ANALYSIS OF ALTERNATIVES

and

SOCIO-ECONOMIC ANALYSIS

Legal name of applicant(s):	Tyco Electronics UK Ltd
Submitted by:	Tyco Electronics UK Ltd
Date:	17 March 2023
Substance:	Chromium trioxide EC No. 215-607-8, CAS 1333-82-0
Use title:	Industrial use of a mixture containing hexavalent chromium compounds in conversion coating and passivation of circular and rectangular connectors in order to meet the requirements of international standards and special requirements of industries subject to harsh environments
Use number:	2

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LIST OF ABBREVIATIONS

AfA	Application for Authorisation
CMG	Connector Manufacturers' Group
CSR	Chemical Safety Report
MRO	Maintenance, Repair and Overhaul
PCN	Product Change Notification
QPL	Qualified Products List
SEA	Socio-Economic Analysis

DECLARATION

We, the Applicant, Tyco Electronics UK Ltd, are aware of the fact that further evidence might be requested by the Health and Safety Executive (HSE) to support the information provided in this document.

Also, we request that the information blanked out in the “public version” of the Analysis of Alternatives and Socio-economic Analysis is not disclosed. We hereby declare that, to the best of our knowledge as of today (17 March 2023), the information is not publicly available, and, in accordance with the due measures of protection that we have implemented, a member of the public should not be able to obtain access to this information without our consent or that of the third party whose commercial interests are at stake.

Signature: Tyco Electronics UK Ltd Date, Place: 17 March 2023, Hastings

1. SUMMARY

CONTEXT

Tyco Electronics UK Ltd requests Authorisation for continued use of chromium trioxide in the surface treatment of connectors (Use 2) beyond the expiry date of the current Authorisation on 21 September 2024.

Tyco Electronics UK Ltd designs and manufactures high performance connectors intended for critical applications, such as encountered in military, aeronautics, space or heavy industry sectors.

Mixtures of hexavalent chromium compounds are used in conversion coating of connectors to provide specific functional properties, particularly in terms of corrosion resistance and conductivity.

SUBSTANCE FUNCTION

Hexavalent chromium is used for the conversion coating of connector parts. As detailed in CSR, the treated surfaces are immersed in hexavalent chromium containing treatment baths. The principal required technical performances for electrical connectors such as those addressed by Use-2 are:

- Corrosion resistance
- Conductivity
- Colour
- Thickness
- Temperature resistance.

IDENTIFICATION OF ALTERNATIVES

Alternatives available to passivate the plated surfaces are trivalent chromium-based chemistries. These passivates require the use of a topcoat (post passivate application) to give consistent colour and wear resistance of the passivate film. These topcoats render the coating non-conductive. The connectors manufactured by Tyco Electronics UK Ltd require conductivity across the surface and between mating halves to ensure grounding or electrical/RFI shielding.

Alternative plating finishes (such as Nickel PTFE) are available. However, a significant portion of the products supplied by the Hastings site are designed to meet customer or external specifications, which do not permit alternative finishes to be used.

These alternatives were assessed and deemed unsuitable for use based on technical performance, customer requirements and industry/military standard requirements.

NON-USE SCENARIO

Taking into account the high level of requirement associated with Use-2, its importance for Tyco Electronics UK Ltd in terms of business, know-how and competitiveness, the most likely non-use scenario is the following:

With the interdiction of CrVI compounds, three situations – that can be combined or not – can be foreseen in this scenario:

1. Downgrade of connectors performances when possible.
2. Loss of activity and partial cease of production.
3. Partial or complete relocation of manufacturing activities outside the EU.

All situations imply halting the production of connectors for a period of time after the sunset date due to relocation, adaptation and requalification delays.

IMPACTS OF GRANTING AUTHORISATION

Monetised impacts of the “applied for use” scenario include costs related to the medical treatment, morbidity and mortality associated with the excess of risk of cancer arising from the exposure to the substances mentioned of workers over the review period.

Given the strategic and commercial aspects of the products concerned by Use-2 for Tyco Electronics UK Ltd, the “non-use” scenario entails strong impacts for them, with a foreseen termination of business and numerous lay-offs.

Impacts of the denial of an authorisation would mainly have economic, social and distributional dimensions:

- Economic impacts on Tyco Electronics UK Ltd activity will include loss of profits and relocation costs.
- Social impacts mainly consist in impacts on employment since employees of Tyco Electronics UK Ltd will be laid off.
- Distributional impacts mainly on Aerospace & Defence industry.

The total monetised impacts of the “non-use” scenario amount to £[redacted] M.

Based upon the present assessment, the socio-economic benefits outweigh the risks arising from the use of the substance by a factor of approximately 212,600.

CONCLUSION

Based on the arguments the Applicant requests an authorisation review period for Use-2 of 7 years in order to pursue the implementation of the substitution process.

2. AIMS AND SCOPE

Tyco Electronics UK Ltd is applying for an authorisation for its use of chromium trioxide in the surface treatment of their products.

This Application for Authorisation (AfA) supports the use of hexavalent chromium compounds in chromium plating, for the manufacture of connector parts, on the site of:-

Tyco Electronics UK Ltd, located in Hastings, United Kingdom.

The aim of the present document is to provide a comprehensive analysis of both the Analysis of Alternatives and Socio-Economic Analysis parts of Tyco Electronics UK Ltd's Use-2 Application for Authorisation (AfA), i.e.:

- to provide a comprehensive understanding of the context of the AfA.
- to describe the company's research work for alternatives, potential alternatives and substitution strategy.
- to provide a comparative assessment of the monetised impacts of the pursued use of the substances ("applied for use" scenario) and the impacts of the denial of an authorisation ("non-use" scenario).

The present Analysis of Alternatives and Socio-Economic Analysis document focuses on Use-2:

> "Industrial use of a mixture containing hexavalent chromium compounds in conversion coating and passivation of circular and rectangular connectors in order to meet the requirements of international standards and special requirements of industries subject to harsh environments"

Scope in a nutshell

Under Use-2, Tyco Electronics UK Ltd currently uses chromium trioxide, as well as acids generated from chromium trioxide and its oligomers) in conversion of circular and rectangular connectors and backshells intended to function in harsh conditions, so as to ensure a high level of performance, in particular in terms of conductivity and corrosion resistance. Main functional requirements for Use-2 are developed in section 3.1.1.

Several key factors, further developed below, should be borne in mind by the reader:

- Up to tens of thousands of connectors can be used for certain applications (aerospace for instance).
- These high performances connectors are vital for the very functioning and therefore the safety of these applications.
- Connectors are made of several subcomponents, requiring specialised skills and equipment for their manufacturing.

Connectors are entrenched in a worldwide system of interconnected standards.

Use-2 pertains to high performances connectors intended to withstand severe atmospheric and mechanical conditions (humidity, temperature, vibrations, corrosive atmosphere) and concerns a vast array of applications in military, aeronautic and heavy industry sectors. Examples of connectors concerned by Use-2 are shown below:

Figure 1. Example of products concerned by Use-2

The harsh environment to which connectors are subject, combined with the normative and specific customer requirements in terms of quality of signal transmission are the conditions that illustrate the highly technical nature of these products. It should also be stressed that connectors in this application are not "standard" office connectors. Connectors concerned by Use-2 are very complex articles implying the manufacture of various components as illustrated below

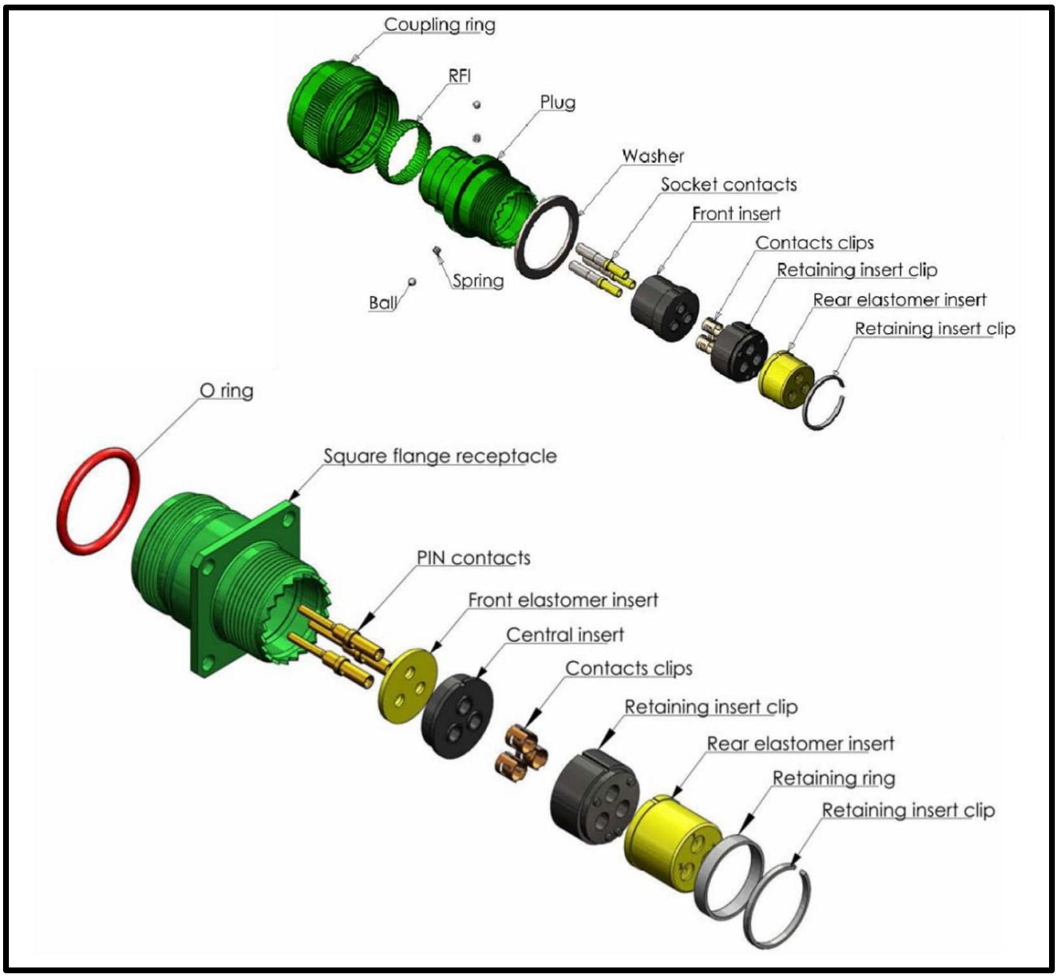

Figure 2. Detailed description of connectors and their components

The term "connector" refers to the entire component. The surface treatment can be implemented essentially on the connector's body, but also on the various sub-components the connectors it contains.

Due to the wide range of their customers' applications, Tyco Electronics UK Ltd design and manufacture a large number of specific connectors that differ in shape, size, number and position of pins, etc.

Surface treatment of connectors is a key condition to the performances of connectors manufactured by Tyco Electronics UK Ltd and the meeting of European and international normative requirements. Use-2 is also therefore at the very heart of the Tyco Electronics UK Ltd's, know-how and activities.

Key figures for Tyco Electronics UK Ltd are as follows:

- Revenues: £[redacted]M
- Employees: 260

It must be stressed that surface treatment is the central step and at the very core of the whole connector manufacturing process. Strong links exist between each process step in terms of know-how and production management.

In order to provide the flexibility needed to produce connectors which are specific according to normative and customer requirements, the whole manufacturing process is fully internalised by Tyco Electronics UK Ltd. Due to the specificities of the connectors (which are often produced in very small batches or even one-off products), all these steps need to be carried out in the same facility.

Each manufacturing process implies specific knowledge and expertise. These steps therefore imply various competences related to each step of manufacturing process and each component of the connectors as illustrated in Figure 3, below:

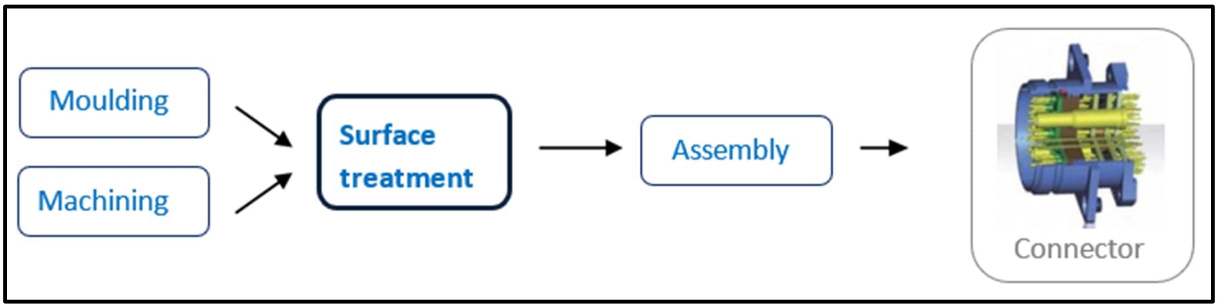

Figure 3. Description of the manufacturing process

Unlike other production steps which involve easily movable machinery (such as injection moulding or milling machines), surface treatment production lines are more than 10 meters long and need to be connected to an effluents treatment plant and are therefore very complex to relocate.

As a consequence, the relocation of the surface treatment workshop would directly impact other production lines such as machining, moulding or assembly, as shown in Figure 3 and thus every profession in charge of these steps.

As a complement, it must be stressed that the connectors market is global and that competing offers outside the UK will potentially be available in the case Tyco Electronics UK Ltd cannot produce connectors impacted by Use-2.

3. ANALYSIS OF ALTERNATIVES

Under Use-2 of the present AfA, hexavalent chromium compounds are used by Tyco Electronics Uk Ltd for the conversion plating of connectors in six facilities located in France, Germany and the United Kingdom.

Conversion plating provides corrosion resistance and conductivity properties to the connectors, as well as other normative functional requirements such as temperature resistance, thread lubricity, coupling and uncoupling torque.

These performances are key to the delivery of a constant and reliable connection in the harsh conditions they are designed to withstand.

3.1. SVHC use applied for

In order to maintain their proper function (data and/or energy transmission) throughout their entire life cycle and through all conditions, connectors concerned by Use-2 are subject to stringent functional requirements.

3.1.1. Description of the function(s) of the Annex XIV substance and performance requirements of associated products

Hexavalent chromium is used for the conversion coating of connector parts. As detailed in CSR, the treated surfaces are immersed in hexavalent chromium containing treatment baths.

Examples of required technical performances for electrical connectors such as those addressed by Use-2 are listed below.

- Corrosion resistance; Salt spray resistance: dynamic test ≤500h
- Conductivity; Shell to shell conductivity before salt spray (0->2.5mV or higher) Shell to shell conductivity after salt spray (0->5mV or higher)
- Colour; black
- Thickness; 12 to 23 µm
- Temperature resistance; -65 / +175°C
- Thread lubricity; 500 mating cycles
- Vibration resistance; Optimal sliding/adhesion
- Coupling and uncoupling torque; Requirements met after exposure to severe corrosion environments
- Aspect after salt spray
- No deterioration of the coupling (e.g. grain formation)

3.1.2. Market analysis of products manufactured with the Annex XIV substance

The original AfA [Souriau-Esterline et al., (2015)] canvassed a broad spectrum of connector users: -

- French Ministry of Defence (DGA)
- Thales
- Dassault
- Airbus
- Alstom
- Safran
- Zodiac

A confirmation was received of the market need for product that meets the requirements of section 3.1.1 of this AfA, both to support MRO of existing equipment and ongoing development of new equipment.

This report also provided detail of the time taken to qualify a new surface finish, this being anywhere up to 3 years from commencement of the activity.

3.1.3. Annual volume of the SVHC used

Based on current production loading and sales forecasts, the predicted use of chromium trioxide is with the following band: -

- 1-10 tonnes per year

3.2. Efforts made to identify alternatives

A close working relationship is maintained with our chemistry suppliers, who we actively encourage to develop more environmentally friendly solutions to the industry requirements.

3.2.1. Research and development

As new chemistries become available from our suppliers, we conduct process trials to assess their suitability for compatibility to industry requirements.

3.2.2. Consultations with customers and suppliers of alternatives

Initial Customer consultations were carried out by the CMG [Souriau-Esterline et al., (2015)]. Industry requirements have not changed since that point.

3.2.3. Data searches

As the subject matter experts, development of new chemistries to meet the unchanging industry requirements is left to the responsibility of the chemistry suppliers.

3.2.4. Identification of alternatives

The main area of focus has been on developing differing chemistries to continue to produce a black, conductive surface on the connectors.

3.2.5. Shortlist of alternatives

Following discussions with suppliers, alternatives were provided for evaluation to Tyco Electronics UK Ltd’s process requirements.

For ease of reference, alternatives selected for evaluation are shown in table 1 below:

Table 1: Shortlisted alternatives.

Number	Alternative name	CAS or EC Number (where applicable)	Description of alternative
1	Clepo X-76	No Chromium compounds	REACH compliant chemistry trial, MacDermid
2	ELV5105	10025-73-7 (Chromium III Chloride)	REACH compliant chemistry trial, MacDermid
3	FiniDip 728 / Finigard 105	13548-38-4 (Chromium III Nitrate)	REACH compliant chemistry trial, Coventya

In addition to the shortlisted alternatives that are detailed in Sections 3.3, process trials were also carried out by Tyco Electronics UK Ltd on the following additional alternatives: TriPass ELV 5100, Kenvert 11, TriPass ELV 5200 and TriPass ELV 7100. All of these share the same fundamental shortcomings as the shortlisted alternatives, so no further testing or analysis was carried out following the preliminary process trials conducted between 2015 and 2023.

3.3. Assessment of shortlisted alternatives

3.3.1. Alternative 1: [CLEPO]

3.3.1.1. General description of Alternative 1

A black passivate based on trivalent chromium chemistry was supplied by one of our regular chemical manufacturers. The process (Clepo) was at the development stage and designed as a black passivate for zinc alloy plating. The passivate requires a topcoat to protect the passivate film from abrasion, enhance colour and evenness of appearance.

The solution would be a direct replacement for the current process. There would be no modifications to plant required, but an additional process in the form of a topcoat would be required. This would add an additional step to the overall process slightly increasing cost and time. An alternative drying method may have to be considered to avoid damaging the topcoat during the drying stage. This was not explored as process failed to meet requirements.

3.3.1.2. Availability of Alternative 1

The process was at the development stage and not commercially available at the time. The trial solution was supplied by the manufacturer’s laboratory, so additive components were not available to purchase and run on a full scale production basis.

3.3.1.3. Safety considerations related to using Alternative 1

Not applicable as process did not make it to market

The Clepo passivate process would be a safer process in regard to not using hexavalent chromium (in the form of chromium trioxide) as the basis of the chemistry.

3.3.1.4. Technical feasibility of Alternative 1

Sample parts were used for the trials. These were typical shells used for our connectors to better represent the function of the process rather than using test pieces or coupons.

The sample parts were processed through the trial passivate solution with and without the topcoat and subjected to electrical testing as per MIL-DTL-38999M (section 4.5.25 – shell to shell conductivity). Parts with topcoat failed test.

Samples were subjected to neutral salt spray (NSS) test as per MIL-DTL-38999M (section 4.5.13.2). This is a 500hr test. The surface corrosion on the samples was notably more on parts without the topcoat, but there were no catastrophic failures as a result. However, all parts failed electrical test after NSS.

The topcoat aided corrosion and handling wear resistance but being nonconductive impacted the electrical conductivity of the component surfaces to the point that they do not meet requirements of the specification.

3.3.1.5. Economic feasibility of Alternative 1

Not applicable as process was not suitable or commercially available

3.3.1.6. Suitability of Alternative 1 for the applicant and in general

Alternative 1 failed to meet the electrical conductivity requirements set out in MIL-DTL-38999M or SAE-AS85049F and was therefore deemed not suitable for use.

3.3.2. Alternative 2: [TriPass ELV5105]

3.3.2.1. General description of Alternative 2

TriPass ELV5105 is a black passivate based on trivalent chromium chemistry rather than hexavalent chromium (chromium trioxide based) chemistry. It is recommended by the manufacturer that the passivate film is used in combination with ELV post dip or a topcoat to maximise performance and appearance characteristics.

A black passivate based on trivalent chromium chemistry was supplied by one of our regular chemical manufacturers. The process is designed for use as a black passivate for zinc alloy plating. The passivate requires a topcoat to protect the passivate film from abrasion, enhance colour and evenness of appearance.

The solution would be a direct replacement for the current process. There would be no modifications to plant required, but an additional process stage in the form of a topcoat would be required. This would add an additional step to the overall process slightly increasing cost and time. As with Alternative 1 a drying method would need to be developed to avoid damaging the topcoat during the drying stage.

3.3.2.2. Availability of Alternative 2

At the time of the trial the chemistry and data sheets were commercially and freely available and the intention of the manufacturer was to continue with availability

3.3.2.3. Safety considerations related to using Alternative 2

The TriPass ELV5105 passivate process would be considered a safer process for operators as it does not contain hexavalent chromium (in the form of chromium trioxide) as the basis of the chemistry. The makeup concentrate contains <5% Chrome (III) chloride (CAS-No.: 10025-73-7) and <1% each of nitric acid (CAS-No.: 7697-37-2), sodium bifluoride (CAS-No.: 1333-83-1) and cobalt nitrate (CAS-No.: 10141-05-6)

Overall, this process with lower concentrations of additives and the omission of hexavalent chromium would be considered safer for the operators and the environment.

3.3.2.4. Technical feasibility of Alternative 2

Machined connector shells were used as samples which are typical of the type used for our connectors. This gives a truer representation of the function of the process compared to using test panels or coupons.

The sample parts were processed through the trial passivate solution with and without the recommended topcoat. They were then subjected to electrical testing as per MIL-DTL-38999M (section 4.5.25 – shell to shell conductivity). Parts with topcoat failed test.

A number of samples were then subjected to neutral salt spray (NSS) test as per MIL-DTL-38999M (section 4.5.13.2). This is a 500hr test. The surface corrosion and salt build up was significantly higher on parts that did not the topcoat. All parts subjected to NSS test failed the electrical test afterwards.

As with previous trials the topcoat aided corrosion and handling wear resistance but being nonconductive impacted the electrical conductivity of the component surfaces to the point that they do not meet requirements of the specification.

3.3.2.5. Economic feasibility of Alternative 2

Not applicable as this process was not suitable for use

3.3.2.6. Suitability of Alternative 2 for the applicant and in general

Alternative 2 failed to meet the electrical conductivity requirements set out in MIL-DTL-38999M or SAE-AS85049F and was therefore deemed not suitable for use.

3.3.3. Alternative 3: [FINIDIP 728 / FINIGARD 105]

3.3.3.1. General description of Alternative 3

FINIDIP 728 is a black passivate based on trivalent chromium. It is recommended by the manufacturer that the passivate film is used in combination with a post dip or a topcoat to maximise performance and appearance characteristics. Finigard 105 was recommended.

A sample of the passivate and the post dip was supplied by the chemical manufacturer for the purposes of carrying out trials in our Plating laboratory. The process is designed for use as a black passivate for zinc alloy plating.

As with previous alternatives this solution would be a direct replacement for the current process and the requirement of additional stage for the post dip. There would be no modifications to plant required. As with Alternatives 1 & 2 a drying method would need to be developed to avoid damaging the topcoat during the drying stage.

3.3.3.2. Availability of Alternative 3

At the time of the trial the chemistry and data sheets were commercially and freely available and the intention of the manufacturer was to continue with availability

3.3.3.3. Safety considerations related to using Alternative 3

The Finidip 728 passivate process would not be considered a particularly safer process. Although it does not contain hexavalent chromium it contains the following in the makeup concentrate:

<20% Chrome (III) nitrate (CAS-No.: 13548-38-4), <10% each of nitric acid (CAS-No.: 7697-37-2), <1% ammonium bifluoride (CAS-No.: 1341-49-7) and <5% cobalt nitrate (CAS-No.: 10141-05-6)

Under classification the make up concentrate is still regarded as potentially carcinogenic (Carc. 1B, H350) and an acute/chronic very toxic risk to marine life (Aquatic acute 1, H400 & Aquatic Chronic 1, H410). It is classified as Acute Tox. 2 (H330 – fatal if inhaled).In addition to risk of serious eye damage (Eye Dam. 1, H318), severe burns (Skin Corr. 1A, H314), allergic skin reaction (Skin Sens. 1, H317), respiratory issues (Resp. Sens. 1, H334)

Overall this process would not be considered any safer for the operator or the environment.

3.3.3.4. Technical feasibility of Alternative 3

Machined connector shells were used as samples which are typical of the type used for our connectors. This gives a truer representation of the function of the process compared to using test panels or coupons.

As the base chemistry for this process is similar to previous alternatives the primary consideration was given to electrical conductivity (resistance) to see if requirements of MIL-DTL-38999M (section 4.5.25 – shell to shell conductivity) could be achieved and also appearance i.e. even black finish.

The sample parts were processed through the trial passivate solution with and without the recommended topcoat. They were then subjected to electrical testing as per MIL-DTL-38999M (section 4.5.25 – shell to shell conductivity). Parts with topcoat failed test.

The trial was ended prior to carrying out any Neutral salt spray (NSS) testing due to the poor electrical performance when topcoat applied. Without topcoat wear resistance of the passivate was unacceptable. Component handling, which would be required during the assembly process caused the passivate film to be eroded exposing the zinc alloy plating. This would then suffer early onset of corrosion (oxidation of the zinc) reducing the potential functional life of the product.

3.3.3.5. Economic feasibility of Alternative 3

Not applicable as this process was not suitable for use

3.3.3.6. Suitability of Alternative 3 for the applicant and in general

Alternative 3 failed to meet the electrical conductivity requirements set out in MIL-DTL-38999M or SAE-AS85049F and was therefore deemed not suitable for use.

3.4. Conclusion on shortlisted alternatives

None of the alternatives identified meet the industry requirements defined in section 3.1.1

4. SOCIO-ECONOMIC ANALYSIS

4.1. Continued use scenario

4.1.1. Summary of substitution activities

No substitution activities have been possible due to the results obtained from trial runs of the identified alternatives from section 3.3 of this document.

4.1.2. Conclusion on suitability of available alternatives in general

Based on development activities to date, no available alternatives are suitable for substitution.

4.1.3. Substitution plan

Not applicable; at the time of submission of the AfA, no alternatives were suitable for substitution.

4.1.3.1. Factors affecting substitution

Not applicable - see 4.1.3

4.1.3.2. List of actions and timetable with milestones

Not applicable - see 4.1.3

•

4.1.3.3. Monitoring of the implementation of the substitution plan

Not applicable - see 4.1.3

4.1.3.4. Conclusions

Not applicable - see 4.1.3

4.1.3.5. References

Not applicable - see 4.1.3

4.1.4. R&D plan

Tyco Electronics UK Ltd remains committed to seeking a REACH-compliant solution to the industry needs, and is working closely with suppliers to assess any new chemistries they develop on an ongoing basis.

4.2. Risks associated with continued use

As quoted in the previous AfA submission [Souriau-Esterline et al., (2015)], the ECHA Risk Assessment committee established a reference dose response relationship for carcinogenicity of hexavalent chromium (including Chromium trioxide and Acids generated from chromium trioxide and their oligomers).

Based on RAC's opinion on excess risks of several chromium compounds, the assessment of the estimate possible impacts on human health related to Use-2 will be based on the excess risks of cancer that can be estimated for the review period are confirmed and specified by air monitoring data and modelling in the associated document.

As described in the CSR, the "applied for use" scenario only presents a risk for workers dedicated to the process and the sporadic workers involved in the process.

It can therefore be stated that the risk for the general population is negligible. The handling of the mixture containing the substance is well managed with general and personal protection equipment and safety procedures.

4.2.1. Impacts on humans

This assessment was not conducted as the alternatives were discounted due to the shortfalls highlighted in the technical feasibility study.

4.2.2. Impacts on environmental compartments

See section 4.2.1

4.2.3. Compilation of human health and environmental impacts

See section 4.2.1

4.3. Non-use scenario

4.3.1. Summary of the consequences of non-use

The main arguments put forward in the previous sections can be summarised as follows:

(a) There is no available alternative to conversion coating of these connectors/backshells that can provide the functional requirements needed to meet the requirements of international standards.

(b) These components are key for Tyco Electronics UK Ltd.'s portfolio: both in terms of what they represent of direct share of revenues and also considering the strategic role they play for customers.

(c) An important part of the business activity related to Use-2 is due to defence applications and as a result, mostly non relocatable.

If the authorisation for Use-2 is not granted, based on these arguments, under the most likely "non-use" scenario, Tyco Electronics UK Ltd. will not be able to immediately maintain the production of these connectors in the sites concerned by Use-2.

As a result, the most likely non-use scenario will entail both:

- Progressive reduction of performance level when possible.
- Relocation.
- Cease of the activity.

4.3.2. Identification of plausible non-use scenarios

See section 4.3.1

4.3.3. Conclusion on the most likely non-use scenario

See section 4.3.1

4.4. Societal costs associated with non-use

4.4.1. Economic impacts on applicants

Based on the 2022 activity, which is considered as representative of the future activity (based on the last 3 years trend revenues), an average of 40% of Tyco Electronics UK Ltd revenues is shown to directly depend on Use-2, i.e. £[redacted]m).

Since no replacement is available for cadmium passivated with Cr6 and due to performances requirements standards, Use-2 cannot be maintained with a downgrade of the performances fulfilled.

Relocation of 70% of Use 2 activity

As a result, most of the conversion of circular and rectangular connectors and Backshells (70% of the activity) would have to be done outside the UK via relocation.

To achieve this, Tyco Electronics UK Ltd will have to carry out requalification steps required for moving.

Considering the average duration for relocation, it is estimated that this will entail:

- A two-years loss of revenues/profits for Tyco Electronics UK Ltd of the share of activity potentially relocatable.
- In addition, with the costs related to the implementation of the settlement such as: relocation of equipment (plating and Assembly line), training of new workers by UK workers, installation costs (building extension, setting up, etc.)

Based on the above assumptions, the calculation of the loss of revenues is synthesised in Table 2 below:

	VALUE
Average annual revenues for TE UK Ltd in 2022	£[redacted]
Share of revenues directly related to Use-2	40 %
Average annual revenues directly related to Use-2	£[redacted]
Economic profitability considered (Return on sales)	28 %
Average annual profits directly related to Use-2	£[redacted]
Share of Use-2 activity potentially relocatable	70 %
Average annual profits related to Use-2 potentially relocatable	£[redacted]
Relocation period considered for the loss of revenues	2 years
Total loss of profits for TE UK Ltd during relocation period	£[redacted]

Table 2. Loss of profits for Tyco Electronics UK Ltd to relocation of activity potentially relocatable as described under "non-use" scenario for Use-2

Moreover, based on the assessment made by the Applicants, the calculation of average costs of the relocation to sites located outside of the UK is synthesised in Table 3 below:

	VALUE
Relocation of equipment (Plating and Assembly line)	£[redacted]
Training of new workers by UK workers	£[redacted]
Installation costs (building extension, setting up, etc.)	£[redacted]
Total relocation costs for TE UK Ltd	£[redacted]

Table 3. Relocation costs for Tyco Electronics UK Ltd under "non-use" scenario for Use-2

Cease of remaining activity (30%)

Since part of the Use-2 activity is related to Defence applications or due to disproportionate relocation costs compared to the profits gained, around 30% of Tyco Electronics UK Ltd's Use-2 activity will be stopped if the authorisation is not granted.

Compared to the "use scenario", this non-use scenario hypothesis will entail a profit lost during all the review period considered.

	VALUE
Average annual revenues directly related to Use-2	£[redacted]
Average annual profits directly related to Use-2	£[redacted]
Share of Use-2 activity not relocatable	30 %
Average 2022 loss of profits related to Non-Use-2 (*)	£[redacted]

Table 4. Parameters related to cease of the activity as described under "non-use" scenario for Use-2

(*): based on 2022 activity assessment considered as representative

YEARS	PROFIT LOSS EXPECTED OVER REVIEW PERIOD FOR USE-2 (PV)
2022	£[redacted]
2023	£[redacted]
2024	£[redacted]
2025	£[redacted]
2026	£[redacted]
2027	£[redacted]
2028	£[redacted]
2029	£[redacted]
2030	£[redacted]
2031	£[redacted]
Total loss of Profit for TE UK Ltd over review period, discounted (*)	£[redacted]

Table 5. Assessment of profits loss for Tyco Electronics UK Ltd related to non-use-2 cease of activity

(*): considering a 4% discount rate over the 2025-2026 period

Synthesis of Economics impacts for Tyco Electronics UK Ltd

The cumulated loss of revenues and profits in the context of the "non-use" scenario for Use-2 amount to:

	VALUE
Total loss of profits for TE UK Ltd during relocation period of activity potentially relocatable	£[redacted]
Total relocation costs (settlement) for TE UK Ltd	£[redacted]
Total loss of Profit for TE UK Ltd over review period due to cease of the activity	£[redacted]
Total Economic impacts for TE UK Ltd	£[redacted]

Table 6. Synthesis of Economics impacts for Tyco Electronics UK Ltd

4.4.2. Economic impacts on the supply chain

No further analysis carried out since previous report as no major change to scenario (see Reference (1)).

4.4.3. Economic impacts on competitors

See comments in section 4.4.2

4.4.4. Wider socio-economic impacts

See comments in section 4.4.2

4.4.5. Compilation of socio-economic impacts

See comments in section 4.4.2

4.5.

4.5. Combined impact assessment

See comments in section 4.4.2

4.6. Sensitivity analysis

See comments in section 4.4.2

4.7. Information to support for the review period

Once a suitable alternative has been identified and process trials completed, the minimum duration required by Tyco Electronics UK Ltd to requalify impacted products, to go through the Product Change Notification (PCN) process and seek customer or industry approvals is likely to be 2 years minimum. The exact duration may extend beyond this when timings are outside of Tyco Electronics UK Ltd control – for example, for items registered on a Qualified Products List such as AS85049 Backshells, testing and approvals may be carried out by the qualifying body, with timings varying depending on their availability and prioritisation.

As no suitable alternative has yet been identified, Tyco Electronics UK Ltd would suggest a normal length of 7 years (as set out in SEAC/20/2013/03) would be appropriate.

5. CONCLUSION

Since the original application for Authorisation, Tyco Electronics UK Ltd has continued to investigate alternatives.

Alternatives available to passivate the plated surfaces are trivalent chromium-based chemistries. These passivates require the use of a topcoat (post passivate application) to give consistent colour and wear resistance of the passivate film. These topcoats render the coating non conductive. The connectors manufactured by Tyco Electronics UK Ltd require conductivity across the surface and between mating halves to ensure grounding or electrical/RFI shielding.
Alternative plating finishes (such as Nickel PTFE) are available. However, a significant portion of the products supplied by the Hastings site are designed to meet customer or external specifications, which do not permit alternative finishes to be used.
These alternatives were assessed and deemed unsuitable for use based on technical performance, customer requirements and industry/military standard requirements.

Section 3 contains details of the assessment of these alternatives.

REFERENCES

(1) Souriau-Esterline et al.,2015; Use-2, Industrial use of a mixture containing hexavalent chromium compounds in conversion coating and passivation of circular and rectangular connectors in order to meet the requirements of international standards and special requirements of industries subject to harsh environments.