BURLINGTON AUTOMATION SERVICES
63 Innovation Drive, Hamilton, Ontario, Canada, L9H 7L8
Phone: 905-689-7771 Fax: 905-689-7773

PythonXS SQUEEZING THE COST OUT OF STRUCTURAL FABRICATION

Plasma cut holes for bolted connections are acceptable by the American Institute of Steel Construction (AISC) as clearly specified in their 2005 and newer AISC Specifications.

Supporting documentation…

1. a page directly from the AISC web site where a questions was asked "*Is it now permissible to use plasma or flame cutting methods to make bolt holes?*"

   The answer was a clear yes, see attached printout (page 2 of this document).

   Feel free to visit the AISC website directly at…

   http://www.modernsteel.com/steelinterchange_details.php?id=93

2. Also attached is the title page from The 2005 AISC Specification along with section M2.5 which comments on thermally cut bolt holes in the AISC specification (pages 4 and 5 of this document).

   It says that that "thermally cut holes shall be **permitted** with a surface roughness profile not exceeding 1,000 mirco inches as defined in ASME B46.1. Gouges shall not exceed a depth of 1/16 in."

   Test results performed by an independent testing lab on Bolt Holes produced by the PythonX show the PythonX meets the above requirements.

   All testing was done in accordance with ASME B46.1-2002 which is specified in the 2005 AISC specification, Section M2.5 "Bolted Construction".

   The spec allows 1000 microinches surface roughness… we averaged 75 microinches on our PythonX produced holes which is on average 13 times better than required.

   For reference we also tested a punched hole (Hole 4 on the report)… which averaged 170 microinches. Our PythonX holes were over 2 times better than the punched holes.

   Testing Lab Report Attached (page 3 of this document).

   The bolt hole quality specifications are quite generous compared to the PythonX's capabilities.

3. There are numerous fabricators that use the PythonX in the United States, Canada and other parts of the world. They have done some high profile jobs including:
   Power generating stations, Automotive assembly plants for Toyota, Ford, 70+ floor high rise buildings and numerous schools, hospitals, wal-marts, government buildings.

   No beam has ever been sent back from site due to hole quality.

Thermal Cutting

Question

07/01/2006

Is it now permissible to use plasma or flame cutting methods to make bolt holes?

Question sent to AISC's Steel Solution Center

Answer(s)

Although previous specifications limited the methods that can be used, the 2005 AISC specification, Section M2.5, allows the use of any hole-making method that results in a surface roughness not exceeding 1,000 microinches. Most methods can be used to achieve this, including punching, drilling, and thermal cutting with flame and plasma equipment.

Charlie Carter, S.E., P.E.
American Institute of Steel Construction

Please feel free to submit a question / answer to solutions@aisc.org

Bodycote

TESTING GROUP
www.bodycote.com
www.bodycotetesting.com

Surface Roughness Report

Date: 01 February 2008

Lab #: 70728
Sample # 128252-128254
Material and Form: Structural steel

Customer: **Burlington Automation**
5041 Fairview Street
Burlington, Ontario
L7L 4W6

Attention to: Paul Kwiatkowski

# of Pieces: 4

1.0 PYTHONX PLASMA CUT BOLT HOLE SURFACE ROUGHNESS EVALUATION

The subject samples produced by the PythonX Plasma Structural Fabrication System were prepared for surface roughness testing. All roughness testing was performed using a Mitutoyo Surftest (MII#: B06662) surface roughness tester in the scale of Ra All testing was based on and performed in accordance with ASME B46.1-2002, 'Surface Texture (Surface Roughness, Waviness, and Lay). The following results were obtained (refer to table);

Roughness Average (Ra)		
Reading #	**1 (µin)**	**2 (µin)**
Hole 1: 0.8610"Ø, cut in 0.5"thick web of W24 x 104 wide flange beam	46	65
Hole 2: 0.8280"Ø, cut in 0.44" thick flange of a W16x31 wide flange beam	92	129
Hole 3: 1.0900"Ø, cut in 0.75" thick leg of a 6x4x3/4 angle	63	59
Hole 4: 0.875"Ø, punched in 0.5" plate	89	251

Note: The test was done on the internal surface of cut holes. Two readings were taken at one hole per structural steel section. The results are listed in the above tables.

For and on behalf of Bodycote Materials Testing Canada Inc.: **Matthew Hogan, Metallurgist**

ANSI/AISC 360-05
An American National Standard

Specification for Structural Steel Buildings

March 9, 2005

Supersedes the *Load and Resistance Factor Design Specification for Structural Steel Buildings* dated December 27, 1999, the *Specification for Structural Steel Buldings—Allowable Stress Design and Plastic Design* dated June 1, 1989, including Supplement No. 1, the *Specification for Allowable Stress Design of Single-Angle Members* dated June 1, 1989, the *Load and Resistance Factor Design Specification for Single-Angle Members* dated November 10, 2000, and the *Load and Resistance Factor Design Specification for the Design of Steel Hollow Structural Sections* dated November 10, 2000, and all previous versions of these specifications.

Approved by the AISC Committee on Specifications and issued by the AISC Board of Directors

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.
One East Wacker Drive, Suite 700
Chicago, Illinois 60601-1802

Reentrant corners, except reentrant corners of *beam copes* and weld access holes, shall meet the requirements of AWS D1.1, Section A5.16. If another specified contour is required it must be shown on the contract documents.

Beam copes and weld access holes shall meet the geometrical requirements of Section J1.6. Beam copes and weld access holes in shapes that are to be galvanized shall be ground. For shapes with a flange thickness not exceeding 2 in. (50 mm) the roughness of *thermally cut* surfaces of copes shall be no greater than a surface roughness value of 2,000 μin. (50 μm) as defined in ASME B46.1 Surface Texture (*Surface Roughness, Waviness, and Lay*). For beam copes and weld access holes in which the curved part of the access hole is thermally cut in ASTM A6/A6M hot-rolled shapes with a flange thickness exceeding 2 in. (50 mm) and welded built-up shapes with material thickness greater than 2 in. (50 mm), a preheat temperature of not less than 150 °F (66 °C) shall be applied prior to thermal cutting. The thermally cut surface of access holes in ASTM A6/A6M hot-rolled shapes with a flange thickness exceeding 2 in. (50 mm) and built-up shapes with a material thickness greater than 2 in. (50 mm) shall be ground and inspected for cracks using magnetic particle inspection in accordance with ASTM E709. Any crack is unacceptable regardless of size or location.

User Note: The AWS Surface Roughness Guide for Oxygen Cutting (AWS C4.1-77) sample 3 may be used as a guide for evaluating the surface roughness of *copes* in shapes with flanges not exceeding 2 in. (50 mm) thick.

3. Planing of Edges

Planing or finishing of sheared or *thermally cut* edges of plates or shapes is not required unless specifically called for in the contract documents or included in a stipulated edge preparation for welding.

4. Welded Construction

The technique of welding, the workmanship, appearance and quality of welds, and the methods used in correcting nonconforming work shall be in accordance with AWS D1.1 except as modified in Section J2.

5. Bolted Construction

Parts of bolted members shall be pinned or bolted and rigidly held together during assembly. Use of a *drift* pin in bolt holes during assembly shall not distort the metal or enlarge the holes. Poor matching of holes shall be cause for rejection.

Bolt holes shall comply with the provisions of the RCSC *Specification for Structural Joints Using ASTM A325 or A490 Bolts*, Section 3.3 except that *thermally cut* holes shall be permitted with a surface roughness profile not exceeding 1,000 μin. (25 μm) as defined in ASME B46.1. *Gouges* shall not exceed a depth of $^1/_{16}$ in. (2 mm).