



U.S. ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND

ASETSDefense Chlorinated Paraffin in DoD Metalworking Fluids
ESTCP Alternate Machining Technologies Waterjet

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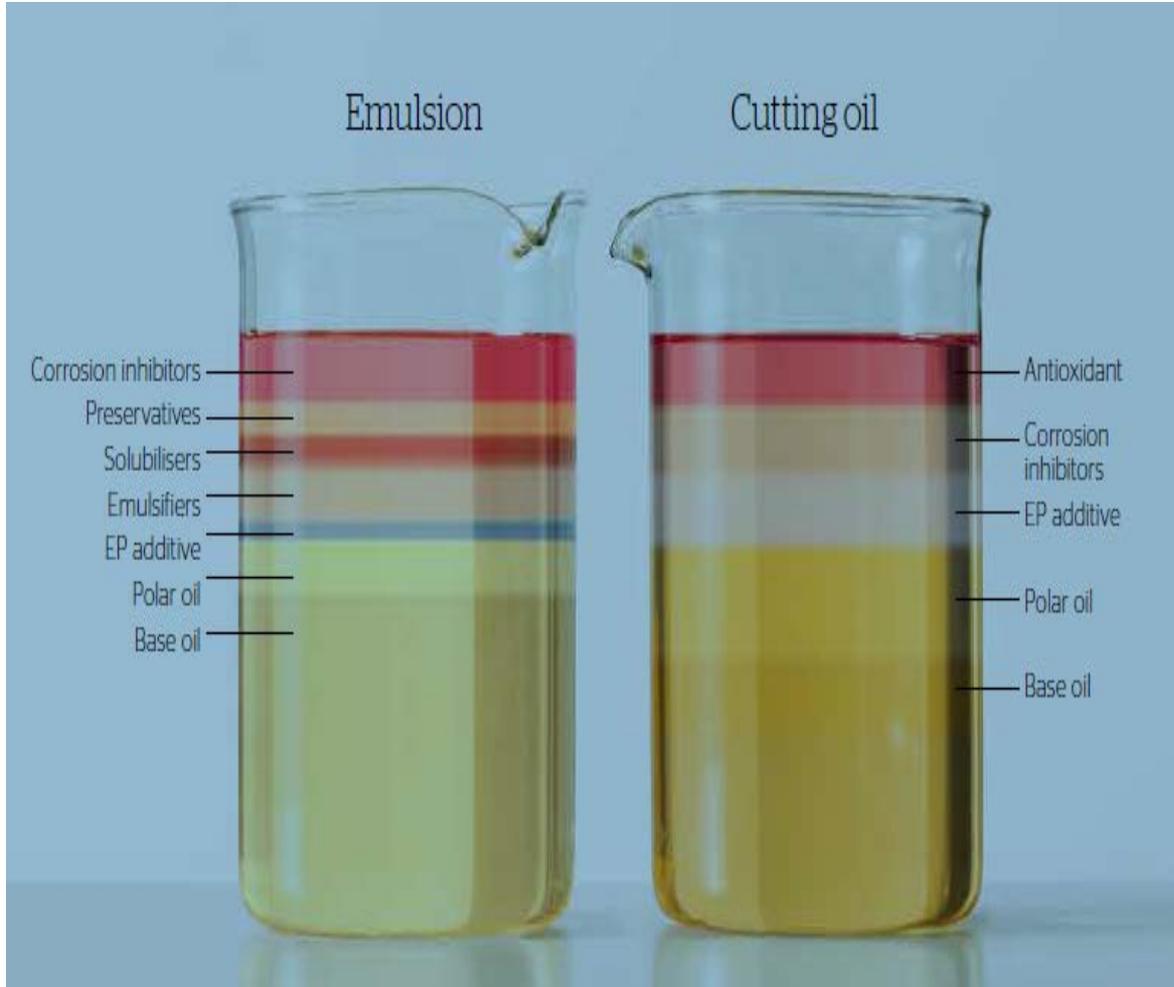
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CUTTING OILS WHAT ARE THEY?

Cutting Oils

- This type of product is not mixed with water, but is applied directly
- Mineral oils, synthetic oils, white oils and esters are used as base oils
- 'Fatty oils' are also often added (such as vegetable oils, animal oils or esters) to protect against wear
- EP additives are also sometimes used (e.g. sulphur, phosphorus or chlorine)
- Better lubricating properties than the water-miscible fluids
- Less cooling effect while machining



Water-Miscible Cutting Fluids

Emulsions

- Emulsion is made by adding a concentrate to water to form a milky product
- The appearance of an emulsion varies with the type product and gives a cream-like color when mixed
- Best at cooling on high speed processes



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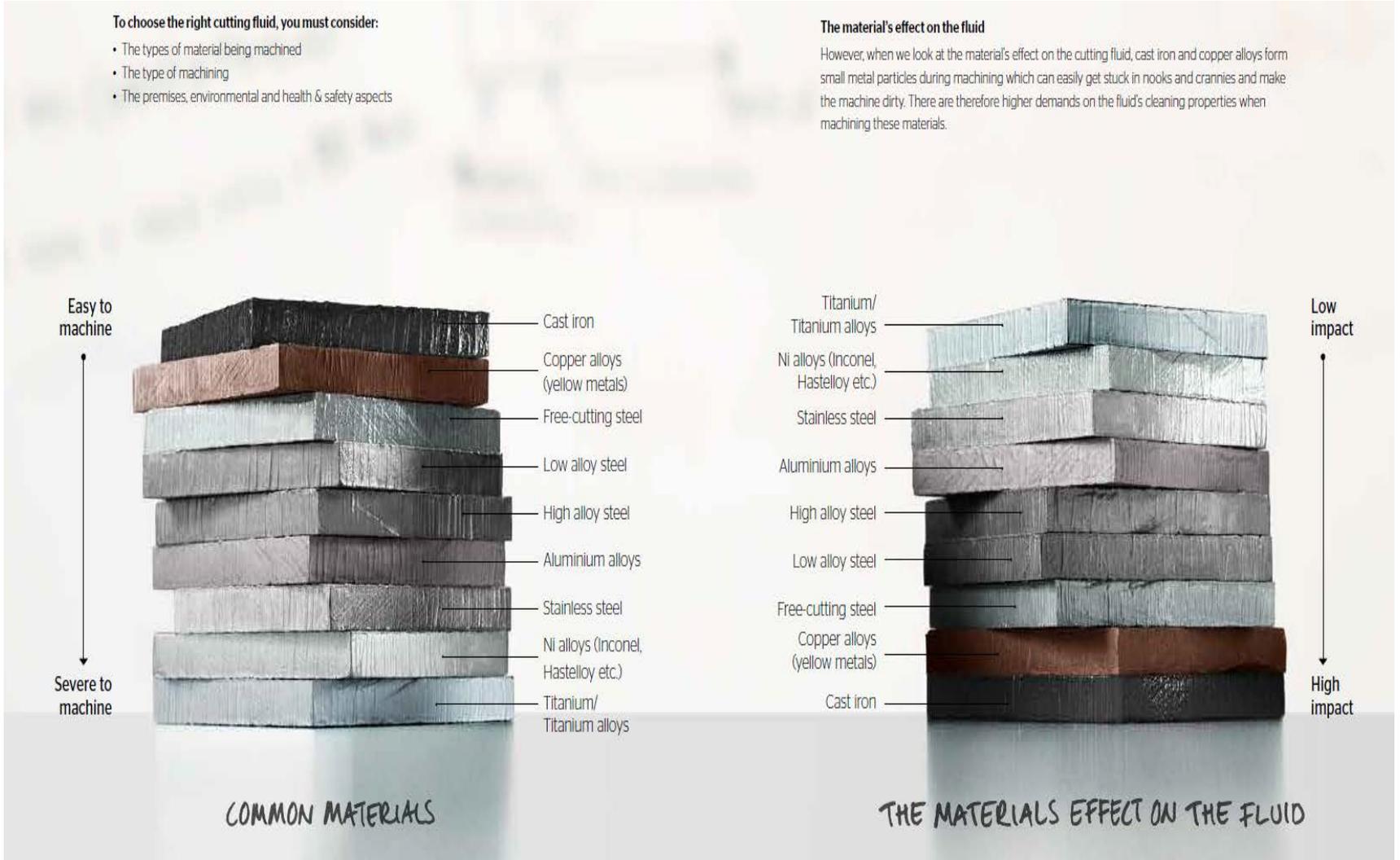
Cutting Oils & Emulsions The Need ?

To choose the right cutting fluid, you must consider:

- The types of material being machined
- The type of machining
- The premises, environmental and health & safety aspects

The material's effect on the fluid

However, when we look at the material's effect on the cutting fluid, cast iron and copper alloys form small metal particles during machining which can easily get stuck in nooks and crannies and make the machine dirty. There are therefore higher demands on the fluid's cleaning properties when machining these materials.





What are Chlorinated Paraffin's?

- Used across the industry as a component of certain metalworking fluids and deformation products
- Also used in, Plastics, Rubber, Paints, Fluids, and Adhesives
 - A complex mixture of polychlorinated normal alkanes with chlorination between 30-70%.
 - Short Chain: carbon length 10-13
 - Medium Chain: carbon length 14-17
 - Long Chain: carbon length greater than 17
 - Functions as an extreme pressure lubricant in metal working fluids



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CHLORINATED PARAFFIN'S

Why Are They Used?

- Inexpensive, but very effective EP compound
- Reacts in the heat generating zone to form a sacrificial lubricating film on the workpiece and tool
- Activates at relatively low temperatures
- Provides very low coefficient of friction
- Is the strongest bond with metal of all EP agents
- Provides superior adherence to metal surfaces
- Is compatible with all types of metal
- Have very high viscosity index
- Has more affinity to heat than other EP agents

Allows a MW fluid to perform well in the most difficult operations at a low material cost.



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Extreme Pressure (EP) Additives

Extreme Pressure Additives Have The Ability To Form Chemical Compounds In The Contact Surface At High Temperatures

The Process:

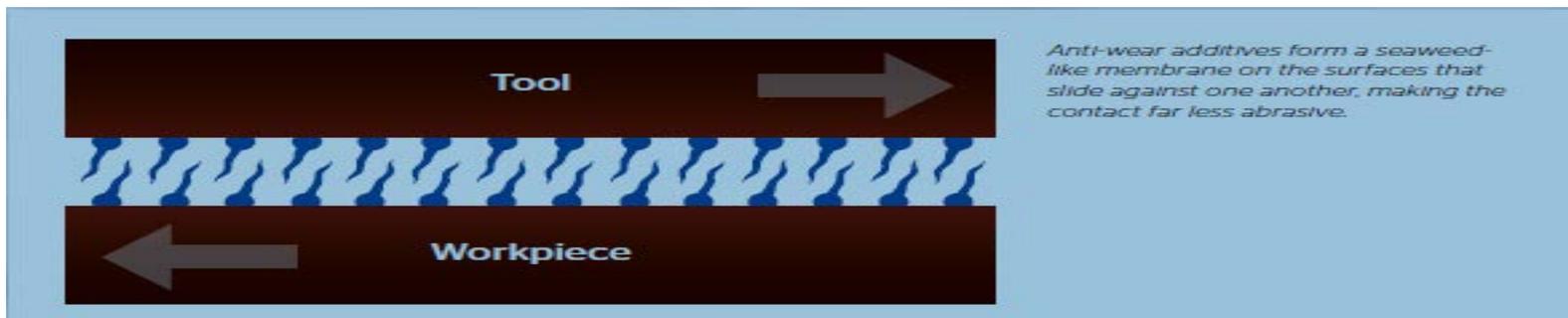
- The Kinetic Energy Is Converted Into A Dramatic Rise In Temperature at the Contact Points

The Result:

- A Shortened Tool Life And Higher Rate Of Rejected Machined Parts

The Additive's Function:

- As The Temperature Rises In The Contact Work Piece, The Additive Is Activated And Provides a Protective Chemical Film That Prevents Welding



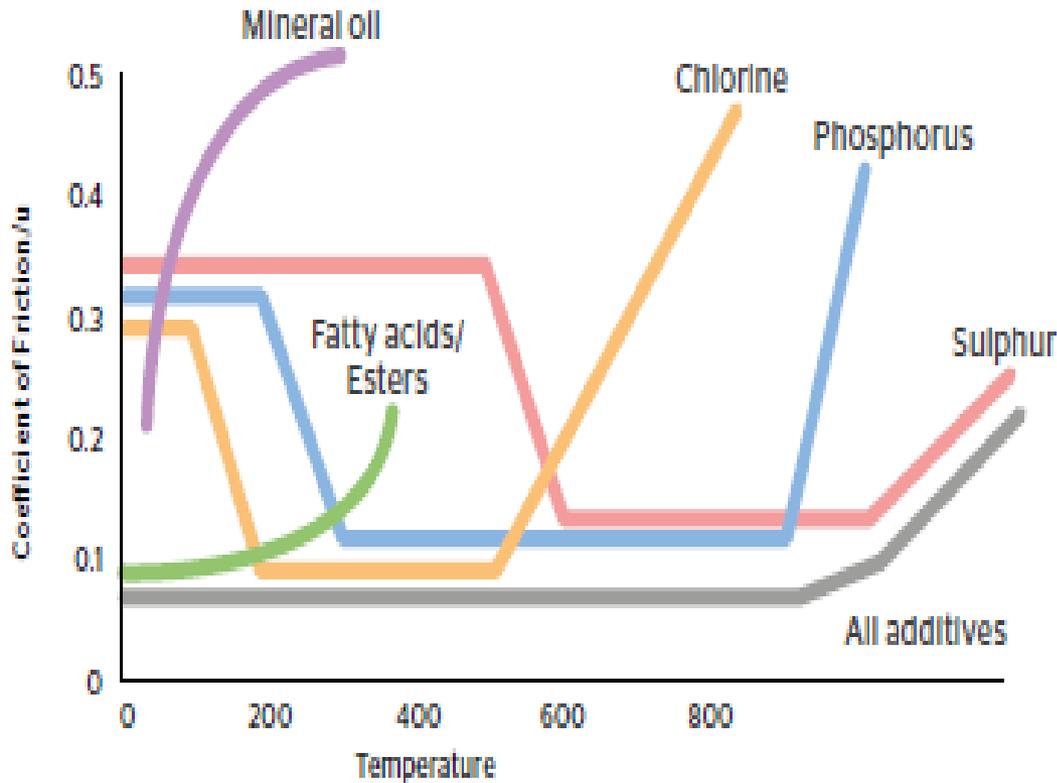


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CHLORINATED PARAFFIN'S

Why Are They Used?

Synergies between different additives



Different kinds of additive may be required depending on the operation and type of material being machined. Generally speaking, for tough machining at high temperatures you need more additives in your oil to ensure cost-effective production. Without the right additives in the oil, you may need to reduce the production rate to maintain the level of quality



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FACTS ABOUT SCCP

- Cost more - waste treatment
- Severely limit the recycling options for the used product
- Cost more to dispose of by incineration
- Must be listed as a hazardous material when shipped by air or ship
- Must be listed as a hazardous material if packaged in bulk
- Are classified as Severe Marine Pollutant



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FUCHS LUBRICANT AND COOLANT AT WVA THAT CONTAIN CP'S

By Formula, Based Upon Chlorinated Paraffin Content:

Ecocut 5468 - 0.4 %

Ecocool 7001 - 1.8 %

Ecocut 336-X - 10.6 %





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EXPECTED REGULATORY CHANGES US EPA

US EPA'S Current Stance on Short Chain CP's

- EPA announced on December 30, 2009, the agency's intention to address the manufacture, import and use of short chain chlorinated paraffin's because they are considered to be:
 - Bio-accumulative in humans & wildlife.
 - Persistent in the environment.
 - Highly toxic to aquatic organisms at low concentrations.
 - Listed as possibly carcinogenic to humans.
- EPA intends to ban or highly restrict manufacture, import, processing and distribution in commerce under the authority of TSCA Section 6.



REGULATORY CHANGES – GLOBAL

Canadian Environment Protection Agency (CEPA)

- CEPA has declared all CPs CEPA “toxic”.
- CEPA has severely restricted all short chain CPs.
- All CPs placed on “virtual elimination” (VE) list due to PBT concerns
- CEPA will require “risk mitigation strategies” for all users of medium and long chain CPs.

- Short chain CPs placed on the SVHC (Substances of Very High Concern) and have since been banned (except for few select uses)
- Medium and long chain CPs will have hazard classification and PBT data scrutinized



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REACH

- REACH is the European Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals
- The aims of REACH are to ensure a high level of protection for human health and the environment from the risks associated with chemical substances
- Both FUCHS AND CASTROL fully supports these objectives and are actively engaged in implementing the regulations





Features of Waterjet Machining

- Process is projected to be quicker, cheaper, more flexible than broaching and uses no cutting oils
- Inconel, tantalum, steel, metal, ceramic, composite - any material can be grooved
- Process consists of just garnet and water
- 100% environmentally friendly, materials totally recyclable



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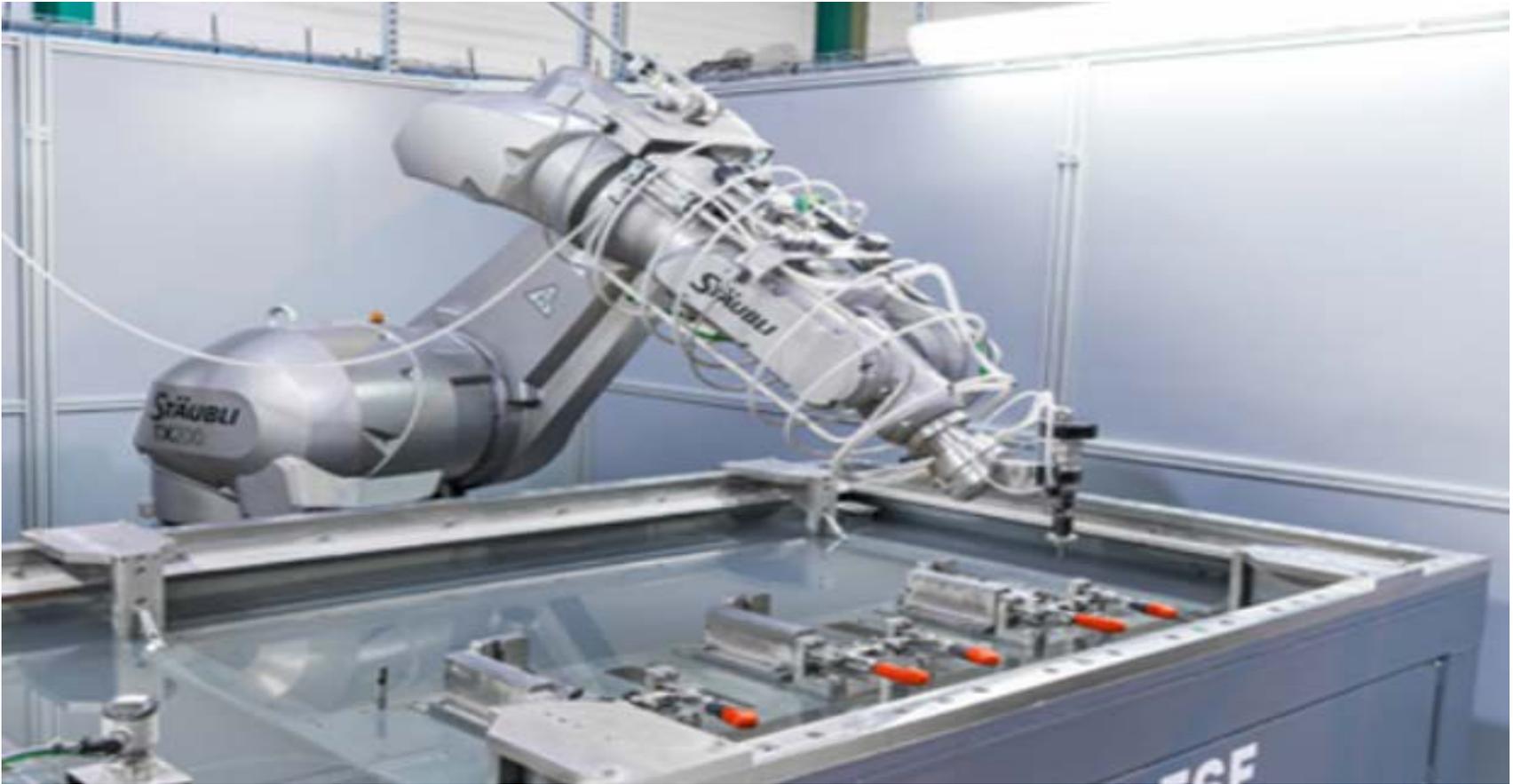
3D Waterjet Objectives

- Develop And Demonstrate The Use Of 3D Waterjet Technology For Rapid Net-Shape Manufacturing - DoD Modernization
- Cost Effective Environmentally Friendly Machining Processes For Weapon Systems
- Waterjet Technology Reduces
 - The Need For High Priced Tooling
 - Chlorinated Lubricants Within DoD



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3D ROBOTIC WATERJET



Robotic waterjet cutter from Shape Technologies Group uses supersonic water and garnet (an abrasive) to slice through and shape a variety of metals, including superalloys, used in the aerospace industry. (Courtesy of Shape Technologies Group)



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3D Waterjet Examples





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Questions?

Special Thanks to Castrol Industrial Lubricants

Special Thanks to FUCHS Industrial Lubricants





BACK UP SLIDES



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CONCERNS WITH MEDIUM & LONG CHAIN CPS

- Expected to be bio-accumulative (using QSAR)
- Expected to be persistent in the environment (using QSAR)
- Medium chain CPs are toxic to sensitive aquatic organisms
- May be a health concern in humans.
 - There are conflicting or inconclusive studies on these issues.
 - There are NO studies that look at CPs specifically in regards to human exposure in metalworking fluids.



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CONCERNS WITH CPS

- Bio accumulative in humans & wildlife.
- Persistent in the environment.
- Highly toxic to aquatic organisms at low concentrations.
- Listed as possibly carcinogenic to humans.

Castrol Industrial has eliminated short chain CPs from our product range