

**INSTITUTE OF
ENVIRONMENTAL
SCIENCES AND
TECHNOLOGY**

**Contamination Control Division
Recommended Practice 012.2**

IEST-RP-CC012.2

Considerations in Cleanroom Design

INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY

1827 Walden Office Square, Suite 400 |

Schaumburg, IL 60173 USA

Phone: (847) 981-0100 • Fax: (847) 981-4130

E-mail: iest@iest.org • Web: www.iest.org



This Recommended Practice is published by the INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY to advance the technical and engineering sciences. Its use is entirely voluntary, and determination of its applicability and suitability for any particular use is solely the responsibility of the user.

This Recommended Practice was prepared by and is under the jurisdiction of Working Group 012 of the IEST Contamination Control Division.

Copyright © 2007 by the **INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY**

Second printing, July 2017

ISBN 978-0-9787868-1-6

PROPOSAL FOR IMPROVEMENT: The Working Groups of the INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY are continually working on improvements to their Recommended Practices and Reference Documents. Suggestions from those who use these documents are welcome. If you have a suggestion regarding this document, please use the online Proposal for Improvement form found on the IEST website at www.iest.org/proposal/form.html.

INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY

1827 Walden Office Square, Suite 400 | Schaumburg, IL 60173 USA

Phone: (847) 981-0100 • Fax: (847) 981-4130

E-mail: iest@iest.org • Web: www.iest.org

Considerations in Cleanroom Design

IEST-RP-CC012.2

CONTENTS

SECTION

1 SCOPE AND LIMITATIONS.....	4
2 REFERENCES	4
3 TERMS AND DEFINITIONS.....	6
4 PLANNING PROCEDURES	8
5 DESIGN REQUIREMENTS	18
6 CLEANROOM CONSTRUCTION PROTOCOL.....	45

FIGURE

1 CLEANROOM ENERGY END USE (EXAMPLE 1).....	14
2 CLEANROOM ENERGY END USE (EXAMPLE 2).....	14
3 UNIDIRECTIONAL AIRFLOW (SA IS SUPPLY AIR; RA IS RETURN AIR)	18
4 NONUNIDIRECTIONAL AIRFLOW (SA IS SUPPLY AIR; RA IS RETURN AIR)	19
5 MIXED AIRFLOW (SA IS SUPPLY AIR; RA IS RETURN AIR)	19
6 SINGLE MAKE-UP AIR SYSTEM (NO RETURN AIR).....	22
7 SINGLE MAKE-UP AIR SYSTEM (SOME RETURN AIR)	22
8 SINGLE MAKE-UP AIR SYSTEM (WITH RECIRCULATING FAN).....	24
9 SINGLE MAKE-UP AIR SYSTEM (WITH RECIRCULATING AIR HANDLING SYSTEM).....	24
10 SINGLE MAKE-UP AIR SYSTEM (WITH RECIRCULATING AIR HANDLING SYSTEM AND RECIRCULATING FAN).....	24
11 GRAPHICAL DEFINITION OF CRITERION CURVES SHOWN IN TABLE 5	33

TABLE

1 CATEGORIES OF CONTAMINANTS	9
2 REDUNDANCY LEVELS	12
3 KEY CONSIDERATIONS FOR IMPROVING ENERGY EFFICIENCY IN CLEANROOMS	16
4 TYPICAL AIRFLOW CHARACTERISTICS IN CLEANROOMS	20
5 NUMERICAL DEFINITION OF CRITERION CURVES SHOWN IN FIGURE 11	34
6 APPLICATION AND INTERPRETATION OF CRITERION CURVES SHOWN IN FIGURE 11	34

APPENDIX

1 REVIEWING AND TESTING CONCEPTS.....	48
2 SAMPLE CLEANROOM CONSTRUCTION PROTOCOL.....	50
3 BIBLIOGRAPHY	59

Considerations in Cleanroom Design

IEST-RP-CC012.2

1 SCOPE AND LIMITATIONS

1.1 Scope

This Recommended Practice (RP) makes recommendations regarding factors to consider in the design of cleanroom facilities. This discussion is limited to those environmental conditions that typically confront cleanroom designers and users.

1.2 Limitations

This RP is limited to the design of cleanroom facilities. Equipment design is not within the scope, nor does this RP address process or operational considerations, except as these considerations relate to cleanroom design.

This RP is intended to provide users with a means to establish performance criteria for cleanrooms. The factors considered are those commonly encountered in cleanrooms, but discussion of these factors is not intended to be all-inclusive. The specified ranges and recommended criteria are intended only to provide a framework. Specific process or other needs may dictate requirements beyond the scope of this document. This document is not intended to supersede specific requirements established by a recognized national or international regulating body.

2 REFERENCES

The following publications were used in the preparation of this document or are considered critical to its content; their citation in no way represents an endorsement or recommendation.

The cited editions of these documents are incorporated into this RP to the extent specified herein. Subsequent revisions of these publications do not automatically supersede the cited editions. Users should investigate the applicability of revised editions of the references.

2.1 Factory Mutual

Cleanroom Materials Flammability Test Protocol
(Class 4910) 07-Sep-06

2.2 International Code Council (ICC)

2006 International Building Code

2006 International Fire Code

2.3 International Organization for Standardization (ISO)

ISO 14644-1: 1999 Cleanrooms and associated controlled environments—Part 1: Classification of air cleanliness

ISO 14644-8: 2005 Cleanrooms and associated controlled environments—Part 8: Classification of Airborne Molecular Contamination

2.4 Institute of Environmental Sciences and Technology (IEST)

IEST-RP-CC001.4: HEPA and ULPA Filters

IEST-RP-CC006.3: Testing Cleanrooms.

IEST-RP-CC007.1: Testing ULPA Filters.

IEST-RP-CC022.2: Electrostatic Charge in Cleanrooms and Other Controlled Environments.

IEST-RP-CC024.1: Measuring and Reporting Vibration in Microelectronics Facilities

IEST-RP-CC031.1 Method for Characterizing Out-gassed Organic Compounds from Cleanroom Materials and Components

IEST-RP-CC034.2: HEPA and ULPA Filter Leak Tests