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# *Hospital Cleaner Damage Resistant Thermoplastics*

*Medical Plastics Conference 2016*

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Wires Home

# Unchecked superbugs could kill 10 million a year, cost \$100 trillion

By REUTERS

PUBLISHED: 19:01 EST, 10 December 2014 | UPDATED: 19:01 EST, 10 December 2014



By Kate Kelland, Health and Science Correspondent

LONDON, Dec 11 (Reuters) - Drug-resistant superbugs could kill an extra 10 million people a year and cost up to \$100 trillion by 2050 if their rampant global spread is not halted, according to a British government-commissioned review.



# HAI COSTS



## HEALTH

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**By Brenda Goodman**

*HealthDay Reporter*

TUESDAY, Sept. 3 (HealthDay News) -- The five most common infections that patients get after they've been admitted to the hospital cost the U.S. health care system almost \$10 billion a year, a new study shows.

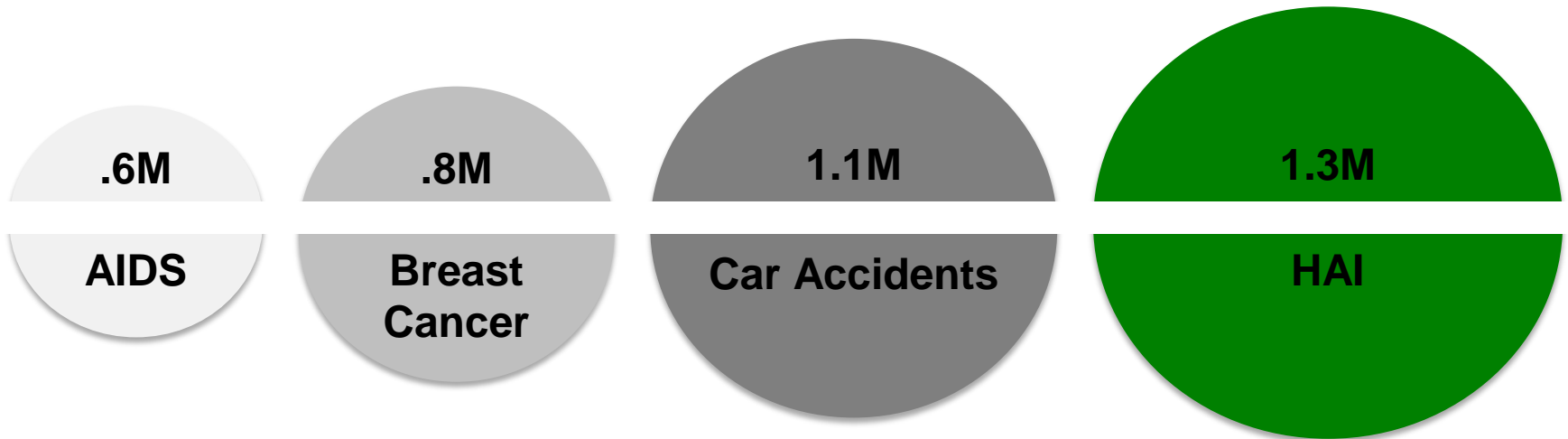
One out of every 20 patients who are admitted to a hospital will fall victim to an infection they pick up while there, according to the U.S. Centers for Disease Control and Prevention. These infections can be serious and even life-threatening, and recent studies have estimated that as many as half of them may be preventable.

They are also expensive to treat. In 2006, in a bid to get hospitals to do more to prevent so-called health care-associated infections, Medicare stopped paying for patient care associated with certain serious



## *HAI HAS GLOBAL IMPACT*

**Estimated number of deaths from hospital acquired infections in the U.S.A., compared to other deaths:**

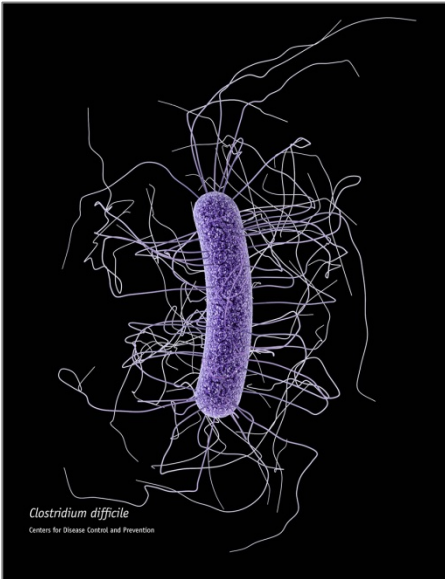




# AGENDA

1. HAI definition and problem statement
2. Disinfection
3. Chemical testing and plastic screening
4. New product development process
5. New class of disinfectant resistant plastics
6. Summary





*Images provided by: Centers for Disease Control and Prevention*

- **Bacteria:** Bordetella(s), Campylobacter, Escherichia Coli, Klebsiella(s)...
- **Multi-Drug Resistant Bacteria:** MRSA, Escherichia Coli, Klebsiella(s)...
- **Viruses:** Influenza, Herpes, Respiratory...
- **Bloodborne Pathogens:** Hepatitis B, Hepatitis C, HIV...
- **Yeast and other fungus:** Candida Albicans...

Even frequent cleaning can cause damage...





# THREE DISINFECTION TYPES

**All three types of the below disinfectants degrade plastic surfaces:**

## **High-level disinfection (critical)**

This will destroy all microorganisms, with the exception of heavy contamination by bacterial spores.

## **Intermediate disinfection (semi-critical)**

This inactivates *Mycobacterium tuberculosis*, vegetative bacteria, most viruses and most fungi, but does not necessarily kill bacterial spores.

## **Low-level disinfection (non-critical)**

This can kill most bacteria, some viruses and some fungi, but cannot be relied on for killing more resistant bacteria such as *M. tuberculosis* or bacterial spores.



**Choice of chemical varies by hospital and may include all classes of disinfectants:**

Level of disinfection required	Spectrum of activity of disinfectant	Active ingredients potentially capable of satisfying these spectra of activity	Factors affecting the efficacy of a disinfectant
<b>High Level</b> (critical)	<ul style="list-style-type: none"> <li>• Sporicidal</li> <li>• Mycobactericidal</li> <li>• Virucidal</li> <li>• Fungicidal</li> <li>• Bactericidal</li> </ul>	<ul style="list-style-type: none"> <li>• Peracetic acid</li> <li>• Chlorine dioxide</li> <li>• Formaldehyde</li> <li>• Glutaraldehyde</li> <li>• Sodium hypochlorite</li> <li>• Stabilized hydrogen peroxide</li> <li>• Succinaldehyde</li> </ul>	<ul style="list-style-type: none"> <li>• Concentration</li> <li>• Contact time</li> <li>• Temperature</li> <li>• Presence of organic matter</li> <li>• pH</li> <li>• Presence of calcium or magnesium ions</li> <li>• Formulation of the disinfectant used</li> </ul>
<b>Intermediate</b> (semi-critical)	<ul style="list-style-type: none"> <li>• Tuberculocidal</li> <li>• Virucidal</li> <li>• Fungicidal</li> <li>• Bactericidal</li> </ul>	<ul style="list-style-type: none"> <li>• Phenol derivatives</li> <li>• Ethyl and isopropyl alcohols</li> </ul>	
<b>Low Level</b> (Non-critical)	<ul style="list-style-type: none"> <li>• Bactericidal</li> </ul>	<ul style="list-style-type: none"> <li>• Quaternary ammonium</li> <li>• Amphiprotic</li> <li>• Amino acids</li> </ul>	



- Chemical Classes
- Stress
- Experimental Design
- Results

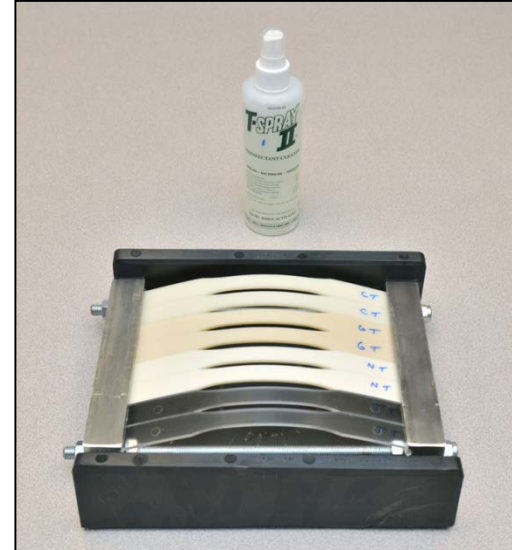




# CHEMICAL CLASSES STUDIED

Base Chemical Class	Typical Brand Names
Alkylamine	T-Spray II™
Glutaraldehyde	Cidex Plus®
Glucoprotamin	Incidin Plus®
Phenol	Birex®
Quaternary compound	Sani-Cloth AF3® Sani-Cloth Active®
Chlorine releasing compound	Sani-Cloth Bleach® Clorox®
Alcohol	CaviCide 1® Super Sani-Cloth® Sani-Cloth Plus®

Birex® is a trademark of Young Dental Manufacturing, LLC. CaviCide® is a trademark of Metrex Research Corporation. Cidex Plus® is a trademark of Johnson & Johnson Corporation. Incidin Plus® is a trademark of Ecolab. Sani-Cloth Active®, Sani-Cloth Bleach®, Sani-Cloth Plus® and Super Sani-Cloth® are trademarks of Professional Disposables International, Inc. T-Spray II™ is a trademark of Pharmaceutical Innovations, Inc.



## Disinfectant Examples:

- Wipes/cloth
- Liquid sprays

## RTP Company Continues Testing:

- Provide a sample
- Will report results



# ORIGINAL OEM DESIGN CRITERIA

## Electronic Medical Devices

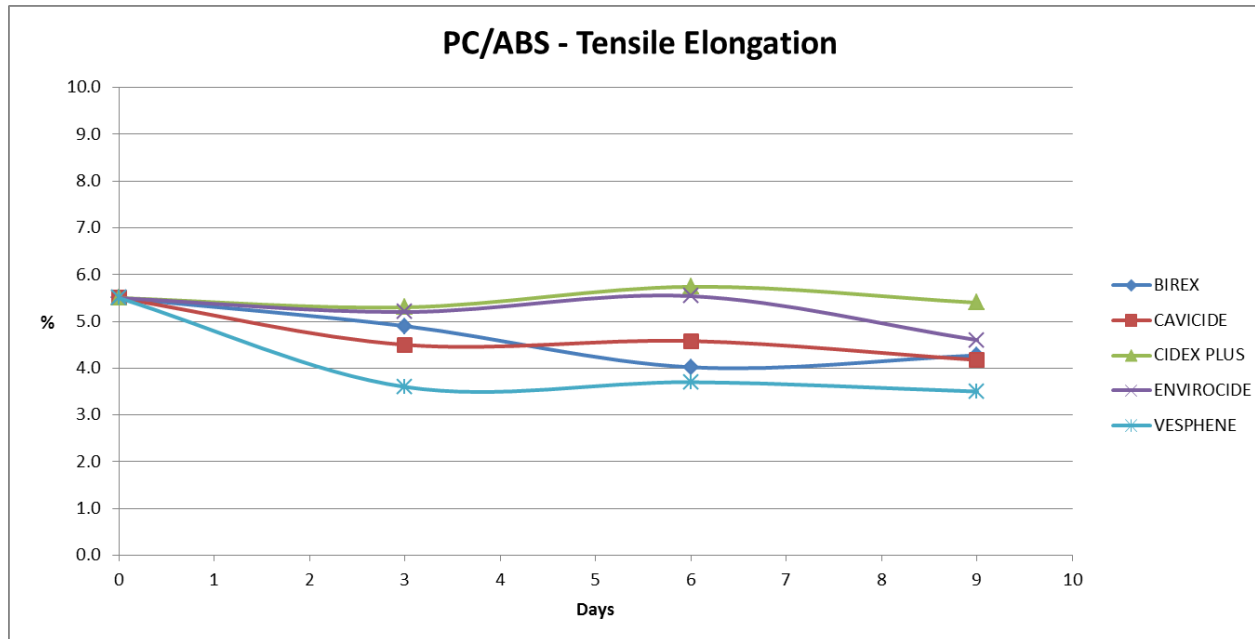
- Dimensionally accurate and stable
- Excellent appearance and surface
- Good impact or drop resistance
- Available in UL V-0 grades
- Affordable
- Favorite grades included PC/ABS and PC



*Chemical resistance added because of failures*



# CHEMICAL IMMERSION TEST



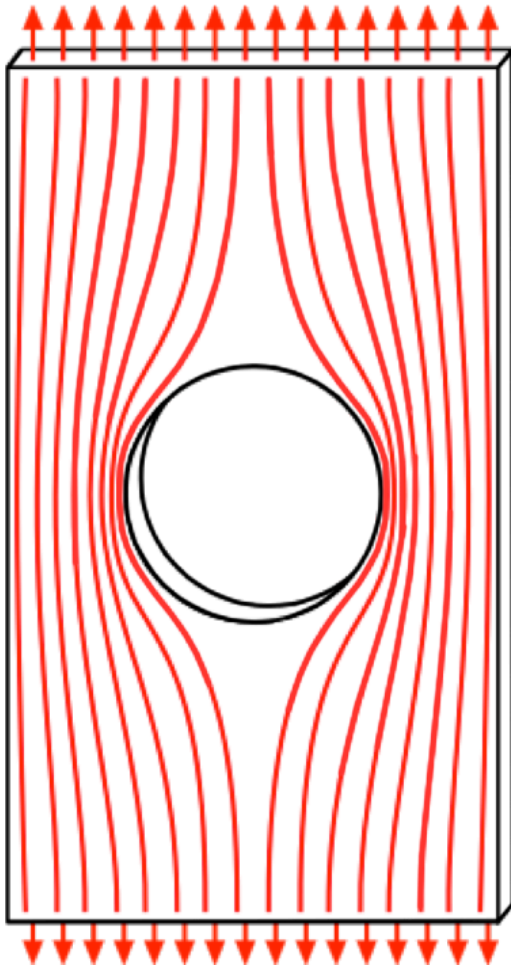
Product tested in 10% stainless steel fiber content for EMI shielding.



## Test Results

- PC/ABS FR is most common housing material
- Conducted a nine day soak and property test
- Results did not explain field failures
- Molded –in stress is highlighted



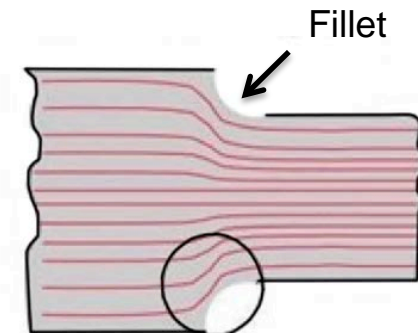
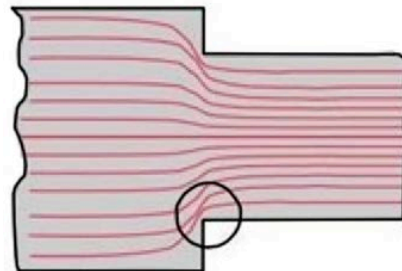


## Part Design

- Sharp corners
- Holes
- Thickness changes

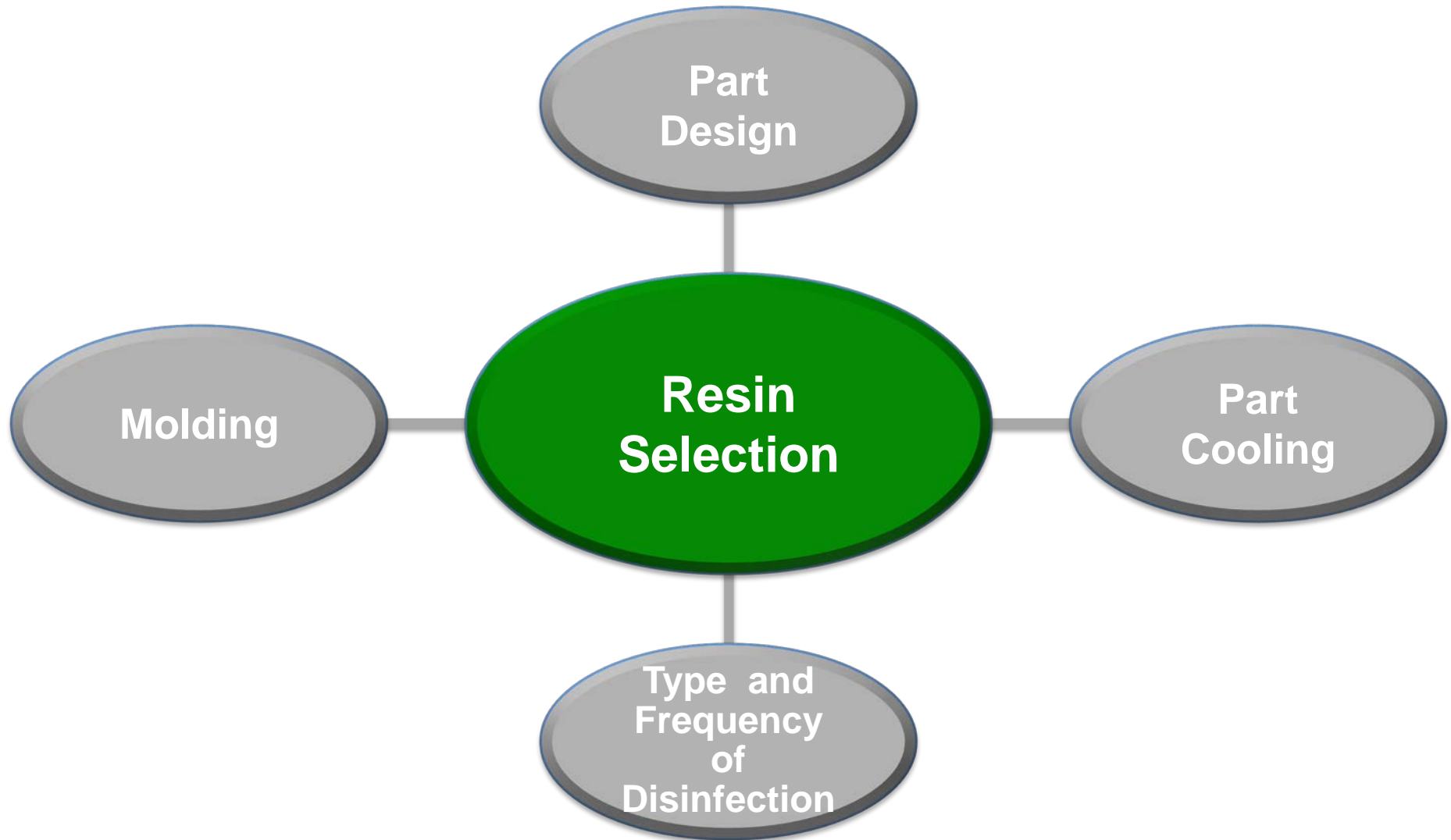
## Injection Molding

- Unbalanced flow
- Differential cooling
- Overpacking
- Gate location





# MANAGING MOLDED-IN STRESS





# DEVELOPMENT APPROACH

- Adopt a New Predictive Test
- Chemical matrix tested on PC/ABS – baseline
- Establish new product development criteria
- Establish chemical testing success criteria
- Screen commercially available resins
  - PC/ABS, PC/PBT, ABS, PC, Polyester, ASA/Nylon, FR Grades – over a dozen screened
- Create and test RTP Company proprietary alloys
- Validate results with customers



## Improved Disinfectant Damage Resistance

### Overall Desired Qualities

- High impact/ductility
- Good dimensional stability
- Shrinkage similar to PC/ABS
- Colorable
- Good surface appearance

### Flame retardant Grades





**Similar physical properties to PC/ABS, better cleaner resistance:**

Physical Property	Targets for Housings
Healthcare Chemical Resistance	Excellent
Izod, Notched (J/m)	> 535
Tensile Strength (MPa)	> 31
Tensile Elongation (%)	> 10
Flexural Modulus (MPa)	1400 – 3500
HDT @ 1.8 MPa (°C)	> 80
Mold Shrinkage (%)	0.6
UL 94	V-0 / 5VA



- **Exposure @ 1% strain**
- **Patch method**
  - Saturate patch every 24 hours
  - Air dry
- **Test physical properties after exposure (96 hours)**



*Test replicated field failures and relative resistance*



# PASS/FAIL CRITERIA



## Tensile Strength

- 75% retention or greater



## Tensile Elongation

- Minimum 10% tensile elongation



## INITIAL CHEMICAL TESTING

- All tested resins and alloys **FAILED** to meet the success criteria.
- **RTP Company Polyester Alloy** had the best all-around performance.
- RTP Company proprietary alloy was selected to be optimized for physical properties, chemical damage resistance, and flame retardant performance.



# INTRODUCING RTP 2000 HC A SERIES

## New HC Grade – Hospital Cleaner Damage Resistant Resin Alloy

- Much improved chemical resistance over existing products on the market
- Meets or exceeds development criteria
- Excellent colorability
- FR grades available
- Available globally





# CAVICIDE 1 - ALCOHOL

Property	RTP 2000 HC	PC/ABS	FR PC/ABS	RTP 2000 HC FR A	FR PC/PBT
Tensile Strength (psi)	5672	Fail	Fail	5668	Fail
Δ Strength	-18%	-100%	-100%	+0%	-100%
Tensile Modulus (psi *10 <sup>6</sup> )	0.23	Fail	Fail	0.20%	Fail
Δ Tensile Modulus	+10%	-100%	-100%	+5%	-100%
Tensile Elongation (%)	82.9% Ductile	Fail	Fail	83.5% Ductile	Fail

- Isopropanol ..... 15%
- Ethanol ..... 7.5%
- Ethylene glycol monobutyl ether (2-butoxyethanol) ..... 1-5%
- Didecylidimethyl ammonium chloride ..... 0.76%





# TENSILE STRENGTH RESULTS

Cleaner	RTP 2000 HC A	PC/ABS	FR PC/ABS	RTP 2000 HC FR A	FR PC/PBT
T-Spray II™ (Chlorine)	✓	✓	✗	✓	✓
Cidex Plus® (Glutaraldehyde)	✓	✗	✗	✓	✓
Birex® (Phenol)	✓	✓	✓	✓	✓
Sani-Cloth Active® (Quaternary Cmpd)	✓	✓	✗	✓	✓
Sani-Cloth Bleach® (Chlorine)	✓	✓	✓	✓	✓
CaviCide 1® (Alcohol)	✓	✗	✗	✓	✗
Super Sani-Cloth® (Alcohol)	✓	✓	✓	✓	✓
Sani-Cloth Plus® (Alcohol)	✓	✗	✗	✓	✗



# TENSILE ELONGATION RESULTS

Cleaner	RTP 2000 HC A	PC/ABS	FR PC/ABS	RTP 2000 HC FR A	FR PC/PBT
T-Spray II™ (Chlorine)	✓	✓	✗	✓	✓
Cidex Plus® (Glutaraldehyde)	✓	✗	✗	✓	✓
Birex® (Phenol)	✓	✓	✓	✓	✓
Sani-Cloth Active® (Quaternary Cmpd)	✓	✗	✗	✓	✗
Sani-Cloth Bleach® (Chlorine)	✓	✓	✓	✓	✓
CaviCide 1® (Alcohol)	✓	✗	✗	✓	✗
Super Sani-Cloth® (Alcohol)	✓	✓	✗	✓	✓
Sani-Cloth Plus® (Alcohol)	✓	✗	✗	✓	✗



# PROPERTY COMPARISON

Property	RTP 2000 HC A	PC/ABS	FR PC/ABS	RTP 2000 HC FR A	FR PC/PBT
Tensile Strength (MPa)	46	52	55	41	50
Tensile Modulus (MPa)	1310	2200	2500	1450	2200
Tensile Elongation(%)	140%	65%	15%	95%	30%
Flex Strength (MPa)	57	86	103	62	88
Notched Impact (J/m)	800	640	640	640	750
HDT @ 1.8 MPa (°C)	78	96	99	80	105
Shrinkage (%)	0.5-0.7	0.5-0.8	0.5-0.8	0.5-0.7	0.7-1.0
Specific Gravity	1.17	1.14	1.20	1.27	1.29
UL 94	HB	HB	V-0 / 5VA	V-0 / 5VA	V-0 / 5VA



# DATASHEET 2000 HC A SERIES

Data sheets available at [www.rtpcompany.com](http://www.rtpcompany.com)



## Product Data Sheet & General Processing Conditions

### RTP 2000 HC A Polyester Alloy Medical Cleaner Resistant UV Stabilized

RTP 2000 HC series are polyester alloys designed to withstand the aggressive cleaners used to disinfect medical equipment

#### PROPERTIES & AVERAGE VALUES OF INJECTION MOLDED SPECIMENS

PERMANENCE	English	SI Metric	ASTM TEST
Specific Gravity	1.17	1.17	D 792
Molding Shrinkage 1/8 in (3.2 mm) section	0.0050 - 0.0070 in/in	0.50 - 0.70 %	D 955

#### MECHANICAL

Impact Strength, Izod notched 1/8 in (3.2 mm) section	15.0 ft-lbs/in	801 J/m	D 256
unnotched 1/8 in (3.2 mm) section	No Break	No Break	D 4812
Tensile Strength	6700 psi	46 MPa	D 638
Tensile Elongation	> 100.0 %	> 100.0 %	D 638
Tensile Modulus	0.19 x 10 <sup>6</sup> psi	1310 MPa	D 638
Flexural Strength	8250 psi	57 MPa	D 790
Flexural Modulus	0.21 x 10 <sup>6</sup> psi	1448 MPa	D 790

#### THERMAL

Deflection Temperature @ 264 psi (1820 kPa)	170 °F	77 °C	D 648
@ 66 psi (455 kPa)	195 °F	91 °C	D 648
Ignition Resistance*			
Flammability**	HB @ 1/16 in	HB @ 1.5 mm	D 635

#### PROPERTY NOTES

Data herein is typical and not to be construed as specifications.

Unless otherwise specified, all data listed is for natural or black colored materials. Pigments can affect properties.

\* This rating is not intended to reflect hazards of this or any other material under actual fire conditions.

\*\* Values per RTP Company testing.

#### GENERAL PROCESSING FOR INJECTION MOLDING

	English	SI Metric
Injection Pressure	15000 - 20000 psi	103 - 138 MPa
Melt Temperature	480 - 520 °F	249 - 271 °C
Mold Temperature	125 - 175 °F	52 - 79 °C
Drying	4 - 6 hrs @ 190 °F	4 - 6 hrs @ 88 °C
Moisture Content	< 0.02 %	< 0.02 %
Dew Point	-40 °F	-40 °C

#### PROCESSING NOTES

14 Apr 2015 JSD



## Product Data Sheet & General Processing Conditions

### RTP 2000 HC FR A Polyester Alloy Flame Retardant UV Stabilized Medical Cleaner Resistant



RTP 2000 HC series are polyester alloys designed to withstand the aggressive cleaners used to disinfect medical equipment

#### PROPERTIES & AVERAGE VALUES OF INJECTION MOLDED SPECIMENS

PERMANENCE	English	SI Metric	ASTM TEST
Specific Gravity	1.27	1.27	D 792
Melt Flow Rate @ 240 °C, / 5 kg	7.00 g/10 min	7.00 g/10 min	D 1238
Molding Shrinkage 1/8 in (3.2 mm) section	0.0050 - 0.0080 in/in	0.50 - 0.80 %	D 955

#### MECHANICAL

Impact Strength, Izod notched 1/8 in (3.2 mm) section	12.0 ft-lbs/in	641 J/m	D 256
unnotched 1/8 in (3.2 mm) section	No Break	No Break	D 4812
Tensile Strength	6000 psi	41 MPa	D 638
Tensile Elongation	> 50.0 %	> 50.0 %	D 638
Tensile Modulus	0.21 x 10 <sup>6</sup> psi	1448 MPa	D 638
Flexural Strength	9000 psi	62 MPa	D 790
Flexural Modulus	0.21 x 10 <sup>6</sup> psi	1448 MPa	D 790

#### THERMAL

Deflection Temperature @ 264 psi (1820 kPa)	180 °F	82 °C	D 648
@ 66 psi (455 kPa)	205 °F	96 °C	D 648
Ignition Resistance*			
Flammability	V-0 @ 1/16 in	V-0 @ 1.5 mm	UL94
Flammability	5VA @ 1/8 in	5VA @ 3.0 mm	UL94

#### PROPERTY NOTES

Data herein is typical and not to be construed as specifications.

Unless otherwise specified, all data listed is for natural or black colored materials. Pigments can affect properties.

\* This rating is not intended to reflect hazards of this or any other material under actual fire conditions.

#### GENERAL PROCESSING FOR INJECTION MOLDING

	English	SI Metric
Injection Pressure	15000 - 20000 psi	103 - 138 MPa
Melt Temperature	480 - 520 °F	249 - 271 °C
Mold Temperature	150 - 180 °F	66 - 82 °C
Drying	4 - 6 hrs @ 190 °F	4 - 6 hrs @ 88 °C
Moisture Content	< 0.02 %	< 0.02 %
Dew Point	-40 °F	-40 °C



# CASE STUDY



- Market:** Electronic Medical Device
- Application:** Housing – Hard surface
- Problem:** Experiencing field failures and all commercially available housing materials were failing chemical testing
- Solution:** RTP 2000 HC FR A
- Benefit:** Provided required cleaner resistance, utilizing the existing tooling





# SUMMARY

## **RTP 2000 HC A Series: a polyester alloy**

- Greatly improved resistance to hospital disinfectant damage
- Available in UL94 V-0/5VA grade
- Physical properties well suited for housings
- Dimensional accuracy and stability
- Similar shrink to PC/ABS
  - Can use existing tooling: PC/ABS, PC/PBT, ABS, PC, PC/ASA
- Fully colorable

*Available for immediate sampling/testing globally*



COLOR • CONDUCTIVE • FILM/SHEET • FLAME RETARDANT  
STRUCTURAL • THERMOPLASTIC ELASTOMERS • WEAR

# Questions?

## Thank You!

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