Innovation & Technology

HVOF Thermal Spray Technology

HVOF (High Velocity Oxygen Fuel) thermal spray technology allows us to apply coatings with extremely low porosity and high bond strength. A mixture of fuel and oxygen is combusted within a thermal spray gun producing temperatures near 6000ºF (3300ºC).

Powerful particles are projected into the high pressure gas stream created by the combustion and accelerated down the barrel of the spray gun at several times the speed of sound. At these speeds and temperature conditions, severe nitrogen porosity adheres to the substrate with superior bond strength – exceeding 10,000 PSI. During coating applications, the coating builds to the specified thickness. This process creates the strongest bond with highest hardness value as compared to any other thermal spray process.

Coating Formulas for Ultimate Effectiveness

Our coating formulations have been designed for optimal effectiveness with our thermal spray application processes. Our winning CarbideX coating formulations are a carbide-tungsten carbide and carefully selected alloys or materials to provide the most economical wear solution available.

By projecting coating materials from a high speed-air and oxygen spray near material may reach high bond strength with minimum deformation to the substrate.

Coating Formulas for a Growing Range of Products and Applications that result in even greater durability, stability and performance enhancement.

Research & Development

Extreme Coatings continues its ongoing research and development technologies that benefit the customer in every industry we serve. Our goal is to meet the needs of the next generation and the next era in engineered surface solutions. Our proprietary coating formulas protect and extend the service life of your most valuable assets, saving you money and improving your bottom line.

Other Coating Solutions

Carboride  •  Niboride  •  Flame Spray

CarbideX Advantage

CarbideX Formula Alloy Composition Hardness

C1000 Formulation of Tungsten Carbide, Cobalt Matrix 68-71 HRC

Key Characteristics:
- Ultimate abrasion resistance with moderate corrosion resistance

C1000Ni Formulation of Tungsten Carbide, Nickel Matrix 68-71 HRC

Key Characteristics:
- Ultimate abrasion and moderate to good corrosion resistance

C1000-17 Formulation of Tungsten Carbide, Cobalt Matrix 66-68 HRC

Key Characteristics:
- Ultimate abrasion and moderate corrosion resistance with ductility

C1000Cr Formulation of Tungsten Carbide, Cobalt, Chrome Matrix 69-70 HRC

Key Characteristics:
- Ultimate abrasion and good to excellent corrosion resistance

C4000 Formulation of Carbon, Chromium, Nickel Matrix 55-60 HRC

Key Characteristics:
- Excellent corrosion and moderate abrasion resistance with high temperature performance

C5000 (CPR) Proprietary Formulation of Carbides within a 58-62 HRC Nickel Chrome Cobalt Matrix

Key Characteristics:
- Moderate wear, extreme corrosion, economical

C6000 Proprietary Formulation of Carbides within a 58-62 HRC Nickel Chrome Cobalt Matrix

Key Characteristics:
- Moderate wear, moderate corrosion, very economical

C9000 Formulation of Tungsten Carbide (micron & 68-71 HRC nanometer particles), Cobalt Matrix

Key Characteristics:
- Excellent wear resistance and good corrosion resistance especially formulated for fine particle abrasion

Carboride  •  Niboride  •  Flame Spray

Distributed by:

Distributed by:

Wear & Corrosion Resistant Coating Solutions for Injection Molding, Compound Mixing & Extrusion Machinery

Single Feedscrews  •  Twin Feedscrews  •  Mixing Rotors  •  Tip Assemblies

www.extremecoatings.net  •  Toll Free: 1-888-367-2569
**A Global Leader in Thermal Spray Coating Solutions**

Since 1996, Extreme Coatings has been a leader in the thermal spray coatings industry, developing innovative solutions to meet the needs of industries worldwide. We specialize in developing wear resistant and corrosion resistant coatings for a variety of applications.

**Our Value Statements - What You Can Expect**

- **Product Performance – Customer Results**: Our CarbideX coatings are designed to provide the highest level of performance and durability, ensuring that your equipment stays operational longer and with less downtime.
- **Less Wear = More Production + Constant Quality + Less Down Time + Improved profit**: Our coatings offer superior wear resistance, allowing for increased production and reduced maintenance costs.
- **ASTM G65 A – Sliding Abrasion Charts**: This chart illustrates the performance of our coatings in sliding abrasion conditions.
- **ASTM G77 – Adhesive Wear Test**: Our coatings are tested in this standard test method to evaluate their resistance to adhesive wear.
- **Friction coefficients may also be established during this test.**

**Testing & Validation**


---

**Typical Components Protected to Maximize Value**

- **Plastic & Rubber Industry**
  - Injection Molding Feedbars
  - Extrusion Feedbars
  - Continuous Mixing Rotors
  - Screw Return Valve/Tip Assemblies
- **Other Miscellaneous Items**
  - Bi-Metallic Components
  - Dies

**Experience & Expertise**

Our industry experience has allowed Extreme Coatings to provide innovative solutions to a variety of industries. Our team of technologists and engineers is dedicated to developing effective coating solutions that meet the specific needs of our clients.

**Successful Solutions, Impressive Results**

Extreme Coatings encapsulates complex industrial components, protecting them from wear and corrosion. By increasing wear resistance, service life is increased and operational efficiency is significantly enhanced.

**Experience & Expertise**

Our focus always remains on our customers’ requirements, and is demonstrated by our dedication to developing effective, successful surface engineering solutions for specific industries and equipment.

**Our Experience & Expertise**

Our industry experience has affected Extreme Coatings’ opportunity to service every industry, and our technology expertise has equipped us with the ability to offer bottom line solutions like no other company in the industry. Our proprietary technologies and a talented product that offers greater value than most all other surface engineering solutions on the market.

**Formulations: Our CarbideX Products**

<table>
<thead>
<tr>
<th>Coating or Alloy Description / Composition</th>
<th>HRC</th>
<th>Rc</th>
<th>Volume Loss mm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1000Ni Formulation - Tungsten Carbide, Nickel Matrix</td>
<td>68-71</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>C1000 Formulation - Tungsten Carbide, Cobalt</td>
<td>68-71</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>Stellite 6 Co/Cr/W</td>
<td>40</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.1127</td>
<td>0.2966</td>
<td></td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.0249</td>
<td>0.2000</td>
<td></td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.0207</td>
<td>0.0641</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.1995</td>
<td>4.7000</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.4000</td>
<td>3.7000</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.1990</td>
<td>1.4000</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.1624</td>
<td>0.5058</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.1370</td>
<td>0.2200</td>
<td></td>
</tr>
</tbody>
</table>

**Less Wear = More Production + Constant Quality + Less Down Time + Improved profit**

- **A**: Is a standard pair of CarbideX feedbars after 12 months processing highly abrasive PVC, showing extremely high wear resistance.
- **B**: Is a standard pair of CarbideX feedbars after 12 months testing PVC, showing extremely high wear resistance.
- **C**: Is a standard CarbideX coated die that has been in operation for over 2 years, showing extremely high wear resistance.
- **D**: Is a standard CarbideX coated die that has been in operation for over 2 years, showing extremely high wear resistance.
- **E**: Is a standard CarbideX coated feedbar after 10 months testing, showing extremely high wear resistance.
- **F**: Is a standard CarbideX coated feedbar after 10 months testing, showing extremely high wear resistance.
- **G**: Is a standard CarbideX coated feedbar after 10 months testing, showing extremely high wear resistance.

---

**Our Value Statements - What You Can Expect**

- **Less Wear = More Production + Constant Quality + Less Down Time + Improved profit**

---

**Our Experience & Expertise**

Our team offers an effective, solution-oriented approach which makes use of advanced thermal spray technologies and proprietary coating formulations. The exceptional quality of our products has enabled us to become trade standards in the plastic and rubber industry for feedbars, mixing rotors, tip assemblies and other processing parts.

**Experience & Expertise**

Comprehensive encapsulation service for tools, components and other parts is offered by Extreme Coatings. Our team offers an effective, solution-oriented approach which makes use of advanced thermal spray technologies and proprietary coating formulations. The exceptional quality of our products has enabled us to become trade standards in the plastic and rubber industry for feedbars, mixing rotors, tip assemblies and other processing parts.

**Successful Solutions, Impressive Results**

Extreme Coatings encapsulates complex industrial components, protecting them from wear and corrosion. By increasing wear resistance, service life is increased and operational efficiency is significantly enhanced.

**Experience & Expertise**

Our focus always remains on our customers’ requirements, and is demonstrated by our dedication to developing effective, successful surface engineering solutions for specific industries and equipment.

**Our Experience & Expertise**

Our industry experience has affected Extreme Coatings’ opportunity to service every industry, and our technology expertise has equipped us with the ability to offer bottom line solutions like no other company in the industry. Our proprietary technologies and a talented product that offers greater value than most all other surface engineering solutions on the market.

**Formulations: Our CarbideX Products**

<table>
<thead>
<tr>
<th>Coating or Alloy Description / Composition</th>
<th>HRC</th>
<th>Rc</th>
<th>Volume Loss mm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1000Ni Formulation - Tungsten Carbide, Nickel Matrix</td>
<td>68-71</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>C1000 Formulation - Tungsten Carbide, Cobalt</td>
<td>68-71</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>Stellite 6 Co/Cr/W</td>
<td>40</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.1127</td>
<td>0.2966</td>
<td></td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.0249</td>
<td>0.2000</td>
<td></td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.0207</td>
<td>0.0641</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.1995</td>
<td>4.7000</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.4000</td>
<td>3.7000</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.1990</td>
<td>1.4000</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.1624</td>
<td>0.5058</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.1370</td>
<td>0.2200</td>
<td></td>
</tr>
</tbody>
</table>

**Less Wear = More Production + Constant Quality + Less Down Time + Improved profit**

- **A**: Is a standard pair of CarbideX feedbars after 12 months processing highly abrasive PVC, showing extremely high wear resistance.
- **B**: Is a standard pair of CarbideX feedbars after 12 months testing PVC, showing extremely high wear resistance.
- **C**: Is a standard CarbideX coated die that has been in operation for over 2 years, showing extremely high wear resistance.
- **D**: Is a standard CarbideX coated die that has been in operation for over 2 years, showing extremely high wear resistance.
- **E**: Is a standard CarbideX coated feedbar after 10 months testing, showing extremely high wear resistance.
- **F**: Is a standard CarbideX coated feedbar after 10 months testing, showing extremely high wear resistance.
- **G**: Is a standard CarbideX coated feedbar after 10 months testing, showing extremely high wear resistance.
**Defining the Value**

**Production Efficiency Advantage Factor**

Production efficiency suffers dramatically as the clearance between feedscrew and barrel increases. While sometimes difficult to determine, an estimate of the cost of production loss such as scrap or downtime will highlight the return on an investment in Extreme Coatings Product Solutions.

Quantifying the cost of inefficiency on a per machine, per month basis we define as the Production Efficiency Advantage Factor or PEAF. This value is typically a reduction in screw or barrel expense. Carbide encapsulation can postpone feedscrew wear better than any other technology available today.

The Extreme Coatings industry specific approach makes our technology valuable through an understanding of the PEAF of a particular process.

**Injection Molding**

A precision injection molder with 100 injection presses, 20 of which run glass filled Nylon, PBT and LCP materials, experiences process inconsistency with a small amount of wear. The small screws (25mm) make small precision parts on a fast cycle. Screws are replaced at .008" - .010" (.20 - .25mm) wear as component part quality and cycle time are impacted. CPM-9V tool steel screws provide 1.5 million cycles while the carbide coated screws provide four (4) million cycles.

Annual Preventive Maintenance (P/M) includes feedscrew measurements every six months. Improved reliability and predictable wear from carbide coating has reduced semi-annual P/M’s to every 18 months or two (2) million cycles.

**Extrusion**

An extruder processing a highly filled (>80%) material repairs or replaces a feedscrew when output rate becomes uncommercial at about .030" (.76mm) of wear. With a hardfaced and chrome plated screw, this much wear occurred in 50-60 days. A tungsten carbide coated feedscrew was installed and processed for 210 days until it reached the same output rate reduction.

The carbide coated screw provided a three-fold increase in service life, however, this coated screw produced more than four times as much product as the previous HiChrome feedscrew. A solid example of the value that minimizing wear can have on a close-tolerance system. This is a prime example of what we term PEAF.

**PEAF Case Studies**

**Injection Cycles**

<table>
<thead>
<tr>
<th>Year</th>
<th>CarbideX</th>
<th>Powder/Melt</th>
<th>Screw/Barrel</th>
<th>O&amp;M</th>
<th>P/M Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4,000,000</td>
<td>600,000</td>
<td>1,500,000</td>
<td>$28,400</td>
<td>$57,600</td>
</tr>
<tr>
<td>2</td>
<td>300,000</td>
<td></td>
<td></td>
<td></td>
<td>$19,200</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0</td>
</tr>
</tbody>
</table>

At $60/hr for skilled labor, 8 hrs to P/M a machine and two P/M operations per year this yields $960 in annual maintenance cost per machine. With 30 machines this is over $28,800 per year in direct labor cost that has been reduced to $960 per 12 months ($19,200 per 12 months savings). This savings does not include annual recovered machine downtime cost that equates to about 150,000 cycles of saleable product not produced.

**Productivity Gain from Tungsten Carbide**

<table>
<thead>
<tr>
<th>Screw Type</th>
<th>CarbideX Screw</th>
<th>C13 &amp; HiC Screw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycles</td>
<td>650</td>
<td>700</td>
</tr>
<tr>
<td>Days</td>
<td>120</td>
<td>60</td>
</tr>
</tbody>
</table>

**CarbideX Formulations**

- **C1000** Formulation of Tungsten Carbide, Cobalt Matrix.
  - Key Characteristics: Ultimate abrasion resistance with moderate corrosion resistance
  - Hardness: 68-71 HRC

- **C1000Ni** Formulation of Tungsten Carbide, Nickel Matrix.
  - Key Characteristics: Ultimate abrasion and moderate corrosion resistance
  - Hardness: 68-71 HRC

- **C1000Cr** Formulation of Tungsten Carbide, Cobalt, Chrome Matrix.
  - Key Characteristics: Ultimate abrasion and good to excellent corrosion resistance
  - Hardness: 69-70 HRC

- **C4000** Formulation of Carbon, Chromium, Nickel Matrix.
  - Key Characteristics: Excellent corrosion and moderate abrasion resistance with high temperature performance
  - Hardness: 55-60 HRC

- **C9000** Formulation of Tungsten Carbide (micron & nanometer particles), Cobalt Matrix.
  - Key Characteristics: Excellent wear resistance and good corrosion resistance specially formulated for fine particle abrasion
  - Hardness: 68-71 HRC

**Full Encapsulation**

- This cut away shows our coating layer uniformly.

**Other Protection Methods**

In applications that do not require wear or corrosion protection in the roots and flight sides, we apply our coating to the flight land /O.D. only.

The process involves masking the roots and flight sides to prevent the coating from adhering to those areas.

**The Core of Our Solutions – What We Do**

Extreme Coatings™ utilizes emerging thermal spray technologies to apply extremely wear and corrosion resistant protective coatings to any size injection molding or extrusion feedscrew. The technology produces crack free coatings with hardness values ranging from 30-70 Rc and thickness' from .005" - .040" (.13 – 1.01mm).
How We Do It - Our Process

1. Inspect new or reconditioned part to be processed
2. Strip & repair as necessary to OEM spec minus coating specification
3. Prepare the surface via grit blast
4. Application of the coating via HVOF
5. Sprayed and sealed - application dependent
6. Finish polishing with diamond abrasive
7. Inspect and measure
8. Part complete with mirror finish
9. Confirm all processing details and coating formula

Key Points
Our process has key elements to obtain the desired specifications and high quality standards:

- 100% QA inspection of received parts to confirm the pre-coating dimensions are correct, tool marks removed, coated area matches drawing, materials of construction, hardness and confirming formula match.

The Problem - Why We Do What We Do

A tight tolerance between the feedscrew and barrel of an injection molding machine or extruder is of vital importance to the production efficiency and the quality of the parts produced. An increase in the gap between the barrel and screws as little as .015" (.38mm) can cause excessive scrap and downtime. Additionally, changes (degradation) in the screw roots and flight sides dimension may cause similar problems.

Defining the Problems
Adjusting injection molding or extrusion machines to compensate for screw-barrel wear is common practice. These adjustments lead to excessive shear heat which can degrade sensitive polymers. Polymer residence time and time at temperature are important considerations when producing high tolerance parts. Maintaining a like-new tolerance between screw and barrel ensures that quality melt is produced at a consistent, predictable rate. An example below:

Expected Results of Our Solutions

- Tight tolerance of close tolerance system maintained
- Cost per pound of kilogram/hour decreases
- Screws last at least two times longer
- Two to four times more production
- Less preventive maintenance (DOWNTIME)
- Barrel life is improved
- Scrap rate decreases
- Output remains consistent
- Cycle times remain consistent
- Polymer integrity maintained

When the OEM tolerance between the screw and barrel is doubled, output decreases by 25% and melt temperature increases. To maintain output, screw speed is increased 50% resulting in higher melt temperature.

Results: Increased power consumption, potential for polymer degradation, decreased productivity and a reduction of the bottom line!
**Defining the Value**

**Production Efficiency Advantage Factor**

Production efficiency suffers dramatically as the clearance between feedscrew and barrel increases. While sometimes difficult to determine, an estimate of the cost of production loss such as scrap or downtime will highlight the return on investment in Extreme Coatings Product Solutions.

Quantifying the cost of inefficiency on a per machine, per month basis we define as the Production Efficiency Advantage Factor or PEAF. This value is typically a reduction in screw or barrel maintenance. Carbide encapsulation can postpone feedscrew wear better than any other technology available today.

The Extreme Coatings industry specific approach makes our technology valuable through an understanding of the PEAF of a particular process.

**PEAF Case Studies**

**Injection Molding**

A precision injection molder with 100 injection presses, 30 of which run glass filled Nylon, PBT and LCP materials, experiences process inconsistency with a small amount of wear. The small screws (25mm) make small precision parts on a fast cycle. Screws are replaced at .008" - .010" (.20 - .25mm) wear as component part quality and cycle time are impacted. CPM-9V tool steel screws provide 1.5 million cycles while the carbide coated screws provide four (4) million cycles.

Annual Preventive Maintenance (P/M) includes feedscrew measurements every six months. Improved reliability and predictable wear from carbide coating has reduced semi-annual P/Ms to every 18 months or two (2) million cycles.

**Extrusion**

An extruder processing a highly filled (>80%) material repairs or replaces a feedscrew when output rate becomes uneconomical at about .030" (.76mm) of wear. With a hardfaced and chrome plated screw, this much wear occurred in 50-60 days. A tungsten carbide coated feedscrew was installed and processed for 210 days until it reached the same output rate reduction.

The carbide coated screw provided a three-fold increase in service life, however, this coated screw produced more than four times as much product as the previous Hf/Chrome feedscrew. A solid example of the value that minimizing wear can have on a close-tolerance system. This is a prime example of what we term PEAF.

**Productivity Gain from Tungsten Carbide**

**Injection Molding**

At $80/hr for skilled labor, 8 hrs to P/M a machine and two P/M operations per year this yields $880 in annual maintenance cost per machine. With 30 machines this is over $26,400 per year in direct labor cost that has been reduced to $900 per 12 months (a $19,500 per 12 months savings). This savings does not include annual recovered machine downtime cost that equates to about 150,000 cycles of saleable product not produced.

**Other Protection Methods**

In applications that do not require wear or corrosion protection in the roots and flight sides, we apply our coating to the flight land /O.D. only. The process involves masking the roots and flight sides to prevent the coating from adhering to those areas.

**CarbideX Formula**

- **C1000**: Formulation of Tungsten Carbide, Cobalt Matrix. 
  - Key Characteristics: Ultimate abrasion resistance with moderate corrosion resistance
  - Hardness: 68-71 HRC

- **C1000Ni**: Formulation of Tungsten Carbide, Nickel Matrix. 
  - Key Characteristics: Ultimate abrasion and moderate to good corrosion resistance
  - Hardness: 68-71 HRC

- **C1000Cr**: Formulation of Tungsten Carbide, Cobalt, Chrome Matrix. 
  - Key Characteristics: Ultimate abrasion and good to excellent corrosion resistance
  - Hardness: 69-70 HRC

- **C4000**: Formulation of Carbon, Chromium, Nickel Matrix. 
  - Key Characteristics: Excellent corrosion and moderate abrasion resistance with high temperature performance
  - Hardness: 55-60 HRC

- **C9000**: Formulation of Tungsten Carbide (micron & nanometer particles), Cobalt Matrix. 
  - Key Characteristics: Excellent wear resistance and good corrosion resistance specially formulated for fine particle abrasion
  - Hardness: 68-71 HRC

*Hardness converted from Vickers/Knoop
**Typical Components Protected to Maximize Value**

<table>
<thead>
<tr>
<th>Plastic &amp; Rubber Industry</th>
<th>Other Miscellaneous Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Injection Molding FeedStocks</td>
<td>• Converger Augers</td>
</tr>
<tr>
<td>• Extruder FeedStocks</td>
<td>• Pump Stations</td>
</tr>
<tr>
<td>• Continuous Mixing Rotors</td>
<td>• Hydraulic Shells</td>
</tr>
<tr>
<td>• Screw Return Value Tip Assemblies</td>
<td>• Heat Exchanger Tubes</td>
</tr>
<tr>
<td>• Screw</td>
<td>• Foes</td>
</tr>
</tbody>
</table>

**Experience & Expertise**

Our industry experience has afforded Extreme Coatings the opportunity to service over 15,000 parts, and our technology expertise has equipped us with the ability to offer bottom-line solutions like no other company in the industry. Our proprietary technologies and a finished product that offers greater value than most all other surface engineering solutions on the market.

This competitive advantage significantly improves our customers’ operating costs through extended service life and a reduction in machine downtime. We view each job as unique, and we take pride in offering a service model that is customized to fulfill individual client needs to advance their productivity.

Our focus always remains on our customers’ requirements, and is demonstrated by our dedication to the business of developing effective, successful surface engineering solutions for specific industries and equipment.

**Formulations: Our CarbideX Products**

<table>
<thead>
<tr>
<th>Coating or Alloy Description /Composition</th>
<th>HRC</th>
<th>Rc</th>
<th>Volume Loss mm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1000Ni Formulation - Tungsten Carbide, Nickel Matrix</td>
<td>68-71</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>Colmonoy 83 Ni/Cr/B/WC</td>
<td>48</td>
<td>16.5</td>
<td></td>
</tr>
<tr>
<td>CPM-9V Iron-Chrome-Vanadium-Moly</td>
<td>54-56</td>
<td>16.8</td>
<td></td>
</tr>
<tr>
<td>C4000 Formulation - Chrome Carbide, Chromium, Nickel</td>
<td>55-60</td>
<td>19.1</td>
<td></td>
</tr>
<tr>
<td>D2 Chrome Carbide Tool Steel</td>
<td>58-60</td>
<td>36.1</td>
<td></td>
</tr>
<tr>
<td>Stellite 6 Co/Cr/W</td>
<td>40</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Nitrided Steel</td>
<td>0.045</td>
<td>0.2966</td>
<td></td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.1127</td>
<td>0.2000</td>
<td></td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.0249</td>
<td>0.0641</td>
<td></td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.4000</td>
<td>3.7000</td>
<td></td>
</tr>
</tbody>
</table>

*Note: This test was mainly done to compare a misconception that a hard coated feedscrew (Ring) in contact with a softer barrel (Block) will cause premature wear to the barrel. This test clearly shows that our tungsten coatings do not wear a barrel faster than the customers chrome plated screws lasted only 6 months on this unique application. Material testing is a very subjective task and can be affected by so many variables that results can be very inconsistent.*

**Testing & Validation**

**ASTM G65 - Sliding Abrasion Charts**

The ASTM G65 test simulates sliding abrasion conditions under moderate pressure, using dry sand to abrade a liner wheel and a block of the material being evaluated. The test allows comparison of wear-resistant materials based on their volume loss in cubic millimeters, with materials of higher wear resistance showing lower volume losses.

**ASTM G77 - Adhesive Wear Test**

The ASTM G77 test determines the resistance of materials to prevent adhesion in a rotating barrel test. The test is used to determine the materials that will not stick to the barrel, and the results are reported as volume loss in cubic millimeters for both the block (stationary block) and the ring. Materials of higher wear resistance have lower volume losses. Friction conditions may also be established during this test.

**Results**

<table>
<thead>
<tr>
<th>Coating or Alloy Description /Composition</th>
<th>Stationary Block</th>
<th>Ring</th>
<th>Block Loss</th>
<th>Ring Loss</th>
<th>Volume Loss mm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1000Ni Formulation - Tungsten Carbide, Nickel Matrix</td>
<td>0.01</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>Colmonoy 83 Ni/Cr/B/WC</td>
<td>0.03</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>CPM-9V Iron-Chrome-Vanadium-Moly</td>
<td>0.05</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>C4000 Formulation - Chrome Carbide, Chromium, Nickel</td>
<td>0.07</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>D2 Chrome Carbide Tool Steel</td>
<td>0.09</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>Stellite 6 Co/Cr/W</td>
<td>0.10</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>Nitrided Steel</td>
<td>0.01</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.03</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>Carbide (WC)</td>
<td>0.02</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>BiMetallic (FeCr)</td>
<td>0.11</td>
<td>0.11</td>
<td>0.02</td>
<td>0.11</td>
<td>0.03</td>
</tr>
</tbody>
</table>

*Note: This test was mainly done to compare a misconception that a hard coated feedscrew (Ring) in contact with a softer barrel (Block) will cause premature wear to the barrel. The results clearly show that our tungsten coatings do not wear a barrel faster than the customers chrome plated screws lasted on this unique application. Material testing is a very subjective task and can be affected by so many variables that results can be very inconsistent.*

**Our Value Statements - What You Can Expect**

- By increasing wear resistance, service life is increased and performance is dramatically enhanced.
- Our technology expertise has equipped us with the ability to offer bottom-line solutions like no other company in the industry. Our proprietary technologies and a finished product that offers greater value than most all other surface engineering solutions on the market.
- Extreme Coatings is a world leader for other surface engineering solutions on the market.
- Extreme Coatings encapsulates complex industrial components, protecting them from wear and corrosion.
- By increasing wear resistance, service life is increased and performance is dramatically enhanced.
- Successful Solutions, Impressive Results
- Extreme Coatings encapsulates complex industrial components, protecting them from wear and corrosion.
- By increasing wear resistance, service life is increased and performance is dramatically enhanced.
- Experience & Expertise
- Our industry experience has afforded Extreme Coatings the opportunity to service over 15,000 parts, and our technology expertise has equipped us with the ability to offer bottom-line solutions like no other company in the industry.
- Our proprietary technologies and a finished product that offers greater value than most all other surface engineering solutions on the market.
- This competitive advantage significantly improves our customers’ operating costs through extended service life and a reduction in machine downtime. We view each job as unique, and we take pride in offering a service model that is customized to fulfill individual client needs to advance their productivity.

**Less Wear = More Production + Constant Quality = Less Down Time + Improved profit**

| Less Wear More Production Constant Quality Less Down Time Improved profit |
|--------------------------------------------------|-----------------|----------|------------------|-----------------|-----------------|----------------|---------------|
| A: Is a standard powder coated feedscrew over 2 months processing highly abrasive ceramic filled polymer. | 95 months | 40% | 150mm Feedscrew | 42% | 7.5% | 50% |
| B: Is a CarbideX C4000 coated Feedscrew after 12 months in the same process. | 45 months | 20% | 150mm Feedscrew | 60% | 5% | 75% |
| C: Is a Nitrided Steel Feedscrew in processing for 150 months processing CPVC and various materials. | 120 months | 30% | 150mm Feedscrew | 70% | 10% | 80% |
| D: Is a CarbideX C9000 coated Feedscrew after 10 months processing highly abrasive ceramic filled polymer. | 90 months | 45% | 150mm Feedscrew | 55% | 15% | 70% |
| E: Is the refurbished 150mm Feedscrew stripped, coated and polished to a <4 RA ui and the ring. | 120 months | 30% | 150mm Feedscrew | 70% | 10% | 80% |
| F: Is a CarbideX C1000 coated Feedscrew after 10 months processing highly abrasive ceramic filled polymer. | 90 months | 45% | 150mm Feedscrew | 55% | 15% | 70% |
| G: Is a CarbideX C9000 coated Feedscrew after 10 months processing highly abrasive ceramic filled polymer. | 90 months | 45% | 150mm Feedscrew | 55% | 15% | 70% |

*For an Injection Molding Machine in the Plastic Industry*
Our Value Statements - What You Can Expect
Encapsulating a plastic injection molding or extrusion feedscrew with a wear and corrosion resistant tungsten or chrome carbide coating will reduce your average amortized monthly feedscrew costs by up to 50% regardless of the type of polymer being processed. The high concentration of extremely hard tungsten or chromium carbides in our coatings provide protection against adhesive and abrasive wear in certain applications. In most cases, you can expect an encapsulated feedscrew to last from two to five times longer than any other hardfacing on the market.

Our Experience & Expertise
Our industry experience has afforded Extreme Coatings the opportunity to service over 25,000 parts, and our focus and dedication to developing effective, successful surface engineering solutions for specific industries and equipment.

Typical Components Protected to Maximize Value
- Injection Molding Feeders
- Extruder Feeders
- Continuous Mixing Rotors
- Skin Return Value/Tip Assemblies
- BiMetallic Rings
- Dies
- Other Miscellaneous Items
  - Conveyer Augers
  - Pump Bearings
  - Hydraulic Shafts
  - Heat Exchanger Tubes
  - Fans

Plastic & Rubber Industry
- Fans
- Hydraulic Shafts
- Pump Sleeves
- Other Miscellaneous Items
  - BiMetallic Rings
  - Heat Exchanger Tubes
  - Fans

Testing & Validation
ASTM G65 A - Sliding Abrasion Charts
The ASTM G65 test simulates sliding abrasion conditions under moderate pressure, using dry sand or steel shot in either a rubber wheel or a black coup abradant. The material being evaluated. The test allows comparison of wear-resistance noted by its volume loss in cubic millimetres, with material of higher wear resistance showing lower volume losses.

ASTM G77 – Adhesive Wear Test
The ASTM G77 test simulates metal-to-metal sliding abrasion involving a block on a rotating machine to test parts in various environments for their ability to resist adhesive wear characteristics, this test replicates "adhesive, abrasive wear" wear. Results are reported in terms of both total weight loss and the ratio of the coefficient of friction. Higher friction results are beneficial for light load and high speed applications. Materials of higher wear resistance have lower volume losses. Friction coefficients may also be recorded during this test.

Formulations: Our CarbideX Products
<table>
<thead>
<tr>
<th>Coating or Alloy Description</th>
<th>Composition</th>
<th>HRC</th>
<th>Rc</th>
<th>Volume Loss mm³</th>
</tr>
</thead>
</table>
| C9000 Formulation - Nano Tungsten Carbide, Cobalt | 68-71 | 4.5
| C1000 Formulation - Tungsten Carbide, Cobalt | 68-71 | 5.5
| Colmonoy 83 Ni/Cr/B/WC | 48 | 16.5
| C4000 Formulation - Chrome Carbide, Chromium, Nickel | 55-60 | 19.1
| HCP Hard Chrome Plating | 68-72 | 28.6
| D2 Chrome Carbide Tool Steel | 58-60 | 36.1
| Nitrided 1.8550 Nitrided Nitralloy Steel | 70 | 68
| Stellite 6 Co/Cr/W | 40 | 55

**Notes:**
- *A* in standard pound weight feedscrew after 10 months processing highly abrasive ceramic filled polymer.
- *B* in CarbideX C1000 coated feedscrew after 10 months in the same processing environment.
- *A* in Nitrided Steel Feedscrew processing PVC after 10 Months of processing.
- *B* in CarbideX C4000 coated 150mm Feedscrew that has been in operation for 95 months processing CPVC and various materials. Prior to this first coating the customers chrome plated screws lasted only 6 months on this unique application.
- *A* in Sliding Abrasion Chart showing lower volume loss compared to other alloys commonly used for wear resistance and actually can increase the barrel life.

**Test Conditions**
- Tested in 3000 meter slide length. Final load and stepped loads to COF criteria.
- Materials cut at 1212 rpm, 6000 RPM and 300 pounds of force.

**Formulations:**
- Colmonoy 83 Ni/Cr/B/WC
- C4000 Formulation - Chrome Carbide, Chromium, Nickel
- HCP Hard Chrome Plating
- D2 Chrome Carbide Tool Steel
- Nitrided 1.8550 Nitrided Nitralloy Steel
- Stellite 6 Co/Cr/W

**Volume loss mm³**
- Tested for 6000 revolutions at a load of 30 lb. (13.6 kg) using a 9 inch (229mm) diameter rubber wheel only in a dry.

**Friction coefficients may also be recorded during this test.**

- Materials cut at 1212 rpm, 6000 RPM and 300 pounds of force.

**Testing Condition**
- Tested in 3000 meter slide length. Final load and stepped loads to COF criteria.
- Materials cut at 1212 rpm, 6000 RPM and 300 pounds of force.
Coating Formulas for Ultimate Effectiveness

Our coating formulations have been designed for optimal effectiveness with our thermal spray application processes. Our winning CarbideX coating formulations combine tungsten carbide with carefully selected alloys or metals to provide the most economical wear solution available. By producing a coating material from a micro and sub-micron size material we achieve high bond strength with superior conformance to the coating builds in the specified thickness. This process creates the strongest bond and highest hardness value as compared to any other thermal spray process.

Other Coating Solutions

CarbideX • Niboride • Flame Spray

CarbideX Formulation Alloy Composition Hardness
C1000 Formulation of Tungsten Carbide, Cobalt Matrix 68-71 HRC
Key Characteristics: Ultimate abrasion resistance with moderate corrosion resistance
C1000Ni Formulation of Tungsten Carbide, Nickel Matrix 68-71 HRC
Key Characteristics: Ultimate abrasion and moderate to good corrosion resistance
C1000-17 Formulation of Tungsten Carbide, Cobalt Matrix 66-68 HRC
Key Characteristics: Ultimate abrasion and moderate corrosion resistance with ductility
C1000Cr Formulation of Tungsten Carbide, Cobalt, Chrome Matrix 69-70 HRC
Key Characteristics: Ultimate abrasion and good to excellent corrosion resistance
C4000 Formulation of Carbon, Chromium, Nickel Matrix 55-60 HRC
Key Characteristics: Excellent corrosion and moderate abrasion resistance with high temperature performance
C5000 (CPR) Proprietary Formulation of Carbides within a 58-62 HRC Nickel Chrome Cobalt Matrix
Key Characteristics: Moderate wear, extreme corrosion, economical
C6000 Proprietary Formulation of Carbides within a 58-62 HRC Nickel Chrome Cobalt Matrix
Key Characteristics: Moderate wear, moderate corrosion, very economical
C9000 Formulation of Tungsten Carbide (micron & nanometer particles), Cobalt Matrix
Key Characteristics: Excellent wear resistance and good corrosion resistance, specially formulated for fine particle abrasion

Innovation & Technology

HVOF Thermal Spray Technology
HVOF (High Velocity Oxygen Fuel) thermal spray technology allows us to apply coatings with extremely low porosity and high bond strength. A mixture of fuel and oxygen are combusted within a thermal spray gun to produce temperatures near 6000ºF (3300ºC). Powder particles are propelled into the high pressure gas stream created by the combustion and accelerated down the barrel of the spray gun at several times the speed of sound. At these speeds and temperature conditions, ceramic particles adhere to the substrate with superior bond strength — exceeding 10,000 PSI. During coating applications, the spray gun is rotated to ensure the coating builds in the specified thickness. This process creates the strongest bond and highest hardness value as compared to any other thermal spray process.

Research & Development

At Extreme Coatings, our mission is to continually research and develop new technologies that benefit our clients in every industry we serve. Our goal is to remain the experts in the field of metalworking and serve our customers in solutions that provide the most value and performance.

www.extremecoatings.net • Toll Free: 1-888-367-2569

Distributed by:
HVOF Thermal Spray Technology

HVOF (High Velocity Oxygen Fuel) thermal spray technology allows us to apply coatings with extremely low porosity and high bond strength. A mixture of fuel and oxygen are combusted within a thermal spray gun producing temperatures near 6000ºF (3300ºC). Powder particles are accelerated into the high pressure gas stream created by the combustion and accelerated down the barrel of the spray gun at speeds near the speed of sound. At these speeds and temperature conditions, ceramic particles adhere to the substrate with superior bond strength – exceeding 10,000 PSI. During coating applications, the powder particles are swept across the coating building up the specified thickness. This process creates the strongest bond and highest hardness value as compared to any other thermal spray process.

Coating Formulas for Ultimate Effectiveness

Our coating formulations have been developed for optimal effectiveness with our thermal spray application processes. Our winning CarbideX coating formulations in a carbide tungsten carbide and carefully selected alloys or matrix to provide the most excellent wear solution available. By producing a coating material from a multi-phase ceramic/particle matrix, we provide high bond strength and superior toughness to the coating. Our coating formulation provides a growing range of products and applications that result in even greater toughness, reliability and performance enhancement.

CarbideX Formula

<table>
<thead>
<tr>
<th>Alloy Composition</th>
<th>Hardness</th>
<th>Key Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1000</td>
<td>68-71 HRC</td>
<td>Ultimate abrasion and moderate corrosion resistance</td>
</tr>
<tr>
<td>C1000Ni</td>
<td>68-71 HRC</td>
<td>Ultimate abrasion and moderate to good corrosion resistance</td>
</tr>
<tr>
<td>C1000-17</td>
<td>66-68 HRC</td>
<td>Ultimate abrasion and moderate corrosion resistance with ductility</td>
</tr>
<tr>
<td>C1000Cr</td>
<td>69-70 HRC</td>
<td>Ultimate abrasion and good to excellent corrosion resistance</td>
</tr>
<tr>
<td>C4000</td>
<td>55-60 HRC</td>
<td>Excellent corrosion and moderate abrasion resistance with high temperature performance</td>
</tr>
<tr>
<td>C5000 (CPR)</td>
<td>58-62 HRC</td>
<td>Moderate wear, extreme corrosion, economical</td>
</tr>
<tr>
<td>C6000</td>
<td>58-62 HRC</td>
<td>Moderate wear, moderate corrosion, very economical</td>
</tr>
<tr>
<td>C9000</td>
<td>68-71 HRC</td>
<td>Excellent wear resistance and good corrosion resistance specially formulated for fine particle abrasion</td>
</tr>
</tbody>
</table>

Other Coating Solutions

Carboride  •  Niboride  •  Flame Spray