REVISED - 6/17/2014

Meeting Minutes
RCSC Main Meeting
Friday, June 7th, 2013 – University of Cincinnati

1. 8: 00 AM Welcome - Call to order and Declaration of a Quorum (Carter)

2. Opening Comments and Circulation of Attendance Sheet (see attached sheet).

3. All attendees introduced themselves.

4. Meeting Agenda was approved as amended with the addition of one new business item proposed by Bob Shaw (see below).

5. Minutes of the June 2012 meeting were approved.

6. Executive Committee Report (Carter)
   a. See attached report.
   b. Carter asked for the main committee approval of a change to the Bylaws that will change the RCSC Standards revision cycle to 6 years instead of the current five years to align with the ICB [correction - IBC] and AISC revision cycles. The motion was made, seconded and passed without opposition.

7. Secretary/Treasurer's Report (Greenslade) – see attachment ref. membership and financials.

8. Nominating Committee for Executive Committee Report – Kasper Chair, Victor Schnuer, Helwig. Nominations:
   a. Jim Swanson to serve another term
   b. Curtis Mayes to replace Jim Ricles whose eligibility expired.

   The ballot on this item currently is active and Carter reminded members of the Council who have not yet voted to do so.

9. Specification Committee report (Harrold)
   a. See the attached report from the June 6, 2013 Specification Committee meeting.
   b. The next issue of the RCSC Standard will be 2014. Any changes not concluded by the end of the 2014 meeting will not be included in the 2014 revision and will carry over as new business for the 2020 revision
   c. Harrold asked for main committee support for the following actions:
      i. The Spec Committee voted to find the negatives of Peter Kasper, Ken Lohr, and Curtis Mayes non-persuasive on the ballot to remove ~~ASTM F1137~~ [ASTM F1136] from the ASTM approved finishes table on ASTM F1852 and F2280 since they are not formally approved by ASTM F16 at this time.
      Harrold made the motion, seconded by Farrell, all present were in favor except Curtis Mayes.
      (It was agreed that a working group will be formed to find a way to allow alternative finishes on structural fasteners with the approval of the engineer of record. The task group consists of the following people. Tom Schlafly, Ken Lohr, Curtis Mayes, Gene Mitchell, Peter Kasper, Jim Soma, Jim Gialamas, Rick Babik, and Darlene Auer)
      ii. The Spec Committee voted to find the negative of Karl Frank non-persuasive on allowing the use of TC bolts in snug-tight joints. Harrold made the motion, seconded by Gene Mitchell; no disapprovals.
      iii. The Spec Committee voted to find the negative of Rodney Baxter non-persuasive on the changes related to fillers.
      Motion made by Harrold, seconded by Schnuer; no disapprovals.
      iv. The Spec Committee asked to have the suggested language that was worked out in a working group on June 6 regarding when short slots are allowed in section 3.3.1 and the

associated commentary considered. Motion made by Larry Kruth, seconded by Tom Schlafly; 13 for, 9 against, 21 abstain. This did NOT receive a sufficient majority in favor so did not pass and will go back to the working group for a new proposal.

v. The Exec Committee agreed to look at ways to keep RCSC members and industry informed of changes that have been approved to go into the next revision such as:
   1. Addenda to the standard
   2. Errata sheets to the standard
   3. List of approved changes in a document on the web site

10. Committee reports
    a. Research Report (Carter for Ricles) – Brahimi report received June 4, 2014. Will be reviewed by Exec Committee and final $5000 will be paid in July if approved. See 10.e below.
    b. Education Report (McGormley) – nothing to report as the activity is to be combined with research. See 10.e below.
    c. Liaison Report (Greenslade): ASTM - ISO - ASME – IFI – see attached report.
    d. Status update of RCSC, AISC, CSA task group (Miazga) – nothing to report.
    e. The Research and Education Committees will be combined in the future to put all proposed expenditure of funds in one committee. Todd Ude has agreed to Chair the new committee. The volunteers to work on this committee are:
       i. Garrett Byrne
       ii. Bill Germuga
       iii. Hussam Mahmoud
       iv. Jon McGormley
       v. Joe Greenslade

       Plus Carly Mc Gee
    f. Tom Schlafly agreed to be the chairman of the Editorial Committee.

11. Technical Presentations were presented:
    a. Chad Larson -- turn and angle installation structural bolt system, http://www.tightenright.com/
    b. Bob Shaw – 180 ksi structural bolts, http://www.steelstructures.com

       Correction - 200 ksi
    c. Dan McLenithan and Markus Whitman (Hypertherm) -- plasma cutting of bolt holes, http://torchmate.com/?gclid=CMbF38CMj7gCFRJo7AodpAwALg
    d. Bolt App by Justin Love (not shown at the meeting) http://justinlove.name/aisc/boltapp/

12. New Business
    a. Bob Shaw requested permission to create a draft RCSC standard covering the XTB bolts.
    b. A working group was created to investigate the hole size verses fin/swell allowance on 1-3/8 and 1-1/2 structural bolts. Members:
       i. Charlie Carter – chair
       ii. Mike Friel
       iii. Bob Shaw
       iv. Victor Schnuer
       v. Gene Mitchell
       vi. Chris Curven

13. Location and Dates for 2014 Annual Meeting Loveland, CO. and hosted by Curtis Mayes with the Specification meeting on June 5, the main committee meeting on June 6 and the Executive Committee meeting on June 4.

14. Adjournment was called at 12:30 EST.

6/7/13

2013 RCSC Annual Meeting Attendees

Mark	First	Last	Company	E-mail
X	Toby	Anderson	Bay Bolt	baybolt@pacbell.net
X	Rick	Babik	NOF Metal Coatings	rick-babik@nofmetalcoatings.com
X	David W.	Bogaty	Spectra Tech., Inc.	dbogaty@spectratechinc.com
X	David	Bornstein	Skidmore Wilhelm	dbornstein@skidmore-wilhelm.com
X	Richard C.	Brown	TurnaSure LLC.	rich.brown@turnasure.com
✓	Garret O.	Byrne		garretbyrne@gmail.com
X	Charles J.	Carter	AISC	carter@aisc.org
X	Darlene	Collis	NOF Metal Coatings	darlene-collis@nofmetalcoating.com
X	Robert J.	Connor	Purdue University-School of Civil Eng.	rconnor@purdue.edu
X	Chris	Curven	Applied Bolting Technology	chrisc@appliedbolting.com
	Nick E.	Deal		ndeal1140@aol.com
X	Gregory	DePhillis	Marubeni-Itochu Steel America	dephillisg@misa.com
✓	Dean G.	Droddy	National Steel City	dean@nsc-us.com
✓	Peter	Dusicka	Portland State University Civil and Env. Eng.	dusicka@pdx.edu
X ✓	Matthew R.	Eatherton	Virginia Tech	meather@vt.edu
✓	Douglas B.	Ferrell	Ferrell Engineering, Inc.	doug.ferrell@ferrellengineering.com
	Karl H.	Frank	Hirschfeld Industries	karl.frank@hirschfeld.com
X	Michael C.	Friel	Haydon Bolts, Inc.	mcfriel@haydonbolts.com
X	Bill	Germuga	St. Louis Screw & Bolt	billg@stlouisscrewbolt.com
X	Jim	Gialamas	Nucor Fastener Division	james.gialamas@nucor-fastener.com
	Brian	Goldsmith	Skidmore Wilhelm	
X	Joe	Greenslade	Industrial Fasteners, Inst.	jgreenslade@indfast.org
X	Allen J.	Harrold	BlueScope Building - North America	ajharrold@butlermfg.com
X	Todd	Helwig	University of Texas at Austin	thelwig@mail.utexas.edu
	Kaushik A.	Iyer	Exponent Inc.	kiyer@exponent.com
	Emmanuel F	Jefferson	The Hanna Group	paul@hannagrp.com
	Charles J.	Kanapicki	Fluor Enterprises, Inc.	ckanapicki@abfjv.com
X	Peter F.	Kasper	Ifastgroupe/Infasco/DSI	PKasper@ifastgroupe.com
	Daniel J.	Kaufman	One E. Wacker Drive	kaufman@aisc.org
X	Lawrence	Kruth	Douglas Steel Fabricating Corp.	lkruth@douglassteel.com
X	Chad M.	Larson	LeJeune Bolt Company	clarson@lejeunebolt.com
	Bill R.	Lindley II	W W Steel, LLC	blindley@wwsteel.com
	Kenneth B.	Lohr	Lohr Fasteners	klohr@aol.com
X	Hussam N.	Mahmoud	Colorado State University	hussam.mahmoud@colostate.edu
✓	Curtis L.	Mayes	L.P.R. Construction	cmayes@lprconstruction.com

Mark	First	Last	Company	E-mail
p	Jonathan C.	McGormley	Wiss, Janney, Elstner Associates	jmcgormley@wje.com
✓	Kevin	Menke	Fastenal	kmenke@fastenal.com
p	Greg	Miazga	Waiward Steel	greg.miazga@waiward.com
✓	Eugene R.	Mitchell		mitch999@comcast.net
✓	Heath E.	Mitchell	AISC	mitchell@aisc.org
p	Justin	Ocel	Department of Transportation	
p	Carly	Pravlik	KTA-Tator, Inc.	cmcgee@kta.com
✓	Aaron	Prchlik	Alta Vista Solutions	aprchlik@altavistasolutions.com
✓	Gian A.	Rassati	University of Cincinnati	gian.rassati@uc.edu
✓	Thomas J.	Schlafly	AISC	schlafly@aisc.org
p	Gerald E.	Schroeder	Fish & Associates, Inc.	gschroeder@mwt.net
✓	Rachel	Shanley	Simpson Gumpertz + Heger	reshanley@sgh.com
✓	Robert E.	Shaw Jr.	Steel Structures Technology Center	rshaw@steelstructures.com
✓	Victor	Shneur	LeJeune Steel Co.	victor.shneur@lejeunesteel.us
✓	W. Lee	Shoemaker	Metal Building Manufacturers Assoc.	lshoemaker@mbma.com
X✓	James A.	Swanson	University of Cincinnati	james.swanson@uc.edu
✓	William A.	Thornton	Cives Steel Company	bthornton@cives.com
✓	Raymond H.	Tide	Wiss, Janney, Elstner Assoc.	rtide@wje.com
	Brad	Tinney	Birmingham Fastener	brad.tinney@bhamfast.com
p	Todd C.	Ude	exp	todd.ude@exp.com
✓	Floyd J.	Vissat	URS	floyd.vissat@urs.com
	Wendy	Wloszek	Skidmore Wilhelm	
p	Joseph A.	Yura	U of T Austin/Phil M. Ferguson Str. Eng. Lab.	yura@mail.utexas.edu
✓	JIM	SOMA	THE MAGNUS group	JSOMA@themagnusgroup.com
✓	PAT	FORTNEY	CIVES ENGINEERING CORP.	PFortney@CIVES.COM
p	Brad	Porter	Birmingham Fastener	brad.porter@bhamfast.com
p	PAUL	HERBST	FASTENAL COMPANY	pherbst@fastenal.com

Dated 6-28-02

XTB and XTB-HX

Nippon Steel & Sumikin Bolten Corp.

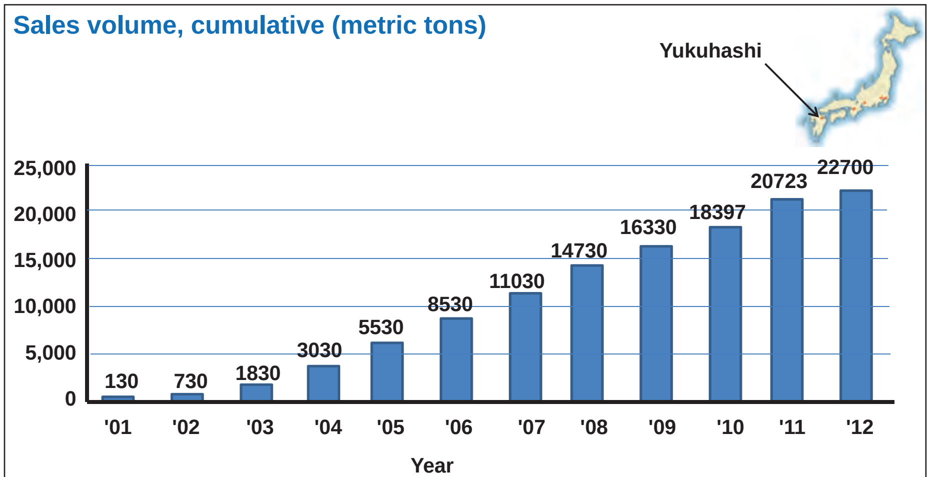
www.bolten.co.jp

MISA Marubeni-Itochu Steel

www.misa.com

Robert E. Shaw, Jr., PE
Steel Structures Technology Center, Inc.
rshaw@steelstructures.com
www.steelstructures.com

Sales volume, cumulative (metric tons)



1 metric ton ≈ 1.1 ton

	Building	Steel Tons	Floors	Area	Bolt sets	Year
1	JAL Hotel Bayside Osaka	4800	32	48,000 m²	46,000	2001
2	NTT Docomo Miyagi	3100	21	31,000 m²	60,000	2001
3	Daido Life Insurance Kasumigaseki	2,300	20	23,000 m²	80,000	2001
4	Nishikanda Redevelopment	6,000	32	60,000 m²	135,000	2002
5	Hitachi Logistic Kyoto	13,000	5	130,000 m²	160,000	2002
6	Kochi Medical Center	11,000	12	110,000 m²	320,000	2003
7	Murata Mfr. Kyoto	5,000	18	50,000 m²	190,000	2003
8	Ion Asahikawa SC	9,000	2	90,000 m²	80,000	2003

1 metric ton ≈ 1.1 ton
1 m² ≈ 10.764 sq ft.

	Building	Steel Tons	Floors	Area	Bolt sets	Year
9	Canon Shimomaruko Lab	7,000		70,000 m^2	180,000	2004
10	Wacal Shiga Warehouse	2,000	3	20,000 m^2	80,000	2005
11	JT Nagoya Redevelopment	28,000	5	287,000 m^2	283,000	2005
12	Nigata Municipal Hospital	10,000	10	100,000 m^2	375,000	2005
13	Namba Parks 2nd	10,000	30	100,000 m^2	150,000	2006
14	Tokyo Disney Hotel	3,500	9	85,000 m^2	15,000	2006
15	Aichi Kouseiren Hospital	5,000		70,000 m^2	185,000	2007
16	Shimane Nuclear Power, No.3	18,000		180,000 m^2	208,000	2007

1 metric ton ≈ 1.1 ton
1 m^2 ≈ 10.764 sq ft.

	Building	Steel Tons	Floors	Area	Bolt sets	Year
17	Panasonic Himeji Plant	15,000		150,000 m^2	400,000	2008
18	Sharp Sakai Plant	60,000		600,000 m^2	600,000	2008
19	Sekisui House Midosuji	8,000	30	80,000 m^2	350,000	2008
20	Osaka Station North	45,000	35	450,000 m^2	310,000	2009
21	JR Tokai Training Center	7,500	6	75,000 m^2	307,000	2010
22	Nakanoshima Festival Hall	20,000	39	200,000 m^2	380,000	2010
23	Abeno Harukasu	21,000	60	210,000 m^2	410,000	2011

1 metric ton ≈ 1.1 ton
1 m^2 ≈ 10.764 sq ft.

Abeno Harukasu	21,000 tons	60 stories	210,000 m^2 2,250,000 sq ft	410,000 bolt sets	2011

XTB-HX

XTB

12GSHTB

NIPPON STEEL TECHNICAL REPORT No. 97 JANUARY 2008

UDC 699 .14 . 018 . 263

Super-High-Strength Bolt, “SHTB®”

Nobuyoshi UNO*1 Manabu KUBOTA*2
Masahiro NAGATA*3 Toshimi TARUI*4
Hideo KANISAWA*5 Shingo YAMASAKI*6
Kiyosaburo AZUMA*4 Toshio MIYAGAWA*7

http://www.nssmc.com/en/tech/report/nsc/no97.html/

(12) **United States Patent** (10) **Patent No.: US 7,070,664 B2**
Uno et al. (45) **Date of Patent: Jul. 4, 2006**

(54) **HIGH STRENGTH BOLT SUPERIOR IN DELAYED FRACTURE RESISTANT PROPERTY AND STEEL MATERIAL FOR THE SAME**

(75) Inventors: **Nobuyoshi Uno**, Futtsu (JP); **Hideo Kanisawa**, Muroran (JP)

(73) Assignee: **Nippon Steel Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 205 days.

(21) Appl. No.: **10/296,572**

(22) PCT Filed: **Mar. 22, 2002**

JP	64-52045	2/1989
JP	1-191762	8/1989
JP	2-267243	11/1990
JP	3-6352	1/1991
JP	3-173745	7/1991
JP	3-229009	10/1991
JP	4-29607	1/1992
JP	5-9653	1/1993
JP	5-70890	3/1993

(Continued)

Primary Examiner—Deborah Yee
(74) *Attorney, Agent, or Firm*—Kenyon & Kenyon LLP

(57) **ABSTRACT**

http://patft.uspto.gov/

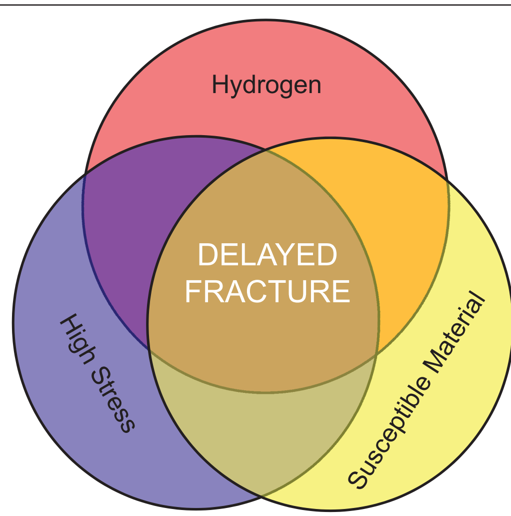
Bolt	Nominal Bolt Diameter, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), min, psi	Elongation in 50 mm, min, %	Reduction of Area, min, %
		min	max			
XTB	1 to 1 1/4 incl	200	215	180	14	40
A490	1/2 to 1 1/2 incl	150	173	130	14	40
A325	1/2 to 1 incl	120		92 *	14	35
	over 1 to 1 1/2	105		81 *	14	35
					* in 4D, min, %	

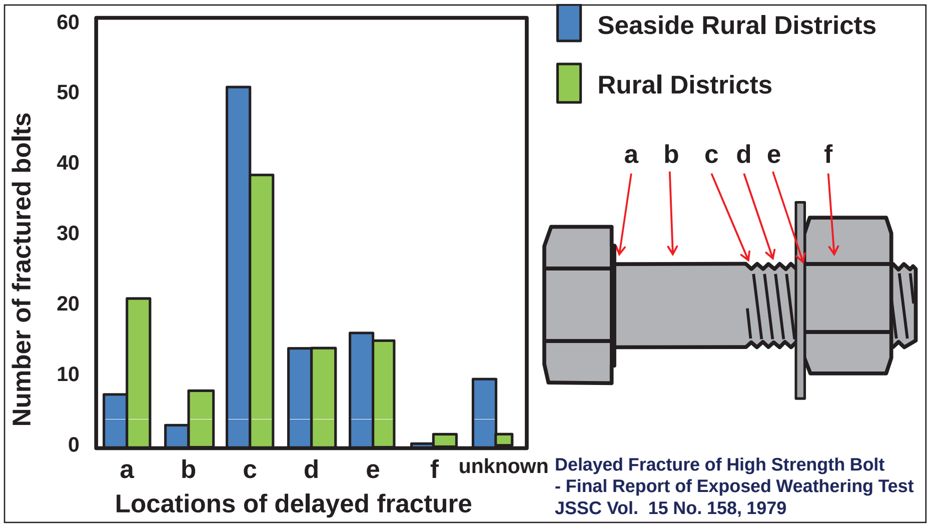
AISC 360, Table J3.2 Nominal Strengths (ksi)	A325 / F1852 (Group A)	A490 / F2280 (Group B)	XTB / XTB-HX (Group C, proposed)
Material Tensile Strength	105/120 min	150 min 170 max	200 min 215 max
Nominal Tensile Strength, F_{nt}	90	113	150
Nominal Shear Strength , F_{nv} (N)	54	68	90
Nominal Shear Strength , F_{nv} (X)	68	84	113

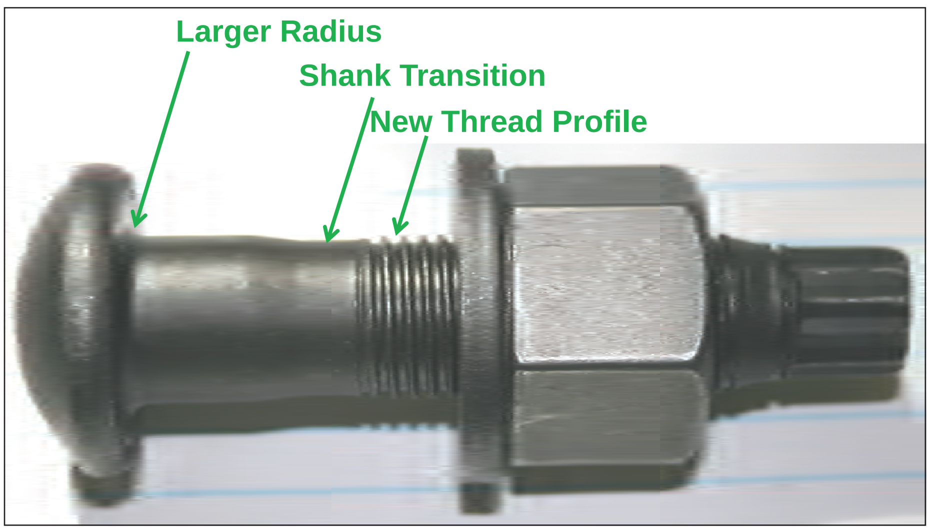
Nominal Strengths	A325 / F1852 (Group A)	A490 / F2280 (Group B)	Increase
	#		67 %
		#	33 %

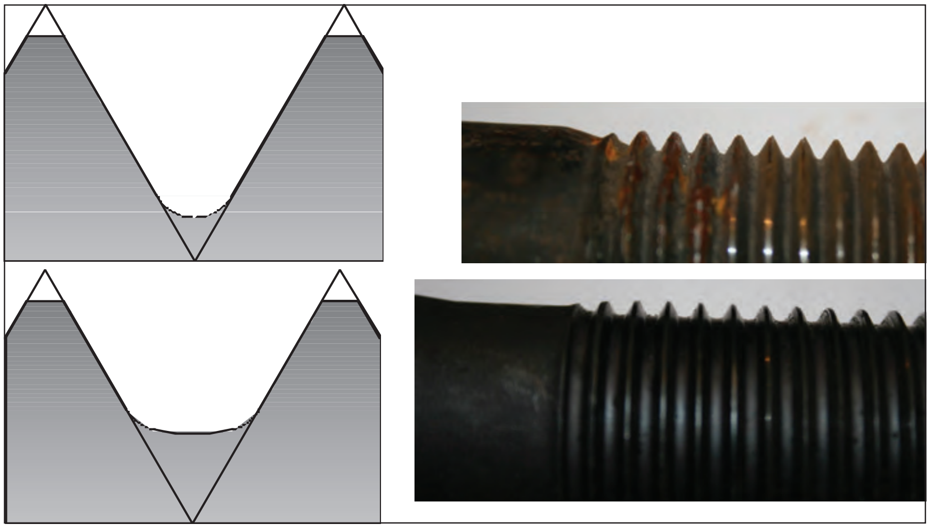
AISC 360, Table J3.1 Minimum Bolt Pretensions (kips)	(Group A)		(Group B)		(Group C, proposed)
	A325	F1852	A490	F2280	XTB / XTB-HX
1"	51	51	64	64	90
1-1/8"	56	56	80	80	113
1-1/4"	71	---	102	---	143
1-3/8"	85	---	121	---	---
1-1/2"	103	---	148	---	---

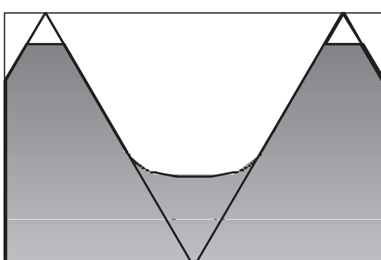
Minimum Bolt Pretensions	A325 / F1852 (Group A)	A490 / F2280 (Group B)	Increase
1"	#		76 %
		#	41 %
1-1/8" and 1-1/4"	#		101 %
		#	40 %



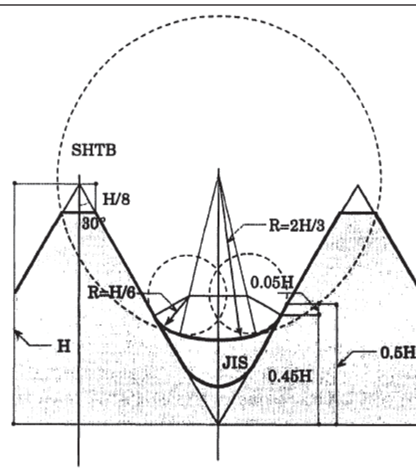

Seaside Rural Districts
Rural Districts
Number of fractured bolts
0
10
20
30
40
50
60
a
b
c
d
e
f
unknown
Locations of delayed fracture
a b c d e f
Delayed Fracture of High Strength Bolt
- Final Report of Exposed Weathering Test
JSSC Vol. 15 No. 158, 1979


Larger Radius
Shank Transition
New Thread Profile





Stress Concentration Factor of XTB thread profile is **about 60%** of conventional thread profile



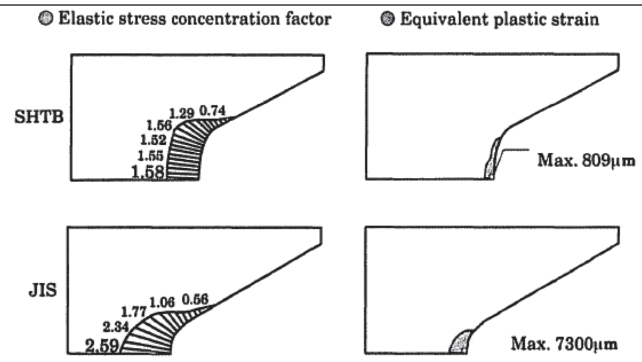
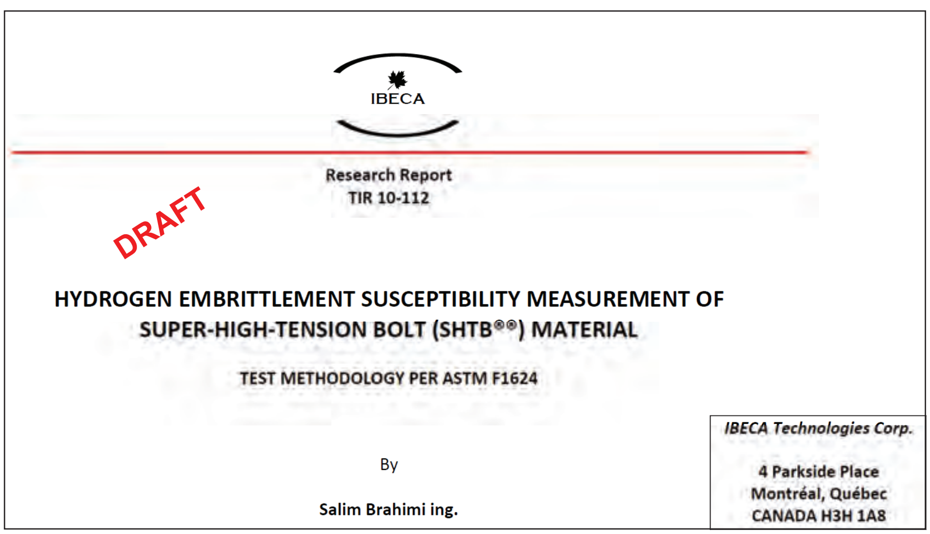


Fig. 7 Elastic stress concentration factor and equivalent plastic strain of thread bottom

An Analytical Study on the Shape of the Screw Thread of High Strength Bolts
Wakiyama, Kim, Tada, Kuwahara & Uno
Journal of Structural Construction Engineering, AIJ, No. 452, Oct 1993

	Composition, %			
	Heat Analysis, %		Product Analysis, %	
Element	**min**	**max**	**min**	**max**
Carbon	0.38	0.42	0.36	0.44
Manganese	0.40	0.60	0.37	0.63
Phosphorus	. . .	0.01	. . .	0.015
Sulfur	. . .	0.01	. . .	0.015
Silicon	. . .	0.10	. . .	0.12
Chromium	1.20	1.40	1.15	1.45
Molybdenum	0.60	0.80	0.57	0.83
Vanadium	0.30	0.40	0.27	0.43
Aluminum, cobalt, niobium / columbium , nickel, titanium, tungsten, zirconium, or any other alloying elements may be added to obtain the desired alloying effect				


IBECA

Research Report
TIR 10-112

DRAFT

HYDROGEN EMBRITTLEMENT SUSCEPTIBILITY MEASUREMENT OF
SUPER-HIGH-TENSION BOLT (SHTB®®) MATERIAL

TEST METHODOLOGY PER ASTM F1624

By

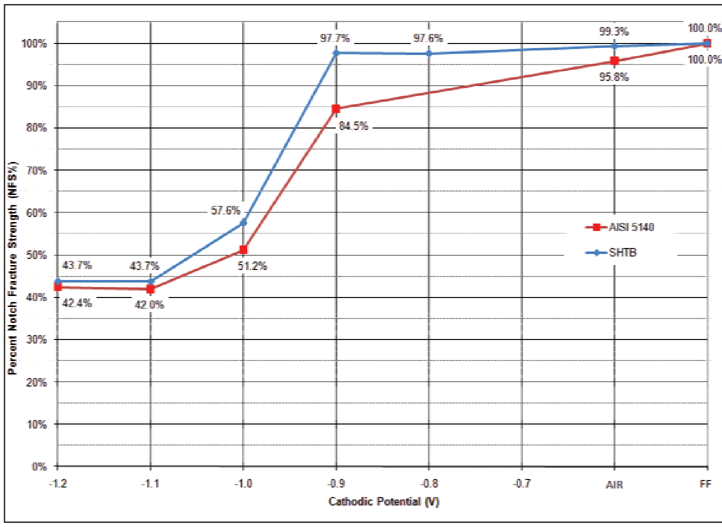
Salim Brahimi ing.

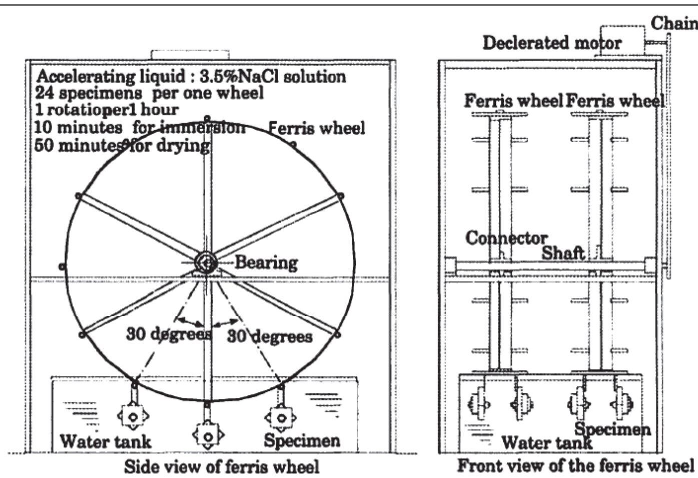
IBECA Technologies Corp.

4 Parkside Place
Montréal, Québec
CANADA H3H 1A8

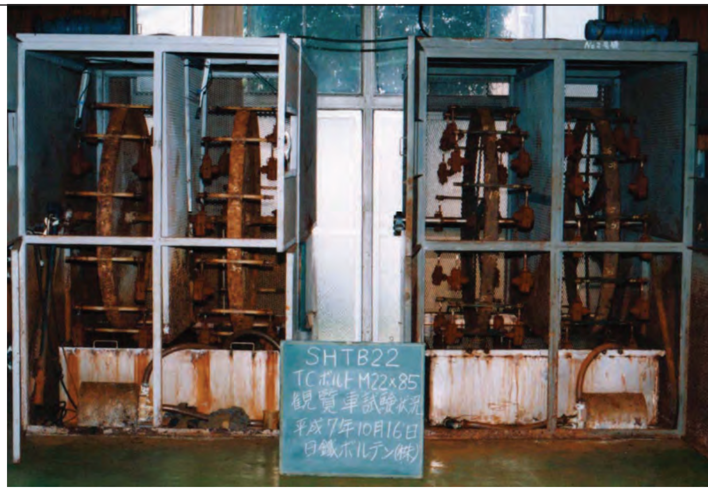
F1624 - 09
Standard Test Method for Measurement of Hydrogen Embrittlement Threshold in Steel by the Incremental Step Loading Technique

Material	Loading	Exposure	Samples
SHTB® (M43)	Fast fracture	Air	5
	ISL	Air	5
	ISL	-1.2 V	5
	ISL	-1.1 V	5
	ISL	-1.0 V	5
	ISL	-0.9 V	5
	ISL	-0.8 V	5
AISI 5140 (M8)	Fast fracture	Air	5
	ISL	Air	5
	ISL	-1.2 V	5
	ISL	-1.1 V	5
	ISL	-1.0 V	5
	ISL	-0.9V	5

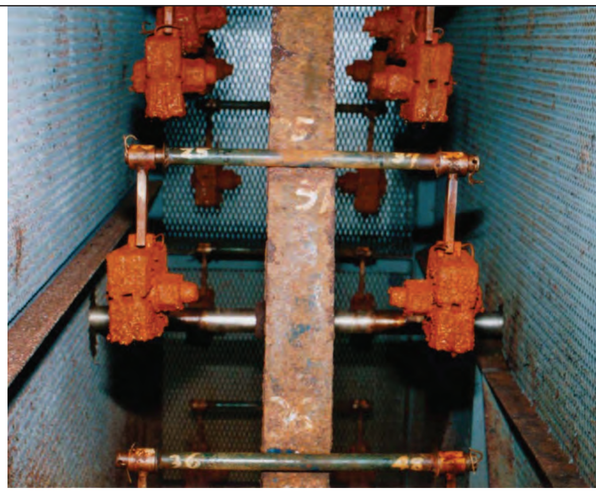




Eto-type Ferris Wheel



Eto-type Ferris Wheel



Eto-type Ferris Wheel

Outdoor exposure test - Okinawa

Outdoor exposure test - Okinawa

1. Scope

1.4 The fastener assemblies are intended for use in structural connections in the following environments conditions:

1.4.1 Interiors, normally dry, including interiors where structural steel is embedded in concrete, encased in masonry, or protected by membrane or noncorrosive contact type fireproofing.

1.4.2 Interiors and exteriors, normally dry, under roof, where the installed assemblies are protected by a shop-applied or field-applied coating to the structural steel system.

1.5 The fastener assemblies are not intended for use in structural connections in the following environments, with or without protection by a shop-applied or field-applied coating to the structural steel system:

1.5.1 Exteriors not under roof.

1.5.2 Chemical environments in which strong concentrations of highly corrosive gases, fumes, or chemicals, either in solution or as concentrated liquids or solids, contact the fasteners or their protective coating.

1.5.3 Heavy industrial environments severe enough to be classified as a chemical environment as described in 1.5.2.

1.5.4 Condensation and high humidity environments maintaining almost continuous condensation, including submerged in water and soil.

1.5.5 Cathodically protected environments, in which current is applied to the structural steel system by the sacrificial anode method or the DC power method.

5.1.5 Protective Coatings

The bolts, nuts and washers shall not be coated by hot dip zinc coating, mechanical deposition, electroplating, dip-spin, dip-drain, or spray methods with zinc or other metallic coatings.

Protective coatings may be shop-applied or field-applied to installed assemblies.

1" diameter	1-1/8" diameter	1-1/4" diameter
3-1/2	3-3/4	4
5	5-1/2	5-1/2
6-1/2	7	7
8	9	9

1" diameter	1-1/8" diameter	1-1/4" diameter
3-1/2	3-3/4	4
5	5-1/2	5-1/2
6-1/2	7	7
8	9	9

Installation Protocol Development and Testing

Turn-of-nut installation - University of Cincinnati

Twist-off bolt installation - Virginia Tech

Direct tension indicator installation
(Applied Bolting Technology, Turnasure)

Calibrated wrench installation

JASS 6, Hexagon

1. Achieve a tight fit of the joint parts.

2. Apply torque value for preliminary tightening.

Nominal Bolt Size	Torque value for preliminary tightening (approximate)	
	(N-m)	(ft-lb)
M20, M22	150	110
M24	200	150
M27	300	220
M30	400	300

3. Apply matchmarks.

4. Apply 120º rotation (standard for up to bolt length ≤ 5 diameters)

5. Visual inspection, rotation ±30º, reject and replace if +30º exceeded

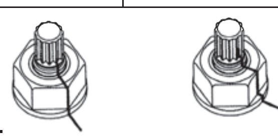
JASS 6, Torshear

1. Achieve a tight fit of the joint parts.

2. Apply torque value for preliminary tightening.

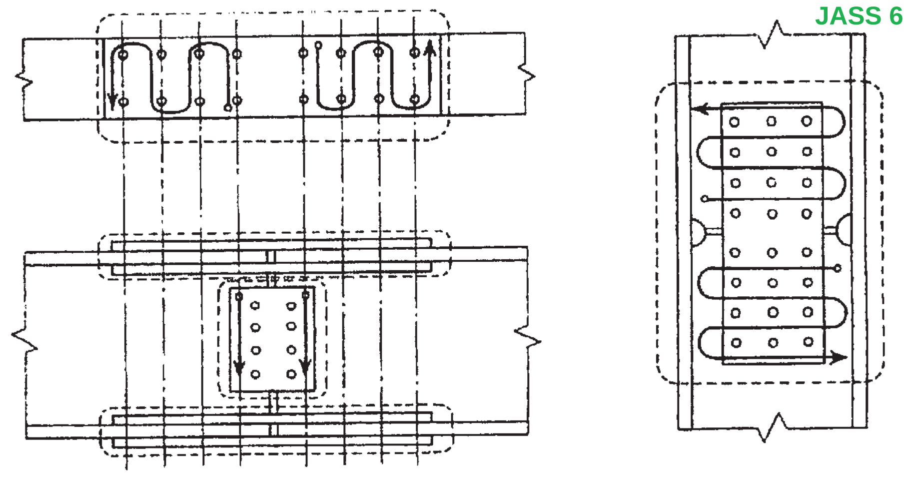
Nominal Bolt Size	Torque value for preliminary tightening (approximate)	
	(N-m)	(ft-lb)
M20, M22	150	110
M24	200	150
M27	300	220
M30	400	300

3. Apply matchmarks.



4. Tighten until twist-off of spline.

5. Visual inspection for remarkable variation in rotation. If so, find average rotation. If rotation varies ±30º from average, reject and replace bolt.



Essential Variables:

Snug Tight Condition (Initial Tension)
- 10%, 50%, 90%/100%

Threads in Grip
- Minimum and Maximum

Bolt Condition
- As-Received
- Dry / Light Rust, Dry / Light Rust Relubricated
- High / Low Temperature Conditions

Hole Type and Connected Material
- (STD, OVS, SSL, LSL)
- Grade of Connected Steel (A36, A572-50)

XTB

VirginiaTech
Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

The Charles E. Via, Jr. Department
of Civil and Environmental Engineering
Blacksburg, VA 24061

Structural Engineering and Materials

Christopher L. Galitz, M.S., P.E.
Graduate Research Assistant

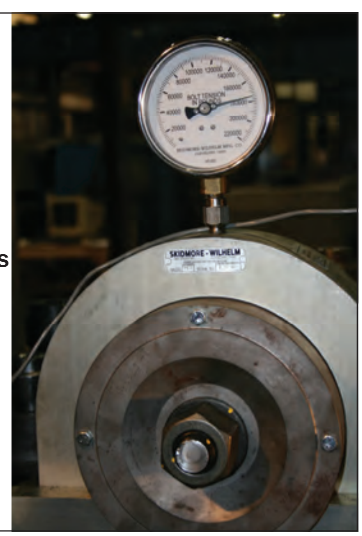
Matthew R. Eatherton, Ph.D., S.E.
Assistant Professor

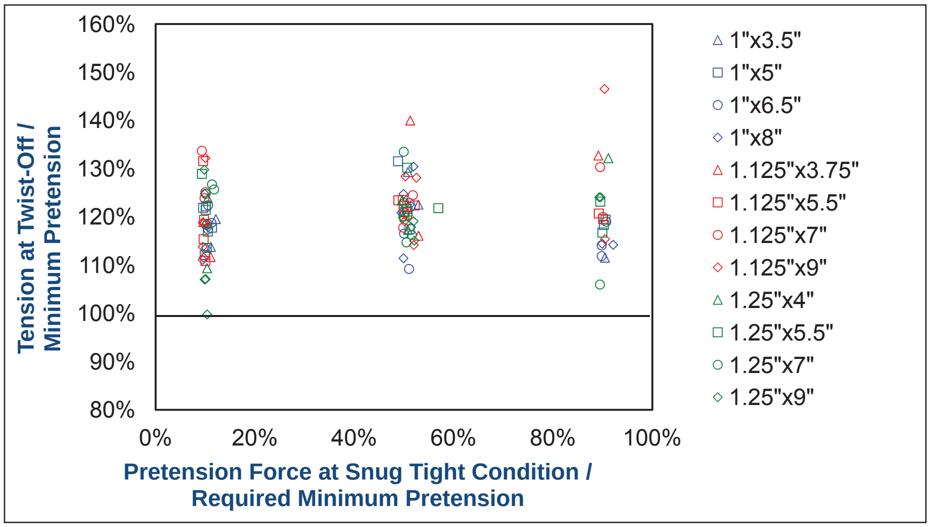
Twist-off wrench

2950 ft-lb torque

Virginia Tech

XTB twist-off
1-1/4" diameter
Minimum required pretension 142 kips
Pre-installation verification test pretension 150 kips
Achieved pretension 178 kips

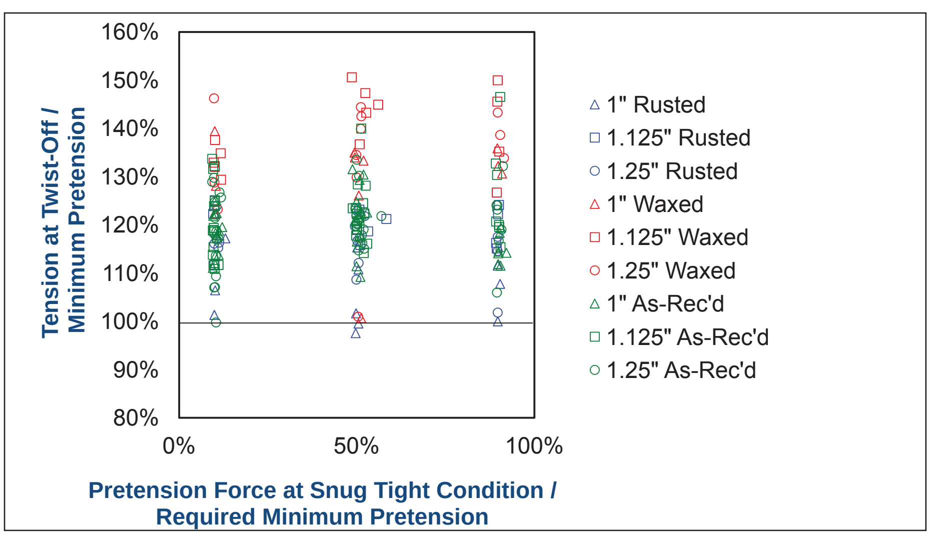


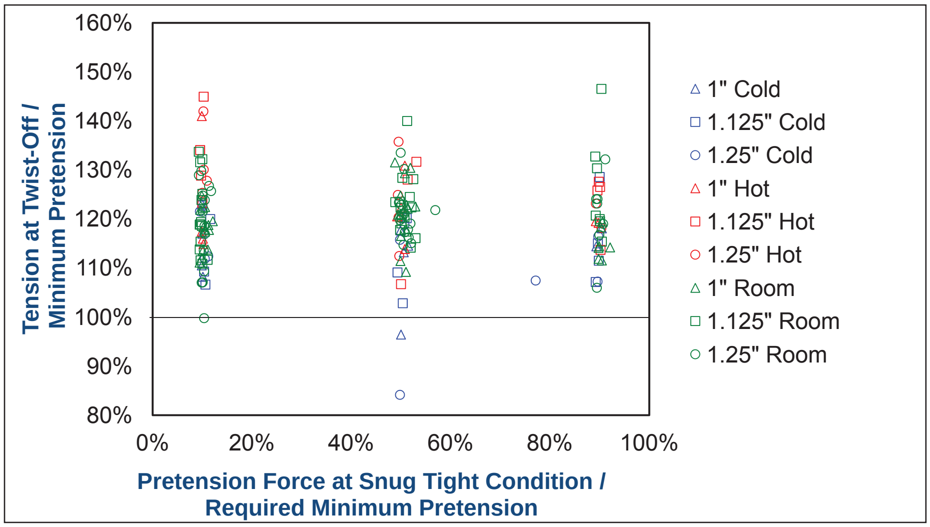


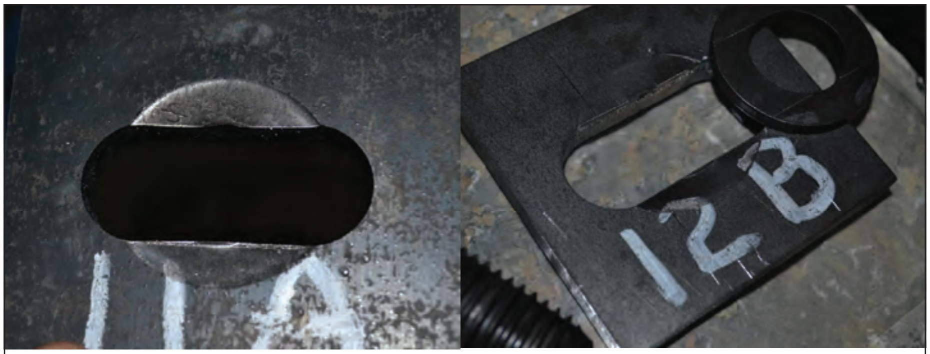
Cleaned with Acetone


Misted with Water Every 7 days for 28 Days

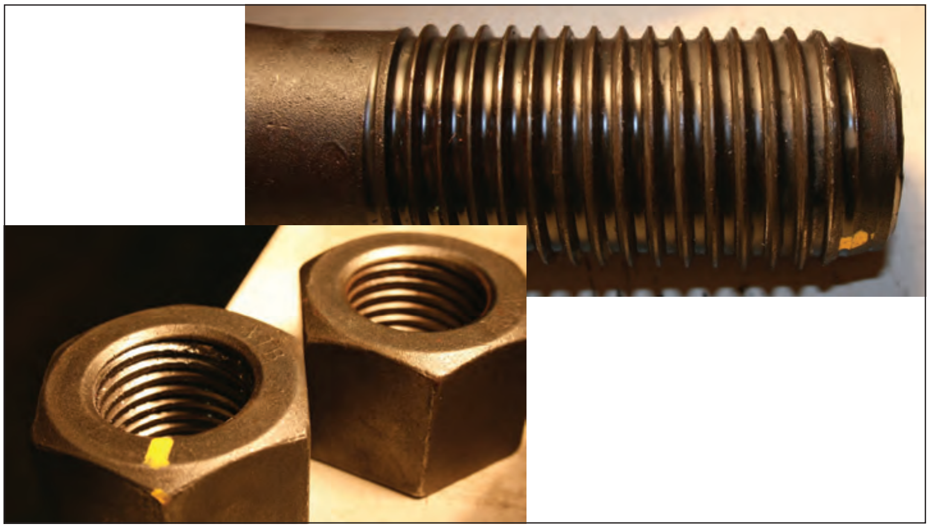
Relubrication with Stick Wax





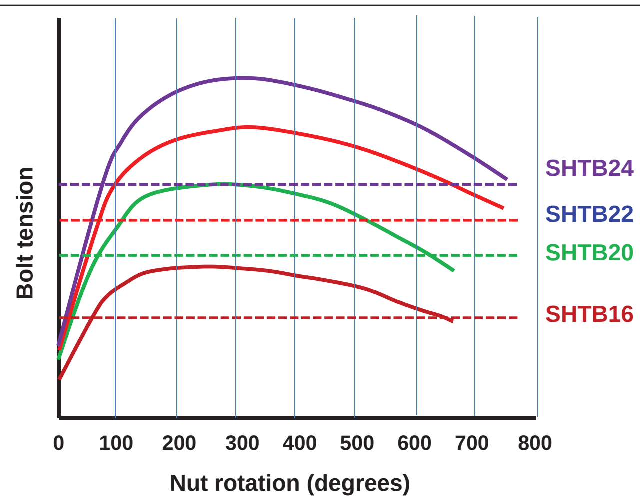


36 ksi plate   50 ksi plate

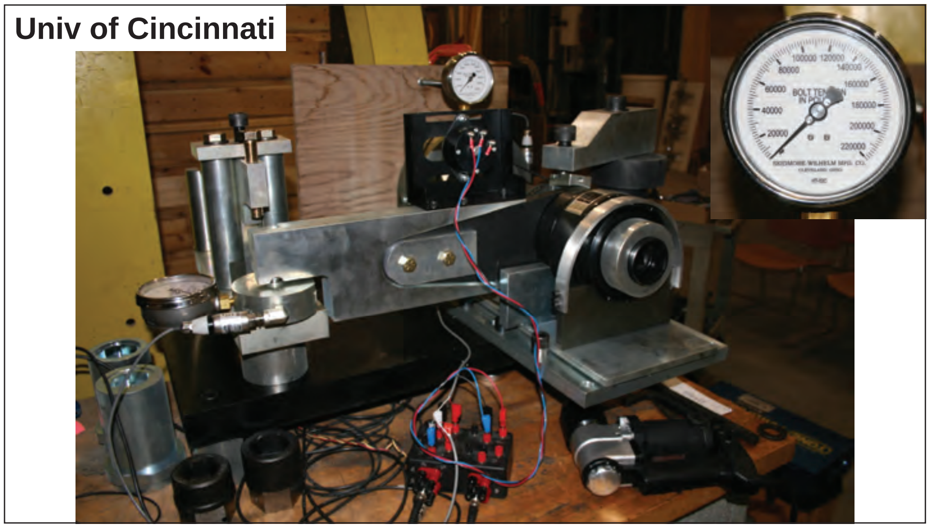


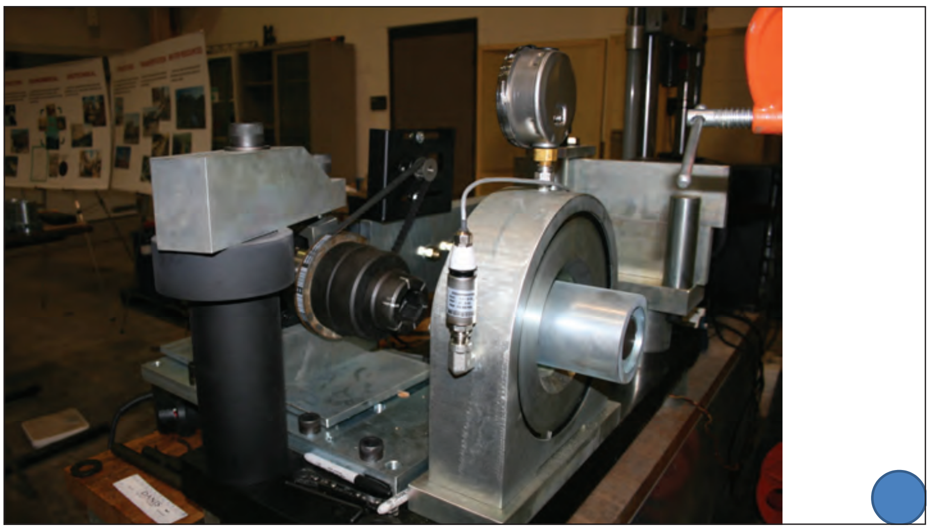
UNIVERSITY OF Cincinnati

Jennifer R Clements
Gian Andrea Rassati
James A Swanson



N97, Figure 12





Test ID: STD-1x3.5-2

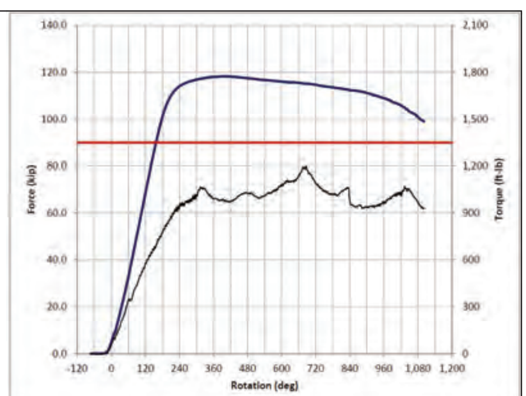
Test Date: 11/21/12

Bolt Diameter: 1.000 (in)
Bolt Length: 3.500 (in)
Min Pretension: 90.0 (kip)
Thread in Grip: Max
Thread Condition: As Received
Failure Mode: Tension

Maximum Torque: 1,197.6 (ft-lb)
Rotational Stiffness: 0.5660 (kip/deg)

Nut Factor: 0.0937
Torque Efficiency: 7.8061 (ft-lb/kip)

	Raw Rotation (deg)	Offset Rotation (deg)	Force (kip)	Torque (ft-lb)
L1:	104.1	32.0	18.1	182.6
L2:	183.5	111.4	63.1	533.7
Min Rotation:	229.5	157.4	90.0	690.5
Ultimate:	472.4	400.3	118.3	984.0
Max Rotation:	1,174.1	1,102.0	99.1	926.8
Failure:	1,174.1	1,102.0	99.1	926.8



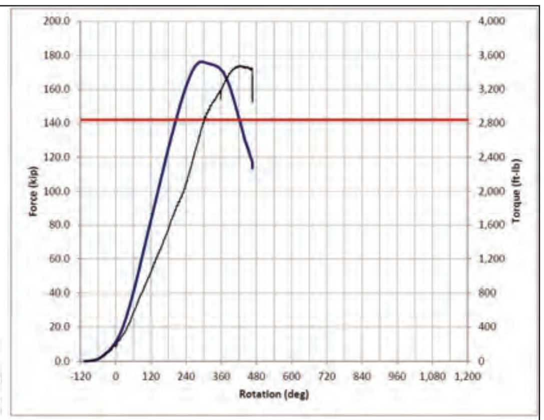
Test ID: STD-1.25x9-4

Test Date: 12/12/12

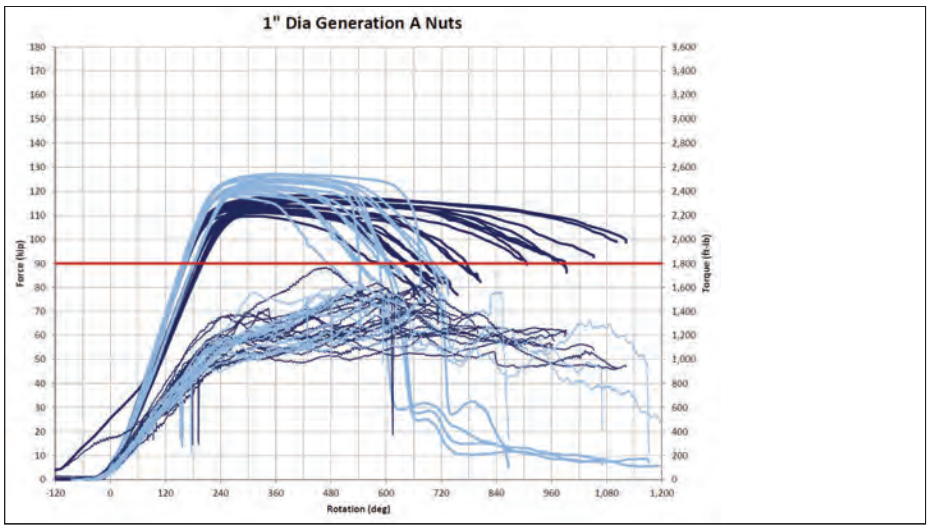
Bolt Diameter: 1.250 (in)
Bolt Length: 9.000 (in)
Min Pretension: 142.0 (kip)

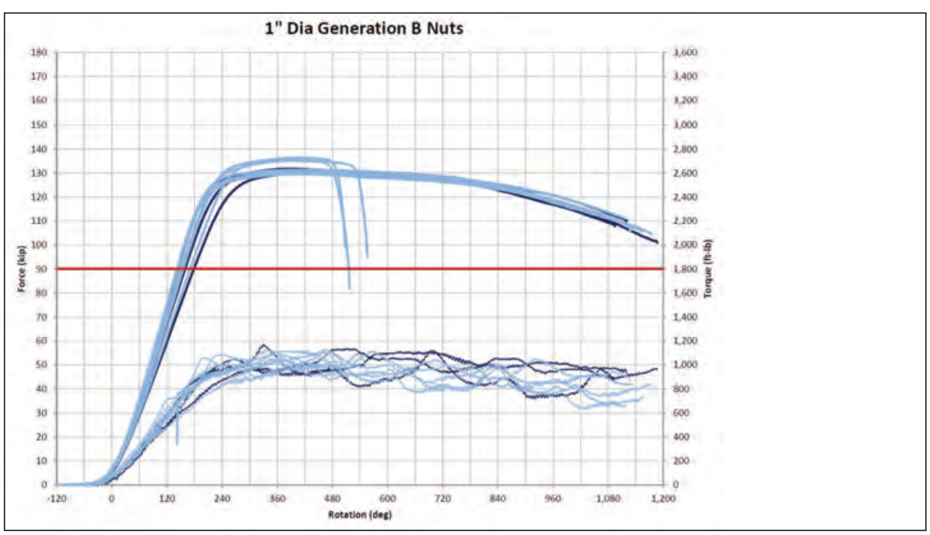
Thread in Grip: Min
Thread Condition: As Received
Failure Mode: Tension
Maximum Torque: 3,482.2 (ft-lb)
Rotational Stiffness: 0.6954 (kip/deg)
Nut Factor: 0.1130
Torque Efficiency: 11.7745 (ft-lb/kip)

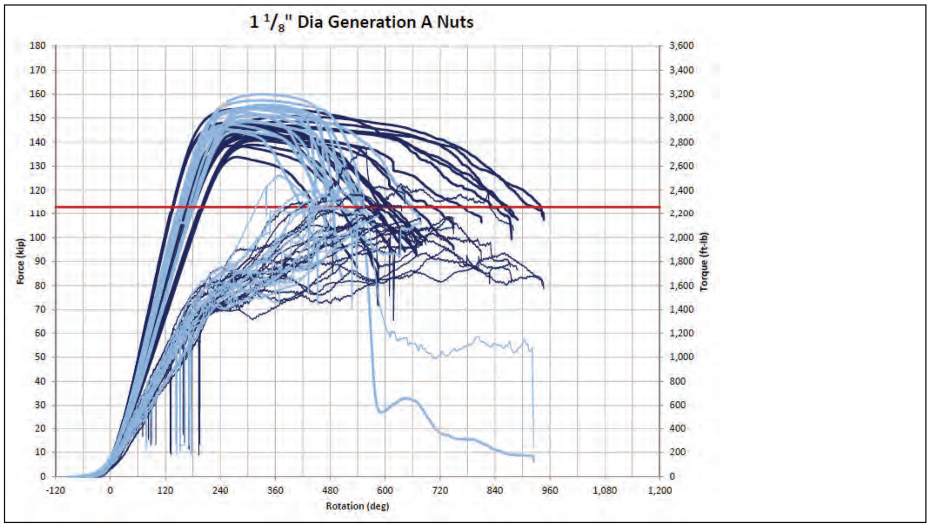
	Raw Rotation (deg)	Offset Rotation (deg)	Force (kip)	Torque (ft-lb)
L1:	147.2	41.2	28.6	416.5
L2:	249.3	143.2	99.6	1,252.2
Min Rotation:	311.7	205.6	142.0	1,790.5
Ultimate:	398.7	292.7	176.1	2,731.2
Max Rotation:	527.9	421.8	142.1	3,466.7
Failure:	572.5	466.4	113.8	3,047.8

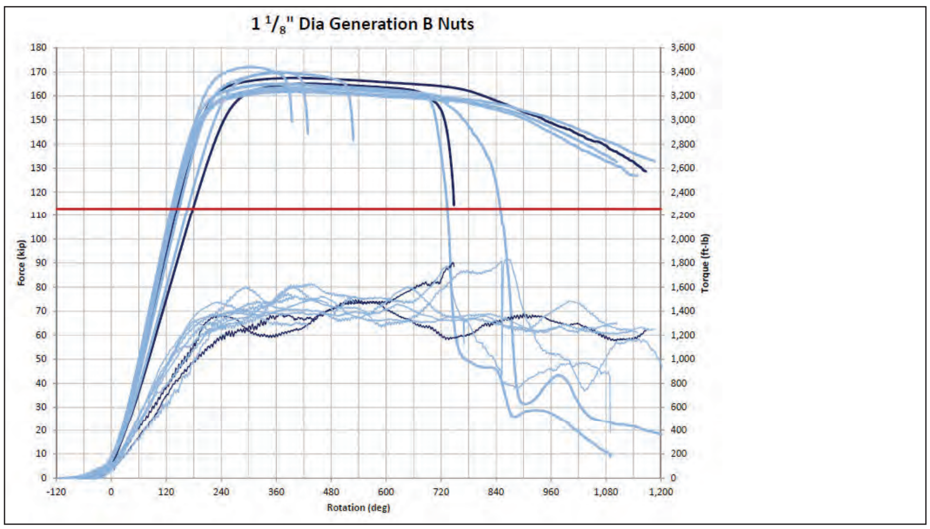


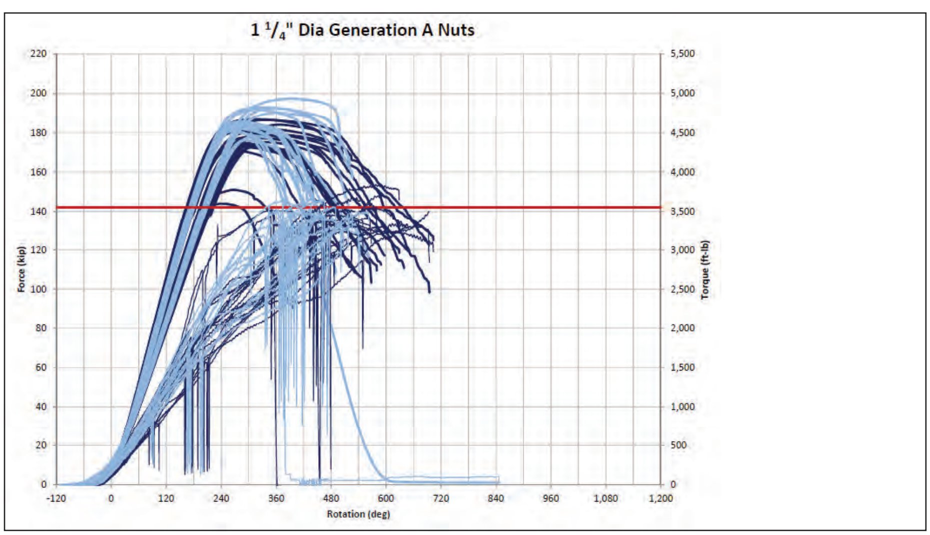

XTB
NEW 1.125-3.75-01

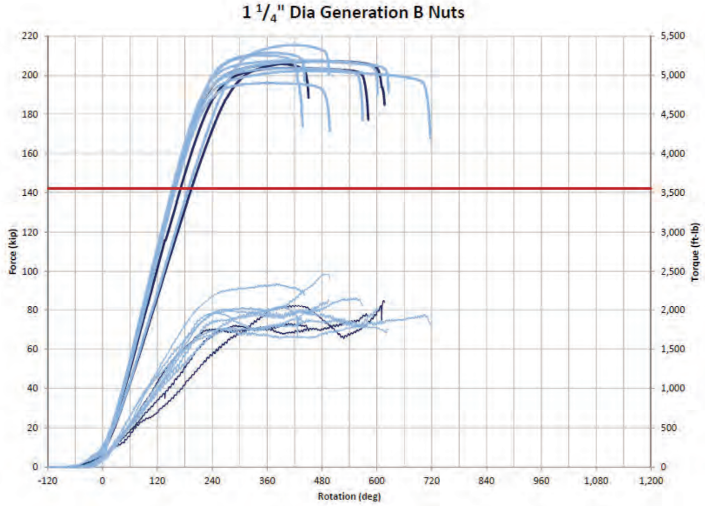

1" Dia Generation A Nuts
Force (kip)
Torque (ft-lb)
Rotation (deg)


1" Dia Generation B Nuts
Force (kip)
Torque (ft-lb)
Rotation (deg)


1 1/8" Dia Generation A Nuts
Force (kip)
Torque (ft-lb)
Rotation (deg)


1 1/8" Dia Generation B Nuts
Force (kip)
Torque (ft-lb)
Rotation (deg)

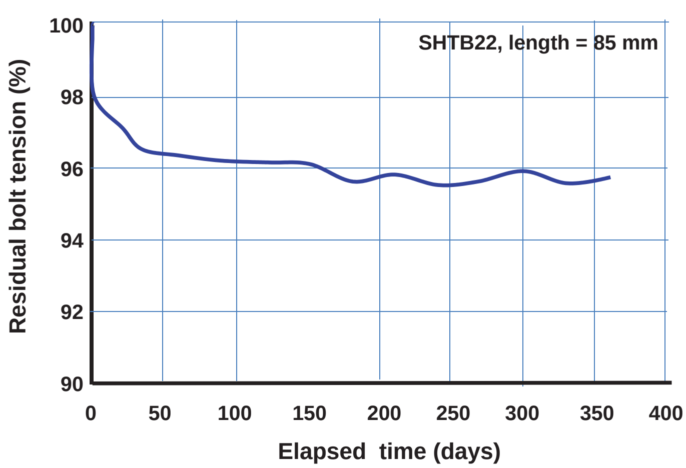

1 1/4" Dia Generation A Nuts
Force (kip)
Torque (ft-lb)
Rotation (deg)



Mechanical Properties Validation

Mechanical Properties of Bolts, Nuts and Washers

- ❑ Tensile strength
- ❑ Proof load
- ❑ Elongation
- ❑ Hardness



Relaxation characteristics **N97, Figure 13**

Connection Design Rules

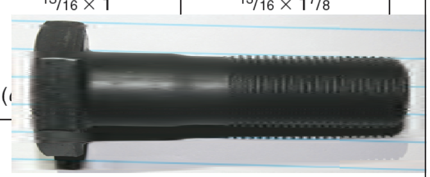
Design of connections:
AISC 360 Chapter J
RCSC Chapter 5
CSA S16 Subclauses 13.11 & 13.12

- ❑ Shear strength
- ❑ Tensile strength
- ❑ Combined shear and tension
- ❑ Oversized and slotted holes
- ❑ Connection material bearing limits
- ❑ Block shear

AISC 360-10

TABLE J3.3
Nominal Hole Dimensions, in.

Bolt Diameter, in.	Hole Dimensions			
	Standard (Dia.)	Oversize (Dia.)	Short-Slot (Width × Length)	Long-Slot (Width × Length)
1/2	9/16	5/8	9/16 × 11/16	9/16 × 1 1/4
5/8	11/16	13/16	11/16 × 7/8	11/16 × 1 9/16
3/4	13/16	15/16	13/16 × 1	13/16 × 1 7/8
7/8	15/16	1 1/16	[illegible]	[illegible]
1	1 1/16	1 1/4	[illegible]	[illegible]
≥ 1 1/8	d + 1/16	d + 5/16	[illegible]	[illegible]

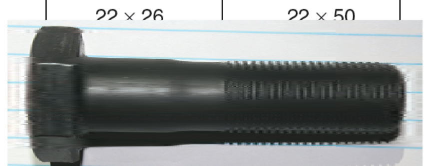


AISC 360-10

TABLE J3.3M
Nominal Hole Dimensions, mm

Bolt Diameter, mm	Hole Dimensions			
	Standard (Dia.)	Oversize (Dia.)	Short-Slot (Width × Length)	Long-Slot (Width × Length)
M16	18	20	18 × 22	18 × 40
M20	22	24	22 × 26	22 × 50
M22	24	28	[illegible]	[illegible]
M24	27[a]	30	[illegible]	[illegible]
M27	30	35	[illegible]	[illegible]
M30	33	38	[illegible]	[illegible]
≥ M36	d + 3	d + 8	[illegible]	[illegible]

[a] Clearance provided allows the use of a 1-in. bolt if desirable.



Bolts in Single Shear – LRFD – ΦR_n						
	A325		A490		XTB	
	N	X	N	X	N	X
1"	31.8	40.0	40.0	49.5	54.0	66.3
1-1/8"	40.3	50.7	50.7	62.6	68.2	83.9
1-1/4"	49.8	62.7	62.7	77.5	86.1	103.6
1-3/8"	59.9	75.5	75.5	93.2	---	---
1-1/2"	71.7	90.3	90.3	112.0	---	---

XTB increase of ~35% over A490
XTB increase of ~70% over A325

Slip-Critical Bolts in Single Shear – LRFD – ΦR_n						
	A325		A490		XTB	
	μ = 0.3	μ = 0.5	μ = 0.3	μ = 0.5	μ = 0.3	μ = 0.5
1"	17.3	28.8	21.7	36.2	30.4	50.6
1-1/8"	19.0	31.6	27.1	45.2	38.3	63.9
1-1/4"	24.1	40.1	34.6	57.6	48.4	80.6
1-3/8"	28.8	48.0	41.0	68.4	---	---
1-1/2"	34.9	58.2	50.2	83.6	---	---

φ = 1.00
1 slip plane
D = 1.13

XTB increase of ~40% over A490
XTB increase of ~75% (1"), ~100% (>1") over A325

Thickness of Connecting Material Required to Develop Shear Strength of Bolt
STD Holes, design using deformation at service load limit

Bolt Diameter	1"		1-1/8"		1-1/4"	
Bolt Spacing	3" on center		3" on center		3.5" or 4" on center	
F_u (ksi)	65	58	65	58	65	58
(N)	0.48	0.53	0.64	0.72	0.74	0.82
(X)	0.59	0.66	0.79	0.89	0.89	0.99

	Approximate Torque Demand for Installation to Minimum Pretension (ft-lbs)			Approximate Torque Demand for Installation to Peak Pretension (ft-lbs)
	A325 (K = 0.18)	A490 (K = 0.18)	XTB (K = 0.12)	XTB (K = 0.12)
1"	850	1100	900	1200
1-1/8"	1050	1500	1300	1700
1-1/4"	1500	2100	1800	2300
1-3/8"	1950	2800	---	
1-1/2"	2600	3700	---	

Model	TN-33EZ
Voltage	115 V
Max. Current	13.5 A
Frequency	50/60 Hz
Max. Torque	2,200 ft-lb
Weight	18.5 lbs

Model	STC30AE
Voltage	115 V
Max. Current	12 A
Frequency	50/60 Hz
Max. Torque	2,200 ft-lb
Weight	21 lbs

Model	S-210EZ
Voltage(S)	220V
Max. Current	5.5A
Max. Power Consumption	1100W
Frequency	50 / 60Hz
Max. Torque	1520 lb-ft
Weight (main body)	36.3 lb

Twist-off wrench

2950 ft-lb torque

Schedule

	Activity	End
A	Evaluation and Research Planning	2011 - August
B	Installation Protocol Development and Testing	2013 - July
C	Hydrogen Embrittlement Resistance	2013 - February
D1	Mechanical Properties Validation	2013 - July
D2	Connection Design Rules	2014 - March
E	Reporting and Implementation	2014 - May

F16.02, WK42185

Standard Specification for
“Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 200 ksi Minimum Tensile Strength

Scope: This specification covers heat treated, steel, tension control bolt-nut-washer assemblies, also referred to as “sets,” having a tensile strength of 200 to 215 ksi. These assemblies are capable of developing a minimum predetermined tension when installed by applying torque to the nut, while at the same time applying a counter torque to separate the spline end from the body of the bolt using an appropriate spline drive installation tool.

Keywords: alternate design fasteners; bolts; alloy steel; fasteners; spline end; structural; tension control bolt; tension control bolt assembly; twist-off bolt

F16.02, WK42185

Standard Specification for
Heavy Hex Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 200 ksi Minimum Tensile Strength

Scope: This specification covers heat treated, alloy steel, heavy hex bolt-nut-washer assemblies, also referred to as "sets," having a tensile strength of 200 to 215 ksi.

Keywords: bolts; alloy steel; fasteners; steel; structural; heavy hex bolt

F16.02, WK42187

Standard Specification for
Compressible-Washer-Type Direct Tension Indicators for Use with XTB and XTB-HX Structural Fasteners

Scope: This specification covers the requirements for compressible-washer-type direct tension indicators capable of indicating the achievement of a specified minimum bolt tension in an XTB or XTB-HX structural bolt.

Keywords: compressible-washer-type; direct tension indicators; DTI; indicators

XTB and XTB-HX

Nippon Steel & Sumikin Bolten Corp.

www.bolten.co.jp

MISA **Marubeni-Itochu Steel**

www.misa.com

Robert E. Shaw, Jr., PE
Steel Structures Technology Center, Inc.
rshaw@steelstructures.com
www.steelstructures.com

Hypertherm®
Cut with confidence

True Hole CuttingTechnology Overview

Dan McLenithan

Product Application Engineer

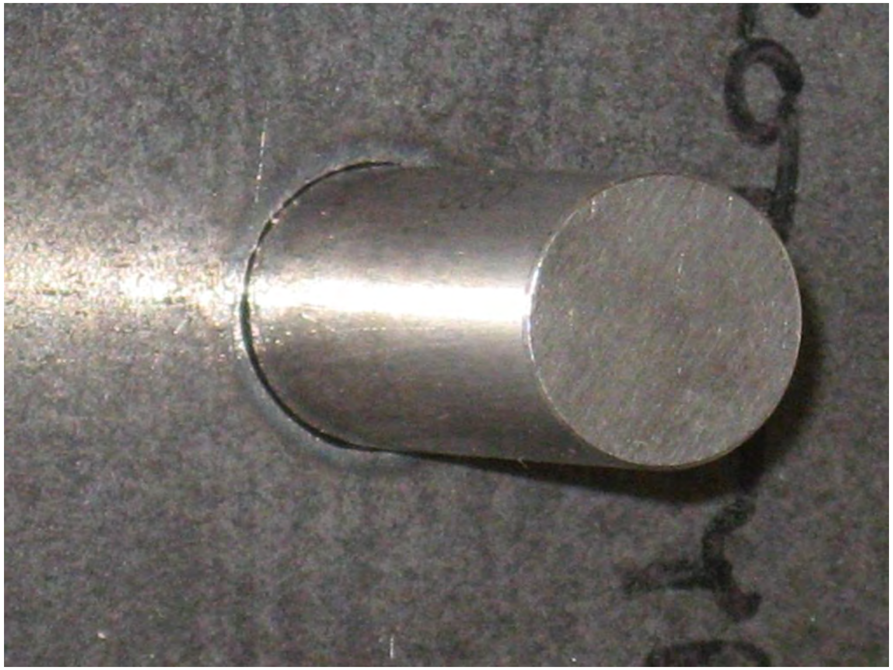
Hypertherm

True Hole Technology

- What is it?
- Why did we develop this technology?
- What are the key benefits?
- How does it work?

True Hole Technology

True Hole technology is a patent-pending technology that was developed by Hypertherm to easily and consistently produce significantly better hole quality than what has previously been possible with plasma

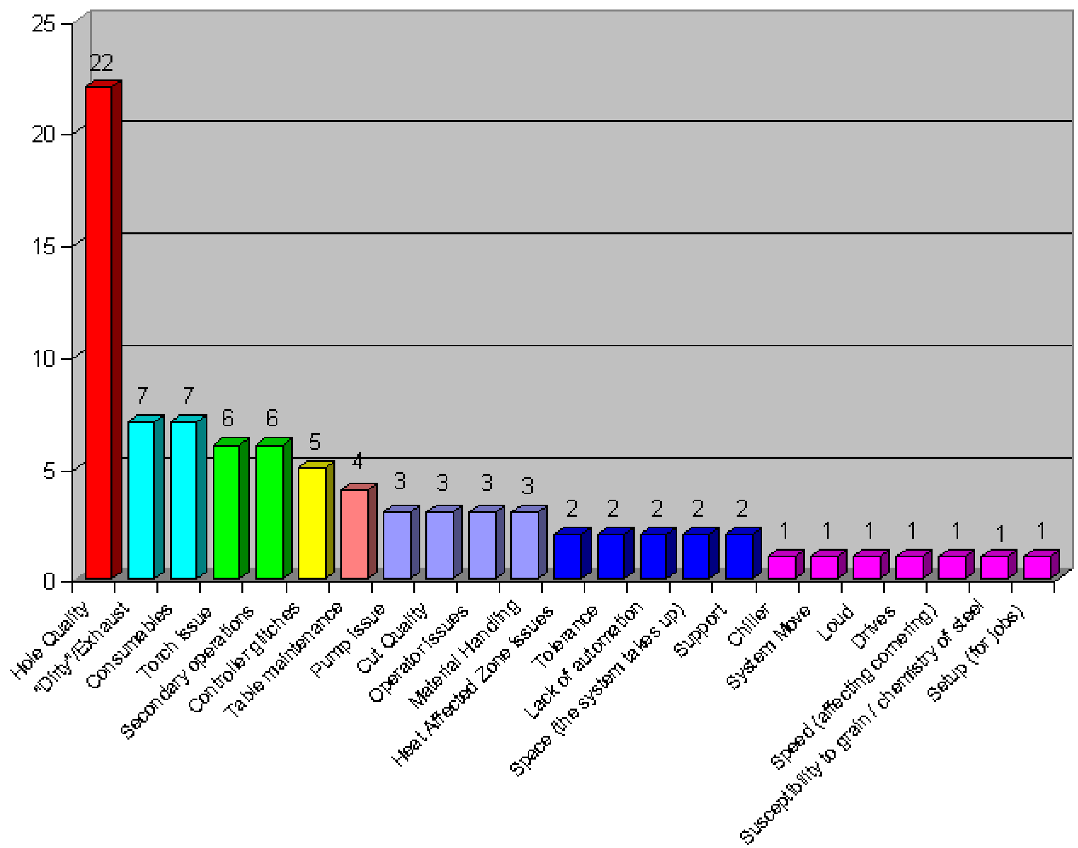


Customer feedback led to True Hole

Hypertherm

#1 complaint about plasma was the quality of the holes

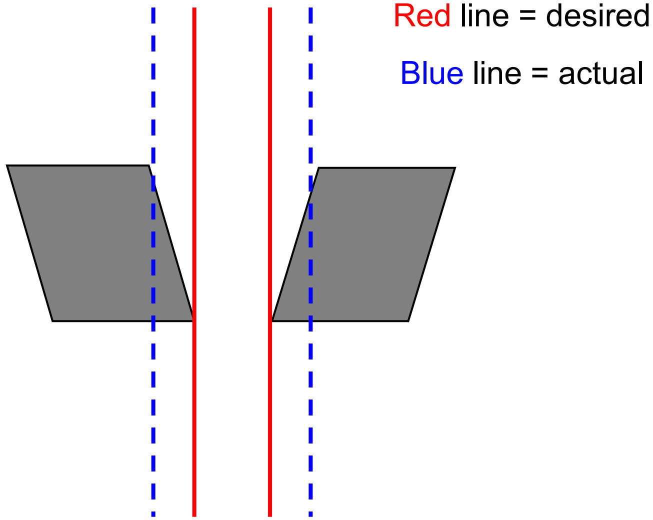
End-user Thermal Survey
Plasma Complaints Frequency Distribution



Common complaints about hole quality

Hypertherm

- Taper – the top and bottom diameter of the hole are inconsistent in width, with a gradual degradation from top to bottom
- Ding/divot – a dent, small cavity, or imperfection on the inside of the hole



Taper

In a perfect hole, the red and blue line will be identical

Ding / divot

Applications for True Hole

- True Hole was designed to produce bolt-quality holes
- The most important feature is to be able to fit a bolt through with a snug fit
- True Hole technology is for mild steel only, gauge to 1” (25mm)
- True Hole technology has been optimized for a 1:1 to 2:1 diameter to thickness ratio

True Hole Technology benefits

Hypertherm

- Virtual elimination of hole taper
- Ding and divot are reduced and biased to the outside of the hole
- Delivers true “bolt-quality” holes
- Hole quality is delivered automatically without operator intervention

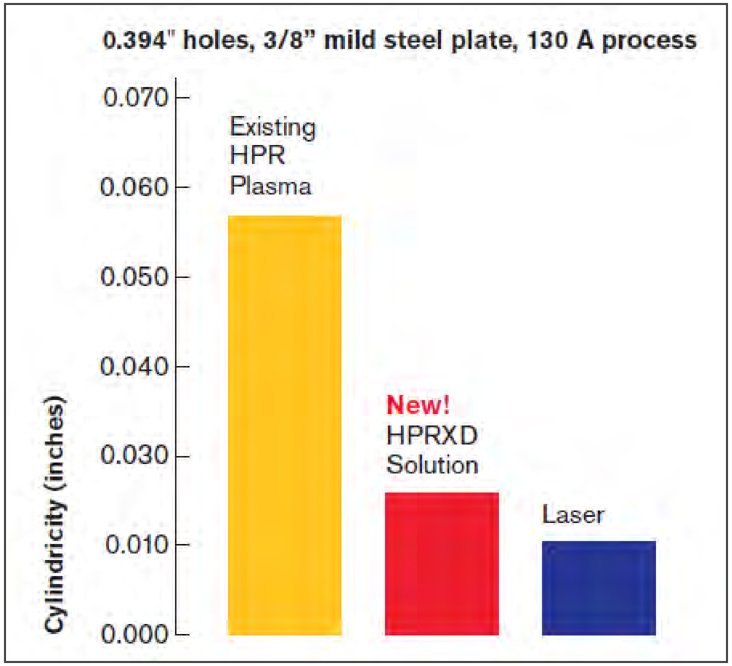
12 mm (1/2") hole **with**
True Hole technology

12 mm (1/2") hole **without**
True Hole technology

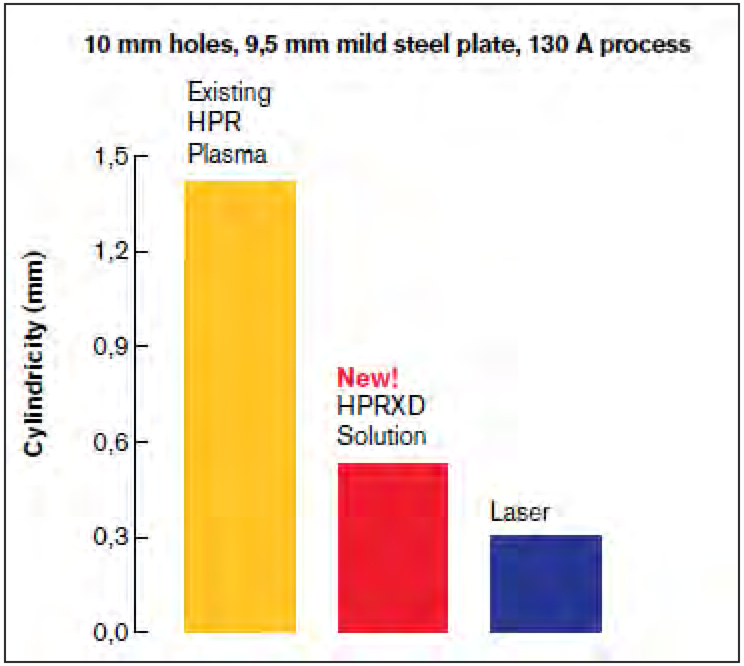
True Hole Technology benefits

Hypertherm

Narrows the gap with laser hole quality



English measurements

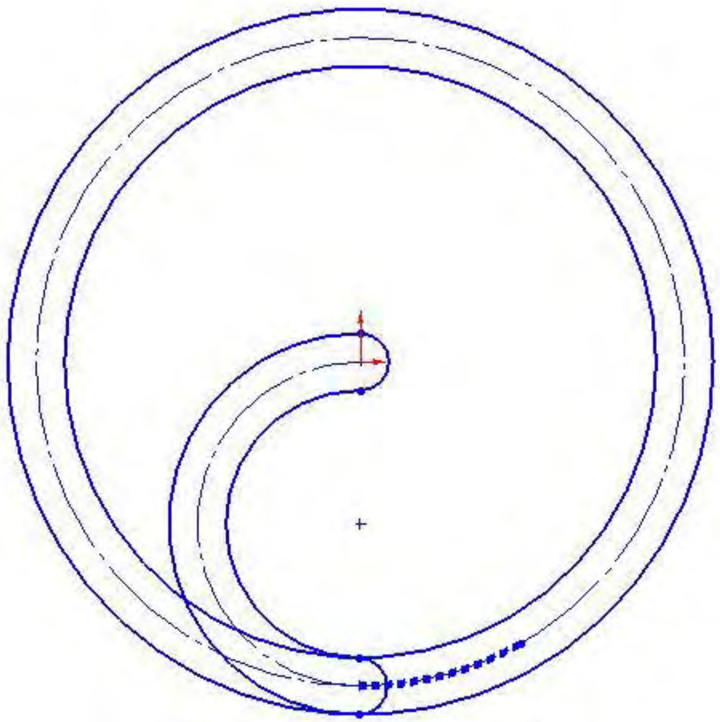


Metric measurements

Cylindricity is a measure of how perfectly circular the hole is, from top to bottom

Overview of True Hole Technology process

Uses a specific combination of the following parameters for optimizing mild steel hole quality that is linked to a given amperage, material thickness, and hole size:



- Process gas selection
- Gas flow rates
- Pierce technique
- Lead in / out technique
- Cut speeds
- Timing

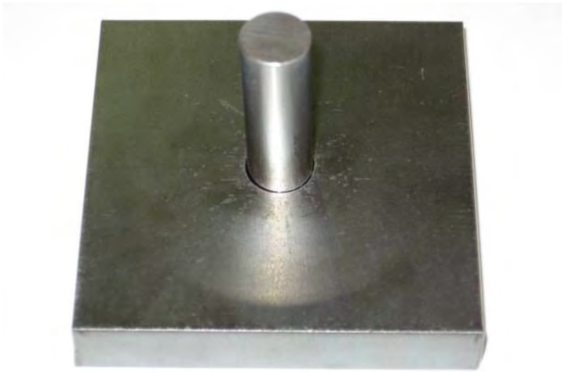
The process is automatically applied by our cutting optimization and nesting software

Taper reduction results

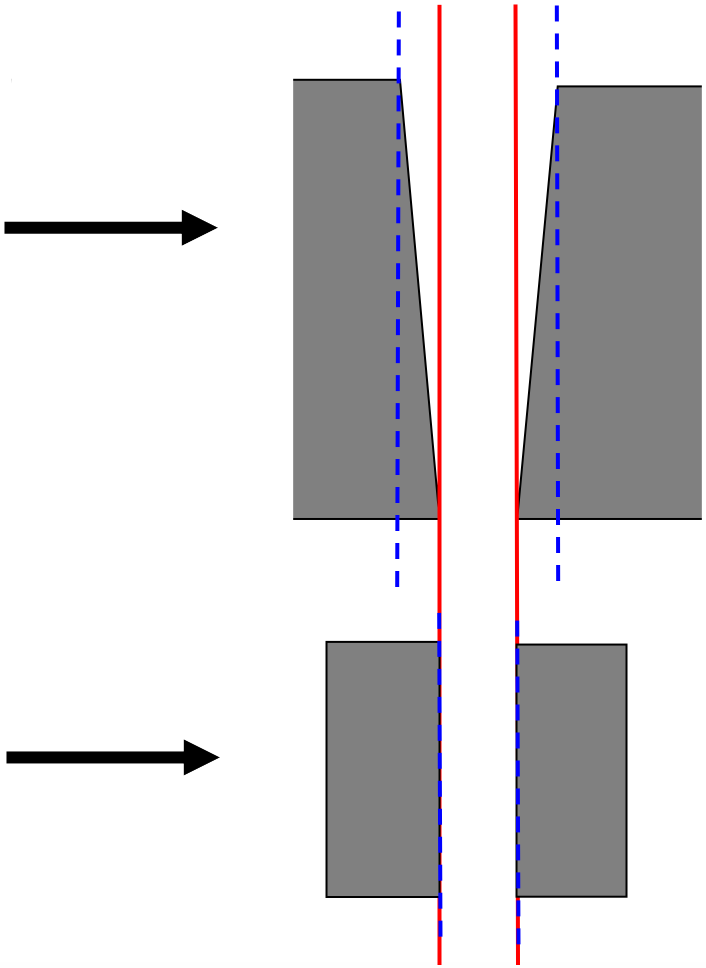
Hypertherm's patent-pending process involves gas switching that virtually eliminates the taper

Cross section of a hole, with taper and without

12 mm hole **without** True Hole technology

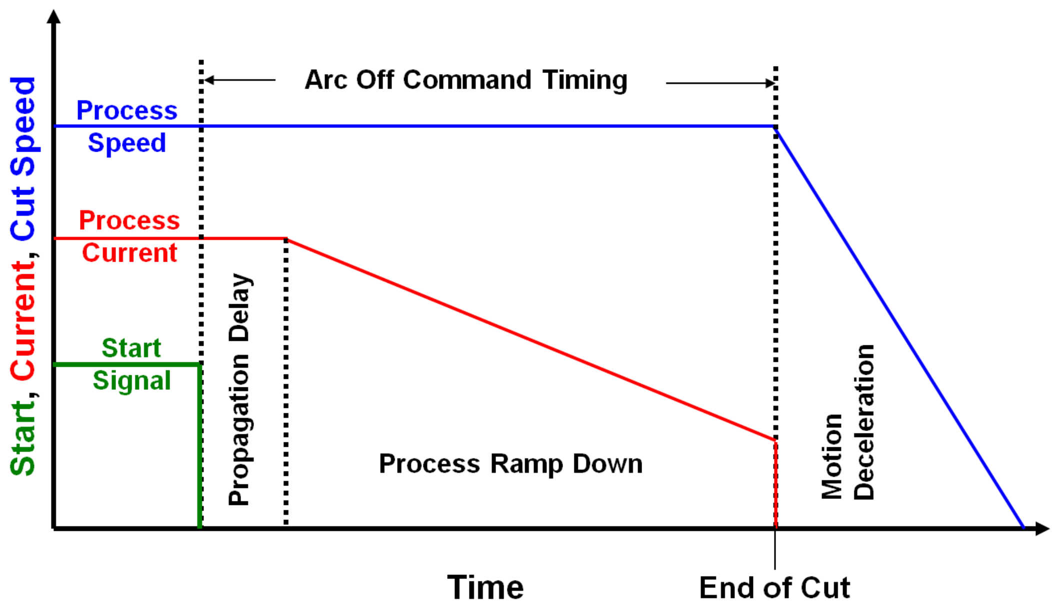


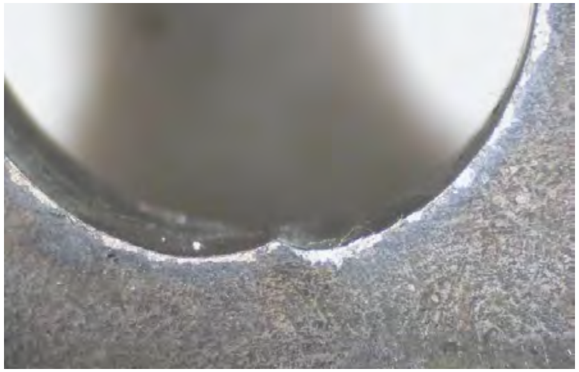
12 mm hole **with** True Hole technology



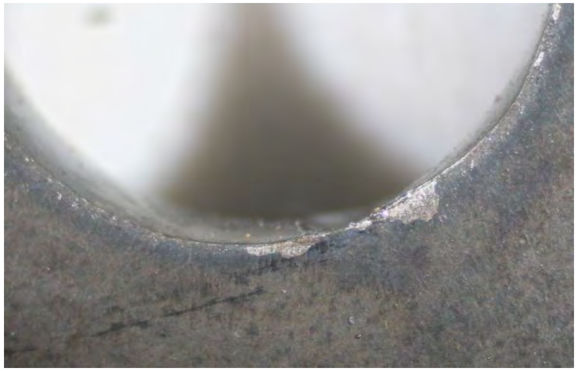
Ding/Divot results

- Through synchronization of the parameter settings and motion path of the arc, the ding/divot are minimized and biased to the outside of the hole
- Instrumental to the result is the overall motion of the cutting machine





Without True Hole technology



With True Hole Technology

Recent Activity- Plasma Cut Holes in Bridge Steel

Hypertherm

- The Nov 2012 release of Ontario Standard Specification OPSS 906 for bridge; now permits plasma arc cutting of holes up to and including 20mm.
- Testing is underway at the Turner Fairbanks Research Center in McLain, VA on the fatigue performance of plasma cut bolt holes
- As per the TRB Research Needs Statement :

“Automated CNC Equipment can be used to cut part contours, bolt holes, copes , slots, and beveled parts in one continuous process …. substantially reducing fabrication time and consequently bridge costs”

- The November 2012 TRB release- Steel Bridge Fabrication endorses plasma as *“one of the most efficient means of cutting steel”*

True Hole Technology requires the use of a HyPerformance Plasma HPRXD auto gas system, along with a True Hole enabled cutting machine, nesting software, CNC, and torch height control

Internal Study Plasma Vs Drilled Holes

Hypertherm

Holes cut in ½” mild steel using plasma were found to:

- Meet RCSC, AISC, AASHTO, and NSBA specification
- Have 1/3 the roughness of a drilled hole
- Have equivalent yield and ultimate strength to drilled holes
- Have a 1.8x increase in fatigue life compared to drilled holes

Thank You!