

**Health and Safety Executive / Local Authorities Enforcement Liaison Committee (HELA)**

**Local Authority Circular**

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**To:** Directors of Environmental Health/ Chief Environmental Health Officers of London, Metropolitan, District and Unitary Authorities and Chief Executives of County Councils.

**For the attention of:** Environmental Services /Trading Standards /Fire Authorities /Other

**This circular gives advice to local authority enforcement officers**

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# PHOTOCOPIERS

## INTRODUCTION

1 This circular explains the operation of a typical photocopier and examines the hazards to health.

## BACKGROUND

### The direct process

2 An image is formed directly on specially treated paper. The process is akin to conventional photography, in that special light sensitive paper is required. This is developed within the machine, often using an ammonia-based process. The remainder of this circular deals with the transfer process which was developed in the 1940's in the USA and originally called 'xerography' (literally 'dry-writing').

### The transfer process

3 A major advantage of this process is that it produces copies on plain paper. An image of the original document is first formed on a light-sensitive surface called the photo conductor (PC) and is then transferred to the paper. The following paragraphs describe the cycle followed to reproduce an image on plain paper.

### Charging the PC

4 In some machines the photo-conductor is an aluminised plastic film coated with an organic material about 10 microns thick. When exposed to an electric field, polarisation takes place through the depth of the film so that the surface carries a

strong negative charge. In the darkness the PC will store this charge; exposure to light dissipates the charge. Because the charge sensitivity of the film diminishes with use it has to be replaced at intervals. The electric field is created by a 'corona', a line wire carrying a very high voltage (7 to 10000 volts) in a three sided metal enclosure or shield. In other machines the PC is a layer of selenium metal (often with additives such as arsenic) flash coated on to a drum.

#### **Exposing the PC**

5 In order to expose the PC the original document is placed on a glass sheet and scanned by a beam of light which is reflected from the document and through a lens system onto the PC. The PC discharges where the light strikes. Light is not reflected from dark areas of the original the corresponding parts of the photo conductor remain charged. A latent image has now been formed on the PC.

#### **Developing the image**

6 In the dry system the developer is a combination of beads of plastic-coated granular substance; the toner is finely powdered carbon black and a polymer resin. When the beads and toner are rubbed together a static charge is generated causing the toner to cling to the beads. This mix is cascaded onto the PC drum and the charge toner in the mix is attracted to the charged areas of the PC drum forming a visible image. The beads fall back into the bottom of the developer reservoir for recycling and additional toner is added to the mix as required.

7 Wet toners contain carbon black in a hydrocarbon solvent and are applied to the PC by a roller and bath. Wet toners are almost invariably handled by a sealed system of containers that plug into the reservoir.

#### **Transferring the image**

8 During the transfer stage the image is transferred from the PC to the paper which passed at a tangent to the PC drum. At this point an electric field from the transfer corona places a strong charge on the back of the paper, attracting the toner in the form of the developed image from the drum to the paper.

#### **Fusing the image**

9 From the PC drum the paper is now moved to the fusing area where heat from a moving fuser lamp which travels along with the paper fuses the toner-polymer mixture to the paper. The finished copy is then delivered to a storage tray.

#### **Cleaning the PC**

10 Most of the toner transfers to the paper but some remains on the PC drum. The remaining toner is cleaned off by exposing it to another corona which dissipates its charge. A rotating brush and an exhaust system remove the toner to the cleaning canister filter bag.

### **HAZARDS**

### **Ultra violet light**

11 The high powered lights used to expose the PC drum produce light in the visible wave band and some ultra violet light (UV), part of which is absorbed by the glass screen. Eye irritation from glare and UV light is prevented by the provision and use of a hinged lid over the glass top of the copier. Damaged lids or covers and the copying of thick books will allow some leakage of light which should be avoided. Operators should not look directly at the light.

### **Ozone**

12 Both the UV light and the corona scan produce ozone by ionising the air. In the latter case it is unavoidable but is reduced in a properly adjusted machine; e.g. correct high voltage adjustment (which is variable to alter the 'darkness' of the copy) and regular cleaning of dust from the corona shields etc. Ventilation of the copier, designed to prevent heat build up, also dissipates the ozone but this can be retained in an unventilated or small room. The Occupational Exposure Standard (OES) for ozone is 0.2 ppm (8hr) and 0.4 ppm (15 mins). Under foreseeable conditions of use, it is unlikely that ozone concentrations would approach either the long or short term standard. Tests have found 0.12 ppm at the discharge from a cooling fan after 1 100 copies have been produced but, more typically, 0.02 ppm was measured in a number of locations at which a very slight smell of ozone was perceptible. 0.02 ppm is generally regarded as the world wide background concentration level of ozone. In London in summer it averages between 0.04 and 0.06 ppm. On smoggy days it may reach 0.2 ppm for some hours.

### **Toner**

13 Toners are fine powders which have a faint plastic odour. Depending on the size of the copier, they are typically composed of iron oxide or magnetite, organic charging agent, acrylic or polyester resin, carbon black and/or inorganic pigments, amorphous silica, and salicylic acid chromium (III) chelate. There are 8-hour TWA OESs for dust of 10 mg/m<sup>3</sup> (total inhalable) and 5 mg/m<sup>3</sup> (respirable), for iron oxide of 10 mg/m<sup>3</sup> (total inhalable) and 5 mg/m<sup>3</sup> (respirable), and for amorphous silica of 6 mg/m<sup>3</sup> (total) and 3 mg/m<sup>3</sup> (respirable).

14 Exposure to total inhalable dust during the use of photocopiers has been measured in the range 0.05-0.23 mg/m<sup>3</sup>, well below the OES for total inhalable dust. The toner component was found to be less than 20% of the total inhalable dust, and therefore exposure to the individual components was well below the respective OESs.

15 During normal use, toner dusts are not considered to present a significant hazard to health.

### **Heat**

16 Operators, particularly those working photocopiers for long periods, often complain of discomfort, e.g.. sore eyes and sore throats. The hot, dry air produced by these machines is likely to be responsible and improved ventilation, with or without humidification, may alleviate the problem.

## **Precautions**

17 In machines using a selenium coated drum, it is customary to replace the drum every few months, or after damage to its surface. Service contracts etc. usually ensure that they are handled by a trained engineer and returned for disposal/reclamation. It is not thought that special protective clothing is necessary, but removal of excessive toner dust, etc., should be done with care.

18 Severity of the hazards referred to in [paragraphs 11 to 16](#) is dependent on the amount of use and the siting of the photocopier. Careful consideration should be given to the siting of machines which are in constant use to ensure a good standard of ventilation. A means of forced ventilation may be necessary in some circumstances.

19 Photocopiers are now able to use coloured toners and certain litho printing plates (for short runs) can also be produced by photocopying.

## **ENFORCEMENT APPROACH**

20 The Paper and Printing Sector Group would be interested to hear of any health and safety problems encountered in the use of photocopiers. Information should be passed via the Area Enforcement Liaison Officer.



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