SOLVE FOR X.

# Pallet Performance in Automated Storage Systems


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MILLWOOD INCORPORATED
Reinventing Unit Load Technology


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## What is X?

- X – how does the pallet interact with the automated system

- X = *f*(input variables)

## Pallet and System Interaction Variables

- Size
- Travel direction
- Lifting limitations
- Friction
- Load Capacity and deflection

## Size

- Contrary to popular belief not all pallets are 48x40
- There is no standard 48x40
- Numerous examples of systems being installed only to find out the unit did not fit
  - Clearances too tight
  - Slave pallets add extra cost

# ANSI MH1 Pallet Standard

- Published by MHI
- New revision published January 2016
  - Addition of alternative pallet materials
- Part 3 Wood Pallets
  - Contains standard tolerances
    - Lumber grades, dimensions
- Part 10
  - Pallets for Automated Systems
  - Written from research funded by MHI in mid 1990's

# ANSI MH1 Pallet Standard – Part 10

- Defines several performance criteria
  - Size Variation
    - +0.125/-0.250 for length and width
    - +0.125/-0.325 for height

## Travel Direction

- Interaction of conveyor system with bottom deck
  - Stringer pallet
    - Basically a unidirectional base
  - Block pallet
    - Perimeter or unidirectional base

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## Travel Direction

- Change of direction
  - Chain transfer
  - Turntable

- Forklift/AGV interface

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# Lifting Limitations

- Interaction with pallet openings
  - Forklift
  - Truck loading
  - Palletizer

# Coefficient of Friction

- $\mu_s = F_h / F_n$
- $F_h$ is the force to initiate pallet movement
- $F_n$ is the weight of the pallet
- Minimum 0.15
- Wood = 0.45, Plastic = 0.30

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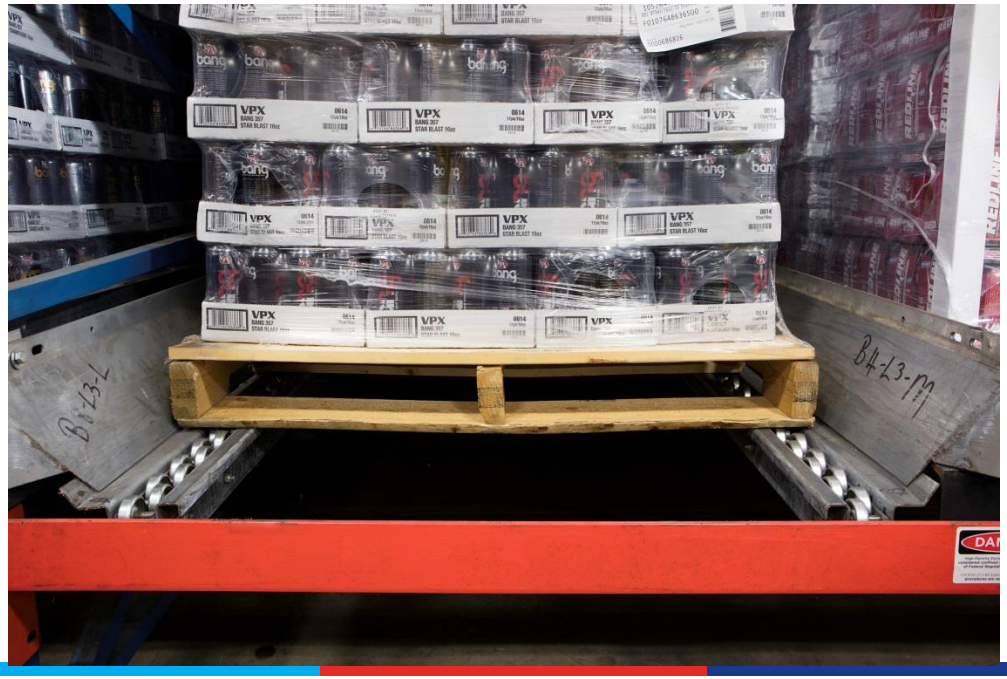
## Load Capacity and Deflection

- Testing – ASTM D1185 or ISO 8611
- Computer analysis
  - PDS or BestLoad

- How to interpret results

# Load Capacity and Deflection - Testing

- Test actual load if it is only load used – most are variable
- Typically using an inflatable airbag
  - Uniform flexible load – worst case scenario



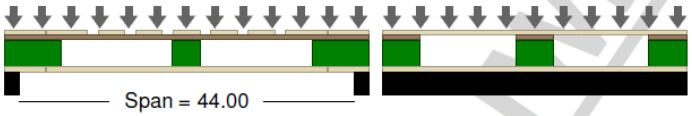
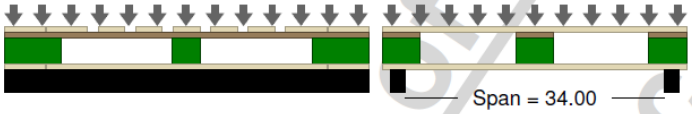
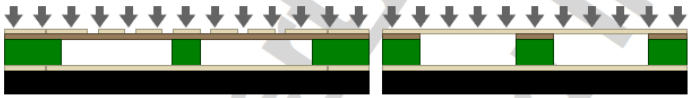
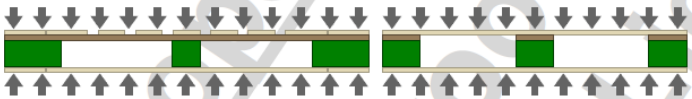
# Load Capacity and Deflection

- Testing will determine **averages**
  - In ASTM D1185 determines safe load capacity
    - From average pallet failure using 2.5 safety factor
    - From average deflection limit of 1.9% of free span using 125% of safe load capacity
      - For a 44” free span on a 48” pallet acceptable limit is 0.84”
  - Part 10 sets a limit of 0.50” at safe load

# Load Capacity and Deflection - PDS

***Classification:*** 48.00 x 40.00, Block-Class, Double-Face Non-Reversible, Full 4-Way, Reusable, New Manufacture

***General Load Type:*** Uniformly Distributed - Full Pallet Coverage
***Load Weight Variability:*** Medium
***Service Environment:*** Dry Environment (EMC <= 19%)

| Support Condition (Side View / End View) | Safe Maximum Load | Deflection at Maximum Load | User Specified Deflection Limit | Maximum Load for Deflection Limit | Critical Member |
|---|---|---|---|---|---|
| Racked Across Length<br>***2 Beam Support***<br>  | 2812 lbs. | 0.69 in. | 0.63 in. | 1892 lbs. | Center Top Stringerbd |
| Racked Across Width<br>***2 Beam Support***<br>  | 3666 lbs. | 0.50 in. | 0.63 in. | 3396 lbs. | Interior Top Deckboard |
| Warehouse Storage<br>***Stacked 1 Unit Load High***<br>  | 10108 lbs. | 0.20 in. | ---- | ---- | Center Top Stringerbd |
| ***Stacked 4 Unit Loads High***<br>  | 3888 lbs. per pallet | 0.20 in. | ---- | ---- | Center Top Stringerbd |

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# Load Capacity and Deflection - PDS

- Safe maximum load is determined from lower 95% MOR of wood species and grade in specification
- Deflection at maximum load is based on average MOE for that load
- User defined deflection limit uses lower 95% MOE to determine load to reach the deflection limit
- In both methods a significant “safety margin” is employed

## Summary

- The pallet is the interface between the product and the handling system
- The pallet specifications and performance are as important as any piece of equipment is the system
- The pallet should be designed with the handling system not after
- Don’t assume the customer will know what pallet to purchase for their new handling system

## *For More Information:*

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ANSI MH1Standard:
http://www.mhi.org/free/8956

Or visit ProMat Booth S2441