GUIDE TO METALWORKING FLUIDS
**Multifunctional Benefits**

ANGUS offers a variety of primary amino alcohols and corrosion inhibitors marketed under the CORRGUARD™ brand name. With a portfolio of globally registered products, we help find solutions to your metalworking fluid challenges.

Additionally, when certain geographic regions pose complex formulating requirements, you can count on ANGUS for assistance. ANGUS helps customers find synergistic combinations that can improve performance or extend the life of a product while overcoming formulating obstacles such as local raw material compatibility.

**Innovation**

ANGUS Original. After more than 70 years as the world’s leading supplier of nitroalkane chemistry, we still strive to be the industry leader in innovation. The most recent product addition to our portfolio, CORRGUARD EXT Amino Alcohol, is a shining example. CORRGUARD EXT helps maximize the life of your metalworking fluid formulation by minimizing corrosion, improving biocide performance and increasing fluid longevity.

**Environmentally Conscious**

ANGUS recognizes the need to help make the planet a better place for all of us—which is why we offer environmentally conscious products such as CORRGUARD SI Corrosion Inhibitor, an exceptional staining inhibitor for aluminum alloys, galvanized steel and Galvaneal. Besides keeping your most important parts looking good while providing emulsification and lubricity, this product is silicate- and phosphorus-free, and is easily waste treated using common techniques such as acid-alum split and ultrafiltration.
**Helping Solve Your Metalworking Fluid Problems**

**Q** My customers say that our emulsion-based fluids don’t last long enough. What can I do to improve fluid life?

A One of the leading causes of short fluid life is microbial degradation. This can lead to loss of emulsion stability, corrosion problems and bad odors. Fluids that have been properly formulated with CORRGUARD™-95 Amino Alcohol and/or CORRGUARD EXT Amino Alcohol and which contain appropriate biocides can last longer than fluids based on other amines.

**Q** I formulate many of my fluids with triazine biocide because it is very cost-effective. However, some customers complain about fungal growth. I am trying to avoid use of fungicides because they are expensive. Is there anything else I can do?

A Triazine is normally not effective against fungi. However, formulations containing appropriate dosages of triazine, along with CORRGUARD-95 and/or CORRGUARD EXT, often exhibit increased resistance to fungal growth.

**Q** I rely heavily on ethanolamines, particularly triethanolamine (TEA) and monoethanolamine (MEA), as relatively inexpensive sources of alkalinity for my fluids. However, in the field some fluids demonstrate microbial degradation and pH drop. When this happens, my customers often complain about release of ammonia odors, especially when they add pH adjusting additives. How can I correct this?

A Biodegradation of ethanolamines has been shown to lead to ammonia formation. The dissolved ammonium hydroxide can suddenly be released as gaseous ammonia when fluid pH is adjusted upward. This results in what is commonly known as “ammonia flush.” In tests conducted under controlled laboratory conditions, CORRGUARD-95 generates only a fraction of the ammonia formed by ethanolamines and is an excellent choice as a formulating and tank-side pH adjustment tool.

**Q** My fluids foam like crazy. As machining speeds increase, this is becoming more and more of a headache for my customers. I use some defoamers but they are often difficult to formulate with. What can I do?

A One of the keys to minimizing foaming is to select raw materials that are inherently low foaming. One foaming culprit can be amines. For example, amine/fatty acid soaps tend to foam in emulsion-based fluids. The amine choice can, however, influence foaming potential. In a controlled ANGUS laboratory study using high-shear mixing, soluble oils formulated with CORRGUARD-95 foamed less than did identical fluids with other amines.

**Q** I have a customer that uses one of my fluids to produce carbide tools. They complain that the fluid changes color over time and are concerned that high levels of dissolved cobalt may harm their workers (dermatitis, etc.). I add inhibitors to my fluids but they only work for a certain amount of time. What can I do?

A Here is another situation where selection of appropriate raw materials is key. In particular, amines can dissolve or leach cobalt from the fines generated during tool production. However, there are significant differences in the leaching potential of the commonly used amines. In an ANGUS laboratory study comparing the leaching tendencies of dilute amine solutions (using carbide swarf), CORRGUARD-95 was found to leach significantly less cobalt than other common amines.

Fluids formulated with CORRGUARD-95 inherently leach less cobalt than fluids based on other amines. To maintain very low cobalt levels, it is suggested that inhibitors such as tolyltriazole be added to the concentrate, or tank-side as necessary.

**Q** My customers are concerned that fluids containing formaldehyde-based biocides such as triazine may release formaldehyde at airborne levels exceeding 0.1 ppm in their plants. This would require us to label our products and force our customers to enact training programs for their employees. Do I have any options short of replacing the formaldehyde-based biocides?

A Laboratory experiments measuring airborne formaldehyde above a synthetic fluid containing ~1000 ppm triazine biocide (use-diluted) showed that when TEA is the only amine, formaldehyde levels in a confined airspace reached ~0.88 ppm. When TEA was replaced with AEPD™-85 Amino Alcohol (present at 2x the level of triazine), airborne formaldehyde was reduced to 0.1 ppm.

**Q** My semi-synthetic metalworking fluid formulation stains aluminum alloys, and our customers don’t want us to add silicates or phosphates to reduce staining. What are my options?

A CORRGUARD SI Corrosion Inhibitor, a phosphate and silicate-free additive, helps prevent staining on all types of aluminum alloys as well as galvanized steel and Galvaneal. In addition, CORRGUARD SI is an excellent co-emulsifier and provides lubricity as well.
## Global Availability

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<th>PRODUCT NAME</th>
<th>SOLUBLE OIL</th>
<th>SEMI-SYNTHETIC</th>
<th>SYNTHETIC</th>
<th>CONCENTRATES</th>
<th>TANK-SIDE ADDITION</th>
<th>COMMENTS</th>
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| **CORRGUARD™-95 Amino Alcohol** | | | | | | - Primary neutralizing alkanolamine for metalworking fluids  
- Leaches minimal cobalt and lead  
- Does not contribute significantly to ammonia release  
- Resists microbial degradation |
| **CORRGUARD SI Corrosion Inhibitor** | | | | | | - Multifunctional stain inhibitor for aluminum alloys, galvanized steel and Galvaneal  
- Environmentally conscious  
- Silicate- and phosphorous-free |
| **DMAMP-80™ Amino Alcohol** | | | | | | - Tertiary neutralizing amine  
- Vapor-phase corrosion inhibitor |
| **TRIS AMINO™ 40% Solubilizer** | | | | | | - Primary neutralizing amine  
- Formaldehyde scavenger |
| **AEPD™-85 Amino Alcohol** | | | | | | - Primary neutralizing amine  
- Replacement for diethanolamine  
- Formaldehyde scavenger |
| **ALKATERGE™-E Oxazoline** | | | | | | - Corrosion inhibitor  
- Invert emulsifier  
- Emulsion stabilizer for oil-in-water systems  
- Hard water stable |
| **ALKATERGE-T Oxazoline** | | | | | | - Corrosion inhibitor  
- Invert emulsifier  
- Emulsion stabilizer for oil-in-water systems  
- Hard water stable |
### Limited Regional Availability

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| CORRGUARD™ RED Amino Alcohol | | | | | | • Balances cost and performance  
• Substitute for monoethanolamine (MEA) and triethanolamine (TEA) combinations  
• Excellent emulsion stability over wide pH range  
• Improved hard water tolerance  
• Low freezing point, making it suitable for colder regions in China |
| CORRGUARD LSA Neutralizing Amine | | | | | | • High purity grade of 2-Amino-2-methyl-1-propanol  
• Low secondary amine (0.75% max.)  
• Meets TRGS 611 requirements from German government  
• Made from an enhanced production process |
| CORRGUARD EXT Amino Alcohol | | | | | | • New synergistic primary amine  
• Improves biocide performance and fluid longevity  
• Can be diluted for tank-side addition  
• Particularly impressive synergy with non-formaldehyde-based Benzisothiazolinone (BIT) |

#### What You Need, Where You Need It

With dedicated sales teams, knowledgeable technical assistance and fully equipped state-of-the-art laboratory testing around the world, help is always within reach.

Customer application centers are available in:

- **Buffalo Grove, IL, USA** (Global Headquarters and Research & Development (R&D) Expertise Center)
- **Horgen, Switzerland**
- **Singapore**
- **Shanghai, China**
- **São Paolo, Brazil**
- **Dubai, United Arab Emirates**
- **Mumbai, India**
ANGUS Chemical Company (ANGUS) is the world’s leading supplier of nitroalkane chemistry, with a wide variety of chemicals available in our product portfolio. Our extensive portfolio of high quality additives is divided into seven key markets to better suit your search for nitroalkane chemistry. ANGUS. People. Chemistry. Commitment.

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