Element Materials Technology
662 Cromwell Avenue
St Paul, MN
55114-1720 USA

P 651 645 3601
F 651 659 7348
T 888 786 7555
info.stpaul@element.com
element.com

Nitroset, LLC.
5600 Bonhomme Road, Suite D
Houston, Texas 77036

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Testing of Nitroset, LLC., CLU222, CLAS325, CLAS332, CLAS525 and CLAS532 Solid Propellant Actuated Power Fastener Clips in Accordance with ICC-ES AC70

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Engineer under the laws of the State of Minnesota.

Jason Steen, P.E.
Registration No. 43491

Prepared By:

Jason Steen, P.E.
Staff Engineer, Building Products Evaluation
Phone: 651-659-7259

Reviewed By:

Thomas A. Kolden, P.E.
Technical Manager
Phone: 651-659-7340

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EAR CONTROLLED

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INTRODUCTION:

This report presents the results of testing performed by Element Materials Technology - St. Paul (Element), on the Nitroset, LLC., CLU222, CLAS325, CLAS332, CLAS525 and CLAS532 solid propellant actuated power fastener clips in concrete with various compressive strengths tested in direct tension, shear and oblique load directions. The scope of our work was limited to the following:

1. Receive sample fasteners for testing in accordance with ICC Evaluation Service's AC70 "Acceptance Criteria for Fasteners Power-Driven Into Concrete, Steel and Masonry Elements" (AC70, February 2012).
2. Conduct tests as listed below in accordance with ICC-ES AC70.

Pin	Substrate	Embedment (inches)	Load Direction
CLU222	4,000 psi NWC	3/4	Tension, Shear and Oblique
	6,000 psi NWC		Tension, Shear and Oblique
CLAS325	4,000 psi NWC	13/16	Tension and Shear
	6,000 psi NWC		Tension and Shear
CLAS332	4,000 psi NWC	1 1/16	Tension and Shear
	6,000 psi NWC		Tension and Shear
CLAS525	4,000 psi NWC	13/16	Tension, Shear and Oblique
	6,000 psi NWC		Tension, Shear and Oblique
CLAS532	4,000 psi NWC	1 1/16	Tension, Shear and Oblique
	6,000 psi NWC		Tension, Shear and Oblique

Normal Weight Concrete - NWC

Table 1 – Test Scope

3. Prepare a report of the test results in accordance with ICC-ES AC70/AC85.

Our work was requested by Mr. Chris Lin of Nitroset and authorized on December 5, 2011 under Nitroset, LLC., purchase order number PO 91361.

SUMMARY OF RESULTING ALLOWABLE LOADS:

The allowable loads shown in ~~the~~ Table 2 are derived from ICC-ES AC70 guidelines for the tested fasteners based on calculations presented in Appendix E of this report.

Pin	Substrate	Embedment (inches)	Allowable Load (lbf)[1]		
			Tension	Shear	Oblique
CLU222	4,000 psi NWC	3/4	107	147	108
	6,000 psi NWC		103	246	186
CLAS325	4,000 psi NWC	13/16	137	144	--
	6,000 psi NWC		113	109	--
CLAS332	4,000 psi NWC	1 1/16	167	277	--
	6,000 psi NWC		153	229	--
CLAS525	4,000 psi NWC	13/16	141	216	135
	6,000 psi NWC		146	164	150
CLAS532	4,000 psi NWC	1 1/16	134	132	190
	6,000 psi NWC		153	130	136

1. Allowable loads with adjusment factors applied.
Normal Weight Concrete - NWC

Table 2 – Allowable Loads

ANCHOR DESCRIPTION:

The Nitroset fasteners tested were identified as CLU222 0.125” diameter solid propellant actuated power fastener with ceiling clip, and CLAS325, CLAS332, CLAS525 and CLAS532 0.145” diameter solid propellant actuated power fastener with ceiling clip. The CLAS525 and 532 are step shank pins with the main shank consisting of a 0.145” diameter with a step down to 0.135” diameter towards the pin point. All models with clips allow for wire or hook application once installed. The solid propellant actuated power fasteners were installed with a NTS501 installation tool. The pins and tools used are shown in the photographs presented on the following pages. Detailed shop drawings of the pin fasteners and clips are located in Appendix C of this report.

SAMPLING:

The tested Nitroset solid propellant actuated power fasteners, as reported herein, were received from Nitroset via shipment from their warehouse facility located in Houston, Texas on December 8, 2011. Element did not sample the fasteners because the fasteners were prototypes at the time. A total of three (3) cartons were received, which contained three (3) containers each of CLU222, CLAS325, CLAS332, CLAS525 and CLAS532 as well as a NTS501 installation tool and accessories. The sampled materials were placed in storage, where the individual components were then taken from the stored supply as needed.

The containers received did not have lot numbers. The following is a listing of the accessories received:

Installation Tool – NTS501

The following photographs show the typical packages, pins and installation accessories:

Photograph 1 – Typical Container

Photograph 2 – Installation Tool (NTS501)

SUBSTRATE MATERIALS:

The test members were constructed of normal weight concrete with 4,000 and 6,000 psi compressive strengths. The concrete was acquired from Cemstone Concrete Products, a local ready-mix supplier.

The materials and structural members used conformed to the requirements of AC70 Section 3.1. The concrete mixtures were proportioned in accordance with the PCA's Design and Control of Concrete Mixtures, Thirteenth Edition. The coarse and fine aggregates conformed to ASTM C33-07. The cement conformed to ASTM C150-07. The substrate members used for testing were constructed by Element personnel. The tests slabs were un-reinforced and contained no admixtures.

The compressive strength of the test members was determined through concrete cylinder testing. The cylinders are referenced by the cast date. For each concrete placement a number of 4 x 8 cylinders were simultaneously cast in accordance with AC70 Section 3.1.1.3 and were tested in accordance with ASTM C 39 and Section 3.1.3 of AC70 along with Table 1 of AC70. The cylinders were stored with their corresponding structural members. At regular intervals, three cylinders were tested and the average compressive strength reported. A strength versus time curve relationship was developed based on the series of data points and the specified strength of the pertinent substrate member was generally derived based on the resulting trend.

Additional data pertaining to the concrete is presented in Appendix B of this report, which includes the derivation of concrete compressive strength. The specific compressive strength associated with each set of tests is listed on the anchor test data sheets in Appendix A.

ANCHOR INSTALLATION:

The pin fasteners were installed and tested on the trowel face of concrete. All pins were installed using the NTS501 installation tool.

TEST PROCEDURES:

The tests were conducted in accordance with ICC-ES AC70 and the applicable provisions listed in ASTM E1190-11 "Standard Test Method for Strength of Power-Actuated Fasteners Installed in Structural Members". The International Accreditation Service, Inc. (IAS) issued a Certificate of Accreditation TL-217, January 12, 2012, listing Element Materials Technology - St. Paul (Element) as an accredited laboratory for a scope of services that includes testing in accordance with AC70. The equipment used to apply the loads included a hydraulic pump and cylinder (ram). The specific equipment used to measure the loads is listed on the test summary sheets in Appendix A, along with the calibration dates. All measurement equipment is calibrated at least annually, and the calibrations are traceable to the National Institute of Standards and Technology (NIST). Measuring equipment included load cells (force transducers) and dial calipers. The test procedures were in accordance with the protocol listed in ASTM E1190. The following photographs show a typical tension test configuration typical shear test configuration and a typical oblique test configuration. All tests were conducted in accordance with AC 70 Section 4.

Photograph 3 – Typical 90-Degree Tension Test Configuration

Photograph 4 – Typical 90-Degree Tension Test Configuration

Photograph 5 – Typical Oblique Tension Test Configuration

TEST RESULTS:

Specific test series information and test data are summarized in the test data sheets presented in Appendix A of this report. Each table contains the test results, along with related data such as estimated concrete compressive strength and calculations for average load, standard deviation and coefficient of variation, and failure modes. The test data is collated by product and test series.

The typical failure modes are depicted in the following photographs:

Photograph 6 – Typical Steel Body Failure Mode (SB)

Photograph 7 – Typical Concrete Cone Failure Mode (CC)

Photograph 8 – Typical Pull-Out Failure Mode (PO)

REMARKS:

The structural members used for the testing described herein were discarded upon completion. The remaining fasteners and associated items are subject to disposal thirty days from the date of this report.

APPENDIX A – TEST DATA SUMMARY SHEETS

The test series data sheets are grouped together by fastener and are in the order corresponding to the test series listed in Table 1 and Table 2 of this report.

CLU222

The CLU222 0.125” diameter solid propellant actuated power fastener with utility clip was tested in tension, 90-degrees to the surface, shear and at an oblique angle (45-degrees to the surface) in 4,000 and 6,000 psi normal weight concrete. Test were performed by installing the clip, via the attached pin into the given substrate and then applying a load through the clip with a pin (clevis) style fixture and recording the ultimate load and failure mode. All fired fastener pins were recorded and the results are shown on pages 11 through 16. If a pin was fired, but did not fully seat (reach the required embedment), or was substantially bent, or was loose because of concrete spall, it was documented, but not tested for loading. The typical reason for untested pins was because the pin glanced off of the coarse aggregate in the concrete and bent (rolled) the pin.

4,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet 120 Degree Clip ICC-ES AC70	Test Type: Tension 4,000 psi; 3/4" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLU222	Mix #	EL3051	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	03/27/12	$F_{u,test,i}$	833
Fastener Size (in.)	0.125	Anchor Location	Top form finish	Standard Deviation	169
Lot Number 1	n/a	Est. Concrete Strength (psi)	4275	%COV	20.2%
Lot Number 2	n/a				
Embedment (in)	3/4				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	8/23/2012	1088	CC	
2	8/23/2012	612	PO	chipped concrete
3	8/23/2012	1089	CC	
4	8/23/2012	833	CC	
5	8/23/2012	X	HA	Hit aggregate chipped concrete
6	8/23/2012	719	CC	
7	8/23/2012	857	CC	
8	8/23/2012	911	PO	
9	8/23/2012	X	HA/BP	Hit aggregate bent pin
10	8/23/2012	825	PO	
11	8/23/2012	797	SB	
12	8/23/2012	X	HA	hit aggregate
13	8/23/2012	598	CC	chipped concrete
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLU222 - Tension

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet 120 Degree Clip ICC-ES AC70	Test Type: Shear 4,000 psi; 3/4" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLU222	Mix #	EL3051	No. of Test Samples, n	11
Fastener Material	Steel	Cast Date	03/27/12	$F_{u,test,i}$	1154
Fastener Size (in.)	0.125	Anchor Location	Top form finish	Standard Deviation	238
Lot Number 1	n/a	Est. Concrete Strength (psi)	4280	%COV	20.6%
Lot Number 2	n/a				
Embedment (in)	3/4				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	8/24/2012	1020	PO	chipped concrete
2	8/24/2012	1042	PO	
3	8/24/2012	824	PO	chipped concrete
4	8/24/2012	708	PO	chipped concrete
5	8/24/2012	1147	PO	
6	8/24/2012	1300	PO	
7	8/24/2012	1182	PO	
8	8/24/2012	1302	PO	
9	8/24/2012	1277	PO	chipped concrete
10	8/24/2012	1424	PO	
11	8/24/2012	1464	PO	
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLU222 – Shear

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet 120 Degree Clip ICC-ES AC70	Test Type: Tension 4,000 psi; 3/4" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLU222	Mix #	TC3161	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	05/04/12	$F_{u,test,i}$	762
Fastener Size (in.)	0.125	Anchor Location	Top form finish	Standard Deviation	154
Lot Number 1	n/a	Est. Concrete Strength (psi)	4200	%COV	20.2%
Lot Number 2	n/a				
Embedment (in)	3/4				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	9/18/2012	987	CC	chipped concrete
2	9/18/2012	1013	PO	
3	9/18/2012	684	PO	chipped concrete
4	9/18/2012	642	PO	chipped concrete
5	9/18/2012	602	PO	
6	9/18/2012	869	CC	
7	9/18/2012	606	PO	
8	9/18/2012	784	CC	
9	9/18/2012	798	CC	chipped concrete
10	9/18/2012	635	CC	
11				
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLU222 – Oblique

6,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet 120 Degree Clip ICC-ES AC70	Test Type: Tension 6,000 psi; 3/4" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLU222	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	07/09/12	$F_{u,test,i}$	798
Fastener Size (in.)	0.125	Anchor Location	Top form finish	Standard Deviation	140
Lot Number 1	n/a	Est. Concrete Strength (psi)	6335	%COV	17.5%
Lot Number 2	n/a				
Embedment (in)	3/4				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	8/9/2012	748	PO	
2	8/9/2012	910	PO	
3	8/9/2012	987	PO	
4	8/9/2012	647	PO	
5	8/9/2012	697	PO	
6	8/9/2012	723	PO	
7	8/9/2012	576	PO	
8	8/9/2012	868	PO	
9	8/9/2012	972	PO	
10	8/9/2012	847	PO	
11				
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLU222 - Tension

Element Materials Technology - Saint Paul	Project No. TCT008560P	Test Project: NitroSet 120 Degree Clip ICC-ES AC70	Test Type: Shear 6,000 psi; 3/4" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLU222	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	07/09/12	$F_{u,test,i}$	1380
Fastener Size (in.)	0.125	Anchor Location	Top form finish	Standard Deviation	162
Lot Number 1	n/a	Est. Concrete Strength (psi)	6385	%COV	11.8%
Lot Number 2	n/a				
Embedment (in)	3/4				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	8/23/2012	1523	PO	
2	8/23/2012	1508	PO	
3	8/23/2012	1372	PO	
4	8/23/2012	1539	PO	
5	8/23/2012	1417	PO	
6	8/23/2012	1236	PO	
7	8/23/2012	1214	PO	
8	8/23/2012	1222	PO	
9	8/23/2012	1159	PO	
10	8/23/2012	1606	PO	
11				
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLU222 - Shear

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet 120 Degree Clip ICC-ES AC70	Test Type: Oblique 6,000 psi; 3/4" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLU222	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	07/09/12	$F_{u,test,i}$	1044
Fastener Size (in.)	0.125	Anchor Location	Top form finish	Standard Deviation	92
Lot Number 1	n/a	Est. Concrete Strength (psi)	6460	%COV	8.8%
Lot Number 2	n/a				
Embedment (in)	3/4				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	9/18/2012	1166	PO	
2	9/18/2012	1006	CC	
3	9/18/2012	985	CC	
4	9/18/2012	1013	PO	
5	9/18/2012	901	PO	
6	9/18/2012	1016	CC	
7	9/18/2012	955	PO	
8	9/18/2012	1168	PO	
9	9/18/2012	1084	CC	
10	9/18/2012	1143	PO	
11				
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLU222 - Oblique

CLAS325

The CLAS325 0.145” diameter solid propellant actuated fastener with Nitro clip was tested in tension 90-degrees to the surface and shear in 4,000 and 6,000 psi normal weight concrete. Test were performed by installing the clip, via the attached pin into the given substrate and then applying a load through the clip with a pin (clevis) style fixture and recording the ultimate load and failure mode. All fired fasteners were recorded and the results are shown on pages 18 through 21. If a pin was fired, but did not fully seat (reach the required embedment), or was substantially bent, or was loose because of concrete spall, it was documented, but not tested for loading. The typical reason for untested pins was because the pin glanced off of the coarse aggregate in the concrete and bent (rolled) the pin.

4,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 4,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS325	Mix #	TC3161	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	05/16/11	$F_{u,test,i}$	769
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	108
Lot Number 1	n/a	Est. Concrete Strength (psi)	3840	%COV	14.0%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	2/22/2012	722	PO	
2	2/22/2012	648	PO	
3	2/22/2012	583	PO	
4	2/22/2012	836	PO	
5	2/22/2012	909	PO	
6	2/22/2012	825	PO	
7	2/22/2012	799	CC	
8	2/22/2012	910	PO	
9	2/22/2012	696	PO	
10	2/22/2012	763	PO	
11				
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS325 - Tension

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Shear 4,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS325	Mix #	TC3161	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	05/16/12	$F_{u,test,i}$	1042
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	213
Lot Number 1	n/a	Est. Concrete Strength (psi)	3840	%COV	20.5%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	2/22/2012	1290	PO	
2	2/22/2012	1036	PO	
3	2/22/2012	964	PO	
4	2/22/2012	804	PO	
5	2/22/2012	1394	SB	
6	2/22/2012	1271	PO	
7	2/22/2012	807	PO	
8	2/22/2012	868	PO	
9	2/22/2012	1093	PO	
10	2/22/2012	897	PO	
11				
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS325 - Shear

6,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 6,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS325	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	07/09/12	$F_{u,test,i}$	630
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	92
Lot Number 1	n/a	Est. Concrete Strength (psi)	6550	%COV	14.7%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	10/25/2012	795	PO	
2	10/25/2012	567	PO	
3	10/25/2012	684	PO	
4	10/25/2012	X	HA	hit aggregate
5	10/25/2012	539	PO	
6	10/25/2012	708	PO	
7	10/25/2012	727	PO	
8	10/25/2012	X	HA	hit aggregate
9	10/25/2012	569	PO	
10	10/25/2012	515	PO	
11	10/25/2012	607	PO	
12	10/25/2012	X	HA	hit aggregate
13	10/25/2012	591	PO	
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS325 - Tension

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Shear 6,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS325	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	07/09/12	$F_{u,test,i}$	1002
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	244
Lot Number 1	n/a	Est. Concrete Strength (psi)	6550	%COV	24.4%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	10/26/2012	1109	PO	
2	10/26/2012	1050	PO	chipped concrete
3	10/26/2012	1158	PO	
4	10/26/2012	1287	PO	
5	10/26/2012	618	PO	chipped concrete
6	10/26/2012	846	PO	
7	10/26/2012	1305	SB	
8	10/26/2012	1014	PO	
9	10/26/2012	1024	PO	chipped concrete
10	10/26/2012	611	PO	chipped concrete
11				
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS325 - Shear

CLAS332

The CLAS332 0.145” diameter solid propellant actuated fastener with Nitro clip was tested in tension 90-degrees to the surface and shear in 4,000 and 6,000 psi normal weight concrete. Test were performed by installing the clip, via the attached pin into the given substrate and then applying a load through the clip with a pin (clevis) style fixture and recording the ultimate load and failure mode. All fired fasteners were recorded and the results are shown on pages 23 through 26. If a pin was fired, but did not fully seat (reach the required embedment), or was substantially bent, or was loose because of concrete spall, it was documented, but not tested for loading. The typical reason for untested pins was because the pin glanced off of the coarse aggregate in the concrete and bent (rolled) the pin.

4,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 4,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS332	Mix #	TC3161	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	05/16/11	$F_{u,test,i}$	1204
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	235
Lot Number 1	n/a	Est. Concrete Strength (psi)	3795	%COV	19.5%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	1/16/2012	1148	PO	
2	1/16/2012	1029	PO	
3	1/16/2012	1376	PO	
4	1/16/2012	1108	PO	
5	1/16/2012	1642	PO	
6	1/16/2012	X	HA	hit aggregate
7	1/16/2012	936	CC	
8	1/16/2012	1038	PO	
9	1/16/2012	1396	PO	
10	1/16/2012	X	HA	hit aggregate
11	1/16/2012	1400	PO	
12	1/16/2012	964	PO	
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS332 – Tension

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Shear 4,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS332	Mix #	TC3161	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	05/16/11	$F_{u,test,i}$	1551
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	140
Lot Number 1	n/a	Est. Concrete Strength (psi)	3795	%COV	9.0%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	1/16/2012	1573	SB	
2	1/16/2012	1462	SB	
3	1/16/2012	1526	SB	
4	1/16/2012	X	HA	hit aggregate
5	1/16/2012	1536	SB	
6	1/16/2012	1595	SB	
7	1/16/2012	1224	SB	
8	1/16/2012	1764	SB	
9	1/16/2012	1569	SB	
10	1/16/2012	1643	SB	
11	1/16/2012	1619	SB	
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS332 – Shear

6,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 6,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS332	Mix #	STO7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	08/19/11	$F_{u,test,i}$	1157
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	244
Lot Number 1	n/a	Est. Concrete Strength (psi)	6960	%COV	21.1%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	1/26/2012	1022	PO	
2	1/26/2012	1085	PO	
3	1/26/2012	1067	PO	
4	1/26/2012	1349	PO	
5	1/26/2012	943	PO	
6	1/26/2012	1307	PO	
7	1/26/2012	1732	SB	
8	1/26/2012	1054	PO	
9	1/26/2012	x	HA	hit aggregate
10	1/26/2012	1081	PO	
11	1/26/2012	925	PO	
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS332 – Tension

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Shear 6,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS332	Mix #	STO7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	08/19/11	$F_{u,test,i}$	1381
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	157
Lot Number 1	n/a	Est. Concrete Strength (psi)	6960	%COV	11.4%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	1/26/2012	1327	PO	
2	1/26/2012	1470	SB	
3	1/26/2012	1607	SB	
4	1/26/2012	X	HA	hit aggregate
5	1/26/2012	1551	SB	
6	1/26/2012	1287	PO	chipped concrete
7	1/26/2012	X	HA	hit aggregate
8	1/26/2012	1443	SB	
9	1/26/2012	1406	SB	
10	1/26/2012	X	HA	hit aggregate
11	1/26/2012	X	HA	hit aggregate
12	1/26/2012	1044	PO	chipped concrete
13	1/26/2012	1354	SB	chipped concrete
14	1/26/2012	1322	SB	
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS332 – Shear

CLAS525

The CLAS525 0.145” main diameter with a 0.135” diameter step shank solid propellant actuated fastener with Nitro clip was tested in tension 90-degrees to the surface, shear and at an oblique angle (45-degrees to the surface) in 4,000 and 6,000 psi normal weight concrete. Test were performed by installing the clip, via the attached pin into the given substrate and then applying a load through the clip with a pin (clevis) style fixture and recording the ultimate load and failure mode. All fired fasteners were recorded and the results are shown on pages 28 through 33. If a pin was fired, but did not fully seat (reach the required embedment), or was substantially bent, or was loose because of concrete spall, it was documented, but not tested for loading. The typical reason for untested pins was because the pin glanced off of the coarse aggregate in the concrete and bent (rolled) the pin.

4,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 4,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS525	Mix #	EL3051	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	04/10/12	$F_{u,test,i}$	790
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	117
Lot Number 1	n/a	Est. Concrete Strength (psi)	4070	%COV	14.9%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	11/9/2012	665	PO	
2	11/9/2012	727	PO	
3	11/9/2012	780	PO	
4	11/9/2012	X	HA	hit aggregate
5	11/9/2012	761	PO	
6	11/9/2012	789	PO	
7	11/9/2012	713	PO	
8	11/9/2012	X	HA	hit aggregate
9	11/9/2012	805	PO	
10	11/9/2012	1080	PO	
11	11/9/2012	871	PO	
12	11/9/2012	708	PO	
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS525 – Tension

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Shear 4,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS525	Mix #	EL3051	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	04/10/12	$F_{u,test,i}$	1210
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	87
Lot Number 1	n/a	Est. Concrete Strength (psi)	4070	%COV	7.2%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	11/9/2012	1209	PO	
2	11/9/2012	1202	PO	
3	11/9/2012	1194	PO	
4	11/9/2012	1151	PO	
5	11/9/2012	1222	PO	
6	11/9/2012	1117	PO	
7	11/9/2012	1167	PO	
8	11/9/2012	X	HA	hit aggregate
9	11/9/2012	X	HA	hit aggregate
10	11/9/2012	1186	PO	
11	11/9/2012	1214	PO	
12	11/9/2012	1439	PO	
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS525 – Shear

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 4,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS525	Mix #	TC3161	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	04/10/12	$F_{u,test,i}$	1000
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	205
Lot Number 1	n/a	Est. Concrete Strength (psi)	4085	%COV	20.5%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	11/15/2012	1254	PO	
2	11/15/2012	1289	PO	
3	11/15/2012	873	PO	
4	11/15/2012	1210	PO	
5	11/15/2012	757	PO	
6	11/15/2012	966	PO	
7	11/15/2012	898	PO	
8	11/15/2012	1148	PO	
9	11/15/2012	841	PO	
10	11/15/2012	768	PO	
11				
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS525 – Oblique

6,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 6,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS525	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	07/09/12	$F_{u,test,i}$	1229
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	185
Lot Number 1	n/a	Est. Concrete Strength (psi)	6580	%COV	15.0%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	11/9/2012	1340	PO	
2	11/9/2012	X	HA	hit aggregate
3	11/9/2012	1240	PO	
4	11/9/2012	1395	CC	
5	11/9/2012	1085	PO	chipped concrete
6	11/9/2012	1406	PO	
7	11/9/2012	816	PO	chipped concrete
8	11/9/2012	1134	PO	
9	11/9/2012	1278	PO	chipped concrete
10	11/9/2012	1188	PO	chipped concrete
11	11/9/2012	1408	PO	
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS525 – Tension

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Shear 6,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS525	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	07/09/12	$F_{u,test,i}$	1279
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	281
Lot Number 1	n/a	Est. Concrete Strength (psi)	6580	%COV	22.0%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	11/9/2012	1539	PO	
2	11/9/2012	1655	PO	
3	11/9/2012	x	HA	hit aggregate
4	11/9/2012	997	PO	
5	11/9/2012	x	HA	hit aggregate
6	11/9/2012	1567	PO	
7	11/9/2012	1057	PO	
8	11/9/2012	1028	PO	
9	11/9/2012	1310	PO	
10	11/9/2012	1154	PO	
11	11/9/2012	1566	PO	
12	11/9/2012	919	PO	
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS525 – Shear

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Oblique 6,000 psi; 13/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS525	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	07/09/12	$F_{u,test,i}$	1200
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	277
Lot Number 1	n/a	Est. Concrete Strength (psi)	6595	%COV	23.1%
Lot Number 2	n/a				
Embedment (in)	13/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	11/15/2012	X	HA	hit aggregate
2	11/15/2012	1087	PO	
3	11/15/2012	1154	PO	
4	11/15/2012	1640	SB	
5	11/15/2012	1178	PO	
6	11/15/2012	973	PO	
7	11/15/2012	1586	PO	
8	11/15/2012	1447	PO	
9	11/15/2012	839	PO	
10	11/15/2012	899	PO	
11	11/15/2012	1195	PO	
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS525 – Oblique

CLAS532

The CLAS532 0.145” main diameter with a 0.135” diameter step shank solid propellant actuated fastener with Nitro clip was tested in tension 90-degrees to the surface, shear and at an oblique angle (45-degrees to the surface) in 4,000 and 6,000 psi normal weight concrete. Test were performed by installing the clip, via the attached pin into the given substrate and then applying a load through the clip with a pin (clevis) style fixture and recording the ultimate load and failure mode. All fired fasteners were recorded and the results are shown on pages 35 through 40. If a pin was fired, but did not fully seat (reach the required embedment), or was substantially bent, or was loose because of concrete spall, it was documented, but not tested for loading. The typical reason for untested pins was because the pin glanced off of the coarse aggregate in the concrete and bent (rolled) the pin.

4,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 4,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/9/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS532	Mix #	EL3051	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	05/16/11	$F_{u,test,i}$	1011
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	179
Lot Number 1	n/a	Est. Concrete Strength (psi)	3910	%COV	17.7%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	4/25/2012	904	PO	
2	4/25/2012	X	HA	hit aggregate
3	4/25/2012	1085	PO	
4	4/25/2012	1323	PO	
5	4/25/2012	1204	SB	
6	4/25/2012	955	SB	
7	4/25/2012	X	CS	concrete spalled
8	4/25/2012	1121	SB	chipped concrete
9	4/25/2012	1019	PO	
10	4/25/2012	751	PO	chipped concrete
11	4/25/2012	785	PO	
12	4/25/2012	963	PO	
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS532 – Tension

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Shear 4,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/9/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS532	Mix #	EL3051	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	05/16/11	$F_{u,test,i}$	1142
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	271
Lot Number 1	n/a	Est. Concrete Strength (psi)	3910	%COV	23.7%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	4/25/2012	X	HA	hit aggregate
2	4/25/2012	X	HA	hit aggregate
3	4/25/2012	X	HA	hit aggregate
4	4/25/2012	1313	PO	
5	4/25/2012	817	PO	chipped concrete
6	4/25/2012	1434	SB	
7	4/25/2012	1287	SB	
8	4/25/2012	835	PO	
9	4/25/2012	737	PO	chipped concrete
10	4/25/2012	958	PO	chipped concrete
11	4/25/2012	1362	SB	
12	4/25/2012	1347	PO	
13	4/25/2012	1330	SB	
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS532 – Shear

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 4,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS532	Mix #	TC3161	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	03/27/12	$F_{u,test,i}$	1063
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	151
Lot Number 1	n/a	Est. Concrete Strength (psi)	4185	%COV	14.2%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	8/1/2012	1124	PO	
2	8/1/2012	X	HA	hit aggregate
3	8/1/2012	1004	PO	chipped concrete
4	8/1/2012	1154	SB	
5	8/1/2012	980	PO	chipped concrete
6	8/1/2012	1324	SB	
7	8/1/2012	1080	SB	chipped concrete
8	8/1/2012	X	HA	hit aggregate
9	8/1/2012	843	PO	
10	8/1/2012	X	HA	hit aggregate
11	8/1/2012	1158	PO	
12	8/1/2012	833	PO	chipped concrete
13	8/1/2012	X	HA	hit aggregate
14	8/1/2012	X	HA	hit aggregate
15	8/1/2012	1125	SB	

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

4,000 psi NWC – CLAS532 – Oblique

6,000 psi NWC:

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Tension 6,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/9/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS532	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	03/16/12	$F_{u,test,i}$	1054
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	220
Lot Number 1	n/a	Est. Concrete Strength (psi)	6590	%COV	20.9%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	4/26/2012	X	HA	hit aggregate
2	4/26/2012	901	SB	
3	4/26/2012	854	PO	chipped concrete
4	4/26/2012	X	HA	hit aggregate
5	4/26/2012	1060	PO	
6	4/26/2012	988	PO	chipped concrete
7	4/26/2012	1284	PO	chipped concrete
8	4/26/2012	948	PO	
9	4/26/2012	1261	PO	
10	4/26/2012	890	SB	chipped concrete
11	4/26/2012	X	HA	hit aggregate
12	4/26/2012	X	HA	hit aggregate
13	4/26/2012	856	SB	
14	4/26/2012	1494	SB	
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS532 – Tension

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Shear 6,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	1/9/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS532	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	03/16/12	$F_{u,test,i}$	1237
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	230
Lot Number 1	n/a	Est. Concrete Strength (psi)	6590	%COV	18.6%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	4/26/2012	730	PO	
2	4/26/2012	1219	SB	
3	4/26/2012	1281	SB	
4	4/26/2012	1360	SB	
5	4/26/2012	1006	SB	
6	4/26/2012	1345	SB	
7	4/26/2012	1137	SB	
8	4/26/2012	1435	SB	
9	4/26/2012	1509	SB	
10	4/26/2012	1349	SB	
11				
12				
13				
14				
15				

Failure Mode Index:

ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS532 – Shear

Element Materials Technology - Saint Paul Project No. TCT008560P	Test Project: NitroSet Nitro Clip ICC-ES AC70	Test Type: Oblique 6,000 psi; 1-1/16" emb.

Setup and Installation		Test Equipment		Calibration
Tech:	Y. Vue	System No.	CME-SPC-904	
Install Tool	NTS501	Load Cell	CME-SPC-061	7/19/2012

Test Specimen Data		Concrete Data		Calculations based on test data:	
Fastener:	CLAS532	Mix #	EL7551	No. of Test Samples, n	10
Fastener Material	Steel	Cast Date	07/09/12	$F_{u,test,i}$	1119
Fastener Size (in.)	0.145	Anchor Location	Top form finish	Standard Deviation	192
Lot Number 1	n/a	Est. Concrete Strength (psi)	6310	%COV	17.1%
Lot Number 2	n/a				
Embedment (in)	1 1/16				

Test No.	Test Date	Ultimate Load (lbf)	Failure Mode	Comments
1	8/2/2012	1085	SB	
2	8/2/2012	1294	SB	
3	8/2/2012	1196	SB	
4	8/2/2012	759	SB	
5	8/2/2012	786	SB	
6	8/2/2012	1251	SB	
7	8/2/2012	1183	SB	
8	8/2/2012	1167	SB	
9	8/2/2012	X	HA	hit aggregate
10	8/2/2012	X	HA	hit aggregate
11	8/2/2012	X	HA	hit aggregate
12	8/2/2012	1219	SB	
13	8/2/2012	X	HA	hit aggregate
14	8/2/2012	1254	SB	
15				

Failure Mode Index:

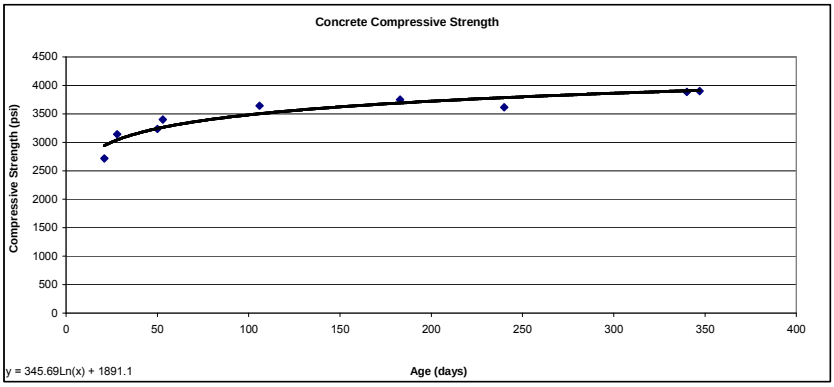
ST - Steel Pin	CC - Concrete Cone	HA - Hit Aggregate	BP - Bent Pin
PO - Pin Pull Out	CS - Concrete Spall	X - No data unable to test pin	SB- Steel Body of Clip

6,000 psi NWC – CLAS532 – Oblique

APPENDIX B – CONCRETE / CYLINDER DATA

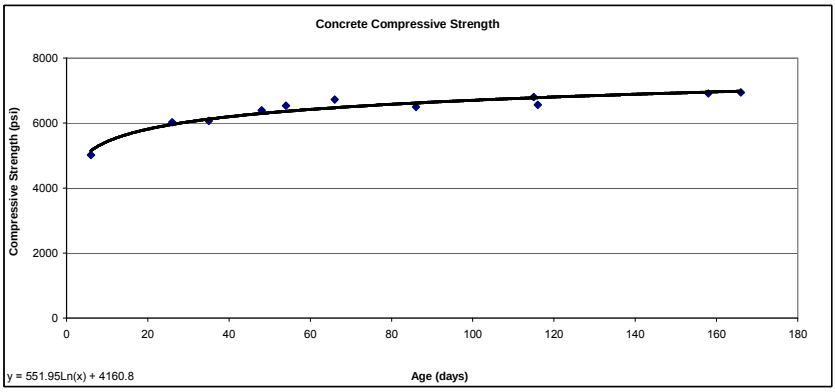
Mix ID: TC3161

Date	Age	Strength	Cylinders
05/16/11	0	0	0
06/06/11	21	2717	3
06/13/11	28	3143	3
07/05/11	50	3237	3
07/08/11	53	3400	3
08/30/11	106	3643	3
11/15/11	183	3750	4
01/11/12	240	3617	3
04/20/12	340	3885	3
04/27/12	347	3902	3



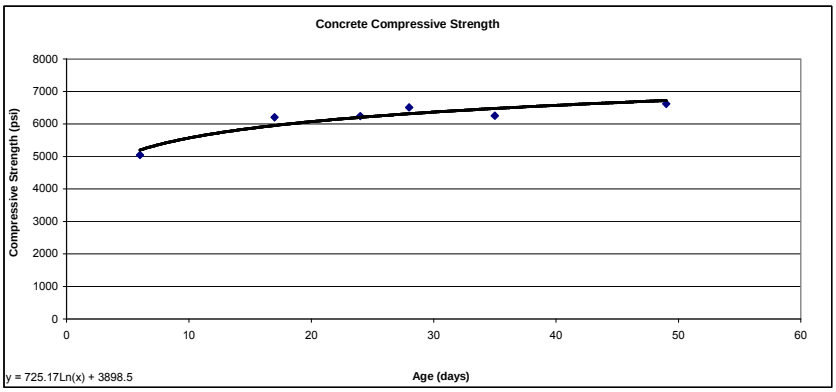
Mix ID: STO7551

Date	Age	Strength	Cylinders
08/19/11	0	0	0
08/25/11	6	5020	3
09/14/11	26	6027	3
09/23/11	35	6070	3
10/06/11	48	6393	3
10/12/11	54	6533	3
10/24/11	66	6723	3
11/13/11	86	6500	3
12/12/11	115	6803	3
12/13/11	116	6560	3
01/24/12	158	6912	3
02/01/12	166	6945	3



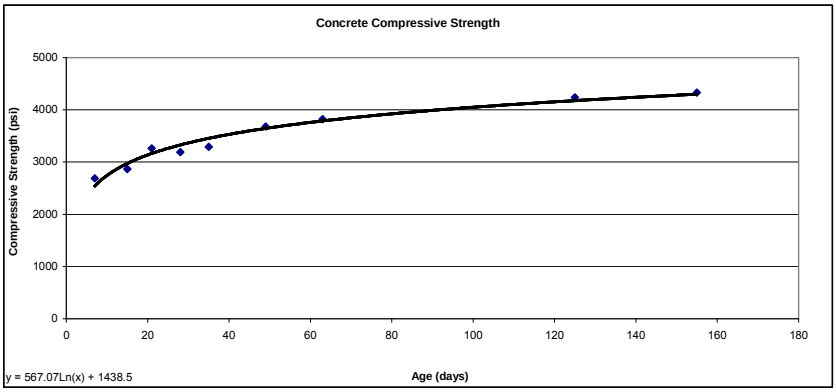
Mix ID: EL7551

Date	Age	Strength	Cylinders
03/16/12	0	0	0
03/22/12	6	5043	3
04/02/12	17	6203	3
04/09/12	24	6243	3
04/13/12	28	6507	3
04/20/12	35	6250	3
05/04/12	49	6620	3



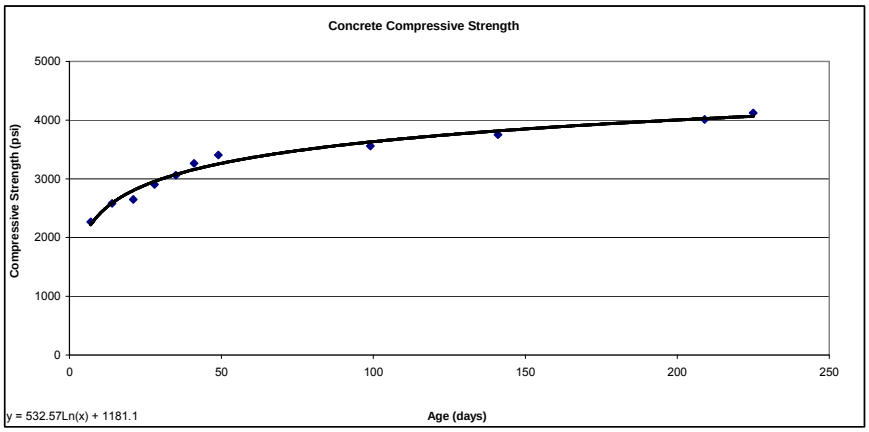
Mix ID: EL3051

Date	Age	Strength	Cylinders
03/27/12	0	0	0
04/03/12	7	2687	3
04/11/12	15	2867	3
04/17/12	21	3263	3
04/24/12	28	3190	3
05/01/12	35	3293	3
05/15/12	49	3680	3
05/29/12	63	3820	3
07/30/12	125	4240	3
08/29/12	155	4332	3



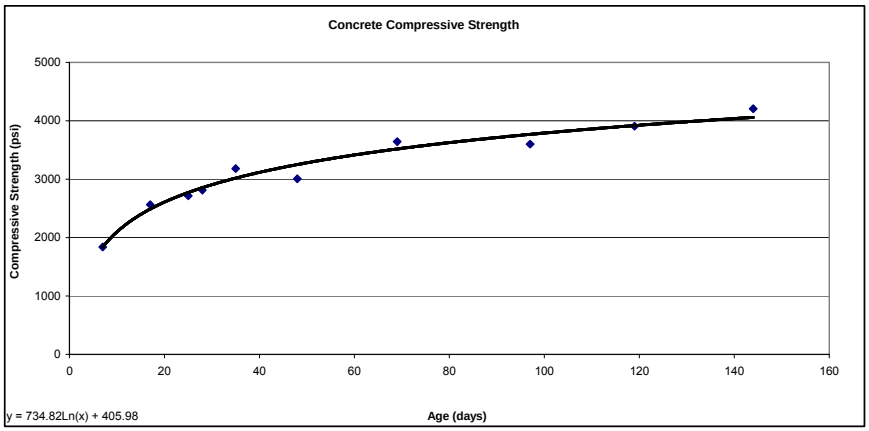
Mix ID: EL3051

Date	Age	Strength	Cylinders
04/10/12	0	0	0
04/17/12	7	2267	3
04/24/12	14	2583	3
05/01/12	21	2650	3
05/08/12	28	2907	3
05/15/12	35	3063	3
05/21/12	41	3263	3
05/29/12	49	3407	3
07/18/12	99	3559	3
08/29/12	141	3753	3
11/05/12	209	4012	3
11/21/12	225	4122	3



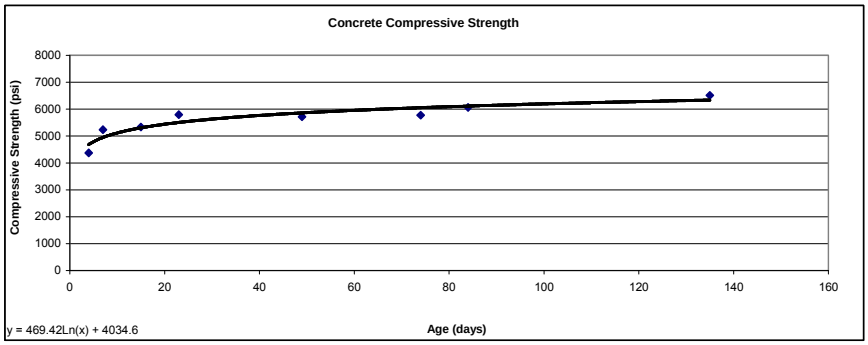
Mix ID: TC3161

Date	Age	Strength	Cylinders
05/04/12	0	0	0
05/11/12	7	1840	3
05/21/12	17	2563	3
05/29/12	25	2717	3
06/01/12	28	2813	3
06/08/12	35	3183	3
06/21/12	48	3007	3
07/12/12	69	3643	3
08/09/12	97	3600	3
08/31/12	119	3907	3
09/25/12	144	4206	3



Mix ID: EL7551

Date	Age	Strength	Cylinders
07/09/12	0	0	0
07/13/12	4	4375	3
07/16/12	7	5237	3
07/24/12	15	5335	3
08/01/12	23	5793	3
08/27/12	49	5720	3
09/21/12	74	5777	3
10/01/12	84	6065	3
11/21/12	135	6512	3



Concrete Cast Dates	Test Dates	Age (Days)	Trend Formula	Calc'd Strength (psi)
05/16/11			346 * LN(AGE) + 1891	
	01/16/12	245		3795
	02/22/12	282		3840
	04/25/12	345		3910
08/19/11			552 * LN(AGE) + 4161	
	01/26/12	160		6960
03/16/12			725 * LN(AGE) + 3899	
	04/26/12	41		6590
03/27/12			567 * LN(AGE) + 1439	
	08/01/12	127		4185
	08/23/12	149		4275
	08/24/12	150		4280
04/10/12			533 * LN(AGE) + 1181	
	11/09/12	227		4070
	11/15/12	233		4085
05/04/12			735 * LN(AGE) + 406	
	09/18/12	175		4200
07/09/12			469 * LN(AGE) + 4035	
	08/02/12	128		6310
	08/09/12	135		6335
	08/23/12	149		6385
	09/18/12	175		6460
	10/25/12	212		6550
	10/26/12	213		6550
	11/09/12	227		6580
	11/15/12	233		6595

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Cemstone Ready Mix, Inc.
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fax (651) 688-0124
2025 Centre Pointe Boulevard, Suite 300
Mendota Heights, MN 55120-1221
www.cemstone.com EOE/AA

CONCRETE MIXTURE DESIGN

Revised On:
MIX ID: TC3161 Oct-31-07

MIX TYPE:	Contractor Specific Mix
CUSTOMER:	Element Material Technology
APPLICATION:	Anchor Bolt Testing
PLACEMENT:	Truck Discharge
STRENGTH:	2,500 psi to 4,000 psi Compressive Strength at 21-Days

CEMENT, Lehigh	(ASTM C 150/TYPE I)	370 lbs.	1.88 ft^3
SAND, Nelson	(ASTM C 33)	1,636 lbs. SSD	9.86 ft^3
3/4" GRAVEL, Nelson	(ASTM C 33/#67)	1,636 lbs. SSD	9.67 ft^3
WATER, **(Use All the Water When Batching)**		315 lbs. = 37.8 gal.	5.05 ft^3
AIR CONTENT,		2.0 %	0.54 ft^3
			27.00 ft^3

WATER-CEMENTITIOUS RATIO,	0.85
SLUMP, at Point of Truck Discharge	4.00 in. to 8.00 in.
CONCRETE UNIT WEIGHT,	146.5 pcf
MIX SUITABILITY FACTOR,	21.1

MIXTURE ADJUSTMENT: Material variation and job site conditions may require mixture adjustments to maintain strength, water-cementitious ratio, slump, air content, and yield.
DISCLAIMER: Cemstone disclaims and negates any warranty whatsoever of this concrete mix design if it is provided to, or used by, another concrete producer.
CONFIDENTIALITY: This concrete mix design is proprietary to, and confidential information of, Cemstone. Its disclosure to a third party or entity, or permitting it to be used in competition with Cemstone, is strictly prohibited and will subject you to an injunction and damages.

PREPARED BY:

Kevin D. Heindel, P.E.

Document Printed On: May-31-12

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phone 1-800-Cemstone or (651) 688-9292
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Mendota Heights, MN 55120-1221
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CONCRETE MIXTURE DESIGN

Revised On:
Sep-28-11

MIX ID: STO7551

MIX TYPE:	Contractor Specific Mix
CUSTOMER:	Element Material Technology
APPLICATION:	Concrete Anchor Testing
PLACEMENT:	Truck Discharge
STRENGTH:	7,500 psi Compressive Strength at 21-Days to 28-Days

CEMENT,	(ASTM C 150/TYPE I)	760 lbs.	3.87 ft^3
SAND,	(ASTM C 33)	1,270 lbs. SSD	7.65 ft^3
3/4" DOLOMITE,	(ASTM C 33/#67)	1,680 lbs. SSD	9.93 ft^3
WATER, **(Use All the Water When Batching)**		319 lbs. = 38.3 gal.	5.11 ft^3
AIR CONTENT,		2.0 %	0.54 ft^3
			27.10 ft^3
HRWRA,	(ASTM C 494/TYPE F)	23 oz. (3.0 oz/cwt)	

WATER-CEMENTITIOUS RATIO,	0.42
SLUMP, at Point of Truck Discharge	7.00 in.
CONCRETE UNIT WEIGHT,	148.7 pcf
MIX SUITABILITY FACTOR,	24.5

MIXTURE ADJUSTMENT: Material variation and job site conditions may require mixture adjustments to maintain strength, water-cementitious ratio, slump, air content, and yield.
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PREPARED BY:

Kevin D. Heindel, P.E.

Document Printed On: May-31-12

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fax (651) 688-0124
2025 Centre Pointe Boulevard, Suite 300
Mendota Heights, MN 55120-1221
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CONCRETE MIXTURE DESIGN

Created On:
Mar-15-12

MIX ID: EL7551

MIX TYPE:	Contractor Specific Mix
CONTRACTOR:	Element Material Technology
APPLICATION:	Anchor Bolt Testing
PLACEMENT:	Truck Discharge
STRENGTH:	6,500 psi to 8,500 psi Compressive Strength at 21-Days

CEMENT, Lehigh	(ASTM C 150/TYPE I)	850 lbs.	4.32 ft^3
SAND,	(ASTM C 33)	1,192 lbs. SSD	7.18 ft^3
3/8" GRAVEL,	(MnDOT 3137/CA-80)	280 lbs. SSD	1.67 ft^3
3/4" DOLO., Falkstone	(ASTM C 33/#67)	1,255 lbs. SSD	7.42 ft^3
WATER, **(Use All the Water When Batching)**		366 lbs. = 43.9 gal.	5.87 ft^3
ENTRAPPED AIR CONTENT,		2.0 %	0.54 ft^3
			27.00 ft^3

WATER-CEMENTITIOUS RATIO,	0.43
SLUMP, at point of truck discharge	4.00 in. to 6.00 in.
CONCRETE UNIT WEIGHT,	146.0 pcf
MIX SUITABILITY FACTOR,	27.8

MIXTURE ADJUSTMENT: Material variation and job site conditions may require mixture adjustments to maintain strength, water-cementitious ratio, slump, air content, and yield.
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PREPARED BY:

Kevin D. Heindel, P.E.

Document Printed On: Mar-15-12

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Cemstone Ready Mix, Inc.
phone 1-800-Cemstone or (651) 688-9292
fax (651) 688-0124
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Mendota Heights, MN 55120-1221
www.cemstone.com EOE/AA

CONCRETE MIXTURE DESIGN

MIX ID: EL3051

Created On: Jan-3-12

MIX TYPE: Contractor Specific Mix
CONTRACTOR: Element Material Technology
APPLICATION: Anchor Bolt Testing
PLACEMENT: Truck Discharge
STRENGTH: 2,500 psi to 4,000 psi Compressive Strength at 21-Days

CEMENT, Lehigh	(ASTM C 150/TYPE I)	370 lbs.	1.88 ft^3
SAND,	(ASTM C 33)	1,386 lbs. SSD	8.35 ft^3
3/8" GRAVEL,	(MnDOT 3137/CA-80)	300 lbs. SSD	1.79 ft^3
3/4" DOLO., Falkstone	(ASTM C 33/#67)	1,640 lbs. SSD	9.70 ft^3
WATER, **(Use All the Water When Batching)**		296 lbs. = 35.5 gal.	4.74 ft^3
ENTRAPPED AIR CONTENT,		2.0 %	0.54 ft^3
			27.00 ft^3

WATER-CEMENTITIOUS RATIO,	0.80
SLUMP, at point of truck discharge	4.00 in. to 6.00 in.
CONCRETE UNIT WEIGHT,	147.8 pcf
MIX SUITABILITY FACTOR,	21.3

MIXTURE ADJUSTMENT: Material variation and job site conditions may require mixture adjustments to maintain strength, water-cementitious ratio, slump, air content, and yield.
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PREPARED BY:

Kevin D. Heindel, P.E.

Document Printed On: Jan-3-12

BRAUN INTERTEC

Material Test Report

Minneapolis Laboratory
Braun Intertec Corporation
Phone: 952-995-2000

Report No: MAT:W11-000370-S1
Issue No: 1

Client: Lindsey Falk
Falkstone, LLC
PO Box 189 227 W 4th St
St. Ansgar, IA, 50472

Project: BL-11-02365
2011 Aggregate Testing
11001 Hampshire Ave S
Bloomington, MN, 55438

PM: Dallas D. Miner, dminer@BraunIntertec.com

Dallas Miner
Laboratory Supervisor
Date of Issue: 5/27/2011

Sample Details

Sample ID: W11-000370-S1
Alternate Sample ID:
Sampled By: Contractor
Sampling Method: ASTM D75/AASHTO T2 Stockpile
Date Sampled: 5/11/2011
Date Submitted: 5/11/2011
Specification: Class 5S (m) - ASTM C33
Source: Falkstone Quarry 93401
Material Type: 3/4" Limestone
Sample Location: Bed #3

Other Test Results

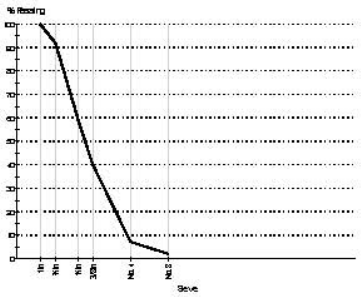
Description	Method	Result	Limits
Loss by abrasion and impact (%)	ASTM C 131 - 06	25	0 – 50
Grading designation		B	
Date Tested		5/17/2011	
Test Type	ASTM C 88 - 05	Coarse	
Preparation		Freshly Prepared	
Solution Type		Magnesium Sulfate	
Plus Number 4 (%)		93	
Total Weighted Coarse Loss (%)		17	0 – 18
Date Tested		5/26/2011	
Specific Gravity (OD)	ASTM C 127 - 07	2.67	
Specific Gravity (SSD)		2.71	
Apparent Specific Gravity		2.79	
Absorption (%)		1.6	
Additional Notes			
Date Tested		5/17/2011	

Particle Size Distribution

Method: ASTM C 136 - 06, ASTM C 117 - 04
Drying by: Oven
Date Tested: 5/12/2011

Sieve Size	% Passing	Limits
1in (25.0mm)	100	
¾in (19.0mm)	92	
½in (12.5mm)	59	
3/8in (9.5mm)	40	
No.4 (4.75mm)	7	
No.8 (2.36mm)	2	
Finer No.200 (75µm)	0.4	0 – 1

Chart



Comments
The test results meet the above referenced specifications.

(c) 2000-2009 QESTLab by SpectraQEST.com

BRAUN INTERTEC

Soundness Test Report

Minneapolis Laboratory
Braun Intertec Corporation
Phone: 952-995-2000

Report No: SSS:W11-000370-S1
Issue No: 1

Client: Lindsey Falk
Falkstone, LLC
PO Box 189 227 W 4th St
St. Ansgar, IA, 50472

Project: BL-11-02365
2011 Aggregate Testing
11001 Hampshire Ave S
Bloomington, MN, 55438

PM: Dallas D. Miner, dminer@BraunIntertec.com

Dallas Miner
Laboratory Supervisor
Date of Issue: 5/27/2011

Sample Details

Sample ID:	W11-000370-S1	**Alternate Sample ID:**	
Sampled By:	Contractor	**Date Sampled:**	5/11/2011
Sampling Method:	ASTM D75/AASHTO T2 Stockpile	**Source:**	Falkstone Quarry 93401
Material:	3/4" Limestone	**Specification:**	Class 5S (m) - ASTM C33
Sample Location:	Bed #3		

General Test Information

ASTM C 88 - 05

Test Type:	Coarse	**Preparation:**	Freshly Prepared
Solution Type:	Magnesium Sulfate	**Plus Number 4 (%):**	93
Total Weighted Coarse Loss (%):	17	0 – 18	

Coarse Aggregate

Sieve Size	Gradation of Original Sample (%)	Weight of Test Fractions Before Test (g)	Percentage Passing Designated Sieve After Test (%)	Weighted Percentage Loss (%)
37.5mm (1½in) to 19.0mm (¾in)	8	523.8	8.3	0.7
19.0mm (¾in) to 9.5mm (3/8in)	52	1005.8	13.8	7.2
9.5mm (3/8in) to 4.75mm (No.4)	33	304.2	24.2	8.0
< 4.75mm (No.4)	7		24.2	1.6

Comments

The test results meet the above referenced specifications.

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EAR CONTROLLED

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

REPORT OF TEST OF FINE AGGREGATE

PROJECT:

2012 MATERIAL CHECK

REPORTED TO:

AGGREGATE INDUSTRIES
2915 WATERS ROAD
SUITE 105
EAGAN, MN 55121

ATTN: MARK BINTZLER
CC: TOM SCHMIT

AET PROJECT NO: 20-11041

DATE: FEBRUARY 25, 2012

SAMPLE NUMBER: 1
SAMPLE IDENTIFICATION: Nelson
TYPE OF AGGREGATE: Concrete Sand

MECHANICAL ANALYSIS	ASTM:C136	HISTORICAL 2011 AVERAGE	ASTM:C33-11, 5S SPECIFICATIONS
Passing 3/8" (9.5 mm)	100%	100%	100%
#4 (4.75 mm)	99	99	95 – 100
#8 (2.36 mm)	91	92	80 – 100
#16 (1.18 mm)	78	78	50 – 85
#30 (600 μm)	50	43	25 – 60
#50(300 μm)	17	12	5 – 30
#100 (150 μm)	4.0	2.2	0 - 10
#200 (75 μm)	1.7	0.8	-
Fineness Modulus	2.61	2.75	2.3 – 3.1

SPECIFIC GRAVITY, ASTM:C128
Bulk/Apparent/Bulk (SSD) 2.536/2.598/2.560

ABSORPTION, %, ASTM:C128 1.0

UNIT WEIGHT, pcf, ASTM:C29
Dry rodded/loose 109.4/103.4

VOIDS, ASTM:C29
Dry rodded/loose 30.7/34.6

550 Cleveland Avenue North | St. Paul, MN 55114
Phone 651-659-9001 | Toll Free 800-972-6364 | Fax 651-659-1379 | www.amengtest.com | AA/EEO
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AET Project No. 20-11041 Nelson Concrete Sand

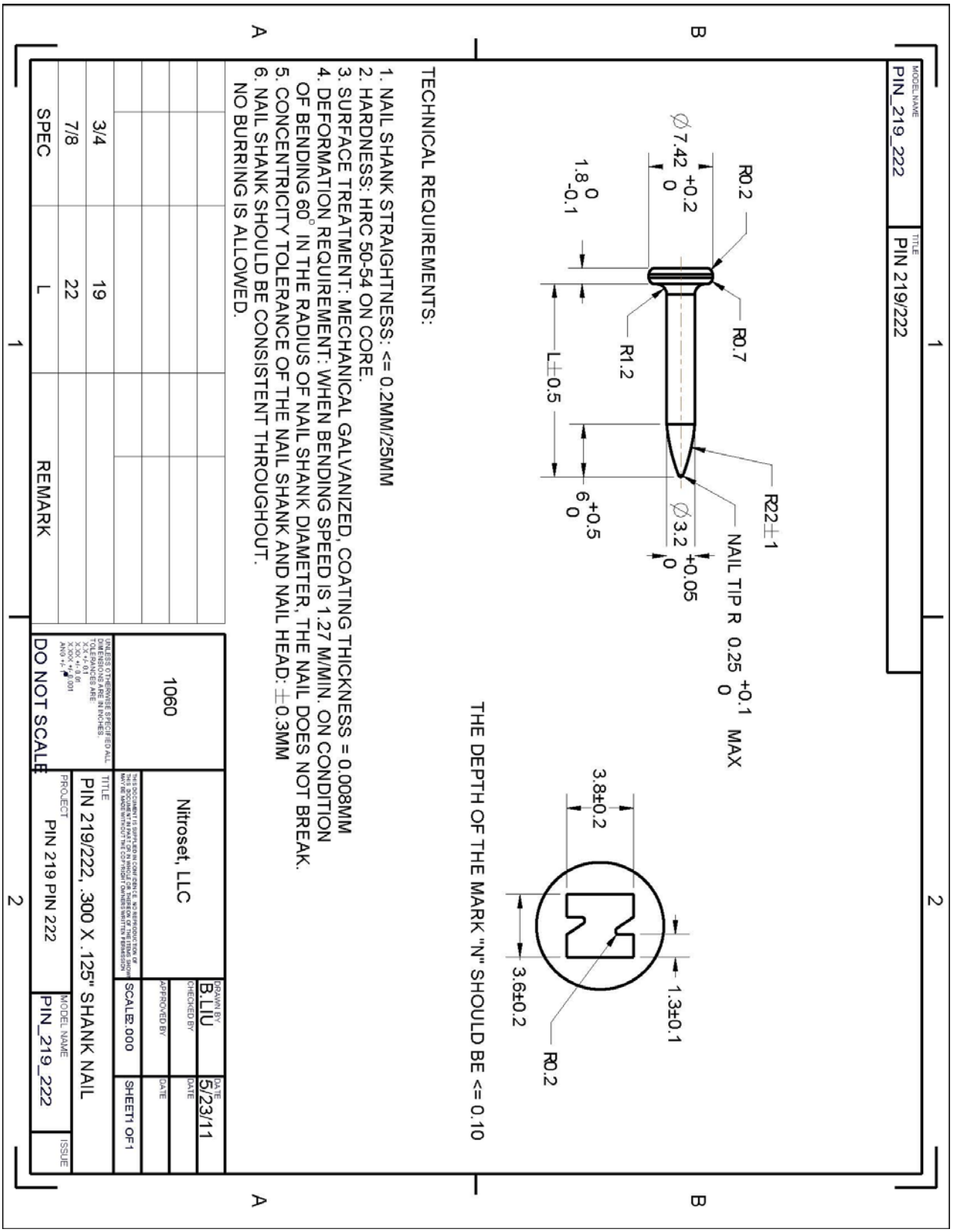
		ASTM:C33-11, 5S SPECIFICATIONS
DELETERIOUS SUBSTANCES:		
MATERIAL FINER THAN #200,75μm %ASTM:C117	1.3	Max. 5.0%, 3.0% for concrete subject to abrasion
CLAY LUMPS & FRIABLE PARTICLES, %ASTM:C142	1.3	Max. 3.0%
ORGANIC IMPURITIES, ASTM:C40	Plate 1 or less	Plate 3 or less
LIGHTWEIGHT PARTICLES, Sp. Grav. Under 2.4, ASTM:C123 A. Total%	1.1	
LIGHTWEIGHT PARTICLES, Sp. Grav. Under 2.0, ASTM:C123 A. Coal and Lignite %	0.00	Max. 1.0, 0.5% where surface appearance of concrete is important
B. Total %	0.2	-
pH: EPA Method 9045C	8.58	
SAND EQUIVALENT, ASTM:D2419	90	
SOUNDNESS LOSS, % ASTM:C88	6.4	Max. 15%

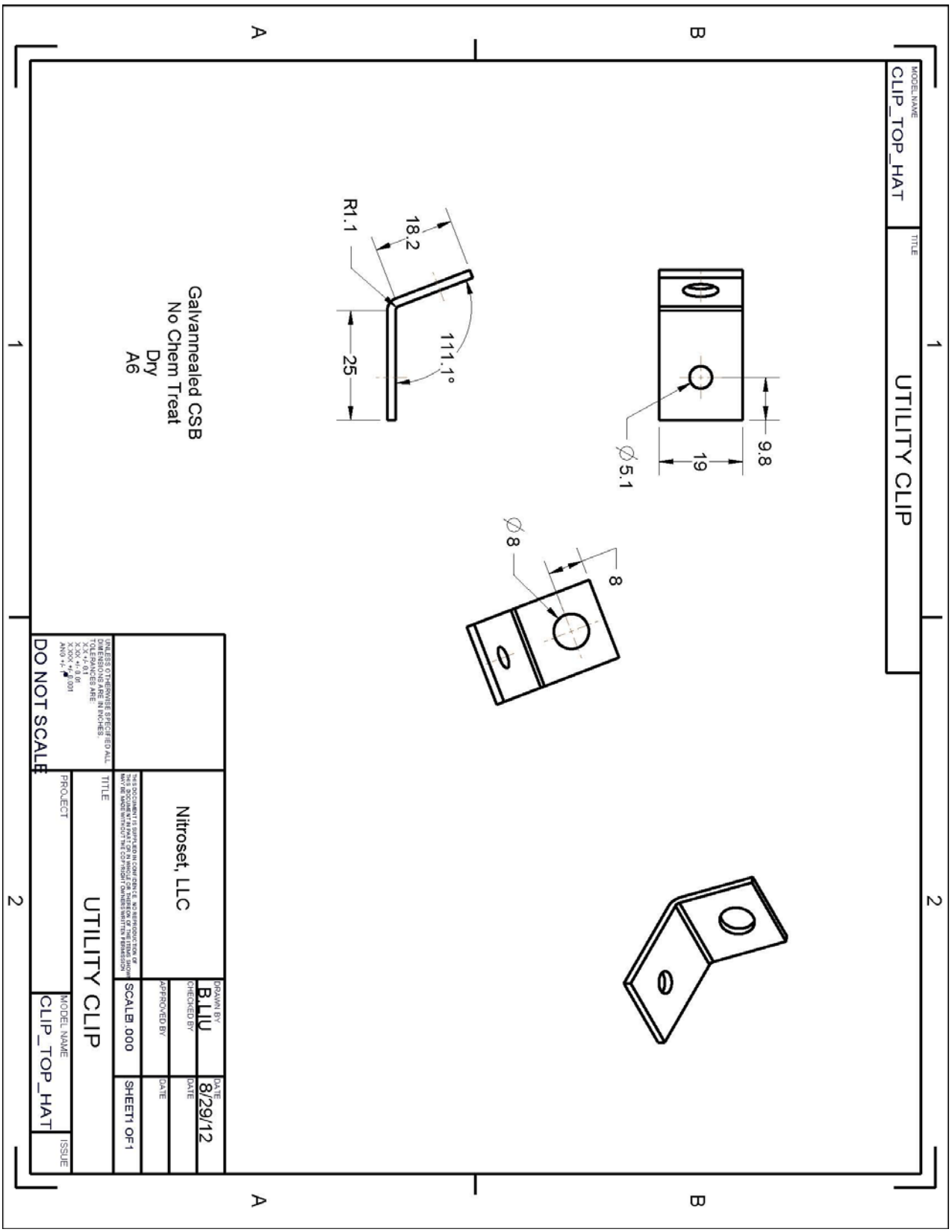
Magnesium Sulfate Soundness Results:
ASTM:C88

Sieve Size	Grading of Original Sample,%	Weight of Test Fraction Before Test, grams	Weight of Test Fraction After Test, grams	Percent Material Passing, Sieve After Test	Weighted Average Loss, %
#4-#8	7.6	100.4	81.5	18.8	1.4
#8-#16	13.5	100.5	90.7	9.8	1.3
#16-#30	27.6	100.3	93.1	7.2	2.0
#30-#50	32.6	100.2	95.0	5.2	1.7
#50-down	18.7	-	-	-	-
TOTALS	100.0	401.4	360.3	-	6.4

Historical data is based on gradations performed during production in 2011.

APPENDIX C – PRODUCT DRAWINGS:

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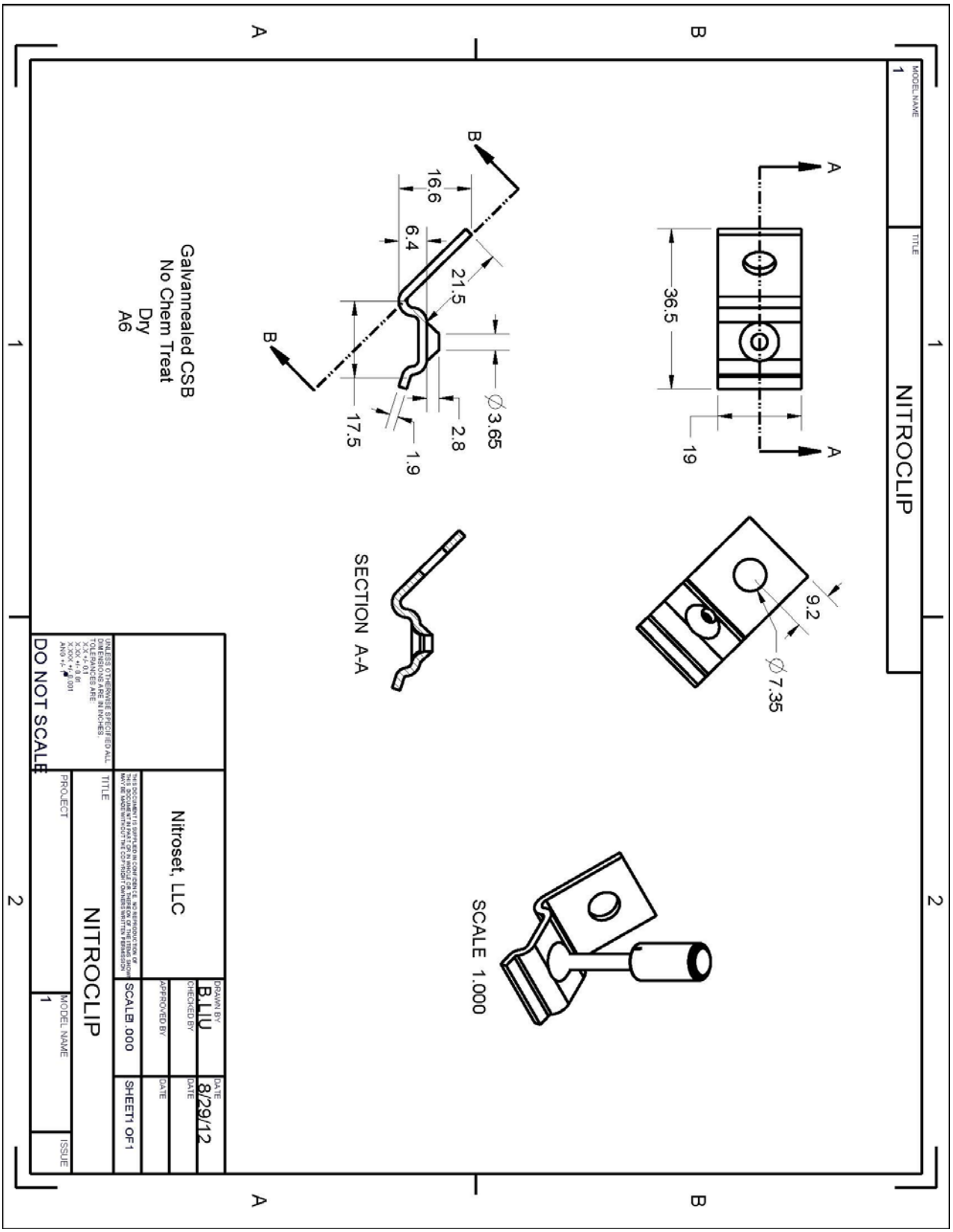
TITLE
UTILITY CLIP
Galvannealed CSB
No Chem Treat
Dry
A6
R1.1
18.2
111.1°
25
Ø5.1
19
9.8
Ø8
8
Nitroset, LLC
DRAWN BY
B.LIU
DATE
8/29/12
CHECKED BY
APPROVED BY
DATE
SCALE .000
SHEET1 OF 1
TITLE
UTILITY CLIP
PROJECT
MODEL NAME
CLIP_TOP_HAT
ISSUE
DO NOT SCALE


NITROCLIP
MODEL NAME
TITLE
Galvannealed CSB
No Chem Treat
Dry
A6
16.6
6.4
21.5
17.5
1.9
2.8
Ø3.65
36.5
19
9.2
Ø7.35
SECTION A-A
SCALE 1.000
DO NOT SCALE
Nitroset, LLC
NITROCLIP
PROJECT
MODEL NAME
ISSUE
DRAWN BY
B.LIU
CHECKED BY
APPROVED BY
DATE
8/29/12
SCALE1.000
SHEET1 OF1

APPENDIX D – MATERIAL VERFICTION:

Part No.: CLAS325
Description: Pin
Material: 1060
Specification: NS

MICROHARDNESS

A cross section of the sample was prepared in accordance with ASTM E3-01 and viewed at 500X using a load of 100g. Conversions are from equations in ASTM E140-07 Appendix X1.1.1 - Non-austenitic Steel Vickers to HRC.

Sample ID	Average of 3 Vickers Hardness Readings	Converted	Converted Scale	Requirement
1	617	56	HRC	NA

DATA PRESENTED FOR INFORMATION ONLY

CHEMISTRY

Element		Result %	Min %	Max %
C	=	0.58	0.55	0.65
Mn	=	0.66	0.60	0.90
P	=	0.016	0.000	0.040
S	=	0.014	0.000	0.050
Si	=	0.23	0.00	NS
Cr	=	0.04	0.00	NS
Ni	=	0.02	0.00	NS
Mo	<	0.01	0.00	NS
Cu	=	0.03	0.00	NS
Fe	=	Balance	Balance	Balance

Chemical analysis conducted in accordance with SOP Chem-10: "Analysis of Metals Samples Using the Thermo Electron ARL Quantris Optical Emission Spectrometer"

DATA PRESENTED FOR INFORMATION ONLY

Part No.: CLAS332
Description: Pin
Material: 1060
Specification: NS

MICROHARDNESS

A cross section of the sample was prepared in accordance with ASTM E3-01 and viewed at 500X using a load of 100g. Conversions are from equations in ASTM E140-07 Appendix X1.1.1 - Non-austenitic Steel Vickers to HRC.

Sample ID	Average of 3 Vickers Hardness Readings	Converted	Converted Scale	Requirement
2	608	56	HRC	NA

DATA PRESENTED FOR INFORMATION ONLY

CHEMISTRY

Element		Result %	Min %	Max %
C	=	0.65	0.55	0.65
Mn	=	0.61	0.60	0.90
P	=	0.025	0.000	0.040
S	=	0.019	0.000	0.050
Si	=	0.29	0.00	NS
Cr	=	0.03	0.00	NS
Ni	=	0.02	0.00	NS
Mo	<	0.01	0.00	NS
Cu	=	0.04	0.00	NS
Fe	=	Balance	Balance	Balance

Chemical analysis conducted in accordance with SOP Chem-10: "Analysis of Metals Samples Using the Thermo Electron ARL Quantris Optical Emission Spectrometer"

DATA PRESENTED FOR INFORMATION ONLY

Part No.: CLAS532
Description: Pin
Material: Similar to 1034
Specification: NS

MICROHARDNESS

A cross section of the sample was prepared in accordance with ASTM E3-01 and viewed at 500X using a load of 100g. Conversions are from equations in ASTM E140-07 Appendix X1.1.1 - Non-austenitic Steel Vickers to HRC.

Sample ID	Average of 3 Vickers Hardness Readings	Converted	Converted Scale	Requirement
3	514	50	HRC	NA

DATA PRESENTED FOR INFORMATION ONLY

CHEMISTRY

Element		Result %	Min %	Max %	
C	=	0.39	0.32	0.38	HIGH
Mn	=	0.48	0.50	0.80	LOW
P	=	0.020	0.000	0.040	
S	=	0.018	0.000	0.050	
Si	=	0.25	0.00	NS	
Cr	=	0.05	0.00	NS	
Ni	=	0.02	0.00	NS	
Mo	<	0.01	0.00	NS	
Cu	=	0.02	0.00	NS	
Fe	=	Balance	Balance	Balance	

Chemical analysis conducted in accordance with SOP Chem-10: "Analysis of Metals Samples Using the Thermo Electron ARL Quantris Optical Emission Spectrometer"

DATA PRESENTED FOR INFORMATION ONLY

Part No.: CLU222
Description: Pin
Material: Similar to 1060
Specification: NS

MICROHARDNESS

A cross section of the sample was prepared in accordance with ASTM E3-01 and viewed at 500X using a load of 100g. Conversions are from equations in ASTM E140-07 Appendix X1.1.1 - Non-austenitic Steel Vickers to HRC.

Sample ID	Average of 3 Vickers Hardness Readings	Converted	Converted Scale	Requirement
4	574	54	HRC	NA

DATA PRESENTED FOR INFORMATION ONLY

CHEMISTRY

Element		Result %	Min %	Max %	
C	=	0.60	0.55	0.65	
Mn	=	0.49	0.60	0.90	LOW
P	=	0.042	0.000	0.040	HIGH
S	=	0.024	0.000	0.050	
Si	=	0.28	0.00	NS	
Cr	=	0.05	0.00	NS	
Ni	=	0.02	0.00	NS	
Mo	<	0.01	0.00	NS	
Cu	=	0.03	0.00	NS	
Fe	=	Balance	Balance	Balance	

Chemical analysis conducted in accordance with SOP Chem-10: "Analysis of Metals Samples Using the Thermo Electron ARL Quantris Optical Emission Spectrometer"

DATA PRESENTED FOR INFORMATION ONLY

Part No.: CLAS325
Description: Clip
Material: 1018
Specification: NS

HARDNESS

Sample ID	Results (HRBW)
6	71

Hardness testing conducted in accordance with ASTM E18-11: "Standard Test Methods for Rockwell Hardness of Metallic Materials"

DATA PRESENTED FOR INFORMATION ONLY

CHEMISTRY

Element		Result %	Min %	Max %
C	=	0.17	0.15	0.20
Mn	=	0.60	0.60	0.90
P	=	0.007	0.000	0.040
S	=	0.020	0.000	0.050
Si	=	0.21	0.00	NS
Cr	=	0.02	0.00	NS
Ni	=	0.01	0.00	NS
Mo	=	0.01	0.00	NS
Cu	=	0.03	0.00	NS
Al	=	0.04	0.00	NS
Fe	=	Balance	Balance	Balance

Chemical analysis conducted in accordance with SOP Chem-10: "Analysis of Metals Samples Using the Thermo Electron ARL Quantris Optical Emission Spectrometer"

DATA PRESENTED FOR INFORMATION ONLY

Part No.: CLAS332
Description: Clip
Material: 1009
Specification: NS

HARDNESS

Sample ID	Results (HRBW)
7	74

Hardness testing conducted in accordance with ASTM E18-11: "Standard Test Methods for Rockwell Hardness of Metallic Materials"

DATA PRESENTED FOR INFORMATION ONLY

CHEMISTRY

Element		Result %	Min %	Max %
C	=	0.11	0.00	0.15
Mn	=	0.49	0.00	0.60
P	=	0.011	0.000	0.040
S	=	0.015	0.000	0.050
Si	=	0.21	0.00	NS
Cr	=	0.03	0.00	NS
Ni	=	0.01	0.00	NS
Mo	=	0.01	0.00	NS
Cu	=	0.04	0.00	NS
Al	=	0.02	0.00	NS
Fe	=	Balance	Balance	Balance

Chemical analysis conducted in accordance with SOP Chem-10: "Analysis of Metals Samples Using the Thermo Electron ARL Quantris Optical Emission Spectrometer"

DATA PRESENTED FOR INFORMATION ONLY

Part No.: CLAS532
Description: Clip
Material: 1009
Specification: NS

HARDNESS

Sample ID	Results (HRBW)
8	77

Hardness testing conducted in accordance with ASTM E18-11: "Standard Test Methods for Rockwell Hardness of Metallic Materials"

DATA PRESENTED FOR INFORMATION ONLY

CHEMISTRY

Element		Result %	Min %	Max %
C	=	0.10	0.00	0.15
Mn	=	0.49	0.00	0.60
P	=	0.014	0.000	0.040
S	=	0.017	0.000	0.050
Si	=	0.22	0.00	NS
Cr	=	0.03	0.00	NS
Ni	=	0.01	0.00	NS
Mo	=	0.01	0.00	NS
Cu	=	0.04	0.00	NS
Al	=	0.02	0.00	NS
Fe	=	Balance	Balance	Balance

Chemical analysis conducted in accordance with SOP Chem-10: "Analysis of Metals Samples Using the Thermo Electron ARL Quantris Optical Emission Spectrometer"

DATA PRESENTED FOR INFORMATION ONLY

Part No.: CLU222
Description: Clip
Material: 1009
Specification: NS

HARDNESS

Sample ID	Results (HRBW)
9	62

Hardness testing conducted in accordance with ASTM E18-11: "Standard Test Methods for Rockwell Hardness of Metallic Materials"

DATA PRESENTED FOR INFORMATION ONLY

CHEMISTRY

Element		Result %	Min %	Max %
C	=	0.07	0.00	0.15
Mn	=	0.42	0.00	0.60
P	=	0.004	0.000	0.040
S	=	0.014	0.000	0.050
Si	=	0.03	0.00	NS
Cr	=	0.01	0.00	NS
Ni	=	0.01	0.00	NS
Mo	=	0.01	0.00	NS
Cu	=	0.01	0.00	NS
Al	=	0.04	0.00	NS
Fe	=	Balance	Balance	Balance

Chemical analysis conducted in accordance with SOP Chem-10: "Analysis of Metals Samples Using the Thermo Electron ARL Quantris Optical Emission Spectrometer"

DATA PRESENTED FOR INFORMATION ONLY

APPENDIX E- LOAD CALCULATIONS:

The allowable loads noted in Table 2 of this report were derived from the testing completed as noted and using our interpretation of AC70, Section 3 in particular. The following paragraphs will depict sample calculations of how the allowable loads stated in Table 2 were obtained.

The main basis of the allowable load was from equation 3-1

$$F_{all} = (F * R * R_f) / \Omega$$

F = Average ultimate load (lbf) of test

Ω = Safety factor determined in accordance with Section 3.3.2

R = Most severe base material reduction factor.

R_f = Fastener based reduction factor.

$$\Omega = [3.5 / (1\text{-}2 * COV)] \geq 5 \qquad \text{equation 3-2}$$

$$R_c = \text{sqrt}\ (f'_c / f'_{c,test}) \qquad \text{equation 3-3}$$

$$R_s = 1\text{-}[(F_{u,test} - F_u) / 100] \qquad \text{equation 3-4}$$

$$R_f = H_c / H_{c,test} \qquad \text{equation 3-5}$$

For fastener testing of 10 replicates that had a COV ≤ 15% the following calculation was performed:

Example referenced CLAS325 4,000 psi, tension

COV = 14.0% therefore Use average ultimate load F = 769 (lbf)

$\Omega = [3.5 / (1\text{-}2 * 0.140)]$ $\Omega = 4.9$ therefore $\Omega = 5$

R = sqrt (4000 / 3840) R = 1.02 therefore R = 1.0

$R_f = 50 / 56$ $R_f = 0.89$ therefore Rf = 0.89

137 (lbf) = (769 (lbf) * 1 * 0.89) / 5

For fastener testing of 10 replicates that had a COV > 15% the following calculation was performed:

Example referenced CLU222 4,000 psi, tension

COV = 20.0% therefore	Use lowest ultimate load	F = 598 (lbf)
Ω = [3.5 / (1-2 * 0.202)]	Ω = 5.9	therefore Ω = 5 based on exception 3.3.1
R = sqrt (4000 / 4275)	R = 0.97	therefore R = 1.0 based on exception 3.3.3.1
R_f = 50 / 56	R_f = 0.89	therefore Rf = 0.89

107 (lbf) = (598 (lbf) * 1 * 0.89) / 5

A complete table showing all tests and calculated values is shown in Figures 1a, 1b, 2a and 2b on the following pages.

Substrate	Pin ID	Direction	Test Load for Test Replicate (lbf)										Test Count
			1	2	3	4	5	6	7	8	9	10	
4000 psi NWC	CLU222	Tension	1088 CC	612 PO	1089 CC	833 CC	719 CC	857 CC	911 PO	825 PO	797 SB	598 CC	10
		Shear	1020 PO	1042 PO	824 PO	1147 PO	1300 PO	1182 PO	1302 PO	1277 PO	1424 PO	1464 PO	10
		Oblique	987 CC	1013 PO	684 PO	642 PO	602 PO	869 CC	606 PO	784 CC	798 CC	635 CC	10
	CLAS325	Tension	722 PO	648 PO	583 PO	836 PO	909 PO	825 PO	799 CC	910 PO	696 PO	763 PO	10
		Shear	1290 PO	1036 PO	964 PO	804 PO	1394 SB	1271 PO	807 PO	868 PO	1093 PO	897 PO	10
	CLAS332	Tension	1148 PO	1029 PO	1376 PO	1108 PO	1642 PO	936 PO	1038 PO	1396 PO	1400 PO	964 PO	10
		Shear	1573 SB	1462 SB	1526 SB	1536 SB	1595 SB	1224 PO	1764 SB	1569 SB	1643 SB	1619 SB	10
	CLAS525	Tension	665 PO	727 PO	780 PO	761 PO	789 PO	713 PO	805 PO	1080 PO	871 PO	708 PO	10
		Shear	1209 PO	1202 PO	1194 PO	1151 PO	1222 PO	1117 PO	1167 PO	1186 PO	1214 PO	1439 PO	10
		Oblique	1254 PO	1289 PO	873 PO	1210 PO	757 PO	966 PO	898 PO	1148 PO	841 PO	768 PO	10
	CLAS532	Tension	904 PO	1085 PO	1323 PO	1204 SB	955 SB	1121 SB	1019 PO	751 PO	785 PO	963 PO	10
		Shear	1313 PO	817 PO/CS	1434 SB	1287 SB	835 PO/HA	737 PO	958 PO	1362 SB	1347 PO	1330 SB	10
		Oblique	1124 PO	1004 PO	1154 SB	980 PO	1324 SB	1080 SB	843 PO	1158 PO	833 PO	1125 SB	10

Definitions:

ST - Steel Pin
PO - Pin Pull Out
CS - Concrete Spall
CC - Concrete Cone
HA - Hit Aggergate
SB - Steel Body of Clip
BP - Bent Pin

Figure 1a – (1 of 2) Calculations of Allowable Loads: CLU222, CLAS325, CLAS332, CLAS525 and CLAS532 4,000 psi NWC

Substrate	Pin ID	Direction	$f'_{c,test}$ (psi)	$f'_{u,test}$	$H'_{c,test}$	F (Average Ultimate Load) lbf.	COV	Minum Ultimate Load (lbf.)	(3-1)	(3-2)	(3-3)	(3-4)	(3-5)
4000 psi NWC	CLU222	Tension	4275	n/a	56	833	**0.202**	598	107	6	1.00	1.00	0.89
		Shear	4280	n/a	56	1198	**0.164**	824	147	5	1.00	1.00	0.89
		Oblique	4200	n/a	56	762	**0.202**	602	108	6	1.00	1.00	0.89
	CLAS325	Tension	3840	n/a	56	769	0.140	583	137	5	1.00	1.00	0.89
		Shear	3840	n/a	56	1042	**0.205**	804	144	6	1.00	1.00	0.89
	CLAS332	Tension	3795	n/a	56	1204	**0.195**	936	167	6	1.00	1.00	0.89
		Shear	3795	n/a	56	1551	0.090	1224	277	5	1.00	1.00	0.89
	CLAS525	Tension	4070	n/a	56	790	0.149	665	141	5	1.00	1.00	0.89
		Shear	4070	n/a	56	1210	0.072	1117	216	5	1.00	1.00	0.89
		Oblique	4085	n/a	56	1000	**0.205**	757	135	6	1.00	1.00	0.89
	CLAS532	Tension	3910	n/a	56	1011	**0.177**	751	134	5	1.00	1.00	0.89
		Shear	3910	n/a	56	1142	**0.237**	737	132	7	1.00	1.00	0.89
		Oblique	4185	n/a	56	1063	0.142	833	190	5	1.00	1.00	0.89

Figure 1b – (2 of 2) Calculations of Allowable Loads: CLU222, CLAS325, CLAS332, CLAS525 and CLAS532 4,000 psi NWC

Substrate	Pin ID	Direction	Test Load for Test Replicate (lbf)										Test Count
			1	2	3	4	5	6	7	8	9	10	
6000 psi NWC	CLU222	Tension	748 PO	910 PO	987 PO	647 PO	697 PO - HA	723 PO	576 PO	868 PO	972 PO	847 PO	10
		Shear	1523 PO	1508 PO	1372 PO	1539 PO	1417 PO	1236 PO	1214 PO	1222 PO	1159 PO	1606 PO	10
		Oblique	1166 PO	1006 CC	985 CC	1013 PO	901 PO	1016 CC	955 PO	1168 PO	1084 CC	1143 PO	10
	CLAS325	Tension	795 PO	567 PO	684 PO	539 PO	708 PO	727 PO	569 PO	515 PO	607 PO	591 PO	10
		Shear	1109 PO	1050 PO	1158 PO	1287 PO	618 PO	846 PO	1305 SB	1014 PO	1024 PO	611 PO	10
	CLAS332	Tension	1022 PO	1085 PO	1067 PO	1349 PO	943 PO	1307 PO	1732 SB	1054 PO	1081 PO	925 PO	10
		Shear	1327 PO	1470 SB	1607 SB	1551 SB	1287 PO	1443 SB	1406 SB	1044 PO	1354 SB	1322 SB	10
	CLAS525	Tension	1340 PO	1240 PO	1395 CC	1085 PO	1406 PO	816 BP	1134 PO	1278 PO	1188 PO	1408 PO	10
		Shear	1539 PO	1655 PO	997 PO	1567 PO	1057 PO	1028 PO	1310 PO	1154 PO	1566 PO	919 PO	10
		Oblique	1087 PO	1154 PO	1640 SB	1178 PO	973 PO	1586 PO	1447 PO	839 PO	899 PO	1195 PO	10
	CLAS532	Tension	901 SB	854 PO	1060 PO	988 PO	1284 PO	948 PO	1261 PO	890 SB	856 SB	1494 SB	10
		Shear	730 PO	1219 SB	1281 SB	1360 SB	1006 SB	1345 SB	1137 SB	1435 SB	1509 SB	1349 SB	10
		Oblique	1085 SB	1294 SB	1196 SB	759 SB	786 PO - HA	1251 SB	1183 SB	1167 SB	1219 SB	1254 SB	10

Definitions:

ST - Steel Pin
PO - Pin Pull Out
CS - Concrete Spall
CC - Concrete Cone
HA - Hit Aggergate
SB - Steel Body of Clip
BP - Bent Pin

Figure 2a - (1 of 2) Calculations for Allowable Loads CLU222, CLAS325, CLAS332, CLAS525 and CLAS532 4,000 psi NWC

Substrate	Pin ID	Direction	$f'_{c,test}$ (psi)	$f'_{u,test}$	$H'_{c,test}$	F (Average Ultimate Load)	COV	Minum Ultimate Load (lbf.)	(3-1)	(3-2)	(3-3)	(3-4)	(3-5)
6000 psi NWC	CLU222	Tension	6335	n/a	56	798	**0.175**	576	103	5	1.00	1.00	0.89
		Shear	6385	n/a	56	1380	0.118	1159	246	5	1.00	1.00	0.89
		Oblique	6460	n/a	56	1044	0.088	901	186	5	1.00	1.00	0.89
	CLAS325	Tension	6550	n/a	56	630	0.147	515	113	5	1.00	1.00	0.89
		Shear	6550	n/a	56	1002	**0.244**	611	109	7	1.00	1.00	0.89
	CLAS332	Tension	6960	n/a	56	1157	**0.211**	925	153	6	0.93	1.00	0.89
		Shear	6960	n/a	56	1381	0.114	1044	229	5	0.93	1.00	0.89
	CLAS525	Tension	6580	n/a	56	1229	**0.150**	816	146	5	1.00	1.00	0.89
		Shear	6580	n/a	56	1279	**0.220**	919	164	6	1.00	1.00	0.89
		Oblique	6595	n/a	56	1200	**0.231**	839	150	7	1.00	1.00	0.89
	CLAS532	Tension	6590	n/a	56	1054	**0.209**	854	153	6	1.00	1.00	0.89
		Shear	6590	n/a	56	1237	**0.186**	730	130	6	1.00	1.00	0.89
		Oblique	6310	n/a	56	1119	**0.171**	759	136	5	1.00	1.00	0.89

Figure 2b - (2 of 2) Calculations for Allowable Loads CLU222, CLAS325, CLAS332, CLAS525 and CLAS532 4,000 psi NWC