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|--|-----------|--|-----------------|----------------------------|---|
|  | | Alberta Industrial Heat Treating Inc. | | External Data Sheet | |
| Issue by: | R&D | Approved by: | Quality Manager | Form-127 | |
| Issue date: | 9/10/2019 | Revision Date: | | Rev.# | 0 |
| | | | | PAGE: 1 of 3 | |

External Data Sheet No.: 20-11

| | | | |
|-------------------|----------------|--------------------------|-------------------------------------|
| Customer: | <u>AIHT</u> | Drawing/ Spec: | <u>NACE MR0175 Sour Service</u> |
| PO No.: | <u>N/A</u> | Part Description: | <u>Nitride Qualification Coupon</u> |
| Batch No.: | <u>19-1801</u> | Material: | <u>4140</u> |
| Heat No.: | <u>196197</u> | Work Order No.: | <u>N/A</u> |

Case Depth Definition: The case depth shall be defined as the deepest perpendicular point from the surface where hardness exceeds 40 HRC as measured with Vickers microhardness indenter and converted to HRC using ASTM E140.

Typical Results:

| | | Acceptance Criteria |
|--|---|----------------------------|
| Measured Case Depth [in. (mm)]: | <u>0.004 (0.15)</u> | <u>0.006" max</u> |
| White Layer Thickness [µm]: | <u>7.3 µm</u> | <u>N/A</u> |
| Surface Hardness [HV_{0.1} (HRC)]: | <u>571 (54)</u> | <u>50 HRC min.</u> |
| Core Hardness [HRB]: | <u>96.0</u> | <u>N/A</u> |
| Average Case Hardness [HV_{0.1} (HRC)]: | <u>531 (51)</u> | <u>N/A</u> |
| Additional Testing Information: | Core Hardness Individual Measurements: 96.0, 96.8, 96.5 HRB No massive nitride networks observed | |

Other Specification Requirements:

Micrographs:



Figure 1: Representative photomicrograph of the hardened section microstructure. DIC Illumination, 3% Nital Etch

Test Results: The material met the requirement of the governing specification.

Date: 6/8/2020

Approved By: _____

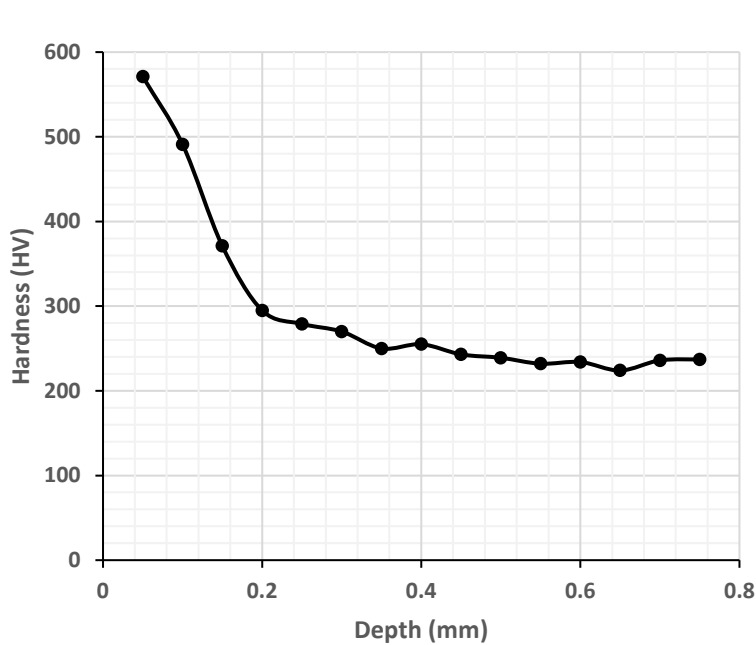
Doug Hamre, P.Eng., Ph.D.



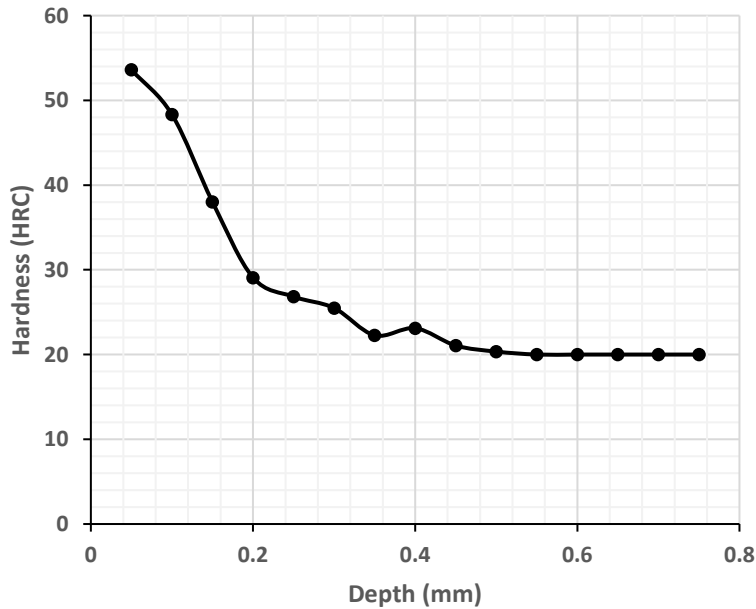
Alberta Industrial Heat Treating Inc.

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| Depth | | Hardness | |
|-------|-------|----------------------|-------------|
| [mm] | [in.] | [HV _{0.2}] | [HRC Conv.] |
| 0.05 | 0.002 | 571 | 53.6 |
| 0.1 | 0.004 | 491 | 48.3 |
| 0.15 | 0.006 | 371 | 38.0 |
| 0.2 | 0.008 | 295 | 29.1 |
| 0.25 | 0.010 | 279 | 26.8 |
| 0.3 | 0.012 | 270 | 25.5 |
| 0.35 | 0.014 | 250 | 22.3 |
| 0.4 | 0.016 | 255 | 23.1 |
| 0.45 | 0.018 | 243 | 21.1 |
| 0.5 | 0.020 | 239 | 20.3 |
| 0.55 | 0.022 | 232 | <20 HRC |
| 0.6 | 0.024 | 234 | <20 HRC |
| 0.65 | 0.026 | 224 | <20 HRC |
| 0.7 | 0.028 | 236 | <20 HRC |
| 0.75 | 0.030 | 237 | <20 HRC |



Alberta Industrial Heat Treating Inc. certifies that all samples were prepared and tested in accordance with applicable ASTM standards unless otherwise stated. Conversions from Vickers microhardness test points (HV0.1) to Rockwell hardness (HRC) have been converted using ASTM E140)

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Scope of Service

The agreement of Apollo Machine & Welding Ltd. and its subsidiaries to perform services extends only to those services specifically provided for in writing. Under no circumstances shall such services extend beyond the performance of the requested inspection of specific equipment provided for in writing and the preparation of reports or similar documents. Any descriptions, statements, comments or expressions made reflect the opinion or observations of the Apollo Machine and Welding Ltd. examiner based solely upon data available at the time, and are not intended, nor can they be construed, as representations or warranties as to the actual circumstances. Apollo Machine & Welding Ltd. does not assume any responsibilities of the owner/operator, and the owner/operator retains complete responsibility for all engineering, repair and use decisions.

Standard of Care

In performing the services provided, Apollo Machine & Welding Ltd. shall use the degree of care and skill ordinarily exercised under similar circumstances by others performing such services in the same or similar locality. No other warranty, expressed or implied, is made or intended by Apollo Machine & Welding Ltd., and all other warranties are expressly disclaimed. In the event of any breach of this warranty, Apollo Machine & Welding Ltd.'s sole and exclusive obligation will be to correct or re-perform the deficient service or, at Apollo Machine & Welding Ltd.'s option, to refund the amount paid for the deficient service.

Limitations of Liability

Nothing in this agreement shall be construed to mean that Apollo Machine & Welding Ltd. assumes any liability on account of injury to persons or property, including death, except and only to the extent those directly caused by the willful or negligent misconduct of Apollo Machine & Welding Ltd. in the context of performing the requested services. In no event shall Apollo Machine & Welding Ltd.'s aggregate liability for any reason, in connection with any claim asserted, exceed the amount paid for the services in question. Apollo Machine & Welding Ltd. shall not be held responsible or liable for any loss, damage or delay caused by accidents, strikes, fires, floods, or other circumstances or causes beyond Apollo Machine & Welding Ltd.'s control, including actions taken or not taken by the owner/operator or other third parties. In no event shall Apollo Machine & Welding Ltd. be liable for indirect, incidental, special, punitive, or consequential damages including, without limitation, damages relating to reputation, lost profits, goodwill, downtime, loss of use, business interruption or other economic loss.

Deviation From External Data Sheet

External Data Sheets are for informative purposes only and are in no way binding. Considerations including, but not limited to: geometry, material condition, chemistry, and surface finish can cause deviations from the typical case depth results exemplified herein. To quantify case depth for individual production batches, batch testing and/or sacrificial coupons would be necessary.