



U.S. Department
of Transportation
**Federal Highway
Administration**

March 26, 2008

1200 New Jersey Ave., S.E.
Washington, DC 20590

In Reply Refer To: HSSD/B-150A

Mr. Andrew Artar
Vice President Sales and Marketing
Gregory Highway Products
4100 13th Street, SW
Canton, OH 44710

Dear Mr. Artar:

This is in response to your letter of November 1, 2007, requesting the Federal Highway Administration's (FHWA) acceptance of your company's single- and dual-face w-beam Gregory Mini Spacer (GMS) Guardrail Systems as a test level 3 (TL-3) device for use on the National Highway System (NHS). Accompanying your letter were reports of crash testing conducted by Southwest Research Institute. You requested that we find this device acceptable for use on the NHS under the provisions of the forthcoming American Association of State Highway and Transportation Officials Manual on Assessing Safety Hardware-2008 (MASH08), which is expected to supersede Report 350 in the near future.

Introduction

The FHWA guidance on crash testing of roadside safety hardware is contained in a memorandum dated July 25, 1997, titled "INFORMATION: Identifying Acceptable Highway Safety Features" and recognizes National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features" as the current crash test guidance. The Gregory Highway Products has chosen to anticipate the adoption of MASH08 by testing with the 2270P vehicle, an option that FHWA has offered with the understanding that testing may need to be done over if changes to the test criteria are made before MASH08 is formally adopted.

The GMS system was found acceptable under NCHRP Report 350 criteria in our FHWA acceptance letter B-150 dated October 27, 2006. Your present request is for MASH08 acceptance of the same barrier system, described as follows:

The GMS system consists of 12-gauge steel W-beam panels mounted directly onto standard, unmodified 6-foot long W6 x 8.5 steel posts with no offset blocks or backup plates, spaced at 6 feet 3 inches and with a top-of-rail height of either 31 inches or 27 5/8 inches. The rail was attached to each post using a 5/16-inch diameter standard hex head bolt incorporated into a proprietary releasable fastener called a "GMS" that enables conventional guardrail and posts to perform without the need for offset blocks.



The two test summary sheets using the 2270P vehicle, one each for the 27 5/8 inch height (Test GMS-4) at TL-2 and one for the same mounting height (Test GMS-6) at TL-3, are enclosed for reference. Testing with the 820C vehicle on the 31 inch dual-face w-beam barrier having two splices at every other post had been conducted under the initial testing (Test GMS-2) and is considered a “worst case scenario” as it used a lighter vehicle than called for in MASH08 potentially subjecting vehicle occupants to higher impact forces, especially since there were two rail connections at each post contacted by the vehicle.

Testing

Full-scale automobile and pickup testing has been conducted on the GMS barrier. Tests GMS-1 and GMS-2 supported FHWA acceptance letter B-150. Tests GMS-4 and GMS-6 were conducted to support the present request. The GMS-4 was intended to be a TL-3 test but a testing malfunction resulted in inadequate impact speed and re-run as GMS-6. Selected barrier and crash test details, including dynamic deflection, are summarized in the following table.

Test #	Test Designation	Barrier Height*	Barrier	Deflection**
GMS-1	MASH08 TL-3 / 3-11	31 inches.	Single faced.	2.92 ft
GMS-2	Report 350 TL-3 / 3-10	31 inches	Dual faced	2.20 ft
GMS-4	MASH08 TL-2 / 2-11	27-5/8 inches	Single faced	2.25 ft
GMS-6	MASH08 TL-3 / 3-11	27-5/8 inches	Single faced	4.33 ft

* Height to top of rail.

** Maximum dynamic deflection. Our current criteria sets the “design deflection distance” at the maximum dynamic deflection recorded in *Report 350* test 3-11. From the crash testing you performed and your analysis (a method that agrees with a tuned Barrier VII analysis), you came up with recommended *Report 350* test 3-11 (2000P) deflection criteria. You recommend that the minimum distances at which the face of a GMS installation be placed from the face of a rigid obstacle (e.g., bridge pier or overhead sign support) be 1.25 m (49 inches), 1.12 m (44 inches), and 0.90 m (35 inches) for standard (6 ft 3 inch), 1/2, and 1/4 post spacing, respectively. These offsets are based on the “working width” deflections seen in the crash tests/analysis and include some degree of pickup truck penetration beyond the vertical plane of the barrier’s dynamic deflection. As with all traffic barriers, larger offset distances would be required to shield similar features from vehicles with higher centers of gravity, such as single-unit trucks or buses, because of the relatively high roll angles seen with these vehicles in rigid and semi-rigid barrier tests of similar height.

Findings

As noted in the enclosed test data summary sheets the test vehicles were smoothly redirected and met occupant impact force and occupant compartment deformation criteria. Therefore, the system described above is acceptable for use on the NHS under the range of conditions tested, when such use is acceptable to the contracting authority. You also requested the following be included in this acceptance letter:

- The GMS-WB system may be installed with top-of-rail height between 27 and 32 inches.
- The GMS-WB may be installed with splices at or between posts.
- The GMS-WB may be installed with Modified G4(1S) W6 x 8.5 steel posts or with G4(2W) nominal 6 x 8 inch rectangular or G4(RW) nominal 7 inch diameter round timber posts.
- The GMS spacer called a “Mini Spacer” may be used on any non-proprietary strong or weak post w-beam barrier length-of-need with or without the use of a spacer block, and such usage will not change the test level of the barrier on which it is used.

We concur in these variations for both single face and dual face installations.

Please note the following standard provisions that apply to the FHWA letters of acceptance:

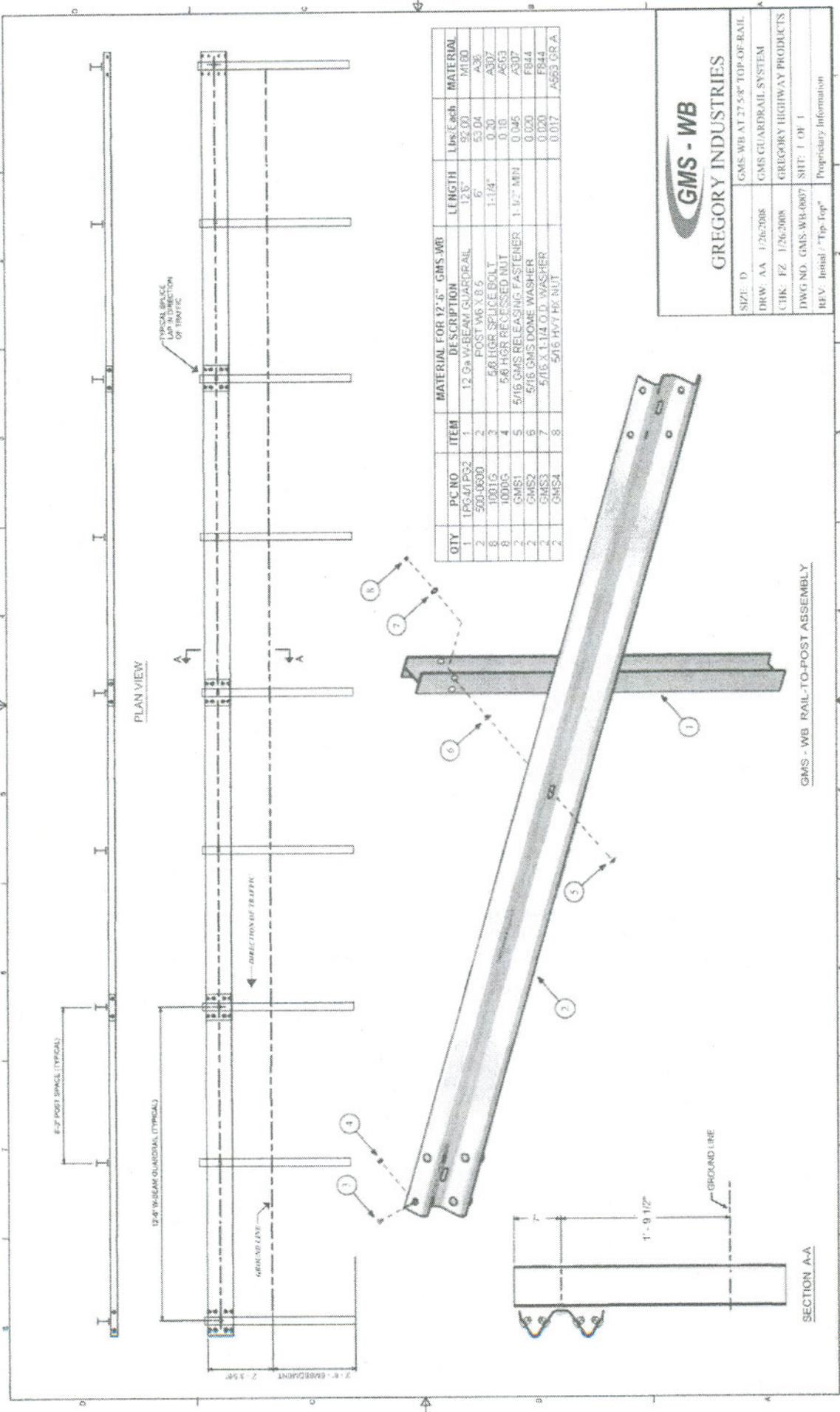
- This acceptance is limited to the crashworthiness characteristics of the devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested we reserve the right to modify or revoke its acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that they will meet the crashworthiness requirements of the FHWA and MASH08.
- To prevent misunderstanding by others, this letter of acceptance is designated as number B-150A and shall not be reproduced except in full. This letter and the test documentation upon which this letter is based are public information. All such letters and documentation may be reviewed at our office upon request.
- The Gregory Mini Spacer is a patented product and considered proprietary. If proprietary devices are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS projects, they: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,



David A. Nicol, P.E.
Director, Office of Safety Design
Office of Safety

2 Enclosures



MATERIAL FOR 12.5" GMS-WB			
QTY	PC NO	DESCRIPTION	MATERIAL
1	1PG-41P52	12 Ga W-BEAM GUARDRAIL	M100
2	500-0600	POST W6 X 8.5	A36
8	1001G	5/8 HGR SPlice BOLT	A307
8	1000G	5/8 HGR RECESSED NUT	A563
2	GMS1	5/16 GMS RELEASING FASTENER	A307
2	GMS2	5/16 GMS DOME WASHER	F844
2	GMS3	5/16 X 1-1/4 O.D. WASHER	F844
2	GMS4	5/16 H-VT HK NUT	A563 GR. A

GMS - WB
GREGORY INDUSTRIES

SIZE: D
 GMS-WB AT 27.5" TOP-OF-RAIL

DRW: AA 1/26/2008
 GMS GUARDRAIL SYSTEM

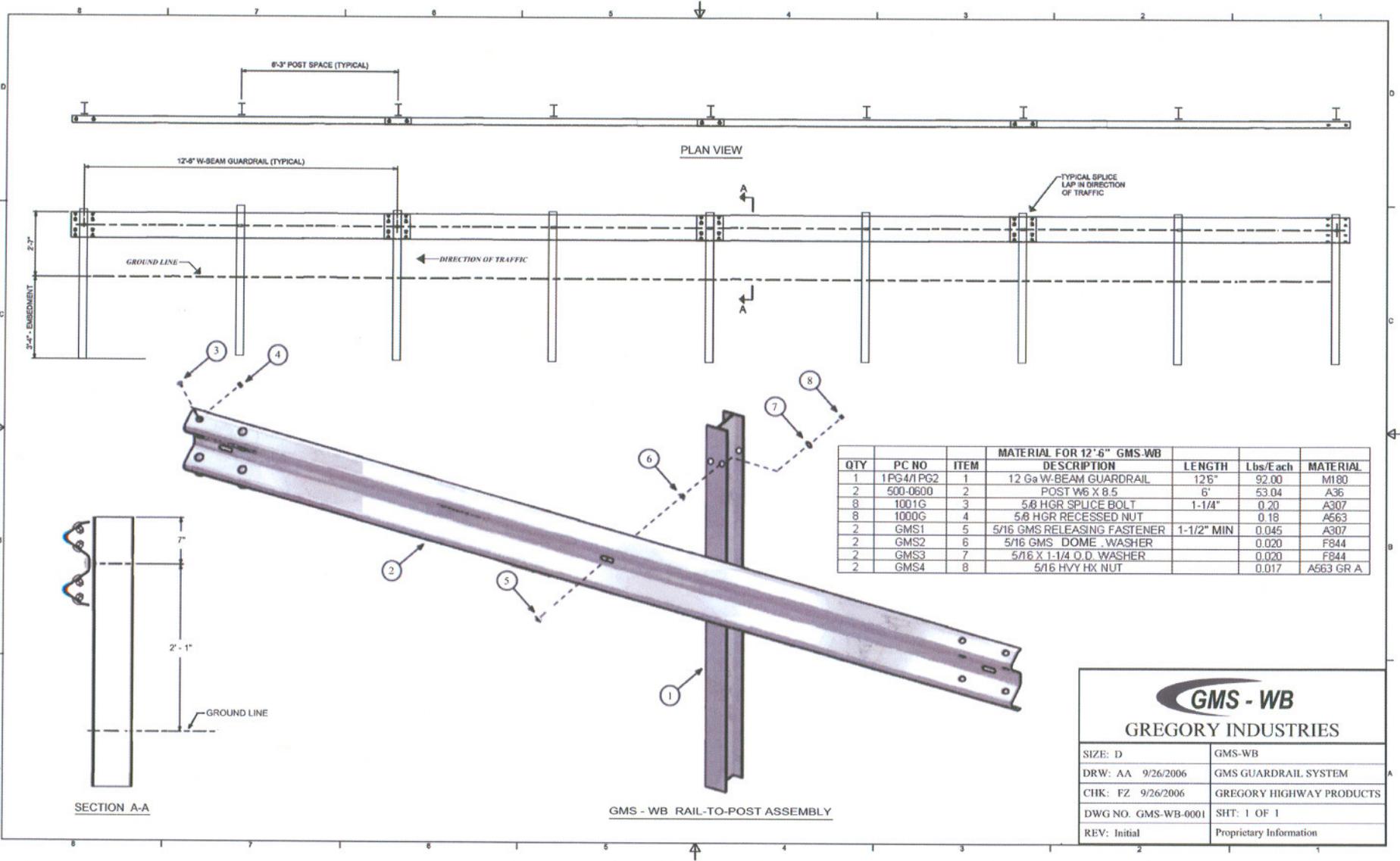
CHK: FZ 1/26/2008
 GREGORY HIGHWAY PRODUCTS

DRG NO. GMS-WB-0007
 SHEET 1 OF 1

REV: Initial / "Tip Top"
 Proprietary Information

GMS - WB RAIL-TO-POST ASSEMBLY

SECTION A-A



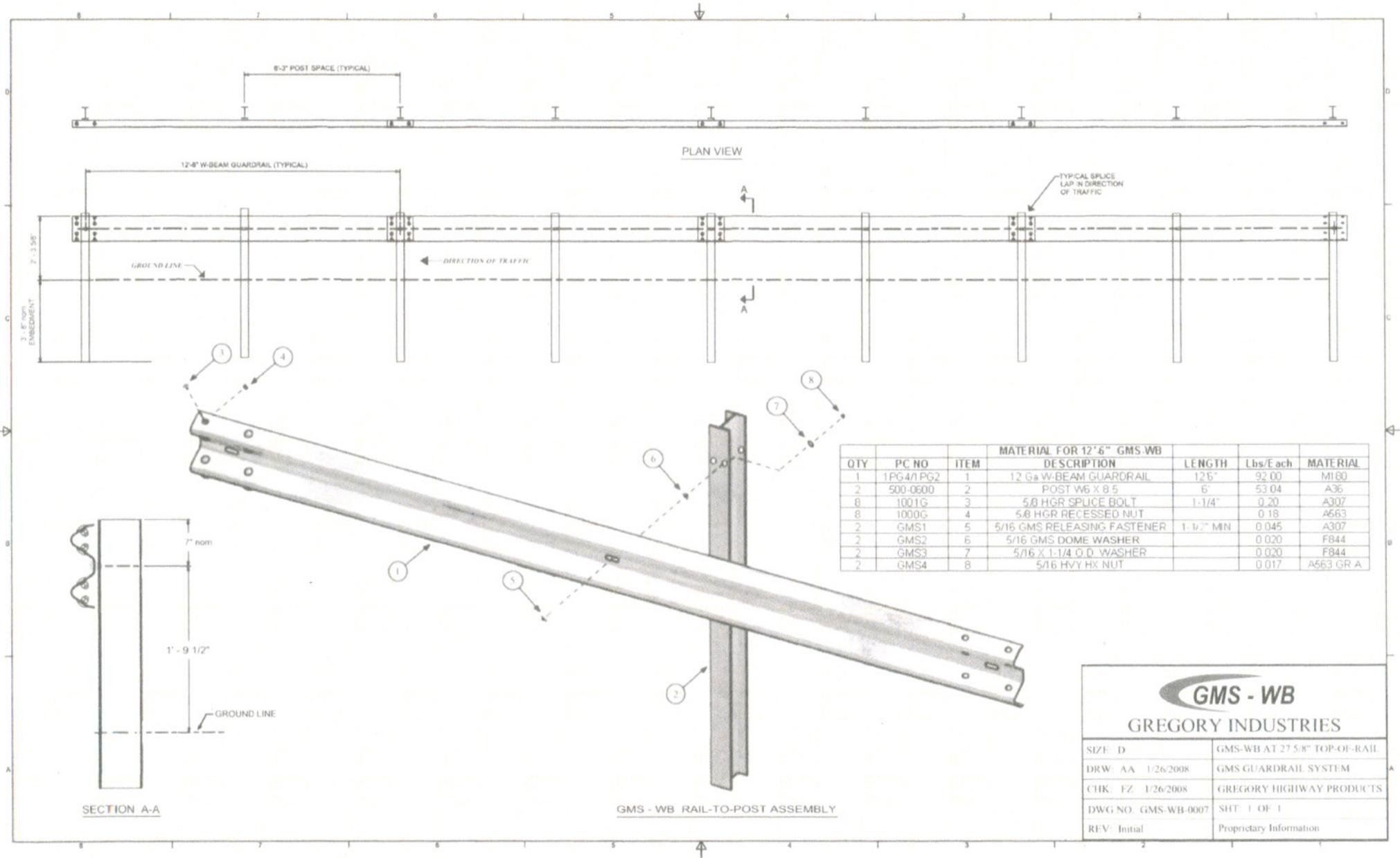
MATERIAL FOR 12" 6" GMS-WB						
QTY	PC NO	ITEM	DESCRIPTION	LENGTH	Lbs/Each	MATERIAL
1	1PG4/1PG2	1	12 Ga W-BEAM GUARDRAIL	126"	92.00	M180
2	500-0600	2	POST W6 X 8.5	6'	53.04	A36
8	1001G	3	5/8 HGR SPLICE BOLT	1-1/4"	0.20	A307
8	1000G	4	5/8 HGR RECESSED NUT		0.18	A563
2	GMS1	5	5/16 GMS RELEASING FASTENER	1-1/2" MIN	0.045	A307
2	GMS2	6	5/16 GMS DOME WASHER		0.020	F844
2	GMS3	7	5/16 X 1-1/4 O.D. WASHER		0.020	F844
2	GMS4	8	5/16 HVY HX NUT		0.017	A563 GR A

GMS - WB
GREGORY INDUSTRIES

SIZE: D	GMS-WB
DRW: AA 9/26/2006	GMS GUARDRAIL SYSTEM
CHK: FZ 9/26/2006	GREGORY HIGHWAY PRODUCTS
DWG NO. GMS-WB-0001	SHT: 1 OF 1
REV: Initial	Proprietary Information

GMS - WB RAIL-TO-POST ASSEMBLY

SECTION A-A



QTY	PC NO	ITEM	MATERIAL FOR 12' 6" GMS-WB	DESCRIPTION	LENGTH	Lbs/Each	MATERIAL
1	1PG4/1PG2	1	12 Ga W-BEAM GUARDRAIL	12 6"	92.00	M180	
2	500-0600	2	POST W6 X 8 5	5'	53.04	A36	
8	1001G	3	5/8 HGR SPLICE BOLT	1-1/4"	0.20	A307	
8	1000G	4	5/8 HGR RECESSED NUT		0.18	A563	
2	GMS1	5	5/16 GMS RELEASING FASTENER	1- 9/16" MIN	0.045	A307	
2	GMS2	6	5/16 GMS DOME WASHER		0.020	F844	
2	GMS3	7	5/16 X 1-1/4 O.D. WASHER		0.020	F844	
2	GMS4	8	5/16 HVY HX NUT		0.017	A563 GR A	

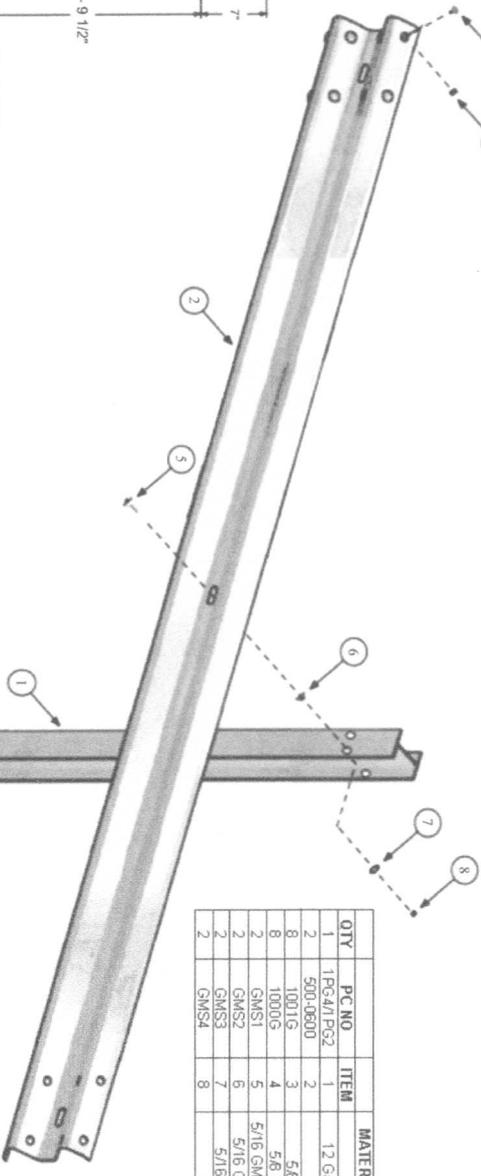
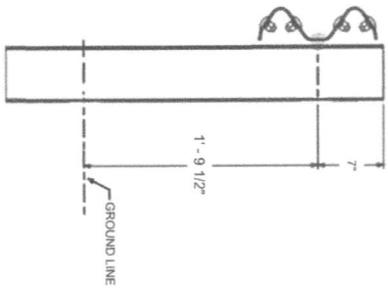
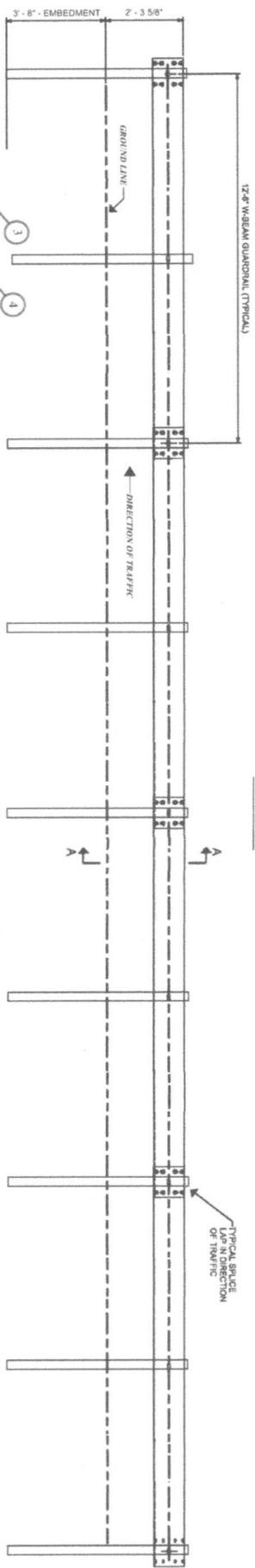


GMS - WB
GREGORY INDUSTRIES

SIZE: D	GMS-WB AT 27 5/8" TOP-OF-RAIL
DRW: AA 1/26/2008	GMS GUARDRAIL SYSTEM
CHK: FZ 1/26/2008	GREGORY HIGHWAY PRODUCTS
DWG NO. GMS-WB-0007	SHT. 1 OF 1
REV: Initial	Proprietary Information

SECTION A-A

GMS - WB RAIL-TO-POST ASSEMBLY



QTY	PC NO	ITEM	MATERIAL FOR 12'-5" GMS-WB	DESCRIPTION	LENGTH	Lbs/each	MATERIAL
1	1PG4/1PG2	1	12 GA W/BEAM GUARDRAIL	12'-5"	92.00	M180	
2	500-0600	2	POST W6 X 8.5	6'	53.04	A36	
2	1001G	3	5/8 HGR SPLICE BOLT	1-1/4"	0.20	A307	
8	1000G	4	5/8 HGR RELEASED NUT	1-1/4" MIN	0.18	A563	
2	GMS1	5	5/16 GMS RELEASE FASTENER		0.045	A307	
2	GMS2	6	5/16 GMS DOME WASHER		0.020	F844	
2	GMS3	7	5/16 X 1-1/4 O.D. WASHER		0.020	F844	
2	GMS4	8	5/16 HVY HV NUT		0.017	A563 GR A	

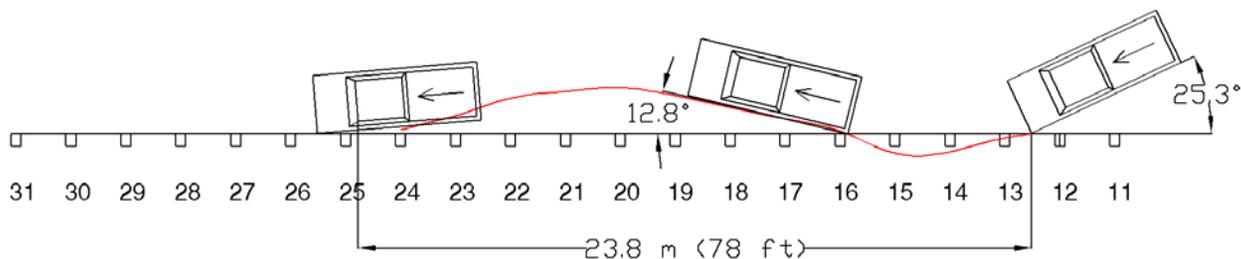
SECTION AA

GMS - WB RAIL-TO-POST ASSEMBLY

GMS - WB
GREGORY INDUSTRIES

SIZE: D	GMS-WB AT 27 5/8" TOP-OF-RAIL
DRW: AA 1/26/2008	GMS GUARDRAIL SYSTEM
CHK: FZ 1/26/2008	GREGORY HIGHWAY PRODUCTS
DWG NO: GMS-WB-0007	SHT: 1 OF 1
REV: Initial / "Top-Top"	Proprietary Information

Table 4.1 – Summary of Test Results and Conditions



20

General Information

Test AgencySouthwest Research Institute
 Test NumberGMS-4
 Test Date08/14/2007
 Test Category2-11

Test Article

TypeLongitudinal Barrier
 Installation Length57.15 m (187.5 ft)
 Nom. Barrier Height702 mm (27-5/8 in)
 Type of Primary Barrier..Modified G4-1S Longitudinal Barrier

Soil

Stable, Dry – “Standard” Soil

Test Vehicle

Type½ Ton Quad Cab Pickup
 Designation2270P
 Model.....2002 Dodge Ram 1500 Quad Cab
 Mass (kg)2200
 Inertial Mass(kg).....2200
 Dummy Mass (kg)NA
 Gross Static Mass (kg).....2200

Impact Conditions

Speed (km/hr)86
 Angle (degrees).....25.3

Exit Conditions

Speed (km/hr)49 (calculated)
 Angle (degrees).....12.8

Occupant Risk Values

Impact Velocity (m/s)
 x-direction4.9
 y-direction-4.2
 Ridedown Accelerations (g’s)
 x-direction-7.1
 y-direction4.7

Post Impact Vehicular Behavior (limited to events <1.000 seconds)

Maximum Roll Angle (degrees)-14.3 @ 0.541 sec.
 Maximum Pitch Angle (degrees)-9.0 @ 0.755 sec.
 Maximum Yaw Angle (degrees).....44.0 @ 0.561 sec.

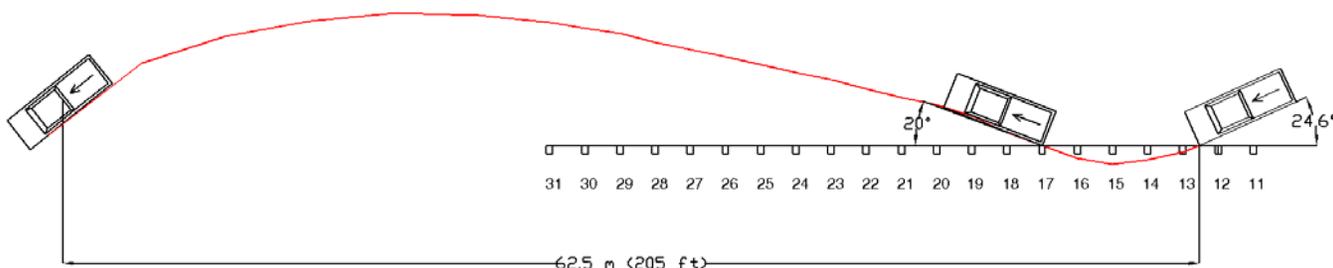
Test Article Deflection

Dynamic0.69 m (2.25 ft)
 Permanent.....0.45 m (1.5 ft)

Vehicle Damage

Exterior
 CDC11LFEW5
 VDS11-LFQ-3
 Interior
 OCDILF0000000
 Max. Deform. (mm)0

Table 4.1 – Summary of Test Results and Conditions



23

General Information

Test AgencySouthwest Research Institute
 Test NumberGMS-6
 Test Date09/24/2007
 Test Category3-11

Test Article

TypeLongitudinal Barrier
 Installation Length57.15 m (187.5 ft)
 Nom. Barrier Height702 mm (27-5/8 in)
 Type of Primary Barrier..Modified G4-1S Longitudinal Barrier

Soil

Stable, Dry – “Standard” Soil

Test Vehicle

Type½ Ton Quad Cab Pickup
 Designation2270P
 Model.....2002 Dodge Ram 1500 Quad Cab
 Mass (kg)2200
 Inertial Mass(kg).....2200
 Dummy Mass (kg)NA
 Gross Static Mass (kg).....2200

Impact Conditions

Speed (km/hr)105.7
 Angle (degrees).....24.6

Exit Conditions

Speed (km/hr)72 (calculated)
 Angle (degrees).....20

Occupant Risk Values

Impact Velocity (m/s)
 x-direction4.0
 y-direction-4.6
 Ridedown Accelerations (g’s)
 x-direction-8.7
 y-direction8.1

Post Impact Vehicular Behavior (limited to events <1.000 seconds)

Maximum Roll Angle (degrees)-46.3 @ 0.871 sec.
 Maximum Pitch Angle (degrees)-17.2 @ 0.850 sec.
 Maximum Yaw Angle (degrees).....52.1 @ 1.446 sec.

Test Article Deflection

Dynamic1.32 m (4.33 ft)
 Permanent.....0.81 m (2.67 ft)

Vehicle Damage

Exterior
 CDC11LFEW9
 VDS11-LFQ-3
 Interior
 OCDILF0000000
 Max. Deform. (mm)0