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

1200 New Jersey Ave., SE
Washington, D.C. 20590

April 21, 2016

In Reply Refer To:
HSST-1 WZ-281B

Mr. Troy Tapley
MDI Worldwide
38271 W. Twelve Mile Road
Farmington Hills, Michigan 48331

Dear Mr. Tapley:

This letter is in response to your May 5, 2015 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number WZ-281B and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following devices are eligible, with details provided in the form which is attached as an integral part of this letter:

- 30TRI tripod sign stand

Scope of this Letter

To be found eligible for Federal-aid funding, modified roadside safety devices should meet the crash test and evaluation criteria contained in the National Cooperative Highway Research Program (NCHRP) Report 350. However, the FHWA, the Department of Transportation, and the United States Government do not regulate the manufacture of roadside safety devices. Eligibility for reimbursement under the Federal-aid highway program does not establish approval, certification or endorsement of the device for any particular purpose or use.

This letter is not a determination by the FHWA, the Department of Transportation, or the United States Government that a vehicle crash involving the device will result in any particular outcome, nor is it a guarantee of the in-service performance of this device. Proper manufacturing, installation, and maintenance are required in order for this device to function as tested.

This finding of eligibility is limited to the crashworthiness of the system and does not cover other structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

Eligibility for Reimbursement

FHWA previously issued an eligibility letter for the roadside safety system described in your pending request. Your pending request now identifies a modification to that roadside safety system.

The original roadside safety device information is provided here:

Name of system: 30TRI tripod sign stand
Type of system: Work Zone Traffic Control Device
Date of original request: April 30, 2009
Date of original FHWA eligibility letter: July 1, 2009
FHWA Control number: WZ-281

The pending modification(s) consists of the following changes:

1. The 30TRI legs are constructed of round steel tubing 1.00 in x .065 in [25mm x 1.5mm] in diameter instead of square steel tubing 1.25 in x 1.25 in x 0.065 in [30 mm x 30 mm x 1.6 mm].

2. The 30TRI overall mass is 12 lbs. [5.4 kg] compared to a mass of 16 lbs. [7.3 kg].

3. Use with the following comparable 48" x 48" (16 – sq. ft) and smaller sign substrates:

    a. 0.375" [9.5mm] and 0.500" [12.7mm] thick plywood signs

    b. 0.080" [2mm], 0.100" [2.5mm], and 0.125" [3mm] thick solid aluminum

    c. 0.080" [2mm] and 0.125" [3mm] aluminum laminates such as: Alpolic, Dibond, Reynolite or similar substrates

    d. 0.400" [10mm] to 0.625" [16mm] corrugated plastics

FHWA concurs with the recommendation of the accredited crash testing laboratory as stated within the attached form.

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

If a manufacturer makes any modification to any of their roadside safety hardware that has an existing eligibility letter from FHWA, the manufacturer must notify FHWA of such modification with a request for continued eligibility for reimbursement. The notice of all modifications to a device must be accompanied by:

- Significant modifications – For these modifications, crash test results must be submitted with accompanying documentation and videos.
- Non-signification modifications – For these modifications, a statement from the crash test laboratory on the potential effect of the modification on the ability of the device to meet the relevant crash test criteria.

FHWA's determination of continued eligibility for the modified hardware will be based on whether the modified hardware will continue to meet the relevant crash test criteria.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of the NCHRP Report 350.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number WZ-281B shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed upon request.

- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.

- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely yours,

Michael S. Griffith

Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	May 20, 2015	○ New ◉ Resubmission
	Name:	Troy Tapley	
	Company:	MDI Worldwide	
	Address:	38271 W. Twelve Mile Road, Farmington Hills, Michigan 48331	
	Country:	United States	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'WZ': Crash Worthy Work Zone Traffic Control Devices	○ Physical Crash Testing ◉ Engineering Analysis	30TRI	NCHRP Report 350	TL3

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the NCHRP Report 350 (Report 350) and that the evaluation results meet the appropriate evaluation criteria in the Report 350.

Identification of the individual or organization responsible for the product:

Contact Name:	Troy Tapley	Same as Submitter ☒
Company Name:	MDI Worldwide	Same as Submitter ☒
Address:	38271 W. Twelve Mile Road, Farmington Hills, Michigan 48331	Same as Submitter ☒
Country:	United States	Same as Submitter ☒
Enter below all disclosures of financial interests as required by the FHWA 'Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.		
Texas Transportation Institute (TTI) Proving Ground was compensated for the cost to perform the evaluation. Contract No. 1503763. No consulting relationships, research funding or other forms of research support, patents, copyrights, other intellectual property interests, licenses, contractual relationships, business ownership or investment interests are retained for the TTI Proving Ground.		

PRODUCT DESCRIPTION

○ New Hardware or Significant Modification	◉ Modification to Existing Hardware	Non-Significant

Product Description of 30TRI
(Reference drawing ERS00801)
The 30TRI is a light weight tripod sign stand used in displaying signs up to 48 inch diamond shape or up to 16 sq. ft. [1.5 sq. meters].
Further description:
The 30TRI sign stand is a portable tripod sign stand capable of displaying signs. The sign stand is constructed of three steel legs that pivot at an attachment bracket located at the top of said sign stand. The three legs are constructed of round steel tubing 1.00 in x .065 in [25.4mm x 1.6mm] in diameter. Rigid signs are held by two Z-shape brackets at the middle of said sign stand. The overall height of the sign stand is 76 in [1930 mm]. The bottom of the sign is 12 in [305 mm] above grade. The total weight of the sign stand is 40 lbs [18.1 kg] which includes the stand of 12 lbs. [5.4 kg] and a 48" x 48" plywood sign of 28.0 lbs [12.7 kg]

Modifications being requested:

The 30TRI is a modification of the 50TRI. The 50TRI was deemed eligible for federal funding in WZ-281 (with 1.25" square tubing and the use of a 1/2" plywood sign). The primary differences between designs are as follows:

a. The 30TRI legs are constructed of round steel tubing 1.00 in x .065 in [25mm x 1.5mm] in diameter. The 50TRI legs are constructed of square steel tubing 1.25 in x 1.25 in x 0.065 in [30 mm x 30 mm x 1.6 mm].
b. The 30TRI overall mass is less. The 30TRI overall mass is 12 lbs. [5.4 kg]. The 50TRI mass is 16 lbs. [7.3 kg].
c. In addition, we request the following substrates to be acceptable for use with the 30TRI.

- Comparable 48" x 48" (16 – sq. ft) and smaller signs
- .375" [9.5mm] and .500" [12.7mm] thick plywood signs
- 0.080" [2mm], 0.100" [2.5mm], and 0.125" [3mm] thick solid aluminum
- 0.080" [2mm] and 0.125" [3mm] aluminum laminates such as: Alpolic, Dibond, Reynolite or similar substrates
- 0.400" [10mm] to 0.625" [16mm] corrugated plastics

CRASH TESTING

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-70 (820C)	NCHRP-350 states this test is intended to evaluate the breakaway, fracture, or yielding mechanisms. Therefore, this test is not needed for this device.	Non-Critical, not conducted
S3-70 (700C)	Testing is optional and not needed for these devices.	Non-Critical, not conducted

Required Test Number	Narrative Description	Evaluation Results
3-71 (820C)	Modification Comparables: a. A NCHRP-350 3-71 test of a Generic Tripod Sign Support was tested as part of the NCHRP-553 project. b. Eligibility letter WZ-281 found the 50TRI design comparable to the tested design with the use of 1/2" thick plywood sign. c. NCHRP-553 report also stated "Because its greater weight tends to make a plywood sign panel more critical from a crashworthiness standpoint, the sign supports successfully tested with plywood substrate are also considered to be acceptable when used with a comparably sized aluminum sign substrate or other lightweight substrate materials (e.g. corrugated plastic)." d. The 30TRI is a lighter weight Tripod Sign Support. TTI Engineering Analysis, Project No. 690900-MDI MISC1 compared the difference in masses and determined the placement of a 15lb ballast on a hook located 38" up along the rear leg would produce comparable center of mass and moments of inertia properties. e. TTI concluded with the comparable properties, the 30TRI should perform in the same rotational manner with lighter weight substrates and require no further testing.	Non-Critical, not conducted
S3-71 (700C)	Testing is optional and not needed for these devices.	Non-Critical, not conducted

Full Scale Crash Testing was done in compliance with NCHRP Report 350 by the following accredited crash test Laboratory. By signature below, the Laboratory agrees in support of this submission that all critical and relevant crash tests for the device listed above were conducted. (cite the laboratory's accreditation status as noted in the crash test reports.):

Testing Laboratory's signature concurs that these modifications are considered Non-Significant.		
Laboratory Name:	Texas Transportation Institute	
Laboratory Signature:	Dean C. Alberson — Digitally signed by Dean C. Alberson DN: cn=Dean C. Alberson, o=Texas A&M Transportation Institute, ou=Roadway Safety and Physical Security Division, email=d-alberson@tti.tamu.edu, c=US Date: 2016.03.22 15:14:34 -05'00'	
Address:	3135 TAMU, College Station, TX 77843-3135	Same as Submitter ☐
Country:	USA	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	A2LA # 2821.01 Valid until 04/30/2017	

Submitter Signature*: Digitally signed by Troy Tapley Date: 2016.03.08 10:16:51 -05'00'

Submit Form

ATTACHMENTS

Attach to this form:

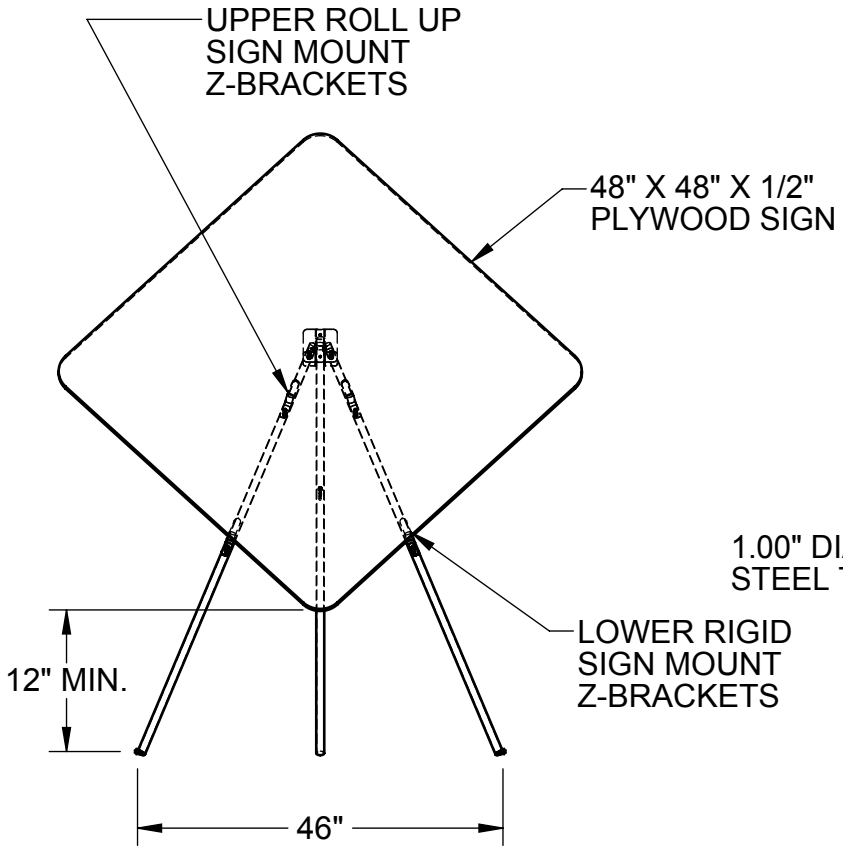
1) Additional disclosures of related financial interest as indicated above.
2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

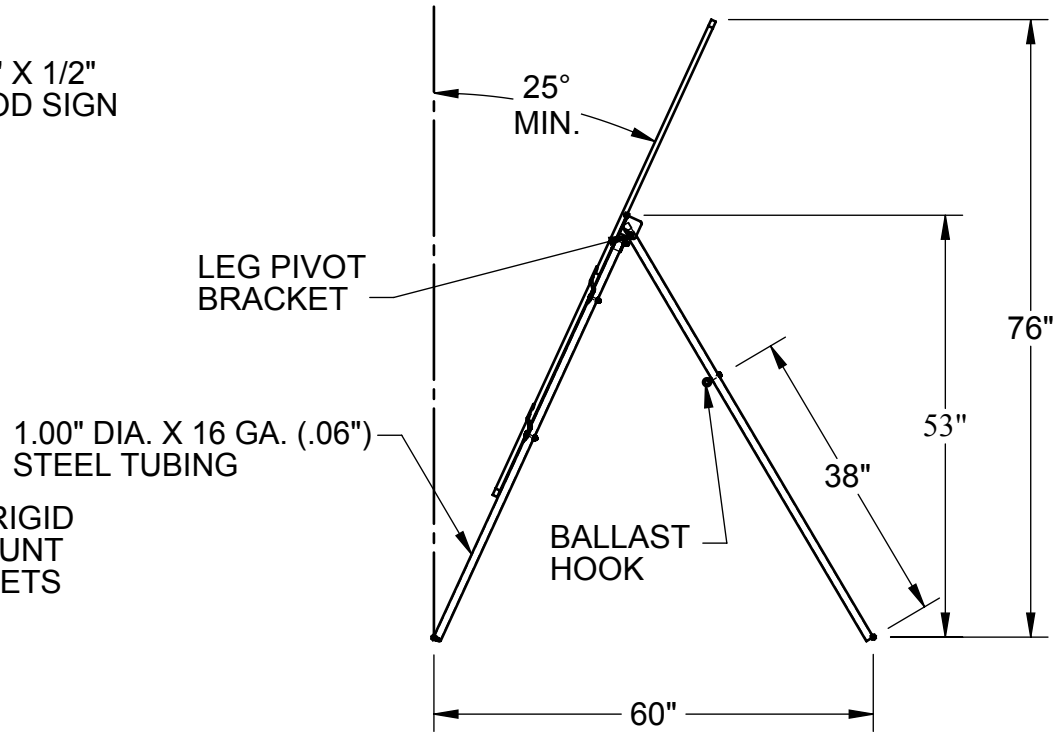
FHWA Official Business Only:

Eligibility Letter		AASHTO TF13	
Number	Date	Designator	Key Words
WZ-281B			Work Zone Sign Support, tripod sign support

MODEL: 30TRI
SCHEMATIC DRAWING
STEEL TRIPOD SIGN STAND

ESR00801





30TRI WEIGHT	
SIGN STAND	12 lbs.
48" SQ. PLYWOOD SIGN	28 lbs
TOTAL:	40 lbs.

MDI Traffic Control Products, 38271 West 12 Mile Road, Farmington Hills, MI 48331-3041 800-521-6776

ESR00801

ESR00801

Texas A&M Transportation Institute
The Texas A&M University System
3135 TAMU
College Station, TX 77843-3135

979-845-6375
Fax: 979-845-6107
http://tti.tamu.edu

March 23, 2016

Mr. Troy Tapley
MDI Worldwide
38271 W. Twelve Mile Road
Farmington Hills, MI 48331

RE: Evaluation and Review of TRIPOD Modifications
(Project No. 690900-MDI MISC1: Contract No. 1503763) Report

Dear Mr. Tapley:

MDI's proposed 30 TRI and 50 TRI were analyzed with and without ballasting. The proposed models were compared to the previously tested tripod detailed in NCHRP report 553. Mass properties, centers of mass, and moments of inertia were calculated for the proposed models. The calculated values were compared to those of the previously tested model in the attached excel spread sheet titled "Tripod Modifications."

The total mass of the tripod and the mass moment of inertia about the x-axis were considered the critical values. The analysis of the model with 15 lb ballasting 38 in up the back leg found the critical values to be within 10% of the previously accepted model for the proposed plywood, aluminum, endurance, and dibond tripod models for both 30 TRI and 50 TRI. Based on the analysis it is expected these models will rotate similarly to the previously tested tripod in the event of an impact.

Texas Transportation Institute (TTI) Proving Ground is an ISO 17025 accredited laboratory with American Association for Laboratory Accreditation (A2LA), testing certificate 2821.01. Other than test results, TTI does not provide certification or endorsement for any product. MDI Worldwide will not use, or permit others to use, the names of the Texas A&M University System (TAMUS), Texas A&M University (TAMU), or the Texas Transportation Institute (TTI) or any abbreviations or trademark in any publicity, or other public presentation which directly or indirectly implies endorsement for any product(s) or service(s).

Please do not hesitate to call me at (979) 458-3874 or email:d-alberson@tamu.edu.

Sincerely,

Dean C. Alberson, Ph.D., P.E.
Senior Research Engineer
Assistant Agency Director

Roadside Safety &
Physical Security Division

		Plywood					Aluminum						
		TTI Design	50 TRI	15 lb bag @ 29"	15 lb bag @ 38"	15 lb bag + 2.5lb bags	TTI Design	50 TRI	15 lb bag @ 29"	15 lb bag @ 38"	15 lb bag + 2.5lb bags	TTI Design	50 TRI
Mass Properties Predicted	Total Mass	--	45.00	60.00	**60.00**	65.00	--	39.10	54.1	**54.1**	59.10	--	28.50
	Mass of Stand	--	16.00	31.00	**31.00**	36.00	--	16.00	31.00	**31.00**	36.00	--	16.00
	Mass of Sign	28.00	28.00	28.00	**28.00**	28.00	22.10	22.10	22.10	**22.10**	22.10	11.50	11.50
	Mass of Flags	--	1.00	1.00	**1.00**	1.00	--	1.00	1.00	**1.00**	1.00	--	1.00
Mass Properties SolidWorks Model	Total Mass	58.95	42.51	57.51	**57.51**	62.51	52.04	35.60	50.59	**48.09**	55.59	42.51	26.07
	Mass of Stand	31.04	13.85	28.85	**28.85**	33.85	31.04	13.85	28.85	**28.85**	33.85	31.04	13.85
	Mass of Sign	27.91	27.91	27.91	**27.91**	27.91	21.00	21.00	21.00	**21.00**	21.00	11.47	11.47
	Mass of Flags	--	0.75	0.75	**0.75**	0.75	--	0.75	0.75	**0.75**	0.75	--	0.75
% Difference Between Model and Drawings	Total Mass	**--**	6%	4%	**4%**	4%	**--**	9%	6%	**11%**	6%	**--**	9%
	Mass of Stand	--	13%	7%	**7%**	6%	--	13%	7%	**7%**	6%	--	13%
	Mass of Sign	0%	0%	0%	**0%**	0%	5%	5%	5%	**5%**	5%	0%	0%
	Mass of Flags	--	25%	25%	**25%**	25%	--	25%	25%	**25%**	25%	--	25%
% Difference Relative to TTI Tripod	Total Mass	**--**	28%	2%	**2%**	6%	**--**	32%	3%	**8%**	7%	**--**	39%
	Mass of Stand	--	55%	7%	**7%**	9%	--	55%	7%	**7%**	9%	--	55%
	Mass of Sign	--	0%	0%	**0%**	0%	--	0%	0%	**0%**	0%	--	0%
Center of Mass Coordinates	x_{cm} [in]	0.050	0.000	0.000	**0.000**	0.000	0.060	0.000	0.000	**0.000**	0.000	0.080	0.000
	y_{cm} [in]	31.380	36.910	30.060	**31.720**	28.940	30.250	35.980	28.460	**30.36**	27.36	27.960	34.070
	z_{cm} [in]	-22.460	-19.590	-22.690	**-21.040**	-20.740	-22.520	-19.790	-23.26	**-21.38**	-21.02	-22.270	-19.880
% Difference Relative to TTI Tripod	x_{cm}	--	0%	0%	**0%**	0%	--	0%	0%	**0%**	0%	--	0%
	y_{cm}	--	18%	4%	**1%**	8%	--	19%	6%	**0%**	10%	--	22%
	z_{cm}	--	13%	1%	**6%**	8%	--	12%	3%	**5%**	7%	--	11%
Principal Axes of Inertia and Principal Moments of Inertia	Ix	(-0.01, 0.91, -0.42)	(0.00, 0.95, -0.31)	(0.00, 1.00, 0.05)	**(0.00, 0.99, -0.12)**	(0.00, 0.98, -0.20)	(-0.00, 0.90, -0.44)	(0.00, 0.96, -0.29)	(0.00, 1.00, 0.07)	**(0.00, 0.99, -0.11)**	(0.00, 0.98, -0.20)	(0.01, 0.87, -0.49)	(0.00, 0.96, -0.27)
	Iy	(-1.00, 0.00, 0.01)	(-1.00, 0.00, 0.00)	(-1.00, 0.00, 0.00)	**(-1.00, 0.00, 0.00)**	(-1.00, 0.00, 0.00)	(-1.00, 0.00, 0.01)	(-1.00, 0.00, 0.00)	(-1.00, 0.00, 0.00)	**(-1.00, 0.00, 0.00)**	(-1.00, 0.00, 0.00)	(-1.00, 0.01, 0.00)	(-1.00, 0.00, 0.00)
	Iz	(0.00, 0.42, 0.91)	(0.00, 0.31, 0.95)	(0.00, -0.05, 1.00)	**(0.00, 0.12, 0.99)**	(0.00, 0.20, 0.98)	(0.00, 0.44, 0.90)	(0.00, 0.29, 0.96)	(0.00, -0.07, 1.00)	**(0.00, 0.11, 0.99)**	(0.00, 0.20, 0.98)	(0.01, 0.49, 0.87)	(0.00, 0.27, 0.96)
	Px [lb*in^2]	16453.94	9439.02	12036.51	**10663.94**	15287.34	15002.41	8042.50	10301.71	**9095.05**	13712.92	13024.41	6134.46
	Py [lb*in^2]	18827.22	14550.48	24064.99	**19568.28**	26798.33	16948.27	13036.96	21548.37	**17421.64**	24180.54	13904.34	10862.65
	Pz [lb*in^2]	24986.05	18782.99	26060.02	**22935.88**	30441.43	21920.88	16027.76	22639.97	**19719.9**	26759.83	17217.38	12124.83
% Difference Relative to TTI Tripod	Px	--	43%	27%	**35%**	7%	--	46%	31%	**39%**	9%	--	53%
	Py	--	23%	28%	**4%**	42%	--	23%	27%	**3%**	43%	--	22%
	Pz	--	25%	4%	**8%**	22%	--	27%	3%	**10%**	22%	--	30%
% Difference of Principal Moments of Inertia about x-axis		**--**	**23%**	**28%**	**4%**	**42%**	**--**	**23%**	**27%**	**3%**	**43%**	**--**	**22%**
Moments of Inertia taken at center of mass and aligned with output coordinate system	Lxx [lb*in^2]	18827.26	14550.48	24064.99	**19568.28**	26798.33	16948.36	13036.96	21548.37	**17421.64**	24180.54	13904.37	10862.65
	Lyy [lb*in^2]	17962.12	10316.35	12075.44	**10850.42**	15865.13	16318.87	8732.57	10364.89	**9226.46**	14252.54	14034.14	6559.12
	Lzz [lb*in^2]	23477.81	17905.66	26021.09	**22749.40**	29863.65	20604.33	15337.69	22576.79	**19588.48**	26220.21	16207.62	11700.17
	Lxy [lb*in^2]	-21.74	0.00	0.00	**0.00**	0.00	-15.27	0.00	0	**0**	0	-2.16	0.00
	Lxz [lb*in^2]	-17.93	0.00	0.00	**0.00**	0.00	-17.60	0.00	0	**0**	0	-19.07	0.00
	Lyz [lb*in^2]	-3254.64	-2725.44	737.80	**-1501.23**	-2902.07	-2715.62	-2243.70	880.65	**-1174.29**	-2597.91	-1792.74	-1537.38
% Difference Relative to TTI Tripod	Lxx	--	23%	28%	**4%**	42%	--	23%	27%	**3%**	43%	--	22%
	Lyy	--	43%	33%	**40%**	12%	--	46%	36%	**43%**	13%	--	53%
	Lzz	--	24%	11%	**3%**	27%	--	26%	10%	**5%**	27%	--	28%
	Lxy	--	100%	100%	**100%**	100%	--	100%	100%	**100%**	100%	--	100%
	Lxz	--	100%	100%	**100%**	100%	--	100%	100%	**100%**	100%	--	100%
	Lyz	--	16%	123%	**54%**	11%	--	17%	132%	**57%**	4%	--	14%
Moments of Inertia taken at output coordinate system	Ixx [lb*in^2]	106626.84	88763.91	105615.05	**102887.92**	106057.15	90968.74	73055.63	89906.77	**87179.64**	90348.87	68218.61	51412.64
	Iyy [lb*in^2]	47713.78	2625.80	41679.41	**36299.59**	42756.60	42719.17	22678.82	37732.42	**32352.61**	38809.62	35110.04	16862.86
	Izz [lb*in^2]	81526.00	75809.65	77967.18	**80619.86**	82230.99	68224.79	61410.12	63567.65	**66220.34**	67831.46	49446.57	41946.43
	Ixy [lb*in^2]	65.74	0.00	0.00	**0.00**	0.00	79.50	0.00	0.00	**0.00**	0.00	98.74	0.00
	Ixz [lb*in^2]	-80.56	0.00	0.00	**0.00**	0.00	-88.16	0.00	0.00	**0.00**	0.00	-99.42	0.00
	Iyz [lb*in^2]	-44812.05	-33456.24	-38477.13	**-39877.73**	-40428.53	-38172.36	-27592.03	-32612.92	**-34013.52**	-34564.31	-28260.15	-19190.98
% Difference Relative to TTI Tripod	Ixx	--	17%	1%	**4%**	1%	--	20%	1%	**4%**	1%	--	25%
	Iyy	--	94%	13%	**24%**	10%	--	47%	12%	**24%**	9%	--	52%
	Izz	--	7%	4%	**1%**	1%	--	10%	7%	**3%**	1%	--	15%
	Ixy	--	100%	100%	**100%**	100%	--	100%	100%	**100%**	100%	--	100%
	Ixz	--	100%	100%	**100%**	100%	--	100%	100%	**100%**	100%	--	100%
	Iyz	--	25%	14%	**11%**	10%	--	28%	15%	**11%**	9%	--	32%

Endurance			Dibond					Roll-Up				
15 lb bag @ 29"	15 lb bag @ 38"	15 lb bag + 2.5lb bags	TTI Design	50 TRI	15 lb bag @ 29"	15 lb bag @ 38"	15 lb bag + 2.5lb bags	TTI Design	50 TRI	15 lb bag @ 29"	15 lb bag @ 38"	15 lb bag + 2.5lb bags
43.50	**43.50**	48.50	--	29.50	44.50	**44.50**	49.50	--	23.70	38.70	**38.70**	43.70
31.00	**31.00**	36.00	--	16.00	31.00	**31.00**	36.00	--	16.00	31.00	**31.00**	36.00
11.50	**11.50**	11.50	12.50	12.50	12.50	**12.50**	12.50	6.70	6.70	6.70	**6.70**	6.70
1.00	**1.00**	1.00	--	1.00	1.00	**1.00**	1.00	--	1.00	1.00	**1.00**	1.00
41.06	**41.06**	46.06	43.50	27.06	42.06	**42.06**	47.06	37.72	21.28	36.28	**36.28**	41.28
28.85	**28.85**	33.85	31.04	13.85	28.85	**28.85**	33.85	31.04	13.85	28.85	**28.85**	33.85
11.47	**11.47**	11.47	12.46	12.46	12.46	**12.46**	12.46	6.68	6.68	6.68	**6.68**	6.68
0.75	**0.75**	0.75	--	0.75	0.75	**0.75**	0.75	--	0.75	0.75	**0.75**	0.75
6%	**6%**	5%	**--**	8%	5%	**5%**	5%	**--**	10%	6%	**6%**	6%
7%	**7%**	6%	--	13%	7%	**7%**	6%	--	13%	7%	**7%**	6%
0%	**0%**	0%	0%	0%	0%	**0%**	0%	0%	0%	0%	**0%**	0%
25%	**25%**	25%	--	25%	25%	**25%**	25%	--	25%	25%	**25%**	25%
3%	**3%**	8%	**--**	38%	3%	**3%**	8%	**--**	44%	4%	**4%**	9%
7%	**7%**	9%	--	55%	7%	**7%**	9%	--	55%	7%	**7%**	9%
0%	**0%**	0%	--	0%	0%	**0%**	0%	--	0%	0%	**0%**	0%
0.000	**0.000**	0.000	0.080	0.000	0.000	**0.000**	0.000	0.100	0.000	0.000	**0.000**	0.000
25.510	**27.840**	24.490	28.280	34.290	25.850	**28.130**	24.820	26.440	32.360	23.380	**26.020**	22.500
-24.120	**-21.800**	-21.320	-22.380	-19.960	-24.070	**-21.810**	-21.330	-22.270	-20.160	-24.840	**-22.220**	-21.630
0%	**0%**	0%	--	0%	0%	**0%**	0%	--	0%	0%	**0%**	0%
9%	**0%**	12%	--	21%	9%	**1%**	12%	--	22%	12%	**2%**	15%
8%	**2%**	4%	--	11%	8%	**3%**	5%	--	9%	12%	**0%**	3%
(0.00, 0.99, 0.11)	**(0.00, 1.00, -0.09)**	(0.00, 0.97, -0.22)	(0.01, 0.88, -0.48)	(0.00, 0.96, -0.27)	(0.00, 0.99, 0.10)	**(0.00, 1.00, -0.09)**	(0.00, 0.97, -0.22)	(0.05, 0.81, -0.58)	(0.00, 0.97, -0.26)	(0.00, 0.99, 0.12)	**(0.00, 1.00, -0.09)**	(0.00, 0.96, -0.27)
(0.00, -0.11, 0.99)	**(-1.00, 0.00, 0.00)**	(-1.00, 0.00, 0.00)	(-1.00, 0.01, 0.00)	(-1.00, 0.00, 0.00)	(0.00, -0.10, 0.99)	**(-1.00, 0.00, 0.00)**	(-1.00, 0.00, 0.00)	(-1.00, 0.04, -0.03)	(-1.00, 0.00, 0.00)	(0.00, -0.12, 0.99)	**(-1.00, 0.00, 0.00)**	(-1.00, 0.00, 0.00)
(1.00, 0.00, 0.00)	**(0.00, 0.09, 1.00)**	(0.00, 0.22, 0.97)	(0.01, 0.48, 0.88)	(0.00, 0.27, 0.96)	(1.00, 0.00, 0.00)	**(0.00, 0.09, 1.00)**	(0.00, 0.22, 0.97)	(0.00, 0.58, 0.81)	(0.00, 0.26, 0.97)	(1.00, 0.00, 0.00)	**(0.00, 0.09, 1.00)**	(0.00, 0.27, 0.96)
7914.80	**6955.80**	11569.98	13208.51	6320.73	8151.79	**7162.16**	11768.29	11885.98	5128.97	6663.91	**5820.81**	10371.03
17504.70	**14183.16**	20132.47	14281.61	11081.71	18036.63	**14508.72**	20549.08	12217.80	9606.50	14444.08	**12186.75**	17612.69
17662.86	**14984.01**	21218.05	17789.08	12535.62	18053.78	**15481.20**	21814.33	14839.90	10045.92	15179.62	**12294.32**	18068.95
39%	**47%**	11%	--	52%	38%	**46%**	11%	--	57%	44%	**51%**	13%
26%	**2%**	45%	--	22%	26%	**2%**	44%	--	21%	18%	**0%**	44%
3%	**13%**	23%	--	30%	1%	**13%**	23%	--	32%	2%	**17%**	22%
27%	**2%**	**45%**	**--**	**22%**	**26%**	**2%**	**44%**	**--**	**21%**	**24%**	**0%**	**44%**
17662.86	**14183.16**	20132.47	14281.67	11081.71	18053.78	**14508.72**	20549.08	12217.03	9606.50	15179.62	**12186.75**	17612.69
8030.96	**7014.55**	12055.16	14276.89	6781.44	8254.24	**7233.03**	12273.95	12894.38	5458.57	6777.63	**5869.16**	10925.53
17388.55	**14925.26**	20732.87	16720.64	12074.90	17934.18	**15410.32**	21308.68	13832.27	9716.31	14330.37	**12245.97**	17514.45
0.00	**0.00**	0.00	-3.96	0.00	0.00	**0.00**	0.00	6.56	0.00	0.00	**0.00**	0.00
0.00	**0.00**	0.00	-18.40	0.00	0.00	**0.00**	0.00	-19.05	0.00	0.00	**0.00**	0.00
1049.00	**-684.26**	-2108.46	-1937.05	-1628.20	1001.10	**-764.59**	-2196.39	-1400.08	-1229.64	933.69	**-557.39**	-1990.25
27%	**2%**	45%	--	22%	26%	**2%**	44%	--	21%	24%	**0%**	44%
43%	**50%**	14%	--	53%	42%	**49%**	14%	--	58%	47%	**54%**	15%
7%	**8%**	28%	--	28%	7%	**8%**	27%	--	30%	4%	**11%**	27%
100%	**100%**	100%	--	100%	100%	**100%**	100%	--	100%	100%	**100%**	100%
100%	**100%**	100%	--	100%	100%	**100%**	100%	--	100%	100%	**100%**	100%
159%	**62%**	18%	--	16%	152%	**61%**	13%	--	12%	167%	**60%**	42%
68263.79	**65536.66**	68705.88	70860.21	53660.63	70511.77	**67784.64**	70953.87	57294.10	40532.06	57383.20	**54656.07**	57825.30
31916.46	**26536.65**	32993.66	36072.69	17556.47	32610.08	**27230.26**	33687.27	31602.32	14104.02	29157.63	**23777.82**	30234.82
44103.97	**46756.65**	48367.78	51503.96	43878.79	46036.33	**48689.01**	50300.14	40202.18	31996.41	34153.95	**36806.63**	38417.76
0.00	**0.00**	0.00	96.68	0.00	0.00	**0.00**	0.00	108.29	0.00	0.00	**0.00**	0.00
0.00	**0.00**	0.00	-98.06	0.00	0.00	**0.00**	0.00	-104.73	0.00	0.00	**0.00**	0.00
-24211.87	**-25612.47**	-26163.26	-29470.91	-20140.03	-25160.92	**-26561.52**	-2196.39	-23610.64	-15108.46	-20129.35	**-21529.95**	-1990.25
0%	**4%**	1%	--	24%	0%	**4%**	0%	--	29%	0%	**5%**	1%
9%	**24%**	6%	--	51%	10%	**25%**	7%	--	55%	8%	**25%**	4%
11%	**5%**	2%	--	15%	11%	**5%**	2%	--	20%	15%	**8%**	4%
100%	**100%**	100%	--	100%	100%	**100%**	100%	--	100%	100%	**100%**	100%
100%	**100%**	100%	--	100%	100%	**100%**	100%	--	100%	100%	**100%**	100%
14%	**9%**	7%	--	32%	15%	**10%**	93%	--	36%	15%	**9%**	92%