CLEAN ROOM
Arc Rated Garments

Specification Guide

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Clean Room Arc Rated Garments - Specification Guide

Overview

Oberon Clean Room Arc Rated Garments provide protection against arc flash hazards and electrostatic discharge. These garments are designed to meet specific cleanliness requirements for use in clean room environments. They are particle-free and made from non-shedding materials to prevent contamination of the environment.

These garments may be worn by workers in industries such as semiconductor manufacturing, pharmaceuticals, and electronics assembly, among others. They are designed to be comfortable and breathable while providing the necessary protection and cleanliness required in these sensitive environments.

Made from flame-resistant Nomex fabric, Oberon Clean Room Arc Rated Garments meet ANSI/ISEA 125 Level 2 Conformity and Arc Flash PPE Category 2 standards with an arc rating of 8 cal/cm^2 and 12 cal/cm^2 respectively.

Please refer to NFPA 70E or CSA Z462 Standards for specific selection requirements.

8 Cal Clean Room Arc Flash Kit

Kit Includes:
- Clean Room Coveralls
- Face Shield
- Hard Cap
- Balaclava
- Booties

Flame Resistance of Textiles

ChemArc 8 (HT544-48/HT544-70)

Original State	Afterflame (Seconds)		Char Length (Inches)		After Glow (Seconds)	
	Warp	Filling	Warp	Filling	Warp	Filling
1	0.0	0.0	1.8	1.7	1.3	0.8
2	0.0	0.0	1.0	1.4	4.0	1.6
3	0.0	0.0	1.8	1.4	2.5	2.0
4	0.0	0.0	1.3	1.4	1.5	1.5
5	0.0	0.0	1.7	1.7	2.0	1.3
Average	0.0	0.0	1.5	1.5	2.3	1.4

ASTM D6413 Standard Test Method for Flame Resistance of Textiles (Vertical Test)						
As-Received Specimens - Length Direction						
	1	2	3	4	5	Average
Afterflame Time(s)	3.0	0.6	2.5	0.0	0.0	1.2
Afterglow Time(s)	1.0	1.8	0.0	16.0	2.2	4.2
Char Length (mm)	48	48	45	39	54	47
Melting & Dripping?	No	No	No	No	No	
As-Received Specimens - Width Direction						
	1	2	3	4	5	Average
Afterflame Time(s)	0.8	1.0	0.6	0.6	0.6	0.7
Afterglow Time(s)	2.0	1.2	16.0	3.0	16.0	7.6
Char Length (mm)	36	39	39	45	39	40
Melting & Dripping?	No	No	No	No	No	
AVG Afterflame(s):	1.0			AVG Char (mm):	43	

NFPA 2112 Section 8.4 Heat and Thermal Shrinkage Resistance Test (Average of 3 Specimens)	
As-Received Specimens	
Length Direction:	-0.9%
Width Direction:	-0.4%
Observations of Melting and Dripping, Ignition, or Separation	No observations of melting and dripping, ignition, or separation on any of the three specimens.
Specimens laundered 3 cycles in accordance with NFPA 2112-2012 Section 8.1.3	
Length Direction:	-0.7%
Width Direction:	-0.6%
Observations of Melting and Dripping, Ignition, or Separation	No observations of melting and dripping, ignition, or separation on any of the three specimens.

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ChemArc 12 (HT541-70)

Original State	Afterflame (Seconds)		Char Length (Inches)		After Glow (Seconds)	
	Warp	Filling	Warp	Filling	Warp	Filling
1	0.0	0.0	1.0	1.3	0.0	0.7
2	0.0	0.0	1.4	1.4	1.2	1.3
3	0.0	0.0	1.8	1.2	1.2	2.0
4	0.0	0.0	1.0	1.0	1.4	2.0
5	0.0	0.0	1.1	0.9	0,8	1.2
Average	**0.0**	**0.0**	**1.3**	**1.2**	**0.9**	**1.4**

ASTM D6413 Standard Test Method for Flame Resistance of Textiles (Vertical Test)						
As-Received Specimens - Length Direction						
	1	2	3	4	5	Average
Afterflame Time(s)	2.2	0.8	1.2	0.6	0.8	1.1
Afterglow Time(s)	0.0	0.6	1.8	2.0	0.0	0.9
Char Length (mm)	30	33	36	33	36	34
Melting & Dripping?	No	No	No	No	No	
As-Received Specimens - Width Direction						
	1	2	3	4	5	Average
Afterflame Time(s)	0.6	0.6	0.6	0.6	1.6	0.8
Afterglow Time(s)	0.0	0.4	0.0	2.8	0.8	0.8
Char Length (mm)	33	36	24	30	36	32
Melting & Dripping?	No	No	No	No	No	
AVG Afterflame(s):	1.0			AVG Char (mm):	43	

| NFPA 2112 Section 8.4 Heat and Thermal Shrinkage Resistance Test (Average of 3 Specimens)	
As-Received Specimens	
Length Direction:	–0.7%
Width Direction:	–0.4%
Observations of Melting and Dripping, Ignition, or Separation	No observations of melting and dripping, ignition, or separation on any of the three specimens.
Specimens laundered 3 cycles in accordance with NFPA 2112-2012 Section 8.1.3	
Length Direction:	–0.5%
Width Direction:	–0.6%
Observations of Melting and Dripping, Ignition, or Separation	No observations of melting and dripping, ignition, or separation on any of the three specimens.

Arc Rating Testing

ChemArc 8 (HT544-70)

- ASTM F1959/F1959M Standard Test Method for Determining the Arc Rating of Materials for Clothing.

Determination of ATPV
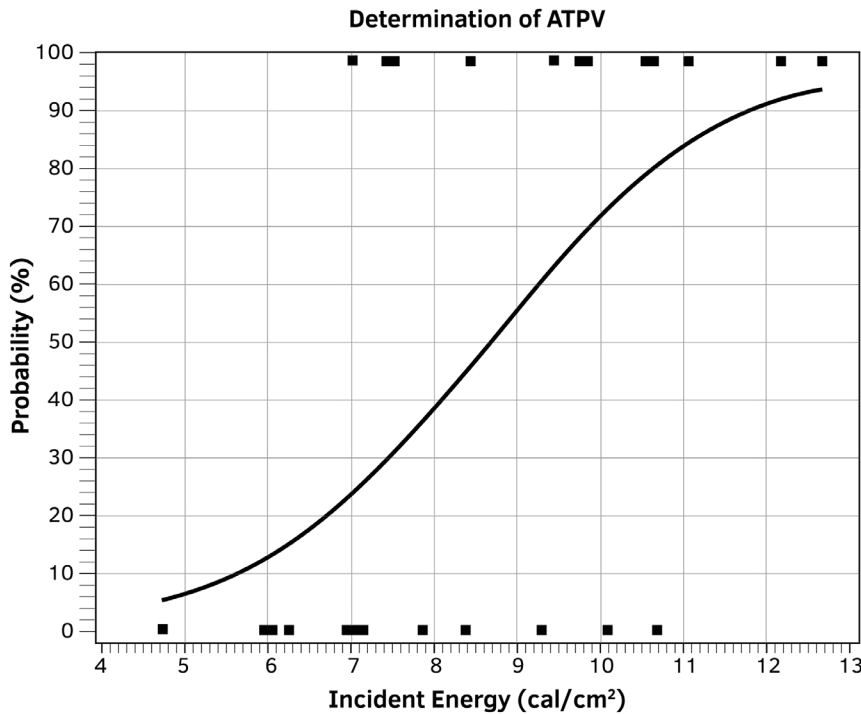
ATPV = 8.7 cal/cm²	
Probability	Ei
5%	4.8
10%	5.6
20%	6.7
30%	7.5
40%	8.1
50%	8.7
60%	9.2
70%	9.8
80%	10.6
90%	11.7

(Note: ATPV is reported to nearest integer for ratings above 10 cal/cm²)

Total points analyzed = 27
Points above Stoll = 13
Points above mix zone = 4
Points below mix zone = 5
Pts within 20% = 15
Pts in mix zone = 18

Determination of HAF
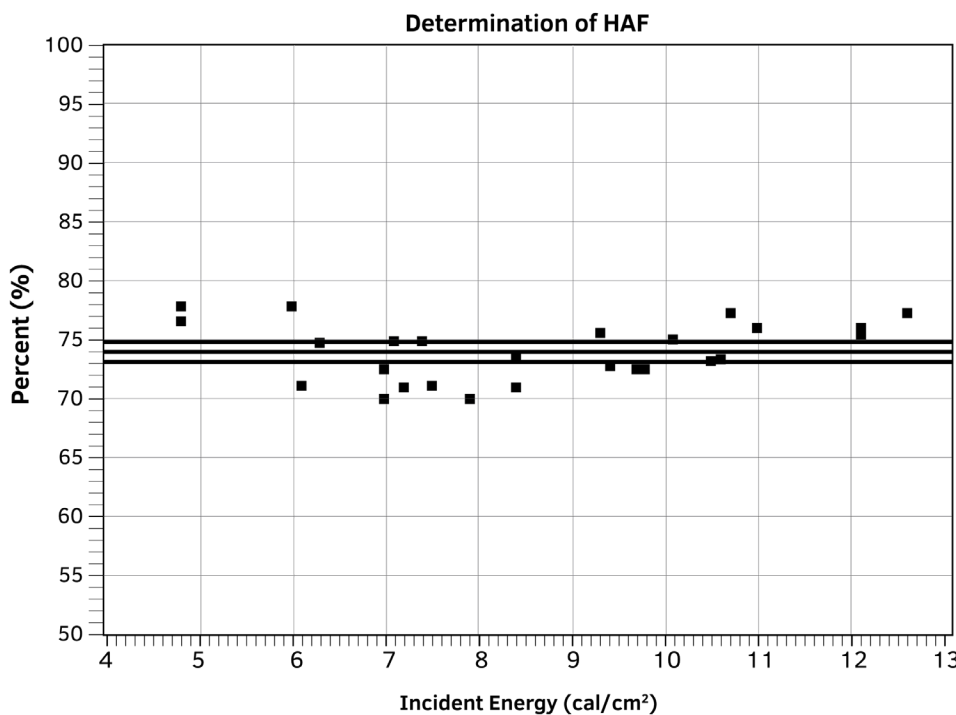
HAF = 74%
Confidence Intervals
95% CI = 73.2, 74.8

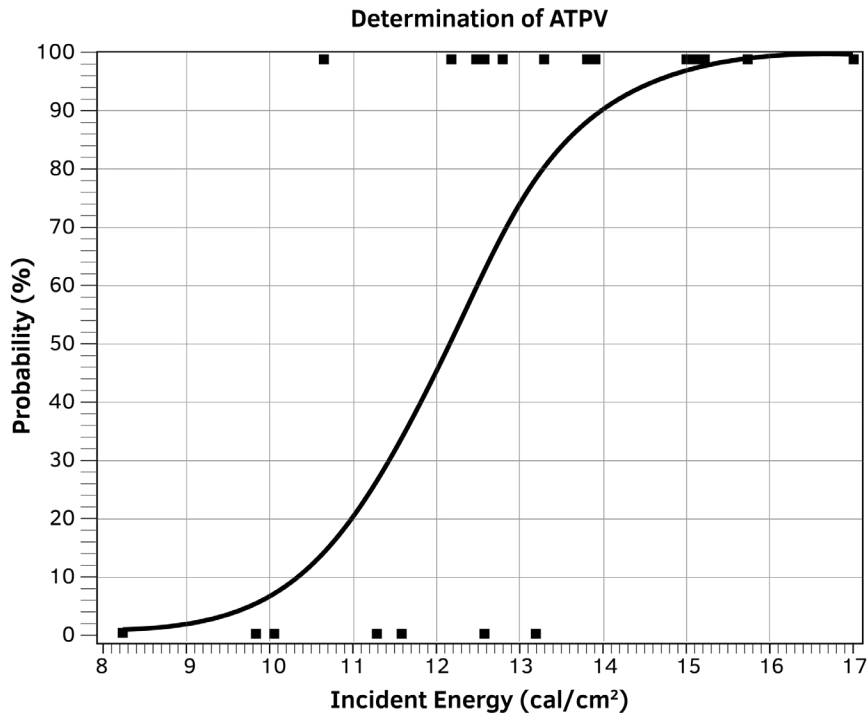| Data Pts	
Best Fit	
95% CI	
95% CI Pts	

ChemArc 12 (HT541-70)

- ASTM F1959/F1959M Standard Test Method for Determining the Arc Rating of Materials for Clothing.

Determination of ATPV

ATPV = 12 cal/cm²	
Probability	Ei
5%	9.7
10%	10.4
20%	11.0
30%	11.5
40%	11.8
50%	12.2
60%	12.5
70%	12.9
80%	13.3
90%	14.0

(Note: ATPV is reported to nearest integer for ratings above 10 cal/cm²)

Total points analyzed = 21
Points above Stoll = 12
Points above mix zone = 7
Points below mix zone = 3
Pts within 20% = 15
Pts in mix zone = 11
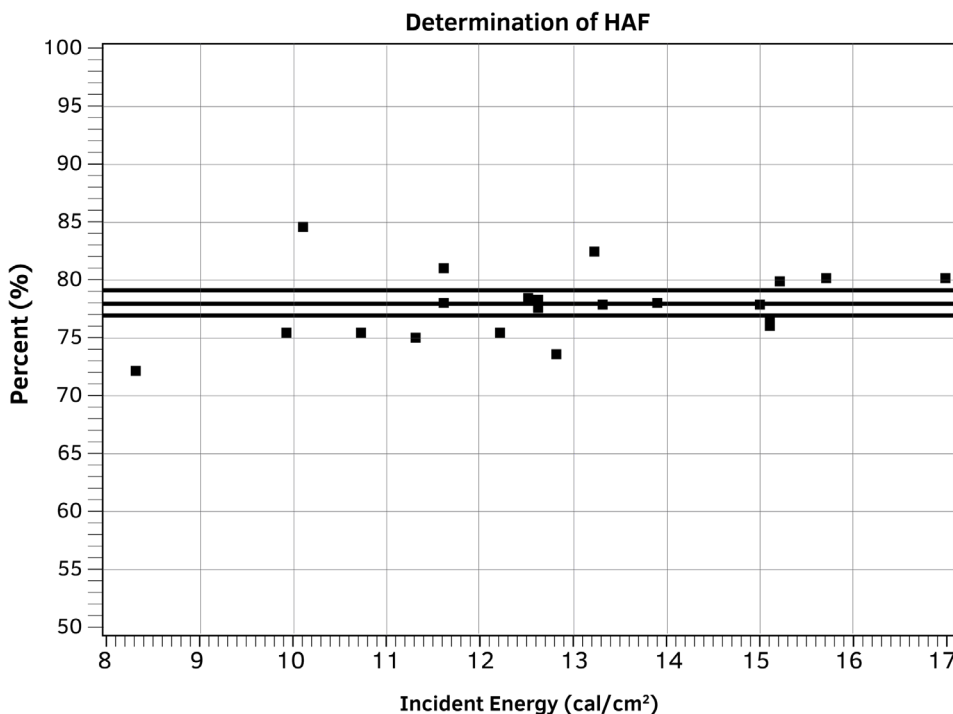
HAF = 78%
Confidence Intervals
95% CI = 76.9, 79.1

Determination of HAF

Data Pts	
Best Fit	
95% CI	
95% CI Pts	

Manikin Testing

Manikin Test - Garment Fabrics

- NFPA 2112 Standard on Flame–Resistant Garments for Protection of Industrial Personnel Against Flash Fire, Section 8.5.

ChemArc 8 (HT544-70)

Conditioning: After 1 Laundering

Testing Parameter	Specimen		
	1	2	3
Exposure Summary			
Reference Heat Flux (cal/cm^2)	1.95	1.95	1.95
Exposure Time (seconds)	3	3	3
Acquisition Time (seconds)	60	60	60
Predicted Burn Injury			
Second Degree Burn Injury (%)	3.28	3.28	4.10
Protected (%)	3.28	2.46	4.10
Unprotected (%)	0.00	0.82	0.00
Third Degree Burn Injury (%)	5.74	5.74	6.56
Protected (%)	0.00	0.00	0.00
Unprotected (%)	5.74	5.74	6.56
Total Transferred Energy (J/cm^2)	874.1	895.0	906.8
Total Body Burn Injury (%)	**9.0**	**9.0**	**11.0**
Average Total Body Burn Injury (%)	**9.7**		

ChemArc 8 - Properties

Arc Flash Test Results

ATPV   (Arc value, ASTM F1959-99):   8.3 cal/cm^2
        (Arc value, IEC 61482-1, Method A):   263.8 kJ/m^2 (Class 1)
Heat Attenuation Factor, HAF: 67.5%

Flammability and Static Decay Test Results

Flame Retardance (NASA NHB 8060.1B):   CLASS1

Initial Flammability (ASTM F1506-01, ASTM D6413)

Char length: 1.5 in (average of warp and fill)
Afterflame: None
Dripping: None
Voltage Decay: 0.15 sec
Surface Resistivity (AATCC 76-1982): 109 ohm/sq
NASA Triboelectric Voltage Decay: 250V @ 3.5 sec, 100V @ 5 sec

Textile Properties

Construction: Plain weave, ¼ in (6.5 mm) grid
Yarn content by weight: 100% multifilament Nomex, <1% carbon
Weight (ASTM D3776, option C):   8.75 oz/yd^2
Air Permeability (ASTM D737):   152 cfm

Other Properties

Chemical Compatibility:
        Salts and alkalis: Excellent
        Organic acids and Chemicals: Excellent
        Jet Fuel: Excellent
        Mineral acids: Good

Laundry Compatibility: DI Water, perchloroethylene, Freon TF
Sterile Compatibility: Steam autoclave & Gama radiation (250 Mrad)
Optical Rating (ASTM E284):   Opaque
Durability (ASTM D4157) 15,000 cycles: No noticeable wear

Clean Room Classification

The FED-STD-209, Airborne Particulate Cleanliness Classes in Clean Rooms & Clean Zones was first published as FS 209 in 1963 by the Institute of Environmental Science and Technology (IEST). It became the foundation of the ISO 14644-1 standard: Cleanrooms and associated controlled environments – Part 1: Classification of air cleanliness by particle concentration which is used today. The FS 209 was replaced by ISO 14644 in 1999 within the EU and in 2001 in the USA.

The ISO 14644 standard defines the classification number of a clean room dependent on the maximum allowable concentration of certain size particles per m^3. The lower the ISO classification number the lower concentration of particles measured, and the 'cleaner' the clean room.

Oberon Clean Room Arc Rated Garments meet the **ISO Class 4/FED-STD-209 Class 10** classification.

ISO Classification Number (N)	Maximum Allowable Concentrations (particles/m³) For Particles Equal To And Greater Than The Considered Sizes Shown Below						FED-STD-209
	0.1 µm	0.2 µm	0.3 µm	0.5 µm	1.0 µm	5.0 µm	
ISO Class 1	10						
ISO Class 2	100	24	10				
ISO Class 3	1,000	237	102	35			Class 1
ISO Class 4	**10,000**	**2,370**	**1,020**	**352**	**83**		**Class 10**
ISO Class 5	100,000	23,700	10,200	3,520	832		Class 100
ISO Class 6	1,000,000	237,000	102,000	35,200	8,320	293	Class 1,000
ISO Class 7				352,000	83,200	2,930	Class 10,000
ISO Class 8				3,520,000	832,000	29,300	Class 100,000
ISO Class 9				35,200,000	8,320,000	293,000	

Laundering Instructions

The laundering of ChemStat and ChemArc garments must be done correctly to retain the durability, longevity, and smooth looks designed into them.

If the following recommendations are heeded, users can expect many years of satisfaction and performance from their garments.

Cleanroom and safety garments require frequent laundering to prevent the buildup of particulates and sebaceous oils from the skin. In particular, sebaceous oils can adversely affect the static-dissipative properties of the fabrics.

NASA and EOS/ESD specify **2 to 4 initial pre-launderings prior to the initial use** of any static-dissipative garment to remove embedded oils and fatty acids imparted to the fabric and garment during manufacture.

For clean rooms with ultra-low Class ratings, **daily changes and launderings are recommended.**

ChemStat and ChemArc fabrics have been designed for a very high frequency of launderings without any lessening of performance under normal cleanroom and cleanroom laundry conditions.

Some ChemStat fabrics are composed of polyester fibers, which are subject to rapid degradation in alkaline environments; therefore, the wash water should be neutralized as closely as possible to a pH value of 7.0 (or slightly less for tolerance). This is especially important in the final rinse prior to drying: as the moisture evaporates, elevated drying temperatures accelerate fiber damage when pH values increase to less tolerable levels. In addition to affecting pH in the drying process, the moisture content can contribute to hard wrinkling if the temperature rises above 130°F (55°C).

ChemArc fabrics are composed of Nomex aramid fibers and are highly resistant to all common acids and alkalis, so the effect of varying pH in the laundry cycle on fabric longevity is less significant, although maintaining a pH close to 7.0 remains preferable.

The temperature and pH of the water should be monitored and recorded continuously to prevent premature fabric wear and abnormally high particle counts. To ensure low particle counts, the laundering of ChemStat may also require more thorough rinsing cycles than with conventional fabrics due to their higher particle filtration efficiency. Do not use chlorine bleach with ChemStat fabrics. Chlorine bleach will not enhance the brightness of color and will attack polyester fibers, reducing fabric strength noticeably.

Direct or indirect chemical exposure in the clean room or laundry may cause ChemStat 939 soles to vary ± ½ size differential over the life of the bootie, from swelling or shrink of the compound. Exposure to ultraviolet light may alter the color of ChemStat 939 soles or Nomex-based fabrics.

Recommendations

- Neutralize wash water to a pH of 7.0.
- Do not exceed 130°F (55°C).
- Maximize water extraction prior to drying.
- Pre-launder garments 2 to 4 times prior to initial use.
- Avoid chlorine bleach.
- Lay ChemStat 939 soles flat during sterilization.

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