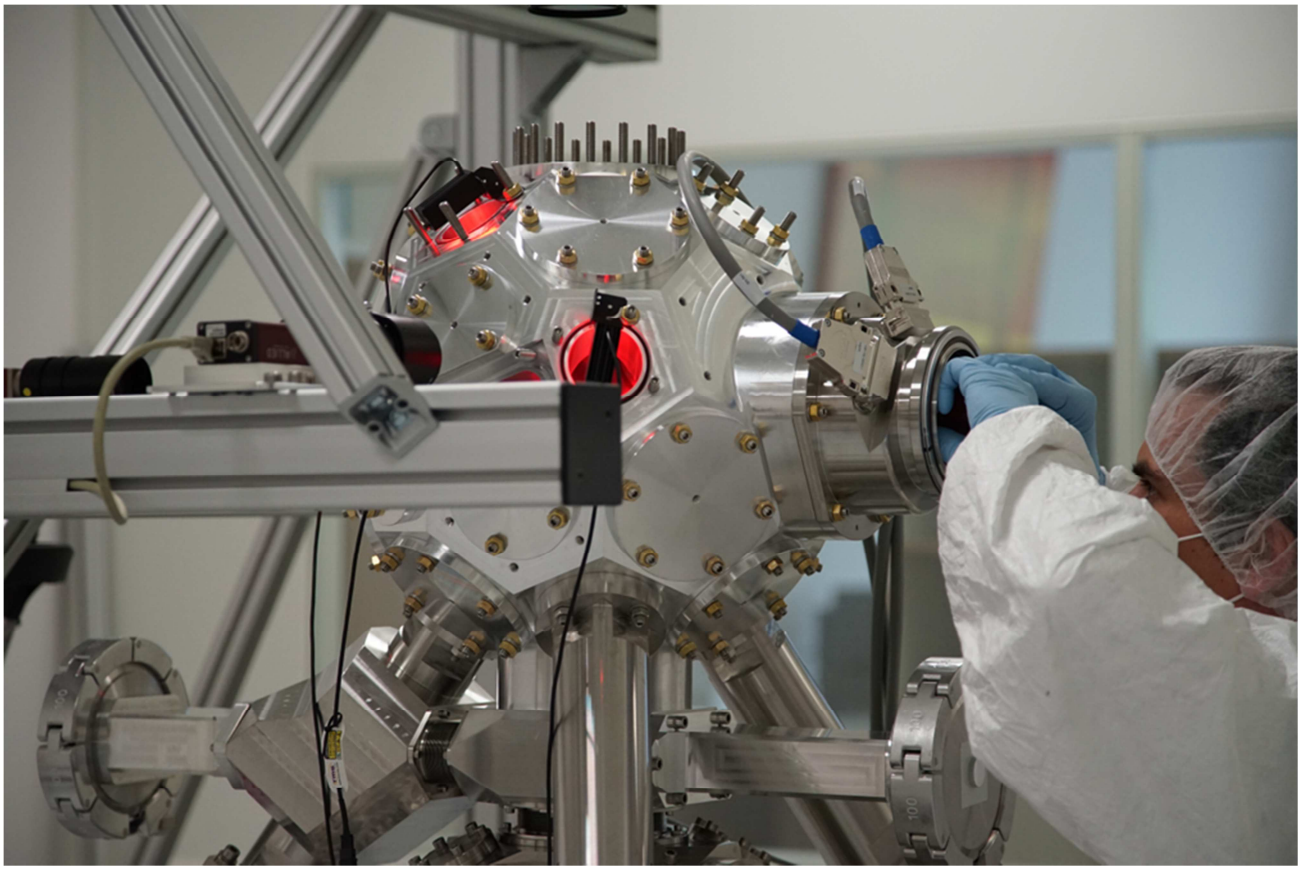
Manufacturing in Cleanrooms at PI (Physik Instrumente)

Capabilities and Capacity



1 Introduction

PI has the capability to manufacture and qualify products under cleanroom conditions at a number of production sites. This capability is extended and improved continually according to market needs.

1.1 Standards

Since 2001, classification of cleanrooms no longer takes place according to US FED STD 209E but instead, according to ISO 14644-1. Some of the cleanroom classifications are listed according to both standards in the following tables.

	Particle per m^3					
Class	0.1 µm	0.2 µm	0.3 µm	0.5 µm	1.0 µm	5.0 µm
ISO 5	100,000	23,700	10,200	3,520	832	
ISO 6	1,000,000	237,000	102,000	35,200	8,320	293
ISO 7				352,000	83,200	2,930
ISO 8				3,520,000	832,000	29,300

Tab. 1 Clean room classification according to ISO14644-1

	Particle per m^3			
Class	0.2 µm	0.3 µm	0.5 µm	5.0 µm
100	26,486	105,994	3,531	
1,000			35,315	247
10,000			353,147	2,472
100,000			3,531,470	24,720

Tab. 2 Cleanroom classification according to US FED STD 209E

2 Available Cleanrooms / Ultraclean Workplaces

In addition to cleanrooms, PI also has ultraclean workplaces, which are installed either inside or outside of the cleanrooms. Their purpose, when compared to the respective environment, is to achieve a further reduction of particle contamination during certain process steps.

The following overview lists the existing and planned facilities according to location.

2.1 PI Karlsruhe

PI Karlsruhe is the largest production und development site in the PI Group. Standard and custom products, mainly in the field of piezo-based positioning systems and hexapods, are assembled and qualified here. All areas for series production, including incoming goods inspection, are cleanrooms according to the ISO 8 classification. In addition, some of these cleanrooms contain ultraclean workplaces according to the ISO 5 classification. The Special Products Fractal has rooms classified according to ISO 7 and ISO 8 as well as ultraclean workplaces according to the ISO 5 classification. A production cleanroom according to the ISO 6 classification is currently being prepared. A laboratory according to the ISO 7 classification is available in the development department.

Cleanroom classification	Available space in m^2
ISO 5	25
ISO 6	(from Q3/2018) 200
ISO 7	600
ISO 8	3,000

Tab. 3 Cleanrooms at PI KA

2.2 PI Ceramic, Lederhose

The entire process chain for multilayer production, beginning with tape casting, is realized at PI Ceramic in cleanrooms according to class 7; the assembly processes for piezo components and sensors also take place consistently in class 7 or class 8 cleanrooms. Depending on the process requirements, cleanrooms according to ISO classes 7 to ISO 9 are available for further selected processes such as sputtering, screen printing, and dispensing.

Cleanroom classification	Available space in m^2
ISO 5	-
ISO 6	-
ISO 7	1,000
ISO 8	300
ISO 9	200

Tab. 4 Cleanrooms at PI Ceramic

2.3 PI miCos, Eschbach

All assembly areas at PI miCos, including incoming goods inspection, are cleanrooms according to the ISO 8 classification. Some of these cleanrooms contain ultraclean workplaces according to the ISO 5 classification. The Engineered Systems area also has a cleanroom according to ISO class 7.

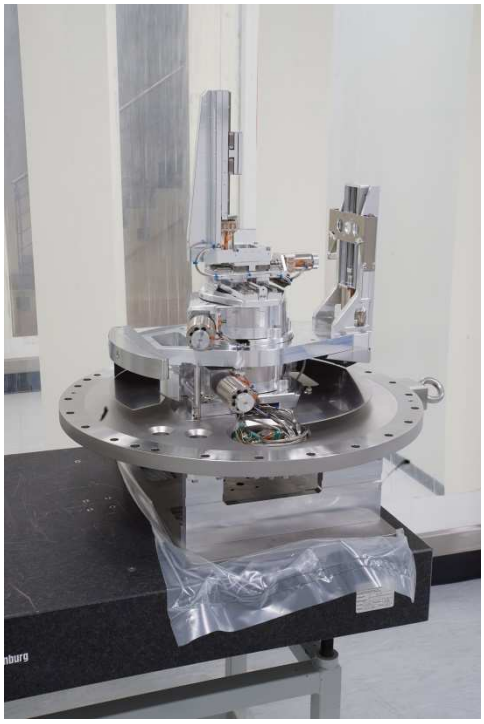


Fig. 1 Multi-axis positioning for spectroscopy, manufactured in a cleanroom in Eschbach according to the ISO 7 classification

2.4 PI USA, Hopkinton

PI USA has an ISO class 8 assembly island in the production area, which includes measuring capabilities, cleaning, and packaging under cleanroom conditions.

Cleanroom classification	Available space in m^2
ISO 5	-
ISO 6	-
ISO 7	-
ISO 8	20

Tab. 5 Cleanrooms at PI USA

3 Supporting Processes

Depending on the processes at the respective locations, PI or its partners have the ability to clean parts and products at each location according to the regulations and then check the cleaning results for particle contamination and if necessary, for other types of contamination as well.

Calibrated particle measuring devices allow PI to monitor the cleanroom quality according the specifications of ISO 14644-1.

PI also has the ability to measure the quantity of particles that originate from its own products under operational conditions.

About PI

Well known for the high quality of its products, PI (Physik Instrumente) has been one of the leading players in the global market for precision positioning technology for many years. PI has been developing and manufacturing standard and OEM products with piezo or motor drives for 40 years. Continuous development of innovative drive concepts, products, and system solutions and more than 200 technology patents distinguish the company history today. PI develops, manufactures, and qualifies all core technology itself: From piezo components, -actuators, and motors as well as magnetic direct drives through air bearings, magnetic and flexure guides to nanometrological sensors, control technology, and software.

PI is therefore not dependent on components available on the market to offer its customers the most advanced solutions. The high vertical range of manufacturing allows complete control over processes and this allows flexible reaction to market developments and new requirements.

By acquiring the majority shares in ACS Motion Control, a worldwide leading developer and manufacturer of modular motion controllers for multi-axis drive systems, PI can also supply customized complete systems for industrial applications that make the highest demand on precision and dynamics. In addition to four locations in Germany, the PI Group is represented internationally by fifteen sales and service subsidiaries.