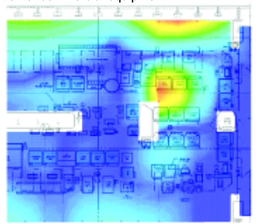
NNI SHOCK & VIBRATION ANALYSIS & TESTING SUPPORT

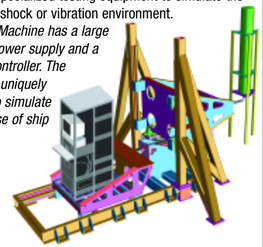
In addition to their shock and vibration expertise, NNI's engineering staff has an extensive background in ship analysis and design. This experience is utilized in analyzing customer problems for C-Worthy™ application and integration issues. Examples of some of the background capabilities of our engineering staff includes:

Analyzing the internal response of ships to enable the insertion of commercial equipment.



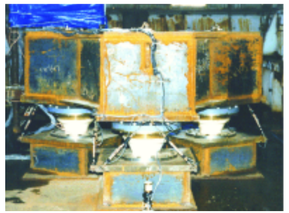
Shock Response of Ship Deck Developed with ABAQUS

Designing specialized testing equipment to simulate the actual ship shock or vibration environment.
(The Chirp Machine has a large hydraulic power supply and a powerful controller. The Machine is uniquely designed to simulate the response of ship decks.)



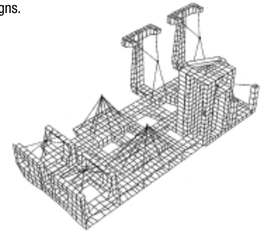
Chirp Machine

Designing specialized testing systems to study the mechanical, shock, or acoustic performance of mounts.



Shock / Acoustic Mount Shock Trials

Creating detailed models of foundations and supporting structure that are used to maximize the efficiency of the designs.



Machinery Foundation Analyzed with MSC/NASTRAN

This experience helps form the foundation of what goes into our C-Worthy™ solutions. Our engineers know ships and ship responses. In addition to shock isolation mounts, NNI offers the following services to our customers:

- Application Engineering
- Shipboard Environment Definition
- Above Mount FEA and response
- Component Level Response Analysis
- Test Program Development (FSP, MWSM, LWSM)
  - Procedure Writing
  - On Site Support
- Test Lab Services
  - Light Weight Shock Machine
  - Vibration Testing
- Chirp Machine Support

C-Worthy™ Shock Mounts

Shock & Vibration Isolation Technology

CW1A-473 X 12O00

Products And Services

Call for information on:
Style 1 and Style 2 Mounts • Custom Mounts • Engineering Services
Installation Services • Testing Services

Newport News Industrial Corporation
182 Enterprise Drive
Newport News, VA 23603
(800) 627-0353 / (757) 380-7053
http://nni.nns.com

NEWPORT NEWS INDUSTRIAL

C-Worthy™

Shock & Vibration Isolation Technology

NORTHROP GRUMMAN
Newport News

US Patent Number 06254070

C-Worthy™ Shock Mounts

PRODUCT SUMMARY

The C-Worthy™ shock mount is a commercial shock and vibration isolator that is rugged enough to enable the use of commercial off-the-shelf equipment in Naval applications to reduce life cycle cost.

Typical Applications

• Navy • Maritime • Seismic • Transportation

TESTING

Although the C-Worthy™ mount is a commercial item, it is compliant to many MIL Spec criteria and has performed well in 901D Barge Testing. The following are examples of proof testing conducted during C-Worthy™ development:

- **MIL-M-17185**
  - Static Load Deflection
  - Vibration
  - Shock Isolation
  - Salt Spray
  - Oil
  - Drift
- **MIL-STD-167/1 Vibration Test**

Additional Testing

- Drop Weight Tests
- Static Pull To Failure
- MIL-S-901D
  - Light Weight Shock Machine
  - Medium Weight Shock Machine
  - Heavy Weight Barge Testing

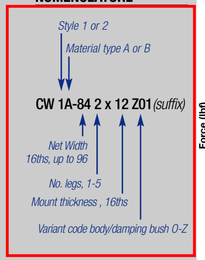
SPECIFICATIONS

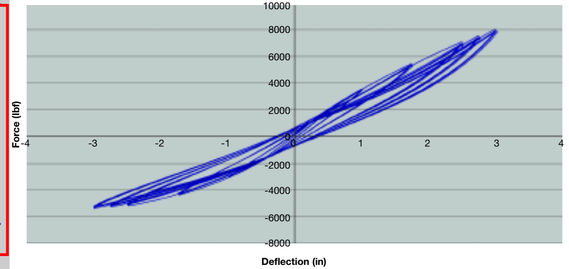
- Weight capacities from 5 to 700 Pounds
- Material Dupont Hytrel®
- Frequency 5 - 7 Hz
- Temperature range -30ºF to 150ºF
- Maximum Drift 0.1 inch @ 150ºF
- 10 to 30 Year Service Life

ADVANTAGES

- Higher damping factor
- Better balance between tensile - compressive deflection regimen
- Relaxation of tolerance on cabinet weight
- Independent adjustment of lateral and vertical stiffness
- Load matching – allows greater ability to make mounts' global (3-axis) center of effort coincident with cabinet CG
- Ability to accommodate customer needs with respect to attachment points and mount orientation.
- The NNI C-Worthy™ Program offers limited free analysis and application engineering services to assist in customer mount selection. This is accomplished by:
  - Three-axis response analysis to a catalog of Floating Shock Platform (FSP) test data.
  - Utilizing multiple fundamental modes (including rocking modes) in a modal transient analysis.
  - Evolving damping (small and large displacements) loss models

PART NUMBER NOMENCLATURE





Typical Force Deflection Curve

C-Worthy™ Shock Mounts

APPLICATION ENGINEERING DATA SHEET

Submit To:
Newport News Industrial
182 Enterprise Drive
Newport News, VA 23603
Phone: (757) 380-7053
Fax: (757) 688-3841
E-mail: nni@nns.com

Requested By:
Name:
Company:

Phone:
Fax:
E-mail:

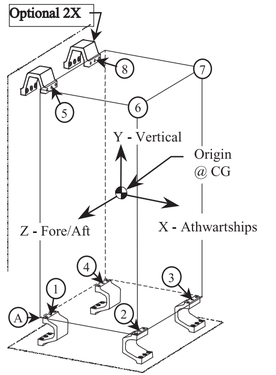
Contact Me Regarding:
☐ Mount Sizing (See Below)
☐ Custom Mounts
☐ Engineering Services
☐ Installation Services

Component Data
System or Component Name:
Shock Test Specification/Performance Requirements (ex, Mil-S-901D/<20 g):
Test Environment/Frequency (ex, Medium Weight Shock, Barge/14 hz deck):
Vibration Test Specification/Performance Requirements (ex,Mil-Std-167/<4 g):
Component Weight in Pounds:
Component Outside Dimensions – X by Y by Z in Inches:

Installation Information
Ship Type (ex, CVN-68):
Mounting location (ex, Deck, Hull, Shell):
Mounting orientation (ex, faces F/A, unrestricted):
Mounting Restrictions (ex, Height restrictions, Base mount only):
Ambient Temperature Range:

Project Scope
Expected deliverable quantities (ex, 12 units in 2004; 12 units in 2005):

Note: *Call for non-naval/maritime installations.*



Standard Mounting Configuration

Cabinet to Ship Orientation

Direction	Axis (X, Y or Z)
Vertical	
Athwartships	
Fore/Aft	

Coordinates of Points in Inches

Point	X	Y	Z
Corner A			
1			
2			
3			
4			
5			
6			
7			
8			

NOTES:
1. Points 1-8 at interface with mount center bolt hole.
2. Sway mounts at Points 5-8 are needed for taller cabinets.
3. Point Coordinates are with respect to the Origin.
4. For points without mounts, enter corner coordinates.
5. Standard configuration shown – contact NNI for others

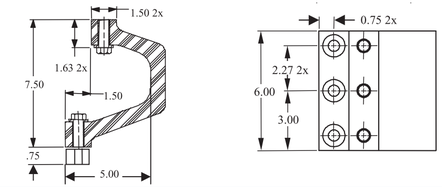
C-Worthy™ Shock Mounts

INSTALLATION GUIDE

This document is provided to highlight information that is necessary for effective C-Worthy™ Shock Mount installation. It is important that the customer adhere to the following criteria as described below to ensure the mounts are able to perform consistent with intended functionality.

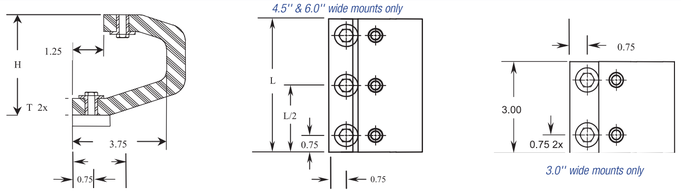
1. C-Worthy™ mounts require a liner/spacer to be installed under the long leg flange for proper operation. (Some installations use alternate mounting means. If this is the case, be certain that the minimum elevation requirement is maintained. There is no maximum.) Style 1 spacers are a minimum 0.75-inch thick. Style 2 spacers are a minimum 0.50-inch thick.
2. Ensure that bolts are inserted in the direction shown in the envelope dimensions figure below.
3. Do not use any spacers, washers, or lock-washers between the bolt head and the bushings as these conditions can reduce the axial travel limits of the mounts.
4. Clearance Requirements - There should be no obstruction that could limit travel of the mount or the isolated equipment for 4 inches in all directions for the Style 1 mount. The Style 2 mount and equipment requires a 3-inch clearance in all directions.
5. Uniformly load all mounts by either blocking equipment or hoisting to ensure mounts are neither over or under loaded during setup. For example, do not locate sway mounts by setting cabinets on base mounts first. Upper mounts provide support for both vertical and sway loads.
6. Orientation of sway mounts should open C facing down. (See standard orientation figure located on Application Engineering Data Sheet.)
7. Mounts should be positioned in the corners of the cabinet as far apart as practical. Refer to standard orientation figure for optimal mount spacing illustration. Standard orientation figure is a suggested orientation. Actual mount orientations may differ from that shown. (Mount spacing is a more critical concern when sway mounts are not utilized.)

Note: *Height and width dimensions remain consistent for all Style 1 mounts and vary with thickness for Style 2. Fastners and spacers not included.*



Style 1 Envelope & Bolting Configuration

4.5" & 6.0" wide mounts only



3.0" wide mounts only

Style 2 Envelope & Bolting Configuration