SFI Spec Seatbelt Webbing Life

Why recertify every 2 years?

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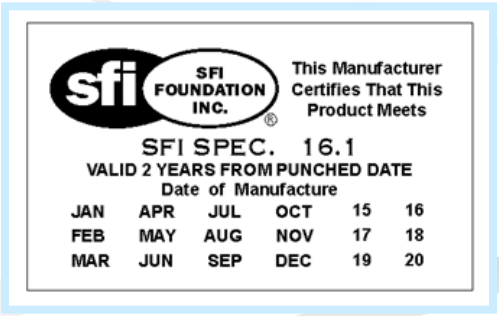
SFI Seatbelt Recertification

- Spec 16.1 – Driver Restraint Assemblies
- Spec 16.2 – Restraint Assemblies for Youth Drivers
- Spec 16.5 – Stock Car Driver Restraint Assemblies
- Spec 16.6 – Advanced Stock Car Driver Restraint Assemblies (new)

- Seatbelts meeting the above SFI Specs are certified ***by the Manufacturer*** that they comply with testing and all other requirements of the specified SFI Program.

Current Label Design:

New Label Design Coming in 2015:



SFI Seatbelt Recertification

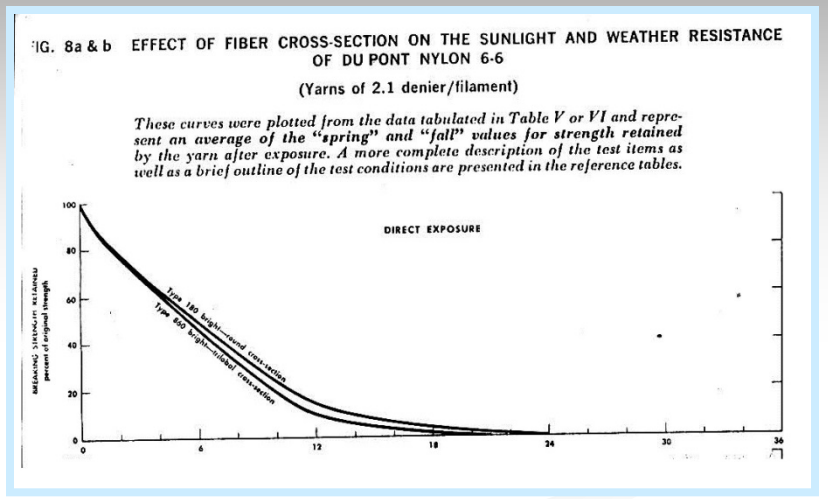
- SFI Specs state: "The useful life of the webbing in the straps shall not exceed two years and they must be replaced at or before that time. Only the original manufacturer can re-web an assembly prior to re-certifying."

- Why?
  - Degradation of webbing strength over time due to environmental exposure.
  - Safety concern.

- The Process
  - Racers contact the manufacturer of their seatbelt assembly for recertification.
  - For cost effectiveness, some seatbelt manufacturers choose complete replacement of a harness rather than rewebbing it.

SFI Seatbelt Recertification

- **Historical Empirical Data** shows significant loss of strength in webbing exposed to outdoor environments. Results are consistent across different studies.
  - DuPont Light & Weather Testing[1]
    - April, 1966
  - US Army Outdoor Weather & Sunlight Testing[2]
    - January, 1993
  - DuPont Sunlight Testing
    - October, 2001



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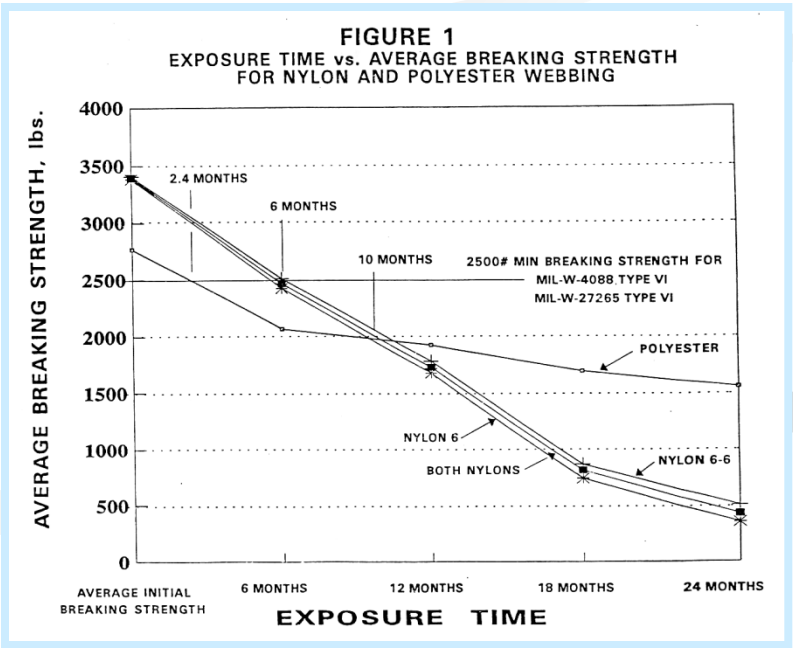

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SFI Seatbelt Recertification

- UV Exposure Laboratory Testing

Environmental Test Cabinet

Individual Webbing Sample

SFI Seatbelt Recertification

- Based on Scientific Test Data
  - UV Testing of 3" Nylon and Polyester Webbing, note that specified minimum breaking strength for SFI 16.1 Lap or Shoulder belt webbing is 6300lbs:

Report Number	Sample	Method	Lbf at Break	Comments	UV % Change
4147	Nylon control	webbing only	10296	"	
4148	Nylon control	straight pull	10887	Untreated new webbing	
4149	Nylon control	"	10463	"	
Nylon Average			**10549**		
4152	Poly control	webbing only	10172	"	
4153	Poly control	straight pull	10285	Untreated new webbing	
4154	Poly control	"	10741	"	
Poly Average			**10399**		
4155	Nylon UV	webbing only	5480	"	
4159	Nylon UV	straight pull	4564	STM G154 cycle 4, 600 hours	
4161	Nylon UV	"	5072	"	Nylon
Nylon Average			**5039**		**-52%**
4156	Poly UV	webbing only	7958	"	
4158	Poly UV	straight pull	7841	STM G154 cycle 4, 600 hours	
4160	Poly UV	"	8370	"	Poly
Poly Average			**8056**		**-23%**

The October – November 2013 SFI UV test conducted according to ASTM UV G154-12a included 400 light-on hours (600 total hours), in a cycle that included humid night conditions (8 hours light-on followed by 4 hours dark and damp), so the UV radiation approximately represented 80% of the yearly UV radiation of Miami, FL.

SFI Seatbelt Recertification

- Based on Scientific Test Data
  - UV Testing of 2" Nylon, Polyester, and Aromatic poly webbing, note that the specified minimum breaking strength for SFI 16.1 Lap or shoulder belt webbing is 6300lbs:

SFI Report Number	Sample	Load at Break	Comments	UV % Change
4249	Poly Control 1	7255	Untreated new webbing	
4250	Poly Control 2	7259	Untreated new webbing	
4251	Poly Control 3	6940	Untreated new webbing	
Poly Control Average		**7151**		
4252	Aromatic poly Control 1	8769	Untreated new webbing	
4253	Aromatic poly Control 2	8612	Untreated new webbing	
4254	Aromatic poly Control 3	7502	Untreated new webbing	
Aromatic poly Control Average		**8294**		
4256	Nylon Control 1	5774	Untreated new webbing	
4259	Nylon Control 2	5655	Untreated new webbing	
4260	Nylon Control 3	5740	Untreated new webbing	
Nylon Control Average		**5723**		
4261	Poly UV 1	3889	ASTM G154 cycle 4, 600 hours	
4262	Poly UV 2	4456	ASTM G154 cycle 4, 600 hours	
4263	Poly UV 3	4091	ASTM G154 cycle 4, 600 hours	
Poly UV Average		**4145**		**-42%**
4264	Aromatic poly UV 1	**5045**	ASTM G154 cycle 4, 600 hours	
4265	Aromatic poly UV 2	**4713**	ASTM G154 cycle 4, 600 hours	
4266	Aromatic poly UV 3	**5141**	ASTM G154 cycle 4, 600 hours	
Aromatic poly UV Average		**4966**		**-40%**
4267	Nylon UV 1	**2792**	ASTM G154 cycle 4, 600 hours	
4268	Nylon UV 2	**2473**	ASTM G154 cycle 4, 600 hours	
4269	Nylon UV 3	**2870**	ASTM G154 cycle 4, 600 hours	
Nylon UV Average		**2712**		**-53%**

SFI Seatbelt Recertification

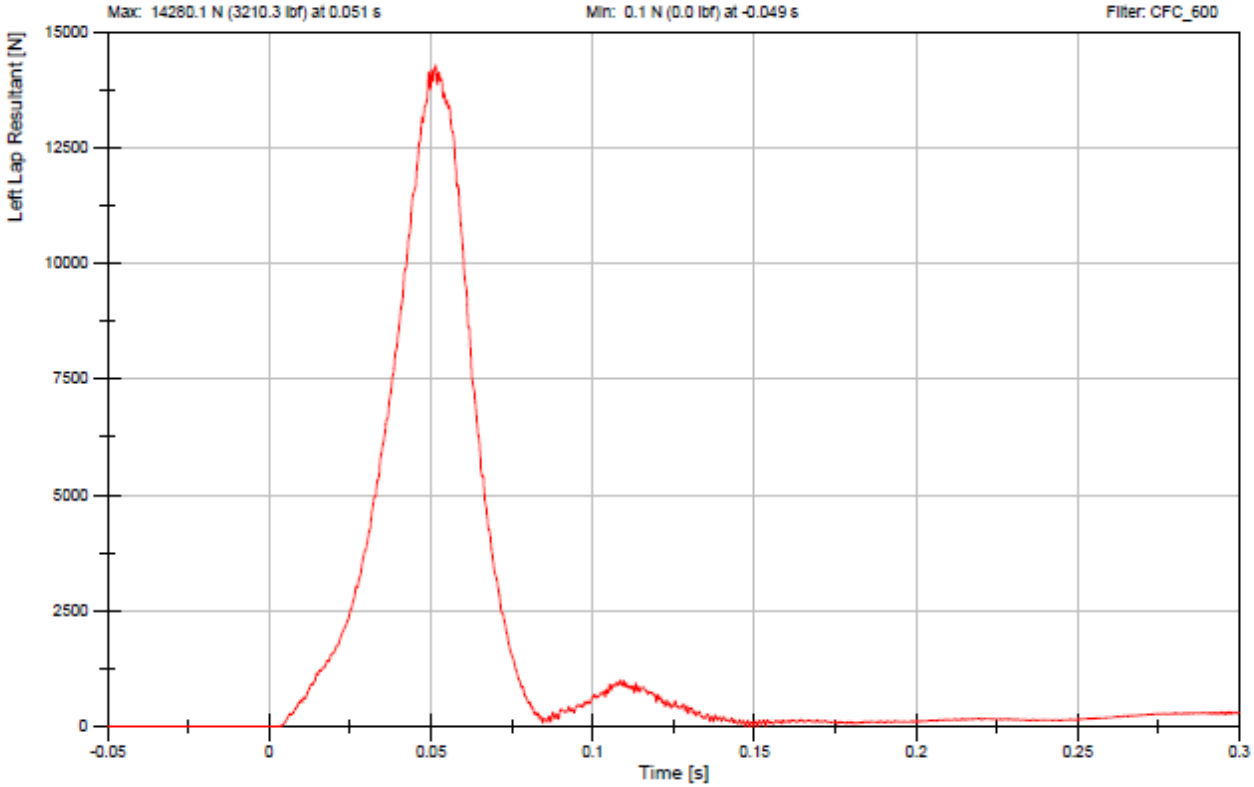
- …But in the real world, belts do not always break in a straight pull, because alignment and fit is never absolutely perfect, belts can "dump."

Lap belt at peak loading with a 168lb dummy during a 68G pulse sled test at approximately 50 milliseconds.

Simulating belt dumping in quasi-static test.

SFI Seatbelt Recertification

- Here is the Lap belt loading of the same dummy 68G pulse from the previous page, showing 3,210lbs of tension on the left lap belt at approximately 51 milliseconds:



SFI Seatbelt Recertification

- Compare the 3,210 force above, with quasi-static dumping testing of **new** 3" Webbing samples….then consider a reduction in strength due to UV:

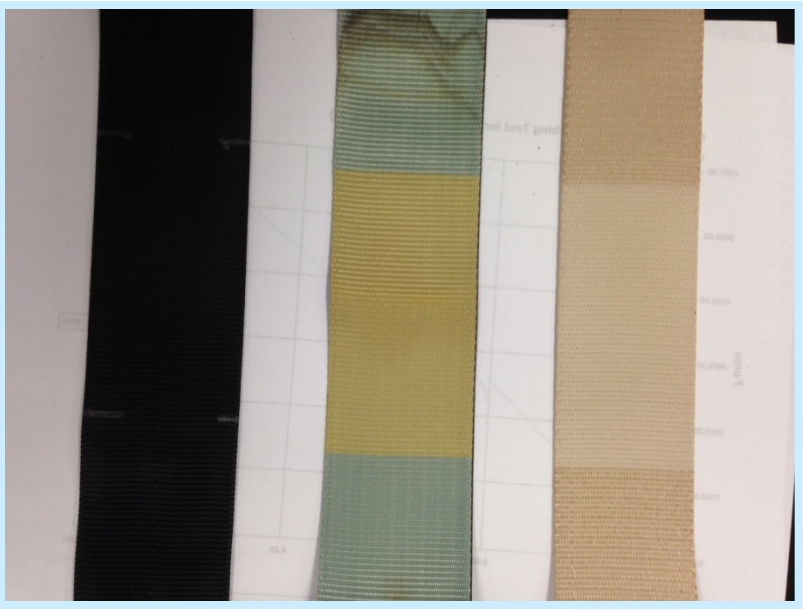
Report Number	Sample	Method	Lbf at Break	Comments
4201	Poly control	"	2594	"
4204	Poly control	dumped	2481	new webbing
4207	Poly control	"	2455	"
Poly Average			**2510**	
4199	Nylon control	"	2565	"
4209	Nylon control	dumped	2647	new webbing
4214	Nylon control	"	2599	"
Nylon Average			**2604**	

SFI Seatbelt Recertification

- Other Considerations
  - Safety is the Priority.
  - Certifications are not valid beyond the expiration dates set by the SFI Specifications for Driver Restraint Assemblies, maintained by a technical committee.
    - Allowing the use of seatbelts past their expiration is a liability risk.
  - Subjective interpretations by Tech Inspectors must be minimized
    - To reduce the liability they incur personally (as well as the track & sanctioning body)
    - It's difficult to reject equipment based on its condition or visual appearance versus meeting an objective specification or date.

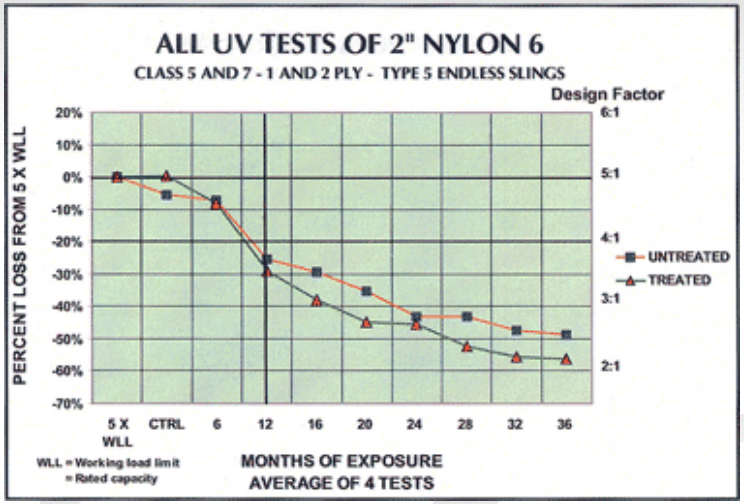
SFI Seatbelt Recertification

- Other Considerations, cont.
  - Webbing Strength Degradation can be Invisible
    - The 3 webbing samples below all have exactly the same exposure/weathering. The weathered area is completely undetectable in the black webbing, despite losing 42% of its strength…2% more than the tan sample on the right. Better dyes can hide the effects of aging, but the effect on the webbing strength is the same:



SFI Seatbelt Recertification

- Other Studies from different industries on webbing strength and UV exposure get the same data and results:
  - National Transportation Safety Board[1]
  - Web Sling & Tie Down Association[2,3]
  - U.S. Army
  - Celanese Corporation
  - Dupont



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NTSB
SAFETY ALERT
National Transportation Safety Board

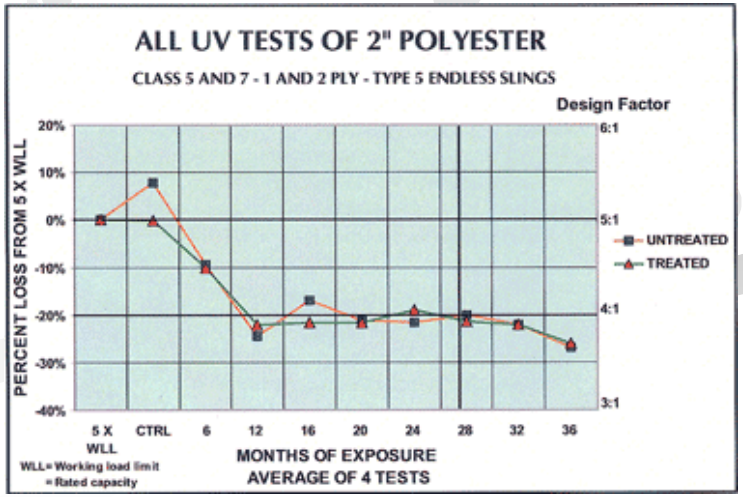
★ Check Your Restraints ★

Carefully follow restraint system maintenance and replacement guidance to prevent death and injuries

The problem

- General aviation aircraft restraints degrade due to age, UV exposure, and repeated use.
- Although restraints are required to be inspected annually, degradation of their capability can be difficult for aircraft owners and maintenance personnel to detect.
- Some aircraft are only equipped with lap belts and do not have shoulder harnesses, which can prevent occupants from impacting the airplane interior during a crash.

1



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