Patent-Pending Apollo-SHIELD™

ALBERTA INDUSTRIAL HEAT TREATING INC.

US Patent Application No. 16/507,285 Canadian Patent Application No. 3,044,930

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APOLLO SHIELD™

OVERVIEW

Apollo-SHIELD™ is a collaborative effort between Alberta Industrial Heat Treatment and Apollo-Clad Laser Cladding. This new patent-pending technology has been developed to combine the best aspects of Carburizing, Nitriding, Laser Heat Treatment, and Induction Heat Treatment.

PROCESS FEATURES

- Surface hardness greater than or equal to that of carburizing (>68HRC in some cases)
- Deep case depths of Induction Heat Treatment
- Low processing temperatures to limit distortion and maintain mechanical properties
- Ability to target specific features like Laser Heat Treatment to maximize value
- Hardness is consistently high throughout the case

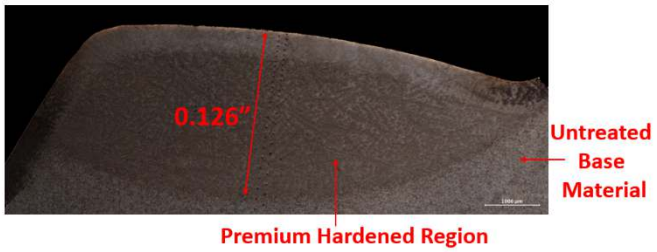
MATERIALS

Hardening depends on specific grade. Alloy steels provide best results.

- 4130, 4140,4145
- 4330V, 4340
- **Constantly evolving catalogue**

SELECTIVE HARDENING

Pretreatment hardens all exposed surfaces that aren't masked. Premium hardening unlocks maximum hardness.



CASE DEPTHS

Premium Hardening Region:

Depth: 0.010"-0.060" (0.25mm-1.5mm)

Hardness: >65HRC (850-1000Hv) Typical

Overall:

Depth:0.020"-0.100" (0.5mm-2mm)

Hardness: 55-60 HRC (600-700 Hv)

780-988-7789

www.aiheattreating.com

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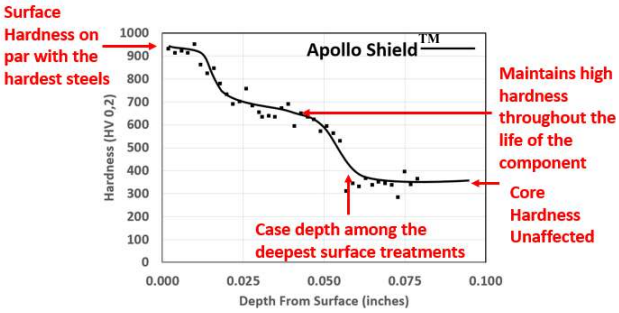
UNIQUE HARDENING PROFILE



The hardening profile of Apollo-SHIELD™ is unique in that it features three distinct regions which combine to create the ideal case hardening treatment:

- Surface hardening on par with the hardest steels makes up the first 0.005-0.025", which provides resistance to galling and abrasion while lowering the coefficient of friction.
- Plateau of fully hardened base material (~55-60HRC for alloy steels) whose depth can be adjusted to control the overall case depth. This improves the resistance to contact fatigue when compared to diffusion hardening methods like nitriding.
- Abrupt return to base material hardness with minimal intercritical microstructures forming.

APPLICATIONS

Apollo-SHIELD™ can improve almost any components which are currently being Nitrided, Carburized, Laser Heat Treated or Induction Heat Treated.

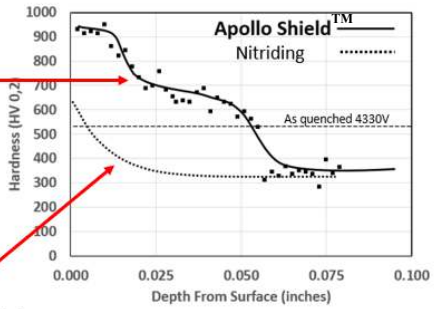
Common applications include: bearing surfaces, mill gearing, rollers, crankshafts, camshafts, etc.

IMPROVEMENT OVER CONVENTIONAL HEAT TREATMENT

Apollo SHIELD:™

Increased surface hardness:

- decreases the coefficient of friction
- increases the resistance to wear mechanisms
  - galling, and contact fatigue



Nitriding:
Quick drop in hardness results in accelerated wear throughout the life of the component

DISRUPTIVE TECHNOLOGY

One of the biggest challenges for design engineers is balancing bulk properties (strength, toughness) with surface properties (hardness, wear-resistance). Carburizing is popular for its relatively deep case depths, but it requires the use of specific grades (8620 and 9310), which are expensive and have relatively low strength. Alloy steel like 4330V can have double the yield strength of 8620 and is substantially cheaper but obtaining the hardness and case depth of carburization has been impossible until now.

Unlike carburizing, Apollo-SHIELD™ doesn't require a quench, which minimizes distortion and maintains the final temper properties of the core material (suitable for finished parts).

Pin-On-Disk testing confirms a significant improvement (**2.6x better than untreated steel**) in wear performance compared to conventional surface hardening methods (nitriding).

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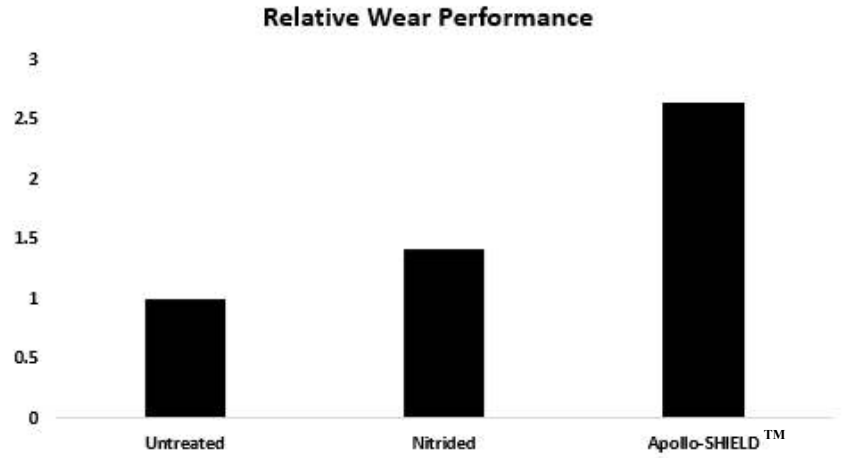

Fig.1 Wear loss relative to untreated AISI 4145 material. Apollo-SHIELD™ hardened 4145 demonstrates a 260% improvement over untreated material, and a 185% improvement over nitrided 4145 as measured with Pin-On-Disk testing.

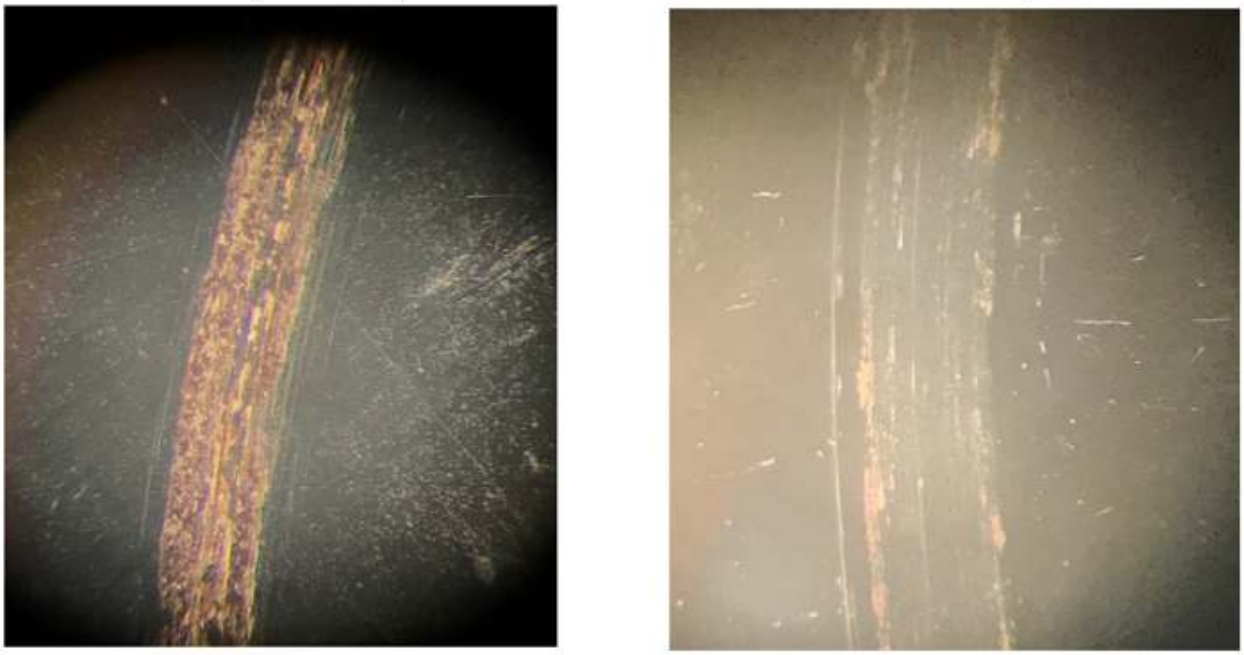

Fig.2 Wear scars of nitrided 4145 (left) and Apollo-SHIELD™ 4145 (right) following Pin-On-Disk testing.