Technology of Cooling Systems Division Required for Overseas Products

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1. Introduction

With the trend toward equipment digitalization, miniaturization, high density and increased speed, cooling fans have come to be incorporated into products in a variety of fields. As a result, Sanyo Denki's "San Ace" series of cooling fans are now exported to various countries around the world. In many cases, they are incorporated into customers' domestically manufactured products, which are then exported.

These Cooling Systems Division products that are destined for overseas markets have two major requirements:

(1) They must be certified and approved under overseas safety standards

(2) They must accommodate the RoHS Directive (restricting the hazardous substance content in products)

From the outset, Sanyo Denki has made an active effort to obtain certification and approval under overseas safety standards for the fans it manufactures. Recently, however, there has been a sudden increase in demand on the part of both domestic and overseas customers for products that comply with the RoHS Directive.

The RoHS ("restriction of hazardous substances") Directive is scheduled to go into effect in July 2006. Major domestic and overseas manufacturers of electrical and electronic products are accelerating their efforts to reduce the quantity of these substances that their products contain, and this is becoming a pressing matter for Sanyo Denki as well.

This report presents a brief overview of overseas safety standards and summarizes the efforts being made by Sanyo Denki to accommodate the RoHS Directive.

2. Overseas safety standards

Sanyo Denki fans have been certified and approved under some or all of the following safety standards:

(1) UL standard (U. S. A.)

(2) CSA standard (Canada)

(3) EN standard (EU)

(4) CCC (China)

When fans are exported or incorporated into products that are subsequently exported, they must be certified and approved under the safety standard of the export destination country. Sanyo Denki is continuing to upgrade its line of products that are certified and approved under various safety standards.

3. RoHS Directive Compliance by the Cooling Systems Division

The RoHS Directive is a regulation that imposes restrictions on the content of specific hazardous substances in electrical and electronic products sold in the countries of the European Union. Under the RoHS Directive, six types of chemical substances will be restricted: cadmium (Cd), lead (Pb), mercury (Hg), hexavalent chromium, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE).

The Cooling Systems Division has promoted efforts to use lead-free solder (beginning in 2000) and to examine ways to ensure compliance with the RoHS Directive (beginning in 2003). Starting with the lots manufactured in June 2005, the Division has switched over to products that comply with the RoHS Directive (although some models are not yet compliant).

3.1 Inclusion in products of materials targeted by the RoHS Directive and nature of accommodation

Table 1 shows the content of the six hazardous substances in question, prior to accommodation of the RoHS Directive. Lead and hexavalent chromium were used in DC and AC fans.

Table 2 shows the components in each product that contain hazardous substances and the method used for replacement of these substances. Fig. 1 and Fig. 2 show specific examples of the locations at which hazardous substances are present.

For purposes of explanation, the following discussion regarding replacement of hazardous substances will consider the case of DC fans.

Table 1 Inclusion in products of materials targeted by the RoHS Directive

	Lead	Hexavalent chromium	Cadmium	Mercury	PBBs	PBDEs
DC fan motor	×	×	○	○	○	○
AC fan motor	×	×	○	○	○	○
Finger guard	○	○	○	○	○	○
Resin filter kit	○	○	○	○	○	○

※ ○ : Not included　　× : included

Table 2 Specific components containing lead and replacement method

Product	Component	Specific Location	Replacement Method
DC fan motor	Solder	SoSolder for board mounting, lead wire attachment and board / stator assembly	Change to lead-free solder
	Electronic component	External electrode plating	Change to lead-free parts
	Brass (free-cutting brass) High-temperature solder	Alloy content	Used to exempt product from RoHS Directive, so measures not needed
AC fan motor	Type metal	Used as alloy content for connection of blade and rotor	Change to tin
	Brass (free-cutting brass)	Alloy content	Used to exempt product from RoHS Directive, so measures not needed
AC fan motor sensor	Electronic component	External electrode plating	Change to lead-free specifications
	Solder	Solder for board mounting, lead wire attachment and board / stator assembly	Change to lead-free solder

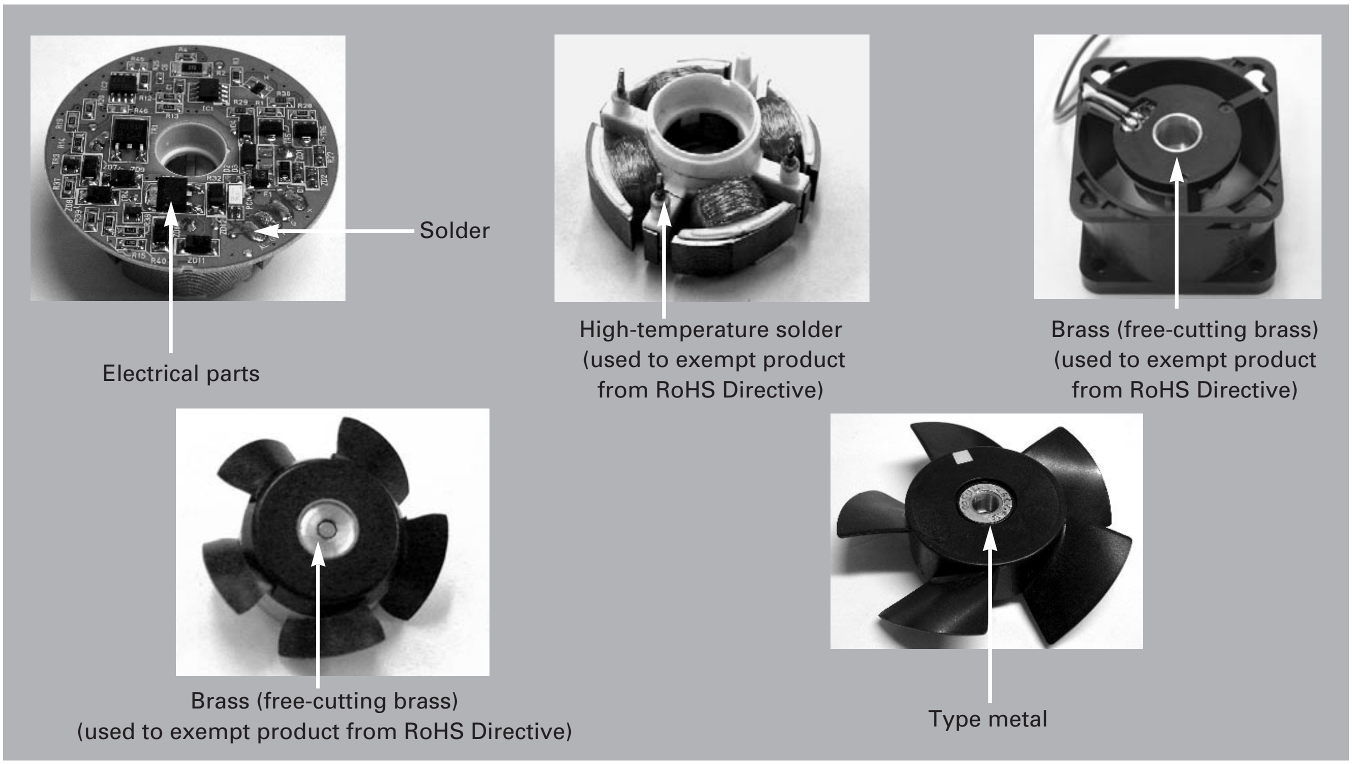

Fig. 1 Location of lead content

Fig. 2 Location of hexavalent chromium content

3.1.1 Use of lead-free solder

In the case of the DC fan, eutectic solder (alloy content: tin 63% lead 37% / melting point: 183℃) was used in three locations: for mounting electronic components on the board, to connect the lead wire to the board, and to connect the coil to the board. This has been changed to lead-free solder (alloy content: tin 96.5% silver 3% copper 0.5% / melting point: 218℃).

The following is a description of the problems encountered in the changeover and the measures implemented to correct these problems.

3.1.1.1 Problem 1: Increased melting point

With the increase of approximately 35℃ in the melting point of solder, the temperature conditions must be changed for each soldering process. However, when eutectic solder is used, it is not possible to simply raise the temperature to match the melting point increase of 35℃ for the reflow and flow processes. Previously, the upper temperature limit for electronic components was 235℃ - 240℃ MAX, so the temperature for the process was set to 235℃ MAX. Along with the changeover to lead-free solder, the upper temperature limit for electronic components has been revised to 255 - 260℃ MAX. However, if the temperature for the process is simply increased to match the increased melting point, the value becomes 235℃ + 35℃ = 270℃, which exceeds the upper temperature limit for electronic components. For this reason, the maximum temperature was set to 250℃ and changes were made to the pre-heating and hold time and so on in order to ensure quality and workability.

3.1.1.2 Problem 2: Reduced wettability (spread during melting)

In the flow process, there was a problem with increased incidence of solder icicles and bridging. This was caused by decreased wettability of the solder resulting from the fact that the lead had been eliminated and the alloy composition had changed, and the fact that oxidation tended to occur due to the increased temperature.

To correct the problem, a method was introduced in which soldering was done in a nitrogen atmosphere. Soldering in a nitrogen atmosphere prevented the solder from oxidizing and improved wettability. The introduction of nitrogen also reduced the incidence of solder icicles and bridging.

3.1.2 Use of lead-free electronic components

In most cases, the electronic components mounted on the board use a tin-lead alloy as plating for the external electrodes. These electronic components are purchased from the manufacturer, and they have been replaced with substitute parts provided by individual manufacturers. Since each part has a different alloy composition for the replacement plating, initially there were concerns regarding the reliability of the connection with the lead-free solder used by Sanyo Denki. However, the solder used by Sanyo Denki has an alloy composition with a proven track record in Japan. Its reliability has been tested by, various component manufacturers, and no particular problems have been encountered.

3.1.3 Use of hexavalent chromium-free rotor cover

With the exception of some long life fans and the like, electrogalvanized steel plates are used for the rotor covers. These steel plates are galvanized and subjected to chromate treatment; hexavalent chromium is used for this chromate treatment. (Fig. 3)

Steel manufacturers already sell chrome-free (chromate-free) steel in which hexavalent chromium is not used. Sanyo Denki has moved ahead with efforts to switch to this type of steel. Only the outermost layer of chromate has been changed; the base metal (steel) and galvanized layer are unchanged. No problems have been noted in connection with this change.

3.2 Control to ensure non-inclusion of the six hazardous substances

To ensure compliance with the RoHS Directive, in an increasing number of cases Sanyo Denki is being asked to provide "assurance" that the target hazardous substances are not included. Up to now, hazardous substance content has been determined and reported based on the results of surveys conducted by individual component manufacturers. However, to accommodate these requests for assurance, there is a need for Sanyo Denki to actually check the content itself.

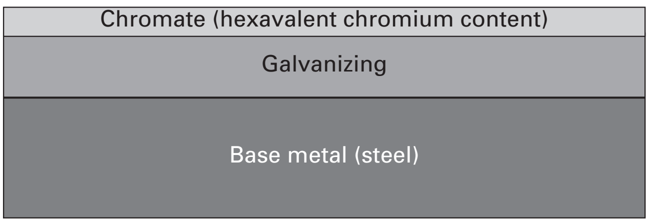

Fig. 3 Chromate treatment

Fig. 4 Energy dispersive X-ray fluorescence analyzer (EDXRF)

For this reason, the Cooling Systems Division has introduced an energy dispersive X-ray fluorescence analyzer (EDXRF) capable of analyzing the content of each element in individual members. This analyzer is being used to conduct analysis and checks for received members.

4. Conclusion

The RoHS Directive will go into effect in July 2006, and this date is fast approaching. Even in China, regulations modeled after the RoHS Directive are planned. With these and other events, the number of requests for compliance is expected to increase in the future. Moreover, due to increased concerns regarding substances that place a burden on the environment, moves to regulate materials in addition to those covered by the RoHS Directive are expected to proceed as well. Sanyo Denki will monitor customer trends and the direction of overseas regulations concerning environmentally hazardous substances, and will continue its efforts to create products with the very minimum environmental burden.

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