



Subject: Request for exemption based on adaptation to scientific and technical progress under directive 200_/95/EC: Use of Hexavalent Chrome for corrosion protection in Aluminum Castings

Dear Oko-institute,

Emerson Process Management companies, including: Fisher Controls International, Inc., Rosemount Inc., Rosemount Nuclear Instruments, Inc., Micro Motion, Inc., Daniel Industries, Inc., Mobrey Group Limited, Remote Automation Solutions and Rosemount Tank Radar AB respectfully submits the following request to support exemption #9 for hexavalent chromium used as a corrosion inhibitor.

Although our products are very different in form and function than listed in the current exemption for carbon steel in absorption refrigerators, the requirements driving the use of hexavalent chromium for anti-corrosion of materials, including for our aluminum castings in harsh environments are similar. Application examples of our aluminum castings include the monitoring and controlling of industrial processes, often used in severe environments that require high reliability and package integrity to protect personnel, environment, and equipment. Product testing carried out confirms that none of the current alternative materials tested to date provide equivalent anti-corrosion protection.

Introduction:

Emerson Process Management is a leading global supplier of products that measure, analyze, control, automate, and improve process and asset performance for customers in the chemical, oil and gas, pulp and paper, pharmaceutical, food and beverage, power, water and wastewater, and other process-related industries. Products include pressure, temperature, level and flow instruments; liquid, gas and combustion analyzers; and control valves and regulators. Plant locations include offshore oil platforms, refineries, pulp and paper mills, chemical and power plants (including nuclear). Failure of the product in these applications could affect plant personnel, the environment, and plant property. Our customers have come to expect and receive high reliability products that have field life exceeding 20 years in many applications. The use of high performing corrosion inhibitors is required to ensure package integrity for explosion proof instrument housings. For the reasons set forth in this letter and attachments, Emerson Process Management has no viable alternative for the use of hexavalent chrome in aluminum castings.

Background on use of hexavalent chrome in aluminum castings

The aluminum castings used in today's product are the lowest cost solution for the containment of an explosion when issued in explosion proof applications. Emerson Process Management products are designed to meet North American, European, and Asia/Pacific Certifications. These include ATEX Flameproof and BASEEFA Approvals, CSA and FM Approvals, and TIIS and SAA Flame and Dustproof Approvals. The explosion proof standards require a minimum 7 threads of engagement for housing covers; and where used, flame paths to cool the flame below ignition temperatures to prevent potentially catastrophic



propagation of the flame. Corrosion of these joints could lead to a safety concern by changing the product seal integrity. To ensure protection and reliability of these products, a thin coating of hexavalent chromium is applied at a rate of approximately 260mg per square meter prior to the paint application to provide the necessary corrosion inhibition that ensures package integrity. This amounts to approximately **9 Kg** of hexavalent chromium that ships into the EU per year for all Emerson Process Management products.

A common industry practice that requires higher product corrosion resistance is the end users' use of dissimilar materials for piping, conduit and other connections. Stainless steel fasteners are often used in the field to ensure fittings do not corrode. These fittings however create a galvanic cell when used with aluminum cast housings. Another area where dissimilar metals cause galvanic corrosion concerns on process instruments is where the sensor module housing threads into the aluminum cast housing. Without superior corrosion protection, galvanic corrosion can make the product seals fail rapidly.

We have noted other industry alternatives to Cr⁺⁺⁶ materials, including non-chromate and trivalent chromium materials. Recently, we noted a report titled "Chromium Alternatives Qualification Testing" dated September 27, 2007, submitted by Concurrent Technologies Corporation for the US Air Force Plant (AFP) 44 facility in Tucson, Arizona. The testing concluded that the baseline hexavalent coating performed the best, followed by a trivalent coating material, and then other non-chromate coating materials. The testing however, was only performed on sheet aluminum test panels, 2024-T3 and 6061-T6.

We have tested several of the alternative conversion coating materials, and while some have fared well on blank 2024-T3 and 6061-T6 aluminum test panels, they did not pass on actual aluminum cast product. We have found that trivalent and non-chromate materials do not provide equivalent protection for the unpainted surfaces that are found in the threaded surfaces and the flame path joints of aluminum castings, the unpainted and painted surfaces within close proximity of dissimilar metals, and painted surfaces in general. (See attached sample test results.)

We support Dr. Goodman's findings stated in his "Review of Directive 2002/95/EC (RoHS) Categories 8 and 9 – Final Report" (ERA Report 2006-0383 – Final Report) where stated on pages 4 and 5, that "research has been carried out with substitute materials and results to date indicate that these can be used as replacements under all conditions **except** those found in the most severe environments such as within chemical and petrochemical process plant." Emerson Process Management products are commonly found in these severe environments.

Existence of feasible substitutes in an industrial and/or commercial scale:

Stainless steel housings have been successfully employed for explosion proof designs.

Other anti-corrosion coatings that rely on trivalent chrome or proprietary non-chrome coatings were reviewed, and the best performing alternatives have been extensively tested



on our products. Product testing carried out confirms that none of the current alternative materials provide equivalent anti-corrosion benefits.

Some coatings (anodizing) do provide corrosion improvement. However, the insulating properties from anodizing do not provide the EMI and safety ground connections required.

Costs and benefits, advantages and disadvantages of such substitutes:

Stainless steel housings weigh approximately 3 to 4 times more than aluminum cast housings and cannot be qualified for certain seismic applications due to the weight increase. Stainless steel contains a large percentage of nickel to achieve the anti-corrosive properties. Stainless Steel use results in costs to the end user that range from 10 to 15 times higher than the aluminum cast product.

Anodize cost is 3-4 times the cost to apply Cr⁺⁺⁶. In order to ensure electrical and EMI protection, corrosion resistance is impaired at connection points.

Precise Wording of the Exemption:

“Cr⁺⁺⁶ used for the corrosion protection of aluminum castings in painted and unpainted housings for industrial monitoring and control applications”.

Technical and scientific evidence:

Please refer to the attached Directive 2002/95/EC check list. Also refer to the attached internal testing performed to ASTM-B117 and the subsequent results on test panels, parts and product.

Please do not hesitate to contact Nick Haywood at Emerson Process Management, in the US at +1 (952) 949-7092, or Clinton Bane at +1 (641)754-2432 if you require additional information or assistance with this request.

Sincerely,

Nick Haywood
Design Engineering Manager
Emerson Process Management
Rosemount Division

Clinton Bane
Senior Quality Engineer
Emerson Process Management
Fisher Controls Division

Attachment to Exemption Request for use of hexavalent chromium for corrosion protection of aluminum castings in industrial monitoring and control applications.

Check List: Directive 2002/95/EC

Technical and scientific evidence in support of request for exemption for hexavalent chromium used for corrosion protection of aluminum die casting for industrial monitoring and control applications.

1a) Please describe the material/component of the electrical and electronic equipment that contains the hazardous substance.

Request exemption for use of hexavalent chrome as a corrosion inhibitor and paint adhesion promoter in aluminum cast housings and associated hardware (covers, etc). Housings provide explosion / flame containment for safety considerations, isolation of electronics from moisture, dust and other contaminants, EMI/RFI protection, and other provisions.

1b) Please indicate the type and quantity of the hazardous substance used in the homogenous material. Please indicate the quantity of the substance in absolute numbers and in percentage by weight in homogeneous material.

Hexavalent Chromate Conversion Coating is applied to the aluminum cast housings at a average rate of 260 mg/m². A typical valve instrument housing has 0.295m² of surface area resulting in 76.6mg of Hexavalent Chrome. The percentage of housing weight this is 0.00419%.

1c) Please indicate the functionality of the substance in the material of the equipment.

Hexavalent chrome provides corrosion resistance for critical flame paths, metal to metal surfaces, o-ring/gasket sealing surfaces, and is electrically conductive. It also provides a surface adhesion improvement between the substrate and painted exterior surfaces.

1d) Estimated annual quantities of the hazardous substance used in this particular application that would enter the EU market.

The total amount of hexavalent chromium entering the EU market was 9 Kg.



2) Please explain why the elimination or substitution of the hazardous substance via design changes or materials and components is currently technically or scientifically impracticable.

Substitution or elimination of hexavalent chromate conversion coatings in aluminum housings will result in shorter life span of the housing in corrosive industrial settings and will potentially damage the integrity of explosion proof joints. This may also lead to premature product failure due to corrosion-created leak paths allowing moisture and/or other detrimental contaminants into the device. Alternative substrate materials such as stainless steel can be used with a significant weight and cost penalty. This weight penalty cannot be tolerated in all applications. No better performing aluminum alloys have been identified. Engineered resins are not yet proven for explosion proof housings. Currently available alternative conversion coatings (tri-chromes and non-chromes) do not perform as well (corrosion resistance and paint adhesion) as hexavalent chrome in corrosive environments.

3) Please indicate if the negative environmental, health and/or consumer safety impacts caused by substitution are likely to outweigh the environmental, health and/or consumer safety benefits. If existing, please refer to relevant studies on negative impacts caused by substitution.

Substitution may jeopardize the integrity of the explosion proof housing. Substitution may also lead to premature product failure due to corrosion-created leak paths allowing moisture and/or other detrimental contaminants into the device. Both of the aforementioned performance degradations have potentially negative environmental, health, and consumer safety impacts considering the industries and end processes where these products are utilized (process measurement/control).

4) Please indicate if feasible substitutes currently exist in an industrial and/or commercial scale. Please indicate the possibilities and/or the status for the development of substitutes and indicate if these substitutes will be available by 1 July 2006 or at a later stage.

Some people have chosen to accept a lower life of product by using one of the commercially available alternatives – tri-chrome or non-chrome conversion coatings. None of these perform as well as hexavalent chrome in the testing we have performed. We continue to monitor the market and test promising replacements. Anodized surfaces are well protected from corrosion but lose the electrically conductive property required for safety and EMI resistance. Stainless steel alternatives are possible.

5) Please indicate if any current restrictions apply to such substitutes. If yes, please quote the appropriate legislation/regulation.

Not applicable.



6) Please indicate the costs and benefits and advantages and disadvantages of such substitutes. If existing, please refer to relevant studies on costs and benefits of such substitutes.

Weight penalty from stainless steel housings require re-evaluation of piping and mounting brackets. In some vibration applications there may not be an acceptable solution due to the 300-400% weight penalty. Stainless steel versus aluminum imposes a cost penalty of approximately 1000-1500 %. Anodizing protects from corrosion but sacrifices the conductive path that is used to ensure safe operation and reduce EMI impact. Non-chrome and tri-chrome based substitutes do not provide equivalent corrosion resistance.

7) Please provide any other relevant information that would support your application for an additional exemption.

Please see supporting test data for comparative tests. Emerson Process Management products are often used in very hazardous and remote industrial locations that demand the highest reliability. Any substitution for the current hexavalent chromium corrosion protection could diminish that reliability and thereby have an impact on the safety of personnel and the environment.