laservision
WE PROTECT YOUR EYES

CE Marking on Eyeware

EN207:1998 vs. EN 207:2010

Thomas Fröhlich

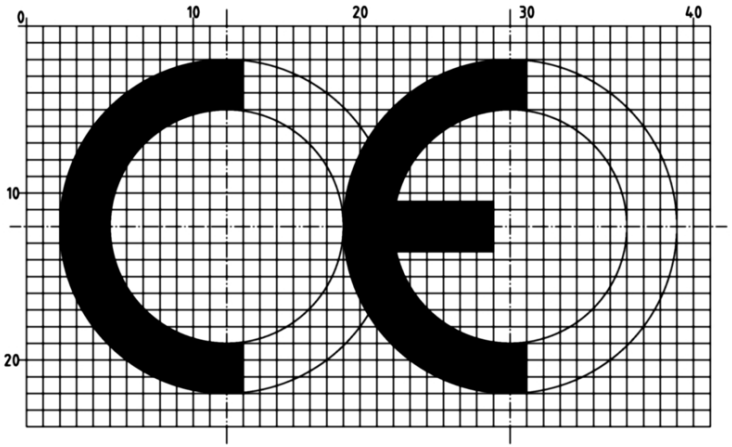
structure

- CE – marking in Europe
- History of EN 207 – Why was a new version needed?
- What is new in EN 207:2010?
- Comparison of testing conditions
- Comparison of determining scale numbers
- summary

laservision
WE PROTECT YOUR EYES

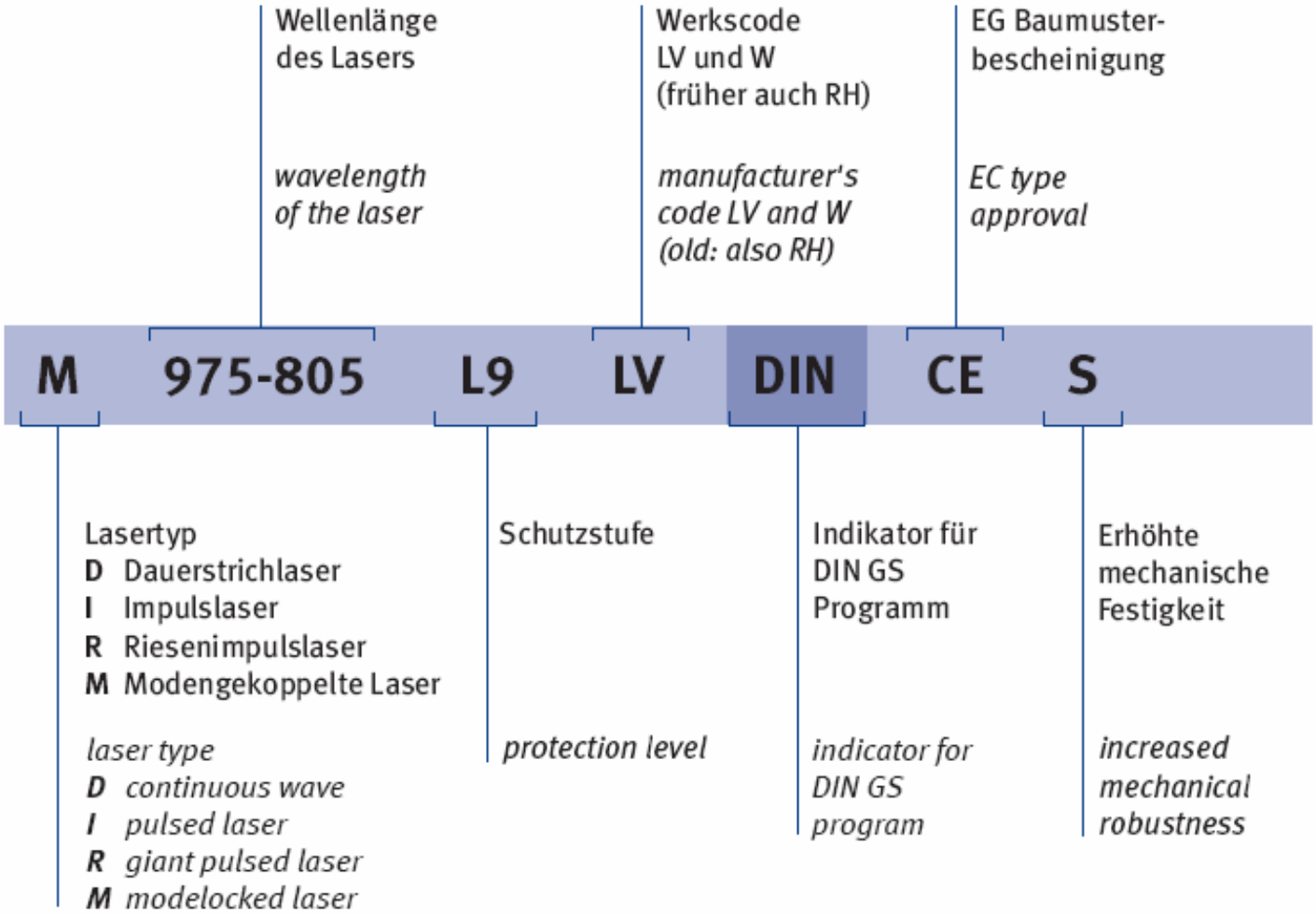
Relevant guidelines and standards for laser safety products in Europe

- EU guideline 89/686
  - guideline describes the basic needs for PPE
- DIN EN 60825-1
  - harmonized standard dfor laser safety. (IEC 60825-1) MPE-Levels, Laser classes, ...)
- DIN EN 207
  - Laser safety eyewear in Europe
- DIN EN 208
  - Alignment filters in Europe



laservision
WE PROTECT YOUR EYES

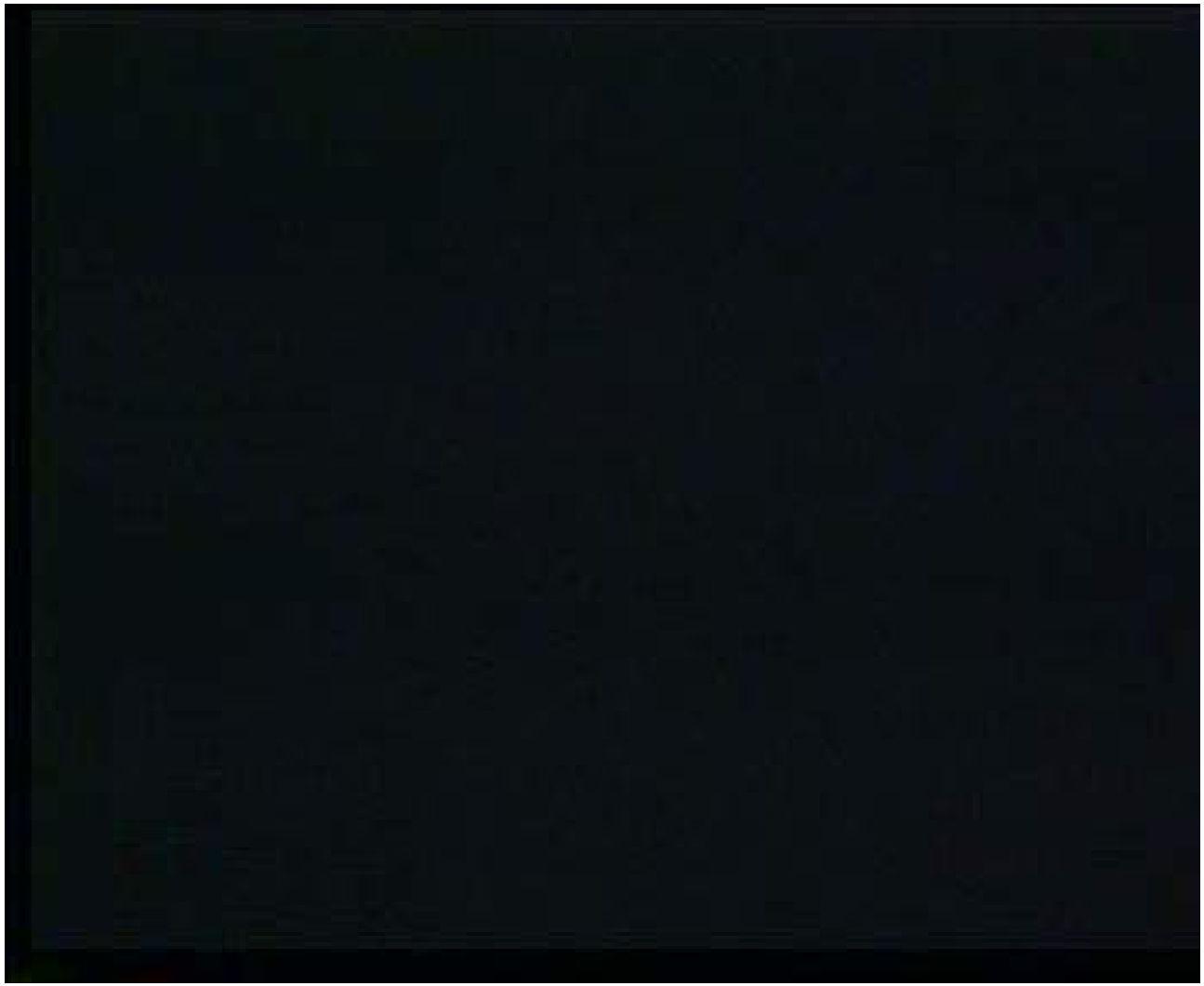
Marking on a laser safety product



laservision

WE PROTECT YOUR EYES

Laser impact test



laservision
WE PROTECT YOUR EYES

EN 207 – History

One main aspect which is different to ANSI 136.7:

Laser impact test: - Why?

The laser safety filters shall protect against an accidental hit of a laser.

How is a laser impact test done?

With available laser sources. (e.g. laser laboratories of the PTB)

→ The laser impact test is only a snapshot based on the available laser systems.

How is the certification process solved?

Independent certification organisations (EU: notified bodies – listed in Brussels) interpret the test results and give a certificate with L-ratings.

Gaps between supporting points (available lasers) will be interpolated.

until 1998 there was no restriction regarding to the laser beam diameter for the impact test:

e.g. cw – laser; 1064 nm; impact test diameter: 100 µm

D L7 ➔min. $E=10^8$ W/m² ➔ min. P = 0,8 W

Basic changes in 1998

1998:

Change in the impact test

→ diameter of testing: D63 = 2mm

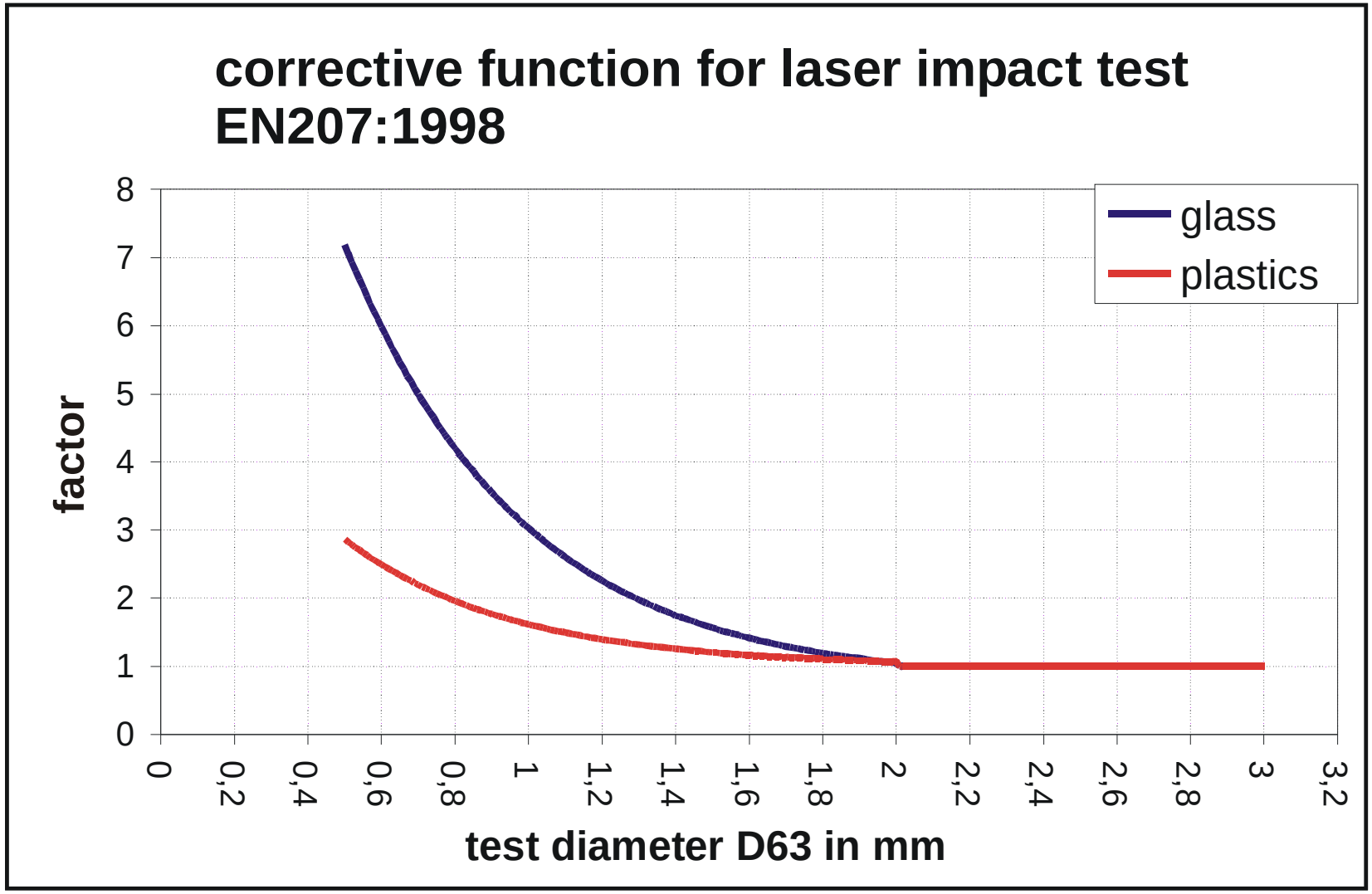
→ if there is no laser available with enough power or Energy a corrective function has to be used: 2 mm > D63 > 0.5 mm

$$\mathbf{F(d) = a_0 + a_1 \cdot e^{-a_2/d}}$$

	glass	plastics
a0	0.769	1
a1	18.29	5.66
a2	0.4778	0.4498

laservision
WE PROTECT YOUR EYES

Corrective function – what does that mean?



Example of a D L6 – test acc. EN 207:1998 at 1064 nm

version 1:

cw – laser: test diameter 2 mm

DL6 ➔ min. $E=10^7$ W/m² ➔ min. P=31.4 W

a test at 313W would also be a DL6 test!

- glass filter withstands the impact test up to a power of ~280W
- plastic filter withstands up to a power ~35 W
  → D L6 for both filters (glass better than plastic)

Example of a D L6 – test acc. EN 207:1998 at 1064 nm

version 2:

cw – Laser: test diameter 0.5 mm

DL6 ➔ min. $E=10^7$ W/m² * F (0.5mm):

glass:	$E = 7.19\ 10^7$ W/m² ;	P = 14.1 W
plastics:	$E = 2.86\ 10^7$ W/m² ;	P = 5.6 W

- glass filter withstands the impact test up to ~20W
- plastic filter withstands without any problems
  → DL6 for both filters (plastic better than glass)

Example of a D L6 – test acc. EN 207:1998 at 1064 nm

version 3:

Pulsed laser: test diameter 2 mm

DL6 ➔ min. $E=10^7$ W/m² ➔ min. Pm=31.4 W ; e.g.: f=10 Hz; Q=3.14 J

- glass filter withstands the test without any problems.
- plastic filter fails the impact test.
  → DL6 for glass and DL5 for plastics

laservision
WE PROTECT YOUR EYES

Resume of the test results

summary:

➔ 1. the corrective function (EN207:1998) brought the safety products to one level.

→the trend was: downgrade of glass and upgrade of plastics.

➔ 2. existing scale numbers have been downgraded

➔ 3. it was possible to “calibrate” the test parameters to get the needed scale numbers.

→ No comparability of products with the same protection level any more

laservision
WE PROTECT YOUR EYES

Change of the standard EN207:2010

So far

Laser impact test: - Why?

The laser safety filters shall protect against an accidental hit of a laser.

BUT: The time a laser safety product withstands the laser impact (10 s) has nothing to do with the time in case of a real laser impact!

New approach

Laser impact test: - Why?

The laser safety filters shall protect against an accidental hit of a laser.

AND: The scale numbers should give a reasonable comparability of laser safety products.

laservision
WE PROTECT YOUR EYES

Differences in between EN 207:1998 and EN207:2010

EN 207: 1998	EN 207: 2010
test diameter:	test diameter:
D63 = 2 mm	D63 = 1 mm
time of laser impact:	time of laser impact:
10 s or 100 pulses and at least 10s	5 s or 50 pulses and at least 5s
Use of the corrective function at smaller test diameters	No smaller test diameter is possible.
For pulsed lasers: C5-factor only for the choice of a product	For pulsed lasers: C5-factor for the choice and for the test of a product
The choice of a laser safety product was to be done over the power/energy density.	The choice of laser safety products has to be done over power / energy density and the user can use a new corrective function.

New corrective function – only in appendix B (voluntary)

glass $\mathbf{F(d) = d^{1,1693}}$

plastics $\mathbf{F(d) = d^{1,2233}}$

laservision

WE PROTECT YOUR EYES

Choice of laser safety glasses with CE

Table 1 — Scale numbers (maximum spectral transmittance and stability to laser radiation) of the filters and/or eye-protectors against laser radiations

Scale number	Maximum spectral transmittance at the laser wavelength $\tau(\lambda)$	Power (E) and energy (H) density for testing the protective effect and stability to laser radiation in the wavelength range								
		180 nm to 315 nm			>315 nm to 1 400 nm			>1 400 nm to 1 000 µm		
		D $\geq 3 \times 10^{4}$	I, R 10^{-9} to 3×10^{4}	M $< 10^{-9}$	D $>5 \times 10^{-4}$	I, R 10^{-9} to 5×10^{-4}	M $<10^{-9}$	D >0,1	I, R 10^{-9} to 0,1	M $<10^{-9}$
		E_D W/m²	$H_{I,R}$ J/m²	E_M W/m²	E_D W/m²	$H_{I,R}$ J/m²	H_M J/m²	E_D W/m²	$H_{I,R}$ J/m²	E_M W/m²
LB1	10^{-1}	0,01	3×10^{2}	3×10^{11}	10^{2}	0,05	$1,5 \times 10^{7}$	10^{4}	10^{3}	10^{12}
LB2	10^{-2}	0,1	3×10^{3}	3×10^{12}	10^{3}	0,5	$1,5 \times 10^{8}$	10^{5}	10^{4}	10^{13}
LB3	10^{-3}	1	3×10^{4}	3×10^{13}	10^{4}	5	0,15	10^{6}	10^{5}	10^{14}
LB4	10^{-4}	10	3×10^{5}	3×10^{14}	10^{5}	5	1,5	10^{7}	10^{6}	10^{15}
LB5	10^{-5}	10^{2}	3×10^{6}	3×10^{15}	10^{6}	5×10^{2}	15	10^{8}	10^{7}	10^{16}
LB6	10^{-6}	10^{3}	3×10^{7}	3×10^{16}	10^{7}	5×10^{3}	$1,5 \times 10^{2}$	10^{9}	10^{8}	10^{17}
LB7	10^{-7}	10^{4}	3×10^{8}	3×10^{17}	10^{8}	5×10^{4}	$1,5 \times 10^{3}$	10^{10}	10^{9}	10^{18}
LB8	10^{-8}	10^{5}	3×10^{9}	3×10^{18}	10^{9}	5×10^{5}	$1,5 \times 10^{4}$	10^{11}	10^{10}	10^{19}
LB9	10^{-9}	10^{6}	3×10^{10}	3×10^{19}	10^{10}	5×10^{6}	$1,5 \times 10^{5}$	10^{12}	10^{11}	10^{20}
LB10	10^{-10}	10^{7}	3×10^{11}	3×10^{20}	10^{11}	5×10^{7}	$1,5 \times 10^{6}$	10^{13}	10^{12}	10^{21}

NOTE The symbols D, I, R and M relative to the test conditions are explained in Table 4.

laservision
WE PROTECT YOUR EYES

summary

The marking will change from L to LB

The testing conditions have been changed

The comparability should become better

There exists a new correction function for the choice of the eyewear.

Thank you for your kind attention