

# QuadGuard® II

## Product Description Manual

Part No. 611298B

Revision F December 2012



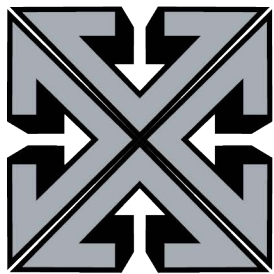
# INGALL

## CIVIL PRODUCTS

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# QuadGuard® II

## Product Description Manual



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**Important:** These instructions are to be used only in conjunction with the assembly, maintenance, and repair of the specified QuadGuard® II system. These instructions are for standard assembly specified by the appropriate highway authority only. In the event the specified system assembly, maintenance, or repair would require a deviation from standard assembly parameters, contact the appropriate highway authority engineer. This system has been accepted by the New Zealand Transport Agency for use on the national highway system under strict criteria utilized by that agency. Ingals Civil representatives are available for consultation if required.

**This Manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Ingals Civil Products at 09 295 1444 or download from website below.**

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® II system information available to Ingals Civil Products at the time of printing. We reserve the right to make changes at any time. Please contact Ingals Civil Products to confirm that you are referring to the most current instructions.

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## **Customer Service Contacts**

Energy Absorption Systems (a Trinity Highway Products company) is committed to the highest level of customer service. Feedback regarding the QuadGuard® II system, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

### **Ingal Civil Products:**

Telephone:	09 295 1444 0212 464 997
E-mail:	<a href="mailto:sales@ingalcivil.co.nz">sales@ingalcivil.co.nz</a>
Internet: Ingal Civil Products	<a href="http://www.ingalcivil.co.nz">www.ingalcivil.co.nz</a>

## **Important Introductory Notes**

Proper assembly of the QuadGuard® II is essential to achieve performance of the system under appropriate federal and state criteria. These instructions should be read in their entirety and understood before assembling the QuadGuard® II. These instructions are to be used only in conjunction with the assembly of the QuadGuard® II and are for standard assemblies only as specified by the applicable highway authority. In the event your system assembly requires or involves deviation from standard parameters or, during the assembly process a question arises, please contact the appropriate highway authority that specified this system at this particular location for guidance. Ingal Civil Products is available for consultation with that agency. These instructions are intended for an individual who is qualified to both read and accurately interpret them as written. They are intended for the individual who is experienced and skilled in the assembly of highway products which are specified and selected by the highway authority.

A set of product and project shop drawings will be supplied by Ingal Civil Products. The shop drawings will be for each section of the assembly. These drawings should be reviewed and studied thoroughly by a qualified individual who is skilled in interpreting them before the start of any assembly.



**Important:** Read safety instructions thoroughly and follow the assembly directions and suggested safe practices before assembling, maintaining, or repairing QuadGuard® II system. Failure to follow this warning can result in serious injury or death to workers and/or bystanders. It further compromises the acceptance of this system by the FHWA. Please keep these instructions for later use.



**Warning:** Ensure that all of the QuadGuard® II system Warnings, Cautions, and Important Statements within the QuadGuard® II Manual are completely followed. Failure to follow this warning could result in serious injury or death in the event of a collision.

## **Recommended Safety Rules for Assembly**

### **\* Important Safety Instructions \***

This Manual must be kept in a location where it is readily available to persons who assemble, maintain, or repair the QuadGuard® II system. Additional copies of this Manual are immediately available from Ingal Civil Products by calling 0212 464 997. Please contact Ingal Civil Products if you have any questions concerning the information in this Manual or about the QuadGuard® II system. This Manual may also be downloaded directly from the websites indicated below.

Always use appropriate safety precautions when operating power equipment, mixing chemicals, moving heavy equipment or QuadGuard® II components. Gloves, safety goggles, steel toe boots, and back protection should be used.

Safety measures incorporating traffic control devices specified by the highway authority must be used to provide safety for personnel while at the assembly, maintenance, or repair site.

## Safety Symbols

This section describes the safety symbols that appear in this QuadGuard® II Manual. Read the Manual for complete safety, assembly, operating, maintenance, repair, and service information.

<u>Symbol</u>	<u>Meaning</u>
---------------	----------------



**Safety Alert Symbol:** Indicates Danger, Warning, or Caution. Failure to read and follow the Danger, Warning, Safety, or Caution indicators could result in serious injury or death to the workers and/or bystanders.

## Warning and Cautions

Read all instructions before assembling, maintaining, or repairing the QuadGuard® II system.



**Warning:** Do not assemble, maintain, or repair the QuadGuard® II system until you have read this Manual thoroughly and completely understand it. Ensure that all Warnings, Cautions and Important statements within the Manual are completely followed. Please call Ingal Civil Products at 0212 464 997 if you do not understand these instructions. Failure to follow this warning could result in serious injury or death in the event of a collision.



**Warning:** Safety measures incorporating appropriate traffic control devices specified by the highway authority must be used to protect all personnel while at the assembly, maintenance or repair site. Failure to follow this warning could result in serious injury or death in the event of a collision.



**Warning:** Use only Energy Absorption Systems parts that are specified herein for the QuadGuard® II for assembling, maintaining or repairing QuadGuard® II system. Do not utilize or otherwise combine parts from other systems, even if those systems are other Energy Absorption Systems or Trinity Highway Products systems. Such configurations have not been tested nor have they been accepted for use. Assembly, maintenance or repairs using unspecified parts or accessories is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with an UNACCEPTED system.



**Warning:** Do NOT modify the QuadGuard® II system in any way. Failure to follow this warning could result in serious injury or death in the event of a collision.



**Warning:** Ensure that the QuadGuard® II system and delineation used meet all federal, state, specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.



**Warning:** Ensure that your assembly meets all appropriate Manual on Uniform Traffic Control Devices (MUTCD) and local standards. Failure to follow this warning could result in serious injury or death in the event of a collision.

## **Limitations and Warnings**

Energy Absorption Systems, in compliance with the National Cooperative Research Highway Program 350 (NCHRP Report 350) "Recommended Procedures for the Safety Performance of Highway Safety Features", contracts with FHWA approved testing facilities to perform crash tests, evaluation of tests, and submittal of results to the Federal Highway Administration for review.

The QuadGuard® II system has been approved by NZTA as meeting the requirements and guidelines of NCHRP Report 350\* TL-1 (2 Bay system), TL-2 (2 Bay system) and TL-3 (5 Bay system). These tests, typically evaluate product performance by closely simulating actual impacts involving a typical range of vehicles on our roadways, from lightweight cars (approx. 820kg [1800 lb.]) to full size pickup trucks (approx. 2000 kg [4400 lb.]) as specified by the FHWA. A product can be certified for multiple Test Levels. The QuadGuard® II is certified to the Test Level(s) as shown below:

Test Level 1: 50 km/h [31 mph]

Test Level 2: 70 km/h [44 mph]

Test Level 3: 100 km/h [62 mph]

**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 350 as approved by FHWA.**

These tests are not intended to represent the performance of products when impacted by every vehicle type or every impact condition.

Ingal Civil Products does not represent nor warrant that the results of these controlled tests show that vehicle impacts with the products in other conditions would necessarily avoid injury to person(s) or property. Impacts that exceed criteria capabilities of the product may not result in acceptable impact performance as outlined in NCHRP Report 350, relative to structural adequacy, occupant risk, and vehicle trajectory. Ingal Civil Products 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 by or in the presence of Ingal Civil Products representatives or by third parties.

The QuadGuard® II system is intended to be assembled, delineated, and maintained in accordance with specific state and federal guidelines. It is important to select the most appropriate product configuration for a site. The customer should be careful to properly select, assemble and maintain the product. Careful evaluation of the site geometry, vehicle population type, speed, traffic direction and visibility are some of the elements that require evaluation in the proper selection of a safety appurtenance. For example, curbs could cause an untested effect on an impacting vehicle.

After an impact occurs, the product should be restored to its original condition as soon as possible. When a potentially reusable safety product is impacted, it is still necessary to restore the product to its original length and inspect all the components as necessary.

## **System Overview**

The QuadGuard® II is a potentially reusable, redirective, non-gating crash cushion for hazards ranging in width from 610 mm to 2285 mm (24" to 120"). It consists of energy-absorbing Cartridges surrounded by a framework of Quad-Beam™ panels.

The QuadGuard® II 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.

### **Impact Performance**

The 5 Bay QuadGuard® II 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 100 km/h [62 mph] at angles up to 20 degrees.

During head-on impacts within NCHRP Report 350 criteria, the QuadGuard® II telescopes rearward and crushes the Cartridges to absorb the energy of impact. When impacted from the side, under those same 350 criteria, crash testing showed that it safely redirects the vehicle back toward its original travel path and away from the hazard.



## How to Determine Left/Right

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

## Counting the Number of Bays

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 (See Figure 1). Five Bay system shown.

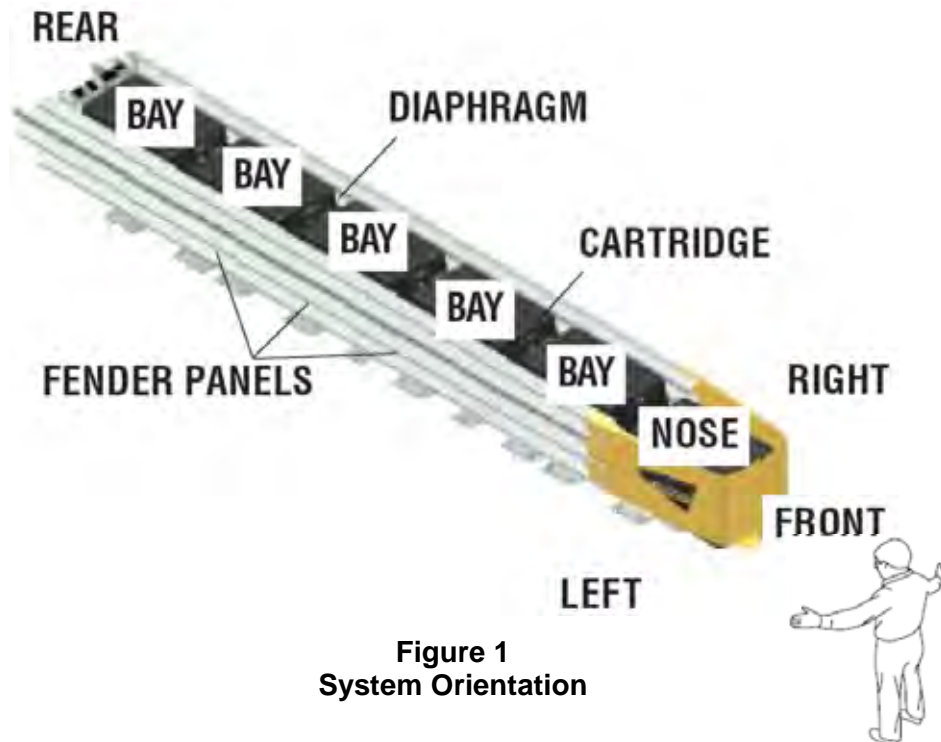


Figure 1  
System Orientation

## Measuring the Width

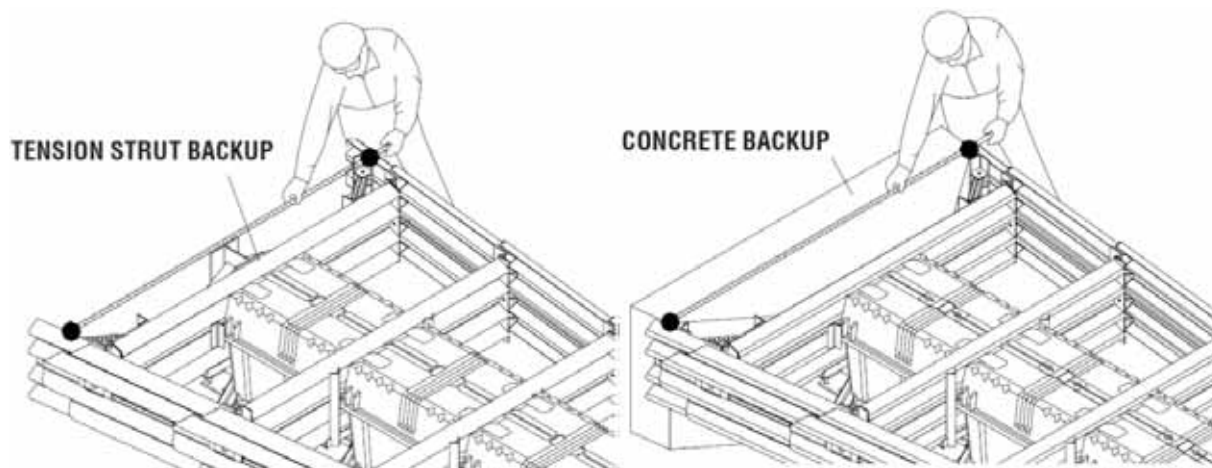
The QuadGuard® II system is available in seven nominal widths:

- 610 mm [24"]
  - 760 mm [30"]
  - 915 mm [36"]
  - 1219 mm [48"]
  - 1755 mm [69"]
  - 2285 mm [90"]
  - 3200 mm [126"]
- (Minimum 3 Bays Required)
- (Minimum 6 Bays Required)

The nominal width of a system with Tension Strut Backup is the width between Side Panels behind the Backup (See Figure 2).

The nominal width of a system with Concrete Backup is the width of the Concrete Backup at location shown in Figure 3.

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



**Figure 2**

**Width of system with Tension Strut Backup**

**Figure 3**

**Width of system with Concrete Backup**

## **QuadGuard® II Deployment Criteria**

Contact Ingal Civil Products Customer Service Department if you would like input as to your specific application. Proper model selection is essential to the performance of the QuadGuard® II system. You will need to answer the following questions:

### **1) Specification of System Width**

The QuadGuard® II system is available in seven nominal widths:

- 610 mm [24"]
- 760 mm [30"]
- 915 mm [36"]
- 1219 mm [48"]
- 1755 mm [69"]
- 2285 mm [90"]
- 3200 mm [126"] Minimum 6 Bays required

As a general rule, selection of the narrowest width that adequately shields the hazard is recommended.

### **2) Specify System Length**

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

### **3) Specify Foundation**

Note that the system must be anchored. MP-3® polyester anchor bolts will be supplied for all required anchorages in concrete. Refer to QuadGuard® II Assembly Manual or MP-3® kits for detailed assembly instructions.

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

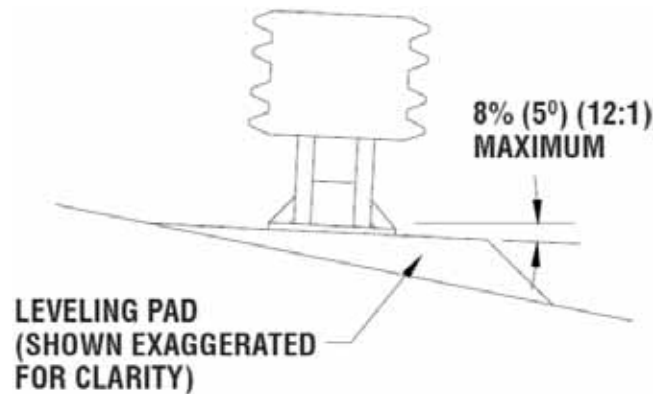
**Existing concrete** – Concrete must be at least 150 mm [6"] thick, reinforced 28 MPa [4000psi] Portland cement concrete (P.C.C.), or 200 mm [8"] thick non-reinforced 28 MPa [4000 psi] P.C. Concrete Roadway, measuring at least 3.66 m [12'-0"] wide by 15.24 m [50'-0"] long. The concrete should be in 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.

## 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 (See 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 Ingal Civil Products Customer Service Department if you would like input with your application. You will need to answer the following questions:

1. **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 100 mm [4"] high should be removed. If possible, curbs taller than 100 mm [4"] high should be removed approximately 15 m [50'] in front of the QuadGuard® II systems and as far back as the system's Backup. Any curbs that must remain should be 100 mm [4"] maximum and be mountable.
2. If the construction site is a gore area (place where two roads diverge), **what is the angle of divergence?**
3. **What is the general geometry of the site**, including the roadway for at least 150 m [500'] in front, so traffic patterns can be visualized?
4. **Is there an existing barrier?** Where there is an existing guardrail or median barrier at the site, the Backup of the QuadGuard® II system should tie into it when possible.
5. **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 hazard is necessary to prevent vehicle interaction (See Page 20).
6. **Are there any other unique features at the site that may affect positioning or performance of the QuadGuard® II system?**

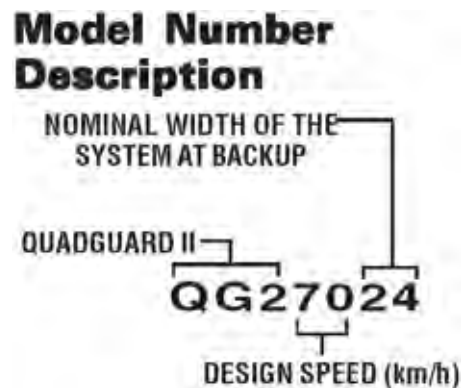
## 6) Other Factors that May Affect Your Deployment:

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 Ingal Civil Products Customer Service Department before proceeding with your design (See Page 3).

Impact conditions which differ from those described in the NCHRP 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 350 evaluation criteria relative to structural adequacy, occupant risk and vehicle trajectory factors.



**Figure 5**  
**Model Number Key**

These following charts represent the modified versions of the QG II length relative to impact speed, which is based on the capacity of the system using a 2000 kg [4400 lb] pickup truck.

**Table A – Speed Chart For Narrow Systems**

# of Bays	Model #	Vehicle Speed kph [mph]	Type I Cartridge Qty.	Type II Cartridge Qty.
1*	QG 240_ _	40 [25]	2	0
2	QG 270_ _	70 [44]	2	1
3*	QG 280_ _	80 [50]	2	2
4*	QG 290_ _	90 [56]	3	2
5	QG 2100_ _	100 [62]	3	3
6*	QG 2105_ _	105 [65]	4	3
7*	QG 2110_ _	110 [68]	4	4
8*	QG 2115_ _	115 [71]	4	5
9*	QG 2120_ _	120 [75]	4	6

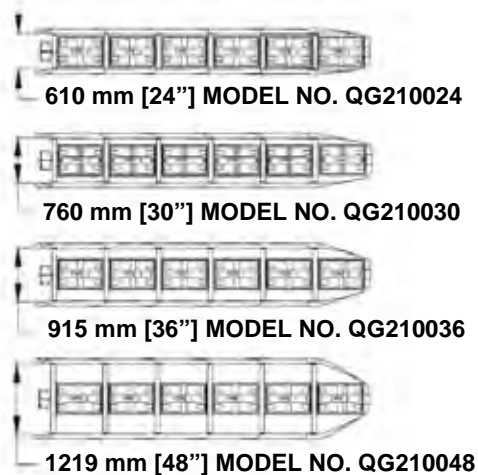
**Table B – Speed Chart For Wide Systems**

# of Bays	Model #	Vehicle Speed kph [mph]	Type I Cartridge Qty.	Type II Cartridge Qty.
3*	QG 270_ _	70 [44]	2	2
4*	QG 280_ _	80 [50]	3	2
5*	QG 2100_ _	100 [62]	3	3
6*	QG 2105_ _	105 [65]	4	3
7*	QG 2110_ _	110 [68]	4	4
8*	QG 2115_ _	115 [71]	4	5
9*	QG 2120_ _	120 [75]	4	6

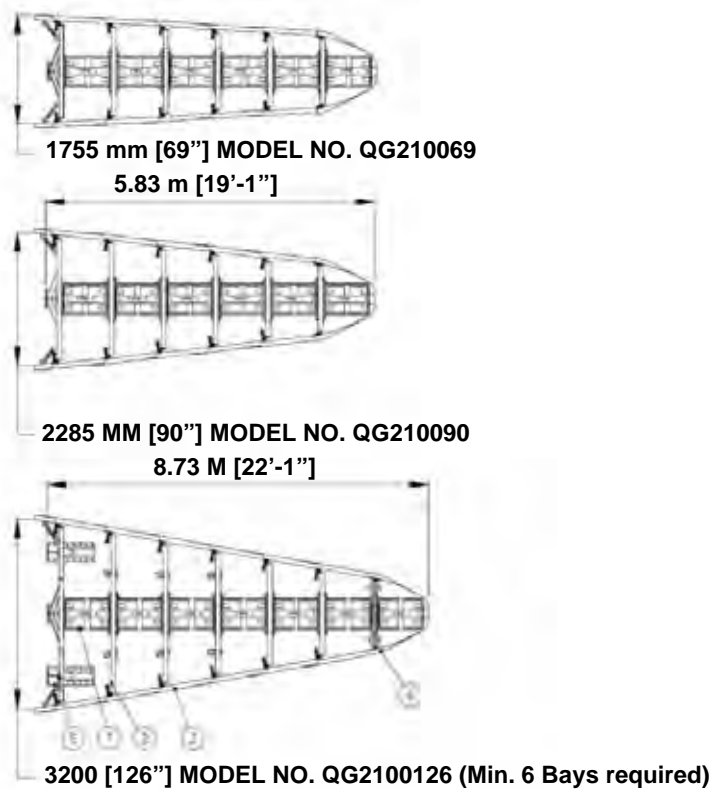
\*System capacity estimated through calculation.

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

QUADGUARD® II SYSTEM  
FOR NARROW HAZARDS



QUADGUARD® II SYSTEM  
FOR WIDE HAZARDS



**Figure 6**  
**Plan & Elevation**  
**(5 Bay system with Tension Strut Backup shown)**

## **Transitioning**

### **Quad-Beam™ End Shoe Transition Panel**

The Quad-Beam™ End Shoe Panel transitions the QuadGuard® II system to vertical faced concrete structures whether it is a concrete Backup or concrete barrier wall (See Page 20). 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® II system to new and existing runs of standard guardrail (See Page 16).

### **Quad-Beam™ to Safety Barrier Transition Panel**

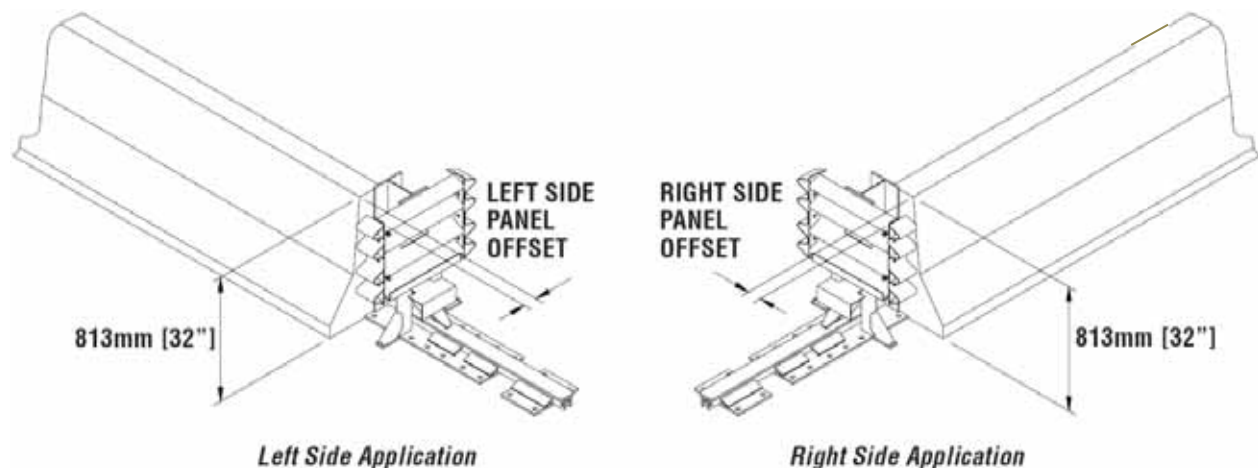
There are several options available when transitioning the QuadGuard® II system to safety shape barrier depending on the shape and position of the barrier.

When transitioning to barriers with a “New Jersey” style profile, the 4" offset Transition Panel is most commonly used (See Page 16). For transitioning to barriers that are in line with the side of the system, use transition assembly 616041B or 616044B. For transitioning a wide system to barrier that runs parallel to the centerline of the system, transition assembly 616048B or 616049B 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 the Single Slope style barriers and parapets, 6" and 8" offset Transition Panels are available. For transitioning a wide system to 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 (See Figure 7). Remember, when assembling the QuadGuard® II 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 performance of the transition.

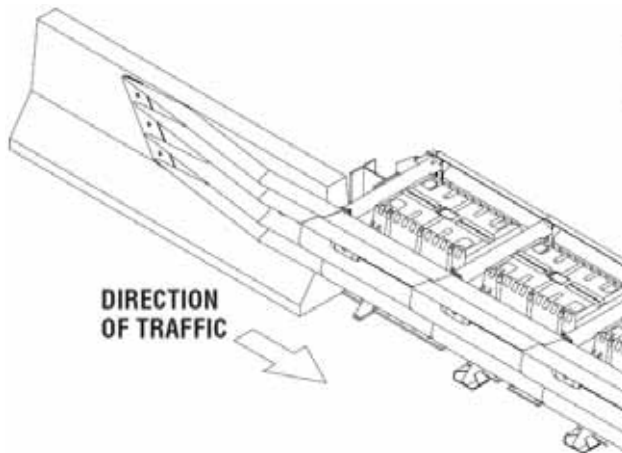


**Figure 7**  
**Transition Panel Offset**

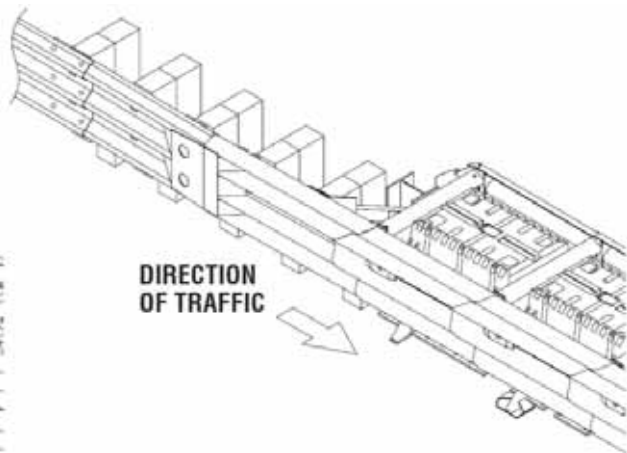


## **Transition Panel Types**

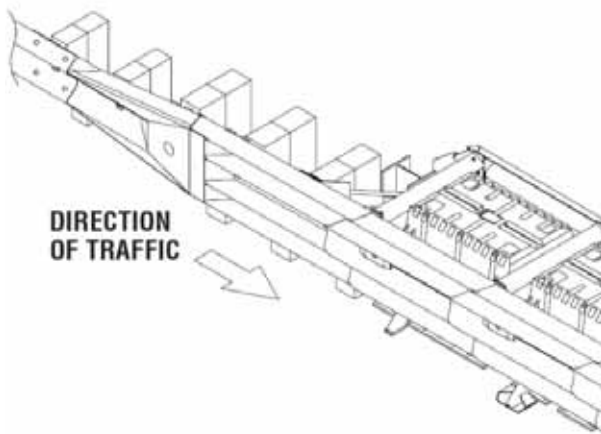
If a system is placed in a location where traffic will be approaching from the rear, a Transition Panel is necessary. Figure 8, 9, 10 and 11 show standard panel types. There are variations for each panel type. The specific panel applied will depend on system and site conditions. Therefore, it is important to send site specific data to the customer service department for a recommendation for exact panel requirements of your application.



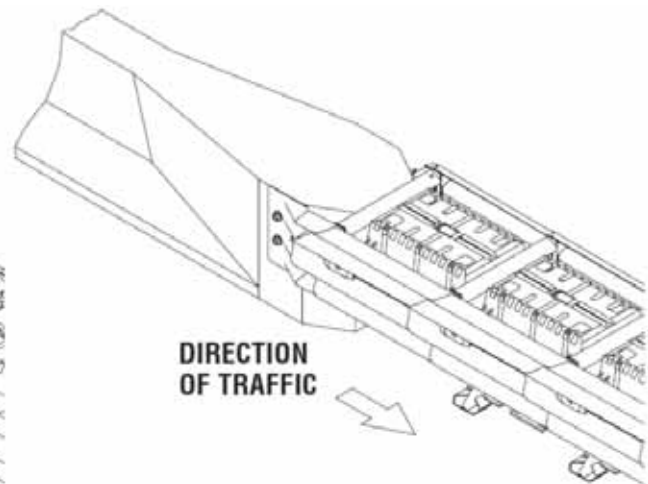
**Figure 8**  
**Quad-Beam™ to Safety Barrier (NJ shape) Transition Panel**



**Figure 9**  
**Quad-Beam™ to Thrie-Beam Transition Panel**



**Figure 10**  
**Quad-Beam™ to W-Beam Transition Panel**



**Figure 11**  
**Quad-Beam™ End Shoe Transition Panel**

## **QuadGuard® II cz Deployment Criteria**

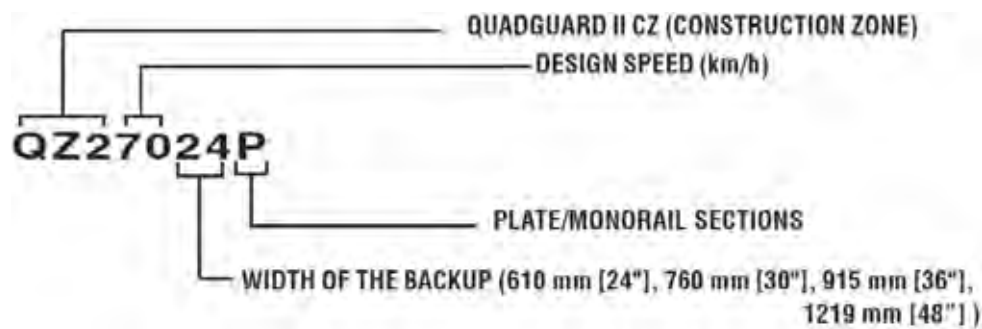
This portable compact crash cushion is for construction zones. The QuadGuard® II cz is available in the same narrow sizes as permanent systems.

The QuadGuard® II cz must be properly anchored (See Pages 15 and 16 for the recommended anchorage of various foundations).

**Table C**  
**QuadGuard® II cz Plate Model Numbers**

Number of Bays	NOMINAL WIDTH		
	610 MM [24"]	760 MM [30"]	915 MM [36"]
2	QZ27024P	QZ27030P	QZ27036P
5	QZ210024P	QZ210030P	QZ210036P

### **Model Number Description**



**Figure 12**  
**Model Number Key**

# **QuadGuard® II Foundation/Anchoring**

## **Concrete Installations**

For concrete installations, the QuadGuard® II system 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 resident project engineer or appropriate highway authority.

Recommended dimension and reinforcement specifications for new concrete pads can be found on the standard drawings.

## **Asphalt Installations**

For asphalt installations in construction zones, QuadGuard® II system may only be assembled with a Tension-Strut Backup. Assemblies on asphalt must provide a minimum of 76 mm [3"] layer of asphalt over a minimum of 76 mm [3"] layer of Portland Cement concrete, 152 mm [6"] layer of asphalt over 152 mm [6"] layer of subbase, or 203 mm [8"] layer of asphalt with no subbase. 460 mm [18"] threaded rods, installed with the two-part MP-3® grout, must be used for these foundations.



**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 6 months. See Post Impact Instructions and Maintenance and Repair instructions in the QuadGuard II Assembly Manual for details.

The QuadGuard® II system 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 Portland Cement Concrete (P.C.C.)

Anchorage: MP-3® with 180 mm [7"] studs 140 mm [5 1/2"] embedment

### **Foundation B: Asphalt over P.C.C.**

Foundation: 76 mm [3"] minimum asphalt concrete (A.C.) over 76 mm [3"] minimum P.C.C.

Anchorage: Length of anchor required is 180 mm [18"] 420 mm [16 1/2"] embedment

### **Foundation C: Asphalt over Subbase**

Foundation: 150 mm [6"] minimum A.C. over 150 mm [6"] minimum Compacted Subbase (C.S.)

Anchorage: MP-3 with 460 mm [18"] studs 420 mm [16 1/2"] embedment

### **Foundation D: Asphalt Only**

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

Anchorage: MP-3 with 460 mm [18"] studs - 420 mm [16 1/2"] embedment

## **Foundation Specifications**

for Foundations A, B, C and D mentioned above:

### **A. C. (Asphalt Concrete)**

AR-4000 A. C. (per ASTM D3381 '83) 3/4" Maximum, Medium (Type A or B) aggregate

<b>Sieve Size</b>	<b>Operating Range (%) Passing</b>
1"	100
3/4"	95-100
3/8"	65-80
No. 4	49-54
No. 8 3	6-40
No. 30 1	8-21
No. 200	3-8



**Caution:** Walk-up inspections are recommended at least once every six months for installations on asphalt.

### **P.C.C. (Portland Cement Concrete)**

Stone aggregate concrete mix

4000 psi minimum compressive strength

(Sampling per ASTM C31-84 or ASTM C42-84a, testing per ASTM C39-84)

### **C.S. (Compacted Subbase)**

150 mm [6"] minimum depth 95% compaction

Class 2 aggregate

<b>Sieve Size</b>	<b>Moving Average % Passing</b>
3"	100
2 1/2"	90-100
No. 4	40-90
No. 200	0-25

## **Assembly**

The QuadGuard® II system is potentially reusable. The system must be inspected after each impact and must be pulled out to its original length. Depending on the impact, components may get damaged and need replacement. That decision is for the appropriate highway authority specifying the maintenance to be performed.

### **Estimated time for Maintenance**

An experienced two person crew with the proper tools and spare parts should be able to complete the work in one to three hours depending on the damage done to the system.

## **Recommended Tools**

### **Documentation**

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

### **Cutting equipment**

- Rebar cutting bit
- Concrete drill bits – 22 mm [7/8"] (\*Two Fluted)
- Grinder, Hacksaw or Torch (optional)
- Electric or Air Drill
- Drill bits 1/16" through 7/8"

\* Ingal Civil Products recommends using two fluted drills bits to achieve acceptable tensile strength when applying the MP-3® anchoring system.

### **Hammers**

- Rotomhammer
- Sledgehammer
- Standard hammer

### **Wrenches**

- Heavy duty impact wrench
- Standard adjustable wrench
- 1/2" drive sockets: 9/16", 11/16", 3/4", 15/16", 1 1/8", 1 1/4"
- 1/2" drive Deep sockets: 15/16", 1 1/4"
- Ratchet and attachments for the above sockets
- 1/2" drive Ratchet and attachments
- 1/2" drive Breaker bar - 24" long
- 1/2" drive Torque wrench: 200 ft.-lbf.
- Crescent Wrench: 300 mm [12"]
- Allen Wrench: 3/8
- Impact Wrench: 1/2"

### **Personal Protective equipment**

- Safety Glasses
- Gloves
- Apron for MP-3® application

### **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.
- Compressor (100 psi) and Generator (5 kW)
- Long pry bar
- Drift pin 300 mm [12"]
- Center punch
- Tape measure 7.5 m [25']
- Chalk line
- Concrete marking pencil
- Nylon bottle brush for cleaning 7/8" drilled holes
- Rags, water, and solvent for touch-up

**Note:** The above list of tools is a general recommendation. Depending on specific site conditions and the complexity of the assembly specified by the appropriate highway authority, additional or fewer tools may be required. Decisions as to what tools are required to perform the job are entirely within the discretion of the specifying highway authority and the authority's selected contractor performing the assembly of the system at the authority's specified site.

## Life Expectancy

### Environment

Except due to impact damage, it is anticipated that the Cartridges can survive in a highway environment for a period ranging from 10 to 15 years from the date of assembly.

### Impacts

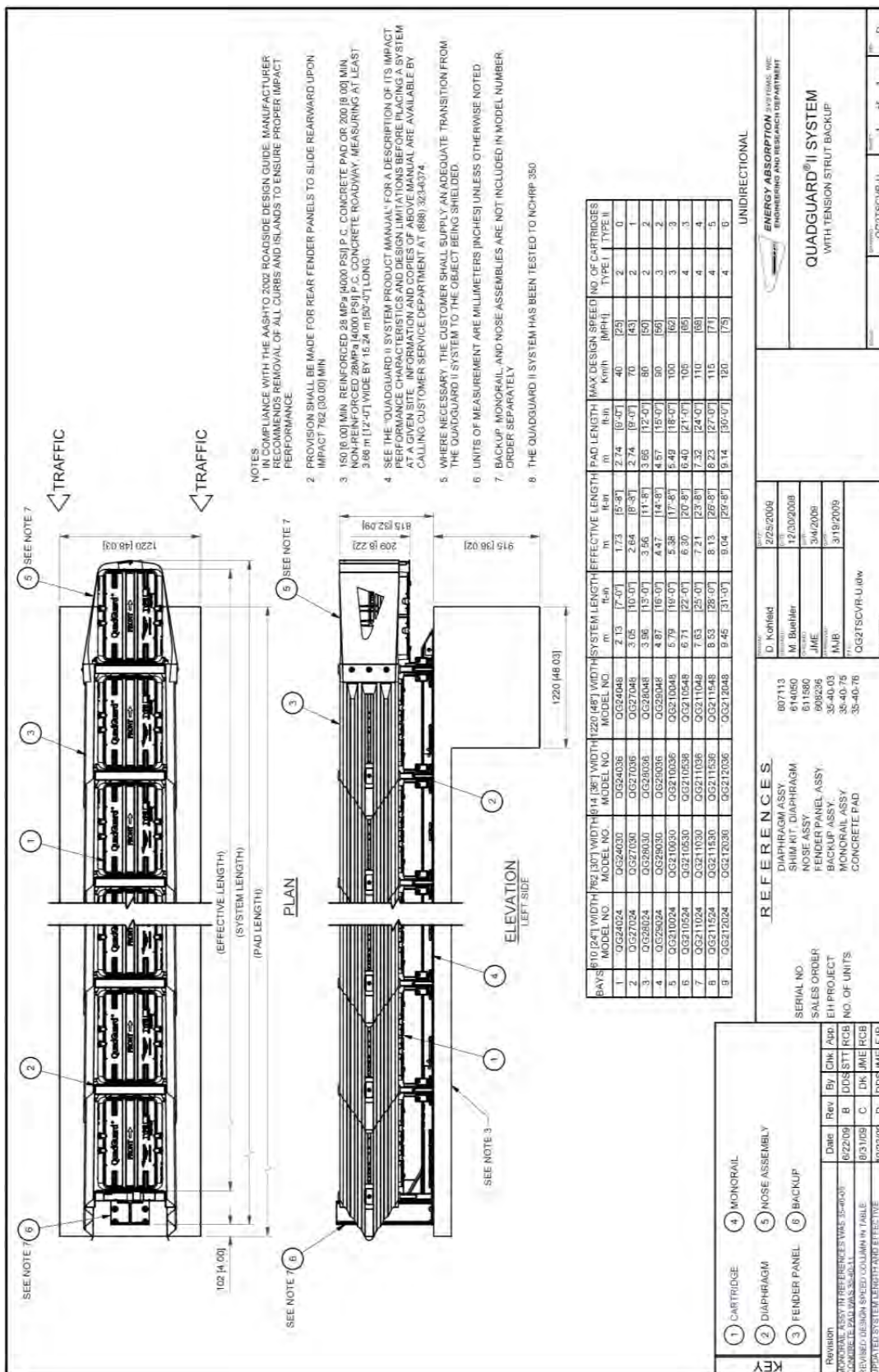
Life expectancy is also dependent on the impacts. This includes:

1. The number of impacts
2. The severity of the impacts
3. The temperature at the time of the impacts.

Systems must be inspected after each impact. Any Cartridge that is crushed or otherwise damaged should be replaced and the system should be pulled out to its original length.

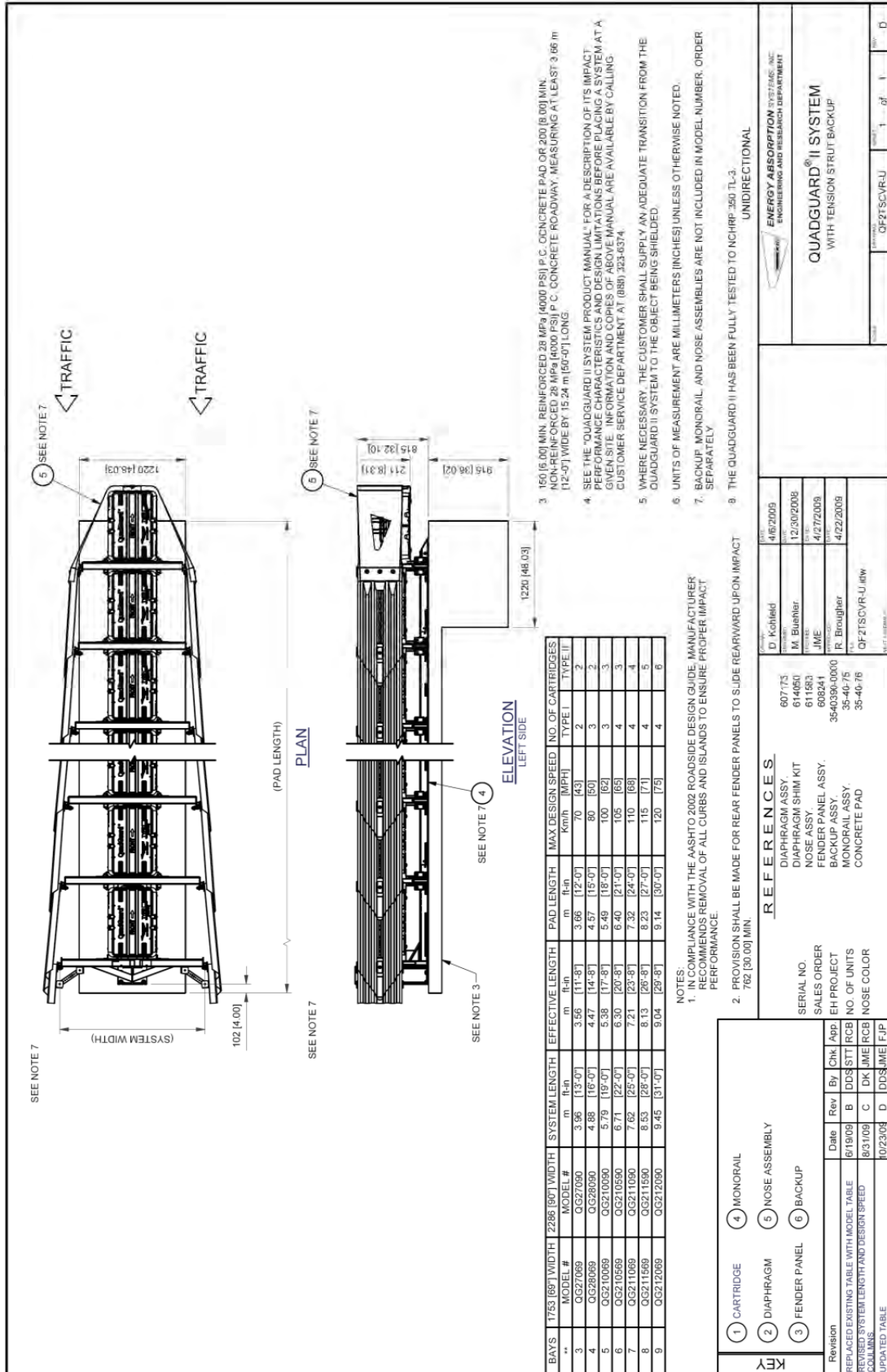


**Caution:** After an impact, always follow the “Post-Impact Instructions” in the maintenance and repair section of the Assembly Manual.



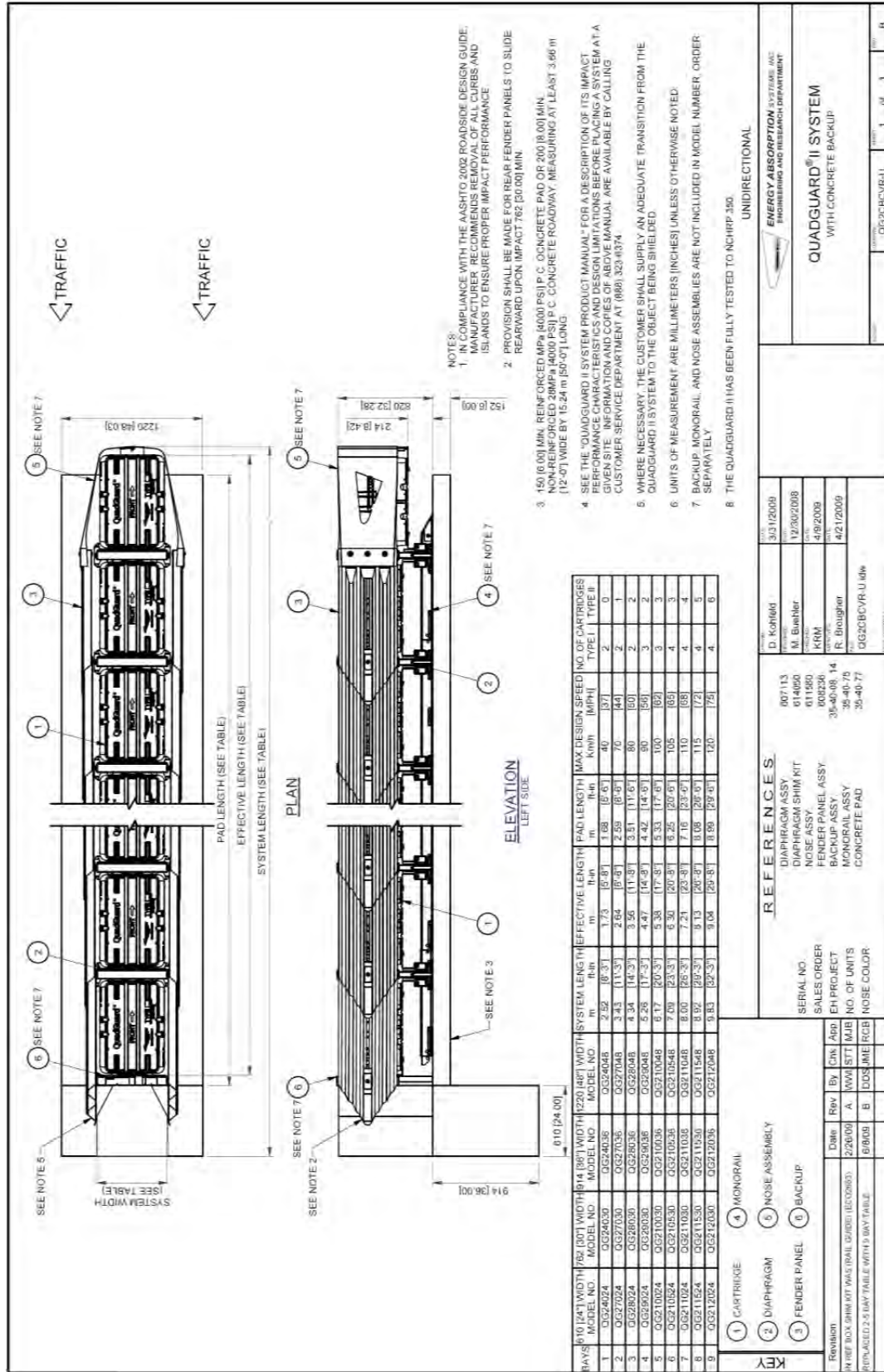
## QuadGuard® II System w/Tension Strut Backup





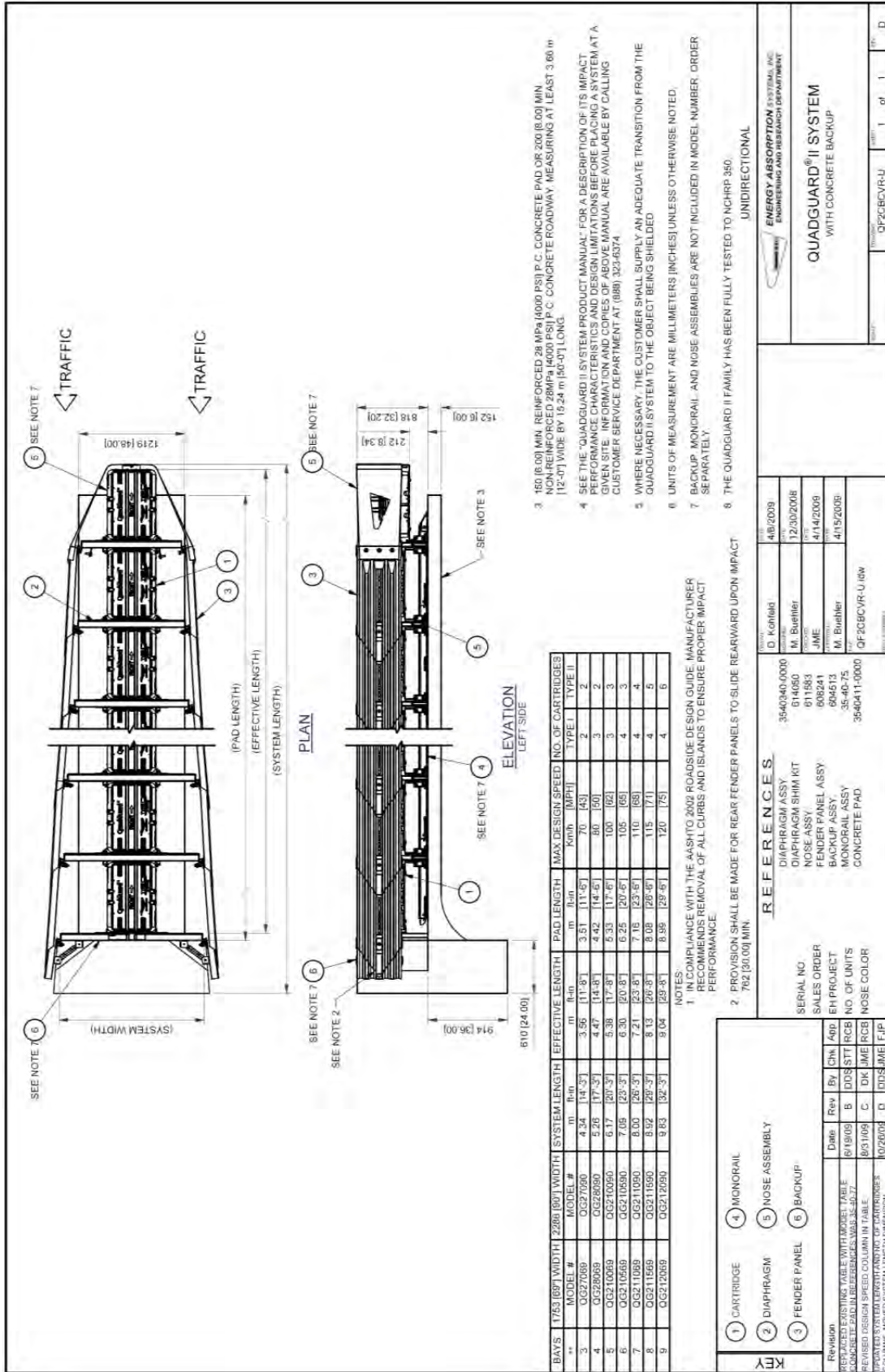
DWG QF2TSCVR-U

# QuadGuard® II System w/Tension Strut Backup Wide



## QuadGuard® II System w/Concrete Backup

DWR QG2CBCVR-U

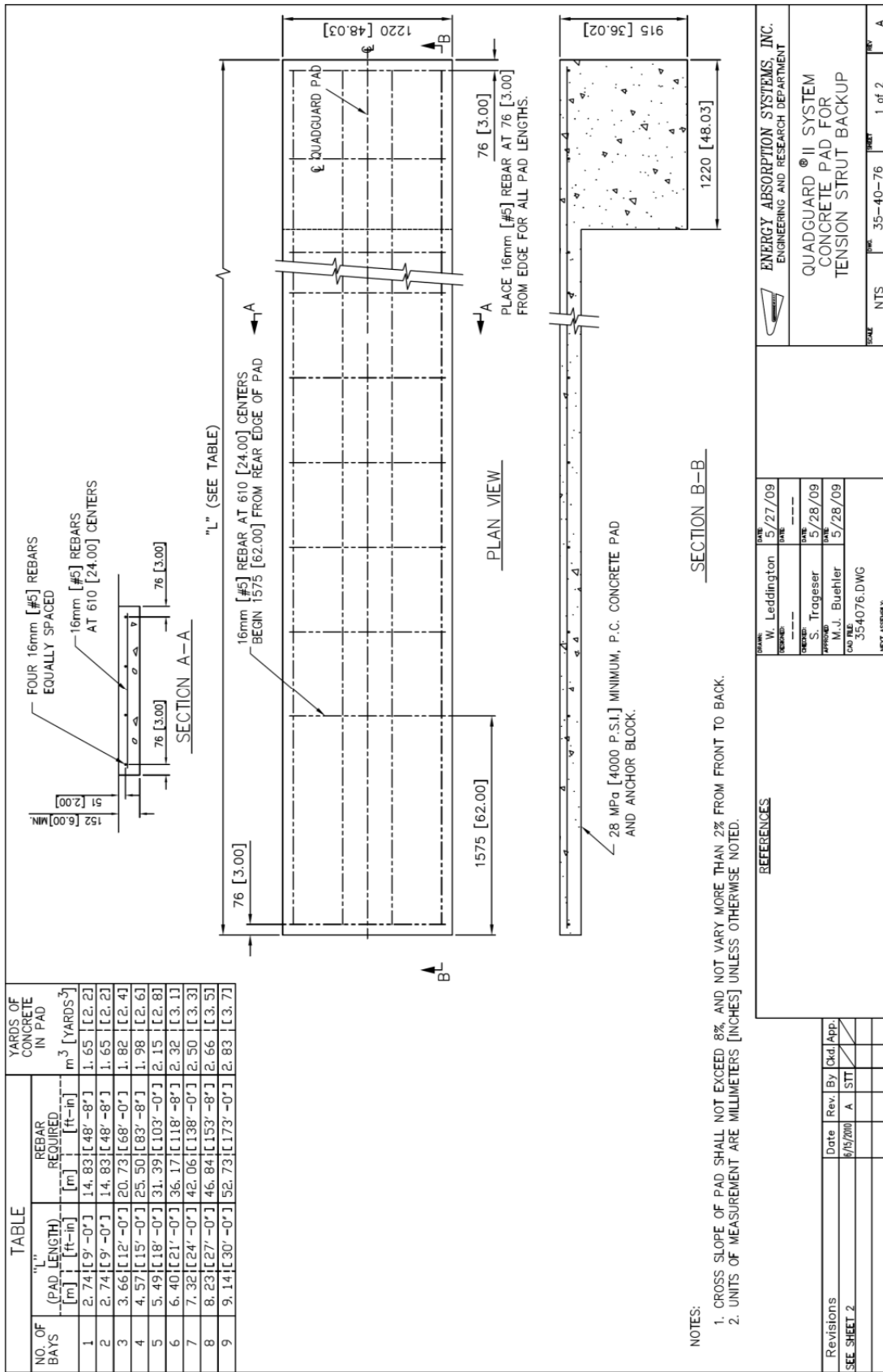


# QuadGuard® II System w/Concrete Backup Wide



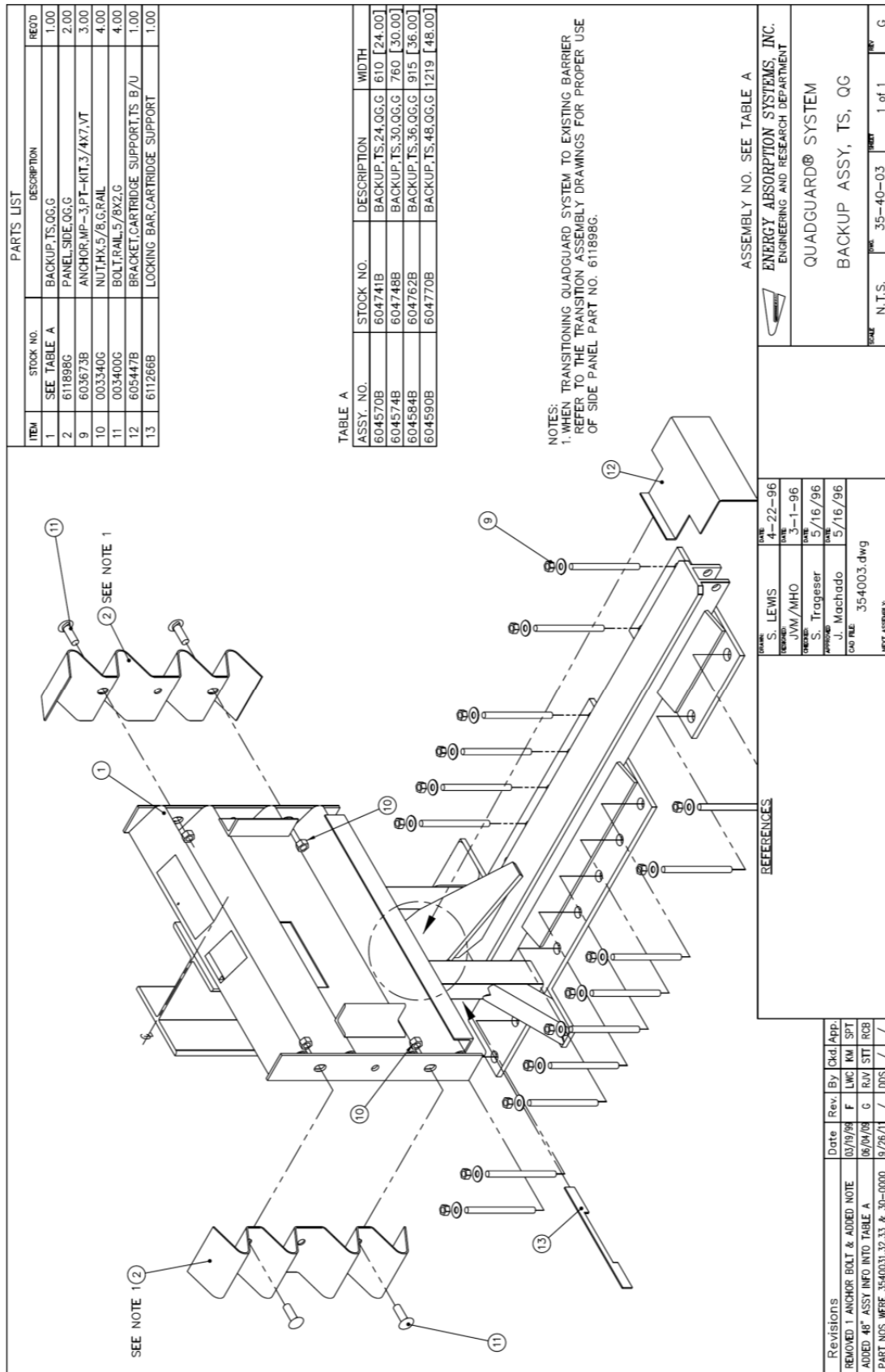
DWR QG2 CZCVR-U

## QuadGuard® II System Construction Zone System



DWG 354076 Sheet 1 of 2

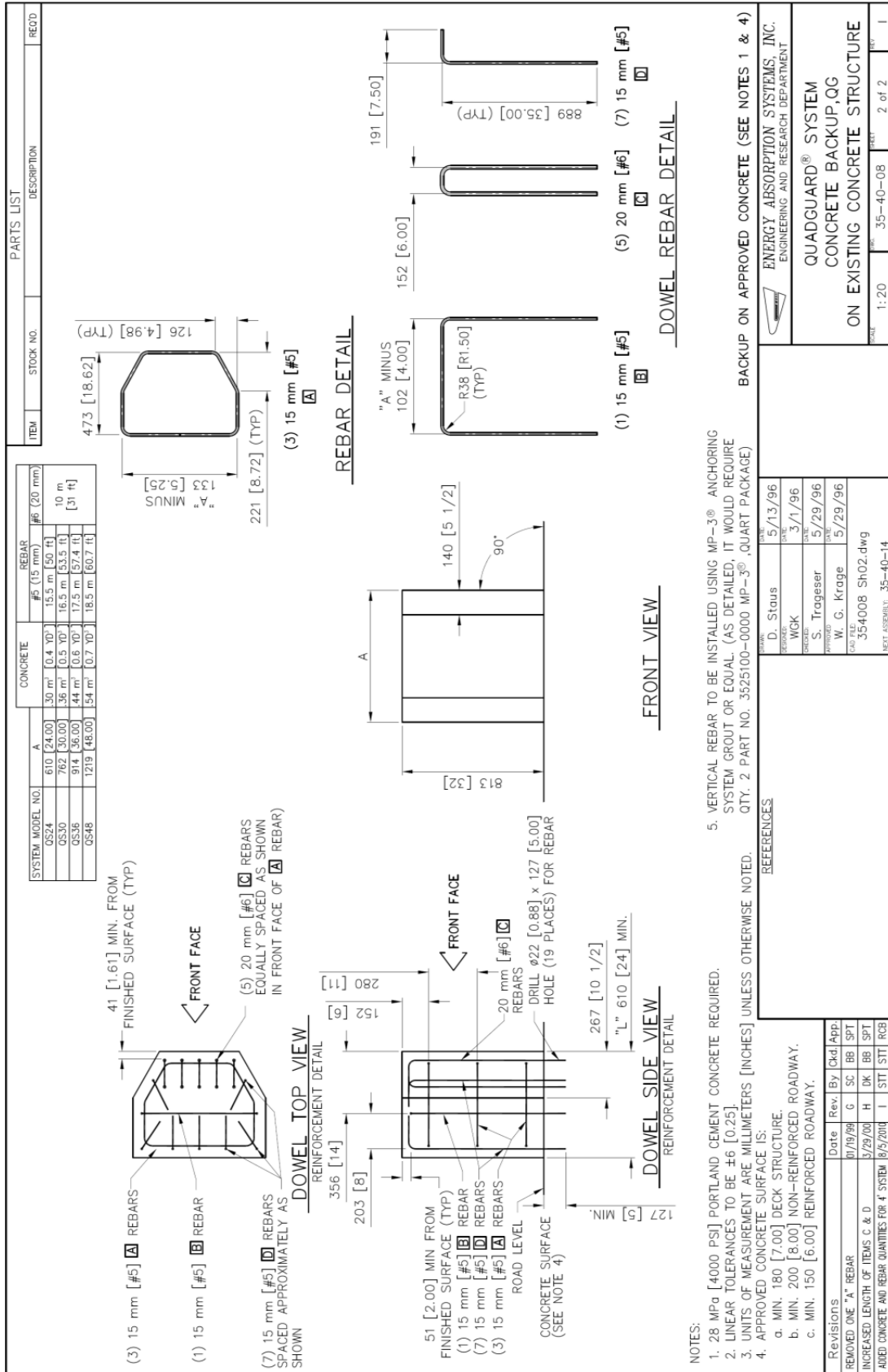




## QuadGuard® II System Backup Assembly, TS, QG

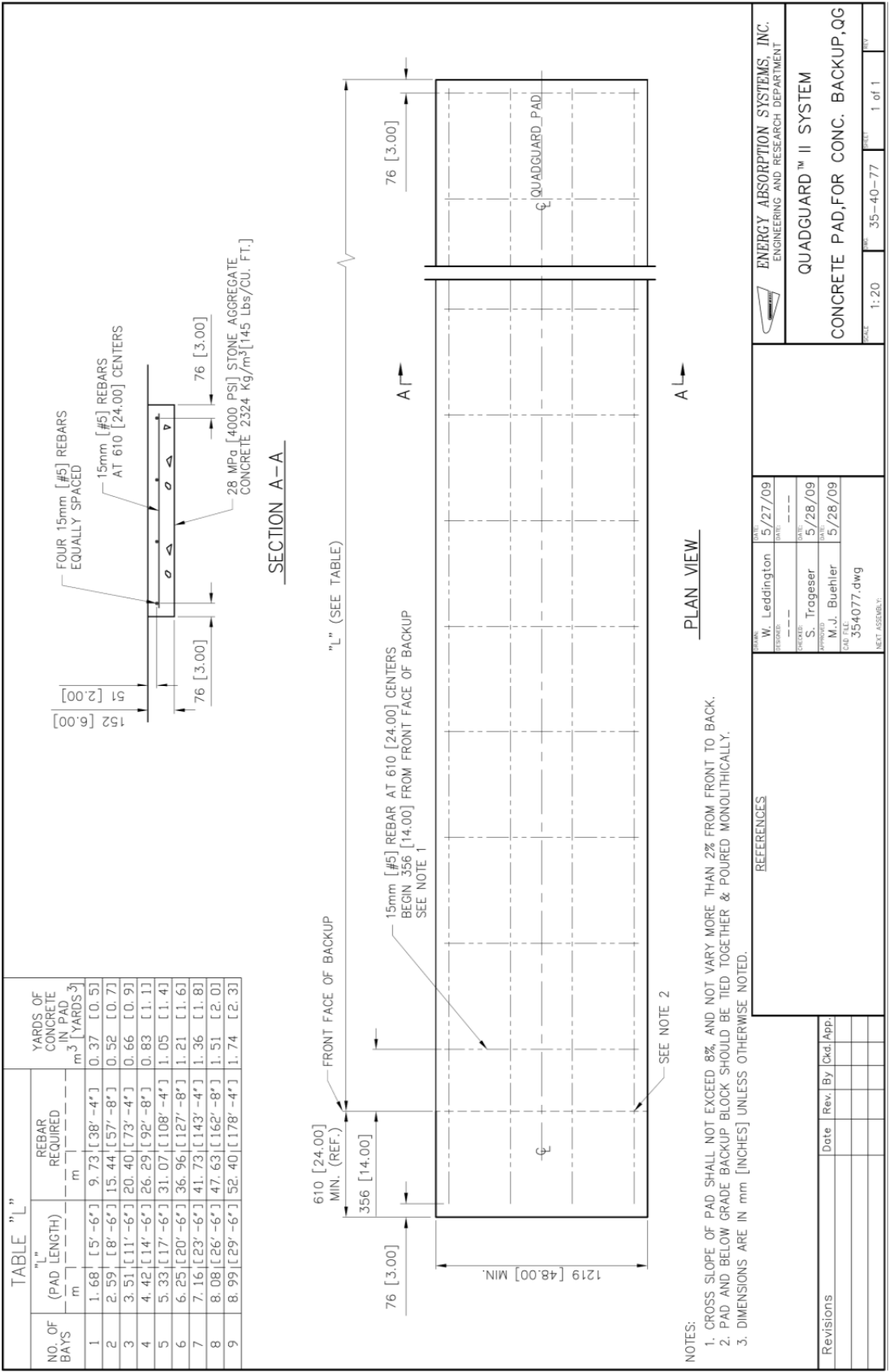




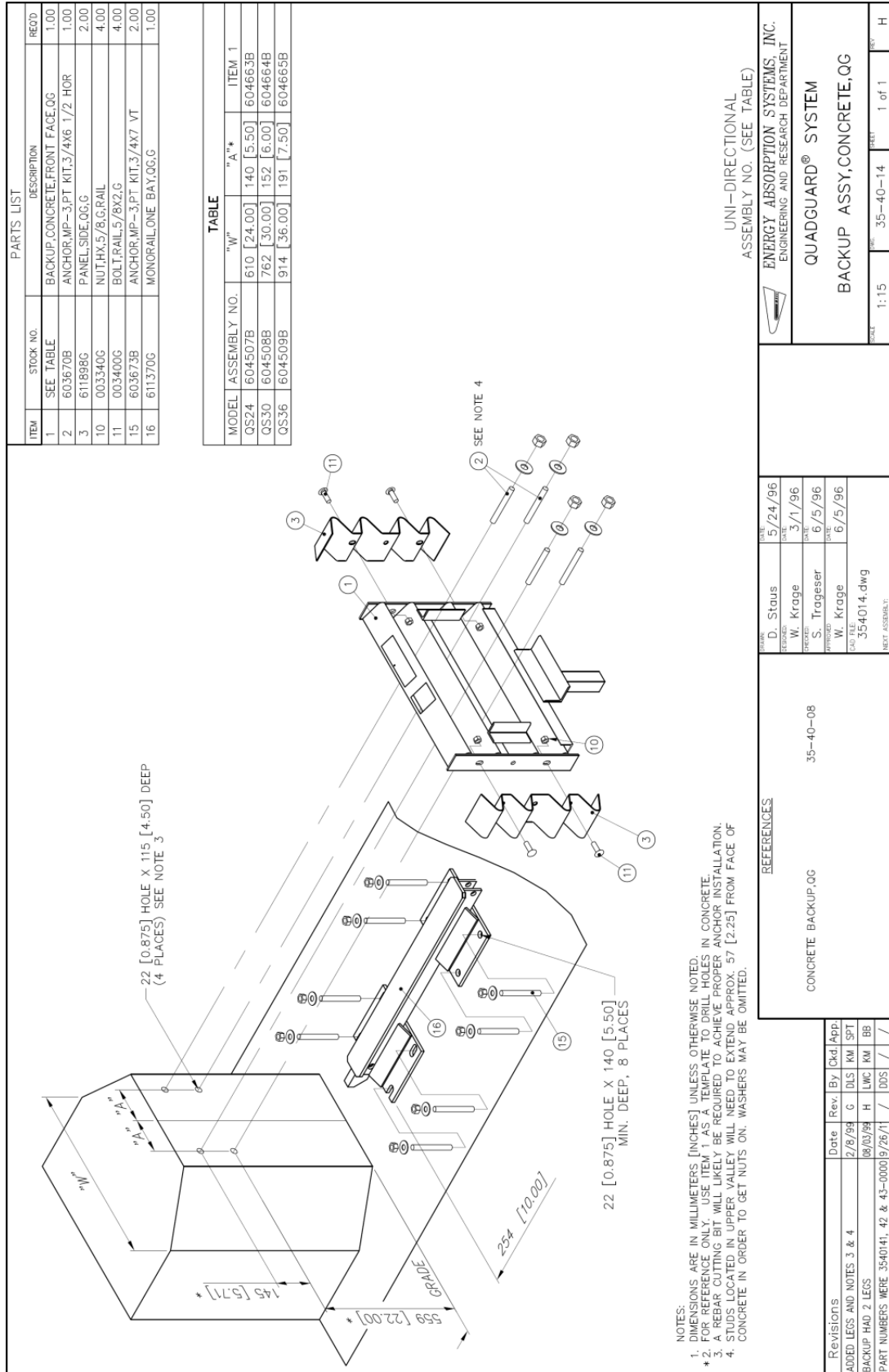


## QuadGuard® II System Concrete B-up, QG on Existing Concrete Structure

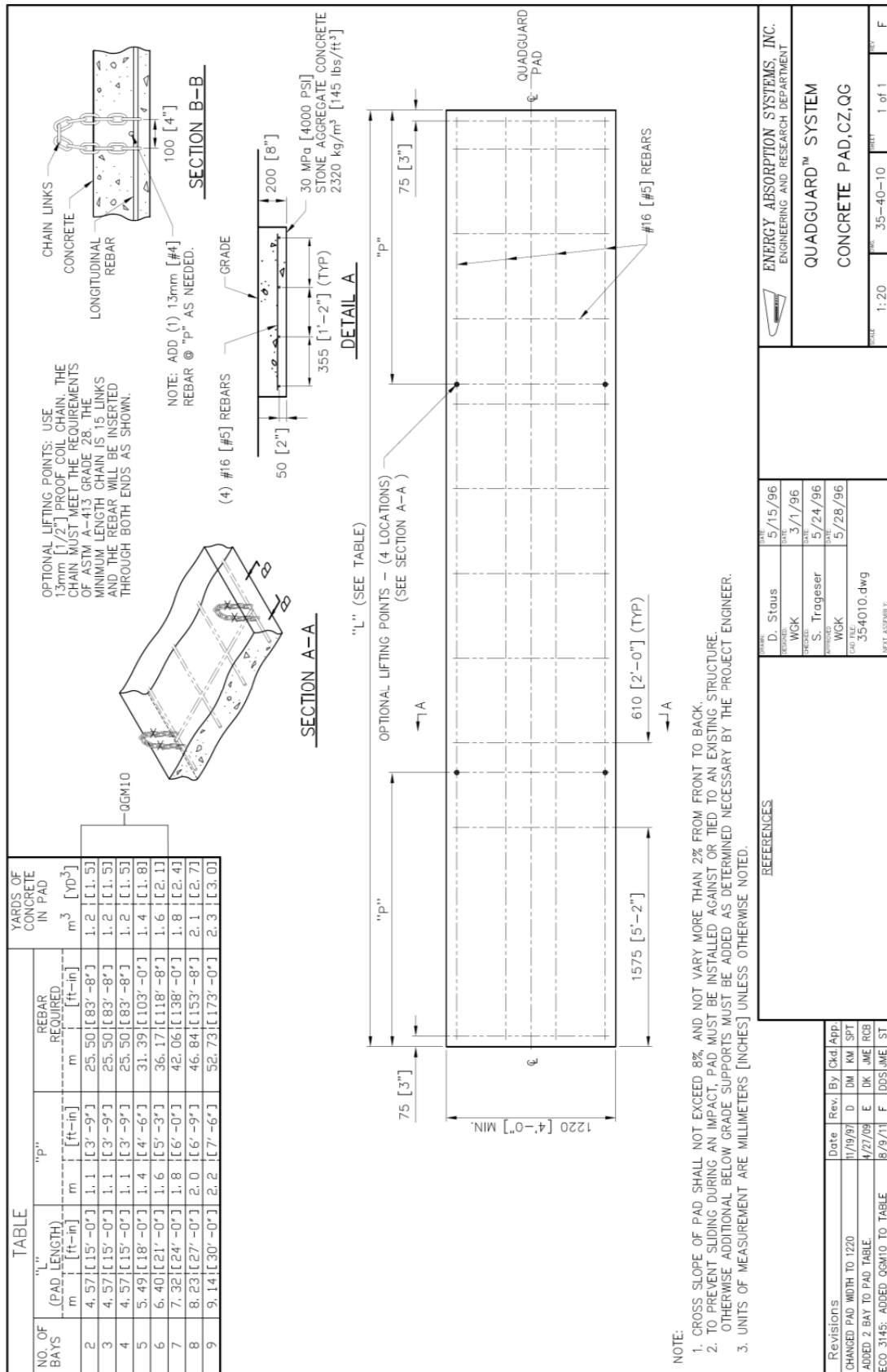
DWG 354008 Sheet 2 of 2



QuadGuard® II System Concrete Pad, for Concrete Backup, QG



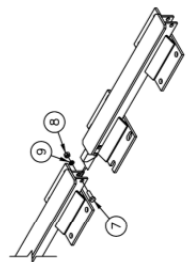
## QuadGuard® II Backup Assembly, Concrete, QG



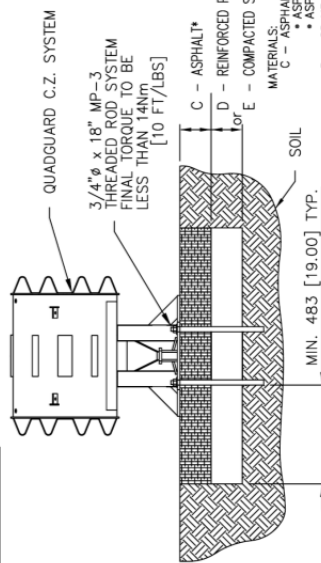
## QuadGuard® II System Concrete Pad, cz, QG

REF. ASSY. OSCZVR

PARTS LIST		RECD											
ITEM	STOCK NO.	DESCRIPTION	3	4	5	6	7	8	9				
1	2700731-0500	ROD, THREADED, 3/4"x18, G5, G	32	38	46	52	58	66	72				
2	2704341-0000	NUT, HX, 3/4", G, GR DH	32	38	46	52	58	66	72				
3	2708081-0000	WASHER, FLAT, 3/4"x2, HVT, G	32	38	46	52	58	66	72				
4	3525100-0000	MP-3, QUART PACKAGE	8	10	12	13	15	17	18				
5	2760231-0000	BRACKET, LIFTING, QG, CZ	4	4	4	4	4	4	4				
6	DELETED		-	-	-	-	-	-	-				
7	2699571-0000	BOLT, HX, 5/8"x3 1/2, G5, G	1	1	2	2	2	2	3				
8	2704141-0000	NUT, HX, 5/8", G	1	1	2	2	2	2	3				
9	2708231-0000	WASHER, LOCK, 5/8", G	1	1	2	2	2	2	3				
10	3540242-0000	INST. QG CZ ANCHOR/LIFT KIT	1	1	1	1	1	1	1				
11	2735492-0000	LABEL, CRATE, QG CZ, LIFT KIT	1	1	1	1	1	1	1				

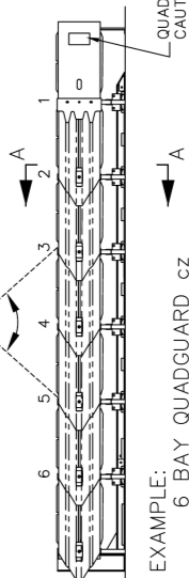


MONORAIL ATTACHMENT  
SCALE - 1:25



SECTION A-A  
REFER TO QUADGUARD CZ ANCHORING SYSTEM  
INSTALLATION & SAFETY INSTRUCTIONS FOR  
FURTHER INFORMATION

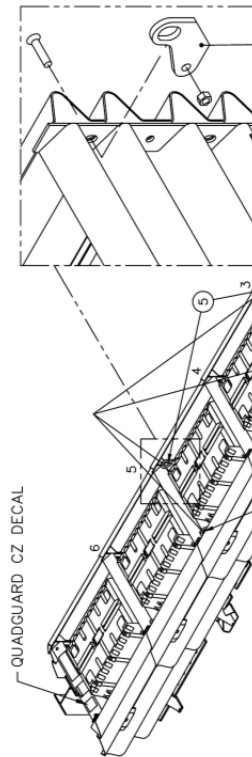
DEPTH COMBINATION		RECD STUD LENGTH	
"C"	"E"	"E"	"E"
152mm [6"]	180mm [7"]	180mm [7"]	180mm [7"]
152mm [6"]	180mm [7"]	180mm [7"]	180mm [7"]
152mm [6"]	180mm [7"]	180mm [7"]	180mm [7"]
203mm [8"]	180mm [7"]	180mm [7"]	180mm [7"]



EXAMPLE:  
6 BAY QUADGUARD cz  
SCALE - 1:50

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 MP-3<sup>®</sup> polyester anchor system, supplied by Energy Absorption Systems, 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.



QUADGUARD CZ DECAL

ITEMS 5 & 6 LOCATION CHART		ATTACH TO	
NO. OF BAYS	ASSEMBLY NUMBER	DIAPHRAGM NO.	
3	3540243-0000	2 & 3	
4	3540244-0000	2 & 4	
5	3540245-0000	2 & 4	
6	3540246-0000	2 & 4	
7	3540247-0000	3 & 6	
8	3540248-0000	3 & 6	
9	3540249-0000	4 & 7	

SCALE - 1:30

QUADGUARD CZ  
CAUTION DECAL  
\* SEE CHART

ASSY NO. 354024\*-0000

ENERGY ABSORPTION SYSTEMS, INC.  
ENGINEERING AND RESEARCH DEPARTMENT

QuadGuard<sup>®</sup> SYSTEM  
CZ ANCHOR/LIFTING KIT, QG,  
(3-9 BAYS)

DATE	BY	CHKD	APP.	Q.C.
10/17/96	D. Staus			
10/15/96	B. Burgess			
10/14/96	K. Mortensen			
10/15/96	S. Turner			

DATE	BY	CHKD	APP.	Q.C.
10/17/96	G			
5/17/98	H			

DATE	BY	CHKD	APP.	Q.C.
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5/17/98	H			

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5/17/98	H			

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5/17/98	H			

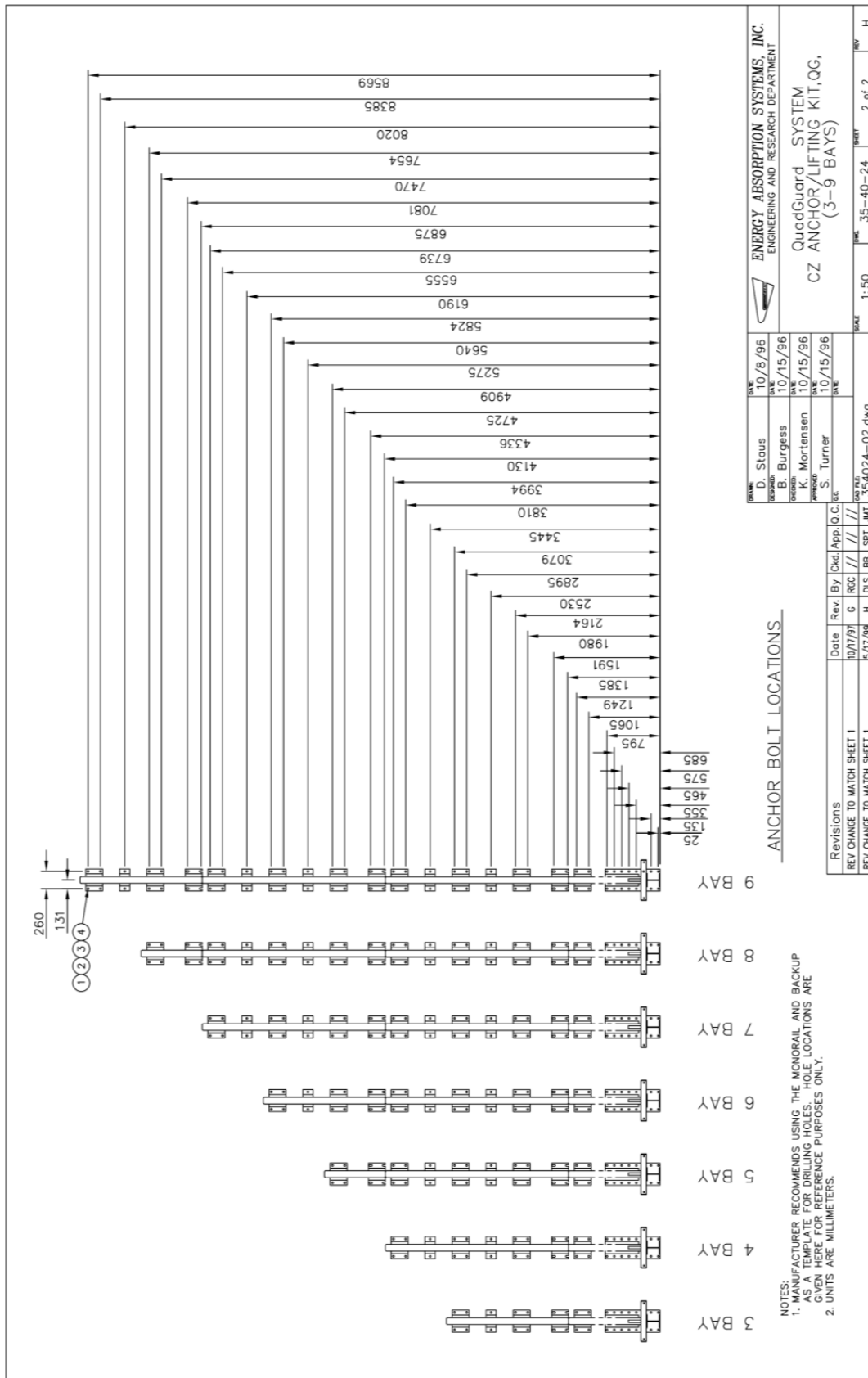
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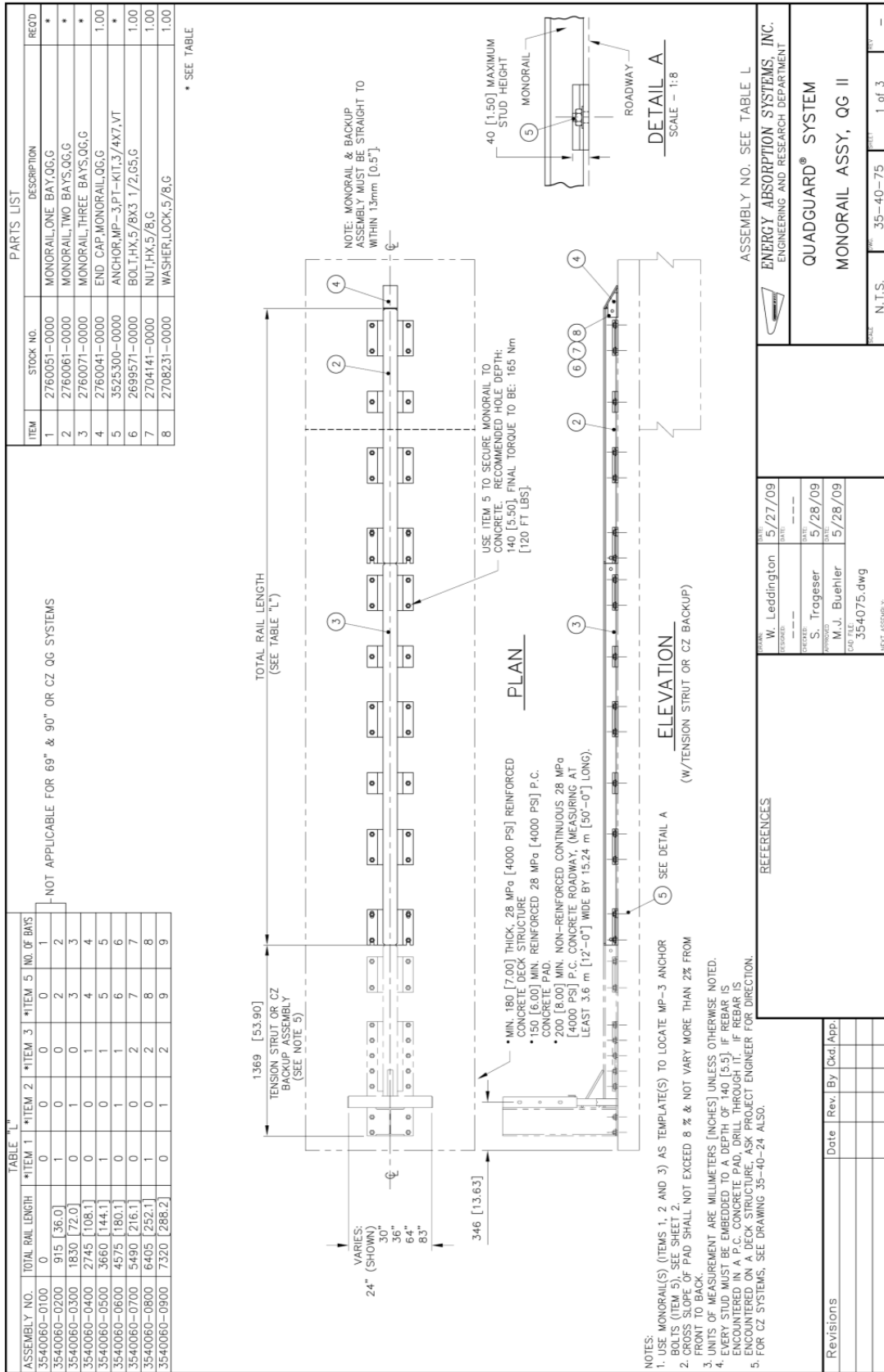
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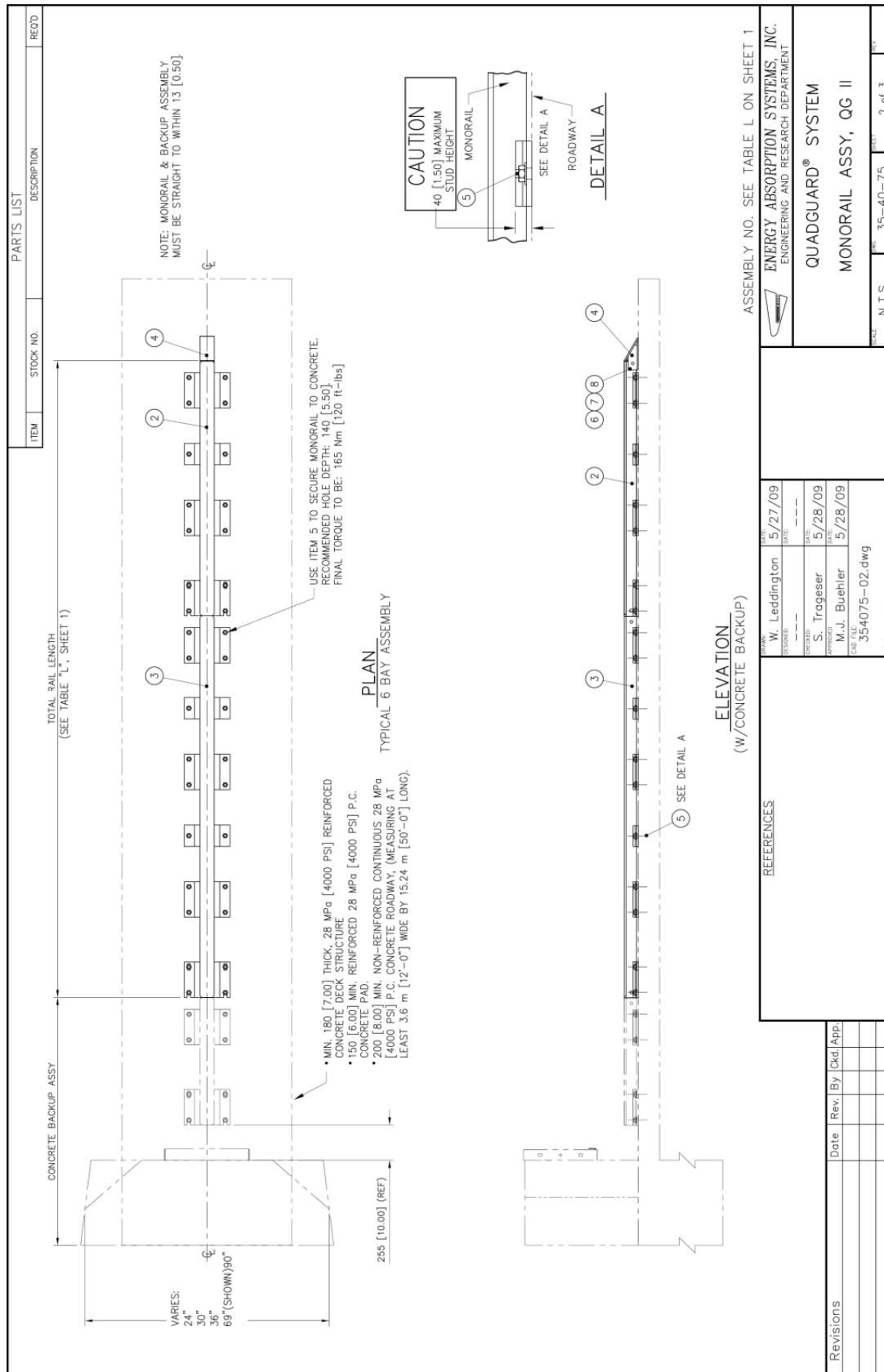
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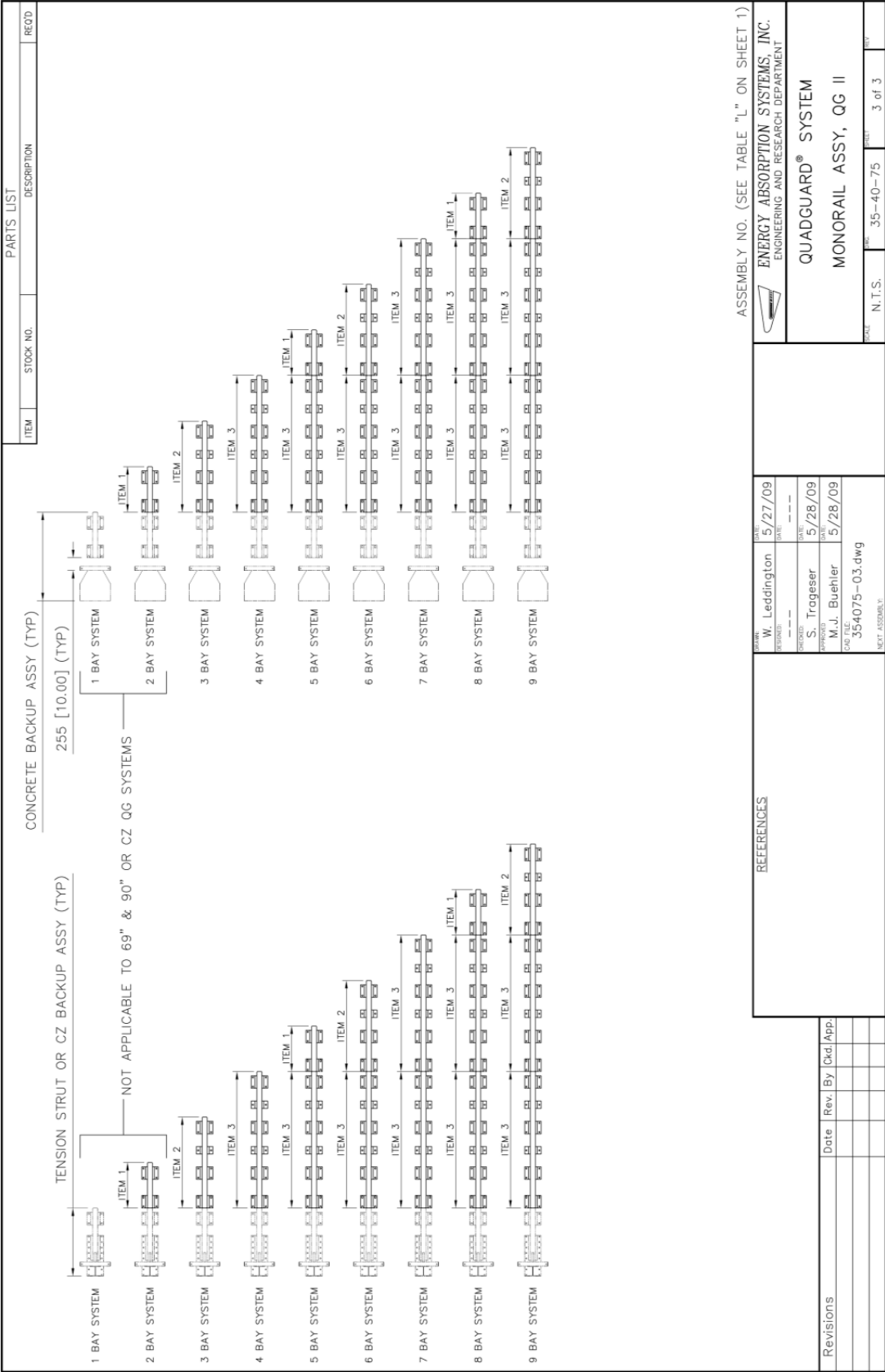




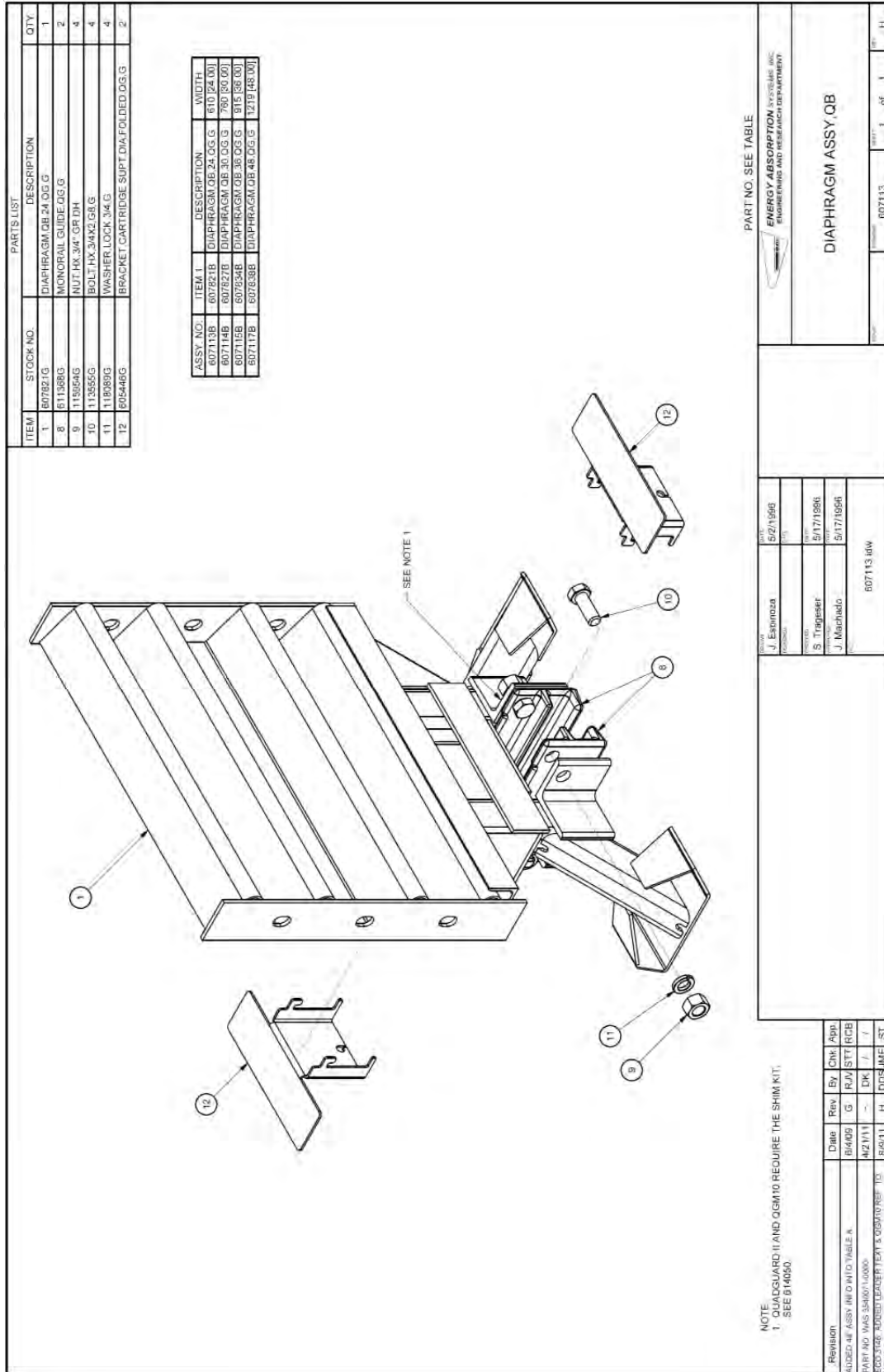
## QuadGuard® II System Monorail Assembly, QG







QuadGuard® II System Monorail Assembly, QG



PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY
1	607821G	DIAPHRAGM QB 24 DG G	1
8	61138RG	MONORAIL GUIDE QG G	2
9	115064G	NUT HK 3/4" GR DH	4
10	113555G	BOLT HK 3/4X2 GR G	4
11	119389G	WASHER LOCK 3/4 G	4
12	606446G	BRACKET CARTRIDGE SUPT DIA FOLDED DG G	2

ASSY NO	ITEM I	DESCRIPTION	WIDTH
607113B	607821B	DIAPHRAGM QB 24 CG G	610 (24.00)
607114B	607821B	DIAPHRAGM QB 30 CG G	760 (30.00)
607115B	607821B	DIAPHRAGM QB 36 CG G	915 (36.00)
607117B	607821B	DIAPHRAGM QB 48 CG G	1219 (48.00)

PART NO. SEE TABLE

ENERGY ABSORPTION SYSTEMS INC.  
ENGINEERING AND RESEARCH DEPARTMENT

DIAPHRAGM ASSY QB

## Diaphragm Assembly, QG

Revision	Date	Rev	By	Chk	App
1	04/09	G	RJM	STT	RCB
2	4/21/11	-	DK	J	I
3	8/9/11	H	DD	JAME	ST

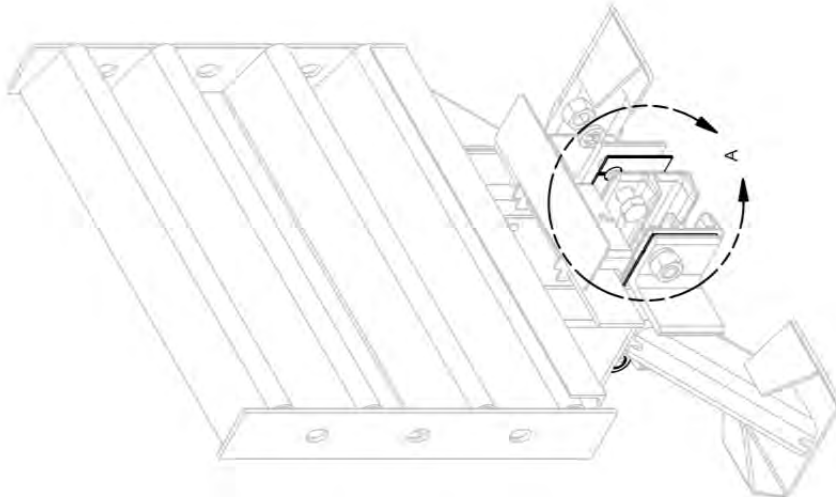
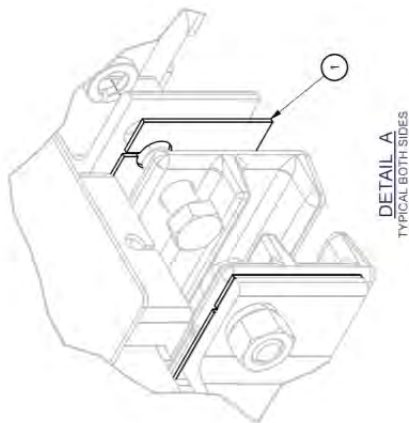
NOTE  
1. QUADGUARD II AND QGM10 REQUIRE THE SHIM KIT,  
SEE 614050.

DATE	BY	CHKD	APPD
5/2/1996	J. Espinoza		
5/17/1996	S. Triggler		
5/17/1996	J. Machado		

607113 B/W

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY
1	614050G	SHIM 1.0X3.5 8X8 G	2


  

Revision		Date	Rev	By	Chk	App
UPDATED ITEM 1		7/14/09	B	DK	JME	RCB
UPDATED ITEM 1		8/14/09	C	WW	KFM	AJC
PART NO. WAS 354075-0000		4/12/11	-	DK	J	J

Author		DATE	BY	CHKD	DATE	BY	CHKD
D. Kohfeld		2/27/2009					
M. Buehler		12/30/2008					
JME		3/4/2009					
MJB		3/19/2009					
614050.dwg							

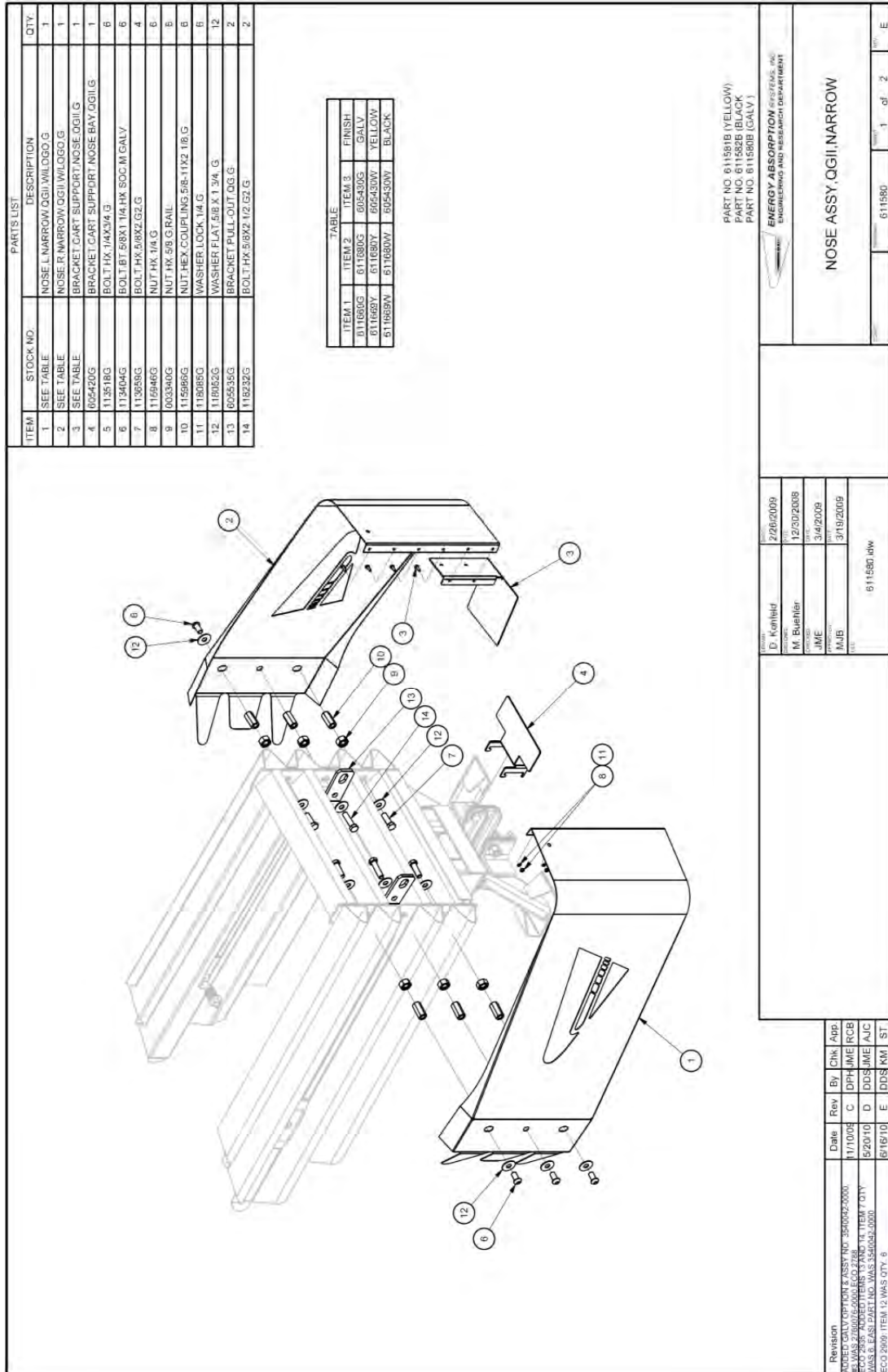
  

ASSEMBLY NO. 614050B	
	
ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT	
SHIM KIT, DIAPHRAGM, RAIL GUIDE, QG II	
REVISED	614050
1	of 1
C	

## Shim Kit, Diaphragm, Rail guide, QG II

DWG 614050





DWG 611580 Sheet 1 of 2





PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	SEE TABLE A	BACKUP, TS, QG WIDE, G	1.00
2	611900G	PANEL, SIDE, QG WIDE, G	2.00
4	113612G	BOLT, HX, 3/8X3 1/2, G2, G, ALL THREAD	16.0
5	115960G	NUT, HX, 3/8, G	16.0
7	118092G	WASHER, LOCK, 3/8, G	16.0
9	603673B	ANCHOR, MP-3, PT-KIT, 3/4X7, VT	3.00
10	003340G	NUT, HX, 5/8, G, RAIL	4.00
11	003400G	BOLT, RAIL, 5/8X2, G	4.00
12	113666G	BOLT, HX, 5/8X4, G5, G	6.00
13	118100G	WASHER, LOCK, 5/8, G	6.00
14	115970G	NUT, HX, 5/8, G	6.00
15	610172G	HINGE PLATE, FENDER PANEL, QG, G	2.00
16	615756B	TEL ST 1 3/4X1 3/4X12GA, H4S, G, 10" LG	4.00
17	615765B	TEL ST 2X2X12GA, H2S, G, 10" LONG	4.00
18	605447B	BRACKET, CARTRIDGE SUPPORT, TS B/U	1.00
19	611266B	LOCKING BAR, CART SUPPORT, QG	1.00

TABLE A			
ASSY. NO.	STOCK NO.	DESCRIPTION	WIDTH
604596B	604785B	BACKUP, TS, 64.0G WIDE, G	1620 [64"]
604599B	604789B	BACKUP, TS, 83.0G WIDE, G	2100 [83"]

NOTES:  
1. WHEN TRANSITIONING QUADGUARD SYSTEM TO EXISTING BARRIER REFER TO THE TRANSITION ASSEMBLY DRAWINGS FOR PROPER USE OF SIDE PANEL PART NO. 611898G.

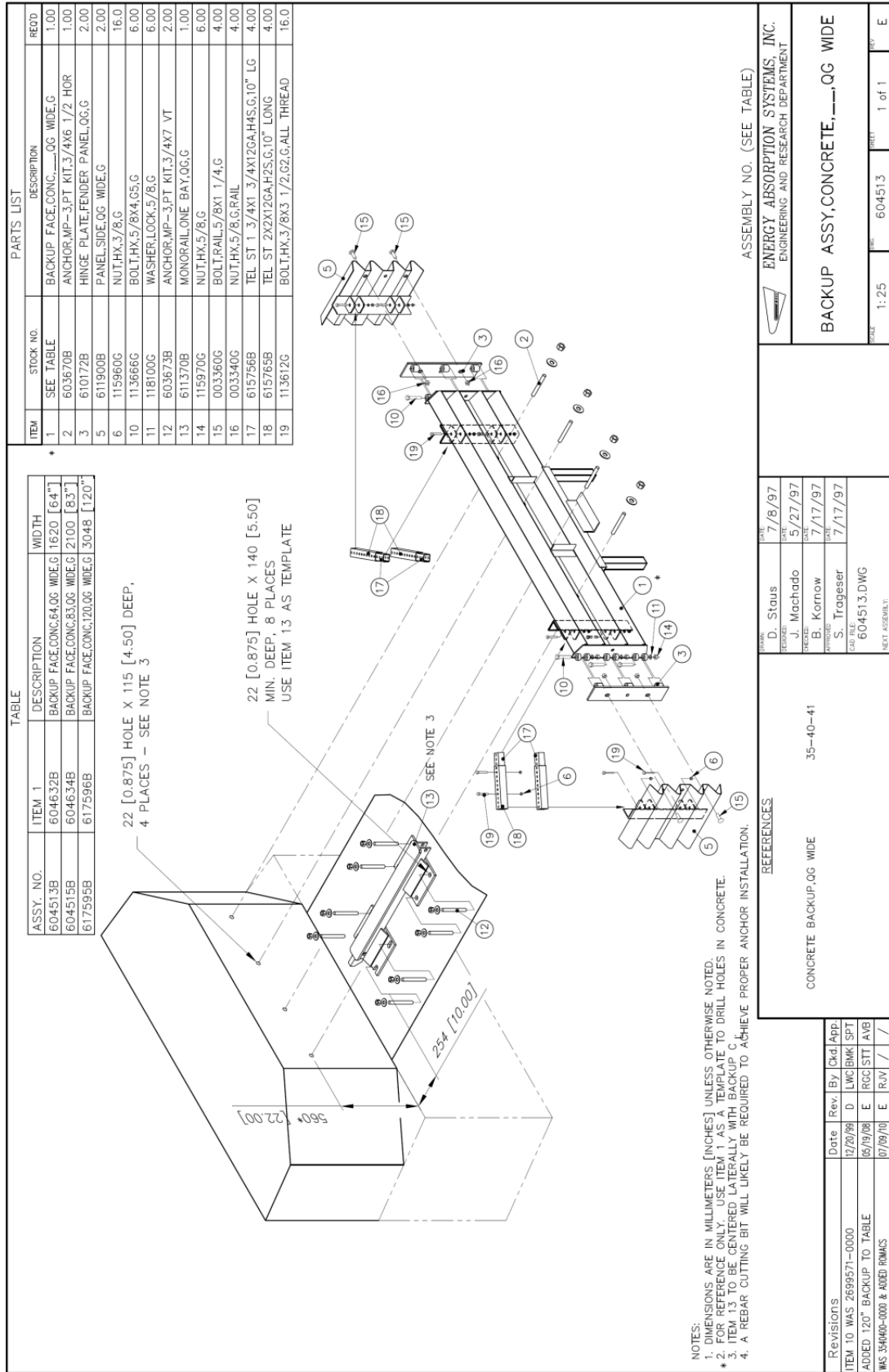
DWG 3540390

REFERENCES			
DATE	DESIGNED BY	DATE	FILE
7/1/97	D. Staus	7/1/97	3540390-0000.dwg
6/2/97	J. Machado	6/2/97	
7/17/97	B. Krage	7/17/97	
7/17/97	J. Machado	7/17/97	

ASSEMBLY NO. SEE TABLE A			
ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT			
QUADGUARD® SYSTEM			
BACKUP ASSY, TS, QG WIDE			

Revisions	Date	Rev.	By	Issd App.
UPDATED HINGES, ITEM 15 WAS 2760433-0000	12/10/99	D	DK	BB SPT
ITEM 12 WAS 2699571-0000	12/20/99	E	LWC	BNK SPT
PART NUMBERS WERE 3540391 & 392-0000	9/27/11	/	DDS	/

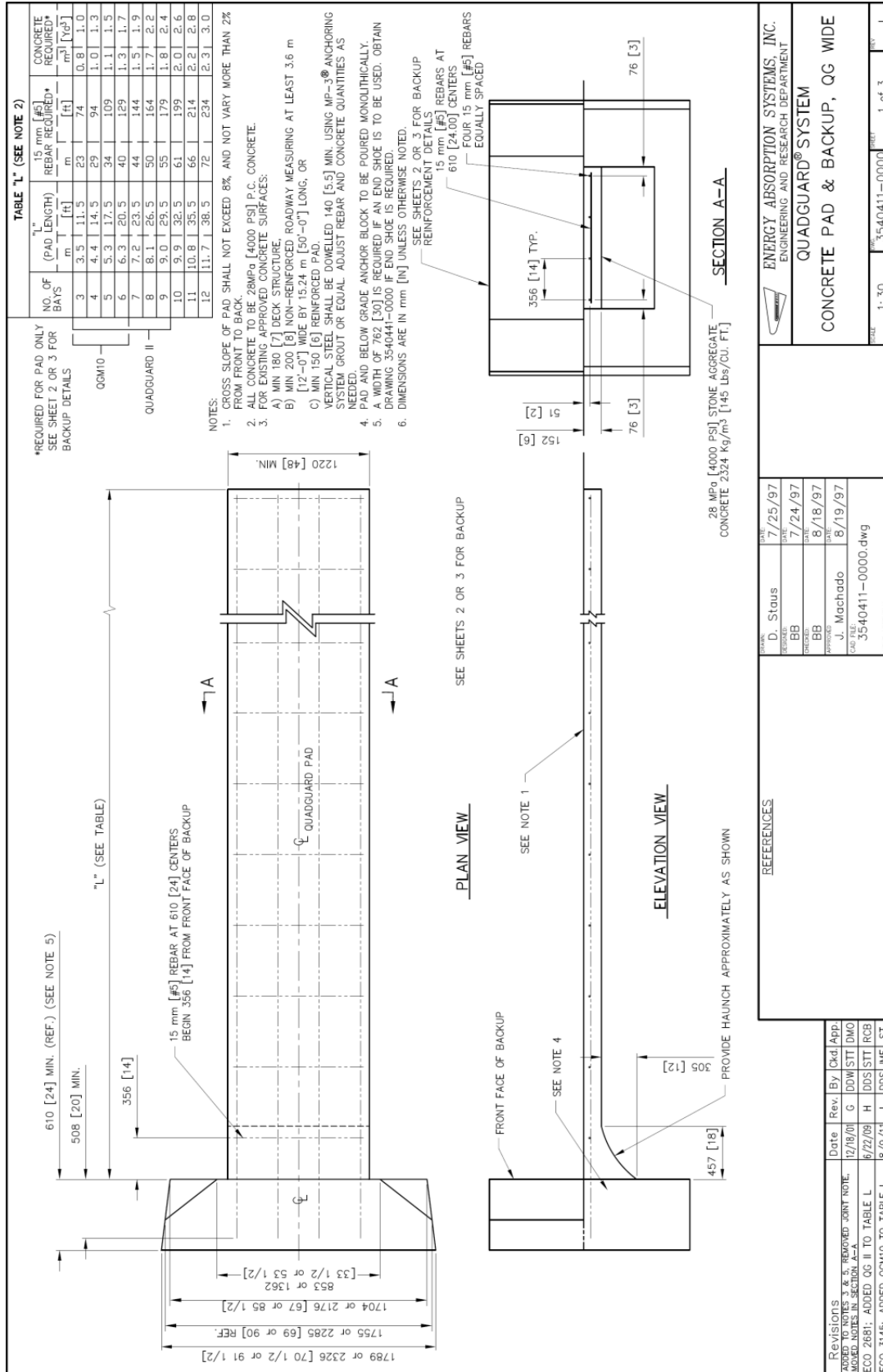
**QuadGuard® II System Backup Assembly, TS, QG Wide**



## Backup Assembly, Concrete, QG Wide

DWG 604513

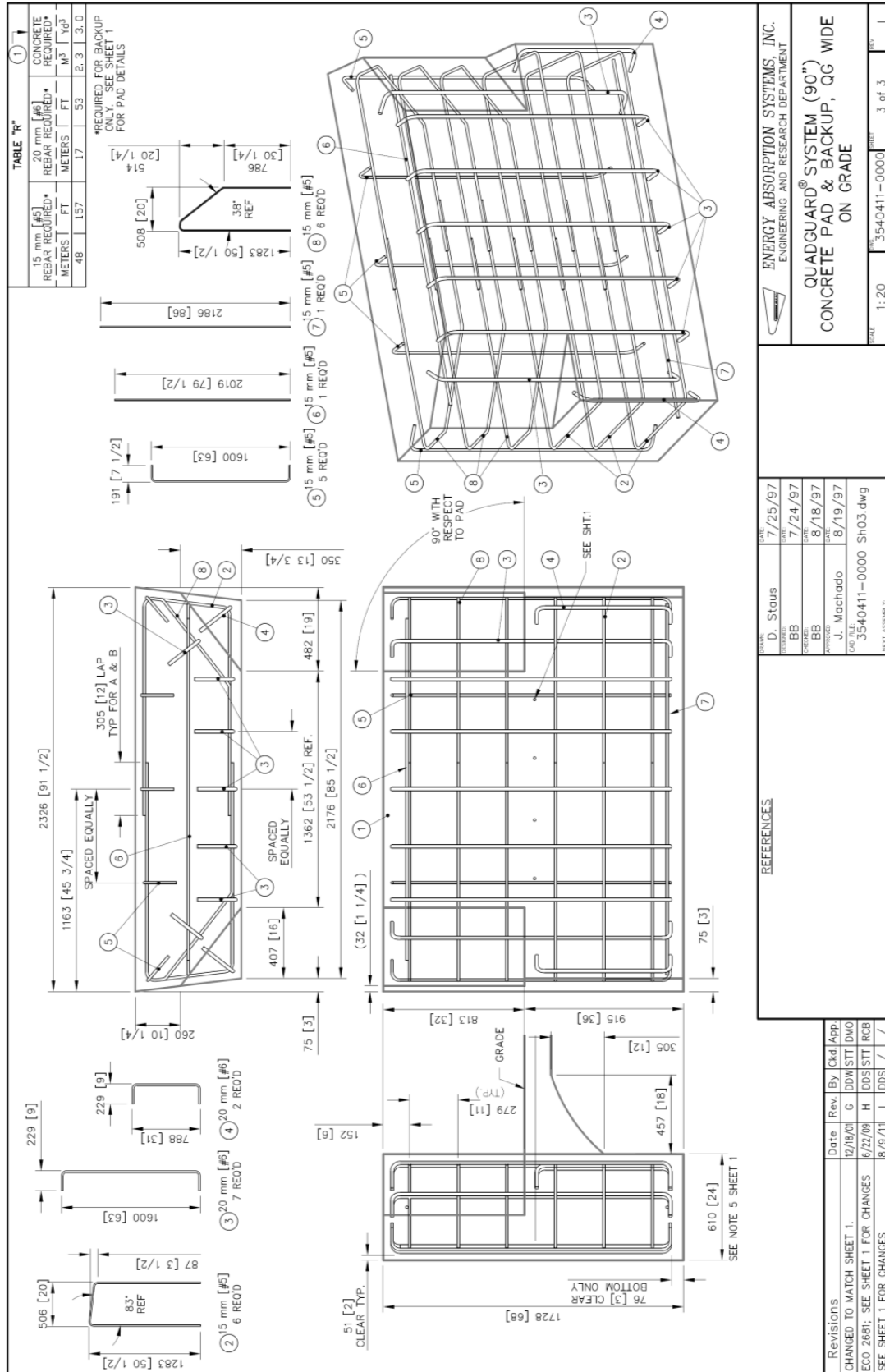




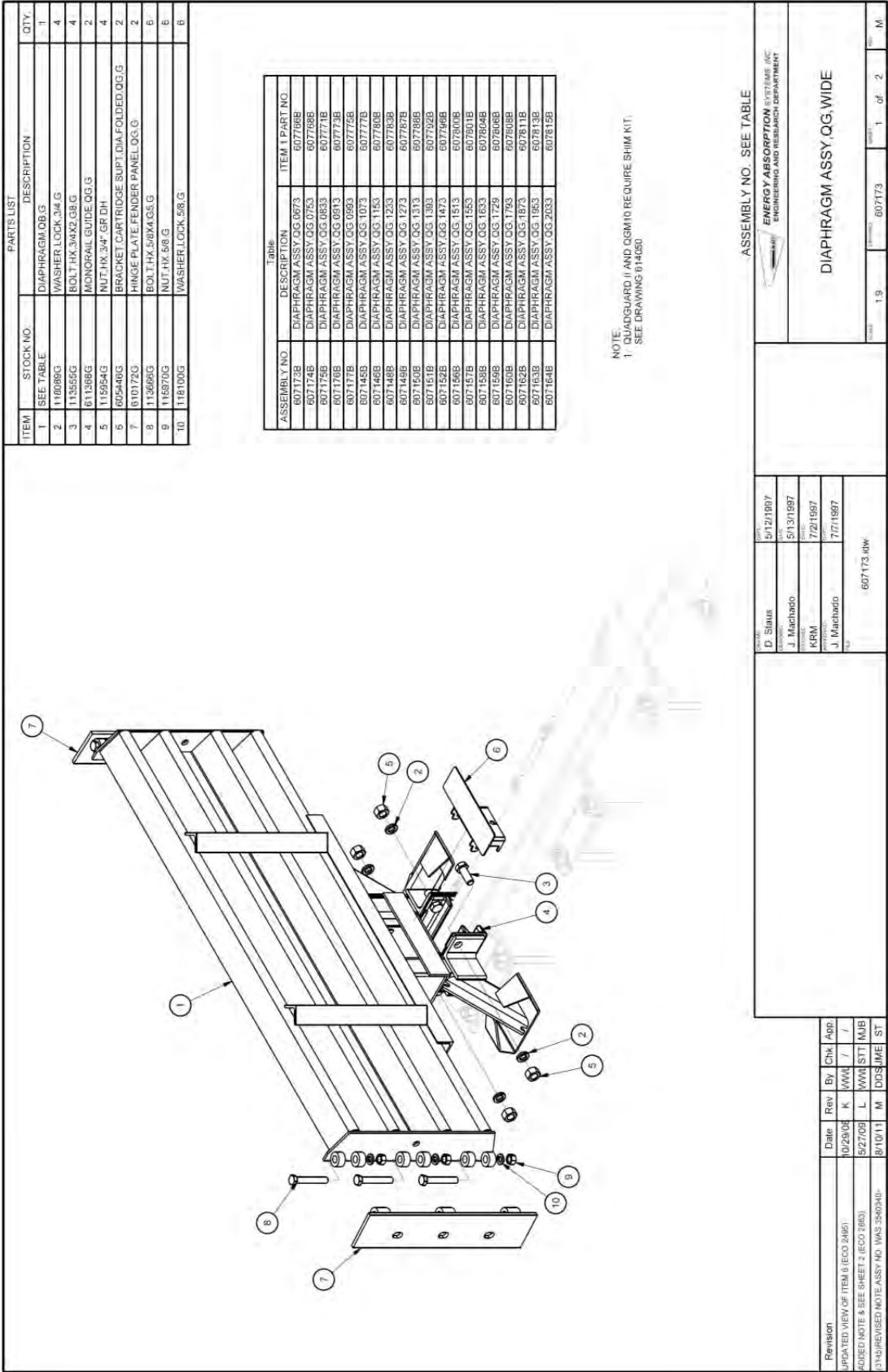
DWG 3540411 Sheet 1 of 3

# QuadGuard® System Concrete Pad & Backup, QG Wide





DWG 3540411 Sheet 3 of 3



PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY
1	SEE TABLE	DIAPHRAGM QB G	1
2	116086G	WASHER LOCK 3/4" G	4
3	113555G	BOLT HK 3/4X2 QB G	4
4	611368G	MINORAIL GUIDE QG G	2
5	115954G	NUT HK 3/4" GR DH	4
6	605448G	BRACKET CARTRIDGE SUPT DIA FOLDED QG G	2
7	610172G	HINGE PLATE FENDER PANEL QG G	2
8	113666G	BOLT HK 5/8X4 QG G	6
9	116970G	NUT HK 5/8 G	6
10	116100G	WASHER LOCK 5/8 G	6

Table		
ASSEMBLY NO	DESCRIPTION	ITEM 1 PART NO
607173E	DIAPHRAGM ASSY QG 0673	607706B
607174B	DIAPHRAGM ASSY QG 0753	607708B
607175B	DIAPHRAGM ASSY QG 0833	607771B
607176B	DIAPHRAGM ASSY QG 0913	607773B
607177B	DIAPHRAGM ASSY QG 0993	607775B
607178B	DIAPHRAGM ASSY QG 1073	607777B
607145B	DIAPHRAGM ASSY QG 1073	607778B
607146B	DIAPHRAGM ASSY QG 1153	607780B
607148B	DIAPHRAGM ASSY QG 1233	607782B
607149B	DIAPHRAGM ASSY QG 1273	607784B
607150B	DIAPHRAGM ASSY QG 1313	607786B
607151B	DIAPHRAGM ASSY QG 1393	607792B
607152B	DIAPHRAGM ASSY QG 1473	607794B
607156B	DIAPHRAGM ASSY QG 1513	607800B
607157B	DIAPHRAGM ASSY QG 1553	607801B
607158B	DIAPHRAGM ASSY QG 1633	607804B
607160B	DIAPHRAGM ASSY QG 1729	607806B
607162B	DIAPHRAGM ASSY QG 1763	607808B
607163B	DIAPHRAGM ASSY QG 1873	607811B
607164B	DIAPHRAGM ASSY QG 1953	607813B
607165B	DIAPHRAGM ASSY QG 2033	607815B

NOTE:  
1. QUADGUARD II AND QGM10 REQUIRE SHIM KIT.  
SEE DRAWING 614050.

ASSEMBLY NO. SEE TABLE

ENERGY ABSORPTION SYSTEMS INC  
ENGINEERING AND RESEARCH DEPARTMENT

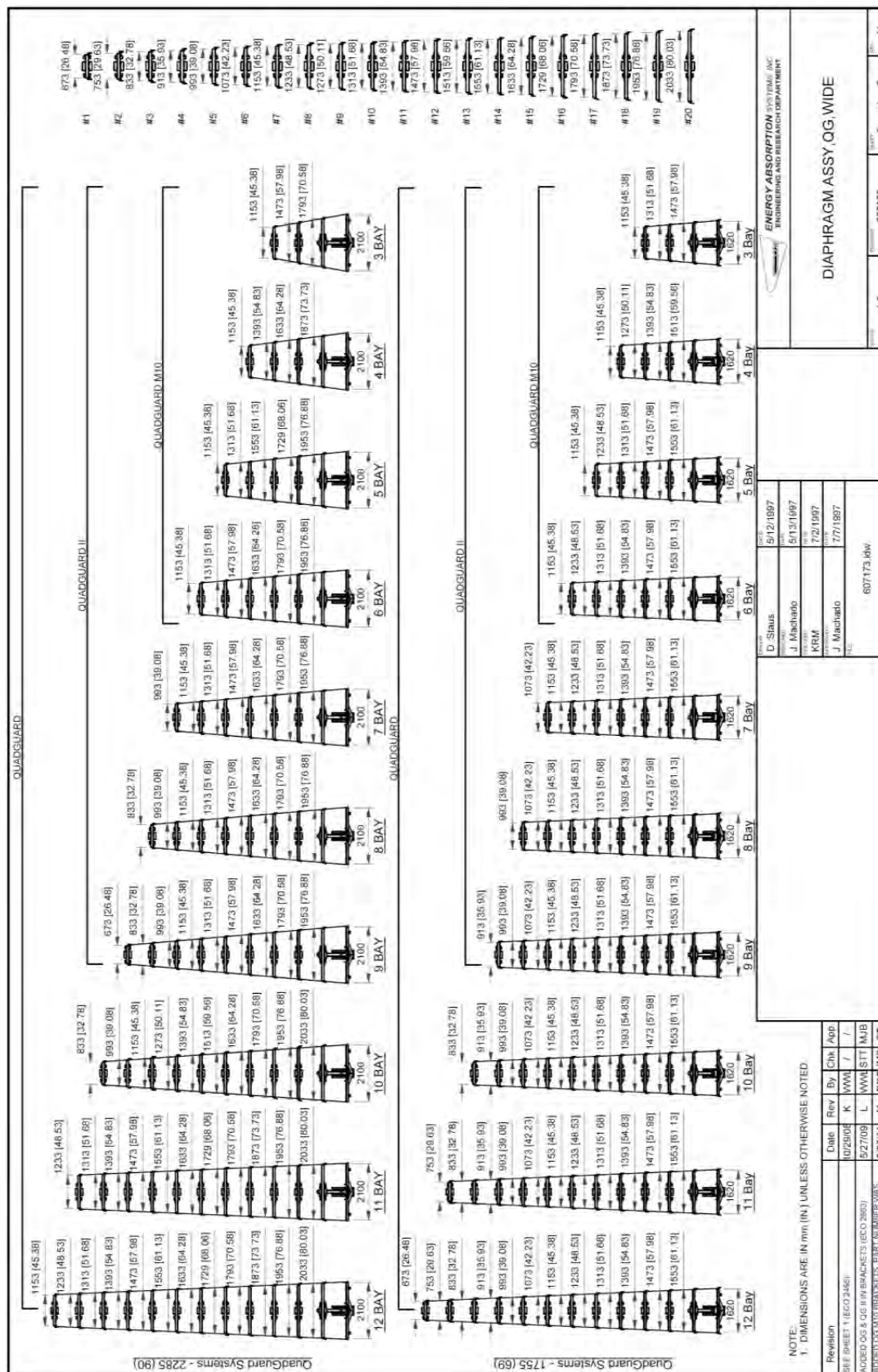
DIAPHRAGM ASSY QG, WIDE

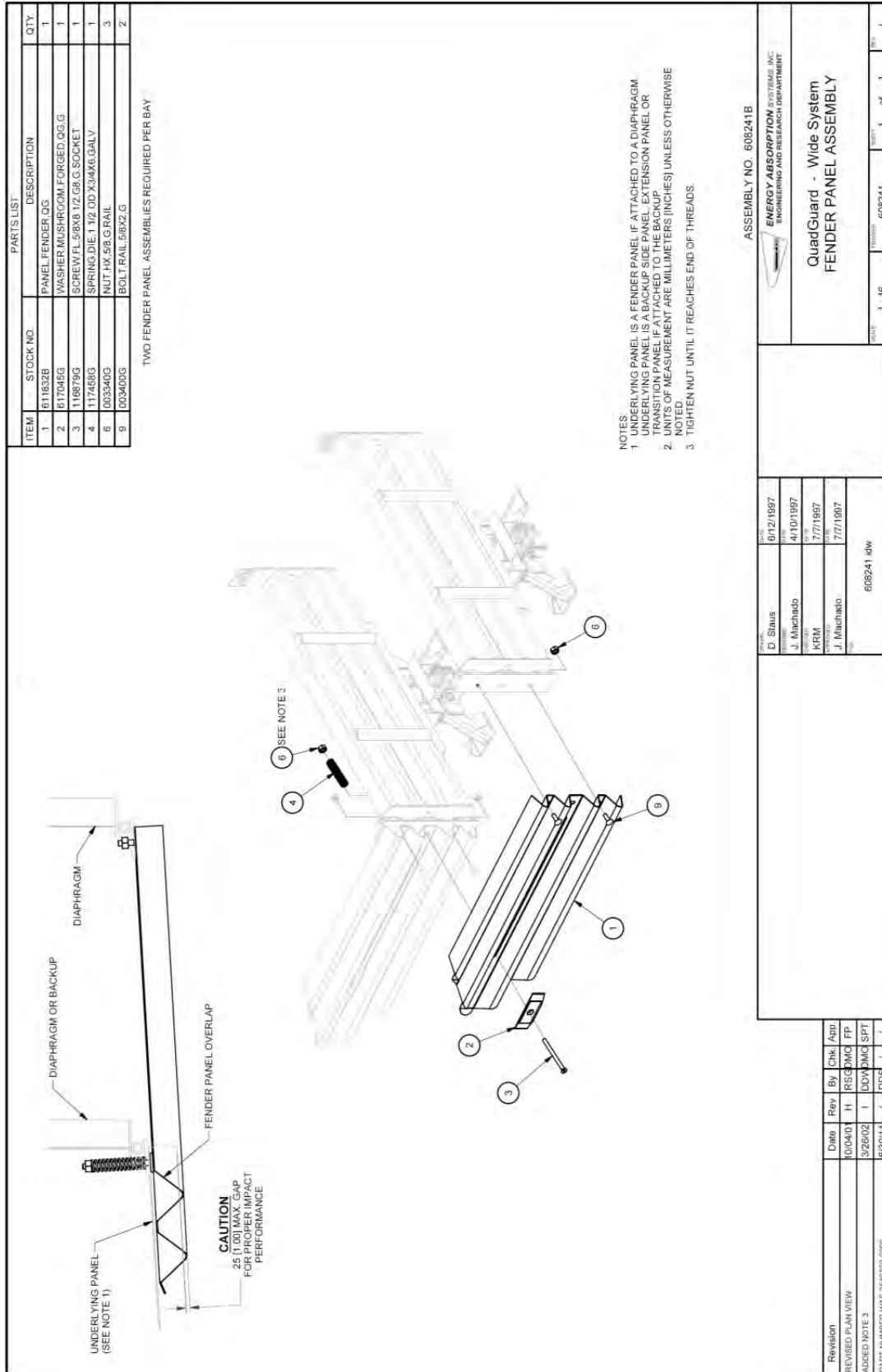
Revision	Date	Rev	By	Chk	App
UPDATED VIEW OF ITEM 6 (ECO 2485)	10/29/08	K	MMW	J	/
QUOTED NOTE & SEE SHEET 2 (ECO 2483)	5/27/08	L	MMW	STT	MMB
3146REVISED NOTE ASSY NO. WAS 390040-	8/10/11	M	JDS	JME	ST

DESIGNED BY D. Slaus	DATE 5/12/1987
DRAWN BY J. Machado	DATE 5/13/1987
CHECKED BY KRM	DATE 7/27/1987
APPROVED BY J. Machado	DATE 7/7/1987
607173 idw	

Diaphragm Assembly, QG, Wide

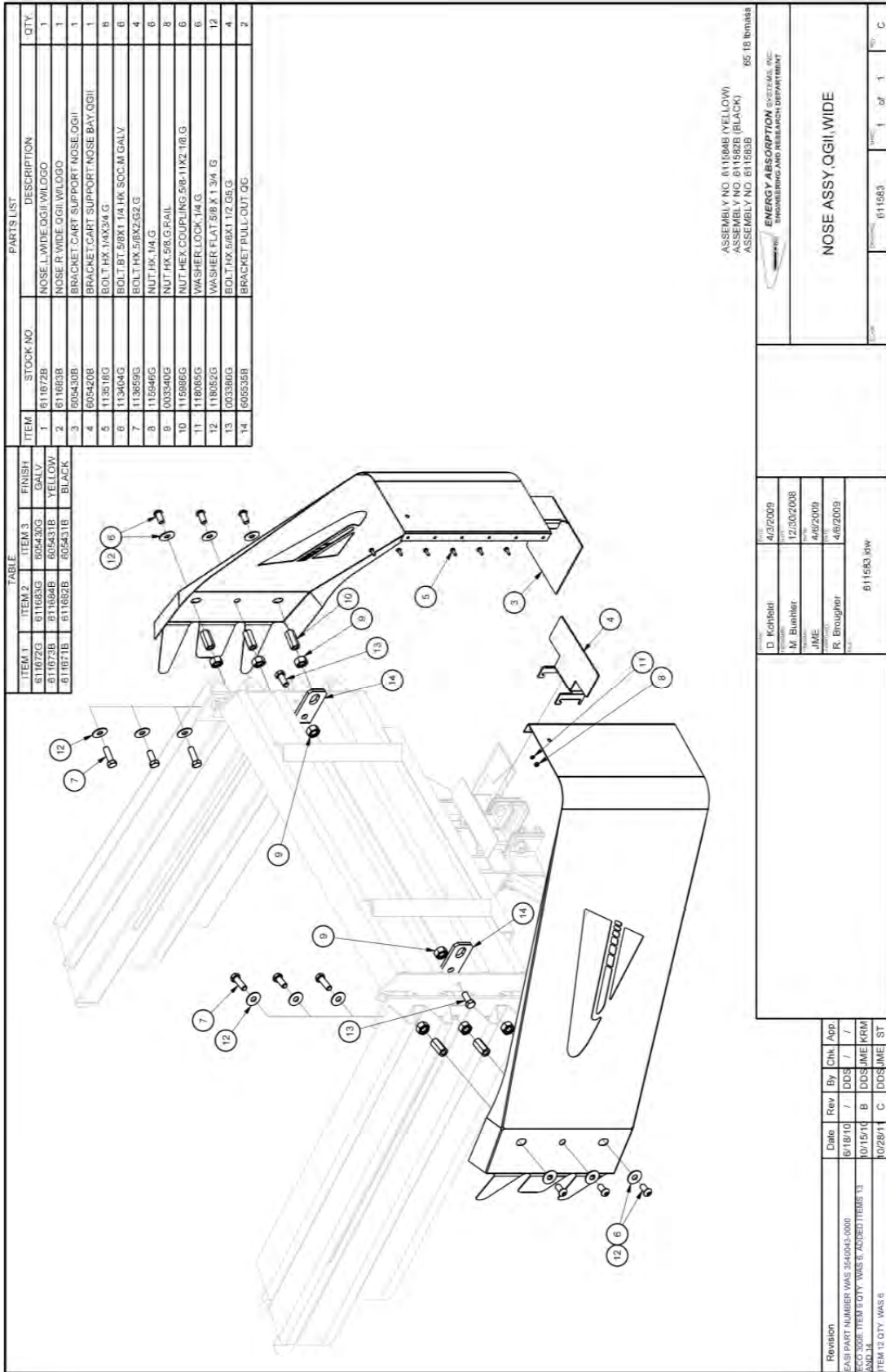
DWG 607173 Sheet 1 of 2





DWG 608241

## QuadGuard® Wide System Fender Panel Assembly



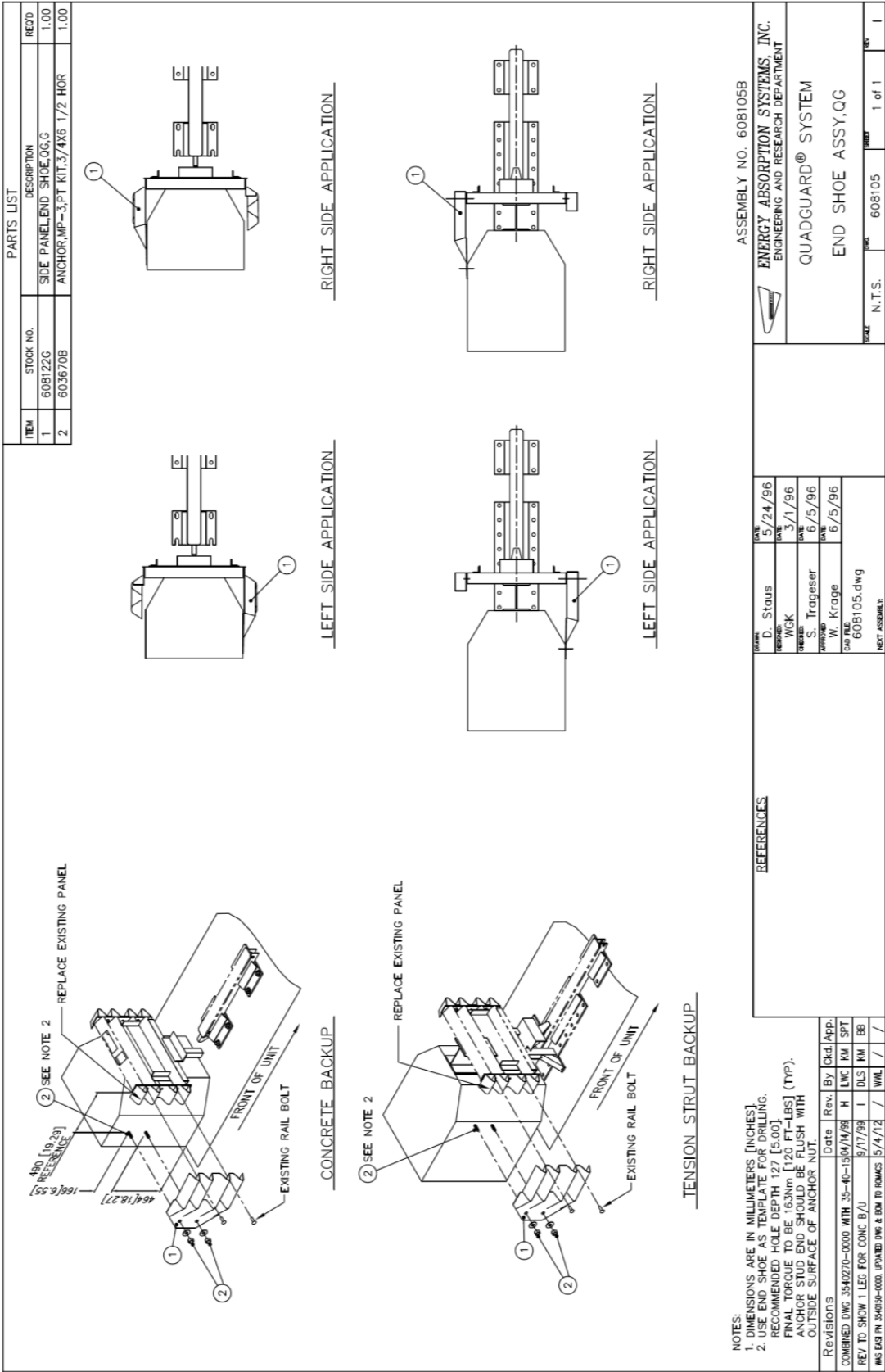
DWG 611583

**Nose Assembly, QGII, Wide**









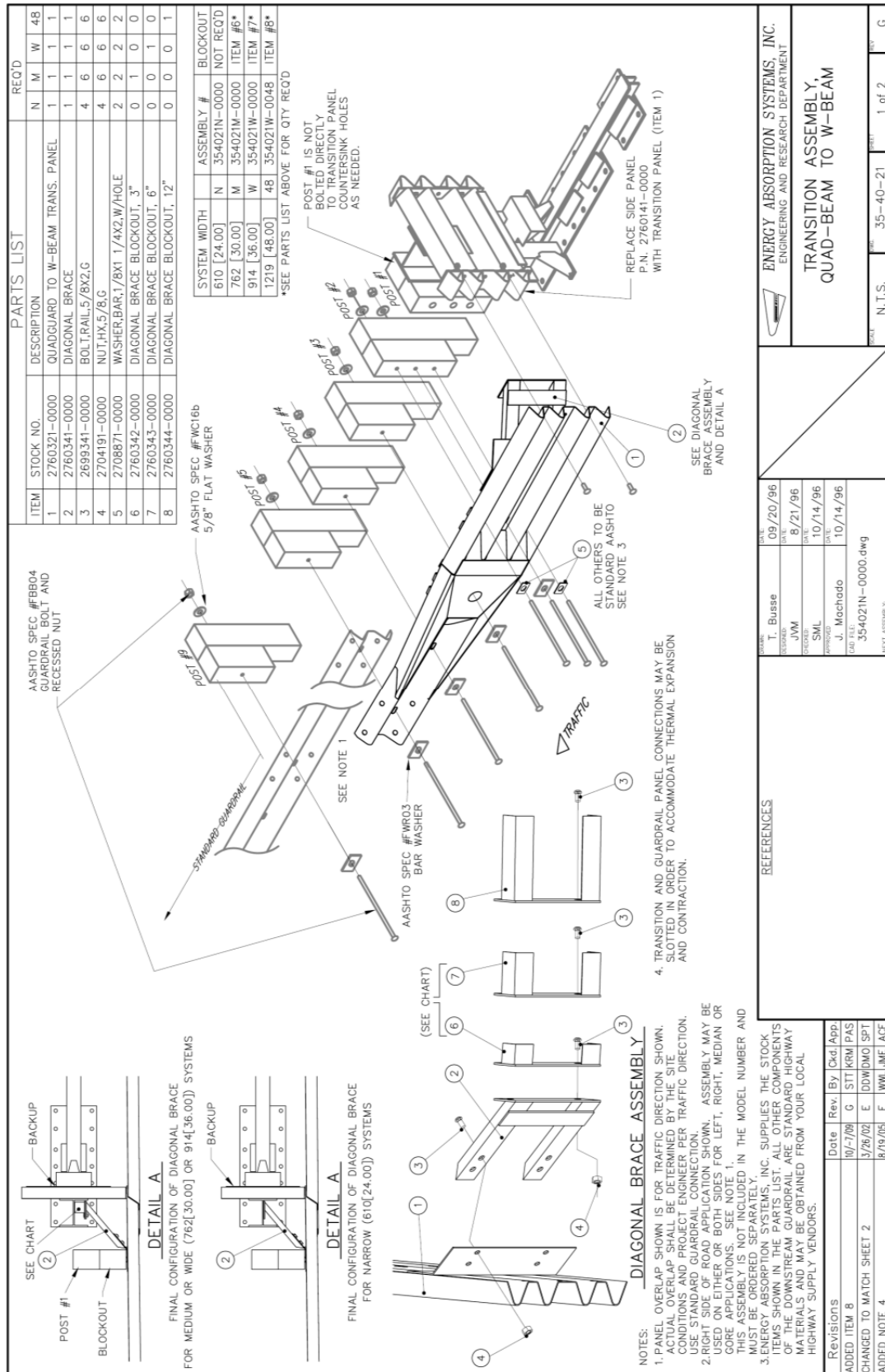
REFERENCES		DATE	BY	CHK	APP
D. Staus	5/24/96				
W. Krage	3/1/96				
S. Trageser	6/5/96				
W. Krage	6/5/96				

ASSEMBLY NO. 608105B		DATE	BY	CHK	APP
ENERGY ABSORPTION SYSTEMS, INC.					
ENGINEERING AND RESEARCH DEPARTMENT					
QUADGUARD® SYSTEM					
END SHOE ASSY, QG					

SCALE	N.T.S.	DATE	BY	CHK	APP
1	608105	1 of 1			

# QuadGuard® End Shoe Assembly





## QuadGuard® Quad-Beam to W-Beam Transition Assembly

DWG 354021N-0000



## Notes

## Notes

## Notes



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