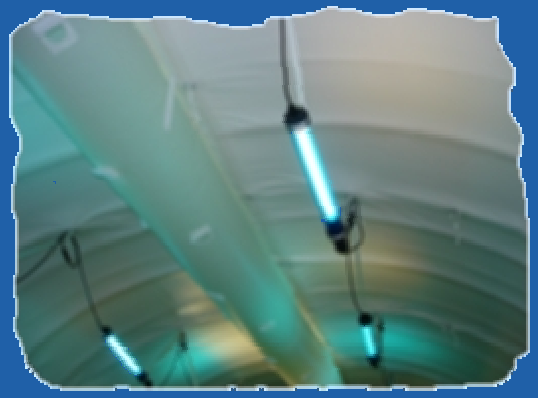
Fluoropolymer-Based Composite Materials Technology in ColPro Systems



Peter Kirk
COLPRO 05 – Monterey, CA
June 23, 2005

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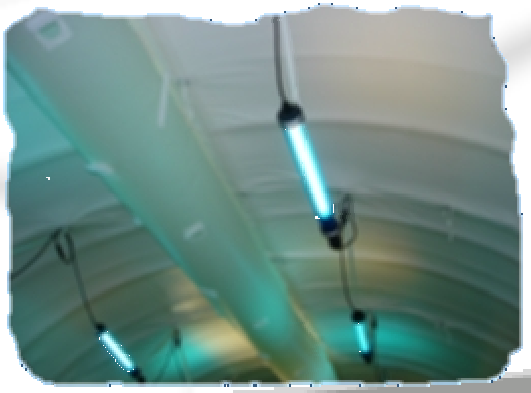
ColPro Presence

- CBPSS Co-developed with U.S Army Natick Soldier Center in late 1980's
  - Current manufacturer of fabric and soft shelter
- Constructed M28 tent liner prototype from new lightweight non-structural composite in Fall 2004
- Designed and built Future Combat Systems (FCS) medical shelter prototype in Spring 2005



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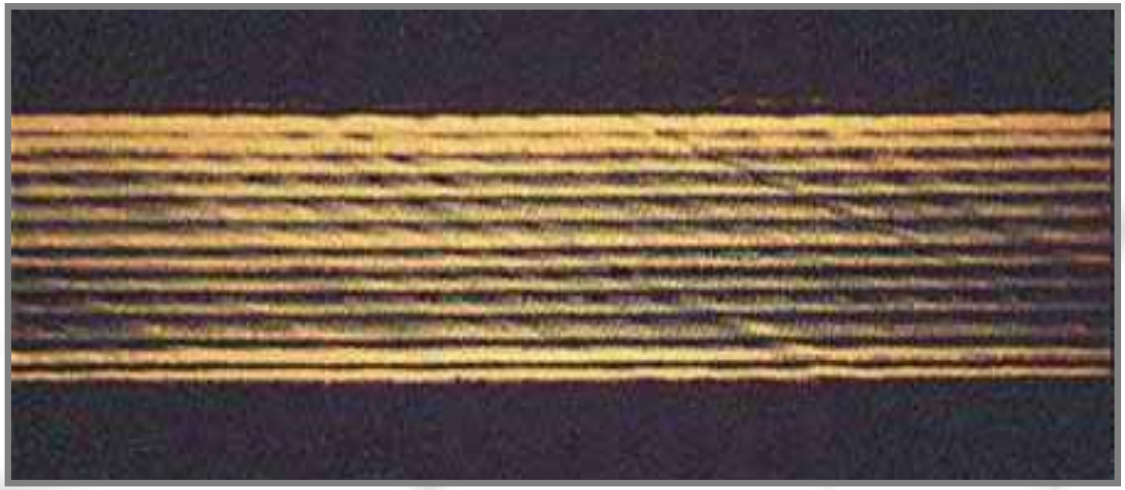
Unique Film Technology

- Cast Fluoropolymer (PTFE based) film technology
  - Exceptional thermal resistance and C/B barrier properties
  - Inert & decontaminable
  - Inherently non-burning
  - Multi-layer, custom application construction

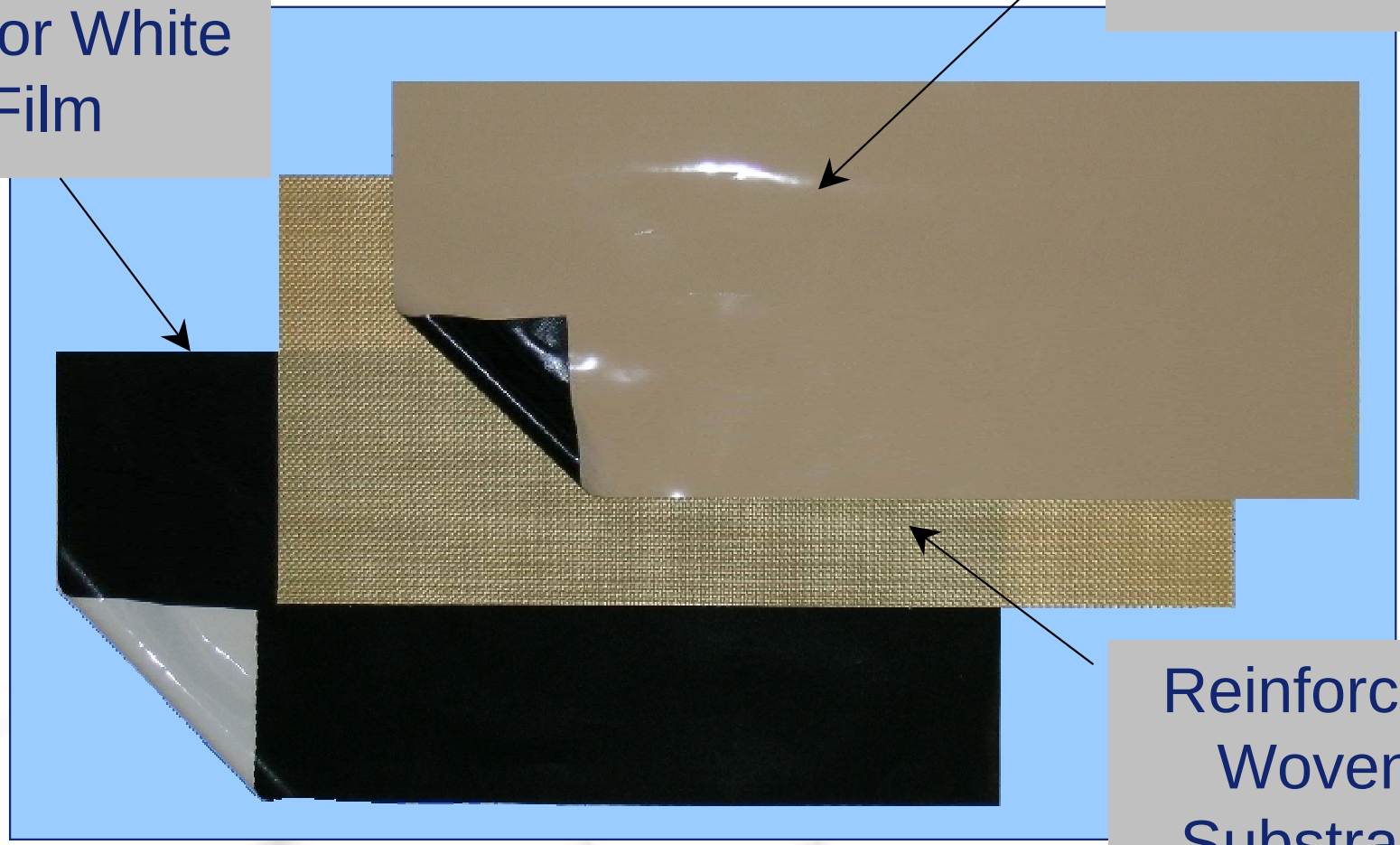


Cast PTFE Film

0.004 Inches Thick

12 Discrete Fused Layers

Composite Structure (Typical 3 Layer)



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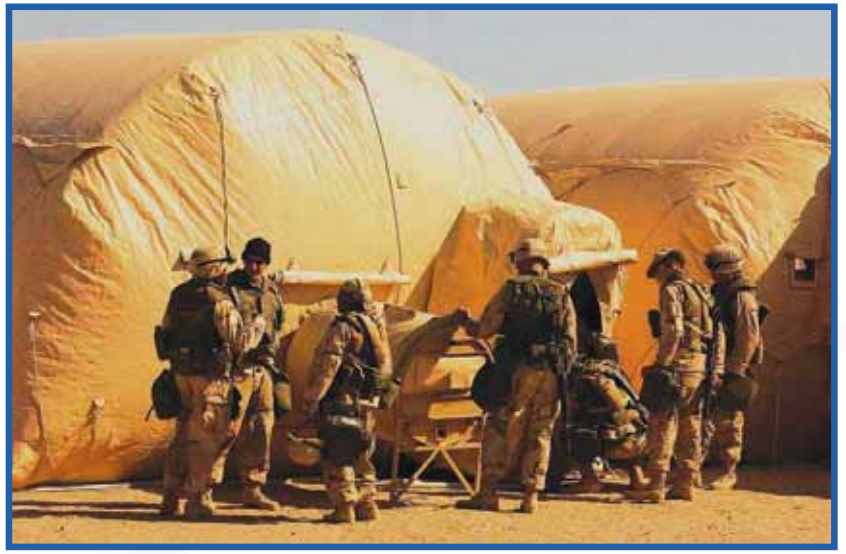
Chemically and Biologically Protected Shelter System (CBPSS)

- Soft shelter constructed from Challenge® X-22 composite
  - 3-layer wall laminate
  - 5-layer floor laminate
- 1987 to 2005



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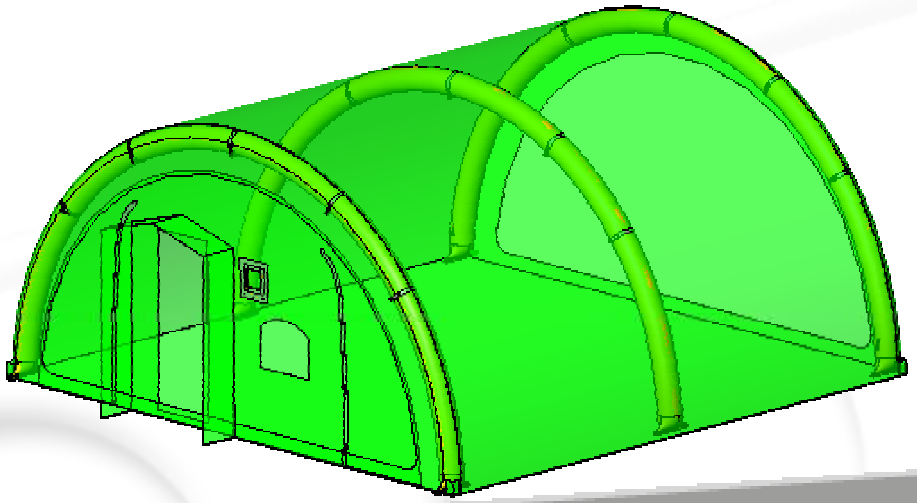
Future Combat Systems (FCS) Shelter

- Prototype shelter constructed from Challenge® X-23
  - Lightweight, 5-layer laminate construction
  - Used for wall and floor
- Completed April 2005



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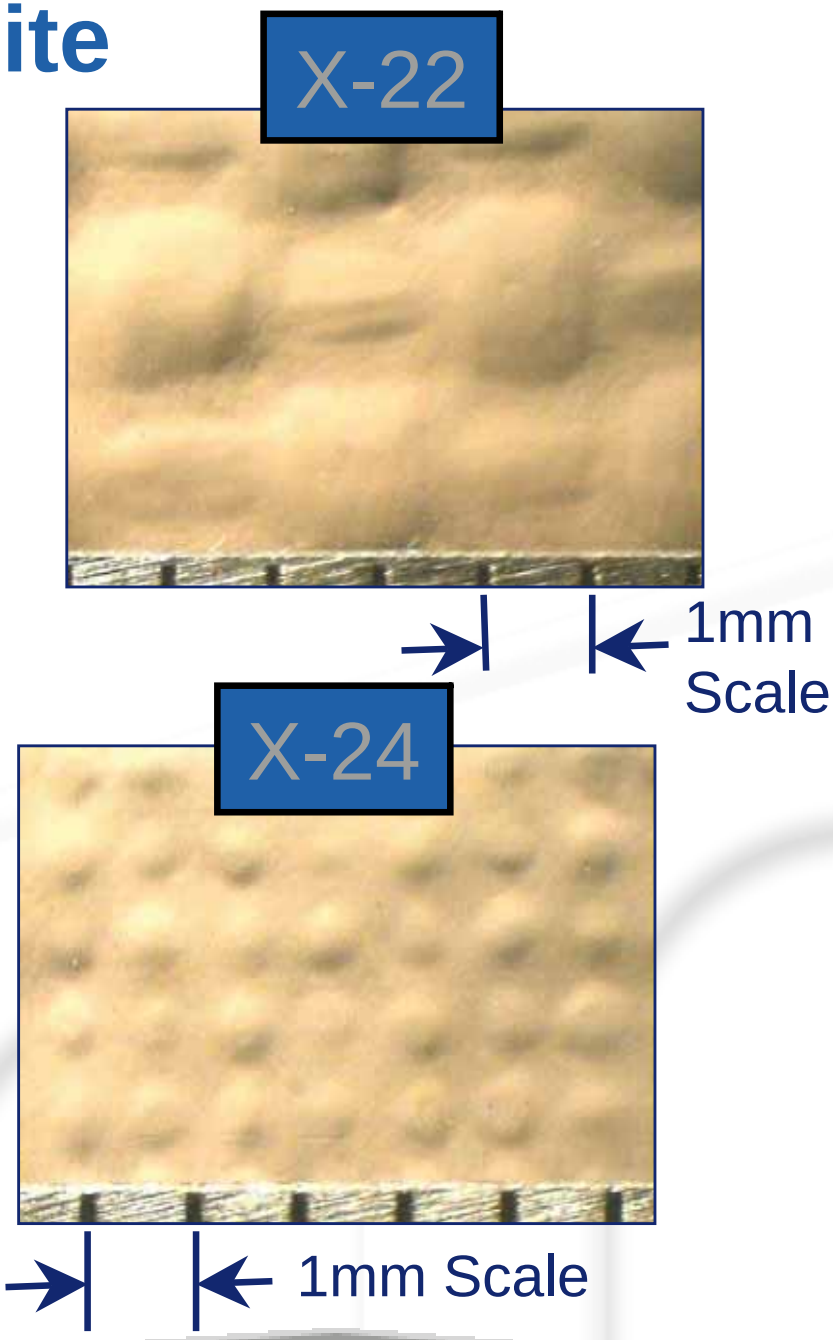
Next Generation Composite Challenge® X-24

- New 3-layer laminate composite includes increased performance over Challenge® X-22
  - 12% Lighter in weight
  - 25% Thinner (less cube)
  - Increased durability
    - 50% thicker interior film
    - Smoother surface texture
  - Better hand (flexibility)
  - Ease of fabrication



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Challenge® Structural Composites Physical Property Comparison

Property	Units	X-22 (wall)	X-22 (floor)	X-23*	X-24*	Test Method
Construction		3-Layers (2 Barrier Layers)	5-Layers (3 Barrier Layers)	5-Layers (3 Barrier Layers)	3-Layers (2 Barrier Layers)	
Weight	oz/yd2	13.0	24.0	16.0	11.5	ASTM D751
Thickness	mil	15.5	27.5	14.5	11.5	ASTM D751
Breaking Strength						
Warp (dry)	lbf/in	>350	>350	>350	>350	ASTM D751
Fill (dry)	lbf/in	>350	>350	>350	>350	
Tear Strength, Trapezoidal						
Warp (dry)	lbf/in	>35	>35	>35	approx 30	ASTM D4851
Fill (dry)	lbf/in	>35	>35	>35	approx 30	
Flame Resistance		0 seconds to flameout				NFPA 701
Water Absorption	%	0.65 typical	0.65 typical	3.4 typical	0.55 typical	MIL-STD-191-5502 (48HR)
Permeation Resistance to Warfare Agents						LP/P DES 1-94b
(72 Hour Exposure)						
Initial Exposure (HD, tGD, VX)		< Minimum Detection Levels		Expected Results		CRDC-SP-84010
After Accelerated Weathering (HD, tGD, VX)		< Minimum Detection Levels		are less than		CRDC-SP-84010
After Decontamination (HD, tGD, VX)		< Minimum Detection Levels		Minimum Detection Levels		CRDC-SP-84010
Spectral Reflectance		To Customer Requirements				
Color		Bi-Color to Customer Requirements				

*Results based on internal test results, not published values

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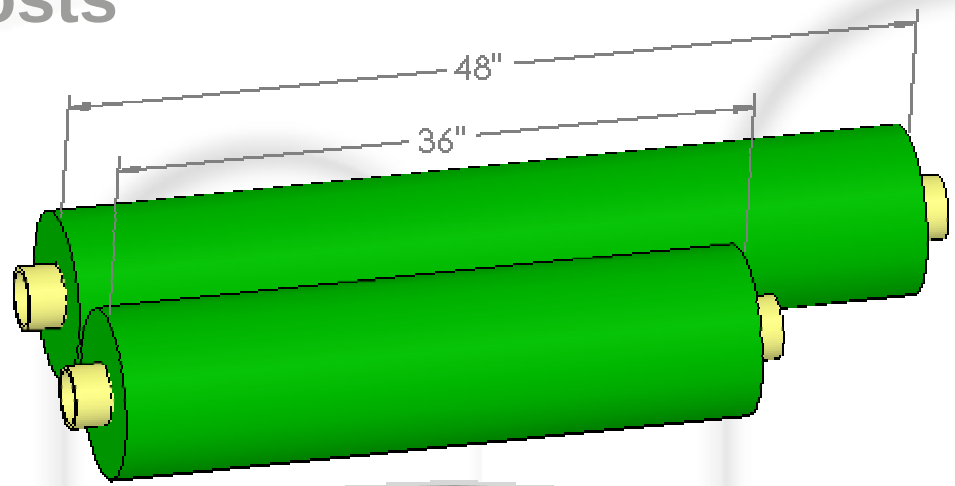
Wide Laminate Composite Capabilities

- **New application of existing lamination technology**
  - **Wider 3-layer laminates**
    - New lamination capabilities allow composites up to 48” wide compared to current 36” wide
- **Benefits to ColPro solutions**
  - **Reduced laminate costs**
  - **Reduced fabrication costs**
    - Fewer seams
    - Simpler patterning



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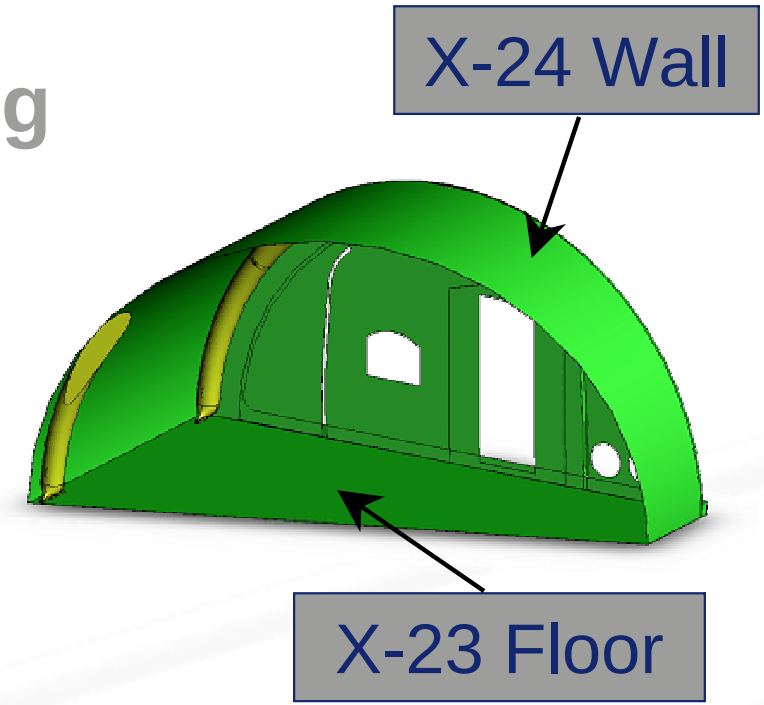
Benefits of New Laminate Composites

- Estimates Based on Existing CBPSS Design (300 SF)
- New improved laminates substituted
  - X-24 @ 48” for walls
  - X-23 @ 36” for floor



Characteristic	Estimated Reduction
Linear Fabric Quantity	25%
Fabrication Labor	4%-6%
Weight	Wall - 21 lb Floor - 17 lb
Cube	1 cu ft
Fabric Cost	16%

Weight saved is enough fabric to add >100SF of shelter space without any increase in system weight

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Tent Liner Non-Structural Composite Challenge® X-CBNL

- M28 tent liner evaluation coordinated by U.S Army Natick Soldier Center
  - Tent liner structural and gas-tight integrity exceeded requirements upon evaluation
  - Superior C/B barrier properties
  - Non-burning

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Questions?

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