



16

CABLE BRACKET ANCHOR RODS

(2011-2012) – 24 Rods

Fabrication Process

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Cable Bracket Anchor Rod

2012 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
	3	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	
		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	Tensioned to 0.75 Fy, with lockoff at ~ 0.7 Fu	
	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
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		
									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 0.68	7/14/2012 N/A	N/A 4/6/2013	N/A 4/19/2013	N/A 5/3/2013	Load During Construction - Tensioned to 0.5 Fy 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.
	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
	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		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
SAN FRANCISCO COUNTY IN SAN FRANCISCO
FROM 0.6 KM TO 1.3 KM EAST OF THE YERBA BUENA TUNNEL EAST PORTAL**

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.**

CONTRACT NO. 04-0120F4

04-SF-80-13.2/13.9

**Bids Open: February 1, 2006
Dated: August 1, 2005**

OSD

10-1.60 CABLE SYSTEM

GENERAL

Description

Cable system shall consist of construction of the shop prefabricated parallel wire strand (PWS) cable system and the suspender system, in accordance with the details shown on the plans, the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

The PWS cable system shall consist of furnishing, fabricating, and erecting the shop prefabricated parallel wire strands, strand sockets, strand anchor rods, shims and nuts, cable wrapping wire, zinc paste, cable bands, cable-band bolts, cable-band caulking, cable shrouds, cable hand ropes, hand-rope anchors, hand-rope supports, hand-rope gates, and appurtenances.

The suspender system shall consist of furnishing, fabricating, and erecting the suspender ropes, suspender rope sockets, suspender rope separators, suspender rope anchor rods and nuts, split collars, elastomeric collars, keeper angles, keeper bolts, shims, suspender clamps, and appurtenances.

Cable saddles shall conform to "Steel Structures" of these special provisions.

The Cable System shall be cleaned and painted in accordance with "Clean and Paint Cable System" of these special provisions.

Prequalification

Attention is directed to "Pre-Award Information/Questionnaire," of these special provisions.

Cable System Quality Control

The Contractor shall designate in writing a Cable System Quality Control Manager (CQCM). The CQCM shall be responsible to the Contractor for the quality control of furnishing and fabricating the Cable System including the materials testing program.

The CQCM shall not be employed by or compensated by any subcontractor, or by other persons or entities hired by subcontractors who will provide services or materials for the project. The CQCM may be an employee of the Contractor.

The CQCM shall be the individual solely responsible to the Contractor for submitting and receiving all correspondence, submittals, and reports regarding the furnishing and fabricating of the cable system sent to and received from the Engineer.

The CQCM shall review, guide, and monitor the shop inspection and shop quality control program, make shop visits at various stages of fabrication as required, and issue certificates of compliance to the Engineer for the materials and fabrication of the cable system.

The CQCM shall prepare test procedures and programs for testing the materials in the Cable System for compliance with the requirements in these special provisions. The CQCM shall review the materials test results, obtain and review certificates of compliance from the suppliers of materials for the Cable System, and submit these results to the Engineer.

Working Drawings

The Contractor shall submit working drawings for the construction of the cable system to the Engineer for approval in conformance with the provisions in "Working Drawings" and "Accelerated Working Drawing Submittals" of these special provisions.

The working drawings shall contain all information required for furnishing, fabricating, and erecting the cable system including, but not limited to, the following:

- A. Complete PWS cable system fabrication engineering documents and supporting calculations for the manufacture of cable wire and fabrication of the shop fabricated parallel wire strands (PWS) including, but not limited to, the following:
 1. Complete cable wire manufacturing drawings showing the cable wire drawing process, cable wire galvanizing process, cable wire coiling process, storage of the completed cable wires, and transportation methods for delivering the cable wire to the strand fabrication shop.
 2. Written procedures for the cable wire drawing process, cable wire galvanizing process, coiling the cable wires, protection and storage of the coiled cable wire, and transportation methods for delivering the cable wire to the strand fabrication shop.
 3. Written procedures for quality control and testing during the cable wire manufacturing process.
 4. Fabrication drawings showing the shop layout for the fabrication of the shop prefabricated parallel wire strand, procedures for measuring strand length for cutting and socketing, procedures for socketing strands, storage of the shop prefabricated strands, and transportation methods for delivering the shop prefabricated strands to the bridge site.

5. Written procedures for the fabrication of the shop prefabricated parallel wire strands, storage of the cable wires, storage of the shop prefabricated strands, and transportation methods for delivering the shop prefabricated strands to the bridge site.
 6. Written procedures for quality control and testing during the fabrication of the shop prefabricated parallel wire strands.
- B. Complete suspender system fabrication engineering documents and supporting calculations for furnishing and fabricating the suspender system including, but not limited to, the following:
1. Suspender ropes manufacturing procedures.
 2. Written procedures for quality control and testing during suspender rope manufacturing.
 3. Written procedures and drawings for pre-stretching, measuring, and socketing the suspender ropes.
- C. Complete cable system construction engineering documents and supporting calculations for erection and monitoring of the cable system including, but not limited to, the following:
1. Erection drawings, written procedures, and calculations showing the temporary works required for the cable system construction, including, but not limited to, footbridges, cross walks, hand ropes, storm restraint system, tramway hauling system, strand storage, unreeling equipment, and temporary cranes.
 2. The Contractor shall develop and verify, as part of his Erection Plan, a set of weights, reactions, box-girder cambers, cable profiles, and suspender forces, which are consistent with a box-girder moment diagram that lies within the range of the allowable box-girder moments shown on the plans. The computed as-built suspender forces of the Contractor's Erection Plan shall henceforth be referred to as suspender load.
 3. The Erection drawings, written procedures, and calculations showing each sequence for each stage of construction of the cable system and transfer of the suspender load to the cable system, including the method of transferring the load through the suspender system to the PWS cable system.
 4. Calculations for each sequence of each stage of construction of the cable system and transfer of the suspender load to the cable system.
 5. Establishing three-dimensional coordinate geometric control points for surveying and measuring the self-anchoring suspension structure for each stage of construction of the cable system and transfer of the suspender load to the cable system.
 6. Calculations for the three-dimensional geometric control points for surveying and measuring the self-anchoring suspension structure for each stage of construction including positioning of the tower saddle and the jacking saddle and transfer of the suspender load to the cable system.
 7. Substantiating calculations for the forces and stresses in the cable system and in the steel box girders and cross beams during the cable system construction including the final set of forces and stresses after the completion of cable system construction and transfer of the suspender load to the cable system.
 8. Written procedures and drawings showing the cable compaction procedures.
 9. Written procedures and drawings for cable wrapping procedures.
 10. Erection drawings for installation of the handropes.
 11. Written procedures and drawings for installation of cable bands, tightening cable band bolts, and cable band caulking.
 12. Written procedures and drawings of the procedures for the friction test of the cable bands.
 13. Erection drawings showing the installation of the suspender system.
 14. Calculations indicating the void ratio within the saddles.
- D. Record of Project Tests
- At the completion of testing, the Contractor shall gather all test data and submit it to the Engineer in a final report. The final report shall include the following:
1. Laboratories where tests were conducted
 2. Certificates of calibration
 3. Names of standard tests
 4. Photographs of the test apparatus
 5. A brief description of what is being tested and all test data, including stress strain curves or load deformation curves, and test data from manufacturers.

The report shall be submitted in a format approved by the Engineer. A draft copy shall be reviewed and approved by the Engineer before the final report is submitted. Twenty bound hard copies and two electronic copies of the approved final report shall be submitted to the Engineer.

The Contractor shall allow the Engineer 60 days to review and approve the cable system working drawings.

Shipping, Handling and Storing Materials

Each heat of steel used for the rod stock used for manufacturing the cable wire shall be identified by a reference number indicating the name of the supplier and date of production, and shall have attached a copy of the mill report for that heat number. The cable wire manufacturer shall track each heat number of the rod stock used in the cable wire drawing process and shall tag each production lot of cable wire with the heat number in such a manner that each production lot of cable wire can be traced back to the original heat numbers.

After drawing and galvanizing, the cable wire shall be formed into coils with a barrel diameter not less than 1500 mm. The finished coil shall be wrapped to protect the wire from damage during shipping and storage. Each coil shall be tagged with a serial number that indicates the heat numbers of the steel that was used to produce the cable wire, and the length and weight of cable wire. The serial number shall be transferred and attached to any wire specimen cut from the coil for testing. Cable wire shall be coiled in such a manner that it can be continuously uncoiled without damage.

After manufacturing, individual shop prefabricated parallel wire strands shall be reeled onto shipping reels with a barrel diameter not less than 2000 mm. Alternatively, individual shop prefabricated parallel wire strands may be shipped on shipping platforms. The parallel wire strands shall be coiled to a loop diameter not less than 2000 mm and shall be secured to the shipping platforms. The shipping platforms shall be constructed to protect the parallel wire strands against damage and shall support the coiled parallel wire strands against any instability of the coil stack by use of bracing or tie downs. Each reel or shipping platform shall be tagged with a strand serial number for that reel or shipping platform that indicates the serial numbers of the coils of cable wire that were used to produce the shop prefabricated parallel wire strand on the reel or shipping platform, the length and location within the cross section of the strand, and the weight of the strand and the total weight of the reeled package or shipping platform package. Shop prefabricated parallel wire strands shall be reeled or coiled in such a manner that the strand can be continuously unreel without damage to the strand and without tangling or jamming. The reels or shipping platforms shall be wrapped and adequately secured to protect the strand from damage during shipping and storage. Prior to strand shipping, sockets shall be securely fastened to the reel flanges or to the shipping platform. Sockets shall not bear against the strand wires. Prior to load out of the shipping platforms, the Contractor shall demonstrate to the Engineer that the parallel wire strand coil is properly secured to the shipping platform to resist the expected shipping loads. Reels or shipping platforms shall be stored within clean, dry enclosures until incorporated into the work. The Contractor shall provide suitable enclosures to prevent moisture from accumulating on the strands. Reels shall be lifted from suitable lifting points located on each flange. Shipping platforms shall be lifted from a minimum of four suitable lifting points located on the platform base perimeter.

MATERIALS AND FABRICATION

General

Material used for the permanent structure shall be purchased new specifically for this contract. The Contractor shall purchase sufficient quantities of material considering the requirements for supplementary material testing, including material for testing as specified herein.

Cable system materials inspection shall conform to the provisions of Section 55-1.03, "Inspection," of the Standard Specifications.

Cable Wire

Cable wire shall be manufactured from steel produced by the basic oxygen or electric furnace process. Wire rod shall be rolled on a rod mill and coiled for shipment to the wire mill. Rods, bright wire, and galvanized wire shall be marked and kept segregated for identification of heat and serial numbers during manufacture.

After drawing is completed, wire shall be hot dip galvanized in molten zinc of purity not less than 99.90 percent conforming to the requirements of ASTM Designation: B6 - High Grade.

A chemical analysis to determine the composition of the steel shall be made by the manufacturer during the pouring of each heat of steel. A copy of this analysis, certified by the manufacturer, shall be furnished to the Engineer immediately on the completion of the analysis. The steel shall conform to the following requirements for chemical composition on cast analysis:

	Percent
Carbon	0.78 to 0.85
Silicon	0.15 to 1.00
Manganese	0.60 to 0.90
Phosphorus	Not Exceeding 0.025
Sulfur	Not Exceeding 0.025
Copper	Not Exceeding 0.10
Nickel	Not Exceeding 0.10
Chromium	Not Exceeding 0.10
Other Elements	Not Exceeding 0.07

Product analyses shall be performed on the finished cable wire or rod. The samples for product analyses shall be taken from any portion of the material, as directed by the Engineer. The steel shall conform to the following requirements for chemical composition variance:

	Over Max.	Under Min.
Carbon	0.01	0.02
Silicon	0.05	0.0
Manganese	0.02	0.02
Phosphorus	0.004	
Sulfur	0.004	
Copper	0.0	
Nickel	0.0	
Chromium	0.0	

Product analysis tests shall be conducted on a minimum of 10 samples of random heats. Material from the heat for which test samples do not meet the specified requirements shall be rejected. The Contractor shall provide additional testing, as directed by the Engineer, to ensure the steel quality in other cable wire produced from the same heat as the failed specimen. For each failed specimen, testing shall consist of a minimum of 2 additional samples from the same heat. If either of the additional samples do not meet the specified requirements, the heat will be rejected. Additional testing shall be completed at the Contractor's expense as approved by the Engineer.

Category	Defect	Degree Permitted
A	Gas Porosity	3
B	Sand Slag Inclusions	3
C	Shrinkage:	
	Type 1	3
	Type 2	3
	Type 3	3
	Type 4	3
D	Crack	Not Permitted
E	Hot Tear	Not Permitted
F	Insert	Not Permitted
G	Mottling	Not Permitted

All castings shall be inspected after machining by the magnetic particle method conforming to the requirements of ASTM Designation: E109 and Acceptance Standard ASTM Designation: E125.

All castings except for sockets shall be stenciled with their heat number and sequence number. Machined surfaces shall have tolerances and roughness as shown on the plans.

Before casting of any production unit, the Contractor shall produce full-size models of all castings. The models shall be approved by the Engineer before the start of casting production units.

All unmachined dimension tolerances of castings shall be +4 mm and -2 mm, unless noted otherwise on the plans.

No paint or oil shall be applied to castings until the castings have been inspected and approved by the Engineer.

Any casting with defects that are deemed non-repairable by the Engineer shall be replaced at the Contractor's expense. Four additional tests on four different castings of the same heat and pattern-type shall be made at the Contractor's expense. If a casting is rejected, all other castings from the same heat shall be radiographically inspected at the Contractor's expense.

Machined surfaces shall be free of voids or other discontinuities that exceed the following:

- A. A maximum of one discontinuity within a radius of 150 mm that has a diameter not exceeding 5 mm
- B. A maximum depth of one half of the diameter, and a rounded shape with no sharp corners

Defects exceeding those defined above may be repaired by welding if approved by the Engineer.

Proposed welding repair procedures shall be submitted in writing to the Engineer for approval and shall include a description of the defects, the size and shape of the excavations, the welding specification, the preheating and post heating, welding consumables, and the welding procedure to be used.

The exterior surfaces of the cable band castings, after acceptance, shall be shop painted with the prime coat as specified in "Clean and Paint Cable System" of these special provisions. The castings shall be masked to prevent painting the machine finished surfaces, cable band bolt contact surfaces, or interior surfaces.

Cable Bands

The diameter of the cable bands shall be verified in the shop, after compaction of a short cable segment (mock cable) constructed to test the friction capacity of the band. Cable bands shall not be manufactured until such test has been conducted and evaluated by the Engineer.

Cable Band Friction Testing

To determine the frictional resistance between the cable bands and the cable, one sliding test shall be performed on a short cable segment in the shop.

The test arrangement shall be based on pushing a short compacted cable segment, no less than 3 meters long through a fixed or restrained type B4 cable band. The Contractor shall develop an apparatus for this test to be approved by the Engineer.

The mock cable shall be compacted to the nominal diameter, or less, and banded outside the confines of the cable band. Several compaction passes shall be conducted with the proposed compaction equipment, and the mock cable circumference and diameters in two orthogonal directions shall be measured and recorded with each pass. The mock cable compaction demonstrates that the cable may be compacted to the diameter shown on the plans. One end of the cable must be precisely squared relative to its length.

Interior surfaces of the cable bands shall be clean and free of any rust, lubricants, and moisture. The surface of the mock cable under the cable band shall be cleaned in accordance with the provisions of Surface Preparation Specification No. 1, "Solvent Cleaning," of the SSPC: The Society for Protective Coatings. Solvent cleaning shall be supplemented by hand tool

cleaning in accordance with the provisions of Surface Preparation Specification No. 2, "Wire Brushing, and Hand Washing, and Rinsing," of the SSPC: The Society for Protective Coatings to remove any non-adherent shop applied coating, or detrimental foreign matter unable to be removed by solvent cleaning. Brass wire brushes shall be used for this surface preparation. Steel wire brushes will not be permitted.

The cable band bolts shall be tightened to 35 % of the nominal bolt tension prescribed for the project. This shall be done through bolt length measurement with an extensometer.

The mock cable shall be jacked down through the cable band. Jacking head displacements shall be recorded along with load and cable slippage. The apparatus shall be such as to maintain stability of the cable and band specimen. The jacking head shall push against a rigid steel block that pushes against the cable uniformly. The block shall be endowed with a tight skirt that prevents the cable from moving away from under the load.

All movements shall be recorded simultaneously until the jacking force drops, or achieves a constant value, but not before the cable has moved through the band by at least 25 mm. The test shall be witnessed by the Engineer. All traces of instrumentation shall be reported.

The friction coefficient shall be calculated as the jacking force at slip divided by the sum of the tension forces in all the cable band bolts, multiplied by 2. If the friction coefficient is 0.28 or greater, no changes are necessary in the band diameter or internal grooves of the band. Otherwise, the Engineer will evaluate the test data, including the actual compacted diameter of the cable and may call for changes in the cable band diameter or internal roughness, or for increase in tension of the anchor bolts.

The cable band used for the sliding tests shall be removed, inspected, and may be reused if not damaged.

Cable band bolts

Cable band bolts shall conform to the requirements of ASTM Designation: A354, Grade BC. Nuts shall conform to the requirements of ASTM Designation: A563. Washers shall conform to ASTM Designation: F436. Cable band bolts, nuts and washers shall be galvanized. The cable band bolts shall have drilled recesses in the center of the bolt head and the center of the bolt shank for extensometer length measurements. All bolts shall receive heat treatment after final machining.

Tensile tests to failure on cable band bolts with nuts shall be performed on a minimum of 30 bolts, but not less than 6 per heat. If one bolt fails to meet the required strength two more bolts from the heat shall be tested. If both bolts meet the specified requirements, the heat will be accepted. If any two bolts from one heat fail to meet the requirements, the heat will be rejected.

Tensile tests, to obtain load-extension curves, shall be carried out on five cable band bolts, but not less than one per heat. The testing apparatus shall be proposed by the Contractor and approved by the Engineer. The load-extension curve shall be recorded continuously. The extension may be measured from the separation of the jaws of the test apparatus. The yield point of the tested specimen shall be compared to that of the specified yield point. If any of the tests does not meet the minimum requirements, two additional tests shall be conducted for that heat. Both tests shall pass the requirements or the heat will be rejected.

Cable Band Butylene Rubber Seal

The butylene rubber seal shall be manufactured to fit tightly within the cable band groove to provide a tight seal. It shall be manufactured from a mold designed for this purpose and shall account for shrinkage of the elastomer during cooling. A loose seal within the band groove will not be permitted.

Cable band caulking

The cable band caulking shall conform to Vulkem 921 or 922 as manufactured by Mameco International, Inc., Cleveland, Ohio, Dynatrol I or II as manufactured by Pekora Corporation, Harleysville, Pa., or Sikaflex 15LM or Sikaflex 2c NS as manufactured by Sika Corporation, Lyndhurst, New Jersey, or approved equal by the Engineer.

Zinc paste waterproof system

Waterproof paste shall be a single component GriKote Z-Complex 2C or equal. The GriKote Z-Complex 2C is a corrosion resistant multiple barrier paste. The paste shall be composed of a blend of zinc oxide, zinc dust and a water displacement corrosion preventing additive.

The GriKote Z-Complex 2C system shall be manufactured by the following supplier:

VENDOR ADDRESS AND PHONE NUMBER
GRIGNARD COMPANY 126 PASSAIC STREET NEWARK, NJ 07104
TEL: 973-412-8900 FAX: 973-412-8906
CONTACT: ETIENNE GRIGNARD

The zinc paste waterproofing system shall conform to the following physical requirements:

TEST METHOD	DESCRIPTION	RESULTS
ASTM D1403	Worked Penetration ½ Scale	300-400
FTM-321	Oil Separation 30 hrs @ 100°C	< 0.75%
PLTL-90	Specific Gravity @ 25°C	2.8 - 3.3 g/cc
ASTM D4048	Copper Corrosion 24 hrs. @ 100°C	Shiny 1a
FTM 5415 Modified	Resistance to Aqueous Solution 168 hrs @ 25 °C Distilled Water (Pass)	Passed: no Disintegration
	Color	Gray
	Workmanship	Smooth and homogeneous

All material components of the Grikote Z-Complex 2C zinc paste waterproofing system shall be supplied to the job site in manufacturer's packaging. Open or damaged containers shall be removed from the job site. The paste shall be delivered in 3.78 L, open head metal cans that contain 11.36 kg of GriKote Z complex 2C.

All material components of the zinc paste waterproofing system shall be stored in a sheltered and dry location out of direct sunlight, and in accordance with manufacturer's recommendations and Health and Safety regulations. The temperature of the product during storage shall be between 23°C and 70°C. Any materials stored for more than three years shall not be used and shall be removed from the job site.

The price quoted by the manufacturer for Grikote Z-Complex 2C is \$11.89 per kilogram. The manufacturer's charge for a factory representative is \$1,200 per day (minimum 4 day visit) for the 3-day periods at the beginning of the application and at the completion of the application. The manufacturer's charge for a factory representative during all other times will be negotiated with the manufacturer. Phone technical support will be provided without charge during normal working hours. The FOB location is Newark, New Jersey 07104. The manufacturer will maintain United States product liability insurance.

The prices quoted will be firm for all orders placed on or before December 31, 2005, provided delivery is accepted within 6 months after the order is placed. For orders placed after December 31, 2005, the total price will be increased 5 percent for each year thereafter, provided delivery is accepted within 6 months after the order is placed. The above prices do not include taxes, freight, and additional insurance.

The zinc paste waterproofing system price includes all materials and technical advice and does not include inspection by a qualified representative of the manufacturer.

Anchor rods

Anchor rods shall conform to the requirements of ASTM Designation: A 354, Grade BC or BD and as specified in these special provisions. Nuts shall conform to the requirements of ASTM Designation: A 563. Washers shall conform to the requirements of ASTM Designation: F 436.

Anchor rods for PWS shall conform to grade BD and shall be mechanically galvanized.

Anchor rods for suspenders shall conform to grade BC and shall be hot-dip galvanized.

Prior to shipment, all rods shall be fully threaded into their assigned mating component, including nuts, to ensure that the thread pitch has been fabricated without error and the process of turning does not strip any of the threads.

Elastomeric Collars

This work consists of the fabrication and installation of pre-molded split collars for the protection of suspender ropes inside steel collars.

Split collars shall be glued at the split surfaces and secured within the steel collar in a snug tight condition.

GENERAL NOTES
DESIGN SPECIFICATION

DESIGN: Caltrans Bridge Design Specifications, Project Specific Design Criteria for the San Francisco Oakland Bay Bridge East Span Seismic Safety Project, Self-Anchored Suspension Bridge Dated 7/15/2002. Selected excerpts from the Project Specific Design Criteria are as follows:

DEAD LOADS: Steel density 7850 kg/m³
Normal Weight Concrete including reinforcement density 2480 kg/m³
Light Weight Concrete including reinforcement density 1920 kg/m³
Deck Overlay 50 mm average density 2365 kg/m³

LIVE LOADS: Two traffic configurations:
1. Twelve lanes of highway traffic plus a bicycle/pedestrian facility on the right side of the Eastbound deck only.
2. Eight lanes of highway traffic plus an LRT system on the inside lane of each deck and a bicycle/pedestrian facility on the right side of the Eastbound deck only.

PERMIT LOAD: P13 BDS Section 3.7.7

STANDARD TRUCK: AASHTO HS20-44

Load Length L (m)	Uniform Load KN/m/lane	Concentrated Load KN/lane
0 < L ≤ 183	9.34	115.7
183 < L < 366	11.68 - L/78.3	144.6 - L/6.33
366 ≤ L	7.01	86.7

Multiple lane load reduction factors (BDS Section 3.12.1) are used for highway loads only. Full LRT train loads are combined with highway loads.

LRT LOAD: See "Sacramento Regional Transit District Light Rail Design Criteria" May 1993.

SEISMIC LOADING: Refer to "Final Ground Motion Report, SFOBB East Span Seismic Safety Project" dated February 2001.

WIND LOADING: Site specific wind profile (see Wind Laboratory Report dated May 2001). The 1-hr average design wind speed at deck level = 148 km/h.

TEMPERATURE GRADIENT: Eleven (11) degrees Celsius between top and bottom of the orthotropic box, with mean temperature being twenty (20) degrees Celsius.

FATIGUE LOADING: As per LRFD provisions of AASHTO 1994.

SHIP COLLISION: "AASHTO Guide Specifications and Commentary for Vessel Collision Design", Volume I, Final Report, February 1991 is used to design for ship impact with annual frequency of collapse equal to or less than 0.0001.

BRIDGE DIMENSIONS: All dimensions on the plans are for the final erected bridge and correspond to an average temperature of twenty (20) degrees Celsius. The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

SUSPENDER REPLACEMENT: The bridge is designed for the temporary removal of any one of the two-part suspenders. However, allowable stresses in the adjacent two-part suspender is increased by 100% for such an event.

STRUCTURAL STEEL: A709M Grade 345 unless noted otherwise on the plans.

HS Bolts: ASTM A325M galvanized unless noted otherwise. All HS bolts shall be installed with threads excluded from shear plane unless noted otherwise.

Bolt Designation: Mxx, Mxx Bolts, Mxx HS, and Mxx HS Bolts refer to HS bolts of size xx millimeters unless noted otherwise.

Substitution of Non-Metric HS Fasteners: Bolts and rods designated as xx Dia shall conform to ASTM standard specifications stated in United States Standard Measures. The diameter in millimeters shall be substituted with the nearest United States Standard Measures specified in the corresponding ASTM standard specifications.

Cap Screws: ASTM F593 or F738M Type 316 hex head stainless steel fastener with stainless steel lock washer & flat washer (ASTM A240) unless noted otherwise. Minimum anchor depth into base plate (length of engaged threads) shall be equal to 2 (two) times the bolt diameter or the plate thickness which ever is smaller. Metric size of stainless steel cap screw shown on the plans may be substituted with the nearest imperial size stainless steel cap screw.

STRUCTURAL STEEL TUBING: ASTM A500 Grade B, Fy = 317 MPa

WELDING: All structural steel plate interfaces shall be connected with continuous complete joint penetration (CJP) welds, unless noted otherwise.

Steel plate interfaces designated as milled-to-bear do not require welding, unless noted otherwise.

All complete joint penetration (CJP) welds shall have back-up bar removed and the weld back-gauged and rewelded unless noted otherwise.

Steel backing may remain permanently for CJP welds with the following notations: "CJP with backing" or "CJP with backup bar".

CABLE SYSTEM: Main Cable: Galvanized Parallel Steel Wire (5.4 mm)
Fy 1350 MPa
Fu ≥ 1760 MPa
Design Elastic Modulus 200 000 MPa
Allowable Stress 689 MPa
Allowable Fatigue Stress Range 179 MPa
Zinc Coating Class A

SUSPENDERS: Galvanized Structural Bridge Ropes (IWRC, ASTM A603)
Allowable Load 0.25 times the Breaking Strength
Allowable Fatigue Stress Range 179 MPa
Elastic Modulus 138 000 MPa
Zinc Coating Class A
Breaking Strength ≥ 1350 MPa

HAND ROPES: Galvanized Structural Strand, ASTM A475

CASTINGS: Tower Saddle, East Saddle, Pier E2 Shear Key stub, Pier E2 Shear Key housing, Pier E2 shear key spherical ring and Pier E2 bearing top housing
Structural Casting Grade 345 Fy = 345 MPa

West Deviation Saddle, West Jacking Saddle
Structural Casting Grade 415 Fy = 415 MPa

Pier E2 bearing bottom housing, solid shaft
Structural Casting Grade 550 Fy = 550 MPa

Cable Bands, Suspender Separators, Split Collars
ASTM A148M Grade 550-345 Fy = 345 MPa

Suspender Sockets/Cable Strand Sockets
ASTM A148M Grade 620-415 Fy = 415 MPa

POST-TENSIONING STRANDS/TIE DOWN STRANDS:
ASTM A416
Fu 1860 MPa

HIGH STRENGTH RODS: Main Cable Strand Anchor Rods, Tower Anchorage Anchor Bolts, Tower Saddle Grillage Bolts, Tower Saddle Tie Rods, East Saddle Tie Rods, East Saddle Anchor Rods, Cable Bracket Anchor Rods, and Pier E2 Bearing and Shear Key Anchor Bolts.
ASTM A354 Grade BD
Fy(Min) 793 MPa
Fu(Min) 965 MPa

Cable Band Bolts, West Deviation Saddle Anchor Rods, Tower Skirt Anchor Bolts, Suspender Assembly Bolts, West Deviation Saddle Tie Rods, West Jacking Saddle Tie Rods, Barrier Anchor Rods, Suspender Socket Anchor Rods, Luminaire Support Anchor Bolts.
ASTM A354, Grade BC
Fy(Min) 683 MPa
Fu(Min) 793 MPa

W2 Cap Beam Vertical PT Rods, Bikepath PT rods
ASTM A722
Fu 1030 MPa

Steel Hinge Beam PT Anchor Rods
High Strength PT Rods (75 mm)
Fu 1030 MPa

Note: All high strength rods (anchor bolts) shall be pretensioned by jacking to 70% of their ultimate tensile strength, unless noted otherwise.

DOWELS: ASTM A633, Grade E
Fy 380 MPa

REINFORCED CONCRETE: f'c = for Concrete Strength & Type Limits, see "General Notes No.3" sheet.
Mild Steel Reinforcement (ASTM A706) fy = 415 MPa
fu = 738 MPa

MAINTENANCE ACCESS HOLES: Sharp edges of all maintenance holes shall be ground smooth with a radius of 5mm. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN



DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	SF	80	13.2/13.9	423	1204

REGISTERED ENGINEER - CIVIL
12-6-04
PLANS APPROVAL DATE
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825 BATTERY STREET
SAN FRANCISCO, CA 94111
To get to the web site, go to: <http://www.dot.ca.gov>

INDEX TO CALTRANS STANDARD PLANS DATED JULY 1999

A10A	Abbreviations
A10B	Symbols
A85	Chain Link Fence
B0-1	Bridge Details
RSP B0-3	Bridge Details
B0-13	Bridge Details
B7-6	Deck Drains-Types D-1 and D-2
B7-11	Utility Details
B11-7	Chain Link Railing
B11-47	Cable Railing
RSP S2	Overhead Signs-Truss, Single Post Type
RSP S3	Overhead Signs-Truss, Two Post Type
RSP S11	Overhead Signs, Walkway Safety Railing

LEGEND:

- Girder face designation A
- Girder stiffener type 4
- Working point W5
- Standard Plan Sheet Number
- Detail Number

ABBREVIATIONS

- BCDC - Bay Conservation and Development Commission
- CJP - Complete Joint Penetration
- CPI - Center Point of Intersection
- EHW - Highest Observed Water Level
- ELW - Lowest Observed Water Level
- EPA - Point of Geometric center of cable strand anchorage on "E" Line girder
- EPI - Point of intersection on "E" Line girder
- EPT - Point of tangency on "E" Line girder
- Long - Longitudinal
- LRT - Light Rail Transit
- NA - Not Applicable
- NTS - Not to scale
- NWC - Normal Weight Concrete
- PJP - Partial Joint Penetration
- PP - Panel Point
- PT - Prestressing
- SDL - Super Imposed Dead Load
- SPCM - Seismic Performance Critical Member
- Symm - Symmetrical
- TTP - Through Thickness Properties
- UNO - Unless Noted Otherwise
- WP - Working Point
- WPA - Point of Geometric center of cable strand anchorage on "W" Line girder
- WPI - Point of intersection on "W" Line girder
- WPT - Point of tangency on "W" Line girder
- WWF - Welded Wire Fabric

R. Valizadeh/V.Toan/Y.L./W.L./F.C.
DESIGN OVERSIGHT
SIGN OFF DATE 12/07/05

5 REVISED PER ADDENDUM NO. 5 DATED DECEMBER 21, 2005

DESIGN	BY M. Nader	CHECKED S. Rodriguez
DETAILS	BY T. Ho	CHECKED S. Rodriguez
QUANTITIES	BY D. Harrison	CHECKED N. Vo

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

R. Manzanarez
PROJECT ENGINEER

BRIDGE NO.	34-0006L/R
KILOMETER POST	13.2/13.9

SAN FRANCISCO OAKLAND BAY BRIDGE EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE (SUPERSTRUCTURE & TOWER)
GENERAL NOTES NO.1

Rev. Date: 5-18-98



CU 04
EA 0120F1

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET	OF
01/15/99 05/15/99 09/08/99 05/21/00 04/26/02 04/26/02 07/01/02 12/14/02 12/01/05	006	



DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SF	80	13.2/13.9	744R4	1204

George Baker
REGISTERED ENGINEER - CIVIL

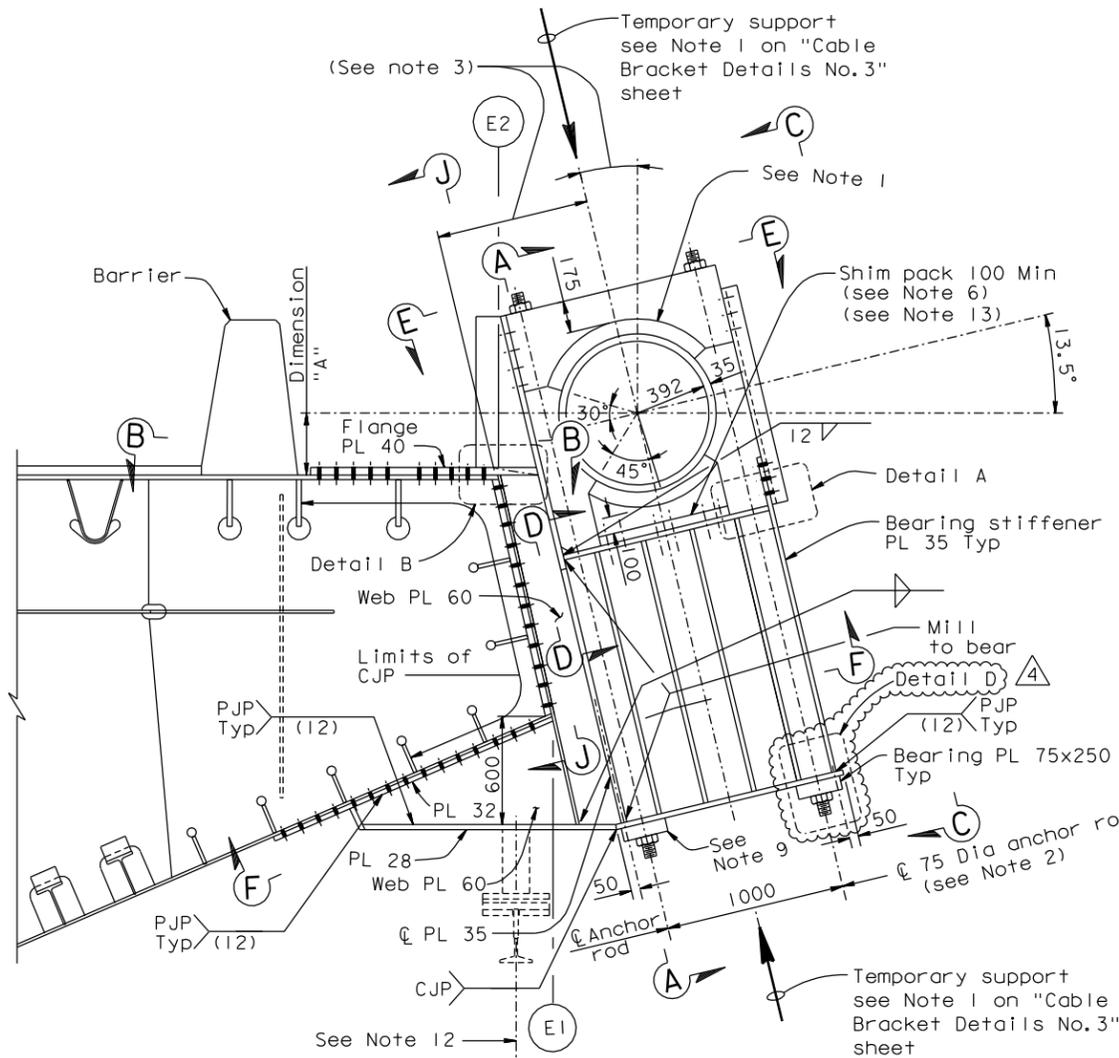
1-27-03
PLANS APPROVAL DATE

George S. Baker
No. C 57112
Exp. 12/31/05
CIVIL
STATE OF CALIFORNIA

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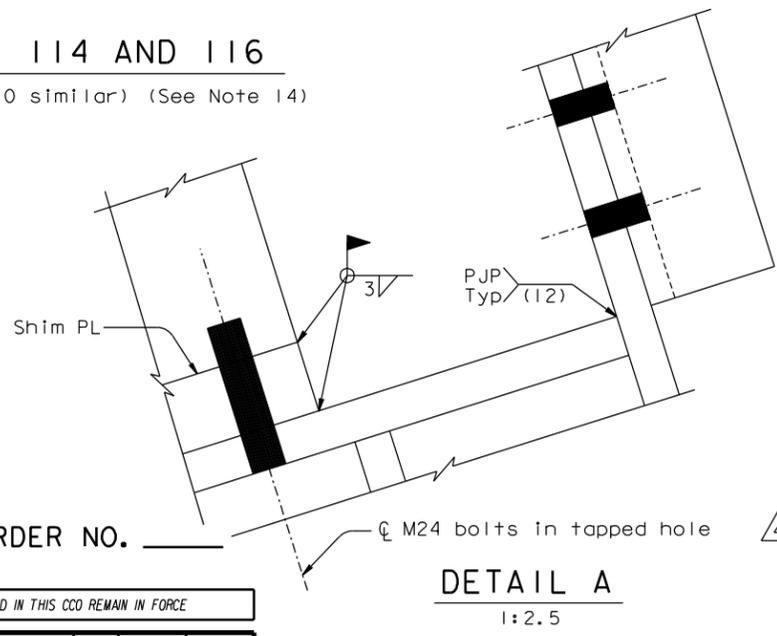
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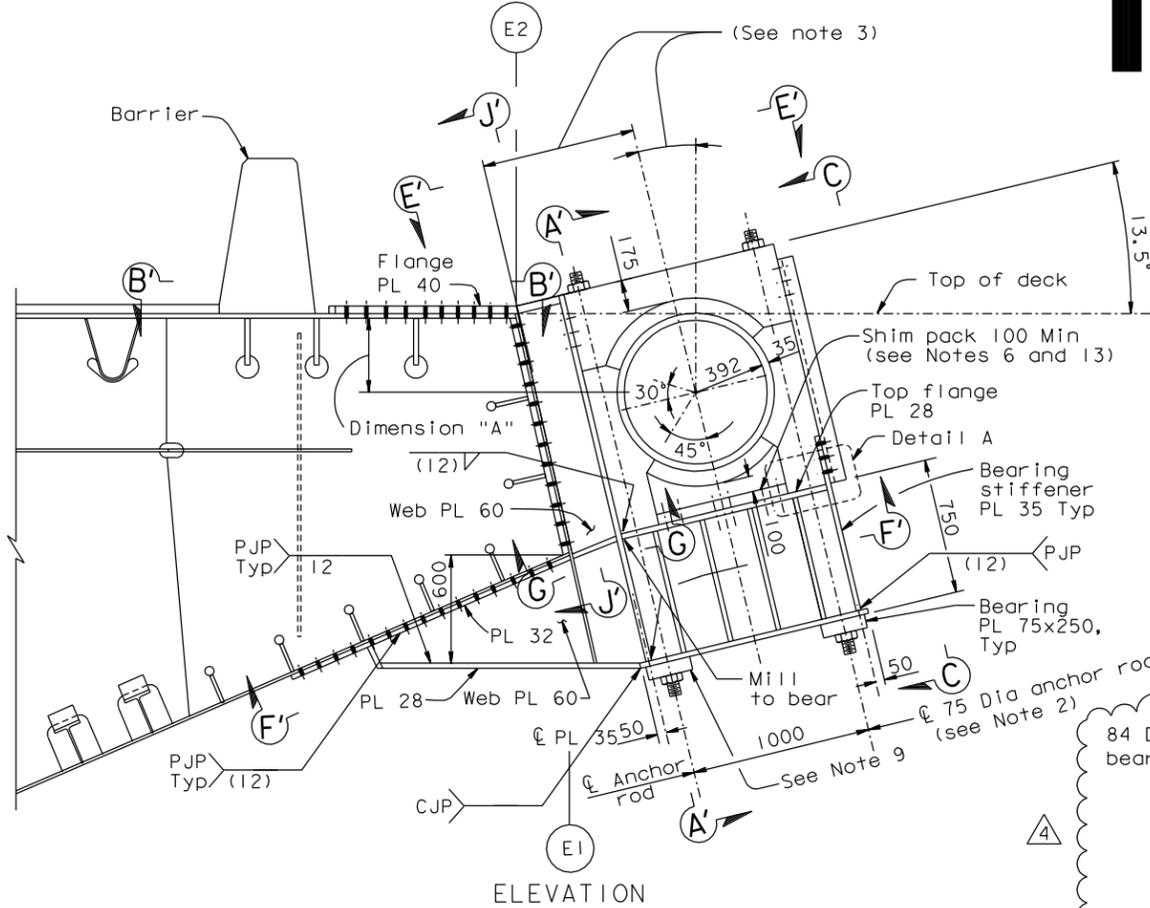


CABLE BRACKET AT PP 112, 114 AND 116
1:20 (PP 110 similar) (See Note 14)

PANEL POINT	DIMENSION "A" (SEE NOTE 3)	
	NORTH CABLE	SOUTH CABLE
110	960	1075 Above deck
112	545 Above deck	630 Above deck
114	240 Above deck	300 Above deck
116	0.0	0.0
ALTERNATIVE	BELOW DECK	BELOW DECK

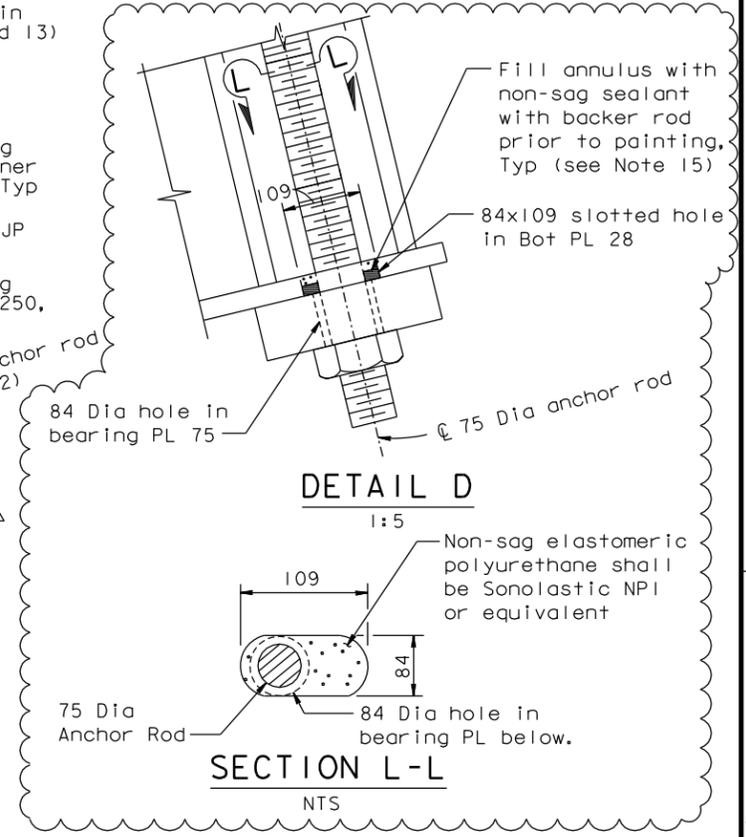


DETAIL A
1:2.5



ALTERNATIVE CABLE BRACKET (See Note 4)
1:20

- For "Cable Bracket Details" sheets all bolts shall be detailed according to the "Bolt Dimension Table". See "Typical Girder Details No.1" sheet. All bolts are HS, unless noted otherwise.
- For "Cable Bracket Details" sheets, unless noted otherwise all fillet welds shall be 6 mm for plate sizes not greater than 20 mm. For plates greater than 20 mm, fillet welds shall be 8 mm, unless noted otherwise.
- At PP116 rod bearing interferes with traveler rails. For alternative rod bearing, see Detail C on "Cable Bracket Details No.2" sheet.
- For Sections A-A, A'-A', B-B, B'-B', C-C, D-D and Detail B, see "Cable Bracket Details No.2" sheet.
- For Views E-E, E'-E', Sections F-F, F'-F', G-G, J-J and J'-J', see "Cable Bracket Details No.3" sheet.
- For location and details of traveler rail support, see "Traveler Rail Details" sheets.
- Shim plate thickness shall be 10 mm each.
- The Contractor shall provide shop drawings for two cable brackets and for two suspender brackets at PP 110 ("E" line and "W" line). The Contractor shall fabricate and install either a cable bracket or a suspender bracket at PP 110 ("E" line and "W" line) as directed by the Engineer. For suspender bracket details see "Suspender Bracket Details" sheets.
- Backer rod shall be closed-cell polyethylene foam backer rod. Contractor may propose alternative, subject to review and approval by the Engineer.
- Primer is required on galvanized steel surfaces prior to application of non-sag sealant. Refer to manufacturer's recommended procedure.



DETAIL D
1:5

SECTION L-L
NTS

NOTES:

- For details of elastomeric bearing see "Cable Band Details No.5" sheet.
- For anchor rod material, see "General Notes" sheet.
- The Contractor shall compute dimension "A" for construction using the cable profile of his Erection Plan. All permanent components shall be fabricated to fit the computed cable profile.
- If Contractor's actual cable center lies below top of deck the alternative bracket may be used.
- At PP114 and PP116 the brackets should be located so as to apply no load to the cable at the completion of construction.
- The Contractor shall allow for the compression of the elastomeric bearing due to the permanent anchor rods in his fabrication and shimming. See "Cable Bracket Details No.3" sheet.



CONTRACT CHANGE ORDER NO. _____
SHEET _____ OF _____

REQUESTS FOR INFORMATION NOT ADDRESSED IN THIS CCO REMAIN IN FORCE				
MARK	DATE	DESCRIPTION	BY	CH'D
Δ	12/12/12	MISCELLANEOUS CABLE MODIFICATIONS	GB	MN 269
Δ	01/28/11	MISCELLANEOUS CABLE SYSTEM DETAILS	GB	MN 3751
Δ	12/18/09	SUSPENDER BRACKETS	GB	MN 104
Δ	02/20/09	SUSPENDER BRACKETS	GB	MN 104
MARK	DATE	DESCRIPTION	BY	CH'D
REVISIONS				

DESIGN	BY G. Baker	CHECKED T. McMeans
DETAILS	BY S. Camo	CHECKED T. McMeans
QUANTITIES	BY D. Turner	CHECKED C. Mibelli

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

R. Manzanarez PROJECT ENGINEER	BRIDGE NO. 34-0006L/R
	KILOMETER POST 13.2/13.9

SAN FRANCISCO OAKLAND BAY BRIDGE EAST SPAN SEISMIC SAFETY PROJECT
SELF-ANCHORED SUSPENSION BRIDGE (SUPERSTRUCTURE & TOWER)
CABLE BRACKET DETAILS NO. 1

R. Valizadeh/V. Toan/Y.L./W.L./F.C.
DESIGN OVERSIGHT
R. Valizadeh/V. Toan/Y.L./W.L./F.C.
SIGN OFF DATE 12/12/12

DEPARTMENT OF TRANSPORTATION - District 4 Toll Bridge Program

333 Burma Rd.
Oakland, CA 94607
(510) 622-5660, (510) 286-0550 fax



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August 24, 2007

Contract No. 04-0120F4
04-SF-80-13.2 / 13.9
Self-Anchored Suspension Bridge
Letter No. 05.03.01-000487

Michael Flowers
Project Executive
American Bridge/Fluor Enterprises, a JV
375 Burma Road
Oakland, CA 94607

Dear Michael Flowers,

Department Audit of Dyson Corporation

The Department has reviewed ABF letter 257, dated August 14, 2007, and the "Corrective Action Request" from the Dyson Corporation, dated August 09, 2007. Based upon the information provided and in accordance with Special Provisions section 8-4, "Audits," the Dyson Corporation receives a "Pass" for the Department audit. This "Pass" applies only to the Dyson Corporation. Suppliers and subcontractors to the Dyson Corporation are subject to separate MFSQA reviews and audits. The following table summarizes the current status of associated audits:

Company	Letter No.	Date of Notice	MFSQA	AUDIT
AAA Galvanizing	321	06-18-2007	Approved	
Art Galvanizing	336	06-22-2007	Approved	
	403	07-25-2007		Contingent Pass
Central Testing Lab	320	06-18-2007	Approved	
	413	07-26-2007		Fail
Custom Industrial Processing	325	06-18-2007	Not Approved	
Industrial Coatings Inc	444	08-06-2007	Approved	
Mechanical Galv-Plating Corp	361	07-05-2007	Approved	
	432	08-02-2007		Pass
North American Galvanizing	337	06-22-2007	Approved	
	421	07-31-2007		Fail
Stork Herron Testing Lab	297	06-06-2007	Approved	
	417	07-30-2007		Contingent Pass
TC Industries	367	07-09-2007	Approved	
Tensile Testing Metallurgical Lab	296	06-06-2007	Approved	
	409	07-26-2007		Pass
Universal Galvanizing	338	06-25-2007	Approved	

The Contractor is reminded that work may not proceed at the facilities receiving a "Contingent Pass," until the outstanding issues detailed in the Department's letters have been addressed.

If you have any further questions, please contact Gary Lai at the Working Drawing Campus.

Sincerely,

A handwritten signature in blue ink that reads "Gary Purcell". The signature is written in a cursive, flowing style.

GARY PURSELL
Resident Engineer

cc: Rick Morrow
Mazen Wahbeh

file: 05.03.01, 55.0097

DEPARTMENT OF TRANSPORTATION - District 4 Toll Bridge Program

333 Burma Rd.
Oakland, CA 94607
(510) 622-5660, (510) 286-0550 fax



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July 09, 2008

Contract No. 04-0120F4
04-SF-80-13.2 / 13.9
Self-Anchored Suspension Bridge
Letter No. 05.03.01-002346

Michael Flowers
Project Executive
American Bridge/Fluor, A JV
375 Burma Road
Oakland, CA 94607

Dear Michael Flowers,

Submittal 674, Rev. 1 - Monnig MFSQA (Response to Audit Contingencies)

The Department has completed review of Submittal ABF-SUB-000674R01, "Monnig MFSQA," dated June 25, 2008, which contains the response to the audit contingencies in State Letter 05.03.01-002100. The submittal is "Approved," and Monnig Industries and Phoenix Manufacturing are receiving a Pass. It is acceptable for Monnig Industries to perform hot dip galvanizing of threaded anchor rods, with Phoenix Manufacturing performing abrasive blasting.

If you have any questions, please contact Dr. Venkatesh Iyer at (858) 967-6363.

Sincerely,

<<< ORIGINAL SIGNED >>>

GARY PURSELL
Resident Engineer

cc: Rick Morrow
Brian Boal
Gary Lai
Venkatesh Iyer
file: 05.03.01, 55.0674

DEPARTMENT OF TRANSPORTATION - District 4 Toll Bridge Program

333 Burma Rd.
Oakland, CA 94607
(510) 622-5660, (510) 286-0550 fax



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February 13, 2009

Contract No. 04-0120F4
04-SF-80-13.2 / 13.9
Self-Anchored Suspension Bridge
Letter No. 05.03.01-003482

Michael Flowers
Project Executive
American Bridge/Fluor, A JV
375 Burma Road
Oakland, CA 94607

Dear Michael Flowers,

Submittal 135, Rev. 4 – MFSQA for Stork Herron Testing Laboratory (STHL)

The Department has completed review of Submittal ABF-SUB-000135R04, "Manufacturing and Fabrication Self Qualification Audit (MFSQA) – Stork Herron Testing Laboratory," dated February 13, 2009. The submittal is "Approved," and accordingly, Mr. Shane Levermann may perform NDT (MT) on the Project for the Dyson Corporation.

If you have any questions, please contact Mohammad Fatemi (916) 813-3677.

Sincerely,

<<< ORIGINAL SIGNED >>>

GARY PURSELL
Resident Engineer

cc: Rick Morrow
Brian Boal
Gary Lai
Mohammad Fatemi
file: 05.03.01, 55.0135

DEPARTMENT OF TRANSPORTATION - District 4 Toll Bridge Program

333 Burma Rd.

Oakland, CA 94607

(510) 622-5660, (510) 286-0550 fax



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July 14, 2008

Contract No. 04-0120F4

04-SF-80-13.2 / 13.9

Self-Anchored Suspension Bridge

Letter No. 05.03.01-002360

Michael Flowers
Project Executive
American Bridge/Fluor, A JV
375 Burma Road
Oakland, CA 94607

Dear Michael Flowers,

Quality Assurance Testing of Externally Threaded Fasteners

This letter is issued in response to renewed discussions at the Working Drawing Campus (WDC) and ABF-RFI-001233R04, concerning the Quality Assurance (QA) testing regimen of externally threaded fasteners, nuts and washers (fastener assemblies) for the SAS Project.

Initial discussions concerning the QA sampling requirements took place at the WDC in June 2007 and predominately concentrated on the QA sampling quantity for specialized and large diameter fastener assemblies used on the Cable System and the E2 Bearing and Shear Keys. A spreadsheet quantifying the sample size was provided at that time in draft format for discussion purposes only.

In addition, the Contractor was reminded at these meetings that QA testing of fastener assemblies will be performed pursuant to Standard Specification Section 6-1.01, "Source of Supply and Quality of Materials," and that the sample quantity, per heat, will be in accordance with Contract Special Provision Section 10-1.59, "Steel Structures," subsection "Bolted Connections," as shown below:

Lot Size (No. of Bolts)	Sample Size (No. of Bolts)
2 to 15	3
16 to 25	4
26 to 50	5
51 to 90	7
91 to 150	8
151 to 280	9
281 to 10,000	12
10,001 to 500,000	16
500,001 and over	20

AMERICAN BRIDGE/FLUOR, A JV

July 14, 2008

Page 2 of 2

The spreadsheet attached to this letter titled "*QA Sampling – Cable System/E2 Bearings & Shear Keys*," modifies the sample size provided above for some of the Cable System and E2 Bearing and Shear Key fastener assemblies. Please provide test samples in accordance with the attachment.

Please contact Brian Boal at (510) 622-5191 should you have any questions.

Sincerely,

A handwritten signature in blue ink that reads "Gary Purcell". The signature is written in a cursive, flowing style.

GARY PURSELL
Resident Engineer

Attachment

cc: Rick Morrow
Brian Boal
Mark Woods
Gary Lai
Venkatesh Iyer
Ryan Smith
file: 05.03.01

QA Sampling - Cable System/E2 Bearings & Shear Keys

Description	Size	Material & Grade	Coating	Dwg Quantity Required	Spare Fasteners	Finished Item (Notes 10, 11, 12)	Material Only (Notes 10 & 13)	Comments
Cable Band Bolts	51mm dia x 6.10	A354-BC	HD Galv	1260	20	5	0	30 Bolts are required in addition to those listed in the table per Section 10-1.60 Cable System, for tensile testing & load extension curves
Cable Band Bolts	51mm dia x 7.10	A354-BC	HD Galv	48	T.B.D. by ABF	1	0	
Cable Band Anchor Rods	75mm dia x ###	A354-BD	HD Galv	24	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
Tower Saddle Tie Rods	4" dia x ###	A354-BD	HD Galv	24	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
East Saddle Tie Rods	3" dia x ***	A354-BD	HD Galv	18	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
East Saddle Anchor Rods	50mm dia x ***	A354-BD	HD Galv	32	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
West Saddle Tie Rods	1.75" dia x ***	A354-BC	HD Galv	42	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
West Deviation Saddle Anchor Rods	50mm dia x ***	A354-BC	HD Galv	168	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
Jacking Saddle Tie Rods	1.5" dia x ***	A354-BC	HD Galv	8	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
Suspender Socket Anchor Rods - Type I	90mm dia x ***	A354-BC	HD Galv	352	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
Suspender Socket Anchor Rods - Type II	100mm dia x ***	A354-BC	HD Galv	48	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
Tower Suspender Anchor Rod	90mm dia x ***	A354-BC	HD Galv	16	T.B.D. by ABF	Included with Type I Suspender	2	
E2 Shear Key	76mm dia x ***	A354-BD	HD Galv	192	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
E2 Shear Key	76mm dia x ***	A354-BD	HD Galv	336	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
E2 Bearing	76mm dia x ***	A354-BD	HD Galv	96	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
E2 Bearing	50mm dia x ***	A354-BD	HD Galv	224	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
Main Cable Anchor Rods	90mm dia x ###	A354-BD	HD Galv	274	T.B.D. by ABF	1	2	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.

Notes/Legend:

- 1) Quantities for testing are per Lot. (Lot implies same diameter, length, heat, as well as heat treatment batch)
- 2) The number of samples indicated will be for Caltrans Lab testing.
- 3) Quantities listed do not take into account re-testing criteria due to failure
- 4) This list is NOT all inclusive. Items not listed are to follow the sampling size table in Section 10-1.59 "Steel Structures" of the Contract Special Provisions
- 5) ### = Fastener length varies; length to be determined by ABF's Means & Methods; *** = Fastener diameter will be determined by ABF's Means & Methods
- 6) A354 does not have metric equivalent. All Fastener diameters will be in imperial. Those shown in imperial were requested in RFI #278R0 & #281R1. Contract Plans - General Note allows for size substitution as clarified in RFI #65R0
- 7) ASTM A354 requires that the number of tests conform to ASTM F1470 and performed in accordance with ASTM F606
- 8) Number of tests/requirements for ASTM F1470 not shown
- 9) Quantities assume that no ROCAP testing required
- 10) Quantities provided are ONLY applicable if manufacturer passes Department Audit
- 11) Finished items shall be fabricated full-size; the Engineer will select one at random, and the fabricator may send to Trans Lab either this sample OR a 1200 mm length cut from a threaded end of the sample.
- 12) Each Finished item sample shall include the same number of washers, nuts, or similar components that will accompany an item's field installation.
- 13) "Material Only" denotes a sample 300 mm in length (minimum) which need not be threaded; it shall be from the same rod stock/heat treatment lots as the finished product.

REQUEST FOR INFORMATION (RFI)

RFI No.: ABF-RFI-001233R04 Submitted By: Gatsos, Levi Pages: 1
 RFI Date: 23-June-2008 Contact Name: Kick, Robert Pages Attached: 0
 Phone No. (510) 808-4571

Subject: E2 Bearing and Shear Key Anchor Rod Spherical Washers	
References:	
Sub/Sup: DYS	Sub RFI #:
Response Required by: 24-June-2008	Response affects critical path activity? Yes

Description:

Per WDC discussions, ABF understands the following;

1. The Proof Test Rod Assemblies are not required to be a part of a permanent heat treatment lot and that the heat treatment and galvanizing can be performed at any facility as long as it is in conformance with the contract requirements. Please confirm.
2. Caltrans would like additional QA samples to be provided for each heat treatment lot of E-2 Bearing and Shear Key Rods. Please provide details and quantity of additional samples per rod heat treatment lot.

Contractor Disposition:

This RFI is being submitted for:

The Cost and Time Impact from this RFI is: Cost and/or time impacts in the performance of our Work will result.

Response:

Agreed Ext. Due Date:

Pages: 1
 Pages Attached: 0

- 1) Contractor's proposal is acceptable.
- 2) For QA testing, the Contractor shall provide the following for each heat treated lot:
 - 3 – Nuts, washers, and plates
 - 1 – Test rod sample threaded 300mm on each end. Min.length of 1200mm
 - 2 – Material rod sample with minimum length of 300mm

The Department will issue a forthcoming letter clarifying QA sampling quantities for the job.

Administrative Action:

This response resolves the RFI.

Date: 25-June-2008	Respondent: Matin, Ron	Phone No.: 510-808-4611
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DEPARTMENT OF TRANSPORTATION - District 4 Toll Bridge Program

333 Burma Rd.
Oakland, CA 94607
(510) 622-5660, (510) 286-0550 fax



*Flex your power
Be energy efficient!*

October 31, 2008

Contract No. 04-0120F4
04-SF-80-13.2 / 13.9
Self-Anchored Suspension Bridge
Letter No. 05.03.01-002906

Michael Flowers
Project Executive
American Bridge/Fluor, A JV
375 Burma Road
Oakland, CA 94607

Dear Michael Flowers,

Authority to Proceed – CCO 91 - Additional Magnetic Particle Testing of Anchor Rods/Bolts

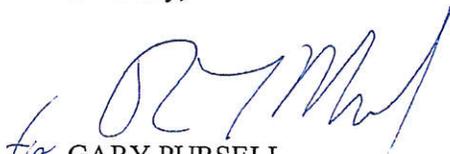
In accordance with Section 4-1.03, "Extra Work," of the Standard Specifications, ABF is directed to perform additional Magnetic Particle Testing (MT) in accordance with ASTM specification A490, on cable bracket anchor rods, main cable anchor rods and other ASTM 354, Grade BD anchor rods and bolts to be tensioned in excess of 0.5Fu. This additional work will be covered under Contract Change Order (CCO) No. 91.

The items requiring additional MT include the following:

1. East Saddle tie rod
2. Pier E2 Shear Key - anchor rods connecting stub to the E2 concrete cross beam
3. Pier E2 Shear Key - anchor bolts connecting OBG with shear key housing
4. Spherical Bushing Bearings (Pier E2) - anchor rods connecting hold down to E2 concrete cross beam
5. Spherical Bushing Bearings (Pier E2) - anchor bolts to OBG
6. Spherical Bushing Bearings (Pier E2) -Spherical bushing assembly bolts
7. Cable bracket anchor rods
8. Main Cable anchor rods

Please contact Brian Boal at 510-622-5191 if you have any questions.

Sincerely,


for GARY PURSELL
Resident Engineer

cc: Rick Morrow, Brian Boal, Gary Lai, Scott Fabel, Jinesh Mehta
file: 05.03.01, 49.091

REQUEST FOR INFORMATION (RFI)

RFI No.: ABF-RFI-001741R00 Submitted By: Smith, Kevin Pages: 2
 RFI Date: 24-April-2009 Contact Name: Smith, Kevin Phone No. (412) 631-1000
 Pages Attached: 0

Subject: CCO 91 Clarification	
References:	
Sub/Sup: ABF	Sub RFI #:
Response Required by: 01-May-2009	Response affects critical path activity?

Description:

ABF has received several questions and RFI 's from our subcontractors and suppliers concerning the Departments direction to perform additional Magnetic Particle Testing (MT) of ASTM A354 rods in Department letter No. 2906 . How is ABF supposed to determine which materials require the additional MT testing?

Method A. Review all the Contract Documents and perform the MT testing on all anchor rods and bolts that are ASTM A354, Grade BD and are to be tensioned in excess of 0.5Fu.

Method B. Only perform the testing on the items specifically listed below:

1. East Saddle tie rod
2. Pier E2 Shear Key - anchor rods connecting stub to the E2 concrete cross beam
3. Pier E2 Shear Key - anchor bolts connecting OBG with shear key housing
4. Spherical Bushing Bearings (Pier E2) - anchor rods connecting hold down to E2 concrete cross beam
5. Spherical Bushing Bearings (Pier E2) - anchor bolts to OBG
6. Spherical Bushing Bearings (Pier E2) -Spherical bushing assembly bolts
7. Cable bracket anchor rods
8. Main Cable anchor rods

Method C. Provide MT testing on all items that either meet the criteria in "Method A" above or are listed in "Method B" above.

Please review and advise.

Contractor Disposition:

This RFI is being submitted for:

The Cost and Time Impact from this RFI is: Not selected

Response:	Agreed Ext. Due Date:
	Pages: <u>2</u>
	Pages Attached: <u>0</u>

Use "Method C" to determine MT testing of ASTM A354 Gr. BD Fasteners.

REQUEST FOR INFORMATION (RFI)

Please note that the Tower Saddle Tie Rods must also be MT tested as informed in the response to ABF-RFI-001735R00. This component was inadvertently omitted from the fasteners listed in State Letter 05.03.01-002906.

Administrative Action:

This response resolves the RFI.

Date: 06-May-2009	Respondent: Collins, Warren	Phone No.: 510-622-5661
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REQUEST FOR INFORMATION (RFI)

RFI No.: ABF-RFI-001741R01 Submitted By: Smith, Kevin Pages: 2
 RFI Date: 22-May-2009 Contact Name: Gatsos, Levi Phone No. 510-808-4600
 Pages Attached: 0

Subject: CCO 91 Clarification	
References:	
Sub/Sup: ABF	Sub RFI #:
Response Required by: 29-May-2009	Response affects critical path activity?

Description:

Per the department's response to ABF-RFI-001741R00, ABF understands the following:

- A. Complete List of Rods to be covered under CCO 91
 1. East Saddle tie rod
 2. Pier E2 Shear Key - anchor rods connecting stub to the E2 concrete cross beam, with the exception of the E2 Shear Key rods located over the Pier E2 Columns which were procured prior to the issuing of CCO 91.
 3. Pier E2 Shear Key - anchor bolts connecting OBG with shear key housing
 4. Spherical Bushing Bearings (Pier E2) - anchor rods connecting hold down to E2 concrete cross beam
 5. Spherical Bushing Bearings (Pier E2) - anchor bolts to OBG
 6. Spherical Bushing Bearings (Pier E2) -Spherical bushing assembly bolts
 7. Cable bracket anchor rods
 8. Main Cable anchor rods
 9. Tower Saddle Tie Rods

Please confirm that the above list contains all rods that require additional MT testing per CCO 91.

B.
 The Tower Saddle Turned Rods have a required final tension of 0.45*Fu, however to achieve this final tension the Tower Saddle Turned Rods will be temporarily tensioned in excess of 0.5*Fu. ABF understands the intent of CCO 91 is to test ASTM A354 Grade BD Rods having a required final tension in excess of 0.5*Fu, therefore ABF has excluded the Tower Saddle Turned Rods from the above list. Please confirm that the Tower Saddle Turned Rods do not require additional MT testing.

Contractor Disposition:

This RFI is being submitted for:
 The Cost and Time Impact from this RFI is: Not selected

Response:	Agreed Ext. Due Date:
	Pages: <u>2</u>
	Pages Attached: <u>0</u>

A: The list appears to be complete. We are not aware of any other A 354 Gr. BD fasteners requiring MT per CCO No. 91.

B: Confirmed, Tower Saddle turned Rods do not require MT testing.

Administrative Action:

This response resolves the RFI.

REQUEST FOR INFORMATION (RFI)

Date: 04-June-2009	Respondent: Collins, Warren	Phone No.: 510-622-5661
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DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING 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
(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 1.7**NOTICE OF MATERIALS TO BE FURNISHED**

To: The Dyson Corporation
53 Freedom Road
Painsville, OH 44077

Report No: NMF-000053
Date: 20-Oct-2008

Contractor: American Bridge/Fluor Enterprises, a JV
375 Burma Road
Oakland, Ca 94607

Resident Engineer: Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607

The above contractor has notified this department that your firm is to furnish the following materials:

Bid Item #	Material Description
66	FURNISH PWS CABLE SYSTEM - CABLE BAND - PWS ANCHOR RODS & HARDWARE - NDT TEST PIECES

In accordance with Section 6-1.01 of the California Department of Transportation Standard Specifications, this material is subject to our inspection and release before shipment is made. Please notify this office as soon as manufacture or fabrication is proposed or as soon as sampling is required, Sampling, tests, and inspection will be made in accordance with Section 6 of the Standard Specifications.

Source inspection is random and does not relieve the contractor of the full responsibility of incorporating materials in the work that comply in all respects with the contract plans and specifications, nor does it preclude the subsequent rejection of materials found to be unsuitable.

Material shipped without proper release shall constitute sufficient reason for rejection.

Please fax the attached Inspection Request Form back to the designated Quality Assurance and Source Inspection Branch. This office must receive the request with sufficient time to complete testing or sampling prior to shipment. Your cooperation in this matter is greatly appreciated.

Sincerely,

Iyer, Venkatesh
Structural Materials Representative

REQUEST FOR INFORMATION (RFI)

RFI No.: ABF-RFI-001631R00 Submitted By: Hester, Daniel Pages: 8
 RFI Date: 05-February-2009 Contact Name: Sheffield, Pat Phone No.
 Pages Attached: 7

Subject: Heat Treatment of A354 Grade BD Material	
References:	
Sub/Sup: DYS	Sub RFI #:
Response Required by: 12-February-2009	Response affects critical path activity?

Description:

ABFJV's supplier (The Dyson Corporation) is in the process of procuring ASTM A354 Grade BD material for use on the project. The mill that Dyson is proposing to use for the material (Gerdau-Ameristeel) is also capable of performing the requisite heat treatment and their own facility (Gerdau-Macsteel). The proposed heat treating facility operates a continuous quench & temper line using induction heating technology. Dyson proposes to procure "fully upgraded" materials from Gerdau-Ameristeel in the quenched & tempered condition in accordance with the contract requirements (ASTM A354 Gr. BD). Consequently, Dyson has the following questions:

1. It is understood that an audit would not be required of the mill/heat treatment facility. Please verify Dyson's understanding.
2. Unlike other facilities, Gerdau-Macsteel heat treating operation is "truly continuous". What would be considered as the heat treat "lot size" for mechanical testing purposes?

Please see the attached for information on the heat treatment facility.

Contractor Disposition:

This RFI is being submitted for:

The Cost and Time Impact from this RFI is: Not selected

Response:	Agreed Ext. Due Date:
	Pages: 1
	Pages Attached: 0

1. Correct, an audit is not required for this mill/heat treatment facility.
2. With the information provided by Gerdau-Macsteel, the heat treatment run would be considered one lot, unless the following occurred during heat treatment:
 - A. An interruption in heat treatment operations,
 - B. The end of a shift or a personnel change,
 - C. A change in the material mill heat.

Administrative Action:

This response resolves the RFI.

Date: 12-February-2009	Respondent: Brignano, Bob	Phone No.: 510-286-0503
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Quench and Temper production lines #1 and #2.

QUENCH AND TEMPER AT IT'S FINEST

The Heat Treating Division of MACSTEEL had its beginnings nearly twenty-five years ago as a "greenfield" operation in Huntington, Indiana. The location was selected for its proximity to major customer bases and it allowed ample room for future expansion. MACSTEEL engineering carefully analyzed available manufacturing processes then "re-engineered" additional capabilities. The resulting unique quench and temper line was able to achieve the following results:

- 1 Straightness deviations of less than 0.030 inch per 3 ft. of tubing material and 0.125" per 5 ft. of bar material.
- 2 Rockwell C hardness uniformity of less than 4 points.
- 3 One-half commercial heat treat tolerances as cited by the (ASTM) American Society Testing and Materials in its A519 specification.

Today, MACSTEEL's Heat Treating Division has three full quench and temper lines coupled with a host of value-added services. Operators are highly skilled and undergo continual technical training that exceeds typical industry practice. With nearly a quarter century of experience MACSTEEL has taken heat treating from an art to a science.

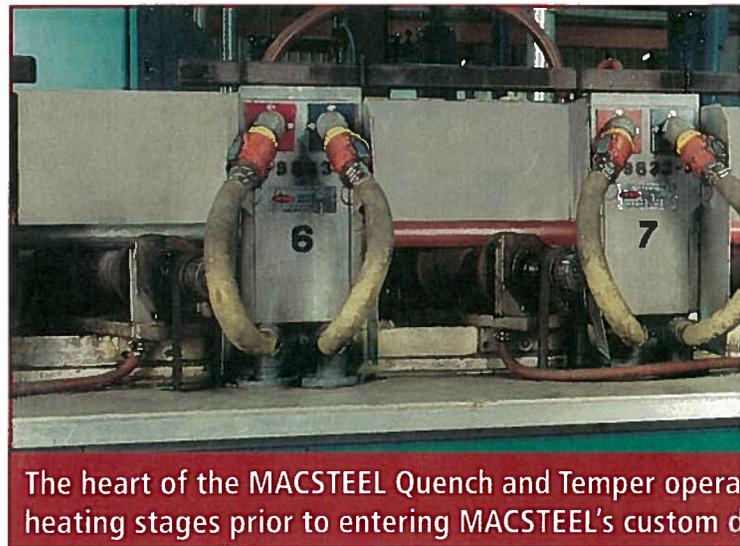
Quench and Temper production line #3.



WHY MACSTEEL HEAT TREATING?

The Heat Treating Division of MACSTEEL is a complete state-of-the-art facility specializing in technically advanced induction heating for long length bars and tubes.

Value-added support equipment for customized cutting, straightening, tensile testing and metallographic analysis are part of what this unique facility has to offer. Another distinctive attribute of this facility is that it can accommodate long bar from 12 to 35 ft. and tube product from 12 to 60 ft. in length. Customers receive the added benefit of single-source responsibility with an array of technical expertise and support that goes through the complete ranks of MACSTEEL in all their world class production facilities. MACSTEEL is recognized for its state-of-the-art metallurgical services and highly experienced product development support.



The heart of the MACSTEEL Quench and Temper operation is the induction heating stages prior to entering MACSTEEL's custom quench tanks.

THE REAL ADVANTAGE OF INDUCTION HEATING FROM MACSTEEL

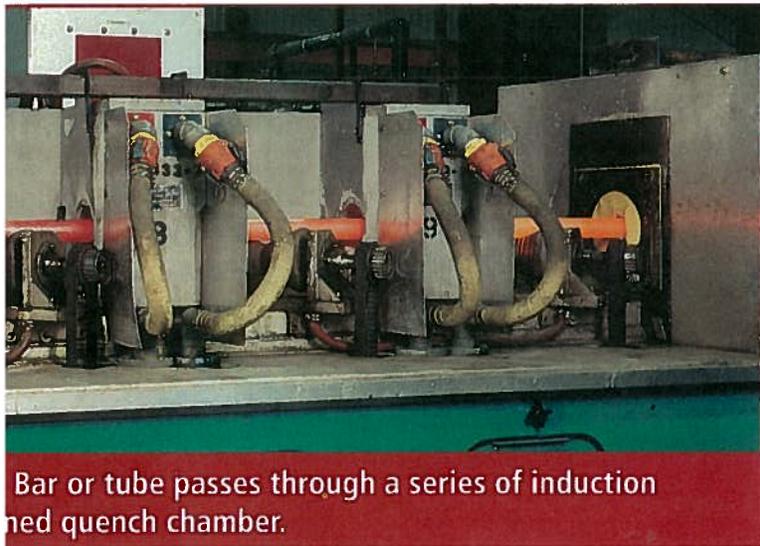
- **ONE PIECE AT A TIME**
Each bar or tube is individually heat treated, ONE BAR AT A TIME. This is better than "batch" heat treating.
- **UNIFORM HEATING**
Each rotating bar or tube is uniformly heated to a precise temperature through computer controlled induction coils.
- **INDIVIDUAL BAR & TUBE QUENCHING**
Every bar or tube is individually quenched through a proprietary quench process that achieves optimum transformation kinetics.
- **SUPERIOR STRAIGHTNESS**
Rotation of individual bars or tubes through the spray quench leads to superior straightness.

THE STEEL HEAT TREATING PROCESS

Individually, every bar or tube is processed through precision controlled induction heating coils to the optimum hardening temperature. The next step is a proprietary quench that achieves the highest quench factor for the most complete transformation. Induction tempering then provides a uniform structure to meet your strength and hardness requirements.

Full length heat treating of bar and tubing enables MACSTEEL customers to machine distortion-free parts, eliminate production processes and save money.

This is really the essence of what makes MACSTEEL's Heat Treating Division unique and special in today's market place.

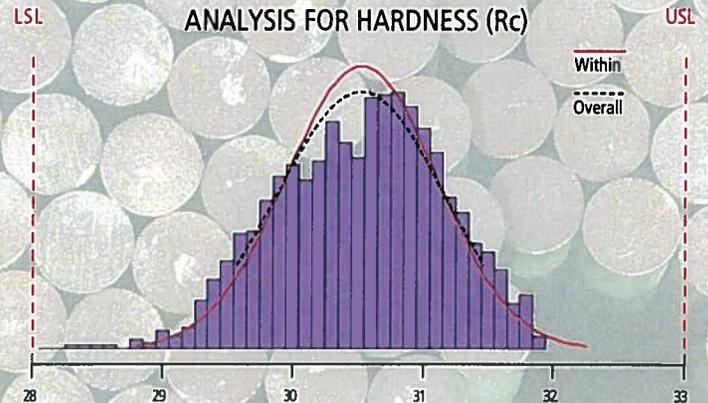


Bar or tube passes through a series of induction heated quench chamber.

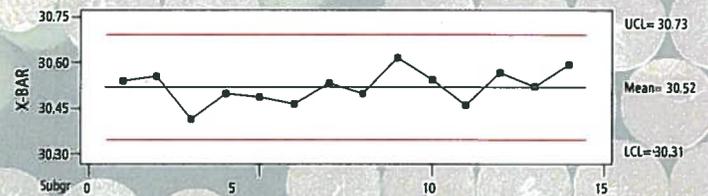
MACSTEEL Heat Treating Division PROCESS CAPABILITY

(Grade 4145, 1.062" diameter)

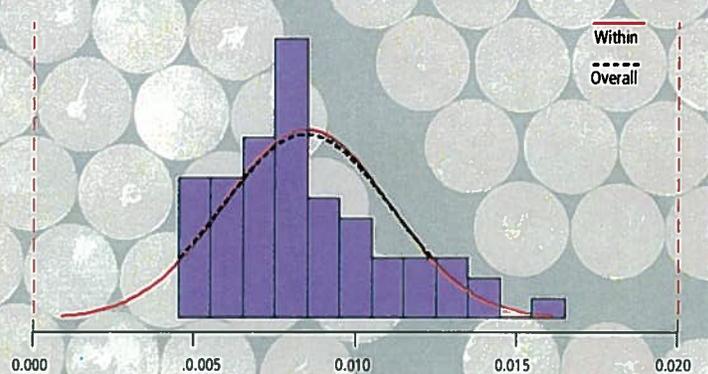
ANALYSIS FOR HARDNESS (Rc)



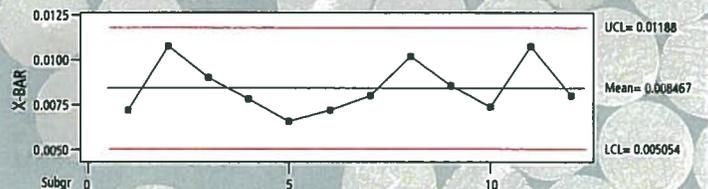
Process Data		Potential (Within) Capability	
USL	33.0000	Cp	2.88
Target	*	CPU	2.86
LSL	28.0000	CPL	2.91
Mean	30.5201	Cpk	2.86
Sample N	1357		
StDev (Within)	0.578314		
StDev (Overall)	0.635911		



ANALYSIS FOR BAR STRAIGHTNESS (TIR)



Process Data		Potential (Within) Capability	
USL	0.0200000	Cp	2.62
Target	*	CPU	3.02
LSL	0.0000000	CPL	2.22
Mean	0.0084667	Cpk	2.22
Sample N	60		
StDev (Within)	0.0025437		
StDev (Overall)	0.0026113		



QUENCH AND TEMPER (Q&T) MACSTEEL

■ STRENGTH AND TOUGHNESS

Each bar and tube transforms to a martensitic structure that is tempered in line to the desired strength and toughness.

■ UNIFORM HARDNESS

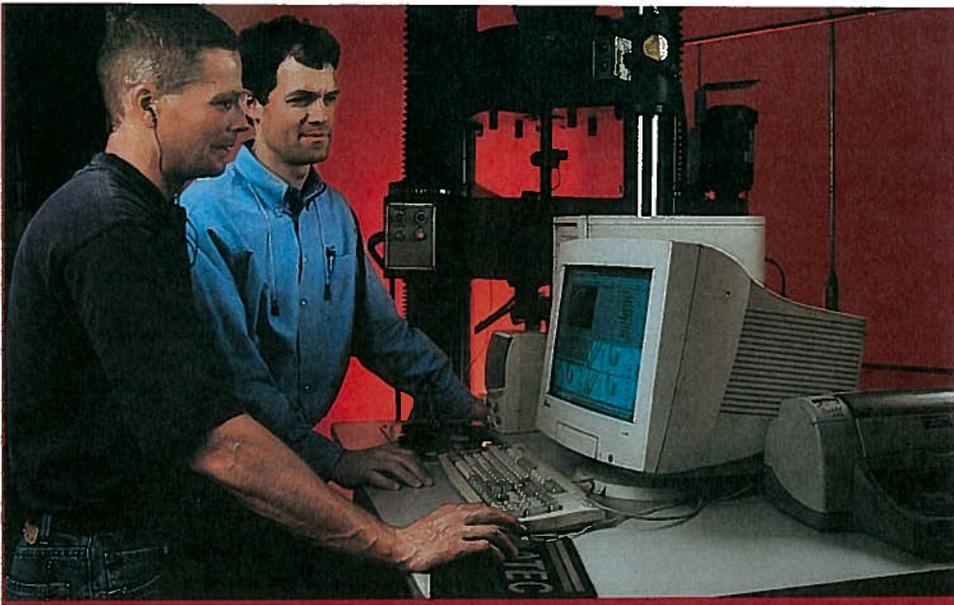
Every bar and tube has uniform hardness end-to-end, piece-to-piece and order-to-order.

■ STRESS FREE & DECARB FREE

Each bar and tube is STRESS FREE, decarb free and ready for your critical part applications.

■ VALUE-ADDED SERVICES

Orders can be CUSTOM CUT (saw or plasma) for specific product applications along with a host of other available services.



Production Bay #3 Tensile Testing Facility.



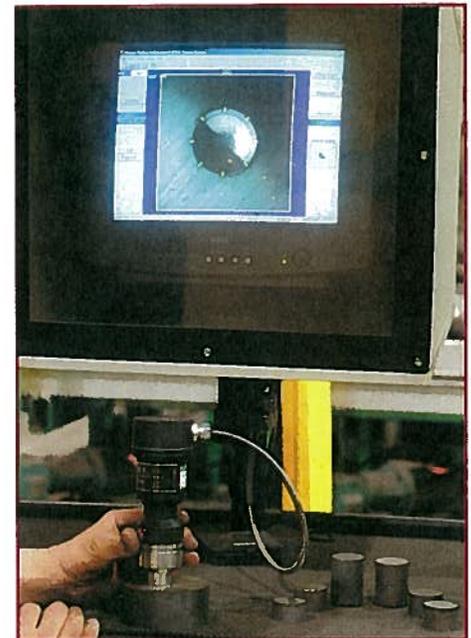
Rockwell Hardness Testing.

QUALITY, CONSISTENCY, DEPENDABILITY

MACSTEEL takes great pride in the quality of its products and in the consistency in which they are delivered. Quality control measures are routine throughout our entire quench and temper process assuring you a reliable product with no need for additionally stress relieving. Also, when MACSTEEL is specified for the raw material as well, you can count on a **stress free and decarb free** product. In any production process a "consistent" quality material is what puts dollars on the bottom line. And that's exactly what you get from the MACSTEEL Heat Treating Division.

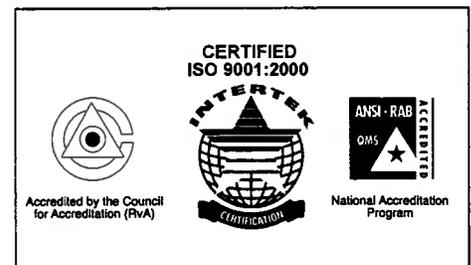
ASK FOR THE MACSTEEL EXPERTS

Let us help you discover new ways to save on your application with a heat treated product. Our people are ready and eager to help you right from the initial design all the way through the production process. Heat treating before machining is a perfect way for you to machine distortion-free parts and eliminate several production steps, thereby saving bottom-line dollars. Test our capabilities. We're ready to work with you from concept to reality. From long-run OEM contract orders to Steel Service Center conversion work, MACSTEEL Heat Treating Division is ready, willing and more than able.



Brinell Hardness Testing.

Bar exiting MACSTEEL's proprietary quenching chamber.



SPECIFICATIONS/CAPABILITIES

GRADES TREATED

- All heat treatable grades of carbon, alloy, and stainless steels.

HEAT TREATMENTS

- Quench & Temper
- Thru-hardening
- Surface hardening
- Normalizing
- Stress Relief Annealing

BAR PRODUCTS

- Hot Finished or Cold Finished
- Size range—0.875" to 4.125"
- Hex Shape (Inquire)

TUBULAR PRODUCTS

- Welded or DOM
- Hot Finished Seamless
- Cold Drawn Seamless
- Size range—0.75" to 6.25" O.D.

LENGTH CAPACITY

- BAR—12 ft. to 35 ft.
- TUBE—12 ft. to 60 ft.
- Max. weight per piece—2000 lb.

STRAIGHTNESS TOLERANCES

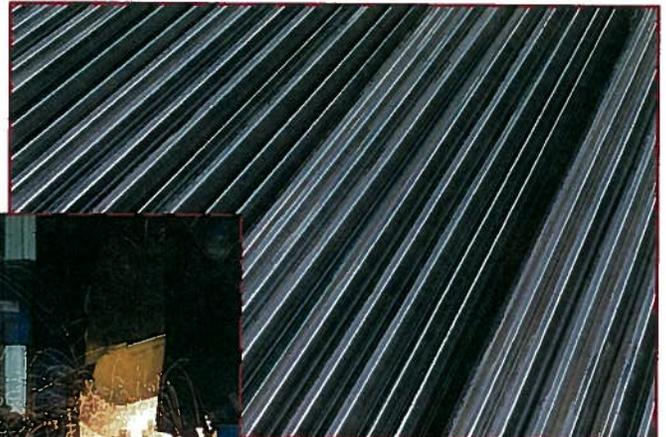
- BAR—0.125" per 5 ft.
- TUBE—0.030" per 3 ft.

CUTTING

- Close tolerance custom cutting...saw and plasma
- Cut to length for product applications

OTHER VALUE-ADDED SERVICES

- Demagnetization
- Chamfering
- Metallurgical support
- Complete traceability
- Complete test reports
- Small quantities available
- Hex bundling
- Stenciling/color coding
- Experimental or trial orders encouraged
- Short lead times
- On-time, all-the-time delivery
- Overseas packaging



CONSISTENT QUALITY



CUSTOM CUTTING



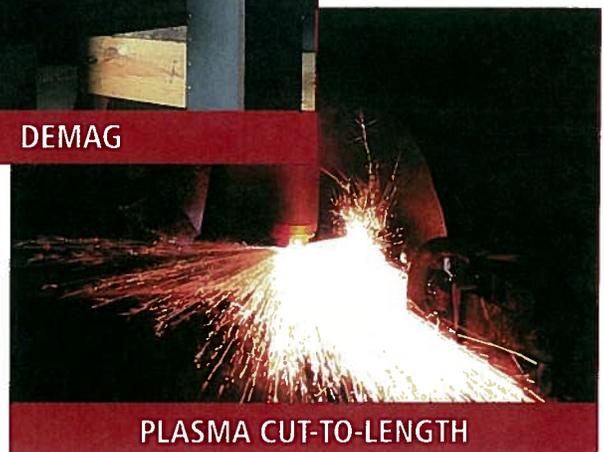
PRECISION QUENCH & TEMPER LINE #3



ON-TIME ALL-THE-TIME DELIVERY

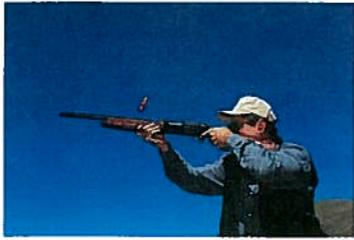


DEMAG

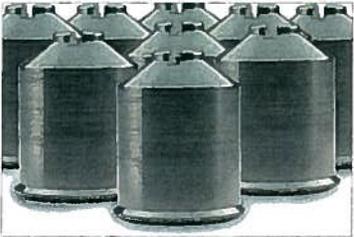


PLASMA CUT-TO-LENGTH

TYPICAL APPLICATIONS



- Automotive drivetrains & suspensions
- Automotive safety appliances
- Axle tubing
- Bolting stock
- Motor shafting
- Off-road equipment
- OCTG high pressure casing & tubing
- Oil country accessories



- Construction equipment
- Crane booms
- Farm equipment machinery
- Gun barrels
- King pins
- Machinery
- Perforator guns
- Screw machine parts
- Stabilizer bars
- Torsion bars
- Truck & Trailers



GERDAU MACSTEEL
HEAT TREAT

25 Commercial Road • Huntington, IN 46750 • 260-356-9520 • Fax 260-356-9522
www.gerdaumacsteel.com

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MSI 0903-5M Printed in U.S.A.



25 Commercial Road
Huntington, IN 46750
(219) 356-9520
Direct (219) 355-2202
Fax (219) 356-9522
Dmelchi@Gerdaumacsteel.com

February 5, 2009

Dyson Corp.
Attn: Mr. Pat Sheffield
53 Freedom Road
Painesville, OH 44077

Subject: Single bar processing vs. batch processing

Dear Mr. Sheffield:

Thank you for allowing me to give a brief overview of our Induction quench and temper heat treating lines. We will receive your material/order for processing at our facility in Huntington Indiana. Your material will be assigned a unique mill order number for our internal tracking. The material will then be run when it is received "complete".

Material is placed on the inlet table and the line is adjusted appropriately for the material size. A three piece sample run will be made and the material qualified for hardness and mechanical properties. After qualifications process is completed we will run the order in its entirety. The material will be run in a bale for bale fashion to maintain traceability. The bars will be processed one-after-another for the entire order. No separate batches will be made or will be distinguishable. In-process checks will be made at the front, middle and back of the material run to validate material specifications. A material sample will be procured for submission to an outside laboratory for any Charpy Impact testing requirements. Material will exit the line and drop into an exit bunk. The material bales will be taken to the finishing operation for further work.

The induction heat treat line consists of 9-18 induction coils for austenitizing. The induction equipment is a minimum of a 1 MWatt unit operating at a nominal 3 KHz. The material is conveyed individually through the coils on skewed rolls for uniform heating and adequate support. The material is butted together on the roll conveyor to provide for uninterrupted heating. The temperature of the material is measured using an infrared pyrometer and recorded for traceability to the order.

The material moves into a robust water quench for superior transformation into martensite. The high pressure spray system is applied to each individual bar in a uniform matter. Each bar sees the same quenching as the material is conveyed through the quench. The uniform quenching is what produces outstanding straightness control.

The Tempering of the bar is then carried out on the bar with the use of induction coils. The individual bars are conveyed through 7-14 induction coils from an 850kWatt inverter operating at a nominal 1 KHz. The material continues to be conveyed on skewed rolls with precision speed control. The tempering temperature is monitored with pyrometers.

Quench and tempered material is rolled off the line onto a cooling table where the material can cool in air. A chain drive will index material across the table. The material will finally exit into a bunk.

The finishing operation will trim two inches of material from each end of the bar. The direct bar ends are harder due to some heat loss during tempering. The cut bars will be chamfered and placed on an inspection table. Each individual bar will be checked for straightness, size. Steel stamping identification of the heat number and any color coding necessary will be applied. Material is tallied and packed for shipment.

If you have any questions or comments, please feel free to contact me on this matter.

Sincerely,

Doug Melchi
Metallurgist

ADA Notice
 For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.

To (Resident Engineer): Gary Purcell

Date: August 19, 2010

You are hereby notified that materials required for use under Contract Number (1) 04-0120F4

Dist. 04 Co. San Francisco Rte. 80 P.M. _____

will be obtained from the following sources:

Contract Bid Item Number (2)	Item Code (3)	Contract Item Description (4)	Item Component (5)	Item Sub-Component (5)	Manufacturer/Provider Name(s) and Address(es) (6)
45		Structural Steel		Fasteners & HS Rods	The Dyson Corp
50		Saddles			53 Freedom Road Painesville, Ohio 44077
52		PWS Cable System & Anchor Rods		Heat Treat	Modern Industries, Inc.
54		Page 1 of 2			613 W. 11th St. Erie, PA 16512
56				Heat Treat	TC Industries, Inc.
57					3703 S. Route 31 Crystal Lake, IL 60012
59				Galvanizing	The Art Galvanizing Works, Inc.
60					3935 Valley Road Cleveland, OH 44109
61				Galvanizing	Bob Monnig Industries, Inc.
82 & 85					400 Industrial Drive Glasgow, MO 65254

It is requested that you arrange for sampling, testing and inspection of materials prior to delivery in accordance with Section 6 of the *Standard Specifications*. It is understood that source inspection does not relieve the prime contractor of the full responsibility for incorporating into the work, materials that comply in all respects with the contract plans and specifications. Nor does it preclude the subsequent rejection of materials found to be unsuitable.

Yours Truly,

(7) c: Materials Administrator, Mail Station #5
 Materials Engineering & Testing Services
 5900 Folsom Blvd, Sacramento, CA 95819
 Fax: (916) 227-7084
 Construction Senior Engineer
 Contractor File
 District Construction Office

Contractor American Bridge / Fluor Enterprises Inc. A Joint Venture		
Address 375 Burma Road		
Business Phone (510) 808-4600	Business Fax (510) 808-4601	E-Mail Address

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To (Resident Engineer): Gary Purcell

Date: August 19, 2010

You are hereby notified that materials required for use under Contract Number (1) 04-0120F4

Dist. 04 Co. San Francisco Rte. 80 P.M.

will be obtained from the following sources:

Contract Bid Item Number (2)	Item Code (3)	Contract Item Description (4)	Item Component (5)	Item Sub-Component (5)	Manufacturer/Provider Name(s) and Address(es) (6)
45		Structural Steel		Blasting	Phoenix Manufacturing, Inc.
50		Saddles			400 Industrial Drive Glasgow, MO 65254
52		PWS Cable System & Anchor Rods		Testing	Stork Herron Testing Labs
54		Page 2 of 2			5405 E. Schaaf Road Cleveland, OH 44131
56				Testing	Tensile Testing Metallurgical Lab
57					4520 Willow Parkway Cleveland, OH 44125
59					
60					
61					
82 & 85					

It is requested that you arrange for sampling, testing and inspection of materials prior to delivery in accordance with Section 6 of the *Standard Specifications*. It is understood that source inspection does not relieve the prime contractor of the full responsibility for incorporating into the work, materials that comply in all respects with the contract plans and specifications. Nor does it preclude the subsequent rejection of materials found to be unsuitable.

Yours Truly,

(7) c: Materials Administrator, Mail Station #5
 Materials Engineering & Testing Services
 5900 Folsom Blvd, Sacramento, CA 95819
 Fax: (916) 227-7084
 Construction Senior Engineer
 Contractor File
 District Construction Office

Contractor		
American Bridge / Fluor Enterprises Inc. A Joint Venture		
Address		
375 Burma Road		
Business Phone	Business Fax	E-Mail Address
(510) 808-4600	(510) 808-4601	



CODE 00F 7

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	SEAM NUMBER 4M76368-2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
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REPORT TO

SHEET TO

TURRET STEEL IND. INC.
105 PINE STREET

TURRET STEEL
PICK UP AT MILL

IMPERIAL , PA 15126-1142

ORDERED

4140 <small>GRADE</small>	3.52" <small>SIZE</small>	32' <small>LENGTH</small>
---------------------------	---------------------------	---------------------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.42	0.97	0.014	0.030	0.20	0.09	1.04	0.17	0.18	0.010	0.023
V	Cb	Ca	N2							
0.003	0.002	0.0013	0.0060							

GRAIN SIZE SPECIFICATION ASTM E112 (5-8)

† OF GRAIN 5-8 AVG

M 100 7.0

HARDNESS SPECIFICATION Q&T (AIM 35-37RC)

CENTER	MID RADIUS	SURFACE	AVERAGE
32.0	35.9	38.7	35.5 HRC

PAGE 1

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gary H. Ridenour
Quality Assurance Representative

CONTINUED ON PAGE 2



CODE 00F 7

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	HEAT NUMBER 4M76368 -2	MOMI GRAF NUMBER 142993 102	DATE 7/19/11
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REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

IMPERIAL , PA 15126-1142

SHIP TO

TURRET STEEL
PICK UP AT MILL

ORDERED

GRADE A140	SIZE 3.52"	LENGTH 32'
---------------	---------------	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

HARDENABILITY SPECIFICATION ASTM A304

ACTUAL

J1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 20 22 24 26 28 30 32 34
57 56 56 56 55 54 54 54 53 52 51 51 49 49 47 46 45 43 41 40 39 38 38 37

MACROCLEANLINESS SPECIFICATION ASTM E381 (S3-R2-C2)

PLATE I

PLATE II

	S	R	C	
AVERAGE	1	1	1	NONE

PHYSICALS SPECIFICATION ASTM A434

02.0 IN

TENSILE (KSI)	YIELD (KSI)	% ELONGATION	REDUCTION OF AREA
158.0	139.0	14.9	52.0

DI CALCULATION SPECIFICATION REPORT

5.706

AUTO ULTRASONIC SPECIFICATION 100%

PAGE 2

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gary W. Ridemour
Quality Assurance Representative

CONTINUED ON PAGE 3



CODE 00F7

GERDAU SPECIAL STEEL NORTH AMERICA
5551 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	HEAT NUMBER 4M76368 -2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
--------------------------------	----------------------	---------------------------	---------------------------------	-----------------

REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

IMPERIAL, PA 15126-1142

ORDER TO

TURRET STEEL
PICK UP AT MILL

ORDERED

GRADE 4140	SIZE 3.52"	LENGTH 32'
---------------	---------------	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

MATERIAL ULTRASONIC TESTED FOR INTERNAL SOUNDNESS.

QUENCH TIME, TEMP, ME SPECIFICATION REPORT

TREATMENT	TEMP F	TIME (MIN.)	MEDIA
AUSTENIZE	1650	8.30	
QUENCH	0		WATER
TEMPER	1090	8.30	

REDUCTION RATIO

RATIO= 7.1 TO 1.0

CIRCOGRAPH..... SPECIFICATION 100%

CIRCOGRAPH TESTED FOR SURFACE IMPERFECTIONS

MATERIAL HAS BEEN VACUUM DEGASSED.

** MATERIAL 100% MELTED AND MANUFACTURED IN THE U.S.A. BY THE ELECTRIC ARC FURNACE AND CONTINUOUS CASTING METHOD. THE PRODUCT HAS NOT BEEN REPAIRED BY WELDING AND THIS MATERIAL HAS NOT BEEN EXPOSED TO MERCURY OR TO ANY OTHER METAL ALLOY THAT IS LIQUID AT AMBIENT TEMPERATURES DURING PROCESSING OR WHILE IN OUR POSSESSION. GERDAU MONITORS ALL INCOMING SCRAP AND ALL HEATS OF STEEL TO ENSURE THAT PRODUCTS SHIPPED ARE FREE OF RADIOACTIVE MATERIAL.

PAGE 3

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gary W. Ridgour
Quality Assurance Representative

CONTINUED ON PAGE 4



CODE 00F7

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	MILL ORDER NUMBER	DATE
31637		4M76368-2	142993 102	7/19/11

REPORT TO

SHIP TO

TURRET STEEL IND. INC.
105 PINE STREET

TURRET STEEL
PICK UP AT MILL

IMPERIAL , PA 15126-1142

ORDERED

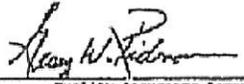
GRADE	SIZE	LENGTH
4140	3.52"	32'

ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

PAGE 4 OF 4

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916


 Gary W. Ridgour
 Quality Assurance Representative



CODE 00F 8

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	SKAT NUMBER 4M76368-2	WORK ORDER NUMBER 142993 102	DAYS 7/19/11
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REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

IMPERIAL , PA 15126-1142

FROM TO

TURRET STEEL
PICK UP AT MILL

ORDERED

GRADE 4140	SIZE 3.52"	LENGTH 32'
---------------	---------------	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.42	0.97	0.014	0.030	0.20	0.09	1.04	0.17	0.18	0.010	0.023
V	Co	Ca	N2							
0.003	0.002	0.0013	0.0060							

GRAIN SIZE SPECIFICATION ASTM E112 (5-8)

% OF GRAIN 5-8 AVG

M 100 7.0

HARDNESS SPECIFICATION Q&T (AIM 35-37RC)

CENTER	MID RADIUS	SURFACE	AVERAGE
32.0	35.9	38.7	35.5 HRC

PAGE 1

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gary V. Ridgour
Quality Assurance Representative

CONTINUED ON PAGE 2



CODE OOF 8

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	HEAT NUMBER 4M7636B -2	MOLE ORDER NUMBER 142993 102	DATE 7/19/11
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REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

SHIP TO

TURRET STEEL
PICK UP AT MILL

IMPERIAL , PA 15126-1142

ORDERED

GRADE 4140	SIZE 3.52"	LENGTH 32'
---------------	---------------	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

HARDENABILITY SPECIFICATION ASTM A304

ACTUAL

J1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34
57	56	56	56	55	54	54	54	53	52	51	51	49	49	47	46	45	43	41	40	39	38	38	37	

MACROCLEANLINESS SPECIFICATION ASTM E381 (S3-R2-C2)

PLATE I

PLATE II

	S	R	C	
AVERAGE	1	1	1	NONE

PHYSICALS SPECIFICATION ASTM A434

02.0 IN

TENSILE (KSI) YIELD (KSI) % ELONGATION REDUCTION OF AREA

158.0	139.0	14.9	52.0
-------	-------	------	------

DI CALCULATION SPECIFICATION REPORT

5.706

AUTO ULTRASONIC SPECIFICATION 100%

PAGE 2

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gary H. Bidauer
Quality Assurance Representative

CONTINUED ON PAGE 3



CODE 00F 8

GERDAU SPECIAL STEEL NORTH AMERICA
5551 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	LOT NUMBER 4M76368 -2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
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REPORT TO

SHIP TO

TURRET STEEL IND. INC.
105 PINE STREET

TURRET STEEL
PICK UP AT MILL

IMPERIAL , PA 15126-1142

ORDERED

4140	GRADE	3.52"	SIZE	32'	LENGTH
------	-------	-------	------	-----	--------

ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

MATERIAL ULTRASONIC TESTED FOR INTERNAL SOUNDNESS.

QUENCH TIME, TEMP, ME SPECIFICATION REPORT

TREATMENT	TEMP F	TIME (MIN.)	MEDIA
AUSTENIZE	1650	8.30	
QUENCH	0		WATER
TEMPER	1090	8.30	

REDUCTION RATIO

RATIO= 7.1 TO 1.0

CIRCOGRAPH..... SPECIFICATION 100%

CIRCOGRAPH TESTED FOR SURFACE IMPERFECTIONS

MATERIAL HAS BEEN VACUUM DEGASSED.

** MATERIAL 100% MELTED AND MANUFACTURED IN THE U.S.A. BY THE ELECTRIC ARC FURNACE AND CONTINUOUS CASTING METHOD. THE PRODUCT HAS NOT BEEN REPAIRED BY WELDING AND THIS MATERIAL HAS NOT BEEN EXPOSED TO MERCURY OR TO ANY OTHER METAL ALLOY THAT IS LIQUID AT AMBIENT TEMPERATURES DURING PROCESSING OR WHILE IN OUR POSSESSION. GERDAU MONITORS ALL INCOMING SCRAP AND ALL HEATS OF STEEL TO ENSURE THAT PRODUCTS SHIPPED ARE FREE OF RADIOACTIVE MATERIAL.

PAGE 3

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gary W. Bidanour
Quality Assurance Representative

CONTINUED ON PAGE 4



CODE 00F 8

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	HEAT NUMBER 4M76368-2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
--------------------------------	----------------------	--------------------------	---------------------------------	-----------------

REPORT TO

SHIP TO

TURRET STEEL IND. INC.
105 PINE STREET

TURRET STEEL
PICK UP AT MILL

IMPERIAL , PA 15126-1142

ORDERED

GRADE 4140	SIZE 3.52"	LENGTH 32'
---------------	---------------	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

PAGE 4 OF 4

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gerry M. Richour
Quality Assurance Representative



CODE 00F9

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	HEAT NUMBER 4M76368-2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
--------------------------------	----------------------	--------------------------	---------------------------------	-----------------

REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

IMPERIAL , PA 15126-1142

SHIP TO

TURRET STEEL
PICK UP AT MILL

ORDERED

GRADE 4140	SIZE 3.52"	LENGTH 32'
---------------	---------------	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.42	0.97	0.014	0.030	0.20	0.09	1.04	0.17	0.18	0.010	0.023
V	Cb	Ca	N2							
0.003	0.002	0.0013	0.0060							

GRAIN SIZE SPECIFICATION ASTM E112 (5-8)

1/2 OF GRAIN 5-8 AVG

M 100 7.0

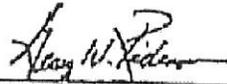
HARDNESS SPECIFICATION Q&T (AIM 35-37RC)

CENTER	MID RADIUS	SURFACE	AVERAGE
32.0	35.9	38.7	35.5 HRC

PAGE 1

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916


 Gary W. Ridenour
 Quality Assurance Representative

CONTINUED ON PAGE 2



CODE 00F9

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	HEAT NUMBER 4M76368 -2	POUR ORDER NUMBER 142993 102	DATE 7/19/11
--------------------------------	----------------------	---------------------------	---------------------------------	-----------------

REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

IMPERIAL, PA 15126-1142

SHIP TO

TURRET STEEL
PICK UP AT MILL

ORDERED

GRADE 4140	SIZE 3.52"	LENGTH 32'
---------------	---------------	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

HARDENABILITY SPECIFICATION ASTM A304

ACTUAL

J1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34
57	56	56	56	55	54	54	54	53	52	51	51	49	49	47	46	45	43	41	40	39	38	38	37	

MACROCLEANLINESS SPECIFICATION ASTM E381 (S3-R2-C2)

PLATE I

PLATE II

	S	R	C	
AVERAGE	1	1	1	NONE

PHYSICALS SPECIFICATION ASTM A434

02.0 IN

TENSILE (KSI)	YIELD (KSI)	% ELONGATION	REDUCTION OF AREA
158.0	139.0	14.9	52.0

DI CALCULATION SPECIFICATION REPORT

5.706

AUTO ULTRASONIC SPECIFICATION 100%

PAGE 2

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gary W. Riderour
Quality Assurance Representative

CONTINUED ON PAGE 3



CODE 00F 9

GERDAU SPECIAL STEEL NORTH AMERICA
5561 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	UNIT NUMBER 4M76368 -2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
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REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

BUY TO

TURRET STEEL
PICK UP AT MILL

IMPERIAL , PA 15126-1142

ORDERED

GRADE 4140	THICKNESS 3.52" <small>PIER</small>	LENGTH 32'
---------------	--	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

MATERIAL ULTRASONIC TESTED FOR INTERNAL SOUNDNESS.

QUENCH TIME, TEMP, ME SPECIFICATION REPORT

TREATMENT	TEMP F	TIME (MIN.)	MEDIA
AUSTENIZE	1650	8.30	
QUENCH	0		WATER
TEMPER	1090	8.30	

REDUCTION RATIO

RATIO= 7.1 TO 1.0

CIRCOGRAPH..... SPECIFICATION 100%

CIRCOGRAPH TESTED FOR SURFACE IMPERFECTIONS

MATERIAL HAS BEEN VACUUM DEGASSED.

** MATERIAL 100% MELTED AND MANUFACTURED IN THE U.S.A. BY THE ELECTRIC ARC FURNACE AND CONTINUOUS CASTING METHOD. THE PRODUCT HAS NOT BEEN REPAIRED BY WELDING AND THIS MATERIAL HAS NOT BEEN EXPOSED TO MERCURY OR TO ANY OTHER METAL ALLOY THAT IS LIQUID AT AMBIENT TEMPERATURES DURING PROCESSING OR WHILE IN OUR POSSESSION. GERDAU MONITORS ALL INCOMING SCRAP AND ALL HEATS OF STEEL TO ENSURE THAT PRODUCTS SHIPPED ARE FREE OF RADIOACTIVE MATERIAL.

PAGE 3

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gary W. Ridgour
Quality Assurance Representative

CONTINUED ON PAGE 4



CODE 00F⁹

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	DEAT NUMBER 4M76368-2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
--------------------------------	----------------------	--------------------------	---------------------------------	-----------------

REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

IMPERIAL , PA 15126-1142

SHIP TO

TURRET STEEL
PICK UP AT MILL

ORDERED

GRADE 4140	SIZE 3.52"	LENGTH 32'
---------------	---------------	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

PAGE 4 OF 4

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Port Smith, AR 72916

Gerry W. Ridenour
Quality Assurance Representative

REQUEST FOR INFORMATION (RFI)

RFI No.: ABF-RFI-002776R00 Submitted By: Kick, Robert Pages: 1
 RFI Date: 03-April-2012 Contact Name: Kick, Robert Phone No. (510) 808-4571
 Pages Attached: 0

Subject: Production of B14 Cable Band Bolts and 3.00" Diameter CCO 215 Spare Anchor Rods	
References:	
Sub/Sup: DYS	Sub RFI #:
Response Required by: 06-April-2012	Response affects critical path activity?

Description:

Dyson plans to utilize residual materials remaining from the production of the PWS Anchor Rods – more specifically: Codes OOF, OOH & OPY for the production of the externally threaded fasteners – B14 Cable Band Anchor Rods and the 3.00" diameter CCO 215 Spare Anchor Rods. Please review and respond to the following.

1. Dyson is requesting permission to produce the above referenced items with machine rolled threads using "pitch diameter bar stock." Please confirm this is acceptable.
2. All three (3) codes of materials, that we are planning on using, (OOF, OOH & OPY) have already been tested and approved for compliance to ASTM A354 Grade BD under the PWS Anchor Rod production activity. Will samples of items need to be submitted to Caltrans for Quality Assurance approval? If yes, please specify types and quantities of samples required.
3. All three (3) codes of materials, that they are planning on using, (OOF, OOH & OPY) have already been MT tested and approved for compliance to CCO 091, under the PWS Anchor Rod production activity. Will samples of these items need to be MT examined in accordance with the CCO 091 requirements?

Contractor Disposition:

This RFI is being submitted for:
 The Cost and Time Impact from this RFI is: Not selected

Response:

Agreed Ext. Due Date:

Pages: 2
 Pages Attached: 0

1. It is acceptable to machine residual PWS anchor rod material as detailed in this RFI to the Pitch Diameter for thread rolling of both the B14 Cable Band Anchor Rods and the CCO #215 Spare Anchor Rods.
2. Provide only Finished Samples of the B14 Cable Band Anchor Rods and the CCO #215 Spare Anchor Rods for Quality Assurance Testing. The Sample frequency remains as provided in State Letter 05.03.01-002360, dated July 14, 2008. The Finished Samples may be provided in the same manner as described in ABF-RFI-001739R00. Do not galvanize the threaded portion of the Finished Sample.
3. Perform MT testing of both the B14 Cable Band Anchor Rods and the CCO #215 Spare Anchor Rods in accordance with CCO #91.

Administrative Action:

REQUEST FOR INFORMATION (RFI)

This response resolves the RFI.

Date: 09-April-2012	Respondent: Collins, Warren	Phone No.: 510-622-5661
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DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING 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
(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 99.15**SOURCE INSPECTION REPORT****Resident Engineer:** Casey, William**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-004102**Date Inspected:** 04-May-2012**Project Name:** SAS Superstructure**OSM Arrival Time:** 700**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1530**Contractor:** The Dyson Corporation**Location:** Painesville OH**Quality Control Contact:** Russell Welsh Jr.**Quality Control Present:** Yes No**Material transfer:** Yes No N/A**Sampled Items:** Yes No N/A**Stock Transfer:** Yes No N/A**OK to Cut:** Yes No N/A**Rebar Test Witness:** Yes No N/A**Delayed/Cancelled:** Yes No N/A**Other:** Reviewed MTR's for previously used material for new parts.**Bridge No:** 34-0006**Component:** B14 Cable Band Anchor Rods**Bid Item:** 45/66**Lot No:** S26-011-12**Summary of Items Observed:**

This Quality Assurance Inspector (QAI) arrived at The Dyson Corporation (TDC), Painesville Ohio, as requested per TL 38 to review MTR's and material to be used for the Anchor Rods.

Upon arrival this QAI met with Russ Welsh Jr. and received copies of the MTR's for material to be reviewed. In phone discussions with Rus it was discussed what would be needed to be ready for the review as TDC was closing early on this day. QAI and Mr. Welsh proceeded to the yard to review material and verify proper traceability to furnished MTR's.

It was relayed to the QAI the 4", ASTM A354-07 Grade BD bar was used for PWS Anchor Rods and rejected previously due to under size threads. The contractor has proposed to turn down the 4" rods to 3" diameter and use for the B14 Cable Band Anchor Rods and CCO 215 Spare Anchor Rods. The rod material had not been gathered as requested and this QAI could not confirm what material was to be used and TDC personell were unable to verify what bar was to be used. A TDC yard crew was assigned to gather the material in question so that this QAI could confirm acceptability.

later in the shift and after the gathering operation this QAI was able to confirm traceability of all (44) bars to the (3) MTR's issued. The quantities for each heat number are as follows:

16 Pieces- TDC Code OPY- Heat Number 3M75738-2

10 Pieces- TDC Code OOH- Heat Number 4M6368-3

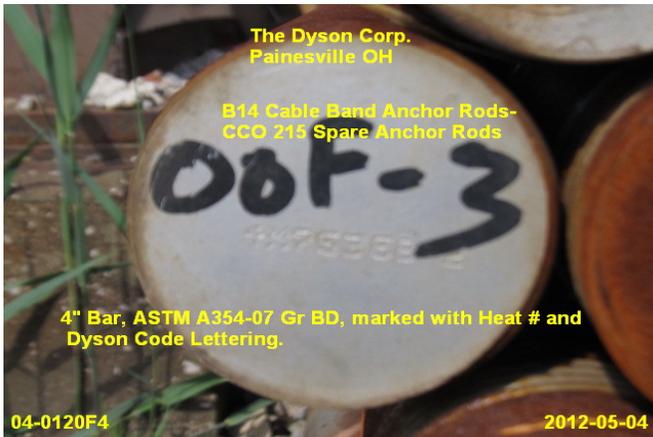
18 Pieces- TDC Code OOF- Heat Number 4M6368-2

These bars are various lengths due to previous machining and are stamped and paint marked with TCD Codes.

A Green tag was placed on one bar for the lot. The Lot Number is S26-011-12. Material was released by this QAI for shipment to Bertin Steel Processing for machining.

SOURCE INSPECTION REPORT

(Continued Page 2 of 3)



Summary of Conversations:

Basic conversation, fundamental to completion of the tasks at hand, occurred between this QAI and TDC QC Personnel.

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 Nina Choy, 858-531-0335, who represents the Office of Structural Materials for your project.

SOURCE INSPECTION REPORT

(Continued Page 3 of 3)

Inspected By:	Sullivan, Kevin	Quality Assurance Inspector
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Reviewed By:	Foerder, Mike	QA Reviewer
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NOTICE OF MATERIALS TO BE USED

CEM-3101 (REV 05/2006) CT# 7541-3511-1

ADA Notice

For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.

To (Resident Engineer):

William Casey

Date:

JUNE 21, 2012

You are hereby notified that materials required for use under Contract Number (1) 04-0120F4

Dist. 04

Co. San Francisco

Rte. 80

P.M.

will be obtained from the following sources:

Contract Bid Item Number (2)	Item Code (3)	Contract Item Description (4)	Item Component (5)	Item Sub-Component (5)	Manufacturer/Provider Name(s) and Address(es) (6)
45		<i>B14 CABLE BOUND ROD</i>		Fasteners & HS Rods	The Dyson Corp
<i>67</i>		<i>E2 RODS</i>			53 Freedom Road Painesville, Ohio 44077
			Is	Heat Treat	Modern Industries, Inc.
		Page 1 of 2		Heat Treat	613 W. 11th St. Erie, PA 16512
				Galvanizing	TC Industries, Inc.
					3703 S. Route 31 Crystal Lake, IL 60012
				Galvanizing	The Art Galvanizing Works, Inc.
					3935 Valley Road Cleveland, OH 44109
				Galvanizing	Bob Monnig Industries, Inc.
					400 Industrial Drive Glasgow, MO 65254

It is requested that you arrange for sampling, testing and inspection of materials prior to delivery in accordance with Section 6 of the *Standard Specifications*. It is understood that source inspection does not relieve the prime contractor of the full responsibility for incorporating into the work, materials that comply in all respects with the contract plans and specifications. Nor does it preclude the subsequent rejection of materials found to be unsuitable.

Yours Truly,

(7) c: Materials Administrator, Mail Station #5
Materials Engineering & Testing Services
5900 Folsom Blvd, Sacramento, CA 95819
Fax: (916) 227-7084
Construction Senior Engineer
Contractor File
District Construction Office

Contractor		
American Bridge / Fluor Enterprises Inc. A Joint Venture		
Address		
375 Burma Road		
Business Phone	Business Fax	E-Mail Address
(510) 808-4600	(510) 808-4601	<i>CKANAPICK@ABFLUOR.COM</i>

NOTICE OF MATERIALS TO BE USED

CEM-3101 (REV 05/2006) CT# 7541-3511-1

ADA Notice

For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.

To (Resident Engineer):

WILLIAM GKEY

Date:

JUNE 21, 2012

You are hereby notified that materials required for use under Contract Number (1) 04-0120F4

Dist. 04

Co. San Francisco

Rte. 80

P.M.

will be obtained from the following sources:

Contract Bid Item Number (2)	Item Code (3)	Contract Item Description (4)	Item Component (5)	Item Sub-Component (5)	Manufacturer/Provider Name(s) and Address(es) (6)
45				Blasting	Phoenix Manufacturing, Inc. 400 Industrial Drive Glasgow, MO 65254
				Testing	Stork Herron Testing Labs 5405 E. Schaaf Road Cleveland, OH 44131
		Page 2 of 2		Testing	Tensile Testing Metallurgical Lab 4520 Willow Parkway Cleveland, OH 44125

It is requested that you arrange for sampling, testing and inspection of materials prior to delivery in accordance with Section 6 of the *Standard Specifications*. It is understood that source inspection does not relieve the prime contractor of the full responsibility for incorporating into the work, materials that comply in all respects with the contract plans and specifications. Nor does it preclude the subsequent rejection of materials found to be unsuitable.

Yours Truly,

(7) c: Materials Administrator, Mail Station #5
Materials Engineering & Testing Services
5900 Folsom Blvd, Sacramento, CA 95819
Fax: (916) 227-7084
Construction Senior Engineer
Contractor File
District Construction Office

Contractor		
American Bridge / Fluor Enterprises Inc. A Joint Venture		
Address		
375 Burma Road		
Business Phone	Business Fax	E-Mail Address
(510) 808-4600	(510) 808-4601	<i>CKANAPJCKI@ABFJV.COM</i>

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING 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
 (707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 76.8**COMPONENT MATERIAL INSPECTION REPORT****Resident Engineer:** Casey, William**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** CMI-000475**Date Inspected:** 21-Jun-2012**Contractor:** Dyson Corp. & Subs**Location:** Painesville OH**Bridge No.:** 34-0006**OSM Arrival Time:** 700**OSM Departure Time:** 1530**Component:#** Anchor Rods/Hex Nuts

The following material has been inspected in accordance with Section 6 of the Standard Specifications at the above location. At this point in the fabrication process it appears to comply with contract plans and specifications.

To be shipped to the following vendor or locations: Hex Nuts to Art Galv. Cleveland Ohio/ Anchor Rods to Element Tech. Cleveland

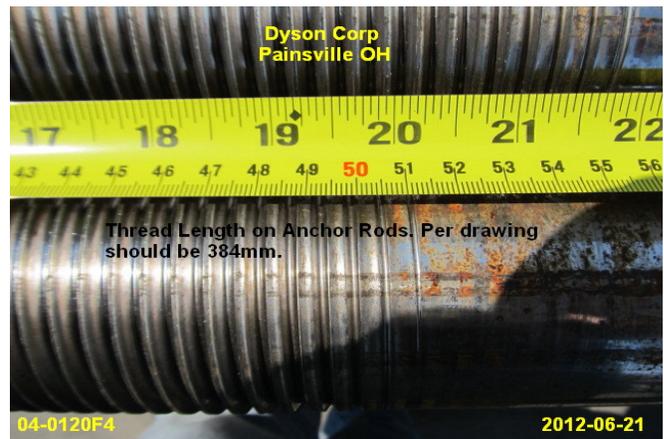
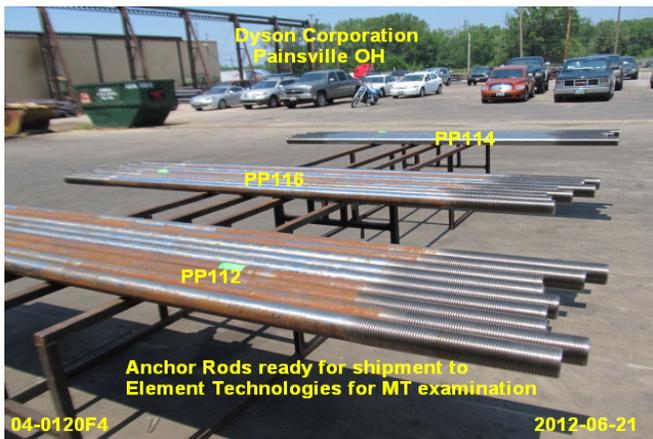
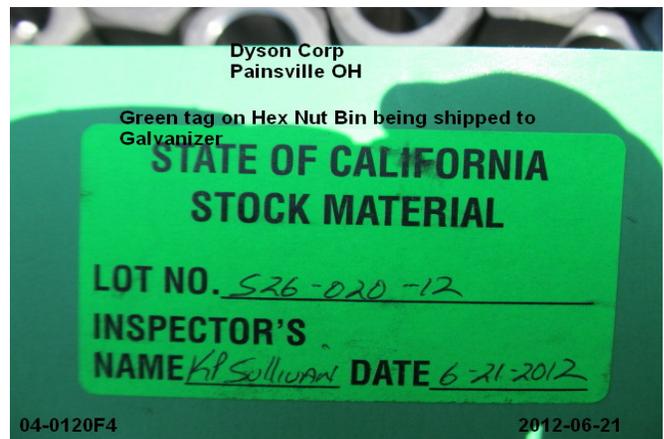
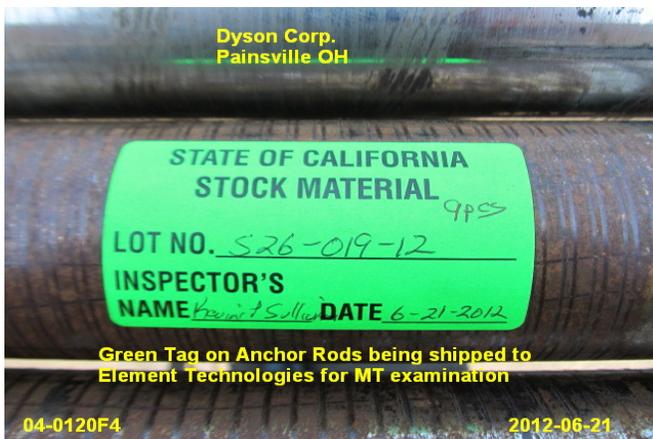
Lot #	Bid Item #	Quantity		Material Description
S26-021-12	66	6	ea	A-354 Gr BD
S26-022-12	45	650	ea	A563 Gr DH-HDG hex

Identification: Green tags attached to bars per size (3) and tags on Nut bins (5)**Summary of Items Observed:**

This Quality Assurance Inspector (QAI) arrived at Dyson Corp. (DC) to Green Tag (24) anchor rods being sent out for MT and (650) 3" heavy Hex Nuts ready for Galvanizing. This QAI met with Russell Welsh Jr., Quality Control Dyson Corp. (QCDC), to view material and Green tag as requested in the TL-38. There are (6) Anchor Rods ready to be sent for MT examination, (2) per size. One of each size will be sent samples after the MT is completed. Anchor Rod dimensions were verified to approved drawing X453-01 by this QAI. DC QC inspection records were reviewed and parts were accepted. Rods are identified as (2) PP112, (2) PP114 and (2) PP116 on the drawing. Rods are being shipped for MT examination by Element Technologies, Cleveland OH (Previously Stork Technologies), and have been Green tagged by this QAI Lot # S26-019-12. MTR's for the 3" Heavy Hex Nut material has been reviewed by this QAI. Material received from Gerdau Ameristeel, A-576-90b, and A29/A29M-05 Heat numbers M660901 and M663197. Dyson is shipping (130) pieces Item 45 Item Code 049328 and (520) Item 45 Item Code 049311. Items are being shipped for Galvanizing, to Art Galvanizing Cleveland OH, and have been Green tagged Lot # S26-020-12. The items observed appear in general conformance with the contract documents and approved drawings at time of shipment.

COMPONENT MATERIAL INSPECTION REPORT

(Continued Page 2 of 3)



Summary of Conversations:

Basic conversation, fundamental to completion of the tasks at hand, occurred between this QAI and DC QC Personnel.

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 Nina Choy, 858-531-0335, who represents the Office of Structural Materials for your project.

COMPONENT MATERIAL INSPECTION REPORT

(Continued Page 3 of 3)

Inspected By:	Sullivan, Kevin	Quality Assurance Inspector
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Reviewed By:	Riley, Ken	QA Reviewer
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REQUEST FOR INFORMATION (RFI)

RFI No.: ABF-RFI-002900R00 Submitted By: Kick, Robert Pages: 11
 RFI Date: 27-June-2012 Contact Name: Sheffield, Pat Phone No. 800 680-3600 EX 202
 Pages Attached: 10

Subject: Cable Band: Anchor Bolts & E2 Spares

References:

Sub/Sup: DYS **Sub RFI #:** RFI-DYS-000007R00

Response Required by: 04-July-2012 **Response affects critical path activity?**

Description:

EXPEDITED RESPONSE REQUESTED.

Please review and confirm the approved source is acceptable as stated in the attached RFI from Dyson Corp. (RFI-DYS-000007R00)

Contractor Disposition:

This RFI is being submitted for:

The Cost and Time Impact from this RFI is: Not selected

Response:

Agreed Ext. Due Date:

Pages: 1
Pages Attached: 0

Confirmed. Personnel and the facilities of Stork Herron Testing Laboratories previously approved to perform NDT on the SAS Project, which now operate under the name of Element Cleveland, may continue to perform NDT without recertification.

Administrative Action:

This response resolves the RFI.

Date: 06-July-2012	Respondent: Collins, Warren	Phone No.: 510-622-5661
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REQUEST FOR INFORMATION (RFI) – ABF&SUB.

RFI No.: _____ Submitted by: The Dyson Corporation Page(s): 1
 RFI Date: June 27, 2012 Contact Name: Patrick Sheffield Phone No. 800.680.3600

Subject: Cable Band Anchor Bolts & E2 Spares

References:

Response required by: <u>July 5, 2012</u> Response affects critical path activity? _____ YES _____ NO

Description:

Stork Herron Testing Laboratories, (the Approved Magnetic Particle Testing provider) now operating as Element - Cleveland underwent a "Rebranding" activity late last year. Please refer to the attached letter, directed to Dyson, explaining the nature of the activity. Please advise if this facility, and personnel, must undergo a recertification. The personnel who performed the previous MT Inspections is still employed by Element-Cleveland.

Contractor Disposition:

This RFI is being submitted for:

- Contractor Convenience.
 Clarification of the Contract Documents. *REQUIREMENTS*
 Engineering Review Request (ERR) for missing design information/coordination.

The Cost and Time Impact from this RFI is:

- No cost or time impacts in the performance of our Work.
 Cost and/or time impacts in the performance of our Work will result.
 We are unable to determine at this point whether there will be cost and/or time impacts.

Response:

Date:	Respondent:	Phone No.:
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RFI Status: (sign and date)

Closed:	Revision Pending:
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Element Materials Technology
5405 E Schaaf Road
Cleveland, OH
44131-1337 USA

P 216 524 1450
F 216 524 1459
T 888 786 7555
info.cleveland@element.com
element.com

June 25, 2012

Attn: Pat Sheffield
Dyson Corporation
Painesville, OH 44077

Dear Mr. Sheffield,

As a client of this laboratory organization please consider this letter as formally notifying you of a name change regarding the former Stork Materials Technology group of testing laboratories, which took effect on December 5, 2011. Our laboratory group will now be known as Element Materials Technology, and each location shall have a unique identifier specific to the Element name. This notification letter is the one of the final steps in the transition away from being a part of the Stork organization and the rebranding of Stork Materials Technology as Element Materials Technology. The original notice was sent out to all Element customers of record between 12/5/11 and 12/8/11, via email, from the Director of Corporate Quality, David Luoni.

The rebranded location name for this laboratory is follows:

Element Cleveland (formerly Stork Herron Testing-Cleveland)

In a previous notification letter, from the Director of Corporate Quality, David Luoni, sent in January, 2011, regarding the change in ownership, it was noted that the business was purchased by *3i*, an international private equity firm, in December 2010. At that time, it was stated that there were no changes to the management structure, organization, or personnel within the group of laboratories, and that a name change would take place before December 31, 2011. All personnel have remained in place, and there are no changes in the basic day-to-day operations of the laboratories. In addition, the Federal Tax ID number did not change. This letter is specifically a notification for a change in name only.

I can be contacted at 216-525-8046 or jeffry.smith@element.com to discuss any quality items of interest with you.

Thank you for your use and support of Element Cleveland.

Sincerely,

Jeffrey J. Smith, Quality Manager
Element Cleveland

cc:file/jjs

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING 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
(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 76.8**COMPONENT MATERIAL INSPECTION REPORT****Resident Engineer:** Casey, William**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** CMI-000474**Date Inspected:** 11-Jul-2012**Contractor:** Dyson Corp. & Subs**Location:** Element Testing, Independence Ohio**Bridge No.:** 34-0006**OSM Arrival Time:** 900**OSM Departure Time:** 1230**Component:#** Cable Band Anchor Rods

The following material has been inspected in accordance with Section 6 of the Standard Specifications at the above location. At this point in the fabrication process it appears to comply with contract plans and specifications.

To be shipped to the following vendor or locations: Dyson Corp, Plainessville Ohio

Lot #	Bid Item #	Quantity		Material Description
B306-029-12 66		2	ea	Cable Band Anchor Rods; 3.00"- 4UNC2A x 3372mm Code 00F7
B306-029-12 66		2	ea	Cable Band Anchor Rods; 3.00"- 4UNC2A x 3129mm Code 00F8
B306-012-12 66		2	ea	Cable Band Anchor Rods; 3.00"- 4UNC2A x 3286mm Code 00F9

Identification: Attached to the MT Certificate**Summary of Items Observed:**

On this date, Quality Assurance Inspector (QAI) Kenneth Riley traveled to Element Testing in Independence Ohio as requested, to witness and green tag release the following items;

Cable Band Anchor Rods; 3.00"- 4UNC2A x 3372mm Code 00F7

Cable Band Anchor Rods; 3.00"- 4UNC2A x 3129mm Code 00F8

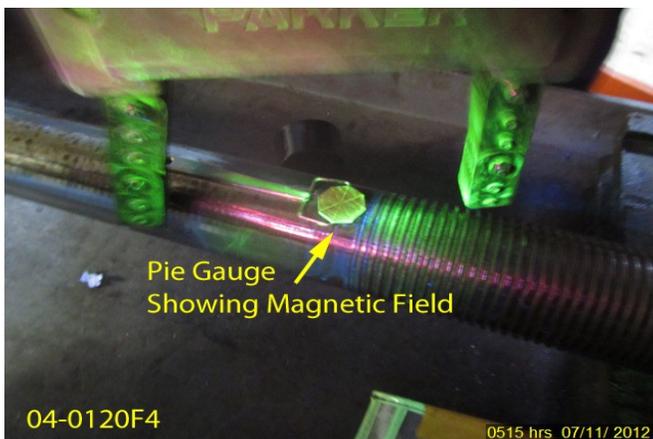
Cable Band Anchor Rods; 3.00"- 4UNC2A x 3286mm Code 00F9

This QA Inspector arrived at the testing facility and met with Dyson Quality Control Manager Russell Wesh and Element Technology (formly Stork technologies) Magnetic Particle (MT) technician Mathew Novack. This QA inspector was escorted to the location where the six (6) anchor rods were staged for lot testing. This QA Inspector spoke with both individuals as to the acceptance criteria to be used and it was relayed that ASTM F688 was identified by the contract documents and there for would be adhered too. The method of testing would be wet MT which included an ultra-Violet light Spectroline model MB-100XR with a Parker probe yoke model DA400 serial number 3005. The MT medium would be Magnaflux 14Am Magnaglo prepared Bath in an aerosol can batch number 11F22K. The technician would use approximately 2-3 cans per anchor rod for testing. The MT technician used a pie gauge prior to the start of the testing to ensure the proper magnetic field was generated and could detect imperfections (Linear Indications) of the components. During the testing on Cable anchor rod 00F-7 a linear indication was noted longitudinally along the shaft of the rod. The QCM used a scotch brite pad and buffed

COMPONENT MATERIAL INSPECTION REPORT

(Continued Page 2 of 2)

the area in question. The MT technician then performed the MT inspection in this region again with the linear indication not present and acceptable results were relayed. This QA inspector received and reviewed the MT test report and test certificate which appeared to be within the general compliance of the contract documents. This QA Inspector affixed a green tag with lot number B306-029-12 to the certificate. The components will be shipped back to Dyson in Painesville, OH.



Summary of Conversations:

Basic conversation, fundamental to completion of the tasks at hand.

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 Nina Choy 510-385-5910, who represents the Office of Structural Materials for your project.

Inspected By: Riley, Ken Quality Assurance Inspector

Reviewed By: Foerder, Mike QA Reviewer

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING 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
(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 76.25A**MATERIAL SUITABILITY REPORT**

Resident Engineer: Casey, William
Address: 333 Burma Road
City: Oakland, CA 94607

Report No: MSR-000071**Report Date:** 19-Jul-2012**SMR Authorization #:****Project Name:** SAS Superstructure**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**Date of NCR:****Contractor:** Dyson Corp. & Subs**Location:** Painesville, OH

The following material has been inspected and found not to comply with contract plans and specifications; however, METS has determined this material may be suitable for its intended purpose.

Lot #	Bid Item #	Quantity		Material Description
B350-002-12	66	24	ea	Cable Band B14 Anchor Rods-3.00"4UNC 2A x various lengths (3372mm,3129mm,& 3286mm 8 each
B350-001-12	66	123	ea	3.00" F436 Washers
B350-001-12	66	83	ea	3.00" F436 Washers
B350-001-12	66	50	ea	3.00" F436 Washers
B350-001-12	66	10	ea	3.00" F436 Washers

Identification:

4 boxes Washers shrink wrapped Green Tag under shrink wrap / Green tag on end of Anchor Rod wrapped in shrink wrap. (see photos below)

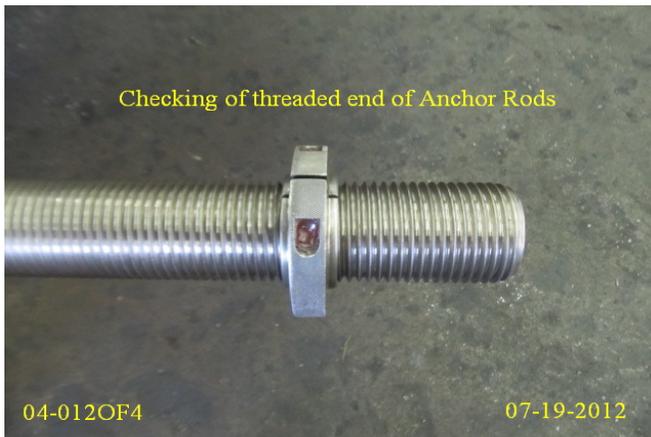
Description of Non-Conformance (NCRs):**Summary of Items Observed:**

This Quality Assurance Inspector (QAI) arrived on site as requested by TL-38 issued on 7-18-2012 at The Dyson Corp in Painesville, Ohio. This QAI was met by Rick Hart Quality Manager at Dyson (QM). This QAI was taken to the area in which the materials for transfer to the galvanizers were located. The materials consisted of Anchor rods and flat washers. The materials were cleaned free of any oil and any other contaminants'. This QAI requested all documentation for the materials IE: MTR's and Approved Drawings. QM presented these materials along with the purchase order for galvanizing. This QAI noted the drawings for these components were not stamped "Approved", and asked the QM the reason why the drawings were not stamped in which the QM responded that the drawings were given to them by American Bridge that way. This QAI then verified the number of washers to be transferred and random dimensional checks was performed on each box of washers, and were found at this time to be within dimensional specifications. Boxes were then banded together and taken to the shrink wrap machine for wrapping prior to shipping at this time this QAI placed a green tag under the shrink wrap to prevent any moisture or loss of tag from occurring.

MATERIAL SUITABILITY REPORT

(Continued Page 2 of 3)

This QAI then proceeded to locate the Anchor rods and perform dimensional checks to the prints. 8 Anchor rods measured 3372mm, 8 Anchor rods measured 3129mm and 8 Anchor rods measured 3286mm. This QAI was asked to take a sample from each heat number for testing by the SMR Mr. Bahjat Dagher via phone conversation on 7-18-2012. This QAI, after reviewing the MTR's discovered that only one (1) sample was needed for testing due to only one heat number was available. This sample was identified with a RED Tag located on the end of one (1) anchor rod, secured with tape with the note wrote to NOT GALVINIZE the threaded ends. This message was relayed to QM to follow up to the Galvanizer.. This QAI received a 3.00" x 4UNC thread gage to check the threaded ends of the anchor rods. Along with the thread gage, QC give this QAI a 3.00" x 4UNC "NO GO" gage to also check for correct threads. This QAI then checked 8 anchor rods on both ends with correct gage, then tried the "Go No Go" gage and found the 8 pieces to be in correct threaded condition at this time of verifying to the drawings.



Summary of Conversations:

As within the scope of work.

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 Bahjat Dagher (510) 557-8250, who represents the Office of Structural Materials for your project.

MATERIAL SUITABILITY REPORT

(Continued Page 3 of 3)

Inspected By: Smith,James

Quality Assurance Inspector

Reviewed By: Riley,Ken

QA Reviewer

DEPARTMENT OF TRANSPORTATION -Toll Bridge Program

333 Burma Rd.
Oakland, CA 94607
(510) 622-5660, (510) 286-0550 fax



*Flex your power
Be energy efficient!*

August 20, 2012

Contract No. 04-0120F4
04-SF-80-13.2 / 13.9
Self-Anchored Suspension Bridge
Letter No. 05.03.01-010850

Brian A Petersen
Project Executive
American Bridge/Fluor, A JV
375 Burma Road
Oakland, CA 94607

Dear Brian Petersen,

Submittal 2708 – B14 Cable Band Anchor Rod Shop Drawings

The Department has completed the review of Submittal ABF-SUB-002708R00, "Cable Band B14: Anchor Rod Shop Drawings," dated July 30, 2012. The submittal is "Approved as Noted," as indicated on the attached drawings and as outlined by the following comment:

CATEGORY A:

1. Anchor Rods at Panel Point 116, E-Line – Stopper Plate Locations:
 - Reduce the rod length by 150mm to provide clearance with the traveler rail.
 - Do not use washers or jam nuts at the stopper plate end of the anchor rod.

If you have any questions, please contact Brian Boal at (510) 622-5191.

Sincerely,

<<< ORIGINAL SIGNED >>>

BRIAN BOAL
Construction Manager (Cable)

For: WILLIAM S. CASEY
Resident Engineer

Attachment

file: 05.03.01, 49.091, 55.2708



A JOINT VENTURE

375 Burma Road Oakland CA 94607
Phone 510-808-4600 / Fax 510-808-4601

LETTER OF SUBMITTAL
SAS Superstructure Project

Run Date 30-Jul-12
Time 12:16 PM

Dated: 30-Jul-2012

SUBMITTAL No: ABF-SUB-002708 Rev: 0

To: William S. Casey
California Department of Transportation
333 Burma Road
Oakland CA 94607
Phone: (510) 622-5100 Fax: (510) 622-5165

Co/Job # 660110
Contract # 04-0120F4
Sub/Supplier: ABF
Sub/Supplier No:

Subject: Cable Band B14: Anchor Rod Shop Drawings

Special Provis. (SP) REF: 10-1.60

Standard Spec. (SS) REF:

RESUBMITTAL/SUPPLEMENTAL REF:

Schedule ID:

We are sending the following attached items: Attached

Via Fax

Plans/Dwgs

Design Report

Samples

Certificates of Compliance

Calculations

Payroll

Specs

Copy of Letter

Change Order

Schedule

Invoice

Other

Item	Date	Copies	Description	Drawing No	Rev	Subcon Dwg No	Rev Status	Pages
01	26-Jul-12	6	Cable Band B14: Anchor Rod Drawing	X453-01	0		Pending	1

These are transmitted as checked below:

For Approval

For Review/comment

Return For Correction

For Your Use

For Information

Other

Remarks:

CC:

Please review / approve by : 16-Aug-2012

Submitted By: Adam Roebuck

Req. Date for Completeness Review: 30-Jul-2012

Project Manager

Checked & Sent By: <<< Original Signed >>>

Document Control

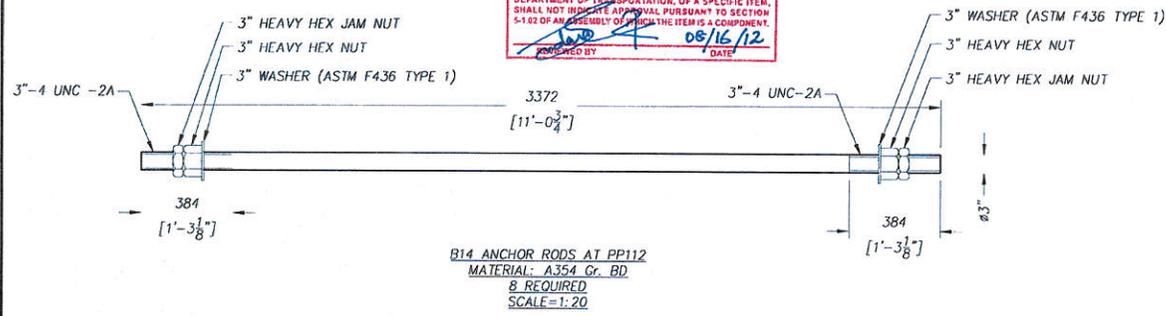


APPROVED
 APPROVED AS NOTED
 RETURNED FOR CORRECTION
 T-Y-LIN INTERNATIONAL AND MOFFATT & NICHOL, a JV
 THE EAST SPAN BRIDGE DESIGN TEAM
 APPROVAL PURSUANT TO SECTION 5-1.02 OF THE
 STANDARD SPECIFICATIONS OF THE STATE OF CALIFORNIA
 DEPARTMENT OF TRANSPORTATION OF A SPECIFIC ITEM,
 SHALL NOT IMPLY THE APPROVAL PURSUANT TO SECTION
 5-1.02 OF AN ASSEMBLY OF WHICH THE ITEM IS A COMPONENT.
 APPROVED BY: *[Signature]* DATE: 08/16/12

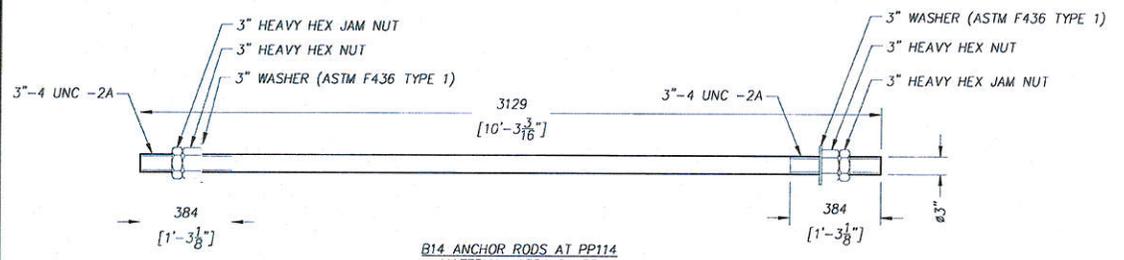
BILL OF MATERIAL						
SHIP MARK	PIECE MARK	QTY.	DESCRIPTION	LENGTH	REMARKS	WEIGHT
X453-01						
	ra	8	#3" A354 Gr. BD ROD	11'-0 3/8"	THREAD 3"-4 UNC-2A	2136lb
X453-02						
	rb	8	#3" A354 Gr. BD ROD	10'-3 3/8"	THREAD 3"-4 UNC-2A	1980lb
X453-03						
	rc	8	#3" A354 Gr. BD ROD	10'-9 3/8"	THREAD 3"-4 UNC-2A	2080lb
	na	50	3" A563 GR DH HEAVY HEX NUT		THREAD 3"-4 UNC-2B +.050 O/S	
	na	50	3" A563 GR DH HEAVY HEX JAM NUT		THREAD 3"-4 UNC-2B +.050 O/S	
	na	50	3" ASTM F436 TYPE 1 WASHER			

SEE 3b & 3c.
 3c. RODS AT E-LINE AT STOPPER PLATE LOCATIONS DO NOT REQUIRE A WASHER + JAMNUT AT BOTTOM END.

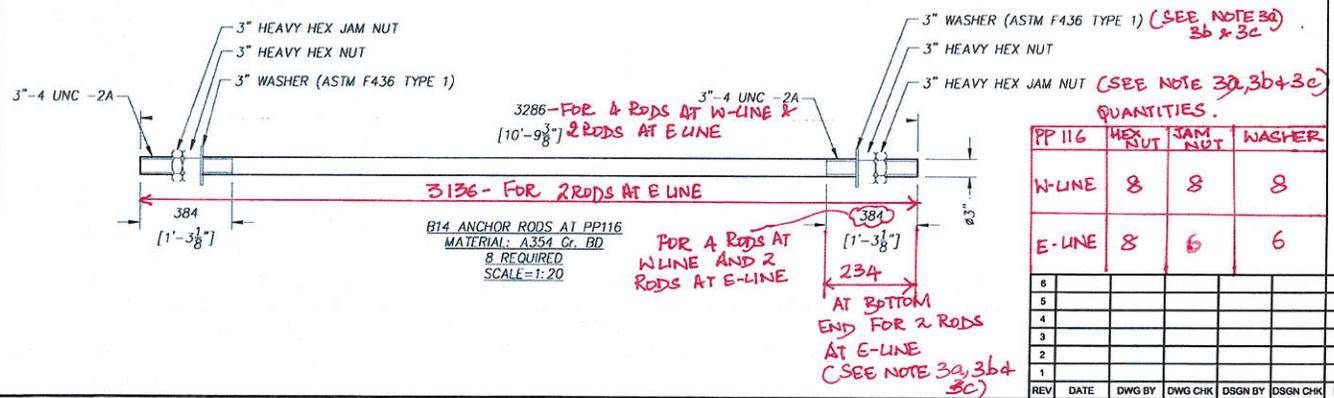
NOTES:
 1. ROD, NUT, AND WASHER SHALL BE PREPARED AND HOT DIP GALVANIZED IN ACCORDANCE WITH SPECIAL PROVISIONS SECTION 10-1.59 FOR ASTM A354 Gr. BD FASTENERS.
 2. PERFORM MAGNETIC PARTICLE TESTING (MT) IN ACCORDANCE WITH ASTM A490 ON THE PWS RODS.
 3a. ROD LENGTHS & QUANTITIES AT PP116 - E+W LINE ARE AS SHOWN.
 3b. RODS AT W LINE SHALL HAVE A WASHER + JAMNUT AT BOTTOM END AS DETAILED.



B14 ANCHOR RODS AT PP112
 MATERIAL: A354 Gr. BD
 8 REQUIRED
 SCALE=1:20



B14 ANCHOR RODS AT PP114
 MATERIAL: A354 Gr. BD
 8 REQUIRED
 SCALE=1:20



B14 ANCHOR RODS AT PP116
 MATERIAL: A354 Gr. BD
 8 REQUIRED
 SCALE=1:20

QUANTITIES

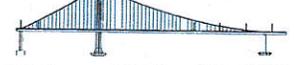
	HEX NUT	JAM NUT	WASHER			
PP 116						
W-LINE	8	8	8			
E-LINE	8	6	6			
6						
6						
4						
3						
2						
1						
REV	DATE	DWG BY	DWG CHK	DSGN BY	DSGN CHK	DESCRIPTION



This stamp indicates that this shop drawing has been reviewed for general conformance with the Project Plans and Special Provisions. This stamp does not constitute that a review of the permanent design has been performed.

FOR FABRICATION

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)
 CABLE BAND B14 ANCHOR RODS



Design By: B. JONES Date: 10/20/11
 Design Chk: K. BALTZER Date: 10/20/11
 Drawn By: B. JONES Date: 10/20/11
 Drawing Chk: K. BALTZER Date: 10/20/11
 In Charge Of: K. BALTZER
 Job No. 660110 Sheet No. X453-01
 Scale: AS NOTED Revision: 0

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING 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
(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 76.15**SOURCE INSPECTION REPORT****Resident Engineer:** Casey, William**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-004421**Date Inspected:** 28-Aug-2012**Project Name:** SAS Superstructure**OSM Arrival Time:** 900**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1030**Contractor:** Dyson Corp. & Subs**Location:** Glasgow, Missouri**Quality Control Contact:** Andy Monnig/Robert Cole**Quality Control Present:** Yes No**Material transfer:** Yes No N/A**Sampled Items:** Yes No N/A**Stock Transfer:** Yes No N/A**OK to Cut:** Yes No N/A**Rebar Test Witness:** Yes No N/A**Delayed/Cancelled:** Yes No N/A**Other:****Bridge No:** 34-0006**Component:** Anchor Rod**Bid Item:** 66**Lot No:** B70-119-12**Summary of Items Observed:**

This report is for Quality Assurance Inspector Ricardo Medina. On this date, the Quality Assurance (QA) Inspector Ricardo Medina was present at Monnig Industries in Glasgow Missouri for observations related to material verification and sample of anchor rod that will be used for this project.

At the time of arrival, the QA Inspector met with Monnig Industries Management Representative Andy Monnig and Quality Control Manager (QCM) Robert Cole. QCM located the material for identification / verification and sample as well as provided a copy of material documentation including the Monnig Industries Certificate of Compliance (COC), Material Test Record (MTR) and other supporting material documentation for review.

After the material documentation was randomly reviewed, the QA Inspector performed random material visual verification and collected the sample listed below in the presence of QCM.

The QA Inspector sampled a 3.00" (76.2mm) - 4UNC 2A X 3286mm (129.375") (Code 00F9) Cable Band B14 Anchor Rod, ASTM A354 Gr. BD - HDG, heat # 4M76368-2. The sample will be used for Quality Assurance (QA) purposes and it is scheduled to be sent to Caltrans Structural Materials Testing Laboratory in Sacramento, CA. The QA Inspector attached sample identification (TL 0101) card # C719273 and assigned a Caltrans Lot # B70-119-12 for tracking purposes. (Please see digital image below).

Please see the QA Inspector's TL-102 Field Inspection Fastener Assembly Sampling Sheet generated on this date for additional information.

SOURCE INSPECTION REPORT

(Continued Page 2 of 2)

The QA Inspector was notified and observed there are a total of twenty seven (27) galvanized anchor rods that will be sent to the job site at a later date. The QA Inspector performed random material verification and observations were notified to QA Task Leader Michael Foerder for future reference.



Summary of Conversations:

Basic communication was performed by the QCM and the QA Inspector during observations and sampling.

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 Nina Choy (510)385-5910, who represents the Office of Structural Materials for your project.

Inspected By:	Riley, Ken	Quality Assurance Inspector
Reviewed By:	Foerder, Mike	QA Reviewer

State of California
Department of Transportation



Structural Materials Testing Laboratory
5900 Folsom Boulevard, Sacramento, CA 95819

TEST REPORT



CERTIFICATE NO. 2364.01

Remarks

ref: ASTM A354, A123, Grade BD, TM03. Lot 1, Heat #4M76368-2.

Sample No: SM-12-1018

Date Sampled: 08/28/12

Date Rec'd: 09/17/12

Date Reported: 09/24/12

Lot No: B7011912

TL-101 / SIC No: C719273

Contract/Permit No: 04-0120F4

Material: 3" HDG Anchor Rod.

Manufacturer: Dyson

Sampler: Ricardo Medina

9/24/12

Results: SAMPLES SUBMITTED ARE SATISFACTORY FOR USE

SOURCE	DISTRICT	E.A.	SUB JOB	SPECIAL DESIGNATION	OBJECT
59318	04	0120F3			1270

12-1018 9-17-12

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
SAMPLE IDENTIFICATION CARD
TL-0101 (REV. 10/97)

CARD NUMBER
C 719273

PRELIMINARY TESTS
 PROCESS TESTS
 ACCEPTANCE TESTS
 INDEPENDENT ASSURANCE TESTS
 DIST. LAB
 TRANS. LAB
 SPECIAL TESTS

SAMPLE SENT TO:
 HDQTRS. LAB
 BRANCH LAB
 DIST. LAB

FIELD NO.
DIST. LAB NO.
LOT NO. B70-119-12
P.O. OR REQ. NO.

SHIPMENT NO.
AUTHORIZATION NO.

SAMPLE OF 3/4" UNC 2X3372MU CABLE BOND
FOR USE IN BKA ANCHOR ROD, ASTM A354
GR. BD-HDG/ASTM A123
SAMPLE FROM 1 LOT OF 27 PIECES, HEAT
4M76368-2.

DEPTH
LOCATION OF SOURCE
GLASSBORO, MISSOURI
THIS SAMPLE AND IS ONE OF A GROUP OF SAMPLES REPRESENTING THIS TESTS (SIC, STA, ETC.)
(NO. CONTAINERS)
OWNER OR MANUFACTURER
DYSON

TEST RESULTS DESIRED
 NORMAL
 PRIORITY
 DATE NEEDED

REMARKS
PLEASE SEND RESULTS TO METS VALLEJO @ 707-649-5493

COVER ADDITIONAL INFORMATION WITH LETTER
DATE SAMPLED 8/28/2012
BY RICARDO MEDINA TITLE QA INSPECTOR
DIST. CO. RTE. PM
ST, 20, 8.2/18.7
LIMITS

CONT. NO. 04-0120F4
FED. NO.
RES. ENGR. OR SUPT. CASEY WILLIAM
ADDRESS 333 BURBANK ROAD OAKLAND CA
CONTRACTOR AMERICAN BRIDGE/FLORIDA
JOINT VEN

ENCLOSE WITH SAMPLE

Print

.500 SAMPLES



Department of Transportation
Structural Materials Testing Laboratory
UTM: BALDWIN 60 Kip

SM Number = 12-1018

Temperature 70°

Sample	Heat Number	Diameter (in)	Reduction of Area Area min (in ²)	Stress at Offset (psi)	Tensile Strength (psi)	Elongation in 4 x d (%)	Tested By	
68A	4M7668-2	1.3375	0.493 ^{147%}	0.1909	.0895 132581 ✓	154630 ✓	15.4 ✓	ddrane FS 4/10
68B	4M7668-2	1.335	0.493 ^{46%}	0.1909	.0881 129247 ✓	154280 ✓	16.3 ✓	ddrane L

^{54%}

FASTENER ASSEMBLY WORKSHEET

SM Number	12-1018	Lot Number	B1011912	Date Received	9-17-12
Contract Number	040120F4	TL-0101 Number	C719273	Date Tested	
Lab Technician	Dave	Test Temperature	70°	Page ____ of ____	

BOLTS: A354 GRADE BD Plain / HDG

Sample No.	/ A						
Heat / Mfg. Lot No.	4M76368-2						
Product Markings	_____						
Size	3"						
Pitch Diameter	2.833	2.832	✓				
Bolt Length	129.5"						
Ring Gage Go/No-Go	_____						
Zinc Coating Thick.	3.73		✓				
Hardness: Rc / Rb	_____						
Spacing	_____						
50Wedge Tensile							

NUTS: ? NO POWER WORK ON NUT

Sample No.							
Mfg. Lot No.							
Product Markings							
Size							
Plug Gage Go/No-Go							
Zinc Coating Thick.							
Hardness: Rc / Rb							
Spacing							
Nut Proof Load							

WASHER:

Sample No.							
Mfg. Lot No.							
Product Markings							
Zinc Coating Thick.							
Hardness: Rc / Rb							
Spacing							

Monnig Industries, Inc.

HOT DIP & MECHANICAL GALVANIZING
P.O. BOX 98
GLASGOW, MO 65254
PH. 660-338-2242 FAX: 660-338-5199

AUGUST 28, 2012

DYSON CORPORATION
50 FREEDOM ROAD
PAINESVILLE, OH 44077

RE: GALVANIZING CERTIFICATE
P.O. 8109 D.E.S.
CALTRAN EA# 040120F4
9 EA 3" X 132.3"
9 EA 3" X 129"
9 EA 3" X 123.2"

THIS WILL CERTIFY THAT THE MATERIAL GALVANIZED ON THE ABOVE
JOB MEETS OR EXCEEDS THE MINIMUM REQUIREMENTS OF ASTM A-123
SPECIFICATIONS.

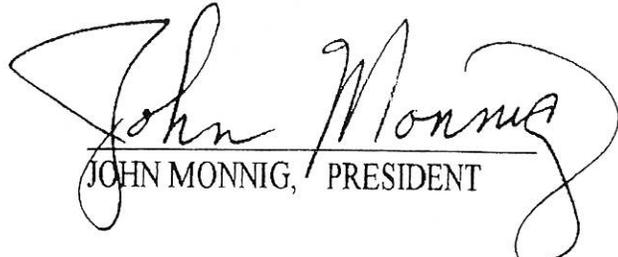
MILL READINGS AVGS:

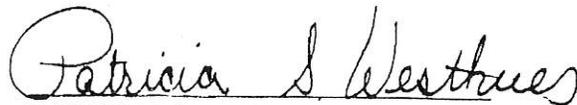
4.3	3.9	3.8	
-----	-----	-----	--

Galvanizing by Monnig Industries is done in the United States using zinc supplied by a US
supplier.

PATRICIA S. WESTHUES
NOTARY PUBLIC STATE OF MISSOURI
HOWARD COUNTY
MY COMMISSION EXP. APR. 18, 2016

CALTRANS HOT #
B70-119-12
RICARDO MEDINA
8/28/2012


JOHN MONNIG, PRESIDENT


PATRICIA S. WESTHUES,
NOTARY PUBLIC



Phoenix Manufacturing, Inc.
P.O. BOX 330
26666 Von Holten Rd.
Cole Camp, MO. 65325
660-668-2611
660-668-3160 (fax)

SSPC-SP10 Near White Metal Blast

Near-White Blast Cleaning - Removal of nearly all mill scale, rust, rust scale, paint, or foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels, to the degree hereafter specified. A Near-White Blast Cleaned Surface Finish is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface except for very light shadows, very slight streaks or slight discolorations caused by rust stain, mill scale oxides, or light, tight residues of paint or coating that may remain. At least 95 percent of each square inch of surface area shall be free of all visible residues, and the remainder shall be limited to the light discoloration mentioned above.

26 D.E.S.

1 Sample



element

Element Materials Technology
5405 E Schaeff Road
Cleveland, OH
44131-1337 USA

P 216-524-1450
F 216-524-1459
T 888-786-7555
info.cleveland@element.com
element.com

M1
TEST

Contact: Debbie Smith
Dyson Corp.
53 Freedom Road
PAINESVILLE, OH 44077-1232

TEST REPORT — (ITAR-CONTROLLED DATA)

Date: 7/11/2012
P.O. No.: 7689
W/O No.: DYS006-12-06-55245-1
Date Received: 6/25/2012

Sample Description: Three (3) Lots (2 pcs. each) 3.00"-4UNC2A Cable Band Anchor Rods,
Material: ASTM A 364, Gr. BD, Test per ASTM A 490, Section 10, ASTM F788,
Caltrans Special Provisions 10-1.59, 10-1.60, and 10-1.61, plus Caltrans Std Specs. 75-1.05

NDT MAGNETIC PARTICLE INSPECTION REPORT

SPECIFICATIONS	
Procedure	ASTM E1444 (Method) per ASTM A490/Caltrans Special Provisions 10-1.59, 10-1.60, 10-1.61 and Caltrans Standard Specifications 75-1.05
Acceptance	ASTM F788-06 (Acceptance Criteria)

EQUIPMENT/MATERIAL DATA		
<input type="checkbox"/> MagWerks MVS-2445	S/N: 000404	Cal. Due Date: 9/22/2012
<input type="checkbox"/> Magnaflux H-720	S/N: 81471	Cal. Due Date: 9/22/2012
<input checked="" type="checkbox"/> Yoke <input checked="" type="checkbox"/> AC <input type="checkbox"/> DC	S/N: 30005	Spacing: 4-6" Cal. Due Date 11/29/2012
Magnaflux Particles:		
<input type="checkbox"/> 8A Red	<input type="checkbox"/> Ardrox 8800	Part Preparation: <input checked="" type="checkbox"/> None Required <input type="checkbox"/> Solvent Clean <input type="checkbox"/> Ultrasonic Cleaner / Water <input type="checkbox"/> Other
<input type="checkbox"/> 3A Black	<input checked="" type="checkbox"/> 14AM	
<input type="checkbox"/> 1 Gray	<input type="checkbox"/> Other	
Batch No. 11F22K		
Wet Particle Carrier: <input type="checkbox"/> Ardrox Base Oil <input checked="" type="checkbox"/> Pre Mixed <input type="checkbox"/> Concentration MI Lot No.		

INSPECTION PARAMETERS		
<input type="checkbox"/> Dry (Visible)	<input checked="" type="checkbox"/> Wet (Fluorescent)	
<input checked="" type="checkbox"/> AC	<input type="checkbox"/> FWDC	<input type="checkbox"/> HWDC
<input type="checkbox"/> Central Conductor (AMPS)	<input type="checkbox"/> Head Shot (AMPS)	
<input type="checkbox"/> Coil (AMPS)	<input type="checkbox"/> Prods (AMPS/Spacing)	
Field Verified by <input checked="" type="checkbox"/> Pie Gage <input type="checkbox"/> QQI <input type="checkbox"/> Half Effect Probe		

INSPECTION PIECE(S) DATA			
Work Order No.	120655246	Purchase Order No.	7689
Material	ASTM A364 Gr. BD	Heat No.	4M76368
Part Cleaning <input type="checkbox"/> Ultrasonic Cleaner, Ardrox 6333A 20%by, Lot No. 05031011, Exp. Date 5/6/2013			
<input type="checkbox"/> Drawing Attached		<input type="checkbox"/> Picture Attached	

The above testing was performed in accordance with the latest revision of the applicable commercial, military and/or international test method unless otherwise noted. The above services were performed in accordance with Element Materials Technology Cleveland's Quality Manual, Edition 1, Revision 4, dated December 5, 2011. Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes. Sample remnants are held for a minimum of 6 months following issuance of test results, at which point they will be discarded unless notified in writing by the client. This material was not contaminated by mercury or chlorinated solvents during the handling and processing at Element Materials Technology Cleveland.

Michael R. Gnydos
General Manager



element

Element Materials Technology
5405 E Schaaf Road
Cleveland, OH
44131-1337 USA

P. 216 524 1450
F. 216 524 1459
T. 888 786 7556
info.cleveland@element.com
element.com

Contact: Debbie Smith
Dyson Corp.
59 Freedom Road
PAINESVILLE, OH 44077-1232

TEST REPORT — ITAR-CONTROLLED DATA

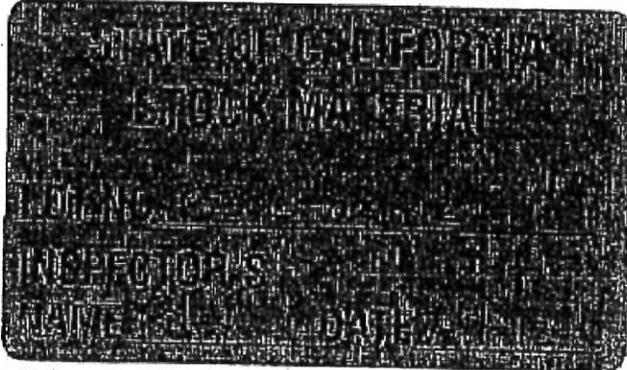
Date: 7/11/2012
P.O. No.: 7689
W/O No.: DYS006-12-06-55245-1
Date Received: 6/25/2012

INSPECTION RESULTS		
Nomenclature	Quantity	Results
3.00" 4UNC2A x 3372mm Cable Band Anchor Rod Code OOF7, S/O 676-1-1	2 Pcs.	<input checked="" type="checkbox"/> Acceptable <input type="checkbox"/> Rejectable
3.00" 4UNC2A x 3129mm Cable Band Anchor Rod Code OOF8, S/O 676-2-1	2 Pcs.	<input checked="" type="checkbox"/> Acceptable <input type="checkbox"/> Rejectable
3.00" 4UNC2A x 3286mm Cable Band Anchor Rod Code OOF9, S/O 676-3-1	2 Pcs.	<input checked="" type="checkbox"/> Acceptable <input type="checkbox"/> Rejectable
Comments: Marking Requirements: Demag and post cleaning requirements: N/A <input type="checkbox"/> Post Preservation: Ardrex 3968, Lot No. 05030711, Expiration Date 4/13/2013		
Inspected by: Matthew Novak	Certification Level <input type="checkbox"/> II <input checked="" type="checkbox"/> III Recertification: 6/25/13	Inspection Date 7/11/12

The reported results represent the actual attributes of the material tested and indicate full compliance with all applicable specification and contract requirements.

Export Controlled (ITAR)

This document contains technical data whose export and re-export/re-transfer is subject to control by the U.S. Department of State under the Arms Export Control Act and the International Traffic in Arms Regulations. The Department of State's prior written approval is required for the export or re-export/re-transfer of such technical data to any foreign person, foreign entity or foreign organization whether in the United States or abroad.



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Michael R. Gaydos
General Manager



Certified Material Test Report

Rod 9/28/2012

53 Freedom Rd
Painesville OH 44077

440-946-3500 Phone
440-362-2700 Fax

DYSON ORDER#	CUSTOMER ORDER#	JOB#	QUANTITY SHIPPED	DATE SHIPPED
676	(L)-660110-SA-017-C/N #26	000676-1-1	8.00	9/28/2012

CUSTOMER
American Bridge / Fluor JV
375 Burma Road
Oakland
CA 94607
USA

PART NUMBER: 03.000-STUD-DOUBLEEND-3372-BD-HDG
PRODUCT DESCRIPTION: 3.00"-4UNC 2A x 3372mm cable band B14 anchor rod, HDG
SPECIFICATIONS: ASTM-A354 Grade BD

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.
Round Bar	3.52	BD	8	OOF7	4M76368

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.

Attachments:

Mill Test Report, Galvanizing Certification, Magnetic Particle Exam Report,

Deborah A. Smith
Q.A. Admin. Assistant

9/28/2012

Pack Number: 2202 Line: 1



Certified Material Test Report

Red

9/28/2012

53 Freedom Rd
Painesville OH 44077

440-948-3500 Phone
440-352-2700 Fax

DYSON ORDER#	CUSTOMER ORDER#	JOB#	QUANTITY SHIPPED	DATE SHIPPED
676	(L)-660110-SA-017-C/N #26	000676-2-1	8.00	9/28/2012

CUSTOMER
American Bridge / Fluor JV
375 Burma Road
Oakland
CA 94607
USA

PART NUMBER: 03.000-STUD-DOUBLEEND-3129-BD-HDG
PRODUCT DESCRIPTION: 3.00"-4UNC 2A x 3129mm cable band B14 anchor rod, HDG
SPECIFICATIONS:

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.
Round Bar	3.52	BD	8	OOFB	4M76368

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.

Attachments:

Mill Test Report, Galvanizing Certification, Magnetic Particle Exam Report,

Deborah A. Smith
Q.A. Admin. Assistant

9/28/2012

Pack Number: 2202 Line: 2



Certified Material Test Report

KOD 9/28/2012

53 Freedom Rd
Painesville OH 44077

440-946-3500 Phone
440-352-2700 Fax

DYSON ORDER#	CUSTOMER ORDER#	JOB#	QUANTITY SHIPPED	DATE SHIPPED
676	(L)-660110-SA-017-C/N #26	000676-3-1	8.00	9/28/2012

CUSTOMER
American Bridge / Fluor JV
375 Burma Road
Oakland
CA 94607
USA

PART NUMBER: 03.000-STUD-DOUBLEEND-3286-BD-HDG
PRODUCT DESCRIPTION: 3.00"-4UNC 2A x 3286mm cable band B14 anchor rod, HDG
SPECIFICATIONS:

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.
Round Bar	3.52	BD	8	OOF9	4M76368

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.

Attachments:

Mill Test Report, Galvanizing Certification, Magnetic Particle Exam Report,

Deborah A. Smith
Q.A. Admin. Assistant

9/28/2012

Pack Number: 2202 Line: 3



CODE 00F

GERDAU SPECIAL STEEL NORTH AMERICA
5551 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	HEAT NUMBER 4M76368-2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
--------------------------------	----------------------	--------------------------	---------------------------------	-----------------

REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

IMPERIAL , PA 15126-1142

SHIP TO

TURRET STEEL
PICK UP AT MILL

ORDERED

GRADE 4140	SIZE 3.52"	LENGTH 32'
---------------	---------------	---------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.42	0.97	0.014	0.030	0.20	0.09	1.04	0.17	0.18	0.010	0.023
V	Cb	Ca	N2							
0.003	0.002	0.0013	0.0060							

GRAIN SIZE SPECIFICATION ASTM E112 (5-8)
% OF GRAIN 5-8 AVG
M 100 7.0

HARDNESS SPECIFICATION Q&T (AIM 35-37RC)
CENTER MID RADIUS SURFACE AVERAGE
32.0 35.9 38.7 35.5 HRC

PAGE 1

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Geary W. Ridenour
Quality Assurance Representative

CONTINUED ON PAGE 2



CODE 00F

GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	HEAT NUMBER 4M76368 -2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
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REPORT TO

TURRET STEEL IND. INC.
105 PINE STREET

SHIP TO

TURRET STEEL
PICK UP AT MILL

IMPERIAL , PA 15126-1142

ORDERED

4140	GRADE	3.52"	SIZE	32'	LENGTH
------	-------	-------	------	-----	--------

ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

HARDENABILITY SPECIFICATION ASTM A304

ACTUAL

J1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34
57	56	56	56	55	54	54	54	53	52	51	51	49	49	47	46	45	43	41	40	39	38	38	37	

MACROCLEANLINESS SPECIFICATION ASTM E381 (S3-R2-C2)

PLATE I

PLATE II

	S	R	C	
AVERAGE	1	1	1	NONE

PHYSICALS SPECIFICATION ASTM A434

02.0 IN

TENSILE (KSI)	YIELD (KSI)	% ELONGATION	REDUCTION OF AREA
158.0	139.0	14.9	52.0

DI CALCULATION SPECIFICATION REPORT

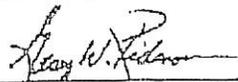
5.706

AUTO ULTRASONIC SPECIFICATION 100%

PAGE 2

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916


Geary W. Ridenour
Quality Assurance Representative

CONTINUED ON PAGE 3



CODE 00F

GERDAU SPECIAL STEEL NORTH AMERICA
5591-MORRILL-ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER 31637	CUSTOMER PART NUMBER	HEAT NUMBER 4M76368 -2	WORK ORDER NUMBER 142993 102	DATE 7/19/11
--------------------------------	----------------------	---------------------------	---------------------------------	-----------------

IMPORT TO

SHIP TO

TURRET STEEL IND. INC.
105 PINE STREET

TURRET STEEL
PICK UP AT MILL

IMPERIAL , PA 15126-1142

ORDERED

4140 <small>GRADE</small>	3.52" <small>SIZE</small>	32' <small>LENGTH</small>
---------------------------	---------------------------	---------------------------

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

MATERIAL ULTRASONIC TESTED FOR INTERNAL SOUNDNESS.

QUENCH TIME,TEMP,ME SPECIFICATION REPORT

TREATMENT	TEMP F	TIME (MIN.)	MEDIA
AUSTENIZE	1650	8.30	WATER
QUENCH	0		
TEMPER	1090	8.30	

REDUCTION RATIO

RATIO= 7.1 TO 1.0

CIRCOGRAPH..... SPECIFICATION 100%

CIRCOGRAPH TESTED FOR SURFACE IMPERFECTIONS

MATERIAL HAS BEEN VACUUM DEGASSED.

** MATERIAL 100% MELTED AND MANUFACTURED IN THE U.S.A. BY THE ELECTRIC ARC FURNACE AND CONTINUOUS CASTING METHOD. THE PRODUCT HAS NOT BEEN REPAIRED BY WELDING AND THIS MATERIAL HAS NOT BEEN EXPOSED TO MERCURY OR TO ANY OTHER METAL ALLOY THAT IS LIQUID AT AMBIENT TEMPERATURES DURING PROCESSING OR WHILE IN OUR POSSESSION. GERDAU MONITORS ALL INCOMING SCRAP AND ALL HEATS OF STEEL TO ENSURE THAT PRODUCTS SHIPPED ARE FREE OF RADIOACTIVE MATERIAL.

PAGE 3

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Gary W. Ridenour
Quality Assurance Representative

CONTINUED ON PAGE 4



GERDAU SPECIAL STEEL NORTH AMERICA
5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CODE OOF

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
31637		4M76368-2	142993 102	7/19/11

REPORT TO

SHIP TO

TURRET STEEL IND. INC.
105 PINE STREET

TURRET STEEL
PICK UP AT MILL

IMPERIAL , PA 15126-1142

ORDERED

GRADE	SIZE	LENGTH
4140	3.52"	32'

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; AIM RC 35 / 37; TSI-130 4/13/07

PAGE 4 OF 4

We certify that these data are correct and in compliance with specified requirements.

Gerdau Arkansas
5225 Planters Road
Fort Smith, AR 72916

Geary W. Ridenour
Quality Assurance Representative

TEST SPECIMEN PREPARATION
AND RECORD

APPROVED FOR USE BY SMTL
QUALITY MANAGER: *[Signature]*

SM No. 1018
12-011

Contract No.
04-0120F4

Requesting Lab Technician
FRED

Date Needed

TL-0101 No.
C 719 273

E.A./Spec. Desg./Object
0400000025-3

Date Received
9/17/12

Date Tested/Provided
9/18/12

<p><input checked="" type="checkbox"/> Machine Shop</p> <p>Work Requested</p> <p><input checked="" type="checkbox"/> standard round tension test specimen, circle one: 0.500"</p> <p><input type="checkbox"/> standard rectangular tension test specimen, circle one: 18" long, 8" gage 8" long, 2" gage length</p> <p><input type="checkbox"/> Charpy, circle one: 10mm x 10mm 10mm x 7.5mm</p> <p><input type="checkbox"/> hardness measurement sample (fasteners)</p> <p><input type="checkbox"/> weld nugget</p> <p><input type="checkbox"/> chemistry slug</p> <p><input type="checkbox"/> other: _____</p> <p><input type="checkbox"/> see instructions →</p>	<p>Heat # 4M76368-2 A & B</p>	<p><input type="checkbox"/> Chemistry Lab</p> <p>type of material:</p> <p>Work Requested</p> <p><input type="checkbox"/> neoprene verification</p> <p><input type="checkbox"/> oil swell</p> <p><input type="checkbox"/> zinc coating weight</p> <p><input type="checkbox"/> steel chemistry analysis</p> <p><input type="checkbox"/> other: _____</p> <p>← <input type="checkbox"/> see instructions</p> <p><input type="checkbox"/> Other (explain)</p>
---	---------------------------------------	---

Comments or further instructions

Finished 9/18/12 Two 500

Chad

The received service is acceptable

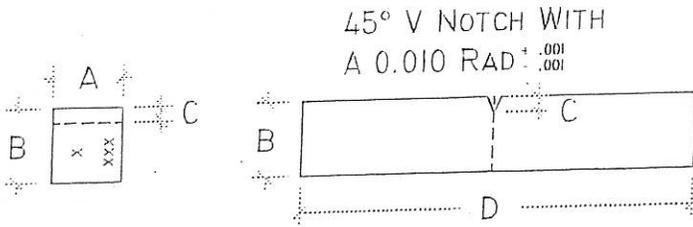
[Signature]
Receiving Lab Technician

9/19/12
Date

Specimen Preparation Information

SM # 12-1018
 EA # _____
 HEAT # 68-2
 PREPARED BY Chuck
 DATE 9-18-12

Charpy Impact Specimens



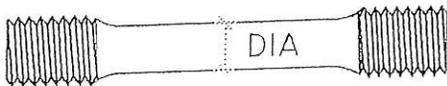
MATERIAL SURFACE
 SPEC # x
 HEAT # xxx
 NOTCH ORIENTATION

OK	1	
	2	
	3	

SPC #	A	B	C	D
	NOTE #2	0.394 ± .001 - .001	0.079 ± .001 - .001	2.165 ± .000 - .100
1				
2				
3				

- NOTE:
- ALL MEASUREMENTS IN INCHES
 - MEASUREMENT "A" 0.394, 0.295, 0.197, 0.098
TOLERANCE ± .001
 - SPECIMENS ARE TO BE SURFACE GROUND

Reduced Tensile Round Specimens



SPC #	DIA
A	<u>.4943</u>
B	<u>.4941</u>

- NOTE: SPECIMEN DIA
- 0.500 ± .010
± .010
 - 0.350 ± .007
± .007

Reduced Tensile Flat Specimens



SPC #	WIDTH
A	
B	

- NOTE: SPECIMEN WIDTH
- 0.500 ± .010

APPROVED FOR USE BY SMTL
 QUALITY MANAGER
Angela B. Mantz

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING 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
(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 1.9**REPORT OF INSPECTION OF MATERIAL****Resident Engineer:** Casey, William**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** RIM-000160**Date Inspected:** 01-Oct-2012**Project Name:** SAS Superstructure**OSM Arrival Time:** 1100**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1400**Contractor:** Monnig Industries Inc.**Location:** Glasgow, MO

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.

Item	Lot #	Bid Item#	Quantity	Material Description
1	B70-138-12	61	16	Cable Band B14 Anchor Rod

Identification: One orange tag was attached to material**Shipped to:** Job Site**Summary of Items Observed:**

On this date, the Quality Assurance (QA) Inspector Ricardo Medina was present at Monnig Industries Inc. in Glasgow Missouri for observations related to material verification and orange tag release of cable band anchor rod that will be used for this project. While on site the QA Inspector observed the following.

At the time of arrival, the QA Inspector met with Monnig Industries Inc. Management Representative Andy Monnig and Quality Control Manager (QCM) Robert Cole. QCM located the material for verification and provided a copy of material documentation including the Monnig Industries Inc. Certificate of Compliance (COC), Material Test Record (MTR) and other supporting material documentation for review. Please note that this material was previously sampled and the satisfactory test report from Caltrans Structural Materials Laboratory was reviewed.

After random reviewing of provided documentation, the QA Inspector performed a random visual verification of the material listed above to ensure it was not damaged and acceptable for use. During the material verification, the QA Inspector observed the galvanizing material appeared to change the original galvanizing appearance (discoloration) at random locations. The QCM relayed to the QA Inspector the partial change of color occurred during the galvanizing curing, cooling and cleaning and that there was no specific explanation to describe the situation.

After reviewing the ASTM A123 Standard Specifications, the QA Inspector notified the Structural Materials Representative (SMR) Yiannis Kourakis and QA Task Leader Michael Foerder of the material discoloration and it was relayed to the QA Inspector that the discoloration is not a reason for rejection and that the material will be acceptable for release. The documentation and visual verification of the material appeared to be in general compliance with the project plans.

The QA Inspector attached one orange tag to the material and assigned a Caltrans lot number B70-138-12 for

REPORT OF INSPECTION OF MATERIAL

(Continued Page 2 of 2)

tracking purposes.



Item Description	WBS	Dwg No.	Status
1 Cable Band B14 Anchor Rod: 3.00" Diameter- 4UNC 2A 3372mm length (Code 00F7). ASTM A354 Gr. BD – HDG.		X453-01	
2 Cable Band B14 Anchor Rod: 3.00" Diameter- 4UNC 2A 3372mm length (Code 00F7). ASTM A354 Gr. BD – HDG.		X453-01	

Summary of Conversations:

As noted in the body of the report above.

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 Gary Thomas (916) 764-6027, who represents the Office of Structural Materials for your project.

Inspected By:	Medina, Ricardo	Quality Assurance Inspector
Reviewed By:	Foerder, Mike	QA Reviewer

Monnig Industries, Inc.

HOT DIP & MECHANICAL GALVANIZING

P.O. BOX 98

GLASGOW, MO 65254

PH. 660-338-2242 FAX: 660-338-5199

AUGUST 28, 2012

DYSON CORPORATION
50 FREEDOM ROAD
PAINESVILLE, OH 44077

RE: GALVANIZING CERTIFICATE
P.O. 8109 D.E.S.
CALTRAN EA# 040120F4
8 EA 3" X 132.3"
8 EA 3" X 123.2

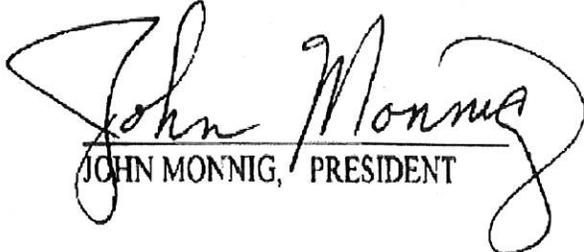
THIS WILL CERTIFY THAT THE MATERIAL GALVANIZED ON THE ABOVE
JOB MEETS OR EXCEEDS THE MINIMUM REQUIREMENTS OF ASTM A-123
SPECIFICATIONS.

MILL READINGS AVGS:

4.3	3.9	3.8	
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Galvanizing by Monnig Industries is done in the United States using zinc supplied by a US
supplier.

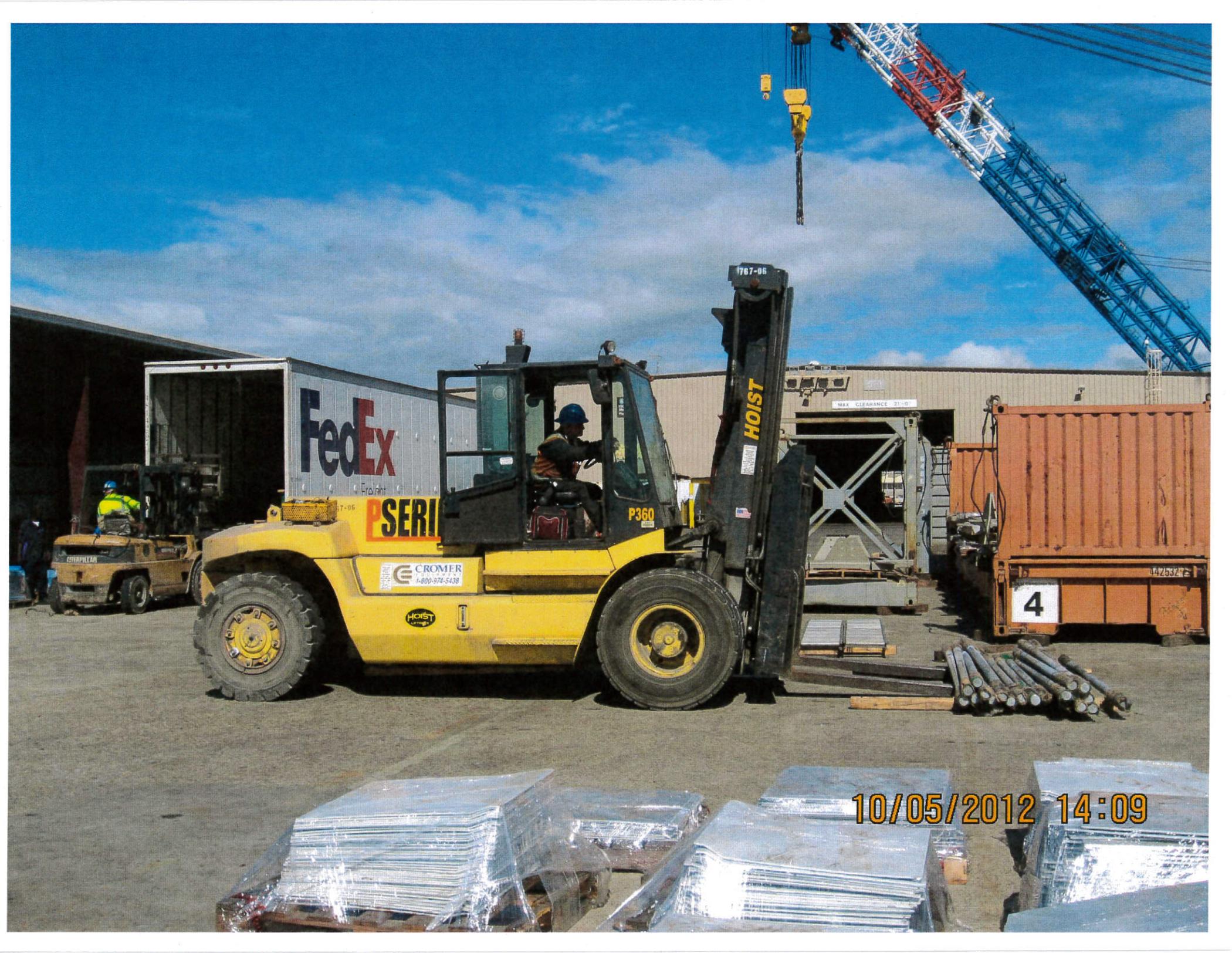
PATRICIA S. WESTHUES
NOTARY PUBLIC STATE OF MISSOURI
HOWARD COUNTY
MY COMMISSION EXP. APR. 18, 2016


JOHN MONNIG, PRESIDENT

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
INSPECTION RELEASE TAG
TL-0524 (REV. 10/03) 16 pcs. ONLY.

STATE LOT NO. B70-138-12
CONTRACT NO. 04-0120F4
RELEASED BY RICARDO DATE 9/1/12
FM 92 1554 * Based upon selective sampling


PATRICIA S. WESTHUES,
NOTARY PUBLIC



10/05/2012 14:09

00-980

10/05/2012 14:10

0017 50

10/05/2012 14:11



10/05/2012 14:11



10/05/2012 14:11



10/05/2012 14:16



10/05/2012 14:17



50

10/05/2012 14:17



10/05/2012 14:18

**STATE OF CALIFORNIA
STOCK MATERIAL**

LOT NO. B346-024-12

INSPECTOR'S

NAME D. Gray **DATE** 9-14-12

10/05/2012 14:18



DLH Container No
4

442532

10/05/2012 14:19



10/05/2012 14:20



10/05/2012 14:20



10/05/2012 14:20

Former location of the METS document package with release tags. Residue is from the sticky back plastic bag with the documents.



10/05/2012 14:21



Former location of the METS document package with release tags. Residue is from the sticky back plastic bag with the documents.

10/05/2012 14:23

DEPARTMENT OF TRANSPORTATION

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Office of Structural Materials

Quality Assurance and Source Inspection



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

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 1.25A**MATERIAL SUITABILITY REPORT**

Resident Engineer: Casey, William
Address: 333 Burma Road
City: Oakland, CA 94607

Report No: MSR-000079**Report Date:** 01-Oct-2012**SMR Authorization #:****Project Name:** SAS Superstructure**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**Date of NCR:****Contractor:** American Bridge/Fluor Enterprises, a JV**Location:** Glasgow, MO

The following material has been inspected and found not to comply with contract plans and specifications; however, METS has determined this material may be suitable for its intended purpose.

Lot #	Bid Item #	Quantity	Material Description
B70-139-12	61	8 ea	Cable Band B14 Anchor Rod

Identification:

One green tag with a blue dot was attached to material

Description of Non-Conformance (NCRs):

Mat Des	BTL #	NCR No	Description of Non-Conformance
SAS Cable	132		

Summary of Items Observed:

The QA Inspector was notified by Structural Materials Representative (SMR) Yiannis Kourakis the material listed above will be release to the job site using a green tag with a blue dot; due to the fact that part of this material will be cut to a different length at the job site. SMR release number provided to the QA inspector was S76-009.

The Quality Control Manager (QCM) Robert Cole provided a copy of material documentation including the Monnig Industries Inc. Certificate of Compliance (COC), Material Test Record (MTR) and other supporting material documentation for review. Please note that this material was previously sampled and the satisfactory test report from Caltrans Structural Materials Laboratory was reviewed.

Item Description	WBS	Dwg No.	Status
1 3.00" Diameter - 4UNC 2A x 3286mm Cable Band B14 Anchor Rod Code (00F9) - ASTM A354 Gr. BD - HDG - Heat # 4M76368-2		X453-01 Rev-0	Galvanized

Summary of Conversations:

As noted in the body of the report.

Comments

MATERIAL SUITABILITY REPORT

(*Continued Page 2 of 2*)

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 Gary Thomas (916) 764-6027, who represents the Office of Structural Materials for your project.

Inspected By:	Medina,Ricardo	Quality Assurance Inspector
Reviewed By:	Foerder,Mike	QA Reviewer

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES

Office of Structural Materials

Quality Assurance and Source Inspection

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Vallejo, CA 94592-1133

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(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 76.25B.yyy**MATERIAL SUITABILITY DOCUMENTATION REPORT****Prime Contractor:** American Bridge/Fluor Enterprises, a JV**Contractor:** Dyson Corp. & Subs**Location:** Painesville, Ohio**Report No:** MSD-000811**Date:** 01-Oct-2012**BTL Mat Des.:****BTL Item No.:****Initiated By/Why:****BTL Summary:**

Two B14 Cable Band Anchor Rods were not fabricated in accordance with the approved shop drawings. The rods were fabricated to a length of 3286mm, as opposed to a length of 3136mm per shop drawing X453-01.

METS Comments**METS Discussion:**

The Contractor has the capability to cut the rods and repair the coating on the jobsite. METS will observe the repair procedure at Pier 7 to ensure that the two rods will be cut to the required length.

Proposed Resolution:

The Contractor suggested shipping the rods to the site and performing the repair work there.

Date discussed with the Construction Engineer: 01-Oct-2012 **Time:** Various:

Construction Comments

Name of the Construction Engineer involved: Warren Collins

Construction agrees with METS recommendation: Yes No

Recommendation from Construction (If NO is checked above):

Contract Change Order required: Yes No **If Yes, CCO number:**

Designer Comments

Name of Design Engineer involved (if applicable):

Recommendation from the Design Engineer (if applicable):

Screening Team involvement: Yes No

Issue requires FAST Involvement: Yes No

Decision by FAST (if YES is checked above):

METS Summary of Final Decision:**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 purpose recommendations. Should you require recommendations concerning repairs or remedial efforts

MATERIAL SUITABILITY DOCUMENTATION REPORT

(Continued Page 2 of 2)

please contact , who represents the Office of Structural Materials for your project.

Inspected By:	Kourakis, Yiannis	Quality Assurance Inspector
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Reviewed By:	Dagher, Bahjat	QA Reviewer
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"Ramesh, Sudarshni"
<sramesh@moffattnichol.com>
>
08/10/2012 11:03 AM

To Ben Jones <bjones@abfjv.com>, Adam Roebuck
<aroebuck@abfjv.com>
cc "George Baker " <george.baker@tylin.com>, "Warren Collins
" <Warren_Collins@dot.ca.gov>
bcc

Subject RE: B14 Anchor Rod Comments

Thanks for getting back to me Ben. I will check on the cutting of the rods.

From: Ben Jones [bjones@abfjv.com]
Sent: Friday, August 10, 2012 9:57 AM
To: Ramesh, Sudarshni; 'Warren Collins'
Cc: 'Adam Roebuck'
Subject: B14 Anchor Rod Comments

Morning Sudarshni,

In response to yesterday's discussion on the B14 Anchor Rods,

-Confirmed that the holes in the top of the cable band strongback are 84mm diameter. The rods are 3" diameter rods though, so a standard oversize hole for a 3" rod would be $d+5/16"$, or $3-5/16"$, or 84.14mm. So I think this hole actually falls under a standard oversize hole and should still be able to take a standard 3" washer.

-The stopper plates for the nut on 116 E-Line are there, so no need for a jam nut at this location

-At PP116E where the rod has low clearance due to the traveler rail, and the bearing block is on the inside of the bracket I see that cutting the rods 150mm shorter on the bottom end would take care of the extra length due to the bearing block and clearance required for the traveler rail. Let me know if you see the same adjustment required.

Ben Jones
Field Engineer
American Bridge/Fluor SFOBB Project
Office: (510)808-4637
Cell: (510)774-1603
bjones@abfjv.com

--

This message has been scanned for viruses and dangerous content by [MailScanner](#), and is believed to be clean.

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES

Office of Structural Materials

Quality Assurance and Source Inspection



Bay Area Branch
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Vallejo, CA 94592-1133
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(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 76.25B**QUALITY ASSURANCE -- NON-CONFORMANCE REPORT****Location:** Painesville, Ohio**Report No:** NCR-001105**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**Date:** 01-Oct-2012**Submitting Contractor:** Dyson Corp. & Subs**NCR #:** DYSN-0006**Type of problem:**

Welding **Concrete** **Other**
Welding **Curing** **Procedural** **Bridge No:** 34-0006
Joint fit-up **Coating** **Other** **Component:** B14 Cable Bands
Procedural **Procedural** **Description:** Anchor Rods fabrication

Reference Description: B14 Cable Band Anchor Rods**Description of Non-Conformance:**

Two B14 Cable Band Anchor Rods were not fabricated in accordance with the approved shop drawings. Per drawing X453-01, two Anchor Rods at the E line, PP116, should have total length of 3136mm. Dyson fabricated these rods to a length of 3286mm, which does not conform to the approved shop drawings.

Applicable reference:

Shop Drawing X453-01

Who discovered the problem: QA Inspector - Kent Smith**Name of individual from Contractor notified:** Bob Kick**Time and method of notification:** Verbal**Name of Caltrans Engineer notified:** Warren Collins**Time and method of notification:** 10.1.12 - Verbal**QC Inspector's Name:** Russell Welsh**Was QC Inspector aware of the problem:** Yes No**Contractor's proposal to correct the problem:**

Ship the components to the job site, and cut the length to the required dimensions. Perform coating repairs per the standard specifications.

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 Patrick Lowry, 916-227-5719, who represents the Office of Structural Materials for your project.

Inspected By: Kourakis, Yiannis

SMR

Reviewed By: Dagher, Bahjat

SMR

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES

Office of Structural Materials

Quality Assurance and Source Inspection



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Vallejo, CA 94592-1133
(707) 649-5453
(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 99.15**SOURCE INSPECTION REPORT****Resident Engineer:** Casey, William**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-004709**Date Inspected:** 20-Nov-2012**Project Name:** SAS Superstructure**OSM Arrival Time:** 700**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1730**Contractor:** Certified Coatings Company Inc.**Location:** SAS Superstructure**Quality Control Contact:** Mr. Chris Eck**Quality Control Present:** Yes No**Material transfer:** Yes No N/A**Sampled Items:** Yes No N/A**Stock Transfer:** Yes No N/A**OK to Cut:** Yes No N/A**Rebar Test Witness:** Yes No N/A**Delayed/Cancelled:** Yes No N/A**Other:** Field Coatings Inspection**Bridge No:** 34-0006**Component:** Cable**Bid Item:** 81**Lot No:** N/A**Summary of Items Observed:**

At the start of the shift this NACE/Quality Assurance Inspector traveled to the SAS Project Site and observed the work and inspection performed by Certified Coatings Company Inc., an American Bridge /Fluor subcontractor. The observations, inspection and testing were performed at the following locations:

On the westbound suspender ropes at panel point 98 Caltrans Construction Engineer Mr. Mahmoud Khandaghabadia rejected the Pegalink adhesion primer applied 11/19/2012. Touch up was required. (1) 400,000 btu indirect fired heater was introduced into the containment at 9:00am. At 9:15am Pegalink was mixed and the required touch up was completed at 9:45am.

9:30am DB 75, WB 65, ST 68, DP 58, RH 55% at panel point 98 west. Overcast.

At Pier #7 (2) cable band brackets were abrasive blasted. CCC's QC performed a visual inspection and SSPC - SP-10 was achieved. Anchor profile was measured = 4.6 mils. At 10:30am Noxyde Blue Gray was mixed. At 10:40am spray application began and was completed at 12:00pm.

10:25am DB 68, WB 59, ST 66, DP 54, RH 62% at Pier #7. Overcast. (work performed inside)

12:00pm DB 67, WB 62, ST 64, DP 57, RH 73% at Pier #7. Overcast. (Heat introduced)

At Pier #7 (2) rods were delivered to the paint connex for paint repair. NCR #DYSN-0006 required that the ends of the rods that were cut off receive (2) coats of MC Zinc 100 primer. MC Zinc 100 was mixed at 1:00pm and the end of the rods were primed with the first coat. The recoat window for the primer requires 6 hours so the 2nd coat of primer will be applied tomorrow, 11/21/2012.

SOURCE INSPECTION REPORT

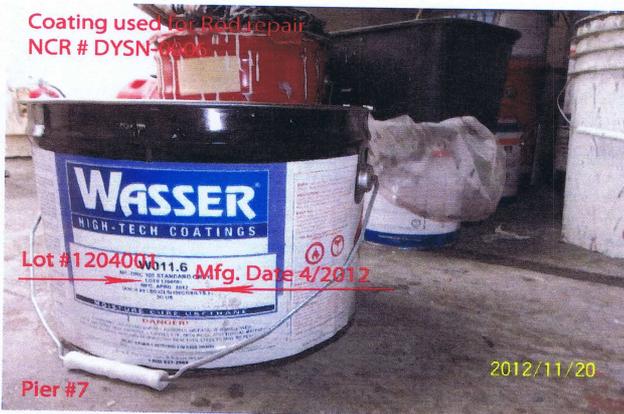
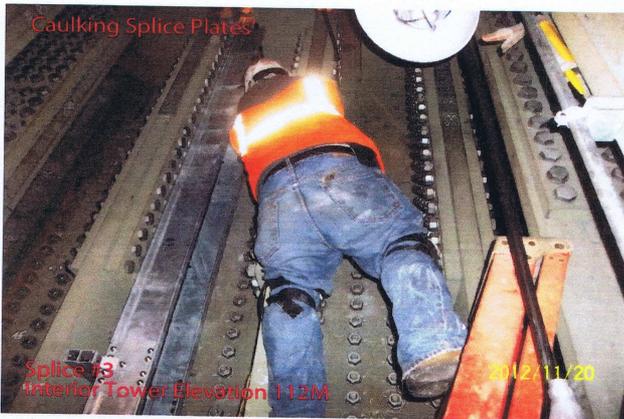
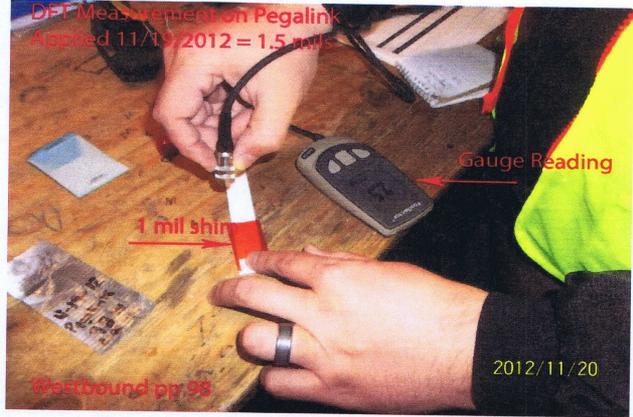
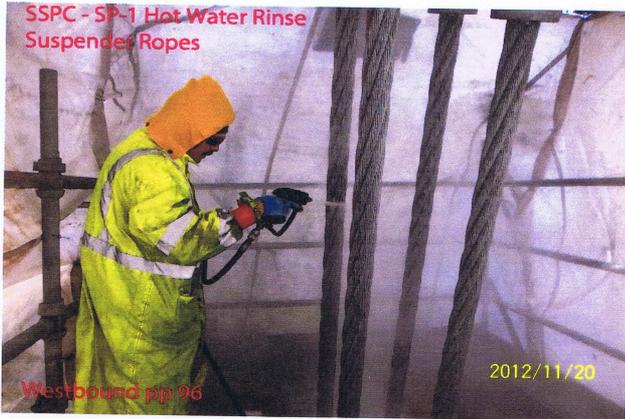
(Continued Page 2 of 3)

Batch #'s for the coatings used today:

Pegalink Adhesion Primer #M23229.

Noxyde Blue Gray #M28143.

MC Zinc 100 Lot #1204001. Mfg. Date 4/2012



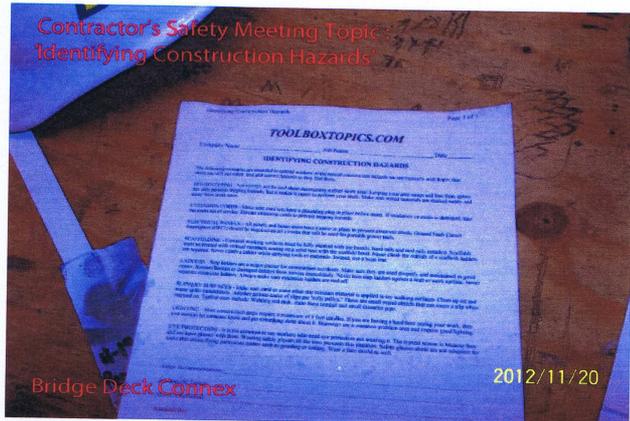
Summary of Conversations:

ABF/JV Scheduling Manager Mr. Andy Castaldi and Certified Coatings Company Inc. Project Manager Mr. James Brockman requested that METS QA Inspector Charles Stewart verify pH testing at panel points 21 east/inboard and 85 west/outboard inside the Barrier Rail where 'Rust Staining' is present on the Interzinc 22. Both

SOURCE INSPECTION REPORT

(Continued Page 3 of 3)

spots tested revealed a pH of 5.



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 Gary Thomas (916) 764-6027, who represents the Office of Structural Materials for your project.

Inspected By: Stewart,Charlie

Quality Assurance Inspector

Reviewed By: Reyes,Danny

QA Reviewer

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING 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
(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: 99.15**SOURCE INSPECTION REPORT****Resident Engineer:** Casey, William**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-004727**Date Inspected:** 21-Nov-2012**Project Name:** SAS Superstructure**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**Contractor:** Certified Coatings Company Inc.**OSM Arrival Time:** 700**OSM Departure Time:** 1530**Location:** SAS Superstructure**Quality Control Contact:** Mr. Chris Van Eck**Material transfer:** Yes No N/A**Stock Transfer:** Yes No N/A**Rebar Test Witness:** Yes No N/A**Other:** Field Coatings Inspection**Bridge No:** 34-0006**Bid Item:** 81**Quality Control Present:** Yes No**Sampled Items:** Yes No N/A**OK to Cut:** Yes No N/A**Delayed/Cancelled:** Yes No N/A**Component:** Cable**Lot No:** N/A**Summary of Items Observed:**

At the start of the shift this NACE/Quality Assurance Inspector traveled to the SAS Project Site and observed the work and inspection performed by Certified Coatings Company Inc., an American Bridge /Fluor subcontractor. The observations, inspection and testing were performed at the following locations:

Visual inspection at westbound panel point 98 suspender ropes on the first intermediate coat was performed by Caltrans Construction Engineer Mr. Mahmoud Khandaghabadia. Holidays were discovered that required touch up with Noxyde Blue Gray. The application of Noxyde Gravel Gray will have to wait until the touch up is performed and the recoat window is satisfied.

Visual inspection of the Pegalink adhesion primer at westbound panel point 96 suspender ropes was performed by METS QA Inspector Charles Stewart. The lower suspender ropes required minor touch up but the ropes above the suspender bracket were acceptable. The Contractor requested to apply the touch up to the lower suspender ropes and apply the 1st intermediate coat to the ropes above the bracket. Caltrans Construction Engineer Mr. Mahmoud Khandaghabadia agreed to allow the Contractor to proceed.

At Pier #7 (2) paint items were addressed.

#1. 2nd coat of Wasser MC Zinc 100 on the rods. (NCR #DYSN-0006)

#2. 2nd coat of Wasser MC Zinc 100 on the galvanized all thread bolts.

At 8:45am Wasser MC Zinc was mixed for application at Pier #7. DFT's were measured on the rod ends = 2.8 mils.

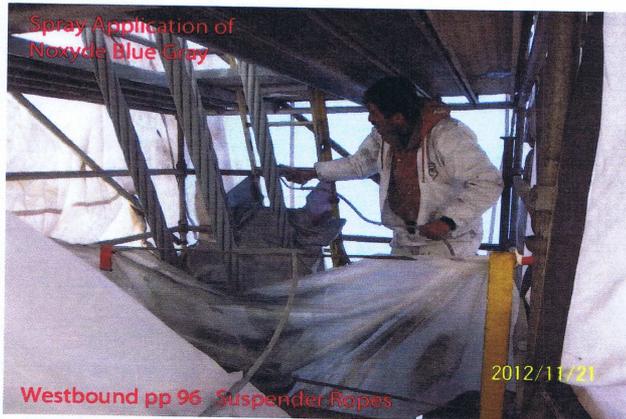
A second coat of primer was applied to the ends of the allthread and cut rod.

8:40am DB 73, WB N/A, ST 65, DP 60, RH 67% at Pier #7. Work was performed inside the paint connex.

SOURCE INSPECTION REPORT

(Continued Page 2 of 2)

Batch #'s for the coatings used today:
Noxyde Blue Gray #M28143. 62 degrees.
Pegalink #M23229. 62 degrees.
MC Zinc 100 Lot #1204001.



Summary of Conversations:

METS ASMR Mr. Adam Kreger discussed RFI-3100, Barrier Rail Rust Staining with METS QA Inspector Charles Stewart. We went to the bridge and identified the issue. Photos were taken.

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 Gary Thomas (916) 764-6027, who represents the Office of Structural Materials for your project.

Inspected By: Stewart,Charlie

Quality Assurance Inspector

Reviewed By: Reyes,Danny

QA Reviewer

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING 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
(707) 649-5493

Contract #: 04-0120F4Cty: SF/ALA Rte: 80 PM: 13.2/13.9File #: xx.25A**QUALITY ASSURANCE -- NON-CONFORMANCE RESOLUTION****Location:** Painesville, Ohio**Report No:** NCS-000982**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**Date:** 21-Nov-2012**Submitting Contractor:** Dyson Corp. & Subs**NCR #:** DYSN-0006**Type of problem:**Welding Concrete Other Welding Curing Procedural **Bridge No:** 34-0006Joint fit-up Coating Other **Component:**Procedural Procedural Descripton:**Date the Non-Conformance Report was written:** 01-Oct-2012**Description of Non-Conformance:**

Two B14 Cable Band Anchor Rods were not fabricated in according with the approved shop drawings. Per drawing X453-01, two Anchor Rods at the E line, PP116, should have total length of 3136mm. Dyson fabricated these rods to a length of 3286mm, which does not conform to the approved shop drawings.

Contractor's proposal to correct the problem:

Ship the components to the job site, and cut the length to the required dimensions. Perform coating repairs per the standard specifications.

Corrective action taken:

On 11/20/12 and 11/21/12 METS witnessed the cutting of the two B14 cable band anchor rods. CCC performed paint repairs on the ends of the rods after cutting. Reference SIR-004727 and SIR-004709.

Did corrective action require Engineer's approval? Yes No**If so, name of Engineer providing approval:****Date:****Is Engineer's approval attached?** Yes No**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 Bahjat Dagher, who represents the Office of Structural Materials for your project.

Inspected By: Kourakis, Yiannis

Quality Assurance Inspector

Reviewed By: Dagher, Bahjat

QA Reviewer

NCR PROPOSED RESOLUTION

To: CALTRANS - SAS Superstructure
333 Burma Road
Oakland CA 94607

Attention: Casey, William
Resident Engineer

Ref: 05.03.06-001048

Subject: NCR No. DYSN-0006

Dated: 23-Oct-2012

Contract No.: 04-0120F4
04-SF-80-13.2 / 13.9

Job Name: SAS Superstructure

Document No.: ABF-NPR-001052 Rev: 00

Contractor's Proposed Resolution:

Reference Resolution: Cut the rods to the appropriate length using a band saw and apply 2 coats of the Wasser MC100 to the cut end.
ABF will:

1. Cut the rods to the appropriate length using a band saw.
2. Apply 2 coats of the Wasser MC100 to the cut end.

Submitted by: Kanapicki, Charles
Attachment(s): ABF-NPR-001052R00

Caltrans' comments:

Status: CLO
Date: 06-Nov-2012

The proposed resolution is accepted with the following qualifications:

1. Provide a 2mm x 45° chamfer at the cut ends after the anchor rod has been reduced to the length detailed in the approved shop drawing provided in Submittal – ABF-SUB-002708R00.
2. Prepare the surface in accordance with the manufacturer's recommendations before applying the two coats of Wasser MC-Zinc 100 organic zinc-rich primer. Apply each coat of the primer to a Dry Film Thickness (DFT) of between 75-125µm (3-5mils) in compliance with the minimum re-coat requirements given in the manufacturer's data sheet. Allow the paint to fully cure before installing the rods.

Submitted by: Collins, Warren
Attachment(s):

Date: 06-Nov-2012

Warren Collins/D04/Caltrans/CAGov

11/20/2012 08:10 AM

To Bahjat Dagher, Bob Brignano/D04/Caltrans/CAGov

cc

Subject B14 Anchor Rod - Field Modification

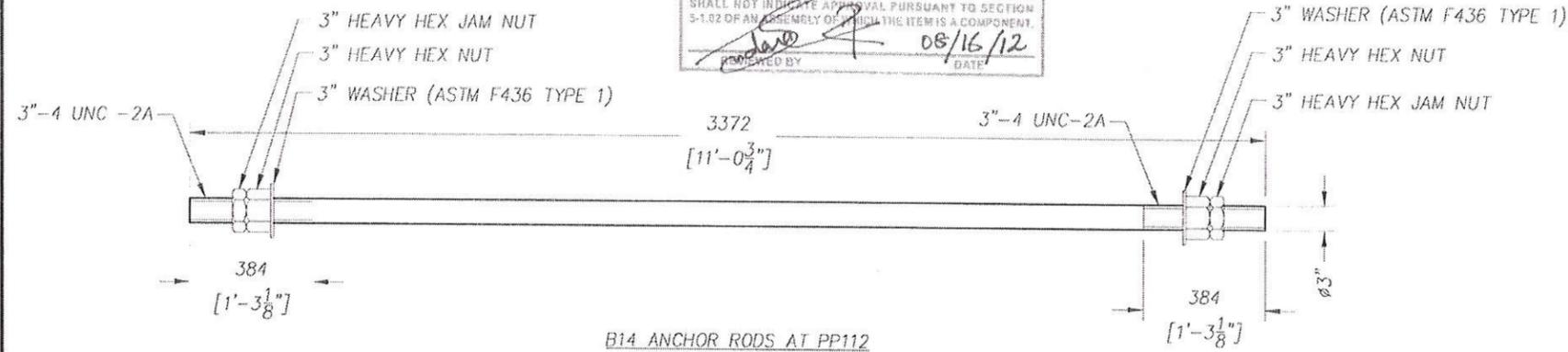
Bob / Bahjat,

ABF will be cutting the two B14 Anchor Rods today in the warehouse, after the morning break - approx 10.30-11.00. These rods were the subject of NCR #DYSN-0006.

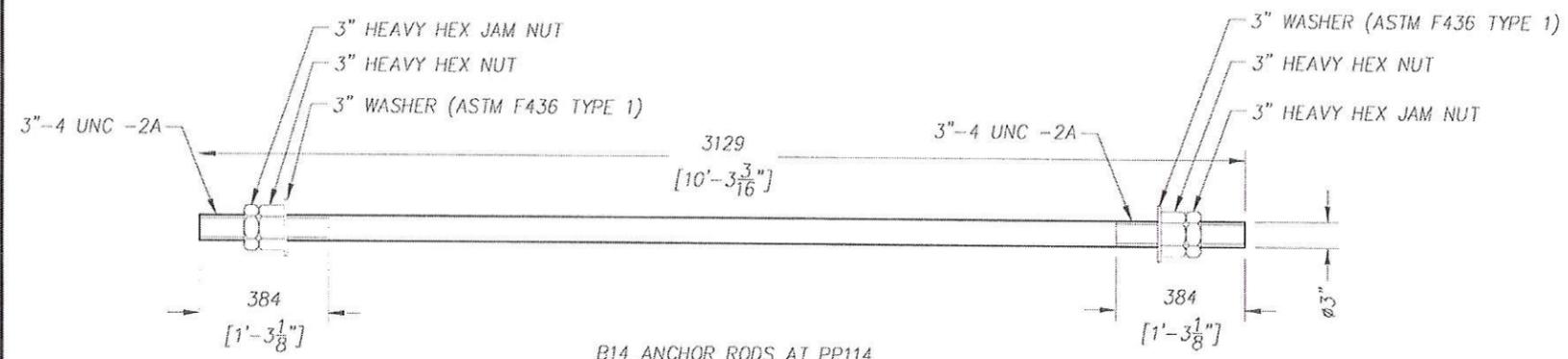
Please let me know if you're planning to witness the work because if not, then I'll cover it.

Warren

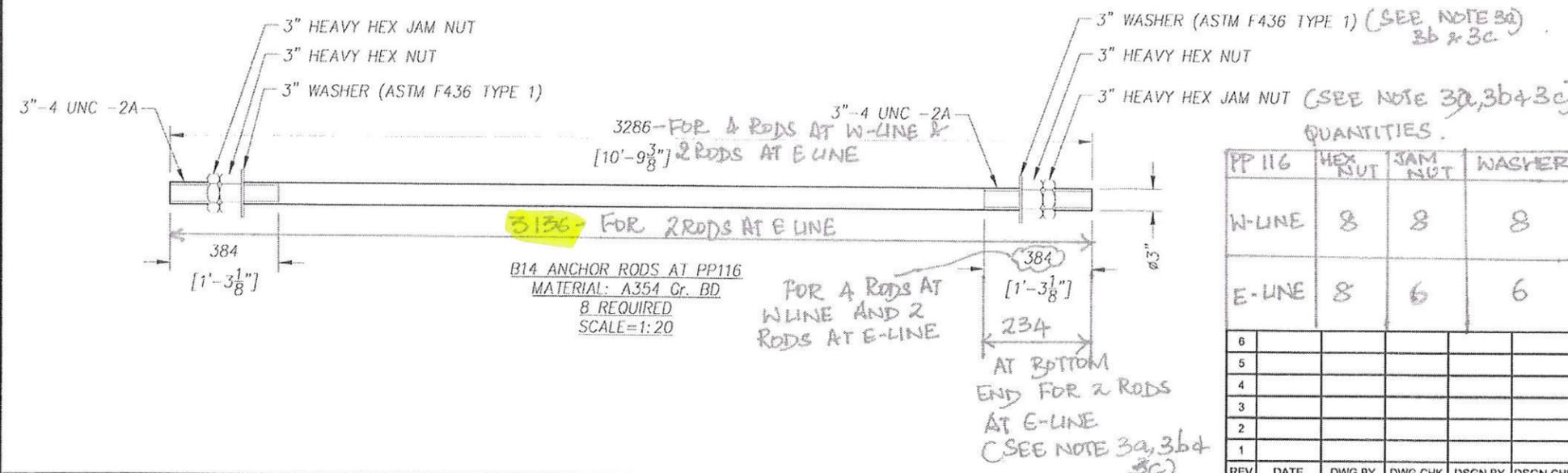
APPROVED
 APPROVED AS NOTED
 RETURNED FOR CORRECTION
 T-Y-LIN INTERNATIONAL AND MOFFATT & NICHOL, JV
 THE EAST SPAN BRIDGE DESIGN TEAM
 APPROVAL PURSUANT TO SECTION 5-1.02 OF THE
 STANDARD SPECIFICATIONS OF THE STATE OF CALIFORNIA
 DEPARTMENT OF TRANSPORTATION, OF A SPECIFIC ITEM,
 SHALL NOT INDICATE APPROVAL PURSUANT TO SECTION
 5-1.02 OF AN ASSEMBLY OF WHICH THE ITEM IS A COMPONENT.
 APPROVED BY: *[Signature]* DATE: 08/16/12



B14 ANCHOR RODS AT PP112
 MATERIAL: A354 Gr. BD
 8 REQUIRED
 SCALE=1:20



B14 ANCHOR RODS AT PP114
 MATERIAL: A354 Gr. BD
 8 REQUIRED
 SCALE=1:20



B14 ANCHOR RODS AT PP116
 MATERIAL: A354 Gr. BD
 8 REQUIRED
 SCALE=1:20

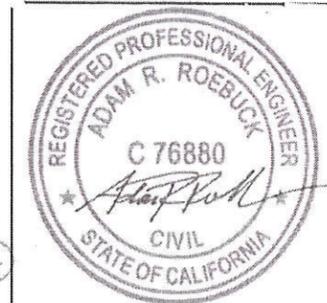
FOR 4 RODS AT W-LINE AND 2 RODS AT E-LINE
 AT BOTTOM END FOR 2 RODS AT E-LINE
 (SEE NOTE 3a, 3b & 3c)

BILL OF MATERIAL						
SHIP MARK	PIECE MARK	QTY.	DESCRIPTION	LENGTH	REMARKS	WEIGHT
X453-01						
	ra	8	ø3" A354 Gr. BD ROD	11'-0 ³ / ₄ "	THREAD 3"-4 UNC-2A	2136lb
X453-02						
	rb	8	ø3" A354 Gr. BD ROD	10'-3 ³ / ₁₆ "	THREAD 3"-4 UNC-2A	1980lb
X453-03						
	rc	8	ø3" A354 Gr. BD ROD	10'-9 ³ / ₈ "	THREAD 3"-4 UNC-2A	2080lb
	na	50	3" A563 GR DH HEAVY HEX NUT		THREAD 3"-4 UNC-2B +.050 O/S	
	na	50	3" A563 GR DH HEAVY HEX NUT		THREAD 3"-4 UNC-2B +.050 O/S	
	na	50	3" ASTM F436 TYPE 1 WASHER			

SEE 3b & 3c.
 3c. RODS AT E-LINE AT STOPPER PLATE LOCATIONS DO NOT REQUIRE A WASHER + JAMNUT AT BOTTOM END.

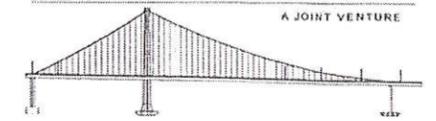
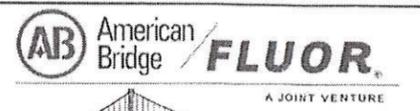
- NOTES:
- ROD, NUT, AND WASHER SHALL BE PREPARED AND HOT DIP GALVANIZED IN ACCORDANCE WITH SPECIAL PROVISIONS SECTION 10-1.59 FOR ASTM A354 Gr. BD FASTENERS.
 - PERFORM MAGNETIC PARTICLE TESTING (MT) IN ACCORDANCE WITH ASTM A490 ON THE PWS RODS.
 - ROD LENGTHS & QUANTITIES AT PP116 - E+W LINE ARE AS SHOWN.
 - RODS AT W LINE SHALL HAVE A WASHER & JAMNUT AT BOTTOM END AS DETAILED.

FOR FABRICATION



This stamp indicates that this shop drawing has been reviewed for general conformance with the Project Plans and Special Provisions. This stamp does not constitute that a review of the permanent design has been performed.

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)
 CABLE BAND B14 ANCHOR RODS



Design By: B. JONES Date: 10/20/11
 Design Chk: K. BALTZER Date: 10/20/11
 Drawn By: B. JONES Date: 10/20/11
 Drawing Chk: K. BALTZER Date: 10/20/11
 In Charge Of: K. BALTZER

Job No. 660110 Sheet No. X453-01
 Scale: AS NOTED Revision: 0

QUANTITIES

	HEX NUT	JAM NUT	WASHER			
PP 116						
W-LINE	8	8	8			
E-LINE	8	6	6			
6						
5						
4						
3						
2						
1						
REV	DATE	DWG BY	DWG CHK	DSGN BY	DSGN CHK	DESCRIPTION



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.

Current edition approved May 1, 2012. Published July 2012. Originally approved in 1928. Last previous edition approved in 2009 as A123/A123M-09. DOI: 10.1520/A0123_A0123M-12.

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.

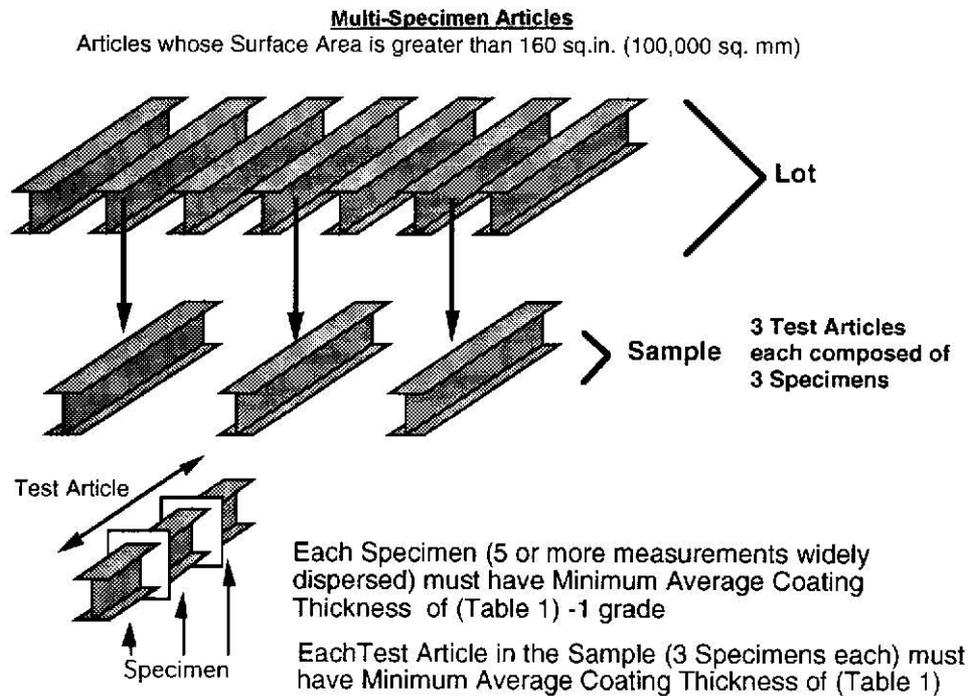
3.2.2 *black, adj*—denotes the condition of not galvanized or otherwise coated. For purposes of this specification the word

“black” does not refer to the color or condition of surface, or to a surface deposit or contamination.

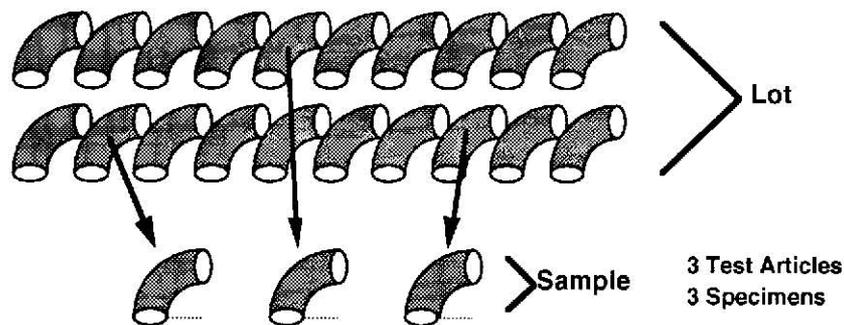
3.2.3 *coating thickness grade, n*—the numerical value from Table 1 at the intersection of a material category and a thickness range.

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.

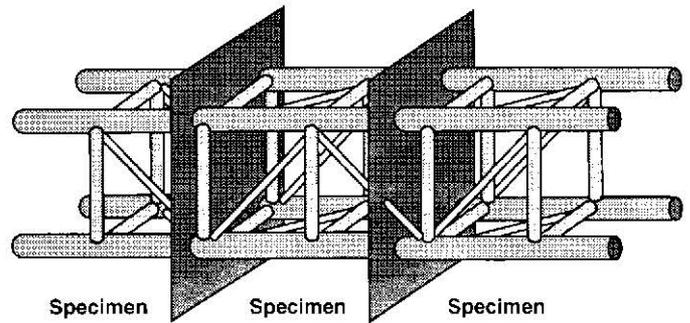
5.4 Zinc—The zinc used in the galvanizing bath shall conform to Specification B6, or Specification B960, or both. If a zinc alloy is used as the primary feed to the galvanizing bath, then the base material used to make that alloy shall conform to Specification B6, or Specification B960, or both.

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.

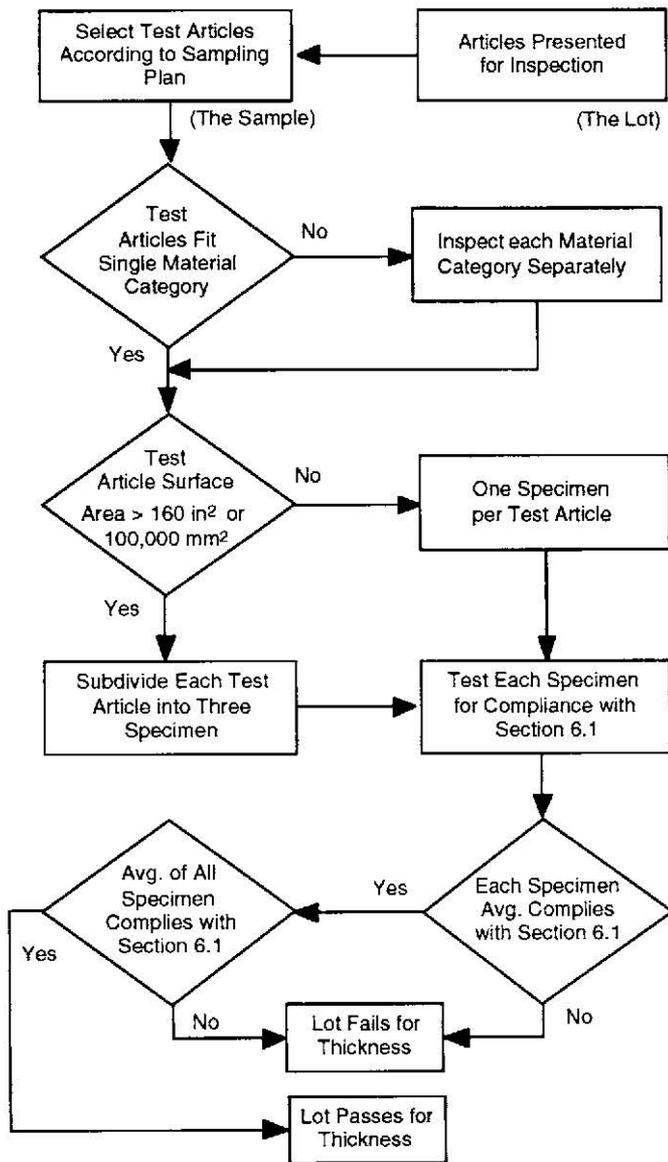


FIG. 3 Coating Thickness Inspection Steps

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 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 1¼ 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 ½ 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 ⅜ 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*.

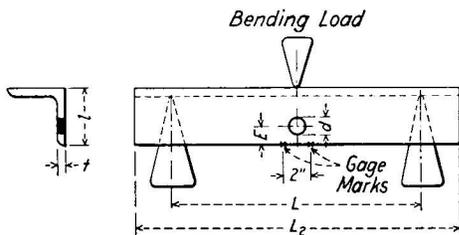
9.4.2.4 The test shall be made upon galvanized specimens having a temperature not below 60°F [16°C] and not over 90°F [32°C] when tested.

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 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 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
1⅝, 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
1/2-13 UNC	0.142	21 300	24 600	17 050	18 500
5/8-11 UNC	0.226	33 900	39 100	27 100	29 400
3/4-10 UNC	0.334	50 100	57 800	40 100	43 400
7/8-9 UNC	0.462	69 300	79 950	55 450	60 100
1-8 UNC	0.606	90 900	104 850	72 700	78 800
1 1/8-7 UNC	0.763	114 450	132 000	91 550	99 200
1 1/4-7 UNC	0.969	145 350	167 650	116 300	126 000
1 3/8-6 UNC	1.155	173 250	199 850	138 600	150 200
1 1/2-6 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 1 1/2 in. in diameter are based on the following:

Bolt Size	Column 3	Column 4	Column 5	Column 6
1/2 to 1 1/2 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			
1/2 to 1 1/2 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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