

# igus®



igus® white paper *in brief* ...

Theme: cleanroom/hygiene

Issue: April 2021

## Energy supply systems and cables for hygienic applications motion plastics in cleanrooms: every particle counts



Source: Adobe Stock

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Abrasion-free, hygienic, flexible, high availability - these are the typical requirements of energy supply systems for semiconductor manufacture. igus® has developed a new application for this concept that has been well-received in microchip manufacture (especially in East Asia), and is suitable for hygienic food production.

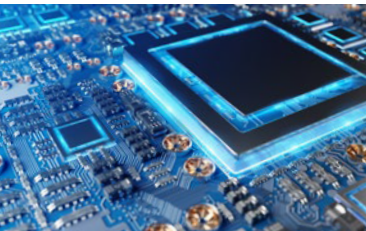
### Main text

How pure is the air in a cleanroom that is classification 1 according to ISO 14644-1, in which components such as semiconductors are manufactured? By themselves, the numbers (per cubic meter, there may be no more than 400 particles that are between 0.5 and 1µm) do not communicate much. To make them meaningful, we need a comparison. One cubic meter of city air contains between 15 and 100 million particles of various sizes, and clean mountain air contains 10 million particles per cubic meter. In one cubic meter of air next to a smoker, there are up to 100 million particles larger than 0.5µm.

This shows that cleanroom requirements for abrasion resistance are extreme and cannot be fulfilled with normal moving components.

### Any foreign particle is a disruption

Why are the requirements so stringent? On a microchip the size of a fingernail, there is room for several billion transistors, and the thickness of the connecting structures is one thousandth of the diameter of a human hair. This means that a foreign particle of any size can ruin a chip and reduce yield. Given the extreme cost of these production plants, even very small particle ingress can make the entire production uneconomical.



**A look at cleanroom manufacturing**

Source: Adobe Stock



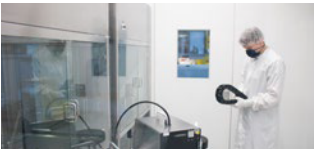
Commercially available ribbon cables with permanently integrated cable elements: the entire system must be replaced if there is damage.

Source: igus GmbH



Cleanroom energy supply system: e-skin® flat with chainflex® CFCLEAN

Source: igus GmbH



igus' in-house laboratory

Source: igus GmbH

## Moving cables: PTFE ribbon cable is the standard

Under these special conditions, special cable types for moving applications must be used. So far, they have usually been PTFE ribbon cables, which are proven and abrasion-free. But they have a disadvantage: if a core breaks, the user must replace the entire system. That takes time. The user is also unable to add additional cables, even when they are needed, so flexibility suffers.

## The customer wants abrasion-resistant, flexible cable guidance

Innovation was required here. igus® developers reacted, developing a user-friendly alternative consisting of two components: CFCLEAN cores and the e-skin® single pod (a plug-in system).

CFCLEAN cables have no outer jacket. Instead, the cores for supplying energy and transmitting motor control, bus, and Ethernet signals are fused together with a PTFE film. Electrical protection is therefore guaranteed, but not mechanical protection. The e-skin® single pod, a newly developed high-performance polymer profile, provides the latter.

## Cable system without outer jacket, suitable for cleanrooms

Unlike the flat ribbon cable system, these profiles are not fused with the cores. A zip fastener makes it possible to open them so that the user can insert the CFCLEAN cores in a few easy steps or, in the case of the closed version, the user can push them through the chamber openings.

This “division of labor” means that the profiles protect the cable elements against mechanical influences and prevent particles from contaminating the ambient air. A further advantage is that the e-skin single pods have a modular design. If users want to start using new cables, they can easily connect single profiles to each other.

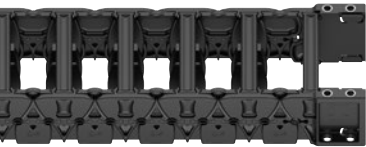
## Tried and tested in our own laboratory

Other advantages of the new solution are quieter operation than that of PTFE flat ribbon systems. And, most importantly the restoring forces



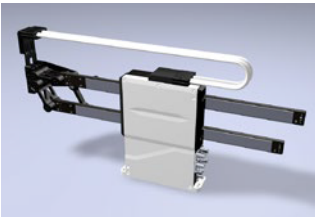
**Service life tests in the igus® laboratory**

Source: igus GmbH



**igus cleanroom e-chain C6 energy chain**

Source: igus GmbH



Weiss GmbH is specialized in the development and manufacture of components for automation technology and a leader in the field of rotary indexing tables and wanted to find a cable feedthrough to the middle of a tool that could hold two sensor cables and two hoses, each with a diameter of four millimeters. The solution was the igus e-skin flat cable guidance system. Service life: over 57 million double strokes.

Source: igus/Weiss GmbH

are significantly lower because the outer jacket is missing (the function of which is taken over by the e-skin®). Given the short cycles and high speeds in the semiconductor industry, this is an important advantage because it reduces wear. And even with all these advantages, the new cleanroom energy supply systems cost around 20% less – in accordance with the igus motto, "Tech up – Cost down".

igus® extensively tested the e-skin® flat cable jacket combined with the CFCLEAN cores for 18 months. In that time, the cleanroom energy supply systems went through 57 million double strokes. The e-skin® single pod individual cables underwent more than 40 million cycles. The tests also showed that the cable systems can be used in cleanrooms (Class 1 according to ISO 14644-1).

### **New materials, new design: the cleanroom energy chain**

There is also a new innovation in classic energy chains for cleanroom applications: the C6 series, which can also be used with Class 1 applications. Here, the developers started at the beginning and developed new, abrasion-resistant materials. They also use new production methods. Some of the components are made using 2K injection molding from very resistant, abrasion-optimized tribo-polymers. And they produced an entirely new design that combines improved damping with lower noise generation and improved abrasion resistance. The result is less abrasion, enhanced transverse stability, and quieter, lower-vibration operation. This is especially true when the C6 is filled with chainflex® cables that can also be used in cleanrooms. This range of cable products is being continuously expanded and already encompasses 1,084 types that have cleanroom classifications of IPA Class 1 or Class 2.

### **Production under cleanroom conditions in Cologne and Korea**

All igus® cleanroom cable and energy supply system production is guaranteed to be particle-free under strict cleanliness conditions.

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**igus cleanroom facility in Korea**

Source: igus GmbH

For example, in Korea, a center for semiconductor production, igus® has manufactured and packaged e-skin® corrugated tubes in a cleanroom-compatible manner and with a high degree of automation since 2020. igus® will soon start operations in a production cleanroom in Cologne as well. The plans – being drawn up jointly with the Fraunhofer IPA institute – are already very advanced.

Additional links:

- ▶ Energy supply systems for cleanrooms – revolutionize overall system effectiveness and generate higher production line yields.  
White paper by igus GmbH, December 2020
- ▶ [www.igus.ca/cleanroom](http://www.igus.ca/cleanroom)

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