



Oil & Gas

## **NORKOOL™ CLEANER, DEGREASER AND INHIBITOR 244**



**SYSTEM MAINTENANCE SOLUTIONS FROM DOW OIL & GAS**

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### Solutions for Heat Transfer Applications from Dow Oil & Gas

The family of heat transfer fluids, corrosion inhibitors, cleaners and degreasers from Dow Oil & Gas sets the standard in quality and performance, in unmatched technical expertise, and in industry-leading service.

### Experience

With more than 50 years of experience in ethylene glycol and propylene glycol-based fluids, Dow Oil & Gas has an unparalleled record of meeting customer needs.

### Service

A total service package includes sample analyses for trouble-free system performance. A laboratory provides fast, accurate and comprehensive test results. Our broad distribution network in the U.S. and Canada means product when and where you want it.

### Quality

Dow Oil & Gas's worldwide quality process reaches everything we do — especially our customers. As an operator dedicated to maintaining your expensive equipment in the highest operating condition, you can count on the Dow Oil & Gas quality effort.

### Value

Dow Oil & Gas offers the industry's widest range of EG and PG fluids — DOWTHERM™ and UCARTHERM™ Heat Transfer Fluids, NORKOOL™ Coolants, NORKOOL HTF Corrosion Inhibitors, NORKOOL System Cleaner, NORKOOL System Degreaser, and NORKOOL Inhibitor 244 surface modifier — products that perform and save you money!



## **NORKOOL™ CLEANER, NORKOOL DEGREASER, NORKOOL INHIBITOR 244**

Chemical cleaning compounds play a vital role in keeping industrial heating and cooling equipment operating efficiently. Of particular importance is the removal of foulants such as corrosion scales, water-derived mineral deposits, grease, and oil-based foulants. The presence of dirt and scales is also common. Cleaning new systems is just as important as cleaning old ones since new systems may be coated with oil or a protective film.

Whether new or old, heat transfer systems that utilize water or water-containing fluids as coolants are likely to accumulate rust, mineral scales and oily contaminants during construction and operation. These scales and contaminants can drastically reduce the heat transfer efficiency of the system because of the low thermal conductivities of the scales and oils compared to the high thermal conductivities of the bare metals.

Even the slightest buildup of rust or other scales can cause a dramatic reduction in heat transfer efficiency. For example, a one-inch-thick piece of steel coated with just 1/16-inch of rust has the same heat transfer characteristics as a four-inch-thick piece of steel. In fact, the thermal conductivity of the scale is in the same range as insulating materials such as firebrick. To make sure the performance of the system meets

design specifications, these insulating contaminants must be removed prior to installation of an industrial heat transfer fluid. However, to ensure optimal system performance, the cleaned metal surface should be immediately protected by a passivating agent to prevent corrosion from flash rusting prior to introducing the new heat transfer agent. Failure to do so will seriously compromise system performance even before it is put into service.

Dow Oil & Gas provides a unique, three-part cleaning system. NORKOOL™ Cleaner and NORKOOL Degreaser have been developed to optimize cleaning, while minimizing detrimental effects to equipment (when used properly). These products are non-corrosive to a wide spectrum of metallic and nonmetallic materials. They are also easy to use by operators and maintenance personnel and have minimal environmental impact (upon disposal in an acceptable wastewater treatment facility). NORKOOL Inhibitor 244 acts as a surface modifier and passivates the cleaned metal surfaces to prevent flash rusting. This ensures that the inhibitor package in the newly installed NORKOOL coolant does not get depleted.





## FEATURES AND BENEFITS

When used together, NORKOOL™ Cleaner, NORKOOL Degreaser and NORKOOL Inhibitor 244 surface modifier offer a number of important advantages:

- **Easy to Use** – There is no need for the neutralizing or exhaustive clean-water rinses associated with acid cleaners. In many instances, no auxiliary equipment is required to apply NORKOOL products. Ease of handling permits more jobs to be done on site.
- **Save Time, Money and Downtime** – On-site use by your personnel, or a qualified cleaning service, eliminates the cost of dismantling equipment, sending it off-site for cleaning services and reassembling. Users are able to realize substantial savings in maintenance time and money, as well as in equipment downtime.
- **Cleaner System** – NORKOOL Cleaner can remove scales that conventional mineral and organic acids remove, plus more! Laboratory testing and customer use verify that our cleaner removes up to three times more rust and other corrosion and mineral scales than some available mineral-acid cleaners.
- **Non-Acidic, Non-Alkaline and Non-Corrosive** – NORKOOL™ Cleaner, NORKOOL Degreaser, and NORKOOL Inhibitor 244 have a negligible effect on gaskets, seals and other non-metallics. While they are generally non-corrosive to metallics, they are an excellent choice in applications where it is critical to minimize changes in dimensions or tolerances of system components.
- **Improved Safety** – The near-neutral pH of NORKOOL Cleaner and NORKOOL Degreaser means that they are much safer to handle than conventional cleaners.
- **Biodegradable** – NORKOOL Cleaner, NORKOOL Degreaser, and NORKOOL Inhibitor 244 contain no heavy metals. They are biodegradable and exhibit little impact on the environment when disposed of properly.

## PRODUCT SYNERGY

In the majority of applications, corrosion and/or other mineral scales and hydrocarbon foulant are present. Therefore, NORKOOL™ Degreaser has been most widely used in combination with NORKOOL Cleaner. Used together, degreasing and descaling in a single step, the products offer a broader spectrum of foulant-removing capabilities.



In addition, the wetting characteristics of NORKOOL™ Degreaser may significantly increase the scale-removing rate of NORKOOL Cleaner, resulting in lower overall application times. The use of NORKOOL Inhibitor 244 not only prevents premature depletion of the coolant but also provides an important buffering action to the new coolant system.

## **PRODUCT DESCRIPTIONS**

### **NORKOOL™ Cleaner**

NORKOOL™ Cleaner, which for optimal results should be used in conjunction with NORKOOL Degreaser, effectively removes such foulants as corrosion scales and water-derived mineral deposits. While it does not contain mineral acid, it is as effective as mineral acids and removes some scales unaffected by acids. The cleaner has also proved to be highly effective in removing scales resulting from atmospheric and non-aqueous corrosion.

NORKOOL Cleaner is a water-based product in which the principal active ingredients are ammonia-neutralized chelating and sequestering agents. These convert water-insoluble chemical compounds — containing such elements as calcium, magnesium, iron, aluminum, zinc, lead and copper — into water-soluble compounds at neutral or near-neutral pH.

Therefore, the product is highly effective in removing corrosion such as rust, as well as lime and other mineral scales.

Other important cleaner ingredients include a green dye to help make the cleaner readily distinguishable and corrosion inhibitors to protect the bare metal once the corrosion products or mineral scale have been removed.

### **NORKOOL™ Degreaser**

NORKOOL™ Degreaser, a companion product used with NORKOOL Cleaner, is the ideal choice for chemical cleaning of hydrocarbon foulants such as oils, greases, waxes, gums, tars and coke. This product provides a highly effective and easy-to-use alternative to compounds containing volatile organic solvents, halogenated solvents or inorganic phosphates.

NORKOOL Degreaser contains a complex mixture of nonionic and anionic surface-active compounds dispersed in water. It is effective and easy to use. And, unlike other degreasers, it is not formulated with volatile organic solvents, halogenated solvents, or inorganic phosphates that may necessitate workplace exposure monitoring and controls, as well as additional disposal requirements.

## NORKOOL™ Inhibitor 244

NORKOOL™ Inhibitor 244 protects against flash rusting. In a freshly cleaned system that is not protected, there is a tendency for the bare metal surface to flash rust on exposure to oxygen. The new coolant will act as a solvent, pulling the rust off into the liquid coolant. This results in several undesirable effects:

- Initiation of scale build-up that may lead to cracked heads and loss of heat transfer.
- Precipitation of inhibitors that can lead to severe corrosion.
- Erosion corrosion resulting in excessive metal wear.

By passivating the metal surface, NORKOOL Inhibitor 244 prevents flash rusting and prepares the surface for the new inhibitor package. It also buffers the system for the new coolant.

## APPLICATIONS FOR NORKOOL™ PRODUCTS

### Natural Gas Processing Equipment

NORKOOL™ Cleaner and NORKOOL Degreaser are ideal products in a wide variety of natural gas applications. For example, natural gas processing equipment, such as triethylene glycol dehydrators, are susceptible to corrosion from gas contaminants and improper fluid maintenance, as well as to scale formation resulting from brackish water intrusions. NORKOOL Cleaner offers an easy-to-use and effective alternative to equipment disassembly and mechanical cleaning to remove these deposits. In addition, sludge can be removed with a water solution of NORKOOL Cleaner instead of highly flammable or caustic materials.

## Gas Compressor Engines

NORKOOL™ Cleaner and NORKOOL Degreaser are used extensively by operators of gas compressor engines to remove scale, sludge and oil from cooling systems. Cooling systems can be simultaneously descaled and degreased. When used properly, these products will not harm gaskets and O-rings and will not attack mineral-filled water pump shaft seeds. NORKOOL Cleaner helps prevent cooling system overheating, power cylinder head cracking due to water passage scaling and partially clogged coolant flow passages in ignition cells.

## Indirect Heaters/Line Heaters

Maintenance of gas transmission pipeline heaters should not be neglected. Due to evaporation of water, the heater becomes underfilled, and the glycol portion of the heat transfer fluid becomes over-concentrated. As a result, to maintain gas temperatures, the heater is frequently over-fired, resulting in both oxidation and coking of the glycol. The heat transfer fluid can become corrosive and the tubes and shell fouled with coke and corrosion scale. Ultimately, the heater fails to heat sufficiently and requires extensive maintenance. Cleaning with NORKOOL Cleaner is an excellent alternative to labor-intensive equipment disassembly and mechanical cleaning. The cleaner also helps to eliminate similar problems in other types of indirect heaters, such as vaporizers, wellhead heaters, or oil pipeline heaters.

## Cogeneration Engines

NORKOOL™ Cleaner effectively removes scale, sludge and oil from reciprocating engine cogeneration cooling and heat recovery systems. Proper use of NORKOOL Cleaner has helped to prevent such problems as power cylinder head cracking and loss of heat transfer efficiency.

## PERFORMANCE OF NORKOOL™ PRODUCTS

### Types of Scales Removed

Field experience and laboratory evaluations show that NORKOOL™ Cleaner can dissolve a wide range of mineral and corrosion scales, as listed in Table 1. This list includes most scales from typical cooling systems. In scales containing two or more of the minerals, NORKOOL Cleaner will tend to preferentially dissolve the minerals listed highest in the table. Repeated cleaner applications will aid in the removal of the secondary scales.

Table 1: Scales Removed by NORKOOL™ Cleaner

SCALE	SCALE CLASSIFICATION	RELATIVE DESCALING EFFECTIVENESS OF NORKOOL™ CLEANER
Rust (Fe <sub>2</sub> O <sub>3</sub> )	Corrosion	Excellent
Lime (CaCO <sub>3</sub> )	Mineral	Excellent
Magnesium Hydroxide	Mineral	Excellent
Cupric Oxide	Corrosion	Excellent
Solder Bloom (lead corrosion)	Corrosion	Excellent
Black Rust (Fe <sub>3</sub> O <sub>4</sub> )	Corrosion	Very Good
Cuprous Oxide	Corrosion	Very Good
Aluminum Oxide	Corrosion	Good
Ferric Hydroxide	Corrosion/Mineral	Fair
Ferrous Hydroxide	Corrosion/Mineral	Fair
Zinc Phosphate	Corrosion	Fair
Aluminum Phosphate	Corrosion	Fair
Calcium Phosphates	Mineral	Slight to Fair
Calcium Sulfates	Mineral	Slight
Magnesium Silicate	Mineral	†

†Relative position in table unknown; however, it has been shown to be dissolved by NORKOOL Cleaner.



## HOW TO USE NORKOOL™ PRODUCTS

### Estimating Cleaner Requirements

As a general guide, a simple 10-percent application of NORKOOL™ Cleaner will remove roughly 1/16-inch of scale. However, the amount of cleaner required to remove all scale may vary, largely because scales are often not uniformly distributed throughout a system and because they have a

variety of densities and a highly variable ratio of surface area-to-liquid capacity. Inspection of the internal surfaces of the system at one, or preferably more, locations likely to have deposits is the best way to reasonably estimate the amount of cleaner required.







When inspecting the system, remove deposits with a sharp instrument to expose the metal surface; repeat at each inspection site to obtain a reliable estimate of scale thickness. These sites can also be inspected during the chemical cleaning to determine the progress or completion of the cleaning process.

### Estimating Degreaser Requirements

When used in conjunction with NORKOOL™ Cleaner, NORKOOL Degreaser should be regarded as a supplement, and the user should follow the cleaning procedures outlined on page 11.

Excellent cleaning solution wetting characteristics are generally obtained at degreaser concentrations of 0.5 volume-percent.

However, the amount of degreaser to use depends on the severity of the hydrocarbon fouling; consult your sales representative for specific recommendations.

### Estimating NORKOOL Inhibitor 244 Requirements

Typically, NORKOOL Inhibitor 244 has proven effective as a surface modifier at a concentration of 5 percent.

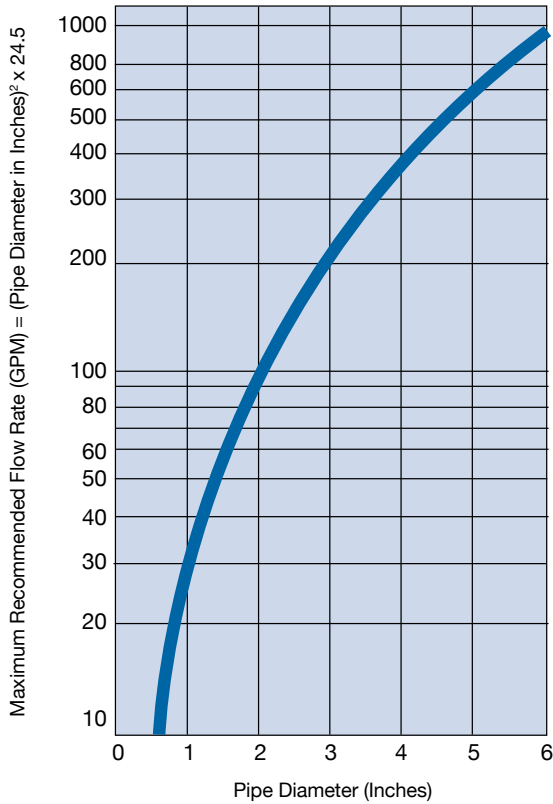
### Operating Conditions During Cleaning

Descaling with NORKOOL Cleaner proceeds at practical rates at temperatures above approximately 120°F (49°C). Dow does not recommend temperatures below this because the time taken to exhaust the cleaning solution will be excessive.

Because the cleaner and degreaser are water based and diluted with water when applied, the boiling point of water [212°F (100°C) at 0 psig] is the upper temperature limit of the cleaning solution. Higher temperatures are possible in pressurized systems. To avoid localized boiling of the cleaning solution, Dow recommends a maximum temperature of 190°F (88°C).

Mechanical circulation or agitation of the cleaning solution is recommended since it accelerates the rate at which scales dissolve. Circulation also assists in reducing the overall usage of the cleaner by removing undissolved scale suspended in the cleaning solution.

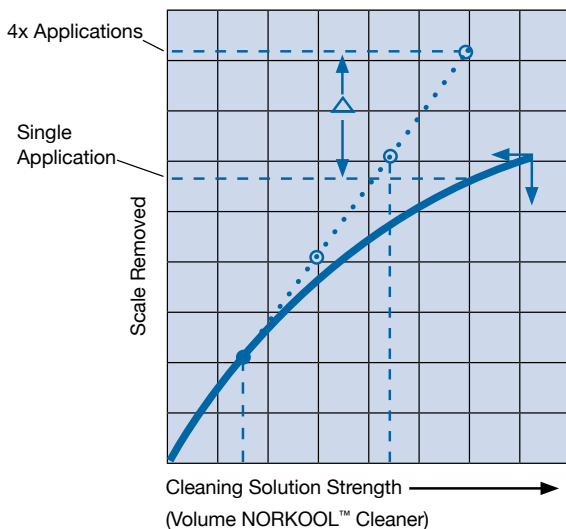
Figure 1: Relation Between Pipe Diameter and Flow Rate



Excessive circulation rates should be avoided. High circulation rates may result in entrainment and subsequent foaming. Because NORKOOL™ Degreaser contains wetting agents, foaming can become a problem if the cleaning solution is excessively aerated. Additionally, the cleaning solution entrains solid scales and metal particles to carry them out of the system. If circulation rates are high, the cleaning solution may cause erosion and attack metallic components in the system.

To avoid this erosion effect, Dow recommends continuous circulation rates corresponding to linear velocities of less than approximately 10 feet per second for ferrous metals and less than 6 feet per second for cuprous metals through the narrowest passage. Figure 1 shows the corresponding relationship between pipe diameter and flow rate. Almost all systems that include circulation pumps in the original design will meet this recommended flow rate.

Figure 2: Cleaning Solution Strength vs. Scale Removed



### Cleaning Solution Strength

In descaling operations, NORKOOL Cleaner is usually diluted with water in recommended solution strengths in the range of 5 to 25 volume-percent. Lower concentrations are recommended to remove thin scales such as those resulting from atmospheric corrosion.

Lower concentrations result in more effective use of the cleaner by maximizing scale dissolving capacity. To illustrate, four 5 volume-percent applications of NORKOOL Cleaner will remove more scale than a single 20 volume-percent application as shown in Figure 2. However, multiple applications take more total time. In a typical application, a recommended compromise of 10 volume-percent of cleaner may be effective.

## Typical Cleaning Procedure

While it is not possible to provide a single cleaning procedure for all situations and equipment, the principal steps are similar in a majority of cases. Typically, the scale is on the internal surfaces of a mechanically circulated closed system that can be heated. (A closed system has no fluid loss except for incidental leakage or minor evaporation.)

1. Drain the original fluid in the system. Choose and inspect appropriate locations in the system to be referenced for cleanliness. Be sure to locate and drain all low points.
2. After inspection, fill the system with deionized water (with air bleeds open) and circulate for 15 to 30 minutes.
3. Discontinue circulation and drain the entire system as quickly as possible through low-point drains. This step will remove loose debris, which might otherwise contribute to depletion of the cleaning solution.
4. Refill the system with deionized water and the desired concentration of NORKOOL™ Cleaner and NORKOOL Degreaser.
5. Operate the system at as high a temperature as possible, up to a maximum of approximately 190°F (88°C), until the cleaning solution is depleted (this can be done by monitoring the pH). Make sure air is excluded from the cleaning solution by venting through air bleeds.
6. Discontinue circulation and drain the system quickly through low-point drains. Then rinse the system with deionized water to remove any loose debris.
7. Inspect the system at the locations identified in step 1.
8. If the system has not been satisfactorily descaled, repeat steps 4 through 7.
9. Once the system is satisfactorily cleaned, thoroughly flush with deionized water until the rinse water runs clear. Additional rinses may be required if NORKOOL Degreaser is used.
10. NORKOOL Inhibitor 244 should then be added in the final deionized water rinse.
11. Install only a high-quality, inhibited heat transfer fluid to minimize the likelihood of a recurrence. Consult your Dow Oil & Gas sales representative for fluid selection assistance.





### Procedure for Descaling Engine Cooling Systems

Choose an inspection site or two that can be used to observe cleaning progress. It is suggested that sites near critical heat transfer surfaces or the hottest fluid be used, e.g., water passages near or in the head.

If the engine cooling system contains corrosion inhibitors or some fluid other than water, drain and rinse with deionized water. Time should be taken at this point to ensure that the cooling system is drained as dry as possible. The ability to completely drain the cooling system will reduce waste and conserve water at final rinsing.

The cleaning solution can be prepared in the cooling system by partially filling the cooling system with deionized water, adding 10 percent of the system volume with NORKOOL™ Cleaner and the recommended amount of NORKOOL Degreaser, and filling the remaining system volume with deionized water. The amount of NORKOOL Degreaser depends on the amount of hydrocarbon contamination present; low levels (0.5 percent) act as a catalyst and reduce the time for the cleaning solution to become fully expended. On the other hand, excessively high levels (>2.0 percent) can lead to foaming problems. Contact your Dow representative for recommended amounts.

Operate the engine normally. Ensure that there is fluid flow in all piping to be cleaned. Normal application time may be from 2 to 48 hours, depending on the nature of the scale present and the amount of NORKOOL Degreaser used.

### Measuring Cleaning Progress

The progress of each application of cleaning solution can be followed by measuring solution pH. Solution pH is best measured by dipping a test strip in a fresh sample for 10-15 seconds. Immediately compare it to the color chart because the material responsible for the pH change volatilizes into the air. At pH 8.1-8.9, the cleaning solution is expended.

Drain the cooling system and open the inspection sites to determine whether the desired amount of scale/sludge has been removed.

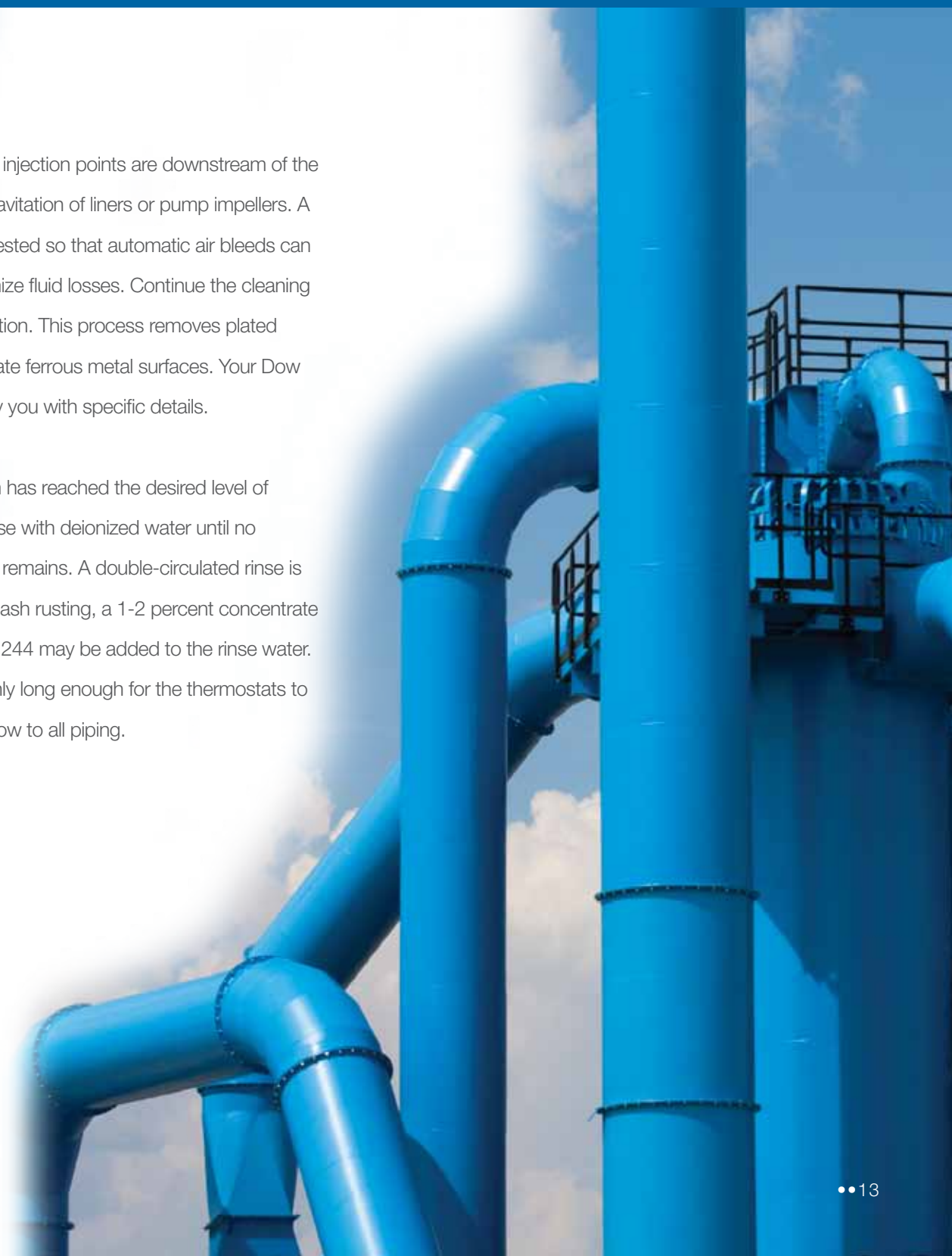
If the cooling system is not clean enough, repeat the above procedure with new cleaning solution.

If copper plating of ferrous metal surfaces is observed when the cleaning solution is expended (pH 8.1-8.9), inject air into the cleaning solution for one hour without reducing the temperature



or circulation. Suggested injection points are downstream of the engine to minimize any cavitation of liners or pump impellers. A low injection rate is suggested so that automatic air bleeds can remove the air and minimize fluid losses. Continue the cleaning process after the air injection. This process removes plated copper and helps passivate ferrous metal surfaces. Your Dow representative can supply you with specific details.

When the cooling system has reached the desired level of scale/sludge removal, rinse with deionized water until no trace of cleaning solution remains. A double-circulated rinse is suggested. To minimize flash rusting, a 1-2 percent concentrate of NORKOOL™ Inhibitor 244 may be added to the rinse water. The engine should run only long enough for the thermostats to open, thereby ensuring flow to all piping.



## Cleaning Solution Depletion

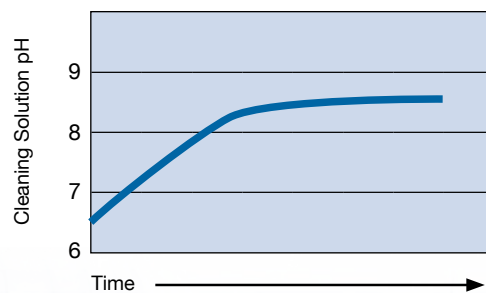
The time required for the cleaning solution to become exhausted depends on a number of factors. Rapid depletion is caused by high temperature, high rate of circulation and low solution strength. Some scales take more time to remove than others. Foulants such as lubricating oil or grease impede the descaling rate and require the simultaneous use of NORKOOL™ Degreaser. Cleaning procedures requiring multiple applications of the cleaner can typically require 4 to 20 hours of exposure for cleaner to be depleted.

Under normal circumstances, depletion of the cleaning solution is readily determined by measuring the solution pH. Once the pH rises above 8.1, the cleaning solution is spent and should be removed from the system. See Figure 3.

If no pH meter is available, pH-sensitive papers are suggested and can be obtained from your sales representative.

When the pH of the cleaning solution remains at a constant value below or at about 8 for an extended period, it is generally an indication that the system is clean.

Figure 3: Cleaning Solution pH Change with Time



## NORKOOL™ CLEANER COMPATIBILITY

### Mixed Metal Systems

In systems containing significant amounts of both ferrous metals (e.g., cast iron, mild steel) and copper-based metals (e.g., copper, brass, bronze), cleaning chemicals tend to cause copper metal to deposit on ferrous metal components. This sets up localized galvanic corrosion cells, which can be detrimental to the long-term cleanliness and life of the system.

With cleaning solutions containing NORKOOL™ Cleaner, this copper metal deposition can be reversed by injecting air into the cleaning solution after it is exhausted. We recommend air injection for approximately one hour prior to draining the cleaning solution. Consult your Dow sales representative for specific recommendations.

### Galvanized Metals

NORKOOL Cleaner is relatively corrosive to metallic zinc, which is commonly used to coat (galvanize) sheet and tubular steel products used in freshwater and/or in air. The cleaner should not be used in galvanized equipment unless etching of this coating is acceptable. Magnesium-based metals are similarly attacked.

### Elastomers

NORKOOL Cleaner has no significant effect on commonly used elastomers shown in Table 2.

### Polyolefins

Test specimens of polypropylene and low density polyethylene soaked in 3 volume-percent solutions of NORKOOL Cleaner showed no appreciable effect on the polyolefin (Table 3).

### Nonmetallic Films

Nonmetallic films were exposed to water and to a 48 volume-percent solution of NORKOOL Cleaner, respectively, at 160°F (71°C). Film swelling was determined after 12 hours of exposure. As shown in Table 4, NORKOOL Cleaner does not cause swelling of PVC, zinc chromate primer, epoxy, polyurethane or Tygofilm. In most cases, it does not impair the film toughness; only the zinc chromate primer experienced softening.





**Table 2: Effect of NORKOOL™ Cleaner on Elastomers**

<b>Elastomer Type</b>	<b>VOLUME SWELL, % EXPOSURE TO NORKOOL™ CLEANER</b>	
	<b>6 hr</b>	<b>12 hr</b>
Buna N	0.53	0.54
Neoprene	0.70	1.14
Butyl Rubber	0.48	0.85

**Table 3: Effect of NORKOOL™ Cleaner on Polyolefins**

<b>MECHANICAL PROPERTY</b>	<b>POLYPROPYLENE</b>		<b>L.D. POLYPROPYLENE</b>	
	<b>Original</b>	<b>Soaked</b>	<b>Original</b>	<b>Soaked</b>
Tensile Strength (psi)	2784	2784	2224	2240
Elongation, %	150	150	200	200
1% Secant Modulus (psi)	146,000	146,000	29,800	29,800
Notched Izod (lb/in) (1)	3.9	4.7	11.1	11.6

(1) 23°C, 0.125-in bar

**Table 4: Effect of NORKOOL™ Cleaner on Nonmetallic Films**

<b>NONMETALLIC FILM</b>	<b>WATER</b>	<b>NORKOOL™ CLEANER</b>
PVC	None	None
Zinc Chromate Primer	None	None
Epoxy	None	None
Polyurethane	None	None
TygoFilm	None	None





## **ENVIRONMENTAL CONSIDERATIONS**

### **Disposal of Cleaning Solutions**

Always dispose of any chemical in accordance with federal, state, and local laws, rules and regulations. Although unused NORKOOL™ Cleaner and NORKOOL Degreaser contain no heavy metals and are biodegradable, the contaminants drawn from the cleaned system may include hazardous materials. Disposal of depleted cleaning solutions should be done as prescribed by the regulatory authorities responsible for the waste generation site.

### **Environmental Considerations**

NORKOOL Cleaner biodegrades rapidly in laboratory tests and is toxic to *Daphnia magna* (water flea) and bacterial populations at concentrations well above those expected to be encountered.

NORKOOL Degreaser also biodegrades rapidly and, although it is moderately toxic to *Daphnia magna* and fathead minnows, it is relatively non-inhibitory to bacterial populations.

### **Biodegradation – Cleaner**

Laboratory tests using unacclimated biomass indicate NORKOOL Cleaner biodegrades rapidly in a river-simulating system with 5- and 20-day biooxidation values of 45 and

68 percent, respectively. Biooxidation is the percentage ratio of biochemical oxygen demand to the ultimate potential oxygen requirements, either measured or calculated.

### **Biodegradation – Degreaser**

Laboratory tests using unacclimated biomass indicate NORKOOL™ Degreaser biodegrades rapidly in a river-simulating system with 5- and 20-day biooxidation values of 45 and 100 percent, respectively.

### **Aquatic Toxicity – Cleaner**

Acute toxicity tests with *Daphnia magna* show NORKOOL Cleaner is slightly toxic with a 48-hour LC50 of 760 mg/L. Also, bacterial inhibition tests indicate a median inhibition concentration (IC50) of 910 mg/L.

### **Aquatic Toxicity Degreaser**

Acute toxicity tests with *Daphnia magna* and fathead minnows show NORKOOL Degreaser is moderately toxic with a 48-hour LC50 of 30 mg/L with *Daphnia magna* and a 96-hour LC50 of 23 mg/L with fathead minnows. Bacterial inhibition tests indicate this product is relatively nontoxic with a median inhibition concentration (IC50) greater than 5000 mg/L.

## PHYSICAL PROPERTIES

Table 5: Typical Physical Properties\*

PROPERTY	NORKOOL™ CLEANER	NORKOOL™ DEGREASER	NORKOOL™ INHIBITOR 244
Color	Green	Amber	Yellow
pH	5.8 - 6.8	7.2 - 8.2	11 - 13
Freezing Point, °F (°C)	18 (-8)	30 (-1.1)	10 (-12)
Normal Boiling Point, °F (°C)	217 (102.7)	213 (100.6)	220 (104)
Vapor Pressure, Reid	1.2	1.4	1.4
Bomb at 100°F (38°C), psia			
Weight per U.S. Gallon at 68°F (20°C), lb	9.36	8.66	9.76
Flash Point			
Pensky-Martens Closed Cup (1)	None	None	None
Cleveland Open Cup (2)	None	None	None

(1) ASTM D 93

(2) ASTM D 92

\*The data provided for these properties are typical values and should not be construed as sales specifications.

## PRODUCT SAFETY

### Product Safety

When considering the use of any Dow Oil & Gas products in a particular application, you should review our latest Material Safety Data Sheets and ensure that the use you intend can be accomplished safely. For Material Safety Data Sheets and other product safety information, contact Dow. Before handling any other products mentioned in the text, you should obtain available product safety information and take necessary steps to ensure safety of use.

No chemical should be used as or in a food, drug, medical device, or cosmetic, or in a product or process in which it may contact a food, drug, medical device, or cosmetic until

the user has determined the suitability and legality of the use. Since government regulations and use conditions are subject to change, it is the user's responsibility to determine that this information is appropriate and suitable under current, applicable laws and regulations.

Dow requests that the customer read, understand, and comply with the information contained in this publication and the current Material Safety Data Sheet(s). The customer should furnish the information in this publication to its employees, contractors and customers, or any other users of the product(s) and request that they do the same.

## EMERGENCY SERVICES AND SUPPORT

Dow maintains 24-hour emergency service for its products.

The American Chemical Council (CHEMTREC), Transport Canada (CANUTEC), and the National Chemical Emergency Center maintain 24-hour emergency service:

LOCATION	DOW PRODUCTS	ALL CHEMICAL PRODUCTS (in case of emergency)
United States and Puerto Rico	800-DOW-CHEM	Phone CHEMTREC: 800-424-9300
Canada	519-339-3711 (collect)	Phone CANUTEC: 613-996-6666 (collect)
Europe Middle East North and Central Africa	49 41 469 12333	
Latin America Asia/Pacific South Africa Any other location worldwide	Phone United States: 989-636-4400 (collect)	
At sea: radio U.S. Coast Guard, who can directly contact: <ul style="list-style-type: none"> <li>• Dow...800-DOW-CHEM</li> <li>• CHEMTREC...800-424-9300.</li> </ul>		
DO NOT WAIT. Phone if in doubt. You will be referred to a specialist for advice.		

### Support Services

For more information about these or any Dow Oil & Gas product, please call the number for your area listed on the back cover of this brochure.





### **TO LEARN MORE...**

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**Europe, Middle East:** Phone Toll Free: +800-3-694-6367\*

Phone: +32 3-450-2240 Fax: +32 3-450-2815

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