Avoid rough handling of explosives and containers of explosives.
- Do not attempt to untangle vehicles until explosives have been removed.
- Gather spilled explosives and place in an isolated location at least 200 feet away from people and vehicles, and identify the explosives with a sign or by any other available method.
- If the damaged vehicle creates a hazardous situation, move the explosives from the vehicle to an isolated location at least 200 feet away from people and vehicles, and identify the explosives with a sign or by any other available method.
- Avoid direct skin contact or inhalation of explosives materials.

C.4.3 Vehicle Accident with No Fire and No Spill

- Shut off the ignition and the quick-disconnect switch.
- Set the brake and block the vehicle to prevent movement.
- Place red emergency reflectors as warning devices.
- Do not smoke or use highway flares within 50 feet of vehicle or explosives (i.e., keep all sources of fire away).
- Do not leave the vehicle unattended.
- Prevent individuals from congregating in the vicinity (i.e., keep people away).
- Give aid and assistance to injured personnel.

- Avoid rough handling of explosives and containers of explosives.
- Do not attempt to untangle vehicles until explosives have been removed.
- Before repairs are performed, contact the ES&H Team explosives safety engineer to determine if explosives should be removed from the vehicle.
- If the damaged vehicle creates a hazardous situation, move the explosives from the vehicle to an isolated location at least 200 feet away from people and vehicles, and identify the explosives with a sign or by any other available method.
- Have the explosives transferred to another LLNL explosives vehicle for delivery to the destination.

C.4.4 Vehicle Breakdown

- Park the vehicle as far as possible (but no less than 5 feet) from the roadway.
- Set the brake and block the vehicle to prevent movement.
- Turn on the vehicle's hazard warning flashers.
- Place red emergency reflectors as warning devices.
- Do not smoke or use highway flares within 50 feet of the vehicle or explosives (i.e., keep all sources of fire away).
- Do not attempt to tow a loaded vehicle.
- Do not leave the vehicle unattended.
- Before repairs are performed, contact the ES&H Team explosives safety engineer to determine if the explosives should be removed from the vehicle.
- Place explosives removed from the vehicle in an isolated location at least 200 feet away from people and vehicles, and identify the explosives with a sign or by any other available method, or have the explosives transferred to another LLNL explosives vehicle.

Appendix E

LLNL Commercial Motor Vehicle Inspection Report

LLNL Commercial Motor Vehicle Inspection Report

**Must Be In Vehicle At All Times When Operating Vehicle
(Check any defective item and give details under remarks)**

LLNL Organization _____ Date _____ Pre-Trip
 Lic # Tractor/Truck _____ Trailer _____ Post-Trip
 Dolly _____ Trailer _____ Odometer Reading _____

TRACTOR/TRUCK/TAXI: (Required for all CMV's as Applicable)

<input type="checkbox"/> Brakes: <input type="checkbox"/> Service <input type="checkbox"/> Parking <input type="checkbox"/> Trailer <input type="checkbox"/> Coupling Devices <input type="checkbox"/> Chock Block <input type="checkbox"/> Electrical System (wires & battery) <input type="checkbox"/> Engine <input type="checkbox"/> Fuel Tanks & Lines	<input type="checkbox"/> Horn <input type="checkbox"/> Lighting Devices & Reflectors <input type="checkbox"/> Rear Vision Mirrors <input type="checkbox"/> Exhaust System <input type="checkbox"/> Placards (if required) <input type="checkbox"/> Emergency Equipment <input type="checkbox"/> Red Emergency Reflectors <input type="checkbox"/> Fire Extinguisher <input type="checkbox"/> Spare Bulbs & Fuses	<input type="checkbox"/> Suspension System <input type="checkbox"/> Steering Mechanism <input type="checkbox"/> Tires <input type="checkbox"/> Wheels & Rims <input type="checkbox"/> W/S Wipers & Defroster <input type="checkbox"/> Cargo Securing Devices <input type="checkbox"/> Other (Explain below)
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

TRAILER/DOLLY:

EXPLOSIVES VEHICLES:

TAXI/BUS:

<input type="checkbox"/> Brake & Electrical Connections <input type="checkbox"/> Brakes <input type="checkbox"/> Coupling Devices & Chains <input type="checkbox"/> Trailer Landing Gear <input type="checkbox"/> Lights & Reflectors	<input type="checkbox"/> Maintenance Inspection within 90 Days <input type="checkbox"/> Battery Quick-Disconnect Switch <input type="checkbox"/> Two-way Radio/Cell Phone <input type="checkbox"/> No Sharp Projections in Cargo Area <input type="checkbox"/> Two Fire Extinguishers	<input type="checkbox"/> Emergency Doors/Lights <input type="checkbox"/> Wheel Chair Lift
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REMARKS:

CONDITION OF THE ABOVE VEHICLE(S) IS SATISFACTORY

Driver Making Report _____ (Signature)

Mechanic Making Repairs _____ (Signature)

Accepting Driver _____ (Signature)

Distribution: HMPTS Assurance Office - original File - yellow Motor Pool - pink
LL6335 (Rev. 10/97) 7600-71300

Appendix G

Motor Vehicle Inspection Form

MOTOR VEHICLE INSPECTION
(Transporting Hazardous Material)

GBL. NO.	ORIGIN	DESTINATION
NAME OF CARRIER		
NAME OF DRIVER		
DATE AND HOUR		
INSTALLATION/ACTIVITY		
DRIVER'S STATE PERMIT NO.		
MEDICAL EXAMINER'S CERTIFICATE AND DATE		

VEHICLE			
TYPE OF VEHICLE <input type="checkbox"/> TRUCK <input type="checkbox"/> TRUCK AND FULL TRAILER <input type="checkbox"/> TRACTOR AND DOUBLE TRAILERS <input type="checkbox"/> TRACTOR AND CLOSED SEMITRAILER <input type="checkbox"/> TRACTOR AND FLATBED TRAILER	TRUCK NUMBER ORIGIN DESTINATION	TRAILER(S) NUMBER ORIGIN DESTINATION	SLEEPER CAB <input type="checkbox"/> YES <input type="checkbox"/> NO VALID LEASE <input type="checkbox"/> YES <input type="checkbox"/> NO I.C.C. NUMBER

*NOTE: All of the following items shall be checked on empty equipment prior to loading.
Items with an asterisk (*) shall be checked on incoming loaded equipment.*

ITEM NO.	CHECK APPROPRIATE COLUMN <i>(See reverse side for explanatory note)</i>	ORIGIN		DESTINATION		REMARKS <i>(Explain unsatisfactory items. Attach separate sheet, if necessary.)</i>
		SAT	UNSAT	SAT	UNSAT	
1.	ENGINE, BODY, CAB, AND CHASSIS CLEAN					
2.	STEERING MECHANISM					
3.	HORN OPERATIVE					
4.	WINDSHIELD AND WIPERS					
5.	SPARE ELECTRIC FUSES AVAILABLE					
6.	REAR VIEW MIRRORS INSTALLED					
7.	HIGHWAY WARNING EQUIPMENT					
* 8.	FULL FIRE EXTINGUISHER INSTALLED					
9.	LIGHTS AND REFLECTORS OPERATIVE					
10.	EXHAUST SYSTEM					
* 11.	LIQUID PETROLEUM GAS POWERED VEHICLES					
* 12.	FUEL TANK, LINE, AND INLET					
13.	COUPLING DEVICES—KINGPIN LOCK					
* 14.	ALL BRAKES OPERATIVE					
* 15.	LANDING GEAR ASSEMBLY OPERATIVE					
16.	SPRINGS AND ASSOCIATED PARTS					
* 17.	TIRES					
18.	CARGO SPACE					
* 19.	ELECTRIC WIRING					
* 20.	TAILGATE AND DOORS SECURED					
* 21.	FIRE- AND WATER-RESISTANT TARPULIN					
22.	ANY OTHER DEFECTS <i>(Specify)</i>					
<input type="checkbox"/> APPROVED <i>(If rejected, give reasons on reverse under "Remarks." Equipment shall be approved if deficiencies are corrected prior to loading.)</i>		SIGNATURE <i>(of Inspector)</i>		SIGNATURE <i>(of Inspector)</i>		
<input type="checkbox"/> REJECTED		ORIGIN		DESTINATION		

ITEMS TO BE CHECKED PRIOR TO RELEASE OF LOADED VEHICLE		ORIGIN	DESTINATION
23.	MIXTURES OF MATERIAL PROHIBITED BY DOT REGS. ARE NOT LOADED ONTO THIS VEHICLE		
* 24.	LOAD IS SECURED TO PREVENT MOVEMENT		
25.	WEIGHT IS PROPERLY DISTRIBUTED AND VEHICLE IS NOT OVERWEIGHT		
* 26.	SEAL(S) APPLIED TO CLOSED VEHICLE; FIRE- AND WATER-RESISTANT TARPULIN APPLIED ON OPEN VEHICLE		
* 27.	SPECIAL INSTRUCTIONS (LL-6169) FURNISHED TO DRIVER		
* 28.	COPY OF VEHICLE INSPECTION (LL-6170) FURNISHED TO DRIVER		
* 29.	PROPER PLACARDS APPLIED		
* 30.	SHIPMENT MADE UNDER DOT EXCEPTION 868		
Signature (of Inspector) Origin		Signature (of Driver) Origin	
Signature (of Inspector) Destination		Signature (of Driver) Destination	

LL 6170