APPENDIX 'D'

CRASH ATTENUATION

VALTIR

QuadGuard®

CRASH CUSHION

PRODUCT DESCRIPTION MANUAL

PN 619185
REVISION B NOVEMBER 2022

QuadGuard®

The QuadGuard® has been tested pursuant to National Cooperative Highway Research Program ("NCHRP") Report 350 specifications. The QuadGuard® has been deemed eligible for federal-aid reimbursement on the National Highway System by the Federal Highway Administration ("FHWA").

Product Description Manual

15601 Dallas Parkway
Suite 525
Addison, Texas 75001

Warning: The local highway authority, distributors, owners, contractors, lessors, and lessees are RESPONSIBLE for the assembly, maintenance, and repair of the QuadGuard®. Failure to fulfill these RESPONSIBILITIES with respect to the assembly, maintenance, and repair of the QuadGuard® could result in serious injury or death.

The instructions contained in this manual supersede all previous information and manuals. All information, illustrations, and specifications in this manual are based on the latest QuadGuard® information available to Valtir at the time of printing. We reserve the right to make changes at any time. Please contact Valtir to confirm that you are referring to the most current instructions.

Part No. 619185

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Customer Service Contacts

Valtir is committed to the highest level of customer service. Feedback regarding the QuadGuard® system, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

Valtir

Telephone:	(888) 323-6374 (USA) (312) 467-6750 (International)
Contact Link	Valtir.com/Contact

Limitations and Warnings

Valtir contracts with FHWA approved testing facilities to perform crash tests, evaluate test results, and submit results to the FHWA for review.

The QuadGuard® system has been deemed eligible for reimbursement by FHWA as meeting the requirements and guidelines of NCHRP Report 350. NCHRP Report 350 tests are designed to evaluate product performance involving a range of vehicles on roadways, from lightweight cars (approx. 1800 lb. [820 kg]) to full size pickup trucks (approx. 4400 lb. [2000 kg]). A product can be certified for multiple Test Levels. QuadGuard® is certified to the Test Level(s) as shown below:

Test Level 2: 43 mph [70 kph]

Test Level 3: 62 mph [100 kph]

These FHWA directed tests are not intended to represent the performance of systems when impacted by every vehicle type or every impact condition existing on the roadway. This system is tested only to the test matrix criteria of NCHRP Report 350 as approved by FHWA.

Valtir expressly disclaims any warranty or liability for injury or damage to persons or property resulting from any impact, collision or harmful contact with products, other vehicles, or nearby hazards or objects by any vehicle, object or person, whether or not the products were assembled in consultation with Valtir or by third parties.

The QuadGuard® is intended to be assembled, delineated, and maintained within specific state and federal guidelines. It is important for the highway authority specifying the use of a highway product to select the most appropriate product configuration for its site specifications. The customer should be careful to properly select, assemble, and maintain the product. Site lay out, vehicle population type; speed, traffic direction, and visibility are important elements that require evaluation in the selection of a highway product. For example, curbs could cause an untested effect on an impacting vehicle.

After an impact occurs, the debris from the impact should be removed from the area immediately and the specified highway product should be evaluated and restored to its original specified condition or replaced as the highway authority determines as soon as possible.

System Overview

The QuadGuard® is a potentially reusable, re-directive, non-gating crash cushion for road features ranging in width from 24” to 126” [610 mm to 3200 mm]. After those impacts observed within NCHRP Report 350 criteria, it has been observed that, potentially, the bulk of the system can be reused. The system consists of energy-absorbing Cartridges surrounded by a framework of Quad-Beam Panels. What constitutes a potentially reusable highway product should only be determined by a trained engineer, experienced in highway products, directed by the DOT, or other appropriate local highway authority.

The QuadGuard® system utilizes two types of Cartridges in a “staged” configuration to address both lighter cars and heavier, high center-of-gravity vehicles. Its modular design allows the system length to be tailored to the design speed of a site. See QuadGuard® Design Table on page 8 to determine the appropriate system length for a given speed.

Impact Performance

The Six Bay QuadGuard® has successfully passed the requirements stipulated in NCHRP Report 350 with both the light car and pickup at speeds of up to **100 km/h [62 mph]** at angles up to 20 degrees.

During head-on impacts, the QuadGuard® system telescopes rearward and crushes to absorb the energy of impact. When impacted from the side, within NCHRP Report 350 criteria, it has been observed to safely redirect the vehicle back toward its original travel path and away from the road feature.

How to Determine Left/Right

To determine left from right when ordering parts, stand in front of the system facing the roadside obstacle. Your left is the system’s left and your right is the system’s right.

System Bay Count

One Bay consists of one Cartridge, one Diaphragm, two Fender Panels, etc. The Nose section is not considered a Bay, though there is a Cartridge in the Nose of each system. Note that this means there will always be one more Cartridge in the system than the number of Bays in the system. To determine number of Bays, count Fender Panels on one side (Figure 1). The Five-Bay system is shown.

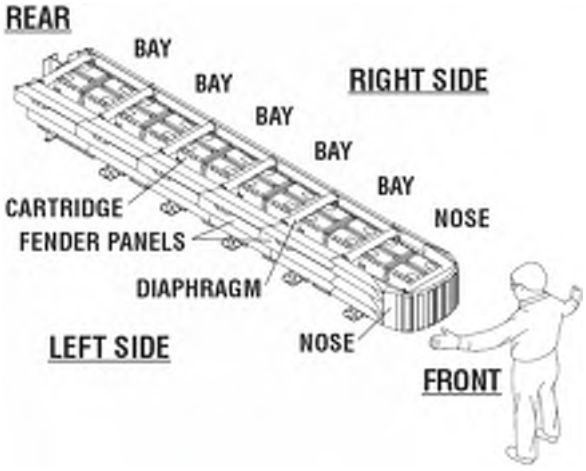


Figure 1
System Orientation

Measuring the Width

The QuadGuard® system is available in seven nominal widths:

- 24” [610 mm]
- 30” [760 mm]
- 36” [915 mm]
- 48” [1219 mm]
- 69” [1755 mm]
- 90” [2285 mm]
- 126” [3200 mm]

The nominal width of a parallel system is the width of the diaphragm (Figure 2).

The nominal width of a wide system is the width at the location shown in Figure 3.

The outside width of the system is approximately 6” [150 mm] to 9” [230 mm] wider than the nominal width. The width of the system is not the same as the width of the Backup.

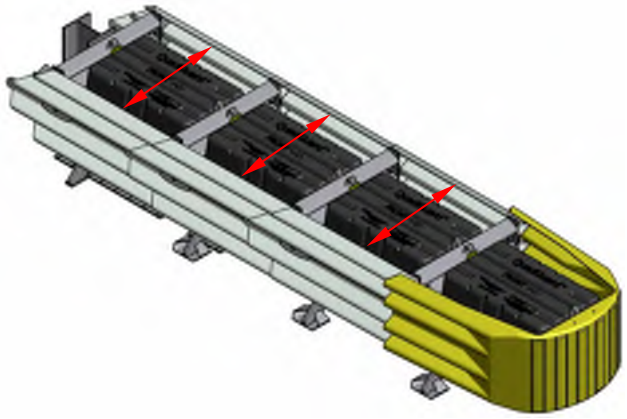


Figure 2
Parallel system

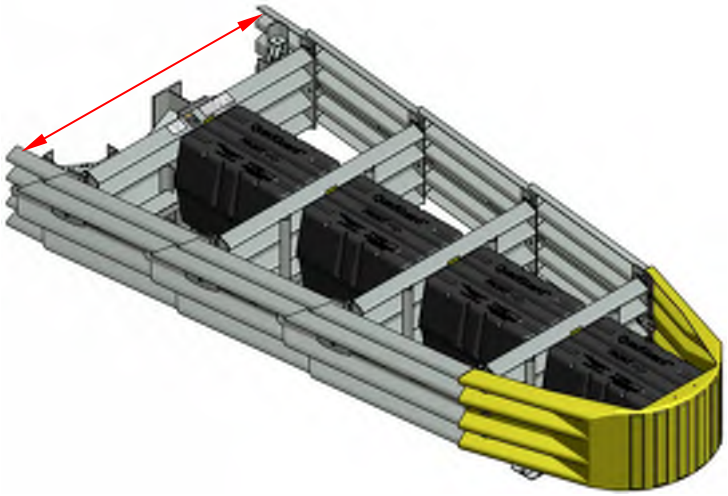


Figure 3
Wide system

QuadGuard® System Criteria

Contact Valtir Customer Service Department if you would like input as to your specific application (p. 3). Proper model selection is essential to QuadGuard® performance. You will need to answer the following questions:

1) Width Specification

As a general rule, selection of the narrowest width that adequately shields the road feature is recommended (p. 5).

2) Specification of System Length

System length is specified by the number of Bays the system includes. The number of Bays required is a function of the intended speed of the roadway.

3) Specify Foundation

The system must be anchored. Refer to QuadGuard® Assembly Manual and approved adhesive anchoring kits for detailed instructions.

A. Is the system to be placed on existing concrete?

Existing concrete – Concrete must be at least 6” [150 mm] thick, reinforced 4000psi [28 MPa] Portland cement concrete (P.C.C.), or 8” [200 mm] thick non-reinforced 4000psi [28 MPa] P.C. Concrete Roadway, measuring at least 12’-0” [3.66 m] wide by 50’-0” [15.24 m] long. The concrete should be in good condition and be free of major cracks.

New concrete – If existing concrete does not meet these criteria, then a new concrete pad must be placed to properly secure the system. See concrete pad details supplied with the system and Concrete Pad Reference drawings (pp. 21, 22).

B. Is there a cross-slope at the construction site?

Cross-slope exists – If there is a cross-slope of more than 8% (5 degrees), or if the cross-slope varies (twists) more than 2% (1 degree) over the length of the system, a concrete leveling pad may be required (Figure 4).
No Cross-slope – No additional action is required.

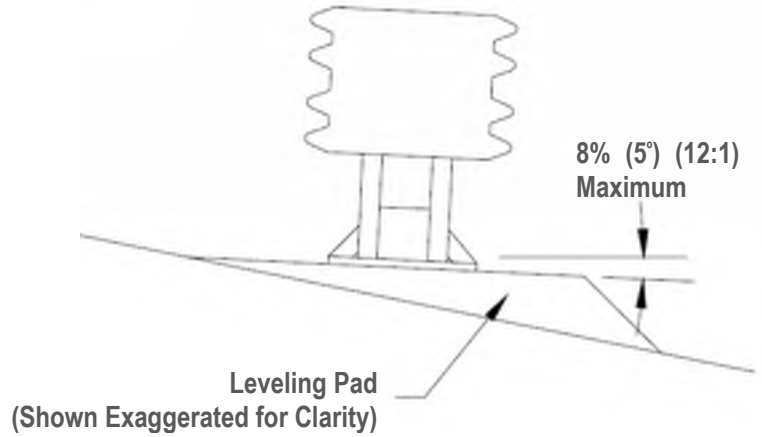


Figure 4
Cross-Slope

4) Specify Backup Structure

The two Backup designs available are the Tension Strut Backup and the Concrete Backup. Both types are appropriate for use on grade or deck.

5) Special Site Conditions

Contact Valtir Customer Service if you have any product questions (p. 3). Please have the following information available for your chosen site:

A) **Are curbs, islands, or elevated objects (delineators or signs) present at the site? What height and width are they?** All curbs and elevated objects over 4” [100 mm] high should be removed. If possible, curbs taller than 4” [100 mm] high should be removed approximately 50’ [15 m] in front of the QuadGuard® systems and as far back as the system’s Backup. Any curbs that must remain should be 4” [100 mm] maximum and be mountable.

B) If the construction site is a gore area (place where two roads diverge), **what is the angle of divergence?**

C) **What is the general geometry of the site**, including the roadway for at least 500’ [150 m] in front, so traffic patterns can be visualized?

D) **Is there an existing barrier?** Where there is an existing guardrail or median barrier at the site, the QuadGuard® Backup should tie into it when possible.

E) **Will there be traffic approaching from the rear of the system?** Is the system in a two-way traffic situation, with traffic going in opposite directions on either side of the system? Or, is the system on the side of the road in a location where crossover traffic is a concern? If so, a Transition from the back of the system to the road feature is necessary to prevent vehicle interaction (p.13).

F) Are there any other unique features at the site that may affect positioning or performance

6) Other Factors that May Affect Your Deployment:

1. The existence of drain inlets.
2. Junction boxes or other appurtenances located near the hazard.
3. Insufficient space for the length preferred.
4. The location and movement of expansion joints.

If these or any other special site conditions exist, please contact Valtir Customer Service Department before proceeding with your design (p. 3).

Impact conditions which differ from those described in the NCHRP Report 350 test matrix for non-gating redirecting crash cushions, may result in different crash results than those encountered in testing.

Furthermore, impacts in excess of TL-3 impact severity, or the existence (at the site of assembly) of curbs or cross-slopes in excess of 8%, may yield performance which does not meet NCHRP Report 350 evaluation criteria relative to structural adequacy, occupant risk, and vehicle trajectory factors.

The following charts represent the modified versions of the QuadGuard® length relative to impact speed of a 4400 lb. [2000 kg] pickup truck.

QuadGuard® Design Table (Average G deceleration values)

Bays	Effective Length	Design km/h Velocity (mph)	40 (25)	50 (31)	60 (37)	70 (44)	80 (50)	90 (56)	100 (62)
6	6.30 m (20'-8")	100 (62)	---	---	---	---	4.7	5.9	7.3 (TL-3)
5*	5.38 m (17'-8")	90 (56)	---	---	---	4.2	5.5	7.0	8.6
4*	4.47 m (14'-8")	80 (50)	---		3.7	5.1	6.6	8.4	10.4
3	3.56 m (11'-8")	70 (44)	---	3.2	4.7	6.4 (TL-2)	8.3	10.5	---
2*	2.64 m (8'-8")	60 (37)	2.8	4.4 (TL-1)	6.3	8.6	11.2	---	---
1*	1.73 m (5'-8")	40 (25)	4.3	6.7	9.6	---	---	---	---

*System capacity estimated through calculation.

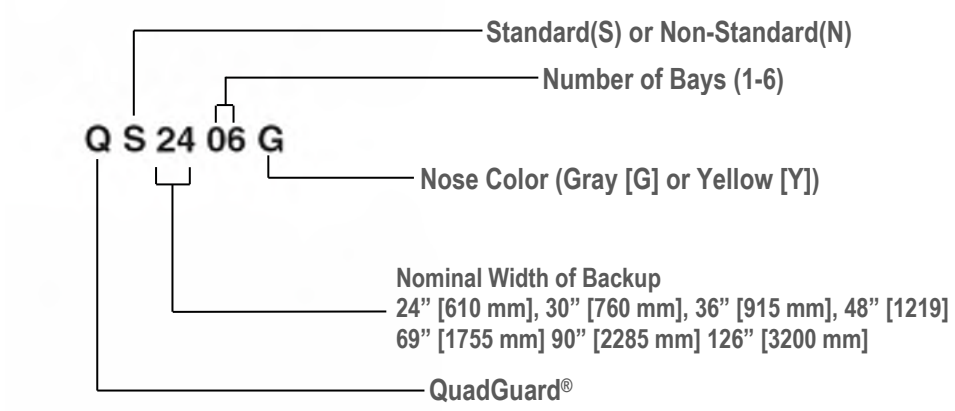
Average G deceleration values are based upon values calculated for vehicles 1800 to 4400 lbs. (820 to 2000 kg) that stop in a distance equal to 85% of the system length.

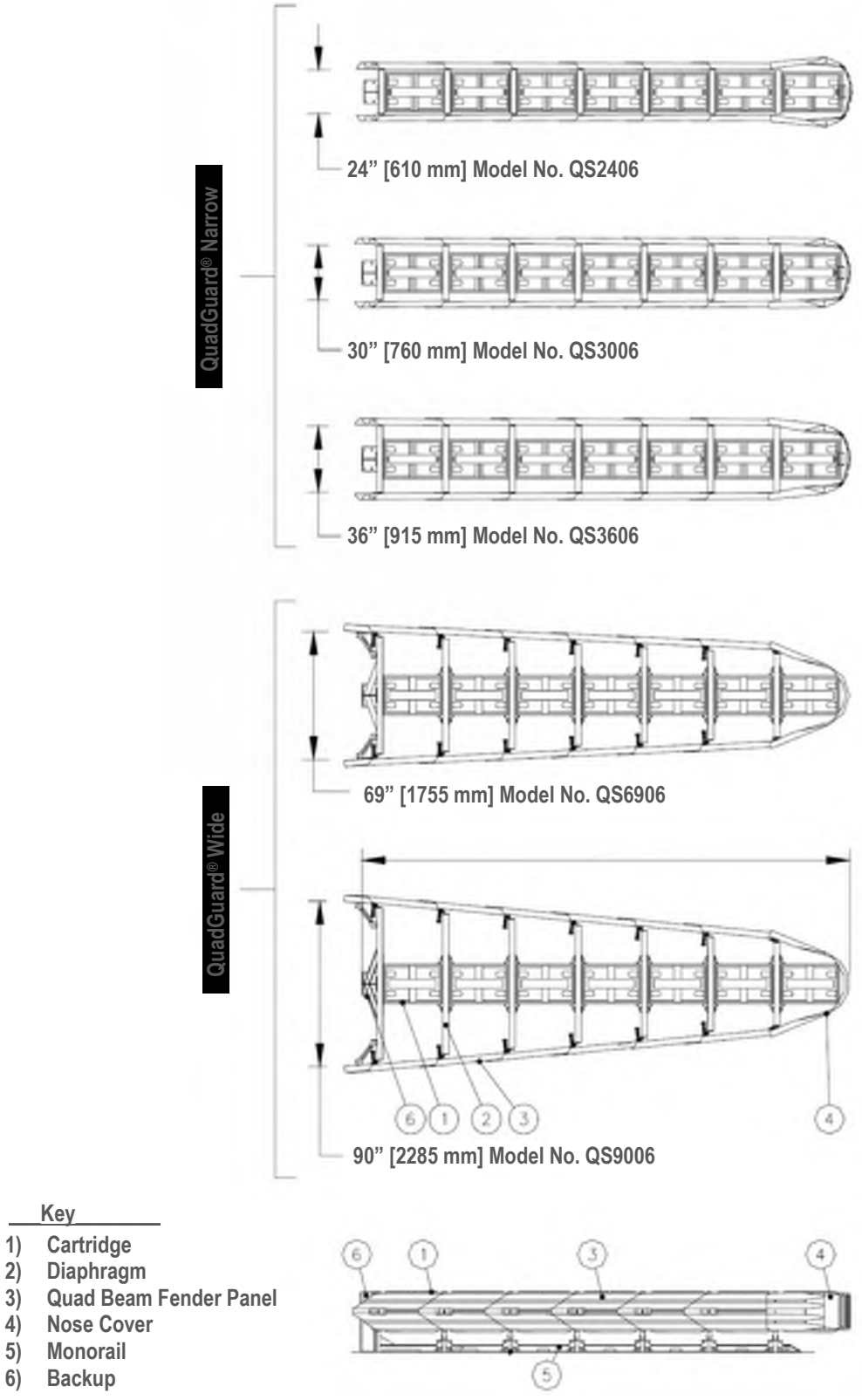
Warning: Shaded area denotes excessive decelerations based upon occupant risk recommendations outlined in NCHRP Report 350 for 4400 lb. [2000 kg] vehicles. Valtir does not recommend choosing systems from this area of the chart.

QuadGuard® Standard System Model Numbers					
Number of Bays	Nominal Width				
	24” [610 mm]	30” [760 mm]	36” [915 mm]	69” [1755 mm]	90” [2285 mm]
1	QS2401PG or Y	QS3001PG or Y	QS3601PG or Y	NA	NA
2	QS2402PG or Y	QS3002PG or Y	QS3602PG or Y	NA	NA
3	QS2403PG or Y	QS3003PG or Y	QS3603PG or Y	QS6903PG or Y	QS9003PG or Y
4	QS2404PG or Y	QS3004PG or Y	QS3604PG or Y	QS6904PG or Y	QS9004PG or Y
5	QS2405PG or Y	QS3005PG or Y	QS3605PG or Y	QS6905PG or Y	QS9005PG or Y
6	QS2406PG or Y	QS3006PG or Y	QS3606PG or Y	QS6906PG or Y	QS9006PG or Y

QuadGuard® Non-Standard System Model Numbers		
Number of Bays	Nominal Width	
	48” [1219 mm]	126” [3200 mm]
1	QN4801PG or Y	NA
2	QN4802PG or Y	NA
3	QN4803PG or Y	NA
4	QN4804PG or Y	NA
5	QN4805PG or Y	NA
6	QN4806PG or Y	QN12606PG or Y

Model Number Description





Key

1) Cartridge
2) Diaphragm
3) Quad Beam Fender Panel
4) Nose Cover
5) Monorail
6) Backup

Figure 5
Plan and Elevation (Six Bay System with Tension Strut Backup Shown)

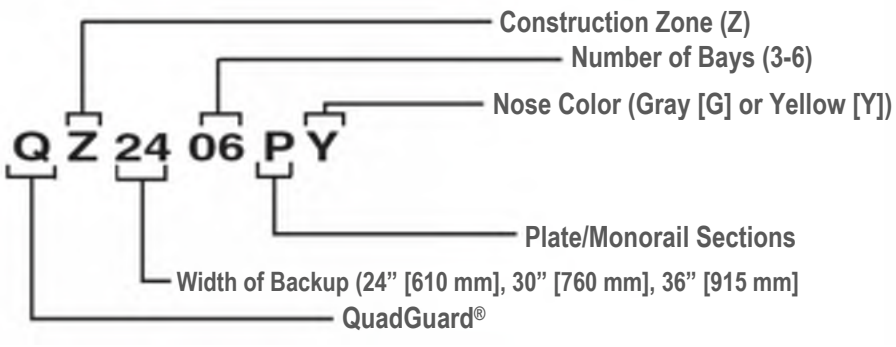
QuadGuard® CZ Design Criteria

This portable compact crash cushion is for construction zones. The QuadGuard® CZ is available in the same narrow sizes as permanent systems. Wide systems are not available.

The QuadGuard® CZ must be properly anchored. Reference the QuadGuard® Assembly Manual (PN 115348) for the recommended anchorage for various foundations.

QuadGuard® CZ Plate Model Numbers			
Number of Bays	Nominal Width		
	24" [610 mm]	30" [760 mm]	36" [915 mm]
3	QZ2403PG or Y	QZ3003PG or Y	QZ3603PG or Y
4	QZ2404PG or Y	QZ3004PG or Y	QZ3604PG or Y
5	QZ2405PG or Y	QZ3005PG or Y	QZ3605PG or Y
6	QZ2406PG or Y	QZ3006PG or Y	QZ3606PG or Y

Model Number Description



QuadGuard® CZ Table (Avg. G deceleration values)									
Bays	Effective Length	Design mph Velocity (kph)	25 (40)	31 (50)	37 (60)	44 (70)	50 (80)	56 (90)	62 (100)
6	20'-8" (6.30 m)	62 (100)	---	---	---	---	4.7	5.9	7.3 **(TL-3)**
5*	17'-8" (5.38 m)	56 (90)	---	---	---	4.2	5.5	7.0	8.6
4*	14'-8" (4.47 m)	50 (80)	---		3.7	5.1	6.6	8.4	10.4
3	11'-8" (3.56 m)	44 (70)	---	3.5	4.7	6.4 **(TL-2)**	8.3	10.5	---

***System capacity estimated through calculation.**

Average G deceleration values are based upon average values calculated for vehicles 1800 to 4400 lbs. (820 to 2000 kg) that stop in a distance equal to 85% of the systems length.

Warning: Shaded area denotes excessive decelerations based upon occupant risk recommendations outlined in NCHRP Report 350 for 4400 lb. (2000 kg) vehicles. Valtir does not recommend choosing systems from this area of the chart.

Transitioning

Quad-Beam End Shoe

Transition Panel

The Quad-Beam End Shoe Panel transitions the QuadGuard® to vertical faced concrete structures whether it is a concrete backup or concrete barrier wall (p.13). An Extended End Shoe is also available. In cases where the corners of the hazard are not chamfered it may be necessary to add wheel deflectors to the structure in order to prevent wheel interaction.

Quad-Beam to Guardrail Transition Panel (W-Beam and Thrie-Beam)

The Quad-Beam to W-Beam and Quad-Beam to Thrie-Beam Transition Panels transition the QuadGuard® to new and existing runs of standard guardrail (p.13).

Quad-Beam to Safety Barrier Transition Panel

There are several options available when transitioning the QuadGuard® system to safety shape barrier depending on the shape and position of the barrier.

When transitioning to barriers with a “New Jersey” style profile, the 4" offset transition panel is most commonly used (p.13). For transitioning to barriers that are in line with the side of the system, use transition assembly 354018L or R. For transitioning a wide system to barrier that runs parallel to the centerline of the system, transition assembly 354042L or R is used. A 9" offset transition panel is also available for transitioning to barriers that are in line with the side of the system.

When transitioning to Single Slope style barriers and parapets, 6” and 8” offset transition panels are available. For transitioning a wide system to Single Slope style barrier that runs parallel to the centerline of the system, a 6” offset Panel is available.

How do you determine the transition panel offset?

Transition Panel Offset is determined by measuring the distance between the face of the barrier and the top edge of the backup diaphragm at 32" above ground level (Figure 6). Remember, when installing the QuadGuard® system that the correct transition panel offset must be achieved in order for the offset bracket to nest between the barrier and transition panel ensuring proper transition performance.

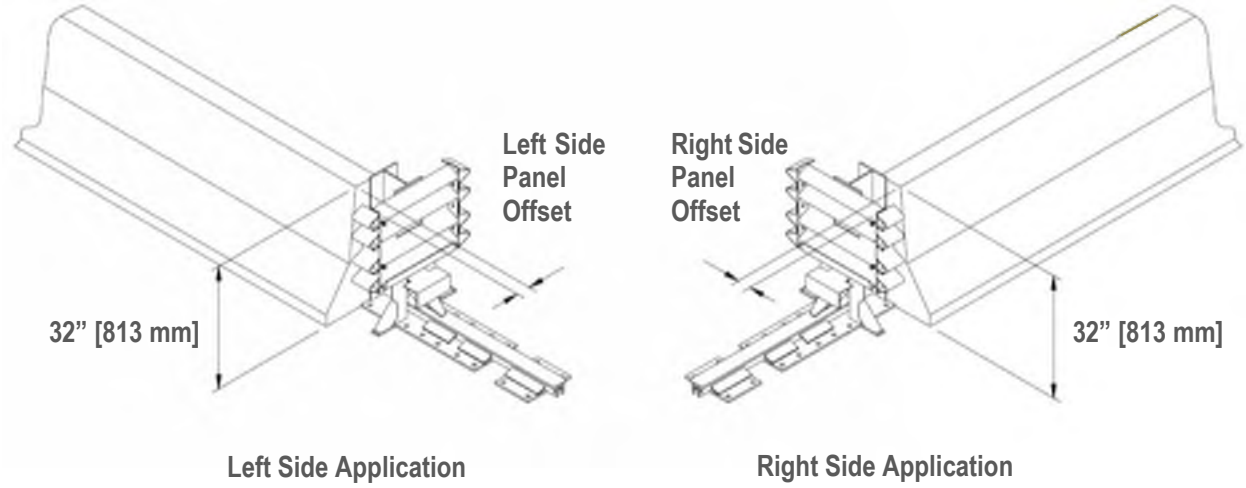


Figure 6
Transition Panel Offset

Transitions and Drawings

Note: The proper Transition Panel or Side Panel must be used for impact performance of the system. The correct Panel(s) to use will depend on traffic direction and roadside obstacle the QuadGuard® is shielding. Contact the Customer Service Department prior to deployment if you have any questions (p. 3).

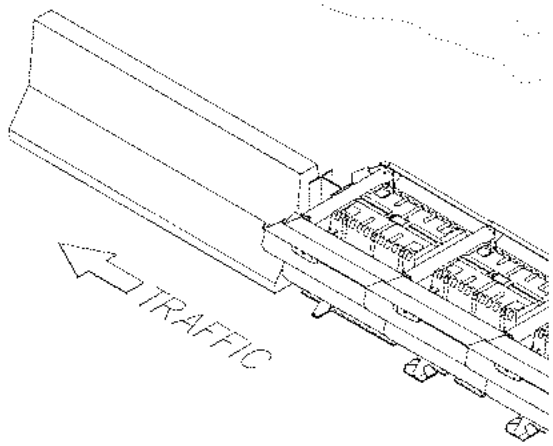


Figure 7
No Transition

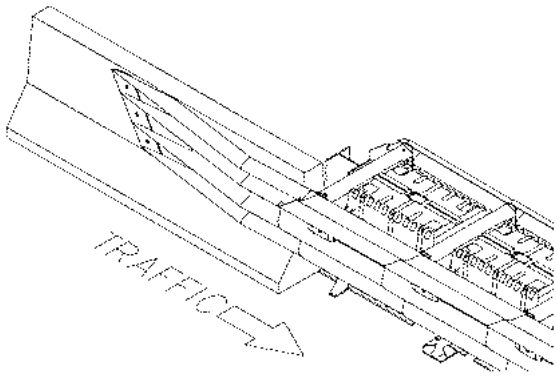


Figure 8
Quad-Beam to Safety Shape Barrier

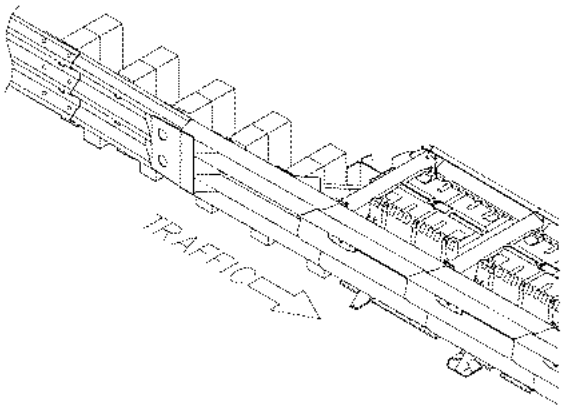


Figure 9
Quad-Beam to Thrie-Beam

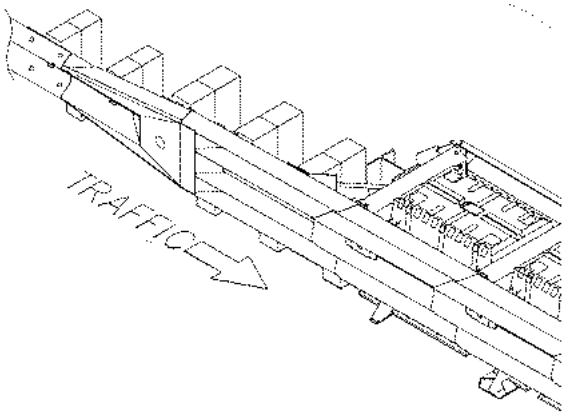


Figure 10
Quad-Beam to W-Beam

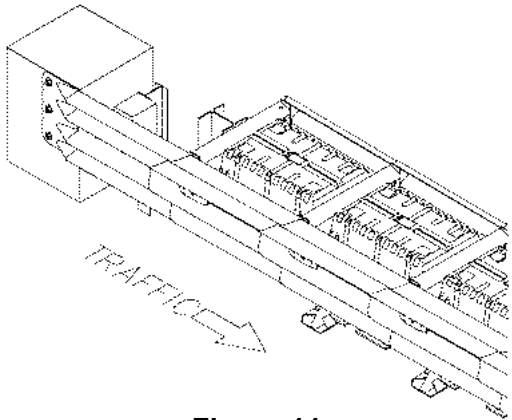
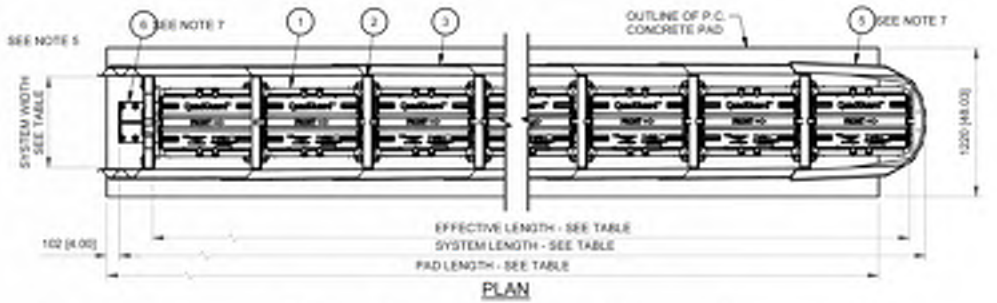
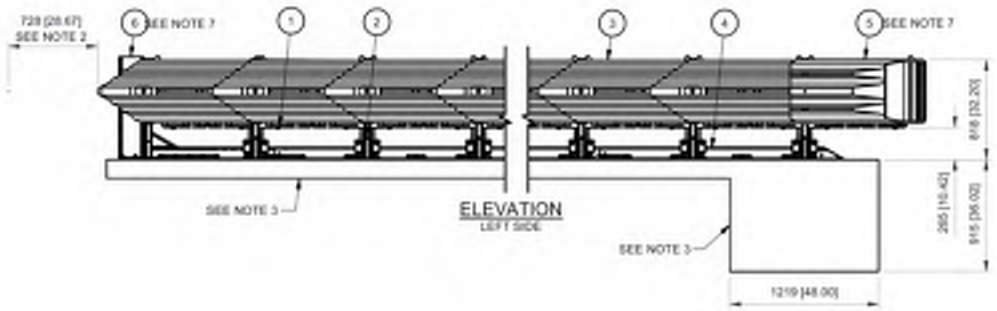


Figure 11
Quad-Beam End Shoe





NOTES:

1. IN COMPLIANCE WITH THE AASHTO 2011 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [30.00] MIN.
3. 150 [6.00] MIN. REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE PAD OR 200 [8.00] MIN. NON-REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE ROADWAY, MEASURING AT LEAST 3.66 m [12'-0"] WIDE BY 15.24 m [50'-0"] LONG. ANCHOR BLOCK IS NOT REQUIRED WHEN USING 8" CONCRETE PAD INSTALLED AGAINST AN IMMOVABLE STRUCTURE SUCH AS A CONCRETE WALL OR ABUTMENT.
4. SEE THE "QUADGUARD SYSTEM PRODUCT MANUAL", FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 323-6374.
5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES], UNLESS OTHERWISE NOTED.
7. BACKUP AND NOSE ASSEMBLIES NOT INCLUDED IN MODEL NUMBER. ORDER SEPARATELY.
8. THE NUMBER OF BAYS INDICATED IN THE TABLE IS BASED ON CALCULATED VALUES TO ENSURE ADEQUATE SYSTEM CAPACITY TO DISSIPATE THE LONGITUDINAL IMPACT ENERGY OF A 2000 kg VEHICLE TRAVELING AT THE SPEED INDICATED.
9. THE SIX BAY SYSTEM HAS BEEN FULLY TESTED AT 100 km/h UNDER THE FULL 8 TEST MATRIX OF NCHRP 350 TL-3.

* G=GRAY OR Y=YELLOW

BAYS	610 [24"] WIDE MODEL #	762 [30"] WIDE MODEL #	914 [36"] WIDE MODEL #	SYSTEM LENGTH m	SYSTEM LENGTH ft-in	EFFECTIVE LENGTH m	EFFECTIVE LENGTH ft-in	PAD LENGTH m	PAD LENGTH ft-in	MAX DESIGN SPEED km/h [MPH]	# OF CARTRIDGES TYPE I	# OF CARTRIDGES TYPE II
1	QS2401*	QS3001*	QS3601*	2.16	[7'-1"]	1.73	[5'-8"]	2.74	[9'-0"]	40 [25]	2	0
2	QS2402*	QS3002*	QS3602*	3.08	[10'-1"]	2.64	[8'-8"]	2.74	[9'-0"]	60 [37]	2	1
3	QS2403*	QS3003*	QS3603*	4.00	[13'-1"]	3.56	[11'-8"]	3.66	[12'-0"]	70 [44]	3	1
4	QS2404*	QS3004*	QS3604*	4.90	[16'-1"]	4.47	[14'-8"]	4.57	[15'-0"]	80 [50]	3	2
5	QS2405*	QS3005*	QS3605*	5.83	[19'-1"]	5.38	[17'-8"]	5.49	[18'-0"]	90 [56]	4	2
6	QS2406*	QS3006*	QS3606*	6.74	[22'-1"]	6.30	[20'-8"]	6.40	[21'-0"]	100 [62]	4	3

UNIDIRECTIONAL

KEY

1. CARTRIDGE
2. DIAPHRAGM
3. FENDER PANEL
4. MONORAIL
5. NOSE ASSEMBLY
6. BACKUP
7.
8.
9.
10.
11.
12.

REFERENCES

SERIAL NO.
SALES ORDER
EH PROJECT
DESIGN SPEED SEE TABLE
NOSE TYPE
NO. OF UNITS

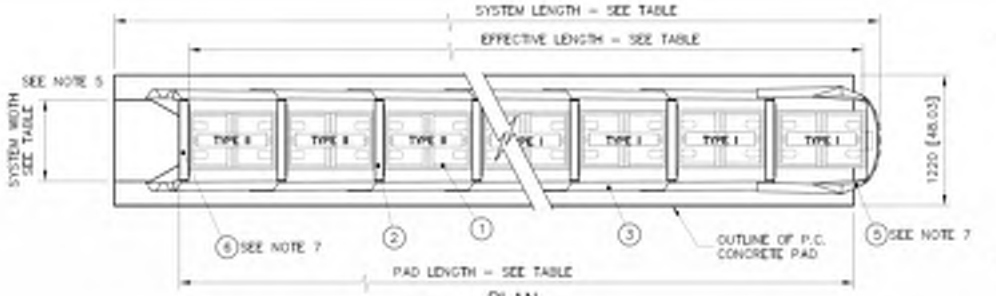
DIAPHRAGM ASSY.	625650
NOSE ASSY.	35-40-05
FENDER PANEL ASSY.	608236
BACKUP ASSY.	604570
MONORAIL ASSY.	35-40-06
CONCRETE PAD	35-40-11
TRANSITION ASSY.	N/A
WHEEL DEFLECTOR ASSY.	N/A

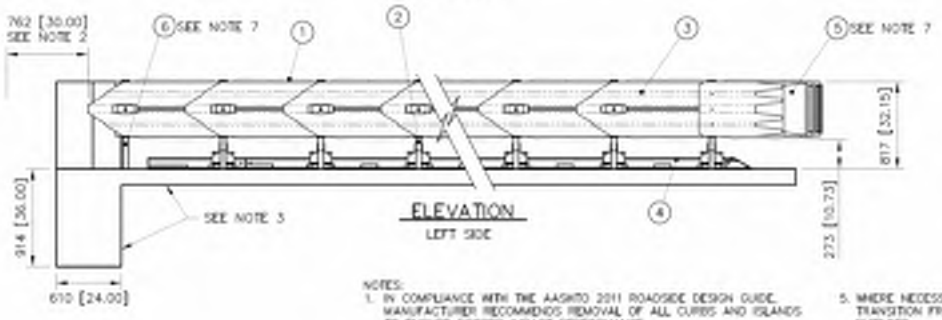
DRAWN	S. LEWIS	DATE	3/21/1996
CHECKED	J. MACHADO	DATE	6/7/1996
DRAWING NO.	SEE TABLE		
FILE	QSTSCVR-U.idw		
	DO NOT SCALE DRAWING		

QUADGUARD® SYSTEM
WITH TENSION STRUT BACKUP

QSTSCVR-U | REV. L | SHEET 1 of 1

[redacted]





NOTES:
1. IN COMPLIANCE WITH THE AASHTO 2011 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [30.00] MIN.
3. 150 [6.00] MIN. REINFORCED 28 MPa (4000 PSI) P.C. CONCRETE PAD OR 200 [8.00] MIN. NON-REINFORCED 28 MPa (4000 PSI) P.C. CONCRETE ROADWAY, MEASURING AT LEAST 3.66 m [12'-0"] WIDE BY 15.24 m [50'-0"] LONG. ANCHOR BLOCK IS NOT REQUIRED WHEN USING 6" CONCRETE PAD INSTALLED AGAINST AN IMMOVABLE STRUCTURE SUCH AS A CONCRETE WALL OR ABUTMENT.
4. SEE THE "QUADGUARD SYSTEM PRODUCT MANUAL", FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 533-6374.
5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD TO THE OBJECT BEING SHIELDED.
6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES], UNLESS OTHERWISE NOTED.
7. BACKUP AND NOSE ASSEMBLIES NOT INCLUDED IN MODEL NUMBER. ORDER SEPARATELY.
8. THE NUMBER OF BAYS INDICATED IN THE TABLE IS BASED ON CALCULATED VALUES TO ENSURE ADEQUATE SYSTEM CAPACITY TO DISSIPATE THE LONGITUDINAL IMPACT ENERGY OF A 2000 kg VEHICLE TRAVELING AT THE SPEED INDICATED.
9. THE SIX BAY SYSTEM HAS BEEN FULLY TESTED AT 100 km/h UNDER THE FULL 8 TEST MATRIX OF NCHRP 350 TL-3.

* G = GREY or Y = YELLOW

BAYS	G=[X] WIDTH MODEL #	Y=[X] WIDTH MODEL #	R=[X] WIDTH MODEL #	SYSTEM LENGTH m	SYSTEM LENGTH ft-in	EFFECTIVE LENGTH m	EFFECTIVE LENGTH ft-in	PAD LENGTH m	PAD LENGTH ft-in	MAX DESIGN SPEED km/h [MPH]	# OF CARTRIDGES TYPE I	# OF CARTRIDGES TYPE II
1	QS2401*	QS3001*	QS3601*	2.59	[8'-6"]	1.73	[5'-8"]	1.68	[5'-6"]	40 [25]	2	0
2	QS2402*	QS3002*	QS3602*	3.51	[11'-6"]	2.64	[8'-8"]	2.59	[8'-6"]	60 [37]	2	1
3	QS2403*	QS3003*	QS3603*	4.42	[14'-6"]	3.56	[11'-8"]	3.51	[11'-6"]	70 [44]	3	1
4	QS2404*	QS3004*	QS3604*	5.33	[17'-6"]	4.47	[14'-8"]	4.42	[14'-6"]	80 [50]	3	2
5	QS2405*	QS3005*	QS3605*	6.25	[20'-6"]	5.38	[17'-8"]	5.33	[17'-6"]	90 [56]	4	2
6	QS2406*	QS3006*	QS3606*	7.16	[23'-6"]	6.30	[20'-8"]	6.25	[20'-6"]	100 [62]	4	3

UNIDIRECTIONAL

KEY

1 QUADGUARD CARTRIDGE	7
2 DIAPHRAGM	8
3 FENDER PANEL	9
4 MONORAIL	10
5 NOSE ASSEMBLY	11
6 BACKUP	12

REFERENCES

SERIAL NO.		DIAPHRAGM ASSY.	625650
SALES ORDER		NOSE ASSY.	35-40-05
EH PROJECT		FENDER PANEL ASSY.	608236
DESIGN SPEED	SEE CHART ABOVE	BACKUP ASSY.	35-40-08, 604507
NOSE TYPE		MONORAIL ASSY.	35-40-06
NO. OF UNITS		CONCRETE PAD	35-40-09
		TRANSITION ASSY.	N/A
		WHEEL DEFLECTOR ASSY.	N/A

T. BUSSE	8/08/96	SEE CHART	
J. MACHADO	8/13/96	QSCBCVR-U.DWG	
		DO NOT SCALE DRAWING	

QUADGUARD® SYSTEM
W/ CONCRETE BACKUP

QSCBCVR-U | M | 1 of 1

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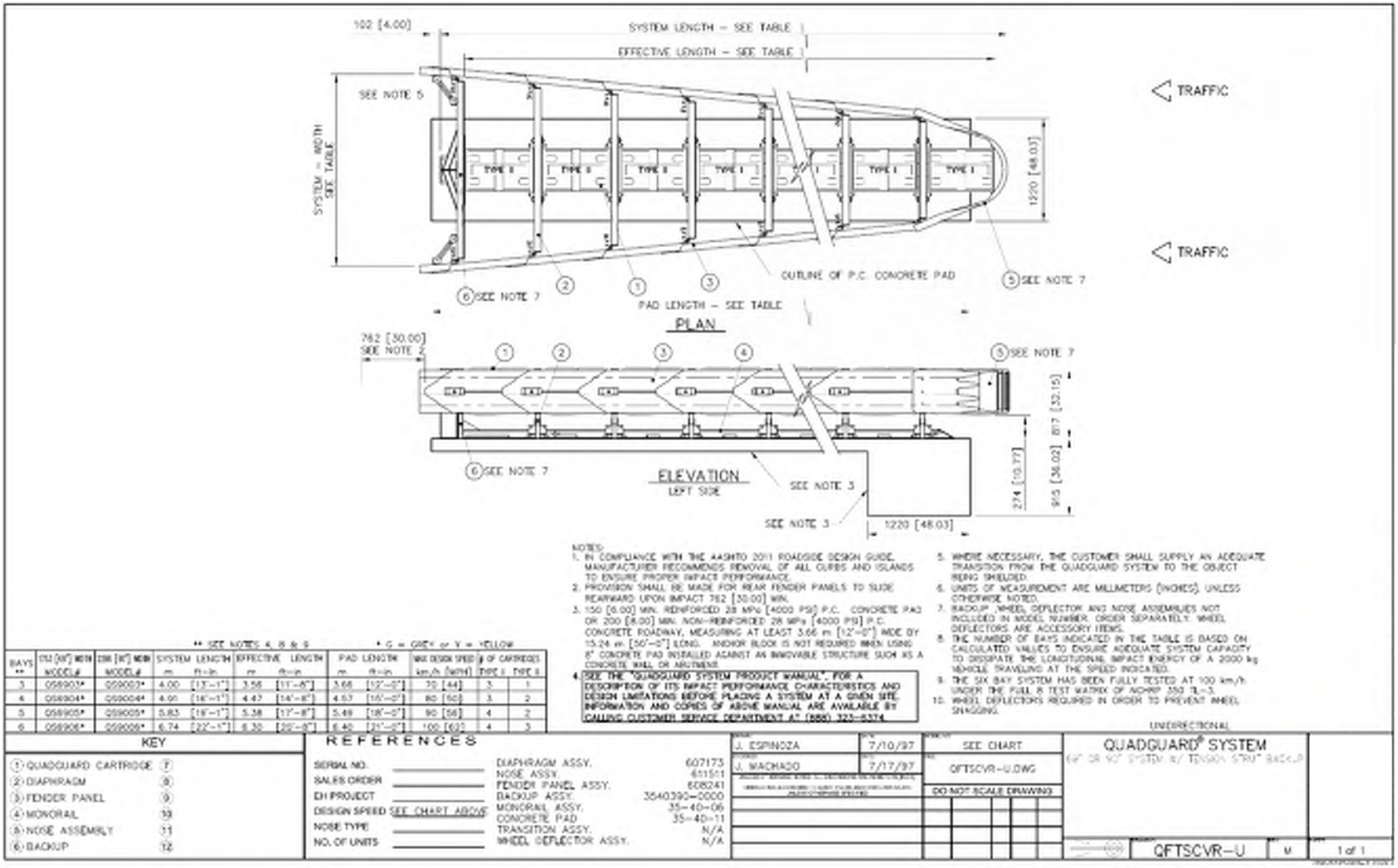

NOTES:
1. IN COMPLIANCE WITH THE AASHTO 2011 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [30.00] MIN.
3. 150 [6.00] MIN. REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE PAD OR 200 [8.00] MIN. NON-REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE ROADWAY, MEASURING AT LEAST 3.66 m [12'-0"] WIDE BY 15.24 m [50'-0"] LONG. ANCHOR BLOCK IS NOT REQUIRED WHEN USING 8" CONCRETE PAD INSTALLED AGAINST AN IMMOVABLE STRUCTURE SUCH AS A CONCRETE WALL OR ABUTMENT.
4. SEE THE "QUADGUARD SYSTEM PRODUCT MANUAL", FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 323-6374.
5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES], UNLESS OTHERWISE NOTED.
7. BACKUP, WHEEL DEFLECTOR AND NOSE ASSEMBLIES NOT INCLUDED IN MODEL NUMBER. ORDER SEPARATELY. WHEEL DEFLECTORS ARE ACCESSORY ITEMS.
8. THE NUMBER OF BAYS INDICATED IN THE TABLE IS BASED ON CALCULATED VALUES TO ENSURE ADEQUATE SYSTEM CAPACITY TO DISSIPATE THE LONGITUDINAL IMPACT ENERGY OF A 2000 kg VEHICLE TRAVELING AT THE SPEED INDICATED.
9. THE SIX BAY SYSTEM HAS BEEN FULLY TESTED AT 100 km/h UNDER THE FULL 8 TEST MATRIX OF NCHRP 350 TL-3.
10. WHEEL DEFLECTORS REQUIRED IN ORDER TO PREVENT WHEEL SNAGGING.

UNIDIRECTIONAL

** SEE NOTES 4, 8 & 9 — * G = GREY or Y = YELLOW

BAYS **	762 [30"] WIDTH MODEL #	1016 [40"] WIDTH MODEL #	SYSTEM LENGTH m	SYSTEM LENGTH ft-in	EFFECTIVE LENGTH m	EFFECTIVE LENGTH ft-in	PAD LENGTH m	PAD LENGTH ft-in	MAX DESIGN SPEED km/h [MPH]	# OF CARTRIDGES TYPE I	# OF CARTRIDGES TYPE II
5	059903*	059003*	4.00	[13'-1"]	3.56	[11'-8"]	3.66	[12'-0"]	70 [44]	3	1
4	059904*	059004*	4.00	[16'-1"]	4.47	[14'-8"]	4.63	[15'-0"]	80 [50]	3	2
5	059905*	059005*	5.83	[19'-1"]	5.38	[17'-8"]	5.49	[18'-0"]	90 [56]	4	2
6	059906*	059006*	6.74	[22'-1"]	6.30	[20'-8"]	6.40	[21'-0"]	100 [62]	4	3

KEY

①	QUADGUARD CARTRIDGE	⑦	
②	DIAPHRAGM	⑧	
③	FENDER PANEL	⑨	
④	MONORAIL	10	
⑤	NOSE ASSEMBLY	11	
⑥	BACKUP	12	

REFERENCES

SERIAL NO.		DIAPHRAGM ASSY.	607173
SALES ORDER		NOSE ASSY.	651511
EH PROJECT		FENDER PANEL ASSY.	608241
DESIGN SPEED	SEE CHART ABOVE	BACKUP ASSY.	3540390-0000
NOSE TYPE		MONORAIL ASSY.	35-40-06
NO. OF UNITS		CONCRETE PAD	35-40-11
		TRANSITION ASSY.	N/A
		WHEEL DEFLECTOR ASSY.	N/A

J. ESPINOZA	7/10/97	SEE CHART	QUADGUARD® SYSTEM
J. MACHADO	7/17/97	QFTSCVR-U.DWG	(40" OR 90" SYSTEM W/ TENSION STRUT BACKUP)
		DO NOT SCALE DRAWING	
		QFTSCVR-U	M — 1 of 1

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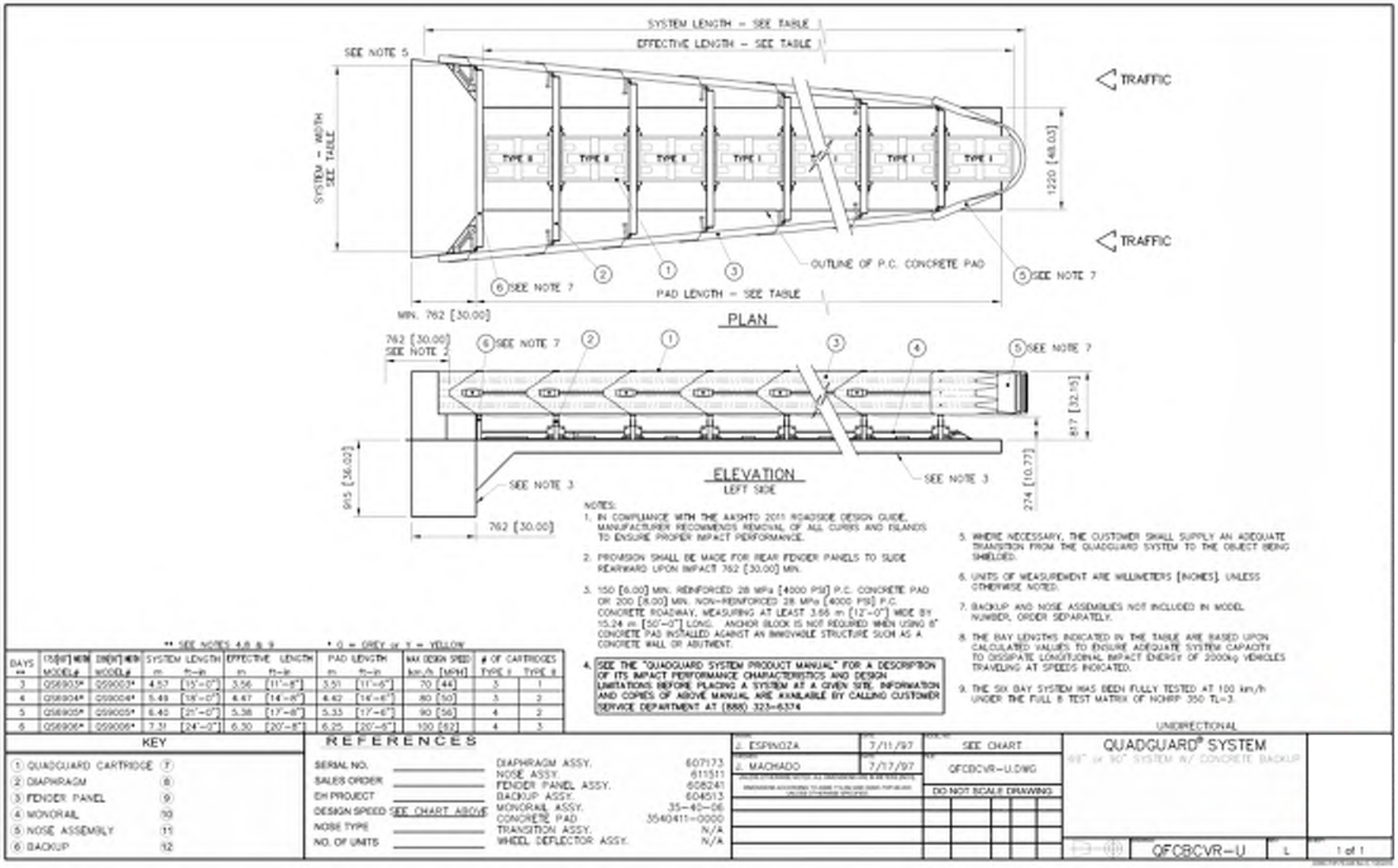

NOTES:

1. IN COMPLIANCE WITH THE AASHTO 2011 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [30.00] MIN.
3. 150 [6.00] MIN. REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE PAD OR 200 [8.00] MIN. NON-REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE ROADWAY, MEASURING AT LEAST 3.66 m [12'-0"] WIDE BY 15.24 m [50'-0"] LONG. ANCHOR BLOCK IS NOT REQUIRED WHEN USING 6" CONCRETE PAD INSTALLED AGAINST AN IMMOVABLE STRUCTURE SUCH AS A CONCRETE WALL OR ABUTMENT.
4. SEE THE "QUADGUARD SYSTEM PRODUCT MANUAL" FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 323-6374.
5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES], UNLESS OTHERWISE NOTED.
7. BACKUP AND NOSE ASSEMBLIES NOT INCLUDED IN MODEL NUMBER, ORDER SEPARATELY.
8. THE BAY LENGTHS INDICATED IN THE TABLE ARE BASED UPON CALCULATED VALUES TO ENSURE ADEQUATE SYSTEM CAPACITY TO DISSIPATE LONGITUDINAL IMPACT ENERGY OF 2000kg VEHICLES TRAVELING AT SPEEDS INDICATED.
9. THE SIX BAY SYSTEM WAS BEEN FULLY TESTED AT 100 km/h UNDER THE FULL 8 TEST MATRIX OF NCHRP 350 TL-3.

UNIDIRECTIONAL

** SEE NOTES 4,8 & 9 — * 0 = GREY or 1 = YELLOW

BAYS **	[IMPERIAL] MODEL #	[METRIC] MODEL #	SYSTEM LENGTH m	SYSTEM LENGTH ft-in	EFFECTIVE LENGTH m	EFFECTIVE LENGTH ft-in	PAD LENGTH m	PAD LENGTH ft-in	MAX DESIGN SPEED km/h [MPH]	# OF CARTRIDGES TYPE I	# OF CARTRIDGES TYPE II
3	QSI6903*	QS9003*	4.57	[15'-0"]	3.56	[11'-8"]	5.51	[11'-6"]	70 [44]	3	1
4	QSI6904*	QS9004*	5.48	[18'-0"]	4.47	[14'-8"]	6.42	[14'-6"]	80 [50]	3	2
5	QSI6905*	QS9005*	6.40	[21'-0"]	5.38	[17'-8"]	5.33	[17'-6"]	90 [56]	4	2
6	QSI6906*	QS9006*	7.31	[24'-0"]	6.30	[20'-8"]	6.25	[20'-6"]	100 [62]	4	3

KEY

1	QUADGUARD CARTRIDGE	7	
2	DIAPHRAGM	8	
3	FENDER PANEL	9	
4	MONORAIL	10	
5	NOSE ASSEMBLY	11	
6	BACKUP	12	

REFERENCES

SERIAL NO. _____
SALES ORDER _____
EH PROJECT _____
DESIGN SPEED SEE CHART ABOVE
NOSE TYPE _____
NO. OF UNITS _____

DIAPHRAGM ASSY.	607173
NOSE ASSY.	611511
FENDER PANEL ASSY.	608241
BACKUP ASSY.	604513
MONORAIL ASSY.	35-40-06
CONCRETE PAD	3540411-0000
TRANSITION ASSY.	N/A
WHEEL DEFLECTOR ASSY.	N/A

J. ESPINOZA	7/11/97	SEE CHART	QUADGUARD® SYSTEM
J. MACHADO	7/17/97	QFCBCVR-U.DWG	66" or 90" SYSTEM W/ CONCRETE BACKUP
		DO NOT SCALE DRAWING	
		QFCBCVR-U	L — 1 of 1

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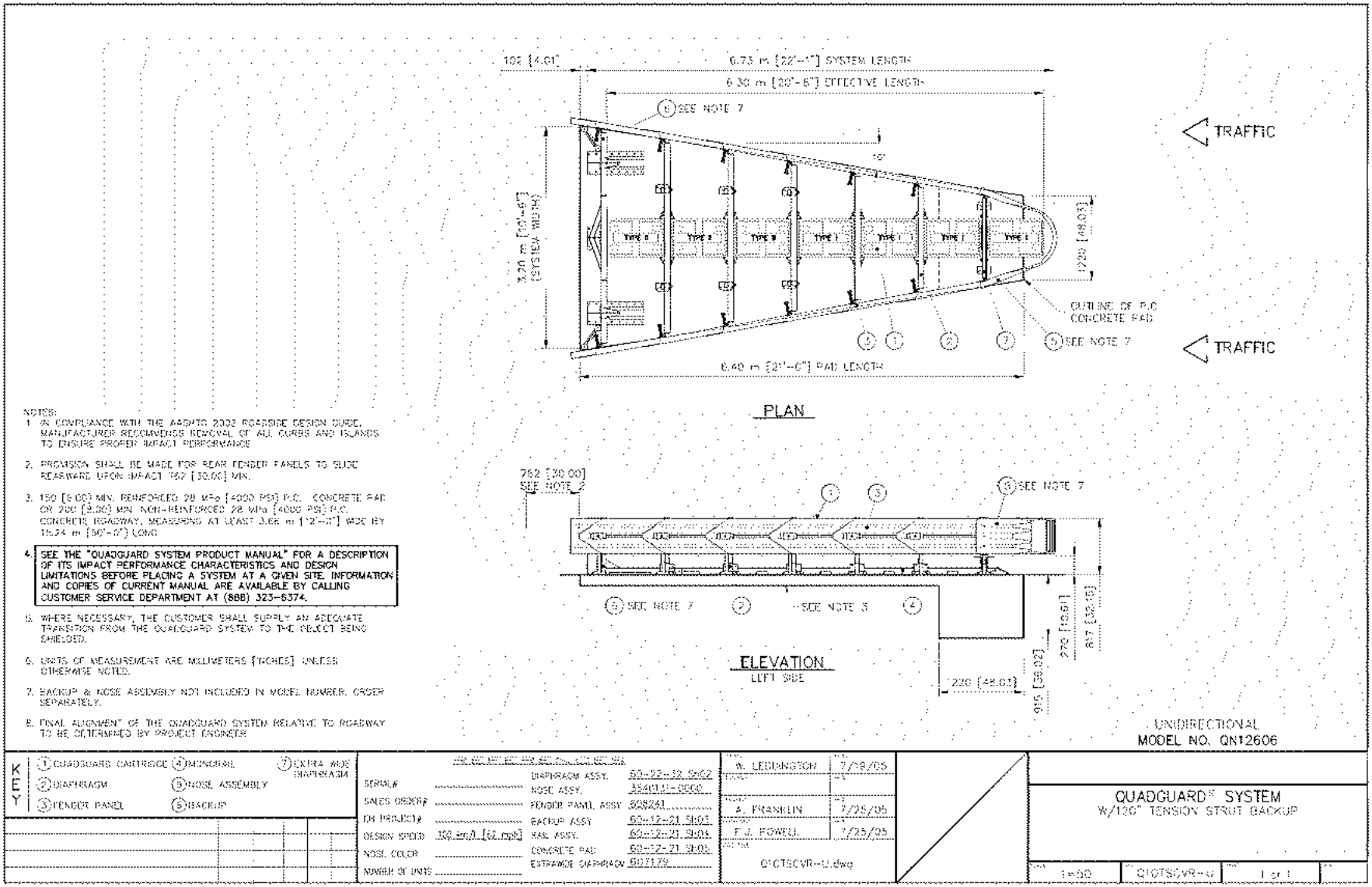

NOTES:
1. IN COMPLIANCE WITH THE AASHTO 2002 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE
2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [30.00] MIN.
3. 150 [6.00] MIN. REINFORCED 28 MPa [4060 PSI] P.C. CONCRETE PAD OR 200 [8.00] MIN. NON-REINFORCED 28 MPa [4060 PSI] P.C. CONCRETE ROADWAY, MEASURING AT LEAST 3.66 m [12'-0"] WIDE BY 15.24 m [50'-0"] LONG
4. SEE THE "QUADGUARD SYSTEM PRODUCT MANUAL" FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF CURRENT MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 323-6374.
5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
7. BACKUP & NOSE ASSEMBLY NOT INCLUDED IN MODEL NUMBER. ORDER SEPARATELY.
8. FINAL ALIGNMENT OF THE QUADGUARD SYSTEM RELATIVE TO ROADWAY TO BE DETERMINED BY PROJECT ENGINEER

KEY
1. QUADGUARD CARTRIDGE
2. DIAPHRAGM
3. FENDER PANEL
4. MONORAIL
5. NOSE ASSEMBLY
6. BACKUP
7. EXTRA NOSE DIAPHRAGM

SERIAL#		DIAPHRAGM ASSY.	60-22-32.9662
SALES ORDER#		NOSE ASSY.	35403.01-0000
OR PROJECT#		FENDER PANEL ASSY	6082A1
DESIGN SPEED	100 km/h [62 mph]	BACKUP ASSY	60-12-21.9805
NOSE COLOR		RAIL ASSY.	60-12-21.9804
NUMBER OF UNITS		CONCRETE PAD	60-12-21.9803
		EXTRA NOSE DIAPHRAGM	60211.79

DRAWN	W. LEDDINGTON	7/19/05
CHECKED		
ENGINEER	A. FRANKLIN	7/25/05
PROJ. MGR.	F.J. POWELL	7/25/05
FILE NAME	QTOTSCVR-U.dwg	

QUADGUARD® SYSTEM
W/120" TENSION STRUT BACKUP

SCALE: 1:100	QTOTSCVR-U	SHEET 1 of 1

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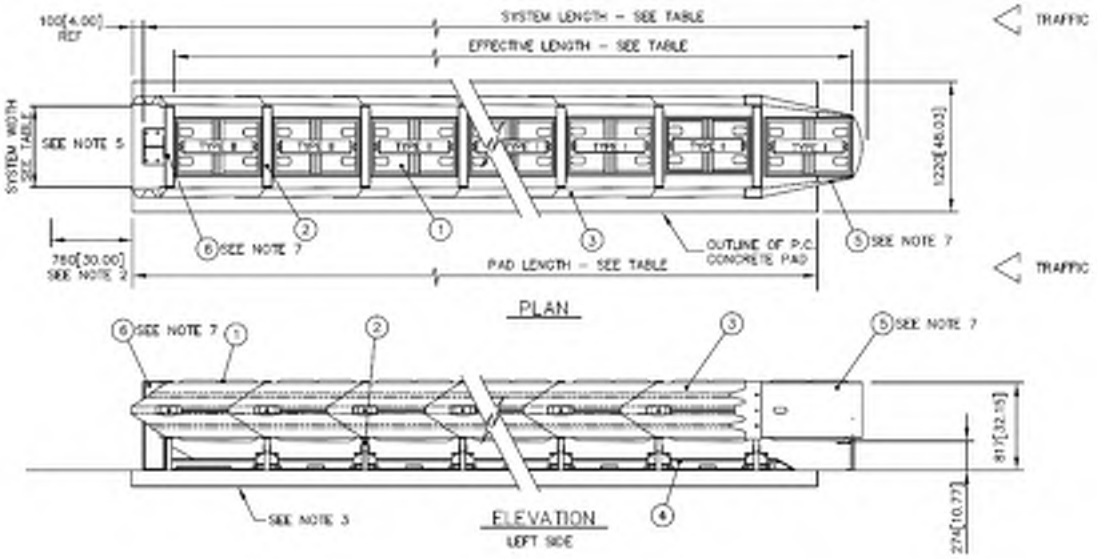

NOTES:
1. IN COMPLIANCE WITH THE AASHTO 2011 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 750 [30.00] MIN.
3. CAUTION: THE QUADGUARD C.Z. MUST BE CORRECTLY ANCHORED FOR PROPER IMPACT PERFORMANCE.
   ATTACH SYSTEM USING ONE OF THE FOLLOWING:
   — 7" STUDS MAY BE USED TO ATTACH SYSTEM TO 28 MPa(4000 PSI) MIN. P.C. CONCRETE PER THE FOLLOWING MINIMUMS **
     a) 150[6.00] NON REINFORCED ROADWAY OR PAD
     b) 200[8.00] REINFORCED PORTABLE PAD PER THE REFERENCE DETAIL
     c) 150[7.00] DECK STRUCTURE
   — 1" THREADED RODS MAY BE USED TO INSTALL SYSTEM ON ASPHALT **
   **REFER TO THE QUADGUARD CZ MP-3 ANCHORING SYSTEM INSTALLATION INSTRUCTIONS FOR SPECIFICATIONS.
4. SEE THE "QUADGUARD SYSTEM PRODUCT MANUAL", FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 323-6374.
5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY A TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
7. NOSE AND BACKUP ASSEMBLIES NOT INCLUDED IN MODEL NUMBER. ORDER SEPARATELY.

* C = GREY or Y = YELLOW

BAYS	MODEL#	MODEL#	MODEL#	SYSTEM LENGTH m	SYSTEM LENGTH ft-in	EFFECTIVE LENGTH m	EFFECTIVE LENGTH ft-in	PAD LENGTH m	PAD LENGTH ft-in	MAX DESIGN SPEED km/h [MPH]	# OF CARTRIDGES TYPE I	# OF CARTRIDGES TYPE II
3	QZ2403*	QZ3003*	QZ3603*	4.00	[13'-1"]	3.56	[11'-8"]	4.57	[15'-0"]	70 [44]	3	1
4	QZ2404*	QZ3004*	QZ3604*	4.90	[16'-1"]	4.47	[14'-8"]	4.57	[15'-0"]	80 [50]	3	2
5	QZ2405*	QZ3005*	QZ3605*	5.82	[19'-1"]	5.38	[17'-8"]	5.49	[18'-0"]	90 [56]	4	2
6	QZ2406*	QZ3006*	QZ3606*	6.74	[22'-1"]	6.30	[20'-8"]	6.40	[21'-0"]	100 [62]	4	3

UNIDIRECTIONAL

KEY

① QG CARTRIDGE
② DIAPHRAGM
③ FENDER PANEL
④ MONORAIL
⑤ NOSE ASSEMBLY
⑥ C.Z. BACKUP

REFERENCES

SERIAL#		PORTABLE CON. PAD	35-40-10
SALES ORDER#		DIAPHRAGM ASSY.	635650
EX PROJECT#		NOSE ASSY.	35-40-SYS
DESIGN SPEED	SEE TABLE	FENDER PANNEL ASSY.	635675
NOSE COLOR		RAIL ASSY.	35-40-06
NUMBER OF UNITS		C.Z. BACKUP ASSY.	35-40-10
		C.Z. KIT	35-40-24
		TRANSITION PANEL	N/A
		PORT. BARRIER ANC.	612006

S. TRAGESER	06/14/96	SEE TABLE	QUADGUARD® C.Z. SYSTEM				
J. MACHADO	06/17/96	QSCZCVR-U.dwg	FOR CONSTRUCTION ZONES				
		DO NOT SCALE DRAWING					
CORRECTED NOTE 7	5/7/14	9/30/19	Q	JMS	ROI	QSCZCVR-U	Q	1 of 1

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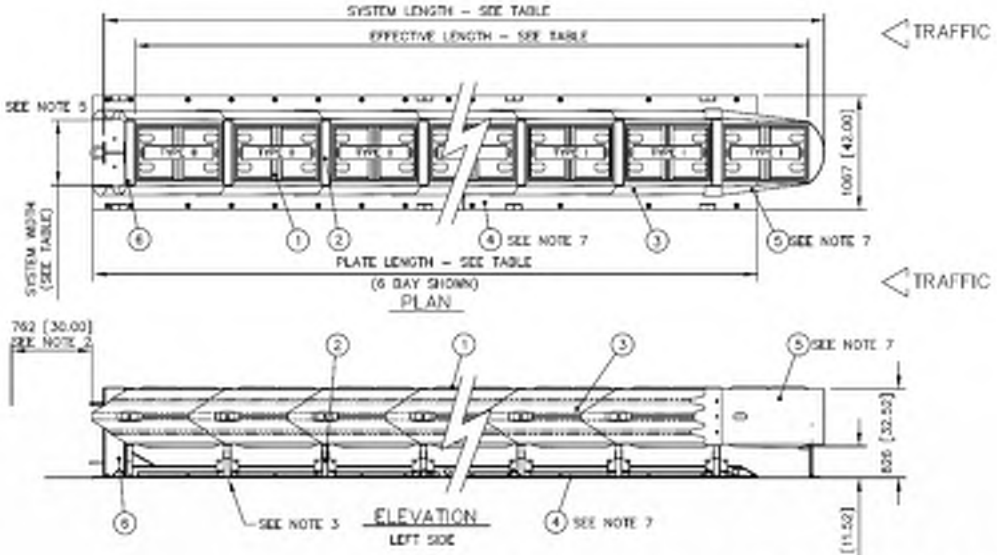

NOTES:
1. IN COMPLIANCE WITH THE AASHTO 2011 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [30.00] MIN.
3. CAUTION: THE QUADGUARD C.Z. MUST BE CORRECTLY ANCHORED FOR PROPER IMPACT PERFORMANCE.
   ATTACH SYSTEM USING ONE OF THE FOLLOWING:
   — 7" STUDS MAY BE USED TO ATTACH SYSTEM TO 28 MPa[4000 PSI] MIN. P.C. CONCRETE PER THE FOLLOWING MINIMUMS: **
     a) 150[6.00] NON REINFORCED ROADWAY OR PAD
     b) 180[7.00] DECK STRUCTURE
   — 1" THREADED RODS MAY BE USED TO INSTALL SYSTEM ON ASPHALT.**
   **REFER TO THE QUADGUARD CZ MP-3 ANCHORING SYSTEM SECTION OF THE "QUADGUARD INSTALLATION MANUAL".
4. SEE THE "QUADGUARD SYSTEM PRODUCT MANUAL", FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 323-6374.
5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
7. NOSE AND ANCHOR ASSEMBLIES NOT INCLUDED IN MODEL NUMBER. ORDER SEPARATELY.

* G = GREY or Y = YELLOW

BAYS	[24] MODEL #	[30] MODEL #	[36] MODEL #	SYSTEM LENGTH m	SYSTEM LENGTH ft-in	EFFECTIVE LENGTH m	EFFECTIVE LENGTH ft-in	PLATE LENGTH m	PLATE LENGTH ft-in	100 DESIGN SPEED km/h [MPH]	# OF CARTRIDGES TYPE I	# OF CARTRIDGES TYPE II
3	022403P*	023003P*	023603P*	4.00	[13'-1"]	3.56	[11'-8"]	3.43	[11'-3"]	70 [44]	3	1
4	022404P*	023004P*	023604P*	4.90	[16'-1"]	4.47	[14'-8"]	4.35	[14'-3"]	80 [50]	3	2
5	022405P*	023005P*	023605P*	5.82	[19'-1"]	5.38	[17'-8"]	5.26	[17'-3"]	90 [56]	4	2
6	022406P*	023006P*	023606P*	6.74	[22'-1"]	6.30	[20'-8"]	6.17	[20'-3"]	100 [62]	4	3

BIDIRECTIONAL

KEY

① QG CARTRIDGE
② DIAPHRAGM
③ FENDER PANEL
④ MONORAIL
⑤ NOSE ASSEMBLY
⑥ C.Z. BACKUP

REFERENCES

SERIAL#
SALES ORDER#
QA PROJECT#
DESIGN SPEED: SEE TABLE
NOSE COLOR
NUMBER OF UNITS

DIAPHRAGM ASSY.	025650
NOSE ASSY.	35-40-40
FENDER PANEL ASSY.	608036
C.Z. BACKUP/PLATE	604482
LIFTING KIT	35-40-23
ANCHOR	603652
*QTY. 1 ANCHOR ASSY.	612006

L. CORKEN	03/26/03	SEE TABLE	QUADGUARD® C.Z. SYSTEM ON A PLATE
R. PROUCHER	03/27/03	QPCZOVR-U.dwg	FOR CONSTRUCTION ZONES
		DO NOT SCALE DRAWING	
		QPCZOVR-U	1 of 1

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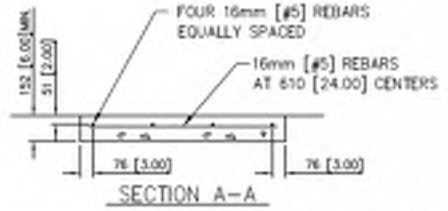
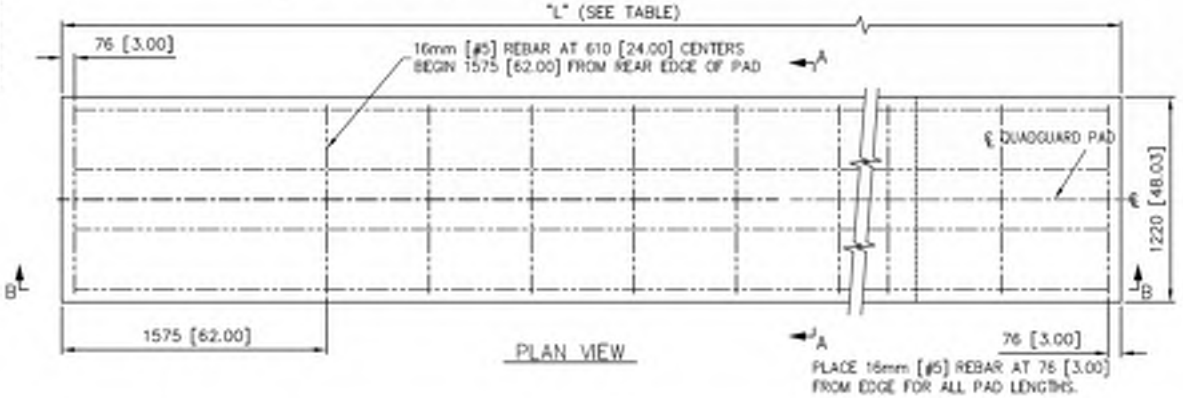
TABLE					YARDS OF CONCRETE IN PAD	
NO. OF BAYS	"L" (PAD LENGTH) [m]	"L" (PAD LENGTH) [ft-in]	REBAR REQUIRED [m]	REBAR REQUIRED [ft-in]	m^3 [YARDS^3]	
1	2.74	[9'-0"]	14.83	[48'-8"]	1.59	[2.1]
2	2.74	[9'-0"]	14.83	[48'-8"]	1.59	[2.1]
3	3.66	[12'-0"]	20.73	[68'-0"]	1.82	[2.4]
4	4.57	[15'-0"]	25.50	[83'-8"]	1.97	[2.6]
5	5.49	[18'-0"]	31.39	[103'-0"]	2.12	[2.8]
6	6.40	[21'-0"]	36.17	[118'-8"]	2.35	[3.1]
7	7.32	[24'-0"]	42.06	[138'-0"]	2.51	[3.3]
8	8.23	[27'-0"]	46.84	[153'-8"]	2.66	[3.5]
9	9.14	[30'-0"]	52.73	[173'-0"]	2.81	[3.7]
10	10.06	[33'-0"]	57.51	[188'-8"]	3.04	[4.0]
11	10.97	[36'-0"]	63.40	[208'-0"]	3.19	[4.2]
12	11.89	[39'-0"]	68.17	[223'-8"]	3.35	[4.4]

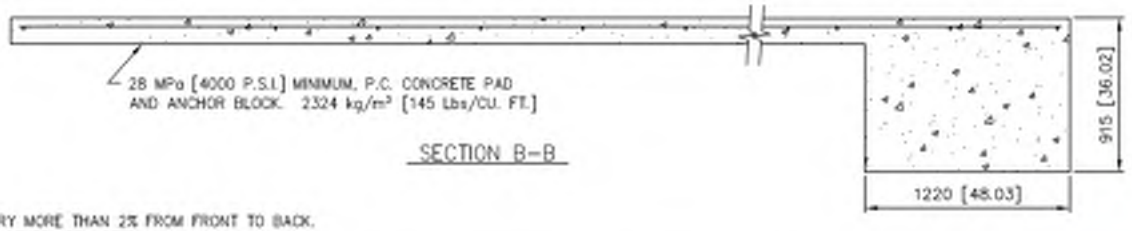
GGM10



SECTION A–A



PLAN VIEW



SECTION B–B

NOTES:

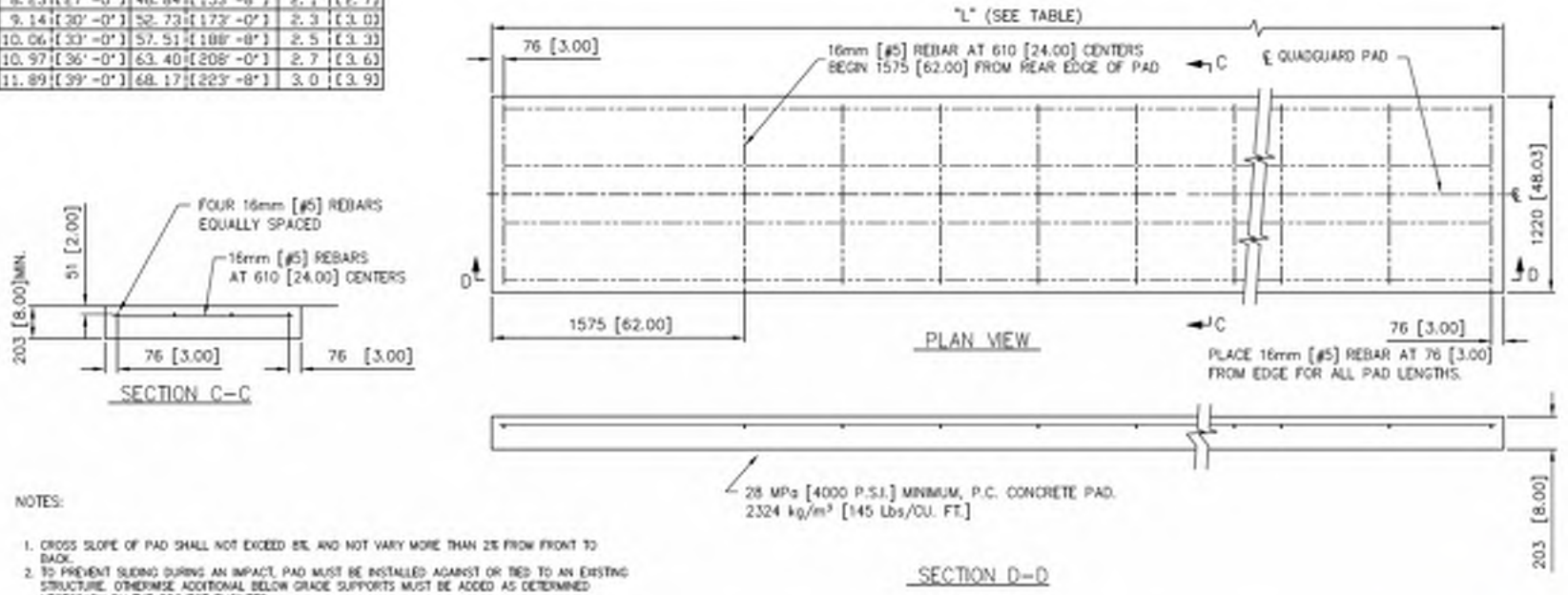
1. CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

N/A	D. STAUS	5/15/96	TOLERANCES PER CEMC-THP-SF-001, UNLESS OTHERWISE SPECIFIED.	QUADGUARD® SYSTEM CONCRETE PAD FOR TENSION STRUT BACKUP
N/A	S. TRAGESER	5/20/96	DO NOT SCALE DRAWING	
ESTIMATED WEIGHT: N/A				35-40-11 H 1 of 3

[redacted]

TABLE				YARDS OF CONCRETE IN PAD	
NO. OF BAYS	"L" (PAD LENGTH)		REBAR REQUIRED		
	[m] : [ft-in]		[m] : [ft-in]	m^3	[YARDS^3]
1	2.74	[9'-0"]	14.83	[48'-8"]	0.7	[0.9]
2	2.74	[9'-0"]	14.83	[48'-8"]	0.7	[0.9]
3	3.66	[12'-0"]	20.73	[68'-0"]	0.9	[1.2]
4	4.57	[15'-0"]	25.50	[83'-8"]	1.2	[1.5]
5	5.49	[18'-0"]	31.39	[103'-0"]	1.4	[1.8]
6	6.40	[21'-0"]	36.17	[118'-8"]	1.6	[2.1]
7	7.32	[24'-0"]	42.06	[138'-0"]	1.8	[2.4]
8	8.23	[27'-0"]	46.84	[153'-8"]	2.1	[2.7]
9	9.14	[30'-0"]	52.73	[173'-0"]	2.3	[3.0]
10	10.06	[33'-0"]	57.51	[188'-8"]	2.5	[3.3]
11	10.97	[36'-0"]	63.40	[208'-0"]	2.7	[3.6]
12	11.89	[39'-0"]	68.17	[223'-8"]	3.0	[3.9]

GGM10



NOTES:

1. CROSS SLOPE OF PAD SHALL NOT EXCEED 8% AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. TO PREVENT SLIDING DURING AN IMPACT, PAD MUST BE INSTALLED AGAINST OR TIED TO AN EXISTING STRUCTURE. OTHERWISE ADDITIONAL BELOW GRADE SUPPORTS MUST BE ADDED AS DETERMINED NECESSARY BY THE PROJECT ENGINEER.
3. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

N/A	D. STAUS	5/15/96	TOLERANCES PER CEMC-TMP-SF-001, UNLESS OTHERWISE SPECIFIED.	QUADGUARD® SYSTEM OPTIONAL 8" CONCRETE PAD WITH REBAR FOR TENSION STRUT BACKUP
N/A	S. TRAGESER	5/20/96	DO NOT SCALE DRAWING	
ESTIMATED WEIGHT: N/A				35-40-11 H 2 of 3

[redacted]

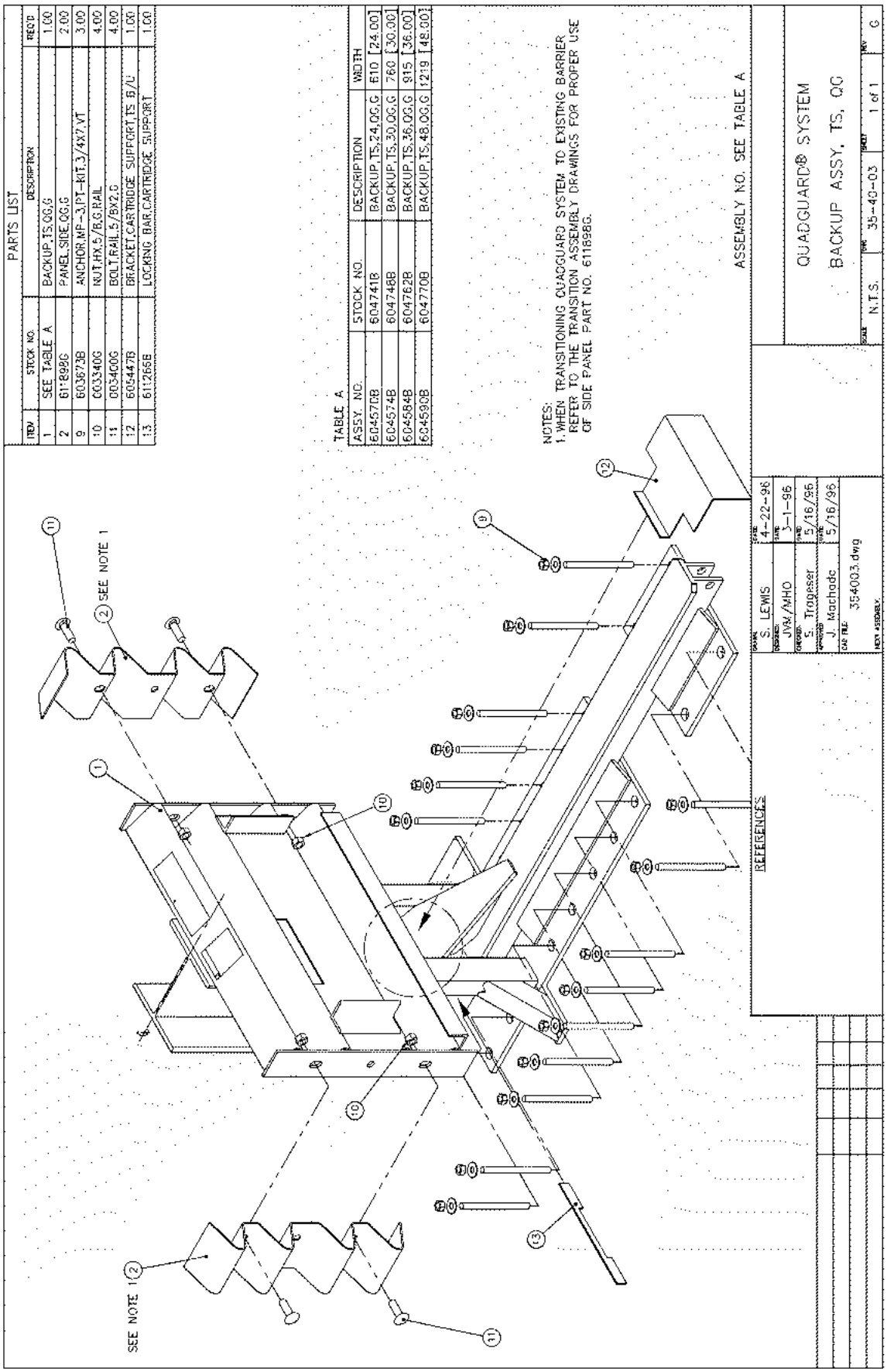
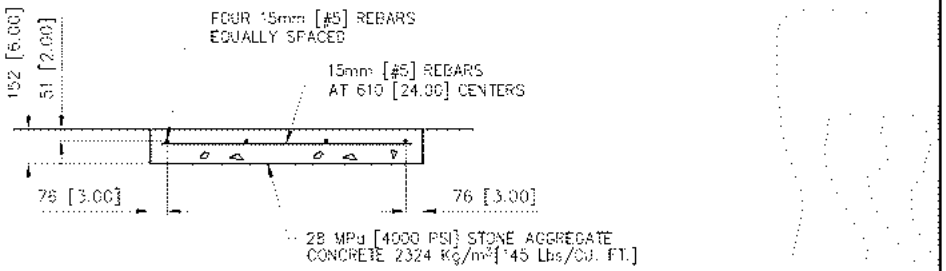

PARTS LIST
REV
STOCK NO.
DESCRIPTION
REQ'D
1 SEE TABLE A BACKUP,TS,QG,G 1.00
2 6118986 PANEL,SIDE,QG,G 2.00
9 603673B ANCHOR,MF-3,PT-KIT,3/4X7,VT 3.00
10 603340G NUT,HX,5/8,G,RAIL 4.00
11 603400G BOLT,RAIL,5/8X2,G 4.00
12 6054478 BRACKET,CARTRIDGE SUPPORT,TS S/U 1.00
13 6112656 LOCKING BAR,CARTRIDGE SUPPORT 1.00
TABLE A
ASSY. NO. STOCK NO. DESCRIPTION WIDTH
6045760 6047418 BACKUP,TS,24,QG,G 610 [24.00]
6045748 6047488 BACKUP,TS,30,QG,G 760 [30.00]
6045784 6047628 BACKUP,TS,36,QG,G 915 [36.00]
6045908 6047708 BACKUP,TS,48,QG,G 1219 [48.00]
NOTES:
1. WHEN TRANSITIONING QUADGUARD SYSTEM TO EXISTING BARRIER REFER TO THE TRANSITION ASSEMBLY DRAWINGS FOR PROPER USE OF SIDE PANEL PART NO. 6118986.
ASSEMBLY NO. SEE TABLE A
QUADGUARD® SYSTEM
BACKUP ASSY, TS, QG
SEE NOTE 1
SEE NOTE 1
REFERENCES
S. LEWIS 4-22-96
JVM/MHO 3-1-96
S. Trapasso 5/16/96
J. Machado 5/16/96
3540G3.dwg
N.T.S.
35-40-03
1 of 1
C

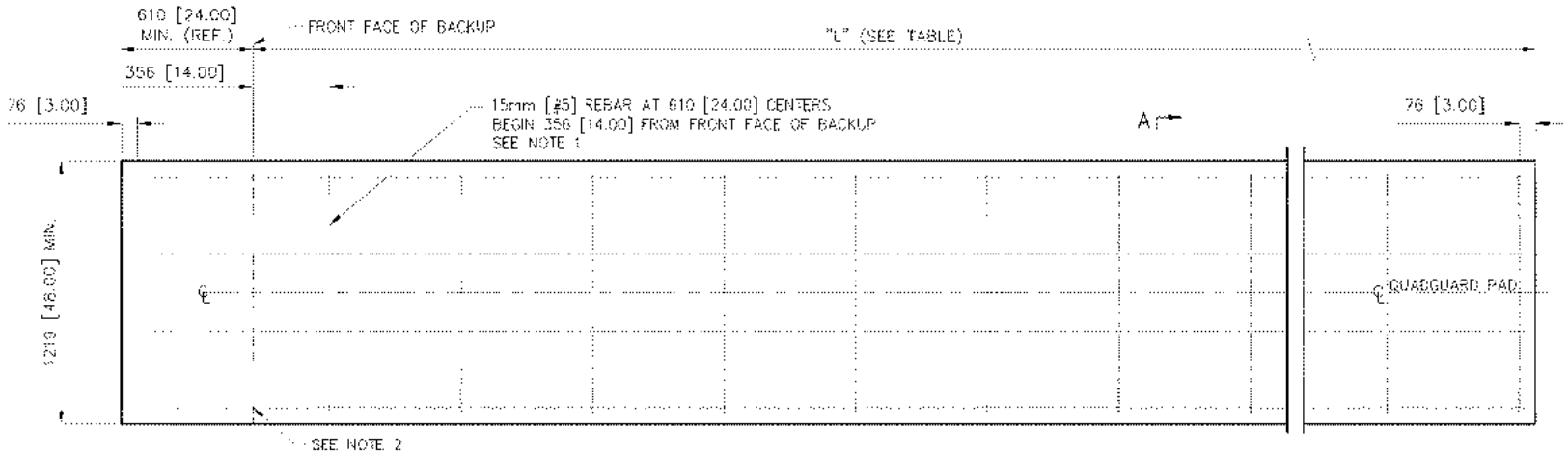
TABLE "L"

NO. OF BAYS	"L" (PAD LENGTH) m		REBAR REQUIRED m		YARDS OF CONCRETE IN PAD m^3 [YARDS^3]	
1	1.68	[5'-6"]	9.73	[38'-4"]	0.37	[0.5]
2	2.59	[8'-6"]	15.44	[57'-8"]	0.52	[0.7]
3	3.51	[11'-6"]	20.40	[73'-4"]	0.66	[0.9]
4	4.42	[14'-6"]	26.29	[92'-8"]	0.83	[1.1]
5	5.33	[17'-6"]	31.07	[108'-4"]	1.05	[1.4]
6	6.25	[20'-6"]	36.96	[127'-8"]	1.21	[1.6]
7	7.16	[23'-6"]	41.73	[143'-4"]	1.36	[1.8]
8	8.08	[26'-6"]	47.63	[162'-8"]	1.51	[2.0]
9	8.99	[29'-6"]	52.40	[178'-4"]	1.74	[2.3]
10	9.91	[32'-6"]	56.30	[197'-8"]	1.89	[2.5]
11	10.82	[35'-6"]	63.07	[213'-4"]	2.04	[2.7]
12	11.74	[38'-6"]	68.96	[232'-8"]	2.20	[2.9]

QQM10



SECTION A–A



PLAN VIEW

NOTES:
1. CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. PAD AND BELOW GRADE BACKUP BLOCK SHOULD BE TIED TOGETHER & POURED MONOLITHICALLY.
3. DIMENSIONS ARE IN mm [INCHES] UNLESS OTHERWISE NOTED.

REFERENCES

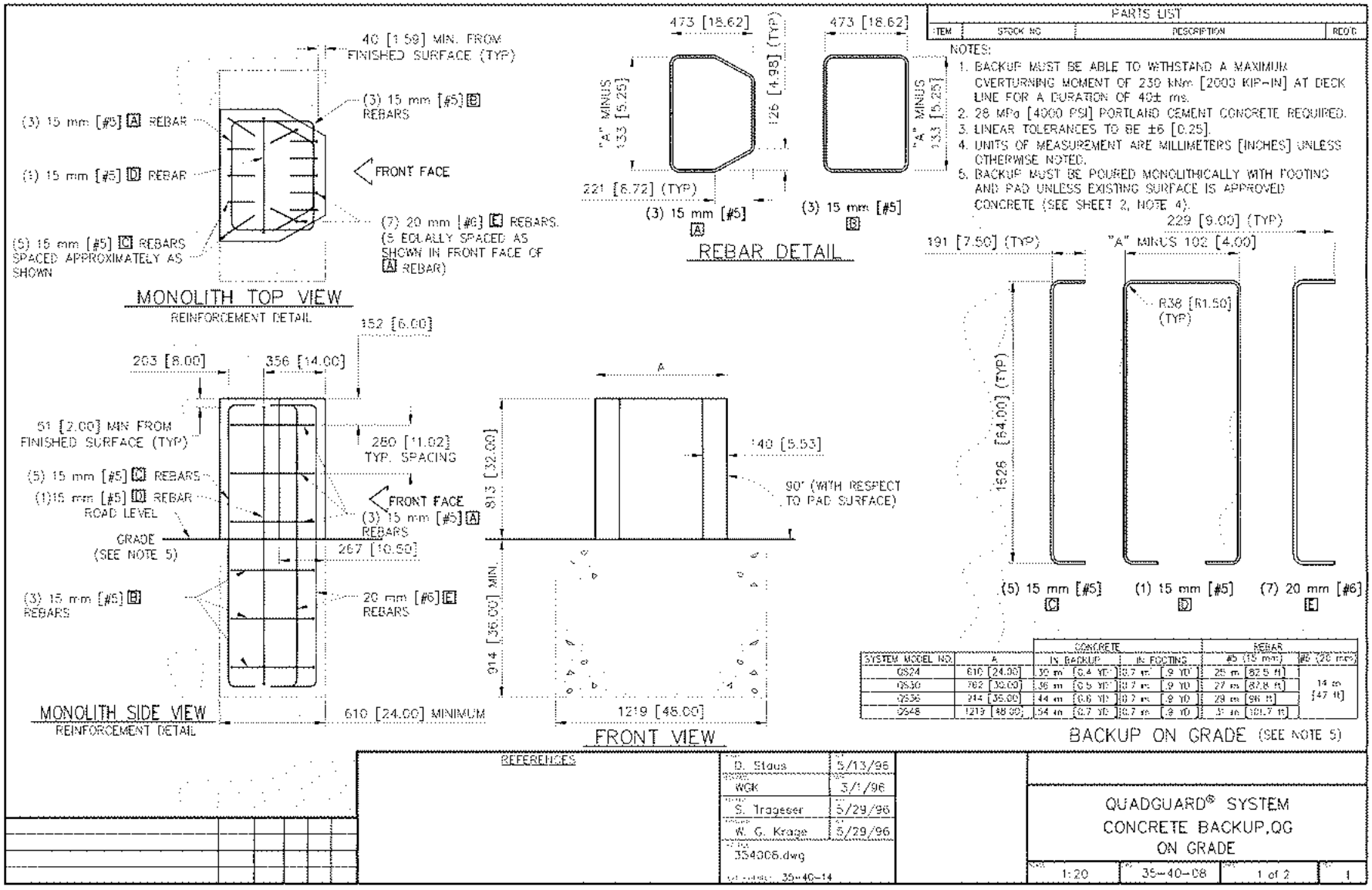
D. Staus	5/15/96
WGK	3/1/96
S. Trageser	5/24/96
WGK	3/1/96
354009.dwg	

QUADGUARD™ SYSTEM

CONCRETE PAD,FOR CONC. BACKUP,QG

1:20	35-40-09	1 of 1	C

[redacted]



REFERENCES

D. Staus	5/13/96
WGK	5/1/96
S. Trageser	5/29/96
W. G. Krage	5/29/96

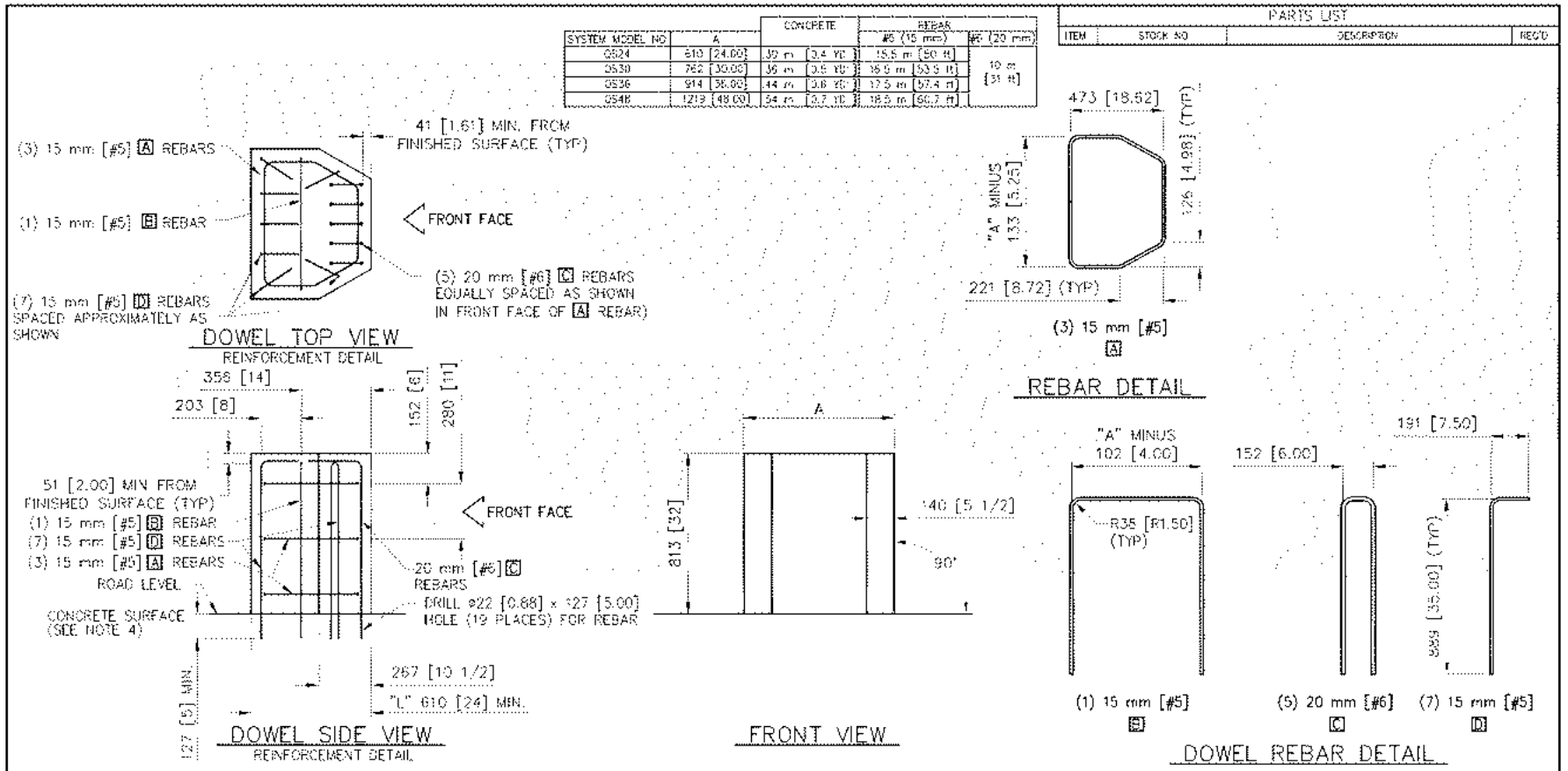
354006.dwg

35-40-14

QUADGUARD® SYSTEM
CONCRETE BACKUP,QG
ON GRADE

1:20	35-40-08	1 of 2	1

[redacted]



NOTES:

1. 28 MPa [4000 PSI] PORTLAND CEMENT CONCRETE REQUIRED.
2. LINEAR TOLERANCES TO BE ±6 [0.25].
3. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
4. APPROVED CONCRETE SURFACE IS:
   a. MIN. 180 [7.00] DECK STRUCTURE.
   b. MIN. 200 [8.00] NON-REINFORCED ROADWAY.
   c. MIN. 150 [6.00] REINFORCED ROADWAY.
5. VERTICAL REBAR TO BE INSTALLED USING MP-3® ANCHORING SYSTEM GROUT OR EQUAL. (AS DETAILED, IT WOULD REQUIRE QTY. 2 PART NO. 3525100-0000 MP-3® QUART PACKAGE)

BACKUP ON APPROVED CONCRETE (SEE NOTES 1 & 4)

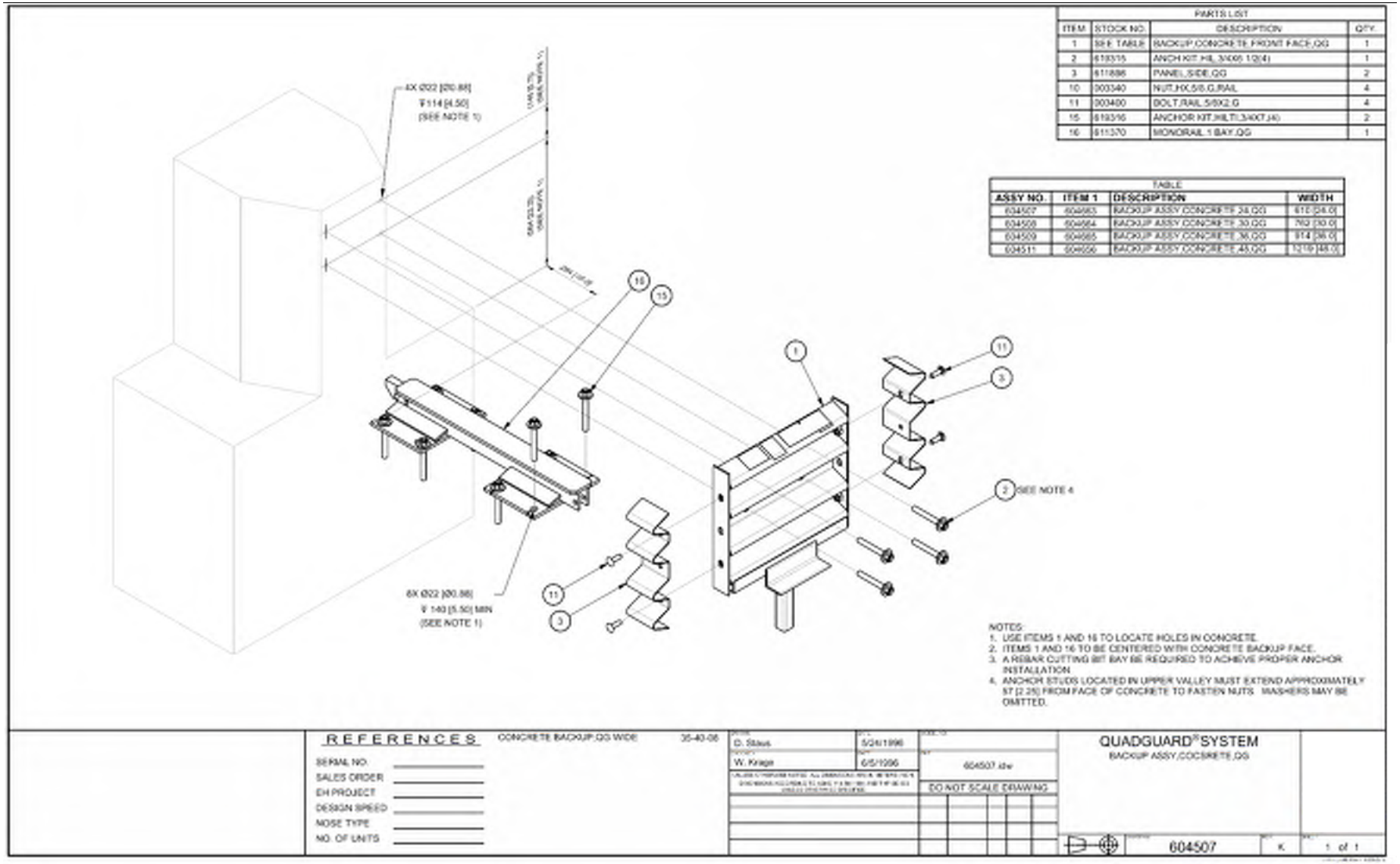
REFERENCES

D. Staus	5/13/96
WGK	3/1/96
S. Trageser	5/29/96
W. C. Krage	5/29/96
354005 Sh02.dwg	
35-46-14	

QUADGUARD® SYSTEM
CONCRETE BACKUP, QG
ON EXISTING CONCRETE STRUCTURE

1:20	35-43-08	2 of 2	1

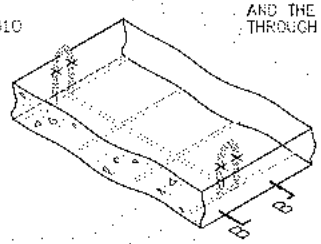
[redacted]


4X Ø22 [Ø0.88]
⌖114 [4.50]
(SEE NOTE 1)
6X Ø22 [Ø0.88]
⌖140 [5.50] MIN
(SEE NOTE 1)
SEE NOTE 4
PARTS LIST
ITEM | STOCK NO. | DESCRIPTION | QTY.
1 | SEE TABLE | BACKUP,CONCRETE FRONT FACE,QG | 1
2 | 619315 | ANCH KIT HIL 3/4X6 1/2(4) | 1
3 | 611886 | PANEL,SIDE,QG | 2
10 | 303340 | NUT,HX,5/8,G,RAIL | 4
11 | 303400 | BOLT,RAIL,5/8X2,G | 4
15 | 619316 | ANCHOR KIT,HILTI,3/4XT,(4) | 2
16 | 611370 | MONORAIL 1 BAY,QG | 1
TABLE
ASSY NO. | ITEM 1 | DESCRIPTION | WIDTH
604507 | 604663 | BACKUP ASSY,CONCRETE,24,QG | 610 [24.0]
604508 | 604664 | BACKUP ASSY,CONCRETE,30,QG | 762 [30.0]
604509 | 604665 | BACKUP ASSY,CONCRETE,36,QG | 914 [36.0]
604511 | 604666 | BACKUP ASSY,CONCRETE,48,QG | 1219 [48.0]
NOTES:
1. USE ITEMS 1 AND 16 TO LOCATE HOLES IN CONCRETE.
2. ITEMS 1 AND 16 TO BE CENTERED WITH CONCRETE BACKUP FACE.
3. A REBAR CUTTING BIT MAY BE REQUIRED TO ACHIEVE PROPER ANCHOR INSTALLATION.
4. ANCHOR STUDS LOCATED IN UPPER VALLEY MUST EXTEND APPROXIMATELY 57 [2.25] FROM FACE OF CONCRETE TO FASTEN NUTS. WASHERS MAY BE OMITTED.
REFERENCES
CONCRETE BACKUP,QG WIDE 35-40-06
SERIAL NO.
SALES ORDER
EH PROJECT
DESIGN SPEED
NOSE TYPE
NO. OF UNITS
D. Staus 5/24/1996
W. Krage 6/5/1996
604507.idw
DO NOT SCALE DRAWING
QUADGUARD® SYSTEM
BACKUP ASSY,CONCRETE,QG
604507 K 1 of 1

[redacted]

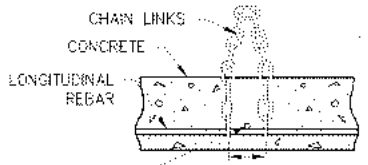
TABLE							YARDS OF CONCRETE IN PAD	
NO. OF BAYS	"L" (PAD LENGTH)		"P"		REBAR REQUIRED			
	m	[ft-in]	m	[ft-in]	m	[ft-in]	m^3	[YD^3]
2	4.57	[15'-0"]	1.1	[3'-9"]	25.50	[83'-8"]	1.2	[1.5]
3	4.57	[15'-0"]	1.1	[3'-9"]	25.50	[83'-8"]	1.2	[1.5]
4	4.57	[15'-0"]	1.1	[3'-9"]	25.50	[83'-8"]	1.2	[1.5]
5	5.49	[18'-0"]	1.4	[4'-6"]	31.39	[103'-0"]	1.4	[1.8]
6	6.40	[21'-0"]	1.6	[5'-3"]	36.17	[118'-8"]	1.6	[2.1]
7	7.32	[24'-0"]	1.8	[6'-0"]	42.06	[138'-0"]	1.8	[2.4]
8	8.23	[27'-0"]	2.0	[6'-9"]	46.84	[153'-8"]	2.1	[2.7]
9	9.14	[30'-0"]	2.2	[7'-6"]	52.73	[173'-0"]	2.3	[3.0]

~90M10



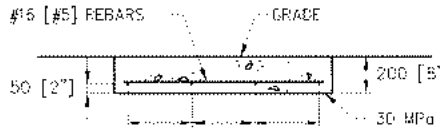
SECTION A–A

OPTIONAL LIFTING POINTS: USE 13mm [1/2"] PROOF COIL CHAIN. THE CHAIN MUST MEET THE REQUIREMENTS OF ASTM A-413 GRADE 28. THE MINIMUM LENGTH CHAIN IS 15 LINKS AND THE REBAR WILL BE INSERTED THROUGH BOTH ENDS AS SHOWN.



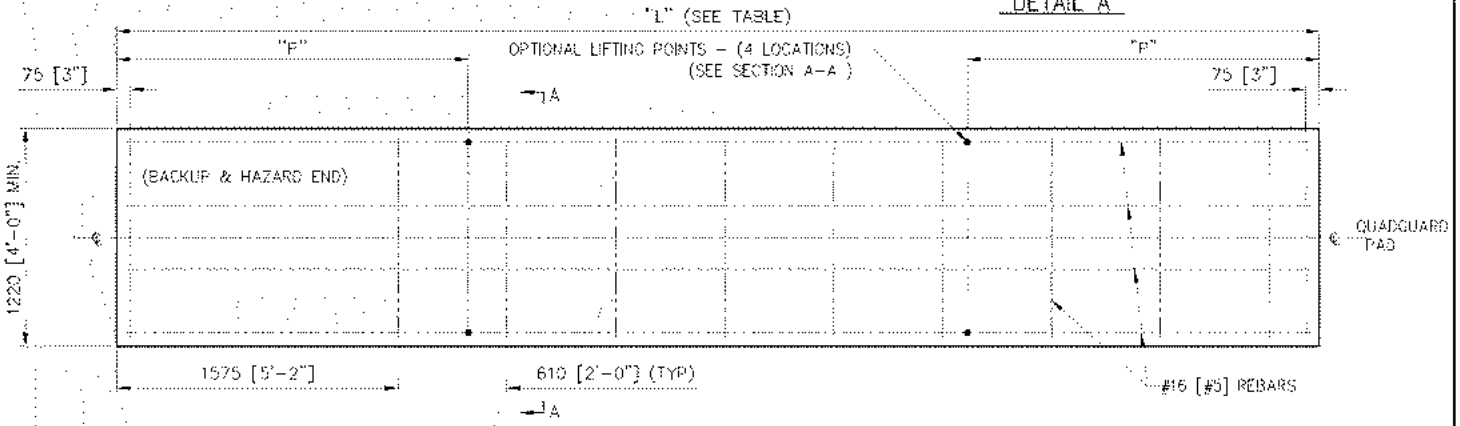
NOTE: ADD (1) 13mm [#4] REBAR @ "P" AS NEEDED.

SECTION B–B



DETAIL A

30 MPa [4000 PSI] STONE AGGREGATE CONCRETE 2320 kg/m³ [145 lbs/ft³]



NOTE:

1. CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. TO PREVENT SLIDING DURING AN IMPACT, PAD MUST BE INSTALLED AGAINST OR TIED TO AN EXISTING STRUCTURE. OTHERWISE ADDITIONAL BELOW GRADE SUPPORTS MUST BE ADDED AS DETERMINED NECESSARY BY THE PROJECT ENGINEER.
3. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

REFERENCES

D. Staus	5/15/96
WGK	5/1/96
S. Trageser	5/24/96
WGK	5/28/96
3540C0.dwg	

QUADGUARD™ SYSTEM

CONCRETE PAD,CZ,QG

1:20	35-40-10	1 of 1	F

[redacted]

TABLE "L"

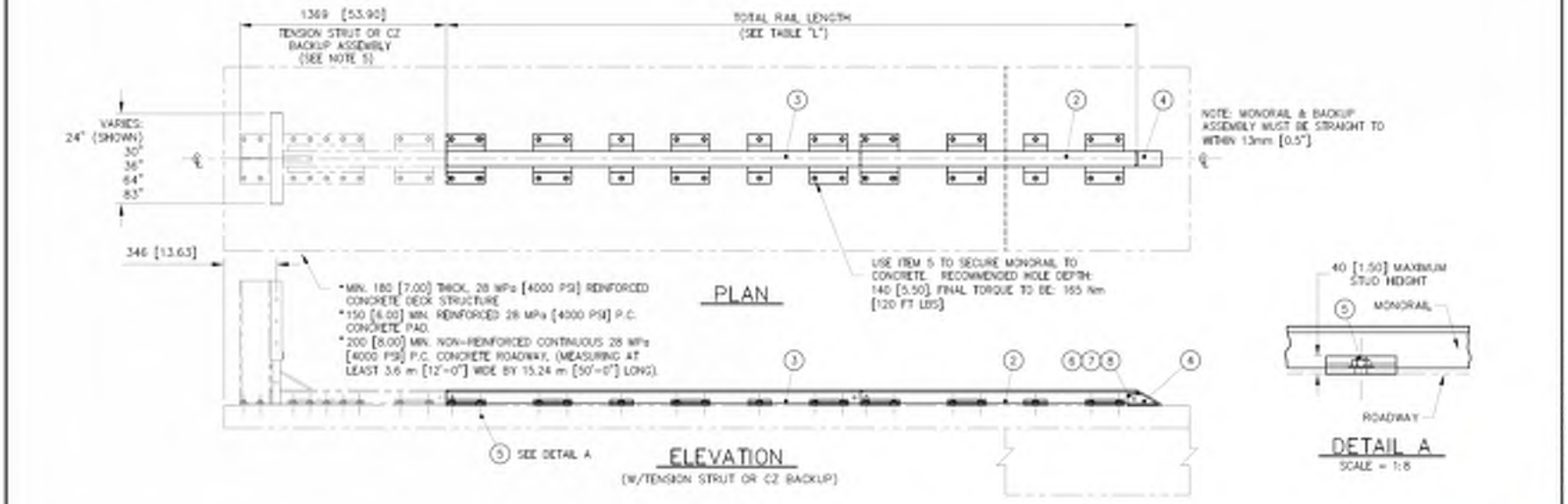
ASSEMBLY NO.	TOTAL RAIL LENGTH	*ITEM 1	*ITEM 2	*ITEM 3	*ITEM 5	NO. OF BAYS
611367	0	0	0	0	0	1
611332	915 [36.0]	1	0	0	2	2
611334	1830 [72.0]	0	1	0	3	3
611340	2745 [108.1]	0	0	1	4	4
611343	3660 [144.1]	1	0	1	5	5
611348	4575 [180.1]	0	1	1	6	6
611353	5490 [216.1]	0	0	2	7	7
611354	6405 [252.1]	1	0	2	8	8
611356	7320 [288.2]	0	1	2	9	9
611329	8235 [324.2]	0	0	3	10	10
611330	9150 [360.2]	1	0	3	12	11
611331	10065 [396.2]	0	1	3	13	12

- NOT APPLICABLE FOR 60°, 90°, 120° OR CZ SYSTEMS
- QQII
- QQM10
- NOT APPLICABLE FOR CZ QQ SYSTEMS

PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	611370	MONORAIL,ONE BAY,QQ,G	*
2	611375	MONORAIL,TWO BAYS,QQ,G	*
3	611379	MONORAIL,THREE BAYS,QQ,G	*
4	608136	END CAP,MONORAIL,QQ,G	1.00
5	619316	ANCH RIT,HIL,3/4X7(6)	*
6	113660	BOLT,HX,5/8X5 1/2,GS,G	1.00
7	115970	NUT,HX,5/8,G	1.00
8	118100	WASHER,LOCK,5/8,G	1.00

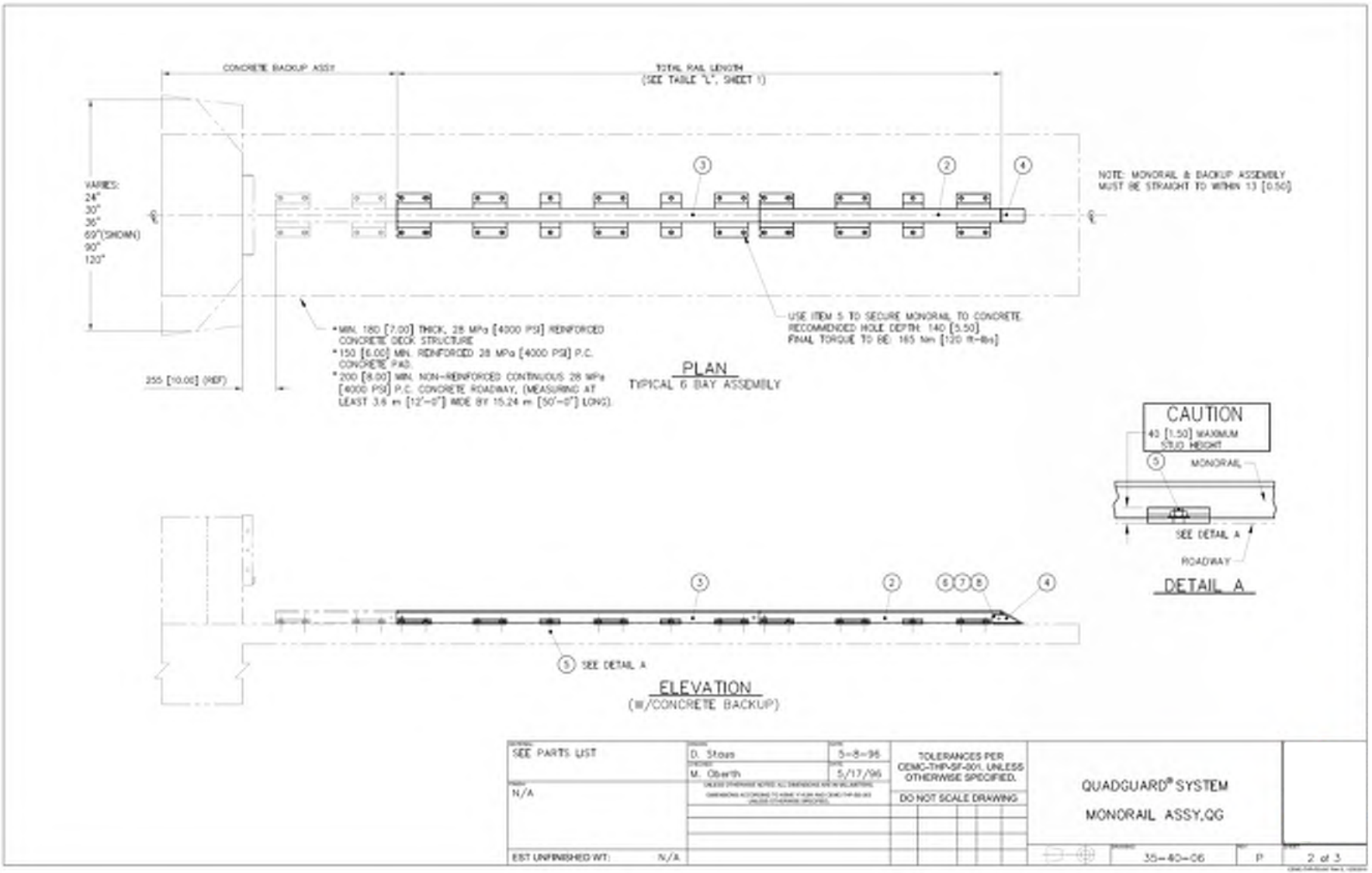
* SEE TABLE

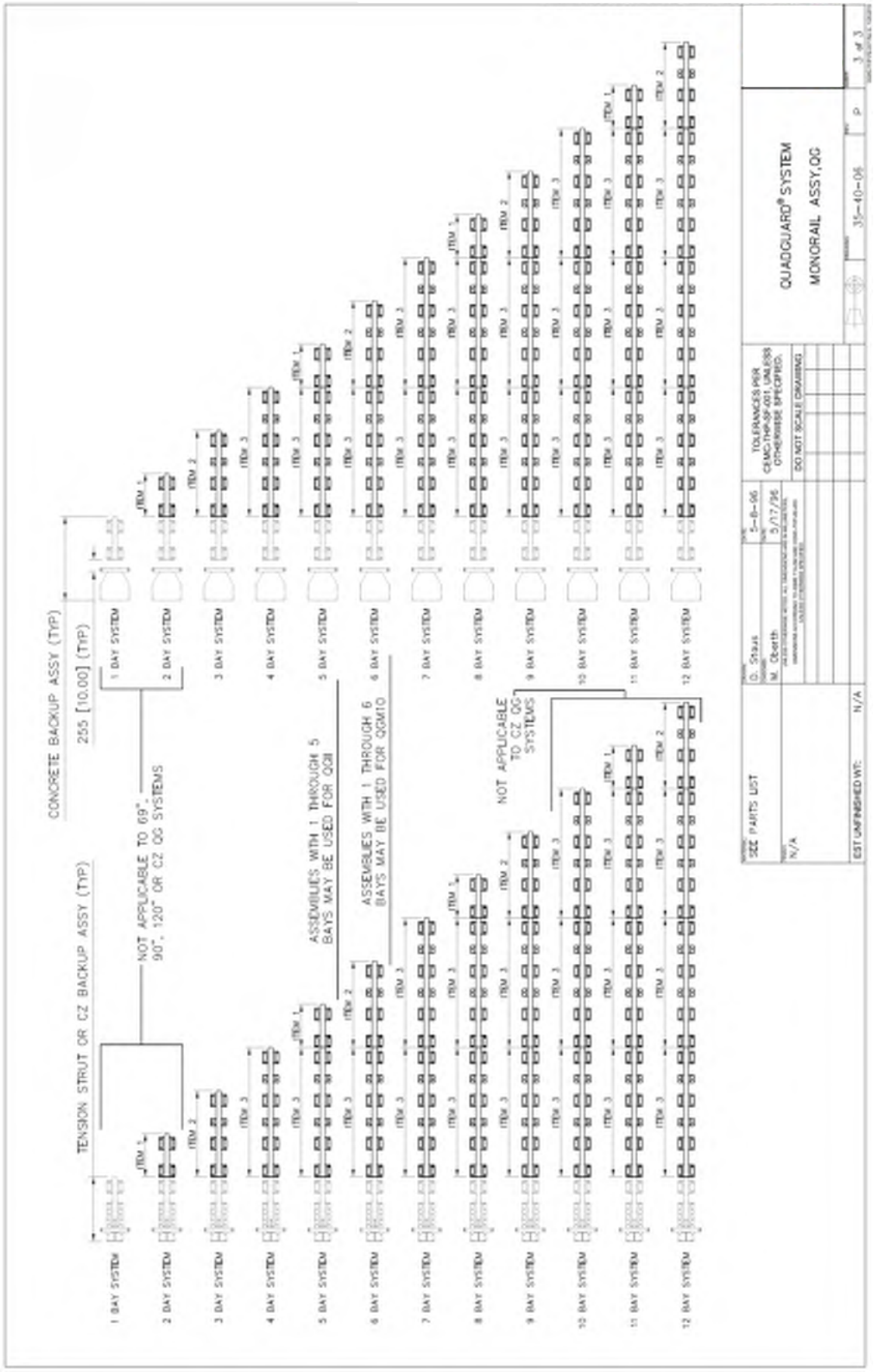


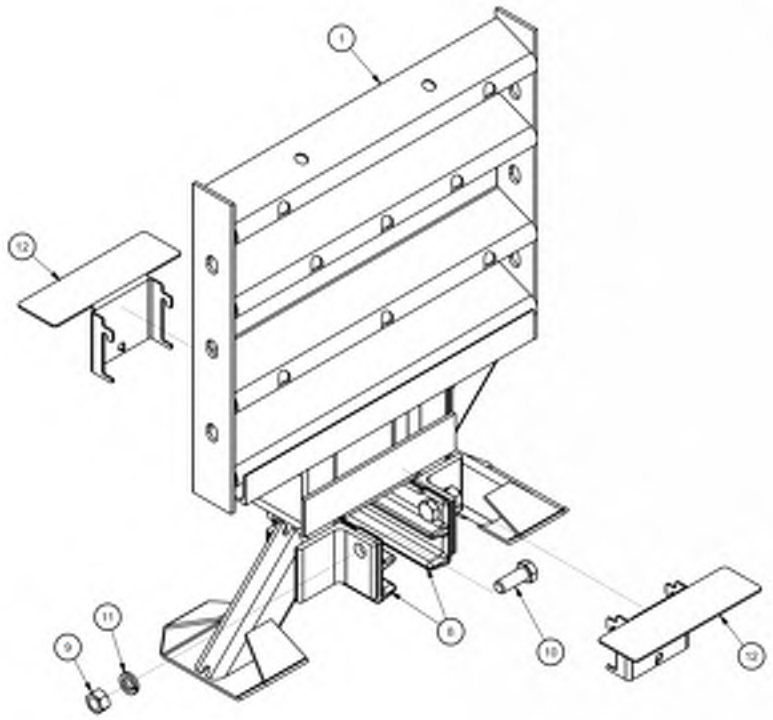
NOTES:
1. USE MONORAIL(S) (ITEMS 1, 2 AND 3) AS TEMPLATE(S) TO LOCATE HILTI ANCHOR BOLTS (ITEM 5). SEE SHEET 2.
2. CROSS SLOPE OF PAD SHALL NOT EXCEED 8 % & NOT VARY MORE THAN 2% FROM FRONT TO BACK.
3. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
4. EVERY STUD MUST BE EMBEDDED TO A DEPTH OF 140 [5.5] IF REBAR IS ENCOUNTERED IN A P.C. CONCRETE PAD, DRILL THROUGH IT. IF REBAR IS ENCOUNTERED ON A DECK STRUCTURE, ASK PROJECT ENGINEER FOR DIRECTION.
5. FOR CZ SYSTEMS, SEE DRAWING 35-40-24 ALSO.

SEE PARTS LIST	D. Staus	5-8-96	TOLERANCES PER CEMC-THP-SP-001, UNLESS OTHERWISE SPECIFIED.	QUADGUARD® SYSTEM
	M. Oberth	5/17/96	DO NOT SCALE DRAWING	MONORAIL ASSY,QQ
N/A				
EST UNFINISHED WT: N/A			35-40-06	P 1 of 3

[redacted]


CONCRETE BACKUP ASSY
TOTAL RAIL LENGTH
(SEE TABLE "L", SHEET 1)
VARIES:
24"
30"
36"
69"(SHOWN)
90"
120"
255 [10.06] (REF)
* MIN. 180 [7.00] THICK, 28 MPa [4000 PSI] REINFORCED CONCRETE DECK STRUCTURE
* 150 [6.00] MIN. REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE PAD.
* 200 [8.00] MIN. NON-REINFORCED CONTINUOUS 28 MPa [4000 PSI] P.C. CONCRETE ROADWAY, (MEASURING AT LEAST 3.6 m [12'-0"] WIDE BY 15.24 m [50'-0"] LONG).
USE ITEM 5 TO SECURE MONORAIL TO CONCRETE.
RECOMMENDED HOLE DEPTH: 140 [5.50]
FINAL TORQUE TO BE: 165 Nm [120 ft-lbs]
NOTE: MONORAIL & BACKUP ASSEMBLY MUST BE STRAIGHT TO WITHIN 13 [0.50]
PLAN
TYPICAL 6 BAY ASSEMBLY
CAUTION
40 [1.50] MAXIMUM STUD HEIGHT
MONORAIL
SEE DETAIL A
ROADWAY
DETAIL A
SEE DETAIL A
ELEVATION
(W/CONCRETE BACKUP)
SEE PARTS LIST
N/A
EST UNFINISHED WT: N/A
D. Stous
5-8-96
M. Oberth
5/17/96
TOLERANCES PER CEMC-THP-SF-001, UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING
QUADGUARD® SYSTEM
MONORAIL ASSY,QG
35-40-06
P
2 of 3


CONCRETE BACKUP ASSY (TYP)
255 [10.00] (TYP)
TENSION STRUT OR CZ BACKUP ASSY (TYP)
NOT APPLICABLE TO 69", 90", 120" OR CZ QG SYSTEMS
ASSEMBLIES WITH 1 THROUGH 5 BAYS MAY BE USED FOR QGII
ASSEMBLIES WITH 1 THROUGH 6 BAYS MAY BE USED FOR QGMTO
NOT APPLICABLE TO CZ QG SYSTEMS
1 BAY SYSTEM
2 BAY SYSTEM
3 BAY SYSTEM
4 BAY SYSTEM
5 BAY SYSTEM
6 BAY SYSTEM
7 BAY SYSTEM
8 BAY SYSTEM
9 BAY SYSTEM
10 BAY SYSTEM
11 BAY SYSTEM
12 BAY SYSTEM
SEE PARTS LIST
N/A
EST UNFINISHED WT: N/A
D. Staus
M. Oberth
5-8-96
5/17/96
TOLERANCES PER CEMCTHP-SP-001, UNLESS OTHERWISE SPECIFIED:
DO NOT SCALE DRAWING
QUADGUARD® SYSTEM
MONORAIL ASSY,QG
35-40-04
P
3 of 3



PARTS LIST

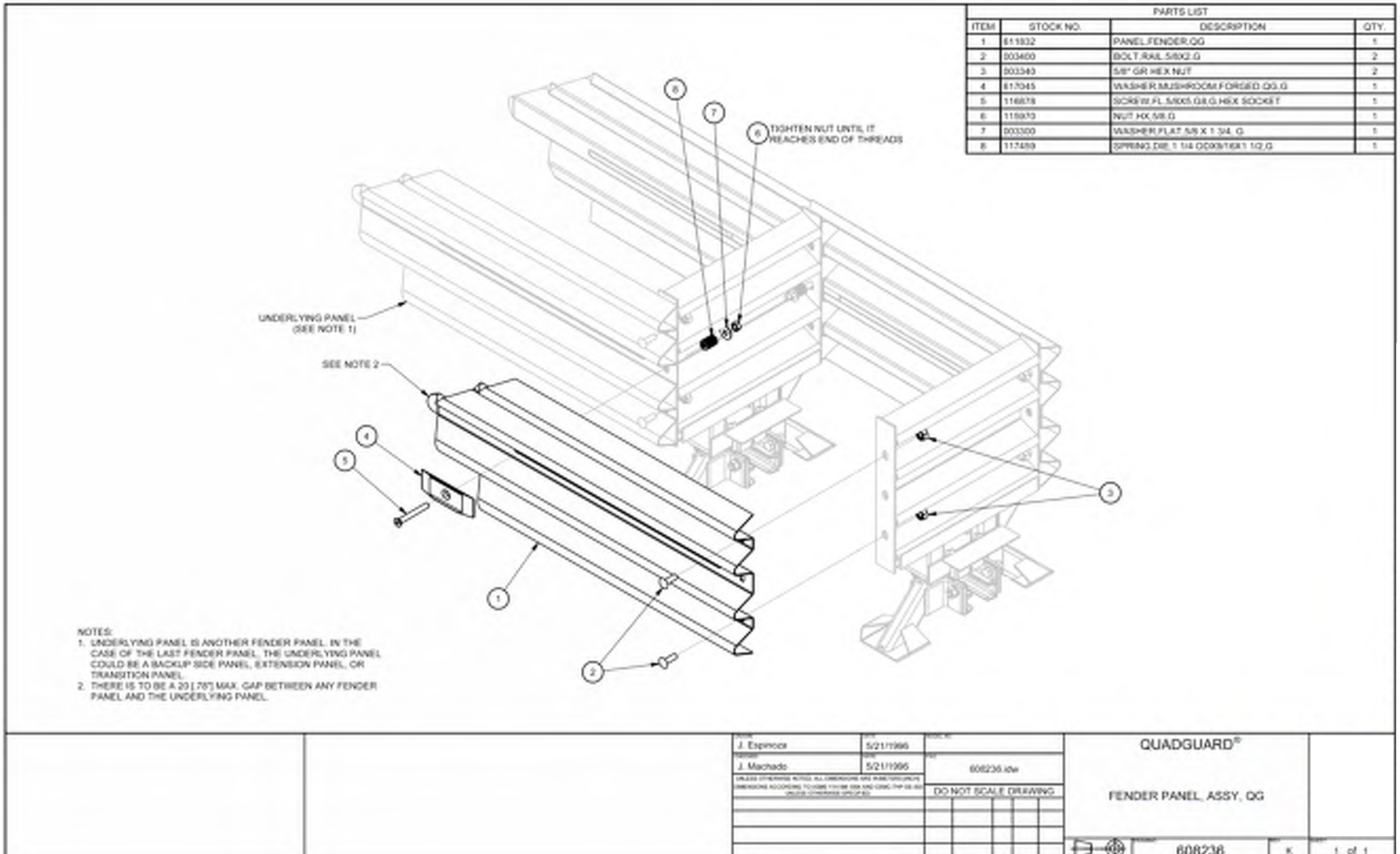
ITEM	STOCK NO.	DESCRIPTION	QTY
1	SEE TABLE	SEE TABLE	1
8	611368	MONORAIL GUIDE,QG,G	2
9	203704	3/4" HVY HEX NUT A563 DH	4
10	113555	BOLT,HX 3/4X2 GR.G	4
11	118089	WASHER,LOCK,3/4,G	4
12	505446	BRACKET,CARTRIDGE SUPT,DIA,FOLDED,QG,G	2

ASSY. NO.	ITEM 1	DESCRIPTION	WIDTH
625650	625647	DIAPHRAGM ISR,24,QG,G	610 [24.00]
625651	625648	DIAPHRAGM,QB,33,QG,G	762 [33.00]
625652	625649	DIAPHRAGM,QB,36,QG,G	915 [36.00]
606813	607838	DIAPHRAGM,QB,48,QG,G	1219 [48.00]

NOTE:
1. QUADGUARD II REQUIRES THE SHIM KIT, SEE 614050.

W. Leddington	4/13/2016	SEE TABLE	DIAPHRAGM ASSY, QB, 24"
A. Van Brocklin	4/28/2016	625650.idw	
		DO NOT SCALE DRAWING	625650 B 1 of 3

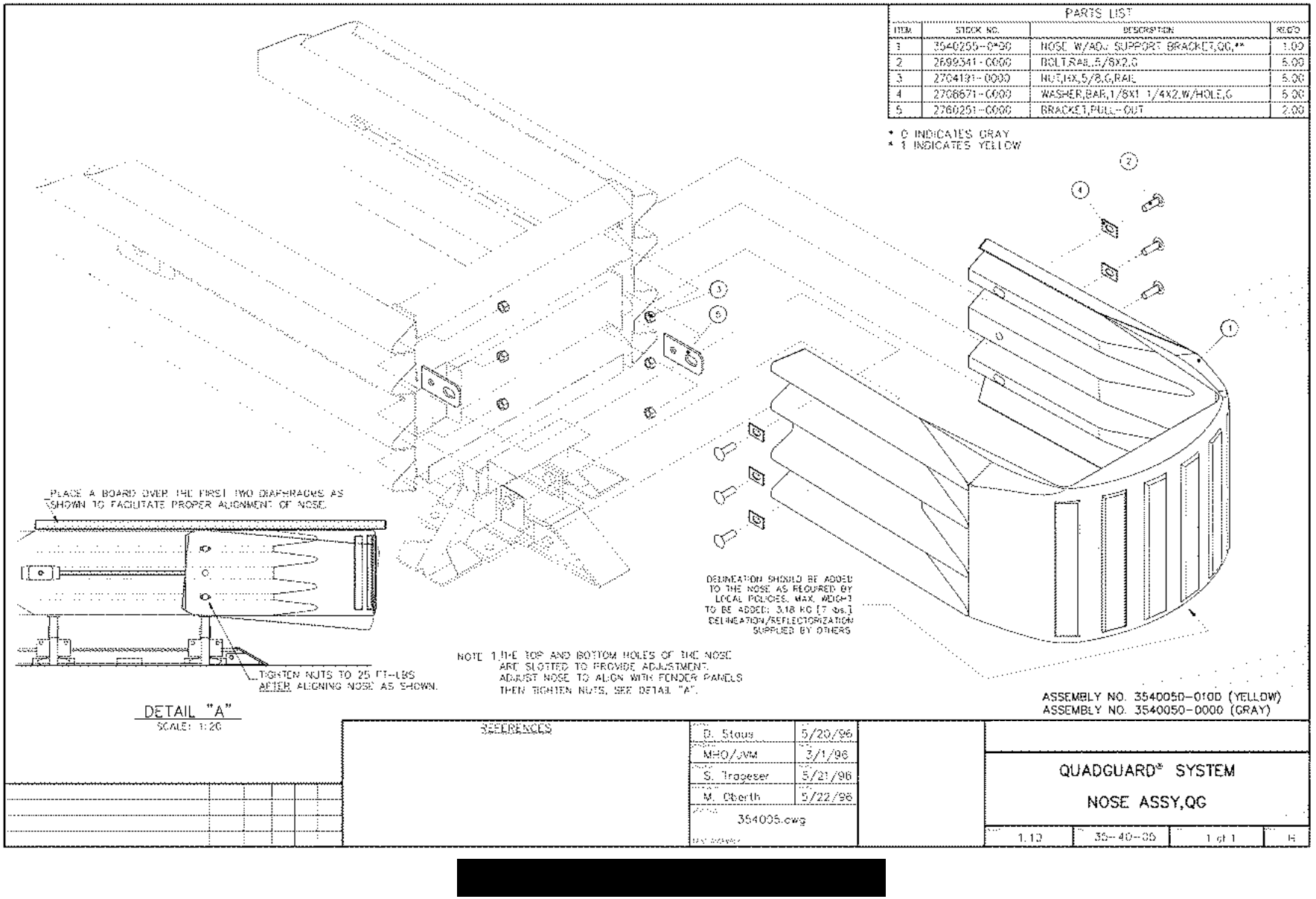
[redacted]


TIGHTEN NUT UNTIL IT REACHES END OF THREADS
UNDERLYING PANEL (SEE NOTE 1)
SEE NOTE 2
NOTES:
1. UNDERLYING PANEL IS ANOTHER FENDER PANEL. IN THE CASE OF THE LAST FENDER PANEL, THE UNDERLYING PANEL COULD BE A BACKUP SIDE PANEL, EXTENSION PANEL, OR TRANSITION PANEL.
2. THERE IS TO BE A 20 [.78"] MAX. GAP BETWEEN ANY FENDER PANEL AND THE UNDERLYING PANEL.
J. Espinoza 5/21/1996
J. Machado 5/21/1996
608236.idw
DO NOT SCALE DRAWING
QUADGUARD®
FENDER PANEL, ASSY, QG
608236
K
1 of 1

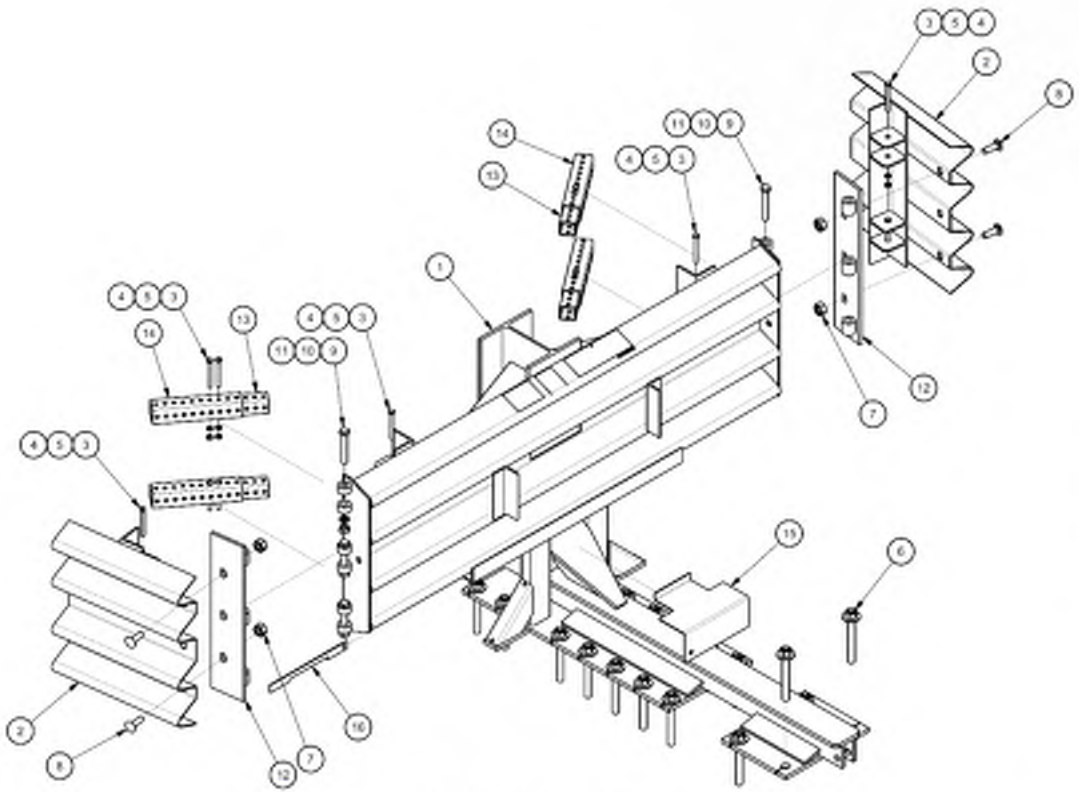
PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	611932	PANEL,FENDER,QG	1
2	003400	BOLT,RAIL,5/8X2,G	2
3	003340	5/8" GR HEX NUT	2
4	617045	WASHER,MUSHROOM,FORGED,QG,G	1
5	116878	SCREW,FL,5/8X5,G8,G,HEX SOCKET	1
6	115970	NUT,HX,5/8,G	1
7	003300	WASHER,FLAT,5/8 X 1 3/4, G	1
8	117459	SPRING,DIE,1 1/4 OD X 9/16 X 1 1/2,G	1

[redacted]


PARTS LIST
ITEM | STOCK NO. | DESCRIPTION | REQ'D
1 | 3540250-0*30 | NOSE W/ADJ. SUPPORT BRACKET,QG,** | 1.00
2 | 2699341-0000 | BOLT,RAIL,5/8X2.5 | 6.00
3 | 2704191-0000 | NUT,HX,5/8,G,RAIL | 6.00
4 | 2706671-0000 | WASHER,BAR,1/8X1 1/4X2.W/HOLE,G | 6.00
5 | 2760251-0006 | BRACKET,PULL-OUT | 2.00
* 0 INDICATES GRAY
* 1 INDICATES YELLOW
PLACE A BOARD OVER THE FIRST TWO DIAPHRAGMS AS SHOWN TO FACILITATE PROPER ALIGNMENT OF NOSE.
TIGHTEN NUTS TO 25 FT-LBS AFTER ALIGNING NOSE AS SHOWN.
DETAIL "A"
SCALE: 1:20
DELINEATION SHOULD BE ADDED TO THE NOSE AS REQUIRED BY LOCAL POLICES. MAX. WEIGHT TO BE ADDED: 3.18 KG [7 lbs.] DELINEATION/REFLECTORIZATION SUPPLIED BY OTHERS
NOTE 1.THE TOP AND BOTTOM HOLES OF THE NOSE ARE SLOTTED TO PROVIDE ADJUSTMENT. ADJUST NOSE TO ALIGN WITH FENDER PANELS THEN TIGHTEN NUTS, SEE DETAIL "A".
ASSEMBLY NO. 3540050-0100 (YELLOW)
ASSEMBLY NO. 3540050-0000 (GRAY)
REFERENCES
D. Staus 5/20/96
MHO/JVM 3/1/96
S. Trageser 5/21/96
M. Oberth 5/22/96
354005.cwg
QUADGUARD® SYSTEM
NOSE ASSY,QG
1.13 | 35-40-05 | 1 of 1 | H

[redacted]



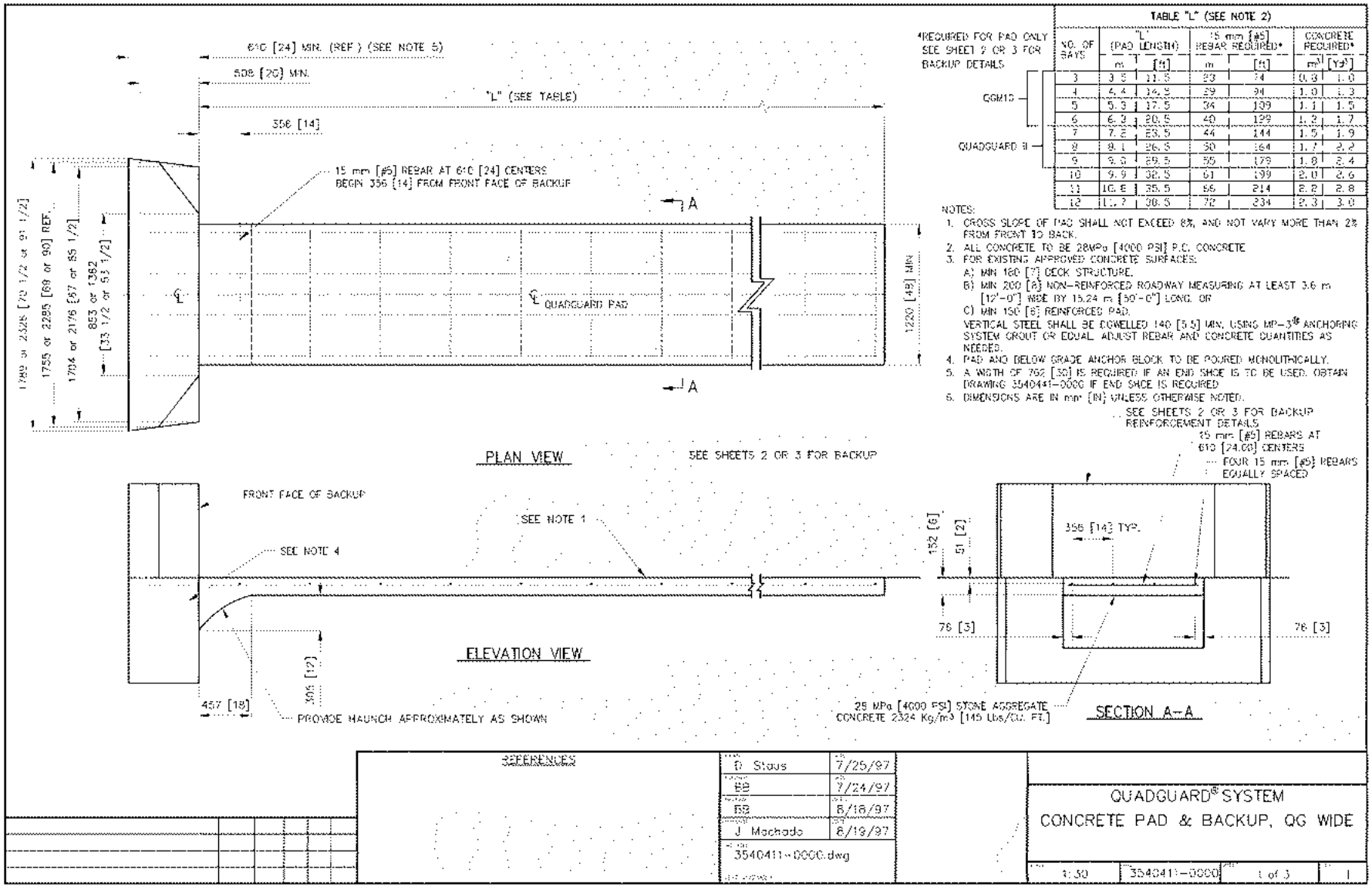
QUADGUARD FAMILY

PARTS LIST	
ITEM	DESCRIPTION
1	BACKUP TS,WIDE W/DECAL
2	PANEL,SIDE,QG,WIDE,G
3	BOLT,HX,3/8X3 1/2,ALL THREAD,GS,G
4	NUT,HX,3/8,G
5	WASHER,LOCK,3/8,G
6	ANCHOR KIT,HILTI,330ml,3/4X7,HI
7	NUT,HX,5/8,G,RAIL
8	BOLT,RAIL,5/8X2,G
9	BOLT,HX,5/8X4,GS,G
10	WASHER,LOCK,5/8,G
11	5/8" HVY HEX NUT A563A
12	HINGE PLATE,FENDER PANEL,QG
13	TEL ST 1 3/4X1 3/4X12 GA X10,HHS,G
14	TEL ST 2X2X12 GA X10,HHS,G
15	BRACKET,CART SUPT,TS B/U,QG
16	LOCKING BAR,CARTRIDGE SUPT,QG

TABLE				
SYSTEM	WIDTH	7" ANCHOR	18" ANCHOR	NO ANCHOR
QG, QGII, QGHS	69"	604596	626520	627519
QG, QGII, QGHS	90"	604599	626521	627520
QG M WIDE	69"	627512	N/A	627523

D. Kohfeld	3/16/2020		QUADGUARD® FAMILY
B. Eckert	2/25/2020	627528.idw	BACKUP ASSEMBLY, TENSION STRUT
		DO NOT SCALE DRAWING	
			627528 - 1 of 2

[redacted]


610 [24] MIN. (REF.) (SEE NOTE 5)
508 [20] MIN.
"L" (SEE TABLE)
356 [14]
15 mm [#5] REBAR AT 610 [24] CENTERS BEGIN 356 [14] FROM FRONT FACE OF BACKUP
A
A
QUADGUARD PAD
1220 [48] MIN.
1789 or 2325 [70 1/2 or 91 1/2]
1755 or 2295 [69 or 90] REF.
1704 or 2176 [67 or 85 1/2]
853 or 1362 [33 1/2 or 53 1/2]
PLAN VIEW
SEE SHEETS 2 OR 3 FOR BACKUP
FRONT FACE OF BACKUP
SEE NOTE 4
SEE NOTE 1
ELEVATION VIEW
457 [18]
305 [12]
PROVIDE HAUNCH APPROXIMATELY AS SHOWN
*REQUIRED FOR PAD ONLY SEE SHEET 2 OR 3 FOR BACKUP DETAILS
QGM10
QUADGUARD II
TABLE "L" (SEE NOTE 2)
NO. OF BAYS
"L" (PAD LENGTH) m [ft]
15 mm [#5] REBAR REQUIRED* m [ft]
CONCRETE REQUIRED* m³ [yd³]
3 3.5 [11.5] 23 [74] 0.8 [1.0]
4 4.4 [14.5] 29 [94] 1.0 [1.3]
5 5.3 [17.5] 34 [109] 1.1 [1.5]
6 6.3 [20.5] 40 [129] 1.2 [1.7]
7 7.2 [23.5] 44 [144] 1.5 [1.9]
8 8.1 [26.5] 50 [164] 1.7 [2.2]
9 9.0 [29.5] 55 [179] 1.8 [2.4]
10 9.9 [32.5] 61 [199] 2.0 [2.6]
11 10.8 [35.5] 66 [214] 2.2 [2.8]
12 11.7 [38.5] 72 [234] 2.3 [3.0]
NOTES:
1. CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. ALL CONCRETE TO BE 28MPa [4000 PSI] P.C. CONCRETE
3. FOR EXISTING APPROVED CONCRETE SURFACES:
A) MIN 180 [7] DECK STRUCTURE.
B) MIN 200 [8] NON-REINFORCED ROADWAY MEASURING AT LEAST 3.6 m [12'-0"] WIDE BY 15.24 m [50'-0"] LONG, OR
C) MIN 150 [6] REINFORCED PAD.
VERTICAL STEEL SHALL BE DOWELLED 140 [5.5] MIN. USING MP-3® ANCHORING SYSTEM GROUT OR EQUAL. ADJUST REBAR AND CONCRETE QUANTITIES AS NEEDED.
4. PAD AND BELOW GRADE ANCHOR BLOCK TO BE POURED MONOLITHICALLY.
5. A WIDTH OF 762 [30] IS REQUIRED IF AN END SHOE IS TO BE USED. OBTAIN DRAWING 3540441-0000 IF END SHOE IS REQUIRED
6. DIMENSIONS ARE IN mm [IN] UNLESS OTHERWISE NOTED.
SEE SHEETS 2 OR 3 FOR BACKUP REINFORCEMENT DETAILS
15 mm [#5] REBARS AT 610 [24.00] CENTERS
FOUR 15 mm [#5] REBARS EQUALLY SPACED
356 [14] TYP.
152 [6]
51 [2]
76 [3]
76 [3]
25 MPa [4000 PSI] STONE AGGREGATE CONCRETE 2324 Kg/m³ [145 Lbs/cu. Ft.]
SECTION A-A
REFERENCES
B. Staus 7/25/97
BB 7/24/97
BB 6/16/97
J. Machado 6/19/97
3540411-0000.dwg
QUADGUARD® SYSTEM
CONCRETE PAD & BACKUP, QG WIDE
1:30
3540411-0000
1 of 3
1

[redacted]

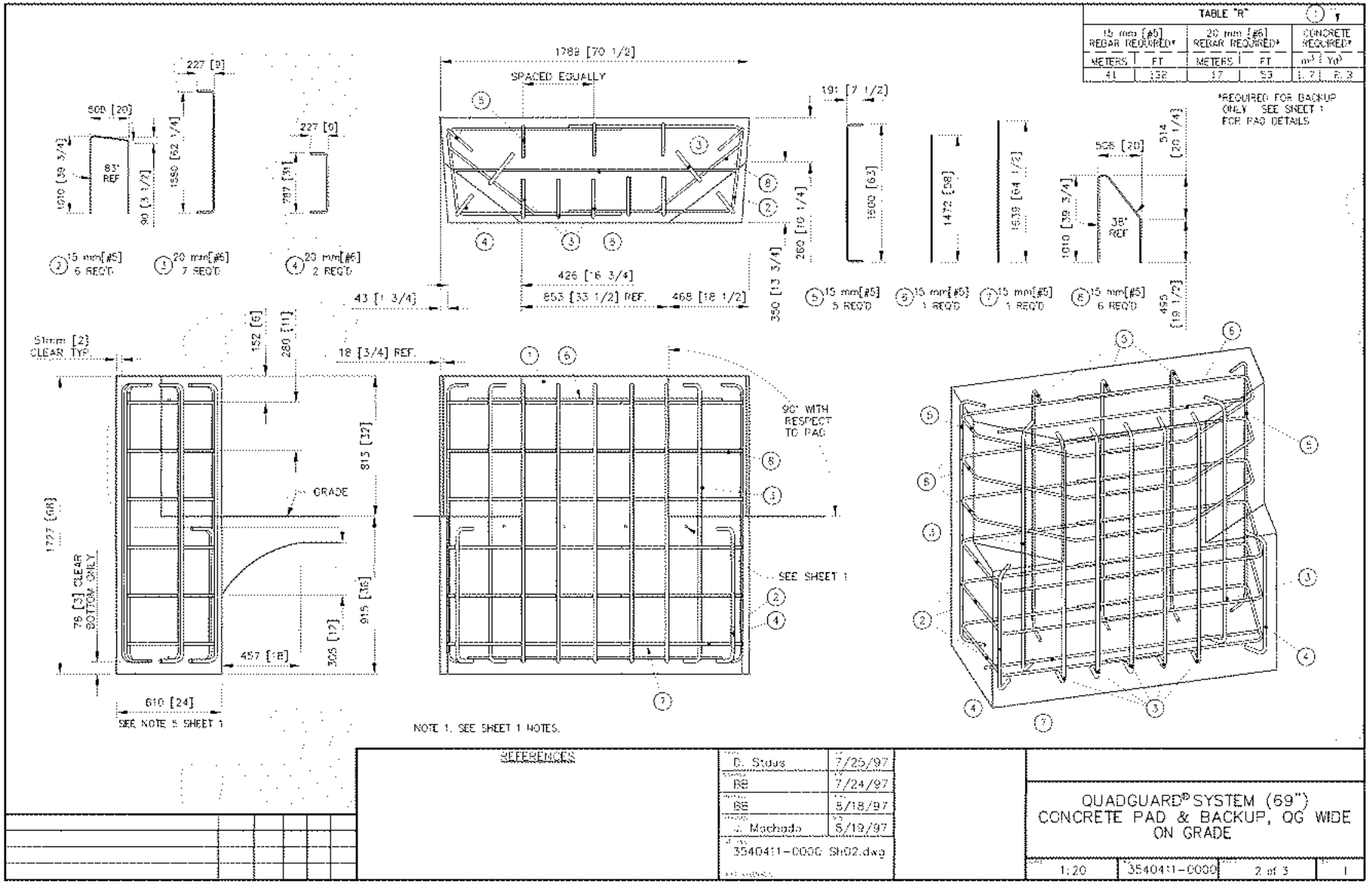
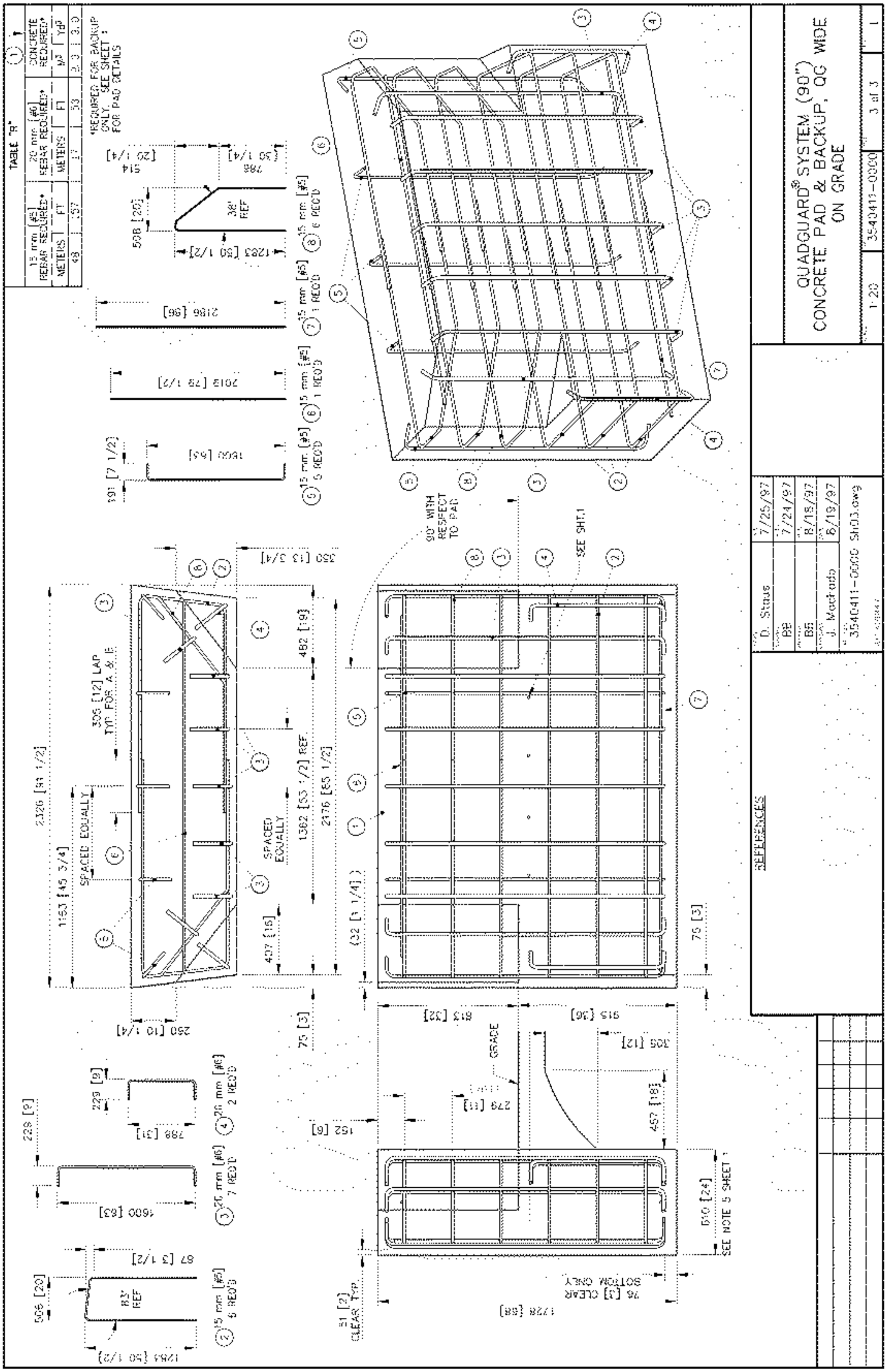
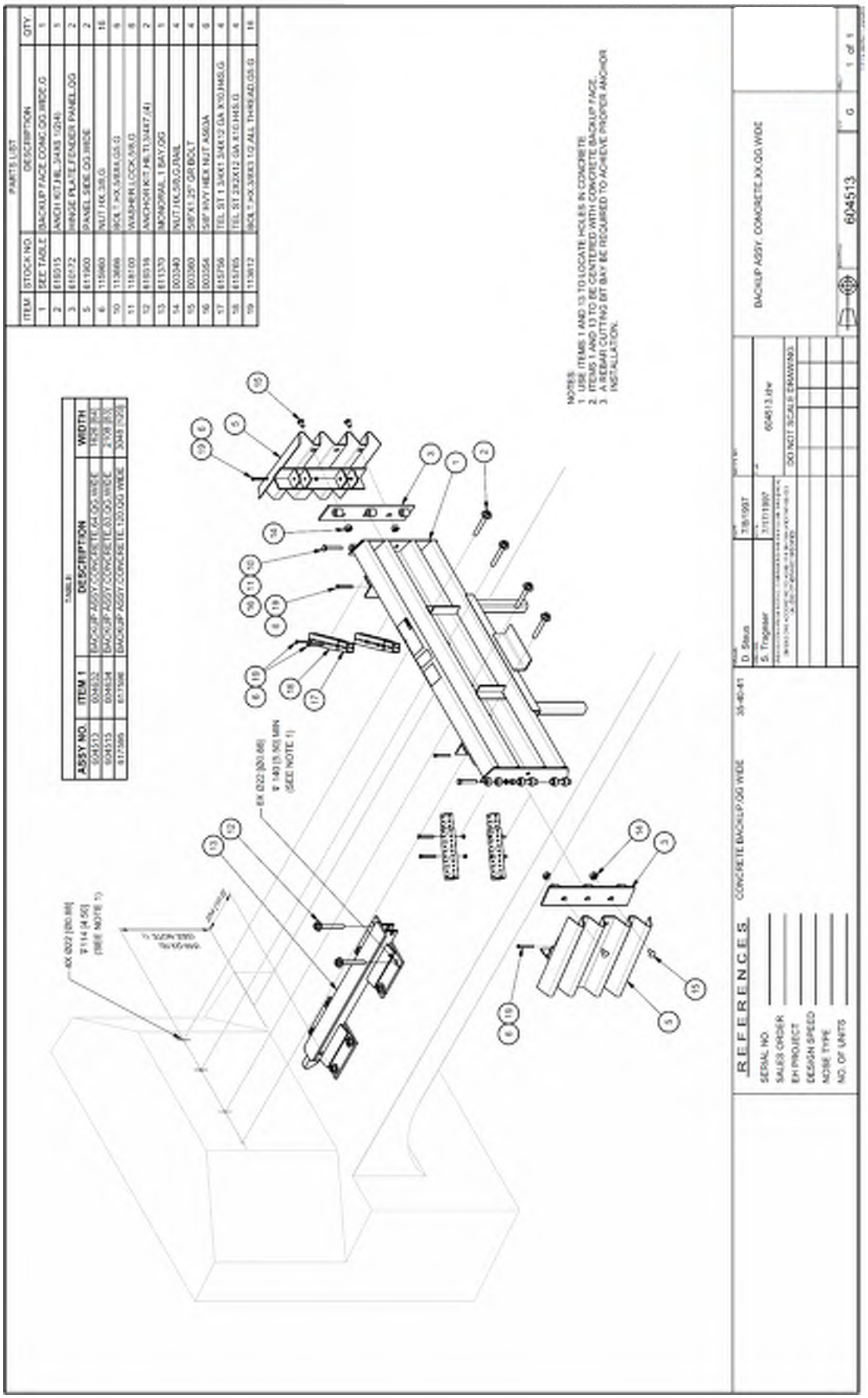
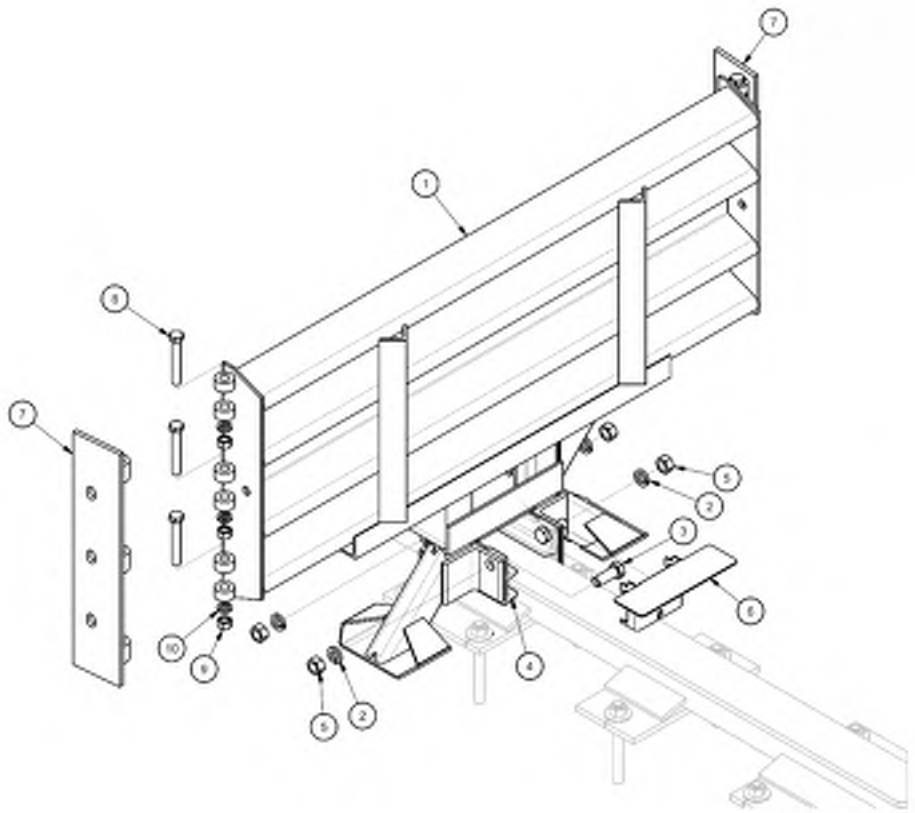


TABLE "R"
15 mm [#5] REBAR REQUIRED*
20 mm [#6] REBAR REQUIRED*
CONCRETE REQUIRED*
METERS | FT | METERS | FT | m³ | Yd³
41 | 138 | 17 | 53 | 1.7 | 6.3
*REQUIRED FOR BACKUP ONLY SEE SHEET 1 FOR PAD DETAILS
1788 [70 1/2]
SPACED EQUALLY
191 [7 1/2]
1500 [63]
1472 [58]
1639 [64 1/2]
508 [20]
514 [20 1/4]
1010 [39 3/4]
38° REF
455 [18 1/2]
260 [10 1/4]
350 [13 3/4]
426 [16 3/4]
853 [33 1/2] REF.
468 [18 1/2]
43 [1 3/4]
227 [9]
508 [20]
1010 [39 3/4]
83° REF
90 [3 1/2]
1580 [62 1/4]
227 [9]
787 [31]
2) 15 mm[#5] 6 REQ'D
3) 20 mm[#6] 7 REQ'D
4) 20 mm[#6] 2 REQ'D
5) 15 mm[#5] 5 REQ'D
6) 15 mm[#5] 1 REQ'D
7) 15 mm[#5] 1 REQ'D
8) 15 mm[#5] 6 REQ'D
51mm [2] CLEAR TYP.
152 [6]
280 [11]
18 [3/4] REF.
915 [32]
GRADE
1727 [68]
76 [3] CLEAR BOTTOM ONLY
915 [36]
305 [12]
457 [18]
610 [24]
SEE NOTE 5 SHEET 1
90° WITH RESPECT TO PAD
SEE SHEET 1
NOTE 1. SEE SHEET 1 NOTES.
REFERENCES
D. Stous 7/25/97
RE 7/24/97
BE 8/18/97
J. Machado 8/19/97
3540411-0000 Sh02.dwg
QUADGUARD® SYSTEM (69")
CONCRETE PAD & BACKUP, QG WIDE
ON GRADE
1:20 | 3540411-0000 | 2 of 3 | 1

[redacted]


QUADGUARD® SYSTEM (90")
CONCRETE PAD & BACKUP, QG WIDE
ON GRADE
3540411-0000
1:20
3 of 3
REFERENCES





PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
11	SEE TABLE	DIAPHRAGM,QB,G	1
2	116089	WASHER,LOCK,3/4,G	4
3	113555	BOLT,HX,3/4X2,GR.G	4
4	511368	MONORAIL GUIDE,QG,G	2
5	303704	3/4" HVY HEX NUT,A563 DH	4
6	605446	BRACKET,CARTRIDGE SUPT,DIA,FOLDED,QG	2
7	613172	HINGE PLATE,FENDER PANEL,QG	2
8	113666	BOLT,HX,5/8X4,GR.G	6
9	303354	5/8" HVY HEX NUT,A563A	6
10	116100	WASHER,LOCK,5/8,G	6

Table

ASSEMBLY NO.	DESCRIPTION	ITEM 1 PART NO.
*607173	DIAPHRAGM ASSY,QG,0873	607786
*607174	DIAPHRAGM ASSY,QG,0753	607730
*607175	DIAPHRAGM ASSY,QG,0853	607771
*607176	DIAPHRAGM ASSY,QG,0913	607773
*607177	DIAPHRAGM ASSY,QG,0993	607775
*607145	DIAPHRAGM ASSY,QG,1373	607777
607146	DIAPHRAGM ASSY,QG,1153	607780
607148	DIAPHRAGM ASSY,QG,1233	607783
607149	DIAPHRAGM ASSY,QG,1273	607787
607150	DIAPHRAGM ASSY,QG,1313	607788
607151	DIAPHRAGM ASSY,QG,1393	607792
607152	DIAPHRAGM ASSY,QG,1473	607796
607156	DIAPHRAGM ASSY,QG,1513	607800
607157	DIAPHRAGM ASSY,QG,1553	607801
607158	DIAPHRAGM ASSY,QG,1633	607804
607159	DIAPHRAGM ASSY,QG,1729	607806
607160	DIAPHRAGM ASSY,QG,1793	607808
607162	DIAPHRAGM ASSY,QG,1873	607811
607163	DIAPHRAGM ASSY,QG,1953	607813
*607164	DIAPHRAGM ASSY,QG,2033	607815

* NO LONGER AVAILABLE

NOTE.
1. QUADGUARD II AND QG810 REQUIRE SHIM KIT, SEE DRAWING 614055.

D. Sliwa	5/12/1997		
J. Machado	7/7/1997	607173.idw	
		DO NOT SCALE DRAWING	

DIAPHRAGM ASSY, QG, WIDE

607173 | N | 1 of 2

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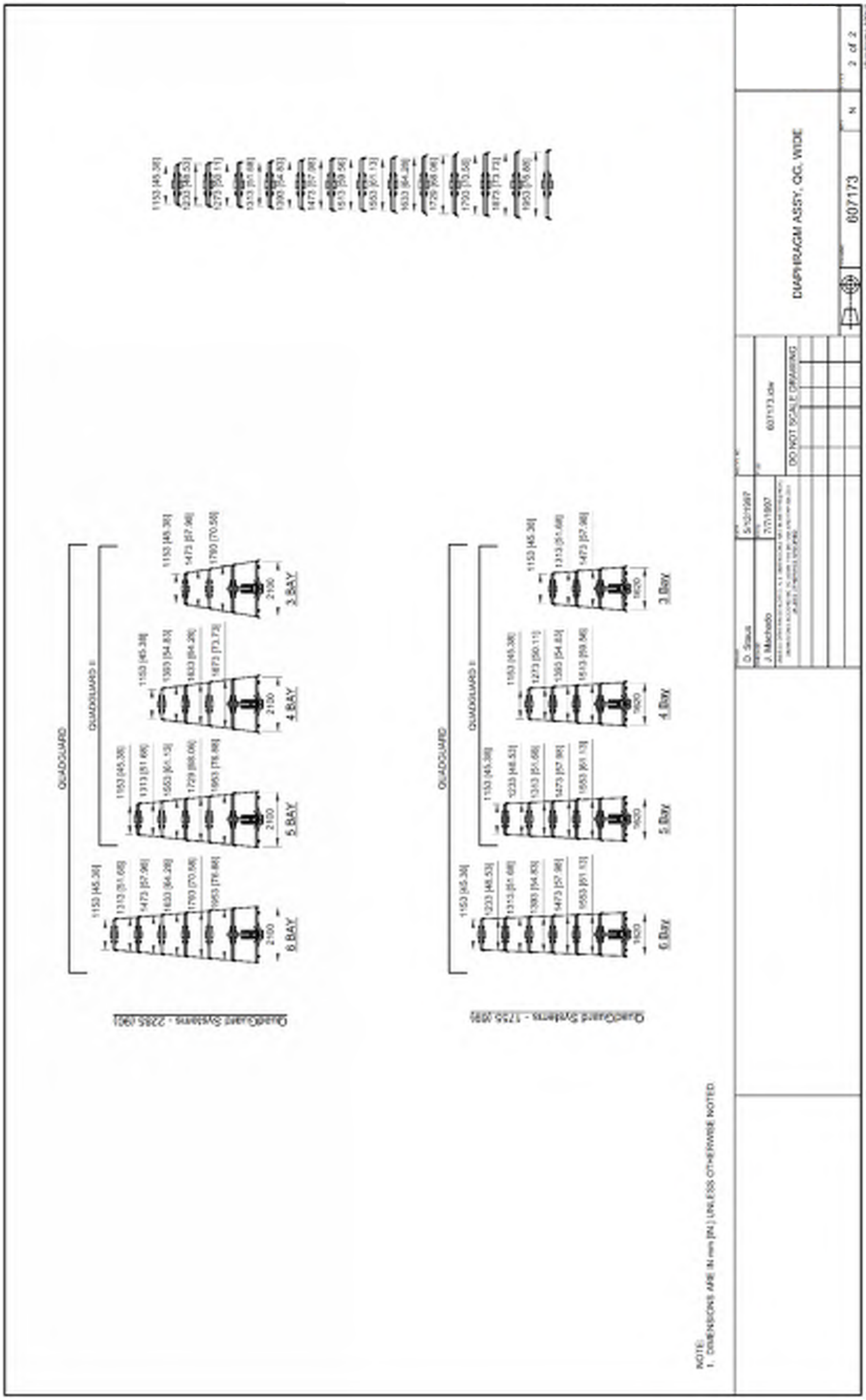
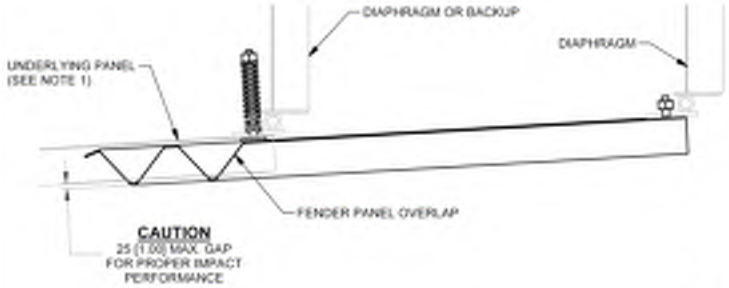
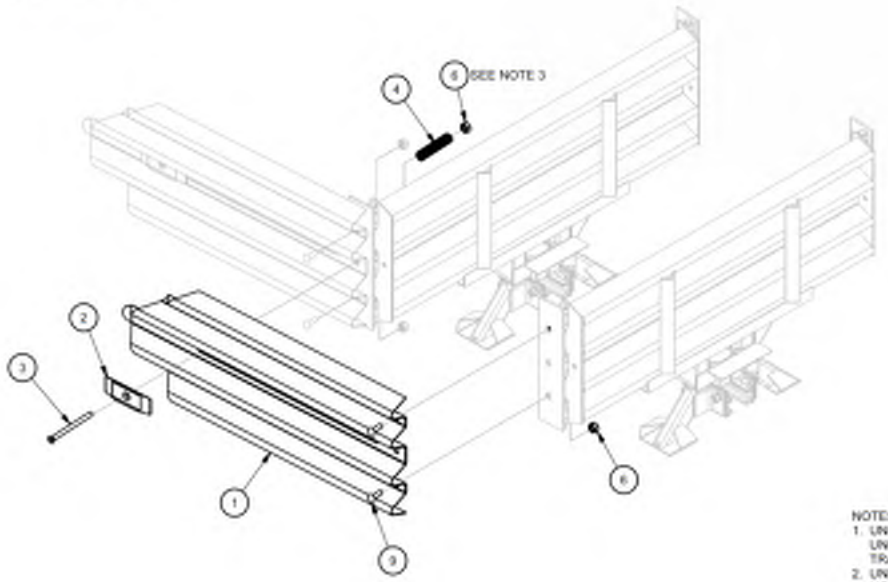

DIAPHRAGM ASSY, QG, WIDE
607173
DO NOT SCALE DRAWING
QUADGUARD
QUADGUARD II
6 BAY
5 BAY
4 BAY
3 BAY
NOTE:
1. DIMENSIONS ARE IN mm [IN.] UNLESS OTHERWISE NOTED.





PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	611832	PANEL,FENDER,QG	1
2	617045	WASHER,MUSHROOM,FORGED,QG,G	1
3	116879	SCREW,FL,5/8X8 1/2,GR.G,SOCKET	1
4	117458	SPRING,DIE,1 1/2 OD X3/4X6,GALV	1
6	003340	NUT,HX,5/8,G,RAIL	3
9	003400	BOLT,RAIL,5/8X2,G	2

TWO FENDER PANEL ASSEMBLIES REQUIRED PER BAY.

NOTES:
1. UNDERLYING PANEL IS A FENDER PANEL IF ATTACHED TO A DIAPHRAGM. UNDERLYING PANEL IS A BACKUP SIDE PANEL, EXTENSION PANEL OR TRANSITION PANEL IF ATTACHED TO THE BACKUP.
2. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
3. TIGHTEN NUT UNTIL IT REACHES END OF THREADS.

ASSEMBLY NO. 608241

D. Staus	6/12/1997
J. Machado	4/15/1997
KRM	7/7/1997
J. Machado	7/7/1997
608241.idw	

QuadGuard - Wide System
FENDER PANEL ASSEMBLY

SCALE	DRAWING	SHEET	REV
1 : 16	608241	1 of 1	J

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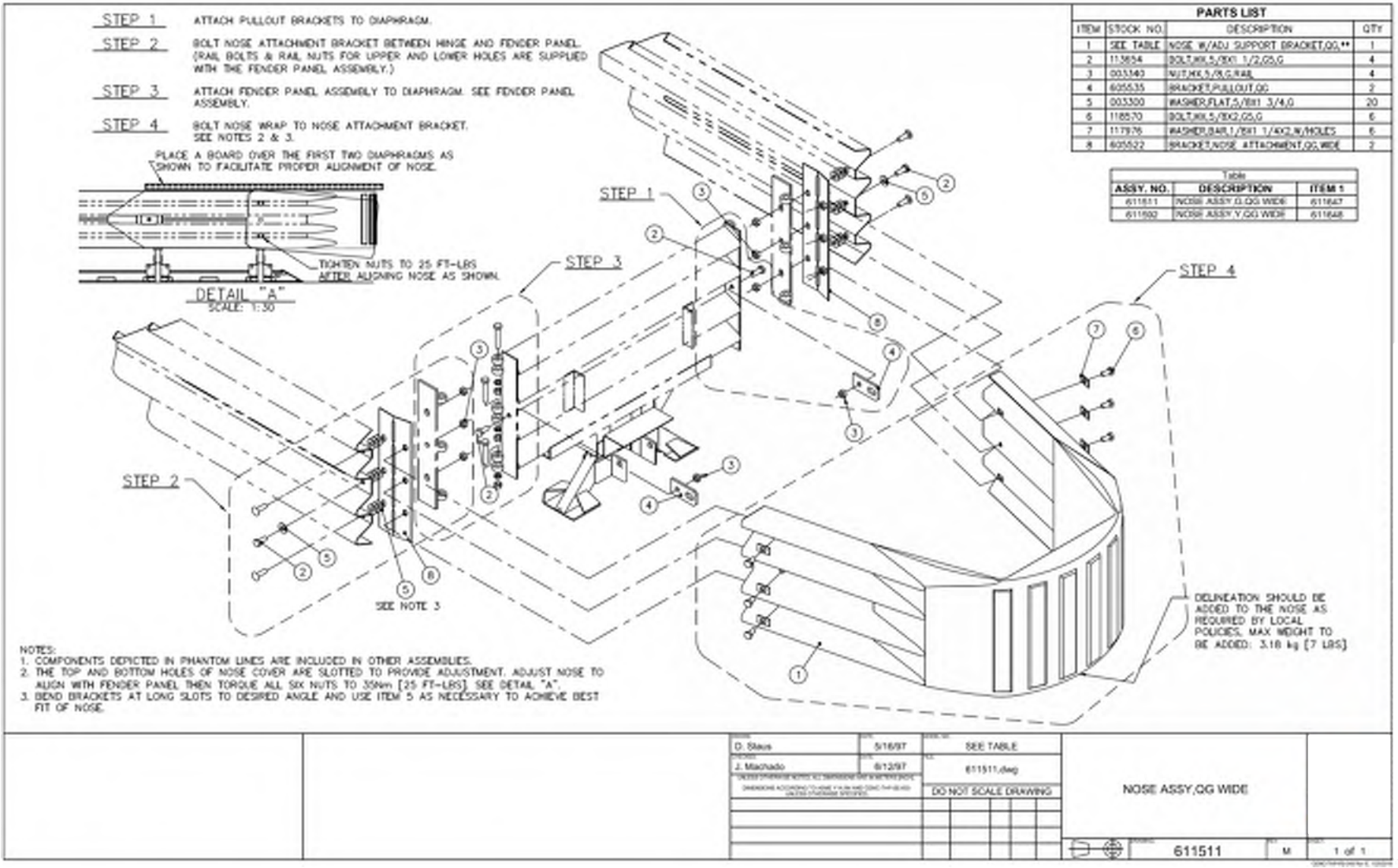


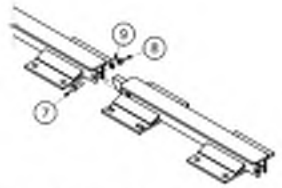
PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY
1	SEE TABLE	NOSE W/ADJ SUPPORT BRACKET,QG,**	1
2	113654	BOLT,HX,5/8X1 1/2,GR.G	4
3	003140	NUT,HX,5/8,G,RAIL	4
4	605535	BRACKET,PULLOUT,QG	2
5	003300	WASHER,FLAT,5/8X1 3/4,G	20
6	118570	BOLT,HX,5/8X2,GR.G	6
7	117976	WASHER,BAR,1/8X1 1/4X2,W/HOLES	6
8	605522	BRACKET,NOSE ATTACHMENT,QG,WIDE	2

Table

ASSY. NO.	DESCRIPTION	ITEM 1
611511	NOSE ASSY,QG WIDE	611647
611502	NOSE ASSY,V,QG WIDE	611648

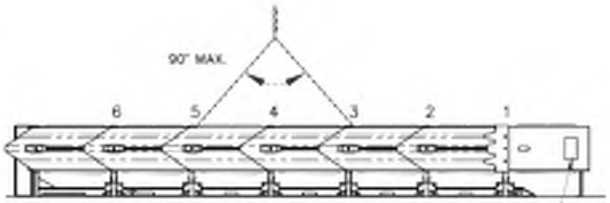
[redacted]



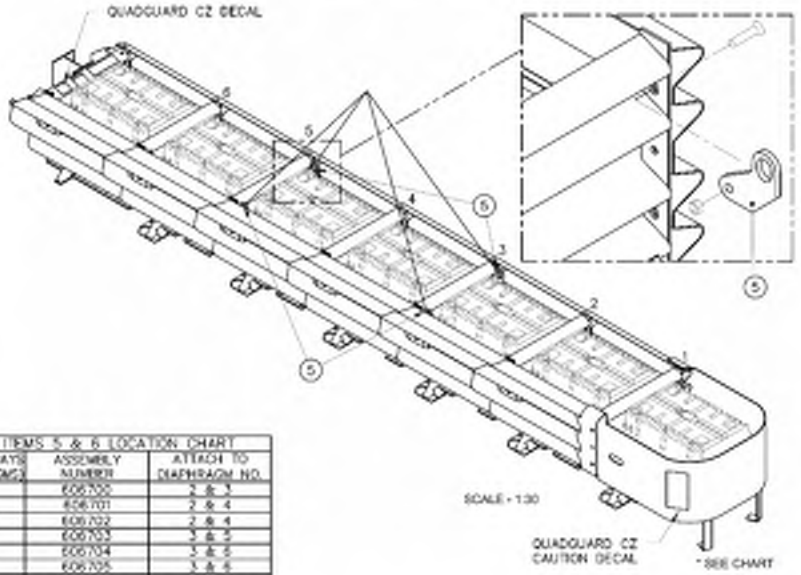
MONORAIL ATTACHMENT

SCALE = 1:25

PARTS LIST								
ITEM	STOCK NO.	DESCRIPTION	REQ'D					
		BAYS →	3	4	5	6	7	8	9
1	116799	ROD,THREADED,3/4x18,GD,G	32	38	46	52	58	66	72
2	003704	NUT,HX,3/4,G,GR DH	32	38	46	52	58	66	72
3	116027	WASHER,FLAT,3/4X2,HVY,G	32	38	46	52	58	66	72
4	116710	ADHESIVE,HY200,330,MIL T	16	19	23	26	29	33	36
5	611207	LIFTING BRACKET,QG,CZ,G	4	4	4	4	4	4	4
7	113660	BOLT,HX,5/8X3 1/2,GD,G	1	1	2	2	2	3	3
8	003354	NUT,HX,5/8,G	1	1	2	2	2	3	3
9	116700	WASHER,LOCK,5/8,G	1	1	2	2	2	3	3
10	115394	INST.,QG CZ ANCHOR/LIFT KIT	1	1	1	1	1	1	1
11	115501	LABEL,CRATT,QG CZ,LIFT KIT	1	1	1	1	1	1	1
12	113797	HIT-RB 7/8" KIT	1	1	1	1	1	1	1



EXAMPLE:
6 BAY QUADGUARD CZ
SCALE - 1:50



ITEMS 5 & 6 LOCATION CHART		
NO. OF BAYS/ DIAPHRAGMS	ASSEMBLY NUMBER	ATTACH TO DIAPHRAGM NO.
3	606700	2 & 1
4	606701	2 & 4
5	606702	2 & 4
6	606703	5 & 2
7	606704	5 & 2
8	606705	5 & 6
9	606706	4 & 7

TO MOVE SYSTEM:

1. Verify monorail sections are bolted together.
2. Attach two lifting brackets each on diaphragms listed (four brackets total). See example.
3. Minimum sling length 3 meters (9 ft). Use fixed equal length slings.
4. Free unit from anchor bolts & grout prior to lifting the system. To accomplish this, start at the nose of the system and use pry bars to gradually raise the system off of the studs. Place blocks such as 2X4's under the monorail and work down the length of unit until the unit is completely free of the studs.
5. Lift the system to new location and re-anchor.
6. ANCHOR SYSTEM FOR PROPER IMPACT PERFORMANCE. Use The Adhesive anchor system, supplied by TRINITY HIGHWAY, or approved equal. QuadGuard cz Systems installed on asphalt must be inspected to ensure the anchors are still properly set following each impact. Re-anchor as necessary. See drawing 35-40-06

ASSEMBLY NO. 606700

SEE PARTS LIST	D. Stous	10/7/96	TOLERANCES PER CEMC-THP-SF-001, UNLESS OTHERWISE SPECIFIED.	QuadGuard® SYSTEM CZ ANCHOR / LIFTING KIT,GG. (3–9 BAYS)
N/A	S. Turner	10/15/96	DO NOT SCALE DRAWING	INSTRUCTION NO. 115394
ESTIMATED WEIGHT: VARIES				606700 K 1 of 2

[redacted]

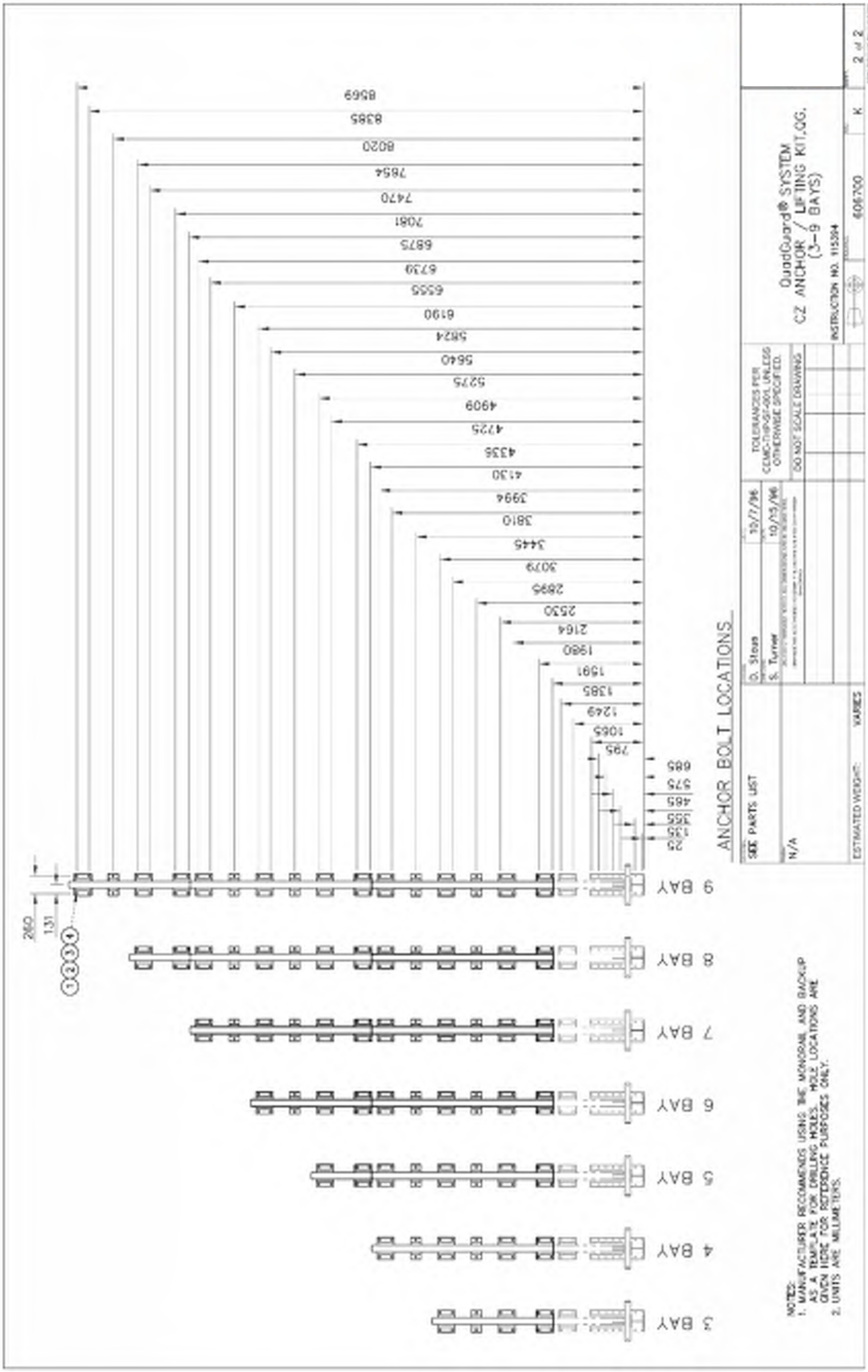
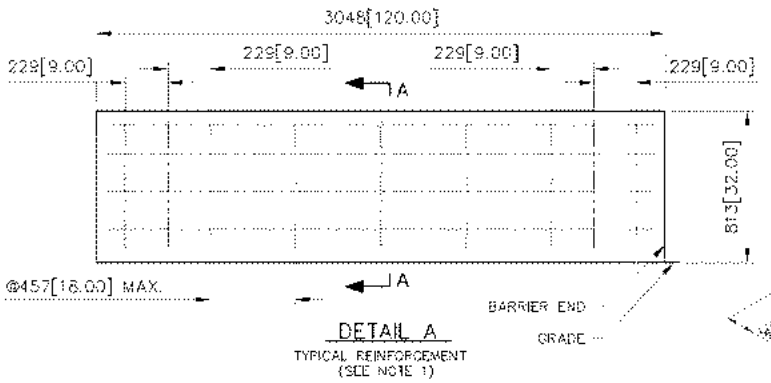
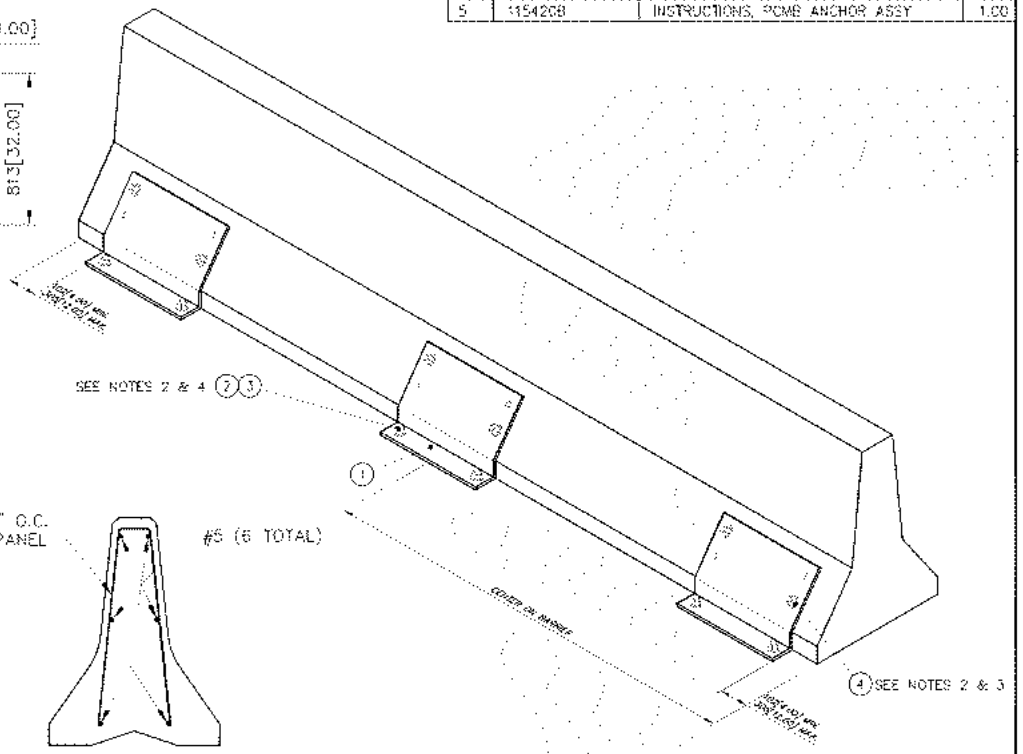

ANCHOR BOLT LOCATIONS
3 BAY
4 BAY
5 BAY
6 BAY
7 BAY
8 BAY
9 BAY
QuadGuard® SYSTEM
CZ ANCHOR / LIFTING KIT,OG,
(3-9 BAYS)
606700
NOTES:
1. MANUFACTURER RECOMMENDS USING THE MONORAIL AND BACKUP AS A TEMPLATE FOR DRILLING HOLES. HOLE LOCATIONS ARE GIVEN HERE FOR REFERENCE PURPOSES ONLY.
2. UNITS ARE MILLIMETERS.

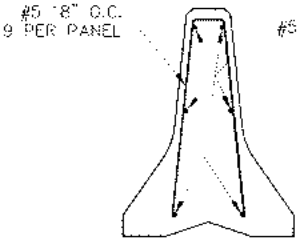
TABLE		
ASSEMBLY NO.	ITEM 1	ITEM 1 DESCRIPTION
6120068	6120060	ANCHOR,PCMB,QG,G
603648B	603653G	ANCHOR,BARRIER,F-SHAPE,G

PARTS LIST			
ITEM	STOCK NO	DESCRIPTION	REVS
1	SEE TABLE	SEE TABLE	6.00
2	603676B	ANCHOR,MP-3,QUART KIT,CZ	3.00
3	1157996	ROD THREADED 3/4X18, GS,G	12.00
4	603670B	ANCHOR, MP-3,PT KIT,3/4X6 1/2 HOR	2.00
5	1154208	INSTRUCTIONS, PCMB ANCHOR ASSY	1.00



DETAIL A
TYPICAL REINFORCEMENT
(SEE NOTE 1)





SECTION A-A

NOTE:
1. THE REINFORCEMENT SHOWN IN DETAIL "A" IS RECOMMENDED FOR PORTABLE CONCRETE BARRIER TO ENSURE ADEQUATE BARRIER INTEGRITY WHEN USED IN COMBINATION WITH THE QUADGUARD SYSTEM. THE DETAIL SHOWN IS BASED ON STATE OF CALIFORNIA STANDARD PLANS FOR TEMPORARY RAILING (TYPE K). VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.
2. USE ANCHOR PLATE AS TEMPLATE FOR DRILLING.
3. RECOMMENDED HOLE DEPTH INTO PCMB IS 127[5.00]. DRILL 4 HOLES IF NECESSARY TO INSTALL A MINIMUM OF 2 ANCHOR BOLTS PER BRACKET. FINAL TORQUE TO BE 163 kN[120 ft-lbs] (TYP.)
4. IMPACT FORCES CAN BE TRANSFERRED INTO TERMINAL END OF THE BARRIER. ADEQUATE ANCHORAGE IS REQUIRED TO ENSURE PROPER IMPACT PERFORMANCE. PCMB MUST BE ANCHORED TO A RIGID SURFACE (NOT DIRT) WITH A MINIMUM OF 12 THREADED RODS (ITEM 3) AS SHOWN, ANCHOR BOTH SIDES OF BARRIER USING ITEM 1 (6 REQUIRED). ATTACH PCMB USING ONE OF THE FOLLOWING:
   6 1/2" STUDS MAY BE USED TO ANCHOR PCMB TO 28 MPa [4000 PSI] MIN. P.C. CONCRETE PER THE FOLLOWING MINIMUM CONCRETE DEPTHS:**
   a) 150 [6.00] NON-REINFORCED ROADWAY.
   b) 180 [7.00] DECK STRUCTURE.
   18" THREADED RODS MAY BE USED TO ANCHOR PCMB TO ASPHALT.(6" MIN. THICKNESS)**
5. MIN. 28 MPa [4,000 PSI] P.C. CONCRETE MEDIAN BARRIER.
6. DIMENSIONS ARE IN MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

**REFER TO THE QUADGUARD CZ MP-3 ANCHORING SYSTEM INSTALLATION INSTRUCTIONS FOR SPECIFICATIONS.

ASSEMBLY NO. 603648B
ASSEMBLY NO. 6120068

REFERENCES

J. Espinoza	7/31/97
S. Turner	11/07/96
KRM	9/12/97
SPT	9/17/97
512005.dwg	

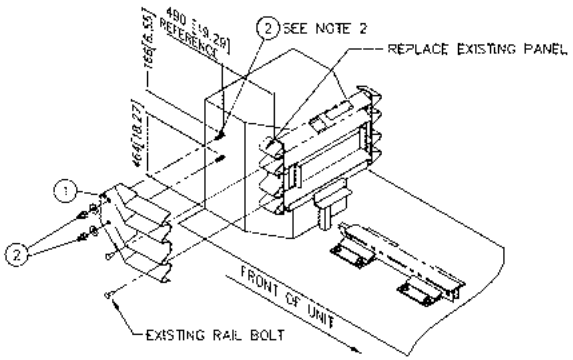
QUADGUARD™ SYSTEM
PCMB ANCHOR ASSEMBLY

INSTRUCTION NUMBER 1154208

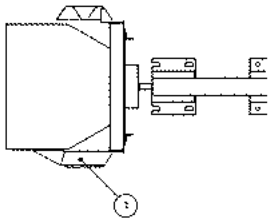
N.T.S.	612005	1 of 1	0

[redacted]

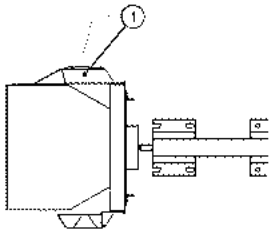
PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	608122G	SIDE PANEL,END SHOE,QG,G	1.00
2	603670B	ANCHOR,MP-3,PT KIT,3/4X6 1/2 HCR	1.00



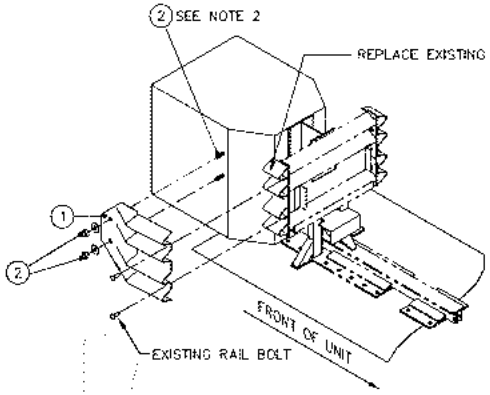
CONCRETE BACKUP



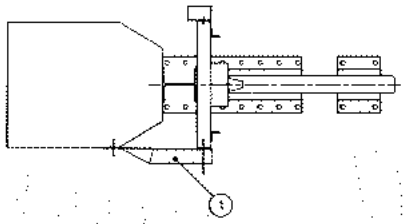
LEFT SIDE APPLICATION



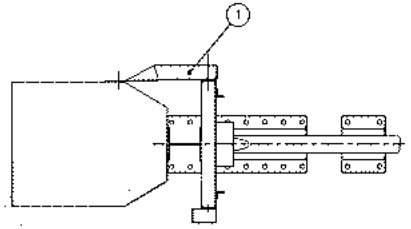
RIGHT SIDE APPLICATION



TENSION STRUT BACKUP



LEFT SIDE APPLICATION



RIGHT SIDE APPLICATION

NOTES:
1. DIMENSIONS ARE IN MILLIMETERS [INCHES].
2. USE END SHOE AS TEMPLATE FOR DRILLING. RECOMMENDED HOLE DEPTH 127 [5.00]. FINAL TORQUE TO BE 163Nm [120 FT-LBS] (TYP). ANCHOR STUD END SHOULD BE FLUSH WITH OUTSIDE SURFACE OF ANCHOR NUT.

REFERENCES

DRAWN: B. Staus	DATE: 5/24/96
DESIGNED: WGK	DATE: 3/1/96
CHECKED: S. Trageser	DATE: 5/5/96
APPROVED: W. Krage	DATE: 6/5/96
CAD FILE: 608105.dwg	
NEXT ASSEMBLY:	

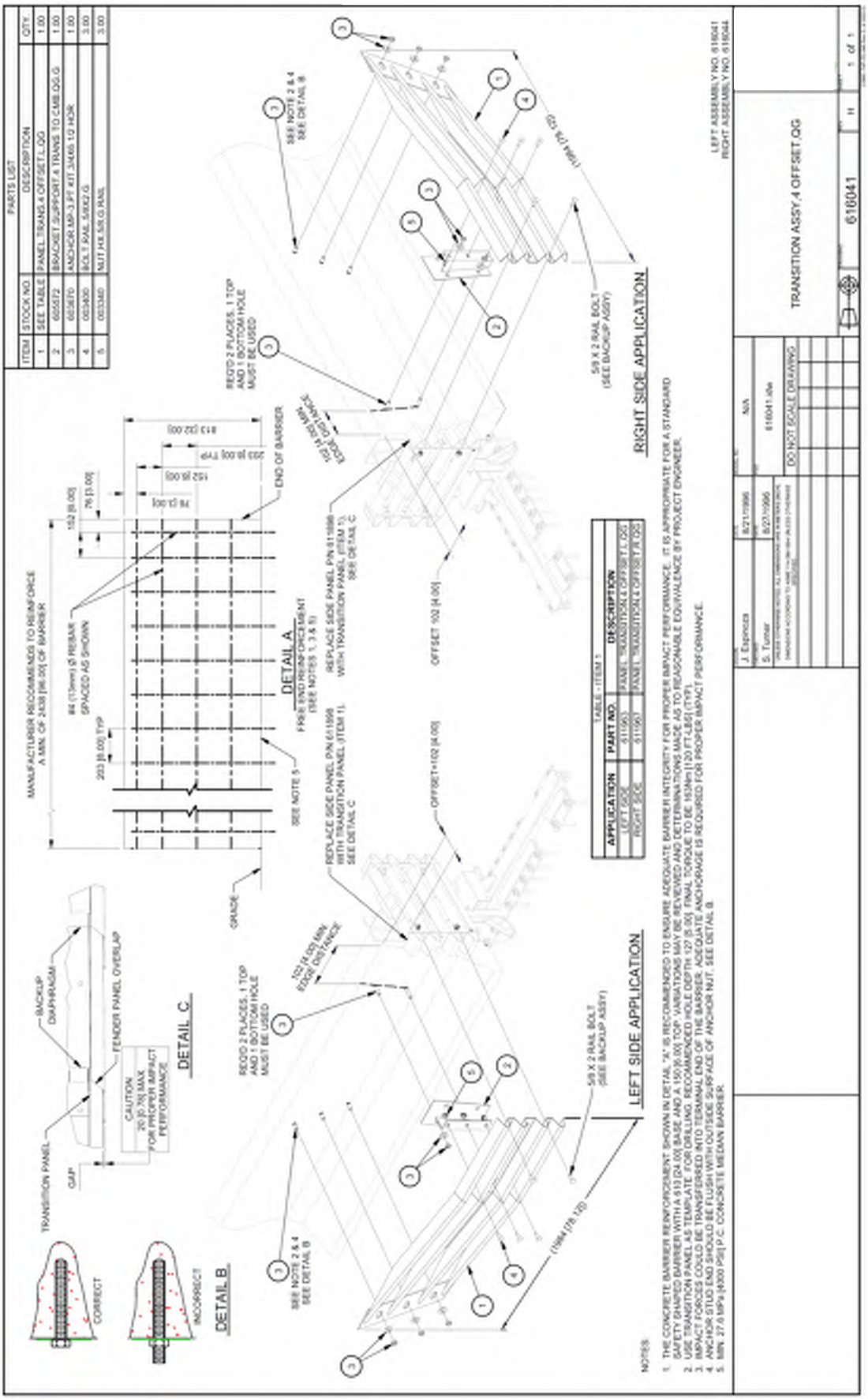
ASSEMBLY NO. 608105B

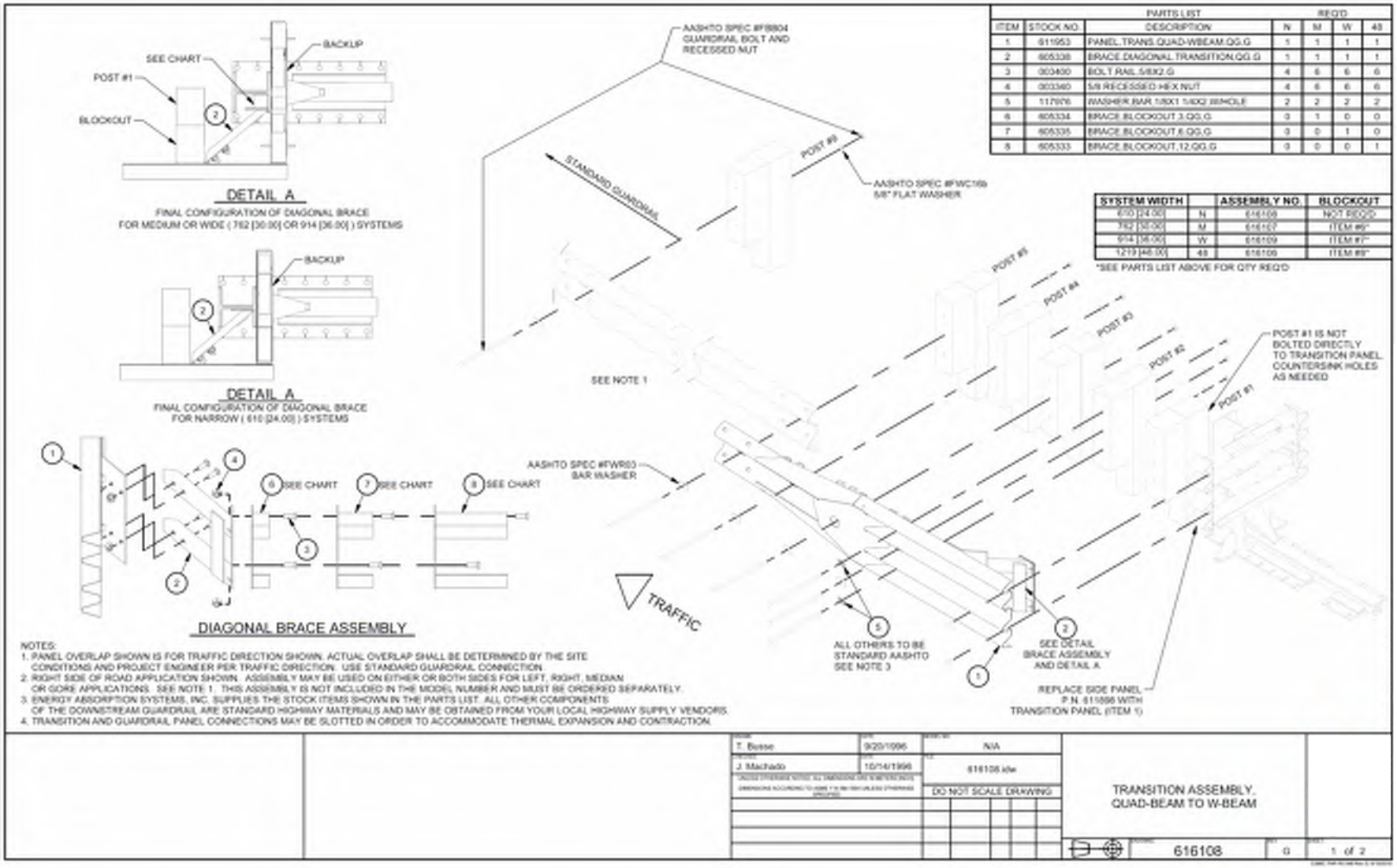
QUADGUARD® SYSTEM

END SHOE ASSY,QG

SCALE	DWG.	SHEET	REV
N.T.S.	608105	1 of 1	I

[redacted]


PARTS LIST
ITEM | STOCK NO | DESCRIPTION | QTY.
1 | SEE TABLE | PANEL TRANS,4 OFFSET,L-QG | 1.00
2 | 605572 | BRACKET,SUPPORT,4 TRANS TO CMB QG/G | 1.00
3 | 605870 | ANCHOR,M9-3,PF KIT,3/4X6 1/2 HOK | 1.00
4 | 083430 | BOLT,RAIL,5/8X2 G | 3.00
5 | 083340 | NUT,HX,5/8 G,RAIL | 3.00
TABLE 1 ITEM 1
APPLICATION | PART NO | DESCRIPTION
LEFT SIDE | 61196() | PANEL-TRANSITION,QC,OFFSET,L,QG
RIGHT SIDE | 61196() | PANEL-TRANSITION,QC,OFFSET,R,QG
LEFT SIDE APPLICATION
RIGHT SIDE APPLICATION
DETAIL A
DETAIL B
DETAIL C
TRANSITION ASSY,4 OFFSET,QG
616041
DO NOT SCALE DRAWING
LEFT ASSEMBLY NO. 616041
RIGHT ASSEMBLY NO. 616044
NOTES
1. THE CONCRETE BARRIER REINFORCEMENT SHOWN IN DETAIL "A" IS RECOMMENDED TO ENSURE ADEQUATE BARRIER INTEGRITY FOR PROPER IMPACT PERFORMANCE. IT IS APPROPRIATE FOR A STANDARD SAFETY SHAPED BARRIER WITH A 610 [24.00] BASE AND A 150 [6.00] TOP. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.
2. USE TRANSITION PANEL AS TEMPLATE FOR DRILLING. RECOMMENDED HOLE DEPTH 127 [5.00]. FINAL TORQUE TO BE 163Nm [120 FT-LBS] (TYP).
3. IMPACT FORCES COULD BE TRANSFERRED INTO TERMINAL END OF THE BARRIER. ADEQUATE ANCHORAGE IS REQUIRED FOR PROPER IMPACT PERFORMANCE.
4. ANCHOR STUD END SHOULD BE FLUSH WITH OUTSIDE SURFACE OF ANCHOR NUT. SEE DETAIL B.
5. MIN 27.6 MPa [4000 PSI] P.C. CONCRETE MEDIAN BARRIER.



PARTS LIST			REQ'D			
ITEM	STOCK NO.	DESCRIPTION	N	M	W	48
1	611953	PANEL,TRANS,QUAD-WBEAM,GG,G	1	1	1	1
2	605338	BRACE,DIAGONAL,TRANSITION,GG,G	1	1	1	1
3	003400	BOLT,RAIL,5/8X2,G	4	6	6	6
4	003340	5/8 RECESSED HEX NUT	4	6	6	6
5	117976	WASHER,BAR,1/8X1 1/4DIA W/HOLE	2	2	2	2
6	605334	BRACE,BLOCKOUT,3,GG,G	0	1	0	0
7	605335	BRACE,BLOCKOUT,6,GG,G	0	0	1	0
8	605333	BRACE,BLOCKOUT,12,GG,G	0	0	0	1

SYSTEM WIDTH		ASSEMBLY NO.	BLOCKOUT
610 [24.00]	N	616106	NOT REQ'D
762 [30.00]	M	616107	ITEM #6*
914 [36.00]	W	616109	ITEM #7*
1219 [48.00]	48	616108	ITEM #8*

*SEE PARTS LIST ABOVE FOR QTY REQ'D

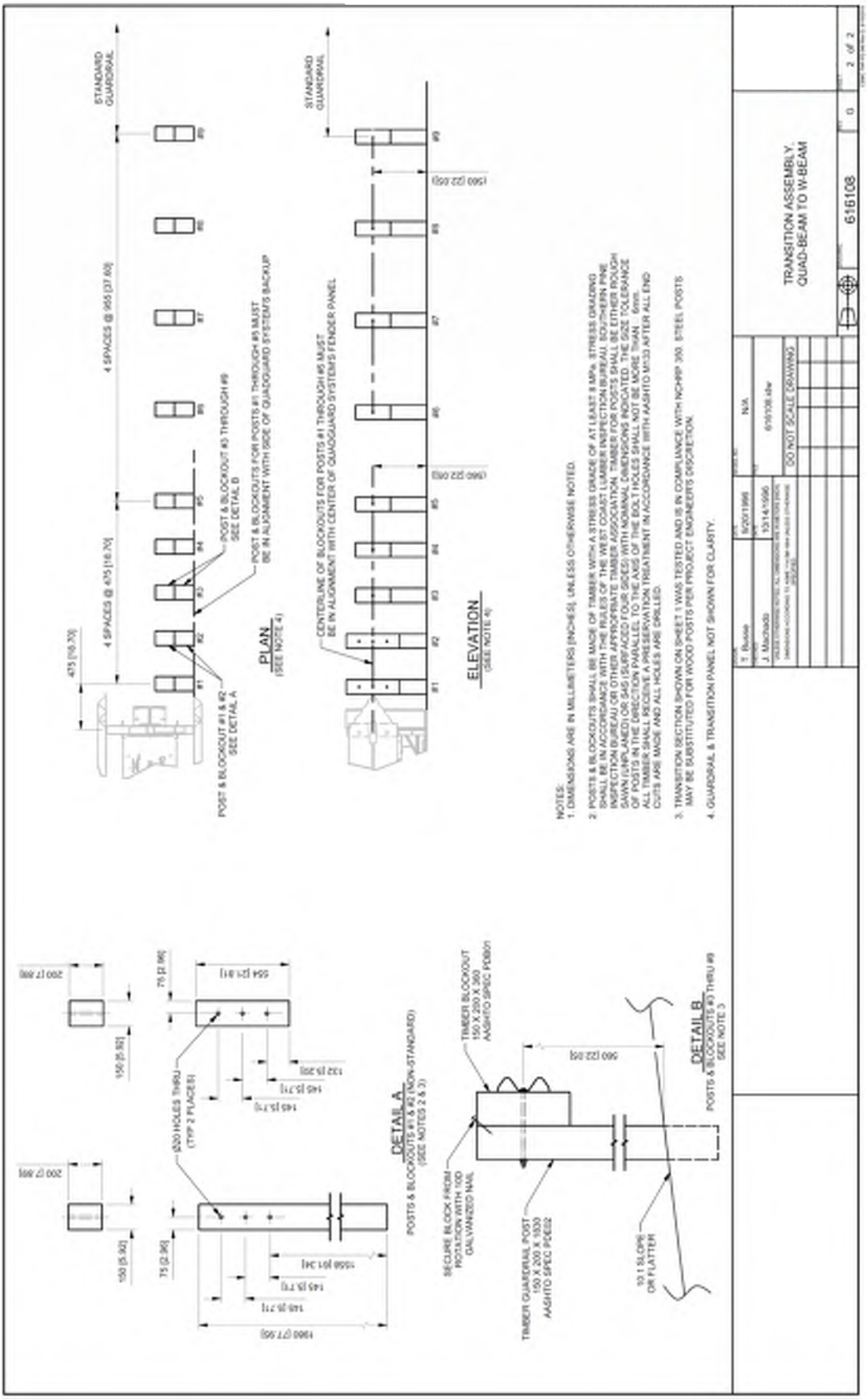
NOTES:
1. PANEL OVERLAP SHOWN IS FOR TRAFFIC DIRECTION SHOWN. ACTUAL OVERLAP SHALL BE DETERMINED BY THE SITE CONDITIONS AND PROJECT ENGINEER PER TRAFFIC DIRECTION. USE STANDARD GUARDRAIL CONNECTION.
2. RIGHT SIDE OF ROAD APPLICATION SHOWN. ASSEMBLY MAY BE USED ON EITHER OR BOTH SIDES FOR LEFT, RIGHT, MEDIAN OR GORE APPLICATIONS. SEE NOTE 1. THIS ASSEMBLY IS NOT INCLUDED IN THE MODEL NUMBER AND MUST BE ORDERED SEPARATELY.
3. ENERGY ABSORPTION SYSTEMS, INC. SUPPLIES THE STOCK ITEMS SHOWN IN THE PARTS LIST. ALL OTHER COMPONENTS OF THE DOWNSTREAM GUARDRAIL ARE STANDARD HIGHWAY MATERIALS AND MAY BE OBTAINED FROM YOUR LOCAL HIGHWAY SUPPLY VENDORS.
4. TRANSITION AND GUARDRAIL PANEL CONNECTIONS MAY BE SLOTTED IN ORDER TO ACCOMMODATE THERMAL EXPANSION AND CONTRACTION.

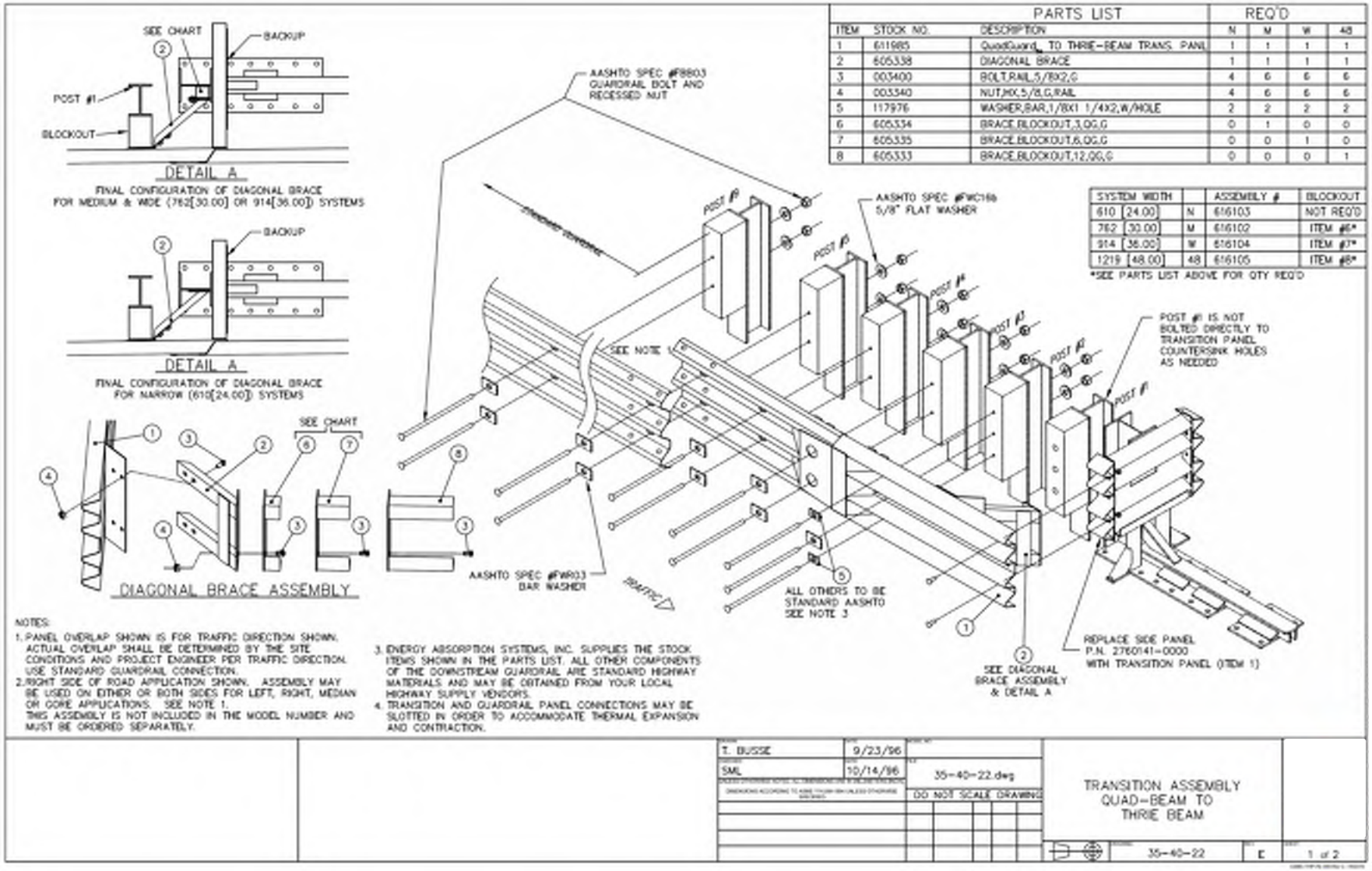
T. Busse	9/20/1996	N/A	
J. Machado	10/14/1996	616108.idw	
		DO NOT SCALE DRAWING	

TRANSITION ASSEMBLY,
QUAD-BEAM TO W-BEAM

616108 | 0 | 1 of 2

[redacted]


TRANSITION ASSEMBLY, QUAD-BEAM TO W-BEAM
616108
DO NOT SCALE DRAWING
PLAN
(SEE NOTE 4)
ELEVATION
(SEE NOTE 4)
DETAIL A
POSTS & BLOCKOUTS #1 & #2 (NON-STANDARD)
(SEE NOTES 2 & 3)
DETAIL B
POSTS & BLOCKOUTS #3 THRU #9
SEE NOTE 3
NOTES:
1. DIMENSIONS ARE IN MILLIMETERS [INCHES], UNLESS OTHERWISE NOTED.
4. GUARDRAIL & TRANSITION PANEL NOT SHOWN FOR CLARITY.



PARTS LIST			REQ'D			
ITEM	STOCK NO.	DESCRIPTION	N	M	W	48
1	611985	QuadGuard, TO THRIE-BEAM TRANS. PANEL	1	1	1	1
2	605338	DIAGONAL BRACE	1	1	1	1
3	003400	BOLT,RAIL,5/8X2,G	4	6	6	6
4	003340	NUT,HX,5/8,G,RAIL	4	6	6	6
5	117976	WASHER,BAR,1/8X1 1/4X2,W/HOLE	2	2	2	2
6	605334	BRACE,BLOCKOUT,3,QQ,G	0	1	0	0
7	605335	BRACE,BLOCKOUT,6,QQ,G	0	0	1	0
8	605333	BRACE,BLOCKOUT,12,QQ,G	0	0	0	1

SYSTEM WIDTH		ASSEMBLY #	BLOCKOUT
610 [24.00]	N	616103	NOT REQ'D
762 [30.00]	M	616102	ITEM #6*
914 [36.00]	W	616104	ITEM #7*
1219 [48.00]	48	616105	ITEM #8*

*SEE PARTS LIST ABOVE FOR QTY REQ'D

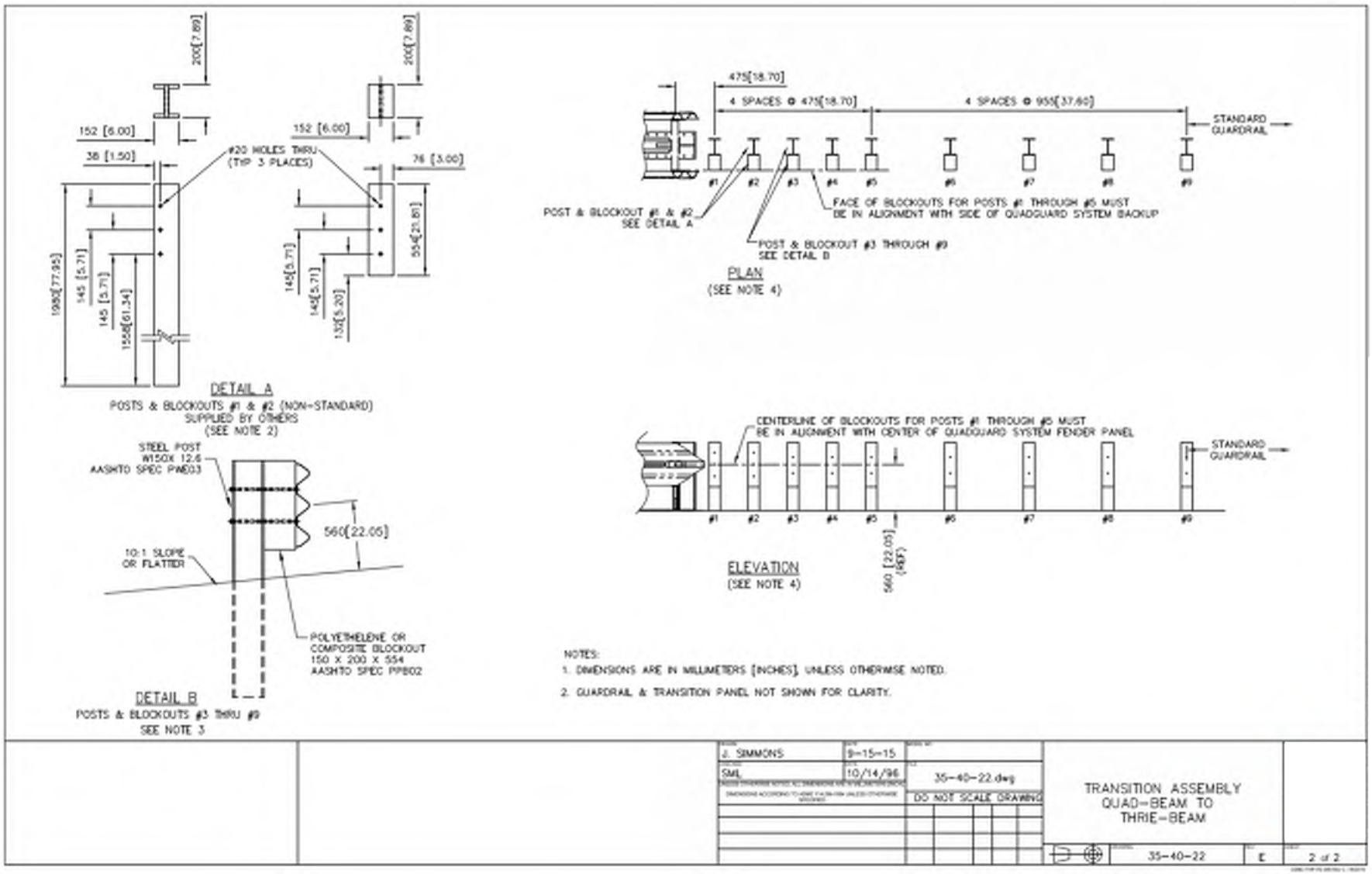
NOTES:
1. PANEL OVERLAP SHOWN IS FOR TRAFFIC DIRECTION SHOWN. ACTUAL OVERLAP SHALL BE DETERMINED BY THE SITE CONDITIONS AND PROJECT ENGINEER PER TRAFFIC DIRECTION. USE STANDARD GUARDRAIL CONNECTION.
2. RIGHT SIDE OF ROAD APPLICATION SHOWN. ASSEMBLY MAY BE USED ON EITHER OR BOTH SIDES FOR LEFT, RIGHT, MEDIAN OR CORE APPLICATIONS. SEE NOTE 1. THIS ASSEMBLY IS NOT INCLUDED IN THE MODEL NUMBER AND MUST BE ORDERED SEPARATELY.
3. ENERGY ABSORPTION SYSTEMS, INC. SUPPLIES THE STOCK ITEMS SHOWN IN THE PARTS LIST. ALL OTHER COMPONENTS OF THE DOWNSTREAM GUARDRAIL ARE STANDARD HIGHWAY MATERIALS AND MAY BE OBTAINED FROM YOUR LOCAL HIGHWAY SUPPLY VENDORS.
4. TRANSITION AND GUARDRAIL PANEL CONNECTIONS MAY BE SLOTTED IN ORDER TO ACCOMMODATE THERMAL EXPANSION AND CONTRACTION.

T. BUSSE	9/23/96		
SML	10/14/96	35-40-22.dwg	
		DO NOT SCALE DRAWING	

TRANSITION ASSEMBLY
QUAD-BEAM TO
THRIE BEAM

35-40-22 | E | 1 of 2

[redacted]


200[7.89]
152 [6.00]
38 [1.50]
#20 HOLES THRU (TYP 3 PLACES)
76 [3.00]
1995[77.95]
145 [5.71]
145 [5.71]
1558[61.34]
554[21.81]
DETAIL A
POSTS & BLOCKOUTS #1 & #2 (NON-STANDARD) SUPPLIED BY OTHERS (SEE NOTE 2)
STEEL POST W150X 12.6 AASHTO SPEC PWB03
560[22.05]
10:1 SLOPE OR FLATTER
POLYETHELENE OR COMPOSITE BLOCKOUT 150 X 200 X 554 AASHTO SPEC PPB02
DETAIL B
POSTS & BLOCKOUTS #3 THRU #9 SEE NOTE 3
475[18.70]
4 SPACES @ 475[18.70]
4 SPACES @ 955[37.60]
STANDARD GUARDRAIL
#1 #2 #3 #4 #5 #6 #7 #8 #9
POST & BLOCKOUT #1 & #2 SEE DETAIL A
FACE OF BLOCKOUTS FOR POSTS #1 THROUGH #5 MUST BE IN ALIGNMENT WITH SIDE OF QUADGUARD SYSTEM BACKUP
POST & BLOCKOUT #3 THROUGH #9 SEE DETAIL B
PLAN
(SEE NOTE 4)
CENTERLINE OF BLOCKOUTS FOR POSTS #1 THROUGH #5 MUST BE IN ALIGNMENT WITH CENTER OF QUADGUARD SYSTEM FENDER PANEL
STANDARD GUARDRAIL
#1 #2 #3 #4 #5 #6 #7 #8 #9
560 [22.05] (REF)
ELEVATION
(SEE NOTE 4)
NOTES:
1. DIMENSIONS ARE IN MILLIMETERS [INCHES], UNLESS OTHERWISE NOTED.
2. GUARDRAIL & TRANSITION PANEL NOT SHOWN FOR CLARITY.
J. SIMMONS
9-15-15
SML
10/14/96
35-40-22.dwg
DO NOT SCALE DRAWING
TRANSITION ASSEMBLY QUAD-BEAM TO THRIE-BEAM
35-40-22
E
2 of 2

Notes:

Notes:

VALTIR
A TIER ABOVE

For more complete information on Valtir products and services, visit us on the web at www.valtir.com. Materials and specifications are subject to change without notice. Please contact Valtir to confirm that you are referring to the most current instructions.

WWW.VALTIR.COM

1.888.323.6374

VALTIR

QuadGuard®
CRASH CUSHION
ASSEMBLY MANUAL

PN 115348
REVISION D NOVEMBER 2022

QuadGuard®

The QuadGuard® system has been tested pursuant to National Cooperative Highway Research Program ("NCHRP") Report 350 specifications. The QuadGuard® system has been deemed eligible for federal-aid reimbursement on the National Highway System by the Federal Highway Administration ("FHWA").

Assembly Manual

15601 Dallas Parkway
Suite 525
Addison, Texas 75001

Warning: The local highway authority, distributors, owners, contractors, lessors, and lessees are RESPONSIBLE for the assembly, maintenance, and repair of the QuadGuard®. Failure to fulfill these RESPONSIBILITIES with respect to the assembly, maintenance, and repair of the QuadGuard® could result in serious injury or death.

Important: These instructions are for standard assembly specified by the appropriate highway authority. In the event the specified system assembly, maintenance, or repair would result in a deviation from these assembly instructions, contact the appropriate highway authority engineer.

This manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Valtir directly at (888) 323-6374 or visit Valtir.com.

The instructions contained in this manual supersede all previous information and manuals. All information, illustrations, and specifications in this manual are based on the latest QuadGuard® information available to Valtir at the time of printing. We reserve the right to make changes at any time. Please contact Valtir to confirm that you are referring to the most current instructions.

Part No. 115348

Table of Contents

Customer Service Contacts

Valtir is committed to the highest level of customer service. Feedback regarding the QuadGuard®, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

Valtir

Telephone:	(888) 323-6374 (USA) (312) 467-6750 (International)
E-mail:	Valtir.com/Contact
Internet:	Valtir.com

Important Introductory Notes

Proper assembly of the QuadGuard® system is critical to achieve performance that has been evaluated and deemed eligible by the FHWA per NCHRP Report 350. These instructions should be read in their entirety and understood before assembling the QuadGuard®. These instructions are to be used in conjunction with the assembly of QuadGuard® and are for standard assemblies only as specified by the applicable highway authority. If you need additional information, or have questions about the QuadGuard®, please contact the highway authority that has planned and specified this assembly and, if needed, contact Valtir Customer Service. This product must be assembled in the location specified by the appropriate highway authority. If there are deviations, alterations, or departures from the assembly instructions specified in this manual, the device may not perform as tested.

Important: **DO NOT** use any component part that has not been specifically specified herein for the QuadGuard® during assembly or repair.

This product has been specified for use by the appropriate highway authority and has been provided to that user who has unique knowledge of how this system is to be assembled. No person should be permitted to assist in the assembly, maintenance, or repair of this system that does not possess the unique knowledge described herein. These instructions are intended for an individual qualified to both read and accurately interpret them as written. These instructions are intended only for an individual experienced and skilled in the assembly of highway products that are specified and selected by the highway authority.

A manufacturer's drawing package will be supplied by Valtir upon request. Each system will be supplied with a specific drawing package unique to that system. Such drawings take precedence over information in this manual and shall be studied thoroughly by a qualified individual who is skilled in interpreting them before the start of any product assembly.

Safety Symbols

This section describes the safety symbols that appear in this QuadGuard® manual. Read the manual for complete safety and assembly information.

Symbol	Meaning
	**Safety Alert Symbol:** Indicates Important, Caution, Warning, or Danger. Failure to read and follow the Important, Caution, Warning, or Danger indicators could result in serious injury or death to the workers and/or bystanders.
	**Warning:** Read safety instructions thoroughly and follow the assembly directions and suggested safe practices before assembling, maintaining, or repairing the QuadGuard®. It is the responsibility of the installer to follow the instruction contained in this manual. Failure to comply with these warnings could result in increased risk of serious injury or death in the event of a vehicle impact with a system.
	**Important:** Please keep up-to-date instructions for later use and reference by anyone involved in the assembly of the product.

Safety Rules for Assembly

*** Important Safety Instructions ***

This manual must be kept in a location where it is readily available to persons who are skilled and experienced in the assembly, maintenance, or repair of the QuadGuard®. Additional copies of this manual are available from Valtir by calling (888) 323-6374, or by visiting Valtir.com/Contact. Please contact Valtir if you have any questions concerning the information in this manual or the QuadGuard®.

It is the responsibility of the installer to use appropriate safety precautions when operating power equipment, mixing chemicals, and when moving heavy equipment or QuadGuard® components. Safety articles including but not necessarily limited to work gloves, eye protection, safety-toe shoes, and back protection should be used.

Warning: It is the responsibility of the installer to use all safety measures incorporating appropriate traffic control devices specified by the highway authority. These measures must be used to protect all personnel while at the assembly, maintenance, or repair site.

Warning: Failure to comply with these warnings could result in increased risk of serious injury or death in the event of a vehicle impact with a system that has not been accepted by the FHWA.

Warning: Use only Valtir parts on the QuadGuard® for assembly, maintenance, or repair. The use of component parts not specified herein is **strictly prohibited**. The QuadGuard® assembled with Valtir Parts has been tested, approved, and accepted for state use by the FHWA. A QuadGuard® using parts other than those specified herein has not been tested, approved, or accepted for state use by the FHWA. Failure to follow this warning could result in increased risk of serious injury or death in the event of a vehicle impact.

Limitations and Warnings

Valtir contracts with FHWA approved testing facilities to perform crash tests, evaluate test results, and submit results to the FHWA for review.

The QuadGuard® system has been deemed eligible for reimbursement by FHWA as meeting the requirements and guidelines of NCHRP Report 350. NCHRP Report 350 tests are designed to evaluate product performance involving a range of vehicles on roadways, from lightweight cars (approx. 1800 lb. [820 kg]) to full size pickup trucks (approx. 4400 lb. [2000 kg]). A product can be certified for multiple Test Levels. The QuadGuard® system is certified to the Test Level(s) as shown below:

Test Level 2: 43 mph [70 kph]

Test Level 3: 62 mph [100 kph]

These FHWA directed tests are not intended to represent the performance of systems when impacted by every vehicle type or every impact condition existing on the roadway. This system is tested only to the test matrix criteria of NCHRP Report 350 as approved by FHWA.

Valtir expressly disclaims any warranty or liability for injury or damage to persons or property resulting from any impact, collision or harmful contact with products, other vehicles, or nearby hazards or objects by any vehicle, object or person, whether or not the products were assembled in consultation with Valtir or by third parties.

The QuadGuard® is intended to be assembled, delineated, and maintained within specific state and federal guidelines. It is important for the highway authority specifying the use of a highway product to select the most appropriate product configuration for its site specifications. The customer should be careful to properly select, assemble, and maintain the product. Site lay out, vehicle population type; speed, traffic direction, and visibility are important elements that require evaluation in the selection of a highway product. For example, curbs could cause an untested effect on an impacting vehicle.

After an impact occurs, the debris from the impact should be removed from the area immediately and the specified highway product should be evaluated and restored to its original specified condition or replaced as the highway authority determines as soon as possible.

Important: It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to determine whether use or reuse of any part of the system is appropriate or acceptable following an impact. Valtir makes no recommendation or suggestion regarding this determination. Each impact is unique.

System Overview

The QuadGuard® is a potentially reusable, re-directive, non-gating crash cushion for roadside obstacles ranging in width from 24” to 126” (610 mm to 3200 mm). It consists of energy-absorbing cartridges surrounded by a framework of Quad-Beam Panels.

Important: Valtir makes no recommendation whether use or reuse of any part of the system is appropriate or acceptable following an impact. It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to make that determination. It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.

The QuadGuard® utilizes two types of cartridges in a staged configuration designed to address both lighter cars and heavier, high center-of-gravity vehicles. Its modular design allows the system length to be tailored to the design speed and appropriate number of Bays for a site (p. 39).

Impact Performance

The 6 Bay QuadGuard® systems have successfully passed the requirements stipulated in NCHRP Report 350, Test Level 3 tests with both the light car and pickup at speeds of up to 62 mph [100 km/h] at angles up to 20 degrees.

During head-on impact testing, within NCHRP Report 350 criteria, the QuadGuard® is designed to telescope rearward to absorb the energy of impact. When impacted from the side, within the applicable NCHRP Report 350 criteria, it is designed to redirect the vehicle back toward its original travel path and away from the roadside obstacle.

Warning: Do NOT modify the QuadGuard® in any way.

Warning: Ensure that the QuadGuard® system and delineation used meet all federal, state, specifying agency, appropriate Manual on Uniform Traffic Control Devices (“MUTCD”), and local specifications.

Warning: It is the responsibility of the installer to ensure that your assembly procedure meets all appropriate Occupational Safety and Health Administration (“OSHA”) and local standards.

Inspect Shipping

Before deploying the QuadGuard®, check the received parts against the shipping list supplied with the system. Make sure all parts have been received.

Important: The Manufacturer’s Drawing Package supplied with the QuadGuard® must be used with these instructions for proper assembly and should take precedence over these general instructions.

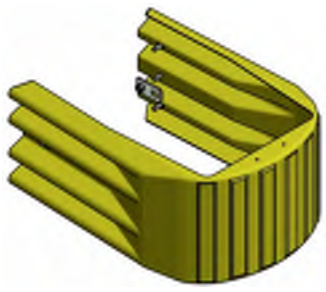
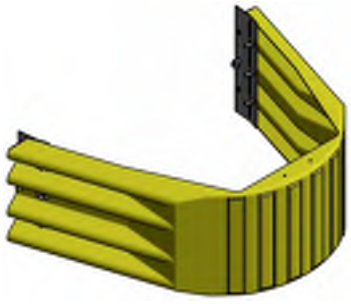
System Components

Below is a list of system components to be used in the repair of your particular QuadGuard® configuration. Please call Valtir customer support if you have any system questions (p. 3).

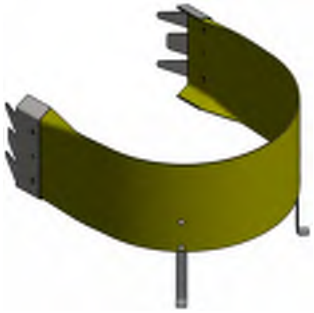
Warning: Use only Valtir parts that are specified herein for the QuadGuard® for assembling, maintaining, or repairing the QuadGuard®. **Do not utilize or otherwise comingle parts from other systems even if those systems are other Valtir systems.** Such configurations have not been tested, nor have they been deemed eligible for use. Assembly, maintenance, or repairs using unspecified parts or accessories is strictly prohibited.

Note: Components are not shown to scale.

Narrow Diaphragm Assemblies *	Wide Diaphragm Assemblies *		
			
625650 - 24” 625651 - 30” 625652 - 36” 606810 - 48”	607173 - 26.48” 607174 – 29.65” 607175 – 32.78” 607176 – 35.93” 607177 – 39.08” 607145 – 42.23” 607146 – 45.38”	607148 – 48.53” 607149 – 50.11” 607150 – 51.68” 607151 – 54.83” 607152 – 57.98” 607156 – 59.56”	607157 – 61.13” 607158 – 64.28” 607159 – 68.06” 607160 – 70.58” 607162 – 73.73” 607163 – 76.88” 607164 – 80.04”

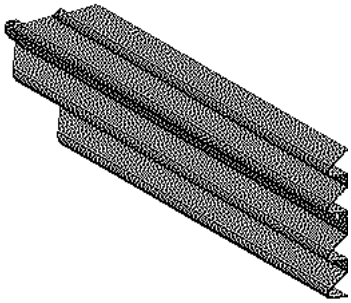
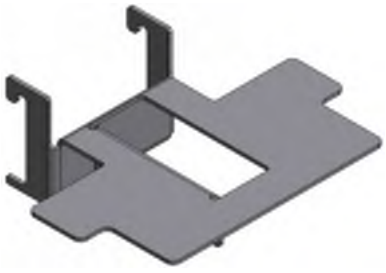
Nose, Narrow Plastic *	Nose, Wide Plastic *	Nose, Narrow Belt *
		
611547 - Yellow 611542 - Gray	611647 - Grey 611648 – Yellow	611538 – Grey 611539 – Yellow

***Parts in red are included in assemblies.**

Nose, Wide Belt *	Cartridge Type I	Cartridge Type II
		
611541 - Yellow 611540 - Grey	606027	606029

Mushroom Washer	Flat Screw 5/8X8 1/2" Wide	Die Spring, 6”, Wide
		
617045	116879	117458

Flat Screw 5/8X5”,G8, Narrow	Die Spring, 1 1/2”, Narrow	Rail Nut, Hex, 5/8”
		
116878	117458	003340

Rail Bolt, 5/8X2”	Panel, Fender Assembly, QG	Bracket, Cart, Nose
		
003400	608236	605420

***Parts in red are included in assemblies.**

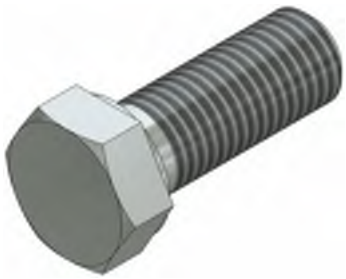
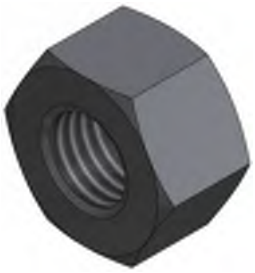
Bolt, Hex, 5/8” X 2 1/2", G5	Bolt, Hex, 1/4" X 3/4", G5	Bracket, Cartridge Support
		
118232	113518	605446

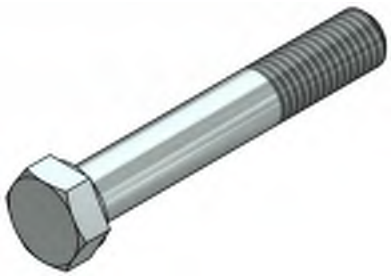
Washer, Lock, 5/8”	Washer, Flat 3/8” X 1”	Nut, Hex, 3/8” X 1”
		
118100	118036	115960

Bolt, Hex, 3/8” X 1”,G5	Washer, Fender, 3/8” X 2”	Bolt, Hex, 5/8”X 1 1/2", G5
		
113596	118038	113654

Bracket, Pull-Out	Shim Kit, 1/8” X 3 5/8” X 8”(2)	Washer, Lock, 3/4"
		
605535	614050	118089

***Parts in red are included in assemblies.**

Bolt, Hex, 3/4" X 2”, G8	Monorail Guide	Nut, Heavy Hex, 3/4"
		
113555	611368	003704

Nut, Heavy Hex, 5/8”	Hinge Plate, Fender Panel	Bolt, Hex, 5/8” X 4”, G5
		
003354	610172	113666

***Parts in red are included in assemblies.**

Panel, Side, QG	Bracket, Cartridge Support TS B/U	Locking Bar, Cartridge Support
		
611898	605447	611266

Approved Adhesive *	Stud, 7”, G5	Washer, Flat, 3/4"
		
619316	117542	118027

*See Valtir Approved Adhesive Anchoring System section on page 12.

Foundation/Anchoring

Warning: It is the responsibility of the local DOT or appropriate highway authority to ensure the assembly conforms to the AASHTO Roadside Design Guide.

Asphalt Installations

QuadGuard® Narrow systems with a Tension-Strut Backup may be temporarily installed in construction zones on asphalt. Assemblies on Asphalt Concrete **("A.C.")** must provide a minimum of 76 mm [3"] layer of asphalt over a minimum of 76 mm [3"] layer of **Portland Cement Concrete ("P.C.C.")**, 152 mm [6"] layer of asphalt over 152 mm [6"] layer of subbase, or 203 mm [8"] layer of asphalt with no subbase.

Important: Only 460 mm [18"] threaded rods, utilizing Valtir approved adhesive, can be used with asphalt foundations. Contact Customer Service for a complete list of approved adhesives (p. 3).

Concrete Installations

For concrete installations, the QuadGuard® should be installed only on an existing or freshly placed and cured concrete base (28 MPa [4000 psi] minimum). Orientation of the concrete base and the attenuator must comply with the project plans or as otherwise determined by the project engineer or appropriate highway authority.

The QuadGuard® may be installed on any of the following foundations using the specified anchorage:

Foundation A: Concrete Pad or Roadway

Foundation: 150 mm [6"] minimum depth P.C.C.

Anchorage: Approved adhesive with 180 mm [7"] studs 140 mm [5 1/2"] embedment

Foundation B: Asphalt over P.C.C.

Foundation: 76 mm [3"] minimum A.C. over 76 mm [3"] minimum P.C.C.

Anchorage: Length of anchor required is 460 mm [18"] 420 mm [16 1/2"] embedment

Foundation C: Asphalt over Compacted Subbase ("C.S.")

Foundation: 150 mm [6"] minimum A.C. over 150 mm [6"] minimum **C.S.**

Anchorage: Approved adhesive with 460 mm [18"] studs 420 mm [16 1/2"] embedment

Foundation D: Asphalt Only

Foundation: 200 mm [8"] minimum A.C.

Anchorage: Approved adhesive with 460 mm [18"] studs - 420 mm [16 1/2"] embedment

Important: Systems mounted on asphalt must be replaced and mounted on fresh, undisturbed asphalt if more than 10% of anchors are found to be loose, broken, or show signs of pull out. If 10% or fewer anchors are damaged, replace the damaged anchors in the existing asphalt. Anchor bolts used on systems mounted on asphalt must be inspected every six months. See Post Impact Instructions and Maintenance and Repair instructions on page 59 and 60.

Valtir Approved Adhesive Anchoring System

A Valtir approved adhesive anchoring system is required to securely anchor crash cushions. Each approved adhesive kit contains adhesive, studs, nuts, washers and instructions. Both vertical and horizontal assemblies are possible using an approved adhesive anchoring system.

Vertical Assemblies

Note: Read all Valtir approved adhesive instructions before starting.

1) **Prepare the Concrete Foundation**

Warning: Do not allow anchoring adhesive to contact skin or eyes. See material safety data sheet supplied with adhesive kit for first-aid procedures. Use only in well-ventilated area. Do not use near open flame.

Warning: Wear gloves and protective eyewear during application.

The anchor bolts (studs) that anchor the QuadGuard® Backup and/or Monorail sections to the concrete foundation must be those shipped in the kit or of high strength steel (Grade B7 or SAE-J429 Grade 5). These studs must be set in minimum 4000 psi [28 MPa] concrete. Allow the concrete to cure a minimum of seven days before applying anchoring adhesive.

2) Drill Boreholes

Caution: It is the responsibility of the installer to consult OSHA silica respiratory standard 29 CFR 1910.134 for debris removal from borehole(s) and use Valtir approved adhesive to achieve optimum tensile strength. Do not use diamond drill bits for drilling boreholes.

Use the Monorail(s) and Tension Strut Backup as drilling templates. Use a rotary hammer drill to drill the boreholes 7/8” [22 mm] diameter to the recommended depth. See the approved adhesive instructions provided with adhesive kit. Check to ensure each borehole is drilled to the proper depth and aligned with the part to be anchored per table below.

Anchoring Information					
Stud Size:	**Orientation**	**Bit Size**	**Minimum Depth**	**Torque**	**Medium**
3/4”x 6 1/2"	Horizontal	7/8” [22 mm]	5 1/4” [133 mm]	Manufacturer Spec	Concrete
3/4”x 7"	Vertical	7/8” [22 mm]	5 3/4” [145 mm]	Manufacturer Spec	Concrete
3/4”x 18"	Vertical	7/8” [22 mm]	16 3/4” [425 mm]	10 ft-lb [15 N-m]	Asphalt

Important: When mounting on asphalt, initial torque shall be as shown in the Anchoring Information table above. Due to the properties of asphalt, anchors may loosen over time. For this reason Valtir recommends anchoring to asphalt only at temporary locations. It is recommended to re-torque anchors in asphalt every six (6) months to the proper initial torque specified.

3) Clean the Boreholes

Blow the concrete dust from the borehole using oil-free compressed air. Thoroughly brush it with a 7/8" diameter steel bristle tube brush and then blow it out again. If the borehole is wet, completely flush it with water while brushing and then blow it clean to remove all water using oil-free compressed air.

Note: Use of the Valtir approved vacuum drilling equipment is authorized to replace the blowing and brushing requirement of Step 3.

4) Apply Approved Adhesive

Fill the borehole 100% full.

Caution: Fill borehole 100% full so it is even with the pavement surface per manufacturer's instructions.

5) Add the Washers and Nuts

Place a flat washer onto the stud then thread a nut on until the end of the stud is flush with the NUT (Figure 1).

6) Insert Studs in Boreholes and Wait for Adhesive to Cure

Push the stud, nut, and washer assembly down through the part and into the borehole until the washer is seated against the part.

Caution: Do not disturb or load the stud until the approved adhesive material has hardened per manufacturer specifications.

7) Torque the Nuts

Once the adhesive has fully cured, torque the nut to the manufacturer's recommended specifications.

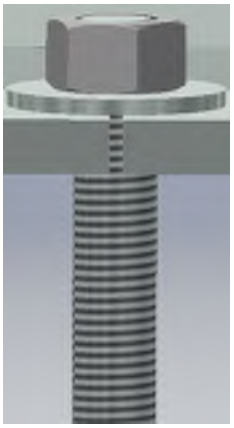


Figure 1
Vertical Application
(Before Applied Torque)

Assembly Cautions

1) Steel rebar

If steel rebar is encountered while drilling an anchor bolt borehole, apply one of the following solutions:

A) Use a rebar drill bit for the **rebar only** and then switch back to the concrete bit to finish drilling into the underlying concrete until the proper borehole depth is reached.

Caution: Do not drill through rebar without first obtaining permission to do so from the project engineer.

B) Drill a new borehole down at an angle past the rebar to the proper depth. Anchor the stud by completely filling both boreholes with an approved adhesive.

Horizontal Assemblies

The horizontal approved adhesive kit is the same as the vertical kit.

Caution: Fill borehole 100% full so it is even with the vertical concrete surface per manufacturer's instructions.

1) **Follow the instructions supplied with your approved adhesive kit**

   Apply approved adhesive to each anchor per instructions.

2) **Add the Washers and Nuts**

   Put washer and nut on stud so the **nut is flush with end of stud**.

3) **Insert each Stud with Washer and Nut into Borehole**

   Push stud through part to be anchored and into borehole. Twist the stud in the approved adhesive to wet the threads.

Important: The stud should be flush with the top of the nut in both **vertical** and **horizontal** applications prior to tightening (Figure 2).

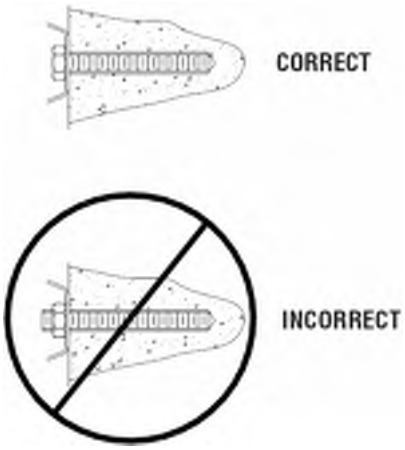


Figure 2
Horizontal Application
(Before Applied Torque)

Caution: Do not disturb or load the stud until the approved adhesive material has hardened (reference approved adhesive kit instructions for hardening times)**.**

4) **Torque the nuts**

   Once the adhesive has fully cured, torque nut(s) to the approved adhesive manufacturing specification.

Recommended Tools

Documentation

- Manufacturer's Assembly Manual
- Manufacturer's Drawing Package

Personal Protective Equipment

- Eye Protection
- Gloves
- Safety Toe Shoes
- Protective Clothing

Cutting Equipment

- Rotary Hammer Drill
- Rebar Cutting Bit
- Concrete Drill Bits – 22 mm [7/8"] **(Double-Fluted**)
- Grinder, Hacksaw or Torch (optional)
- Drill Bits 1/16" through 7/8"

Important: Valtir recommends using double-fluted drill bits to achieve optimum tensile strength when applying an approved adhesive to the anchoring system (p.12).

Hammers

- Sledgehammer
- Standard hammer

Wrenches

- Heavy Duty 1/2" drive impact wrench
- 1/2" drive Sockets: 9/16", 11/16", 3/4", 15/16", 1 1/8", 1 1/4"
- 1/2" drive Deep Well Sockets: 15/16", 1 1/4"
- 1/2" drive Ratchet and Attachments
- 1/2" drive Breaker Bar – 24" long
- 1/2" drive Torque Wrench: 200 ft-lb
- Crescent Wrench: 300 mm [12"]
- Allen Wrench: 3/8"

Important: Because every impact is different, Valtir makes no recommendation whether use or reuse of any part of the system is appropriate or acceptable following an impact. It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to make that determination. It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.

Miscellaneous

- Traffic Control Equipment
- Lifting and moving equipment (A lifting device is preferred although a forklift can be used.) Minimum 5,000 lb. capacity required.
- Air Compressor (100 psi minimum) and Generator (5 kW)
- Long Pry Bar
- Drift Pin 12” [300 mm]
- Center Punch
- Tape Measure 25’ [7.5 m]
- Chalk Line
- Concrete Marking Pencil
- Steel bristled tube brush for cleaning 7/8” drilled boreholes
- Rags, water, and solvent for touch-up

Note: The above list of tools is a general recommendation and should not be considered an exhaustive list. Depending on specific site conditions and the complexity of the assembly specified by the appropriate highway authority the required tools may vary. Decisions as to what tools are needed to perform the assembly properly are the responsibility of the specifying highway authority and the authority’s selected contractor performing the assembly of the system at the authority’s specified assembly site.

How to Determine Left/Right

To determine left from right when ordering parts, stand in front of the system facing the roadside obstacle. Your left is the system’s left and your right is the system’s right.

System Bay Count

One Bay consists of one Cartridge, one Diaphragm, two Fender Panels, etc. The Nose section is not considered a Bay, though there is a Cartridge in the Nose of each system. Note that this means there will always be one more Cartridge in the system than the number of Bays in the system. To determine number of Bays, count Fender Panels on one side (Figure 3). The Five-Bay system is shown.

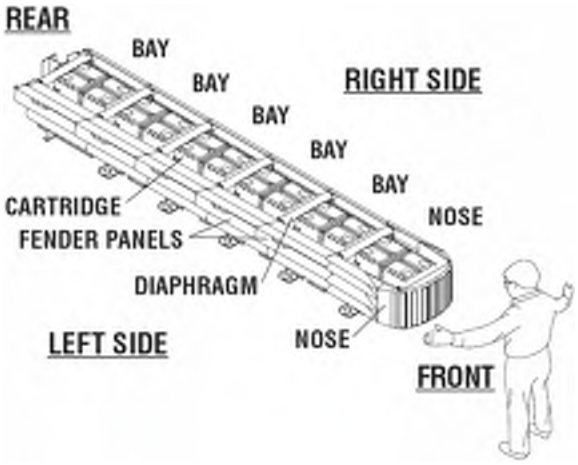


Figure 3 - Orientation

Measuring the Width

The QuadGuard® is available in five nominal widths:

- 24” [610 mm]
- 30” [760 mm]
- 36” [915 mm]
- 48” [1219 mm]
- 69” [1755 mm]
- 90” [2285 mm]
- 126” [3200 mm]

The nominal width of a parallel system is the width of the diaphragm (Figure 4).

The nominal width of a wide system is the width at the location shown in Figure 5.

The outside width of the system is approximately 6” [150 mm] to 9” [230 mm] wider than the nominal width. The width of the system is not the same as the width of the Backup.

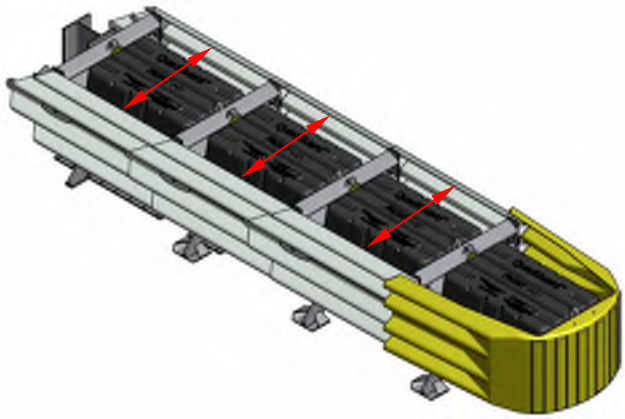


Figure 4
Parallel system

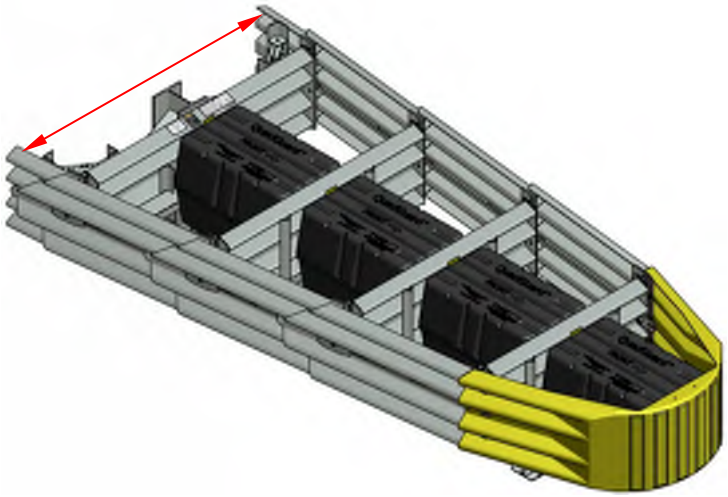


Figure 5
Wide system

Site Preparation/Foundation

A QuadGuard® should be assembled only on an existing or freshly placed and cured concrete base (4000 psi [28 MPa] minimum). Location and orientation of the concrete base and attenuator must comply with project plans or as otherwise determined by the resident project engineer.

Recommended dimension and reinforcement specifications for new concrete foundations are provided in Valtir concrete foundation drawings, supplied with the system. The system may be assembled on a non-reinforced concrete roadway (minimum 8" [200 mm] thick). Deployment cross-slope shall not exceed 8% and should not twist more than 2% over the length of the system; the foundation surface shall have a light broom finish.

Caution: Accurate placement of all steel rebar is critical to avoid interference with the concrete anchor bolts.

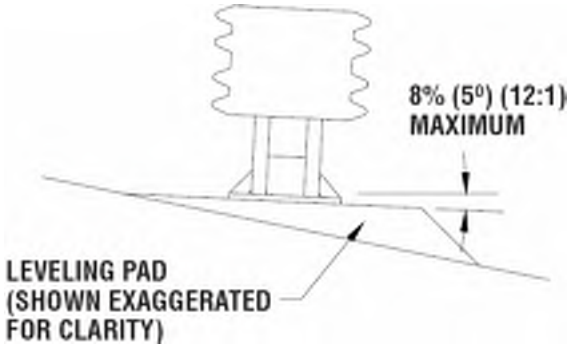


Figure 6
Cross-Slope

Warning: Location of the Backup in relation to nearby objects will affect the operation of the attenuator. Upon impact, the Fender Panels telescope rearward and extend beyond the rigid Backup as much as 30" [760 mm]. Position the Backup so that the rear ends of the last Fender Panels are a minimum of 30" [760 mm] forward of objects that would otherwise interfere with movement of the rearmost Fender Panels. Failure to comply with this requirement will result in impaired system performance offering motorists less protection and component damage.

Narrow System Identification

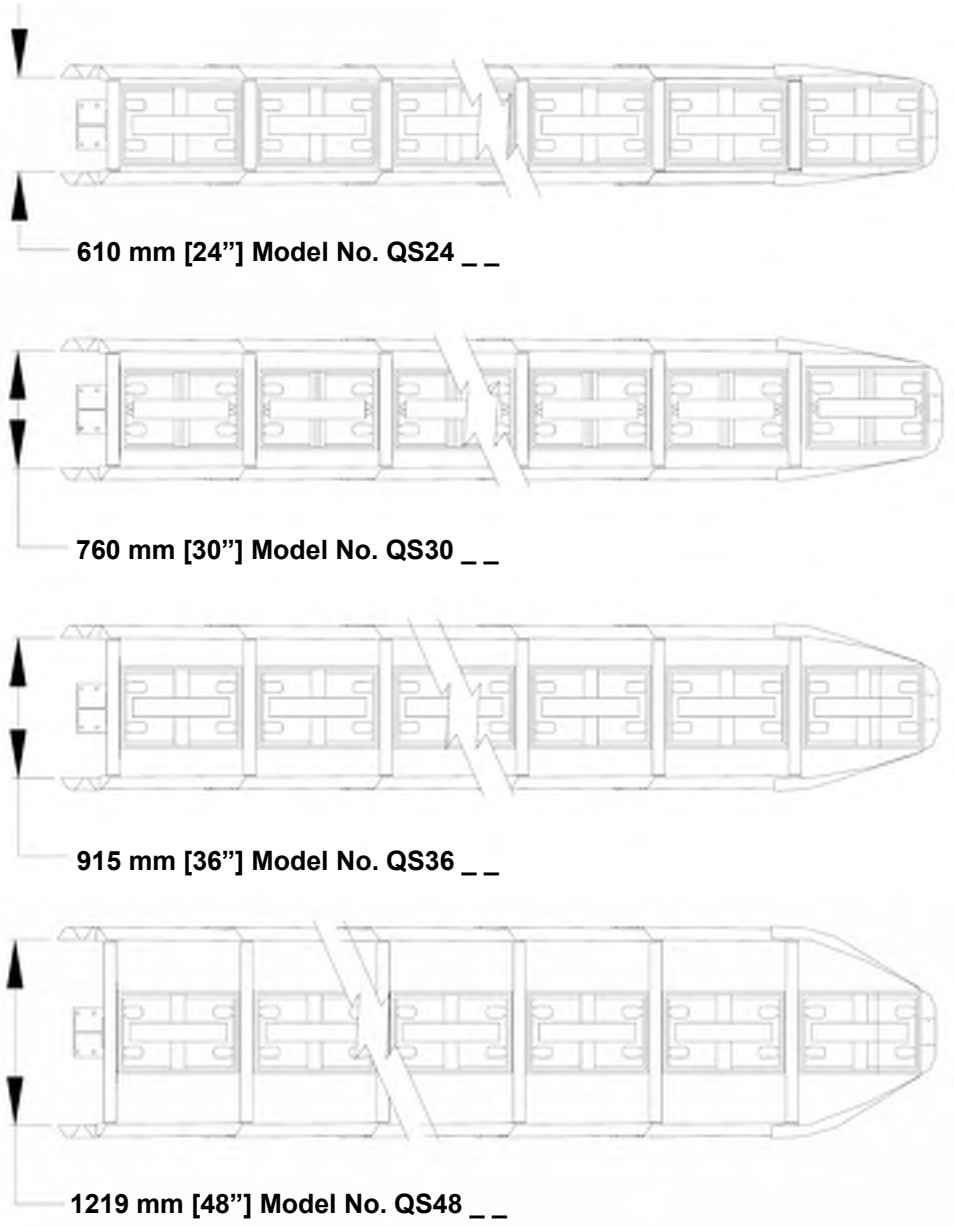


Figure 7
Narrow System(s) and Model Numbers

Inspect Shipping

Check all received parts against the shipping list supplied before QuadGuard® deployment. Make sure all parts have been received.

Important: The Manufacturer's Drawing Package supplied with the QuadGuard® must be used with these instructions for proper assembly and should take precedence over these general instructions.

Determine Backup and Transition Type

The QuadGuard® is available with a Tension Strut Backup or a Concrete Backup. See Figure(s) 8 and 9, along with the Backup Assembly drawing, to determine which type of Backup is being deployed.

A Transition Panel or Side Panel must be used on each side of the Backup. A Side Panel is not needed when a Transition Panel is used. Several types of Transitions are available for use with the QuadGuard®. See Figures 10 - 14 and the Drawing Package to determine which type of Panels to attach.

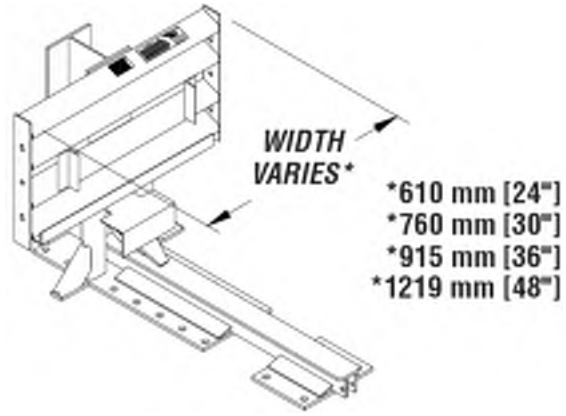


Figure 8
Tension Strut Backup

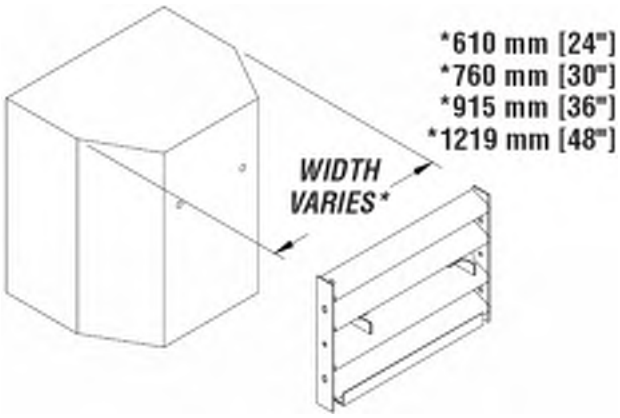


Figure 9
Concrete Backup

Narrow Transitions

Note: The proper Transition Panel or Side Panel must be used for impact performance of the system. The correct Panel(s) to use will depend on the direction of traffic and what type of barrier or roadside obstacle the QuadGuard® is shielding. Contact the Customer Service Department prior to deployment if you have any questions (p. 3).

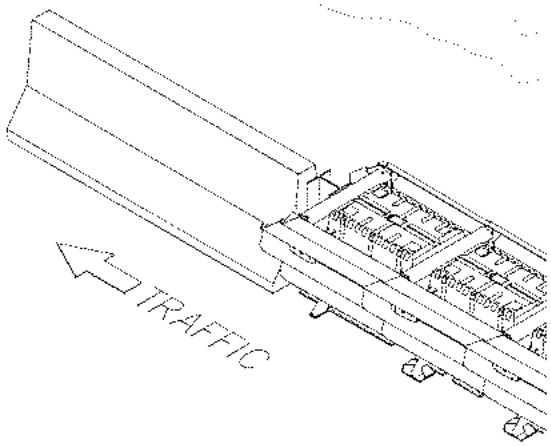


Figure 10
No Transition

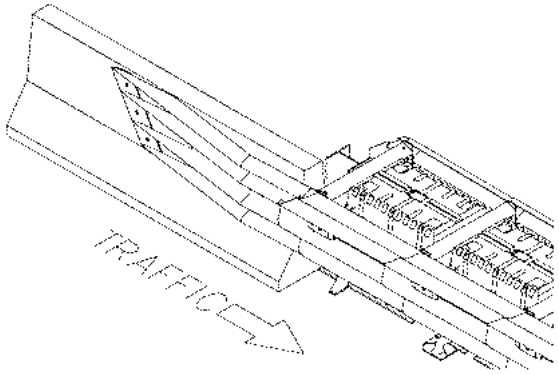


Figure 11
Quad-Beam™ to Safety Shape Barrier

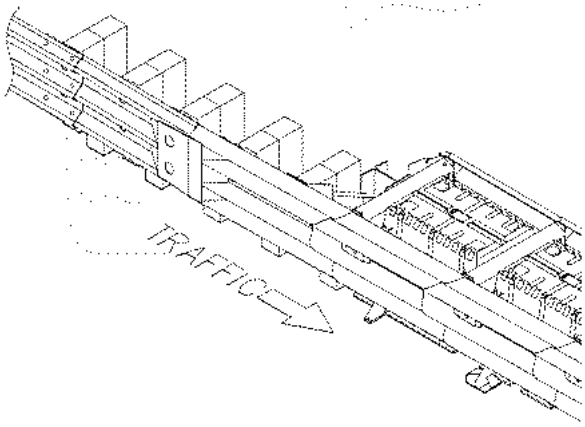


Figure 12
Quad-Beam™ to Thrie-Beam

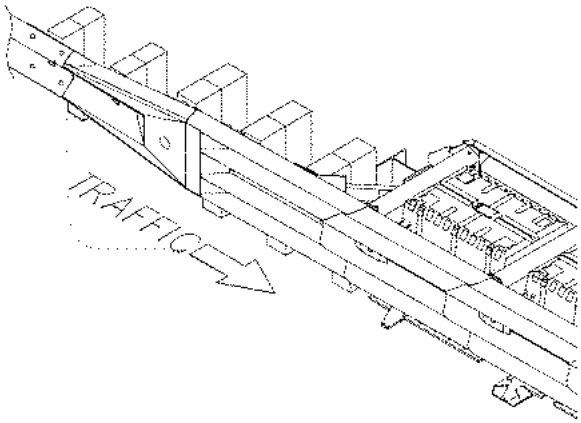


Figure 13
Quad-Beam™ to W-Beam

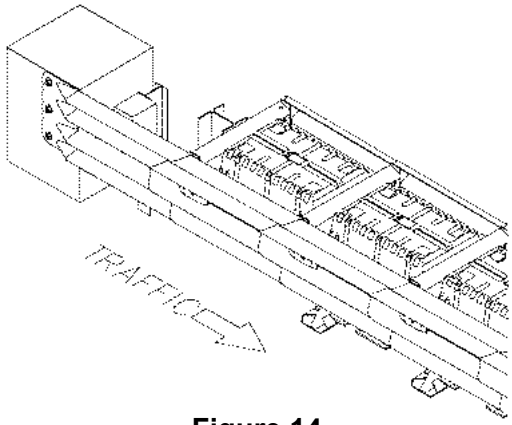


Figure 14
Quad-Beam™ End Shoe

Assembly Narrow

1) Mark System Location

Locate the centerline of the system by measuring the proper offset from the roadside obstacle. See the Drawing Package supplied with the system. Place chalk line to mark the centerline of the system. Mark a construction line parallel to the center line and offset 6.5" [165 mm] to one side as shown in Figure 15. The edge of the Monorail will be positioned on this line.

Note: The concrete foundation must comply with the project plans supplied with the system.

Warning: Location of system with respect to the roadside obstacle is critical and dependent on the type of Transition Panel used. Please refer to the Drawing Package supplied with the system for details.

Figure 15
(Top view of concrete foundation)

2) Anchor the Backup

A) Concrete Backup Construction (Figure 16)

Locate Backup Face Plate using the Backup Assembly drawing. Verify that any applicable Transition Panels fit properly before anchoring the Face Plate. Drill anchor holes in the Concrete Backup using the Face Plate as a template. Anchor the Face Plate to the Concrete Backup using the approved adhesive kit supplied with the system (p. 12).

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

B) Tension Strut Backup Assembly (Figure 17)

Locate Tension Strut Backup and Monorail on foundation with side of Monorail on the construction line (p. 26). Verify that any applicable Transition Panels fit properly before anchoring Backup. Drill anchor holes in foundation using the Backup as template. Anchor the Backup to the concrete foundation using an approved anchoring system (p. 12).

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

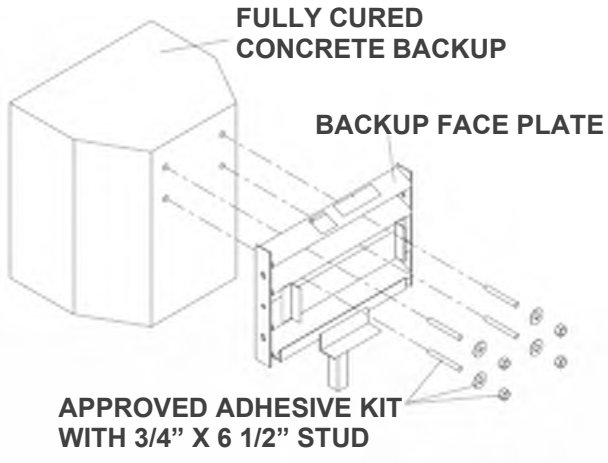


Figure 16
Anchoring Backup Face Plate to Concrete Backup

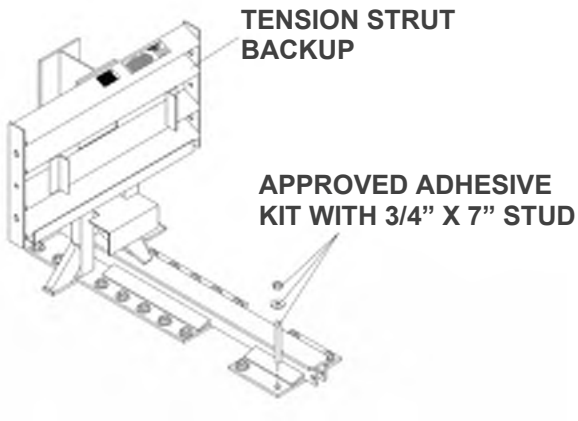


Figure 17
Anchoring Tension Strut Backup to Foundation

Warning: Improper alignment at the Monorail Sections will prevent proper system collapse during impact.

Monorail Alignment

It is important to align each segment of Monorail from the back to the front of the system (±1/4" [6 mm]). Anchor each Monorail section using the provided Valtir approved adhesive kit. See Figures 18 - 21 and the approved adhesive instructions included with the adhesive kit (p. 12).

Drill 0.78" [20 mm] diameter by 5 3/4" [145 mm] boreholes using the Monorail as a template. Do not drill through foundation.

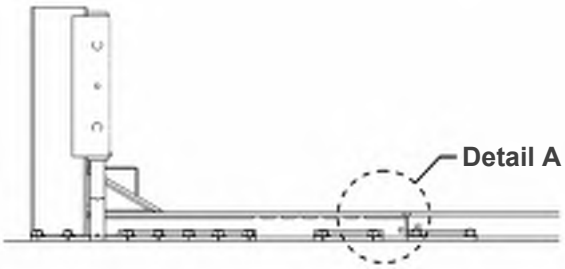
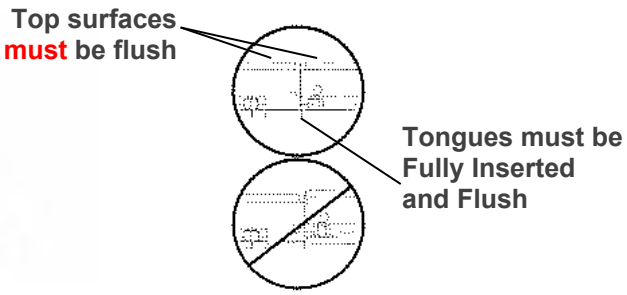


Figure 18
Rail Height and Alignment



Detail A

3) Anchor the Monorail

A) Monorail Assembly for Concrete Backup (Figure 19)

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Monorail foot 10” forward of front face of Concrete Backup.

Orient the Monorail so that the Monorail tongues face Backup.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

Anchor each Monorail section using the approved adhesive kits provided. Reference the adhesive manufacturer’s instructions included with kit. It is important to attach each segment of Monorail in alignment from the back to the front of the system (±1/4” [6 mm]).

Warning: Improper alignment at the Monorail splice joints will prevent proper system collapse during impact (p. 26).

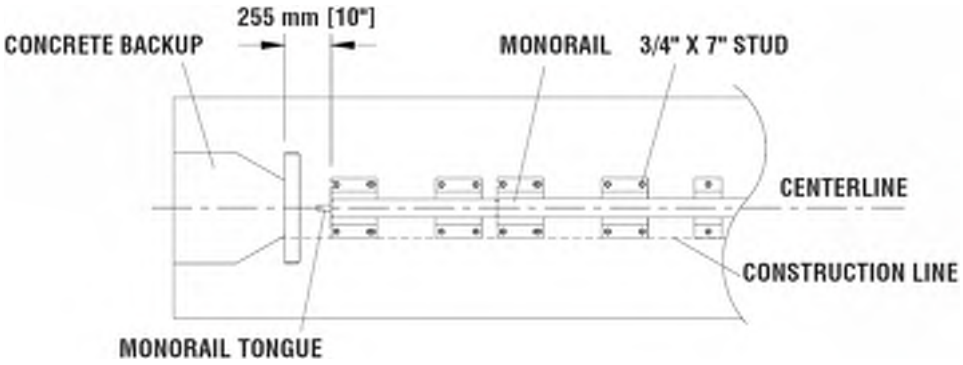


Figure 19
Monorail Location for Concrete Backup

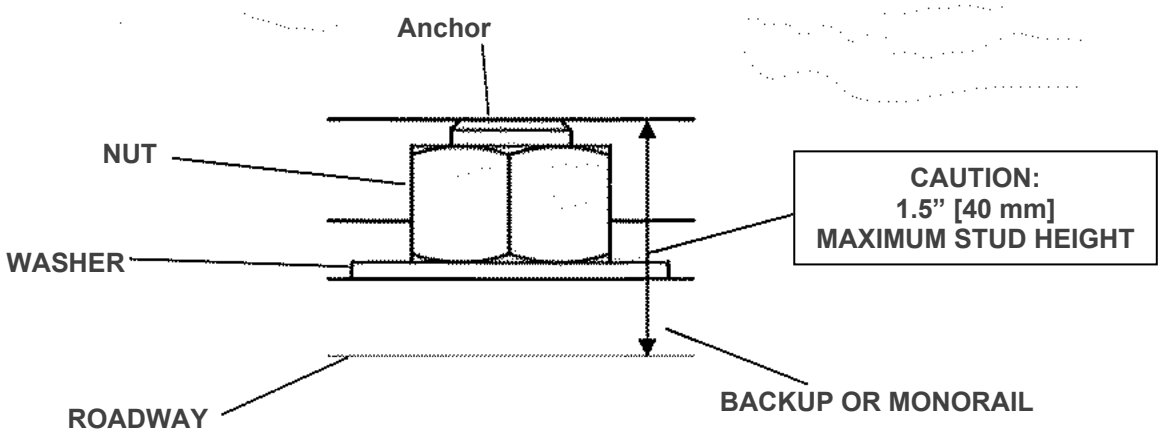


Figure 20
Proper Stud Height

B) Monorail Assembly for Tension Strut Backup (Figure 21)

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Backup foot 4” forward of edge of foundation (Figure 21).

Drill 5 1/2” [140 mm] deep anchor holes using the Monorail as a template. Do not drill through foundation.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

Anchor each Monorail section using the approved adhesive kits provided. Reference the adhesive manufacturer’s instructions included with kit. It is important to attach each segment of Monorail in alignment from the back to the front of the system (±1/4” [6 mm]).

Warning: Improper alignment at the Monorail splice joints will prevent proper system collapse during impact (p. 26).

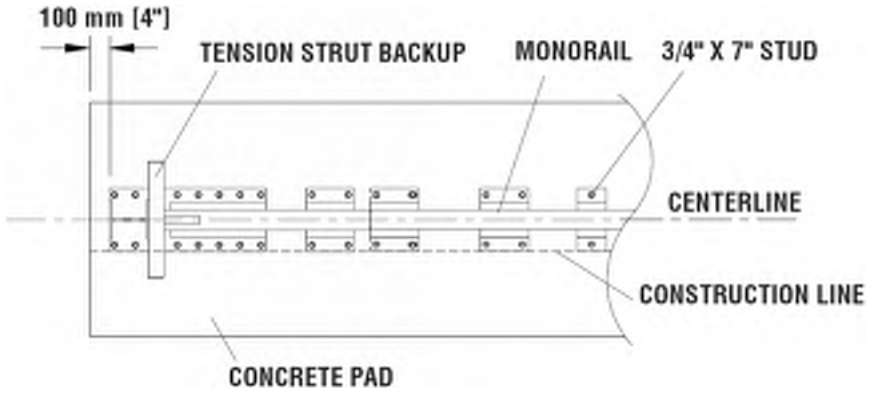


Figure 21
Backup and Monorail Location for Tension Strut Backup

5) Attach Side Panels and/or Transition Panels to Backup Assembly

Attach Transition Panel or Side Panel to side of Backup using 5/8” rail bolt and 5/8” rail nut (two places - top and bottom holes only). See Figure 22 and Backup Assembly drawing.

Note: A Side Panel is not needed when a Transition Panel is used.

Assembly tip:

Use drift pin to align the center hole of the Panel with the center hole of the Backup before inserting the rail bolts.

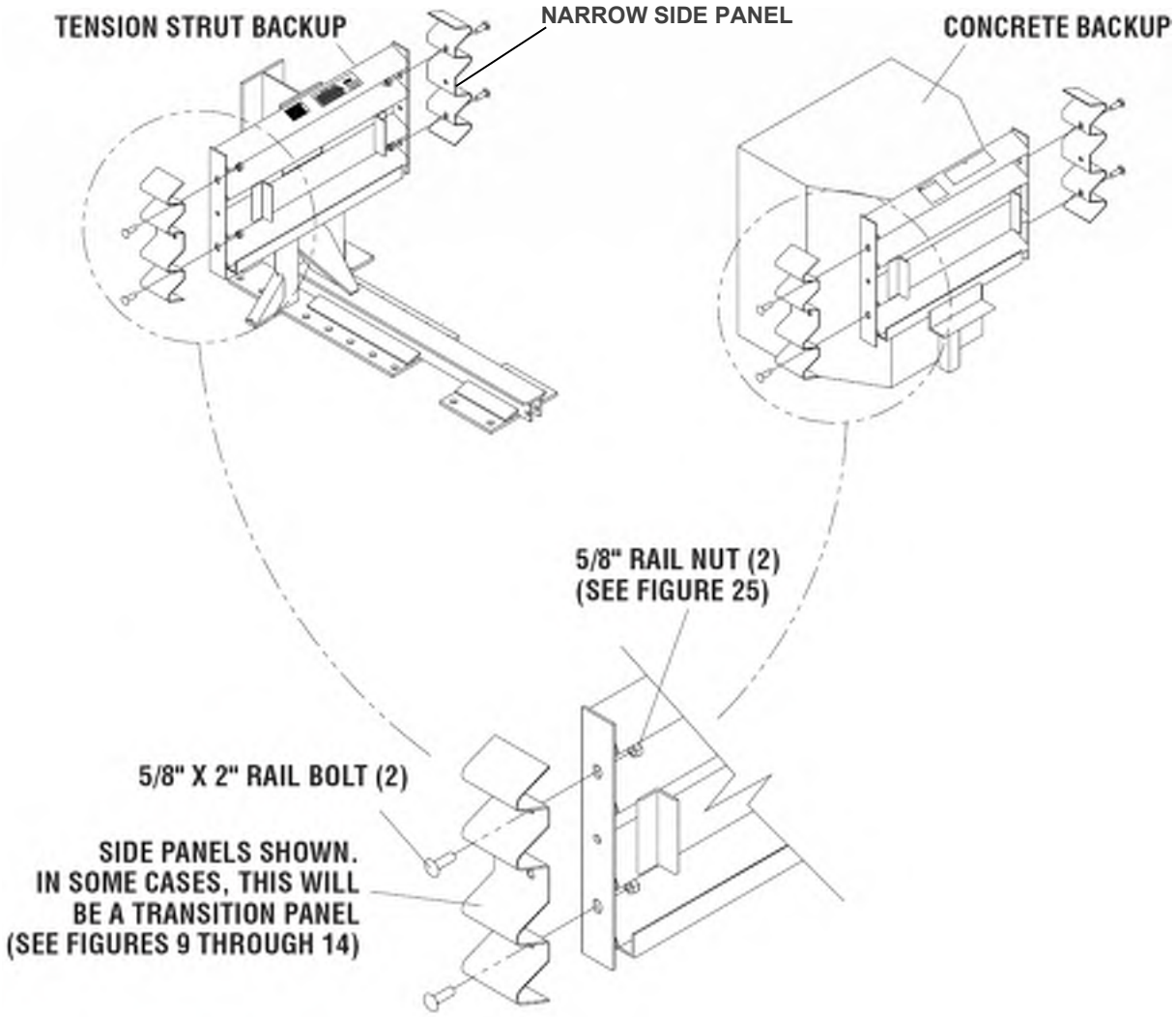


Figure 22
Side Panel/Transition Panel Attachment

6) Attach Monorail Guides

Attach Monorail guides to Diaphragm as shown in Figure 23.

Insert 3/4" x 2” G8 hex bolt through Monorail guide and Diaphragm, oriented as shown in Figure 22. Secure with 3/4" lock washer and 3/4" hex nut (typical 4 places). See also Diaphragm Assembly drawing.

Repeat process for each Diaphragm.

7) Attach Diaphragms

Orient a Diaphragm so that the front face of the Diaphragm shape faces toward the Nose of the system as shown in Figure 24. Slide one Diaphragm all the way to the Backup to ensure the system is able to collapse properly during impact. Once this has been verified, slide the Diaphragm forward to approximately 36” [915 mm] in front of the Backup. Orient and slide all other Diaphragms onto Monorail and position each approximately as shown in Figure 25.

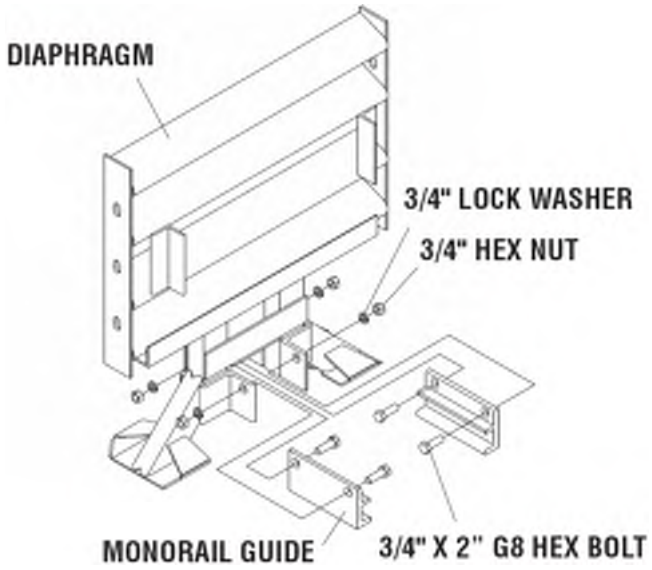


Figure 23
Monorail Guide Attachment

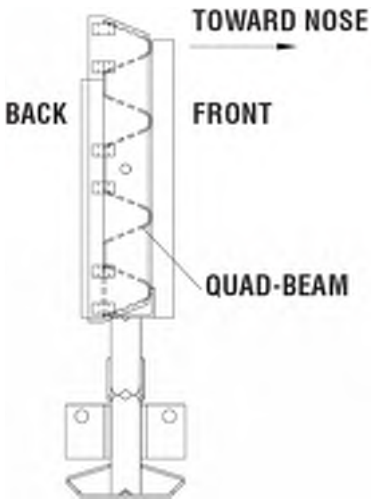


Figure 24
Diaphragm Orientation

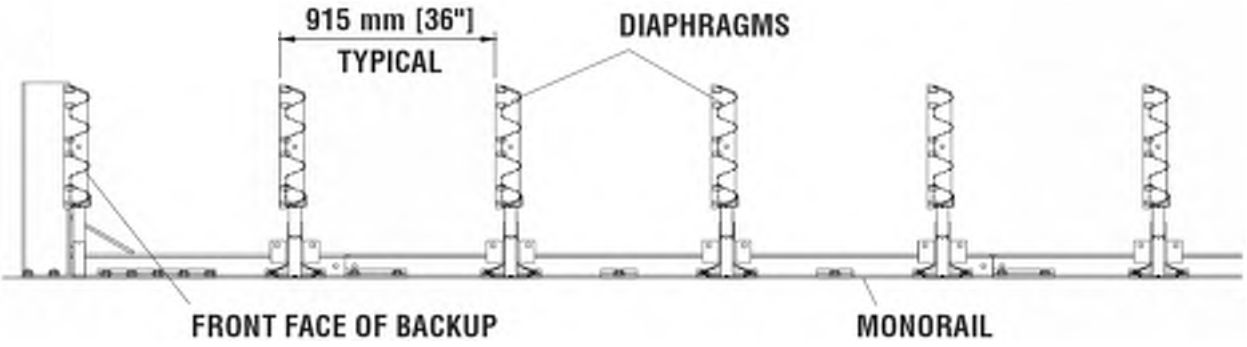


Figure 25
Diaphragm Spacing

8) Attach Fender Panels

Note: Do not mix the 5/8” rail nuts (large) with the 5/8” hex nuts (small) (Figure 26).

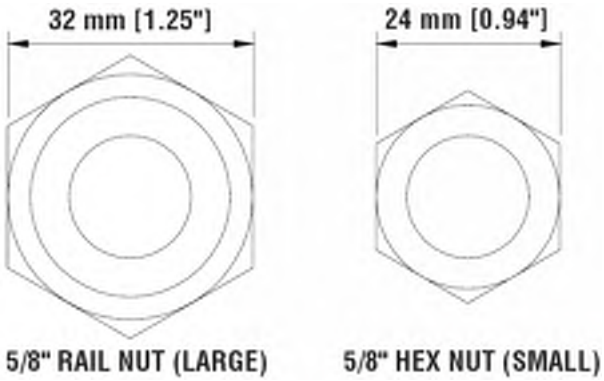


Figure 26
Rail Nuts are Oversize

Starting at the Backup, attach left and right Fender Panels shown on page 30 and Fender Panel Assembly drawing.

Step 1

Place the Fender Panel so that the center of the slot of the rearward Diaphragm is lined up with the approximate center of the slot in the Fender Panel.

Attach Mushroom Washer Assembly as shown in Figure 27 and Detail 27a and Detail 27b but do not torque at this time. (This helps to balance the Fender Panel.)

Step 2

Slide the Fender Panel forward until the holes in the Fender Panel line up with the holes in the forward Diaphragm.

Step 3

Use a drift pin to align the center hole of the Fender Panel with the center hole of the Diaphragm.

Step 4

Attach the front of the Fender Panels to the next Diaphragm using two (2) rail bolts and large hex rail nuts per side. Use only the top and bottom holes; leave the center hole open until the next Fender Panel is attached.

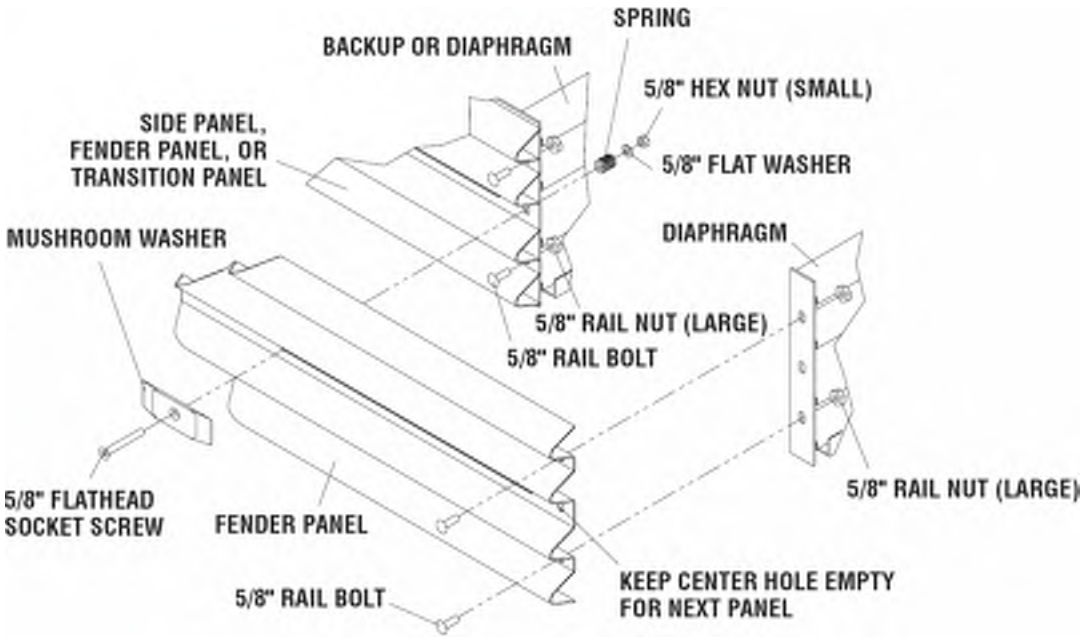
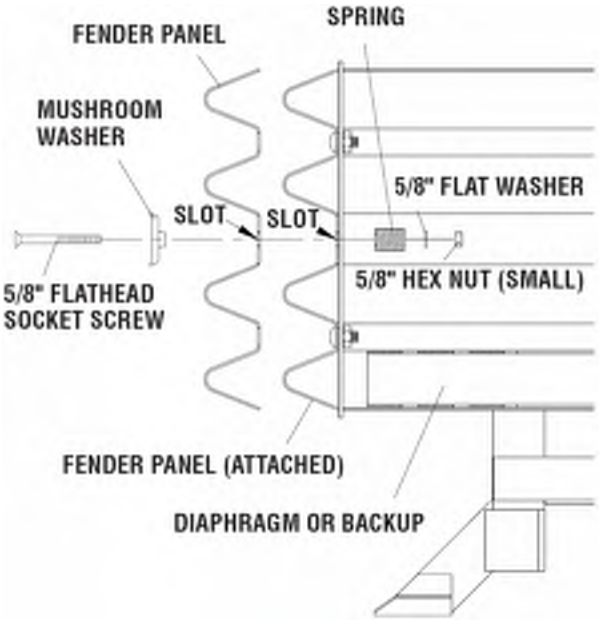


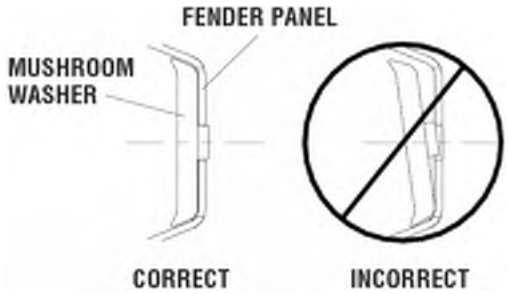
Figure 27
Fender Panel Assembly

Step 5

Be sure Mushroom Washer lays flat against the Fender Panel as shown in Figure 27b. Standoff on Mushroom Washer must be seated completely through slot.



Detail 27a
Mushroom Washer Attachment



Detail 27b
Mushroom Washer Orientation

Step 6

Check Diaphragm spacing to ensure 36” [915 mm] between rear faces of consecutive Diaphragms as shown in Figure 28 and Fender Panel Assembly drawing.

Step 7

Once proper spacing has been achieved, torque the Mushroom Washer Assembly (small hex) nut until it reaches the end of the threads.

Assemble the remaining Diaphragms and Fender Panels following the same procedures.

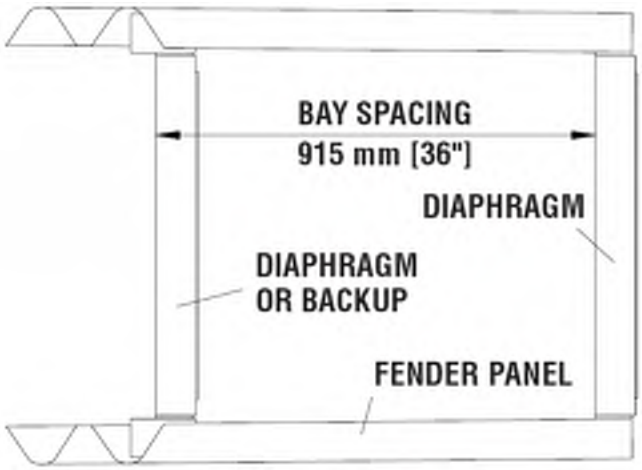


Figure 28
Proper Diaphragms Spacing

9) Attach End Cap

Using 5/8” x 3 1/2" G5 hex bolt, 5/8” hex nut and 5/8” lock washer, attach the End Cap to the front of the first Monorail segment, as shown in Figure 29 and Monorail Assembly drawing.

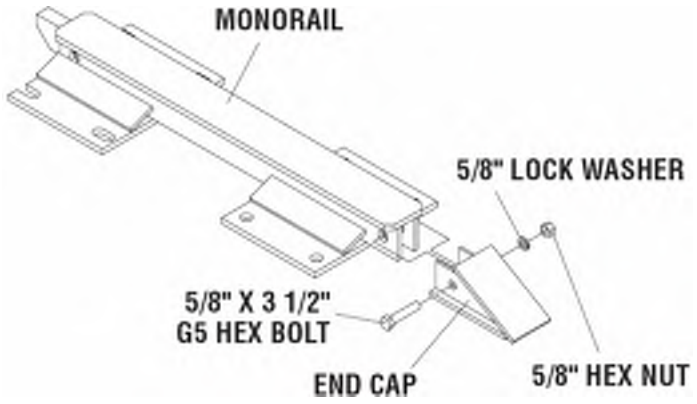


Figure 29
Monorail End Cap Assembly

10) Attach Cartridge Support Brackets

Attach lower Cartridge Support Bracket to front and back of all Diaphragms and front of Backup as shown in Figures 31 to 33, the Diaphragm Assembly drawings and the Backup Assembly drawings (p. 35).

Note: 24” [610 mm] wide systems do not have Side Cartridge Support Brackets: 30” [762 mm], 36” [914 mm] and 48” [1219 mm] wide systems have Side Cartridge Support Brackets welded to the Backup and Diaphragms.

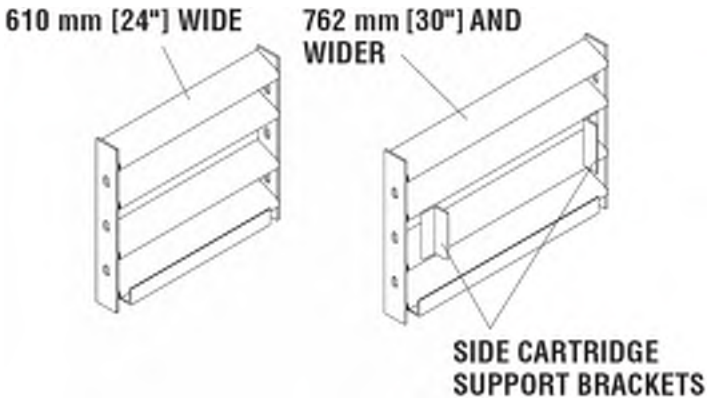


Figure 30
Side Cartridge Support Brackets

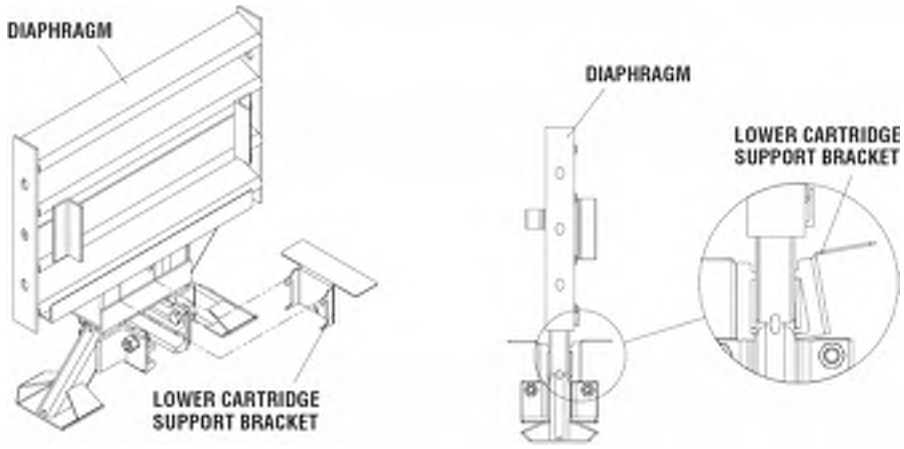


Figure 31
Lower Cartridge Support Bracket Assembly

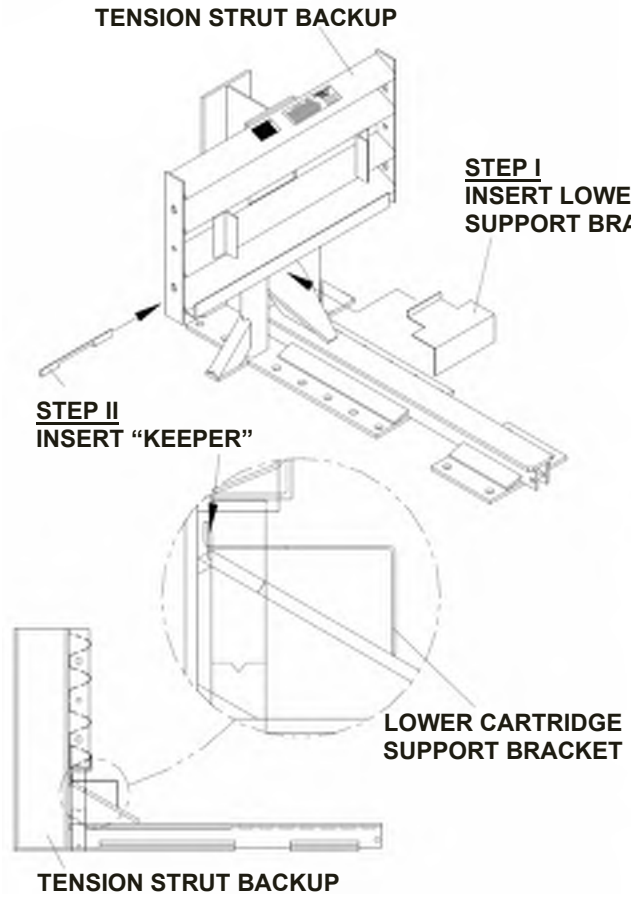


Figure 32
Lower Cartridge Support Bracket
(Tension Strut Backup)

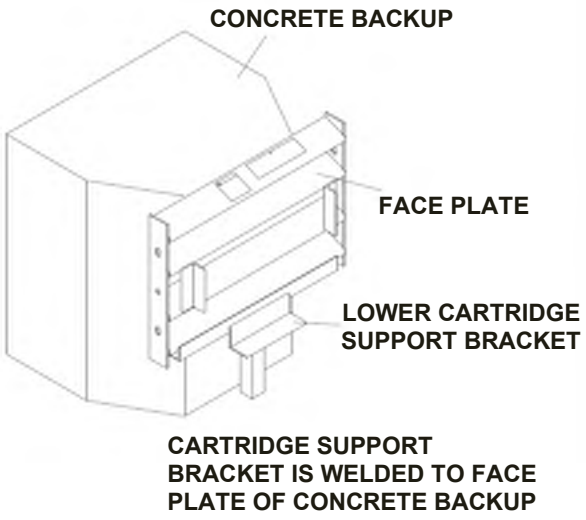


Figure 33
Lower Cartridge Support Bracket
(Concrete Backup)

Attach Nose

11a) Attach Plastic Nose Assembly

Determine which style of Cartridges your system has. If your system has Cartridge style A as shown in Figure 34, attach Cartridge Support in the upper two slots as shown.

If your system has Cartridge style B as shown in Figure 34, attach Cartridge Support in the lower two slots as shown.

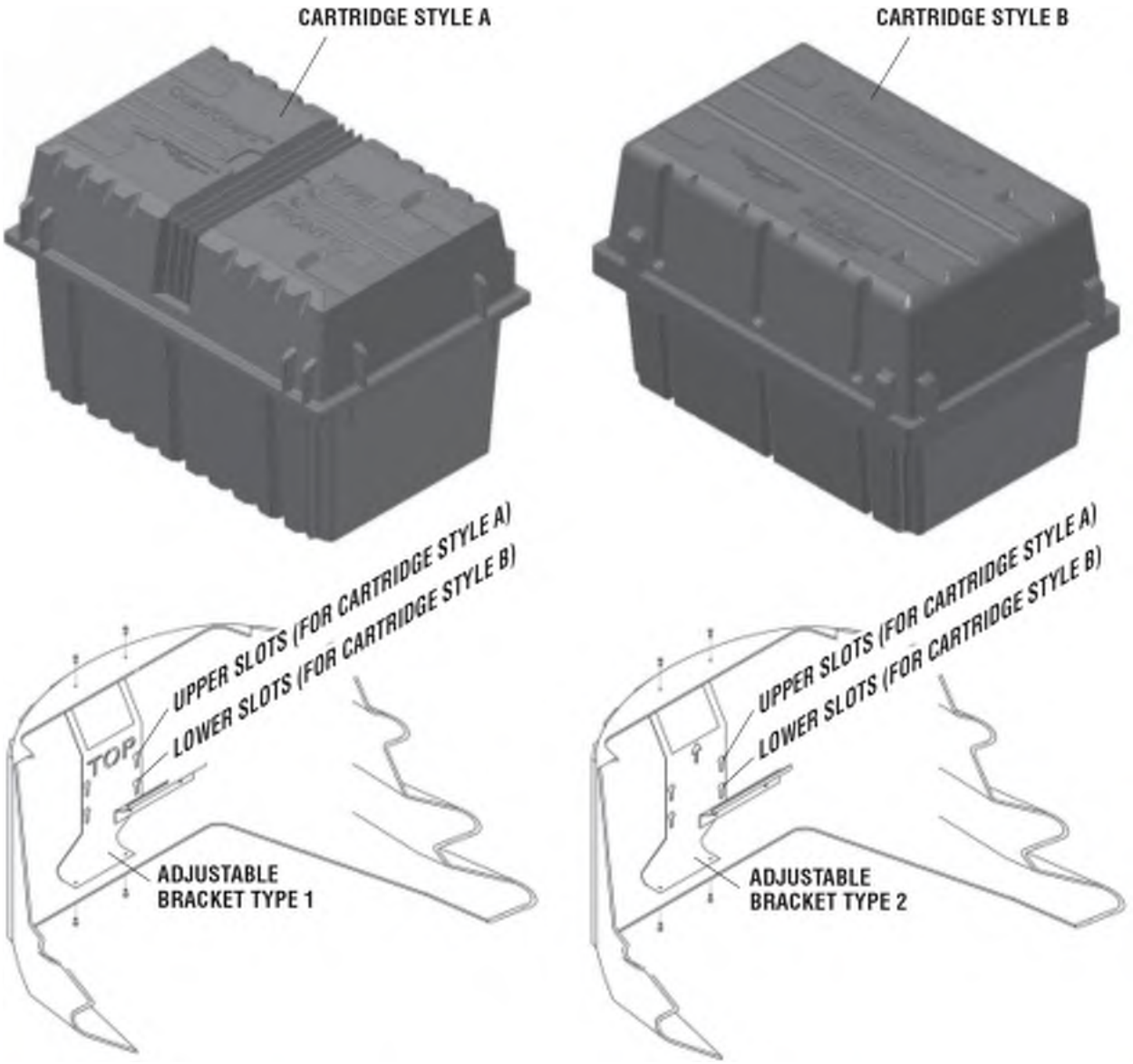
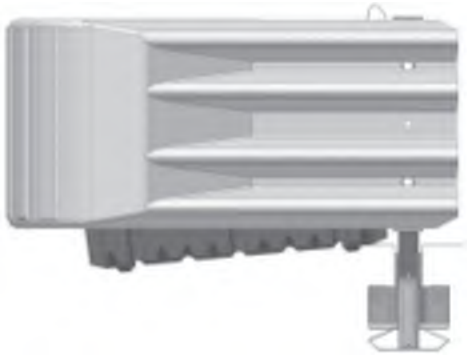


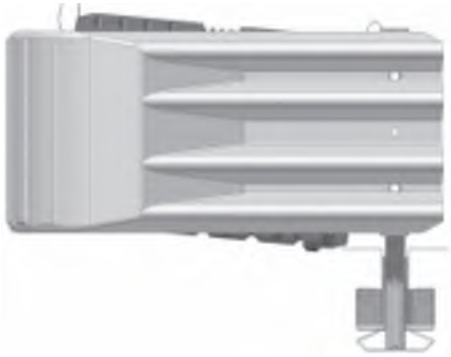
Figure 34
Adjustable Bracket Locations

As shown in Detail 34a, Cartridge Style A is attached with the Adjustable Support Bracket **incorrectly** in the lower position.



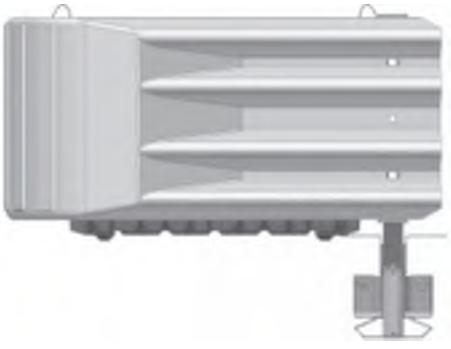
Detail 34a
<u>Incorrect</u> Attachment of Adjustable Cartridge Support Bracket

As shown in Detail 34b, Cartridge Style B is attached with the Adjustable Cartridge Support Bracket **incorrectly** in the upper position.



Detail 34b
<u>Incorrect</u> Attachment of Adjustable Cartridge Support Bracket

Detail 34c shows the Adjustable Cartridge Support Bracket attached **correctly.**

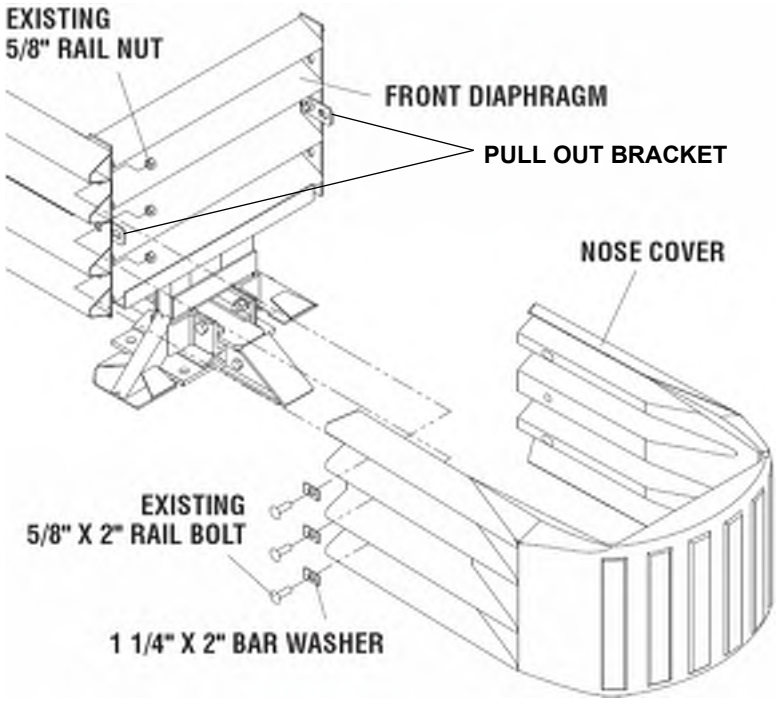


Detail 34c
<u>Correct</u> Attachment of Adjustable Cartridge Support Bracket

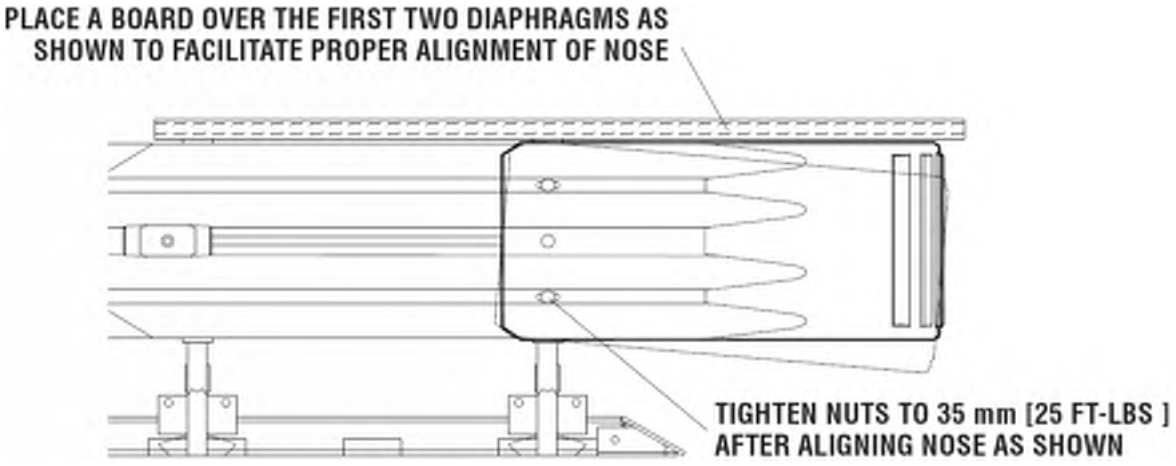
Bolt the Nose Assembly directly to the Front Diaphragm, as shown in Detail 34d and the Nose Assembly drawings, using six (6) rail bolts which also hold the front two Fender Panels to the Diaphragm with Bar Washer under each bolt.

Place Pullout Brackets under center nuts.

The top and bottom holes of the Nose are slotted to provide adjustment. Adjust so the top edge of the Nose is level with the top edge of the Fender Panels and then torque all six (6) nuts to 25 lbf-ft [35 N-m].



Detail 34d
Nose Assembly



Detail 34e
Adjust Nose

11b) Optional Belt Nose Assembly

a. Using 5/8” x 5” hex bolt, two (2) 5/8” x 1 3/4" flat washers and 5/8” hex nut, attach Fender Panel to front Diaphragm top and bottom as shown in Figure 35 (two places per side).
b. Using 5/8” x 5” hex bolt and 5/8” hex nut, attach Pullout Bracket to front Diaphragm and Fender Panel middle as shown (one place per side).
c. Thread second 5/8” nuts onto the attached bolts. Be sure the faces of the nuts are flush with humps on Fender Panels (Figure 35). Slide third 5/8” x 1 3/4” flat washers onto bolts (three places per side).
d. Align holes in each end of the Nose Belt with the attached bolts (three per side) and slide Nose Belt onto bolts.
e. Align holes in Belt Clamps with bolts and slide Belt Clamps onto bolts.
f. Using fourth 5/8” x 1 3/4" flat washer and third 5/8” hex nut, secure the Belt Clamps and Nose Belt (three places per side).

Refer also to Nose Belt Assembly drawing.

Note: Nose alignment shown in Figure 34e not necessary with Nose Belt Assembly (p. 38).

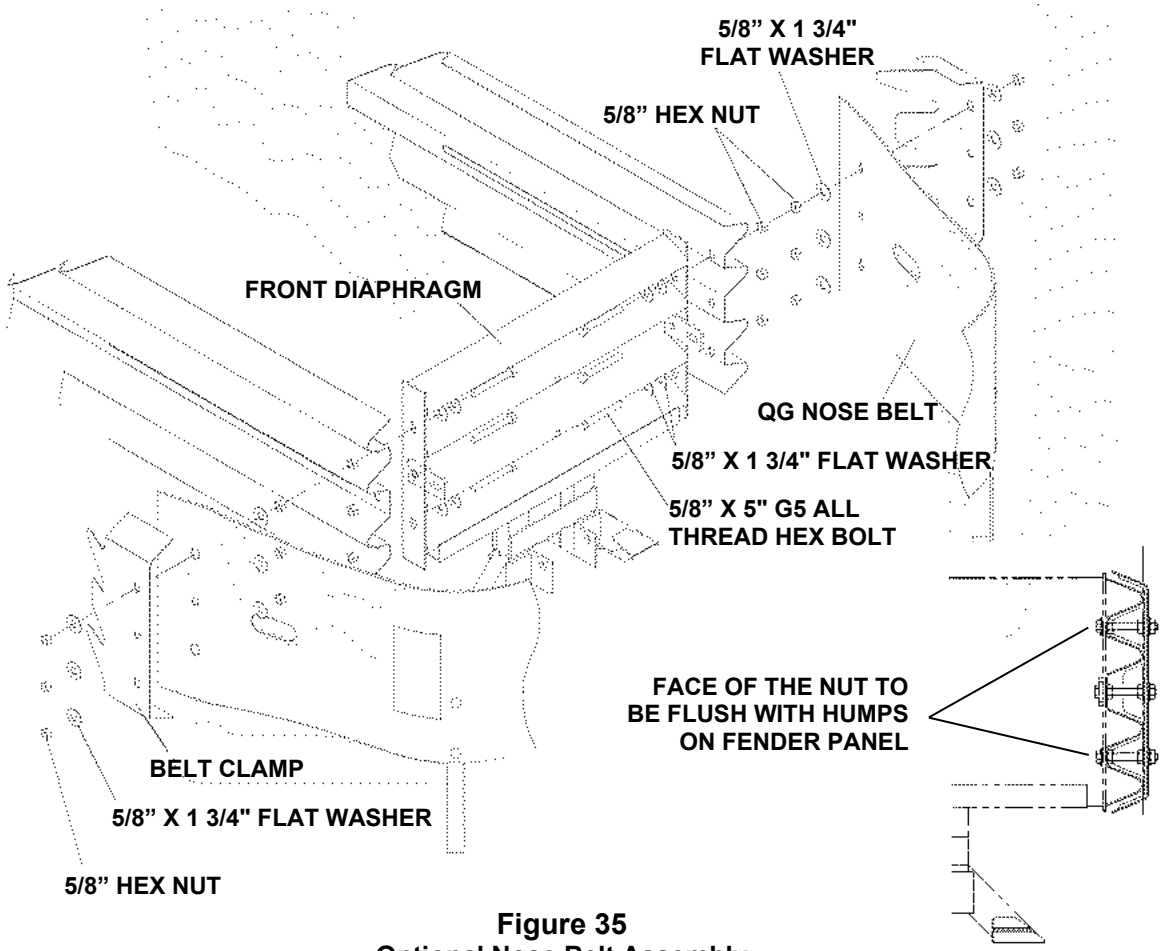


Figure 35
Optional Nose Belt Assembly

Note: Nose of system may be delineated to comply with local codes (chevron, reflective material, signs, etc. supplied by others).

12) Checking the System Assembly

At this point recheck to ensure that all fasteners are properly tightened throughout the system (anchor bolts, etc.). See warning below. Check all Fender Panels. If they do not fit tightly against the underlying Panel, system realignment may be necessary (Figure 36).

Warning:
Bolt Torque Requirements
Anchor Studs – p. 12 May slightly protrude above nuts
Critical Clearances
Anchor Studs above nuts – Figure 20, p. 25 Fender Panel Gap Narrow – 0.78” [20 mm]

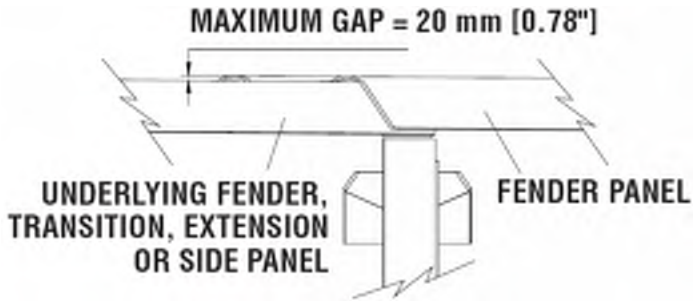


Figure 36
Fender Panel Gap for Narrow Systems

13) Cartridge Assembly

Be sure the Adjustable Cartridge Support in the Nose is attached correctly. See “Attach Nose Assembly” in Step 11 on page 33. The top surface of the Nose Cartridge should be horizontal.

It is the responsibility of the installer to place the appropriate Cartridge in each Bay and Nose section of the QuadGuard®. Type 1 Cartridges are placed toward the front (Nose) of the system; Type II Cartridges are placed toward the rear (Backup) of the system (p. 38).

Warning: Placing the wrong Cartridge in the Nose or any Bay is strictly prohibited pursuant to NCHRP Report 350 testing criteria. Such configurations have not been accepted for use and may result in unacceptable crash performance.

I-TYPE I CARTRIDGE
II-TYPE II CARTRIDGE

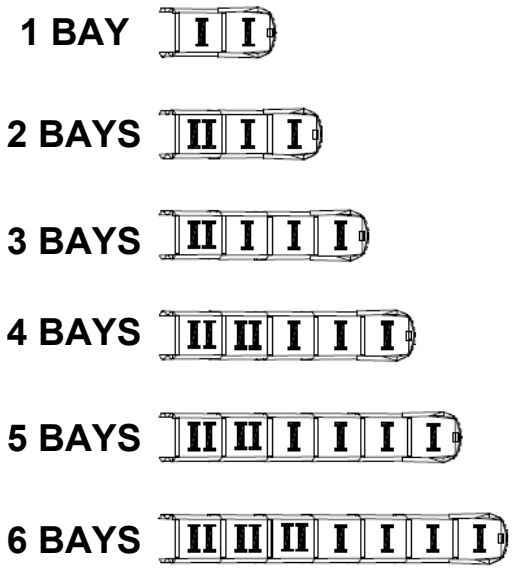


Figure 37
Cartridge Placement

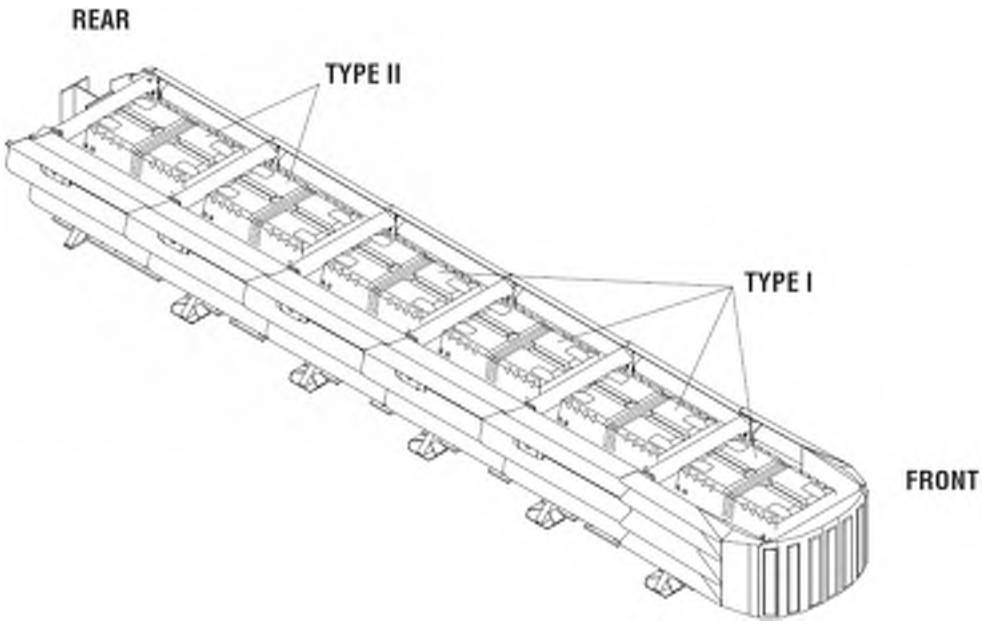


Figure 38
5-Bay Cartridge Placement Shown

Wide System Identification

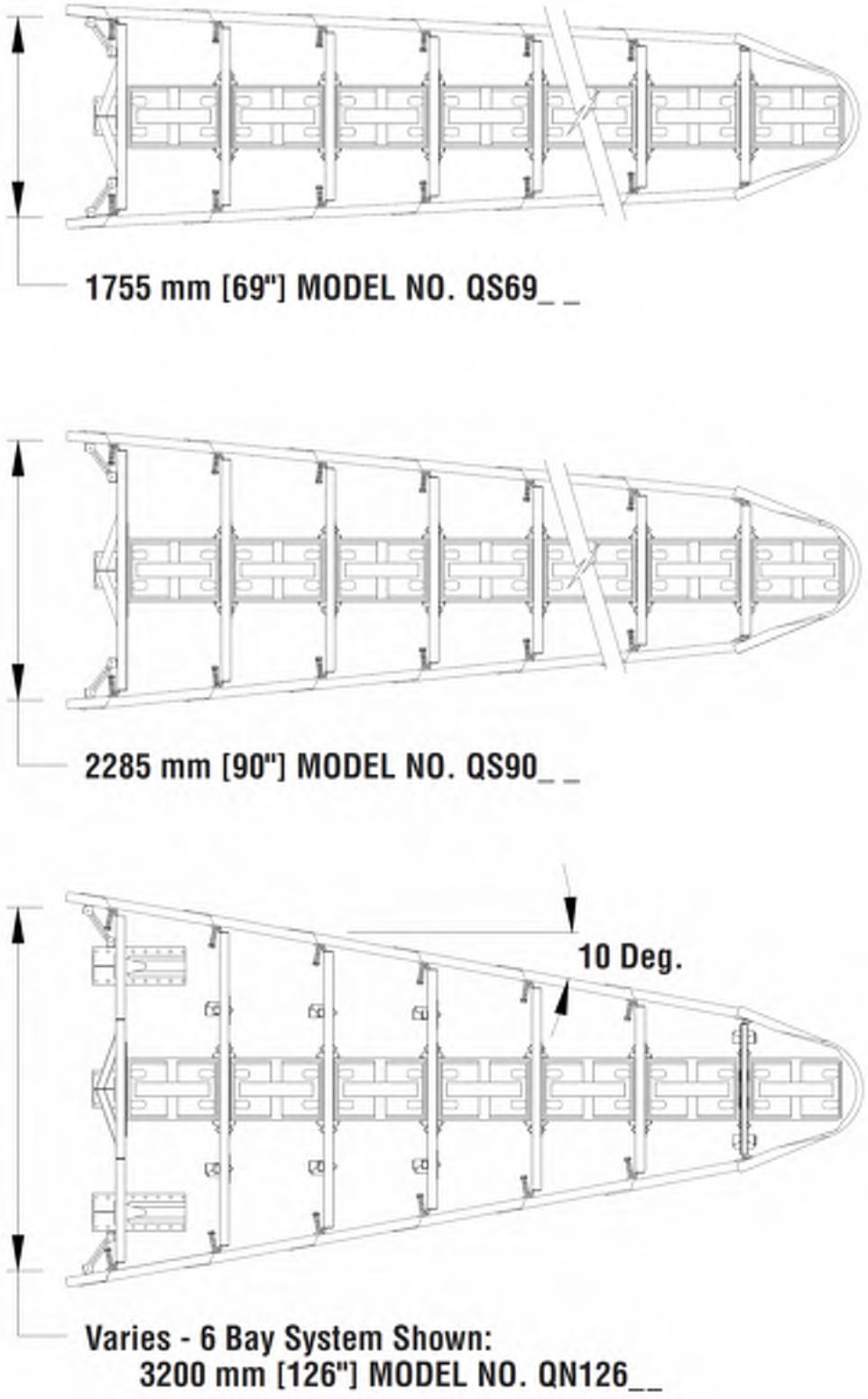


Figure 39
Wide Systems and Model Numbers

Inspect Shipping

Check all received parts against the shipping list supplied before QuadGuard® deployment. Make sure all parts have been received.

Caution: The Drawing Package supplied with the QuadGuard® must be used with these instructions for proper assembly and should take precedence over these general instructions.

Determine Backup and Transition Type

The QuadGuard® is available with a Tension Strut Backup or a Concrete Backup. See Figures 40 and 41, along with the Backup assembly drawing, to determine which type of Backup is being deployed.

A Transition Panel or Side Panel must be used on each side of the Backup. A Side Panel is not needed when a Transition Panel is used. Several types of transitions are available for use with the QuadGuard®. See Figures 42 through 46 and the drawing package to determine which types of panels to attach.

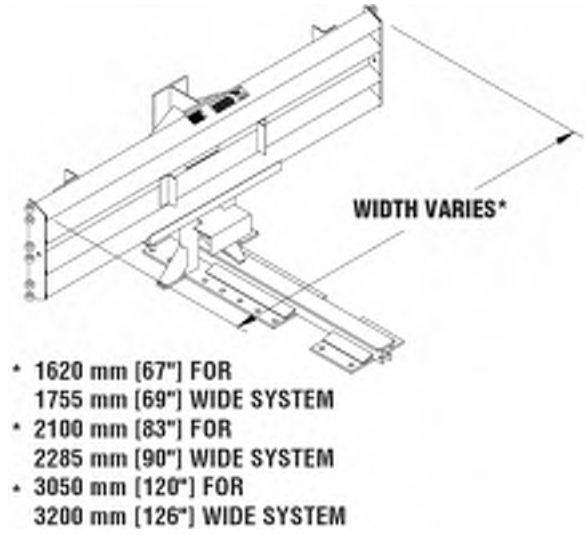


Figure 40
Tension Strut Backup

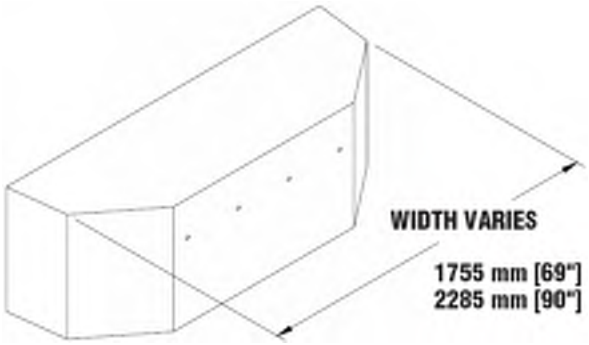


Figure 41
Concrete Backup

Wide Transitions

Note: The proper Transition Panel or Side Panel must be used for impact performance of the system. The correct Panel(s) to use will depend on the direction of traffic and what type of barrier or roadside feature the QuadGuard® is shielding. Contact the Customer Service Department prior to deployment if you have any questions.

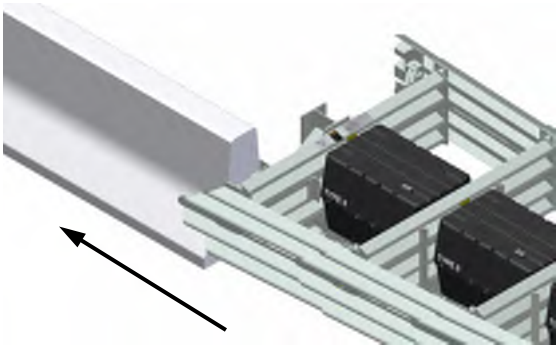


Figure 42
No Transition

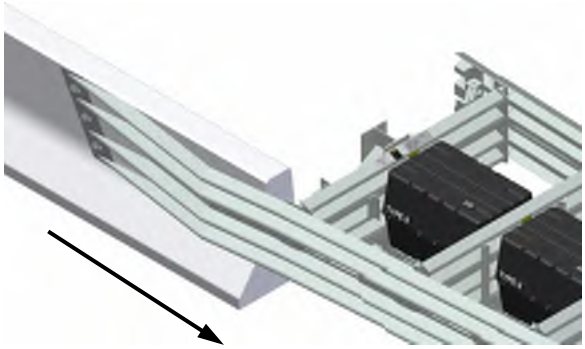


Figure 43
Quad-Beam™ to Safety Shape Barrier

Note: Arrows indicate traffic direction.

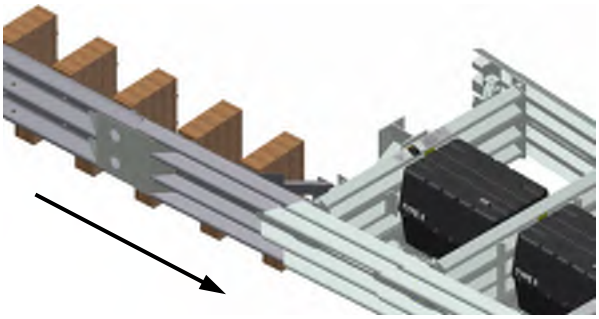


Figure 44
Quad-Beam™ to Thrie-Beam

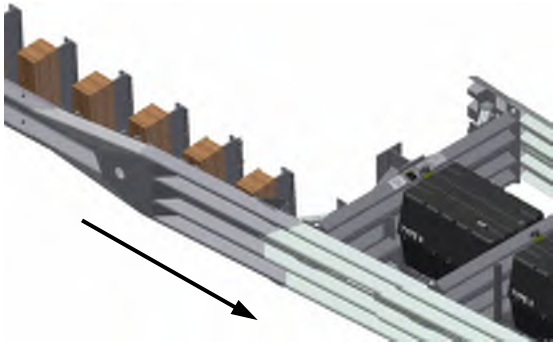


Figure 45
Quad-Beam™ to W-Beam

Note: Arrows indicate traffic direction.

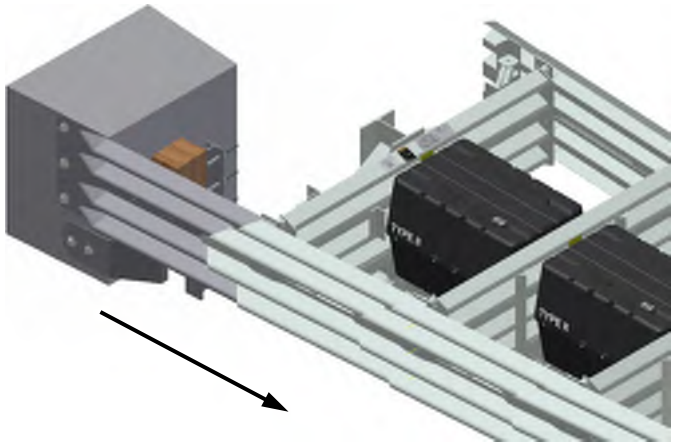


Figure 46
Quad-Beam™ End Shoe

Assembly Wide

1) Mark System Location

Locate the centerline of the system by measuring the proper offset from the roadside obstacle. See the Drawing Package supplied with the system. Place chalk line to mark the centerline of the system. Mark a construction line parallel to the center line and offset 6.5” [165 mm] to one side as shown in Figure 47. The edge of the Monorail will be placed on this line.

Note: The concrete foundation must comply with the project plans supplied with the system.

Warning: Location of system with respect to the roadside obstacle is critical and dependent on the type of Transition Panel used. See the Project Plans supplied with the system for details.

Figure 47
(Top view of concrete foundation)

2) Anchor the Backup

A) Concrete Backup Construction (Figure 48)

Locate Backup Face Plate using the Backup assembly drawing. Verify that any applicable Transition Panels fit properly before anchoring the Face Plate. Drill anchor holes in the Concrete Backup using the Face Plate as a template. Anchor the Face Plate to the Concrete Backup using the approved adhesive anchoring system supplied with the QuadGuard® (p. 12).

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

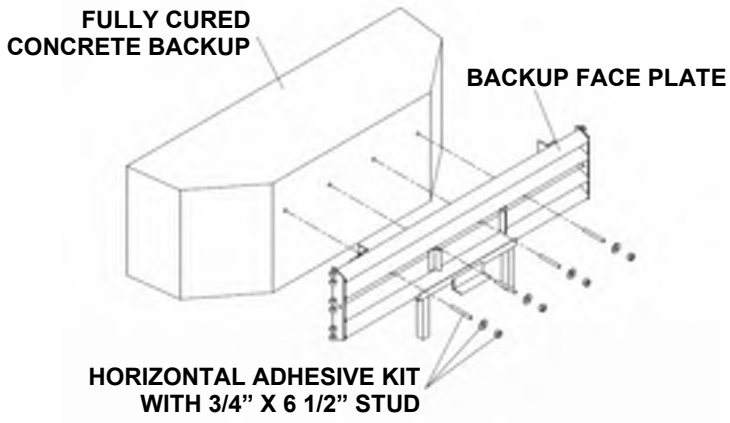


Figure 48
Anchor Backup Face Plate to Concrete Backup

B) Monorail Assembly for Tension Strut Backup

Locate the Tension Strut Backup on foundation with side of Monorail on the construction line on page 46 (Figure 52). Verify that any applicable Transition Panels fit properly before anchoring Backup. Drill anchor holes in foundation using the Backup as template. Anchor the Backup to the concrete foundation using the approved adhesive kit supplied with the QuadGuard® (p. 12).

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

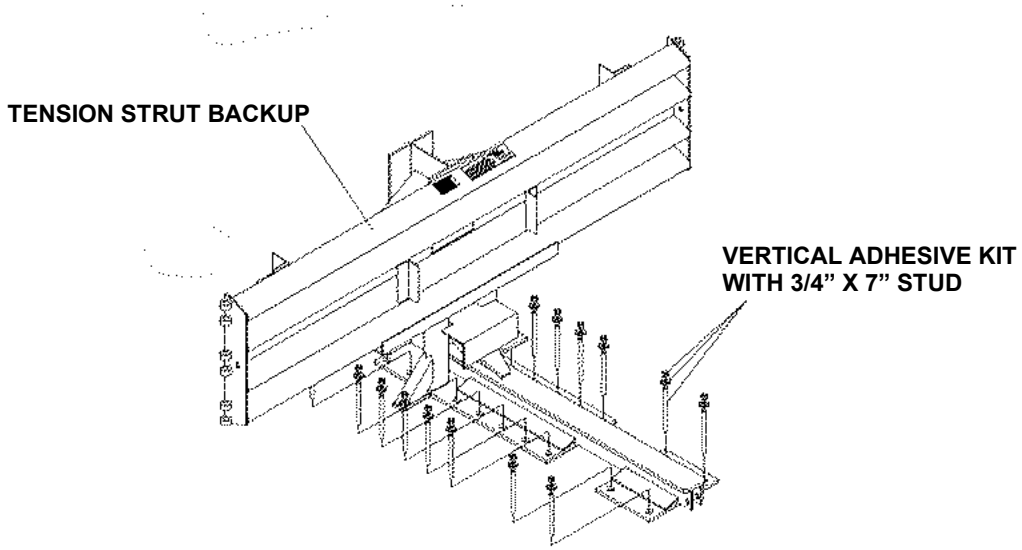


Figure 49
Anchoring Tension Strut Backup to Foundation

Monorail Alignment

It is important to align each segment of Monorail from the back to the front of the system (±1/4" [6 mm]). Anchor each Monorail section using the provided Valtir approved adhesive kit. See Figure(s) 50, 52 - 54 and the approved adhesive instructions included with the adhesive kit (p. 12).

Drill 0.78" [20 mm] diameter by 5 3/4" [145 mm] boreholes using the Monorail as a template. Do not drill through foundation.

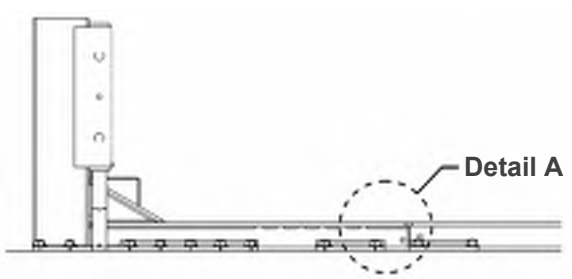
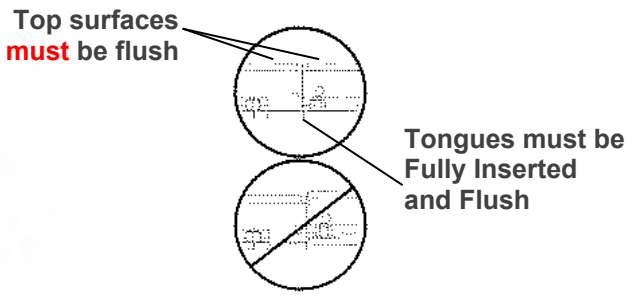


Figure 50
Rail Height and Alignment



Detail A

C) Extra-Wide Tension Strut Backup Assembly (Figure 51)

Locate the Extra-Wide Tension Strut Backup center section and Monorail on foundation with side of Monorail on the construction line (p.44).

Locate the Extra-Wide Tension Strut Backup left section on the left side of the center section, aligning the three holes in the side plates.

Locate the Extra-Wide Tension Strut Backup right section on the right side of the center section, aligning the three holes in the side plates.

Secure the Backup sections to each other using 5/8” x 2” hex bolt, 5/8” x 1 3/4" flat washer (2), 5/8” lock washer and 5/8” hex nut (6 places) as shown in Figure 51 and Detail 51A.

Verify that any applicable Transition Panels fit properly before anchoring Backup. Drill anchor holes in foundation using the Backup as template. Anchor the Backup to the foundation using an approved adhesive supplied with the QuadGuard®.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

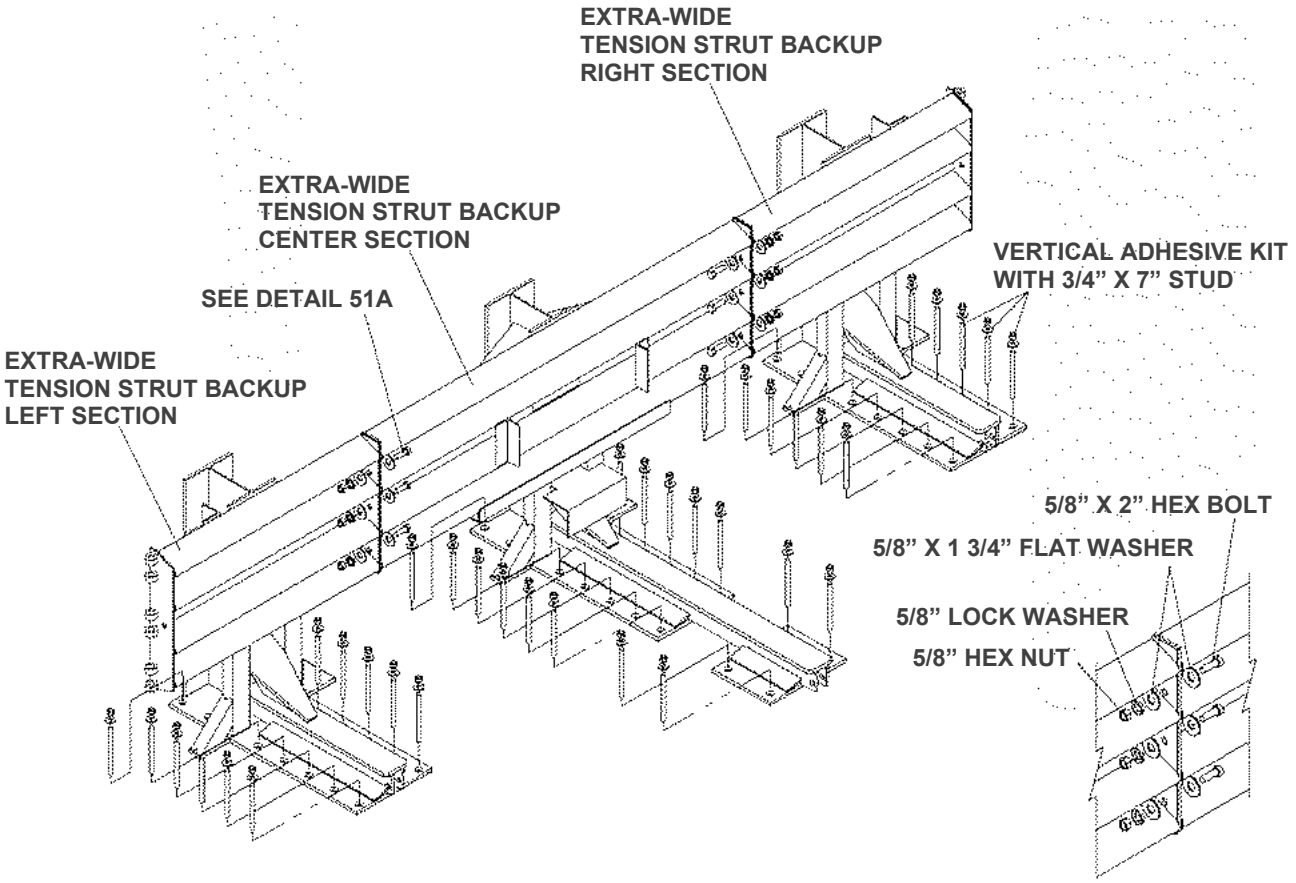


Figure 51
Anchoring Extra-Wide Tension Strut Backup

Detail 51A

4) Anchor the Monorail

A) Monorail Assembly for Concrete Backup (Figure 52).

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Monorail foot forward of front face of Concrete Backup (Figure 52).

Orient the Monorail so that the Monorail tongues face the Concrete Backup (Figure 52).

Drill 5 1/2" [140 mm] deep anchor holes using the Monorail as a template. Do not drill through foundation.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

Anchor each Monorail section using the approved adhesive kits provided. See Figure 51 and the approved adhesive kit instructions included with this manual (p. 12). It is important to attach each segment of Monorail in alignment from the back to the front of the system (±1/4” [6 mm]).

Warning: Improper alignment at the Monorail Splice Joints will prevent proper system collapse during an impact.

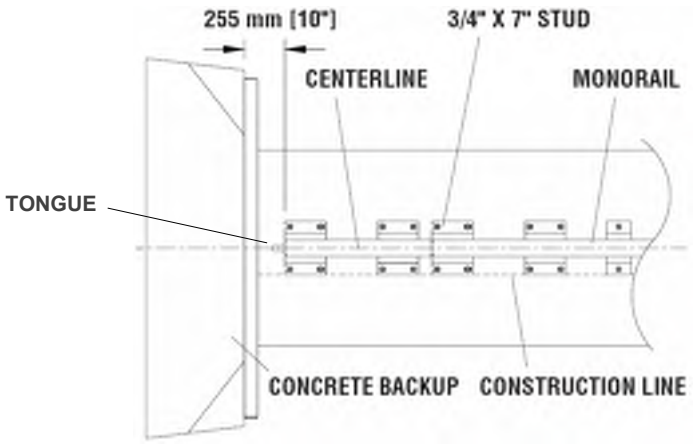


Figure 52
Monorail Location for Concrete Backup

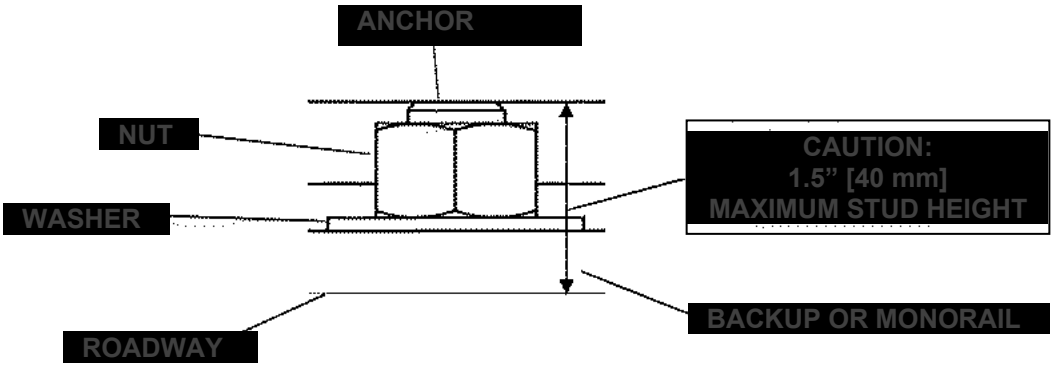


Figure 53
Proper Stud Height

B) Monorail Assembly for Tension Strut Backup (Figure 54).

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Backup foot 4” forward of edge of foundation (Figure 54).

Drill 5 1/2” [140 mm] deep anchor holes using the Monorail as a template. Do not drill through foundation.

Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

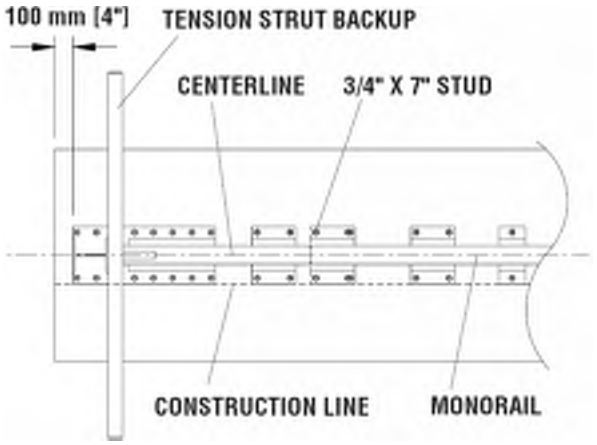


Figure 54
Backup and Monorail Location for Tension Strut Backup

5) Attach Side Panels and/or Transition Panels to Backup Assembly (Figure 55).

a. Attach Hinge Plate to the Transition Panel or Side Panel using 5/8” rail bolt and 5/8” rail nut (two places – top and bottom holes only).

b. Attach Transition Panel or Side Panel assembly to side of Backup using 5/8” x 4” hex bolt, 5/8” lock washer and 5/8” hex nut at three places on each side of Backup (Figure 55).

c. Attach diagonal brace to Fender Panel and Backup using 3/8” hex bolt, 3/8” lock washer and 3/8” hex nut (two places per brace: 4 places per side).

d. Secure each diagonal brace with 3/8” hex bolt, 3/8” lock washer, and 3/8” hex nut (two places per brace) as shown in Figure 55.

Note: A Side Panel is not needed when a Transition Panel is used. Diagonal braces not used with some Transition Panels. See drawing package.

Assembly tip:

Use drift pin to align the center hole of the Panel with the center hole of the Backup before attaching the rail bolts.

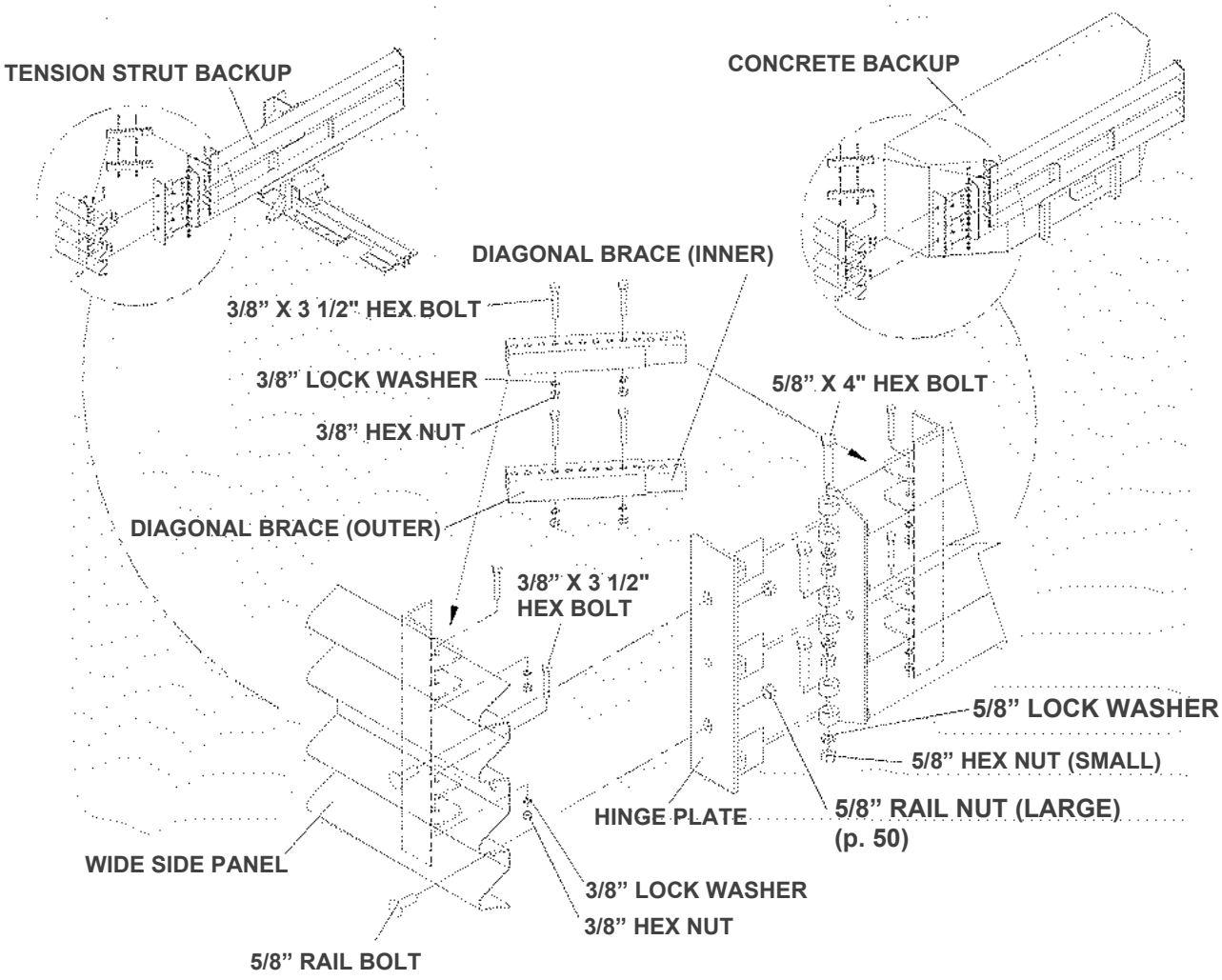


Figure 55
Side Panel/Transition Panel Attachment

6) Attach Monorail Guides

Insert 3/4” x 2” G8 hex bolt through Monorail guide and Diaphragm, oriented as shown in Figure 56. Secure with 3/4” lock washer and 3/4” hex nut (typical two places per guide). See also Diaphragm assembly drawing. Shims are sandwiched between Monorail guides and Diaphragm.

Repeat process for each Diaphragm.

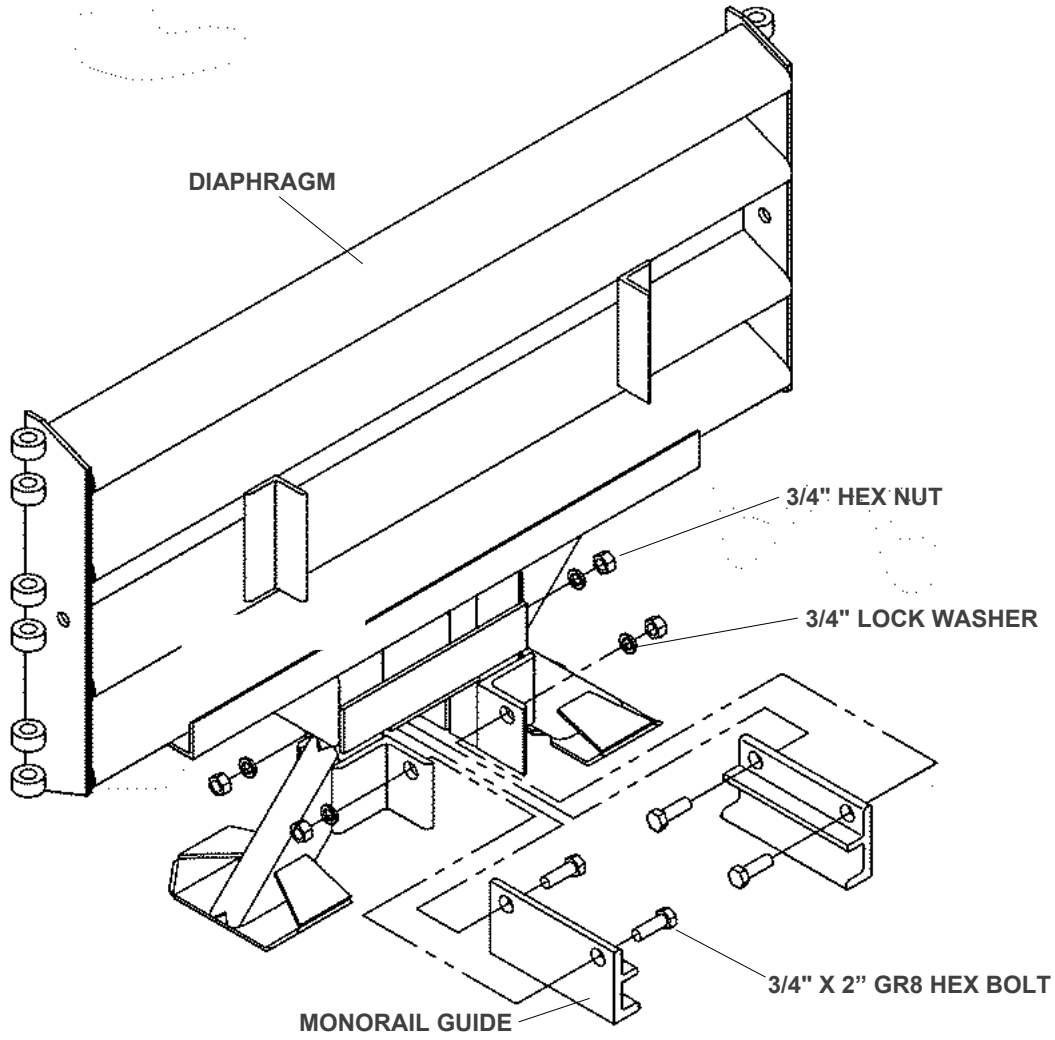


Figure 56
Monorail Guide Attachment

7) Attach Diaphragms

Orient the widest Diaphragm so that the front face of the Diaphragm shape faces toward the Nose of the system as shown in Figure 57. **The widest Diaphragm must be attached closest to the Backup with each subsequent Diaphragm being progressively narrower.**

Slide the widest Diaphragm onto the Monorail and all the way to the Backup to ensure system is able to collapse properly during impact. Once this has been verified, slide the Diaphragm forward to approximately 36” [915 mm] in front of the Backup.

Orient and slide all other Diaphragms onto Monorail and position each approximately as shown in Figure 58.

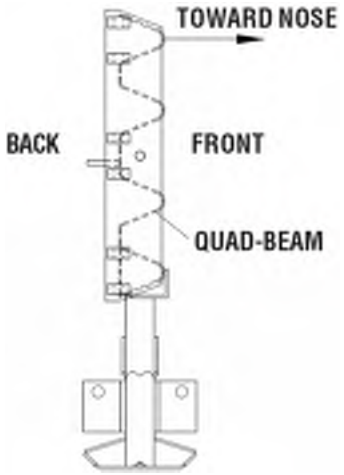


Figure 57
Diaphragm Orientation

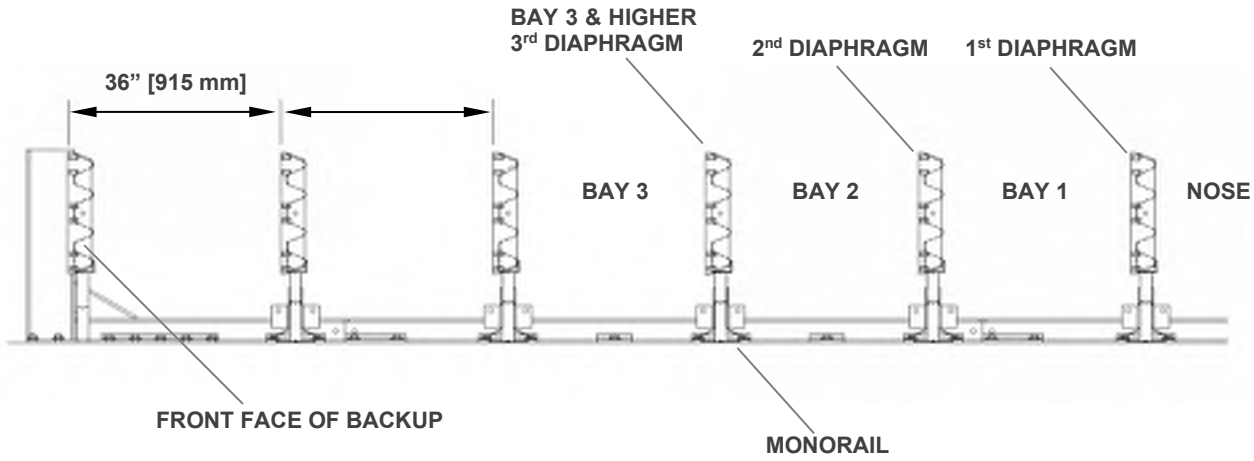


Figure 58
Diaphragm spacing

8) Attach Hinge Plate onto Fender Panels

Note: Do not mix the 5/8” rail nuts (large) with the 5/8” hex nuts (small) (Figure 59).

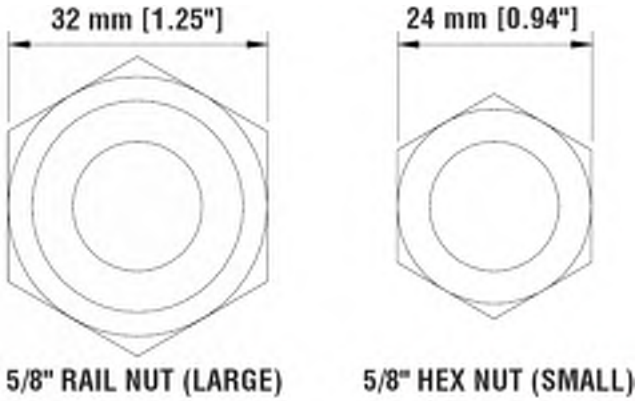


Figure 59
Rail Nuts are Oversize

Note: For proper impact performance, wide systems must use Hinge Plates.

Attach Hinge Plate on each Fender Panel using two (2) 5/8” rail bolts and two (2) 5/8” rail nuts, using top and bottom holes only, leaving the center-hole open as shown in Figure 60.

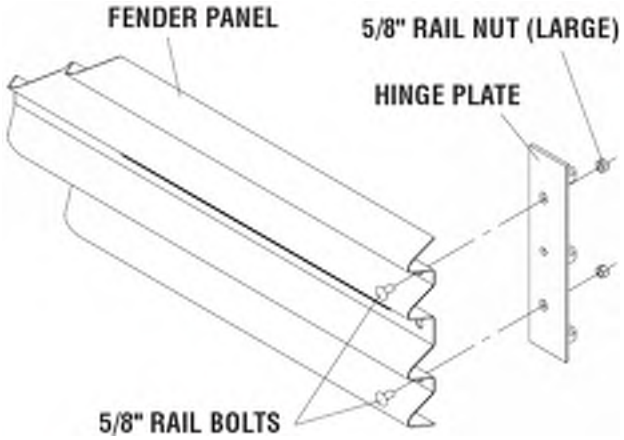


Figure 60
Hinge Plate Assembly

9) Attach Fender Panels

Starting at the Backup, attach left and right Fender Panels as shown in Figure 61 and Fender Panel Assembly drawing.

Step 1

Place the Fender Panel so that the center of the slot of the rearward Diaphragm is lined up with the approximate center of the slot in the Fender Panel.

Attach Mushroom Washer Assembly as shown in Figure 61, Detail 61a and Detail 61b, but do not torque at this time (this helps to balance the Fender Panel).

Step 2

Slide the Fender Panel forward until the holes in the Fender Panel line up with the holes in the forward Diaphragm.

Step 3

Use a drift pin to align the center hole of the Fender Panel with the center hole of the Diaphragm.

Step 4

Attach the front of the Fender Panels to the next Diaphragm using two (2) rail bolts and large hex nuts per side. Use only the top and bottom holes; leave the center hole open until the next Fender Panel is attached.

Step 5

Be sure Mushroom Washer lays flat against the Fender Panel as shown in Detail 61a. Standoff on Mushroom Washer must be seated completely through slot.

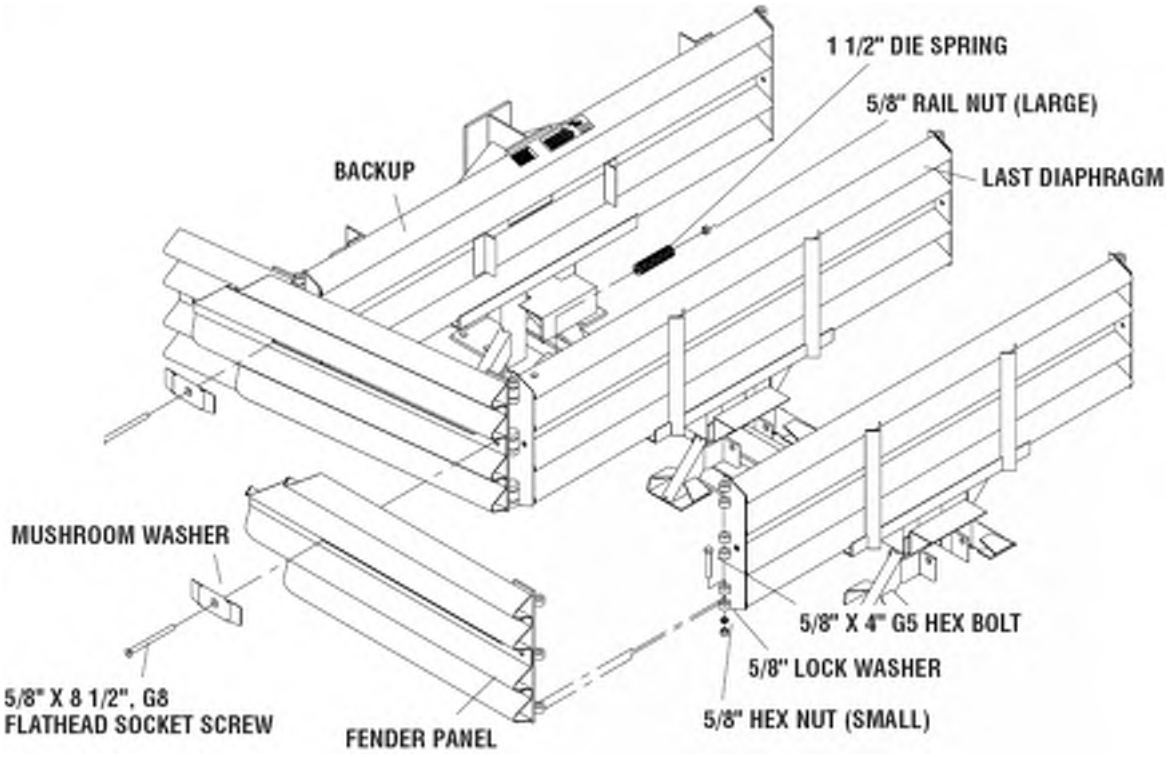
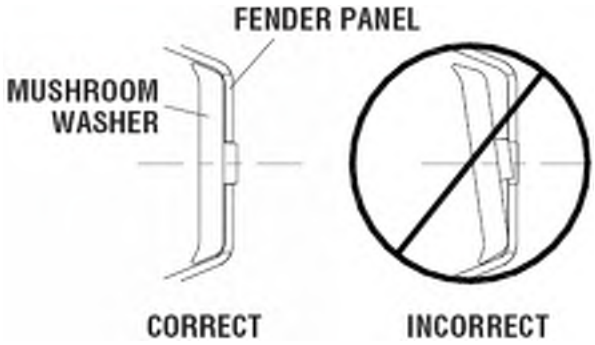
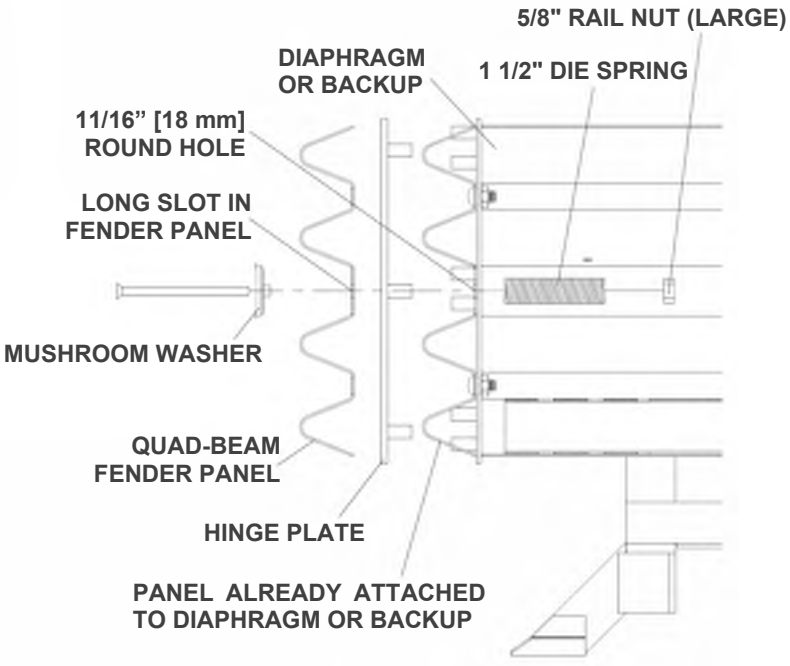


Figure 61
Fender Panel Assembly



Detail 61A
Mushroom Washer Orientation



Detail 61B
Mushroom Washer Attachment

Step 6

Check Diaphragm spacing to ensure 36” [915 mm] between rear faces of consecutive Diaphragms as shown in Figure 62 and Fender Panel Assembly drawing.

Step 7

Once the proper spacing has been achieved, torque the Mushroom Washer Assembly (small hex nut) until it reaches the end of the threads. Assemble the remaining Diaphragms and Fender Panels following the same procedures.

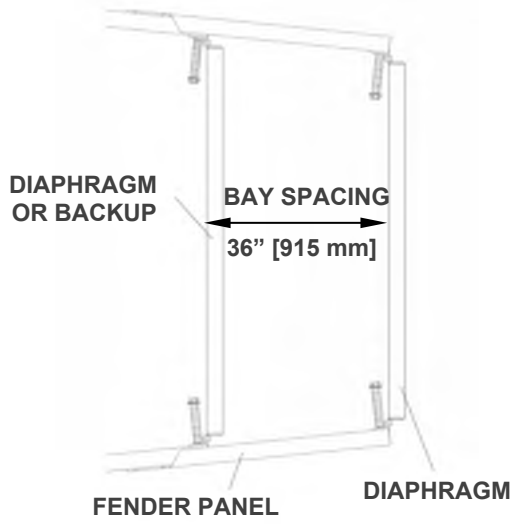


Figure 62
Proper Diaphragm Spacing

10) Attach End Cap

Using 5/8” x 3 1/2” G5 hex bolt, 5/8” hex nut and 5/8” lock washer, attach the End Cap to the front of the first Monorail segment as shown in Figure 63 and the Monorail Assembly drawing.

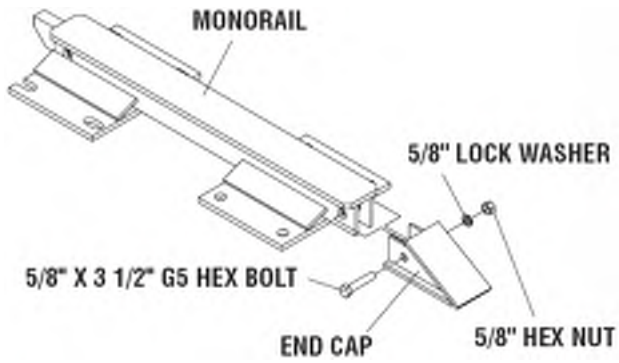


Figure 63
Monorail End Cap Assembly

11) Assemble Cartridge Support Brackets

Attach lower Cartridge Support Bracket to front and back of all Diaphragms and front of Backup as shown in Figures 64 - 67, the Backup Assembly drawing and the Diaphragm Assembly drawing.

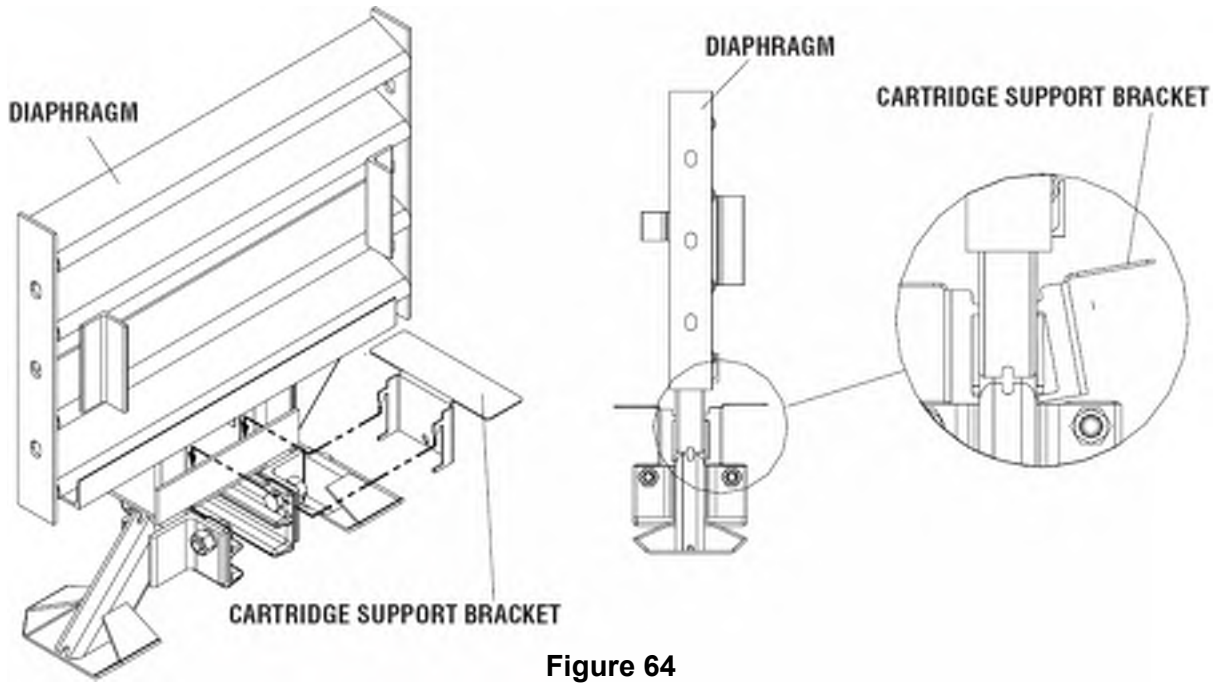


Figure 64
Diaphragm with
Cartridge Support Bracket

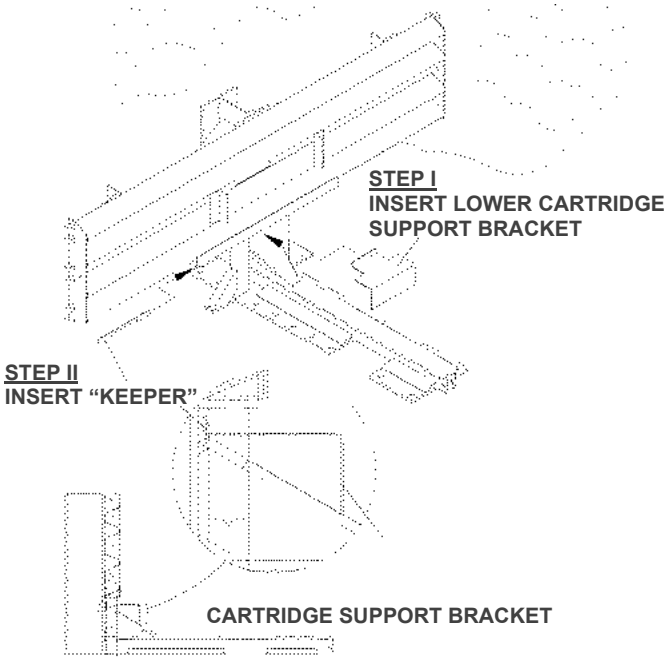


Figure 65
Cartridge Support Bracket
(Tension Strut Backup)

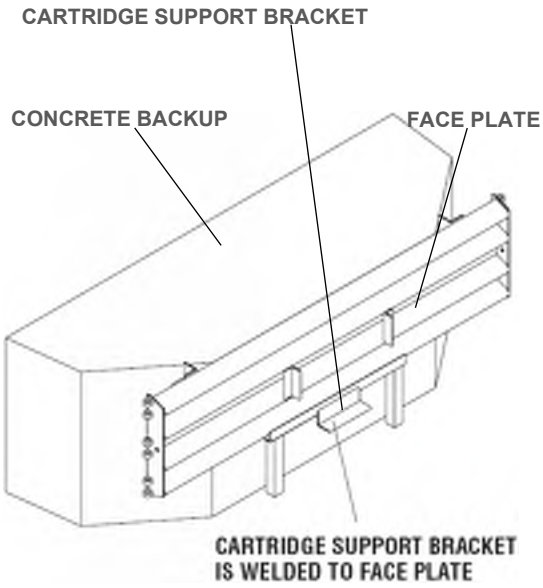


Figure 66
Cartridge Support Bracket
(Concrete Backup)

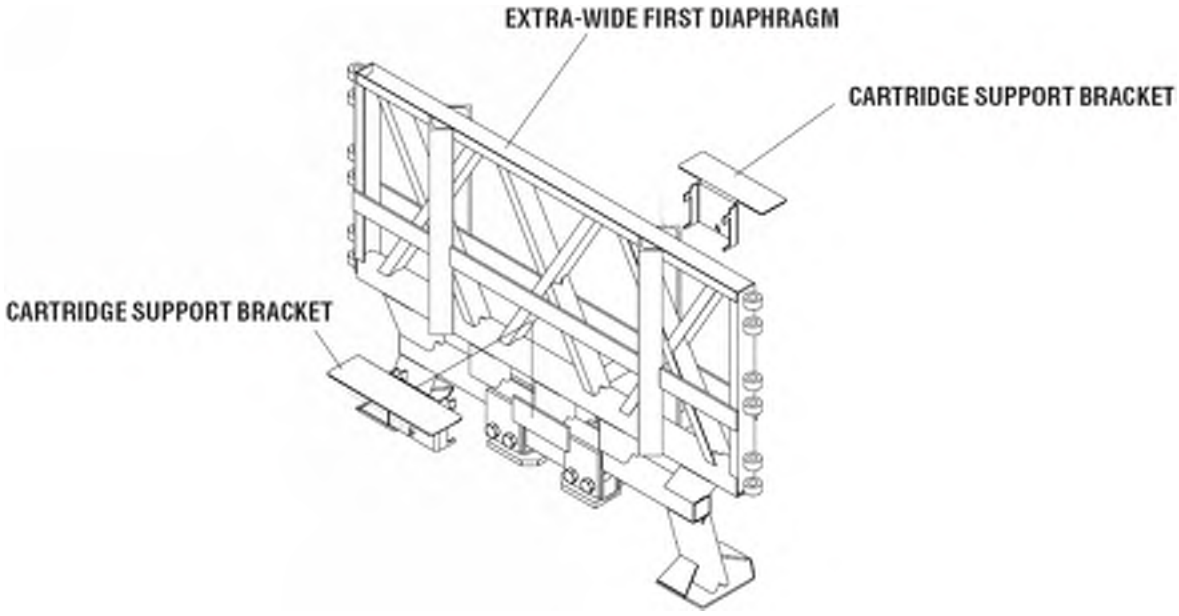


Figure 67
Extra-Wide First Diaphragm

12) Attach Nose Assembly

See pages 34 – 37 for Nose Assembly information.

13) Checking the System Assembly

At this point recheck to ensure all fasteners are properly tightened throughout the system (anchor bolts, etc.). See warning below. Check all Fender Panels. If they do not fit tightly against the underlying Fender Panels, system realignment may be necessary (Figure 68).

Warning:
Bolt Torque Requirements
Anchor Studs – p. 12 May slightly protrude above nuts
Critical Clearances
Anchor Studs above nuts – Figure 53, p. 46 Fender Panel Gap Wide – 25 mm [1.00”]

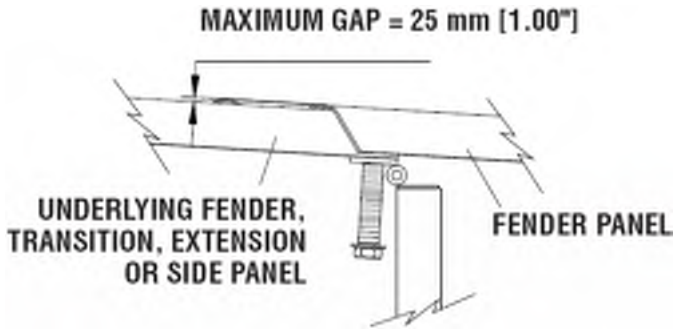


Figure 68
Fender Panel Gap for <u>Wide Systems</u>

14) Cartridge Placement

Be sure the Adjustable Cartridge Support in the Nose is attached correctly (p. 36). The top surface of the Nose Cartridge should be horizontal.

It is the responsibility of the installer to place the appropriate Cartridge in each Bay and Nose section of the QuadGuard®. Type I Cartridges are placed toward the front and Nose of the system; Type II Cartridges are placed toward the rear of the system (Figure 69).

Warning: Placing the wrong Cartridge in the Nose or any Bay is strictly prohibited pursuant to NCHRP Report 350 testing criteria. Such configurations have not been accepted for use and may result in unacceptable crash performance.

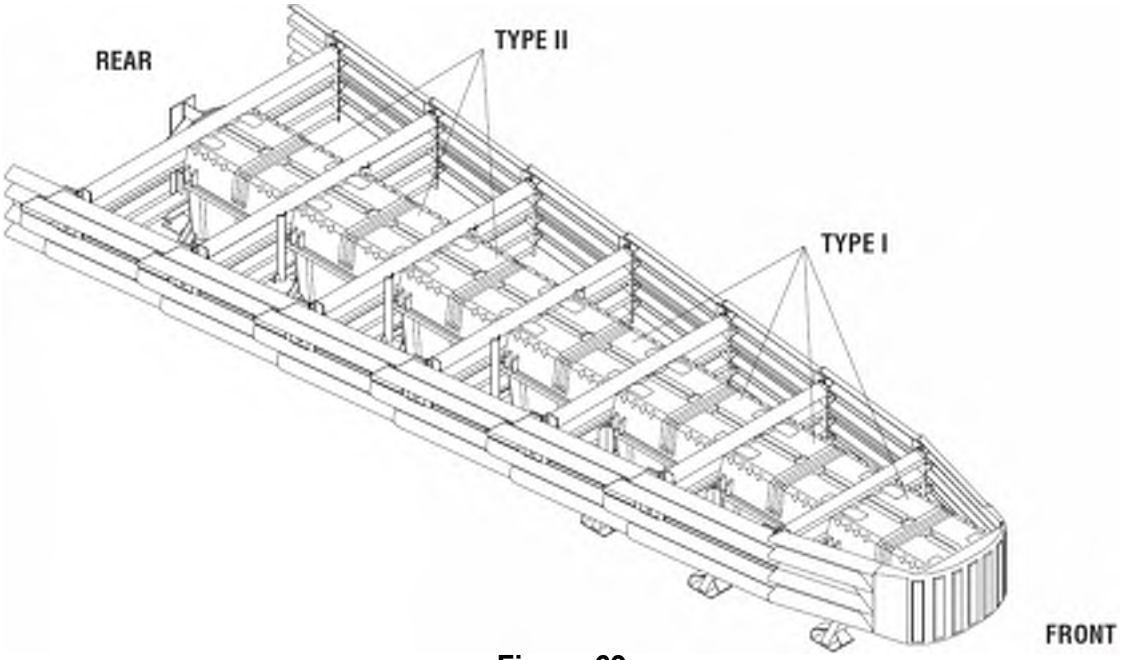


Figure 69
Typical Cartridge Layout
(Six - Bay System Shown)

I-TYPE I CARTRIDGE
II-TYPE II CARTRIDGE

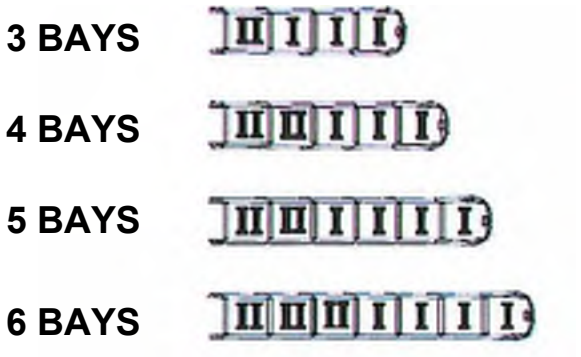


Figure 70
Cartridge Placement

QuadGuard® Final Inspection Checklist

Site Location: _____

Date: _____

Inspector: _____

Refer to the QuadGuard® manual and/or drawing package.

- ☐ Clearance of 30” minimum behind rear Fender Panels for movement (p. 19)
- ☐ Proper Transition Panel is used for the type of barrier (p. 22, 42)
- ☐ Every borehole and slot in Backup and Monorail is utilized (p. 23, 24, 44, 45, 46, 47)
- ☐ Anchor stud(s) height is 1.5” or less above the pad (p. 24)
- ☐ If no transition is used, narrow side panels are used with backup (p. 26,47)
- ☐ Monorail guides are attached to the Diaphragms with shims (p. 27, 47)
- ☐ Mushroom Washer tabs lay flat within fender panel slots (p. 29, 51)
- ☐ Fender Panel nuts are bottomed out on Mushroom Washer bolt (p. 29,52)
- ☐ Monorail End Cap Assembly in place (p. 31, 53)
- ☐ Cartridges are level and the same height in each Bay (p. 35, 56)
- ☐ Nose Cartridge is level (p. 34)
- ☐ Fender Panel gap is 0.78” or less for Narrow systems (p. 37)
- ☐ Fender Panel gap is 1” or less for Wide systems (p. 55)
- ☐ Cartridge types are in properly placed in each Bay (p. 38, 56)
- ☐ Bolts and nuts are properly tightened throughout the system (p. 37, 56)
- ☐ Anchor nuts are torqued to adhesive manufacture specification (p. 12)
- ☐ System is clear of debris

Important: It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.

Maintenance and Repair

Inspection Frequency

Inspections are recommended as needed based upon volume of traffic and impact history. Visual Drive-By Inspections are recommended at least once a month. Walk-Up Inspections are recommended every six months for systems asphalt and once a year for concrete.

Visual Drive-By Inspection

1) Check to see if there is evidence of an impact. If so, a walk-up inspection will be necessary.
2) Check to see if the Cartridges appear to be off the Support Brackets. Any damaged Cartridges will need to be replaced.

Warning: See Cartridge placement instructions on page 38.

3) Be sure the Nose is in place.
4) Note the location and condition of the QuadGuard® and the date of visual drive-by inspection.

Walk-Up Inspection

- ☐ Clear and dispose of any debris on the site.
- ☐ Clear and remove excessive dirt from around the Monorail and Diaphragm feet.
- ☐ Bolts are tight and rust free.
- ☐ Anchor bolts are securely anchored.
- ☐ Ensure Diaphragm Legs are straight.
- ☐ All Mushroom Washer Assemblies are properly seated.
- ☐ Fender Panels and Transition Panels should nest tightly against the system.
- ☐ Be sure Cartridges have not been damaged and are properly seated on their Support Brackets. To ensure intended speed characteristics, partially crushed Cartridges (due to low speed impacts) shall be replaced.
- ☐ Make all necessary repairs as described above. See Post-Impact Instructions for more information on next page.
- ☐ To determine if a product should be replaced or is potentially reusable, a trained engineer experienced in highway products and directed by the DOT, or other appropriate local highway authority, must be consulted.

Post-Impact Instructions

Warning: If either (**wide or narrow**) system is anchored to asphalt, up to 10% of the total anchors may be replaced if damaged. If more than 10% of the anchors are damaged, the system should be relocated to fresh, undisturbed asphalt and redeployed using the 18” [460 mm] threaded rods.

Narrow or Wide System

1) Deploy the appropriate traffic-control devices for protection.
2) Check to see that all anchor bolts have remained firmly anchored in the roadway surface. Replace any that are loose, broken, or pulled out.

   The proper performance of the system during an angle impact depends on the Monorail Anchors being properly anchored.

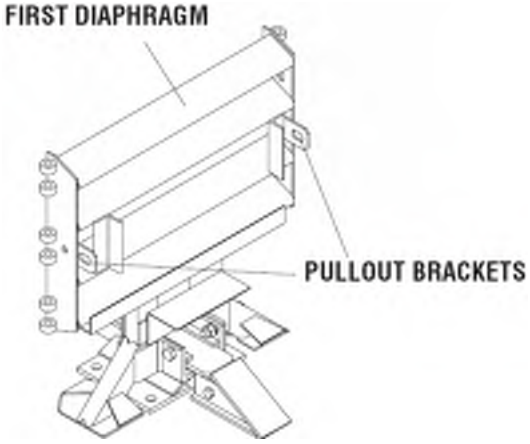
Caution: QuadGuard® Wide systems should **never** be anchored to asphalt.

3) Clear and dispose of any debris on the site.
4) Check the system to be certain that the Mushroom Washer Assemblies holding the Fender Panels together are still intact and that the system has not been deformed in a way that would prevent pulling it back to its original position.
5) Be sure that the Diaphragm Support Legs are all properly attached to the Monorail.

Caution: **Use safety goggles and gloves when refurbishing the Mushroom Spring Assembly.** Do not place fingers underneath an assembled Mushroom Washer. Parts may suddenly shift and fingers may be pinched. If the spring is still under compression as the nut is nearing the end of the bolt, to prevent injury, make sure that the spring is restrained with a clamp so it does not suddenly release when nut is removed from the Mushroom Washer Bolt.

6) Attach chain to Pullout Brackets on first Diaphragm for QuadGuard® Narrow or Wide (Figure 71). Attach both ends of chain to a heavy vehicle (such as a 1 ton pickup).

Warning: Stand clear in case chain breaks or becomes disconnected.



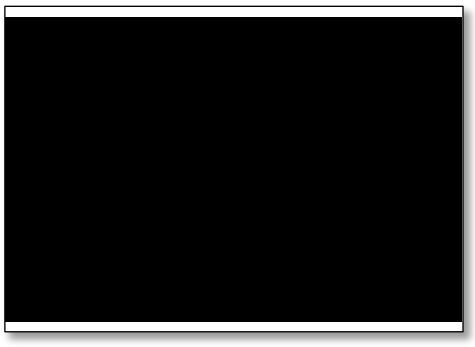


Figure 71
Pullout Brackets

7) Remove all crushed Cartridges from within the system.

8) Check to see that the Diaphragms are in usable condition. Diaphragms which are bowed or have bent legs must be replaced.

9) Check the **gaps between Fender Panels**. The maximum gap allowed for these overlapping parts (including Fender Panels overlapping Panels behind the system) is .78" [20 mm] for **narrow systems** and 1.00" [25 mm] for **wide systems**. Be sure the Mushroom Washer Assemblies are torqued to the end of the threads. If the gaps between the Fender Panels are still too large, it may be necessary to replace bent parts.

Warning:	
Fender Panel	Maximum gap allowed:
Narrow Systems	**0.78" [20 mm]**
Wide Systems	**1.00" [25 mm]**

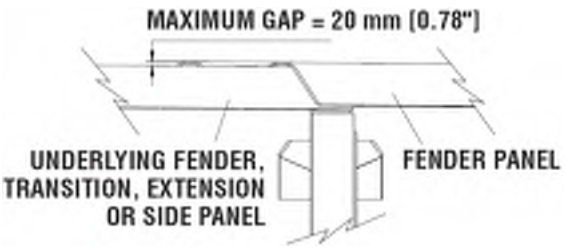


Figure 72
Narrow Systems Fender Panel Gap

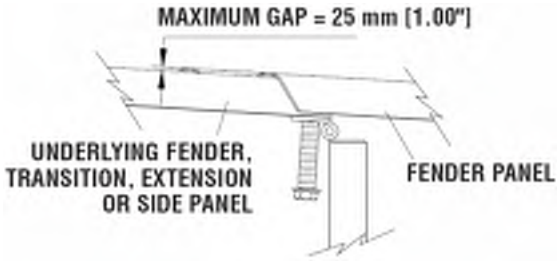


Figure 73
Wide Systems Fender Panel Gap

10) Replace all crushed Cartridges (p. 38 & 56).

11) Remove damaged Nose Assembly. Attach the new Nose to the first Diaphragm using the six (6) rail bolts, coupling nuts, rail nuts, cap screws, Pull-Out Brackets, and Bar Washers that hold the Nose to the first Diaphragm. Adjust Nose to align with Fender Panels and then tighten all six (6) nuts.

Warning:
Bolt Torque Requirements - p. 12
Critical Clearances
Anchor Studs above nuts – Figure 20, p. 24 **Fender Panel Gap Narrow – 0.78" [20 mm]** **Fender Panel Gap Wide – 1.00" [25 mm]**

12) Confirm the torque of all bolts on the system (p. 12).

13) Check to be certain that the site is free from any debris.

14) The QuadGuard® is now ready for use.

Parts Ordering Procedure

Make a list of all damaged parts using part descriptions shown on page 63 and 64 of the system images. Answer the following questions in the spaces provided. This information is necessary to receive the proper parts.

QuadGuard® System Ordering Information Chart		
Description:	**Choices**	**Fill in this section**
What is the system width? (p. 17)	24” [610 mm] 30” [760 mm] 36” [915 mm] 48” [1219 mm] 69” [1755 mm] 90” [2285 mm] 126” [3200 mm]	
How many Bays (p. 16)?	Narrow systems: 1 through 6 Wide systems: 3 through 6	
What type of Backup does the system have (p. 20)?	Concrete Tension Strut	
What type of Transition Panel is required? Side Panel and Transition Panel Types (p. 21) Note right side, left side, or both sides (p. 16)	• Quad to W • Quad to Thrie • Quad to Safety Shape Barrier • Quad to End Shoe • 4” Offset Panel	

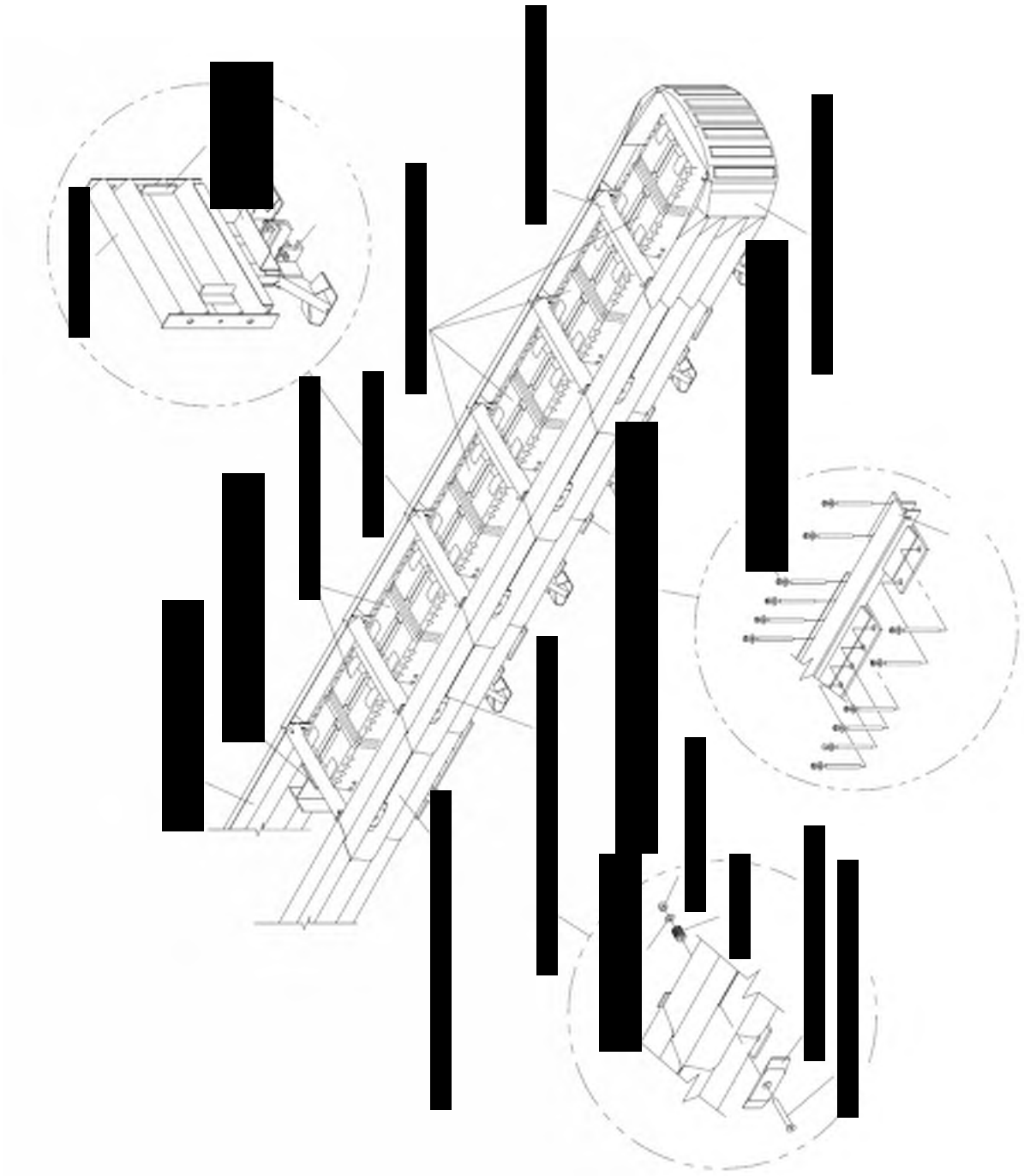


Figure 74
QuadGuard® Narrow (Parallel)

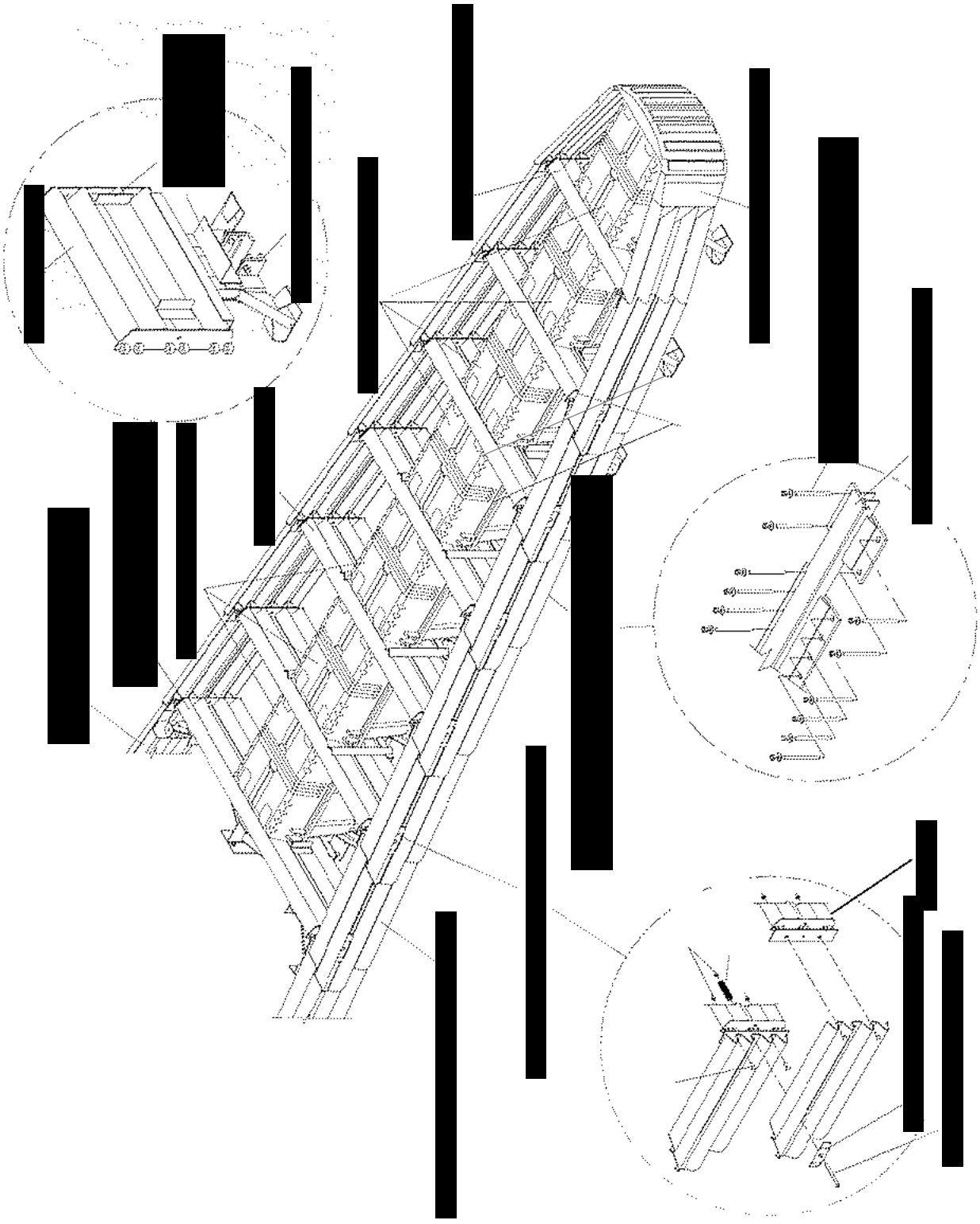


Figure 75
QuadGuard® Wide

Notes:

Notes:

Notes:

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A TIER ABOVE

For more complete information on Valtir products and services, visit us on the web at www.valtir.com. Materials and specifications are subject to change without notice. Please contact Valtir to confirm that you are referring to the most current instructions.

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LINDSAY™ TRANSPORTATION SOLUTIONS

P/N ABSORB-M (ECN 4119)

REVISIONS				
DATE	**ECN**	**PUBLISHED ECN**	**REVISION**	**DESCRIPTION OF CHANGE**
08/14/2019	4119	4119	A	New release

Important For Your Safety

We have provided important safety messages in this manual. **ALWAYS** read and obey all safety messages.

This is the safety alert symbol. 

This symbol alerts you to hazards that can kill or hurt you and others. All safety messages will be preceded by the safety alert symbol and the word "DANGER", "WARNING", or "CAUTION".

These words mean:

DANGER **IMMEDIATE HAZARDS THAT WILL RESULT IN SEVERE PERSONAL INJURY OR DEATH.**

WARNING **Hazards or unsafe practices that COULD result in severe personal injury or death.**

CAUTION Hazards or unsafe practices that COULD result in minor personal injury or product or property damage.

This manual must be available to the person(s) overseeing and/or assembling the crash cushion system at all times. For additional copies, or if you have any questions about any portion of this manual, see below to contact Lindsay Transportation Solutions.

Contact Information

Lindsay Transportation Solutions

U.S. Toll Free: (888) 800-3691

or

+1 (707) 374-6800

www.lindsaytransportationsolutions.com

STANDARD LIMITED WARRANTY

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The products with which this limited warranty is provided (the "Products") are intended to be installed, operated, and maintained in a manner not inconsistent with instructional materials provided by LTS, the AASHTO Roadside Design Guide (as applicable), and state and federal guidelines (as applicable). Selection and proper installation, operation, and maintenance of any highway safety product, including the Products, is the responsibility of the highway authority and state department of transportation.

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W030587 Rev. 11 revised October 16, 2017

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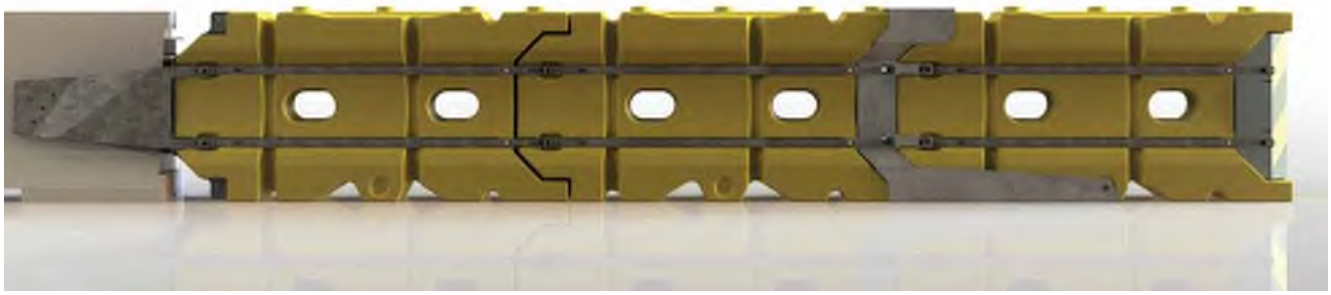
Table of Contents

ABSORB-M™ System Overview



The ABSORB-M™ is a non-redirective, gating, crash cushion designed to meet the latest test standards defined in the *Manual for Assessing Safety Hardware (MASH), Second Edition, 2016*. The ABSORB-M™ system utilizes Tension Straps, a Midnose, a Transition, and water-filled Element Assemblies (Elements) to absorb kinetic energy and safely contain or control the penetration trajectory of impacting vehicles.

The system is comprised of a Nose Plate, Elements, Pin Assemblies (Pins), a Midnose, a Transition, and mechanical anchors. The front Element is always empty with remaining Element(s) full of water. Each Element is pre-assembled with Tension Straps secured with bolts and a thread locking compound.

The system has a nominal 42" height, 24" width, and an effective length of 251-3/4" for TL-3 and 175-3/4" for TL-2. The maximum length of the system, as measured from the Nose Plate to the end of the Transition Strap is approximately 284" for TL-3 and 208" for TL-2.

ABSORB-M™ is designed to accommodate a variety of permanent and portable safety shape, constant slope, and other shapes of barrier up to 42" height.

Recommended Tools

NOTE: The list of tools, safety equipment, and traffic control is a general recommendation and should not be considered a comprehensive list. Depending on the specific characteristics of the job site and the complexity of the repair or assembly, more or less tools may be necessary.

Required Tools

- Tape Measure
- Chalk Line
- Marking Paint
- Rotary Hammer
- Masonry Bit
  5/8" (16mm) x 6" (150mm)
- Compressed Air
- 3/4" Diameter Brush
- 1/2" Drive Deep Sockets
  15/16" (24mm)
- Impact Wrench
  (pneumatic or electric)
- 1/2" Drive Torque Wrench
  5 ft-lbf [8 N-m] to 100 ft-lbf [135 N-m]

NOTE: Water source with a flexible hose (maximum 3" diameter) and a minimum 500 Gallon capacity is required for a 3 element, TL-3 system. For cold weather regions, a few typical Anti-Freeze agents are listed on Page 27.

Safety Equipment

- Safety Glasses
- Hearing Protection
- Gloves
- Steel Toe Boots
- Hard Hat
- Safety Vest
- Dust Mask

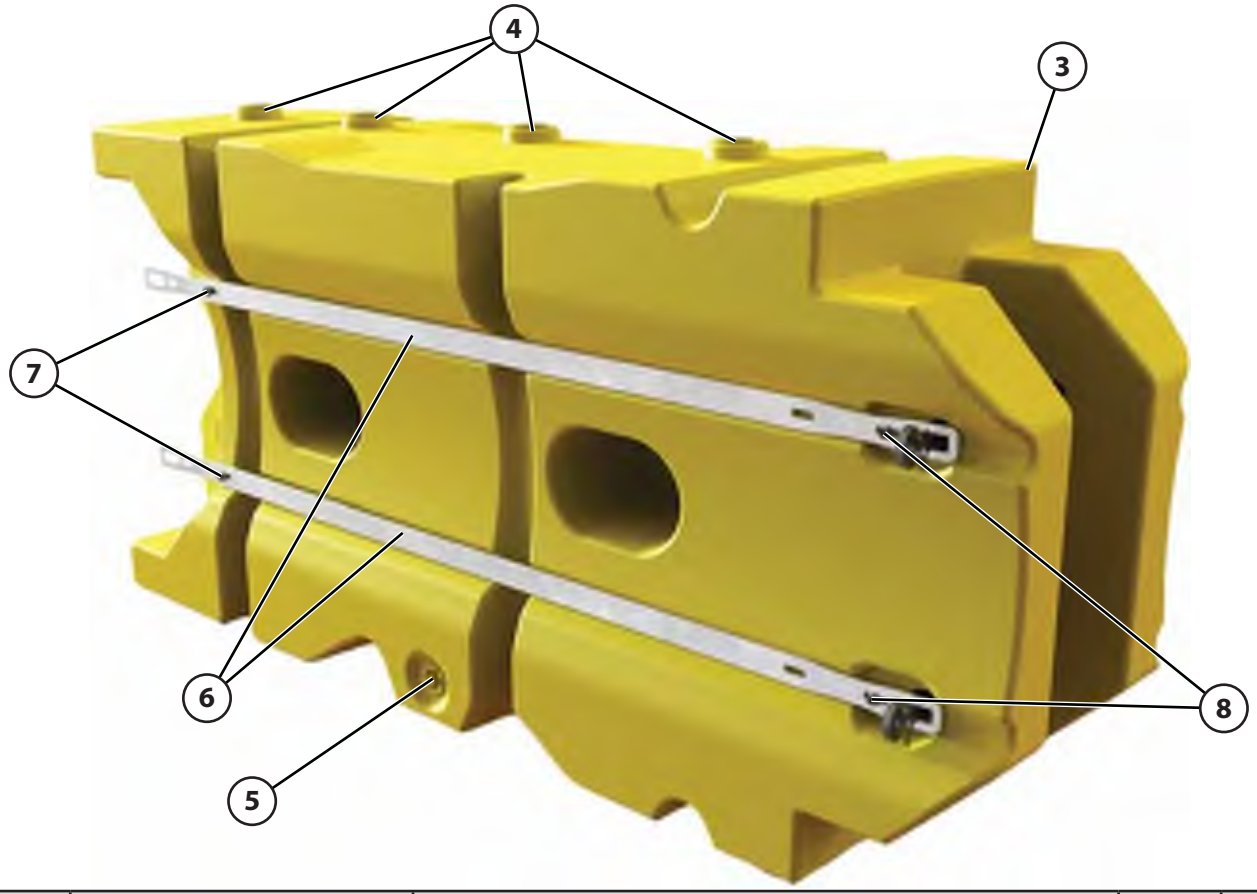
Traffic Control

- Traffic Control Equipment
- Traffic Control Plan

Parts Identification

⚠ WARNING Use only Lindsay Transportation Solutions parts that are specified by Lindsay Transportation Solutions for use with the ABSORB-M™ System. The use of unspecified parts is prohibited and could result in severe personal injury or death.

Item #	Part #	Description	TL-2	TL-3
2	BSI-1808006-00	ELEMENT ASSEMBLY	2	3



3	BSI-1808002-00*	ELEMENT	2	3
4	BSI-4004598*	CAP	8	12
5	BSI-4004599*	PLUG	2	3
6	BSI-1809053-00*	TENSION STRAP, GALVANIZED	8	12
7	BSI-2001998*	C-SCR FH 3/8-16 X 1-1/2 GR5 PLT	8	12
8	BSI-2001999*	C-SCR FH 3/8-16 X 1 GR5 PLT	8	12

*Components pre-assembled with Element Assembly.

Parts Identification (Cont.)

1  **Transition** BSI-1809036-00		9  **Midnose** BSI-1809035-00		10  **Nose Plate*** BSI-1808014-00	
TL-2, Qty. 1	TL-3, Qty. 1	TL-2, Qty. 1	TL-3, Qty. 1	TL-2, Qty. 1	TL-3, Qty. 1
11  **Transition Strap LH** BSI-1809037-00		12  **Transition Strap RH** BSI-1809038-00		13  **Pin Assembly** BSI-1808005-00	
TL-2, Qty. 1	TL-3, Qty. 1	TL-2, Qty. 1	TL-3, Qty. 1	TL-2, Qty. 8	TL-3, Qty. 10
14  **Anchor 5/8-11 x 6 In.** BSI-2002001					
TL-2, Qty. 6	TL-3, Qty. 6				

* Delineation sticker not included. Shown for reference only.

Bill of Materials

Item #	Part #	Description	TL-2	TL-3
1	BSI-1809036-00	TRANSITION, GALVANIZED	1	1
2	BSI-1808006-00	ELEMENT ASSEMBLY	2	3
3	BSI-1808002-00*	ELEMENT	2	3
4	BSI-4004598*	CAP	8	12
5	BSI-4004599*	PLUG	2	3
6	BSI-1809053-00*	TENSION STRAP, GALVANIZED	8	12
7	BSI-2001998*	C-SCR FH 3/8-16 X 1-1/2 GR5 PLT	8	12
8	BSI-2001999*	C-SCR FH 3/8-16 X 1 GR5 PLT	8	12
9	BSI-1809035-00	MIDNOSE, GALVANIZED	1	1
10	BSI-1808014-00	NOSE PLATE	1	1
11	BSI-1809037-00	TRANSITION STRAP LH, GALVANIZED	1	1
12	BSI-1809038-00	TRANSITION STRAP RH, GALVANIZED	1	1
13	BSI-1808005-00	PIN ASSEMBLY	8	10
14	BSI-2002001	ANC MECH 5/8-11 X 6 GALV	6	6

*Components pre-assembled with Element Assembly.

Preparation

Foundation

The ABSORB-M™ system is designed to perform on a variety of foundations including concrete, asphalt, and any other surfaces capable of bearing the weight of the system.

Uneven surfaces should be flattened, and large debris removed from the foundation prior to installation.

Cross slopes of up to 8% (5° or 1:12 slope) can be accommodated with the standard hardware and the instructions provided in this manual. For slopes in excess of 8%, contact Lindsay Transportation Solutions Customer Service at (888) 800-3691.

Transition

ABSORB-M™ is designed to accommodate a variety of permanent and portable safety shape, constant slope, and other shapes of barrier up to 42" height.

Placement and installation of the ABSORB-M™ system must be accomplished in accordance with the guidelines and recommendations set forth in the *"AASHTO Road Side Design Guide"* FHWA memoranda and other state and local standards.

Before installing the ABSORB-M™ system, ensure that all the materials required for the system are on site and have been identified.

Documentation

Prior to installation and assembly of the ABSORB-M™ system, ensure you have read and understand the installation and assembly instructions. The following items should be reviewed and understood prior to installation.

- Installation and Assembly Manual (check for current revision posted at http://www.barriersystemsinc.com/ See page 2.
- Installation and Assembly Video, Mobile App - The Lindsay Guide App is available as a free download from the Apple Store® and Google Play™.
- Installation and Assembly Video, Online - Full installation videos can be viewed online at http://lindsay.guide
- System Drawings (check http://www.barriersystemsinc.com/ for current revision, located in installation manual.)

Important Notes

- Sign Convention
  - The term Front = At the Nose Plate
  - The term Rear = At the Transition
- This manual follows installation steps for a complete ABSORB-M™ system that is installed on site or relocated to another location.

⚠ DANGER ABSORB-M™ SYSTEM IS DESIGNED TO BE INSTALLED WITH THE FRONT ELEMENT ALWAYS EMPTY WITH REMAINING ELEMENT(S) FULL OF WATER. FAILURE TO DO SO WILL RESULT IN IMPROPER PERFORMANCE OF THE SYSTEM AND MAY CAUSE SERIOUS BODILY INJURY.

See Page 22 for water filling instructions.

⚠ DANGER IN REGIONS WHERE THE WATER FILLED ELEMENTS COULD BECOME FROZEN, APPROPRIATE ANTI-FREEZE SOLUTIONS SHOULD BE USED. FAILURE TO DO SO WILL RESULT IN IMPROPER PERFORMANCE OF THE SYSTEM AND MAY CAUSE SERIOUS BODILY INJURY.

Care should be taken to ensure that appropriate Anti-Freeze solutions are used in accordance with federal, state, and local requirements. A few typical Anti-Freeze solutions are listed on Page 27.

Anchoring Specifications

The ABSORB-M™ system uses mechanical wedge anchors to secure the Transition Straps to the transition barrier.

Alternative anchorage hardware/methods (epoxy systems or mechanical anchors) may be used such that they meet or exceed the mechanical properties as follows:

	Transition Anchors
Hardware Diameter	5/8"
Pull-out Strength	28,250 lbs
Shear Strength	28,250 lbs

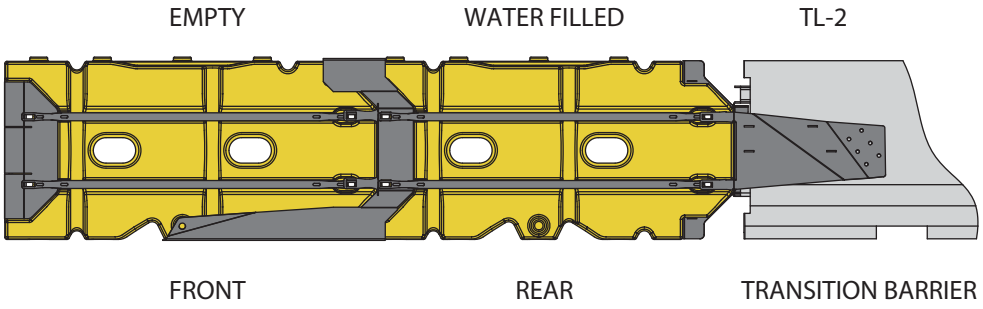
System Torque Chart

Transition Installation*	
Anchor Bolts	60 ft-lbs (80 N-m)

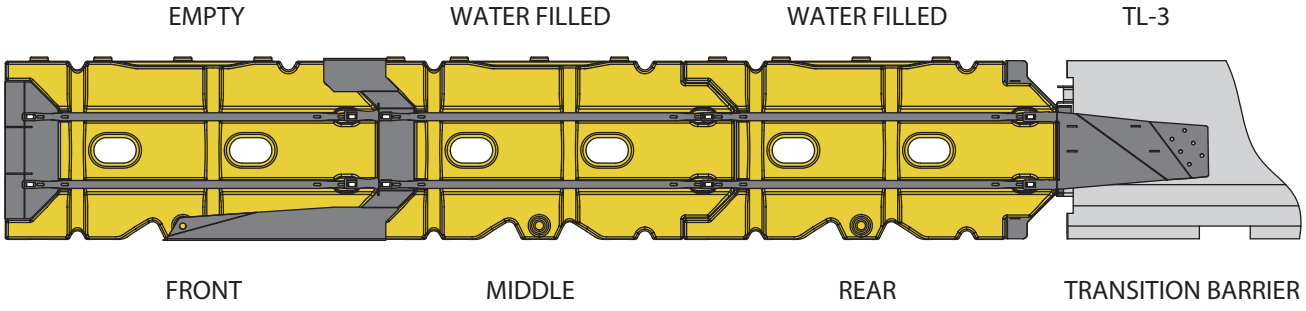
* Using a torque wrench is always the preferred method to tighten hardware for the ABSORB-M™ system, per anchor bolt manufacturer specifications.

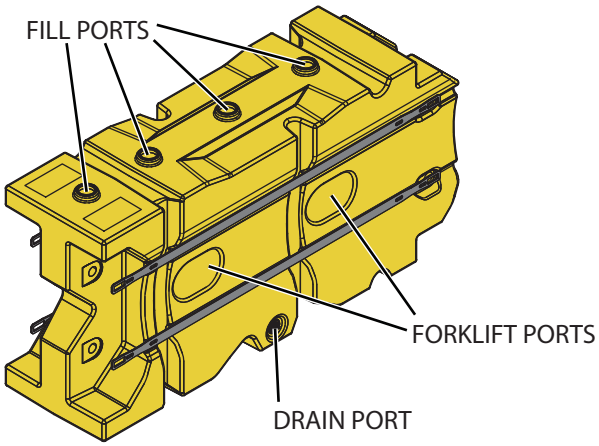
Configuration Details

ABSORB-M TL-2 System

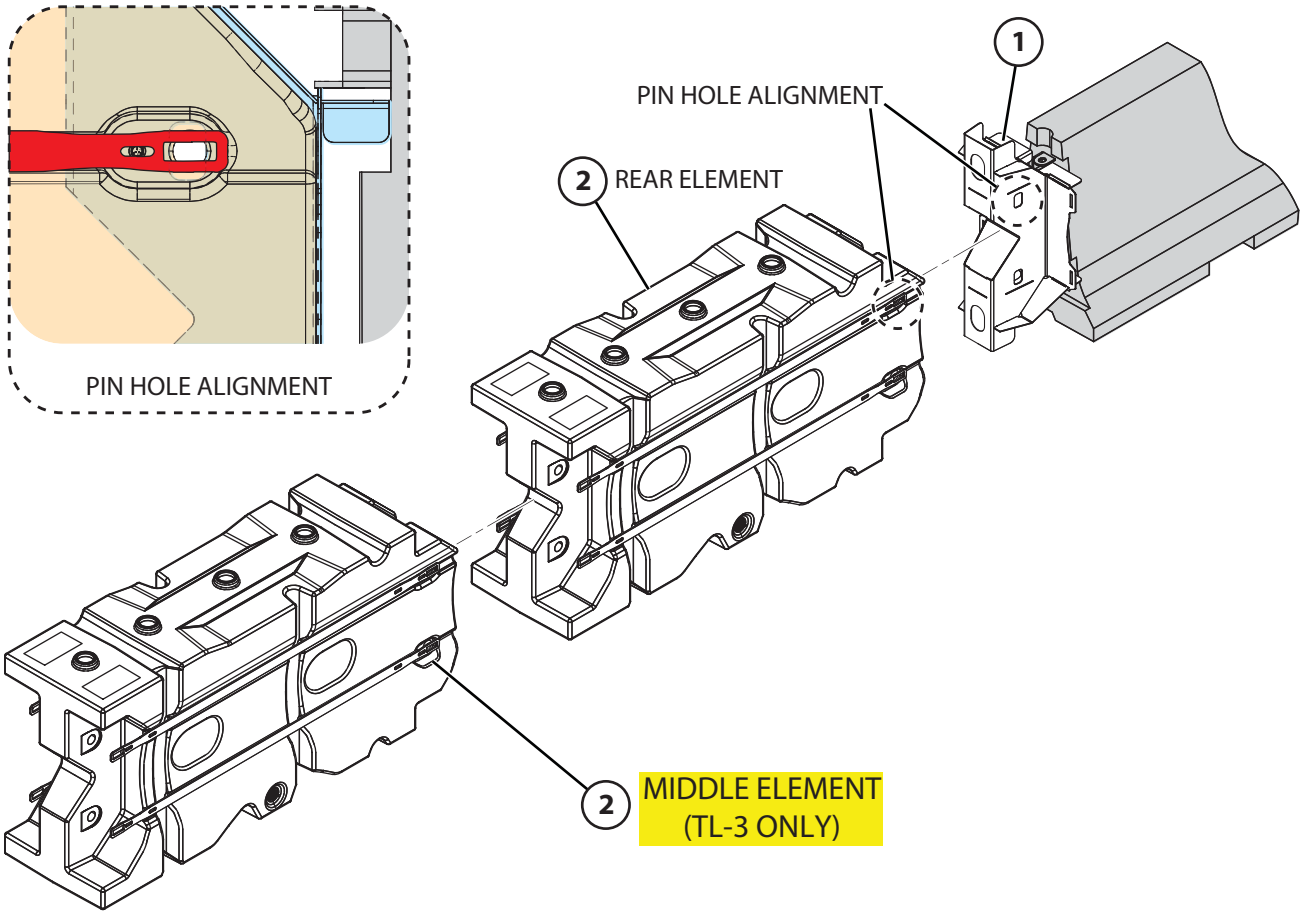


ABSORB-M TL-3 System





Step 1 - Transition and Rear Element(s)



Item #	Part #	Description	TL-2	TL-3
1	BSI-1809036-00	TRANSITION, GALVANIZED	1	1
2	BSI-1808006-00	ELEMENT ASSEMBLY	1	2

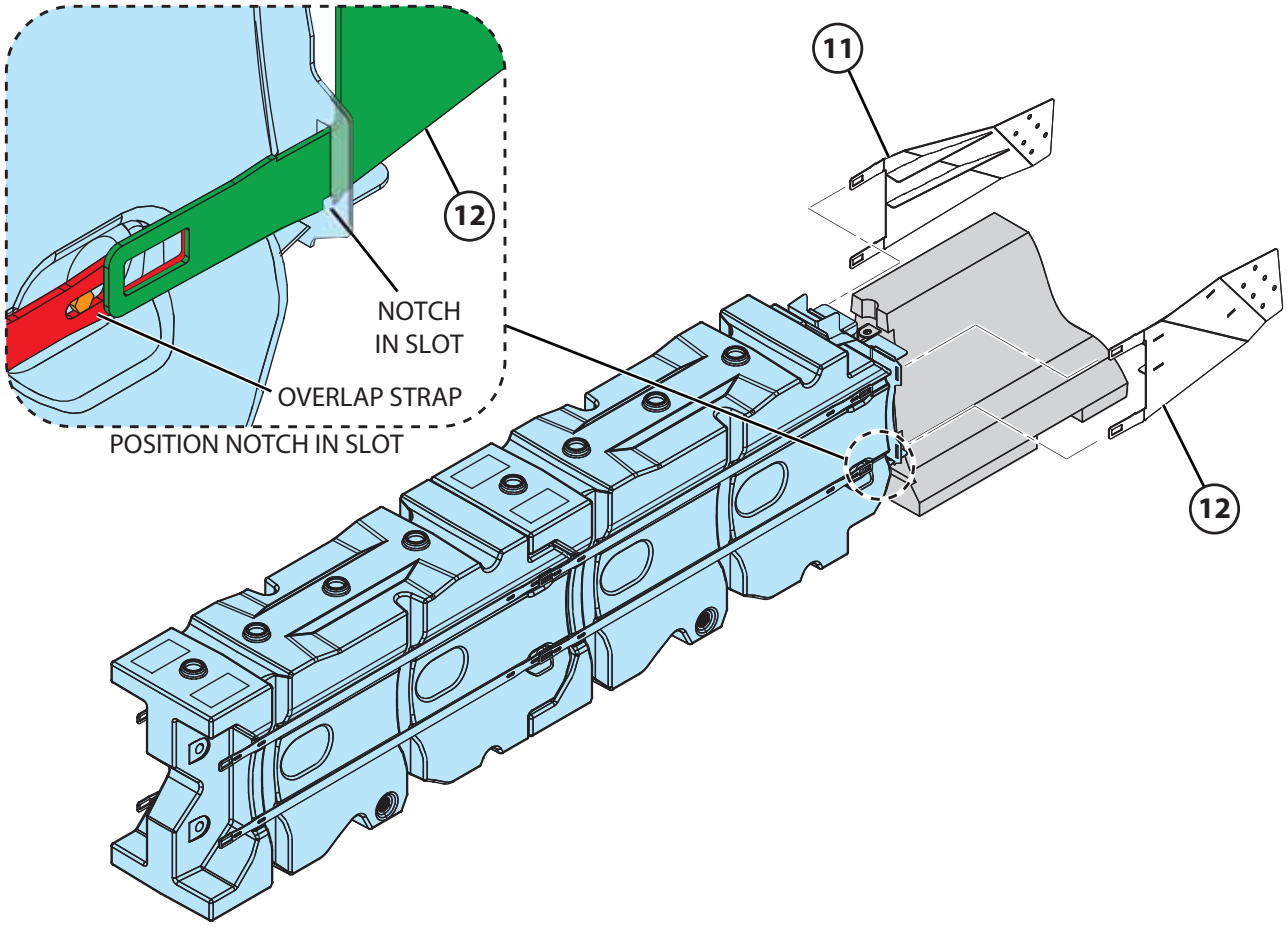
1.1 Position Transition (item 1) as shown. Ensure the Transition is vertical

1.2 Position rear Element (item 2) as shown. Adjust spacing such that center of the pin holes are aligned. For TL-2 systems, skip to Step 2 – Transition Straps

1.3 (TL-3 only) Position middle Element (item 2) as shown. Adjust spacing such that center of the pin holes are aligned.

NOTE: For TL-3, Tension Straps of the rear Element should overlap Tension straps of the Middle Element.

Step 2 - Transition Straps



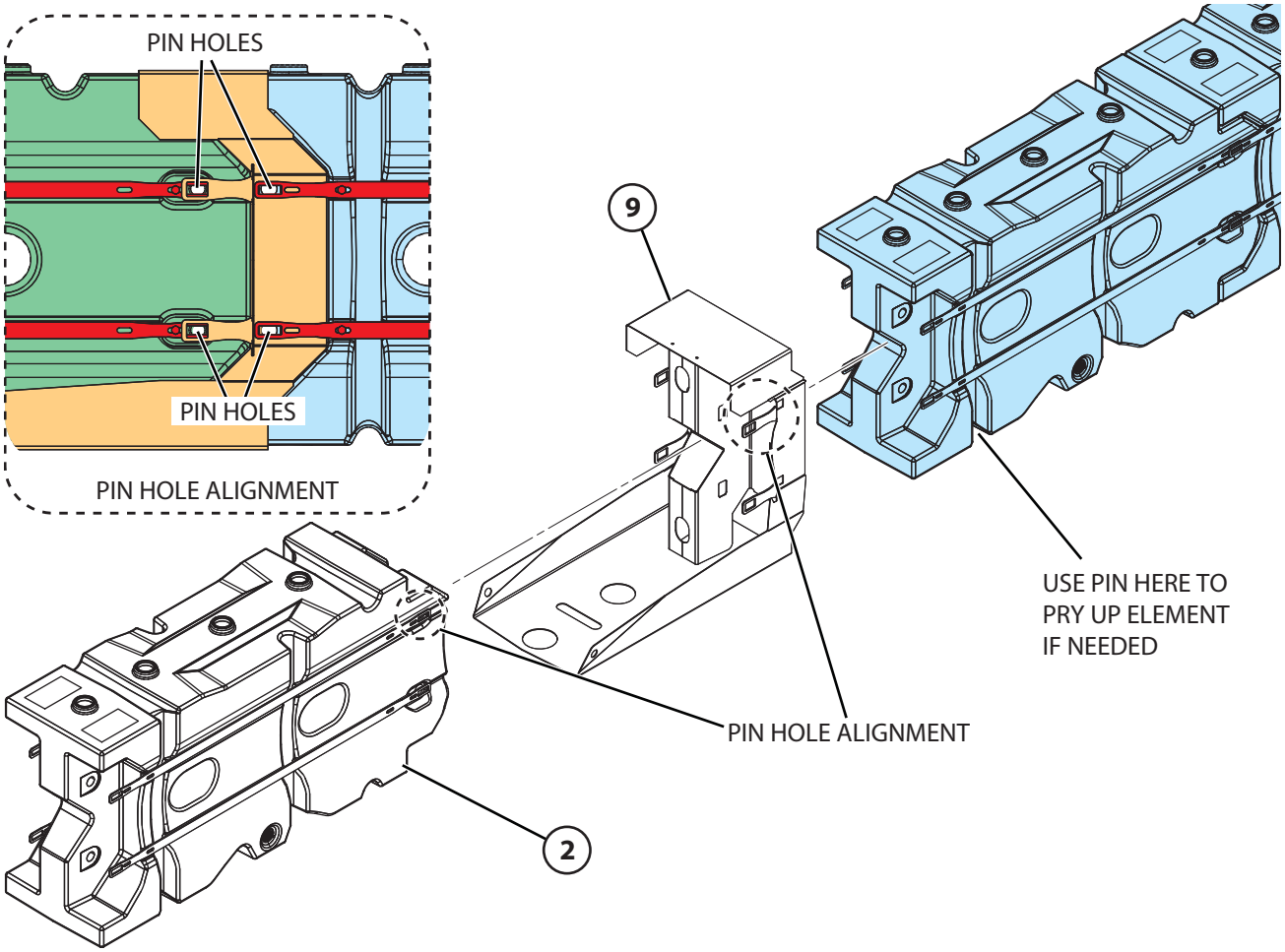
Item #	Part #	Description	TL-2	TL-3
11	BSI-1809037-00	TRANSITION STRAP LH, GALVANIZED	1	1
12	BSI-1809038-00	TRANSITION STRAP RH, GALVANIZED	1	1

2.1 Slide corresponding Transition Strap, LH (item 11) and Transition Strap, RH (item 12) through the open slots in the Transition as shown above.

2.2 Position each Transition Strap so that the notch in the Pin Tab aligns with the bottom edge of the slot as shown in the section view above.

NOTE: The Transition Strap Tabs should overlap the rear element Tension Strap. The pin holes of the Element, Transition and Transition Straps should all align. If they do not align, reposition the Element and Transition accordingly.

Step 3 - Midnose and Front Element



Item #	Part #	Description	TL-2	TL-3
2	BSI-1808006-00	ELEMENT ASSEMBLY	1	1
9	BSI-1809035-00	MIDNOSE, GALVANIZED	1	1

3.1 Slide Midnose (item 9) under the last Element placed. Align the pin holes. Two person lift recommended.

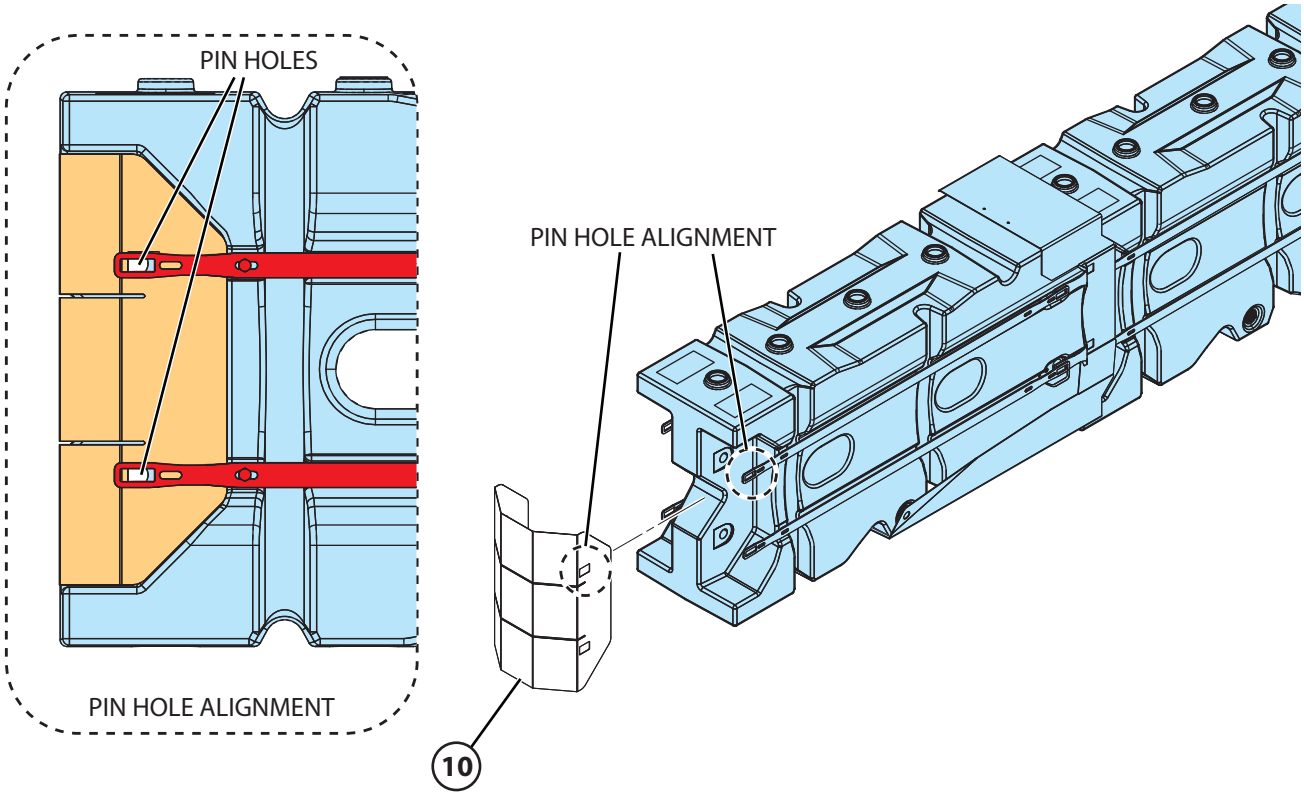
PRO-TIP: A Pin (item 13) can be used to pry up the Element enough to slide the Midnose into position.

NOTE: Tension Straps of the last placed Element should overlap the Midnose.

3.2 Place the front Element (item 2) into the Midnose (item 9). Align the pin holes.

NOTE: Midnose Pin Tabs should overlap the Tension Straps of the front Element.

Step 4 - Nose Plate



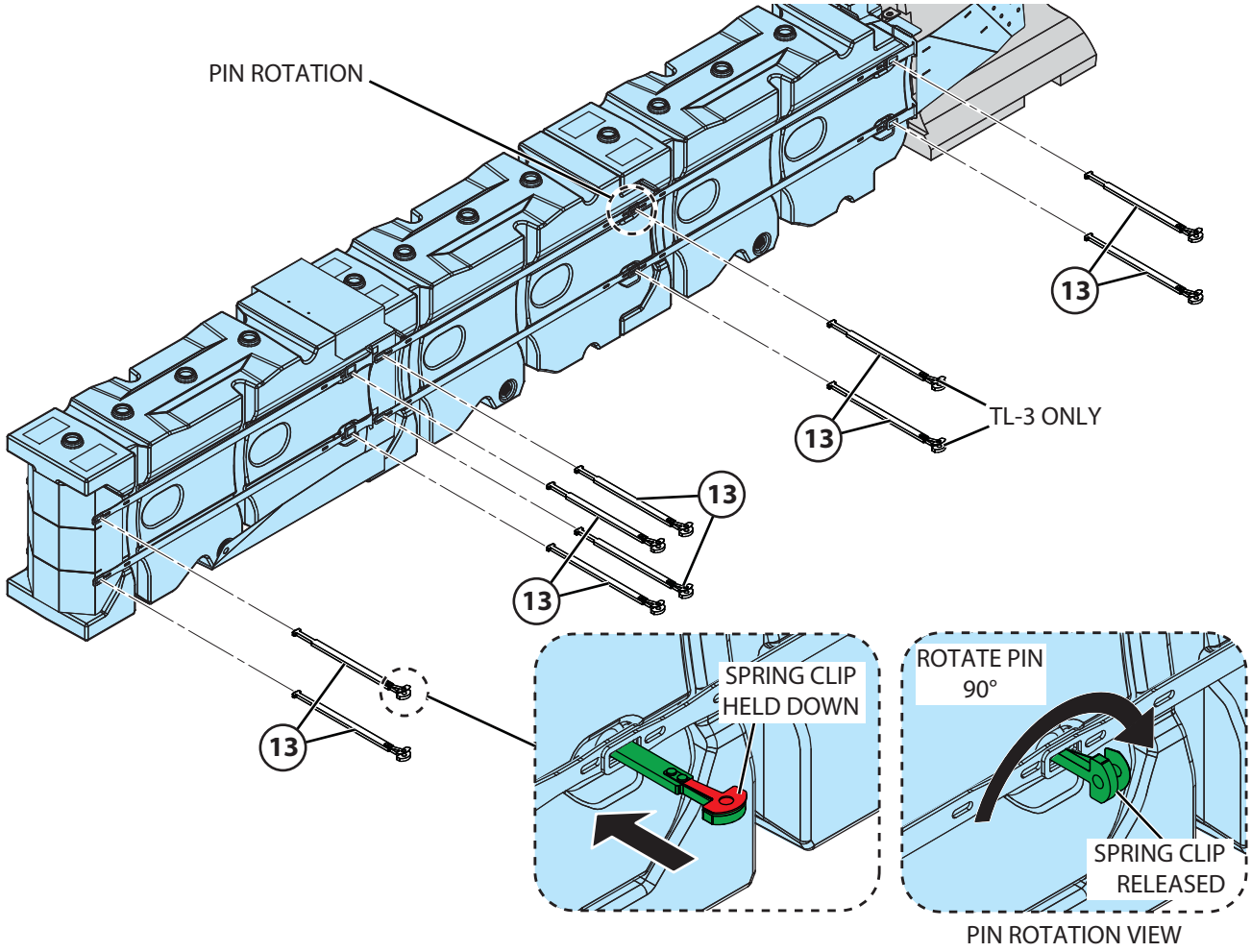
Item #	Part #	Description	TL-2	TL-3
10	BSI-1808014-00	NOSE PLATE	1	1

4.1 Nest Nose Plate (item 10) into the open recess of the front Element. Align pin holes.

NOTE: Tension Straps of the front Element should overlap the Nose Plate.

4.2 Apply delineation decal per federal, state, or local government regulations. Delineation decal NOT included with system.

Step 5 - Pin Assemblies



Item #	Part #	Description	TL-2	TL-3
13	BSI-1808005-00	PIN ASSEMBLY	8	10

5.1 Insert the Pin Assembly (item 13), as shown, with the Spring Clip held firmly down and the wider face of the pin facing upward, until the head of the Pin reaches the Transition Strap.

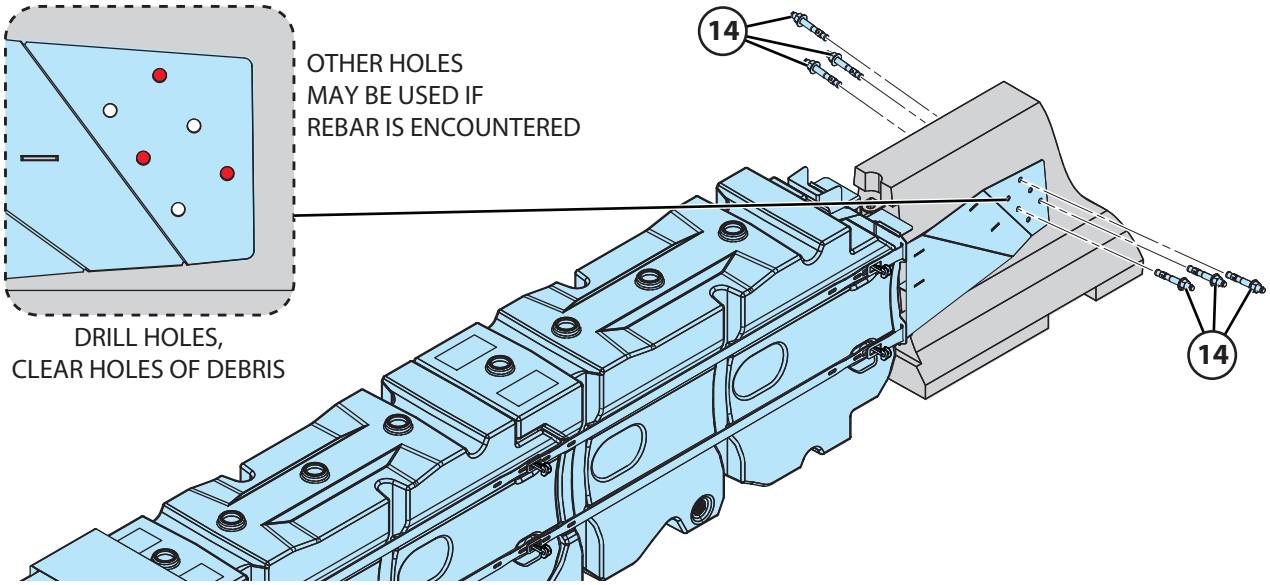
5.2 With the Spring Clip still held down turn the Pin 90° and release the Spring Clip into the "locked" position.

5.3 Check the opposite side and ensure the point end of the Pin Assembly is completely passed through the Transition Strap

5.4 Repeat this process for all pins at the locations shown.

PRO-TIP: Install pins from the same side to avoid confusion during visual inspection.

Step 6 - Transition Strap Anchoring



Item #	Part #	Description	TL-2	TL-3
14	BSI-2002001	ANC MECH 5/8-11 X 6 GALV	6	6

Barrier Anchor Depth
3-3/4" [10 cm]

6.1 Upon completion of the previous steps, mark and drill into the barrier for 3 of 6 holes per transition strap. Drill 5/8" hole diameter for mechanical anchors.

6.2 Clear holes of debris with compressed air and brush. Wear PPE.

⚠ CAUTION Wear proper PPE when clearing debris. This operation produces silica dust.

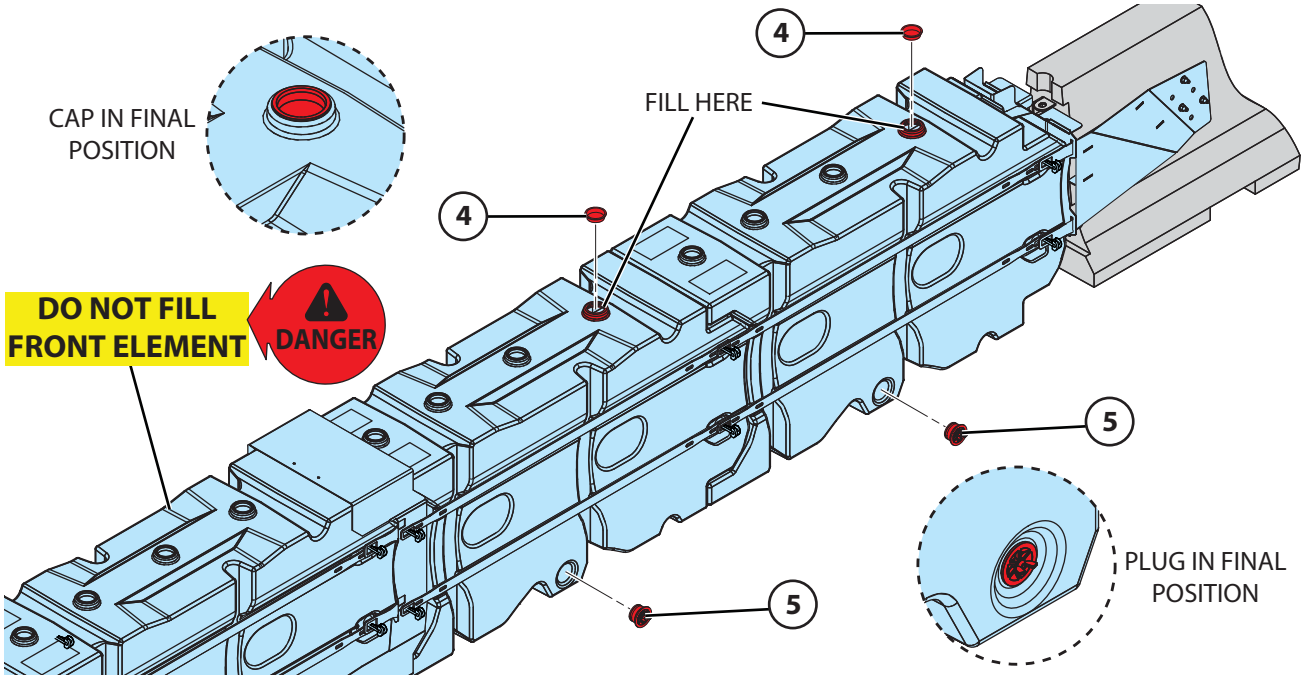
⚠ DANGER HOLES MUST BE DRILLED TO DEPTH AND CLEARED OF DEBRIS TO ENSURE RECOMMENDED ANCHORAGE IS ACHIEVED.

6.3 Insert anchors (item 14). **Torque to 60 ft-lbs (80 N-m).**

PRO-TIP: Pre-assemble anchor hardware kit with 3-4 threads minimum on top of the nut.

NOTE: If using alternative anchoring, install per manufacturer's recommendation. See Page 14 for anchor specifications.

Step 7 - Filling Rear Element(s)



Item #	Part #	Description	TL-2	TL-3
4	BSI-4004598	CAP	8	12
5	BSI-4004599	PLUG	2	3

7.1 Ensure Plug (item 5) seated fully in the drain port. Rotate nut clockwise by hand until firmly secured.

7.2 Remove Cap (item 4) from the fill port of the rearmost Element(s) and complete fill with water. Approximately 250 gallons per Element.

7.3 Seat caps (item 4) fully.

7.4 Check the Plug at the drain port for leaks. Hand tighten Plug as needed if any leaking is observed.

⚠ DANGER ABSORB-M™ SYSTEM IS DESIGNED TO BE INSTALLED WITH THE FRONT ELEMENT ASSEMBLY (ELEMENT) ALWAYS EMPTY WITH REMAINING ELEMENT(S) FULL OF WATER. FAILURE TO DO SO WILL RESULT IN IMPROPER PERFORMANCE OF THE SYSTEM AND MAY CAUSE SERIOUS BODILY INJURY.

⚠ DANGER IN REGIONS WHERE THE WATER FILLED ELEMENTS COULD BECOME FROZEN, APPROPRIATE ANTI-FREEZE SOLUTIONS SHOULD BE USED. FAILURE TO DO SO WILL RESULT IN IMPROPER PERFORMANCE OF THE SYSTEM AND MAY CAUSE SERIOUS BODILY INJURY.

Care should be taken to ensure that appropriate Anti-Freeze solutions are used in accordance with federal, state, and local requirements. A few typical Anti-Freeze solutions are listed on page 27.

System Relocation

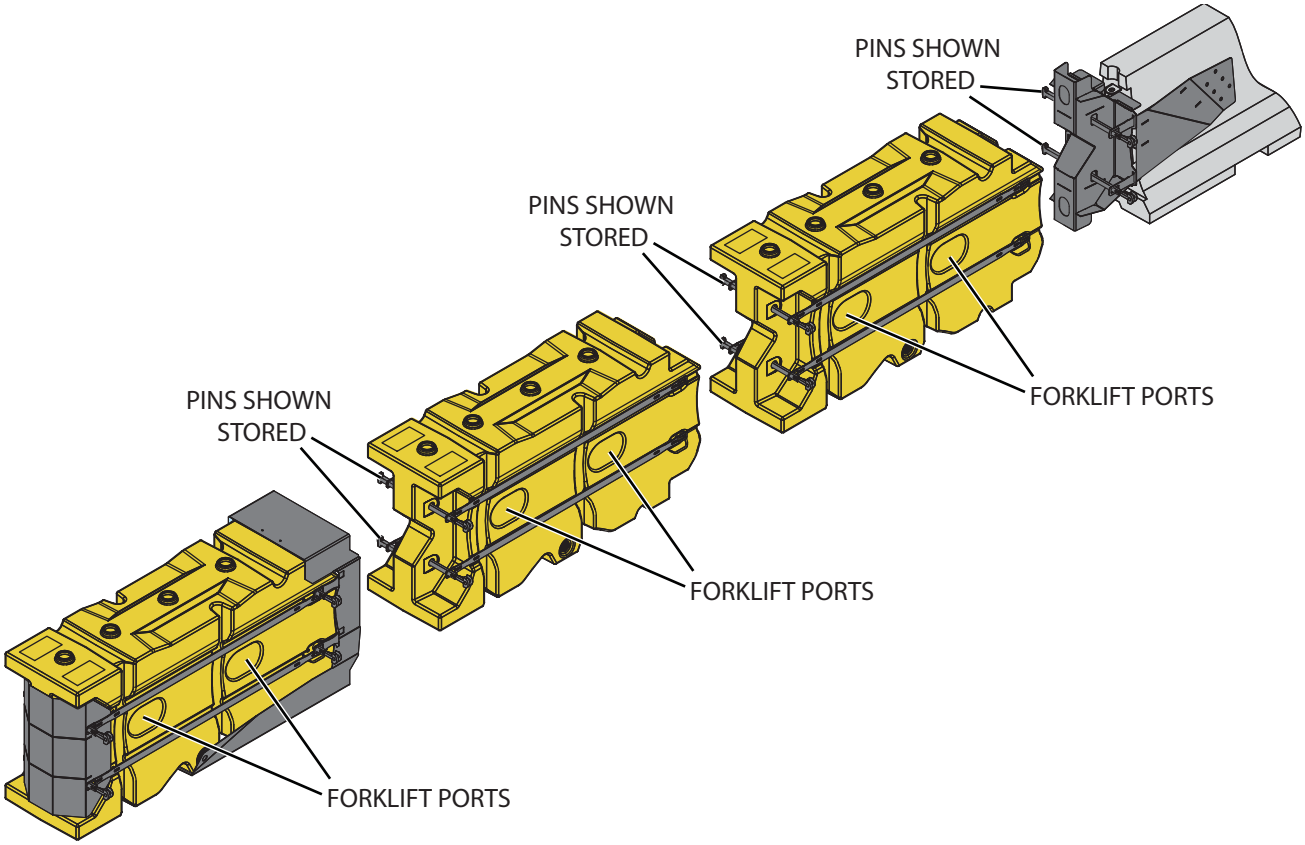
The ABSORB-M™ system is designed to be assembled with empty or full Elements. Although installation of the system prior to filling the Elements is preferred, the following instructions will allow the user to relocate a filled system with ease.

To transport empty Elements, first drain the water from the element by loosening the nut on the Plug and removing it from the drain port. Allow approximately five minutes for Element to drain completely. Crack the fill ports partially to improve drain flow.

Disassemble the elements by removing the pins. Store pins in separated elements for transport.

Users may transport the Transition while attached to the rear Element or the transition barrier. Both options are detailed on the following page.

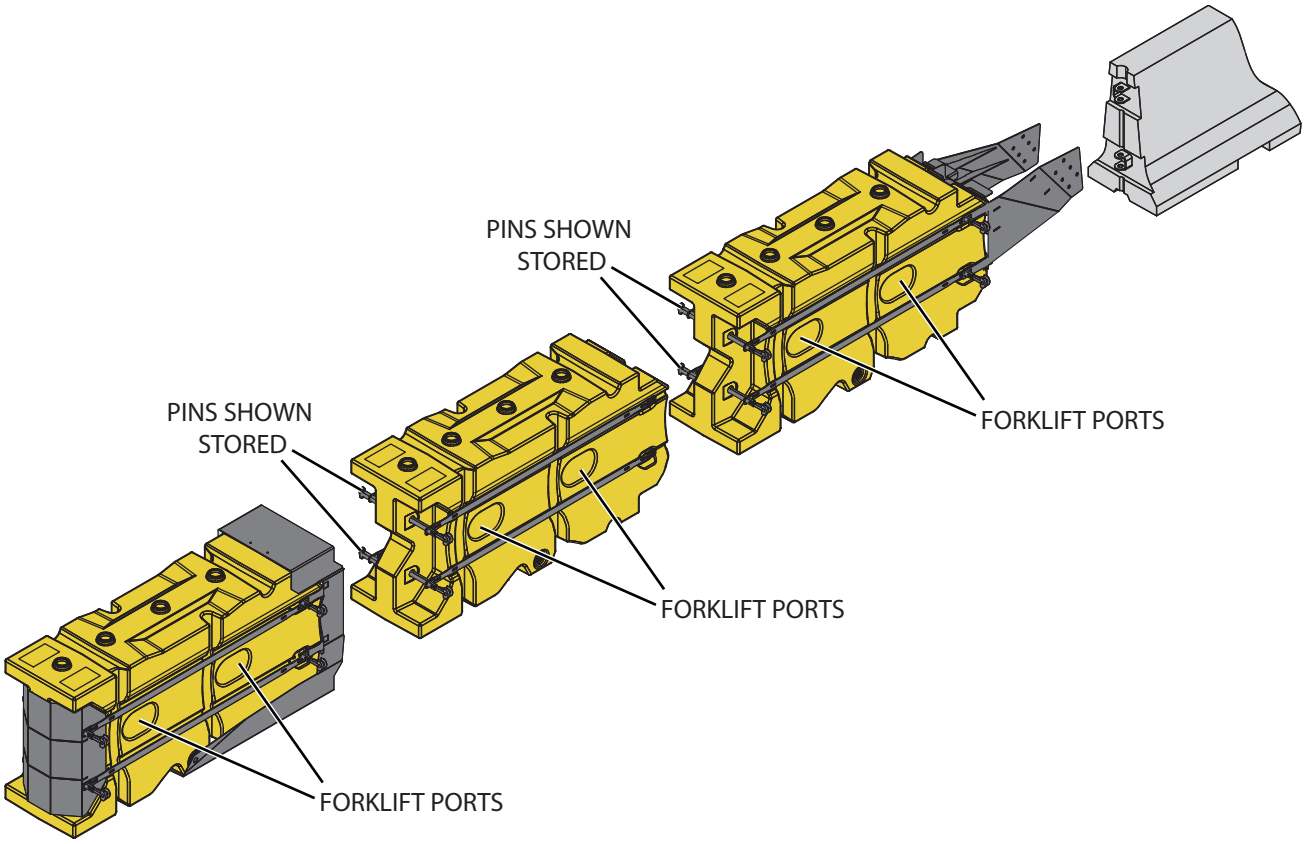
Option 1 - Transition with the Barrier



1. **Front Element, Nose Plate and Midnose:** connected with pins and lifted at the fork-lift holes.
2. **Middle and Rear Elements:** Transported individually. Pins can be stored in the locked position with the Elements.
3. **Transition Straps and Barrier:** Side Straps should remain secured to Transition Barrier. After rear element is removed, re-install the Pins to secure Transition to Transition Straps and Transition Barrier.

⚠ WARNING **Do not stack water-filled Elements.**

Option 2 - Transition with the Rear Element



1. **Front Element, Nose Plate and Midnose:** connected with pins and lifted at the fork-lift holes.
2. **Middle Element:** Transported individually. Pins can be stored in the locked position with the Element.
3. **Transition and Rear Element:** Transition Straps should remain pinned to the rear Element. Unbolt from the transition Barrier and lift at the forklift holes.

⚠ WARNING **Do not stack water-filled Elements.**

Pro Tip: When lifting the rear barrier off the transition barrier, use a Pin as a spacer to keep the Transition Straps separated from the anchors.

Anti-Freeze Solutions

In regions where the water filled ABSORB-M™ Element(s) could become frozen, proper Anti-Freeze agents should be used. Care should be taken to ensure that proper Anti-Freeze agents are used in accordance with local regulations, environmental concerns and ensuring that any post impact liquid on the road surface does not constitute an undue hazard to adjacent motorists.

The information outlined in this document is intended to provide a general guide to ABSORB-M™ users for choosing, calculating, and applying Anti-Freeze solutions. The actual method and implementation of an Anti-Freezing solution should be determined by federal, state and local standards and in accordance with the specific manufacturer's instructions.

Considerations for choosing an Anti-Freeze should include environmental impact on local vegetation and waterways, corrosion of existing structures, and the effect on concrete or asphalt roadways. Transportation, installation, and handling of the material should also be considered. The examples listed below are products commonly used on highways as de-icing road and bridge conditioners and for dust control. Specific information pertaining to these products regarding said considerations should be readily available from the product supplier or manufacturer.

The correct mixture of Anti-Freeze and water is critical to insure proper ice prevention and performance of the ABSORB-M™ crash cushion. The freezing capacity depends on the particular chemical and the solution concentrate by percent weight of the solution. Both too little and too much solution will result in diminished freezing capacity. The ideal solution concentration for maximum capacity is specific to the chemical chosen. It may be desirable to reduce the concentration for cost savings if the maximum capacity is not necessary.

Depending on the form the chemical is provided; such as a fluid, powder, or pellet; the actual amount of the desired chemical may not constitute 100% of the material by weight. It is important to account for the actual weight of the deicing chemical when mixing the solution.

Typical solution concentrations are listed in the table on page 27. Some of the following are available as a fluid solution of definite concentration or pellets and flakes in various sized bags. If purchased in flake or pellet form, care must be taken in dissolving it in water. Also, the concentrate must be calculated from the actual Anti-Freeze agent content. For example, if the flake/pellet agent purchased has a Calcium Chloride content of 80% and a 29% solution by weight is desired, the quantity added must account for the impurity of the agent. These principles apply to many various Anti-Freezing chemicals.

Table of Typical Anti-Freeze Solutions

Anti-Freeze Agent	Concentration, %	Operating Temp, °F [°C]
Calcium Chloride (CaCl2)	29%	-51 [-60]
Liquid CMA (Calcium Magnesium Acetate)	33%	-28 [-18]
Magnesium Chloride (MgCL2)	22%	-33 [-28]
Sodium Chloride (NaCl)	23%	-21 [-6]
Liquid Potassium Acetate (KAc)	49%	-60 [-76]

Single Element Capacity

Liquid Capacity, gal [L]	Water Weight, lb [kg]
250 [946]	2,086 [946]

Anti-Freeze Chemical Companies

The following companies are manufacturers of deicing chemicals. These are just a few examples. These companies or their local distributors should be able to supply further information and options for your application.

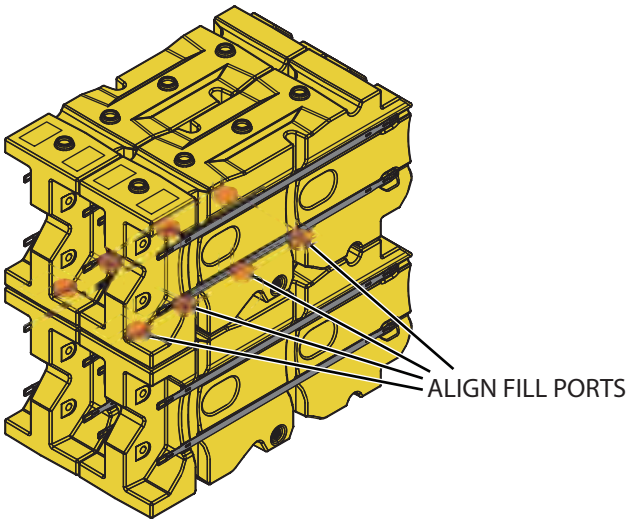
Dow Chemical Company
USA or Canada (800)-447-4369
Worldwide (989)-832-1466
www.dow.com
Contact for local Distributor, or find on Web Site

Cargill Salt
(888)-385-7258
Highway and Specialty Deicing Customer Service (800)-600-7258
www.cargillsalt.com
Contact for information and distribution

Cryotech Deicing Technology
Main Office and Plant – Iowa (800)-346-7237
www.cryotech.com
Contact for information, Branch Offices, and distribution

Transportation and Storage

When empty, Elements are designed to be transported and stored in stacks of up to two high. Careful attention should be paid to aligning the fill ports with the reciprocal recess at the bottom of each Element. The raised fill ports will prevent shifting during transit.



⚠ WARNING Elements that have not been drained completely should not be stacked.

Inspector Checklist

Confirm all items in the checklist have been properly completed and hardware installed properly.

Installation Checklist		
Date	Initial	Item
		Midnose is under the front Element, connected by two (2) pins, and attached to the next element by two (2) Pins. (Step 3, Page 18)
		Nose Plate is attached to front Element by two (2) Pins. (Step 4, Page 19)
		(TL-3 only) Middle and rear Elements connected by two (2) Pins. (Step 5, Page 20)
		Rear Element connected to Transition and both Transition Straps by two (2) Pins. (Step 5, Page 20)
		Transition Straps secured to the Transition Barrier with at least three (3) Anchors on each side. (Step 6, Page 21)
		Anchors torqued to 60 ft-lbf [80 N-m]. (Step 6, Page 21)
		Front Element empty. (Step 7, Page 22)
		Rear Element(s) full of water. (Step 7, Page 22)
		Plug at drain ports fully seated and secure with no sign of leakage. (Step 7, Page 22)
		Caps at fill ports are fully seated. (Step 7, Page 22)
Cold Weather Applications Only		
		Anti-Freeze solution applied in accordance with manufacturer's specifications.

Inspector signature: _____ Date: _____

Maintenance Inspection

Crash cushions, like all roadside safety hardware, require inspection to ensure they are in acceptable working condition. Regular inspections of the ABSORB-M™ system is recommended and shall be made by the local highway authority. Frequency of the inspections shall be made based on site conditions, traffic volumes, and crash history. Please follow the Local guidelines for frequency of inspections to ensure adequate repairs are made to the system. Walk-up inspections are recommended at least twice a year.

Walk-Up Inspections

Recommended Frequency – Twice a Year

Before performing walk-up inspections, ensure traffic control is deployed in accordance with local guidelines.

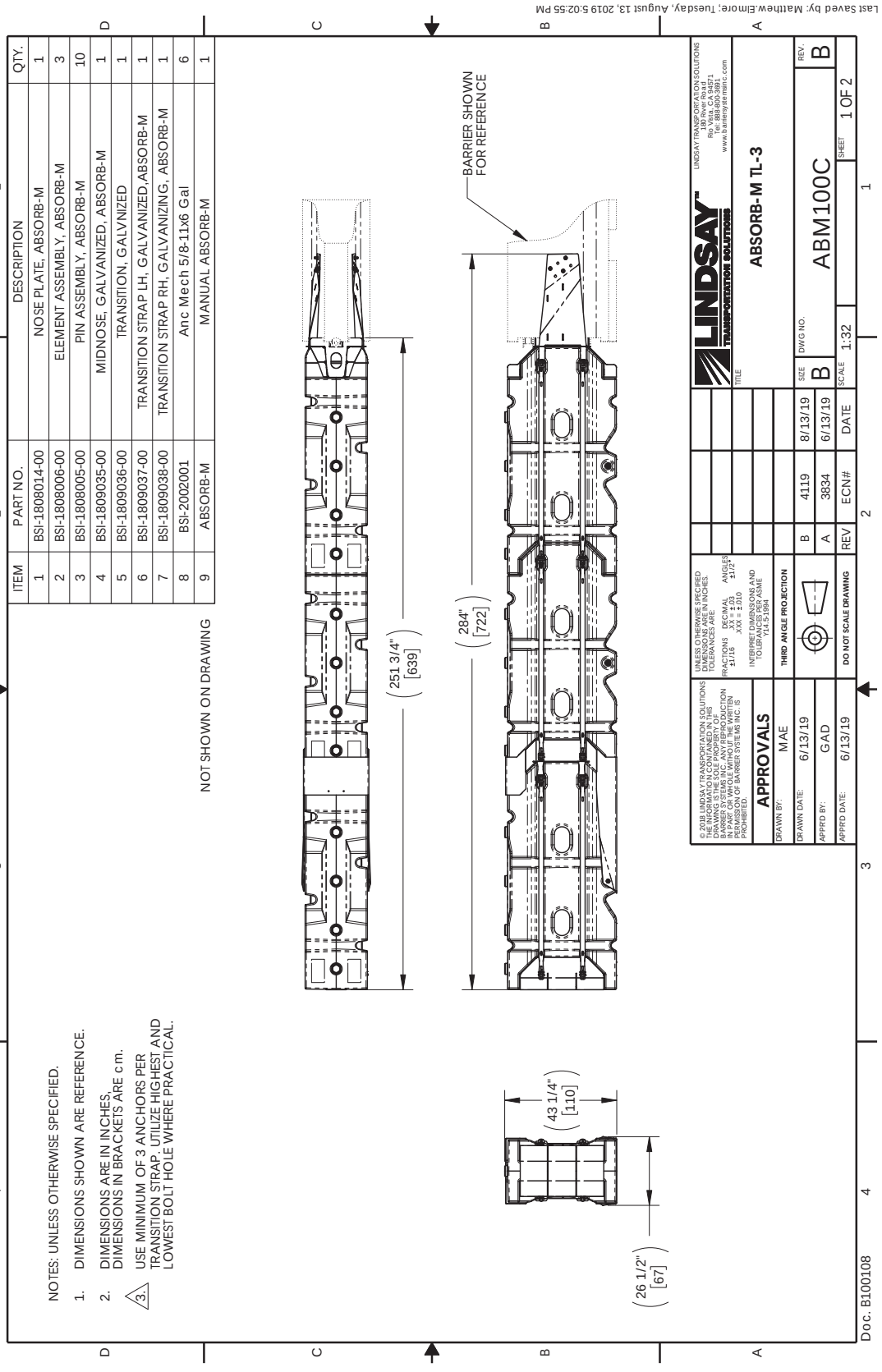
Check for:

- Water level is within 2" of the top of the Element's fill ports.
- Front element is empty
- Damage caused by vehicle impacts
- Damage caused by impacts from roadside maintenance equipment
- Misalignment
- Missing components
- Vandalism
- Clear and dispose of any debris in and around the system

After inspection is complete, ensure all items identified during the inspection process are corrected. The ABSORB-M™ system shall be returned to proper condition as outlined in the installation instructions.

Walk-Up Inspection	
Item	Comment
Water level is within 2" of the top.	
Front element is empty	
Damage caused by vehicle impacts	
Minor damage caused by impacts from roadside maintenance equipment	
Misalignment	
Missing components	
Vandalism	
Clear and dispose of any debris in and around the system	
Grading around system	
Inspector Signature:	Date:
Print Name:	Location:

Drawings


Last Saved by: Matthew.Elmore; Tuesday, August 13, 2019 5:02:55 PM
ITEM | PART NO. | DESCRIPTION | QTY.
1 | BSI-1808014-00 | NOSE PLATE, ABSORB-M | 1
2 | BSI-1808006-00 | ELEMENT ASSEMBLY, ABSORB-M | 3
3 | BSI-1808005-00 | PIN ASSEMBLY, ABSORB-M | 10
4 | BSI-1809035-00 | MIDNOSE, GALVANIZED, ABSORB-M | 1
5 | BSI-1809036-00 | TRANSITION, GALVNIZED | 1
6 | BSI-1809037-00 | TRANSITION STRAP LH, GALVANIZED,ABSORB-M | 1
7 | BSI-1809038-00 | TRANSITION STRAP RH, GALVANIZING, ABSORB-M | 1
8 | BSI-2002001 | Anc Mech 5/8-11x6 Gal | 6
9 | ABSORB-M | MANUAL ABSORB-M | 1
NOTES: UNLESS OTHERWISE SPECIFIED.
1. DIMENSIONS SHOWN ARE REFERENCE.
2. DIMENSIONS ARE IN INCHES, DIMENSIONS IN BRACKETS ARE c.m.
3. USE MINIMUM OF 3 ANCHORS PER TRANSITION STRAP. UTILIZE HIGHEST AND LOWEST BOLT HOLE WHERE PRACTICAL.
NOT SHOWN ON DRAWING
251 3/4" [639]
284" [722]
BARRIER SHOWN FOR REFERENCE
43 1/4" [110]
26 1/2" [67]
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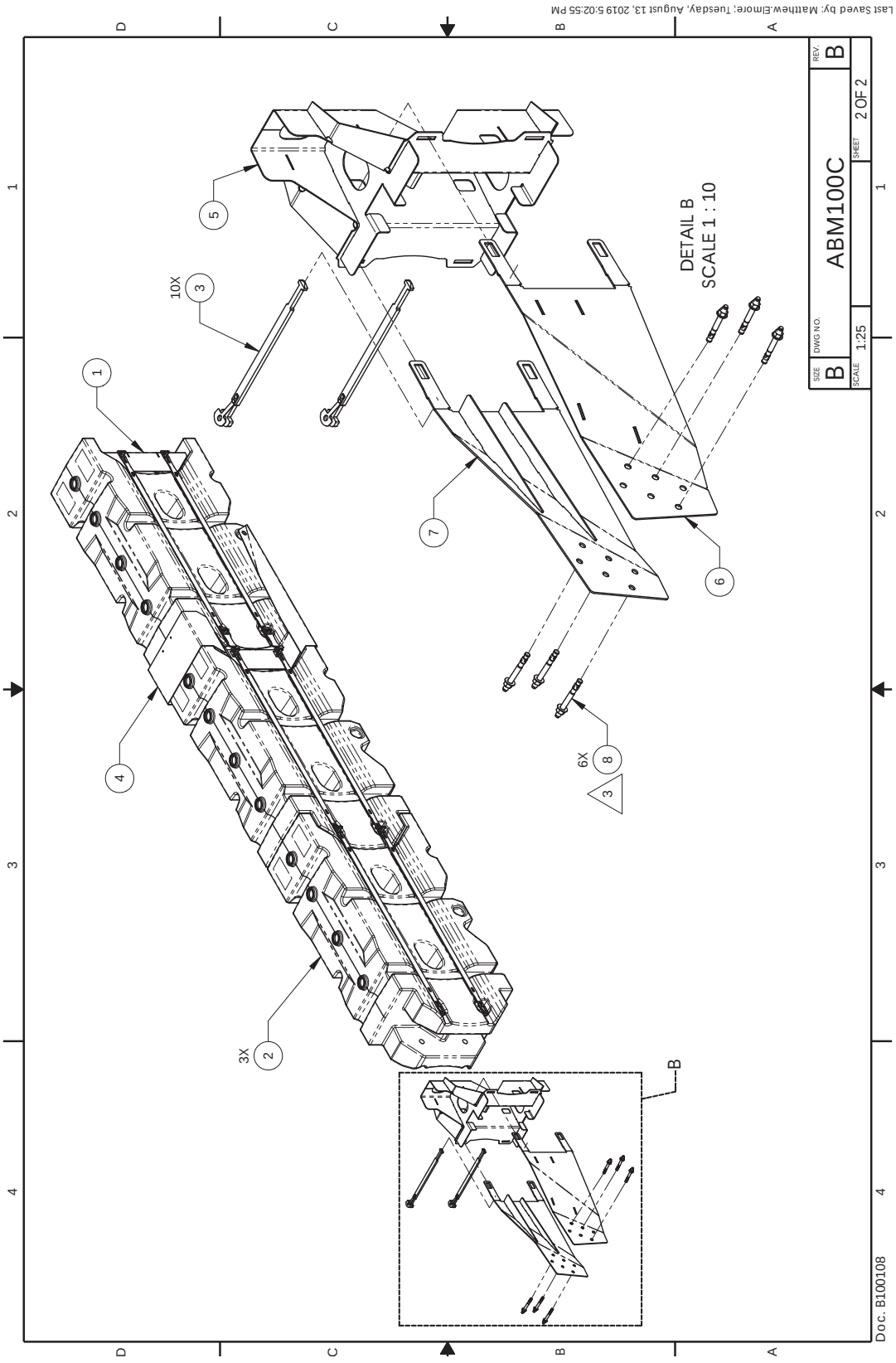
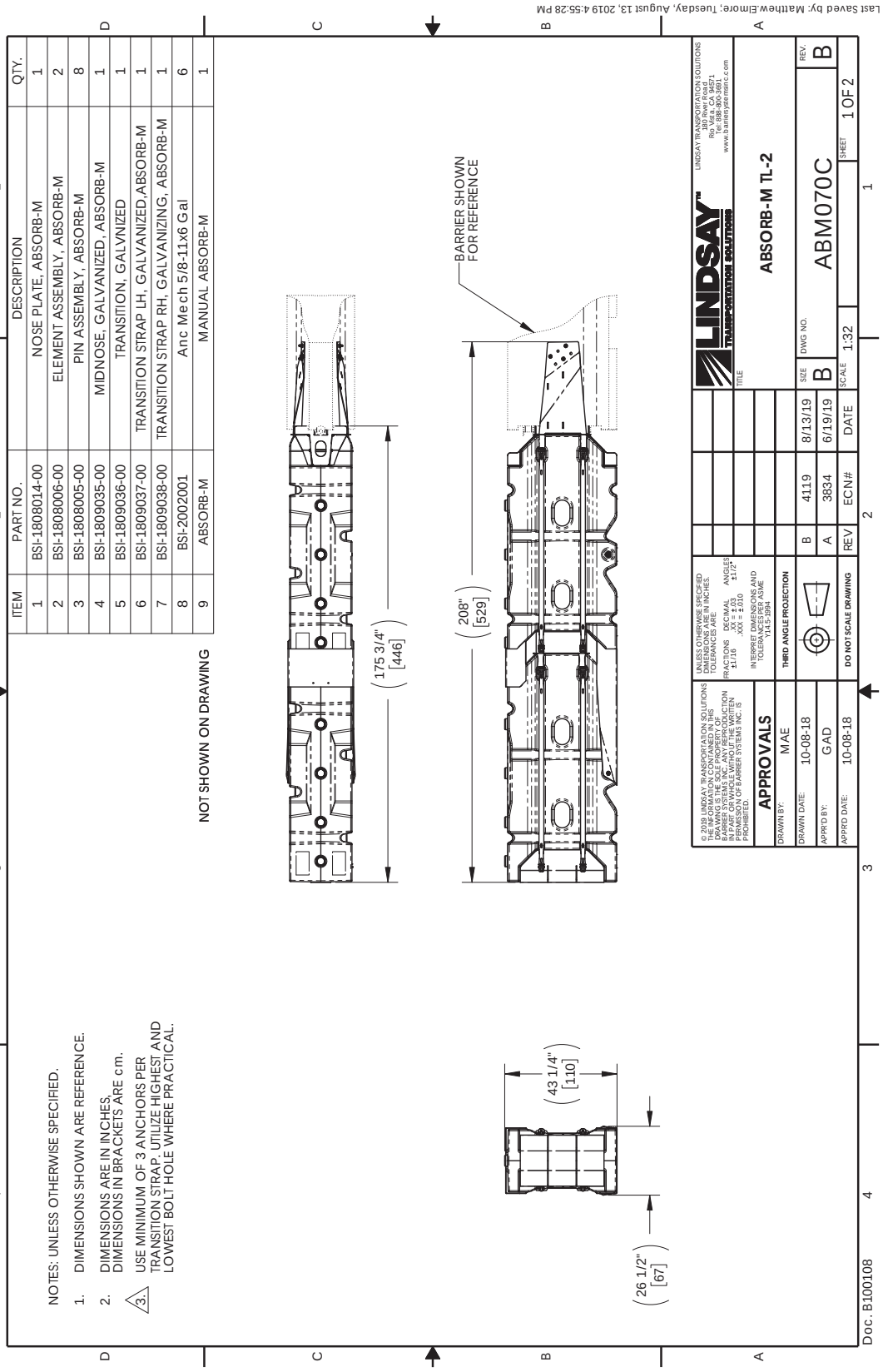
APPROVALS
DRAWN BY: MAE
DRAWN DATE: 6/13/19
APPR'D BY: GAD
APPR'D DATE: 6/13/19
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:
FRACTIONS ±1/16 DECIMAL XX = ±.03 XXX = ±.010 ANGLES ±1/2°
INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5-1994
THIRD ANGLE PROJECTION
DO NOT SCALE DRAWING
REV | ECN# | DATE
B | 4119 | 8/13/19
A | 3834 | 6/13/19
LINDSAY TRANSPORTATION SOLUTIONS
ABSORB-M TL-3
SIZE B
DWG NO. ABM100C
REV. B
SCALE 1:32
SHEET 1 OF 2
Doc. B100108

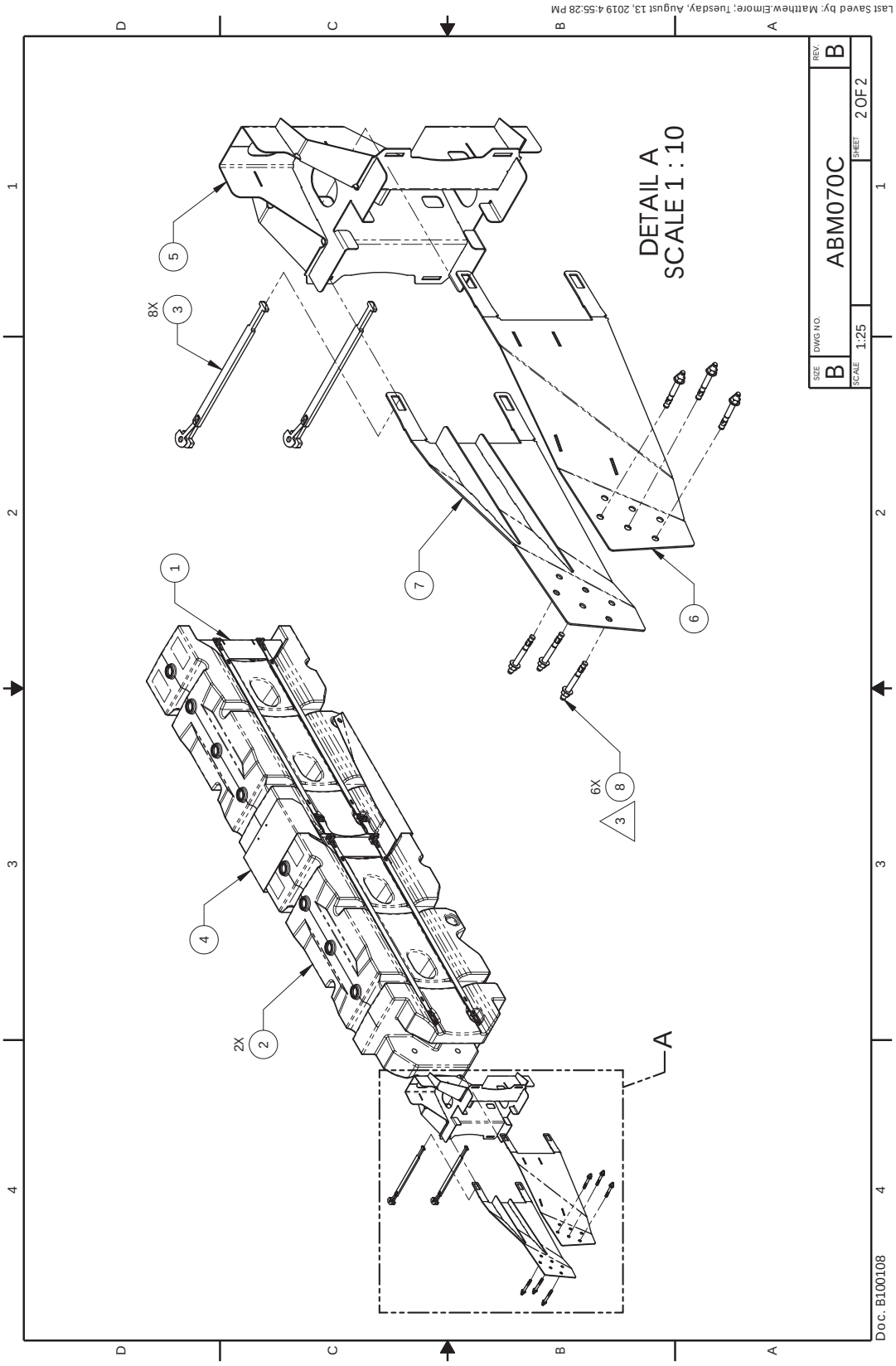
Drawings (Cont.)



Drawings (Cont.)



Drawings (Cont.)



Long-Term Storage

⚠ WARNING **Do not stack full elements.**

Fill caps should be fully seating to prevent water from accumulating inside the elements.

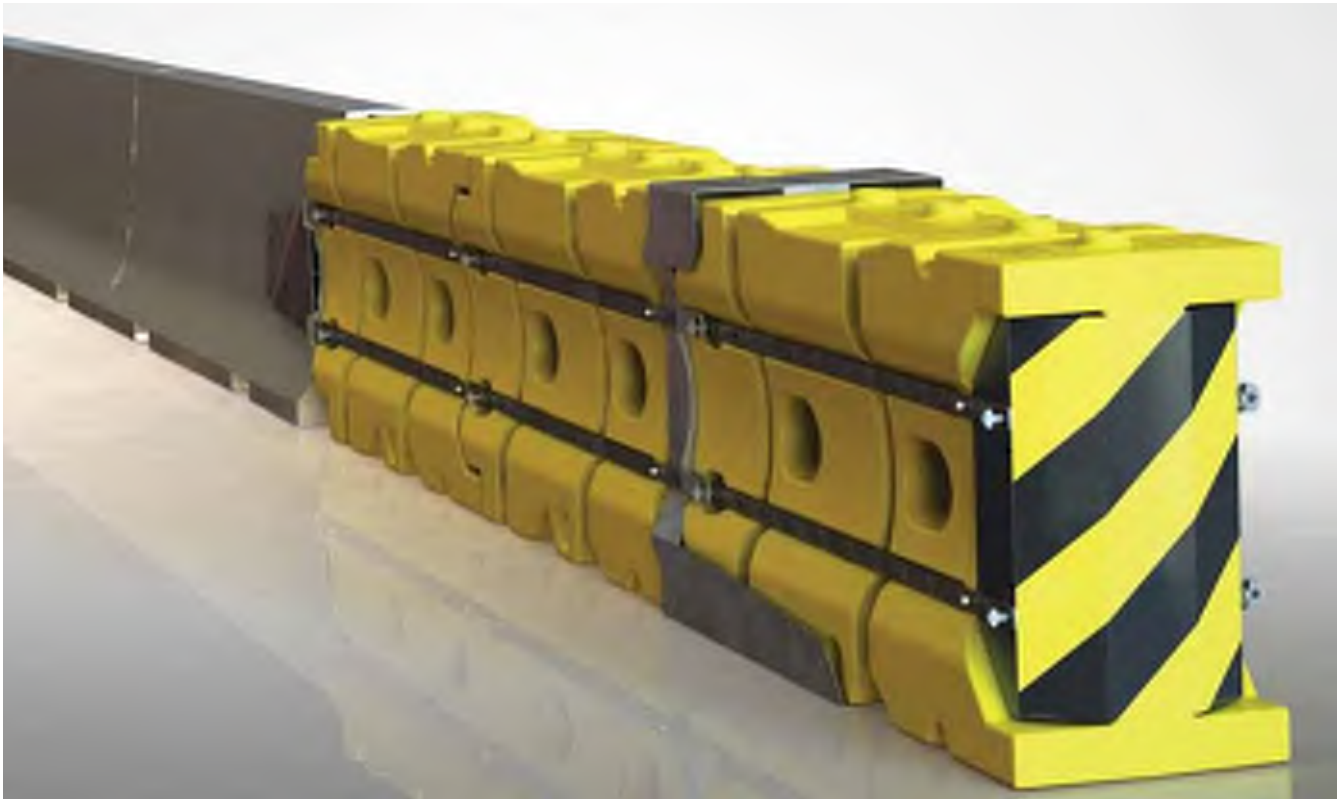
Store materials under cover in dry, well-ventilated conditions, away from doorways open to the environment.

Provide adequate ventilation between stacked metal pieces. Elevate and separate metal articles stacked outdoors with spacers (poplar, ash, spruce).

Incline parts to allow for maximum drainage.

Avoid stacking material directly on soil or decaying vegetation.

For crated items, remove the lids to provide better ventilation and drying of the galvanized parts. Customers will need to remove kits packed in cardboard boxes from the crates and store them inside.



LINDSAY TRANSPORTATION SOLUTIONS | BARRIER SYSTEMS BY LINDSAY | RAILROAD PRODUCTS BY LINDSAY | SNOLINE BY LINDSAY

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P/N ABSORB-M (ECN 4119)