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**A MARKET-WEIGHTED DESCRIPTION
OF LOW-BEAM HEADLIGHTING
PATTERNS IN EUROPE: 2003**

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16. Abstract This study was designed to provide updated photometric information about current European low-beam headlamps. The sample included 20 headlamps manufactured for use on the 20 best-selling passenger vehicles for model year 2003 in 19 European countries. The vehicles sampled represent 47% of all vehicles sold in these countries. The lamps were purchased directly from vehicle dealerships. The photometric information for each lamp was weighted by the sales figures for the corresponding vehicle. The results are presented in tabular form for the 25th-percentile, the 50th-percentile (median), and the 75th-percentile luminous intensities (from 45° left to 45° right, and from 5° down to 7° up). The results are also presented in graphical form for the median luminous intensities (from 45° left to 45° right, and from 10° down to 10° up), as well as for the median illuminance incident on vertical surfaces at various locations on the roadway.					
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INTRODUCTION

In 1997 we published a report that included a market-weighted description of low-beam headlighting patterns in the U.S. (Sivak, Flannagan, Kojima, & Traube, 1997). That information was based on photometry of headlamps on the 23 best-selling passenger vehicles for model year 1997. That study was followed by an analogous study in which market-weighted output for the low-beam headlamps on the 20 best-selling passenger vehicles for model year 2000 in Europe were collected (Sivak, Flannagan, & Schoettle, 2000). Most recently, another analogous study was conducted in which market-weighted descriptions of both low-beam and high-beam headlighting patterns for the U.S. and Europe were documented (Schoettle, Sivak, & Flannagan, 2001). The present study was designed to update the market-weighted database of current European low-beam headlamps for model year 2003.

The main features of this study were as follows:

- The lamps to be photometered were directly purchased from vehicle dealerships, thus avoiding the potential problem of self-selection with donated lamps.
- The selected lamps were designed for use on 47% of all passenger vehicles currently being sold in 19 European countries.
- The obtained photometric information was weighted by the current sales figures for the respective vehicle models.

METHOD

Approach

The approach consisted of the following steps:

- (1) Obtain luminous-intensity matrix for lamps designed to be used on the best-selling passenger vehicles.
- (2) Use the current sales data for the respective vehicles to derive a sales-weighted distribution of luminous intensities at each test point.
- (3) For each test point, calculate selected percentiles—25th, 50th (median), and 75th—of the sales-weighted distribution of luminous intensities.

Photometry

The measurements were made in a photometry lab using a goniometer. Mounting fixtures provided by each lamp manufacturer were used to secure the lamps to the goniometer whenever possible. Visual aiming was used to align the lamps prior to the photometry. The horizontal aim placed the right end of the horizontal part of the vertical cutoff at the vertical axis. The vertical aim was set by first aligning the vertical cutoff on the left side with the horizontal, and then displacing the beam 0.6° (1%) down. The aiming of all lamps was supervised by the same person—a lighting engineer with 37 years of headlighting experience. We performed the photometry as defined by the following ranges of horizontal and vertical angles (in relation to the headlamp axes): in the horizontal direction, the angles ranged from 60° left (L) to 60° right (R) in steps of 0.2° ; in the vertical direction, the angles ranged from 15° down (D) to 10° up (U) in steps of 0.2° .

The lamps were continuously energized for approximately 30 minutes each prior to performing the photometry. All measurements were made at 12.8 V with standard production bulbs supplied with the lamps at the time of purchase.

The purpose of the study was to obtain estimates of real-world light output; the study was not designed to evaluate compliance with regulations. Consequently, we used a fixed voltage (as opposed to voltage based on flux criterion), standard production bulbs (as opposed to accurate, rated bulbs), and no re-aiming (as opposed to re-aiming based on preliminary photometric results).

We determined the luminous intensities at the 25th-percentile, the 50th-percentile (median), and the 75th-percentile for test points in a rectangular matrix defined by the following ranges of horizontal and vertical angles (in relation to the headlamp axes): in the horizontal direction, from 45° left (L) to 45° right (R) in steps of 0.5° ; in the vertical direction, from 10° down (D) to 10° up (U) in steps of 0.5° .

Sample

A total of 20 lamps constituted the sample. All lamps (and the corresponding bulbs for each lamp) were for model year 2003, and they were purchased in June 2003 in the Munich Metropolitan Area, Germany. The lamps were produced by three lighting companies and were designed for vehicles produced by 10 vehicle manufacturers. All were left-side lamps for use on the 20 best-selling passenger vehicles in Europe for the calendar year 2002 (which includes model years 2002 and 2003). The vehicle sales data included the following 19 countries (in descending order of total sales): Germany, United Kingdom, Italy, France, Spain, The Netherlands, Belgium, Switzerland, Austria, Greece, Sweden, Portugal, Ireland, Finland, Hungary, Denmark, Norway, Luxembourg, and Iceland (Automotive News, 2003).

The 20 vehicles were as follows (also in descending order of sales): Peugeot 206, Volkswagen Golf, Ford Focus, Renault Clio, Peugeot 307, Fiat Punto, Volkswagen Polo, BMW 3 Series, Opel Astra, Opel Corsa, Ford Fiesta, Volkswagen Passat, Audi A4, Renault Mégane, Mercedes C-Class, Renault Scénic, Ford Mondeo, Renault Laguna, Citroën Xsara Picasso, and Opel Zafira (Automotive News Europe, 2003). These 20 vehicles constituted 47% of all passenger vehicles sold in Europe during 2002 (Automotive News Europe, 2003).

Several vehicles offered optional high-intensity discharge (HID) lamps, along with standard tungsten-halogen lamps. Our sample included only lamps with tungsten-halogen bulbs, made by four different bulb manufacturers. A breakdown of lamps by light source for the 20 vehicle models surveyed is shown in Table 1. Summaries of several design features of the tested lamps are shown in Table 2 (optics) and Table 3 (lens materials).

Table 1
Breakdown of the light sources used in the tested lamps.

Light source	Number of vehicles	Sales-weighted percentage of all vehicles
H7	16	77.1
H4	4	22.9
Total	20	100.0

Table 2
Optics of the tested lamps.

Optics	Number of vehicles	Sales-weighted percentage of all vehicles
Reflector optics	14	69.6
Lens optics	4	20.5
Projector	2	9.9
Total	20	100.0

Table 3
Lens materials of the tested lamps.

Lens material*	Number of vehicles	Sales-weighted percentage of all vehicles
Plastic	18	87.2
Glass	2	12.8
Total	20	100.0

* Outermost lens material only. Does not include the glass in projector optics.

RESULTS

Table 4 lists the 25th-percentile, the 50th-percentile (median), and the 75th-percentile luminous intensities. The horizontal steps in Table 4 are 0.5° between 0° and 5° , 1° between 5° and 10° , and 5° between 10° and 45° (all for left or right). Because of space limitations, the vertical range in Table 4 has been reduced. (The full available data range is from 10° up to 10° down; the range in Table 4 is from 7° up to 5° down.)

Figure 1 presents isocandela diagrams corresponding to the median luminous intensities for the sales-weighted sample representing the low-beam headlamps on current European passenger vehicles.

Figure 2 presents the isoilluminance diagram (in lux) corresponding to the median illuminance incident on a vertical surface at various roadway locations from the low-beam headlamps on current European passenger vehicles. (The headlamp height and separation used are from Schoettle, Sivak, & Nakata, 2002.)

Table 4
Luminous intensities (cd) for the sales-weighted sample representing the low-beam headlamps on current passenger vehicles in Europe. The entries in each cell are (from top to bottom) the 25th-percentile, the 50th-percentile (median), and the 75th-percentile. (Test voltage: 12.8 V.)

	45L	40L	35L	30L	25L	20L	15L	10L	9L	8L	7L	6L	5L	4.5L	4L	3.5L	3L	2.5L	2L	1.5L	1L	0.5L	0
7U	12	12	13	14	20	27	32	37	42	40	41	41	44	45	45	46	47	47	48	48	49	51	52
	19	20	24	33	39	46	48	53	55	54	56	59	59	59	60	60	60	60	61	61	61	62	65
	94	56	52	57	68	77	66	68	69	70	70	70	71	71	70	71	74	77	79	79	79	79	85
6.5U	11	11	13	14	21	29	33	38	41	41	42	43	45	46	47	48	49	49	52	54	55	55	54
	30	24	33	36	41	47	52	55	59	57	58	59	62	62	61	62	62	62	61	63	63	64	65
	94	59	55	58	69	84	69	72	74	73	74	75	75	76	76	76	76	76	76	77	79	81	88
6U	11	11	13	15	22	30	37	41	45	44	45	49	51	51	51	52	51	54	56	56	56	56	57
	23	25	28	30	42	48	55	57	56	58	63	65	65	64	63	63	63	63	64	66	67	70	73
	97	64	53	58	70	87	72	76	78	78	78	79	80	81	82	85	88	90	91	91	90	89	90
5.5U	11	11	13	16	25	31	38	47	48	48	48	52	50	55	54	53	58	59	59	60	60	60	61
	20	25	27	31	44	49	57	62	61	63	64	67	67	67	66	69	68	67	68	71	73	73	73
	99	71	54	59	70	89	76	79	81	88	92	93	97	97	97	97	97	98	105	107	108	104	102
5U	11	11	13	20	26	33	42	50	51	52	52	54	55	57	59	61	62	62	62	62	62	65	64
	21	21	27	32	49	51	57	65	67	67	69	70	70	74	73	72	73	74	76	78	78	78	78
	94	72	55	59	68	90	79	84	86	97	96	96	100	101	102	101	101	107	119	116	117	117	119
4.5U	11	11	13	20	27	36	46	52	55	55	57	58	63	65	67	67	68	69	67	71	71	70	71
	22	22	29	34	50	52	57	72	75	75	79	78	78	77	76	77	81	82	82	84	83	82	82
	91	73	57	60	69	91	83	88	103	103	102	101	106	107	108	113	122	137	144	135	132	133	144
4U	11	11	13	20	28	39	49	57	60	62	66	68	72	73	74	75	75	76	78	79	78	77	75
	21	22	29	38	48	53	68	89	90	89	87	90	87	85	85	90	97	95	94	94	91	89	85
	98	74	59	61	69	90	93	103	111	111	112	120	120	118	123	130	138	143	149	163	167	170	190
3.5U	11	12	14	20	30	43	50	61	65	70	72	75	79	78	78	80	79	77	77	79	80	81	80
	20	25	31	41	49	59	75	100	103	103	101	100	99	99	99	101	102	102	100	96	95	98	98
	98	73	59	61	71	89	107	121	123	121	132	143	145	141	140	139	143	148	157	168	194	220	241
3U	11	12	14	21	32	46	55	71	76	79	83	87	93	95	98	98	98	97	94	94	96	97	95
	20	29	31	49	51	71	77	107	112	115	114	116	115	115	113	115	115	116	119	121	125	128	130
	85	73	59	61	73	88	120	131	136	141	161	166	154	147	149	158	157	155	180	191	214	245	251
2.5U	11	12	15	22	34	46	57	75	76	78	80	86	89	88	88	88	89	89	89	89	91	87	82
	21	25	33	54	51	72	81	108	119	124	124	126	124	123	120	119	119	118	118	117	117	119	132
	85	72	60	64	77	92	125	134	140	145	156	164	151	150	154	152	154	167	191	217	222	240	277
2U	12	12	15	23	39	50	65	85	90	96	103	105	116	118	119	120	125	125	128	130	128	124	129
	21	24	35	56	52	73	85	110	125	131	133	136	138	138	139	146	149	154	154	155	158	161	165
	81	71	65	66	85	100	116	142	155	150	156	171	193	199	202	203	202	209	226	246	225	249	289
1.5U	12	12	16	26	42	53	67	81	92	95	99	102	98	102	108	114	114	111	109	101	102	100	91
	21	25	36	58	54	79	91	122	129	125	128	132	138	131	125	124	129	129	131	127	127	137	155
	78	72	65	72	87	116	126	163	162	158	155	151	152	152	150	150	156	178	188	194	197	218	248
1U	12	13	17	29	46	58	82	125	131	129	136	141	149	149	160	170	164	163	172	184	197	183	168
	21	27	38	57	57	83	103	139	150	151	153	160	167	177	183	187	192	199	219	225	228	218	201
	76	71	64	76	97	123	145	158	182	180	191	219	223	226	228	228	228	239	252	275	273	293	310
0.5U	11	14	15	24	45	64	83	120	128	128	112	106	101	118	115	125	114	125	130	115	127	115	89
	20	28	38	57	57	81	113	150	150	143	157	166	159	162	164	162	172	176	177	169	155	159	185
	75	73	65	69	106	110	149	184	201	204	200	204	210	197	203	209	203	204	207	224	226	231	319
0	11	14	14	24	57	78	115	157	166	174	202	222	208	239	273	280	281	279	295	327	324	323	322
	19	27	38	59	66	102	125	198	210	231	249	258	284	298	320	336	362	386	411	427	428	432	362
	75	71	66	73	121	144	185	227	248	281	298	319	343	361	373	406	427	462	495	506	539	464	
0.5D	11	13	16	29	63	93	144	197	200	196	168	181	186	187	179	174	208	212	199	219	167	191	275
	18	25	38	58	86	150	173	218	245	253	313	312	289	290	284	291	275	274	295	370	346	407	620
	72	70	68	88	131	187	229	297	318	347	347	386	415	377	438	491	495	563	635	686	746	888	1629
1D	10	13	18	37	65	127	177	479	663	841	971	1257	1485	1753	2003	2284	2532	2722	2970	3199	3549	4188	5304
	18	23	34	66	140	222	343	858	1087	1303	1548	1939	2226	2435	2773	3080	3317	3606	3909	4303	4829	5678	7744
	65	73	68	101	269	579	758	1280	1347	1837	2099	2549	2963	3266	3559	3891	4741	5207	5375	5618	6249	7599	9903
1.5D	11	13	23	55	87	221	560	1672	1965	2296	2990	4038	5598	5654	6104	6159	6397	6505	7054	7848	8548	9192	10431
	19	23	42	87	243	463	1026	2436	3093	3743	4641	5189	6291	6563	7364	8362	8653	9187	9874	10615	12409	12675	14242
	61	72	66	177	419	1034	1744	3700	4340	4982	5554	6266	6930	7714	8869	9745	10343	12124	12953	13533	14251	15497	19212
2D	10	13	18	63	103	342	1185	2239	2647	3377	4481	5313	6390	6596	6842	7116	7339	7369	7427	7901	8434	8812	8894
	20	28	45	105	341	714	1663	3702	4294	5022	5394	6228	7748	8529	9397	10211	10905	11736	12599	13716	14302	14482	16128
	62	72	85	252	595	1477	2605	5343	6013	6960	7669	8753	9896	10536	11795	12987	13926	15611	17208	17365	16306	17591	19816
2.5D	10	13	17	67	184	534	1535	2902	3428	4119	4765	5189	5374	5475	5675	5970	6295	6620	6946	7318	7624	7762	7826
	21	26	48	126	355	978	2050	4373	5147	5590	6232	7343	8723	9154	9596	10269	11082	11706	12272	12758	13289	13945	14123
	65	69	90	302	705	1897	3028	5706	6720	7623	8647	9401	10962	11855	12873	13986	14389	15004	15069	15775	16165	15981	17932
3D	11	12	17	89	309	598	1405	3114	3497	3875	4504	4812	5055	5150	5273	5497	5786	6048	6237	6391	6481	6584	6731
	25	32	48	134	437	1141	2396	4131	5018	5701	6075	6647	7379	7808	8286	8882	9378	9740	10003	9994	10008	10925	10709
	70	66	73	302	761	1796	3193	5481	6070	6867	7591	8517	10138	10802	11238	11372	12292	12779	12991	13017	13450	14313	13874
3.5D	10	12	18	116	264	691	1471	3062	3298	3515	4174	4712	5086	5192	5273	5453	5578	5681	5788	5810	5843	5911	5994
	21	42	52	183	531	1310	2433	3859</															

	0.5R	1R	1.5R	2R	2.5R	3R	3.5R	4R	4.5R	5R	6R	7R	8R	9R	10R	15R	20R	25R	30R	35R	40R	45R
7U	52	51	53	52	51	49	48	47	45	44	43	41	39	36	34	38	28	17	11	7	4	3
	65	66	66	66	66	67	67	67	66	64	61	61	57	58	55	49	42	31	22	20	10	7
	95	104	122	125	126	115	104	92	82	82	95	91	89	87	85	89	56	46	37	35	13	12
6.5U	54	55	55	55	54	55	53	53	50	48	46	45	43	40	37	38	28	17	12	7	4	3
	65	66	66	67	68	68	69	70	70	66	63	65	61	63	60	50	40	24	22	20	10	7
	97	108	116	118	115	110	101	89	77	80	89	95	87	88	85	82	59	47	39	35	15	11
6U	60	62	61	62	64	61	57	54	54	53	47	47	47	46	40	40	30	18	12	9	4	3
	75	78	77	76	75	74	74	74	73	71	69	67	66	67	64	53	42	31	22	20	11	7
	97	106	113	116	112	104	95	84	84	86	91	97	96	98	98	98	63	48	42	35	16	11
5.5U	64	64	65	67	70	68	66	61	59	56	51	49	51	50	47	39	33	19	13	9	5	3
	75	80	81	79	79	79	78	76	74	74	74	72	71	72	69	58	48	32	22	21	11	6
	100	98	98	100	103	100	99	97	98	101	96	101	97	95	92	104	67	50	44	35	16	11
5U	62	61	65	70	73	73	71	66	58	57	53	52	52	49	47	43	36	20	13	8	6	3
	78	80	81	82	82	82	78	74	74	76	78	76	74	77	76	62	48	33	24	20	11	7
	124	127	130	134	134	129	121	113	110	109	99	96	101	96	94	103	79	52	45	35	16	12
4.5U	73	70	72	71	70	70	71	72	69	63	61	57	54	53	53	43	39	21	13	9	5	3
	83	85	88	87	85	85	84	85	87	87	83	82	83	82	81	69	51	35	26	21	9	7
	152	152	150	144	148	149	148	145	139	133	109	112	108	100	100	103	91	60	41	39	16	12
4U	73	70	71	72	76	78	76	74	71	70	66	69	63	58	55	48	39	23	15	9	4	3
	84	85	89	92	97	99	98	93	90	92	100	96	92	88	86	73	51	35	26	22	9	6
	191	178	180	183	177	169	163	163	155	149	123	113	110	105	104	106	106	65	52	43	18	9
3.5U	83	91	92	87	80	80	82	85	84	85	79	74	67	65	67	54	39	24	18	9	4	3
	101	106	113	111	108	105	109	115	109	109	103	104	104	103	93	75	53	37	27	24	10	6
	253	226	206	181	186	175	176	181	176	166	156	119	122	119	116	116	128	69	55	43	17	10
3U	91	88	86	95	107	107	99	92	86	85	84	84	75	67	64	59	43	25	21	9	4	3
	121	119	116	126	139	143	138	127	121	126	130	120	118	109	100	79	59	41	26	24	11	6
	240	212	197	197	206	198	196	188	187	174	157	155	139	133	145	134	136	80	58	48	18	11
2.5U	91	104	112	108	97	95	86	87	97	103	102	90	90	81	76	63	49	27	23	9	4	3
	142	151	148	149	131	141	146	141	145	152	137	135	116	132	130	89	64	42	29	21	11	6
	299	310	283	221	229	188	194	196	195	186	186	190	188	200	206	186	153	94	62	48	20	11
2U	117	105	99	107	120	152	149	120	124	118	115	115	99	92	88	76	53	32	26	10	4	3
	151	125	142	168	193	200	174	161	160	162	165	152	159	158	162	105	75	49	36	27	11	6
	238	199	222	230	259	261	247	223	227	222	222	217	223	284	416	231	171	102	68	48	21	10
1.5U	104	141	154	123	99	82	79	105	121	141	130	119	132	166	178	108	58	37	28	10	4	3
	193	215	211	163	120	152	162	172	211	195	183	200	268	276	324	165	99	71	40	29	11	6
	277	330	304	261	203	193	236	262	246	245	255	339	792	1036	885	381	203	112	92	58	26	13
1U	108	91	119	131	177	230	198	154	164	164	222	357	487	373	313	167	71	44	27	10	4	3
	171	142	154	216	299	291	266	244	236	313	496	537	790	745	685	258	142	98	45	32	11	6
	279	228	186	340	372	359	317	304	390	428	956	1699	2319	1648	1203	572	233	121	81	64	37	12
0.5U	133	249	244	208	98	112	103	274	522	733	1271	1231	982	827	610	197	91	46	27	10	4	3
	259	364	398	304	172	232	425	652	1125	1288	1647	1608	1592	1506	945	360	156	113	61	35	11	6
	424	525	465	424	325	384	740	1435	2079	2769	3682	3848	2835	1920	1701	671	279	166	106	71	34	12
0	119	155	176	302	783	1146	1580	2237	2689	2862	2574	2121	1430	1130	773	244	127	53	33	15	5	3
	281	218	328	859	1829	2990	4173	4425	4587	4240	4012	3030	2513	1993	1296	482	233	145	67	36	11	6
	350	339	870	1707	2794	3797	4903	5315	5342	5565	5034	4133	3366	2526	2076	883	344	182	121	77	38	12
0.5D	628	1333	2303	3532	4780	5383	5121	4695	4464	4523	3325	2460	1664	1143	960	346	143	60	26	10	3	2
	1338	3065	5713	7649	7597	7700	7505	6955	6382	5688	4642	3529	2821	2048	1344	556	265	157	74	34	13	6
	2793	5146	7034	9228	10340	10833	10364	9260	8336	7332	6226	4991	3983	3078	2617	1168	465	229	145	78	45	12
1D	7542	8789	9901	9947	9131	8109	7274	6793	6049	5242	4119	2721	2093	1809	1395	474	275	72	28	11	3	2
	10418	13340	14238	14134	13278	11974	10568	8604	7041	6129	4925	4177	3431	2614	2046	805	374	184	78	40	12	6
	12983	15966	17128	16827	16065	14351	12400	11036	10132	9515	7928	6106	4907	3940	3318	1723	653	307	169	79	47	12
1.5D	11627	11622	11677	11632	10893	10078	8423	7163	6319	5745	4716	3769	3083	2318	1869	772	277	116	32	12	4	4
	15185	16848	16582	15552	14166	13119	11891	10502	9244	7760	6239	5083	4285	3000	2373	1172	496	179	86	44	12	7
	21969	23990	23488	21089	18283	16505	15121	13823	12792	12102	8927	6942	5540	4878	4125	1964	875	365	195	87	46	12
2D	8706	8715	8739	8558	8277	7902	7660	7214	6744	6139	5274	4265	3366	2770	2268	834	322	107	39	13	5	3
	17250	16410	15291	14418	13589	12543	11683	11033	9952	8830	7254	6132	5300	4196	3382	1812	580	269	102	52	12	7
	21447	21029	21266	20773	19175	17607	16543	15306	14141	12649	9286	7697	6206	5547	5177	2256	1406	693	197	91	46	11
2.5D	7747	7612	7413	7229	7171	7182	7100	6848	6514	6003	5348	4646	3902	3172	2620	1025	366	110	43	15	5	4
	14114	13900	13459	13079	12709	12163	11337	10526	9639	8985	7510	6220	5552	4692	4466	1982	551	303	113	57	14	5
	17195	18158	18731	18520	17394	16183	15079	14870	13366	11676	9799	8272	7170	6203	5485	2774	1701	750	197	92	49	13
3D	6758	6733	6585	6478	6548	6545	6465	6310	5901	5444	4621	4452	3860	3256	2892	1172	486	111	44	16	4	4
	10310	10145	10099	10333	10285	9780	9063	8390	8038	7842	6715	5876	5188	4737	4466	2152	708	326	141	57	13	5
	13356	14070	14692	14726	14253	13982	12712	12573	12250	11737	10070	8688	7308	6758	5966	3005	1665	572	201	93	47	12
3.5D	5945	5898	5915	5955	5994	5964	5737	5444	5504	5313	4910	4324	3725	3412	2986	1587	543	132	44	21	4	3
	8288	8044	7674	7321	7073	6883	6686	6430	6178	5932	5557	4935	4374	4012	3649	2425	850	361	155	53	14	6
	10971	11183	11104	11099	11192	11184	11008	10755	10420	10010	9134	8089	6924	6241	5664	2862	1542	518	223	112	49	11
4D	4988	5138	5241	5254	5065	4976	4860	4710	4604	4533	4223	3763	3427	3099	2794	1592	591	160	46			

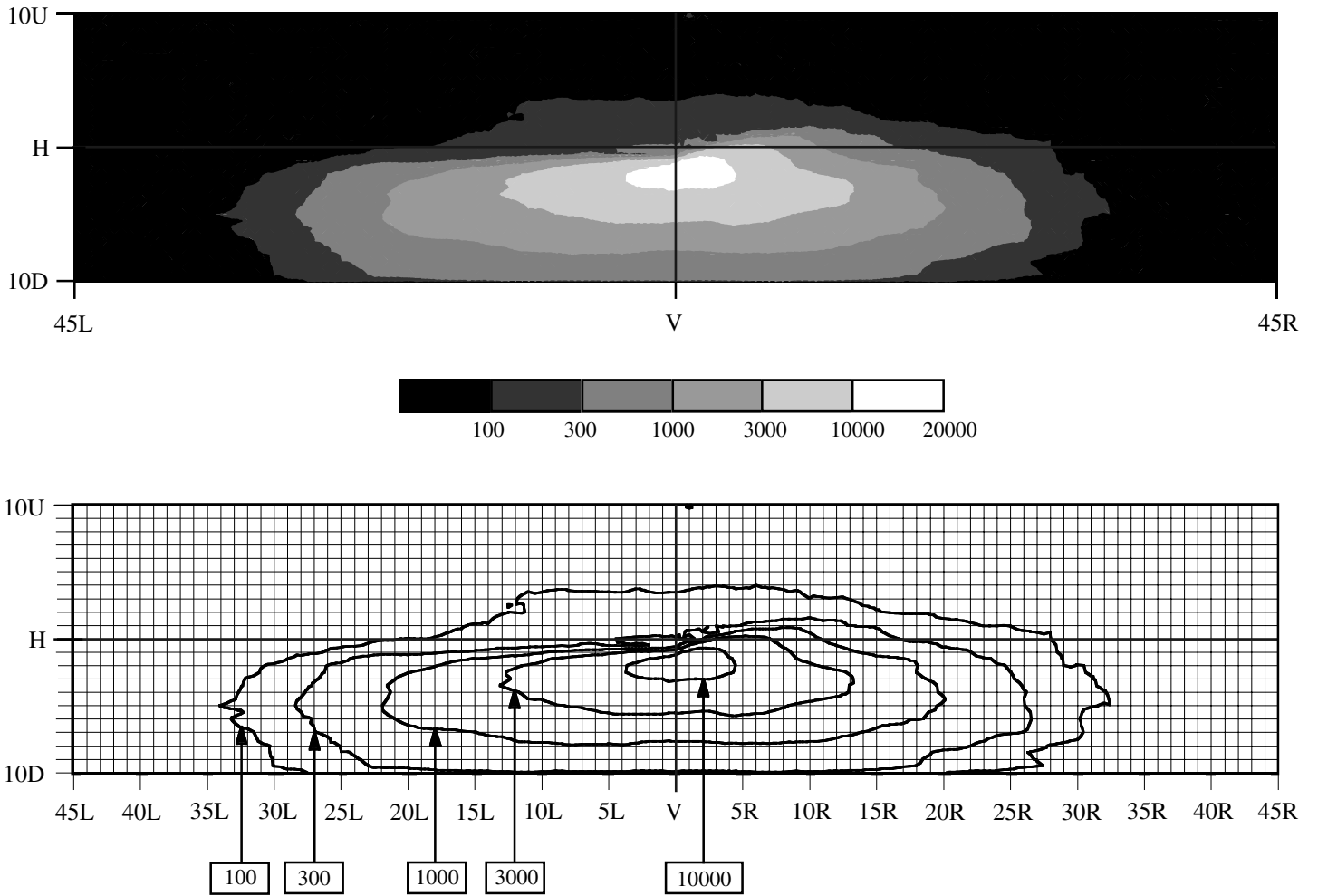


Figure 1. Isocandela diagrams of the median luminous intensities for the sales-weighted sample representing the low-beam headlamps on current passenger vehicles in Europe. The two panels represent the same information in two different formats. (Test voltage: 12.8 V.)

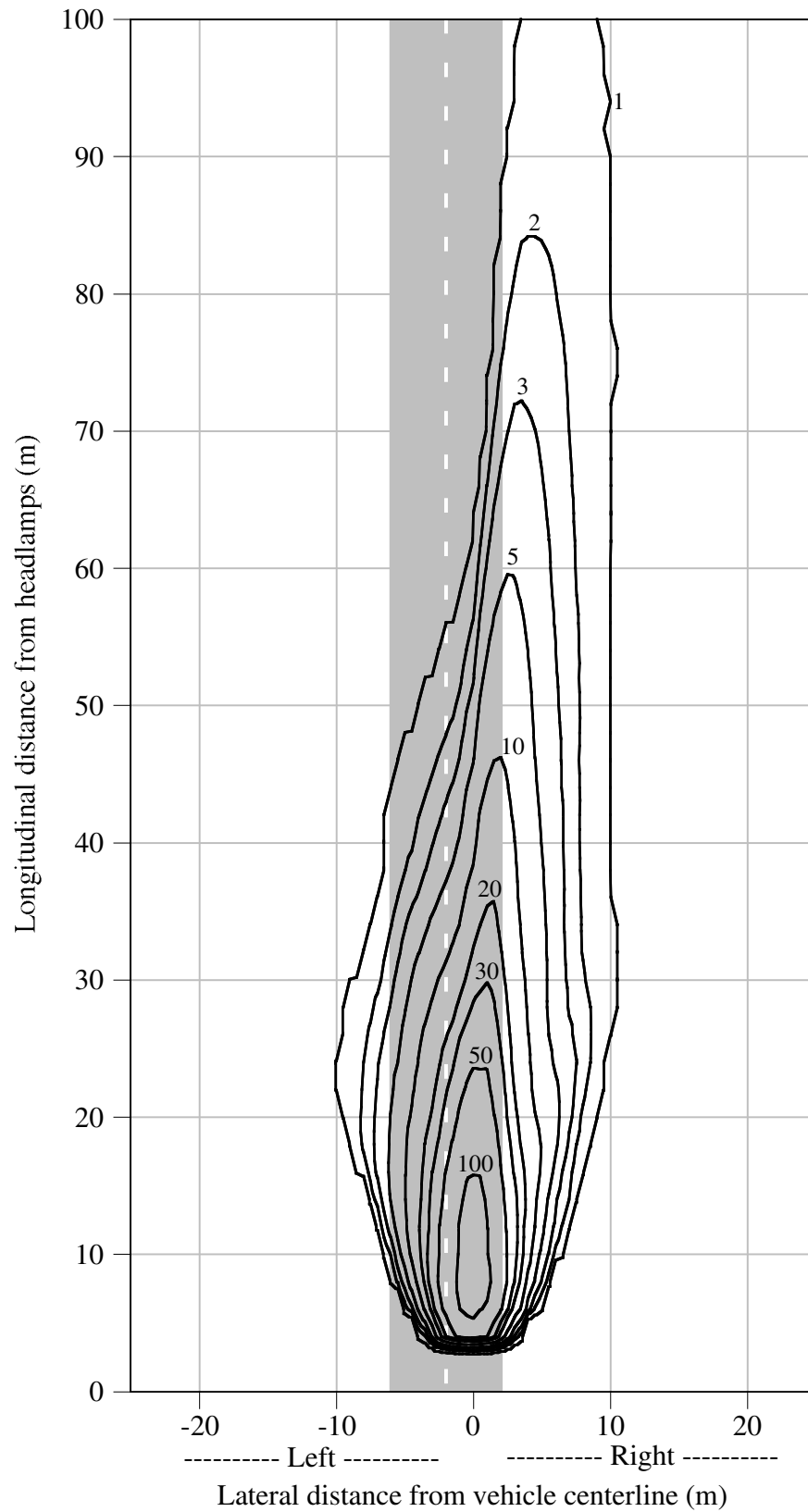


Figure 2. Isoilluminance diagram (in lux) on a vertical surface at the road surface from a pair of lamps with the median luminous intensities for the sales-weighted sample representing the low-beam headlamps on current passenger vehicles in Europe. The shaded area represents a standard two-lane road. (Test voltage: 12.8 V. Lamp mounting height: 0.66 m. Lamp separation: 1.20 m. Lane width: 3.7 m.)

DISCUSSION

The present analysis is not based on a complete census of current low-beam headlamps in Europe, but on a sample constituting 47% of all lamps for passenger vehicles sold in 19 European countries. However, we do not have reasons to believe that there are systematic differences between the lamps that were sampled and those that were not (with the exception of HID headlamps). We believe that the data presented in this report provide valid estimates of the luminous intensities that can be expected at various angles with respect to the headlamp axes of low-beam tungsten-halogen headlamps currently used in Europe. Thus, the data could be used to calculate the expected illuminance reaching targets with known geometric relationships to the headlamps, such as traffic signs, road delineation, the eyes of oncoming drivers, or rearview mirrors on preceding vehicles.

As we pointed out in our previous market-weighted low beam descriptions (Sivak et al., 1997; Sivak et al., 2000; Schoettle et al., 2001), data such as these should not be used to calculate gradients of luminous intensities for adjacent points in space (e.g., for estimating the sharpness of the cutoff that is important for visual aiming of the beam pattern). This is because the transitions from the more intense to the less intense parts of the beam pattern are not precisely in the same locations for all lamps. Consequently, although the present analysis provides valid estimates of luminous intensities for individual points, a computation of gradients between points based on the present analysis would underestimate the actual gradients. This caveat applies not only to the present data, but also to any aggregate data for non-identical beam patterns.

As indicated above, this study was not designed to evaluate compliance with ECE regulations, and thus standard procedures for compliance testing were not followed. Consequently, comparison of the present data with the regulations would be inappropriate.

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