Dimensional Weight Pricing: What Does this Mean and How Can We Avoid Large Logistics Cost?

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Defining Dimensional Weight

• Defined as the ratio between the weight and the volume of a shipper.
  – Pounds / Cubic Inches (English)
  – **Pounds / Cubic Feet (English)**
  – Kilograms / Cubic Meters (Metric)
Defining Dimensional Weight

• Oftentimes referred to as:
  – Volumetric weight
  – DIM Weight
  – Cubic Weight

Density = \frac{\text{Weight}}{\text{Volume}}
Defining Dimensional Weight

• Determines the cost of transportation services
• Based on:
  – Package
    • Weight of the package
    • Volume (Dimensions) of the package
  – Vehicle
    • Maximum weight limit of the vehicle
    • Maximum volume limit of the vehicle
Defining Dimensional Weight

• Calculations
  – Determine the cubic volume of the package
  – Units
    • Lbs / Inches$^3$
      – Weight / (Length*Width*Height)
    • Lbs / Feet$^3$
      – Weight / ((Length*Width*Height) / 1728)
  – Usually calculated based on weight per cubic foot
Why is it important?

• Almost all carriers are now (or soon to be) calculating an allowable (dimensional) weight for the size (and weight) of the package you are shipping.

• If the dimensional weight exceeds the actual weight of the package – you will be charged the dimensional weight
Why is it important?

• The result is a dramatic increase in revenue for carriers based on charging by dimensional weight
  – Adjusted shipping charges

• Difficult to adapt and plan for because there are no international or domestic standards for dimensional weight covering all modes of transportation
Why is it important?

• Each vehicle (trucks, airplanes, ships, trains) can only carry a specified maximum weight and maximum volume
  – The carriers cost to ship a load will remain the same regardless of what is shipped
Why is it important?

• Your billable weight will either be the actual weight or the dimensional weight of the cargo
  – Therefore charging on dimensional weight ensures the carrier is getting paid appropriately for the space the packages takes up on its vehicles
  – >>>> Whichever is greater!!
Why is it important?

• Caused by
  – Response to rising fuel costs
  – Increase popularity of online shopping
  • Amazon
  • McMaster Carr
  • Ebay
Why is it important?

• “Common” or “Standard” Dimensional Weight Ratios are listed below:
  – 10.4 lb/ft\(^3\) (Common IATA Shipments)
  – 8.9 lb/ft\(^3\) (Common Domestic Shipments)

• Packages likely to be penalized are:
  – Lighter larger than average size packages
    • Examples: Popcorn and Styrofoam Cups
  – Heavily dense packages
    • Examples: Equipment, Machinery, Raw Materials
Why is it important?

• Companies should try to optimize their package system to be as close as possible to the “standard” dimension weights
  – Avoid being charged for space not used
  – Avoid “adjusted” shipping costs
How is Dimensional Weight Measured?

- Large carriers use automated (in-line) conveyor dimensions to calculate the dimensional weight of the packages
  - Efficient
  - High speed
  - Accurate
  - No human interaction required
How is Dimensional Weight Measured?

- Light Curtain
- Laser Tachometer
- Laser
- Scale
How is Dimensional Weight Measured?
Example #1

- Carrier states one cubic foot will have a minimum weight allowance of 20 pounds / cubic foot

<table>
<thead>
<tr>
<th>Shipper Size</th>
<th>Weight (lbs)</th>
<th>Cubic Foot Conversion (ft³)</th>
<th>Weight to Volume Ratio</th>
<th>Dimensional Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12”x12”x12”</td>
<td>10</td>
<td>1</td>
<td>10 lb / ft³</td>
<td>20</td>
</tr>
<tr>
<td>12”x12”x12”</td>
<td>20</td>
<td>1</td>
<td>20 lb / ft³</td>
<td>20</td>
</tr>
<tr>
<td>12”x12”x12”</td>
<td>25</td>
<td>1</td>
<td>25 lb / ft³</td>
<td>25</td>
</tr>
</tbody>
</table>
Example #2

- Carrier states one cubic foot will have a minimum weight allowance of 10 pounds / cubic foot.

<table>
<thead>
<tr>
<th>Shipper Size</th>
<th>Weight (lbs)</th>
<th>Cubic Foot Conversion (ft³)</th>
<th>Weight to Volume Ratio (lbs) / ft³</th>
<th>Dimensional Weight (lbs) / ft³</th>
<th>Charged Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>24”x12”x12”</td>
<td>30</td>
<td>2.0</td>
<td>15</td>
<td>15</td>
<td>30 lbs</td>
</tr>
<tr>
<td>18”x18”x18”</td>
<td>20</td>
<td>3.375</td>
<td>5.9</td>
<td>10</td>
<td>33.75 lbs</td>
</tr>
<tr>
<td>10”x10”x10”</td>
<td>10</td>
<td>0.578</td>
<td>17.3</td>
<td>17.3</td>
<td>10 lbs</td>
</tr>
</tbody>
</table>
How to Improve Dimensional Weight

• Determine product fragility
  – Eliminates over packaging
• Improve the product (ruggedness)
  – Reduces the packaging materials required
• Change cushioning materials
  – Different materials offer different deflection and protection characteristics at different thicknesses
Determine Product Fragility

- Product shock testing per ASTM D3332 Method B
  - Simulates package being shipped in the distribution environment
  - Margin testing
  - Determines exactly how and where to package your product
Determine Product Fragility

- Product shock testing per ASTM D3332 Method B
Product Improvements

- Reduction in materials
- Reduction in package size
- Reduction in overall “cube”
- Fit more units per pallet
  - Easier to work with
Different Packaging Materials

• Different materials have different deflection properties
  – Same amount of protection with a different thickness
  – Usually materials that deflect more are more costly
  • Might be worth it depending on dimensional weight charges
Different Packaging Materials

- EPS
- EPS / EPE
- PU
- EPE
- PP
- EPS
Minimum Cushion Thickness Equation

\[ D_{\text{min}} = \left[ \frac{2h}{(C \times G)} \right] \times 25.4 \]

Where:
- \( D_{\text{min}} \) = minimum stopping distance (deflection) for the cushion system
- \( h \) = design drop height of package
- \( G \) = fragility of product
- \( C \) = percentage of cushion compression before bottoming out

Note: 25.4 is to convert the units of mm to inches
**Examples**

\[ D_{\text{min}} = \frac{2h}{(C \times G)} \]

<table>
<thead>
<tr>
<th>Product Fragility (G’s)</th>
<th>Design Drop Height (in)</th>
<th>Cushion Material</th>
<th>% Cushion Compression</th>
<th>Minimum Thickness (in.)</th>
<th>Product Size (in.)</th>
<th>Shipper Size (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>36</td>
<td>EPS</td>
<td>50</td>
<td>2.9</td>
<td>10 x 10 x 10</td>
<td>15.8 x 15.8 x 15.8</td>
</tr>
<tr>
<td>50</td>
<td>36</td>
<td>EPE</td>
<td>70</td>
<td>2.1</td>
<td>10 x 10 x 10</td>
<td>14.1 x 14.1 x 14.1</td>
</tr>
<tr>
<td>65</td>
<td>36</td>
<td>EPS</td>
<td>50</td>
<td>2.2</td>
<td>10 x 10 x 10</td>
<td>14.4 x 14.4 x 14.4</td>
</tr>
<tr>
<td>65</td>
<td>36</td>
<td>EPE</td>
<td>70</td>
<td>1.6</td>
<td>10 x 10 x 10</td>
<td>13.2 x 13.2 x 13.2</td>
</tr>
<tr>
<td>90</td>
<td>36</td>
<td>EPS</td>
<td>50</td>
<td>1.6</td>
<td>10 x 10 x 10</td>
<td>13.2 x 13.2 x 13.2</td>
</tr>
<tr>
<td>90</td>
<td>36</td>
<td>EPE</td>
<td>70</td>
<td>1.4</td>
<td>10 x 10 x 10</td>
<td>12.8 x 12.8 x 12.8</td>
</tr>
</tbody>
</table>

\( D_{\text{min}} \)  = minimum stopping distance (deflection) for the cushion system

\( h \)  = design drop height of package

\( G \)  = fragility of product

\( C \)  = percentage of cushion compression before bottoming out
## Examples
### Dimensional Weight Calculations

<table>
<thead>
<tr>
<th>Shipper Size (in.)</th>
<th>Weight (lbs)</th>
<th>Cubic Foot Conversion (ft³)</th>
<th>Weight to Volume Ratio</th>
<th>Dimensional Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.8 x 15.8 x 15.8</td>
<td>15</td>
<td>2.3</td>
<td>6.5 lb / ft³</td>
<td>10.4 lb / ft³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.1 x 14.1 x 14.1</td>
<td>15</td>
<td>1.6</td>
<td>9.4 lb / ft³</td>
<td>10.4 lb / ft³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.4 x 14.4 x 14.4</td>
<td>15</td>
<td>1.7</td>
<td>8.8 lb / ft³</td>
<td>10.4 lb / ft³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.2 x 13.2 x 13.2</td>
<td>15</td>
<td>1.3</td>
<td>11.5 lb / ft³</td>
<td>11.5 lb / ft³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.2 x 13.2 x 13.2</td>
<td>15</td>
<td>1.3</td>
<td>11.5 lb / ft³</td>
<td>11.5 lb / ft³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.8 x 12.8 x 12.8</td>
<td>15</td>
<td>1.2</td>
<td>12.5 lb / ft³</td>
<td>12.5 lb / ft³</td>
</tr>
</tbody>
</table>
Examples

Using GMA Notched Pallet
(48”x40”) Footprint, Stack Height <60”

<table>
<thead>
<tr>
<th>Shipper Size (in.)</th>
<th>Product Fragility (G’s)</th>
<th>Cushion Material</th>
<th>Units per Pallet</th>
<th>Pallets Needed if Shipping 1000 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.8 x 15.8 x 15.8</td>
<td>50</td>
<td>EPS</td>
<td>18</td>
<td>56</td>
</tr>
<tr>
<td>14.1 x 14.1 x 14.1</td>
<td>50</td>
<td>EPE</td>
<td>18</td>
<td>56</td>
</tr>
<tr>
<td>14.4 x 14.4 x 14.4</td>
<td>65</td>
<td>EPS</td>
<td>18</td>
<td>56</td>
</tr>
<tr>
<td>13.2 x 13.2 x 13.2</td>
<td>65</td>
<td>EPE</td>
<td>36</td>
<td>28</td>
</tr>
<tr>
<td>13.2 x 13.2 x 13.2</td>
<td>90</td>
<td>EPS</td>
<td>36</td>
<td>28</td>
</tr>
<tr>
<td>12.8 x 12.8 x 12.8</td>
<td>90</td>
<td>EPE</td>
<td>36</td>
<td>28</td>
</tr>
</tbody>
</table>
Examples
Using GMA Notched Pallet
(48”x40”) Footprint, Maximum Stack Height <60”

18 Units / Pallet

15.8 x 15.8 x 15.8
14.1 x 14.1 x 14.1
14.4 x 14.4 x 14.4

36 Units / Pallet

13.2 x 13.2 x 13.2
13.2 x 13.2 x 13.2
12.8 x 12.8 x 12.8
Conclusions!

• Knowing exactly how to calculate dimensional weight is key to minimizing adjusted costs of shipping packages

• Dimensional weight pricing is quickly becoming the industry standard
Conclusions!

- Companies need to adapt in order to avoid adjusted costs
  - Determine product fragility
  - Improve the product (ruggedness)
  - Change cushioning materials
QUESTIONS?
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