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2016 Mango Packaging Task Force

FINAL REPORT

Mangos are one of the fastest growing produce commodities in the United States, and there is potential to continue this growth trend in the coming years. However, the mango industry is facing several packaging and distribution related issues that need to be addressed in order for the U.S. mango market to maximize its full potential. U.S. retailers also consistently agree that mango packaging and palletization need improvement.

Mangos are also one of the last major produce commodities that do not have a standard size box and do not consistently utilize the standard 40”x48” size pallets. While the majority of the produce industry uses a 5-down standard common footprint, the mango industry utilizes smaller-size boxes (e.g. 12-downs and 14-downs) that do not stack well with other produce boxes and can damage other commodities when mixed pallets are consolidated. Pallets with smaller-size boxes are also less stable and fall over with more frequency. In addition, as mango conditioning is becomes more common there are concerns that the current mango box designs and materials are not always holding up to the humid conditions commonly found in ripening rooms. These deficiencies increase transfer costs, labor, risk, and liability, and the expenses are commonly passed down to the growers and packers.

Aware of these challenges the National Mango Board (NMB) organized the Mango Packaging Task Force (Mango-PTF) in 2016 with the purpose of bringing together mango industry stakeholders, which included growers, packers, exporters, importers, and retailers. The mission of the Mango-PTF was to identify the packaging and palletization issues affecting the mango supply chain, and to emphasize the steps that are necessary to improve the current practices and reduce shrinkage, while also increasing mango movement at the retail level. Five major retailers were included in the Mango-PTF in order to better understand consumer level perspectives and advance solutions that work best in the crucial final leg of the supply chain.

The purpose of the Mango-PTF was not to change all current practices overnight, but rather to identify the main issues and to offer solutions. Over the course of 2016 the Mango-PTF met three times and reached consensus on three major issues of concern that need to be addressed as soon as possible:

1. Pallet quality needs to improve and pallet size needs to be a consistent dimension of 40”x48”;
2. The mango industry needs a consistent standard-size mango box with a 5-down common footprint;
3. The mango industry needs to improve packaging quality guidelines, maintain consistency, and continue to promote conditioning in forced-air cooling and ripening rooms. Although mango conditioning has increased movement, improvements also need to be made to the current packaging in order to better withstand the heat, humidity, and forced air conditions that are common in ripening rooms.

The Mango-PTF members unanimously agreed that if these issues can be addressed, there is potential to elevate mangos to the next level and make it a high-volume commodity.

1. Palletization

In general, there are two pallet sizes used in the mango industry, 40”x48” and 40”x44”. This difference is influenced by the mode of transportation that is used to ship mango pallets. For mangos entering the U.S. by land, the standard 40”x48” pallets are used, and for mangos shipped via sea container the smaller 40”x44” pallets are used because they fit 22 pallets of 40”x44”, instead of 20 pallets of 40”x48” into the sea containers. There is a belief that smaller size pallets allow more product to fit inside sea containers, however, this is not always the case. Although there may be more boxes, the net product weight is not always increased. The box dimensions have been reduced in size to fit on smaller pallets, which allows for more boxes and pallets in the sea containers, but the amount of actual product in the container is not increased. Keeping packaging costs as low as possible has always been a driving force in order to stay competitive. Unfortunately, this strategy has become counterproductive because the theoretical lower cost per box is being offset and surpassed by the percentage of damaged and rejected product, the additional cost of transferring boxes to 40”x48” pallets upon arrival to the U.S., restacking costs, and slower growth at retail due to the additional labor and physical damage suffered by the fruit.

The main disadvantage of using 40”x44” pallets is that the U.S. produce industry is setup to handle the 40”x48” pallets. Therefore, mango boxes that are not on 40”x48” pallets must be transferred to standard size pallets either by hand-stacking or with a clamp/transfer machine. Both transfer methods can damage and weaken the structure and stability of the boxes, which then leads to unstable pallets that fall over during transit and cause lost product, lost time, and risk of injury. Other significant issues include:

- Due to the use of low quality materials and inconsistent manufacturing practices, mango pallets are not holding up to the rigor of multiple loading and unloading that is necessary to get through the entire supply change.
- Forklift blades are set up to handle 40”x48” pallets. A common incident with the shorter 40”x44” pallets is that when they are picked up, the forklift blades extend into the neighboring pallets and break the boards, which then causes further pallet instability.

<u>Task Force Consensus and Next Steps</u>:

a. The mango industry needs to transition immediately to 40”x48” GMA pallets on all shipments.
b. 4-way entry block pallets are preferred as they facilitate warehouse movements including pallet jacks and allow for easier sideways loading in truck trailers.
c. Specifications on pallet materials, strength, spacing, heights, and manufacturing are being developed and will be provided as guidelines to the industry.

2. Packaging

The mango industry currently uses several box designs and sizes, with the most common size being the 12-down and 14-down boxes. Over the years the mango industry has developed boxes that fit the size and dimensions of the fruit grown in each of the producing regions, and also to maximize the amount of product that can be transported in enclosed trailers and sea containers. However, there are disadvantages with the current mango boxes:

- <u>Instability</u> – A pallet stacked with smaller size boxes is much more unstable than one with larger size boxes. Furthermore, if the pallet is not stacked tightly and secured properly, or if

the packaging and palletization materials are weak, then it is much more likely that the pallet will fall over. The problem becomes worse the longer the transit period and the more a pallet is handled, and especially if it goes through the fruit conditioning process.

- Less Display Space – Retailers often use these shipping boxes to create in-store displays. Smaller-size boxes means less display space overall.
- More Waste – Smaller boxes generate more waste material to throw away.
- More Labor Required - Smaller boxes require more labor any time a box is moved or restacked, whether it's at the packing facility, warehouse, the retail level, and translates to additional costs all along the supply chain.
- Inconsistent Ventilation - Varying many box designs provide inconsistent ventilation and air flow, and create issues in both cooling and fruit conditioning.
- Ripening Room Forced Air Is Compromised – When offshore 40"x44" pallet box footprint is transferred onto 40"x48" pallets that are required by retailers, it leaves a 4 inch gap between pallets in the rooms. This gap compromises the airflow because air finds the path of least resistance instead of traveling through the boxes.
- Inconsistent Material Quality - Another concern is the inconsistent quality of materials used to manufacture mango boxes. It is common for packers to request specific box requirements, but then receive lower quality materials and boxes. This creates issues along the entire supply chain, including boxes collapsing and pallets turning, and boxes breaking down during the fruit conditioning process.

Retailers contend with fresh fruit packaging issues on a regular basis, and because of consumer trends and behavior, many are now setting their own fruit packaging requirements. One packaging preference that has been unequivocally specified as the best option from the retailer perspective, and by four of the five retailer representatives on the Mango-PTF, are the reusable plastic containers (RPCs), which have become the top option for handling many produce items, including mangos, for several reasons:

- RPCs are made of materials that offer consistent quality and strength;
- Are already available in a 5-down common footprint,
- Are naturally more stable when palletized,
- Their design allows for better airflow for cooling and conditioning purposes,
- No cardboard waste is generated.

Growers and shippers on the Mango-PTF initially expressed concerns with the use of RPCs. Among the most common concerns were: will RPCs damage soft fruit, what happens when filled RPCs are rejected, and what if RPCs are not available in our production areas? Retailers on the task force indicated that they have been conducting tests on RPC shipment for multiple mango varieties and sizes. These retailers have seen positive results and have already started incorporating RPCs in their mango distribution. There are instances, such as with mature Ataulfo or Kent mango varieties that can experience damage in RPCs. Nonetheless, some retailers have tested the RPCs with breathable foam liners and have had success with fruit arrivals free of damage. Additional research and testing is being conducted on this issue.

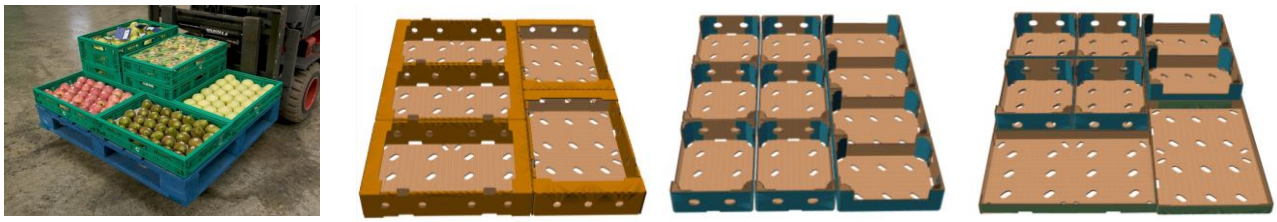
As for RPC mango shipments that may be rejected, the produce industry currently deals with other rejected RPCs and although additional steps are necessary, there is a system in place where the logistics are coordinated between the shipper and the RPC provider and the containers are retrieved and collected.

Retailers are aware that RPCs may not be an option for every mango producing region, but they highly encourage RPC use any time they are available. When RPCs are not available, then the next best option retailers prefer is a 5-down cardboard box. The 5-down box is currently used by the majority of the produce industry because it provides more efficient stacking, better pallet stability, larger display area, and allows for pallet consolidation when multiple produce items need to be stacked together without causing damage.

Concerns raised with the 5-down box design included the cost of re-tooling packing lines to handle a new size box and the unknown expense of new packaging materials. The Mango-PTF concluded that there will be an overall savings when you factor in two major expenses that will be significantly reduced: 1) box re-stacking costs, and 2) deductions that are made from product that is ruined or damaged when pallets fall over. In addition, box manufacturers calculate that the packaging cost per piece of fruit in a 5-down box will remain relatively the same.

Task Force Consensus and Next Steps:

a. The mango industry needs to move towards a new and consistent 5-down common footprint box design that will allow for improved pallet stability, more efficient handling, less shrinkage, faster cooling, consistent fruit conditioning, and reduce overall costs.
b. Minimum packaging material standards need to be developed with the purpose of strengthening the box, while also improving ventilation and airflow for cooling and fruit conditioning purposes.
c. Specifications on box designs, dimensions, ventilation patterns, packing counts, sizes, weights, and other criteria are being developed and will be provided as guidelines to the mango industry.
d. Five options will be available in the 5-down common footprint design:
    - 5-down RPC box to be used where available,
    - 5-down cardboard box, as an alternative to the RPC,
    - 10-down RPC box to be used where available,
    - 10-down cardboard box,
    - 5-down skeleton tray that holds two (2) boxes, and
    - 5-down master case that holds eight (8) club boxes.



Prototype examples of 5-down common footprint mango box designs. These images are for demonstration purposes only and final designs are still under development.

3. Conditioned Fruit

The purpose of conditioning, or ripening, fruit is to improve consistency and eating quality, which leads to repeat purchases and increased demand. Retailers and foodservice providers are aware that an overwhelming majority of consumers, 81 percent, prefer to purchase fruit that is ripe-and-ready-to-eat. The sooner a piece of fruit is consumed, the sooner the consumer will come back for

more. In addition, consumer studies show that a mango's flavor profile increases significantly if consumed at its optimal point. Therefore, properly conditioned mangos will benefit both the ripe-and-ready-to-eat and fresh-cut sectors alike, and will allow mango consumption to continue increasing at an accelerated rate.

Fruit conditioning is a common practice with bananas, tomatoes, avocados, pears, and each year it is becoming more common with mangos. All these fruits produce ethylene and can be conditioned similarly and in the same ripening chambers. Nevertheless, each pallet needs to be examined, and depending on the condition of the fruit, selective conditioning is often necessary. For this reason fruit conditioning is not an option for all handlers. There are distribution centers that specialize in fruit conditioning, however, the mango industry needs to continue taking steps to encourage and facilitate the process and handling of conditioned fruit. This includes providing consistent quality fruit so it conditions well, stable pallets, reliable packaging quality, and efficient box air flow.

Task Force Consensus and Next Steps:

a. The NMB has conducted research and has developed a "Mango Handling and Ripening Protocol" that is currently available to the industry. In addition, NMB has a postharvest technician that is visiting mango distributors to conduct on-site visits and is providing free-of-charge consultations. These services will continue to be provided in 2017, but the NMB will focus on distributers and fresh-cut operations that already have a mango program in place and are looking to improve.
b. The Mango-PTF understands that mango conditioning affects product palletization and packaging and is taking this into account in the research that is being conducted on the minimum specifications for box design and carton strength.

Conclusion

The mango industry has an enormous opportunity to improve its packaging, reduce product damage, and increase mango movement as a result. The Mango-PTF was established to raise understanding of the challenges faced as an industry, to begin the process of consumer focused and retailer inspired packaging, and to lead initiatives that will resolve the current packaging issues. The task force purpose was not to decide on the best packaging design and expect the industry to adopt it and make changes overnight. New packaging options can only be introduced when there is an accepting receiver willing to take the product. Rather, the purpose of the Mango-PTF was to support the mango industry and provide research, specifications, and guidance that will assist shippers and box manufacturing companies to develop solid options.

There are retailers already using, and many others are requesting a 5-down common footprint option for mangos. It is expected that if retailers prefer and support these new packaging options, then the entire industry will adopt and transition over to a 5-down common footprint. Therefore, it is only a matter of time before these packaging solutions find their way into the market.

Next Steps for the Mango-PTF:

a. Decide what research and testing will be conducted in order to finalize the pallet and packaging material specifications and guidelines.
b. Once research and testing is finalized, review the results and support the specifications and guidelines that will be presented to the mango industry.

NATIONAL MANGO BOARD

PACKAGING STUDY

October, 2019

VIDEO HIGHLIGHTING THE NEW MANGO BOX:

Click Here: https://www.youtube.com/watch?v=5p4rqxy2nCk

PURPOSE OF THE PROJECT

The National Mango Board (NMB) organized a Packaging Task Force in 2016.

Mission: Gather insight from mango industry stakeholders (including growers, packers, exporters, importers, and retailers):

- Identify the current packaging and palletization challenges and any other issues affecting the mango supply chain.
- Emphasize the necessary steps to improve the mango industry's handling practices and reduce shrinkage.
- Advance increased mango movement at the retail level.

ORIGINAL TASK FORCE

- Albertson's/ Safeway — Davis Mochizuki, Director of Produce
- Kroger — Phil Davis, Supply Chain; Lyle O'Banion, Assistant Process Change Manager
- Walmart — Wynn Peterson, Senior Produce Merchant; Gary Campisi, Sr. Director, Quality Control
- Wegman's — Chris Foos, Produce Ripener
- Whole Foods — Chris Romano, Global Produce

- Greg Golden, Amazon Produce Network
- Jojo Shiba, GM Produce Sales
- Sergio Palala, Splendid by Porvenir
- Michael Warren, Central American Produce Co.
- Oscar Orrantia, Durexporta (Ecuador)
- Altamir Martins, Finobrasa Agroindustrial S.A. (Brazil)
- Jorge Perez, Perez Orgánico S. A. de C. V. (Mexico)
- Joaquin Balarezo, Sunshine Export (Peru)
- Veny Marti, Martex Farms (Puerto Rico)
- María Guzmán-Sotomayor and Daniel Lopez Silva, International Paper
- Luis Cristerna, Smurfit Kappa

DISCOVERY

a) Suboptimal designs and materials are being used for pallets and boxes.

b) Mango industry does not use a standard size box and does not consistently utilize the standard 40”x48” size pallets.

c) Majority of the produce industry uses a 5-down standard box footprint, the mango industry utilizes smaller-size boxes (e.g. 12-downs and 14-downs). Resulting challenges include:
   - Mango boxes do not stack well with other produce boxes and can damage other commodities when mixed pallets are consolidated.
   - Pallets with smaller-size boxes are less stable and fall over with more frequency.
   - Current mango box designs and materials are inconsistent and do not hold up well to the humid conditions commonly found in ripening rooms.

d) These deficiencies increase transfer costs, labor, risk and liability, and expenses are commonly passed down to the growers and packers.

WHAT DID WE DO…

The NMB began a palletization and packaging project with researchers and manufacturers:

- Cal Poly University and Michigan State University researchers
- Smurfit Kappa and International Paper carton manufacturers

Four box designs were tested:

- Compression Testing
- Bottom-face Bowing
- Forced-Air Cooling

UPDATED PALLET DESIGN

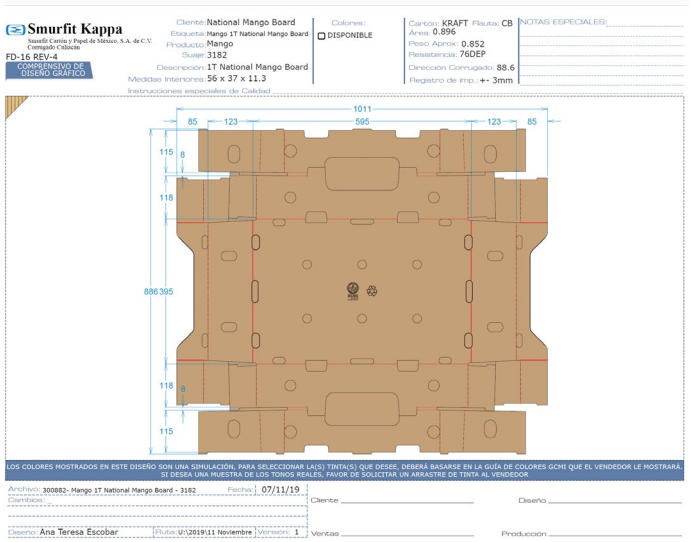
SINGLE USE, 4-WAY, DOUBLE-FACE, NON-REVERSIBLE

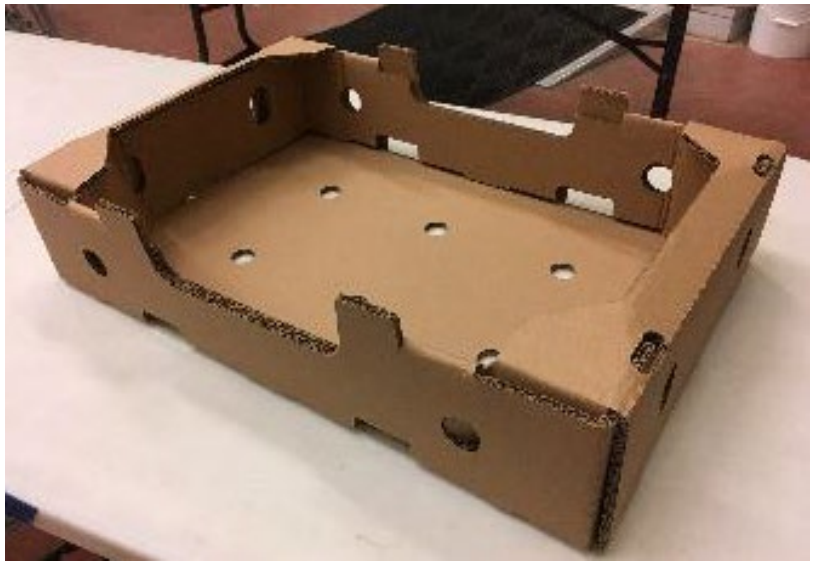
New

UPDATED BOX DESIGN

COMMON FOOTPRINT, 5-DOWN BOX

New





BENEFITS OF THE UPDATED DESIGNS

1) Ease of Use and Efficacy
   - 3 of the 4 Kg. round mango boxes = 1 common footprint box
   - Less labor involved
   - Filling the box with product
   - Stacking and unstacking boxes
   - More display space

2) Improved Pallet Stability
   - Larger base per box
   - Both the pallets and boxes are stronger as a result of the design and materials
   - No pallet transfer gaps

3) Improved Ventilation
   - Additional side and bottom air vents
   - Optimal alignment of vent holes

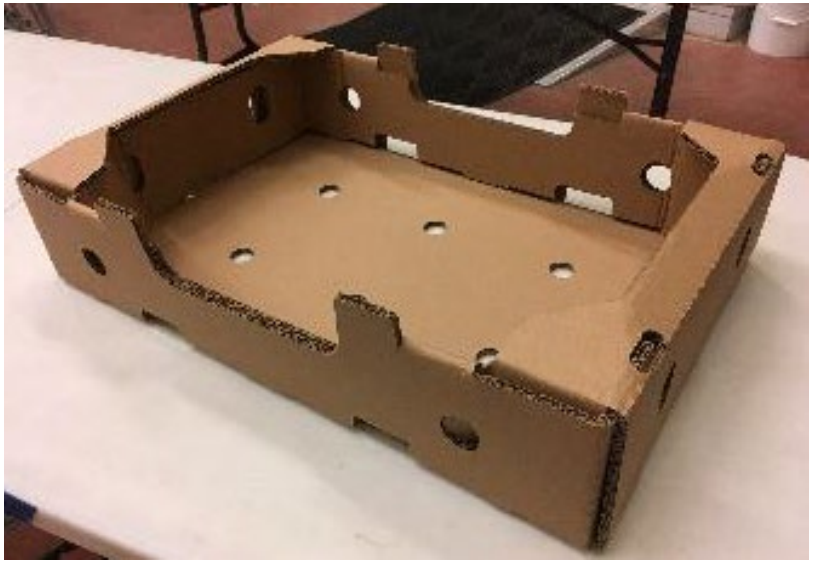
4) Better Durability in High-Humidity Environments
   - Improved crushing resistance and less bottom-face bowing

5) Reduce Overall Total Costs
   - Less fruit damaged = reduced shrink
   - Less carton to dispose of at the end

SUMMARY OF FINDINGS

Updated mango box designs are being recommended for a common footprint box

- Mini-platform on the top of the box provides better support during shipment.
- Less bottom-face bowing which is beneficial in reducing bruising related abuse on mangos during shipment.
- Faster cooling rate.
- Overall improvement in handling.



4 KG BOX TO 5-DOWN BOX CONVERSION

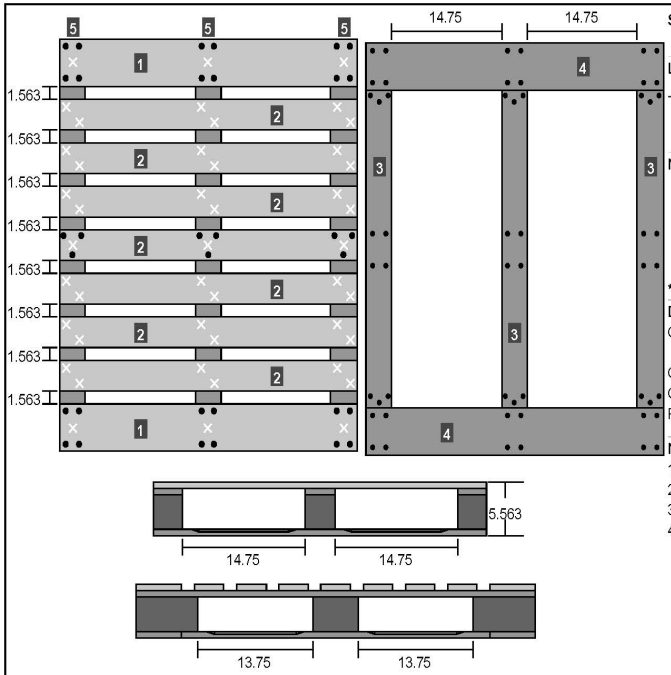
Tommy Atkins

Trays per layer	Corrugated Board	*Mango Count	Mangos/Tray	Weight (lbs.)	Weight (Kg)	Average Mango Weight (grams)	Std. Dev Mango Weight(grams)
5	Double Wall BC-Flute	6	20	32.1	14.6	710.0	57.0
5	Double Wall BC-Flute	7	23	30.8	14.0	592.0	51.0
5	Double Wall BC-Flute	8	25	28.9	13.1	509.0	35.0
5	Double Wall BC-Flute	9	27	28.3	12.8	459.0	39.0
5	Double Wall BC-Flute	10	30	28.3	12.8	414.0	43.0
5	Double Wall BC-Flute	12	37	25.6	11.6	303.0	36.0


Mango.org
QUESTIONS &
DISCUSSION

APPENDIX:

4-WAY DOUBLE FACE WOODEN PALLET



Style: Single-Use, 4Way
DoubleFace Non-reversible, Perimeter Base

Lumber: **Acceptable Lumber Species:**
100% Ponderosa Pine

Min Part Grade: Standard And Better

Max Moisture Content: 19%

Nails: (45 Mat fastener, 87 nails)
See notes below

Length:
Gauge:
Type:
Point:

* or equivalent

Dimensional Tolerance:
Out of Square deviation 1/4"
(1/2" Difference in diagonals).
Overall Length & Width deviation + or - 3/16".
Overall pallet height deviation + or - 1/8".
Pallets shall lie flat at all points within 1/2".

Notes: (lengths in inches)
1. Species - ponderosa, radiata, carribean, loblolly pines
2. Nail TD 3 X 0.120 Inches annular thread.
3. Nail BD 2.5 X 0.120 inches annular thread
4. Clinch nail 1.75 X 0.105 plain clinched or 1.5 inch screw

Deckboards

Item	Qty.	Dimensions
1	2	40.0L x 5.5W x 0.69T
2	7	40.0L x 3.5W x 0.69T
3	3	37.0L x 3.5W x 0.69T
4	2	5.5L x 40.0W x 0.69T

Stringer Boards

Item	Qty.	Dimensions
5	3	48.0L x 3.5W x 0.69T

Blocks

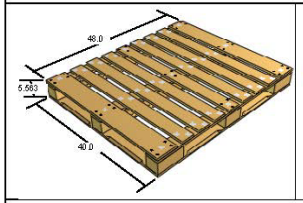
< W >	Qty.	Dimensions
	6	7.5L x 3.5W x 3.5H
	3	5.5L x 3.5W x 3.5H

Approved Pending
Version No. 1
ID. Mango Pallet
Drawing No. 1

Pallet Analysis — Best Pallet Version 3.3.1o*

Prepared By: White and Company LLC
Company: Cal Poly
Analysis ID: SA pine mango pallet V 2
Address:
Date: Oct 12, 2017
San Luis Abispo

Pallet Information: 48.0 in L x 40.0 in W, Weight - 47.8 lbs, HT for Export, Single-Use
Pallet Description: 4Way, DoubleFace , Non-reversible, Block pallet, Chamfered
Pallet Lumber: Ponderosa Pine



Analysis Summary

Required Payload:	2600 lbs
Predicted Maximum Safe Load:	2746 lbs
LoadVariability:	Low

Analysis

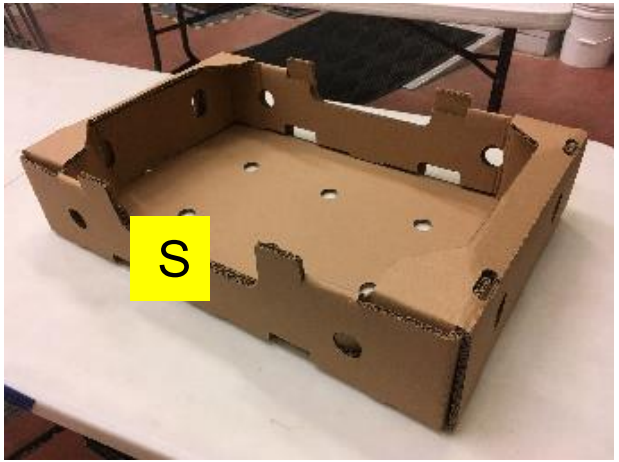
Storage and Handling Conditions	Predicted Maximum Safe Load (lbs)lbs)	Initial Average Deflection (in)in)	Critical Members
Forktine Parallel to Length	8221	0.3	Top Deckboard
Forktine Perpendicular to Length	2746	0.55	Top Stringer
Stacked 1 High	6757	0.14	Top Stringer

Forktine spacing = 14.25, length = 42.0, and width = 5.0

Disclaimer: The performance estimates of Best Pallet represent the best available engineering information compiled to date. However, the quality of workmanship, the input data, and the conditions in which pallets are used may vary widely. Therefore, White & Company, LLC cannot accept responsibility for pallet performance or design as actually constructed. Performance estimates from Best Pallet should be verified by testing of prototypes prior to implementation.

CORRUGATED BOARD SPECIFICATIONS

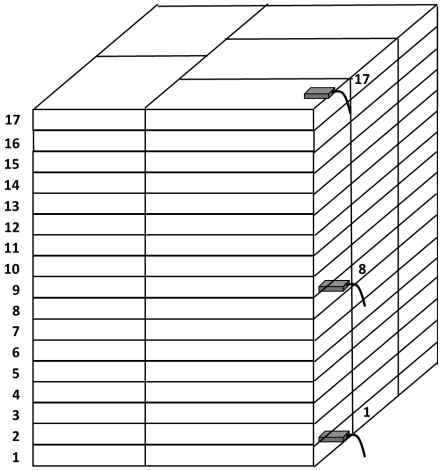
- Double wall board: B/C Flute
- Water resistant adhesive
- Board Combination 35lb - 36lb - 26lb - 36lb - 35lb (Liner-medium-Liner-Medium-Liner)
- ECT – 73 lb./in

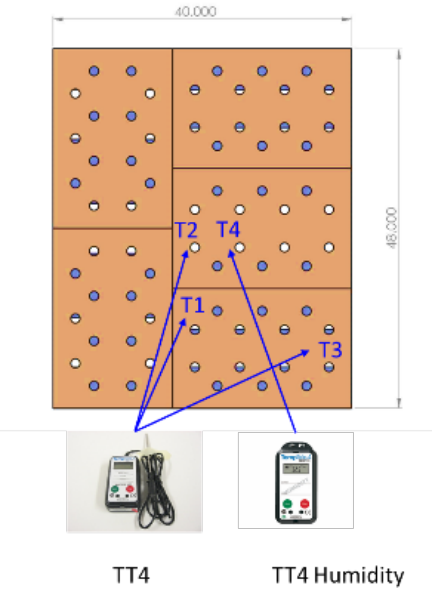


FORCED AIR COOLING TEST

DATA RECORDER INSTRUMENTATION

- To determine the 7/8 cooling time, temperature recorders were placed in layers 1,10 and 17 of the palletized load of mangos.
- Two ‘TT4’ temperature recorder probes in location T1 and T2 were inserted into the pulp of the mango to monitor temperature of fruit.
- A temperature and humidity recorder was placed in location T4 on layers 1,7 and 17 to monitor headspace temperature and humidity during transportation.
- A temperature recorder was placed in location T3 on layers 1,7 and 17 to monitor cooling tunnel temperature.





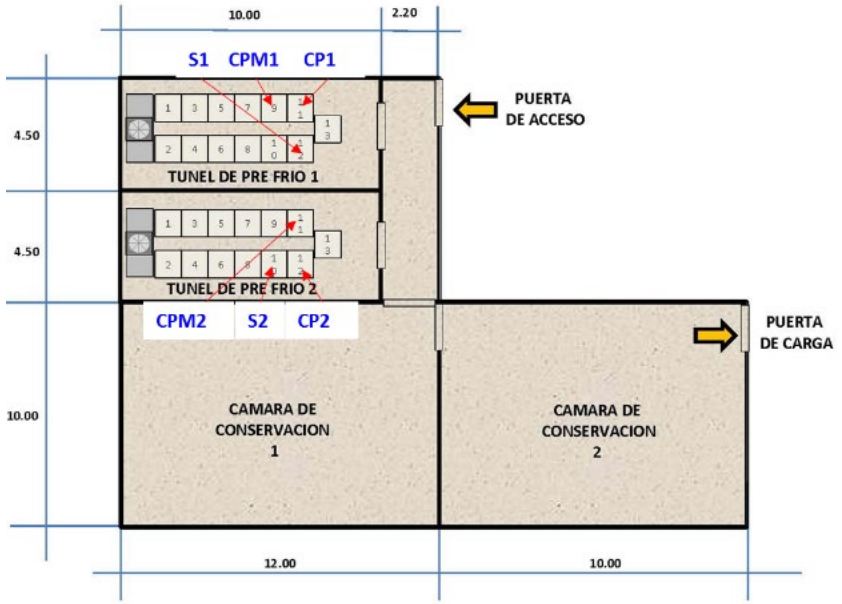
TT4 TT4 Humidity

FORCED AIR COOLING TEST

PALLET LOCATION

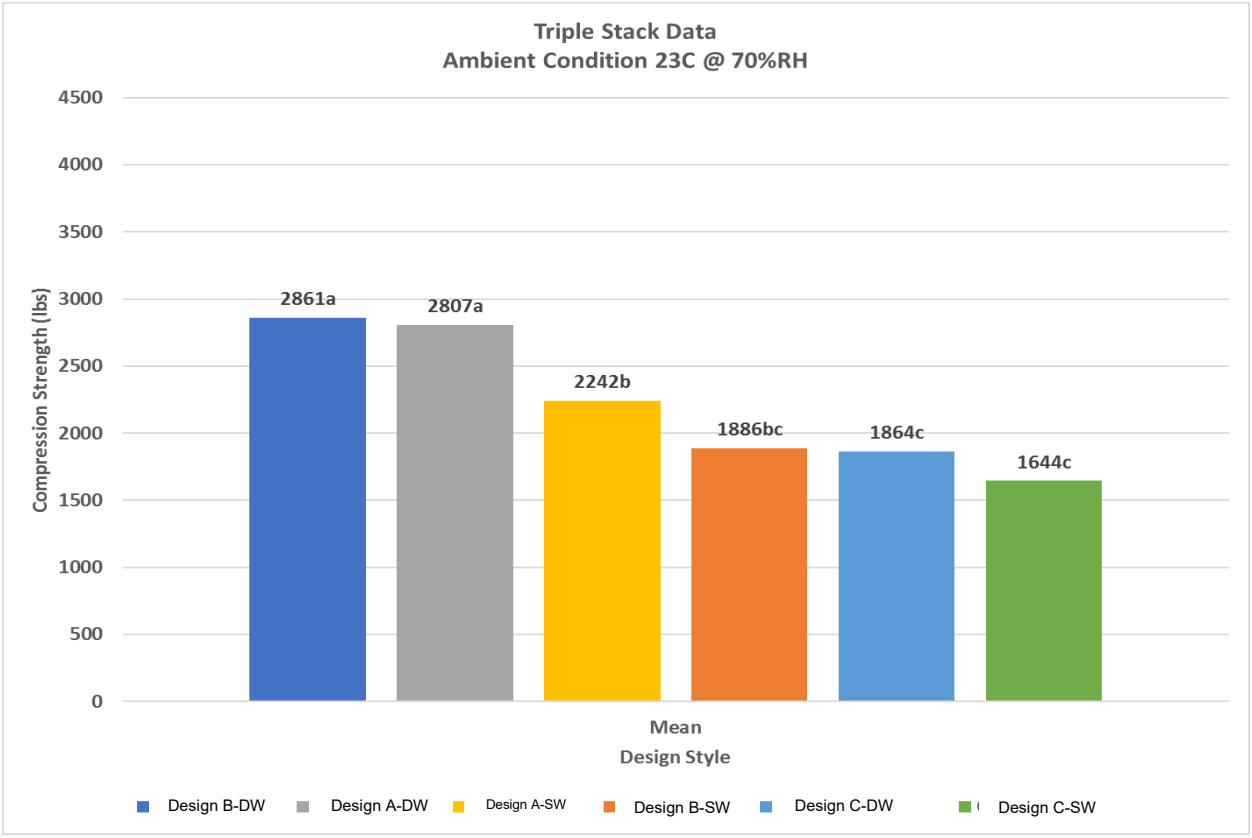
- Two cooling tunnels were used to force air cool 6 palletized load.
- Locations of the pallets are indicated on the picture.
- Initial average internal fruit temperature was 91F and the cooling tunnel temperature was 52F.
- Therefore the 7/8th cooling time will be the time taken to bring down the internal fruit temperature to approximately 56F-7/8th cooling temperature.
- Tunnel 1 ran for approximately 4 hours
- Tunnel 2 ran for approximately 2 hrs 20 mins.

LAYOUT CUARTOS FRIOS GRUMAN



Capacidad de pallets por tunel: 13 pallets
Tipo de caja: Display 4 kg
Temperatura de entrada: 80 -84 F°
Temperatura de salida: 48 -52 F°
Tiempo promedio de pre enfriado: 2 horas 45 minutos

COMPRESSION STUDY



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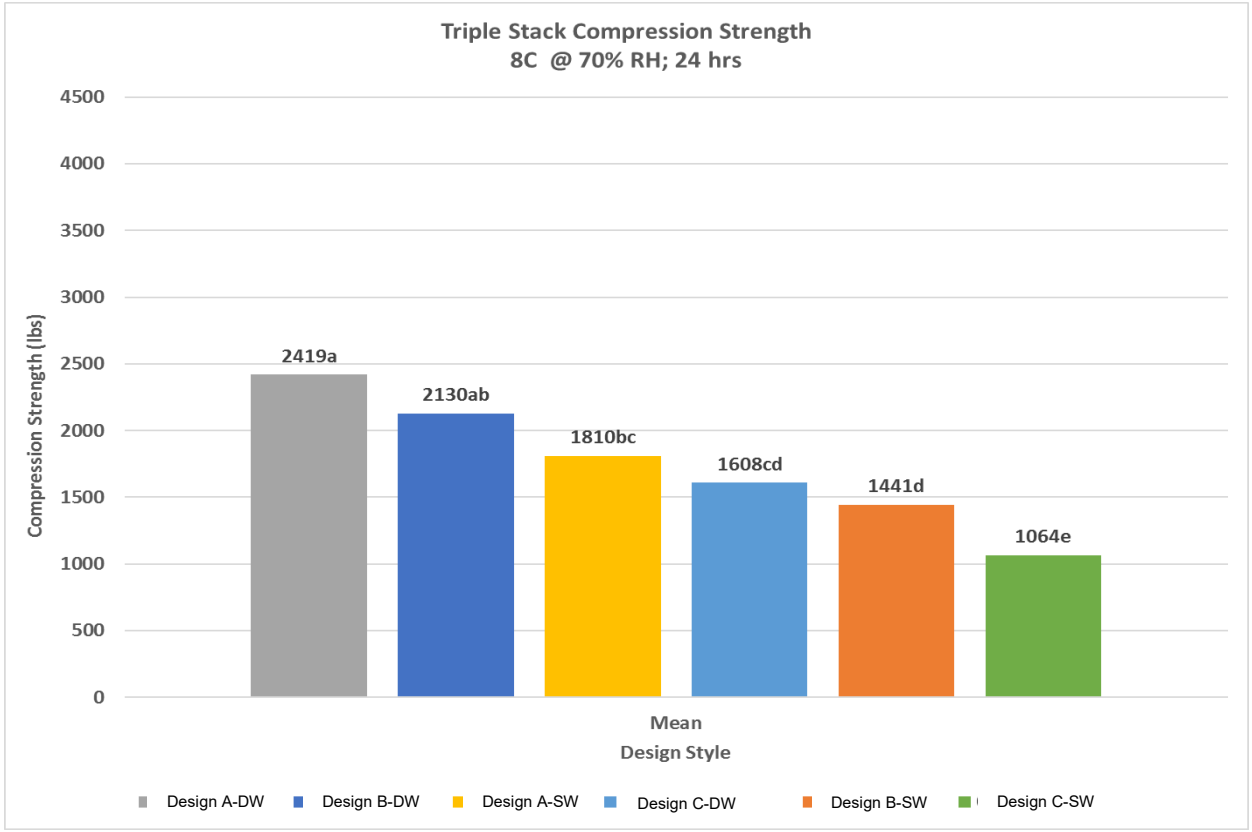


FORCED AIR COOLING TEST

- Project implementation completed: Chahuites, Oaxaca, Mexico mid-April (from April 14 to 18).
- A total of 74 thermometers were installed in 6 different pallets: each box design was set up in a pallet of 17 layers.
- Bottom, mid and top layers (pallet) had 4 thermometers each located in 4 different positions (Except for Design A and Design C, where in the middle layer there were only 3 thermometers).
- The thermometers were calibrated in house to record temperature of the fruit, temperature of the tunnels, temperature of the containers, humidity of the tunnels, humidity of the box, humidity of the container etc.

FORCED AIR COOLING TEST

- A comparative cooling rate study was conducted on pallet loads of the A, B, and C, tray designs in duplicate.
- A standardized 40” X 48” wooden block style developed by PIs was used for palletizing the 5-down trays. Pallet Style- Single Use; 4-Way Double-Face Non-reversible.
- Six pallet loads (17 high x 5-down) were prepared. Trays were filled with 28 mangos per tray (Tommy size-9 ct./4 Kg tray).

FORCED AIR COOLING TEST

RESULTS TUNNEL 1

Tray Type	Predicted 7/8th Cooling Time (Hrs)					
	T1 Location			T2 Location		
	Layer 17	Layer 8	Layer 1	Layer 17	Layer 8	Layer 1
Design B	1.60	3.54	4.74	1.64	*	4.91
Design C	1.52	3.95	4.04	2.14	*	*
Design A	1.29	*	*	1.92	2.79	2.50

Tray Type	Predicted 7/8th Cooling Time (Hrs)					
	T3 Location			T4 Location		
	Layer 17	Layer 8	Layer 1	Layer 17	Layer 8	Layer 1
Design B	1.42	2.93	2.30	0.37	*	*
Design C	2.09	*	3.92	0.78	2.82	*
Design A	1.42	2.93	2.30	0.43	1.63	1.25

FORCED AIR COOLING TEST

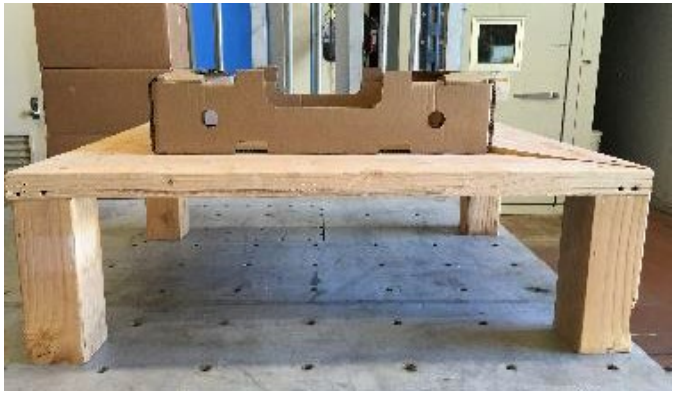
RESULTS TUNNEL 2

Tray Type	Predicted 7/8th Cooling Time (Hrs)					
	T1 Location			T2 Location		
	Layer 17	Layer 8	Layer 1	Layer 17	Layer 8	Layer 1
Design B	3.24	9.41	5.25	1.96	6.49	3.80
Design C	1.55	3.74	3.26	1.77	7.86	8.45
Design A	3.43	*	*	1.73	2.93	3.55

Tray Type	Predicted 7/8th Cooling Time (Hrs)					
	T3 Location			T4 Location		
	Layer 17	Layer 8	Layer 1	Layer 17	Layer 8	Layer 1
Design B	1.99	5.27	*	1.48	2.44	0.88
Design C	1.99	5.27	*	0.39	7.37	3.58
Design A	0.98	2.90	*	0.24	1.93	1.76

BOTTOM FACE BOWING – POST VIBRATION STUDY

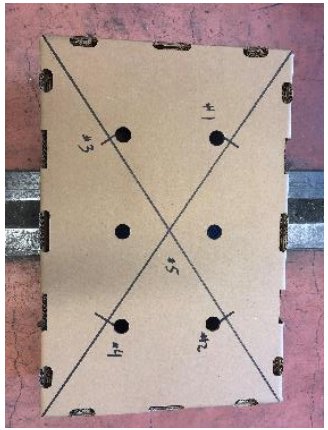
- Mango Variety Tommy 8 Count (4 Kg Tray).
- Mangos Conditioned at 8^{o}C* and 70% RH in trays for 24 hrs.
- Vibration Test- ASTM 4169; Assurance Level II; 60 minutes.
- Quantified bottom face bowing.

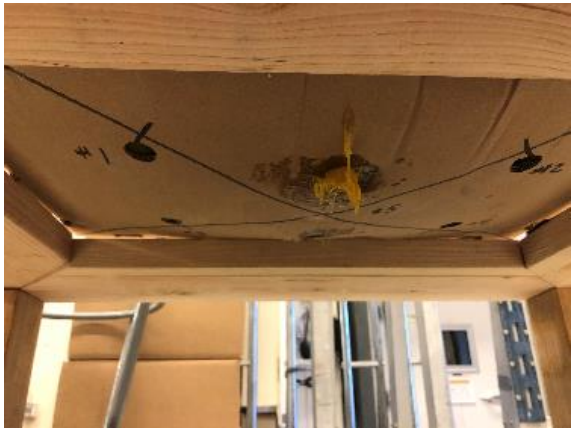


BOTTOM FACE BOWING – POST VIBRATION STUDY

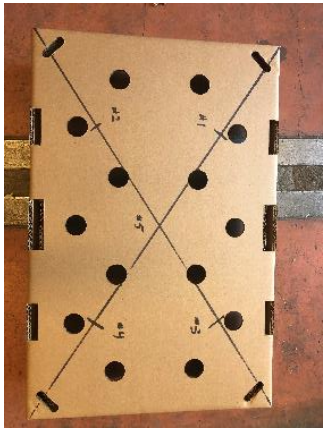
- The average bottom face bowing for Design A was 0.14 inches versus Design B was 0.52 inches.

Design “A”

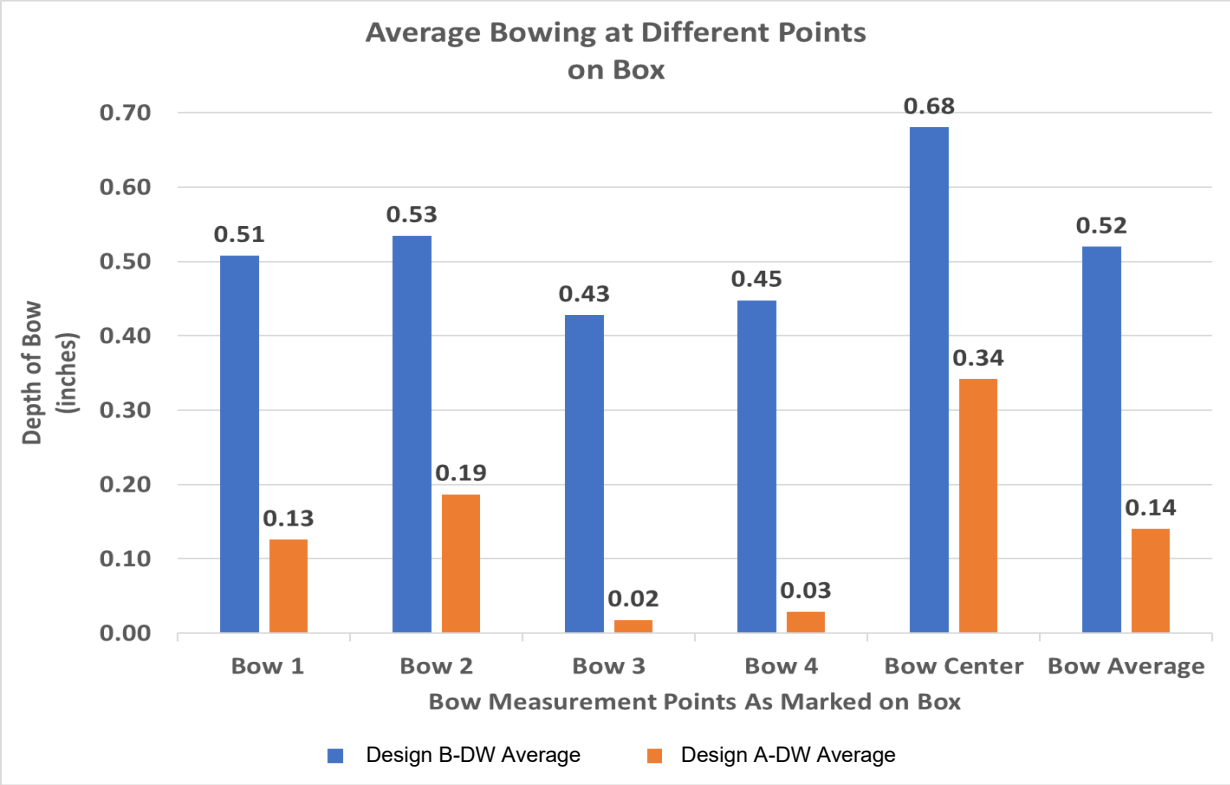




Design “B”



BOTTOM FACE BOWING – POST VIBRATION STUDY



Smurfit Kappa

Smurfit Cartón y Papel de México, S.A. de C.V.
Corrugado Culiacán

FD-16 REV-4

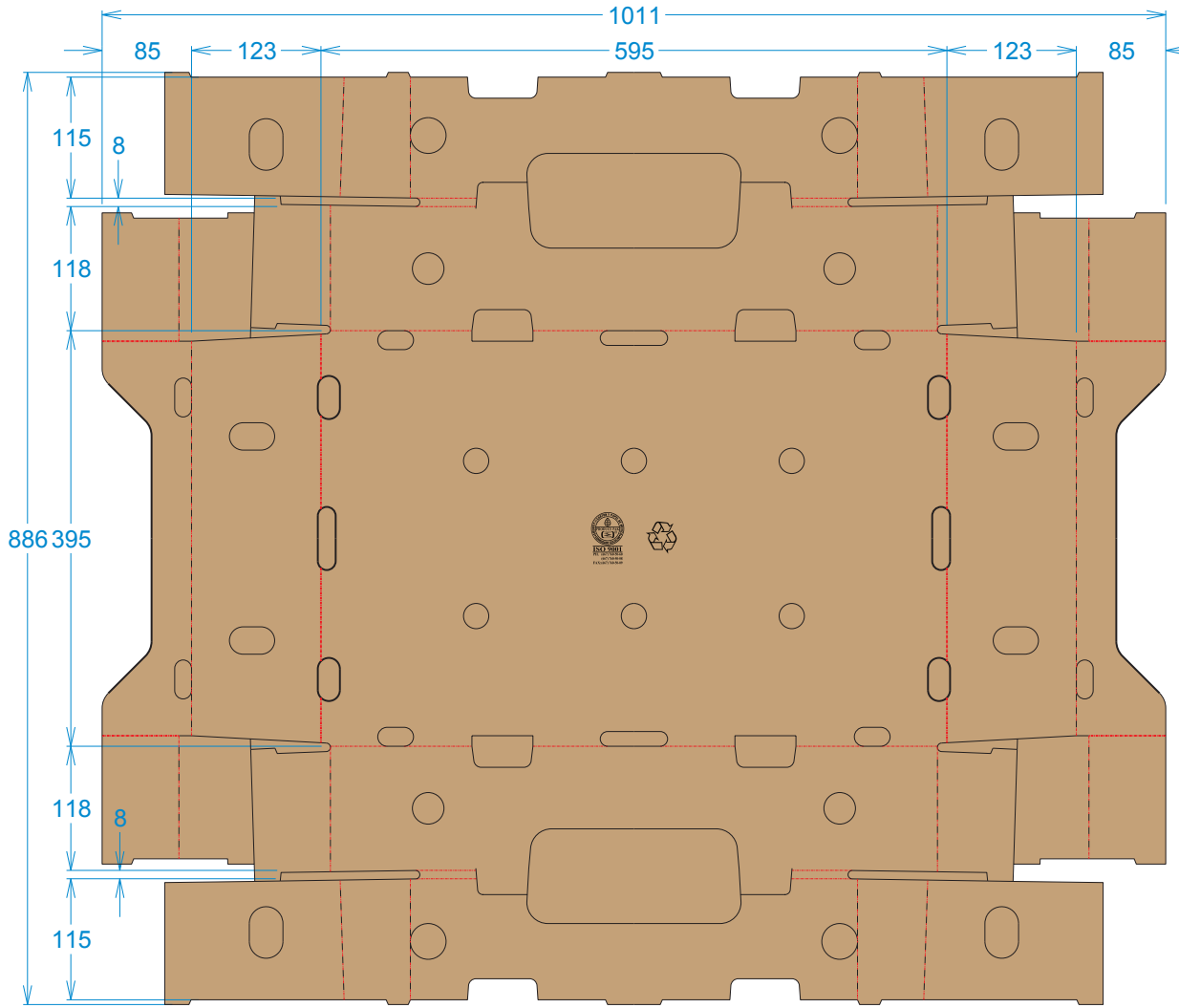
COMPRENSIVO DE DISEÑO GRÁFICO

Cliente: National Mango Board
Etiqueta: Mango 1T National Mango Board
Producto: Mango
Suaje: 3182
Descripción: 1T National Mango Board
Medidas Interiores: 56 x 37 x 11.3
Instrucciones especiales de Calidad

Colores:
☐ DISPONIBLE

Cartón: KRAFT Flauta: CB
Área: 0.896
Peso Aprox: 0.852
Resistencia: 76DEP
Dirección Corrugado: 88.6
Registro de imp.: +- 3mm

NOTAS ESPECIALES:



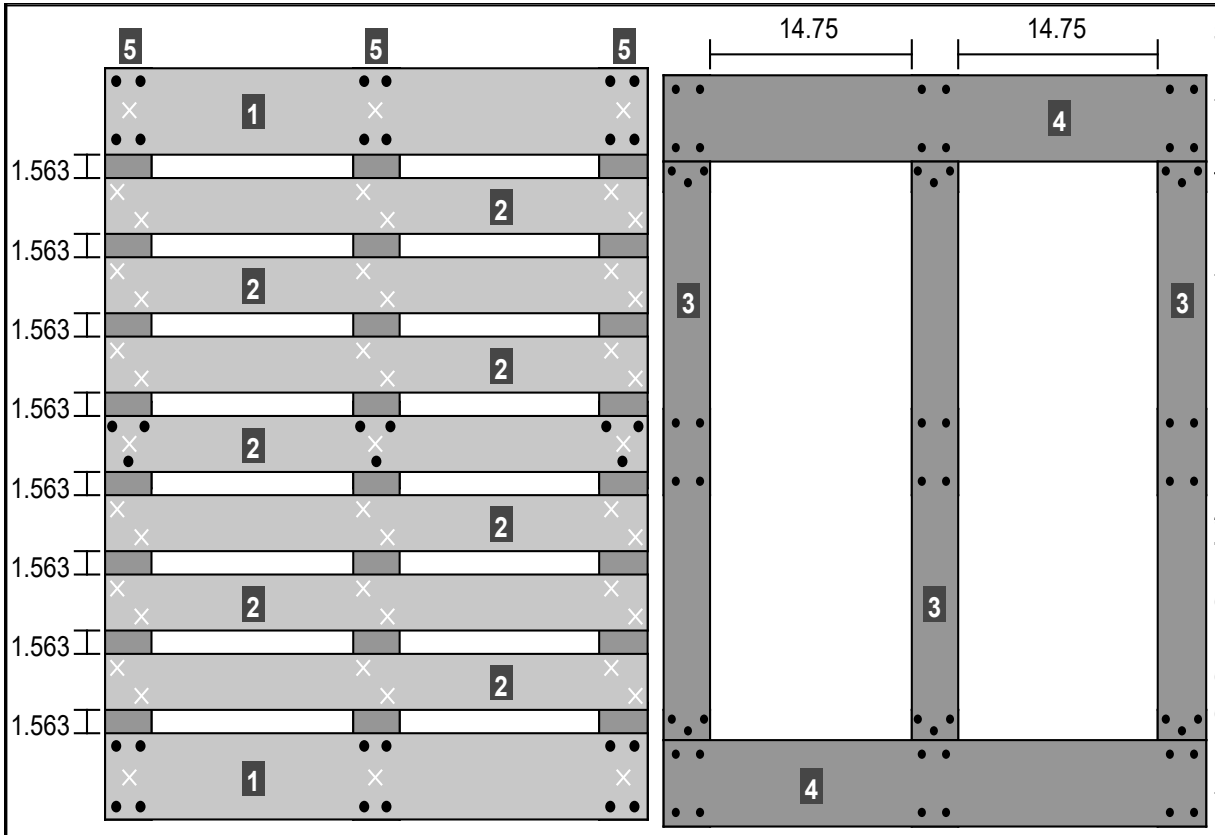
LOS COLORES MOSTRADOS EN ESTE DISEÑO SON UNA SIMULACIÓN, PARA SELECCIONAR LA(S) TINTA(S) QUE DESEE, DEBERÁ BASARSE EN LA GUÍA DE COLORES GCMI QUE EL VENDEDOR LE MOSTRARÁ. SI DESEA UNA MUESTRA DE LOS TONOS REALES, FAVOR DE SOLICITAR UN ARRASTRE DE TINTA AL VENDEDOR

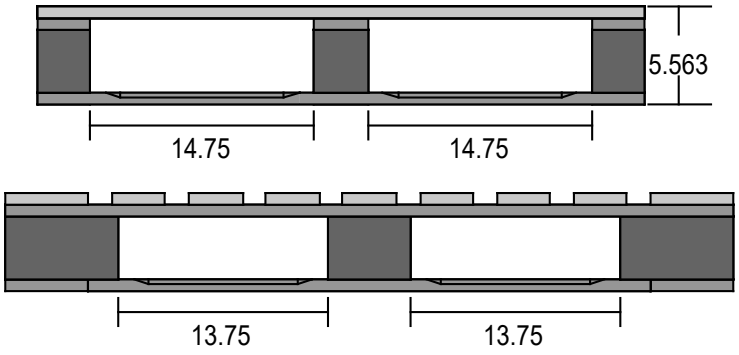
Archivo: 300882- Mango 1T National Mango Board - 3182 Fecha: 07/11/19
Cambios: _

Diseño: Ana Teresa Escobar Ruta: U:\2019\11 Noviembre Versión: 1

Cliente _____ Diseño _____

Ventas _____ Producción _____





Style: Single-Use, 4Way
DoubleFace Non-reversible, Perimeter Base

Lumber: **Acceptable Lumber Species:**
100% Ponderosa Pine

Min Part Grade: Standard And Better

Max Moisture Content: 19%

Nails: (45 Mat fastener, 87 nails)
See notes below

Length:
Gauge:
Type:
Point:

*** or equivalent**

Dimensional Tolerance:
Out of Square deviation 1/4"
(1/2" Difference in diagonals).
Overall Length & Width deviation + or - 3/16".
Overall pallet height deviation + or - 1/8".
Pallets shall lie flat at all points within 1/2".

Notes: (lengths in inches)
1. Species - ponderosa, radiata, carribean, loblolly pines
2. Nail TD 3 X 0.120 Inches annular thread.
3. Nail BD 2.5 X 0.120 inches annular thread
4. Clinch nail 1.75 X 0.105 plain clinched or 1.5 inch screw

Deckboards

Item	Qty.	Dimensions
1	2	40.0L x 5.5W x 0.69T
2	7	40.0L x 3.5W x 0.69T
3	3	37.0L x 3.5W x 0.69T
4	2	5.5L x 40.0W x 0.69T

Stringer Boards

Item	Qty.	Dimensions
5	3	48.0L x 3.5W x 0.69T

Blocks

< W >	Qty.	Dimensions
	6	7.5L x 3.5W x 3.5H
	3	5.5L x 3.5W x 3.5H

Approved Pending

Version No. 1

ID. Mango Pallet

Drawing No. 1

Pallet Analysis

Best Pallet Version 3.3.1o*

Prepared By: White and Company LLC

Company: Cal Poly

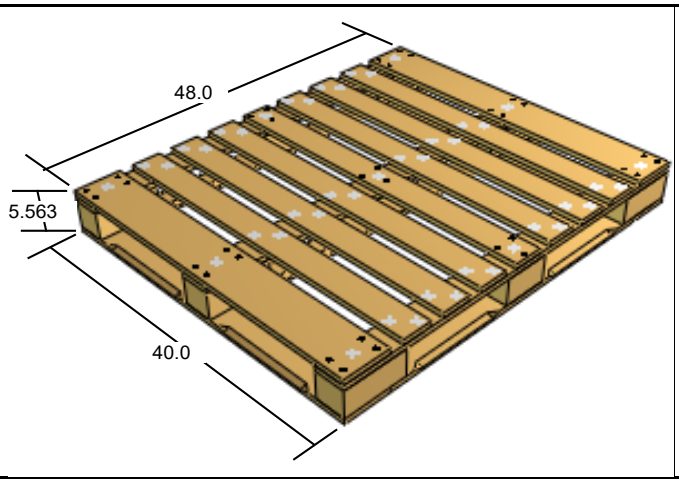
Analysis ID: SA pine mango pallet V 2

Address:

Date: Oct 12, 2017

San Luis Abispo

Pallet Information:48.0 in L x 40.0 in W, Weight - 47.8 lbs, HT for Export, Single-Use
Pallet Description:4Way, DoubleFace , Non-reversible, Block pallet, Chamfered
Pallet Lumber: Ponderosa Pine



Analysis Summary

Required Payload: **2600 lbs**

Predicted Maximum Safe Load: 2746 lbs

LoadVariability: **Low**

Analysis

Storage and Handling Conditions	Predicted Maximum Safe Load (lbs)lbs)	Initial Average Deflection (in)in)	Critical Members
Forktine Parallel to Length	8221	0.3	Top Deckboard
Forktine Perpendicular to Length	2746	0.55	Top Stringer
Stacked 1 High	6757	0.14	Top Stringer

Forktine spacing = 14.25, length = 42.0, and width = 5.0