

[Engineering Specification 3ADENVM0002](#)

Compliance Requirements for the European Union Directive (and other jurisdictions) on the Restriction of the Use of Certain Hazardous Substances (RoHS) in Electrical and Electronic Equipment for TGCS

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1.0 Change History

Version	Date	Change Description
REV000	7/15/2015	First TGCS version. Based on IBM 97P3864, N46906.

2.0 Scope

2.1 Objectives

Deliverables must comply with the European Union Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, amendments, and with the requirements in this specification.

In order to comply with this Directive, Deliverables must not contain lead (Pb), mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBBs) and/or polybrominated diphenyl ethers

(PBDEs) in some cases above certain levels. See Sections 3.2, 3.3, and 3.4 for more specific information on exemptions and allowable substitute materials.

In addition to this specification, TGCS maintains other environmental specifications for Deliverables, for example, TGCS Engineering Specification 3ADENVM0001 - Baseline Environmental Requirements for Supplier Deliverables to TGCS. See Section 4 for details. Where multiple documents exist which contain requirements for the same Deliverable, the most restrictive requirement applies.

Per TGCS Engineering Specification 3ADENVM0001, suppliers are required to complete a Product Content Declaration (PCD) for TGCS Suppliers for Deliverables sold to TGCS.

2.2 Definitions

Deliverable(s) - any tangible item(s) delivered by or for a Supplier to TGCS in accordance with a purchase contract or other agreement with TGCS. Deliverables include, but are not limited to, components, Materials, Parts, Products and tools. See Section 2.3 for specific information about tools and consumable items.

Homogeneous Material - Means one material of uniform composition throughout or a material, consisting of a combination of materials that cannot be disjointed or separated into different materials by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes. For example, a plastic cover is a "Homogeneous Material" if it consists of one type of plastic that is not coated with or has attached to it or inside it any other kinds of materials. In this case, the limit values found in Table 1 would apply to the plastic. An electric cable that consists of metal wires surrounded by nonmetallic insulation materials is an example of a "nonhomogeneous material" because the different materials could be separated by mechanical processes. In this case, the limit values found in Table 1 would apply to each of the separated materials. A semiconductor package contains many homogeneous materials which include plastic molding material, tin-electroplating coatings on the lead (Pb) frame, the lead frame alloy and gold-bonding wires. Homogeneous is understood to be of uniform composition throughout.

Intentionally Added or Intentional Addition - a substance is deliberately utilized in the production of a Deliverable.

Materials - chemical substances and preparations that are supplied for the production of Parts, Products and other items (e.g., structural plastics, metals, coatings, paints, and adhesives) and chemical substances or preparations that are shipped with Parts or Products, such as toner, cleaners, lubricants, oils, and refrigerants.

Not Detected - below the detection limit of established test standards or appropriate industry wide test methods. In general, these test standards/ methods should achieve trace level detection or at the lowest detection capabilities of the specific sample matrix.

Parts - fabricated Materials, components, devices and assemblies.

Products - stand alone, final assemblies including complete machines supplied by an original equipment manufacturer (OEM).

RoHS - an acronym for the European Union (EU) Directive 2011/65/EU (recast) on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment, subsequent amendments to this Directive, and

<http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:174:0088:0110:EN:PDF>.

2.3 Application and Verification

This engineering specification applies to all Deliverables supplied for TGCS which have this specification cited on their respective TGCS part number drawings, part or product specifications, procurement agreements, purchase contracts, purchase orders or other procurement documentation. The supplier is responsible for compliance with this specification as well as for any subcontracted operations and procured Parts, Materials, Products or assemblies used in the manufacture of Deliverables for TGCS applications. Upon request by TGCS, the supplier will verify via analytical testing, compliance to this specification. Supplier may use analytical techniques to confirm results. Additional information available in section 3.1.

This specification does not apply to consumable items such as CDs, DVDs, floppy disks, tape cartridges, non-electrical tools (e.g., hammers, screwdrivers, ladders), customer instruction manuals or product packaging materials (e.g., cardboard and wood pallets). Electrical and electronic tools (with the exception of large-scale stationary industrial tools) are included within the scope of the EU RoHS Directive. These tools (e.g., electronic drills, electronic tools for welding, soldering, riveting, nailing or screwing) must meet the requirements of Sections 3.1, 3.2, 3.3.4, 3.4, 3.5 and 3.6 only of this specification.

This document should not be used on component documentation unless

1. The component will never be exposed to soldering temperatures.
2. The component is expected to be able to be processed at higher temperatures based on supplier and/or TGCS evaluation.

This document does not imply qualification has been complete at the component or assembly level.

Deviation from the requirements of this specification must have prior written approval by TGCS's procurement representative. TGCS Procurement shall obtain the documented consent from the appropriate TGCS representatives. TGCS Procurement must contact the author of this document for details on the documentation requirements for deviations.

2.4 Document Administration

This document is maintained and controlled by Toshiba Global Commerce Solutions.

This document is property of Toshiba Global Commerce Solutions (TGCS). All questions must be referred to the TGCS purchasing department.

3.0 Requirements

3.1 Substances Prohibited From Use

The EU RoHS Directive and legal requirements in other jurisdictions ban the use of the following in new electrical and electronic products:

- Lead (Pb),
- Mercury (Hg),
- Cadmium (Cd),
- Hexavalent chromium (Cr⁺⁶),
- Polybrominated biphenyl (PBB) flame retardants, and • Polybrominated diphenyl ether (PBDE) flame retardants.

This prohibition applies to the above substances and all compounds containing these substances. These substances and compounds must not be in or on any Deliverable, except for the exemptions listed in Section 3.2 or in the allowed concentrations found in Table 1 below. The maximum allowable level found in a Homogeneous Material (e.g., metal, adhesive, paint, plastic, plating), cannot exceed the levels found in the table below. Please note these substances, generally in specific applications, have more restrictive requirements than those cited by the EU RoHS Directive. Please refer to TGCS Engineering Specification 3ADENVM0001 for more restrictive requirements for all of the RoHS substances.

Substance	RoHS Maximum Concentration Value in a Homogeneous Material	Additional application restrictions may apply. See TGCS specification 3ADENVM0001 for more details.
Lead (Pb)	0.1% or 1,000 ppm	Specific applications have more restrictive levels
Mercury (Hg)	0.1% or 1,000 ppm	Any detectable level must be reported except unavoidable impurities at levels below 10ppm.
Cadmium (Cd)	0.1% or 100 ppm	Any detectable level must be reported for plating and surface coating applications.
Hexavalent Chromium (Cr ⁺⁶)	0.1% or 1,000 ppm	Specific applications have more restrictive levels.
Polybrominated biphenyl (PBB) flame retardants	0.1% or 1,000 ppm	Any detectable level must be reported.
Polybrominated diphenyl ether (PBDE) flame retardants. Note: TGCS includes Decabromo diphenyl ether in this category.	0.1% or 1,000 ppm	Any detectable level must be reported.

When laboratory sampling is completed for testing the RoHS substances in Table 1, the test method must be in accordance with the latest version of IEC 62321 Electrotechnical products – Determination of levels of six regulated substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ethers) as referred to in EN50581:2012, Technical Documentation for the Assessment of Electrical and Electronic Products with Respect to the Restriction of Hazardous Substances.

There are other jurisdictions, other than the EU Member States, with RoHS types of requirements. The list below is not complete and is provided for information only. In some jurisdictions the product scope and requirements are different from the scope and requirements of the EU Directive. Deliverables to TGCS which cite this specification must meet the requirements of this specification irrespective of the jurisdiction where the Deliverable is transferred to TGCS.

- Multiple US States
- New York City
- People’s Republic of China
- European Free Trade Association Countries
- EU Candidate and Potential Candidate Countries
- Brazil
- Korea
- Ukraine
- Vietnam
- India
- Gibraltar
- Monaco
- San Marino
- Vatican City

3.2 Exemptions

The following are the applications which are exempt from the requirements of RoHS as cited by the EU Directive, and subsequent amendments. The prohibition, as stated in Section 3.1, is in place for all other applications. TGCS has determined some of the exemptions will not be allowed for TGCS products. This information is noted by the exemption. Where specified by TGCS in the procurement documents some of these exemptions may still be used when the order is for spare parts for the repair and reuse of equipment placed on the market prior to a specific date.

Exemptions in the following table without defined expiration dates will expire on July 21st, 2016 unless further notification is received from the EU. If notification is received from the EU regarding exemption expirations, TGCS will assess and update this specification and table as necessary.

No.	Exemption	Current EU Expiration Date	TGCS Requirements
1	Mercury in single capped (compact) fluorescent lamps not exceeding (per burner):		
1(a)	For general lighting purposes < 30 Watts: 2.5 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
1(b)	For general lighting purposes \geq 30 Watts and < 50 Watts: 3.5 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.

1(c)	For general lighting purposes ≥ 50 Watts and < 150 W: 5 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
1(d)	For general lighting purposes ≥ 150 Watts: 15 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
1(e)	For general lighting purposes with circular or square structural shape and tube diameter ≤ 17 mm: 7 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
1(f)	For special purposes: 5 mg	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
1(g)	For general lighting purposes < 30 W with a lifetime equal or above 20 000 h: 3.5 mg or less	31 December 2017	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
2(a)	Mercury in double-capped linear fluorescent lamps for general lighting purposes not exceeding (per lamp):		
2(a)(1)	Tri-band phosphor with normal lifetime and a tube diameter < 9 mm (e.g., T2): 4 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
2(a)(2)	Tri-band phosphor with normal lifetime and a tube diameter ≥ 9 mm and ≤ 17 mm (e.g., T5): 3 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
2(a)(3)	Tri-band phosphor with normal lifetime and a tube diameter > 17 mm and ≤ 28 mm (e.g., T8): 3.5 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
2(a)(4)	Tri-band phosphor with normal lifetime and a tube diameter > 28 mm (e.g., T12): 3.5 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
2(a)(5)	Tri-band phosphor with long lifetime ($> 25,000$ h): 5 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.

Table 2. RoHS Exemptions			
No.	Exemption	Current EU Expiration Date	TGCS Requirements
2(b)	Mercury in other fluorescent lamps not exceeding (per lamp):		
2(b)(1)	Linear halophosphate lamps with tube > 28 mm (e.g., T10 and T12): 10 mg or less	Expired	This exemption is not allowed for TGCS Deliverables (expired 13 April 2012)
2(b)(2)	Non-linear halophosphate lamps (all diameters): 15 mg or less.	13 April 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
2(b)(3)	Non-linear tri-band phosphor lamps with tube diameter > 17 mm (e.g., T9): 15 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
2(b)(4)	Lamps for other general lighting and special purposes (e.g., induction lamps): 15 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.

3	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp): (Please note this is the exemption which should be used for CCFLs in liquid crystal displays (LCD). Exemptions 1, 2, and 4 should not be used for LCD CCFLs.)		
3(a)	Mercury in CCFL and EEFL for special purposes not exceeding per lamp – Short lamp length (≤ 500 mm): 3.5 mg	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
3(b)	Mercury in CCFL and EEFL for special purposes not exceeding per lamp –Medium lamp length (> 500 mm and ≤ 1500 mm): 5 mg	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
3(c)	Mercury in CCFL and EEFL for special purposes not exceeding per lamp –Long lamp length (> 1500 mm): 13 mg	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
4(a)	Mercury in other low pressure discharge lamps (per lamp): 15 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
4(b)	Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) in lamps with improved colour rendering index Ra > 60 :		
4(b)-I	P ≤ 155 W: 30 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
4(b)-II	155 W $< P \leq 405$ W: 40 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
4(b)-III	P > 405 W: 40 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
4(c)	Mercury in other High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner):		
4(c)-I	P ≤ 155 W: 25 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
4(c)-II	155 W $< P \leq 405$ W: 30 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
4(c)-III	P > 405 W: 40 mg or less	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
4(d)	Mercury in High Pressure Mercury (vapour) lamps (HPMV)	13 April 2015	This exemption is not allowed for TGCS Deliverables.

Table 2. RoHS Exemptions			
No.	Exemption	Current EU Expiration Date	TGCS Requirements
4(e)	Mercury in metal halide lamps (MH)	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.

4(f)	Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
4(g)	Mercury in hand crafted luminous discharge tubes used for signs, decorative or architectural and specialist lighting and light-artwork, where the mercury content shall be limited as follows: (a) 20mg per electrode pair + 0.3 mg per tube length in cm, but not more than 80 mg, for outdoor applications and indoor applications exposed to temperatures below 20 °C. (b) 15 mg per electrode pair + 0.24 mg per tube length in cm, but not more than 80mg, for all other indoor applications.	31 December 2018	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
5(a)	Lead (Pb) in the glass of cathode ray tubes	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
5(b)	Lead (Pb) in glass of fluorescent tubes not exceeding 0.2% by weight	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
6(a)	Lead (Pb) as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35% lead by weight	21 July 2016	An extension for 5 more years and/or change in scope is expected.
6(b)	Lead (Pb) as an alloying element in aluminum containing up to 0.4% lead by weight	21 July 2016	An extension for 5 more years and/or change in scope is expected.
6(c)	Copper alloy containing up to 4% lead (Pb) by weight	21 July 2016	An extension for 5 more years and/or change in scope is expected.
7(a)	Lead (Pb) in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead)	21 July 2016	An extension for 5 more years and/or change in scope is expected.
7(b)	Lead (Pb) in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission, and network management for telecommunications	21 July 2016	This exemption is not allowed for parts and products which cite this specification on prints, contracts, statements of work, etc.
7(c)-I	Electrical and electronic components containing lead (Pb) in a glass or ceramic other than dielectric ceramic in capacitors, e.g., piezoelectronic devices, or in a glass or ceramic matrix compound	21 July 2016	An extension for 5 more years and/or change in scope is expected.
7(c)-II	Lead (Pb) in dielectric ceramic in capacitors for a rated voltage of 125V AC or 250V DC or higher	21 July 2016	An extension for 5 more years and/or change in scope is expected.
7(c)-III	Lead (Pb) in dielectric ceramic in capacitors for a rated voltage of less than 125V AC or 250V DC	Expired	This exemption is not allowed for TGCS Deliverables (Expired on 1 January 2013 and after that date may be used in spare parts for EEE placed on the market before 1 January 2013)
7(c)-IV	Lead (Pb) in PZT based dielectric ceramic materials for capacitors being part of integrated circuits or discrete semiconductors	21 July 2016	This exemption is not allowed for TGCS Deliverables.
8(a)	Cadmium and its compounds in one shot pellet type thermal cut-offs (expires 21 July 2016)	21 July 2016	This exemption is not allowed for TGCS Deliverables
8(b)	Cadmium and its compounds in electrical contacts	21 July 2016	This exemption is not allowed for TGCS Deliverables assigned an TGCS part number released after January 16 th , 2015.
9	Hexavalent chromium as an anticorrosion agent of the carbon steel cooling system in absorption	21 July 2016	This exemption is not allowed for TGCS Deliverables assigned an TGCS part number released after January 16 th , 2015.

	refrigerators up to 0.75 % weight in the cooling solution		
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Table 2. RoHS Exemptions			
No.	Exemption	Current EU Expiration Date	TGCS Requirements
9(a)	DecaBDE in polymeric applications	Expired	This exemption is not allowed TGCS Deliverables (expired on 30 June 2008)
9(b)	Lead (Pb) in bearing shells and bushes for refrigerant-containing compressors for heating, ventilation, air conditioning and refrigeration (HVACR) applications	21 July 2016	This exemption is not allowed for TGCS Deliverables assigned an TGCS part number released after January 16 th , 2015.
11(a)	Lead (Pb) used in C-press compliant pin connector systems	Expired	This exemption is not allowed for TGCS Deliverables. (expired September 2010)
11(b)	Lead (Pb) used in other than C-press compliant pin connector systems	Expired	This exemption is not allowed for TGCS Deliverables. (Expired on 1 January 2013 and after that date may be used in spare parts for EEE placed on the market before 1 January 2013)
12	Lead (Pb) as a coating material for the thermal conduction module C-ring	Expired	This exemption is not allowed for TGCS Deliverables. (expired 24 September 2010)
13(a)	Lead (Pb) in white glasses used for optical applications	21 July 2016	An extension for 5 more years and/or change in scope is expected.
13(b)	Cadmium and lead (Pb) in filter glasses and glasses used for reflectance standards	21 July 2016	An extension for 5 more years and/or change in scope is expected.
14	Lead (Pb) in solders consisting of more than two elements for the connection between the pins and the package of microprocessors with a lead content of more than 80% and less than 85% by weight	Expired	This exemption is not allowed for TGCS Deliverables. (expired 1 January 2011)
15	Lead (Pb) in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages	21 July 2016	This exemption is allowed but set to expire July 21 st , 2016. A change in scope is expected, but some applications will likely expire in 2017.
16	Lead (Pb) in linear incandescent lamps with silicate coated tubes	Expired	This exemption is not allowed for TGCS Deliverables (expired 1 September 2013)
17	Lead (Pb) halide as radiant agent in High Intensity Discharge (HID) lamps used for professional reprography applications	21 July 2016	This exemption is not allowed for TGCS Deliverables assigned an TGCS part number released after January 16 th , 2015.
18(a)	Lead (Pb) as activator in the fluorescent powder (1% lead by weight or less) of discharge lamps when used as specialty lamps for diazoprinting reprography, lithography, insect traps, photochemical and curing processes containing phosphors such as SMS ((Sr,Ba) ₂ MgSi ₂ O ₇ :Pb)	Expired	This exemption is not allowed for TGCS Deliverables (expired 1 January 2011)
18(b)	Lead (Pb) as activator in the fluorescent powder (1% lead by weight or less) of discharge lamps when used as sun tanning lamps containing phosphors such as BSP (BaSi ₂ O ₅ :Pb)	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16 th , 2015.
19	Lead (Pb) with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with PbSn-Hg as auxiliary amalgam in very compact Energy Saving Lamps (ESL)	Expired	This exemption is not allowed for TGCS Deliverables (expired 1 June 2011)
20	Lead (Pb) oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays (LCDs)	Expired	This exemption is not allowed for TGCS Deliverable (expired 1 June 2011)

21	Lead (Pb) and Cadmium (Cd) in printing inks for the application of enamels on glasses, such as borosilicate and soda lime glasses	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
22	Lead (Pb) as impurity in RIG (rare earth iron garnet) Faraday rotators used for fibre optic communications systems	Expired	This exemption is not allowed for TGCS Deliverables (expired 31 December 2009)
23	Lead (Pb) in finishes of fine pitch components other than connectors with a pitch of 0.65 mm and less	Expired	This exemption is not allowed for TGCS Deliverables (expired 24 September 2010)
24	Lead (Pb) in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.

Table 2. RoHS Exemptions			
No.	Exemption	Current EU Expiration Date	TGCS Requirements
25	Lead (Pb) oxide in surface conduction electron emitter displays (SED) used in structural elements, notably in the seal frit and frit ring	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
26	Lead (Pb) oxide in the glass envelope of black light blue lamps	Expired	This exemption is not allowed for TGCS Deliverables (expired 1 June 2011)
27	Lead (Pb) alloys as solder for transducers used in highpowered (designated to operate for several hours at acoustic power levels of 125 dB SPL and above) loudspeakers	Expired	This exemption is not allowed for TGCS Deliverables (expired 24 September 2010)
28	Hexavalent chromium in corrosion preventive coating of unpainted metal sheeting and fasteners used for corrosion protection and Electromagnetic Interference Shielding in equipment falling under category three of Directive 2002/96/EC (IT and telecommunications equipment)	Expired	This exemption is not allowed for TGCS Deliverables (expired 01 July 2007)
29	Lead (Pb) bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC	21 July 2016	An extension for 5 more years and/or change in scope is expected.
30	Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers with sound pressure levels of 100 dB (A) and more	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
31	Lead (Pb) in soldering materials in mercury free flat fluorescent lamps (which e.g. are used for liquid crystal displays, design or industrial lighting)	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
32	Lead (Pb) oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
33	Lead (Pb) in solders for the soldering of thin copper wires of 100 µm diameter and less in power transformers	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
34	Lead (Pb) in cermet-based trimmer potentiometer elements	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
35	Cadmium in photoresistors for optocouplers applied in professional audio equipment	Expired	This exemption is not allowed for TGCS Deliverables (expired 31 December 2009)
36	Mercury used as a cathode sputtering inhibitor in DC plasma displays with a content up to 30 mg per display	Expired	This exemption is not allowed for TGCS Deliverables (expired 1 July 2010)

37	Lead (Pb) in the plating layer of high voltage diodes on the basis of a zinc borate glass body	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
38	Cadmium and cadmium oxide in thick film pastes used on aluminum bonded beryllium oxide	21 July 2016	This exemption will not be allowed for TGCS Deliverables assigned an TGCS part number released after January 16th , 2015.
39	Cadmium in colour converting II-VI LEDs (< 10 µg Cd per mm ² of light-emitting area) for use in solid state illumination or display systems	Expired	This exemption is not allowed for TGCS Deliverables (expired 1 July 2014)
40	Cadmium in photoresistors for analogue optocouplers applied in professional audio equipment	Expired	This exemption is not allowed for TGCS Deliverables (expired 31 December 2013)
41	Lead (Pb) in solders and termination finishes of electrical and electronic components and finishes of printed circuit boards used in ignition modules and other electrical and electronic engine control systems, which for technical reasons must be mounted directly on or in the crankcase or cylinder of hand-held combustion engines (classes SH:1, SH:2, SH:3, of Directive 97/68/EC of the European Parliament and the Council)	31 Dec 2018	This exemption is not allowed for TGCS Deliverables

Batteries are exempt from the EU RoHS Directive but have their own requirements for material restrictions in other EU Directives and legal requirements in other jurisdictions. See TGCS Engineering Specification 3ADENVM0001 for material restrictions for batteries.

3.3 Lead (Pb) and Lead (Pb) Compounds

3.3.1 Acceptable Lead (Pb) – Free Finishes for Electronic Components

The table below lists finishes that are acceptable per this specification. Finishes not designated in the following table may be acceptable pending review and approval by TGCS Development Engineering. Contact TGCS Procurement Engineering for information about this review. Typical applications include, but are not limited to, lead-frames, heat sinks, and connectors. The minimum tin or tin alloy thickness is determined by the applications.

Finish	Notes
Palladium-Nickel (PdNi) with gold (Au) flash	For connectors, gold (Au) flash is 5-10 microinches.
Palladium-Nickel (PdNi) without gold (Au) flash	For connectors, TGCS approval is required if gold (Au) flash is omitted from the mating or termination areas.
Fused, dipped or reflowed 100% Tin (Sn) or Tin (Sn) Alloys	Acceptable without additional mitigation. Alloying elements include silver (Ag), bismuth (Bi), copper (Cu), zinc (Zn), and nickel (Ni).
Tin over nickel underlay (Sn/Ni)	Connectors require 1.25 microns nickel (Ni) thickness. Non-connector applications require 1.0 micron minimum nickel (Ni) thickness. Nickel (Ni) films with less than 1.0 micron thickness require TGCS Development Engineering approval. Both bright and matte tins are acceptable with Nickel (Ni) underlay.
Annealed Tin (Sn) (matte, bright, or alloyed) over copper (Cu) base metal	Annealing temperature must be greater than 120°C for one hour or more. Annealing must occur within two weeks after plating. Anneal is not required if lead/pin pitch is > 1mm.

	For connectors: no forming after annealing.
Tin (Sn) over Alloy 42 (Fe/Ni) base metal, with or without Copper (Cu) underlay	Annealing is not required.
Tin alloy: Tin-Bismuth (SnBi) Nominal Bismuth (Bi) concentration: 2 - 4%. Total Bismuth (Bi) range: 1 - 5%	All other Bismuth (Bi) contents require TGCS approval. Acceptable over copper, nickel, and Alloy 42 (FeNi). For connectors, specific TGCS approval required for any Tin-bismuth (SnBi) usage.
Tin alloy: Tin-Silver (SnAg). Minimum Silver (Ag) concentration: 1%	All other silver (Ag) contents require TGCS approval. Acceptable over copper, nickel, and Alloy 42 (FeNi).
Tin alloy Tin-Copper (SnCu) annealed over a copper (Cu) base metal and Tin-copper (SnCu) over Nickel (Ni) underlay	Tin-copper (SnCu) over Copper (not annealed), and Tin-copper (SnCu) over Alloy 42 (FeNi) are not unconditionally acceptable as a finish. Requires TGCS Development Engineering approval.
Noble Metals: Gold (Au)	For connector applications there must be a nickel underlay. The gold (Au) thickness is determined by the application.
Noble Metals: Silver (Ag)	All silver (Ag) finishes require TGCS Development Engineering approval.
Immersion Tin	Does not require additional mitigation. Has been approved for heat sinks. Requires approval based on test data.
Nickel (Ni)	Unconditionally acceptable for non-soldered surfaces, generally very difficult to solder.

Solderable finishes which are conditionally acceptable are listed in TGCS Procurement Specification **873444**.

3.3.2 Printed Circuit Boards

Except for the specific exemptions listed in Section 2.2, printed circuit boards must not contain lead (Pb) in amounts greater than those shown in Table 1 including printed circuit board finishes. The RoHS compatible finishes listed in the table below must also pass further TGCS standard qualifications outside the scope of this specification. TGCS designed cards using the finishes listed below, require approval from TGCS Printed Circuit Board (PCB) Procurement Engineering.

Finish	Notes
Immersion Tin	Requires approval from TGCS PCB Procurement Engineering.
Organic Solder Preservatives (OSPs)	Preferred, for example benzotriazole (BTA). Refer to TGCS Procurement Specification 53P4082 for guidelines in selecting the appropriate OSP.
HASL (Hot Air Solder Leveled) Tin or Tin Alloy	Requires approval from TGCS PCB Procurement Engineering.
Immersion Silver	Requires approval from TGCS PCB Procurement Engineering.
Electroless Nickel Immersion Gold	Requires approval from TGCS PCB Procurement Engineering.
Electrolytic Nickel with noble metal over plate	Requires approval from TGCS PCB Procurement Engineering.

Laminate material must be compatible with the Lead (Pb)-free assembly process and temperatures. The surface finish must be compatible with the Lead (Pb) - free solder alloys. Note that other TGCS specifications may be applicable to the qualification of a PCB supplier's use of any surface finish on a PCB used for TGCS. Contact TGCS PCB Procurement Engineering for further information.

3.3.3 Ball and Column Grid Array (BGA and CGA)

All solder bumps/balls and solder column technology must be Lead (Pb) free and must be approved by TGCS Procurement Engineering to ensure compatibility with entire Lead (Pb) - free solder system.

3.3.4 Cables and Connectors

Cable assembly components (e.g., jacket material, over molding materials, housings, tapes, shrink tubing, latches, thumbscrews) will be free of lead (Pb) compounds such as lead-based stabilizers and pigments, except where concentrations in the homogeneous material are less than the maximum concentration values cited in Table 1 or have an applicable exemption as cited in Section 3.2.

Connectors/cable assemblies must be compatible with the appropriate lead-free assembly and rework processes, including SMT reflow with a minimum body temperature exposure of 245°C, or PTH wave solder with a nominal solder bath temperature of 265°C. Interconnects not meeting these criteria require approval from TGCS Procurement Engineering.

3.3.5 Acceptable Non-lead (Pb) Solders for Paste, Wave and Rework Solder

Use of non-lead (Pb) solders for paste, wave, rework, and assembly is required, and the specific solders require both qualification and approval from TGCS Procurement Engineering.

3.4 Hexavalent Chromium (CR +6) and Hexavalent Chromium (CR +6) Compounds

Hexavalent chromium and its compounds must not be used in finishing processes for sheet steel, aluminized, electroless nickel and die cast parts, fasteners and heatsinks. Hexavalent chromium and its compounds must not be used prior to painting or in other surface treatments for metal parts.

Hexavalent chromium and its compounds must not be used in leather articles or articles containing leather parts coming into contact with skin in concentrations equal to or greater than 3mg/kg (0.0003% by weight) of the total dry weight of the leather.

3.4.1 Acceptable Substitutes for Metal Finishes

Acceptable substitutes for hexavalent chromium finishes may include but are not limited to the list below. Note: The following list cites finishes that are compliant to RoHS requirements. Other requirements such as aesthetics may be necessary for parts. The part print is the master document which cites the material code to be used.

- TGCS Material Code 06-091D, E and F: Hot dip galvanized steel sheet without chromate
- TGCS Material Code 06-091H: Steel, galvanized, commercial quality, coating designation Z120/G30, hot dipped galvanized, minimum spangled, temper passed (extra smooth) with hexavalent chromium-free chemical treatment, not oiled
- TGCS Material Codes 06-131C: Steel, low carbon, commercial quality, electrogalvanized with hexavalent chromium-free chemical treatment, class B (ASTM A591)
- TGCS Material Codes 07-xxx: Steels, alloy
- TGCS Material Code 41-020 - Nickel plating

- TGCS Material Code 41-027: Nickel-phosphorous electroless plating; specify thickness and class: decorative (alphabetic) and heat-treat (numeric). Post-plating processes which may include hexavalent chromium compounds are not permitted. Note: After 12/01/04, all electroless nickel bath chemistries must not employ Lead (Pb) or Cadmium (Cd) compounds in their formulation
- TGCS Material Code 41-091 Type 2A: Zinc plating, black, 5-10 micrometers zinc with Type 2 black chromate must be hexavalent chromium-free, 0.7 grams per square meter
- TGCS Material Code 41-091 Type 3: Zinc plating, black, non-conductive black finish
- TGCS Material Code 41-093: Zinc plating, includes supplementary yellow or clear chromate conversion coating as specified below:
 - Type 1A: 5 micrometers zinc minimum with yellow iridescent chromate conversion coating which must be hexavalent chromium-free
 - Type 2A: 5 micrometers zinc minimum with clear chromate conversion coating which must be hexavalent chromium-free
 - Type 3A: (for thread-forming fasteners) 5-8 micrometers nickel alloy, 5-8 micrometers zinc with yellow iridescent coating which must be hexavalent chromium-free
- TGCS Material Code 41-217A: Hexavalent chromium-free chromate conversion coating: tan on aluminum alloys
- TGCS Material Code 41-218A, Hexavalent chromium-free chromate conversion coating: clear on aluminum alloys
- TGCS Material Code 41-219A, Hexavalent chromium- free conversion coating for magnesium alloys
- TGCS Material Code 41-225A, Hexavalent chromium-free conversion coating: black on aluminum alloys, 0.45 grams per square meter
 - Steel with electroplated chromium finishes must be reviewed and approved by the TGCS Development organization responsible for this hardware application
 - Anodization is considered to be a compliant process
 - TGCS Material Code 61-0956 Electro-coating process, Black.

Multiple TGCS Material Codes have cited a specific ASTM standard at the above web address. Certification to that standard is acceptable verification of compliance to this specification.

3.4.2 Base Materials

The following are considered to be compliant to this specification and RoHS as long as the lead (Pb) content does not exceed the maximum concentration value referenced in Table 1 - 0.1% by weight in a homogeneous material. There is an additional exemption for the lead (Pb) content in steel, aluminum and copper alloys referenced below, see Section 2.2 for maximum allowable lead (Pb) content in these alloys. Future releases of this specification will eliminate the exemptions for lead (Pb) as an alloying element in steel and aluminum and in copper alloys as these exemptions are eliminated by the EU RoHS Directive.

If a surface coating is specified, it must also be compliant with this specification and RoHS. Surface coatings include plating and surface treatments such as passivation of steel. Please note surface coatings are not required for every application of a base metal.

- 06-XXX: Carbon steels that are not RoHS compliant are marked as such in the TGCS Materials Bulletin. Surface coatings must be specified and must be RoHS compliant also (see Section 2.4.1.)
 - 07-XXX: Stainless steels.
- 06-080 - Steel, aluminized, type 1 or 2: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment.
- 06-081A - Steel, aluminized, type 1, commercial quality, coating designation T1-40: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-081B - Steel, aluminized, type 1, commercial quality, coating designation T1-25: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-082A - Steel, aluminized, type 1, drawing quality, coating designation T1-25: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-082B - Steel, aluminized, type 1, drawing quality, coating designation T1-25: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-083A - Steel, aluminized, type 2, commercial quality, coating designation T2-100: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-083B - Steel, aluminized, type 2, commercial quality, coating designation T2-65: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 01-XXX: Aluminum and aluminum alloys. Surface coatings must be specified and compliant
- 03-XXX: Copper and copper alloys. Surface coatings must be specified and compliant
- 12- XXX: Magnesium and magnesium alloys. Surface coatings must be specified and compliant
 - 15-510, 511 and 512: Titanium and titanium alloys. Surface coatings must be specified and compliant
 - 14-100, 101, 102, 110, 120, and 130: Zinc die cast alloys.

3.5 Cadmium (Cd) and Cadmium (Cd) Compounds

Cadmium and its compounds and alloys must not be used in processes for or on TGCS Deliverables (except where concentrations on or in the homogeneous material are less than the maximum concentration values cited in Table 1) Examples of prohibited uses include but are not limited to the following applications:

- Coloration pigments, for example in cable conductor insulation or cable jacket material
- Stabilizers, for example in polyvinyl chloride (PVC) cables.

3.6 PBBs and PBDEs

Polybrominated biphenyls and polybrominated diphenyl ethers must not be used in TGCS Deliverables. Examples of prohibited uses include but are not limited to the following applications:

- Flame retardants in printed circuit boards, components, gasketing and plastic resin parts. This ban applies to all 209 congeners of PBBs and all 209 congeners of PBDEs including, but not limited to the following:

Polybrominated Biphenyls (PBBs)	Chemical Abstracts Service (CAS) #
2-Bromobiphenyl	2052-07-05
3-Bromobiphenyl	2113-57-7
4-Bromobiphenyl	92-66-0
Decabromobiphenyl	13654-09-06
Dibromobiphenyl	92-86-4
Heptabromobiphenyl	59080-40-9
Hexabromobiphenyl	59080-40-9
Hexabromo-1,1-biphenyl	36355-01-8,
Nonabromobiphenyl	27753-52-2
Octabromobiphenyl	61288-13-9
Pentabromobiphenyl	56307-79-0
Polybrominated Biphenyl	59536-65-1
Tetrabromobiphenyl	40088-45-7
Tribromobiphenyl	59080-34-1
Firemaster FF-1	67774-32-7
Polybrominated Diphenyl Ethers (PBDEs)	CAS #
Bromobiphenyl Ether	101-55-3
Decabromobiphenyl Ether	1163-19-5
Dibromobiphenyl Ether	2050-47-7
Heptabromobiphenyl Ether	68928-80-3
Hexabromobiphenyl Ether	36483-60-0
Polybrominated Diphenyl Ethers (PBDEs)	CAS #
Nonabromobiphenyl Ether	63936-56-1
Octabromobiphenyl Ether	32536-52-0
Pentabromobiphenyl Ether	32534-81-9
Tetrabromobiphenyl Ether	40088-47-9
Tribromobiphenyl Ether	49690-94-0

4.0 References

California Electronic Waste Recycling Act of 2003. <http://www.ciwmb.ca.gov/Electronics/Act2003/>

EU Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)

<http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:174:0088:0110:EN:PDF>

Commission Delegated Directive 2014/14/EU of 18 Oct 2013, amending, for the purpose of adapting to technical progress, the Annex III to Directive 2011/65/EU of the European Parliament and of the Council as regards an exemption for 3.5 mg mercury per lamp in single capped compact fluorescent lamps for general lighting purposes < 30 W with a lifetime equal to or above 20,000 hours
<http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2014:004:0071:0072:EN:PDF>

Commission Delegated Directive 2014/76/EU of 13 March 2014 amending, for the purposes of adapting to technical progress, Annex III to Directive 2011/65/EU of the European Parliament and of the Council as regards an exemption for Mercury in hand crafted luminous discharge tubes (HLDTs) used for signs, decorative or architectural and specialist lighting and light-artwork <http://eurlex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:32014L0076&from=EN>

Commission Delegated Directive 2014/72/EU of 13 March 2014 amending, for the purposes of adapting to technical progress, Annex III to Directive 2011/65/EU of the European Parliament and of the Council as regards an exemption for lead (Pb) in solders and termination finishes of electrical and electronic components and finishes of printed circuit boards used in ignition modules and other electrical and electronic engine control systems <http://eurlex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:32014L0072&from=EN>

EU Commission Decision 2011/534/EU of 8 September 2011 amending for the purposes of adapting to technical progress, the Annex to Directive 2002/95/EC of the European Parliament and of the Council as regards exemptions for applications containing lead (Pb) or cadmium
<http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:234:0044:0045:en:PDF>

Nilsson, Nils H., Malmgren-Hansen, B, and Ivan Christensen. *Denmark Development and use of screening methods to determine chromium (IV) and brominated flame retardants in electrical and electronic equipment*. Environmental Project No. 1292 2009. <http://www2.mst.dk/udgiv/publications/2009/978-87-7052-987-7/pdf/978-87-7052-988-4.pdf>

Louisiana Mercury Risk Reduction Act of 2006
<http://www.deq.louisiana.gov/portal/Portals/0/surveillance/mercury/La.%20Mercury%20Risk%20Reduction%20Act.pdf>

New Jersey Electronic Waste Recycling Act http://www.njleg.state.nj.us/2006/Bills/PL07/347_.PDF

Norway Product Control Regulation Chapter 2. Restricted Substances and Preparations
<http://www.miljodirektoratet.no/no/Regelverk/Forskrifter/Regulations-relating-to-restrictions-on-the-manufacture-import-export-sale-and-use-of-chemicals-and-other-products-hazardous-to-health-and-the-environment-Product-Regulations/Chapter-2-Regulated-substances-preparations-and-products/>

Rhode Island Mercury Education and Reduction Act
<http://webserver.rilin.state.ri.us/Statutes/TITLE23/23-24.9/INDEX.HTM>

CENELEC, EN 50581:2012, Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.
<http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=6360462>

IEC 62321, Electrotechnical products - Determination of Levels of Six Regulated Substances,
International
Electrotechnical Commission. <http://www.iec.ch>