



# ***COOL WORX***™

## **Energy Savings & Corrosion Protection**

**For HVAC/R Systems**

### **APPLICATOR GUIDE**



**26-C87**

# COOL WORX APPLICATOR GUIDE

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## I. COOL WORX INTRODUCTION

Cool Worx™ is an air-dry water-based acrylic coating powered with GMG Graphene. Cool Worx provides a novel way of increasing heat transfer of air-cooled heat exchangers in HVAC/R, precision cooling, and industrial process cooling applications. The coating is specifically developed for air cooled round tube plate fin (RTPF) and microchannel heat exchangers made of copper/aluminum or all aluminum construction; but also heat exchangers of stainless steel or ferrous alloys. Cool Worx can be used on previously coated and non-coated coils after the coil is properly prepared for its application. Cool Worx can be applied on equipment panels as well when properly cleaned and dried.

### Graphene

Graphene is a two-dimensional allotrope of carbon that is one atom thick, and it forms the fundamental building block for few layered and multilayered graphene. The scientific developments with graphene have been more recent and have drawn much interest for its spectrum of unique combination of properties.

### Benefits of Graphene

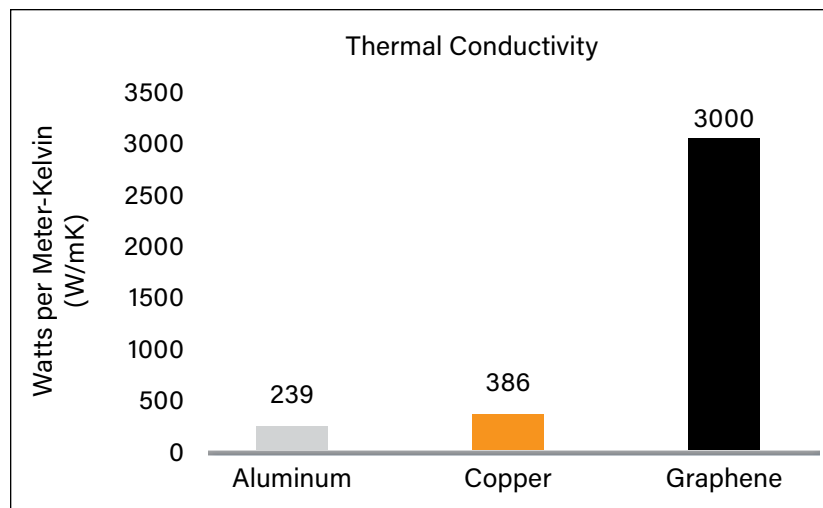
There are a handful of special properties of GMG's Graphene that are beneficial. For its use in Cool Worx, we utilize these unique qualities:

- **High surface area**

Approximately 0.04 wt. ounces (one gram) has a micro surface area up to 3200 sq. feet within the thin coating layer. With the application of Cool Worx, it provides added surface area of the HVAC/R, process coiling, or thermal management coil to help reject heat.

- **High Thermal Conductivity**

Graphene has a reported thermal conductivity of approximately 3000 Watts per Meter-Kelvin (W/mK), making it 12 times more conductive than aluminum and 7 times more than copper! An integrated high conductor in the coil coating aids in rejecting heat from the metal constructed coil.



- **Impermeability**

Even the smallest atom, helium, cannot pass through a sheet of graphene. This impervious layer prevents oxygen from reaching metal surfaces, making it exceptional in eliminating metal corrosion. Graphene has hydrophobic (water repelling) properties when applied in a coating that aid in reducing corrosion.

## II. APPLICATIONS

Air cooled condensers and evaporators in HVAC/R, process cooling, and thermal management systems:

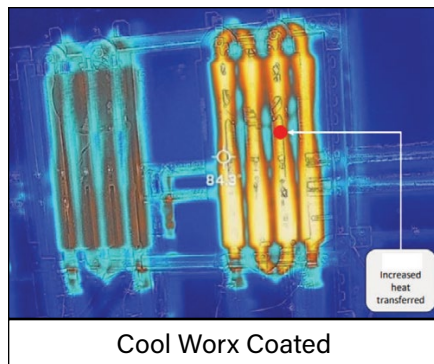
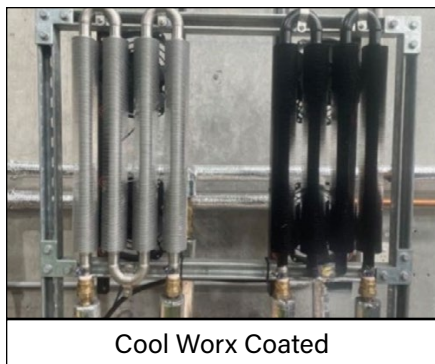
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|----------------------|-----------------------------|---------------------|
| ■ Office Buildings   | ■ Schools                   | ■ Food Storage      |
| ■ Retail Outlets     | ■ Data Centers              | ■ Transport Cooling |
| ■ Hospitals          | ■ Restaurants               | ■ Industrial        |
| ■ Medical Facilities | ■ Hotels                    | ■ Energy Production |
| ■ Care Centers       | ■ Supermarket Refrigeration | ■ Other             |

The best opportunities for desired return on investment (ROI) with energy savings and/or corrosion protection are larger systems or multiple systems at commercial properties. This is especially true where the systems are running at average or above average run time throughout the year in markets where the energy cost are at the national average or higher. Refrigeration systems are excellent candidates to improve efficiency, corrosion protection of the coil, prolong CapEx replacement of the equipment. They also serve as great case studies in Cool Worx benefit since they often and have less variability in the field to showcase its benefit. See Nu-Calgon for details.

Additional Cool Worx opportunities include coastal or other corrosive applications. Cool Worx preserves further coil degradation, restores some lost heat exchanger capability in an effort to prolong CAPEX in system replacement.

In addition to outdoor coils where Cool Worx is commonly applied, Cool Worx has also shown benefit when applied to evaporators. Third party testing has also shown Cool Worx to have antimicrobial properties, which is another benefit for the indoor coil. Application of Cool Worx for the evaporator is best done before the system is commissioned to allow proper coating cure. For applicable larger systems already in service, the use of UV light to facilitate Cool Worx curing is another potential strategy as circumstances dictate. See Nu-Calgon for specific guidance.

Cool Worx has shown benefit in an applicable radiant heating opportunity to improve the emissivity of the metal surface. See the pictures of the test below on a test rig circulating 195°F water.



## III. INVESTMENT TOOLS

### A. Return on Investment (ROI) Calculator

Nu-Calgon has developed a Cool Worx ROI calculator intended to serve as an analytic/sales tool to sell the merits of Cool Worx on a per case basis for the equipment owner. The calculator requires specific system inputs, including run time per day/year along with other inputs such as applicator's expected investment cost of applying Cool Worx (materials and labor) so the end-user can see the expected ROI. The calculator has a default 10% energy savings target, a reasonable expectation on field trials to set ROI calculation expectations. Contact Nu-Calgon for further questions on the ROI calculator.

## B. Estimated Time Guidelines

| Application                       | Setup/Dismantle Time: Day One | Coil Cleaning Time: Day One | Cool Worx Coating Preparation Time: Day Two | Cool Worx Coating Application Time: Day Two | Clean Up & Reassemble Time: Day Two | Estimated Total Time (Based on coating both sides of coil, time would be less with air intake side only) |
|-----------------------------------|-------------------------------|-----------------------------|---------------------------------------------|---------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------|
| Highwall Split AC (up to 1 ton)   | 15 minutes                    | 20 minutes                  | 30 minutes                                  | 15 minutes                                  | 20 minutes                          | 1.6 hours                                                                                                |
| Highwall Split AC (1.5 to 2 tons) | 15 minutes                    | 20 minutes                  | 45 minutes                                  | 15 minutes                                  | 20 minutes                          | 1.9 hours                                                                                                |
| Highwall Split AC (2 to 3 tons)   | 20 minutes                    | 20 minutes                  | 45 minutes                                  | 15 minutes                                  | 30 minutes                          | 2.2 hours                                                                                                |
| Ducted Split AC Small             | 20 minutes                    | 20 minutes                  | 45 minutes                                  | 30 minutes                                  | 30 minutes                          | 2.4 hours                                                                                                |
| Ducted Split AC Large             | 20 minutes                    | 20 minutes                  | 1 hour                                      | 30 minutes                                  | 30 minutes                          | 2.7 hours                                                                                                |
| Package Unit Single Coil          | 20 minutes                    | 20 minutes                  | 2 hours                                     | 30 minutes                                  | 45 minutes                          | 3.9 hours                                                                                                |
| Package Unit Twin Coil            | 30 minutes                    | 30 minutes                  | 3 hours                                     | 1 hour                                      | 1 hour                              | 6 hours                                                                                                  |
| Chiller Up To 10 Coils            | 1 day                         |                             |                                             | 1.5 days                                    |                                     | 2.5 days                                                                                                 |
| Chiller 10-20 Coils               | 2 days                        |                             |                                             | 3 days                                      |                                     | 5 days                                                                                                   |
| Chiller 20+ Coils                 | 2-3 days                      |                             |                                             | 3+ days (depends)                           |                                     | 5+ days                                                                                                  |
| VRV System Single Coil            | 20 minutes                    | 20 minutes                  | 2 hours                                     | 15 minutes                                  | 45 minutes                          | 3.7 hours                                                                                                |
| VRV System Twin Coil              | 30 minutes                    | 30 minutes                  | 3 hours                                     | 30 minutes                                  | 1 hour                              | 5.5 hours                                                                                                |

**Comments:** Above values are estimates and will vary per jobsite depending on system location, coil accessibility, equipment design, weather conditions, water and power availability, etc.

**Cool Worx Coverage:** *Estimated coverage area for Cool Worx is 20 sq. ft. coil surface area per Nu-Calgon's triple coat method per quart.* Nu-Calgon recommends coating both sides of the condenser coil if easily accessible to where it makes economic sense with the investment of time. Depending on specific circumstances, maybe the air intake side and partial of the other backside of the coil or only the air intake side of the coil is feasible due to coil accessibility constraints with condenser design with field application of Cool Worx.

**Many field trials have shown excellent energy savings results with quick return on investment with only applying Cool Worx on the air intake side with systems with average or above average run times in areas with elevated energy cost. The final approach will depend on application and what makes the most financial sense on coil accessibility in equipment design. If corrosion protection is the primary concern in corrosive environments, added thought needs to be considered to paint as much of both sides of the coil that can be reasonably accomplished.**

## C. Cool Worx Coverage Guidelines

- ▶ Cool Worx will cover approximately 20 sq. ft. of coil surface area at four-inch coil depth using the three-coat method specified by Nu-Calgon. Usage is subject to coil condition, coil depth, sprayer setting, and how it is applied. For specific details, see other Nu-Calgon literature on application of Cool Worx.
- ▶ Field trials have shown at a minimum the air intake side of the outdoor coil must be applied with Cool Worx using the three-coat method for coil performance enhancement with improved corrosion protection. However, applying the backside of the coil, or what can reasonably be reached in a timely manner to meet investment expectations, is preferred for best results, especially with corrosion resistance.
- ▶ First measure the length and width (in inches) of each exposed outdoor coil panel to calculate the total surface area of the coil on the air intake side.
- ▶ Use the calculation on the following page to calculate how many quarts of Cool Worx is required for the task per coil side. Please note the following:
  - If multiple coils are the same dimension, use the calculated value below and multiple the number of panels that are of the same dimension to add the total surface area of the air intake size of the coil.
  - If multiple coils are different dimensions, calculate each coil separately using the calculation on the following page and add each of calculations to achieve total surface area.
  - If both air intake side and backside of coil can be coated with Cool Worx, calculate the surface area of the air intake side of the coil and multiply by two.
  - If only partial coverage of backside of the coil can reasonably be achieved, approximate the percentage and add to the requirements of the air intake side. As an example, if the square surface area of the air intake side is 40 sq. ft. and one can easily reach 85% of the backside of the coil then the total surface area for planning purposes would  $40 \times 1.85 = 74$  sq. ft.

### Requirement Calculation:

**Coil Length (inches) x Coil Width (inches) / 2880 = Quart(s) of Cool Worx required per coil side**

#### Guideline examples:

- Typical five-ton outdoor coil requires one quart of Cool Worx per coil side
- Typical thirty ton outdoor coil requires 3-4 quarts of Cool Worx per coil side

## **D. Scope of Work Documentation**

In addition to literature on Cool Worx, ROI calculations on Cool Worx investment, a scope of work document is available for Cool Worx partners to provide the end-user to showcase the Cool Worx process on their asset(s).

## **IV. COOL WORX**

### **A. Test Set-Up Considerations**

1. It is vital to identify systems where field variables are isolated/minimized. Situations to avoid would be varying internal loads or expected wild swings in outdoor temperatures changing to thermostat, etc. These fluctuating conditions affect system operation and will taint the comparative test results. Also, when Cool Worx is applied in very humid environments, such as coastal regions, it can take several weeks for benefit of the coating to manifest in testing because the coating needs more time to cure.
2. Ideal test sites to evaluate Cool Worx will have these considerations:
  - a. Must be an air-cooled heat exchanger used in HVAC/R, precision cooling, or industrial process cooling applications. Another option includes applicable radiant heat coils, contact Nu-Calgon for details.
  - b. For maximum benefit, a slightly compromised or corroded coil is ideal to show more restoring opportunity. However, this is not necessary since independent laboratory testing has shown 15% pull down rate reduction and 5% energy savings benefit when Cool Worx was applied on a new OEM coated coil.
    - i. Note: If the coil fins are too severely damaged to where the coating would not properly adhere to the surface, Cool Worx is not recommended due to the substrate being too compromised. If rust exists, this must be addressed first so Cool Worx will adhere to the surface.
  - c. Ideal applications will have the internal load isolated as much as possible so wild swings in load will not affect the results. Preferred settings would be a section of unoccupied classroom(s) for a period of time, or a freezer with a constant refrigeration load or something similar.
  - d. Depending on the sophistication of determining the benefit of Cool Worx, the outdoor ambient conditions will need to be considered in the final calculations. Both energy and ambient conditions would need to be monitored before and application of Cool Worx for an ample period of time. There are market available energy and temperature monitors available for this type of testing, please contact Nu-Calgon for assistance.
3. There are several ways to evaluate Cool Worx. Typically, Cool Worx is evaluated with energy and temperature monitors over time before and after coating application. Comparable calculations can be made before and after coating application.
4. Sometimes a more simplified approach is desired to see if a benefit can be quickly witnessed. This can be accomplished by running a comparative pull down rate of a system before/after coating the outdoor coil with Cool Worx. A good test set-up example would be as follows:
  - An air conditioning system that cools a large classroom where the room will be empty for a few days and the outdoor temperature is expected to be relatively consistent. Place a small, constant heat load in the room so there is some adequate load on the system to cool the space to where it would take a minimum 30-45 minutes to pull the room to set temperature.

Allow the room to warm, record the starting temperature and time how long it takes to reach the temperature set point. Coat the condenser coil, allow to cure for a minimum 24 hours where ambient temperature is above 50°F and relative humidity is below 80%. Repeat the test on day three (or sometime in a couple of weeks if a humid ongoing outdoor climate to allow coating to fully cure). It is important to start at the same start temperature with the same properly sized artificial load in the room used in the baseline testing to minimize any variance. Repeat the test with the Cool Worx coated condenser and record the time it took to pull down to the same set temperature as the baseline test and compare results.

## B. Tools/Supplies Required

### Personal Protection Equipment

- Protective eyewear
- Nitrile gloves
- APF 10 rated disposable respirator with Cool Worx handling (i.e., 3M model 8210)
- APF 1000 rated respirator during Cool Worx spraying. Nu-Calgon recommends 3M Powerflow Face Mounted PAPR; 3M product number 6900PF
- Dermal protection during Cool Worx application (paint coveralls)

### Nu-Calgon Coil Cleaner (Situation Choice For Coil Preparation)

#### Tri-Powr' HD (4371-88)

- Use for newer bare metal coils where only a detergent-based cleaner is required to properly remove dirt and grime off the bare aluminum or aluminum/copper coil (use at 4:1 dilution). Use this cleaner for stainless steel substrates or to clean the equipment panels if it's desired to paint the equipment panels with Cool Worx.

#### Nu-Brite (4291-08)

- Use for previously coated coils, whether there is any coating flaking or not, plus circumstances where light to moderate corrosion already exists on the coil (use at 10:1 dilution). The requirement of a more aggressive cleaner in these circumstances properly etches the prior coating and/or removes corrosion on the existing coil for best Cool Worx adhesion.

### Coil Gun (4774-0) or Pump-Up Sprayer and Hose/Nozzle

#### Power Blower - Optional

- Required if Cool Worx application is done one service call. Power blower ensures coil is completely dry before application of Cool Worx, which is vital for adhesion. Nu-Calgon's preferred route in many situations is to clean the coil the prior day to ensure thoroughly coil drying for Cool Worx application the following day. Cool Worx requires a bone-dry surface for proper adhesion.

### Outdoor Painters Masking Tape (two-inch width)

#### Pre-Tape (Combined Tape/Plastic Sheeting) - Optional

#### Wire Brush/Rust Converter (To Address Rust Areas Before Cool Worx Application)

#### Dragon Towels (4162-01)

#### Dragon Wipes (4162-75)

#### Hand Tools To Remove Applicable Equipment Panels

#### Cool Worx (4158-20)

#### Paint Tarp/Drop Cloth

#### Absorbent Powder

Estimated coverage: One quart per 20 sq. ft. of coil surface area, triple light coat method (or 10 sq. ft. per coil side). To determine coverage of a coil, calculate area of coil by measuring the length and width of the coil **IN INCHES**. Use the following calculation:

$$L \times W / 2880 = \text{Estimated quart(s) of Cool Worx needed. (Four quarts per gallon)}$$

### Sprayer Recommendations:

#### Small Jobs:

**Graco TrueCoat 360** (electric) or **Graco Ultra Handheld** (battery) airless sprayers (013-017 sprayer tip) allow for versatile spraying from any angle.

A well-designed low cost electrical HVLP sprayer (i.e., Wagner Flexio types) can be used for a small, easily accessible coil requiring simple sprayer maneuvering.

#### Medium/Large Jobs:

**Titan CapSpray X115 Capliner System**. Allows for easy day-to-day transitions between jobs, simple clean-up and enhanced paint atomization for deeper coil penetration vs. lower cost HVLP market options.

- Use #2 needle with Maxum gun, at mid-set paint flow setting
- Highest air flow setting on machine/gun for best atomization

#### Large Jobs:

Air-Assisted Airless Sprayer: **Graco Titron Sprayer, 1.4 mm nozzle**

Compressor Air Paint Sprayer Specification Requirements:

- 1.5 – 1.7 mm nozzle
- Tank capacity: Minimum 15 gallon
- Air Pressure: 50-80 psi
- Use tight spray pattern

## C. Process



## D. Procedure

**Cool Worx is to be applied by Nu-Calgon trained HVAC/R professionals only. Consult Cool Worx and applicable Nu-Calgon coil cleaner safety data sheet (SDS) before use.**

*Cool Worx application is recommended over a two-day period to allow the condenser coil to thoroughly dry before applying Cool Worx. If necessary, Cool Worx can be applied in one day if a power blower (optional) is used along with turning on the system to help facilitate drying the coil. **It's necessary for the coil to be bone-dry for proper Cool Worx adhesion to the coil.** For this reason, the two-day method is preferred to allow overnight drying during system operation – especially if line-up of systems will be coated at a jobsite.*

*For days when applying Cool Worx on outdoor units, apply when the outdoor temperature is between 50°F - 100°F when there is no immediate rain in the forecast. Lower humidity days are preferred if circumstances dictate. Cool Worx can be applied in higher humidity situations, such as coastal regions, it simply will take longer for the coating to fully cure to provide max benefit.*

### DAY ONE

1. Take inventory of tools/supplies to ensure proper items are ready at the jobsite.
2. Review the condition of the outdoor coil for Cool Worx application that requires cleaning preparation. Cool Worx can be applied on coated or non-coated aluminum and/or copper constructed HVAC/R coils or process coiling coils of stainless steel or ferrous construction. (Cool Worx can be applied on other surfaces with proper preparation for Cool Worx adhesion – see Nu-Calgon for details.)
  - a. For new coils or coils in good condition where dust/grime simply need to be removed, use Nu-Calgon's Tri-Pow'r HD per label instructions at a 4:1 dilution ('B' setting on the Nu-Calgon Coil Gun) followed by a thorough rinse with fresh water.
  - b. For corroded coils or previously coated coils where the coating is starting to separate from the coil, Nu-Calgon's Nu-Brite is required to aggressively clean and etch the previous coating on the coil for best adhesion. (Note: if the coil is too severely corroded, this is not a Cool Worx opportunity.) Use Nu-Brite at a 10:1 dilution ('E' setting on the Nu-Calgon Coil Gun) followed by a thorough rinse with fresh water.
3. **OPTIONAL:** If Cool Worx is to be applied to the coil on the same day, a power blower is required to help facilitate drying of the coil surface. It is also recommended to turn the system on (air conditioning mode if heat pump) to ensure the coil surface is bone-dry before Cool Worx application.
4. Documentation - take photos before and after Cool Worx application.

NOTE: It's imperative any rust surfaces are previously addressed with a mechanical brush and rust converter to ensure proper Cool Worx adhesion.

### DAY TWO

5. **Ensure it is a favorable day for painting – not windy and above a 50°F outdoor temperature.** Tape off equipment panels with rough surface painters tape to protect them from overspray. Lay down paint drop cloths and prepare necessary tools/supplies for applying Cool Worx. Ensure PPE is present including nitrile gloves; disposable APF-10 disposable mask, APF-1000 respirator when spraying Cool Worx with a HVLP sprayer. Nu-Calgon recommends the reasonably priced 3M Powerflow Face Mounted PAPR; 3M product number 6900PF, an APF-1000 rated respirator, plus dermal protection.
6. For small/medium size jobs, Nu-Calgon recommends the Graco TrueCoat 360 for its spraying versatility from any angle to provide as much coil coverage as possible. For repetitive larger applications, Titan CapSpray 115 (6 stage HVLP) or Graco Triton Air-Assisted Airless Spray Systems is recommended.
7. **Turn off system.** Proceed to shake each bottle of Cool Worx vigorously for one minute to ensure paint contents are properly mixed. Fill the sprayer bottle with Cool Worx, toggle the paint coverage setting on the sprayer to a light setting and confirm nozzle orientation. Test spray pattern on a piece of cardboard before spraying coil.
8. **Spray method:** Nu-Calgon guidelines for applying Cool Worx to refrigerant coils requires three light coatings. At a minimum, the air intake side requires this three coat method to assist in energy savings. Its advantageous to cover as much of the backside of the coil as reasonable, if easy to access, to improve the benefits of Cool Worx. The three light coat method is as follows:
  - a. **First Coating:** Have the sprayer tip positioned **90 degrees (straight-on) to the coil**, with the sprayer tip 2 to 3 inches away from the coil surface. Starting at the top left corner of the coil, coat in continuous sweeping motions of the coil surface. This coating provides coverage to the interior of the coil, roughly four inch paint penetration into the coil - including the first coating pass of the tube bundle (for RTPF coils) or parallel tube bundles (microchannel coil designs). Proceed with providing the first coating to the entire coil surface.

**FIRST COAT:** Position sprayer 90° to coil, 2-3 inches away. Make sweeping left to right motions to paint inside coil. Coating provides minimum four inch depth coverage into coil. See figure 1.



**FIGURE 1**

**b. Second Coating:** Rotate the sprayer position **45 degrees LEFT to the coil** with the sprayer tip 2 to 3 inches away from the coil surface. This sprayer orientation angle in relation to the coil will coat on **left side** of the aluminum fin panels of the coil. Starting at the top left corner of the coil, coat in continuous sweeping motions, left to right – depress the trigger after each sweep and repeat sweeping left to right paint coverage as you progress down the coil. Apply the second coating immediately after the first coating- no need to wait.

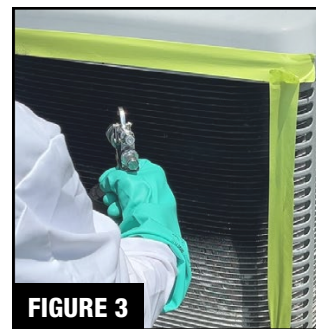
**SECOND COAT:** Tilt sprayer 45° LEFT of the coil, 2-3 inches away. Make sweeping motions to paint coil. Coating step paints one side of each fin. See figure 2.



**FIGURE 2**

**c. Third Coating:** Rotate the sprayer position **45 degrees RIGHT to the coil** with the sprayer tip 2 to 3 inches away from the coil surface. This sprayer orientation angle in relation to the coil will coat **right side** of the aluminum fin panels of the coil. Starting at the top left corner of the coil, coat in continuous sweeping motions, left to right – depress the trigger after each sweep and repeat sweeping left to right paint coverage as you progress down the coil. Apply the third coating immediately after the second coating- no need to wait.

**THIRD COAT:** Tilt sprayer 45° RIGHT of the coil, 2-3 inches away. Make sweeping motions to paint coil. Coating step paints opposite side of each fin. See figure 3.



**FIGURE 3**

9. After painting is complete, document Cool Worx application with pictures and reassemble necessary equipment panel(s) and start removing overspray tape from the unit. Allow 10 minutes before turning on the system so that Cool Worx is touch dry. As the system operates, it expedites the curing of Cool Worx.

**Drying Time:** As with any coating, the drying time varies with jobsite temperature and humidity. At 75°F, with a relative humidity of 50%, Cool Worx is touch dry in five minutes, surface can be handled in one hour and it fully cures in 24 hours. Lower ambient temperatures and higher humidity level will extend a full cure up to a few days.

10. Pour any unused Cool Worx back into its original container. Refer to the job site clean-up section for further information.
11. **Apply supplied Cool Worx decal to equipment panel. Record application date.**

**IMPORTANT:** The discussion above focuses on application of Cool Worx for outdoor coils. Cool Worx has been successfully used on evaporator coils where the coil can be accessed for application. In this application, Cool Worx provides the same benefit as the outdoor coil – aids in transmission of heat, plus corrosion protection of the coil. With evaporators, this requires extra consideration for how to cure the coating. The best approach is to coat the indoor coil independently before its installation in the field. Another option includes the use of UV lights to facilitate coating cure in applicable size equipment already in service. Consult Nu-Calgon for further guidance.

Through independent testing, it has been confirmed Cool Worx improves how the coil radiates eight fold when used in applicable surfaces. Potential applications include radiant heat opportunities when the continuous coil or metal surface is below 300°F.

## **E. Job Site Clean-Up**

1. Ensure PPE is used during Cool Worx clean-up, including protective eyewear, APF-10 rated disposable respirator (3M model 8210) and nitrile gloves.
2. Pour all remaining Cool Worx from sprayer bottle back into the original Cool Worx bottle for future use, tighten cap, and store bottle in a conditioned environment. Do not store on back of truck for an extended period of time since this will affect its shelf-life for a future use.
3. Cool Worx is a water-based acrylic resin coating. The sprayer and other jobsite tools can be simply cleaned with water. Do **NOT** release any of the clean-up into a water stream. As with any paint clean-up, follow local guidelines on proper disposal. The easiest way to rid of water used in sprayer clean-up is to use a chemical absorbent powder and then discard.
4. For disposable sprayer cups, rags, overspray tape that have remaining Cool Worx residue, allow to dry and then dispose in ordinary trash following local guidelines.

## **F. Coil Maintenance**

Cool Worx is a novel conductive coating that provides improved heat transfer and corrosion protection for air-cooled HVAC/R, process cooling, and precision cooling coils.

With the investment in the Cool Worx coating, it's important to maintain maximum coil performance and warranty with ongoing coil cleaning maintenance with the correct cleaner to rid the coil of insulating dirt and other debris.

Within a six month to year timeframe of applying Cool Worx, Nu-Calgon recommends the use of Cal-Green, Tri-Pow'r HD, or Blackhawk coil cleaner with the Coil Gun or with a pump-up sprayer for cleaning the outdoor coil. Follow applicable bottle

instructions for dilution, 10-minute dwell time on coil, then a thorough water rinse.

If Cool Worx was used on an evaporator application Nu-Calgon's Evap-Pow'r or Evap-Green are other viable options for the indoor coil. Follow label instructions using a pump-up sprayer, followed with a thorough water rinse. (Do not treat application as a non-rinse; wash coil after cleaning.)

**Important:** Use only Nu-Calgon approved coil cleaners Cal-Green, Tri-Pow'r HD, Blackhawk, Evap-Pow'r or Evap-Green following the applicable label instructions to maintain Cool Worx's limited five-year warranty.

Do **NOT** any of the following on a Cool Worx coated coil since it will damage the coating and will void the warranty requiring Cool Worx reapplication:

- Any solvent-based cleaner
- Any aggressive acidic or alkaline brightener coil cleaner
- Any diluted coil cleaning solution where the pH is not between 4 to 12 (Do NOT use any market aggressive brightener cleaners such as Nu-Brite)
- Use of any high-pressure water sprayer to clean the coil



## V. HANDLING AND STORAGE

### a. Transportation

Cool Worx is not classified as a Dangerous Good by US Department of Transportation (DOT), Transportation of Dangerous Goods (TDG), IATA (air transport) or IMDG (marine transport). No special transport conditions are necessary unless required by other regulations. Please consult Nu-Calgon's Cool Worx Safety Data Sheet (SDS) for further details.

### b. Storage

Store Cool Worx in its original container in a conditioned environment (50°F to 85°F climate) and away from direct sunlight. The shelf-life of Cool Worx is five plus years when stored in its original unopened container. Once opened, the partially used Cool Worx contents have an anticipated shelf-life of one year. Cool Worx must be thoroughly mixed prior to each use. See Nu-Calgon's Cool Worx SDS for specific storage requirement details.

Avoid storing Cool Worx in situations where it could freeze for best shelf-life expectations and to ensure Nu-Calgon warranty coverage for product workmanship. In circumstances where it has occurred, Nu-Calgon has performed freeze-thaw tests with three cycles allowing Cool Worx to freeze at 0°F and then allowed to thaw overnight. Testing showed no issue with flow, color variance, stratification, or any appearance of any clumps showing it has some resiliency if an event unknowingly occurred.

## VI. LIMITED WARRANTY

Nu-Calgon warrants to the purchaser ("**Purchaser**") of Cool Worx™ supplied by Nu-Calgon ("**Product**") will, during the Warranty Term (defined below) be free of material defects and will provide adequate heat transfer and protection. This Limited Warranty is subject to the terms and conditions set forth in this Limited Warranty document, including without limitation, on the conditions that:

- (i) Purchaser to be fully trained by Nu-Calgon or (ii) the Product was installed in adherence to the Nu-Calgon approved and recommended application guidelines, (iii) compliant maintenance and cleaning takes place (and that the program is being administered to the full extent) every six (6) months, and (iiii) the Product is utilized within the approved conditions and atmospheres for which the coating system has been formulated to protect against<sup>1</sup>.

This Limited Warranty document sets out the entire financial liability of Nu-Calgon (including any liability for the acts or omissions of its personnel) in respect of: (i) any failure of the Product to comply with this Limited Warranty; (ii) any use made of the Product; and (iii) any representation, statement or tortious act or omission (including negligence) of Nu-Calgon in connection with the provision of the Product. See the "Your Remedies" section at the end of this Limited Warranty.

This Limited Warranty covers any defects in material supplied by Nu-Calgon and such Product's performance when applied per Nu-Calgon's application guideline (as published and updated from time to time) and does not cover any failure of adequate workmanship in the application of the Product.

The "Warranty Term" means the five (5) year period commencing on the verified date that Cool Worx was applied to the coil.

### EXCLUSIONS

Notwithstanding anything in this document, the Limited Warranty does not apply to any defect, failure, loss or damage:

- not directly caused by defects in the Product;
- suffered where the Product was not installed or applied in accordance with Nu-Calgon's application guidelines (as published and updated from time to time);
- suffered due to failure to correctly complete maintenance and cleaning program at least once every six (6) months;
- connected to or arising in respect of the deterioration of substrate material (e.g., excessive damage of existing coils); or
- connected to or arising from poor workmanship in adhering to the Nu-Calgon application procedures (as published and updated from time to time).

Nu-Calgon makes no warranty and hereby disclaims any warranty:

- that the Product supplied in connection with this document will meet your requirements or be fit for any particular purpose or function other than as specified in any applicable purchase order or similar; or
- about the suitability or performance of any third-party service provider referred to you by Nu-Calgon.

### **EXCEPT FOR THE EXPRESS WRITTEN WARRANTIES MADE BY NU-CALGON IN THIS LIMITED WARRANTY DOCUMENT, NU-CALGON MAKES NO WARRANTIES WITH RESPECT TO THE PRODUCT AND DISCLAIMS**

<sup>1</sup>To provide up to 5 years of superior heat transfer and protection, the Product is formulated for the following conditions and atmospheres: Air cooled coils used in stationery and transport HVAC/R, thermal management and process cooling applications within the application and duty temperature range stated in Nu-Calgon literature. For corrosive industrial applications, contact Nu-Calgon for added guidance on whether the specific application is suitable for Cool Worx.

**ALL STATUTORY OR IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE AND ANY WARRANTIES OF NON-INFRINGEMENT. IN NO EVENT SHALL NU-CALGON BE LIABLE TO YOU OR YOUR CUSTOMERS FOR AN INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGE, LOSS OF ANTICIPATED PROFITS, LOSS OF BUSINESS, LOSS OF OPPORTUNITY, LOSS OF REPUTATION OR OTHER ECONOMIC LOSS ARISING FROM FOR ANY REASON WHATSOEVER.**

**YOUR SOLE REMEDY AND THE SOLE LIABILITY OF NU-CALGON UNDER THIS WARRANTY, IS THE REPLACEMENT OF PRODUCT AND DOES NOT INCLUDE LABOR OR COSTS ASSOCIATED WITH THE APPLICATION OR REMOVAL OF ANY PRODUCT.**

*(Some states do not allow limitations on how long an implied warranty lasts or limitations on incidental or consequential damages, so portions of the limitations above might not apply to you. This warranty gives you specific legal rights, and you may have other rights, which vary from state to state.)*

### Warranty Conditions; End User Obligations

To obtain warranty service under the Limited Warranty, you must first contact your supplier/contractor to discuss the problem and the most appropriate solution for you.

In the event of an application failure and an ensuing dispute as to the cause of said failure, a collaborative team of a Nu-Calgon personnel member, an applicator, and the end-user will meet in good faith to: (i) discuss the condition of units prior to application; and (ii) review the installation process, with the goal of mutually determining the root cause of the failure.

In addition to the other terms of this Limited Warranty, in order to be eligible for coverage by the Limited Warranty, each of the following conditions must be satisfied:

- Documentation such as system photos, system vitals as condensing unit energy usage, system pressures and temperatures before and after Cool Worx application including any service records prior and post Cool Worx application.
- The exposure conditions of the coil must have at no time exceeded the limitations of Cool Worx stated in literature
- Inspection / maintenance requirements must have been performed in accordance with Nu-Calgon's recommendations using Nu-Calgon's approved chemicals and methods;
- Product must be applied by trained contractor;
- Product must be applied and maintained according to Nu-Calgon product application and maintenance instructions to a properly prepared surface;
- Nu-Calgon must be provided proof of application, including before/after coil photos, and proof of purchase for the Product;
- No improper cleaning chemicals or high-pressure water is used to clean the coil after application of the Product;
- Notice of any failure must have been presented, in writing, to Nu-Calgon within fifteen (15) days of discovering the defect.

| Contractor Obligations for Warranty Submittal | Record Date | Pre-Cool Worx Application | Post Cool Worx Application |
|-----------------------------------------------|-------------|---------------------------|----------------------------|
| Pictures of System                            | √           | √                         | √                          |
| Pictures of System Coil(s)                    | √           | √                         | √                          |
| Condensing Unit Energy Usage                  | √           | √                         | √                          |
| System Pressures/Temperatures                 | √           | √                         | √                          |
| Service Records                               | √           | √                         | √                          |
| Pictures of Defect Area(s)                    | √           |                           | √                          |

**FOR THE AVOIDANCE OF DOUBT, THIS LIMITED WARRANTY WILL NOT APPLY TO ANY DAMAGES, FAILURE OR LOSSES, AND NU-CALGON WILL HAVE NO OBLIGATIONS, TO THE EXTENT EACH OF THE CONDITIONS SET OUT ABOVE ARE NOT SATISFIED.**

The corrosion limitations have been tested in excess of 30,000 hours under the ASTM B117 salt spray conditions.

## **ACTIONS REQUIRED TO MAINTAIN THE LIMITED WARRANTY**

Failure to comply with each of the following requirements will cause this Limited Warranty to become void and of no further force and effect:

- Performing regular maintenance in accordance with Nu-Calgon guidelines and recommended practices (as published and updated from time to time). Coil cleaning is considered regular maintenance during the Warranty Term. Unless otherwise advised by Nu-Calgon, coil cleaning requires the use of Nu-Calgon's Cal-Green (for outdoor) or Evap-Green (for indoor), or other Nu-Calgon cleaner with a designed pH of 7-12 with water dilution, with an immediate low-pressure water rinse to maintain Cool Worx warranty. Do not use wire brushes, scrapers, or other abrasives that may damage the coating. High pressure water spray or the use of acid / solvent / amine / ether / ester cleaners or aggressive alkaline cleaners formulated with sodium/potassium hydroxide will void the warranty.
- Maintaining evidence/records of all regular maintenance and cleaning performed;
- Storing unopened Product in accordance with the Store and Handling section of applicable Nu-Calgon supporting literature;
- Providing prompt attention to needed repair and service of equipment or coating, including as recommended by Nu-Calgon guidelines and recommended practices (as published and updated from time to time); and
- Scheduling and recording with reasonable supporting evidence that coil cleaning and inspection of coated coil(s) takes place as follows:
  - Coils must be cleaned at least every six months and may require more frequent cleaning in highly aggressive environments; and
  - Following the cleaning of the coil, inspect and log as follows:
    - Check coating for abrasion, erosion, or corrosion damage;
    - Inspect for coating damage at the fin edges, fin/tube interface and at the "U" bends of the header portion of the coil or micro channels edges and
    - Notify Nu-Calgon within 15 days of discovery of any coating damage. Notification must include evidence of coating failure, e.g. fin samples, photographs, etc.

**FOR THE AVOIDANCE OF DOUBT, YOU WILL NOT BE COVERED BY THE LIMITED WARRANTY, AND NU-CALGON WILL HAVE NO OBLIGATION TO YOU, TO THE EXTENT EACH OF THE CONDITIONS SET OUT ABOVE ARE NOT SATISFIED.**

## **YOUR REMEDIES**

For any breach of this Limited Warranty, Nu-Calgon's sole obligation and liability shall be to replace, at no cost, an equivalent quantity of Product required re-coat/re-apply Product to those areas of the coil where the Product defect has occurred.

## **VII. DISCLAIMER**

Nu-Calgon literature contains general information about the benefits of Cool Worx™. Product information and trial should not be used as a substitute for the customer's own quality assurance, control, substantiation and/or testing protocols to ensure that Nu-Calgon products are safe, effective, and fully satisfactory for the intended use. The information is offered in good faith and is believed to be accurate at the time of printing or when electronically posted on Nu-Calgon's website.

The statements and graphical representations made with respect to data and energy savings described are indicative only and are not guaranteed. The actual savings and other elements (including performance standards) detailed depend on several factors, including the operating conditions of the customer equipment to which the product is being applied (which are subject to variability and uncertainty).

As a result, the product may perform differently from how it is described. While care has been taken to provide accurate figures, to the extent permitted by law, we give no warranty and make no representation as to the performance of the specified product and we accept no liability for a failure to perform at the standards described. One should conduct their own independent investigations to determine whether the specified product is suitable for your business.

## VIII. COOL WORX SPECIFICATIONS

| Properties                                                   | Result                   | Test Method         |
|--------------------------------------------------------------|--------------------------|---------------------|
| Salt Spray                                                   | 30,000 Hours             | ASTM B117           |
| Salt Spray, Acidic                                           | 3,000 Hours              | ASTM G85 A1         |
| Sal/Sulfur Dioxide Spray                                     | 720 Hours                | ASTM G85-09: A4     |
| Water Immersion                                              | 500 Hours                | ASTM D870           |
| Cross Hatch                                                  | Level 0 European 5B, B-A | ASTM D3359-88 53151 |
| UV Resistance                                                | Exceeds 1000 Hours       | ASRM D4587          |
| Flexibility                                                  | PASS                     | ASTM D522M          |
| Thermal Conductivity                                         | 15 W/mK                  | ASTM E1225          |
| C5 Condensation                                              | PASS                     | ISO 6270            |
| C5 Chemical Resistance                                       | PASS                     | ISO 7523            |
| Viscosity (Krebs, KU)                                        | 93-98                    |                     |
| Viscosity (Centipoise, cP)                                   | 1300-1500                |                     |
| Solids % by volume/wt.                                       | 30-50%                   |                     |
| Density                                                      | 1.016 Kg/L               |                     |
| pH                                                           | 8-10                     |                     |
| Gloss at 20°/60°                                             | 65/92                    |                     |
| VOC                                                          | 165 grams/liter          |                     |
| Flash Point                                                  | Water-born/non-flammable |                     |
| Dry Film Thickness                                           | 15 microns               |                     |
| Ambient Temperature Recommendation<br>for Cool Worx Spraying | 45°F to 100°F            |                     |

## IX. IMPORTANT TOUCHPOINTS

- ▶ Determining if the application is appropriate for Cool Worx:
  - Determine expected payback of investment. System run time, size, energy cost and other considerations need to be considered before applying Cool Worx.
  - Confirm long-term coil cleaning plan. If the outdoor coil is in an application that will continue to get laden with tough to remove cooking greases or pollen that is difficult to remove with a mild cleaner and requires ongoing use of an aggressive acidic or sodium/potassium hydroxide-based coil cleaner, then this is not an application for Cool Worx. Coil cleaners with a usage pH between 7 to 12 are to be used with a Cool Worx coated coil. Nu-Calgon specifically recommends Cal-Green, Tri-Pow'r or Blackhawk cleaners for outdoor air-cooled coils where Cool Worx has been applied to maintain heat exchanger performance during its service duty - followed by an immediate water rinse. Do not allow cleaners to stay on coil longer than 10 minutes before water rinse.
  - Confirm applicable service duty temperature for Cool Worx. Cool Worx is applicable with continuous duty between -20°F to 300°F, intermittent brief temperature of up to 500°F (during defrost) is permissible with. **Note:** In applications where the coating could see brief temperatures above 300°F, the sheen of Cool Worx could change over time from semi-gloss to a matte finish; but Cool Worx still maintains its stated functionality.
- ▶ Apply Cool Worx to as much of the condenser coil surface area that is reasonable and cost effective to maximize the benefit of the product. At a minimum, the air intake side of the condenser coil needs full coverage, using the three light coat method with applying the coating at three spray angles to the coil maximize fin coverage. Case studies have shown coating only the air intake side, or coating the air intake side and partially the backside coil provided significant energy benefit. Naturally, the goal is to always coat as much of both sides of the condenser coil as reasonable to optimize the energy savings potential of Cool Worx; but more so for corrosion protection.
- ▶ Each job site is different. If there are obstructions or coil design considerations, whether it is the air intake, or backside of coil or coil depth, please contact Nu-Calgon to discuss specifics.
- ▶ Like any coating application, surface preparation is everything.
  - For previously coated coils or severely corroded coils, use Nu-Brite following its label instructions at a 10:1 dilution (setting 'E' with Nu-Calgon Coil Gun) with a thorough rinse of the coil to best prepare the surface.
  - For newer condenser coils or coils and/or laden with salt or suitable evaporator application, clean with Tri-Pow'r HD at a 4:1 dilution (setting 'B' with Nu-Calgon Coil Gun) following label instructions, then with thorough fresh water rinse.
- ▶ **Important!** Coil surface must be **completely dry** before Cool Worx can be applied. Applying the coating will not adhere to a wet coil surface and will void warranty.
- ▶ Cool Worx procedure can be completed in a single day or broken into two partial days – depending on the complexity of the system and number of systems at the site. If the plan is to complete in a single day, ensure the coil is completely dry, and have available a power blower after the cleaning or turn system on for a period of time to expedite a thorough drying of the outdoor coil surface. The recommended route to ensure thorough coil dryness to ensure good Cool Worx adhesion is to clean the coil the day prior, allow to dry thoroughly overnight and apply Cool Worx coating the following day. Always apply Cool Worx within 24 hours after the coil is cleaned and prepped.
- ▶ Apply Cool Worx coating when the outdoor temperature is between 45°F and 100°F with humidity below 80% where there is no immediate chance of rain. For coastal environments or other where there is higher ongoing humidity, it will take a longer time for the coating to cure, days or even a few weeks. The benefit of Cool Worx is not realized until the coating is fully cured, so in those situations please be patient to cure at a slower rate in higher humidity conditions. In high humidity coastal environments, full cure may take up to two weeks before full benefit of coating is seen.
- ▶ Apply Cool Worx in three thin even coats across the coil. Apply first coat at 90 degrees to coil surface, second coat from right at 45 degrees to cover left side of aluminum fins, third coat from right at 45 degrees to cover left side of aluminum fins.
- ▶ Always use one of the approved Nu-Calgon coil cleaners (Cal-Green, Tri-Pow'r HD, Blackhawk) following label instructions on dilution and an immediate (within 10 minutes) thorough water rinse post-application of Cool Worx for the outdoor coil. **NEVER use a high pressure water sprayer on a Cool Worx coated coil for rinsing or other. For a suitable industrial application of an indoor coil, use Nu-Calgon Evap Pow'r or Evap-Green coil cleaners. Always use approved cleaner, an aggressive alkaline or acidic cleaner will damage the coating and void warranty.**

## X. FREQUENTLY ASKED QUESTIONS

### 1. **What is Cool Worx?**

Cool Worx is a unique air-dry water-based acrylic HVAC/R coil coating. Cool Worx is powered by GMG Graphene to provide a novel way of increasing heat transfer of air-cooled coils used in HVAC/R equipment. The coating provides coil corrosion resistance as well. The coating is specifically developed for air cooled round tube plate fin (RTPF) and microchannel heat exchangers made of copper/aluminum or all aluminum construction. Cool Worx is not suitable for water-cooled condensers. Cool Worx can be used on stainless steel or unpainted/painted steel surfaces in applicable situations.

### 2. **What is graphene?**

Graphene is a two-dimensional allotrope of carbon that is one atom thick that exhibits an extraordinary ability to conduct heat with its ability to superconduct via vibrational mechanical energy (phonon heat transfer) by its lattice of carbon atoms.

### 3. **How does Cool Worx provide energy savings?**

Inside a very thin layer of Cool Worx, graphene increases the heat transfer process allowing more efficient operation of the system with less energy and lowers CO2 emissions.

With new systems or systems in the field, the unique properties of graphene within Cool Worx transfers heat at a much faster rate, creating more efficient system operation and faster time to reach cooling set points. Faster cooling with less fan and compressor operating times results in energy savings.

The coating restores lost efficiency caused by corrosion of the existing coil.

### 4. **Why is GMG Graphene unique?**

GMG Graphene is produced from a proprietary process from natural gas not mined graphite. This process produces high quality, low input costs, scalable, tunable and low contaminant graphene suitable for use in clean-technology applications.

### 5. **Has the technology in Cool Worx been independently tested?**

Independent testing has shown an average 15% pull down rate reduction and a 5% reduction in compressor wattage on a outdoor coil of a NEW system. Another independent study of the coating applied to eleven systems already in service and saw an energy reduction in the tested systems between 5% to 20% or an average 12%.

### 6. **What average energy savings should I expect with Cool Worx?**

Independent testing has shown 15% improvement of pull-down rate and 5% reduction in compressor wattage on a NEW coated coil. Depending on degradation of the coil in the field, systems in service saw improved wattage reduction where an independent study showed an average of 12%, the results were specific to each situation in the study. Field tests have shown a range of 8 to 30+% depending on the condition of the coil where slightly degraded coil saw most improvement.

The actual savings will depend on factors including variable operating conditions, climate, system loads, change in temperature set points, system design and age. As a result, the product may perform differently from how it is described. Testing is recommended where these variables can be best isolated to properly and fairly evaluate properties of Cool Worx to determine if the product provides the necessary benefit for a particular application. Nu-Calgon has tools and recommendations to help in the evaluation process. Nu-Calgon uses a reasonable 10% savings target with ROI expectations in discussions with Cool Worx.

### 7. **What type of equipment can Cool Worx be applied on?**

Cool Worx is primarily for air cooled coils used in HVAC/R, industrial process cooling, and thermal management applications. Cool Worx can be applied on any size equipment, typically the larger size equipment with average or longer run times operating in areas with higher kilowatt cost see the quickest return on investment.

Studies have shown benefit with the application of Cool Worx on evaporators too on applicable type of systems. Considerations with the use of UV lights are required to help facilitate Cool Worx curing for evaporator applications; its best to coat the evaporator prior to system commissioning. See Nu-Calgon for further guidance.

Cool Worx would also find benefit on coils in radiant heat applications since the coating improves the thermal radiation of the surface by eight fold. See Nu-Calgon for further guidance.

**8. Is Cool Worx only for air condenser coils?**

Generally, this is where the product is applied to abate ongoing environmental corrosion of the coil and to improve heat transfer rate of the condenser.

However, with proper preparation of the condensing unit for proper surface adhesion, a contractor can apply the coating to the metal cabinet panels to assist in adding in system longevity in the corrosive environment if they so chose. In corrosive environments, where the evaporator can easily be accessed, Cool Worx can be applied to the evaporator provided the coil is properly prepared, completely dry for the paint application – and the use of UV lights to help Cool Worx coating cure. More preferably, apply Cool Worx to the evaporator coil before the system is commissioned. Cool Worx has hydrophobic properties, so water tracking could be affected. Cool Worx has also shown to have antimicrobial properties which is beneficial attribute for an indoor coil. Contact Nu-Calgon for further questions.

**9. Are there other Cool Worx benefits?**

Cool Worx also has excellent corrosion protection achieving 30,000 hours of salt spray (ASTM B117) and can extend the life of equipment in a corrosive environment. Improved efficiency with better heat dissipation of the coil in hot weather conditions aids in a potentially lower condensing pressure along with high-pressure trip-outs resulting in cost savings with expensive technician callouts.

The properties of graphene used in Cool Worx may aid in the defrost time in specific applications. See Nu-Calgon with questions.

**10. What Nu-Calgon coil cleaners should be used to clean the coil before application of Cool Worx?**

Nu-Calgon's Tri-Pow'r HD should be used on newer, bare aluminum and/or copper coils with slight to no corrosion of the coil whether it is RTPF or microchannel design. With slightly corroded coils or previously coated condenser (outdoor) coils, Nu-Calgon's more aggressive alkaline Nu-Brite coil cleaner (at a 10:1 dilution) is recommended in these situations to best remove corrosion off the coil or to remove existing coating flaking surface so Cool Worx will best adhere to this substrate.

**11. How often should Cool Worx be applied?**

Cool Worx is a one-lifetime application. It is imperative to use milder coil cleaners approved by Nu-Calgon to maintain the coating since an aggressive brightener cleaner (Nu-Brite and others similar) will damage the coating to where reapplication would be necessary to repair. Using non-approved cleaners will void the warranty.

**12. What cleaner is recommended to clean the condenser coil after Cool Worx is applied?**

Allow two weeks for Cool Worx to fully cure on the coil before applying any coil cleaner. Only use mild cleaners for cleaning the condenser coil with the coating. Nu-Calgon recommends Cal-Green, Tri-Pow'r or Blackhawk for outdoor cleaners or Evap-Green if the coating is deemed appropriate for a particular indoor coil application every six months after the coating application.

Cool Worx when fully cured has hydrophobic properties that make subsequent cleaning much easier with a milder cleaner such as Cal-Green.

**13. Does it affect the equipment's warranty?**

Equipment manufacturer's have varying warranty coverage that addresses the entire piece of equipment and various components in the system. Always follow OEM guidelines to ensure warranty coverage. Condenser coils, depending on how they are treated at the factory or other applicator can have more limited coverage due to potential corrosive microclimates in the field. Cool Worx aids in addressing ongoing oxidation/degradation of the aluminum coil from the date it was installed. Cool Worx provides corrosion resistance to the coil as well as reinstates some heat transfer capability that was lost due to metal degradation after it was installed. Nu-Calgon continues to be in discussions with OEMs with the the novel properties Cool Worx provides.

**14. What makes Cool Worx different than other coil coatings in the market?**

Other coil coatings in the market provide corrosion resistance to the coil and they nominally affect heat transfer rate. Cool Worx is a two-in-one product which provides top-tier corrosion resistance but also makes the coil more conductive with its application vs. not applying a coating or a using a competing coating.

**15. What is return on investment or payback?**

Cool Worx has excellent payback models in comparison to other capital energy savings options. Cool Worx is an operating or maintenance expense (OPEX). Its payback will be based on the size of the equipment, run-time, equipment condition (coil) condition, and local kilowatt cost. Each of these variables need to be considered in determining its specific return on investment for an application, but payback is generally expected less than 1 to 3

years in many commercial and industrial applications. Nu-Calgon is working with utilities companies and others to promote the value proposition of Cool Worx. Since the coating makes the system more efficient, this can only aid with its service longevity.

**Nu-Calgon has a ROI calculator for Cool Worx to determine if a specific asset is a good candidate for Cool Worx. The calculator uses run time estimates, size of system, local energy cost and other specific inputs, including the investment cost to apply Cool Worx to provide the necessary data to present to the organizational decision maker or owner of the asset.**

**16. How do you prove to customers it works?**

The best approach is to find an application/system where variables can be best isolated so there is a consistent compare of before and after application of Cool Worx. This includes a consistent cooling load and reasonably consistent weather pattern since these variables will affect how the system performs. It is imperative to gather energy data before and after application of Cool Worx plus other system vitals. It is also imperative to know that it will take several days or more for the coating to cure before performance is best realized. For specific questions, contact Nu-Calgon.

**17. What type of customers will benefit?**

Cool Worx can be used on any sized air conditioning, refrigeration, precision cooling or industrial cooling air cooled heat exchanger. End-users that most benefit with quicker ROI will be those with higher energy costs tied to their overall operating costs, and/or those who are looking to protect the outdoor coil to extend the life of their equipment.

Small to medium businesses generally don't have a lot of levers to pull to offset savings weighing in inventory, staffing and rent costs. The ability to reduce energy cost with Cool Worx's ability to save operational costs, achievable year on year – especially if a local utility company has a program available to offset the application cost.

Some notable examples of high use/energy applications including air conditioning/refrigeration systems in commercial buildings such as stores, offices, schools, gymnasiums, libraries, hospitals, clinics and others including supermarkets, plus data centers and industrial applications.

**18. Can I use Cool Worx for any condenser coil?**

Yes! For use with round tube plate fin (RTPF), microchannel heat exchanger (MCHE) coil designs in the HVAC/R, process cooling, and thermal management systems.

**19. Can I use Cool Worx on a coated coil?**

Yes, the current coating will need to be treated for Cool Worx for best adhesion. If there is existing coating, use Nu-Calgon Nu-Brite at a 10:1 dilution, followed by a water rinse (and coil drying) to remove existing coating flaking/etch the coating surface to ensure good adhesion of Cool Worx.

**20. Will I see the benefits of Cool Worx on a coated coil vs. bare metal coil surface?**

Yes, independent testing on a new OEM coated coil, first cleaned/prepped with an alkaline cleaner, followed by Cool Worx application showed a 15% pull-down rate improvement with a 5% energy benefit on a constant load study. Systems and applications do vary as well as the final benefit of using Cool Worx.

**21. How do I apply Cool Worx?**

Apply Cool Worx with any market available electric or battery powered HVLP sprayer or pneumatic HVLP sprayer for a small job. When using the sprayer, set to wide spray pattern, set paint flow to low. It is always recommended to test spray pattern on a piece of scrap material to dial in spray pattern and technique before starting on a coil.

**Nu-Calgon recommends the Graco TrueCoat 360 or Titan CapSpray X115 CapLiner System that allows a lot of versatility to spray the coil in any sprayer gun position.**

When using an pneumatic HVLP sprayer, set air pressure to 50-80 psi with a 1.5 - 1.7mm sprayer tip – use a portable oil-free air compressor with a minimum 15 gallon volume tank to ensure it can keep up with spraying requirements. Nu-Calgon guidelines for coil surfaces requires three light coat coats from three different spraying angles.

**22. How much coverage should I expect Cool Worx?**

The practical coverage is approximately 20 sq. ft. per quart (coil surface). For coil application we recommend three light coats at three different angles (straight, 45° left, 45° right) for best coverage of the tube, aluminum fin or microchannel surface area. For planning purposes, estimate 20 sq. ft. of coil surface area per quart when applying three light coats at different angles to the coil. Ultimately, how the applicator applies the coating dictates coverage area.

**23. Can you apply too much/little Cool Worx?**

Yes, undercoating may lead to inferior performance. Testing has shown Cool Worx to be forgiving if some excess overcoating occurred – within reason. Three light coats at three different application sprayer angles to the coil (90 degrees to coil, 45 degrees left to coil, and 45 degrees right to the coil). When applying Cool Worx, position the sprayer about four inches from the coil. The dry film thickness of Cool Worx is 15 microns, it will not cause an air flow restriction.

**24. How much time should I plan for the application process?**

Application timing depends on complexity of coil access, equipment size and conditions. Some applications may be a little quicker and other situations much longer depending on its own uniqueness.

Depending on how this is planned, this can be a one or two-day process. For the preferred two-day process, the coils at the jobsite are cleaned and allowed to thoroughly dry overnight with Cool Worx applied to the coils of the equipment line-up the following day.

Alternatively, the process can be easily completed in a single day. However, the use of a power blower is strongly recommended between the cleaning to quickly facilitate a thorough coil drying before Cool Worx application.

**IMPORTANT:** The coil surface must be completely dry before the application of Cool Worx so it properly adheres to the coil.

**25. What's the recommended conditions for applying Cool Worx?**

Apply when the outdoor temperature is between 50°F and 100°F with a relative humidity less than 80%. Do not apply coating if there is a high probability of rain within the next 24 hours.

**26. What is the dry time for Cool Worx?**

This depends on outdoor temperature and humidity. At 70°F and less than 80% relative humidity, expect Cool Worx to touch dry in five minutes, can recoat in 10 minutes, handled in one hour, complete cure in 24 hours. In climates that have ongoing long periods of time at high humidity (coastal environments), full cure may take a week or longer.

**27. What is the recommended storage conditions of Cool Worx?**

Store in cool (60°F to 75°F) conditioned environment, away from direct sunlight in its original, unopened packaging. Do not expose Cool Worx to freezing (below 32°F) conditions with outside storage or elevated temperatures – this could affect the shelf life of the product.

**28. If Cool Worx is exposed to freezing temperatures or is frozen, is it still good?**

The short answer is yes, we have performed cyclical testing to where paint has been exposed to three separate freeze cycles, allowed to thaw and tested successfully. However, it is possible that if Cool Worx is exposed to extreme storage conditions well beyond what we recommend for extended period of times that could alter its properties. If the coating looks suspicious when the container is opened, contact Nu-Calgon.

**29. What is Cool Worx's storage life?**

Five years in its original unopened bottle when stored in a conditioned environment away from direct sunlight. With an opened or partly used bottle of Cool Worx, its nominal shelf life is 12 months.

**30. What are the most important considerations with Cool Worx?**

Determine if the application is the right fit for Cool Worx by reviewing system size, run time, condition of the equipment, and local kW cost so it provides the required ROI to the end-user.

In evaluating Cool Worx, Nu-Calgon has a payback estimator and has test set-up suggestions to ensure reasonably consistent cooling loads and outdoor conditions to have best comparative results to highlight the benefit of the coating.

Once Cool Worx is applied to the coil, more aggressive coil cleaners in the market like Nu-Calgon's Nu-Brite can no longer be used. Before applying, ensure using mild cleaners such as Nu-Calgon's Cal-Green is suitable long term coil cleaning strategy.

Like any paint system, surface preparation is everything! If the coil is too severely corroded to the point where the fins are brittle, this is not an application for Cool Worx. Clean coils with the right cleaner to properly prepare the surface. If rust exists, this must be addressed first with the use of a mechanical brush and/or rust converter product to allow for best Cool Worx adhesion.

**IMPORTANT:** The coil must be dry before applying Cool Worx. A wet coil surface will inhibit good adhesion and must be avoided. Clean the coil the day before and apply the next day or if done on the same day, use a power blower to accelerate good drying before applying Cool Worx.

Use a milder cleaner option approved by Nu-Calgon for long-term maintenance of coil efficiency with removing materials from the coil after Cool Worx application. Aggressive acidic or sodium/potassium hydroxide water-based or solvent-based cleaners will damage the coating to where it will require a recoat.

Cool Worx can be repainted over if an area of the coil needs to be touched up. If the coating has a general surface compromised, it must be stripped with an alkaline brightener to start over.

**31. What if I have trouble fully accessing the coil to apply Cool Worx?**

Applying Cool Worx in the field with existing equipment requires application specific planning, and understanding how to best access as much coil surface area on both sides of the coil as possible for best corrosion protection and energy savings potential. There may be circumstances where coil depth, and/or coil geometries/access where limited coil exposure to where applying Cool Worx may not make sense. Each circumstance needs to be reviewed on its own merit.

The good news with current findings is that worthy energy gains have been seen with only a good coating (three thin coats from different sprayer angles) on the air intake side of the condenser coil. Third party and field testing have all been done with coating condensers in field assembled condensing units. Coil coverage in these circumstances is never perfect, it is about what can be reasonably available for best coverage to optimize the benefit of Cool Worx. Independent findings have shown field applications of assembled systems have shown 15% pull down rate reduction and 5% energy savings on a new coil. Coils in service averaged a 12% energy savings; some applications dramatically more because of system circumstances. As the system ages in service, where the coil has seen some ongoing specific microclimate degradation, field testing routinely has shown higher realized energy cost savings when compared to testing on a new coil.

**32. What chemical environments can Cool Worx be exposed to?**

Cool Worx is formulated to help with heat transfer of coils in acidic industry environments. Contact Nu-Calgon with detailed requirements to see if Cool Worx is suitable for a specific corrosive environment.

**33. What are the regulatory requirements for Cool Worx?**

1. For Nu-Calgon trained HVAC/R professionals only. Cool Worx CANNOT be resold or given away to any other individual.
2. Follow label requirements for personal protective equipment (PPE). This includes protective eyewear, proper respirator use during handling and spraying, nitrile gloves, and necessary dermal protection.
3. Follow proper disposal requirements following local laws. Do NOT release Cool Worx direct into a water stream. Collect water used during sprayer clean-up with a chemical absorbent. Allow rags and empty Cool Worx bottles to dry before proper disposal.

Nu-Calgon requires written agreements with Cool Worx applicators to have on file to acknowledge these requirements and for any warranty consideration.