U.S. Department of Transportation
Federal Highway Administration

1200 New Jersey Avenue, SE.
Washington, DC 20590

March 25, 2008

In Reply Refer To: HSSD/B-173

Owen S. Denman, P.E.
President and CEO
Barrier Systems, Inc.
180 River Road
Rio Vista, California 94571

Dear Mr. Denman:

This letter is in response to your request for Federal Highway Administration (FHWA) acceptance of a roadside safety system for use on the National Highway System (NHS).

Name of system: ArmorGuard™ Barrier (AGB)
Type of system: Steel Safety Barriers, also Moveable Barriers
Test Level: Test Level 3
Testing conducted by: Safe Technologies, Inc.
Date of request: December 19, 2007
Date of follow-up: Test summary PDFs requested and rec'd 3/20/08

You requested that we find this system acceptable for use on the NHS under the provisions of National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

Requirements

Roadside safety devices/systems should meet the guidelines contained in the NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features". FHWA Memorandum "Action: Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

Description

ArmorGuard™ Barrier (AGB) is the new name of a steel safety-shaped barrier system tested and accepted as the SafeGuard Gate System in FHWA Acceptance Letter B-87 dated July 6, 2001, and as the SafeGuard Link system in B-108 dated November 4, 2002.

The AGB sections are constructed of metal and are assembled in 8.5 meter (28 foot) increments. The sections are hinged at both ends and can be unpinned, jacked up on wheels and moved in any direction. One end can be unpinned and swung open or both ends of a section can be released to remove the whole section.

MOVING THE AMERICAN ECONOMY

A drawing of a typical ArmorGuard™ Barrier Section is shown in Appendix "D". The length of each AGB including the hinge assembly is 8.5 m (28 feet) and the effective overall height is 847 mm (33.3 inches). The effective width of the upright portion of the base is 727 mm (28.6 inches) and the effective width of the "T" top section is 513 mm (20 inches). The mass of an 8.5 meter AGB section is approximately 1350 kg (2,975 lbs.). The hinge assemblies at each end of the gate are protected from impacts by removable aluminum or steel covers that are held in place by removable pins. The section hinges are connected to each other with a 28.6 mm (1.125 inches) diameter ASTM C1018 steel connecting pin.

Currently Accepted For these uses:	**New Testing, proposed approval for use:**
Attached to 6 m (20 foot) portable concrete barrier (B-108, 11/04/2002)	Test 1 Attached to 3m (10 foot) portable concrete barrier (Test WGB03) (Figure 1, enclosed)
Single sections used between permanent median barrier (B-87, 07/06/2001)	Test 2 Multiple sections used between permanent median barrier (Test WGB04) (Figure 6, enclosed)
8 meter panels consisting of two 4 meter panels spliced together	Test 3 Solid 8 meter panel sections (Figure 11, enclosed)

As shown in the table above, the purpose of test WGB03 is to have the AGB approved for use in combination with 3 meter (10 foot) or longer portable concrete barrier sections attached at the ends. The condition that is currently approved is with 6 meter (20 foot) sections of portable concrete barrier attached at the ends. The concrete barrier segments are not pinned along their length but free to move except at the end.

The second test, WGB04, was conducted using multiple sections of AGB installed between a permanent median barrier. The condition that is currently approved was tested with a single AGB barrier section installed between permanent median barrier.

The third test was run to validate the performance of solid 8 meter panel sections. Previous designs consist of two 4 meter panels spliced together.

These tests also validate the design and performance of an alternate universal transition that was not previously tested.

Request for Acceptance

You specifically requested the following for the ArmorGuard Link and Gate systems:

1) The system name changes from SafeGuard Link to ArmorGuard Link and SafeGuard Gate to ArmorGuard gate.

2) The application of multiple ArmorGuard Link segments connected directly to or between permanent barriers.

3) The application of multiple ArmorGuard Link segments connected to or between any crashworthy temporary concrete barrier arrays with minimum barrier lengths of 3 meters.

4) The use of the alternative transition assembly as tested for ArmorGuard Link or Gate systems.

5) The use of the redesigned bulkheads and full length 8 meter panels into the ArmorGuard Link and Gate systems.

Crash Testing

Test Level	Test Designation		Impact Conditions			Impact Point
	NCHRP 350 Test No.	Safe Technologies Test No.	Vehicle	Nominal Speed (km/h)	Nominal Angle (deg)	
3	3-21	WGB03	2000P	100	25	CIP
3	3-21	WGB04	2000P	100	25	CIP
3	3-21	AG8M1	2000P	100	25	CIP

Crash test data summary sheets for these three tests are enclosed for reference. In each test the vehicle was redirected without noticeable snagging and did not experience appreciable pitch or roll.

Findings

The system described in requests 1 through 5 above and detailed in the enclosed drawings and crash testing is acceptable for use on the NHS under the range of conditions tested, when proposed by a State.

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

- This acceptance is limited to the crashworthiness characteristics of the systems and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the system 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 system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.

- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.

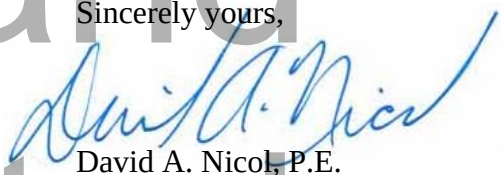
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.

- To prevent misunderstanding by others, this letter of acceptance is designated as number B-173 and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.

- ArmorGuard barriers are patented products and considered proprietary. If proprietary devices/systems 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.

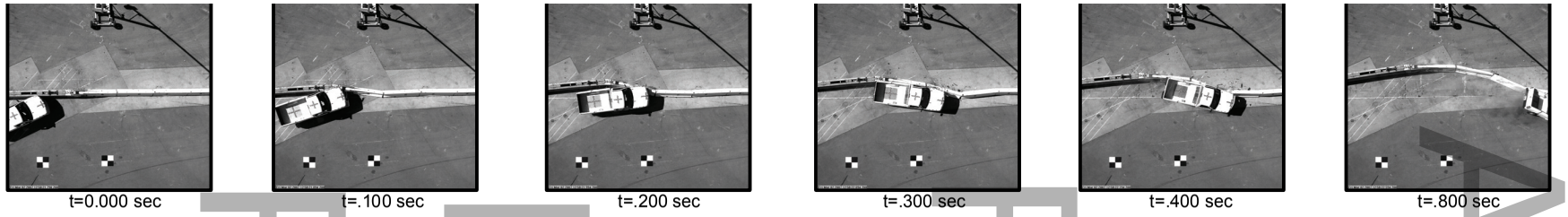
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate system, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

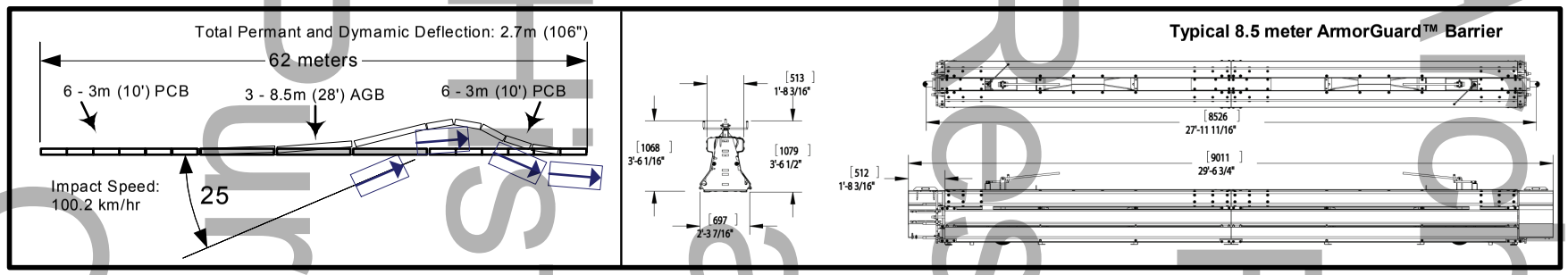
Sincerely yours,



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

2 Enclosures





General Information

Test Agency	**SAFE TECHNOLOGIES, INC.**
Test Designation	**NCHRP Report 350 3-21**
Test No.	**STI Test #WGB03**
Date	3/2/2007

Test Article

Type	ArmorGuard™ Barrier (formerly SafeGuard®)
Installation Length	Total Barrier Length : 62 meters (204')
Size and/or dimension and material of key elements	Individual AGB Length: 8.5 meters (28') Height: 847mm (33.3") Width (base) 727mm (28.6")

Test Vehicle

Type	Production Model
Designation	2000P
Model	1990 Chevrolet 3/4 ton pickup
Mass (kg)	
Curb	1818
Test Inertial	1983
Dummy(s)	n/a
Gross Static	1983

Impact Conditions

Speed (km/h)	100.2
Angle (deg)	25
Impact Severity (kJ)	137.1

Exit Conditions

Speed (km/h)	52.6
Angle (deg)	20

Occupant Risk Values

Impact velocity (m/s)	
x-direction	4.4
y-direction	-5
Ridedown Acceleration (g's)	
x-direction	-7.8
y-direction	9.1
THIV (km/hr)	22.4
PHD (g's)	9.2
ASI	1.1

Test Article Deflection (mm)

Dynamic	2667
Permanent	2667

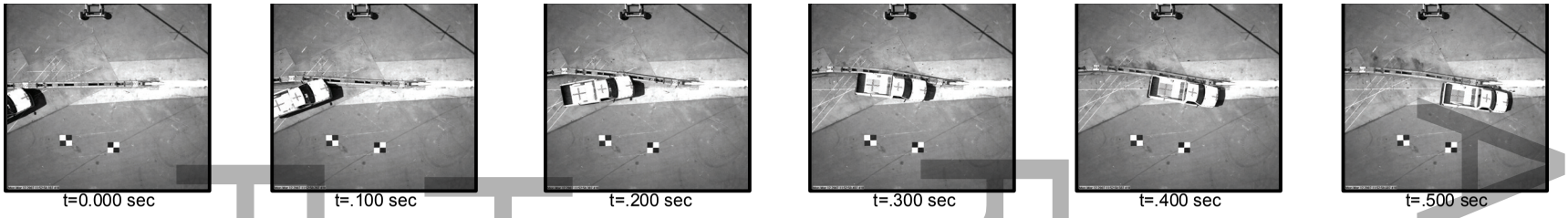
Vehicle Damage

Exterior	
VDS	FLQ-4
CDC	11FLEE4
Interior	
OCDI	LF0010000

Post-Impact Vehicular beharior (deg - gyro @ c.g)

Maximum Roll Angle (before capture)	-11.4
Maximum Pitch angle (before capture)	-11.8
Maximum Yaw Angle (before capture)	50.7

Figure 1. Summary of Results



General Information

Test Agency	**SAFE TECHNOLOGIES, INC.**
Test Designation	**NCHRP Report 350 3-21**
Test No	**STI Test #WGB04**
Date	3/12/2007

Test Article

Type	ArmorGuard™ barrier (formerly SafeGuard®)
Installation Length	Total Barrier Length : 58.5 meters (192')
Size and/or dimension and material of key elements	Individual AGB Length: 8.5 meters (28') Height: 847mm (33.3") Width (base) 727mm (28.6")

Test Vehicle

Type	Production Model
Designation	2000P
Model	1990 Chevrolet 3/4 ton pickup
Mass (kg)	
Curb	1825.5
Test Inertial	1961
Dummy(s)	n/a
Gross Static	1961

Impact Conditions

Speed (km/h)	103.4
Angle (deg)	25
Impact Severity (kJ)	144

Exit Conditions

Speed (km/h)	67.5
Angle (deg)	7

Occupant Risk Values

Impact velocity (m/s)	
x-direction	4.7
y-direction	-4.4
Ridedown Acceleration (g's)	
x-direction	-6.3
y-direction	11.6
THIV (km/hr)	21.3
PHD (g's)	11.6
ASI	1

Test Article Deflection (mm)

Dynamic	1200 (49")
Permanent	900 (35")

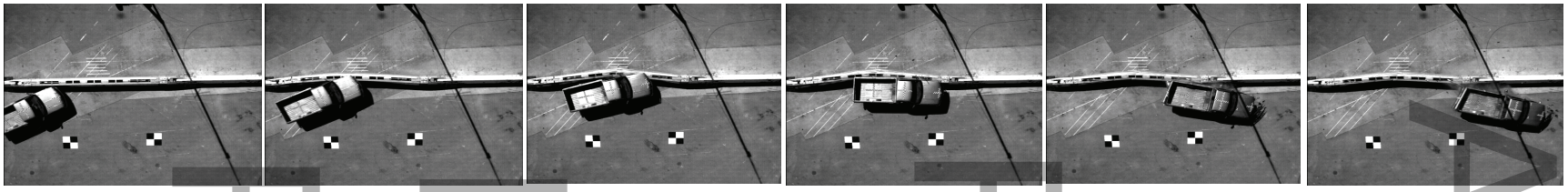
Vehicle Damage

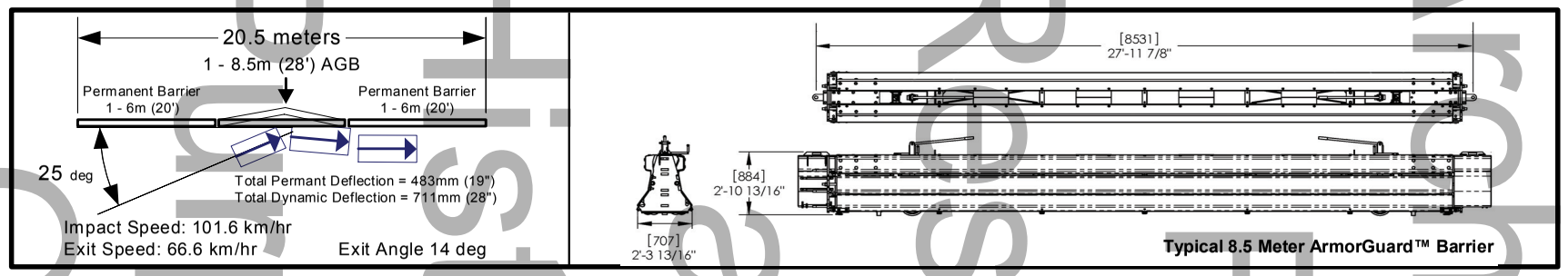
Exterior	
VDS	LFQ-3
CDC	11FLEE3
Interior	
OCDI	LF0010000

Post-Impact Vehicular behavior (deg - gyro @ c.g)

Maximum Roll Angle (before capture)	9.8
Maximum Pitch angle (before capture)	8.7
Maximum Yaw Angle (before capture)	36.8

Figure 6. Summary of Results





General Information

Test Agency	**SAFE TECHNOLOGIES, INC.**
Test Designation	**NCHRP Report 350 3-21**
Test No	**STI Test #AG8M1**
Date	5/8/2007

Test Article

Type	ArmorGuard™ barrier (formerly SafeGuard®)
Installation Length	Total Barrier Length : 20.5 meters (67')
Size and/or dimension and material of key elements	Individual AGB Length: 8.5 meters (28') Height: 847mm (33.3") Width (base) 727mm (28.6")

Test Vehicle

Type	Production Model
Designation	2000P
Model	1990 Chevrolet 3/4 ton pickup
Mass (kg)	
Curb	1780
Test Inertial	2001
Dummy(s)	n/a
Gross Static	2001

Impact Conditions

Speed (km/h)	101.6
Angle (deg)	25
Impact Severity (kJ)	142

Exit Conditions

Speed (km/h)	66.6
Angle (deg)	14

Occupant Risk Values

Impact velocity (m/s)	
x-direction	5
y-direction	-5.3
Ridedown Acceleration (g's)	
x-direction	-7.1
y-direction	10.1
THIV (km/hr)	24.4
PHD (g's)	11.7
ASI	1

Test Article Deflection (mm)

Dynamic	711 (28")
Permanent	483 (19")

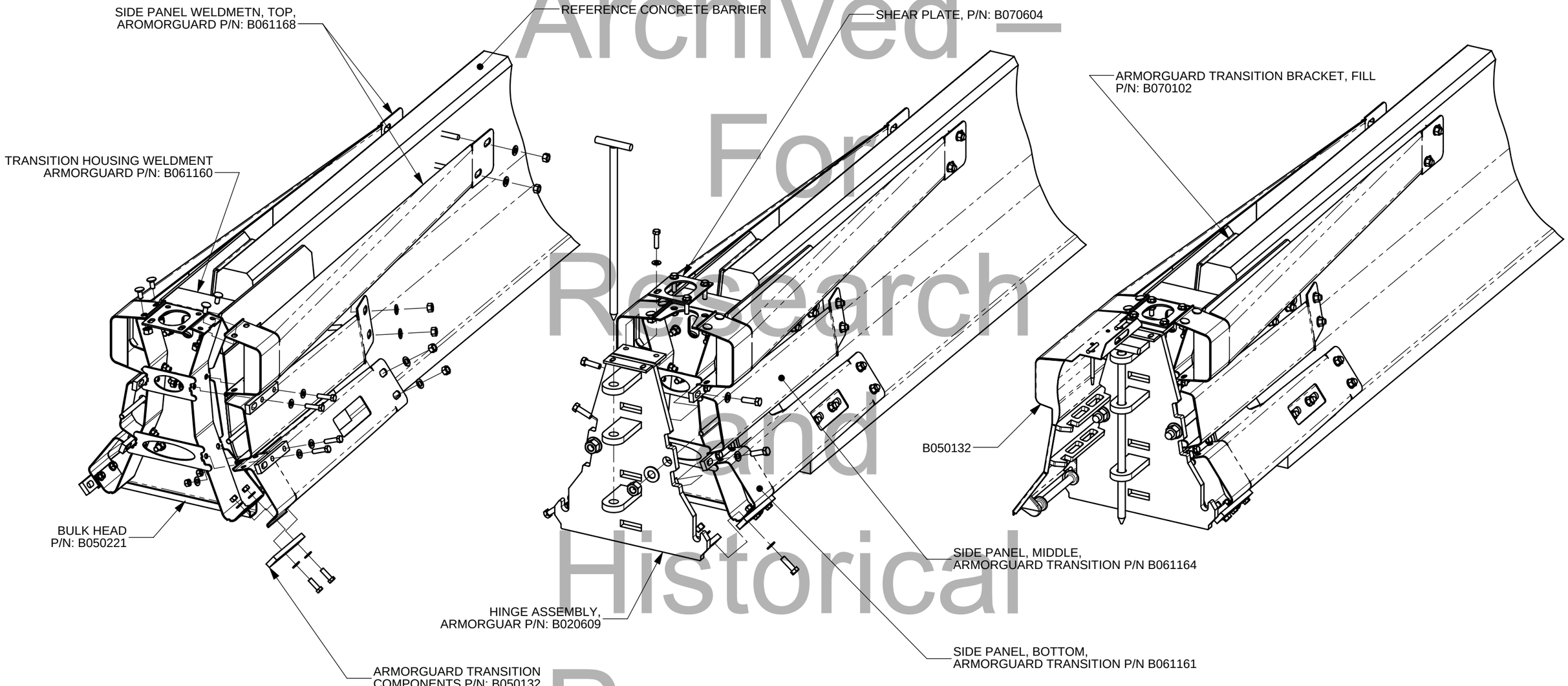
Vehicle Damage

Exterior	
VDS	LFQ-4
CDC	11FLEE4
Interior	
OCDI	LF0002000

Post-Impact Vehicular behavior (deg - gyro @ c.g)

Maximum Roll Angle (before capture)	-6.9
Maximum Pitch angle (before capture)	-4.2
Maximum Yaw Angle (at separation)	14

Figure 11. Summary of Results



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APPR'D BY		

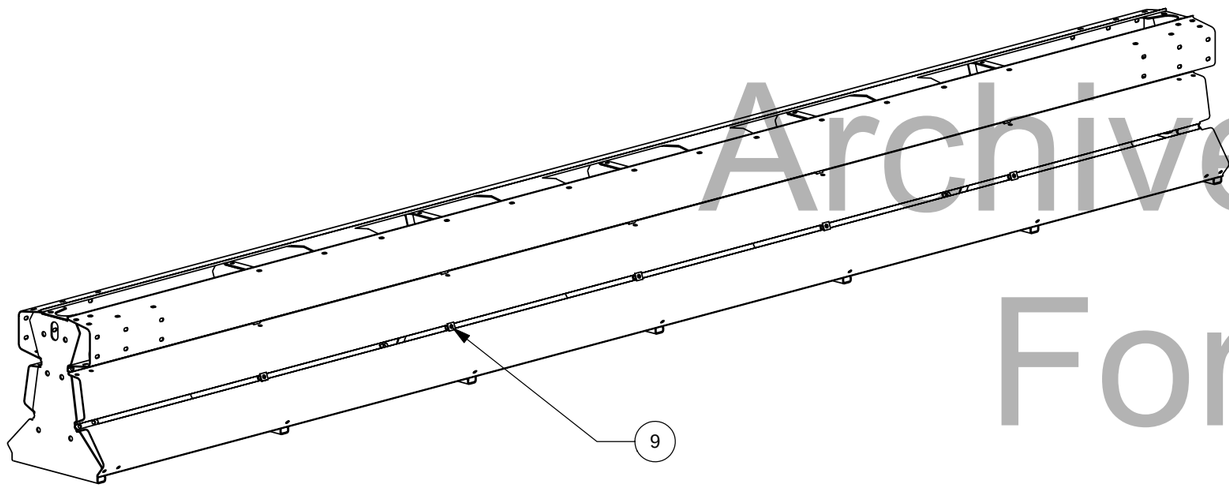
TITLE:
TRANSITION ASSEMBLY
ARMORGUARD

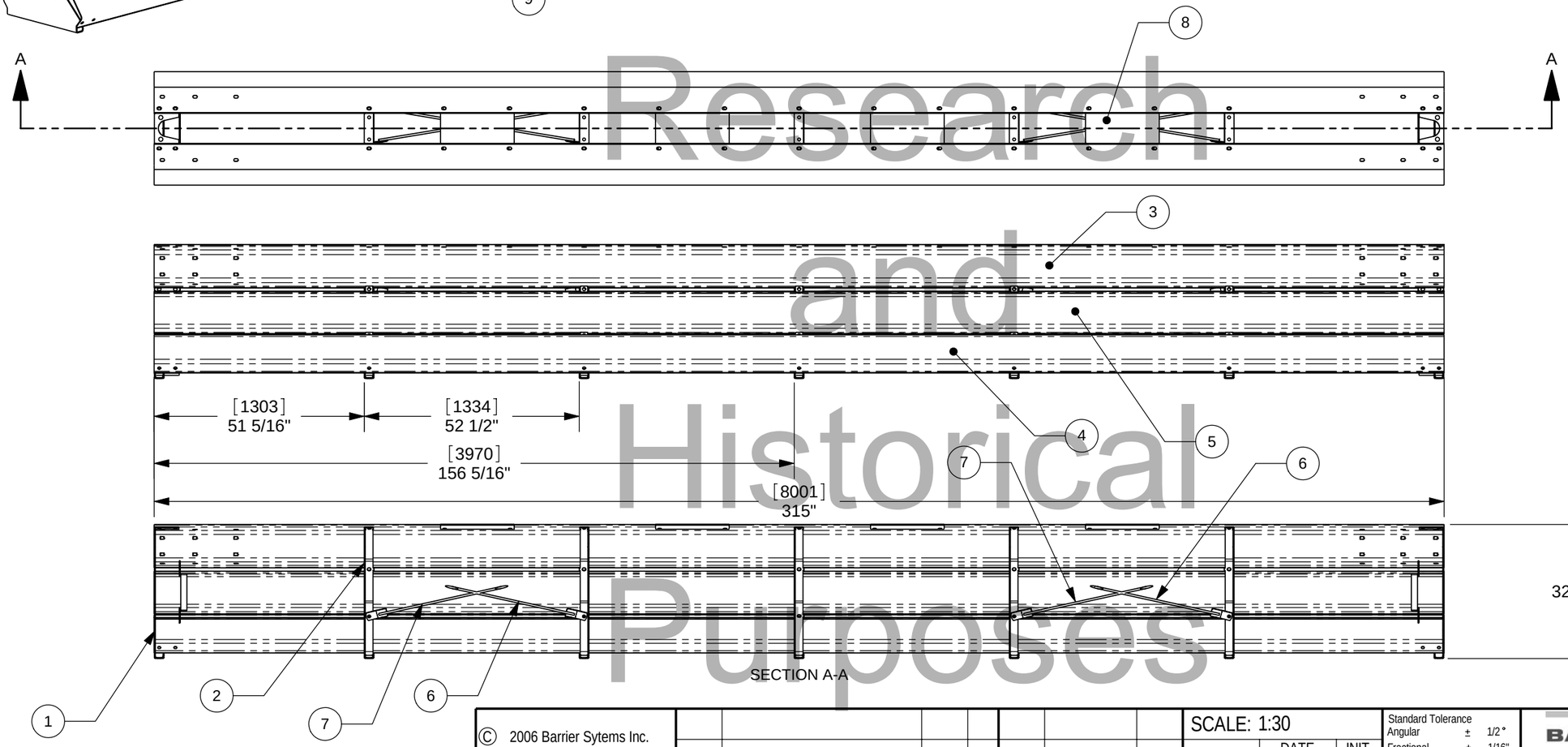
Standard Tolerance		
Angular	±	1/2 °
Fractional	±	1/16"
Dec .XXX=	±	.010
Dec .XX=	±	.030

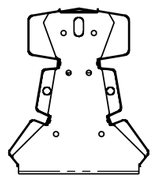
BARRIER SYSTEMS INC
180 RIVER RD, RIO VISTA, CA 94571
TEL: 707-374-6800 FAX: 707-374-6801

SHEET	DRAWING NUMBER	REV
1 OF 1	B070603-US	

Item	Qty	Part Description	Part#	U/M
1	2.00	END SUPPORT,BSI,SAFEGUARD	B050221	EACH
2	5.00	MIDDLE SUPPORT,BSI,SAFEGUARD	B050402	EACH
3	2.00	Top Panel, 8 Meter	B050828	EACH
4	2.00	Bottom Panel, 8 Meter	B050829	EACH
5	2.00	Middle Panel, 8 Meter	B050830	EACH
6	2.00	Diagonal Right Sfg Dwg No. BR-	B010201	EACH
7	2.00	Diag Left Sfg Dwg No. BR-1035	B001205	EACH
8	4.00	Mid Shear Plt Sfg rev "A"	B010130	EACH
9	20.00	Clamp Strip Sfg Dwg No. BR-102	A010423	EACH
10	72.00	C-SCR HH 5/8-11x2 Gr2 Gal	2001205	EACH
11	144.00	Wshr 5/8 F436 Struct Galv	2000118	EACH
12	8.00	Nut Jam 5/8-11 Gr2 Gal	2001403	EACH
13	64.00	Nut HN 5/8-11 A563 Gr2 Gal	2000134	EACH







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APPR'D BY		

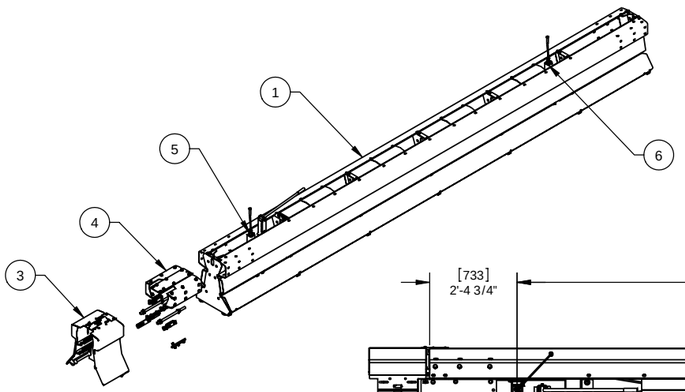
Standard Tolerance		
Angular	±	1/2 °
Fractional	±	1/16"
Dec .XXX=	±	.010
Dec .XX=	±	.030

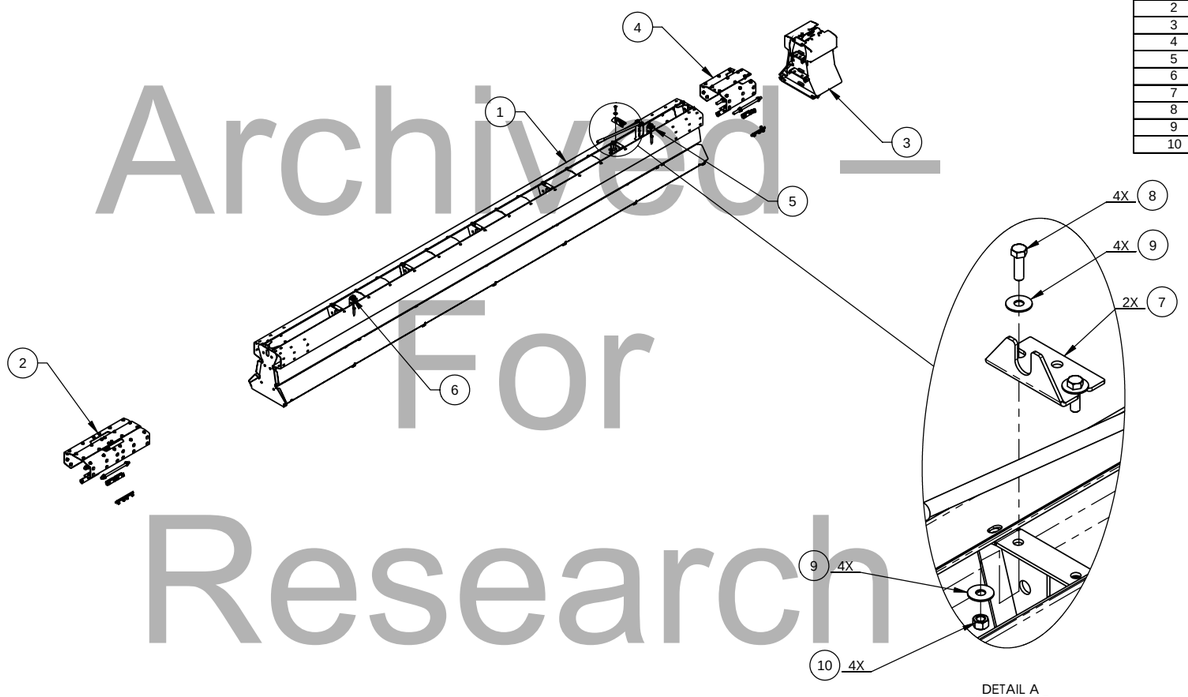
TITLE:
8M ARMORGUARD
STANDARD COMPONENTS

BARRIER SYSTEMS INC
180 RIVER RD, RIO VISTA, CA 94571
TEL: 707-374-6800 FAX: 707-374-6801

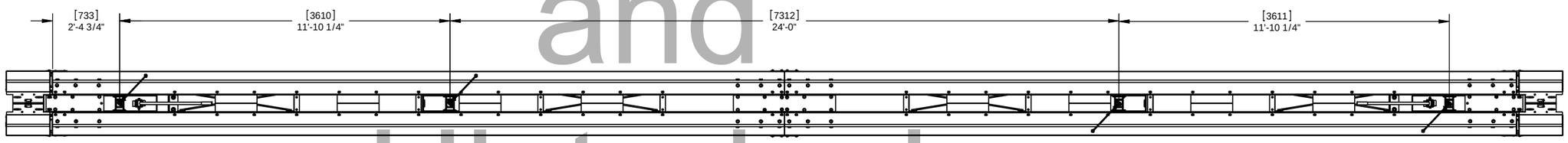
SHEET	DRAWING NUMBER	REV
1 OF 1	B060979-US	

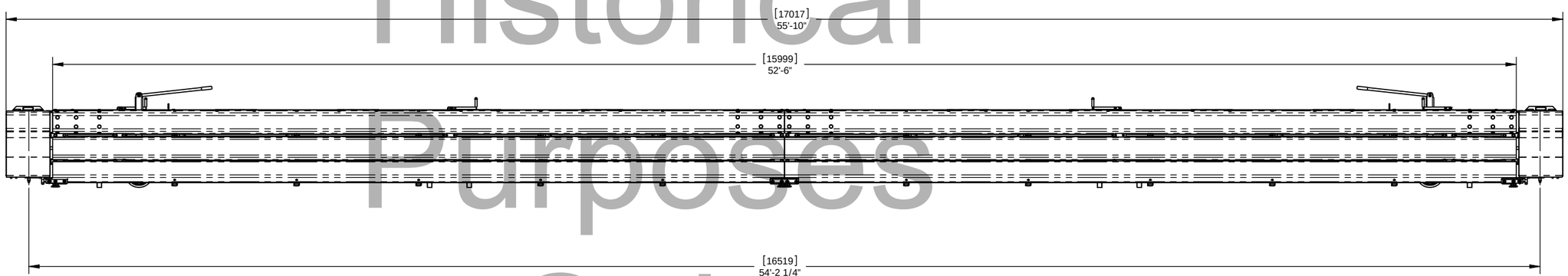
Item	Qty	Part Description	Part#	U/M
1	2.00	8M Safeguard Link Module	B060979	EACH
2	1.00	Coupling Set, 4 Meter Section, Safeguard	B010343	EACH
3	2.00	Hinge Assembly, Safeguard Gate	B020609	EACH
4	2.00	Hinge Mount Set, Safeguard	B010342	EACH
5	2.00	LINK WHEEL ASSY, MANUAL	B040706	EACH
6	2.00	WHEEL ASSEMBLY, MANUAL CASTER SAFEGUARD LINK SYSTEM	B050835	EACH
7	2.00	Sfg Saddle Link Steering	B020777	EACH
8	4.00	C-SCR HH 5/8-11x2 Gr2 Gal	2001205	EACH
9	8.00	Wshr 5/8 F436 Struct Galv	2000118	EACH
10	4.00	Nut HN 5/8-11 A563 Gr2 Gal	2000134	EACH

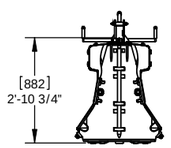




DETAIL A
SCALE 1 : 5







REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM

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APPR'D BY		

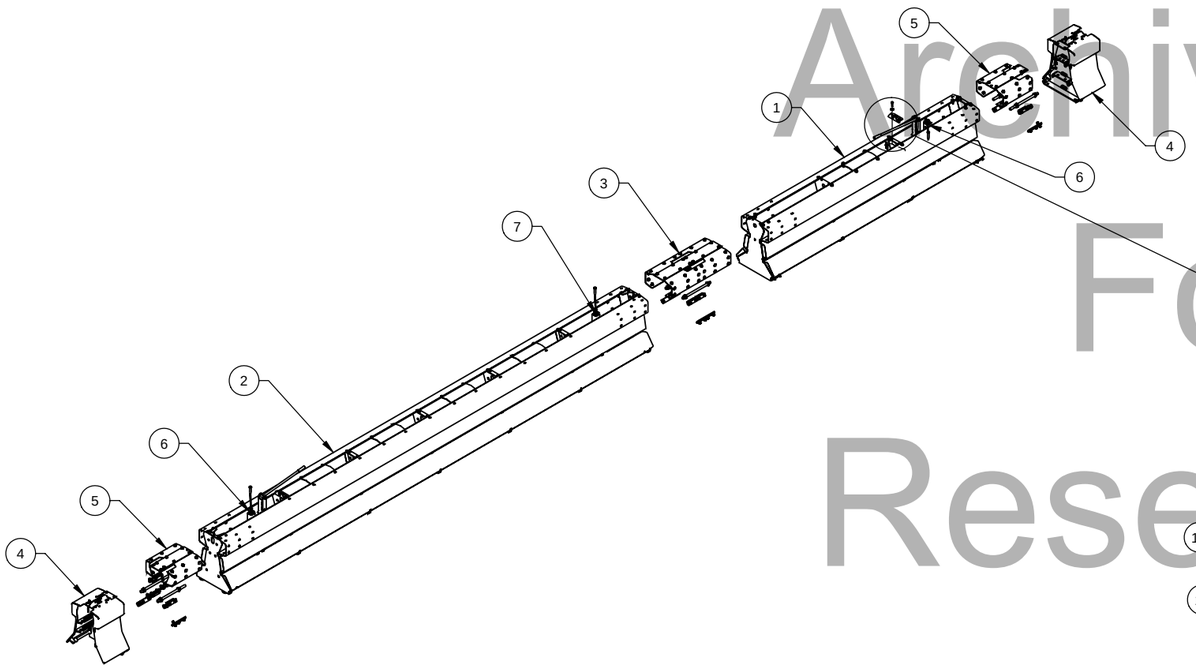
Standard Tolerance
Angular ± 1/2°
Fractional ± 1/16
Dec .XXX± ± .010
Dec .XX± ± .030

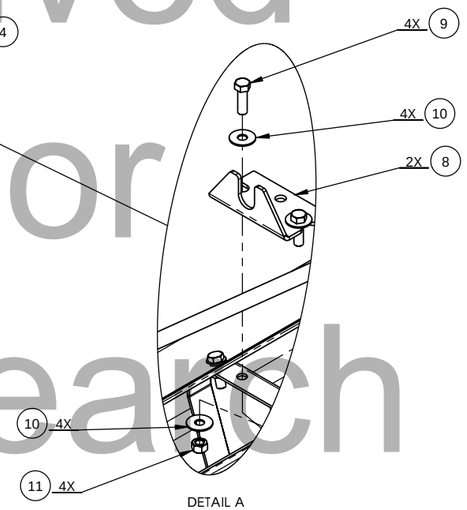
TITLE
ARMORGUARD 16M GATE ASS'Y, MANUAL, STANDARD

BARRIER SYSTEMS INC
180 RIVER RD, RIO VISTA, CA 94571
TEL: 707-374-6800 FAX: 707-374-6801

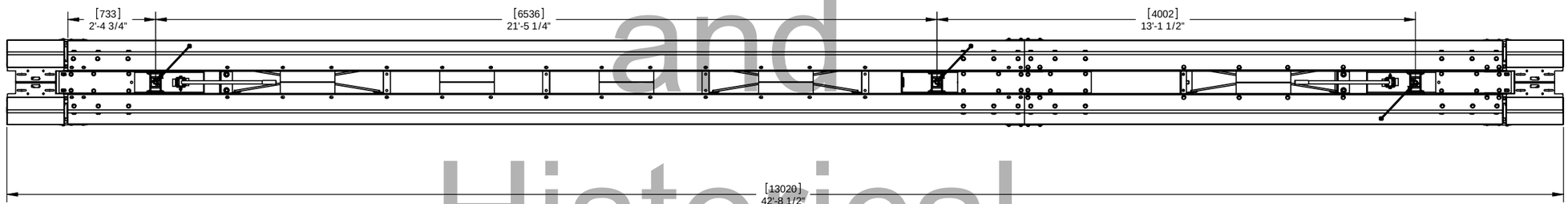
SHEET	DRAWING NUMBER	REV.
1 OF 1	16AGMS-US	

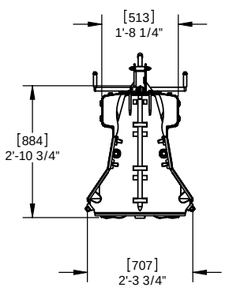
Item	Qty	Part Description	Part#	U/M
1	1.00	4 Meter Section Assembly, Safeguard	B010336	EACH
2	1.00	8M Safeguard Link Module	B060979	EACH
3	1.00	Coupling Set, 4 Meter Section, Safeguard	B010343	EACH
4	2.00	Hinge Assembly, Safeguard Gate	B020609	EACH
5	2.00	Hinge Mount Set, Safeguard	B010342	EACH
6	2.00	LINK WHEEL ASSY, MANUAL	B040706	EACH
7	1.00	WHEEL ASSEMBLY, MANUAL CASTER SAFEGUARD LINK SYSTEM	B050835	EACH
8	2.00	Sfg Saddle Link Steering	B020777	EACH
9	4.00	C-SCR HH 5/8-11x2 Gr2 Gal	2001205	EACH
10	8.00	Wshr 5/8 F436 Struct Galv	2000118	EACH
11	4.00	Nut HN 5/8-11 A563 Gr2 Gal	2000134	EACH

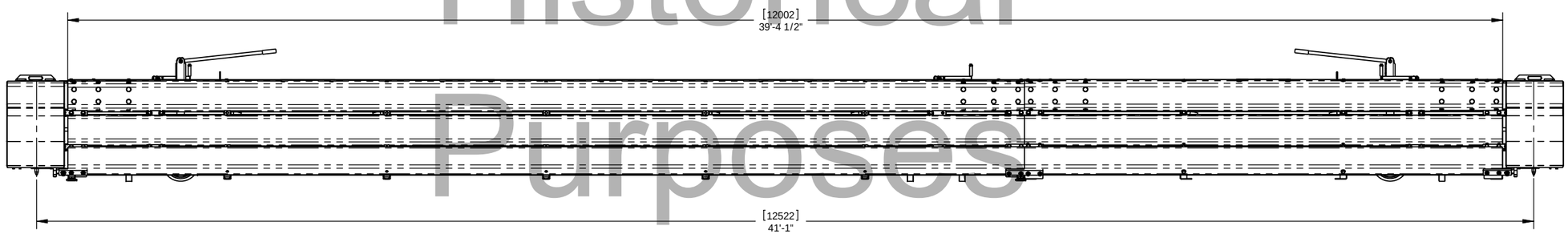




DETAIL A
SCALE 1 : 5







REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM

SCALE: 1:20

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APPR'D BY		

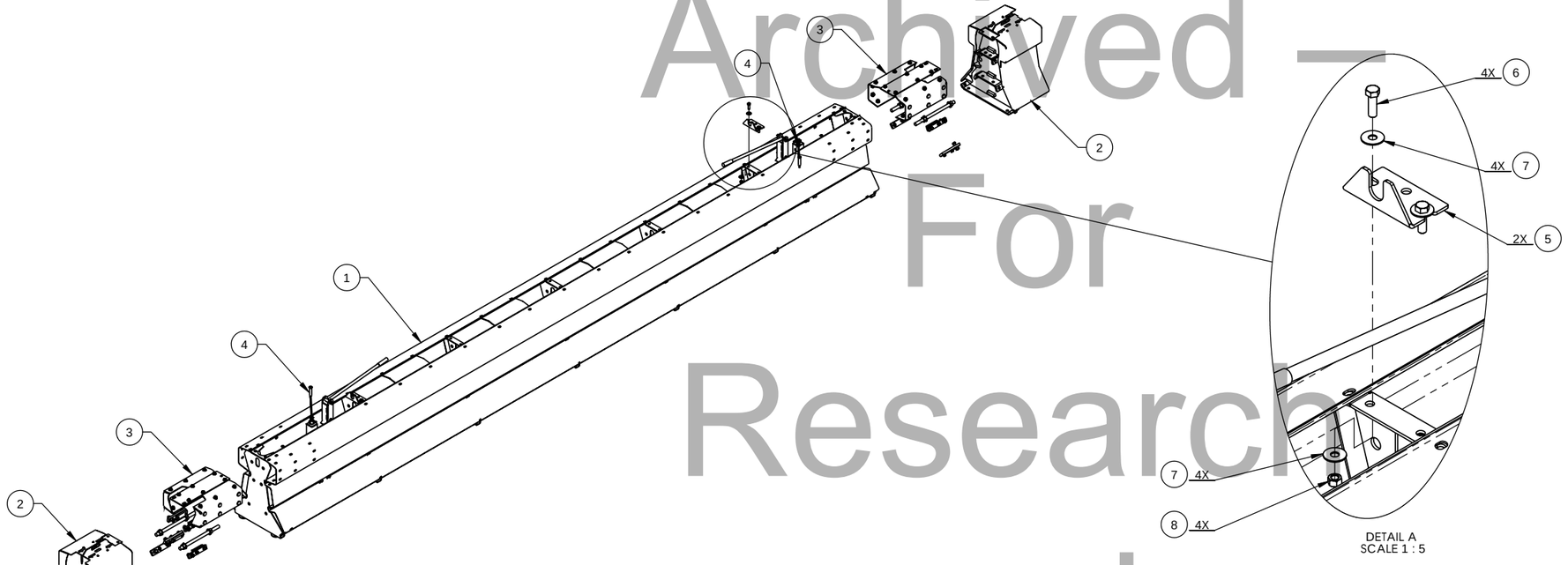
Standard Tolerance
Angular ± 1/2°
Fractional ± 1/16
Dec .XXX= ± .010
Dec .XX= ± .030

TITLE: ARMORGUARD 12M GATE ASS'Y, MANUAL STANDARD

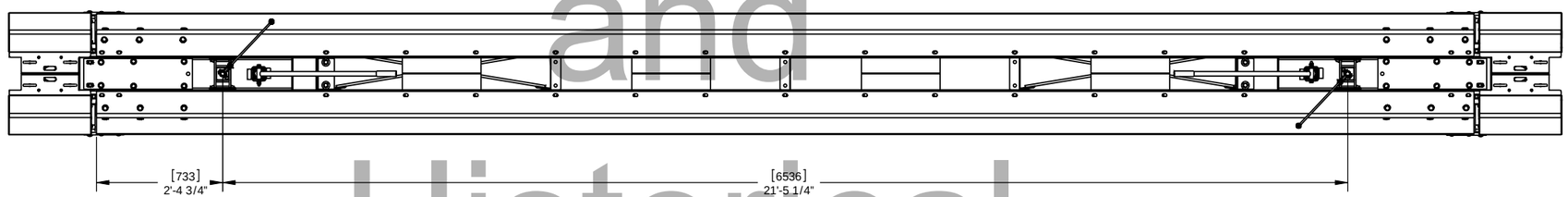
BARRIER SYSTEMS INC
180 RIVER RD, RIO VISTA, CA 94571
TEL: 707-374-6800 FAX: 707-374-6801

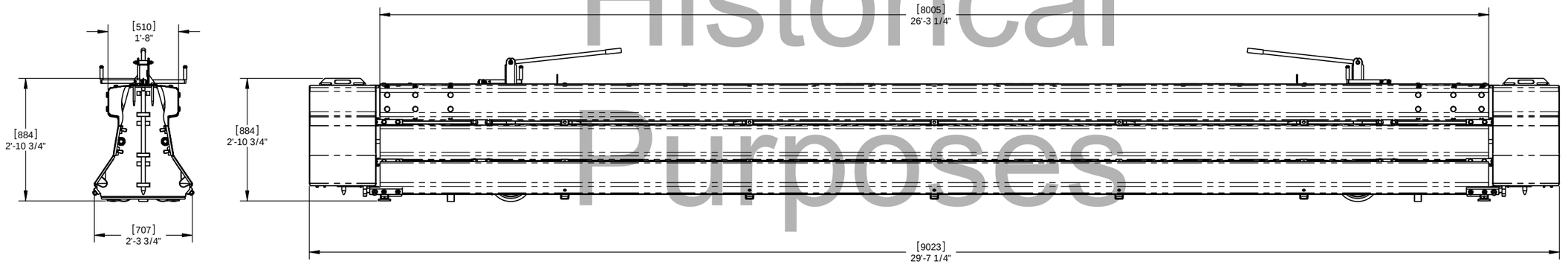
SHEET	DRAWING NUMBER	REV.
1 OF 1	12AGMS-US	

Item	Qty	Part Description	Part#	U/M
1	1.00	8M Safeguard Link Module	B060979	EACH
2	2.00	Hinge Assembly, Safeguard Gate	B020609	EACH
3	2.00	Hinge Mount Set, Safeguard	B010342	EACH
4	2.00	LINK WHEEL ASSY, MANUAL	B040706	EACH
5	2.00	Sfg Saddle Link Steering	B020777	EACH
6	4.00	C-SCR HH 5/8-11x2 Gr2 Gal	2001205	EACH
7	8.00	W/shr 5/8 F436 Struct Galv	2000118	EACH
8	4.00	Nut HN 5/8-11 A563 Gr2 Gal	2000134	EACH



DETAIL A
SCALE 1 : 5





REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM

SCALE: 1:16

	DATE	INIT.
DRAWN BY	11/29/07	AEM
APPR'D BY		

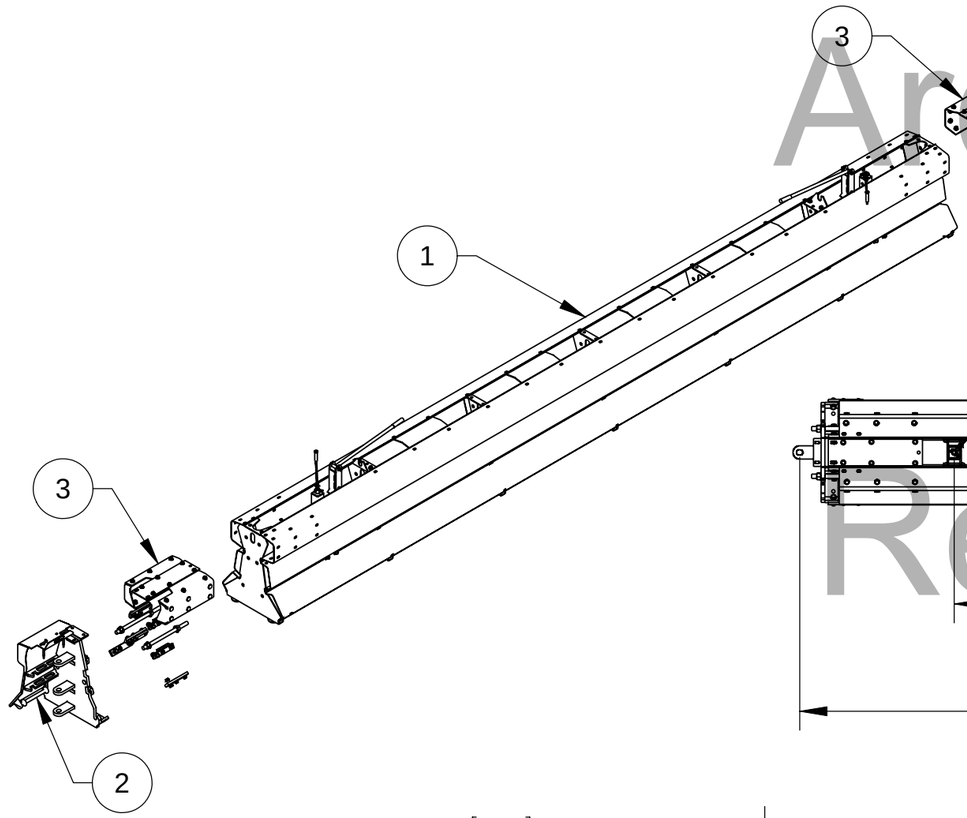
Standard Tolerance
Angular: ± 1/2°
Fractional: ° 1/16
Dec .XXX= ± .010
Dec .XX= ± .030

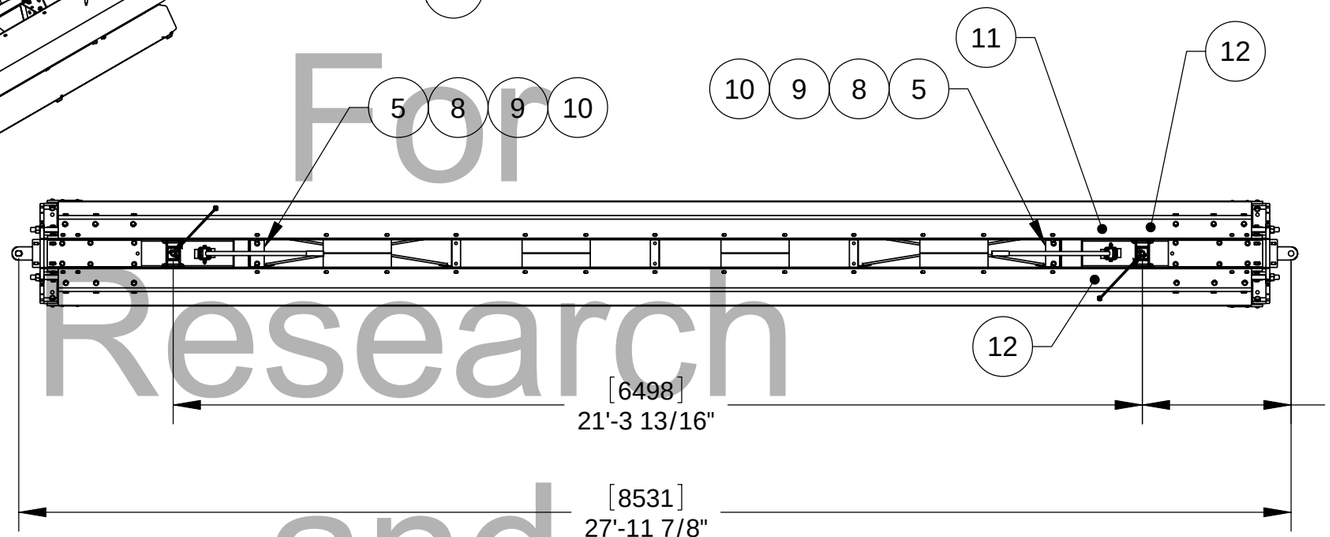
TITLE: ARMORGUARD 8M GATE ASS'Y, MANUAL, STANDARD

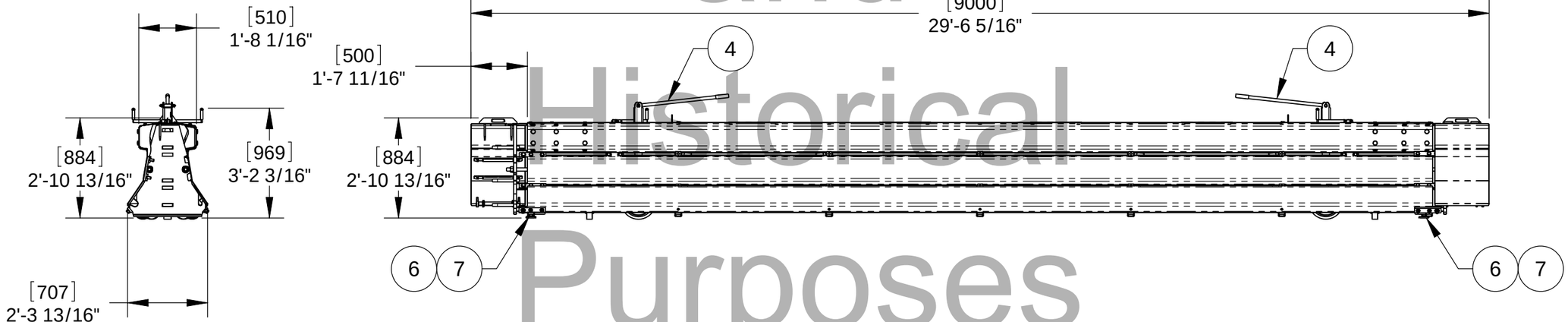
BARRIER SYSTEMS INC
180 RIVER RD, RIO VISTA, CA 94571
TEL: 707-374-6800 FAX: 707-374-6801

SHEET	DRAWING NUMBER	REV.
1 OF 1	08AGMS-US	

Item	Qty	Part Description	Part#	U/M
1	1.00	8M Safeguard Link Module	B060979	EACH
2	1.00	Hinge Assembly, Safeguard Link	B020784	EACH
3	2.00	Hinge Mount Set, Sfg Link	B020789	EACH
4	2.00	LINK WHEEL ASSY, MANUAL	B040706	EACH
5	2.00	Sfg Saddle Link Steering	B020777	EACH
6	4.00	Foot 13" Narrow Barrier Plasti	A010317	EACH
7	4.00	Nut SFN 1/2-13 Gr5 Plt	2001247	EACH
8	4.00	C-SCR HH 5/8-11x2 Gr2 Gal	2001205	EACH
9	4.00	Nut HN 5/8-11 A563 Gr2 Gal	2000134	EACH
10	8.00	Wshr 5/8 F436 Struct Galv	2000118	EACH
11	4.00	Decal Caution Keep Feet Clear	B030368	EACH
12	4.00	Decal Jack Rotation	B030369	EACH







REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM

SCALE: 1:40

	DATE	INIT.
DRAWN BY	11/29/07	AEM
APPR'D BY		

Standard Tolerance
Angular ± 1/2°
Fractional ± 1/16"
Dec .XXX= ± .010
Dec .XX= ± .030

TITLE:
ARMORGUARD MODULAR
8 METER LINK

BARRIER SYSTEMS INC
180 RIVER RD, RIO VISTA, CA 94571
TEL: 707-374-6800 FAX: 707-374-6801

SHEET	DRAWING NUMBER	REV
1 OF 1	08ABMS-US	