



Atlantic Thread & Supply  
Company, Inc.

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# CPSC MATTRESS SEMINAR

## REASONABLE CRITERIA and MATTRESS ASSEMBLY

ATLANTIC THREAD & SUPPLY COMPANY

# Agenda

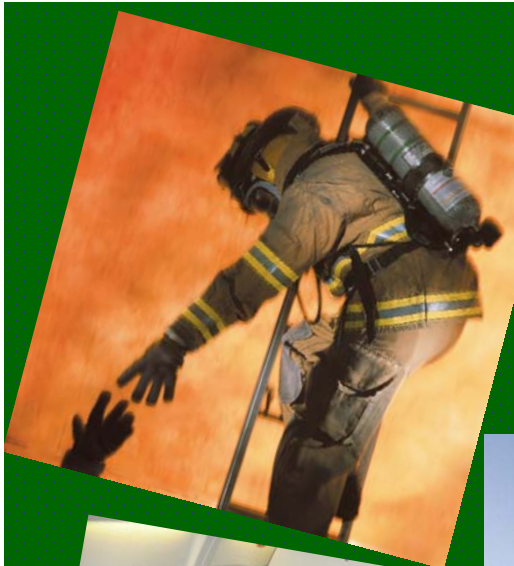
- Why is Atlantic Thread Here Today?
- Who is Atlantic Thread?
- Key Components
- What Is the Issue?
- Reasonable Criteria
- Para-Aramid Sewing Thread
  - Comparison of properties

# Why Is Atlantic Thread Here?

- Atlantic Thread was asked to participate in this seminar to present information about “reasonable criteria” as related to para-aramid sewing thread

# Who is Atlantic Thread?

- Atlantic Thread is a specialty supplier of flame resistant (FR) sewing threads. For more than 25 years, Atlantic has supplied sewing thread used in many high performance industries. These include...



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# Key Components

- **Key components used to reduce the threat of the CFR1633 open flame are:**
  - **FR barrier fabric**
  - **mattress edge tape**
  - **FR sewing thread**

# What Is the Issue?

- In order to develop subordinate prototypes under the umbrella of qualified and confirmed prototypes, the CFR1633 regulation allows substitution of one material for another material based on documentation of “reasonable criteria”.



# Reasonable Criteria Documentation

- Objective
- Data Based

# Why is Reasonable Criteria Important?

- Failure of a mattress can mean
- STOP ORDER
- LOST REVENUE

# Lost Sales/Profits

## Stop Order – Lost Sales Revenue

					LOST REVENUE	
A	B	C	D	E	F	G
MATTRESS UNITS PER DAY	MATTRESS UNITS PER WEEK	WHOLESALE SELLING PRICE	WEEKLY SALES	YEARLY SALES	CPSC STOP ORDER 1 WEEK	CPSC STOP ORDER 2 WEEK
			(B X C)	(D X 50)	(B X C)	(F X 2)
100	500	\$225.00	\$112,500.00	\$5,625,000.00	\$112,500.00	\$225,000.00
200	1000	\$225.00	\$225,000.00	\$11,250,000.00	\$225,000.00	\$450,000.00
500	2500	\$225.00	\$562,500.00	\$28,125,000.00	\$562,500.00	\$1,125,000.00
1000	5000	\$225.00	\$1,125,000.00	\$56,250,000.00	\$1,125,000.00	\$2,250,000.00

# FROM CPSC QNAs (NOVEMBER 2006)

“Mattress prototypes would not require re-qualification due to a change in thread provided that both threads are made from fibers having the same generic fiber classification (e.g. para-aramid) and have essentially the same performance characteristics, strength properties, and FR performance. The thread properties need to be equivalent in characteristics and performance rather than bear the same tradename or manufacturer name.”

- **“Are para-aramid fibers the same?”**

**KEVLAR®**

**TWARON®**

**YES**

KEVLAR® is a registered trademark of E.I. DuPont  
TWARON® is a registered trademark of Teijin-Twaron

- **“Are all para-aramid sewing threads the same?”**

**NO**



# Para-Aramid Sewing Threads

- The industry is currently being supplied with three types of para-aramid sewing thread:

<b>-Monocord TEX 40</b>	<b>\$\$\$\$</b>
<b>-TEX 50 CRAQ-SPUN®</b>	<b>\$\$\$</b>
<b>-Short staple TEX 60</b>	<b>\$\$</b>

# How Are These Sewing Threads Made?

- **Monocord filament:** A single filament of continuous and infinite length as produced by fiber manufacturers
- **Long Staple:** Long staple filament, typically 5 to 9 inches in length and then twisted into yarn
- **Short staple:** Short staple filament, cut into short lengths, typically 1.5 to 2.5 inches in length and then twisted into yarn



# Break Strength Characteristics

Sewing thread break strength contributes:

- To the Initial seam break strength
- To the reduction of stitching defects
- Retained seam break strength after exposure to flame and high heat

# Initial Sewing Thread Break Strength

THREAD TYPE	SIZE	BREAK STRENGTH	ELONGATION TO BREAK	HIGHER THAN NYLON?
MONOCORD PARA-ARAMID	TEX 40	18-20 lbs	3-5%	YES
CRAQ-SPUN® PARA-ARAMID	TEX 50	15-17 lbs	4-6%	YES
FILAMENT NYLON	SIZE 69	10-12 lbs	20-22%	-
SHORT STAPLE PARA-ARAMID	TEX 60	9-11 lbs	4-6%	NO

# Sewing Thread Break Strength After High Heat Exposure

THREAD TYPE	SIZE	AVERAGE BREAK STRENGTH BEFORE EXPOSURE	AVERAGE BREAK STRENGTH AFTER EXPOSURE*	HIGHEST RETAINED STRENGTH?
MONOCORD PARA-ARAMID	TEX 40	19 lbs	12 lbs	Yes
CRAQ-SPUN® PARA-ARAMID	TEX 50	16 lbs	11 lbs	Yes
FILAMENT NYLON	Size 69	11 lbs	0 lbs	-
SHORT STAPLE PARA-ARAMID	TEX 60	10 lbs	6.5 lbs	No

\*Using ASTM D 7016, Standard Test Method to Evaluate Edge Binding Components Used in a Mattress After Exposure to an Open Flame

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# Initial Seam Break Strength

THREAD TYPE	SIZE	AVERAGE BREAK STRENGTH	X	AVERAGE STITCHES PER INCH	X	401 CHAINSTITCH FACTOR 1.7	=	SEAM STRENGTH	HIGHER THAN NYLON?
MONOCORD PARA-ARAMID	TEX 40	19 lbs	X	6	X	1.7	=	194 lbs	Yes
CRAQ-SPUN® PARA-ARAMID	TEX 50	16 lbs	X	6	X	1.7	=	163 lbs	Yes
FILAMENT NYLON	Size 69	11 lbs	X	6	X	1.7	=	112 lbs	-
SHORT STAPLE PARA-ARAMID	TEX 60	10 lbs	X	6	X	1.7	=	102 lbs	No

# Seam Break Strength After Flame and High Heat Exposure

THREAD TYPE	SIZE	SEAM STRENGTH BEFORE FLAME EXPOSURE	RETAINED SEAM STRENGTH AFTER FLAME EXPOSURE FOR 60 SECONDS*	HIGHEST RETAINED SEAM STRENGTH?
MONOCORD PARA-ARAMID	TEX 40	163 lbs	33 lbs	Yes
CRAQ-SPUN® PARA-ARAMID	TEX 50	154 lbs	32 lbs	Yes
FILAMENT NYLON	Size 69	112 lbs	0 lbs	-
SHORT STAPLE PARA-ARAMID	TEX 60	102 lbs	17 lbs	No

\*Using ASTM D 7016, Standard Test Method to Evaluate Edge Binding Components Used in a Mattress After Exposure to an Open Flame

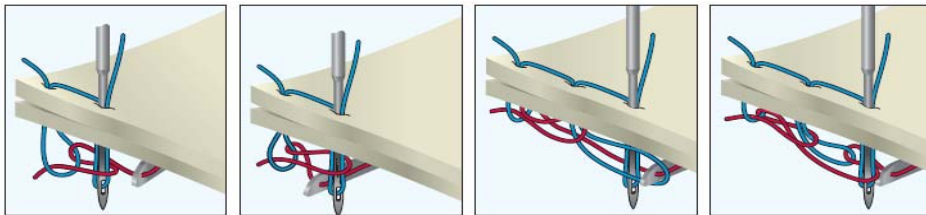
# Tape Edge Sewing Machine



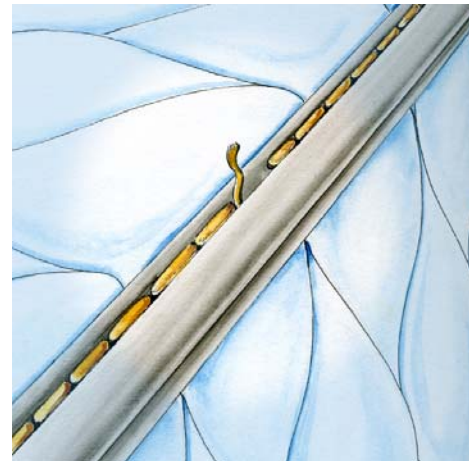
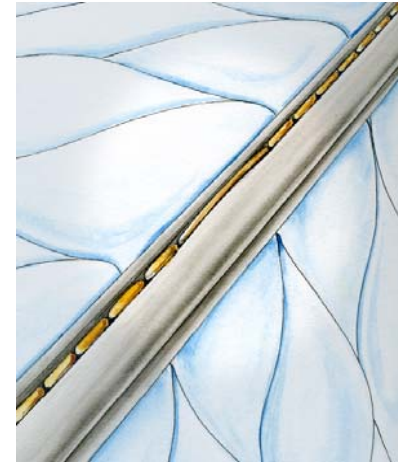
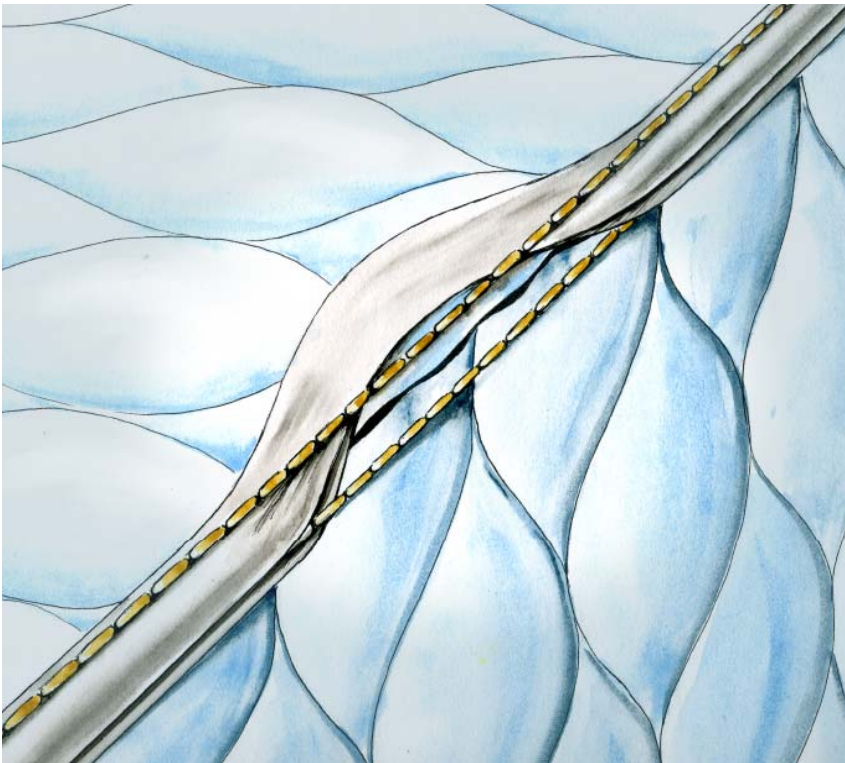
- Sewing thread must have sufficient strength and elongation to tolerate high speed starts and sudden stops without rupturing

# 401 Chainstitch

The movement  
of the machine  
parts must be  
very precise

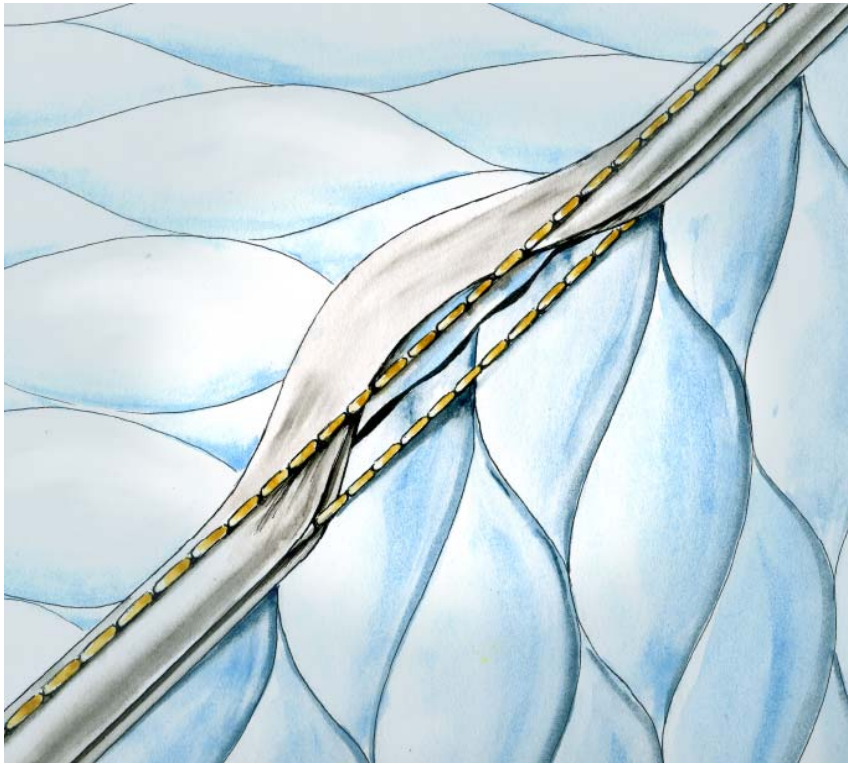


# Factory Production Stitching Defects Potential Points of Entry For An Open Flame



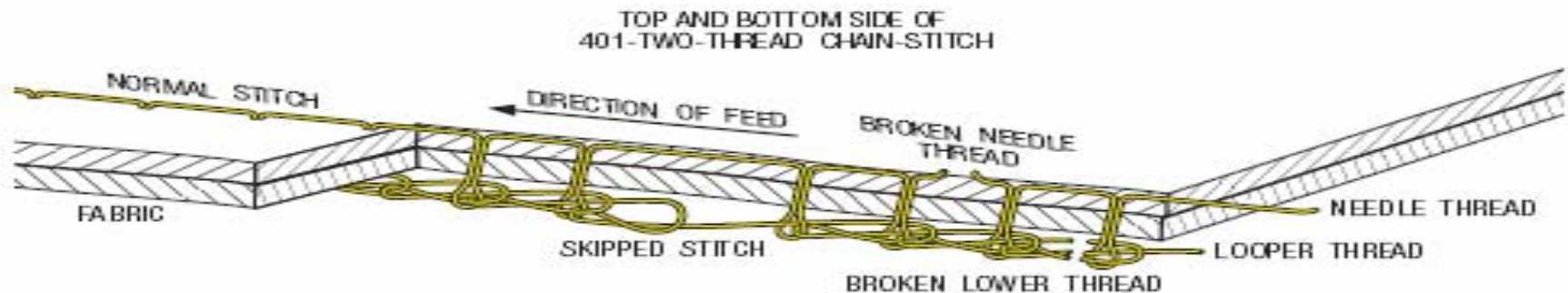


# Skewed Tape Edge



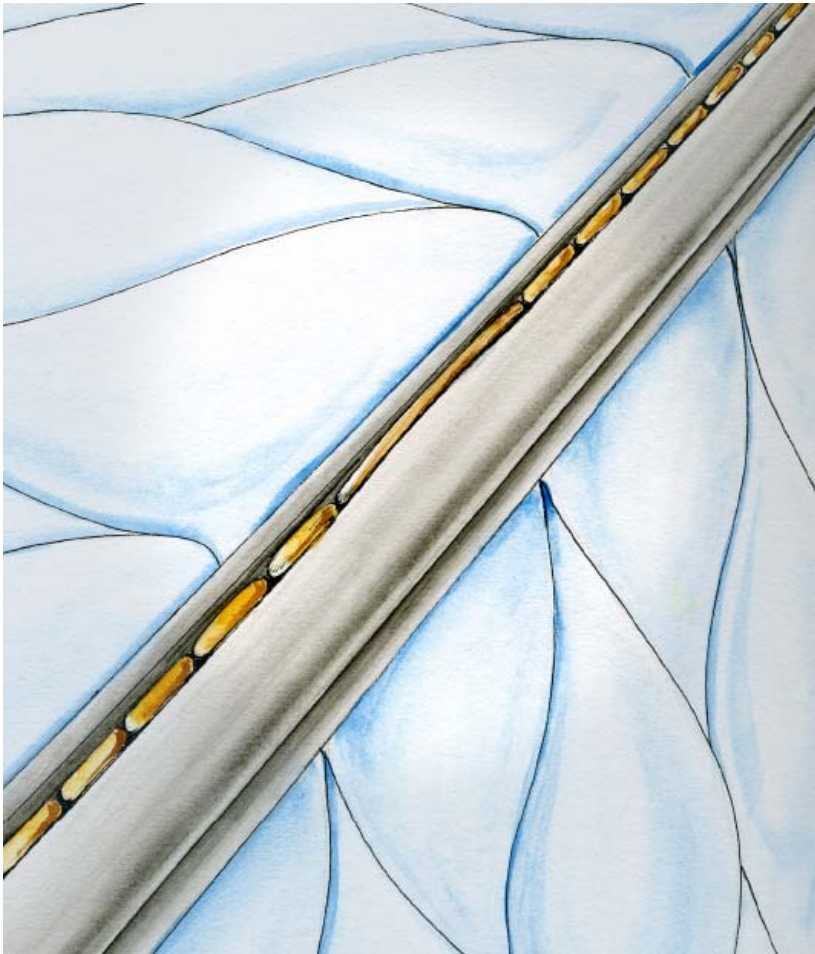
- Mattress tape fails to align with seam
- Mattress tape does not completely encapsulate the edges at the junction of top panel/border panel

# Schematic Drawing of Skipped Stitches



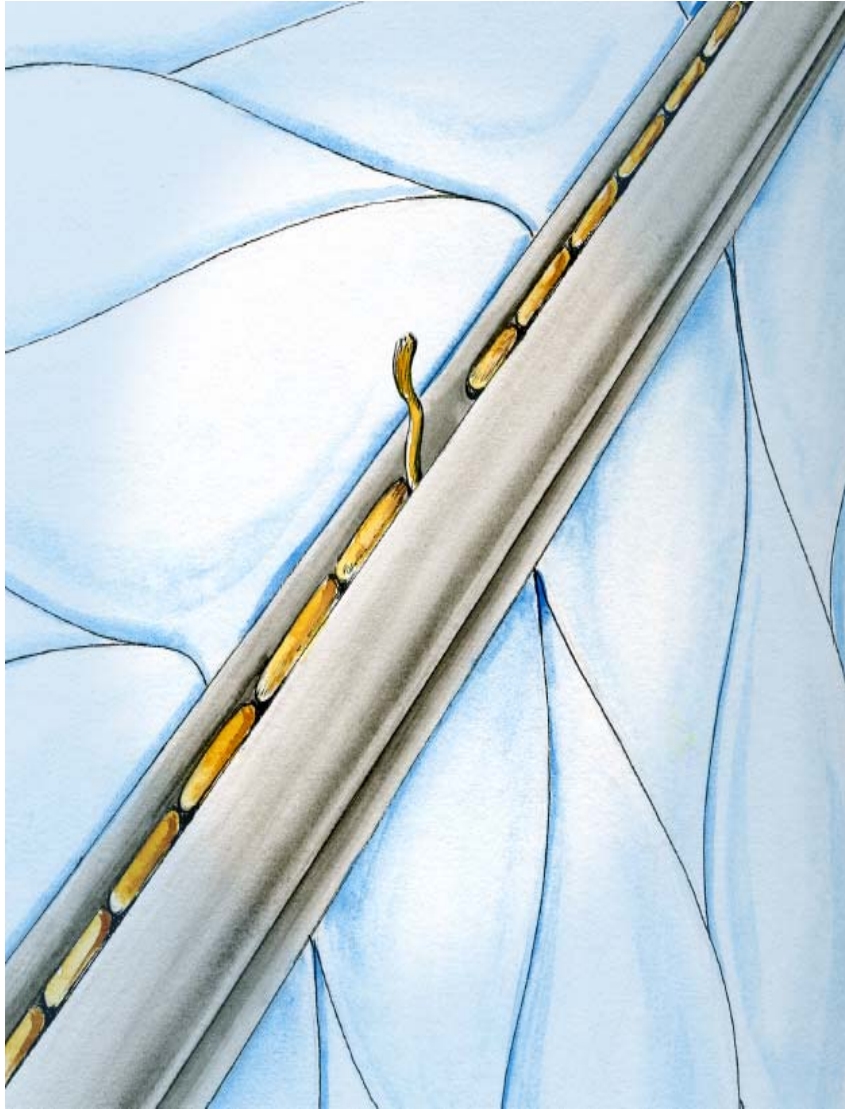
- **Skipped stitches represent failure of either top or bottom thread to complete the interlocking of the stitch due to malfunction either by sewing machine or sewing thread.**

# Skipped Stitches



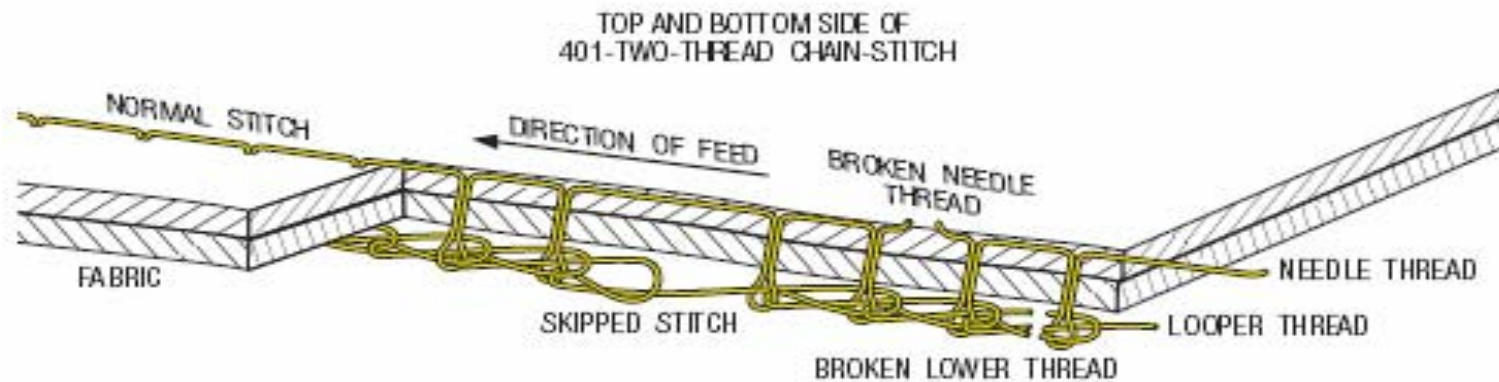
**If skipped stitches do not result in broken stitches they can go undetected.**

# Broken Stitches



Broken stitches represent a rupture of either the top or bottom thread.

# Schematic Drawing of Broken Stitches



Broken stitches usually occur when the applied stress exceeds the break strength of the sewing thread.

# Stitching Test

A proprietary stitching test was developed to predict the incidence of broken stitches.



The stitching test was developed in conjunction with leading equipment manufacturers.

# Details of Stitching Test

- **Procedure**

- Operator starts to sew at maximum speed and stops suddenly at one of the specified lengths.
- This is repeated until 25 stitch lines are completed at each distance.
- Number of broken stitches is noted.

- Broken stitch frequency correlates with sewing thread break strength.

# Incidence of Broken Stitches

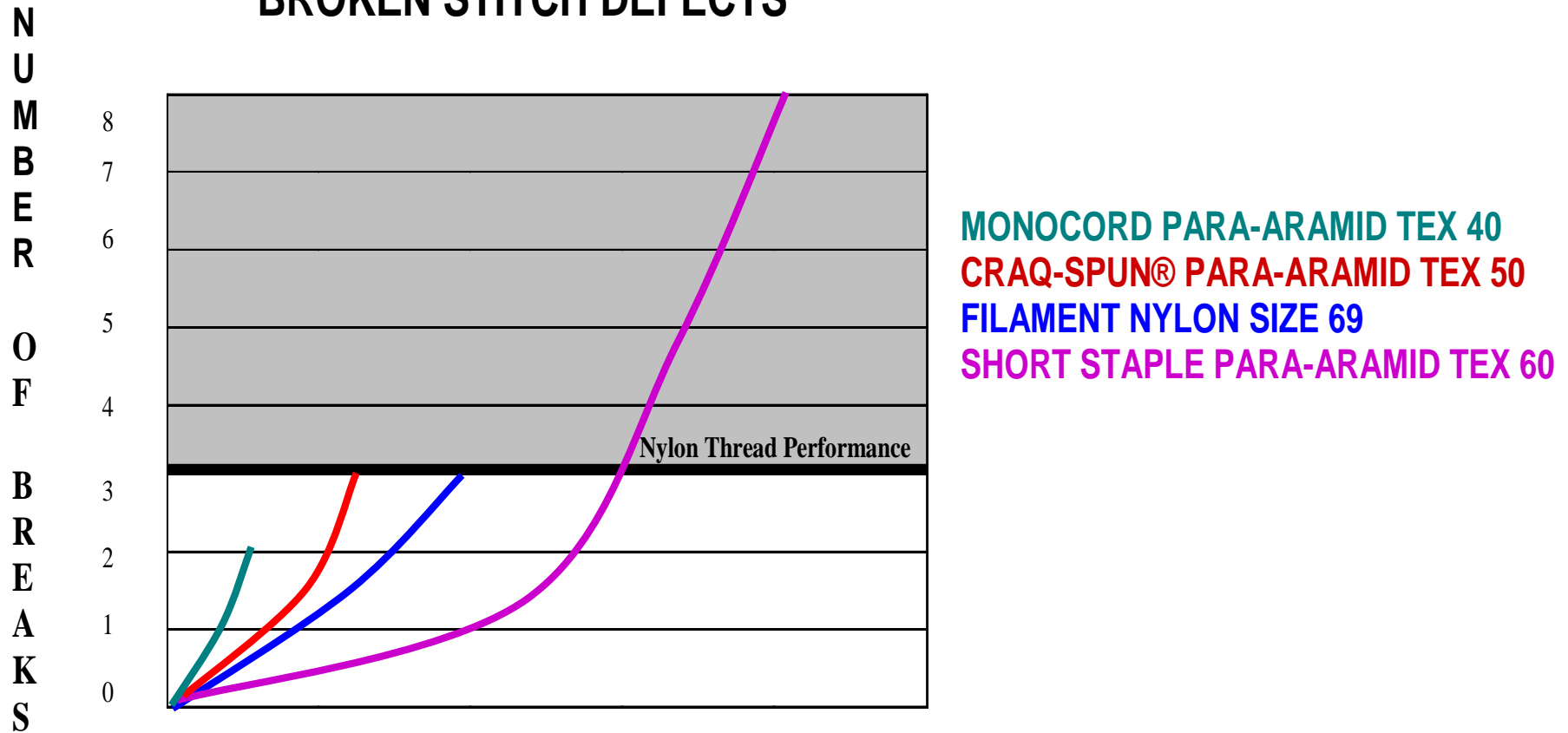
STITCH LINE DISTANCE	18 INCHES	24 INCHES	36 INCHES	42 INCHES	TOTAL BROKEN STITCHES
SEWING THREAD TYPE					
MONOCORD PARA-ARAMID TEX 40	0	0	1	1	2
CRAQ-SPUN® PARA-ARAMID TEX 50	0	0	2	1	3
FILAMENT NYLON SIZE 69	0	1	1	1	3
SHORT STAPLE PARA-ARAMID TEX 60	1	2	3	2	8

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# Incidence of Broken Stitches

## BROKEN STITCH DEFECTS

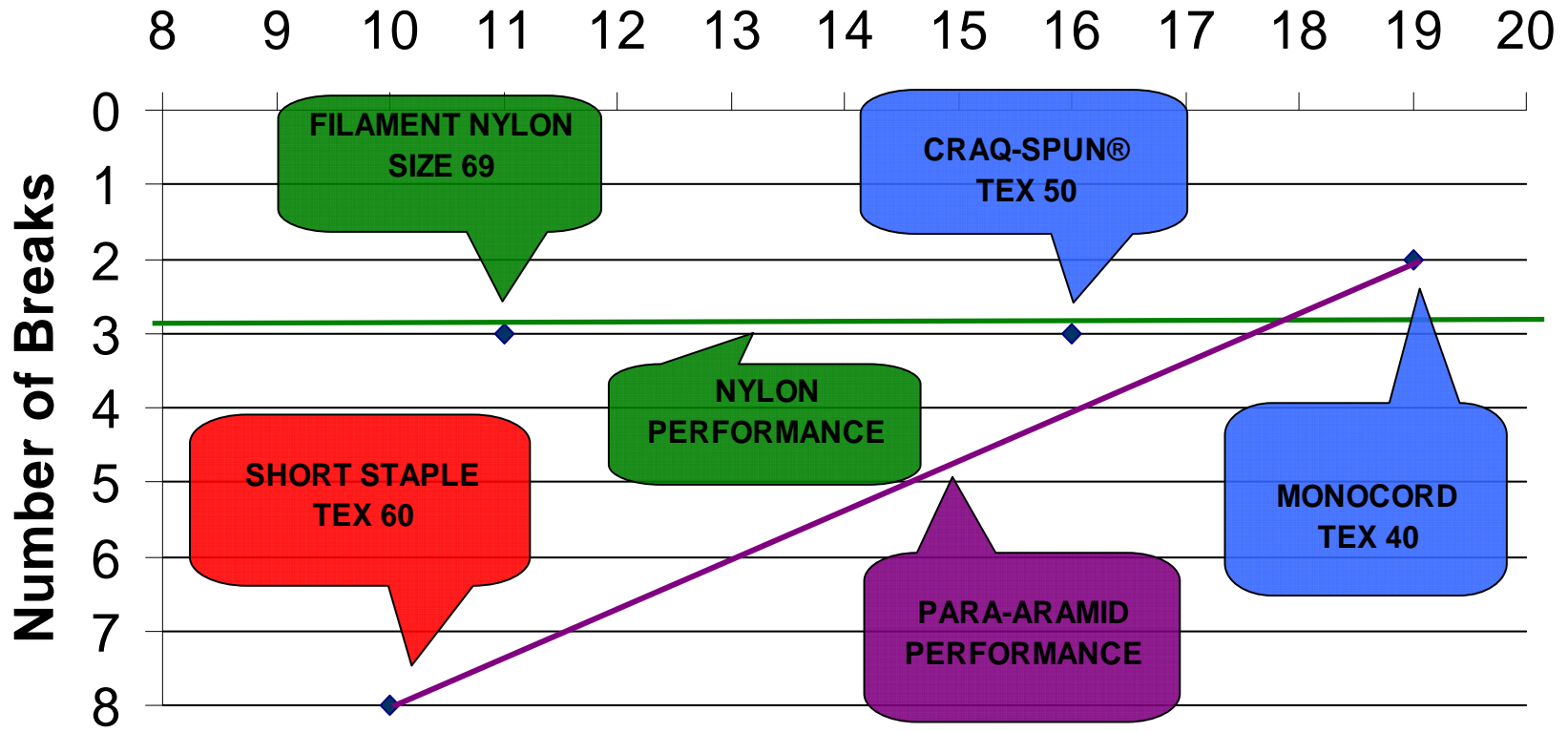


# Correlation of Broken Stitches with Sewing Thread Break Strength

STITCH LINE DISTANCE	18 INCHES	24 INCHES	36 INCHES	42 INCHES	TOTAL BROKEN STITCHES	AVERAGE BREAK STRENGTH
SEWING THREAD TYPE						
MONOCORD PARA-ARAMID TEX 40	0	0	1	1	2	19 lbs
CRAQ-SPUN® PARA-ARAMID TEX 50	0	0	2	1	3	16 lbs
FILAMENT NYLON SIZE 69	0	1	1	1	3	11 lbs
SHORT STAPLE PARA-ARAMID TEX 60	1	2	3	2	8	10 lbs

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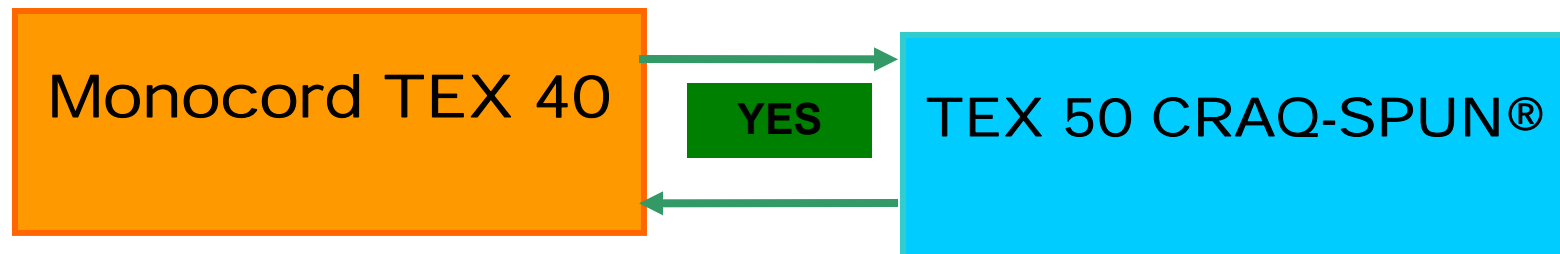
## Sewing Thread Average Break Strength, lbf



# FROM CPSC QNAs (NOVEMBER 2006)

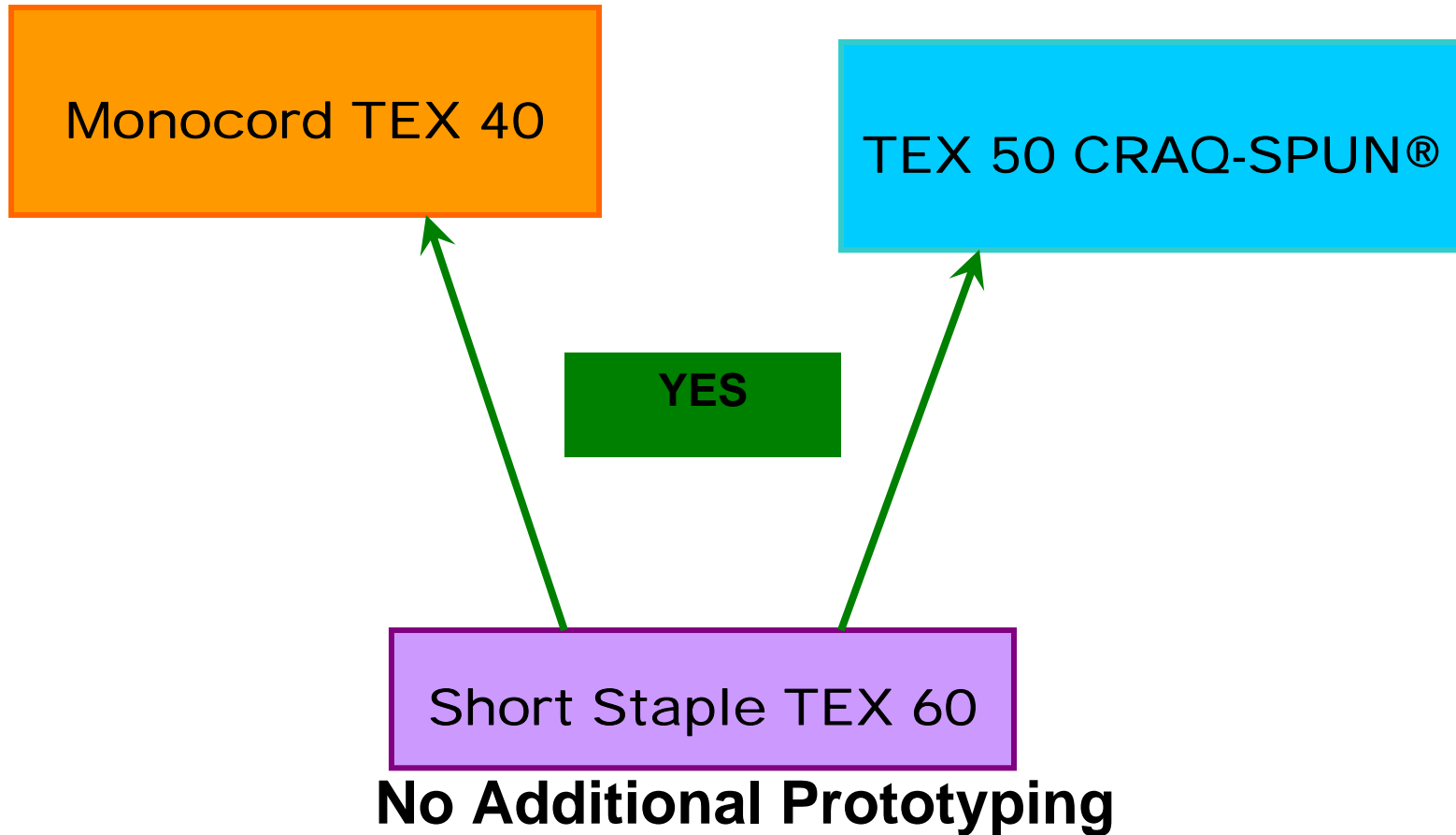
“Mattress prototypes would not require re-qualification due to a change in thread provided that both threads are made from fibers having the same generic fiber classification (e.g. para-aramid) and have essentially the same performance characteristics, strength properties, and FR performance. The thread properties need to be equivalent in characteristics and performance rather than bear the same tradename or manufacturer name.”

# Interchangeability Based on “Reasonable Criteria”

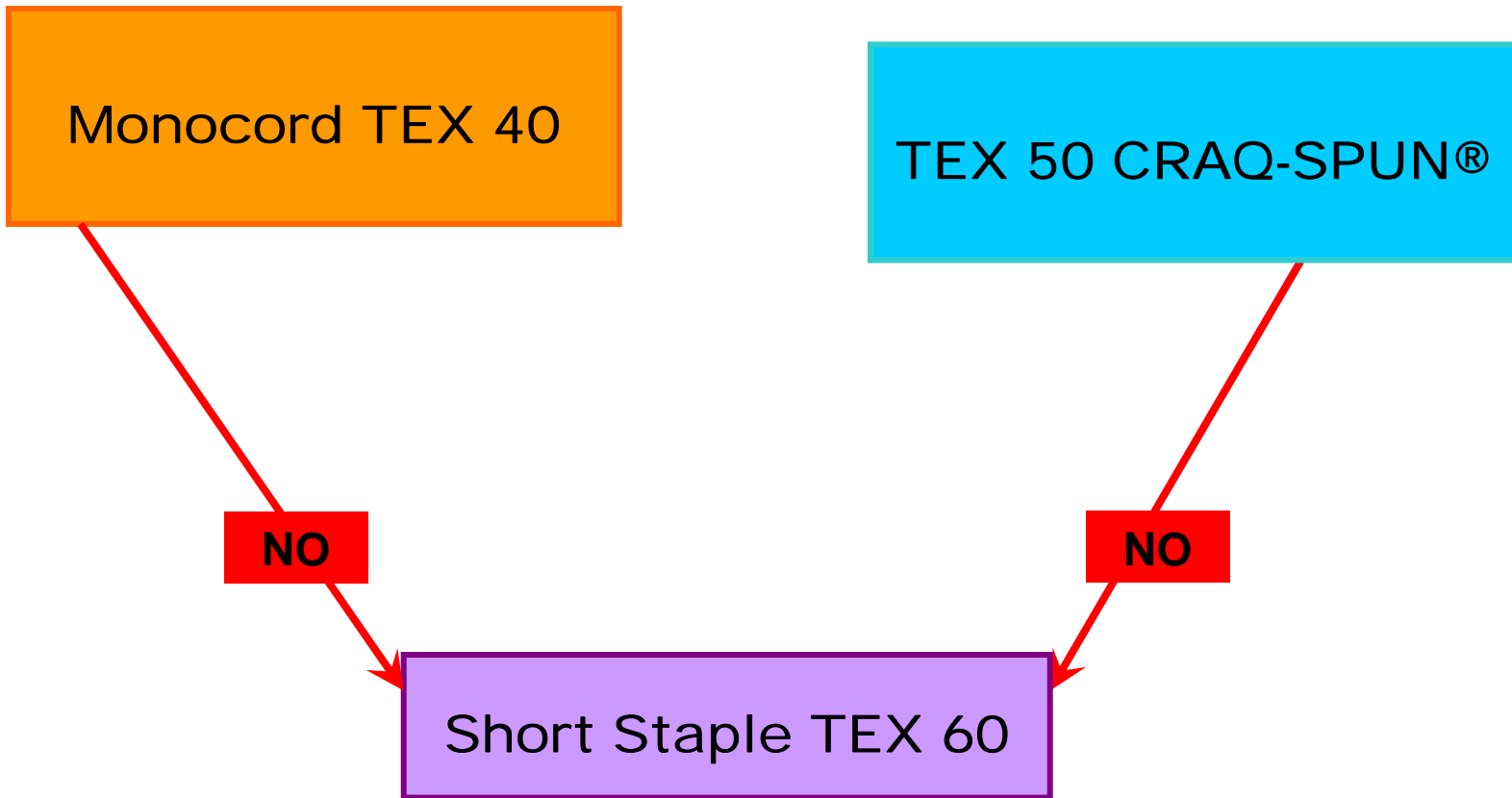


## No Additional Prototyping

# Interchangeability Based on “Reasonable Criteria”

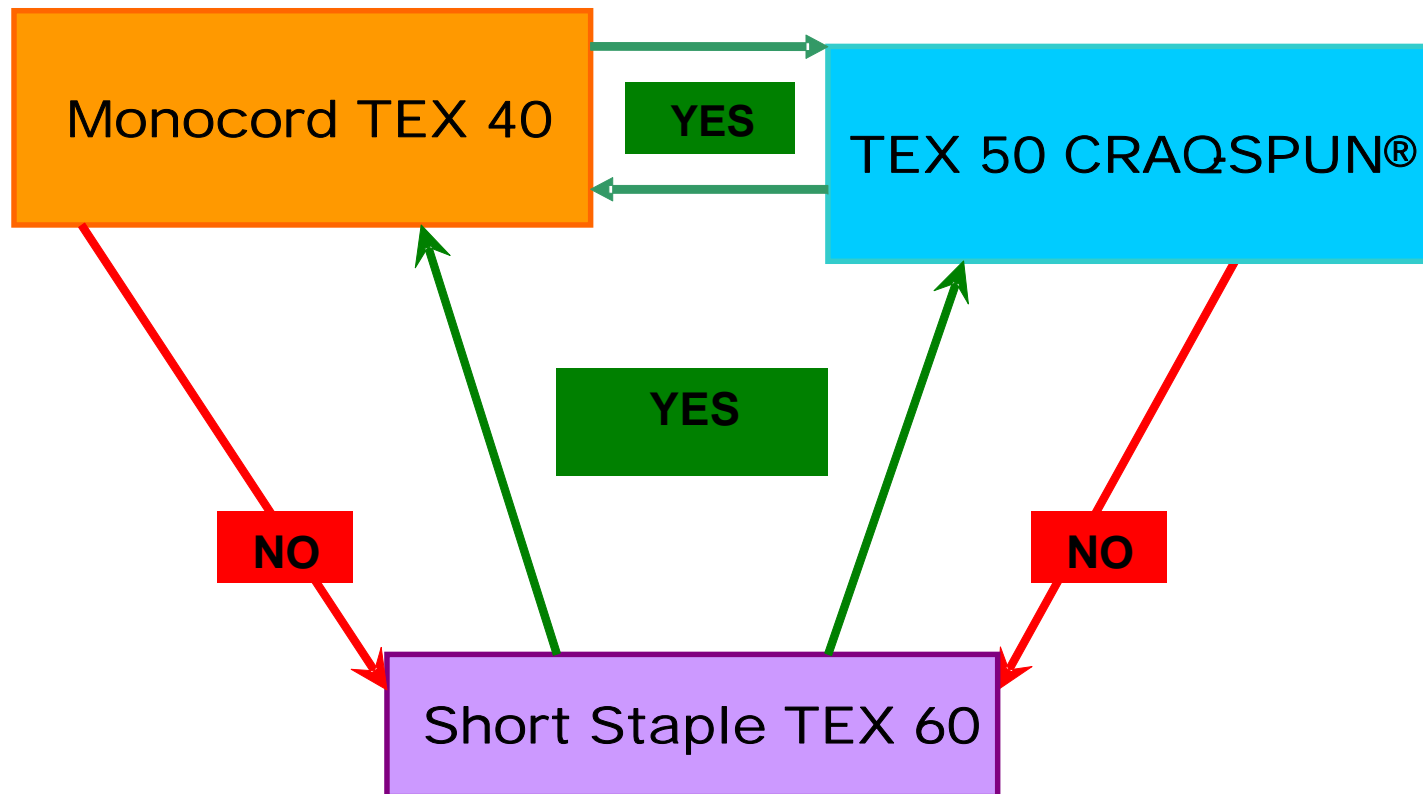


# Interchangeability Based on “Reasonable Criteria”



**Requires Additional (Qualified/Confirmed) Prototype Testing**

# Interchangeability Based on “Reasonable Criteria”





# Conclusion

- Although all para-aramid sewing threads offer the same FR characteristics, they **do not** offer the same strength characteristics, the same sewability or the same performance

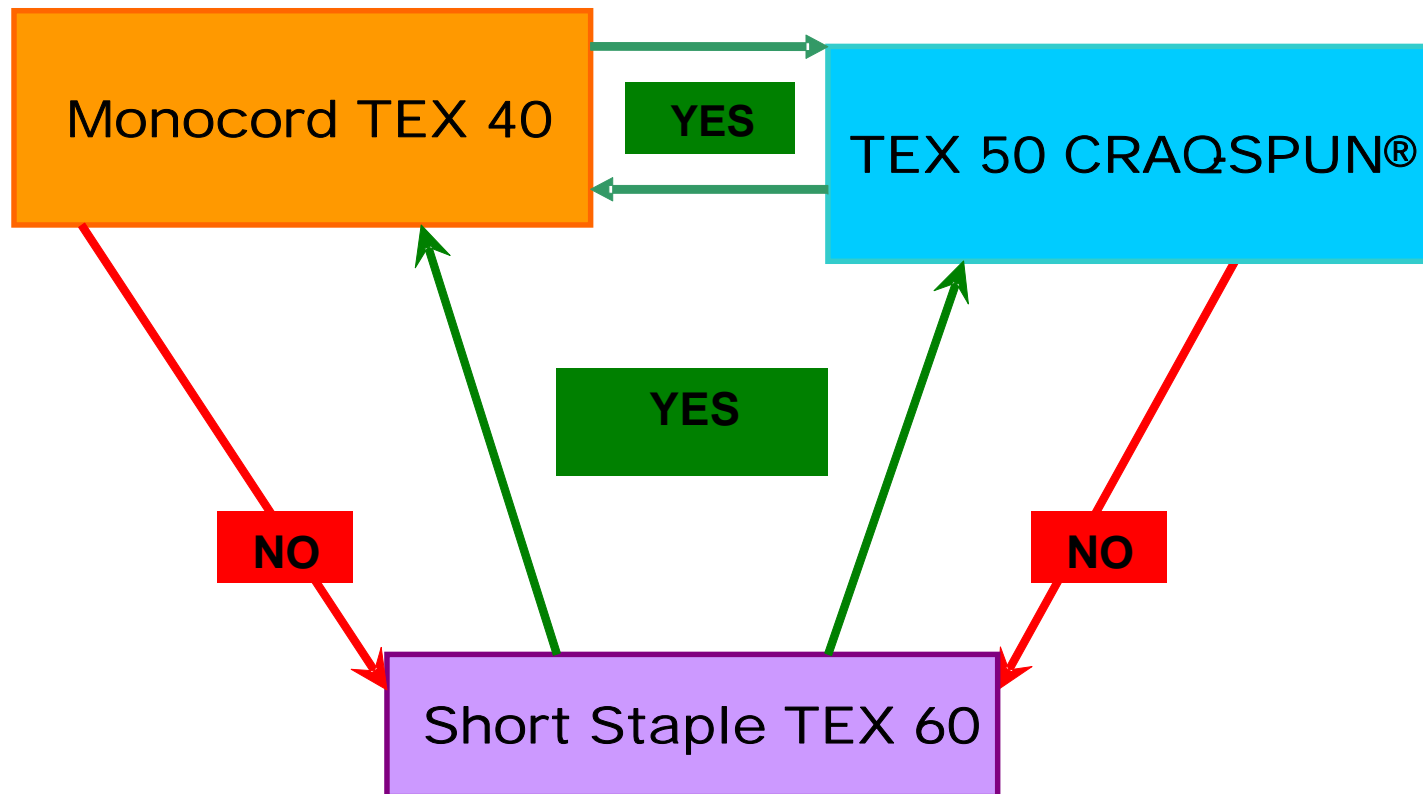
- Monocord TEX 40 and TEX 50 CRAQ-SPUN® sewing threads are interchangeable, and may be substituted for each other **without additional prototyping**
- Monocord TEX 40 and TEX 50 CRAQ-SPUN® sewing threads may be substituted for short staple TEX 60 **without additional prototyping**

# However...

Based on the comments about Component Matters in  
the QNA's from November, 2006

Short Staple TEX 60 **may NOT be  
substituted** for **either** Monocord  
TEX 40 or TEX 50 CRAQ-SPUN®  
without additional prototyping

# Interchangeability Based on “Reasonable Criteria”



# A Non-Compliant Mattress



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# Compliant Mattress (Self-Extinguishing)





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