aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Chemicals, Lubricants and Accessories

Catalog G-1, April 2012

Parker

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Catalog G-1, April 2012 supersedes Catalog G-1, January 2008 and all prior publications.

Lubricants - Retrofit To Emkarate Polyol Ester

Emkarate RL and the Rapid Retrofit Technique Reduces Retrofit Time

A proprietary technique has been developed to save time retrofitting CFC/HCFC systems to environmentally friendly HFC refrigerants and EMKARATE RL lubricants. This procedure eliminates many of the service visits now required as part of the "dilution retrofit method" which typically involves up to five lubricant flushes. This novel technique improves the cost effectiveness of transitioning from CFC and HCFC refrigerants to long term HFC refrigerants and EMKARATE RL lubricants.

The Advantages

- Lower labor costs by reducing service visits from 3-5 to only 1 or 2 visits.
- Lubricant cost can be reduced by the cost of 1 to 2 lubricant changes.

The Concept Behind The Technique

- Most of the mineral oil retained in a system is in the evaporator.
- EMKARATE RL polyol ester lubricant exhibits a greater surface affinity for metal than does traditional mineral oil.
- This property can be used to "push" the mineral oil off the metal surface of the evaporator and back to the compressor.
- Specific application of these principles (patent pending) can reduce the time and cost of the "dilution retrofit method" without potentially changing system chemistry, with the introduction of new chemicals to the system as other flushing fluid methods suggest.

An Overview Of The Procedure

- Prior and post lubricant change procedures should be followed including changing system filter-driers.
- With the system shut down, EMKARATE RL polyol ester is added to the liquid line after the liquid receiver.
- The system is started with evaporators fully loaded for the EMKARATE RL polyol ester to "push" the mineral oil out.
- The lubricant level must be monitored and drained from the compressors as necessary to maintain proper fill levels.
- After the EMKARATE RL polyol ester has returned to the compressor, the standard lubricant change is done.
- If necessary, further lubricant changes are carried out to get the desired level of residual mineral oil or alkylbenzene oil.

Lubricants - Retrofit To Emkarate Polyol Ester

Emkarate RL and the Rapid Retrofit Technique Reduces Retrofit Time

Specific Instructions

1. Gather and record all system operation data in order to establish base line information.
2. Begin defrost cycle on all evaporators in order to maximize the return of mineral or alkylbenzene oil to the compressor. If defrost cycle is not included in the system design go to step three.
3. Shut down refrigerant system and isolate the compressor. Remove refrigerant from compressor through access ports by using proper methods with recovery equipment. Balance of CFC or HCFC refrigerant will remain isolated in the system.
4. This "down" time will allow the oil in the compressor to warm, allowing it to drain easier.
5. Drain mineral oil from compressor. Use a hand pump to remove oil residue in compressor sump.
6. Install drain valves on all compressors to drain off returning mineral oil to prevent over filling of compressors.
7. Recharge compressors with the OEM required fill of approved EMKARATE RL lubricant. Use with appropriate equipment (sealed refrigeration oil pumps, etc.) using proper procedures.
8. Isolate and change filter-driers.
9. With oil hand pump, add an additional volume of EMKARATE RL lubricant equal to 1/2 of what was just charged to the compressor(s) through the liquid line after the condenser (or after the liquid receiver).
10. Ensure that all automatic/manual defrosts remain off.
11. Recharge the portion of CFC or HCFC that was removed from the compressor in step three.
12. Restart the refrigeration system, recall 50% extra lubricant now exists in the system.
13. Monitor compressor crankcase oil levels, and drain crankcases as necessary to maintain proper oil levels. In approximately 30 minutes, most of the extra POE lubricant including much of the remaining mineral or alkybenzene oil, will have drained from the system.
14. After 30 to 40 minutes, run defrost cycle(s) again to maximize oil return to the compressors.
15. Shut down refrigeration system and sample the oil from the compressor crankcase; if there are multiple compressors, sample each compressor.
16. Using a refractometer or Virginia RTK test kit, test the sample(s) for residual mineral oil content. For the first trial, you should not expect the residual mineral oil to automatically have reached the target of ≤5%. If you're sampling more than one compressor, take an average of the test results.
17. Isolate compressors once again, and recover CFC or HCFC in compressors.
18. Drain lubricant from compressors, and charge with an equal volume of the same EMKARATE RL lubricant. Use hand pump to remove oil residue in compressor sump.
19. Isolate and change filter-driers.
20. Restart refrigeration system and run to achieve full circulation of lubricant/refrigeration mixture.
21. After brief run time, sample lubricant and test with refractometer or test kit.
    - If mineral oil residue is below 5% (and it should be at this time), turn system off and recover CFC or HCFC refrigerant. Charge system with the desired HFC refrigerant.
    - Though unlikely, if the mineral oil residue is still above 5% repeat steps 15 - 18 and retest.

Emkarate RL Frequently Asked Questions

What is hygroscopicity and its association with lubricants?

Hygroscopicity is a term used to describe the affinity for moisture of a lubricant and/or refrigerant. HFC refrigerants and POE lubricant have polar molecular structures, which attract polar water molecules. The solubility of water in HFCs, such as R134a is many times greater than in the CFCs they replace. POEs are also hygroscopic and can pick up more moisture from their surroundings and hold it much tighter than traditionally used mineral oils. The most hygroscopic refrigeration lubricants in descending order are: PAGs, PVEs, POEs, ABs, and mineral oils. The rate at which POEs pick up moisture is dependent on temperature, relative humidity, exposure time, and relative surface area. Polyaklyene glycol (PAG) lubricant is typically used in automotive applictions and polyvinylether (PVE) is used sparingly in certain regions of the world.

How does moisture enter a refrigeration system?

Moisture can enter the refrigeration system by a number of routes:

- Improper evacuation of the system
- System leaks
- System components
- Improper handling of the refrigerant
- Improper handling of POE lubricants (e.g. excessive exposure to air)

How is moisture measured in the refrigeration system?

The most practical form of system testing is the use of a moisture and liquid indicator. This device gives field guidance to the moisture level in the system. At a minimum, the filter-drier must be changed if an elevated moisture level is seen in the moisture and liquid indicator. For an in depth evaluation of the refrigerant and lubricant mixture, laboratory options are available.

Karl Fisher titration (ASTM E1064) has become the accepted standard method for laboratory determination of moisture in refrigerants and lubricants. Purpose built equipment is commercially available from several manufacturers. Samples of lubricants can be taken and placed inside the Virginia OA-1 test kit. This test kit is sent to our lab for complete analysis, which includes moisture content levels.

What does the term hydrolysis mean?

Hydrolysis is the reverse of the esterification process, in which water reacts with an ester to form partial esters, the original organic acid and alcohol. The degree of hydrolysis is driven by the amount of water present. The speed at which hydrolysis occurs is dependent on the temperature of the system and the acid content (acids can act as a catalyst). In addition to an elevated acid content select lubricant additives and impurities inside the system can catalyze this reaction.

What should the moisture content be for refrigeration lubricants?

Less than 50 ppm in the lubricant before addition to the refrigeration system and <100 ppm in the system.

POE's are very hygroscopic. Must I throw out any unused lubricant once I have opened the can?

No, as long as the container of POE is tightly capped immediately after each use, the lubricant can be used until the container is exhausted.

What procedures are recommended for maintaining low moisture contents in POE lubricants?

Good practices should eliminate most potential sources of moisture.

- Avoid exposing POE lubricant to air for an extended period of time (<10 minutes).
- Keep containers of POE lubricants tightly closed except when the oil is actually being dispensed.
- Keep the compressor and refrigeration system components closed, except when work is actually being performed on the equipment. Never leave the equipment open during work breaks, overnight, or while doing other work.
- Keep POE lubricants in their original containers.
- Ensure that any vessel or equipment used to transfer the POE is thoroughly dried.
- The use of a new appropriately sized filter-drier, after servicing a refrigeration system, will reduce the impact of moisture introduction that could have occurred.

Emkarate RL Frequently Asked Questions

At what temperature will EMKARATE RL lubricant break down?

Lubricants with a thermal stability of >175°C (347°F) has generally been shown to be of sufficient stability to work well in refrigeration systems. The glass sealed tube test, as described by ASHRE Standard 97, is widely used to assess the stability of refrigeration lubricants. This method is widely viewed as the standard for thermal stability screening tests. Historical test results using this procedure show EMKARATE RL lubricants excel in thermal stability, by achieving results beyond 175°C.

Are there EMKARATE RL lubricants for low temperature applications?

Several years of research by the lubricant manufacturer, and ultra low temperature system manufacturers using a variety of compressors, have shown the "H" series lubricants demonstrate outstanding performance. Compressor screening and field trials have demonstrated that EMKARATE RL "H" lubricant possess good lubricant return and excellent lubricating performance at temperatures as low as -100°C (-166°F) with R508, R503 and other ultra low temperature refrigerants. Cascade systems and environmental chambers have been commercially using various low temperature refrigerants and EMKARATE RL "H" lubricants successfully for several years.

It is important to note, that for ultra low temperature applications, all the components of the lubricant including the addition of additives have to demonstrate good solubility and low temperature flow characteristics. Correct formulation of the polyol ester lubricant eliminates components which have poor low temperature flow performance. If the polyol ester lubricant is incorrectly formulated, components which have poor low temperature flow performance can precipitate leading to waxy deposits and poor performance at the metering device. This can occur with lubricants which are miscible at very low temperatures. Extensive testing of the "H" series has shown them to be highly resistant to waxy deposit formation.

The superior lubricity of the Emkarate RL "H" series lubricants also allows them to be used without antiwear additives, thus avoiding the many potential disadvantages of employing this additive. Their excellent performance has resulted in a wide range of approvals. EMKARATE RL32H is particularly suitable for cryogenic applications.

How do I dispose of EMKARATE RL after use?

EMKARATE RL lubricants can be handled in a manner similar to used mineral or alkylbenzene oils. Using approved oil recoverers, disposal should always be carried out in accordance with local, state and national regulations.

What is the EMKARATE shelf life?

Shelf life is two years provided correct handling procedures are followed.

What can I use to check acid level in a refrigeration system?

The most convenient method of testing the acid level of a refrigeration oil is the use of a Virginia acid test kit. A more accurate, but less convenient, method of measuring acid value is to use the Virginia OA-1 test kit and send an oil sample to our certified test laboratory, which will evaluate the total contaminant content in the lubricant.

What refrigerants are EMKARATE RL lubricants compatible with?

All CFCs, HCFCs, HFCs, carbon dioxide and hydrocarbons (e.g. R290, R600a) refrigerants.

EMKARATE RL lubricants are **not** compatible with ammonia (R717).

What elastomers are compatible with EMKARATE RL?

Generally Acceptable: HNBR, NBR (Buna-N), NYLON 6-6 , TEFLON

Marginal: EPDM (EPR), NEOPRENE

Generally Unacceptable: Butyl Rubber, Fluorocarbon Rubber (FPM) (Viton), Natural Rubber (NR)

NBR/HNBR should exceed >36% nitrile content. Elastomer compounds supplied by different suppliers can yield different results. Individual testing of specific products is highly recommended.

Are there new brand names for Icematic products?

The following Icematic products have been rebranded under the Emkarate RL brand.

ICEMATIC	EMKARATE
Icematic SW32 and 32C	Emkarate RL32H
Icematic E68 and SW68A	Emakrate RL68H
Icematic SW68C	Emkarate RL68H

Emkarate RL Product Data

Value	Viscosity at 105°F (40°C)	Viscosity at 212°F (100°C)	Pour Point	Density at 68°F (20°C)	Flash Point
Units	**CST**	**CST**	**°F (°C)**	**g/ml**	**°F (°C)**
Test Method	**D445**	**D445**	**D97**	**D1298**	**D92**
LE32H	32.5	5.8	-51 (-46)	0.977	496 (258)
LE32-3MAF	31.2	5.9	<-40 (<-40)	0.981	>446 (>230)
LE68H	65.5	9.3	-38 (-39)	0.980	518 (270)

Value	Water Content	Acid Value	Hydroxyl Value	Calour	Miscibility 10% Lube in R134a
Units	**ppm**	**mg KOH/g**	**mg KOH/g**	**Hazen**	**°F (°C)**
Test Method	**E1064-85**	***in-house**	**E326**	**D1209**	**in house**
LE32H	<40	0.02	<4.5	60	-44 (-42)
LE32-3MAF	<50	0.02	<4.5	–	-22 (-30)
LE68H	<40	0.02	<4.5	70	-15 (-26)

Test methods are ASTM Standard methods unless otherwise stated.
**This is a modified version of ASTM D974.*

Emkarate Polyol Ester Cross Reference

INDUSTRY LUBRICANT	VISCOSITY		EMKARATE RL LUBRICANT	VIRGINIA PRODUCT
	SUS	ISO		
Atochem Planet Elf ACD32AW	150	32	RL 32H	LE 32H
Atochem Planet Elf ACD46AW	200	46	RL 46H	LE 46H
Atochem Planet Elf ACD68AW	300	68	RL 68H	LE 68H
BVA S68	300	68	RL 68H	LE 68H
BVA 32	150	32	RL 32H	LE 32H
BVA 68	300	68	RL 68H	LE 68H
Castrol Icematic SW 32	150	32	RL 32H	LE 32H
Castrol Icematic SW 32C	150	32	RL 32H	LE 32H
Castrol Icematic SW 68C	300	68	RL 68H	LE 68H
Castrol Icematic E 68	300	68	RL 68H	LE 68H
Carrier PP 47-12	300	68	RL 68H	LE 68H
Carrier PP 47-16	150	32	RL 32H	LE 32H
Carrier PP 47-17	300	68	RL 68H	LE 68H
Carrier PP 47-25	150	32	RL 32H	LE 32H
Carrier PP 47-26	300	68	RL 68H	LE 68H
Carrier PP 47-30	150	32	RL 32H	LE 32H
PP23BZ102	150	32	RL 32H	LE 32H
PP33BZ106	150	32	RL 32H	LE 32H
PP23BZ107	300	68	RL 68H	LE 68H
Copeland 22CC	100	22	RL 32-3MAF	LE 32-3MAF
Copeland 323MAF	300	32	RL 32-3MAF	LE 32-3MAF
CPI Solest 31HE	150	32	RL 32H	LE 32H
CPI Solest 32	150	32	RL 32H	LE 32H
CPI Solest LT32	150	32	RL 32H	LE 32H
CPI Solest LT32NA	150	32	RL 32H	LE 32H
CPI Solest 68	300	68	RL 68H	LE 68H
CPI Solest 68NA	300	68	RL 68H	LE 68H
Emery 2927-A	150	32	RL 32H	LE 32H
Freol Alpha 68	300	68	RL 68H	LE 68H
Hatco EAL 22CC	100	22	RL 32-3MAF	LE 32-3MAF
Hatco EAL 32	150	32	RL 32H	LE 32H
Hatco EAL 32ST	150	32	RL 32H	LE 32H
Hatco EAL 68	300	68	RL 68H	LE 68H

Emkarate Polyol Ester Cross Reference

INDUSTRY LUBRICANT	VISCOSITY		EMKARATE RL LUBRICANT	VIRGINIA PRODUCT
	SUS	ISO		
Henry Pro-Eco 2821	150	32	RL 32H	LE 32H
Henry Pro-Eco 2887	200	32	RL 32H	LE 32H
Henry Pro-Eco 2830	300	68	RL 68H	LE 68H
HULS Anderol RCF-E32	150	32	RL 32H	LE 32H
HULS Anderol RCF-E68	300	68	RL 68H	LE 68H
Hydro Balance ISO32	150	32	RL 32H	LE 32H
Hydro Balance ISO68	300	68	RL 68H	LE 68H
Lubrizol 2916S	300	68	RL 68H	LE 68H
Lubrizol Lubrikuhl ISO68	300	68	RL 68H	LE 68H
Mobil Artic EAL 322R	150	32	RL 32H	LE 32H
Mobil Artic 22CC	100	22	RL 32-3MAF	LE 32-3MAF
Mobil Artic 32	150	32	RL 32H	LE 32H
Mobil Artic 323MAF	150	32	RL 32-3MAF	LE 32-3MAF
Mobil Artic 68	300	68	RL 68H	LE 68H
National NPE-32	150	32	RL 32H	LE 32H
National NPE-68	300	68	RL 68H	LE 68H
Reniso E32	150	32	RL 32H	LE 32H
Reniso E68	300	68	RL 68H	LE 68H
Reniso Triton SEZ 32	150	32	RL 32H	LE 32H
Summit RPE-32	150	32	RL 32H	LE 32H
Summit RPE-68	300	68	RL 68H	LE 68H
Suniso SL 32	150	32	RL 32H	LE 32H
Suniso SL 68	300	68	RL 68H	LE 68H
Texaco HFC 32	150	32	RL 32H	LE 32H
Texaco HFC 68	300	68	RL 68H	LE 68H
Texaco HFC 32NA	150	32	RL 32H	LE 32H
Texaco HFC 68NA	300	68	RL 68H	LE 68H
Thermo King 203-413	150	32	RL 32H	LE 32H
Thermo King 203-426	150	32	RL 32H	LE 32H
Thermo King 203-433	150	32	RL 32-3MAF	LE 32-3MAF
York Type K	150	32	RL 32H	LE 32H
York Type L	150	32	RL 32H	LE 32H
York Type H	300	68	RL 68H	LE 68H

Emkarate RL Lubricants - Approval List

Industrial and commercial compressor manufacturers - HFC/HCFC Systems

EQUIPMENT MANUFACTURER	COMPRESSOR TYPE / (MODEL)	APPROVED EMKARATE RL GRADE(S)	VIRGINIA CATALOG NO.
BITZER	Reciprocating (M)	RL 32H	LE 32H
	Reciprocating (H)	RL 68H	LE 68H
BLISSFIELD	Reciprocating (M)	RL 32H	LE 32H
	Reciprocating	RL 68H	LE 68H
BOCK	Reciprocating (H, M)	RL 68H	LE 68H
BOEING	Service (Aerospace)	RL 68H	LE 68H
CARLYLE CARRIER TRANSICOLD	Centrifugal (17DA, 17EA)	RL 32H	LE 32H
	Centrifugal (17MPS, 17FA)	RL 68H	LE 68H
	Reciprocating (05G, 5K, 5F, 5H, 06D, 06E, 06CC)	RL 68H	LE 68H
CARRIER TOYO	Reciprocating	RL 68H	LE 68H
CARRIER TRANSICOLD	Scroll	RL 32-3MAF	LE 32-3MAF
DORIN	Reciprocating	RL 32H & 68H	LE 32H & 68H
DUNHAM BUSH	Reciprocating (D-B Metic and D line)	RL 32H & 68H	LE 32H & 68H
FRIGOPOL	Reciprocating (60-DLB-13 to 80-DLB-30)	RL 32H	LE 32H
GRASSO (GEA)	Reciprocating	RL 32H, 68H & 100E	LE 32H & 68H
HARTFORD	Reciprocating (M)	RL 32H	LE 32H
	Reciprocating (H)	RL 68H	LE 68H
LOCKHEED MARTIN	Used to service Lockheed owned compressors	RL 68H	LE 68H
McQUAY (J&E Hall)	Centrifugal	RL 32H	LE 32H
	Screw	RL 68H, 68HP, 100E, 220Hplus	LE 68H
MYCOM	Reciprocating	RL 68H, 100E	LE 68H
NATO MILITARY NSN	NSN 6850-P4314-H	RL 32H	LE 32H
	NSN 9150-01-435-1899	RL 68H	LE 68H
	NSN 9150-01-410-8972	RL 68H	LE 68H
	NSN 9150-01-387-4469	RL 68H	LE 68H
PRESTCOLD	Reciprocating	RL 32-3MAF	LE 32-3MAF
REFCOMP	Reciprocating	RL 32H & 68H	LE 32H & 68H
ROLTEC	Screw	RL 68H ,170H & 220Hplus	LE 68H
ROYCE	Reciprocating	RL 32H	LE 32H
SABROE	Reciprocating	RL 32H, 46H, & 68H	LE 32H & 68H
	Screw	RL 68H, 100E, 170H	LE 68H
THERMO KING	Reciprocating	RL 32H	LE 32H
TRANE	Reciprocating	RL 68H	LE 68H
	Screw	RL 68H	LE 68H

This approval list should be used as a guide only. User should confirm with the original equipment manufacturer which EMKARATE RL grade is qualified for use with a particular combination of compressor model, refrigerant and application.

Lubricants / Oils

EMKARATE RL™ Polyol Ester Refrigeration Lubricants

Emkarate RL polyol ester refrigeration lubricants are specifically designed for use with HFC and HCFC refrigerants. The Emkarate line of polyol ester lubricants is one of the most widely accepted brands by major OEMs. Use in a range of applications, including reciprocating, centrifugal, rotary, screw and scroll compressors. ***Products LE32-3MAFQ and LE32-3MAF1 are Copeland Approved.***

- Excellent thermal stability.
- Much lower pour points than mineral oils. Superior low temperature performance.

Viscosity	1 Quart	1 Gallon	5 Gallon
100 SUS (ISO 22)	–	–	–
150 SUS (ISO 32)	LE32-3MAFQ	LE32-3MAF1	–
150 SUS (ISO 32)	LE32HQ	LE32H1	–
300 SUS (ISO 68)	LE68HQ	LE68H1	LE68H5

55 gallon drums are available as special order.
Emkarate products not listed maybe available as special order.

SUNISO™ Mineral Refrigeration Oils

Suniso premium naphthenic based refrigeration and A/C oils have been the AC/R industry standard for over 40 years because of the long trouble-free service records of systems that have used Suniso refrigeration oils. ***Products L316, L318 and L321 are Copeland Approved.***

- Low floc point. Low wax content minimizes the potential for wax separation when used in low temperature applications.
- Low pour point prevents oil from congealing in refrigerant lines.
- Freedom from moisture and other contaminants prevents premature wear and the plugging of lines and oil ports.
- Controlled viscosity. Maintains high film strength even when diluted with refrigerant, yet remains fluid under extreme low temperature operating conditions.
- High dielectric strength allows the oil/refrigerant mixture to serve as an insulator between the motor windings and the body in a compressor.
- High chemical stability minimizes the reaction with refrigerants and other materials that are a part of the system.
- For use with CFC, HCFC and HC refrigerants, as well as some non-fluorocarbon refrigerants including ammonia.

Viscosity	1 Quart	1 Gallon	5 Gallon
150 SUS (ISO 32)	L316	L318	L321
300 SUS (ISO 68)	–	L319	L322
500 SUS (ISO 100)	–	L320	–

55 gallon drums are available as special order.

Lubricants / Oils

Alkylbenzene Refrigeration Lubricants

Virginia alkylbenzene lubricants have been recommended by refrigerant producers and compressor manufacturers for use with the interim HCFC's as well as with CFC's and ammonia. ***Product LAB-201 is Copeland Approved.***

Viscosity	1 Gallon
150 SUS (ISO 32)	LAB151
200 SUS (ISO 46)	LAB201
300 SUS (ISO 68)	LAB301

55 gallon drums are available as special order.

Dual Purpose Vacuum Pump Oil

Specially formulated to seal and lubricate vacuum pumps, as well as acting as a highly effective flushing agent for cleaning vacuum pumps to prevent buildup of sludge and dirt deposits. It's unique combination of additives gives greater lubricity and film strength than straight mineral oil. These additives not only prevent, but actually remove sludge that may have formed before the use of Virginia vacuum pump oil. Virginia dual purpose vacuum pump oil leaves a protective film, protecting the pump from rust and corrosion.

- Lower vapor pressure.
- Powerful anti-sludge agent.
- Prevents rust and corrosion.

1 Quart	1 Gallon
L340	L341

TKO™ Refrigeration Oil Acid Test Kit

One bottle test kit is a simple and cost effective method of determining whether the acid level is within an acceptable range for mineral or alkylbenzene lubricants. Simply fill the bottle with oil to the line on bottle neck and shake.

- Ultra-sensitive color change guarantees an accurate test. Marginal conditions cause partial color changes.
- If the test remains purple, oil is safe. If it turns yellow, acid is too high.
- For use with mineral and alkylbenzene lubricants.
- Color comparison chart in every box.
- Inexpensive to use - billable test.

1 Test Kit
TKO

ETK™ Refrigeration Oil Acid Test Kit

Similar to the TKO test kit, but formulated for POE lubricants. Designed specifically for use with polyol ester lubricants. Test for acid contamination in the compressor's crankcase which can be indicative of lubricant decomposition.

- Adjusted for the higher acid levels of POE lubricants.
- If test remains purple, the oil is safe. If it turns yellow, acid is too high.
- Ultra-sensitive color change guarantees an accurate test. Marginal conditions cause partial color changes.
- Color comparison chart in every box.

1 Test Kit
ETK

Lubricants / Oils

RTK™ Retrofit Test Kit

For use with Emkarate™ polyol ester lubricants to analyze residual mineral oil content during retrofit. In preparation for retrofitting a system to an HCFC, HFC or HC refrigerant, the existing mineral oil must be flushed out and the crankcase refilled with a compatible lubricant. The RTK™ retrofit test kit gives you a simple but accurate indication of whether or not the mineral oil has, in fact, been reduced to an acceptable level. The RTK™ gives a visual indication if the mineral oil content is greater than 5%, between 1 and 5% or below 1%. This allows the technician to easily and inexpensively meet the requirements of the system manufacturer.

1 Test Kit
RTK

OA-1™ Oil Analysis Kit

The OA-1 kit is designed to assist the technician in evaluating the condition of the operating compressor. Using the kit, a sample of any refrigerant lubricant is sent to our laboratory. A complete spectrographic analysis indicating the presence (in ppm) of up to 21 contaminants (including metals which indicate wear), plus a chemical analysis for acid, moisture content and oil viscosity is mailed to the submitter. Based on these readings, the report suggests maintenance and repairs which may be needed. If additional oil samples from the same compressor are sent at later dates, the test report for each sample will list not only the current analysis, but also all of the previous analyses. This builds a history of that compressor's condition and allows the technician to predict needed maintenance and/or replacement.

1 Test Kit
OA-1

MAINTENANCE RECOMMENDATIONS FOR LAB NO.

5105 RECEIVED ON 15-DEC-06 FROM: COMPANY XYZ, DALLAS, TX

Additional samples for baseline / trend is required. Assure continued routine sampling. The silicone is not causing any apparent abrasive wear. Visual appearance does not reveal any abnormalities.

EVAL ID: #4500

SPECTROCHEMICAL ANALYSIS IN PARTS PER MILLION BY WEIGHT

LAB NO.	IRON	CHROMIUM	NICKEL	ALUMINUM	LEAD	COPPER	TIN	SILVER	TITANIUM	SILICON	BORON	SODIUM	POTASSIUM	MOLYBDENUM	PHOSPHORUS	ZINC	CALCIUM	BARIUM	MAGNESIUM	ANTIMONY	VANADIUM	
7065	<1	<1	<1	<1	<1	<1	<1	<.1	<1	<1	<1	<1	14				<10	<10	<1	<30	<1	09-NOV-05
5105	<1	<1	<1	<1	<1	<1	<1	<.1	<1	54						<1	<10	<10	<1	<30	1	06-DEC-06

Example Of Test Results

SAMPLE INFOR

LAB NO.	Mi/Hr Unit	...nr Oil	Oil Add	WATER PPM	VIS CS 40 C	TAN D974
7065				37	61.0	0.02
5105				22	55.4	0.01

Oil Charging Pump

The VOP-H pump is designed to remove oil for recovery, conversions and also to add oil to existing systems. The oil pumps universal stopper automatically adjusts to standard openings in 1, 2-1/2, and 5 gallon containers. The VOP-H is designed to pump against pressures up to 200 psi and comes with a transfer hose and fittings that attach to the bottom of the unit to pump oil from or to equipment quickly and efficiently. For use with alkyl-benzene, ester-based, polyol ester, mineral, and synthetic oils.

Hand Style Oil Pump
VOP-H

Coil Cleaning Basics

Cleaning air conditioner condenser and evaporator coils is a basic need for proper system maintenance. In fact, it is probably the number one performed maintenance task by air conditioning service technicians. It seems however, that with the entrance of so many manufacturers and packagers of coil cleaners, that some of the facts about coil cleaning has been lost. As a premier supplier of coil cleaners for the trade, we will discuss in general terms why coils need to be cleaned, the best way to clean coils, and the different kinds of cleaners on the market today. The disscussion is with aluminum-finned air conditioning applications, but the principles apply to refrigeration applications.

Both condenser and evaporator coils are made for one purpose - to transfer heat. The evaporator coil (indoor coil) is generally designed to pick up heat from the inside air, and the condenser coil (outdoor coil) is designed to give off this heat to the outside air. The exception is a heat pump application in the heating mode where the functions are reversed. As dirt, hair, lint, grass, grease and other contaminants coat the fins and tubes of the coils, the transfer of heat is reduced and system problems increase. A dirty evaporator coil causes less air movement over the coil which results in less heat pickup for the refrigerant. If the heat pickup is not sufficient to vaporize the refrigerant, then one of two things typically occurs: 1) Liquid refrigerant travels back to the compressor and will either wash the lubricant off the bearings and lock the compressor or cause the rotor to drag on the stator and cause a compressor burnout, or 2) liquid refrigerant travels back to the compressor cylinders and the hydraulic pressure breaks valves, typically the suction valves. In the case of a dirty condenser coil, the reduced heat transfer results in higher than normal head pressure and discharge temperatures. This condition causes the compressor to work harder to pump against the higher pressures. The end result is the compressor motor overheats and wears out prematurely. In either case, a dirty condenser or evaporator coil, the compressor is the component that is usually affected the most, not to mention that in both cases the cooling capacity of the system is reduced, resulting in higher electric bills. For these reasons, it is important that both condenser and evaporator coils be cleaned at regular intervals.

Dirty Coils Increase Head Pressure

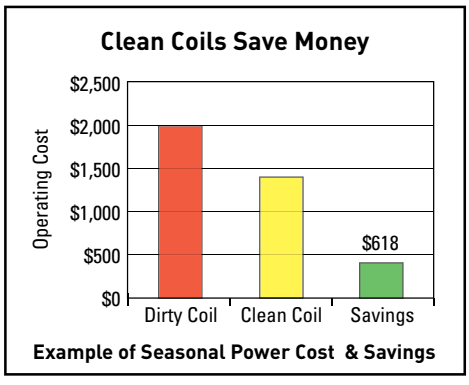
Accumulated dirt, dust and grease insulate against heat transfer. Dirt prevents the condenser coil from rejecting heat as it was designed and elevate head pressure. When head pressure rises, so does eletricity because, of power requirements.

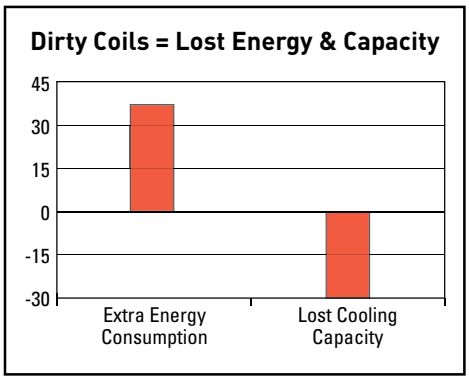
Dirty Coils Decrease Capacity

Higher head pressure also reduces system BTU capacity, by as much as 30%. A 10 ton unit may now only be capable of providing 7 tons of cooling. This causes an increase in run time and inadequate comfort cooling or refrigeration.

Dirty Coils Cost Money

Increased amperage draw combined with longer run time adds up to much higher energy bills. A 10 ton A/C system operating for 1500 hours could use as much as 37% more power when the coils are dirty. With a kWH cost of 8.3 cents this would cost the owner $618 more to operate (or $62 per ton more with dirty coils).





Evaporator Coil Cleaning Basics

Inspection:
Evaporator coils are probably the most difficult to clean. They are usually packed tightly inside a blower compartment that are usually difficult to service. They may be located over bathtubs, in tight dark closets, on rooftops in commercial applications, in a hot attic or a myriad of other places that are usually cramped, dark and uncomfortable. Due to these inconveniences, evaporator coils are often left alone and not cleaned until a system problem emerges. An evaporator coil should be inspected every six months and may need to be cleaned every six months to four years, depending on environment and filtration.

Cleaning:
Make sure to disconnect the power to the unit while cleaning the coil. This will prevent a potential electrical hazard. Disassemble the unit to the extent that both sides of the coil can be accessed. For applications that have matted hair and dirt on the intake side of the coil, it is important that they be carefully brushed clean. Failure to do so will severely limit the penetration of the coil cleaner and dramatically reduce its effectiveness. There are several disposable types of coil brushes available from different manufacturers that do a very good job of cleaning the surface dirt off while keeping your hands away from the filth and fins. One note of warning - the fins on a/c coils are very sharp and can cause severe cuts to skin. Be sure to avoid contact with the coil with your hands, arms, etc. It's advisable to wear gloves, face mask and apron during this procedure since potential organisms growing on the coil and contact with lungs, skin, eyes or clothing may transmit disease. Once the surface dirt has been removed, a good evaporator coil cleaner, such as Acti-Klean should be mixed in a low pressure sprayer with water in a dilution ration of between 3:1 to 1:1, depending on the condition of the coil and the type of dirt encountered. Acti-Klean is a concentrated set of soaps and surfactants (wetting agents that help the cleaner penetrate the coil fully). The coil should then be sprayed liberally from both sides of the coil with the coil cleaner solution. This coil cleaner will not create the foam that condenser coil cleaners do, so don't be shy applying the coil cleaner. Make sure that the liquid does not fall onto electrical components in the system. The cleaner will cut through grease and oils, as well as dislodge any dirt, dust and hair that may be trapped in the coil and rinses them down the condensate drain. An alternative option would be Virginia Coil Klean aerosol coil cleaner. This product will foam out dirt and dust and is certainly more convenient in the aerosol container, although it is more costly than cleaners like Acti-Klean. When the coil is clean, it is recommended that where possible the coil be rinsed off. This will aid in removing any remaining dirt from the coil. If this is not possible, then the condensate created by running the a/c system will rinse off any remaining cleaner. Depending on temperature and humidity conditions, the unit should run for between 15 minutes to 1 hour to ensure all cleaner is rinsed off the coil.

Sanitizing:
In recent years, indoor air quality receives a lot of attention. Often a case of "black mold" in some air conditioning system is reported in the news and the entire building must be evacuated and sanitized. It is a good idea after cleaning the coil that an EPA registered bacteriostat such as Virginia Bio-Klean be used on the coil and surrounding ductwork and insulation to ensure that any minor growths and odors are eliminated. Doing so provides your customer a valuable service by ensuring that mold and other growths do not develop throughout the system. It is important the technician pays close attention to the volume of dirt and other growths coming off the coil. It is not uncommon for release dirt to block the opening of the condensate drain line and restrict the draining of water. If this is observed, the blockage should be removed before the drain pan overflows.

Drain Pan Treatment:
While cleaning the coil, it is a good time to clean the drain pan as well. Simply clean out any rust and deposits that may be sitting in the bottom of the pan with a towel, rag or other means. Once again, be careful not to rub your hand across the coil as the edges are quite sharp. Protective gloves are recommended. Occasional use of Virgina brand pan treatments will dramatically reduce the growth of algae and bacterial growths in the drain pan including Legionella and other serious organisms.

Condenser Coil Cleaning Basics

Condenser coil cleaning is one of those subjects in which there is much misdirection and misinformation being propagated by some manufacturers/distributors that has caused unfortunate confusion in the industry. Addressed below are answers to common questions to set the record straight on the use of these products.

Why do condenser coil cleaners foam and evaporator coils usually don't?

Condenser coils depend on a chemical reaction between the aluminum fins and either a strong acid or alkaline solution to clean the coils. This chemical reaction produces heat and several fumes and gasses (primarily hydrogen) which causes the coil cleaner to foam and push out the dirt loosened by the wetting and heating process. If a foaming condenser coil cleaner is used and does not foam, it means that aluminum is not in the coil (possibly a steel or copper coil), or grease, oil, paint or some other substance is keeping the cleaner from contacting the aluminum and creating the reaction. Due to the fumes given off in this process, these types of cleaners are not suitable for use inside. Evaporator coil cleaners are specifically formulated for indoor use and, although probably not as effective as the foaming condenser coil cleaners, they are effective cleaners on the types of dirt commonly found on evaporator coils.

What is the difference between the acid and non-acid condenser coil cleaners?

In the past, acid based condenser coil cleaners were the standard. There really was no other option. The primary acid of choice was hydrofluoric acid (HF) because it reacted well with aluminum to create the desired foam. It was common knowledge that HF was a serious chemical and needed to be used with a certain amount of caution. One of the peculiar things about HF is that if it comes in contact with skin, it typically does not create a burning sensation immediately. Instead it can soak into the skin and later cause the user pain. By this time, skin and tissue damage is advanced and may require a trip to the doctor for a neutralizing injection. Due to this danger, coil cleaner manufacturers developed a non-acid (alkaline) coil cleaner whose primary ingredient was either sodium hydroxide or potassium hydroxide, both of which are very similar chemically. These chemicals do cause a burning sensation when in contact with skin and the discomfort will encourage the user to rinse the cleaner off before serious skin and tissue damage occurs. It should be noted, however, that neither type of cleaner should be called safe. Both the acid and alkaline condenser coil cleaners can cause serious skin and eye damage, and the vapors, especially those during the cleaning process, can cause serious lung and throat problems and should be used with caution. Due to the change of ground pH, both types of cleaners can kill grass and other foliage immediately around the condenser coil. Both types of coil cleaners are technically biodegradable. Both types are for outdoor use only. Both types should be rinsed thoroughly from the coil and surrounding area when the coil cleaning process is complete. These are serious chemicals and demand serious respect.

How much foam do I need to clean the coil?

One of the interesting things that has come about in recent years is the push for cleaners with more and more foam generation. This begs the question "how much foam is really enough?" The idea to keep in mind is that you need enough foam to push out the quantity of dirt down in the coil. More foam does not necessarily mean that the unit is getting any cleaner. Clean is clean - anything more is too much. Before cleaning the condenser coil, the coil should be inspected to determine how dirty it really is. In the vast majority of cases, the coil just has a light coat of dirt and dust covering the surfaces and really just needs a light cleaning. Using super-high foaming cleaners straight out of the bottle is overkill. In most applications, a good coil cleaner such as Acti-Brite or Alki-Foam mixed to a dilution ratio of between 1:2 and 1:4 is usually adequate for most cleaning jobs. The reality is that most technicians love to see thick foam and tend to use the cleaners straight. We discourage this practice because it usually is not needed, can result in damage to the fin stock and results unnecessary amounts of chemicals are transferred into the ground. If inspection determines that a condenser coil is very dirty with grease or other difficult dirt, then a dilution ratio of 1:1 will usually result in a very thick foam and enough chemical to clean virtually any application. If the coil remains dirty after one application, then rinse it off and reapply at a 1:1 ratio.

I get confused with all the different coil cleaners that some companies offer. How many cleaners do I need?

Some companies offer an overwhelming number of different coil cleaners that typically contain hydrofluoric acid and either sodium hydroxide or potassium hydroxide. In reality, most of these coil cleaners are essentially the same chemicals in slightly different proportion or dilution. We believe that our approach is simpler and easier to remember. Sell a basic line of condenser coil cleaners and let the contractor determine what dilution is needed for a specific application. If an application requires light to moderate cleaning, mix the chemicals at a 1:4 to 1:3 ratio. For difficult cleaning jobs, mix the cleaners at a 1:1 to 1:2 ratio. It's that simple.

Condenser Coil Cleaning Basics

Inspection:
Before cleaning a condenser coil, make sure to break power to the unit. Perform an inspection of the coil to determine how dirty it is. This should entail disassembly of the unit to the extent that if there are multiple rows of coils, you can inspect between the rows to determine the depth of dirt. On multiple row coils, it is not uncommon to have a quantity of dirt make it through the outside row of coils and block the inside row of coils. The unit may look clean from the outside, but airflow is blocked.

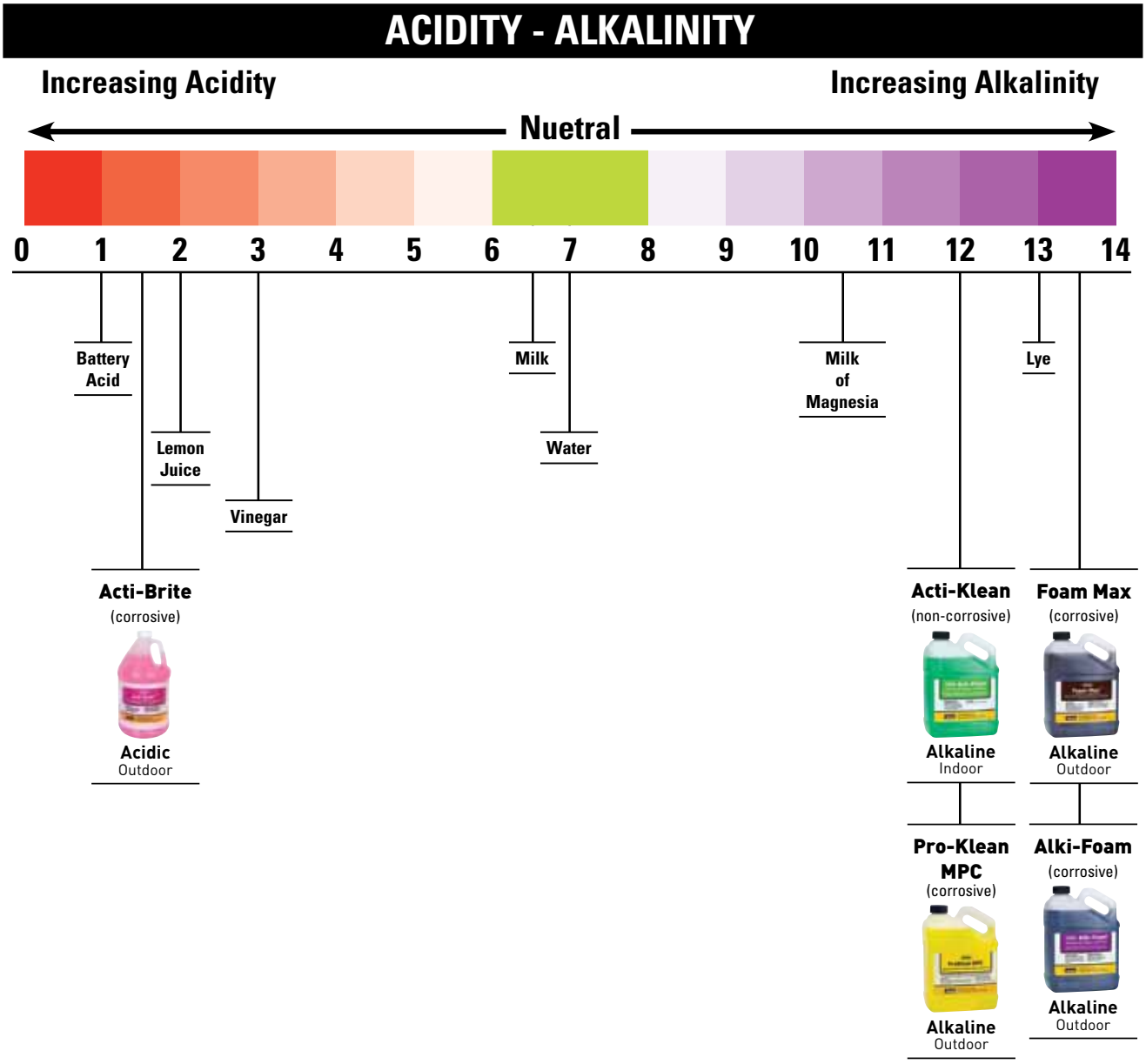
Cleaning:
If accumulations of dirt, dust, cottonwood or other contaminants is matted on the face of the coil, it is a good idea to use a coil brush similar to the one discussed in the evaporator coil section to quickly brush the condenser coil face. This will aid in penetration of the coil cleaner and speed up the job considerably. After inspection, mix your coil cleaner in a low pressure sprayer to a ratio appropriate for the amount of dirt on the coil (1:1 to 1:2 for heavily soiled coils, 1:3 to 1:4 for light to medium soiled coils). It is recommended that due to the nature of these chemicals, chemical impervious gloves, goggles and apron are worn. Always make sure to put the cleaner in the sprayer first, then add the appropriate amount of water. Wet the coil with water first as this will aid penetration of the cleaner into the coils. Apply the cleaner to both the inlet and outlet side of the coil, saturating the coil with cleaner. Caution should be taken on windy days as condenser coil cleaners can etch glass and remove paint from vehicles, as well as cause harm to anyone standing downwind. Do not allow the cleaner to rest on other system components. Sprayers with foaming tips are not recommended as pre foaming the cleaner will hinder penetration into the coils. The foam generated is a chemical reaction with the aluminum, not from a spray tip. Allow the cleaner to work for a maximum of five minutes. During this time, foam should form and dirt should be visibly carried out on the foam. Smoke or other vapors may be visible during this time which are a side effect of the chemical reaction and is not something to be concerned about. Begin rinsing the coil from the top down, taking care not to splash the cleaner on yourself or other surfaces as damage may occur. Continue to rinse the coil until no more foam is visible coming out the bottom of the condenser coil. Be sure to rinse all of the cleaner out of the coil as the cleaners may cause coil damage if left to dry on the coil. Rinse the surrounding area thoroughly with water, reassemble the unit and restore power to the condenser. Always be sure to rinse out the sprayer when finished as the chemicals may cause damage to all but the best sprayers over time.

Coil Cleaner Selection Chart

	Acti-Brite AB1, AB5	Foam Max FM1	Alki-Foam AKF1, AKF5	Pro-Klean MPC1	Acti-Klean AK1, AK5	Coil-Klean IAQ CKIAQ1, CKIAQ16, CKIAQ20	Coil-Klean CK20	Blast-A-Coil BAC-20	Bio-Klean BKQ, BK1	Coat-A-Coil CC20-C
										
	Acidic Outdoor	**Alkaline** Outdoor	**Alkaline** Outdoor	**Alkaline** Outdoor	**Alkaline** Indoor	**Disinfectant** Indoor	**Alkaline** Indoor/Outdoor	**Solvent** Ventilated Area*	**Biocide** Indoor	**Protectant** Indoor/Outdoor
APPLICATIONS										
Condenser Coils	●	●	●	○			●	●		●
Evaporator Coils					●	○	●		○	●
Fan Blades				○			●	●		●
Electronic Air Filters				○						
CLEANING POWER										
Oil & Grease	●	●	●	○				●		
Cooking Grease		●	●	○				●		
Corrosion & Oxidation	●	●	●							
Dirt & Grime	●	●	●	○	●	○	●	●		
Dust & Lint	●	●	●	○	●	○	●	●		
Bugs	●	●	●							
Grass & Cottonwood	●	●	●	○						
Tobacco Stains				○						
MAJOR BENEFITS										
Foaming	● EXTREME	● EXTREME	● EXTREME				●			
Brightening	● EXTREME	●	●							
Non-Rinsing					●	○	●	●		
Degreasing		● EXTREME	● EXTREME	○				●		
Coil Protection										●
Biodegradable	●	●	●	○	●	○	●		○	
Bacterial Stat									○	
Disinfectant / Mildewstat						○				

Read directions on products, product bulletins, and Material Safety Data Sheet for correct use of products and protective equipment requirements.
** Use with good ventilation.*

pH Scale


ACIDITY - ALKALINITY
Increasing Acidity
Increasing Alkalinity
Nuetral
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Battery Acid
Lemon Juice
Vinegar
Milk
Water
Milk of Magnesia
Lye
Acti-Brite
(corrosive)
Acidic
Outdoor
Acti-Klean
(non-corrosive)
Alkaline
Indoor
Foam Max
(corrosive)
Alkaline
Outdoor
Pro-Klean MPC
(corrosive)
Alkaline
Outdoor
Alki-Foam
(corrosive)
Alkaline
Outdoor

Premium Coil Cleaners

Foam-Max™

Virginia Foam-Max is a super high-foaming, alkaline based, outdoor condenser coil cleaner designed for extra tough cleaning jobs. This cleaner creates a super thick foam when used on aluminum condenser coils that cuts through grease, grime and oil and pushes out feathers, dirt, dust, leaves and grass. This highly concentrated formula can be used in lighter dilution ratios to make an economical cleaner for standard cleaning jobs.

1 Gallon
FM1

Alki-Foam™

An alternative method of cleaning fin and tube surfaces of outdoor A/C and refrigeration condensers. The expanding foam action pushes contamination from heat transfer surfaces and increases airflow for increased energy savings. This biodegradable, high foaming formula contains alkaline plus surfactants and is especially effective where grease accumulations have been deposited. This product also removes lint, grass, leaves, insects, feathers and smoke film.

1 Gallon	5 Gallon
AKF1	AKF5

55 gallon drums are available as special order.

Acti-Brite™

This is our acid-based, high-foaming outdoor condenser coil cleaner. It is designed to push contamination from heat transfer surfaces and increase airflow for increased efficiency. Effectively foams away stubborn deposits from air cooled condensers, leaving them clean and bright. The liquid penetrates deep into the recesses of the coils and the expanding foam pushes contamination such as lint, grass, leaves, insects, feathers and smoke film out to be rinsed away easily with water.

1 Gallon	5 Gallon
AB1	AB5

55 gallon drums are available as special order.

Acti-Klean™

A heavy duty combination of cleaners and surfactants in a concentrated evaporator coil cleaner. Provides effective deep cleaning of evaporator coils to help restore system efficiency. Fast acting, biodegradable, nontoxic, easy to use. Periodic usage prevents odor causing accumulations that stop up coils. Cleans coils of dirt, lint, hair, grease, slime accumulations, and oil. Can use system generated condensate to rinse away dirt and detergent.

1 Gallon	5 Gallon
AK1	AK5

55 gallon drums are available as special order.

ProKlean MPC™

The special formulation of this biodegradable, multi-purpose cleaner provides effective removal of stubborn deposits which may have proven resistant to other cleaners. MPC is ideal for difficult cleaning tasks such as cleaning electronic air cleaners, permanent air filters, evaporator and condenser coils, and other applications which require deep penetrating action. ProKlean MPC works well with high pressure washers.

1 Gallon
MPC1

Premium Coil Cleaners, Electronic Cell Cleaner

Coil Klean IAQ™

No rinse evaporator coil disinfectant and foaming cleaner that effectively controls mold, slime, and bacteria. This one step disinfectant cleaner is perfect for air conditioners, commercial air handling units, HVAC cooling coils, refrigeration equipment and evaporator coils.

16 Oz. Concentrate	1 Gallon Concentrate
CKIAQ16OZ	CKIAQ1

18 oz. aerosol available, see page 26.

Bio-Klean™

An air conditioning antimicrobial product intended for direct application on coils and other problem surfaces. Bio-Klean is highly effective at eliminating odor-causing microorganisms as well as controlling mold, mildew, algae and bacterial growth. This product has undergone a comprehensive battery of tests at both private labs and major universities proving its effectiveness and safety. It works by robbing organisms of an electron, killing them instantly. Because different electrons are removed each time, there is no way that an organism can become resistant. This product is clear, virtually odorless, non-flammable and non-explosive. There is no rinsing required after application.

1 Quart	1 Gallon
BKQ	BK1

ECC Electronic Cell Cleaner

This specially formulated cleaner provides effective, safe cleaning of air cleaning equipment. Very effective at removing dust, hair, smoke film, pollen and mold spores, as well as bacteria from the surface of the cells, ionizer wires and prefilters. No scrubbing or high pressure sprayers required. Simply spray it on, let it sit a few minutes, then rinse away.

1 Quart	1 Gallon
ECC	ECC-G

Chemical Sprayers

Spray Doc® Premium Tank Sprayers

Non-corrosive polyethylene premium tank sprayers are the perfect solution for many commercial and industrial applications. Crack resistant and made to last, these tough sprayers are easy to operate and clean after use.

1 Gallon
1000P

Pressurized Hand Sprayer

Convenient size, ideal for applying water soluble chemicals. Adjustable spray tip for a steady stream or wide fan spray. Simply pump and spray.

1/2 Gallon
050P

Ice Machine Cleaners, Scale Removers

Metal Safe Ice Machine Cleaner/Scale Remover

Metal Safe -- safe to use on nickel and tin plated evaporators. Used to clean all types of ice machines: cube, tube or flake, and for descaling commercial dishwashers. Restores ice machine efficiency and taste by removing the lime scale build up that develops on ice machines which can insulate cold plates and decrease ice production.

16 Oz.	1 Gallon
H420-16OZ	H421

Ice Machine Cleaner/Scale Remover

Can be used to clean ice machines: cube, tube or flake, and for descaling commercial dishwashers. Restores ice machine efficiency and taste by removing the lime scale that builds up on the cold plates and other surfaces which can decrease ice production and quality. Not recommended for use on plated evaporators.

16 Oz.	1 Gallon
H418-16OZ	H419

Liquid Scale Remover

To be used for cleaning heavily scaled equipment, for removing problem scales, and for those jobs where speed and the higher capacity of liquid are an economic requirement. Liquid scale remover has anti-foaming agents included in its formula. Also contains inhibitors to minimize metal damage.

1 Gallon	5 Gallon
WL1	WL5

Acid Pump

Acid Pump

The H460B acid pump is designed to circulate dilute solutions of inhibited scale removers for acid cleaning air conditioning and refrigeration systems. The hermetically sealed motor makes this unit completely submersible and comes complete with a 6' 3-wire, self grounding cord.

115V 60Hz
H460B

Accessory Hose Kit

The H461 accessory hose kit for the H460B acid pump contains 20 ft. of clear vinyl tubing, 2 plastic male adapters, 2 vinyl hose clamps and 1 stainless steel hose clamp.

20 ft.
H461

Drain Pan Treatments

CDC Anti-Clog®

CDC anti-clog is a simple to use, yet highly effective biocide. This condensate drain pan treatment controls the growth of algae and slime, and it inhibits the growth of harmful bacteria, including those causing Legionnaires disease. Unlike tablets, the plastic encapsulated unit will not block the condensate drain. A corrosion inhibitor is also released to provide rust protection to all metal parts exposed to the condensate. Depending on the climate and the amount of condensate produced, CDC anti-clog will provide effective treatment of condensate for up to 4 months of protection.

Up to 5 tons	5 to 15 tons
FT/C	AT/C

Pan Bar Gold™

Virginia Pan Bar Gold™ strips are simple to use, yet highly effective biocide strips to improve indoor air quality. This condensate drain pan treatment controls the growth of algae and slime, and it inhibits the growth of harmful bacteria, including those causing Legionnaires disease. The product formulation consists of a biocide, corrosion inhibitor, surfactants and odor counteractants to meet all the needs for drain pan protection. Depending on the climate and the amount of condensate produced, Pan Bar Gold™ strip will provide effective treatment of condensate for up to 6 months of protection.

Up to 1-1/2 tons	Up to 2-1/2 tons	Up to 3 to 5 tons	Up to 6 to 10 tons
PBG1C	PBG2C	PBG3C	PBG4C

Leak Locators

Gas Leak Locator

Our original leak detector continues to be one of the industry's most popular. This leak detector is a high viscosity formula, allowing it to be used on higher temperature applications, and it is non-freezing, which makes it effective on all low temperature applications. Gas Leak Locator "sticks" to fittings and joints and a stream of bubbles will form in a few seconds if a leak is present. Gas Leak Locator has a fluorescent dye included in the formula for high visibility, and it comes complete with a dauber on the cap for easy application.

8 Oz. With Dauber	1 Gallon
GL6	GL128

Locator Leak Detector

An extremely effective leak locator in an easy to use package. Because of it's unique formulation, this leak detector is more accurate than electronic leak detectors and can detect even microscopic system leaks within seconds. Simply spray it on all connections and look for the bubbles. No bubbles, no leaks. Locator has been formulated with a red fluorescent dye making visibility easier, even in low light. Since it comes in a handy spray bottle, it is ideal for checking leaks in hard to reach areas, such as inside coils and on fittings that are not easy to reach.

32 Oz. Spray	1 Gallon
LOC	LOC-G

Anti-Freeze

Pipe Saver™ Anti-Freeze

Pipe Saver is a corrosion inhibited propylene glycol based anti-freeze that offers a safer alternative to the more toxic ethylene glycol based solutions. It can protect pipes from bursting down to -100°F (-73°C). Applications include chillers, hydronic heating and process coolers.

1 Gallon
PS1

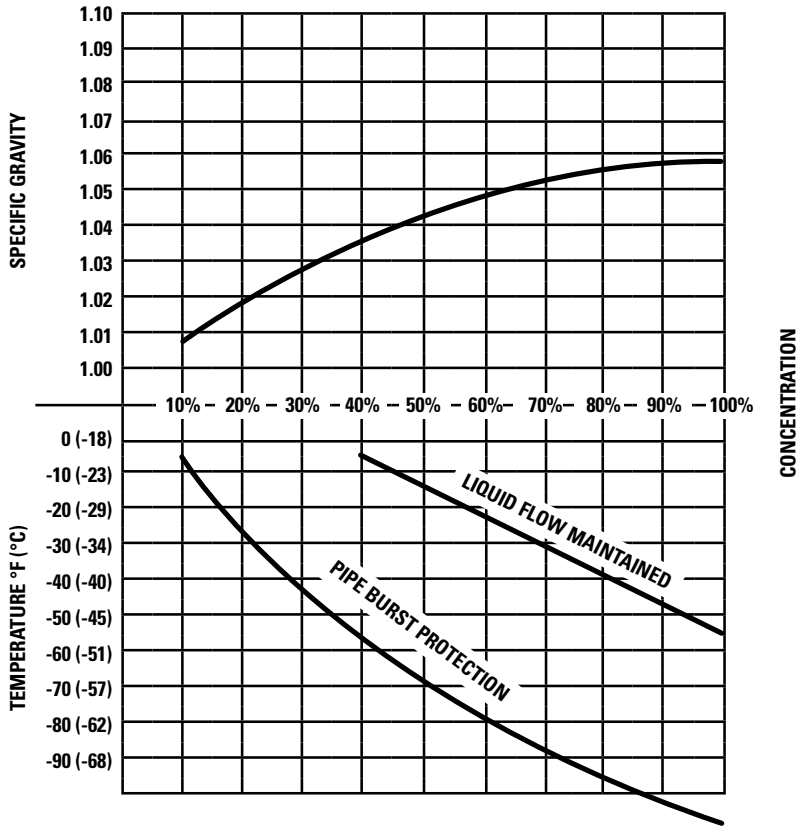
55 gallon drums are available as special order.

PSH Hydrometer

The PSH hydrometer provides the quickest, most economical means of determining the degree of freeze protection by measuring the specific gravity of Pipe Saver product in a system.

1 Hydrometer
PSH

Pipe Saver™ Chart



Insulations, Sealants

Foam Insulation Tape

Prevents pipe sweat. Can also be used to reduce heat loss on hot pipes below 180°F (82°C). Easily cuts into pieces and molds around fittings and valves, eliminating the high cost of specialty cast forms. Adheres to clean metal surfaces and to itself.

Premium	Aternative
K501 (1/8" x 2" x 30')	K502 (1/8" x 2" x 30')

Premium Cork Insulation Tape

Premium product may be used for either hot or cold temperature applications within its continuous duty service temperature range of -20°F to 190°F (-29°C to 88°C). For use on pipes or tubes, in commercial or residential buildings, A/C units, refrigerated units and other similar types of applications. For hot or cold pipes. Stops dripping caused by pipe condensation. Adheres to metal and will not crack or dry out. Self adhering for multiple layers.

Premium	Bulk
PT1 (1/8" x 2" x 30')	VCT2 (1/8" x 2" x 30')

Premium Hi-Temp Cork Insulation Tape

Premium Hi-Temp Cork Insulation Tape is an eco-friendly, non-asphalt based product specifically formulated to provide insulation and to prevent condensation on pipes, fittings, and tubing. It is specifically designed for locations where high ambient temperatures of up to 325°F (163°C) are the norm. Examples of such locations are confined areas of refrigerators and freezers. This product adheres to most clean, dry surfaces and to itself, making possible to apply more than one layer without adding fasteners or adhesives. It is sufficiently soft and pliable to be molded. Temperature range of -20°F to 325°F (-29°C to 163°C).

Premium
PTH1 (1/8" x 2" x 30')

Premium Elastic Sealant Cords & Compound

Premium Elastic Sealant Cords and Compounds are non-hardening, water-resistant, and formulated from the highest quality materials. They are non-staining, non-bleeding, and have excellent adhesion to clean dry surfaces. Supplied in ready-to-use extruded cords or bulk compound. These sealant products are widely used in air conditioning and refrigeration industries to seal around outer cases, behind hinges, and under breaker strips. They can also be used in many other applications to seal around such items as utility panels, cables, ducts, and window frames. With it being water-resistant and permanently pliable, this product is an excellent sealant having a wide variety of applications to provide an effective barrier against water, moisture, dirt and dust.

Cords	Compound
PP33 (3/16" x 100')	PP22 (2 lbs.)
PP36 (3/8" x 25')	

Silicone Sealant

Ideal for sealing around windows, plenums, lines and electrical connections and many other applications with a service temperature range of -62°F to 400°F (-52°C to 204°C).

Color	10 Oz. Tube
Clear	VSC10-C

Mastics, Heat Transfer, Thermal Block

Insulation Mastic

An asphalt emulsion containing a highly efficient cellular material for reducing heat transfer and conductivity. It is designed specifically for coating large area surfaces to prevent moisture condensation and dripping. Once dry, it is waterproof, and forms a coating that is resistant to strong acids and alkalines which makes it an excellent weatherproofer. It dries non-poisonous, non-corrosive and odorless. Virginia Insulation Mastic has a temperature range of -20°F to 200°F (-29°C to 93°C), and will not flow below 250°F (121°C).

1 Gallon
PM11

Thermal Mastic

Heat conducting compound that increases heat transfer four times the amount of mechanical mounting alone. The result is faster response times from expansion valves and controls when connecting the sensor bulb to the suction line, better heat transmission between coils and liners. Thermal Mastic has a working temperature range from -60°F to 212°F (-51.1°C to 100°C).

7.5 Oz. Tube	1 Gallon	5 Gallon	55 Gallon
PM8	PM21	PM25	PM50

Thermal Block™

Effectively absorbs surface heat generated by welding, brazing or soldering. Heat can transmit along pipes and other surfaces and damage sensitive materials and painted surfaces. Thermal Block helps prevent warping, buckling or other distortion on light gauge material, as well as preventing blistering, discoloration or cracking. Now there is no longer any need for wet rags and ice blocks. Thermal Block is applied directly out of the tube onto the surface that needs protection. It is nontoxic, harmless to skin, odorless and asbestos free. Thermal Block is easily cleaned up with water and can be applied to all metals.

11 Oz. Tube
TB2

Aerosol Products

Blast-A-Coil™

This solvent-based, non-ozone depleting aerosol condenser coil cleaner allows the user to Blast-A-Coil with a high pressure liquid that cuts through grease and dirt on refrigeration coils. Cleans grease, dirt, lint and other debris instantly with minimum effort and doesn't require rinsing. Leaves the coil clean and bright with the efficiency restored.

18 Oz. Aerosol
BAC-20

Coil Klean™

Coil Klean is a foaming aerosol evaporator coil cleaner. It penetrates deep into the fins and foams out oil, grease, dust and dirt, leaving fins and surfaces clean and efficient. The aerosol container makes it easy to use, with no mixing required. In applications in which rinsing is not possible, Coil Klean is self rinsing on units generating sufficient amounts of condensate.

19 Oz. Aerosol
CK20

Aerosol Products

Coat-A-Coil™

Forms a hard coating on surfaces and coils protecting them from the damaging effects of salt spray and other chemically active environments. The unique formula provides this protection with NO loss to heat transfer, making Coat-A-Coil excellent for use on both evaporator and condenser coils.

18 Oz. Aerosol
CC20-C

Coil Klean IAQ™

No rinse evaporator coil disinfectant and foaming cleaner that effectively controls mold, slime, and bacteria. This one step disinfectant cleaner is perfect for air conditioners, commercial air handling units, HVAC cooling coils, refrigeration equipment and evaporator coils.

18 Oz. Aerosol
CKIAQ20

Food Grade Silicone Lubricant

This high quality lubricant is for use on moving parts to keep them operating smoothly and quietly. This product is for use on most sliding surfaces that are not intended to be painted or plated, such as drawer and window slides, door hinges, locks, seals and zippers. This lubricant is odorless, colorless, heat-stable and nonstaining.

11 Oz. Aerosol
FGS16

B-Wasp II™

B Wasp II is a concentrated wasp, yellow jacket and hornet killer. This product has a spray nozzle designed for aiming a powerful stream to kill flying insects up to 15 feet away, which helps keep you out of danger. B Wasp II is fast acting on insects which are hit directly, and leaves a residue which repels others for an extended period of time, provided it is not washed off. Good for use around condensing units, electrical panels, food processing plants, farms, restaurants, utility poles and home applications.

13.5 Oz. Aerosol
VB WASP

Handi-Foam® HC

HANDI-FOAM® HC is a multipurpose, U.L. classified, one component polyurethane foam designed to fill, insulate and seal around gaps, beneath base plates, mud sills, top plate penetrations, corner joints, t-joints, exterior cracks, around utility panels, pipes, duct penetrations, etc. It is specifically designed to be dispensed as a bead for filling cracks, crevices, and to fill smaller cavities on flat or irregular surfaces. HANDI-FOAM® HC dries tack-free in approximately 8-10 minutes or less depending on moisture and temperature conditions. It fully cures within 24 hours.

12 Oz. Aerosol
P30002

Nut-Buster™

The latest break through in penetrating technology. By combining rapid freezing action with an advanced rust eating formulation, seized or rusted parts are easily released. Shrinkage of sprayed parts quickly breaks open micro fine fissures allowing lubricant to easily penetrate the toughest rust. The innovative XA-17™ rust eating technology dissolves rust making the job a snap and future maintenance easier as well.

9 Oz. Aerosol
NB9

OFFER OF SALE

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods or work described will be referred to as "Products".

1. **Terms and Conditions.** Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is expressly conditioned on Buyer's assent to these Terms and Conditions and to the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional term or condition of Buyer's order or any other document issued by Buyer.

2. **Price Adjustments; Payments.** Prices stated on the reverse side or preceding pages of this document are valid for 30 days. After 30 days, Seller may change prices to reflect any increase in its costs resulting from state, federal or local legislation, price increases from its suppliers, or any change in the rate, charge, or classification of any carrier. The prices stated on the reverse or preceding pages of this document do not include any sales, use, or other taxes unless so stated specifically. Unless otherwise specified by Seller, all prices are F.O.B. Seller's facility, and payment is due 30 days from the date of invoice. After 30 days, Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. **Delivery Dates; Title and Risk; Shipment.** All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon tender to the carrier at Seller's facility (i.e., when it's on the truck, it's yours). Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's changes in shipping, product specifications or in accordance with Section 13, herein.

4. **Warranty.** Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. This warranty is made only to Buyer and does not extend to anyone to whom Products are sold after purchased from Seller. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

5. **Claims; Commencement of Actions.** Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 60 days after delivery or, in the case of an alleged breach of warranty, within 30 days after the date within the warranty period on which the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for any amount due to Seller from Buyer) must be commenced within thirteen months from the date of tender of delivery by Seller or, for a cause of action based upon an alleged breach of warranty, within thirteen months from the date within the warranty period on which the defect is or should have been discovered by Buyer.

6. **LIMITATION OF LIABILITY.** UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. **IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NONDELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**

7. **Contingencies.** Seller shall not be liable for any default or delay in performance if caused by circumstances beyond the reasonable control of Seller.

8. **User Responsibility.** The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

9. **Loss to Buyer's Property.** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

10. **Special Tooling.** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

11. **Buyer's Obligation; Rights of Seller.** To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest. Seller shall have a security interest in, and lien upon, any property of Buyer in Seller's possession as security for the payment of any amounts owed to Seller by Buyer.

12. **Improper use and Indemnity.** Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

13. **Cancellations and Changes.** Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

14. **Limitation on Assignment.** Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

15. **Entire Agreement.** This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of the agreement. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

16. **Waiver and Severability.** Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

17. **Termination.** This agreement may be terminated by Seller for any reason and at any time by giving Buyer thirty (30) days written notice of termination. In addition, Seller may by written notice immediately terminate this agreement for the following: (a) Buyer commits a breach of any provision of this agreement (b) the appointment of a trustee, receiver or custodian for all or any part of Buyer's property (c) the filing of a petition for relief in bankruptcy of the other Party on its own behalf, or by a third party (d) an assignment for the benefit of creditors, or (e) the dissolution or liquidation of the Buyer.

18. **Governing Law.** This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement. Disputes between the parties shall not be settled by arbitration unless, after a dispute has arisen, both parties expressly agree in writing to arbitrate the dispute.

19. **Indemnity for Infringement of Intellectual Property Rights.** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

20. **Taxes.** Unless otherwise indicated, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of Products.

21. **Equal Opportunity Clause.** For the performance of government contracts and where dollar value of the Products exceed $10,000, the equal employment opportunity clauses in Executive Order 11246, VEVRAA, and 41 C.F.R. §§ 60-1.4(a), 60-741.5(a), and 60-250.4, are hereby incorporated.

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