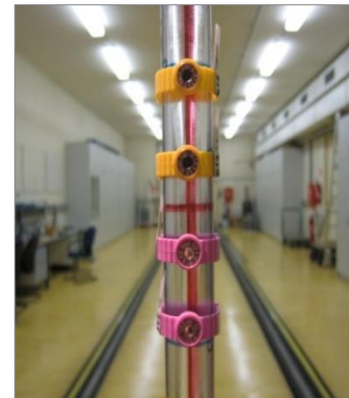


# EURADOS INTERCOMPARISONS FOR PERSONAL DOSEMETERS (2008-2010): RESULTS & CONCLUSIONS

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- 1) Introduction to EURADOS & the intercomparison programme
- 2) Intercomparison methods
- 3) IC 2008 - whole body dosimeters
- 4) IC 2009 - extremity dosimeters
- 5) IC 2010 - whole body dosimeters
- 6) Conclusions



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# 1) Introduction to EURADOS

## European Radiation Dosimetry Group

“The objective of EURADOS is to advance the scientific understanding and the technical development of the dosimetry of ionising radiation in the fields of radiation protection, radiobiology, radiation therapy and medical diagnosis by the stimulation of collaboration between European laboratories, specially those of the European Communities.”

[www.eurados.org](http://www.eurados.org)

[eurados.IC2012@babcock.co.uk](mailto:eurados.IC2012@babcock.co.uk)

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## 1) Introduction to the intercomparison programme

- ✓ **Personal Dosimeter Intercomparisons - aims**
  - ✓ Check the operations of individual monitoring services (IMS)
  - ✓ Enable **anonymous** comparison of participants' results
  - ✓ QA - demonstrate compliance with appropriate QM Systems
  
- ✓ **Participation is recommended in international literature & standards**
  - ✓ RP-160: Technical recommendations for monitoring individuals occupationally exposed to external radiation, EC (2009)
  - ✓ ISO 17025: General requirements for the competence of testing and calibration laboratories, EN ISO/IEC 17025:2005

## 1) Introduction to the intercomparison programme

- ✓ EURADOS-WG2 (2007): A programme of sustainable intercomparisons
  - ✓ Schedule: whole body every 2 years + extremity or neutron in between
  - ✓ Conform, as far as possible, with ISO 14146:2000 – trumpet curves
  - ✓ Accredited laboratories to provide the irradiations
  - ✓ Issue “Certificate of Participation” –  
**but no “pass/fail” assessment of results**
  - ✓ **Participant price – 1250 Euros**

## 2) Intercomparison Methods

- ✓ EURADOS Council formally appoint Organising Group (OG ) and co-ordinator
- ✓ Preparation – proposal with draft irradiation plan & budget
- ✓ EURADOS Council approval & announcement
- ✓ Applications, invoices, dosimeters sent to co-ordinator
- ✓ Intercomparison procedures....
- ✓ "Certificates of Participation" issued at participants meeting

$$R = \frac{H_{p,participant}}{H_{p,reference}}$$

## 2) Intercomparison Methods - procedures



i) Dosimeters arrive



ii) Re-label all dosimeters



iii) Dosimeters → irradiation lab



iv) Return dosimeters to IMS

## 2) EURADOS AM 2011 Prague - Participants meeting



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A-1180 Wien, Artlgasse 38 • Tel. +43(0)1-21110-6027 • Fax +43(0)1-21110-6030 • E-Mail: ppt@bev.guv.at DNR: 0037028

**Prüfungsschein** Prüfungsschein Nr. T10-1118/14  
**Measurement Certificate** Measurement Certificate No. T10-1118/14

**Hersteller** EURADOS  
**Manufacturer** Intercomparison 2010

**Hersteller** EURADOS  
**Manufacturer** Intercomparison 2010

**Auftraggeber** EURADOS  
**Customer** Intercomparison 2010

Dieses Zertifikat ist in Übereinstimmung mit den Kalibrier- und Messmöglichkeiten (CMCs), wie sie im Anhang C des gegenseitigen Abkommens (MRA) des Internationalen Komitees für Maß und Gewicht (CIPM) enthalten sind. Im Rahmen des MRA wird die Gültigkeit der Kalibrier- und Prüfbescheinigungen von allen teilnehmenden Instituten für die im Anhang C spezifizierten Messgrößen, Messverfahren und Messunsicherheiten gegenseitig anerkannt (nähere Informationen unter <http://www.bipm.org>).

This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the CIPM. Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement.

**PTPJ** BEV - Bundesamt für Eich- und Vermessungswesen **BEV**

Prüfungsschein Nr. T10-1118/14  
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**Ergebnisse der Prüfung:**  
**Results:**

Resulting dose equivalent values and related uncertainties for the dosimeters of the participant's dosimeter system are given in the following table:

whole body dose-meter	irradiation date	radiation quality	angle of radiation incidence	air kerma rate	personal dose equivalent per irradiation	expanded uncertainty	total personal dose equivalent	personal dose equivalent per irradiation	total personal dose equivalent	remark
		ISO 4037	$\theta$ , °	$K_a$ , mGy/s	$H_p(10)$ mSv	$U(k=2)$ %	$H_p(10)$ mSv	$H_p(0,07)$ mSv	$H_p(0,07)$ mSv	
S14-01	06.10.2010	W250	0	0,0065	1,50	5,0	3,00	1,44	2,94	)
S14-02	21.10.2010	S-Cs	0	0,012	1,50	4,0	3,00	1,50	2,94	)
S14-03	07.10.2010	N40	0	0,0021	1,50	5,0	3,00	1,59	3,09	)
S14-04	21.10.2010	S-Cs	0	0,012	1,50	4,0	3,00	1,59	3,09	)
S14-05	07.10.2010	N40	30	0,0021	1,00	5,0	1,00	1,10	1,10	-
S14-06	07.10.2010	N40	30	0,0021	1,00	5,0	1,00	1,10	1,10	-
S14-07	13.10.2010	W110	45 y-axis	0,023	5,00	5,0	5,00	4,79	4,79	-
S14-08	13.10.2010	W110	-45 y-axis	0,023	5,00	5,0	5,00	4,79	4,79	-
S14-09	14.10.2010	W110	45 x-axis	0,023	5,00	5,0	5,00	4,78	4,78	-
S14-10	14.10.2010	W110	-45 x-axis	0,023	5,00	5,0	5,00	4,78	4,78	-
S14-11	18.10.2010	S-Cs	0	0,012	12,0	4,0	12,0	12,0	12,0	-
S14-12	18.10.2010	S-Cs	0	0,012	12,0	4,0	12,0	12,0	12,0	-
S14-13	19.10.2010	S-Cs	0	0,012	2,50	4,0	2,50	2,50	2,50	-
S14-14	19.10.2010	S-Cs	0	0,012	2,50	4,0	2,50	2,50	2,50	-
S14-15	19.10.2010	S-Cs	0	0,012	2,50	4,0	2,50	2,50	2,50	-
S14-16	19.10.2010	S-Cs	0	0,012	2,50	4,0	2,50	2,50	2,50	-
S14-17	25.10.2010	S-Cs	0	0,0052	0,500	4,0	0,500	0,500	0,500	-
S14-18	25.10.2010	S-Cs	0	0,0052	0,500	4,0	0,500	0,500	0,500	-
S14-19	27.10.2010	S-Cs	0	0,72	250	4,0	250	250	250	-
S14-20	27.10.2010	S-Co	0	0,72	250	4,0	250	250	250	-
S14-21	-	-	-	-	-	-	-	-	-	)
S14-22	-	-	-	-	-	-	-	-	-	)
S14-23	-	-	-	-	-	-	-	-	-	)
S14-24	-	-	-	-	-	-	-	-	-	)
S14-25	-	-	-	-	-	-	-	-	-	)
S14-26	-	-	-	-	-	-	-	-	-	)

) Expanded uncertainty for the total personal dose equivalent:  $U = 3,2\%$  ( $k = 2$ )  
 ) un irradiated

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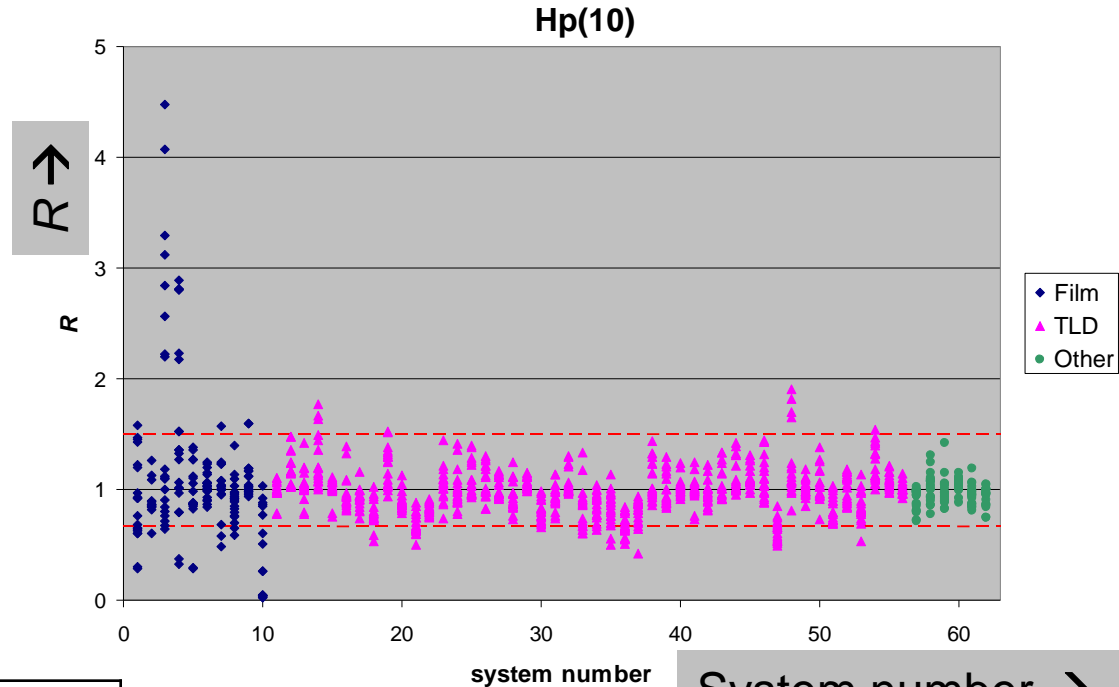
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This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the CIPM. Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement.

### 3) IC 2008 for whole body dosimeters

✓ OG: T. Grimbergen, M. Figel, A.M. Romero, H. Stadtmann, A. Mc Whan

Quality	$H_p(10)$ , $H_p(0,07)$ (mSv)	Number of dosimeters
N-60	3	2
N-60 45°	3	2
N-150 45°	3	2
N-60 + S-Cs	(3 + 1)	2
S-Cs + N-60	(3 + 1)	2
S-Cs	0.5	2
S-Cs	3	4
S-Cs	10	2
S-Co	150	2



Participants	52 IMS / 62 systems from 24 countries (only 48 with both Hp(10) and Hp(0,07))
Type	Film (10) TLD (46) Others (6)
Irradiations	GAEC (Greek Atomic Energy Commission)

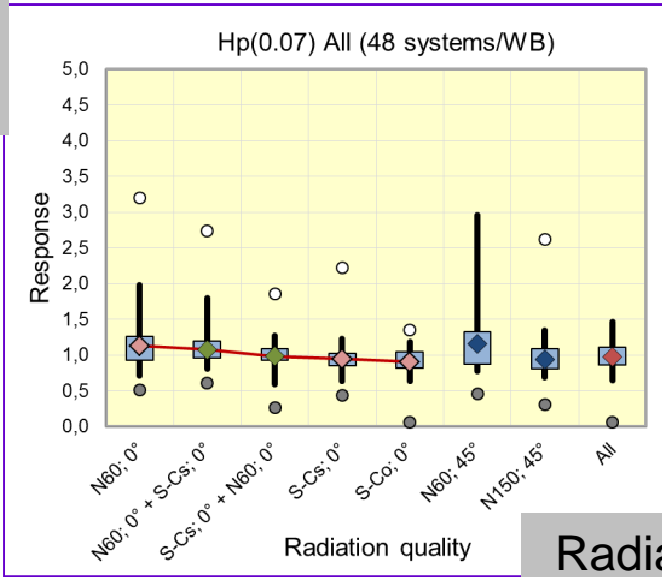
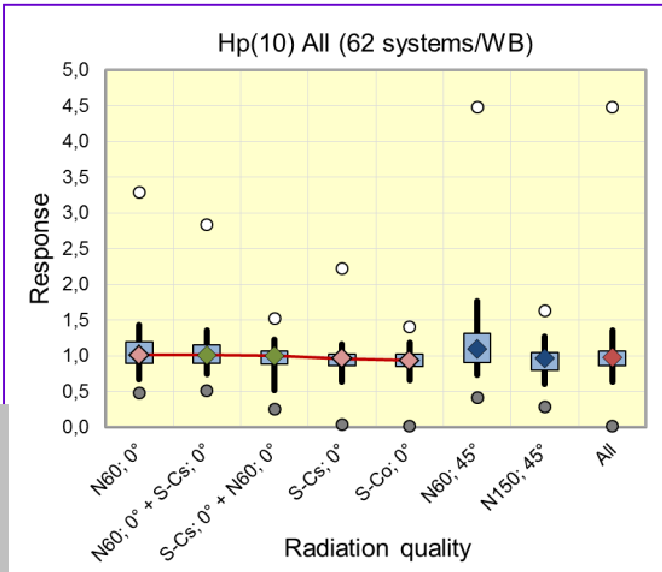
**Results out of range:**

**Hp(10) = 7%, Hp(0,07) = 12%**



## 3) IC 2008 for whole body dosimeters

Response →



Radiation quality →

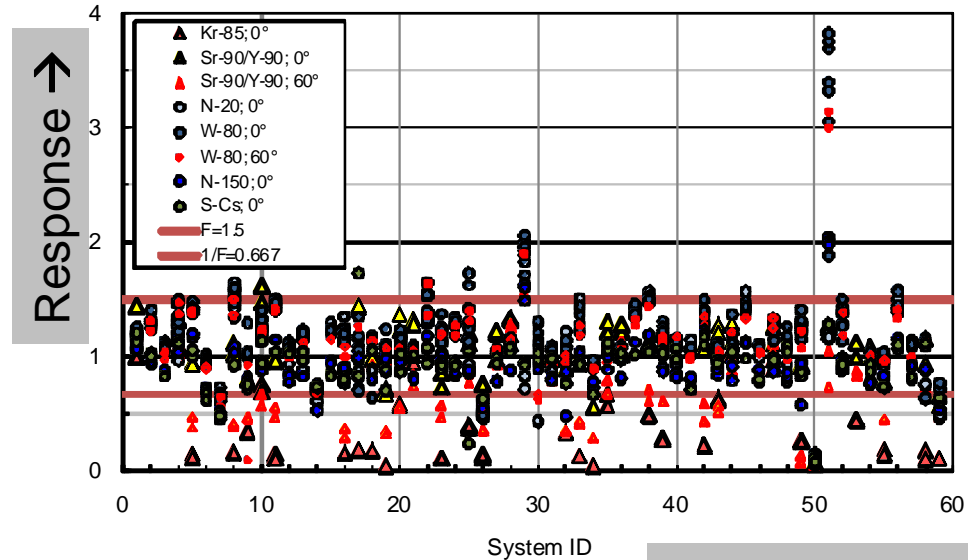
- ✓ 63% of the systems were TLDs using LiF:Mg,Ti as the detector
- ✓ Greater variation observed for Hp(0,07) compared to Hp(10) results
- ✓ Marked difficulty for some systems with N-60 45°
- ✓ 74% of the systems met the trumpet curve criteria (maximum 2 “outliers”)
- ✓ 60% of the systems had no values out of range

diamond = median  
 box = 50% of range  
 bar = 90% of range  
 dots = max and min

## 4) IC 2009 for extremity doseimeters

✓ OG: T. Grimbergen, M. Figel, A.M. Romero, H. Stadtman, A. Mc Whan

Radiation	Quality	$H_p(0,07)$ (mSv)	Number of doseimeters
Beta	$^{85}\text{Kr}$ , $0^\circ$	25	2
	$^{90}\text{Sr}/^{90}\text{Y}$ ; $0^\circ$	10	2
	$^{90}\text{Sr}/^{90}\text{Y}$ ; $60^\circ$	10	2
Photons	N-20; $0^\circ$	40	2
	W-80; $0^\circ$	5	2
	W-80; $0^\circ$	50	2
	W-80; $0^\circ$	400	4
	W-80; $60^\circ$	50	2
	N-150; $0^\circ$	25	2
	S-Cs; $0^\circ$	30	2



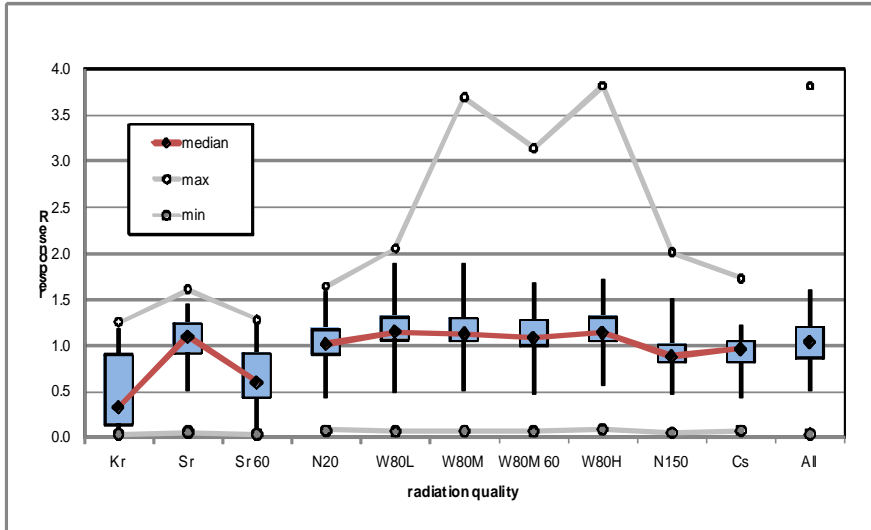
Participants	44 IMS / 59 systems from 18 countries (only 37 for mixed fields - beta & photon)
Type	Ring (46) Fingertip (4) Wrist/Ankle (9)
Irradiations	Seibersdorf (Austria), IRSN (France)

**Number of results out of range:**

**Photons = 10%, Beta = 35%**

## 4) IC 2009 for extremity doseimeters

Response →



diamond = median  
 box = 50% of range  
 bar = 90% of range  
 dots = max & min

Radiation quality →

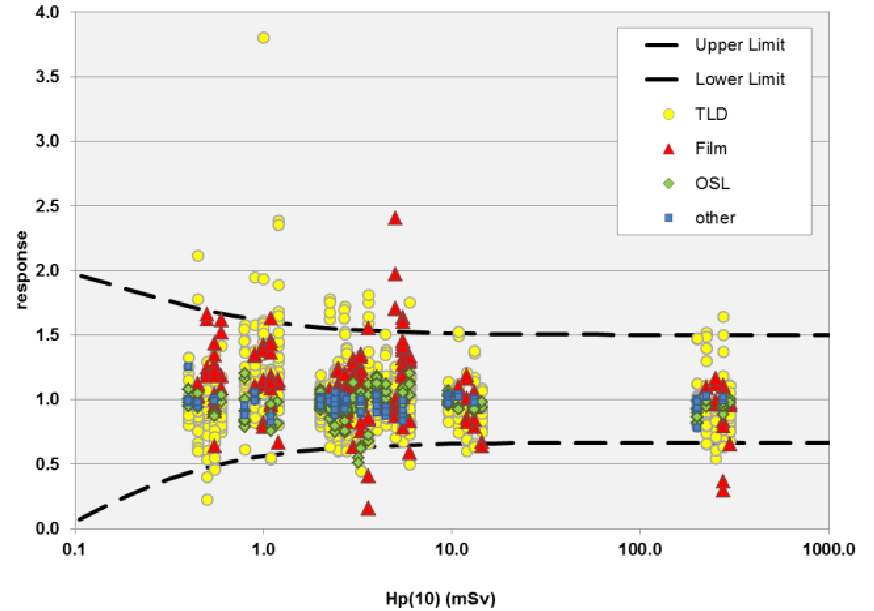
- ✓ 48% of the systems used LiF:Mg,Cu,P as detector element
- ✓ Poorer results for beta irradiations: Kr-80, due to low energy, and for Sr-90 at 60° due to the irradiation angle. Strong dependence on energy & angle.
- ✓ For the photon irradiation, linear & angular responses are satisfactory
- ✓ 54% of the systems met the “trumpet curves criteria” (maximum of 2 outliers”)
- ✓ 45% of the systems had all values inside the range

# 5) IC 2010 for whole body dosimeters

✓ OG: A. Mc Whan, E. Fantuzzi, M. Figel, T. Grimbergen A.M. Romero, H. Stadtmann

Quality	$H_p(10)$ , $H_p(0,07)$ (mSv)	Number of dosimeters
N-40 30°	1	2
N-40 + S-Cs	3	2
W-110 45° X	5	2
W-110 45° Y	5	2
W-250 + S-Cs	3	2
S-Cs	0.5	2
S-Cs	2.5	4
S-Cs	12	2
S-Co	250	2

Response →

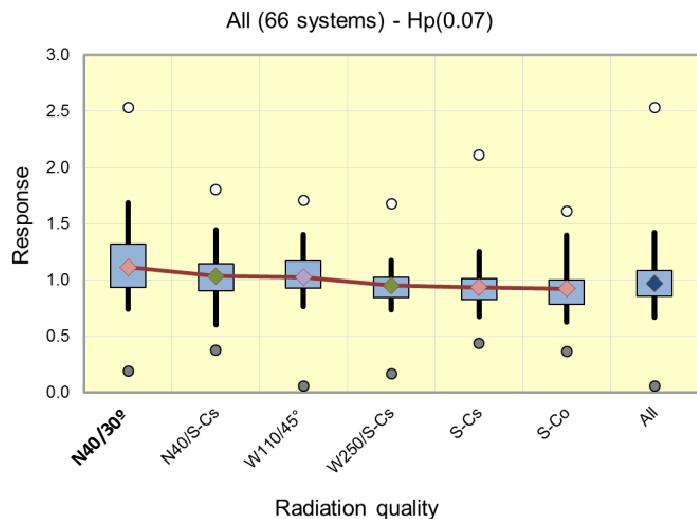
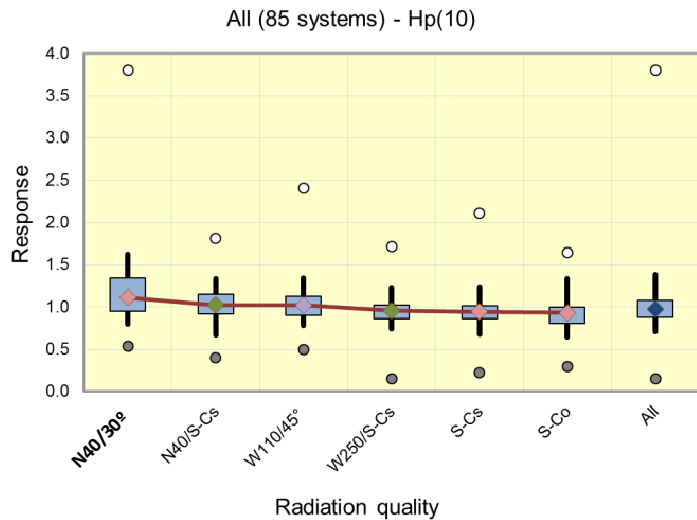


$H_p(10)$  mSv →

**Number of results out of range:**  
 **$H_p(10) = 5\%$ ,  $H_p(0,07) = 9\%$**

Participants	70 IMS / 85 systems from 30 countries (only 66 with both $H_p(10)$ and $H_p(0,07)$ )
Type	Film – 13 TLD – 59 OSL- 8 Other - 5
Irradiations	BEV - Austria

## 5) IC 2010 for whole body doseimeters



- ✓ 63% of TLD systems used LiF: Mg, Ti as a detector.
- ✓ Greater spread of results for Hp (0.07) than for Hp (10)
- ✓ Marked problems for some systems for N40/30 °
- ✓ 86% of systems met the criteria for trumpet curves (maximum 2 "outliers")
- ✓ 74% without any value out of range

diamond = median  
 box = 50% of range  
 bar = 90% of range  
 dots = max and min

## 6) Conclusions

- 1) The high levels of interest and participation confirm the need for the IMS participation in dosimetry intercomparisons
- 2) The results show that European IMS have, in general a very high standard, although improvement is needed in some aspects, eg extremity dosimetry
- 3) Between 2008 and 2010 there was an observed improvement in the performance of film dosimeter systems
- 4) EURADOS is currently running 2 intercomparisons:
  - whole body photon (IC2012)
  - neutron-gamma mixed fields (IC2012n)

**Application deadline 29 June !**



**THANK YOU FOR YOUR ATTENTION**

