U.S. Consumer Product Safety Commission
LOG OF MEETING

SUBJECT: *APSP-16 Round Robin Task Group meeting to discuss development of a testing protocol to validate proposed changes to the APSP standard for Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, and Hot Tubs; Includes a CPSC presentation on Pilot Study Design Factors and Design of Experiment*

DATE OF MEETING: February 08. 2012 and February 09, 2012

LOG ENTRY SOURCE: James Hyatt

DATE OF LOG ENTRY SOURCE:

LOCATION: CPSC National Evaluation Testing and Evaluation Center (NPTEC) at 5 Research Place, Rockville, MD 20850

CPSC ATTENDEES: Perry Sharpless, Kevin Gipson, Sarah Garland, Mark Eilbert, James Hyatt, Andrew Stadnik (part time)

NON-CPSC ATTENDEES:

Sal Aridi	National Sanitation Foundation (NSF)
Steve Barnes	Pentair Water Pool and Spa
Dominic Conn	Paramount Industries
Carvin DiGiovanni	Association of Pool and Spa Professionals (APSP)
Ray Mirzaei	Waterway Plastics
Robert Rung	Hayward Pool Products
Kevin Schaefer	National Sanitation Foundation (NSF)
Paul Pennington	Pool Safety Council
Chris Scoville	QAI Laboratories (2nd day only)
TonyZhou	International Association of Plumbing and Mechanical Officials (IAPMO)

SUMMARY OF MEETING:

The meeting was called to order at 8:30 am on 02/28/2012 by Perry Sharpless.. After introductions, Perry Sharpless distributed a copy of a daily agenda for Day One and Day Two (copy attached) and Paul Pennington distributed a copy of a document titled Round Robin Protocol Task Force - Suggested Discussion Topics. A copy of this document is also attached. Kevin Gipson and Sarah Garland took the

floor and began a 60 minute PowerPoint presentation titled: *Potential Design of Experiment Overview for ANSI/APSP-16 Committee"* A copy of the PowerPoint presentation is attached.

Discussion followed throughout the2-day meeting: The TG agreed that APSP-16-7.4 was the latest version of APSP-16. APSP-16 7.4 includes approximately 125 proposed changes, some are editorial and some are substantive. At the end of the 2-day meeting, the TG group agreed to the following:

Five labs will participate in the RR testing. The participants are: CPSC, IAPMO, NSF, QAI and UL. UL was not present, but it was agreed on day one that UL would be a participant.

The TG agreed that a "Pilot Run" would be incorporated into the RR testing and that the final parameters of the RR would be determined after the Pilot results were evaluated by the TG. A summary of the Pilot Run/RR Protocol developed at the meeting and summarized by Paul Pennington is attached.

In addition to developing the Pilot Run/RR protocol, discussion included:

- Source of hair test wigs that meet the APSP-16 4.1.2.1 Type 1 definition "A full head of natural, fine, straight, blond European, human hair with cuticle on hair stems..." specifications and the concept of a hair test fixture designed and fabricated to resemble the human skull, but using hair strands that are attached in groups, and not from a full head of natural hair. Some test labs are using wigs that cost approximately $3000.00 while other are using wigs that are less costly. The wig/test fixture provided by CPSC for inspection included significant bleached hair not from a European Caucasian source even though CPSC noted that the wig was purchased as such. Sal Aridi indicated that NSF would take the lead to develop the design for a prototype type 1 hair test fixture based on clamping linear bundles or strips of bundled hair to the simulated skull using various clamping techniques. This fixture was referred to as the IWC, or 'inverted wedding cake' test fixture. The simulated skull consists of layers to which the linear hair bundles are clamped.
- The use of a closed vs. open head form for the Type 1 test fixture. Some Labs, including CPSC use a head form that is open at the neck while others use a head form that is closed at the neck. The discussion focused on the additional resistance/drag caused by the open head form and the effect that might have on pull off forces.
- Paul Pennington briefly noted an APSP 'long range plan' to study and possibly replace the blocking element with a fixture that more closely represents the human body. The CPSC Lab Director stated, that depending on available resources and the scope of the project, the CPSC may be able to participate is such a project.
- The foam used in the BBE. Discussion focused on the variance found is the foam called out in APSP-16 5.1.3 Test Equipment. This paragraph calls out a "Closed Cell NBR/PVC Foam with a compression deflection value of 1.5 psi to 3.0 psi at 25% deflection as measured in accordance with ASTM D 1056-00. As a result of this discussion, NSF will purchase the appropriate foam bun, measure the compression deflection value, and distribute foam that meets the requirement to

the test labs. Discussion also included the aging of foam, testing imprints, and the location/use of the 'skin' side. It was agreed that as long at the exposed surface of the foam was 'skinned', it did not matter if the side facing and bonded to the plywood backing was skinned or not. Note: subsequent review of APSP-16, +7.4 finds that APSP-16 paragraph 5.1.3 and the specifications for the foam is not in Section 5 of the -7.4 version.

- Paul Pennington requested CPSC to select the SOFAs for the Pilot Test and the Round Robin testing. Jim Hyatt acknowledged that CPSC would make the selections.
- APSP asked CPSC to provide guidance for the inclusion of 'accreditation' and certification language in the proposed revision. For the purpose of this meeting, it was clarified that test labs are 'accredited' for a particular test method by an accreditation body and the manufacturers are required to have their SOFAs 'certified' to meet the appropriate standard by a test lab.

Enclosures:

CPSC Day One Agenda
CPSC Day Two Agenda
Round Robin Protocol Task Force - Suggested Discussion Topics
Potential Design of Experiment Overview for ANSI/APSP-16 Committee – Power Point presentation
Pilot Run/RR Protocol

U.S. CPSC
National Product Testing and Evaluation Center

Date: Feb 8 2012 Meeting: APSP-16 Task Group MTG Host/Lead: CPSC/

Attendee	Representing	Phone	E-mail
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DAY 2

U.S. CPSC
National Product Testing and Evaluation Center

Date: Feb 9, '12 Meeting: APSP-16 RR TASK GrP Host/Lead: P. Sharpless

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APSP-16 Round-Robin Task Force

Kick-off Meeting Agenda

Wednesday February 8, 2012

8:30 a.m.	Meeting is called to order. Opening remarks from CPSC. Discussion of meeting ground rules. Overview of lab operations at NPTEC. Opening remarks from APSP.
8:45 a.m.	Introductions.
9:00 a.m.	Presentation of draft experimental design protocol by Kevin Gipson.
10:00 a.m.	Break.
10:15 a.m.	Discussion of experimental design
12:00 p.m.	Lunch.
1:30 p.m.	Discussion. Participants, which SOFAs to test. Pilot runs. Videotaping.
2:30 p.m.	Break.
2:45 p.m.	Discussion. Instructions to techs. Tolerances. BBE use and life-expectancy. Schedule, APSP-16 version
5:00 p.m.	Day 1 closing remarks and adjournment.

APSP-16 Round-Robin Task Force

Kick-off Meeting Agenda

Thursday February 9, 2012

8:30	Meeting is called to order. Opening remarks from CPSC and APSP.
8:45	Discussion. Hair test. Re-use and conditioning of hair.
10:00	Break.
10:15	Lab tour.
12:00	Lunch.
1:30	Open discussion.
2:30	Break.
2:45	Open discussion. Need for day 3?
5:00	Day 2 closing remarks, adjournment.

ROUND ROBIN PROTOCOL TASK FORCE

Suggested Discussion Topics

1. We should begin with a "Pilot Run" for the body block and hair test. All four labs will test the American 8" Anti-Vortex SOFA 10 times at a single flow rate each with three technicians. This will let us know the variances before we start the full Round Robin Testing.

2. The Round Robin testing as well as the Pilot should be videotaped with each technician. Technicians may not observe another technician performing the test.

3. There should be no special instructions to the technicians as the APSP-16 Standard should speak for itself.

4. ***Videotaping is a good idea - need to define location of camera, lighting, underwater?, multiple cameras? What will be included in the frame? e.g. just the cover and hair? or include the skull/wand. Will there be a target on the skull/wand to allow evaluation of velocity?*** The video should cover enough angles to give a perspective on approach and how the skull ends up sitting against the fitting. Also if it becomes entangled in the SOFA a close up as best as possible to show how or what is holding the hair. I also believe it would be beneficial to observe the technicians as they prepare the hair for test (trimming, weighing, affixing to skull, washing and combing)

5. What is an acceptable tolerance or difference between labs?

6. Ten SOFAs will be tested. Five that were recalled or have issues of concern and five comparable SOFAs that were not recalled. (SOFA list to follow)

7. There should be an assortment of sizes and include two (unblockable) channel SOFAs.

ROUND ROBIN PROTOCOL TASK FORCE

Suggested Discussion Topics

8. Test labs may not communicate with other labs once the RR starts. This will prevent one lab (A) from calling another lab (B) asking how they achieved some test that lab (A) was having difficulty with.

9. Discussion of BBEs. Regarding the question of a BBE conforming shape after age- if ALL Labs started with new BBEs this aging question would probably not be a factor. Later history may support a stated life span.

10. Leif and Carvin are working with CPSC on what references should be in the standard for accredited labs and accredited certification bodies. ISO, ANSI, ILAC,..etc.

11. We are working off of APSP-16 crossover +7.4.

ROUND ROBIN PROTOCOL TASK FORCE

3rd Interim report following CPSC Test Center meeting Feb. 8-9, 2012

February 27, 2012

CPSC Mathematical Statisticians introduced the *Design of Experiments* (DOE) to the Task Force.

The DOE will establish the protocol for CPSC to compare the APSP-16 approved February 17, 2011 to APSP-16 7.4. CPSC has the duty to make sure the changes do not make the standard less safe when compared. The Mathematical Statisticians took note of various factors that could produce variances between test labs for the Round Robin (RR) Tests. This information will be input into the (DOE) software program to determine the most efficient design. The design will be complete in two or three weeks. This Design is only for the pilot study (1 SOFA). If does not include the SOFA information that follows. The DOE will include such criteria as:

1. How many times at a single flow rate should a SOFA be tested,
2. Exactly how many but not which SOFA's to be tested. CPSC will randomly assign SOFA's with x characteristics to the testing combinations from a list provided by LSM. The pilot program will use the characteristics of the SOFA's in the design, instead of the individual SOFA's
3. Only Hair and Body Block tests will be included.
4. All will be floor tested.
5. What is an acceptable tolerance or difference between labs will be determined to be a result of the testing, not a consideration going in one of the goals is to find out what the differences in the labs are.
6. SOFA's will be chosen from the following criteria:

Spa: 4" diameter, will be approximately 1 ¼" profile.

Small: 8" diameter, one 0 to 1/2 " profile and one 1 ½ " to 2" profile.

Large: 12' X 12" one low profile and one high profile

Channel SOFA, Typically 3" X 32f" one low profile and one high profile

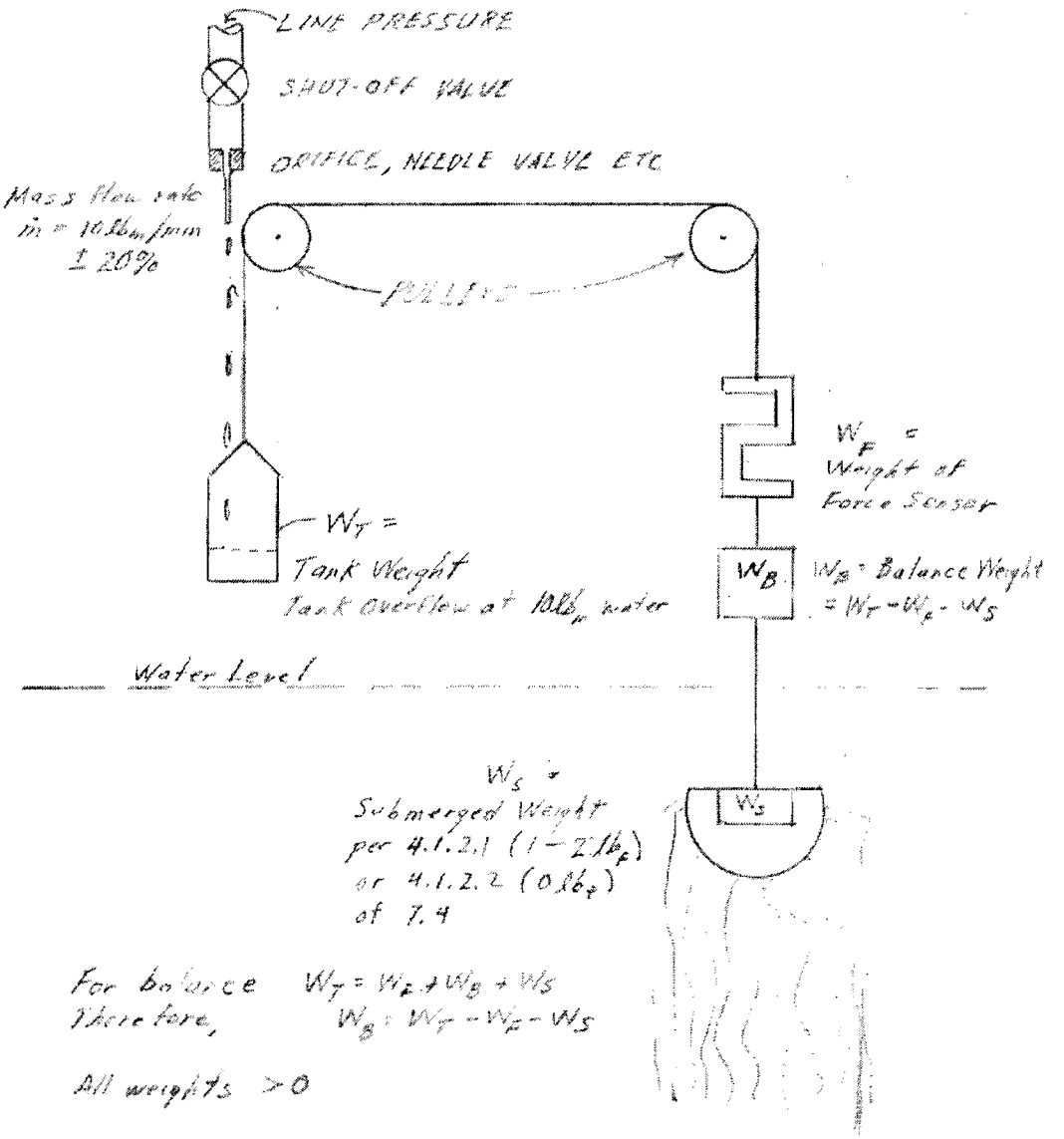
The DOE/ CPSC protocol will be combined with the RR Task force protocol for a final draft to be submitted for approval by to the full APSP-16 Committee.

Protocol items agreed upon by the RR Task Force with CPSC participation and help

- Once the final RR Protocol is complete, a "Pilot Run" with one predetermined SOFA will be conducted by each participating lab. For the pilot run (Steve and Carvin) will locate five 8" diameter solid top cover/grates with perimeter opening models similar to the old "anti vortex" sofa.
- Two technicians in each lab will each separately perform the tests.
- Technicians may not observe another technician performing the test
- All pilot and RR tests will be videotaped with three cameras. Two cameras underneath the blocking element at right angles to capture experiment, especially on the hair test. The third camera will view the technician's movements of the hair or body elements. More details will be supplied before pilot test. Steve Barnes to supply details for reasonably priced cameras.
- Steve will also determine a "target" on the skull and provide a "grid" or some other means to measure velocity.
- Steve to create split screen viewing for simultaneous viewing.
- Technicians will also be videotaped prepping wigs. Trimming, weighing, washing, combing, and affixing to skull.
- Foam, NSF has volunteered to purchase and cut foam for Body Blocking Elements (BBE's) for all the test labs including CPSC. This is for the Pilot only for now. This way all labs have the same hardness, etc.
- For Pilot run, a practical lab guide to determine *Centering* on plunger. Objective is to position the Body Blocking Element within ¼". Both X and Y axis is to be specified. Use tape measure and then mark with tape on floor of test tank. This is to eliminate eccentricity when pulling BBE off.
- Labs are to provide basic drawings and multiple pictures of their test rigs to show positioning.
- Test labs may not communicate with other labs once the RR starts.
- Labs must use a new wig for Pilot tests. Each lab will use their own same source and type for wigs. Further protocol for wigs will be discussed after anticipated new Case in APSP-16.
- There will be a minimum two minute rest period between tests.

- Identical sumps to be used.
- Hair mass to be weighed dry.
- For the Hair "sweep" test, all labs use the same ear to ear back and forth motion. And be In accordance the text in the standards.

To be explained and discussed further and will be the proposed "water bottle" Hair Test .There is some question as to whether this is considered a change to 7.4 and therefore requires a new Case.



GENERAL ARRANGEMENT
HAIR TESTING -

2/15/12

Potential Design of Experiment Overview for ANSI/APSP-16 Committee

Kevin Gipson
Sarah Garland, Ph.D.
Mathematical Statisticians
Division of Hazard Analysis, Directorate for Epidemiology
U.S. Consumer Product Safety Commission

Meeting with ANSI/APSP-16 Committee

February 8-9, 2012

The information expressed in this presentation is to assist and provide guidance to the ANSI/APSP-16 Committee in developing an experimental design to test and evaluate the current and proposed suction outlet fitting assembly (SOFA) testing standards, and to examine the repeatability of SOFA testing at the labs conducting these tests.

Portions of this work were done in collaboration with CPSC's Laboratory Sciences Mechanical Division staff.

Outline

- Introduction
  - Background
  - Design of Experiment (DOE)
- Proposed Design Setup
  - Goals & Response
  - Design Factors
  - Working Design
- Analysis Approach & Considerations
- Summary

Introduction

Background–Standards

- Virginia Graeme Baker Pool and Spa Safety Act requires certification to ASME A112.19.8-2007 or any successor standard.

- Current recognized successor standard–ANSI/APSP-16 2011

- Proposed successor standard–ANSI/APSP-16 Rev 7.4
  - Pump capacity changed to 1.0 from 1.25 x flow rating of fitting
  - Hair tests will be performed at constant force, not constant speed
  - Body Block Element (BBE) is modified to include different size BBE foam blockers
  - Variable speed drives (VSDs)–Pump flow variation by motor speed not allowed

Background–Types of Tests for Both Standards

- Physical tests–Pass/fail

- Hair and Body Block Element (BBE) tests
  - ❑ SOFA flow rating is minimum of hair or BBE test rating
  - ❑ Hair test method–Raw flow rating multiplied by 0.8 = test rating

Hair tests (both)

❑ Full head of hair

❑ Hair in ponytail

BBE tests

❑ Current standard has one BBE test

❑ Proposed standard adds a second Body Block Test

Background–Testing Issues

- Procedure issues
  - BBE testing–Corrected through updated guidance
    - Floor surrounding SOFA
    - Using tested BBE (18″ by 23″)
  - Hair testing
    - Can produce inconsistent results under repeated test conditions
    - Removal force is a function of both the hydraulic forces present and entanglement between the grate–High variable response
    - Many hair tests conducted manually
    - ANSI/APSP-16 suggests worst-case–Left to discretion of operator
- VSDs
  - Can produce inflated flow ratings

Background–Issues

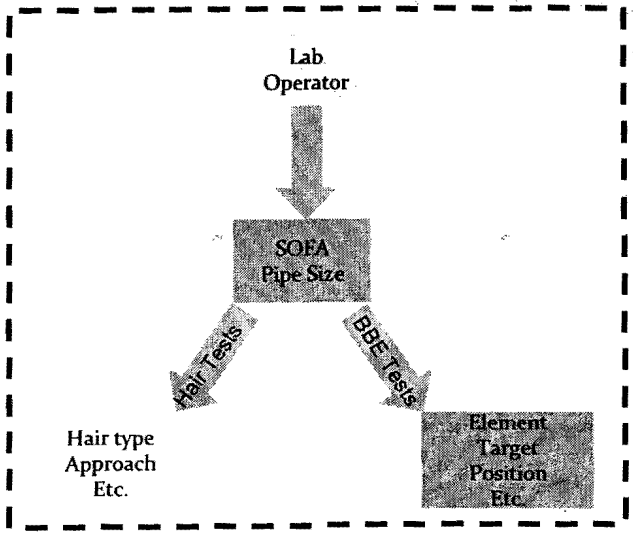
SOFA Testing

Two SOFA testing standards

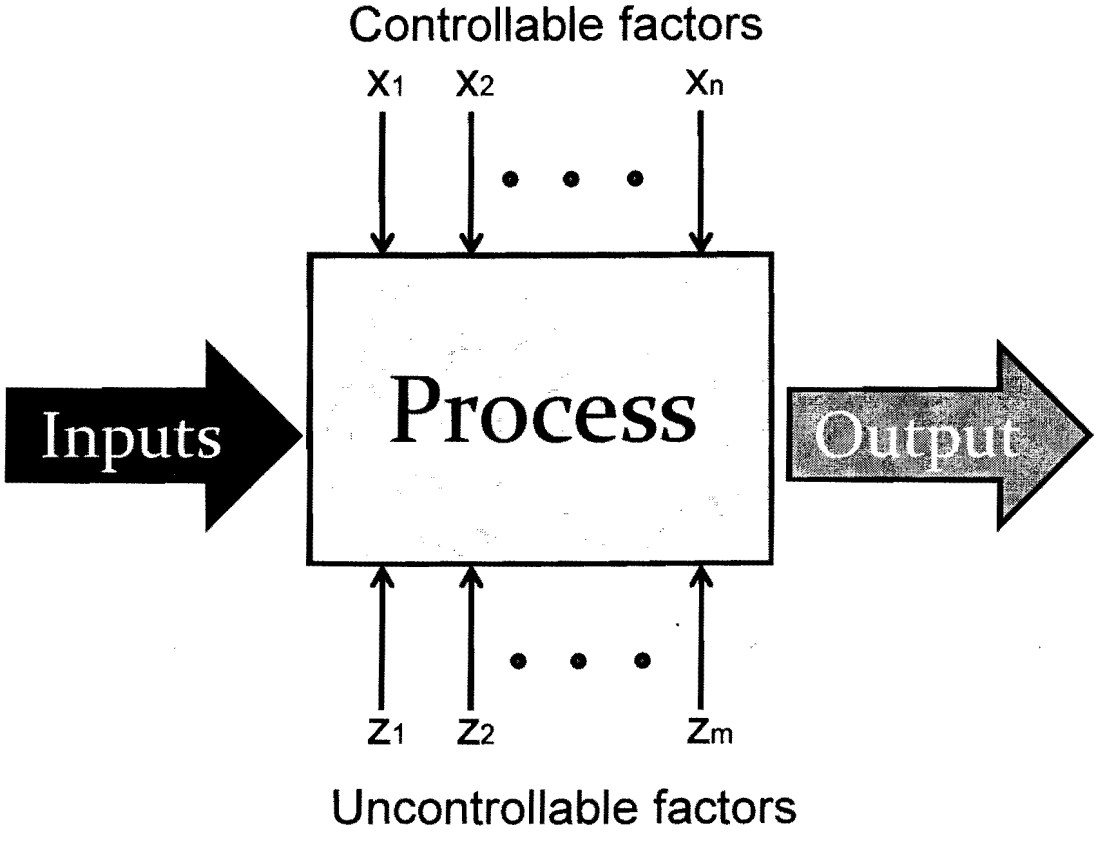
Two sets of tests
- Hair tests
- BBE tests

Potential differences between labs

Design of experiment (DOE) to examine differences



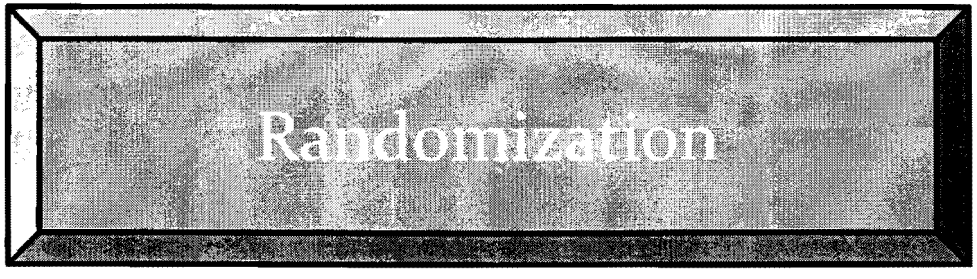
DOE–General Model of a Process



Montgomery, Douglas C. Designs and Analysis of Experiments. 6th ed. New Jersey: John Wiley & Sons, 2005.

DOE–Experimental Design

Three basic principles for the conduct of experimental designs:



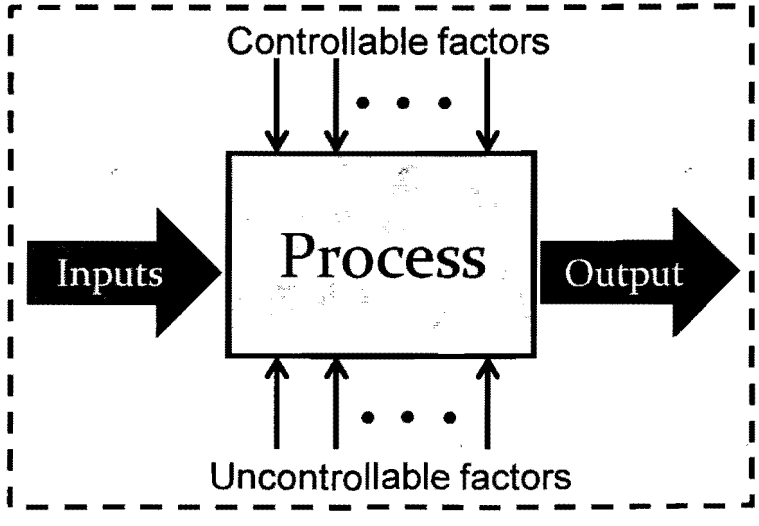
Replication

Local control of error

Proposed Design Setup

Goals & Response

- Goals
  - Primary goal
    - Demonstrate that the proposed SOFA standard provides equivalent level of safety to current standard
  - Secondary goal
    - Examine differences between testing labs
- Response (output)–Measure dependent on the design factors
  - ANSI/APSP-16 removal force
    - Measured in pounds of force
    - Body block element and hair tests

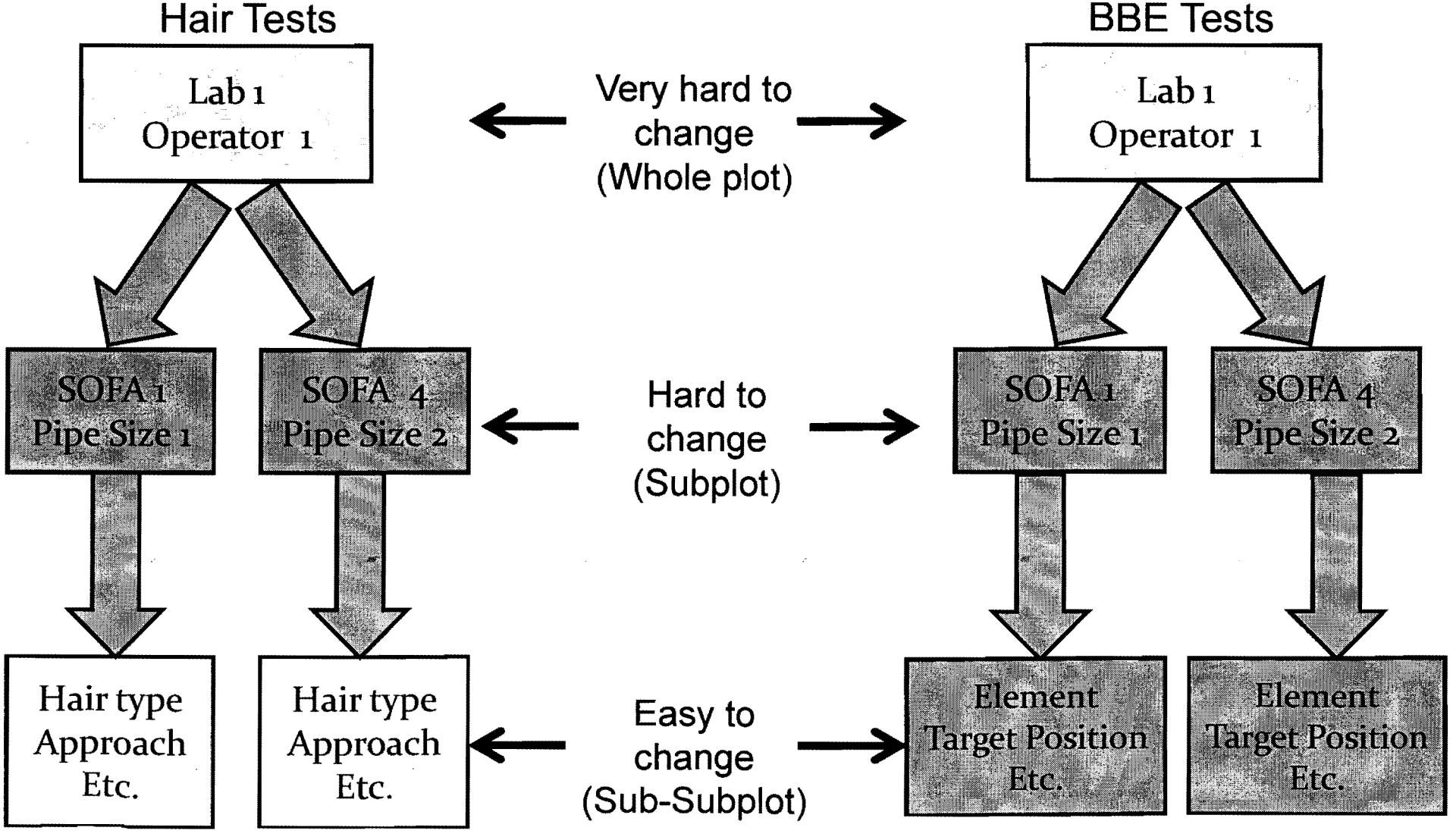


Design Factors

- Definition
  - Design used to evaluate the effect of "factors" on the "response"
  - Running the experiment involves varying the categories of the factors in a random manner and measuring the response at each combination of factor categories
- Design can be created after
  - Factors established
  - Characteristics of factors defined
- Characteristics that need to be defined
  - Type
  - Number of categories or continuous

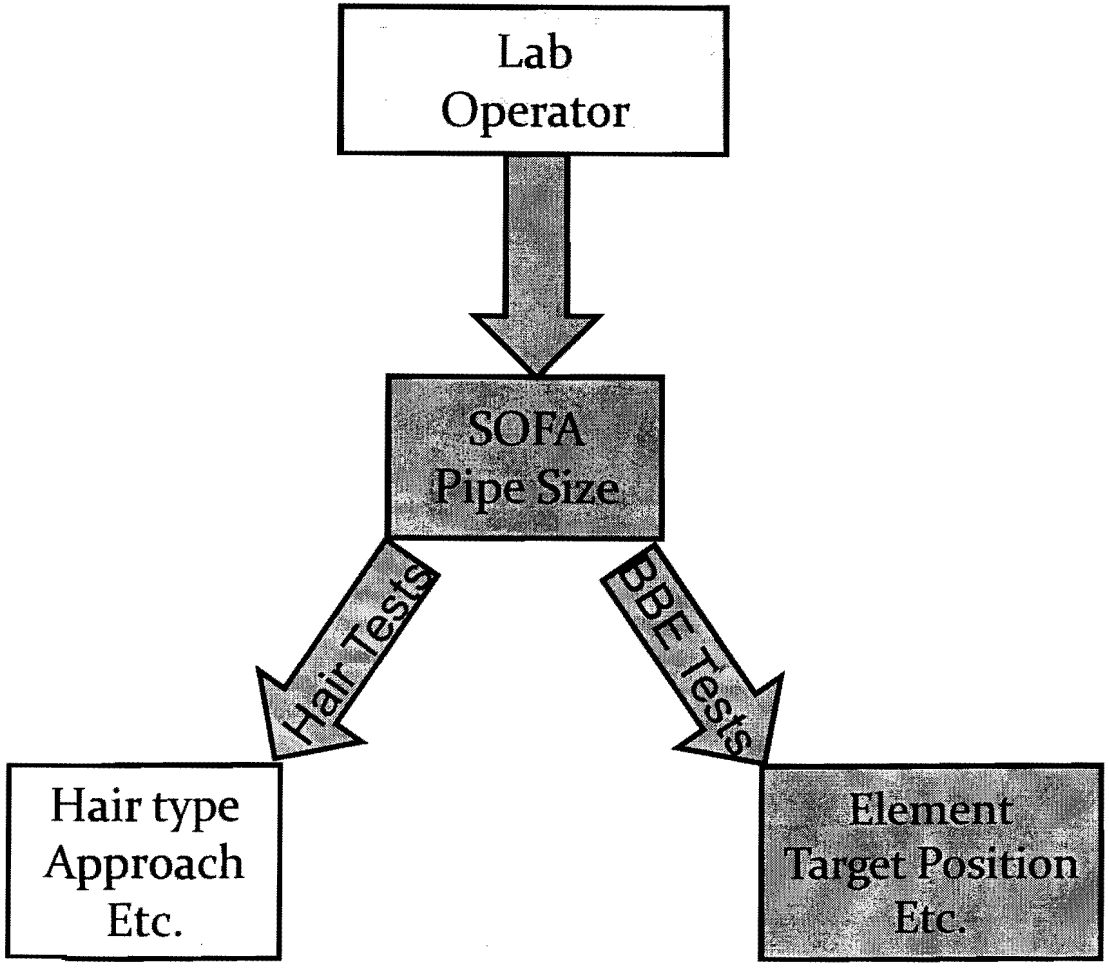
Other factors not in design can be recorded and studied outside the design.

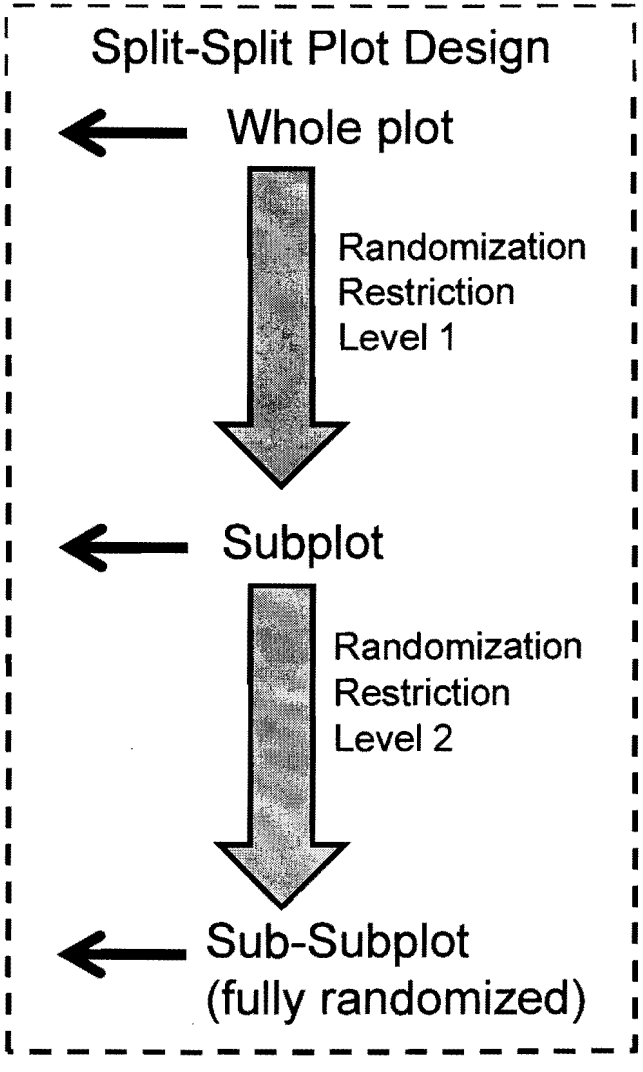
Design Factors–*Randomization Example*



Design Factors–Levels of Randomization

Both tests can be performed with minimal changes

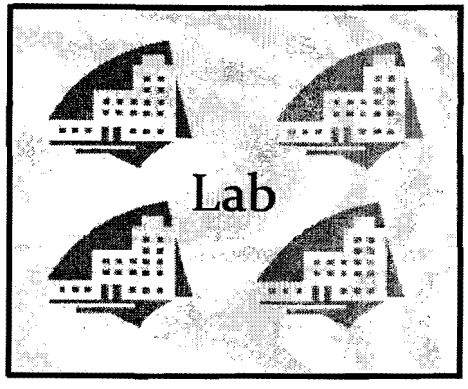


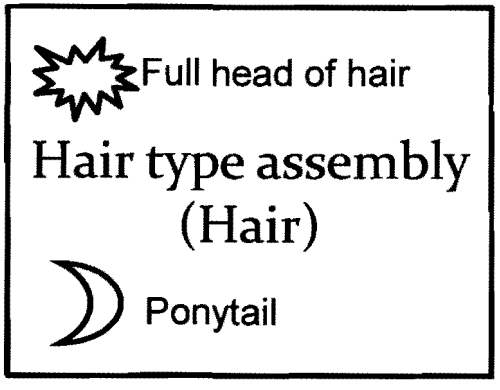


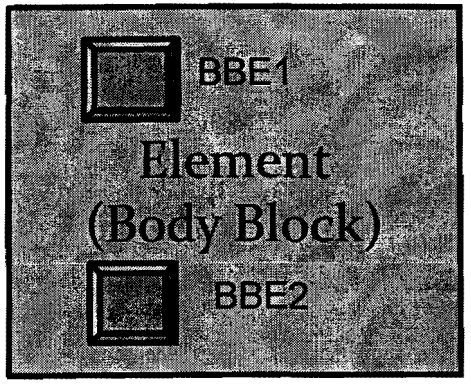
Two separate tests but one randomization scheme.

Design Factors–Categorical or Continuous

- Categorical–Discrete number of possibilities
  - *Examples:*







- Continuous–Uncontrolled
  - *Examples:*

Design Factors–Common

Table 1: Design Factors Common to Both Hair Tests and Body Block Tests

Factor	Comments	Type	Number of Categories or Continuous	Category Description (if applicable)
Lab	Not finalized.	Whole plot	4	Lab 1 Lab 2 Lab 3 Lab 4
Operator	Additional information needed from labs to determine categories.	Whole plot	To Be Determined (TBD)	
SOFA	Not finalized. Dependent on SOFAs chosen.	Subplot	3	Spa Small Big
SOFA profile	Not finalized. Determination of use as a factor is questionable. Dependent on SOFAs chosen.	Subplot	TBD	
Pipe size	Not finalized. Dependent on SOFAs chosen. There will be disallowed combinations.	Subplot	TBD	

Notice the asymmetrical properties for categories.

Design Factors–Hair

Table 2: Additional Design Factors for Hair Tests

Factor	Comments	Type*	Number of Categories or Continuous	Category Description (if applicable) **Proposed std (bold)**
Hair type assembly		Sub-Subplot	2	Full head
				Ponytail
Approach time		Sub-subplot	2	**30 seconds**
				60 seconds
Target position		Sub-subplot	2	Fixed
				Worst case
Motion		Sub-subplot	2	Sweep
				Worst case
Flow rate		Sub-subplot	Continuous (uncontrolled)	
Pull*		Sub-subplot	4	Pull Velocity 1
				Pull Velocity 2
				Force 1
				Force 2

* Suggested to have two velocities and two forces for this variable

Design Factors–BBE

Table 3: Additional Design Factors for BBE Tests

Factor	Comments	Type*	Number of Category or Continuous	Category Description (if applicable) **Proposed std (bold)**
Element size		Sub-subplot	2	BBE1
				BBE2
Dwell time		Sub-subplot	Continuous (uncontrolled)	
Flow rate		Sub-subplot	Continuous (uncontrolled)	
Target position		Sub-subplot	2	Centered
				Largest area
Rest period	TBD if a factor in design generation and testing.	Sub-subplot	Continuous (uncontrolled)	

Notice there are both categorical and continuous factors.

Working Design–Overview

Split-Split Plot Design

Unknown/Adjust design factors
- Make decision about factors and determine unknowns
- Add or drop design factors or change categories

Determine interactions
- 2 factor interactions
  - ❑SMEs input as necessary
- 3 factors (if deemed appropriate)

Generate the design (computer-based)
- Determine sample size (based on previous testing data)
- Test design (based on previous testing data)

Determine factors to record and analyze outside the design

Analysis Approach & Considerations

Analysis Approach

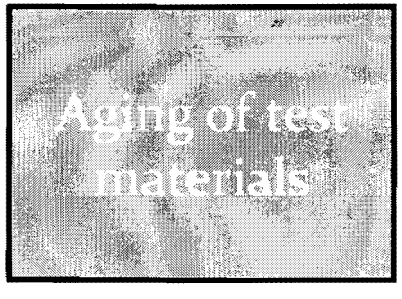
- DOE (design factors & continuous variables)
  - Analysis of covariance
  - Meet goals

Standards comparison

Difference between labs

- Other variables of interest (not in design)
  - Can study and draw conclusions
  - *Examples:*

Tank temperature



Considerations

- Chosen design may need to change to accommodate all needs

- Sample size has not been determined
  - Sample size will need to deal with
    - Ability to estimate a model and be able to detect differences
      - *Example: Differences between the two approach times (hair)*
    - Consider set-up and testing for each run could take considerable time
  - Resource availability may influence final design

Considerations (cont.)

- Fixed-effect design
  - Generalizations limited–Tested variables and levels
  - *Example: Generalizations for the SOFAs are limited to SOFAs tested and are not applicable to all SOFAs*
- Design assumes some inherent homogeneity
  - *Example: SOFA "A" tested at lab A will be assumed to be the same as SOFA "A" being tested at lab B.*
- Decision was made to test only SOFAs on floor of the pool
  - Omits a location variable
  - Wall testing data will not be gathered

Summary

Summary

- Two goals
  - Compare two standards
  - Examine lab differences
- Suggest split-split plot design
  - Two levels of randomization restrictions
  - Computer-based, not a traditional design
    - Handles the asymmetrical properties without having a full factorial
  - Two designs, one randomization scheme
    - Two analyses–Hair and body block
- To be determined
  - Final set of factors and categories
  - Final design
  - Sample size

References

- Kowalski, S.M., *et. al.* "Tutorial: Industrial Split-Plot Designs." Quality Engineering, 19:1-15. 2007.

- Montgomery, Douglas C. Designs and Analysis of Experiments. 6th ed. New Jersey: John Wiley & Sons, 2005.

Thank you!

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- Questions?