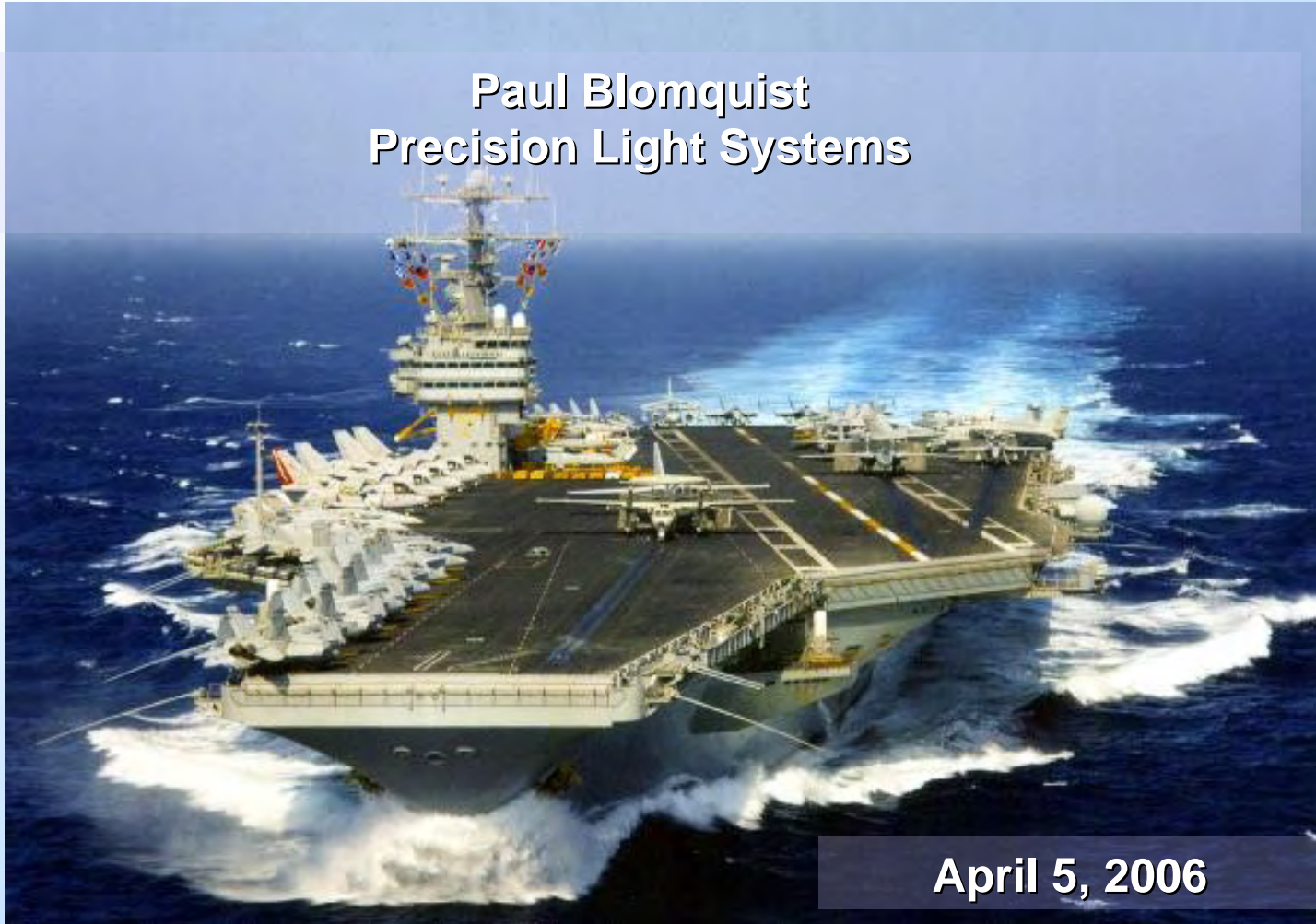




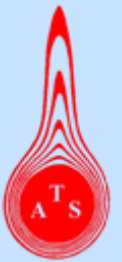
# NSRP SP-7 Meeting



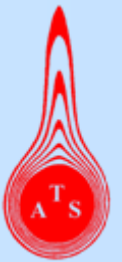
Paul Blomquist  
Precision Light Systems



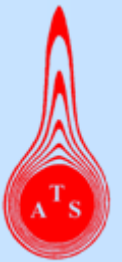
April 5, 2006



- **Current Shipbuilder-Focused Projects**
- **Common Goals & Synergy of Laser Projects**
- **Challenges of Super-Duplex Hybrid Welds**
- **Recent LASCOR Deliveries**
- **Summary**



- **Laser Fabricated Structural Shapes for Naval Applications**
  - SBIR Phase II & III FY00-04
  - Optimized Structural Shapes for Shipbuilding
  - Trial on SSN-688 Safety Line Tracks (Complete Q3 FY05)
- **Laser Panel Welding Project**
  - SBIR Phase I – Laser Plate Butt Welding (FY04)
  - SBIR Phase II –
  - Butt Welding for Shipyard Application
  - Establish Laser Panel Manufacturing Capability
    - Large-Scale; Generic in Nature, Highly Flexible
    - Program Supports all Platforms



## CTC LASCOR Project (FY04-06)

- ATS Proposal in Response to RFQ of 11/03
- Manufacture Precision Hi-Strength Sandwich Panels
- Target Application: CVN-78

## ONR SBIR – Low Distortion Panel Line Upgrade

## ATS/TSI Commercialization Efforts

- Joint Venture Formation
- Commercialization Agreements in Place (ESAB)

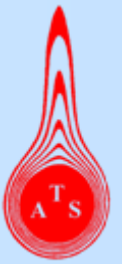
## Maine Technology Institute Projects

- Laser Facility (ATS) – FY 2001
- Panel Manufacturing Facility (TSI) – FY2005
- Total in Excess of \$650K State & Internal Funds



# Common Goals of Laser Projects

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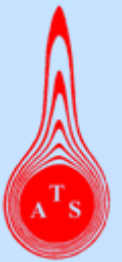


- High-speed fabrication to achieve manufacturing cost goals
- Accurate fabrication to achieve dimensional goals & reduce assy. cost
- Flexibility to achieve wide range of applications
- Design flexibility:
  - Can add to mission capability with low impact on overall vessel performance
  - Can modify Design to Suit DFA Goals
- High Accuracy Provides Significant Opportunity for Downstream Assembly Cost Savings



# Synergy of Current Projects

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## Laser Fabricated Structural Shapes for Naval Applications

- Qualified Product & Process for Hybrid Welding of T's
- System Implemented on Modified ESAB Production Equipment

## Laser Panel Welding Project

- Laser Plate Butt Welding: Transfer PC/QA System to Butt Welds
- Laser Panel Manufacturing: Adapt System to Sandwich Panels

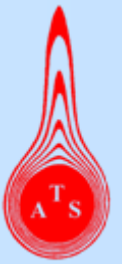
## CTC LASCOR Project (FY04-06)

- Benefits from Prior/Concurrent Project Developments
- Target Application: CVN-78
- Scheduled to Take Advantage of Output from all COE's (iMAST, NJC, CTC & Prior Work of Others)



# Synergy of Current Projects – Cont'd

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## CTC LASCOR Project

- ATS efforts do not compete with or duplicate COE objectives
- Gains leverage from Laser Panel Welding Project

## Laser Panel Welding Project

- Provides cost-share via significant non-federal investment
- Takes advantage of European successes
- Provides quick start-up for larger panels for development
- Pilot plant for lead-in to efficient larger scale manufacturing

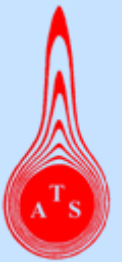
- **Fiber Laser System**
- **10 kW Continuous Output**
- **High-Efficiency Operation**
- **Butt welds;**
- **Stake welds; or**
- **Fillet-reinforced tee joints**
- **Capable of cutting or welding**
- **Performance Evaluation Underway**





# LASCOR Manufacturing Concepts

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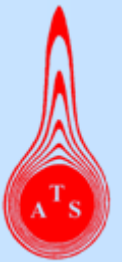


## ATS/PLS Goals

**High Dimensional Accuracy**

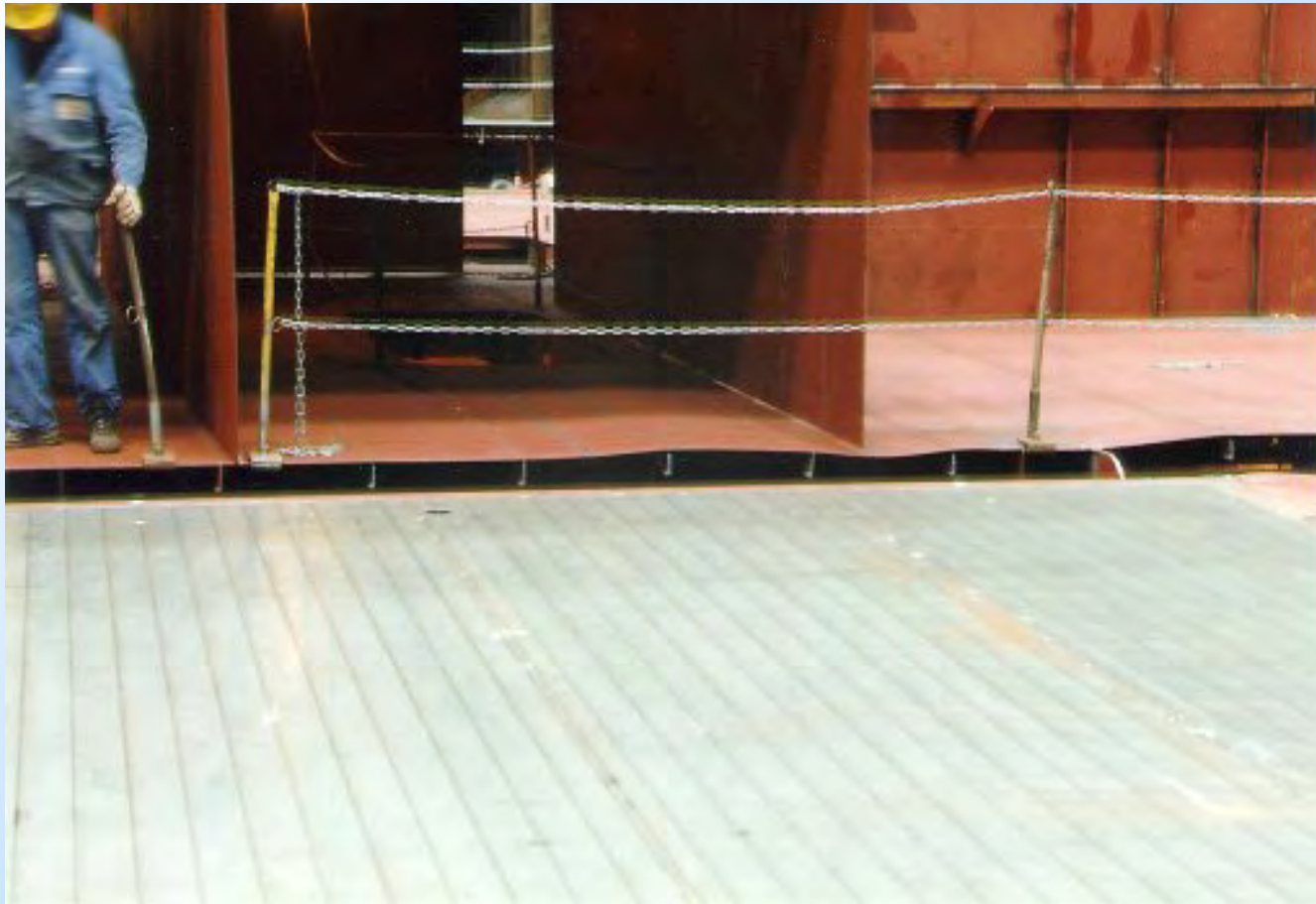
**Proper Weld Quality**

**Cost-Competitive Facility**

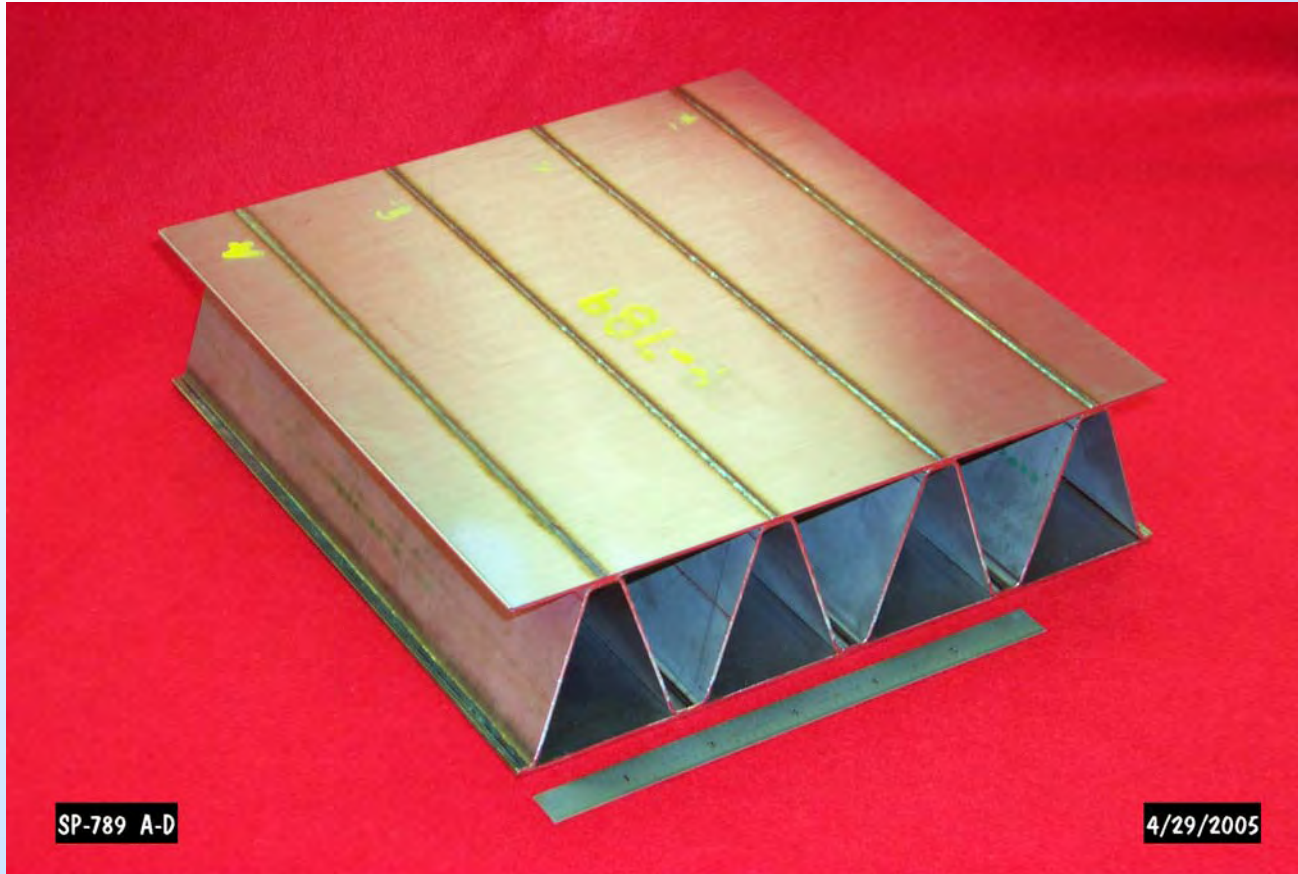


- Evaluate Suitability of Control System to:
  - Retro-Fit as GMAW-only Upgrade
  - Work within tolerance window of existing equipment
  - Achieve higher weld speed & smaller welds
  
- Opportunity to use Thinner Plate
  - Lower weight
  - Lower cost (of higher performance)
  - Some designs exist, but are not implemented
  
- Project underway

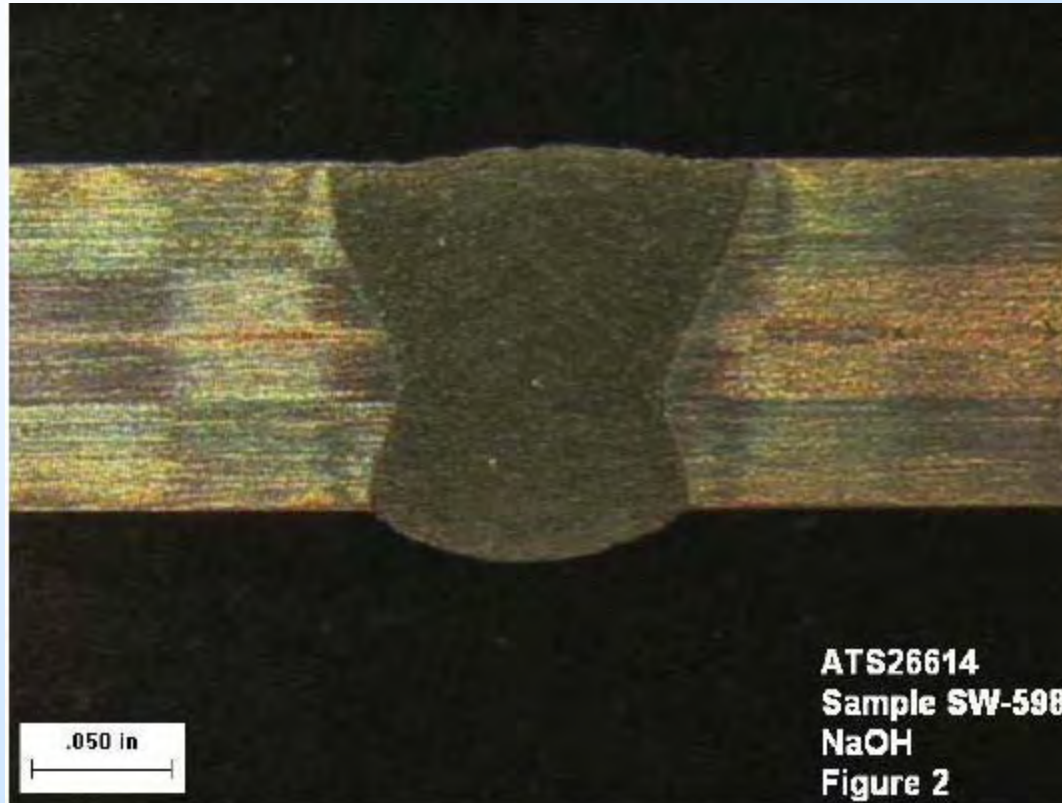




**Meyer-Werft I-core (foreground) – Traditional Deck (background)**



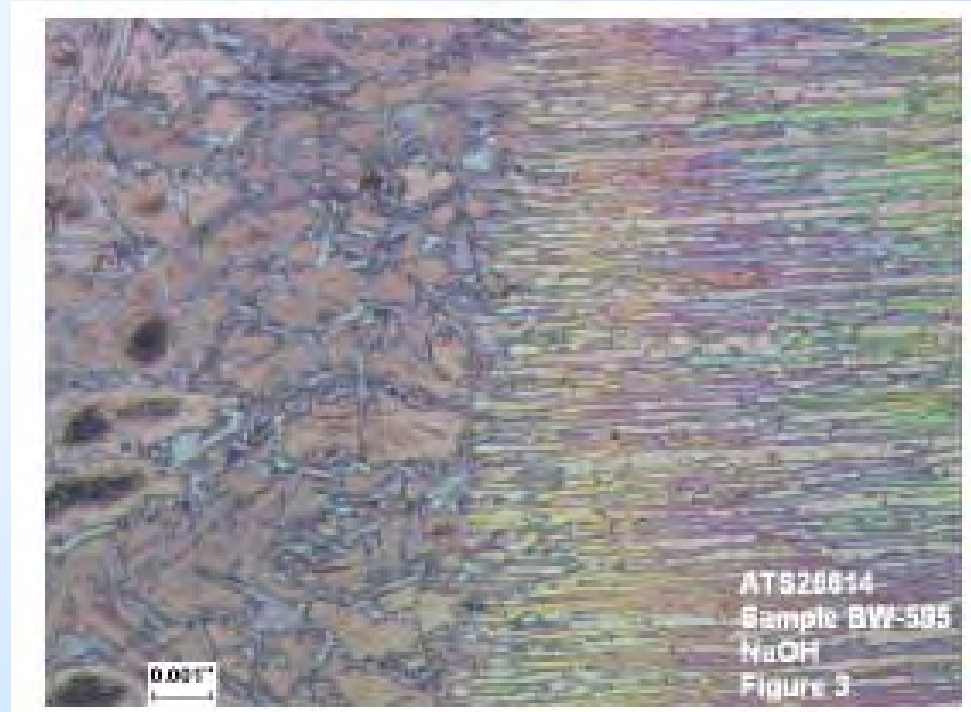
**First Sub-scale Sandwich Panel Welded at ATS Facility**



Autogenous Full-penetration stake weld in 1.5mm Fe255 SD-50

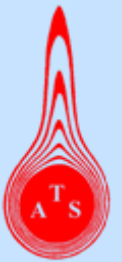
Fusion zone width determination

- Full-penetration stake weld
- Metallographic analyses
- Hardness testing
- Ferrite/Austenite determination
  - ~ 25/75% A/F (50/50 Ideal)





# LASCOR Manufacturing Concepts



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## Product Goals Put Manufacturing at Cross-Purposes:

### Welds Must Be Strong Enough

Strength Related to Width at Interface (= 100% thickness of thinnest)

### Welds Must Have Proper Microstructure

Strength and Corrosion Resistance Related to A/F Ratio

### Panels Must Be Flat

Max out of Plane  $\leq$  0.250 inch

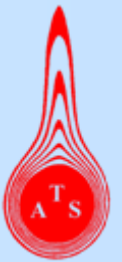
### Panels Must be Produced at Acceptable Cost

### High Welding Speeds Desirable

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# LASCOR Manufacturing Concepts



## Weld Strength

**Required Weld Joint Efficiency (Fab Doc) – Must Sustain Service Loads**

**Required Yield Strength (Qual Doc) – Must Exceed Mat'l Specified Min**

**Quantitative Tests – Validate Weld Performance to Mat'l Specified Min**

**Qualitative Tests – Only Validate Weld Performance on each Item**

## Example:

**Actual Stress < Allowable Max Stress < Spec Min Yield < Actual Test Specimen**

## Current Weld Procedure

L/GMAW Process

ER-2209 Filler, N<sub>2</sub> Shield Gas

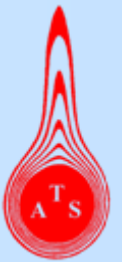
A/F Ratio ~ 53/47

Width ~ 1.25 mm (100% = 1.5)

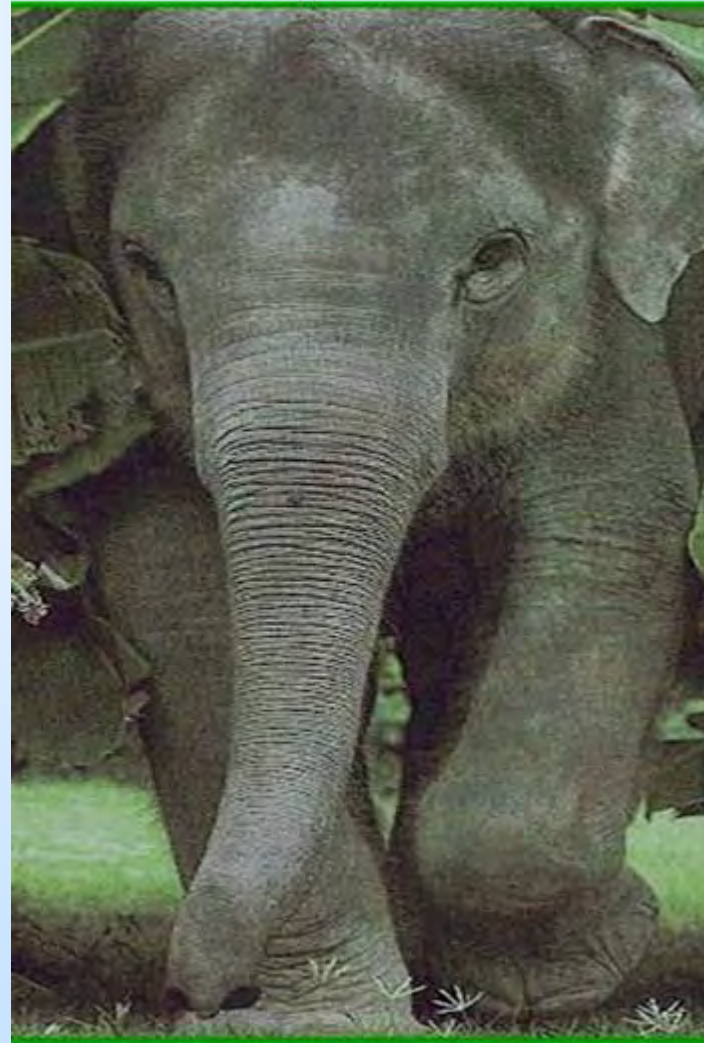
Strong Enough?



## Is Our Weld Strong Enough?



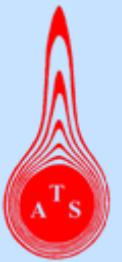
1000 microns





# LASCOR Manufacturing Concepts

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## Limitations of Available Materials

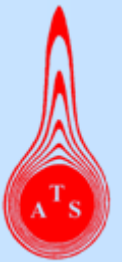
**First Estimates based on 316L & HSS Materials**

**80-100 KSI Steels not readily available with desired properties**

**“Ferralium” down-selected due to properties & width**

**Width issues brought in undesirable dimensional variance**

**Plate vs sheet in ASTM A-480**

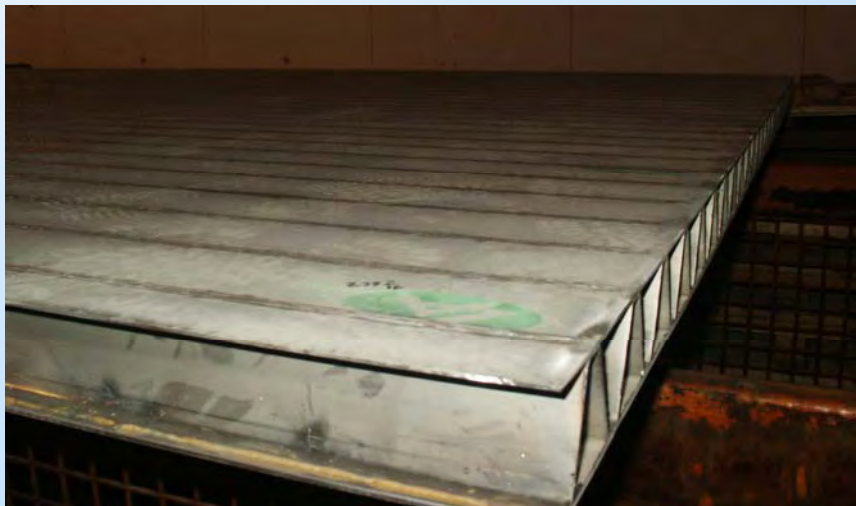
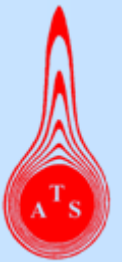


## ➤ Base Material Costs

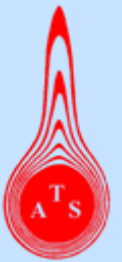
- Aggressively Pursued Alternatives
- Made First Inquiries into Enhanced 2205
  - Active Support from ATS Supplier Network
  - Early Response from A-L Technical Staff thru ATS Supplier
- Gained Active Involvement of CTC & NG-NN
  - Closure achieved thru efforts of CTC & NG-NN
- Result: Better than 50% Material Cost Reduction
- Potential for Further Reduction in Phase II



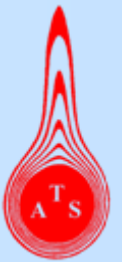
# 78" X 240 Lascor Panels



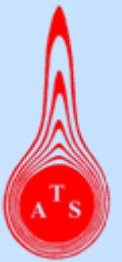
# 78" X 240 Lascor Panels

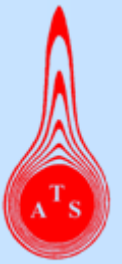


# 78" X 240 Lascor Panels



# 78" X 240 Lascor Panels





- **Firmly committed to commercialization**
  - **Established Precision Light Systems as manufacturing/commercialization activity**
- **Aggressively pursuing *total* cost-reduction**
- **Created facility capable of 15 X 50 ft panels**
- **Leveraging on efforts of other activities/programs**
- **Created capacity to meet short-term needs for panels**
- **Operational in Q4 CY05**