Navy Evaluation and Use of Alternative Fastening Technologies For Life-Cycle Cost Reduction

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- Navy Fastener Issues
- Evaluating Alternatives
- A Success Story
- Technologies Being Evaluated
- Technologies For Evaluation
- The Way Forward

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Navy Fastener Issues

- Ships use millions of fasteners (bolts, nuts, etc.)
  - Assemble and install machinery
  - Install piping, cabling, ventilation ducting, walls, etc.
- Ship fasteners have wide variety
  - Size range - more than 6-inches diameter to very small
  - Materials - steel, stainless steel, bronze, Monel, K-Monel, Inconel, titanium, and others
  - Environments – mild to very corrosive

Navy Fastener Issues

- Traditional fastener technologies no longer good enough
  - Large diameter fasteners difficult to install
  - Fitted (body bound bolts) expensive to install
  - Welded studs dangerous to install
- The Navy needs new fastening technologies
  - Commercial non-traditional fastening technologies provide opportunities
  - Require evaluation to determine if they meet Navy needs

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Evaluating Alternatives

- Navy requirements
  - Common requirements – Vibration, etc.
  - Unique requirements – UNDEX Shock
    - MIL-S-901 governing specification
    - Focused on assemblies, not components
- Evaluation program
  - Must ensure technology meets requirements
  - Must consider full range of potential applications and environments
  - Must do enough testing, but no more
  - Must be cheap!

Evaluating Alternatives

Navy Fastener Evaluation Program Outline

- Identify candidate technologies
  - Shipyards
  - Technology review
- Obtain NAVSEA interest
  - Funding source
- Review existing data
  - Vibration testing
  - FEA, etc.

Navy Fastener Evaluation Program Outline

- Evaluate as appropriate
  - Identify appropriate uses and criteria
  - Comparative test
  - Analyze data
- Develop guidance for technology use

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Evaluating Alternatives

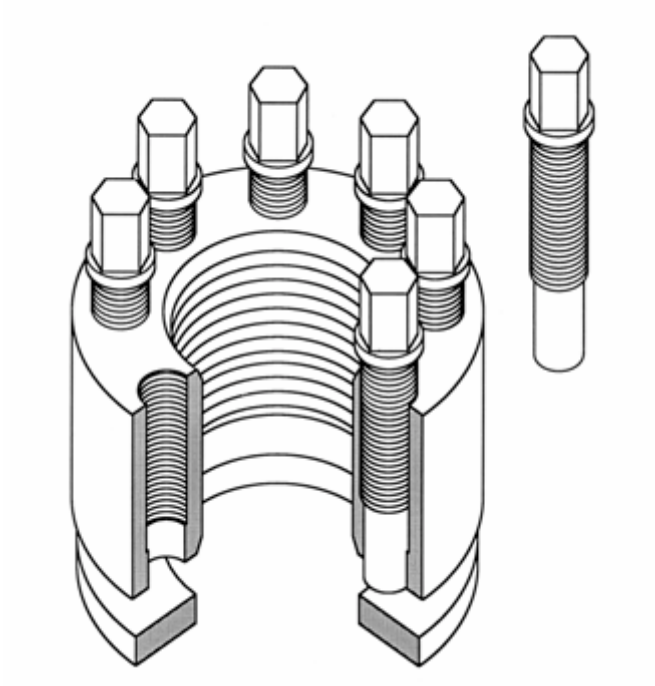
Multi-Jackbolt Tensioners

- Features
  - Easier to torque alternative to large nuts
  - Passed comparative shock testing
  - Authorized as substitute for conventional nuts, with conditions
- Advantages
  - Easy to torque, requires hand tools instead of large hydraulic torque wrench
  - Saves installation time

Multi-Jackbolt Tensioners

- Disadvantages
  - Sole source
  - Costs more than conventional nut
- Used on Navy applications:
  - Shaft seal
  - Shaft coupling
  - Propulsion machinery foundations
  - Other applications

Multi-Jackbolt Tensioners



Multi-Jackbolt Tensioners

Expanding Bolts

- Features
  - Alternative to fitted (also called body bound) bolts
  - Consist of an inner stud and an outer expanding sleeve
  - Several manufacturers, several types, subtle but important differences
- Advantages
  - Easier to install - bolt expands to fill hole
  - Less machining, no rework

Technologies Being Evaluated

Expanding Bolts

Expanding Bolts

- Disadvantages
  - Each type sole source, types not interchangeable
  - Can cost more than fitted bolt
- Evaluation status:
  - One type passed initial screening testing
  - Seeking funding to evaluate
  - Several shipyards asking to use
    - Propulsion machinery foundations
    - Shaft couplings

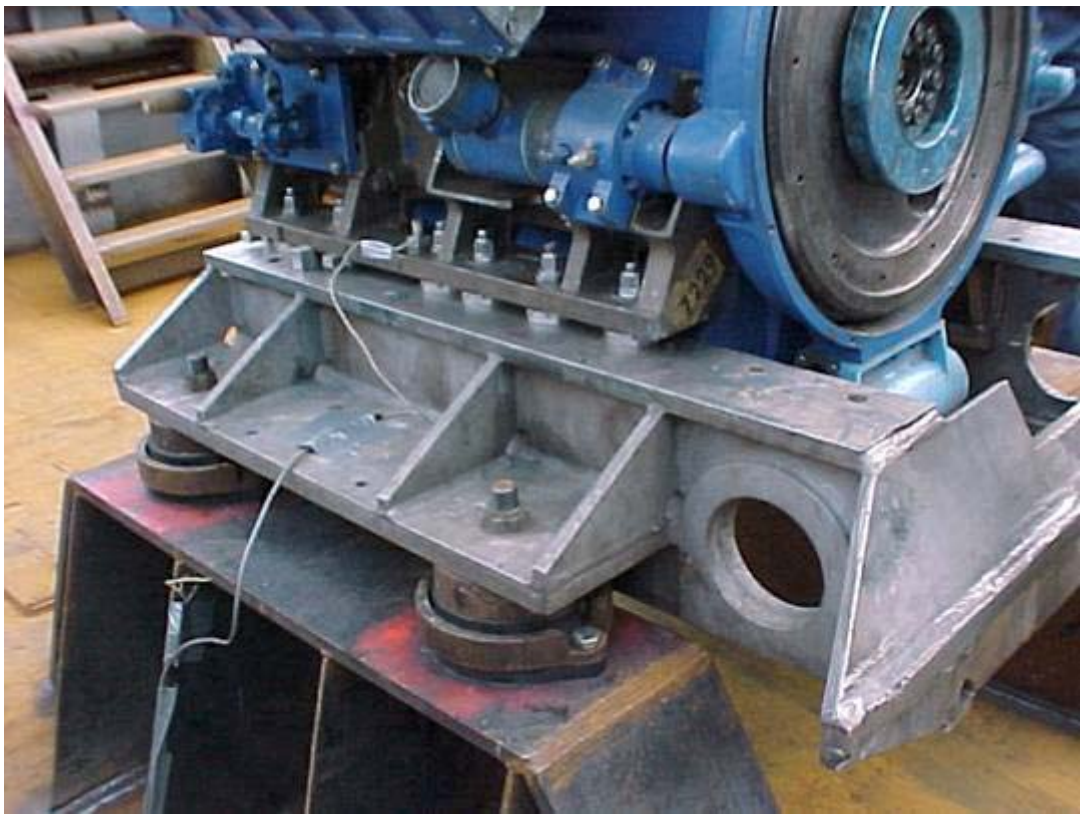
Adjustable Chocks

- Features
  - Alternative to machined solid metal chocks used to align machinery to foundations
- Advantages
  - Significantly faster to install
  - No rework
  - Significant cost savings

Technologies Being Evaluated

Adjustable Chocks

Adjustable Chocks



Adjustable Chocks

- Disadvantages
  - Sole source
  - Can have smaller contact area
  - Other issues?
- Evaluation status:
  - Evaluation tested
  - Expect approval for new applications
  - More testing needed for retrofit – seeking funding

Adhesively Mounted Studs

- Features
  - Alternative to welded studs for mounting light weight components
- Advantages
  - Eliminates costs associated with welding
    - •Fire watch on opposite side of bulkhead
    - •Flammables removal on opposite side of bulkhead
    - •Gas-free of tanks, voids, etc.

Adhesively Mounted Studs

- Disadvantages
  - Sole source
  - Longevity and compatibility of adhesive
  - Other issues?
- Evaluation status:
  - Seeking funding to evaluate

Adhesively Mounted Studs

The Way Forward

- Commercial non-traditional fastener technologies provide opportunities
  - Cost savings over current techniques
  - New capabilities
- Well designed evaluation and implementation programs will minimize risk while providing benefits