

TCB Training



**Introduction to Evaluating Compliance/SAR Review
of Handset Transmitters for Equipment Approval–
Supplement C – 01-01**

and

Part 22/24 Handsets, and Hand held Devices

October 2005 Updates to

May 2003 Training

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- Includes updates from between May '03 to October '05.
- See associated presentation titled *“Introduction to RF Exposure Evaluation for Handsets, and Hand-helds”* for context.



Background

- TCB must receive the following training to certify devices with certain RF exposure concerns
 - Supplement C/handset training (allows TCB certification of Pt 22/24 handsets only)
 - General RF exposure training (for all other devices under July 2002 exclusion list)
- All other TCBs must use 2000 exclusion list.



Supplement C - 01-01

- Title: “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields”
- General in nature regarding mobile and portable devices
- Emphasis for Pt 22/24 handsets based on IEEE STD 1528 standard
- Apply to other devices carefully.
- TCBs will apply as standard for SAR reviews of Pt 22/24 devices



Supplement C - 01-01

○ Outline

- Introduction
- Section 1 “FCC rules for RF compliance of mobile and portable devices
- Section 2 Guidelines for evaluating mobile and portable devices discusses both SAR measurement and computation methods
- Section 3 RF exposure compliance for spread spectrum transmitters (not relevant for this training)



Supplement C - 01-01

○ Outline

- Appendix A: FCC exposure criteria
- Appendix B: Information for documenting SAR compliance
- Appendix C: Tissue dielectric parameters
- Appendix D: SAR measurement procedures

Supplement C - 01-01



- released on 06/29/01 to replace version 97-01 issued on 12/30/97
 - considered applicable SAR measurement procedures in SCC-34/SC-2 IEEE STD 1528 DRAFT
 - updated recommendations for documenting compliance (Appendix B)
 - incorporated IEEE STD 1528 head tissue dielectric parameters and updated body tissue dielectric parameters according to the rationale for using homogeneous phantoms (Appendix C)

Supplement C - 01-01



- related documents - <http://www.fcc.gov/oet/dockets/et93-62/>
 - *Report and Order*
 - original - ET Docket 93-62, FCC 96-326, 11 FCC Rcd. 15123 (1996)
 - 1st MO&O - ET Docket 93-62, FCC 96-489, 11 FCC Rcd. 17512 (1997)
 - 2nd MO&O and NPRM - ET Docket 93-62, FCC 97-303, 12 FCC Rcd. 13494 (1997)



Supplement C - 01-01

- related documents - <http://www.fcc.gov/oet/dockets/et93-62/>

- *OET Bulletins* -
<http://www.fcc.gov/oet/info/documents/bulletins/>
 - Bulletin 65, Edition 97-01, released August 25, 1997
 - Supplement A & B (broadcast and amateur radio)
 - Overview of RF exposure and MPE evaluation
 - Related update Public Notice DA 02-1438
 - Bulletin 56, Fourth Edition, released August 1999
 - Q & A on RF exposure - consumer info



Supplement C - 01-01

- provided SAR measurement recommendations for handsets (Appendix D), including head and body-worn conditions, allowing TCB to approve cellular and PCS handsets that involve SAR evaluation
- TCB must use Supplement C procedures
- Supplement C is based on but in some cases varies slightly from IEEE STD 1528.
- slides here relevant only to IEEE STD 1528 are place in “reference” section

IEEE STD 1528 and Supplement C Update



- IEEE STD 1528 updates (not all relevant to Supplement C)
 - frequency exclusions/provisions FCC21
 - power exclusions/provisions*
 - flat phantom: major axis $\geq 0.6 \lambda$, minor axis $\geq 0.5 \lambda$ * not relevant to Supplement C FCC18
 - improved measurement uncertainty procedures* FCC19
 - clarified tissue dielectric property measurement recommendations* FCC20
 - some changes in SAR system validation procedures

FCC18 SCC-34/SC-2 Revised Proposal (as of 03/29/02) -

The issue under consideration relates to cellular handset with multi-mode capability. In particular, those handsets that feature different modes of operation within one or several frequency bands, where these modes are set to different nominal power.

The earlier proposal (not approved during the January meeting) was discussed. An alternative proposal, also based on SAR measurements, was formulated. The proposal is explained below.

Suppose the handset can operate in two modes (A and B) with nominal power P_A and P_B where $P_A > P_B + 2\text{dB}$, within the same frequency band. The testing procedure is as follows:

1. Test the handset in mode A, according to the procedure already established in P1528;
2. Test mode B in each configuration listed below, provided that it produced a peak SAR larger than one half of the compliance limit in mode A, with the additional provision that at least the configuration that produced the highest peak SAR in mode A be tested:
 - a. Left Ear, Touch position (antenna position and channel that produced highest peak SAR in mode A);
 - b. Left Ear, Tilt position (antenna position and channel that produced highest peak SAR in mode A);
 - c. Right Ear, Touch position (antenna position and channel that produced highest peak SAR in mode A);
 - d. Right Ear, Tilt position (antenna position and channel that produced highest peak SAR in mode A);
3. If the peak SAR measured in mode B is lower than 85% of that measured in mode A for each one of the above configurations, then no further testing of the handset in mode B is required. The 15% margin specified herein is equal to the acceptable measured uncertainty in P1528;
4. If at least one of the measured peak SAR in mode B is equal or larger than 85% of the corresponding one in mode A, then a complete test of the handset in mode B should be performed according to the procedure established in P1528.

It is understood that if the above proposal is accepted and incorporated in P1528, it should not be perceived as a binding provision for the regulatory agencies, but rather as an interpretative recommendation. It is further recommended that handset manufacturers provide independent test labs with relevant information regarding the operation and technology of multi mode devices, compatibly with intellectual property rights on said technology.

NOTE: the above procedures do not apply when $P_A \leq P_B + 2\text{dB}$

Focus User, 3/31/2002

FCC19 Annex E and Annex X of latest SCC-34/SC-2 revisions for P1528

Focus User, 3/31/2002

FCC20 Annex B of latest revised SCC-34/SC-2 P1528

Focus User, 3/31/2002

FCC21

SCC-34/SC-2: Considering the reasonable performance expectations of cellular phone antennas in terms of VSWR over the operating bandwidth, the unanimous consensus was to endorse the FCC suggestion to modify the exclusion threshold from 2 dB to 3 dB

Focus User, 3/31/2002

IEEE STD 1528 and Supplement C Update



- Supplement C updates: for TCB approval purposes
 - Phantom transition ended see PN 02-1438
 - use following criteria to reduce the number of tests according to , see PN 02-1438
 - frequency provisions/criteria
 - power provisions/criteria
 - measurement uncertainty: use latest IEEE STD 1528 draft
 - E-field probe calibration issues: see February 2002 TCB training slides* FCC22
 - SAR system verification issues: see February 2002 TCB training slides* FCC23

FCC22 field probe calibration requirements can be probe design dependent; test labs should verify the capability of a field probe, including the applicability of probe calibration data, for testing an individual device

Focus User, 3/31/2002

FCC23 when dipoles are not available for verifying SAR system performance at certain test frequencies, test labs are expected to build their own dipoles according to P1528 specifications

Focus User, 3/31/2002

FCC MPE Exposure Limits



(A) Limits for Occupational/Controlled Exposure Section 1.1310

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

1.1310 Applies to fixed and mobile devices, and portable above 6 GHz

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes) ^{Note 2}
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

Averaging time techniques typically for Occupational. Limited application for G.P.

f = frequency in MHz

*Plane-wave equivalent power density

NOTE 1: See Section 1 for discussion of exposure categories.

NOTE 2: The averaging time for General Population/Uncontrolled exposure to fixed transmitters is not applicable for mobile and portable transmitters. See 47 CFR §§2.1091 and 2.1093 on source-based time-averaging requirements for mobile and portable transmitters.

FCC Portable Limits (SAR)



(A) Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

(B) Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

NOTE 1: See Section 1 for discussion of exposure categories.

NOTE 2: **Whole-Body SAR** is averaged over the entire body, **partial-body SAR** is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. **SAR for hands, wrists, feet and ankles** is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

NOTE 3: At frequencies above 6.0 GHz, SAR limits are not applicable and MPE limits for power density should be applied at 5 cm or more from the transmitting device.

Note 4: The time averaging criteria for field strength and power density do not apply to general population SAR limit of 47 CFR §2.1093.

Note 4:
"Source
based
averaging
allowed"

50% usage
DF for Gen.
Pop.-PTT
devices
allowed

Supplement C: RF exposure Evaluation



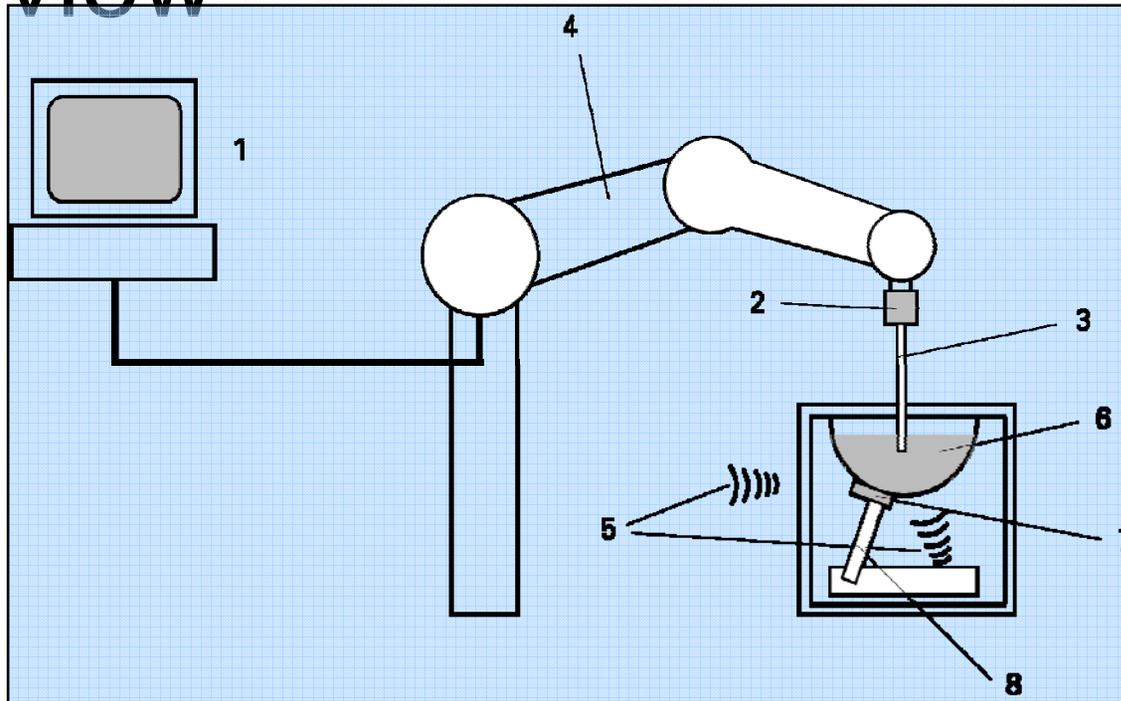
- This class covers Pt 22/24 handsets only
- Supplement C can apply to other device types to the extent possible
- MPE and SAR evaluation of other devices evaluation not covered in this course. Please refer to OET Bulletin 65 and follow-on TCB classes

Supplement C: SAR Evaluation



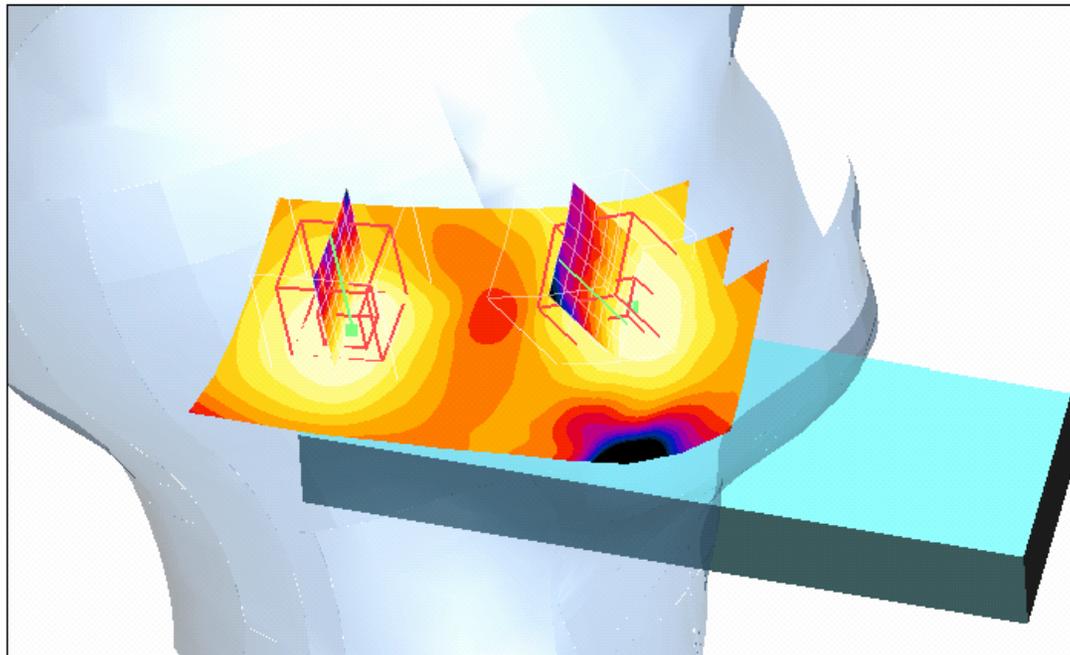
- evaluating SAR compliance with measurements
 - SAR measurement system
 - test device
 - test environment
 - estimating measurement uncertainty
 - reporting

SAR Measurement Overview



- 1) computer for data recording
- 2) data acquisition unit
- 3) dosimetric E-field probe
- 4) probe positioner
- 5) ambient field
- 6) phantom shell with tissue simulating liquid
- 7) device under test
- 8) device positioner

Area and Zoom Scans



TCB Training



Evaluating compliance/SAR Review of Part 22 Subpart H and Part 24 Wireless Handsets for Equipment Approval

Supplement C - 01-01: Phantom

12-13 May, 2003

Supplement C: Phantom Recommendations



- Supplement C recommends SCC-34/SC-2 SAM head phantom, see Public Notice 02-1438
- Supplement C specifies flat phantom for body-worn tests and system verification



IEEE STD 1528 Draft: Phantom

- head phantom goal
 - to provide conservative and repeatable SAR measurements using
 - a homogeneous phantom with specific shape and dimension
 - specific tissue dielectric properties
 - specific handset test positions
 - specific test protocols
 - to evaluate near-field exposure conditions of handsets
 - to ensure proper energy coupling in the cheek region

IEEE STD 1528 Draft: Phantom



- head phantom goal
 - to provide suitable ear simulation for
 - handset positioning
 - energy coupling in the head
 - to support measurement without a hand model
 - to avoid excessive overestimate of SAR

Supplement C: Phantom Recommendations

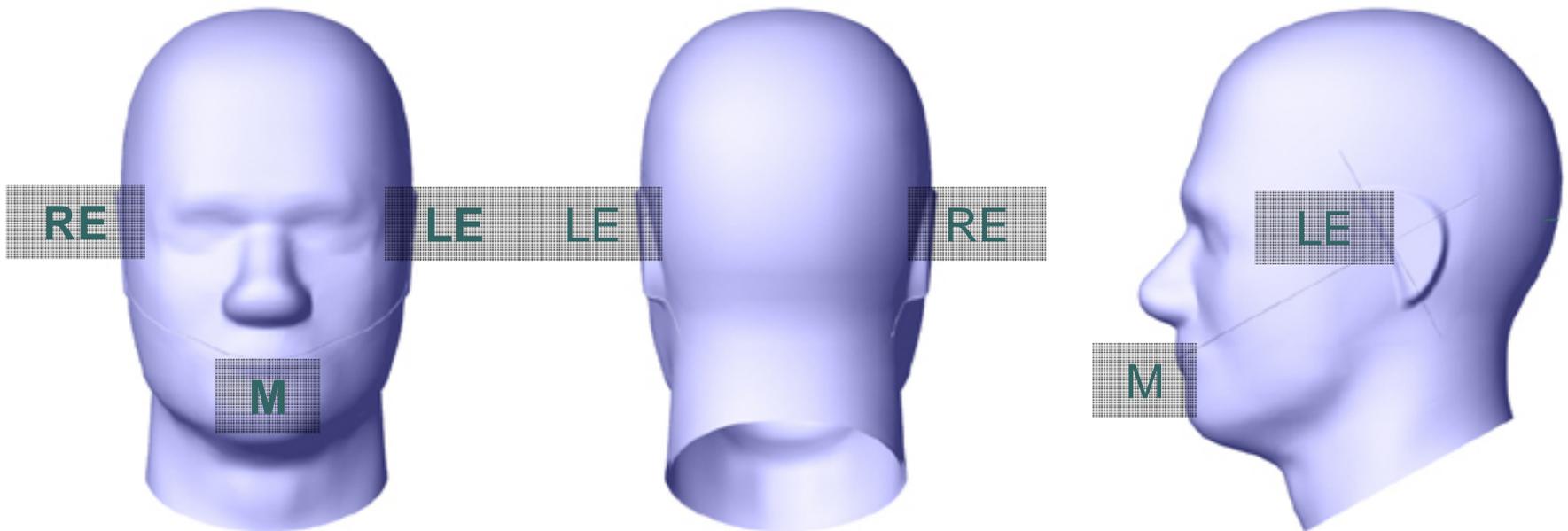


- SCC-34/SC-2 SAM phantom shell specification
 - dielectric constant (ϵ_r) < 5.0
 - loss tangent < 0.05
 - SAM shape is defined based on Army statistical measurements
 - thickness
 - 2.0 ± 0.2 mm in measurement regions
 - 2.0 ± 0.5 mm elsewhere
 - Ear spacer specified (6 mm thick)

Supplement C: Reference Plane



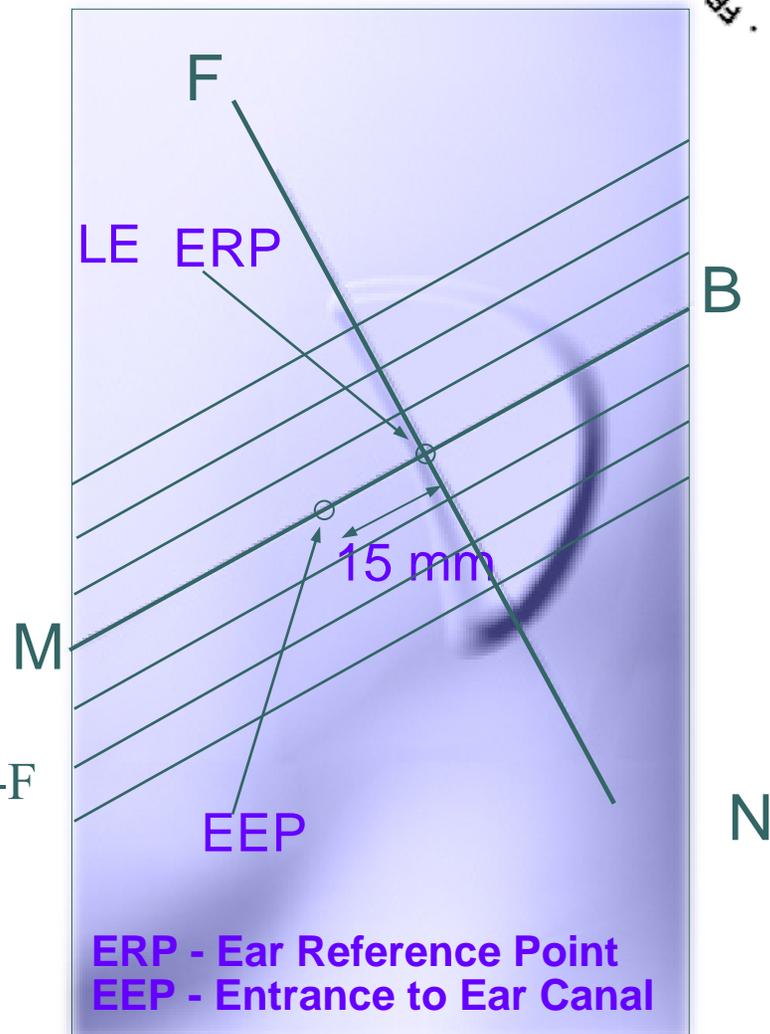
Reference Plane contains points RE, LE and M



Supplement C: Ear Reference Point



- Reference lines
 - M-B in reference plane
 - N-F \perp to M-B
 - N-F and M-B intersect at ERP
- ERP is 1.5 cm above EEP
- Ear spacer
 - 6.0 cm along N-F
 - 6.0 ± 0.2 mm thick at ERP
 - tapered and truncated below N-F



Supplement C: Phantom Recommendations



- use flat phantom to test for certain other configurations
 - body-worn and other body operating conditions
 - in front of a person's face, such as in PTT mode (not eye/nose exposure)

Supplement C: Phantom Recommendations



- flat phantom specifications
 - flat phantom > 2 times test device & antenna dimension
 - $\epsilon_r < 5.0$; loss tangent < 0.05
 - 2.0 ± 0.2 mm thick in measurement regions
 - tissue depth filled to 15.0 ± 0.5 cm
 - verification phantom specs. are different

SAR Testing

- Supplement C recommends that phantom should be twice the size in critical dimensions of the DUT.



- For laptops the DUT is generally considered the transmitting module and/or antenna.

IEEE STD 1528 Draft: Phantom



- o IEEE STD 1528 reference materials follows



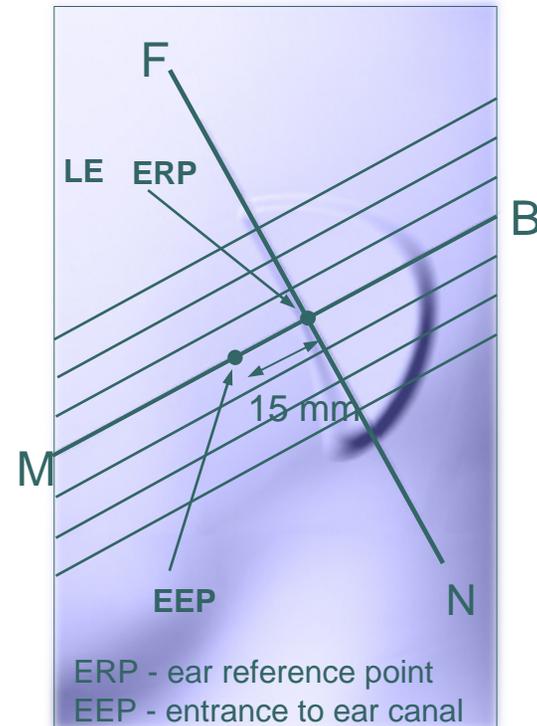
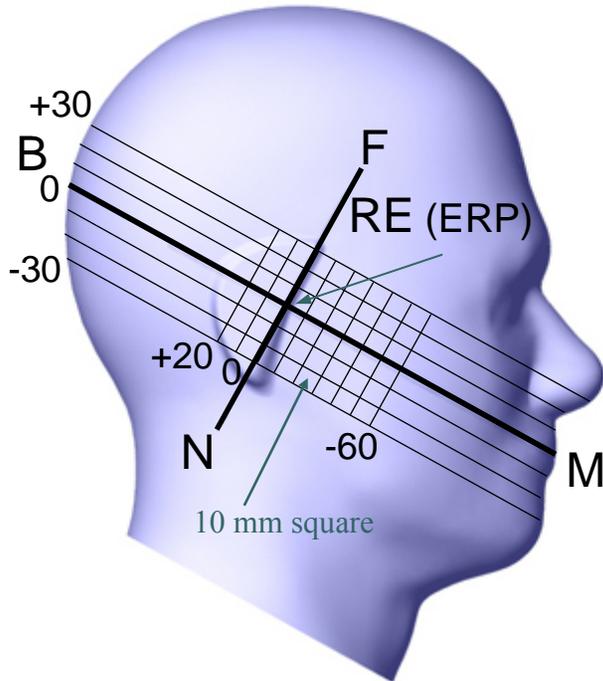
IEEE STD 1528 Draft: Phantom

- phantom - Section 4, Annex B, C, D
 - head phantom requirements in general (4.1, D4)
 - simulated tissue dielectric properties (4.2, B, C)
 - recommended head tissue dielectric parameters (4.5.1)
 - tissue dielectric measurement techniques (B1)
 - reference liquids for tissue dielectric measurements (B2)
 - tissue recipes (C2)
 - SCC-34/SC-2 recommended head model - SAM (4.5.2)
 - SAM derived from selected U.S Army head data (D2)
 - SAM cross-sections (D3)
 - phantom uncertainty (4.4)
 - flat phantom requirements (4.5.3, D1)

IEEE STD 1528 Draft: Phantom



SCC-34/SC-2 head model - SAM

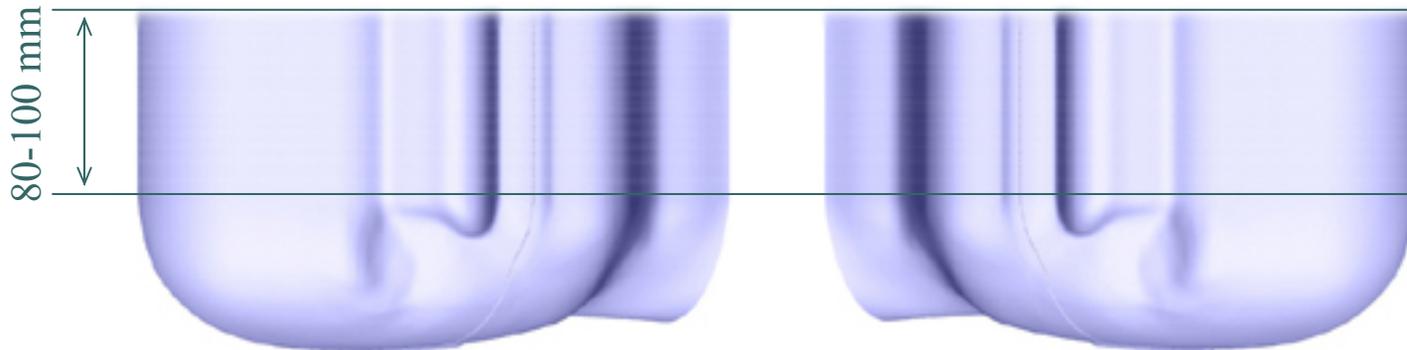


(Source: IEEE SCC-34/SC-2, IEEE STD 1528 Draft)

IEEE STD 1528 Draft: Phantom

SCC-34/SC-2 head model - SAM

- shell thickness
 - ear spacer region: 6.0 ± 0.2 mm max.
 - other measurement regions: 2.0 ± 0.2 mm
 - non critical regions: 2.0 ± 0.5 mm
- liquid depth: 15.0 ± 0.5 cm from ERP
- shell material: $\epsilon_r < 5.0$ and loss tangent < 0.05



(Source: IEEE SCC-34/SC-2, IEEE STD 1528 Draft)

IEEE STD 1528 Draft: Phantom



SCC-34/SC-2 head model - derived parameters

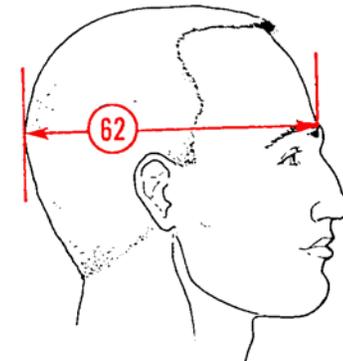
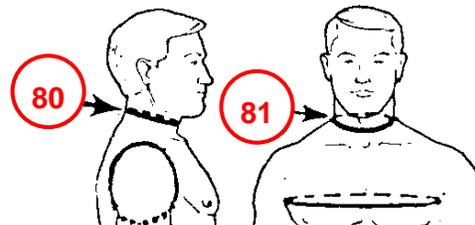
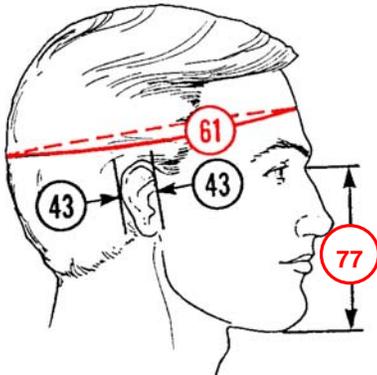
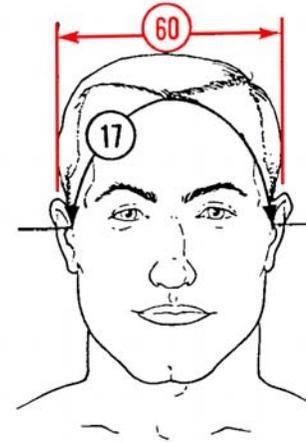
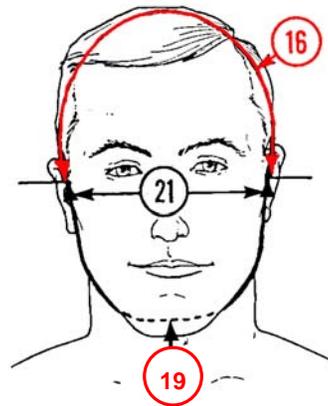
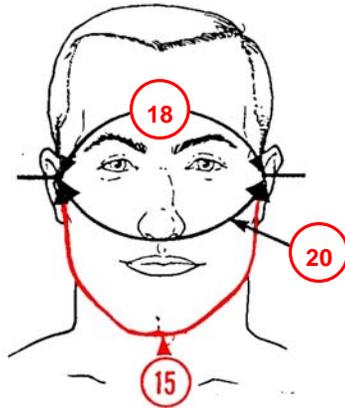
Ref.	Anatomy	Gordon report (mm)			SAM (mm)	Deviation (%)
		Mean value	Std deviation	90 th Percentile		
15	Bitracion Chin Arc	325.8	13.4	343.1	329.3	-4.0
16	Bitracion Coronal Arc	353.3	12.9	369.7	367.3	-0.6
18	Bitracion Frontal Arc	304.3	10.6	318.2	314.1	-1.3
19	Bitracion Submandibular Arc	304.2	14.5	323.2	333.5	3.2
20	Bitracion Subnasale Arc	292	11.1	306.3	305.3	-0.3
60	Head Breadth	151.7	5.4	158.6	158.4	-0.1
61	Head Circumference	567.7	15.4	587.3	594.8	1.3
62	Head Length	197.1	7.1	206	206.0	0.0
77	Menton-Sellion Length	121.9	6.5	130.4	125.0	-4.1
80	Neck Circumference	379.6	19.7	405.3	395.4	-2.5
81	Neck Circumference Base	408.4	20.5	434.9	455.7	4.8

(Source: IEEE SCC-34/SC-2, IEEE STD 1528 Draft)

IEEE STD 1528 Draft: Phantom



SCC-34/SC-2 head model - derived parameters



(Source: IEEE SCC-34/SC-2, IEEE STD 1528 Draft)

TCB Training



Evaluating compliance/SAR Review of Part 22 Subpart H and Part 24 Wireless Handsets for Equipment Approval

Supplement C - 01-01: Tissue Parameters

12-13 May, 2003

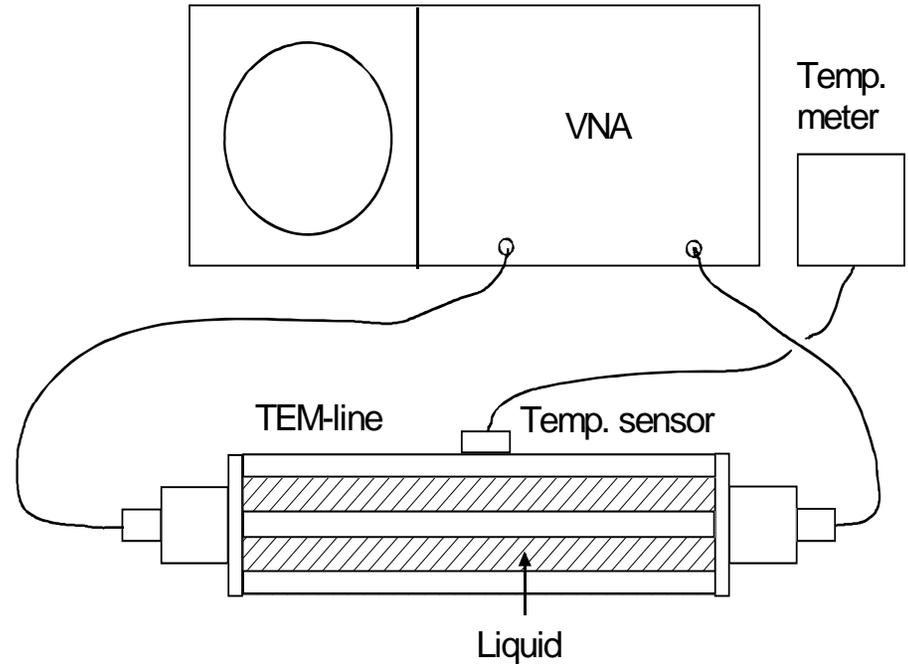
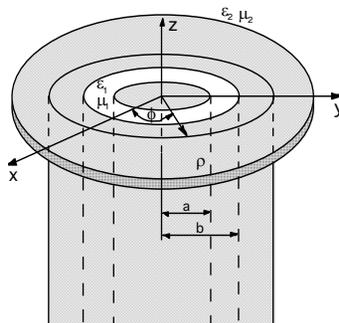
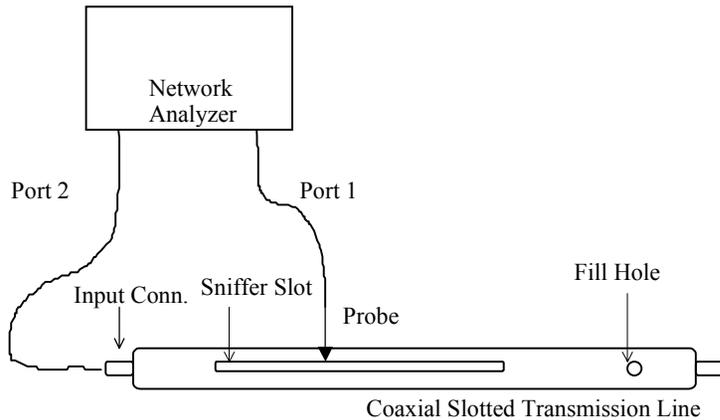


IEEE STD 1528 Draft: Tissue liquid

- simulated head tissue dielectric properties
 - the choice of tissue parameters in a homogeneous phantom determines the amount of SAR overestimation
 - need standardized tissue dielectric parameters to reduce measurement variations
 - standardized liquid values
 - provide tissue dielectric parameter measurement procedures
 - provide recommendations on tissue recipes

IEEE STD 1528 Draft: Tissue Liquid

Tissue dielectric property measurement



(Source: based on IEEE SCC-34/SC-2, IEEE STD 1528 Draft)

Supplement C: Tissue Parameters



Target Frequency (MHz)	Head		Body	
	ϵ_r	σ (S/m)	ϵ_r	σ (S/m)
* 150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
* 915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
* 1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
* 5800	35.3	5.27	48.2	6.00

All head marked * and body are Non IEEE STD 1528 values

(ϵ_r = relative permittivity, σ = conductivity and $\rho = 1000 \text{ kg/m}^3$)



Somewhat old as of April 2003, See latest IEEE STD 1528, and following slides

Supplement C: Tissue Recipes

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized, 16 MΩ⁺ resistivity

HEC: Hydroxyethyl Cellulose

DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

Supplement C: Tissue Parameters



- 2450 MHz head liquid recipe per Kwok Chan
April 2003

H2O 58.55%

DGBE 6.96%

Triton x-100 35.38%

NaCl 0.11% (use less to bring down conductivity)

- Measured 38-39 relative permittivity
- 1.85-1.9 conductivity

Draft IEEE STD 1528: Tissue Parameters

Draft CD 1.1 – December 29, 2002

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IEEE Std 1528-200X



C.2 Tissue-simulating liquid formulas (permittivity/conductivity)

Table C.1 – Suggested recipes for achieving target dielectric parameters[B5], [B132]

Frequency (MHz)	300			450			835			900			1450			1800			1900		1950	2000		2100		2450			3000
Recipe #	1	1	3	1	1	2	3	1	1	2	2	3	1	2	4	1	2	4	1	1	2	2	2	3	1				
Ingredients (% by weight)																													
1,2-Propanediol						64.81																							
Bactericide	0.19	0.19	0.5	0.1	0.1		0.5					0.5															0.5		
Diacetin			48.9				49.2					49.43															49.75		
DGBE								45.41	47	13.84	44.92		44.92	13.84	45	50	50	7.99	7.99							7.99			
HEC	0.98	0.98		1	1																								
NaCl	5.95	3.95	1.7	1.45	1.48	0.79	1.1	0.67	0.36	0.35	0.18	0.64	0.18	0.35											0.16	0.16		0.16	
Sucrose	55.32	56.32		57	56.5																								
Triton X-100												30.45						30.45							19.97	19.97		19.97	
Water	37.56	38.56	48.9	40.45	40.92	34.4	49.2	53.82	52.64	55.36	54.9	49.43	54.9	55.36	55	50	50	71.88	71.88	49.75	49.75	49.75	49.75	49.75	49.75	49.75	49.75	49.75	
Measured dielectric parameters																													
ϵ'_r	46	43.4	44.3	41.6	41.2	41.8	42.7	40.9	39.3	41	40.4	39.2	39.9	41	40.1	37	36.8	41.1	40.3	39.2	37.9								
σ (S/m)	0.86	0.85	0.9	0.9	0.98	0.97	0.99	1.21	1.39	1.38	1.4	1.4	1.42	1.38	1.41	1.4	1.51	1.55	1.88	1.82	2.46								
Temp. (°C)	22	22	20	22	22	22	20	22	22	21	22	20	21	21	20	22	22	20	20	20	20	20	20	20	20	20	20	20	
Target dielectric parameters (Table 5-1)																													
ϵ'_r	45.3	43.5	41.5	41.5	40.5							40						39.8	39.2									38.5	
σ (S/m)	0.87	0.87	0.9	0.97	1.2							1.4						1.49	1.8									2.4	

NOTE: Multiple columns for any single frequency are optional recipes.

Recipe #, reference: 1 [B5], 2 [B132], 3 [B109], 4 [B44].

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 — This is an unapproved IEEE Standards Draft subject to change —.

Supplement C: Tissue Parameters



- transmission band overlaps with tissue target frequency
 - tissue parameters at mid-band $< \pm 5\%$ of target values
- otherwise, at other frequencies
 - linearly interpolate tissue parameters between closest pair of target frequencies
 - tissue parameters at mid-band $< \pm 5\%$ of target values
- up to 10% tolerance above 2 GHz (outdated) -- newer recipes should be within 5% up to 3 GHz. Above 3 GHz greater tolerance may be needed.

Supplement C: Tissue Parameters



- tissue medium temperature variation
 - $< \pm 2^{\circ}\text{C}$ during SAR measurement
 - $\pm 2^{\circ}\text{C}$ of tissue dielectric parameters measurement conditions
- tissue parameter measurement
 - daily when used for measurements
 - more often - conditions of high evaporation rate or low humidity

IEEE STD 1528 Draft: Tissue liquid

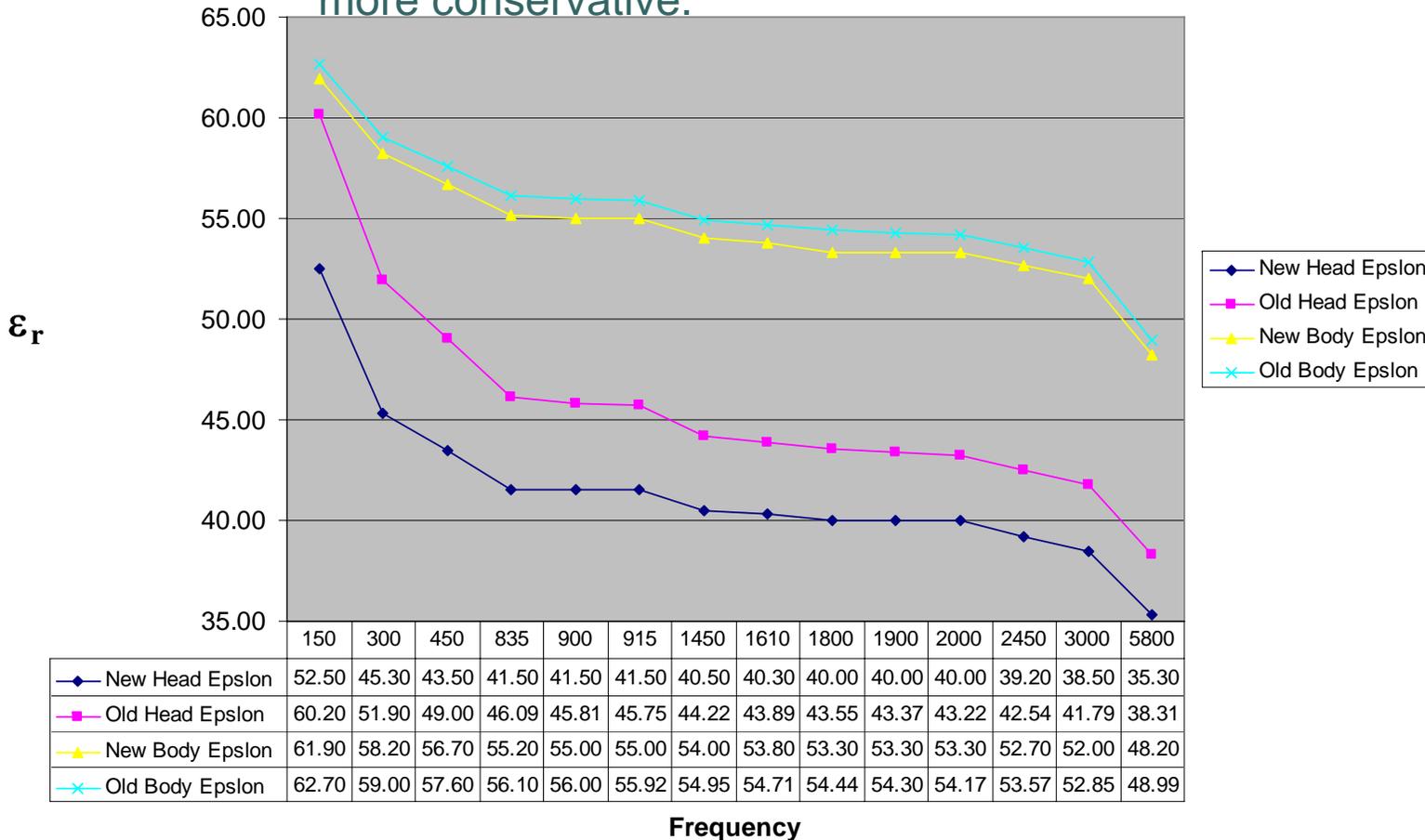


- Reference material follows

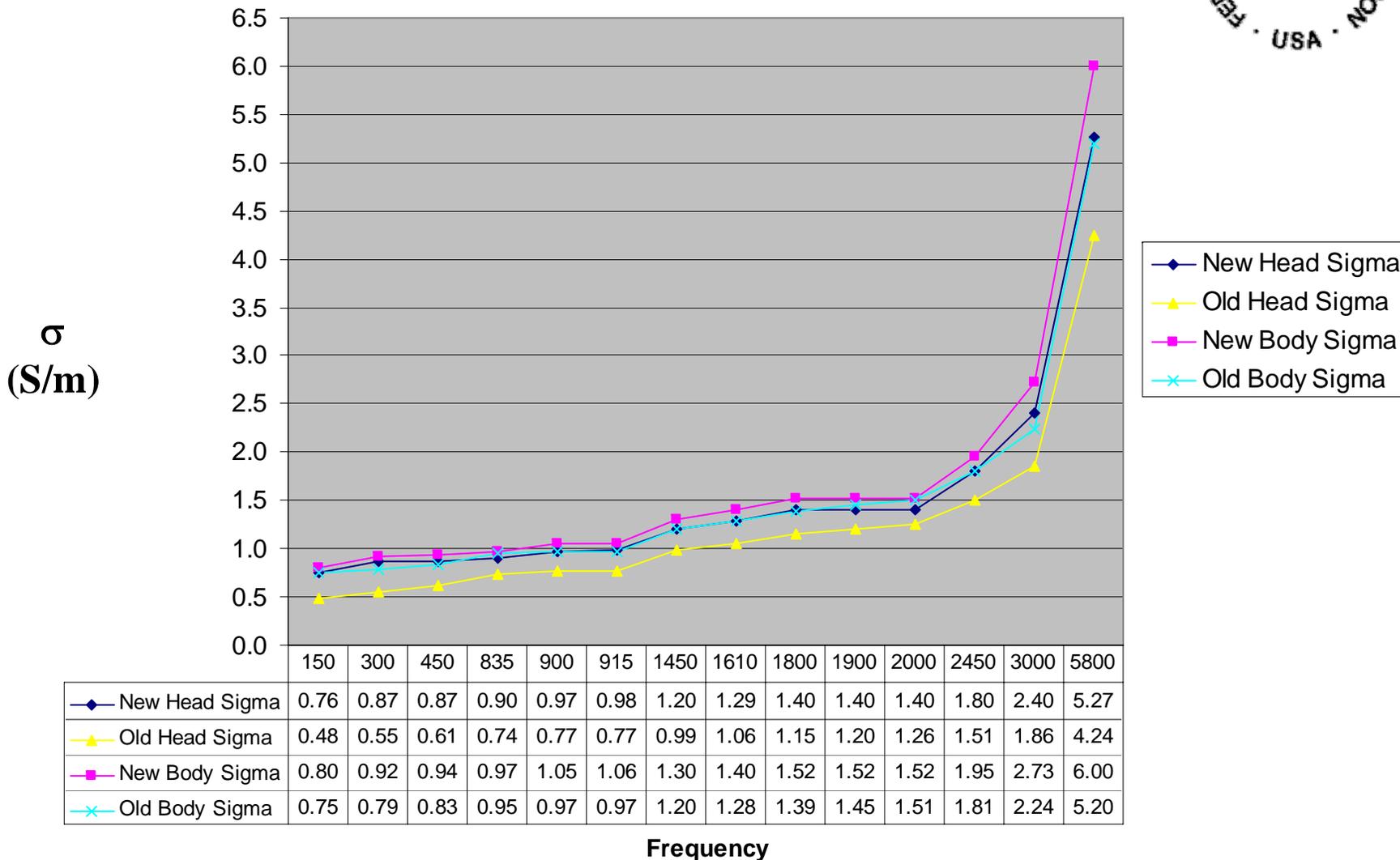
Supplement C: Tissue Parameters



Old values (97-01 version) New values 01-01 version. New values follow same trend and are more conservative.



Supplement C: Tissue Parameters



TCB Training



Evaluating compliance/SAR Review of Part 22 Subpart H and Part 24 Wireless Handsets for Equipment Approval

Supplement C – 01-01 Scan Procedures

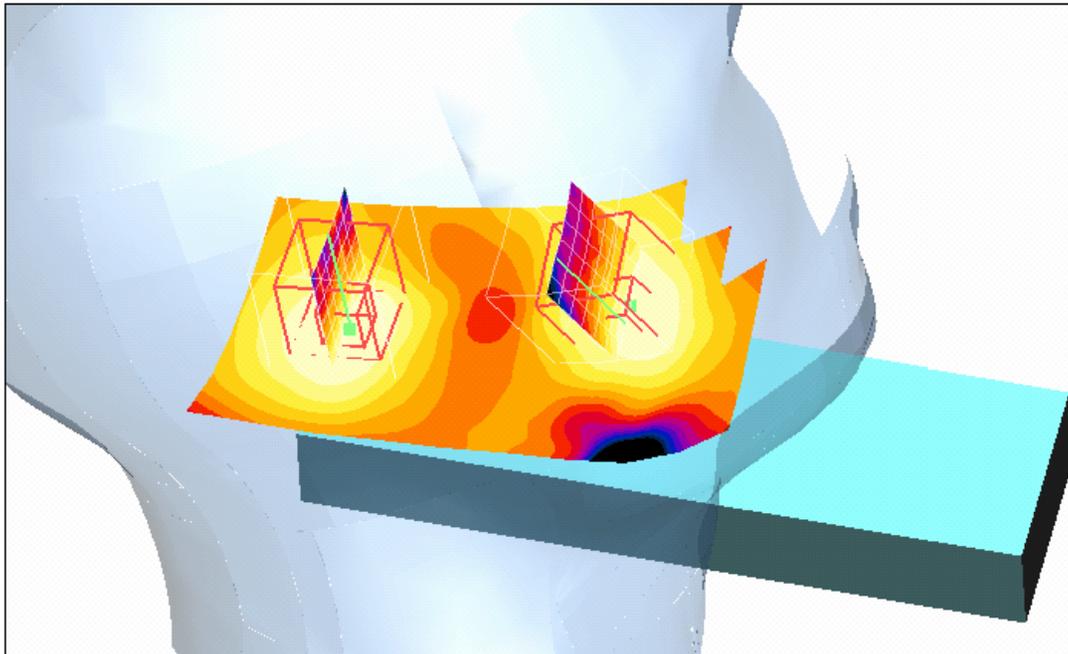
12-13 May, 2003

Supplement C: Scan Procedures



- field scan considerations
 - homogeneous phantom
 - peak SAR near phantom surface
 - probe boundary effects error
 - probe tip $> \frac{1}{2}$ probe diameter from phantom surface unless compensated
 - evaluate near-field exposure conditions
 - area scan to search for peaks
 - zoom scan to determine 1-g SAR

Area and Zoom Scans



Supplement C: Scan Procedure



○ Area Scan

- cover an area of the phantom larger than that projected by the device and its antenna
- at a fixed distance from the inside surface of .5 probe diameter $< \text{distance} \leq 8.0 \pm 1.0$ mm
- measurement resolution
 - sufficient to allow interpolation algorithms to identify SAR peaks to ± 5.0 mm
 - 1 - 2 cm spatial resolution is typically sufficient (1 cm is typically used)

Supplement C: Scan Procedure



○ Area Scan

● peak locations

- identify on SAR plots with respect to device outline and phantom reference grid
- perform zoom scan on all peaks within 2.0 dB of the highest peak
- repeat area scan with expanded boundaries if peaks are closer than 5.0 mm (10.8 mm for 10-gram SAR) from scan boundary
- consider probe boundary effects and isotropy errors when scan near phantom side-wall - tilt probe or phantom as necessary

Supplement C: Scan Procedure



- zoom scan
 - centered at peak locations interpolated from area scan measurements
 - scan extends 1.5 times the linear dimension of 1 or 10 gram cube in all directions from each area scan peak (including extrapolation to surface) (extends 3 times linear dimension from surface)

Supplement C: Scan Procedure



- zoom scan
 - points near the phantom surface
 - Measured in the z direction
 - first 2 points - within 1.0 cm from surface
 - last point - SAR value < 25% of first point
 - adjacent points - < 5.0 mm separation
 - points at surface are extrapolated from measured points in z direction
 - 4th order polynomial least square fit typically used for extrapolation
 - new extrapolation coefficients for each z axis scan

Supplement C: Scan Procedure



- zoom scan
 - measurement resolution
 - sufficient to allow the interpolation algorithms to compute SAR values on a 2.0 mm grid with < 5% error
 - 5 - 8 mm spatial resolution is typically sufficient (depends on gradient of SAR contour)
 - 7x7x6 points typical for 5mm spacing (7th point in z extrapolated)
 - determine the highest 1-g SAR
 - typically by trapezoidal integration

TCB Training



Evaluating compliance/SAR Review of Part 22 Subpart H and Part 24 Wireless Handsets for Equipment Approval

Supplement C – 01-01 Test Device

**October 2005 Updates to May 2003
Training**



Supplement C: Test Device

- test sample requirement
 - §2.908 - test sample identical to production units
 - §2.909 - grantee responsibility
 - need performance and production tolerances to establish test conditions (primarily power)

- device conditions



Device Class

- Handheld and lap held devices are PCB or TNB
- Devices with body worn accessories are PCT or TNT
- Devices held at the ear are PCE/TNE
- Use the more “distinctive” class if a device has multiple use positions*



Supplement C: Test Device

- output power
 - test at maximum output (within 5% of maximum)
 - may scale SAR by up to max. to compensate*
 - verify output stability according to device specifications
 - conducted output measurement before & after SAR
 - or measure SAR drift before and after SAR if applicable
 - device cannot maintain a constant average output
 - evaluate SAR based on highest expected exposure according to battery capacity
 - assure conservative SAR
 - device is operating within designed range

m1

m1

Q&A . Need further explanation on how the 5% scaling of output power is applied in the SAR checklist.

Supplement C states: "Transmitters should be tested at the maximum output level for normal operation within the intended wireless networks, to avoid undesirable performance issues that could lead to SAR changes. The measured SAR values may be scaled to cover certain output tolerances expected among production units during normal use provided the scaled values are within 5% of the measured values." If scaling is needed to an output power beyond 5% of as tested, SAR test should be repeated with power adjusted to the scaled target level. In general the grant should reflect whatever power level was tested.

Additional background info for 5% scaling guideline is given in following excerpts from Interpretations Database.

http://hraunfoss.fcc.gov/eas_public/SilverStream/Pages/pg_html_fts_res.html?letter=1202

25 Sep. 2001

Request for clarifications on Supplement C – 0101

Received from a specific group on July 16, 2001

"Question 12. Page 49-50, the issue of TDMA scaling was not answered to clarify how to perform this test on devices not intended to be operated continuously in transmit mode for 20 -30 minutes at the highest TDMA duty factor.

FCC Answer 12. Handsets are generally designed to operate continuously until the battery runs out. The generic procedures developed for testing most handsets may not apply to non-standard devices and operating configurations. Commission staff has already discussed the issues relating to a specific product from this manufacturer.

Question 18. A maximum limit of 5% scaling to max power will require that the transmit power be artificially adjusted to the upper limit of the production transmit power specification window. This may not be possible for some products wherein the normal distribution is significantly below the upper limit which is based on a worst case unit. Other designs do not have factory adjustable power and instead rely on the design and component tolerances to provide a high yield to the transmit power specification window. How should these products be handled?

FCC Answer 18. The handsets manufactured today typically require rather tight tolerance to meet network and design requirements. We anticipate a very small number of products to be in this category. When the SAR is close to the limit and the output variations among production units are high, testing at output levels significantly below the upper limit may not demonstrate compliance. The described situations are more likely to appear in unlicensed transmitters."

mperrine, 5/2/2003



Supplement C: Test Device

- battery options
 - test with fully charged batteries
 - impact of battery configurations on SAR
 - battery cell configurations and construction
 - physical dimensions
 - for physically similar batteries changes in radiated power may indicate need for SAR testing



Supplement C: Test Device

- signaling modes
 - test with built-in test modes
 - AMPS - unmodulated carrier
 - TDMA - test signal with time-division duty factor
 - CDMA - full vocoder rate and maximum occupied bandwidth
 - test modes not available or inappropriate
 - activate test device through base-station simulator
 - downlink signal at test device should be 20-30 dB < uplink signal
 - Look for CDMA watch for VOX like modes



Supplement C: Test Device

- signaling modes
 - multiple modes operating in same frequency band
 - test all modes with maximum source-based time-averaged output within 1.0 dB of the mode with highest output see PN 02-1438
 - TCBs with CDMA 2000 or UMTS devices should seek FCC advise prior to granting
 - modes with substantially low duty factor
 - evaluate SAR at highest expected duty factor
 - device may not be able to maintain constant peak output due to hardware or battery limitations at artificially higher DFs
 - can SAR system measure correctly
 - co-located transmitters e.g. Blue Tooth



Supplement C: Test Device

- time averaging
 - satisfy source-based time averaging requirement
 - inherent to device hardware or transmission protocol
 - operational duty factors do not qualify (PTT device exception, 50% allowed for gen. pop., other percentage for occupational, if justified)



Supplement C: Test Device

- time averaging
 - test with source-based time averaging duty factor not with constant transmission /CW

 - time averaging requirements for general population/uncontrolled and occupational/controlled exposure are different (source based only and 50% DF for PTT special case)



Duty Factor and GSM

- Test with maximum average power for both body-worn and head positions.*
 - Typically use only GSM (1 time slot) mode when testing at ear unless
 - If GPRS Class A capable (allows simultaneous voice and data)—use GPRS
- GPRS capabilities of the device should be clearly stated in the filing. Please include the two GPRS classes (e.g. class 10 and class A).
- Apply this concept when evaluating non GSM devices with duty factors.
- Duty factor need not be included on the grant comment when clear or standard protocol is used.*



Supplement C: Test Device

- operating capabilities
 - test channels
 - high, middle and low frequency channels per band
 - middle channel only if transmission band < 10 MHz or SAR < 3 dB below limit see PN 02-1438



Frequency Criteria Update

- currently indicated in Appendix D of Supplement C 01-01, last paragraph of section “Device Operating Next to a Person’s Ear,”
 - “If the SAR measured at the middle channel for each test configuration (left, right, Cheek/Touch, Tilt/Ear, extended and retracted) is at least 2.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).”
 - SCC-34/SC-2 has revised its recommended SAR measurement procedures from 2.0 dB to 3.0 dB

Power Criteria Update



- SCC-34/SC-2 revised procedures for testing wireless handsets
- with multiple operating modes in the same frequency band*
- Current procedures in Appendix D of Supplement C 01-01 require all modes with a maximum source-based time-averaged output within 1.0 dB of the mode with the highest output to be tested to demonstrate compliance, which should be replaced with the following procedures

Power Criteria Update



- procedure
 - when multiple operating modes exist within the same frequency band and the lower output mode is 2 dB or less from that in the highest output mode, test the device in the that lower output mode according to the normal Supplement C requirements; otherwise, continue with the following procedures
 - when multiple operating modes exist within the same frequency band and the lower output mode is lower than that in the highest output mode by more than 2 dB, test the device in the highest output mode according to the normal Supplement C requirements and apply the following procedures
 - test each lower output modes in the configuration that resulted in the highest 1-g SAR in the mode with the highest output

Power Criteria Update



- procedure continued
 - in additional, test the lower output modes in the following configurations when the 1-g SAR for the highest output mode of such configurations are greater than 0.8 W/kg:
 - the antenna position and channel that produced the highest 1-g SAR in the Left Head Touch Position
 - the antenna position and channel that produced the highest 1-g SAR in the Left Head Tilt Position
 - the antenna position and channel that produced the highest 1-g SAR in the Right Head Touch Position
 - the antenna position and channel that produced the highest 1-g SAR in the Right Head Tilt Position
 - if the 1-g SAR measured for any configuration in each of the lower output mode is $\geq 85\%$ of that measured for the highest output mode, the normal Supplement C requirements should be used to complete the entire set of required tests for such lower output mode(s)



Power droop

- power droop—Assure SAR is conservative
 - generally a problem for low cost PTTs
 - SAR measurement error because of assumption of static field
 - test as normally used, can scale SAR results up by drift.
 - optimize scan procedures as possible to.
 - Shortened scans
 - Focused scans

TCB Training



Evaluating compliance/SAR Review of Part 22 Subpart H and Part 24 Wireless Handsets for Equipment Approval

Supplement C – 01-01 Device Test Position

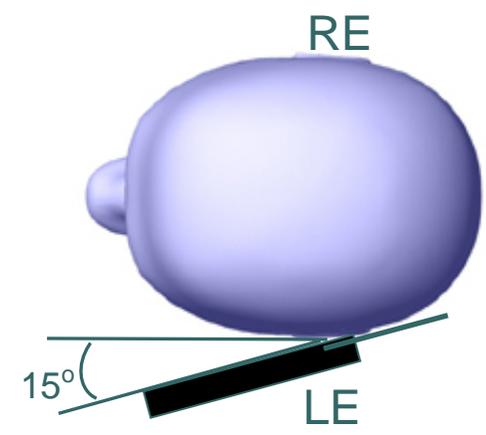
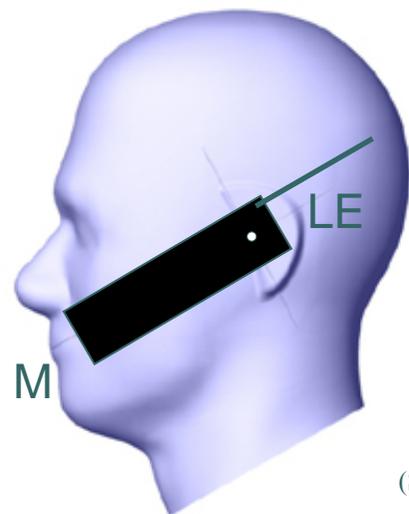
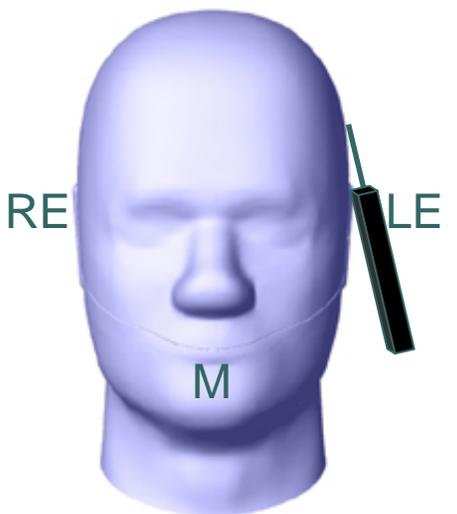
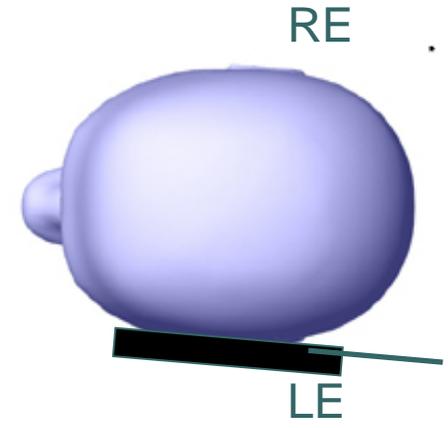
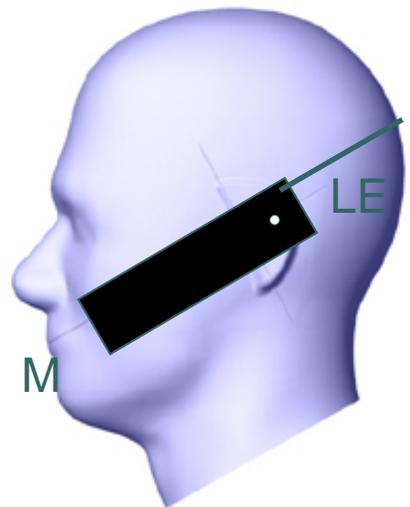
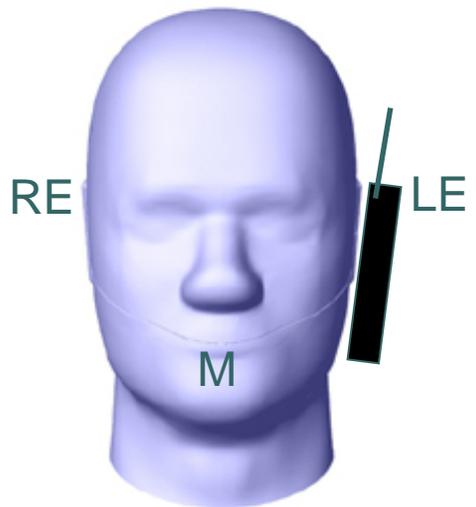
**October 2005 Updates to May 2003
Training**

Supplement C: Device Test Position



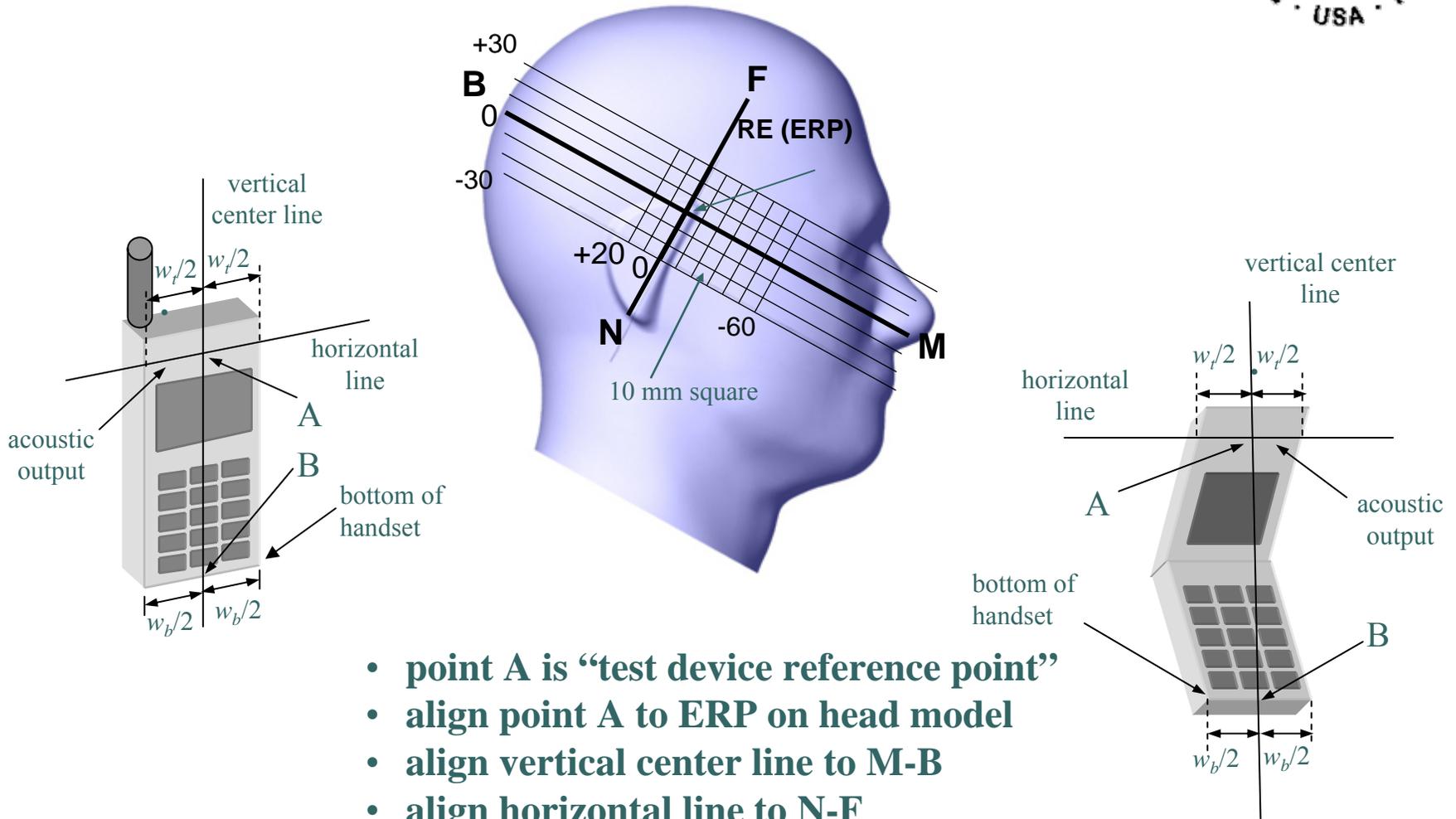
- IEEE STD 1528 standardizes head test positions for Pt 22/24 like handsets
 - two test positions - “cheek/touch” and “ear/tilt”
- Supplement C gives body-worn test positions
- test other positions based on expected/intended use e.g. pocket, necklace or held to face test positions.
- test worst case conditions as appropriate

IEEE STD 1528 Draft: Device Test Positions



(Source: based on IEEE SCC-34/SC-2, IEEE STD 1528 Draft)

Supplement C: Device Test Position



Supplement C: Device Test Position



- for head start with “initial ear position”
 - ear-piece of device pressed against ear spacer on phantom
 - align “test device reference point” (A) to ERP on phantom
 - align vertical center-line on the front of device to M-B line on phantom
 - align the front surface (horizontal line) of the device parallel to N-F line

Supplement C: Device Test Position



- cheek/touch position
 - from IEP pivot against ERP and N-F line to bring handset to touch cheek

Supplement C: Device Test Position



- ear/tilt position
 - establish cheek/touch position
 - maintain all alignments and translate handset away from cheek
 - rotate with respect to “test device reference point” (A) away from the mouth by 15°
 - maintain all alignments and translate handset back to the cheek until it touches the phantom or the ear spacer
 - if antenna touches the phantom/head first (before the device body), repeat process with less than 15° tilt until the device and antenna touches the phantom simultaneously

Supplement C: Device Test Position



- ear/tilt position
 - Following statement relates to pre SAM interim phantom
 - establish and measure at “initial ear position” if
 - ear-piece of handset is not in full contact with the ear spacer on the phantom, in cheek/touch position AND peak SAR location for cheek/touch position is at the ear spacer region or corresponds to the ear-piece region on the device establish cheek/touch position

Supplement C: Device Test Position



Phantom Configurations	Device Test Positions	Antenna Position	SAR (W/kg)								
			Device Test channel, Frequency & Output								
			Channel: ___ ___ MHz			Channel: ___ ___ MHz			Channel: ___ ___ MHz		
			SAR W/kg	Power before	Power after	SAR W/kg	Power before	Power after	SAR W/kg	Power before	Power after
Left Side of Head	Cheek / Touch	extended									
		retracted									
	Ear / Tilt	extended									
		retracted									
Right Side of Head	Cheek / Touch	extended									
		retracted									
	Ear / Tilt	extended									
		retracted									

- When the measured SAR at the middle channel of each test configuration (left, right, Cheek/Touch, Tile/Ear, extended and retracted) is at least 3.0 dB (changed in PN 02-1438) lower than the SAR limit, testing at the high and low channels is optional
- If the test device has a transmission band less than 10 MHz, testing at the high and low frequency channels is optional

Supplement C: Device Test Position



- Body-worn operating configurations
 - belt-clips, holsters supplied or available as options
 - test SAR with specific body-worn accessories in normal operating conditions with a flat phantom and body parameters
 - with antenna extended and retracted at high, middle & low frequency channels
 - if separation distance is the only parameter that affects SAR, the nonmetal accessory providing the smallest separation may be tested
 - with headset

Supplement C: Device Test Position



- Body-worn operating configurations
 - belt-clips, holsters supplied or available as options
 - User instruction- *“For body worn operation, this phone has been tested and meets the FCC RF exposure guidelines when used with the (manufacturer name) accessories supplied or designated for this product. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.”*

Supplement C: Device Test Position



- Body-worn operating configurations
 - specific belt-clips, holsters are not supplied or available as options for the device
 - test with 1.5 cm air separation between the back of the device and a flat phantom (not exceeding 2.5 cm)
 - can only use accessories that can provide a separation larger than that tested and and there is no metal in the assembly
 - with headset

Supplement C: Device Test Position



- Body-worn operating configurations
 - specific belt-clips, holsters are not supplied or available as options for the device
 - user instructions
 - *“For body worn operation, this phone has been tested and meets FCC RF exposure guidelines when used with an accessory that contains no metal and that positions the handset a minimum of (specified distance) from the body. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.”*

Supplement C: Device Test Position



- Body-worn operating configurations
 - Combinations with and without accessory
 - *“For body worn operation, this phone has been tested and meets the FCC RF exposure guidelines when used with a (manufacturer name) accessory designated for this product or when used with an accessory that contains no metal and that positions the handset a minimum of (specified distance) from the body.”*

SAR Testing

- Supplement C recommends that phantom should be twice the size in critical dimensions of the DUT.



- For laptops the DUT is generally considered the transmitting module and/or antenna.

Face versus Ear SAR



- **When held-to-ear is worse case configuration held-to-face results do not need to be reported for TNE/PCE.***
- **When held-to-ear mode is applicable, PTTs need evaluation.**
- **Grant notes should list SAR as “head” not “face”. Add the following if desired, “SAR was evaluated for held-to-ear and held-to-face operating modes”**



Next to Body Use

- Devices with Neck worn lanyards or that are intended to be next to the body should be tested with 0 gap and body tissue liquid. *
- Check user manual for references to such use conditions.

● An eyelet on the device does not necessitate use of neck lanyards. Instructions to the user should be considered.

User Manual Extract

...2. ACCESSORIES

- Ni-MH Battery Pack
- 120VAC Wall Charger for CD-26
- CLIP-14 Belt Clip with screw
- Lanyard
- Owner's Manual.....



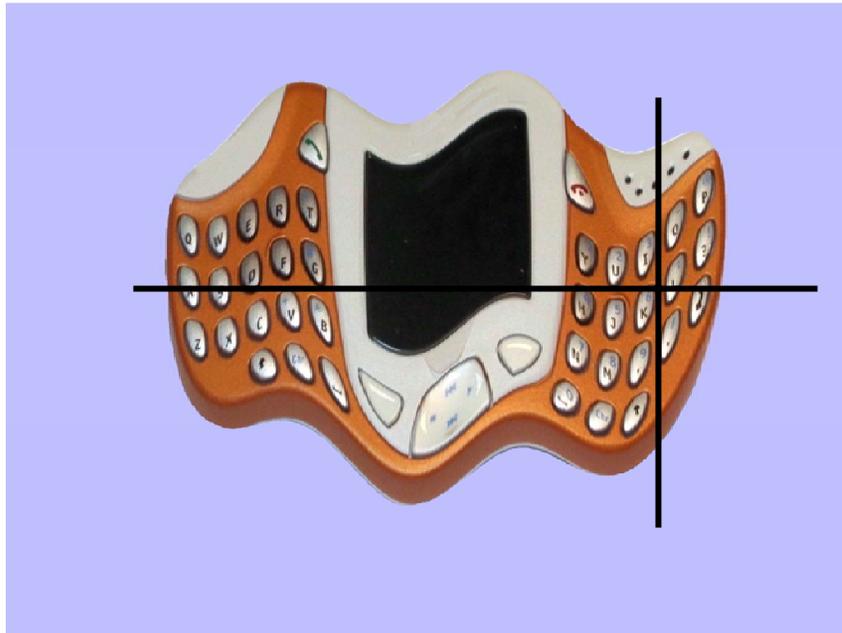
Reviews– Specific Issues

Handset usage positions

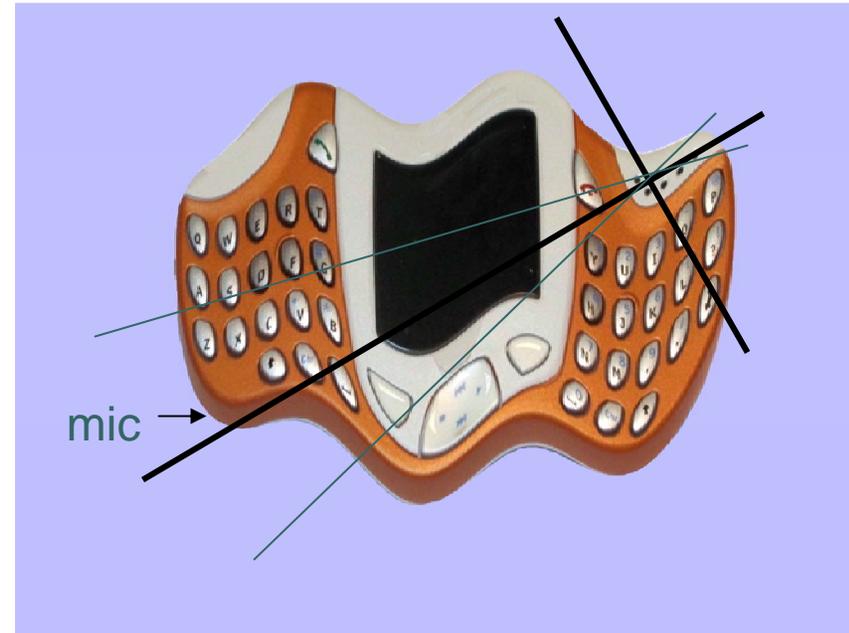
- When held-to-ear is worst case configuration head-to-face results do not need to be reported for TNE/PCEs.
- Evaluate PTTs for held-to-ear mode if applicable.
- Grant notes list SAR as “head” not “face”. Add the following if desired, “SAR was evaluated for held-to-ear and held-to-face operating modes”

“Current Issues”

Unusual form factors and reference lines



OR



“Current Issues”

Unusual form factors and reference lines



From August TCB conference call

Question: With regards to determining reference lines for SAR testing of handsets, what type of devices do the recommendations for reference lines under "Device Operating Next to a Person's Ear" on Page 41 of Supplement C apply? How are reference lines for other devices determined?

“Current Issues”

Unusual form factors and reference lines



Response: Supplement C Page 41 reference line definition applies only to what is referred to as "most wireless handsets", meaning conventional styled portable phones -- flat and rectangular or in a typical clam-shell style. For these conventional shaped phones the alignment point is the intersection of vertical & horizontal center lines on the phone. The ear piece may be somewhat off centered but not by a substantial distance.

For phones with non-conventional shapes, the IEEE SCC-34/SC-2 committee which drafted IEEE STD 1528 allowed or considered alternative alignment procedures. When alternative phone alignment is applicable for SAR evaluation, the intent is to test according to normal use configurations.

continued

“Current Issues”

Unusual form factors and reference lines



continued

Determining normal usage configurations or positions may require judgmental interpretation. For this reason, until procedures to determine normal use configurations are provided, TCBs should query the FCC during their review for a determination or confirmation of necessary test positions for devices with unconventional shapes. The TCB should assure that all determined test positions are evaluated. For a particularly unusual device shape, the FCC reserves the right to require the filing for Certification to be submitted to the FCC.

New— Mobile to Portable and Portable to Mobile



- TCBs may process Class II filings for the following specific situations*¹:
 - Add passive vehicle-mount antenna to held-to-head, body-worn and hand-held devices (TNE, PCE, PCT, TNT).²
 - Add additional specific hosts/antennas to devices approved with Limited Modular Approval.³

TCB Training



Evaluating compliance/SAR Review of Part 22 Subpart H and Part 24 Wireless Handsets for Equipment Approval

Supplement C – 01-01 Ambient Condition

12-13 May, 2003

Supplement C: Ambient Conditions



- characterize the RF environment of the test site
- monitor ambient conditions during tests
 - RF noise and interference effects
 - high frequency - test equipment
 - low frequency - field probe performance
 - verify with SAR measurement with no RF power when necessary

Supplement C: Ambient Conditions



- monitor ambient conditions during tests

- temperature and humidity effects
 - typical operating conditions for most test equipment
 - 20 - 26°C and 30 - 70% humidity
 - tissue dielectric parameter Recommendation - ± 2 °C
 - electrostatic discharge at low humidity conditions
 - impact on field probe, tissue medium and equipment

TCB Training



Evaluating compliance/SAR Review of Part 22 Subpart H and Part 24 Wireless Handsets for Equipment Approval

Supplement C – 01-01 Test Report

**October 2005 Updates to May 2003
Training**

Supplement C: Test Report



- FCC Reminder Sheet, based on appendix B
- class will cover reminder sheet to address the following slides



Supplement C: Test Report

- **test device and exposure categories**
 - **general information**
 - FCC ID
 - an affirmative statement of compliance (§2.909)
 - device category - mobile or portable
 - exposure environment - controlled or uncontrolled
 - **operating configurations and test conditions**
 - production unit or an *identical* prototype (§2.908)
 - test device description, operating configurations
 - operating frequencies, modes, max. output ratings
 - operating tolerances
 - antenna types, operating positions, body-worn configurations, battery options etc.
 - test signal, time-averaging, max. measured output



Supplement C: Test Report

- SAR measurements
 - SAR system and site descriptions
 - E-field probe - specs, calibration record etc.
 - system performance verification
 - setup description, tissue parameters, 1-g SAR, uncertainty
 - phantom(head, body) - specifications and tolerance
 - tissue dielectric properties
 - composition of ingredients
 - measured dielectric parameters at mid-band frequencies
 - temperature and ambient conditions for dielectric measurement

Supplement C: Test Report



- photos of device and accessories
 - identify the device and its accessory configurations
 - identify characteristics and components that affects SAR e.g. ear jack, memory slots, extendable antenna, alternate batteries etc.
 - as justification for reducing the number of tests

Supplement C: Test Report



- setup photos, illustrations and descriptions
 - to show test configurations
 - with and without accessories attached to the device
 - headset and other necessary connections and lead placement etc.
 - demonstrate appropriate test positions
 - device holder - description and positioning tolerance
 - antenna positions and device positioning procedures

Supplement C: Test Report



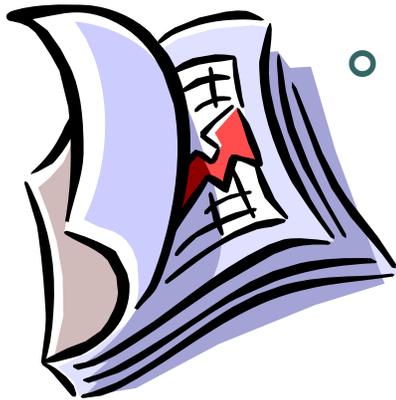
- SAR plots
 - to show peak SAR location with respect to the device
 - to justify reducing the number of tests
 - see reminder sheet for details to include
 - observe well behaved SAR measurement

Supplement C: Test Report



- SAR measurements
 - peak SAR locations
 - area scan search and interpolation procedures
 - identify peak with respect to device and phantom
 - 1-g SAR
 - zoom scan procedures
 - extrapolation, interpolation and integration procedures
 - measurement uncertainty
 - list of error components for the measurement
 - combined standard uncertainty and expanded uncertainty
 - address abnormal uncertainty issues
 - documenting compliance
 - tabulated test data and SAR plots to show compliance

User Instructions and Grant Comments



- Information on test configurations, calculation assumptions, grant comments, other EAS exhibits and user instructions should be consistent.
- User instructions should assure compliant operation of the device and address relevant issues.
 - Collocation with other transmitters.
 - Definition of host devices for modular transmitters.
 - Body worn accessory information.
 - Minimal MPE distance, and installation and antenna requirements.
 - Occupational training.
 - PTT usage duty factor including VOX and data operations.*



SAR Values in Grant Comment

- Recommended formats for PCE/TNE devices; two examples.
 - Single band

Highest reported SAR values are AMPS (Pt 22)- head: 1.33 W/kg; body: 0.79 W/kg.
 - Dual band

The highest reported SAR values are: CDMA 800 (Part 22) – head 0.09 W/kg; body 0.75 W/kg; CDMA PCS (Part 24) – head 0.12 W/kg; body 1.41 W/kg.
- State highest head and body value for each band of operation.

Misc. RFx Grant Notes - Review



- Consistent grant notes are used for uniformity in application processing, and may be updated as part of ongoing Lab policy reviews and concurrent with docket 03-137
- Example: 15.247 desktop 100mW or less
 - Either can be used:
 - “The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons ...”
 - “This device is approved as a mobile device with respect to RF exposure compliance.”
 - Mobile device grants should list other distance for FCC RF exposure compliance when greater than 20cm

User Manual RFx Info - Review



- Layman's description of RF exposure and general or specific means to comply with FCC RFx limits
- User-instruction separation distances differing from those used in evaluation should be appropriate and explained
- General collocation definition and restrictions

User Manual RfX Info - Review



- Clearly describe intended and approved host(s) for generic module grants
 - Example: laptop only if that is how tested
- Body-worn/accessory instructions, if applicable, consistent with test configurations
 - Example: see Suppl. C & previous TCB training notes
- Other instructions specific to a device needed for user to operate in compliance with FCC rules
 - Example: indoor-only use for NII 5.2 GHz band

TCB Training



Evaluating compliance/SAR Review of Part 22 Subpart H and Part 24 Wireless Handsets for Equipment Approval

Preparing for SAR Review

**October 2005 Updates to May 2003
Training**



Preparing for SAR review

- External photographs
 - look for antenna type
 - look for covers/lids
 - look for batteries, accessories and jacks
 - agreement with stated device type



Preparing for SAR review

- Users manual
 - check RF safety statements
 - look for batteries, and accessories
 - test other positions based on expected/intended use e.g. pocket, necklace or held to face test positions.
 - test worst case conditions as appropriate



Preparing for SAR review

- Users manual
 - special operating modes such as GPRS
 - BT or other co-located transmitters
 - card slots



Preparing for SAR review

- EMC report
 - get emission types
 - get maximum power
 - power tolerances
 - look for accessories



Preparing for SAR review

- Tune-up procedure/operational description
 - look for power specifications
 - get power tolerances
 - look for control methods/codes

Preparing for SAR review



Review Practice EA101663



Preparing for SAR review

EA101663

- External photographs
 - look for antenna type-- retractable
 - look for covers/lids— has cover
 - look for batteries, accessories and jacks— 1 battery, headset jack
 - Agreement with stated device type-- yes



Preparing for SAR review

EA101663

- Users manual
 - check RF safety statement— good statement
 - look for batteries, and accessories— search on batter, cover, answer, GPRS, camera and headset. Possibly can transmit with cover closed
 - determine user configurations— nothing unusual



Preparing for SAR review

EA101663

- EMC report
 - Get emission types— 800 MHz AMPs and CDMA
 - Get maximum power— radiated measured, conducted from BW plots
 - Get power tolerances
 - Look for accessories— 1 battery



Preparing for SAR review

EA101663

- Tune-up procedure/operational description
 - Look for power specifications
 - Look for control methods/codes— **control codes**



Sailing through an Audit

- Double check filing details
 - Form 731 entries typos and missing lines
 - Missing or incorrect exhibits
- Use Supplement C procedures to the extent possible
 - Justification given otherwise
- Use 2000 exclusion procedures carefully where more current procedures or guidance have not been given
- FCC SAR reminder sheet



Sailing through an Audit

- Account for “old issues”
- Account for “current issues”
- Anticipate new problems
 - Example— new technology or usage position
- Use TCB training and interpretations data base as first point of search
- Contact FCC for all questions when unsure



Sailing through an Audit

Recent TCB strides toward conformity to Supplement C aka “old issues” discussed during February 2002 training

- Reporting-
 - comprehensive and follows Supplement C
- Tissue parameters
 - within target window



Sailing through an Audit

Recent TCB strides toward conformity to Supplement C aka “old issues” discussed during February 2002 training

- Probe calibrations
 - Done in band and in appropriate liquid type
 - 800 FOR 600 WMTS
 - 450 FOR 378-430 DEVICE
 - 2400 at 2700
 - 1800 at 1600
 - 1800 at 1900



Sailing through an Audit

Recent strides toward conformity to Supplement C aka “old issues”

- Updates to Supplement C in Public Notice DA 02-1438
 - Phantom changeover
 - Reduce test configurations for lower power modes
- Flat Phantom thickness - 2 mm



Sailing through an Audit

○ “Current Issues”

- Flat Phantom size for large PTTs—twice device size
- Smartphones/PDAs may require special test configurations-lap-held and shirt pocket positions should be tested if these are intended/expected usage positions, user warnings should be considered if not



Sailing through an Audit

- “Current Issues”
 - Special accessories require special test configurations
 - Card slots for expanded functionality
 - Bluetooth transmitters and collocation issue
 - Cameras/MP3 players



Reviews– Specific Issues

Accessories--BT Add-on to Handsets

- Separate FCC ID is necessary.* Use Module Approval procedure (Limited) when appropriate.
- Device must comply with EMC and SAR limits in all final configurations.



Reviews– Specific Issues

Accessories-BT Add-on to Handsets

- Like modules, OEM coordination/control or specific “hosts” are best strategies.
 - Limit undefined host devices to a family of manufacturer X devices. Manufacturer accepts compliance responsibility.
 - Provide means to prevent use with other phones. Ideally use unique connector or software controls.
 - SAR collocation evaluation with all intended hosts is not requested for most standard configurations* but can be provided.
 - proposed grant comment *



Reviews– Specific Issues

Smart phone collocated transmitters

- TCB should perform SAR review only in cases where current TCB exclusion list allows.
- Section II e applies for Parts 22/24 and SMR devices.*
- Rulemaking outcome may apply.

Hand-helds PTT



- Hand-helds PTT issues follow

“Current Issues”

Grant comment and user manual statements



PTT devices

- For general population exposure when above TCB threshold include:
 - usage duty factor instructions
 - Body worn use
- Always needed for Occupational exposure
- Reference TSB-133 effort
- NPRM 03-132 addresses warning labels

New OET RF Exposure Policies— SAR for PTTs



Previous – SAR is requested for PTTs (non SMR) devices over 1.5 W for FCC filings. TCB use exclusion list thresholds.

Updated – SAR is requested only for GMRS PTTs device over 1.0 W for FCC filings. No change for TCB filings

- New thresholds for all devices are being considered. FCC and TCB thresholds are expected to be harmonized.

New OET RF Exposure Policies— Gen. Pop. vs Occupational



Previous— Part 15, GMRS, FRS and public network devices must meet general population exposure limits. GMRS exception if marketing plan prevents access by the public. Other Part 90 devices are implied to operate in occupational conditions only. *

Updated— No change.

- TCBs should apply the above guidance
- User instructions/warnings consistent with current practices should be provided for exhibit.
- The ongoing NPRM addresses user instruction issues.

KDB RFX Parts 80,90 PTT - Review



- TCB filings for categ. excl. devices require SAR evaluation if output power is greater than low thresholds of July02 TCB Excl. List
- For PTT distance d is from phantom to back of device (like Part 22/24 handset body-worn test configuration)
- FCC and TCB filings do not request SAR for typical **VHF** (e.g., 150 MHz f_c) PTT devices
 - Standard testing and review/approval procedures are still not defined
 - SAR data if voluntarily submitted can be considered and reviewed by FCC not TCB

KDB RFx Parts 80,90 PTT (cont)



- RF exposure training instructions and labeling info is required for most Part 90 PTT portables, and Part 80 where applicable, to satisfy occupational criteria
 - Alternatively SAR data showing compliance with general population limit may be submitted (to FCC not TCB if 150 MHz band)
- RFx evaluation for body-worn transmit modes usually needed for devices having:
 - Headset jack
 - Remote speaker/mic control unit (e.g., at shoulder-strap)

RFx for Parts 90,80 PTT with Other Rule Parts on Grant



- Part 22
 - Occupational allowed for fixed (base station) only
 - Do NOT list on grants for mobile/portable devices that qualify for and use occupational limits
- Some 95A (GMRS) w/ Part 90 occupational have been allowed - make sure that device will not be marketed for general population use
- 74H Low Power Auxiliary Service $P \leq 1W$



PTTs

- power droop—Assure SAR is conservative
 - define droop-- power vs time plots
 - retest SAR with stabilized power for comparison to original results
 - wait for power to stabilize, scale to maximum
 - use external source, use RF chokes on cables

Power Droop

