MATERIALS USED IN HARD DISK DRIVES

1.0 PURPOSE:

This document provides a list and description of materials and components commonly used in Hard Disk Drives (HDD) and some of the potential contamination problems which may be caused by or affect these materials.

2.0 SCOPE:

Materials and component parts which are typically used within disk drives are specifically addressed. Each item is discussed in terms of: material; use; contamination control (CC) exposures.

3.0 DEFINITIONS/TERMS:

Base Casting - The main component of the disk drive, to which all of the other components are directly or indirectly attached.

Crash Stops - A small plastic part, sometimes containing a magnet and/or an elastomeric bumper, used to restrain the HSA from moving beyond the I.D. and O.D. boundaries of the prescribed travel.

Filters - Typically up to four types can be found in an HDD. Recirculation filters are found in the air flow path, created by the spinning motion of the media, and are designed to filter out particles which become airborne during the operation of the drive. Breather filters are located on the cover or base casting and are designed to allow for pressure equalization in the drive, without the introduction of particulate contamination. A third type of filter is an organic adsorption filter which is used to prevent organic vapors or reactive gases from entering the drive or condensing on the media or sliders within the drive. There are also desiccant containing filters to lower the relative humidity.

Gaskets - Gaskets can take the form of standard O-rings, custom elastomeric rings or other shapes as well as custom foam die cuttings. They are typically used to seal around and between components such as motors to base castings or covers to base castings.

HGA - Head Gimbal Assembly, a sub-assembly including: trace suspensions and/or metallic suspensions and sliders.

HSA - Head Stack Assembly, a complete assembly including: a comb or suspensions or trace suspensions; pivot or bearing assembly; actuator/coil; sliders; amplifier module; flex cable and connector.

Media - Magnetic recording disks consisting of several layers, an example of which is the following: an aluminum substrate, an electroless nickel layer, a chromium isolation layer, a Co-based magnetic layer, a carbon overcoat and a lubricant layer.

Motor - Provides the hub for attachment of the media, spacers and top clamp as well as the armature and bearings to spin the media under the sliders at high rotational speeds.

Slider - A component made of ceramic, ferrite or other proprietary materials which contains the reading and writing elements (heads) which fly over the media spaced by the slider's air bearing surface (ABS).

Spacers - Rings made of aluminum, stainless steel (SS) or ceramic used to control the disk to disk spacing of the disk stack.

Suspension - The stainless steel stamping to which the slider and wire are mounted. In addition they provide the head spacing and preload to establish the proper flying height and attitude.

Tape Seals - An adhesive strip used to wrap around the perimeter of the HDD to seal the gap between the top cover and the base casting.

Top Clamps - Stainless steel or aluminum disk installed via interference pressing or screws attachment to hold the media and disk spacer rings in place on the motor hub.

Top Cover - A stainless steel, aluminum, plastic or combination material which is used to cover the drive so that external particulate contamination is excluded. Frequently the cover incorporates a damper for sound attenuation.

VCM - Voice Coil Magnets, used in combination with the actuator coils to move the sliders radially across the media

4.0 DRIVE MATERIAL LISTING:

BASE CASTINGS:

Material: Pure aluminum or aluminum alloys

Use: Provides the platform for direct or indirect attachment of all of the other drive components

Contamination Control (CC) Exposures:

1. Bare aluminum castings have quite a rough surface and can be difficult to clean as well as being a particle source.
2. Usually a surface treatment such as E-coat or Alodine is required to control contamination. Both can be problematic if not properly applied.
3. Typically have relatively complex shapes with machined areas and blind and/or through holes which compound cleaning and drying problems.
4. Outgassing from improperly cured E-coat and organotin content in these have been problem in the past.

CRASH STOPS:

Material: Injection molded plastic piece with an elastomeric bumper and sometimes a permanent magnet latch.

Use: Used to restrain the HSA from moving beyond the I.D. and O.D. boundaries of the prescribed travel zone, and also to latch the HSA into the landing zone or unloaded position for drive shut-down.

CC Exposures:
1. Magnetic contamination of crash stops can occur during manufacturing and shipping or handling.
2. The elastomeric bumper can be difficult to clean, but due to the small size they are typically not a major contamination source.

FILTERS:

Material: Woven or matted synthetic fibers; glass fibers; carbon fibers or granules, and expanded PTFE.

Use: Typically used to filter out particles which become airborne during the operation of the drive, to allow for pressure equalization within the drive and for organic vapor adsorption.

CC Exposures:
1. Fibers on the filters as well as fibers shedding from the edges can be a manufacturing problem with HDD filters, but these problems are uncommon.

GASKETS:

Material: Synthetic rubber; synthetic foam elastomer; Teflon™ , PTFE.

Use: Gaskets can be standard O-rings, custom elastomeric rings or other shapes, as well as custom foam die cuttings. They are typically used to seal around and between components such as motors to base castings or covers to base castings and around connectors.

CC Exposures:
1. Material and manufacturing process selection are critical to getting clean gaskets. Under cured elastomers, especially silicones, can outgas and cause product killing contamination.
2. Die-cut foam gaskets can be loaded with particles along the cut edges and are nearly impossible to clean.
3. Adhesives used to hold foam gaskets or custom designed elastomeric rings in place are another potential source of harmful outgassing materials.

HGA:

Material: A combination of materials which may include: ceramic or ferrite sliders; stainless steel epoxy; copper or gold wires; plastic or Teflon wire insulation.

Use: Provides the attachment point and suspension for the sliders.

CC Exposures:
1. Suspension components may be loaded with small SS particles which are difficult to remove.
2. Sliders may be contaminated with assembly debris including: abrasive particles from the lapping process and uncured adhesives.

HSA:

Material: All of the materials in an HGA plus: flex cables; cable connectors; amplifier modules; pivot bearings; actuator coils.

Use: The complete assembly for mounting the sliders to the actuator and moving them across the media during operation of the drive.

CC Exposures:
1. Cleaning processes must be gentle to avoid damaging the fragile slider wire attachments.
2. Many of the components are received in a ready to use condition, but they may not be clean enough for use as received, depending on the cleaning handling, storage and shipping which has previously occurred.
3. Magnesium comb castings may be saturated with quenching oil which is extremely difficult to remove with an aqueous cleaning process.
4. Pivot or bearing pressing generates particles which cannot removed with aqueous cleaning due to potential bearing damage and grease cross contamination.

MEDIA:

Material: Aluminum, glass or ceramic disks which are coated to provide the magnetic recording layer and a lubricated surface.

Use: The magnetic recording layer provides the small magnetic domains which store the zeros and ones which make up the binary data records.

CC Exposures:
1. The media cannot be cleaned and is used as received from the disk manufacturing process. Some processes result in disks which are highly contaminated with particles.
2. Lube components can collect on the sliders and form a “glue” which can collect more and more particles until a head crash occurs.
3. Inadequate isolation layers and porous carbon overcoats can result in nickel layer and/or magnetic layer corrosion.
4. Pre-sputter contamination on the media can result in poor Glide yields, high thermal asperities or sputter layer delamination.
5. Contaminated lube baths can result in disk surface contamination.

MOTOR:

Material: Machined aluminum hub, bearings, internal armature assembly.

Use: Provides the hub for attachment of the media, spacers and top clamp as well as the armature and bearings to spin the media under the sliders at high rotational speeds.

CC Exposures:
1. Motors are normally received ready to use and cannot be aqueously cleaned after assembly. Therefore the cleanliness of the motor is dependent on the cleanliness of the motor manufacturers process.
2. Magnetic particles from within the motor are a known contamination problem.
3. Outgassing of bearing grease from the motor into the drive is another known problem.

SPACERS:

Material: Aluminum, stainless steel or ceramic

Use: Used to control the disk to disk spacing of the media stack.

CC Exposures:
1. Stamped stainless steel generally contains a large number of particles and is very difficult to clean. Machined SS is generally much cleaner and more cleanable.
2. Ceramic spacers are also difficult to clean and can break during handing and under the stress of being torqued down in a disk stack.

TAPE SEALS:

Material: Plastic or paper tape coated with adhesive

Use: Wrapped around the perimeter of the HDD to seal the gap between the top cover and the base casting.

CC Exposures:
1. Paper die cut tapes may have high levels of surface particles.
2. The adhesive layer is exposed to the inside of the HDD and outgassing can cause drive failures.
3. Plastic tapes can generate high voltages when stripped from their backing.

TOP CLAMPS:

Material: Aluminum or stainless steel

Use: Used to hold the media and disk spacer rings in place on the motor hub.

CC Exposures:
1. Stamped stainless steel generally contains a large number of particles and is very difficult to clean. Machined SS is generally much cleaner and more cleanable.
2. Machined aluminum is generally cleaner than stamped stainless, but galls during screw installation and creates a lot of particles during disassembly, should the drive have to be reworked.

TOP COVER:

Material: Aluminum, stainless steel, plastic or a combination of these materials.

Use: Used to cover the drive to exclude external particles and atmospheric contamination.

CC Exposures:
1. Sub-assembled covers cannot be cleaned in an aqueous cleaner if the parts are assembled with adhesive.
2. Due to the large surface area, even reasonably clean cover assemblies still contain many millions of particles which are exposed to the inside of the drive.

VCM:

Material: Stainless steel or nickel plated stainless steel, rare earth permanent magnets epoxy or nickel coated.

Use: Provide the field through which the actuator coil is moved to control the slider positioning on the media.

CC Exposures:
1. Should not be cleaned if they are received with the magnets attached.
2. Have the exposure of being received with magnetic contamination.
3. Epoxy coated magnets are much more likely than nickel coated magnets to chip or break and cause magnetic contamination.

5.0 REPORTING METRICS:

N/A

6.0 REFERENCES:

N/A

7.0 APPENDIX:

N/A