Assuring Stainless Steel Surface Quality

3-A SSI 2018 Education Program – Exceeding Customer Expectations Through Hygienic Design

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Geir Moe, Consultant to Nickel Institute
What is the Nickel Institute?

- Is the global association of leading primary nickel producers.

- Our mission is to promote and support the use of nickel in appropriate applications.

nickelinstitute.org

- We provide “free” technical support to users of nickel containing materials, such as stainless steel, nickel alloys and nickel plating

inquiries.nickelinstitute.org

- Through our science division NiPERA Inc. we also undertake leading edge scientific research concerning nickel relevant to human health and the environment.

nipera.org
Why is Nickel Institute interested in stainless steel and food contact applications?

- Two thirds of primary nickel production is used to make stainless steel (primarily stainless steels, such as Type 304 and 316)
- ~20% of SS goes into food contact applications
Geir Moe - experience

• **18 years in stainless steel distribution with**
  1989-1999 QA Manager & Application Metallurgist with Avesta Sheffield Canadian Operations
  1999-2007 QA Manager & Application Metallurgist RASCO Specialty Metals; Integris Metals - Canada; Ryerson - Canada

• **2008-2013 Senior Materials Engineer – Hatch Autoclave Technology Group**
  (working with stainless steel, nickel alloys and titanium)

• **2014 to present - Nickel Institute**
  - Global Technical Inquiry Service Coordinator
    inquiries.nickelinstitute.org
  - Stainless Steel Consultant
Has sheet surface quality deteriorated?

Comments from distributors

Western Canada

• Have had very few complaints as far as SS sheets are concerned. The majority of our 304/316 sheet, 11ga and thinner, is from Taiwan.

• As far as Chinese material goes, I doubt Chinese origin would be huge issue as far as the light gauge fab shops are concerned.

• The main complaint has been getting #4 sheets where they did a belt change and a sheet or two were not fully finished. That has not happened in quite a while though. (this would typically be flagged by the polisher)
Comments from distributors

Toronto area

• Supply some large Restaurant/Food Equipment fabricators and can't think of the last mill surface related issue I had with either 2B or #4 polish

• Most of the #4 my customers get is North American origin.

Southern Ontario

• Have not seen an increase in surface defects #4 or 2B. We sell (with great success) Chinese sheet.
Has sheet surface quality deteriorated?

Comments from distributors

Eastern Canada

• More problems with surface finish in the past 4 years than the previous 15 years. Majority of material is North American origin.

• Customers appear to have less issues with Chinese material (sold by competitors) and when compared to North American side by side, Chinese material appears brighter.
Has sheet surface quality deteriorated?
Comment from sheet polisher

**Independent stainless steel sheet polisher**

- Initially Chinese material had problems, now as good as North American mills
- Defects are random to all mills and random throughout a coil when present
Has sheet surface quality deteriorated?
Is material national origin a problem?

• In general, it appears that Chinese sheet is at least equal to and in some cases perceived to be superior to sheet of other origins.

• China is a huge market with many stainless steel producers. Undoubtedly, quality control and production equipment will vary between these many producers.

• Suitability of material may vary due to which mills your supplier sources their material.
Has sheet surface quality deteriorated?

Nickel Intensity of Use
Heinz H. Pariser, End-Use of Nickel 2004-2013

Nickel Intensity of Use - 2013
(First Use & "Real" End Use Estimates)

Each circle shows the relative amount of material produced or used in each country.

- **First Use** – where nickel is first used to make a nickel containing material such as stainless steel, nickel alloy, nickel plating...
- **Real End Use** – where that nickel containing material is actually used to make a product, such as a kitchen sink, pots and pans...
Has sheet surface quality deteriorated?

Nickel First Use Breakdown

Heinz H. Pariser, End-Use of Nickel 2004-2013

Nickel First Use Breakdown 2013

- China produces more stainless steel than the rest of the world combined
On March 1, 2018 Allegheny Technologies announced the formation of its joint venture with Tsingshan Group (the world’s largest stainless steel melter).

Tsingshan will provide stainless steel slabs from its new Indonesian stainless steel mill where it plans to produce 2 million tons of stainless steel slab per year.

Allegheny will produce 60-inch wide stainless steel sheet at its Direct Roll Anneal and Pickle Line in Midland, Pennsylvania. (projected production of ~270,000 tons per year)
How are material requirements defined?

- **ASTM A240**
  
  *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*

  Defines chemical composition and mechanical properties

  evokes ASTM A480

- **ASTM A480**
  
  *Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip*
ASTM A480 describes

• Heat treatment requirements for each grade of stainless steel
• Tolerances (thickness, width, flatness, ...)
• Material Certification
• Ordering information
  Quantity
  Grade (304L, 316L, ...)
  Form (sheet, plate, or strip)
  Dimensions (thickness, width, length)
  Finish
    o 2D (cold-rolled, dull finish)
    o 2B (cold-rolled, bright finish)
    o #3 (Intermediate polished finish)
    o #4 (General purpose polished finish)
    o #8 (Mirror finish)
What can be done to assure sheet quality?
Definition of 2B and No. 4 finish - ASTM A480

• **2B Finish** - Cold-rolled, bright finish
  
  A smooth, moderately reflective cold-rolled annealed and pickled or descaled finish typically produced by imparting a final light cold-rolled pass using polished rolls. This general-purpose finish is more readily polished than No. 1 or 2D finishes.

• **No. 4 Finish** - General purpose polished finish, one or both sides.
  
  A linearly textured finish that may be produced by either mechanical polishing or rolling. Average surface roughness (Ra) may generally be up to 25 micro-inches. There may also be overlap in measurements of surface roughness for both No. 3 and No. 4 finishes.

  These surface finishes are not quantifiable/measurable
What can be done to assure sheet quality?

Workmanship – ASTM A480

• The material shall be of uniform quality consistent with good manufacturing and inspection practices. The steel shall have no imperfections of a nature or degree, for the type and quality ordered, that will adversely affect the stamping, forming, machining, or fabrication of finished parts.

HOWEVER...

• There is no ASTM standard that describes imperfections and their degree that will adversely affect the stamping, forming, machining, or fabrication of finished parts.

• Fortunately there is understanding between mills, distributors and end-users as to what are imperfections.

• Mills only accept responsibility for the cost of the material.
Types of defects

- Blips
- Dings
- Moons
- Crossbreaks
- Leveler stop mark
- Arbor buckle
- Chatter
- Boardmarks
- Out of flat

- Corrosion
- Pits
- Stains
- Damaged edge
- Slivers
- Hole
- Scratches
- Weld
Challenges to quality?

• Sheets are cut from coil by either an independent cut to length operator or in-house at the distributor. Typically an adhesive surface film is applied in-line to protect the surface. Unfortunately, it is difficult and potentially costly to inspect coil surface quality during cut to length operation prior to application of film.

• Surface film provides surface protection during shipment, handling, fabrication and welding. Unfortunately, film makes inspection of surface prior to fabrication impossible.
Possible actions to ensure sheet quality

- Surface finish is a not measurable requirement, its appearance can vary between suppliers. Thus, ensure supplier understands your needs.
- Restrict sheet to mills of consistent quality and finish that meets your requirements (changing mill source due to price may incur costs elsewhere).
- Specify cut sheet with a paper interleal so sheets can be inspected individually and then manually apply an adhesive surface film for protection during fabrication and welding. Recognize the additional time and expense.
THANK YOU FOR YOUR ATTENTION

QUESTIONS?