December 10, 2003

Refer to: HSA-10/CC42-A

Barry D. Stephens, P.E.
Senior Vice President of Engineering
Energy Absorption Systems, Incorporated
3617 Cincinnati Avenue
Rocklin, California 95765

Dear Mr. Stephens:

In his July 16, 1997, letter to Mr. J. M. Essex, Mr. Dwight A. Horne accepted a 6-bay QuadGuard designed to shield an obstacle up to 2286-mm wide (QuadGuard-Wide) for use on the National Highway System (NHS). With an effective attenuator length of 6.7 m, this design resulted in a maximum side panel flare of 6 degrees.

Your November 15, 2003, letter to Mr. Richard Powers of my staff requested acceptance of a 6-bay QuadGuard-Wide attenuator with a side panel flare of 10 degrees designed to shield an obstacle 3.0-m wide (as shown in Enclosure 1). To support this request, you ran two tests to verify the crash performance of the wider design. Members of my staff had previously agreed that this minimum test matrix comprised the most critical tests for the wider QuadGuard and that the remaining tests could be waived. The summary results of the two successful tests (NCHRP Report 350 tests 3-32 and 3-38) are shown in Enclosures 2 and 3. To meet the Report 350 occupant risk parameters for test 3-32, a lightweight front diaphragm was designed and used in that test. This design is shown as Enclosure 4.

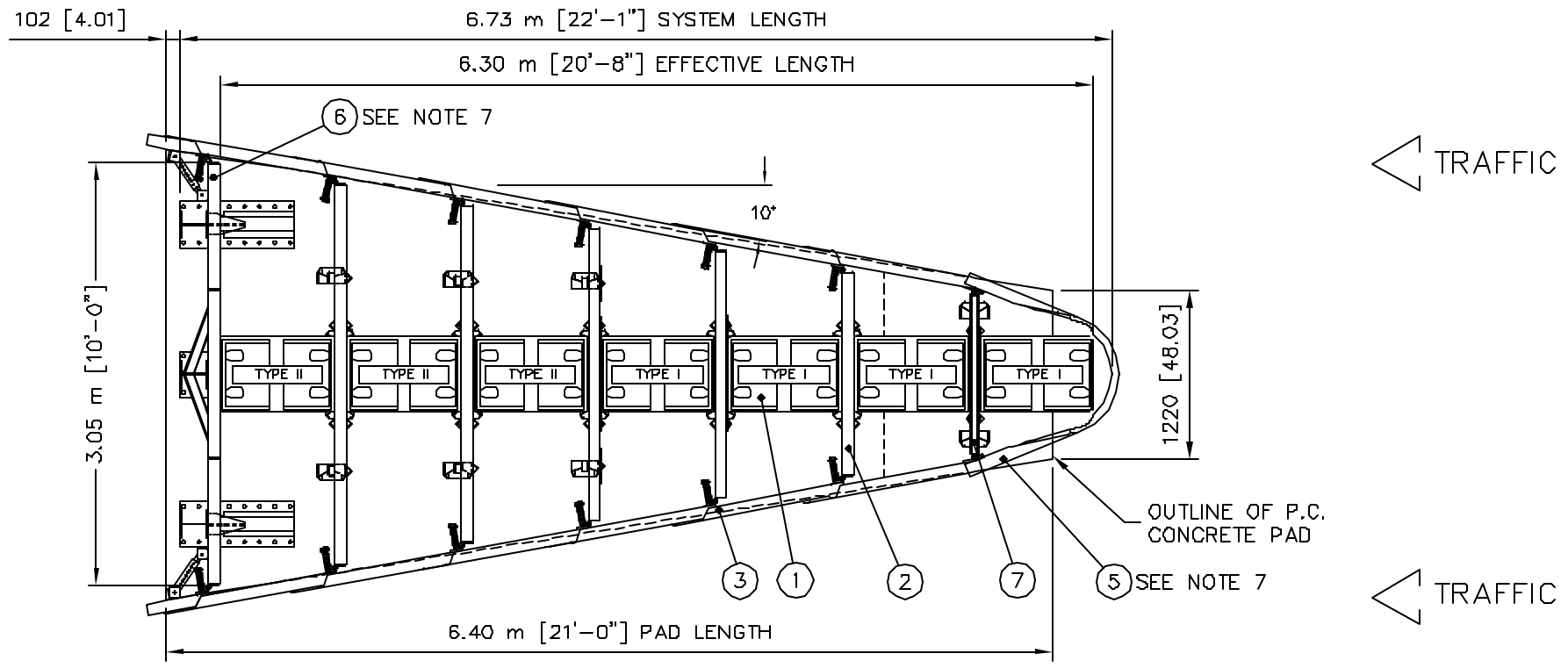
Based on staff review of the tests you conducted, I agree that 6-bay (or longer) QuadGuard units with a side panel flare not to exceed 10 degrees may be used on the NHS as test level 3 attenuators when the lightweight front diaphragm is used. For obstacles wider than 3.0 m, the 10-degree angle may be extended by adding increasingly wider diaphragms to the attenuator or, preferably, by continuing the same flare with a crashworthy transition connecting the back corners of the QuadGuard to the shielded obstacle.

Sincerely yours,

/***Original signed by***/

John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

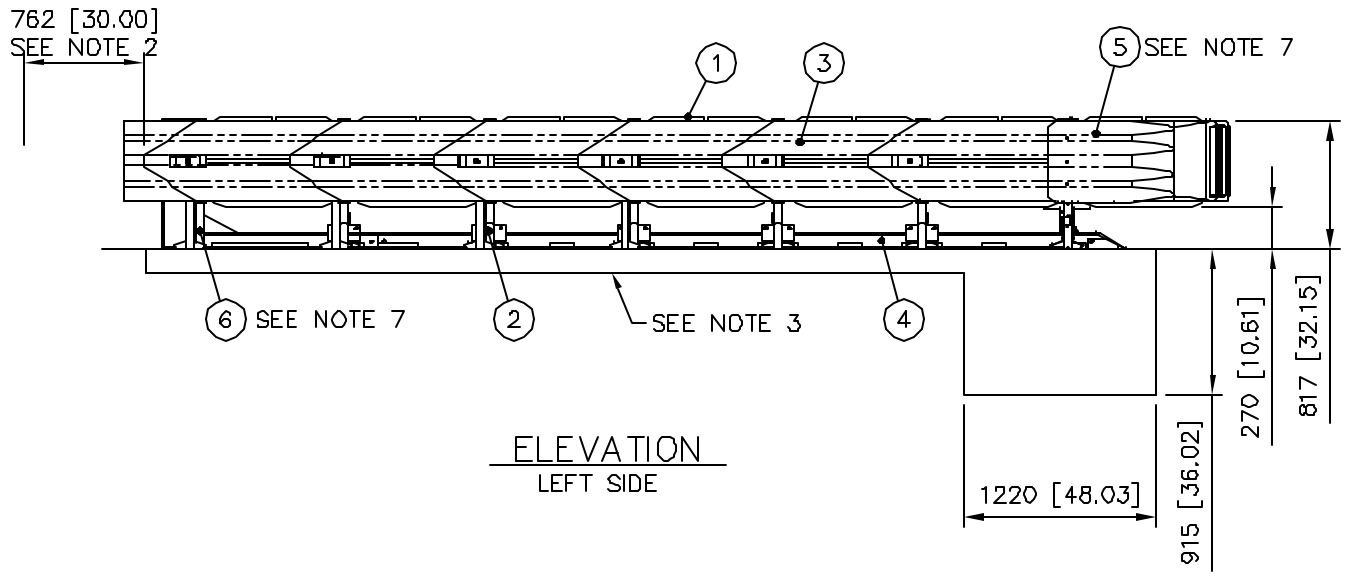
4 Enclosures



PLAN

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. 152 [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.
4. SEE THE "QUADGUARD SYSTEM DESIGN 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 (312) 467-6750.
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. 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.



ELEVATION
LEFT SIDE

UNIDIRECTIONAL
MODEL NO. QN12606

KEY

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

Revisions	Date	Rev.	By	Ckd.	App.

REFERENCES

SERIAL# _____
SALES ORDER# _____
EH PROJECT# _____
DESIGN SPEED 100 km/h [62 mph]
NOSE COLOR _____
NUMBER OF UNITS _____

DIAPHRAGM ASSY.	60-22-32 Sh02
NOSE ASSY.	3540131-0000
FENDER PANEL ASSY.	3540370-0000
BACKUP ASSY.	60-22-32 Sh03
RAIL ASSY.	60-22-32 Sh04
CONCRETE PAD	60-22-32 Sh05
EXTRAWIDE DIAPHRAGM	6010432-1153

DRAWN: D. Kohfeld	DATE: 11/4/03		
DESIGNED:	DATE:		
CHECKED:	DATE:		
APPROVED	DATE:		
CAD FILE: 602232.dwg			

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® SYSTEM
W/120" TENSION STRUT BACKUP

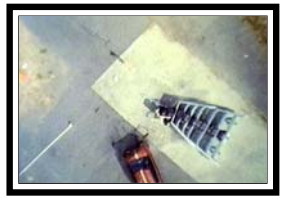
SCALE	DWG.	SHEET	REV
1=50	60-22-32	1 of 5	

t = 0.000 sec

t = 0.144 sec

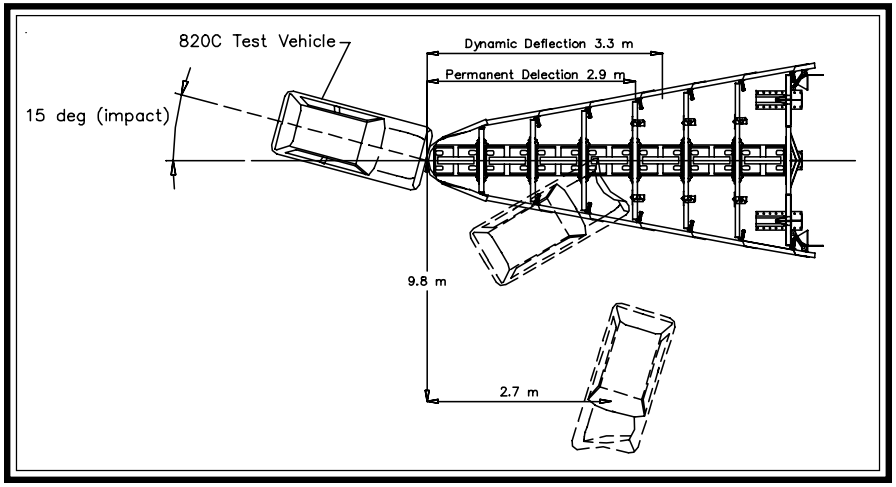
t = 0.144 sec

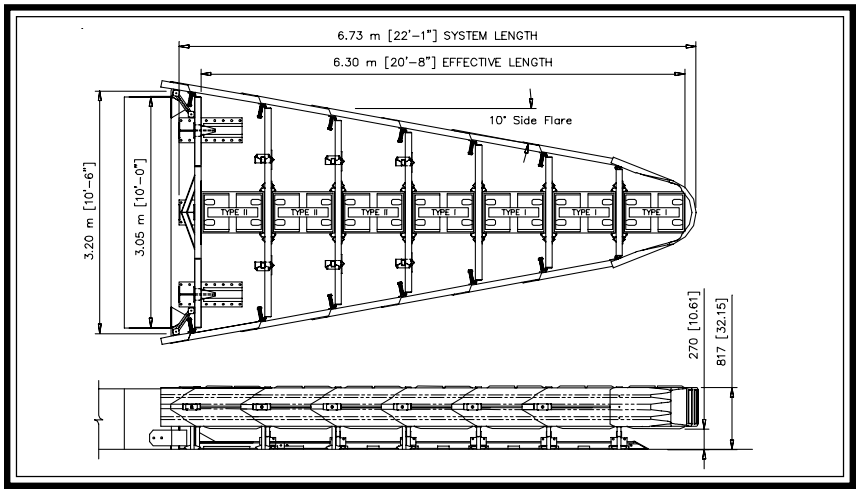
t = 0.288 sec



t = 0.432 sec

t = Final sec





General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-32
Test No.	01-6127-010
Date	10/22/03

Test Article

Type	Energy Absorption Systems, Inc.
	QuadGuard QN12606
Installation Length	6 bay 6.73 m (system length)
Size and/or dimension and material of key elements	Backup width 3.05 m (10 deg side flare angle)
Foundation and Anchoring	Dry portland cement concrete, MP-3 Anchoring System

Test Vehicle

Type	Production Model
Designation	820C
Model	1988 Ford Festiva
Mass (kg)	
Curb	786
Test inertial	805
Dummy	75
Gross Static	880

Impact Conditions

Speed (km/h)	99.7
Angle (deg)	15
Impact Severity (kJ)	308.5

Exit conditions

Speed (km/h)	N/A
Angle (deg)	N/A

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	11.9
y-direction	-0.5
Ridedown Acceleration (g's)	
x-direction	-12.4
y-direction	2.9

European Committee for Normalization (CEN) Values

THIV (km/h)	43.9
PHD (g's)	12.5
ASI	1.2

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	-24.6
Maximum Pitch Angle	-13.0
Maximum Yaw Angle	-267.9

Test Article Deflections (m)

Dynamic	3.3
Permanent	2.9

Vehicle Damage (Primary Impact)

Exterior	
VDS	FC-5
CDC	11FCEW3
Interior	
VCDI	AS0000000
Maximum Deformation (mm)	Negligible

Figure 1. Summary of Results - QuadGuard QN12606 Test 01-6127-010

Prepared by: John F. LaTurner, P.E. - Manager. Report 224 - Issued 11/03

E-TECH Testing Services, Inc.
3617 B Cincinnati Avenue
Rocklin, CA 95765
PHONE (916) 645-8188
FAX (916) 645-3653

t = 0.048 sec

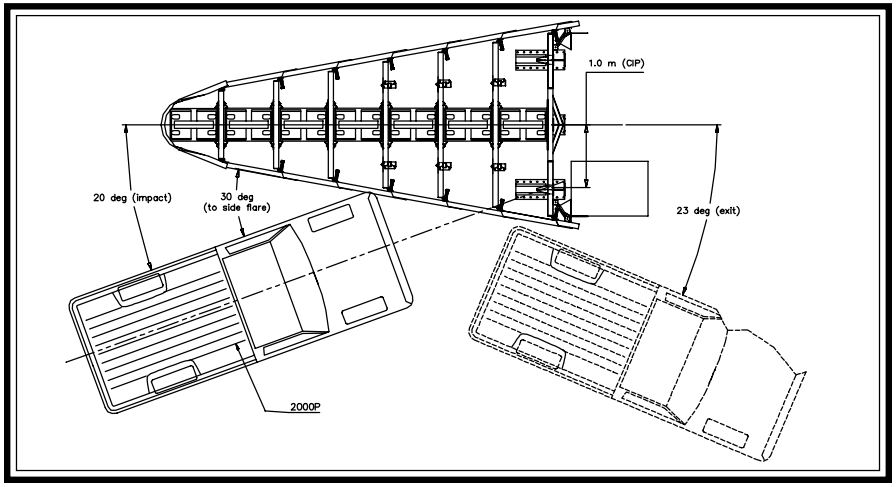
t = 0.096 sec

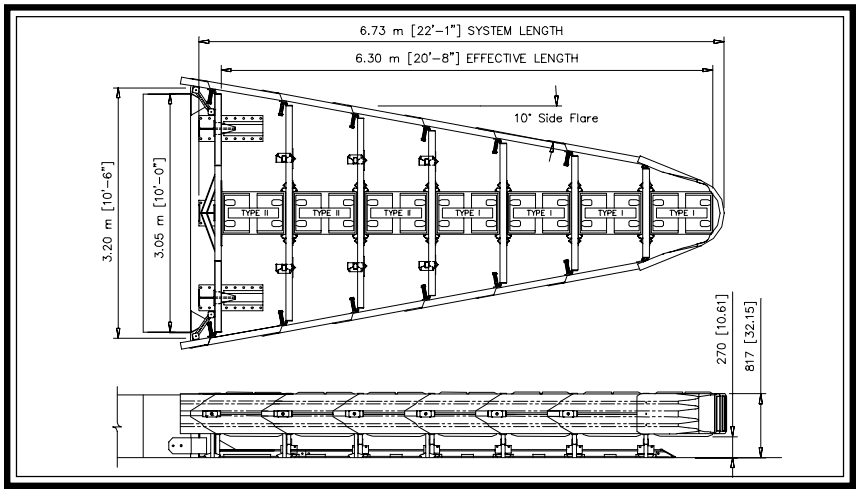
t = 0.144 sec

t = 0.192 sec

t = 0.240 sec

t = 0.288





General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-38
Test No.	01-6127-009
Date	3/27/03

Test Article

Type	Energy Absorption Systems, Inc.
	QuadGuard Mdl. QN12606
Installation Length	6 bay 6.73 m (system length)
Size and/or dimension and material of key elements	Backup width 3.05 m (10 deg side flare angle) with transition to anchored concrete block
Foundation and Anchoring	Dry portland cement concrete, MP-3 Anchoring System

Test Vehicle

Type	Production Model
Designation	2000P
Model	1994 Chevrolet C-2500
Mass (kg)	
Curb	1871
Test inertial	1988
Dummy	N/A
Gross Static	1988

Impact Conditions

Speed (km/h)	101.1
Angle (deg)	20
Impact Severity (kJ)	91.6

Exit conditions

Speed (km/h)	61.2
Angle (deg)	23

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	7.1
y-direction	8.7
Ridedown Acceleration (g's)	
x-direction	-8.4
y-direction	13.3

European Committee for Normalization (CEN) Values

THIV (km/h)	39.5
PHD (g's)	16.1
ASI	2.0

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	-17.9
Maximum Pitch Angle	-16.4
Maximum Yaw Angle	66.4

Test Article Deflections (m)

Dynamic	Negligible
Permanent	Negligible

Vehicle Damage (Primary Impact)

Exterior	
VDS	LFQ-5
CDC	11LDEW3
Interior	
VCDI	LF1000000
Maximum Deformation (mm)	57

Figure 1. Summary of Results - QuadGuard QN12606 Test 01-6127-009

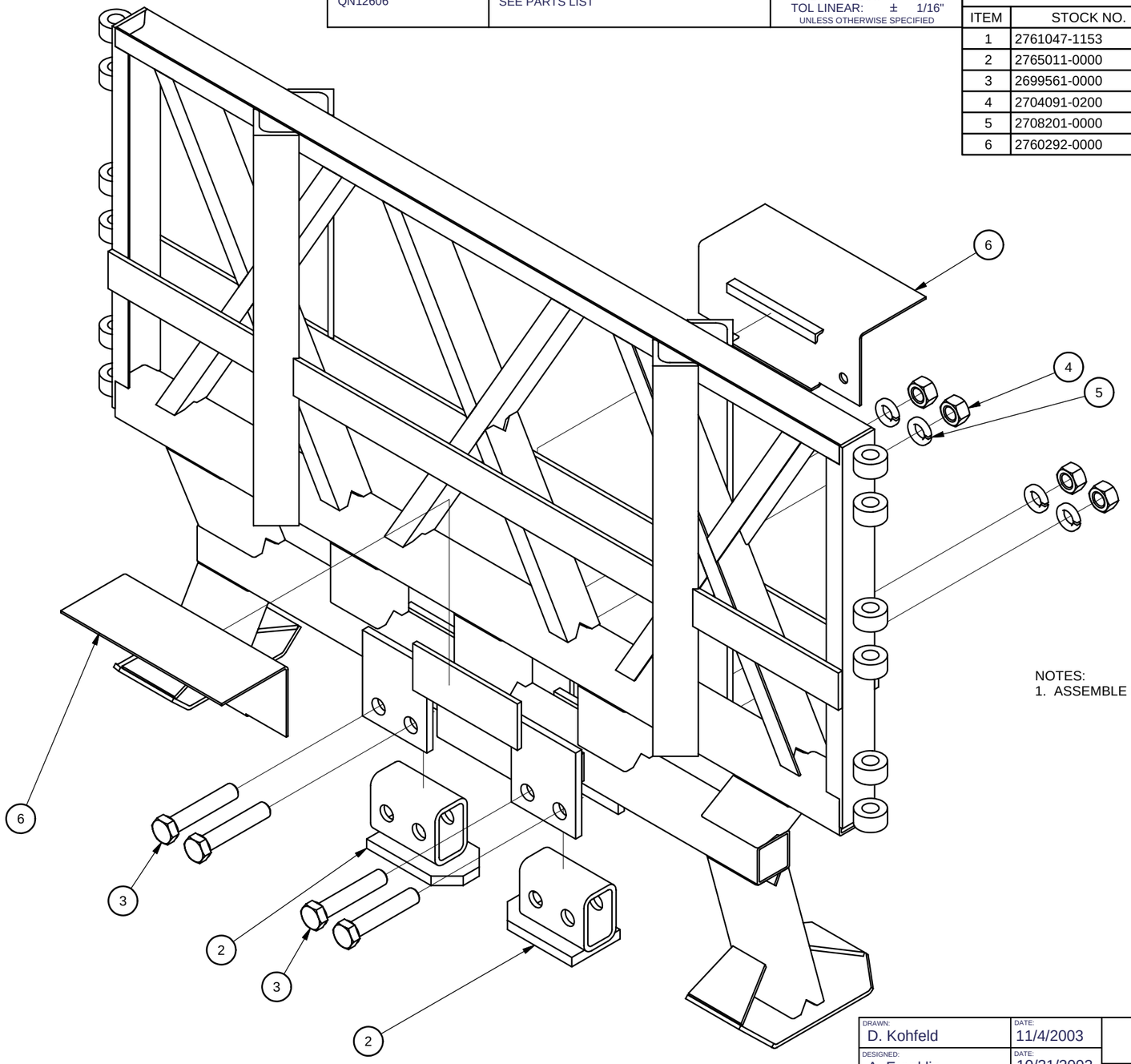
Prepared by: John F. LaTurner, P.E. - Manager. Report 206 - Issued 4/03

E-TECH Testing Services, Inc.
3617 B Cincinnatti Avenue
Rocklin, CA 95765
PHONE (916) 645-8188
FAX (916) 645-3653

NEXT ASSEMBLY:	MATERIAL:	TOL ANGULAR: ± 1˚
QN12606	SEE PARTS LIST	TOL LINEAR: ± 1/16"
		UNLESS OTHERWISE SPECIFIED

PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	2761047-1153	DIAPHRAGM,QG,EXTRAWIDE,1153,G	1
2	2765011-0000	RAIL GUIDE,REACT,G	2
3	2699561-0000	BOLT,HX,3/4X4,G5,G	4
4	2704091-0200	NUT,HX,3/4,G	4
5	2708201-0000	WASHER,LOCK,3/4,G	4
6	2760292-0000	BRACKET,CARTRIDGE SUPT,DIA,QG,G	2



NOTES:
1. ASSEMBLE ITEMS 2 WITH FASTENERS AS SHOWN.

ASSEMBLY NO. 6010432-1153

DRAWN: D. Kohfeld	DATE: 11/4/2003	ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
DESIGNED: A. Franklin	DATE: 10/31/2003	
CHECKED: A. Franklin	DATE: 11/10/2003	DIAPHRAGM ASSY,QG,EX-WIDE,1153
APPROVED: SPT	DATE: 11/10/2003	
Q.C. STT	DATE: 11/11/2003	

FILE:	SCALE:	DRAWING:	SHEET:	REV
6010432-1153	3/16=1	6010432-1153	1 of 1	