THEMATIC NETWORK FOR
ULTRAVIOLET MEASUREMENTS

Working Group 4: UV Measurements related to health and safety

UV Measurements Related to Artificial Tanning Units

Final Report
November 2000

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FOREWORD

Working Group 4 was established by the EU Thematic Network for Ultraviolet Measurements in March 1998 to provide practical advice on suitable measurement techniques in health and safety aspects of ultraviolet radiation. The group decided to work on sunbeds and to produce an agreed methodology appropriate for measuring UV from an artificial tanning unit. Interpretation of standards and measurement techniques vary in different countries throughout Europe. It has become apparent that there is a need for a common approach to how measurements are carried out.

In the first chapter, some issues of interpretation are considered for typetesting of sunbeds according to EN60335-2-27. Next, the question of replacement lamps and labelling of such lamps in sunbeds is addressed. Following this, a list of acceptable replacement lamps for UV-Type 3 sunbeds is proposed. Thereafter, a specification of a field measurement device for sunbeds is defined. Finally, a sunbed database is described.

In all cases, the intention has been to raise the issues which are considered to be problematical and to offer a consensus view on a suitable solution. Where such a view was not possible, an attempt has been made to outline the options.

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13 October 2000

ACKNOWLEDGEMENTS

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Special Acknowledgement for discussion documents and presentation of data

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1 Typetesting of Sunbeds According to EN 60335-2-27

1.1 Background

All tanning units have to be tested according to the EN 60335-2-27 "Safety of household and similar electrical appliances. Part 2: Particular requirements for appliances for skin exposure to ultraviolet and infrared radiation." According to this standard, suntanning devices are classified into one of four types, specified by the emission of erythemally effective UV-irradiance.

The UV-protocols either made by the manufacturer, commercial testing laboratories or health authorities often diverge. Differences by a factor of 4 have been observed between European laboratories, mainly in the short wavelength-range, when the same device was measured. This is possibly due to differing testing methodology, irradiance scales, or different interpretation of the standard. It may also be due to improper production control by the manufacturers of tanning devices and/or UV sources.

By experience some laboratories classify tanning units without specifying UV-sources, which is the most important component when it comes to the UV-irradiance. UV-sources with identical names can have widely different spectral irradiance which are not acceptable. A difference up to a factor of 9 in CIE-weighted irradiance is registered. Requirements for the production quality are necessary.

Typetesting conditions are specified, pointing on possibly inadequately testing conditions as stated in EN 60335-2-27.

1.2 Considerations for Typetesting of Sunbeds.

Interpretations of and comments to some of the clauses in EN 60335-2-27 pt. 32.101 are presented in this part.

32.101 "The appliance is supplied at rated voltage…"

The appliance is supplied at rated voltage ± 10 VAC. The spectral results are corrected according to the difference from nominally 230 VAC by 0,5 % increase in both UVA and UVB per VAC around 230 V. No electrical parts influencing the UV irradiance should later be changed from the tested prototype.

32.101 "UV emitters which have been aged by supplying them at rated voltage for a period of

- *5 h ± 15 min. for fluorescent lamps;*
- *1h ± 15 min. for high-intensity discharge lamps."*

" ... operated for approximately half of the maximum exposure time allowed by the timer."

The sunbeds shall be equipped with new lamps when arriving at test laboratory. The ageing of the sunlamps has to be performed at the test laboratory. The acrylic plates are cleaned with pure water before measuring. Measurements start 10 minutes after the sunbed has been switched on.

1.3 Criteria Regarding the Measuring Instrument

32.101 Notes 2:

"... mean irradiance over a circular area having a diameter not exceeding 20 mm."
"... response ... proportional to the cosine..."
"... bandwidth not exceeding 2,5 nm."

A new amendment has confirmed that in 32.101 the maximum value throughout the tanning surface is to be recorded. The new amendment has been added to the standard IEC335-2-27 (Amendment 1:2000-02) and also to the EN standard. Under 32.101 of 60335-2-27 a new line has been added to the second sentence in the third paragraph "the measuring instrument being positioned so that the highest radiation is recorded."

A broadband radiometer with probe for erythemally spectral responsivity according to CIE can be used for localising the positions of maximum irradiance and for mapping the uniformity over the tanning surface. It should be noted that a broadband UVA detector is not sufficient for this purpose, especially when combination of different UV-sources is used. Maximum is decided with all sources turned on.

To measure spectral irradiance, a spectroradiometer based on a double monochromator system is needed for proper stray light rejection. An uncertainty budget including uncertainties due to standard lamp, transfer, repeatability, stray light, linearity, cosine error, wavelength accuracy is needed. Measurement accuracy shall be within ± 15 %.

Ambient temperature shall be 23 ± 2°C. The instrument has to be temperature stabilised or corrected.

The monochromator has to be treated so that no loose parts can move due to turning of the instrument. Use of optical fibre is preferable.

The input optic should be cosine matched or corrected.

Traceability to national standard laboratory is required.

1.4 Measuring Distance

32.101 "The irradiance is measured at the shortest recommended exposure distance"

Notes 2: "The exposure distance of UV emitters which are located over a person is the distance between the emitter and the supporting surface, reduced by 0,3 m."

In general, measurement of canopy is performed 0,3 m above the bench with the diffuser normal to the upper surface while the bench is covered. However, models having an extreme curved canopy or very strong UV-sources or inhomogeneous irradiance demand particular evaluation. In these cases, it may be more appropriate to measure with the diffuser at a different angle other than normal to the upper surface to correspond to measurement on the body surface.

1.5 Use of Reflectors

The irradiation from the upper and lower canopies should be measured separately. To do this, it is common practice to cover one set of lamps while measuring from the other. It

should be noted that some tanning units use lamps situated alongside the person with the light directed up on to reflectors to irradiate the upper surface of the body. In these machines, the same principle should apply that the lamps used to irradiate the upper and lower surfaces should be measured separately.

1.6 Evaluation of the Measured Values.

The total effective short and long wave irradiance must be less than 0,15 W/m^2 for any exposure distance to comply with UV type 3.

The question arises as to criteria for Pass or Fail. After much discussion opinion was divided on the following two options.

1. The test is Passed if the measured value is equal to or below the limit regardless of the uncertainty of measurement. If the measurement value is above the limit, again regardless of uncertainty, the test is not Passed. The testing laboratory may give a Fail decision or, at its own discretion, allow a second measurement to be carried out.

2. The test is Passed if the measured value is equal to or below the limit regardless of the uncertainty of measurement (as above). Also, if the measurement value is above the limit but within the limits of uncertainty, then the test is Passed. The test is Failed if the measurement value minus the uncertainty is above the limit.

At this stage the Working Group offers these two alternatives for further discussion.

1.7 Criteria for Acceptable Laboratories

The criteria for measuring instruments have to be fulfilled. Calibration of all instruments must be traceable to national standards laboratory. Calibration routines shall be documented and subject to external audit. The laboratory should participate in blind test intercomparison, testing on both irradiance standards and full size solaria.

1.8 Recommendations for Standardised Test Protocols

The test protocols should have similarly specified results and measurement information including the following information:

- UV-sources have to be specified in the classification document.
- Instrument used
- Uncertainty level
- Traceability to standard laboratory
- The irradiance levels must be specified as maximum values

2 Replacement and Labelling of Tube Lamps in Sunbeds

2.1 The Problem

Standardised categorisation and labelling of replacement fluorescent tube lamps for sunbeds is needed for the following reasons:

1. A specific UV lamp may be marketed with different brand names and type identifications due to appliance manufacturers' (OEM) requests to have their own identification on the UV source. All these lamps are identical but only the lamp identified in the marking on the appliance may be used for replacement purposes. There should be a system in place that allows lamps that are verified identical to be used.

2. Lamps marketed with the same brand name may have different emission characteristics. This may arise because they are sourced from different manufacturers or because the manufacturer has changed the specification. The lamp is identified in the marking on the appliance and may be used for replacement purposes. This problem should be addressed.

3. Another important problem arises when different manufacturers produce lamps under licence with significantly different emissions. Lamps produced by different manufacturers may have the same name but different specification.

4. There is a continuous development going on in the lamp industry, which means that new lamps with changed specifications are replacing old types. In those cases where the new lamp has UV-properties, which does not change the UV-type classification or exposure schedule of the appliance the new lamp should be allowed as replacement.

5. When a UV-appliance, sometimes very expensive, needs replacement of lamps and the original lamps are no longer available the owner will seek after equivalent lamps as long as the appliance is still in working order. UV-appliance owners need information from a reliable source on what lamp to choose when the original lamp is no longer available.

6. Health and safety personnel need simple, clear information when carrying out on-site inspections that the lamps used in a particular UV appliance do not reduce its safety.

7. National health authorities in some countries have realised this and national lists of equivalent lamps are officially issued. The lists are prepared according to nationally varying criteria. A harmonisation of criteria for equivalency of replacement fluorescent tube lamps is needed.

There is no easy and in general reliable way for a sunbed owner to select replacement lamps from different other lamp manufacturers – or even from the same manufacturer without disregarding the original exposure schedule from the sunbed manufacturer. Non-original replacement lamps in sunbeds may cause the sunbed UV-type to change and the user-instructions to become invalid. Sometimes too powerful replacement lamps cause sunburns.

2.2 Standards and Specifications

The problem of replacing old lamp models with new lamp models in tanning appliances is complex and not adequately addressed either in the safety standard for appliances for skin exposure to ultraviolet radiation IEC 335-2-27 (EN60335-2-27) or in the standard for measuring and specifying sunlamps IEC1228 (EN61228).

The latter standard states in an amendment (A1:1996) that: "The specification of the ultraviolet radiation of lamps according to this standard does not imply that on that basis a judgement can be made about direct replacement of lamps in a specific skin treatment appliance."

The radiation emission from the tanning appliance depends on a number of factors in addition to the type of lamp. These factors include: the number of lamps, the space between the lamps, the condition of the reflector, the electrical circuitry, the type of cover and its condition, the operating temperature of the lamps. These factors can all influence significantly the radiation received by the person using the appliance.

2.2.1 The Standard for Tanning Appliances IEC 335-2-27

The IEC safety standard 335-2-27 for tanning appliances describes how to measure, evaluate and specify the ultraviolet radiation from appliances equipped with original lamps as specified by the manufacturer of the appliance. It sets limits to the radiated power per unit area (irradiance, Watts per square meter) which is incident on the person using the appliance. Exposure schedule and recommendations for use in manuals etc is based on measured erythemally weighted irradiance data of the appliance equipped with the original lamps.

The standard states that replaceable UV emitters in appliances have to be replaced only by identical UV emitters. Appliances with replaceable emitters shall be marked with the type reference (manufacturer and model) of the emitter. Some appliances list several alternative emitters. The standard requires no UV-radiation characteristics of the emitter to be specified and labelled on the sunbed. There is no general equivalency data on the appliance regarding the lamps to help replace one brand or model with another.

The standard further states how the appliance, shall be categorised and labelled with UV-type based on measured erythemal CIE-weighted effective integrated irradiance (Watts/m²) below and above 320 nm. Sunbeds of UV-types 1, 2 and 4 have very high levels of UVA- and/or UVB-radiation and are intended for professional or medical use requiring special competence or caution - according to the standard. UV-type 3 solaria can be used by unskilled persons and the erythemally effective ultraviolet radiation, weighted according to CIE's action spectrum, is limited to 0,15 W/m², not only in the UVB-region below 320 nm but also in the UVA-region above 320 nm. The total (UVA + UVB) permitted erythemally effective level of ultraviolet radiation is 0,3 W/m², comparable to tropical sun.

2.2.2 The Standard for Lamps used in Tanning Appliances IEC 1228

The IEC standard 1228 for sunbed lamp measurements describes how to measure, evaluate and specify the ultraviolet power of lamps which are used in appliances for sun-tanning purposes. It states how lamps can be specified (but not labelled) based on measured erythemal CIE-weighted total effective radiant flux (Watts) below and above 320 nm. The lamp measurement standard 1228 specifies no categorisation or labelling system

compatible with the UV-types of the sunbed standard. There is no equivalency-guidance on the lamps to help replace one lamp with another in a sunbed.

The standard is not suited for fluorescent tube lamps which have an integrated reflector. Unlike standard fluorescent lamps, they do not emit through the complete tube wall (360°) but, rather, an inbuilt reflector causes emission only through part of the tube wall (160°). Measurement of total flux may be less than for the standard lamp, but the irradiance directed towards the exposed person will be greater. Reflector lamps can emit less total UV-power than non-reflector versions of the same lamp model but still cause higher UV-irradiance levels on a person in a sunbed.

2.2.3 Data Sheet Specifications of Lamps by Manufacturers

Electrical wattage, UVB percentage and physical UVA-flux of lamps are specified in most manufacturers' data sheets. In addition erythemal UV-flux below and above 320 nm according to IEC 1228 may be found in some data sheets. On the lamps however, usually only the electrical wattage is labelled plus the manufacturer's market name and identifications.

2.2.4 Spectral Filtering in the Appliance

It is important to note that the values in lamp data sheets or from the lamp measurement standard IEC 1228 are based on the naked lamp without cover! However, the upper and lower halves of a tanning appliance usually have acrylic covers. Some of these covers partly filter out the UVB of a lamp's output. Transmission characteristics of different acrylics in the UVB part differ tremendously (Philips Cleo Natural Product Information 3222 635 18851 11/98).

It has been demonstrated that replacement lamps with the same erythemal data as original lamps according to IEC 1228, but with different UVB percentage, in sunbeds may cause the sunbed UV-type to change from UV-type 3 "intended to be used by unskilled persons" to UV-type 4 "intended to be used following medical advice."

UVC-radiation of sunbed lamps is not desirable, but some appliances and acrylics effectively filter it out – regardless of the UVC-emission of the naked lamps.

2.2.5 UV-Radiation Levels of Lamps and Sunbeds

Theoretically the irradiance is constant at all distances from a radiating wall of infinite dimensions. At close distances this is true both for sunbed canopies as well as for single sunbed lamps. In general the excitance (irradiance at the surface) of a single tube lamp is representative of the maximum achievable UV-level of a tanning appliance with such lamps.

This could be explored for improving and making the applicable lamp and sunbed standards more complementing.

2.2.6 Modifying the IEC1228 Measurement Data

Erythemal radiant flux of a sunbed lamp, measured in large integrating spheres or by measurement of spectral irradiance and application of a suitable geometrical factor, as alternatives specified according to IEC1228, can be transformed to surface excitance by dividing the total flux by the lamp's total glass envelope area (0,2 m² of a 100 W tube

lamp). Surface excitance of lamps with an integral reflector can be calculated by dividing the flux with the total glass envelope area of the non-reflector opening (160/360 × 0,2 = 0,09 m²) of the lamp.

2.3 Criteria Necessary for Equivalency of Lamps

Certain requirements must be fulfilled (within reasonable margins) by equivalent replacement lamps:

1. A sunbed's recommended timer settings and exposure schedule should not change. The total level of erythemally effective irradiance should be roughly the same (± 20 %). A user should not be overexposed and perhaps burned because the lamps have been replaced. This means that the exposure duration required to produce erythema should not change.

2. A sunbed's spectral characteristics should not change. It is not considered acceptable to replace an erythemal exposure resulting from a certain portion of UVB of one lamp with the same erythemal exposure resulting from extreme levels of UVA from another lamp - or vice versa. The proportion of UVB should remain (± 20 %). The weighted short-wave UV of two lamp models need to match within 10 %.

3. A sunbed's UV-type should not change. This combines requirement 1 and 2.

2.3.1 Erythemal Quantity

The erythemal quantity should make lamps comparable, but should also be relevant to and indicative of the total erythemal level of UV-radiation in the appliance.

Table 1. Alternatives for erythemal quantities

UV-index	UV-index is defined as CIE-weighted erythemal irradiance multiplied by 40. To specify sunbed lamps the range should be 280 – 400 nm. Advantage: Already used world-wide to specify solar strength to public.
MED's/h	CIE-weighted erythemal irradiance. Definition of MED varies and also depends on skin type. 1MED = 210 J/m² (USA) or 250 J/m² (Germany). Philips Skin types: I = 125, II = 200, III = 300, IV = 450.
SED's/h	CIE-weighted irradiance. 1 SED = 100 J/m². Advantage: Standardised by CIE ("Standard Erythemal Dose"). Disadvantage: Not relevant for erythema. Unknown by public.
St. sun factor fs Or % of st. Sun	Factor (fs) or percent (%) of the erythemal irradiance of a standard sun (0,3 W/m² CIE = 1,0). E.g.: 0,8, 1,0, 1,2, 1,4 etc. Advantage: Easy to explain and disseminate Disadvantage: Unknown by public. No st. sun defined, what and where?
Burn-time	Minutes. Reciprocal of MED/h
St. burn-time factor	This can be based on standardising a lamp on normalised figures e.g. UV-irradiance = 100 W/m² and 1 SED. Then a tanning time can be used as a standardisation factor
Flux	Total erythemal radiation (IEC 1228) in W or mW. E.g.: 35 mW, 65 mW.

2.3.2 Spectral Data or Info

Table 2. Alternatives for spectral data

% UVB	Percent integrated "physical" UVB 280 – 315 nm of UVA 315 – 400 nm. Advantage: Widely used in data sheets, known among professionals and tanners. The only (?) criterion that distinguishes otherwise similar lamps which in tests give different UV-types.
Erythemal Ratio	Erythemally (CIE) weighted UV integrated below and above 320 nm.
"Sun similarity"	Spectral shape of lamp compared to spectral shape of a standard solar spectrum. Alternatives: Relative spectral match – least squares sum of differences for pair of spectra. Lamp spectrum normalised to unity compared to standard solar spectrum normalised to unit area. Same as a) but with CIE-weighted spectra. Correlation coefficient with a solar spectrum (physical or CIE). Some other mathematical or statistical parameter describing similarity of spectral shape.

2.3.3 Combinations

One suggestion (from NRPA) is to define classes (A, B, …G) of tubes depending on the range of UVI:

A: $0 \leq UVI < 4$
B: $4 \leq UVI < 6$
C: $6 \leq UVI < 8$
D: $8 \leq UVI < 10$
E: $10 \leq UVI < 12$
F: $12 \leq UVI < 16$
G: $16 \leq UVI$

UVI-classes can be combined with solar spectral match classes defined with a defined width. Example: Sunlamp class C12 means $6 \leq UVI < 8$ and solar match factor 6 % – 12 %.

2.3.4 Comments

Ideally three numbers might be desired on sunbed tube lamps: An erythemal quantity, UVB% and Solar spectral match. However this may be too complicated and there is limited space available on the lamps for additional information. Maybe only two numbers can be used, an erythemal quantity indicating the strength of the lamp and some spectral info. Example: UV-index (or "Sunfactor") and UVB% (or Solar spectral match).

The erythemal quantity is essential and should indicate power level of the lamp in the appliance (e.g. UVI, MED/h, SED/h, fs, Burn-time, St.burn-time factor). Total erythemal flux is already measured (IEC1228) but does not properly indicate the increased irradiance of reflector lamps.

If sunlamps are properly characterised, the UV-index could be used to give people a comparison of the strength of the UV-lamp emissions compared with the values of ambient UV. This statement is extracted from a WMO-WHO Meeting of Experts on Standardisation of UV-indices (1997).

The spectral info or quantity should make sure that UVB is not replacing UVA or vice-versa, time-settings need not to be changed due to filtering of the appliance and that the appliance UV-type does not change. Only UVB% has proven to clearly distinguish between lamps that may change the UV-type but otherwise have similar erythemal quantities, erythemal ratios and Solar spectral match.

To comply with CIE definitions, the borderline between UVB and UVA should be 315 nm. However, EN IEC335-2-27 requires erythemal-weighted irradiance below and above 320 nm. So, it proposed that the borderline for erythemal-weighted irradiance should correspond to that which is in the IEC standard, which is currently 320 nm, while using a borderline of 315 nm for UVA/UVB.

A spectral quantity based on a ratio of either biologically weighted short-wave and long-wave radiation below and above a border wavelength (presently 320 nm in EN60335-2-27 and EN61228), or a ratio of weighted short-wave to weighted total radiation, could also serve to distinguish between lamps with such spectral differences that they otherwise might change the appliance's UV-type, recommended exposure times, and possibly cause overexposure of a client.

It should be noted that a definition of lamp equivalency from a 'safety'-point of view will better benefit from such a weighted ratio, if the border wavelength is sufficiently short and as close as possible to the cut-off region of most acrylics – but still above it. Physical UVB is by CIE defined 280 – 315 nm and a physical UVB/UVA-ratio does clearly distinguish between lamps.

An erythemally-weighted ratio below and above 320 nm may also do so in most cases. Erythemal ratio below and above 320 nm has the advantage to utilise the weighted spectral bands already defined in both the standards EN60335-2-27 and EN61228, and is an often preferred alternative. It may however be unreliable in some cases. A ratio of erythemal radiation below and above a slightly shorter border wavelength e.g. 315 nm would be preferable. That is because most acrylics filtering effects are in the spectral region below 315 nm. An example: Two lamps may have the same erythemal radiation both below and above 320 nm, but different UVB-radiation. A lamp with most of its erythemally weighted short-wavelength radiation between say 300 – 320 nm might overexpose and possibly burn people in some sunbeds if it replaces another and original lamp with the SAME erythemally weighted short-wavelength radiation, but with most of it in the spectral region 290 – 310 nm where a larger fraction of the 'burning' radiation is reduced by the acrylic. However, this can not so easily happen if the short-wavelength region is defined up to say 315 nm only – as physical UVB is.

Table 3. Examples*

UV-source:	Phys solar Corr Coeff	CIE solar Corr Coeff	UVB/ UVA	UV-index	SEDs per h	MEDs (210J) per h	CIE erythemal Short-wave /Total radiation 250-400	
	r (spectr)	r (CIE sp)					Border 315nm	Border 320 nm
Sun&Sky Canary Islands. Summer noon (860701-1402)	1,00	1,00	3,7%	12,7	11,4	5,4	67,4%	79,4%
Sun&Sky Stockholm noon (9.7.81 13:00)	0,99	0,96	2,2%	5,9	5,3	2,5	78,4%	87,3%
Philips-TL100W-Professional-Holland- (after 7,5 h)	0,65	0,90	1,3%	15,1	13,6	6,5	63,4%	69,8%
Philips-TL-100W-R-Professional (after 6h)	0,65	0,91	1,3%	27,0	24,3	11,6	62,4%	69,1%
Philips-Professional-S-100W-Holland (after 6 h)	0,64	0,87	1,8%	15,9	14,3	6,8	57,9%	68,6%
Philips-Performance-100W-Holland (after 5 h)	0,64	0,49	0,7%	7,5	6,8	3,2	36,0%	43,3%
Philips-TL40W12	-0,21	0,34	129%	909	818	390	99,2%	99,7%
Philips-TL-100W/10R-UVA	0,53	-0,12	0,05%	3,1	2,8	1,3	6,3%	6,7%
Philips Cleo Natural TL100/WW (5h)	0,61	0,89	3,8%	15,3	13,8	6,6	66,4%	78,8%
JK-Ergoline-UVA-176D38-Profi-140W	0,53	-0,09	0,07%	3,1	2,8	1,3	9,6%	10,0%
New Technology Energy TXN – 100W-ATP-LTD-UK-T144 (after 5h)	0,68	0,60	1,0%	13,0	11,7	5,6	59,3%	64,8%
Wolff Eurosun-S3-ES3-71-100W USA	0,55	0,65	3,4%	30,5	27,5	13,1	92,8%	95,1%
Wolff Eurosun-S3-ES3-71-100W Germany	0,53	0,52	0,5%	7,9	7,1	3,4	76,5%	78,1%
Wolff Rapid Sonne DA1-724-100W (5h)	0,76	0,63	1,0%	6,1	5,5	2,6	40,1%	52,4%
Wolff GoldSun-RS-G2-10-100W	0,73	0,75	1,3%	8,1	7,3	3,5	61,7%	69,7%
Wolff Bellarium-S-SA1-12-100W	0,75	0,83	2,0%	12,3	11,1	5,3	61,8%	72,1%
Cosmedico Arimed B-13300/100W (5h)	0,71	0,96	3,4%	21,6	19,4	9,3	72,0%	81,2%

**(Preliminary info and compilation of some spectral irradiance measurements at the surface of the tubes. Data from the Swedish Radiation Protection Institute)*

2.3.5 Uncertainty

There is uncertainty associated both with measurements and product variability (20 %). Higher precision is not necessary due to human tolerances. Lamps should be labelled with numbers in ranges (UVI: 10 – 12, UVB: 1,0 – 1,2 % etc.) or rounded off.

Example:

UV-index values	1 – 9	should be in integers 1, 2, …. 8, 9
”	10 – 20	should be even numbers
”	21 – 40	should be 25, 30, etc.
”	> 40	should be 40, 50, etc.

2.3.6 Lamp Equivalence Labels on Appliances

If lamps generally are marked with equivalence data, also tanning appliances should have such data on labels. Appliances should be labelled with the equivalence data of the original lamps rather than (or in addition to) the identification of lamp manufacturer and lamp model.

2.3.7 Recommendations

Recommendations

General: Lamps should be labelled with equivalence data.

Specific: Fluorescent tube lamps should be labelled with:

1. An erythemal quantity (UV-index)
2. Information of spectral shape (UVB/UVA%)

The recommendation is to label lamps with UV-index and UVB/UVA%.

3 List of Acceptable Replacement Lamps for UV-Type 3 Sunbeds

It is important to ensure that the radiation characteristics of a tanning appliance are not significantly altered and that the instructions for use are still valid when fitting replacement UV lamps and other components. Sunbeds must meet technical safety requirements of the European standard (EN 60 335-2-27), be categorised in UV-type, have appropriate UV-type label, and be labelled with the type reference of the emitters. For tanning units labelled "UV-type 3" this means limited levels of erythemally effective short-wave and long-wave UV-irradiance and that the appliance may be used by unskilled persons without special competence or training.

If possible use original lamps!

If original fluorescent tube lamps are not available the standard lamps listed here are generally acceptable for UV-type 3 sunbeds intended for cosmetic tanning and may from a radiation protection point of view be used instead of the originals. The list is not complete or definite and may be subject to changes.

Reflector versions of the listed 100 W standard tube lamps are acceptable only in sunbeds originally intended for reflector fluorescent tube lamps or in lamp-positions intended for "R-lamps." Reflector lamps must not be used to replace standard lamps.

Table 4. Manufacturer, Model, Watt, etc

Bermuda Gold Advantage 100W	Philips UVA ("CLEO") 100W
Brilliant Sun Plus 10122/100W Cosmedico	Philips UVA Performance 100W
Cosmolux UVA A1-11 100W	Solana Energy UVA 100W
Cosmolux UVA Plus 10200 100W	Suvarium Profi High-Power A305 100W
Crystal-Sun DA1-760 100W	Wolff Fitsun DA1-710 100W
Ergoline Superpower 100W	Wolff Solarium A1-11 100W
Globalux N-NA1-11 100W	Wolff Solarium Plus A1-12 100W
Osram Eversun L100W/79 100W	Wolff Rapid-Sonne DA1-724 100W

In tanning units intended for 140-160 watt tube lamps the following lamps may be used:

Philips TL 176D38/10 140W	J.K. Ergoline UVA Profi 176D38 140W

4 Specification of Field Measurement Device for Sunbeds

4.1 Introduction

The European Standard, EN 60335-2-27:1997, specifies UV emission levels which are permitted for tanning appliances. Depending on the results obtained, the appliances are categorised into one of four different types, each of which has different conditions of use. The measurements required for typetesting would normally be undertaken in an optical radiation laboratory, suitably equipped with calibrated spectral measuring equipment.

There is considerable merit in carrying out regular inspections of suntan premises and, in the course of these visits, it is desirable to be able to carry out simple field measurements to check the emission from the sunbed and ensure that it is still suitable for use.

There are a number of UV meters available commercially. The purpose of this document is not to promote any particular product but, simply, to produce an acceptable generic specification.

4.2 European Standard

European Standard, EN 60335-2-27:1997 deals with the safety of tanning appliances. It defines four different categories of appliance with limits of effective irradiance shown in the table. Effective irradiance is the radiant power per unit area at a specified distance weighted by a specified erythema action curve.

Table 5. Categories of appliance

UV type Appliance	**Effective Irradiance W/m^2**	**Effective Irradiance W/m^2**
	$250\ nm < \lambda \leq 320\ nm$	$320\ nm < \lambda \leq 400\ nm$
1	$< 0{,}0005$	$\geq 0{,}15$
2	0,0005 to 0,15	$\geq 0{,}15$
3	$< 0{,}15$	$< 0{,}15$
4	$\geq 0{,}15$	$< 0{,}15$

UV type 1 appliance: Appliance provided with a UV emitter such that the biological effect is caused by radiation having wavelengths longer than 320 nm and characterised by a relatively high irradiance in the range 320 nm to 400 nm.

UV type 2 appliance: Appliance provided with a UV emitter such that the biological effect is caused by radiation having wavelengths both shorter and longer than 320 nm and characterised by a relatively high irradiance in the range 320 nm to 400 nm.

UV type 3 appliance: Appliance provided with a UV emitter such that the biological effect is caused by radiation having wavelengths both shorter and longer than 320 nm and characterised by a limited irradiance over the whole UV radiation band.

UV type 4 appliance: Appliance provided with a UV emitter such that the biological effect is caused by radiation having wavelengths shorter than 320 nm.

Type 1 and type 2 appliances should be used under supervision of appropriately trained persons. Type 3 appliances may be used by unskilled persons. Type 4 appliances are intended to be used following medical advice.

General remarks:

- Operators should ensure that the UV type is not altered either by changes in the lamps, electrical components, or lamp covers.

- As part of an on-site inspection, it is desirable to be able to make a measurement to monitor the UV type of the sunbed.

The described categories actually allow an upper limit of the total effective irradiance of solaria which are used in tanning salons to 1,6 W_{eff}/m^2 for types 1 & 2 and to 0,3 W_{eff}/m^2 for type 3. For comparison: solar irradiance may reach 0,3 W_{eff}/m^2, and this "natural value" should not be exceeded by sunbeds of type 3. Due to possible manipulations described above the overall power of these devices can be increased dramatically resulting in misleading user instructions and exposure schedules - as well as a change of UV-type. Therefore this possible increase in total biologically effective power should be controlled in running solaria.

4.3 Radiometer for Field Measurements

1. This specification is intended to be used as a guide when selecting a UV detector for a field instrument which may be used for monitoring purposes only. It is not intended for a measurement instrument, which will be used for typetesting of the tanning appliance.
2. It must be portable, simple, and easy to use by someone with minimal technical knowledge.
3. The detector should have a response which allows the effective irradiance to be determined both above and below 320 nm.
4. Wavelength response of the detector should agree with the specified action spectrum to within 20 %.
5. Measurement of effective irradiance above and below 320 nm should be accurate to within 20 % of the limit values, e.g. if the limit value is 0,15 W/m^2 measurement accuracy should be 0,03 W/cm^2.
6. Stray light rejection should be better than 1 in 10^3.
7. If the UV detector is suited to monitor only one type of sunbed, e.g. type 3, this should be clearly stated.
8. If the instrument is a broadband detector, it should be calibrated using lamps with similar spectra to those which are used in the salon.
9. Calibration of detector should be traceable to a national standards laboratory and should be performed annually.
10. The angular response of the detector should be cosine (f_2 error as defined in CIE 69 should not exceed 10 %).
11. Temperature coefficient should be within 10 % for temperature range 10 to 50°C.

5 Sunbed Database

5.1 Content

A database has been established which contains a wide range of information relevant to the measurement of UV radiation from an artificial tanning unit. This comprises the following:

- Technical guidance notes related to sunbeds (installation, maximum output, spectra, spectral measurements, lamp replacement)
- Laws and regulations (national, EU)
- Standards (national, EU)
- Other relevant information (projects, reports, planned regulations and guidance notes, training programmes, other issues)
- Published papers relating to sunbeds

5.2 Format

Much of this material is not easily available in the open literature. Although the style and the type of these references vary largely, they have been "standardised" and imported into a literature reference system (Reference Manager, ver. 9.). In addition, a Medline search was carried out (searching the scientific literature for solarium-related publications), resulting in 113 references; most of these have abstracts. This may be helpful to those not having access to a CDROM or Internet based literature retrieval system.

The database may be distributed to anyone interested, in various formats:

- A WORD printout on paper, or a WORD file (via E-mail) that may be used as a searchable document
- Reference Manager (version 8 or 9) files (2 files approx. 1,1 MB), for those having access to a computer with the RefMan programme
- A RIS (Research Information System) formatted printout of the RefMan files, suitable for import into any other literature database system

The WG4 group members, and also other readers with access to relevant information on sunbeds as indicated above, are invited to submit their information to: gunnar.brunborg@folkehelsa.no

- The information should preferably be submitted in English (if this is not possible now, please give us the text in a preliminary form in whatever language, and we may discuss a translation at a later stage)
- The submitted text should preferably be structured as follows (however, you do not have to add tags/identifiers; we take care of that): AUTHOR(S), ADDRESS/INSTITUTION, TITLE, SOURCE (Journal etc., Publisher/editor(s)/place if book), VOLUME, PAGE(s), YEAR, LEGAL STATUS (regulation/technical note/law), COUNTRY, ABSTRACT, FULL TEXT (if possible), KEYWORD (one or more), link to website, NOTES