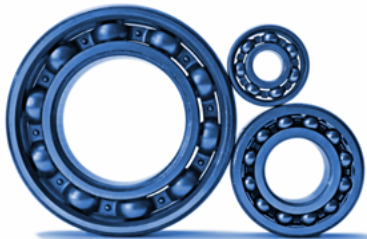


DISCOVER CRYOGENIC PROCESSING



**EXTENDING LIFE FOR METAL COMPONENTS
WHILE REDUCING MAINTENANCE EXPENSES**



REDUCE TOOL EXPENSES BY MORE THAN HALF *for* HIGH CARBON TOOLS

300 BELOW'S DEEP CRYOGENIC TREATMENT GIVES YOU THE COMPETITIVE EDGE OVER YOUR TOUGHEST COMPETITION.



300 Below / Cryo-Tech is the pioneer of cryogenic processing, since 1966. As the world's largest and oldest cryogenics firm, we know better than anyone how to expertly increase strength, stability and wear life on tools, dies and other wear components.

We freeze your materials to -184°C / -300°F with liquid nitrogen using a computer-controlled temperature profile to modify microstructures and improve properties of objects in treatment.



~300% LONGER LIFE FOR 20% COST.

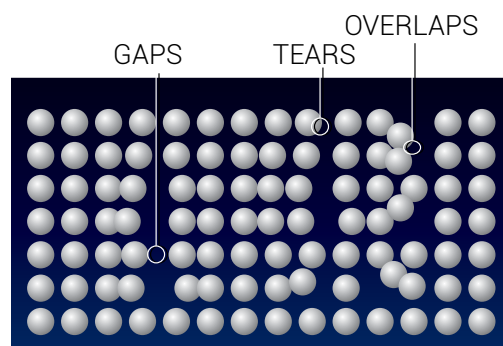
UNDERSTANDING THE CRYO-TECH PROCESS

Our process is an extension of the heating / quenching / tempering cycle for metals, based on contraction and expansion of a metal object's molecular structure. When an object is cast or formed for the first time, its microstructure is randomly set while cooling. Resetting the jumbled molecular structure to become more uniform and evenly dispersed leads to a wide range of benefits for the part.

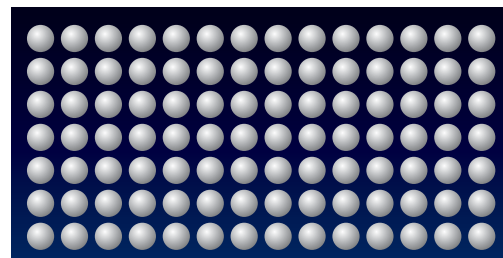
Most heat treatment operations fail to subject parts to a quench below ambient temperatures. (Most high-use facilities submerge parts in water or oil even at elevated temperatures due to repeated quenching.) Our process works to EXTEND the benefits of a proper quench. We may even repair improperly quenched materials.

300 Below's cryogenic treatment process is widely imitated but seldom duplicated. Our equipment is in 30+ countries, and our decades-old treatment profiles are called-for engineering specifications at NASA, DoD and quality-minded organizations. You have witnessed thermal shock while watching an ice cube crack upon submersion in a cup of hot coffee, which is exactly the opposite of what our process achieves. Yet some vendors submerge parts in open vats of liquid nitrogen, or claim benefits at -110°F with dry ice. We NEVER take shortcuts with your parts.

Cryo-Tech is a dry process: components are never compromised through thermal shock, nor do they fail to reach deep cryogenic temperatures. Liquid nitrogen (LN2) vapors are released above the boiling point of LN2 at -195.79°C (-320°F). Our only variables are time and temperature, adjusted by the thickness of your parts.



Molecular structure formation with flaws from out of phase solidification



Denser, realigned molecular structure resulting from cryogenic processing

LONGER TIMES AT LOWER TEMPS ESTABLISH CRYSTAL ALIGNMENT, ENHANCE BONDING ENERGY, AND OBTAIN STRUCTURAL BALANCE THROUGHOUT EVERY MATERIAL.

THE LOGIC FOR UTILIZING SUBZERO STEEL TREATMENTS

STEEL is heat treated to impart the most desirable combinations of hardness, toughness, wear resistance and ductility. These characteristics are imparted by varying the alloy ingredients of the steel as well as time and temperatures in treatment. Changing the microstructure of finished steel only occurs through subsequent thermal treatment or through a dry cryogenic treatment process.

WHY USE -300°F?

Using true cryogenic treatment (going below -280°F / -173°C) has been shown to improve the microstructure of steels regardless of how long it has been since these steels were heat-treated or placed into use.

Steel exhibits enhanced wear resistance, plus uniform stress, dimensional stability, durability, and other surface imperfections improve, after cryo treatment. Hoop, tensile and compressive stress is “relieved” by imparting uniform stress into an object. However, cryogenic processing is NOT a surface coating. Our irreversible process affects the entire molecular structure for the lifetime of the component.

In steel, retained austenite is large and unstable, so obtaining a more hard and stable martensitic structure is preferred. Previous research indicates success with dry ice and other cooling methods to around -100°F (-73°C) as a way to improve stability and wear resistance, with some retained austenite converted to martensite, but this arduous process only improves stability to a degree. These results are minimal unless performed as an integral part of the heat treatment cycle, no later than 6 minutes after steel is quenched to room temperature. Furthermore, weaker “subzero” treatments will not remove all retained austenite from steel, nor are there other positive effects.

CRYOGENIC TREATMENT: HERE TO HELP

Dry cryogenic treatment also supports martensitic transformation, but there are substantial enhancements beyond weaker subzero treatments, because cryogenic treatment provides up to six additional material benefits. Stress relief and stabilization is the foundation for improvement which leads to other benefits:



ENHANCED MACHINABILITY

Parts are often far easier to machine after treatment.



ABRASIVE WEAR RESISTANCE

Not all components respond, but many candidates yield substantial lifetime gains.



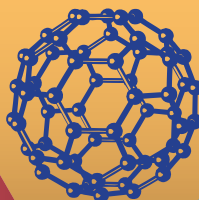
CYCLE FATIGUE ENHANCEMENT

Springs / cyclical parts add more cycles before failure



HEAT TRANSMISSIVITY

In recent university studies, heat transmissivity increased significantly following treatment.

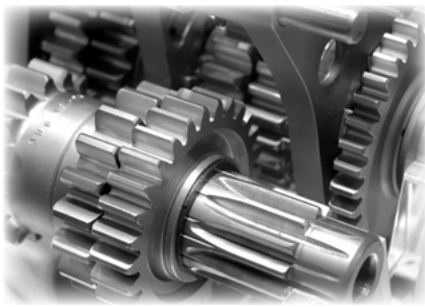


STRESS RELIEF & STABILIZATION



CORROSION INHIBITION

Closing microstructure gaps ensures substantial gains from cryogenics once salt spray tested



In a series of tests conducted at Louisiana Tech University, Dr. Randall F. Barron discovered that using a cryogenic process imparts steel materials with significant long term benefits. Primary benefits include:



superior transformation of virtually all retained austenite to martensite



significant increases in wear resistance of the treated steels, compared to normally heat-treated control samples of steel



improvements in the wear resistance even among steel previously treated using dry ice or other -100°F methods



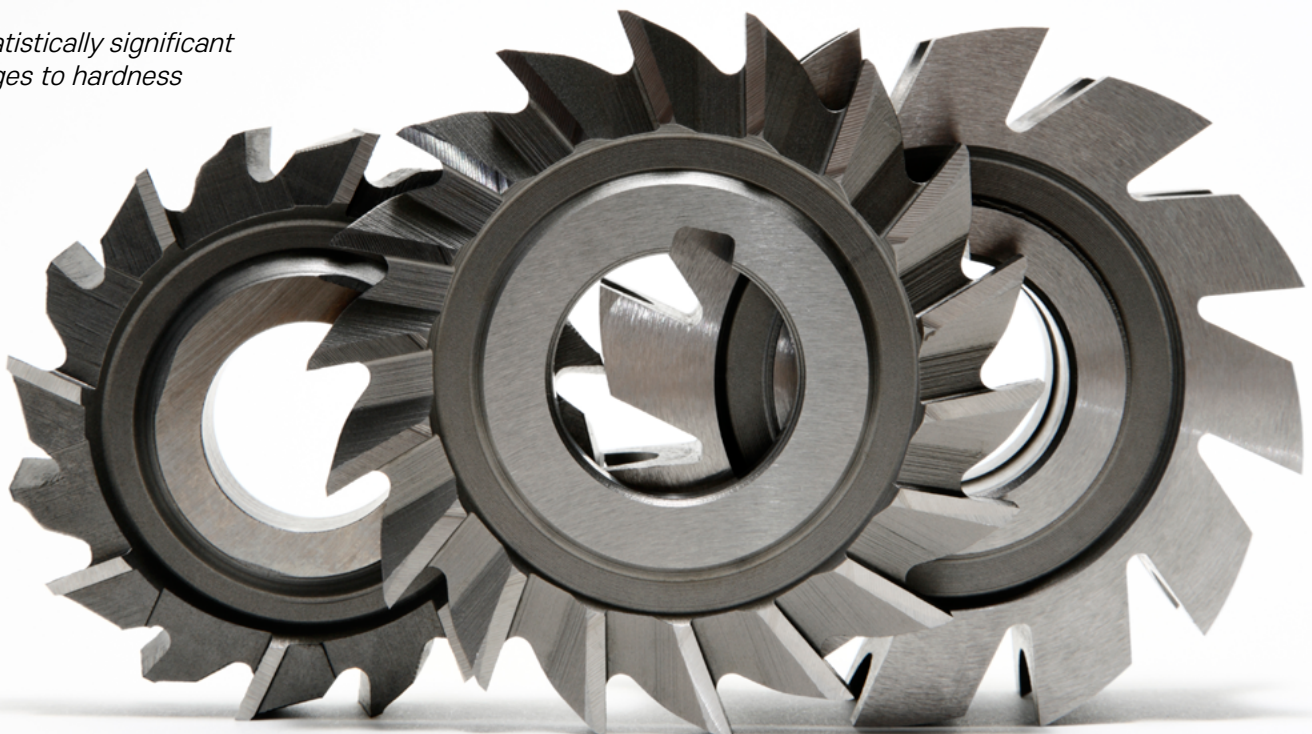
formation of fine carbon carbide particles within the microstructures of steel (micro eta carbides)



no statistically significant changes to hardness

When parts reach lower temperatures, 300 Below's deep cryogenic process shows substantial benefits for a wide variety of tooling and other materials:

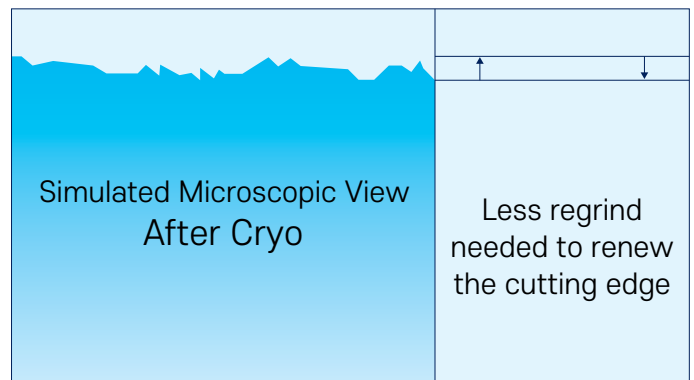
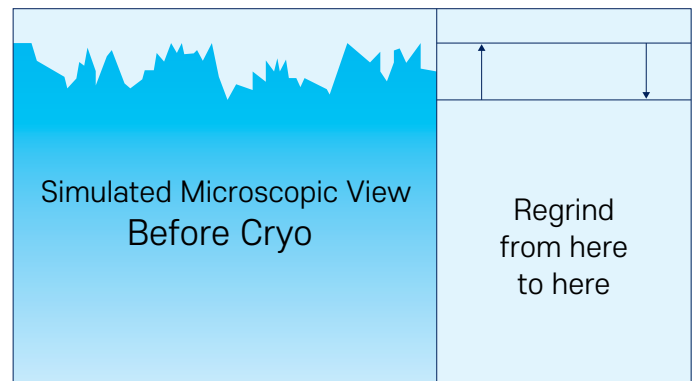
APPLICATION	COMPANY	TOOL MATERIAL	RESULTS	COST REDUCTION
Broach	Metal Milling Company	Carbide	300%	-67%
Broach	Auto Manufacturer	Hi-Nickel	250%	-60%
Chipper	Box Manufacturer	Carbide	500%	-80%
Deburring	University Study	Inconel	400%	-75%
Dental drill	Dentist	400 Stainless	500%	-80%
Die	Casting Company	Hi-Ni Alloy	300%	-67%
Drills	Aircraft Manufacturer	M42, M7, C2	300%	-67%
Electrodes	7 Studies	Welding	600%	-67%
End Mill	Aerospace Contractor	M42	450%	-78%
Face Mill	Aerospace Contractor	C2 Carbide	400%	-75%
Gear Cutter	Major Manufacturer	Ti-N Coated	350%	-71%
Hob	Turbine Manufacturer	M2, M7	250%	-67%
Key Cutter	Aerospace Contractor	M2, M7	250%	-60%
Logging	Logging Company	Saw Chain	400%	-75%
Milling	Aircraft Manufacturer	M7	250%	-60%
Milling	Machine Shop	347 Stainless	375%	-73%
Punching	Major Manufacturer	M7	600%	-83%
Shredder	Paper Manufacturer	M7	400%	-75%
Slicer	Plastics Manufacturer	M7	600%	-83%
Stamping Die	Steel Furniture	D2	1000%	-90%
Tap	Tool Maker	C2 Carbide	600%	-83%
Woodcutting	Pro Woodworker	High Speed Stainless	500%	-80%
Corrosion	University Study	S2, M2, 4142, 316	Increased Resistance	
Machinability	Machine Shop	Aluminum Thin Wall Castings	50% Time Savings	



COMPARISON OF COLD VS. CRYO TREATMENTS

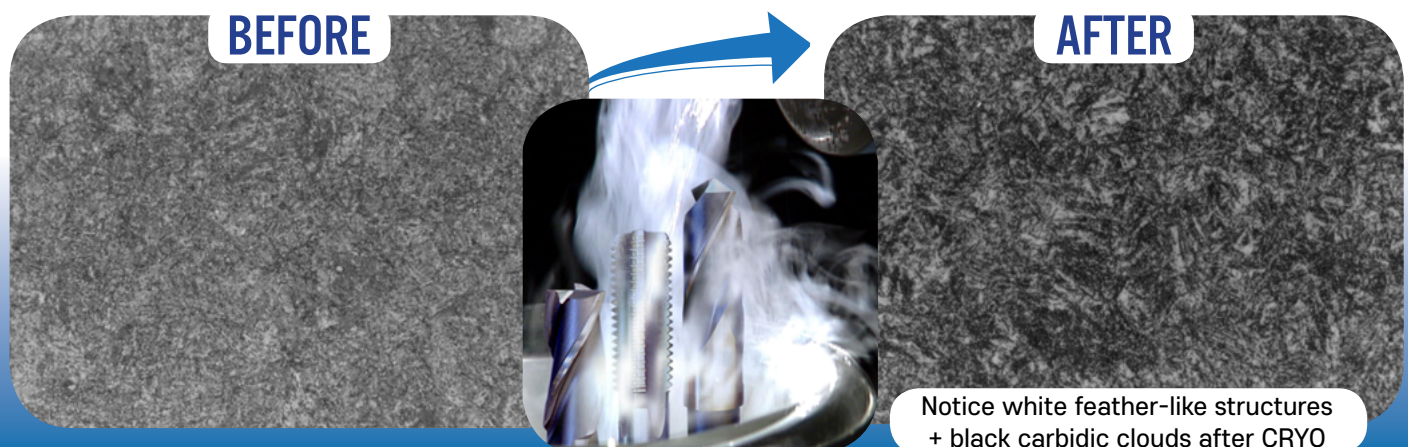
STUDY MEASURED PERCENTAGE OF WEAR IMPROVEMENTS AMONG STEEL COMPOSITIONS

AISI#	DESCRIPTION	-110°F	-310°F
D-2	High carbon / chromium die	216%	717%
A-2	Chromium cold work die	104%	460%
S-7	Silicon tool steel	141%	403%
52100	Bearing steel	95%	320%
O-1	Oil hardening cold work die	121%	318%
A-10	Graphite tool steel	130%	164%
M-1	Molybdenum high speed	45%	125%
H-13	Chromium / moly hot die	64%	109%
M-2	Tungsten / moly high speed	17%	103%
T-1	Tungsten high speed	41%	76%
CPM-10V	Alloy steel	0%	31%
P-20	Mold steel	23%	30%
440	Martensitic stainless	28%	21%
430	Ferritic stainless	16%	19%
303	Austenitic stainless	5%	10%
8620	Nickel-chromium-moly steel	12%	4%
C1020	Carbon steel	0%	0%
AQS	Graphitic cast iron	0%	0%
A-6	Manganese air cold work die	0%	0%
T-2	Tungsten high speed	0%	0%



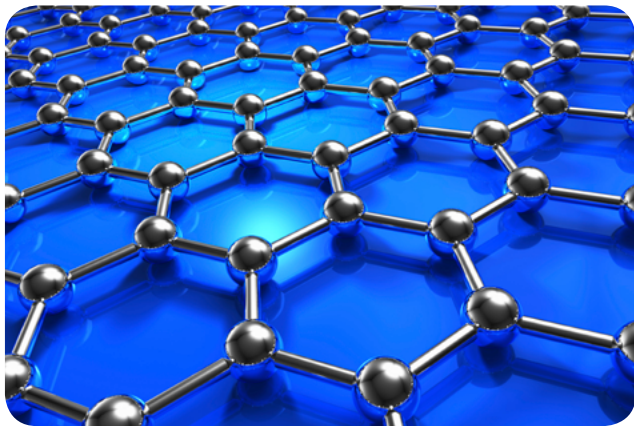
Cryogenic processing indicates gains for tooling and other wearable components by increasing BOTH operational lifespan and functional lifespan. When measuring increases in life, if a part lasts 200% longer after cryogenic treatment, it may indicate a 400% increase in overall life when factoring in regrinds because you remove half as much surface. For wear resistance benefits, a proper heat treatment is required PRIOR to cryogenic processing.

THESE TWO 1000X MAGNIFICATION PHOTO-MICROGRAPHS SHOW THE MICROSTRUCTURE OF A SAMPLE OF HARDENED A-2 STEEL BEFORE AND AFTER CRYO-TECH PROCESSING





300 Below's Decatur, IL
cryo treatment facility



ADVANTAGES WITH THE CRYO-TECH PROCESS

- 🐧 Retained Austenite to Martensite Transformation
- 🐧 Molecular Realignment & Dimensional Stabilization
- 🐧 One-Time Life-Long Irreversible Treatment
- 🐧 FAST **72 Hour Turnaround** Processing Time
- 🐧 Largest Equipment in the Cryogenic Industry
- 🐧 Extra Safeguards for Sensitive Components
- 🐧 An Environmentally Friendly **GREEN** Process
- 🐧 100% No-Hassle Money Back Guarantee
- 🐧 Lowest rate guaranteed by at least 110%

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