

# Dycem Purity Documentation

## Introduction

The data in the following table is a summary of tests undertaken on Dycem products over the last nine years as part of the company's continued programme of research and development. The test data, designed to substantiate the properties of Dycem products for use in critical environments, is divided into two distinct areas of investigation:

- 1. Outgassing Behaviour – Organic Components:** A series of tests directed to establish whether organic components used in the manufacture of Dycem products are released into the atmosphere under conditions and in environments where the product will be used.
- 2. Composition and Physical Transfer – Inorganic Components:** A series of tests directed to establish the presence of inorganic components, existing mainly as metal ions, in Dycem products and electronic components such as wafers or disks.

## Results

### Outgassing

In common with many other products based wholly or in part on organic polymeric compositions, Dycem products release minute quantities of organic components when exposed for prolonged periods to elevated temperatures. At 50°C, tests over a period of more than eight hours show release of quantities less than 0.1 microgram per gram of product for Dycem products in the form of Clean-Zone flooring and rollers. A typical peel-off mat shows a slightly higher level of emission.

When tested at 50°C to test methods such as ASTM E-595 and European Space Agency Specifications, no omissions are observed. Dycem Clean Zone meets the criteria specified for materials to be used in space.

At ambient temperatures, sensitive measurements by head-space gas chromatograph and mass spectroscopy techniques (HS/GC/MS) used in the Swedish Flooring Association FLEC tests show no detectable levels of emission for Dycem Clean-Zone. Similar performance is observed for commercial grades of flooring widely specified for

use within cleanroom environments and typical peel-off mats show the same behaviour.

It is likely that (HS/GC/MS) techniques will be a principal feature of draft standards on outgassing to be published by the Institute of Environmental Sciences in 1998.

Under normal conditions of usage, therefore, a range of results supports the conclusion that Dycem Clean-Zone represents no outgassing hazard in cleanroom environments at ambient temperatures.

### **Composition and Physical Transfer**

Measurement by neutron bombardment in the NAA (Neutron Activation Analysis) test method, a sensitive procedure for bulk material analysis, establishes relatively high levels of Sodium, Potassium and Barium in Dycem products together with somewhat lower levels of Titanium, Zinc and Iron.

These elements are bound within the organic matrix and will not become separated from the mass of material so as to enter the environment in which the product is used. It has been demonstrated, however, by surface measurement technology (TXRF analysis), that some transfer can occur over time to other surfaces with which the product may be in direct continuous contact.

Dycem products are not recommended, therefore for applications where the material may remain in sustained direct contact with surfaces sensitive to electronic contamination, such as a silicon wafer or a disk.

## **Tests**

### **Outgassing**

#### **Surface Science Laboratories CA, USA**

Report No: 5030 – 0593

Date: June 24 1993

Method: Analysis by Fourier Transform Infrared (FTIR) Spectroscopy using reflectance microscopy

#### **NASA (Materials Science Laboratory)**

Report No: MTB – 711 – 87

Date: June 20 1988

Method: Measurement of Total Material Loss  
ASTM G595

**MTS Pendar (UK)**

Report No: 46798  
 Date: September 2 1991  
 Method: Conducted using the European Space Agency  
 Specifications P55-01-702  
 Test temperature 125°C  
 Collector temperature 25°C

**Concentration**

**Genetic GmbH München, Germany**

Report No: 10047  
 Date: July 22 1996  
 Method: NAA

**Transfer Test**

**Genetic GmbH München, Germany**

Report No: 10047  
 Date: July 22 1996  
 Method: TXRF

**Purity Tests**

Dycem has been independently tested (EVC Test Method) at the practical working temperature (ambient) and no emissions were detected.

**To the best of our knowledge, this information is correct at printing.**

**Purity study of Dycem vs. Peel-off mat**

| Element               | Dycem         |            |          | Peel-off mat               |              |              |
|-----------------------|---------------|------------|----------|----------------------------|--------------|--------------|
|                       | Concentration | Outgassing |          | Transfer test              | Outgassing   |              |
|                       |               | RT*        | Ug/gram* | Conc (at/cm <sup>2</sup> ) | RT*          | Ug/gram*     |
| Aliphatic Alcohol     | -             |            |          |                            | 6.2          | 0.04         |
| Aliphatic Hydrocarbon | -             |            |          |                            | 2.80<br>7.00 | 0.04<br>0.04 |
| Carbon Disulfides     | -             |            |          |                            | 1.47         | 0.04         |
| Chlorinated solvent   | -             | 2.32       | 0.1      |                            |              |              |
| Antimony (Sb)         | 2.93          |            |          |                            |              |              |

|                 |            |  |  |           |  |  |
|-----------------|------------|--|--|-----------|--|--|
| Arsenic (As)    | -          |  |  |           |  |  |
| Barium (Ba)     | 500        |  |  | 2.3E + 13 |  |  |
| Bromine (Br)    | 12.9       |  |  |           |  |  |
| Cadmium (Cd)    | 1.20       |  |  |           |  |  |
| Caesium (Cs)    | 0.089      |  |  |           |  |  |
| Calcium (Ca)    | -          |  |  |           |  |  |
| Cerium (Ce)     | 0.65       |  |  |           |  |  |
| Chromium (Cr)   | 0.51       |  |  |           |  |  |
| Chlorine (Cl)   | -          |  |  | 5.8E + 13 |  |  |
| Cobalt (Co)     | 0.76       |  |  |           |  |  |
| Copper (Cu)     | -          |  |  | 3.9E + 11 |  |  |
| Europium (Eu)   | 0.016      |  |  |           |  |  |
| Gadolinium (Gd) | -          |  |  |           |  |  |
| Gallium (Ga)    | 0.41       |  |  |           |  |  |
| Gold (Au)       | 0.001<br>1 |  |  |           |  |  |
| Hafnium (Hf)    | 0.043      |  |  |           |  |  |
| Holmium (Ho)    | -          |  |  |           |  |  |
| Indium (In)     | -          |  |  |           |  |  |
| Iridium (Ir)    | -          |  |  |           |  |  |
| Iron (Fe)       | 60.2       |  |  | 2.0E + 12 |  |  |
| Lanthanum (La)  | 0.28       |  |  |           |  |  |
| Lutetium (Lu)   | -          |  |  |           |  |  |
| Mercury (Hg)    | -          |  |  |           |  |  |

|                   |       |  |  |           |  |  |
|-------------------|-------|--|--|-----------|--|--|
| Molybdenum (Mo)   | -     |  |  |           |  |  |
| Neodymium (Nd)    | -     |  |  |           |  |  |
| Nickel (Ni)       | -     |  |  |           |  |  |
| Osmium (Os)       | -     |  |  |           |  |  |
| Palladium (Pd)    | -     |  |  |           |  |  |
| Platinum (Pt)     | -     |  |  |           |  |  |
| Potassium (K)     | 630   |  |  | 6.0E + 13 |  |  |
| Praseodymium (Pr) | -     |  |  |           |  |  |
| Rhenium (Re)      | -     |  |  |           |  |  |
| Rubidium (Rb)     | 1.55  |  |  |           |  |  |
| Ruthenium (Ru)    | -     |  |  |           |  |  |
| Samarium (Sm)     | 0.11  |  |  |           |  |  |
| Scandium (Sc)     | 0.049 |  |  |           |  |  |
| Selenium (Se)     | -     |  |  |           |  |  |
| Silver (Ag)       | -     |  |  |           |  |  |
| Sodium (Na)       | 1904  |  |  |           |  |  |
| Strontium (Sr)    | -     |  |  |           |  |  |
| Sulphur (S)       | -     |  |  | 1.6R + 14 |  |  |
| Tantalum (Ta)     | -     |  |  |           |  |  |
| Terbium (Tb)      | 0.030 |  |  |           |  |  |
| Thorium (Th)      | 0.17  |  |  |           |  |  |
| Tin (Sn)          | -     |  |  |           |  |  |
| Titanium (Ti)     | 305   |  |  |           |  |  |

|                |       |  |  |  |  |  |
|----------------|-------|--|--|--|--|--|
| Tungsten (W)   | 0.17  |  |  |  |  |  |
| Tellurium (Te) | -     |  |  |  |  |  |
| Uranium (U)    | 0.15  |  |  |  |  |  |
| Ytterbium (Yb) | 0.034 |  |  |  |  |  |
| Yttrium (Y)    | -     |  |  |  |  |  |
| Zirconium (Zr) | -     |  |  |  |  |  |

**Outgassing:**

RT = Retention time in minutes

Ug/gram = Estimate of outgassed amount in micrograms/grams

Sample based on response to heptane

**DYCEM AND THE ENVIRONMENT**

Dycem Products only need to be cleaned, so no waste is generated, unlike peel off mats where an 8" ball of consumable waste is generated from peeled sheets.

**Can Dycem be recycled ? Yes,** because Dycem has a thermoplastic base, Dycem Products can be shredded, re-melted and recycled into products with a similar polymeric base and compatible formulations. Protectamats can be recycled into products which use recycled polymer such as garden hoses and moulded footwear. Clean Zone and Work Zone can be recycled into flooring and carpet tiles.

**Dycem Products are not environmentally hazardous.** They can be safely disposed of by normal methods of disposal for industrial and household waste such as incinerators or land-fill.

Dycem products do not create static charges, unlike Peel Off mats which can generate up to 5,000 volts with each sheet peeled.

The data presented and the conclusions expressed in this publication are presented in good faith and are believed to be correct at the time of publication.