Super Hard Steel® Wear Plate Solutions

STRATEGEM™
ISO 9002 - 2008

For Severe Sliding Abrasion and Impact

Super Hard Steel® (SHS) wear plate is a patented family of advanced surface technology solutions designed to outperform carbides, overlay and Q&T steel products such as Brinell, AR-steel and Hardox.

Key Performance Characteristics

- Very high hardness 66 - 71 HRc
- Exceptional resistance to severe sliding abrasion
- Toughness equivalent to 400 Brinell Q&T plate
- Forming/cutting response similar to standard chrome carbide wear plate

Industrial Use

Environments such as hard rock mining, aggregates quarries and concrete

SHS wear plate provides abrasive wear resistance up to 60% better than chrome carbide wear plate.

SHS Wear Plate Applications

SHS wear plate is suitable for use as various lining for mining and quarry of highway truck beds and bodies, loader buckets, drag line buckets and wheels, chutes, conveyors, crushers, troughs and hoppers.

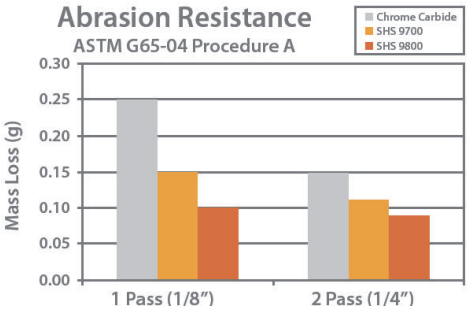
SHS Wear Plate is Fabricated from SHS Alloys

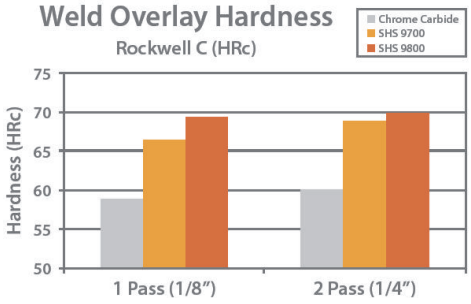
SHS wear plate solutions are fabricated from SHS 9700 and SHS 9800 alloys applied as overlay on carbon steel and low alloy steel substrates.

SHS 9700	Superior to traditional carbide remedies, yet highly cost effective
SHS 9800	Premium solution for extreme service environments

Exceptional Wear Resistance

Exceptional resistance to severe sliding abrasion is the result of the refined nanoscale microstructure and even distribution of fine borocarbide phases of SHS 9700 and SHS 9800. Both alloys have been compared to standard chrome carbide overlay plate by means of ASTMG 65 - 04 Procedure Awear testing that measures low stress abrasion resistance. When applied as a one or two pass weld overlay, ASTMG 65 - 04 wear tests show SHS 9700 to have a 40% increase and SHS 9800 to have a 60% increase inwear resistance over chrome carbides.



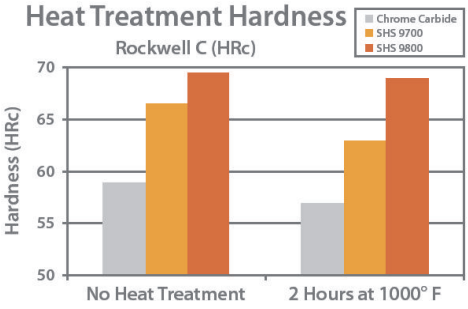


High Hardness

SHS 9700 and SHS 9800 typically provide 66 - 70 Hrc in a single pass overlay, and 68 - 71Hrc in a double pass overlay, resulting in wear plate with exceptional resistance to scratching, gouging and low angle sliding abrasion common in applications such as chutes and liners.

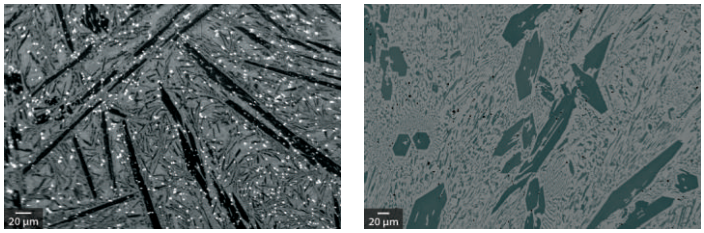
High Hardness Maintained After Heat Treatment

After heat treatment for two hours at 1000°F and air cooled to room temperature, the hardness of single pass SHS 9700 and SHS 9800 overlay samples was compared to a single pass chrome carbide overlay sample. SHS overlays maintained higher hardness than chrome carbide overlays in heat treated and non-heat treated conditions allowing for insensitivity to welding conditions and enabling for post weld tempering. SHS 9800is especially resistant to softening.



Microstructure Improves Abrasion Resistance

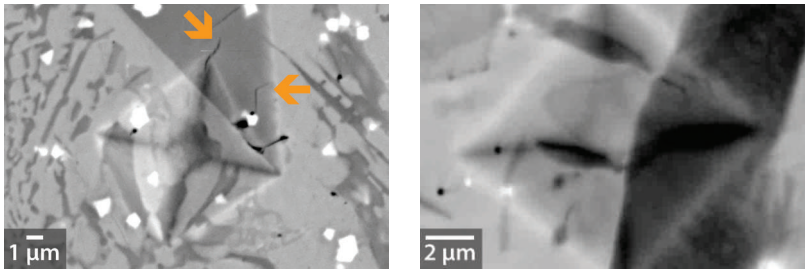
SHS 9700 and SHS 9800 are designed to produce very fine hard metal borocarbides during welding and solidifcation. This in-weld formation results in a highly uniform distribution of carbides within an iron based ferritic matrix. This is shown in the following SEM images comparing typical SHS and chrome carbide microstructures. The rectangular white borocarbide is a clear example of the very fne carbides present in the SHS microstructure diferentiating itfrom the typical chrome carbide microstructure. Theuniquecombination ofhigh uniformity andveryfnegrainsinthenanoscale microstructure provide shigh hardness andwear resistance to SHS wear plate allowing it to excel inenvironments where abrasion can aggressively attack standard hard facing materials.



SEM micrographs show typical microstructures of an SHS weld overlay, left, and chrome carbide weld overlay, right.

Improved Impact Resistance

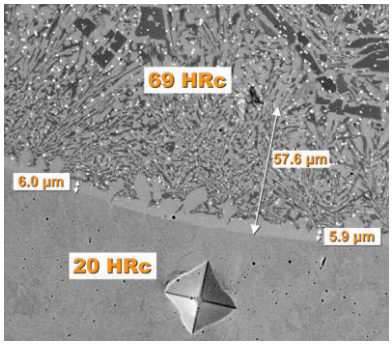
The superior toughness of SHS 9700 and SHS 9800 overlays results from the in-weld formation of a large quantity of refined complex borocarbide phases which are surrounded by ductile phases. These borocarbide phases are completely wetted by the matrix and prevent premature pull-out, delamination and crack nucleation. Their refined nature allows the reduction of stress concentration sites and the ductile matrix supplies efective crack blunting and bridging, resulting in improved impact resistance.



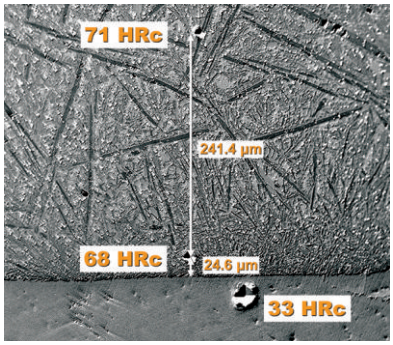
Cracks induced by the microhardness indent in the left SEM image of an SHS 9700 overlay are quickly blunted and stopped by the ductile matrix, or they do not form at all as demonstrated by the SHS 9800 overlay to the right.

Minimal Dilution

SHS 9700 and SHS 9800 have been engineered to overcome dilution. SHS overlay achieves maximum hardness in single pass deposits through the entire weld allowing the overlay to be fully protective throughout the volume.



Single pass SHS 9700 overlay achieves 68 HRc within 57.6 µm (0.003in) of the weld overlay interface.



Single pass SHS 9800 overlay achieves 68 HRc within 4.6 µm (0.0010in) of the weld overlay interface.

Usability

The high hardness and better wear resistance performance characteristics of SHS 9700 and SHS 9800 alloys do not change or reduce usability. SHS 9700 and SHS 9800 wearplate will respond very similarly to standard chrome carbide overlay plate during forming, cutting, fabrication and installation by tack or plug welding.

Formability

SHS 9700 and SHS 9800 wearplate can be rolled or formed by press brake in to desired shapes for specific applications. Formability is similar to standard overlay plates and dependant on thickness and weld position on the inner or outer diameter. Two radii for a typical single pass SHS 9700 overlay can beseen in the image to the right. The SHS 9700 sample with the tighter radius has been formed with the weld on the inner diameter.

OD, top, and ID radii for a typical single passSHS 9700 overlay.

Cutting

Plasma arc cutting is recommended for shape cutting and large hole piercing. As with chrome carbide wear plate, SHS 9700 and SHS 9800 wear plate cannot be fame cut. For applications requiring less precision, SHS 9700 and SHS 9800 overlay material can also be removed by means of carbon arc gouging. SHS 9700 and SHS 9800 overlays are non-machinable and, if necessary, surface finishing can be done by grinding or EDM.

SHS Wear Plate Installation

SHS wear plate can be installed by plug or fillet welding, or bolted in to place. Any weld seams should be over laid with SHS wire to prevent wear caused by under cutting at the seams.

A Mining & Aggregates Industry Case Study

SHS Wear Plate Out performs Q&T Plate at Southwest USA Hard Rock Mine

Super Hard Steel®

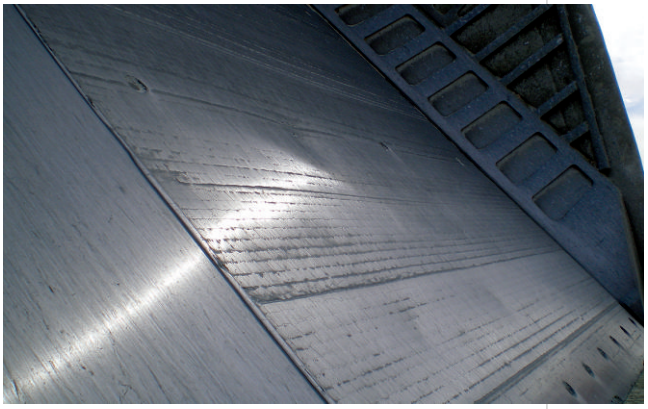
Summary

An SHS 9700 wear plate was installed in October 2007in the bed of a240 ton off highway haul truck in service at a hard rock mine in the Southwest USA. The SHS 9700 wear plate was installed as aside-by-side comparison to a 500 Brinell wear plate at the rear section of the haul truck bed, which receives the greatest amount of severe sliding abrasive wear.

Performance Results

A performance inspection of the SHS 9700 wear plate in March2008 after hauling 1.2 million tons of ore revealed very little surface wear with the weld texture remaining clearly visible, as demonstrated in the image below to the right.

SHS 9700 wear plate (9'x8')after installation in October 2007.



SHS 9700 plate in March 2008 after hauling 1.2 million tons of ore.

A second inspection in September 2008 after hauling 3.2 million tons of ore revealed little surface wear to the SHS 9700 wear plate. In contrast, the 500 Brinell wear plate had worn into the heads of the bolts securing it to the truck bed. The SHS 9700 wear plate had signifcant life time remaining while the 500 Brinell was due for replacement. The SHS 9700 wear plate also survived without failure after direct impact with a shovel dipper which resulted in a large dent in both the wear plate and underlying truck bed.

Additional Information

For specific applications, pricing, cost analysis, wear plate size specifications, fabrication methods, weld ability and delivery options, contact Nano Steel toll free at 1-877-93-NANO.

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SHS 9700 Wear Plate Solution

Rockwell C (HRc) Hardness	Wear Resistance	Impact Resistance
66-69 Hrc	ASTM G65-04 Procedure A 6,000 cycles mass loss 0.11 - 0.15g (+/-0.0)	Drop Impact Testing– Passed multiple impacts at 165 ft-lbs