

3 & 4

E2 SHEAR KEY & BEARING ANCHOR RODS (TOP)

*(2009-2010) – 320 Shear Key Rods
224 Bearing Rods*

Fabrication Processes

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E2 Shear Key and Bearing Top Anchor Rods (Before CCO 215)

2009 – 2010 TIMELINE

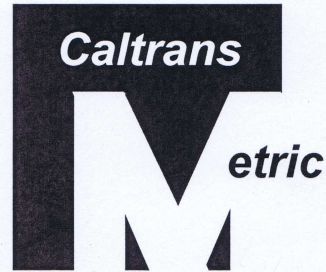
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ADDITIONAL DOCUMENTS

ASTM A123
ASTM A143
ASTM A153
ASTM A354
ASTM A490

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

Total = 2306 New information after 5/6/2013 Update is highlighted Red



STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

**NOTICE TO CONTRACTORS
AND
SPECIAL PROVISIONS
FOR CONSTRUCTION ON STATE HIGHWAY IN
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

10-1.47 SPHERICAL BUSHING BEARING (PIER E2)

This work shall consist of fabricating and installing the spherical bushing bearing on Pier E2 in conformance with details shown on the plans and the requirements of these special provisions.

The spherical bushing bearing consists of spherical bushing assembly, bearing top housing, bearing bottom housing, bearing hold down assembly, retaining ring plates, solid shaft, dust cover, base plate, bearing plate, anchor bolts, and assembly bolts. The lubricant shall be self-lubricated and shall be provided for all bronze surfaces and other surfaces as shown on the plans. Bearings shall be anchored in place with high strength non-shrink grout.

Spherical bushing bearings shall be furnished and installed at Pier E2.

GENERAL

Attention is directed to "Steel Structures," of these special provisions for steel casting requirements.

Attention is directed to "Shear Key (Pier E2)," of these special provisions for additional installation requirements.

Attention is directed to "Lubricant and Test," of these special provisions.

The design loads, design rotations, design displacements, and alignment tolerances shall conform to the values as shown on the plans.

WORKING DRAWINGS

The Contractor shall submit working drawings in conformance with the provisions in "Working Drawings," of these special provisions.

Working drawings shall include complete details, information, drawings, and substantiating calculations of the spherical bushing bearing and its components and the method, materials, equipment, and procedures of fabrication and installation that the Contractor proposes to use including the placement of high strength non-shrink grout.

Working drawing submittals shall include the following:

- A. Bearing fabrication plans for all bearings including complete details for each component.
- B. All ASTM, AASHTO, or other material designations including dust cover and its connection to other bearing components, and retaining ring plates.
- C. The bushing wall thickness, fits, and tolerances.
- D. Storage and shipping plans including details of handling and supporting of the bearings. Each bearing shipment shall be accompanied by a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall state that the materials and fabrication involved comply in all respects to the specifications and data submitted in obtaining approval.
- E. Installation plans including the following:
 - 1. Method, materials, equipment, sequence, detailed procedures, and temporary support details that the Contractor proposes to use for installation of the spherical bushing bearing. The Contractor's proposed spherical bushing bearing installation including the solid shaft press fit shall not damage the lubricant at any given time during the installation. The Contractor's proposed spherical bushing bearing installation procedures and sequences shall be detailed in the superstructure construction sequences as specified in these special provisions.
 - 2. The Contractor's calculated relative distances for a) relative distance between the centerline of E2 floor beam at box girder (normal to vertical profile) and the centerline of Pier E2 (vertical); distance is measured in the longitudinal direction along the top horizontal surface of concrete crossbeam, and b) relative distance between centerline of longitudinal shear plates (normal to cross slope) and centerline of Pier E2 (vertical); distance is measured in the transverse direction along the top sloped surface of the concrete crossbeam.
- F. Details of lifting locations and mechanisms.

A supplement to the working drawings shall include the following:

- A. The quality control plan (QCP). The QCP of the spherical bushing bearings shall conform to the requirements in "Quality Control" of these special provisions and shall include descriptions, details, and procedures for the fabrication and installation of the spherical bushing bearings, except that the portion of the QCP for welding shall be submitted separately in conformance with "Welding" in these special provisions.
- B. The manufacturer of the spherical bushing bearing shall submit to the Engineer a manual for the bearing inspection, maintenance, and replacement. This manual shall include:
 - 1. A record of spherical bushing bearing for each component including the tracing of all components during the fabrication and installation of spherical bushing bearing.

2. Recommended life expectancy for each bearing component.
3. Recommended frequency for bearing inspection and maintenance schedule.
4. Procedures and details to perform the bearing inspection and maintenance.
5. List of indication of bearing defects and the associated repair methods, if applicable.
6. Procedures and sequences for bearing replacement including locations of temporary support, estimate of jacking load for each temporary support location, sequences and methods of detensioning anchor bolts, method of debonding between concrete and base plates and anchor bolts, method of removing and replacing bearings, a list of equipment to be used for bearing replacement, and traffic, safety, and environmental impact.

Each working drawing and calculation sheet shall be signed by an engineer who is registered as a Civil Engineer or Mechanical Engineer in the State of California. After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 40 days to review the submittal.

Upon completion of installation, the Contractor shall submit to the Engineer certification stating that each spherical bushing bearing has been installed in accordance with the approved working drawings and supplements installation procedure.

MATERIALS

The materials specifications of spherical bushing bearing components shall conform to the following table:

Component	ASTM Specifications
Anchor Bolts	A354, Grade BD
Assembly Bolts	A240, Type 316
Bearing Plate	B22-C86300
Spherical Housing	A744, Grade CF-8M
Spherical Ball	B271-C86300
Solid Shaft	Structural Casting, Grade 550
Bearing Bottom Housing	Structural Casting, Grade 550
Bearing Top Housing	Structural Casting, Grade 345
Bearing Hold Down Assembly	Structural Casting, Grade 345

Attention is directed to "Welding" and "Audits" of these special provisions.

Attention is directed to "Lubricant and Test" of these special provisions.

Prestressing operation of anchor bolts shall conform to the requirements in "Prestressing Concrete," elsewhere in these special provisions.

High strength nonshrink grout shall conform to the requirements in "High Strength Nonshrink Grout," elsewhere in these special provisions.

Steel components including plates and anchor bolts shall conform to the details shown on the plans, the provisions in "Steel Structures," of the Standard Specifications, and these special provisions.

Clean and paint spherical bushing bearing shall conform to the requirements in "Clean and Paint Structural Steel (Seismic Joint, Spherical Bushing Bearing, and Shear Key)," of these special provisions.

The bronze alloy for the spherical ball and ring bushing shall be high strength manganese bronze centrifugally cast conforming to the requirements of ASTM Designation: B271-C86300. The stainless steel for the spherical housing shall be centrifugally cast conforming to the requirements of ASTM Designation: A744 Grade CF-8F. All items integral to and for the assembly of the bearing shall be stainless steel conforming to ASTM Designation: A 240, Type 304 or Type 316.

The bushing wall thickness, fits, and tolerances shall be as recommended by the manufacturer and specified in the working drawings and supplement.

QUALITY CONTROL

Quality Control (QC) shall be the responsibility of the Contractor. Quality Control shall be performed by an entity having a line of responsibility distinctly different from that of the manufacturer's fabrication department. As a minimum, the Contractor shall perform inspection and testing prior to fabrication, during fabrication, and after fabrication as specified herein and additionally as necessary to ensure that materials and workmanship conform to the requirements of the contract documents. Quality Control shall apply to each component of the spherical bushing bearing in addition to the assembly, shipping and installation of the bearing.

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all fabrication.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

Each QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship.

The Contractor shall provide sufficient number of QC Inspectors to ensure continuous inspection.

The Contractor shall designate in writing a Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of the fabrication, including materials and workmanship, performed by the Contractor and subcontractors.

The QCM shall be the sole individual responsible to the Contractor for submitting and receiving all correspondences, required submittals, and reports to and from the Engineer.

The Contractor shall submit to the Engineer 3 copies of Quality Control Plan (QCP), in conformance with the requirements in "Working Drawings," of these special provisions. As a minimum, each QCP shall include the following:

- A. A manual including equipment, testing procedures, and code of safe practices.
- B. The names, qualifications, and documentation of certifications for the QCM and all QC Inspectors.
- C. An organizational chart showing all QC personnel and their assigned QC responsibilities.
- D. The methods and frequencies for performing all required quality control procedures, including QC inspection forms to be used, as required by the specifications including:
 - 1. All visual inspections.
 - 2. Tests.
 - 3. Calibration procedures and calibration frequency for all equipment.
- E. Forms to be used for Certificates of Compliance, monthly production logs, and monthly reports.
- F. Mill certificates and material certificates.
- G. Shipping plan.
- H. Installation plan.

Prior to submitting the QCP, a pre-fabrication meeting between the Engineer, Contractor, and fabricator, any entity performing spherical bushing bearing component fabrication or subcontractor to the Fabricator, shall be held to discuss the requirements for the QCP. The pre-fabrication meeting shall be held in San Francisco Bay Area.

After a complete QCP is submitted, the Contractor shall allow the Engineer 10 days to review the submittal. An amended QCP or addendum shall be submitted to, and approved in writing by the Engineer, for proposed revisions to the approved QCP. The Contractor shall allow the Engineer 10 days to complete the review of the amended QCP or addendum.

After final approval of the QCP, amended QCP, or addendum, the Contractor shall submit 7 copies to the Engineer of each of these approved documents.

It is expressly understood that the Engineer's approval of the Contractor's QCP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications. The Engineer's approval shall not constitute a waiver of any requirement of the plans and specifications nor relieve the Contractor of any obligation thereunder, and defective work, materials, and equipment may be rejected notwithstanding approval of the QCP.

A monthly production log for fabrication shall be kept by the QCM for each day that fabrication is performed. The monthly report from each QC Inspector shall be included in the log.

The QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each spherical bushing bearing. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work have been performed in conformance with the details shown on the plans and approved working drawings and the provisions of the Standard Specifications and these special provisions.

FABRICATION AND INSTALLATION

Attention is directed to "Steel Structures," of these special provisions for fabrication and installation of spherical bushing bearings at Pier E2. The Contractor shall also conform to the requirements specified herein.

Conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for spherical bushing bearings.

Finish coats will not be required on the bearings.

Each bearing shall be marked for location and orientation in conformance with the approved working drawing and supplement. Bearings shall be secured to shipping skids in a manner that assures protection during transportation and off-loading. Each skid shall be wrapped in moisture proof and dust proof covers at all times until immediately before installation.

The retainer ring, boss plate, pin, and spacer pipe shall conform to ASTM Specifications as shown on the plans.

FABRICATION AND INSTALLATION

Attention is directed to Section, "Steel Structures," of these special provisions for fabrication and installation of tower cross bracing spherical bushing bearings. The Contractor shall also conform to the requirements specified herein.

The coefficient of friction for bearing lubricant shall be equal or less than 0.10.

Conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for tower cross bracing spherical bushing bearings.

Finish coats will not be required on the bearings.

The Contractor shall provide the rubber covers to tower cross bracing spherical bushing bearings to seal the bearings with the details in the approved working drawings and supplement.

Each bearing shall be marked for location and orientation in conformance with the approved working drawing and supplement. Bearings shall be secured to shipping skids in a manner that assures protection during transportation and off-loading. Each skid shall be wrapped in moisture proof and dust proof covers at all times until immediately before installation.

Damaged bearings shall be replaced.

A qualified representative of the manufacturer shall be present during installation of all tower cross bracing spherical bushing bearings.

Full compensation for fabricating tower cross bracing spherical bushing bearing shall be considered as included in the contract prices paid per kilogram for furnish structural steel (bridge) (tower), and no separate payment will be made therefor.

Full compensation installing tower cross bracing spherical bushing bearing shall be considered as included in the contract prices paid per kilogram for erect structural steel (bridge) (tower), and no separate payment will be made therefor.

10-1.50 SHEAR KEY (PIER E2)

This work shall consist of fabricating, testing, and installing the shear key on Pier E2 in conformance with details shown on the plans and the requirements of these special provisions.

The shear key consists of shear key housing with nut retainer assemblies, shear key stub, spherical ring with retainer brackets, spherical housing, bearing plates, shim plates, neoprene pads, dust cover, anchor bolts, high-strength bolts, and assembly bolts. The lubricant shall be self-lubricated and shall be provided for all bronze surfaces and other surfaces as shown on the plans. Shear keys shall be anchored in place with high strength non-shrink grout.

The shear key bushing consists of spherical ring, spherical housing, and bearing plates.

Shear keys shall be furnished and installed at Pier E2.

GENERAL

Attention is directed to "Steel Structures," of these special provisions for steel casting requirements.

Attention is directed to "Spherical Bushing Bearing (Pier E2)," of these special provisions for additional installation requirements.

The design loads, design rotations, design displacements, and alignment tolerances shall conform to the values shown on the plans.

WORKING DRAWINGS

The Contractor shall submit working drawings in conformance with the provisions in "Working Drawings," of these special provisions.

Working drawings shall include complete details, information, drawings, and substantiating calculations of the shear key and its components and the method, materials, equipment, and procedures of fabrication and installation that the Contractor proposes to use including the placement of high strength non-shrink grout.

Working drawing submittals shall include the following:

- A. Shear key fabrication plans including complete details for each component.
- B. All ASTM, AASHTO, or other material designations including dust cover and its connection to other shear key components.
- C. Storage and shipping plans including details of handling and supporting of the shear keys. Each shear key shipment shall be accompanied by a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall state that the materials and fabrication involved comply in all respects to the specifications and data submitted in obtaining approval.
- D. Installation plans including the following:

1. Method, materials, equipment, sequence, detailed procedures, and temporary support details that the Contractor proposes to use for installation of the shear key. The Contractor's proposed shear key installation procedures and sequences shall be detailed in the superstructure construction sequences as specified elsewhere in these special provisions.
2. The Contractor's calculated relative distances for a) relative distance between the centerline of Pier E2 floor beam at box girder (normal to vertical profile) and the centerline of Pier E2 (vertical); distance is measured in the longitudinal direction along the top horizontal surface of concrete crossbeam, and b) relative distance between centerline of box girder (normal to cross slope) and centerline of Pier E2 (vertical); distance is measured in the transverse direction along the top sloped surface of the concrete crossbeam.

E. Details of lifting locations and mechanisms.

A supplement to the working drawings shall include the following:

- A. The quality control plan (QCP). The QCP of the shear keys shall conform to the requirements in "Quality Control" of these special provisions and shall include descriptions, details, and procedures for the fabrication and installation of the shear keys, except that the portion of the QCP for welding shall be submitted separately in conformance with "Welding" of these special provisions.
- B. The Contractor shall submit to the Engineer a manual for the shear key inspection, maintenance, and replacement. This manual shall include:
 1. A record of shear key for each component including the tracing of all components during the fabrication and installation of shear key.
 2. Recommended life expectancy for each shear key component.
 3. Recommended frequency for shear key inspection and maintenance schedule.
 4. Procedures and details to perform the shear key inspection and maintenance.
 5. List of indication of shear key defects and the associated repair methods, if applicable.
 6. Procedures and sequences for shear key bushing replacement, a list of equipment to be used for shear key bushing replacement, and traffic, safety, and environmental impact.

Each working drawing and calculation sheet shall be signed by an engineer who is registered as a Civil Engineer or Mechanical Engineer in the State of California.

After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 40 days to review the submittal.

Upon completion of installation, the Contractor shall submit to the Engineer certification stating that each shear key has been installed in accordance with the approved working drawings and supplements installation procedure.

MATERIALS

The materials specifications of shear key components shall conform to the following table:

Component	ASTM Specifications
Shear Key Housing, Shear Key Stub, Spherical Ring	Structural Casting, Grade 345
Spherical Housing	High Strength Manganese Bronze Centrifugally Cast, B271-C86300
Anchor Bolts	A354, Grade BD
Assembly Bolts	A240, Type 316
High Strength Bolts	A 325M
Bearing Plate & Shim Plate	A 709M Grade 345

Attention is directed to "Welding" and "Steel Audits" of these special provisions.

Attention is directed to "Lubricant and Test" of these special provisions.

Prestressing operation of anchor bolts shall conform to the requirements in "Prestressing Concrete" of these special provisions.

High strength nonshrink grout shall conform to the requirements in "High Strength Nonshrink Grout" of these special provisions.

Steel components including plates and anchor bolts shall conform to the details shown on the plans, the provisions in "Steel Structures," of the Standard Specifications, and these special provisions.

Neoprene pads shall conform to Section 51-1.145, "Strip Waterstops," of the Standard Specifications and these special provisions. Neoprene pads shall have the following properties:

- A. Neoprene shall have a durometer hardness between 25-45
- B. The compressive strength shall not exceed 1000 kPa at 50% compression.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall be furnished to the Engineer certifying that the neoprene to be furnished conforms to the above provisions. The Certificate of Compliance shall be supported by a certified copy of the results of tests performed by the manufacturer on the neoprene pads.

Clean and paint shear key shall conform to the requirements in "Clean and Paint Structural Steel (Seismic Joint, Spherical Bushing Bearing, and Shear Key)," of these special provisions.

The bronze alloy for the spherical housing shall be high strength manganese bronze centrifugally cast conforming to the requirements of ASTM Designation: B271-C86300. The mating surfaces of the spherical ring and bearing plate shall be stainless steel weld overlay conforming to the requirements of ASTM Designation: A240 Type 316. All items integral to and for the assembly of the shear key bushing shall be stainless steel conforming to ASTM Designation: A 240, Type 304 or Type 316.

QUALITY CONTROL

Quality Control (QC) shall be the responsibility of the Contractor. Quality Control shall be performed by an entity having a line of responsibility distinctly different from that of the manufacturer's fabrication department. As a minimum, the Contractor shall perform inspection and testing prior to fabrication, during fabrication, and after fabrication as specified herein and additionally as necessary to ensure that materials and workmanship conform to the requirements of the contract documents. Quality Control shall apply to each component of the shear key in addition to the assembly, shipping and installation of the shear key.

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all fabrication.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

Each QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship.

The Contractor shall provide sufficient number of QC Inspectors to ensure continuous inspection.

The Contractor shall designate in writing a Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of the fabrication, including materials and workmanship, performed by the Contractor and subcontractors.

The QCM shall be the sole individual responsible to the Contractor for submitting and receiving all correspondences, required submittals, and reports to and from the Engineer.

The Contractor shall submit to the Engineer 3 copies of Quality Control Plan (QCP), in conformance with the requirements in "Working Drawings," of these special provisions. As a minimum, each QCP shall include the following:

- A. A manual including equipment, testing procedures, and code of safe practices.
- B. The names, qualifications, and documentation of certifications for the QCM and all QC Inspectors.
- C. An organizational chart showing all QC personnel and their assigned QC responsibilities.
- D. The methods and frequencies for performing all required quality control procedures, including QC inspection forms to be used, as required by the specifications including:
 - 1. All visual inspections.
 - 2. Tests.
 - 3. Calibration procedures and calibration frequency for all equipment.
- E. Forms to be used for Certificates of Compliance, monthly production logs, and monthly reports.
- F. Mill certificates and material certificates.
- G. Shipping plan.
- H. Installation plan.

Prior to submitting the QCP, a pre-fabrication meeting between the Engineer, Contractor, and fabricator, any entity performing shear key component fabrication or subcontractor to the Fabricator, shall be held to discuss the requirements for the QCP. The pre-fabrication meeting shall be held in San Francisco Bay Area.

persons or entities hired by subcontractors who will provide other services or materials for the project, and shall have the following:

- A. A tensile testing machine capable of breaking the largest size of reinforcing bar to be tested.
- B. Operators who have received formal training for performing the testing requirements of ASTM Designation: A 970/A 970M.
- C. A record of annual calibration of testing equipment performed by an independent third party that has 1) standards that are traceable to the National Institute of Standards and Technology, and 2) a formal reporting procedure, including published test forms.

The Engineer shall be notified in writing when any lots of headed bar reinforcement are ready for testing. The notification shall include the number of lots to be tested and the location where the tests are to be conducted. After notification has been received, test samples will be randomly selected by the Engineer from each production lot of headed bar reinforcement which is ready for shipment to the jobsite. If epoxy coating is required, test samples will be taken after the headed bar reinforcement has been prepared for epoxy coating. The Engineer will be at the testing site within a maximum of one week after receiving written notification that the samples are at the testing site and ready for testing. In the event the Engineer fails to be present at the testing site within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by failure of the Engineer to be present at the testing site, the Contractor will be compensated for any resulting loss in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

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

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

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

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

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

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

MEASUREMENT AND PAYMENT

Full compensation for headed bar reinforcement shall be considered as included in the contract price paid per kilogram for bar reinforcing steel (bridge) and no separate payment will be made therefor.

Full compensation for epoxy-coated headed bar reinforcement shall be considered as included in the contract price paid per kilogram for bar reinforcing steel (epoxy-coated) (bridge) and no separate payment will be made therefor.

10-1.59 STEEL STRUCTURES

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

Fabricators and suppliers shall be certified under the AISC Quality Certification Program, Category Cbr, Major Steel Bridges, with endorsement F, Fracture Critical members, except that certification will not be required for fabrication of the tower strut façade and tower skirt. Alternatively, ISO 9001:2000 certification standard may be substituted for the AISC Quality Certification Program.

Details of box girder and crossbeam connections shall conform to the AASHTO Standard Specifications for Highway Bridges, unless otherwise shown on the plans.

Attention is directed to "Accelerated Working Drawings Submittal," of these special provisions.

- A. Minimum tension shall be verified using the "Pre-Installation Verification Turn-of-the-Nut Method," of the "Structural Bolting Handbook," published by the Steel Structures Technology Center, Incorporated, except that the required rotation shall be as given in Table 8.2. of this section and the required tension shall be as shown in the following table:

**Pre-Installation Verification
Required Tension, N***

Bolt Size, mm	A325M Bolts	A490M Bolts
M16	96 000	120 000
M20	149 000	188 000
M22	185 000	232 000
M24	215 000	270 000
M27	280 000	351 000
M30	342 000	428 000
M36	499 000	625 000
*The above values are 5% higher than the required pretension values used for design, actual installation and inspection, rounded to the nearest kN.		

- B. Rotational-capacity tests in accordance with the requirements in Section 11.5.6.4.2 "Rotational-Capacity Tests," of the AASHTO LRFD Bridge Construction Specifications, except that Table 11.5.6.4.1-2 "Nut Rotation from the Snug Condition," is replaced by Table 8.2. of this section.

Test results shall confirm both the minimum bolt tension and the rotational capacity of the bolts. If either test fails, the Contractor shall modify the nut rotation in Table 8.2. of this section until the requirements of both tests are satisfied. No adjustment in compensation will be allowed for modifications to the nut rotations as necessary to satisfy test requirements. Revisions to Table 8.2. shall be approved by the Engineer prior to bolting operations.

The Engineer will randomly sample and perform quality assurance testing of high strength fasteners. Samples will be obtained at locations chosen by the Engineer. The Contractor shall provide the number of bolts specified below to the Engineer for quality assurance testing:

Bolt Sampling Size

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

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

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

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

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

Steel fasteners, designated on the plans as A 354, Grade BC, and A 354, Grade BD, shall conform to the requirements of ASTM Designation: A 354. Steel fastener components for steel fasteners designated as A 354 shall include a bolt, nut and hardened washer. Nuts for steel fasteners designated as A 354 shall conform to Section 55-2.01, "Description," of the Standard Specifications. Nuts shall be zinc coated and be furnished with a dry lubricant conforming to Supplementary Requirement S1 and S2 in ASTM Designation: A 563.

Steel fasteners designated on the plans as A 354, Grade BD shall be tensioned not less than the value shown on the plans. Prior to installation, the Contractor shall submit to the Engineer for approval the methods and equipment to be used to tension steel fasteners designated as A354, Grade BD in accordance with Section 55-1.02, "Drawings," of the Standard Specifications. Working drawings shall include methods and equipment to be used to evaluate: 1) the presence of a lubricant, 2) the efficiency of the lubricant, and 3) the compatibility of the high strength steel bolt, nut and hardened washer.

Except where sub-punching is permitted, bolt holes shall be drilled or reamed, unless otherwise shown on the plans.

Punching

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

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

Prestressing High-Strength Bolts

High-strength A354 bolts shall be tensioned by means of hydraulic jacks so that the force in the bolts shall not be less than the value shown on the plans.

The maximum temporary tensile stress (jacking stress) in high-strength bolts shall not exceed 75 percent of the specified minimum ultimate tensile strength of the material. Prestressing forces in high-strength bolts shall consider all losses, including creep of steel, losses due to sequence of stressing, and other losses specific to the method or system of prestressing used by the Contractor.

Hydraulic jacks used for prestressing high-strength bolts shall be calibrated in accordance with the requirements in Section 50-1.08, "Prestressing," of the Standard Specifications.

Final prestressing high strength A354 bolts at the tower anchorage shall be performed after the full dead load is transferred to the cable system.

ASSEMBLY

The method of erection of the suspended structure and tower shall be determined by the Contractor to meet the seismic design load criteria and ensure control of box girder and tower deflections due to wind induced oscillations.

The Contractor shall carry out the necessary structural analyses for the erection procedure to demonstrate the adequacy of the procedure. Details of these analyses and of any supplementary damping or other measures shall be submitted to the Engineer for review and approval.

Wind pressure effects during erection shall be calculated using a gust wind appropriate to a return period of not less than 25 years and shall allow for variation of speed with height per ANSI ASCE 7-95. The 25-year wind corresponds to a 77 mph one-hour average wind speed (and a corresponding 3-second gust wind speed of 100 mph) at deck elevation of 50 meters, as well as a critical flutter wind speed threshold of 112 mph based on a 1000-year return period. The Contractor shall provide temporary connections between adjacent lift sections in order to ensure sufficient torsional stiffness of the suspended structure. The Contractor shall also provide the proper support of the suspended structure during all stages of erection. The Contractor shall similarly ensure control of tower deflections due to wind-induced oscillations at all stages of erection and shall provide holdback stays or other damping devices as necessary. All such temporary measures shall be approved by the Engineer.

Wind design loads may be reduced during lifting operations.

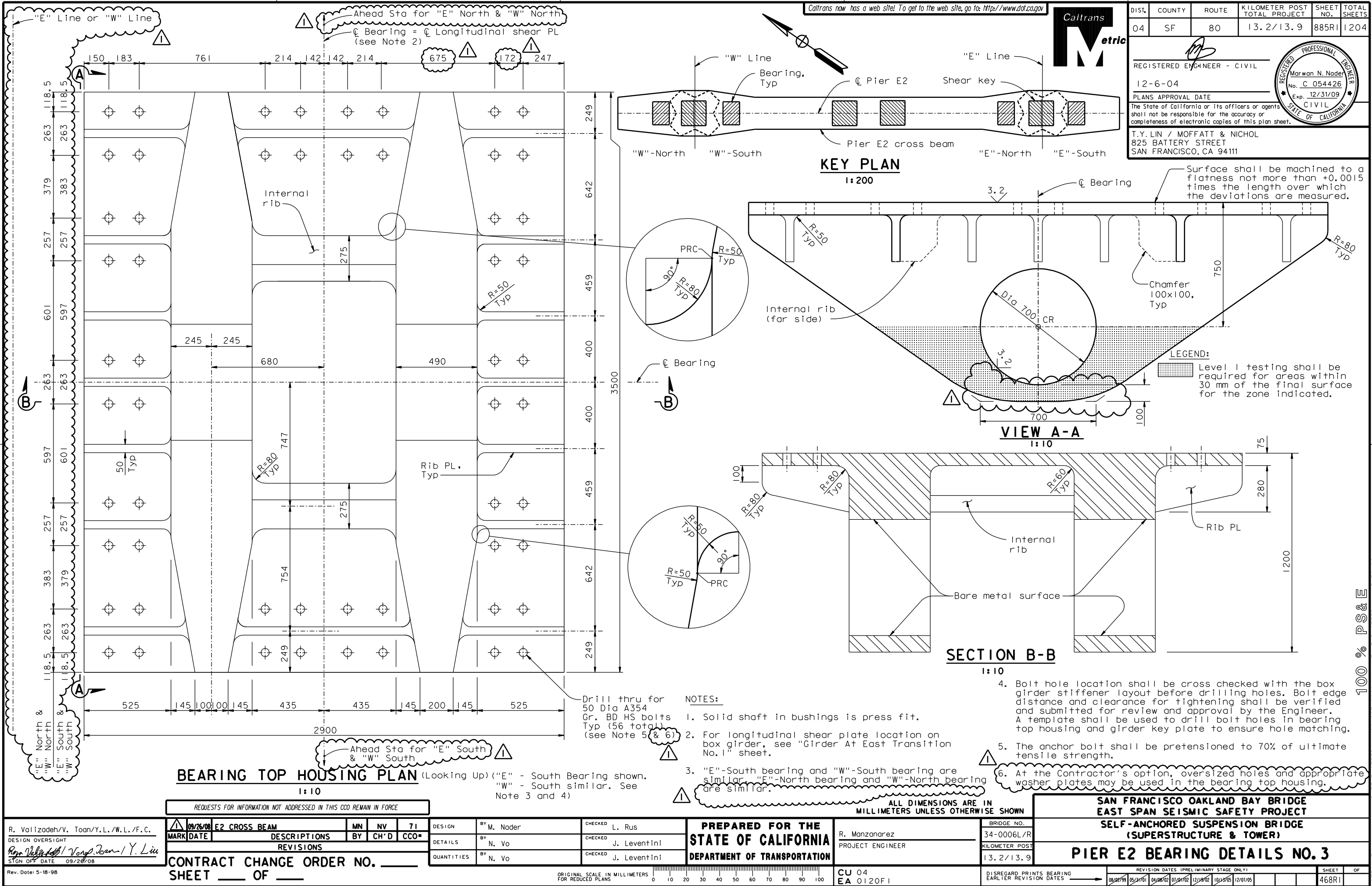
Seismic loading during erection shall conform to the seismic loading requirements specified in "TEMPORARY TOWERS," subsection "TEMPORARY TOWER DESIGN," subsection "Seismic Design Loads," of these special provisions.

The erection procedure shall be such that the maximum stresses in any part of the permanent structure do not cause any permanent deformation or damage. Appropriate values of loads and safety factors for erection loading conditions shall be submitted by the Contractor to the Engineer for review and approval.

The details of any fastenings which the Contractor may require in any part of the permanent works for erection, and the procedure for their removal, shall be submitted to the Engineer for approval.

Tower

Tower lifts shall be in lengths as indicated on the plans. Exterior plates of the tower shafts shall be fabricated with direction of rolling aligned along the vertical direction of the tower. Within each lift, the number of transverse splices of the





DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SF	80	13.2/13.9	888R1	1204

REGISTERED ENGINEER - CIVIL

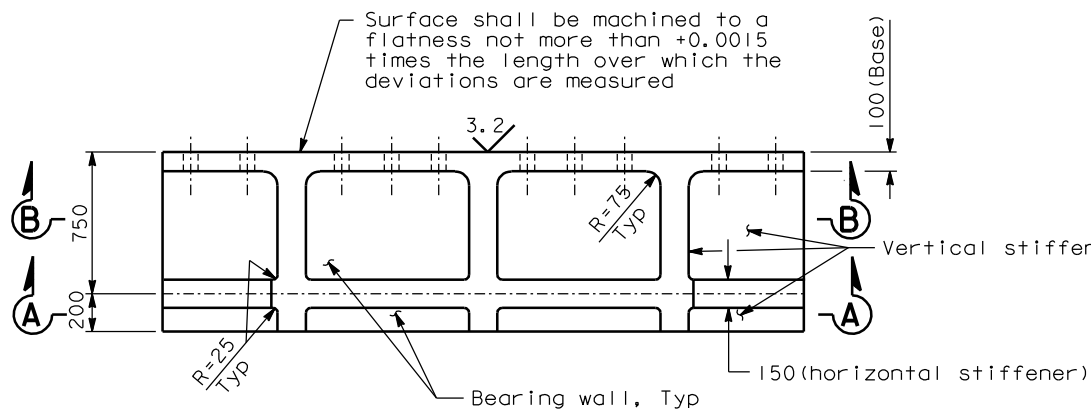
12-6-04

PLANS APPROVAL DATE

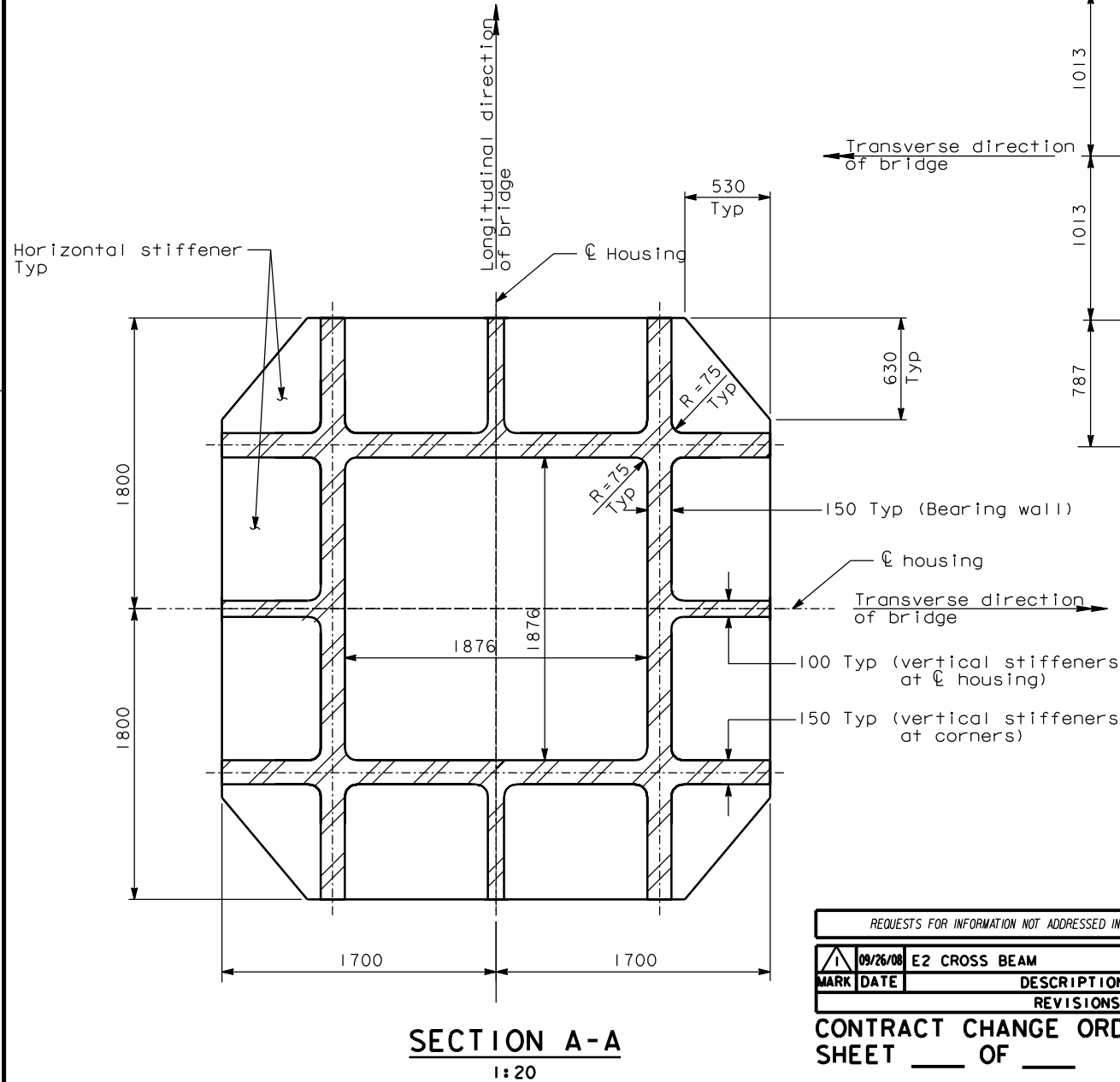
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

T.Y. LIN / MOFFATT & NICHOL
825 BATTERY STREET
SAN FRANCISCO, CA 94111

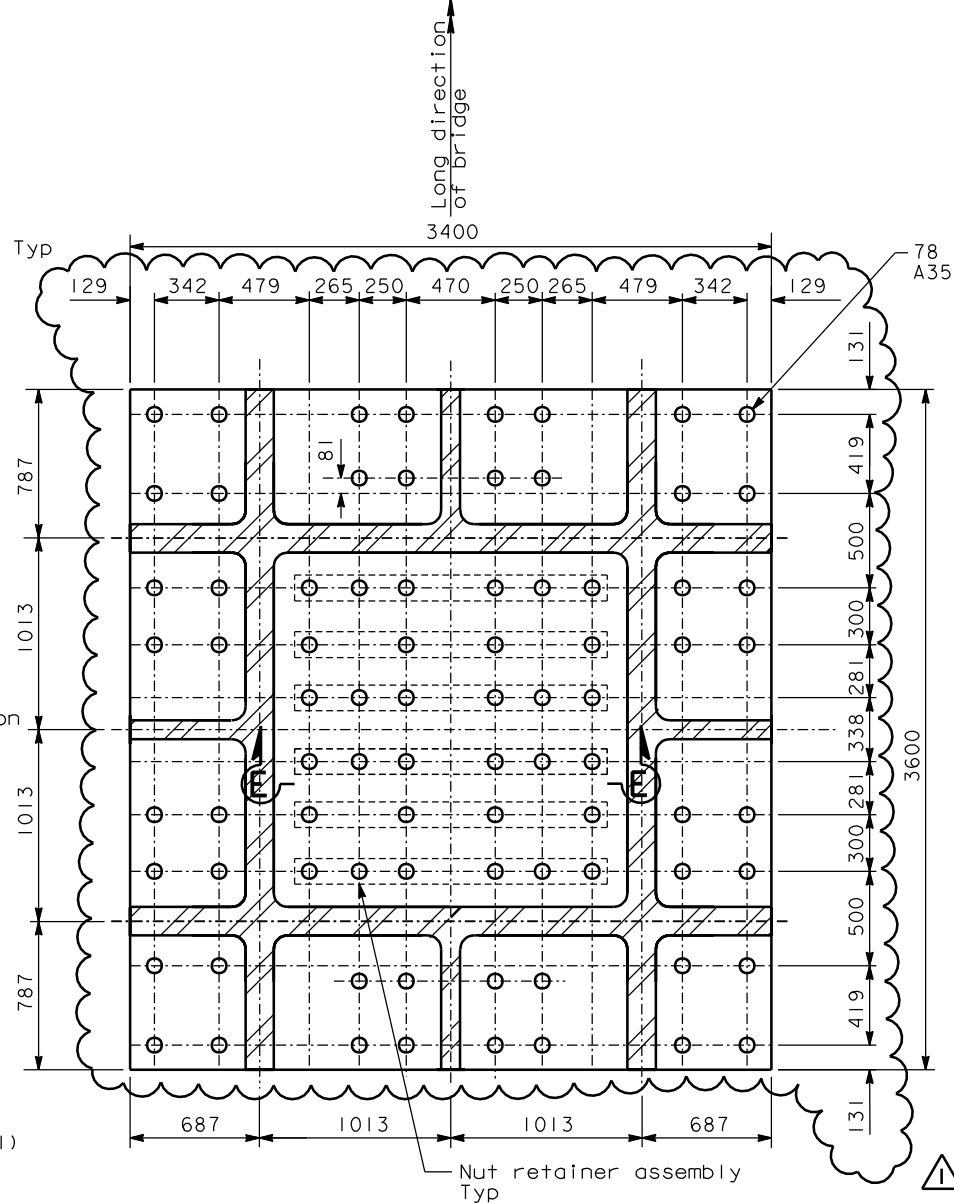
Caltrans now has a web site! To get to the web site, go to: <http://www.dot.ca.gov>



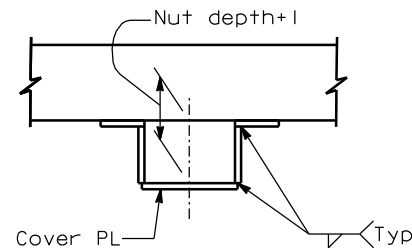
ELEVATION - SHEAR KEY HOUSING
I:20



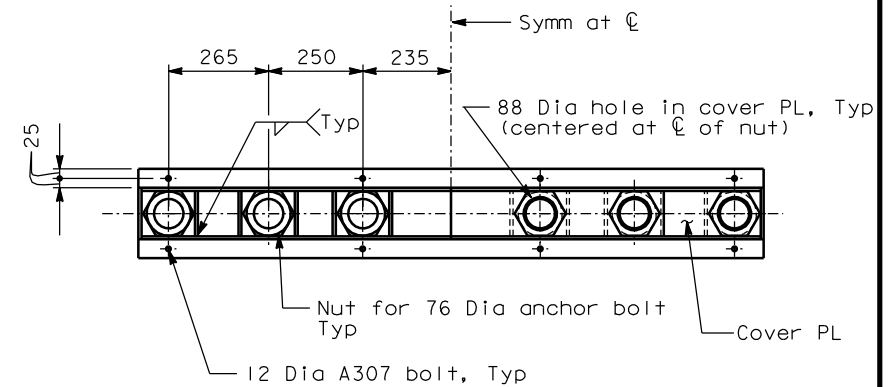
SECTION A-A
I:20



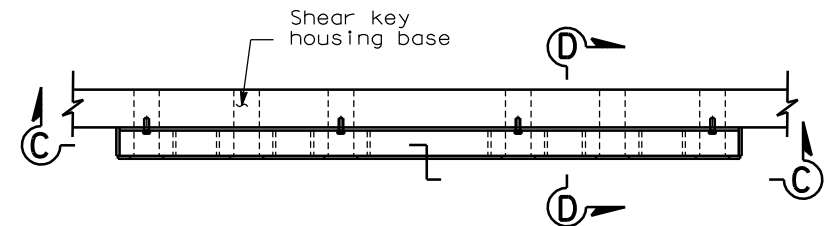
SECTION B-B (For details not shown see Section A-A)
I:20



SECTION D-D
I:5



SECTION C-C
I:10



VIEW E-E
NUT RETAINER ASSEMBLY-ELEVATION
I:10
(All plates 8 mm thick)

NOTES:

- The shear key housing shall be Structural Casting Grade 345.
- The shear key housing bolt layout shall accommodate the girder and crossbeam plate stiffener location. For girder details at Pier E2, see "Girder At Pier E2 details" sheet. For crossbeam details at pier E2, see "Crossbeam at Pier E2" sheets.
- Bolt hole location shall be cross checked with the box girder and crossbeam stiffener layout before drilling holes. Bolt edge distance and clearance for tightening shall be verified and submitted for review and approval by the Engineer. A template shall be used to drill bolt holes in shear key housing and girder key plate to ensure hole matching.
- The anchor bolts shall be pretensioned to 70% of ultimate tensile strength.
- Nut retainer assemblies including nuts shall be installed to shear key housing prior to assembling housing to bushing and stub.
- Machined washers at bolt heads shall be used if necessary at stiffener fillets.

REQUESTS FOR INFORMATION NOT ADDRESSED IN THIS CCO REMAIN IN FORCE					
MARK	DATE	DESCRIPTIONS	BY	CH'D	CCO#
REVISIONS					

CONTRACT CHANGE ORDER NO. _____
SHEET _____ OF _____

R. Valizadeh/V. Toan/Y.L./W.L./F.C.
DESIGN OVERSIGHT
R. Valizadeh/V. Toan/Y.L./F.C.
SIGN OFF DATE 09/26/08

Rev. Date: 5-18-98

DESIGN	BY M. Nader	CHECKED J. Denis
DETAILS	BY N. Vo	CHECKED J. Denis
QUANTITIES	BY N. Vo	CHECKED J. Denis

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)

PIER E2 SHEAR KEY DETAILS NO.2

DISREGARD PRINTS BEARING
EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

04/08/02	01/08/02	12/07/02	05/08/03	12/01/05	SHEET 471R1 OF
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ORIGINAL SCALE IN MILLIMETERS
FOR REDUCED PLANS

CU 04
EA 0120F1

FILE => I:\bb\04-012001\sas\contract plans and cco\cco\in progress\cco*71\original 09-26-08\dgn\akrsd01b.dgn

100 % P S & E
DATE PLOTTED => 08 OCT 2008
TIME PLOTTED => 15:40:47
USERNAME => p10m

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,



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 MFSOA (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

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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

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,



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 610	A354 BC	HD Galv	1260		20	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 710	A354 BC	HD Galv	48	T.B.D. by ABF	1	0	In all cases, three (3) samples per heat are required. At the Contractor's option, 3 full size finished items may be furnished.
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		
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 length to 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

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

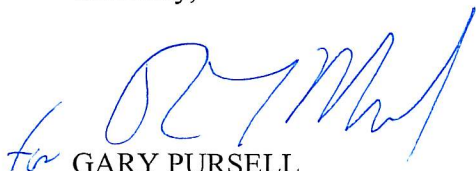
In accordance with Section 4-1.03, "Extra Work," of the Standard Specifications, ABF is directed to perform additional Magnetic Particle Testing (MT) in accordance with ASTM specification A490, on cable bracket anchor rods, main cable anchor rods and other ASTM 354, Grade BD anchor rods and bolts to 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-001741R00Submitted By: Smith, KevinPages: 2Pages Attached: 0RFI Date: 24-April-2009Contact Name: Smith, KevinPhone No. (412) 631-1000**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: 2Pages Attached: 0

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 Pages Attached: 0
Phone No. 510-808-4600

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 $0.45 \cdot F_u$, however to achieve this final tension the Tower Saddle Turned Rods will be temporarily tensioned in excess of $0.5 \cdot F_u$. ABF understands the intent of CCO 91 is to test ASTM A354 Grade BD Rods having a required final tension in excess of $0.5 \cdot F_u$, 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:** 2**Pages Attached:** 0

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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REQUEST FOR INFORMATION (RFI)

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

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.

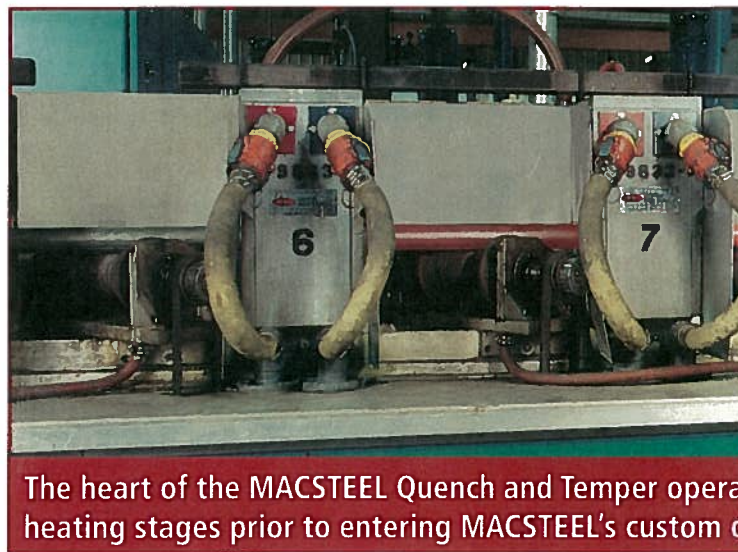
Quench and Temper production line #3.



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: heating stages prior to entering MACSTEEL's custom quench tanks.

THE REAL ADVANTAGE OF FROM INDIVIDUAL HEAT TREATING

■ 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

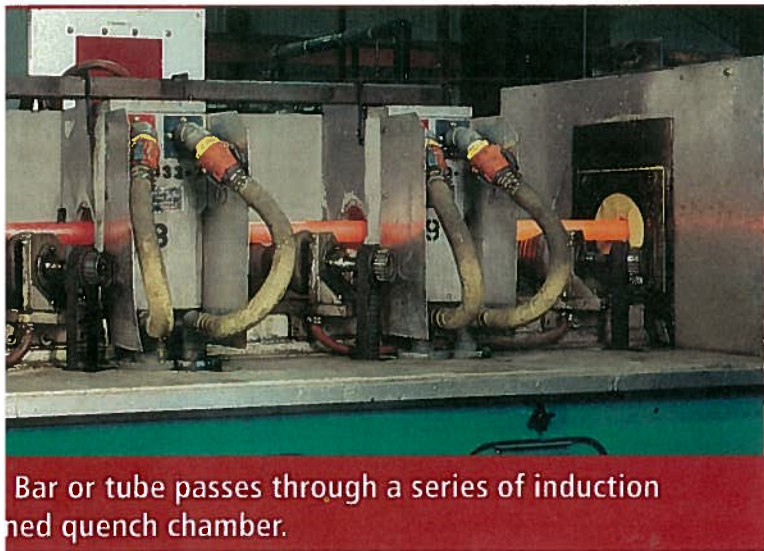
Rotation of individual bars or tubes through the spray quench leads to superior straightness.

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.



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.

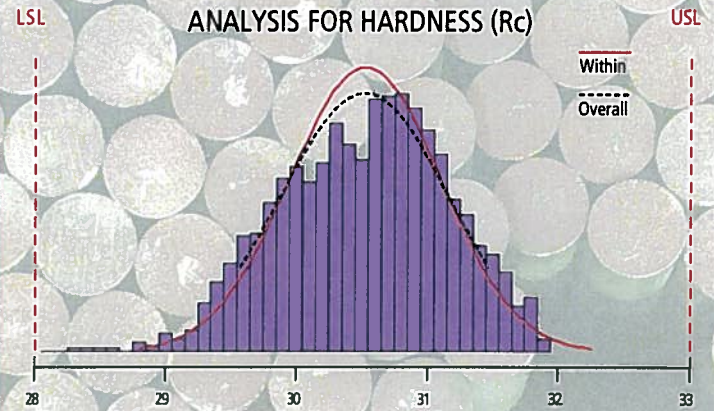
■ VALUE-ADDED SERVICES

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

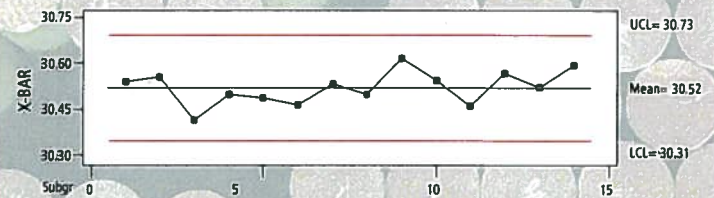
MACSTEEL Heat Treating Division PROCESS CAPABILITY

(Grade 4145, 1.062" diameter)

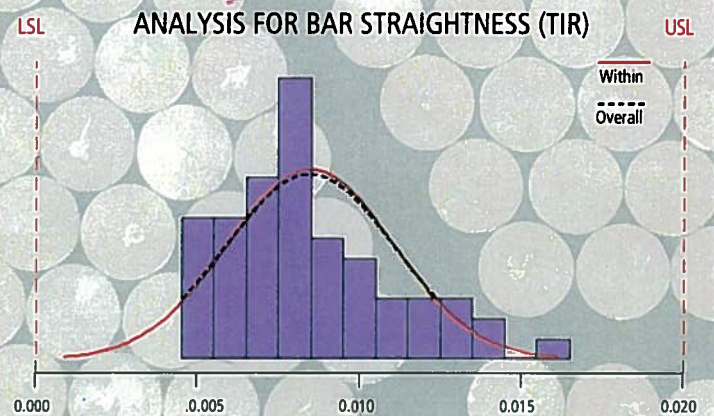
ANALYSIS FOR HARDNESS (Rc)



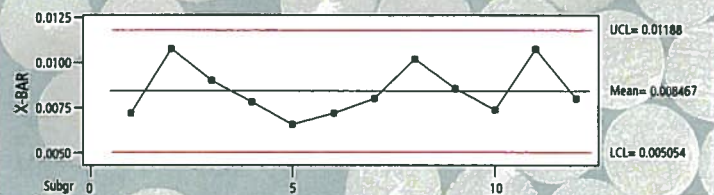
Process Data		Potential (Within) Capability	
USL	33.0000	Cp	2.88
Target	*	CPU	2.86
LSL	28.0000	CPL	2.91
Mean	30.5201	Cpk	2.86
Sample N	1357		
StDev (Within)	0.578314		
StDev (Overall)	0.635911		

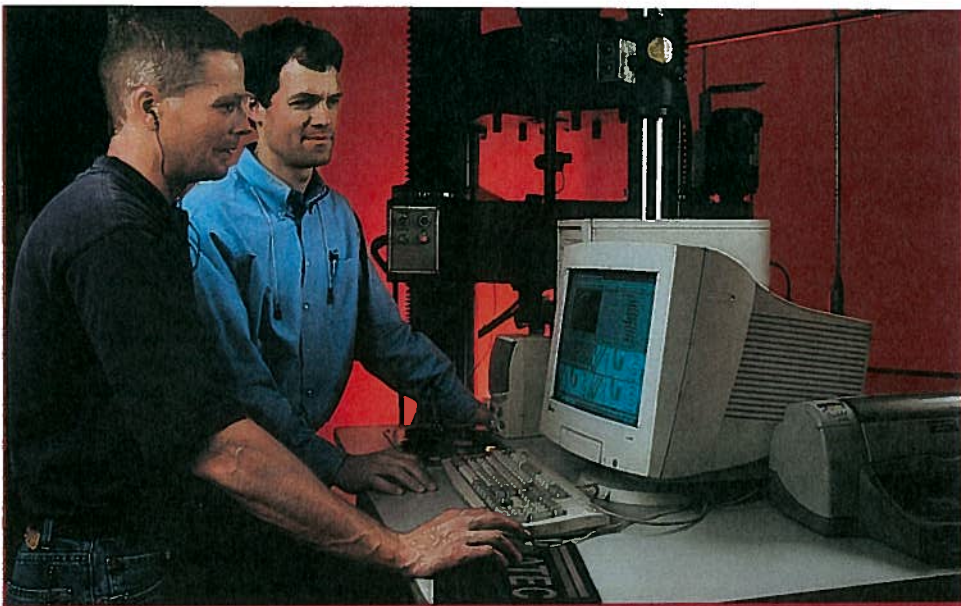


ANALYSIS FOR BAR STRAIGHTNESS (TIR)

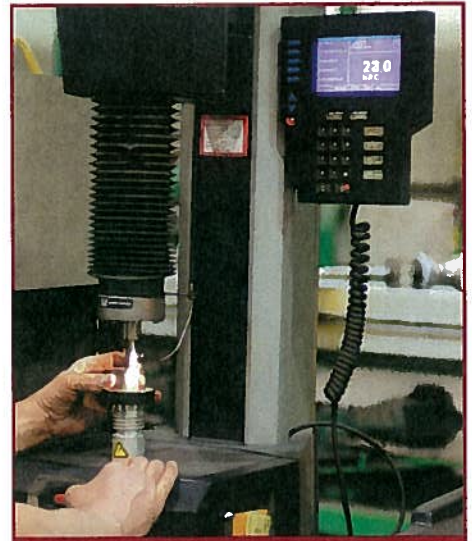


Process Data		Potential (Within) Capability	
USL	0.0200000	Cp	2.62
Target	*	CPU	3.02
LSL	0.0000000	CPL	2.22
Mean	0.0084667	Cpk	2.22
Sample N	60		
StDev (Within)	0.0025437		
StDev (Overall)	0.0026113		





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.

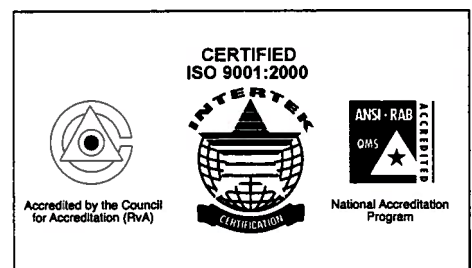
ASK FOR THE MACSTEEL EXPERTS

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

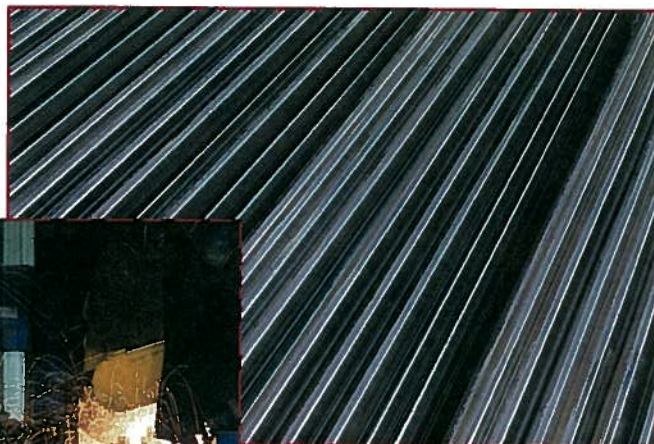
- BAR—0.125" per 5 ft.
- TUBE—0.030" per 3 ft.

CUTTING

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

OTHER VALUE-ADDED SERVICES

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



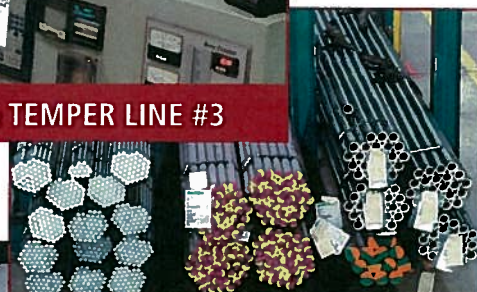
CONSISTENT QUALITY



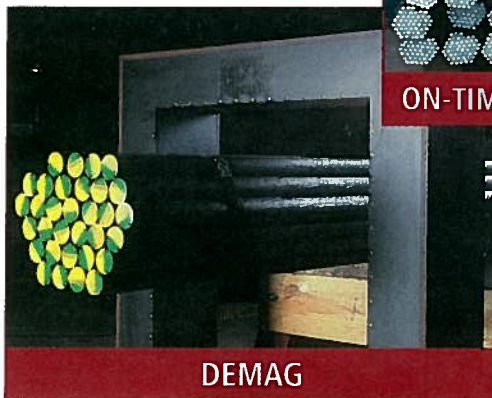
CUSTOM CUTTING



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

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www.gerdaumacsteel.com

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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

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!*

June 24, 2009

Contract No. 04-0120F4
04-SF-80-13.2 / 13.9
Self-Anchored Suspension Bridge
Letter No. 05.03.01-005551

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

Dear Michael Flowers,

Submittal 692, Rev. 6 - Pier E2 Bearing Shop Drawings

The Department has completed review of Submittal ABF-SUB-000692R06, "Pier E2 Bearing Shop Drawings," dated September 14, 2009. The submittal is "Approved."

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

Sincerely,

<<< ORIGINAL SIGNED >>>

GARY PURSELL
Resident Engineer

Attachment

cc: Rick Morrow
Brian Boal
Gary Lai
Nina Choy
file: 05.03.01, 55.0692

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

LETTER OF SUBMITTAL
SAS Superstructure Project

Run Date 14-Sep-09
Time 10:58 AM

Dated: 14-Sep-2009

SUBMITTAL No: ABF-SUB-000692 Rev: 6

To: Gary Pursell

Co/Job # 660110

California Department of Transportation

Contract # 04-0120F4

333 Burma Road

Sub/Supplier: HMI

Oakland

CA

94607

Sub/Supplier No: HMI-SFOBB-WD-001R6

Phone: (510) 622-5100 Fax: (510) 622-5165

Subject: Pier E2 Bearing Shop Drawings

Special Provis. (SP) REF: 10-1.47

Standard Spec. (SS) REF:

Schedule ID:

RESUBMITTAL/SUPPLEMENTAL REF:

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	14-Sep-09	6	Pier E2 Bearing Working Drawing HMI SFOBB WD 001		6			Pending	4
02	25-Aug-09	6	Bearing hold down for E2 Bearing	HMI-04-06-000005	5	E2B-884-10	4	Pending	
03	17-Jul-09	6	Bearing Top Housing for E2 Bearing	HMI-04-06-000011	4	E2B-885-10-1	2	Pending	
04	17-Jul-09	6	Bearing Top Housing for E2 Bearing	HMI-04-06-000012	4	E2B-885-10-2	2	Pending	

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 : 28-Sep-2009

Submitted By: Sabrina Levine

Project Manager

Checked & Sent By:

<<< Original Signed >>>

Document Control

Rev.	Revision note	Date	Checked
1	Revised	2008.6.20	K C Shin
2	Hole, Facing and bolt hole dist. was changed	2009.7.17	K C Shin

**BIGGS CARDOSA
ASSOCIATES INC**
STRUCTURAL ENGINEERS

865 The Alameda
San Jose, CA 95126-3133

Stamped and signed working drawings certify that these drawings have been reviewed and are in general conformance with the Contract Documents under the profession's normal "Standard of Care" for shop drawing review.



Top side

4 Bearing

Surface shall be machined to a flatness not more than $+0.0015$ times the length over which the deviations are measured.

LEGEND:

 Level 1 testing shall be required for areas within 30mm of the final surface for the zone indicated

1 VIEW "B"-"B"

I.D.No
Ref dwg no.:SFOBB-E2B-883-11

☒ 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 INDICATE APPROVAL PURSUANT TO SECTION
5-1.02 OF AN ASSEMBLY OF WHICH THE ITEM IS A COMPONENT

REVIEWED BY hman z No DATE 09/23/09

DETAIL "E"
(Scale 1/12.5)


Q'TY 2sets

01	Bearing top housing	1200×2900×3500	A14M 550-34.5	1	24,063	
No	Part name	Dimension	Mat'l	Q'ty	Weight	Remark
Tolerances except as noted ISO 13920 CLASS A, E ISO 2768-1-m		Surface roughness Ra/μm	Welding except as noted EN 287-1/2 EN 288-1/2/3/4			
Designed by K C SHIN	Checked by C I PARK	Approved by H K KIM	Date 2008 3 17	Scale 1 / 25		

es	SAN FRANCISCO OAKLAND BAY BRIDGE, EAST SPAN SELF-ANCHORED SUSPENSION BRIDGE ROUTE 80, DISTRICT 04, SF COUNTY, CA BRIDGE NOS. 34-0006L KP13 2 & 34-0006R, KP 13 9 STATE OF CALIFORNIA DEPT. OF TRANSPORTATION CONTRACT NO 04-0120F4 ENGINEER: CALTRANS, T.Y. LIN/MOFFATT & NICHOL, JV CONTRACTOR: AMERICAN BRIDGE/FLUOR ENTERPRISES, JV
----	---

70	Drawing Name	Bearing top housing for E2 BEARING
ed		

 HOCHANG MACHINERY INDUSTRIES CO., LTD	Drawing No SFOBB-E2B-885-10		Revision 
	Projection 	Sheet of total sheets 1 of 2	

"E" Line for (B4) 
"W" Line for (B3)

I.D.No.
Ref dwg no SFOBB-E2B-883-11

2900

"B"

Ri

"¢"

VIEW "A"- "A"
(Looking up)

NOTE:

1 This housing is for "E"-South(B4) & "W"-South(B3) bearing

△ 2 $\phi 70$ holes to be machined together Template (by others item)

△ Ref Dwq 885/1204

56- ϕ 70 Holes
56- ϕ 160 Facing $\triangle 2$

DETAIL "C"
(Scale: 1/12.5)

DETAIL "D"
(Scale 1/125)

DETAIL "B"
(Scale 1/12 5)

1 Casting tolerances

Tolerance for linear dimensions(mm) unaffected by machined surfaces										
Linear Dimension, L	L < 60	60 ≤ L < 120	120 ≤ L < 250	250 ≤ L < 400	400 ≤ L < 630	630 ≤ L < 1000	1000 ≤ L < 1600	1600 ≤ L < 2500	2500 ≤ L < 4000	4000 ≤ L
	Tolerance	4.5	5.5	7.0	9.0	11.0	13.0	16.0	19.0	31.0

Tolerance for thickness of ribs(mm) where both faces are not machined										
Thickness range	t < 16	16 ≤ t < 30	30 ≤ t < 50	50 ≤ t < 80	80 ≤ t < 120	120 ≤ t < 180	180 ≤ t < 250	250 ≤ t < 315	315 ≤ t < 400	400 ≤ t
Tolerance	+6.0 -3.0	+9.0 -3.0	+10.0 -3.0	+11.0 -3.0	+12.0 -3.0	+13.0 -3.0	+15.0 -3.0	+19.0 -3.0	+27.0 -3.0	+35.0 -3.0

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!*

September 28, 2009

Contract No. 04-0120F4
04-SF-80-13.2 / 13.9
Self-Anchored Suspension Bridge
Letter No. 05.03.01-005580

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

Dear Michael Flowers,

Submittal 693, Rev. 6 - Pier E2 Shear Key Shop Drawings

The Department has completed review of Submittal ABF-SUB-000693R06, "Pier E2 Shear Key Shop Drawings," dated September 24, 2009. The submittal is "Approved."

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

Sincerely,

<<< ORIGINAL SIGNED >>>

GARY PURSELL
Resident Engineer

Attachment

cc: Rick Morrow
Brian Boal
Gary Lai
Nina Choy
file: 05.03.01, 55.0693

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

LETTER OF SUBMITTAL
SAS Superstructure Project

Run Date 24-Sep-09
Time 8:35 AM

Dated: 24-Sep-2009

SUBMITTAL No: ABF-SUB-000693 Rev: 6

To: Gary Pursell

Co/Job # 660110

California Department of Transportation

Contract # 04-0120F4

333 Burma Road

Sub/Supplier: HMI

Oakland CA 94607

Sub/Supplier No: HMI-SFOBB-WD-002R06

Phone: (510) 622-5100 Fax: (510) 622-5165

Subject: Pier E2 Shear Key Shop Drawings

Special Provis. (SP) REF: 10-1.47

Standard Spec. (SS) REF:

Schedule ID:

RESUBMITTAL/SUPPLEMENTAL REF:

We are sending the following attached items:

☒ Attached

☐ Via Fax

☒ Plans/Dwgs

☐ Design Report

☐ Samples

☐ Certificates of Compliance

☐ Calculations

☐ Payroll

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☐ Copy of Letter

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☐ Schedule

☐ Invoice

☐ Other

Item	Date	Copies	Description	Drawing No	Rev	Subcon Dwg No	Rev	Status	Pages
01	24-Sep-09	6	Pier E2 Shear Key Shop Drawings HMI-SFOBB-WD-002		6			Pending	2
02	24-Sep-09	6	HMI Pier E2 Shear Key - Plan History		6			Pending	2
03	24-Sep-09	6	HMI Pier E2 Shear Key - Drawing List		6			Pending	1
04	09-Apr-09	6	Assembly for Shear Key	HMI-04-06-000015	6	SK-887-10-1	4	Pending	
05	10-Jan-09	6	Assembly for Shear Key	HMI-04-06-000016	6	SK-887-10-2	3	Pending	

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 : 08-Oct-2009

Submitted By: Sabrina Levine

Project Manager

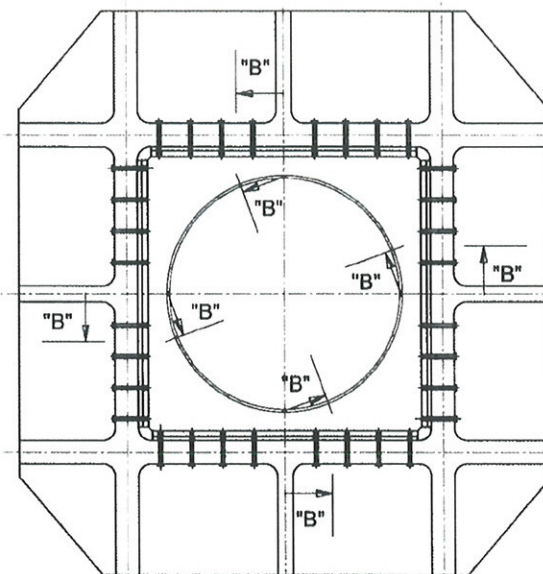
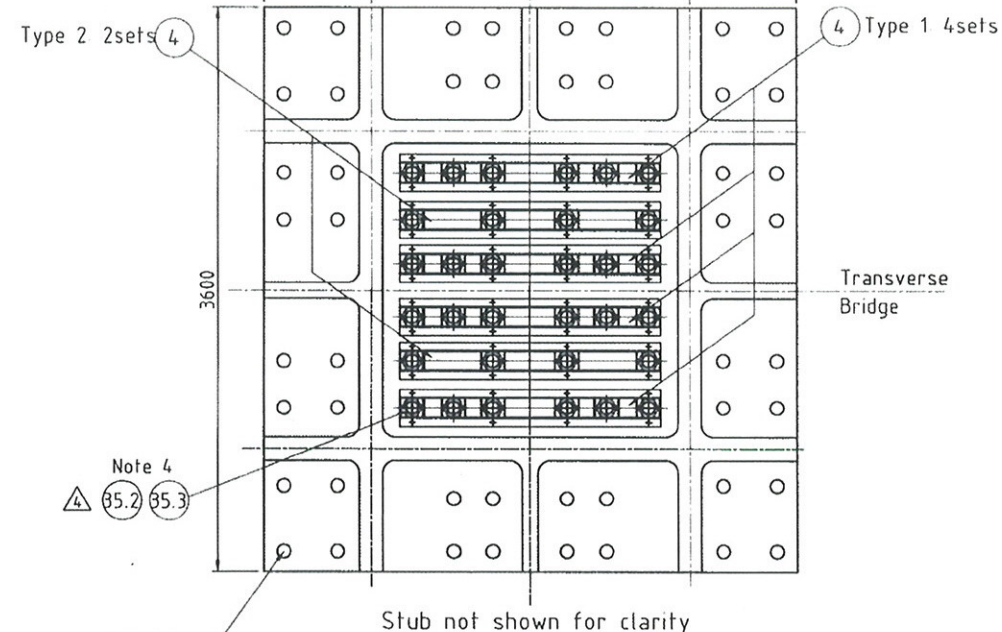
Checked & Sent By: <<< Original Signed >>>

Document Control

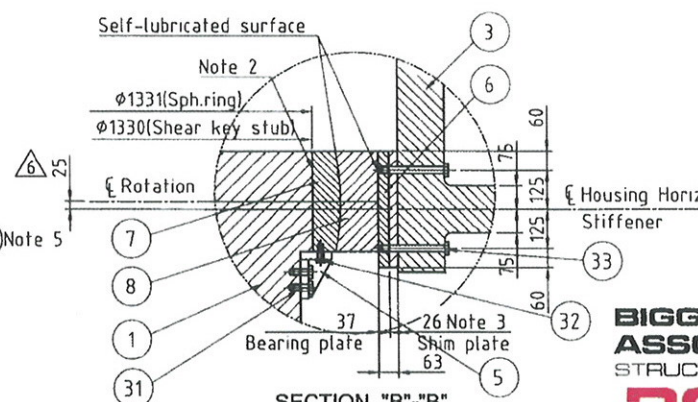
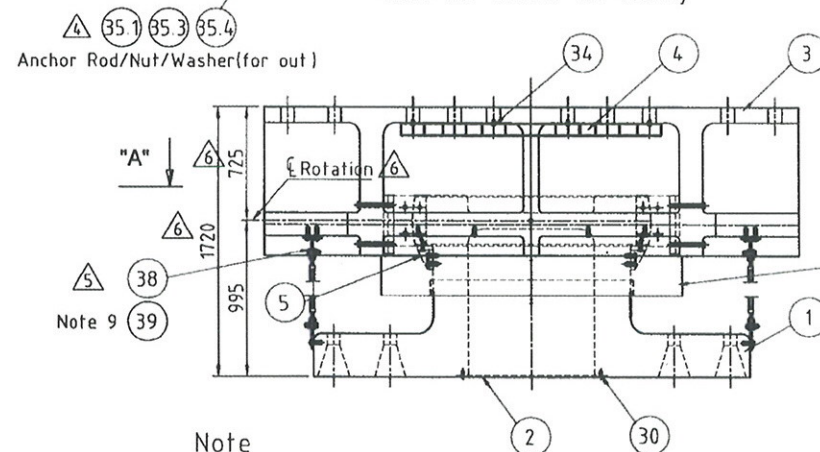
APPROVED
APPROVED AS NOTED
RETURNED FOR CORRECTION
T-Y-LIN INTERNATIONAL AND MOFFATT & NICHOL, a JV
THE EAST SPAN BRIDGE DESIGN TEAM
APPROVAL PURSUANT TO SECTION 5-1.02 OF THE
STANDARD SPECIFICATIONS OF THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION, OF A SPECIFIC ITEM,
SHALL NOT INDICATE APPROVAL PURSUANT TO SECTION
5-1.02 OF AN ASSEMBLY OF WHICH THE ITEM IS A COMPONENT.
REVIEWED BY
DATE 09/28/09

5	- Item 38, 39 and Note 9 were added (1 of 2) - Item 39, 40 and Note 9 were added (2 of 2)	2009 8 25	K.C. Shin
6	Height was changed (1, 2 of 2)	2009 9 23	K.C. Shin

Rev.	Revision note	Date	Checked
1	Revised	2008 6 20	K.C. Shin
2	Weight is revised and Note 6 was added	2008 10 27	K.C. Shin
3	- Letter was changed from on Note 6 - Two revision marker was reflected on item 6 and 9 (sheet 2 of 2) - Note 3 was moved on SECTION "C"-"C" (sheet 2 of 2)	2009 01 10	K.C. Shin
4	- Item 34 Q'ty was changed - Item 35 1(1 of 2), 36 1(2 of 2) was revised - Item 35 2, 35 3 and 35 4 was added (1 of 2) - Item 36 2, 36 3 and 36 4 was added (2 of 2) - Note 7 was added	2009 4 9	K.C. Shin



VIEW "A"-"A"



SECTION "B"-"B"
(scale: 1/22.5)

BIGGS CARDOSA ASSOCIATES INC
STRUCTURAL ENGINEERS
BCA
865 The Alameda
San Jose, CA 95126-3133

Stamped and signed working drawings certify that these drawings have been reviewed and are in general conformance with the Contract Documents under the profession's normal "Standard of Care" for shop drawing review.

Ref Dwg: 887,888B/1204



Q'TY 2sets					
39	Hex bolt	3/4"UNC x50L, A307	48		
38	Turnbuckle(jaw&jaw)	3/4"UNC x6	16		WLL:2.36Mton "temporary"
37	Hex.nut	1/4"UNC, A240 Type 316	12		for dust cover
36	Hex bolt	1/4"UNCx15, A240 Type 316	48		for dust cover
35.4	Plain Washer	3"UNC, F436	48		
35.3	Heavy Hex nut	3"UNC, A563 DH	160		
35.2	Anchor Rod(for in.)	3"UNC x537, A354 BD	32		
35.1	Anchor Rod(for out.)	3"UNC x1337, A354 BD	48		
34	Hex bolt	1/2"UNC x 25, A307	48		
33	Hex bolt	M22 x 200, HS bolt	64		
32	Hex.bolt	M16 x 50, HS bolt	36		
31	Hex bolt	M22 x 50, HS bolt	72		
30	Counter sunk bolt	1/2"UNC x 25, A240 Type 316	8		
21	Template	For Housing hole drilling			by others
20	Dust cover	DWG SFOBB-SK-887-22	2	66	
08	Spherical housing	DWG 3207034	1	1,647	Lubrite
07	Spherical ring ass'y	DWG SFOBB-SK-888-20	1	940	
06	Bearing plate ass'y 1	DWG SFOBB-SK-888-13	4	1,185	
05	Retainer bk't	DWG SFOBB-SK-888-12	12	136	
04	Nut retainer bk't	DWG: SFOBB-SK-888-11	6	390	
03	Housing	DWG SFOBB-SK-888-10	1	31,760	
02	Cover plate	DWG SFOBB-SK-887-21	1	57	
01	Stub	DWG SFOBB-SK-887-20	1	20,640	
No.	Part name	Dimension	Mat'l	Q'ty	Weight Remark

Tolerances except as noted ISO 13920 CLASS A, E ISO 2768-1-m		Surface roughness Ra/μm	Welding except as noted EN 287-1/2 EN 288-1/2/3/4	
Designed by K.C. SHIN	Checked by C.I. PARK	Approved by H.K. KIM	Date 2008 3 24	Scale 1/45
SAN FRANCISCO OAKLAND BAY BRIDGE, EAST SPAN SELF-ANCHORED SUSPENSION BRIDGE ROUTE 80, DISTRICT 04, SF COUNTY, CA. BRIDGE NOS. 34-0006L KP13.2 & 34-0006R, KP 13.9 STATE OF CALIFORNIA DEPT OF TRANSPORTATION CONTRACT NO 04-0120F4 ENGINEER: CALTRANS, T Y LIN/MOFFATT & NICHOL, JV. CONTRACTOR: AMERICAN BRIDGE/FLUOR ENTERPRISES, JV.				

Drawing Name Assembly for Shear key		Drawing No SFOBB-SK-887-10	Revision 6
HOCHANG MACHINERY INDUSTRIES CO., LTD		Projection 1st	Sheet of total sheets 1 of 2

CERTIFIED MATERIAL TEST REPORT

CODE NCJ

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
6015		M32854	228544 101	7/13/09

REPORT TO

QUALITY ASSURANCE
THE DYSON CORPORATION

53 FREEDOM RD.

PAINESVILLE, OH 44077

SHIP TO

JOS. DYSON & SONS INC.

53 FREEDOM RD.

PAINESVILLE, OH 44077

ORDERED

GRADE	SIZE	LENGTH
4140	3. "	22' 7 3/4"

CUSTOMER SPECIFICATIONS

ASTM A354-07 GRADE BD; Q&T; (AIM FOR 35-37 ROCKWELL C)

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.43	0.88	0.014	0.033	0.26	0.15	0.93	0.17	0.20	0.009	0.020
V	Ca	Nb								
0.010	0.0006	0.003								

RAIN SIZE

SPECIFICATION ASTM E112

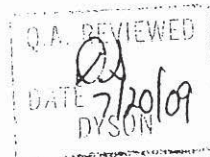
FINE GRAIN 5-8

ARDNESS

SPECIFICATION ASTM E10

AFTER HT TREAT

SURFACE HARDNESS (HRC)

BATCH 1 - 36 (100 bars)
BATCH 2 - 32 (119 bars)
BATCH 3 - 35 (40 bars)
BATCH 4 - 37 (10 bars)


PAGE 1

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

Gerda MacSteel Monroe
300 East Front Street
Monroe, MI 48161


Chris Easter
Quality Assurance Representative

CONTINUED ON PAGE 2

CERTIFIED MATERIAL TEST REPORT
CODE NCJ

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
6015		M32854	228544 101	7/13/09

REPORT TO
QUALITY ASSURANCE
THE DYSON CORPORATION

53 FREEDOM RD.

PAINESVILLE , OH 44077

SHIP TO

JOS. DYSON & SONS INC.

53 FREEDOM RD.

PAINESVILLE , OH 44077

ORDERED

GRADE	SIZE	LENGTH
4140	3. "	22' 7 3/4"

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; (AIM FOR 35-37 ROCKWELL C)

HARDENABILITY SPECIFICATION ASTM A255/A304

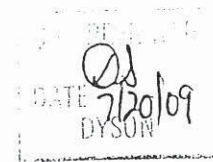
THEORETICAL	J1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34
	58	58	58	58	58	58	58	56	55	53		51		49		47	46	46		44		41		39	

PHYSICALS SPECIFICATION ASTM E8/A370 AFTER HT TREAT
2.0 IN

TENSILE (KSI)	YIELD (KSI)	% ELONGATION	REDUCTION OF AREA
	Tensile (KSI)	YIELD	ELONGATION
BATCH 1 -	157.8	136.1	16
BATCH 2 -	155.6	133.1	17
BATCH 3 -	158.2	137.7	14
BATCH 4 -	153.0	133.0	14.8
			ROA
			47 (100 bars)
			53 (119 bars)
			40 (40 bars)
			44 (10 bars)

REDUCTION RATIO

RATIO= 4.9 TO 1.0




SURFACE INSPECT TO ASTM F788/F788M-02

** 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

PAGE 2

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

Gerda MacSteel Monroe
3000 East Front Street
Monroe, MI 48161


Chris Easter
Quality Assurance Representative

CONTINUED ON PAGE 3

CERTIFIED MATERIAL TEST REPORT
CODE NCJ

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
6015		M32854	228544 101	7/13/09

REPORT TO

QUALITY ASSURANCE
THE DYSON CORPORATION

53 FREEDOM RD.

PAINESVILLE , OH 44077

SHIP TO

JOS. DYSON & SONS INC.

53 FREEDOM RD.

PAINESVILLE , OH 44077

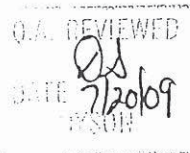
ORDERED

GRADE	SIZE	LENGTH
4140	3 . "	22 ' 7 3/4 "

CUSTOMER SPECIFICATIONS

ASTM A354-07 GRADE BD; Q&T; (AIM FOR 35-37 ROCKWELL C)

TO MERCURY OR TO ANY OTHER METAL ALLOY THAT IS LIQUID AT AMBIENT
TEMPERATURES DURING PROCESSING OR WHILE IN OUR POSSESSION. **



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

CERTIFIED MATERIAL TEST REPORT
CODE NCJ 2

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
56015		M32854	228544 101	7/13/09

REPORT TO
QUALITY ASSURANCE
THE DYSON CORPORATION

53 FREEDOM RD.

PAINESVILLE , OH 44077

SHIP TO

JOS. DYSON & SONS INC.

53 FREEDOM RD.

PAINESVILLE , OH 44077

ORDERED

GRADE	SIZE	LENGTH
4140	3. "	22' 7 3/4"

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; (AIM FOR 35-37 ROCKWELL C)

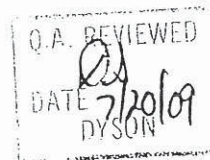
CHEMICAL ANALYSIS

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.43	0.88	0.014	0.033	0.26	0.15	0.93	0.17	0.20	0.009	0.020
V	Ca	Nb								
0.010	0.0006	0.003								

GRAIN SIZE SPECIFICATION ASTM E112 FINE GRAIN 5-8

HARDNESS SPECIFICATION ASTM E10 AFTER HT TREAT

SURFACE HARDNESS (HRC)
BATCH 1 - 36 (100 bars)
BATCH 2 - 32 (119 bars)
BATCH 3 - 35 (40 bars)
BATCH 4 - 37 (10 bars)



CERTIFIED MATERIAL TEST REPORT
CODE NCJ2

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
66015		M32854	228544 101	7/13/09

SHIP TO

REPORT TO
QUALITY ASSURANCE
THE DYSON CORPORATION

JOS. DYSON & SONS INC.

53 FREEDOM RD.

53 FREEDOM RD.

PAINESVILLE, OH 44077

PAINESVILLE, OH 44077

ORDERED

GRADE	SIZE	LENGTH
4140	3. "	22' 7 3/4"

CUSTOMER SPECIFICATIONS

ASTM A354-07 GRADE BD; Q&T; (AIM FOR 35-37 ROCKWELL C)

HARDENABILITY

SPECIFICATION ASTM A255/A304

THEORETICAL

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
58	58	58	58	58	58	58	56	55	53		51		49		47	46	46		44		41		39	

PHYSICALS

SPECIFICATION ASTM E8/A370

AFTER HT TREAT

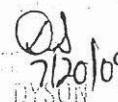
2.0 IN

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

	Tensile(KSI)	YIELD	ELONGATION	ROA
BATCH 1 -	157.8	136.1	16	47 (100 bars)
BATCH 2 -	155.6	133.1	17	53 (119 bars)
BATCH 3 -	158.2	137.7	14	40 (40 bars)
BATCH 4 -	153.0	133.0	14.8	44 (10 bars)

REDUCTION RATIO

RATIO= 4.9 TO 1.0


7/20/09
DYSON


SURFACE INSPECT TO ASTM F788/F788M-02

** 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

PAGE 2

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

Gerda MacSteel Monroe
3000 East Front Street
Monroe, MI 48161


Chris Easter
Quality Assurance Representative

CONTINUED ON PAGE 3



GERDAU MACSTEEL

5591 MORRILL ROAD
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CODE NCJ2

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
66015		M32854	228544 101	7/13/09

REPORT TO

SHIP TO

QUALITY ASSURANCE
THE DYSON CORPORATION

JOS. DYSON & SONS INC.

53 FREEDOM RD.

53 FREEDOM RD.

PAINESVILLE , OH 44077

PAINESVILLE , OH 44077

ORDERED

GRADE	SIZE	LENGTH
4140	3. "	22' 7 3/4"

CUSTOMER SPECIFICATIONS

ASTM A354-07 GRADE BD; Q&T; (AIM FOR 35-37 ROCKWELL C)

TO MERCURY OR TO ANY OTHER METAL ALLOY THAT IS LIQUID AT AMBIENT
TEMPERATURES DURING PROCESSING OR WHILE IN OUR POSSESSION. **



PAGE 3 OF 3

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

Gerda MacSteel Monroe
1000 East Front Street
Monroe, MI 48161

Chris Easter
Quality Assurance Representative

KREHER STEEL COMPANY, LLC.

PO/Rel

I hereby certify that this data is correct as
contained in the records of this company.
I hereby certify that no mercury came in contact

Certificate of Mill Test Results

1 - 000000-000

Pg 1/2

with or no weld repair was done to this product
while in our possession.
Attn:

ART NO.

CODE NSH



GERDAU MACSTEEL

ONE JACKSON SQUARE
SUITE 500
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
17123	4811	M30263	221035 101	7/21/08

SHIP TO

REPORT TO

ERIN
KREHER STEEL

1550 N. 25TH AVE

MELROSE PARK, IL 60160

KREHER-STEEL

1550 N. 25TH AVE.

MELROSE PARK, IL 60160

GRADE	SIZE	ORDERED	LENGTH
4140	2"	RND	24' 3"
CUSTOMER SPECIFICATIONS			
ASTM A29/A29M-05 / A322-07 / E381-01			

CHEMICAL ANALYSIS

C /	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.41	0.86	0.019	0.026	0.25	0.09	0.93	0.20	0.23	0.008	0.024
V	Nb									
0.007	0.003									

GRAIN SIZE

SPECIFICATION ASTM E112

FINE GRAIN 5-8

HARDENABILITY

SPECIFICATION ASTM A255/A304

THEORETICAL																											
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	57	57	57	57	57	57	55	54	53		50		48		46	46	45		43		41			38			

MACROCLEANLINESS

SPECIFICATION ASTM E381

PLATE I

PLATE II

AVERAGE	S	R	C
	1	1	1

NONE

T+Pto-1.852^H

PAGE 1

Gerda MacSteel Monroe
1800 E. 25th St.
Monroe, LA 70646

CONTINUED ON PAGE 2

KREHER STEEL COMPANY, LLC.

Certificate of Mill Test Results

1 -000000-000

PO/Re

I hereby certify that this data is correct as
contained in the records of this company.
I hereby certify that no mercury came in contact

with or no weld repair was done to this product
while in our possession.

Pg 2/2

PART NO.

CODE NSH



ONE JACKSON SQUARE
SUITE 500
JACKSON, MICHIGAN 49201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
17123	4811	M30263	221035 101	7/21/08

REPORT TO

ERIN
KREHER STEEL

1550 N. 25TH AVE

MELROSE PARK, IL 60160

SHIP TO

KREHER STEEL

1550 N. 25TH AVE.

MELROSE PARK, IL 60160

ORDERED

GRADE	SIZE	LENGTH
4140	2" RND	24' 3"

CUSTOMER SPECIFICATIONS

ASTM A29/A29M-05; A322-07; E381-01

REDUCTION RATIO

RATIO= 11.5 TO 1.0

** 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. **



T+P to 1.852"Ø

PAGE 2 OF 2

These data are correct and compliance with applicable requirements.

Chris Easter

KREHER STEEL COMPANY, LLC.

PO/Rel

I hereby certify that this data is correct as
contained in the records of this company.
I hereby certify that no mercury came in contact

Certificate of Mill Test Results

1-000000-000

Pg 1/2

ART NO.

CODE NSH 2



ONE JACKSON SQUARE
SUITE 500
JACKSON, MICHIGAN 48201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
17123	4811	M30263	221035 101	7/21/08

SHIP TO

REPORT TO

ERIN
KREHER STEEL

KREHER STEEL

1550 N. 25TH AVE

1550 N. 25TH AVE.

MELROSE PARK, IL 60160

MELROSE PARK, IL 60160

ORDERED

GRADE	SIZE	LENGTH
4140 /	2" RND	24' 3"
CUSTOMER SPECIFICATIONS		
ASTM A29/A29M-05; A322-07; E381-01		

CHEMICAL ANALYSIS

C /	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.41	0.86	0.019	0.026	0.25	0.09	0.93	0.20	0.23	0.008	0.024
V	Nb									
0.007	0.003									

GRAIN SIZE

SPECIFICATION ASTM E112

FINE GRAIN 5-8

HARDENABILITY

SPECIFICATION ASTM A255/A304

THEORETICAL	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	57	57	57	57	57	57	57	55	54	53		50	48	46	46	45		43		41		38			

MACROCLEANLINESS

SPECIFICATION ASTM E381

PLATE I

PLATE II

AVERAGE	S	R	C
	1	1	1

NONE



T+Pto 1.852"0

PAGE 1

GERDAU MACSTEEL
18000 East Front Street
Mishawaka, IN 46545

CONTINUED ON PAGE 2

NSH

KREHER STEEL COMPANY, LLC.

Certificate of Mill Test Results

PO/Re

1 -000000-000

Pg 2/2

RT NO.

I hereby certify that this data is correct as
contained in the records of this company.
I hereby certify that no mercury came in contact

with or no weld repair was done to this product
while in our possession.
Attn:

CODE NSH 2



ONE JACKSON SQUARE
SUITE 500
JACKSON, MICHIGAN 48201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
17123	4811	M30263	221035 101	7/21/08

REPORT TO

SHIP TO

ERIN
KREHER STEEL

KREHER STEEL

1550 N. 25TH AVE

1550 N. 25TH AVE.

MELROSE PARK, IL 60160

MELROSE PARK, IL 60160

ORDERED

GRADE	SIZE	LENGTH
4140	2" RND	24' 3"

CUSTOMER SPECIFICATIONS

ASTM A29/A29M-05; A322-07; E381-01

REDUCTION RATIO

RATIO= 11.5 TO 1.0

** 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. **



T+P to 1.852"Ø

PAGE 2 OF 2

We certify that these data are correct and in compliance with applicable requirements.
Gerdau MacSteel, Monterrey, Mexico
100% Electrically Produced
Gerdau MacSteel, Monterrey, Mexico

Chris Easter
Quality Assurance Supervisor

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:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-001167**Date Inspected:** 11-Nov-2009**Project Name:** SAS Superstructure**OSM Arrival Time:** 800**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1600**Contractor:** Dyson Corp. & Subs**Location:** Dyson Corp, Painesville OH**Quality Control Contact:** Bob Bobnar**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:** Magnetic Particle Testing**Bridge No:** 34-0006**Component:** E2 Shear Key all Threaded Rod**Bid Item:** 61**Lot No:** B206**Summary of Items Observed:**

The QA Inspector arrived at Dyson Corporation in Painesville, OH to perform material releases and to randomly observe the in process magnetic particle testing (MT) of E2 Shear Key 76mm diameter all threaded rods. The following observations were made:

Upon the arrival of the QA Inspector the Dyson Quality Control Manager (QCM) Bob Bobnar informed the QA Inspector of the on going issues with the E2 Shear Key all threaded rods. The QCM informed the QA Inspector the above identified material was previously determined to have unacceptable MT indications located by a level II MT technician at Stork Heron Testing in Cleveland, OH. The QCM informed the QA Inspector the indications were thought to be quench cracks in the base material of the rods and were rejected by the Stork Heron level II technician. Mr. Bobnar went on to inform the QA Inspector, Dyson representatives did not agree the indications were quench cracks, rather they were tooling marks from when the thread were cut into the rods. The QA Inspector was informed destructive testing of the microstructure was performed on one of the rods and the indications were determined to be non-relevant and accepted by the Stork Heron Level II Technician. The QA Inspector, Dyson QCM and Quality Representative Dave Sukenik traveled to Stork Heron Testing to observe the MT.

Stork Heron Testing

Upon the arrival of the above identified persons, the Heron Testing MT Technician Shane Levermann met the QA Inspector and Dyson Representatives and performed the MT of the 3"-4UNC-2A A354 BD rods to re-produce the indications previously located. The QA Inspector randomly observed the MT Technician perform MT with a head shot and coil shot under a black light. Mr. Levermann informed the QA Inspector the suspended bath of particles is

SOURCE INSPECTION REPORT

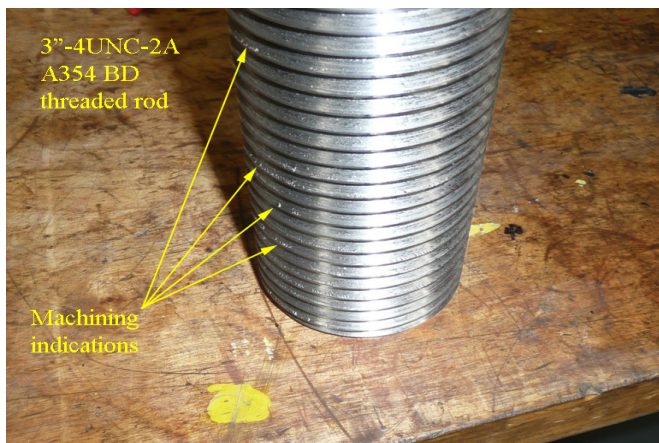
(Continued Page 2 of 3)

tested and calibrated every morning prior to use. The QA Inspector randomly observed the MT and observed the indications under the black light after the head shot and coil shot. The QA Inspector randomly observed the MT technician perform MT on 15 of the rods identified above. It was noted after the original MT and based upon the Heron destructive testing of the microstructure of the parts identified, the results accepting the indications appear to be acceptable.

During the MT it was determined several of the rods were rejected by the Heron Level II technician, the indications were classified as machining tears and rejected for depth by the MT technician (pictured below). Mr. Levermann informed the QA Inspector the indications were rejectable per ASTM-F788M-06 for depth of the tears near the end of the threads. The QA Inspector asked the MT technician how the depth of the tears was being determined and the technician informed the QA Inspector, he used to be a machinist and he just can tell by judging. The QA Inspector did observe the indications under the black light after the head shot and coil shot was completed. The QA Inspector could not accurately determine the depth of the indications. The QA Inspector randomly observed the following rods tested NCJ9 (3), NCJ6 (3), NCJ5 (3), NCJ7 (3), NCJ2 (3), the QA Inspector randomly observed the MT of 15 total threaded rods identified above.

After the MT was completed the QA Inspector and Dyson Representatives returned to Dyson Corporation, the Dyson Representatives asked the QA Inspector what his interpretation of the MT defects identified above appeared to be. The QA Inspector informed the Dyson Representatives, due to a lack of sufficient measuring methods to determine the depth of the indications; the QA Inspector could not accurately determine the relevancy of the defects. The QA Inspector was informed by the Dyson Representatives, they did not feel the MT indications were rejectable. The QA Inspector was asked what they could do other than accept the results of the testing. The QA Inspector suggested Dyson contact the MT Level III technician at Stork Heron Testing for a second opinion of the interpretation of the result of the testing.

The QA Inspector performed Green Tag releases of material to be shipped to Hochang Machinery in Korea and Wire Co in Missouri. The QA Inspector performed material verification of MTR's and dimensional verification of the contract requirements. After the material was determined to be in general compliance with the contract requirements a green tag release was placed on the supporting documentation to be shipped with the material (see TL-6011 for the above identified date).



SOURCE INSPECTION REPORT

(Continued Page 3 of 3)

Summary of Conversations:

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

Inspected By:	Bettencourt,Rick	Quality Assurance Inspector
Reviewed By:	Levell,Bill	QA Reviewer

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 #: 76.15**SOURCE INSPECTION REPORT****Resident Engineer:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-001168**Date Inspected:** 17-Nov-2009**Project Name:** SAS Superstructure**OSM Arrival Time:** 800**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1700**Contractor:** Dyson Corp. & Subs**Location:** Dyson Corp, Painesville OH**Quality Control Contact:** Bob Bobnar**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:** High Strength fasteners/Suspender Sockets**Bid Item:** 45,61**Lot No:** B206**Summary of Items Observed:**

The QA Inspector arrived at Dyson Corporation in Painesville, OH to perform material releases and to randomly observe the in process machining and threading of the Type I suspender sockets, The following observations were made:

Type I Suspender Sockets

The QA Inspector randomly observed the Dyson Machinist identified as Steve Joslin operating the CNC Lathe cutting the threads in the above identified parts. The QA Inspector randomly observed the machinist change tooling dyes on the lathe, one to bore out the center of the socket and the other to perform the actual cutting of the threads. The QA Inspector noted it takes approximately 15 minutes to bore out and thread one suspender socket.

3" Hardened Flat Washer

The QA Inspector was informed by the Quality Control Manager Bob Bobnar, the above identified washers had been shipped back from Arts Galvanizing and did not appear to meet the requirements of ASTM 153. The QA Inspector randomly observed the washers and noted the coating appeared to be clumpy and very uneven (pictured below). The Dyson Sales Manager Pat Sheffield informed the QA Inspector, it appeared to the washers had stuck together and were pulled apart thus creating the clumpy uneven finish. Mr. Bobnar informed the QA Inspector Non Conformance Report identified as 09-15 was written in regards to the galvanized coating. The QA Inspector noted the material is to be shipped back to Arts galvanizing to be stripped and re-galvanized.

3"-4UNC-2A A354BD threaded rod

Previously reported by the QA Inspector on 11/10/09 MT indications were located and rejected by the Stork Heron

SOURCE INSPECTION REPORT

(Continued Page 2 of 2)

Level II MT Technician. Upon the QA Inspectors arrival at Dyson, the QA Inspector was informed that destructive testing was performed on the parts and determined to be acceptable by Stork Heron. The parts were originally rejected by the Level II Technician for depth of machining tears on the threads of the rods. The QA Inspector was present at the time of the previous testing, and could not accurately determine the depth of the indications at the time of the rejections by the Stork Heron Technician. Previously stated above, destructive testing was performed in the form off a cross sectional view of Metallographic examination. Based on the Metallographic examination performed by Stork Heron Testing, the indications appear to be acceptable for depth of the indications.



Summary of Conversations:

As noted 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 , who represents the Office of Structural Materials for your project.

Inspected By:	Bettencourt,Rick
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Quality Assurance Inspector

Reviewed By:	Levell,Bill
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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 #: 76.8**COMPONENT MATERIAL INSPECTION REPORT****Resident Engineer:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** CMI-000130**Date Inspected:** 20-Nov-2009**Contractor:** Dyson Corp. & Subs**OSM Arrival Time:** 800**Location:** Dyson Corp, Painesville OH**OSM Departure Time:** 1700**Bridge No.:** 34-0006**Component:#** High Strength Fasteners

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: Monnig Industries, Glasgow MO

Lot #	Bid Item #	Quantity		Material Description
B206-114-09 61		271	ea	3.00" 4 Hvy Hex Full Nut, A563 Gr DH, Galvanized
B206-114-09 61		290	ea	3.00" 4 Hvy Hex Full Nut, A563 Gr DH, Galvanized
B206-114-09 45		464	ea	2.00" 4-1/2 Hvy Hex Full Nut, A563 Gr DH, Galvanized
B206-114-09 45		174	ea	2.00" 4-1/2 x 1079MM TFL Stud, A354 Gr BD, Galvanized
B206-114-09 61		75	ea	NCJ 3.00" 4 x 1337MM TFL Stud, A354 Gr BD, Galvanized
B206-114-09 61		28	ea	NCJ2 3.00" 4 x 1337MM TFL Stud, A354 Gr BD, Galvanized
B206-114-09 61		13	ea	NCJ4 3.00" 4 x 537MM TFL Stud, A354 Gr BD, Galvanized
B206-114-09 61		26	ea	NCJ5 3.00" 4 x 537MM TFL Stud, A354 Gr BD, Galvanized
B206-114-09 61		2	ea	NCJ6 3.00" 4 x 537MM TFL Stud, A354 Gr BD, Galvanized
B206-114-09 61		102	ea	NCJ7 3.00" 4 x 1312MM TFL Stud, A354 Gr BD, Galvanized
B206-114-09 61		50	ea	NCJ8 3.00" 4 x 512MM TFL Stud, A354 Gr BD, Galvanized
B206-114-09 61		20	ea	NCJ9 3.00" 4 x 512MM TFL Stud, A354 Gr BD, Galvanized

Identification: Green Tag Release was placed on the supporting documentation to be shipped with the material

Summary of Items Observed:

The QA Inspector reviewed the contractors shipping documentation and verified the quantities and material specifications. The QA Inspector randomly observed the material and documentation appeared to be in general compliance with the contract requirements. The QA Inspector placed a green tag release on the bolt documentation Caltrans lot number B206-114-09 was issued for tracking purposes. The QA Inspector noted the material was being released to Monnig Industries in Glasgow, Mo for blasting and galvanizing. The QA Inspector was informed by all of the above identified material will be sent to Monnig so sampling and releasing of the material would be simpler.

COMPONENT MATERIAL INSPECTION REPORT

(Continued Page 2 of 2)



Summary of Conversations:

As noted 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 , who represents the Office of Structural Materials for your project.

Inspected By: Bettencourt, Rick

Quality Assurance Inspector

Reviewed By: Levell, Bill

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 #: 76.15**SOURCE INSPECTION REPORT****Resident Engineer:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-001207**Date Inspected:** 23-Nov-2009**Project Name:** SAS Superstructure**OSM Arrival Time:** 1300**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1500**Contractor:** Dyson Corp. & Subs**Location:** Stork Herron, Cleveland

Quality Control Contact: Bob Bobnar
Material transfer: Yes No N/A
Stock Transfer: Yes No N/A
Rebar Test Witness: Yes No N/A

Quality Control Present: Yes No
Sampled Items: Yes No N/A
OK to Cut: Yes No N/A
Delayed/Cancelled: Yes No N/A

Other: Witness Magnetic Particle testing**Bridge No:** 34-0006**Component:** High Strength Rods**Bid Item:** 61/45**Lot No:** B206**Summary of Items Observed:**

The QA Inspector arrived at Dyson Corporation in Painesville, OH to perform material releases and to randomly observe the in process magnetic particle testing (MT) of E2 Shear Key 76mm diameter all threaded rods. The following observations were made:

Stork Heron Testing

Upon the arrival of Dyson Corp Quality Control Manager (QCM) Bob Bobnar and the QA Inspector, the Heron Testing MT Technician Shane Levermann met the QA Inspector and Dyson Representatives and performed the MT of the 3"-4UNC-2A A354 BD rods. The QA Inspector randomly observed the MT Technician perform MT with a head shot and coil shot under a black light. Mr. Levermann informed the QA Inspector the suspended bath of particles is tested and calibrated every morning prior to use. The QA Inspector randomly observed the MT and observed the indications under the black light after the head shot and coil shot. The QA Inspector randomly observed the MT technician perform MT on 4 of the 3" diameter rods and 5 of the 2" diameter of rods identified above. It was observed by the QA Inspector similar MT indications were located in the 3" diameter rods that were discovered in the initial testing performed. It was noted after the original MT and based upon the Heron destructive testing of the microstructure of the parts identified, the results accepting the indications appear to be in compliance with the contract requirements.

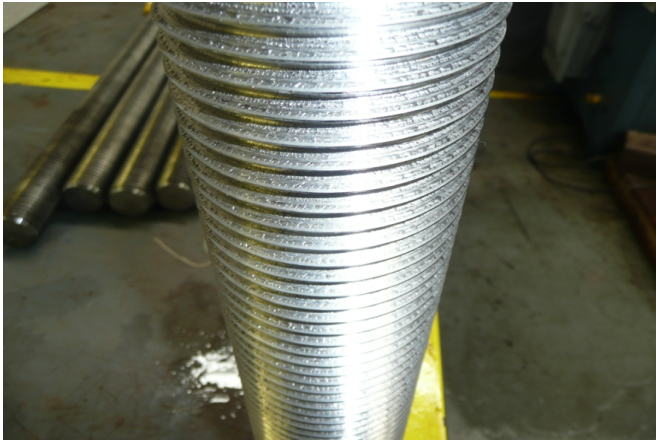
It was observed during the testing of the 3" diameter rods identified as NCJ3, two of the 4 rods tested had been tested prior to the arrival at Stork Herron Testing. The Stork Herron level II MT technician informed the QA Inspector he will be noted the parts had been tested with wet florescent MT prior to the arrival at the testing facility. The QA Inspector noted, due to the previous MT indications located and prior to the destructive testing

SOURCE INSPECTION REPORT

(Continued Page 2 of 2)

random rods were tested at Dyson for information only. The Dyson QCM informed the QA Inspector two random rods were selected for informational MT, so Dyson representatives could observe the MT indications that were previously rejected by Stork Herron.

After the completion of the testing all of the 9 total rods were accepted and a MT report was generated by the Stork Herron Technician.



Summary of Conversations:

As noted 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 , who represents the Office of Structural Materials for your project.

Inspected By:	Bettencourt,Rick
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Quality Assurance Inspector

Reviewed By:	Levell,Bill
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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 #: 76.8**COMPONENT MATERIAL INSPECTION REPORT****Resident Engineer:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** CMI-000131**Date Inspected:** 24-Nov-2009**Contractor:** Dyson Corp. & Subs**Location:** Dyson Corp. Painesville OH**Bridge No.:** 34-0006**OSM Arrival Time:** 800**OSM Departure Time:** 1630**Component:#** High Strength Fasteners

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: Monnig industries Inc. Glasgow, MO

Lot #	Bid Item #	Quantity		Material Description
B206-117-09 61		4	ea	NCJ3 3.00" 4 x 537MM TFL Stud, A354 Gr BD, Galvanized
B206-117-09 45		78	ea	NSH2 2.00" 4-1/2 x 1105MM TFL Stud, A354 Gr BD, Galvanized
B206-117-09 61		336	ea	NBI 3.00" Hardened Flat Washer, F436, Galvanized
B206-117-09 45		260	ea	NET 5.039" OD x 2.125" ID x 30MM Thick Washer, F436, HDG

Identification: Green Tag was placed on the documentation to be sent with the material**Summary of Items Observed:**

The QA Inspector reviewed the contractors shipping documentation and verified the quantities and material specifications. The QA Inspector randomly observed the material and documentation appeared to be in general compliance with the contract requirements. The QA Inspector placed a green tag release on the bolt documentation Caltrans lot number B206-117-09 was issued for tracking purposes. The QA Inspector noted the material was being released to Monnig Industries in Glasgow, Mo for blasting and galvanizing. The QA Inspector was informed by all of the above identified material will be sent to Monnig so sampling and releasing of the material would be simpler.

Summary of Conversations:

No pertinent conversation noted.

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

Inspected By: Bettencourt, Rick

Quality Assurance Inspector

Reviewed By: Levell, Bill

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 #: 76.8**COMPONENT MATERIAL INSPECTION REPORT****Resident Engineer:** Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** CMI-000134**Date Inspected:** 01-Dec-2009**Contractor:** Dyson Corp. & Subs**Location:** Dyson Corp. Painesville, OH**Bridge No.:** 34-0006**OSM Arrival Time:** 800**OSM Departure Time:** 1630**Component:#** High Strength Fasteners

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: Monnig Industries, Glasgow MO

Lot #	Bid Item #	Quantity	Material Description
B206-119-09 61		30 ea	NCJ3 3.00" 4 x 537MM TFL Stud, A354 Gr BD, Galvanized

Identification: Green Tag was placed directly on the material to be shipped with the material**Summary of Items Observed:**

The QA Inspector reviewed the contractors shipping documentation and verified the quantities and material specifications. The QA Inspector randomly observed the material and documentation appeared to be in general compliance with the contract requirements. The QA Inspector placed a green tag release on the bolt documentation Caltrans lot number B206-117-09 was issued for tracking purposes. The QA Inspector noted the material was being released to Monnig Industries in Glasgow, Mo for blasting and galvanizing. The QA Inspector was informed by all of the above identified material will be sent to Monnig so sampling and releasing of the material would be simpler.

Summary of Conversations:

No pertinent conversation noted.

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

Inspected By: Bettencourt, Rick

Quality Assurance Inspector

Reviewed By: Levell, Bill

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:** Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-001664**Date Inspected:** 20-Jan-2010**Project Name:** SAS Superstructure**OSM Arrival Time:** 930**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1300**Contractor:** Monnig Industries, Inc**Location:** Glasgow, MO**Quality Control Contact:** Ryan Monnig**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:** E2 Bearing and Shear Key All Threaded Rods Hot Dip Galvanizing**Bridge No:** 34-0006**Component:** 3" and 2" Dia. All Threaded Rods**Bid Item:** See below**Lot No:** N/A**Summary of Items Observed:**

Caltrans Office of Structural Material (OSM) Quality Assurance (QA) Inspector Joselito Lizardo was present as requested to perform bolt sampling that were blasted and galvanized by Monnig Industries, Inc, at Glasgow, MO.

This QA met with Mr. Ryan Monnig of Monnig Industries to perform sampling of bolts that were blasted and galvanized by their company. The 2" and 3" diameter with various lengths, all threaded rods per ASTM A354 Gr. BD were blasted per Surface Preparation Specification No. 10, Near White Blast Cleaning and galvanized per ASTM A-153. QA has previously monitored the blasting and galvanizing on these mentioned all threaded rods and deemed acceptable to the project specification. The 2" and 3" diameter all threaded rods per ASTM A354 Gr. BD have Bid Item Number of 45 and 61 respectively.

Monnig personnel prepared all the necessary supporting documents that were included in the shipment of the rod/test samples. QA reviewed the documentation and the sets of samples (full length finished item and "Material Only") to be shipped. After finding the documents and samples were in order, QA made a Caltrans Sample Identification Cards (TL-0101) with assigned Caltrans Lot number B231-002-10 and B231-003-10 and were attached to the documentation.

SOURCE INSPECTION REPORT

(Continued Page 2 of 2)



Summary of Conversations:

No significant conversation occurred.

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

Inspected By: Lizardo, Joselito

Quality Assurance Inspector

Reviewed By: Levell, Bill

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 A354BD, A153, TM 03. Lot #NCJ, NCJ2; Heat #M32854

Sample No: SM-10-0084

Date Sampled: 01/20/10

Date Rec'd: 01/26/10

Date Reported: 01/29/10

Lot No: B23100310

TL-101 / SIC No: C715359

Contract/Permit No: 04-0120F4

Material: 3"x 52.64" A354 Grade BD HDG Suspender Socket Anchor Bolt

Manufacturer: DYSON

Sampler: J. Lizardo

Results: SAMPLES SUBMITTED ARE SATISFACTORY FOR USE

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

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

CARD NUMBER
C 715359

☐ PRELIMINARY TESTS
☐ PROCESS TESTS
☐ ACCEPTANCE TESTS
☐ INDEPENDENT ASSURANCE TESTS
☒ SPECIAL TESTS

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

SHIPMENT NO. _____ AUTHORIZATION NO. _____

FIELD NO. _____ DIST. LAB NO. _____
LOT NO. 824-003-10 P.O. OR REQ. NO. _____

SAMPLE OF 3" Ø ASTM A354 GR BD / MATERIAL ONLY
FOR USE IN SHOBB. S&S 22 BEARING / SHEAR KEY

SAMPLE FROM 1" Ø A354 GR BD X 1337" ALL THREADED
4" - 3" Ø X 12" LONG MATERIAL ONLY
DEPTH _____

LOCATION OF SOURCE MDXING INDUSTRIES
400 INDUSTRIAL DRIVE, GILGOW, MD

THIS SAMPLE IS SHIPPED IN 1 PALETTE AND IS ONE OF _____ SAMPLES REPRESENTING A GROUP OF _____ (NO. CONTAINERS) (TONGS, GALS, BBL'S, STA ETC)

OWNER OR MANUFACTURER MDXING INDUSTRIES

TOTAL QUANTITY AVAILABLE 6 TEST RESULTS DESIRED ☐ NORMAL ☐ PRIORITY

REMARKS 3" Ø X A354 GR BD ALL THREADED, NCJ1
1 - 3" Ø X A354 GR BD " " NCJ2
2 - 3" Ø X 12" LONG, NCJ1 MATERIAL ONLY
2 - 3" Ø X 12" LONG, NCJ2 " "

COVER ADDITIONAL INFORMATION WITH LETTER
DATE SAMPLED 1/20/10 TITLE QA INSPECTOR
BY J. LIZARDO DIST. CO. RTE. PM _____

LIMITS 04-DIRDER SPECIALS / ASTM A354

CONT. NO. 04-DIRDER FED. NO. _____

RES. ENGR. ELBERT GARY MURSELL

ADDRESS 333 BURMA RD, OAKLAND, CA
CONTRACTOR AMERICAN BUILDING / FLOOR A JV
370 BURMA RD, OAKLAND, CA

ENCLOSE WITH SAMPLE

Lab Manager

Print

Quality Manager

11-0084

11/26

Caltrans Test Number:		0		Field Inspectors Fastener Assembly Sampling Sheet											
Date Sampled:	1/20/2010	Contractor:		Monnig Industries, Inc				Bid Item No.:		61					
Contract:	04-0120F4	Location Sampled:		400 Industrial Drive, Glasgow, MO				Contact:		Ryan Monnig					
CT Lot No.	8231-003-1	Sampled By:		J Lizardo				Title:		Quality Assurance					
R. E.'s Name:	Gary Pursell	Inspectors Office:		Emeryville				Phone #:		(510) 301-1112		Fax #:		(510) 601-1776	
R. E.'s Address:	333 Burma Road							Co.:		SF		Rt.:		80	
City St. Zip:	Oakland, Ca 94607							Date Released:				Ship To:		Trans Lab	
								Identification:				File Loc.:		1 .09	
Sample No.	1	2	3	4	5	6	7	8	9	10					
Assembly or Rocap No.	N/A	N/A													
Quantity Available	75	28													
Number of Samples	3 *	3 *													
Bolt Manufacture	DYSON	DYSON													
Heat Number	M32854	M32854													
Mfg. Lot Number	NCJ	NCJ2													
Grade/Description	A354 Gr. BD	A354 Gr. BD													
Size	3" X 52.64"	3" X 52.64"													
Finish	Hot Dip Galv.	Hot Dip Galv.													
Verify Test Reports	yes	yes													
Pass/Fail	Pass	Pass													
Nut Manufacture	N/A	N/A													
Heat Number															
Mfg. Lot Number															
Grade															
Finish															
Verify Test Reports															
Pass/Fail															
Washer Manufacture	N/A	N/A													
Heat Number															
Mfg. Lot Number															
Grade															
Finish															
Verify Test Reports															
Pass/Fail															
Notes:	* Sample: 1-full size finish (1337mm long) and 2-12 inches Material Only (Blank Bars) (3-total) per lot.														
Note to TL-29:															

SM Number 10-0084 Lot Number 623160310

Page / of

Contract 04-0120F4 TL-0101 Number C715359 Date Rec'd. 1/26/10 Date Tested: 1/28/10

Rolls: A354 BD HDG

Lab Technician:

FILED S

[illegible]

Nuls:

[illegible]

Washer:

[illegible]

.505 SAMPLES

A354-BD



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

SM Number = 10-0084

Sample	Heat Number	Diameter (in)	Area (in ²)	Stress at Offset (psi)	Tensile Strength (psi)	Elongation in 4 x d (%)	Tested By
CJA1	NCJ	0.499	0.1956	147647	163450	16.9	FSaylor
CJB2	NCJ	0.498	0.1948	146680	162660	16.6	FSaylor
CJ2A1	NCJ2	0.502	0.1979	145511	162710	16.6	FSaylor
CJ2B2	NCJ2	0.499	0.1956	145578	161440	16.5	FSaylor

S. M. NO. 10-0084	DATE RECEIVED 1/26/10
T 101 NO. C715359	CONF., W.O., OR P.Q. NO. 04-0120F4
LOT NO. B23100310	F.A.P. NO.

TEST NAME	DISTRICT	COUNTY	ROUTE	POST MILES
CONTRACTOR	SAMPLED BY		DATE SAMPLED	SUPPLY SOURCE
AGENCY	MANUFACTURER		MATERIAL TESTED FOR	

[illegible]

REMARKS

A354 BD H06

DATE TESTED	TESTED BY	APPROVED BY
1/29/10	FLD S.	

END OF REPORT

TEST SPECIMEN PREPARATION
AND RECORD

APPROVED FOR USE BY SMTL
QUALITY MANAGER: *B. Berger*

SM No.
10-0084

Contract No.
04-0120F4

Requesting Lab Technician
F Saylor

Date Needed
normal

TL-0101 No.
C715359

E.A./Spec. Desg./Object
04-0120F3

Date Received
1/26/10

Date Tested/Provided
1/28/10

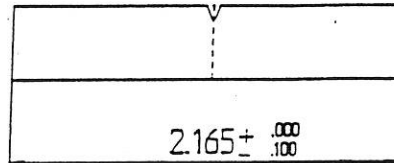
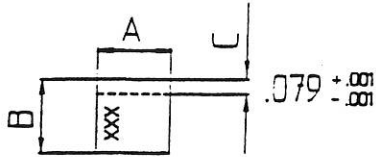
<input type="checkbox"/> Machine Shop Work Requested <input checked="" type="checkbox"/> standard round tension test specimen, circle one: 0.500" 0.350" 0.250" <input type="checkbox"/> standard rectangular tension test specimen, circle one: 18" long, 8" gage length 8" long, 2" gage length <input type="checkbox"/> Charpy, circle one: 10mm x 10mm 10mm x 7.5mm <input type="checkbox"/> hardness measurement sample (fasteners) <input type="checkbox"/> weld nugget <input type="checkbox"/> chemistry slug <input type="checkbox"/> other: _____ hardness <input checked="" type="checkbox"/> see instructions →	Please Machine .505, 3" x 52.64" Lot #NCJ, Mark A1, B1 CJ-A1, B2 Lot #NCJ2, Mark A2, B2 CJ2-A1-B2	<input type="checkbox"/> Chemistry Lab type of material: _____ Work Requested <input type="checkbox"/> neoprene verification <input type="checkbox"/> oil swell <input type="checkbox"/> zinc coating weight <input type="checkbox"/> steel chemistry analysis <input type="checkbox"/> other: _____ ← <input type="checkbox"/> see instructions <input type="checkbox"/> Other (explain)
--	---	--

Comments or further instructions	The received service is acceptable <i>FRED S.</i> Receiving Lab Technician <i>1/29/10</i> Date
----------------------------------	--

TRANSLAB

S.M. INSPECTION REPORT FOR HEAT # CJ2

COMPLETED BY ms
DATE: 1-28-10



CHARPY IMPACT SPECIMENS

☐ FULL SIZE 10MM X 10MM

☐ REDUCED

MATERIAL SURFACE



NOTCH ORIENTATION

OK

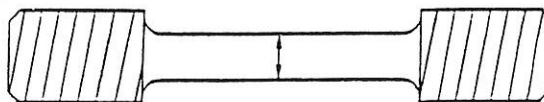
1	
2	
3	

A B C 2.165 .010 R ± .001

1					
2					
3					

NOTE: IMPACT SPECIMENS ARE TO BE GROUND TO $.394 \pm .003$ ON SURFACE GRINDER
ASTM E23 CALLS FOR 45 deg. V NOTCH WITH A .010 + or - .001 RADIUS

A DIA.



☒ .500 ± .010

☐ .350 ± .007

☐ OTHER

A DIA. IS

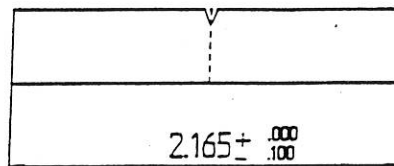
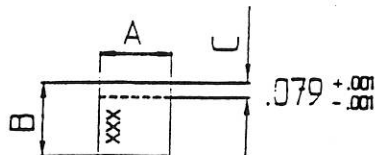
A	.5025
B	.500

NOTES / SPECIAL INSTRUCTIONS

TRANSLAB

S.M. INSPECTION REPORT FOR HEAT # CJ

COMPLETED BY mg
DATE: 1-28-10



CHARPY IMPACT SPECIMENS

☐ FULL SIZE 10MM X 10MM

☐ REDUCED

MATERIAL SURFACE



NOTCH ORIENTATION

OK

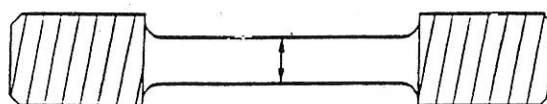
1	
2	
3	

A B C 2.165 .010 R ± .001

1					
2					
3					

NOTE: IMPACT SPECIMENS ARE TO BE GROUND TO $.394 \pm .003$ ON SURFACE GRINDER
ASTM E23 CALLS FOR 45 deg. V NOTCH WITH A $.010 \pm .001$ RADIUS

A DIA.



☒ .500 ± .010

☐ .350 ± .007

☐ OTHER

A DIA. IS

A	.500
B	.498

NOTES / SPECIAL INSTRUCTIONS

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 A354BD, A153, TM 03. Lot #NSH, NSH2: Heat #M30263. Lot NSH is Satisfactory For Use. (Yield Strength Passes Per Rounding Rule in ASTM A370) Lot #NSH2 FAILS - Low Yield

Sample No: SM-10-0083

Date Sampled: 01/20/10

Date Rec'd: 01/26/10

Date Reported: 02/01/10

Lot No: B23100210

TL-101 / SIC No: C715358

Contract/Permit No: 04-0120F4

Material: 2"x 43.50" HDG Suspender Socket Anchor Bolt

Manufacturer: DYSON

Sampler: J. Lizardo

Results: Lot #NSH2 Does Not Comply With Specifications. Lot #NSH is Satisfactory For Use.

SOURCE
59318DISTRICT
04E.A.
0120F3

SUB JOB

SPECIAL DESIGNATION

OBJECT
1270

1-26 10-0083
STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SAMPLE IDENTIFICATION CARD
CARD NUMBER
C 715358
TL-0101 (REV. 10/97)

FIELD NO. _____
DIST. LAB NO. _____
LOT NO. B231-00210
P.O. OR REQ. NO. _____
SHIPMENT NO. _____
AUTHORIZATION NO. _____
SAMPLE SENT TO:
☐ PRELIMINARY TESTS
☐ PROCESS TESTS
☐ ACCEPTANCE TESTS
☐ INDEPENDENT ASSURANCE TESTS
☐ DIST. LAB
☒ TRANS. LAB
SPECIAL TESTS
SAMPLE OF 2" Ø ASTM A354 GR BD MATERIAL ONLY
FOR USE IN STEEL S&S E2 BEARING / SHAR KEY

SAMPLE FROM 2" Ø A354 GR BD X195 MM ALL THREADED
4 - 2" Ø X 22" LONG MATERIAL ONLY
DEPTH
LOCATION OF SOURCE MANNING INDUSTRIES
400 INDUSTRIAL DRIVE GLASSBORO, NJ
THIS SAMPLE AND IS ONE OF _____ SAMPLES REPRESENTING _____ (NO. CONTAINERS) PALLET
TOTAL QUANTITY 2000
TEST RESULTS DESIRED: _____
DATE NEEDED _____
REMARKS 2" Ø X A354 GR BD ALL THREADED, NSH
1 - 2" Ø X A354 GR BD " " NSH2
2 - 2" Ø X 22" LONG, NSH MATERIAL ONLY
2 - 2" Ø X 22" LONG, NSH2 " "

COVER ADDITIONAL INFORMATION WITH LETTER
DATE SAMPLED 1/20/10
BY J. LIZARDO
TITLE QA INSPECTOR
DIST. CO. RTE. PM

LIMITS 2" Ø - D12DF4 SPECIALS / ASTM A354
CONT. NO. 04 - D12DF4
FED. NO. _____
RES. ENGR. OR SUPPL. GARY PURSELL
ADDRESS 333 BURNHAM RD OAKLAND, CA
CONTRACTOR AMERICAN BRIDGE / FILLER, A JV
375 BURNHAM RD, OAKLAND, CA

ENCLOSE WITH SAMPLE

Lab Manager

Print

Quality Manager

10-0083

1/26

Caltrans Test Number:		0		Field Inspectors Fastener Assembly Sampling Sheet									
Date Sampled:	1/20/2010	Contractor:		Monnig Industries, Inc				Bid Item No.:		45			
Contract:	04-0120F4	Location Sampled:		400 Industrial Drive, Glasgow, MO				Contact:		Ryan Monnig			
CT Lot No.	0231-002-1	Sampled By:		J Lizardo				Title:		Quality Assurance			
R. E.'s Name:	Gary Pursell	Inspectors Office:		Emeryville				Phone #:		(510) 301-1112			
R. E.'s Address:	333 Burma Road	Co.:		SF				Rt.:		80			
City St. Zip:	Oakland, Ca 94607	Date Released:						Ship To:		Trans Lab			
Sample No.		Identification:						File Loc.:		1.09			
Assembly or Rocap No.	N/A	1	2	3	4	5	6	7	8	9	10		
Quantity Available	174	N/A	N/A										
Number of Samples	3 *	3 *	3 *										
Bolt Manufacture	DYSON	DYSON	DYSON										
Heat Number	M30263	M30263	M30263										
Mfg. Lot Number	NSH	NSH	NSH2										
Grade/Description	A354 Gr. BD	A354 Gr. BD	A354 Gr. BD										
Size	2" X 43.50"	2" X 43.50"	2" X 43.50"										
Finish	Hot Dip Galv.	Hot Dip Galv.	Hot Dip Galv.										
Verify Test Reports	yes	yes	yes										
Pass/Fail	Pass	Pass	FAIL										
Nut Manufacture	N/A	N/A	N/A										
Heat Number													
Mfg. Lot Number													
Grade													
Finish													
Verify Test Reports													
Pass/Fail													
Washer Manufacture	N/A	N/A	N/A										
Heat Number													
Mfg. Lot Number													
Grade													
Finish													
Verify Test Reports													
Pass/Fail													
Notes:	* Sample: 1- full size finish(1105mm long) and 2-22 inches Material Only (Blank Bars) (3-total) per lot.												
Note to TL-29:													

FASILENER ASSEMBLY WORKSHEET

APPROVE OR USE BY SM
QUALITY MANAGER

SM Number 10-0083 Lot Number 023100210

Page 7 of 7

Date Rec'd. 1/26/10 Date Tested: 1/28/10

alts: A354 BD #DCT

Lab Technician: FRED S

Sample No.	Lab Technician:
Mfg. Lot No.	FRED S.
Product Markings	
Size	
Pitch Diameter	
Bolt Length	
Ring Gages/Go Nogo	
Zinc Coating Thick.	
Hardness Rc / Rb	
Wedge Tensile	

[illegible][illegible]

.505 SAMPLES



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

SM Number = 10-0083

Sample	Heat Number	Diameter (in)	Area (in ²)	Stress at Offset (psi)	Tensile Strength (psi)	Elongation in 4 x d % 14 min	Tested By
A1	NSH	0.5	0.1963	131075	162240	14.5	FSaylor
B1	NSH	0.499	0.1956	128560	161830	15.1	FSaylor
A2	NSH2	0.499	0.1956	130994	163590	16.2	FSaylor
B2	NSH2	0.499	0.1956	125553	158900	15.7	FSaylor
SHA	M30263, NSH	0.499	0.1956	129467	164820	17	FSaylor
SHB	M30263, NSH	0.499	0.1956	129592	160860	16.1	FSaylor
SH2A	M30263, NSH2	0.499	0.1956	127925	159890	16.1	FSaylor
SH2B	M30263, NSH2	0.5	0.1963	128275	160340	16.7	FSaylor

NSH Avg of 4 Test = 129674 psi: Rounds up to 130,000 OK
NSH2 Avg of 4 Test = 128187 psi: Rounds down to 128,000 Fail
Low Yield

S. M. NO. 10-0683	DATE RECEIVED 1/26/10
T 101 NO. C 715358	CONT. W.O. OR P.O. NO. 04-0120F4
LOT NO. B23100210	F.A.P. NO.

[illegible]

A354 BD HD6

REMARKS

TESTED BY FRED S

APPROVED BY

FM 3018 M 95

S. M. NO.	10-0083	DATE RECEIVED	1/26/10
T 101 NO.	06715358	CONT., W.O., OR P.O. NO.	04-012074
LOT NO.		F.A.P. NO.	

POST MILES

SUPPLY SOURCE

MATERIAL TESTED FOR

SPECIFICATIONS

A354 BD

TESTED BY

FILED SAYLOR

APPROVED BY

FM 3018 M 95

TEST SPECIMEN PREPARATION
AND RECORD

APPROVED FOR USE BY SMTL
QUALITY MANAGER: *B. Bengt*

SM No.
10-0083

Contract No. *0120F4*
04-0402

Requesting Lab Technician
Glen

Date Needed
Routine

TL-0101 No.
C715358

E.A./Spec. Desg./Object
04-0120F3

Date Received
1-26-10

Date Tested/Provided

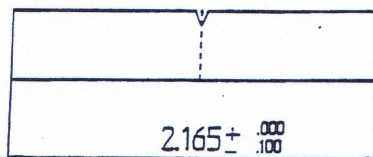
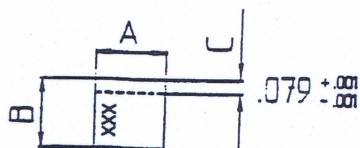
<input checked="" type="checkbox"/> Machine Shop Work Requested <input checked="" type="checkbox"/> standard round tension test specimen, circle one: <i>(0.500)</i> 0.350" 0.250" <input type="checkbox"/> standard rectangular tension test specimen, circle one: 18" long, 8" gage length 8" long, 2" gage length <input type="checkbox"/> Charpy, circle one: 10mm x 10mm 10mm x 7.5mm <input type="checkbox"/> hardness measurement sample (fasteners) <input type="checkbox"/> weld nugget <input type="checkbox"/> chemistry slug <input type="checkbox"/> other: _____ <input type="checkbox"/> see instructions →	Instructions <i>2 505's each</i> <i>Lot # NSH & NSH2</i> <i>Heat # M30263</i> <i>Retest - Low Yield</i> <i>Mark SH A & B</i> <i>SH2 A & B</i>	<input type="checkbox"/> Chemistry Lab type of material: _____ Work Requested <input type="checkbox"/> neoprene verification <input type="checkbox"/> oil swell <input type="checkbox"/> zinc coating weight <input type="checkbox"/> steel chemistry analysis <input type="checkbox"/> other: _____ ← <input type="checkbox"/> see instructions <input type="checkbox"/> Other (explain)
---	---	--

Comments or further instructions	The received service is acceptable <i>Fred Saylor</i> Receiving Lab Technician <i>2/1/10</i> Date
----------------------------------	---

TRANSLAB

S.M. INSPECTION REPORT FOR HEAT # SH2

COMPLETED BY ms
DATE: 2-1-10



CHARPY IMPACT SPECIMENS

- ☐ FULL SIZE 10MM X 10MM
☐ REDUCED

MATERIAL SURFACE



NOTCH ORIENTATION

OK

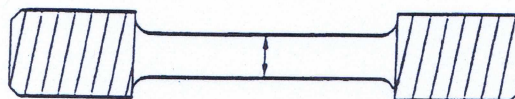
1	
2	
3	

A B C 2.165 .010 R ± .001

1					
2					
3					

NOTE: IMPACT SPECIMENS ARE TO BE GROUND TO $.394 \pm .003$ ON SURFACE GRINDER
ASTM E23 CALLS FOR 45 deg. V NOTCH WITH A $.010 \pm .001$ RADIUS

A DIA.



☒ .500 ± .010

☐ .350 ± .007

☐ OTHER

A DIA. IS

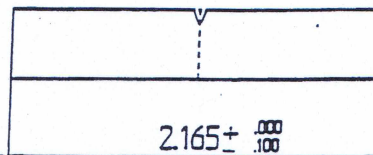
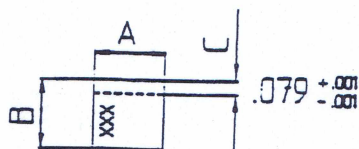
A	.500
B	.502

NOTES / SPECIAL INSTRUCTIONS

TRANSLAB

S.M. INSPECTION REPORT FOR HEAT # SH

COMPLETED BY MA
DATE: 2-1-10



CHARPY IMPACT SPECIMENS

☐ FULL SIZE 10MM X 10MM

☐ REDUCED

MATERIAL SURFACE



NOTCH ORIENTATION

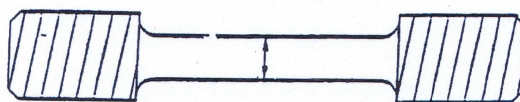
OK	
1	
2	
3	

A B C 2.165 ± .010 R ± .001

1					
2					
3					

NOTE: IMPACT SPECIMENS ARE TO BE GROUND TO .394 ± .003 ON SURFACE GRINDER
ASTM E23 CALLS FOR 45 deg. V NOTCH WITH A .010 + or - .001 RADIUS

A DIA.



☒ .500 ± .010

☐ .350 ± .007

☐ OTHER

A DIA. IS

A	.500
B	.500

NOTES / SPECIAL INSTRUCTIONS

STRUCTURAL MATERIALS TESTING LABORATORY
FORM TL-652 (REV. 3/05)

TEST SPECIMEN PREPARATION
AND RECORD

APPROVED FOR USE BY SMTL
QUALITY MANAGER: *B. Berga*

SM No.
10-0083

Contract No.
04-0120F4

Requesting Lab Technician
F Saylor

Date Needed
normal

TL-0101 No.
C715358

E.A./Spec. Desg./Object
04-0120F3

Date Received
1/26/10

Date Tested/Provided
1/28/10

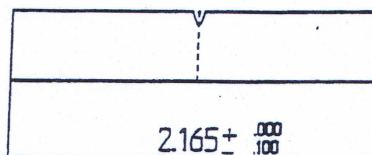
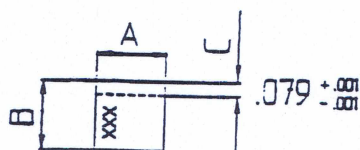
<p><input checked="" type="checkbox"/> Machine Shop</p> <p>Work Requested</p> <p><input checked="" type="checkbox"/> standard round tension test specimen, circle one: 0.500" 0.350" 0.250"</p> <p><input type="checkbox"/> standard rectangular tension test specimen, circle one: 18" long, 8" gage length 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: _____ hardness</p> <p><input checked="" type="checkbox"/> see instructions →</p>	<p>Please Machine .505 2" x 43.50"</p> <p>Lot #NSH, Mark A1, B1</p> <p>Lot #NSH2, Mark A2, B2</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>
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Comments or further instructions	The received service is acceptable
	<p><i>PRD S.</i></p> <p>Receiving Lab Technician</p>
	<p><i>1/29/10</i></p> <p>Date</p>

TRANSLAB

S.M. INSPECTION REPORT FOR HEAT # A2

COMPLETED BY MA
DATE: 1-28-10



CHARPY IMPACT SPECIMENS

- ☐ FULL SIZE 10MM X 10MM
☐ REDUCED

MATERIAL SURFACE



NOTCH ORIENTATION

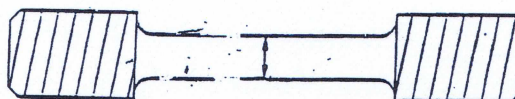
OK	
1	
2	
3	

A B C 2.165 .010 R ± .001

1					
2					
3					

NOTE: IMPACT SPECIMENS ARE TO BE GROUND TO $.394 \pm .008$ ON SURFACE GRINDER
ASTM E23 CALLS FOR 45 deg. V NOTCH WITH A $.010 \pm .001$ RADIUS

A DIA.



☒ $.500 \pm .010$

☐ $.350 \pm .007$

☐ OTHER

A DIA. IS

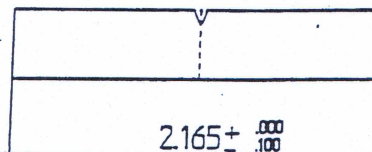
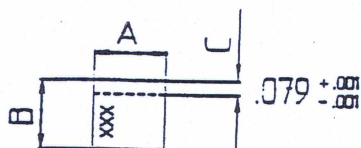
A	.500
B	.500

NOTES / SPECIAL INSTRUCTIONS

TRANSLAB

S.M. INSPECTION REPORT FOR HEAT # AI

COMPLETED BY MS
DATE: 1-28-10



CHARPY IMPACT SPECIMENS

- ☐ FULL SIZE 10MM X 10MM
☐ REDUCED

MATERIAL SURFACE	OK
<input type="checkbox"/>	1
<input type="checkbox"/>	2
<input type="checkbox"/>	3

A B C 2.165 .010 R ± .001

1					
2					
3					

NOTE: IMPACT SPECIMENS ARE TO BE GROUND TO $.394 \pm .001$ ON SURFACE GRINDER
ASTM E23 CALLS FOR 45 deg. V NOTCH WITH A $.010 \pm .001$ RADIUS

A DIA.



- ☒ $.500 \pm .001$
☐ $.350 \pm .001$
☐ OTHER

A DIA. IS

A	.500
B	.500

NOTES / SPECIAL INSTRUCTIONS

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:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-001770**Date Inspected:** 08-Feb-2010**Project Name:** SAS Superstructure**OSM Arrival Time:** 930**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1400**Contractor:** Monnig Industries**Location:** Glasgow, MO**Quality Control Contact:** Ryan Monnig**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:** E2 Bearing and Shear Key All Threaded Rods Hot Dip Galvanizing**Bridge No:** 34-0006**Component:** 2" Dia. All Threaded Rods**Bid Item:** 45**Lot No:** B231-007-10**Summary of Items Observed:**

Caltrans Office of Structural Material (OSM) Quality Assurance (QA) Inspector Joselito Lizardo was present as requested to perform bolt sampling that were blasted and galvanized by Monnig Industries, Inc, at Glasgow, MO.

This QA met with Mr. Ryan Monnig of Monnig Industries to perform sampling of bolts that were blasted and galvanized by their company. The 2" and 3" diameter with various lengths, all threaded rods per ASTM A354 Gr. BD were blasted per Surface Preparation Specification No. 10, Near White Blast Cleaning and galvanized per ASTM A-153. QA had previously monitored the blasting and galvanizing on these mentioned all threaded rods and

deemed acceptable to the project specification. These 2" and 3" diameter all threaded rods had been previously sampled dated January 20th, 2010 and the test results came up satisfactory except on the 2" diameter with the trace heat code of NSH2 that fell short of the project requirements. Due to the unacceptable test result on the 2" diameter all threaded rod, Dyson Corporation who manufactured the rods requested for a retest.

QA and Monnig personnel proceeded to where the rods were stored. Both QA and Monnig Personnel verified the location of the pallet that contained 2" diameter all threaded with the heat trace code NSH2. After verifying the correct heat trace code, this QA picked 3 – 2" diameter all threaded out of the 78 rods that were on top of the pallet to be the QA Samples.

Monnig personnel prepared all the necessary supporting documents that were included in the shipment of the rod/test samples. QA reviewed the documentation and the set of samples (3 - full length finished items) to be shipped. After finding the documents and samples were in order, QA made a Caltrans Sample Identification

SOURCE INSPECTION REPORT

(Continued Page 2 of 2)

Card (TL-0101) with assigned Caltrans Lot number B231-007-10 and was attached to the documentation.



Summary of Conversations:

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

Inspected By:	Lizardo, Joselito	Quality Assurance Inspector
----------------------	-------------------	-----------------------------

Reviewed By:	Levell, Bill	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 #: 76.8**COMPONENT MATERIAL INSPECTION REPORT****Resident Engineer:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** CMI-000185**Date Inspected:** 10-Feb-2010**Contractor:** Dyson Corp. & Subs**Location:** Monnig Industries, Glasgow, MO**Bridge No.:** 34-0006**OSM Arrival Time:** 1400**OSM Departure Time:** 1600**Component:#** E2 Bearing/Shear Key Anchor Rod

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: American Bridge/Fluor AJV, 375 Burmah Road, Oakland, CA

Lot #	Bid Item #	Quantity		Material Description
B231-009-10 61		75	ea	ASTM A354 Gr. BD - 3-00"-4UNC-2A x 52.64" Threaded Full Length Stud, Heat Code NCJ
B231-009-10 61		28	ea	ASTM A354 Gr. BD - 3-00"-4UNC-2A x 52.64" Threaded Full Length Stud, Heat Code NCJ2
B231-009-10 61		13	ea	ASTM A354 Gr. BD - 3-00"-4UNC-2A x 21.14" Threaded Full Length Stud, Heat Code NCJ4
B231-009-10 61		20	ea	ASTM A354 Gr. BD - 3-00"-4UNC-2A x 21.14" Threaded Full Length Stud, Heat Code NCJ5
B231-009-10 61		2	ea	ASTM A354 Gr. BD - 3-00"-4UNC-2A x 21.14" Threaded Full Length Stud, Heat Code NCJ6
B231-009-10 61		102	ea	ASTM A354 Gr. BD - 3-00"-4UNC-2A x 51.65" Threaded Full Length Stud, Heat Code NCJ7
B231-009-10 61		50	ea	ASTM A354 Gr. BD - 3-00"-4UNC-2A x 20.16" Threaded Full Length Stud, Heat Code NCJ8
B231-009-10 61		20	ea	ASTM A354 Gr. BD - 3-00"-4UNC-2A x 20.16" Threaded Full Length Stud, Heat Code NCJ9
B231-009-10 61		34	ea	ASTM A354 Gr. BD - 3-00"-4UNC-2A x 21.14" Threaded Full Length Stud, Heat Code NCJ3
B231-010-10 61		260	ea	ASTM A563 Gr. DH - 3-00"-4UNC-2B x 20.16" Heavy Hex Nut, Heat Code NAL2
B231-010-10 61		260	ea	ASTM A563 Gr. DH - 3-00"-4UNC-2B x 20.16" Heavy Hex Nut, Heat Code NAL3
B231-011-10 61		168	ea	ASTM F436 Type 1, 3.00" Diameter Hardened Flat Washer, Heat Code NBI

Identification: Orange Tag attached on each Dyson Corp. Certificate of Compliance (10 sheets)

COMPONENT MATERIAL INSPECTION REPORT

(Continued Page 2 of 2)

Summary of Items Observed:

Caltrans Office of Structural Material (OSM) Quality Assurance (QA) Inspector Joselito Lizardo was present as requested to perform material release on the galvanized 3.0" diameter all threaded rods performed at Monnig Industries in Glasgow, MO. In addition this QA Inspector was also requested to release 3.0" diameter heavy hex nuts and hardened flat washer that were manufactured by Dyson Corp. and previously green tagged with Caltrans Lot number B206-114-09 and B206-117-09.

QA Joselito Lizardo reviewed the Monnig Industries and Dyson Corporation's Certified Material Test Report/Certificate of Compliance.

QA Joselito Lizardo also made random observations of the materials as they were presented. QA Inspector Lizardo noted that the material and documentation appeared to be in general compliance with the contract requirements. QA Inspector Lizardo issued an orange tag with Caltrans QA lot number B231-009-10 for all 3.0" diameter all threaded rod, B231-010-10 for all 3.0" diameter Heavy Hex Nuts and B231-011-10 for all 3.0" diameter Hardened Flat Washers all with bid item #61.

QA Inspector Lizardo was informed by Mr. Ryan Monnig that the material will be shipped to American Bridge/Fluor AJV, 375 Burmah Road, Oakland, CA.

Summary of Conversations:

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

Inspected By:	Lizardo, Joselito
----------------------	-------------------

Quality Assurance Inspector

Reviewed By:	Levell, Bill
---------------------	--------------

QA Reviewer

CERTIFIED MATERIAL TEST REPORT

DYSON CORP.
DOMESTIC NUT

53 Freedom Road
Painesville, OH 44077

440-946-3500
440-352-2700 fax

DYSON ORDER#	CUSTOMER ORDER#	ITEM NUMBER	QUANTITY SHIPPED	DATE SHIPPED
L 103208	E2 Bearing & Shear Key	4 of 11	103 pcs	11/20/09

CUSTOMER
Hochang Machinery Industries Co., Ltd.
SFOBB - E2 Bearing & Shear Key / Bolt
#743-65 YangDeung-Ri, Sangbuk-Myun
Uiju-Gun, N/A Ulsan
Korea

PRODUCT DESCRIPTION

3.00"-4 UNC-2A x 1337mm (52.64") OAL threaded full length rod,
HDG per ASTM-A153 w/near white metal blast prior to galvanize.
Ref: SFOBB-SK-887-10-35(1), Bid Item 61, Item Code 049323
Hochang BOM Item 14.1

SPECIFICATIONS

ASTM-A354-07 Grade BD with special provisions
10-1.59, 10-1.60, 10-1.61 std specifications 75-1.05
Caltrans hold points apply to this order
Preliminary CMTR issued on 11/20/09

DRAWING
SFOBB-SK-887-10-35-1

STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.	ORIGINAL MILL
Round Bar	3.000	BD	76	NCJ	M32854	Gerdau Macsteel
Round Bar	3.000	BD	28	NCJ2	M32854	Gerdau Macsteel

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

1. The steel was melted and manufactured in the USA and the product was manufactured and tested in the USA.

Attachments:

Mill Test Reports
N.D.E. Reports
Galvanizing Certification



Deborah A. Smith
Q.A. Admin. Assistant

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

CERTIFIED MATERIAL TEST REPORT
CODE NCJ

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
6015		M32854	228544 101	7/13/09

REPORT TO

QUALITY ASSURANCE
THE DYSON CORPORATION

53 FREEDOM RD.

PAINESVILLE, OH 44077

SHIP TO

JOS. DYSON & SONS INC.

53 FREEDOM RD.

PAINESVILLE, OH 44077

ORDERED

GRADE	SIZE	LENGTH
4140	3. "	22' 7 3/4"

CUSTOMER SPECIFICATIONS

ASTM A354-07 GRADE BD; Q&T; (AIM FOR 35-37 ROCKWELL C)

CHEMICAL ANALYSIS

C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.43	0.88	0.014	0.033	0.26	0.15	0.93	0.17	0.20	0.009	0.020
V	Ca	Nb								
0.010	0.0006	0.003								

RAIN SIZE

SPECIFICATION ASTM E112

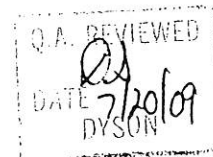
FINE GRAIN 5-8

ARDNESS

SPECIFICATION ASTM E10

AFTER HT TREAT


SURFACE HARDNESS (HRC)

BATCH 1 - 36 (100 bars)
BATCH 2 - 32 (119 bars)
BATCH 3 - 35 (40 bars)
BATCH 4 - 37 (10 bars)


PAGE 1

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

Gerda MacSteel Monroe
300 East Front Street
Monroe, MI 48161


Chris Easter
Quality Assurance Representative

CONTINUED ON PAGE 2

CERTIFIED MATERIAL TEST REPORT

CODE NCJ

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
6015		M32854	228544 101	7/13/09

REPORT TO
QUALITY ASSURANCE
THE DYSON CORPORATION

53 FREEDOM RD.

PAINESVILLE , OH 44077

SHIP TO

JOS. DYSON & SONS INC.

53 FREEDOM RD.

PAINESVILLE , OH 44077

ORDERED

GRADE	SIZE	LENGTH
4140	3. "	22' 7 3/4"

CUSTOMER SPECIFICATIONS
ASTM A354-07 GRADE BD; Q&T; (AIM FOR 35-37 ROCKWELL C)

HARDENABILITY SPECIFICATION ASTM A255/A304

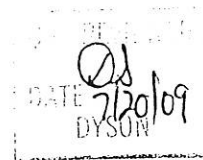
THEORETICAL
J1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 20 22 24 26 28 30 32 34
58 58 58 58 58 58 58 56 55 53 51 49 47 46 46 44 41 39

PHYSICALS SPECIFICATION ASTM E8/A370 AFTER HT TREAT
2.0 IN

TENSILE (KSI)	YIELD (KSI)	% ELONGATION	REDUCTION OF AREA
	Tensile (KSI)	YIELD	ELONGATION
BATCH 1 -	157.8	136.1	16
BATCH 2 -	155.6	133.1	17
BATCH 3 -	158.2	137.7	14
BATCH 4 -	153.0	133.0	14.8
			ROA
			47 (100 bars)
			53 (119 bars)
			40 (40 bars)
			44 (10 bars)

REDUCTION RATIO

RATIO= 4.9 TO 1.0




SURFACE INSPECT TO ASTM F788/F788M-02

** 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

PAGE 2

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

Gerdau MacSteel Monroe
3000 East Front Street
Monroe, MI 48161


Chris Easter
Quality Assurance Representative

CONTINUED ON PAGE 3

CERTIFIED MATERIAL TEST REPORT
CODE NCJ

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
6015		M32854	228544 101	7/13/09

REPORT TO
QUALITY ASSURANCE
THE DYSON CORPORATION

53 FREEDOM RD.

PAINESVILLE , OH 44077

SHIP TO
JOS. DYSON & SONS INC.

53 FREEDOM RD.

PAINESVILLE , OH 44077

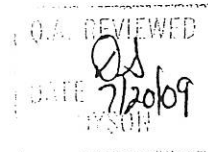
ORDERED

GRADE	SIZE	LENGTH
4140	3 . "	22' 7 3/4"

CUSTOMER SPECIFICATIONS

ASTM A354-07 GRADE BD; Q&T; (AIM FOR 35-37 ROCKWELL C)

TO MERCURY OR TO ANY OTHER METAL ALLOY THAT IS LIQUID AT AMBIENT
TEMPERATURES DURING PROCESSING OR WHILE IN OUR POSSESSION. **



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

11/12/2009

Steve Marsh
Dyson Corp.
53 Freedom Road
53 Freedom Rd
PAINESVILLE, OH 44077-1232

Material Testing and Non-Destructive
Testing

5405 E. Schaaf Road
Cleveland, OH 44131
USA

Date Received: 11/5/2009

Telephone : (216) 524-1450
Fax : (216) 524-1459
Website : www.storkherron.com

Test Report No.: DYS006-09-11-91483-1 *REVISED

TEST REPORT

P.O. No.: 69090

Sample Description: One (1) Lot (5 Pcs.) 3.00"-4UNC-2A X 1337mm (52.64") OAL Threaded Full Length Rods, Material per ASTM A354, Grade BD, ASTM A490-08a, ASTM F788, Caltran Special Provisions 10-1.59, 10-1.60, and 10-1.61 plus Caltrans Standard Specifications 75-1.05 Apply, Job #: 103208, Customer PO#: E2 Bearing & Shear Key, Heat #/Heat Code: M32854/ NCJ

MAGNETIC PARTICLE INSPECTION REPORT

Standard:	ASTM F788 - 06	
Procedure:	SOP 42.03	
METHOD		
<input type="checkbox"/> Dry		<input checked="" type="checkbox"/> Wet
PARTICLES		
Magnaflux Particles: <input type="checkbox"/> 8A Red <input checked="" type="checkbox"/> 14A <input type="checkbox"/> 3A Black <input type="checkbox"/> 14AM <input type="checkbox"/> 1 Gray <input type="checkbox"/> Other Batch No. 95A069	Part Preparation: <input checked="" type="checkbox"/> None Required <input type="checkbox"/> Solvent Clean <input type="checkbox"/> Grinding <input type="checkbox"/> Other	Wet Particle Carrier: <input checked="" type="checkbox"/> Magnaflux Carrier II <input type="checkbox"/> Pre Mixed <input type="checkbox"/> Concentration MI Batch No. 07C066
CURRENT		
<input type="checkbox"/> AC		<input checked="" type="checkbox"/> FWDC
<input type="checkbox"/> Central Conductor (AMPS)		<input checked="" type="checkbox"/> Head Shot (AMPS) 1600-1800
<input checked="" type="checkbox"/> Coil (AMPS) 1800-2000		<input type="checkbox"/> Prods (AMPS/Spacing)
Field Verified by: <input checked="" type="checkbox"/> Pie Gage <input type="checkbox"/> QQI <input type="checkbox"/> Hall Effect Probe		
EQUIPMENT		
<input checked="" type="checkbox"/> Magnaflux H-720 S/N: 81471 Cal Due Date: 3/24/2010		

The above services were performed in accordance with Herron Testing Laboratories' Quality Assurance Program Edition 1, Revision 3 dated 6/30/09. 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 Stork-Herron Testing Laboratories facilities.

Paula Tesar

Paula Tesar
Quality Administrator

11/12/2009

Steve Marsh
Dyson Corp.
53 Freedom Road
53 Freedom Rd
PAINESVILLE, OH 44077-1232

Material Testing and Non-Destructive
Testing

5405 E. Schaaf Road
Cleveland, OH 44131
USA

Date Received: 11/5/2009

Telephone : (216) 524-1450

Fax : (216) 524-1459

Website : www.storkherron.com

Test Report No.: DYS006-09-11-91483-1 *REVISED

TEST REPORT

P.O. No.: 69090

MAGNETIC PARTICLE INSPECTION RESULTS	
Quantity	Results
3 Pcs NCJ 3"-4UNC-2AX512mm	Acceptable
2Pcs NCJ 3"-4UNC-2AX512mm	A: Reject for possible lapping or tears MPI indications are located on the top portion of the threads(Crest). B: Subsequent metallographic examination revealed the indications were the result of tool marks which are acceptable per specification ASTM F788.*
Comments:	
Marking Requirements:	
Demag and post cleaning requirements: < 2 Gauss	
Inspected by: Shane Levermann	Certification: ASNT-SNT-TC-1A Level <input checked="" type="checkbox"/> II <input type="checkbox"/> III

EXPORT CONTROLLED (ITAR)

THE TECHNICAL DATA AND / OR MATERIALS ASSOCIATED WITH THIS ORDER FALLS WITHIN THE DEFINITION OF THE INTERNATIONAL TRAFFIC IN ARMS REGULATIONS (ITAR) AND IS SUBJECT TO THE EXPORT CONTROL LAWS OF THE U.S. GOVERNMENT. TRANSFER OF THIS DATA BY ANY MEANS TO A FOREIGN PERSON OR FOREIGN ENTITY, WHETHER IN THE UNITED STATES OR ABROAD, WITHOUT AN EXPORT LICENSE, ITAR EXEMPTION OR OTHER APPROVAL FROM THE U.S. DEPARTMENT OF STATE, IS PROHIBITED.

*REVISED 11-20-09: Certification revised to include results of metallographic examination

The above services were performed in accordance with Herron Testing Laboratories' Quality Assurance Program Edition 1, Revision 3 dated 6/30/09. 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 Stork-Herron Testing Laboratories facilities.

Paula Tesar

Paula Tesar
Quality Administrator

11/12/2009

Steve Marsh
Dyson Corp.
53 Freedom Road
53 Freedom Rd
PAINESVILLE, OH 44077-1232

Material Testing and Non-Destructive
Testing

5405 E. Schaaf Road
Cleveland, OH 44131
USA

Date Received: 11/5/2009

Telephone : (216) 524-1450

Fax : (216) 524-1459

Website : www.storkherron.com

Test Report No.: DYS006-09-11-91483-1 *REVISED

TEST REPORT

P.O. No.: 69090

Sample Description: One (1) Lot (5 Pcs.) 3.00"-4UNC-2A X 1337mm (52.64") OAL Threaded Full Length Rods, Material per ASTM A354, Grade BD, ASTM A490-08a, ASTM F788, Caltran Special Provisions 10-1.59, 10-1.60, and 10-1.61 plus Caltrans Standard Specifications 75-1.05 Apply, Job #: 103208, Customer PO#: E2 Bearing & Shear Key, Heat #/Heat Code: M32854/ NCJ

MAGNETIC PARTICLE INSPECTION REPORT

Standard:	ASTM F788 - 06	
Procedure:	SOP 42.03	
METHOD		
<input type="checkbox"/> Dry		<input checked="" type="checkbox"/> Wet
PARTICLES		
Magnaflux Particles: <input type="checkbox"/> 8A Red <input checked="" type="checkbox"/> 14A <input type="checkbox"/> 3A Black <input type="checkbox"/> 14AM <input type="checkbox"/> 1 Gray <input type="checkbox"/> Other Batch No. 95A069	Part Preparation: <input checked="" type="checkbox"/> None Required <input type="checkbox"/> Solvent Clean <input type="checkbox"/> Grinding <input type="checkbox"/> Other	Wet Particle Carrier: <input checked="" type="checkbox"/> Magnaflux Carrier II <input type="checkbox"/> Pre Mixed <input type="checkbox"/> Concentration MI Batch No. 07C066
CURRENT		
<input type="checkbox"/> AC		<input checked="" type="checkbox"/> FWDC
<input type="checkbox"/> Central Conductor (AMPS)		<input checked="" type="checkbox"/> Head Shot (AMPS) 1600-1800
<input checked="" type="checkbox"/> Coil (AMPS) 1800-2000		<input type="checkbox"/> Prods (AMPS/Spacing)
Field Verified by: <input checked="" type="checkbox"/> Pie Gage <input type="checkbox"/> QQI <input type="checkbox"/> Hall Effect Probe		
EQUIPMENT		
<input checked="" type="checkbox"/> Magnaflux H-720 S/N: 81471 Cal Due Date: 3/24/2010		

The above services were performed in accordance with Herron Testing Laboratories' Quality Assurance Program Edition 1, Revision 3 dated 6/30/09. 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 Stork-Herron Testing Laboratories facilities.

Paula Tesar

Paula Tesar
Quality Administrator

11/12/2009

Steve Marsh
Dyson Corp.
53 Freedom Road
53 Freedom Rd
PAINESVILLE, OH 44077-1232

Material Testing and Non-Destructive
Testing

5405 E. Schaaf Road
Cleveland, OH 44131
USA

Date Received: 11/5/2009

Telephone : (216) 524-1450

Fax : (216) 524-1459

Website : www.storkherron.com

Test Report No.: DYS006-09-11-91483-1 *REVISED

TEST REPORT

P.O. No.: 69090

MAGNETIC PARTICLE INSPECTION RESULTS	
Quantity	Results
3 Pcs NCJ 3"-4UNC-2AX512mm	Acceptable
2Pcs NCJ 3"-4UNC-2AX512mm	A: Reject for possible lapping or tears MPI Indications are located on the top portion of the threads(Crest). B: Subsequent metallographic examination revealed the indications were the result of tool marks which are acceptable per specification ASTM F788.*
Comments:	
Marking Requirements:	
Demag and post cleaning requirements: < 2 Gauss	
Inspected by: Shane Levermann	Certification: ASNT-SNT-TC-1A Level <input checked="" type="checkbox"/> II <input type="checkbox"/> III

EXPORT CONTROLLED (ITAR)

THE TECHNICAL DATA AND / OR MATERIALS ASSOCIATED WITH THIS ORDER FALLS WITHIN THE DEFINITION OF THE INTERNATIONAL TRAFFIC IN ARMS REGULATIONS (ITAR) AND IS SUBJECT TO THE EXPORT CONTROL LAWS OF THE U.S. GOVERNMENT. TRANSFER OF THIS DATA BY ANY MEANS TO A FOREIGN PERSON OR FOREIGN ENTITY, WHETHER IN THE UNITED STATES OR ABROAD, WITHOUT AN EXPORT LICENSE, ITAR EXEMPTION OR OTHER APPROVAL FROM THE U.S. DEPARTMENT OF STATE, IS PROHIBITED.

*REVISED 11-20-09: Certification revised to include results of metallographic examination

The above services were performed in accordance with Herron Testing Laboratories' Quality Assurance Program Edition 1. Revision 3 dated 6/30/09. 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 Stork-Herron Testing Laboratories facilities.

Paula Tesar

Paula Tesar
Quality Administrator

Monnig Industries, Inc.

HOT DIP & MECHANICAL GALVANIZING

P.O. BOX 98

GLASGOW, MO 65254

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

JANUARY 20, 2010

DYSON CORPORATION
50 FREEDOM ROAD
PAINESVILLE, OH 44077

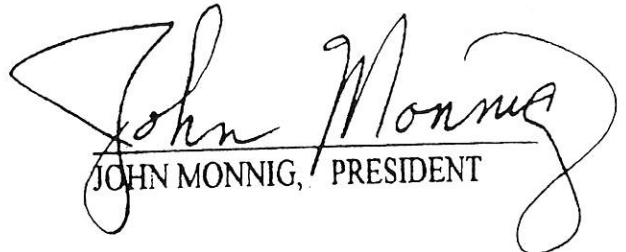
RE: GALVANIZING CERTIFICATE-CALTRAN
P.O. 69398 103 PCS 3.00" X 52.64" THREADED
35 PCS 3.00" X 21.14" THREADED
102 PCS 3.00" X 51.65" THREADED
70 PCS 3.00" X 20.16" THREADED
252 PCS 2.00" X 43.50" THREADED
P.O. 69475 34 PCS 3.00" X 21.14" THREADED
78 PCS 2.00" X 43.50" THREADED


THIS WILL CERTIFY THAT THE MATERIAL GALVANIZED ON THE ABOVE
JOB MEETS OR EXCEEDS THE MINIMUM REQUIREMENTS OF ASTM A-153
SPECIFICATIONS.

MILL READINGS

4.0	4.8	4.3	5.2
4.5	5.5	6.2	7.0
5.1	5.3	4.5	5.0

PATRICIA S. WESTHUES
NOTARY PUBLIC STATE OF MISSOURI
HOWARD COUNTY
MY COMMISSION EXP. APR. 18, 2012


JOHN MONNIG, PRESIDENT


PATRICIA S. WESTHUES,
NOTARY PUBLIC

HORSEHEAD CORPORATION

METAL SHIPPING RECORD

TAP	SHIP. WT.	Fe	Pb	Cd	Al	DATE
351	3173					11-20-09
350	3045					Customer:
352	3163	.018	.873	.014	.000	BOB MONNIG
353	2977					Destination:
345	3017					Glasgow, Mo
342	2908					Order No.:
343	3101					145914
344	2968					Grade:
347	2970					PW-500L
346	2993					44,000
349	2991					4 Lowboys
348	3000					Net Weight:
341	3083					42425
340	3036					Special Instructions:
						Dock/Side
						Tally
						Assays

Received Time Nov. 19. 9:22AM

50N

HORSEHEAD CORPORATION

METAL SHIPPING RECORD

TAP	SHIP WT.	Fe	Pb	Cd	Al	DATE
971	2996					11-20-09
928	3338					Customer:
973	3068					BOB MONNIG
969	3023					Destination:
961A	3021					Glasgow, Mo
970	3065					Order No.:
968	3022					145913
972	3088					Grade:
926	3311					PW-500L
921	3387					44,000
927	3330					14 Lowboys
920	3314					Net Weight:
923	3172	.021	.889	.022	.000	44325
925	3250					Special Instructions:
						Dock/Side
						Tally
						Assays

Received Time Nov. 19. 9:22AM

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 A354BD, A153, TM 03. Lot #NSH2; Heat #M30263. (Retest of SM #10-0083) Retest Samples Are Satisfactory For Use.

Sample No: SM-10-0135

Date Sampled: 02/08/10

Date Rec'd: 02/11/10

Date Reported: 02/17/10

Lot No: B23100710

TL-101 / SIC No: C715360

Contract/Permit No: 04-0120F4

Material: 2"x 43.50" HDG Suspender Socket Anchor Bolt (Retest of SM 10-0083)

Manufacturer: Dyson

Sampler: J. Lizarro

2-18-10

Results: SAMPLES SUBMITTED ARE SATISFACTORY FOR USE

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

2-11 10-0135

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
SAMPLE IDENTIFICATION CARD
TL-0107 (REV. 10/97) CARD NUMBER C 715360

☐ PRELIMINARY TESTS
☐ PROCESS TESTS
☐ ACCEPTANCE TESTS
☐ INDEPENDENT ASSURANCE TESTS

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

INDEPENDENT ASSURANCE TESTS
☐ DIST. LAB.
☒ SPECIAL TESTS

SHIPMENT NO. AUTHORIZATION NO. Retest 10-0083

SAMPLE OF 2" Ø ASTM A354 GR BD FOR USE IN SPOBBS SUS ER BEARING / SHEAR KEY

SAMPLE FROM 3-2" Ø A354 GR BD X 1105 mm ALL THREADED ROD

DEPTH

LOCATION OF SOURCE MANNING INDUSTRIES
400 INDUSTRIAL DRIVE, GAKGOW, MO

THIS SAMPLE IS SHIPPED IN (NO. CONTAINERS) 1

SAMPLES REPRESENTING (NO. TESTS) 8 PCS

OWNER OR MANUFACTURER MANNING

TOTAL QUANTITY AVAILABLE 3

TEST RESULTS DESIRED ☒ NORMAL ☐ PRIORITY

DATE NEEDED

REMARKS 3-2" Ø A354 GR BD X 1105 mm ALL THREADED WITH HEAT TRACE CODE NSH2 (Retest)

COVER ADDITIONAL INFORMATION WITH LETTER

DATE SAMPLED 2/8/10

BY J. LIZARRO TITLE QA INSPECTOR

DIST. CO. RTE. PM

LIMITS 04-0120F4 SPECIALS / ASTM A354

CONT. NO. 04 - 0120F4

FED. NO.

RES. ENGR. GARY PURSELL

ADDRESS 333 BURMAN RD, DAKLON, CA

CONTRACTOR AMERICAN BRIDGE / FLOOR A JV

375 BURMAN RD, DAKLON, CA

ENCLOSE WITH SAMPLE

Print

Contract 04-0120F4 TL-0101 Number C715360 Date Rec'd. 2/11/10 Date Tested: 2/16/10

Lab Technician:

Nuts:

Washer:

[illegible]

.505 SAMPLES



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

SM Number = 10-0135

Sample	Heat Number	Diameter (in)	Area (in ²)	Stress at Offset (psi)	Tensile Strength (psi)	Elongation in 4 x d (%)	Tested By
A	NSH2	0.507	0.2019	130 ⁰⁰⁰ 146946	150 ⁰⁰⁰ 161100	16.2	EMcCrory
B	NSH2	0.507	0.2019	150377	163000	14.6	EMcCrory
C	NSH2	0.507	0.2019	148735	162210	15.2	EMcCrory
D	NSH2	0.505	0.2003	151101	164130	14.6	EMcCrory
				OK	OK	OK	

S. M. NO.	DATE RECEIVED
10-0135	2/11/10
T 101 NO.	CONT. W/O. OR P.O. NO.
	04-0120F4
LOT NO.	FAP. NO.

TEST NAME	DISTRICT	COUNTY	ROUTE	POST MILES
CONTRACTOR	SAMPLED BY		DATE SAMPLED	SUPPLY SOURCE
AGENCY	MANUFACTURER		MATERIAL TESTED FOR	

[illegible]

SPECIFICATIONS

1354

REMARKS

DATE TESTED	2/16/10	TESTED BY	EM	APPROVED BY
EM 30421006				

STRUCTURAL MATERIALS TESTING LABORATORY
FORM TL-652 (REV. 3/05)

TEST SPECIMEN PREPARATION
AND RECORD

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

SM No.
10-0135

Contract No.
04-0120F4

Requesting Lab Technician
F Saylor

Date Needed
normal


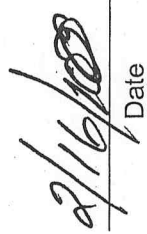
TL-0101 No.
C715360

E.A./Spec. Desg./Object
04-0120F3

Date Received
2-11-10

Date Tested/Provided
2-16-10

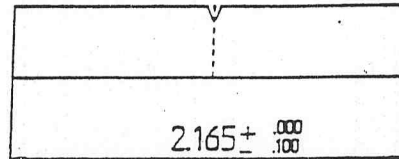
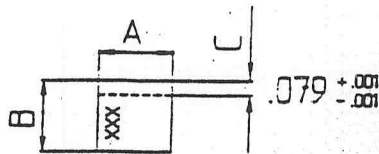
<input checked="" type="checkbox"/> Machine Shop Work Requested <input checked="" type="checkbox"/> standard round tension test specimen, circle one: 0.500" 0.350" 0.250" <input type="checkbox"/> standard rectangular tension test specimen, circle one: 18" long, 8" gage length 8" long, 2" gage length <input type="checkbox"/> Charpy, circle one: 10mm x 10mm 10mm x 7.5mm <input type="checkbox"/> hardness measurement sample (fasteners) <input type="checkbox"/> weld nugget <input type="checkbox"/> chemistry slug <input type="checkbox"/> other: _____ hardness <input checked="" type="checkbox"/> see instructions →	Heat #M30263 ReTest of SM 10-0083 Please Machine .505 Mark 263A, B, C, D	<input type="checkbox"/> Chemistry Lab type of material: _____ Work Requested <input type="checkbox"/> neoprene verification <input type="checkbox"/> oil swell <input type="checkbox"/> zinc coating weight <input type="checkbox"/> steel chemistry analysis <input type="checkbox"/> other: _____ ← <input type="checkbox"/> see instructions <input type="checkbox"/> Other (explain)
---	--	--

Comments or further instructions	The received service is acceptable  Receiving Lab Technician  Date
----------------------------------	--

TRANSLAB

S.M. INSPECTION REPORT FOR HEAT # 263

COMPLETED BY ms
DATE: 2-16-10



MATERIAL SURFACE



NOTCH ORIENTATION

OK

1	
2	
3	

CHARPY IMPACT SPECIMENS

☐ FULL SIZE 10MM X 10MM

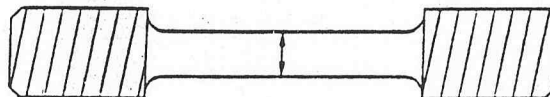
☐ REDUCED

A B C 2.165 .010 R ± .001

1					
2					
3					

NOTE: IMPACT SPECIMENS ARE TO BE GROUND TO $.394 \pm .003$ ON SURFACE GRINDER
ASTM E23 CALLS FOR 45 deg. V NOTCH WITH A $.010 \pm .001$ RADIUS

A DIA.



☒ $.500 \pm .010$

☐ $.350 \pm .007$

☐ OTHER

A DIA. IS

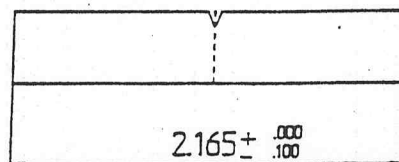
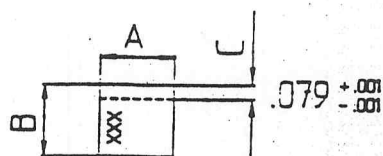
C.		.507
D.		.503

NOTES / SPECIAL INSTRUCTIONS

TRANSLAB

S.M. INSPECTION REPORT FOR HEAT # _____

COMPLETED BY _____
DATE: _____



CHARPY IMPACT SPECIMENS

☐ FULL SIZE 10MM X 10MM

☐ REDUCED

MATERIAL
SURFACE



NOTCH
ORIENTATION

OK

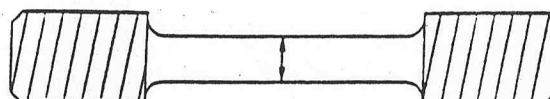
1	
2	
3	

A B C 2.165 .010 R ± .001

1					
2					
3					

NOTE: IMPACT SPECIMENS ARE TO BE GROUND
TO $.394 \pm .003$ ON SURFACE GRINDER
ASTM E23 CALLS FOR 45 deg. V NOTCH
WITH A $.010 \pm .001$ RADIUS

A DIA.



☐ $.500 \pm .010$

☐ $.350 \pm .007$

☐ OTHER

A DIA. IS

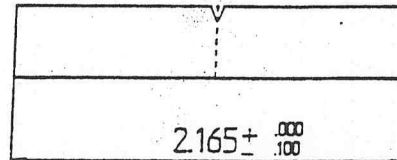
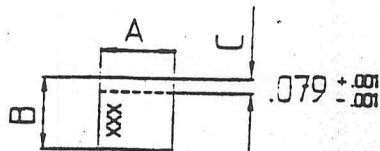
A	
B	

NOTES / SPECIAL INSTRUCTIONS

TRANSLAB

S.M. INSPECTION REPORT FOR HEAT # 263

COMPLETED BY ma
DATE: 2-16-10



CHARPY IMPACT SPECIMENS

- ☐ FULL SIZE 10MM X 10MM
☐ REDUCED

MATERIAL SURFACE



NOTCH ORIENTATION

OK

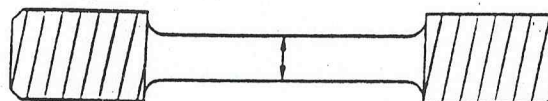
1	
2	
3	

A B C 2.165 .010 R ± .001

1					
2					
3					

NOTE: IMPACT SPECIMENS ARE TO BE GROUND TO $.394 \pm .003$ ON SURFACE GRINDER
ASTM E23 CALLS FOR 45 deg. V NOTCH WITH A $.010 \pm .001$ RADIUS

A DIA.



☒ .500 ± .010 / .010

☐ .350 ± .007 / .007

☐ OTHER

A DIA. IS

A	.507
B	.506

NOTES / SPECIAL INSTRUCTIONS

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:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-001796**Date Inspected:** 17-Feb-2010**Project Name:** SAS Superstructure**OSM Arrival Time:** 800**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1630**Contractor:** Dyson Corp. & Subs**Location:** Painesville, Ohio**Quality Control Contact:** Bob Bobnar**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:** Fastener Assemblies**Bridge No:** 34-0006**Component:** Cable System, E2 Bearing, Shear Keys**Bid Item:** 45,59,61,68**Lot No:** B208-023-10, B208-024-10**Summary of Items Observed:**

The Caltrans Quality Assurance (QA) Inspector Sherri Brannon was present at Dyson Corp in Painesville, Ohio, to observe the fabrication of components that will be used in the San Francisco / Oakland Bay Bridge (SFOBB) project.

The QA Inspector was requested to select check samples that will be sent to TransLab for testing. QA Inspector Brannon reviewed the contractor's Certificate of Compliance (C.O.C) and shipping documentation. QA Inspector Brannon also made random observations of the materials as it was presented. QA Inspector Brannon noted that the material and documentation appeared to be in general compliance with the contract requirements. The QA Inspector reviewed the contract requirements and State Letter 05.03.01-002360 and selected the material / parts to be sampled. The QA Inspector issued TL-101 # C726454 with lot # B208-023-10 for the ASTM A709 Grade 50 - 9.84" x 11.81" rectangle x 3.68" ID bearing plate washers, Lot Code-NLU, Heat #D4327. The samples were put onto pallets for shipment. QA Inspector Brannon spoke with SMR Kittick Guest on sample quantities.

The QA Inspector was requested to select check samples that will be sent to TransLab for testing. QA Inspector Brannon reviewed the contractor's Certificate of Compliance (C.O.C) and shipping documentation. QA Inspector Brannon also made random observations of the materials as it was presented. QA Inspector Brannon noted that the material and documentation appeared to be in general compliance with the contract requirements. The QA Inspector reviewed the contract requirements and State Letter 05.03.01-002360 and selected the material / parts to be sampled. The QA Inspector issued TL-101 # C726455 with lot # B208-024-10 for the ASTM A563 Grade DH - 3.00"-4UNC-2B heavy hex spherical nut Lot Code-NGB2, Heat #M653662. The samples were put onto pallets for shipment. QA Inspector Brannon spoke with SMR Kittick Guest on sample quantities.

SOURCE INSPECTION REPORT

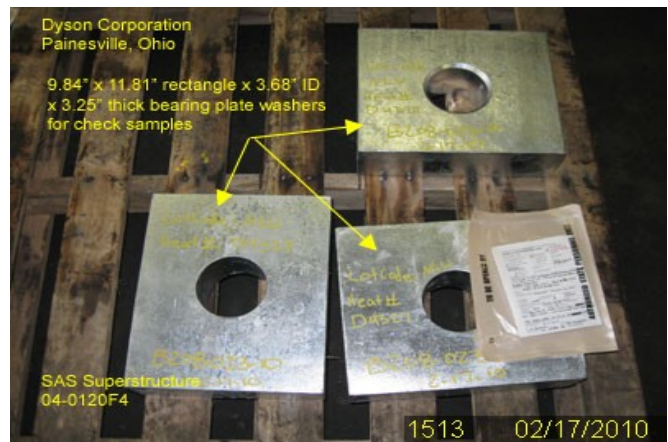
(Continued Page 2 of 2)

QA Inspector Brannon checked the status of pending tests results and informed Mr. Bobnar that retest check samples for the ASTM A354 Grade BD 2.00"-4.5UNC-2A x 1105mm OAL threaded full length rod results are satisfactory for use. QA Inspector Brannon relayed this information to the Structural Materials Representatives (SMRs) Nina Choy and Kitrich Guest. Reference documents: Caltrans QA Lot No: B231-007-10; Sample Identification Card TL-101 No: C715360; and Structural Materials Testing Laboratory Sample No: SM-10-0135 (retest of SM-10-0083).

The QA Inspector Brannon randomly observed Dyson personnel machining / fabricating components for fasteners assemblies for the following: bid item #45 - Furnish and Install Spherical Bushing Bearing (Pier E2), bid item #59 -Furnish Structural Steel (Bridge) (Saddle), bid item #61 - Furnish and Install Shear Key (Pier E2), and bid item #68 - Furnish Suspender System. QA Inspector Brannon made general observations of the milling, machining and threading of the various components (rods, bolts, nuts, washers). The QA Inspector Brannon noted that all observed work appeared to be performed to commonly accepted industry standards and procedures.

QA Inspector Brannon also updated tracking log for tracking different components at various stages for machining, galvanizing, painting, magnetic particle testing, shipping and sampling of QA check samples.

The following digital photograph below illustrates observation of the activities being performed.



Summary of Conversations:

As stated within this report.

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: Brannon, Sherri

Quality Assurance Inspector

Reviewed By: Levell, Bill

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 #: 76.15**SOURCE INSPECTION REPORT****Resident Engineer:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** SIR-001798**Date Inspected:** 19-Feb-2010**Project Name:** SAS Superstructure**OSM Arrival Time:** 800**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1630**Contractor:** Dyson Corp. & Subs**Location:** Painesville, Ohio**Quality Control Contact:** Bob Bobnar**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:** Fastener Assemblies**Bridge No:** 34-0006**Component:** Cable System, E2 Bearing, Shear Keys**Bid Item:** 45,59,61,68**Lot No:** B208-027-10**Summary of Items Observed:**

The Caltrans Quality Assurance (QA) Inspector Sherri Brannon was present at Dyson Corporation in Painesville, Ohio, to observe the fabrication of components that will be used in the San Francisco / Oakland Bay Bridge (SFOBB) project.

Mr. Bob Bobnar informed QA Inspector Brannon that the replacement rods for ASTM A354 Grade BD 2.00"-4.5UNC-2A x 1105mm OAL threaded full length rods for bid items #45, are ready for QA Inspection for green tag release for shipping back to Dyson Corporation. QA Inspector Brannon traveled to Art Galvanizing and reviewed applicable documents and verified quantities. After review of the documents and material to be shipped QA Inspector Brannon assigned Caltrans lot number B208-027-10. See Caltrans Component Material Inspection Report, TL-6011 dated February 19, 2010 for specific information.

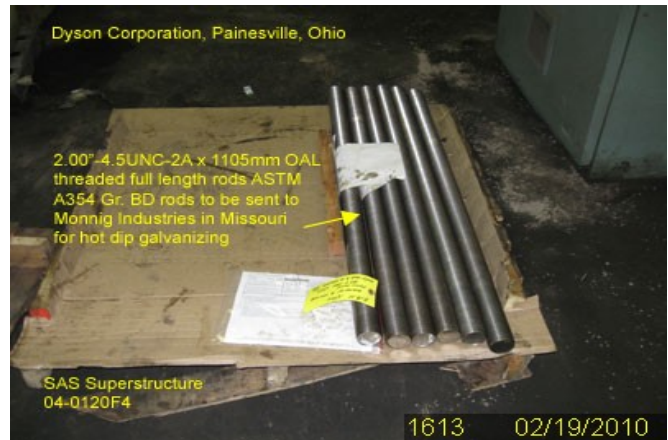
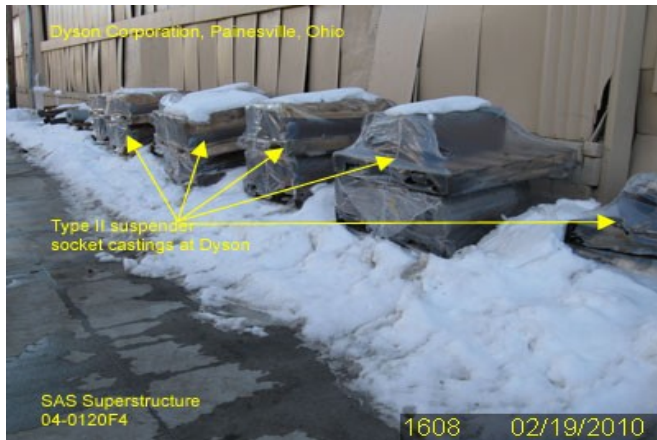
The QA Inspector Brannon randomly observed Dyson personnel machining / fabricating components for fasteners assemblies for the following: bid item #45 - Furnish and Install Spherical Bushing Bearing (Pier E2), bid item #59 -Furnish Structural Steel (Bridge) (Saddle), bid item #61 - Furnish and Install Shear Key (Pier E2), and bid item #68 - Furnish Suspender System. QA Inspector Brannon made general observations of the milling, machining and threading of the various components (rods, bolts, nuts, washers). The QA Inspector Brannon noted that all observed work appeared to be performed to commonly accepted industry standards and procedures.

QA Inspector Brannon also updated tracking log for tracking different components at various stages for machining, galvanizing, painting, magnetic particle testing, shipping and sampling of QA check samples.

SOURCE INSPECTION REPORT

(Continued Page 2 of 2)

The following digital photograph below illustrates observation of the activities being performed.



Summary of Conversations:

As stated within this report.

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: Brannon, Sherri

Quality Assurance Inspector

Reviewed By: Levell, Bill

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 #: 76.8**COMPONENT MATERIAL INSPECTION REPORT****Resident Engineer:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** CMI-000191**Date Inspected:** 19-Feb-2010**Contractor:** Dyson Corp. & Subs**Location:** Painesville, Ohio**Bridge No.:** 34-0006**OSM Arrival Time:** 800**OSM Departure Time:** 1630**Component:#** E2 Bearing

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: Monnig Industries, 400 Industrial Drive, Glasgow, Missouri

Lot #	Bid Item #	Quantity	Material Description
B208-027-10	45	3 ea	ASTM A354 Grade BD 2.00"-4.5UNC-2A x 1105mm OAL threaded full length rod, Lot Code-NSH2, Heat #M30263

Identification: Green tag attached to Certificate of Compliance / Shipping Package.**Summary of Items Observed:**

QA Inspector Brannon reviewed the contractor's Certificate of Compliance (C.O.C) and shipping documentation. QA Inspector Brannon also made random observations of the materials as it was presented. QA Inspector Brannon noted that the material and documentation appeared to be in general compliance with the contract requirements. QA Inspector Brannon issued a green tag with Caltrans QA lot number B208-027-10 for bid item #45 - Furnish and Install Spherical Bushing Bearing (Pier E2)for tracking purposes. QA Inspector Brannon was informed by Mr. Bob Bobnar that the material being shipped is to replace the retest samples sent to Translab for retesting.

Summary of Conversations:

As stated within this report.

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: Brannon, Sherri

Quality Assurance Inspector

Reviewed By: Levell, Bill

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 #: 1.9**REPORT OF INSPECTION OF MATERIAL****Resident Engineer:**Pursell, Gary**Address:** 333 Burma Road**City:** Oakland, CA 94607**Report No:** RIM-000016**Date Inspected:** 05-Mar-2010**Project Name:** SAS Superstructure**OSM Arrival Time:** 930**Prime Contractor:** American Bridge/Fluor Enterprises, a JV**OSM Departure Time:** 1400**Contractor:** Monnig Industries**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	B231-012-10	45	174	ASTM A354 Gr. BD, 2.00" - 4.5 UNC-2A x 42.48" Threaded Full Length Rod, Heat Code NSH
2	B231-013-10	45	78	ASTM A354 Gr. BD, 2.00" - 4.5 UNC-2A x 42.48" Threaded Full Length Rod, Heat Code NSH2
3	B231-014-10	45	464	ASTM A563 Gr DH 2.00" - 4.5 UNC-2B Heavy Hex Nut, Heat Code DCMO

Identification: Orange Tag attached to each COC**Shipped to:** ABF, 375

Burma

Road,

Oakland,

CA

Summary of Items Observed:

Caltrans Office of Structural Material (OSM) Quality Assurance (QA) Inspector Joselito Lizardo was present as requested to perform material release on the galvanized 2.0" diameter all threaded rods performed at Monnig Industries in Glasgow, MO. In addition this QA Inspector was also requested to release 2.0" diameter heavy hex nuts that were manufactured by Dyson Corp. and previously green tagged with Caltrans Lot number B206-114-09.

This 2" diameter all threaded rods are being released by virtue of satisfactory test results from Caltrans Structural Materials Testing Laboratory dated February 1, 2010 (NSH) and February 18, 2010 (NSH2). QA Joselito Lizardo reviewed the Monnig Industries and Dyson Corporation's Certified Material Test Report/Certificate of Compliance and deemed acceptable.

QA Joselito Lizardo also made random observations of the materials as they were presented. QA Inspector Lizardo noted that the material and documentation appeared to be in general compliance with the contract requirements. QA Inspector Lizardo issued an orange tag with Caltrans QA lot number B231-012-10 for the 2.0" diameter all threaded rod with heat code NSH, B231-013-10 for the 2.0" diameter all threaded rod with heat code NSH2 and B231-014-10 for the 2" diameter Heavy Hex Nuts.

REPORT OF INSPECTION OF MATERIAL

(Continued Page 2 of 2)

Summary of Conversations:

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

Inspected By:	Lizardo, Joselito
----------------------	-------------------

Quality Assurance Inspector

Reviewed By:	Levell, Bill
---------------------	--------------

QA Reviewer

CERTIFIED MATERIAL TEST REPORT

DYSON CORP.
DOMESTIC NUT

53 Freedom Road
 Painesville, OH 44077

440-946-3500
 440-352-2700 fax

DYSON ORDER#	CUSTOMER ORDER#	ITEM NUMBER	QUANTITY SHIPPED	DATE SHIPPED
L 103205	E2 Bearing & Shear Key	1 of 11	pcs	

CUSTOMER
 Hochang Machinery Industries Co., Ltd.
 SFOBB - E2 Bearing & Shear Key / Bolt
 #743-65 YangDeung-Ri, Sangbuk-Myun
 Uiju-Gun, N/A Ulsan
 Korea

DRAWING
 SFOBB-E2B-883-10-36-1

PRODUCT DESCRIPTION
 2.00"-4.5UNC-2A x 1079mm (42.48") OAL threaded
 full length rod, HDG per ASTM-A153 w/near white
 metal blast prior to galvanize. Ref:
 SFOBB-E2B-883-10-36.1, Bid Item 45, Item Code

SPECIFICATIONS
 ASTM-A354-07 Grade BD with special provisions
 10-1.59, 10-1.60, 10-1.61 std specifications 75-1.05
 Caltrans hold points apply to this order
 Preliminary CMTR issued on 11/20/09


STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.	ORIGINAL MILL
Round Bar	1.852	BD	174	NSH	M30263	Gerdau

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

1. The steel was melted and manufactured in the USA and the product was manufactured and tested in the USA.

Attachments:

Mill Test Reports
 Mechanical Test Reports
 Galvanizing Certification


 Deborah A. Smith
 Q.A. Admin. Assistant

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

KREHER STEEL COMPANY, LLC.

PO/Rel

I hereby certify that this data is correct as contained in the records of this company.
I hereby certify that no mercury came in contact

Certificate of Mill Test Results

1 - 000000-000

Pg 1/2

with or no weld repair was done to this product while in our possession.
Attn:

ART NO.

CODE NSH



ONE JACKSON SQUARE
SUITE 500
JACKSON, MICHIGAN 48201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
17123	4811	M30263	221035 101	7/21/08

SHIP TO

REPORT TO

ERIN
KREHER STEEL

1550 N. 25TH AVE

MELROSE PARK, IL 60160

KREHER-STEEL

1550 N. 25TH AVE.

MELROSE PARK, IL 60160

GRADE	SIZE	ORDERED	LENGTH
4140	2"	RND	24' 3"
CUSTOMER SPECIFICATIONS			
ASTM A29/A29M-05 / A322-07 / E381-01			

CHEMICAL ANALYSIS

C /	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.41	0.86	0.019	0.026	0.25	0.09	0.93	0.20	0.23	0.008	0.024
V	Nb									
0.007	0.003									

GRAIN SIZE

SPECIFICATION ASTM E112

FINE GRAIN 5-8

HARDENABILITY

SPECIFICATION ASTM A255/A304

THEORETICAL																											
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	57	57	57	57	57	57	55	54	53		50		48		46	46	45		43		41		38				

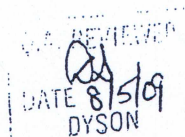
MACROCLEANLINESS

SPECIFICATION ASTM E381

PLATE I

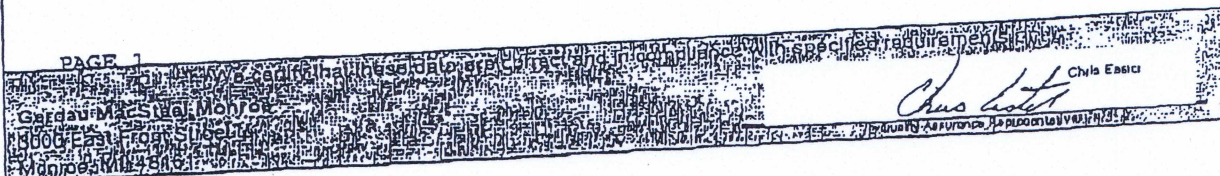
PLATE II

AVERAGE	S	R	C	NONE
1	1	1	1	



T+Pto 1.852"0

PAGE 1



CONTINUED ON PAGE 2

KREHER STEEL COMPANY, LLC.

Certificate of Mill Test Results

1 -000000-000

Pg 2/2

P.O./Ref

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

with or no weld repair was done to this product while in our possession.

I hereby certify that no mercury came in contact

Attn:

PART NO.

CODE NSH



GERDAU MACSTEEL

ONE JACKSON SQUARE
SUITE 300
JACKSON, MICHIGAN 48201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
17123	4811	M30263	221035 101	7/21/08

REPORT TO

ERIN
KREHER STEEL

1550 N. 25TH AVE

MELROSE PARK , IL 60160

SHIP TO

KREHER STEEL

1550 N. 25TH AVE.

MELROSE PARK , IL 60160

ORDERED

GRADE	SIZE	LENGTH
4140	2" RND	24' 3"

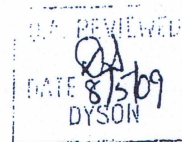
CUSTOMER SPECIFICATIONS

ASTM A29/A29M-05; A322-07; E381-01

REDUCTION RATIO

RATIO= 11.5 TO 1.0

** 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. **



T+P to 1.852"ø

PAGE 2 OF 2

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

Gerdau MacSteel Monitor

Chris Easter



TC Industries Test Center
 3703 South Route 31
 Crystal Lake, IL 60012-1412
 Telephone 815/459/2400 Fax 815/459/3419



Certificate No. 1281-01

TEST REPORT

REPORT NO: 145085C

DATE: JULY 30, 2009

PAGE 1 OF 1

TO:

SUPPLEMENT TO REPORT# 145085B
 KREHER STEEL CO.
 1550 NORTH 26TH AVENUE
 MELROSE PARK, IL 60160

SHIP TO: KREHER STEEL CO.
 1550 NORTH 26TH AVENUE
 MELROSE PARK, IL 60180

CODE NSH

DESC: 88 PCS	2"RD X 24'S"	HEAT#: M30263	GRADE: 4140	WT: 22892
	PO: 1-110131	MO: N/A	CO: 048697	LOT: 64853
SPEC: QUENCH, TEMPER, STRAIGHTEN	ASTM-A354-BD-07A			
	AIM RC 33/37 @ SURFACE			
PROCESS: FURN TEMP :	1600	FURN TIME hh:mm:	1.20	QUENCH: OIL
TEMPER TEMP:	1015	TEMPER TIME hh:mm:	2.00	
STRESS TEMP:		STRESS TIME hh:mm:		
PARAMETER	UNITS	LIMITS	TEST RESULTS (See sampling plan on back)	
TENSILE	KSI	150 N/A	SAMPLE#1 159	SAMPLE#2 157
YIELD 2%	KSI	130 N/A	SAMPLE#1 131	SAMPLE#2 130
ELONG 2"	%	14 N/A	SAMPLE#1 16	SAMPLE#2 17
RED AREA	%	40 N/A	SAMPLE#1 64	SAMPLE#2 64
SURF RC	HRC	0 N/A	36	35
			37	36
MID RAD RC	HRC	0 N/A	36	34
			34	33
CORE RC	HRC	0 N/A	37	34
			37	32

TC INDUSTRIES AND SUBCONTRACTED LABS (A2LA ACCREDITED)	
Tensile, Standard Tensile, Full Secn Charpy V 10mmx10mm Microhardness, Knoop* TC: TC Ind Test Center Cert #1281-01 12/8/11	Rockwell Brinell Spectro* Macroetch EX: Exova Services Cert #0288 6/30/10 Cert #0104 12/31/10 Cert #0188 11/30/10 MSI: Metallurgical Services Cert #0510 12/31/10
Micro Analysis* Decarb Measure Chemistry*	

*Not Included in our scope of accreditation

Ken Rueff
 Ken Rueff
 Test Center Supervisor

12.16F 7/8/09
 THE SAMPLE #1 RESULTS ARE FROM PILE# 11044587 BATCH 1: 29 PCS
 THE SAMPLE #2 RESULTS ARE FROM PILE# 11044588 BATCH 2: 29 PCS
 THE SAMPLE #3 RESULTS ARE FROM PILE# 10927221 BATCH 3: 30 PCS

Q.A. REVIEWED
 DATE 8/5/09
 DYSON

T+P to 1.852"φ

We make no deviations from test methods unless noted. It should not be assumed that mechanical properties of raw material heat treated to meet standard will have the same properties of a finished testener whose original material characteristics may have been significantly altered by any treatment used/added and no welding/weld repair was performed on this material while in the possession of TC Industries, Inc.

This test report displays a raised "TC Industries Test Center" seal. This test report relates only to the items tested and shall not be used in full, without the written permission of TC Industries Test Center.



TC Industries Test Center

3703 South Route 31
Crystal Lake, IL 60012-1412
Telephone 815/459/2400 Fax 815/459/3419



Certificate No. 1281-01

TEST REPORT

REPORT NO: 145085C

DATE: JULY 30, 2009

PAGE 1 OF 1

TO:

SUPPLEMENT TO REPORT# 145085B

KREHER STEEL CO.
1550 NORTH 25TH AVENUE
MELROSE PARK, IL 60160

SHIP TO: KREHER STEEL CO.

1550 NORTH 25TH AVENUE
MELROSE PARK, IL 80180

CODE NSH

DESC: 88 PCS	2"RD X 24'3"	HEAT#: M30263	GRADE: 4140	WT: 22892	
	PO: 1-110131	MO: N/A	CO: 048697	LOT: 64853	
SPEC: QUENCH, TEMPER, STRAIGHTEN		ASTM-A354-BD-07A			
AIM RC 33/37 @ SURFACE					
PROCESS:	FURN TEMP: 1600	FURN TIME hh:mm: 1.20	QUENCH: OIL		
	TEMPER TEMP: 1015	TEMPER TIME hh:mm: 2.00			
	STRESS TEMP:	STRESS TIME hh:mm:			
PARAMETER	UNITS	LIMITS	TEST RESULTS (See sampling plan on back)		
TENSILE	KSI	150 N/A	SAMPLE#1 159	SAMPLE#2 157	SAMPLE#3 156 ^
YIELD .2%	KSI	130 N/A	SAMPLE#1 131	SAMPLE#2 130	SAMPLE#3 136 ^
ELONG 2"	%	14 N/A	SAMPLE#1 16	SAMPLE#2 17	SAMPLE#3 17 ^
RED AREA	%	40 N/A	SAMPLE#1 64	SAMPLE#2 54	SAMPLE#3 53 ^
SURF RC	HRC	0 N/A	36	35	37
			37	35	36
MID RAD RC	HRC	0 N/A	36	34	36
			34	33	37
CORE RC	HRC	0 N/A	37	33	34
			37	35	32

TC INDUSTRIES AND SUBCONTRACTED LABS (A2LA ACCREDITED)

Tensile, Standard	TC	Rockwell	TC	Micro Analysis*
Tensile, Full Secn		Brinell		Decarb Measure
Charpy V 10mmx10mm		Spectro*		Chemistry*
Microhardness, Knoop*		Macroetch		
TC: TC Ind Test Center	EX: Exova Services	MSI: Metallurgical Services		
Cert #1281-01	Cert #0288 6/30/10	Cert #0510		
2/28/11	Cert #0104 12/31/10	12/31/10		
	Cert #0188 11/30/10			

TIME .08:15

*Not Included in our scope of accreditation

Ken Rueff

Ken Rueff

Test Center Supervisor

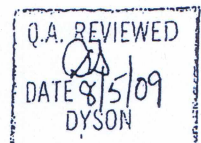
FC 4.12.16F 7/8/09

FC 4.12.16F 7/8/09

TENSILE SAMPLE #1 RESULTS ARE FROM PILE# 11044587 BATCH 1: 29 PCS

TENSILE SAMPLE #2 RESULTS ARE FROM PILE# 11044588 BATCH 2: 29 PCS

TENSILE SAMPLE #3 RESULTS ARE FROM PILE# 10927221 BATCH 3: 30 PCS



There are no deviations from test methods unless noted. It should not be assumed that mechanical properties of raw material heat treated to a fastener standard will have the same properties of a finished fastener whose original material characteristics may have been significantly altered.

No mercury was used/added and no welding/weld repair was performed on this material while in the possession of TC Industries, Inc.

This original test report displays a raised "TC Industries Test Center" seal. This test report relates only to the items tested and shall not be reproduced, except in full, without the written permission of TC Industries Test Center

700909F80L

SE:01 6002/08/20

CERTIFIED TEST REPORT

Dyson Corporation
53 Freedom Road
Painesville OH 44077

Job No.: A9-251-199
Date: 9-9-09
Cust. PO#: 68200

Description: 1 sample 1.852" Dia.
SO# L103205 & L103205A Cust PO# E2 Bearing & Shear Key
Code# NSH & NSH2

Material: AISI 4140 Heat# M30263

Spec: ASTM A354-07 Grade BD

TEST RESULTS

<u>Code</u>	<u>Tensile, ksi</u>	<u>Yield, .2% ksi</u>	<u>Elong., % in 4D</u>	<u>Red. of Area, %</u>
Customer Req. (Min.):	150	130	14	40
NSH	159	133	16	54
NSH2	164	139	15	55

Test Method: ASTM A370-09a

The above **conforms** to specifications listed.

This material tested in accordance with the Tensile Testing's Quality System Manual dated 2/15/07 Rev. D as audited and approved by Dyson. The reported results represent the actual attributes of the material tested and indicate full compliance with all applicable specification and contract requirements. We certify that the foregoing is a true copy of the data resulting from tests performed in the laboratory.



Authorized Signature

Timothy J. Adams, President

10/16/2009

Steve Marsh
Dyson Corp.
53 Freedom Road
53 Freedom Rd
PAINESVILLE, OH 44077-1232

Date Received: 10/7/2009

Test Report No.: DYS006-09-10-89917-1

Material Testing and Non-Destructive
Testing

5405 E. Schaaf Road
Cleveland, OH 44131
USA

Telephone : (216) 524-1450
Fax : (216) 524-1459
Website : www.storkherron.com

TEST REPORT

P.O. No.: 68610

Sample Description: Seven (7) 2.00"-4.5UNC-2A X 1105MM (43.50") Threaded Full Length Rods, Material per ASTM A354, Grade BD, ASTM A490-08a with acceptance criteria per ASTM F788, Caltran Special Provisions 10-1.59, 10-1.60, 10-1.61, plus Caltrans Standard Spec 75-1.05 Apply, Customer PO#: E2 Bearing & Shear Key, Job #: L103205, Heat #/Heat Code M30263/NSH

MAGNETIC PARTICLE INSPECTION REPORT

Standard:	ASTM F788	
Procedure:	SOP 42.03	
METHOD		
<input type="checkbox"/> Dry		<input checked="" type="checkbox"/> Wet
PARTICLES		
Magnaflux Particles: <input type="checkbox"/> 8A Red <input checked="" type="checkbox"/> 14A <input type="checkbox"/> 3A Black <input type="checkbox"/> 14AM <input type="checkbox"/> 1 Gray <input type="checkbox"/> Other Batch No. 95A069	Part Preparation: <input checked="" type="checkbox"/> None Required <input type="checkbox"/> Solvent Clean <input type="checkbox"/> Grinding <input type="checkbox"/> Other	Wet Particle Carrier: <input checked="" type="checkbox"/> Magnaflux Carrier II <input type="checkbox"/> Pre Mixed <input type="checkbox"/> Concentration MI Batch No. 07C066
CURRENT		
<input type="checkbox"/> AC		<input checked="" type="checkbox"/> FWDC
<input type="checkbox"/> Central Conductor (AMPS)		<input checked="" type="checkbox"/> Head Shot (AMPS) 1100
<input checked="" type="checkbox"/> Coil (AMPS) 1000		<input type="checkbox"/> Prods (AMPS/Spacing)
Field Verified by: <input checked="" type="checkbox"/> Pie Gage <input type="checkbox"/> QQI <input type="checkbox"/> Hall Effect Probe		
EQUIPMENT		
<input checked="" type="checkbox"/> Magnaflux H-720 S/N: 81471 Cal Due Date: 3/24/2010		

The above services were performed in accordance with Herron Testing Laboratories' Quality Assurance Program Edition 1, Revision 3 dated 6/30/09. 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 Stork-Herron Testing Laboratories facilities.

Paula Tesar

Paula Tesar
Quality Administrator

10/16/2009

Steve Marsh
Dyson Corp.
53 Freedom Road
53 Freedom Rd
PAINESVILLE, OH 44077-1232

Date Received: 10/7/2009

Test Report No.: DYS006-09-10-89917-1

Material Testing and Non-Destructive
Testing

5405 E. Schaaf Road
Cleveland, OH 44131
USA

Telephone : (216) 524-1450
Fax : (216) 524-1459
Website : www.storkherron.com

TEST REPORT

P.O. No.: 68610

MAGNETIC PARTICLE INSPECTION RESULTS	
Quantity	Results
7pcs Job# L103205 Ht# M30263/NSH E2 Bearing and Shear Key 2" 4.5UNC-2A X 1105MM Threaded full length Rod.	Acceptable
Comments: Marking Requirements: Demag and post cleaning requirements: < 2 Gauss	
Certification Expiration: 4/25/2013	
Inspected by: Shane Levermann	Certification: ASNT-SNT-TC-1A Level <input checked="" type="checkbox"/> II <input type="checkbox"/> III

EXPORT CONTROLLED (ITAR)

THE TECHNICAL DATA AND / OR MATERIALS ASSOCIATED WITH THIS ORDER FALLS WITHIN THE DEFINITION OF THE INTERNATIONAL TRAFFIC IN ARMS REGULATIONS (ITAR) AND IS SUBJECT TO THE EXPORT CONTROL LAWS OF THE U.S. GOVERNMENT. TRANSFER OF THIS DATA BY ANY MEANS TO A FOREIGN PERSON OR FOREIGN ENTITY, WHETHER IN THE UNITED STATES OR ABROAD, WITHOUT AN EXPORT LICENSE, ITAR EXEMPTION OR OTHER APPROVAL FROM THE U.S. DEPARTMENT OF STATE, IS PROHIBITED.

The above services were performed in accordance with Herron Testing Laboratories' Quality Assurance Program Edition 1, Revision 3 dated 6/30/09. 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 Stork-Herron Testing Laboratories facilities.

Paula Tesar
Quality Administrator

Monnig Industries, Inc.

HOT DIP & MECHANICAL GALVANIZING

P.O. BOX 98

GLASGOW, MO 65254

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

JANUARY 20, 2010

DYSON CORPORATION
50 FREEDOM ROAD
PAINESVILLE, OH 44077

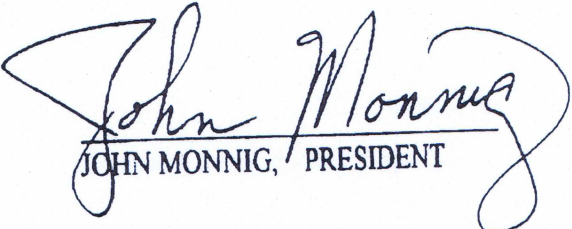
RE: GALVANIZING CERTIFICATE-CALTRAN
P.O. 69398 103 PCS 3.00" X 52.64" THREADED
35 PCS 3.00" X 21.14" THREADED
102 PCS 3.00" X 51.65" THREADED
70 PCS 3.00" X 20.16" THREADED
252 PCS 2.00" X 43.50" THREADED
P.O. 69475 34 PCS 3.00" X 21.14" THREADED
78 PCS 2.00" X 43.50" THREADED


THIS WILL CERTIFY THAT THE MATERIAL GALVANIZED ON THE ABOVE
JOB MEETS OR EXCEEDS THE MINIMUM REQUIREMENTS OF ASTM A-153
SPECIFICATIONS.

MILL READINGS

4.0	4.8	4.3	5.2
4.5	5.5	6.2	7.0
5.1	5.3	4.5	5.0

PATRICIA S. WESTHUES
NOTARY PUBLIC STATE OF MISSOURI
HOWARD COUNTY
MY COMMISSION EXP. APR. 18, 2012


JOHN MONNIG, PRESIDENT


PATRICIA S. WESTHUES,
NOTARY PUBLIC

HORSEHEAD CORPORATION

METAL SHIPPING RECORD

TAP	SHIP. WT.	Fe	Pb	Cd	Al	DATE
351	3113					11-20-09
350	3045					Customer:
352	3163	.018	.873	.014	.000	BOB MONNIG
353	2977					Destination:
345	3017					Glasgow, Mo
342	2908					Order No.:
343	3101					145914
344	2968					Grade:
347	2970					PW-500L
346	2993					44,000
349	2991					14 Lowboys
348	3000					Net Weight:
341	3083					42425
340	3036					Special Instructions:
						Dock/Side
						Tally
						Assays

Received Time Nov. 19. 9:22AM

50N

HORSEHEAD CORPORATION

METAL SHIPPING RECORD

TAP	SHIP WT.	Fe	Pb	Cd	Al	DATE
971	2996					11-20-09
978	3338					Customer:
973	3068					BOB MONNIG
969	3023					Destination:
961A	3021					Glasgow, Mo
970	3065					Order No.:
968	3022					145913
972	3088					Grade:
926	3311					PW-500L
921	3387					44,000
927	3330					14 Lowboys
920	3314					Net Weight:
923	3172	.021	.889	.022	.000	44325
925	3250					Special Instructions:
						Dock/Side
						Tally
						Assays

Received Time Nov. 19. 9:22AM

CERTIFIED MATERIAL TEST REPORT**DYSON CORP.**
DTN DOMESTIC NUT**53 Freedom Road**
Painesville, OH 44077**440-946-3500**
440-352-2700 fax

DYSON ORDER#	CUSTOMER ORDER#	ITEM NUMBER	QUANTITY SHIPPED	DATE SHIPPED
L 103205	E2 Bearing & Shear Key	1 of 11	78 pcs	11/24/09

CUSTOMER

Hochang Machinery Industries Co., Ltd.
SFOBB - E2 Bearing & Shear Key / Bolt
#743-65 YangDeung-Ri, Sangbuk-Myun
Uiju-Gun, N/A Ulsan
Korea

PRODUCT DESCRIPTION

2.00"-4.5UNC-2A x 1105mm (42.48") OAL threaded full length rod,
HDC per ASTM-A153 w/near white metal blast prior to galvanize.
Ref: SFOBB-E2B-883-10-36.1, Bid Item 45, Item Code 049311,
Hochang BOM-Item 6.1

DRAWING

SFOBB-E2B-883-10-36-1

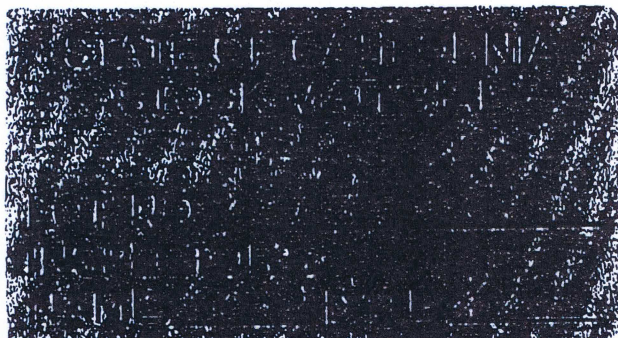
SPECIFICATIONS

ASTM-A354-07 Grade BD with special provisions
10-1.59, 10-1.60, 10-1.61 std specifications 75-1.05
Caltrans hold points apply to this order
Preliminary CMTR issued on 11/20/09

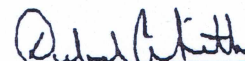
STARTING MATERIAL	DIA	GRADE	QTY	LOT CODE	HEAT NO.	ORIGINAL MILL
Round Bar	1.852	BD	78	NSH2	M30263	Gerdau

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

1. The steel was melted and manufactured in the USA and the product was manufactured and tested in the USA.

**Attachments:**

Mill Test Reports
Mechanical Test Reports
Galvanizing Certification


Deborah A. Smith

Q.A. Admin. Assistant

11/24/09

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

KREHER STEEL COMPANY, LLC.

PO/Rel

I hereby certify that this data is correct as
contained in the records of this company.
I hereby certify that no mercury came in contact

Certificate of Mill Test Results

1-000000-000

Pg 1/2

with or no weld repair was done to this product
while in our possession.
Attn:

ART NO.

CODE NSH 2



GERDAU MACSTEEL

ONE JACKSON SQUARE
SUITE 500
JACKSON, MICHIGAN 48201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
17123	4811	M30263	221035 101	7/21/08

SHIP TO

REPORT TO

ERIN
KREHER STEEL

1550 N. 25TH AVE

MELROSE PARK, IL 60160

KREHER STEEL

1550 N. 25TH AVE.

MELROSE PARK, IL 60160

ORDERED

GRADE	SIZE	LENGTH
4140	2" RND	24' 3"
CUSTOMER SPECIFICATIONS		
ASTM A29/A29M-05 / A322-07 / E381-01		

CHEMICAL ANALYSIS

C /	Mn	P	S	Si	Ni	Cr	Mo	Cu	Sn	Al
0.41	0.86	0.019	0.026	0.25	0.09	0.93	0.20	0.23	0.008	0.024
V	Nb									
0.007	0.003									

GRAIN SIZE

SPECIFICATION ASTM E112

FINE GRAIN 5-8

HARDENABILITY

SPECIFICATION ASTM A255/A304

THEORETICAL

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	57	57	57	57	57	57	55	54	53	50	48	46	46	45	43	41	38							

MACROCLEANLINESS

SPECIFICATION ASTM E381

PLATE I

PLATE II

AVERAGE	S	R	C
1	1	1	1

NONE

Q.A. REVIEWED
DATE 8/5/09
DYSON

T+Pto 1.852"0

PAGE 1

Gerda MacSteel Mon or
18000 East 1st Street
Mooresville, NC 28115

CONTINUED ON PAGE 2

NSH

KREHER STEEL COMPANY, LLC.

Certificate of Mill Test Results

PO/Rel

1 -000000-000

Pg 2/2

RT NO.

I hereby certify that this data is correct as contained in the records of this company.
I hereby certify that no mercury came in contact

with or no weld repair was done to this product while in our possession.
Attn:

CODE NSH 2



ONE JACKSON SQUARE
SUITE 500
JACKSON, MICHIGAN 48201

CERTIFIED MATERIAL TEST REPORT

CUSTOMER ORDER NUMBER	CUSTOMER PART NUMBER	HEAT NUMBER	WORK ORDER NUMBER	DATE
17123	4811	M30263	221035 101	7/21/08

REPORT TO
ERIN
KREHER STEEL
1550 N. 25TH AVE
MELROSE PARK , IL 60160

SHIP TO
KREHER STEEL
1550 N. 25TH AVE.
MELROSE PARK , IL 60160

ORDERED

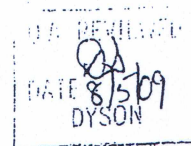
GRADE	SIZE	RND	LENGTH
4140	2"	RND	24' 3"

CUSTOMER SPECIFICATIONS
ASTM A29/A29M-05; A322-07; E381-01

REDUCTION RATIO

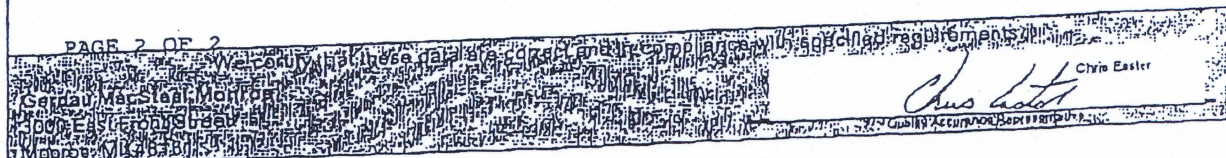
RATIO= 11.5 TO 1.0

** 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. **



T+P to 1.852"

PAGE 2 OF 2





TC Industries Test Center
 3703 South Route 31
 Crystal Lake, IL 60012-1412
 Telephone 815/459/2400 Fax 815/459/3419



Certificate No. 1281-01

TEST REPORT

REPORT NO: 145085C

DATE: JULY 30, 2009

PAGE 1 OF 1

TO: KREHER STEEL CO.
 1550 NORTH 26TH AVENUE
 MELROSE PARK, IL 60160

SHIP TO: KREHER STEEL CO.
 1550 NORTH 26TH AVENUE
 MELROSE PARK, IL 60160

CODE NSH 2

DESC: 88 PCS	2"RD X 24"3"	HEAT#: M30263	GRADE: 4140	WT: 22892	
	PO: 1-110131	MO: N/A	CO: 048697	LOT: 64853	
SPEC: QUENCH, TEMPER, STRAIGHTEN	ASTM-A354-BD-07A				
AIMRC 33/37 @ SURFACE					
PROCESS: FURN TEMP :	1600	FURN TIME hh:mm:	1.20	QUENCH: OIL	
TEMPER TEMP:	1015	TEMPER TIME hh:mm:	2.00		
STRESS TEMP:					
STRESS TIME hh:mm:					
PARAMETER	UNITS	LIMITS	TEST RESULTS (See sampling plan on back)		
TENSILE	KSI	150 N/A	SAMPLE#1 159	SAMPLE#2 157	SAMPLE#3 156 ^
YIELD .2%	KSI	130 N/A	SAMPLE#1 131	SAMPLE#2 130	SAMPLE#3 136 ^
ELONG 2"	%	14 N/A	SAMPLE#1 16	SAMPLE#2 17	SAMPLE#3 17 ^
RED AREA	%	40 N/A	SAMPLE#1 64	SAMPLE#2 64	SAMPLE#3 53 ^
SURF RC	HRC	0 N/A	36	35	37
			37	35	36
AID RAD RC	HRC	0 N/A	36	34	35
			34	33	34
ORE RC	HRC	0 N/A	37	33	34
			37	35	32

TC INDUSTRIES AND SUBCONTRACTED LABS (A2LA ACCREDITED)

TC Industries, Standard	TC	Rockwell	TC	Micro Analysis*
Tensile, Full Secn		Brinell		Decarb Measure
Charpy V 10mmx10mm		Spectro*		Chemistry*
Microhardness, Knoop*		Macroetch		
TC: TC Ind Test Center	EX: Exova Services	MSI: Metallurgical Services		
cert #1281-01	Cert #0288 6/30/10	Cert #0510		
28/11	Cert #0104 12/31/10	12/31/10		
	Cert #0188 11/30/10			

*Not Included in our scope of accreditation

Ken Rueff
 Ken Rueff

Test Center Supervisor

12.16F 7/8/09

ILE SAMPLE #1 RESULTS ARE FROM PILE# 11044587 BATCH 1: 29 PCS
 LE SAMPLE #2 RESULTS ARE FROM PILE# 11044588 BATCH 2: 29 PCS
 LE SAMPLE #3 RESULTS ARE FROM PILE# 10927221 BATCH 3: 30 PCS

Q.A. REVIEWED
DATE 8/5/09
DYSON

T+P to 1.852"φ

no deviations from test methods unless noted. It should not be assumed that mechanical properties of raw material heat treated to per standard will have the same properties of a finished fastener whose original material characteristics may have been significantly

any was used/added and no welding/weld repair was performed on this material while in the possession of TC Industries, Inc.

test report displays a released "TC Industries Test Center" seal. This test report relates only to the items tested and shall not be used, except in full, without the written permission of TC Industries Test Center



TC Industries Test Center

3703 South Route 31
Crystal Lake, IL 60012-1412
Telephone 815/459/2400 Fax 815/459/3419



Certificate No. 1281-01

TEST REPORT

REPORT NO: 145085C

DATE: JULY 30, 2009

PAGE 1 OF 1

TO: SUPPLEMENT TO REPORT# 145085B
KREHER STEEL CO.
1550 NORTH 25TH AVENUE
MELROSE PARK, IL 60160

SHIP TO: KREHER STEEL CO.
1550 NORTH 25TH AVENUE
MELROSE PARK, IL 60160

CODE NSH2

DESC:	88 PCS	2"RD X 24"3"	HEAT#: M30263	GRADE: 4140	WT: 22892
		PO: 1-110131	MO: N/A	CO: 048697	LOT: 64653
SPEC:	QUENCH, TEMPER, STRAIGHTEN		ASTM-A354-BD-07A		
	AIM RC 33/37 @ SURFACE				
PROCESS:	FURN TEMP :	1600	FURN TIME hh.mm:	1.20	QUENCH: OIL
	TEMPER TEMP:	1015	TEMPER TIME hh.mm:	2.00	
	STRESS TEMP:		STRESS TIME hh.mm:		
PARAMETER	UNITS	LIMITS		TEST RESULTS (See sampling plan on back)	
TENSILE	KSI	150	N/A	SAMPLE#1 159	SAMPLE#2 157 SAMPLE#3 156 ^
YIELD .2%	KSI	130	N/A	SAMPLE#1 131	SAMPLE#2 130 SAMPLE#3 136 ^
ELONG 2"	%	14	N/A	SAMPLE#1 16	SAMPLE#2 17 SAMPLE#3 17 ^
RED AREA	%	40	N/A	SAMPLE#1 64	SAMPLE#2 64 SAMPLE#3 53 ^
SURF RC	HRC	0	N/A	36	35 37 36 36 37
				37	35 36 35 35 36
MID RAD RC	HRC	0	N/A	36	34 36 36 34 34
				34	33 36 37 34 33
CORE RC	HRC	0	N/A	37	33 34 34 32 32
				37	35 33

TC INDUSTRIES AND SUBCONTRACTED LABS (A2LA ACCREDITED)

Tensile, Standard	TC	Rockwell	TC	Micro Analysis*
Tensile, Full Secn		Brinell		Decarb Measure
Charpy V 10mmx10mm		Spectro*		Chemistry*
Microhardness, Knoop*		Macroetch		
TC: TC Ind Test Center	EX: Exova Services	MSI: Metallurgical Services		
Cert #1281-01	Cert #0286 6/30/10	Cert #0510		
2/28/11	Cert #0104 12/31/10	12/31/10		
	Cert #0188 11/30/10			

TIME 08:15

*Not Included in our scope of accreditation

Ken Rueff
Ken Rueff

Test Center Supervisor

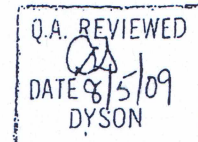
FC 4.12.16F 7/8/09

FC 4.12.16F 7/8/09

TENSILE SAMPLE #1 RESULTS ARE FROM PILE# I1044587 BATCH 1: 29 PCS

TENSILE SAMPLE #2 RESULTS ARE FROM PILE# I1044588 BATCH 2: 29 PCS

TENSILE SAMPLE #3 RESULTS ARE FROM PILE# I0927221 BATCH 3: 30 PCS



There are no deviations from test methods unless noted. It should not be assumed that mechanical properties of raw material heat treated to a fastener standard will have the same properties of a finished fastener whose original material characteristics may have been significantly altered.

No mercury was used/added and no welding/weld repair was performed on this material while in the possession of TC Industries, Inc.

This original test report displays a released "TC Industries Test Center" seal. This test report relates only to the items tested and shall not be reproduced, except in full, without the written permission of TC Industries Test Center.

7000000000

95:01 6002/06/20



A DIVISION OF J.T. ADAMS CO., INC.

4520 WILLOW PARKWAY
CLEVELAND, OHIO 44125
PHONE (216) 641-3290
FAX (216) 641-1223
www.tensile.com

CERTIFIED TEST REPORT

Dyson Corporation
53 Freedom Road
Painesville OH 44077

Job No.: A9-251-199
Date: 9-9-09
Cust. PO#: 68200

Description: 1 sample 1.852" Dia.
SO# L103205 & L103205A Cust PO# E2 Bearing & Shear Key
Code# NSH & NSH2

Material: AISI 4140 Heat# M30263

Spec: ASTM A354-07 Grade BD

TEST RESULTS

<u>Code</u>	<u>Tensile, ksi</u>	<u>Yield, .2% ksi</u>	<u>Elong., % in 4D</u>	<u>Red. of Area, %</u>
Customer Req. (Min.):	150	130	14	40
NSH	159	133	16	54
NSH2	164	139	15	55

Test Method: ASTM A370-09a

The above **conforms** to specifications listed.

This material tested in accordance with the Tensile Testing's Quality System Manual dated 2/15/07 Rev. D as audited and approved by Dyson. The reported results represent the actual attributes of the material tested and indicate full compliance with all applicable specification and contract requirements. We certify that the foregoing is a true copy of the data resulting from tests performed in the laboratory.


Authorized Signature

Timothy J. Adams, President



Page 1 of 1

This Report May Not Be Reproduced Except In Full

This report represents Tensile Testing interpretation of the results obtained from the test and is not to be construed as a Warranty of the condition of the materials tested. Tensile Testing shall not be held liable for misinterpretation of conditions, loss, damage, injury or death arising from or attributable to delay preceding a test or subsequent to performance of a test.

Monnig Industries, Inc.

HOT DIP & MECHANICAL GALVANIZING

P.O. BOX 98

GLASGOW, MO 65254

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

JANUARY 20, 2010

DYSON CORPORATION
50 FREEDOM ROAD
PAINESVILLE, OH 44077

RE: GALVANIZING CERTIFICATE-CALTRAN

P.O. 69398 103 PCS 3.00" X 52.64" THREADED

35 PCS 3.00" X 21.14" THREADED

102 PCS 3.00" X 51.65" THREADED

70 PCS 3.00" X 20.16" THREADED

252 PCS 2.00" X 43.50" THREADED

P.O. 69475 34 PCS 3.00" X 21.14" THREADED

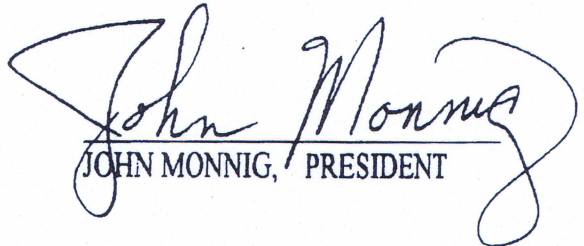
78 PCS 2.00" X 43.50" THREADED


THIS WILL CERTIFY THAT THE MATERIAL GALVANIZED ON THE ABOVE
JOB MEETS OR EXCEEDS THE MINIMUM REQUIREMENTS OF ASTM A-153
SPECIFICATIONS.

MILL READINGS

4.0	4.8	4.3	5.2
4.5	5.5	6.2	7.0
5.1	5.3	4.5	5.0

PATRICIA S. WESTHUES
NOTARY PUBLIC STATE OF MISSOURI
HOWARD COUNTY
MY COMMISSION EXP. APR. 18, 2012


JOHN MONNIG, PRESIDENT


PATRICIA S. WESTHUES,
NOTARY PUBLIC

HORSEHEAD CORPORATION

METAL SHIPPING RECORD

TAP	SHIP. WT.	Fe	Pb	Cd	Al	DATE
351	3173					11-20-09
350	3045					Customer:
352	3163	.018	.873	.014	.000	BOB MONNIG
353	2977					Destination:
345	3017					Glasgow, Mo
342	2928					Order No.:
343	3101					145914
344	2968					Grade:
347	2970					PW-500L
346	2993					44,000
349	2991					14 Lowboys
348	3000					Net Weight:
341	3083					42425
340	3036					Special Instructions:
						Dock/Side
						Tally
						Assays

Received Time Nov. 19. 9:22AM

50N

HORSEHEAD CORPORATION

METAL SHIPPING RECORD

TAP	SHIP WT.	Fe	Pb	Cd	Al	DATE
971	2996					11-20-09
928	3338					Customer:
973	3068					BOB MONNIG
969	3023					Destination:
961A	3021					Glasgow, Mo
970	3005					Order No.:
968	3022					145913
972	3088					Grade:
926	3311					PW-500L
921	3387					44,000
927	3330					14 Lowboys
920	3314					Net Weight:
923	3172	.021	.889	.022	.000	44325
925	3250					Special Instructions:
						Dock/Side
						Tally
						Assays

Received Time Nov. 19. 9:22AM



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 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 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 cross 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

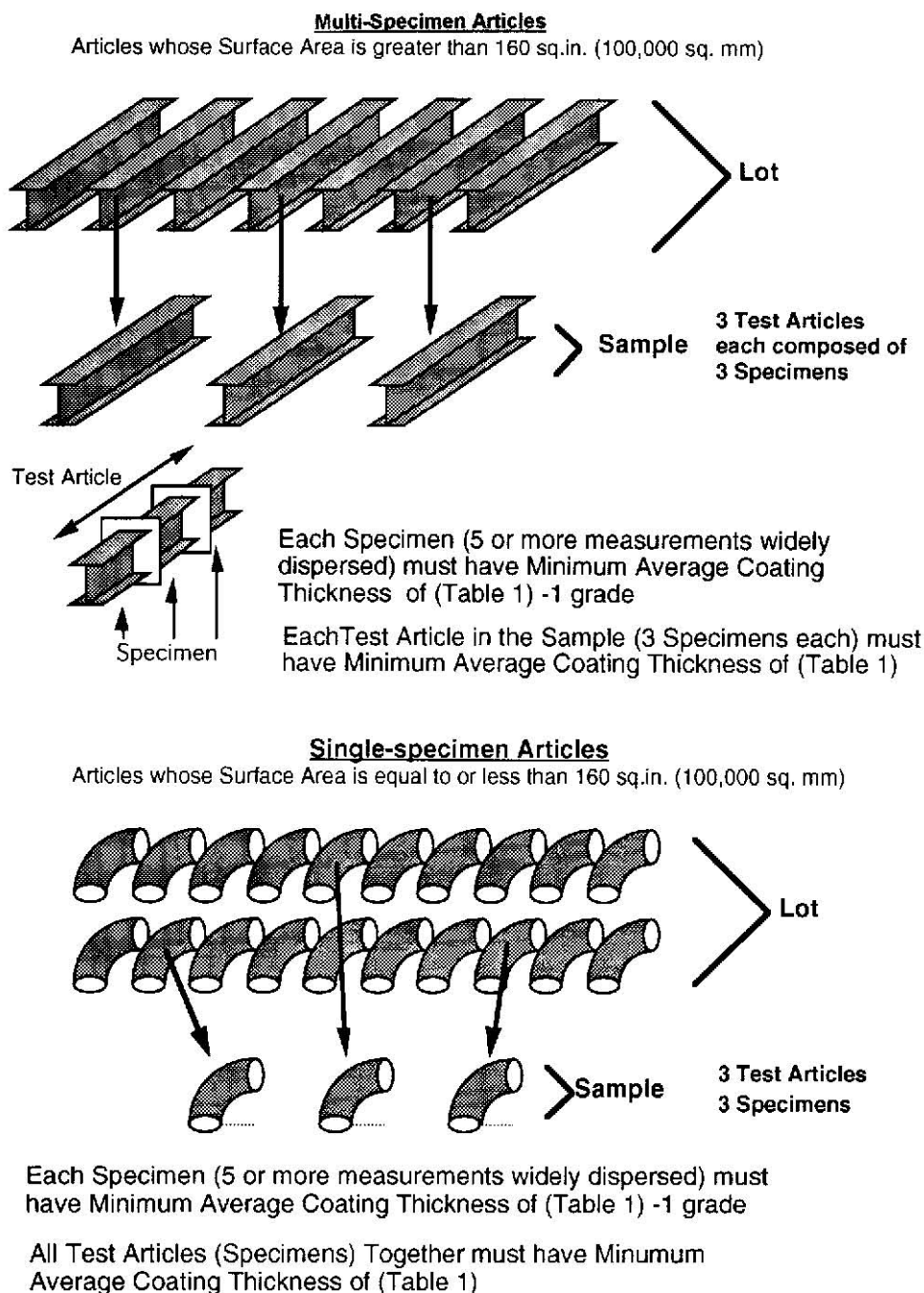


FIG. 1 Single- and Multi-Specimen Articles



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)	$\geq 1/4$ (≥ 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.

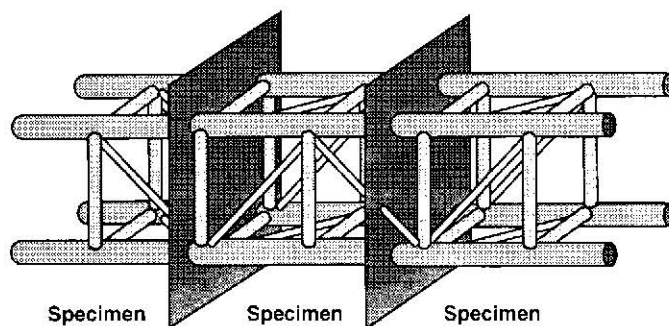
5.4 Zinc—The zinc used in the galvanizing bath shall conform to Specification B6, or Specification B960, or both. If a zinc alloy is used as the primary feed to the galvanizing bath, then the base material used to make that alloy shall conform to Specification B6, or Specification B960, or both.

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.

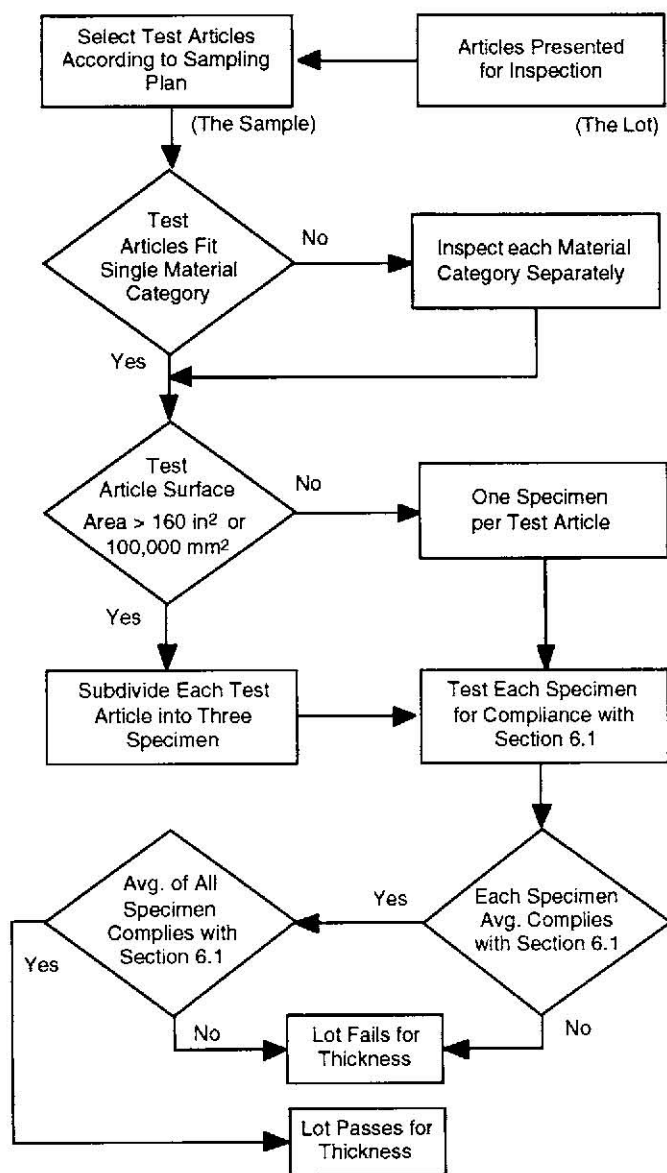


FIG. 3 Coating Thickness Inspection Steps

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 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 ½-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 ½-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 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 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 1½ 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

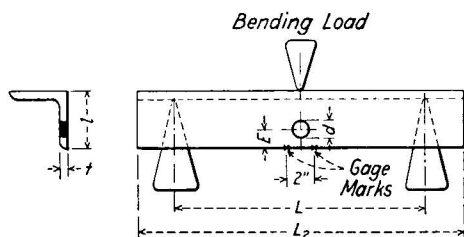


FIG. 1 Specimen for Elongation after Fracture

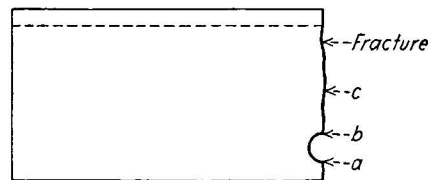


FIG. 2 Measurement of Reduction of Thickness after Fracture

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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.*

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:

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 For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard.

3.1.1 The following terms and definitions are specific to this specification. Terminology **A 902** contains other terms and definitions relating to metallic-coated steel products. Terminology **F 1789** contains other terms and definitions relating to mechanical fasteners.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *average coating thickness, n*—the average of the specimen coating thickness values for the samples in an inspection lot.

3.2.2 *bare spots, n*—uncoated areas on the surface of the steel part that contain no measurable zinc coating.

3.2.3 *dross inclusions, n*—the iron/zinc intermetallics present in a galvanized coating in a form other than the layer growth of the coating.

3.2.4 *individual measurement, n*—the reading from a magnetic thickness gauge of a single coating spot thickness, or the microscopic reading of a coating thickness as seen in an optical microscope at one spot.

3.2.5 *inspection lot, n*—the quantity of identical parts cleaned, fluxed and galvanized together at one time in an appropriate container that is being submitted for acceptance as a group.

3.2.6 *malleable casting, n*—a steel article that has been subjected to a prolonged anneal to decarburize or graphitize the part to remove as much of the carbon as possible or to convert the carbon to graphite, which permits plastic deformation in compression without rupture.

3.2.7 *sample, n*—a collection of individual units of product from a single inspection lot selected in accordance with Section 6 and intended to represent that inspection lot for acceptance.

3.2.8 *specimen, n*—an individual test article upon which thickness measurements or weight determinations are performed.

3.2.9 *specimen coating thickness, n*—the average thickness from no less than five test measurements on a specimen, when each measurement location is selected to provide the widest dispersion (in all applicable directions) of locations within the specimen volume.

3.2.10 *threaded areas, n*—the sections of a steel part that have threads formed before hot-dip galvanizing.

4. Materials and Manufacture

4.1 *Steel or Iron*—Ferrous articles to be hot-dip zinc coated shall conform to specifications designated by the purchaser.

4.2 *Zinc*—The zinc used for the coating shall conform to Specification **B 6**, or Specification **B 960**, or both, and shall be at least equal to the grade designated as “Prime Western.”

4.2.1 If a zinc alloy is used as the primary feed for the galvanizing bath, then the base material used to make that alloy shall conform to Specification **B 6** or Specification **B 960**, or both.

4.2.2 The molten metal in the working volume of the galvanizing bath shall contain not less than an average value of 98.0 % zinc by weight [mass].

NOTE 1—The galvanizer may choose to add trace amounts of certain elements (for example, aluminum, nickel, bismuth, or tin) to the zinc bath to help in the processing of certain reactive steels or to enhance the cosmetic appearance of the finished product. The elements can be added to the galvanizing bath as a master feed alloy, or they can be added to the bath by the galvanizer as individual feeds.

4.3 *Minimum Coating Weight [Mass] or Minimum Coating Thickness*—The minimum coating weight [mass] or the minimum coating thickness shall conform to the requirements prescribed in **Table 1** for the material category and thickness of material in which the article belongs.

4.4 *Threaded Articles*—The zinc coating on threads shall not be subjected to a cutting, rolling, or finishing-tool operation, unless specifically authorized by the purchaser. In order to meet overlapping allowances, tapping the threads of nuts or tapped holes after galvanizing is not prohibited.

4.5 *Touch-up and Repair*—Bare spots that are found on parts after galvanizing shall be renovated by use of the methods found in Practice **A 780** if the following criteria are met. The bare spots shall have an area totalling not more than 1 % of the surface area to be coated excluding threaded areas of the piece and the bare spots shall not include any threaded areas of the

TABLE 1 Thickness or Weight [Mass] of Zinc Coating for Various Classes of Material

NOTE 1—Length of the piece, stated in Classes B-1, B-2, and B-3, refers to the finished dimension of the piece after fabrication.

Class of Material	Weight [Mass] of Zinc Coating, oz/ft ² [g/m ²] of Surface, Minimum		Coating Thickness, mils [microns], Minimum	
	Average of Specimens Tested	Any Individual Specimen	Average of Specimens Tested	Any Individual Specimen
<i>Class A</i> —Castings—Malleable Iron, Steel	2.00 [610]	1.80 [550]	3.4 [86]	3.1 [79]
<i>Class B</i> —Rolled, pressed, and forged articles (except those which would be included under Classes C and D):				
B-1— $\frac{3}{16}$ in. [4.76 mm] and over in thickness and over 15 in. [381 mm] in length	2.00 [610]	1.80 [550]	3.4 [86]	3.1 [79]
B-2—under $\frac{3}{16}$ in. [4.76 mm] in thickness and over 15 in. [381 mm] in length	1.50 [458]	1.25 [381]	2.6 [66]	2.1 [53]
B-3—any thickness and 15 in. [381 mm] and under in length	1.30 [397]	1.10 [336]	2.2 [56]	1.9 [48]
<i>Class C</i> —Fasteners over $\frac{3}{16}$ in. [9.52 mm] in diameter and similar articles. Washers $\frac{3}{16}$ in. and $\frac{1}{4}$ in. [4.76 and 6.35 mm] in thickness	1.25 [381]	1.00 [305]	2.1 [53]	1.7 [43]
<i>Class D</i> —Fasteners $\frac{3}{16}$ in. [9.52 mm] and under in diameter, rivets, nails and similar articles. Washers under $\frac{3}{16}$ in. [4.76 mm] in thickness	1.00 [305]	0.85 [259]	1.7 [43]	1.4 [36]

piece. The thickness of the repair shall be equal to the surrounding galvanized coating except for repairs made by paints containing zinc dust in which case the thickness of the repair shall be 50 % greater than the thickness of the galvanized coating required for the class of material, but shall not be greater than 4.0 mils [100 µm]. Repair thickness measurements shall be made in accordance with Practice **A 780**. The galvanizer shall make repairs unless directed by the purchaser to deliver items unrepaired for subsequent renovation by the purchaser.

5. Workmanship, Finish, and Appearance

5.1 The zinc-coated articles shall be free from uncoated areas, blisters, flux deposits, dross inclusions, and other types of projections that would interfere with the intended use of the articles, or other defects not consistent with good galvanizing practice.

5.2 The zinc coating shall be smooth and reasonably uniform in thickness.

NOTE 2—Smoothness of surface is a relative term. Minor roughness that does not interfere with the intended use of the part, or roughness that is related to the as-received (ungalvanized) surface condition of the part, shall not be grounds for rejection.

NOTE 3—Since this specification is applicable to items that are centrifuged or otherwise handled to remove excess bath metal (see **1.2**), irregular coating distribution is not normally encountered. Drainage problems, which manifest themselves as local excess coating thickness that would interfere with function or as edge tears or spikes that present a safety hazard because of their sharpness, are grounds for rejection under the terms of **5.1**.

5.3 Embrittlement is a potential condition of steel that is cold-worked, depending on such factors as the steel type (strength level, aging characteristics), thickness, degree of cold work, and galvanizing process. The galvanizer, the designer and the fabricator shall take precautions against embrittlement. The precautions to fabricate properly and prepare the material for galvanizing to prevent embrittlement are described in Practice **A 143/A 143M**.

NOTE 4—Low service temperatures increase the risk of brittle failure of all plain carbon steels including those which have been galvanized. This temperature embrittling effect varies with type of steel. The expected service temperature should thus be taken into account when selecting steels for galvanizing.

5.4 Malleable castings shall be of such composition as will preclude the possibility that they become embrittled by the galvanizing process, or they shall be either cooled from the anneal, or subsequently heat-treated so as to immunize them against embrittlement.

5.5 The zinc coating shall adhere tenaciously to the surface of the base metal.

5.6 If the galvanized material covered by this specification is bent or otherwise fabricated to the degree that causes the zinc coatings to stretch or compress beyond the limit of elasticity, any cracking or flaking of the coating resulting from the bending or fabricating shall not be cause for rejection.

6. Sampling

6.1 Test specimens shall be selected at random from each inspection lot.

6.2 The method of selection and sample size shall be agreed upon between the galvanizer and the purchaser. Otherwise, the sample size selected from each lot shall be as follows:

Number of Pieces in Lot	Sample Size
3 or less	all
4 to 500	3
501 to 1200	5
1201 to 3200	8
3201 to 10 000	13
10 001 and over	20

6.3 A specimen that fails to conform to a requirement of this specification shall not be used to determine the conformance to other requirements.

6.4 The method of sampling for fasteners that are required to meet the standards of the Fastener Quality Act is described in Guide **F 1470**. Sample quantities and definitions of terminology are included in the referenced specification.

7. Test Methods

7.1 Tests shall be made to ensure that the zinc coating is being furnished in accordance with this specification and as specified for the following:

7.1.1 Minimum coating weight [mass] or minimum coating thickness in **4.3**.

7.1.2 Finish and appearance in **5.1** and **5.2**.

7.1.3 Embrittlement in **5.3** and **5.4**.

7.1.4 Adherence in **5.5**.

7.2 *Average Weight [Mass] of Coating:*

7.2.1 The average weight [mass] of the zinc coating shall be determined by weighing specimens after pickling and drying and again after galvanizing unless the method described in **7.2.2** is used. The number of specimens that are used to determine the average of an inspection lot shall be derived from Section **6**.

NOTE 5—This method does not take into account the weight [mass] of iron reacted from the article that is incorporated into the coating. It will thus underestimate coating weight [mass] by up to approximately 10 %. Base metal reactivity will affect the extent of underestimation.

7.2.2 In the case of materials inspected after galvanizing, the average weight [mass] of coating shall be determined by stripping the number of specimens derived in Section **6** in accordance with Test Method **A 90/A 90M**, and averaging the results of the individual specimens, unless the method described in **7.2.1** is used.

7.3 *Average Thickness of Coating:*

7.3.1 In the case of fasteners such as bolts, nuts, and screws, the determination of the thickness of coating shall be made on a portion of the article that does not include any threads.

7.3.2 The average thickness of coating shall be determined by magnetic thickness gage in accordance with Practice **E 376** unless the method described in **7.3.3** is used. The thickness shall be measured on at least five widely separated spots on a specimen. No individual spot measurement shall be cause for rejection. If an individual spot does not provide a coating thickness reading, this spot must be repaired in accordance with **4.5**. The five or more individual coating thickness measurements on a specimen must be averaged to determine the specimen average coating thickness. The average coating thickness for the inspection lot is determined by averaging the

specimen average coating thickness values for the number of specimens derived from Section 6.

7.3.3 The thickness of coating shall be determined by cross section and optical measurement in accordance with Test Method B 487, unless the method described in 7.3.2 is used. The thickness thus determined is a point value. No less than five such measurements shall be made at locations on the specimen, which are as widely dispersed as practical, so as to be representative of the whole surface of the specimen. The average of no less than five such measurements is the specimen average coating thickness. The average coating thickness for the inspection lot is determined by averaging the specimen average coating thickness values for the number of specimens derived from Section 6.

7.4 *Finish and Appearance*—The test for finish and appearance shall be conducted through visual inspection without additional magnification.

7.5 *Embrittlement*—Hardware that is susceptible to embrittlement shall be tested in accordance with Practice A 143/A 143M. The tests shall be performed through agreement between the galvanizer and the purchaser.

7.6 *Adherence*—Determine adherence of the zinc coating to the surface of the base metal by cutting or prying with the point of a stout knife, applied with considerable pressure in a manner tending to remove a portion of the coating. The adherence shall be considered inadequate if the coating delaminates in the form of a layer of skin so as to expose the base metal in advance of the knife point. Do not use testing carried out at edges or corners (points of lowest coating adherence) to determine adherence of coating. Likewise, do not use removal of small particles of the coating by paring or whittling to determine failure.

8. Inspection

8.1 The inspector representing the purchaser shall have access at all times while work on the contract of the purchaser is being performed, to those areas of the manufacturer's work which concern the application of the zinc coating to the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the zinc coating is being furnished in accordance with this specification. All inspection and tests shall be made at the place of manufacture

prior to shipments, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

9. Rejection and Retest

9.1 For all galvanized articles except those fasteners that must meet the requirements of the Fastener Quality Act, the following sections are used to determine rejection and retesting.

9.2 When partial inspection of materials to determine conformity with visual requirements of Section 5 warrants rejection of a lot, the galvanizer is not prohibited from sorting the lot and submitting it once again for inspection.

9.3 The number of specimens in a sample of a lot permitted to fail to conformance tests shall be agreed upon between the galvanizer and the purchaser.

9.4 If a set of test specimens fails to conform to the requirements of this specification, two additional sets shall be tested, both of which shall conform to the requirements in every respect, or the lot of material represented by the specimens shall be rejected.

9.5 Materials that have been rejected for reasons other than embrittlement are not prohibited from being stripped, regalvanized, and resubmitted for test and inspection. They shall then conform to the requirements of this specification.

10. Packaging

10.1 The supplier shall employ such methods of packaging zinc-coated articles as shall be required to ensure their receipt by the purchaser in satisfactory condition, with the use to be made of the article being taken into consideration.

11. Certification

11.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each inspection lot have been either tested or inspected as directed by this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

12. Keywords

12.1 coatings, zinc; galvanized coatings; steel hardware, zinc coated; steel products, metallic coated; zinc coatings, steel products

SUMMARY OF CHANGES

Committee A05 has identified the location of selected changes to this standard since the last issue, A 153/A 153M - 05, that may impact the use of this standard. (May 1, 2009)

(I) Revised 4.2 and 4.2.1 to add new zinc standard B 960.

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Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners¹

This standard is issued under the fixed designation A354; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification² covers the chemical and mechanical requirements of quenched and tempered alloy steel bolts, studs, and other externally threaded fasteners 4 in. and under in diameter for application at normal atmospheric temperatures, where high strength is required and for limited application at elevated temperature (**Note 1**). Any alloy steel capable of meeting the minimum mechanical and chemical properties set forth in this specification may be used.

NOTE 1—For bolts, studs, or other externally threaded fasteners, to be used at elevated temperatures, refer to Specification **A193/A193M**.

1.2 Two levels of bolting strength are covered, designated Grades BC and BD. Selection will depend upon design and the stresses and service for which the product is to be used.

NOTE 2—Quenched and tempered alloy steel bolts for structural steel joints up through 1½ in. in diameter are covered in Specification **A490**. Alloy steel bolts, studs, and other externally threaded fasteners (that is, heavy hex-structural bolts over 1½ in., hex bolts, anchor bolts, and countersunk bolts) exhibiting similar mechanical properties to bolts conforming to Specification **A490** shall be covered by Grade BD of this specification.

When bolts of Grade BD of this specification are considered for pretensioned applications in excess of 50 % of the bolt tensile strength, the additional requirements of head size, maximum tensile strength, nut size and strength, washer hardness, tests, and inspections contained in Specification **A490** should be carefully considered.

1.3 Nuts are covered in Specification **A563**. Unless otherwise specified, the grade and style of nut for each grade of fastener shall be as follows:

¹ This specification is under the jurisdiction of ASTM Committee **F16** on Fasteners and is the direct responsibility of Subcommittee **F16.02** on Steel Bolts, Nuts, Rivets and Washers.

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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
⅝, ⅜	0.017
⅞, ½	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
⅝	18	0.0524	6 550	5 500	5 700	7 850	6 300	6 800
⅝	24	0.0580	7 250	6 090	6 300	8 700	6 950	7 500
¾	16	0.0775	9 700	8 150	8 450	11 650	9 300	10 075
¾	24	0.0878	11 000	9 220	9 550	13 200	10 500	11 400
7/16	14	0.1063	13 300	11 150	11 600	15 950	12 750	13 850
7/16	20	0.1187	14 840	12 470	12 900	17 800	14 200	15 400
½	13	0.1419	17 750	14 900	15 450	21 300	17 050	18 500
½	20	0.1599	19 990	16 790	17 400	24 000	19 200	20 750
9/16	12	0.182	22 750	19 100	19 850	27 300	21 850	23 600
9/16	18	0.203	25 400	21 400	22 100	30 400	24 400	26 350
5/8	11	0.226	28 250	23 750	24 650	33 900	27 100	29 400
5/8	18	0.256	32 000	26 800	27 900	38 400	30 700	33 250
¾	10	0.334	41 750	35 050	36 400	50 100	40 100	43 400
¾	16	0.373	46 600	39 100	40 650	56 000	44 800	48 450
7/8	9	0.462	57 750	48 500	50 350	69 300	55 450	60 100
7/8	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 1/8	7	0.763	95 400	80 100	83 150	114 450	91 550	99 200
1 1/8	8	0.790	98 750	82 950	86 200	118 500	94 800	102 700
1 1/8	12	0.856	107 000	89 800	93 300	128 400	102 700	111 250
1 1/4	7	0.969	121 150	101 750	105 600	145 350	116 300	126 000
1 1/4	8	1.000	125 000	105 000	109 000	150 000	120 000	130 000
1 1/4	12	1.073	134 100	112 600	116 950	161 000	128 800	139 450
1 3/8	6	1.155	144 400	121 300	125 900	173 250	138 600	150 200
1 3/8	8	1.233	154 150	129 450	134 400	185 000	148 000	160 300
1 3/8	12	1.315	164 400	138 100	143 300	197 200	157 800	170 950
1 1/2	6	1.405	175 650	147 550	153 150	210 750	168 600	182 500
1 1/2	8	1.492	186 500	156 650	162 250	233 800	175 050	194 000
1 1/2	12	1.581	197 600	166 000	172 300	237 200	189 700	205 500
1 3/4	5	1.90	237 500	199 500	207 100	285 000	228 000	247 000
1 3/4	8	2.08	260 000	218 400	226 700	312 000	249 600	270 000
2	4 1/2	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 1/4	4 1/2	3.25	406 250	341 250	354 250	487 000	390 000	422 500
2 1/4	8	3.56	445 000	373 800	388 050	534 000	422 200	462 800
2 1/2	4	4.00	500 000	420 000	436 000	600 000	480 000	520 000
2 1/2	8	4.44	550 000	466 200	483 950	666 000	532 800	577 200
2 3/4	4	4.93	566 950	468 350	488 050	690 200	517 650	566 950
2 3/4	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 1/4	4	7.10	816 500	674 500	702 900	994 000	745 500	816 500
3 1/4	8	7.69	884 350	730 550	761 300	1 076 600	807 650	884 350
3 1/2	4	8.33	957 950	791 350	824 650	1 166 200	874 650	957 950
3 1/2	8	8.96	1 030 400	851 200	887 050	1 254 400	940 800	1 030 400
3 3/4	4	9.66	1 110 900	917 700	956 350	1 352 400	1 014 300	1 110 900
3 3/4	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 [$D - 0.9743/\eta$]² where D = nominal diameter, in., and η = 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 ½ to 1½ 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*

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

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>.

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.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁵ Available from Industrial Fastener Institute, (IFI), 6363 Oak Tree Boulevard, Independence, OH 44131. <http://www.industrial-fasteners.org>.

⁶ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:F16-1001.

**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 tensile 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 tensile tested shall be qualified on the basis of hardness.

6.2.2 For bolts on which hardness and tension tests are performed, acceptance based on tensile requirements shall take precedence in the event of low hardness readings.

7. Carburization/Decarburization

7.1 This test is intended to evaluate the presence or absence of carburization and decarburization as determined by the difference in microhardness near the surface and core.

7.2 *Requirements*:

7.2.1 *Carburization*—The bolts shall show no evidence of a carburized surface when evaluated in accordance with **12.2**.

7.2.2 *Decarburization*—Hardness value differences shall not exceed the requirements set forth for decarburization in Test Method **F2328** materials when evaluated in accordance with **12.2**.

8. Dimensions

8.1 *Head and Body*:

**TABLE 3 Hardness Requirements for Bolts
½ to 1½ in. Nominal Size**

Size, in.	Nominal Length, in.	Brinell		Rockwell C	
		min	max	min	max
½ to 1, incl.	Less than $2D$	311	352	33	38
	$2D$ and longer	...	352	...	38
Over 1 to 1½, incl.	Less than $3D$	311	352	33	38
	$3D$ and longer	...	352	...	38

TABLE 4 Tensile Load Requirements for Bolts Tested Full-Size

Bolt Size, Threads per Inch, and Series Designation	Stress Area, ^A in. ²	Tensile Load, ^B lbf		Proof Load, ^B lbf	Alternative Proof Load, ^B lbf
		min	max	Length Measurement Method	Yield Strength Method
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
½-13 UNC	0.142	21 300	24 600	17 050	18 500
⅝-11 UNC	0.226	33 900	39 100	27 100	29 400
¾-10 UNC	0.334	50 100	57 800	40 100	43 400
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
1⅛-7 UNC	0.763	114 450	132 000	91 550	99 200
1¼-7 UNC	0.969	145 350	167 650	116 300	126 000
1⅜-6 UNC	1.155	173 250	199 850	138 600	150 200
1½-6 UNC	1.405	210 750	243 100	168 600	182 600

^A The stress area is calculated as follows:

$$A_s = 0.7854 [D - (0.9743/n)]^2$$

where:

A_s = stress area, in.²
 D = nominal bolt size, and
 n = threads per inch.

^B Loads tabulated and loads to be used for tests of full-size bolts larger than 1½ in. in diameter are based on the following:

Bolt Size	Column 3	Column 4	Column 5	Column 6
½ to 1½ in., incl	150 000 psi	173 000 psi	120 000 psi	130 000 psi

TABLE 5 Tensile Strength Requirements for Specimens Machined from Bolts

Bolt Size, in.	Tensile Strength, psi		Yield Strength (0.2 % offset), min, psi	Elongation in 2 in. or 50 mm, min, %	Reduction of Area, min, %
	min	max			
½ to 1½ in., incl	150 000	173 000	130 000	14	40

8.1.1 Unless otherwise specified, bolts shall conform to the dimensions for heavy hex structural bolts specified in ASME B18.2.6.

8.1.2 The thread length shall not be changed from that specified in ASME B18.2.6 for heavy hex structural bolts. Bolts requiring thread lengths other than those required by this specification shall be ordered under Specification A354 Gr. BD.

8.2 *Threads*—Threads shall be the Unified Coarse Thread Series as specified in ASME B1.1 and shall have Class 2A tolerances.

9. Workmanship

9.1 The allowable limits, inspection, and evaluation of the surface discontinuities, quench cracks, forging cracks, head bursts, shear bursts, seams, folds, thread laps, voids, tool marks, nicks, and gouges shall be in accordance with Specification F788/F788M.

10. Magnetic Particle Inspection for Longitudinal Discontinuities and Transverse Cracks

10.1 Requirements:

10.1.1 Each sample representative of the lot shall be magnetic particle inspected for longitudinal discontinuities and transverse cracks.

10.1.2 The lot, as represented by the sample, shall be free from nonconforming bolts, as defined in Specification F788/F788M, when inspected in accordance with 10.2.1-10.2.3.

10.2 Inspection Procedure:

10.2.1 The inspection sample shall be selected at random from each lot in accordance with Practice F1470 and examined for longitudinal discontinuities and transverse cracks.

10.2.2 Magnetic particle inspection shall be conducted in accordance with Guide E709 or Practice E1444. Guide E709 shall be used for referee purposes. If any nonconforming bolt is found during the manufacturer's examination of the lot selected in 10.2.1, the lot shall be 100 % magnetic particle inspected, and all nonconforming bolts shall be removed and scrapped or destroyed.

10.2.3 Eddy current or liquid penetrant inspection shall be an acceptable substitute for the 100 % magnetic particle inspection when nonconforming bolts are found and 100 % inspection is required. On completion of the eddy current or liquid penetrant inspection, a random sample selected from each lot in accordance with Practice F1470 shall be re-examined by the magnetic particle method. In case of controversy, the magnetic particle test shall take precedence.

10.2.4 Magnetic particle indications of themselves shall not be cause for rejection. If in the opinion of the quality assurance

representative the indications may be cause for rejection, a sample taken in accordance with Practice **F1470** shall be examined by microscopic examination or removal by surface grinding to determine if the indicated discontinuities are within the specified limits.

11. Number of Tests and Retests

11.1 Testing Responsibility:

11.1.1 Each lot shall be tested by the manufacturer prior to shipment in accordance with the lot identification control quality assurance plan in **11.2-11.5**.

11.1.2 When bolts are furnished by a source other than the manufacturer, the Responsible Party as defined in **16.1** shall be responsible for assuring all tests have been performed and the bolts comply with the requirements of this specification.

11.2 *Purpose of Lot Inspection*—The purpose of a lot inspection program shall be to ensure that each lot as represented by the samples tested conforms to the requirements of this specification. For such a plan to be fully effective, it is essential that secondary processors, distributors, and purchasers maintain the identification and integrity of each lot until the product is installed.

11.3 *Lot Method*—All bolts shall be processed in accordance with a lot identification-control quality assurance plan. The manufacturer, secondary processors, and distributors shall identify and maintain the integrity of each lot of bolts from raw-material selection through all processing operations and treatments to final packing and shipment. Each lot shall be assigned its own lot-identification number, each lot shall be tested, and the inspection test reports for each lot shall be retained.

11.4 *Lot Definition*—A lot shall be a quantity of uniquely identified heavy hex structural bolts of the same nominal size and length produced consecutively at the initial operation from a single mill heat of material and processed at one time, by the same process, in the same manner, so that statistical sampling is valid. The identity of the lot and lot integrity shall be maintained throughout all subsequent operations and packaging.

11.5 Number of Tests:

11.5.1 The minimum number of tests from each lot for the tests specified below shall be as follows:

Tests	Number of Tests in Accordance with
Hardness, tensile strength, proof load	Practice F1470
Surface discontinuities	Specification F788/F789M
Magnetic particle inspection	Specification F788/F789M
Dimensions and thread fit	ASME B18.2.6

11.5.2 For carburization and decarburization tests, not less than one sample unit per manufactured lot shall be tested for microhardness.

12. Test Methods

12.1 Tensile, Proof Load, and Hardness:

12.1.1 Tensile, proof load, and hardness tests shall be conducted in accordance with Test Methods **F606**.

12.1.2 Tensile strength shall be determined using the Wedge or Axial Tension Testing Method of Full Size Product Method or the Machined Test Specimens Method, depending on size and nominal length as specified in **6.2.1-6.2.2**. Fracture on

full-size tests shall be in the body or threads of the bolt without a fracture at the junction of the head and body.

12.1.3 Proof load shall be determined using Method 1, Length Measurement, or Method 2, Yield Strength, at the option of the manufacturer.

12.2 *Carburization/Decarburization*—Tests shall be conducted in accordance with Test Method **F2328** Hardness Method.

12.3 *Microhardness*—Tests shall be conducted in accordance with Test Method **E384**.

12.4 *Magnetic Particle*—Inspection shall be conducted in accordance with Section **10**.

13. Inspection

13.1 If the inspection described in **13.2** is required by the purchaser, it shall be specified in the inquiry and contract or order.

13.2 The purchaser's representative shall have free entry to all parts of manufacturer's works or supplier's place of business that concern the manufacture of the material ordered. The manufacturer or supplier shall afford the purchaser's representative all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspections required by the specification that are requested by the purchaser's representative shall be made before shipment, and shall be conducted as not to interfere unnecessarily with the operation of the manufacturer's works or supplier's place of business.

14. Rejection and Rehearing

14.1 Disposition of nonconforming material shall be in accordance with Practice **F1470** section titled "Disposition of Nonconforming Lots."

15. Certification

15.1 When specified on the purchase order, the manufacturer or supplier, whichever is the responsible party as defined in Section **16** shall furnish the purchaser a test report that includes the following:

15.1.1 Heat analysis, heat number, and a statement certifying that heats having bismuth, selenium, tellurium, or lead intentionally added were not used to produce the bolts;

15.1.2 Results of hardness, tensile, and proof load tests;

15.1.3 Results of magnetic particle inspection for longitudinal discontinuities and transverse cracks;

15.1.4 Results of tests and inspections for surface discontinuities including visual inspection for head bursts;

15.1.5 Results of carburization and decarburization tests;

15.1.6 Statement of compliance with dimensional and thread fit requirements;

15.1.7 Lot number and purchase order number;

15.1.8 Complete mailing address of responsible party; and

15.1.9 Title and signature of the individual assigned certification responsibility by the company officers.

15.2 Failure to include all the required information on the test report shall be cause for rejection.

16. Responsibility

16.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser.

17. Product Marking

17.1 *Manufacturer's Identification*—All Type 1 and Type 3 bolts shall be marked by the manufacturer with a unique identifier to identify the manufacturer or private label distributor, as appropriate.

17.2 Grade Identification:

17.2.1 Type 1 bolts shall be marked “A490.”

17.2.2 Type 3 bolts shall be marked “A490” underlined.

17.3 *Marking Location and Methods*—All marking shall be located on the top of the bolt head and shall be either raised or depressed at the manufacturer's option.

17.4 *Acceptance Criteria*—Bolts that are not marked in accordance with these provisions shall be considered nonconforming and subject to rejection.

17.5 Type and manufacturer's or private label distributor's identification shall be separate and distinct. The two identifi-

cations shall preferably be in different locations and, when on the same level, shall be separated by at least two spaces.

18. Packaging and Package Marking

18.1 Packaging:

18.1.1 Unless otherwise specified, packaging shall be in accordance with Practice **D3951**.

18.1.2 When special packaging requirements are required, they shall be defined at the time of the inquiry and order.

18.2 Package Marking:

18.2.1 Each shipping unit shall include or be plainly marked with the following information:

18.2.1.1 ASTM designation and type,

18.2.1.2 Size,

18.2.1.3 Name and brand or trademark of the manufacturer,

18.2.1.4 Number of pieces,

18.2.1.5 Lot number,

18.2.1.6 Purchase order number, and

18.2.1.7 Country of origin.

19. Keywords

19.1 bolts; alloy steel; steel; structural; weathering steel

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (A490–11) that may impact the use of this standard. (Approved April 1, 2012.)

- (1) *Revised*—Section **2** to include protective coating **F2833** grade 1.
- (2) *Revised*—**3.1** to include protective coating **F2833** grade 1.
- (3) *Revised*—**3.2.1** to include protective coating **F2833** grade 1.

- (4) *Revised*—**3.3** to include protective coating **F2833** grade 1.
- (5) *Revised*—**4.3.1** to include protective coating **F2833** grade 1.

Committee F16 has identified the location of selected changes to this standard since the last issue (A490–10a^{e1}) that may impact the use of this standard. (Approved Dec. 15, 2011.)

- (1) *Revised*—**Table 1**.

Committee F16 has identified the location of selected changes to this standard since the last issue (A490–10) that may impact the use of this standard. (Approved Dec. 1, 2010.)

- (1) *Revised*—In **Table 3**, reduced maximum Rockwell C hardness from 39 to 38 HRC

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