Semiconductor Operations

Texas Instruments

Texas Instruments Equipment Crating Manual

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TI Information - Selective Disclosure

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1–Introduction

1.1 Scope

This manual defines the minimum general requirements for the preparation, crating of equipment which will be shipped to any Texas Instruments Incorporated facility.

1.2 Responsibility

It will be the responsibility of Texas Instruments Incorporated and its subsidiaries (TI) to define a preferred crating process, and monitor for supplier compliance to Texas Instruments Incorporated requirements. It will be the responsibility of the supplier to:

1. Ensure their crating, rigging process and materials comply with all applicable laws and regulations that may supersede these requirements.
2. Ensure shipments are economically packed and palletized.
3. Ensure shipment containers and contents are suitably packaged to guard from equipment damages.
4. Ensure export shipments are crated as defined by this manual.

1.3 Application

Adherence to the requirements of this manual is necessary to minimize shipping damage, reduce costs, and streamline TI's receiving process.

Special packing specifications called out on a request or purchase order (PO) will take precedence over this specification if they are in conflict.

1.4 Communication

All supplier's questions, communications, and exception requests are to be coordinated through the TI Category Procurement personnel (buyers).

1.5 Compliance

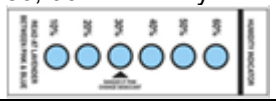
Compliance to the TI crating and rigging requirements, safety guidelines, and legal regulations contained in this manual will be enforced as a condition of purchase per TI purchase contracts. TI reserves the right to:

1. Reject and return any shipments that are improperly crated or identified.
2. Charge the supplier for costs of labor and materials for any re-crating resulting from non-compliance with this manual or other direction referenced on the PO.
3. Remove from its list of approved supplier sources any supplier that, after notice, repeatedly fails to comply with Texas Instruments Inc. packing requirements.
4. Any shipper requiring deviation from requirements contained in this specification must receive written authorization from the TI Category Procurement personnel prior to shipment.

2–Crating Requirements

2.1 MATERIALS

Many materials associated with wood packaging and crating operations are required to facilitate compliance to the requirements herein and are integral to uniform appearance and necessary performance. The most common materials are listed in this section.

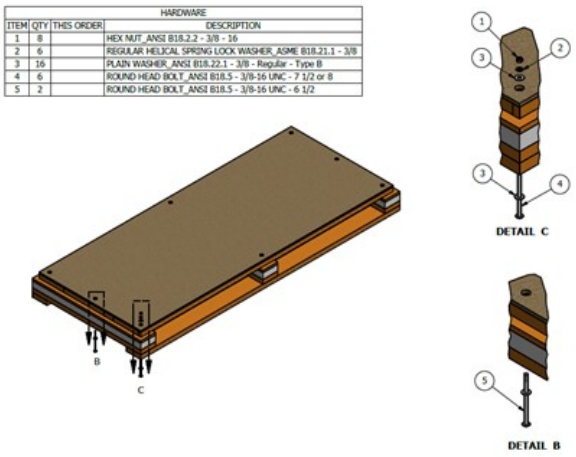
Item	Material	Requirement
1	**Wood packing material**	All wood packaging material, regardless of species, must be heat treated to meet ISPM15 standards.
2	**Lumber**	Lumber species/groups tc \l2 "2.2.1 Lumber species/groups are to be Douglas fir or Hem/fir, Standard or better based on U.S. Western Lumber Grading Rules, or equivalent strength softwoods available to the crating location. Cleat stock for plywood boxes are to be Ponderosa Pine/Sugar Pine or White Woods, #3 common or better, or local equivalent. Species listed as Group II woods are preferred.
3	**Plywood**	Plywood grades are tc \l2 "2.2.2 Plywood grades are to be a minimum 3 ply (5 ply or more for 1/2 inch and larger plywood) C-D Exterior, C-D Plugged, or “Sanded Shop” (Sanded Shop-Cutting Panel) with exterior glue in accordance with U.S. Commercial Standard PS-1. Floating Decks may be “Underlayment” quality when appropriate
4	**Moisture Vapor barrier bag**	Moisture vapor barrier tc \l2 "2.2.6 Moisture vapor barrier material-flexible, supported, heat sealable: Aluminum foil laminate with a moisture vapor transmission rate of less than 0.02 grams/100 square inches/°F/24 hours.
5	**Steel Strapping**	tc \l2 "2.2.9 Steel strapping: 0.75 x 0.020 inches (19 x 0.5 millimeters) commercial steel strapping (minimum size).
6	**Shock indicator/ Tilt watch/Tracking Devices**	ShockWatch® 1 impact non resettable indicators P/N #48000K (25g). Tilt Watch and Tracking Devices
7	**Marine wrap/ Polytarp**	Out of gauge crates must be completely covered by reinforced industrial strength poly tarp (aka marine wrap) Tarps mil thickness should be 18 mils or higher. In gauge crates must have a poly tarp cap
8	**Humidity indicator**	Humidity indicator: 6 dot indicator monitoring levels 10, 20, 30, 40, 50, 60% humidity. Model S-8028. 
9	**Cushion wrapping material**	tc \l2 "2.2.7 Cushion wrapping material: 1. Polyethylene foam sheeting, 0.125 - 0.25 inches (3 - 6 millimeters) thick unless otherwise specified. 2. Polyethylene bubble cushioning unless otherwise specified. (Loose fill expanded polystyrene (EPS) or paper products are not permitted)
10	**Cushion Base**	tc \l2 "2.2.4 Cushion foam types: 1. Polyurethane (urafoam) 1.2-2.2 pounds per cubic foot 2. Polyethylene (ethafoam) 1.0-2.0 pounds per cubic foot 3. Polyethylene (ethafoam) 2.0-4.0 pounds per cubic foot 4. Polyethylene (ethafoam) 4.0-6.0 pounds per cubic foot

11	**Equipment weight < 2500kgs** **Equipment weight > 2500kgs**	1. 3/8" (0.95cm) thick (minimum) plywood for the sides and covers 2. 1" x 4" (2.5cm x 10cm) wood for cleats 3. ½" (1.25cm) thick plywood for decking 4. 2" (5cm) (nominal thickness) wood slabs for the crate's base 1. 1/2" (1.25cm) thick (minimum) plywood for the sides and covers 2. 2" x 4" (5cm x 10cm) wood for cleats 3. 1" (2.5cm) thick plywood for flooring 4. 3" (7.5cm) (nominal thickness) wood slabs for the crate's base

Note 1: All component materials must be lag bolted, or screwed together (do not use glue or nails to close the crates).
Note 2: All component materials must be lag bolted, or screwed together (do not use glue or nails to close the crates).

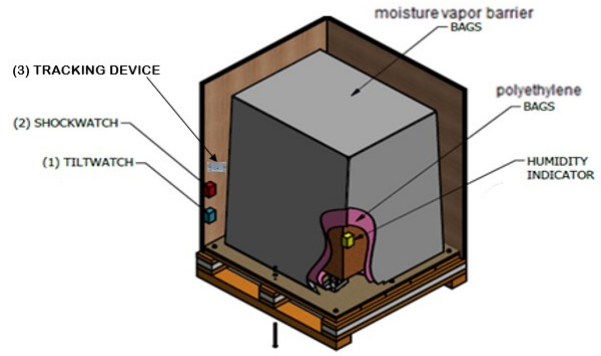
2.2 General Requirements for Equipment

a. Maximum outside crating dimensions for airfreight is 118 inches (300cm) tall and 97 inches (246cm) wide. Anything larger than these dimensions are not recommended for shipment by air or by surface transportation.



- 4- way entry base
- Equipment main body, main body, or sensitive must have a 2in (5cm) floating base with #4 ethylene foam material (of sufficient density to support the weight, ref 6.3.3) either in the deck or in the skid, and if at all possible, the foot/base of the equipment should be bolted against the crate's base.
- support equipment such as pumps, chillers, power boxes, etc. may use a non-floating base

The TI logistics team are the only people who can authorize which equipment is less sensitive (guidance will be based on TI engineering). Authorization must be received in writing.

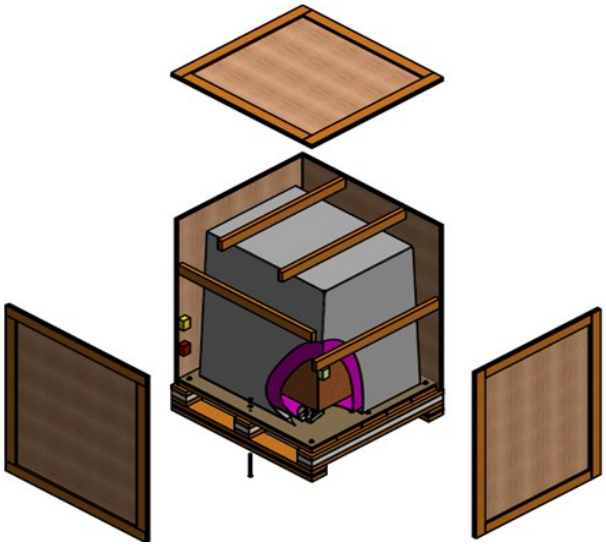


Crate Device Requirement

MARKING	LOCATION	QUANTITY
TILT WATCH	Outside end wall of crate	1
SHOCK WATCH	Floating dock or outside walls if no floating dock	1
TRACKING DEVICE	Attach to the exterior of the crate	1

Equipment should be wrapped and bagged in the following order:

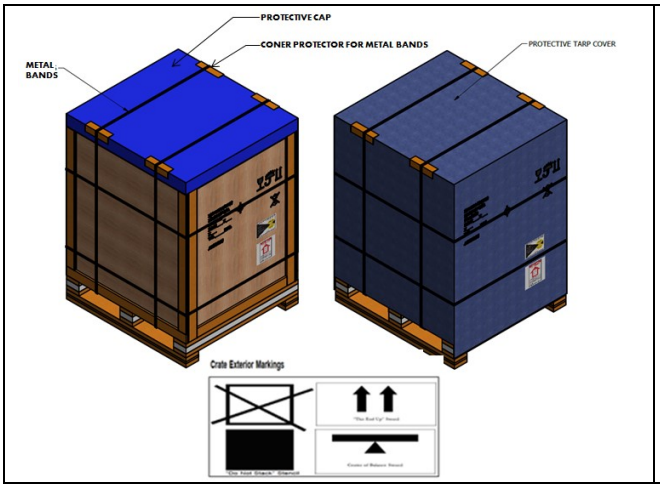
1. All sharp edges on the equipment and all points on the bottom of the tool that come in contact with the base of the crate should be protected with 1/4" polyethylene sheets. Bubble wrap and foam can be used on sharp edges on the equipment but not under the equipment.
2. Stretchwrap the equipment.
3. Place Humidity Indicator on equipment.
4. Place desiccant around the bottom of the equipment. Desiccant requirements section 2.3
5. Seal equipment in polyethylene bag.
6. Seal Barrier bag. Use a Mil-B-13 1H type 1, Class III (or TI approved equivalent) moisture vapor barrier bag material. All barrier bags should have the seams on the side of the equipment, not on the top of the equipment.
7. Place Tiltwatch and Shockwatch outside of the crate
8. Place Tracking Device on the exterior of the crate



- Crates must be reinforced with additional cleating and/or joists with foam padding against the equipment in all corners to prevent equipment damage from movement, and crate compression from shipping straps and metal banding.
- Equipment on casters must be blocked up off the casters

****TI procedure uses blocking/bracing and metal banding to secure crates inside the ocean container. Crates could collapse under tension from banding and straps if not properly reinforced****

1. Each crate shall be clearly marked with its weight, center of balance, tool ID and destination address.
2. The packing list shall specify what piece of equipment is in each container.
3. The following markings will be applied by vinyl labels:
    a. “Delicate Instruments” labels
    b. “Do Not Drop” labels
    c. Tiltwatch® and Tiltwatch® Companion labels
    d. Shockwatch® and Shockwatch® Companion labels
    e. Tracking Device® and Tracking Device® Companion labels
4. The following markings will be applied by stencil (Ex: images below)
    a. Up Arrows
    b. Center of Balance
    c. To / From
    d. PO or MISTY (tool identification) number
    e. Box ___ of ___, Weights, Dimensions, 1/2” (1.25cm) high letters minimum



- All crates must be tarped prior to movement from the building / original location for protection.
- Equipment transported on flat rack ocean containers requires secondary tarps.
- When crating equipment over 48" (122cm) tall, the shortest dimension (length or width) of the base should not be less than half the height of the equipment to ensure stability of the crate in transit.
- All crates are to be banded with ¾" (2cm) steel banding after closure (minimum 1 around vertically and 1 around horizontally).

Notes

1. All support hardware or separate components (e.g., cables, spare parts) shall be packaged in separate containers from the main unit.
2. Equipment should always be transported in air ride vans when traveling over land >50km
3. Crating Compliance Check list will be completed with every tool shipment and attached to the inside of the crate
4. Contact TI Procurement (Buyer) for exceptions requested to TI crating requirements.

2.3 Desiccant requirements

1. All barrier bagged equipment must have activated desiccant absorbent inserted between the product bagging and the moisture vapor barrier material. Distribute desiccant evenly around the equipment.
2. Do not leave desiccant exposed to open air for more than 15 minutes prior to sealing the barrier bag.
3. All desiccant containers must remain closed and sealed air-tight when not in use.

REQUIRED AMOUNT OF DESICCANT FOR STORAGE 6 MONTHS OR LESS				
Volume Cubic Feet	**Volume Cubic Meters**	**Number of 2 unit bags**	**Number of 8 unit bags**	**Number of 16 unit bags**
1 - 25	.03 - .71	35.00	9.00	5.00
26 - 50	.072 - 1.42	70.00	18.00	9.00
51 - 75	1.43 - 2.12	105.00	27.00	14.00
76 - 104	2.13 - 2.95	146.00	37.00	19.00
105 or greater	2.96 or greater	160.00	40.00	20.00

* If storage is greater than six months then multiply required number of desiccant units by 2*

4. Calculate the air space volume inside the barrier bag using the following procedure:

    a. Total cubic feet or cubic meters of equipment x .15 = air space volume inside the barrier bag.

2.4 Workmanship

All crates and components shall be free from imperfections, which may affect their utility, result in damage to the contents, or may cause injury.

1. Crates shall be free of cracked, damaged, or broken fasteners.

2. Nails shall not be bent or exposed and shall be driven so as not to cause the wood to split.
3. Crates shall not have broken or split runners or skids.
4. Plywood shall be cut square and at no point shall the edge of the plywood extend more than 1/16 inch over or under the panel size as determined by the cleat assembly.
5. Adjacent boards in a panel shall be matched in thickness within a maximum tolerance of 1/16 inch.
6. All components shall be adequately blocked and braced to prevent shifting or movement during handling and transportation. Special brackets will be required to brace system mainframes and some miscellaneous components.
7. Place heavier items on the bottom of the container and the lighter or more fragile items on the top. ***Do not overpack the crates.***
8. Any sharp corners should be cushioned to protect the vapor barrier bag from tearing.
9. Lightly stretch wrap the moisture barrier bagged units to evacuate excess air prior to final sealing. Use at least two layers, taking care not to apply excessive pressure to sharp edges that could puncture the moisture barrier bag.

2.5 Digital Tracking Devices

1. Tracking Devices will be provided by TI's chosen provider at no additional cost to shipper/crater.
2. Shipper/crater shall be responsible for:
   a. Ordering of tracking device
   b. Attaching tracking device to main body or highest value crate.
      i. Devices shall be attached to the exterior of the crate using the same guidelines for shock and tilt watches
      ii. Devices shall be attached using the supplied brackets and in accordance with the provided instructions.
   c. Ensuring tracking devices are fully charged and activated prior to shipment departure
      i. Instructions for these actions will be provided by TI's chosen provider.
   d. Completion of all applicable export permits and approvals

3. Tracking devices are required on all semiconductor manufacturing equipment with a value > $250K and travelling more than 50km or on any other shipment if requested by TI.
   a. Value shall be determined by total shipment value.
      Example: Shipment of a single tool >$250K shall require one tracking device
      Example: Shipment of three tools with individual values of $100K shall require one tracking device.
4. Digital Tracking devices details are subject to change without notice.
   a. System Loco HGD4

2.6 Damages Upon Receipt

1. TI will immediately or as soon as practicable, document any internal damage found upon uncrating of equipment, and notify all interested parties accordingly.
2. Should internal or external damage occur in transit resulting from damage due to supplier's improper crating, TI may withhold payment equal to the total cost of tool installation until the installation is completed, and tool is proven to be, or not to be, production worthy.
   a) At that time any additional installation costs resulting from damage due to supplier's improper crating shall be determined per qualified engineering.
   b) If the tool is deemed production worthy, TI will release withheld funds equal to the amount of standard installation costs. All additional installation and/or inspection costs resulting from damage due to supplier's improper crating shall be borne by the supplier.

2.7 Crated Equipment "Factory Loaded" by Shipper into Ocean Container

1. NEVER double stack crates
2. Each crate loaded into an ocean freight container will be fully secured to protect the crate and its contents against in transit container movement in accordance with standard blocking and bracing procedures.
3. Cargo loaded onto FLAT RACK OR OPEN TOP containers must be completely covered by reinforced industrial strength poly tarp (aka marine wrap) and secured so that the cargo is completely protected against the natural elements. Tarps mil thickness should be 18 mils or higher. There can be no areas where the cargo is exposed in any way such as holes in the wrapping material or uncovered areas no matter how small. A careful visual inspection to ensure complete wrapping protection must be made.
4. Digital photographs of each capital equipment shipment must be taken after the capital equipment is first loaded into the container at origin
5. "Factory Loaded" Ocean Container Transport
    a. Semi-conductor manufacturing equipment (wafer fab and test) CANNOT be moved by rail without prior TI Logistics approval.
    b. All road transportation of semi-conductor manufacturing equipment (wafer fab and test) in excess of 50 kilometers travel distance will be via road transport equipment with AIR RIDE SUSPENSION only. This applies whether or not the capital equipment is containerized at that point in time. This criteria includes drayage to origin port and transport from destination port to final delivery address.

3–Crating Compliance Checklist

PO# _____ Supplier _____ Equipment Manufacturer_____

This document to be printed and included with each tool crate shipped. Verify and check the critical steps required to protect sensitive equipment from the extremes of transportation and weather in transit.

Cushion Base:
- **Density of foam acceptable to support tool** _____
- **Thickness of Foam on base (5cm preferred)** _____

Equipment secured to bases
- **Bolted or** _____
- **Blocked & Braced** _____

Cross bracing:
- **Cross bracing at crate top** _____

Barrier Bag: _____
- **Sharp edges cushioned to protect barrier bag** _____
- **Barrier bag holds vacuum** _____
- **Vapor barrier bag is wrapped with stretch wrap** _____

Humidity Indicator placed on equipment _____
(Model S-8028: Levels 10, 20, 30, 40, 50, 60%)

Desiccant:
- **Number of desiccant bags** _____
- **Desiccant units for each bag** _____

Shock Watch:
**should be placed 18"-24" from the floor, close to a corner. One set of ShockWatch per crate on opposing corners. **
- **25G rating of shock watch:** _____
- **Tilt watch** _____

Tracking Device: _____

Each crate clearly marked with weight, center of balance, equipment ID and destination address. _____

Final Covering
- **Protective vinyl cap installed** _____
- **Equipment completely tarped** _____

- Please reference current version of TI Packaging document # 6512960 at https://wpl.ext.ti.com/itc/itc.htm for full spec requirements.
- EXCEPTION requests: Contact TI Procurement (Buyer) for exceptions requested to TI requirements.

COMMENT:

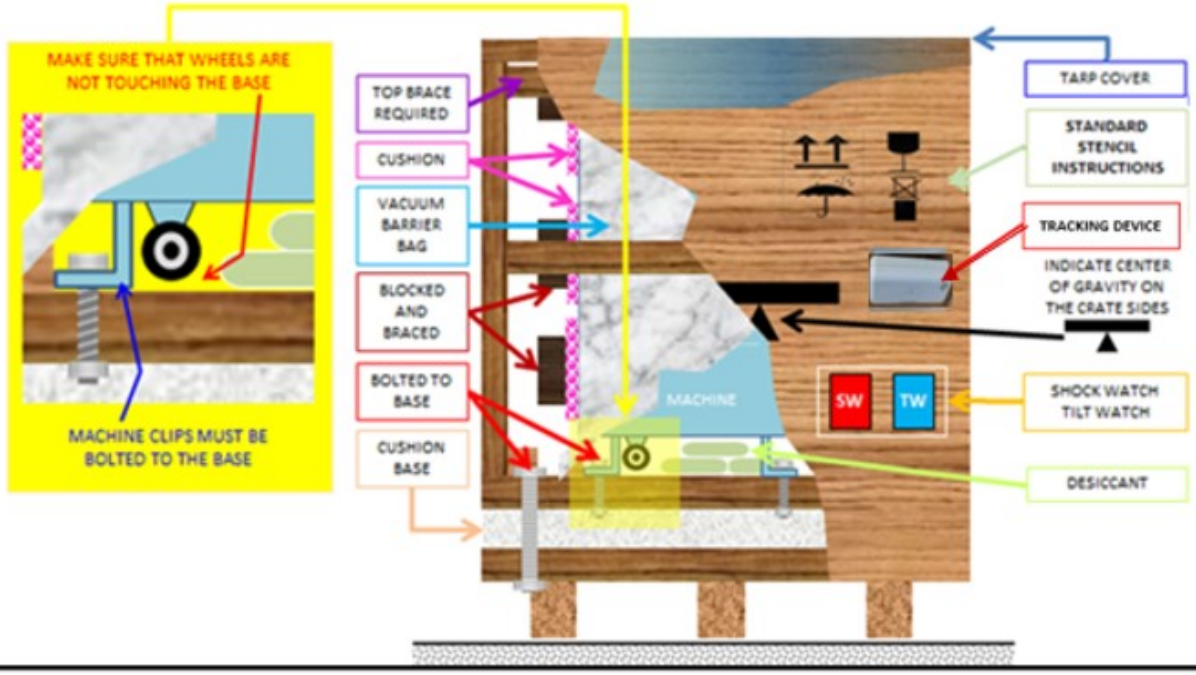
ORIGIN:

Inspected By _____ **Date of Crating** _____

BASIC CRATING REQUIREMENTS

EQUIPMENT CRATING

BARRIER BAG: Protects the machine from Humidity. Must hold vacuum. Make sure sharp edges are cushioned to protect the barrier bag.
BLOCK & BRACE (top and middle): Protects the machine from tipping inside crate while in transit. Top bracing (cross bracing) is required.
BOLTED TO BASE: Protects the machine from dislodgement while in transit. Preferably using the machine clips to anchor to the base of the crate.
CUSHION BASE: Protects the machine from strong vibrations while in transit. Must be at least 5cm thick; or dense enough to support the tool weight.
DESICCANT: Collects moisture and reduces humidity inside the vacuum sealed barrier bag.
SHOCK WATCH: Provides information if crate was subjected beyond G force rating. Must be 18~24 inches from floor toward a corner, 1 set SW required.
TILT WATCH: Provides information if crate was subjected beyond certain angle limit to gravity
STENCIL INSTRUCTIONS: Provides standard information on the proper care and handling of the crate
TARP COVER: To protect the crate from rain/water. This ensures that the crate will not soak in water from the top.
CENTER OF GRAVITY: This provides a guide to the forklift/crane operator of the estimate centers of gravity inside the crate. Required on all sides of crate.
Tracking Device – Provide real time visibility of TI shipments



4–Hazmat - Battery shipments

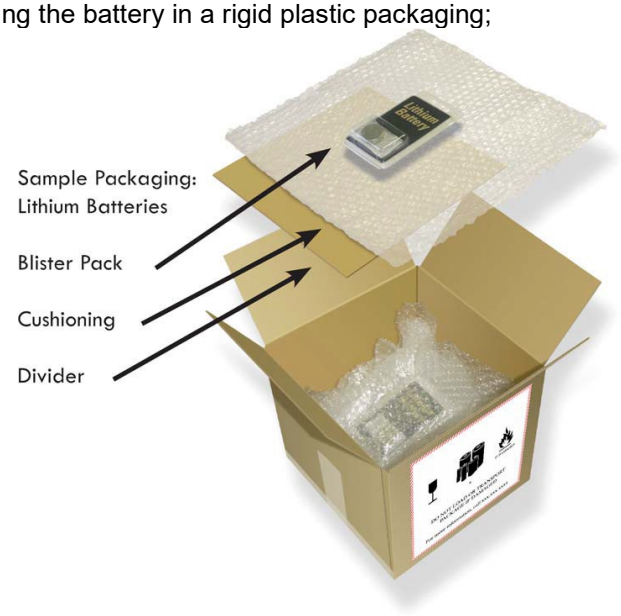
GLOBAL – Shipments containing LITHIUM ION BATTERIES

- MSDS (Material Safety Data Sheet), is required and can be obtained from the manufacturer.
- Remove battery from any device, example; laptop or cell phone

Packaging of shipment

Batteries must be individually package in non-conductive material such as bubble wrap or plastic bag

- Securely attaching covers of sufficient strength to protect the terminals
- Packaging the battery in a rigid plastic packaging;



- Separating or packing batteries in a manner to prevent contact with other batteries, devices or conductive materials (e.g., metal) in the packagings
- Ensuring exposed terminals or connectors are protected with non-conductive caps, non-conductive tape, or by other appropriate means.
- If not impact resistant, the outer packaging should not be used as the sole means of protecting the battery terminals from damage or short-circuiting.
- Batteries should be securely cushioned and packed to prevent shifting which could loosen terminal caps or
- Re-orient the terminals to produce short circuits.

5– Country Specific Requirements

ASIA (all Asia requirements include those of JAPAN)
To expedite customs clearance and meet all government requirements, the following is required on your export documentation:

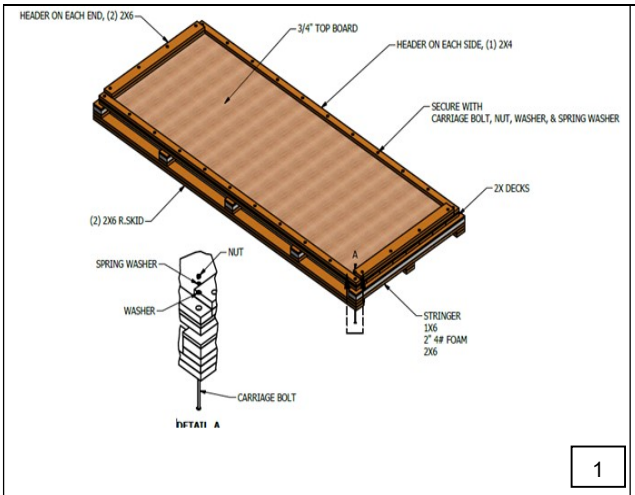
Commercial Invoice (in English) containing:
- Shipper's name and address
- Ship to address (and preferably name and telephone # for the person receiving the shipment)
- TI PO number or other reference number on an airway bill (if applicable) and in the invoice as well
- Concise detailed description of all products shipped. Use terms that a layman can understand, such as, Analog/digital Integrated Circuit or Bipolar Digital Integrated Circuit (not I.C. or Semiconductor); or Computer Board, Test Board, or Burn-in Board (not just Board)
- All products shipped must be indicated on the invoice, this includes any samples sent free of charge (FOC), samples MUST have a "fair market value" for customs purpose only
- Include part number, quantities, country of origin/manufacture
- In the packing list, include in the description (device name, etc.), quantities, identification numbers/markings for all products shipped in box/crates
- Value for all products shipped (price paid or payable) in U.S. dollars
- List terms of sale or trade (e.g., Ex-Factory, FOB destination, etc.)
- Exporting Country Harmonized Tariff Schedule (HTS) for each item shipped (or U.S. HTS number if known)
- Shipping item's ECCN (Export Control Classification Number)

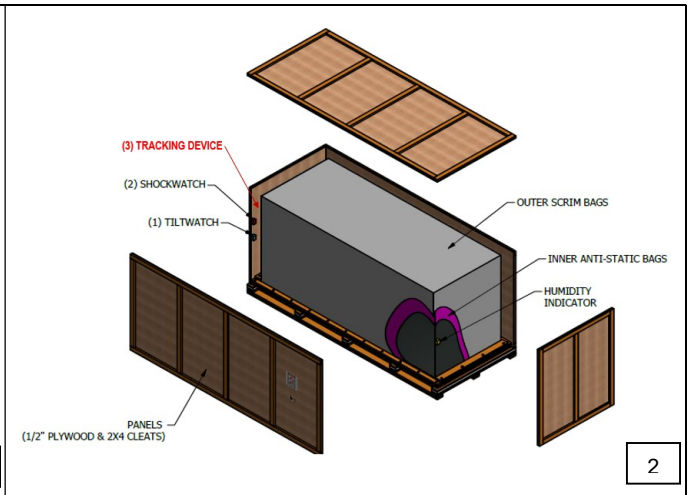
Tips:
- Shipments containing computers, monitors, laser equipment, cell phones and cameras must provide the manufacturer's name and address and serial numbers for customs approval.
- Chemicals and toxic substances are subject to certification requirement statements on the invoice (Toxic Substance Control Act). A Material Safety Data Sheet (MSDS) which contains the manufacturer's name, address, and phone # is required.

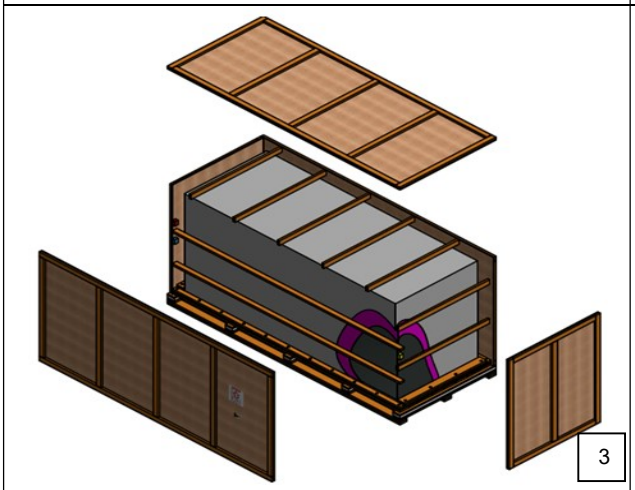
CHINA
China requires documented compliance with the International Plant Protection Convention for all materials (i.e. pallets, cardboard packaging). This document is referred to as a "NON WOOD DECLARATION DOCUMENT".

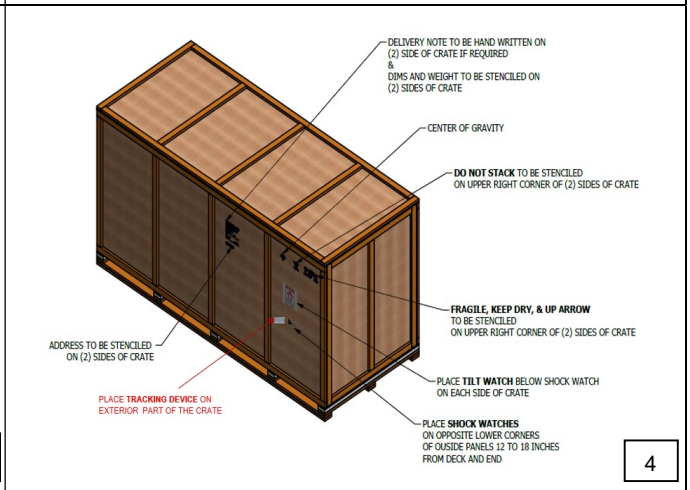
6– Diagrams and Drawings

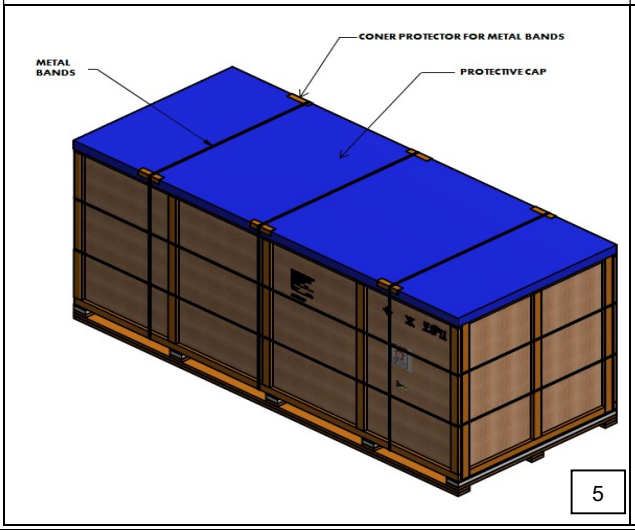
Heavy Duty Crate Design > 2500kgs

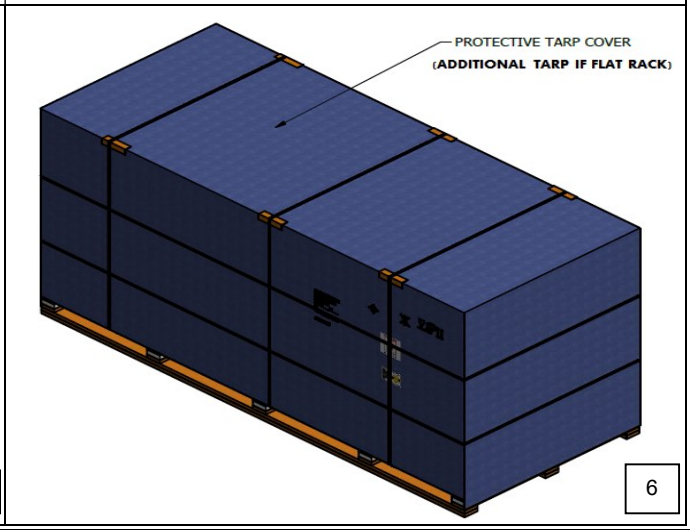




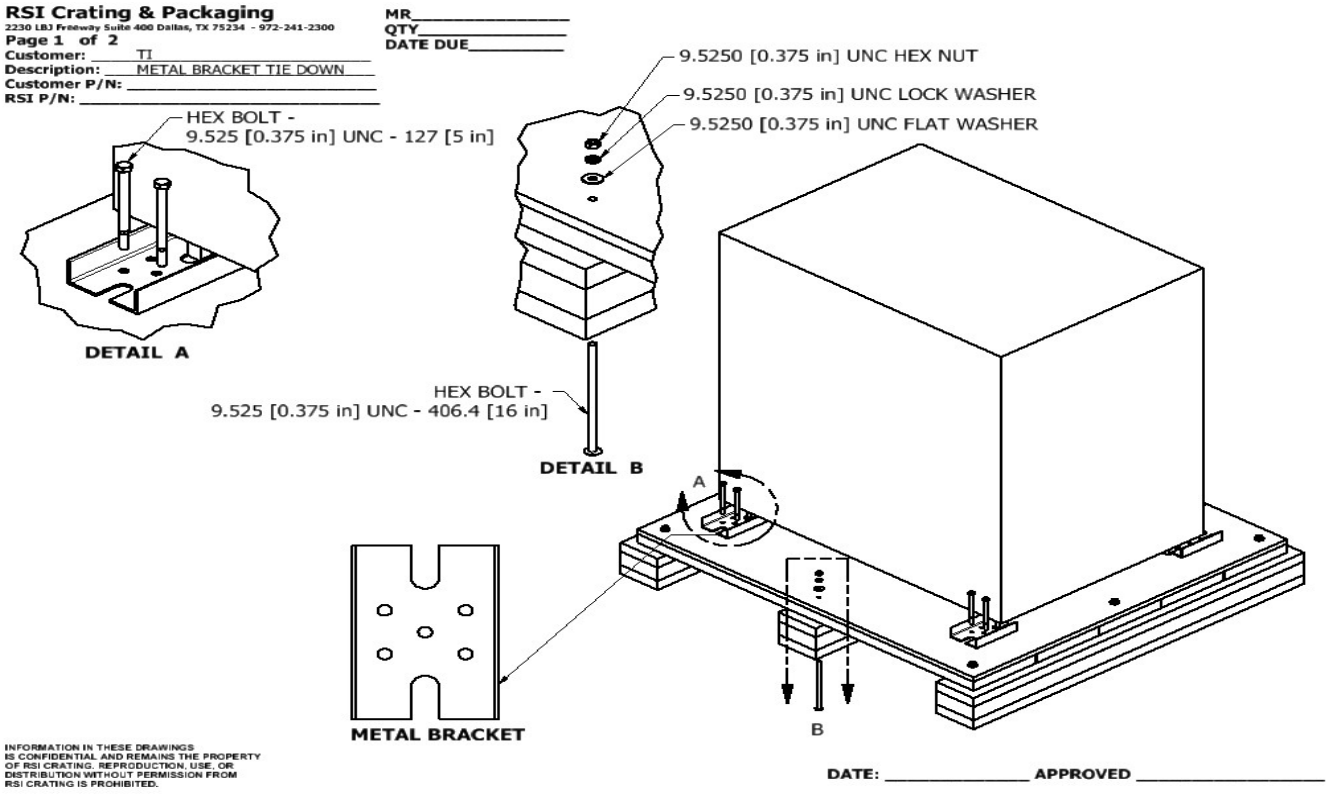


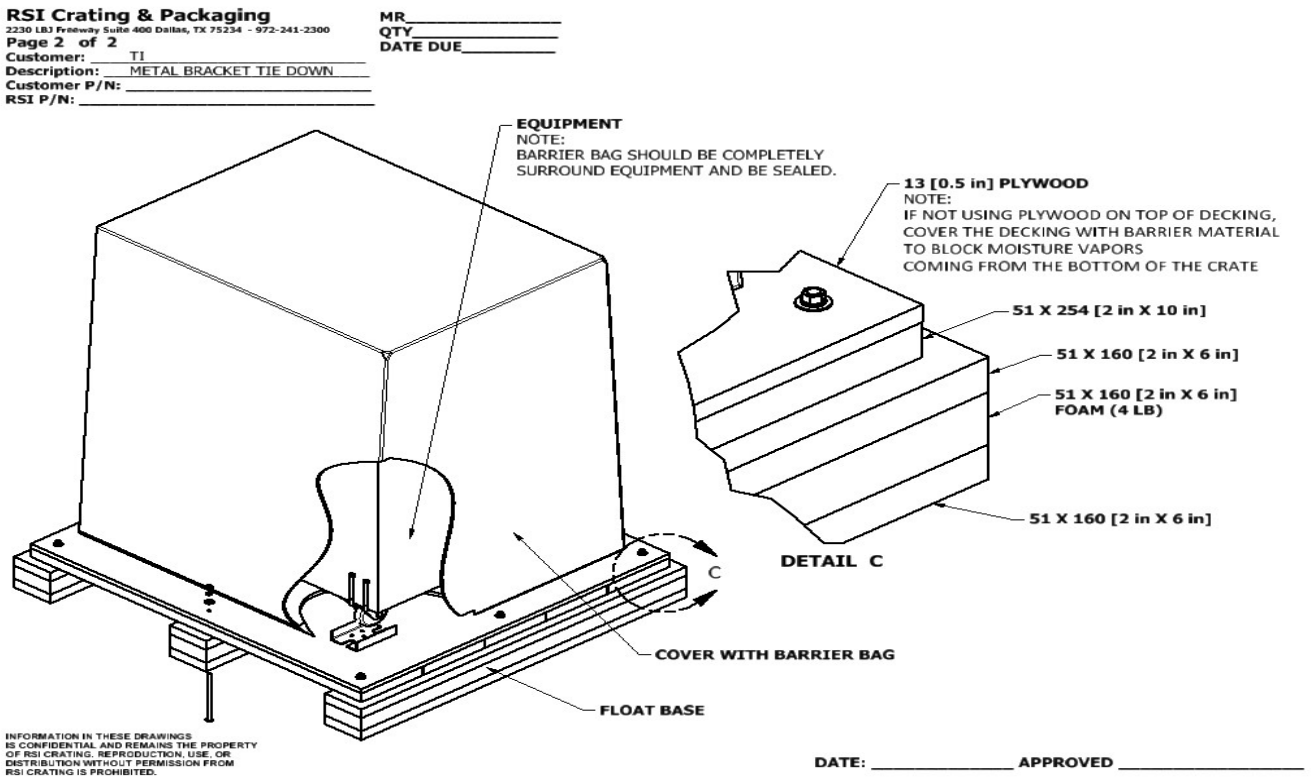






CRATING DIAGRAM FOR METAL BRACKET TIE DOWN

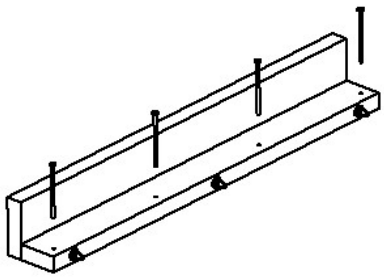


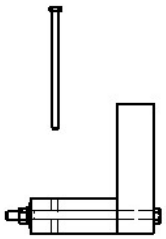


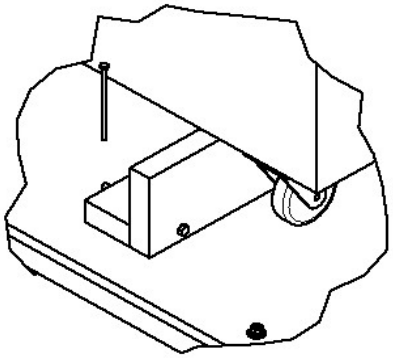
CRATING DIAGRAM FOR BLOCKING EQUIPMENT WITH WHEELS

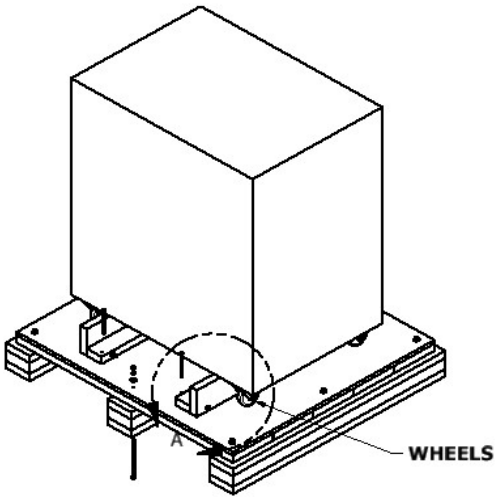
RSI Crating & Packaging
2230 LBJ Freeway Suite 400 Dallas, TX 75234 - 972-241-2300
Page 1 of 1
Customer: TI
Description: BLOCKING FOR EQUIPMENT WITH WHEELS
Customer P/N: _____
RSI P/N: _____

MR_____
QTY_____
DATE DUE_____









DETAIL A

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DATE: _____ **APPROVED** _____

7– Lessons Learned

Collapsed Crates: The below crates were not reinforced and collapse during the transit from origin. All crate top panel will need to be reinforced with additional cleating and/or joists to prevent compression. Maximum cleat spacing is 30 inches.

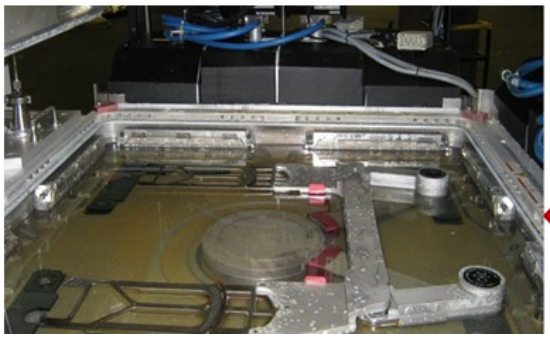
<u>Water Damage:</u> Discovered 40 gallons of water inside the equipment. This most-likely happened during transit prior to the poly tarp being installed. All equipment must have protective poly tarp caps install prior to moving the equipment from the origin facility.

Water on top of stretch wrap
And barrier bag

20" opening in the barrier bag

No support at the top of the tool

Water inside of the Transfer chamber



Revision History

Revision	Description
A	ECO # 2157723, G. Besa, 04/25/2016, W. Nisperos Formal release
B	ECO # 2158896, Chris Durant, G. Besa, 06/17/2016, W. Nisperos, update parag 2 crating requirements
C	ECO # 2168831, 09/19/17, V. Orpilla, W. Nisperos; Update document
D	ECR #2208155, 04/05/24, V. Orpilla, M. Castillo; 1) Added digitalTracking Device requirement

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