

APPENDIX 4

August 17, 2005
Metal Working Fluids
Strategy for Toxicological Evaluation

Nomination

The National Institute for Occupational Safety and Health (NIOSH) has concluded that chronic exposure to presently used metal working fluid formulations may pose an unrecognized cancer hazard to workers. To test this hypothesis, NIOSH nominated metal working fluids for toxicological testing by the National Toxicology Program (NTP). The nomination of metal working fluids as a candidate for chronic inhalation studies is based upon their high production volume, the large number of occupationally-exposed workers, and the lack of carcinogenicity and chronic toxicological data for this class of mixtures. In its nomination, NIOSH indicated it would interact with the NTP in selection of metal working fluids for testing. The following is a summary of key steps taken to date in the development of strategy for the testing of nine metal working fluids.

The NTP has made a commitment to assess the health hazards posed by exposure to complex mixtures such as dioxin-like chemicals, AIDS therapies, or asphalt fume (Bucher and Lucier, 1997). However, testing of a formulation in a chronic bioassay is atypical. The present nomination is based on the hypothesis that inhalation of the liquid aerosols of presently used formulations produced by the metal working fluid applications represents an unrecognized potential cancer hazard for workers. Assessment of this hazard can best be achieved by the testing of metal working fluid formulations in a chronic inhalation bioassay.

Background

From a toxicological testing perspective, potential hazards in product formulations are typically identified by testing of individual constituents. Recognized carcinogens such as nitrosating agents and short-chained-chlorinated paraffin have been eliminated from metal working fluids. Suspect carcinogens such as ethanolamines have been reduced in concentration in some formulations in an attempt to reduce the potential cancer hazard posed by metal working fluid exposure. Presently, epidemiological data are unavailable to determine if these modifications have reduced the cancer risk associated with metal working fluid exposure.

Over the last several decades, substantial changes have been made in the metalworking industry, including changes in metal working fluid composition, reduction of impurities, and reduction of exposure concentrations. These changes have likely reduced the cancer risks. Yet, the risk of cancer from metal

working fluid exposures in the mid-1970s and later remains to be determined. This is because a definitive study has not yet been conducted on workers entering metal working fluid-exposed jobs during this period. Thus, there is an unclear potential for current metal working fluids to pose a similar carcinogenic hazard. Because the concern for adverse health effects via exposure of workers to metal working fluid aerosols, these studies need to be conducted by the inhalation route using metal working fluid aerosols with a particle size that is respirable in rodents.

Metal working fluids are typically categorized as removal fluids, forming fluids, protecting fluids and treating fluids. The largest category in terms of industry consumption is removal fluids with more than 100 million gallons consumed annually. This constitutes more than 40 % of all metal working fluids. Metal removal fluids are used where cutting action is the primary machining technique. Removal fluids act to cool machined parts and to wash away bits or chips of metal. They also reduce friction and protect machined parts from corrosion. Metal removal fluids are typically considered to be of two general types; non-water miscible and water miscible. Non-water miscible fluids are straight oils or neat oils and typically mineral oils. Water miscible metal removal fluids are subdivided into water-soluble oils, semisynthetic fluids, and synthetic. The difference between the water-soluble oils and the semisynthetic fluids is oil content, with the oil content of soluble oils being about 60% and the oil content of semisynthetic being about 10%. It is estimated that 80 million gallons of water miscible fluids are sold each year in the United States and that this constitutes approximately 75% of the total metal removal fluid market.

Metal Working Fluid Candidates

Since there are believed to be hundreds of metal working formulations in use, selecting a few for testing is a daunting task with a variety of inherited risks. Most notable among the risks is the selection of a fluid that is not representative of what workers are exposed to resulting in data of limited use. However, if fluids comparable to those that a large number of workers are exposed are tested, data will be of use in assessment of potential health risks in those workers.

The highly competitive and proprietary nature of metal working formulations has prevented an accurate assessment that would define the specific constituents of formulations, the demographics of their use, and associated occupational exposures. Nonetheless, there is considerable information available as to the general makeup of the metal working fluids and the most widely used constituents, at least in terms of their chemical classes. Because of the extensive industrial use of metal working fluids, available information primarily from the Independent Lubricating Manufacturers Association (ILMA) indicates that many or most constituents are high production volume chemicals (HPV - more than 1

million pounds produced per annum) and hazard assessments of inadequately tested chemicals are being addressed through industry sponsorship of EPA's HPV challenge. Therefore, data from acute toxicity studies will be available for many constituents in the next few years. Not covered under the HPV challenge is assessment of metal working fluid formulations via inhalation exposure; nor will there be assessment of cancer risk posed by untested constituents.

Conceptually, the simplest way to determine the metal working fluid to which the greatest number of workers are exposed would be to conduct a national survey of metal working shops. NIOSH does not have the capacity to do this. An alternative approach to estimating occupational exposure is to identify metal working fluids with the highest consumption or the highest production. Unfortunately, this information is not readily available because of the competitive nature of the metal working fluid market. Producers consider this information proprietary and do not make it available. Nonetheless, it is generally known which companies are considered the industry leaders in terms of production. Based on information from a variety of sources, the companies listed in Table 1 are considered to be the ten leading marketers of metal working fluids in the United States. Each of these producers has highlighted products in their marketing materials which are readily available on the internet. Among the products identified by the producers, 5-6 have been selected from each of the top five producers and are listed in Table 2. Although the selection process was arbitrary, an effort was made to select a cross section of each producer's product line. Specific comments on each formulation are provided in appendix A.

Figure 1

Supplier	Gallon/year (millions)	% Total sales
Milicron	>10	>10
Castrol Industries North America	>10	>10
Fuchs Lubricants	>1<10	>1<10
Master Chemical	>1<10	>1<10
Metal Working Lubricants	>1<10	>1<10
Mobil Oil	>1<10	>1<10
D.A. Stuart	>1<10	>1<10
Elf Aquitaine	>1<10	>1<10
Quaker	>1<10	>1<10
Equilon Lubricants	>1<10	>1<10

NIOSH recommended that the NTP focus on the 29 products listed in Table 2 as the most suitable candidates for testing. After making inquiries, the NTP determined that only 18 of the 29 were presently commercially available. This is because several are presently unavailable in the United States, or available only as custom blends that would be prepared if large quantities were procured.

Table 2. Metal Removal Fluids Marketed by the Top Five Producers in the United States

Producer	Product Name	Fluid Type	Available
Milacron	CIMPERIAL 1070	Soluble Oil	yes
Milacron	VALCOOL VNT 650	Soluble Oil	yes
Milacron	CIMSTAR 3733	Semi-Synthetic	yes
Milacron	VALCOOL VNT 700	Semi-Synthetic	yes
Milacron	CIMTECH 310	Synthetic	yes
Milacron	VALCOOL VNT 910	Synthetic	yes
Castrol Industries	COOLEGE 6600	Soluble Oil	yes
Castrol Industries	SUPEREDGE 6768	Soluble Oil	yes
Castrol Industries	CLEAREGE 6519	Semi-Synthetic	yes
Castrol Industries	CLEAREGE 6584	Semi-Synthetic	yes
Castrol Industries	SYNTILO 1023	Synthetic	yes
Castrol Industries	SYNTILO 9951	Synthetic	yes
Fuchs Lubricants	Ecocool Soluble 30	Semi-Synthetic	no
Fuchs Lubricants	Ecocool ALU-CF	Semi-Synthetic	no
Fuchs Lubricants	Ecocool EP 1	Semi-Synthetic	no
Fuchs Lubricants	Ecocool Resist EP	Semi-Synthetic	no
Fuchs Lubricants	Ecocool S 69 CF	Semi-Synthetic	no
Master Chemical	TRIM 41-3A	Semi-Synthetic	yes
Master Chemical	TRIM VX	Soluble Oil	yes
Master Chemical	TRIM EP	Semi-Synthetic	yes
Master Chemical	TRIM SC 210	Semi-Synthetic	yes
Master Chemical	TRIM 229	Synthetic	yes
Master Chemical	TRIM C170 ALW	Synthetic	yes
Metal Working Lub.	711-G	Soluble Oil	no
Metal Working Lub.	251-G	Soluble Oil	no

Metal Working Lub.	3300-B	Semi-Synthetic	no
Metal Working Lub.	1300 SWL	Semi-Synthetic	no
Metal Working Lub.	10210 TOOL ADE	Synthetic	no
Metal Working Lub.	1100	Synthetic	no

NIOSH is committed to protecting workers at all phases of metal working fluid use. The objective of the proposed studies is to determine if chronic inhalation exposure to neat metal working fluid formulations causes cancer in experimental animals. It is well recognized that Chemical modification and contamination of metal working fluids with microbes and metals contribute to the occupational hazards associated with use of metal working fluids. However, these hazards cannot be addressed until adequate testing assesses the hazards associated with unused metal working formulations.

Testing Strategy

The present nomination for testing a metal working fluid as a complex mixture without explicitly defining the specific formulation at the onset was submitted in order to provide an opportunity for the NTP to interact with NIOSH in defining a testing protocol and the formulations to be tested. Before proceeding to identifying test formulations, NTP examined the strengths and weaknesses of the conceptual framework of this nomination and provide recommendations and guidance. Prior to procuring metal working fluids from selected suppliers, NIOSH developed an initial or “straw-man” strategy for the selection and testing of metal working fluids (Table 3). It was recognized that as each step was attained, outcomes would provide additional information and corresponding assessments that would affect subsequent decisions, thereby leading to modifications of the final strategy.

Table 3. Initial Strategy for Selection and Testing of Metal Working Fluids

1	Select 10 - 12of the most widely used soluble/semis-synthetic fluids
2	Identify constituents of formulations by chemical class and CAS number
3	Conduct <i>in vitro</i> assessment for DNA damage, mutagenicity and possible cell transformation on the formulations and constituents
4	Rank for future testing the formulations and constituents based on outcome of <i>in vitro</i> tests
5	Select 2-3 formulations that encompass most of the constituents of the 10-12 selected formulations
6	Conduct 14 day (possibly 90 day) inhalation studies that assess inflammation, DNA damage or other indicators of cancer potential on formulations and their key constituents

7	conduct a 2-year chronic inhalation bioassay on at least one formulation
8	Evaluate short-term test results of constituents for the need to test individual constituents in a 2-year chronic inhalation bioassay

The testing approach outlined in Table 3 is not novel. In a review of toxicological methodologies for testing mixtures, it is referred to as the Atop down@ approach (Feron et al., 1998). That is to say the hazard associated with the mixtures is determined first or independent of the components of the mixture. This contrasts with making inferences about the hazard associated with exposure to a mixture based solely on toxicity of the constituents. There is precedence for this approach in the testing of metal working fluids. Schaper and Detweiler (1991) evaluated the acute respiratory effects of ten different aerosolized metal working fluids in a mouse bioassay. Of the ten, the most potent sensory and pulmonary irritant was evaluated in a follow-up study (Detweiler-Okabayashi and Schaper, 1996). The 12 components, including water, were evaluated in the same bioassay for comparison of effects of the individual constituents to that of the metal worker fluid formulation. While only sensory and pulmonary irritation was evaluated, the experimental design is considered applicable systemic toxicity and carcinogenesis. For example, Ito et al. (1996) successfully assessed the tumor promoting capacity of a mixture of 20 pesticides at two different doses in an 8-week liver cancer model. Results from the mixture study were compared to known effects of the individual pesticides.

Metal Working Fluid Selection

The NTP contracted with Battelle for chemical characterization of the 18 metal working fluids identified as commercially available in Table 2. The chemical characterization was to be used to aid ranking of the formulations for toxicological testing. The prioritization was necessary because it is unrealistic to test all 18; especially when some may be comparable in chemical composition. Specific criteria for ranking were discussed but not formalized as it was uncertain as to what information would be available at completion of the preliminary chemical assessment. In addition to the Battelle analyses, information from producers marketing materials, material safety data sheets, and independent chemical analyses conducted by NIOSH were also to be used in the ranking process.

Battelle used HPCL analysis to identify some constituents and classes of chemicals in the 18 metal working fluids. In addition to providing the results of their analyses, Battelle submitted recommendations to be considered in ranking the formulations for toxicological assessment. These recommendations are summarized below.

- 1) Select either Cimperial 1070, Superdedge 6768, or Valcool VNT 650 as a representative of these three soluble oils.
- 2) Eliminate Cooledge 6600 and Trim 41-3 as they are similar but less complex than Cimperial 1070, Superdedge 6768, and Valcool VNT 650.
- 3) Select Trim VX as unique among the six soluble oils.
- 4) Select either Cimstar 3733, Trim SC210, or Trim EP as a representative of these three semi-synthetic oils.
- 5) Select either Clearedge 6584 or VNT 700 as a representative of these two semi-synthetic oils.
- 6) Eliminate Clearedge 6519 because it is unique among the MWFs and, therefore, not representative.
- 7) Select either Valcool VNT 910, Cimtech 310, or Syntilo 1023 as a representative of these three synthetic fluids.
- 8) Select Trim 229 because it is complex and different than other synthetic fluids or select either Syntilo 9951 or Trim C170 as a representative of the these two synthetic fluids.

Following the guidelines presented by Battelle, NIOSH scientists reviewed Battelle's recommendations and its own chemical assessment of the 18 metal working fluids and recommended the following:

- 1) Retain Superdedge 6768 and Cimperial 1070 for further study, and defer Valcool VNT 650 from further evaluation.
- 2) Defer Cooledge 6600 and Trim 41-3 from further evaluation.
- 3) Retain Trim VX for further study.
- 4) Retain Cimstar 3733 and Trim SC210 for further study, and defer Trim EP from further evaluation.
- 5) Retain Clearedge 6584 for further study, and defer VNT 700 from further evaluation.

6) No Chromatograph was provided for Clearedge 6519. If it is as complex as indicated it could be an interesting substance and recommend further evaluation.

7) Retain Cimtech 310 and Syntilo 1023 for further study, and defer Valcool VNT 910 from further evaluation.

8) Retain Trim 229 for further study, and defer Syntilo 9951 and Trim C170 from further evaluation.

The decision process for designating chemicals for further study or for deferral was somewhat arbitrary. Ideally, the products should have been ranked based on the greatest to least need for toxicological evaluation. Unfortunately, this was not practical with the limited information available on each product. As an alternative, three criteria were used to reduce the list of 18 products to 9 that should be evaluated further. One criterion for selection was to include products from at least three companies in each of the categories. Two other criteria that ran somewhat counter to one another were to select products that were representative of a category, but to also give consideration to complex or unusual products. The following metal working fluids were retained for further study:

Soluble Oils	Producer
Superedge 6768	Castrol
Trim VX	Master
Cimperol 1070	Milicron
Semi-synthetic	
Cimstar 3733	Milicron
Clearedge 6584	Castrol
Trim SC210	Master Chemical
Synthetic	
Cimtech 310	Milicron
Trim 229	Master Chemical
Syntilo 1023	Castrol

The following were deferred:

Trim 41-3A, Coolridge 660, ValcoolVNT 650
Trim EP, Valcool VNT 700, Clearidge 6519
Trim C170, Valcool VNT 910, Syntilo 9951

The nine retained products were recommended for further chemical evaluation and toxicological testing by the NTP. It was recommended metal working fluids designated as deferred not be evaluated further, but be retained for possible later evaluation.

Study Design

The NTP accepted the selection recommendations of NIOSH.

The NTP Study Design Team made the following recommendations for testing:

1. Conduct mutagenicity studies on all 9 MWF using the standard Salmonella assays. A range of MWF concentrations in water will be used.
2. Conduct 14-day repeated dose inhalation studies in male and female F344 rats and B6C3F1 mice using liquid aerosols of the 9 MWF. In the 14-day study, the potential effects of MWF on lung of rats and mice will be evaluated by means of the Comet assay.
3. Conduct standard 13-week inhalation studies of the 9 MWF in male and female F344 rats and B6C3F1 mice. A range of liquid aerosol concentrations will be selected based upon results of the acute and repeated dose studies. Collect blood samples from mice at the end of the 13-week study for analysis in the micronucleus assay. SMVCE will not be performed.
4. Based upon the results of the above studies, 3 MWF (one compound/class) will be selected for chronic inhalation study.

The metal working fluids will be studied in the order listed in the table beginning with the semisynthetics. Appropriate measures will be taken to ensure that the aqueous solutions (emulsions) do not separate prior to aerosol generation, and to utilize fresh solutions devoid of bacterial/fungal contamination. The proposed maximum total aerosol concentration is 40 mg/m³ for the 14-day studies.

Metal Working Fluids for Subchronic Inhalation Studies

A. Semisynthetics	<u>Dilution</u>	<u>Aerosol Conc (mg/m³)</u>
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1. Cimstar 3800	none	0, 2.5, 5, 10, 20, 40
2. Trim SC210	none	0, 2.5, 5, 10, 20, 40
3. Clearedge 6584	none	0, 2.5, 5, 10, 20, 40

B. Synthetics

4. Cimtech 310	none	0, 2.5, 5, 10, 20, 40
5. Syntilo 1023	none	0, 2.5, 5, 10, 20, 40
6. Trim 229	none	0, 2.5, 5, 10, 20, 40

C. Soluble Oils

7. Superedge 6768	none	0, 2.5, 5, 10, 20, 40
8. Cimperial 1070	none	0, 2.5, 5, 10, 20, 40
9. Trim VX	none	0, 2.5, 5, 10, 20, 40

References

Bucher, J.R. and Lucier, G. (1998). Current approaches toward chemical mixture studies at the National Institute of Environmental Health Sciences and the U.S. Toxicology Program. *Environ. Health Perspec.* 106, 1295-1298.

Detweiler-Okabayashi, K.A. and Schaper, M.M. (1996). Respiratory effects of a synthetic metalworking fluid and its components. *Arch. Toxicol.* 70, 195-201.

Feron, V.J., Cassee, F.R., and Groten, J.P. (1998). Toxicology of chemical mixtures: International perspective. *Environ. Health Perspec.* 106, 1281-1289.

Ito, N., Hagiwara, A., Tamano, S., Futacuchi, M., Imaida, K., Shirai, T. (1996). Effect of pesticide mixtures at the acceptable daily intake levels on rat carcinogenesis. *Food, Chem. Toxicol.* 34, 1091-1096.

Schaper, M. and Detwiler, K. (1991). Evaluation of the acute respiratory effects of aerosolized machining fluids in mice. *Fundam. Appl. Toxicol.* 16, 309-319.

Thorne, P.S. and DeKoster, J.A. (1996). Pulmonary effects of machining fluids in guinea pigs and mice. *AIHAJ* 57, 1168-1172.

Appendix A
Information on producers and products listed in Table 2

Milicron Inc.
2090 Florence Ave
Cincinnati OH 45206
Phone 513-487-5000
FAX 513-487-5057
e-mail: info@milicron.com

Milpro Internet Tool Crib and e-business of Milicron Inc.
<http://lccat.milpro.com/scripts/>

Milpro internet site lists 23 metal removal products which include
Straight Oils - One
Soluble Oils - Four
Semi-Synthetic Fluids - Nine
Synthetic Fluids - Eight

Two soluble oils marketed by Milicron are:

CIMPERIAL® 1070 metalworking fluid is a new generation, water-soluble, premium soluble oil that has "one-fluid-all operations" capability. It is recommended for moderate to heavy-duty machining and grinding of ferrous and nonferrous metals. It is not recommended for use on magnesium. CIMPERIAL 1070 does not contain nitrites, phenols, or chlorinated solvents.

VALCOOL® VNT® 650 metalworking fluid is a new generation, water-soluble, premium soluble oil recommended for moderate to heavy-duty machining and grinding of ferrous and nonferrous metals. It is not recommended for use on magnesium. VNT 650 does not contain nitrites, phenols, or chlorinated solvents.

Two semi-synthetic fluids marketed by Milicron are:

CIMSTAR® 3733 metalworking fluid is a water-soluble semisynthetic that blends the technological advantages of modern day synthetics with the performance capabilities of soluble oils. It is recommended for general-purpose machining and grinding of nonferrous and ferrous metals. It is especially well suited for machining aluminum. It is not recommended for use on magnesium. CIMSTAR 3733 does not contain nitrites, phenols, chlorinated solvents, or chlorine.

VALCOOL® VNT® 700 metalworking fluid is a water-soluble semisynthetic that blends the technological advantages of modern day synthetics with the

performance capabilities of soluble oils. It is recommended for general-purpose machining and grinding of ferrous and nonferrous metals. It is not recommended for use on magnesium. VNT 700 does not contain nitrites, phenols, silicones, chlorinated solvents, or chlorine.

Two synthetic fluids marketed by Milicron are:

CIMTECH® 310 metalworking fluid is a unique, low pH, water-diluteable synthetic designed to meet or exceed the strict requirements of the aerospace industry. It is recommended for moderate to heavy-duty machining and grinding of ferrous, nonferrous, and exotic metals. It is not recommended for use on magnesium. CIMTECH 310 does not contain nitrites, phenols, chlorine, silicones, mineral oil, or chlorinated solvents.

VALCOOL® VNT® 910 metalworking fluid is a clear, water-diluteable synthetic that is low foaming. It is recommended for moderate to heavy-duty machining and grinding of ferrous metals. VNT 910 is especially effective for machining and grinding all ferrous metals. It is not recommended for use on magnesium. VNT 910 does not contain nitrites, phenols, chlorine, silicones, mineral oil, or chlorinated solvents.

Castrol Industrial North America Inc.
1001 West 31st Street
Downers Grove IL
Illinois 60515 U.S.A.
Phone 630- 241-4000
FAX 630- 241-1957

[Http://www.castrolindustrial.com](http://www.castrolindustrial.com)

Product line addresses a variety of metal working applications and nineteen products are listed on Castrol's Web site:
Straight Oils - Three
Solubles - Three
Semi-Synthetics - Five
Synthetics - Eight

Two Soluble oils marketed by Castrol are:

Cooledge 6600 - water soluble cutting and grinding fluid for moderate machining and grinding of ferrous and nonferrous metals

Superedge 6768 - water soluble cutting and grinding fluid for severe operations on ferrous and nonferrous metals that is formulated with and extreme pressure additive.

Two Semi-synthetic fluids marketed by Castrol are:

Clearedge 6519 - semi-synthetic cutting and grinding fluid for machining and grinding of ferrous and non ferrous alloys. It is suited for job shops that want a single fluid to machine a variety of metals

Clearedge 6584 - semi-synthetic cutting and grinding fluid for machining and grinding of ferrous and non ferrous alloys formulated with and extreme pressure additive. Contains mineral oil, hydrotreated heavy naphthenic petroleum distillates, chlorinated paraffin, alkanolamine.

Two synthetic fluids marketed by Castrol are:

Two synthetic fluids marketed by Castrol are:

SYNTILO1023 is an oil-dispersing, synthetic cutting and grinding fluid formulated for cast iron transfer lines that is engineered to separate tramp oil to the surface of the fluid where it can be removed by skimming. It also disperses small amounts of oil throughout the fluid to create a thin film which protects parts, chips and machine surfaces. This unique oil-dispersing characteristic reduces corrosion and "clinkering" while helping the fluid to remain clean and resist depletion.

SYNTILO 9951 is an economical synthetic cutting and grinding fluid that is recommended for machining and grinding of ferrous metals, stainless steels and alloys. This oil-rejecting fluid offers the necessary cooling properties for high speed operations. Additionally, it provides corrosion protection and bioresistance.

Fuchs Lubricants Co.
17050 Lathrop Avenue
Harvey, IL 60426
Tel: 708-333-8900
Fax: 708-333-9180
e-mail: info@fuchs
<http://www.fuchs.com>

Fuchs Lubricants Co. has achieved its current position as a major supplier of

metalworking lubricants, process cleaners and corrosion preventives to the American metalworking industry through the merging of several of the country's oldest and most respected metalworking lubricant manufacturers. Notable among these are H.A. Montgomery; Metal Lubricants Co., Franklin Oil, Grafo Colloids, and the metalworking division of Witco Corporation.

Fuchs lists 12 neat cutting oils, 7 water-miscible fluids, one (1) synthetic emulsion and a variety of gear oils, corrosion inhibitors, and other miscellaneous fluids on its Web site (<http://www.fuchs.com.cn/new/products.htm>) among these are included the following water miscible metal removal fluids:

Four semi-synthetic fluids marketed by Fuchs are:

Ecocool Soluble 30 - Semi-synthetic emulsion that is free of chlorine, phenol and nitrite that is for general machining of cast iron, steel and non-ferrous metal.

Ecocool ALU-CF - Semi-synthetic emulsion that is free of chlorine, phenol and nitrite that is for difficult machining of all materials, especially aluminum and its alloy.

Ecocool EP 1 - Semi-synthetic emulsion that is free of phenol and nitrite that is for severe machining material especially aluminum and its alloy

Ecocool Resist EP - Semi-synthetic emulsion that is free of phenol and nitrite that is for severe machining processes

One synthetic fluid marketed by Fuchs is:

Ecocool S 69 CF - Synthetic emulsion free of chlorine, phenol and nitrite with excellent lubricity and wear resistance; especially for the machining, grinding and honing.

Master Chemical Corporation
501 West Boundary
Perrysburg, OH 43551-1263
Phone: 419-874-7902
FAX: 419-874-0684
e-mail: info@masterchemical.com
<http://www.masterchemical.com>

Developer and manufacture of cutting and grinding fluids - Ninety three (93) products are listed on Master Chemicals Web page (8/31/01). The break down

of products is as follows:

- Straight Oils - Ten
- Emulsions - Twenty six
- Semi-Synthentics - Nine
- Synthetics - Twenty seven
- Tapping Comounds -Six
- Honing Oils - Four
- EDM fluids - Two
- Speciality fluids - Nine

Two soluble oil fluids marketed by Master Chemical Corporation are:

TRIM 41-3A is a low foam, high lubricity soluble oil which requires minimal maintenance in even the most demanding fluid management systems. It has broad application in machining and grinding on a wide range of materials. The very high levels of both chemical and mechanical lubricity in this product handle the toughest machining and grinding jobs. The stable and predictable performance of TRIM® 41-3A makes it a first choice for high-quality, consistent parts manufacturing.

TRIM VX - soluble oil coolant concentrate designed to do the heaviest duty machining operations. It contains very high levels of EP additives including stable chlorine and sulfur. Additional friction modifiers, including sulfurized fats and particle size modification technology are used to reduce the mechanical friction seen in many heavy-duty machining and grinding operations.

Two semi-synthetic fluids marketed by Master Chemical Corporation are:

TRIM EP - heavy duty semi-synthetic coolant containing chlorine and sulfur extreme pressure (EP) additives and synthetic fats for excellent tool life and outstanding cutting performance on soft, gummy work materials.

TRIM SC 210 - semi-synthetic cutting and grinding fluid concentrate. It is a general purpose product for the multi-material, multi-operations shop. It has the wetting and cooling characteristics of a premium heavy duty synthetic for superior turning, milling and plain grinding operations. This product was designed to comply with the most stringent health, safety and environmental mandates.

Two synthetic fluids marketed by Master Chemical Corporation are:

TRIM 229 - A chemical true solution coolant concentrate. It is designed to deliver the maximum chemical rust protection to ferrous materials at the minimum possible working concentration. TRIM 229 is often used in surface grinding

where foam is an issue. It may also be used in water tanks under burning tables or plasma arc welding and in leak detection dip tanks as an abrasive cut off coolant.

TRIM C170ALW - A synthetic cutting and grinding fluid concentrate. It is designed to take advantage of the newest chemical technologies to provide a clean, long lived, oil free product for the manufacture of aluminum die cast wheels and other high value die cast aluminum parts.

Metalworking Lubricants Company

25 Silver Dome Industrial Park

Pontiac MI 48342

Phone: 248-332-3500

FAX: 248-332-4959

e-mail: sales@mwlco.com

<http://www.metalworkinglubricants.com>

Metalworking Lubricants Company has over 10,000 formulas in its product line. Metalworking Lubricants campy lists seven cutting oils and ten cutting and grinding fluids on its Web page. Additional formulas are available upon request.

Two soluble oils marketed by Metalworking Lubricants are:

711-G General purpose conventional soluble oil

251- All purpose heavy duty soluble oil

Two semi-synthetic fluids marketed by Metalworking Lubricants are:

3300-B Semi-synthetic general purpose fluid

1300 SWL Micro emulsion fluid for all metals

Two synthetic fluids marketed by Metalworking Lubricants are:

10210 TOOL ADE - General purpose complete synthetic fluid

1100 - Complete synthetic grinding fluid for ferrous metals