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# INDUSTRY STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

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# Rigid gas permeable contact lenses for orthokeratology

# 角膜塑形用硬性透气接触镜



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**Issued by: the State Food and Drug Administration**

# Table of Contents

# Foreword

This Standard is not equivalent to international standard, it is drafted by referencing to the technical contents of the relevant international and domestic standards; and the relevant contents of the foreign and domestic law and regulations, mainly including:

ISO 8320-1 Ophthalmic Optics -- Vocabulary of Contact Lenses and Care Products -- Basic Requirements

ISO 8321-1 Optics and Optic Instruments -- Contact Lenses -- Part 1: Rigid Gas Permeable Contact Lens

ISO 8599 Ophthalmic Optics -- Contact Lenses -- Spectral Transmittance Test

ISO 9337-1 Ophthalmic Optics -- Contact Lenses -- Back Vertex Dioptrie Test -- Part 1: Lensometer

ISO 9338 Ophthalmic Optics -- Contact Lenses -- Diameter Measurement

ISO 9339-1 Ophthalmic Optics -- Contact Lenses -- Thickness Measurement -- Part 1: Rigid Contact Lenses

ISO 9340 Ophthalmic Optics -- Contact Lenses -- Stress Test of Rigid Contact Lenses

ISO 9341 Ophthalmic Optics -- Contact Lenses -- Tests for Inherent Quality and Surface Defect of Rigid Contact Lenses

ISO 9363-1 Ophthalmic Optics -- Contact Lenses -- Biological Compatibility of Contact Lenses -- Evaluation on Cytotoxicity Test -- Part 1: Agar Overlay Test and Growth Inhibition Test

ISO 9394 Ophthalmic Optics -- Evaluation on Material Biocompatibility of Contact Lenses -- Test of Contact Lenses in Rabbits' Eyes

ISO 9913-1 Ophthalmic Optics -- Contact Lenses -- Polarographic Oxygen Permeability Measurement

ISO 9913-2 Ophthalmic Optics -- Contact Lenses -- Measurement of Oxygen Permeability through Coulomb

ISO 9914 Ophthalmic Optics - Contact Lenses - Measurements for Refractive Index -- Materials -- Contact Lenses

ISO 10338 Ophthalmic Optics -- Contact Lenses -- Curvature Measurement

ISO 10334 Ophthalmic Optics -- Contact Lenses -- Salt Solution Used in the Test of Contact Lenses

ISO 10340 Ophthalmic Optics -- Contact Lenses -- Methods for Measurement of Extractable Materials

ISO 11539 Ophthalmic Optics -- Contact Lenses -- Methods for the Classification of Care Products for Contact Lenses and Corneal Contact Lenses

ISO 14534 Ophthalmic Optics -- Vocabulary of Contact Lenses and Care Products -- Basic Requirements

“Administrative regulations of the Provisions on the Supervision and Administration of Orthokeratology

Operation" issued by the State Food and Drug Administration.

"Technical document of the Listing Guide for Rigid Gas Permeable Contact Lenses for Orthokeratology" issued by the FDA of USA.

This Standard is related to the technical and safety performance of medical devices and products, and is a mandatory standard.

Annex A and Annex B of this Standard are the normative annexes. At the same time, in consideration of the actual situation of rigid gas permeable contact lenses for orthokeratology in the implementation of orthokeratology, the quality of the rigid gas permeable contact lenses for orthokeratology is only one aspect of its efficacy and safety in clinical application, and proper fitting is another important aspect. For this reason, in Annex C of this Standard, the recommended standardized fitting program is proposed as the informative annex of this Standard.

This Standard is proposed by the State Food and Drug Administration.

This Standard is under the jurisdiction of the National Technical Committee on Optics & Optic Instruments of Standardization Administration of China.

This Standard is drafted by Hangzhou Medical Device Quality Supervision and Inspection Center of State Food and Drug Administration.

Main Drafters of this Standard: He Tao, Jia Xiaohang, Chen Xianhua, Jiang Xiaolu and Wen Yan.

# Rigid Gas Permeable Contact Lenses for Orthokeratology

## 1 Scope

This Standard specifies the classification, technical requirements, testing method, inspection rules, packing requirement and the recommended fitting program of the rigid gas permeable contact lenses for orthokeratology.

## 2 Normative References

The articles contained in the following documents have become part of this Standard when they are quoted herein. For the dated documents so quoted, all the modifications (excluding corrections) or revisions made thereafter shall not be applicable to this Standard. For the undated documents so quoted, the latest edition shall be applicable to this Standard.

GB/T 14233.2 Test Methods for Infusion, Transfusion, Injection Equipments for Medical Use Part 2: Biological Test Methods
GB/T 17341 Optics and Optical Instruments Lensometer
GB/T 16886.5 Biological Evaluation of Medical Devices Part 5: Tests for in vitro Cytotoxicity
GB/T 16886.10 Biological Evaluation of Medical Devices Part 10: Eye Irritation and Sensitization Tests
GB/T 16886.11 Biological Evaluation of Medical Devices Part 11: Tests for Systemic Toxicity
ISO 10334 Ophthalmic Optics -- Contact Lenses -- Salt Solution Used in the Test of Contact Lenses
Pharmacopeia of the People's Republic of China (2000 edition)

## 3 Terms and Definitions

For the purpose of this Standard, the following terms and definitions apply.

**3.1**

**Contact Lenses**

Any lens designed to be worn on the front surface of the cornea.

Note: The definition of contact lenses includes the myopic lenses, hyperopia lenses and trial (diagnostic) lenses.

**3.2**

**Rigid Gas Permeable Contact Lenses**

The contact lenses made of rigid gas permeable material, usually the polymeric material used for contact lenses contains the organic silicone and organic fluorine.

**3.3**

**Rigid Gas Permeable Contact Lenses for Orthokeratology**

The rigid gas permeable contact lenses for orthokeratology (hereinafter referred to as orthokeratology contact lenses) that are used to correct the refractive errors of eyes through the corneal refractive

therapy in order to change the shape of cornea.

**3.4**

**Oxygen Permeability (*Dk* value)**

Arithmetic product of the gas dissolution coefficient and the diffusion coefficient.

Note 1: This is one of the most commonly used parameters of materials of the contact lenses.

Note 2: Unit in $(cm^2/s)[mL\ O_2/(mL \cdot hPa)]$ or $(cm^3\ O_2 \cdot cm)/(cm \cdot s \cdot hPa)$. The *Dk* value obtained through the hPa is multiplied by 1.333 22, to get the *Dk* value in unit of mmhg.

Note 3: Oxygen Permeability Coefficient: oxygen flux of the contact lens material of the unit-thickness, under certain conditions and under the unit gas pressure difference.

$$\text{Oxygen Permeability Coefficient} = \frac{\text{Gas Volume } (cm^3) \text{ X Thickness (cm)}}{\text{Area } (cm^2) \text{ X Time (s) X Pressure Difference (hPa)}}$$

**3.5**

**Oxygen Transmissibility (Dk/t value)**

The oxygen permeability coefficient divided by the average thickness of the measured material.

**3.6**

**Trial (diagnostic) Lens**

The lens only used by researcher or wearer to confirm or assist to confirm the specifications of the lens of the potential contact lens wearer.

**3.7**

**Wetting Angle**

The included angle of the interface tangential lines formed between the standard salt solution, inspected material and air.

**3.8**

**Modulus**

The stress generated when specific strain occurs to the tested material, in unit MPa.

**3.9**

**Total Extractable**

The percentage of the total content of the monomer molecular polymer and other extractable AND the original mass.

**3.10**

**Total Diameters**

#### 7.7.1.3 Testing

The testing chamber is opened, lubricating oil is applied on the circular base of the sample tested, the tested sample is placed, the circular sealing rubber ring is placed on the laboratory sample, then the testing chamber is closed, and the bolts are fastened, to enable the front surface chamber at the upper part of the tested sample to be strictly isolated from the rear curved surface chamber at the lower part. Thermostatic switch of the testing equipment is started, to enable the temperature of the testing chamber to be 35°C±0.5°C constantly. The test air-flow is led to the inlet of the front curved surface chamber and discharged from the exhaust port. The air-flow rate is 50 mL/ min to 60 mL/ min, 3 mL/ min to 4 mL/ min, then stabilized between 5 mL/ min to 15 mL/ min, and kept for 10 min to 30 min. At the same time, the reference air-flow is blown in from the air inlet of the rear curved-surface cabin, to observe the current meter of the exhaust port of the rear curved-surface cabin, ENABLE the measured current to be gradually stabilized, and RECORD the $V_0$ value of the initial voltage. The stable time of the formation of the initial voltage is about 10 min to 20 min for the high oxygen permeability material, and several hours, even over-night time for the low oxygen permeability material. At this time, the inlet and outlet of the test air-flow shall be closed, and the inlet of the reference air-flow will be also closed, LET the current meter's test value to increase gradually, ACHIEVE the new stable level, and RECORD the output voltage $V_E$ value; the stable time formed by the output voltage is 5 min to 10 min for the high oxygen permeability material and needs 1 h to 2 h for the low oxygen permeability material. In order to control the voltage value, the load resistance of 5.3 Ω ~ 53 Ω is usually connected in series to the coulombmeter, to control the output voltage between 0.1 mV and 50 mV. The oxygen air-flow rate value of the tested sample can be calculated with Formula (9) in accordance with the measured value (Unit: $\mu LO_2/s$). The oxygen permeability coefficient of the tested sample can be calculated with Formula (6). The oxygen permeability of the tested sample can be calculated with Formula (10) in accordance with the calculation value of the oxygen permeability coefficient:

$$Dk/t = \frac{Dk}{t} \qquad \cdots\cdots(10)$$

Where:

$Dk/t$ -- Oxygen permeability;

$t$ -- Average thickness, with the unit of centimeter (cm), for the calculation method, see Formula (6).

The testing results shall meet the requirements in 5.3.3.

### 7.7.2 Test of Oxygen Permeability Coefficient with Polarographic Method (Used for Reference)

#### 7.7.2.1 Requirements for Test Instrument

The polarographic permeability determinator shown in Figure 6 with the measurement range of $0\sim75\times10^{-11}(cm^2/s)[mLO_2/(mL\times hPa)]@35℃$.

a) The cathode of the instrument is made of 24 k gold or platinum with the mass fraction of 99.9%,

# Annex A
# (Normative)
# Invitro Cytotoxicity Testing of Orthokeratology Contact Lens Material:
# Agar Overlay Test Methods

## A.1 Scope

The annex is provided with the invitro cytotoxicity testing methods of orthokeratology contact lens material: agar overlay tests and growth inhibition tests. The purpose is to test whether the cytotoxicity substances filtered off and (or) extractable cytotoxicity substances exist in the trial lens material.

Note 1: precautions given in GB/ T 16886.5.

Note 2: At least one invitro test shall be conducted to the lens material before the clinical evaluation, and any of the following testing methods is applicable.

## A.2 Principles

The test purpose is to determine whether the filtered and (or) extractable cytotoxic substance exist.

The agar overlay test is used to evaluate whether the toxic substances are filtered out in the solid material. The specimen of the test is contacted to a layer of agar surface, the agar overlay is filtered from the soluble substance of the specimen through the invitro culture monolayer cells of the intravital coloring agent, and permeates the agar layer, if the toxicant is found, the cell may be inactivated or damaged and dissolved, and the intravital coloring agent may fade. The size of the faded area can indicate the amount of the toxic substances and the toxicity intensity.

## A.3 Agar Overlay Test

### A.3.1 Instrument and Solution

#### A.3.1.1 Instrument

Standard culture dish, sterile equipment (autoclave sterilizer and thin plastic filter), clean operating platform, 37°C5% carbon dioxide incubator, water bath, glass test tube used for cultivation and disposable plastic consumables product.

#### A.3.1.2 Culture Medium

Sterile culture medium for cell growth.

Note 1: The directly-used sterile culture medium can be purchased, or the arranged raw material treated with the sterilization technology can be used. In the case that one or more components can not be used for the sterilization technology, the filtration sterilization can be conducted through the membrane after the preparation.

Note 2: The culture medium completed is the Dulbecco alleviating Eagle medium, including 3.7% of the sodium bicarbonate, 10% volume of the fetal bovine serum (FCS) and 100 IU/mL of the penicillin streptomycin combination.

Note 3: In the case that the culture medium does not contain glutamine, or the culture medium is sterilized under the high pressure, the glutamine shall be added before the culture medium is used.

#### A.3.1.3 Agar Medium

shall be free of the fluorescein vital staining. The general test can be conducted in the eyes at either side, but for the best result, the test shall be conducted in the eyes at the same side, and the eyes at the non-test side are for the contrast.

B.6.2.3 From the 1st day to the 21st day, the lenses shall be taken out 7 h to 8 h after the wearing. The lens removed is cared in accordance with B.6.2.

Note: The day when the lens is worn is regarded as the first day.

B.6.2.4 If the lens worn needs to be worn again or changed, the recording must be conducted. The lens-wearing condition of the rabbit shall be examined regularly, and the examination shall be conducted every one hour if possible.

B.6.2.5 If any change is found in the lens appearance, the change shall be recorded timely.

B.6.1.6 The test shall be conducted in accordance with 7.2.1 to 7.2.5 everyday.

B.6.2.7 On the 22nd day, the lenses shall be removed from the rabbit eyes 4 h to 8 h later.

Note: The lenses shall be reserved and further examined by the manufacturer.

### B.6.3 Examination for Rabbit Eyes

B.6.3.1 From the 1st day to the 7th day, the 9th day to the 14th day and the 16th day to the 21st day, before the lenses are removed, the examination shall be conducted to each rabbit eye, and scoring shall be conducted in accordance with the scoring system (see Table B.2). In additional, the rabbit eyes shall be examined everyday, in order to discover and timely record the abnormalities. It is advisable to record the behaviors of rabbit, and the behavior of striking or scratching the lens are the early manifestation of the eye irritation.

B.6.3.2 On the 8th, 15th and 22nd day, after the lenses are removed, the microscope of the slit lamp shall be used to examine the eyes of each rabbit and the fluorescein vital staining, and scoring shall be conducted in accordance with the MCDonald-Shadduck scoring system (see Table B.1).

### B.6.4 Animal Weighing

On the 22nd day, the rabbit weight shall be weighed with the balance and shall be recorded.

### B.6.5 Histological Examination

B.6.5.1 On the 22nd day, after the lenses are removed, and after the completion of the clinical examination, the animals shall be killed.

B.6.5.2 The eyes and accessories shall be removed and fixed in the 10% formaldehyde solution.

B.6.5.3 The fixed tissue is wrapped with the wax and cut into pieces, observed under the microscope after being colored, and the results shall be examined and evaluated by the experienced professionals.

Note: if the following cases occur, the histological examination is not required:

(1) No abnormality of any animal is observed during the test at any observation phase,

(2) When the positive results are confirmed through the visual observation.

is softly taken down.

### C.8.5 Testing for Flatten Vision

After wearing the orthokeratology contact lenses for the first time, the myopic refraction degree of the central area of the cornea is reduced due to the flattening, the eyesight is improved, and the improvement degree is positively related to the orthokeratology effect, so the flatten vision of the eye wearing the lens shall be tested and recorded.

## C.9 Allotment of Orthokeratology Contact Lens

C.9.1 The wearer is distributed of a complete set of things during the initial lens wearing, including lens-caring solution, eye drops, lens box, lens-wearing bar, instruction for use, etc.

C.9.2 The wearer shall be trained to enable himself/herself to master the methods for lens wearing and removal.

C.9.3 The wearer shall be trained to enable himself/herself to master the lens caring method.

C.9.4 The clinical manifestations and precautions for lens-wearing at the first time shall be explained to the wear and the wear shall be informed of the re-inspection time.

## C.10 Re-inspection of the Orthokeratology Contact Lenses

### C.10.1 Re-inspection Time

The re-inspection shall be conducted on the 1st day, 1st week, 2nd week, 1st month, 2nd month, 3rd month after the lenses being worn, and the lenses shall be re-inspected every 3 months after the 3rd month.

### C.10.2 Re-inspection Items

#### C.10.1.1 Eyesight

The eyesight includes the shaped distant vision and near vision.

### C10.2.2 Refraction Inspection

The refractive prescription of the myopia allowance after the corneal shaping shall be determined and recorded, and the refractive shaping amount shall be analyzed in comparison with the test results of the preliminary diagnosis. The automatic refractor is used to test the refractive condition of the eye with the orthokeratology contact lens, the higher pseudo astigmatism can be tested possibly, and therefore, the refractive condition of the eye with the orthokeratology contact lens shall be determined mainly with the integrated refractor.

### C.10.2.3 Testing of the Corneal Curvature

The corneal curvature focal power after shaping shall be determined and recorded, the curvature shaping amount shall be analyzed in comparison with the test results of the preliminary diagnosis.

### C.10.2.4 Corneal Topography Testing

The corneal topography indicates the degree and quality of the orthokeratology, and provides the basis

## References and Original Chinese Documents

[1] YY 0477-2004 Rigid gas permeable contact lenses for orthokeratology.
http://www.chinesestandard.net/Default.aspx?PDF-English-ID=YY%200477-2004