



Truck Group

# Summer '99 at Bumper/Fascia/Grille

June 21-August 27

Harris Yong

Princeton University '00

Mechanical Engineering

# Introduction

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- Bumper/Fascia/Grille Wall Display
- GMT 820C Grille Subsystem SSTS
- Fascia/Fender Interference
- Wheel Cladding/Endcap Interface
- Other Experiences



# Wall Display: Intro

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## Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Display of future (2001+)  
bumper/fascia/grille components

→ Product familiarity

→ Complexity reduction

→ Contacts:

→ DLTs:

→ Paul Dupire, Dave Scott, Dave Zellers...

→ Designers:

→ Renata Fadenelli, Ron Jennings, Kathy Straka...



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# Wall Display: Products

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## Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ GMT 355

→ GMT 360/370

→ GMT 560/565

→ GMT 610

→ GMT 820C

→ GMT 820D/830D

→ GMT 880



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# Wall Display: Format

Wall Display

→ Nameplates in columns (down)

GMT 820C  
Grille SSTS

→ Components in rows (across)

Fascia/Fender  
Interference

→ Part number and usage labels

Endcap/Wheel  
Cladding  
Interface

→ RPO codes

Other  
Experiences

Confidential



# Wall Display: Format

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Wall Display

→ Detail exploded drawings under solid views

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

Confidential



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# Wall Display: Format

Wall Display

→ Entire front and rear end views for complete picture

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

Confidential



# Wall Display: Spreadsheet

## Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Spreadsheet with  
additional (less  
developed  
products)

→ GMT 305

→ GMT 806

→ GMT 836/836D

→ RPO Glossary

Confidential



# GMT 820C Grille SSTS: Intro

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Grilles previously under:

→ Exterior Trim (GMT 360 60.4 Exterior Trim SSTS)

→ Front End Sheet Metal (GMT 800 60.1 Front End Sheet Metal and Grille SSTS)

→ Create independent Grille Subsystem (60.4.9) SSTS

→ create GMT 820C SSTS as a template for future grille subsystems



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# GMT 820C Grille SSTS: Contacts

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ **Contacts:**

→ Ellen McTigue

→ Ceena Farmer

→ Development, DPG, etc.



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# GMT 820C Grille SSTS: Coverpage

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

## GMT820C Grille Subsystem Technical Specification

GM Truck Group

Spec No: GMT820C 60.4.9  
Date: August ?, 1999



Approved: \_\_\_\_\_ Date \_\_\_\_\_  
Jim Clement, Validation EGM  
GMT820C Body Exterior

Approved: \_\_\_\_\_ Date \_\_\_\_\_  
Robert Morgner, PMT Director  
GMT820C Exterior Hardware and Rear Closures

Approved: \_\_\_\_\_ Date \_\_\_\_\_  
Bill Knapp, VSE  
GMT820C Body Exterior

Approved: \_\_\_\_\_ Date \_\_\_\_\_  
Abdi Lawassani, Exterior Trim EGM  
GMT820C Exterior Hardware



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# GMT 820C Grille SSTS: Major Changes

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

- Removed irrelevant non-grille subsystem information
- Increased objectivity
- Ensured all specifications can be validated
  - worked with Validation Engineer
- Conformed to NAO 60.4 Exterior Trim template up to 4 "decimal places"



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# GMT 820C Grille SSTS: VCRI

Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ References formal procedures for our specifications

Requirement			Procedure		Validation Method	Validation Organization	Supporting Paragraph
Paragraph Number	Title	Type	Number	Title			
S.60.4.9-3.2.1	Performance		N/A				
S.60.4.9-3.2.1.1	Protect the Vehicle Body		MTL9126	Opening Trim Stone Damage	T	MPG-PA	
S.60.4.9-3.2.1.2	Safety			External Projections (Export)	T	MPG-PA	
S.60.4.9-3.2.1.2.1	External Projections for Export		MTL0681		T	MPG-PA	
S.60.4.9-3.2.1.2.2	Low-Speed Front Impact Performance		MTL0682	Bumper - Impact Generic Inspection Procedure- Inspection Per Drawing or Specification	T	MPG-PA	
S.60.4.9-3.2.1.2.3	Driver's Field of Vision		MTL8004	Generic Inspection Procedure- Inspection Per Drawing or Specification	I	DRE	
S.60.4.9-3.2.1.3	Squeaks and Rattles		MTL8004	Generic Inspection Procedure- Mechanical/Visual Inspections	I	DRE	
S.60.4.9-3.2.1.4	Exterior Body Appearance		MTL8006		I	DRE	
S.60.4.9-3.2.1.4.1	Color and Surface Finish		MTL4220	Supplier Interior Components - Exposure Durability	T	SUPP	
S.60.4.9-3.2.1.4.2 a,b	Color Fade, Yellowing, and Gloss Retention		MTL0128		T	DPG	
S.60.4.9-3.2.1.4.3	Staining		MTL4220	Supplier	T	SUPP	
S.60.4.9-3.2.1.4.4	Painted Vehicle Finish		MTL4220	Supplier	T	SUPP	
S.60.4.9-3.2.1.4.4.1	Color Performance		MTL4220	Supplier	T	SUPP	



# Fascia/Fender Interference: Intro

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Wall Display

→ PRTS/PCIC Problem MD0171

GMT 820C  
Grille SSTS

→ T-Series Tilt Cab (GMT 540)

Fascia/Fender  
Interference

→ Contacts:

→ Craig Denbaas

Endcap/Wheel  
Cladding  
Interface

→ Mike Gulick

→ Jason Baker

Other  
Experiences

→ Isuzu Warehouse (Janesville, WI)

→ Janesville Assembly

→ Dimensional Lab

→ Various suppliers



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# Fascia/Fender Interference: Problem

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Wall Display

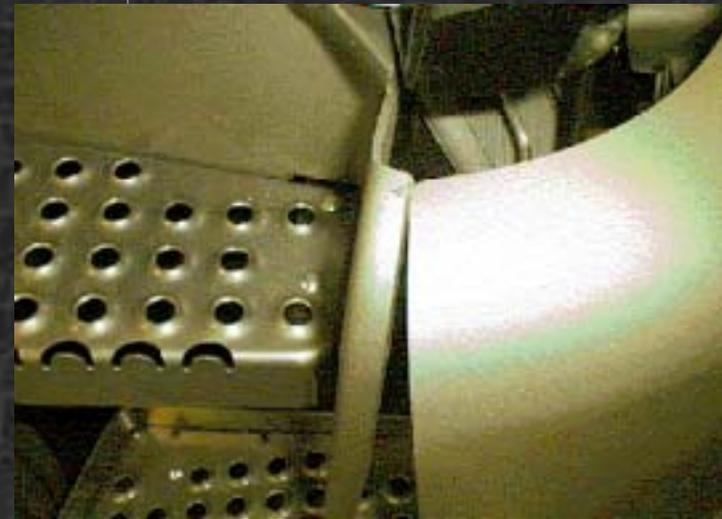
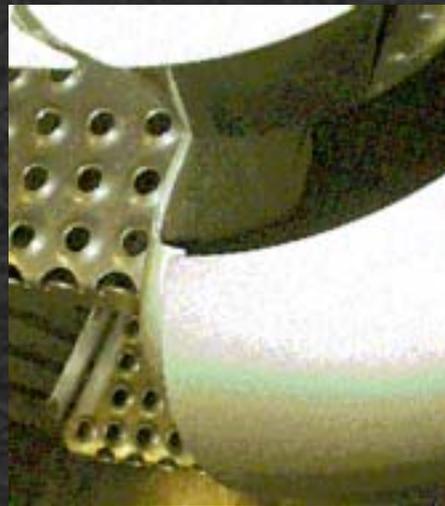
GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Fascia edges contact fender extension around steps when cab is tilted  
→ insufficient clearance



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# Fascia/Fender Interference: Parts

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Wall Display

→ Fascia

GMT 820C  
Grille SSTS

→ Bumper impact bar

Fascia/Fender  
Interference

→ Bumper assembly "horseshoe"  
brackets

Endcap/Wheel  
Cladding  
Interface

→ Bumper to frame brackets

Other  
Experiences

→ Fender extension



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# Fascia/Fender Interference: Previous Studies

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Wall Display

GMT 820C  
Grille SSTs

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ VSM study in 1996

→ fore/aft variation

→ fascia to cab  
parallelism

→ Most variation in:

→ cab

→ frame

→ fender

**ZONE 4 ANALYSIS (Fascia Assembly)**



**Front Bumper Assembly to Cab: Parallelism**

Area 1: This is a Build Tolerance Objective. The parallelism is to be held to within 5.0mm. The VSM result is 5.5mm.

Major Contributors:	% contribution
1) Cab	66.0
2) Frame	31.6
3) Front Bumper Assembly	1.2
4) Bumper Support Bracket	1.2

**Front Bumper Assembly to Body Fender: Flush F/A**

Area 2: This is a Build Tolerance Objective. The flushness is to be held to 0.0mm +/-5.0mm. The VSM result is 0.0mm +/-5.5.

Major Contributors:	% contribution
1) Body Fender	42.0
2) Cab	33.6
3) Frame	14.0
4) Bumper Support Bracket	8.4
5) Front Bumper Assembly	1.9

**CONCLUSION/RECOMMENDATION**

In Area 1, the greatest contributor to parallelism variation is the Cab Assembly. The variation is attributed to Cab sheet metal tolerances and geometry effects at Cab attachment to the Frame. In Area 2, the Cab and Body Fender are the main contributors to the flushness variation between the Bumper Assembly and Body Fender. The Body Fender and Cab have large detail tolerances and the Cab is influenced greatly by its attachment to the Frame.

GM CONFIDENTIAL - DISCLOSURES MUST BE CONTROLLED BY RECIPIENT



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# Fascia/Fender Interference: Pre-Assembly

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Wall Display

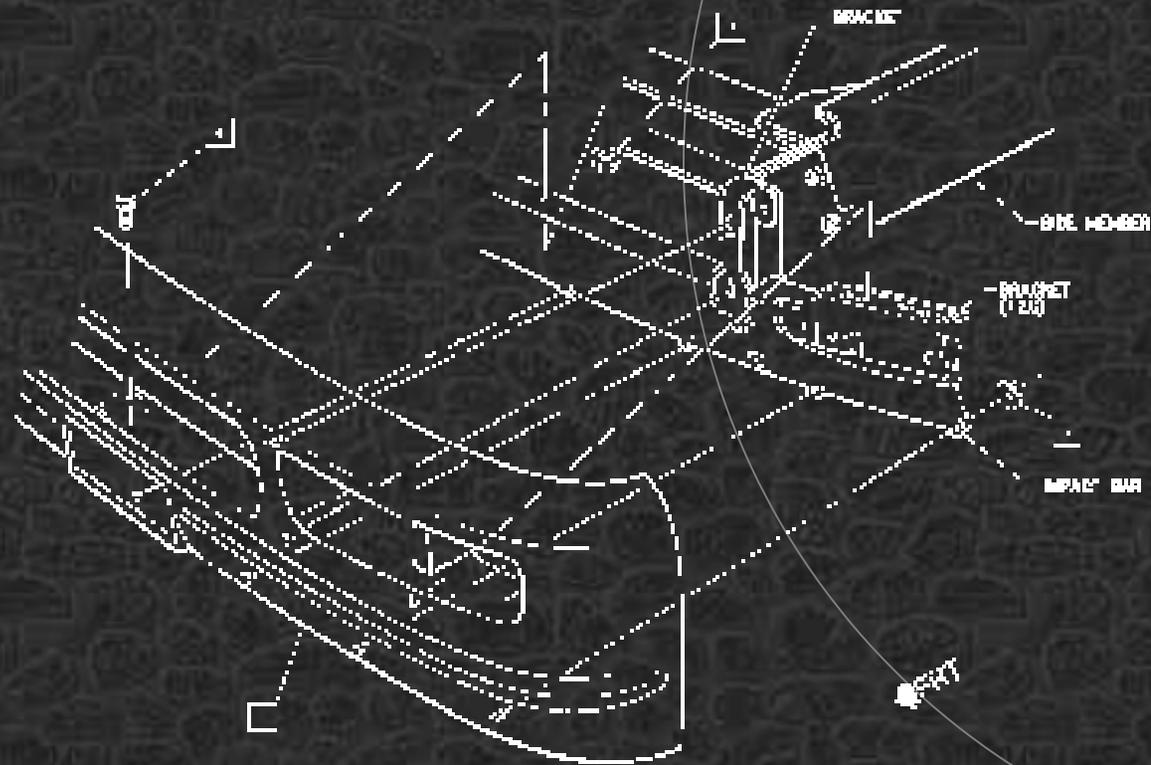
GMT 820C  
Grille SSTs

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Pre-assembled at Isuzu Warehouse  
(Janesville, WI)



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# Fascia/Fender Interference: Pre-Assembly

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences



→ Minimal  
variation  
due to  
"cross-  
slotting"

→ Adequate check fixtures



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# Fascia/Fender Interference: Assembly

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Large cross-car variation of bumper assembly

→ previous quick fix by shifting assembly to the passenger side

→ Tried one M10x22x3.1 washer at each top stud to generate forward movement



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# Fascia/Fender Interference: PAA

Wall Display

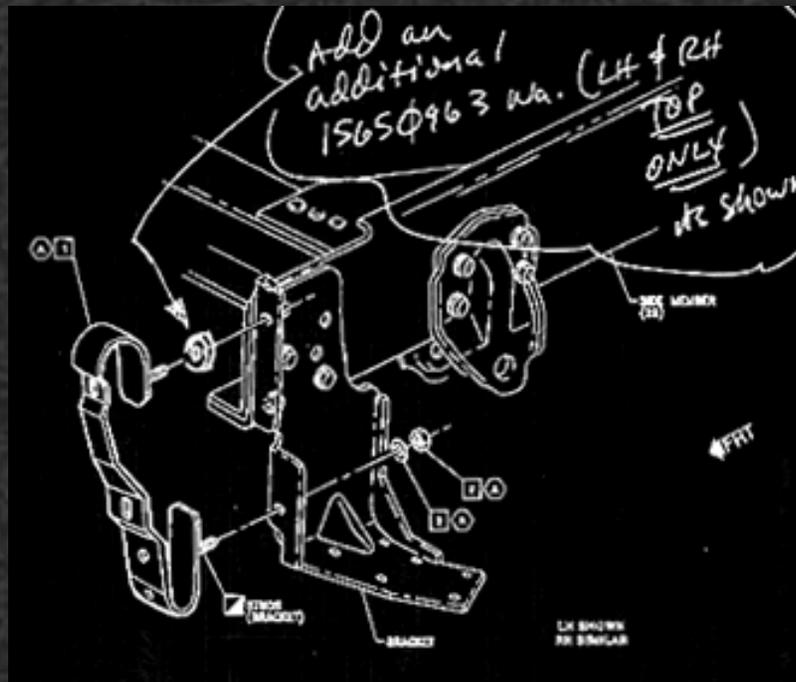
GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Washers introduced as PAA T0F-0-026



PRODUCTION ACTION AUTHORIZATION

PROBLEM: T0F-0-026  
OPEN DATE: 8/16/99  
CLOSE DATE:

REQ. NO.	REQ. LINE NO.										
1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6
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99	99	99	99	99	99	99	99	99	99	99	99
100	100	100	100	100	100	100	100	100	100	100	100

RELEASE AN ADDITIONAL WASHER BETWEEN THE FRONT BUMPER BRACKET AND THE STEP BUMPER PAD.

NOTE: ASSEMBLY (DO NOT OVERTIGHTEN) TO MONITOR FOR ALIGNMENT IF FOUL CONDITION OCCURS.

# Fascia/Fender Interference: PAA

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ "The washer shim works wonderfully so far. The vehicles in the audit have had 0 defects on the bumper."

→ "From the limited number of jobs I have seen, it is a simple fix that is working amazingly well."



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# Fascia/Fender Interference: Fascia

Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

- Romeo RIM (Tier 2 supplier):
  - molds fascias
  - good check fixtures
  - layout of pieces OK

Detail	Characteristic	Class		Print Tol.	Inspection Results		
	Dimension/Specification	▼			①	②	③
1	1042.89				1044.98/1044.31	1045.34/1045.07	1045.07/1045.5
2	337.66				336.9/337.2	334.7/334.2	336.1/336.5
3	564.5				564/565.4	564/564.5	564/565



# Fascia/Fender Interference: Fascia

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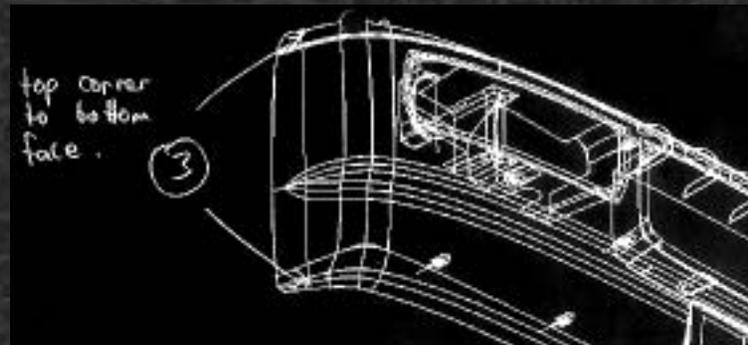
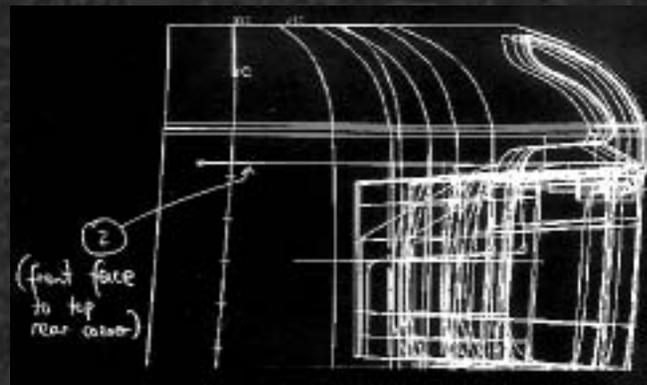
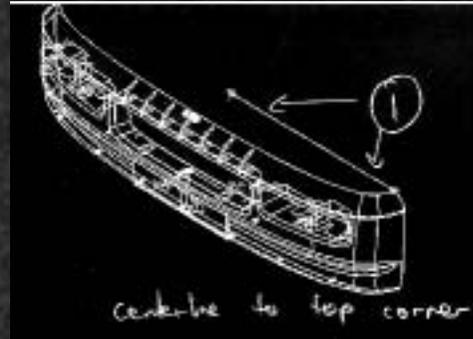
Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences



- All perpendicular distances
- 1. Centerline to inside top corner
- 2. Top rear edge to front face
- 3. Inside top corner to bottom



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# Fascia/Fender Interference: Fascia

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

- Vaungarde (Tier 1 supplier):
  - paints fascias
  - received pictures of paint process



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# Fascia/Fender Interference: Bumper Assembly Bracket

Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Dimensional Lab CMM results out of specification

→ concavity at weld studs

→ non-parallel rear faces

→ other deviations from specifications



# Fascia/Fender Interference: Bumper Assembly Bracket

Wall Display

GMT 820C  
Grille SSTs

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Working with Delwal for quality control and building it greater forward clearance

→ known problem

→ loop radii control



NTM#	CHARACTERISTIC	SPECIFICATION	#1	#2	#3	#4	#5	#6	DISPOSITION
1	FLATNESS	6.50	+ 0.80	- 0.50	0.19				REJECTED
2	FLATNESS	6.35	+ 0.75	- 0.50	0.06				ACCEPTED
3	FORM LOCATION HIGH	94.80	+ 4.00	- 4.00	94.10				ACCEPTED
4	FORM LOCATION HIGH	28.80	+ 4.00	- 4.00	28.59				ACCEPTED
5	FORM LOCATION LOW	94.80	+ 4.00	- 4.00	99.28				ACCEPTED
6	FORM LOCATION LOW	28.80	+ 4.00	- 4.00	37.85				ACCEPTED
7	FORM RADIUS	42.80	+ 2.00	- 2.00	42.75				ACCEPTED
8	FORM RADIUS	27.80	+ 2.00	- 2.00	27.18				ACCEPTED
			-	-					
			+	-					

# Fascia/Fender Interference: Bumper to Frame Bracket 29

Wall Display

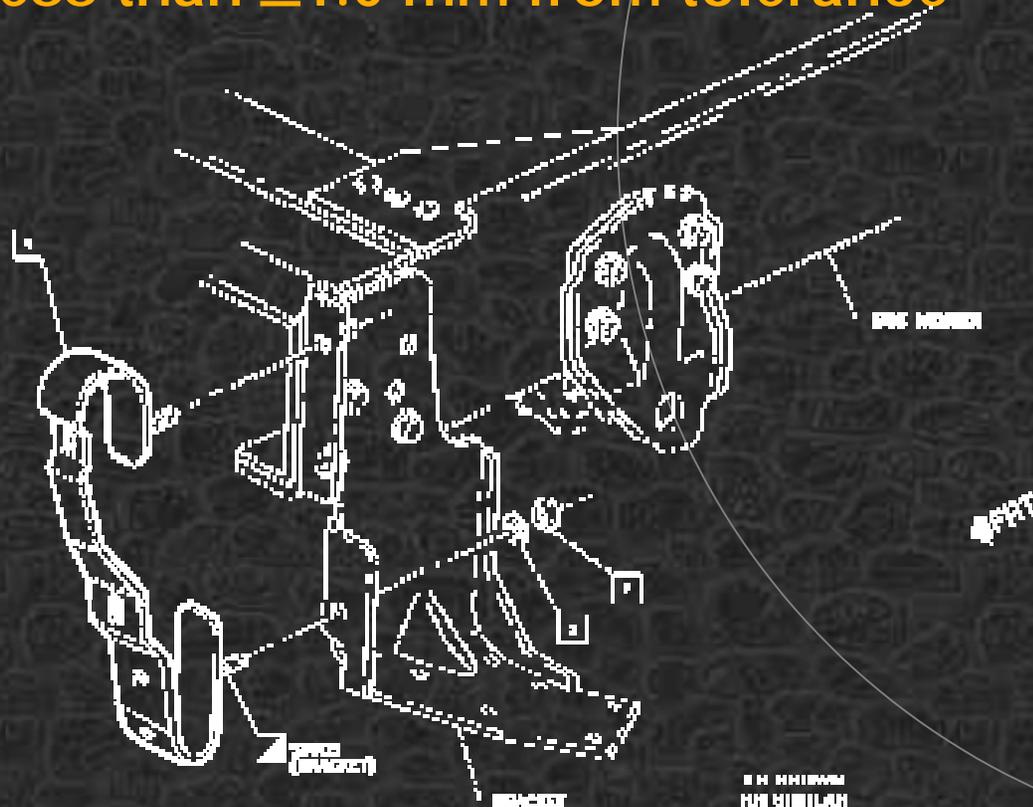
GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

- Bumper to frame brackets very slightly out of specification
- less than  $\pm 1.0$  mm from tolerance



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# Fascia/Fender Interference: Action

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ PRTS status moved from Root Cause to Solution

→ Pursue bumper assembly bracket quality control

→ Monitor PAA success

→ Now assigned to Supplier Quality Assurance



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# Endcap/Wheel Cladding Interface: Intro

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Wall Display

→ PRTS/PCIC Problem ST0102

GMT 820C  
Grille SSTS

→ J.D. Power concern

Fascia/Fender  
Interference

→ Oldsmobile Bravada

→ Contacts:

Endcap/Wheel  
Cladding  
Interface

→ Craig Denbaas

→ Curtis Heim

Other  
Experiences

→ Imam Salie

→ Pat Moran GMC-Oldsmobile

→ mock-up

→ various suppliers



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# Endcap/Wheel Cladding Interface: Parts

Wall Display

GMT 820C  
Grille SSTS

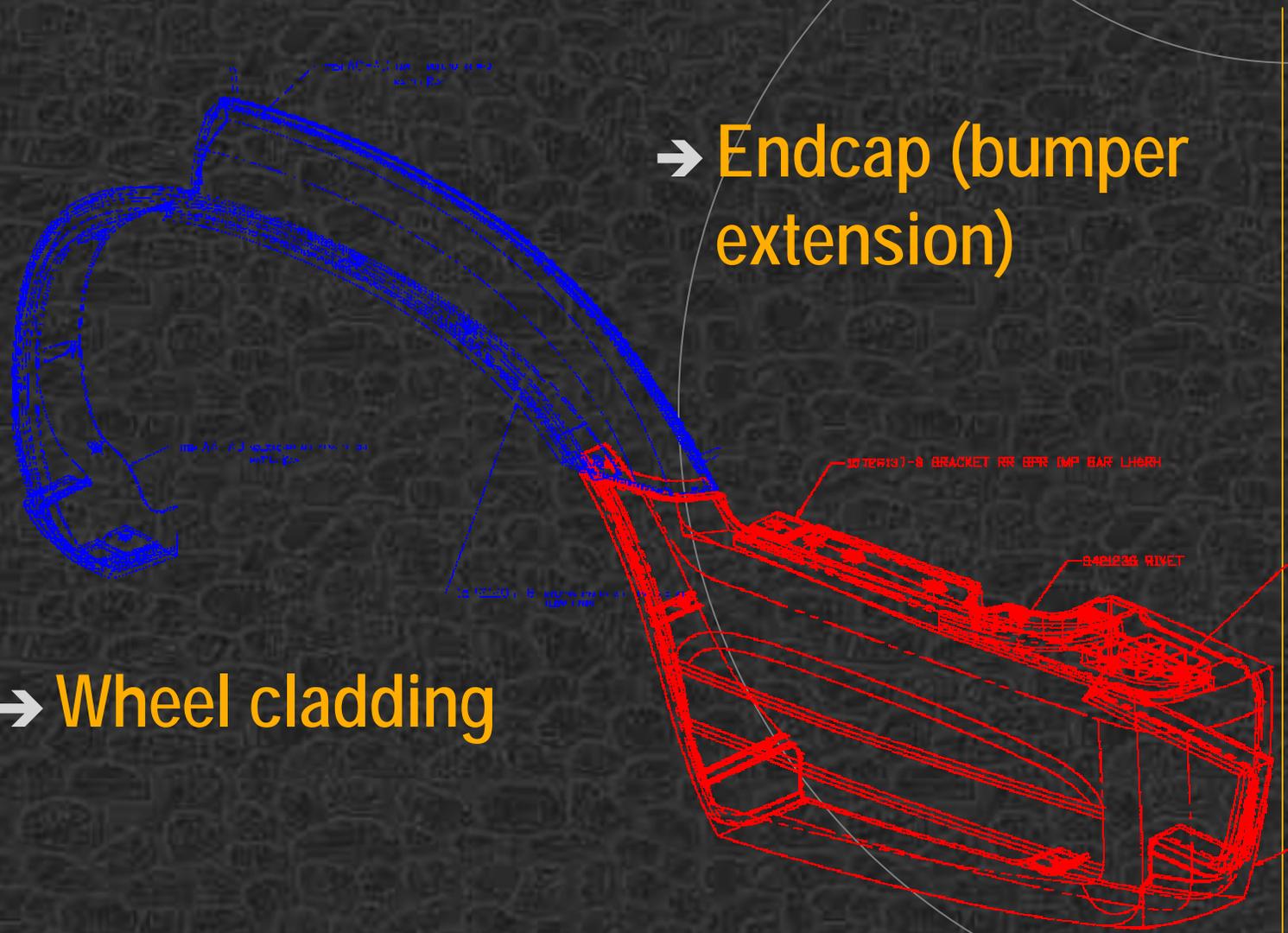
Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Wheel cladding

→ Endcap (bumper extension)



# Endcap/Wheel Cladding Interface: Survey

Wall Display

GMT 820C  
Grille SSTs

Fascia/Fender  
Interference

**Endcap/Wheel  
Cladding  
Interface**

Other  
Experiences

→ 4 LH and 4 RH cases of "peel-away"  
among 20 vehicles  
→ all showed endcap misfit condition

<u>MY</u>	<u>VIN</u>	<u>Age</u>	<u>Site</u>	<u>Wheel Flare (L)</u>	<u>End Cap (L)</u>	<u>Wheel Flare (R)</u>	<u>End Cap (R)</u>
99	725755	New	Validation Center	OK	OK	OK	Force fit
98	703929	Used	Validation Center	Peel	Force fit	OK	Force fit
99	711420	Used	Validation Center	OK	Force fit	OK	Force fit
99	712803	Used	Validation Center	OK	Force fit	OK	Force fit
99	714458	Used	Validation Center	OK	OK	OK	Force fit
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	OK	!	Peel	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	Peel	!	Peel	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	OK	!	Peel	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
99		New	Pat Moran Oldsmobile	OK	!	OK	!
Problem Totals (20 Vehicles):				4	18	4	20



# Endcap/Wheel Cladding Interface: Previous Studies

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Previously focused on wheel  
cladding only

→ Some twisting from paint process  
→ but CMM results OK



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# Endcap/Wheel Cladding Interface: Root Causes

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Wall Display

GMT 820C  
Grille SSTs

Fascia/Fender  
Interference

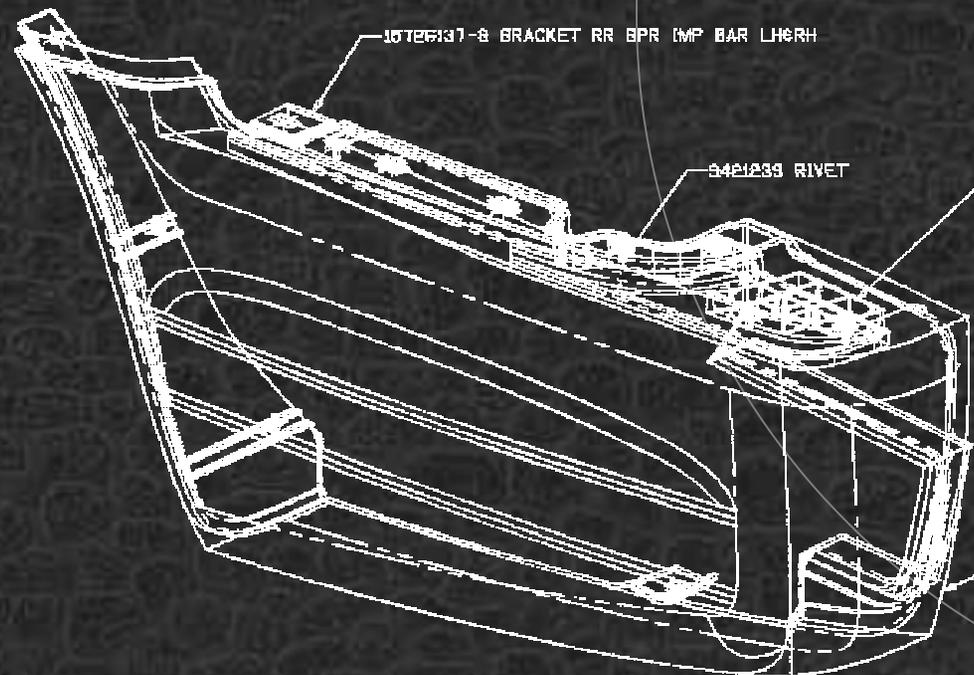
Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Mock-up of parts to determine root causes:

→ twisting of wheel cladding (paint racks)

→ LH/RH endcap asymmetry



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# Endcap/Wheel Cladding Interface: Root Causes

37

Wall Display

GMT 820C

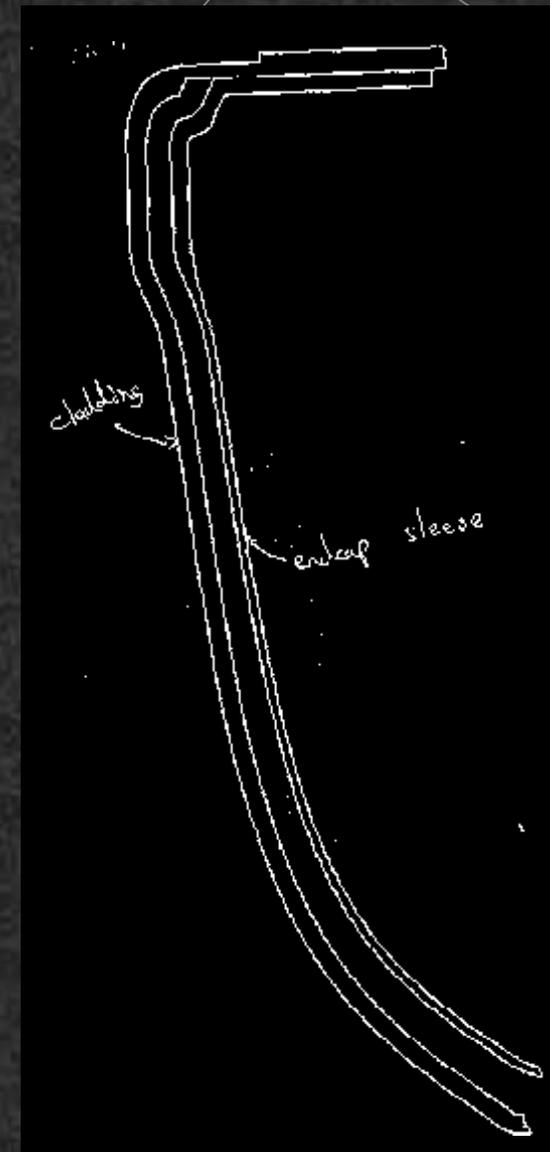
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ More root causes:  
→ poor contour  
matching of endcap  
and wheel cladding



Truck Group

# Endcap/Wheel Cladding Interface: Root Causes

38

Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

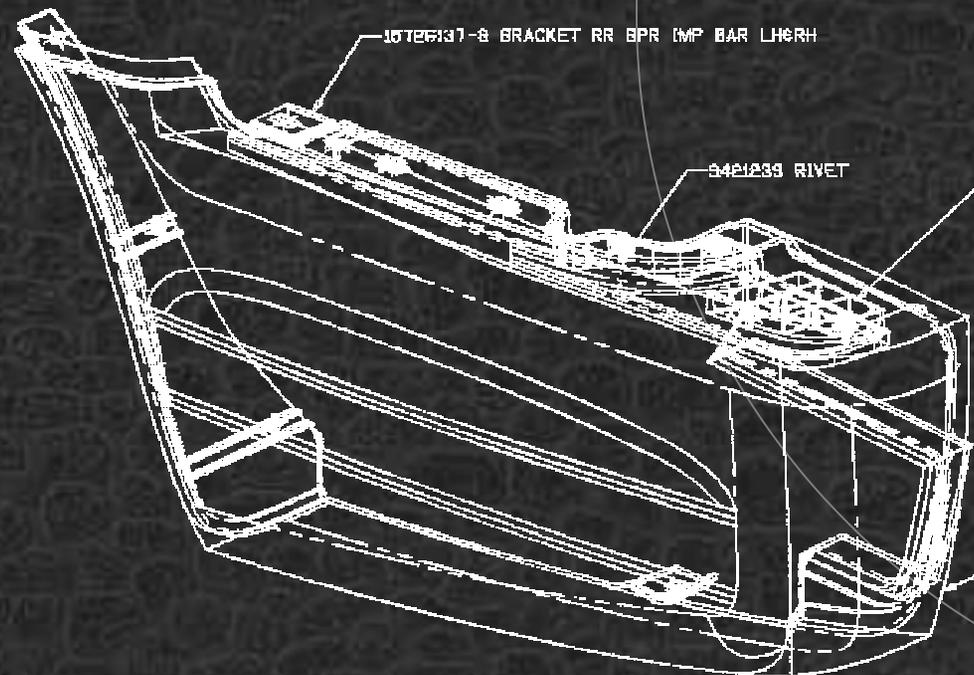
Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ More root causes:

→ 3-D curvature in endcap poorly designed and poorly controlled in manufacturing

→ pushes parts outboard, leading to peel-away



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# Endcap/Wheel Cladding Interface: Section Studies

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Wall Display

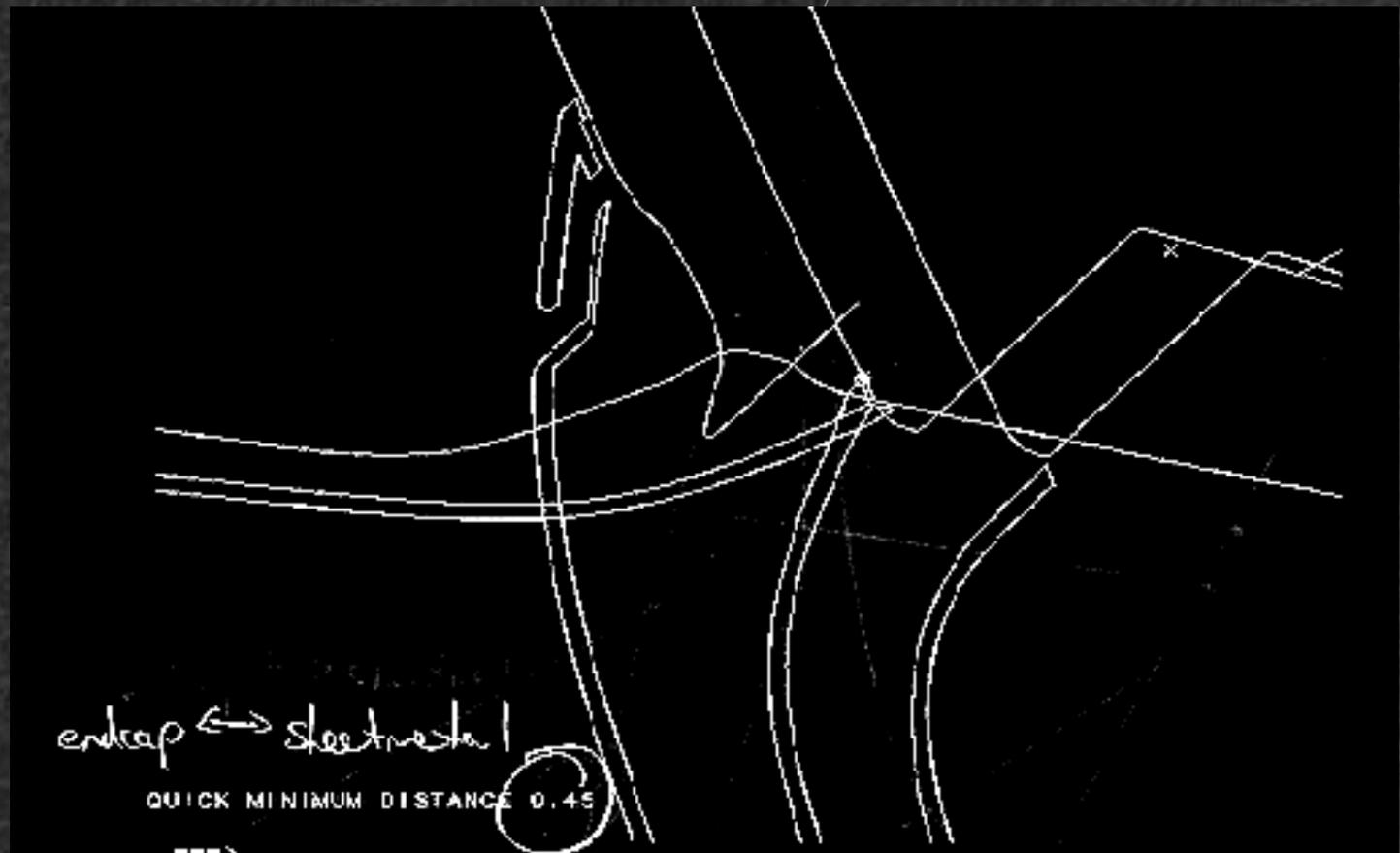
GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ 0.45 mm (endcap to sheetmetal)



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# Endcap/Wheel Cladding Interface: Section Studies

40

Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ 3.12 mm (endcap sleeve to sheetmetal)



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# Endcap/Wheel Cladding Interface: Section Studies

41

Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

**Endcap/Wheel  
Cladding  
Interface**

Other  
Experiences

→ 4.43 mm (endcap sleeve to cladding)



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# Endcap/Wheel Cladding Interface: Section Studies

42

Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

**Endcap/Wheel  
Cladding  
Interface**

Other  
Experiences

→ 14.39 mm (sleeve extension length)



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# Endcap/Wheel Cladding Interface: Action

43

Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Mock-up review with Key Plastics  
(endcap supplier)

→ check manufacturing process and part  
variation

→ Control more dimensions

→ check 3-D curvature

→ current endcap only verified in length

→ Consider reducing sleeve length

→ reduce likelihood of sleeve pushing outward  
on wheel cladding



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# Other Experiences: Bumper/Fascia/Grille

44

Wall Display

GMT 820C  
Grille SSTs

Fascia/Fender  
Interference

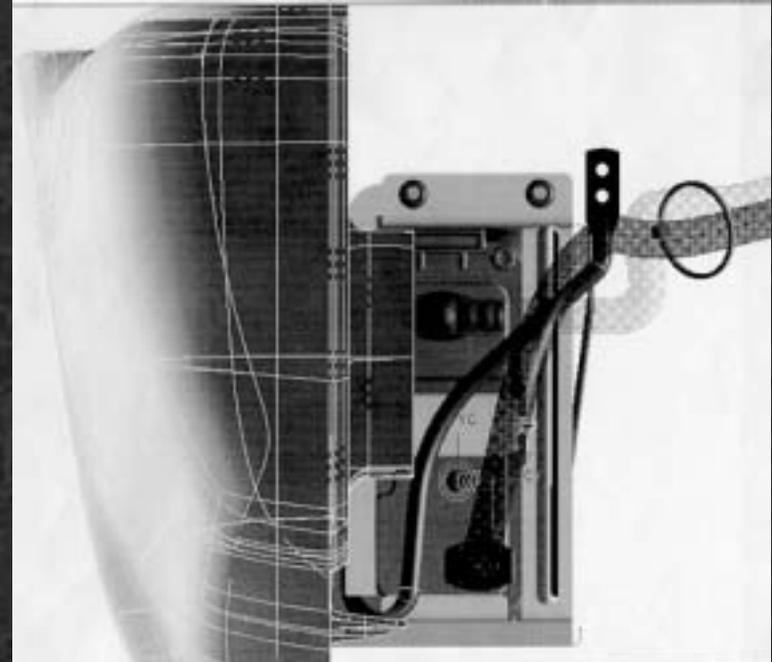
Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ S/T Utility endcap brace change  
mocked up

→ allow for new fuel system packaging

→ redesign OK



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# Other Experiences: Bumper/Fascia/Grille

45

Wall Display

→ June 21: Validation Center

GMT 820C  
Grille SSTS

→ Alex Winter

Fascia/Fender  
Interference

→ June 29: Complexity Reduction  
Workshop

Endcap/Wheel  
Cladding  
Interface

→ July 2: Design Studio

→ Ellen McTigue

Other  
Experiences

→ July 20: Romeo RIM

→ Craig Denbaas



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# Other Experiences: Bumper/Fascia/Grille

46

Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ July 28: Janesville Assembly and  
Isuzu Warehouse

→ August 3: Complexity Reduction  
Workshop

→ August 4: Vehma

→ Alex Winter

→ August 17: Gilbar

→ Alex Winter



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# Other Experiences: Education Relations

47

Wall Display

→ June 24: Student Summit

GMT 820C  
Grille SSTS

→ August 6: Validation Center

Fascia/Fender  
Interference

→ August 6: Pontiac East Assembly

Endcap/Wheel  
Cladding  
Interface

→ August 12: Executive and Intern  
Forum

Other  
Experiences

→ Tech Club (June 30, July 28, August  
10, August 24)



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# End of Summer Impressions (+)

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences

→ Enjoyed responsibilities as a DRE

→ Valued the challenging “interfacial” and  
“program manager” role of a DRE

→ Learned about the design to  
production process

→ Experienced root cause analysis  
and problem resolution

→ Assembly plant exposure



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# End of Summer Impressions (-)

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Wall Display

→ **Complex "system"**

GMT 820C

→ **time and money to implement actions**

Grille SSTS

Fascia/Fender  
Interference

→ **Challenging but not in the  
academically technical aspect**

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences



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# Q & A

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Wall Display

GMT 820C  
Grille SSTS

Fascia/Fender  
Interference

Endcap/Wheel  
Cladding  
Interface

Other  
Experiences



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