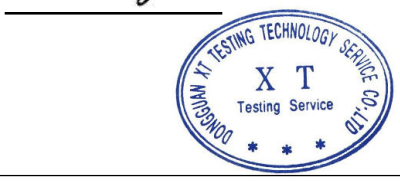
TEST REPORT

EN 207:2017

Personal eye-protection equipment - Filters and eye-protectors against laser radiation (laser eye-protectors)

Test report reference No..... :	PECTCF-PPE	
Tested by (+ signature)..... :	James Li	
Approved by (+ signature)..... :	Kevin Zhang	
Date of issue..... :	2022-12-02	
Contents..... :	14 pages	
..... :		
Client		
Name..... :	LASERDOCK LIMITED	
Address..... :	12/F, San Toi Building, 137-139 Connaught Road Central, Hong Kong	
Test specification		
Standard used during verification..... :	EN 207:2017	
Test item		
Description..... :	OD 1.7 ND Goggles	
Trademark..... :	Wicked Lasers	
Model and/or type reference..... :	BP-3267, WL BP	
Manufacturer..... :	PENGBO ENTERPRISES CO., LTD. NO.4 INDUSTRIAL ESTATE, SANDONG ROAD, HUADU DISTRICT, GUANGZHOU, CHINA	

Test case verdicts

Test case does not apply to the test object..... : N/A(Not applicable)

Test item does meet the requirement..... : P(Pass)

Test item does not meet the requirement..... : F(Fail)

Testing

Date of receipt of test item ..... : 2022-11-17

Date(s) of performance of test..... : 2022-11-17 - 2022-12-02

General remarks

This test report shall not be reproduced except in full without the written approval of the testing laboratory.

The test results presented in this report relate only to the item tested.

"(see remark #)" refers to a remark appended to the report.

"(see appended table)" refers to a table appended to the report.

Throughout this report a comma is used as the decimal separator.

Test location:
Dongguan China

3	Requirements		--
3.1	Spectral transmittance of filters and frames		--
	When tested according to 4.2, the maximum spectral transmittance at the wavelength(s) or in the wavelength range(s) of protection shall not exceed the values specified in Table 1 for the applicable scale number.		P
3.2	Luminous transmittance of filters		--
	When assessed in accordance with 4.3, the luminous transmittance of the filter relative to the D65 standard illuminant (see ISO 11664-2:2007) shall be at least 20 %. However, luminous transmittance lower than 20 % may be accepted provided that the manufacturer supplies information related to the increase of the intensity of illumination at the relevant workplace in accordance with Clause 5.		P
3.3	Resistance of filters and frames to laser radiation		--
	When tested according to 4.4, the filters and frames shall meet the requirements of 3.1 and shall not lose their protective effect under the influence of laser radiation of the power (E)/ energy density (H) as specified in Table 1 and shall not show any induced transmission (reversible bleaching). No splinters shall come away from the side of the filter facing the eye under the influence of the laser radiation. Any melting or other damage of the surface during the course of irradiation is not considered negative if the protective effect is still maintained.		P
3.4	Refractive values of filters and eye-protectors		--
	When assessed in accordance with 4.5, the maximum refractive values of filters and eyeprotectors with no corrective effect shall be as given in Table 2. The maximum refractive values apply to the range specified in 7.1.2.1 of EN 166:2001.		P
3.5	Quality of material and surface of filters		--
3.5.1	Material and surface defects		--
	The material and surface defects of filters shall be assessed in accordance with 4.6.1. Except for a marginal area of 5 mm wide, filters shall be free from any material or surface defects likely to impair the intended use, such as bubbles, scratches, inclusions, dull spots, mould marks, scoring or other defects originating from the manufacturing process. No holes are allowed anywhere in the filters.		P

3.5.2	Diffusion of light		--
	The reduced luminous coefficient l* of a filter, determined in accordance with 4.6.2, shall not be		P
	greater than $l^* = 0{,}50 \frac{\mathrm{cd/m^2}}{\mathrm{lx}}$		
3.6	Stability of filters and eye-protectors to ultraviolet radiation and elevated temperature		--
3.6.1	Stability to ultraviolet radiation		--
	When exposed to ultraviolet radiation in accordance with 4.7.1, the properties of filters and eye-protectors shall not change to such an extent that they can no longer satisfy the requirements of 3.1, 3.2,3.4 and 3.5. The relative change in the luminous transmittance shall be ≤ 10 %: $\left\|\frac{\Delta\tau_v}{\tau_v}\right\| \le 10\ \%$ The spectral transmittance for the laser wavelengths shall, however, in no case exceed the maximum spectral transmittance corresponding to the indicated scale number.		P
3.6.2	Stability at elevated temperature		--
	After exposure to elevated temperature in accordance with 4.7.2, filters and eye-protectors shall satisfy the requirements of 3.1, 3.2, 3.4 and 3.5. The relative change in the luminous transmittance shall not exceed 5 %: $\left\|\frac{\Delta\tau_v}{\tau_v}\right\| \le 5\ \%$ The spectral transmittance for the laser wavelength shall, however, in no case exceed the maximum spectral transmittance corresponding to the indicated scale number.		P
3.7	Resistance of filters and frames to ignition by contact with hot surfaces		--
	When tested in accordance with 4.8, the filters and frames shall not ignite or continue to glow.		P
3.8	Field of vision of eye-protectors		--
	Eye-protectors shall have a clear field of vision of at least 40° in the vertical and horizontal directions for each eye when measured in accordance with 4.9 (see Figure 1).		P
3.9	Construction of filters and frames		--

	Filters shall be constructed so that when tested in accordance with 4.4 followed by a visual inspection no splinters are detached from the side of the filter facing the eye. If the filters consist of several individual filters, they shall be assembled in such a way that they cannot be interchanged. Filters shall not be interchangeable in the frame. An exception is possible if the protection to laser radiation is determined only by the filter(s) and no part of the frame lies inside the protected range as defined below. In this case the marking of the eyeprotector shall be on the filter(s) and there is no		P

	requirement for the frame to satisfy 3.3 on resistance to laser radiation. The frame shall be designed so that no laser radiation can penetrate from the side. This requirement is met if for the horizontal angle range α from - 50° (nasal side) to + 90° (temporal side) the vertical angle range β is protected within the following limit angles in degrees (°). The upward limit β u of the protected range shall be: $\beta_u = 55 - 0,0013 \times (\alpha - 12)^2 - 1,3 \times 10^{-6} (\alpha - 12)^4$ The downward limit β l of the protected range shall be: $\beta_l = -70 + 10^{-5} \times (\alpha - 22)^2 + 2,3 \times 10^{-6} (\alpha - 22)^4$ Testing shall be done in accordance with 4.10.		
3.10	Mechanical strength of eye-protectors		--
3.10.1	Basic requirement		--
	Filters for protection against laser radiation shall satisfy the requirement for minimum robustness as specified in 7.1.4.1 of EN 166:2001. The frames of the eye-protectors shall satisfy the requirements of 7.1.4.2 or 7.2.2 of EN 166:2001.		P
3.10.2	Optional requirements		--
	If the mechanical strength of filters and eyeprotectors against laser radiation is required to satisfy more stringent requirements, the requirements specified in 7.1.4.2 or the requirements specified in 7.2.2 of EN 166:2001 shall be met.		P
4	Testing		--
4.1	General		--

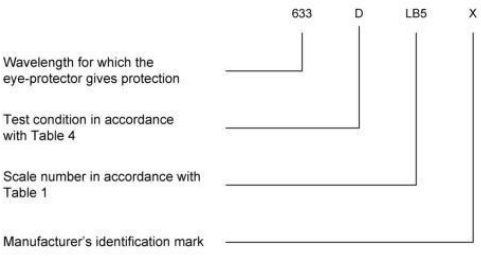
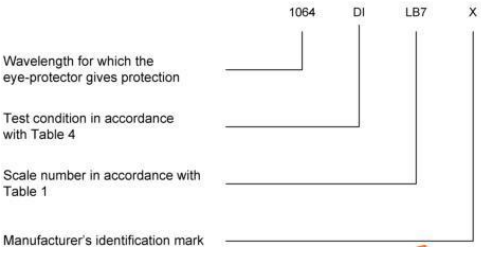
	The testing schedule in Table 3 shall be applied to testing of filters, frames and complete eyeprotectors. The sequence of testing 1 to 9 and 13 to 16 may be changed. At least 16 filters or eight complete eye-protectors are required for testing. If testing for several wavelengths (wavelength ranges) or testing conditions according to 4.4 and/or several optional requirements has to be done, more than 16 samples may be necessary.		P
4.2	Spectral transmittance of filters and frames		--
	The spectral transmittance shall be determined for normal incidence. Filters with angular-dependent transmittance (such as interference layers) for the wavelength range from 400 nm to 1 400 nm shall be measured at angles of incidence between 0° and 30° with polarized radiation and an orientation of the polarization direction giving the highest value of the spectral transmittance. Filters with angular-dependent transmittance for other wavelengths shall be measured at angles of incidence between 0° and 90° with polarized radiation. In this case, the scale number results from the highest of the spectral transmittance values measured. Testing shall be done in accordance with EN 167:2001, Clause 6.		P
4.3	Luminous transmittance of filters		--
	The luminous transmittance shall be determined for normal incidence, relative to the D65 standard illuminant (see ISO 11664-1:2007 and ISO 116642:2007). The test shall be performed according to EN 167:2001, Clause 6.		P
4.4	Resistance of filters and frames to laser radiation		--

	The test shall be carried out with laser radiation of the specified wavelengths and the power and energy densities given in Table 1. The spectral transmittance shall be measured for each laser wavelength during the exposure to laser radiation. The values of energy density (H) in Table 1 for testing the resistance against laser radiation for pulsed lasers (I, R, M) shall be multiplied with the factor N -1/4 , where N is the number of pulses in 5 s. The frame shall be exposed to radiation at the point of least thickness for each of the materials used (with the exception of headbands). The diameter d 63 of the laser beam during this test shall be (1 ± 0,1) mm. The diameter d 63 is the area of the smallest circle containing 63 % of the laser power/energy. For pulse durations < 1 ns, the diameter d 63 of the laser beam during this test shall be ≥ 0,5 mm. In the case of rectangular beams, the dimensions specified apply to the shortest side of the rectangle. The duration of the test shall be taken from Table 4. Testing shall be done at least for 5 s, but in the case of pulsed operation never with less than 50 pulses. For pulsed lasers, testing shall be done with low repetition rates (≤25 Hz). If it is not possible, the energy density used for testing shall be given and the product shall be marked in accordance with 6.1, d). All laser protective filters and frames shall be tested in accordance with the test condition D. If commercially available, testing at mode D shall be done with a real CW laser. If it is not feasible, testing shall be done with a pulsed laser system at a minimum pulse repetition frequency ν of ν ≥ 25 Hz. If no laser with pulse repetition rates higher than 25 Hz is available, a pulsed laser system at a minimum pulse repetition frequency of ν ≥ 5 Hz shall be used to test condition D. If additional protection against pulsed lasers is required, the filters and laser eye-protectors shall be tested according to one or several of the test conditions I, R or M. Lasers which do not show spiking at the		P

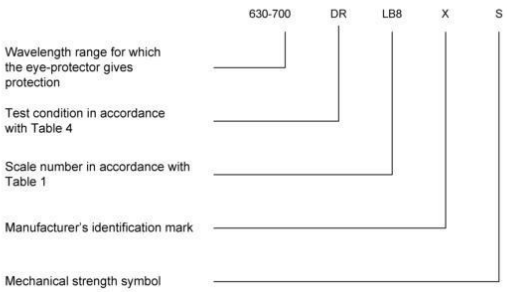
	beginning of the emission shall be used. The spatial and temporal beam profile shall be documented, except for temporal profiles of M mode lasers.		
4.5	Refractive value of filters and eye-protectors		--
	The test shall be carried out in accordance with Clause 3 of EN 167:2001.		P
4.6	Quality of material and surface of filters		--
4.6.1	Material and surface defects		--

	The test shall be carried out in accordance with Clause 5 of EN 167:2001. Thin film filters should be carefully examined for defects (scratches and holes) as damage of deposited layer can affect protection against laser radiation.		P
4.6.2	Diffusion of light		--
	The test shall be carried out in accordance with Clause 4 of EN 167:2001. If the simplified method cannot be used because the spectral transmittance is too low, the basic method shall be used.		P
4.7	Stability to UV radiation and stability to elevated temperature		--
4.7.1	Stability to UV radiation		--
	The test shall be carried out in accordance with Clause 6 of EN 168:2001, with the lamp running at a power of 450 W and an exposure time of (50 ± 0,2) h.		P
4.7.2	Stability to elevated temperature		--
	Filters and eye-protectors shall be stored for at least 7 h in a climatic cabinet at a temperature of (55 ± 2) ° C and a relative humidity of > 60 %, and then stored for at least 2 h at room temperature.		P
4.8	Resistance of filters and frames to ignition by contact with hot surfaces		--
	The test shall be carried out in accordance with Clause 7 of EN 168:2001.		P
4.9	Field of vision of eye-protectors		--
	For measuring the field of vision, the test head specified in EN 168:2001 with the eye-protector without filters shall be mounted as shown in the example of set up illustrated in Figure 1 so that the two axes of rotation A and B and the optical axis C intersect in the middle of the front surface of one eye. Irradiation is provided by a laser beam of diameter (1 ± 0,5) mm along axis C. When rotated around axis A, the difference in the angular positions at which the light beam no longer hits the eye gives the vertical field of vision. By rotating around axis B, the difference between the angular		P
	position at which the light beam no longer hits the eye and the line of vision of the test head parallel to the optical axis C gives half the horizontal field of vision. Other methods are permissible if they give identical results.		
4.10	Determination of the protected range		--

	Using the apparatus as given in 4.9 the scan shall verify that the eye-protector covers at least the range as defined by the limits β u and β l .		P
4.11	Frames		--
4.11.1	It shall be tested by means of manual and visual inspection whether the filters are interchangeable.		P
4.11.2	The test shall be carried out using the method given in 4.9. The zero values of the angles α and β are reached when the axis A, B and C of the test apparatus are perpendicular to each other.		P
4.12	Mechanical strength		--
	The test shall be carried out in accordance with Clause 4 of EN 168:2001.		P
5	Information supplied by the manufacturer		--
	In addition to the requirements of EN 166:2001, Clause 10, the selection criteria and instructions for use shall contain at least the following: a) luminous transmittance; b) if the luminous transmittance is less than 20 %, this shall be indicated and the user shall be recommended to increase the intensity of illumination at the workplace; c) in the case of tinted and coloured filters a warning to the user that the recognition of warning lights or warning signals can be impaired; d) the information that eye-protectors are only intended to give protection against accidental radiation and that both the limit values and the resistance tests are based on a maximum period of 5 s; e) a warning that eye-protectors and filters against laser radiation which have been damaged, have scratched oculars or which have undergone a colour change shall not be used anymore; f) an explanation of the symbols used in the marking; g) details regarding an appropriate cleaning method; h) in case of filters with angle dependent transmittance an information shall be given that the protection is only provided for angles of incidence up to 30° . Instructions shall include a warning of risk of exposure to laser radiation due to reflection from reflective parts (including eye-protectors), tilting or		P

	misalignment of optical components. Instructions shall include a recommendation that in areas where there is a risk of exposure to laser radiation appropriate eye-protection should be worn by all personnel. In addition, the manufacturers shall supply additional data in the form of transmission curves.		
6	Marking		--
6.1	Eye-protectors		--
	The following shall be marked permanently on the filters or the frames for identification: a) wavelength(s) or wavelength range (given in nanometres (nm)) in which the filter provides protection; b) the symbol for the test condition (see Table 4); c) scale number (see Table 1); If the filter guarantees protection in one or several spectral ranges, the lowest scale number shall be given in the corresponding spectral range. d) if the eye-protector is not tested with low repetition rates (≤25 Hz), the suffix Y shall be added to the scale number, e.g. RLB5Y; e) manufacturer's identification mark; In order to prevent multiple use, only marks granted at European or national level shall be used. f) if the eye-protector satisfies the mechanical strength requirement of 3.10.2, one of the marks specified in Clause 9 of EN 166:2001 shall also be added. If the symbols are marked on the filters, they shall not impair vision nor the protective effect.		P
	EXAMPLE 1  EXAMPLE 2  		--

.

	EXAMPLE 3  		--
	If several marks apply to a laser radiation eyeprotector, all these marks shall be applied, or alternatively the manufacturer's identification mark, the certification mark and the mechanical strength symbol shall be specified only once; the other identification elements shall be separated by a +. EXAMPLE 4 Marking might become very lengthy if a filter or a frame protects against several wavelength. In these cases, the mark may be pooled as follows: 10600 D LB3 + IR LB4 1064 DI LB8 + R LB9 633 D LB4 + IR LB5 X S where the symbols have the same meaning as in precedent examples.		P
6.2	Filters		--
	As filters in eye-protectors against laser radiation shall not be interchangeable, they need not be marked separately if the complete eye-protectors are marked. Filters to be used as viewing windows in appliances and installations shall be marked in accordance with 6.1.		P

End of report

ANNEX A:

Photo-documentation

Photo 1 General appearance of the EUT

Photo 2 General appearance of the EUT

Photo 3 General appearance of the EUT

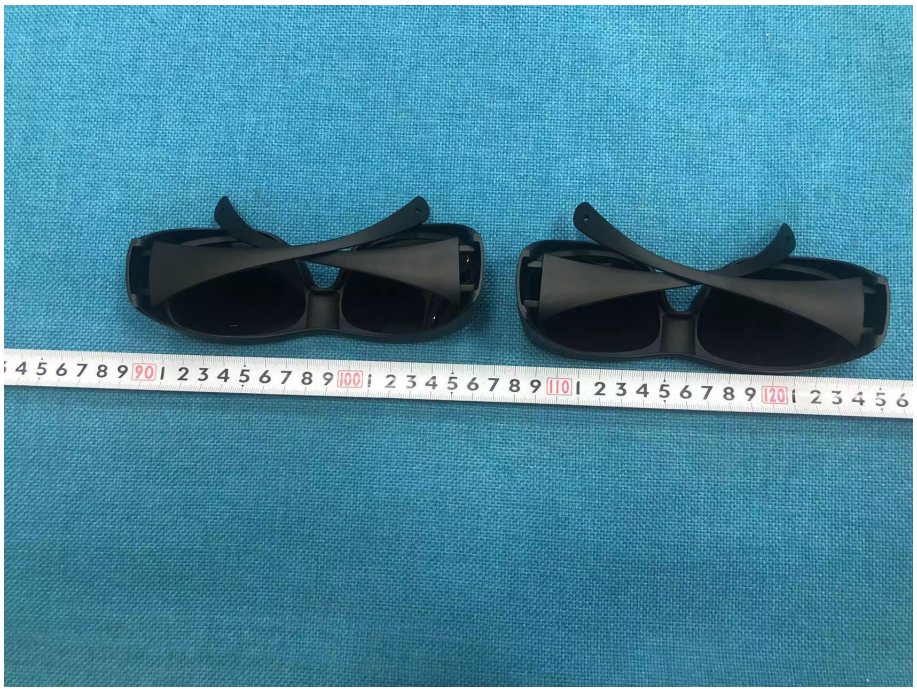


Photo 4 General appearance of the EUT