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### **The Criticality of the Specialty Metals Industry to the National Defense and Berry Amendment**

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The Specialty Steel Industry of North America (SSINA) is comprised of virtually all North American manufacturers of stainless steel and nickel-based alloys, including superalloys. SSINA members also produce such specialty metals as titanium and titanium alloys, cobalt alloys, zirconium and niobium alloys. The U.S. specialty metals industry is modern, efficient, and is at the leading edge in both new product development and the implementation of advanced manufacturing technology.

Maintaining a healthy domestic specialty metals industry and preserving its ability to create new, leading edge technology are vital to the national security interests of the U.S. Last December, the specialty metals industry published a critical review of this subject that unequivocally demonstrated this point. This report, which can be found on the SSINA website, [SSINA.com](http://SSINA.com), provides numerous examples that graphically illustrate the critical role that the industry's leading edge technology and manufacturing capability play in national defense. In the press release associated with the release of the report, the Deputy Under Secretary of Defense for Industrial Policy was quoted as saying:

There is no question that specialty metals are critical to national defense, and the U.S. specialty metals industry is a very important supplier of these materials to various defense contractors. And myriad defense programs would be negatively impacted by specialty metal supply disruptions.

As stated in this report, virtually every U.S. military platform is dependent on these materials. Whether it is missiles, jet aircraft, submarines, helicopters, Humvees or munitions, American-made specialty metals, such as titanium, superalloys, and certain specialty steels are crucial components of U.S. military strength. U.S. weapons systems, military aircraft and other defense systems cannot be built or operated without these materials. A summary of various defense-specific applications for certain specialty metals is attached.

**Because of the criticality of these materials to our defense interests, the U.S. specialty metals industry opposes any proposal to narrow the scope of the materials currently covered by the so-called Berry Amendment, specialty metals clause (10 U.S.C. § 2533a), which requires the use of domestically-produced specialty metals in defense applications. The industry also opposes any proposals, including those recently put forth by the Department of Defense (DoD), which would alter the manner in which the Berry Amendment is administered by permitting the substitution of non-compliant materials in defense contracts.**

## **The Importance of the Berry Amendment,** **Specialty Metals Clause**

The Berry Amendment, specialty metals clause has been in effect since 1973. The law has ensured that our domestic specialty metals industry remains an important element of the domestic industrial base. The existence of the law is confirmation of Congress' repeated recognition of the importance of the specialty metals industry to the national defense.

The specialty metals amendment operates to provide U.S. specialty metals producers a core of guaranteed orders associated with specific military end uses. However, because of the unique and changing applications associated with our defense programs, the floor of orders provided by the specialty metals clause ensures that U.S. producers will invest in the manufacturing capacity, process technology, research and development necessary to meet these evolving needs.

Although few companies outside the U.S. currently can meet the demanding specifications required by our military, any attempt to weaken the specialty metals provision or to narrow its scope will, over time, weaken this industry and place the U.S. in the unenviable position of dependency on a few offshore suppliers for materials that are vital to our national defense requirements. For example, there is currently only one melter of defense-quality titanium alloys outside the United States. The source is located in Russia. Adoption of any legislative proposal to weaken the specialty metals clause to permit this Russian supplier to supplant U.S. producers of titanium could ultimately lead to U.S. military dependency on a formerly state-owned Soviet-era entity. Significantly, the Russian government is contemplating a reassertion of government control over its domestic titanium producer. Similar scenarios are occurring with respect to specialty metals produced in China, as well.

The Berry Amendment has been falsely blamed for shortages in the supply of specialty metals. The titanium and superalloy businesses, for example, are cyclical in nature and those cycles are usually related to the cycles in aerospace sector. Even if the Berry Amendment did not exist, these cycles would.

Furthermore, under the Defense Production Act, DoD always is first in line for U.S. domestic production capacity. This built-in preference for the U.S. Government over all other customers ensures products that are required under the Berry Amendment will always go first to DoD applications.

Finally, even if instances exist where non-compliance could take place as a result of non-availability, there is a solution in the Berry Amendment itself: the waiver process. Repeated analyses by the specialty metals industry has failed to reveal any significant short supply situations. What has been revealed is a past tendency for lax enforcement of the Berry Amendment in the context of a desire on the part of lower-tier defense contractors to purchase artificially low priced, subsidized foreign imports of specialty metal.

Despite the absence of any proven examples of unavailability, the Berry Amendment remains under political attack. Non-compliant companies, including many lower-tier subcontractors, rather than making the effort to bring their supply chains into compliance,

instead have focused their efforts on attacking the law. These efforts have given rise to a number of legislative proposals that threaten the very foundation of the law. One such proposal would remove many, if not most, of the critical materials outside the scope of the law; the second would permit the free substitution of non-compliant merchandise based on some “future purchase” of comparable materials. Both of these proposals must be rejected.

**The Senate Proposal to Limit the Scope of the Berry Amendment  
To Titanium and Nickel Should Be Rejected**

The Senate Armed Services Committee recently included in the FY 2007 National Defense Authorization Act (S. 2767), a provision (section 822) which would modify the long-standing definition of “specialty metals” thereby limiting the application of the law to only nickel and titanium alloys. The provision is in direct conflict with the current Department of Defense definition, embodied in DFARS § 252.225-7014, which includes other critical specialty metals including certain specialty steels, as well as cobalt and zirconium-based alloys. Indeed, the House-passed version of the Defense Authorization Act (H.R. 5122) attempts to codify that long-standing definition.

- *The Senate proposal arbitrarily determines which metals are critical for defense applications.* The Senate Committee proposal has essentially drawn a line between titanium and nickel on the one hand, and all other specialty metals on the other, without giving any consideration whatsoever to the strategic importance of the materials which were excluded.
- *The excluded materials are critical to some of the nation’s most important military applications.* The numerous military applications associated with these materials are documented in the attachments to this paper.
- *DoD has long-recognized the critical importance of these materials.* In implementing the Berry Amendment, the Department of Defense has maintained the following long-standing definition of “specialty metals”:

“Specialty metals” means—

(i) Steel—

(A) With a maximum alloy content exceeding one or more of the following limits: manganese, 1.65 percent; silicon, 0.60 percent; or copper, 0.60 percent; or

(B) Containing more than 0.25 percent of any of the following elements: aluminum, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, or vanadium;

(ii) Metal alloys consisting of nickel, iron-nickel, and cobalt base alloys containing a total of other alloying metals (except iron) in excess of 10 percent;

(iii) Titanium and titanium alloys; or

(iv) Zirconium and zirconium base alloys.

The Department of Defense definition accurately reflects the scope of those materials most critical for our military platforms.

- *The excluded materials are readily available from U.S. producers.* Random allegations of unavailability have been proven unfounded.

### **The DoD Specialty Metals “Substitution” Proposal Is Unsound**

A second major legislative concern is a proposal first put forth by the Department of Defense and backed by the Aerospace Industries Association that will eliminate the requirement that specialty metals utilized for defense purposes be melted in the U.S. The proposal, which has been repeatedly rejected by the Congress, would permit foreign materials to be substituted for domestic material if a contractor asserts that an amount of “domestically-melted specialty metals at least equivalent in quality and amount” will be purchased during the contract period. The proposal also contains a provision that would permit significant purchases of foreign-sourced specialty metals under the guise of a “de minimis” exception, supposedly intended to address inadvertent cases of non-compliance at the fourth tier subcontractor level (e.g. fasteners). As currently drafted, the “de minimis” provision would permit significant use of non-compliant metals at virtually every level of the supply chain. Congress must reject both elements of this proposal in their entirety.

The DoD proposal posits a solution where no problem exists. The proposal is premised on the notion that compliance with the Berry Amendment requires defense contractors to maintain separate production lines. Avoiding the “problem” of having two separate production lines is not a justification for abandoning the Berry Amendment (or any other procurement law), and the burden of compliance, in any event, is vastly exaggerated. Every defense contractor must comply with many laws and rules, and the fact that the defense contractor may also sell to commercial customers does not relieve the contractor of his obligation to obey all U.S. government contracting laws.

Beyond this key point, it is clear that the whole argument about the “burden” of having separate production lines is vastly exaggerated. A military aircraft will be different in many ways from its dual-use commercial counterpart. The manufacturing processes will have some efficiencies of overlap, but there are many significant differences between making, say, an aerial refueling tanker and a commercial 767. Is DoD really trying to say that having separately sourced parts is too great a burden?

The DoD proposal is also practically unsound for a number of other reasons:

- *A contracting shell game -- DoD’s proposal will reduce sales for U.S. suppliers.* The DoD proposal would permit prime contractors to obtain what is, in effect, a “credit” against their obligation to use domestic specialty metals on military programs for each pound of domestic metal that they *already would be purchasing* for their commercial product lines. In short, every such dollar that is not directly spent on domestic specialty metals for use in military programs could conceivably become a lost dollar in sales for the U.S. industry.

- *Under DoD's proposal, the old floor becomes the new ceiling.* The DoD proposal could have a severe impact on the U.S. specialty metals industry because under such an approach the allocated percentage for domestic metal could become a *ceiling* rather than a *floor* regarding all U.S. aircraft, military and commercial. The domestic industry must, in order to survive, supply both military and commercial aviation. The specialty metals amendment was intended to provide a floor, or a core line of business, for domestic specialty metals suppliers. Beyond this floor, the U.S. industry now competes vigorously to supply the commercial aircraft industry, as well. Under the DoD proposal, the domestic industry would almost certainly receive a lesser volume of combined military and commercial sales.
- *The titanium example: Under the DoD proposal, U.S. military aircraft will be made from Russian, not U.S., titanium.* The DoD proposal is inconsistent with the principles underlying the Berry Amendment, which seeks to ensure that U.S. military equipment is made in the U.S. from U.S. materials. Under the DoD proposal, U.S. military items no longer would be made from U.S. materials and produced by U.S. suppliers. On the contrary, it would be likely, under this approach, that the U.S. military would be using non-Berry Amendment compliant materials. If the DoD proposal were current law, U.S. military aircraft fighting in Iraq would almost certainly contain substantially more Russian than U.S. titanium.
- *Specialty metals are not a fungible commodities as implied by the DoD proposal.* The DoD proposal does not take into account the importance of defense related business to the ongoing development of domestic manufacturing capacity, process technology and research and development. Sourcing advanced products offshore would reduce the investment in all of the foregoing, leading to the eventual dependence of the Defense Department on offshore suppliers.

### Conclusion

For more than 30 years, the Berry Amendment, specialty metals clause has reflected the criticality of the specialty metals sector to the national defense. The continued worldwide technological leadership of the industry is a monument to the provision's effectiveness. The provision has withstood attacks based on claims that it increases costs, is impractical, cannot be enforced, places our defense contractors at a competitive disadvantage, and disrupts the supply chain at the subcontractor level. None of these claims has withstood scrutiny in prior legislative cycles.

The domestic specialty metals industry has been consistently responsive to the needs of the military, particularly in times of emergency, providing on a timely basis, the critical materials that are the foundation of virtually every major defense platform. The U.S. cannot afford to have these materials controlled by offshore suppliers. As it has in the past, Congress should reject proposals to weaken or narrow the scope of the specialty metals amendment. On the contrary, Congress should continue to reassert the importance of compliance in connection with this law.

# **EXHIBIT 1**

**SUMMARY OF SSINA DEFENSE-RELATED BUSINESS**

<b>Type</b>	<b>Application</b>	<b>Specialty Metals Classification</b>
<b>Missiles</b>	Guidance	Magnetic/Electronic
	Motors	Magnetic/Electronic
	Locking Pins	Stainless Steel
	Engine	High Temperature Alloy
	Control Fins	Magnetic/Electronic
	Fuel Cell	Stainless Steel
	Solenoid Switch	Stainless Steel
	Wave Tube Assembly	Magnetic/Electronic
	Air to Air Missile	High Strength Alloy
	Thrust Nozzle	Titanium Alloy
	Gas Bottle	Stainless Steel
	Cut Core Transformers	Magnetic/Electronic
	Structurals	Stainless Steel
	Steering Vanes	High Strength Tungsten
	Missile Casings	High Strength Alloy Steel
	Gas Generator Reducer	Niobium Alloy
<b>Aircraft</b>	Missile Components	Alloy Steel
	Aircraft Missile Bearings	Stainless Steel
	Magnetic Shield	Magnetic/Electronic
Guidance	Magnetic/Electronic	
Generators	Magnetic/Electronic	

Type	Application	Specialty Metals Classification
	Structurals	Stainless Steel
	Blades	High Temperature Alloy
	Rings	High Temperature Alloy
	Shafts	High Strength Alloy Steel
	Disks	High Temperature Alloy
	Engine Blade	Magnetic/Electronic
	Engine Mounts	High Strength Alloy Steel
	Wing Controls/Navigation	High Temperature Alloy
	Pylon Assembly	Stainless Steel
	Gear Assembly	High Strength Alloy Steel
	Jet Engine Case	High Temperature Alloy
	Engine Drive Shaft	High Temperature Alloy
	Landing Gear	High Strength Alloy Steel
	Lift Fan Gear	Alloy Steel
	Engine Components and Fasteners	High Temperature Alloy Steel
	Engine Manifold	Stainless Steel
	Engine Power Unit	Stainless Steel
	Generator Laminations	Magnetic/Electronic
	APU's, Generators	Magnetic/Electronic
	Bolts	Alloy Steel
	Blind Rivets	Stainless Steel
	Rivets	Corrosion Resistant Alloy
	Rivets - Aircraft Brake Shoes	Stainless Steel
	Airframe/Structural/Gears	Alloy Steel
	Landing Gear	Stainless Steel
	Engine and Transmission Bearings	High Temperature Bearing Steel
	Tail Hooks	High Strength Alloy Steel

Type	Application	Specialty Metals Classification
	Flap Actuators	High Strength Alloy Steel
	Rocket Engine Castings	Alloy Steel
	Gas Turbine Engines	Nickel/Cobalt High Strength Alloy
	High Pressure Hydraulics	Titanium Alloy Tubing
	Jet Engine Tail Feathers	Niobium Alloy
	Rocket Nozzle Thrust Skirt Extension	Niobium Alloy
	Vectoring Nozzle	Vanadium Alloy
	Hot Gas System	Tantalum Alloy
	Single Crystal Turbine Blades	High Temperature Alloy
	Hypersonic Scramjet Engine	Niobium Alloy
	Gun Barrels	Alloy Steel
	Catapult Rails	Stainless Steel
	Honeycomb Applications	Titanium Alloy
	Aircraft Fasteners	High Temperature Nickel Alloy
	Aircraft Structural	High Strength Alloy Steel
	Aircraft Components	Alloy Steel
<b>Helicopters</b>	Main Gear	Alloy Steel
	Engines	High Temperature Alloy
	Rotor Housing	Stainless Steel
	Rotor Gear	Alloy Steel
	Main Rotor	Alloy Steel
	Engine Compressor	High Temperature Alloy
	Blade Stabilizer	Stainless Steel
	Transmission Gears	Chromium-Nickel-Steel
	Rotor Shafts	Low Alloy Nickel Steel
	Rotor Flanges	Low Alloy Nickel Steel

<b>Type</b>	<b>Application</b>	<b>Specialty Metals Classification</b>
	Rotor Flanges	Stainless Steel
	Engine and Transmission Bearings	High Temperature Bearing Steel
<b>M-1 Tank</b>	Engine Cover	Stainless Steel
	Engine Blade	High Temperature Alloy
	Torsion Bars	High Strength Alloy Steel
<b>Bradley</b>	Gun Turret	High Strength Alloy Steel
	Torsion Bars	High Strength Alloy Steel
<b>Humvee</b>	Door struts	Stainless Steel
	Armor	Titanium Alloy
<b>Stryker</b>	Light Weight Road Wheels	Titanium Alloy
<b>Submarines</b>	Piping Systems	Stainless & Hi-Temp.
	Launcher Tube	Stainless Steel
	Propulsion Shaft Magnetic	Magnetic/Electronic
	Propulsion	Nickel/ Titanium Alloy
	Power Generation	Nickel/ Titanium Alloy
	Weapons support	Nickel/ Titanium Alloy
	Reactor Core	Magnetic/Electronic
	Fasteners	High Strength Superalloy
<b>Munitions</b>	Fuse Devices	Stainless Steel
	Fuses	High Strength Alloy Steel
	Bunker Buster Bombs	High Strength Alloy Steel

Type	Application	Specialty Metals Classification
Artillery	Cannon Barrels	High Strength Alloy Steel
Space Shuttle	Engine Ring Resistor	High Temperature Alloy
	Booster Rocket Skin	Magnetic/Electronic
		High Strength Alloy Steel
Marine/Navy	Rivets	Corrosion Resistant Alloy
	Nuclear Systems	Stainless Steel, Zirconium Alloy
	Nuclear Fasteners	Alloy Steel
	Turbines	Stainless Steel
	Shipboard Water Filtration	Titanium Alloy
	Torpedo Launch Systems	Titanium Alloy
	Shafts	Stainless Steel
Other	Bolts	Alloy Steel
	Nuclear Weapons Components	Magnetic/Electronic
	Reactor Core	Magnetic/Electronic
	Radar Aegis System	Magnetic/Electronic
	Night Goggles Glass to Metal Seal	Magnetic/Electronic
	Missile Castings	High Strength Alloy Steel
	Honeycomb Applications	Titanium Alloy

# **EXHIBIT 2**

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Products below are manufactured by one or more SSINA member companies, often on an exclusive basis. It is obvious from the comments provided that these materials are critical to the functioning of the military systems indicated. It is also apparent from these examples that considerable investment has been required, and continues to be required, to develop, manufacture and improve the properties of these specialty materials and reduce their manufacturing costs.

## **Aerospace**

The Apache attack helicopter is a benchmark of durability and survivability in the harshest environmental and battle conditions. A large part of that capability is due to survivability of the main and tail rotors. The primary structural members (spars) of these rotors are produced from a high tech specialty metal made by an SSINA member company.

The Joint Strike Fighter F-35 aircraft is planned to replace the aging fleet of A-10, F-16, F-18, and AV-8Bs beginning in 2008. Pratt & Whitney is producing the F135 engine that will power the F-35. The F-135 engine will run at elevated temperatures and only the highest technology nickel-based alloys can be used. P&W chose to work with an SSINA member company because of their superior technology for melting and fabrication of nickel-based alloys enabling design of the F-135 turbine engine and the Joint Strike Fighter.

The Joint Strike Fighter F-35 is expected to be in production for more than 30 years. Each plane will utilize approximately 2,000 pounds of an SSINA member company's material, including a special proprietary stainless alloy. This alloy was developed to meet the demanding requirements of critical components used in the manufacture of military aircraft and to insure that components can work in the most difficult environments – all the time. Gears and bearings made from this alloy will fly on the naval version. The essentially maintenance-free stainless parts can withstand high temperatures and salty sea water and will also be able to rotate in the engine nozzle 90° - a neat trick that allows a plane to land vertically, coming down like an elevator. The functionality of the Joint Strike Fighter would not be possible without this proprietary alloy.

The US Navy F/A-18E/F fighter jet utilizes another patented alloy in several vital components that was developed and made by an SSINA member company. If landing gear fails, it is most often because of stress- corrosion cracking or insufficient toughness. The landing gear needed a tougher alloy with improved resistance to stress corrosion cracking for landings on decks. To prevent such failures, a super strong alloy was developed. Because of these characteristics, it was designed into the nose and main landing gear. Other naval aircraft applications include the shanks for arrester hooks, fasteners, and various structural components. In 1992, this alloy was named one of the top material advances of the decade by the National Association for Science, Technology

and Society. An enhanced version can also be found in numerous naval aircraft applications.

The F119 and F135 turbine engines power the F-22 Raptor and F-35 Joint Strike Fighter aircraft, the air superiority aircraft for the future. An SSINA member company developed and qualified larger diameter titanium forging billet practices improving the supply of these critical products.

Materials used for airframes on military aircraft require toughness and strength, while managing life cycle costs and addressing environmental concerns. To meet this design challenge, an SSINA member company developed a new stainless steel. This stainless steel has an unparalleled combination of high strength, fracture toughness and resistance to stress corrosion cracking. This alloy has longer service life resulting in reduced maintenance and aircraft operating costs. By using this stainless alloy, the need to surface-treat has been eliminated.

Inside the hottest part of jet engines used in numerous military aircrafts, a metal turbine blade must be able to operate 1500° Celsius (2700° Fahrenheit). A normal metal would melt at 1500° Celsius. Besides the design adjustments made by the engine manufacturers, an SSINA member company developed several nickel-based alloys for certain engine and airplane parts. One of these superalloys has a tightly controlled grain size and chemical composition resulting in optimum forged component processing and alloy performance. This alloy is used for critical rotating metal turbine components in military aircraft, which require longer-life parts in the highest quality expectations.

Critical to performance of gas turbine jet engines used in military aircraft is the tight control of air flow in the high-pressure compressor section where temperatures can exceed 650° Celsius (1200° Fahrenheit). Air leaking past compressor blades in either the forward or backward direction can adversely affect fuel consumption and aerodynamics stability. An SSINA member company developed a controlled-expansion alloy in order to minimize clearance throughout the range of temperatures encountered in all flight conditions resulting in optimized engine thrust, efficiency fuel economy, flying range in part life- all critical to military applications.

An SSINA member company sells a proprietary precipitation hardening alloy to honeycomb manufacturers for various applications in fighter jets. Most of this is for structural areas that require high strength to weight ratios.

Other specialty metals products from an SSINA member company are used in the following defense applications: fasteners, clamps, seal rings, and springs. Those products are also used in commercial jets.

An SSINA member company supplies a high-strength, low-alloy steel used for the leading edge on military helicopter blades. This product is a protective shield,

specifically important during landing and takeoffs in sandy conditions. This product is vital in Middle East operations.

An SSINA member company supplies High Strength Low Alloy steel in the form of remelted bloom bar with special tolerances. The remelted steel is used for the Lockheed Martin C-130 Flap Tracks, which is a three-year program.

Hypersonic (> Mach 3) space and missile applications will require skin materials that can handle temperatures in excess of 1200°F. Existing skin materials used on military aircraft and missiles cannot withstand the extreme temperatures experienced by hypersonic vehicles. An SSINA member company is working with the Air Force Research Laboratory to produce temperature resistant sheet from a new proprietary alloy.

The US Air Force is evaluating lower-cost, temperature resistant materials for existing turbine engines. A new proprietary alloy was developed and patented by an SSINA member company for use in applications subject to 1300°F temperatures. This alloy was recently selected as the best alternative to replace a higher cost alloy for low-pressure turbine case applications in legacy and future military engines.

F-100 and F-135 (JSF) jet engine "tail-feathers" are made from a unique specialty metal alloy sheet material supplied by an SSINA member company. These metal strips shape and form the afterburner plume for these military engines. This is one of approximately 200 refractory metal alloys developed for high temperature applications. These alloys require significant, novel, high tech manufacturing capability.

### **Missiles and Rockets**

The second stage of Delta II rocket nozzle thrust skirt extension for the P&W RL-10 engine is made from a proprietary alloy sheet supplied by an SSINA member company. This project requires the ability to successfully cold roll thin sheets of this alloy which is relatively soft at room temperature, and very easy to damage during rolling.

### **Land Based Vehicles**

Light weight road wheels for the Stryker vehicle are made from a titanium alloy by an SSINA member company. Wheels are cast using a unique process and then machined, painted, and rubber coated.

An SSINA member company produces high strength low alloy steel in the form of remelted billet. The billet is used for the Bradley Fighting Vehicle Hydraulic Motor Race, which is an expedited multi-year program.

## **Naval Applications**

SSINA member companies are key suppliers of materials that meet the Navy's advanced technical requirements. Specialty materials such as nickel alloys, specialty steel, and titanium alloys are continually evolving to meet enhanced material specifications used in propulsion, power generation, support structures, hardware, desalination, and weapons support. Technical support and alloy development spanning more than a quarter-century have focused on meeting ever-increasing life expectancy for propulsion units and support systems, helping to increase service life from 20-years to an estimated 40-years.

## **Armor and Munitions**

An SSINA member company currently supplies "dual hard" specialty steel for the critical door struts of the US Army Humvee.

## **Fuel Cells**

This developing technology is intended to supply electric power for numerous military applications from the individual soldier's electronic and communication system needs to ground attack equipment and aerospace applications. An SSINA member company is deeply engaged with many of the US producers of fuel cell systems. These manufacturers are relying on our industry to develop and supply engineered materials to meet these demanding requirements.

## **Other**

SSINA member companies are principal suppliers of ingot and billet to the forging and extrusion industry, which manufacture critical products for use in many different DOD applications, some of which are described above. These starting materials enable forging and extrusion facilities to meet demanding specification requirements such as "Sub Safe Level 1" and "Noform Specification Materials." Applications include: helicopter shafts, missile fins, ballast blow valves, high pressure valve blocks, torpedo tubes, nuclear cooling systems, aircraft carrier launch bar and space shuttle connecting rings. The forgings can weigh as little as three pounds or as much as 50,000 pounds.