LONG TERM, IN-VEHICLE POLYURETHANE SEATING DURABILITY PERFORMANCE

Introduction

The long-term performance of polyurethane auto seating has been reviewed recently in "Auto Cushioning Through the Ages" (www.moldedFoam-IP.org). Polyurethane cushioning is the accepted material used world-wide in all vehicles. This poster will illustrate that PU cushioning is a viable, long-term seating medium.

Three scenarios are presented:
1. Evaluation of cushion and back parts extracted from discarded/wrecked auto mobiles from junk yards/recycling yards
2. Long term evaluation of cushions cycled in and out of police cruisers for at least the equivalent of 'one vehicle lifetime'
3. Extraction and evaluation of complete vehicle seating packages from two "expired" vehicles, one with a considerable odometer reading (310 000 kms) and the other having a very long period of usage (almost a quarter of a century).

All seat foams have been tested against the original OEM specifications for each part and include both physical and flammability properties.

Phase 1: Auto Parts Removed From Recycling Junk-yards

- To determine if foam cushioning had retained it's initial properties or not
- Cushioning obtained from Ontario, W Virginia and Texas and odometer readings recorded (up to 326Kkms)
- Tested in an ISO 17025 accredited lab
- Cushioning fair-to-good in appearance but some parts had crumbly surfaces (Texas)
- Part hardness retained
- Foam properties mostly retained and met original specs including fatigue properties
- Foam still met FMVSS 302 flammability requirements

Foam Physical Properties of Parts Removed from Recycling Yards

								Compression Set			
OEM	Odometer Reading km	Part Type	Hardness* (Spec)	Density kg/m³	Tensil Strength kPa	Elongation %	Tear Resistance N/m	Dry Set	75% Def %	Humid Aged %	Flammability FMVSS 302 Rating
Ford	123.4 K	Cushion	49 (44-53) 39 (36-44) 26 (24-32)	44	205	140	354	--	14	12	N.R.
Ford		Back	62 (63-73) 33 (28-38) 22 (18-23)	34	203	140	N.D.	--	21	26	N.R.
Ford	51 K	Cushion	77 (70-78) 61 (60-70) 40 (38-47)	41	242	130	347	--	27	23	N.R.
Ford	Unknown	Cushion	150 (145-155) 128 (115-135) 100 (85-95)	40	193	220	N.D.	--	19	19	SE, SE/NBR B (all pass)
GM	Unknown	Cushion	255 (21/-262)	39	143	150	N.D.	15	11	19	N.R.
GM	Unknown	Back	119 (?)	24	157	N.R.	213	21	--	N.R.	SE/NBR

Conclusions

- Foam still had acceptable properties but it was not possible to correlate foam performance with vehicle odometer readings
- Parts had unknown history and no info on occupant weights or driving styles

Phase 2: Police Vehicle Durability Study

- Foam and competitive material cushioning installed in police cruisers
- Cushions made with various PU chemistries or fibrous materials (natural or synthetic)
- Fully-trimmed seats installed in vehicles and used for 3/4 weeks before removal and re-evaluation in the lab for hardness, thickness change and seat creep
- Seats re-installed in vehicles for repeated periods until the equivalent of "one vehicle lifetime" of use
- PU cushions performed well, fibrous cushioning failed
- Foam cushioning tested for physicals and results compared with initial properties --essentially no change in properties after usage
- Long term seat usage resulted in retained seating comfort and maintenance of H-point

Physical Properties of Automotive Cushions of Various Types

Foam Type Foam History	GM 6293M			TDI Based Foam After Fleet Testing			MDI Based Foam		
Foam Properties	Units	Class B	Class C	#7	#1	Aged Over One Year	As Produced	One Year Fleet Use	Aged Over One Year
Core Density	kg/m³	40 min	32 min	40	46	36	35-36	35	35
IFD @ 50% Def	N	--	--	373	217	309	321-330	289	340
Tensile Strength	kPa	90 min	82 min	237	190	204	153-167	207	215
Elongation	%	120 min	100 min	160	170	143	125-128	127	123
Tear Strength	N/m	220 min	200 min	368	301	315	242-274	204	189
Compression Set 90% Def	%	16 max	18 max	17	8	21	17-21	30	22
75% Def	%	14 max	16 max	20	8	8	14-21	16	15
50% Def after Humid Aging	%	25 max	30 max	23	12	26	20-23	28	26
CFD Change after Humid Aging	%	± 25 max	± 25 max	-9	-4	-9	-8/-11	-24	-9
Hysteresis Loss	%	--	--	29	20	28	37	34	35

Conclusions

- Well-formulated PU cushioning retains it's H-point, seat comfort and the foam components do not exhibit any physical property degradation
- Alternative cushioning materials were completely unacceptable
- Fleet study considered as a useful "foam rating test" to determine the performance of foam cushioning and to eliminate unacceptable PU formulations or other padding materials

Phase 3: Discarded Vehicle Study

A. 1994 Chevrolet Lumina
- Vehicle scrapped due to engine problems
- Odometer reading 310K kms and used by "conservative" drivers
- Seats removed and photographed before being disassembled in a Comfort Lab
- All foam parts (front cushions and backs, rear cushion and back) examined/photo graphed before testing (photos)
- Cigarette burns through cover stock noted but cushioning foam unaffected
- Foam parts still met GM6293M spec requirements with a few exceptions and passed both FMSS 302 and the stricter GM9070P max burn rate of 63.5mm/min

B. 1986 Ford Crown Victoria LTD
- 25 year old vehicle just recently scrapped
- Only 86.6K kms on odometer ; thus low usage but long in service
- Used by drivers weighing up to 136kg
- Visually seats in excellent condition throughout vehicle; no rips, sagging or staining
- Cushioning removed easily from seats and both HR and hot foam padding found
- Front cushions in good shape with minimal deformation
- Front backs (hot foam chemistry) were badly ripped due to frame cutting
- Rear cushion and back benches exhibited virtually no damage but pre-usage repairs noted
- Front cushion still retained spec hardness
- Front backs (hot foam) had low core densities (21 - 27kg/m3)
- Parts still had very good physical properties
- HR foam parts met both the FMVSS 303 and the Ford flammability requirements with SE or SE/NBR ratings but the hot foam backs exhibited burn rates of 45 - 79mm/min, still meeting requirements

Conclusions
- Seats removed from scrapped vehicles with high odometer reading or exceptionally long-term service (almost a quarter of a century) still retained excellent visual appearance
- Foam parts extracted from these seats have retained their physical properties that mostly still meet the original OEM specs and flammability requirements

Summary and Conclusions
- Foam parts extracted from recycling-/scrap- yard vehicles mostly retain good physical properties that still meet the OEM specs
- Foam parts from yards where the climatic conditions caused surface crumbling may exhibit some burn rates but still perform satisfactorily
- Well-formulated cushions perform well in cyclic, long-term usage for at least one vehicle lifetime and even longer
- Foam parts removed from scrapped vehicles, either with high usage level or after a long service life have retained their target properties and would have been capable of further, extended usage
- Well-formulated PU foam (especially the HR type) has been proven to perform well in use offering both comfortable seating support and very long term durability performance

Ford Crown Victoria Parts Tested to Original Specifications

Property / Part	Units	Driver Cushion	Passenger Cushion	Rear Cushion	Rear Back	221C
Core Density	kg/m³	30.4	31.9	34.1	37.2	
Tensile Strength	kPa	160	194	183	226	83 min
Elongation	%	150	180	150	180	120 min
Tear Strength	N/m	290	275	264	296	210 min
75% Def Comp Set	%	7	10	11	11	20 max
75% Def HACS	%	10	13	10	13	30 max
Flammability		SE(3X) SE/NBR(3X)	SE(6X)	SE/NBR(1X) SE/B 45.2 SE/B 46.5 SE/B 52.9 SE/B 57.8	SE(1X) SE/NBR(1X)	

Molded Polyurethane Foam Industry Panel

Mission Statement

The Industry Panel Mission is to Create Automotive Seating Foam Specifications that are Practical and Functionally Driven to Achieve Basic Commonality Within the Automotive Industry and Establish Best Practices

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David Zedan, Chrysler LLC · Brian Witkowski, Ford Motor Company · Angela Neagos, General Motors · Diane McQueen, General Motors

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Website www.moldedFoam-IP.org
- Full "Long Term, In-Vehicle Polyurethane Seating Durability Performance" report
- Industry Panel Polyurethane Foam Specification
- Recommended Technical Papers
- Molded Foam Guidelines

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