



Multilayer Ceramic Chip Capacitors Environmental Information

**Frequently asked questions regarding the constituents of a MLCC and
Company Environmental Position**

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Abstract

MLCC users continue to request Environmental Information regarding TDK's MLCC's. This paper will provide TDK Components USA, Inc. Environmental stance and information regarding capacitor constituents.

MLCC Environmental

Frequently asked questions regarding MLCC's and their Environmental Impact.

Robert D. Wilkerson

Question 1: Does TDK's Capacitors contain Banned or Restricted Substances?

No. TDK's capacitors are lead free, RoHS and WEEE compliant. TDK MLCC's do not contain any listed or banned substances nor does TDK use any of the substances listed in Figure 1 during manufacturing.

Figure 1: Typical Industry List of Banned or Restricted Substances

Metals	CAS No.
Aluminium	
Antimony Compounds (except trioxide)	7440-36-0 & compds
Arsenic/ Arsenic Compounds	7440-38-2 & compds
Barium/ Barium Compounds	7440-39-3 & compds
Beryllium/ Beryllium Compounds	7440-41-7 & compds
Bismuth/compounds	7440-69-9 & compds
Brass	
Cadmium/ Cadmium Compounds	7440-43-9 & compds
Chromium (III)	16065-83-1
Chromium (VI) Compounds	18540-29-9
Cobalt/compounds	7440-48-4 & compds
Lead/ Lead Compounds	7439-92-1 & compds
Mercury/ Mercury Compounds	7439-97-6 & compds
Organo-tin Compounds	Group
Selenium/Compounds	7782-49-2 & compds
Tellurium/Compounds	13494-80-9 & compds
Thallium/ Thallium Compounds	7440-28-0 & compds
Zinc Chromate	13530-65-9
Zinc Compounds (except chromate)	7440-66-6 & compds

Plastics/ Flame Retardants	CAS No.
PVC	9002-86-2
Asbestos/Compounds	group
Antimonous Trioxide	1309-64-4
Chloroparaffin	Group
Monomethyldibromodiphenyl-methane	099688-47-8
Monomethyldichlorodiphenyl-methane	076253-60-6
Monomethyltetrachloro-diphenylmethane	
Polybromated biphenyl (PBB)	group
Polybromated diphenylether (PBDE/PBDO)	group
Polybromated Terphenyl	group
Polychlorinated biphenyls (PCB)	1336-36-3
Polychlorinated terphenyls (PCT)	61788-33-8
Tetrabromobisphenol-A	79-94-7
Tetramethylthiuram disulfide (Thiram)	137-26-8
Trimethylphosphate	000512-56-1
Triphenylphosphate	119-86-6
Tris (1-aziridinyl) phosphine oxide	545-55-1
Tris (2,3-dibromopropyl) phosphate	126-72-7

Additives/Other Materials	CAS No.
Amines, aliphatic	Group
4-Aminobiphenyl	000092-67-1
Aniline	000062-53-3
Aniline salts	Group
Anthracene	120-12-7
Chloraniline	27134-26-5
Chlorofluorocarbons	Group
Ethylene Glycol Ethers (EGE)	Group
Isothiazoliinones	Group
Halogenated Aromatic Compounds as monomers	Group
Halogenated dioxins & furans	Group
2-Naphtylamine	000091-59-8
Organic Halogen Compounds	Group
Organic Phosphorous Compounds	Group
Organic Silicon Compounds	Group
Pentachlorophenol salts and compounds	Group
Phenol	000108-95-2
Phthlates	Group
Small Fibers	Group

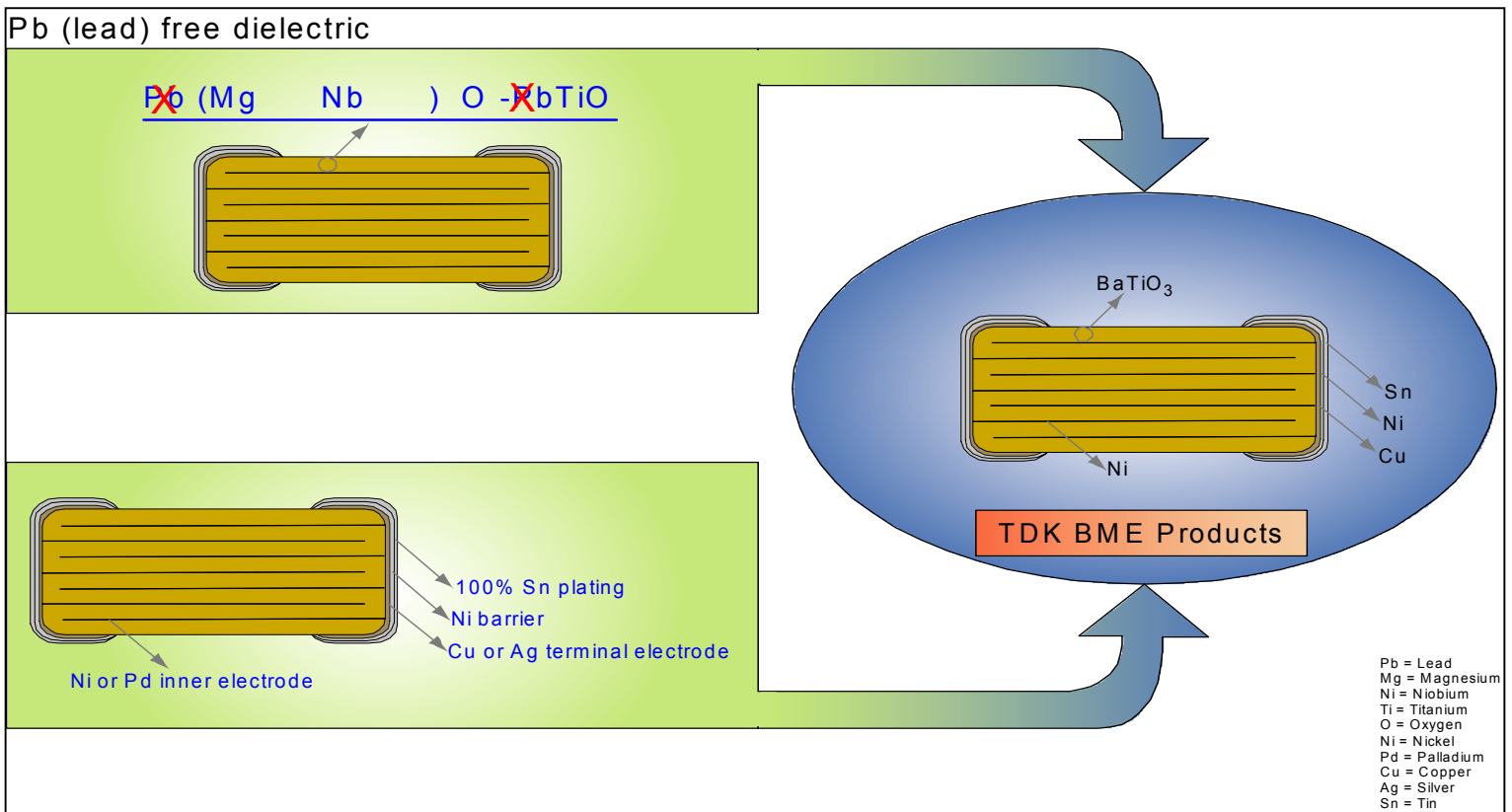
Dyes	CAS No.
2,4,5-Trimethylaniline salts	Group
2,4-Diaminoanisol salts	Group
2,4-Toluylendiamine salts	Group
2-Amino-4-nitroluene salts	Group
2-Naphthylamine salts	Group
3,3'-Dichloro benzidine salts	Group
3,3'-Dimethoxy benzidine salts	Group
3,3'-Dimethyl-4,4'-diamino - diphenylmehtane salts	Group
3,3'-Dimethylbenzidine salts	Group
4,4'-Diaminodiphenyl-methane salts	Group
4,4'-Methylene-to (2-chloraniline) salts	Group
4,4'-Oxydianiline salts	Group
4,4'-Thiodianiline salts	Group
4-Aminobiphenyl salts	Group
4-Chloro toluidine salts	Group
Benzidine	000092-87-5
Benzidine salts	Group
m-Toluidine	000108-44-1
o-Aminoazotoluene salts	Group
o-Toluidine	000095-53-4
o-Toluidine salts	Group
p-Chloraniline salts	Group
p-Cresidine salts	Group
p-Toluidine	106-49-0

Question 2: What are the materials used to construct a capacitor?

The breakdown of a capacitor is described in Figure 2.

Figure 2: Materials used to construct a capacitor

- ◆ **Raw capacitor** - (Barium Titanate CAS #12047-27-7) - The bare ceramic body is made of mult layers of barium titanate and nickel or palladium internal electrodes depending on the capacitor type.
- ◆ **External Electrode** - (Copper CAS #7440-50-8 or Silver CAS #7440-22-4) - Copper or Silver is applied to the capacitor through a termination process as an external electrode. Copper or Silver is used depending on the capacitor type.
- ◆ **Applied Metals for Thermal Barrier** - (Nickel CAS #7440-02-0) - Nickel is electroplated onto the capacitor external electrode as a thermal barrier against solder heat.
- ◆ **Applied Metal for Solderability** - (Tin CAS #7440-31-5) - Tin is electroplated onto nickel thermal barrier for its solderability performance characteristics.



Question 3: What are the material weight percentages of TDK's capacitors per type and size?

The table below references the total chip weight and the constituent weight percentages per application.

Figure 3: Materials Weight Percentage Declaration

Multilayer Ceramic Chip Capacitor Materials Declaration

All Capacitors				Percentage of Total Weight			
Capacitor	Thickness	Type	Per Chip Weight (Grams)	Barium Titanate	Ni	Sn	Silver
1005	0.00	Pd	0.001	80.00	2.40	7.60	10.00
1608	0.80	Pd	0.006	83.35	1.65	6.70	8.30
2012	0.60	Pd	0.009	77.50	1.30	5.60	15.60
2012	0.85	Pd	0.011	82.15	1.45	5.82	10.58
2012	1.20	Pd	0.017	88.25	0.70	2.82	8.23
3216	0.60	Pd	0.012	89.87	1.20	4.80	4.13
3216	0.85	Pd	0.023	90.90	0.56	2.18	6.36
3216	1.10	Pd	0.032	93.33	0.60	2.40	3.67
3216	1.30	Pd	0.038	94.44	0.46	1.77	3.33
Capacitor	Thickness	Type	Per Chip Weight (Grams)	Barium Titanate	Ni	Sn	Copper
1005	0.00	TME	0.001	80.00	2.40	7.60	10.00
1608	0.80	TME	0.005	79.80	2.00	8.00	10.20
2012	0.60	TME	0.007	71.32	2.86	11.43	14.39
2012	0.85	TME	0.010	79.89	1.20	4.80	14.11
2012	1.20	TME	0.016	87.37	1.00	4.00	7.63
3216	0.60	TME	0.010	89.87	1.20	4.80	4.13
3216	0.85	TME	0.022	90.90	0.56	2.18	6.36
3216	1.10	TME	0.030	93.33	0.60	2.40	3.67
3216	1.30	TME	0.036	94.44	0.44	1.79	3.33
3216	1.60	TME	0.050	94.00	1.00	2.00	3.00
3225	0.00	TME	0.103	95.10	0.80	1.00	3.10

Question 4: How much Lead is in TDK Capacitors

Capacitors produced at TDK Components USA, Inc. have manufactured LEAD FREE since the year 1999.

TDK's Environmental Position

Frequently asked questions regarding TDK's Environmental Programs

Question 5: What is TDK's Corporate Directives for Environmental Activities?

TDK has developed a Basic Environmental Action Plan (Figure 4) and a Zero Emissions Strategy (Figure 5) for all TDK subsidiaries foreign and domestic.

Figure 4: Action Plan 2010

Having made environmental preservation one of its top-priority management policies, TDK adopted in October 2002 "TDK Environmental Action 2010," a basic plan covering the period until 2010, as the next step in its environmental undertakings. "TDK Environmental Action 2010" specifies nine activity categories and sets specific medium- to long-term goals based on the companies business characteristics. The plan also clarifies the roles and responsibilities of sites, business divisions, and staff function. Activities started in April 2003.

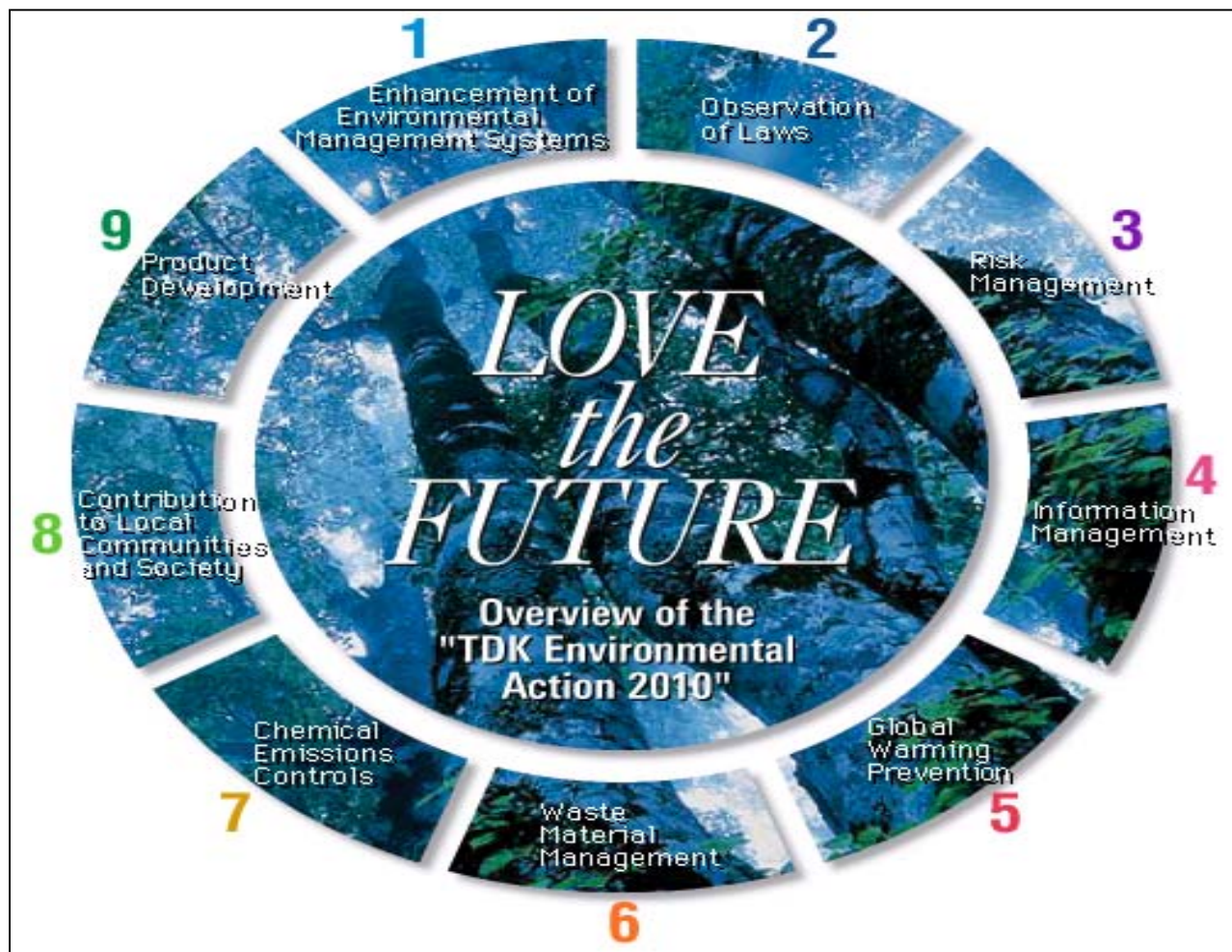
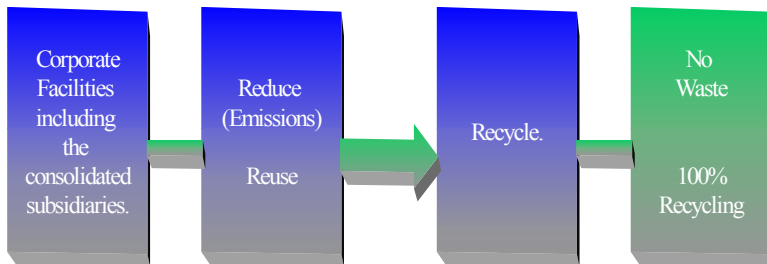


Figure 5: Zero Emissions Strategy

Zero Emissions at TDK

TDK is working hard to lower the volume of waste oil, sludge, waste acids, waste plastics, dust, and discarded glass containers since they account for the main portion of the total waste generated. Improving yield through advanced manufacturing methods and incorporating recycling in to the production process are helping curtail the generation of waste. In addition, technology is being developed to recover reusable materials from waste products. The ultimate goal is to reduce the volume of unavoidable waste materials and to achieve 100% recycling.



Definition of Zero Emissions

TDK's Zero Emissions: Eco-factory-type Zero.

The final target is 100% recycling through reduction, reuse, and recycling of waste matter produced by plants.

Target Substances : 17 categories of substances as determined by TDK's waste matter classification. Substances such as medical waste, excreta, and radioactive waste which are prohibited by law from being separately recycled are not included.

Target Venues : Sites having or expected to have ISO certification including the consolidated subsidiaries.

Target Dates : End of March 2004 (108th Term) for TDK Taiwan Corporation, TDK Components USA Inc., TDK Manufacturing Deutschland GmbH, DK Recording Media Europe S.A., and BT Magnet - Technologies GmbH.

Certification : Zero Emissions have to be sustained for a period of over six months.

Taiwan TDK= TDK Taiwan Corporation
TCU = TDK Components USA, Inc.
TMD = TDK Manufacturing Deutschland GmbH
TRE = TDK Recording Media Europe S.A.
BTMT = BT Magnet-Technologies GmbH

Question 6: What Environmental Certifications does TDK Components USA, Inc. hold?

TDK Components USA, Inc. has been ISO 14001 Certified by Underwriters Laboratories since April 22, 1999 (Figure 6). TDK Components was also honored as a Charter Member in the National Environmental Achievement Track for our commitments to Environmental Management, continuous improvement, public outreach, and environmental compliance on December 13, 2000 (Figure 7). TDK Components has also been recognized as a Green business leader and information can be found at www.GreenBizLeaders.com. TDK Components Environmental Policy dictates the commitments in order to sustain these certifications (Figure 8).

Figure 6: ISO 14001 Certificate

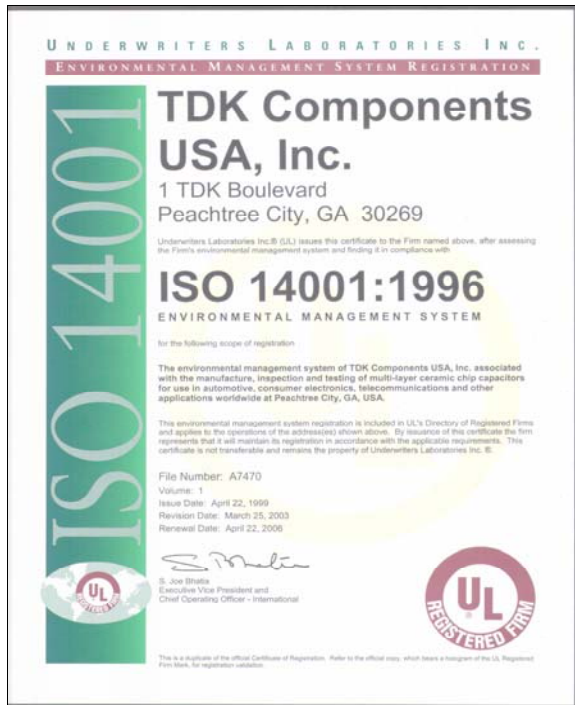


Figure 7: Achievement Track Certificate



TDK Corporation Global Environmental Policy

The entire TDK Group must cooperate with the “Recycling Society”, paying attention to environmental protection, the conservation of energy and natural resources and all other factors affecting the global environment.

TDK Components USA Environmental Policy

TDK Components USA shall establish, implement and maintain a comprehensive Environmental Management System (EMS) in which we are:

- Committed to the continual improvement of our facility to create environment-friendly products, systems, processes, and other operations;
- Committed to the prevention of pollution with concentration at source reduction;
- Committed to recycle materials, conserve energy and natural resources as is technically feasible;
- Committed to compliance with relevant government legislation and regulations, conformance to TDK Corporation environmental standards, and to other requirements; and
- Committed to setting environmental objectives and targets in order to measure environmental performance.



Question 7: How can I find more information on TDK's & Environmental Programs?

**Write to: TDK Components USA, Inc.
1 TDK Boulevard
Peachtree City Ga. 30269
ATTN: EMS Department**

**Contact: Ken Takekawa
Quality Management Manager
770-631-0410 Ext. 228**

or

**Robert D. Wilkerson
Sr. Environmental Engineer
770-631-0410 Ext. 253**

**“Aiming for Environment-friendly
Global Industry!”**



TDK Environmental Awareness
Slogan and Symbol

EMS-420-01*N01

Approved: *[Signature]* [Redacted]