



12 & 13 TOWER ANCHOR RODS (TYPE 1 & 2)

(2007-2008) – 424 Rods

Fabrication Process

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Tower Anchor Rods

2009-2010 TIMELINE

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ADDITIONAL DOCUMENTS

ASTM A123
ASTM A143
ASTM A153
ASTM A354
ASTM A490

Location and Item	Component Description	Rod (no head) or Bolt (with head)	Threads Cut or Rolled	Supplier	Diameter (in)	Overall Length (ft)	Overall Length (mm)	Quantity Installed (not including spares)	De-Humidified Zone?	Tighten Method	Final Tension (fraction of Fu or UTS)	Date Tension or Loading Complete	Date Re-Inspected (by 4/8/13)	Date Re-Inspected (by 4/23/13)	Date Re-Inspected (by 5/5/13)	Notes		
E2 Bearings and Shear Keys	1	E2 Shear Key - Connect to Concrete - Above Column, Under OBG [S1, S2]	rod	Cut	Dyson	3	17.2 10.0	5235 3035	60 36	96	No	Tension	0.7	3/5/2013	daily check	daily check	daily check	Tensioned to 0.75 Fy, with lockoff at ~ 0.7 Fu 32 of 96 rods broke after tensioning, then tension level lowered
	2	E2 Shear Key - Connect to Concrete - Above Bent Cap, Under Crossbeam [S3, S4]	rod	Cut	Dyson	3	21.9	6676	96									192
		E2 Bearing - Connect to Concrete - Under OBG [B1, B2, B3, B4]	rod	Cut	Dyson	3	22.6 22.2	6902 6777	64 32	320	No	Tension	0.7	4/9/2013	daily check	daily check	daily check	
	3	E2 Shear Key - Connect to OBG [S1, S2]	rod	Cut	Dyson	3	4.4 1.8	1337 537	96 64									320
		E2 Shear Key - Connect to Crossbeam [S3, S4]	rod	Cut	Dyson	3	4.3 1.7	1312 512	96 64	224	No	Tension	0.7	9/12/2012	4/6/2013	4/17/13 to 4/23/13	5/3/2013	
	4	E2 Bearing - Connect to OBG [B1, B2, B3, B4]	rod	Cut	Dyson	2	3.6	1105	224									No
	5	E2 Bearing Assembly Bolts (Spherical Bushing Halves)	rod	Cut	Dyson for Lubrite for Hochang	1	2.4	733	96	No	Tension	0.61	July 2009	not accessible	not accessible	not accessible	Connect 2 halves of the spherical bushing assembly housing together at Lubrite; rods are internal to bearings and all rods are not accessible after bearing assembly at Hochang (December 2009 & January 2010); rods tensioned to 0.7 Fy.	
6	E2 Bearing Assembly Bolts (Retaining Rings)	Socket Head Cap Screw	Cut	Dyson for Hochang	1	0.2	55	336	No	snug + 1/4 turn	~0.4	January 2010	4/6/2013 (for 32 accessible bolts)	4/23/2013 (for 32 accessible bolts)	5/3/2013 (for 32 accessible bolts)	Bolts thread into drill and tap holes to attach retaining rings that secure the Lubrite spherical bushing assembly in the bottom housing; bolts are mechanically galvanized, not hot dip galvanized; bolts are internal to bearings and not accessible after bearing assembly at Hochang, except for a small number of bolts in limited areas -> 32 of 336 bolts are accessible.		
Cable Anchorage	7	PWS Anchor Rods - PWS Socket to Anchorage	rod	55 Cut (20%) 219 Rolled (80%)	Dyson	3-1/2	27.9 to 31.8	8500 to 9700	274	Yes	Load Transfer	0.26	9/26/2012	4/6/2013	4/20&22/2013	5/4/2013	With DL after load transfer (current condition)	
												0.29	N/A	N/A	N/A	N/A	With DL + Added DL	
												0.32	N/A	N/A	N/A	N/A	Service Load (Group 1)	
												0.35	N/A	N/A	N/A	N/A	SEE (Seismic)	
Top of Tower	8	Tower Saddle Tie Rods	rod	Rolled	Dyson	4	6.0 to 17.5	1840 to 5325	25	Yes	Tension	0.41	7/14/2012	N/A	N/A	N/A	Load During Construction - Tensioned to 0.5 Fy	
												0.68	N/A	4/6/2013	4/19/2013	5/3/2013	Additional tension in tie rods from cable with service load	
	9	Turned Rods at Tower Saddle Segment Splices	rod	Cut	Dyson	3 @ Threads [-3-1/16 @ Shank]	1.5 1.4	463 415	100 8	108	Yes	Tension	0.45	4/6/2011	4/6/2013	4/19/2013	5/3/2013	Located at the 2 field splices connecting the 3 tower saddle segments; 100 rods tensioned prior to saddle erection; 8 rods only snug tight after tie rod tensioning due to conflict with tie rods.
												snug	~0.1	7/14/2012				
10	Tower Saddle to Grillage Anchor Bolts	Hex Bolt	Cut	Dyson	3	1.2	360	90	Head Yes, Nut No	snug	~0.1	3/25/2013	4/6/2013	4/19/2013	5/3/2013	Snug tightened before and after load transfer: Initial Tension complete on 5/20/2011; final tension complete on 3/25/2013.		
11	Tower Outrigger Boom (for Maintenance) at Top of Tower	Hex Bolt	Cut	Dyson	3	2.1	630	4	No	snug	~0.1	July 2012	4/6/2013	4/19/2013	5/4/2013	Act as pins for swinging out and then securing the maintenance outrigger boom at the top of 2 of 4 tower head chimneys. At each boom, one bolt is loaded and other bolt is unloaded in the current boom position. The currently unloaded bolt will be installed snug tight when the boom is swung out for use (future position).		
Bottom of Tower	12	Tower Anchor Rods - Tower at Footing (3" Dia)	rod	Cut	Vulcan Threaded Products for KOS for KFM (04-0120E4)	3	25.6	7789	388	Yes	Tension	0.48	4/17/2013	N/A	4/20/2013 4/22/2013	5/5/2013	Tensioned to 1800 kN = 404.7 kips; Tension before and after load transfer: Initial Tension Late 2010 through Early 2011; Final Tension 2013	
	13	Tower Anchor Rods - Tower at Footing (4" Dia)	rod	Cut	Vulcan Threaded Products for KOS for KFM (04-0120E4)	4	25.7	7839	36	Yes	Tension	0.37	4/17/2013	N/A	4/20/2013 4/22/2013	5/5/2013	Tensioned to 2530 kN = 568.8 kips; Tension before and after load transfer: Initial Tension Late 2010 through Early 2011; Final Tension 2013	
East Saddles	14	East Saddle Anchor Rods	rod	Cut	Dyson for JSW	2	2.6	800	32	Yes	snug	~0.1	May 2010	4/7/2013	4/21/2013	5/3/2013	specified gap under nut/washer at one end of rod and 2 nuts snug against each other at other end of rod -> snug tight for portion of rod	
	15	East Saddle Tie Rods	Hex Bolt	Cut	Dyson	3	4.7	1420	18	Yes	snug	~0.1 0.2	4/13/2012 N/A	N/A 4/7/2013	N/A 4/21/2013	N/A 5/3/2013	Snug tightened before load transfer Additional tension in tie rods from cable with service load	
East Cable	16	B14 Cable Bands - Cable Brackets - at East End of Bridge - Strongback Anchor Rods	rod	Rolled	Dyson	3	10.3 to 11.1	3129 to 3372	24	No	Tension	0.16	2/8/2013	4/7/2013	4/21/2013	5/4/2013	pre-compress neoprene between strongback and cable band	
W2 Bent Cap	17	W2 Bikepath Anchor Rods	rod	Cut	Dyson	~1-3/16 [Metric M30]	1.5	460	43	No	Not Determined Yet	N/A	N/A	N/A	N/A	Details for bikepath connections are being redesigned and are not final. The 18 anchor rods at the bottom connections will be abandoned. The 25 anchor rods at the top connections will be used and supplemented with additional anchor rods. These rods will be tensioned on the separate YBITS-2 Contract.		

Total = 2306

New information after 5/6/2013 Update is highlighted Red



STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

**NOTICE TO CONTRACTORS
AND
SPECIAL PROVISIONS
FOR CONSTRUCTION ON STATE HIGHWAY IN
THE CITY AND COUNTY OF SAN FRANCISCO
AT YERBA BUENA ISLAND
DISTRICT 04, ROUTE 80**

For Use in Connection with Standard Specifications Dated JULY 1999, Standard Plans Dated JULY 1999, and Labor Surcharge and Equipment Rental Rates.

(INFORMAL BIDS CONTRACT)

CONTRACT NO. 04-0120E4

04-SF-80-13.4,13.8

ACBRIM-080-(094)N

**Bids Open: December 16, 2003
Dated: October 17, 2003**

OSD

the work is delayed or interfered with by failure of the Engineer to be present at the testing site, the Contractor will be compensated for any resulting loss in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

A minimum of 3 samples from each production lot shall be tested. One tensile test shall be conducted on each sample.

Tensile tests shall conform to the requirements specified in ASTM Designation: A 970/A 970M, Section 7, except that at rupture, there shall be visible signs of necking in the reinforcing bar 1) at a minimum distance of one bar diameter away from the head to bar connection for friction welded headed bar reinforcement, or 2) outside the affected zone for integrally forged headed bar reinforcement.

The affected zone for integrally forged headed bar reinforcement is the portion of the reinforcing bar where any properties of the bar, including the physical, metallurgical, or material characteristics, have been altered during the manufacturing process.

If one of the test specimens fails to meet the specified requirements, one retest shall be performed on one additional sample, selected by the Engineer, from the same production lot. If the additional test specimen, or if more than one of the original test specimens fail to meet these requirements, all headed bar reinforcement in the lot represented by the tests will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials," of the Standard Specifications.

A Production Test Report for all testing performed on each lot shall be prepared by the independent testing laboratory and submitted to the Engineer as specified herein. The report shall be signed by an engineer who represents the laboratory and is registered as a Civil Engineer in the State of California. The report shall include the following information for each set: contract number, bridge number, lot number, bar size, type of headed bar reinforcement, physical conditions of test sample, any notable defects, limits of affected zone, location of visible necking area, and the ultimate strength of each headed bar.

Each unit of headed bar reinforcement in a production lot to be shipped to the site shall be tagged in a manner such that production lots can be accurately identified at the jobsite. All unidentified headed bar reinforcement received at the jobsite will be rejected.

MEASUREMENT AND PAYMENT

Quantities of headed bar reinforcement will be measured as units determined from the number of heads shown on the plans or as directed by the Engineer.

The contract unit price paid for headed bar reinforcement shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing headed bar reinforcement, including all preparation work required prior to epoxy-coating and conforming to all testing requirements, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Bar reinforcement to be used in the manufacture of headed bar reinforcement, epoxy-coating headed bar reinforcement, and placing the completed headed bar reinforcement into the work will be measured and paid for as specified in Section 52, "Reinforcement," of the Standard Specifications, except that the lengths to be used in the computation of calculated masses of the bar reinforcement shall be the entire length of the completed headed bar, including heads.

10-1.31 STEEL STRUCTURES

Construction of steel structures shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

Fabricators and suppliers shall be certified under the AISC Quality Certification Program, Category Cbr, Major Steel Bridges.

Erectors shall be certified under the AISC Quality Certification Program, Category CASE, Certified Advanced Steel Erector.

GENERAL

Attention is directed to "Construction Surveying," of these special provisions.

Attention is directed to "Welding" in Section 8, "Materials," of these special provisions.

WORKING DRAWINGS

Attention is directed to "Working Drawings," elsewhere in these special provisions.

Section 55-1.02, "Drawings," of the Standard Specifications shall not apply.

Working drawings shall contain all information required for the fabrication of structural steel, including, at a minimum, the following:

- A. Design geometry lines and fabrication geometry working lines, including vertical, longitudinal and transverse;

- B. Details of temporary fabrication in plan, elevation and section, material specification and grades, weld details and all tolerances;
- C. Material and weld designations including the ASTM material specification, processes of shop fabrication including cutting, grinding and welding, weld symbols as required by AWS D1.5, and for each weld, the "Joint Designation" as listed in figures 2.4 or 2.5 of AWS D1.5;
- D. Distortion control plan in accordance with AWS D1.5, Section 3.4;

The Contractor shall allow the Engineer 70 working days to review the structural steel working drawings.

TEMPLATE

Twelve months prior to the completion of the number of days bid, the Contractor shall furnish to the Engineer working drawings for the as-fabricated tower footing. This shall include the following:

A. A plan view of the tower footing at Elev. 3.00 m of sufficient scale showing the labeled location of the following items:

- 1. As-fabricated tower anchorage anchor bolt pipe sleeves
- 2. As-fabricated tower anchorage anchor bolts
- 3. As-fabricated dowels

B. A summary of locations and corresponding coordinates of the following items in tabular form using the Global Positioning System (GPS) consistent with the requirements of "Construction Surveying" of these special provisions. Coordinates for the listed items shall be provided for the following elevations:

- 1. As-fabricated tower anchorage anchor bolt pipe sleeves: Elev. 3.00m
- 2. As-fabricated tower anchorage anchor bolts: Elev. 3.00 m and Elev. 5.50 m (approximate top of tower anchorage anchor bolts)
- 3. As-fabricated dowels: Elev. 3.00 m and 3.24 m

C. Location and coordinate summaries segregated by item type.

The Contractor shall allow the Engineer 25 working days to review and accept the tower footing working drawings.

Twelve months prior to the completion of the number of days bid, the Contractor shall furnish to the Engineer a steel template of sufficient rigidity with holes that correspond to the as-fabricated location of the tower anchorage anchor bolt pipe sleeves and dowels. The steel template shall be comprised of four (4) match-marked quadrants or as otherwise approved by the Engineer. The Contractor shall submit steel template working drawings to the Engineer 30 working days prior to fabrication of the steel template. The Contractor shall allow the Engineer 10 working days to review and approve steel template working drawings.

The Contractor shall demonstrate the accuracy of the template, as witnessed by the Engineer, by physically placing it over the as-fabricated steel pile cap. The Contractor shall notify the Engineer 7 working days prior to the fitting of the template.

The Contractor shall make the template available to the State for use on other Contracts. Transportation of the steel template will be paid for by extra work at force account.

ERECTION PLAN

The Contractor shall submit working drawings and supplemental calculations for the erection of structural steel in accordance with the requirements in "Working Drawings," of these special provisions.

Working drawings shall contain all information required for the erection of structural steel, including, at a minimum, the following:

- A. Details and limits of each section to be erected;
- B. Details of attachments to each section for transportation and lifting including location, welding and removal procedures;
- C. Methods for transportation and lifting of each section;

- D. Details of temporary work platforms and other aids required for field welding;
- E. Locations and methods for tack and final welds;
- F. Timing and methods for dimensional checks; and
- G. Timing and methods for visual and nondestructive examination.

Supplemental calculations shall include, but not be limited to, the following:

- A. Calculations indicating the stress on the permanent structure due to attachments and erection.

The Contractor shall allow the Engineer 70 working days to review the erection working drawings.

After erection, all lifting attachments shall be removed. Removal of welds shall not damage the permanent steel structure materials. All remaining welds shall be ground flush and damaged areas shall be repaired in accordance with the requirements of ANSI/AASHTO/AWS D1.5. Areas of damaged paint shall be cleaned and painted as specified in "Clean and Paint Structural Steel," of these special provisions.

MATERIALS

Structural steel shall conform to ASTM Designation: A709M, Grade 345 with Supplementary Requirement S83 "Non-Fracture-Critical, T, Material; Toughness Test and Marking." Charpy V-notch (CVN) impact values for steel procurement shall be reported on the mill test report and shall conform to ASTM Designation: A 709M for Zone 2, except as shown on the plans.

Dowels shall conform to ASTM Designation: A633M, Grade E with Supplementary Requirement S1 (Notch Toughness Test) at frequency P, meeting 34 J at -7C.

Material conforming to ASTM Designation: A 709M, Grade 345W shall not be substituted for ASTM Designation: A 709M, non-weathering steel grades.

Ducts for prestressing high-strength ASTM Designation: A 354 bolts shall be galvanized steel pipe conforming to the requirements in ASTM Designation: A 53 or galvanized rigid steel conduit conforming to UL Publication 6 for Rigid Metallic Conduit.

Galvanizing for rigid steel conduit or steel pipe shall be tested in conformance with the requirements in ASTM Designation: A 239. Adjacent sections of steel conduit or pipe shall be connected with galvanized standard couplings.

Grouting of high strength A354 bolts shall conform to the provisions in Section 50-1.09 "Bonding and Grouting," of the Standard Specifications. Grout injection pipes shall be furnished by the Contractor as shown on the plans.

Elastomeric pads used for pile centralizers shall conform to the requirements for plain elastomeric bearing pads in Section 51-1.12H(1), "Plain and Fabric Reinforced Elastomeric Bearing Pads," of the Standard Specifications.

Pile centralizers shall be bonded to pile sleeves with adhesive conforming to Federal Specification MMM-A-121, as shown on the plans.

Ducts, fasteners, and grout caps for prestressing ASTM Designation: A354 bolts shall be considered structural steel (bridge).

High-strength fastener assemblies, and other bolts attached to structural steel with nuts and washers shall be zinc-coated, except as noted. When direct tension indicators are used in these assemblies, the direct tension indicator and all components of the fastener assembly shall be zinc-coated by the mechanical deposition process.

THROUGH-THICKNESS QUALITY

Where through-thickness quality steel is shown on the plans, the steel shall meet the low sulfur and reduction of area requirements of AWS D1.5, Section 12.4.4.1. Additionally, each plate shall be ultrasonically examined and shall meet the acceptance criteria in conformance with the requirements in ASTM Designation: A578, Level C. The Contractor may specify these requirements at any additional location at no additional cost to the State.

FABRICATION

Quality of Workmanship

The Engineer may inspect fabrications for dimensional accuracy, fabrication practices, welding, and for compliance with these special provisions.

Fabrication/Erection Procedure and Mock-Ups

The Contractor shall submit to the Engineer for approval in accordance with the requirement in "Working Drawings," of these special provisions, written, detailed procedures for the fabrication and erection of the complex assemblies listed below.

Procedures shall include the assembly and welding sequence and shall be of sufficient detail to demonstrate the proposed fabrication procedure and verify the inspectability of welds.

Fabrication and erection procedures are required for the following locations:

- A. E2 Footing Girder Assemblies
- B. Tower Footing Assembly (girder system for pile sleeves to tower)
- C. Pile to footing connection

In addition, the Contractor shall prepare a mock-up of the pile to footing connection in accordance with "Field Welding of Pile/Sleeve Connector Plates" of this section to demonstrate the proposed fabrication procedure and verify the inspectability of each weld.

The mock-up shall comprise a complete fabrication of the specified detail as shown on the plans, but with member lengths that need not extend beyond the joint more than 0.5 m.

The Contractor shall prepare a written fabrication and welding sequence and a preliminary mock-up made of wood, plastic, dense Styrofoam or other material approved by the Engineer. The preliminary mock-up shall be one quarter to one half scale and shall demonstrate the assembly sequence. These shall be submitted for review by the Engineer, and approval shall be given before the mock-up is fabricated in steel. The Engineer shall witness all fit-up and welding for each steel mock-up.

The completed steel mock-up shall be examined visually and by Magnetic Particle (MT) and, in addition, by either UT or RT in accordance with the nondestructive examination table listed under "Shop Welding" of this section. Nondestructive examination shall be completed using the nondestructive examination procedures that are proposed for production. Mock-up assemblies shall then be sectioned as directed by the Engineer to produce three macroetch samples per weld that shall be evaluated per AWS D1.5. Approval of the fabrication and erection procedure and the nondestructive examination procedures shall be contingent on satisfactory results from the mock-up examination and destructive tests.

Mechanical Cutting

Mechanical shearing of material of thickness greater than 8 mm is prohibited. Mechanically sheared edges shall be ground smooth. All cracks emanating from these edges shall be removed.

Flame, Plasma And Arc Cutting

All cut edges shall be ground to remove dross, slag and hardened material.

Bent Plate

Cold-bent rolled steel plates shall conform to the following:

- A. The axis of bending shall be perpendicular to the direction of plate rolling. The entire length of bend shall be formed simultaneously.
- B. The radius of bend shall be as shown on the plans.
- C. Before bending, the plate corners that are perpendicular to the axis of the bend shall be rounded to a radius of 2 mm.

Match-Marking

Match markings shall be made with low stress die stamps or other method that will not notch the steel.

Punching

The first paragraph of Section 55-3.14A(1) "Punching," of the Standard Specifications shall not apply.

Punching or sub-punching of Grade 250 structural steel where the material is thicker than 16 mm will not be permitted. Punching or sub-punching of high-strength structural steel where the material is thicker than 12 mm will not be permitted.

Tower Anchor Bolts

Steel fasteners, designated on the plans as A 354, Grade BC, and A 354, Grade BD, shall conform to the requirements of ASTM Designation: A 354, Grade BC and Grade BD, respectively. Steel fastener components for steel fasteners designated as A 354, Grade BC and Grade BD shall include a bolt, nut and hardened washer. Nuts for steel fasteners shall conform to Section 55-2.01, "Description," of the Standard Specifications.

Steel fasteners designated on the plans as A 354, Grade BD shall be dry blast cleaned in accordance with the provisions of Surface Preparation Specification No. 10, "Near White Blast Cleaning," of the "SSPC: The Society for Protective Coatings".

Steel fasteners designated on the plans as A 354, Grade BC, and A 354, Grade BD, shall be galvanized in accordance with the requirements in Section 75-1.05, "Galvanizing," of the Standard Specifications and shall conform to the requirements in ASTM Designation: A123 for bolts and ASTM Designation: A153 for nuts and hardware. Steel fastener assemblies designated as A354, Grade BD, shall be galvanized within 4 hours of being dry blast cleaned.

The Contractor shall submit certified test reports showing that the A 354 fasteners conform to the provisions in ASTM Designation: A 143.

The Contractor shall deliver the zinc-coated nuts and hardened washers to the Engineer at a location to be determined by the Engineer. Said location will be within 25 km of the San Francisco-Oakland Bay Bridge Toll Plaza. Zinc-coated nuts and hardened washers shall be delivered to the Engineer within three months prior to completion of the work. The Contractor shall notify the Engineer at least two months prior to delivery of the material.

Zinc-coated nuts and hardened washers shall be packaged for the protection of the steel against physical damage and corrosion during shipping and storage. The shipping package shall be clearly marked with a statement that the package contains nuts and hardened washers for the San Francisco-Oakland Bay Bridge, the bolt type, grade, and the date packaged.

The Contractor shall furnish and install corrosion protective coverings on tower anchor bolts as shown on the plans. Prior to installing the corrosion protective coverings, the Contractor shall prevent water and other deleterious material from entering the pipe sleeves. Corrosion protective covers shall be on the Department's current prequalified list prior to use.

The Department maintains a list of prequalified corrosion protective covers. The prequalified list can be obtained by contacting the Transportation Laboratory and is available at the Department's internet site at:

http://www.dot.ca.gov/hq/esc/approved_products_list/

Tower Drainage System

Drain pipe, fittings, liners, and grates shall conform to the details shown on the plans, manufactured from high-density polyethylene (HDPE), and suitable for the transmission of non-potable water. Joints in HDPE pipe shall be butt-fused. Pipe wall thickness shall be adequate to withstand loads from construction installation and concrete placement operations.

SURFACE PREPARATION

For all bolted connections, the contact surfaces and inside surfaces of bolt holes shall be cleaned and coated before assembly in conformance with the provisions for cleaning and painting structural steel of these special provisions.

WELDING OF STEEL STRUCTURES

Table 2.2 of ANSI/ AASHTO/AWS D1.5 is superseded by the following table:

Base Metal Thickness of the Thicker Part Joined, mm	Minimum Effective Partial Joint Penetration Groove Weld Size, * mm
Over 13 to 19 inclusive	6
Over 19 to 38 inclusive	8
Over 38 to 57 inclusive	10
Over 57 to 150 inclusive	13
Over 150	16

* Except the weld size need not exceed the thickness of the thinner part

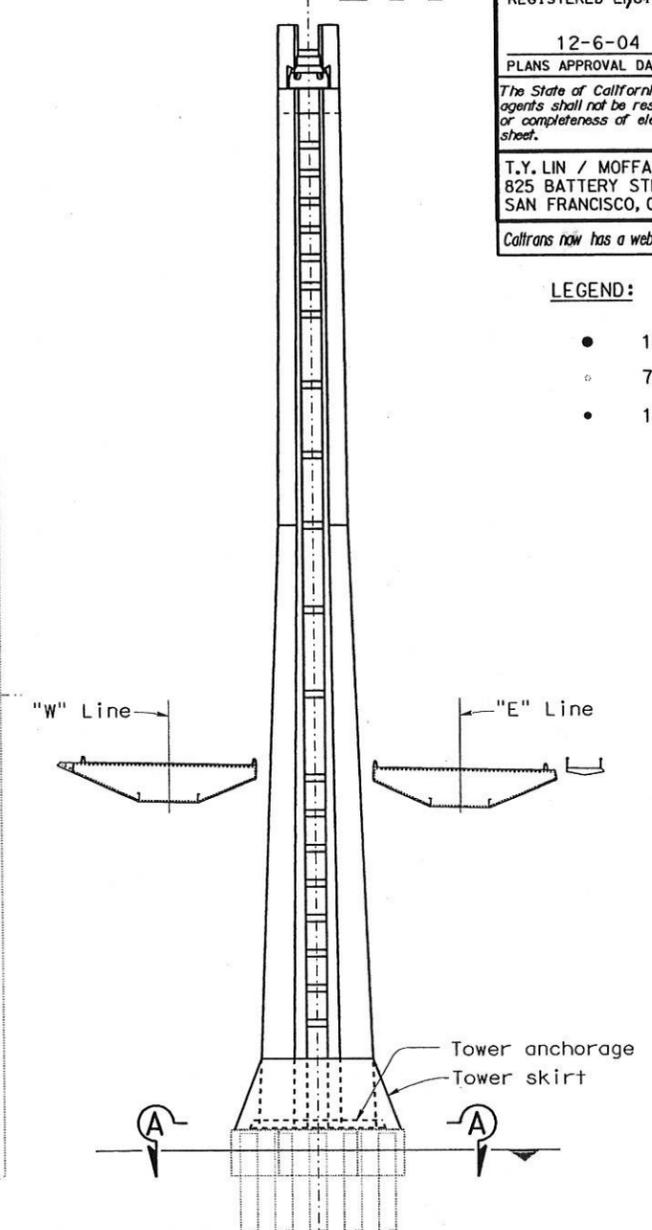
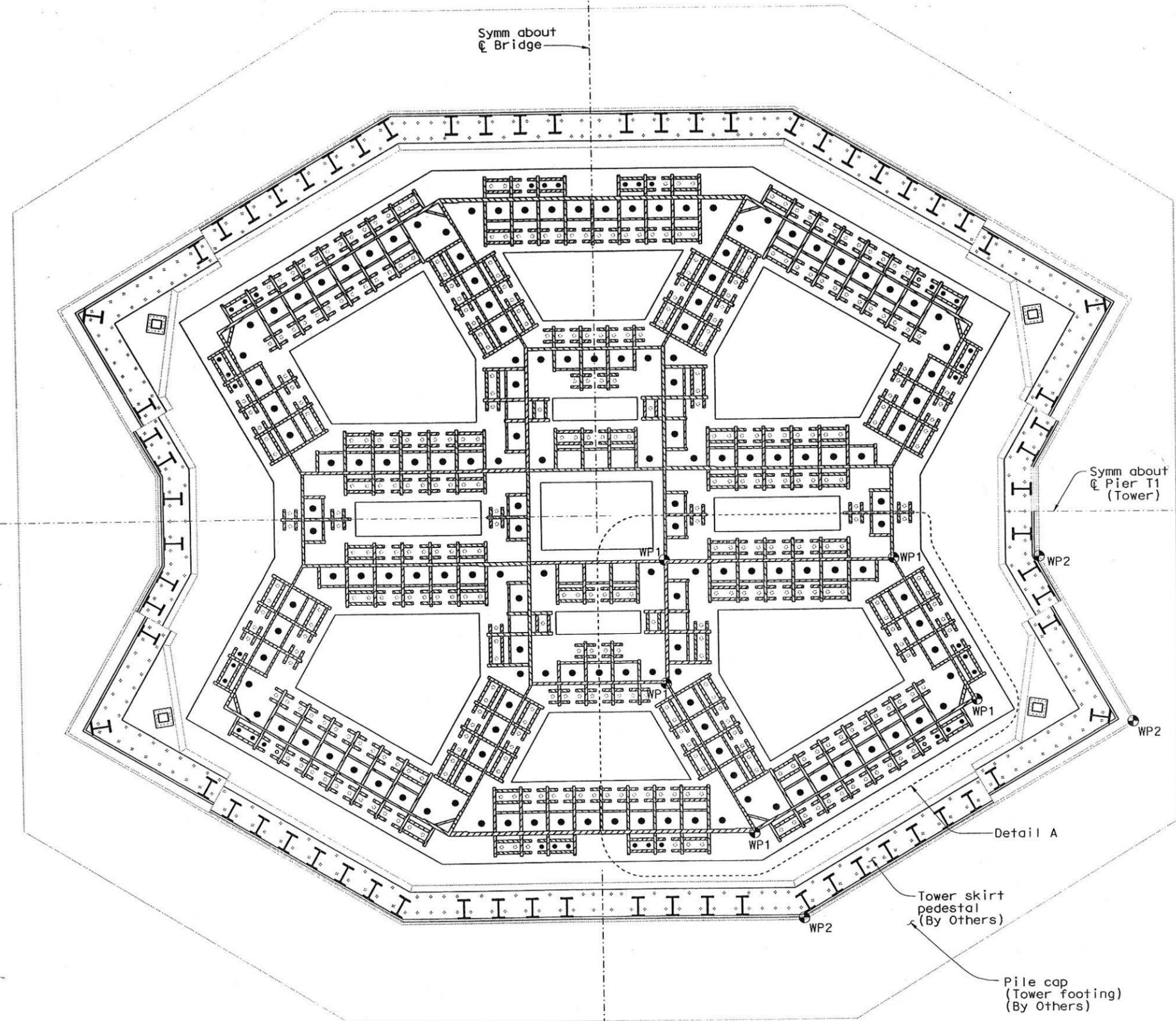
All corner and T-joint groove welds shall be reinforced with fillet welds with a size of 1/4 times the thickness of the abutting member, or 10 mm, which ever is less.

Dimensional details and workmanship for welded joints in tubular and pipe connections shall conform to the provisions in Part A, "Common Requirements of Nontubular and Tubular Connections," and Part D, "Specific Requirements for Tubular Connections," in Section 2 of AWS D1.1.

Backing for welds that are subject to computed stress which are left in place in the completed structure as shown on the plans or approved by the Engineer shall be a single length. Backing shall be of the same material as the structural steel being welded. Single lengths of backing shall be obtained by using a continuous strip, or may consist of lengths of backing joined by complete joint penetration butt welds. Butt welds in the backing material shall be tested in conformance with the requirements in AWS D1.5, Section 3.13.1. Butt welds in backing material shall be ground flush as necessary to obtain proper inspection and for proper fit-up in the weld joint with which the backing is to be used.



DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SF	80	13.2/13.9	593	1204
REGISTERED ENGINEER - CIVIL					
12-6-04					
PLANS APPROVAL DATE					
<small>The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.</small>					
T.Y. LIN / MOFFATT & NICHOL 825 BATTERY STREET SAN FRANCISCO, CA 94111					
<small>Caltrans now has a web site! To get to the web site, go to: http://www.dot.ca.gov</small>					



KEY ELEVATION

1:500

NOTES:

1. For Detail A, see "Tower Anchorage Details No.2, 3 and 4" sheets.
2. For tower skirt details, see "Tower Skirt Details" sheets.
3. Tower base plate holes for dowels and tower anchorage anchor bolts shall be drilled based on furnished template.

100% P&E

SECTION A-A

1:50
(Tower skirt not shown for clarity)

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

R. Valizadeh/V.Toan/Y.L./M.L./F.C.
DESIGN OVERSIGHT
Ran Valizadeh / V. Toan / Y. Lin
 SIGN OFF DATE 04/19/04
 Rev. Date 5-18-98

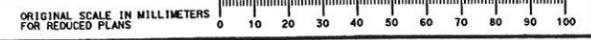
DESIGN	BY M. Nader	CHECKED S. Camo
DETAILS	BY L. RUS	CHECKED S. Camo
QUANTITIES	BY L. RUS	CHECKED Y. Zhang

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

R. Manzanarez
PROJECT ENGINEER

BRIDGE NO.	34-006L/R
KILOMETER POST	13.2/13.9

SAN FRANCISCO OAKLAND BAY BRIDGE EAST SPAN SEISMIC SAFETY PROJECT SELF-ANCHORED SUSPENSION BRIDGE (SUPERSTRUCTURE & TOWER)	
TOWER ANCHORAGE DETAILS NO.1	
REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET 176 OF



CU 04
EA 0120F1
FILE => aetwa01a.dgn

DISREGARD PRINTS BEARING EARLIER REVISION DATES

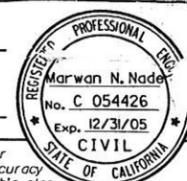
01/25/99	05/25/99	08/02/99	09/24/01	04/08/02	07/01/02	12/19/02		
----------	----------	----------	----------	----------	----------	----------	--	--

USERNAME => trmguye DATE PLOTTED => 09-DEC-2004 TIME PLOTTED => 14:34

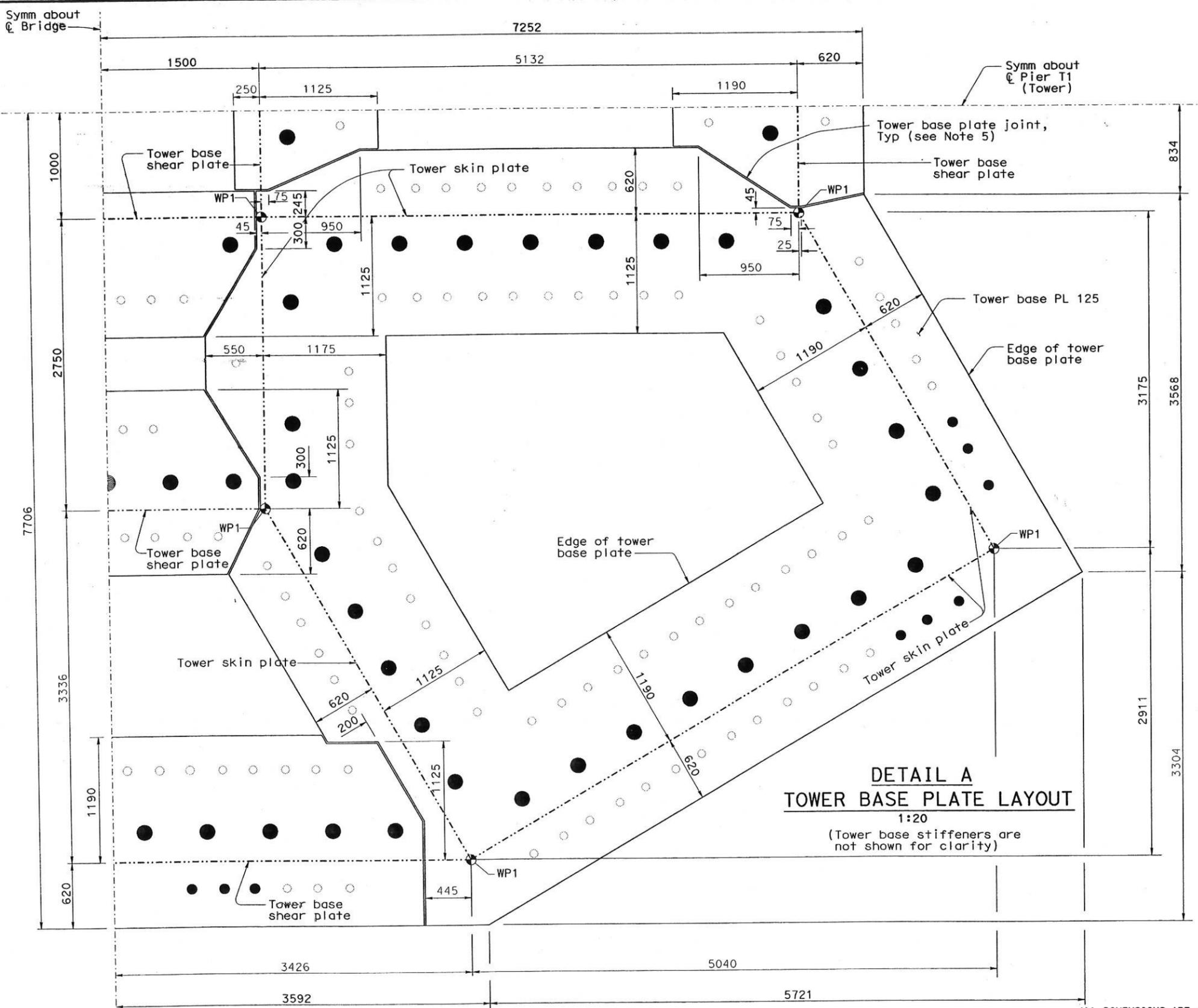


DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SF	80	13.2/13.9	594	1204

REGISTERED ENGINEER - CIVIL
 12-6-04
 PLANS APPROVAL DATE
 The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.



T.Y. LIN / MOFFATT & NICHOL
 825 BATTERY STREET
 SAN FRANCISCO, CA 94111
 Caltrans now has a web site! To get to the web site, go to: <http://www.dot.ca.gov>



- LEGEND:**
- Tower base plate outline
 - - - - Edges of tower skin & tower base shear plate outline
 - 150 Dia dowel
 - 75 Dia anchor bolt
 - 100 Dia anchor bolt
 - ⊕ WP1- Geometric working point @ Elev 3.125 m

- NOTES:**
- For anchor bolts and dowels layout, see "Tower Anchorage Details No.3" sheet.
 - For tower base stiffener layout, see "Tower Anchorage Details No.4" sheet.
 - Tower anchorage WP are extrapolated using control cross sections WP shown in "Tower Layout No.4" sheet. Tower anchorage WP are for information only, and shall not govern the control cross section WP.
 - For anchor bolt hole details, see "Tower Anchorage Details No.6" sheet. For dowel hole detail, see "Tower Anchorage Details No.7" sheet.
 - For details of tower base plate joint, see "Tower Anchorage Details No.8" sheet.

DETAIL A
TOWER BASE PLATE LAYOUT
 1:20
 (Tower base stiffeners are not shown for clarity)

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

R. Valizadeh/V. Toan/Y.L./W.L./F.C.
 DESIGN OVERSIGHT
 SIGN OFF DATE 01/30/04

DESIGN	BY M. Nader	CHECKED S. Camo
DETAILS	BY L. Rus	CHECKED S. Camo
QUANTITIES	BY L. Rus	CHECKED Y. Zhang

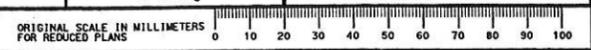
PREPARED FOR THE
 STATE OF CALIFORNIA
 DEPARTMENT OF TRANSPORTATION

R. Manzanarez
 PROJECT ENGINEER
 BRIDGE NO. 34-0006L/R
 KILOMETER POST 13.2/13.9
 CU 04
 EA 0120F1
 FILE => aetwa01.dgn

SAN FRANCISCO OAKLAND BAY BRIDGE
 EAST SPAN SEISMIC SAFETY PROJECT
 SELF-ANCHORED SUSPENSION BRIDGE
 (SUPERSTRUCTURE & TOWER)
TOWER ANCHORAGE DETAILS NO.2

REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET	OF
01/15/99 05/15/99 09/02/99 05/17/01 04/08/02 01/07/02 12/15/02	177	177

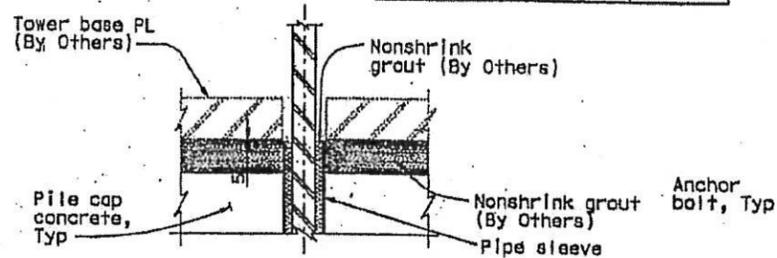
DISREGARD PRINTS BEARING EARLIER REVISION DATES



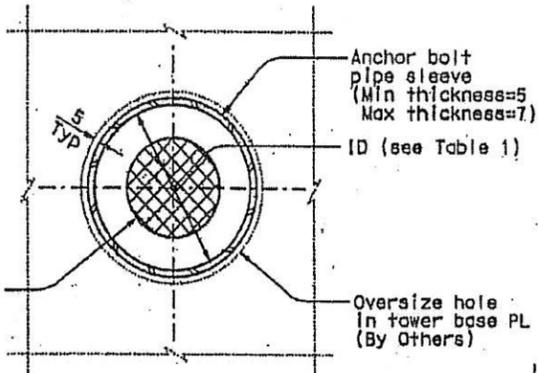
DATE PLOTTED => 09-DEC-2004 100% PLS&E USERNAME => TT

Table 1

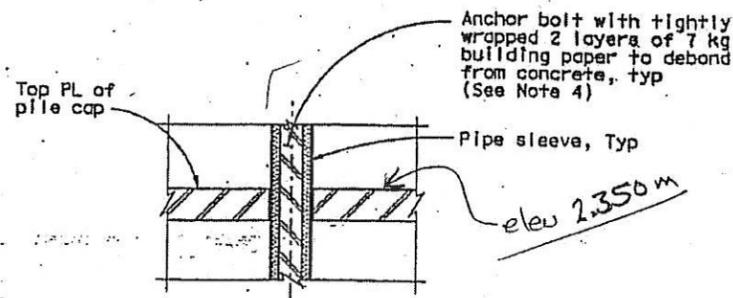
Anchor Bolt Pipe Sleeve	75 Dia	100 Dia
ID	125	150



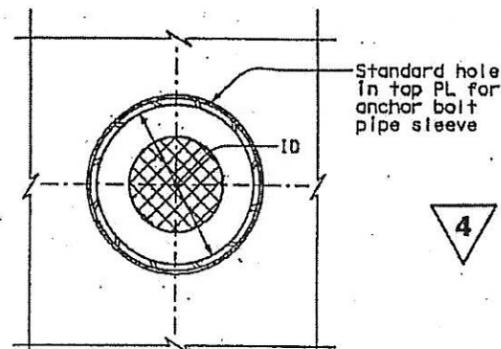
AT TOWER BASE PLATE



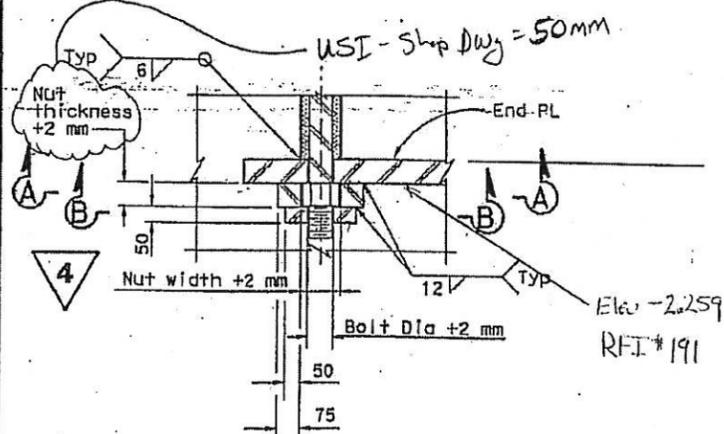
AT TOWER BASE PLATE



AT TOP PLATE OF PILE CAP

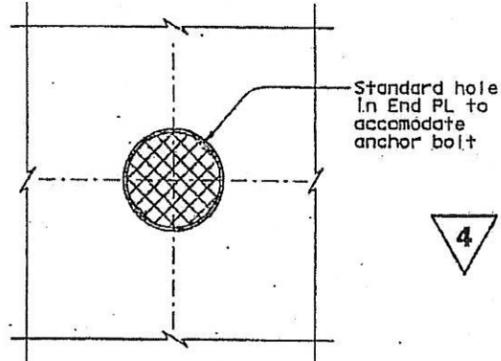


AT TOP PLATE OF PILE CAP



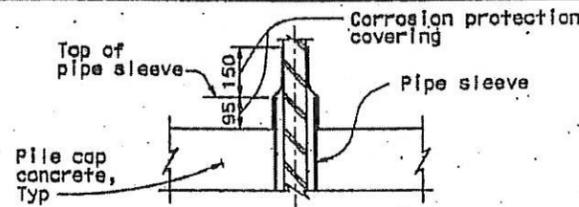
AT END PLATE

ANCHOR BOLT ELEVATION VIEW (see Note 5) 1:10



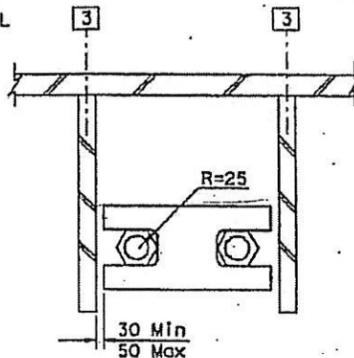
AT END PLATE

ANCHOR BOLT HOLE PLAN VIEW 1:2.5

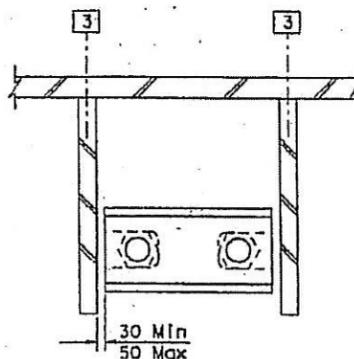


CORROSION PROTECTION OF ANCHOR RODS

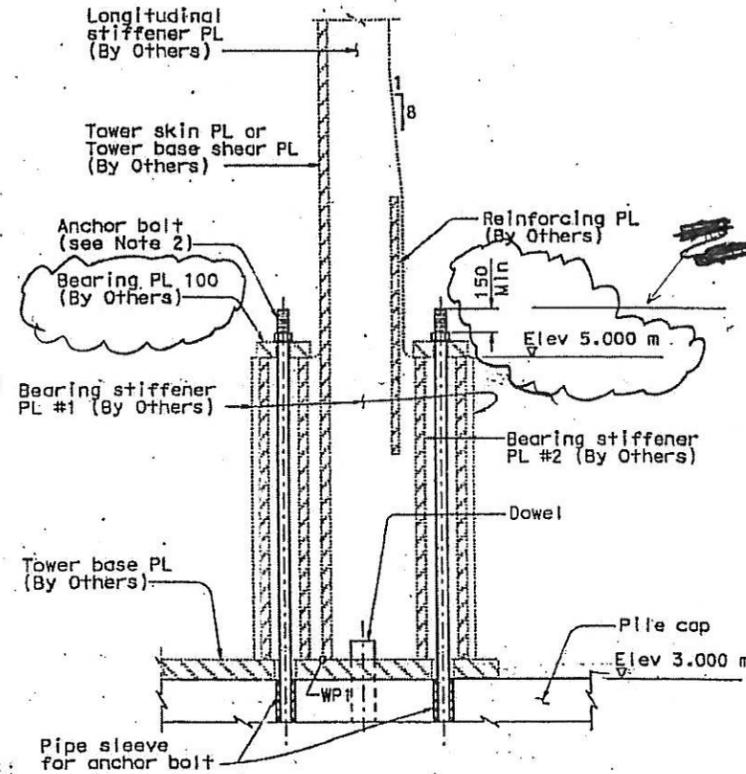
(See Note 3) 1:10



SECTION A-A (Typical section shown; others similar) 1:10



SECTION B-B (Typical section shown; others similar) 1:10



TYPICAL TOWER ANCHORAGE CROSS SECTION SECTION E-E 1:20

NOTES:

- Anchor bolt pipe sleeve shall be filled with nonshrink grout (By Others).
- The anchor bolts are shown in their final erected position. The Contractor shall provide anchor bolts with a minimum length of 150 mm above the top face of the nut for pretensioning operations (By Others).
- Tower anchorage anchor bolts shall be protected against corrosion.
- Wrapped building paper shall be installed along full height of pipe sleeve.
- The Contractor may propose an alternate detail at end plate to secure anchor rod and nut, subject to review and approval by the Engineer.

4 REVISED PER ADDENDUM NO. 4 DATED DECEMBER 19, 2003

R. Vafizadeh/V. Toan/Y.L./W.L./F.C.
DESIGN OVERSIGHT
R. Manzanarez/V. Toan/Y.L./F.C.
SIGN OFF DATE: 12/18/03
REVISED DATE: 12/18/03

DESIGN	BY M. Nader	CHECKED S. Cao
DETAILS	BY L. Rus	CHECKED S. Cao
QUANTITIES	BY L. Rus	CHECKED Y. Zhang

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

R. Manzanarez
PROJECT ENGINEER

BRIDGE NO.
34-0006L/R
KILOMETER POST
13.4/13.8

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

SELF-ANCHORED
SUSPENSION BRIDGE (E2&T1)

TOWER ANCHORAGE DETAILS NO.5

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS

CU 04
EA 0120E1

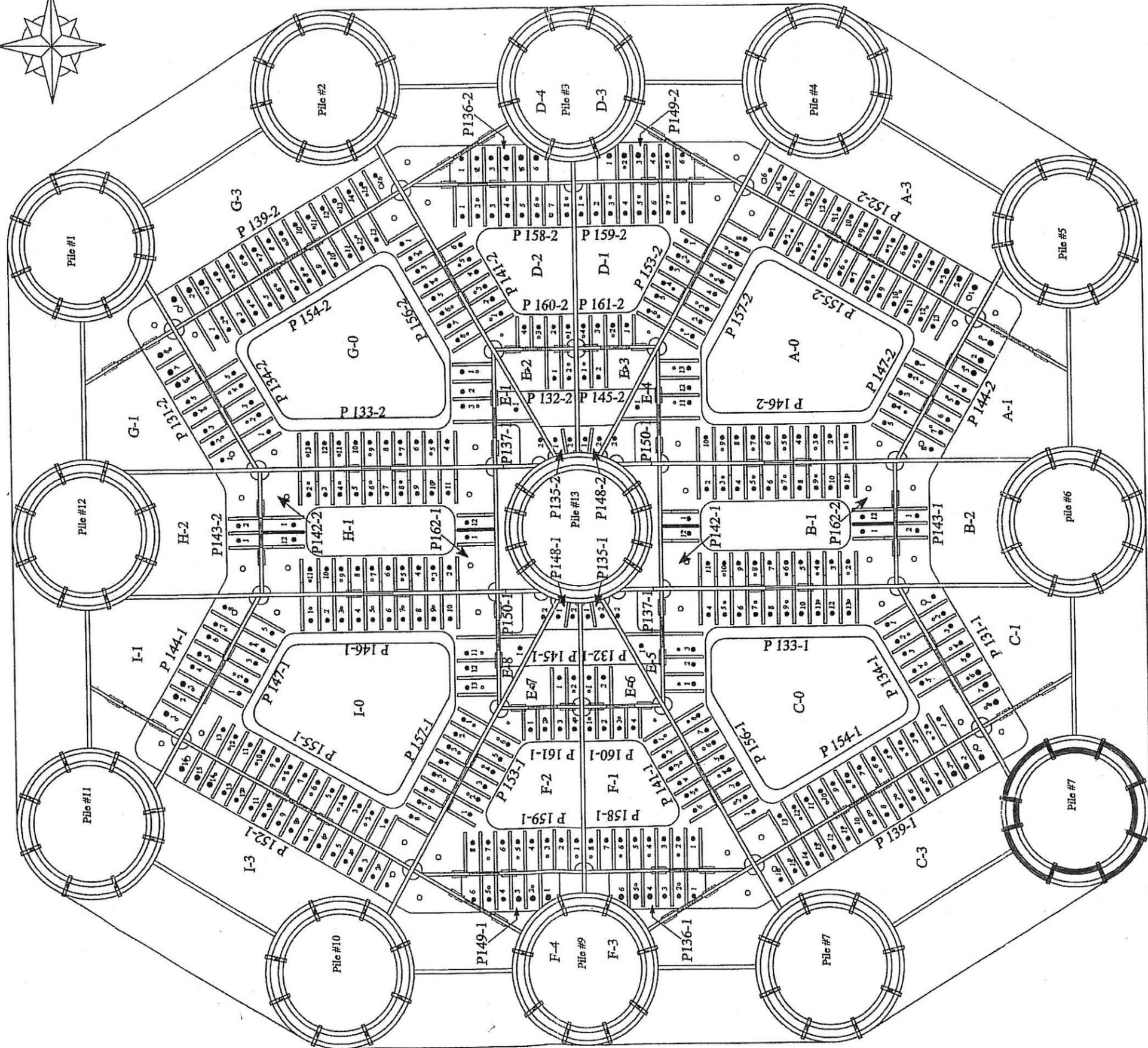
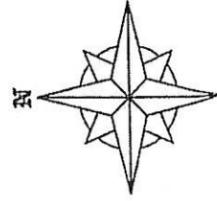
DISREGARD PRINTS BEARING
EARLIER REVISION DATES

REVISION DATES (PREF. IN NUM. STAGE ONLY)

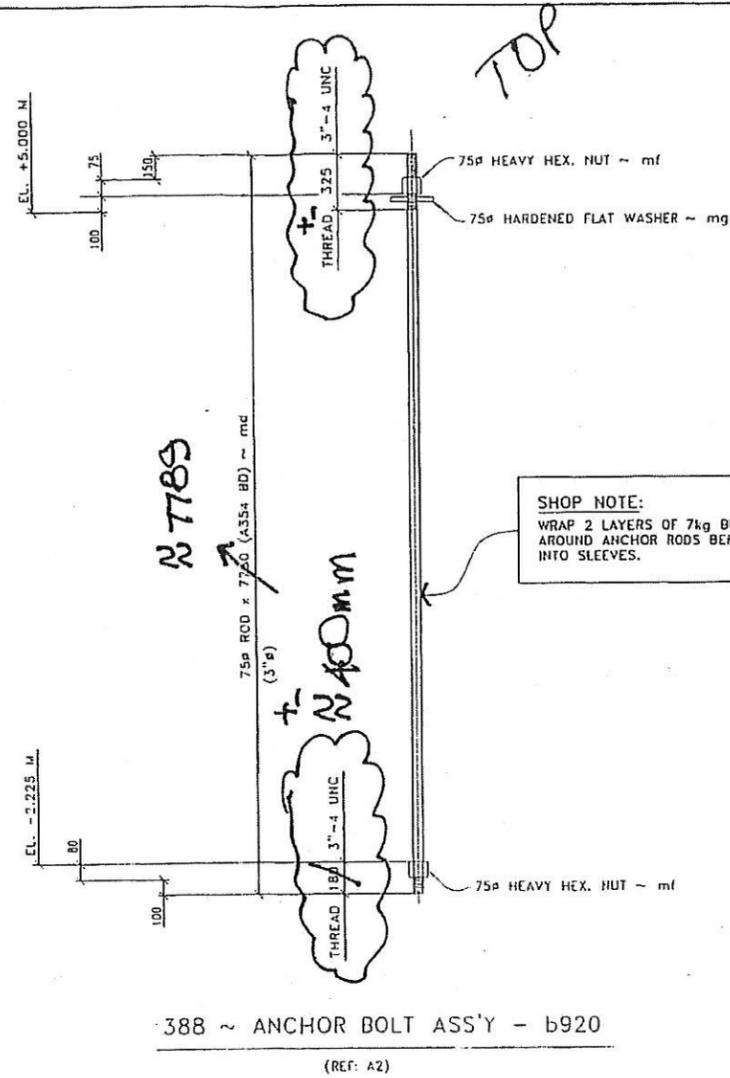
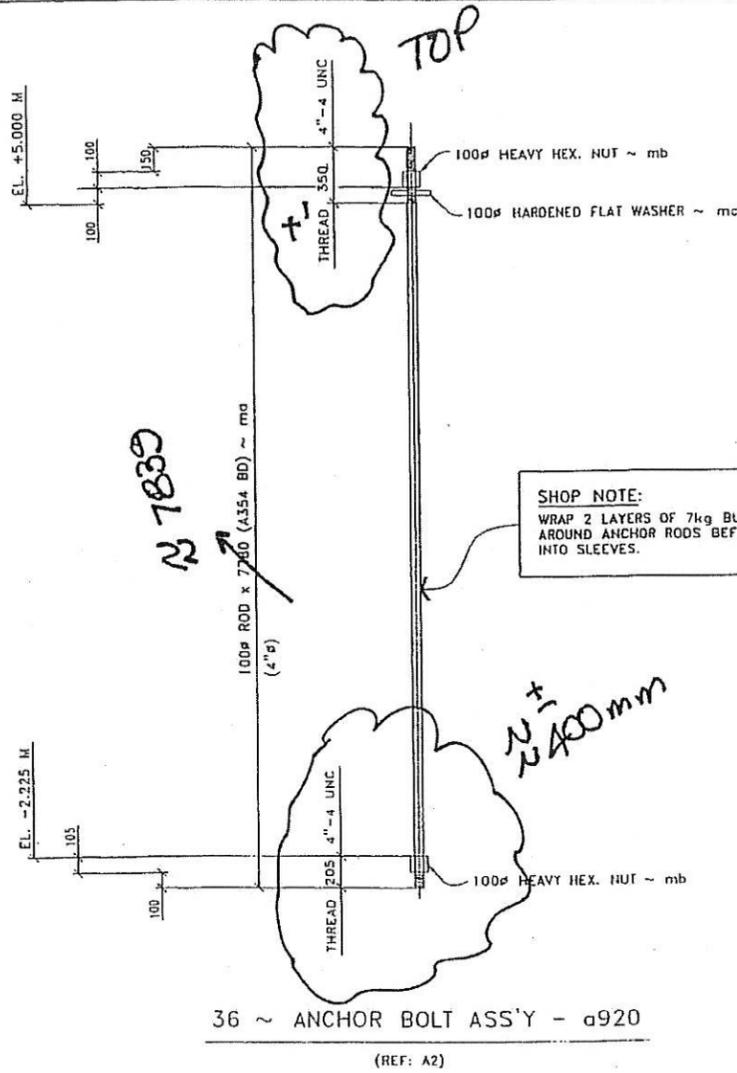
SHEET 046

DATE PLOTTED => 15-DEC-2003 TIME PLOTTED => 11:12

Anchor Rod / Sleeve Layout



G:\MANSOOR\CALTRANS_SFOBB_PIER T1_BASE\DWG\920-1.DWG 9-27-04 2:19:22 PM PST



NOTE-1:
75# & 100# RODS TO BE GALVANIZED
PER A123 & NUTS & WASHER FOR BOTH 75# & 100# RODS
TO BE GALVANIZED PER A153

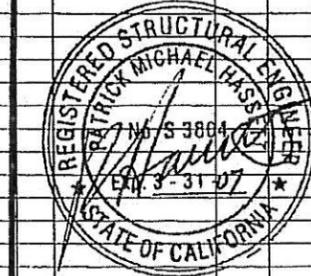
BILL OF MATERIAL

MARK	QTY.	DESCRIPTION	LENGTH mm	UNIT WT.	WEIGHT (Kg)	S/L	REMARKS
a920	36	A.B. ASSEMBLY					
md	36	100# ROD	7	780	495	17823	10/18 A354 BD T.2E
mb	72	100# HVY HEX NUT			9.9	712	10/22 A563 GR.DH
mc	36	100# HARD FLAT WASH.					F436
b920	388	A.B. ASSEMBLY					
md	388	75# ROD	7	730	277	107346	10/20 A354 BD T.2E
mf	776	75# HVY HEX NUT			4.3	3344	10/23 A563 GR.DH
mg	388	75# HARD FLAT WASH.					F436

SEE NOTE-1
①

SEE NOTE-1
①

This stamp indicates that the drawing has been checked to meet the structural requirements of the Drawings and



Specifications of the Project Contract No. Referenced on this sheet. Dimensions have not been checked.

DO NOT SHIP FROM THIS SHEET

EDGE DISTANCE -
SPACING NOT SHOWN -
CONNECTORS:
GENERAL NOTES:

HOLES SHOP PAINT: GALVANIZE (SEE NOTE-1)
AS NOTED BASE CANS
PREPARATION FOR PAINT: SP10

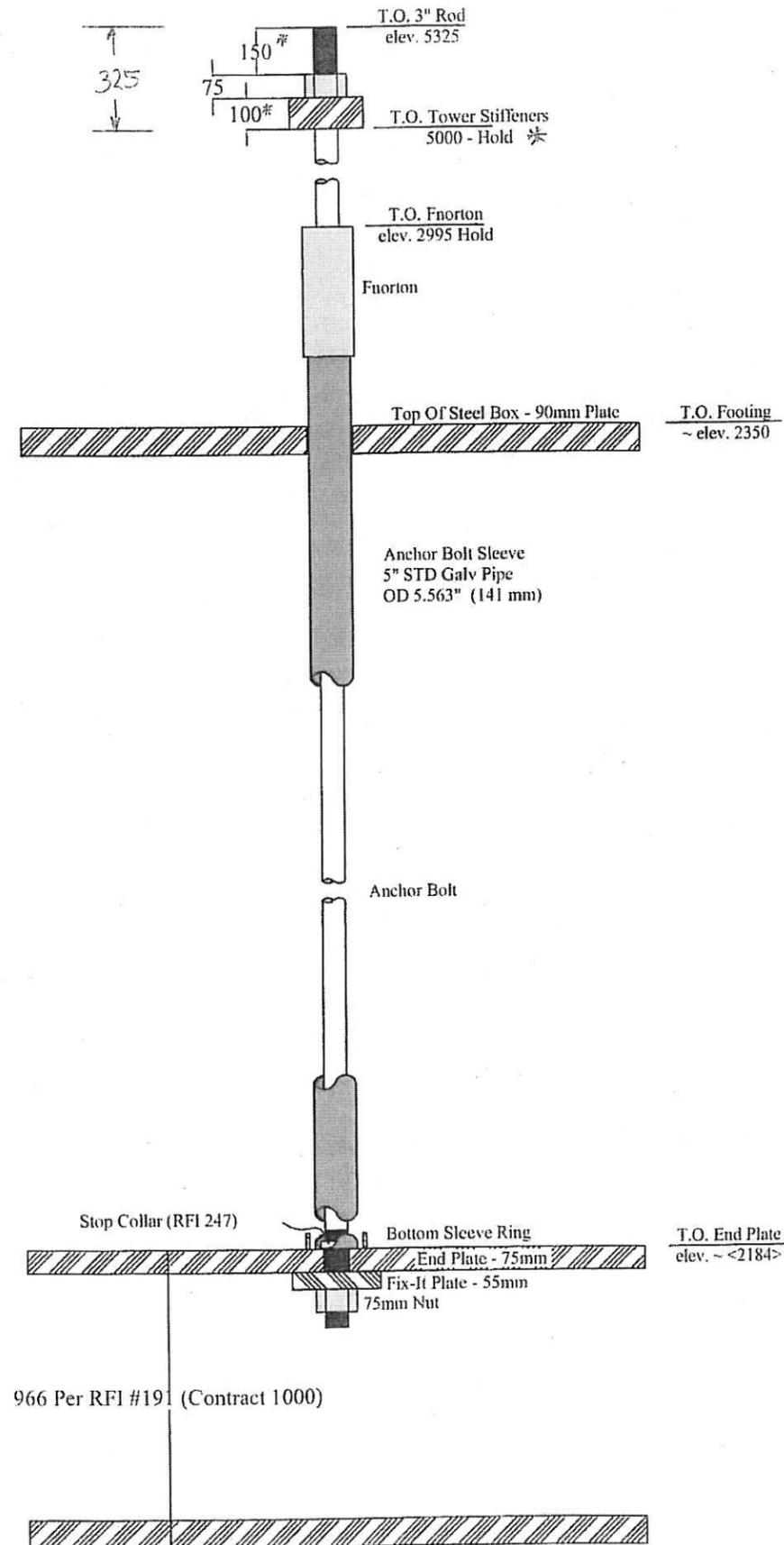
MR	REVISION	BY	DATE
1	mc & mg MAT'L GRADE REV'D @ B.O.M	MA	09-27-04



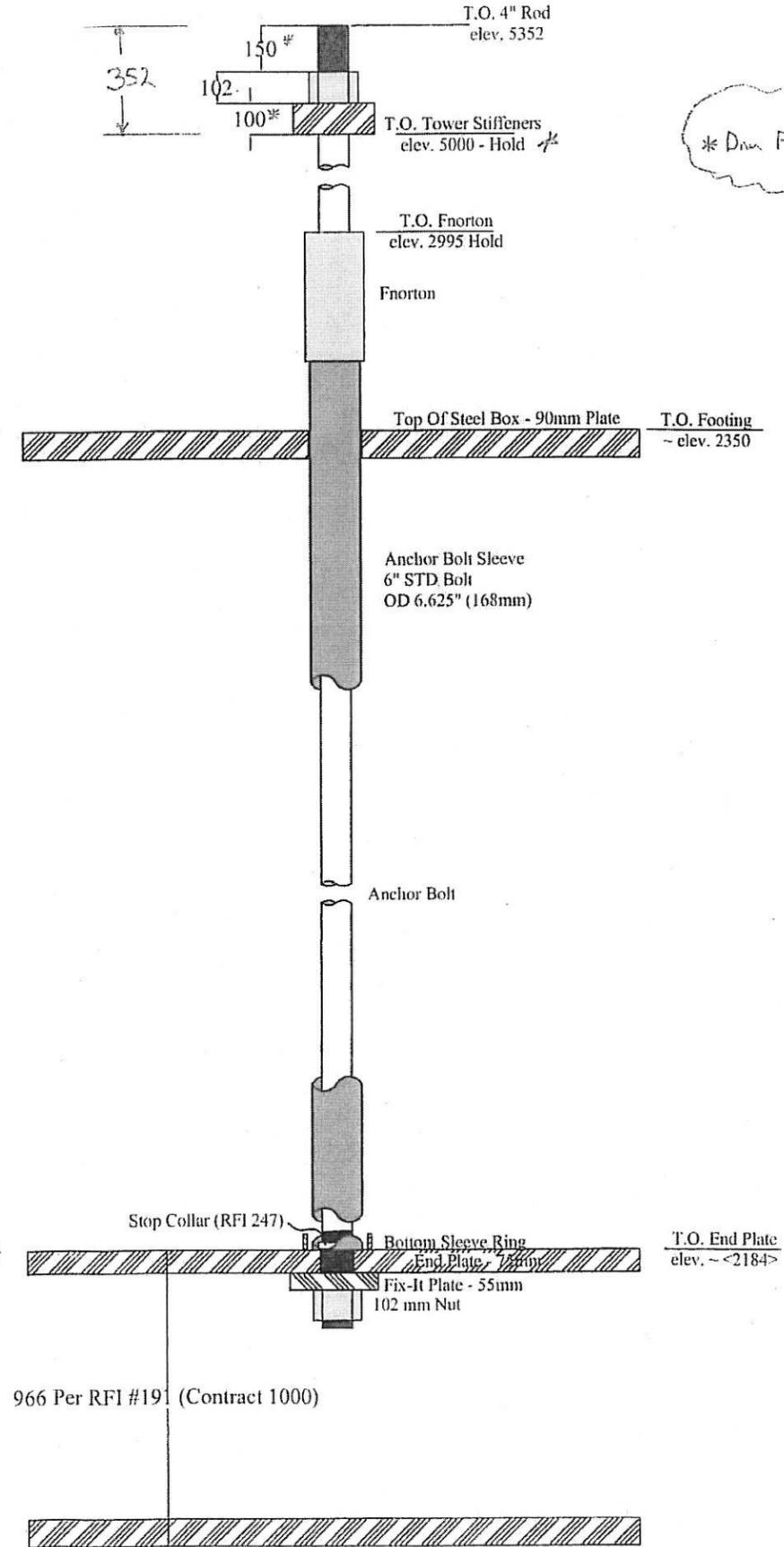
UNIVERSAL STRUCTURAL, INC.
604 S.E. VICTORY AVE.
VANCOUVER, WASHINGTON

SHEET TITLE: ANCHOR BOLT ASSEMBLIES	MATERIAL SPEC. AS SHOWN
PROJECT: PIER T1 FOOTING-San Francisco Oakland Bay Bridge	ERECTION DWG. -
KP 13.4 BRIDGE NO. 34-0006	REF. DWG. -
CONTRACT NO.: 04-0120E4	
ENGINEER: TY LIN / WOFFATT & NICHOL	
CONTRACTOR: KFM, JV	
DRAWN BY: LY	DATE: 05/10/04
CHECKED BY: RM	DATE: 05/13/04
JOB NO. 24142	SHEET NO. 920
	REV. 1

3" Anchor Rod Assembly



4" Anchor Rod Assembly



* Draw From 6304118 Contract Plans

DEPARTMENT OF TRANSPORTATION - District 4 Toll Bridge Program

333 Burma Rd.
Oakland, CA 94607
(510) 286-0500, (510) 286-0550 fax



Kiewit-FCI-Manson, JV
220 Burma Rd.
Oakland, CA 94607

Christopher J. Villa
Deputy Project Director

April 28, 2004

Contract No. 04-0120E4
04-SF-80-13.4, 13.8
SAS T1 & E2 Foundations
SFOBB-ESSSP

Letter No. 0016

Subject: Response to RFI No. 10 (Anchor Rods & Sleeves)

Dear Christopher,

Regarding the three items in this RFI:

1. The 75 mm and 100 mm diameter anchor bolts can be ordered as 3" and 4" diameter, respectively.
2. The sleeves for the 75 mm (3") diameter anchor bolts can be ordered as 5" diameter standard A53 Grade B pipes.
3. The sleeves for the 100 mm (4") diameter anchor bolts can be ordered as 6" diameter standard A53 Grade B pipes.

If you have any questions or need additional information, please contact this office.

Sincerely,

Pedro J. Sanchez
Resident Engineer

cc: N. Locke
M. Vilcheck
P. Sanchez
L. Woo

file: 05.003.01, 56.010

SFOBB - SAS (E2&T1) Project
825 Battery Street, San Francisco, CA 94111
Telephone (415) 291-3700 Facsimile (415) 433-0807

REQUEST FOR INFORMATION (RFI) RESPONSE

SFOBB SAS (E2&T1) Project # 04-0120E4

To: Caltrans
333 Burma Road
Oakland, CA 94607

Date: April 26, 2004
Date Received: April 23, 2004
Contract No: 04-0120E4
04-SF-80-13.4, 13.8
Job Name: SAS (E2&T1) Project - SFOBB

Attn: Mark Vilcheck

RFI No.: 10

Subject: Candraft RFI #1 - Anchor Rods and Sleeves - USI RFI #17

Background:

None.

Response to RFI:

1. Yes, the anchor bolts can be ordered as 3" and 4" diameter.
2. Yes, for the 3" diameter anchor bolts, 5" diameter standard A53 Grade B pipes can be ordered.
3. Yes, for the 4" diameter anchor bolts, 6" diameter standard A53 Grade B pipes can be ordered.

Action:

None.

Remarks:

Potential Time Impact: No

Potential Cost Impact: No

Remarks:

Response Attachments:

Answered By: J. Duxbury

QA / QC By: M. Nader

CC: File: TYLIN/MN-

000044 APR 27 3
RECEIVED



P.O. BOX 23223 Oakland, CA 94623
Phone (510) 419-0120 / Fax (510) 839-0666

REQUEST FOR INFORMATION (RFI)
SAS E2/T1 FOUNDATION

DATE: 4/15/2004

TO: CALIFORNIA DEPARTMENT OF TRANSPORTATION
P. Sanchez
333 Burma Road
OAKLAND, CA 94607

KFM RFI NO: 10
CO/JOB #: tbd
CONTRACT #: 04-0120E4
SUB/SUPPLIER: _____
SUB/SUPPLIER RFI NO: _____

DATE REQUESTED BY: 4/20/2004 GROUP: _____
SUBJECT: Candraft RFI #1 - Anchor Rods and Sleeves - USI RFI #17

DRAWING NO. REFERENCE(S): Contract Drawings 60 and 61 SPECIFICATION REFERENCE: 10-1.30
SHOP DRAWING REFERENCE: _____ OTHER: _____

RESUBMITTAL/SUPPLEMENTAL REF. NO.: _____

DESCRIPTION (ATTACHMENTS AS NEEDED):

000018 APR 15 3

RECEIVED

POTENTIAL TIME IMPACT? yes POTENTIAL COST IMPACT? _____ SCHEDULE ACTIVITY ID#: tbd

GENERAL EXPLANATION OF POTENTIAL IMPACTS (IF REQUIRED):

CALTRANS RESPONSE (ATTACHMENTS AS REQUIRED):

ANSWERED BY: _____ DATE ANSWERED & SENT TO KFM: _____

ROUTE COPIES / RESPONSES TO: FILE / (ATTACH INTERNAL ROUTING FORM IF NECESSARY)

PREPARED BY: Frank Daams
(KFM ORIGINATOR)

REVIEWED BY: Rich Westerheid
(KFM MANAGER)

REVIEWED BY: _____
(CCO Mgr.)

SUBMITTED BY: _____
(CONTRACT ADMIN / DCS STAFF)

For questions and/or comments:
Please contact the KFM Originator listed above at (510) 419-0120

Copy To: Job Office Files

56.0010

604 S.E. Victory, Ave.
Vancouver, WA, 98661
Ph: (360) 695-1261
Fax: (360) 696-3590



Fax

To: Rich Westerheid (KFM)	From: Brad Young
Fax: (510) 839-0666	Pages: 2
Phone: (510) 419-0120	Date: 4/14/2004
Re: RFI 17 SFOBB - T1 Tower Footing	CC: Dave Gardner (TMF), Derek Davies (Candraft), file
<input checked="" type="checkbox"/> Urgent <input checked="" type="checkbox"/> For Review <input type="checkbox"/> Please Comment <input checked="" type="checkbox"/> Please Reply <input type="checkbox"/> Please Recycle	

Rich,

Please find the attached RFI #17 for review and response. Please feel free to call me if there are any questions.

Thanks,

Brad Young

Original of this fax will not be mailed.

SKYWAY-BAY BRIDGE PROJECT KIEWIT / FCI / MANSON, A JV	
DATE 4/15/04	CO/JOB 364-3726
ROUTED BY:	NO 04-012024
TO: R. Westerheid	SPECIAL NOTES TO BE SCANNED
INTERNAL KFM COPIES TO:	
EXTERNAL COPIES TO:	
SCANNED: Y N FILED TO:	

REQUEST FOR INFORMATION

Universal Structural, Inc.

**Project: San Francisco Oakland Bay Bridge – East Span Seismic Safety Project
Seismic Retrofit Project No. 612
State of California Department of Transportation**

Bid Item No. 26 Partial (Pier T1 Tower Footing)

USI Job No.

USI R.F.I. NO: 17

Date: 4/14/04

Subject: Candraft RFI #1 – Anchor Rods and Sleeves.

Specification Section: 10-1.30-Steel Structures.

Drawing Reference: Contract Drawing 60 and 61 of 118.

Question:

Please confirm the use of the following:

1. *The Anchor Bolts are called out on the drawing as being 75mm diameter and 100mm diameter. Please confirm that these can be ordered as 3" diameter and 4" diameter Anchor Bolts.*
2. *The Sleeves for the 75mm (3") Anchor Bolts can be ordered as 5" Diameter Std. A53 Gr. B Pipes, which is 141.3mm OD x 6.55mm wall.*
3. *The Sleeves for the 100mm (4") Anchor Bolts can be ordered as 6" Diameter Std. A53 Gr. B Pipes, which is 168.3mm OD x 7.11mm wall.*

If you have any questions or need further clarification, please feel free to contact me.

*Thanks,
Brad.*

Signed: _____

Representing: Universal Structural, Inc.

Date: 4/14/2004

Date Response Needed: 4/20/04

Reply:

Signed: _____

Date: _____

Representing: _____

No. Keeping consistency with SAS projects

DEPARTMENT OF TRANSPORTATION - District 4 Toll Bridge Program

333 Burma Rd.
Oakland, CA 94607
(510) 286-0538, (510) 286-0550 fax



Kiewit-FCI-Manson, JV
220 Burma Rd.
Oakland, CA 94607

Attn: Mr. Christopher Villa
Deputy Project Director

March 31, 2006

Contract No. 04-0120E4
04-SF-80-13.4, 13.8
SAS T1 & E2 Foundations
SFOBB-ESSSP

Letter No. 05.003.01-000956

Subject: Response to RFI No. 202, Revision No. 00 (KOS RFI 18 - Anchor Rod Thread Length)

Dear Christopher,

RFI No. 202, Revision No. 00, dated March 23, 2006, pertains to a request by the Contractor for clarification of the exact length of the threaded rods at Pier T1. Regarding this RFI, the thread length at the top and bottom of tower anchor rods are shown on Sheet 920 of Submittal No. 781, Revision No. 01 dated February 6, 2006.

If you have any questions or need additional information, please contact Mark Vilcheck at (510) 286-0526.

Sincerely,

<<< ORIGINAL SIGNED >>>

Mark Vilcheck
Structure Representative

For: Pedro J. Sanchez
Resident Engineer

cc: P. Sanchez
M. Woods
J. Duxbury

file: 05.003.01, 56.202



P.O. BOX 23223 Oakland, CA 94623
Phone (510) 419-0120 / Fax (510) 832-1456

Request for Information (RFI) Report
SAS Foundations E2/T1 Project

Run Date 23-Mar-06
Time 3:26 PM

Dated: 3/23/06

To: **Pedro Sanchez**
Caltrans - SAS E2/T1 Foundation Project
333 Burma Road
Oakland CA 94607
Phone: 510-286-0538 Fax:

RFI No: KFM-RFI-000202 Rev: 00
Co/Job # 364-4347
Contract # 04-0120E4
Sub/Supplier: KOS
Sub/Supplier No: 18

Date Requested By: 30-Mar-2006

Group: T1

Subject: KOS RFI 18 - Anchor Rod Thread Length

Drawing No. Ref:

Specification Ref: 10-1.31

Other:
Resubmittal/Supplement Ref:

Description (Attachments As Needed):

Please see the attached KOS RFI 18 regarding the specified thread length for T1 anchor rods and respond.

Potential Time Impact? Yes

Potential Cost Impact? Yes

Schedule Activity ID#:

General Explanation of Potential Impact (If Required):

Response (Attachments As Required):

Answered By:

Date Answered:

CC:

Prepared By: George Atkinson *gha*
Originator 3/23/06

Reviewed By: *[Signature]*
Dan Proctor

Reviewed By: *[Signature]*
CCO Manager

Submitted By: *[Signature]*
Contract Admin/DCS Staff

Kiewit Offshore Services, Ltd.

REQUEST FOR INFORMATION

No. 018

2440 Kiewit Road
Ingleside, Texas 78362

Phone: (361)-775-4300

TITLE: Threaded Length of Anchor Rods

DATE: 3/22/2006

PROJECT: T1 Tower Footing

JOB: 21103

TO: George Atkinson
Kiewit/FCI/Manson
220 Burma Road
Oakland, CA 94607
Phone: 510-627-1000
Fax: 510-832-1456

WORK STARTED:
WORK COMPLETED:
ANSWER REQUIRED: 3/29/2006

REQUEST:

The contract documents do not specify the exact required thread length on the anchor rods. The top connection calls out a 150mm min of thread above the nut, but does not reference any additional thread needed below the nut. The bottom threaded connection is similarly detailed, but without a minimum exposed thread length. Please advise of the length of thread needed on the top and bottom of the tower anchor rods.

Requested By: Kiewit Offshore Services, Ltd.

Signed: Phil Sechler **Date:** 3/22/06
Phil Sechler

ANSWER:

Answered By: Kiewit/FCI/Manson

Signed: _____ **Date:** _____
George Atkinson



P.O. BOX 23223 Oakland, CA 94623
Phone (510) 419-0120 / Fax (510) 832-1456

Request for Information (RFI) Report
SAS Foundations E2/T1 Project

Run Date 24-Mar-06
Time 2:46 PM

Dated: 24-Mar-2006

To: Pedro Sanchez
Caltrans - SAS E2/T1 Foundation Project
333 Burma Road
Oakland CA 94607
Phone: 510-286-0538 Fax:

RFI No: KFM-RFI-000202 **Rev:** 00
Co/Job # 364-4347
Contract # 04-0120E4
Sub/Supplier: KOS
Sub/Supplier No: 18

Date Requested By: 30-Mar-2006

Group: T1

Subject: KOS RFI 18 - Anchor Rod Thread Length

Drawing No. Ref:

Specification Ref: 10-1.31

Other:

Resubmittal/Supplement Ref:

Description (Attachments As Needed):

Please see the attached KOS RFI 18 regarding the specified thread length for T1 anchor rods and respond.

Potential Time Impact? Yes

Potential Cost Impact? Yes

Schedule Activity ID#:

General Explanation of Potential Impact (If Required):

Response (Attachments As Required):

Answered By:

Date Answered:

CC:

Prepared By: George Atkinson
Originator

Reviewed By: Dan Proctor

Reviewed By: CCO Manager

Submitted By: <<< Original Signed >>>
Contract Admin/DCS Staff



DEPARTMENT OF TRANSPORTATION - District 4 Toll Bridge Program

333 Burma Rd.
Oakland, CA 94607
(510) 286-0538, (510) 286-0550 fax



Kiewit-FCI-Manson, JV
220 Burma Rd.
Oakland, CA 94607

Attn: Mr. Lee Zink
Project Director

October 10, 2006

Contract No. 04-0120E4
04-SF-80-13.4, 13.8
SAS T1 & E2 Foundations
SFOBB-ESSSP

Letter No. 05.003.01-002080

Subject: Response to RFI No. 299, Revision No. 00 (T1 Anchor Bolt Required Thread for Stressing by Others)

Dear Lee,

RFI No. 299, Revision No. 00, pertains to the thread length on the Pier T1 anchor bolts. Regarding this RFI, the anchor bolts will be stressed to 70% GUTS (approximately 30mm elongation) by others. The 100-mm thread length below the top nut of the anchor bolt is sufficient for the expected rod extension due to prestress. However, it is not sufficient to address the full spectrum of possible fabrication and erection tolerances.

If you have any questions or need additional information, please contact Mark Vilcheck at (510) 286-0526.

Sincerely,

A handwritten signature in black ink, appearing to read "Mark Vilcheck".

Mark Vilcheck
Structure Representative

For: Pedro J. Sanchez
Resident Engineer

cc: P. Sanchez
M. Woods
J. Duxbury

file: 05.003.01, 56.299

A date stamp consisting of a circle containing a stylized "M" and the text "OCT 16 2006".
OCT 16 2006



P.O. BOX 23223 Oakland, CA 94623
Phone (510) 419-0120 / Fax (510) 832-1456

Request for Information (RFI) Report
SAS Foundations E2/T1 Project

Run Date 12-Sep-06
Time 10:26 AM

Dated: 9/12/06

To: Pedro Sanchez
Caltrans - SAS E2/T1 Foundation Project
333 Burma Road
Oakland CA 94607
Phone: 510-286-0538 Fax:

RFI No: KFM-RFI-000299 Rev: 00
Co/Job # 364-4347
Contract # 04-0120E4
Sub/Supplier: KOS
Sub/Supplier No:

Date Requested By: 19-Sep-2006

Group: T1

Subject: T1 Anchor Bolt Required Thread for Stressing by Others

Drawing No. Ref:

Specification Ref:

Other: T1 shop drawing sheet 920

Resubmittal/Supplement Ref:

Description (Attachments As Needed):

KFM requests re-confirmation that the 100mm of thread below the upper anchor rod nut as shown on the shop drawings is sufficient for stressing the anchor rods. The SAS contractor will be stressing the rods when the tower is installed and KFM is not aware of the stressing requirements or what amount the rod will elongate when stressed. KFM would like to assure the proper amount of threads are provided.

Potential Time Impact? Yes

Potential Cost Impact? Yes

Schedule Activity ID#:

General Explanation of Potential Impact (If Required):

Response (Attachments As Required):

Answered By:

Date Answered:

005117 SEP 14 08
RECEIVED

CC:

Prepared By: Dave Russ Originator

Reviewed By: _____

Reviewed By: CCO Manager

Submitted By: Contract Admin/DCS Staff

56.299

SEP 19 2006



SFOBB - SAS (E2&T1) Project
Two Harrison Street, Suite 500, San Francisco, CA 94105
Telephone (415) 291-3700 Facsimile (415) 433-0807

REQUEST FOR INFORMATION (RFI) RESPONSE

SFOBB SAS (E2&T1) Project # 04-0120E4

To: Caltrans
333 Burma Road
Oakland, CA 94607

Date: October 9, 2006
Date Received: September 15, 2006
Contract No: 04-0120E4
04-SF-80-13.4, 13.8
Job Name: SAS (E2&T1) Project - SFOBB

Attn: Mark Vilcheck

RFI No.: 247 R1
Subject: T1 - Alternative Bolt Keeper Detail

Background:

The JV understands that RFI Nos. 247 R1, 298, and 299 pertain to top or bottom thread lengths on the T1 anchor bolts. Please note that determination of thread lengths are considered the Contractor's means and methods and shall not be the responsibility of the JV. The JV considers the information provided on the Contractor Plans and the submitted shop drawings sufficient for the Contractor to fabricate and erect the anchor bolts per design.

Response to RFI:

The 25mm thread above the collar appears to be reasonable, but cannot be approved at this time. The full spectrum of possible fabrication and erection tolerances shall be included in the calculations of thread length. The method by which the Contractor intends to achieve specified elevation of the top of the anchor bolts must also be considered.

Per Plan Sheet 63 of 118, the top of the anchor bolt shall be at a minimum elevation of 5.330m and 5.355m for the 75mm and 100mm anchor bolts, respectively (given that the anchor bolt nut thicknesses per the shop drawings are 80mm and 105mm for the 75mm and 100mm anchor bolts, respectively). From the sketch provided, it appears that the Contractor intends to maintain the 100mm stick out below the nut. The sketch does not address the case when the 55mm bearing plate is used to correct for mis-located/ oversized holes on the end plate.

Please note that it is acceptable to reduce the 100mm stick out below the nut based on Contractor's means and methods. The Contractor shall provide a value for the stick out for consideration.

Also please refer to responses to RFI's 298 and 299.

Action:

None.

Remarks:

None.

Potential Time Impact: No

Potential Cost Impact: No

Response Attachments:

Answered By: C. Choi, M. Benoit, J. Denis

QA / QC By: J. Duxbury, M. Nader

CC: File: TYLIN/MN

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES

MATERIALS ENGINEERING AND TESTING SERVICES

Office of Structural Materials

Quality Assurance and Source Inspection

Bay Area Branch

690 Walnut Ave., St. 150

Vallejo, CA 94592-1133

(707) 649-5453

FAX: (707) 649-5493

Contract #: **04-0120E4**Cty **SF** Rte **80** PM **13.4/13.8.**File # **45.25 B**

QUALITY ASSURANCE - NONCONFORMANCE REPORT

Location: **Ingleside, Texas**Date: **January 10, 2007**Prime Contractor: **Kiewit/FCI/Manson (KFM) – Joint Venture**

NCR #132

Submitting Contractor: **Kiewit Offshore Services (KOS)****Type of problem:**

Welding	<input type="checkbox"/>	Concrete	<input type="checkbox"/>	Other	<input checked="" type="checkbox"/>	Galvanizing
Welding:	<input type="checkbox"/>	Curing:	<input type="checkbox"/>	Procedural:	<input type="checkbox"/>	Bridge No.: #34-0006L/R
Joint fit-up:	<input type="checkbox"/>	Coating:	<input type="checkbox"/>	Other:	<input type="checkbox"/>	Component: Anchor Rods
Procedural:	<input type="checkbox"/>	Procedural:	<input type="checkbox"/>			

Description of Non-Conformance: KOS Quality Control (QC) Representatives allowed KOS to repair areas of multiple galvanized coated anchor rods using Zinc-It Instant Cold Galvanize in an aerosol can. The Standard Specifications July 1999, Section 75-1.05 prohibit the use of the use of aerosol cans for the repair of galvanizing. See the following digital photographs for additional information.



QUALITY ASSURANCE - NONCONFORMANCE REPORT

(Continued, Page 2 of 2)



Applicable reference: Standard Specifications July 1999, Section 75-1.05

Who discovered the problem: Caltrans Quality Assurance Inspector Mary Madere

Name of individual from Contractor notified: KOS Quality Control Representative (QC) Mr. George Barnhill

Time and method of notification: Verbal with Mr. Barnhill at approximately 1600 hours, on January 10, 2007.

Name of Caltrans Engineer notified: Mark Vilcheck, Structures Representative

Time and method of notification: 1605 hours, December 11, 2007, via verbal communication

QC Inspector's Name: George Barnhill

Was the QC Inspector aware of problem: Yes

Contractor's proposal to correct the problem: The Contractor indicated during a meeting on January 11, 2007 that the cold galvanizing would be removed and repaired in accordance with the Standard Specifications.

Comments: This report is for the purpose of determining general conformance with the contract documents and is not for the purpose of making repair or fit for purpose recommendations. Should you require recommendations concerning repairs or remedial efforts please contact, Ryan Smith (858) 232-6799 who represents the Office of Structural Materials for your project.

Inspected By: Mary Madere

Quality Assurance Inspector

Reviewed By: Robert Cuellar

QA Reviewer



P.O. BOX 23223 Oakland, CA 94623
 Phone (510) 419-0120 / Fax (510) 832-1456

LETTER OF SUBMITTAL
SAS Foundations E2/T1 Project

Run Date 23-Jan-07
 Time 1:28 PM

Dated: 23-Jan-2007

SUBMITTAL No: KFM-SUB-001276

Rev: 00

To: **Pedro Sanchez**
 Caltrans - SAS E2/T1 Foundation Project
 333 Burma Road
 Oakland CA 94607
 Phone: 510-286-0538 Fax:

Co/Job # 364-4347
 Contract # 04-0120E4
 Sub/Supplier: KOS
 Sub/Supplier No: 802

Subject: KOS Response to NCR per SL-2545 - Aerosol Cold-Galv Paint

Special Provis. (SP) REF: 10-1.31
 Standard Spec. (SS) REF:

RESUBMITTAL/SUPPLEMENTAL REF:

We are sending the following attached items: Attached

Via Fax

- Contract Plans/Specs
- Certs of Compl./Samples
- Drawings/Calculations
- Schedule
- Change Order
- Progress Estimate Request
- Copy of Letter
- Payroll Information

- Working Drawings
- WQCP and/or Addenda
- Weekly Weld Reports
- CWR Procedure

Item	Date	Copies	Description	Drawing No	Rev	Status	Pages
01	22-Jan-07	1	KOS TRN-802 NCR 132 Clearing Documents		0	Pending	

These are transmitted as checked below:

- For Approval
- For Review/Comment
- Return For Correction
- For Your Use
- As Requested
- For Information

Remarks:

CC:

Please review / approve by : _____

Submitted By: **George Atkinson**

(KFM Staff Member – Originator of Transmittal)

Checked & Sent By: _____

George Atkinson
 Contract Admin/DCS Staff



Kiewit

2440 Kiewit Road
Ingleside, Texas 78362
Phone: (361)-775-4300

Kiewit Offshore Services, Ltd.

TRANSMITTAL

No. 00802

KOS Job: 21103

PROJECT: T1 Tower Footing
Kiewit Offshore Services, Ltd.

REF: NCR# 132 Closing Doc

ATTN: George Atkinson

DATE: 1/22/2007

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
<input type="checkbox"/> Shop Drawings	<input type="checkbox"/> Approval	<input type="checkbox"/> Approved as Submitted
<input type="checkbox"/> Letter	<input checked="" type="checkbox"/> Your Use	<input type="checkbox"/> Approved as Noted
<input type="checkbox"/> Prints	<input checked="" type="checkbox"/> As Requested	<input type="checkbox"/> Returned After Loan
<input type="checkbox"/> Change Order	<input type="checkbox"/> Review and Comment	<input type="checkbox"/> Resubmit
<input type="checkbox"/> Plans		<input type="checkbox"/> Submit
<input type="checkbox"/> Samples	SENT VIA:	<input type="checkbox"/> Returned
<input type="checkbox"/> Specifications	<input checked="" type="checkbox"/> Attached	<input type="checkbox"/> Returned for Corrections
<input checked="" type="checkbox"/> Other:	<input type="checkbox"/> Separate Cover Via:	<input type="checkbox"/> Due Date:

DRAWING NO.	REV.	COPIES	DATE	DESCRIPTION
NCR# 132		1	1/22/2007	Closing of NCR #132

Remarks:

Signed: 
George Barnhill



George Atkinson
QCM KFM JV.
Oakland, CA

Date: 1/20/2007

Subject: Clearing of NCR #132

George:

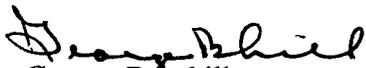
KOS was issued NCR (#132).

The Department issued a Non-conformance Report (NCR) at Kiewit Offshore Services, Ltd. (KOS) in Ingleside, Texas, on January 10, 2007. The NCR was generated when QA observed that KOS QC allowed KOS to repair areas of multiple galvanized coated anchor rods using "Zinc-It Instant Cold Galvanize" in an aerosol can. Section 75-1.05 of the Standard Specification prohibits the use of aerosol cans for the repair of galvanized surfaced.

KOS did use the aerosol cans of "Zinc-It Instant Cold Galvanize" to touch up the abraded or damage areas on the anchor bolts in violation of Standard Specification 75-1.05. KOS will remove the paint from the areas that have been sprayed with the cold galvanize from the aerosol cans by wire brushing and sanding to remove the paint. KOS will apply two applications of unthinned zinc – rich primer (organic vehicle type) conforming to the provisions in Section 91.

KOS has removed the cans of "Zinc-It Instant Cold Galvanize" from the jobsite and will not permit it to be used again.

KOS is asking that the Department close this NCR. If you have any questions I can be reached at 361-775-4420 or on my cell at 361-385-0189.


George Barnhill
QCM KOS
Ingleside, TX

Cc: Scott Cheney, Mike Brown

Memorandum

*Flex your power!
Be energy efficient!*

To: MARK VILCHECK
Structure Representative
333 Burma Road
Oakland, CA 94607

Date: January 31, 2007
File: 04-0120E4
E2/T1 Foundations

From: RYAN T. SMITH
Structural Materials Representative
Quality Assurance and Source Inspection Branch
Office of Structural Materials

KFM SUBMITTAL 1276-00 –KIEWIT OFFSHORE SERVICES (KOS) RESPONSE TO NONCONFORMANCE REPORTS 132

The Materials Engineering Testing Service (METS) has reviewed the KFM Submittal 1276-00, dated January 23, 2007. In this submittal the Contractor is requesting to close the METS Nonconformance Report (NCR) 132, which documented the Contractor's use of galvanizing from an aerosol can for repair of galvanized surfaces on the T1 anchor rods.

The Standard Specifications July 1999, Section 75-1.05 prohibit the use of the use of aerosol cans for the repair of galvanizing. METS understands the Contractor used the aerosol galvanizing due to a lack of knowledge of the referenced specification. As indicated in the KOS letter dated January 20, 2007, the Contractor has removed the aerosol galvanizing and will repair all damaged areas on the anchor rods in accordance with the contract specifications. METS understands this to be an isolated case and considers NCR #132 to be resolved at this time.

If you have any questions, or would like to discuss the issues, please call me at (858) 232-6799.

cc: Rafael Bolon
Tom Shimada
Patryk Pich
Robert Cuellar

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
 MATERIALS ENGINEERING AND TESTING SERVICES
 Office of Structural Materials
 Quality Assurance and Source Inspection

Bay Area Branch

690 Walnut Ave., St. 150
 Vallejo, CA 94592-1133
 (707) 649-5453
 FAX: (707) 649-5493



Contract #: 04-0120E4
 Cty SF Rte 80 PM 13.4/13.8
 File # 45.9

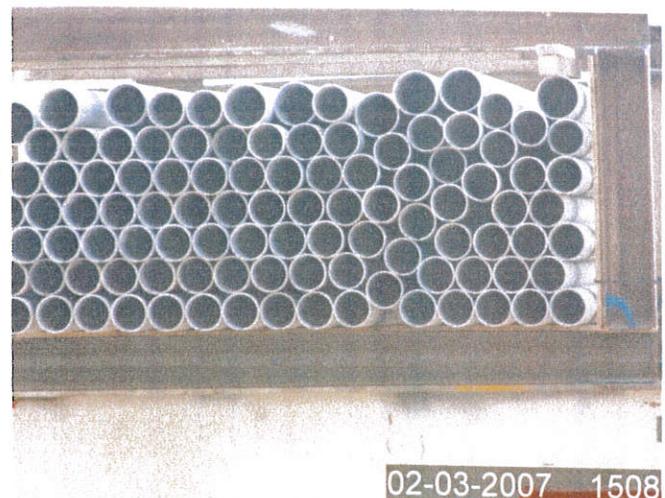
REPORT OF INSPECTION OF MATERIAL**Resident Engineer** Pedro Sanchez**Date Inspected:** 2-3-07**Address:** 333 Burma Road**City:** Oakland, CA**Project Name:** SFOBB E2/T1 Foundations**OSM Arrival Time:** 0700**Prime Contractor:** Kiewit/FCI/Manson (KFM) – Joint Venture**OSM Departure Time:** 1530**Contractor:** Kiewit Offshore Services (KOS)**Location:** Ingleside, TX

The following material has been inspected in accordance with Section 6 of the Standard Specifications and found to substantially comply* with contract plans and specifications.

Lot #	Bid Item #	Quantity	Material Description
B67-003-07	26 (F)	388	5025 mm X 5" Diameter Schedule 40 Galvanized Pipe (Plain Ends)
B67-003-07	26 (F)	36	5025 mm X 6" Diameter Schedule 40 Galvanized Pipe (Plain Ends)
			Total Weight of Shipment: 47525 kilograms

Identification: Five (5) Orange Tags firmly affixed to the shipment**Shipped to:** Jobsite

Summary of Items Observed and Conversations: KOS Representative Mayra Zuniga presented the Caltrans Quality Assurance (QA) Inspector with a Bill of Lading and galvanizing certificates for the KFM supplied items listed above. Ms. Zuniga stated that KOS would like to request a release to the jobsite. The QA Inspector performed a random review of the contractor supplied documents. After a random visual inspection of the identified items, the QA Inspector issued lot number B67-003-07 and an orange tag release to the jobsite. See the following digital photographs for additional information.



REPORT OF INSPECTION OF MATERIAL

Page 2 of 2

Comments: This report is for the purpose of determining conformance with the contract documents and is not for the purpose of making repair or fit for purpose recommendations. Should you require recommendations concerning repairs or remedial efforts please contact Ryan Smith (858) 232-6799, who represents the Office of Structural Materials for your project.

Inspected By: Mary Maderé



Quality Assurance Inspector

Reviewed By: Robert Cuellar



QA Reviewer

*Based on random sampling, testing and inspection procedures. Subject to final inspection by the Resident Engineer.

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
 MATERIALS ENGINEERING AND TESTING SERVICES
 Office of Structural Materials
 Quality Assurance and Source Inspection



Bay Area Branch
 690 Walnut Ave., St. 150
 Vallejo, CA 94592-1133
 (707) 649-5453
 FAX: (707) 649-5493

Contract #: 04-0120E4
 Cty SF Rte 80 PM 13.4/13.8
 File # 45.9

REPORT OF INSPECTION OF MATERIAL

Resident Engineer Pedro Sanchez

Date Inspected: 2-3-07

Address: 333 Burma Road

City: Oakland, CA

Project Name: SFOBB E2/T1 Foundations

OSM Arrival Time: 0700

Prime Contractor: Kiewit/FCI/Manson (KFM) – Joint Venture

OSM Departure Time: 1530

Contractor: Kiewit Offshore Services (KOS)

Location: Ingleside, TX

The following material has been inspected in accordance with Section 6 of the Standard Specifications and found to substantially comply* with contract plans and specifications.

Lot #	Bid Item #	Quantity	Material Description
B67-002-07	26 (F)	388	7789 mm X 3" Diameter Galvanized Anchor Rods (Threaded Each End)
B67-002-07	26 (F)	36	7839 mm X 4" Diameter Galvanized Anchor Rods (Threaded Each End)
			Total Weight of Shipment: 125,813 kilograms

Identification: Five (5) Orange Tags firmly affixed to the shipment

Shipped to: Jobsite

Summary of Items Observed and Conversations: KOS Representative Mayra Zuniga presented the Caltrans Quality Assurance (QA) Inspector with a Bill of Lading, galvanizing certificates, coating documents and Inspection & Testing Reports for the items listed above. Ms. Zuniga stated that KOS would like to request a release to the jobsite. The QA Inspector performed a random review of the contractor supplied documents. After a random visual inspection of the identified items, the QA Inspector issued lot number B67-002-07 and an orange tag release to the jobsite. See the following digital photographs for additional information.



REPORT OF INSPECTION OF MATERIAL

Page 2 of 2

Comments: This report is for the purpose of determining conformance with the contract documents and is not for the purpose of making repair or fit for purpose recommendations. Should you require recommendations concerning repairs or remedial efforts please contact Ryan Smith (858) 232-6799, who represents the Office of Structural Materials for your project.

Inspected By: Mary Madere



Quality Assurance Inspector

Reviewed By: Robert Cuellar



QA Reviewer

*Based on random sampling, testing and inspection procedures. Subject to final inspection by the Resident Engineer.



244 KIEWIT ROAD
 INGLESIDE
 TX
 78362

Phone: 361-775-4300
 Fax: 361-775-0467

CONFIRMATION
 ORDER

This number must appear on all packing slips, shipping documents, packages and invoices.	
21103-32274b	
Page Number 1 of 2	Purchase Order Date JUN/21/2006

Supplier: INTERNATIONAL GASKET
 MYRON
 5819 LEOPARD
 CORPUS CHRISTI, TX
 78408
 Phone: 361-289-1614

Ship-to: KIEWIT OFFSHORE SERVICES, LTD.
 2440 KIEWIT ROAD
 INGLESIDE
 TX
 78362

TERMS	F.O.B.	DELIVERY	REQUESTED BY	REQ. NO.
NET 30 DAYS	DESTINATION	VENDOR TRUCK	P SECHLER	27775

LN	QUANTITY	DESCRIPTION	DELIVERY	PRICE/UNIT	EXTENSION
1	388 EA	ANCHOR BOLTS, A354 BD GALV. WITH 2 EACH A563 HVY NUTS GALV. & 1 EACH F436 TYPE 1 FLAT WASHER GALV, 3" OD, 305-5/8" LENGTH, 13" THREAD LENGTH ON ONE END & 7" THREAD LENGTH ON ONE END	NOV/06/2006		
2	36 EA	ANCHOR BOLTS, A354 BD GALV. WITH 2 EACH A563 HVY NUTS GALV. & 1 EACH F436 TYPE 1 FLAT WASHER GALV, 4" OD, 307-5/8" LENGTH, 13-3/4" THREAD LENGTH ON ONE END & 8" THREAD LENGTH ON ONE END	JAN/19/2007		
NOTE: 1) VENDOR TO MEET ALL SPEC & REQUIREMENTS AS PER ATTACHED DRAWING & SPECIFICATIONS. 2) 3" & 4" RODS TO BE GALVANIZED PER A123 & NUTS & WASHER FOR BOTH 3" & 4" RODS TO BE GALVANIZED PER A153. 3) ALL MATERIAL MUST MEET DOT "BUY AMERICA". MATERIAL MUST BE MELTED AND MANUFACTURED IN THE UNITED STATES. ***** CONFIRMATION: DO NOT DUPLICATE. ORDER PLACED BY JACK UPTON ON 6-6-06 CERTIFICATE OF COMPLIANCE REQUIRED WITH DELIVERY. ALL MATERIAL TO MEET LATEST REVISION OF ASTM, ANSI OR API SPECIFICATIONS. ***** UPON ARRIVAL, CONTACT: TONY MELLIN END USE: TOWER ANCHOR BOLTS Continued on next page...					

- (1) Invoice each PO separately in duplicate showing above PO number and shipping information.
- (2) All duty and/or taxes must be shown separately on invoice where applicable.
- (3) This order is subject to the terms and conditions stated.
- (4) Federal Tax ID #47-0822068

Jack Upton
 K.O.S. SIGNATURE



2440 KIEWIT ROAD
 INGLESIDE
 TX
 78362

Phone: 361-775-4300
 Fax: 361-775-0467

CONFIRMATION
 ORDER

This number must appear on all packing slips,
 shipping documents, packages and invoices.

21103-32274b

Page Number
2 of 2

Purchase Order Date
JUN/21/2006

Supplier: INTERNATIONAL GASKET
 MYRON
 5819 LEOPARD
 CORPUS CHRISTI, TX
 78408
 Phone: 361-289-1614

Ship-to: KIEWIT OFFSHORE SERVICES, LTD.
 2440 KIEWIT ROAD
 INGLESIDE
 TX
 78362

TERMS	F.O.B.	DELIVERY	REQUESTED BY	REQ. NO.
NET 30 DAYS	DESTINATION	VENDOR TRUCK	P SECHLER	27775

LN	QUANTITY	DESCRIPTION	DELIVERY	PRICE/UNIT	EXTENSION
		SELLER'S AGREEMENT			
		THE WRITTEN ACKNOWLEDGEMENT OF THIS PURCHASE ORDER BY SELLER, THE SHIPMENT OF ANY GOODS, THE COMMENCEMENT OF ANY WORK, OR THE PERFORMANCE OF ANY SERVICES HEREUNDER BY SELLER, SHALL CONSTITUTE ACCEPTANCE BY SELLER OF THIS PURCHASE ORDER AND ITS TERMS AND CONDITIONS.			
		** MODIFIED JAN/30/2007 / RE-PRINTED JAN/30/2007 **			
				Total:	

- (1) Invoice each PO separately in duplicate showing above PO number and shipping information.
- (2) All duty and/or taxes must be shown separately on invoice where applicable.
- (3) This order is subject to the terms and conditions stated.
- (4) Federal Tax ID #47-0822068

K.G.S. SIGNATURE

KFM
 Caltrans SAS Foundations E2, T1

T1 Loose Items Shipping List

Line	Qty	UOM	Description	#/ea	Extension		
					#'s	Sh.	Tons
1	388	ea	Anchor Rod - 7789mm x 3" dia galvanized (threaded ea end)	613	237,844		119
2	36	ea	Anchor Rod - 7839mm x 4" galvanized (threaded ea end)	1,098	39,528		20
3	388	ea	Anchor Rod Sleeve - 5025mm x 5" dia Sch 40 pipe galvanized (plain ends)	241	93,508		47
4	36	ea	Anchor Rod Sleeve - 5025mm x 6" dia Sch 40 pipe galvanized (plain ends)	313	11,268		6
5			Sub-Total		382,148		191



Kiewit

2440 Kiewit Road
Ingleside, Texas 78362
Phone: 361-775-4300

Kiewit Offshore Services, Ltd.

TRANSMITTAL

No. 00956

KOS Job: 21103

PROJECT: T1 Tower Footing
CALIFORNIA DEPT OF TRANSPORTATION

REF: Galvanizing-Preliminary

ATTN: CAL REPRESENTATIVE

DATE: 2/2/2007

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
<input type="checkbox"/> Shop Drawings	<input type="checkbox"/> Approval	<input type="checkbox"/> Approved as Submitted
<input type="checkbox"/> Letter	<input type="checkbox"/> Your Use	<input type="checkbox"/> Approved as Noted
<input type="checkbox"/> Prints	<input type="checkbox"/> As Requested	<input type="checkbox"/> Returned After Loan
<input type="checkbox"/> Change Order	<input type="checkbox"/> Review and Comment	<input type="checkbox"/> Resubmit
<input type="checkbox"/> Plans		<input type="checkbox"/> Submit
<input type="checkbox"/> Samples	SENT VIA:	<input type="checkbox"/> Returned
<input type="checkbox"/> Specifications		<input checked="" type="checkbox"/> Attached
<input type="checkbox"/> Other:	<input type="checkbox"/> Separate Cover Via:	<input type="checkbox"/> Returned for Corrections
		<input type="checkbox"/> Due Date:

DRAWING NO.	REV.	COPIES	DATE	DESCRIPTION
	1		2/2/2007	Galvanizing-Preliminary

Remarks: Attached you will find a copy of the Galvanizing information for the anchor rods, pipe sleeves, hex nuts.

Signed: 
Mayra Zuniga

TENNESSEE GALVANIZING, INC.
P O BOX 609
JASPER, TN 37347

SHIPPING ADDRESS:
1335 INDUSTRIAL BLYD.
JASPER, TN. 37347

GALVANIZING CERTIFICATION:

WE HEREBY CERTIFY THAT THE FOLLOWING MATERIALS HAVE BEEN GALVANIZED IN ACCORDANCE WITH THE SPECIFICATIONS AS SET FORTH BY ASTM-A-123/A89A 123M-00. FINAL INSPECTION HAS BEEN MADE AND MATERIALS MEET ALL REQUIREMENTS.

CUSTOMER NAME: VULCAN THREADED PRODUCTS, INC.
P O BOX 509
PELHAM, AL 35124

CUSTOMER'S PURCHASE ORDER #: 23316

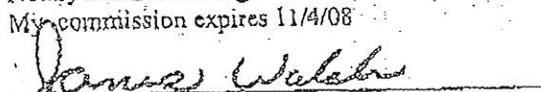
INVOICE #:

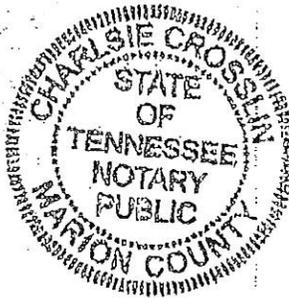
MATERIAL GALVANIZED: RODS



DAVID S WARE, PRESIDENT/CEO
Sworn to and subscribed before me
JANUARY 19, 2007


CHARLSIE CROSSLIN
Notary Public-At-Large
My commission expires 11/4/08


JAMES W. WALDEN, QUALITY MGR.



Myron / Adam,

Please pass on to your customer.

361-289-9029

Leo

TENNESSEE GALVANIZING, INC.
P O BOX 609
JASPER, TN 37347

SHIPPING ADDRESS:
1515 INDUSTRIAL BLVD.
JASPER, TN 37347

GALVANIZING CERTIFICATION:

WE HEREBY CERTIFY THAT THE FOLLOWING MATERIALS HAVE BEEN GALVANIZED IN ACCORDANCE WITH THE SPECIFICATIONS AS SET FORTH BY ASTM-A-153A 153M-00. FINAL INSPECTION HAS BEEN MADE AND MATERIALS MEET ALL REQUIREMENTS.

CUSTOMER NAME: VULCAN THREADED PRODUCTS, INC.
P O BOX 509
PELHAM, AL 35124

CUSTOMER'S PURCHASE ORDER #: 171352

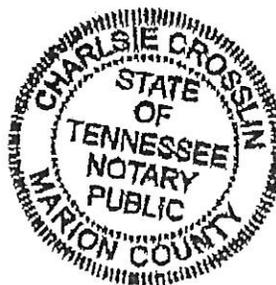
INVOICE #: IO38654

MATERIAL GALVANIZED: DER

David S. Ware
DAVID S WARE, PRESIDENT/CEO

Sworn to and subscribed before me
JANUARY 16, 2007

Charlsie Crosslin
CHARLSIE CROSSLIN
Notary Public-At-Large
My commission expires 11/04/08



James Walden
JAMES WALDEN, QUALITY CONTROL MGR.



Houston Galvanizing Services
7407 C.E. King Parkway
PO Box 24720
Houston, TX 77229-4720
281.458.1550
Fax-281.458.2515

January 29, 2007

Mr. Jack Upton
Kiewit Offshore Services
2440 Kiewit Road
Ingleside, TX 778362

FAX# 361.775.4430

Re: Galvanizing Procedures
Job# 21103-37242

PROCESS CERTIFICATION

This is to certify that all materials hot dip galvanized by Aztec Galvanizing Services are done in accordance with ASTM A 123/A 123M-02 , & E376-03 specifications.

PROCEDURES

The material is first soaked in a hot caustic solution to remove oils and other organic materials. After a water rinse, the material is pickled in approximately 15% solution of hydrochloric acid until free of rust and scale. Following a water rinse and submersion in a heated solution of preflux, the material is dipped in molten zinc at approximately 830° Fahrenheit. Time in the molten zinc varies according to the shape and weight of the parts. Parts are allowed to cool and hand cleaned to remove excessive zinc and sharp projections.

Lonnie J. McLead
Plant Manager



K-T Galvanizing Company, Inc.
P.O. Box 560 - 5105 East 3rd Street
Katy, Texas 77492
Ph: 281-391-9201 Fax 281-391-5819
www.ktgalvanizing.com



January 4, 2007

Gulf Coast Fasteners
P.O. Box 19331
Houston, Tx 77224

RE: CERTIFICATE OF COMPLIANCE BLANKET CERTIFICATE

To Whom It May Concern:

We certify that our Hot Dip process meets the requirements of
ASTM A153, class C specifications.

Sincerely,

Al Peck
President

AP/pm

COMPANY *International Basket & Supply*
INVOICE 109178
P.O. 116854



Original # 6-11-05
035889-00

METALLURGICAL CERTIFICATE

TAG NO. R55979
HEAT NO. A08980
SIZE & DESCRIPTION: 1/4 x 44.40 x 120.00
HR P&C
SPECIFICATION: C1050

CHEMICAL ANALYSIS								
C	Mn	P	S	SI	Cr	Al	Mo	Cu
0.530	0.730	0.007	0.001	0.170	0.000	0.028	0.000	0.000

MECHANICAL PROPERTIES			
TENSILE (PSI)	YIELD (PSI)	%ELONG IN 2"	RD

WE HEREBY CERTIFY THAT THE FOREGOING INFORMATION WAS FURNISHED TO US BY OUR SUPPLIER OR RESULTED FROM TESTS PERFORMED BY AN INDEPENDENT LABORATORY.

SIGNED: J. J.

DATE: 6/13/2005

"Melted & Manufactured in the USA"



BINDER METAL PRODUCTS

INCORPORATED



14909 SOUTH BROADWAY | P.O. BOX 2306 / GARDENA, CALIFORNIA 90248-1817

General FAX: (310) 532-9527
 Sales FAX: (310) 532-1284
 E-Mail: nslosa@bindormetal.com

(323) 321-4035
 OUTSIDE CALIFORNIA
 (800) 233-0896

INSPECTION & TEST REPORT

CUSTOMER & ADDRESS:		CUST P.O. NO:	PACKING SLIP NO.	MFG DATE	LOT NO.	DATE
GULF COAST FASTENERS, INC.		J9928	145847-01	12-14-08	W8747	12-16-08
P.O. BOX 19831 1628 TOWNHURST HOUSTON, TX 77043		*THIS LAB REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN PERMISSION OF THE B&P LAB *LAB RESULTS PERTAIN ONLY TO THE ITEMS TESTED				
GENERAL REQUIREMENTS			PROCESSING DATA AND INSP/TEST RESULTS			
PART NO	FP4.00		HEAT TREATING			
PRODUCT FAMILY	4" F436 PLAIN		HEAT TREAT SPECIFICATION MIL-H-8875			
PRODUCT SPECIFICATION	ASTM F436-1999		HEAT TREAT REQUIREMENT 38 TO 45 HRC			
MATERIAL GRADE & SPEC	AISI 4130 STEEL		CLEAN OKAY			
MATERIAL HEAT NUMBER	4527		ENOC QUENCH 1600			
LOT SIZE	180 PIECES SHIPPED		TEMPER 750			
INSPECTION AND TEST DATA			INSP METHOD SAMPLING			
DIMENSIONAL			SAMPLING PLAN ABM "O" = "O", SAMPLING PLAN			
INSP METHOD	SPC <input checked="" type="checkbox"/> SAMPLING <input type="checkbox"/>		A.Q.I./INSP LEVEL 4.0/1A			
SAMPLING PLAN	ASQ C=0		SAMPLE SIZE 29 PCS			
LEVEL/A.Q.I.	4.0 aqi, LEVEL 1A		ACTUAL RESULT 41.3-45.0 HRC			
SAMPLE SIZE	10 PCS, EACH 30 MIN		INSP RESULT ACCEPT <input checked="" type="checkbox"/> REJECT <input type="checkbox"/>			
D.P.	7.488		INSPECTOR BRIAN SHAIN			
I. D.	4.125		PLATING			
THICKNESS	.250		FINISH SPECIFICATIONS			
OTHER	PARTS TAKEN FROM LARGER MFG LOT*		FINISH REQUIREMENT PLAIN FINISH			
OTHER	MANUFACTURED IN THE USA		INSP METHOD			
OTHER			SAMPLING PLAN			
OTHER			A.Q.I./INSP LEVEL			
INSP RESULT	ACCEPT <input checked="" type="checkbox"/> REJECT <input type="checkbox"/>		SAMPLE SIZE			
INSPECTOR	SALVADOR MARQUEZ		ACTUAL RESULT			
*MATERIALS MEET SPECIFIED REQUIREMENTS:			INSP RESULT ACCEPT <input type="checkbox"/> REJECT <input type="checkbox"/>			
YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>			INSPECTOR			
DEVIATIONS FROM STD TEST METHODS NONE						

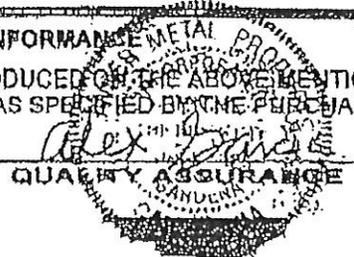
*HEAD MARKING FOR F436 IS "B"

CERTIFICATE OF CONFORMANCE

I, ALEX GARCIA, HEREBY CERTIFY THAT THE GOODS PRODUCED ON THE ABOVE MENTIONED PURCHASE ORDER MEET THE STATED REQUIREMENTS, AS SPECIFIED BY THE PURCHASE ORDER AND ANY RELATED OR REFERENCED DOCUMENTS.

FORM #BMP-116

Manufacturers of:



S E R V I N G T H E I N D U S T R Y S I N C E 1 9 2 6



Alloyed 17 11-15
045569-00

METALLURGICAL CERTIFICATE

TAG NOS. TBA
HEAT NO. 4527
SIZE & DESCRIPTION: .250 x 48.760 x 120.00
HR P&O
SPECIFICATION: 4130

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Cr	Al	Mo	Cu
0.290	0.470	0.008	0.001	0.200	0.830	0.040	0.180	0.030

MECHANICAL PROPERTIES

TENSILE (PSI)	YIELD (PSI)	%ELONG IN 2"	Rb

WE HEREBY CERTIFY THAT THE FOREGOING INFORMATION WAS FURNISHED TO US BY OUR SUPPLIER OR RESULTED FROM TESTS PERFORMED BY AN INDEPENDENT LABORATORY.

SIGNED: *J.J.*

DATE: 11/29/2008

****MELTED & MANUFACTURED IN THE USA****

SPINDLETOP BOLT CO.

825 Delmar

Beaumont, TX 77707

Phone 409.842.9555 Fax 409.842.3929

CERTIFIED TEST REPORT

Sold To:
KIEWIT OFFSHORE SERVICES Ltd.

Date: 1/30/2007
Customer P.O. Number: 21103-32274
Sales Order Number:

QTY. SHIPPED	Heat #	Description
	NTF-024	4-8 ASTM A194 2H HEAVY HEX NUT ASTM A153 HDG
	NTF-024B	3-8 ASTM A194 2H HEAVY HEX NUT ASTM A123 HDG

Chemical Analysis

Heat Code	Heat Number	C	Mn	P	S	Si	Ni	Cr	Mo
NTF-024	A060962	0.430	0.580	0.008	0.024	0.280	0.080	0.190	0.030
NTF-024B	501325	0.460	0.840	0.012	0.023	0.240	0.083	0.146	0.020

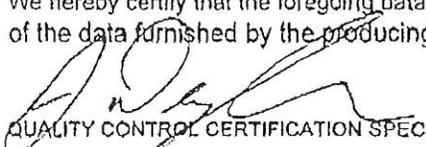
PHYSICAL ANALYSIS

Heat Code	Yield/Proofload	Tensile	Elongation %	R.A.%	Tempering	Hardness
NTF-024	N/A	N/A	N/A	N/A	N/A	255 HBW
NTF-024B	N/A	N/A	N/A	N/A	N/A	262 HBW

Galvanizing Certification:

We hereby certify that the following materials have been galvanized in accordance with the specifications as set forth by ASTM A153 and ASTM A123. Final inspection has been made and materials meet all requirements.

We hereby certify that the foregoing data is a true copy of the data furnished by the producing mill.


QUALITY CONTROL CERTIFICATION SPECIALIST

CERTIFIED TEST REPORT

DYSON CORP.

DYN DOMESTIC NUT

53 Freedom Road
Painesville, OH 44077

440-948-3500
440-352-2700 fax

DYSON ORDER#	CUSTOMER ORDER#	ITEM NUMBER	QUANTITY SHIPPED	DATE SHIPPED
S 84944	23324	2 of 2	60 pcs	10/12/06

CUSTOMER
FSA Spindletop Bolt Co., Inc.
825 Delmar Street
Beaumont, TX 77707
USA

PRODUCT DESCRIPTION
4.00"-4UNC-2B (.031" o/s) Heavy Hex Nut, HDG per
ASTM-A153

SPECIFICATIONS
ASTM-A194 Grade 2H

DRAWING
Dyson Std

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.	ORIGINAL MILL
Round Bar	4.500	1045	60	JPR13	A040140	Steel Dynamics

The product listed above was manufactured, tested, sampled, and inspected in accordance with the specification, purchase order, and any supplementary requirements and was found to meet those requirements unless otherwise noted.

Hardness Results: 255 HBW 235 HBW after 24 hr. H.T. on sample nut in accordance with ASTM-A194 Grade 2H

Attachments:

Mill Test Report



Deborah A. Smith
Q.A. Admin. Assistant
10/12/06



Test Cert 272

Date 2/25/2004

8000 N. County Road, 225 East
 Princeton, IN 46167
 Telephone: (317) 892-7185
 Fax: (317) 892-7285

CODE JPR13

Sales Order # 428-17

Product 4.50" Rnd

Bar Size 4.50"

Customer Jade Sterling

Spec

Bar Shape Round

PO 28422

Heat A040140

Bar Length 40' 02"

Partnum

Rolling Order#

Reduction Ratio 8.77:1

CustGrade 1045

Grain Practice Rhs Grain

CHEMICAL ANALYSIS - HEAT

C	Mn	P	S	Si	Ni	Cr	Mo	Al	Cu	Sn
0.46	0.66	0.010	0.022	0.28	0.12	0.13	0.02	0.024	0.25	0.010
Ti	B	N	Y	Co	Ca	Fe	Mi	Te	Ce	Bi
		0.0060								

Q.A. REVIEWED
 DA
 DATE 7/22/04
 DYSON

Any alterations to this report voids Steel Dynamics' warranting of results. No weld repair has been performed on this material. Unless otherwise noted, this material was melted, continuously cast and rolled in the USA. This material has not been exposed to mercury while under the control of Steel Dynamics. This material is not radioactive and has not been exposed to radioactivity while under the control of Steel Dynamics. I hereby certify that the content of this report is accurate and correct. All tests and operations performed by this material manufacturer are in compliance with the requirements of the material specifications and applicable purchaser designated requirements.

Signed:
 Quality Assurance

JPR

CERTIFIED TEST REPORT

DYSON CORP.

DYN DOMESTIC NUT

53 Freedom Road
Painesville, OH 44077

440-946-3500
440-352-2700 fax

DYSON ORDER#	CUSTOMER ORDER#	ITEM NUMBER	QUANTITY SHIPPED	DATE SHIPPED
S 84944	23324	2 of 2	13 pcs	10/18/06

CUSTOMER
FSA Spindletop Bolt Co., Inc.
825 Delmar Street
Beaumont, TX 77707
USA

PRODUCT DESCRIPTION
4.00"-4UNC-2B (.031" o/s) Heavy Hex Nut, HDG per
ASTM-A153

SPECIFICATIONS
ASTM-A194 Grade 2H

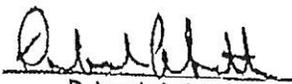
DRAWING
Dyson Std

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.	ORIGINAL MILL
Round Bar	4.500	1043	13	LBX2	A060962	Steel Dynamics

The product listed above was manufactured, tested, sampled, and inspected in accordance with the specification, purchase order, and any supplementary requirements and was found to meet those requirements unless otherwise noted.

Hardness Results: 255 HBW 241 HBW after 24 hr. H.T. on sample nut in accordance with ASTM-A194 Grade 2H

Attachments:
Mill Test Report


Deborah A. Smith
Q.A. Admin. Assistant
10/18/06

CERTIFIED TEST REPORT

 DYSON CORP.

DTN DOMESTIC NUT

53 Freedom Road
Painesville, OH 44077

440-946-3800
440-352-2700 fax

DYSON ORDER#	CUSTOMER ORDER#	ITEM NUMBER	QUANTITY SHIPPED	DATE SHIPPED
S 84943	23324	1 of 2	778 pcs	9/29/06

CUSTOMER
FSA Spindletop Bolt Co., Inc.
825 Delmar Street
Beaumont, TX 77707
USA

PRODUCT DESCRIPTION
3.00"-4UNC-2B (.031" O/S) Heavy Hex Nut, HDG per
ASTM-A153

SPECIFICATIONS
ASTM-A194 Grade 2H

DRAWING
Dyson Std

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.	ORIGINAL MILL
Round Bar	3.250	1043	778	KGP4	501323	Alton Steel

The product listed above was manufactured, tested, sampled, and inspected in accordance with the specification, purchase order, and any supplementary requirements and was found to meet those requirements unless otherwise noted.

1. The steel was melted and manufactured in the USA and the product was manufactured and tested in the USA.
2. Hardness Results: 262 HBW 248 HBW after 24 hr. H.T. on sample nut in accordance with ASTM-A194 Grade 2H

Attachments:

Mill Test Report



Deborah A. Smith

Q.A. Admn. Assistant

9/29/06



Alton Steel Test Lab
 #5 Cut Street
 Alton, IL, 62002-9011
 (618) 463-4490 EXT 2486
 (618) 463-4491 (Fax)

CODE KGPA

BILL TO

The Dyson Corporation
 53 Freedom Road
 Palmsville, OH 44077

SHIP TO

The Dyson Corporation
 53 Freedom Road
 Palmsville, OH 44077

Date	06/24/2005	Customer PO	41670-3	Specifications
ASI Ord No.	5897	Customer PT.	STOCK	SAE 1045
ASI Ord Line Item	1			ASTM A 29-04

Item Description
 Steel Bar, Hot Rolled, 3.2500, 24' 0"

Heat Number	Yield PSI	Tensile PSI	% Elongation	% ROA	Hard Test
-------------	-----------	-------------	--------------	-------	-----------

CHEMICAL ANALYSIS TEST METHODS ASTM E-419 & E-1019

Heat Number	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	Cb	V	B	N
501325	0.46	0.04	0.012	0.023	0.24	0.24	0.083	0.146	0.020	0.016	0.007	0.025	0.002	0.0002	0.0024

JOMINY HARDENABILITY USING ASTM A-268 CALCULATED FROM CHEMICAL DT

Heat Number	GS	D1
501325	6	1.59

SPECIAL TEST RESULTS

ADDITIONAL COMMENTS

No mercury, lead, radium, or alpha containing material or equipment is used or deliberately added in the production of this steel. No weld or weld repairs were performed on this material. This Steel is 100% Electric Arc Furnace Melted and Rolled in the U.S.A.

Alteration or reproduction of this report, except in full, is not allowed without written approval by a representative of Alton Steel Incorporated.

I hereby certify that the above tests are correct as contained in the records of ALTON STEEL INCORPORATED

Subscribed and sworn to before me, a Notary Public, in and for the County of Madison, State of Illinois

(Approved) Rupert Cauley

this _____ Day of _____

R. Cauley

My commission expires _____

(Notary Public)

QA REVIEWED
 DATE 7/18/05
 DYSON

KGPA

DEPARTMENT OF TRANSPORTATION - District 4 Toll Bridge Program

333 Burma Rd.
Oakland, CA 94607
(510) 286-0538, (510) 286-0550 fax



Kiewit-FCI-Manson, JV
220 Burma Rd.
Oakland, CA 94607

April 18, 2007

Attn: Mr. Lee Zink
Project Director

Contract No. 04-0120E4
04-SF-80-13.4, 13.8
SAS T1 & E2 Foundations
SFOBB-ESSSP

Letter No. 05.003.01-003051

Subject: Request for Pricing of Petrolatum Tape System for Pier T1 Anchor Rods

Dear Lee,

As discussed with Mr. David Russ of Kiewit-FCI-Manson (KFM) on April 4, 2007, and April 17, 2007, the Department requests an order-of-magnitude cost estimate for KFM to provide the 3-layer corrosion protection system, consisting of petrolatum paste, petrolatum-impregnated fiber tape, and 20-mil-thick PVC tape, as bond breaking material for the Pier T1 anchor rods, in lieu of the specified 7 kg building paper, shown on Project Plan Sheet No. 63/118. The estimate shall include costs and corresponding credits associated with the material substitution, as well as a breakdown of extra work and possible time impacts, if any, related to installation of the 3-layer debonding system.

If you have any questions or need additional information, please contact Mark Vilcheck at (510) 286-0526.

Sincerely,

A handwritten signature in black ink, appearing to read "Mark Vilcheck", written over a horizontal line.

Mark Vilcheck
Structure Representative

For: Pedro J. Sanchez
Resident Engineer

cc: P. Sanchez
M. Woods
J. Duxbury

file: 05.003.01

APR 19 2007

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

HC-5 (Rev. 5/93)

CONTRACT CHANGE ORDER NO. 67 SUPPL. NO. ---

ROAD 04-SF-80-13.4, 13.8 SHEET 1 OF 1 SHEETS

FEDERAL NO.(S) --- CONTRACT NO.: 04-0120E4

To Kiewit-FCI-Manson, a JV, Contractor

You are hereby directed to make herein described changes from the plans and specifications or do the following described work not included in the plans and specifications of the contract.

NOTE: This change order is not effective until approved by The Chief Engineer.

Description of work to be done, estimate of quantities, and prices to be paid. Segregated between additional work at contract price and force account. Unless otherwise stated, rates for rental equipment cover only such time as equipment is actually used and no allowance will be made for idle time.

CHANGE REQUESTED BY THE ENGINEER

The last percentage shown is the net accumulated increase or decrease from the original quantity in the Engineer's Estimate.

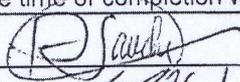
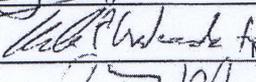
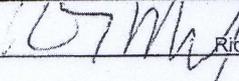
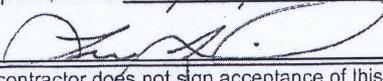
Adjustment of Compensation at Agreed Lump Sum

In lieu of the wrapped 7-kg building paper shown in Note 4 on Sheet No. 63/118, "Tower Anchorage Details No. 5," of the Project Plans, the Contractor shall furnish and install a petrolatum tape system on the Pier T1 anchor bolts. The petrolatum tape system shall consist of the following:

1. Petrolatum tape primer;
2. Petrolatum tape;
3. PVC outerwrap tape with a minimum thickness of 20 mils.

Product information for the components of the petrolatum tape system shall be submitted for the Engineer's approval, and no unapproved components shall be installed. All components of the petrolatum tape system shall be installed in accordance with the manufacturer's recommendations.

An agreed lump sum payment of \$92,858.00 will be made for the above work. This agreed sum constitutes full compensation, including all markups, for this Change Order.

Cost \$ 92,858.00		
By reason of this order the time of completion will be adjusted as follows: No Adjustment		
Submitted by: <u></u>	<u>Pedro J. Sanchez, Resident Engineer</u>	Date <u>8-31-07</u>
Approval Recommended by: <u></u>	<u>Mark Milcheck, Structure Representative</u>	Date <u>20 Dec. 2007</u>
Approved: Chief Engineer by: <u></u>	<u>Richard Morrow, Construction Manager</u>	Date <u>1/23/07</u>
We, the undersigned contractor, have given careful consideration to the change proposed and hereby agree, if this proposal is approved, that we will provide all equipment, furnish all materials, except as may otherwise noted above, and perform all services necessary for the work above specified, and will accept as full payment therefore the prices shown above.		
Accepted, Date <u>12/14/07</u>	Contractor <u>Kiewit-FCI-Manson, a JV</u>	
By: <u></u>	Title <u>Project Director</u>	

If the contractor does not sign acceptance of this change order, his attention is directed to the requirements of the specifications as to proceeding with the ordered work and filing a written protest within the time therein specified.

CONTRACT CHANGE ORDER MEMORANDUM

DC-CEM-4903 (OLD HC-39 REV. 6/93) CT# 7541-3544-0

DATE

Dec. 20, 2007

TO Rick Morrow		FILE 04-0120E4	
FROM Pedro J. Sanchez		04-SF-80-13.4, 13.8	
CCO NO 67	SUPPLEMENT NO. ---	CATEGORY CODE CHPR	CONTINGENCY BALANCE (including this change) \$542,548.94
\$ 92,858.00		INCREASE <input checked="" type="checkbox"/> DECREASE <input type="checkbox"/>	HEADQUARTERS APPROVAL REQUIRED? YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>
SUPPLEMENTAL FUNDS PROVIDED \$ 0.00		IS THIS REQUEST IN ACCORDANCE WITH ENVIRONMENTAL DOCUMENTS? YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>	

THIS CHANGE ORDER PROVIDES FOR:

This project is for the construction of the foundations for the Self-Anchored Suspension portion of the east span of the San Francisco-Oakland Bay Bridge (Bridge No. 34-0006L/R).

This Change Order provides for the installation of a petrolatum tape system upon the anchor bolts in the Pier T1 footing.

Anchor bolts will be installed in the T1 footing to act as tiedowns for the SAS tower. The anchor bolts will be secured to end plates within the footing box at their bottoms and will be placed within pipe sleeves that pass through the top plate of the Pier T1 footing box. Nonshrink grout will be placed between the anchor bolts and the anchor bolt pipe sleeves under a subsequent contract. To ensure that the anchor bolts will not bond with the nonshrink grout, the Project Plans specify that the anchor bolts will be wrapped with 2 layers of 7-kg building paper under this contract.

However, it is estimated that approximately 2 to 3 years will pass from the time that the anchor bolts are installed under this contract to the time that nonshrink grout is placed under the subsequent contract. Because of this, the State is concerned that the building paper will not be sufficient to protect the anchor bolts from the effects of the local marine environment during that time span, as the building paper's primary purpose is to act as a debonding agent between the anchor bolts and the nonshrink grout. Although the building paper by its presence will provide some corrosion protection to the anchor bolts, the State does not believe that it will sufficiently protect the anchor bolts from corrosion during a lengthy exposure period.

After consulting with METS and the Project Designer, the Engineer has determined that a petrolatum tape system will provide better corrosion protection for the anchor bolts than building paper and will also serve as a better debonding agent between the anchor bolts and the nonshrink grout. The petrolatum tape system is resistant to both water and salt and will effectively seal the anchor bolts and act as a debonding agent. The petrolatum tape system will consist of a primer (displace moisture and inhibit corrosion), petrolatum tape (a petrolatum-impregnated fabric tape that will be placed over the primer), and an overwrap (PVC sheeting to seal the tape and primer). The Contractor will be required to submit all proposed components for the Engineer's approval and to install the petrolatum tape system in accordance with the manufacturer's recommendations.

Therefore, the Contractor shall furnish and install a petrolatum tape system on the Pier T1 anchor bolts in lieu of wrapped 7-kg building paper.

For this Change Order, the Contractor will receive an Agreed Lump Sum payment of \$92,858.00. A cost analysis is on file.

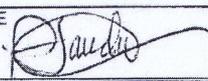
Maintenance concurrence for this Change Order is unnecessary, as the work for this Change Order will not affect future Maintenance operations.

This Change Order was discussed with the following people, who all concurred with this Change Order:

1. Rick Morrow (Construction Manager)
2. Mimy Ma (Project Engineer)
3. James Duxbury (T.Y. Lin International, consultant Project Designers)
4. Rob Reis (Sr. Materials and Research Engineer, METS Corrosion Technology Branch)

The Resident Engineer recommends the approval of this Change Order.

No adjustment of contract time is warranted, as this Change Order will not affect the controlling operation.

CONCURRED BY:		ESTIMATE OF COST	
STRUCTURE REPRESENTATIVE	DATE	THIS REQUEST	TOTAL TO DATE
Mark Vilcheck	20 Dec 2007		
SR BRIDGE ENGINEER	DATE	ITEMS	
Mark Woods	20 Dec 2007	FORCE ACCOUNT	
FHWA REPRESENTATIVE	DATE	AGREED PRICE	\$92,858.00
n/a	n/a	ADJUSTMENT	\$92,858.00
PROJECT ENGINEER	DATE	TOTAL	\$92,858.00
Mimy Ma	8-22-07		\$92,858.00
OTHER (SPECIFY)	DATE	FEDERAL PARTICIPATION	
James Duxbury, T.Y. Lin Intl., Project Designer	8-22-07	<input type="checkbox"/> PARTICIPATING <input type="checkbox"/> PARTICIPATING IN PART <input checked="" type="checkbox"/> NONE <input type="checkbox"/> NON-PARTICIPATING (MAINTENANCE) <input type="checkbox"/> NON-PARTICIPATING	
	DATE	FEDERAL SEGREGATION (IF MORE THAN ONE FUNDING SOURCE OR P.I.P. TYPE)	
Rob Reis, METS Corrosion Tech. Branch	8-23-07	<input type="checkbox"/> CCO FUNDED PER CONTRACT <input type="checkbox"/> CCO FUNDED AS FOLLOWS	
DISTRICT PRIOR APPROVAL BY	DATE	FEDERAL FUNDING SOURCE	PERCENT
Rick Morrow	8-30-07		
HQ (ISSUE & APPROVE) (TO PROCEED) BY	DATE		
---	---		
RESIDENT ENGINEER SIGNATURE	DATE		
	12-20-07		

05.007.03-000009

Mark
Woods/D04/Caltrans/CAGov
08/27/2007 03:12 PM

To Rob Reis/HQ/Caltrans/CAGov@DOT
cc Mark Vilcheck/D04/Caltrans/CAGov@DOT, Tom
Shimada/D04/Caltrans/CAGov@DOT
bcc
Subject Re: Fw: Draft CCO 67 (Protect T1 Anchor Bolts)

Here are some pictures of the Denso wrapping of two of our anchor rods.



IMG_0523.jpg



IMG_0521.jpg



IMG_0522.jpg

Mark Woods
Senior Bridge Engineer
SFOBB E2/T1 Bridge Construction Engineer
SFOBB SAS Tower Structure Representative
(510) 622-5107
(510) 385-6897 -- cell
Rob Reis/HQ/Caltrans/CAGov



Rob
Reis/HQ/Caltrans/CAGov
08/23/2007 09:21 AM

To Mark Woods/D04/Caltrans/CAGov@DOT
cc Mark Vilcheck/D04/Caltrans/CAGov@DOT, Tom
Shimada/D04/Caltrans/CAGov@DOT
Subject Re: Fw: Draft CCO 67 (Protect T1 Anchor Bolts)

Mark,

I concur regarding the substitution of the petrolatum tape system as outlined in proposed Draft CCO #67 for E2/T1 for the original wrapping with 2 layers of 7-kg building paper that were included in the contract. The petrolatum tape system will provide better corrosion protection for the anchor bolts (prior to grouting) than the building paper. As you noted, testing was completed to satisfy the designer of the debonding characteristics of the tape wrapped anchor rods.

Photo's of the debonding testing would be good for me to have as a record in my files if you have them in digital format.

Thanks,

Rob

Rob Reis, P.E.
Senior Materials and Research Engineer
Corrosion Specialist
Corrosion Technology Branch
Materials Engineering and Testing Services
Phone: (916) 227-7287
Fax: (916) 227-7075

For individuals with sensory disabilities, this document can be made available in Braille, large print,

05.007.03
49.067

04-0120E4
04-SF-80-13.4, 13.8
SAS T1 & E2 Foundations
SFOBB-ESSSP

audiocassette or computer disk upon request.

To obtain one of these alternate formats, please call (916) 227-8185 or TTY 711 or write to Della Moore, Division of Engineering Services, P.O. Box 168041, Mail Stop 9, Room 509, Sacramento, CA 95816-8041.

Mark Woods/D04/Caltrans/CAGov

Mark
Woods/D04/Caltrans/CAGov
08/22/2007 02:47 PM

To Rob Reis/HQ/Caltrans/CAGov@DOT
cc Mark Vilcheck, Tom Shimada/D04/Caltrans/CAGov@DOT
Subject Fw: Draft CCO 67 (Protect T1 Anchor Bolts)

Rob,

Attached, please find a CCO for E2/T1 to replace the 7kg building paper wrap called for around the anchor rods on T1 with a Denso system. The designer likes the debonding properties that the Denso system provides. The additional benefits of long term corrosion protection are also appreciated. I have pictures of the denso tape rod demonstration that we did to check debonding from concrete if you would like to see them. Please review the attached CCO and CCO Memo and offer your concurrence if you do.



CCO 67 Memo DRAFT1.doc

Mark Woods
Senior Bridge Engineer
SFOBB E2/T1 Bridge Construction Engineer
SFOBB SAS Tower Structure Representative
(510) 622-5107
(510) 385-6897 -- cell

----- Forwarded by Mark Woods/D04/Caltrans/CAGov on 08/22/2007 02:28 PM -----

Tom
Shimada/D04/Caltrans/CAGov
08/22/2007 10:23 AM

To Mark Woods/D04/Caltrans/CAGov@DOT
cc Mark Vilcheck/D04/Caltrans/CAGov@DOT
Subject Draft CCO 67 (Protect T1 Anchor Bolts)

Mark --

Here are my drafts for CCO No. 67.

Tom



CCO 67 DRAFT1.doc

[attachment "CCO 67 Memo DRAFT1.doc" deleted by Mark Woods/D04/Caltrans/CAGov]









P.O. BOX 23223 Oakland, CA 94623
 Phone (510) 419-0120 / Fax (510) 832-1456

LETTER OF TRANSMITTAL
SAS Foundations E2/T1 Project

Run Date 23-Jul-07
 Time 9:32 AM

Dated: 7/24/2007

To: Pedro Sanchez
 Caltrans - SAS E2/T1 Foundation Project
 333 Burma Road
 Oakland CA 94607
 Phone: 510-286-0538 Fax:

TRANSMITTAL No: KFM-TRN-000575 Rev: 00
 Co/Job # 364-4347
 Contract # 04-0120E4
 Sub/Supplier: KOS
 Sub/Supplier No: 980

Subject: KOS T1 QC Documentation

Special Provis. (SP) REF: 10-1.31
 Standard Spec. (SS) REF:
 RESUBMITTAL/SUPPLEMENTAL REF:

- We are sending the following attached items: Attached Via Fax
- Contract Plans/Specs
 - Certs of Compl./Samples
 - Working Drawings
 - Drawings/Calculations
 - Schedule
 - WQCP and/or Addenda
 - Change Order
 - Progress Estimate Request
 - Weekly Welding Reports
 - Copy of Letter
 - Payroll Information
 - CWR Procedure

Item	Date	Copies	Description	Pages
01	29-Jan-2007	2	KOS T1 QC Documentation Vols 1-4	

These are transmitted as checked below:

- For Approval
- For Review/Comment
- Return For Correction
- For Your Use
- As Requested
- For Information

Remarks:

These two sets are transmitted for CT files and records. One original documentation package was retained by METS at time of shipment.

CC:

Submitted By: George Atkinson *gla*
 (KFM Staff Member - Originator of Transmittal)

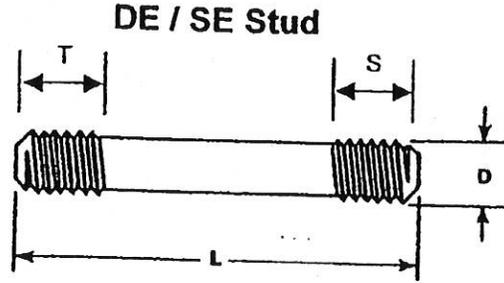
Checked & Sent By: *Spurks*
 Contract Admin/DCS Staff

TABLE OF CONTENTS
CALTRANS T-1 FOOTING
KOS JOB 21103
TRACEABILITY DOCUMENTATION

<u>DESCRIPTION</u>	<u>VOLUME</u>
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2.BILL OF LADING	I
3.WELD MAPPED DRAWINGS	I
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B.MT	I-II
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7.EATON DOCUMENTS	IV
A.13 SLEEVE PACKAGES	
B.T1-1 RE-NDE OF JOINTS	

VULGII
 THREADED PRODUCTS, INC.
 Specialty Division
 Phone: 800-768-8522
 Fax: 205-620-5150

please confirm
Thank you



Quotation

Date: 10/4/06

To: Gary 409 842-3929

From: Lee

	Qty	D	L	T	S	Cost	Unit
1	388	3-4	30 6 ¹ / ₁₆ "	15 5 ¹ / ₁₆ "	12 13 ¹ / ₁₆ "		
2	36	4-4	30 8 ¹ / ₁₆ "	16 1 ¹ / ₄ "	13 13 ¹ / ₁₆ "		
3							
4							
5							
6							
7							
8							
9							
10							

Quoting above as: Bulk Packaged, FOB Pelham, Alabama

Threads Rolled or Cut (circled), gauged to a finished hex nut

Steel A354BD

Finish HDG

Approx. Delivery

Dimensional Tolerances

Price and delivery are subject to availability of material at time of order.
 Industry standard +/- 10% on quantities being shipped. Valid for 30 days.

WORK SHEET

Project T.I. FOOTING

Estimator FRB / G.H.

Item No.

Type of Work ANCHOR ROD THREADING Date SEPT. 28, 2006

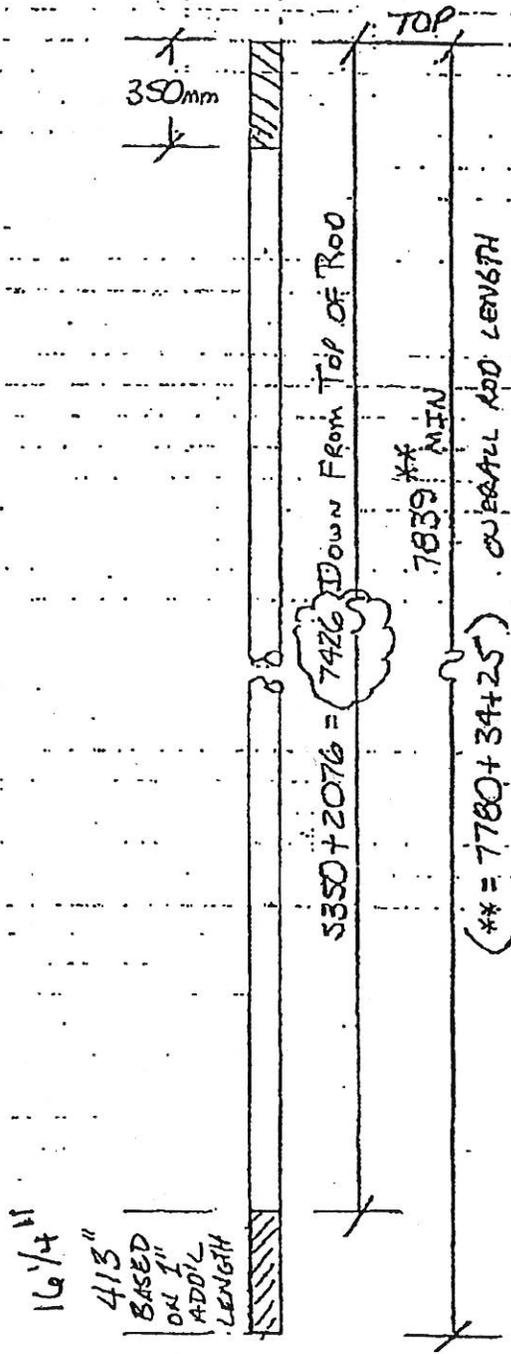
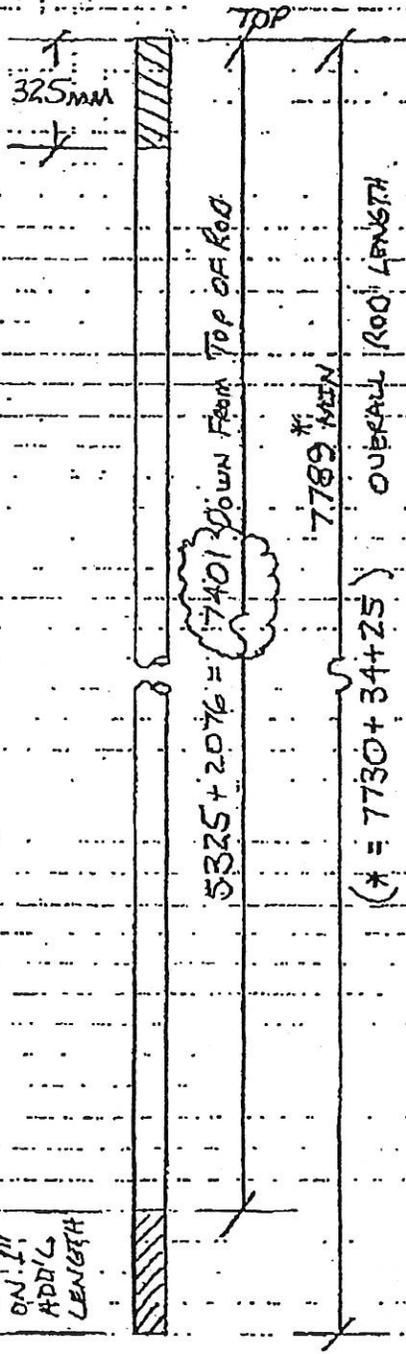
Sheet No. 1 OF 1

3" ϕ Rod

4" ϕ Rod

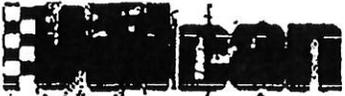
SPINDLETOP BOLT CO., INC.
825 DEL MAR STREET
BEAUMONT, TX 77707
PHONE (409) 842-9555
FAX (409) 842-3929

John Lee
Jany



15 5/16"
588"
BASED
ON 1"
ADD'L
LENGTH

16 1/4"
415"
BASED
ON 1"
ADD'L
LENGTH



THEADED PRODUCTS, INC.

Industry Division

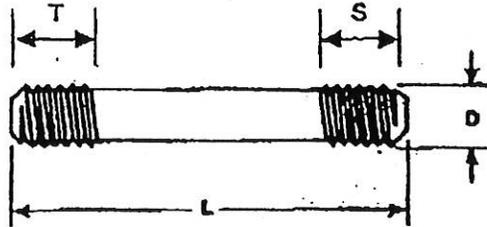
Phone: 800-768-8522

Fax: 205-620-6150

* Updated specs. in v33 measurements
Please confirm

Thank you

DE / SE Stud



Go with it
Gary Robson
10.06.06

Quotation

Date: 10/4/06

To: Gary 409 842-3929

From: Lee

Qty.	D	L	T	S	Cost	Unit
1	3-4	30 6 ¹ / ₁₆ "	15 5 ¹ / ₁₆ "	12 13 ¹ / ₁₆ "		
2	4-4	30 8 ¹ / ₁₆ "	16 1 ¹ / ₄ "	13 13 ¹ / ₁₆ "		
3						
4						
5						
6						
7						
8						
9						
10						

Quoting above as: Bulk Packaged, FOB Pelham, Alabama

Threads: Rolled or Cut (circled), gauged to a finished hex nut

Steel: A354 BP

Finish: HDG

Approx. Delivery

Dimensional Tolerances

Price and delivery are subject to availability of material at time of order.
Industry standard +/- 10% on quantities being shipped. Valid for 30 days.

#10 CROSSCREEK TRAIL
 PELHAM, AL 35124
 PH:(205) 620-5100
 FAX:(205) 620-5150

TEST REPORT

TEST DATE:	8/21-22/2006	REPORT DATE:	8/21-22/2006	LAB#	63604, 63609
------------	--------------	--------------	--------------	------	--------------

CHEMISTRY

C	Mn	P	S	Si	Cr	Mo	V	Al
.41	.88	.012	.019	.3	.96	.16	.005	.028

MANUFACTURER INFORMATION

MANUFACTURER:	VULCAN THREADED PRODUCTS
MANUFACTURE DATE:	8/20-21/2006
SAMPLING SCHEME:	ASTM A354-BD
PERSON PERFORMING SAMPLING:	DAVE CHMIELARSKI
COUNTRY OF ORIGIN	UNITED STATES

PRODUCT INFORMATION

SIZE:	3.00 DIAMETER BAR	SPECIFICATION:	ASTM A193
GRADE:	A354 BD	REVISION YEAR:	2004
HEAT:	A062789	LOT#:	25564

PROCESS (HEAT TREAT) INFORMATION

HEAT TREAT METHOD & TIME:	INDUCTION
TEMPERING TEMP:	1170 DEG. F.
QUENCH & COOLING METHOD:	WATER QUENCH & AMBIENT COOLED

MECHANICAL TEST RESULTS

CONTAINER #	C2001127	C2001133	C2001150	C2001441	C2001557	
TENSILE STRENGTH:	155,100	158,700	161,200	157,300	162,100	PSI
YIELD STRENGTH:	136,200	141,400	144,800	139,900	145,800	PSI
ELONGATION:	18	18	17	21	17	%
REDUCTION OF AREA:	47	52	51	53	48	%
HARDNESS MID RADIUS:	34	33	33	33	33	HRC

MATERIAL IS PRODUCED MERCURY FREE AND NOT REPAIRED BY WELDING

ALL TEST AND ANALYSIS PERFORMED IN ACCORDANCE WITH PROCEDURES DERIVED FROM METHODS DESCRIBED AND APPROVED BY THE ASTM AND OTHER ACCEPTED INDUSTRY PRACTICES.

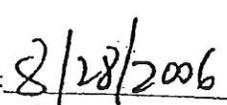
I CERTIFY THAT THE ABOVE RESULTS OF TEST AND/OR ANALYSIS TO BE CORRECT AS CONTAINED IN THE RECORDS OF VULCAN THREADED PRODUCTS.

JEFF HAYES
 PURCHASING MANAGER

SIGNED: _____



DATE: 8/28/2006



#10 CROSSCREEK TRAIL
 PELHAM, AL 35124
 PH:(205) 620-5100
 FAX:(205) 620-5150

TEST REPORT

TEST DATE:	8/21/2006	REPORT DATE:	8/21/2006	LAB#	63603
------------	-----------	--------------	-----------	------	-------

CHEMISTRY

C	Mn	P	S	Si	Cr	Mo	V	Al
.41	.88	.012	.019	.3	.96	.16	.005	.028

MANUFACTURER INFORMATION

MANUFACTURER:	VULCAN THREADED PRODUCTS
MANUFACTURE DATE:	8/19/2006
SAMPLING SCHEME:	ASTM A354-BD
PERSON PERFORMING SAMPLING:	DAVE CHMIELARSKI
COUNTRY OF ORIGIN	UNITED STATES

PRODUCT INFORMATION

SIZE:	3.00 DIAMETER BAR	SPECIFICATION:	ASTM A193
GRADE:	A354 BD	REVISION YEAR:	2004
HEAT:	A062789	LOT#:	25564

PROCESS (HEAT TREAT) INFORMATION

HEAT TREAT METHOD & TIME:	INDUCTION
TEMPERING TEMP:	1170 DEG. F.
QUENCH & COOLING METHOD:	WATER QUENCH & AMBIENT COOLED

MECHANICAL TEST RESULTS

CONTAINER #	C2001102	C2001108	C2001112	C2001122	
TENSILE STRENGTH:	156,200	151,000	161,000	160,200	PSI
YIELD STRENGTH:	138,400	131,100	143,400	142,900	PSI
ELONGATION:	18	18	18	17	%
REDUCTION OF AREA:	52	53	51	49	%
HARDNESS MID RADIUS:	33	33	32	33	HRC

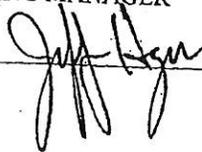
MATERIAL IS PRODUCED MERCURY FREE AND NOT REPAIRED BY WELDING

ALL TEST AND ANALYSIS PERFORMED IN ACCORDANCE WITH PROCEDURES DERIVED FROM METHODS DESCRIBED AND APPROVED BY THE ASTM AND OTHER ACCEPTED INDUSTRY PRACTICES.

I CERTIFY THAT THE ABOVE RESULTS OF TEST AND/OR ANALYSIS TO BE CORRECT AS CONTAINED IN THE RECORDS OF VULCAN THREADED PRODUCTS.

JEFF HAYES
 PURCHASING MANAGER

SIGNED: _____



DATE: _____

8/28/2006

REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/21/2006
 Report Date: 08/21/2006
 Lab Number: 63603
 P. O. Number: P173145-001

MANUFACTURER INFORMATION
 Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/19/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 3.000" Diameter Bars
 Grade: BD
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA

Lot Number: 25564
 Heat Number: A062789
 Lot Size: -

TEST RESULTS

Property	Unit	MECHANICAL TEST RESULTS			
		Container # C2001102	Container # C2001108	Container # C2001112	Container # C2001122
Tensile Strength	psi	156,200	151,000	161,000	160,200
Yield Strength	psi	138,400	131,100	143,400	142,900
Elongation	%	18	18	18	17
Reduction of Area	%	52	53	51	49
Hardness	HRC	33	33	32	33
Hardness, -0.060	HRC	34	-	-	-

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A354 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

[Signature]
 Quality Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 -February 15, 2002

REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/21/2006
 Report Date: 08/21/2006
 Lab Number: 63603
 P. O. Number: P173145-001

Sample Identification: (1) 3.000" Diameter Bar, Lot # 25564, Heat # A062789

Properties	Unit	SPECIMEN IDENTIFICATION				
		Container #				
Hardness Testing		C2001102				
Depth from Surface, In						
1/8	HRC	33				
1/4	HRC	34				
3/8	HRC	35				
1/2	HRC	36				
5/8	HRC	33				
3/4	HRC	33				
7/8	HRC	31				
1	HRC	30				
1-1/8	HRC	30				
1-1/4	HRC	29				
1-3/8	HRC	28				
1-1/2	HRC	27				

Test Method(s): ASTM E18

Respectfully Submitted,
Materials Technology, Inc.



Quality Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 - February 15, 2002



www.mti-hist.al.com
 213 Lyon Lane
 Birmingham, AL 35211
 205.940.9480
 866.RUN.TEST

PORT OF ANALYSIS

Vulcan Threaded Products
 PO Box 509
 Pelham, AL 35124
 Attention: Dave Chmielarski

Test Date: 08/21/2006
 Report Date: 08/21/2006
 Lab Number: 63603
 P. O. Number: P173145-001

MANUFACTURER INFORMATION

Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/19/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

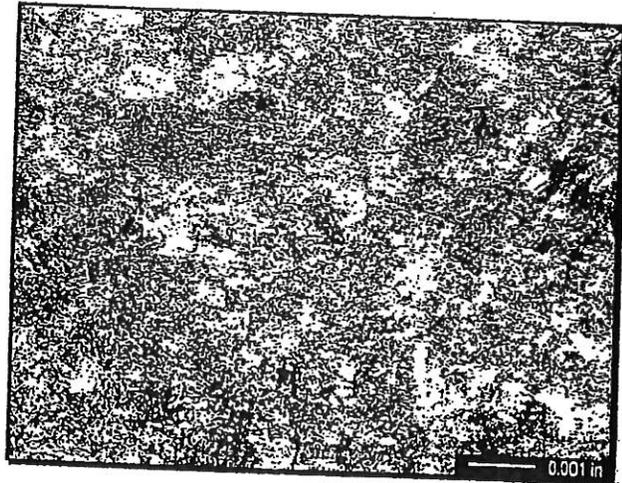
Size: 3.000" Diameter Bar
 Grade: B7
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA

Lot Number: 25564
 Heat Number: A062789
 Lot Size: -

MICROSTRUCTURAL TEST RESULTS

Sample ID	C2001102
Etchant	Vilella's
Magnification	500 x
Photograph Number	#1
Microstructure Evaluation	Predominantly Tempered Martensite



Procedure: The sample was polished using progressively finer polishing papers up to 600 grit. Final polishing used 3-micron diamond compound and 0.3-micron alumina. Etching was at room temperature for 5-20 seconds to reveal the microstructure.

Test Methods: ASTM E3

Respectfully Submitted,
MATERIALS TECHNOLOGY, INC.

[Signature]
 Quality Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 - February 15, 2002.



www.TestMetal.com
 213 Lyon Lane
 Birmingham, AL 35211
 205.940.9480
 866.RUN.TEST

REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/21/2006
 Report Date: 08/21/2006
 Lab Number: 63604
 P. O. Number: P173145-001

MANUFACTURER INFORMATION

Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/20/2006, 08/21/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 3.000" Diameter Bar
 Grade: BD
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA
 Lot Number: 25564
 Heat Number: A062789
 Lot Size: -

TEST RESULTS

Property	Unit	MECHANICAL TEST RESULTS	
		Container # C2001127	Container # C2001133
Tensile Strength	psi	155,100	158,700
Yield Strength	psi	136,200	141,400
Elongation	%	18	18
Reduction of Area	%	47	52
Hardness	HRC	34	33

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A354 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 - February 15, 2002

REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/22/2006
 Report Date: 08/22/2006
 Lab Number: 63609
 P. O. Number: P173145-001

MANUFACTURER INFORMATION
 Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/21/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 3.000" Diameter Bars
 Grade: BD
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA
 Lot Number: 25564
 Heat Number: A062789
 Lot Size:

TEST RESULTS

Property	Unit	MECHANICAL TEST RESULTS		
		Container # C2001150	Container # C2001441	Container # C2001557
Tensile Strength	psi	161,200	157,300	162,100
Yield Strength	psi	144,800	139,900	145,800
Elongation	%	17	21	17
Reduction of Area	%	51	53	48
Hardness	HRC	33	33	33

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A354 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

[Signature]
 Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 - February 15, 2002

N 4140
 "A" Coil 16 LARGES
 "B" Coils 16 LARGES
 1st Quench 340 PEN 224
 Size 3.00 H/R
 Parallel/Series PARALLEL
 Parallel/Series SERIES
 2nd Quench 340 PEN ALL
 Length 308"
 Capacitor Taps 15 in / out
 Capacitor Taps 15 in / out
 Quench Rings 340 PEN 224 CLOSED
 Heat A062789
 Spd. Up 1.20
 Conv. Spd. 1.20
 DEPTH 20.0

P	AUSTINIZING - Coil "A"				TEMPERING - Coil "B"				PROC SPD	START SIZE	FINISH SIZE	LOT #	CONT #
	VLT	AMP	K.W.	FRQ	TEMP	DATE	VLT	AMP					
0.5	46.00					8-18-00	52.50						
0.5	78.2	55.3	61.8	1820	"	52.4	74.6	57.3	44.4	1195		25564	C2001102
0.7	78.1	55.4	61.8	"	"	52.4	74.6	57.4	44.3	"		"	C2001108
2.0	78.3	54.9	61.7	1820	"	52.6	74.7	57.2	44.4	"		"	C2001112
7.1	78.4	54.7	61.5	"	"	51.9	74.8	57.3	44.2	"		"	C2001118
17.5	78.0	55.3	61.7	"	"	52.4	74.6	57.5	44.2	"		"	C2001118
9.0	77.4	55.3	62.0	"	8-21	52.7	74.8	57.7	44.7	"		"	C2001122
20.3	78.1	55.5	61.8	"	"	53.1	74.4	57.2	44.2	"		"	C2001127
20.0	78.9	55.3	61.5	"	"	52.8	73.1	57.0	44.3	"		"	C2001133
22.6	78.7	55.2	61.8	"	"	52.1	74.2	57.0	44.3	"		"	C2001136
30.5	78.4	55.1	61.8	"	"	52.3	74.8	57.6	44.4	"		"	C2001150
39.7	78.1	55.4	61.7	1820	"	52.7	74.2	57.4	44.3	"		"	C2001204
40.1	78.8	55.3	61.5	"	"	52.5	74.5	57.6	44.2	1199		"	C2001451
										1185		"	C2001557

16 PC
 SAMPLE
 SAMPLE
 SAMPLE
 SAMPLE
 SAMPLE
 SAMPLE
 SAMPLE
 SAMPLE
 SAMPLE

Certified Material Test Report

Part #: 21869	Mill Order: 0606258	Heat #: A062789	Issued: 9/2/2006 09:44:52
Work Order: 32104	Sales Order: 17866-1	Customer: Vulcan	PO #: P171213-001-1
Load #: 33987	Reference #:	Reference Desc:	End Use:
Size: 3"	Shape: Round	Grade: 4140	Length: 25'06"
Grain Practice: AI Fine Grain (5-8) per ASTM A29		Reduction Ratio: 19.6 to 1	Disposition: 1

Ladle Chemistry Analysis (ASTM A29)

C	Mn	P	S	Si	Al	Cu	Ni	Cr	Mo	Sn	N	V	Cb	B	Ca	W	Ti	DI
0.41	0.88	0.012	0.019	0.30	0.028	0.29	0.10	0.96	0.16	0.012	0.0073	0.005	0.004	0.0001	0.0011	0.010	0.001	5.34
Pb		Co																
0.002		0.008																

Product Check Analysis (ASTM A29)

	C	Mn	P	S	Si	Al	Cu	Ni	Cr	Mo	Sn	N	V	Cb	Ti	B	Ca
Front																	
Back																	

Jominy (ASTM A255)

	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J12	J14	J16	J18	J20	J24	J28	J32
Calc'd	56	56	56	56	56	56	56	55	53	52	49	48	45	45	44	43	40	37
Front																		
Back																		

Microcleanliness (ASTM E46)

Method A										Method C		Method E		Austenitic Grainsize	Macrostructure		
AT	AH	BT	BH	CT	CH	DT	DH	S	O	SAM "B"		SAM "D"			ASTM E381		
															S	R	C

Mechanical Properties (ASTM A370)

Tensile Properties					Hardness			Magnetic Particle Inspection	
Tensile Strength	0.2% Yield Strength	% Elongation	% ROA		BHN	Rb	Rc	Frequency	Severity

Comments/Specs

ASTM A322 (latest rev.)

Condition: As-Rolled, Hot-Rolled

I hereby certify that the content of this report is correct and accurate, and that all tests and operations performed on this material were in compliance with applicable material specifications and purchaser designated requirements.


 Trevor Klipp - Rolling Mill Metallurgist

Any alteration to this report voids Steel Dynamic's warranting of results. No weld repair has been performed on this material. This material is not radioactive and has not been exposed to radioactivity while under the control of Steel Dynamics. This material has not been exposed to mercury while under the control of Steel Dynamics. Unless otherwise noted, this material was melted, continually cast, and rolled in the USA; w/ all testing performed by Steel Dynamics.

VULCAN THREADED PRODUCTS
 #10 CROSSCREEK TRAIL
 PELHAM, AL 35124
 PH:(205) 620-5100
 FAX:(205) 620-5150

TEST REPORT

TEST DATE:	8/21/2006	REPORT DATE:	8/21/2006	LAB#	63602
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CHEMISTRY

C	Mn	P	S	Si	Cr	Mo	V	Al
.39	.95	.013	.02	.27	1.02	.16	.007	.027

MANUFACTURER INFORMATION

MANUFACTURER:	VULCAN THREADED PRODUCTS
MANUFACTURE DATE:	8/18-19/2006
SAMPLING SCHEME:	ASTM A354-BD
PERSON PERFORMING SAMPLING:	DAVE CHMIELARSKI
COUNTRY OF ORIGIN	UNITED STATES

PRODUCT INFORMATION

SIZE:	3.000 DIAMETER BAR	SPECIFICATION:	ASTM A193
GRADE:	A354 BD	REVISION YEAR:	2004
HEAT:	A062731	LOT#:	25555

PROCESS (HEAT TREAT) INFORMATION

HEAT TREAT METHOD & TIME:	INDUCTION
TEMPERING TEMP:	1175 DEG. F.
QUENCH & COOLING METHOD:	WATER QUENCH & AMBIENT COOLED

MECHANICAL TEST RESULTS

CONTAINER #	C2001030	C2001059	C2001084	C2001088	C2001094	
TENSILE STRENGTH:	165,300	155,700	164,500	162,800	158,100	PSI
YIELD STRENGTH:	152,000	138,400	149,800	147,800	141,400	PSI
ELONGATION:	17	19	17	16	18	%
REDUCTION OF AREA:	52	51	52	49	50	%
HARDNESS MID RADIUS:	34	34	34	35	34	HRC

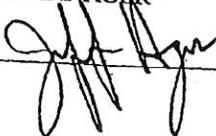
MATERIAL IS PRODUCED MERCURY FREE AND NOT REPAIRED BY WELDING

ALL TEST AND ANALYSIS PERFORMED IN ACCORDANCE WITH PROCEDURES DERIVED FROM METHODS DESCRIBED AND APPROVED BY THE ASTM AND OTHER ACCEPTED INDUSTRY PRACTICES.

I CERTIFY THAT THE ABOVE RESULTS OF TEST AND/OR ANALYSIS TO BE CORRECT AS CONTAINED IN THE RECORDS OF VULCAN THREADED PRODUCTS.

JEFF HAYES
 PURCHASING MANAGER

SIGNED:



DATE:

8/28/2006

VULCAN THREADED PRODUCTS
 #10 CROSSCREEK TRAIL
 PELHAM, AL 35124
 PH:(205) 620-5100
 FAX:(205) 620-5150

TEST REPORT

TEST DATE:	8/18/2006	REPORT DATE:	8/21/2006	LAB#	53584
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CHEMISTRY

C	Mn	P	S	Si	Cr	Mo	V	Al
.39	.95	.013	.02	.27	1.02	.16	.007	.027

MANUFACTURER INFORMATION

MANUFACTURER:	VULCAN THREADED PRODUCTS
MANUFACTURE DATE:	8/17-18/2006
SAMPLING SCHEME:	ASTM A354-BD
PERSON PERFORMING SAMPLING:	DAVE CHMIELARSKI
COUNTRY OF ORIGIN	UNITED STATES

PRODUCT INFORMATION

SIZE:	3.000 DIAMETER BAR	SPECIFICATION:	ASTM A193
GRADE:	A354 BD	REVISION YEAR:	2004
HEAT:	A062731	LOT#:	25555

PROCESS (HEAT TREAT) INFORMATION

HEAT TREAT METHOD & TIME:	INDUCTION
TEMPERING TEMP:	1175 DEG. F.
QUENCH & COOLING METHOD:	WATER QUENCH & AMBIENT COOLED

MECHANICAL TEST RESULTS

CONTAINER #	C2000540	C2000709	C2000773	C2000790	C2000801	
TENSILE STRENGTH:	159,500	160,500	15,9900	161,500	160,500	PSI
YIELD STRENGTH:	144,300	145,600	144,700	146,500	145,700	PSI
ELONGATION:	18	18	19	18	18	%
REDUCTION OF AREA:	52	52	51	51	52	%
HARDNESS MID RADIUS:	35	35	35	35	35	HRC

MATERIAL IS PRODUCED MERCURY FREE AND NOT REPAIRED BY WELDING

ALL TEST AND ANALYSIS PERFORMED IN ACCORDANCE WITH PROCEDURES DERIVED FROM METHODS DESCRIBED AND APPROVED BY THE ASTM AND OTHER ACCEPTED INDUSTRY PRACTICES.

I CERTIFY THAT THE ABOVE RESULTS OF TEST AND/OR ANALYSIS TO BE CORRECT AS CONTAINED IN THE RECORDS OF VULCAN THREADED PRODUCTS.

JEFF HAYES
 PURCHASING MANAGER

SIGNED:



DATE:

8/28/2006

VULCAN THREADED PRODUCTS
 #10 CROSSCREEK TRAIL
 PELHAM, AL 35124
 PH:(205) 620-5100
 FAX:(205) 620-5150

TEST REPORT

TEST DATE:	8/17-21/2006	REPORT DATE:	8/18-21/2006	LAB#	63581, 63592, 63602
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CHEMISTRY

C	Mn	P	S	Si	Cr	Mo	V	Al
.39	.95	.013	.02	.27	1.02	.16	.007	.027

MANUFACTURER INFORMATION

MANUFACTURER:	VULCAN THREADED PRODUCTS
MANUFACTURE DATE:	8/18-19/2006
SAMPLING SCHEME:	ASTM A354-BD
PERSON PERFORMING SAMPLING:	DAVE CHMIELARSKI
COUNTRY OF ORIGIN	UNITED STATES

PRODUCT INFORMATION

SIZE:	3.000 DIAMETER BAR	SPECIFICATION:	ASTM A193
GRADE:	A354 BD	REVISION YEAR:	2004
HEAT:	A062731	LOT#:	25555

PROCESS (HEAT TREAT) INFORMATION

HEAT TREAT METHOD & TIME:	INDUCTION.
TEMPERING TEMP:	1175 DEG. F.
QUENCH & COOLING METHOD:	WATER QUENCH & AMBIENT COOLED

MECHANICAL TEST RESULTS

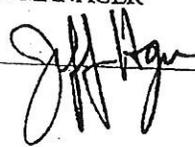
CONTAINER #	C2000866	C2000989	C2001097	C2000130	C2000131	
TENSILE STRENGTH:	162,500	166,800	156,000	159,600	157,700	PSI
YIELD STRENGTH:	147,900	152,900	138,800	139,700	141,000	PSI
ELONGATION:	17	17	18	16	18	%
REDUCTION OF AREA:	50	50	53	50	50	%
HARDNESS MID RADIUS:	33	34	33	34	34	HRC

MATERIAL IS PRODUCED MERCURY FREE AND NOT REPAIRED BY WELDING

ALL TEST AND ANALYSIS PERFORMED IN ACCORDANCE WITH PROCEDURES DERIVED FROM METHODS DESCRIBED AND APPROVED BY THE ASTM AND OTHER ACCEPTED INDUSTRY PRACTICES.

I CERTIFY THAT THE ABOVE RESULTS OF TEST AND/OR ANALYSIS TO BE CORRECT AS CONTAINED IN THE RECORDS OF VULCAN THREADED PRODUCTS.

JEFF HAYES
 PURCHASING MANAGER

SIGNED: 

DATE: 8/28/2006

VULCAN THREADED PRODUCTS
 #10 CROSSCREEK TRAIL
 PELHAM, AL 35124
 PH:(205) 620-5100
 FAX:(205) 620-5150

TEST REPORT

TEST DATE:	8/17/2006	REPORT DATE:	8/17-18/2006	LAB#	63566, 63581
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CHEMISTRY

C	Mn	P	S	Si	Cr	Mo	V	Al
.39	.95	.013	.02	.27	1.02	.16	.007	.027

MANUFACTURER INFORMATION

MANUFACTURER:	VULCAN THREADED PRODUCTS
MANUFACTURE DATE:	8/17/2006
SAMPLING SCHEME:	ASTM A354-BD
PERSON PERFORMING SAMPLING:	DAVE CHMIELARSKI
COUNTRY OF ORIGIN	UNITED STATES

PRODUCT INFORMATION

SIZE:	3.000 DIAMETER BAR	SPECIFICATION:	ASTM A193
GRADE:	A354 BD	REVISION YEAR:	2004
HEAT:	A062731	LOT#:	25555

PROCESS (HEAT TREAT) INFORMATION

HEAT TREAT METHOD & TIME:	INDUCTION
TEMPERING TEMP:	1175 DEG. F.
QUENCH & COOLING METHOD:	WATER QUENCH & AMBIENT COOLED

MECHANICAL TEST RESULTS

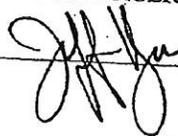
CONTAINER #	C2000118	C2000123	C2000126	C2000129		
TENSILE STRENGTH:	160,200	160,000	163,600	162,000		PSI
YIELD STRENGTH:	144,500	144,500	148,700	145,700		PSI
ELONGATION:	17	19	17	18		%
REDUCTION OF AREA:	49	51	50	52		%
HARDNESS MID RADIUS:	34	34	34	34		HRC

MATERIAL IS PRODUCED MERCURY FREE AND NOT REPAIRED BY WELDING

ALL TEST AND ANALYSIS PERFORMED IN ACCORDANCE WITH PROCEDURES DERIVED FROM METHODS DESCRIBED AND APPROVED BY THE ASTM AND OTHER ACCEPTED INDUSTRY PRACTICES.

I CERTIFY THAT THE ABOVE RESULTS OF TEST AND/OR ANALYSIS TO BE CORRECT AS CONTAINED IN THE RECORDS OF VULCAN THREADED PRODUCTS.

JEFF HAYES
 PURCHASING MANAGER

SIGNED: 

DATE: 8/28/2006



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 Birmingham, AL 35211
 205.940.9480
 866.RUN.TEST

REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/17/2006
 Report Date: 08/17/2006
 Lab Number: 63566
 P. O. Number: P173145-001

MANUFACTURER INFORMATION

Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/17/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 3.000" Diameter Bars
 Grade: BD
 Head Type: N/A

Specification: ASTM A354
 Coating Type: None
 Coating Specification: NA

Lot Number: 25555
 Heat Number: A062731
 Lot Size: -

TEST RESULTS

Property	Unit	Container #	MECHANICAL TEST RESULTS		
			Container #	Container #	Container #
Tensile Strength	psi	C2000118	C2000123	C2000126	
Yield Strength	psi	160,200	160,000	163,600	
Elongation	%	144,500	144,500	148,700	
Reduction of Area	%	17	19	17	
Hardness	HRC	49	51	50	
		34	34	34	

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A193 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

[Signature]
 Quality Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 -February 15, 2002



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REPORT OF ANALYSIS

Vulcan Threaded Products
 PO Box 509
 Pelham, AL 35124
 Attention: Dave Chmielarski

Test Date: 08/17/2006
 Report Date: 08/17/2006
 Lab Number: 63566
 P. O. Number: P173145-001

MANUFACTURER INFORMATION

Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
Head Marking

Manufacture Date: 08/17/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

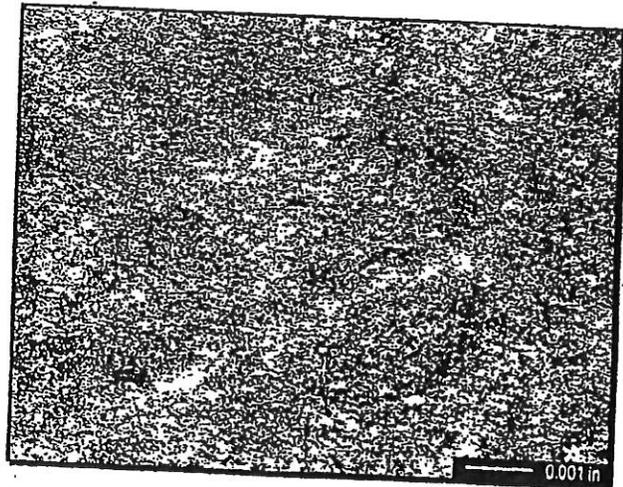
Size: 3.000" Diameter Bar
 Grade: B7
 Head Type: N/A

Specification
 Coating Type
 Coating Specification

ASTM A354-04
 None
 NA
 Lot Number: 25555
 Heat Number: A062731
 Lot Size: -

MICROSTRUCTURAL TEST RESULTS

Sample ID	C2000118
Etchant	Vilella's
Magnification	500 x
Micrograph Number	#1
Microstructure Evaluation	Predominantly Tempered Martensite



Procedure: The sample was polished using progressively finer polishing papers up to 600 grit. Final polishing used 3-micron diamond compound and 0.3-micron alumina. Etching was at room temperature for 5-20 seconds to reveal the microstructure.

Test Methods: ASTM E3

Respectfully Submitted,
MATERIALS TECHNOLOGY, INC.

[Signature]
 Quality Assurance Representative

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REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/17/2006
 Report Date: 08/18/2006
 Lab Number: 63581
 P. O. Number: P173145-001

MANUFACTURER INFORMATION

Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/17/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 3.000" Diameter Bars
 Grade: BD
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA

Lot Number: 25555
 Heat Number: A062731
 Lot Size: -

TEST RESULTS

Property	Unit	Container #	MECHANICAL TEST RESULTS	
			Container #	Container #
Tensile Strength	psi	C2000129 162,000	C2000130 159,600	C2000131 157,700
Yield Strength	psi	145,700	139,700	141,000
Elongation	%	18	16	18
Reduction of Area	%	52	50	50
Hardness	HRC	34	34	34

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A354 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

Quality Assurance Representative

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REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/18/2006
 Report Date: 08/21/2006
 Lab Number: 63584
 P. O. Number: P173145-001

MANUFACTURER INFORMATION
 Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/17/2006, 08/18/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 3.000" Diameter Bars
 Grade: BD
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA
 Lot Number: 25555
 Heat Number: A062731
 Lot Size: -

TEST RESULTS

Property	Unit	MECHANICAL TEST RESULTS				
		Container # C2000540	Container # C2000709	Container # C2000773	Container # C2000790	Container # C2000801
Tensile Strength	psi	159,500	160,500	159,900	161,500	160,500
Yield Strength	psi	144,300	145,600	144,700	146,500	145,700
Elongation	%	18	18	19	18	18
Reduction of Area	%	52	52	51	51	52
Hardness	HRC	35	35	35	35	35

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A354 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

Quality Assurance Representative

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REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/18/2006
 Report Date: 08/18/2006
 Lab Number: 63592
 P. O. Number: P173145-001

MANUFACTURER INFORMATION

Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/18/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 3.000" Diameter Bars
 Grade: BD
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA

Lot Number: 25555
 Heat Number: A062731
 Lot Size: -

TEST RESULTS

Property	Unit	MECHANICAL TEST RESULTS	
		Container # C2000866	Container # C2000989
Tensile Strength	psi	162,500	166,800
Yield Strength	psi	147,900	152,900
Elongation	%	17	17
Reduction of Area	%	50	50
Hardness	HRC	33	34

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A354 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

Dave Chmielarski
 Quality Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

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REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/21/2006
 Report Date: 08/21/2006
 Lab Number: 63602
 P. O. Number: P173145-001

MANUFACTURER INFORMATION
 Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, Al 35124

Fastener Insignia
Head Marking

Manufacture Date: 08/18/2006, 08/19/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 3.000" Diameter Bars
 Grade: BD
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA
 Lot Number: 25555
 Heat Number: A062731
 Lot Size:

TEST RESULTS

Property	Unit	MECHANICAL TEST RESULTS					
		Container # C2001030	Container # C2001059	Container # C2001084	Container # C2001088	Container # C2001094	Container # C2001097
Tensile Strength	psi	165,300	155,700	164,500	162,800	158,100	156,000
Yield Strength	psi	152,000	138,400	149,800	147,800	141,400	138,800
Elongation	%	17	19	17	16	18	18
Reduction of Area	%	52	51	52	49	50	53
Hardness	HRC	34	34	34	35	34	33

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A354 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

[Signature]
 Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 - February 15, 2002

Material: 4140 Size: 3.000 HDG length: 308" Heat: AA2731
 "A" Coils: 6 charge Parallel/Serial: Parallel Capacitor Taps: 15m - 1out Spd. Up: 1.20
 "B" Coils: 6 charge Parallel/Serial: Series Capacitor Taps: 14m - 2out Conv. Spd: 2.00
 1st Quench: 1/2 Dip - All 2nd Quench: 3 Dip - All Quench Rings: 1/2 Dip - All

Temp	AUSTINIZING - Coil "A"				TEMPERING - Coil "B"				PROC SPD	START SIZE	FINISH SIZE	LOT #	CONT #
	VLT	AMP	K.W.	FREQ	DATE	VLT	AMP	K.W.					
88.4	46.0				8-17	52.5							
89.2	46.7	77.7	54.7	62.0	11	52.8	74.7	57.5	44.5	155	2.75	2.75	2000118
89.6	46.4	78.6	54.8	61.7	11	52.8	75.4	57.9	44.4	155	2.75	2.75	2000120
89.5	46.6	78.8	55.5	61.8	11	53.3	74.0	57.2	44.3	155	2.75	2.75	2000123
90.1	46.9	78.9	55.1	61.8	11	52.8	75.1	56.4	44.4	155	2.75	2.75	2000126
89.8	46.6	78.0	54.6	61.7	11	52.2	74.3	56.7	44.3	155	2.75	2.75	2000129
90.5	46.6	77.8	54.7	61.7	11	52.5	73.3	56.9	44.1	155	2.75	2.75	2000130
91.6	46.5	77.8	55.0	61.7	11	52.2	75.8	57.1	44.2	155	2.75	2.75	2000131
92.3	46.7	78.7	55.4	61.4	11	52.9	75.2	57.1	44.0	155	2.75	2.75	2000131
92.5	46.8	78.7	55.4	61.5	11	52.4	74.3	56.6	44.0	155	2.75	2.75	2000132
92.4	47.5	78.7	54.7	61.3	11	52.7	74.7	57.9	44.0	155	2.75	2.75	2000133
91.8	46.0	78.8	54.8	61.9	11	52.8	74.0	57.5	44.6	155	2.75	2.75	2000134
91.7	47.0	78.1	55.1	61.6	11	53.8	74.8	57.5	44.2	155	2.75	2.75	2000135
89.5	46.9	78.1	55.3	61.6	11	53.5	73.0	57.3	44.0	155	2.75	2.75	2000136
90.2	47.5	78.8	55.4	61.7	11	52.9	74.4	57.1	44.3	155	2.75	2.75	2000137
89.7	46.9	78.5	55.4	61.5	11	53.0	74.3	57.1	44.1	155	2.75	2.75	2000138
88.5	46.6	78.7	55.5	61.7	11	52.5	74.7	56.9	44.3	155	2.75	2.75	2000139
88.9	46.4	79.5	55.6	61.7	11	52.2	74.2	57.2	44.1	155	2.75	2.75	2000140
89.3	46.6	78.6	55.3	61.7	11	53.1	74.4	56.9	44.1	155	2.75	2.75	2000141
	46.8	77.9	55.0	61.4	11	52.9	74.5	57.3	44.0	155	2.75	2.75	2000142
		77.3	54.3	61.6	11	53.3	75.1	56.4	44.0	155	2.75	2.75	2000143

COPY →
As of July 24, 2004

Certified Material Test Report

# : 21868	Mill Order : 0606257	Heat # : A062731	Issued : 8/10/2006 10:46:58
Work Order : 32104	Sales Order : 17866-1	Customer : Vulcan	PO # : P171213-001-1
Load # : 36613	Reference # :	Reference Desc :	End Use :
Size : 3"	Shape : Round	Grade : 4140	Length : 25'08"
Grain Practice : A1 Fine Grain (5-8) per ASTM A29		Reduction Ratio : 19.6 to 1	Disposition : 1

Ladle Chemistry Analysis (ASTM A29)

C	Mn	P	S	Si	Al	Cu	Ni	Cr	Mo	Sn	N	V	Cb	B	Ca	W	Ti	DI
0.39	0.95	0.013	0.020	0.27	0.027	0.31	0.11	1.02	0.16	0.009	0.0069	0.007	0.003	0.0003	0.0007	0.011	0.001	5.83
Pb	Co																	
0.004	0.053																	

Product Check Analysis (ASTM A29)

C	Mn	P	S	Si	Al	Cu	Ni	Cr	Mo	Sn	N	V	Cb	Ti	B	Ca
Front																
Back																

Jominy (ASTM A255)

J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J12	J14	J16	J18	J20	J24	J28	J32
Calc'd																	
Front																	
Back																	

Microcleanliness (ASTM E45)

Method A								Method C		Method E		Austenitic Grainsize	Macrostructure		
AT	AH	BT	BH	CT	CH	DT	DH	S	O	SAM "B"	SAM "D"		ASTM E381		
											S	R	C		

Mechanical Properties (ASTM A370)

Tensile Properties				Hardness			Magnetic Particle Inspection	
Tensile Strength	0.2% Yield Strength	% Elongation	% ROA	BHN	Rb	Rc	Frequency	Severity

Comments/Specs

ASTM A322 (latest rev.)

Condition : As-Rolled, Hot-Rolled

I hereby certify that the content of this report is correct and accurate, and that all tests and operations performed on this material were in compliance with applicable material specifications and purchaser designated requirements.


Trevor Klipp - Rolling Mill Metallurgist

Any alteration to this report voids Steel Dynamic's warranting of results. No weld repair has been performed on this material. This material is not radioactive and has not been exposed to radioactivity while under the control of Steel Dynamics. This material has not been exposed to mercury while under the control of Steel Dynamics. Unless otherwise noted, this material was melted, continually cast, and rolled in the USA; with all testing performed by Steel Dynamics.

#10 CROSSCREEK TRAIL
 PELHAM, AL 35124
 PH:(205) 620-5100
 FAX:(205) 620-5150

TEST REPORT

TEST DATE:	8/22/2006	REPORT DATE:	8/22-23/2006	LAB#	63613, 63628
------------	-----------	--------------	--------------	------	--------------

CHEMISTRY

C	Mn	P	S	Si	Cr	Mo	V	Al
.4	.90	.011	.017	.27	.97	.16	.005	.026

MANUFACTURER INFORMATION

MANUFACTURER:	VULCAN THREADED PRODUCTS
MANUFACTURE DATE:	8/21-22/2006
SAMPLING SCHEME:	ASTM A354-BD
PERSON PERFORMING SAMPLING:	DAVE CHMIELARSKI
COUNTRY OF ORIGIN	UNITED STATES

PRODUCT INFORMATION

SIZE:	4.00 DIAMETER BAR	SPECIFICATION:	ASTM A193
GRADE:	A354 BD	REVISION YEAR:	2004
HEAT:	A062700	LOT#:	25579

PROCESS (HEAT TREAT) INFORMATION

HEAT TREAT METHOD & TIME:	INDUCTION
TEMPERING TEMP:	1120 DEG. F.
QUENCH & COOLING METHOD:	WATER QUENCH & AMBIENT COOLED

MECHANICAL TEST RESULTS

CONTAINER #	C2002152	C2002199	C2002209	C2002220	C2002377	
TENSILE STRENGTH:	155,400	151,800	152,400	158,100	153,300	PSI
YIELD STRENGTH:	134,100	129,900	130,200	136,000	129,300	PSI
ELONGATION:	16	17	17	16	15	%
REDUCTION OF AREA:	40	50	48	44	41	%
HARDNESS MID RADIUS:	34	33	33	33	33	HRC

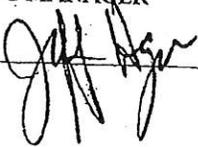
MATERIAL IS PRODUCED MERCURY FREE AND NOT REPAIRED BY WELDING

ALL TEST AND ANALYSIS PERFORMED IN ACCORDANCE WITH PROCEDURES DERIVED FROM METHODS DESCRIBED AND APPROVED BY THE ASTM AND OTHER ACCEPTED INDUSTRY PRACTICES.

I CERTIFY THAT THE ABOVE RESULTS OF TEST AND/OR ANALYSIS TO BE CORRECT AS CONTAINED IN THE RECORDS OF VULCAN THREADED PRODUCTS.

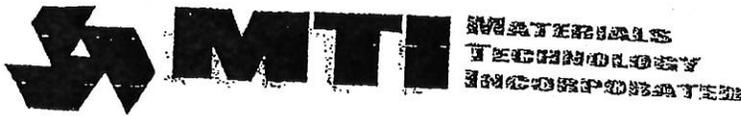
JEFF HAYES
 PURCHASING MANAGER

SIGNED: _____



DATE: _____

8/28/2006



www.IestMetal.com
 213 Lyon Lane
 Birmingham, AL 35211
 205.940.9480
 866.RUN.TEST

REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/22/2006
 Report Date: 08/22/2006
 Lab Number: 63613
 P. O. Number: P173145-001

MANUFACTURER INFORMATION

Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/21/2006, 08/22/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 4.000" Diameter Bars
 Grade: BD
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA

Lot Number: 25579
 Heat Number: a062700
 Lot Size: -

TEST RESULTS

Property	Unit	MECHANICAL TEST RESULTS		
		Container # C2002152	Container # C2002199	Container # C2002209
Tensile Strength	psi	155,400	151,800	152,400
Yield Strength	psi	134,100	129,900	130,200
Elongation	%	16	17	17
Reduction of Area	%	40	50	48
Hardness	HRC	34	33	33

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A354 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

[Signature]
 Quality Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 - February 15, 2002

REPORT OF ANALYSIS

Vulcan Threaded Products
 PO Box 509
 Pelham, AL 35124
 Attention: Dave Chmielarski

Test Date: 08/22/2006
 Report Date: 08/22/2006
 Lab Number: 63613
 P. O. Number: P173145-001

MANUFACTURER INFORMATION

Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/21/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

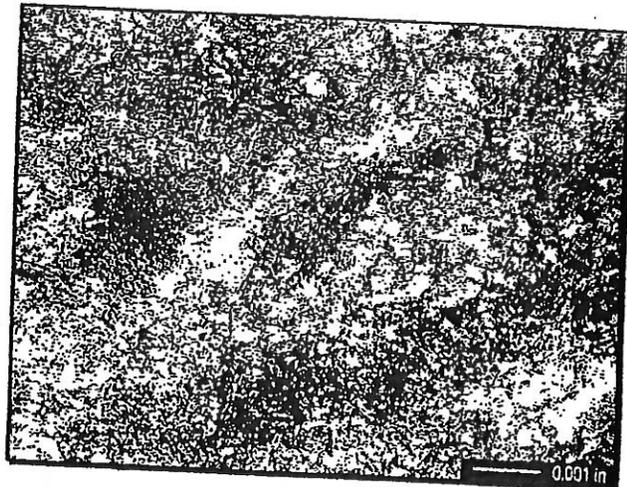
Size: 4.000" Diameter Bar
 Grade: BD
 Head Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA

Lot Number: 25579
 Heat Number: a062700
 Lot Size: -

MICROSTRUCTURAL TEST RESULTS

Sample ID	C2002152
Etchant	Vilella's
Magnification	500 x
Graph Number	#1
Microstructure Evaluation	Predominantly Tempered Martensite



Procedure: The sample was polished using progressively finer polishing papers up to 600 grit. Final polishing used 3-micron diamond compound and 0.3-micron alumina. Etching was at room temperature for 5-20 seconds to reveal the microstructure.

Test Methods: ASTM E3.

Respectfully Submitted,
MATERIALS TECHNOLOGY, INC.

[Signature]
 Quality Assurance Representative

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Testing efforts were in accordance with MTI QA Program, Rev. 2 - February 15, 2002.

REPORT OF ANALYSIS

Vulcan Threaded Products
 Attention: Dave Chmielarski
 P.O. Box 509
 Pelham, AL 35124

Test Date: 08/22/2006
 Report Date: 08/23/2006
 Lab Number: 63628
 P. O. Number: P173145-001

MANUFACTURER INFORMATION
 Vulcan Threaded Products
 10 Crosscreek Trail
 Pelham, AL 35124

Fastener Insignia
 -
Head Marking
 -

Manufacture Date: 08/22/2006
 Sampling Scheme: ASTM A354
 Person performing Sampling: Dave Chmielarski
 Company performing Sampling: Vulcan Threaded Products

PRODUCT INFORMATION

Size: 4.00" Diameter Bars
 Grade: BD
 Lead Type: N/A

Specification: ASTM A354-04
 Coating Type: None
 Coating Specification: NA

Lot Number: 25579
 Heat Number: a062700
 Lot Size: -

TEST RESULTS

Property	Unit	MECHANICAL TEST RESULTS	
		Container # C2002220	Container # C2002377
Tensile Strength	psi	158,100	153,300
Yield Strength	psi	136,000	129,300
Elongation	%	16	15
Reduction of Area	%	44	41
Hardness	HRC	33	33

Test Methods: ASTM A370 (0.2% Offset Yield, Gage=4d), ASTM E18

The specimen(s) tested meet(s) the requirements of ASTM A354 for the properties reported above.

Respectfully Submitted,
 Materials Technology, Inc.

[Signature]
 C / Assurance Representative

Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 -February 15, 2002

Material #11
"B" Coils
1st Quench

7140
6 Lg
6 Lg
3/4 Open All

Size
Parallel/Series
Parallel/Series
2nd Quench

4: HRB
Parallel
Series
3/4 Open All

Le
Capacitor Taps
Capacitor Taps
Quench Rings

310"
15 In - 1 Out
14 In - 2 Out
1/2 Open All (21-24 closed)

Heat A082700
Spd. Up 1.35
Conv. Spd. .2
Delay 33.0

ISS	AUSTINIZING - Coil "A"				TEMPERING - Coil "B"				PROC SPD	START SIZE	FINISH SIZE	LOT #	CONT #	sample	
	VLT	AMP	K.W.	FRQ	TEMP	DATE	VLT	AMP							K.W.
36.50															
36.6	115.9	54.4	68.8	68.5	8-21-06	46.50	46.7	77.8	52.6	41.8	1120	25579	21002120	sample	
36.8	96.0	54.4	68.5	68.5	"	"	46.6	77.7	52.6	41.4	"	11	21002152	sample	
36.7	96.2	54.6	68.4	68.4	8-22-06	46.7	46.7	77.6	52.7	41.3	"	11	21002199	sample	
36.6	96.4	54.9	68.4	68.4	"	"	46.7	77.6	52.7	41.3	"	11	21002209	sample	
36.7	95.8	54.2	68.5	68.5	"	"	46.7	77.6	52.8	41.3	"	11	21002220	sample	
36.4	96.5	55.3	68.4	68.4	"	"	47.4	77.8	52.6	41.1	"	11	21002377	sample	

Certified Material Test Report

: 21962 Mill Order : 0606365 Heat # : A062700 Issued : 8/4/2006 08:08:16
 k Order : 32106 Sales Order : 17867-1 Customer : Vulcan PO # : P171213-001-2
 Load # : 36157 Reference # : Reference Desc : End Use :
 Size : 4" Shape : Round Grade : 4140 Length : 25'10"
 Grain Practice : Al Fine Grain (5-8) per ASTM A29 Reduction Ratio : 11.0 to 1 Disposition : 1

Ladle Chemistry Analysis (ASTM A29)

C	Mn	P	S	Si	Al	Cu	Ni	Cr	Mo	Sn	N	V	Cb	B	Ca	W	Ti	DI
0.40	0.90	0.011	0.017	0.27	0.026	0.24	0.13	0.87	0.16	0.012	0.0060	0.005	0.002	0.0001	0.0010	0.010	0.001	5.37
Pb	Co																	
0.004	0.007																	

Product Check Analysis (ASTM A29)

	C	Mn	P	S	Si	Al	Cu	Ni	Cr	Mo	Sn	N	V	Cb	Ti	B	Ca
Front																	
Back																	

Chemical Analysis (ASTM A255)

	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J12	J14	J16	J18	J20	J24	J28	J32
Calc'd	56	56	56	56	56	56	56	55	53	51	48	48	45	44	44	42	40	37
Front																		
Back																		

Microcleanliness (ASTM E46)

Method A										Method C		Method E		Austenitic Grain Size	Macrostructure		
AT	AH	BT	BH	CT	CH	DT	DH	S	O	SAM "B"	SAM "D"	S	R		C		

Mechanical Properties (ASTM A370)

Tensile Properties				Hardness			Magnetic Particle Inspection	
Tensile Strength	0.2% Yield Strength	% Elongation	% RDA	BHN	Rb	Rc	Frequency	Severity

Comments/Specs

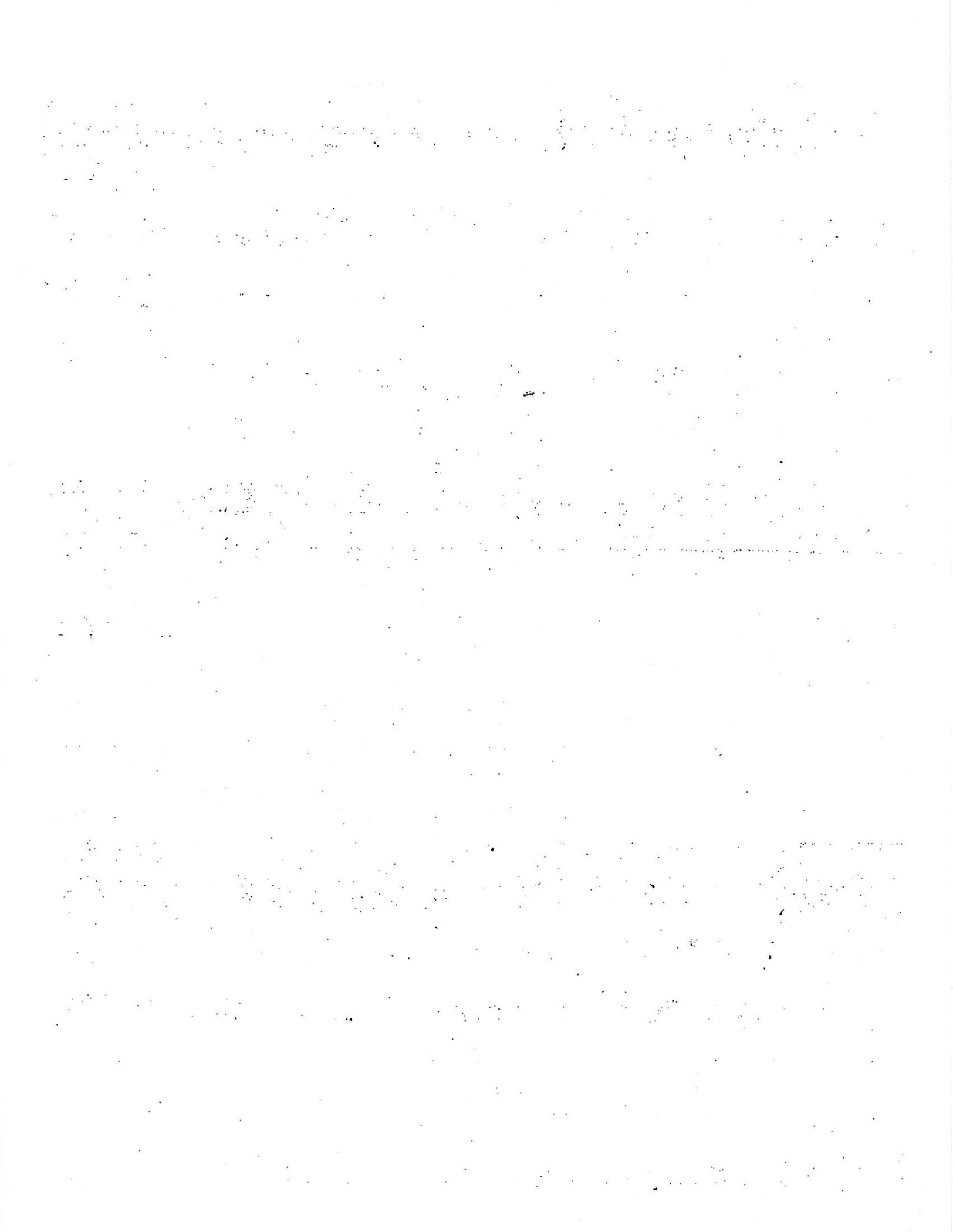
ASTM A322 (latest rev.)

Condition: As-Rolled, Hot-Rolled

we hereby certify that the content of this report is correct and accurate, and that all tests and operations performed on this material were in compliance with applicable material specifications and purchaser designated requirements.


Trevor Klipp - Rolling Mill Metallurgist

Any alteration to this report voids Steel Dynamic's warranting of results. No weld repair has been performed on this material. This material is not radioactive and has not been exposed to radioactivity while under the control of Steel Dynamics. This material has not been exposed to mercury while under the control of Steel Dynamics. Unless otherwise noted, this material was melted, continually cast, and rolled in the USA; w/ all testing performed by Steel Dynamics.



TENNESSEE GALVANIZING, INC.
P O BOX 609
JASPER, TN 37347

SHIPPING ADDRESS:
1535 INDUSTRIAL BLVD.
JASPER, TN. 37347

GALVANIZING CERTIFICATION:

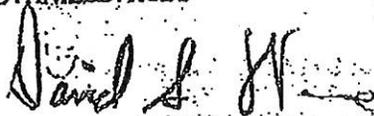
WE HEREBY CERTIFY THAT THE FOLLOWING MATERIALS HAVE BEEN GALVANIZED IN ACCORDANCE WITH THE SPECIFICATIONS AS SET FORTH BY ASTM-A-123/A89A 123M-00. FINAL INSPECTION HAS BEEN MADE AND MATERIALS MEET ALL REQUIREMENTS.

CUSTOMER NAME: VULCAN THREADED PRODUCTS, INC.
P O BOX 509
PELHAM, AL 35124

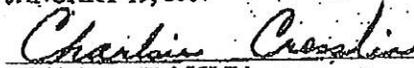
CUSTOMER'S PURCHASE ORDER #: 23316

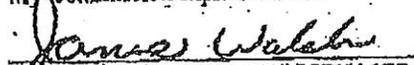
INVOICE #:

MATERIAL GALVANIZED: RODS



DAVID S. WARE, PRESIDENT/CEO
Sworn to and subscribed before me
JANUARY 19, 2007


CHARLSIE CROSSLIN
Notary Public-At-Large
My commission expires 11/4/08


JAMES W. WALDEN, QUALITY MGR.



Myron / Adam,

Please pass on to your customer.

361-289-9029

Leo

TENNESSEE GALVANIZING, INC.
P O BOX 609
JASPER, TN 37347

SHIPPING ADDRESS:
1535 INDUSTRIAL BLVD.
JASPER, TN 37347

GALVANIZING CERTIFICATION:

WE HEREBY CERTIFY THAT THE FOLLOWING MATERIALS HAVE BEEN GALVANIZED IN ACCORDANCE WITH THE SPECIFICATIONS AS SET FORTH BY ASTM-A-153A 153M-00. FINAL INSPECTION HAS BEEN MADE AND MATERIALS MEET ALL REQUIREMENTS.

CUSTOMER NAME: VULCAN THREADED PRODUCTS, INC.
P O BOX 509
PELHAM, AL 35124

CUSTOMER'S PURCHASE ORDER #: 171352

INVOICE #: IQ38654

MATERIAL GALVANIZED: DER

David S Ware
DAVID S WARE, PRESIDENT/CEO
Sworn to and subscribed before me
JANUARY 16, 2007

Charles Crosslin
CHARLES CROSSLIN
Notary Public-At-Large
My commission expires 11/04/08

James Walden
JAMES WALDEN, QUALITY CONTROL MGR.





Houston Galvanizing Services
7407 C.E. King Parkway
PO Box 24720
Houston, TX 77229-4720
281.458.1550
Fax-281.458.2515

January 29, 2007

Mr. Jack Upton
Kiewit Offshore Services
2440 Kiewit Road
Ingleside, TX 778362

FAX# 361.775.4430

Re: Galvanizing Procedures
Job# 21103-37242

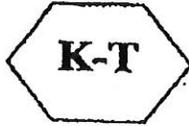
PROCESS CERTIFICATION

This is to certify that all materials hot dip galvanized by Aztec Galvanizing Services are done in accordance with ASTM A 123/A 123M-02 , & E376-03 specifications.

PROCEDURES

The material is first soaked in a hot caustic solution to remove oils and other organic materials. After a water rinse, the material is pickled in approximately 15% solution of hydrochloric acid until free of rust and scale. Following a water rinse and submersion in a heated solution of preflux, the material is dipped in molten zinc at approximately 830° Fahrenheit. Time in the molten zinc varies according to the shape and weight of the parts. Parts are allowed to cool and hand cleaned to remove excessive zinc and sharp projections.

Lonnie J. McLead
Plant Manager



K-T Galvanizing Company, Inc.
P.O. Box 560 - 5105 East 3rd Street
Katy, Texas 77492
Ph: 281-391-9201 Fax 281-391-5819
www.ktgalvanizing.com



January 4, 2007

Gulf Coast Fasteners
P.O. Box 19331
Houston, Tx 77224

RE: CERTIFICATE OF COMPLIANCE BLANKET CERTIFICATE

To Whom It May Concern:

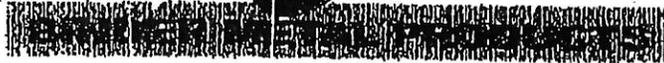
We certify that our Hot Dip process meets the requirements of
ASTM A153, class C specifications.

Sincerely,

Al Peck
President

AP/pm

COMPANY *International Basket & Supply*
INVOICE *109178*
P.O. *116854*



INCORPORATED



14909 SOUTH BROADWAY / P.O. BOX 2308 / GARDENA, CALIFORNIA 90248-1817

General FAX: (310) 532-9527
 Sales FAX: (310) 532-1264
 E-Mail: sales@blindernm.com

(323) 321-4835
 OUTSIDE CALIFORNIA
 (800) 222-0890

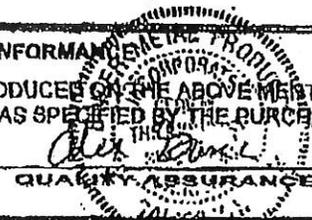
INSPECTION & TEST REPORT

CUSTOMER & ADDRESS:		CUST P.O. NO:	PACKING SLIP NO:	MFG DATE	LOT NO.	DATE
GULF COAST FASTENERS, INC.		J2582	147841-09	8-26-06	76903	8-28-06
P.O. BOX 19301 1626 TOWNHURST HOUSTON, TX 77043		THIS LAB REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN PERMISSION OF THE BMP LAB LAB RESULTS PERTAIN ONLY TO THE ITEMS TESTED				
GENERAL REQUIREMENTS			PROCESSING DATA AND INSP/TEST RESULTS			
PART NO	FP3.00	HEAT TREATING		HEAT TREAT SPECIFICATION MIL-H-8875		
PRODUCT FAMILY	3" F436 PLAIN	HEAT TREAT REQUIREMENT		38 TO 45 HRC		
PRODUCT SPECIFICATION	ASTM F436-1993	CLEAN		OKAY		
MATERIAL GRADE & SPEC	AISI C1060 MED STEEL	ENDO QUENCH		1600		
MATERIAL HEAT NUMBER	A06880	TEMPER		750		
LOT SIZE	700 PIECES SHIPPED	INSP METHOD		SAMPLING		
INSPECTION AND TEST DATA			SAMPLING PLAN ASM 'C' = 'D', SAMPLING PLAN			
DIMENSIONAL			A.Q.L INSP LEVEL 4.0MA			
INSP METHOD	6PC <input checked="" type="checkbox"/> SAMPLING <input type="checkbox"/>	SAMPLING PLAN		ASQ C-0		
SAMPLING PLAN	ASQ C-0	LEVEL/A.Q.L.		4.0 aql, LEVEL 1A		
LEVEL/A.Q.L.	4.0 aql, LEVEL 1A	SAMPLE SIZE		10 PCS, EACH 30 MIN		
SAMPLE SIZE	10 PCS, EACH 30 MIN	O.D.		5.490		
O.D.	5.490	I.D.		3.155		
I.D.	3.155	THICKNESS		.254		
THICKNESS	.254	OTHER		PARTS TAKEN FROM LARGER MFG LOT		
OTHER	PARTS TAKEN FROM LARGER MFG LOT	OTHER		MANUFACTURED IN THE USA.		
OTHER	MANUFACTURED IN THE USA.	OTHER		FINISH REQUIREMENT PLAIN FINISH		
OTHER	FINISH REQUIREMENT PLAIN FINISH	OTHER		INSP METHOD		
OTHER	INSP METHOD	OTHER		SAMPLING PLAN		
OTHER	SAMPLING PLAN	OTHER		A.Q.L/INSP LEVEL		
OTHER	A.Q.L/INSP LEVEL	INSP RESULT		ACCEPT <input checked="" type="checkbox"/> REJECT <input type="checkbox"/>		
INSP RESULT	ACCEPT <input checked="" type="checkbox"/> REJECT <input type="checkbox"/>	INSPECTOR		SALVADOR MARQUEZ		
INSPECTOR	SALVADOR MARQUEZ	OTHER		ACTUAL RESULT		
OTHER	ACTUAL RESULT	OTHER		INSP RESULT		
OTHER	INSP RESULT	OTHER		ACCEPT <input type="checkbox"/> REJECT <input type="checkbox"/>		
OTHER	ACCEPT <input type="checkbox"/> REJECT <input type="checkbox"/>	OTHER		INSPECTOR		
OTHER	INSPECTOR	OTHER		MATERIALS MEET SPECIFIED REQUIREMENTS:		
OTHER	MATERIALS MEET SPECIFIED REQUIREMENTS:	OTHER		YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>		
OTHER	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>	OTHER		DEVIATIONS FROM STD TEST METHODS NONE		
OTHER	DEVIATIONS FROM STD TEST METHODS NONE	OTHER		HEAD MARKING FOR F436 IS "B"		
OTHER	HEAD MARKING FOR F436 IS "B"	OTHER		CERTIFICATE OF CONFORMANCE		

I, ALEX GARCIA, HEREBY CERTIFY THAT THE GOODS PRODUCED ON THE ABOVE MENTIONED PURCHASE ORDER MEET THE STATED REQUIREMENTS, AS SPECIFIED BY THE PURCHASE ORDER AND ANY RELATED OR REFERENCED DOCUMENTS.

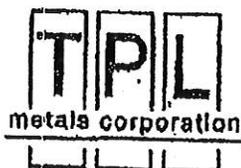
FORM #BKH-116

Manufacturers of:



STANDARD WASHERS • S.A.E. WASHERS • BUSHING WASHERS

SERVING THE INDUSTRY SINCE 1925



original 116-110005
035889-00

METALLURGICAL CERTIFICATE

TAG NO. R55979
HEAT NO. AQB880
SIZE & DESCRIPTION: 1/4 x 44.10 x 120.00
HR P&C
SPECIFICATION: C1050

CHEMICAL ANALYSIS								
C	Mn	P	S	Si	Cr	Al	Mo	Cu
0.530	0.730	0.007	0.001	0.170	0.000	0.028	0.000	0.000

MECHANICAL PROPERTIES			
TENSILE (PSI)	YIELD (PSI)	%ELONG IN 2"	Rb

WE HEREBY CERTIFY THAT THE FOREGOING INFORMATION WAS FURNISHED TO US BY OUR SUPPLIER OR RESULTED FROM TESTS PERFORMED BY AN INDEPENDENT LABORATORY.

SIGNED: J. J.

DATE: 6/13/2005

"Milled & Manufactured in the USA"



BINDER METAL PRODUCTS
INCORPORATED



14909 SOUTH BROADWAY / P.O. BOX 2306 / GARDENA, CALIFORNIA 90248-1817

General FAX: (310) 532-9527
Sales FAX: (310) 532-1264
E-Mail: sales@bindermetal.com

(323) 321-4035
OUTSIDE CALIFORNIA
(800) 233-0898

INSPECTION & TEST REPORT

CUSTOMER & ADDRESS: GULF COAST FASTENERS, INC. P.O. BOX 19837 1629 TOWNHURST HOUSTON, TX 77043	CUST P.O. NO.: J5926	PACKING SLIP NO.: 145847-01	MFG DATE: 12-14-08	LOT NO.: W8747	DATE: 12-18-08
*THIS LAB REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN PERMISSION OF THE BMP LAB *LAB RESULTS PERTAIN ONLY TO THE ITEMS TESTED					
GENERAL REQUIREMENTS			PROCESSING DATA AND INSP/TEST RESULTS		
PART NO FP4.00			HEAT TREATING		
PRODUCT FAMILY 4" F436 PLAIN			HEAT TREAT SPECIFICATION MIL-H-8875		
PRODUCT SPECIFICATION ASTM F436-1993			HEAT TREAT REQUIREMENT 38 TO 45 HRC		
MATERIAL GRADE & SPEC AISI 4130 STEEL			CLEAN OKAY		
MATERIAL HEAT NUMBER 4527			ENDO QUENCH 1600		
LOT SIZE 180 PIECES SHIPPED			TEMPER 750		
INSPECTION AND TEST DATA			INSP METHOD SAMPLING		
DIMENSIONAL			SAMPLING PLAN ABM 'C' = 0, SAMPLING PLAN		
INSP METHOD SPC <input checked="" type="checkbox"/> SAMPLING <input type="checkbox"/>			A.Q.L./INSP LEVEL 4.0/1A		
SAMPLING PLAN ASQ C=0			SAMPLE SIZE 29 PCS		
LEVEL/A.Q.L. 4.0 BQ, LEVEL 1A			ACTUAL RESULT 41.3-45.0 HRC		
SAMPLE SIZE 10 PCS. EACH 30 MIN			INSP RESULT ACCEPT <input checked="" type="checkbox"/> REJECT <input type="checkbox"/>		
O.D. 7.488			INSPECTOR BRIAN SHAIN		
I.D. 4.125			PLATING		
THICKNESS .250			FINISH SPECIFICATIONS		
OTHER PARTS TAKEN FROM LARGER MFG LOT			FINISH REQUIREMENT PLAIN FINISH		
OTHER MANUFACTURED IN THE USA			INSP METHOD		
OTHER			SAMPLING PLAN		
OTHER			A.Q.L./INSP LEVEL		
INSP RESULT ACCEPT <input checked="" type="checkbox"/> REJECT <input type="checkbox"/>			SAMPLE SIZE		
INSPECTOR SALVADOR MARQUEZ			ACTUAL RESULT		
MATERIALS MEET SPECIFIED REQUIREMENTS: YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>			INSP RESULT ACCEPT <input type="checkbox"/> REJECT <input type="checkbox"/>		
			INSPECTOR		
DEVIATIONS FROM STD TEST METHODS NONE					

*HEAD MARKING FOR F436 IS "B"

CERTIFICATE OF CONFORMANCE

I, ALEX GARCIA, HEREBY CERTIFY THAT THE GOODS PRODUCED ON THE ABOVE MENTIONED PURCHASE ORDER MEET THE STATED REQUIREMENTS, AS SPECIFIED BY THE PURCHASE ORDER AND ANY RELATED OR REFERENCED DOCUMENTS.

FORM #BMP-116

Manufacturers of:





Original #1 11-19
045569-00

METALLURGICAL CERTIFICATE

TAG NOS. TBA
HEAT NO. 4527
SIZE & DESCRIPTION: .250 x 48.750 x 120.00
HR P&O
SPECIFICATION: 4130

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Cr	Al	Mo	Cu
0.290	0.470	0.009	0.001	0.200	0.830	0.040	0.160	0.030

MECHANICAL PROPERTIES

TENSILE (PSI)	YIELD (PSI)	%ELONG IN 2"	Rb

WE HEREBY CERTIFY THAT THE FOREGOING INFORMATION WAS FURNISHED TO US BY OUR SUPPLIER OR RESULTED FROM TESTS PERFORMED BY AN INDEPENDENT LABORATORY.

SIGNED: J.S.

DATE: 11/29/2008

"MELTED & MANUFACTURED IN THE USA"

SPINDLETOP BOLT CO.

625 Delmar

Beaumont, TX 77707

Phone 409.842.9555 Fax 409.842.3929

CERTIFIED TEST REPORT

Sold To:
KIEWIT OFFSHORE SERVICES Ltd.

Date: 1/30/2007
Customer P.O. Number: 21103-32274
Sales Order Number:

QTY. SHIPPED	Heat #	Description
	NTF-024	4-8 ASTM A194 2H HEAVY HEX NUT ASTM A153 HDG
	NTF-024B	3-8 ASTM A194 2H HEAVY HEX NUT ASTM A123 HDG

Chemical Analysis

Heat Code	Heat Number	C	Mn	P	S	Si	Ni	Cr	Mo
NTF-024	A060962	0.430	0.560	0.008	0.024	0.280	0.080	0.190	0.030
NTF-024B	501326	0.460	0.840	0.012	0.023	0.240	0.083	0.146	0.020

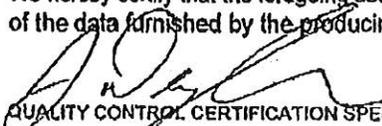
PHYSICAL ANALYSIS

Heat Code	Yield/Proofload	Tensile	Elongation %	R.A.%	Tempering	Hardness
NTF-024	N/A	N/A	N/A	N/A	N/A	255 HBW
NTF-024B	N/A	N/A	N/A	N/A	N/A	262 HBW

Galvanizing Certification:

We hereby certify that the following materials have been galvanized in accordance with the specifications as set forth by ASTM A153 and ASTM A123. Final inspection has been made and materials meet all requirements.

We hereby certify that the foregoing data is a true copy of the data furnished by the producing mill.


QUALITY CONTROL CERTIFICATION SPECIALIST

CERTIFIED TEST REPORT

DYSON CORP.

JTN DOMESTIC NUT

53 Freedom Road
Palmsville, OH 44077

440-948-3500
440-352-2700 fax

DYSON ORDER#	CUSTOMER ORDER#	ITEM NUMBER	QUANTITY SHIPPED	DATE SHIPPED
S 84944	23324	2 of 2	60 pcs	10/12/06

CUSTOMER
FSA Spindletop Bolt Co., Inc.
825 Delmar Street
Beaumont, TX 77707
USA

PRODUCT DESCRIPTION
4.00"-4UNC-2B (.031" o/s) Heavy Hex Nut, HDG per
ASTM-A153

SPECIFICATIONS
ASTM-A194 Grade 2H

DRAWING
Dyson Std

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.	ORIGINAL MILL
Round Bar	4.500	1045	60	JPR13	A040140	Steel Dynamics

The product listed above was manufactured, tested, sampled, and inspected in accordance with the specification, purchase order, and any supplementary requirements and was found to meet those requirements unless otherwise noted.

Hardness Results: 255 HBW 235 HBW after 24 hr. H.T. on sample nut in accordance with ASTM-A194 Grade 2H

Attachments:

Mill Test Report



Deborah A. Smith
Q.A. Admin. Assistant

10/12/06

LARGE DIAMETER FASTENERS & FORGINGS / STANDARDS & SPECIALS / COMMERCIAL, MILITARY & NUCLEAR SPECIFICATIONS



8000 N. County Road 725 East
 Fishers, IN 46167
 Telephone: (317) 892-7188
 Fax: (317) 882-7285

Test Cert 272

Date 7/26/2004

CODE JPR13

Sales Order # 428-17

Product 4.50" Rod

Bar Size 4.50"

Customer Jade Sterling

Spec

Bar Shape Round

PO 28422

Heat A040140

Bar Length 40' 02"

Part Item

Rolling Order #

Reduction Ratio 8.77:1

Customer Grade 1045

Grain Practice Rhs Grain

CHEMICAL ANALYSIS - HEAT

C	MN	P	S	SI	NI	CR	MO	AL	CU	SN
0.46	0.66	0.010	0.022	0.28	0.12	0.13	0.02	0.024	0.25	0.010
TI	B	N	V	CO	CA	PB	BI	TE	CE	PI
		0.0060								

Q.A. REVIEWED
 DA
 DATE 7/23/04
 DYSON

Any alterations to this report voids Steel Dynamics warranty of results. No weld repair has been performed on this material. Unless otherwise noted, this material was melted, continuously cast and rolled in the USA. This material has not been exposed to mercury while under the control of Steel Dynamics. This material is not radioactive and has not been exposed to radioactivity while under the control of Steel Dynamics. I hereby certify that the content of this report is accurate and correct. All tests and operations performed by this material manufacturer are in compliance with the requirements of the material specifications and applicable purchaser designated requirements.

Signed: 
 Quality Assurance

JPR

CERTIFIED TEST REPORT

PC DYSON CORP.

DYN DOMESTIC NUT

53 Freedom Road
Painesville, OH 44077

440-948-3500
440-352-2700 fax

DYSON ORDER#	CUSTOMER ORDER#	ITEM NUMBER	QUANTITY SHIPPED	DATE SHIPPED
S 84944	23324	2 of 2	13 pcs	10/18/06

CUSTOMER
FSA Spindletop Bolt Co., Inc.
825 Delmar Street
Beaumont, TX 77707
USA

PRODUCT DESCRIPTION
4.00"-4UNC-2B (.001" o/s) Heavy Hex Nut, HDG per
ASTM-A153

SPECIFICATIONS
ASTM-A194 Grade 2H

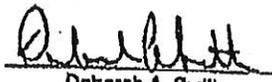
DRAWING
Dyson Std

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.	ORIGINAL MILL
Round Bar	4.500	1045	13	LBX2	A060962	Steel Dynamics

The product listed above was manufactured, tested, sampled, and inspected in accordance with the specification, purchase order, and any supplementary requirements and was found to meet those requirements unless otherwise noted.

Hardness Results: 255 HBW 241 HBW after 24 hr. H.T. on sample nut in accordance with ASTM-A194 Grade 2H

Attachments:
Mill Test Report


Deborah A. Smith
Q.A. Admin. Assistant
10/18/06

PART NO.

PO/Rd

I hereby certify that the data is correct as contained in the records of this company.

TEST RESULTS OF MATERIAL Test Results
1-000029-070

Pk 1/1

Att: DYSON



CODE LBX2

8000 M. Doughty Road 27th West
P.O. Box 69, MI 48107
Phone: (313) 884-2800
Fax: (313) 884-2884

Certified Material Test Report

Cart #: 17098

Work Order:

Load #: 29718

Size: 4-1/2"

Grain Practice: All Fine Grain (S-B) per ASTM A20

M/I Order: 0002101

Sales Order: 11087-1

Reference #:

Shape: Round

Heat #: A06006E

Customer: Krupp Steel Company

Reference Desc:

Grade: 1040/1045

Reduction Ratio: 8.7 to 1

Invent: 8/17/2008 00:42:17

PO #: 87747-1

End Use:

Length: 80'00"

Disposition: 1

Major Chemistry Analysis (ASTM A20)

C	Mn	P	S	Si	Al	Cr	Ni	Co	Mg	Sn	N	V	As	Cu	W	Ti	Cl	
0.43	0.68	0.008	0.024	0.28	0.026	0.27	0.06	0.19	0.03	0.018	0.0078	0.001	0.004	0.0001	0.0013	0.010	0.012	1.28
Ph	Ce																	
0.004	0.008																	

Product Check Analysis (ASTM A20)

C	Mn	P	S	Si	Al	Cr	Ni	Co	Mg	Sn	N	V	As	Cu	W	Ti	Cl
Front																	
Back																	

Dimensional (ASTM A20)

J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18
Calc'd																	
Front																	
Back																	

Microstructure (ASTM E4)

Method A								Method C		Method E		Macrostructure	
AT	AH	BT	BH	CT	CH	DT	DH	E	D	EAM	SAW	ASTM E351	ASTM E351
												7	

Mechanical Properties (ASTM A370)

Tensile Properties				Hardness			Magnetic Particle Inspection	
Tensile Strength	0.2% Yield Strength	% Elongation	% RDA	BHN	HR	KA	Frequency	Reactivity
84,548 psi	64,620 psi	20.0	41.8	160				

Comments/Notes

ASTM A370-80b (latest rev.)

Q.A. REVIEWED
DATE 9/1/08
DYSON

Condition: As-fabricated, Hot-Rolled

I hereby certify that the content of this report is correct and accurate, and that all test and operations performed on this material were in accordance with applicable material specifications and purchaser designated requirements.

Travel Stop - Rolling Mill Metallurgist

Any alteration to this report voids Steel Dynamics' warranty of results. No weld repair has been performed on this material. This material is not radioactive and has not been exposed to radioactivity while under the control of Steel Dynamics. This material has not been exposed to gamma rays while under the control of Steel Dynamics. Unless otherwise noted, this material was received, conditionally used, and tested in the US by all testing performed by Steel Dynamics.

CERTIFIED TEST REPORT

DYSON CORP.

DOMESTIC NUT

53 Freedom Road
Painesville, OH 44077

440-946-3800
440-352-2700 fax

DYSON ORDER#	CUSTOMER ORDER#	ITEM NUMBER	QUANTITY SHIPPED	DATE SHIPPED
S 84943	23324	1 of 2	778 pcs	9/29/06

CUSTOMER
FSA Spindletop Bolt Co., Inc.
825 Delmar Street
Beaumont, TX 77707
USA

PRODUCT DESCRIPTION
3.00"-4UNC-2B (.031" O/S) Heavy Hex Nut, HDG per ASTM-A153

SPECIFICATIONS
ASTM-A194 Grade 2H

DRAWING
Dyson Std

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.	ORIGINAL MILL
Round Bar	3.250	1045	778	KGP4	501325	Alton Steel

The product listed above was manufactured, tested, sampled, and inspected in accordance with the specification, purchase order, and any supplementary requirements and was found to meet those requirements unless otherwise noted.

1. The steel was melted and manufactured in the USA and the product was manufactured and tested in the USA.
2. Hardness Results; 262 HBW 248 HBW after 24 hr. H.T. on sample nut in accordance with ASTM-A194 Grade 2H

Attachments:
Mill Test Report


Deborah A. Smith
Q.A. Adm'n. Assistant
9/29/06



STEEL MILL TEST REPORT

Alton Steel Test Lab
#5 Cut Street
Alton, IL 62002-9011
(618) 463-4490 EXT 2486
(618) 463-4491 (Fax)

CODE KGPA

BILL TO

The Dyson Corporation
53 Freedom Road
Painesville, OH 44077

SHIP TO

The Dyson Corporation
53 Freedom Road
Painesville, OH 44077

Date	06/24/2005	Customer PO	41670-3	Specifications
ASI Ord No.	8897	Customer PT.	STOCK	SAB 1045
ASI Ord Line Item	1			ASTM A 29-01

Item Description
Steel Bar, Hot Rolled, 3.2500, 24' 0"

Heat Number	Yield PSI	Tensile PSI	% Elongation	% ROA	Band Test
-------------	-----------	-------------	--------------	-------	-----------

Heat Number	CHEMICAL ANALYSIS TEST METHODS ASTM E-419 & E-1019														
	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Sn	Al	Cb	V	B	N
501329	0.46	0.04	0.012	0.023	0.24	0.24	0.083	0.146	0.020	0.016	0.007	0.025	0.002	0.0002	0.0024

JOMINY HARDENABILITY USING ASTM A-268 CALCULATED FROM CHEMICAL DX

Heat Number	GS	DI
501329	B	1.59

SPECIAL TEST RESULTS

ADDITIONAL COMMENTS

No mercury, lead, radium, or alpha containing material or pigment is used or deliberately added in the production of this steel. No weld or weld repairs were performed on this material. This steel is 100% Electric Arc Furnace Melted and Rolled in the U.S.A.

Alteration or reproduction of this report, except in full, is not allowed without written approval by a representative of Alton Steel Incorporated.

I hereby certify that the above tests are correct as contained in the records of ALTON STEEL INCORPORATED

Subscribed and sworn to before me, a Notary Public, in and for the County of Madison, State of Illinois

(Approved) Robert Cauley

this _____ Day of _____

My commission expires _____

R. Cauley

(Notary Public)

REVIEWED
DATE 7/19/05
DYSON

KGPA

K00975 3
SS
G9758

SCOT FORGE

Phone 847/587-1000
Fax 847/587-2000
Toll Free 800/433-6621

2001 Wren Lane, Box B
Spring Grove, IL 60081

ORDER NO.

543509

ENTERED
11/19/07

KIEWIT OFFSHORE SERVICES LTD
2440 KIEWIT RD
INGLESIDE, TX 78362

MATERIAL CERTIFICATION

CUSTOMER ORDER NUMBER 21103-32328	ITEM 2	OF 2	CUSTOMER JOB NUMBER	DATE SHIPPED
PART NUMBER	B/P NUMBER		F.O.B. SCOT FORGE VIA	DATE PREPARED 11/29/2006

DESCRIPTION OF MATERIAL AND SPECIFICATIONS

Material: ASTM A765-01 Grade IV Test Method 4
Heat Treat: to meet mechanical properties EXCEPT 78,000 MIN TENSILE
Destructive Test: per Specification
Finish: Rough Machine to sizes shown
Other: MAG PARTICLE INCLUDED
Size: OD 5.9055 Length 173.625 (inches)

Surface: 250 RMS
Comment: Stock to make 4 pieces 42.913" long

NO. OF PIECES: 6 HEAT NUMBER: R2953 (MILL - EQS-ELLWOOD QUALITY)
Additional prefix letter stamped on product with heat number is for SCOT FORGE inventory purposes only and (MSDS PREVIOUSLY SENT)
not relevant to heat number

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Al	V	Cb
0.20	1.28	0.015	0.017	0.25	0.09	0.12	0.03	0.24	0.032	0.004	0.002

Austenite grain size: 7/8

MECHANICAL PROPERTIES

PCS	TENSILE PSI	YIELD PSI (.2% OFFSET)	ELONGATION IN 2 - %	REDUCTION OF AREA %	COMMENTS
1	82,500	54,000	31.	71.	1A LONG
1	82,500	54,000	31.	70.	2A LONG
1	82,000	54,000	31.	71.	3A LONG
1	81,500	52,500	31.	72.	4A LONG

006840 MAY 23 6

RECEIVED

21103-32328

Round Bar
6 @ 5.905" x 173.625'

THIS IS TO CERTIFY THAT THE REPORTED LADLE ANALYSIS (AND/OR TESTS) SHOWN ON THIS REPORT ARE CORRECT AS CONTAINED IN THE RECORDS OF THE COMPANY

APPROVED BY:

Richard Gabrys
RICHARD GABRYS
QUALITY ASSURANCE DIR.

K00975 3 N
SS
G9758
HEAT# R2953



ORDER NO.

543509

KIEWIT OFFSHORE SERVICES LTD
2440 KIEWIT RD
INGLESIDE, TX 78362

MATERIAL CERTIFICATION

We certify that the material listed was not processed with mercury bearing instruments and/or equipment which might cause contamination, nor was mercury handled in the immediate vicinity during the manufacturing process.

Testing, inspection, and documentation in accordance with EN 10204:2004 Type 3.1 and ISO 10474 Type 3.1.B

Material provided has been produced by Scot Forge under an approved quality program as defined within the Scot Forge QA Manual, Revision Dated 10/11/04

The recording of false, fictitious or fraudulent statements or entries on this document may be punishable as a felony under Federal Statute

The products supplied are in compliance with the quantity and quality requirements of the purchase order and specifications noted. The test reports represent the actual attributes of the items furnished and the test results are in full compliance with all applicable specifications and order requirements

THIS IS TO CERTIFY THAT THE REPORTED LADLE ANALYSIS (AND/OR 'S) SHOWN ON THIS REPORT ARE CORRECT AS CONTAINED IN RECORDS OF THE COMPANY

APPROVED BY:


RICHARD GABRYS
QUALITY ASSURANCE DIR.

K00975 3 N
 SS
 G9758
 HEAT# R2953



ORDER NO.
543509

KIEWIT OFFSHORE SERVICES LTD
 2440 KIEWIT RD
 INGLESIDE, TX 78362

MATERIAL CERTIFICATION

CERTIFICATE OF INSPECTION

MAGNETIC PARTICLE PER S4 OF ASMT A-765-01

TEST NUMBER : 20-001 11/08/2006 SURFACE CONDITION : MACHINED

TECHNIQUE

EQUIPMENT MAKE : MAGNAFLUX		MODEL : D-2100XL	SERIAL NUMBER: 205125	
Batch #	Particle Type	Vehicle	Concentration	Application
05D086	14A/WET FLUORES	WATER PLUS CONDITIONERS	.1 - .4	SPRAY
Circular Magnetization		Longitudinal Magnetization		
DC CURRENT : 3000 AMPS		DC CURRENT : 3000 AMPS		
Continuous	Residual	Demagnetization Method	Residual Field	
X		AUTOMATIC STEP	+/-3 GAUSS	

<u>HEAT NO.</u>	<u>QTY TESTED</u>	<u>REMARKS</u>
R2953	6	OK PER ACCEPTED DEVIATION 061113-4

JOHN HERMAN LEVEL II

THIS IS TO CERTIFY THAT THE REPORTED LADLE ANALYSIS (AND/OR
 3) SHOWN ON THIS REPORT ARE CORRECT AS CONTAINED IN
 RECORDS OF THE COMPANY

APPROVED BY:

Richard Gabrys
 RICHARD GABRYS
 QUALITY ASSURANCE DIR.

K00975 0
SS
B7853

SCOT FORGE

Phone 847/587-1000
Fax 847/587-3000
Toll Free 800/435-6621

8001 Wirtz Road, Box 8
Spring Grove, IL 60081

ORDER NO.

540867

KIEWIT OFFSHORE SERVICES LTD
2440 KIEWIT RD
INGLESIDE, TX 78362 H+N1091

MATERIAL CERTIFICATION

C
S-765F401 - 2ø 5 7/8" x 35 1/6" Roundbar 21103-32328

CUSTOMER ORDER NUMBER 21103-32328	ITEM 1	OF 2	CUSTOMER JOB NUMBER	DATE SHIPPED 10/05/2006
PART NUMBER	B/P NUMBER		F.O.B. SCOT FORGE VIA INWAY	DATE PREPARED 10/17/2006

DESCRIPTION OF MATERIAL AND SPECIFICATIONS

Material ASTM A765-01 Grade IV Test Method 4
Heat Treat to meet mechanical properties EXCEPT 78,000 MIN TENSILE
Destructive Test per Specification
Finish Rough Machine to sizes shown
Other MAG PARTICLE INCLUDED
Size OD Length (inches)
5.9055 213.625

Surface 250 RMS
Comment Stock to make 6 pieces 35.039" long

NO. OF PIECES 11 HEAT NUMBER N1091 (MILL - ELLWOOD NATIONAL)
Additional prefix letter stamped on product with heat (MSDS PREVIOUSLY SENT)
number is for SCOT FORGE inventory purposes only and
not relevant to heat number

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Al	V	Cb
0.18	1.28	0.013	0.014	0.22	0.07	0.06	0.01	0.18	0.016	0.004	0.002

Austenite grain size: 7/8

MECHANICAL PROPERTIES

PCS	TENSILE PSI	YIELD PSI (.2% OFFSET)	ELONGATION IN 2 - %	REDUCTION OF AREA %	COMMENTS
1	79,800	61,700	30.2	68	LONGITUDINAL

C
S-765F401
2ø 5 7/8" x 35 1/6" Roundbar
21103-32328
H. N1091

THIS IS TO CERTIFY THAT THE REPORTED LADLE ANALYSIS (AND/OR TESTS) SHOWN ON THIS REPORT ARE CORRECT AS CONTAINED IN THE RECORDS OF THE COMPANY

APPROVED BY:

Richard Gabrys
RICHARD GABRYS
QUALITY ASSURANCE DIR.

K00975 0 N
SS

B7853
HEAT# N1091

SCOT FORGE

Phone 847/587-1000
Fax 847/587-2000
Toll Free 800-433-6631



801 Wino Road, Box 1
Spring Grove, IL 60081

ORDER NO.

540867

KIEWIT OFFSHORE SERVICES LTD
2440 KIEWIT RD
INGLESIDE, TX. 78362

MATERIAL CERTIFICATION

IMPACT RESULTS

TEMP	1st	2nd	3rd	COMMENTS
(CHARPY) 19 F	123 FT/LBS	147 FT/LBS	140 FT/LBS	LONGITUDINAL

HARDNESS RESULTS

PCS	BRINELL
7	3000 KG LOAD
4	170
	174

PRODUCT ANALYSIS WAS PERFORMED AND FOUND ACCEPTABLE
(SEE ATTACHED)

We certify that the material listed was not processed with mercury bearing instruments and/or equipment which might cause contamination, nor was mercury handled in the immediate vicinity during the manufacturing process.

Testing, inspection, and documentation in accordance with EN 10204:2004 Type 3.1 and ISO 10474 Type 3.1.B

Material provided has been produced by Scot Forge under an approved quality program as defined within the Scot Forge QA Manual, Revision Dated 10/11/04

The recording of false, fictitious or fraudulent statements or entries on this document may be punishable as a felony under Federal Statute

The products supplied are in compliance with the quantity and quality requirements of the purchase order and specifications noted. The test reports represent the actual attributes of the items furnished and the test results are in full compliance with all applicable specifications and order requirements

THIS IS TO CERTIFY THAT THE REPORTED LADLE ANALYSIS (AND/OR TESTS) SHOWN ON THIS REPORT ARE CORRECT AS CONTAINED IN THE RECORDS OF THE COMPANY

APPROVED BY:

RICHARD GABRYS
QUALITY ASSURANCE DIR.

K00975 0 N
SS

B7853

HEAT# N1091

SCOTT FORGE

Phone 947/587-1000
Fax 947/587-2000
Toll Free 800/433-4621

8001 Wain Road, Box 11
Spring Grove, N. 60081

ORDER NO.

540867

KIEWIT OFFSHORE SERVICES LTD
2440 KIEWIT RD
INGLESIDE, TX 78362

MATERIAL CERTIFICATION

CERTIFICATE OF INSPECTION

MAGNETIC PARTICLE PER PER S4-OF ASTM A765-01

TEST NUMBER : 19-001 10/03/2006 SURFACE CONDITION : 250 RMS OR BETTER

TECHNIQUE

EQUIPMENT MAKE : MAGNAFLUX		MODEL : D-2100XL	SERIAL NUMBER: 205125	
Batch #	Particle Type	Vehicle	Concentration	Application
05D086	14A/WET FLUORES	WATER PLUS CONDITIONERS	.1 - .4	SPRAY
Circular Magnetization		Longitudinal Magnetization		
DC CURRENT : 2500 AMPS		DC CURRENT : 2500 AMPS		
Continuous	Residual	Demagnetization Method	Residual Field	
X		AUTOMATIC STEP	+/-3 GAUSS	

HEAT NO.	QTY TESTED	REMARKS
N1091	11	No reportable indications/acceptable

JOHN HERMAN LEVEL II

THIS IS TO CERTIFY THAT THE REPORTED LADLE ANALYSIS (AND/OR TESTS) SHOWN ON THIS REPORT ARE CORRECT AS CONTAINED IN THE RECORDS OF THE COMPANY

APPROVED BY:

Richard Gabrys
RICHARD GABRYS
QUALITY ASSURANCE DIR.



P.O. BOX 23223 Oakland, CA 94623
 Phone (510) 419-0120 / Fax (510) 832-1456

LETTER OF TRANSMITTAL
SAS Foundations E2/T1 Project

Run Date 19-Dec-07
 Time 1:12 PM

Dated: 12/19/07

TRANSMITTAL No: KFM-TRN-000666

Rev: 00

To: **Pedro Sanchez**
 Caltrans - SAS E2/T1 Foundation Project
 333 Burma Road
 Oakland CA 94607
 Phone: 510-286-0538 Fax:

Co/Job # 364-4347
 Contract # 04-0120E4
 Sub/Supplier:
 Sub/Supplier No:

Subject: Transfer of Material - ABF Anchor Bolt Hardware

Special Provis. (SP) REF:
 Standard Spec. (SS) REF:
 RESUBMITTAL/SUPPLEMENTAL REF:

We are sending the following attached items: Attached Via Fax

- | | | |
|------------------------------------------------|----------------------------------------------------|-------------------------------------------------|
| <input type="checkbox"/> Contract Plans/Specs | <input type="checkbox"/> Certs of Compl./Samples | <input type="checkbox"/> Working Drawings |
| <input type="checkbox"/> Drawings/Calculations | <input type="checkbox"/> Schedule | <input type="checkbox"/> WQCP and/or Addenda |
| <input type="checkbox"/> Change Order | <input type="checkbox"/> Progress Estimate Request | <input type="checkbox"/> Weekly Welding Reports |
| <input type="checkbox"/> Copy of Letter | <input type="checkbox"/> Payroll Information | <input type="checkbox"/> CWR Procedure |

Item	Date	Copies	Description	Pages
01	19-Dec-2007	1	Bill of Lading for ABF Anchor Bolt Hardware	

These are transmitted as checked below:

- | | | |
|--------------------------------------------------|--------------------------------------------------|-----------------------------------------------------|
| <input type="checkbox"/> For Approval | <input type="checkbox"/> For Review/Comment | <input type="checkbox"/> Return For Correction |
| <input checked="" type="checkbox"/> For Your Use | <input checked="" type="checkbox"/> As Requested | <input checked="" type="checkbox"/> For Information |

Remarks:

CC:

Submitted By: **Andrew Markarian**
 (KFM Staff Member - Originator of Transmittal)

Checked & Sent By: *[Signature]*
 Contract Admin/DCS Staff

RECEIVED
 007781 DEC 20 07
 Page 1 of 1



DEPARTMENT OF TRANSPORTATION – District 4 Toll Bridge
 333 Burma Rd.
 Oakland, CA 94607
 Telephone (510) 286-0500 Fax (510) 286-0550

LETTER OF TRANSMITTAL

To: Kiewit-FCI-Manson, JV
 220 Burma Rd.
 Oakland CA 94607

Date: 20-Dec-2007

Attn: Dan Proctor

Contract No: 04-0120E4
 04-SF-80-13.4. 13.8

Job Name: SAS T1 & E2 Foundations, SFOBB-ESSSP
 Transmittal No.: 05.003.02-000346

Subject: Contract Change Order No. 74 (Install Temporary Anchor Rods)

Enclosed please find the following items:

- | | | |
|---------------------------------------------------|--------------------------------------------------|-----------------------------------------------------|
| <input type="checkbox"/> Shop Drawings | <input checked="" type="checkbox"/> Change Order | <input type="checkbox"/> Submittal(s) |
| <input type="checkbox"/> WSWD Report(s) | <input type="checkbox"/> Plans | <input type="checkbox"/> Other |
| <input type="checkbox"/> Daily Extra Work Reports | <input type="checkbox"/> Progress Payment | <input type="checkbox"/> Certified Payroll |
| <input type="checkbox"/> RFI | <input type="checkbox"/> State Letter | <input type="checkbox"/> Certificates of Compliance |

Item	Copies	Sheets	Description	Dated
1	1	6	Contract Change Order No. 74	20-Dec-2007

These Are Transmitted As Checked Below:

- | | | |
|-------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------|
| <input type="checkbox"/> For Approval or Action | <input type="checkbox"/> Approved as submitted | <input type="checkbox"/> Resubmit ___ Copies for approval |
| <input type="checkbox"/> For Your Use | <input type="checkbox"/> Approved as Noted | <input type="checkbox"/> Submit ___ Copies for distribution |
| <input type="checkbox"/> As Requested | <input type="checkbox"/> Returned for Corrections | <input type="checkbox"/> Return ___ Corrected prints |
| <input type="checkbox"/> For Review & Comment | <input type="checkbox"/> Other | <input checked="" type="checkbox"/> Sign and Return |

Remarks:

One (1) copy of Contract Change Order No. 74 is attached for Kiewit-FCI-Manson's (KFM) review and signature. Please sign and return the original Change Order to this office. However, if the Change Order is not acceptable to KFM, please return it along with a letter that explains KFM's position. If you have any questions or need additional information, please contact this office.

Signed: 
 Tom Shimada
 Asst. Structure Representative

Copy To:
 File: 05.003.02, 49.074

CONTRACT CHANGE ORDER NO. 74 SUPPL. NO. ---

ROAD 04-SF-80-13.4, 13.8 SHEET 1 OF 6 SHEETS

FEDERAL NO.(S) --- CONTRACT NO.: 04-0120E4

To Kiewit-FCI-Manson, a JV, Contractor

You are hereby directed to make herein described changes from the plans and specifications or do the following described work not included in the plans and specifications of the contract.

NOTE: This change order is not effective until approved by The Chief Engineer.

Description of work to be done, estimate of quantities, and prices to be paid. Segregated between additional work at contract price and force account. Unless otherwise stated, rates for rental equipment cover only such time as equipment is actually used and no allowance will be made for idle time.

CHANGE REQUESTED BY THE ENGINEER

The last percentage shown is the net accumulated increase or decrease from the original quantity in the Engineer's Estimate.

Extra Work at Agreed Lump Sum

As shown on Sheets 2 through 6 of this Change Order, install anchor rod assemblies at the Pier T1 piles.

The anchor rod assemblies will be furnished by the State and will be available for delivery to the Contractor at the Pier 7 warehouse located at 160 Dunkirk Rd., Oakland, CA.

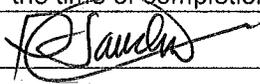
The Phase 1 Denso Tape shown on Sheets 3, 4, and 5 of this Change Order will be installed by others prior to the delivery of the assemblies to the Contractor.

An agreed lump sum payment of \$70,979.00 will be made for the above work. This agreed sum constitutes full compensation, including all markups, for this Change Order.

Consideration of a time adjustment will be deferred until the completion of the work specified in this Change Order. The determination of a commensurate time extension will be made in accordance with the provisions of Section 8-1.07, "Liquidated Damages," of the Standard Specifications.

Cost \$ 70,979.00

By reason of this order the time of completion will be adjusted as follows: **Deferred**

Submitted by:  Pedro J. Sanchez, Resident Engineer Date 12-20-07

Approval Recommended by: Mark Vilcheck, Structure Representative Date _____

Approved: Chief Engineer by: Richard Morrow, Construction Manager Date _____

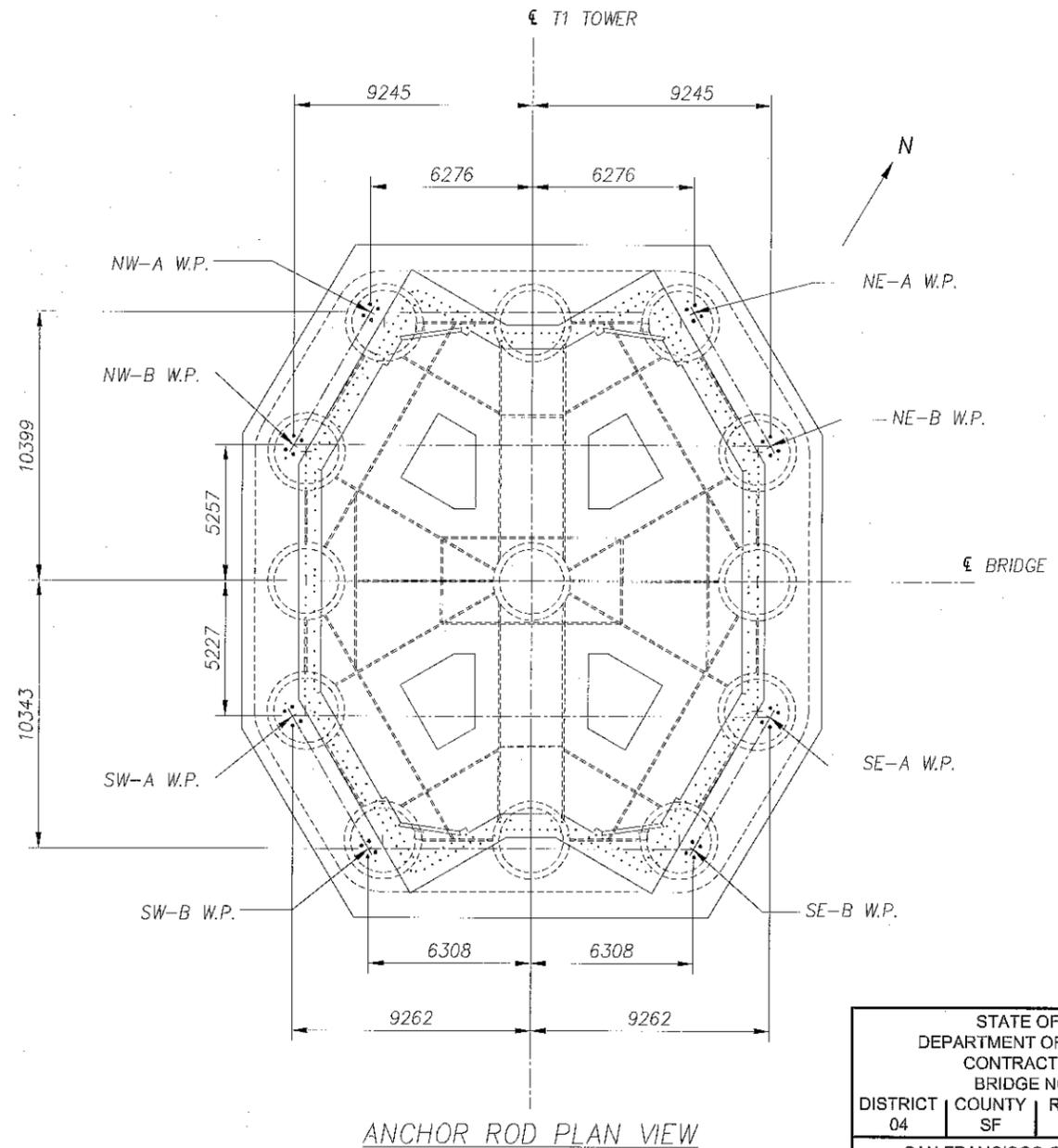
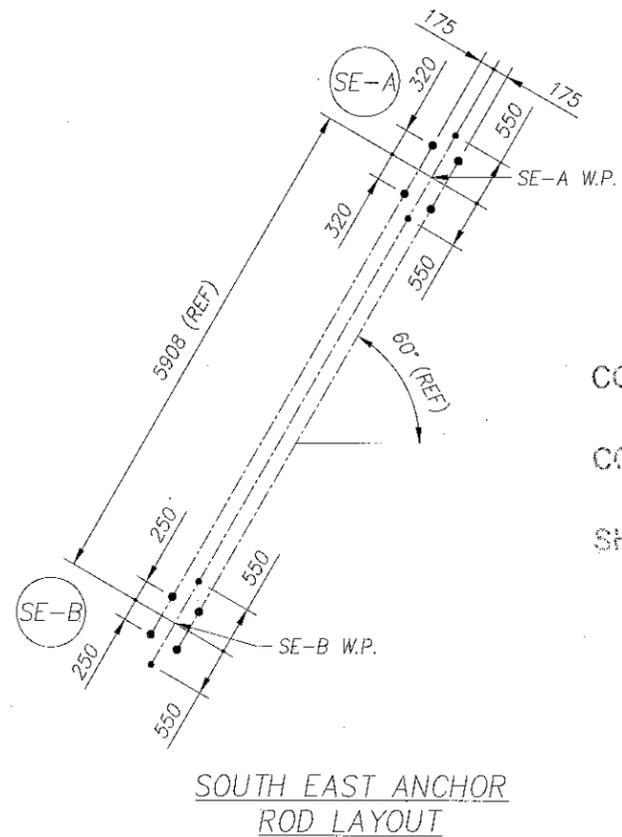
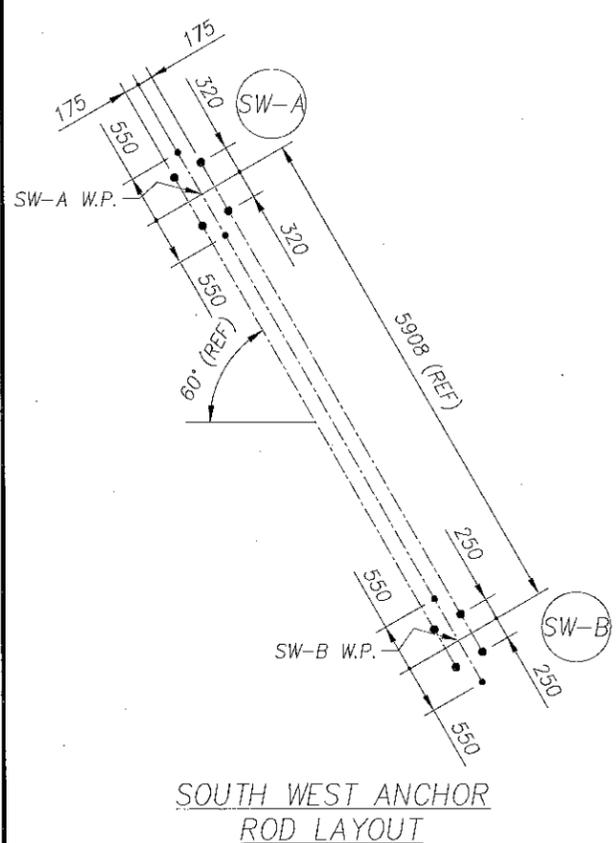
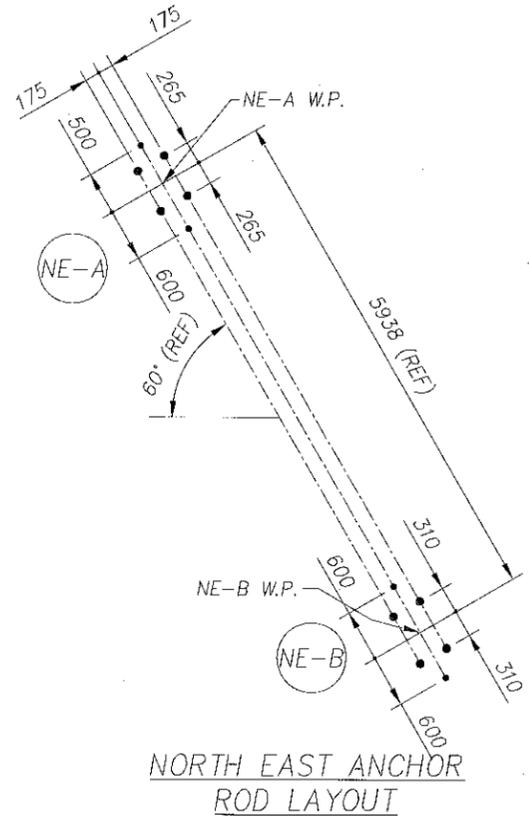
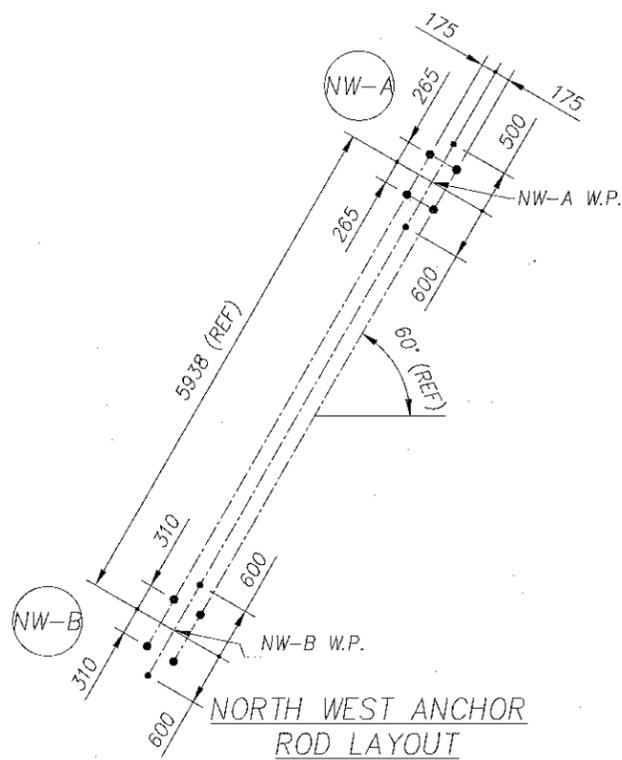
We, the undersigned contractor, have given careful consideration to the change proposed and hereby agree, if this proposal is approved, that we will provide all equipment, furnish all materials, except as may otherwise noted above, and perform all services necessary for the work above specified, and will accept as full payment therefore the prices shown above.

Accepted, Date _____ Contractor Kiewit-FCI-Manson, a JV

By: _____ Title _____

If the contractor does not sign acceptance of this change order, his attention is directed to the requirements of the specifications as to proceeding with the ordered work and filing a written protest within the time therein specified.

Dec 06, 2007 - 11:31am S:\ABF-SUB-000237R00 - Pier T1 Anchor Rods D Driving Frame\Drawings\ABF-SUB-237R02 - Pier T1 Anchor Rods.dwg



CONTRACT NO. 04-0120EA

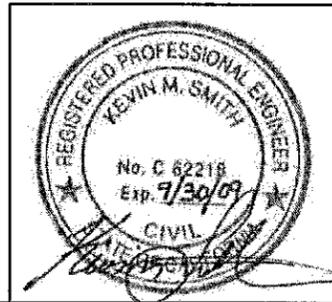
CONTRACT CHANGE ORDER NO. 74

SHEET 2 OF 6

LEGEND

- W.P. WORK POINT
- REF REFERENCE DIMENSION
- ANCHOR ROD
- SHEAR DOWEL

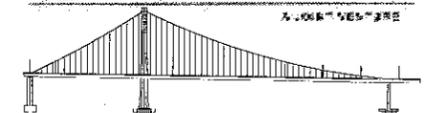
REV	DATE	BY	DESCRIPTION
6			
5			
4			
3			
2			
1	12-06-07	KMS	Updated PE Stamp



STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION CONTRACT NO. 04-0120F4 BRIDGE NO. 34-0006L/R			
DISTRICT	COUNTY	ROUTE	KILOMETER POST
04	SF	80	13.2 / 13.9

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE AND TOWER)

PIER T1 ANCHOR RODS
D DRIVING FRAME
GENERAL LAYOUT

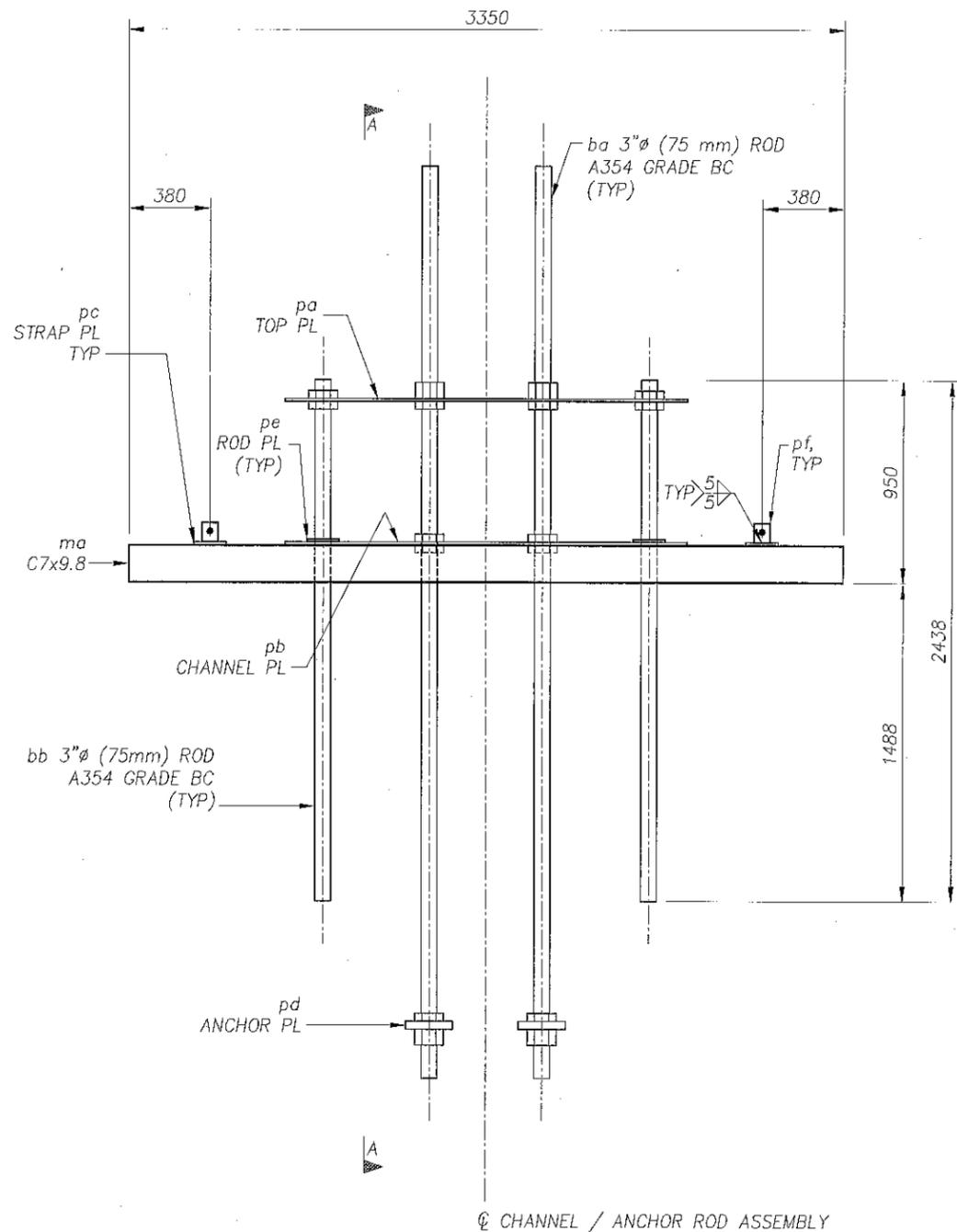


Made By: G. TRELA Date: 7/31/07
Checked By: NG / ST Date: 7/31/07
In Charge Of: R. CROCKETT

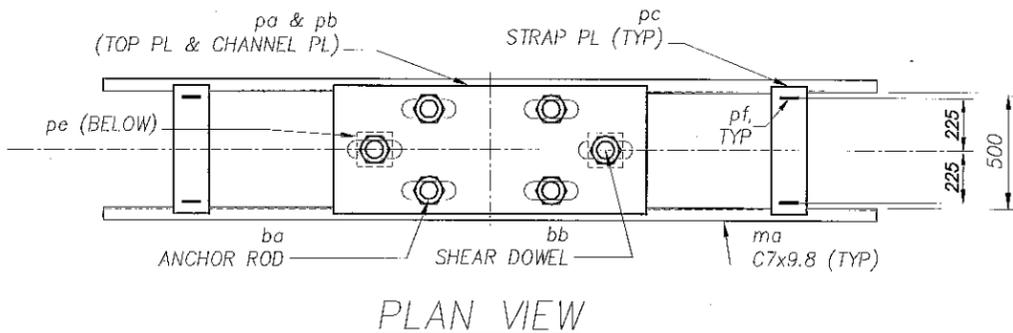
Job No. 660110 Sheet No. 1

Scale: NTS Revision: 1

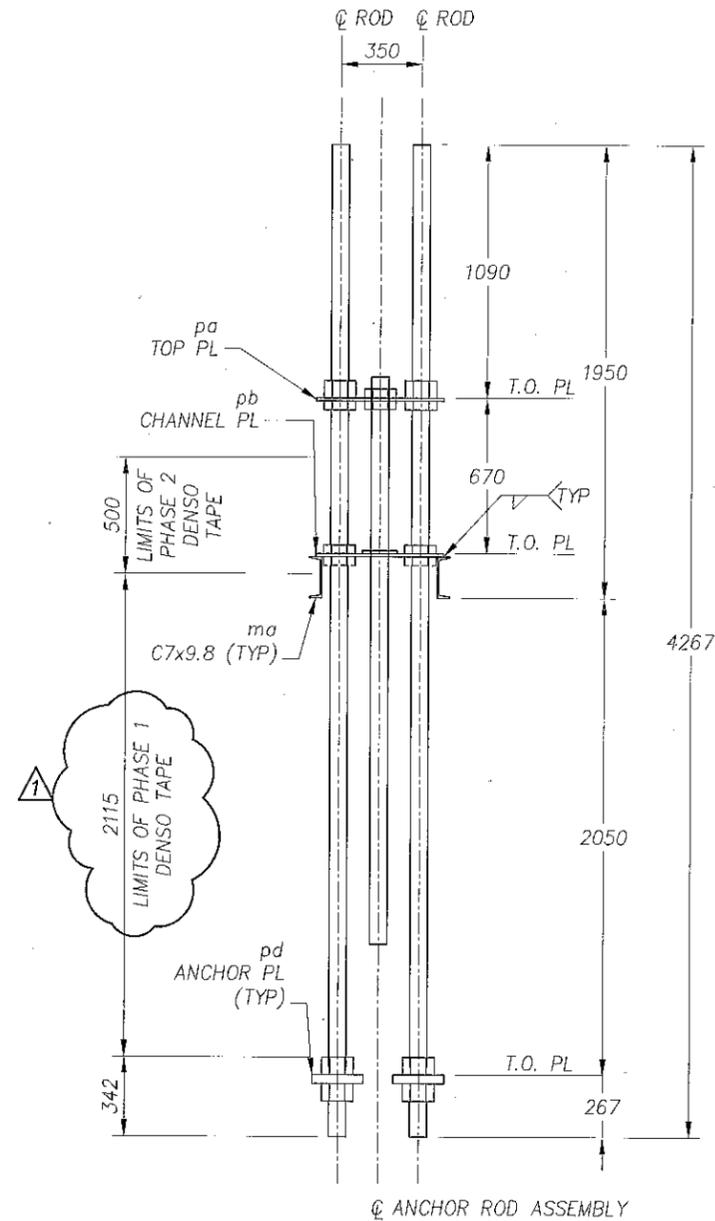
Dec 06, 2007 - 11:23am S:\ABF-SUB-000237R00 - Pier T1 Anchor Rods D Driving Frame\Drawings\ABF-SUB-237R02 - Pier T1 Anchor Rods.dwg



ANCHOR ROD ASSEMBLY DETAIL



PLAN VIEW



SECTION A-A

GENERAL NOTES:
1. FOR FABRICATION NOTES SEE SHEET NO. 4

CONTRACT NO. 04-0120EA

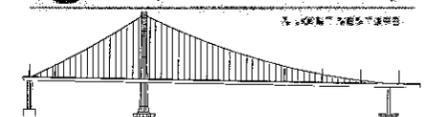
CONTRACT CHANGE ORDER NO. 74

SHEET 3 OF 6

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
CONTRACT NO. 04-0120F4
BRIDGE NO. 34-0006L/R
DISTRICT 04 COUNTY SF ROUTE 80 KILOMETER POST 13.2 / 13.9

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE AND TOWER)

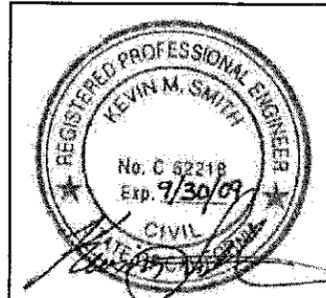
PIER T1 ANCHOR RODS
D DRIVING FRAME
ANCHOR ROD ASSEMBLY DETAIL



Made By: G. TRELA Date: 7/31/07
Checked By: NG / ST Date: 7/31/07
In Charge Of: R. CROCKETT

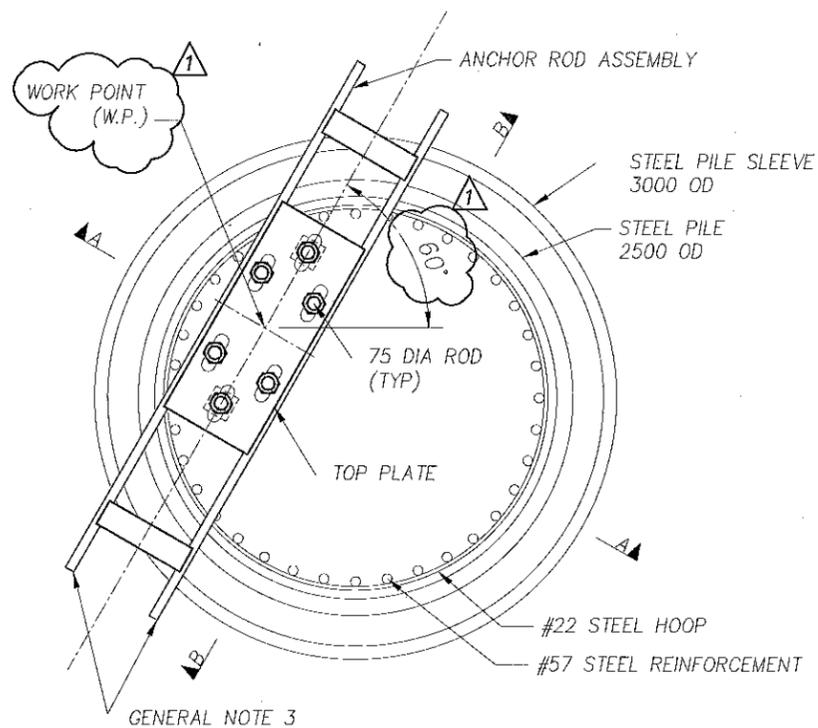
Job No. 660110 Sheet No. 2

Scale: NTS Revision: 1

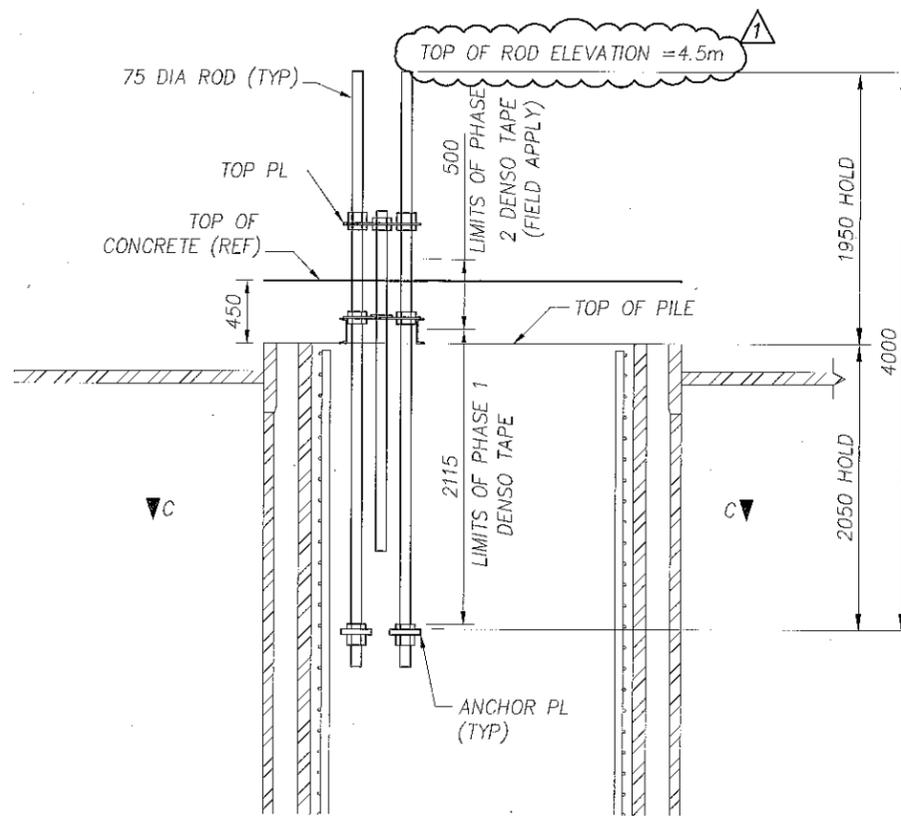


6			
5			
4			
3			
2			
1	12-06-07	NG / KMS	Revised Dimension / Updated PE Stamp
REV	DATE	BY	DESCRIPTION

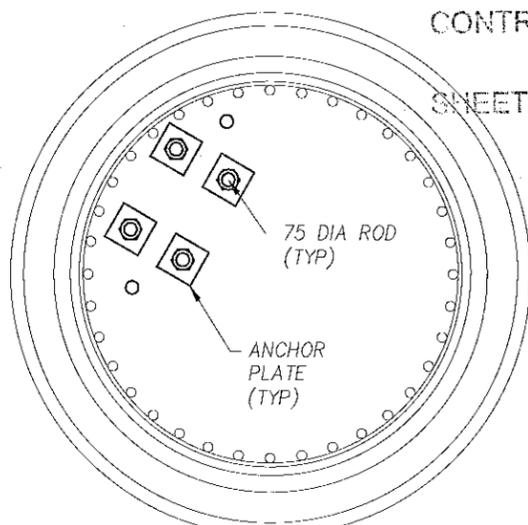
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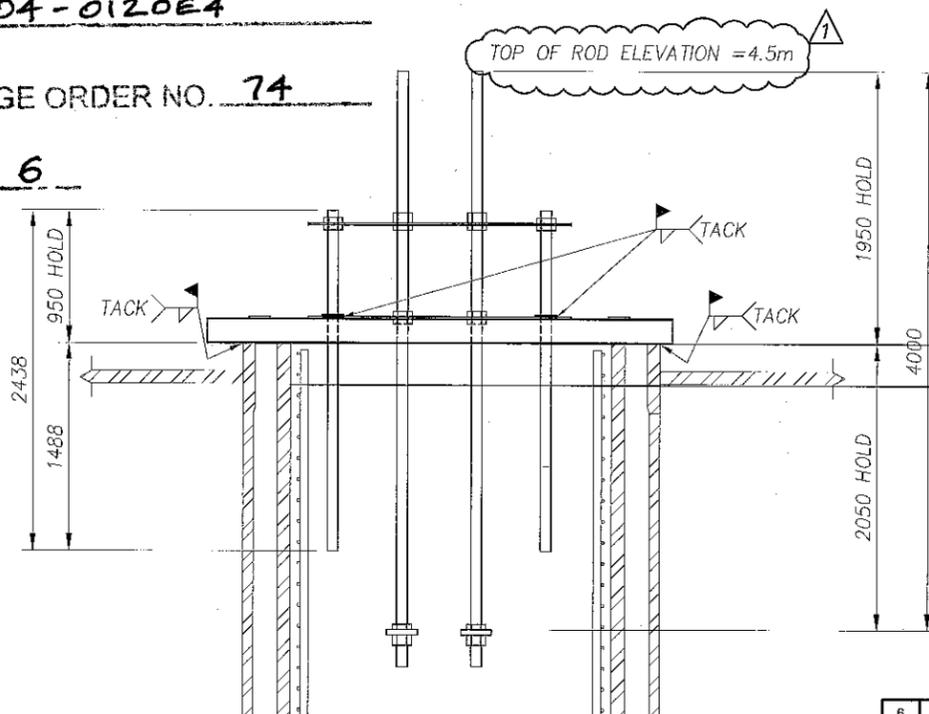
TYPICAL ANCHOR ROD PLAN VIEW



SECTION A-A



SECTION C-C



SECTION B-B

CONTRACT NO. 04-0120E4

CONTRACT CHANGE ORDER NO. 74

SHEET 4 OF 6

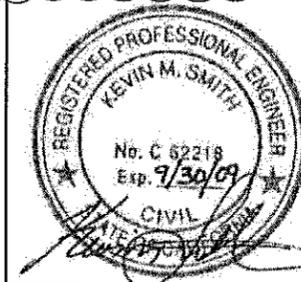
ANCHOR ROD INSTALLATION PROCEDURE OPTION
EIGHT ANCHOR ROD ASSEMBLIES, AS SHOWN ON SHEET 2, WILL BE SHOP ASSEMBLED FOR EACH ANCHOR BOLT GROUP SHOWN ON SHEET 1.

THE FOLLOWING INSTALLATION PROCEDURE IS APPLICABLE TO EACH OF THE 8 ANCHOR ROD ASSEMBLIES AS SHOWN ON SHEET 1.

1. LOWER ANCHOR ROD ASSEMBLY ONTO THE RESPECTIVE T1 FOOTING STEEL PILE.
2. SURVEY THE ANCHOR ROD ASSEMBLY INTO POSITION PER SHEET 1. ANCHOR ROD ASSEMBLY TOP PLATE WILL BE SCRIBED WITH A WORK POINT TO VERIFY THE LOCATION RELATIVE TO T1 TOWER CENTERLINE OF PIER / CENTERLINE OF BRIDGE INTERSECTION PER SHEET 1. SHIM AS NEEDED TO ENSURE THAT ANCHOR RODS ARE VERTICAL.
3. ADJUST ASSEMBLIES SUCH THAT A AND B ANCHOR ROD RESPECTIVE CENTERLINES MATCH AS SHOWN ON SHEET 1.
4. SECURE LOCATION OF ANCHOR ROD ASSEMBLY BY TACK WELDING EACH END OF EACH ANCHOR ROD ASSEMBLY CHANNEL TO THE T1 FOOTING STEEL PILE.
5. WITH EACH ASSEMBLY SECURED TO THE T1 FOOTING STEEL PILES, ADJUST RODS Laterally AS NEEDED WITHIN SLOTTED HOLES OF EACH ASSEMBLY TO AVOID TOP MAT OF REBAR.
6. POUR PILE CONCRETE.
7. SURVEY AS BUILT ANCHOR RODS.
8. REMOVE ANCHOR ROD ASSEMBLY TOP PLATE AND NUTS.
9. REMOVE NUTS ON TOP OF ANCHOR ROD ASSEMBLY CHANNEL PLATE.
10. GRIND OFF TACK WELD HOLDING SHEAR DOWELS TO ASSEMBLY CHANNELS
11. REMOVE ANCHOR ROD ASSEMBLY CHANNELS (STRAP PLATES AND CHANNEL PLATE ARE SHOP WELDED TO THE CHANNELS).
12. REMOVE REMAINING NUTS ON EACH OF THE FOUR ANCHOR RODS.
13. FIELD INSTALL PHASE 2 DENSO TAPE.

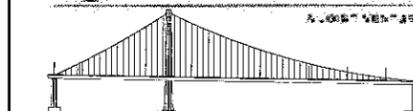
GENERAL NOTES

1. ABF TO SELF PERFORM ROD AS-BUILT.
2. ALL NUTS, PLATES, AND ASSEMBLY MATERIAL TO BE RETURNED TO ABF.
3. CHANNEL OVERHANG ON PILE MAY BE CUT AFTER STEP 4 TO AVOID ANY INTERFERENCES.
4. WORK POINT TOLERANCE = $\pm 25\text{mm}$
5. TWIST TOLERANCE ABOUT W.P. = 1.4°
6. TOP OF ROD ELEV TOLERANCE = $\pm 10\text{mm}$.
7. ROD PLUMB TOLERANCE = 1:200



STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION CONTRACT NO. 04-0120F4 BRIDGE NO. 34-006L/R			
DISTRICT 04	COUNTY SF	ROUTE 80	KILOMETER POST 13.2 / 13.9
SAN FRANCISCO OAKLAND BAY BRIDGE EAST SPAN SEISMIC SAFETY PROJECT SELF ANCHORED SUSPENSION BRIDGE (SUPERSTRUCTURE AND TOWER)			

PIER T1 ANCHOR RODS
D DRIVING FRAME
ROD ASSEMBLY INSTALLATION PROCEDURE



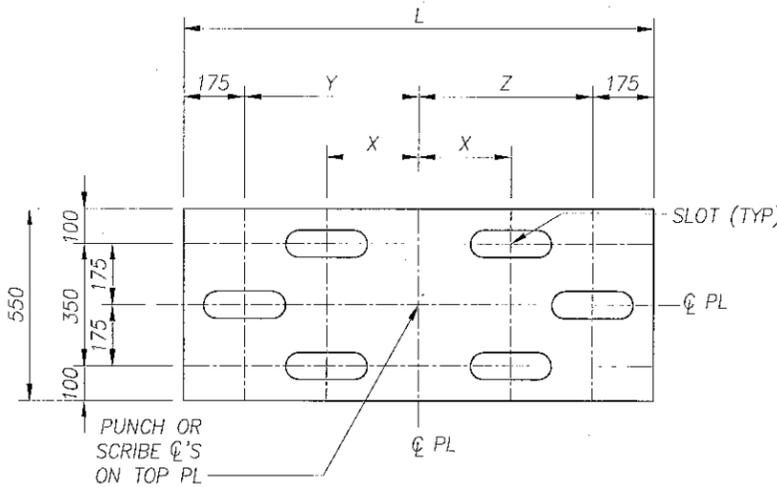
Made By: G. TRELA Date: 7/31/07
Checked By: NG / ST Date: 7/31/07
In Charge Of: R. CROCKETT

Job No. 660110 Sheet No. 3

Scale: NTS Revision: 2

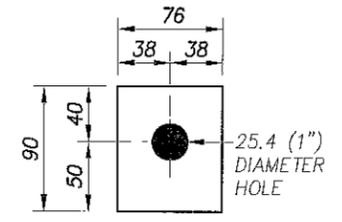
6			
5			
4			
3			
2	12-06-07	KMS	Updated PE Stamp
1	10-16-07	NG	TOP OF ROD ELEVATION & NOTE 1, 4, 5, 6 & 7
REV	DATE	BY	DESCRIPTION

Dec 06, 2007 11:30am S:\ABF-SUB-000237R00 - Pier T1 Anchor Rods D Driving Frame (Submittal)\R02 Drawings\ABF-SUB-237R02 - Pier T1 Anchor Rods.dwg

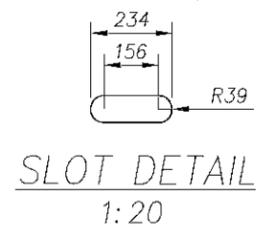
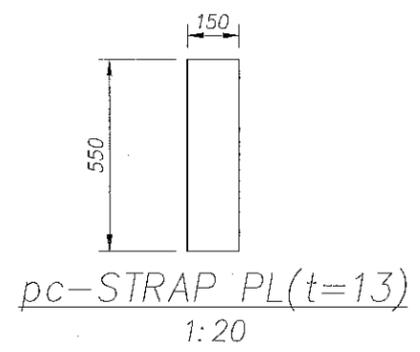


pa-TOP PL DETAIL (t=13)
 pb-CHANNEL PL DETAIL (t=13)
 1:20

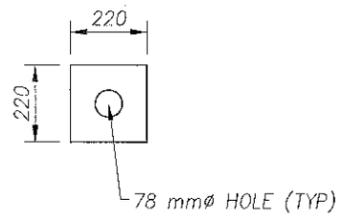
MARK	ROD GROUP	L	X	Y	Z
pa-1, pb-1	NW-A, NE-A	1450	265	600	500
pa-2, pb-2	NW-B, NE-B	1550	310	600	600
pa-3, pb-3	SW-A, SE-A	1450	320	550	550
pa-4, pb-4	SW-B, SE-B	1450	250	550	550



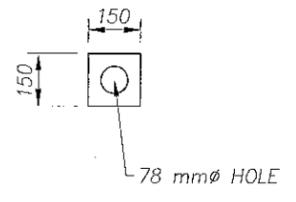
pf-LIFTING LUG DETAIL (t=7)
 1:5



pc-STRAP PL (t=13)
 1:20
 SLOT DETAIL
 1:20



pd-ANCHOR PL (t=38)
 1:20



pe-PL NUT (t=13)
 1:20

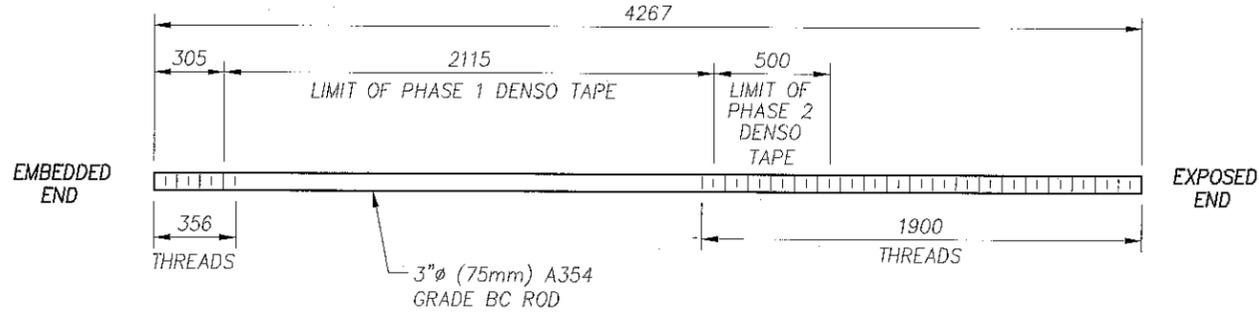
- FABRICATION NOTES:**
1. ALL DIMENSIONS ARE IN MILLIMETER, UNLESS NOTED OTHERWISE.
 2. ANCHOR RODS ARE TO BE ASTM A354 GRADE BC.
 3. CHANNEL AND PLATE MATERIAL SHALL CONFORM TO ASTM A36.
 4. WELDING SHALL CONFORM TO AWS D1.1 USING E70XX ELECTRODES.
 5. NO PAINT REQUIRED.

CONTRACT NO. 04-0120E4

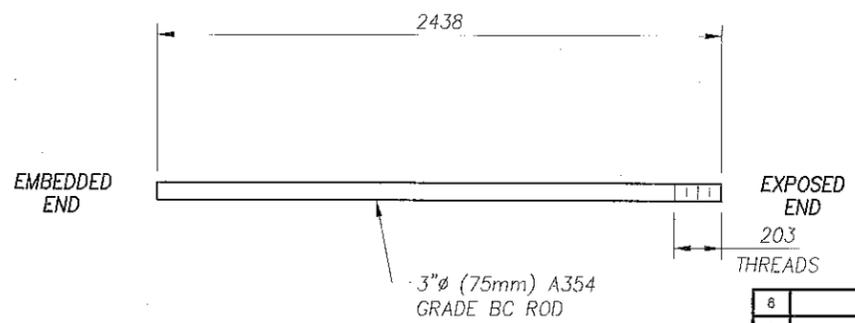
CONTRACT CHANGE ORDER NO. 74

SHEET 5 OF 6

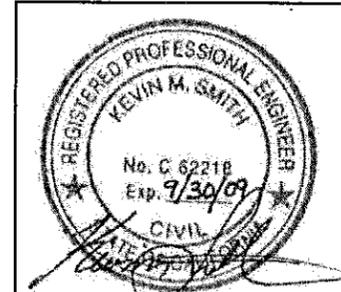
LINE	TOTAL NO. of PCS	BILL OF MATERIAL				REMARKS
		DESCRIPTION	LENGTH	MARK	WEIGHT (kg)	
1	2	PL 13x550	1456	pa-1	163.6	-
2	2	PL 13x550	1556	pa-2	174.8	-
3	2	PL 13x550	1456	pa-3	163.6	-
4	2	PL 13x550	1456	pa-4	163.6	-
5	-	-	-	-	-	-
6	2	PL 13x550	1456	pb-1	163.6	-
7	2	PL 13x550	1556	pb-2	174.8	-
8	2	PL 13x550	1456	pb-3	163.6	-
9	2	PL 13x550	1456	pb-4	163.6	-
10	-	-	-	-	-	-
11	16	PL 13x150	550	pc	134.8	-
12	-	-	-	-	-	-
13	32	PL 38x220	220	pd	462.4	-
14	-	-	-	-	-	-
15	16	PL 13x150	150	pe	36.8	-
16	32	PL 7 X 76	90	pf	12.0	REVISION 1
17	16	C 7x9.8	3350	ma	782.4	-
18	-	-	-	-	-	-
19	32	3"Ø A354 ROD	4267	ba	4739.2	GRADE BC
20	16	3"Ø A354 ROD	2438	bb	1353.6	GRADE BC
21	-	-	-	-	-	-
22	64	FULL HEIGHT NUT	-	-	281.6	-
23	160	HALF HEIGHT NUT	-	-	352.0	-
24	-	-	-	-	-	-
25	8	ASSEMBLIES	-	-	9474	-



ba-ANCHOR ROD DETAIL
 1:30



bb-SHEAR DOWEL DETAIL
 1:30



REV	DATE	BY	DESCRIPTION
6			
5			
4			
3			
2			
1	12-06-07	KMS	Updated PE Stamp

STATE OF CALIFORNIA
 DEPARTMENT OF TRANSPORTATION
 CONTRACT NO. 04-0120F4
 BRIDGE NO. 34-0006LR
 DISTRICT 04 COUNTY SF ROUTE 80 KILOMETER POST 13.2 / 13.9

SAN FRANCISCO OAKLAND BAY BRIDGE
 EAST SPAN SEISMIC SAFETY PROJECT
 SELF ANCHORED SUSPENSION BRIDGE
 (SUPERSTRUCTURE AND TOWER)



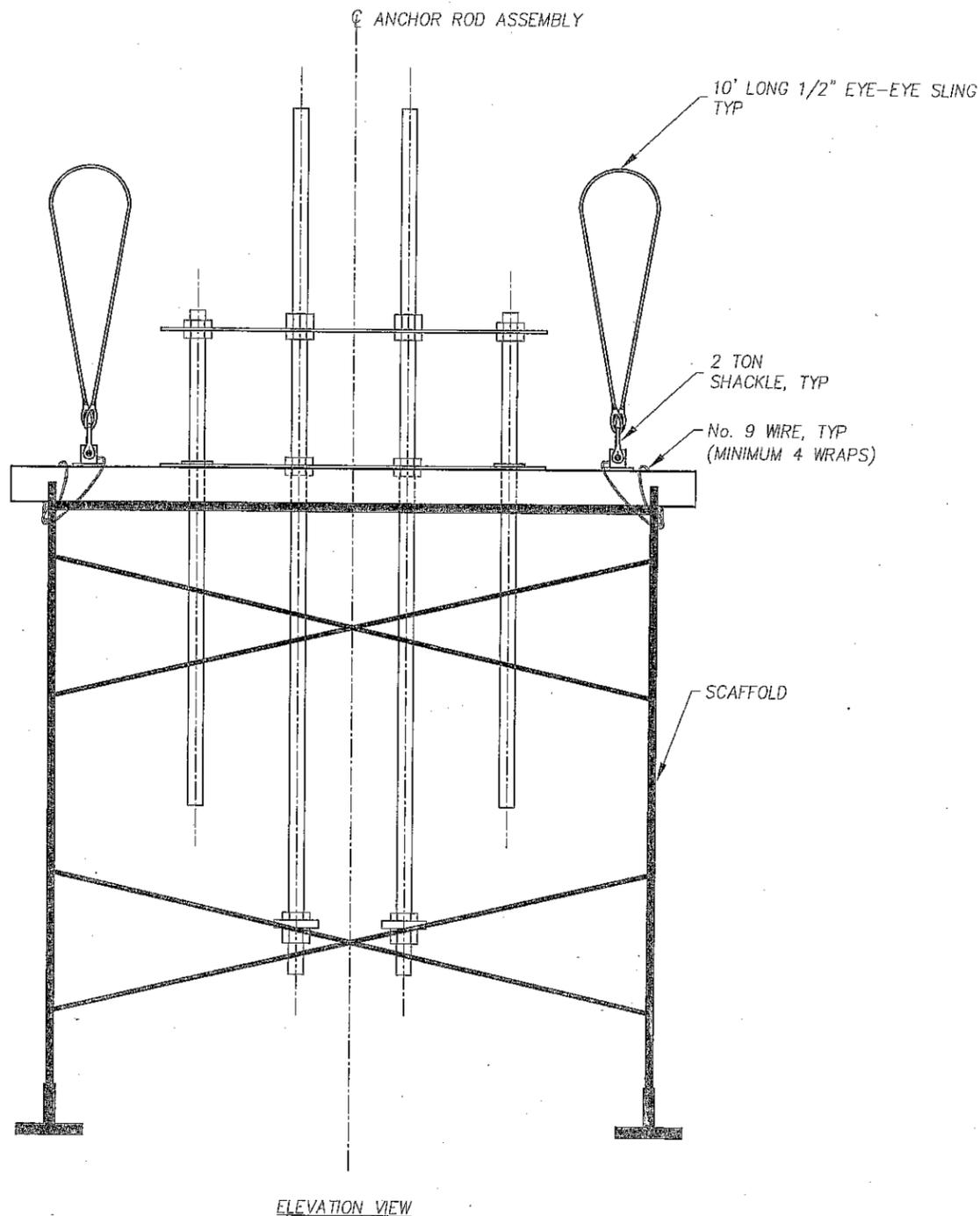
PIER T1 ANCHOR RODS
 D DRIVING FRAME
 DETAIL SHEET

Made By: G. TRELA Date: 7/31/07
 Checked By: NG / ST Date: 7/31/07
 In Charge Of: R. CROCKETT

Job No. 660110 Sheet No. 4
 Scale: NTS Revision: 1

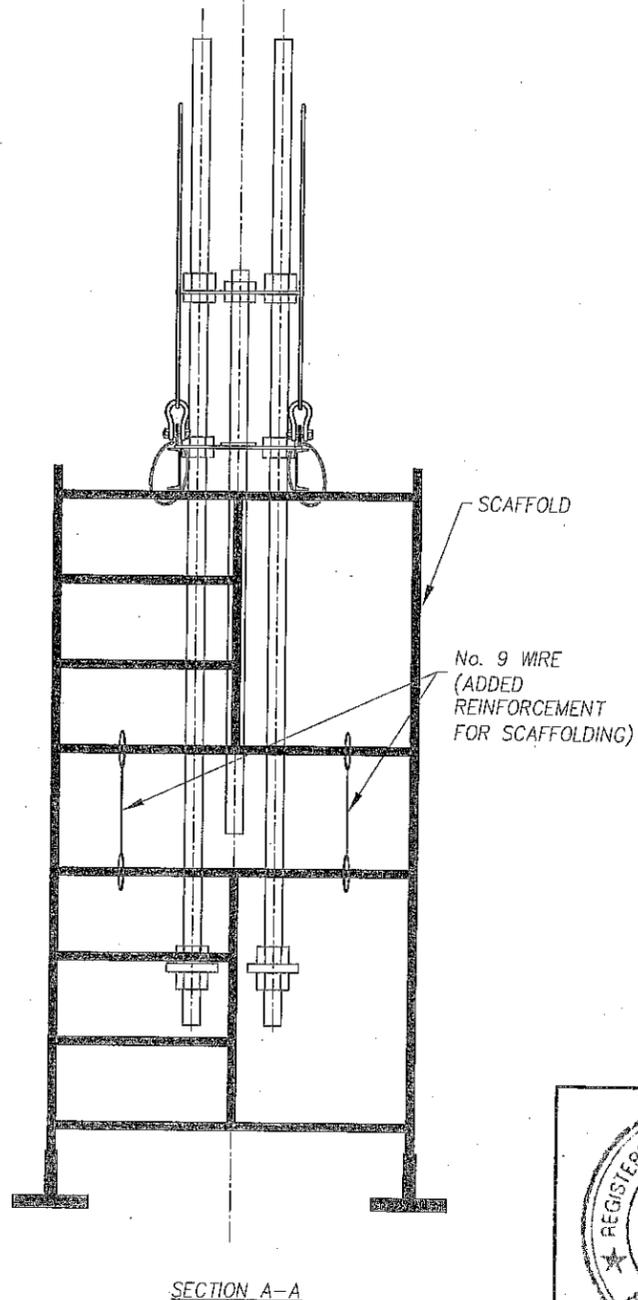
Oct 04, 2007 - 1:55pm S:\ABF-SUB-000237R00 - Pier T1 Anchor Rods D Driving Frame\Submittal\RO0\Drawings\DWG\Anchor Bolt Layout R00 - Official Submittal.dwg

A



ELEVATION VIEW

ANCHOR ROD ASSEMBLY



SECTION A-A

ANCHOR ROD ASSEMBLY / SUPPORT SCAFFOLD
PICKING PLAN

GENERAL NOTES:

1. ABF TO PROVIDE 2 TON SHACKLES AND 1/2" WIRE ROPE SLINGS AS SHOWN.
2. WRAPS OF No. 9 WIRE SHALL BE TWISTED TAUT TO SECURE THE CHANNELS TO THE SCAFFOLD FRAME.

CONTRACT NO. 04-0120E4

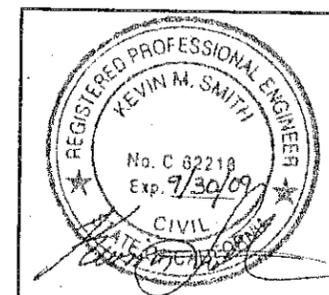
CONTRACT CHANGE ORDER NO. 74

SHEET 6 OF 6

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION CONTRACT NO. 04-0120F4 BRIDGE NO. 34-0006L/R			
DISTRICT 04	COUNTY SF	ROUTE 80	KILOMETER POST 13.2 / 13.9

SAN FRANCISCO OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT
SELF ANCHORED SUSPENSION BRIDGE
(SUPERSTRUCTURE AND TOWER)

PIER T1 ANCHOR RODS
ANCHOR ROD ASSEMBLY / SCAFFOLDING SUPPORT
PICK PLAN



Made By: N GRECO Date: 10-03-07
Checked By: KMS Date: 10-04-07
In Charge Of: R. CROCKETT

Job No. 660110 Sheet No. 5

Scale: NTS Revision: 0

6			
5			
4			
3			
2			
1			
REV	DATE	BY	DESCRIPTION



P.O. BOX 23223 Oakland, CA 94623
 Phone (510) 419-0120 / Fax (510) 832-1456

LETTER OF SUBMITTAL
SAS Foundations E2/T1 Project

Run Date 10-Jan-08
 Time 12:12 PM

Dated: 1/10/08
 To: Pedro Sanchez
 Caltrans - SAS E2/T1 Foundation Project
 333 Burma Road
 Oakland CA 94607
 Phone: 510-286-0538 Fax:

SUBMITTAL No: KFM-SUB-001718 Rev: 01
 Co/Job # 364-4347
 Contract # 04-0120E4
 Sub/Supplier:
 Sub/Supplier No:

Subject: T1 Footing Dowel/Rod Survey

Special Provis. (SP) REF: 10-1.31
 Standard Spec. (SS) REF:
 RESUBMITTAL/SUPPLEMENTAL REF:

- We are sending the following attached items: Attached Via Fax
- Contract Plans/Specs
 - Drawings/Calculations
 - Change Order
 - Copy of Letter
 - Certs of Compl./Samples
 - Schedule
 - Progress Estimate Request
 - Payroll Information
 - Working Drawings
 - WQCP and/or Addenda
 - Weekly Weld Reports
 - CWR Procedure

Item	Date	Copies	Description	Drawing No	Rev	Status	Pages
01	09-Jan-08	3	T1 Anchor Rod and Dowel Survey -- Supplemental Information		0	Pending	
02	09-Jan-08	3	Anchor Rod As-Built Survey (Rev4)		0	Pending	
03	10-Jan-08	3	Dowel As-Built Survey		0	Pending	
04	04-Jan-08	3	T1 Anchor Rod / Sleeve Layout		0	Pending	
05	08-Jan-08	3	T1 Dowel Numbering Layout		0	Pending	
06	10-Jan-08	1	CD w/ Spreadsheet Files		0	Pending	

- These are transmitted as checked below:
- For Approval
 - For Your Use
 - For Review/Comment
 - As Requested
 - Return For Correction
 - For Information

Remarks:

CC:

Please review / approve by :

Submitted By: *Geo Atkinson*
 (KFM Staff Member - Originator of Transmittal)

Checked & Sent By: *R. Senning*
 Contract Admin/DCS Staff



P.O. BOX 23223 Oakland, CA 94623
 Phone (510) 419-0120 / Fax (510) 832-1456

LETTER OF SUBMITTAL
SAS Foundations E2/T1 Project

Run Date 30-Jan-08
 Time 9:29 AM

Dated: 1-31-08

SUBMITTAL No: KFM-SUB-001718

Rev: 02

To: Pedro Sanchez
 Caltrans - SAS E2/T1 Foundation Project
 333 Burma Road
 Oakland CA 94607
 Phone: 510-286-0538 Fax:

Co/Job # 364-4347
 Contract # 04-0120E4
 Sub/Supplier:
 Sub/Supplier No:

Subject: T1 Footing Dowel/Rod Survey

Special Provis. (SP) REF: 10-1.31

Standard Spec. (SS) REF:

RESUBMITTAL/SUPPLEMENTAL REF:

We are sending the following attached items: Attached

Via Fax

- Contract Plans/Specs
- Drawings/Calculations
- Change Order
- Copy of Letter

- Certs of Compl./Samples
- Schedule
- Progress Estimate Request
- Payroll Information

- Working Drawings
- WQCP and/or Addenda
- Weekly Weld Reports
- CWR Procedure

Item	Date	Copies	Description	Drawing No	Rev	Status	Pages
01		3	T1 Anchor Rod and Dowel Survey -- Supplemental Information		0	Pending	1
02		3	Anchor Rod As-Built Survey (Rev7) 1-20-08		1	Pending	13
04		3	T1 Anchor Rod / Sleeve Layout		1	Pending	1
06		1	CD w/ Spreadsheet Files		1	Pending	

These are transmitted as checked below:

- For Approval
- For Your Use
- For Review/Comment
- As Requested
- Return For Correction
- For Information

Remarks:

CC:

Please review / approve by : 27-Feb-2008

Submitted By: Dave Russ
 (KFM Staff Member - Originator of Transmittal)

Checked & Sent By: *D. Senings*
 Contract Admin/DCS Staff

T1 Anchor Rod and Dowel Survey – Supplemental Information

Point Designations

Plan views of the anchor rod and dowel locations are provided with each position labeled. The numbering plan used is consistent with the plan used by KOS at the time of fabrication.

Anchor rod location designations on the spreadsheets have the dashes eliminated and leading zeros added to the specific hole location but otherwise correspond to the location plan attached.

Survey Method

Due to site conditions that preclude a GPS survey as specified in Special Provisions 10-1.3, the as built dowel and anchor rod locations were determined using conventional construction survey methodology. A Trimble total station as a survey instrument. Horizontal and vertical control points are as provided by Caltrans.

For targeting, a corner cube was used for the tops of the dowels. To locate the radius point of the dowel at a lower point along the rod a machined jig having two fixed prisms at fixed offset was used. This jig allows for the location of the center point by mathematically projecting the line between the two prisms the fixed offset distance.

The equipment and methods used should provide a reasonable horizontal working tolerance of about +/- 6 millimeters at one sigma (68% confidence). To get to 95% confidence the approximate error ellipse would be about +/-12 millimeters. This is based on a statistical analysis of instrument errors, targeting errors, pointing errors, and distances involved.

As-Built Anchor Rod Survey

Point # Top	Top Northing	Top Easting	Top Elevation	Point # Bottom	Bottom Northing	Bottom Easting	Bottom Elevation
RT1311001	647586.719	1836381.360	5.336	R1311001R	647586.716	1836381.361	3.243
RT1311002	647586.376	1836381.192	5.335	R1311002R	647586.369	1836381.198	3.236
RT1311003	647586.114	1836381.058	5.336	R1311003R	647586.110	1836381.066	3.271
1311004C	647585.750	1836380.891	5.340	1311004F	647585.754	1836380.899	3.301
R61311005	647585.502	1836380.774	5.335	R6131105R	647585.4969	1836380.781	3.201
R61311006	647585.143	1836380.607	5.366	R6131106R	647585.1444	1836380.608	3.228
R61311007	647584.883	1836380.493	5.365	R6131107R	647584.8783	1836380.498	3.258
1311008C	647584.523	1836380.299	5.366	1311008F	647584.522	1836380.310	3.319
1312001C	647600.205	1836375.594	5.334	1312001F	647600.211	1836375.605	3.247
1312002C	647600.563	1836375.783	5.337	1312002F	647600.566	1836375.779	3.244
R61312003	647600.821	1836375.908	5.335	R61312003R	647600.8216	1836375.906	3.167
1312004C	647601.189	1836376.074	5.338	1312004F	647601.192	1836376.075	3.226
1312005C	647601.431	1836376.198	5.337	1312005F	647601.437	1836376.196	3.228
1312006C	647601.777	1836376.358	5.360	1312006F	647601.786	1836376.366	3.189
1312007C	647602.050	1836376.481	5.362	1312007F	647602.054	1836376.487	3.233
1312008C	647602.404	1836376.666	5.365	1312008F	647602.416	1836376.667	3.211
1321001C	647591.640	1836376.114	5.340	1321001F	647591.643	1836376.121	3.215
1321002C	647591.394	1836376.281	5.344	1321002F	647591.399	1836376.278	3.219
1322001C	647595.516	1836380.684	5.341	1322001F	647595.513	1836380.681	3.220
1322002C	647595.286	1836380.855	5.345	1322002F	647595.286	1836380.853	3.209
R61331001	647589.778	1836377.189	5.34	R61331001R	647589.7756	1836377.199	3.219
RT1331002	647590.008	1836377.517	5.342	R1331002R	647590.005	1836377.526	3.247
R61331003	647590.183	1836377.759	5.334	R61331003R	647590.1894	1836377.766	3.233
1331004C	647590.314	1836378.537	5.343	1331004F	647590.314	1836378.540	3.259
R61331005	647590.026	1836378.73	5.34	R61331005R	647590.0192	1836378.741	3.215
1331006C	647589.797	1836378.894	5.342	1331006F	647589.803	1836378.894	3.252
1331007C	647589.514	1836379.086	5.342	1331007F	647589.510	1836379.090	3.228
1331008C	647589.279	1836379.248	5.348	1331008F	647589.285	1836379.247	3.193
1331009C	647589.000	1836379.428	5.342	1331009F	647588.996	1836379.434	3.192
1331010C	647588.751	1836379.596	5.340	1331010F	647588.755	1836379.598	3.202
1331011C	647588.485	1836379.797	5.342	1331011F	647588.485	1836379.801	3.221
1311012C	647588.245	1836379.961	5.343	1331012F	647588.248	1836379.962	3.203
1331013C	647587.980	1836380.138	5.334	1331013F	647587.975	1836380.145	3.186
1332001C	647597.150	1836379.746	5.339	1332001F	647597.149	1836379.752	3.200
1332002C	647596.925	1836379.418	5.337	1332002F	647596.924	1836379.425	3.226
1332003C	647596.758	1836379.183	5.337	1332003F	647596.748	1836379.183	3.189
RT1332004	647596.655	1836378.443	5.334	R1332004R	647596.649	1836378.436	3.297
1332005C	647596.900	1836378.247	5.336	1332005F	647596.903	1836378.247	3.195
1332006C	647597.138	1836378.072	5.336	1332006F	647597.141	1836378.070	3.211
1332007C	647597.426	1836377.879	5.331	1332007F	647597.434	1836377.878	3.200
1332008C	647597.644	1836377.726	5.336	1332008F	647597.654	1836377.721	3.199
1332009C	647597.929	1836377.519	5.339	1332009F	647597.939	1836377.521	3.210
1332010C	647598.173	1836377.396	5.335	1332010F	647598.173	1836377.387	3.198
1332011C	647598.445	1836377.171	5.338	1332011F	647598.451	1836377.170	3.205
1332012C	647598.681	1836376.994	5.336	1332012F	647598.687	1836376.996	3.189
1332013C	647598.962	1836376.799	5.338	1332013F	647598.964	1836376.805	3.229
1341001C	647587.190	1836380.391	5.344	1341001F	647587.184	1836380.391	3.258
1341002C	647586.832	1836380.216	5.341	1341002F	647586.829	1836380.221	3.202
1341003C	647586.576	1836380.115	5.365	1341003F	647586.569	1836380.107	3.234
1341004C	647586.235	1836379.940	5.338	1341004F	647586.228	1836379.934	3.195
1341005C	647585.973	1836379.808	5.335	1341005F	647585.977	1836379.810	3.264
1342001C	647599.752	1836376.582	5.332	1342001F	647599.760	1836376.581	3.224
1342002C	647600.100	1836376.758	5.336	1342002F	647600.109	1836376.756	3.326
1342003C	647600.367	1836376.877	5.336	1342003F	647600.372	1836376.874	3.204
1342004C	647600.726	1836377.051	5.337	1342004F	647600.725	1836377.047	3.280
1342005C	647600.974	1836377.170	5.338	1342005F	647600.978	1836377.169	3.308
1351001C	647592.352	1836377.131	5.340	1351001F	647592.347	1836377.125	3.232
1351002C	647592.105	1836377.300	5.339	1351002F	647592.109	1836377.301	3.208
RT1352001	647594.809	1836379.663	5.330	R1352001R	647594.804	1836379.673	3.222
RT1352002	647594.581	1836379.851	5.329	R1352002R	647594.582	1836379.849	3.211
1361001C	647587.443	1836373.752	5.340	1361001F	647587.448	1836373.751	3.271

As-Built Anchor Rod Survey

Point # Top	Top Northing	Top Easting	Top Elevation	Point # Bottom	Bottom Northing	Bottom Easting	Bottom Elevation
RT1361002	647587.706	1836373.547	5.339	R1361002R	647587.706	1836373.542	3.220
1361003C	647587.950	1836373.407	5.336	1361003F	647587.958	1836373.399	3.237
1361004C	647588.211	1836373.224	5.370	1361004F	647588.216	1836373.214	3.276
1361005C	647588.449	1836373.065	5.370	1361005F	647588.446	1836373.058	3.256
1361006C	647588.700	1836372.869	5.370	1361006F	647588.701	1836372.865	3.259
RT1362001	647599.481	1836383.231	5.332	R1362001R	647599.480	1836383.229	3.218
RT1362002	647599.253	1836383.417	5.331	R1362002R	647599.252	1836383.422	3.230
RT1362003	647598.986	1836383.563	5.349	R1362003R	647598.981	1836383.570	3.213
RT1362004	647598.714	1836383.763	5.372	R1362004R	647598.716	1836383.761	3.254
RT1362005	647598.484	1836383.913	5.369	R1362005R	647598.493	1836383.913	3.264
RT1362006	647598.269	1836384.092	5.365	R1362006R	647598.271	1836384.095	3.267
13701001C	647595.851	1836379.750	5.337	13701001F	647595.855	1836379.754	3.249
1371002EC	647595.079	1836379.528	5.336	13701002F	647595.078	1836379.525	3.313
1371001C	647591.841	1836377.456	5.336	1371001F	647591.848	1836377.457	3.166
1371002C	647591.098	1836377.239	5.335	1371002F	647591.100	1836377.238	3.172
RT1391001	647584.160	1836379.248	5.368	R1391001R	647584.150	1836379.255	3.202
1391002C	647584.296	1836378.943	5.368	1391002F	647584.293	1836378.940	3.241
RT1391003	647584.416	1836378.666	5.364	R1391003R	647584.406	1836378.666	3.190
1391004C	647584.564	1836378.365	3.342	1391004F	647584.562	1836378.371	3.302
1391005C	647584.678	1836378.104	5.340	1391005F	647584.679	1836378.108	3.209
RT1391006	647584.843	1836377.829	5.334	R1391006R	647584.836	1836377.830	3.257
RT1391007	647584.945	1836377.561	5.338	R1391007R	647584.942	1836377.561	3.241
1391008C	647585.097	1836377.269	5.343	1391008F	647585.103	1836377.263	3.255
1391009C	647585.217	1836376.998	5.339	1391009F	647585.214	1836376.988	2.237
1391010C	647585.364	1836376.682	5.339	1391010F	647585.370	1836376.682	3.237
1391011C	647585.495	1836376.403	5.343	1391011F	647585.488	1836376.410	3.264
1391012C	647585.628	1836376.126	5.343	1391012F	647585.626	1836376.128	3.213
1391013C	647585.748	1836375.841	5.335	1391013F	647585.757	1836375.841	3.229
RT1391014	647585.873	1836375.565	5.326	R1391014R	647585.872	1836375.564	3.238
1391015C	647586.017	1836375.293	5.333	1391015F	647586.018	1836375.297	3.292
1391016C	647586.151	1836374.973	5.337	1391016F	647586.148	1836374.979	3.256
RT1392001	647602.771	1836377.714	5.365	R1392001R	647602.781	1836377.715	3.258
R61392002	647602.642	1836378.023	5.367	R6139202R	647602.6405	1836378.028	3.25
RT1392003	647602.506	1836378.301	5.369	R1392003R	647602.513	1836378.298	3.258
R61392004	647602.395	1836378.586	5.34	R6139204R	647602.385	1836378.586	3.228
1392005C	647602.239	1836378.847	5.338	1392005F	647602.239	1836378.849	3.246
1392006C	647602.091	1836379.155	5.335	1392006F	647602.098	1836379.158	3.232
1392007C	647601.973	1836379.413	5.332	1392007F	647601.964	1836379.416	3.296
RT1392008	647601.818	1836379.708	5.342	R1392008R	647601.821	1836379.714	3.245
1392009C	647601.705	1836379.979	5.337	1392009F	647601.702	1836379.980	3.212
RT1392010	647601.550	1836380.281	5.335	R1392010R	647601.554	1836380.279	3.222
1392011C	647601.431	1836380.539	5.339	1392011F	647601.429	1836380.541	3.426
1392012C	647601.286	1836380.846	5.336	1392012F	647601.285	1836380.844	3.482
RT1392013	647601.157	1836381.119	5.337	R1392013R	647601.162	1836381.115	3.223
1392014C	647601.027	1836381.403	5.336	1392014F	647601.029	1836381.406	3.417
RT1392015	647600.886	1836381.686	5.335	R1392015R	647600.894	1836381.686	3.288
1392016C	647600.762	1836381.968	5.337	1392016F	647600.768	1836381.973	3.429
1411001C	647589.809	1836375.836	5.342	1411001F	647589.804	1836375.832	3.262
1411002C	647589.499	1836375.691	5.342	1411002F	647589.499	1836375.691	3.232
1411003C	647589.235	1836375.548	5.338	1411003F	647589.238	1836375.553	3.240
1411004C	647588.929	1836375.434	5.343	1411004F	647588.927	1836375.425	3.253
1411005C	647588.672	1836375.305	5.340	1411005F	647588.674	1836375.299	3.310
1411006C	647588.379	1836375.156	5.341	1411006F	647588.378	1836375.148	3.268
T1412001	647597.134	1836381.147	5.339	B1412001F	647597.138	1836381.151	3.382
T1412002	647597.447	1836381.300	5.338	B1412002F	647597.449	1836381.299	3.394
T1412003	647597.720	1836381.416	5.343	B1412003F	647597.719	1836381.419	3.403
T1412004	647598.011	1836381.545	5.338	B1412004F	647598.009	1836381.549	3.384
T1412005	647598.264	1836381.678	5.335	B1412005F	647598.265	1836381.680	3.395
T1412006	647598.561	1836381.806	5.338	B1412006F	647598.563	1836381.810	3.446
1421001C	647588.640	1836381.650	5.343	1421001F	647588.641	1836381.648	3.242
RT1421002	647588.516	1836380.981	5.339	R1421002R	647588.517	1836380.987	3.319
RT1421003	647588.800	1836380.793	5.339	R1421003R	647588.806	1836380.793	3.273
1421004C	647589.036	1836380.629	5.341	1421004F	647589.043	1836380.635	3.225
1421005C	647589.320	1836380.449	5.343	1421005F	647589.330	1836380.448	3.221

As-Built Anchor Rod Survey

Point # Top	Top Northing	Top Easting	Top Elevation	Point # Bottom	Bottom Northing	Bottom Easting	Bottom Elevation
1421006C	647589.563	1836380.276	5.340	1421006F	647589.572	1836380.278	3.214
1421007C	647589.844	1836380.071	5.344	1421007F	647589.849	1836380.080	3.197
RT1421008	647590.068	1836379.921	5.336	R1421008R	647590.078	1836379.921	3.227
RT1421009	647590.344	1836379.726	5.337	R1421009R	647590.353	1836379.726	3.223
RT1421010	647590.576	1836379.566	5.339	R1421010R	647590.584	1836379.566	3.232
RT1421011	647590.864	1836379.374	5.335	R1421011R	647590.874	1836379.372	3.257
1421012C	647591.520	1836379.668	5.342	1421012F	647591.526	1836379.666	3.213
1422001C	647598.291	1836375.328	5.336	1422001F	647598.299	1836375.328	3.248
1422002C	647598.382	1836375.979	3.342	1422002F	647598.388	1836375.985	3.212
1422003C	647598.106	1836376.172	5.344	1422003F	647598.116	1836376.174	3.209
1422004C	647597.878	1836376.333	5.345	1422004F	647597.880	1836376.340	3.215
RT1422005	647597.591	1836376.525	5.337	R1422005R	647597.591	1836376.531	3.227
1422006C	647597.358	1836376.689	5.342	1422006F	647597.356	1836376.697	3.212
1422007C	647597.071	1836376.883	5.333	1422007F	647597.079	1836376.885	3.197
1422008C	647596.845	1836377.051	5.335	1422008F	647596.842	1836377.058	3.200
RT1422009	647596.573	1836377.249	5.342	R1422009R	647596.567	1836377.252	3.230
1422010C	647596.336	1836377.408	5.347	1422010F	647596.337	1836377.410	3.189
1422011C	647596.043	1836377.596	5.344	1422011F	647596.046	1836377.601	3.210
1422012C	647595.416	1836377.319	5.345	1422012F	647595.409	1836377.320	3.223
RT1431001	647587.890	1836382.510	5.337	R1431001R	647587.883	1836382.510	3.316
RT1431002	647587.724	1836382.284	5.335	R1431002R	647587.720	1836382.277	3.276
1432001C	647599.052	1836374.473	5.333	1432001F	647599.053	1836374.472	3.239
1432002C	647599.201	1836374.694	5.334	1432002F	647599.209	1836374.695	3.263
1441001C	647598.355	1836370.777	5.362	1441001F	647598.358	1836370.778	3.295
R61441002	647598.388	1836371.164	5.363	R6144102R	647598.3868	1836371.163	3.248
RT1441003	647598.388	1836371.163	5.364	R1441003R	647598.389	1836371.163	3.311
RT1441004	647598.439	1836371.861	5.339	R1441004R	647598.442	1836371.857	3.237
RT1441005	647598.449	1836372.144	5.340	R1441005R	647598.451	1836372.142	3.243
R61441006	647598.479	1836372.524	5.339	R6144106R	647598.4835	1836372.524	3.233
RT1441007	647598.515	1836372.831	5.344	R1441007R	647598.512	1836372.829	3.270
RT1441008	647598.544	1836373.210	5.356	R1441008R	647598.542	1836373.216	3.261
1442001C	647588.562	1836386.193	5.368	1442001F	647588.569	1836386.195	3.336
1442002C	647588.528	1836385.820	5.367	1442002F	647588.536	1836385.816	3.315
RT1442003	647588.524	1836385.492	5.363	R1442003R	647588.521	1836385.495	3.281
RT1442004	647588.497	1836385.122	5.335	R1442004R	647588.495	1836385.117	3.286
1442005C	647588.464	1836384.829	5.340	1442005F	647588.468	1836384.834	3.236
1442006C	647588.439	1836384.447	5.340	1442006F	647588.444	1836384.450	3.260
1442007C	647588.414	1836384.151	5.338	1442007F	647588.416	1836384.157	3.199
1442008C	647588.364	1836383.783	5.339	1442008F	647588.365	1836383.786	3.213
1451001C	647592.116	1836375.774	5.343	1451001F	647592.123	1836375.778	3.238
1451002C	647591.871	1836375.951	5.339	1451002F	647591.876	1836375.943	3.218
1452001C	647595.043	1836381.018	5.330	1452001F	647595.035	1836381.017	3.234
1452002C	647594.798	1836381.177	5.343	1452002F	647594.799	1836381.175	3.179
1461001C	647596.956	1836373.930	5.336	1461001F	647596.962	1836373.937	3.248
RT1461002	647596.695	1836374.125	5.336	R1461002R	647596.705	1836374.129	3.208
1461003C	647596.458	1836374.279	5.335	1461003F	647596.458	1836374.289	3.191
1461004C	647596.173	1836374.477	5.333	1461004F	647596.176	1836374.482	3.191
1461005C	647595.932	1836374.638	5.334	1461005F	647595.935	1836374.642	3.202
RT1461006	647595.663	1836374.828	5.340	R1461006R	647595.665	1836374.836	3.240
1461007C	647595.428	1836375.000	5.335	1461007F	647595.430	1836375.003	3.204
1461008C	647595.149	1836375.190	5.333	1461008F	647595.151	1836375.196	3.254
1461009C	647594.906	1836375.361	5.335	1461009F	647594.909	1836375.364	3.364
1461010C	647594.632	1836375.546	5.336	1461010F	647594.632	1836375.554	3.331
RT1461011	647593.974	1836375.158	4.078	R1461011R	647593.969	1836375.158	3.146
1461012C	647593.812	1836374.913	5.339	1461012F	647593.809	1836374.914	3.231
1461013C	647593.582	1836374.608	5.345	1461013F	647593.582	1836374.606	3.214
RT1462001	647589.954	1836383.019	5.337	R1462001R	647589.949	1836383.028	3.267
RT1462002	647590.229	1836382.836	5.336	R1462002R	647590.225	1836382.839	3.296
1462003C	647590.467	1836382.687	5.342	1462003F	647590.469	1836382.683	3.205
1462004C	647590.753	1836382.486	5.341	1462004F	647590.751	1836382.486	3.200
RT1462005	647590.979	1836382.313	5.337	R1462005R	647590.980	1836382.314	3.275
1462006C	647591.272	1836382.124	5.342	1462006F	647591.276	1836382.122	3.191
1462007C	647591.501	1836381.970	5.342	1462007F	647591.504	1836381.966	3.191
1462008C	647591.789	1836381.773	5.345	1462008F	647591.790	1836381.773	3.241
1462009C	647592.028	1836381.616	5.342	1462009F	647592.029	1836381.610	3.215

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Point # Top	Top Northing	Top Easting	Top Elevation	Point # Bottom	Bottom Northing	Bottom Easting	Bottom Elevation
RT1462010	647592.286	1836381.440	5.338	R1462010R	647592.285	1836381.433	3.325
1462011C	647592.958	1836381.809	5.341	1462011F	647592.963	1836381.811	3.262
RT1462012	647593.132	1836382.066	5.339	R1462012R	647593.131	1836382.062	3.148
1462013C	647593.348	1836382.382	5.343	1462013F	647593.352	1836382.380	3.209
1471001C	647597.375	1836371.932	5.335	1471001F	647597.367	1836371.934	3.306
1471002C	647597.388	1836372.233	5.334	1471002F	647597.390	1836372.233	3.296
1471003C	647597.420	1836372.613	5.336	1471003F	647597.426	1836372.619	3.255
1471004C	647597.467	1836372.898	5.335	1471004F	647597.460	1836372.906	3.14
RT1471005	647597.481	1836373.294	5.336	R1471005R	647597.484	1836373.292	3.265
1472001C	647589.575	1836385.022	5.343	1472001F	647589.574	1836385.028	3.306
RT1472002	647589.555	1836384.731	5.339	R1472002R	647589.557	1836384.734	3.214
RT1472003	647589.506	1836384.359	5.339	R1472003R	647589.510	1836384.360	3.263
RT1472004	647589.496	1836384.056	5.341	R1472004R	647589.501	1836384.059	3.258
RT1472005	647589.465	1836383.704	5.341	R1472005R	647589.460	1836383.703	3.259
RT1481001	647592.846	1836376.757	5.338	R1481001R	647592.841	1836376.768	3.216
RT1481002	647592.593	1836376.960	5.340	R1481002R	647592.590	1836376.955	3.231
1482001C	647594.342	1836380.030	5.345	1482001F	647594.336	1836380.027	3.217
1482002C	647594.080	1836380.184	5.338	1482002F	647594.085	1836380.185	3.204
1491001C	647589.932	1836372.033	5.370	1491001F	647589.921	1836372.028	3.223
1491002C	647590.200	1836371.856	5.370	1491002F	647590.197	1836371.854	3.265
1491003C	647590.398	1836371.692	5.369	1491003F	647590.406	1836371.687	3.248
1491004C	647590.659	1836371.523	5.341	1491004F	647590.668	1836371.511	3.235
1491005C	647590.893	1836371.355	5.339	1491005F	647590.901	1836371.348	3.245
1491006C	647591.176	1836371.170	5.344	1491006F	647591.182	1836371.163	3.214
R61492001	647597.021	1836384.929	5.365	R61492001R	647597.0261	1836384.93	3.245
R61492002	647596.757	1836385.113	5.371	R61492002R	647596.7618	1836385.117	3.255
R61492003	647596.547	1836385.275	5.367	R61492003R	647596.5533	1836385.272	3.244
R61492004	647596.242	1836385.459	5.344	R61492004R	647596.2457	1836385.459	3.215
R61492005	647596.038	1836385.605	5.341	R61492005R	647596.0358	1836385.612	3.216
1492006C	647595.760	1836385.800	5.351	1492006F	647595.768	1836385.799	3.230
R61501001	647593.153	1836375.833	5.37	R6150101R	647593.1592	1836375.841	3.226
1501002C	647593.081	1836376.616	5.338	1501002F	647593.086	1836376.614	3.179
1502001C	647593.782	1836381.133	5.334	1502001F	647593.786	1836381.134	3.163
1502002C	647593.855	1836380.367	5.326	1502002F	647593.849	1836380.366	3.214
RT1521001	647592.803	1836370.438	5.342	R1521001R	647592.798	1836370.430	3.208
RT1521002	647593.128	1836370.409	5.339	R1521002R	647593.123	1836370.407	3.202
1521003C	647593.435	1836370.385	5.339	1521003F	647593.434	1836370.387	3.238
1521004C	647593.739	1836370.369	5.337	1521004F	647593.742	1836370.364	3.239
1521005C	647594.035	1836370.322	5.338	1521005F	647594.038	1836370.324	3.230
1521006C	647594.355	1836370.322	5.336	1521006F	647594.357	1836370.316	3.312
R61521007	647594.642	1836370.289	5.338	R6152107R	647594.6421	1836370.291	3.225
1521008C	647594.990	1836370.263	5.336	1521008F	647594.992	1836370.262	3.228
1521009C	647595.285	1836370.216	5.336	1521009F	647595.288	1836370.224	3.211
RT1521010	647595.596	1836370.211	5.337	R1521010R	647595.596	1836370.207	3.196
RT1521011	647595.884	1836370.197	5.336	R1521011R	647595.882	1836370.190	3.245
1521012C	647596.229	1836370.136	5.338	1521012F	647596.230	1836370.143	3.213
1521013C	647596.518	1836370.133	5.338	1521013F	647596.524	1836370.130	3.283
1521014C	647596.852	1836370.109	5.358	1521014F	647596.858	1836370.105	3.252
1521015C	647597.149	1836370.081	5.361	1521015F	647597.145	1836370.086	3.278
1521016C	647597.482	1836370.069	5.361	1521016F	647597.481	1836370.064	3.417
RT1522001	647589.433	1836386.934	5.364	R1522001R	647589.438	1836386.941	3.317
RT1522002	647589.792	1836386.904	5.361	R1522002R	647589.795	1836386.914	3.269
1522003C	647590.092	1836386.886	5.368	1522003F	647590.086	1836386.890	3.412
RT1522004	647590.404	1836386.844	5.336	R1522004R	647590.403	1836386.849	3.265
RT1522005	647590.701	1836386.825	5.338	R1522005R	647590.701	1836386.827	3.262
RT1522006	647591.027	1836386.796	5.336	R1522006R	647591.032	1836386.803	3.260
1522007C	647591.329	1836386.773	5.336	1522007F	647591.331	1836386.772	3.100
RT1522008	647591.649	1836386.747	5.338	R1522008R	647591.651	1836386.751	3.253
RT1522009	647591.945	1836386.723	5.335	R1522009R	647591.947	1836386.723	3.275
RT1522010	647592.283	1836386.700	5.334	R1522010R	647592.281	1836386.702	3.273
1522011C	647592.580	1836386.682	5.339	1522011F	647592.580	1836386.680	3.247
1522012C	647592.902	1836386.649	5.341	1522012F	647592.907	1836386.655	3.227
RT1522013	647593.195	1836386.615	5.340	R1522013R	647593.192	1836386.617	3.281
RT1522014	647593.522	1836386.595	5.336	R1522014R	647593.526	1836386.595	3.295

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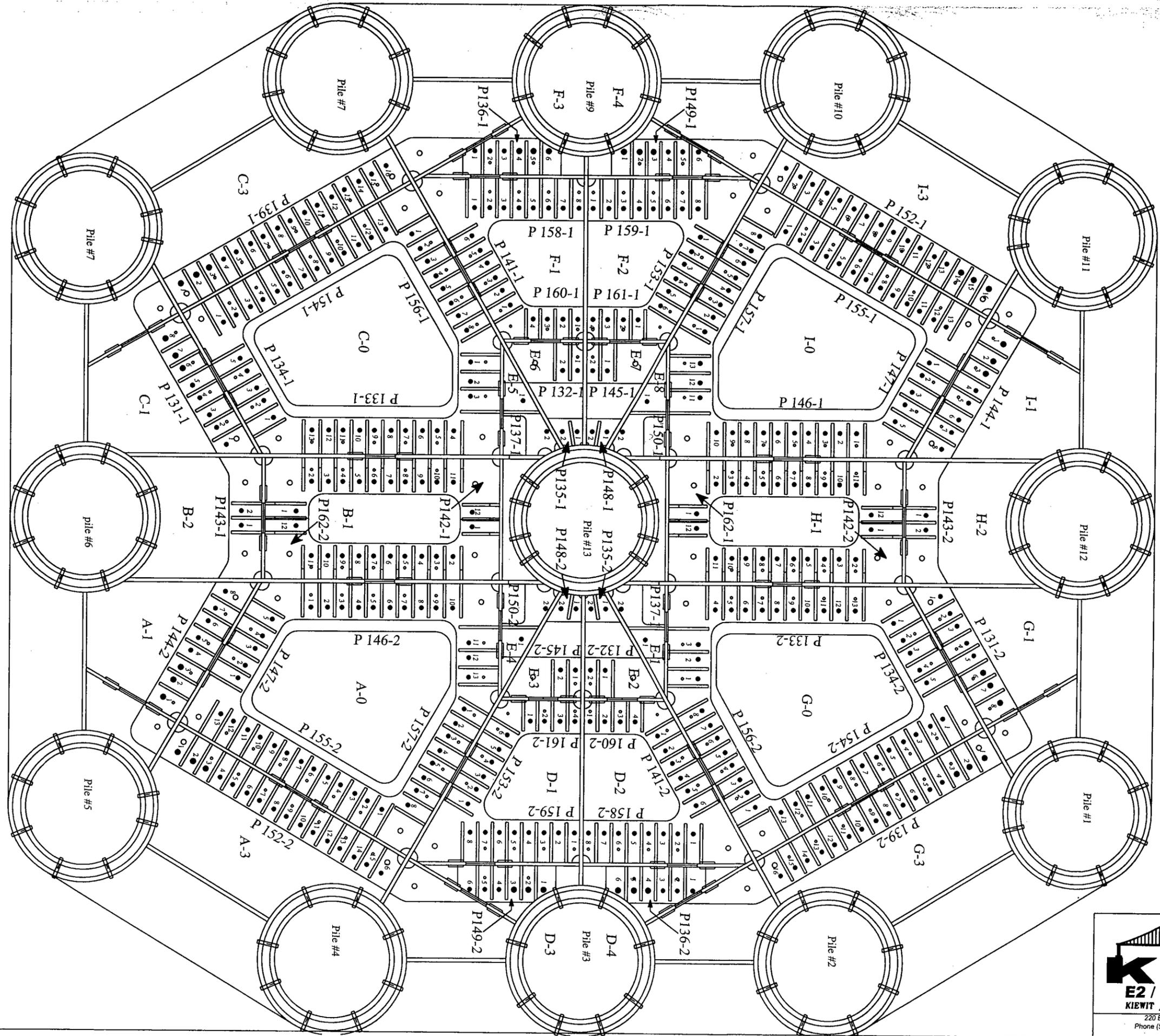
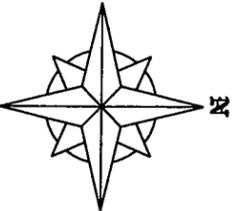
Point # Top	Top Northing	Top Easting	Top Elevation	Point # Bottom	Bottom Northing	Bottom Easting	Bottom Elevation
RT1522015	647593.801	1836386.576	5.337	R1522015R	647593.803	1836386.575	3.244
R61522016	647594.135	1836386.546	5.335	R61522016R	647594.147	1836386.547	3.229
1531001C	647592.156	1836372.527	5.342	1531001F	647592.155	1836372.522	3.291
RT1531002	647592.176	1836372.853	5.342	R1531002R	647592.172	1836372.851	3.255
1531003C	647592.210	1836373.125	5.345	1531003F	647592.209	1836373.132	3.259
1531004C	647592.231	1836373.472	5.340	1531004F	647592.230	1836373.478	3.229
1531005C	647592.260	1836373.765	5.339	1531005F	647592.259	1836373.772	3.275
1531006C	647592.272	1836374.099	5.339	1531006F	647592.273	1836374.105	3.231
1532001C	647594.794	1836384.437	5.343	1532001F	647594.795	1836384.441	3.229
1532002C	647594.772	1836384.091	5.341	1532002F	647594.769	1836384.096	3.224
1532003C	647594.742	1836383.833	5.341	1532003F	647594.740	1836383.825	3.236
1532004C	647594.713	1836383.480	5.345	1532004F	647594.710	1836383.478	3.239
1532005C	647594.689	1836383.202	5.339	1532005F	647594.686	1836383.198	3.216
1532006C	647594.666	1836382.860	5.343	1532006F	647594.662	1836382.861	3.223
1541001C	647585.267	1836379.392	5.341	1541001F	647585.267	1836379.401	3.213
1541002C	647585.400	1836379.128	5.345	1541002F	647585.397	1836379.132	3.324
1541003C	647585.526	1836378.832	5.340	1541003F	647585.531	1836378.830	3.321
RT1541004	647585.664	1836378.561	5.340	R1541004R	647585.665	1836378.567	3.248
1541005C	647585.807	1836378.272	5.346	1541005F	647585.805	1836378.273	3.221
1541006C	647585.924	1836378.001	5.348	1541006F	647585.928	1836378.003	3.249
RT1541007	647586.058	1836377.711	5.343	R1541007R	647586.063	1836377.712	3.281
RT1541008	647586.176	1836377.443	5.339	R1541008R	647586.182	1836377.447	3.228
1541009C	647586.328	1836377.139	5.340	1541009F	647586.331	1836377.140	3.211
T1541010	647586.462	1836376.876	5.342	1541010F	647586.461	1836376.877	3.306
1541011C	647586.599	1836376.590	5.346	1541011F	647586.604	1836376.585	3.330
1541012C	647586.721	1836376.310	5.345	1541012F	647586.730	1836376.307	3.296
1541013C	647586.870	1836376.017	5.345	1541013F	647586.870	1836376.017	3.292
1542001C	647601.648	1836377.583	5.337	1542001F	647601.652	1836377.583	3.279
1542002C	647601.527	1836377.836	5.339	1542002F	647601.527	1836377.840	3.376
1542003C	647601.386	1836378.139	5.337	1542003F	647601.388	1836378.139	3.275
1542004C	647601.258	1836378.386	5.339	1542004F	647601.251	1836378.391	3.182
1542005C	647601.111	1836378.690	5.341	1542005F	647601.114	1836378.695	3.249
1542006C	647600.978	1836378.959	5.336	1542006F	647600.986	1836378.963	3.289
1542007C	647600.832	1836379.255	5.337	1542007F	647600.837	1836379.261	3.191
1542008C	647600.733	1836379.524	5.336	1542008F	647600.728	1836379.526	3.179
1542009C	647600.587	1836379.817	5.337	1542009F	647600.585	1836379.824	3.209
1542010C	647600.456	1836380.074	5.339	1542010F	647600.457	1836380.081	3.294
1542011C	647600.316	1836380.390	5.336	1542011F	647600.314	1836380.393	3.229
1542012C	647600.192	1836380.658	5.336	1542012F	647600.191	1836380.660	3.241
1542013C	647600.034	1836380.959	5.340	1542013F	647600.041	1836380.961	3.279
1551001C	647593.494	1836371.458	5.338	1551001F	647593.500	1836371.456	3.268
1551002C	647593.826	1836371.424	5.338	1551002F	647593.829	1836371.431	3.247
1551003C	647594.127	1836371.413	5.354	1551003F	647594.130	1836371.409	3.269
1551004C	647594.456	1836371.378	5.351	1551004F	647594.457	1836371.381	3.300
1551005C	647594.744	1836371.354	5.334	1551005F	647594.746	1836371.357	3.238
1551006C	647595.071	1836371.328	5.333	1551006F	647595.079	1836371.335	3.202
1551007C	647595.355	1836371.304	5.333	1551007F	647595.360	1836371.307	3.194
1551008C	647595.703	1836371.284	5.333	1551008F	647595.706	1836371.290	3.295
1551009C	647595.982	1836371.265	5.334	1551009F	647595.990	1836371.261	3.250
RT1551010	647596.321	1836371.227	5.336	R1551010R	647596.317	1836371.228	3.219
1551011C	647596.619	1836371.221	5.333	1551011F	647596.622	1836371.219	3.255
1551012C	647596.937	1836371.179	5.335	1551012F	647596.936	1836371.183	3.313
1551013C	647597.226	1836371.174	5.335	1551013F	647597.230	1836371.167	3.223
1552001C	647593.415	1836385.510	5.345	1552001F	647593.421	1836385.509	3.215
RT1552002	647593.120	1836385.547	5.342	R1552002R	647593.115	1836385.542	3.232
RT1552003	647592.783	1836385.554	5.335	R1552003R	647592.794	1836385.557	3.225
RT1552004	647592.485	1836385.598	5.333	R1552004R	647592.483	1836385.590	3.237
RT1552005	647592.149	1836385.615	5.332	R1552005R	647592.161	1836385.615	3.239
RT1552006	647591.876	1836385.638	5.333	R1552006R	647591.873	1836385.638	3.233
RT1552007	647591.560	1836385.666	5.333	R1552007R	647591.563	1836385.663	3.232
RT1552008	647591.263	1836385.679	5.331	R1552008R	647591.256	1836385.679	3.246
RT1552009	647590.935	1836385.710	5.336	R1552009R	647590.939	1836385.707	3.215
RT1552010	647590.618	1836385.760	5.335	R1552010R	647590.617	1836385.755	3.224
RT1552011	647590.302	1836385.784	5.336	R1552011R	647590.310	1836385.776	3.275

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Point # Top	Top Northing	Top Easting	Top Elevation	Point # Bottom	Bottom Northing	Bottom Easting	Bottom Elevation
RT1552012	647589.997	1836385.810	5.338	R1552012R	647589.996	1836385.801	3.224
RT1552013	647589.686	1836385.793	5.337	R1552013R	647589.689	1836385.796	3.239
1561001C	647587.365	1836375.773	5.345	1561001F	647587.367	1836375.783	3.203
1561002C	647587.670	1836375.925	5.346	1561002F	647587.667	1836375.932	3.235
R61561003	647587.927	1836376.052	5.336	R61561003R	647587.9296	1836376.055	3.207
1561004C	647588.222	1836376.179	5.343	1561004F	647588.225	1836376.187	3.207
1561005C	647588.491	1836376.311	5.347	1561005F	647588.491	1836376.320	0.251
1561006C	647588.792	1836376.456	5.342	1561006F	647588.789	1836376.462	3.206
R61561007	647589.054	1836376.584	5.336	R6156107R	647589.0578	1836376.587	3.229
R61561008	647589.349	1836376.728	5.341	R61561008R	647589.3499	1836376.735	3.216
1562001C	647599.570	1836381.173	5.338	1562001F	647599.571	1836381.173	3.235
1562002C	647599.285	1836381.017	5.339	1562002F	647599.282	1836381.022	3.255
1562003C	647598.998	1836380.882	5.331	1562003F	647599.003	1836380.892	3.231
1562004C	647598.710	1836380.747	5.337	1562004F	647598.715	1836380.755	3.234
1562005C	647598.435	1836380.628	5.359	1562005F	647598.436	1836380.636	3.320
1562006C	647598.145	1836380.488	5.340	1562006F	647598.150	1836380.496	3.227
1562007C	647597.878	1836380.360	5.340	1562007F	647597.876	1836380.363	3.230
1562008C	647597.568	1836380.212	5.334	1562008F	647597.568	1836380.222	3.293
1571001C	647593.304	1836374.023	5.336	1571001F	647593.301	1836374.024	3.299
1571002C	647593.280	1836373.701	5.334	1571002F	647593.279	1836373.705	3.254
1571003C	647593.235	1836373.401	5.340	1571003F	647593.239	1836373.408	3.244
1571004C	647593.225	1836373.075	5.338	1571004F	647593.222	1836373.072	3.304
1571005C	647593.198	1836372.787	5.336	1571005F	647593.193	1836372.785	3.237
1571006C	647593.175	1836372.452	5.339	1571006F	647593.177	1836372.452	3.204
1571007C	647593.139	1836372.159	5.333	1571007F	647593.144	1836372.160	3.279
1571008C	647593.116	1836371.823	5.338	1571008F	647593.117	1836371.822	3.243
1572001C	647593.634	1836382.931	5.343	1572001F	647593.638	1836382.924	3.221
1572002C	647593.678	1836383.268	5.342	1572002F	647593.682	1836383.273	3.204
1572003C	647593.695	1836383.550	5.346	1572003F	647593.701	1836383.556	3.192
1572004C	647593.721	1836383.894	5.344	1572004F	647593.727	1836383.901	3.193
1572005C	647593.748	1836384.180	5.347	1572005F	647593.748	1836384.179	3.189
1572006C	647593.765	1836384.526	5.343	1572006F	647593.771	1836384.521	3.185
1572007C	647593.793	1836384.814	5.343	1572007F	647593.799	1836384.815	3.212
1572008C	647593.823	1836385.136	5.346	1572008F	647593.826	1836385.142	3.210
1581001C	647588.070	1836374.642	5.341	1581001F	647588.072	1836374.650	3.308
1581002C	647588.330	1836374.485	5.341	1581002F	647588.336	1836374.483	3.210
1581003C	647588.581	1836374.309	5.342	1581003F	647588.582	1836374.312	3.217
1581004C	647588.828	1836374.139	5.341	1581004F	647588.827	1836374.141	3.238
1581005C	647589.058	1836373.968	5.343	1581005F	647589.066	1836373.972	3.227
1581006C	647589.327	1836373.798	5.340	1581006F	647589.333	1836373.801	3.208
1581007C	647589.560	1836373.631	5.340	1581007F	647589.557	1836373.628	3.307
1581008C	647589.815	1836373.457	5.340	1581008F	647589.817	1836373.463	3.219
1582001C	647598.864	1836382.334	5.335	1582001F	647598.861	1836382.336	3.284
1582002C	647598.597	1836382.499	5.336	1582002F	647598.605	1836382.497	3.260
1582003C	647598.358	1836382.662	5.335	1582003F	647598.365	1836382.664	3.211
1582004C	647598.103	1836382.846	5.339	1582004F	647598.106	1836382.845	3.255
1582005C	647597.865	1836383.008	5.344	1582005F	647597.869	1836383.005	3.279
1582006C	647597.600	1836383.184	5.340	1582006F	647597.603	1836383.187	3.340
1582007C	647597.367	1836383.337	5.343	1582007F	647597.368	1836383.336	3.248
1582008C	647597.109	1836383.514	5.339	1582008F	647597.110	1836383.518	3.240
1591001C	647590.059	1836373.289	5.341	1591001F	647590.061	1836373.296	3.196
RT1591002	647590.052	1836373.291	5.339	R1591002R	647590.054	1836373.291	3.229
1591003C	647590.548	1836372.940	5.343	1591003F	647590.555	1836372.942	3.319
1591004C	647590.809	1836372.778	5.340	1591004F	647590.813	1836372.778	3.221
1591005C	647591.045	1836372.602	5.343	1591005F	647591.044	1836372.607	3.208
1591006C	647591.301	1836372.425	5.349	1591006F	647591.302	1836372.432	3.232
1591007C	647591.523	1836372.272	5.341	1591007F	647591.528	1836372.270	3.241
RT1591008	647591.784	1836372.081	5.341	R1591008R	647591.788	1836372.079	3.226
1592001C	647596.883	1836383.671	5.340	1592001F	647596.891	1836383.668	3.242
1592002C	647596.621	1836383.853	5.341	1592002F	647596.626	1836383.852	3.269
1592003C	647596.382	1836384.018	5.340	1592003F	647596.383	1836384.018	3.237
1592004C	647596.130	1836384.183	5.341	1592004F	647596.136	1836384.185	3.234

As-Built Anchor Rod Survey

Point # Top	Top Northing	Top Easting	Top Elevation	Point # Bottom	Bottom Northing	Bottom Easting	Bottom Elevation
1592005C	647595.882	1836384.352	5.341	1592005F	647595.884	1836384.354	3.242
1592006C	647595.626	1836384.532	5.337	1592006F	647595.628	1836384.535	3.239
1592007C	647595.379	1836384.691	5.342	1592007F	647595.386	1836384.695	3.278
1592008C	647595.128	1836384.872	5.340	1592008F	647595.132	1836384.873	3.341
1601001C	647591.070	1836375.254	5.341	1601001F	647591.070	1836375.255	3.207
1601002C	647590.843	1836375.419	5.342	1601002F	647590.840	1836375.426	3.214
1601003C	647590.580	1836375.611	5.344	1601003F	647590.577	1836375.607	3.208
1601004C	647590.348	1836375.769	5.343	1601004F	647590.340	1836375.769	3.211
1602001C	647595.859	1836381.690	5.343	1602001F	647595.857	1836381.687	3.218
1602002C	647596.102	1836381.532	5.340	1602002F	647596.103	1836381.527	3.229
1602003C	647596.355	1836381.343	5.341	1602003F	647596.356	1836381.340	3.232
1602004C	647596.600	1836381.184	5.339	1602004F	647596.596	1836381.183	3.211
1611001C	647592.047	1836374.584	5.347	1611001F	647592.048	1836374.585	3.203
1611002C	647591.824	1836374.748	5.348	1611002F	647591.819	1836374.747	3.209
1611003C	647591.562	1836374.928	5.349	1611003F	647591.564	1836374.926	3.201
RT1611004	647591.323	1836375.084	5.345	R1611004R	647591.321	1836375.083	3.244
1612001C	647594.890	1836382.378	5.339	1612001F	647594.893	1836382.380	3.215
1612002C	647595.127	1836382.212	5.339	1612002F	647595.129	1836382.208	3.206
1612003C	647595.378	1836382.038	5.338	1612003F	647595.380	1836382.034	3.214
1612004C	647595.615	1836381.867	5.343	1612004F	647595.615	1836381.862	3.205
RT1621001	647595.249	1836377.104	5.339	R1621001R	647595.251	1836377.098	3.460
1621002C	647595.207	1836376.381	5.343	1621002F	647595.207	1836376.384	3.175
RT1621003	647595.490	1836376.168	5.336	R1621003R	647595.490	1836376.170	3.146
1621004C	647595.728	1836376.033	5.342	1621004F	647595.729	1836376.028	3.228
1621005C	647596.019	1836375.827	5.337	1621005F	647596.016	1836375.829	3.248
1621006C	647596.252	1836375.671	5.343	1621006F	647596.254	1836375.670	3.193
1621007C	647596.534	1836375.487	5.339	1621007F	647596.530	1836375.486	3.211
1621008C	647596.760	1836375.324	5.341	1621008F	647596.765	1836375.318	3.184
1621009C	647597.038	1836375.132	5.344	1621009F	647597.035	1836375.127	3.199
1621010C	647597.278	1836374.966	5.345	1621010F	647597.276	1836374.967	3.180
1621011C	647597.557	1836374.788	5.341	1621011F	647597.555	1836374.782	3.192
1621012C	647598.132	1836375.096	5.346	1621012F	647598.133	1836375.096	3.203
1622001C	647591.673	1836379.892	5.344	1622001F	647591.676	1836379.898	3.202
1622002C	647591.711	1836380.592	5.343	1622002F	647591.708	1836380.599	3.282
RT1622003	647591.421	1836380.785	5.337	R1622003R	647591.422	1836380.783	3.272
1622004C	647591.183	1836380.939	5.343	1622004F	647591.188	1836380.942	3.210
1622005C	647590.911	1836381.135	5.343	1622005F	647590.913	1836381.137	3.205
1622006C	647590.688	1836381.297	5.342	1622006F	647590.694	1836381.295	3.222
1622007C	647590.404	1836381.487	5.338	1622007F	647590.410	1836381.485	3.215
RT1622008	647590.162	1836381.657	5.333	R1622008R	647590.158	1836381.655	3.255
RT1622009	647589.888	1836381.836	5.336	R1622009R	647589.884	1836381.831	3.327
1622010C	647589.685	1836382.005	5.350	1622010F	647589.679	1836382.010	3.212
1622011C	647589.393	1836382.197	5.343	1622011F	647589.392	1836382.195	3.212
RT1622012	647588.785	1836381.855	5.336	R1622012R	647588.783	1836381.859	3.275




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Anchor Rod / Sleeve Layout		
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Scale:	AS NOTED	Sheet: 1



Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products¹

This standard is issued under the fixed designation A123/A123M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers the requirements for zinc coating (galvanizing) by the hot-dip process on iron and steel products made from rolled pressed and forged shapes, castings, plates, bars, and strips.

1.2 This specification covers both unfabricated products and fabricated products, for example, assembled steel products, structural steel fabrications, large tubes already bent or welded before galvanizing, and wire work fabricated from uncoated steel wire. This specification also covers steel forgings and iron castings incorporated into pieces fabricated before galvanizing or which are too large to be centrifuged (or otherwise handled to remove excess galvanizing bath metal).

NOTE 1—This specification covers those products previously addressed in Specifications A123-78 and A386-78.

1.3 This specification does not apply to wire, pipe, tube, or steel sheet which is galvanized on specialized or continuous lines, or to steel less than 22 gage (0.0299 in.) [0.76 mm] thick.

1.4 The galvanizing of hardware items that are to be centrifuged or otherwise handled to remove excess zinc (such as bolts and similar threaded fasteners, castings and rolled, pressed and forged items) shall be in accordance with Specification [A153/A153M](#).

1.5 Fabricated reinforcing steel bar assemblies are covered by the present specification. The galvanizing of separate reinforcing steel bars shall be in accordance with Specification [A767/A767M](#).

1.6 This specification is applicable to orders in either inch-pound units (as A123) or SI units (as A123M). Inch-pound units and SI units are not necessarily exact equivalents. Within the text of this specification and where appropriate, SI units are shown in parentheses. Each system shall be used independently of the other without combining values in any way. In the case of orders in SI units, all testing and inspection shall be done using the metric equivalent of the test or

inspection method as appropriate. In the case of orders in SI units, such shall be stated to the galvanizer when the order is placed.

2. Referenced Documents

2.1 ASTM Standards:²

- [A47/A47M](#) Specification for Ferritic Malleable Iron Castings
- [A90/A90M](#) Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
- [A143/A143M](#) Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
- [A153/A153M](#) Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- [A384/A384M](#) Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
- [A385](#) Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
- [A767/A767M](#) Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
- [A780](#) Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- [A902](#) Terminology Relating to Metallic Coated Steel Products
- [B6](#) Specification for Zinc
- [B487](#) Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section
- [B602](#) Test Method for Attribute Sampling of Metallic and Inorganic Coatings
- [B960](#) Specification for Prime Western Grade-Recycled (PWG-R) Zinc
- [E376](#) Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods

¹ This specification is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.13 on Structural Shapes and Hardware Specifications.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard.

3. Terminology (See Fig. 1)

3.1 Definitions:

3.1.1 The following terms and definitions are specific to this specification. Terminology A902 contains other terms and definitions relating to metallic-coated steel products.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *average coating thickness, n*—the average of three specimen coating thicknesses.

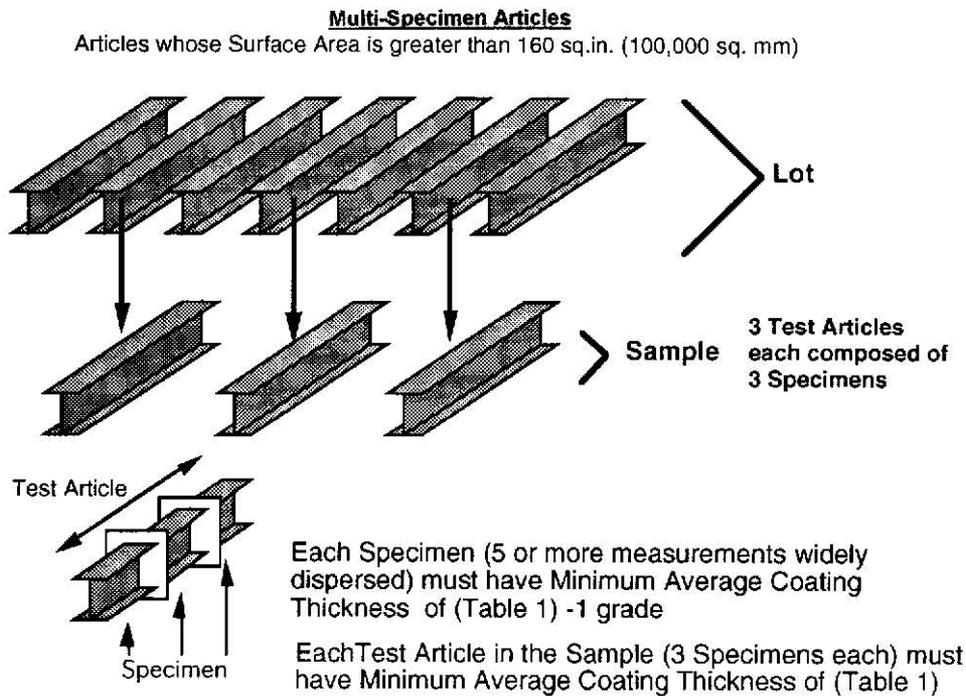
3.2.2 *black, adj*—denotes the condition of not galvanized or otherwise coated. For purposes of this specification the word

“black” does not refer to the color or condition of surface, or to a surface deposit or contamination.

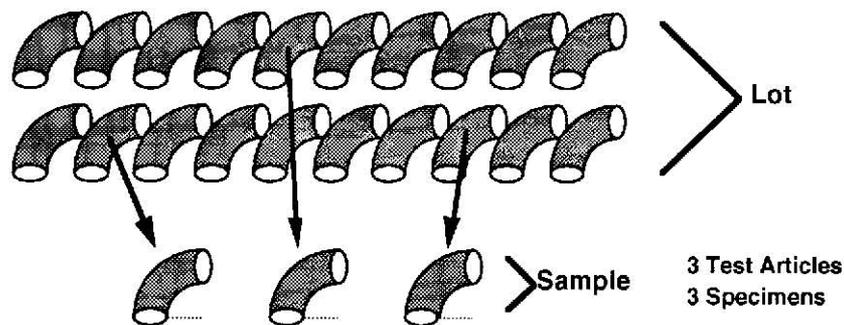
3.2.3 *coating thickness grade, n*—the numerical value from Table 1 at the intersection of a material category and a thickness range.

3.2.4 *gross dross inclusions, n*—the iron/zinc intermetallics present in a galvanized coating in a form other than finely dispersed pimples.

3.2.4.1 *Discussion*—These inclusions would create an exposed steel spot if they were removed from the coating. These



Single-specimen Articles
Articles whose Surface Area is equal to or less than 160 sq.in. (100,000 sq. mm)



Each Specimen (5 or more measurements widely dispersed) must have Minimum Average Coating Thickness of (Table 1) -1 grade

All Test Articles (Specimens) Together must have Minimum Average Coating Thickness of (Table 1)

FIG. 1 Single- and Multi-Specimen Articles

TABLE 1 Minimum Average Coating Thickness Grade by Material Category

Material Category	All Specimens Tested				
	Steel Thickness Range (Measured), in. (mm)				
	<1/16 (<1.6)	1/16 to <1/8 (1.6 to <3.2)	1/8 to 3/16 (3.2 to 4.8)	>3/16 to <1/4 (>4.8 to <6.4)	≥1/4 (≥6.4)
Structural Shapes and Plate	45	65	75	75	100
Strip and Bar	45	65	75	75	100
Pipe and Tubing	45	45	75	75	75
Wire	35	50	60	65	80
Reinforcing Bar	100

inclusions are raised surfaces and are easily knocked off through contact with lifting straps or chains, tools, fixtures, or other galvanized parts.

3.2.5 *material category, n*—the general class or type of material or process of manufacture, or both, that nominally describes a unit of product, or from which a unit of product is made. For example, bar grating belongs to the category “strip,” handrail belongs to the category “pipe,” etc.

3.2.6 *multi-specimen article, n*—a unit of product whose surface area is greater than 160 in.² [100 000 mm²]. For thickness testing purposes, articles whose surface area is greater than 160 in.² are subdivided into three continuous local sections, nominally equal in surface area, each of which constitutes a specimen. In the case of any such local section containing more than one material category or steel thickness range as delineated in Table 1, that section will contain more than one specimen (see Fig. 1).

3.2.7 *sample, n*—a collection of individual units of product from a single lot selected in accordance with Section 7, and intended to represent that lot for acceptance. If a sample is taken as representing the lot for acceptance, the sample shall be taken at random from the lot without regard to the perceived quality or appearance of any individual unit in the lot being sampled. The sample consists of one or more test articles.

3.2.8 *single-specimen article, n*—a unit of product whose surface area is equal to or less than 160 in.² [100 000 mm²] or that is centrifuged or otherwise similarly handled in the galvanizing process to remove excess galvanizing bath metal (free zinc). For thickness testing purposes, the entire surface area of each unit of product constitutes a specimen. In the case of any such article containing more than one material category or steel thickness range as delineated in Table 1, that article will contain more than one specimen (see Fig. 1).

3.2.9 *specimen, n*—the surface of an individual test article or a portion of a test article, upon which thickness measurements are to be performed, which is a member of a lot, or a member of a sample representing that lot. For magnetic thickness measurements, specimen excludes any area of the surface which is subject to processes (such as flame cutting, machining, threading, etc.) that can be expected to result in surface conditions not representative of the general surface condition of the test article, or is disqualified by the measurement method. The minimum average coating thickness grade for any specimen shall be one coating grade below that required for the appropriate material category and thickness in Table 1. For a unit of product whose surface area is equal to or less than 160 in.² [100 000 mm²], the entire surface area of each test article constitutes a specimen. In the case of an article

containing more than one material category or steel thickness range as delineated in Table 1, that article will contain more than one specimen, as appropriate (see Fig. 1).

3.2.10 *specimen coating thickness, n*—the average thickness from no less than five test measurements on a specimen, when each measurement location is selected to provide the widest dispersion (in all applicable directions) of locations for the steel category of the test article within the confines of the specimen volume.

3.2.11 *test article, n*—an individual unit of product that is a member of the sample and that is examined for conformance to a part of this specification.

4. Ordering Information

4.1 Orders for coatings provided under this specification shall include the following:

- 4.1.1 Quantity (number of pieces to be galvanized) and total weight.
- 4.1.2 Description (type and size of products) and weight.
- 4.1.3 ASTM specification designation and year of issue.
- 4.1.4 Material identification (see 5.1) and surface condition or contamination.
- 4.1.5 Sampling plan, if different from 7.3.
- 4.1.6 Special test requirements (see 8.1).
- 4.1.7 Special requirements (special stacking, heavier coating weight, etc.).
- 4.1.8 Tagging or piece identification method.

5. Materials and Manufacture

5.1 *Steel or Iron*—The specification, grade, or designation and type and degree of surface contamination of the iron or steel in articles to be galvanized shall be supplied by the purchaser to the hot-dip galvanizer prior to galvanizing.

NOTE 2—The presence in steels and weld metal, in certain percentages, of some elements such as silicon, carbon, and phosphorus tends to accelerate the growth of the zinc-iron alloy layer so that the coating may have a matte finish with little or no outer zinc layer. The galvanizer has only limited control over this condition. The mass, shape, and amount of cold working of the product being galvanized may also affect this condition. Practice A385 provides guidance on steel selection and discusses the effects of various elements in steel compositions (for example, silicon), that influence coating weight and appearance.

5.2 *Fabrication*—The design and fabrication of the product to be galvanized are the responsibilities of the designer and the fabricator. Practices A143/A143M, A384/A384M, and A385 provide guidance for steel fabrication for optimum hot dip galvanizing and shall be complied with in both design and fabrication. Consultation between the designer, fabricator, and

galvanizer at appropriate stages in the design and fabrication process will reduce future problems.

5.3 *Castings*—The composition and heat treatment of iron and steel castings shall conform to specifications designated by the purchaser. Some types of castings have been known to show potential problems with predisposition to being embrittled during the normal thermal cycle of hot-dip galvanizing. It is the responsibility of the purchaser to heat treat or otherwise allow for the possibility of such embrittling phenomena. The requirements for malleable iron castings to be galvanized shall be as stated in Specification A47/A47M.

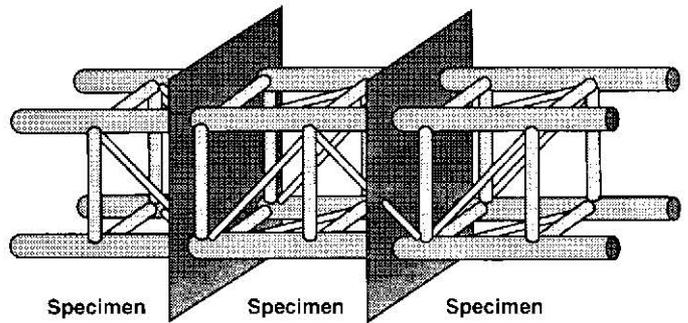
5.4 *Zinc*—The zinc used in the galvanizing bath shall conform to Specification B6, or Specification B960, or both. If a zinc alloy is used as the primary feed to the galvanizing bath, then the base material used to make that alloy shall conform to Specification B6, or Specification B960, or both.

5.5 *Bath Composition*—The molten metal in the working volume of the galvanizing bath shall contain not less than an average value of 98.0 % zinc by weight.

NOTE 3—The galvanizer may choose to add trace amounts of certain elements (for example, aluminum, nickel, and tin) to the zinc bath to help in the processing of certain reactive steels or to enhance the cosmetic appearance of the finished product. The use of these trace elements is permitted provided that the bulk chemistry of the galvanizing bath is at least 98.0 % zinc by weight. The elements can be added to the galvanizing bath as part of a pre-alloyed zinc feed, or they can be added to the bath by the galvanizer using a master feed alloy.

6. Coating Properties

6.1 *Coating Thickness*—The average thickness of coating for all specimens tested shall conform to the requirements of Table 1 for the categories and thicknesses of the material being galvanized. Minimum average thickness of coating for any individual specimen is one coating grade less than that required in Table 1. Where products consisting of various material thicknesses or categories are galvanized, the coating thickness grades for each thickness range and material category of material shall be as shown in Table 1. In the case of orders in SI units, the values in Table 1, shall be applicable as metric units in micrometres. In the case of orders in inch-pound units, the measured value shall be converted to coating grade units by the use of Table 2. The specification of coating thicknesses heavier than those required by Table 1 shall be subject to mutual agreement between the galvanizer and the purchaser. (Fig. 2 is a graphic representation of the sampling and



NOTE 1—Each specimen comprises nominally one third of the total surface area of the article. A minimum of five measurements should be made within the volume of each specimen, as widely dispersed within that volume as is practical, so as to represent as much as possible, the general coating thickness within that specimen volume.

FIG. 2 Articles Made of Many Components

specimen delineation steps, and Fig. 3 is a graphic representation of the coating thickness inspection steps.)

6.1.1 For articles whose surface area is greater than 160 in.² [100 000 mm²] (multi-specimen articles), each test article in the sample must meet the appropriate minimum average coating thickness grade requirements of Table 1, and each specimen coating thickness grade comprising that overall average for each test article shall average not less than one coating grade below that required in Table 1.

6.1.2 For articles whose surface area is equal to or less than 160 in.² [100 000 mm²] (single-specimen articles), the average of all test articles in the sample must meet the appropriate minimum average coating thickness grade requirements of Table 1, and for each test article, its specimen coating thickness shall be not less than one coating grade below that required in Table 1.

6.1.3 No individual measurement, or cluster of measurements at the same general location, on a test specimen shall be cause for rejection under the coating thickness requirements of this specification provided that when those measurements are averaged with the other dispersed measurements to determine the specimen coating thickness grade for that specimen, the requirements of 6.1.1 or 6.1.2, as appropriate are met.

NOTE 4—The coating thickness grades in Table 1 represent the minimum value obtainable with a high level of confidence for the ranges typically found in each material category. While most coating thicknesses

TABLE 2 Coating Thickness Grade^A

Coating Grade	mils	oz/ft ²	µm	g/m ²
35	1.4	0.8	35	245
45	1.8	1.0	45	320
50	2.0	1.2	50	355
55	2.2	1.3	55	390
60	2.4	1.4	60	425
65	2.6	1.5	65	460
75	3.0	1.7	75	530
80	3.1	1.9	80	565
85	3.3	2.0	85	600
100	3.9	2.3	100	705

^A The values in micrometres (µm) are based on the Coating Grade. The other values are based on conversions using the following formulas: mils = µm × 0.03937; oz/ft² = µm × 0.02316; g/m² = µm × 7.067.

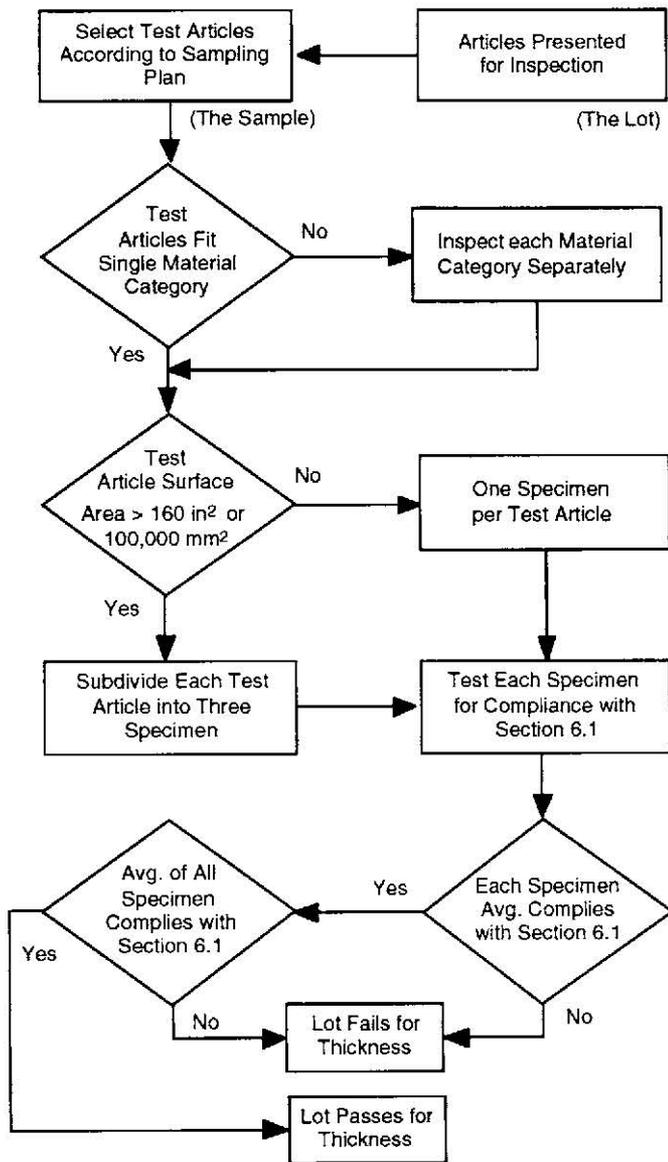


FIG. 3 Coating Thickness Inspection Steps

will be in excess of those values, some materials in each category may be less reactive (for example, because of chemistry or surface condition) than other materials of the steel category spectrum. Therefore, some articles may have a coating grade at or close to the minimum requirement shown in Table 1. In such cases, the precision and accuracy of the coating thickness measuring technique should be taken into consideration when rejecting such articles for coating thickness below that required by this specification. Purchasers desiring a guarantee of heavier coatings than the minimum thicknesses shown herein should use the special requirements (see 4.1.6) to specify coating thickness grades higher than those shown in Table 1. In addition, the purchaser should anticipate the need for test batches or extra preparation steps, or both, such as blasting before galvanizing or other methods, to attempt to reach the higher requirements with consistency. Some higher-than-standard thicknesses may be impractical or unattainable.

6.2 *Finish*—The coating shall be continuous (except as provided below), and as reasonably smooth and uniform in thickness as the weight, size, shape of the item, and necessary handling of the item during the dipping and draining operations

at the galvanizing kettle will permit. Except for local excess coating thickness which would interfere with the use of the product, or make it dangerous to handle (edge tears or spikes), rejection for nonuniform coating shall be made only for plainly visible excess coating not related to design factors such as holes, joints, or special drainage problems (see Note 6). Since surface smoothness is a relative term, minor roughness that does not interfere with the intended use of the product, or roughness that is related to the as-received (un-galvanized) surface condition, steel chemistry, or steel reactivity to zinc shall not be grounds for rejection (see Note 7). Surface conditions related to deficiencies related to design, detailing, or fabrication as addressed by Practice A385 shall not be grounds for rejection. The zinc coating on threaded components of articles galvanized under this specification shall conform to that required in Specification A153/A153M. Surfaces that remain uncoated after galvanizing shall be renovated in accordance with the methods in Practice A780 unless directed by the purchaser to leave the uncoated areas untreated for subsequent renovation by the purchaser.

6.2.1 Each area subject to renovation shall be 1 in. [25 mm] or less in its narrowest dimension.

6.2.2 The total area subject to renovation on each article shall be no more than ½ of 1 % of the accessible surface area to be coated on that article, or 36 in.² per short ton [256 cm² per metric ton] of piece weight, whichever is less.

NOTE 5—Inaccessible surface areas are those which cannot be reached for appropriate surface preparation and application of repair materials as described in Practice A780. Such inaccessible areas, for example, would be the internal surfaces of certain tanks, poles, pipes, tubes, and so forth.

6.2.3 The thickness of renovation shall be that required by the thickness grade for the appropriate material category and thickness range in Table 1 in accordance with the requirements of 6.1, except that for renovation using zinc paints, the thickness of renovation shall be 50 % higher than that required by Table 1, but not greater than 4.0 mils.

6.2.4 When areas requiring renovation exceed the criteria previously provided, or are inaccessible for repair, the coating shall be rejected.

NOTE 6—The requirements for the finish of a galvanized product address themselves to a visual type of inspection. They do not address the matter of measured coating thickness variations that can be encountered because of different steels or different thicknesses of a given steel being used in an assembly.

NOTE 7—Items which are prepared for galvanizing by abrasive cleaning will generally develop a thicker coating with a moderately rougher surface.

6.3 *Threaded Components in Assemblies*—The zinc coating on external threads shall not be subjected to a cutting, rolling, or finishing tool operation, unless specifically authorized by the purchaser. Internal threads are not prohibited from being tapped or retapped after galvanizing. Coatings shall conform to the requirements of Specification A153/A153M.

6.4 *Appearance*—Upon shipment from the galvanizing facility, galvanized articles shall be free from uncoated areas, blisters, flux deposits, and gross cross inclusions. Lumps, projections, globules, or heavy deposits of zinc which will interfere with the intended use of the material will not be



permitted. Plain holes of 1/2-in. [12.5-mm] diameter or more shall be clean and reasonably free from excess zinc. Marks in the zinc coating caused by tongs or other items used in handling the article during the galvanizing operation shall not be cause for rejection unless such marks have exposed the base metal and the bare metal areas exceed allowable maximums from 6.2.1 and 6.2.2. The pieces shall be handled so that after galvanizing they will not freeze together on cooling.

NOTE 8—Depending upon product design or material thickness, or both, filming or excess zinc buildup in plain holes of less than 1/2-in. [12.5-mm] diameter may occur that requires additional work to make the holes usable as intended.

6.5 *Adherence*—The zinc coating shall withstand handling consistent with the nature and thickness of the coating and the normal use of the article, without peeling or flaking.

NOTE 9—Although some material may be formed after galvanizing, in general the zinc coating on the articles covered by this specification is too heavy to permit severe bending without damaging the coating.

7. Sampling

7.1 Sampling of each lot shall be performed for conformance with the requirements of this specification.

7.2 A lot is a unit of production or shipment from which a sample is taken for testing. Unless otherwise agreed upon between the galvanizer and the purchaser, or established within this specification, the lot shall be as follows: For testing at a galvanizer’s facility, a lot is one or more articles of the same type and size comprising a single order or a single delivery load, whichever is the smaller, or any number of articles identified as a lot by the galvanizer, when these have been galvanized within a single production shift and in the same bath. For test by the purchaser after delivery, the lot consists of the single order or the single delivery load, whichever is the smaller, unless the lot identity, established in accordance with the above, is maintained and clearly indicated in the shipment by the galvanizer.

7.3 The method of selection and number of test specimens shall be agreed upon between the galvanizer and the purchaser. Otherwise, the test specimens shall be selected at random from each lot. In this case, the minimum number of specimens from each lot shall be as follows:

Number of Pieces in Lot	Number of Specimens
3 or less	all
4 to 500	3
501 to 1 200	5
1 201 to 3 200	8
3 201 to 10 000	13
10 001 and over	20

NOTE 10—Where a number of identical items are to be galvanized, a statistical sampling plan may be desired. Such a plan is contained in Test Method B602 which addresses sampling procedures for the inspection of electrodeposited metallic coatings and related finishes. If Test Method B602 is used, the level of sampling shall be agreed upon between the galvanizer and the purchaser at the time the coating order is placed.

7.4 A test specimen which fails to conform to a requirement of this specification shall not be used to determine the conformance to other requirements.

8. Test Methods

8.1 *Test Requirements*—The following tests shall be conducted to ensure that the zinc coating is being furnished in accordance with this specification. The specifying of tests for adhesion and embrittlement shall be subject to mutual agreement between the galvanizer and purchaser. Visual inspection of the coating shall be made for compliance with the requirements.

8.2 *Thickness of Coating Test*—The thickness of coating is determined by one or more of the three methods described as follows.

8.2.1 *Magnetic Thickness Measurements*— The thickness of the coating shall be determined by magnetic thickness gage measurements in accordance with Practice E376 unless the methods described in 8.2.2, 8.2.3, or 8.2.4 are used. For each specimen (as described in 3.2.9) five or more measurements shall be made at points widely dispersed throughout the volume occupied by the specimen so as to represent as much as practical, the entire surface area of the test specimen. The average of the five or more measurements thus made for each specimen is the specimen coating thickness.

8.2.1.1 For articles whose surface area is greater than 160 in.² [100 000 mm²] (multi-specimen articles as described in 3.2.6), the average of the three specimen coating thickness grades comprising each test article is the average coating thickness for that test article. A specimen must be evaluated for each steel category and material thickness within the requirements for each specimen of the test article.

8.2.1.2 For articles whose surface area is equal to or less than 160 in.² [100 000 mm²] (single-specimen articles as described in 3.2.8), the average of all specimen coating thickness grades is the average coating thickness for the sample.

8.2.1.3 In the case of threaded components, the thickness of coating shall be made on a portion of the article that does not include any threads.

8.2.1.4 The use of magnetic measurement methods is appropriate for larger articles, and is appropriate for smaller articles when there is sufficient flat surface area for the probe tip to sit flat on the surface using Practice E376.

8.2.2 *Stripping Method*—The average weight of coating shall be determined by stripping a test article, a specimen removed from a test article, or group of test articles in the case of very small items such as nails, etc., in accordance with Test Method A90/A90M unless the methods described in 8.2.1, 8.2.3, or 8.2.4 are used. The weight of coating per unit area thus determined is converted to equivalent coating thickness values in accordance with Table 2 (rounding up or down as appropriate). The thickness of coating thus obtained is the test article coating thickness, or in the case of a specimen removed from a test article, is the specimen average coating thickness.

8.2.2.1 The stripping method is a destructive test and is appropriate for single specimen articles, but is not practical for multi-specimen articles.

8.2.3 *Weighing Before and After Galvanizing*—The average weight of coating shall be determined by weighing articles before and after galvanizing, subtracting the first weight from the second and dividing the result by the surface area unless the



methods described in 8.2.1, 8.2.2, or 8.2.4 are used. The first weight shall be determined after pickling and drying and the second after cooling to ambient temperature. The weight of coating per unit area thus determined is converted to equivalent coating thickness values according to Table 2 (rounding up or down as appropriate). The thickness of coating thus obtained is the test article coating thickness.

8.2.3.1 The weighing before and after method is appropriate for single-specimen articles, but is not practical for multi-specimen articles.

NOTE 11—Both the stripping method and the weighing before and after method do not take into account the weight of iron reacted from the article that is incorporated into the coating. Thus, the methods may underestimate coating weight (and therefore the calculated thickness) by up to 10 %. The accuracy of both methods will be influenced by the accuracy to which the surface area of the articles tested can be determined.

8.2.4 *Microscopy*—The thickness of coating shall be determined by cross-sectional and optical measurement in accordance with Test Method B487 unless the methods described in 8.2.1, 8.2.2, or 8.2.3 are used. The thickness thus determined is a point value. No less than five such measurements shall be made at locations on the test article which are as widely dispersed as practical, so as to be representative of the whole surface of the test article. The average of no less than five such measurements is the specimen coating thickness.

8.2.4.1 The microscopy method is a destructive test and is appropriate for single-specimen articles, but is not practical for multi-specimen articles.

8.2.5 *Referee Method*—In the event of a dispute over thickness of coating measurements, the dispute shall be resolved as follows:

8.2.5.1 For multi-specimen articles, a new sample shall be taken randomly from the lot of material, which has twice the number of test articles as the sample which failed to conform to this specification. If the lot size is such that the sample size cannot be doubled, then the sample size shall be as previous, but the number of widely dispersed sites at which measurements were made shall be doubled, and these sites will constitute the new sample. This new sample shall be measured using magnetic thickness gages which have been calibrated for accuracy against reference material thickness standards. If the lot is found to be nonconforming by the new sample, the galvanizer has the right to sort the lot for conforming articles by individual test, to re-galvanize non-conforming articles, or to renovate the nonconforming articles in accordance with 6.2.

8.2.5.2 For single-specimen articles, a new sample shall be taken randomly from the lot of material, which has twice the number of test articles as the sample which failed to conform to this specification. The test method for the new sample shall be selected by mutual agreement between the purchaser and galvanizer. If the lot is found to be nonconforming by the new sample, the galvanizer has the right to sort the lot for conforming articles by individual test, to re-galvanize non-conforming articles, or to renovate the nonconforming articles in accordance with 6.2.

8.3 *Adhesion*—Determine adhesion of the zinc coating to the surface of the base metal by cutting or prying with the point of a stout knife, applied with considerable pressure in a manner

tending to remove a portion of the coating. The adhesion shall be considered inadequate if the coating flakes off in the form of a layer of the coating so as to expose the base metal in advance of the knife point. Do not use testing carried out at edges or corners (points of lowest coating adhesion) to determine adhesion of the coating. Likewise, do not use removal of small particles of the coating by paring or whittling to determine failure.

8.4 *Embrittlement*—Test for embrittlement shall be made in accordance with Practice A143/A143M. These tests shall not be required unless strong evidence of embrittlement is present.

9. Inspection, Rejection, and Retest

9.1 *Inspection by the Galvanizer*—It is the responsibility of the galvanizer to ensure compliance with this specification. This shall be achieved by an in-plant inspection program designed to maintain the coating thickness, finish, and appearance within the requirements of this specification unless the inspection is performed in accordance with 9.2.

9.2 *Inspection By the Purchaser*—The purchaser shall accept or reject material by inspection either through the galvanizer's inspector, the purchaser's inspector, or an independent inspector. The inspector representing the purchaser shall have access at all times to those areas of the galvanizer's facility which concern the application of the zinc coating to the material ordered while work on the contract of the purchaser is being performed. The galvanizer shall afford the inspector all reasonable facilities to satisfy him that the zinc coating is being furnished in accordance with this specification.

9.3 *Location*—The material shall be inspected at the galvanizer's plant prior to shipment. However, by agreement the purchaser is not prohibited from making tests which govern the acceptance or rejection of the materials in his own laboratory or elsewhere.

9.4 *Reinspection*—When inspection of materials to determine conformity with the visual requirements of 6.2 warrants rejection of a lot, the galvanizer is not prohibited from sorting the lot and submit it once again for acceptance after he has removed any nonconforming articles and replaced them with conforming articles.

9.5 The sampling plan that was used when the lot was first inspected shall be used for resampling of a sorted lot. By mutual agreement, the galvanizer is not prohibited from submitting the lot remaining after sorting and removing nonconforming articles without replacement of the nonconforming articles. In such case, the now-smaller lot shall be treated as a new lot for purposes of inspection and acceptance.

9.6 Materials that have been rejected for reasons other than embrittlement are not prohibited from being stripped and regalvanized and again submitted for inspection and test at which time they shall conform to the requirements of this specification.

10. Certification

10.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed by this specification and the requirements have been met.

When specified in the purchase order or contract, a report of the test results shall be furnished.

11. Keywords

11.1 coatings—zinc; galvanized coatings; steel products—metallic coated; zinc coatings—steel products

SUMMARY OF CHANGES

Committee A05 has identified the location of selected changes to this standard since the last issue (A123/A123M - 09) that may impact the use of this standard. (May 15, 2012)

(I) Revised **Table 1**.

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Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement¹

This standard is issued under the fixed designation A 143/A 143M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This practice covers procedures that can be followed to safeguard against the possible embrittlement of steel hot-dip galvanized after fabrication, and outlines test procedures for detecting embrittlement. Conditions of fabrication may induce a susceptibility to embrittlement in certain steels that can be accelerated by galvanizing. Embrittlement is not a common occurrence, however, and this discussion does not imply that galvanizing increases embrittlement where good fabricating and galvanizing procedures are employed. Where history has shown that for specific steels, processes and galvanizing procedures have been satisfactory, this history will serve as an indication that no embrittlement problem is to be expected for those steels, processes, and galvanizing procedures.

1.2 This practice is applicable in either inch-pounds or SI units. Inch-pounds and SI units are not necessarily exact equivalents. Within the text of this practice and where appropriate, SI units are shown in brackets.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

¹ This practice is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.13 on Structural Shapes and Hardware Specifications.

Originally Prepared by Subcommittee A05.10 on Embrittlement Investigation of Committee A05 on Corrosion of Iron and Steel and based on an investigation made by Battelle Memorial Institute under American Society for Testing and Materials' sponsorship. See *Proceedings*, Am. Soc. Testing Mats., Vol 31, Part I, 1931, p. 211; also paper by Samuel Epstein, "Embrittlement of Hot-Dip Galvanized Structural Steel," see *Proceedings*, Am. Soc. Testing Mats., Vol 32, Part II, 1932, p. 293.

Current edition approved May 1, 2007. Published June 2007. Originally approved in 1932. Last previous edition approved in 2003 as A 143/A 143M - 03.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

3. Terminology

3.1 Definition:

3.1.1 *embrittlement, n*—the loss or partial loss of ductility in a steel where an embrittled product characteristically fails by fracture without appreciable deformation; types of embrittlement usually encountered in galvanized steel are related to aging phenomena, cold working, and absorption of hydrogen.

4. Factors in Embrittlement

4.1 Embrittlement or loss of ductility in steel is often associated with strain-aging. Strain-aging refers to the delayed increase in hardness and strength, and loss of ductility and impact resistance which occur in susceptible steels as a result of the strains induced by cold working. The aging changes proceed slowly at room temperature, but proceed at an accelerated rate as the aging temperature is raised and may occur rapidly at the galvanizing temperature of approximately 850°F [455°C].

4.2 Hydrogen embrittlement may also occur due to the possibility of atomic hydrogen being absorbed by the steel. The susceptibility to hydrogen embrittlement is influenced by the type of steel, its previous heat treatment, and degree of previous cold work. In the case of galvanized steel, the acid pickling reaction prior to galvanizing presents a potential source of hydrogen. However, the heat of the galvanizing bath partially expels hydrogen that may have been absorbed. In practice hydrogen embrittlement of galvanized steel is usually of concern only if the steel exceeds approximately 150 ksi [1100 MPa] in ultimate tensile strength, or if it has been severely cold worked prior to pickling.

4.3 Loss of ductility of cold-worked steels is dependent on many factors including the type of steel (strength level, aging characteristics), thickness of steel, and degree of cold work, and is accentuated by areas of stress concentration such as caused by notches, holes, fillets of small radii, sharp bends, etc.

4.4 Low temperatures increase the risk of brittle failure of all plain carbon steels including steel that has been galvanized. The rate at which this temperature loss of ductility occurs varies for different steels. The expected service temperature should thus be taken into account when selecting the steel.

5. Steels

5.1 Open-hearth, basic-oxygen, and electric-furnace steels shall be used for galvanizing. Other materials that can be galvanized include continuous cast slabs, steel or iron castings, and wrought iron.

6. Cold Working and Thermal Treatment

6.1 For intermediate and heavy shapes, plates, and hardware, cold bend radii should not be less than that which is proven satisfactory by practice or by the recommendations of the steel manufacturer. These criteria generally depend on the direction of grain, strength, and type of steel. A cold bending radius of three times (3×) the section thickness, or as recommended in *AISC Manual of Steel Construction*,³ will ordinarily ensure satisfactory properties in the final product. Although sharper bending on thin sections can usually be tolerated, embrittlement may occur if cold bending is especially severe. If the design requires sharper bending than discussed herein, the bending should be done hot, or if done cold the material should be subsequently annealed or stress relieved as noted in 6.3.

6.2 Smaller shapes, including thickness up to ¼ in. [6.4 mm] may be cold worked by punching without subsequent annealing or stress-relieving. Shapes ⅝ to 1⅛ in. [8 to 18 mm] in thickness are not seriously affected as to serviceability by cold punching or if the punching is done under good shop practice. The heavier shapes, ¾ in. [19 mm] and over, shall be reamed with at least ⅛ in. [1.6 mm] of metal removed from the periphery of the hole after punching, or shall be drilled, or thermally treated prior to galvanizing as noted in 6.3.

6.3 Fabrication in accordance with the principles outlined in 6.1 and 6.2 will normally obviate the need for thermal treatment. However, if required, proper thermal treatment shall precede galvanizing of the steel. For heavy cold deformation exemplified by cold rolling, sheared edges, punched holes, or cold-formed rods and bolts, subcritical annealing at temperatures from 1200 to 1300°F [650 to 705°C] should be employed. For less severe cold deformation typified by cold bending, roll forming, etc., it is advisable to limit the thermal treatment to stress relieving at a maximum of 1100°F [595°C] to avoid excessive grain growth or alternatively to fully normalize the steel at temperatures from 1600 to 1700°F [870 to 925°C]. The time at temperature should be approximately 1 h/in. [24 min/cm] of section thickness.

6.4 Flame cut copes on structural beams shall have a minimum radius of 1 in. [2.5 cm]. After cutting, the cut surface shall be ground to remove notches, grooves, and irregular surface features to leave the surface smooth.

7. Preparation for Galvanizing

7.1 Hydrogen can be absorbed during pickling and in some instances, as noted in 4.2, may contribute to embrittlement of the galvanized product. The likelihood of this, or of surface cracking occurring, is increased by excessive pickling temperature, prolonged pickling time, and poor inhibition of the pickling acid. Heating to 300°F [150°C] after pickling and before galvanizing in most cases results in expulsion of hydrogen absorbed during pickling.

7.2 Abrasive blast cleaning followed by flash pickling may also be employed when over-pickling is of concern or when very high strength steel, ultimate tensile strength higher than 150 ksi [1100 MPa], must be galvanized. The abrasive blast cleaning does not generate hydrogen while it is cleaning the surface of the steel. The flash pickling after abrasive blast cleaning is used to remove any final traces of blast media before hot-dip galvanizing.

8. Responsibility for Avoiding Embrittlement

8.1 Design of the product and selection of the proper steel to withstand normal galvanizing operations without embrittlement are the responsibility of the designer. The fabricator shall be responsible for employing suitable fabrication procedures. The galvanizer shall employ proper pickling and galvanizing procedures.

9. Testing for Embrittlement of Steel Shapes, Steel Castings, Threaded Articles, and Hardware Items

9.1 Subject to base material and dimensional limitations, the tests given in 9.2, 9.3, 9.4, or 9.5, or a combination thereof, shall apply. If one test specimen should be found embrittled by these tests, two additional specimens should be tested. Failure of either the second or the third specimen shall be cause for rejection of the lot (see Note 1) that the samples represent.

NOTE 1—A lot is a unit of production from which a sample may be taken for testing. Unless otherwise agreed upon by the manufacturer and the purchaser, or established within this practice, the lot shall be as follows: For test at a manufacturer's facility, a lot is one or more articles of the same type and size comprising a single order or a single delivery load, whichever is the smaller, or a smaller number of articles identified as a lot by the manufacturer, when these have been galvanized within a single production shift. For test by purchaser after delivery, the lot consists of the single order or the single delivery load, whichever is the smaller, unless the lot identity, established in accordance with the above, is maintained and clearly indicated in the shipment by the manufacturer.

9.2 A bend test for embrittlement of galvanized steel hardware such as bolts, pole and tower steps, braces, rods, reinforcing bars, etc., consists of bending the article and comparing the degree of bending to that which is obtained on a similar ungalvanized article. The article, before and after galvanizing, may be clamped in a vise and using a lever if necessary, bent until cracking of the base steel occurs, or to 90° whichever is less. The galvanized article should withstand a degree of bending substantially the same as the ungalvanized article. Flaking or spalling of the galvanized coating is not to be construed as an embrittlement failure. For threaded articles, the test shall be made on the unthreaded portion.

9.3 Small steel castings and steel hardware of such shape or size that do not permit bending may be struck a sharp blow

³ Available from American Institute of Steel Construction (AISC), One East Wacker Drive, Suite 3100, Chicago, IL 60601-2001. 9th Edition.

with a 2-lb [1-kg] hammer and the results for both galvanized and ungalvanized samples compared. If the article withstands such a blow in the ungalvanized condition, but after galvanizing cracks under the blow, it shall be considered embrittled.

9.4 A test for embrittlement of galvanized steel angles is detailed as follows:

9.4.1 *Test Specimen*—A test specimen with a length determined by the table in 9.4.2.1 and by Fig. 1 shall be cut from the steel angle before galvanizing. A hole shall be made in the test specimen at its midlength, using the same procedure as will be employed in the fabricated material which the specimen represents, whether this be by punching, punching and reaming, or drilling. The dimensional values, diameter, and location of hole shall be not less than those employed in the structural details. Care should be taken not to place the hole near stamped or rolled-in identification marks. The specimen shall then be galvanized. For determining the elongation after fracture, a 2-in. [51-mm] gage length (Fig. 1) shall be prick-punched in the middle of the edge of the vertical leg of the galvanized angle along a line parallel to its length and centered directly under the hole. For specimens under 1/2 in. [13 mm] in thickness, or those in which the distance from the edge of the hole to the edge of the angle is less than 3/8 in. [10 mm], a 1-in. [25-mm] gage length shall be used.

9.4.2 *Procedure:*

9.4.2.1 The test shall be made in a universal testing machine, or by other means such as a press with the load applied slowly, until fracture of the galvanized test specimen occurs. The length of the test specimen and the distance between the supports are shown in the following table:

Leg of Angle, <i>l</i> , in. [mm] (see Fig. 1)	Length Between Supports, <i>L</i> ₁ , in. [mm]	Minimum Length, <i>L</i> ₂ , in. [mm]
Up to 4 [102], incl	14 [356]	18 [457]
Over 4 to 6 [102 to 152], incl	20 [508]	24 [610]
Over 6 to 8 [152 to 203], incl	30 [762]	36 [914]

9.4.2.2 After the test, the distance along the gage length from each punch mark to the corresponding edge of the fracture shall be measured to 0.01 in. [0.25 mm] with a flexible scale and the percentage of elongation calculated from the sum of these distances.

9.4.2.3 For determining the percentage reduction of thickness after fracture, the reduction shall be measured with a ball-point micrometer at the three locations indicated in Fig. 2: namely *a*, outer side of hole; *b*, inner side of hole; and *c*, middle of leg. The percentage reduction of thickness shall be calculated on the basis of the original thickness of the angle and the average of the three values at *a*, *b*, and *c*.

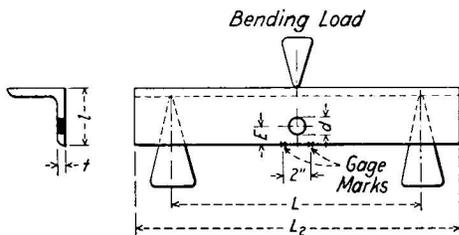
9.4.2.4 The test shall be made upon galvanized specimens having a temperature not below 60°F [16°C] and not over 90°F [32°C] when tested.

9.4.3 *Requirements*—The elongation measured in accordance with 9.4.2.2 shall be not less than 5 % with the following exception: when the specimen does not show 5 % elongation, the reduction in thickness shall be measured in accordance with 9.4.2.3. The sum of the percentage of elongation plus the average percentage reduction of thickness shall not be less than 10.

9.5 For hot-dip galvanized externally threaded fasteners, an alternate test to Section 9.2 for embrittlement is detailed in Test Method F 606.

10. Keywords

10.1 coatings-zinc; galvanized coatings; steel products-metallic coated; zinc coatings-steel products



NOTE 1—2 in. = 51 mm.

FIG. 1 Specimen for Elongation after Fracture



FIG. 2 Measurement of Reduction of Thickness after Fracture

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Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware¹

This standard is issued under the fixed designation A 153/A 153M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers zinc coatings applied by the hot-dip process on iron and steel hardware. The hot-dip galvanizing process consists of parts being immersed in molten zinc for a sufficient time to allow a metallurgical reaction between iron from the steel surface and the molten zinc, resulting in the formation of Zn/Fe alloy layers bonding the coating to the steel surface.

1.2 This specification is intended to be applicable to hardware items that are centrifuged or otherwise handled to remove excess galvanizing bath metal (free zinc). Coating thickness grade requirements reflect this.

1.3 This specification is applicable to orders in either inch-pound units (as A 153) or in SI units (as A 153M). Inch-pound units and SI units are not necessarily exact equivalents. Within the text of this specification and where appropriate, SI units are shown in brackets. Each system shall be used independently of the other without combining values in any way. In the case of orders in SI units, all testing and inspection shall be done using the metric equivalent of the test or inspection method as appropriate. In the case of orders in SI units, such shall be stated to the galvanizer when the order is placed.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

¹ This specification is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.13 on Structural Shapes and Hardware Specifications.

Current edition approved May 1, 2009. Published May 2009. Originally approved in 1933. Last previous edition approved in 2005 as A 153/A 153M - 05.

2. Referenced Documents

2.1 ASTM Standards:²

A 90/A 90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

A 143/A 143M Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement

A 780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

A 902 Terminology Relating to Metallic Coated Steel Products

B 6 Specification for Zinc

B 487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

B 960 Specification for Prime Western Grade-Recycled (PWG-R) Zinc

E 376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Examination Methods

F 1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

F 1789 Terminology for F16 Mechanical Fasteners

3. Terminology

3.1 Definitions:

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard.

3.1.1 The following terms and definitions are specific to this specification. Terminology **A 902** contains other terms and definitions relating to metallic-coated steel products. Terminology **F 1789** contains other terms and definitions relating to mechanical fasteners.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *average coating thickness, n*—the average of the specimen coating thickness values for the samples in an inspection lot.

3.2.2 *bare spots, n*—uncoated areas on the surface of the steel part that contain no measurable zinc coating.

3.2.3 *dross inclusions, n*—the iron/zinc intermetallics present in a galvanized coating in a form other than the layer growth of the coating.

3.2.4 *individual measurement, n*—the reading from a magnetic thickness gauge of a single coating spot thickness, or the microscopic reading of a coating thickness as seen in an optical microscope at one spot.

3.2.5 *inspection lot, n*—the quantity of identical parts cleaned, fluxed and galvanized together at one time in an appropriate container that is being submitted for acceptance as a group.

3.2.6 *malleable casting, n*—a steel article that has been subjected to a prolonged anneal to decarburize or graphitize the part to remove as much of the carbon as possible or to convert the carbon to graphite, which permits plastic deformation in compression without rupture.

3.2.7 *sample, n*—a collection of individual units of product from a single inspection lot selected in accordance with Section 6 and intended to represent that inspection lot for acceptance.

3.2.8 *specimen, n*—an individual test article upon which thickness measurements or weight determinations are performed.

3.2.9 *specimen coating thickness, n*—the average thickness from no less than five test measurements on a specimen, when each measurement location is selected to provide the widest dispersion (in all applicable directions) of locations within the specimen volume.

3.2.10 *threaded areas, n*—the sections of a steel part that have threads formed before hot-dip galvanizing.

4. Materials and Manufacture

4.1 *Steel or Iron*—Ferrous articles to be hot-dip zinc coated shall conform to specifications designated by the purchaser.

4.2 *Zinc*—The zinc used for the coating shall conform to Specification **B 6**, or Specification **B 960**, or both, and shall be at least equal to the grade designated as “Prime Western.”

4.2.1 If a zinc alloy is used as the primary feed for the galvanizing bath, then the base material used to make that alloy shall conform to Specification **B 6** or Specification **B 960**, or both.

4.2.2 The molten metal in the working volume of the galvanizing bath shall contain not less than an average value of 98.0 % zinc by weight [mass].

NOTE 1—The galvanizer may choose to add trace amounts of certain elements (for example, aluminum, nickel, bismuth, or tin) to the zinc bath to help in the processing of certain reactive steels or to enhance the cosmetic appearance of the finished product. The elements can be added to the galvanizing bath as a master feed alloy, or they can be added to the bath by the galvanizer as individual feeds.

4.3 *Minimum Coating Weight [Mass] or Minimum Coating Thickness*—The minimum coating weight [mass] or the minimum coating thickness shall conform to the requirements prescribed in **Table 1** for the material category and thickness of material in which the article belongs.

4.4 *Threaded Articles*—The zinc coating on threads shall not be subjected to a cutting, rolling, or finishing-tool operation, unless specifically authorized by the purchaser. In order to meet overlapping allowances, tapping the threads of nuts or tapped holes after galvanizing is not prohibited.

4.5 *Touch-up and Repair*—Bare spots that are found on parts after galvanizing shall be renovated by use of the methods found in **Practice A 780** if the following criteria are met. The bare spots shall have an area totalling not more than 1 % of the surface area to be coated excluding threaded areas of the piece and the bare spots shall not include any threaded areas of the

TABLE 1 Thickness or Weight [Mass] of Zinc Coating for Various Classes of Material

NOTE 1—Length of the piece, stated in Classes B-1, B-2, and B-3, refers to the finished dimension of the piece after fabrication.

Class of Material	Weight [Mass] of Zinc Coating, oz/ft ² [g/m ²] of Surface, Minimum		Coating Thickness, mils [microns], Minimum	
	Average of Specimens Tested	Any Individual Specimen	Average of Specimens Tested	Any Individual Specimen
<i>Class A</i> —Castings—Malleable Iron, Steel	2.00 [610]	1.80 [550]	3.4 [86]	3.1 [79]
<i>Class B</i> —Rolled, pressed, and forged articles (except those which would be included under Classes C and D):				
B-1— $\frac{3}{16}$ in. [4.76 mm] and over in thickness and over 15 in. [381 mm] in length	2.00 [610]	1.80 [550]	3.4 [86]	3.1 [79]
B-2—under $\frac{3}{16}$ in. [4.76 mm] in thickness and over 15 in. [381 mm] in length	1.50 [458]	1.25 [381]	2.6 [66]	2.1 [53]
B-3—any thickness and 15 in. [381 mm] and under in length	1.30 [397]	1.10 [336]	2.2 [56]	1.9 [48]
<i>Class C</i> —Fasteners over $\frac{3}{16}$ in. [9.52 mm] in diameter and similar articles. Washers $\frac{3}{16}$ in. and $\frac{1}{4}$ in. [4.76 and 6.35 mm] in thickness	1.25 [381]	1.00 [305]	2.1 [53]	1.7 [43]
<i>Class D</i> —Fasteners $\frac{3}{16}$ in. [9.52 mm] and under in diameter, rivets, nails and similar articles. Washers under $\frac{3}{16}$ in. [4.76 mm] in thickness	1.00 [305]	0.85 [259]	1.7 [43]	1.4 [36]

piece. The thickness of the repair shall be equal to the surrounding galvanized coating except for repairs made by paints containing zinc dust in which case the thickness of the repair shall be 50 % greater than the thickness of the galvanized coating required for the class of material, but shall not be greater than 4.0 mils [100 μm]. Repair thickness measurements shall be made in accordance with Practice **A 780**. The galvanizer shall make repairs unless directed by the purchaser to deliver items unrepaired for subsequent renovation by the purchaser.

5. Workmanship, Finish, and Appearance

5.1 The zinc-coated articles shall be free from uncoated areas, blisters, flux deposits, dross inclusions, and other types of projections that would interfere with the intended use of the articles, or other defects not consistent with good galvanizing practice.

5.2 The zinc coating shall be smooth and reasonably uniform in thickness.

NOTE 2—Smoothness of surface is a relative term. Minor roughness that does not interfere with the intended use of the part, or roughness that is related to the as-received (ungalvanized) surface condition of the part, shall not be grounds for rejection.

NOTE 3—Since this specification is applicable to items that are centrifuged or otherwise handled to remove excess bath metal (see **1.2**), irregular coating distribution is not normally encountered. Drainage problems, which manifest themselves as local excess coating thickness that would interfere with function or as edge tears or spikes that present a safety hazard because of their sharpness, are grounds for rejection under the terms of **5.1**.

5.3 Embrittlement is a potential condition of steel that is cold-worked, depending on such factors as the steel type (strength level, aging characteristics), thickness, degree of cold work, and galvanizing process. The galvanizer, the designer and the fabricator shall take precautions against embrittlement. The precautions to fabricate properly and prepare the material for galvanizing to prevent embrittlement are described in Practice **A 143/A 143M**.

NOTE 4—Low service temperatures increase the risk of brittle failure of all plain carbon steels including those which have been galvanized. This temperature embrittling effect varies with type of steel. The expected service temperature should thus be taken into account when selecting steels for galvanizing.

5.4 Malleable castings shall be of such composition as will preclude the possibility that they become embrittled by the galvanizing process, or they shall be either cooled from the anneal, or subsequently heat-treated so as to immunize them against embrittlement.

5.5 The zinc coating shall adhere tenaciously to the surface of the base metal.

5.6 If the galvanized material covered by this specification is bent or otherwise fabricated to the degree that causes the zinc coatings to stretch or compress beyond the limit of elasticity, any cracking or flaking of the coating resulting from the bending or fabricating shall not be cause for rejection.

6. Sampling

6.1 Test specimens shall be selected at random from each inspection lot.

6.2 The method of selection and sample size shall be agreed upon between the galvanizer and the purchaser. Otherwise, the sample size selected from each lot shall be as follows:

Number of Pieces in Lot	Sample Size
3 or less	all
4 to 500	3
501 to 1200	5
1201 to 3200	8
3201 to 10 000	13
10 001 and over	20

6.3 A specimen that fails to conform to a requirement of this specification shall not be used to determine the conformance to other requirements.

6.4 The method of sampling for fasteners that are required to meet the standards of the Fastener Quality Act is described in Guide **F 1470**. Sample quantities and definitions of terminology are included in the referenced specification.

7. Test Methods

7.1 Tests shall be made to ensure that the zinc coating is being furnished in accordance with this specification and as specified for the following:

7.1.1 Minimum coating weight [mass] or minimum coating thickness in **4.3**.

7.1.2 Finish and appearance in **5.1** and **5.2**.

7.1.3 Embrittlement in **5.3** and **5.4**.

7.1.4 Adherence in **5.5**.

7.2 *Average Weight [Mass] of Coating:*

7.2.1 The average weight [mass] of the zinc coating shall be determined by weighing specimens after pickling and drying and again after galvanizing unless the method described in **7.2.2** is used. The number of specimens that are used to determine the average of an inspection lot shall be derived from Section **6**.

NOTE 5—This method does not take into account the weight [mass] of iron reacted from the article that is incorporated into the coating. It will thus underestimate coating weight [mass] by up to approximately 10 %. Base metal reactivity will affect the extent of underestimation.

7.2.2 In the case of materials inspected after galvanizing, the average weight [mass] of coating shall be determined by stripping the number of specimens derived in Section **6** in accordance with Test Method **A 90/A 90M**, and averaging the results of the individual specimens, unless the method described in **7.2.1** is used.

7.3 *Average Thickness of Coating:*

7.3.1 In the case of fasteners such as bolts, nuts, and screws, the determination of the thickness of coating shall be made on a portion of the article that does not include any threads.

7.3.2 The average thickness of coating shall be determined by magnetic thickness gage in accordance with Practice **E 376** unless the method described in **7.3.3** is used. The thickness shall be measured on at least five widely separated spots on a specimen. No individual spot measurement shall be cause for rejection. If an individual spot does not provide a coating thickness reading, this spot must be repaired in accordance with **4.5**. The five or more individual coating thickness measurements on a specimen must be averaged to determine the specimen average coating thickness. The average coating thickness for the inspection lot is determined by averaging the

specimen average coating thickness values for the number of specimens derived from Section 6.

7.3.3 The thickness of coating shall be determined by cross section and optical measurement in accordance with Test Method B 487, unless the method described in 7.3.2 is used. The thickness thus determined is a point value. No less than five such measurements shall be made at locations on the specimen, which are as widely dispersed as practical, so as to be representative of the whole surface of the specimen. The average of no less than five such measurements is the specimen average coating thickness. The average coating thickness for the inspection lot is determined by averaging the specimen average coating thickness values for the number of specimens derived from Section 6.

7.4 *Finish and Appearance*—The test for finish and appearance shall be conducted through visual inspection without additional magnification.

7.5 *Embrittlement*—Hardware that is susceptible to embrittlement shall be tested in accordance with Practice A 143/ A 143M. The tests shall be performed through agreement between the galvanizer and the purchaser.

7.6 *Adherence*—Determine adherence of the zinc coating to the surface of the base metal by cutting or prying with the point of a stout knife, applied with considerable pressure in a manner tending to remove a portion of the coating. The adherence shall be considered inadequate if the coating delaminates in the form of a layer of skin so as to expose the base metal in advance of the knife point. Do not use testing carried out at edges or corners (points of lowest coating adherence) to determine adherence of coating. Likewise, do not use removal of small particles of the coating by paring or whittling to determine failure.

8. Inspection

8.1 The inspector representing the purchaser shall have access at all times while work on the contract of the purchaser is being performed, to those areas of the manufacturer's work which concern the application of the zinc coating to the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the zinc coating is being furnished in accordance with this specification. All inspection and tests shall be made at the place of manufacture

prior to shipments, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

9. Rejection and Retest

9.1 For all galvanized articles except those fasteners that must meet the requirements of the Fastener Quality Act, the following sections are used to determine rejection and retesting.

9.2 When partial inspection of materials to determine conformity with visual requirements of Section 5 warrants rejection of a lot, the galvanizer is not prohibited from sorting the lot and submitting it once again for inspection.

9.3 The number of specimens in a sample of a lot permitted to fail to conformance tests shall be agreed upon between the galvanizer and the purchaser.

9.4 If a set of test specimens fails to conform to the requirements of this specification, two additional sets shall be tested, both of which shall conform to the requirements in every respect, or the lot of material represented by the specimens shall be rejected.

9.5 Materials that have been rejected for reasons other than embrittlement are not prohibited from being stripped, regalvanized, and resubmitted for test and inspection. They shall then conform to the requirements of this specification.

10. Packaging

10.1 The supplier shall employ such methods of packaging zinc-coated articles as shall be required to ensure their receipt by the purchaser in satisfactory condition, with the use to be made of the article being taken into consideration.

11. Certification

11.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each inspection lot have been either tested or inspected as directed by this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

12. Keywords

12.1 coatings, zinc; galvanized coatings; steel hardware, zinc coated; steel products, metallic coated; zinc coatings, steel products

SUMMARY OF CHANGES

Committee A05 has identified the location of selected changes to this standard since the last issue, A 153/A 153M - 05, that may impact the use of this standard. (May 1, 2009)

(I) Revised 4.2 and 4.2.1 to add new zinc standard B 960.

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Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners¹

This standard is issued under the fixed designation A354; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification² covers the chemical and mechanical requirements of quenched and tempered alloy steel bolts, studs, and other externally threaded fasteners 4 in. and under in diameter for application at normal atmospheric temperatures, where high strength is required and for limited application at elevated temperature (Note 1). Any alloy steel capable of meeting the minimum mechanical and chemical properties set forth in this specification may be used.

NOTE 1—For bolts, studs, or other externally threaded fasteners, to be used at elevated temperatures, refer to Specification A193/A193M.

1.2 Two levels of bolting strength are covered, designated Grades BC and BD. Selection will depend upon design and the stresses and service for which the product is to be used.

NOTE 2—Quenched and tempered alloy steel bolts for structural steel joints up through 1½ in. in diameter are covered in Specification A490. Alloy steel bolts, studs, and other externally threaded fasteners (that is, heavy hex-structural bolts over 1½ in., hex bolts, anchor bolts, and countersunk bolts) exhibiting similar mechanical properties to bolts conforming to Specification A490 shall be covered by Grade BD of this specification.

When bolts of Grade BD of this specification are considered for pretensioned applications in excess of 50 % of the bolt tensile strength, the additional requirements of head size, maximum tensile strength, nut size and strength, washer hardness, tests, and inspections contained in Specification A490 should be carefully considered.

1.3 Nuts are covered in Specification A563. Unless otherwise specified, the grade and style of nut for each grade of fastener shall be as follows:

¹ This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.02 on Steel Bolts, Nuts, Rivets and Washers.

Current edition approved Dec. 15, 2011. Published December 2011. Originally approved in 1952. Last previous edition approved in 2007 as A354–07a. DOI: 10.1520/A0354-11.

² For ASME Boiler and Pressure Vessel Code applications see related Specification SA-354 in Section II of that Code.

Grade of Fastener and Surface Finish	Nut Grade and Style ^A
BC, plain (or with a coating of insufficient thickness to require over-tapped nuts)	C, heavy hex
BC, zinc-coated (or with a coating thickness requiring over-tapped nuts)	DH, heavy hex
BD, all finishes	DH, heavy hex

^A Nuts of other grades and styles having specified proof load stresses (Specification A563, Table 3) greater than the specified grade and style of nut are suitable.

1.4 The values stated in inch-pound units are to be regarded as the standard.

1.5 Terms used in this specification are defined in Terminology F1789 unless otherwise defined herein.

2. Referenced Documents

2.1 ASTM Standards:³

- A193/A193M Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- A490 Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
- A563 Specification for Carbon and Alloy Steel Nuts
- A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- B695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
- D3951 Practice for Commercial Packaging
- F436 Specification for Hardened Steel Washers
- F606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard.

F788/F788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series

F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

F1789 Terminology for F16 Mechanical Fasteners

F2329 Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

2.2 *ASME Standards*.⁴

B1.1 Unified Screw Threads

B18.2.1 Square and Hex Bolts and Screws, Inch Series

B18.24 Part Identifying Number (PIN) Code System Standard for B18 Fastener Products

3. Ordering Information

3.1 Orders for bolts and studs (including nuts and accessories) under this specification shall include the following:

3.1.1 ASTM designation and year of issue,

3.1.2 Name of product (that is, bolt or stud),

3.1.3 Grade (that is, BC or BD),

3.1.4 Quantities (number of pieces by size, including nuts),

3.1.5 Size and length,

3.1.6 Washers—Specify quantity and size (separate from bolts) (4.3),

3.1.7 *Zinc Coating*—When zinc-coated Grade BC fasteners are required, specify the zinc-coating process required, for example hot-dip, mechanically deposited, or no preference (see 4.4).

3.1.8 *Other Finishes*—Specify other protective finish, if required.

3.1.9 Specify if inspection at point of manufacture is required,

3.1.10 Specify if Certification (Section 14) is required, and

3.1.11 Specify additional testing (Section 9) or special requirements.

3.1.12 For establishment of a part identifying system, see ASME **B18.24**.

4. Materials and Manufacture

4.1 The steel shall be made by the open-hearth, electric-furnace, or basic-oxygen process.

4.2 All fasteners shall be heat-treated. At the option of the manufacturer, heat treatment may be performed on the raw material, during the manufacturing operations, or after final machining. Heat treatment shall consist of quenching in a liquid medium (except Grade BD sizes 1½ in. and smaller shall be quenched in oil) from above the transformation temperature and then tempering by reheating to a temperature of not less than 800°F (427°C) for Grade BC and for Grade BD.

4.3 When used, suitable hardened washers shall be quenched and tempered (non-carburized) in accordance with Specification **F436**.

4.4 *Zinc Coatings, Hot-Dip and Mechanically Deposited:*

4.4.1 When zinc-coated fasteners are required, the purchaser shall specify the zinc coating process, for example, hot-dip, mechanically deposited, or no preference.

4.4.2 When “hot-dip” is specified, the fasteners shall be zinc coated by the hot-dip process in accordance with the requirements of Specification **F2329**.

4.4.3 When mechanically deposited is specified, the fasteners shall be zinc-coated by the mechanical-deposition process in accordance with the requirements of Class 55 of Specification **B695**.

4.4.4 When no preference is specified, the supplier may furnish either a hot-dip zinc coating in accordance with Specification **F2329**, or a mechanically deposited zinc coating in accordance with Specification **B695**, Class 55. Threaded components (bolts and nuts) shall be coated by the same zinc-coating process and the supplier’s option is limited to one process per item with no mixed processes in a lot.

NOTE 3—When the intended application requires that assembled tension exceeds 50 % of minimum bolt proof load, an anti-galling lubricant may be needed. Application of such a lubricant to nuts and a test of the lubricant efficiency are provided in Supplementary Requirement S1 of Specification **A563** and should be specified when required.

4.5 Zinc-coated bolts and nuts shall be shipped in the same container unless specifically requested otherwise by the purchaser.

NOTE 4—Research conducted on bolts of similar material and manufacture indicates that hydrogen-stress cracking or stress cracking corrosion may occur on hot-dip galvanized Grade BD bolts.

5. Chemical Composition

5.1 All fasteners shall be made from alloy steel conforming to the chemical composition requirements in accordance with **Table 1**. The steel shall contain sufficient alloying elements to qualify it as an alloy steel.

NOTE 5—Steel is considered to be alloy, by the American Iron and Steel Institute, when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: manganese, 1.65 %; silicon, 0.60 %; copper, 0.60 %; or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, chromium up to 3.99 %, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying elements added to obtain a desired alloying effect.

5.2 Product analysis may be made by the purchaser from finished material representing each lot of fasteners. The chemical composition thus determined shall conform to the requirements given in **Table 1**. Choice of alloy steel composition necessary to ensure meeting the specified mechanical requirements shall be made by the manufacturer and shall be reported to the purchaser for information purposes only.

5.3 Application of heats of steel to which bismuth, selenium, tellurium, or lead has been intentionally added shall not be permitted.

5.4 Chemical analyses shall be performed in accordance with Test Methods, Practices, and Terminology **A751**.

6. Mechanical Properties

6.1 Fasteners shall not exceed the maximum hardness specified in **Table 2**. Fasteners less than three diameters in length

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

TABLE 1 Chemical Requirements

Alloy Steel		
Element	Heat Analysis, %	Product Analysis, %
Carbon:		
For sizes through 1½ in.	0.30 to 0.53	0.28 to 0.55
For sizes larger than 1½ in.	0.35 to 0.53	0.33 to 0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045
Alloying Elements	A	A
Alloy Steel with Boron Addition		
Element	Heat Analysis, %	Product Analysis, %
Carbon		
For sizes through 1½ in.	0.30-0.48	0.28-0.50
For sizes larger than 1½ in.	0.35-0.53	0.35-0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.040	0.045
Sulfur, max	0.040	0.045
Boron	0.0005-0.003	0.0005-0.003
Alloying Elements	A	A

^ASteel, as defined by the American Iron and Steel Institute, shall be considered to be alloy when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: Manganese, 1.65%; silicon, 0.60%; copper, 0.60% or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, chromium up to 3.99%, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying elements added to obtain a desired alloying effect.

TABLE 2 Hardness Requirements for Full-Size Fasteners

Size, in.	Grade	Hardness			
		Brinell		Rockwell C	
		Minimum	Maximum	Minimum	Maximum
¼ to 2½	BC	255	331	26	36
Over 2½	BC	235	311	22	33
¼ to 2½	BD	311	363	33	39
Over 2½	BD	293	363	31	39

and studs less than four diameters in length shall have hardness values not less than the minimum nor more than the maximum hardness limits required in **Table 2**, as hardness is the only requirement.

6.2 Fasteners 1⅜ in. in diameter or less for Grade BC and 1¼ in. in diameter or less for Grade BD, other than those excepted in 6.1, shall be tested full size and shall conform to the tensile strength and either the proof load or the yield strength requirements in accordance with **Table 3**.

6.3 Fasteners larger than 1⅜ in. in diameter for Grade BC and fasteners larger than 1¼ in. in diameter for Grade BD, other than those excepted in 6.1, shall preferably be tested full size and when so tested, shall conform to the tensile strength and either the proof load or yield strength requirements in accordance with **Table 3**. When equipment of sufficient capacity for full-size testing is not available, or when the length of the fastener makes full-size testing impractical, machined specimens shall be tested and shall conform to the requirements in accordance with **Table 4**. In the event that fasteners

are tested by both full-size and by the machined test specimen methods, the full-size test shall govern if a controversy between the two methods exists.

6.4 For fasteners on which both hardness and tension tests are performed, acceptance based on tensile requirements shall take precedence in the event that there is controversy over low readings of hardness tests.

7. Dimensions

7.1 *Bolts*—Unless otherwise specified, the bolts shall be Hex Head with dimensions conforming to the latest issue of **ASME B18.2.1**.

7.2 *Studs*—Studs shall have dimensions conforming to those specified by the purchaser.

7.3 *Threads*:

7.3.1 Unless otherwise specified, threads shall be the Unified National Coarse Thread Series as specified in **B1.1**, and shall have Class 2 A tolerances.

7.3.2 When specified, threads shall be the Unified National Fine Thread Series, 8-Pitch Thread Series for sizes over 1 in. or 14-Pitch UNS on 1 in. size as specified in **ANSI B1.1** and shall have Class 2A tolerances.

7.3.3 Unless otherwise specified, bolts and studs to be used with nuts or tapped holes that have been tapped oversize, in accordance with **Specification A563**, shall have Class 2A threads before hot dip or mechanically deposited zinc coating. After zinc coating, the maximum limit of pitch and major diameter may exceed the Class 2A limit by the following amount:

Diameter, in.	Oversize Limit, in. (mm) ^A
¼	0.016
⅜, ⅝	0.017
⅞, 1½	0.018
⅞ to ¾, incl	0.020
¾	0.022
1.0 to 1¼, incl	0.024
1⅜, 1½	0.027
1¾ to 4.0, incl	0.050

^A These values are the same as the overlapping required for zinc-coated nuts in **Specification A563**.

8. Workmanship

8.1 Surface discontinuity limits shall be in accordance with **Specification F788/F788M**.

9. Number of Tests

9.1 *Testing Responsibility*:

9.1.1 Each lot shall be tested by the manufacturer prior to shipment in accordance with the lot identification control quality assurance plan in 9.2 through 9.6.

9.1.2 When fasteners are furnished by a source other than the manufacturer, the responsible party as defined in 12.1 shall be responsible for ensuring that all tests have been performed and the fasteners comply with the requirements of this specification.

9.2 *Purpose of Lot Inspection*—The purpose of a lot inspection program is to ensure that each lot conforms to the requirements of this specification. For such a plan to be fully effective it is essential that secondary processors, distributors,

TABLE 3 Tensile Requirements for All Full-Size Fasteners—Inch-Pound Units

Bolt Size, in.	Threads per inch	Stress Area, ^A in. ²	Grade BC			Grade BD		
			Tensile Strength, min, lbf ^B	Proof Load, min, lbf ^C	Yield Strength (0.2 % offset), min, lbf ^D	Tensile Strength, min, lbf ^E	Proof Load, min, lbf ^F	Yield Strength (0.2 % offset), min, lbf ^G
1	2	3	4	5	6	7	8	9
¼	20	0.0318	4 000	3 350	3 450	4 750	3 800	4 100
¼	28	0.0364	4 550	3 820	3 950	5 450	4 350	4 700
⅜	18	0.0524	6 550	5 500	5 700	7 850	6 300	6 800
⅜	24	0.0580	7 250	6 090	6 300	8 700	6 950	7 500
½	16	0.0775	9 700	8 150	8 450	11 650	9 300	10 075
½	24	0.0878	11 000	9 220	9 550	13 200	10 500	11 400
⅝	14	0.1063	13 300	11 150	11 600	15 950	12 750	13 850
⅝	20	0.1187	14 840	12 470	12 900	17 800	14 200	15 400
¾	13	0.1419	17 750	14 900	15 450	21 300	17 050	18 500
¾	20	0.1599	19 990	16 790	17 400	24 000	19 200	20 750
⅞	12	0.182	22 750	19 100	19 850	27 300	21 850	23 600
⅞	18	0.203	25 400	21 400	22 100	30 400	24 400	26 350
1	11	0.226	28 250	23 750	24 650	33 900	27 100	29 400
1	18	0.256	32 000	26 800	27 900	38 400	30 700	33 250
1 ¼	10	0.334	41 750	35 050	36 400	50 100	40 100	43 400
1 ¼	16	0.373	46 600	39 100	40 650	56 000	44 800	48 450
1 ½	9	0.462	57 750	48 500	50 350	69 300	55 450	60 100
1 ½	14	0.509	63 600	53 400	55 450	76 400	61 100	66 150
1	8	0.606	75 750	63 650	66 050	90 900	72 700	78 800
1	12	0.663	82 900	69 700	72 250	99 400	79 600	86 150
1	14 UNS	0.679	84 900	71 300	74 400	101 900	81 500	88 250
1 ⅛	7	0.763	95 400	80 100	83 150	114 450	91 550	99 200
1 ⅛	8	0.790	98 750	82 950	86 200	118 500	94 800	102 700
1 ⅛	12	0.856	107 000	89 800	93 300	128 400	102 700	111 250
1 ¼	7	0.969	121 150	101 750	105 600	145 350	116 300	126 000
1 ¼	8	1.000	125 000	105 000	109 000	150 000	120 000	130 000
1 ¼	12	1.073	134 100	112 600	116 950	161 000	128 800	139 450
1 ½	6	1.155	144 400	121 300	125 900	173 250	138 600	150 200
1 ½	8	1.233	154 150	129 450	134 400	185 000	148 000	160 300
1 ½	12	1.315	164 400	138 100	143 300	197 200	157 800	170 950
1 ½	6	1.405	175 650	147 550	153 150	210 750	168 600	182 500
1 ½	8	1.492	186 500	156 650	162 250	233 800	175 050	194 000
1 ½	12	1.581	197 600	166 000	172 300	237 200	189 700	205 500
1 ¾	5	1.90	237 500	199 500	207 100	285 000	228 000	247 000
1 ¾	8	2.08	260 000	218 400	226 700	312 000	249 600	270 000
2	4 ½	2.50	312 500	262 500	272 500	375 000	300 000	325 000
2	8	2.77	346 250	290 850	301 950	415 000	332 400	360 000
2 ¼	4 ½	3.25	406 250	341 250	354 250	487 000	390 000	422 500
2 ¼	8	3.56	445 000	373 800	388 050	534 000	422 200	462 800
2 ½	4	4.00	500 000	420 000	436 000	600 000	480 000	520 000
2 ½	8	4.44	550 000	466 200	483 950	666 000	532 800	577 200
2 ¾	4	4.93	566 950	468 350	488 050	690 200	517 650	566 950
2 ¾	8	5.43	624 450	515 850	537 550	750 200	570 150	624 450
3	4	5.97	686 550	567 150	591 050	835 800	626 850	686 550
3	8	6.51	748 650	618 450	644 500	911 400	683 550	748 650
3 ¼	4	7.10	816 500	674 500	702 900	994 000	745 500	816 500
3 ¼	8	7.69	884 350	730 550	761 300	1 076 600	807 650	884 350
3 ½	4	8.33	957 950	791 350	824 650	1 166 200	874 650	957 950
3 ½	8	8.96	1 030 400	851 200	887 050	1 254 400	940 800	1 030 400
3 ¾	4	9.66	1 110 900	917 700	956 350	1 352 400	1 014 300	1 110 900
3 ¾	8	10.34	1 199 100	983 300	1 023 650	1 447 600	1 085 700	1 189 100
4	4	11.08	1 274 200	1 052 600	1 096 900	1 551 200	1 163 400	1 274 200
4	8	11.81	1 358 200	1 122 000	1 169 200	1 653 400	1 240 050	1 358 150

^A Stress Area, in.² = 0.7854 [D – 0.9743/n]² where D = nominal diameter, in., and n = threads/in.

^B Based on 125 000 psi for sizes ¼ to 2 ½ in., inclusive, and on 115 000 psi for sizes over 2 ½ to 4 in., inclusive.

^C Based on 105 000 psi for sizes ¼ to 2 ½ in., inclusive, and on 95 000 psi for sizes over 2 ½ to 4 in., inclusive.

^D Based on 109 000 psi for sizes ¼ to 2 ½ in., inclusive, and on 99 000 psi for sizes over 2 ½ to 4 in., inclusive.

^E Based on 150 000 psi for sizes ¼ to 2 ½ in., inclusive, and on 140 000 psi for sizes over 2 ½ to 4 in., inclusive.

^F Based on 120 000 psi for sizes ¼ to 2 ½ in., inclusive, and on 105 000 psi for sizes over 2 ½ to 4 in., inclusive.

^G Based on 130 000 psi for sizes ¼ to 2 ½ in., inclusive, and on 115 000 psi for sizes over 2 ½ to 4 in., inclusive.

TABLE 4 Mechanical Requirements for Machined Specimens

Grade	Size, in.	Tensile Strength min, psi	Yield Strength (0.2 % offset), min, psi	Elonga- tion in 2 in. min, %	Reduc- tion of Area, min, %
BC	¼ to 2½, incl	125 000	109 000	16	50
BC	Over 2½	115 000	99 000	16	45
BD	¼ to 2½, incl	150 000	130 000	14	40
BD	Over 2½	140 000	115 000	14	40

and purchasers maintain the identification and integrity of each lot until the product is installed.

9.3 Lot Processing—All fasteners shall be processed in accordance with a lot identification-control quality assurance plan. The manufacturer, secondary processors, and distributors shall identify and maintain the integrity of each lot of fasteners from raw-material selection through all processing operations and treatments to final packing and shipment. Each lot shall be assigned its own lot-identification number, each lot shall be tested, and the inspection test reports for each lot shall be retained.

9.4 Lot Definition—A lot is a quantity of a uniquely identified fastener product of the same nominal size and length produced consecutively at the initial operation from a single mill heat of material and heat treatment lot and processed at one time, by the same process, in the same manner so that statistical sampling is valid. The identity of the lot is maintained throughout all subsequent operations and packaging.

9.5 Number of Tests—The minimum number of tests from each production lot for the tests specified below shall be in accordance with Guide **F1470**.

Hardness
Tensile

Coating Weight/Thickness
Workmanship (Surface Disconti-
nuities Section 8)

Proof Load

9.5.1 The number of tests for dimensional and thread fit compliance shall be in accordance with the quality assurance provisions of the referenced dimensional standards.

9.6 If any test specimen shows defective machining it may be discarded and another specimen substituted.

10. Test Methods

10.1 Test methods shall be conducted in accordance with Test Methods **F606**.

10.2 Proof load, rather than yield strength determination is preferred and shall be the arbitration method for fasteners 1¼ in. and under in diameter.

10.3 Hexagon bolts shall be tested by the wedge tension method. Fracture shall be in the body or threads of the bolt without any fracture at the junction of the head and body.

10.3.1 At the option of the manufacturer, the yield strength test (Method 2, Yield Strength paragraph of Test Methods **F606**) and the wedge tension test (Wedge Tension Testing of Full-Size Product paragraph, both from the Test Method section of Test Methods **F606**) may be accomplished concurrently to satisfy **10.2** and **10.3**.

10.4 Studs and bolts other than those in **10.3** shall be tested by the axial tension method.

10.4.1 At the option of the manufacturer, the yield strength test and the axial tension test may be accomplished concurrently to satisfy **10.2** and **10.4**.

10.5 The speed of testing determined with a free running crosshead shall be a maximum of ⅛ in. (3.2 mm)/min for the bolt proof load (or yield strength) determination and a maximum of 1 in. (25.4 mm)/min for the tensile strength determination.

11. Inspection

11.1 If the inspection described in **11.2** is required by the purchaser, it shall be specified in the inquiry and contract or purchase order.

11.2 The inspector representing the purchaser shall have free entry to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspections required by the specification that are requested by the purchaser's representative shall be made before shipment, and shall be conducted as not to interfere unnecessarily with the operation of the works.

12. Responsibility

12.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser.

13. Rejection and Rehearing

13.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

14. Certification

14.1 When specified on the purchase order, the manufacturer or supplier, whichever is the responsible party in accordance with Section **12**, shall furnish the purchaser a test report which includes the following:

14.1.1 Product description, grade, quantity, ASTM Specification Number and issue date,

14.1.2 Alloy grade (AISI, SAE, UNS, etc.), heat analysis, and heat number, and type of quench,

14.1.3 Results of hardness, tensile, and proof load tests, as applicable,

14.1.4 Statement of compliance to Protective Coating Specification (if applicable),

14.1.5 Statement of compliance with the surface discontinuity requirements of Specification **F788/F788M**,

14.1.6 Statement of compliance dimensionally,

14.1.7 Report, describe, or illustrate manufacturer's markings and their location,

14.1.8 Lot number, purchase order number, and date shipped,

14.1.9 Country of origin, and

14.1.10 Title and signature of the individual assigned certification responsibility by the company officers, with complete mailing address.

14.2 Failure to include all the required information on the test report shall be cause for rejection.

15. Product Marking

15.1 *Manufacturers Identification*—All products shall be marked by the manufacturer with a unique identifier to identify the manufacturer or private label distributor, as appropriate.

15.2 *Grade Identification:*

15.2.1 All Grade BC products shall be marked “BC”.

15.2.2 All Grade BD products shall be marked “BD”. In addition to the “BD” marking, the product may be marked with 6 radial lines 60° apart if manufactured from alloy steel conforming to the requirements of this specification.

15.3 *Marking Location and Methods:*

15.3.1 Bolts shall be marked on the top of the bolt head.

15.3.2 Where studs have both coarse and fine threads, all markings shall appear on the coarse thread end or, if preferred, the manufacturer’s identification shall appear on the fine thread end and the grade marking on the coarse thread end.

15.3.3 Continuous thread studs may be marked on either end.

15.3.4 All markings may be raised or depressed at the manufacturer’s option.

15.3.5 Grade and manufacturer’s or private label distributor’s identification shall be separate and distinct. The two identifications shall preferably be in different locations and when on the same level shall be separated by at least two spaces.

16. Packaging and Package Marking

16.1 *Packaging:*

16.1.1 Unless otherwise specified, packaging shall be in accordance with Practice **D3951**.

16.1.2 When special packaging requirements are required, they shall be defined at the time of the inquiry and order.

16.2 *Package Marking:*

16.2.1 Each shipping unit shall include or be plainly marked with the following information:

16.2.1.1 ASTM designation and grade,

16.2.1.2 Size,

16.2.1.3 Name and brand or trademark of the manufacturer,

16.2.1.4 Number of pieces,

16.2.1.5 Purchase order number, and

16.2.1.6 Country of origin.

17. Keywords

17.1 alloy steel; bolts; steel; studs

SUPPLEMENTARY REQUIREMENTS

S1. Marking

S1.1 Studs that are continuously threaded with the same class of thread shall be marked on each end with the marking in accordance with Section **15**.

S1.2 Marking small sizes (customarily less than 0.375 in. (9.525 mm)) may not be practical. Consult the producer for the minimum size that can be marked.

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (A354-07a) that may impact the use of this standard. (Approved Dec. 15, 2011.)

(I) *Revised*—**Table 1**.

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Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength¹

This standard is issued under the fixed designation A490; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers two types of quenched and tempered, alloy steel, heavy hex structural bolts having a tensile strength of 150 to 173 ksi.

1.2 These bolts are intended for use in structural connections. These connections are covered under the requirements of the Specification for Structural Joints Using Specification A325 or A490 bolts, approved by the Research Council on Structural Connections; endorsed by the American Institute of Steel Construction and by the Industrial Fastener Institute.²

1.3 The bolts are furnished in sizes 1/2 to 1 1/2 in., inclusive. They are designated by type denoting chemical composition as follows:

Type	Description
Type 1	Medium carbon alloy steel
Type 2	Withdrawn in 2002
Type 3	Weathering steel

1.4 This specification provides that heavy hex structural bolts shall be furnished unless other dimensional requirements are specified on the purchase order.

1.5 Terms used in this specification are defined in Terminology F1789 unless otherwise defined herein.

1.6 For metric bolts, see Specification A490M Classes 10.9 and 10.9.3

1.7 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.8 The following safety hazards caveat pertains only to the Test Methods portion, Section 12 of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user*

¹ This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.02 on Steel Bolts, Nuts, Rivets and Washers.

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² Available from American Institute of Steel Construction (AISC), One E. Wacker Dr., Suite 700, Chicago, IL 60601-2001, <http://www.aisc.org>.

of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards:³

- A194/A194M Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- A325 Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- A354 Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
- A490M Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
- A563 Specification for Carbon and Alloy Steel Nuts
- A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- D3951 Practice for Commercial Packaging
- E384 Test Method for Knoop and Vickers Hardness of Materials
- E709 Guide for Magnetic Particle Testing
- E1444 Practice for Magnetic Particle Testing
- F436 Specification for Hardened Steel Washers
- F606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
- F788/F788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series
- F959 Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
- F1136 Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
- F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard.**

- F1789** Terminology for F16 Mechanical Fasteners
- F2328** Test Method for Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws and Studs
- F2833** Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type
- G101** Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

2.2 ASME Standards.⁴

B1.1 Unified Screw Threads

B18.2.6 Fasteners for Use in Structural Applications

B18.24 Part Identification Number (PIN) Code System Standard for B18 Fastener Products

2.3 IFI Standard.⁵

IFI 144 Test Evaluation Procedures for Coating Qualification Intended for Use on High-Strength Bolts

3. Ordering Information

3.1 Orders for heavy hex structural bolts under this specification shall include the following:

- 3.1.1 Quantity (number of pieces of bolts and accessories);
- 3.1.2 Size, including nominal bolt diameter, thread pitch, and bolt length. The thread length shall not be changed;
- 3.1.3 Name of product: heavy hex structural bolts, or other such bolts as specified;
- 3.1.4 Type of bolt (Type 1 or 3). When type is not specified, either Type 1 or Type 3 shall be furnished at the supplier's option;
- 3.1.5 ASTM designation and year of issue,
- 3.1.6 Other components such as nuts, washers, and washer-type direct tension indicators, if required;
- 3.1.7 Test Reports, if required (see Section 15); and
- 3.1.8 Protective coating per Specification **F1136**, Grade 3, if required. See 4.3.
- 3.1.9 Protective coating per Specification **F2833**, Grade 1, if required. See 4.3.
- 3.1.10 Special requirements.
- 3.1.11 For establishment of a part identifying system, see ASME **B18.24**.

NOTE 1—A typical ordering description follows: 1000 pieces 1–8 in. dia × 4 in. long heavy hex structural bolt, Type 1, *ASTM A490 – 02*; each with two hardened washers, ASTM **F436** Type 1; and one heavy hex nut, ASTM **A563** Grade DH.

3.2 Recommended Nuts:

3.2.1 Nuts conforming to the requirements of Specification **A563** are the recommended nuts for use with Specification A490 heavy hex structural bolts. The nuts shall be of the class and have a surface finish for each type of bolt as follows:

Bolt Type and Finish	Nut Class and Finish
1, plain (uncoated)	A563 —DH, DH3 plain (uncoated)

1, coated in accordance with Specification **F1136**, Grade 3 or Specification **F2833**, Grade 1.

A563—coated in accordance with Specification **F1136**, Grade 5 or Specification **F2833**, Grade 1.

3, weathering steel

A563—DH3, weathering steel

3.2.2 Alternatively, nuts conforming to Specification **A194/A194M** Gr. 2H plain (uncoated) are considered a suitable substitute for use with Specification A490 Type 1 heavy hex structural bolts.

3.3 *Recommended Washers*—Washers conforming to Specification **F436** are the recommended washers for use with Specification A490 heavy hex structural bolts. The washers shall have a surface finish for each type of bolt as follows:

Bolt Type and Finish	Washer Finish
1, plain (uncoated)	plain (uncoated)
1, coated in accordance with F1136 , Grade 3 or F2833 , Grade 1.	plain, coated in accordance with F1136 , Grade 3 or F2833 , Grade 1.
3, weathering steel	weathering steel

3.4 *Other Accessories*—When compressible washer type direct tension indicators are specified to be used with these bolts, they shall conform to Specification **F959** Type 490.

4. Materials and Manufacture

4.1 *Heat Treatment*—Type 1 and Type 3 bolts shall be heat treated by quenching in oil from the austenitic temperature and then tempered by reheating to a temperature of not less than 800°F.

4.2 *Threading*—The threads shall be cut or rolled.

4.3 *Protective Coatings:*

4.3.1 When a protective coating is required and specified, the bolts shall be coated with Zinc/Aluminum Corrosion Protective Coatings in accordance with Specification **F1136**, Grade 3 or Specification **F2833**, Grade 1. These coatings have been qualified based on the findings of an investigation founded on **IFI 144**.⁶

4.3.2 No other metallic coatings are permitted unless authorized by Committee F16. Future consideration of any coating will be based on results of testing performed in accordance with the procedures in **IFI 144**, and submitted to Committee F16 for review (See note 2).

NOTE 2—For more detail see the H. E. Townsend Report “Effects of Zinc Coatings on Stress Corrosion Cracking and Hydrogen Embrittlement of Low Alloy Steel,” published in Metallurgical Transactions, Vol. 6, April 1975.

5. Chemical Composition

5.1 Type 1 bolts shall be alloy steel conforming to the chemical composition specified in **Table 1**. The steel shall contain sufficient alloying elements to qualify it as an alloy steel (see **Table 1**, footnote A.).

5.2 Type 3 bolts shall be weathering steel conforming to the chemical composition requirements in **Table 2**. See Guide **G101** for methods of estimating the atmospheric corrosion resistance of low alloy steel.

⁶ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:F16-1001.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5900, <http://www.asme.org>.

⁵ Available from Industrial Fastener Institute, (IFI), 6363 Oak Tree Boulevard, Independence, OH 44131. <http://www.industrial-fasteners.org>.

TABLE 1 Chemical Requirements for Type 1 Bolts

Alloy Steel		
Element	Heat Analysis, %	Product Analysis, %
Carbon		
For sizes through 1½ in.	0.30–0.48	0.28–0.50
For size 1½ in.	0.35–0.53	0.33–0.55
Phosphorus, max	0.040	0.045
Manganese, min	0.60	0.57
Sulfur, max	0.040	0.045
Alloying Elements	^A	^A
Alloy Steel with Boron Addition		
Element	Heat Analysis, %	Product Analysis, %
Carbon		
For sizes through 1½ in.	0.30–0.48	0.28–0.50
For size 1½ in.	0.35–0.53	0.35–0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.040	0.045
Sulfur, max	0.040	0.045
Boron	0.0005–0.003	0.0005–0.003
Alloying Elements	^A	^A

^ASteel, as defined by the American Iron and Steel Institute, shall be considered to be alloy when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: Manganese, 1.65 %; silicon, 0.60 %; copper, 0.60 % or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, chromium up to 3.99 %, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying elements added to obtain a desired alloying effect.

TABLE 2 Chemical Requirements for Type 3 Bolts

Element	Heat Analysis, %	Product Analysis, %
Carbon		
Sizes 0.75 in. and smaller	0.20–0.53	0.19–0.55
Sizes larger than 0.75 in.	0.30–0.53	0.28–0.55
Manganese, min	0.40	0.37
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045
Copper	0.20–0.60	0.17–0.63
Chromium, min	0.45	0.42
Nickel, min	0.20	0.17
or		
Molybdenum, min	0.15	0.14

5.3 Product analyses made on finished bolts representing each lot shall conform to the product analysis requirements specified in **Tables 1 and 2**, as applicable.

5.4 Heats of steel to which bismuth, selenium, tellurium, or lead has been intentionally added shall not be used for bolts furnished to this specification. Compliance with this requirement shall be based on certification that steels having these elements intentionally added were not used.

5.5 Chemical analyses shall be performed in accordance with Test Methods, Practices, and Terminology **A751**.

6. Mechanical Properties

6.1 *Hardness*—The bolts shall conform to the hardness specified in **Table 3**.

6.2 *Tensile Properties*:

6.2.1 Except as permitted in **6.2.1.1** for long bolts and **6.2.1.2** for short bolts, sizes 1.00 in. and smaller having a nominal length of $2\frac{1}{4}D$ and longer and sizes larger than 1.00 in. having a nominal length of $3D$ and longer shall be wedge tested full size and shall conform to the minimum and maximum wedge tensile load, and proof load or alternative proof load specified in **Table 4**. The load achieved during proof load testing shall be equal to or greater than the specified proof load.

6.2.1.1 When the length of the bolt makes full-size testing impractical, machined specimens shall be tested and shall conform to the requirements specified in **Table 5**. When bolts are tested by both full-size and machined specimen methods, the full-size test shall take precedence.

6.2.1.2 Sizes 1.00 in. and smaller having a nominal length shorter than $2\frac{1}{4}D$ down to $2D$, inclusive, that cannot be wedge tested shall be axially tension tested full size and shall conform to the minimum tensile load and proof load or alternate proof load specified in **Table 4**. Sizes 1.00 in. and smaller having a nominal length shorter than $2D$ and sizes larger than 1.00 in. with nominal lengths shorter than $3D$ that cannot be axially tension tested shall be qualified on the basis of hardness.

6.2.2 For bolts on which hardness and tension tests are performed, acceptance based on tensile requirements shall take precedence in the event of low hardness readings.

7. Carburization/Decarburization

7.1 This test is intended to evaluate the presence or absence of carburization and decarburization as determined by the difference in microhardness near the surface and core.

7.2 *Requirements*:

7.2.1 *Carburization*—The bolts shall show no evidence of a carburized surface when evaluated in accordance with **12.2**.

7.2.2 *Decarburization*—Hardness value differences shall not exceed the requirements set forth for decarburization in Test Method **F2328** materials when evaluated in accordance with **12.2**.

8. Dimensions

8.1 *Head and Body*:

**TABLE 3 Hardness Requirements for Bolts
½ to 1½ in. Nominal Size**

Size, in.	Nominal Length, in.	Brinell		Rockwell C	
		min	max	min	max
½ to 1, incl.	Less than $2D$	311	352	33	38
	$2D$ and longer	...	352	...	38
Over 1 to 1½, incl.	Less than $3D$	311	352	33	38
	$3D$ and longer	...	352	...	38

TABLE 4 Tensile Load Requirements for Bolts Tested Full-Size

Bolt Size, Threads per Inch, and Series Designation	Stress Area, ^A in. ²	Tensile Load, ^B lbf		Proof Load, ^B lbf	Alternative Proof Load, ^B lbf
		min	max	Length Measurement Method	Yield Strength Method
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
½-13 UNC	0.142	21 300	24 600	17 050	18 500
⅝-11 UNC	0.226	33 900	39 100	27 100	29 400
¾-10 UNC	0.334	50 100	57 800	40 100	43 400
⅞-9 UNC	0.462	69 300	79 950	55 450	60 100
1-8 UNC	0.606	90 900	104 850	72 700	78 800
1⅛-7 UNC	0.763	114 450	132 000	91 550	99 200
1¼-7 UNC	0.969	145 350	167 650	116 300	126 000
1⅜-6 UNC	1.155	173 250	199 850	138 600	150 200
1½-6 UNC	1.405	210 750	243 100	168 600	182 600

^A The stress area is calculated as follows:

$$A_s = 0.7854 [D - (0.9743/n)]^2$$

where:

A_s = stress area, in.²
 D = nominal bolt size, and
 n = threads per inch.

^B Loads tabulated and loads to be used for tests of full-size bolts larger than 1½ in. in diameter are based on the following:

Bolt Size	Column 3	Column 4	Column 5	Column 6
½ to 1½ in., incl	150 000 psi	173 000 psi	120 000 psi	130 000 psi

TABLE 5 Tensile Strength Requirements for Specimens Machined from Bolts

Bolt Size, in.	Tensile Strength, psi		Yield Strength (0.2 % offset), min, psi	Elongation in 2 in. or 50 mm, min, %	Reduction of Area, min, %
	min	max			
½ to 1½ in., incl	150 000	173 000	130 000	14	40

8.1.1 Unless otherwise specified, bolts shall conform to the dimensions for heavy hex structural bolts specified in ASME B18.2.6.

8.1.2 The thread length shall not be changed from that specified in ASME B18.2.6 for heavy hex structural bolts. Bolts requiring thread lengths other than those required by this specification shall be ordered under Specification A354 Gr. BD.

8.2 *Threads*—Threads shall be the Unified Coarse Thread Series as specified in ASME B1.1 and shall have Class 2A tolerances.

9. Workmanship

9.1 The allowable limits, inspection, and evaluation of the surface discontinuities, quench cracks, forging cracks, head bursts, shear bursts, seams, folds, thread laps, voids, tool marks, nicks, and gouges shall be in accordance with Specification F788/F788M.

10. Magnetic Particle Inspection for Longitudinal Discontinuities and Transverse Cracks

10.1 Requirements:

10.1.1 Each sample representative of the lot shall be magnetic particle inspected for longitudinal discontinuities and transverse cracks.

10.1.2 The lot, as represented by the sample, shall be free from nonconforming bolts, as defined in Specification F788/F788M, when inspected in accordance with 10.2.1-10.2.3.

10.2 Inspection Procedure:

10.2.1 The inspection sample shall be selected at random from each lot in accordance with Practice F1470 and examined for longitudinal discontinuities and transverse cracks.

10.2.2 Magnetic particle inspection shall be conducted in accordance with Guide E709 or Practice E1444. Guide E709 shall be used for referee purposes. If any nonconforming bolt is found during the manufacturer's examination of the lot selected in 10.2.1, the lot shall be 100 % magnetic particle inspected, and all nonconforming bolts shall be removed and scrapped or destroyed.

10.2.3 Eddy current or liquid penetrant inspection shall be an acceptable substitute for the 100 % magnetic particle inspection when nonconforming bolts are found and 100 % inspection is required. On completion of the eddy current or liquid penetrant inspection, a random sample selected from each lot in accordance with Practice F1470 shall be re-examined by the magnetic particle method. In case of controversy, the magnetic particle test shall take precedence.

10.2.4 Magnetic particle indications of themselves shall not be cause for rejection. If in the opinion of the quality assurance

representative the indications may be cause for rejection, a sample taken in accordance with Practice F1470 shall be examined by microscopic examination or removal by surface grinding to determine if the indicated discontinuities are within the specified limits.

11. Number of Tests and Retests

11.1 Testing Responsibility:

11.1.1 Each lot shall be tested by the manufacturer prior to shipment in accordance with the lot identification control quality assurance plan in 11.2-11.5.

11.1.2 When bolts are furnished by a source other than the manufacturer, the Responsible Party as defined in 16.1 shall be responsible for assuring all tests have been performed and the bolts comply with the requirements of this specification.

11.2 *Purpose of Lot Inspection*—The purpose of a lot inspection program shall be to ensure that each lot as represented by the samples tested conforms to the requirements of this specification. For such a plan to be fully effective, it is essential that secondary processors, distributors, and purchasers maintain the identification and integrity of each lot until the product is installed.

11.3 *Lot Method*—All bolts shall be processed in accordance with a lot identification-control quality assurance plan. The manufacturer, secondary processors, and distributors shall identify and maintain the integrity of each lot of bolts from raw-material selection through all processing operations and treatments to final packing and shipment. Each lot shall be assigned its own lot-identification number, each lot shall be tested, and the inspection test reports for each lot shall be retained.

11.4 *Lot Definition*—A lot shall be a quantity of uniquely identified heavy hex structural bolts of the same nominal size and length produced consecutively at the initial operation from a single mill heat of material and processed at one time, by the same process, in the same manner, so that statistical sampling is valid. The identity of the lot and lot integrity shall be maintained throughout all subsequent operations and packaging.

11.5 Number of Tests:

11.5.1 The minimum number of tests from each lot for the tests specified below shall be as follows:

Tests	Number of Tests in Accordance with
Hardness, tensile strength, proof load	Practice F1470
Surface discontinuities	Specification F788/F789M
Magnetic particle inspection	Specification F788/F789M
Dimensions and thread fit	ASME B18.2.6

11.5.2 For carburization and decarburization tests, not less than one sample unit per manufactured lot shall be tested for microhardness.

12. Test Methods

12.1 Tensile, Proof Load, and Hardness:

12.1.1 Tensile, proof load, and hardness tests shall be conducted in accordance with Test Methods F606.

12.1.2 Tensile strength shall be determined using the Wedge or Axial Tension Testing Method of Full Size Product Method or the Machined Test Specimens Method, depending on size and nominal length as specified in 6.2.1-6.2.2. Fracture on

full-size tests shall be in the body or threads of the bolt without a fracture at the junction of the head and body.

12.1.3 Proof load shall be determined using Method 1, Length Measurement, or Method 2, Yield Strength, at the option of the manufacturer.

12.2 *Carburization/Decarburization*—Tests shall be conducted in accordance with Test Method F2328 Hardness Method.

12.3 *Microhardness*—Tests shall be conducted in accordance with Test Method E384.

12.4 *Magnetic Particle*—Inspection shall be conducted in accordance with Section 10.

13. Inspection

13.1 If the inspection described in 13.2 is required by the purchaser, it shall be specified in the inquiry and contract or order.

13.2 The purchaser's representative shall have free entry to all parts of manufacturer's works or supplier's place of business that concern the manufacture of the material ordered. The manufacturer or supplier shall afford the purchaser's representative all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspections required by the specification that are requested by the purchaser's representative shall be made before shipment, and shall be conducted as not to interfere unnecessarily with the operation of the manufacturer's works or supplier's place of business.

14. Rejection and Rehearing

14.1 Disposition of nonconforming material shall be in accordance with Practice F1470 section titled "Disposition of Nonconforming Lots."

15. Certification

15.1 When specified on the purchase order, the manufacturer or supplier, whichever is the responsible party as defined in Section 16 shall furnish the purchaser a test report that includes the following:

15.1.1 Heat analysis, heat number, and a statement certifying that heats having bismuth, selenium, tellurium, or lead intentionally added were not used to produce the bolts;

15.1.2 Results of hardness, tensile, and proof load tests;

15.1.3 Results of magnetic particle inspection for longitudinal discontinuities and transverse cracks;

15.1.4 Results of tests and inspections for surface discontinuities including visual inspection for head bursts;

15.1.5 Results of carburization and decarburization tests;

15.1.6 Statement of compliance with dimensional and thread fit requirements;

15.1.7 Lot number and purchase order number;

15.1.8 Complete mailing address of responsible party; and

15.1.9 Title and signature of the individual assigned certification responsibility by the company officers.

15.2 Failure to include all the required information on the test report shall be cause for rejection.

16. Responsibility

16.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser.

17. Product Marking

17.1 *Manufacturer's Identification*—All Type 1 and Type 3 bolts shall be marked by the manufacturer with a unique identifier to identify the manufacturer or private label distributor, as appropriate.

17.2 *Grade Identification:*

17.2.1 Type 1 bolts shall be marked “A490.”

17.2.2 Type 3 bolts shall be marked “A490” underlined.

17.3 *Marking Location and Methods*—All marking shall be located on the top of the bolt head and shall be either raised or depressed at the manufacturer's option.

17.4 *Acceptance Criteria*—Bolts that are not marked in accordance with these provisions shall be considered nonconforming and subject to rejection.

17.5 Type and manufacturer's or private label distributor's identification shall be separate and distinct. The two identifi-

cations shall preferably be in different locations and, when on the same level, shall be separated by at least two spaces.

18. Packaging and Package Marking

18.1 *Packaging:*

18.1.1 Unless otherwise specified, packaging shall be in accordance with Practice **D3951**.

18.1.2 When special packaging requirements are required, they shall be defined at the time of the inquiry and order.

18.2 *Package Marking:*

18.2.1 Each shipping unit shall include or be plainly marked with the following information:

18.2.1.1 ASTM designation and type,

18.2.1.2 Size,

18.2.1.3 Name and brand or trademark of the manufacturer,

18.2.1.4 Number of pieces,

18.2.1.5 Lot number,

18.2.1.6 Purchase order number, and

18.2.1.7 Country of origin.

19. Keywords

19.1 bolts; alloy steel; steel; structural; weathering steel

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (A490–11) that may impact the use of this standard. (Approved April 1, 2012.)

(1) *Revised*—Section 2 to include protective coating **F2833** grade 1.

(2) *Revised*—3.1 to include protective coating **F2833** grade 1.

(3) *Revised*—3.2.1 to include protective coating **F2833** grade 1.

(4) *Revised*—3.3 to include protective coating **F2833** grade 1.

(5) *Revised*—4.3.1 to include protective coating **F2833** grade 1.

Committee F16 has identified the location of selected changes to this standard since the last issue (A490–10a^{e1}) that may impact the use of this standard. (Approved Dec. 15, 2011.)

(1) *Revised*—Table 1.

Committee F16 has identified the location of selected changes to this standard since the last issue (A490–10) that may impact the use of this standard. (Approved Dec. 1, 2010.)

(1) *Revised*—In Table 3, reduced maximum Rockwell C hardness from 39 to 38 HRC

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