

GRAINPRO® TRANSAFELINER™

# INSTRUCTION MANUAL

(Vacuum Method)

MA4081RAD1219-01



“A GREEN, NOT ONLY FOR  
PROFIT COMPANY”

scan me



**GrainPro® , Inc.**

1401 K Street NW, Suite 502, Washington D.C. 20005 USA  
Phone: 202-921-6700 Website: [www.grainpro.com](http://www.grainpro.com)  
Email: [sales@grainpro.com](mailto:sales@grainpro.com)

**GrainPro® Philippines, Inc.**

Lot 46 Efficiency Avenue, Subic Bay Gateway Park I, Subic Bay Freeport Zone 2222 Philippines  
Phone: +63 47 252 7884 Fax: +63 47 252 7885 Website: [www.grainpro.com](http://www.grainpro.com)  
Email: [salesasia@grainpro.com](mailto:salesasia@grainpro.com)

**GrainPro® Kenya**

Shop A2, Space Apartments Mai Mahiu Road, Near T Mall Nairobi, KENYA  
Phone: +254 710 933 717 Website: [www.grainpro.com](http://www.grainpro.com)  
Email: [saleseafrica@grainpro.com](mailto:saleseafrica@grainpro.com)

**GrainPro® Mexico**

Cto. Garona No. 903, Sección Tres, Col. Amberes, 37237, León, Gto. Mexico  
Phone (Mobile): +52 1 (477) 392-0851 Website: [www.grainpro.com](http://www.grainpro.com)  
Email: [guillermo@grainpro.com](mailto:guillermo@grainpro.com)

**GrainPro® Costa Rica**

Paseo Colón, Centro Colón, en Bufete Robles Oreamuno District Merced, San José, Costa Rica  
Phone: +506 4701-1173 Website: [www.grainpro.com](http://www.grainpro.com)  
Email: [chema@grainpro.com](mailto:chema@grainpro.com)

**GrainPro® India Postharvest Technology Pvt Ltd**

B305, Grande View 7 Hsg. Soc. Ltd., Phase - I, Near Ashok Leyland, Ambegaon BK, PUNE,  
Pune, Maharashtra, India, 411046  
Phone (Mobile): +91 9970157263 Website: [www.grainpro.com](http://www.grainpro.com)  
Email: [avinash@grainpro.com](mailto:avinash@grainpro.com)

GrainPro® Inc., 1401 K Street NW, Suite 502, Washington D.C. 20005 USA  
Copyright 2019 GrainPro®, Inc.

# 1. PREPARATION

## 1.1. PREPARATION

1.1.1. Check the moisture content of the commodity using GrainPro Moisture Meter (MM5) (available for sale from GrainPro, Inc.) to ensure the MC is at a safe level for storage/transport.

Recommended Moisture Content:

Coffee – 11.5-12%

Cocoa – 6-7%

Rice – 13-14%



1.1.2. Workers should not wear shoes with spikes that might cause damage to the TSL.



1.1.3. Ensure that container floor is free of any sharp objects that may damage the liner.



1.1.4. Place a mat or thick cardboard on the floor as additional protection for the TSL.



1.1.5. Place the TSL box at the back end of the container.



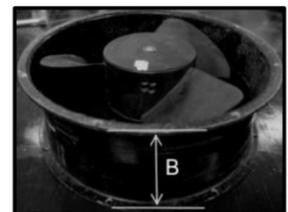
- 1.1.6. Pull the top portion to unfold the TSL, make sure that the GP logo is facing up for proper orientation.



## 2. INSTALLATION USING VACUUM METHOD

### 2.1. INSTALLATION PROCESS

For the vacuum method, a ventilator/fan shall be used to create negative pressure between the shipping container and the TSL. The ventilator should have at least a 1000 m<sup>3</sup>/minute of flow rate.



- 2.1.1. Place the ventilator/fan on the top corner of the container next to its door, this could be on either left or right side of the container. A clamp could be used to keep the ventilator in place.



- 2.1.2. Fold at least 150cm of the TSL away from the door opening starting from the zipper. Then tape the folded section around the perimeter of the container door.



Note: Make sure not to cover the ventilator with the folded TSL section to avoid possible damage.

- 2.1.3. Turn on the ventilator and wait until the TSL spreads perfectly on the sides and ceiling of the container van. A worker can also enter the TSL to help spread the TSL material and help correct any folds in the TSL.

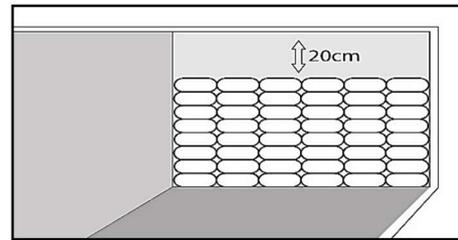


2.1.4. Place cardboards on the TSL floor and along the walls for added protection;

2.1.4.1. **For Manual Loading** - workers should not wear shoes with spikes that might cause damage to the liner.



2.1.5. When stacking bags, make sure to leave at least 20cm distance between the roof of the container and top of the stacks to prevent condensation.



### 3. SEALING

#### 3.1. USE OF DESICCANTS/DRY BAGS (REQUIRED)

Desiccants are commonly used to protect goods against moisture damage. Hygroscopic commodities, such as cocoa, coffee, and various nuts and grains are particularly susceptible to mold and rot when exposed to condensation and humidity.



3.1.1. Requirement:

- a. One-thousand two-hundred (1200) grams or 6 bags of GrainPro Dry Bags per 20-footer.
- b. Two-thousand four-hundred (2400) grams or 12 bags of GrainPro Dry Bags per 40-footer.

Note: 1 GrainPro Dry Bag contains 200 grams of calcium chloride and can absorb grams of moisture

3.1.2. Place the GrainPro Dry Bags in perforated bags or sacks to prevent direct contact with commodity.

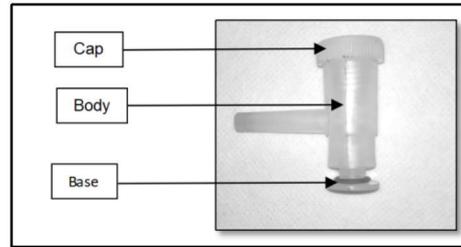
3.1.3. Cardboards/cartons may be placed on top of the stack (Cardboards/cartons provide increased water absorption). Then put the desiccants on top of the cardboards/cartons.

#### 3.2. PLASTIC VALVE INSTALLATION FOR PRESSURE DECAY TEST (PDT), CO<sub>2</sub> OR O<sub>2</sub> READING

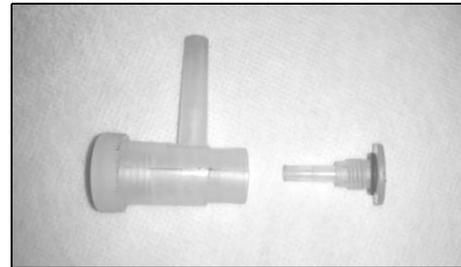
Install plastic valve before sealing or zipping the liner. Conduct PDT after sealing. CO<sub>2</sub> or O<sub>2</sub> reading (optional) is taken upon arrival of the container to verify the integrity of the TSL's hermeticity. After use, close the plastic valve.

3.2.1. Plastic valve components:

- A. Cap – To open and close the valve
- B. Body – Where tube or hose is inserted for Pressure Decay Test (PDT) and CO<sub>2</sub> or O<sub>2</sub> reading
- C. Base – Use for piercing the liner



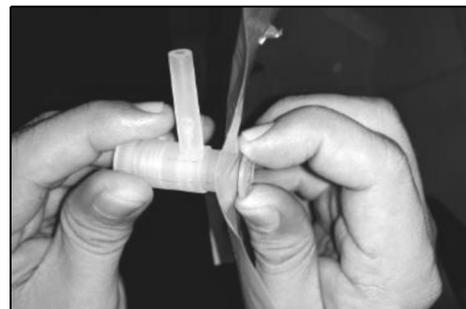
3.2.2. Dismantle the plastic valve by unscrewing the base.



3.2.3. Pierce the TSL using the plastic valve. Piercing is done from the inner side of the TSL (approximately 20 cm from the zipper).



3.2.4. Screw the plastic valve body. The cap of the plastic valve should be positioned outside the loaded TSL. Firmly tightened the body into the base to prevent leakage.



**3.3. SEALING OF 2-TRACK PE ZIPPER**

- 3.3.1. Remove the ventilator from the container door. Then remove the tapes and unfold the excess liner from the door perimeter and let it loose.



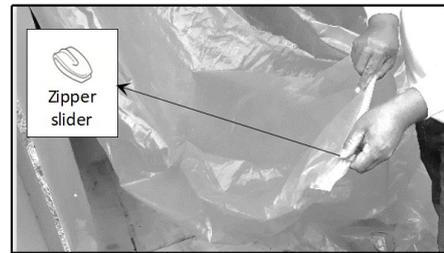
3.3.2. Hold the 2-track zippers together. Align for proper sealing.



3.3.3. Manually zip a few centimeters enough to initially engage the zipper slider.



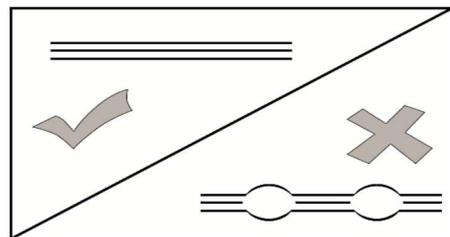
3.3.4. Position the zipper slider on the manually zipped portion of the zip lock.



3.3.5. For ease of zipping two persons are required. One person does the zipping and the other person holds the other end steadily, making both sections of the zipper in a straight line to avoid the zipper length being misaligned.



3.3.6. If uneven zipper ends are observed, slightly stretch both ends of the zipper and redo the zipping from end to end.

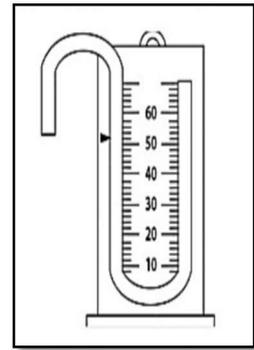


3.3.7. Fold extra liner and tape it against the stack. Ensure that no liner is stuck in-between doors.

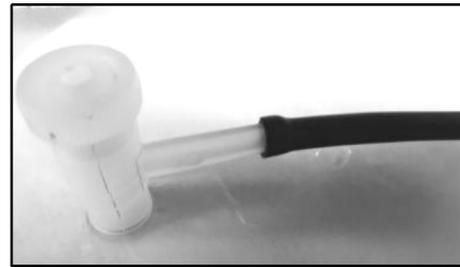


### 3.4. PRESSURE DECAY (VACUUM) TEST

3.4.1. After zipping/sealing of the TSL, perform a pressure (vacuum) decay test (PDT) to ensure gas-tightness. With this test a manometer, vacuum pump and stopwatch are needed. A digital manometer of a commercially available or improvised U-tube manometer can be used to monitor the pressure.



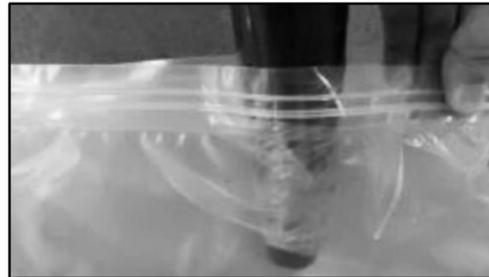
3.4.2. Connect the manometer hose to the plastic valve previously installed in the TSL.



3.4.3. Twist the plastic valve cap to open.



3.4.4. Using a vacuum pump with at least 2.3 cubic meters of suction capacity per minute. Create at least -250 Pascals (Pa) or -25 millimeters' water (mm H<sub>2</sub>O) vacuum inside the TSL by partially opening a portion of the zipper and insert the vacuum pump suction port.



3.4.5. For TSL to be considered sufficiently airtight, the initial vacuum should not decrease by more than one-half ( $\frac{1}{2}$ ) of the final vacuum (created by the vacuum pump) within five (5) minutes.

3.4.6. If the PDT test failed, check for holes/tears and poorly sealed zippers then repeat the PDT procedures.



3.4.7. After conducting PDT, twist the plastic valve closed.



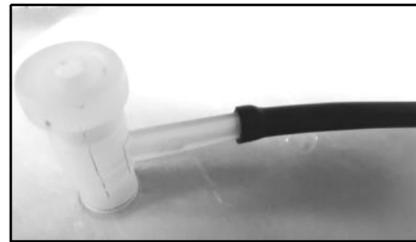
### 3.5. INSTALLING THE FLEXIBLE ADAPTER HOSE FOR CO<sub>2</sub> OR O<sub>2</sub> READING

To ensure gas-tightness, instead of PDT as an alternative the container with TSL can be checked using the CO<sub>2</sub> analyzer or O<sub>2</sub> analyzer.

3.5.1. The flexible adapter hose is included in the GrainPro Carbon Dioxide Analyzer or the user can find equivalent flexible hose from local hardware using the specifications as shown:

Inside Diameter	4 mm (0.16 in.)
Length	>5 cm (2 in.)

3.5.2. When taking the carbon dioxide or oxygen reading, connect the flexible adapter hose to the plastic valve.



3.5.3. Twist the plastic valve cap to open.

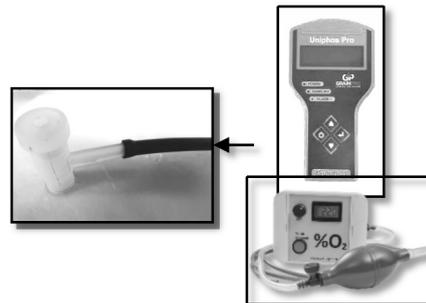


3.5.4. Connect the O<sub>2</sub> or CO<sub>2</sub> analyzer to the flexible adapter hose and the reading. Take readings of CO<sub>2</sub> and O<sub>2</sub> using the available analyzer.

Acceptable Values:

For O<sub>2</sub> analyzer, 3% or below after 15 to 30 days.

For CO<sub>2</sub> analyzer, 10 to 15% after 15 to 30 days.



- 3.5.5. Twist the plastic valve cap to close after taking the readings.



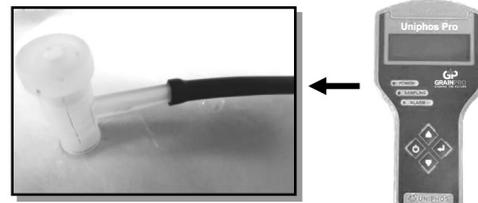
### 3.6. USING CARBON DIOXIDE ANALYZER FOR MONITORING (WITHOUT CO<sub>2</sub> FLUSHING) - OPTIONAL

The GrainPro CO<sub>2</sub> analyzer uses a non-dispersive infrared radiation (NDIR) sensor for the detection of carbon dioxide. When a sensor encounters a target gas, voltage signal is generated in proportion to the gas concentration. This voltage signal is amplified, digitized and displayed on the instrument's OLED display.

- 3.6.1. When taking the carbon dioxide reading, connect the flexible adapter hose into the plastic valve.



- 3.6.2. Using the analyzer, carbon dioxide level can be checked through the plastic valve with flexible adapter hose before unloading. Increased carbon dioxide level indicates absence of any source of leaks from punctures, holes or damages. CO<sub>2</sub> level of ambient air is 0.04%.



- 3.6.3. Monitoring of carbon dioxide level is recommended to ensure control of insect infestation. Details of using CO<sub>2</sub> analyzer are discussed in the analyzer's instruction manual.

## 4. CARBON DIOXIDE PURGING

### 4.1. CARBON DIOXIDE (CO<sub>2</sub>) SAFETY

- 4.1.1. Carbon dioxide does not support life. It can act as a simple asphyxiant by diluting the concentration of oxygen in air below the levels necessary to support life. As it is heavier than air it will tend to concentrate at lower levels.
- 4.1.2. Avoid breathing gas. Do not get in eyes, on skin, or on clothing. Wear leather safety gloves and safety shoes when handling cylinders.
- 4.1.3. Protect cylinders from physical damage. Do not drag, roll, slide or drop. While moving cylinder, always keep the removable valve cover in place. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders.
- 4.1.4. Never insert an object (e.g., wrench, screwdriver, and pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier.
- 4.1.5. Close the cylinder valve after each use; keep closed even when empty.
- 4.1.6. Never apply flame or localized heat directly to any part of the cylinder. High temperatures may damage the cylinder and could cause the pressure relief device to fail.

## 4.2. CALCULATION OF CARBON DIOXIDE REQUIREMENT

### 4.2.1. Carbon dioxide requirement formula:

- a. Total Volume – Volume Occupied by the Commodity.
- b. For every 2.0 kg CO<sub>2</sub>, 1 cubic meter of air is replaced.
- c. Formula: (1 minus bulk density) x Volume (in m<sup>3</sup>) x 2

### Recommendations:

- If commodity temperature is at 15 deg Celsius or below, there is no need for TSL.
- If commodity temperature is 15-20 deg Celsius, use TSL without carbon dioxide flushing but fumigation should be conducted upon arrival.
- If commodity temperature is above 20 deg Celsius, use TSL with carbon dioxide flushing.

### CARBON DIOXIDE REQUIREMENT BASED ON COMMODITY

COMMODITY	BULK	AMOUNT OF CARBON DIOXIDE (CO <sub>2</sub> ) FOR PURGING, kg		
	DENSITY	TSL 20	TSL 40	TSL 40 High Cube
	MT/m <sup>3</sup>	33	66	76
Barley	0.62	25.1	50.2	57.9
Cashew nuts	0.50	33.0	66.0	76.2
Chia seeds	0.68	21.1	42.2	48.8
Chickpeas	0.74	17.2	34.3	39.6
Cocoa beans	0.56	29.0	58.1	67.1
Coffee beans	0.59	27.1	54.1	62.5
Cotton seed	0.40	39.6	79.2	91.4
Cowpea	0.75	16.5	33.0	38.1
Maize	0.72	18.5	37.0	42.7
Millet	0.63	24.4	48.8	56.4
Mung bean	0.75	16.5	33.0	38.1
Oats	0.43	37.6	75.2	86.9
Paddy	0.60	26.4	52.8	61.0
Paddy, rice bran	0.55	29.7	59.4	68.6
Peanuts, shelled	0.64	23.8	47.5	54.9
Rice, milled	0.80	13.2	26.4	30.5
Rye	0.72	18.5	37.0	42.7
Sesame	0.59	27.1	54.1	62.5
Sorghum	0.72	18.5	37.0	42.7
Soybean	0.75	16.5	33.0	38.1
Sunflower	0.41	38.9	77.9	89.9
Wheat	0.77	15.2	30.4	35.1
Coffee beans	0.59	27.1	54.1	62.5
Cotton seed	0.40	39.6	79.2	91.4
Cowpea	0.75	16.5	33.0	38.1
Maize	0.72	18.5	37.0	42.7
Millet	0.63	24.4	48.8	56.4
Mung bean	0.75	16.5	33.0	38.1
Oats	0.43	37.6	75.2	86.9
Paddy	0.60	26.4	52.8	61.0
Paddy, rice bran	0.55	29.7	59.4	68.6

Peanuts, shelled	0.64	23.8	47.5	54.9
Rice, milled	0.80	13.2	26.4	30.5
Rye	0.72	18.5	37.0	42.7
Sesame	0.59	27.1	54.1	62.5
Sorghum	0.72	18.5	37.0	42.7
Soybean	0.75	16.5	33.0	38.1
Sunflower	0.41	38.9	77.9	89.9
Wheat	0.77	15.2	30.4	35.1

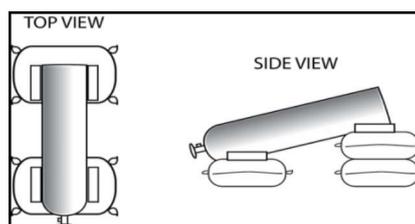
#### 4.3. PROCEDURE FOR PURGING WITH CARBON DIOXIDE (CO<sub>2</sub>)

4.3.1. Make sure that enough CO<sub>2</sub> is available on site. The weight of the CO<sub>2</sub> in the cylinder is supplied by the industrial companies (i.e. 22kg standard capacities which may be used to calculate the number of cylinders required). CO<sub>2</sub> cylinders are available with or without siphon (dip tube). For rapid flushing, the cylinder without siphon should be inverted.

4.3.2. For rapid flushing, the cylinder should be inverted using mechanical inverter. However, the cylinders with siphon should be in upright position during flushing.



4.3.3. If a mechanical inverter is not available, a makeshift inverter can be made using sandbags or other improvised technique. The cylinder should be inverted with its top resting on one sandbag and the bottom end resting on pile of two or three sandbags high.



4.3.4. A standard high-pressure hose (available only as separate item) should be connected to the cylinder. This hose should be guaranteed to withstand a pressure of 88 atmospheres (1,300 psi, or 92 kg/cm<sup>2</sup>). Ensure that all connections are made properly, and gaskets are in place where they are required. The high-pressure hose should have a length of about 2-meter and have matching coupler at cylinder.



4.3.5. Open a section of the zipper and insert the pressure kit. This serves as outlet to discharge O<sub>2</sub> when flushing.



4.3.6. Open the cylinder valve. Adjust opening of the valve until sound of liquid passing through the hose is heard. The liquid CO<sub>2</sub> flushes into the TSL and evaporates inside, it pushes the air upward, acting as a piston, until the air is totally replaced. The opening through the zipper serve as an outlet for the displaced air.



4.3.7. Ice formation along the pressurized hose and the pipe connector during CO<sub>2</sub> flushing:

4.3.7.1. During this procedure, some ice may form around the gas inlet and high-pressure hose.



4.3.7.2. Flushing (emptying of the cylinder) depends on the amount of CO<sub>2</sub> to be applied. Emptying one 22kg cylinder should only take about 20 to 30 minutes. If the pressure hose or the inlet valve gets blocked with ice, this is an indication that the CO<sub>2</sub> is being released too quickly. If this happens the cylinder should be closed until the ice melts, and then the cylinder valve should be re-opened and adjusted to reduce the flow.

4.3.7.3. An additional indication that the gas is being released too quickly is when the liner begins to balloon out because pressure begins to build-up inside. If this happens, the gas flow should be decreased at the cylinder valve until the rate of air being expelled through the outlet port is about the same as the rate of CO<sub>2</sub> entering the liner.

4.3.7.4. If necessary, for small scale applications and the cylinder is not inverted, weighing scales may be used to control the weight of the gas delivered. In this case the gas is released slowly through a pressure gauge which can be adjusted to control the flowrate.

4.3.8. Since CO<sub>2</sub> is heavier than air, the air in the TSL displaces upwards and is lifted out of the container through the outlet port. Complete displacement is not possible as there is always some mixing at the interface between the air and the CO<sub>2</sub>. However, if the final CO<sub>2</sub> concentration reaches 80% then the O<sub>2</sub> concentration in the remaining air amounts to 4%. This mixing of the CO<sub>2</sub> with the remaining air, and absorption of CO<sub>2</sub> by the commodity, takes 12-24 hours depending on temperature. This is the time to determine the initial concentration of CO<sub>2</sub>.

4.3.9. After the required weight of CO<sub>2</sub> has been flushed, immediately:

4.3.9.1. Close the CO<sub>2</sub> cylinder valve.



4.3.9.2. Close the zipper thoroughly using the slider.



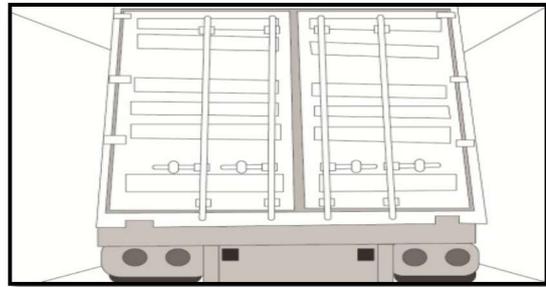
4.3.10. For controlling stored-product insects, maintaining CO<sub>2</sub> above 50% for 10 days, or CO<sub>2</sub> above 35% for 15 days is sufficient to provide complete control, after which the liner may be opened. In addition, temperature accelerates treatment. Effective insect control may be achieved in as little as three days at 25° and less at higher temperatures.

4.3.11. Although CO<sub>2</sub> is not toxic, it is an asphyxiant. It is advisable to unzip the TSL and wait until most of the CO<sub>2</sub> has dispersed.

#### 4.4. CLOSING AND OPENING OF THE SHIPPING CONTAINER

4.4.1. Close the shipping container carefully and be sure not to pinch/squeeze the excess liner material between the container doors.

4.4.2. Care should be taken when opening the shipping container considering shifting of loads while on transit. It is advised to open one side of the door first to check the loads.



### 5. MAINTENANCE AND CARE

#### 5.1. REPAIRING PUNCTURES AND OTHER DAMAGES

5.1.1. Use an ordinary 2" wide plastic adhesive tape:  
Clean the surface of the damaged area with damp cloth and allow the surface to totally dry before applying the plastic tape.

5.1.2. Protective maintenance:

5.1.2.1. Check the plastic tape occasionally and replace or re-patch if necessary.



### 6. RECYCLING

#### 6.1. RECYCLING

GrainPro TSL is made of polyethylene with barrier layer.

6.1.1. The products can be delivered to the nearest recycling facilities in the area.

6.1.2. Plastic #4 – LDPE (Low Density Polyethylene) can be recycled into compost bins, paneling, trash can liners and cans, floor tiles, and shipping envelopes.