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Electrical and Electronic Equipment Testing

The rapid development of electronic technology gives rise to surging electrical and electronic equipment (EEE). Based on statistics, the global market scale of electronic information equipment has reached as high as USD 2 trillion and consumption in electronic information industry is still on the increase. Meanwhile, green IT industry becomes the mainstream of future development under the pressure of environmental hazards and resource shortage. So the regulation concerning hazardous substances in end products is stricter.

Many countries have issued eco-friendly directives such as RoHS and WEEE for electrical and electronic equipment one after another owing to strengthened environmental awareness. All those directives, especially REACH regulation issued by the European Union, have great impact on the manufacture and sale for electrical and electronic equipment. It therefore appears necessary for companies to track the latest requirements of electrical and electronic equipment in various countries.

I. EEE Regulations or Directives

1. RoHS Directive

RoHS Directive of the European Union covers an extensive scope of products, including almost all of electrical and electronic equipment, medical devices, telecommunications equipment, toys and security information products. It not only includes finished products, but also spare parts, raw materials and packaging intended for the production of the finished products, thus closely associated with the entire manufacture chain.

EU RoHS is the Directive on the Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment. The first version of RoHS Directive (2002/95/EC) was passed by the European Parliament on 27 January 2003; the European Union published the new harmonised version of RoHS Directive (2011/65/EU) on 1 July 2011

and the new directive became effective on 21 July 2011 to repeal the previous version. Except to the European Union, most other countries also administer electrical and electronic equipment with similar regulations. Refer to the following table for details:

Comparison of EEE Regulations/Directives

Requirement Region	Regulation/ Directive	Hazardous Substance/Limit (ppm)	Applicable Scope	Date of Applicability
EU	2011/65/EU 2015/863/EU	Cadmium 100 Mercury 1,000 Lead 1,000 Hexavalent chromium 1,000 PBB 1,000 PBDE 1,000 DEHP 1,000 BBP 1,000 DBP 1,000 DIBP 1,000	1. Large household appliances 2. Small household appliances 3. IT and telecommunications equipment 4. Consumer equipment 5. Lighting equipment 6. Electrical and electronic tools 7. Toys, leisure and sports equipment 8. Medical devices 9. Monitoring and control instruments including industrial monitoring and control instruments 10. Automatic dispensers 11. Other EEE not covered by any of the categories above	1) The restriction of Cd, Hg, Pb, Cr (VI), PBB and PBDE: 1 July 2006; 2) The restriction of DEHP, BBP, DBP and DIBP : 22 July 2019 (excluding medical devices, monitoring and control instruments); 22 July 2021 (for medical devices, monitoring and control instruments)
China	Administrative Measures for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products	Cadmium and its compounds 100 Hexavalent chromium and its compounds 1,000 Mercury and its compounds 1,000 Lead and its compounds 1,000 PBB 1,000 PBDE 1,000	1. Communication equipment 2. Radio & TV equipment 3. Computer and other office Equipment 4. Household electrical and electronic equipment 5. Electronic instrumentation 6. Industrial electronic equipment 7. Electric tools 8. Electronic equipment and devices for medical use 9. Lighting products 10. Electronic products for cultural activities, education, arts, sports and entertainment	1) Electronic information products: 1 March 2007 2) Electrical and electronic products: 1 July 2016
US	H.R.2420	Cadmium 100 Hexavalent chromium 1,000 Mercury 1,000 Lead 1,000 PBB 1,000 PBDE 1,000	Electrical and electronic equipment	1 January 2010
South Korea	The Act for Resource Recycling of Electrical/ Electronic Products and Automobile	Mercury 1,000 Lead 1,000 PBB 1,000 PBDE 1,000	Television sets, refrigerators, air conditioners, computers, stereos, mobile phones, typewriters, copying equipment, facsimile machines, compact cars, light trucks	1 January 2008
Japan	JIS C 0950		Personal computers, independent air conditioners, television sets, microwaves, washing machines, refrigerators and clothes dryers	1 July 2006

Non-compliances Cases

Category	Material	Substance that May Exceed Limit
Plastic components	ABS, PP, PVC	Total bromine
Rubber components	ABS, PP, PVC	Cadmium, lead
Bolts		Hexavalent chromium
Nametags and labels	Metal	Lead
Plastic packaging, filling and other accessories		Cadmium, lead
Electronic components such as circuit boards and battery packs		Soldering tin
Power cords	Insulation layer	Lead
Painted components	Paints and vanishes	Lead

2. REACH Regulation

REACH is the Regulation (EC) NO 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals, which came into force on 1 June 2007 and applied on 1 June 2008. It becomes a harmonised regulation concerning preventative administration on all chemicals to be placed on the EU market superseding more than 40 directives and regulations for chemical management. Therefore its implementation materially impacts the export to the European Union.

- Pursuant to REACH Regulation, notification and information communication should be fulfilled by businesses where substances of very high concern (SVHCs) are present;
- Electrical and electronic equipment should comply with the restrictions set forth in Annex XVII to REACH Regulation.

Possible SVHC in EEE

Category	Possible SVHC
Plastic components	Phthalates, tris(2-chloroethyl) phosphate, aluminosilicate refractory ceramic fibres, triethyl arsenate, 2,4-Dinitrotoluene, lead chromate molybdate sulphate red, lead sulfochromate yellow, lead chromate
Rubber components	Phthalates, tris(2-chloroethyl) phosphate, aluminosilicate refractory ceramic fibres , cobalt dichloride, triethyl arsenate, 2,4-Dinitrotoluene, lead chromate molybdate sulphate red, lead sulfochromate yellow, lead chromate
Metal components	Potassium dichromate, SCCP, sodium dichromate
Paints	4,4'-Diaminodiphenylmethane, phthalates, anthracene, cobalt dichloride, bis(tributyltin) oxide (TBTO), 2,4-Dinitrotoluene, lead chromate molybdate sulphate red, lead sulfochromate yellow, lead chromate
Glass	Triethyl arsenate, arsenic pentoxide, diarsenic trioxide, cobalt dichloride, trilead diarsenate
Ceramic	Aluminosilicate refractory ceramic fibres , arsenic pentoxide, diarsenic trioxide
Electronic components	Hexabromocyclododecane (HBCDD), trilead diarsenate, aluminosilicate refractory ceramic fibres , zirconia aluminosilicate refractory ceramic fibres
Insulation materials	Aluminosilicate refractory ceramic fibres , zirconia aluminosilicate refractory ceramic fibres
Adhesives	SCCP, bis(tributyltin) oxide (TBTO), trichloroethylene, boric acid

* The above information is only for reference.

Restricted Substances under REACH in EEE

Category	Possible Restricted Substances under Annex XVII
Plastic components	Cadmium and its compounds, diphenylether (pentabromo derivative), diphenylether (octabromo derivative), cyclohexane, heptadecafluorooctanesulfonic acid (PFOS)
Rubber components	Diphenylether (pentabromo derivative), diphenylether (octabromo derivative), cyclohexane, heptadecafluorooctane sulfonic acid (PFOS)
Metal components	Nickel and its compounds, SCCP
Electronic components	Polychlorinated terphenyls (PCTs), cadmium and its compounds, diphenylether (pentabromo derivative), diphenylether (octabromo derivative), heptadecafluorooctane sulfonic acid (PFOS)
Insulation materials	Asbestos fibres
Coolants	The presence of CMR substances under REACH is not allowed
Adhesives	Chloroform, pentachloroethane, benzene, toluene

* The above information is only for reference.

3. Other Regulations or Directives

1) WEEE Directive

The European Union passed Directive 2002/96/EC "Waste Electrical and Electronic Equipment (WEEE)" on 27 January 2003 requiring manufacturers fulfil the responsibility of collecting, recycling and disposing WEEE properly. The directive became effective on 13 February 2003 and was superseded by Directive 2012/19/EU on 15 February 2014.

WEEE Directive covers a wide range of products, including: large household appliances, small household appliances, IT and telecommunications equipment, consumer equipment, lighting equipment, electrical and electronic tools, toys, leisure and sports equipment, medical devices, monitoring and control instruments including industrial monitoring and control instruments, automatic dispensers.

2) Battery Directive

On 26 March 1991, the European Parliament released Directive 91/157/EEC "Batteries and Accumulators Containing Certain Dangerous Substances" to regulate lead, cadmium and mercury in batteries and accumulators.

On 26 September 2006, the European Union published new Directive 2006/66/EC "Batteries and Accumulators and Waste Batteries and Accumulators", which officially replaced the previous version on 26 September 2008. The new Directive 2006/66/EC includes waste batteries and accumulators in regulation, applicable to battery packs, portable batteries or accumulators, automotive batteries or accumulators, as well as industrial batteries or accumulators.

3) Packaging Directive

Directive 94/62/EC "Packaging and Packaging Waste" clarifies the target for recovery and reuse of packaging and packaging waste and sets limits on the concentrations of heavy metals: the sum of concentration levels of lead, cadmium, mercury and hexavalent chromium present in packaging or packaging components shall not exceed 0,01%(W%). The directive was published on the *Official Journal of the European Union* on 31 December 1994 and transposed as a national law among EU Member States on 30 June 1996.

4) POPs Regulation

Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Due to their persistent properties, POPs bioaccumulate with potential significant impacts on human health and the environment. On 29 April 2004, the European Union issued (EC) No 850/2004 (POPs Regulation) aiming to prohibit or restrict the manufacture and use of POPs in electrical and electronic equipment (EEE). A lot POPs are restricted or prohibited in EEE under the regulation such as tetrabromodiphenyl ether, pentabromodiphenyl ether, hexabromodiphenyl ether and heptabromodiphenyl ether, as well as perfluorooctane sulfonic acid and its derivatives (hereinafter "PFOS"), SCCP.

II. Hazardous Substances in EEE

1. Phthalates

Phthalates is a general term for compounds which result from the reaction of phthalic anhydride and alcohol. Such substances are mainly employed as plasticisers to soften plastics and rubber. They are widely used in EEE, toys, coatings, ink, apparel, packaging materials, detergents, lubricants and personal care articles, etc. But when the concentration of phthalates exceeds a certain level, it may disrupt endocrine of human bodies, bringing harm to the development of children. Currently, many countries have different regulations on phthalates.

C&K Testing can provide testing services for the following phthalates (not limited to those in the form):

Substance	CAS No.	EU REACH Annex XVII	US CPSIA	China GB 6675	Canada SOR/2010-298	US Prop 65
DEHP	117-81-7	√	√	√	√	√
DBP	84-74-2	√	√	√	√	√
BBP	85-68-7	√	√	√	√	√
DINP	28553-12-0 68515-48-0	√	√	√	√	√
DIDP	26761-40-0 68515-49-1	√	√	√	√	√
DNOP	117-84-0	√	√	√	√	
DnHP	84-75-3					√

2. Heavy Metals

Heavy metals usually exist in electric wires, coatings and circuit boards and so they are common in EEE. However, the presence of the heavy metals usually causes allergy or does damage to liver, kidney and nervous system of users, even is carcinogenic to human bodies. So the regulation on heavy metals in EEE is quite stringent in particular.

Substance	Regulatory Compliance					Application
	RoHS Directive	SVHC	REACH Annex XVII	Packaging Directive	Battery Directive	
Cadmium (Cd)	√	√	√	√	√	Electric supply wires, electric wires and switch points, batteries, outer casing and PCB
Lead (Pb)	√		√	√	√	Solder, glass, PVC stabilisers, electric wires, plastic components and polished components
Mercury (Hg)	√		√	√	√	Switches, LCD, relays, bulbs
Hexavalent chromium (Cr(VI))	√		√	√		Surface treatment for the casing, metal anticorrosion coating

3. Halogenated Flame Retardants

Burning point can be raised where halogens (fluorine, chlorine, bromine and iodine) are added in polymers such as plastics to the effect of flame retardants. But the halogenated gases released are toxic to immunity system, adversely influencing endocrine system, reproduction and development and even are carcinogenic. Most halogenated substances are environmental hormones.

Application of Halogens in EEE:

Common flame retardants: PBBs, PBDEs, TBBP-A, PCB / PCT/PCN, HBCDD, 2,4,6-Tribromophenol, SCCP

Products of very high concern: circuit boards, computers, fuel cells, television sets, typewriters

Regulations on Halogen Restrictions:

Regulation	Restricted Substance
RoHS 2.0 (2011/65/EU)	Brominated flame retardants: PBBs, PBDEs
Montreal Protocol on Substances that Depletethe Ozone Layer (Global)	CFCs (5), Halon (3)
Stockholm Convention, EPOPs Regulation	OCPs, HCB, PCBs, PCDDs, PCDFs
IEC non-halogenated requirements (IEC 61249-2-21)	Cl≤900ppm, Br≤900ppm, Cl+Br≤1,500ppm

4. PAHs

The new standard AfPS GS 2014:01 PAK to regulate PAHs for GS marking entered into force since 1 July 2015 and the previous standard ZEK 01.4-08 went invalid since 30 June 2015. It is noticeable that electrical and electronic equipment, toys, food packaging, plastic products, rubber products and machinery that intended to apply for GS marking should comply with the new test requirements for PAHs.

Unit: ppm

Parameter	Category 1	Category 2		Category 3	
	Materials intended to be put in the mouth, or materials of toys with intended long-term skin contact (longer than 30s)	Materials not covered by category 1, with foreseeable skin contact for longer than 30 seconds (long-term skin contact) or repeated short-term contact		Materials not covered by Category 1 or 2 with foreseeable skin contact up to 30 seconds (short-term skin contact)	
		Toys in the scope of 2009/48/EC	Other products	Toys in the scope of 2009/48/EC	Other products
BENZO(a)PYRENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
BENZO(e)PYRENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
BENZO(a)ANTHRACENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
BENZO(b)FLUORANTHENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
BENZO(j)FLUORANTHENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
BENZO(k)FLUORANTHENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
CHRYSENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
DIBENZO(a,h)ANTHRACENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
BENZO(g,h,i)PERYLENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
INDENO(1,2,3-cd)PYRENE	< 0,2	< 0,2	< 0,5	< 0,5	< 1
ACENAPHTHYLENE ACENAPHTHENE FLUORENE PHENANTHRENE PYRENE ANTHRACENE FLUORANTHENE	<1 (Sum)	< 5 (Sum)	< 10 (Sum)	< 20 (Sum)	< 50 (Sum)
NAPHTHALENE	< 1	< 2		< 10	
Sum of 18 PAHs	< 1	< 5	< 10	< 20	< 50

5. PFOS

Perfluorooctane sulfonic acid (PFOS) is widely used in metal electroplating, suppressant of chromic acid mist for electronic etching sink and electronic chemistry. The EU included the restriction of PFOS in Annex XVII to REACH Regulation. However, the part was deleted from REACH in 2011 as higher requirements are stipulated in an amendment to POPs Regulation by Regulation (EU) NO 757/2010.

Requirements in EU Directive for PFOS are as below:

PFOS Limit	For PFOS as substances or in preparations, they shall not be placed on the market in a concentration equal to or greater than 0,001 % by weight.
	For concentrations of PFOS in semi-finished products or articles, or parts thereof, the concentration of PFOS should be lower than 0,1 % by weight.
	For textile products or other coated materials, the amount of PFOS should be lower than 1 µg/m ²

Stipulations of Other Countries

- ✓ US Environmental Protection Agency issued PFOS ban in 2000, excluding special applications in aviation, photography and micro-electronics industries;
- ✓ The Government of Canada announced that PFOS and its derivatives were listed as hazardous substances in 2006 ;
- ✓ Australia stipulates that the application of PFOS and related chemicals is allowed when no safer alternatives are available;
- ✓ Sweden proposed a global ban on PFOS and its derivatives according to Stockholm Convention concerning POPs in 2005.

6. Asbestos

Asbestos are naturally occurring fibrous minerals as silicates with a structure of thin fibrous crystals, containing oxides of magnesium, iron, aluminum and sodium, and silicon dioxide. Asbestos fibres will be released to the air in powdery and it may accumulate in the lung to cause organ canceration after absorbed by human bodies.

Owing to good tensile strength, insulation, anti-corrosion and inflammability, asbestos are often applied in fire-proof and insulation materials.

- ✓ In 2009, China carried out *Determination of Asbestos in Products* (GB/T 23263-2009), applicable to the determination of asbestos in materials, for construction, friction, sealing, insulation and nonmetallic minerals;
- ✓ In 1999, EU published Directive 1999/77/EC to specify the restrictions on the use of crocidolite, amosite, chrysotile, antophyllite, actinolite and tremolite, which are now listed under REACH Annex XVII;
- ✓ The United States has began to restrict asbestos since 1971 and prohibited the production and use of asbestos and its products since 1992;
- ✓ Japan has prohibited the use of asbestos in products since 2008.

III. Recommendation of Common Test Items for EEE

Chemical Test

- RoHS
- SVHC/REACH Annex XVII
- Flame retardants
- Phthalates
- PAHs
- Packaging materials (Cd, Pb, Hg, Cr⁶⁺)
- Heavy metals of batteries
- PCB /PCTs/ PCNs
- Azodyes
- Formaldehyde
- Nickel release
- PCP and other phenols
- Organic tin compounds
- Chlorinated organic carriers
- SCCP
- NP
- PFOS /PFOA
- Halogens (fluorine, chlorine, bromine, iodine)
- Solvents (VOC)
- PVC and its mixtures
- Benzotriazole
- Asbestos

Safety Test

- Electric shock
- Energy hazards
- Fire
- Mechanical and heat hazards
- Radiation hazards
- Chemical hazards

Performance Test

- Electromechanical circulation, weariness, corrosion, cold/thermal shock
- Energy efficiency of heating and cooling equipment
- Energy consumption of lighting equipment, household appliances and tools
- Life and durability
- Noise
- Vibration

EMC Test

- US: FCC Part 2.962 of 47 CFR
- Canada: All Radio Standards Specifications (RSS) and Broadcasting Equipment Technical Standards (BETS) in the Category 1
- Equipment Standards List
- EU: CE-EMC in accordance with Directive 2004/108/EC
- Australia: C-tick
- Japan: VCCI

IV. Attentive Services

C&K Testing also renders five extra services while providing strong technical support:

- Special offers for testing on a regular basis;
- Management and integration of suppliers for free;
- Sharing of the latest technical news;
- Door-to-door training and orientation for suppliers;
- Customised solutions.

V. Company Profile

C&K Testing is a leading testing company to render you specialised solutions concerning green and sustainable development of products. Established in 2008, we've helped thousands of customers to minimise the risks of their products to human health and the environment through our testing services.

Our company is a member of CIRS which is a leading product safety management consulting firm. With our offices in Ireland and the United States as well as our laboratory in China, a global network of testing facilities enables you to meet all the relevant regulatory requirements across different markets more cost-efficiently.

Combining widely global recognition and extensive local experience, staffed by knowledgeable experts, C&K Testing will help you to gain a competitive advantage in the global marketplace by ensuring product safety and quality, removing trade barriers and optimising manufacturing procedures.

Our Testing Services: food and food-related products, cosmetics, environment, consumer products, industrial goods and chemicals, etc.



An Authoritative Platform for 3rd-Party Testing

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