



Emerson Climate Technologies  
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14 February, 2008

**STAKEHOLDER CONSULTATION ON  
ADAPTION TO SCIENTIFIC AND TECHNICAL PROGRESS  
UNDER DIRECTIVE 2002/95/EC ON THE  
RESTRICTIONS OF THE USE OF CERTAIN HAZEROUS  
SUBSTANCES IN ELECTRICAL AND ELECTRONIC EQUIPMENT  
FOR THE PURPOSE OF A POSSIBLE AMENDMENT OF ANNEX EXEMPTION 8(a.)  
(CADMIUM AND ITS COMPOUNDS IN ELECTRICAL CONTACTS)**

**Company Background:**

Emerson Electric, with sales exceeding USD 22.5 billion brings technology and engineering together to provide innovative solutions in industrial automation; process control; heating, ventilation and air conditioning; electronic and telecommunications; and appliances and tools. Emerson Climate Technologies Inc. (formerly Copeland Corporation), is a subsidiary of Emerson Electric and has divisions in the US, Europe and Asia, and is the largest manufacturer of commercial and residential air conditioning and refrigeration compressors. It has a global manufacturing capacity of over 8 million compressors yearly on three continents.

Emerson Climate Technologies, Inc. designs and manufactures air conditioning and refrigeration compressors for the HVACR/HP (Heating, Ventilation, Air Conditioning Refrigeration and Heat Pump) industries. The compressors are a "component" within the final HVACR/HP system. The HVACR/HP system is what is ultimately sold to the end user. The HVACR/HP market sector that we service produces relatively large systems which are composed of a condensing unit outside of the building along with an evaporator sub-system located on the inside. Another primary application of our compressors is for Heat Pump Water Heaters. These systems are installed by professional electricians (that is, hard wired) and building contractors. Emerson Climate Technologies, Inc. does not produce compressors for small systems such as household food storage refrigerators or window air conditioners.

**Position Summary:**

Emerson Climate Technologies strongly supports the RoHS initiative and is committed to finding alternatives to cadmium containing contacts (Figure 3) presently used in HVACR/HP products. However, a major obstacle prevents us from meeting the October 2009 deadline. Component samples using cadmium-free contacts have just recently been made available for validation in our products. These proposed components must be subjected to a long and comprehensive performance, reliability and durability tests to assure they will perform to specification, safely over the expected life of the compressors and associated HVACR/HP systems.

Therefore, Emerson Climate Technologies, Inc. unequivocally advocates the continuance of RoHS Annex Exemption 8(a.) **pertaining to cadmium and its compounds in electrical contacts used in the HVACR/HP industry. To that end, we submit the following comments for your consideration in favor of amending the exemption in such a manner as to grant an extension for high current carrying air conditioning and refrigeration motor protectors, relays and contactors:**

- 1.) Emerson Climate Technologies does not agree with the cited conclusions of the previous evaluation as part of the "Adaption to scientific and technical progress under Directive 2002/95/EC Stakeholder Consultation document titled Specific questions exemption 8." Progress to date has not produced a cadmium-free contact design that in our experience is a direct replacement that ensures equivalent performance, reliability and safety of the hermetic protectors (Figure 1), relays and contactors (Figure 2) all widely used in the HVACR/HP industry. Emerson Climate Technologies believes that by removing the exemption it will put the HVACR/HP industry at risk which in turn will potentially compromise the processing and preservation of food, medical and pharmaceutical products, cooling of critical telecommunication and mainframe information technology equipment widely used in public health and safety; and providing necessary air conditioning comfort to hospitals and infirmaries. The safety of persons relying on the proper operation of such equipment and also those servicing and repairing same might be put at increased risk.

Significant progress has been made by our protector, relay and contactor suppliers to identify cadmium-free candidate design options for validation. Necessary tests are currently in process to validate these proposed designs and ensure they are equivalently safe and function as designed over the expected life of the end product. Successful completion of these tests is necessary to validate the proposed contact designs and determine if any further re-design effort is needed. Compressors with these new contacts must undergo reliability and field testing to confirm satisfactory performance over the expected life of the components. The many critical applications of our products make it necessary that every effort be made to limit risk to customers served by the HVACR/HP industry.

To date, Emerson Climate Technologies has not had the opportunity to evaluate cadmium-free replacement contacts for the relays and contactors we specify to control the compressors and the systems into which they are installed. Relays are a critical component used to start compressors and contactors are used in almost all systems which use Emerson Climate Technologies' compressors. Testing of relays and contactors using cadmium-free contacts is required to ensure adequate life of the components by breaking the current without welding.

- 2.) Removal of cadmium directly affects the function of electrical contacts used on hermetic motor overload protectors used on compressor motors and on compressor control relays and contactors. The hermetic motor protector is an important primary line break safety device used extensively in hermetic air conditioning, heat pump and refrigeration compressors. The protector function is to break the electric circuit in the event the motor is subjected to electrical or thermal overload conditions that could cause catastrophic failure or pose a potential safety risk. These protectors contain multi-layered contacts where the alloy of the thin top layer containing 10-15% cadmium by weight. Cadmium is a material that allows high current carrying contacts to function predictably and cycle repeatedly (multi-shot) with long life. At Emerson Climate Technologies, the use of cadmium in the protectors currently amounts to about 229 kg per year in total distributed over about 7.4 million protectors expected to be put in use worldwide in FY08. The use of cadmium in relays and contactors supplied by Emerson Climate Technologies totals 15kg annually. Total usage of cadmium in relays and contactors in all systems probably approaches 250 kg annually in combination with components supplied by the end user.

- 3.) The cadmium containing contacts are the very components within the hermetic protector and on compressor relays and contacts that conduct line current from the supply to the motor. The contacts must separate and break the circuit when needed and in doing so are subject to arc erosion and welding. Contacts with a surface containing cadmium alloys truly have superior performance, durability and safety advantages, particularly those which are used on high current carrying (over 15 amp contact rating) and high cycling applications. High current and high cycling conditions are unique to our HVACR/HP industry. Proposed substitution materials such as AgSnO and AgZnO in such applications come with increased risk of contact welding (Figure 1) that could prevent function of this important safety device. In addition, reduced contact life caused by accelerated erosion due to repeated arcing during cycling is a significant issue the industry must overcome. Contacts with a cadmium alloy coating remains the industries best design choice at this time and any substitution warrants careful evaluation before introduction into the marketplace. Necessary reliability qualifications, product evaluations and extensive analysis beyond supplier bench tests are required. Product testing of the proposed devices in multiple scenarios on several thousand compressor models is required. Long term reliability is a key concern. Unfortunately, it is an attribute that is difficult to predict using accelerated testing. Hence, extensive life testing of multiple protector configurations in compressors is expected to take a few years to complete.

Component supplier information made available to us has shown that the proposed cadmium-free designs may not fully meet the same performance specifications as the cadmium containing product and may not all be direct replacement designs. If proven to be the case by our compressor testing now in process, this significant difference will require repeating the complete protector development and selection process potentially on hundreds of affected models along with mandatory regulatory testing and filing of new configurations. The key point here is that the cadmium-free versions may not simply be “drop-in” replacements.

- 4.) It is Emerson Climate Technologies' opinion that the environment, public health and consumer safety is better preserved by continuing to permit cadmium contacts in the overload protectors, relays and contactors, until substitute materials with equivalent performance and reliability characteristics are found. The consequences of utilizing a less capable device would mean increased service disruption due to a less reliable product and elevated concern for product safety. Protector failures may lead to electrical shorts that may result in a Fusite (through shell conductor) pin failure constituting a rupture of the pressurized compressor shell. Persons servicing and repairing systems with premature contact failures could be in danger due to welded contact failures that would keep the electrical power applied. Industries using our products such as food processing and preservation, medical and pharmaceutical products, cooling of critical telecommunication and information technology equipment that are used in public safety; and necessary air conditioning comfort to hospitals and infirmaries would be at risk. Premature failures would result in increased incidences of compressor replacements, refrigerant release into the atmosphere, and significant economical implications, not only on end users, but on the entire industry as well. Replacing more compressors in-the-field translates into an increased likelihood of accidental refrigerant leakage into the atmosphere also having adverse impact on the environment.
- 5.) Our suppliers of hermetic motor overload protectors, relays and contactors are now jointly working with Emerson Climate Technologies evaluating their proposed respective cadmium-free design candidates on compressors. We currently have 12 cadmium-free protector designs being evaluated on 14 compressor applications. The focus of our ongoing program is to concentrate on the higher current devices first which pose the greatest concern for early contact failure. This process is estimated to take 2 years to complete across all compressor applications while production implementation onto affected product may require an additional 4 years. Our customers may need to re-qualify and re-certify their electrical systems on applications that require re-designed components. Development work on cadmium-free contacts for relays and contactors has not commenced.
- 6.) Emerson Climate Technologies believes replacement devices with the proposed cadmium-free contacts could possibly be validated and implemented by October 2013. This belief is based on good progress to date and assuming no unforeseen technical setback is encountered. Since these new designs are not yet fully validated by industry to meet specification when installed in the compressor and in applied HVACR/HP systems, we respectfully request a provision be included to allow a review and further amendment of the exemption to accommodate any serious and unforeseen technical issue that would disqualify the proposed designs currently under review.

- 7.) Emerson Climate Technologies is committed to be an industry leader in protecting the environment through removal of hazardous substances from our products. In doing so we must make every effort to ensure the industries and communities served by the HVACR/HP and refrigeration industry are not put at increased risk by any product changes made toward that end. A hasty change could result in major issues for our customers and compromise public safety and add to the disposal burden of prematurely failed equipment.
- 8.) Per "Adaption to scientific and technical progress under Directive 2002/95/EC Stakeholder Consultation document titled Specific questions exemption 8." In reference to listed Item 8, Emerson Climate Technologies proposes the wording of the exemption be changed to allow cadmium containing contacts in devices that carry high current (over 15 amps) including but not limited to hermetic motor protectors, relays and contactors an extension to the exemption from the directive of 4 years. This estimated timeframe is necessary to complete validation of the proposed designs and make a safe transition to non-cadmium containing designs.

Emerson Climate Technologies is committed to developing a substitute material for cadmium contactors. However, the concern is that feasible substitutes recently made available to us by our suppliers have not proved to be truly equivalent nor have they been thoroughly evaluated to the required level to be qualified on compressors. The consequence of releasing new designs with uncertain or reduced capability would mean increased concern for product safety, increased service disruption and increased repair cost to the end user. Increased loss of service and product in critical applications such as perishable medical products, heat pump heating, water heating, food processing and spoilage would be imposed on the affected economies. There would also be an increase in costs associated with increased incidences of compressor replacements related to contaminated refrigerant disposal, new refrigerant replacement and disposal of failed compressors and any affected system components.

Emerson Climate Technology is committed to continuously improving the value of its products in terms of environmental aspects, safety, cost, performance, durability and reliability. We are committed to our search for better alternatives to cadmium currently used in our products.

Do not hesitate to contact us, should you need any further technical and scientific evidence.

Yours sincerely,

Ken Monnier  
Vice President, Air Conditioning Division  
Emerson Climate Technologies

**Figure 1**



**Hermetic Motor Protector**

**Figure 2**



**Contact**

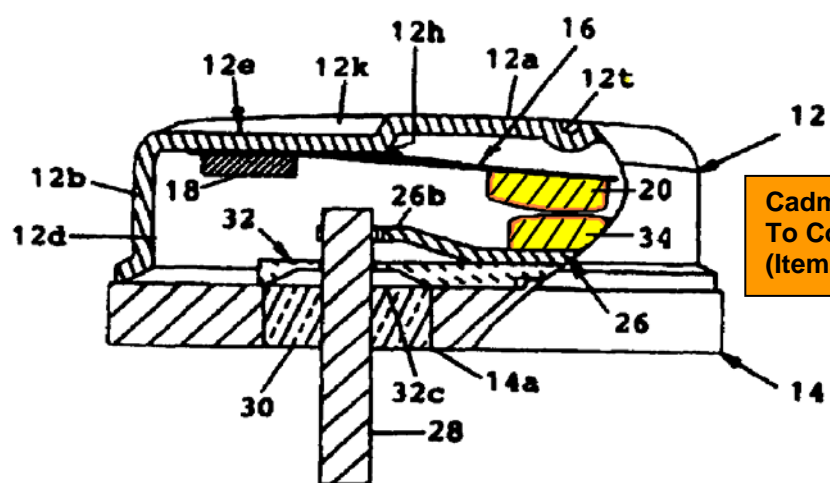
GE and Electrica Relays (shown upside down for clarity)



Extra Terminal Block

**Relay**

### Figure 3



**Search for Alternate Contacts Material In Emerson  
Appliance Motor Switches**  
(AgCdO, AgNi & AgSnO, AgZnO)  
February 12, 2008

**Executive Summary of Switch Contact Testing**

When searching for a switch contact alternative to AgCdO for use in our split phase and capacitor start washer and dryer motors, Emerson included samples from various suppliers with various materials alternatives.

Emerson appliance product was tested using AgSnO and AgNi contacts. From our testing, 80% of the product using AgSnO & AgNi contacts failed Emerson's testing and our customer's product requirements.

Failure modes included contact welding and contact erosion resulting in reduced product life. Industry standards and customer product requirements require switch contact life to be a minimum of 200,000 cycles equating to approximately 10 years of product life. Typically, the alternate contact materials that were tested in most cases failed significantly before 100,000 cycles.

This reduction in switch operating life would equate to a significant reduction in product life in the application. This reduction in product life would result in significantly more motors being discarded and thrown away thus increasing the waste over what is happening today. Also, customer expectations of operating life would be greatly reduced over today's product. Emerson Appliance Motors continues to use AgCdO contacts in product today since it has proven to be the best switch contact material for washer and dryer motors.

**Specific questions pertaining to exemption 8**

***Original Exemption***

"Cadmium and its compounds in electrical contacts and cadmium plating except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations". . . **until 1 July 2010**

***Proposed Exemption***

Cadmium and its compounds in electrical contacts until **1 July 2009**, except for Mechanical pellet-type one-shot thermal cut-offs as from 1 July 2007 and except for Applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations.



**1. Please state whether you agree with the above cited conclusions of the previous evaluation or not and justify your statement. What has changed since 2006?**

Emerson is not in agreement with the proposed exemption above. Emerson has tested AgSnO and AgNiO contacts in washer applications resulting in either welded contacts (**unit failure**) or contact erosion. As a result product life was reduced and testing was discontinued. Note, reduced product life will increase the rate of product disposal in landfills.

**2. Please specify exactly which applications are covered by this exemption. What is the technical function of cadmium in the applications?**

a) The Emerson applications covered by the **“original exemption”** include all washer and dryer motor product. (b) Contacts made from Ag and cadmium oxide provide low contact resistance, high wear resistance and high anti-weld characteristics for Emerson product.

**3. Please state the amount of cadmium used per application, the cadmium content in the homogeneous material, the annual production volume as well as the number of applications related to exemption 8 put on the EU market annually.**

All Emerson applications using AgCdo contacts are made up of 90% Ag/10% Cdo. The annual production rate for washer/dryer application is "millions of units per annum". Emerson is requesting that both applications continue under the **“original exemption”**.

**4. Please justify whether and in which of these applications the use of cadmium and its compounds are still technically necessary and in which it can be substituted.**

Based on testing of washer/dryer motor applications, motors using AgSnO and AgNi experienced reduced motor life or contact welding. AgCdO continues to be the best contact choice for Emerson's washer and dryer applications.

**5. Please describe the research and other efforts to replace cadmium and its compounds in the applications in which you still consider it as irreplaceable.**

- **Emerson Appliance is “proactive” in finding an alternate solution/contact**
  - Working with our current contact supplier to determine if there is an alternate contact(s) that works best in Emerson's motor applications. Testing required to verify product performance.
- Emerson's contact supplier has proposed several alternate materials but **no guarantees** could be made that Emerson will have equivalent performance as AgCdo. However, internal and customer testing will be conducted and data disseminated accordingly.

**6. Please provide a roadmap with activities, milestones and timelines towards the replacement of cadmium in these applications**

Below is Emerson's action plan and time-line to generate data to determine if the alternate contacts recommended by the contact supplier is sufficient as a replacement based on Emerson's customer requirements:

- Sample contacts expected @ Emerson week of 02/11/08
- Motor samples may take up to 30-45 days to produce since production interruption will be necessary to run 4 different type of material samples in Emerson's mfg. plant.
- Weibull distributions will be generated to determine best contact candidate
- Both export and North American made motor models will be tested to determine if there is a suitable contact replacement for both styles of applications for lean efforts.
- Testing is expected to take 90-120 days for confirmed results

**7. Assuming the current exemption will be given an expiry date, what date do you think is technologically feasible for the industry?**

For switches used in washer and dryer application with an alternative contact solution, Emerson's internal long-term reliability data can be reviewed and if acceptable, can entertain removal of the Exemption by 2010.

However, if a suitable replacement is not available there could be product/contact design changes needed to achieve product that is RoHs compliant. This process could easily take up to four years. It is recommended, therefore, that no expiry date be defined but rather allow for a review of Exemption 8 in July of 2012.

**8. If you do not agree with the wording proposed during the last evaluation, please propose a new wording and justify your proposal.**

(a) Cadmium and its compounds in electrical contacts and cadmium plating, except for mechanical pellet-type one-shot thermal cut-offs as from 1 July 2010 and except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations.

***In addition, if a suitable contact replacement will not successfully work in product due to hazardous failure modes, product is eligible for individual/specific exemption if accompanied by supporting data.***



**Therm-O-Disc**  
**Search for Cd-Free Alternate Contacts In Thermal Cutoffs, Motor Protectors and other Limit**  
**Thermostats**  
**February 14, 2008**

**Specific questions pertaining to Exemption 8**

***Original Exemption***

**“Cadmium and its compounds in electrical contacts and cadmium plating except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations”**

***Proposed Exemption***

**(a) Cadmium and its compounds in electrical contacts until 1 July 2009, except for Mechanical pellet-type one-shot thermal cut-offs as from 1 July 2007 and except for Applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations.**

**1. Please state whether you agree with the above cited conclusions of the previous evaluation or not and justify your statement. What has changed since 2006?**

As stated to the Oeko Institut at the Stakeholders meeting and thereafter, we did not agree with the recommendation to exclusively remove pellet-type one-shot thermal cut-offs (TCO) from Exemption 8 effective 1 July 2007.

While RoHS compliant TCOs pass short term EN testing, from the customer perspective, short-term testing was not a substitute for long-term field experience (i.e., the laboratory of the field.) The market place has been approaching the shift to Cd-Free TCOs at a prudent rate. The sudden removal of Exemption 8 at this time would create a rush in approval testing, capacity problems, logistical problems and potentially hasty decisions that would could impact product safety.

We also did not agree with the recommendation to accelerate the expiration of Exemption 8 to 1 July 2009 for all other applications of cadmium in electrical contacts for similar reasons as above. The industry needs time to find and adequately test alternatives to the long proven reliability offered by cadmium containing contacts, especially for safety applications.

**2. Please specify exactly which applications are covered by this exemption. What is the technical function of cadmium in the applications?**

- a) Pellet-type one-shot thermal cut-offs (TCO)
- b) 20M bimetal self resetting thermal motor protector
- c) 49T bimetal high temperature self resetting limit control (protector)
- d) 14T bimetal self resetting regulating or limit control (protector)

The use of AgCdO provides long term reliability against contacts welding closed as well as minimizing contact splatter for cycling contacts. (Contact splatter may degrade surrounding insulative materials.) Both conditions could result in failure to electrically open the circuit which would be considered a potential safety hazard for protector type devices. For T-O-D, AgCdO has demonstrated its value in cycling electrical loads of 10-70 Amps and, in particular, inductive loads for protecting motors.

**3. Please state the amount of cadmium used per application, the cadmium content in the homogeneous material, the annual production volume as well as the number of applications related to exemption 8 put on the EU market annually.**

Response is **NOT FOR PUBLICATION**.

**4. Please justify whether and in which of these applications the use of cadmium and its compounds are still technically necessary and in which it can be substituted.**

- a) **TCOs** – As noted in the April 4, 2006 letter to Stephanie Zangl of the Oeko Institut: “A TCO is a safety critical device which must function when called upon to operate and may sit dormant for years – five, ten, even as many as twenty years before being required to operate. Therm-O-Disc, like its competitors, has subjected both the non-RoHS and RoHS compliant products to a battery of short-term tests as part of receiving EN60691 approval. However, from the perspective of many of Therm O Disc's customers, accelerated/short-term testing is not a substitute for long-term successful field experience”.

Assuming there have been no issues raised in the field, we could support the removal of Exemption 8 for TCOs in 2010.

- b) **20M Self resetting thermal protectors** – The issue with replacing AgCdO contacts in cycling thermal protectors is long term reliability at high currents and high inductance. A requirement for the 20M bimetal self resetting thermal motor protector, for example, can exceed 50 amp with a 45% power factor. AgCdO contacts have proven for over 40 years to provide the protection needed in this aggressive application. The benefits of AgCdO contacts are well-documented in literature, particularly its ability resist welding at high currents. To date, no alternate Cd-Free contact material has been approved.

- c) & d) **49T & 14T Self resetting limit controls** – Same as b)

**5. Please describe the research and other efforts to replace cadmium and its compounds in the applications in which you still consider it as irreplaceable.**

Therm-O-Disc has been pursuing alternate contact materials and designs with its many suppliers. This includes AgNi, AgCuONiO and AgSnOInO, to name a few. In all cases, extensive testing is needed to assess any design change, followed by testing to approve their use in our product to Test Agency standards (e.g., EN60730).

**6. Please provide a roadmap with activities, milestones and timelines towards the replacement of cadmium in these applications**

For the 20M Self resetting thermal protector, the timing to find an acceptable material is unknown, but candidate materials are identified. To assess these particular materials will take four to six months. If successful (i.e., they meet Therm-O-Disc and customer's requirement, approval by Test Agencies will be required. It will take six to twelve months to test and obtain all the needed agency approvals ( e.g., UL, VDE). More importantly, all Therm-O-Disc customers will then have to obtain agency approval of our Cd-Free product for use in their application. Timing for this can vary, depending on the application and its associated Agency standard, but two years is not an unusual amount of time for our customers to complete their re-approvals.

For 49T & 14T Self resetting limit controls, similar issues and timing is expected.

**7. Assuming the current exemption will be given an expiry date, what date do you think is technologically feasible for the industry?**

For pellet-type one shot thermal cutoffs, long-term reliability data can be reviewed and if acceptable, can entertain removal of the Exemption by 2010.

However, the 20M Self resetting thermal protector will need time to identify an alternate contact material that affords the same reliability found in the present AgCdO contacts. Applications such as electric motors used in appliances require that these thermal protectors have the same reliability whether using Cd bearing or Cd-Free contacts. Once an acceptable material is identified, application and agency approvals are required by Therm-O-Disc, our customer, and the customer of our customer. This process could easily take four years. It is recommended, therefore, that no expiry date be defined but rather allow for a review of Exemption 8 in July, 2012.

For 49T & 14T Self resetting limit controls, similar issues and timing is expected.

**8. If you do not agree with the wording proposed during the last evaluation, please propose a new wording and justify your proposal.**

This exemption should read: "Cadmium and its compounds in electrical contacts and cadmium plating, except for Mechanical pellet-type one-shot thermal cut-offs as from 1 July 2010 and except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to the restriction on the marketing and use of certain dangerous substances and preparations".