Developing the 1st Edition of the Standard for Safety for Battery Fire Containment Products, UL 5800

October 29, 2019

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Agenda

I. Background on battery fires in-flight

II. Battery fire containment products

III. Research supporting technical decisions of UL 5800 draft

IV. Outcomes of Standards Technical Panels (STPs)

V. Ongoing development of UL 5800

OVER 400 UL STPS

OVER 60 STAFF

LOCATED IN THE US, CANADA, CHINA, DENMARK, AND INDIA

STANDARD FOR SAFETY FOR BATTERY FIRE CONTAINMENT PRODUCTS, UL 5800

STP 5800 NOW HAS 38 VOTING MEMBERS

OVER

1,600 STANDARDS

PUBLISHED

OVER 120 YEARS

OF EXPERIENCE IN STANDARDS DEVELOPMENT

MORE THAN

3,400 UNIQUE

STP MEMBERS

Hazards of Lithium Ion Battery Fires

1. Smoke
2. Heat
3. Flames
4. Projectiles

Smoke – Inhalation hazards and visual obscuration

Projectiles – Unpredictable and potentially sharp or flaming

Flames and Heat – Burn risks and ignition risk for nearby items

History of Battery Fires In-Flight

- FAA database documents 250+ air/airport incidents with lithium and lithium ion batteries since March 1991[1]
- 60+ incidents in 2018
- 30+ incidents in 2019

Feb. 2018
Flight CZ3539
China Southern Airlines

[1] FAA Office of Security and Hazardous Material Safety
[2] https://twitter.com/jacdecnew/status/967691118082232322
[3] http://techio.co/this-is-the-moment-a-portable-charger-caught-fire-in-a-planes-overhead-bin/

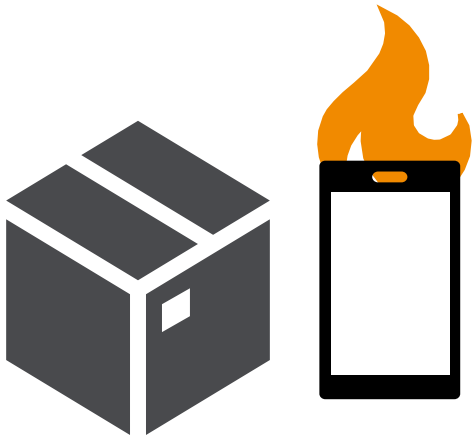
Challenges for Airlines and Flight Crew

1. Evacuation is not practical
2. Flight diversions are expensive and logistically challenging
3. Smoke and flames are upsetting to passengers
4. Inhaled smoke is an irritant
5. Smoke obscures visibility for pilots
6. PPE and firefighting equipment is limited

https://wjla.com/news/nation-world/passengers-evacuated-after-smoke-fills-cabin-of-flight-in-seattle

Battery Fire Containment Products

- Designed for passenger cabin, not cargo applications
- No standard for performance criteria
- Intended for one-time use
- Hard cases and soft pouches
- Some include suppression
- Some include PPE



Thermal Runaway and Containment Timeline

Precursors to Thermal Runaway

Thermal Runaway

Flames Extinguished and Device Cooled

Device Transferred into Containment Product

UL 5800 test starts here

Additional Thermal Runaway Behavior of Device

Performance Criteria of UL 5800

Progress during STP Meetings

1. Determined scope
2. Classification system
3. Sample preparation
4. Mechanics of test method
5. Initial discussions of fuel load
6. Settled most performance criteria

UL 5800

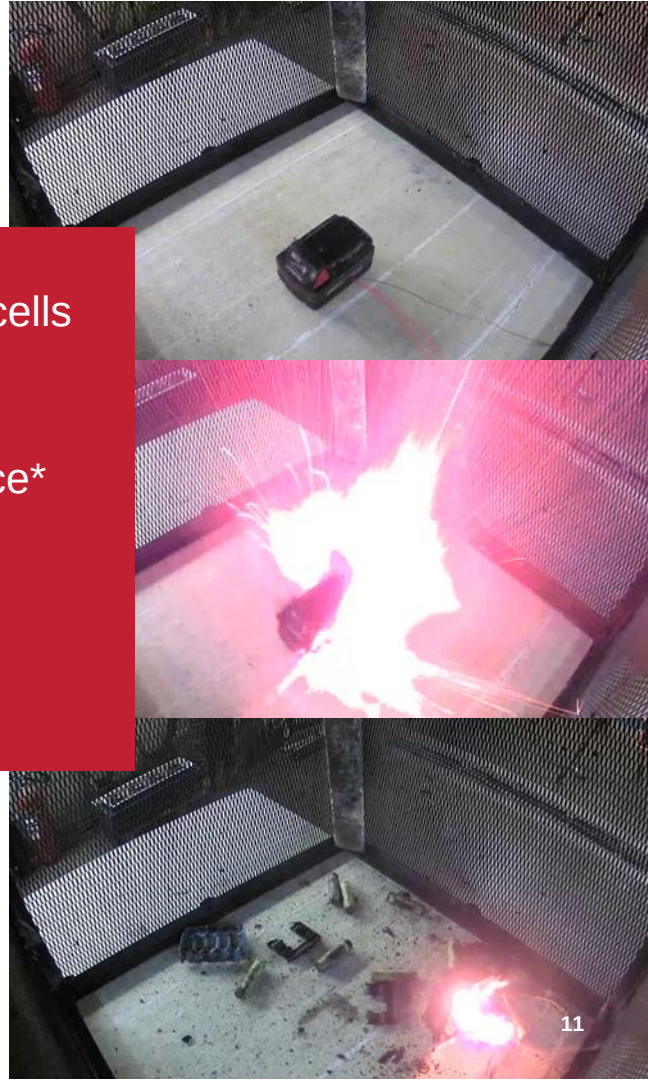
Standard for Safety for Battery Fire Containment Products

CONTENTS

Scope of UL 5800 (Draft)

- Covers portable electronic devices, installed and uninstalled cells
- Pertains to both lithium ion and lithium metal cells
- Addresses efficacy of containment functions, not user interface*
- For inhabited compartments, not for cargo applications

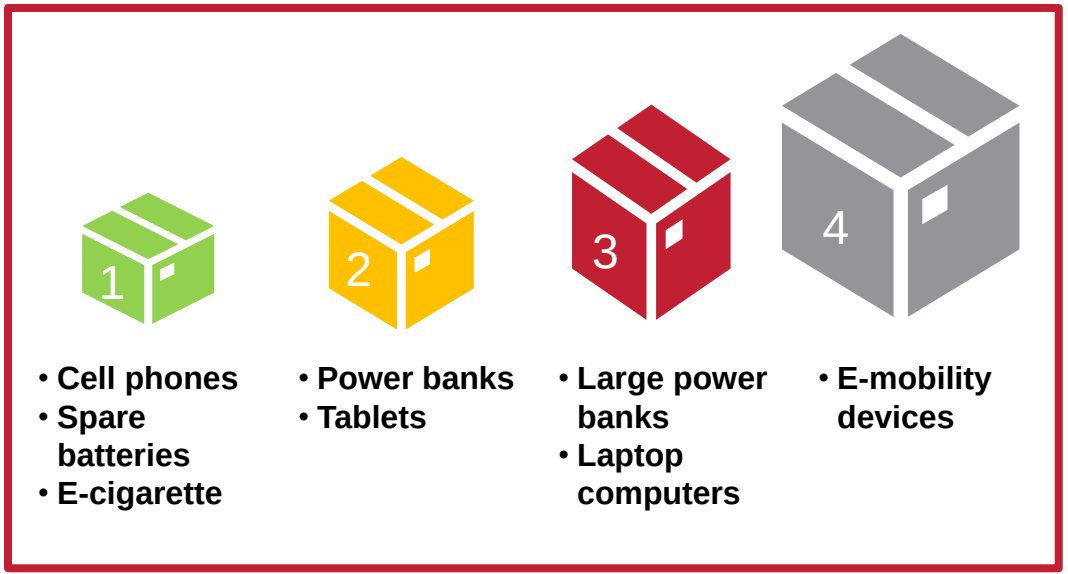
*Discussions ongoing as to how to address human interaction



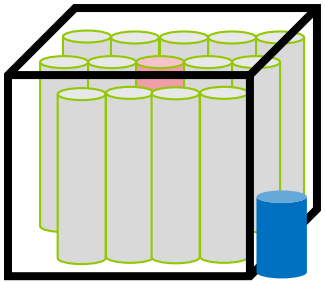
Classification System

Containing hazards from a fuel load representing:

- Class 1 – 50 Wh
- Class 2 – 100 Wh
- Class 3 – 160 Wh
- Class 4 – 300 Wh

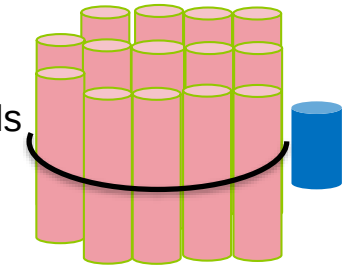


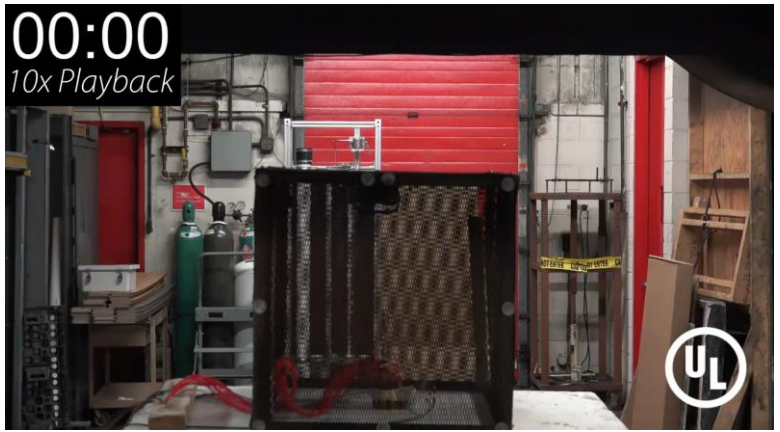
Proposed* Fuel Load for “Class 3 – 160 Wh” Characteristics



- 14 18650 Cells bound together
- Heater wrapped around 1 cell
- Smoke candle

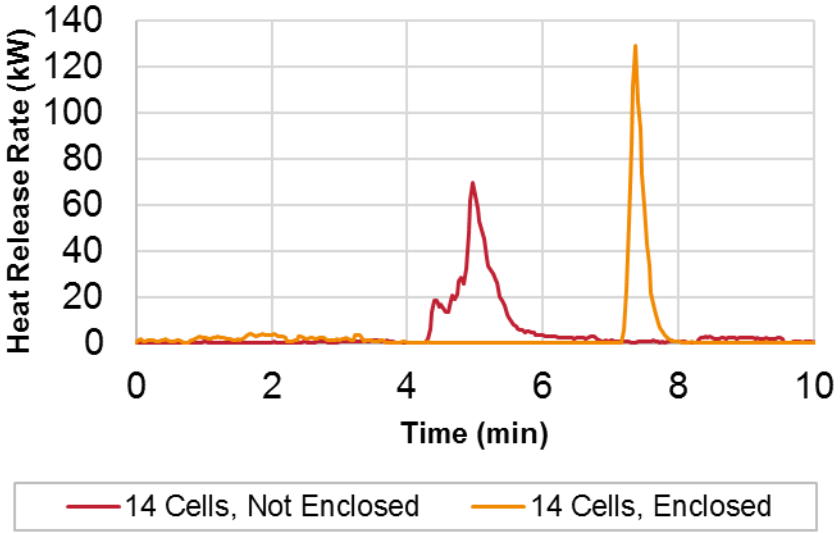
- 14 18650 Cells separate
- Heater wrapped around 14 cells
- Smoke candle

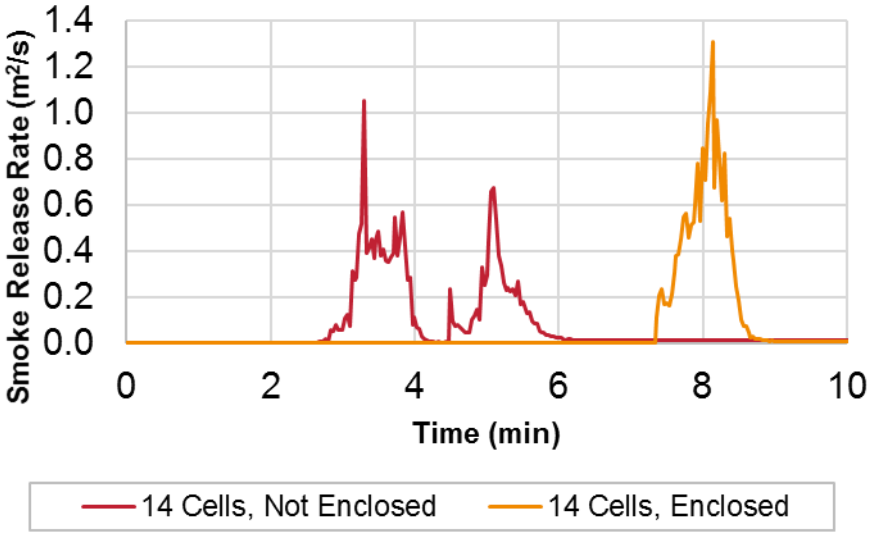




*Final STP decision has not been made

Proposed* Fuel Load for “Class 3 – 160 Wh” – Properties





14 Cells Bound Together	14 Cells Separate
Peak HRR: 118 kW	Peak HRR: 65 kW
Total Heat: 2.2 MJ	Total Heat: 2.4 MJ

14 Cells Bound Together	14 Cells Separate
Peak SRR: 1.3 m^2/s	Peak SRR: 1.1 m^2/s
Total Smoke: 39 m^2	Total Smoke: 41 m^2

*Final STP decision has not been made

Performance Criteria

Flames

No flaming allowed outside product, indicated by glowing or igniting cheesecloth.

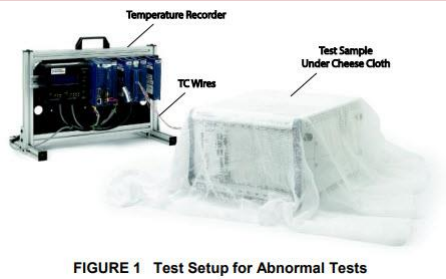


FIGURE 1 Test Setup for Abnormal Tests

Lohbeck, David, “Product safety testing limits risk of shock, fire, and injury. Part 2,” EDN, March 15, 2013, p. 4.

Heat

Exterior surface temperature limits:

Location	Composition of Surface	
	Metal	Non-metallic
Handles or knobs that are grasped for lifting, carrying, or holding.	50°C (122°F)	60°C (140°F)
Surfaces other than a heating function surface and known to be hot due to proximity to the heating function surface.	60°C (140°F)	85°C (185°F)

Shrapnel

Shrapnel or other harmful debris do not escape the containment product.

Smoke

<u>Performance Level 1</u>
Smoke is confined within the containment product

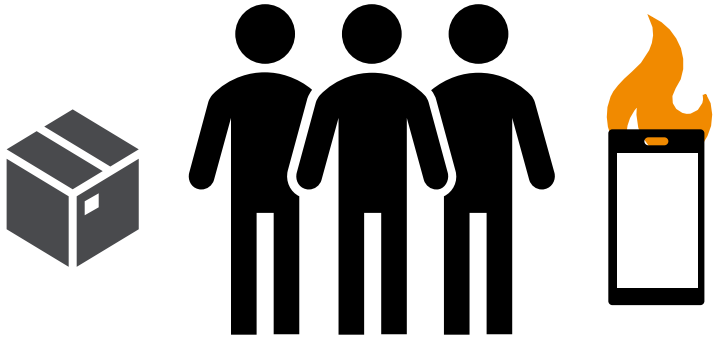
<u>Performance Level 2</u>
No more than a specified* amount of smoke is released from the containment product

*Exact quantity not decided yet

Discussion Topics for Next STP Meeting

Meeting Details: UL Headquarters in Northbrook, IL, on December 3 and 4, 2019

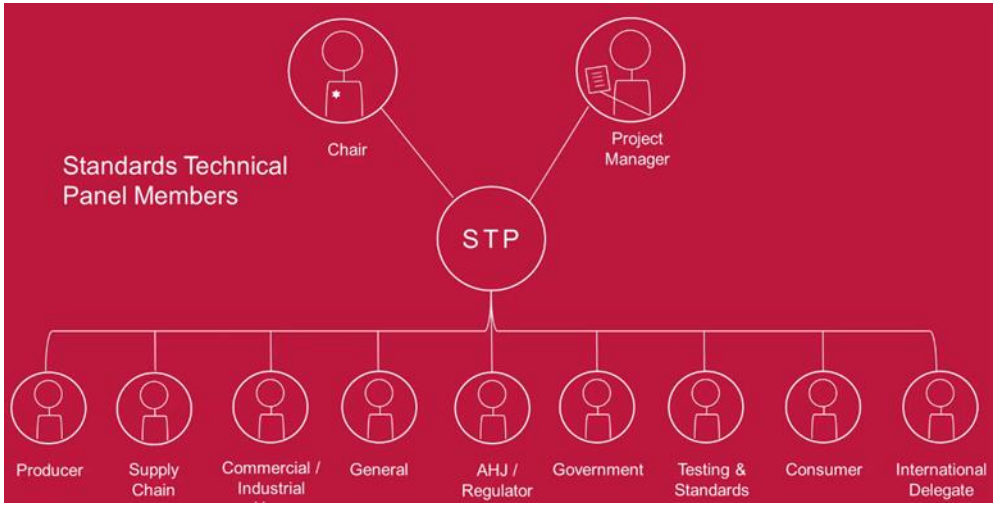
1. What should the finalized fuel loads be?
2. How to quantify a threshold for “too much smoke”?
3. How can the standard best address reuse of the product or use for multiple devices at one time?
4. How to protect users from handling prescribed vents? Should prescribed vents meet the external temperature criteria of the rest of the product?
5. Is it appropriate to require the gloves comply with NFPA 1971?

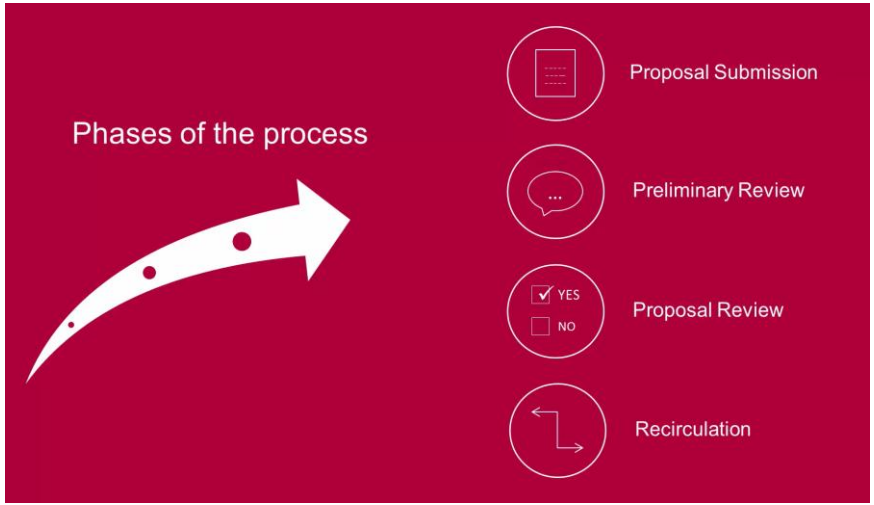


ANSI/UL STP Standards Development Process

The Standards Technical Panel (STP) is the heart of the UL Standards Development Process. It is the Consensus body for developing and maintaining UL Standards. Formed to review, comment, and vote on proposals for UL Standards. Membership is limited to one member per company.

STP members represent a balance of interest categories and STP 5800 now has 38 voting members.





Stakeholder and Public Review Involvement

- ✓ The UL Standards development process is open and anyone can participate
- ✓ Encourage participation by all stakeholders
- ✓ Stakeholders can submit proposals, comment on proposals, participate in working/task groups, attend STP meetings
- ✓ Stakeholders are not STP members and cannot vote

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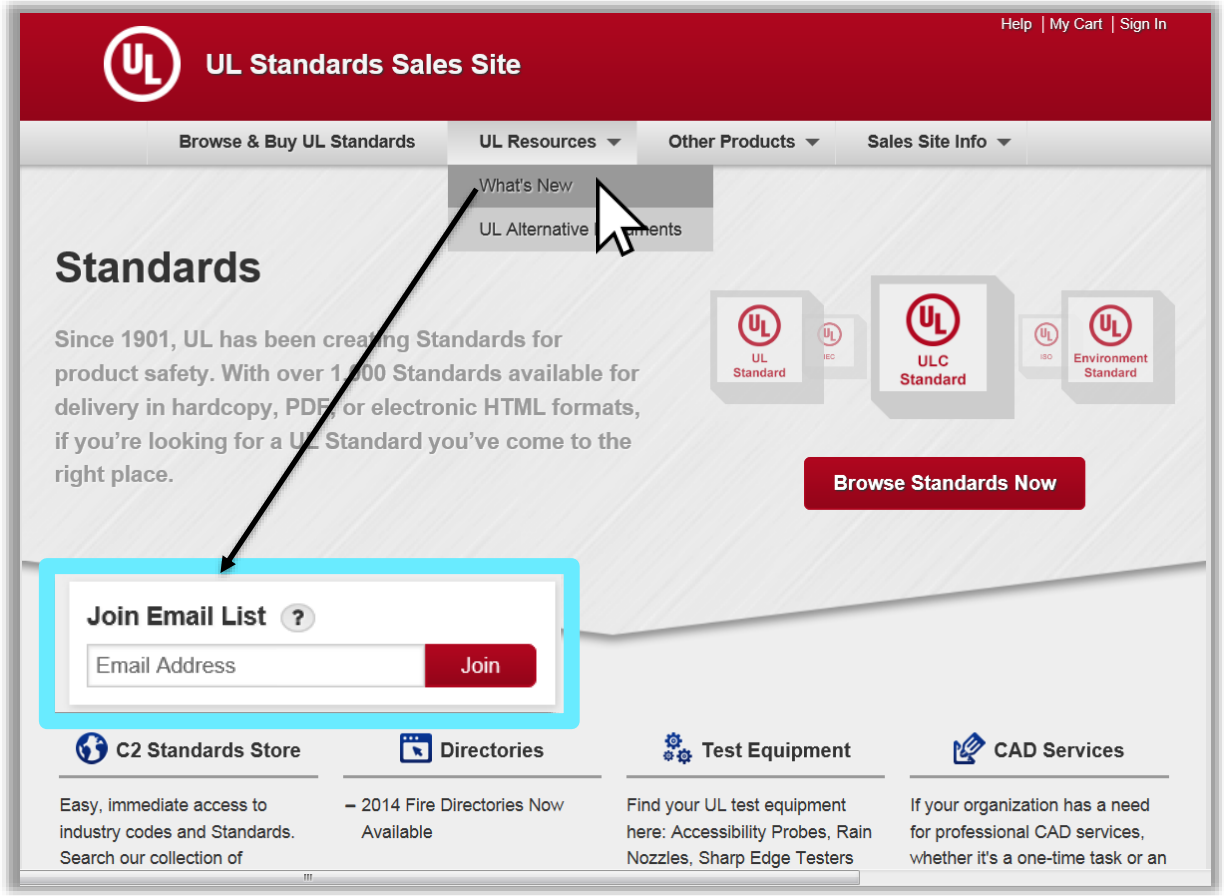
https://www.shopulstandards.com/



Helpful Links for the UL Standards Development Process

Standards Development Process YouTube video
https://www.youtube.com/watch?v=PU3apx7gLVU#action=share

General Standards Website:
http://ulstandards.ul.com/

Request to Attend an STP Meeting as a Guest:
http://csds.ul.com/Home/MeetingsDefault.aspx

Join a Standards Technical Panel (STP) with the online membership application:
https://csds.ul.com/STPInfo/ApplicationHomePage.aspx

Subscribe to What's New:
https://www.shopulstandards.com/WhatsNew.aspx

Thank you for your time!

Questions?

Extra Slides

UL 1971 – Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting

Some of the performance tests include:

- Flame Resistance Test (3)
- Thermal Protective Performance
- Heat and Thermal Shrinkage Resistance
- Conductive Heat Resistance
- Thread Melting
- Cut Resistance
- Puncture Resistance
- Glove Hand Function
- Seam-Breaking Strength
- Glove Donning
- Glove Tool
- Transmitted and Stored Thermal Energy

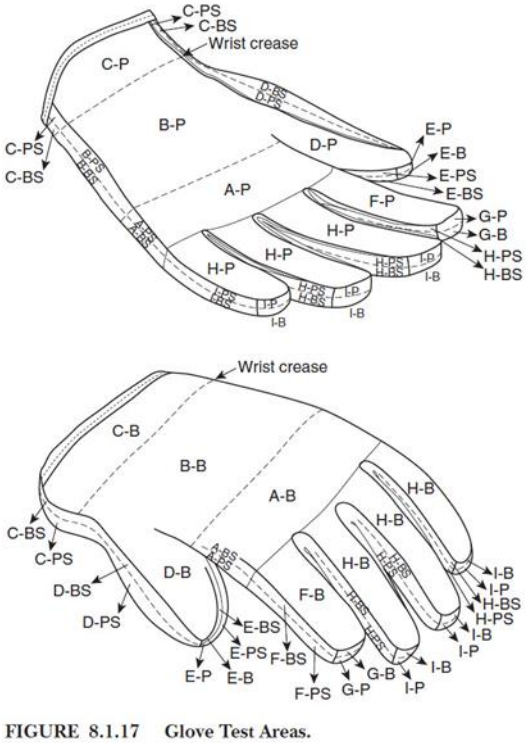


FIGURE 8.1.17 Glove Test Areas.