Ford Analysis of Selected Aftermarket Copy Parts

vs.

Genuine Ford OE Replacement Parts

Paul Massie
Ford Customer Service Division
Powertrain & Collision Product
Marketing Manager

Other Ford Attendees

Roger Chen
Crash Development Engineer

Dave Bauch
Sensor Technical Specialist

Steve Nantau
FCSD Project Strategy Manager

Special Guests

OEM Ollie

Aftermarket Adam

Why Am I Here?

- At the July 2010, CIC meeting Ford presented the findings of our comparison of selected aftermarket parts to our OEM versions
- We presented Computer Aided Engineering models for the Mustang Bumper Beams and F-Series Radiator Core Support
- I committed then to bring you the results of actual crash testing data if engineering time could be made available in our safety labs

Aftermarket Copy Parts Compared to Our Ford OEM Parts

- 05-09 Mustang front and rear bumper beams
- 08-09 Focus front and rear bumper beams
- 05-09 Mustang bumper isolators
- 06-08 F-150 bumper brackets
- 04-07 F-150 radiator core support

Previous Ford Test Findings

- Ford launched our own investigation of selected aftermarket copy structural parts
- At the July CIC meeting, Ford showed how poorly constructed these aftermarket copy parts were
- Ford shared results that describe in detail the differences between “like,” “kind” and “quality” of the tested OEM and aftermarket copy parts
- Ford found tested aftermarket copy parts were inferior and could compromise a vehicle’s performance and occupant safety in a crash
- Ford’s analysis raised red flags about aftermarket copy collision parts

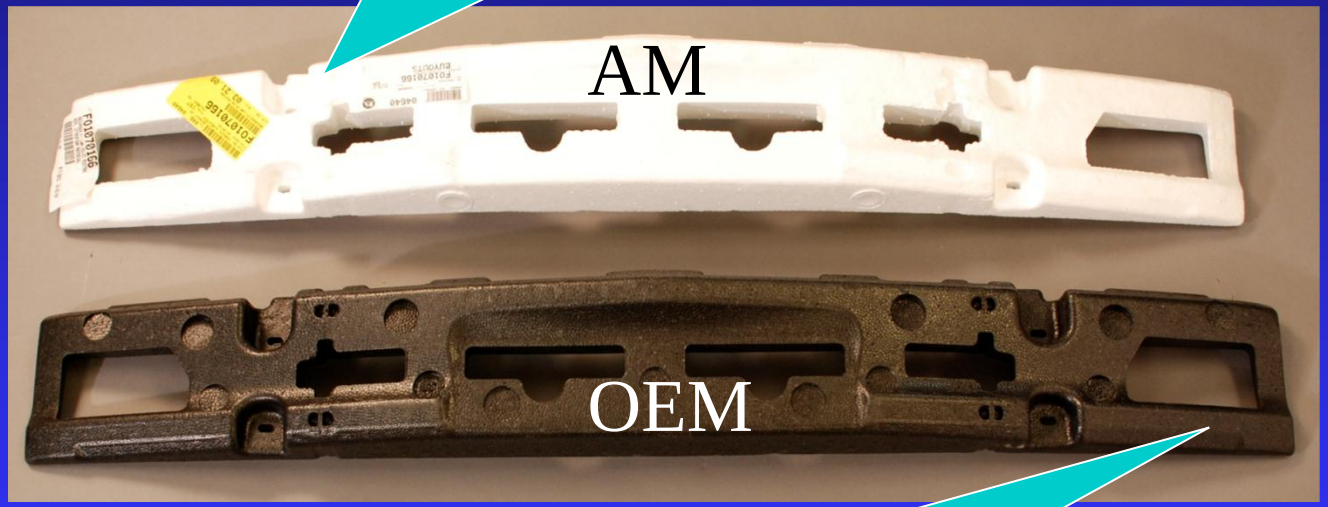
Ford's Analysis of Aftermarket Copy Parts' Materials, Weights, Thicknesses & Forming Processes

- Ford reproduced the reciprocating saw cross-cut test with similar results as demonstrated at previous venues
- Using an air chisel Ford cut apart aftermarket spot welds which did not meet Ford spot welding specifications
  (1mm +1mm thickness requires minimum 5mm nugget size)
- Aftermarket copy parts' metal gauge thickness and weight were less then the OEM with only one exception found
- Aftermarket copy parts' material usage varied significantly from OEM
- There were significant structural differences between the aftermarket copy parts and the OEM parts

Mustang Bumper Isolator

Polystyrene

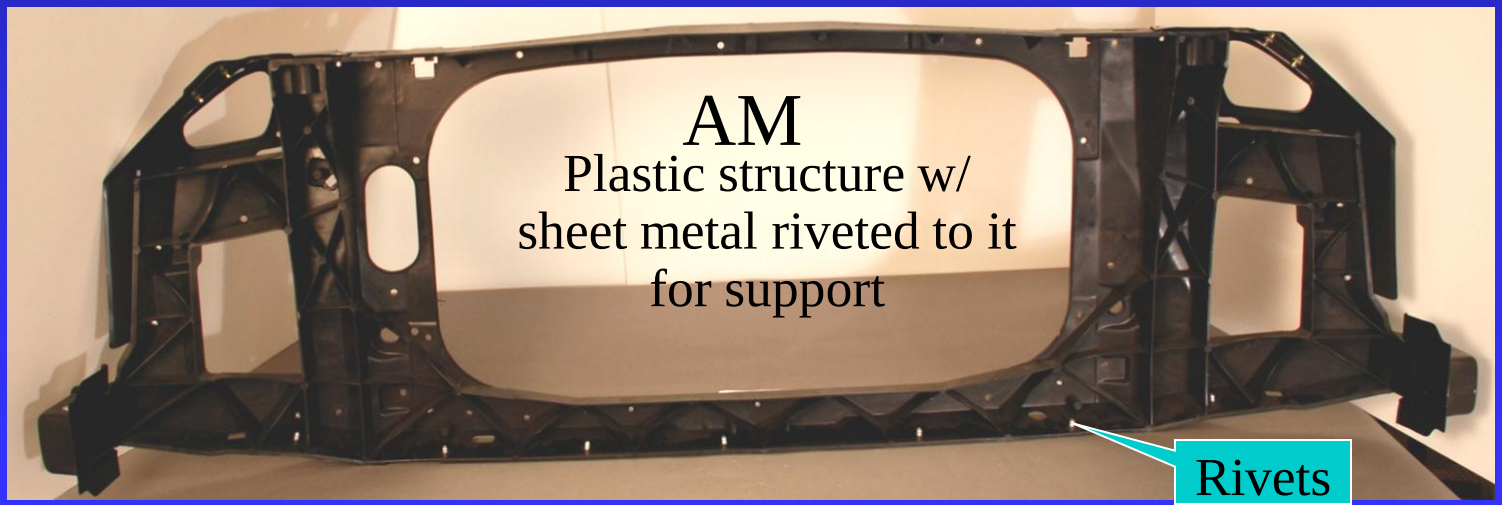
Component is lighter and cells are not as dense



Polypropylene #4

Component is much more sturdy, heavy and dense

F-150 Radiator Core Support



F-Series Bumper Bracket Weights

OEM = 6.20 lbs.

AM = 2.85 lbs.

F-Series Bumper Bracket Thickness

OEM = 4.68mm

AM = 2.21mm

Without The OEM Part to Compare to…

How Are Body Shops to Know a Good Aftermarket Copy Part From a Bad One ???

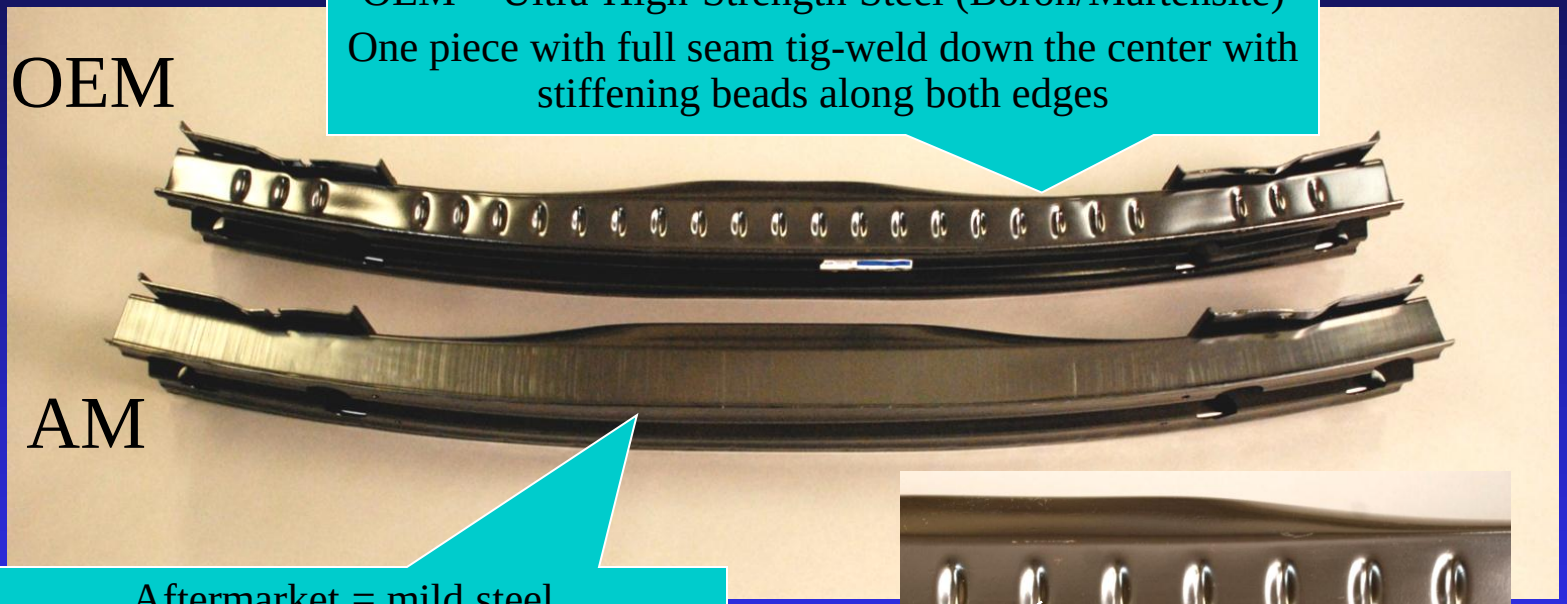
Visual Comparison of Aftermarket and OEM Parts

OEM = Ultra-High-Strength Steel (Boron/Martensite)

One piece with full seam tig-weld down the center with stiffening beads along both edges

OEM

AM



Aftermarket = mild steel

Two-piece spot-welded together with no stiffening beads

OEM

Stiffening beads

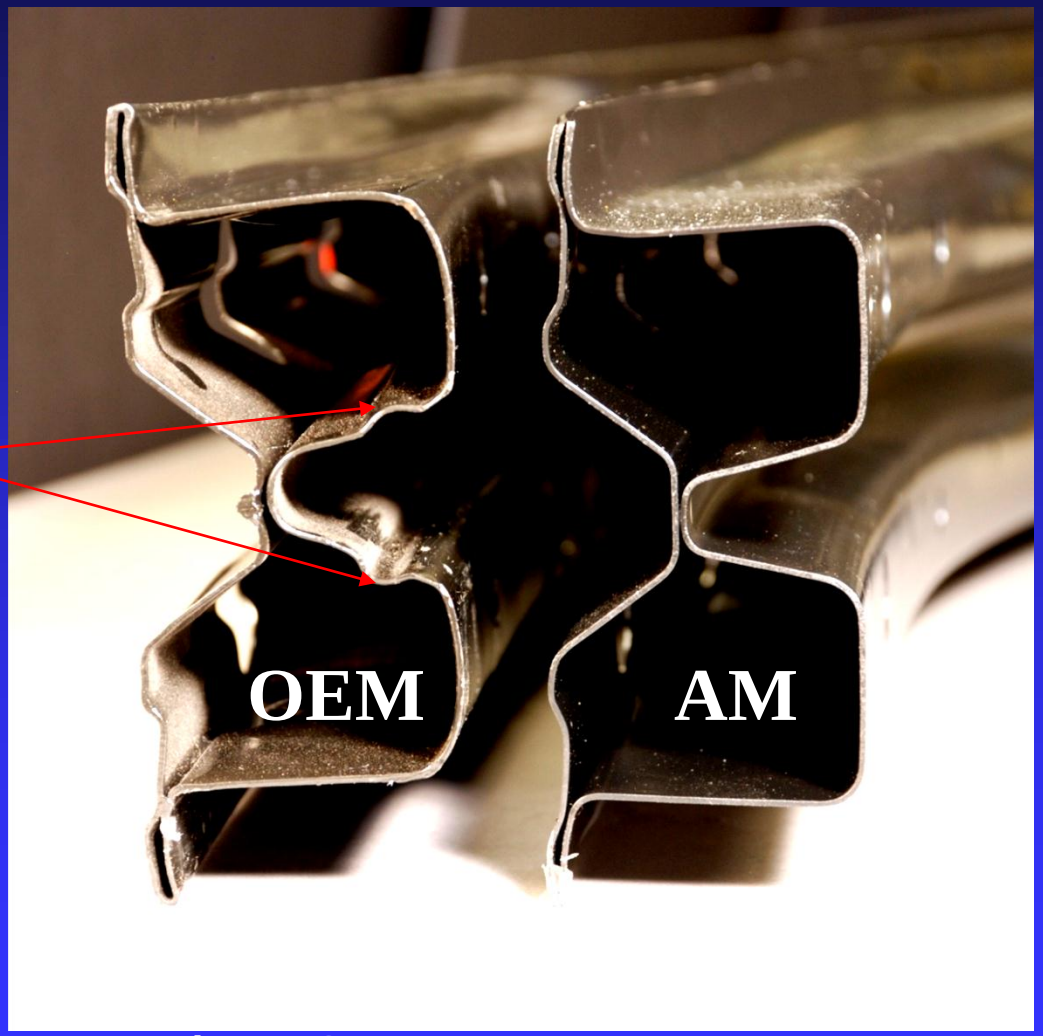
Visual Comparison of Aftermarket and OEM Parts

One piece with full seam tig-weld

Two pieces spot-welded together

Visual Comparison of Aftermarket and OEM Parts

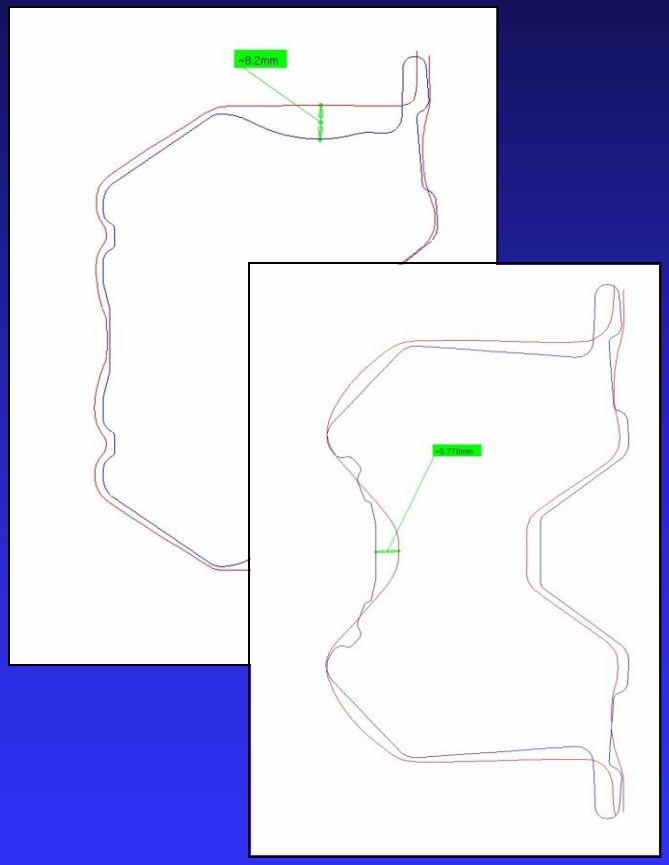
Bumper beam longitudinal stiffening beads

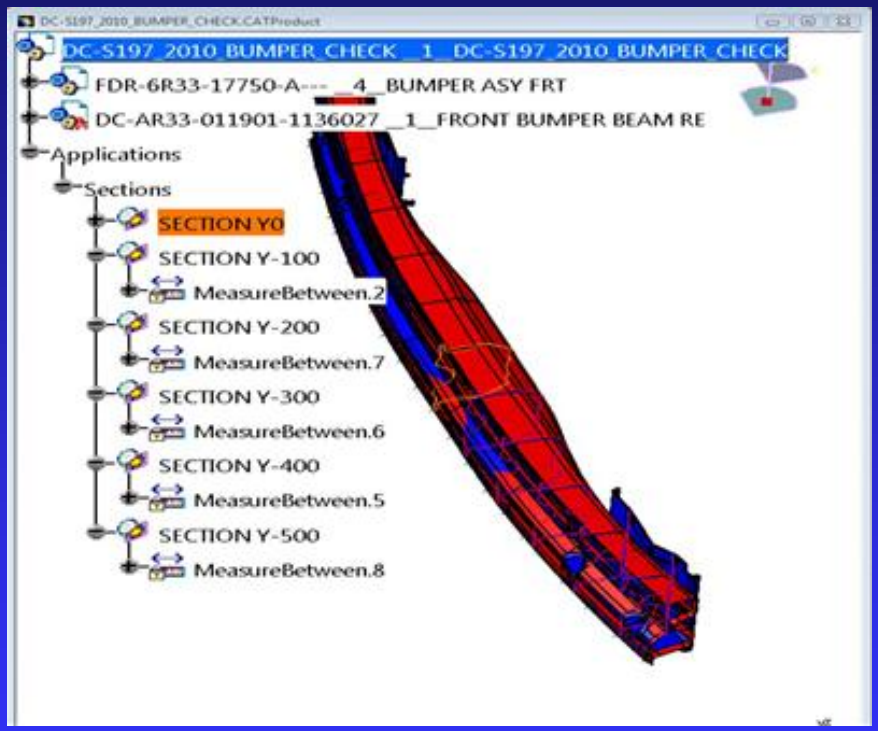


Ford Engineers Used CAE Models to Compare Aftermarket Parts to OEM

- "Coupons" were cut from both OE and aftermarket copy parts and sent to Ford Central Labs to determine material composition
- Aftermarket copy parts were electronically scanned so their dimensions could be determined and compared to Ford OE parts using CAE Testing
- CAE models of the aftermarket performance were built by substituting the aftermarket copy parts' material composition and dimensional measurements for the Ford parts

Mustang Aftermarket Bumper Beam Analysis
Dimensional Check





Blue = OEM

Red = Aftermarket

All Steels are Not the Same and are Not *"Like Kind"*

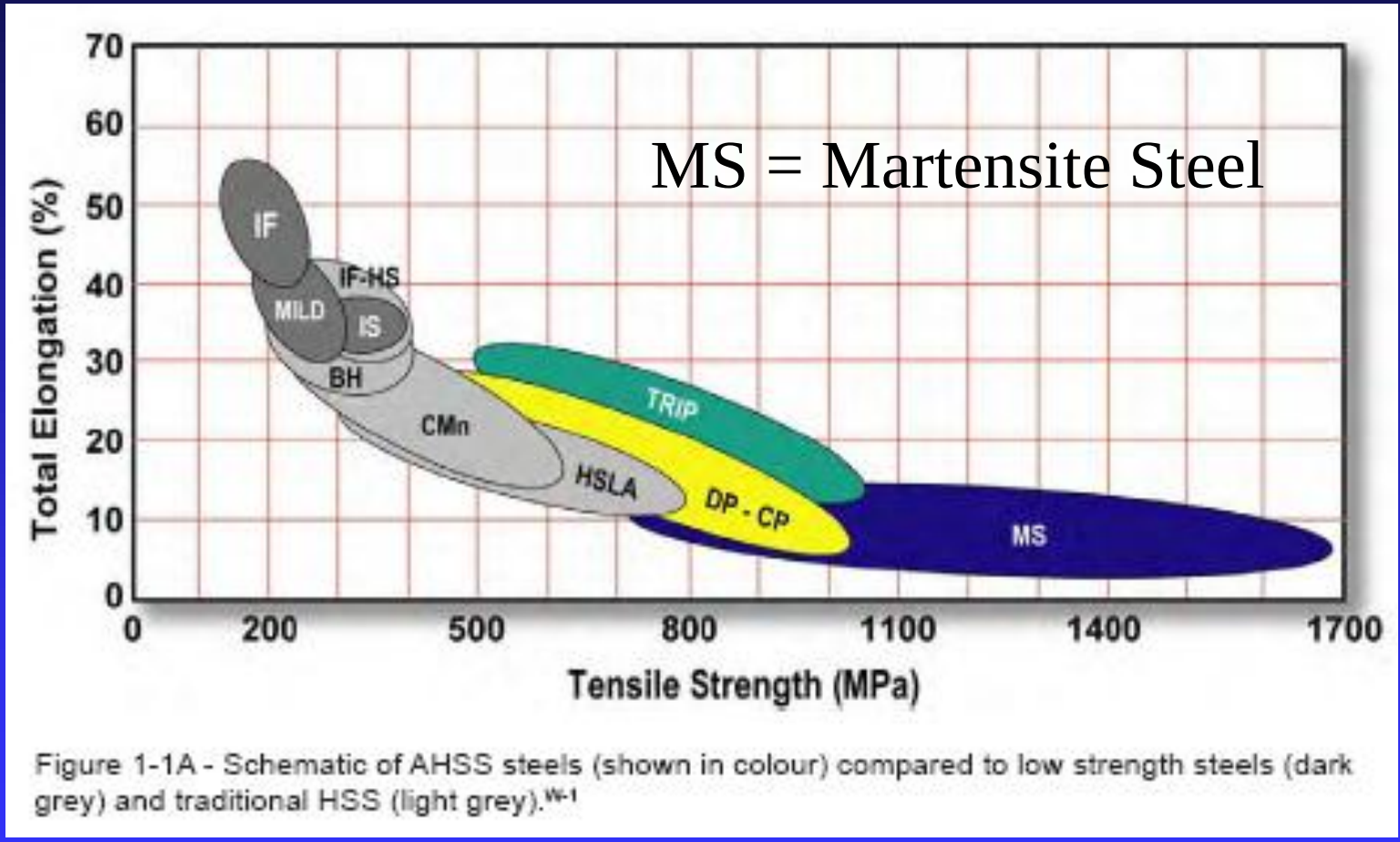
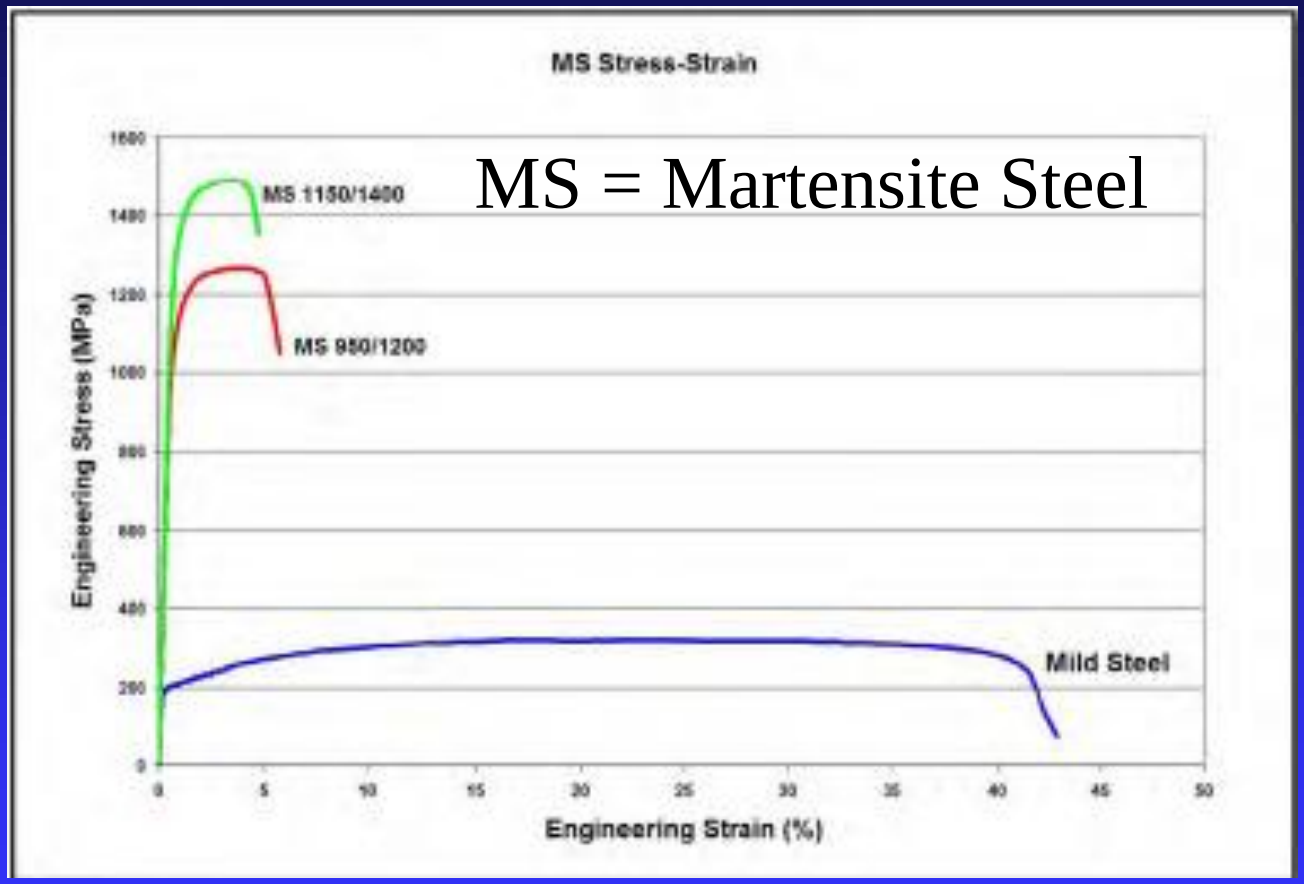


Figure 1-1A - Schematic of AHSS steels (shown in colour) compared to low strength steels (dark grey) and traditional HSS (light grey).[W-1]

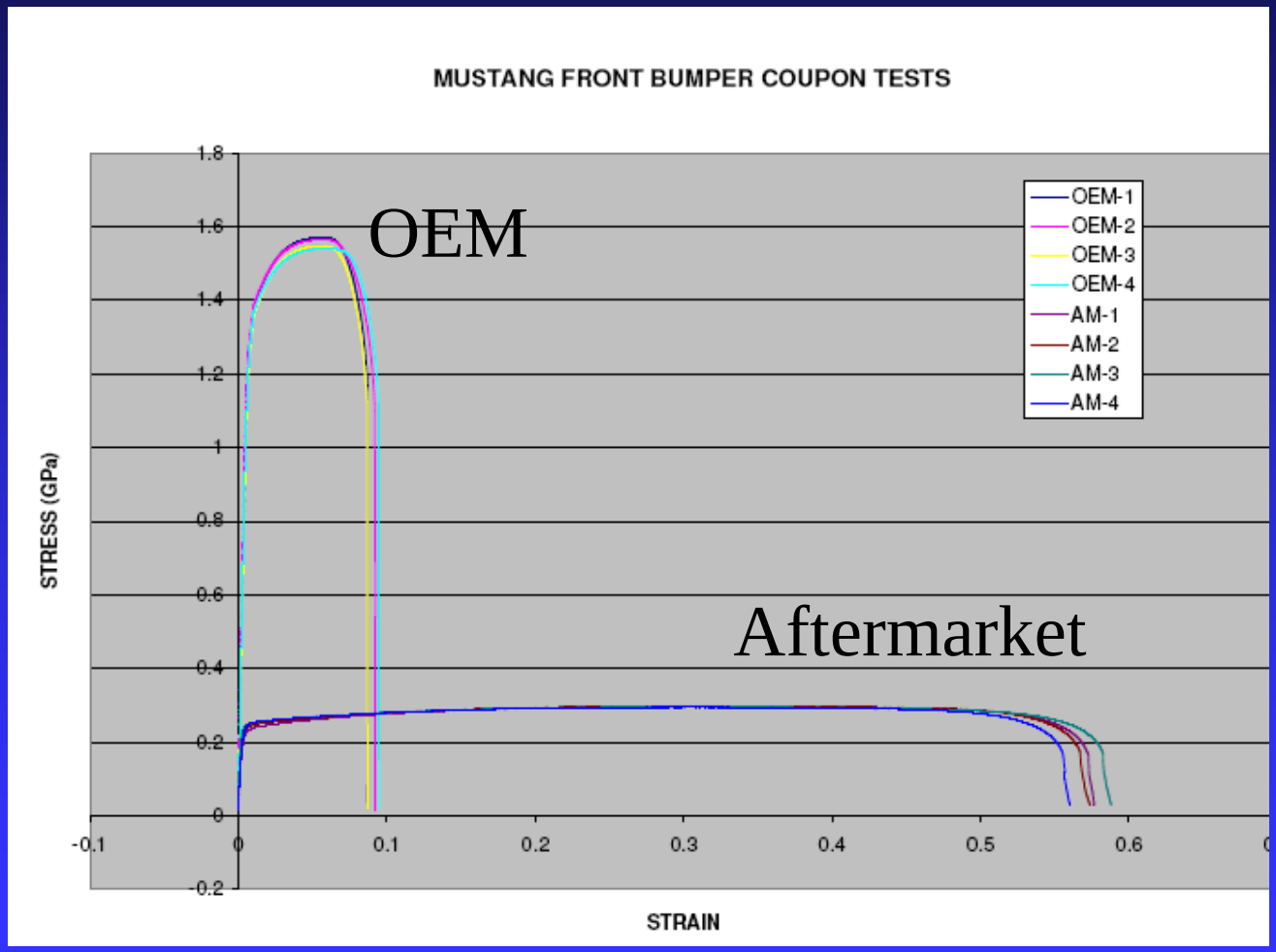
Source : WorldAutoSteel "Advanced High Strength Steel (AHSS) Application Guidelines", Version 4.1, June 2009

Stress vs. Strain Signatures



Source : WorldAutoSteel "Advanced High Strength Steel (AHSS) Application Guidelines", Version 4.1, June 2009

Mustang Aftermarket Bumper Analysis vs. OEM



Mustang Aftermarket Bumper Beam Analysis
Front Bumper Coupon Tests

After Market

Sample	.2% Yield MPa	Tensile MPa	% Elongation in 1"
AM-1	223.0	298.5	48
AM-2	225.9	298.3	47
AM-3	235.4	296.6	51
AM-4	239.3	295.8	49
Ave	230.9	297.3	49
Std Dev	7.7	1.3	2

OEM

Sample	.2% Yield MPa	Tensile MPa	% Elongation in 1"
OEM-1	1303.9	1565.6	8
OEM-2	1278.9	1561.3	9
OEM-3	1273.3	1551.2	7
OEM-4	1280.3	1543.7	8
Ave	1284.1	1555.5	8
Std Dev	13.5	9.9	1

All Steels are Not the Same and are Not *"Like Kind"*

Mild Steels

High Strength Steels

Ultra High Strength Steels

Table 1-2 – Steel grades available for Future Steel Vehicle.[W-2] sorted by yield strength

Steel Grade	YS (MPa)	UTS (MPa)	Tot. EL (%)
Mild 140/270	140	270	42-48
BH 210/340	210	340	35-41
BH 260/370	260	370	32-36
IF 260/410	260	410	34-48
BH 280/400	280	400	30-34
IF 300/420	300	420	29-36
DP300/500	300	500	30-34
FB 330/450	330	450	29-33
HSLA 350/450	350	450	23-27
DP 350/600	350	600	24-30
TRIP 350/600	350	600	29-33
DP 400/700	400	700	19-25
TRIP 400/700	400	700	24-28
HSLA 420/500	420	500	22-26
FB 450/600	450	600	18-26
TRIP 450/800	450	800	26-32
TWIP 450/1000	450	1000	50-54
HSLA 490/600	490	600	20-25
CP 500/800	500	800	10-14
DP 500/800	500	800	14-20
HSLA 550/650	550	650	19-23
DP 700/1000	700	1000	12-17
CP 800/1000	800	1000	8-13
MS 950/1200	950	1200	5-7
CP 1000/1200	1000	1200	8-10
HF 1050/1500 (22MnB5)			
- *Conventional Forming*	340	480	23 -27
- *Heat Treated Post Forming*	1050	1500	5-7
MS 1150/1400	1150	1400	4-7
MS 1250/1520	1250	1520	3-6

AM

AM

OEM

OEM

YS and UTS are minimum values

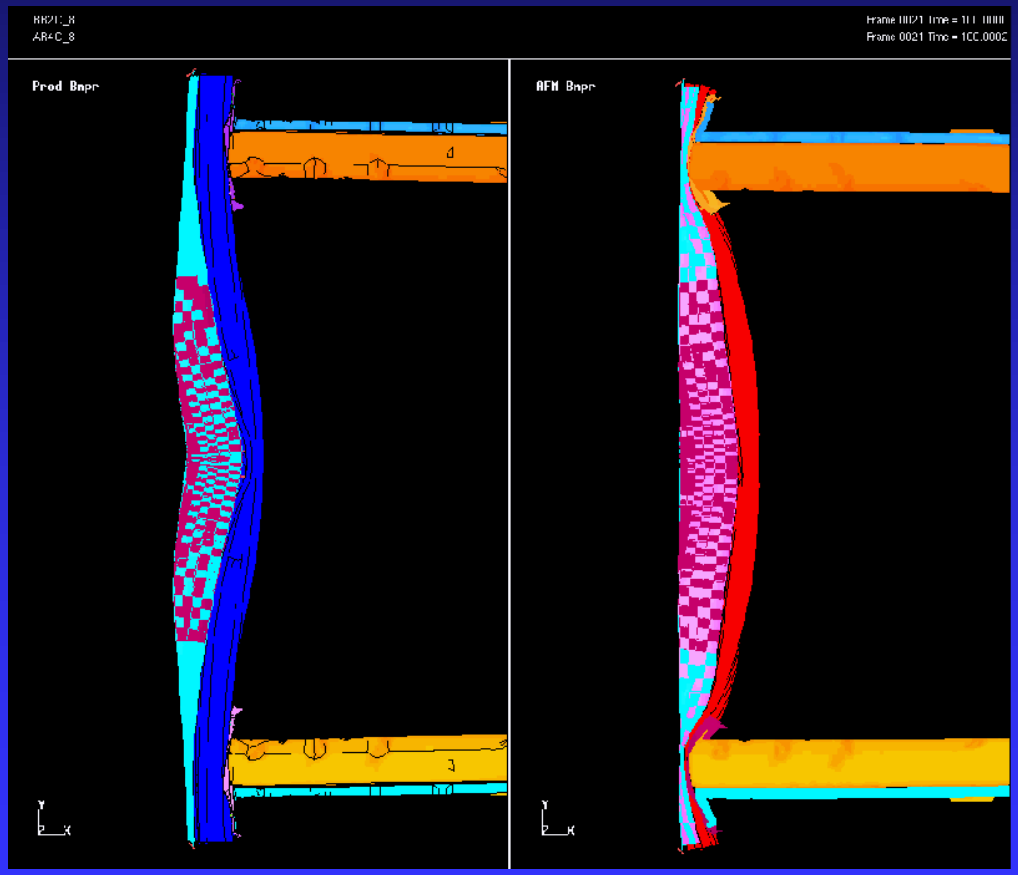
Tot. EL (Total Elongation) range shows typical values for a broad range of sheet thicknesses and gauge lengths.

Weaker

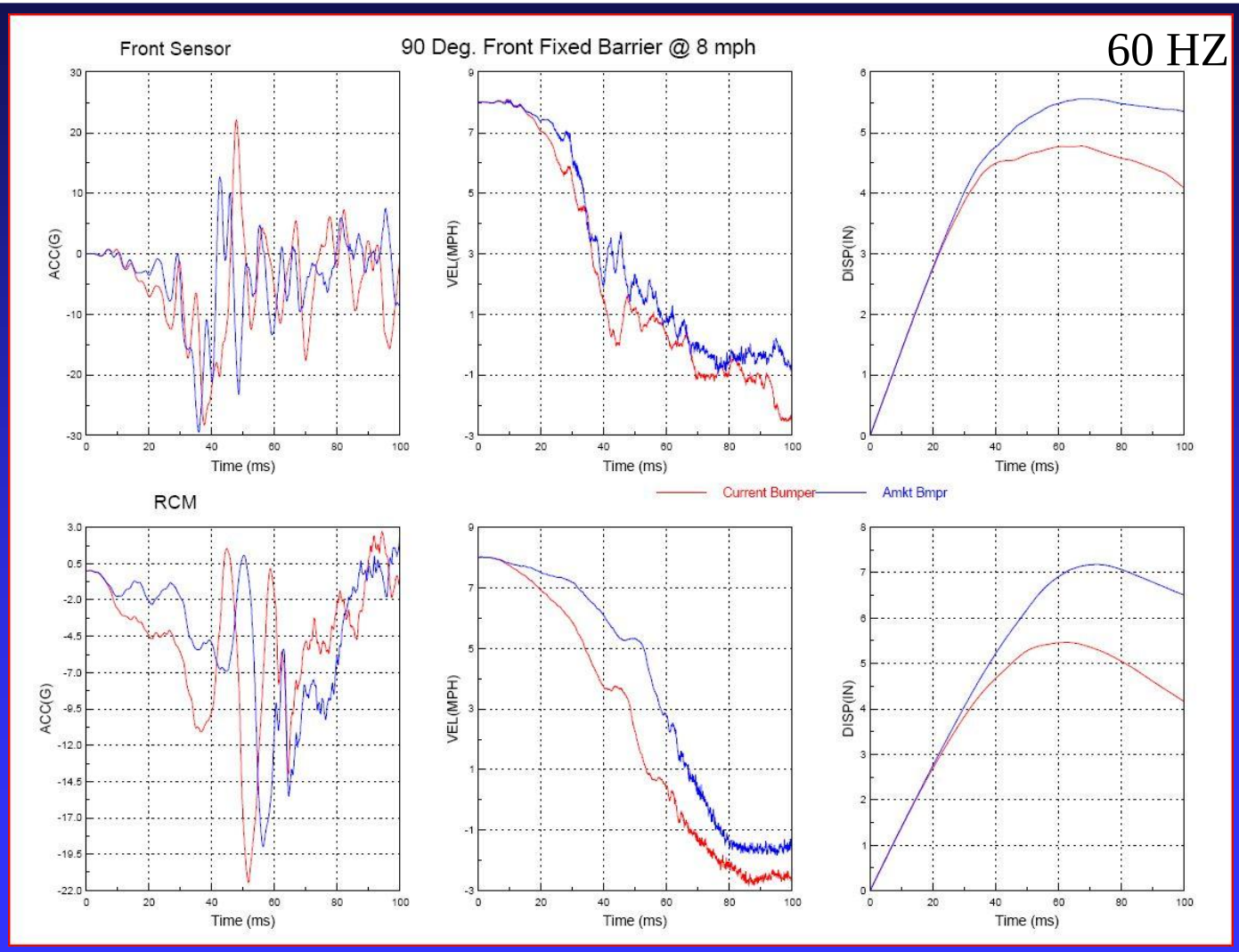
Stronger

Source : WorldAutoSteel "Advanced High Strength Steel (AHSS) Application Guidelines", Version 4.1, June 2009

Front Mustang CAE Bumper Beam Analysis
Frontal Sensor Test at 8-mph



CAE Comparison @ 8 mph



Tested Aftermarket Copy Parts Are NOT of "Like Kind and Quality" to OEM

- Our analysis revealed tested aftermarket copy parts are substantially different in:
  - Raw materials used to make the part
  - Material weight and thickness
  - Manufacturing processes to construct the part
  - Dimensional and structural integrity
  - Performance (for the tested bumper beam and radiator support)
- If a supplier provided the tested parts to Ford for production or service parts they would be rejected as they do not meet our specifications
- The tested parts are not of "Like Kind and Quality" to OEM and should not be used in states requiring "Like Kind and Quality" for collision repair
- The tested parts are not equivalent to or better than OE
- The tested parts do not return the vehicle to pre-accident condition

SO, WHAT'S NEW?

MUSTANG AFTERMARKET BUMPER TESTING

Ford Safety Engineering

Via Sled Test -- 10/06/2010

Crash Barrier Test -- 10/19-20/2010

Crash Test Modes Used in Development of the Frontal Safety System (Partial List)

Regulatory & Insurance Institute for Highway Safety

- 16-mph Rigid Frontal Barrier
- 25-mph Unbelted Rigid Barrier
- 30-mph Belted Rigid Barrier
- 35-mph Rigid Barrier (NCAP)
- 25-mph 30 Degree Front Angular Right
- 25-mph 30 Degree Front Angular Left
- 30-mph 30 Degree Front Angular Right
- 30-mph 30 Degree Front Angular Left
- 25-mph 40% Offset Deformable Barrier
- 40-mph 40% Offset Deformable Barrier

Ford Crash Test Modes (Partial List)

Barriers

- 8-mph Rigid Frontal Barrier Airbag Non-deployment
- 12-mph Rigid Frontal Barrier
- 16-ph Rigid Frontal Barrier
- 22-mph Rigid Frontal Barrier

Angular Rigid Barrier

- 20-mph Angular Rigid Barrier
- 25-mph Angular Rigid Barrier

40% Offset Deformable Barrier

- 25-mph 40% Offset Deformable Barrier
- 40-mph 40% Offset Deformable Barrier

Front Structural Components Function as a System for Safety

Via Sled Component Test

- Via Sled named after company that installed it (Via Systems)
- Allows for Dynamic component-level testing prior to vehicle-level testing
- Evaluates how a component will react under dynamic crash conditions
- Is used to develop, and evaluate a design before incorporation into a higher-level system

VIA Sled Pre-Test Setup

OEM Bumper Beam

Aftermarket Bumper Beam

VIA Sled Pre-Test Setup

OEM Bumper Beam

Aftermarket Bumper Beam

Via Sled Test @ 6 MPH

OEM Bumper Beam

Aftermarket Bumper Beam

2 Video Slides Play
In CIC Live Presentation

VIA Sled Post-Test LH Side Bumper

OEM Bumper Beam

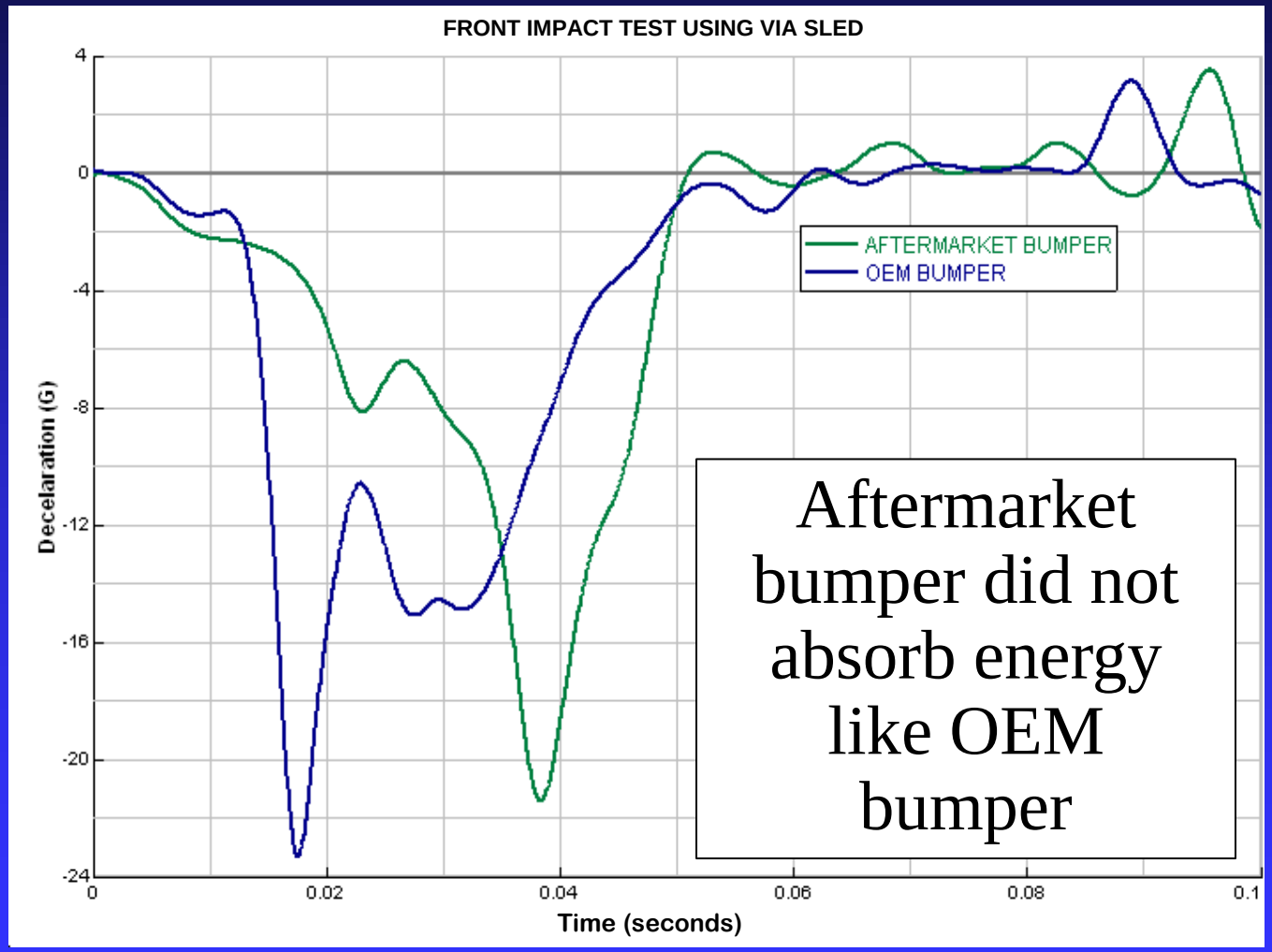
Aftermarket Bumper Beam

VIA Sled Post-Test RH Side Bumper

OEM Bumper Beam

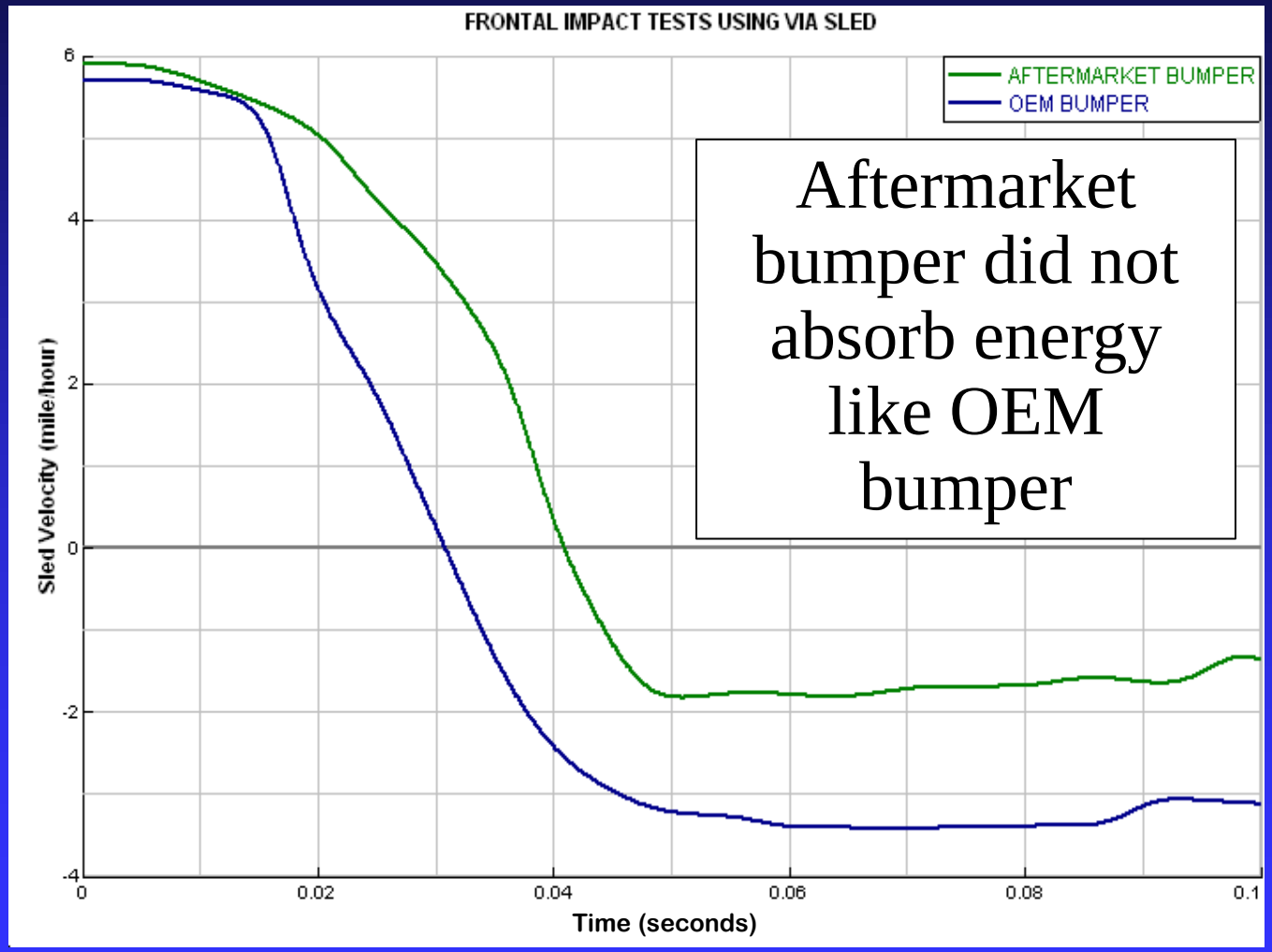
Aftermarket Bumper Beam

Via Sled Bumper Beam Deceleration Results



Aftermarket bumper did not absorb energy like OEM bumper

Via Sled Bumper Beam Velocity Results

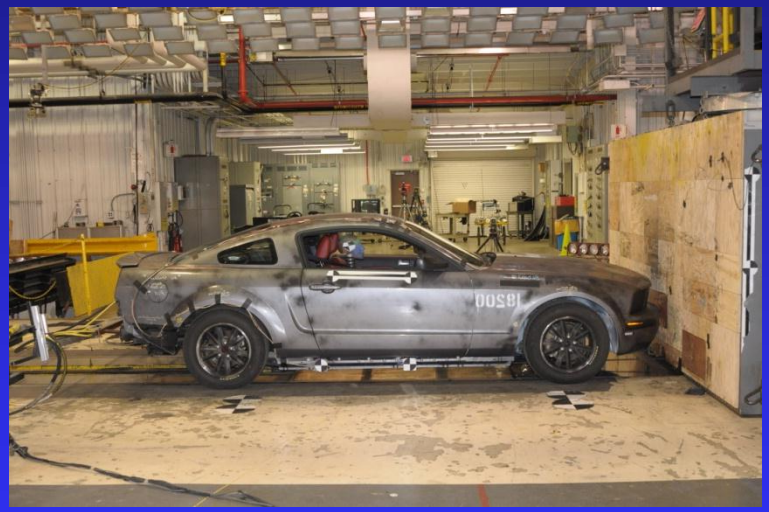


Crash Barrier Testing

‘07 Mustang – Front Bumper Beam, Absorber & Isolator

OEM Bumper Beam

Test Vehicle



Aftermarket Bumper Beam

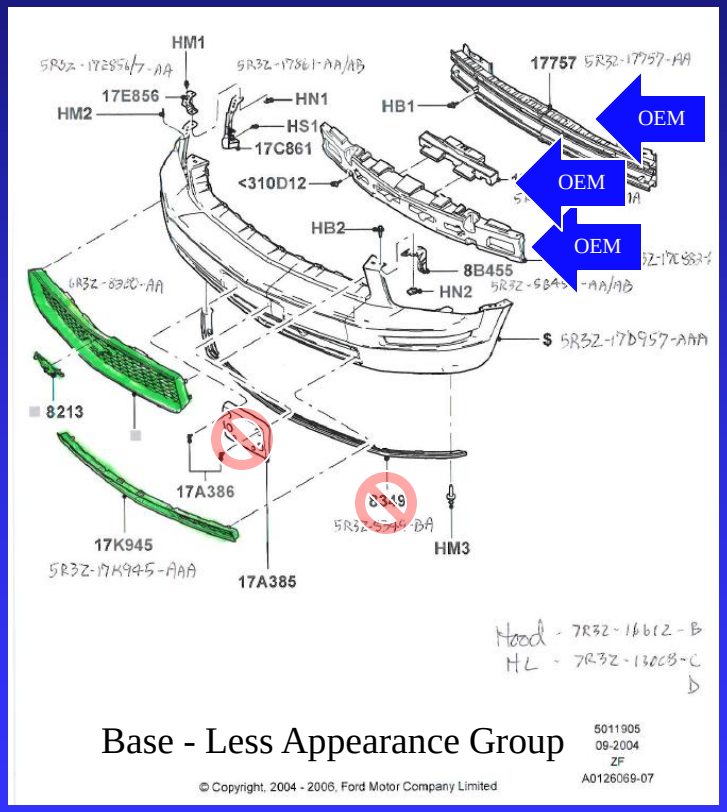
Test Vehicle

Vehicle Prep For Crash Barrier 5-MPH Crash

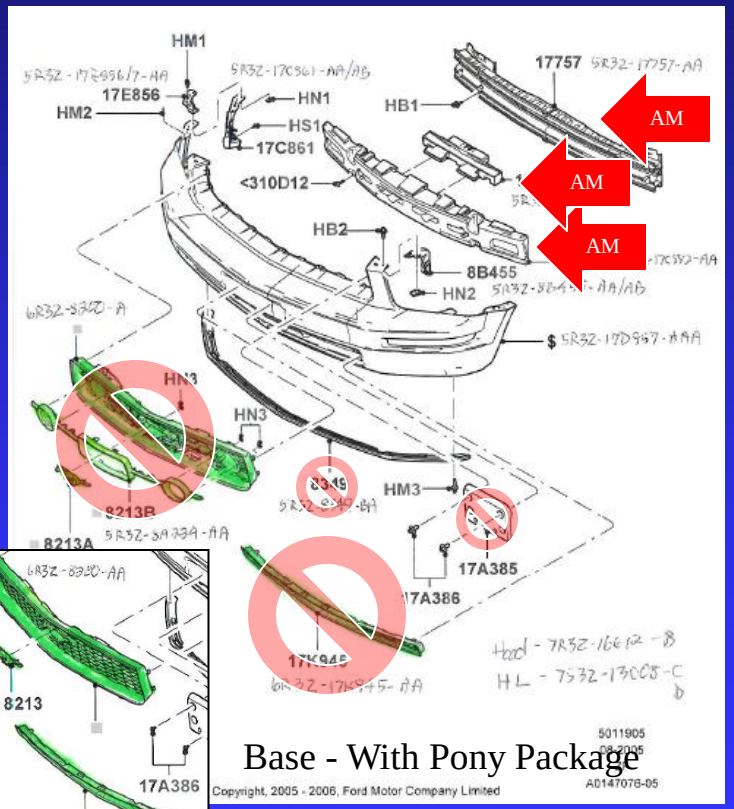
- Vehicles instrumented with accelerometer and test recording equipment
  - Airbag system deactivated consistent with Ford sensor testing protocol
- Production front bumper beams, absorbers and isolators removed and discarded
- Vehicles built back up for crash:
  - Aftermarket vehicle built up with new aftermarket copy replacement bumper beam, absorber, isolator and remaining production parts
    - Production pony upper/lower grilles were replaced with new OEM service parts “base grilles” so they would match the OEM vehicle grilles
  - OEM vehicle built up with new OEM service replacement bumper beam, absorber, isolator and remaining production parts

Crash Vehicles Built Up Using Same Parts (except beam, absorber & isolator)

OEM Bumper Beam Test Vehicle

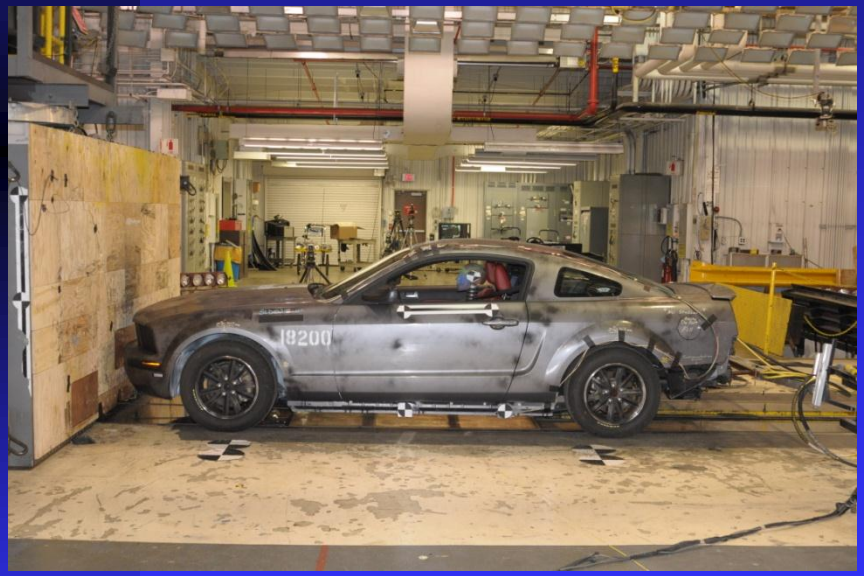


Aftermarket Bumper Beam Test Vehicle

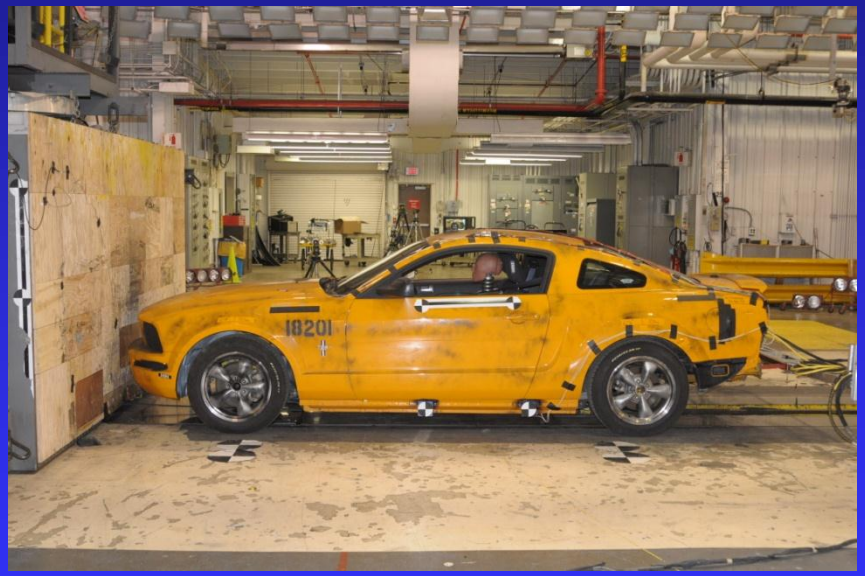


5-MPH Crash Barrier Test

OEM Bumper Beam Test Vehicle



Aftermarket Bumper Beam Test Vehicle



This Slide Is A Video
In CIC Live Presentation

5-MPH Crash Barrier Test

OE

AM

OE

AM

Vehicle Prep For Crash Barrier 8-MPH Crash

- Vehicles front-end components removed and inspected for damage
- Sensors/recording modules left intact
- Vehicles built back up for second crash:
  - Aftermarket vehicle built up with new aftermarket copy replacement bumper beam, absorber and isolator
    - Also received new OEM service replacement fascia, right headlight (due to damage), hood and misc. hardware as needed
  - OEM vehicle built up with new OEM service replacement bumper beam, absorber, isolator
    - Also received new OEM service replacement fascia, hood and misc. hardware as needed

8-MPH Crash Barrier Test

OEM Bumper Beam Test Vehicle

Aftermarket Bumper Beam Test Vehicle

This Slide Is A Video
In CIC Live Presentation

8-MPH Crash Barrier Test

OEM Bumper Beam Test Vehicle

Aftermarket Bumper Beam Test Vehicle

8-MPH Crash Barrier Test

OEM Bumper Beam Test Vehicle

Aftermarket Bumper Beam Test Vehicle

8-MPH Crash Barrier Test

OEM Bumper Beam Test Vehicle

Aftermarket Bumper Beam Test Vehicle

Estimate of Damages

As Written by Ex-Insurance Company Adjuster

Mustang Crash Barrier Tests
OEM vs Aftermarket Bumper Beam, Absorber and Isolator
5-mph and 8-mph flat barrier tests
2007 Mustang V6

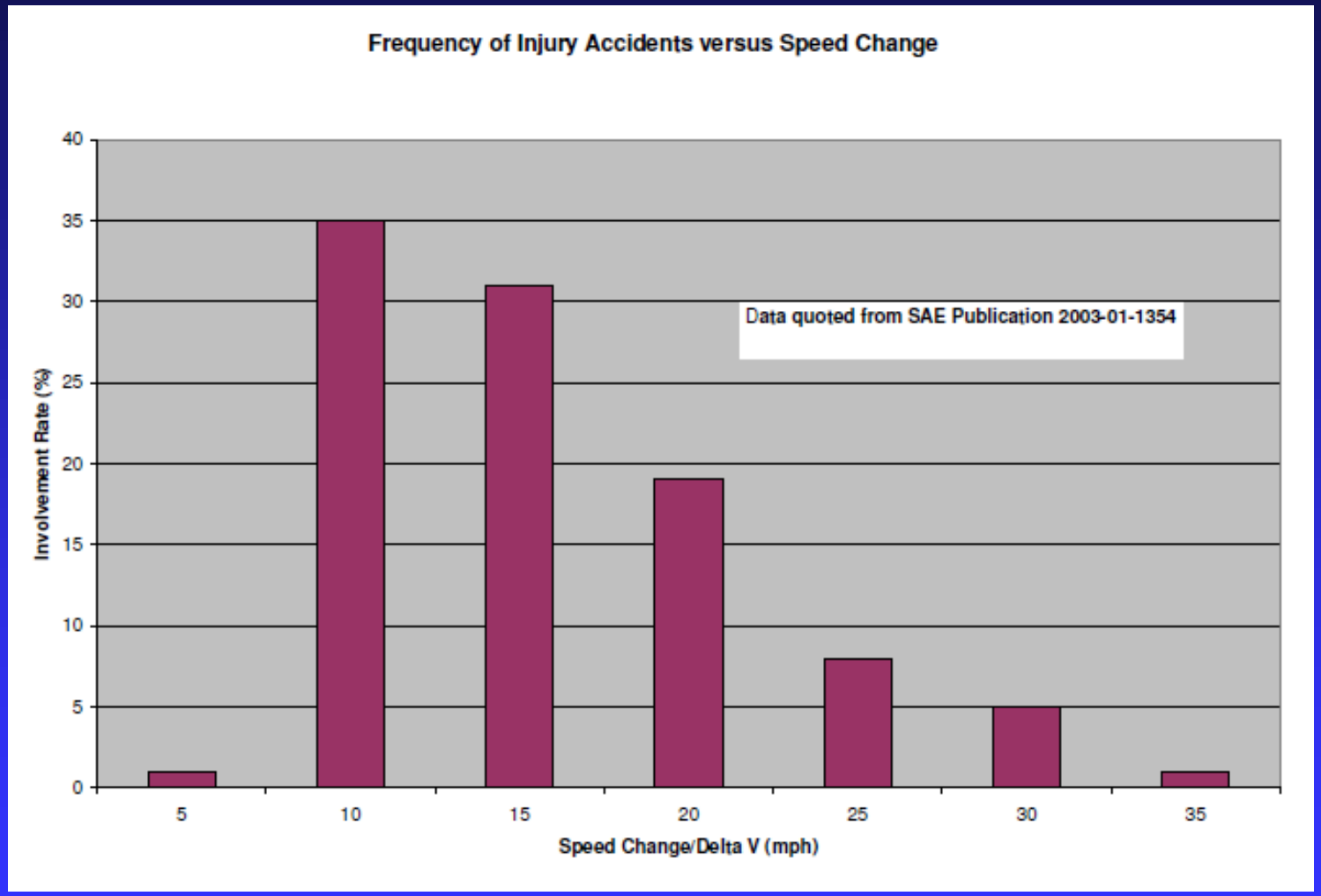
Damage Summary

Tests		Damage Estimate	
5-MPH Hit			
OEM Bumper Beam Test Vehicle	$	1,224.38	(a)
Aftermarket Bumper Beam Test Vehicle	$	2,982.03	(b)
8-MPH Hit			
OEM Bumper Beam Test Vehicle	$	3,440.68	(a)
Aftermarket Bumper Beam Test Vehicle	$	3,815.92	(b) (*)
-Additional Repair Cost -- Driver Airbag	$	706.00	(**)
-Additional Repair Cost -- Both Airbags	$	1,578.00	(**)

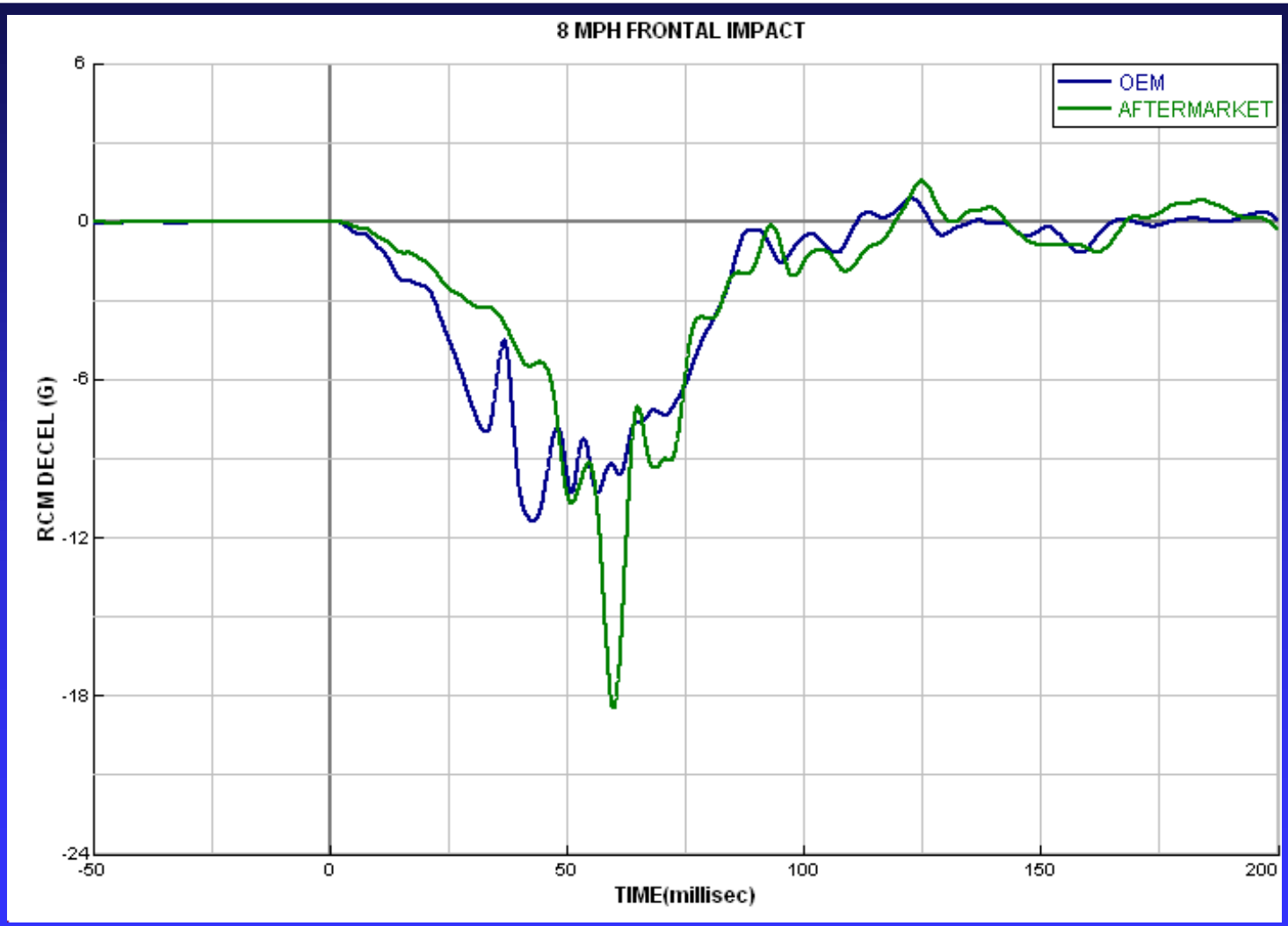
(a) Used all OE parts prices
(b) Used aftermarket parts prices for bumper beam, absorber and isolator (OE prices for rest)
(*) Does not include cost associated with airbag deployment in cases where it might deploy
(**) In cases where airbags may deploy when they should not

Labor Rate = $45.00 per Hour
Paint & Materials = $26.00 per Refinish Hour

Frequency of Accidents (with injuries) vs. Velocity Change



8-MPH Crash Pulse Comparison OEM vs. Aftermarket Bumper System



Aftermarket Bumper Beam Effects on Sensor Performance

- Crash Energy Absorbed by the aftermarket bumper beam is less than the crash energy absorbed by the OEM bumper beam.
- Airbag deployments at low speeds will increase with the aftermarket copy bumper beam, absorber and isolator

Ford's Next Steps

- Continue to Work with:
  - NHTSA
  - Industry trade associations
  - Automobile Alliance
  - Governmental and regulatory agencies
  - Elected officials

For oversight of aftermarket parts and their impact on the safety of the driving public