

WEARTECH® SHS™ 8000W

Severe Abrasion, Wire Arc Spray

Application Process

THSP-ASW Twin Wire
Arc Spraying

Material Chemistry (wt%)

Chromium	< 22%
Boron	< 5%
Molybdenum	< 5%
Niobium	< 5%
Carbon	< 2%
Manganese	< 1%
Silicon	< 1%
Iron	Balance

Microhardness (HVO .3)

1000-1200 typical

Microhardness (Average)

Elevated Temperature

1030 kg/mm ²	70° F
912 kg/mm ²	300° F
620 kg/mm ²	600° F
309 kg/mm ²	1200° F
117 kg/mm ²	1400° F

Wear Resistance

ASTM G65-04 Procedure B
2,000 cycles
Typical mass loss 0.18 g

Elevated Temp Erosion

Using coal fired boiler fly ash
for 20 min at 30° impact angle
(α) at 1200° F

volume loss (mm³)
 $\alpha = 30^\circ$

SHS8000W	1.50
Competitor 1	3.05
1018 steel plate	8.47

Bond Strength

ASTM C633-01
8 ksi (55MPa) typical

Coating Description

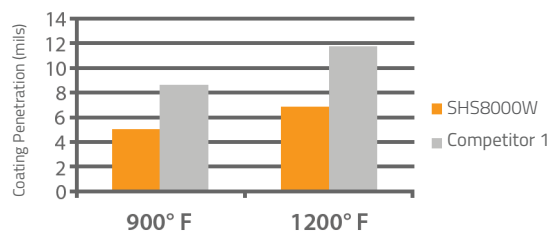
SHS8000W is a glass forming iron based alloy that forms a nanocomposite comprised of a mixed amorphous and nanoscale microstructure when sprayed as a coating. SHS8000W features high wear resistance, elevated temperature erosion resistance and a unique high hardness/toughness combination.

Key Performance Characteristics

- Excels in elevated temperature environments where fly ash and bed ash erosion occurs
- Superior bond strength without necessity of bond coat
- Excellent abrasion resistance
- Hardness increases as a function of time and temperature

SHS8000W coatings exhibit excellent combinations of corrosion and wear resistance, superior bond strength and high impact resistance. Superior bond strength values signify that this material has exceptional adhesion and cohesion. This also highlights the material's extremely low residual stress (even at high thicknesses) inherent in this coating type. The probability of "pull-out" of individual particles during wear, erosion and other service conditions is extremely low. Low coating permeability results in a highly corrosion resistant barrier. Low oxide content contributes to high bond strength due to the very limited presence of internal voids and other defects. These characteristics provide predictable coating performance across a broad variety of service environments. SHS8000W is especially resistant to elevated temperature oxidation, erosion and corrosion for protecting boiler tubes in coal fired boilers.

High Temperature Erosion
Bituminous Coal Ash



Elevated Temperature Erosion Resistance

SHS8000W combines erosion with high hardness in elevated temperature environments where fly ash and bed ash erosion occurs. Based on results from aggressive accelerated elevated temperature erosion tests with highly erosive fly ash from a coal fired boiler at 30° and 90° impact angles, SHS8000W coatings can provide increased lifetime over carbon steel substrate and leading industry standard protective coatings.

Industrial Uses

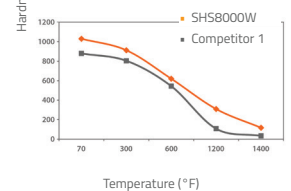
Power Generation
Oil & Gas

Power Industry Application



SHS8000W coatings can increase boiler tube service lifetime

Elevated Temperature Microhardness



SHS8000W excels in elevated temperature environments

WEARTECH® SHS™ 8000W

Severe Abrasion, Wire Arc Spray

Coating Properties

Density (g/cm ³)	7.30
Porosity/Oxides	< 5%
Coefficient of Friction	0.316
Thermal Expansion	
Temperature	Slope
100-500° C	8.53
Thermal Conductivity	
Temperature	(W/mK)
23° C	4.280
50° C	4.678
75° C	5.055
100° C	5.269
125° C	5.505
150° C	5.707

Impact Resistance

Drop Impact Testing:
No delamination/cracking
at 480 in-lbs

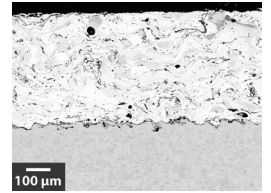
Impact Resistance

Impact testing on SHS8000W coatings was performed using a Gardner Impact testing machine with a 12 lb. test weight and 0.5 in. diameter impact punch dropped from 40 in height. As-sprayed and heat-treated (one hour soak at 600° C, water quenched) coatings of 0.020 in. thickness were tested. The as-sprayed and heat-treated coatings survived 480 in-lbs impact and demonstrated the ability to deform with the substrate without chipping, cracking or delaminating.

Universal Applicability

When SHS8000W is sprayed directly onto substrate alloys using conventional twin wire thermal spray equipment and standard substrate preparation practices, and without a bond coat, extremely high bond strength is achieved. In ASTM C633-01 Adhesion/Cohesion Bond Strength Tests, extremely high bond strength is achieved for SHS8000W coatings on plain carbon steel, far exceeding bond strength of conventional coating materials.

SEM Micrograph



SEM micrograph of SHS8000W coating on a mild substrate

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The Lincoln Electric Company is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for information or advice about their use of our products. Our employees respond to inquiries to the best of their ability based on information provided to them by the customers and the knowledge they may have concerning the application. Our employees, however, are not in a position to verify the information provided or to evaluate the engineering requirements for the particular weldment. Accordingly, Lincoln Electric does not warrant or guarantee or assume any liability with respect to such information or advice. Moreover, the provision of such information or advice does not create, expand, or alter any warranty on our products. Any express or implied warranty that might arise from the information or advice, including any implied warranty of merchantability or any warranty of fitness for any customers' particular purpose is specifically disclaimed.

Lincoln Electric is a responsive manufacturer, but the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying these types of fabrication methods and service requirements.

Subject to Change – This information is accurate to the best of our knowledge at the time of printing. Please refer to www.lincolnelectric.com for any updated information.

WEARTECH® SHS® 8000W

Severe Abrasion

KEY FEATURES

- Excels in elevated temperature environments where fly ash and bed ash erosion occurs
- Superior bond strength without necessity of bond coat
- Hardness increases as a function of time and temperature

TYPICAL APPLICATIONS

- Boiler Tubes
- Oil & Gas
- Power Generation
- Pulp & Paper

DIAMETERS / PACKAGING

Diameter in (mm)	25 lb (11.3 kg) Spool PLW	400 lb (181 kg) Accu-Trak Drum
1/16 (1.6)	ED035665	ED035972

MECHANICAL PROPERTIES

Vicker's Hardness (HV0.3)	Wear Resistance	Bond Strength ksi (MPa)
1000-1200	ASTM G65-04 Procedure B 0.18 g mass loss	ASTM C633-01 Glue Failure 8 (55)

DEPOSIT COMPOSITION

	%Fe	%C	%Cr	%B	%Mo	%Nb	%Mn	%Si
Requirements	Balance	<2	<22	<5	<5	<5	<1	<1

TYPICAL OPERATING PROCEDURES

Tip Size in (mm)	Air Cap	Positioner	Amperes (Amps)	Voltage (V)	Air Motor (psi)	Atomizing Air (psi)	Arc Jet Air (psi)	Transverse Rate in/min (m/min)	Standoff in (mm)
1/16 (1.6)	Blue	Short Cross	250	32	50	70	80	276 (7)	6 (152)

* This procedure was developed on a TAFE 8830/8835 system. Changes in equipment, materials, and substrates may change optimum procedures. Listed procedures should only be used as a starting point.

IMPORTANT: SPECIAL VENTILATION AND/OR EXHAUST REQUIRED

Fumes from the normal use of some welding products can contain significant quantities of components - such as chromium and manganese - which can lower the 5.0 mg/m³ maximum exposure guideline for general welding fume.

BEFORE USE, READ AND UNDERSTAND THE MATERIAL SAFETY DATA SHEET (MSDS) FOR THIS PRODUCT AND SPECIFIC INFORMATION PRINTED ON THE PRODUCT CONTAINER.

Material Safety Data Sheets (MSDS) and Certificates of Conformance are available on our website at www.lincolnelectric.com

TEST RESULTS

Test results for mechanical properties, deposit or electrode composition and diffusible hydrogen levels were obtained from a weld produced and tested according to prescribed standards, and should not be assumed to be the expected results in a particular application or weldment. Actual results will vary depending on many factors, including, but not limited to, weld procedure, plate chemistry and temperature, weldment design and fabrication methods. Users are cautioned to confirm by qualification testing, or other appropriate means, the suitability of any welding consumable and procedure before use in the intended application.

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