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Working Party on Lighting and Light-Signalling (GRE)
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agenda item 4.3.)

RATIONALE OF HARMONIZED DRIVING BEAM (MAIN-BEAM) PATTERN

Transmitted by the Expert from the Working Party "Brussels 1952" (GTB)

Note: The text reproduced below was prepared by the Chairman of the GTB Coordinating Committee, Mr. David Moore, as a consequence of the harmonization work on the passing beam pattern, requested by GRE.
The proposal was considered and approved by GTB at its ninety-first plenary session, held from 9-11 May 2001 in Rome.

Note: This document is distributed to the Experts on lighting and light-signalling only.

1. BACKGROUND

At its twenty-fourth session GRE formally requested GTB to prepare proposals on a new harmonized passing (dipped-beam) pattern, given the scientific and industrial expertise of GTB in this field. GTB accepted this task and established the Coordinating Committee; whose members for most of the working time were:

Mr. Guy Dorleans, Valeo, Chairman GTB Harmonization WG
Mr. Jeff Erion, Visteon, Chairman SAE Lighting Committee
Mr. David Grainger, SMMT, representing OICA
Mr. Masao Muraoka, Koito, representing JASIC
Dr. Kare Rumar, Sweden, Swedish Research Institute
Dr. Hans Schmidt-Clausen, University of Darmstadt
Mr. Wim van Dam, Philips, Chairman GTB Light Sources WG
Mr. Hanno Westermann, Hella, Chairman GTB SVP WG
Dr. David Moore, Continental Design, Chairman

Because of retirements, within the last year, Mr. Ad deVisser has replaced Mr. van Dam; Dr. Karl Manz has replaced Mr. H. Westermann; and Mr. Geoff Draper is now the new Coordinating Committee Chairman.

As the GTB Coordinating Committee worked on the dipped-beam pattern many references were made about the **main-beam (high beam) pattern and it became apparent that the work programme of the Coordinating Committee needed to be extended to include the main-beam.** GTB approved this additional work.

The general approach of the Coordinating Committee has been to study the existing ECE main-beam and the U.S. high beam patterns, take the best features from both beam patterns and combine them into one harmonized beam pattern.

Table 1 - ECE MAIN-BEAM (Reference luminous flux at approximately 12.0 Volts) TYPE APPROVAL

TEST POINT NUMBER	TEST POINT LOCATION	Present ECE Regulations Nos. 8 & 20	
		Min.	Max.
1	H-V	80% of Max.	-
2	H-2.57R & 2.57L	15,000	-
3	H-5.15R & 5.15L	3,750	-
	MAX. LUMINOUS INTENSITY	30,000	112,500

Table 2 - U.S. HIGH BEAM (12.8 Volts) - DESIGN TO CONFORM

TEST POINT NUMBER	TEST POINT LOCATION	Present NHTSA Table 17A (Two headlamp system)		Present NHTSA Table 27 (9004 & 9007)	
		Min.	Max.	Min.	Max.
1	H-V	40,000	75,000	20,000	75,000
2	H-3R & 3L	15,000	-	10,000	-
3	H-6R & 6L	5,000	-	3,250	-
4	H-9R & 9L	3,000	-	1,500	-
5	H-12R & 12L	1,500	-	750	-
6	1U-3R & 3L	5,000	-	2,000	-
7	2U-V	1,500	-	1,000	-
8	1 1/2D-V	5,000	-	5,000	-
9	2 1/2D-V	2,500	-	2,500	-
10	4D-V	-	12,000	-	5,000
11	1 1/2D-9R & 9L	2,000	-	1,500	-
12	2 1/2D-12R & 12L	1,000	-	750	-

COMPARISON OF THE BEST FEATURES

ECE Main Beam (Table 1 and Figure 1)

- Higher maximum intensity allowed
- Maximum wherever it is, is controlled
- Narrow beam makes higher maximum easier
- H-V value a percentage of the maximum

U.S. High Beam (Table 2 and Figure 2)

- H-V is limited by a maximum, but technically maximum could be anywhere and is not limited
- Wider spread
- Higher minimum at H-V required with certain bulbs
- Control of foreground maximum
- Test points in pattern above and below H-H line

One table of photometric requirements (Table 3) when the primary high beam operates by itself.

Another table of photometric requirements (Table 4) for a secondary high beam used along with the low beam or when there is a primary high beam lighted.

Photometric table to be used when the primary high beam headlamp operates by itself and no other low beam headlamps or no other primary high beam headlamps are lighted.

Table 3 - Primary high beam headlamp.

VALUES IN COLUMNS B & C ARE U.S. DESIGN TO CONFORM;
REFERENCE LUMINOUS FLUX AT 12.8 Volts

VALUES IN COLUMNS D & E ARE EUROPEAN TYPE APPROVAL;
REFERENCE LUMINOUS FLUX AT 12.0 Volts

VALUES FOR EUROPEAN COP WILL BE MADE LATER

	A	B	C	D	E
TEST POINT NUMBER	TEST POINT LOCATION	PRIMARY MAIN BEAM; U.S. DESIGN TO CONFORM; REFERENCE LUMINOUS FLUX AT 12.8 Volts		PRIMARY MAIN BEAM; EUROPEAN TYPE APPROVAL; REFERENCE LUMINOUS FLUX AT 12.0 Volts	
		Min.	Max.	Min.	Max.
1	H-V (1)	(1)	---	(1)	---
2	H-3R & 3L	15,000	---	12,000	---
3	H-6R & 6L	5,000	---	4,000	---
4	H-9R & 9L	3,000	---	2,400	---
5	H-12R & 12L	1,000	---	800	---
6	2U-V	1,500	---	1,200	---
7	4D-V	---	(2)	---	(2)
	MIN. LUMINOUS INTENSITY OF THE MAXIMUM	40,000	---	32,000	---
	MAX. LUMINOUS INTENSITY	---	140,000(3)	---	112,500(3)

(1) Intensity at H-V shall be equal to or greater than 80% of the maximum intensity in the beam pattern.

(2) Intensity at 4D-V shall be equal to or less than 30% of the maximum intensity in the beam pattern.

(3) 112,500 cd at the Reference luminous flux, approx. 12.0 Volts
140,000 cd at the Reference luminous flux, approx. 12.8 Volts

Photometric table to be used when there is a low beam headlamp remaining lighted or there is a primary high beam headlamp lighted.

Table 4 - Secondary high beam headlamp operated with a harmonized low beam headlamp or a Table 3 primary high beam headlamp.

VALUES IN COLUMNS B & C ARE U.S. DESIGN TO CONFORM;
REFERENCE LUMINOUS FLUX AT 12.8 Volts

VALUES IN COLUMNS D & E ARE EUROPEAN TYPE APPROVAL;
REFERENCE LUMINOUS FLUX AT 12.0 Volts

VALUES FOR EUROPEAN COP WILL BE MADE LATER.

	A	B	C	D	E
TEST POINT NUMBER	TEST POINT LOCATION	SECONDARY MAIN BEAM; U.S. DESIGN TO CONFORM; REFERENCE LUMINOUS FLUX AT 12.8 Volts		SECONDARY MAIN BEAM; EUROPEAN TYPE APPROVAL; REFERENCE LUMINOUS FLUX AT 12.0 Volts	
		Min.	Max.	Min.	Max.
1	H-V (1)	(1)	---	(1)	---
2	H-3R & 3L	15,000	---	12,000	---
3	H-6R & 6L	5,000	---	4,000	---
6	2U-V	1,500	---	1,200	---
7	4D-V	---	(2)	---	(2)
	MIN. LUMINOUS INTENSITY OF THE MAXIMUM	40,000	---	32,000	---
	MAX. LUMINOUS INTENSITY	---	140,000(3) (4)	---	112,500(3) (4)

(1) Intensity at H-V shall be equal to or greater than 80 % of the maximum intensity in the beam pattern.

(2) Intensity at 4D-V shall be equal to or less than 30 % of the maximum intensity in the beam pattern.

(3) 112,500 cd at the Reference luminous flux, approx. 12.0 Volts
140,000 cd at the Reference luminous flux, approx. 12.8 Volts

(4) Type 3 plus Type 4 maximum values added together must be no greater than 140,000 cd at 12.8 Volts for the U.S. and no greater than 112,500 cd at 12.0 Volts for Europe.

HARMONIZED MAIN (HIGH) BEAM PROPOSAL
(Tables 3 and 4 along with Figures 3 and 4)

Higher maximum than presently in the United States of America

Higher minimum than present for some bulbs at H-V required

Maximum wherever it is, is controlled

At least the harmonized dipped beam or the primary high beam has wider spread angles

Control of foreground maximum

Foreground maximum is a percentage of the maximum in the beam

Test points in pattern above and below H-H line

2. GENERAL

All ECE headlamp regulations using a halogen light source are based on photometric testing at the reference luminous flux of the light source at 12.0 V. All U.S. lighting regulations are based on photometric testing at 12.8 V. The proposal from the GTB Coordinating Committee is based on reference luminous flux of the light source at 12.0 V for Europe and on reference luminous flux of the light source at 12.8 V for the U.S. At some time in the future there may be an agreement on a common voltage then this difference will be resolved.

3. MAXIMUM AND H-V TEST POINT

In the existing ECE main beam pattern the H-V value must be greater than 80 % of the maximum of the beam. The maximum of the beam, which could be located at some point other than H-V, must be greater than 48 lux (30,000 cd). Therefore, the H-V value must be greater than 24,000 cd if the maximum of the beam is the minimum allowed.

In the existing U.S. high beam pattern the H-V maximum is limited to 75,000 cd. Technically there is not any control on the location of the maximum, nor on the value at that location. The intent is the maximum of the beam is limited to 75,000 cd, however the words in FMVSS 108 and in the SAE standards do not state this. The minimum value specified at H-V is 20,000 cd or 40,000 cd depending on the light source used.

The proposed harmonized main beam has a maximum allowed value of 112,500 cd at 12.0 V and 140,000 cd at 12.8 V. The H-V value shall be equal to or greater than 80 % of the maximum intensity in the beam pattern. Therefore, the proposed allowed maximum is higher than the existing U.S. maximum and the proposed allowed maximum is completely controlled where in the existing U.S. beam pattern it is not controlled.

This increase in the proposed maximum will allow an increase of five to ten per cent in seeing distance.

4. SPREAD

The existing ECE main beam pattern has test point locations along the H-H line at 2.57° R & 2.57° L and at 5.15° R & 5.15° L. Many ECE type approved headlamps have much wider spread than the existing requirements. The existing U.S. high beam pattern has test point locations along the H-H line at 3° R & L; 6° R & L; 9° R & L; and 12° R & L.

The proposed harmonized primary main beam has test point locations along the H-H line at the wider test point locations of the U.S. beam pattern (3° R & L; 6° R & L; 9° R & L; and 12° R & L). It is felt this offers an improvement over the existing ECE main beam pattern and is not a severe penalty in the optical design process. The proposed harmonized secondary main beam, if it is used, only has the test points at 3° R & L and 6° R & L because the wider spread will be provided by the harmonized dipped beam or by the primary main beam.

5. FOREGROUND CONTROL

The existing ECE main beam pattern does not limit the foreground light. The existing U.S. high beam has a maximum limit that depends on:

- Is the low beam lighted along with the high beam?
- Or is the high beam headlamp lighted by itself?

Some amount of foreground light is necessary and desired. The minimum needed and the maximum allowed are not easily defined nor determined. Some research indicates excessive foreground light actually causes a reduction in seeing distance for the driver of the vehicle. Also when driving on wet roads, large foreground light values will cause more reflected light into opposing driver's eyes. On high beam this should not be a problem, because people should not be using the high beam when an opposing driver is a short distance away.

The proposed harmonized main beam has a requirement at the 4D-V test point that the maximum limit is 30 % of the maximum intensity in the beam pattern. The Coordinating Committee considered various percentage values (30 %-40 % of the beam maximum); various fixed values (10,000 - 15,000 – 20,000 cd); various test point locations (3D-V; 4D-V; 4D-4R) and finally agreed to the value and location noted above.

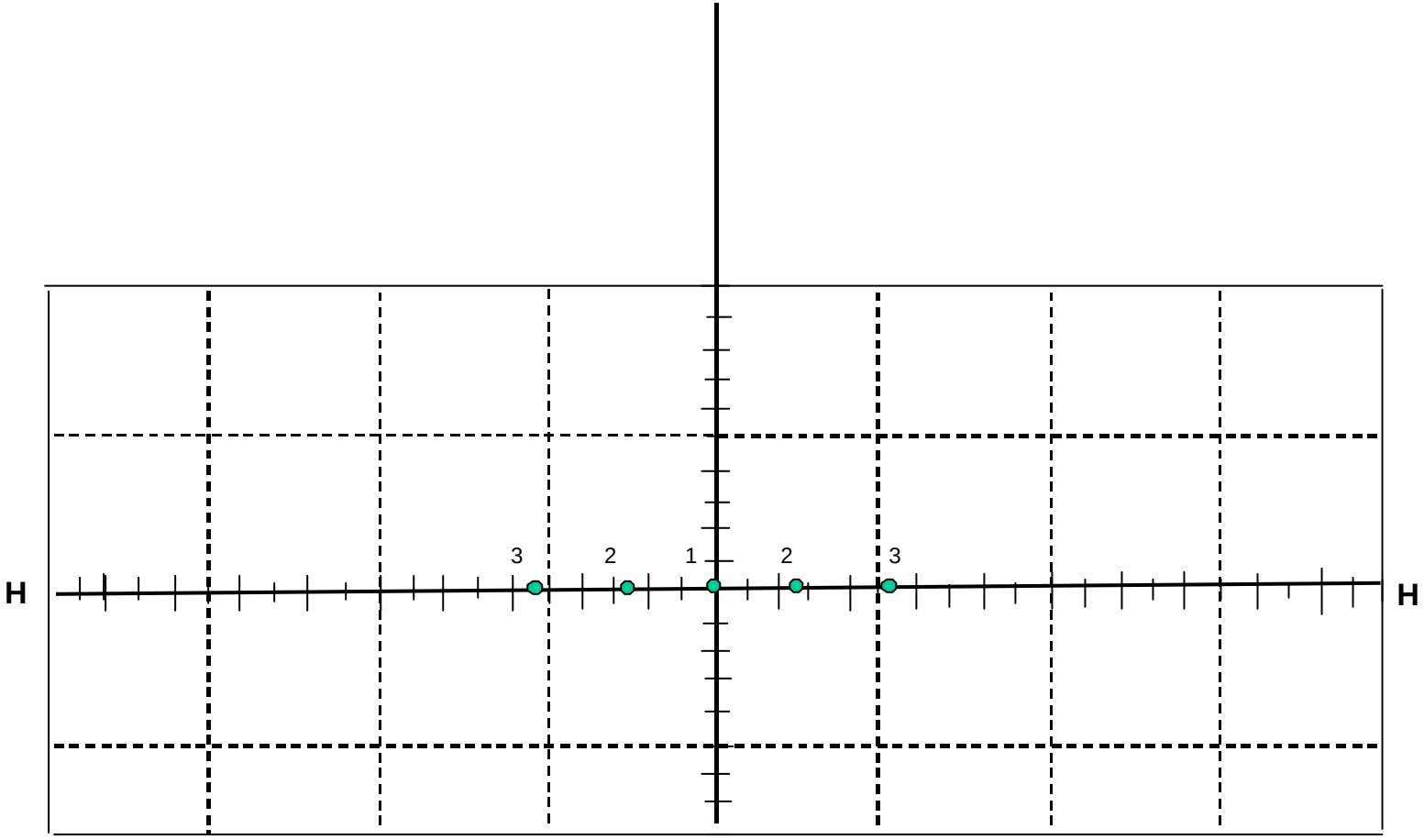
6. LIGHT ABOVE THE HORIZONTAL LINE

The existing ECE main beam pattern does not have any required value above the H-H line. The existing U.S. high beam pattern does have one requirement at the 2U-V test point. It was felt that some vertical spread should be required in the main beam pattern, otherwise it would be legal to only make a "horizontal line of light" for the main beam.

ECE MAIN BEAM REGULATION 7/16/99

FIGURE 1

Type Approval Values
at reference luminous flux
at 12.0 V



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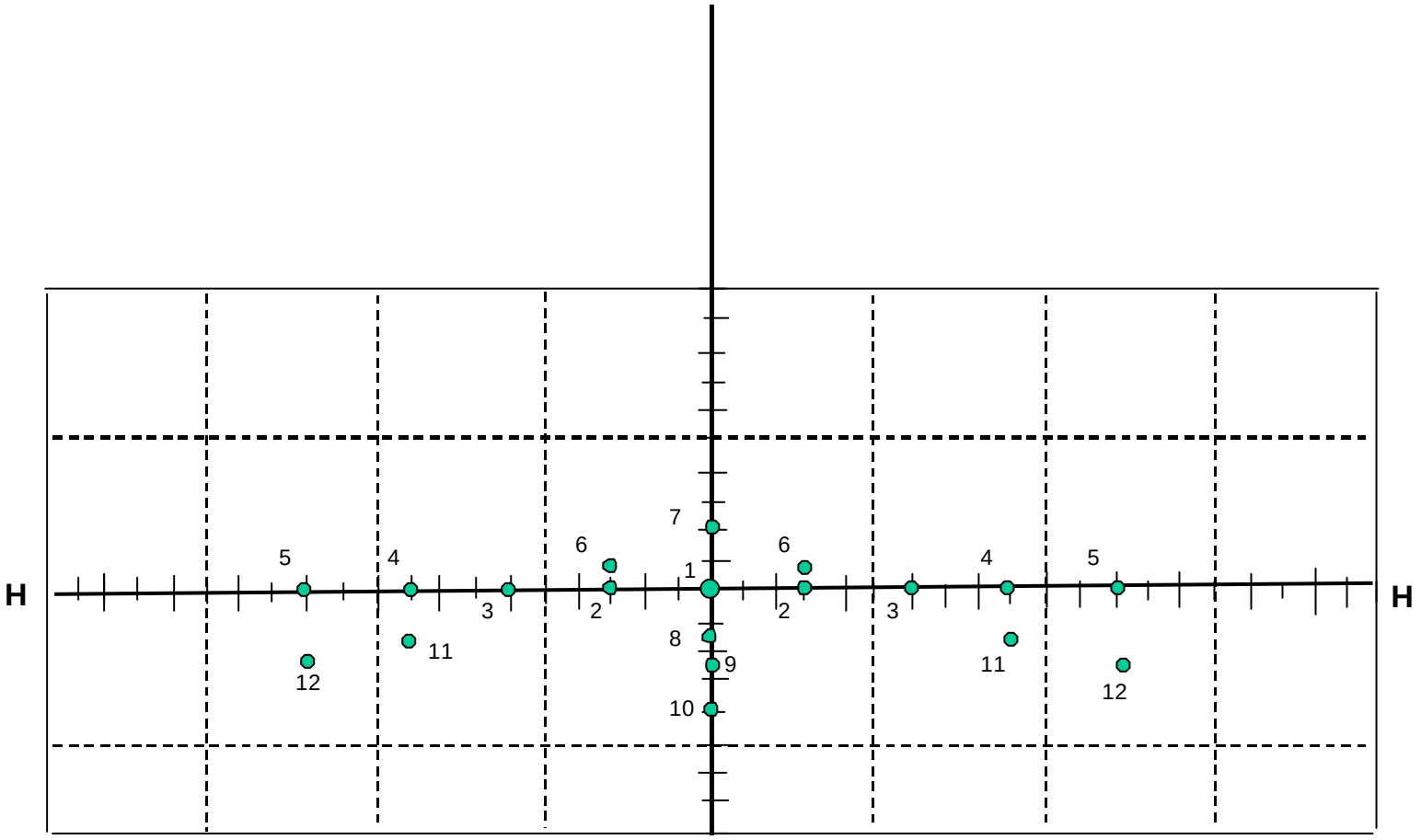
U.S. HIGH BEAM STANDARD 7/16/99

FIGURE 2

Design to Conform Values
at 12.8 V



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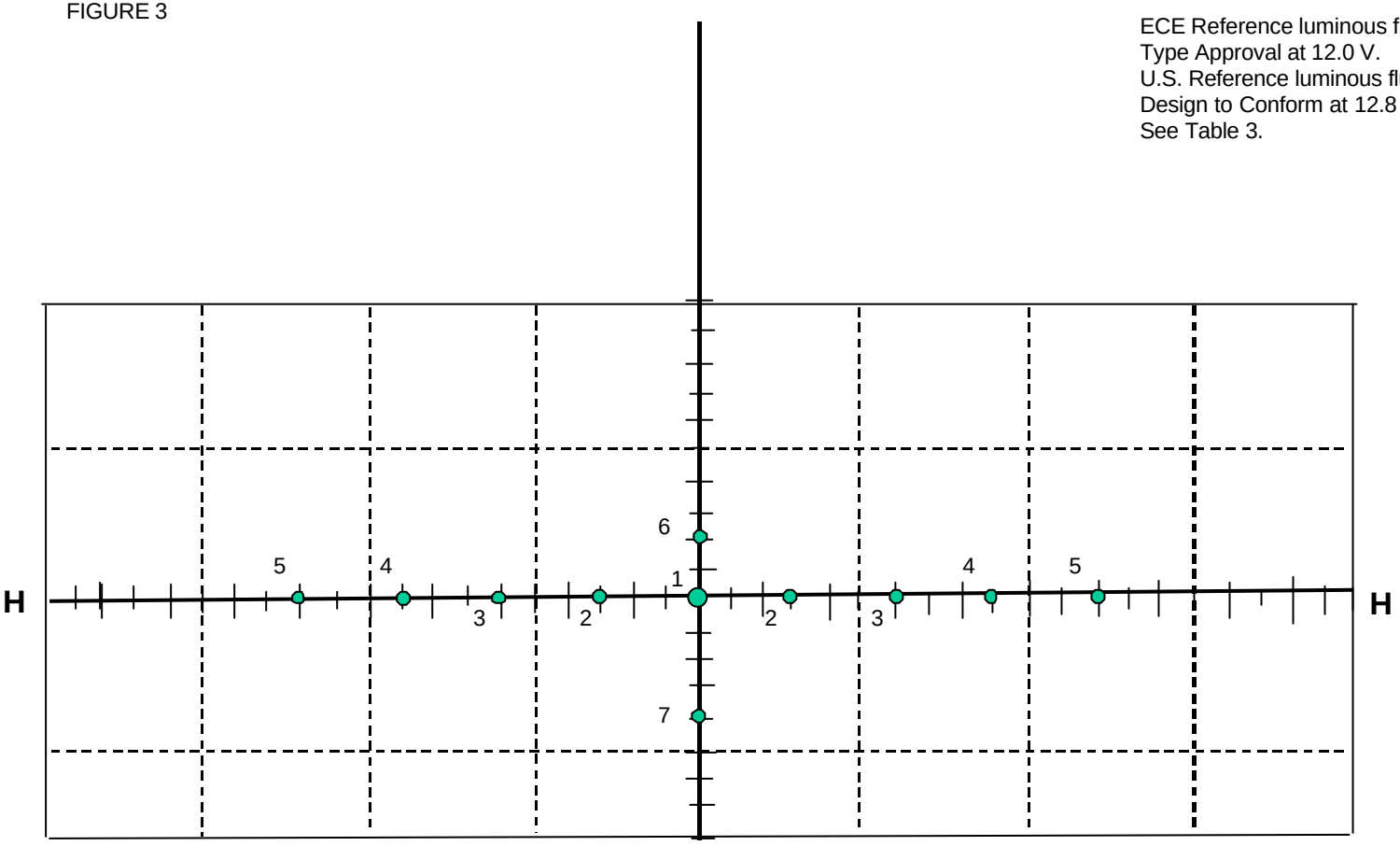
HARMONIZED PRIMARY MAIN (HIGH) BEAM
PROPOSAL 12/13/2000

FIGURE 3

ECE Reference luminous flux,
Type Approval at 12.0 V.
U.S. Reference luminous flux,
Design to Conform at 12.8 V.
See Table 3.



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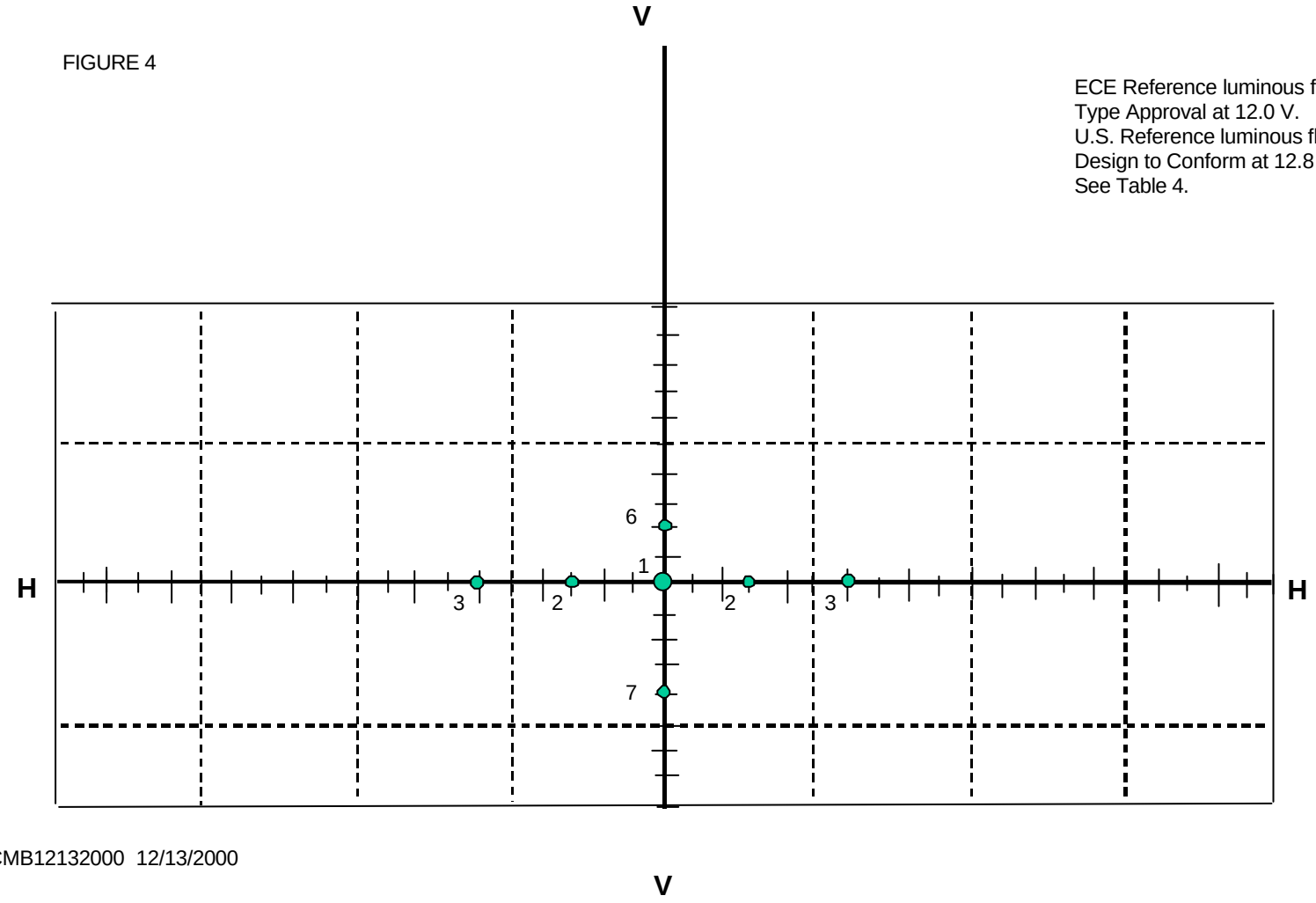
HARMONIZED SECONDARY MAIN (HIGH) BEAM
PROPOSAL 12/13/2000

FIGURE 4



ECE Reference luminous flux,
Type Approval at 12.0 V.
U.S. Reference luminous flux,
Design to Conform at 12.8 V
See Table 4.

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