Boston™

Materials and Solutions

Product Guide

Material matters.

BAUSCH + LOMB

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Material matters.

Mission Statement

Through constant innovation
and continual improvement
of our business processes,
we will strive to be
the worldwide leader in
providing the highest quality
GP materials and care products.

Contents

Introduction to Gas Permeable Materials

Overview

Advances in diagnostic technology have provided information that corneal structure and function is adversely affected over time if not supplied with adequate oxygen. It was these concerns that led to the development and use of modern gas permeable (GP) contact lens materials. The desirable optical effects of early generation rigid lens materials have been maintained with the added benefit of providing more oxygen to the cornea, thereby increasing the safety of patient lens wear.

Bausch + Lomb Boston's commitment to the field of GP contact lens research has always been to improve the comfort, physiology, and safety of GP lens wear. This has resulted in the introduction of innovative gas permeable lens materials and lens care products throughout the company's history.

The following section contains a basic explanation of corneal physiology and a description of various physical characteristics of gas permeable contact lens materials. This information permits the fitter to select the appropriate gas permeable lens material for each wearer.

Corneal Physiology

The cornea is comprised of five distinct layers. Each layer has a structure that contributes to the corneal strength, function, or both. One of the most important of these corneal layers is the innermost, the endothelium.

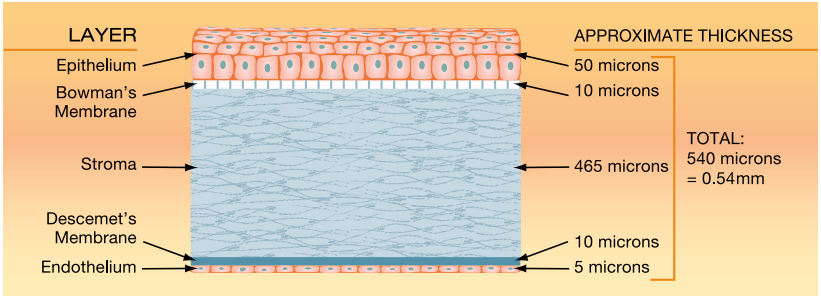
The endothelium has two important functions:

- Permeability barrier, allowing the diffusion of nutrients to the cornea.
- Pump mechanism regulates water to maintain the cornea in a partially hydrated state.

The endothelium is a single cell layer that lines the posterior surface of the cornea. The endothelial cells are flat, hexagonal, and are in direct contact with the aqueous humor of the anterior chamber. This cell layer has limited (if any) capacity to regenerate. The endothelial surface can be visualized and photographed in vivo, with the specular microscope.

Changes in endothelial morphology can occur from a variety of sources, including trauma, inflammation, and long-term oxygen deprivation (hypoxia) as seen in wearers of PMMA.

It is for these reasons that GP lens permeability plays an important role in corneal physiology.



Corneal layers

Physical Properties of GP Materials

Oxygen

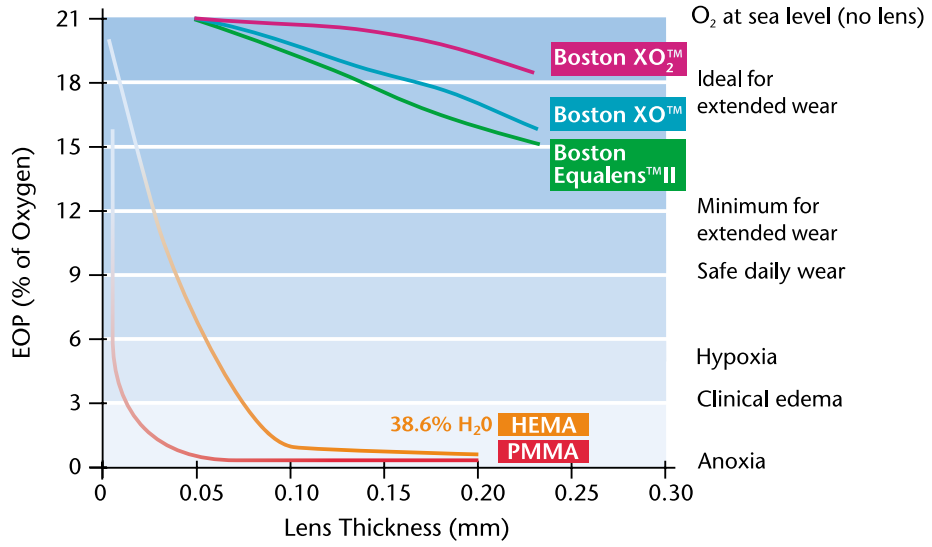
Dk: This term is used to denote the oxygen permeability of rigid and soft contact lens materials. "D" is the inherent ability of the material to allow oxygen to diffuse through; "k" represents the degree to which oxygen is solubilized within or on the material, since water plays some role in absorbing and assisting in the transport of oxygen.

There are several methods to measure permeability. The gas-to-gas method uses a wafer of lens material or a lens affixed to a graduated capillary tube. This allows the volume of oxygen to be measured as it passes through the test material. The ISO/Fatt method uses a wafer or lens affixed to the end of an oxygen probe. The probe is then immersed in a liquid medium. The amount of oxygen that is able to flow through the lens material is then measured. ISO/Fatt is the method used to determine the Dk of Boston materials.

Dk/t: Refers to the transmissibility of a material when it is made into either a plus or minus lens; "t" represents the thickness of a given lens. The significance of this measurement is that the amount of oxygen transmitted can vary depending on the thickness.

EOP: This is perhaps a more meaningful and clinically important value, since it represents the actual amount of oxygen that passes through the lens and reaches the cornea. This measurement takes into account the total lens (material and design).[1]

Equivalent oxygen percentage*



	PMMA	Boston™ II	Boston ES™	Boston™ IV	Boston™ Equalens™	Boston EO™	Boston™ Equalens™ II	Boston XO™	Boston XO2™
Dk (ISO/Fatt; cgs units)†	0	12	18	19	47	58	85	100	141
Recommended C.T. (-3.00 D)†	N/A	0.15	0.12	0.15	0.15	0.12	0.15	0.15	0.15
Dk/t at recommended C.T.†	0	8	15	13	31	48	57	67	94

1. Brennan N.A., Efron N., Carney L.G. 1987. "Corneal Oxygen Availability during Contact Lens Wear: A Comparison of Methodologies," American Journal of Optometry & Physiological Optics, 65,1: 19–24

* ISO/Fatt method expressed in cgs units. EOP and Dk/t measurements are approximate. Data on file.

† Data on file

Wetting Angle

Wetting angle is often used as a predictor of the on-eye wetting characteristic of a GP contact lens material. In theory, a low contact angle equates to good lens surface wetting.

The standard test methods for measuring the contact angle of contact lens materials are defined in ANSI Z80.20-2004 as the sessile drop method and the captive bubble method. Due to the wide number of variables that can influence wetting angle measurements, the ANSI standard clearly defines the sample preparation, sample conditioning, experimental apparatus, and environmental conditions under which these tests must be run.

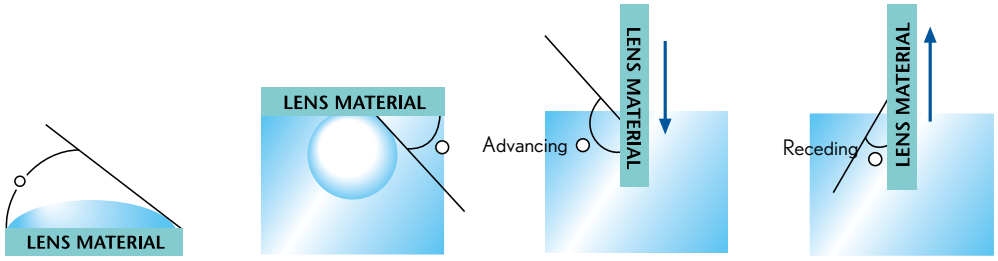
The sessile drop method measures the angle of contact between a liquid and solid when a drop of standard saline solution is placed on a contact lens surface in air.

The captive bubble method measures the angle of contact between a gas bubble and a polymer surface when a bubble of air floats up against the underside of a flat polymer surface in standard saline solution. In 1978, the CLMA adopted this method as their standard for determining wetting angles on GP materials.

Another method of measuring contact angle is the Wilhelmy plate method where wetting angles are not measured directly, but are calculated from force measurements as a function of immersion depth of the lens material in saline solution. Two contact angles, an advancing and a receding angle, for a single lens material can be easily determined. The difference between these two angles is called the contact angle hysteresis. The receding angle measured by the Wilhelmy plate method has been found to be similar to the contact angle measured by the captive bubble technique. But, both angles are needed to completely describe the wetting properties dynamically.

A word of caution must be raised when attempting to use any of these contact angle methods to predict actual on-eye wetting characteristic of a GP lens. The human tear film contains components (mucin, lipid, lactoferrin, lysozyme, etc.) that significantly contribute to on-eye contact lens wettability. The drop of conditioning solution applied to a lens is quickly replaced by tear fluid upon insertion of the lens in the eye. Tear components can vary significantly from person to person. Therefore, it is difficult to develop a laboratory testing standard that accurately predicts on-eye wetting performance.

Methods of determining contact angles



Sessile Drop | Captive Bubble | Wilhelmy Plate

	PMMA	Boston™ II	Boston ES™	Boston™ IV	Boston™ Equalens™	Boston EO™	Boston™ Equalens™ II	Boston XO™	Boston XO_2™
Captive Bubble*	60°	20°	52°	17°	30°	49°	30°	49°	38°

* Data on file

Hardness

Hardness is generally measured in one of two ways, either by the Rockwell R Hardness method or the Shore D Hardness method. Both methods measure the relative resistance of a GP material to indentation and provide an empirical hardness value intended primarily for quality control purposes. No simple correlation exists between hardness determined by either of these two methods and the fundamental properties of the material being tested. To better understand the resistance of a GP material to mechanical wear and tear, modulus and toughness should be measured.

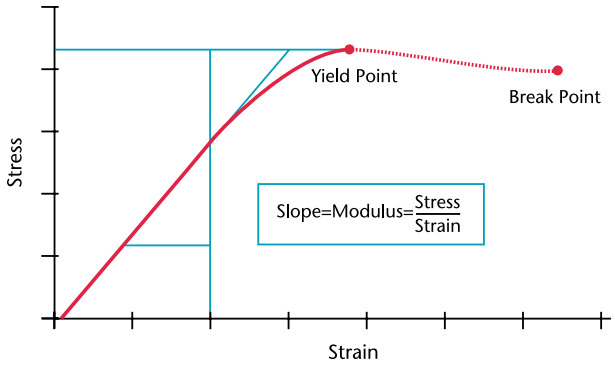
	PMMA	Boston™ II	Boston ES™	Boston™ IV	Boston™ Equalens™	Boston EO™	Boston™ Equalens™ II	Boston XO™	Boston XO_2™
Rockwell R*	124	119	118	117	117	114	114	112	100
Shore D*	91	85	85	84	82	83	81	81	78

Modulus

(MPa): (Flexural Modulus)

A force (stress) is applied to a lens causing the lens to deform (strain). This deformation is measured until breakage occurs or until the deformation reaches some predetermined point. The flexural modulus is the ratio of the stress to strain and is a measure of how well a material resists deformation. This quality relates to the stiffness of the plastic and affects its ability to "mask" astigmatism. This is also an important factor in determining lens design and thickness.

Stress–Strain Testing†

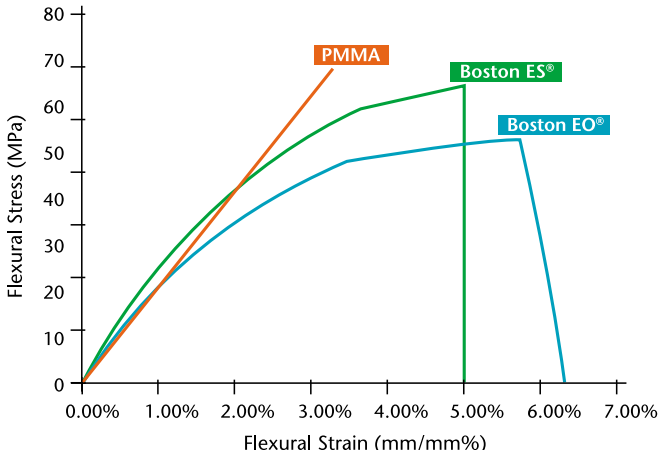


Toughness

(MNm/m^3): (Toughness)

In this test, the lens material sample is flexed until it breaks or reaches some predetermined deformation point. The energy that a lens can absorb before it reaches this point is the toughness of the material. In GPs, this quality relates to lens handling and durability.

Stress–Strain Testing Fracture Resistance†



	PMMA	Boston™ II	Boston ES™	Boston™ IV	Boston™ Equalens™	Boston EO™	Boston™ Equalens™ II	Boston XO™	Boston XO_2™
Modulus*	2432	1800	1900	1600	1600	1600	1300	1500	1160
Toughness*	2.5	3.0	3.4	2.8	2.8	2.6	0.8	2.6	2.7

* Data on file

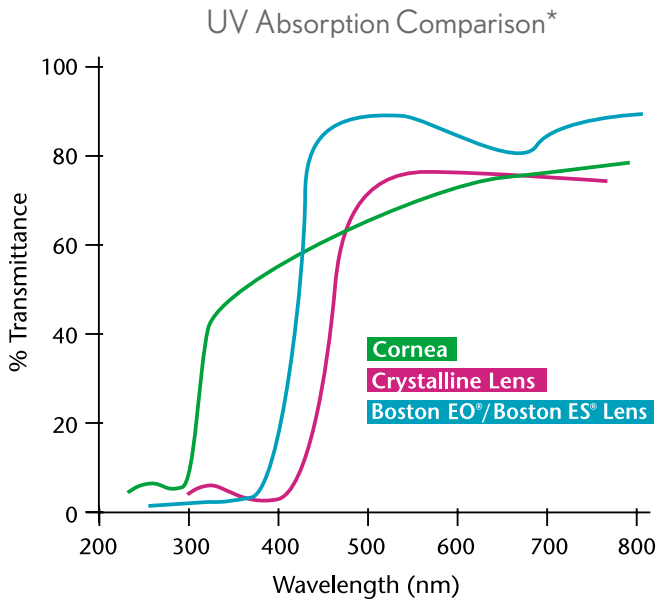
† ISO/Fatt method expressed in cgs units. EOP and Dk/t measurements are approximate. Data on file

Ultraviolet Absorber

Ultraviolet radiation (UVR) is found adjacent to visible light on the electromagnetic spectrum. UVR is emitted in a range of wavelengths. The shortest wavelength contains the most powerful energy and is most harmful.

This energy is measured in nanometers (one billionth of a meter). UVR begins at approximately 100 nm and extends to 400 nm and is split into three bands: UVC, UVB, and UVA. UVC rays (100–200 nm) are absorbed by earth's atmosphere. UVB (280 nm–315 nm) are the rays that pass through cloud cover that cause tanning and sunburn. UVA (316 nm–380 nm) rays are nearest to the visible light spectrum and least dangerous of the three wavelengths.

Use of UVR absorbers in contact lenses reduces the amount of UV radiation that reaches the underlying structures of the eye (cornea, crystalline lens, retina, etc.), but does not offer total protection. Protective eyewear (sunglasses, goggles, etc.) is still recommended for maximum protection. The presence of UVR absorbers in GP contact lenses may cause fluorescein pattern detail to be less visible when viewed with the customary white light and cobalt blue filter. A simple, inexpensive method for enhancing fluorescein pattern viewing is to add a #12 yellow Wratten filter over the front of the slit lamp objectives. Slit lamp filter kits are available from Bausch + Lomb.



	Boston™ II	Boston ES™	Boston™ IV	Boston™ Equalens™	Boston EO™	Boston™ Equalens™ II	Boston XO™	Boston XO_2™
Available with AND without UV absorber†		●			●	●	●	●
Available with UV absorber ONLY†				●				
Available without UV absorber ONLY†	●		●					

NOTE: Not all colors are available both with and without UV blocker for every material. See chart, page 15 for details.

* ISO/Fatt method expressed in cgs units. EOP and Dk/t measurements are approximate. Data on file

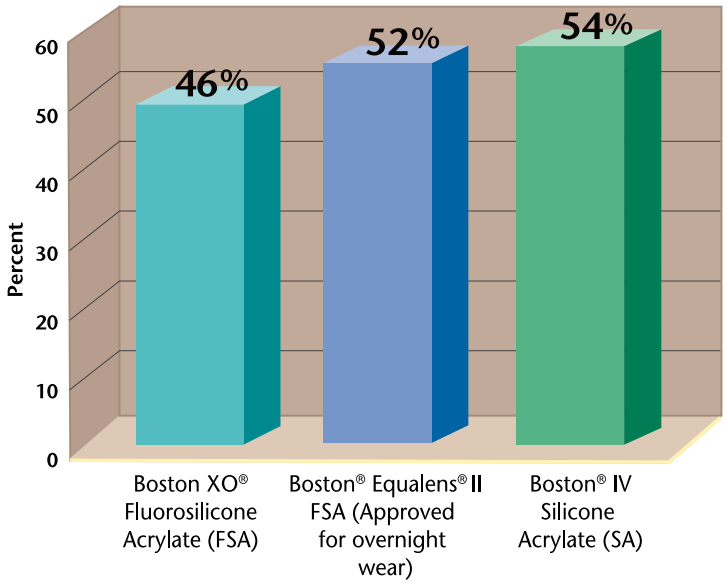
† Data on file

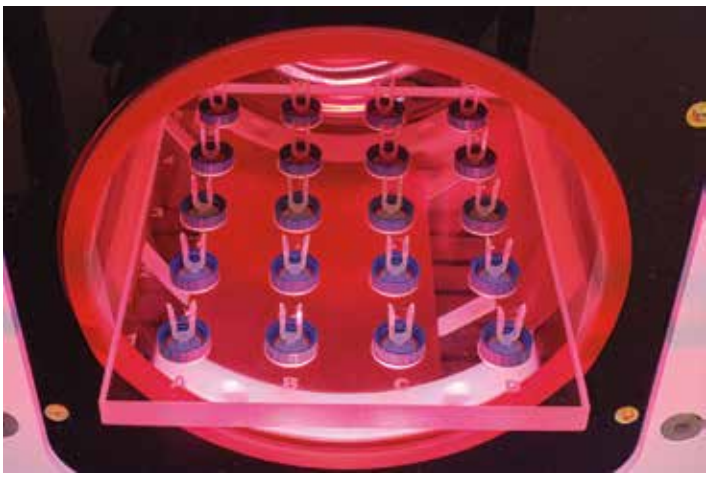
Plasma Treatment

Plasma Treatment is an exciting advancement in the manufacture of GP lenses made with Boston materials. Lenses are placed in a specialized vacuum chamber and bombarded with oxygen ions through the use of a radio frequency generator. The optimized process effectively removes any remaining residuals from the lens manufacturing process from the surface of the lens without changing the bulk material properties. This process dramatically reduces the wetting angle of the lenses and may improve their comfort for the wearer. To ensure optimal conditions for the fitter and wearer, it is recommend that plasma treated lenses be sent out wet in Boston SIMPLUS™ multi-action solution.

It is important to remember that Boston materials are inherently wettable and do not require plasma treatment to make them wettable. This has always been and continues to be an important benefit. Therfore, we do not expect Boston plasma treated lenses to become non-wetting after prolonged use and/or time.

Percent reduction in contact angle after plasma treatment*





Plasma chamber with lens tray

* Data on file

Bausch + Lomb Boston™ Materials

The Boston™ lens materials have undergone an evolutionary process that includes the following developments:

- Increased oxygen while maintaining good wetting and deposit resistance
- Increased stability and durability without compromising corneal physiology
- Improved lens machining qualities and yields, without sacrificing clinical performance

A significant advancement in Fluoro Silicone Acrylate (FSA) technology occurred with the introduction of the AERCOR™ chemical architecture. This unique polymer chemistry permits us to maintain and increase oxygen delivery while reducing silicon. Two of these products are Boston EO™ and Boston ES™.

The current Boston family of GP lens materials also includes Boston XO™, a second generation FSA. This material offers superpermeability[1] and is as dimensionally stable as GPs of much lower Dk. Boston XO™ is steadily growing in popularity for use in ortho-k, flexible wear, and GP planned replacement programs.

The newest Boston material, Boston XO_2™, provides outstanding oxygen permeability without compromising wettability, stability, or comfort. Boston XO_2™ has been specifically designed to meet the practitioner's demand for a hyper Dk material that can be manufactured in a wide variety of lens designs, including special applications.

The following sections describe the characteristics of each of the Boston™ lens materials and specific applications.

1 Benjamin W. J. 1993. "EOP and Dk/L: The quest for hyper transmissibility," *Journal of the American Optometric Association* 64, 3

Boston™ Large Diameter Options

To meet the demanding needs of specialty GP fitters, Boston materials are available in a variety of large diameters:

Diameter	Material		
	Boston™ Equalens™ II	Boston XO™	Boston XO_2™
17	–	Clear, Ice Blue	Clear, Ice Blue
21	–	Clear	Clear
26	–	Clear	Clear
27	Clear	–	–

Large Diameter: Possible indications and uses:

- Scleral and semi-scleral GP lens designs
- Irregular corneas
- Post refractive surgery
- Where GP lens comfort is essential
- Difficulty in adapting to GP lens wear
- Where a stable lens fit is required

Boston™ Materials Recommendations

Application/Usage	Boston ES™ AERCOR™ Chemistry	Boston EO™ AERCOR™ Chemistry	Boston XO™ Second Generation FSA*	Boston XO_2™ Third Generation FSA*
Daily wear	Excellent	Excellent	Excellent	Excellent
Planned replacement	Not recommended	Not recommended	Excellent	Excellent
Thin designs	Excellent	Excellent	Not recommended	Not recommended
Ultrathin designs	Excellent	Not recommended	Not recommended	Not recommended
Toric designs	Excellent (Hyperopic toric)	Excellent	Excellent (Hyperopic toric)	Excellent
Presbyopic designs	Excellent	Excellent	Excellent	Excellent
Corneal rehabilitation (post PMMA wear)	Excellent	Good	Good	Good
GPC rehabilitation	Excellent	Excellent	Excellent	Excellent
Keratoconus	Excellent	Excellent	Excellent	Excellent
Aphakia	Fair	Good	Excellent	Excellent
Post corneal surgery fitting	Excellent	Excellent	Excellent	Excellent
High oxygen demand corneas	Fair	Excellent	Excellent	Excellent
Dry eye	Excellent	Excellent	Excellent	Excellent

* Fluoro Silicone Acrylate

Boston™ II Material

Material Generic Name:	itafocon A
Material Type:	Silicone acrylate
Indications:	• Myopia • Hyperopia • Astigmatism • Keratoconus
Button Diameter	12.7mm
Modality:	Daily wear
Special Applications: *	• Toric (front, back, bi-toric) designs • Identified lipid depositors • Habitual lens breakage
Special Attributes: *	• Fitting characteristics similar to PMMA • Handling tint: blue

Dk † (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
12	10–12%	1.471	1.13	119	85	1800 MPa	3.0MNm/m^3	none

* Data on file

† in cgs units

Boston ES™ Material

Material Generic Name:	enflufocon A
Material Type:	AERCOR™ fluoro silicone acrylate
Indications:	• Myopia • Hyperopia • Astigmatism • Aphakia • Keratoconus • Post surgical • Irregular corneal conditions • Presbyopia
Button Diameter	12.7mm
Modality:	Daily wear
Special Applications: *	• Toric (front, back, bi-toric) designs • Aspheric designs • Presbyopic designs (multifocal/bifocal) • Keratoconus designs • Thin designs (0.12mm @ 3.00 D) • Ultra thin designs (0.10mm @ 3.00 D) • GPC (rehabilitation) • Wetting/lens depositing problems or lens breakage problems
Special Attributes: *	• Exceptional durability and modulus • Exceptional wetting and deposit resistance • Handling tints: blue, ice blue, green, brown, gray, clear
AERCOR™ Chemical Architecture:	• Low silicon content • Oxygen-permeable "foundation" • Oxygen-permeable crosslinking

Dk † (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
18	5–7%	1.443	1.22	118	85	1900 MPa	3.4 MNm/m^3	with/without (blue only)

* Data on file

† in cgs units

Boston™ IV Material

Material Generic Name:	itafocon B
Material Type:	Silicone acrylate
Indications:	• Myopia • Hyperopia • Astigmatism • Keratoconus • Presbyopia
Button Diameter	12.7mm
Modality:	Daily wear
Special Applications: *	• Toric (front, back, bi-toric) • Identified lipid depositors • Rehabilitation of PMMA wearers
Special Attributes: *	• Fitting characteristics similar to Boston II • Handling tint: blue

Dk† (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
19	14–16%	1.469	1.10	117	84	1600 MPa	2.8 MNm/m^3	none

* Data on file

† in cgs units

Boston™ Equalens™ Material

Material Generic Name:	itafluorofocon A
Material Type:	Fluoro silicone acrylate
Indications:	• Myopia • Hyperopia • Astigmatism • Aphakia • Presbyopia
Button Diameter	12.7mm
Modality:	• Daily wear • Flexible wear • Extended wear
Special Applications: *	• Variable wearing schedules (FW) • Post-corneal surgery fitting • Handling tint: blue
Special Attributes: *	• Fluorinated polymer for improved oxygen delivery • Contains UV absorber

Dk† (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
47	13–15%	1.439	1.19	117	82	1600 MPa	2.8 MNm/m^3	with only

* Data on file

† in cgs units

Boston EO™ Material

Material Generic Name:	enflufocon B	
Material Type:	AERCOR™ fluoro silicone acrylate	
Indications:	• Myopia • Hyperopia • Astigmatism • Aphakia	• Keratoconus • Post surgical • Irregular corneal conditions • Presbyopia
Button Diameter	12.7mm	
Modality:	Daily wear	
Special Applications: *	• Hyperopic toric designs • Keratoconus • Presbyopic designs (multifocal/bifocal)	• Thin designs (0.12mm @ 3.00 D) • Corneas with high oxygen demand • GPC rehabilitation • Corneal rehabilitation (after stabilization)
Special Attributes: *	• Fitting/manufacturing characteristics similar to Boston ES • Excellent wetting/deposit resistance	• Handling tints: blue, ice blue, green, brown, gray, ice green, electric blue
AERCOR™ Chemical Architecture:	• Low silicon content • Oxygen-permeable "foundation"	• Oxygen-permeable crosslinking

Dk † (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
58	5-7%	1.429	1.23	114	83	1600 MPa	2.6 MNm/m^3	with/without

* Data on file

† in cgs units

Boston™ Equalens™ II Material

Material Generic Name:	oprifocon A	
Material Type:	Fluoro silicone acrylate	
Indications:	• Myopia • Hyperopia • Astigmatism	• Aphakia • Post surgical • Presbyopia
Button Diameters	12.7mm, 27mm	
Modality:	• Daily wear • Flexible wear	• Extended wear
Special Applications: *	• Corneas with high oxygen demand • Orthokeratology (ortho-k) • Presbyopic designs (multifocal/bifocal)	• Post-corneal surgical fitting • Scleral lens designs
Special Attributes: *	• High oxygen delivery	• Handling tints: blue, clear, green

Dk † (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
85	9-10%	1.423	1.24	114	81	1300 MPa	0.8 MNm/m^3	with/without

* Data on file

† in cgs units

Boston XO™ Material

Material Generic Name:	hexafocon A
Material Type:	Fluoro silicone acrylate
Indications:	• Myopia • Hyperopia • Astigmatism • Aphakia • Keratoconus • Post surgical • Irregular corneal conditions • Presbyopia
Button Diameters	12.7mm, 17mm, 21mm, 26mm
Modality:	Daily wear
Special Applications: *	• Post-corneal surgery fitting • Planned replacement programs • Presbyopic designs (multifocal/bifocal) • Corneas with high oxygen demand • Orthokeratology (ortho-k) • Scleral designs • Large diameter lenses for non-diseased eyes
Special Attributes: *	• High oxygen delivery • Stability equaling that of lower Dk materials • Handling tints: ice blue, violet, blue, green, clear

Dk† (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
100	8–9%	1.415	1.27	112	81	1500 MPa	2.6 MNm/m^3	with/without

* Data on file

† in cgs units

Boston XO_2™ Material

Material Generic Name:	hexafocon B
Material Type:	Fluoro silicone acrylate
Indications:	• Myopia • Hyperopia • Astigmatism • Aphakia • Keratoconus • Post surgical • Irregular corneal conditions • Presbyopia
Button Diameters	12.7mm, 17mm, 21mm, 26mm
Modality:	Daily wear
Special Applications: *	• Post-corneal surgery fitting • Planned replacement programs • Presbyopic designs (multifocal/bifocal) • Corneas with high oxygen demand • Orthokeratology (ortho-k) • Scleral designs • Large diameter lenses for non-diseased eyes
Special Attributes: *	• Hyper-transmissability • Stability equaling that of lower Dk materials • Handling tints: ice blue, violet, blue, green

Dk† (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
141	12–13%	1.424	1.19	100	78	1160 MPa	2.7 MNm/m^3	with/without

* Data on file

† in cgs units

Quantum™ I Material

Material Generic Name:	siflufocon A
Material Type:	Fluoro silicone acrylate
Indications:	• Myopia • Hyperopia • Astigmatism
Button Diameter	12.7mm
Modality:	• Daily Wear • Flexible Wear
Special Applications: *	• Presbyopic designs (multifocal/bifocal) • Toric lens designs
Special Attributes: *	• Handling tints (I) - ice blue

Dk† (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness (MN m/m³)	UV Absorber
33	7-8%	1.428	1.25	114	84	1730 MPa	2.2	without

† in cgs units

Quantum™ II Material

Material Generic Name:	hexafocon A	
Material Type:	Fluoro silicone acrylate	
Indications:	• Myopia • Hyperopia • Astigmatism • Aphakia	
Button Diameter	12.7mm	
Modality:	• Daily Wear • Flexible Wear • Extended Wear	
Special Applications: *	• Post-corneal surgery fitting • Presbyopic designs	• Corneas with high oxygen demand • Orthokeratology (ortho-k)
Special Attributes: *	• Exceptional material stability • Excellent oxygen for all wearing schedules (19% EOP)	• Excellent wetting/deposit resistance • Handling tints (1) - ice blue

Dk† (ISO/Fatt)	Silicon Content	Refractive Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness (MN m/m³)	UV Absorber
100	8-9%	1.414	1.26	112	81	1415 MPa	2.1	without

† in cgs units

Materials Specifications*

	Boston™ II	Boston ES™	Boston™ IV	Boston™ Equalens™	Boston EO™	Boston™ Equalens™ II	Boston XO™	Boston XO_2™	Quantum I	Quantum II
Permeability (ISO/Fatt) cgs units †	12	18	19	47	58	85	100	141	33	100
Rockwell Hardness	119	118	117	117	114	114	112	100	114	112
Shore D Hardness	85	85	84	82	83	81	81	78	84	81
Refractive Index	1.471	1.443	1.469	1.439	1.429	1.423	1.415	1.424	1.428	1.414
Modulus (MPa)	1800	1900	1600	1600	1600	1300	1500	1160	1730	1420
Toughness (MNm/m^3)	3.0	3.4	2.8	2.8	2.6	0.8	2.6	2.7	2.2	2.1
Silicon Content	10-12%	5-7%	14-16%	13-15%	5-7%	9-10%	8-9%	12-13%	7-8%	8-9%
Wetting Angle (captive bubble)	20°	52°	17°	30°	49°	30°	49°	38°	48°	49°
Dynamic Contact Angle (advanced/ receding)	58°/ 57°	52°/ 50°	58°/ 57°	59°/ 56°	62°/ 60°	59°/ 56°	59°/ 58°	50°/ 40°	62°/ 60°	67°/ 66°
Specific Gravity	1.13	1.22	1.10	1.19	1.23	1.24	1.27	1.19	1.25	1.27

* All data on file

† $x10^{-11} cm^3 O_2(cm)/[(sec.)(cm^2)(mm\ Hg)]@35°C$

Materials Specifications*

	Boston™ II	Boston ES™	Boston™ IV	Boston™ Equalens™	Boston EO™	Boston™ Equalens™ II	Boston XO™	Boston XO_2™	Quantum I	Quantum II
Available color tints with UV blocker										
Blue		●		●	●	●	●	●		
Ice Blue		●			●		●	●		
Electric Blue					●					
Clear (large diameter only for XO and XO_2)		●					●	●		
Green		●			●	●	●	●		
Ice Green					●					
Gray		●			●					
Brown		●			●					
Violet							●	●		
Ice Gray					●					
Available color tints without UV blocker										
Blue	●	●	●		●		●	●		
Ice Blue							●	●	●	●
Electric Blue										
Clear (large diameter only)						●	●			
Green							●	●		
Violet							●	●		
Brown					●					
Gray					●					

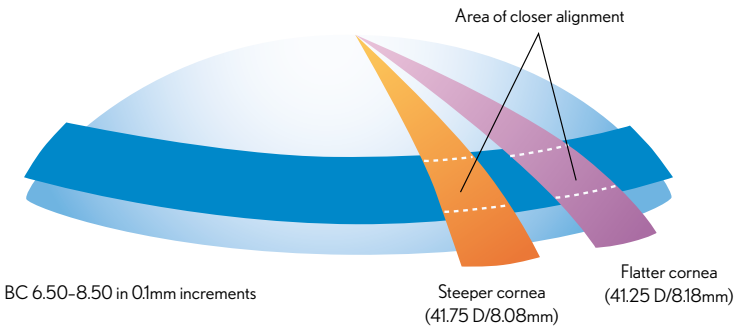
Bausch + Lomb Boston™ Lens Designs

Introduction

The Boston brand's commitment to the field of GP contact lens research has always been to improve the comfort, physiology, and safety of GP lens wear. This has resulted in the introduction of innovative gas permeable lens materials and lens care products throughout the company's history.

The Bausch + Lomb Boston Envision™ bi-aspheric back surface lens design combines features of both GP material and lens design to improve comfort for the wearer and streamline the fitting process for the practitioner.

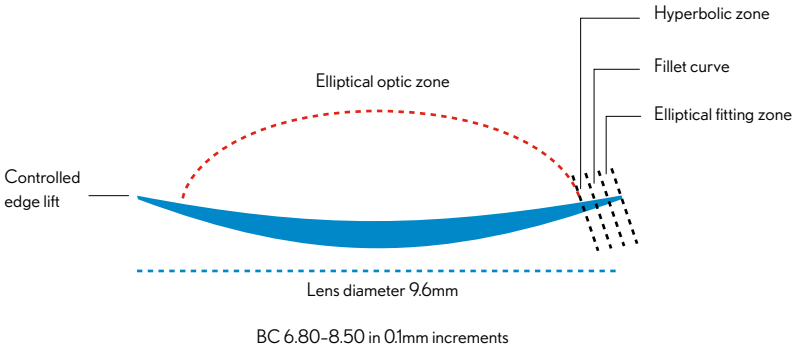
Boston Envision™ fitting band



The wide fitting zone allows for greater fitting success.
NOTE: Flatter and steeper corneas fall within fitting zone.

Bausch + Lomb Boston offers the B oston MultiVision™ design to answer the needs of the growing presbyopic population worldwide. MultiVision is a multi-aspheric multifocal GP design that combines the principles of simultaneous and translating vision to provide exceptional distance, intermediate, and near visual acuity for those lens wearers requiring early and advanced presbyopic correction.

Boston MultiVision™ aspheric contact lens back surface design



Boston Envision™ Design

Material Generic Name:	enflufocon B	
Material Type:	Boston EO™ AERCOR™ fluoro silicone acrylate NOTE: Other Boston materials may be available. Consult your GP laboratory.	
Indications:	• Myopia • Hyperopia	• Astigmatism
Modality:	• Daily wear	• Flexible wear
Special Applications: *	• Early keratoconus • Moderate amounts of corneal astigmatism (<4.00 D)	• Post-corneal surgery fitting • Irregular corneal topography
Special Attributes: *	• Bi-aspheric back surface • Efficient, streamlined fitting system • Minimal number of lens parameters fit majority of lens candidates	• Wide diameter range availability (9.3 to 10.3mm) • Handling tint: blue
AERCOR™ Chemical Architecture:	• Low silicon content • Oxygen-permeable "foundation"	• Oxygen-permeable crosslinking

9.6mm Diameter			
Flat "K" Range (Diopters)	Flat "K" Range (Millimeters)	Corneal Astigmatism ±1.50 D	Corneal Astigmatism >1.50 D
39.50 and below: Trial fitting recommended			
39.75-40.25	8.49-8.39	8.30mm	8.20mm
40.50-41.00	8.33-8.23	8.20mm	8.10mm
41.25-41.75	8.18-8.08	8.10mm	8.00mm
42.00-42.50	8.04-7.94	8.00mm	7.90mm
42.75-43.25	7.90-7.80	7.90mm	7.80mm
43.50-44.00	7.76-7.67	7.80mm	7.70mm
44.25-44.75	7.63-7.54	7.70mm	7.60mm
45.00-45.50	7.50-7.42	7.60mm	7.50mm
45.75-46.25	7.38-7.30	7.50mm	7.40mm
46.50-47.00	7.26-7.18	7.40mm	7.30mm
47.25-47.75	7.14-7.07	7.30mm	7.20mm
48.00-48.50	7.03-6.96	7.20mm	7.10mm
48.75-49.25	6.92-6.85	7.10mm	7.00mm
49.50 and above: Trial fitting recommended			

Dk† (ISO/Fatt)	Silicon Content	Ref. Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
58	5-7%	1.429	1.23	114	85	1600 MPa	2.6 MPa (mm/mm)	with only

* Data on file

† in cgs units

Boston MultiVision™ Design

Material Generic Name:	enflufocon A	
Material Type:	Boston ES™ AERCOR™ fluoro silicone acrylate NOTE: Other Boston materials may be available. Consult your GP laboratory.	
Indications:	• Presbyopia • Myopia	• Hyperopia • Astigmatism
Modality:	Daily wear	
Special Applications: *	• Any combination of above indications	• Handling tints (1): blue
Unique Attributes: *	• Multi-aspheric back surface geometry • Extremely comfortable lens design • Easy fitting process with minimum number of lenses required	• High rate of success and patient satisfaction • One diameter: 9.6mm
AERCOR™ Chemical Architecture:	• Low silicon content • Oxygen-permeable "foundation"	• Oxygen-permeable crosslinking

9.6mm DIAMETER			
Flat "K" Range		Corneal Astigmatism	
(Diopters)	(Millimeters)	≤1.50 D	>1.50 D
38.75 and below: Trial fitting recommended			
39.00–39.25	8.65–8.60	–	8.40mm
39.50–39.75	8.54–8.49	8.40mm	8.30mm
40.00–40.25	8.44–8.39	8.30mm	8.20mm
40.50–40.75	8.33–8.28	8.20mm	8.10mm
41.00–41.25	8.23–8.18	8.10mm	8.00mm
41.50–41.75	8.13–8.08	8.00mm	7.90mm
42.00–42.25	8.04–7.99	7.90mm	7.80mm
42.50–42.75	7.94–7.90	7.80mm	7.70mm
43.00–43.25	7.85–7.80	7.70mm	7.60mm
43.50–43.75	7.76–7.71	7.60mm	7.50mm
44.00–44.25	7.67–7.63	7.50mm	7.40mm
44.50–44.75	7.58–7.54	7.40mm	7.30mm
45.00–45.50	7.50–7.42	7.30mm	7.20mm
45.75–46.25	7.38–7.30	7.20mm	7.10mm
46.50–47.00	7.26–7.18	7.10mm	7.00mm
47.25–47.75	7.14–7.07	7.00mm	–
48.00 and above: Trial fitting recommended			

Dk† (ISO/Fatt)	Silicon Content	Ref. Index	Specific Gravity	Rockwell Hardness	Shore D Hardness	Modulus	Toughness	UV Absorber
18	5–7%	1.443	1.22	118	85	1900 MPa	3.4 MPa (mm/mm)	with only

* Data on file

† in cgs units

Bausch + Lomb Boston™ Solutions

Introduction

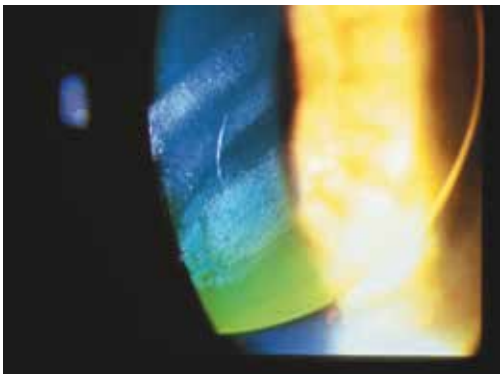
The surfaces of GP lenses have unique properties. Among these are more reactive (energized) surfaces due to the addition of silicon and the ionic charge these lenses possess.

For comfortable and safe wear of contact lenses, and to prevent surface drying and lens adhesions, the surfaces of the lenses should be free of particulate matter and deposits. They should stay as wet as possible to repel deposits and feel comfortable, and be rewetted as needed to maintain wearer comfort throughout the wearing cycle.

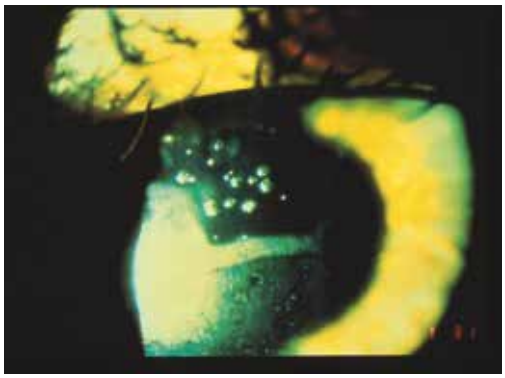
The Boston family of lens care products has been specifically formulated to work with the unique surface properties of GP lenses. The following section discusses the mechanism of lens deposition and describes how the Boston Solutions clean and condition GP lenses.

Boston™ Solutions

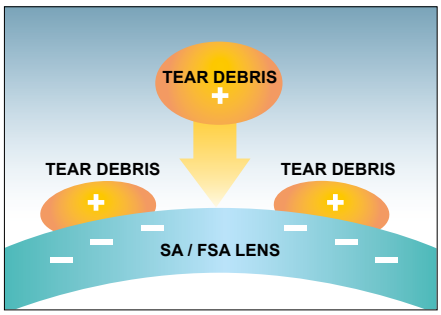
CLEANING SOLUTIONS	YEAR INTRODUCED
Boston Advance™ Cleaner (Visibly Tinted Formula)	1999
Boston Advance™ Cleaner	1990
Boston™ Original Formula Cleaner	1978
CONDITIONING SOLUTIONS	
Boston Advance™ Comfort Formula Conditioning Solution	1993
Boston™ Original Formula Conditioning Solution	1978
MULTI-ACTION SOLUTION	
Boston Simplicity™ (discontinued)	1995
Boston SIMPLUS™	2003
REWETTING DROPS	
Boston™ Rewetting Drops	1988
LIQUID ENZYMATIC CLEANER	
Boston™ One Step Liquid Enzyme Cleaner	1999



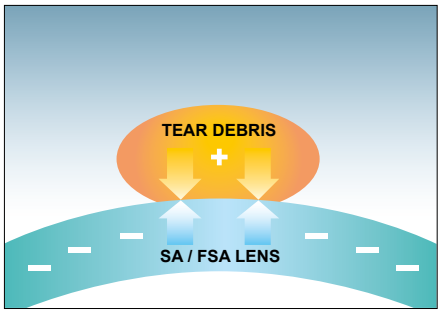
Protein deposits on GP lens



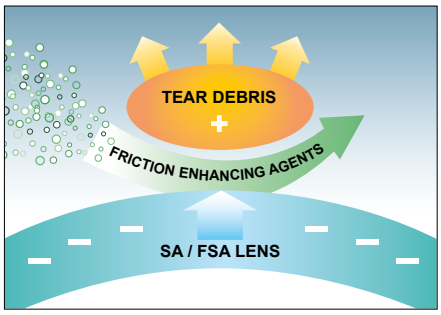
Lipid deposits on GP lens



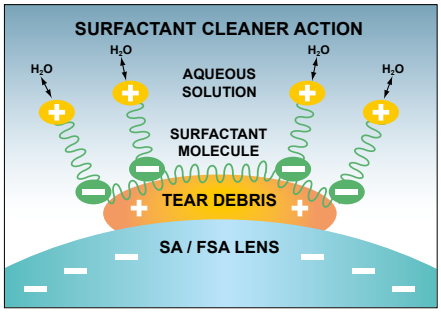
1. Ionic deposit attraction.



2. Tear debris bound on lens.



3. Friction-enhancing agent action.



4. Surfactant action.

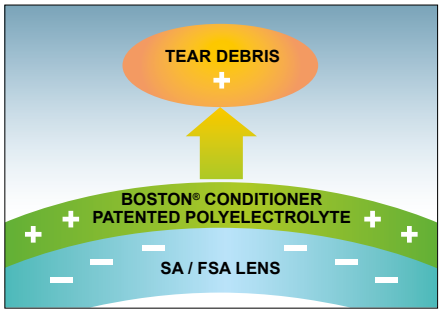
Cleaning

The presence of silicon in GP lens material formulations make these lens surfaces dry faster. These negatively-charged surfaces attract and tightly bind the positively-charged protein and lipid components found in the tear film.

The Boston™ lens cleaners contain patented friction-enhancing agents that help to mechanically break the adhesive bonds that are formed between the lens and the deposits without damaging the lens surface. During daily cleaning, the surfactant attaches to the deposit and lowers the surface energy (attraction) between the deposit and the lens. Water is attracted to the surfactant molecule to help lift the deposit off the lens surface, envelop it, and prevent the rebinding of the deposit to the lens surface.

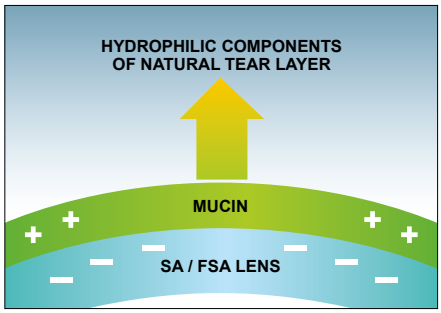
Conditioning

The Boston™ conditioning solutions are uniquely formulated to condition the surfaces of silicone acrylate and fluoro silicone acrylate (SA–FSA) lenses by facilitating the formation of a cushioning layer of solution. Patented hydrophilic polymers in the solutions have an electrostatic affinity for the surfaces of the gas permeable lenses.



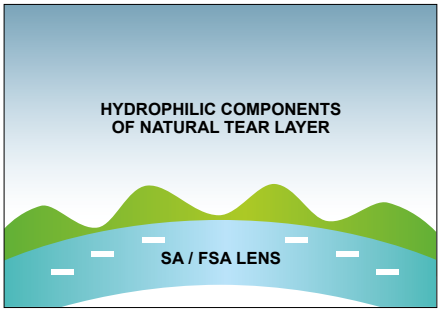
1. Hydrophilic polymers form a cushioning layer and repel debris.

The result is an increase in the wettability of the surface, allowing the lens to wet better, and stay wetter longer between blinking cycles. This, in turn, decreases lens surface drying and helps to repel deposits, until the tear film mucin coats the lens to maintain lens wetting.

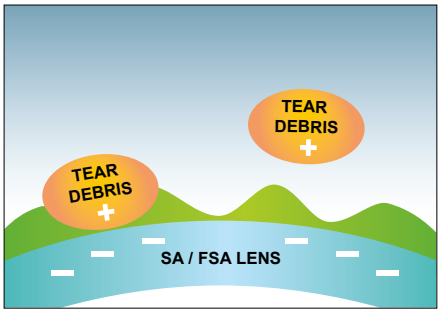


2. Decreased surface drying promotes mucin coating of the lens.

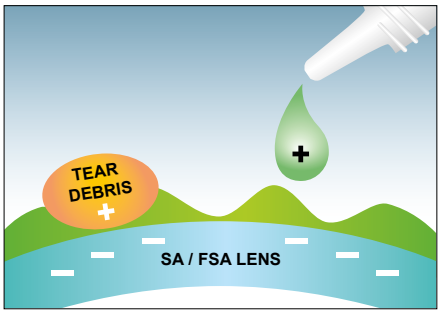
The hydrophilic coating on the lens that the Boston™ conditioners provide promotes the formation of the natural hydrophilic tear layer components, resulting in extended wearing time and comfort.



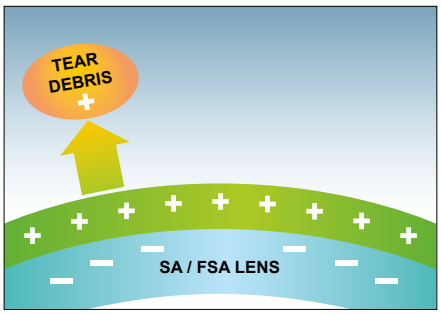
1. Breakdown of hydrophilic components of natural tear layer



2. Adherence of debris to dry spot on lens.



3. Boston™ Rewetting Drops coat and rewet lenses.



4. Naturally conditioned tear film mucin.

Rewetting

Over time, the hydrophilic tear components will gradually break down as a result of environmental factors, deposit formation, or inadequate patient blinking. When tear film continuity is not maintained, lens surfaces can dry. This produces sites where protein and lipids can become attached causing discomfort and reduced wearing time for the patient.

The unique formulation of the Boston™ rewetting drops utilizes hydrophilic polyelectrolytes that bind to the dry lens surfaces to rewet the lens, prevent deposit adherence, and extend the wearing time for the patient.

Enzymatic Cleaning

Boston™ One Step liquid enzymatic cleaner is the easiest way to remove stubborn protein deposits weekly from GP lenses. This clear, odorless cleaner works together with the disinfecting step, right in the lens case. Many practitioners will recommend using an enzymatic cleaner at least once a week to maintain contact lens wearing comfort.

Boston SIMPLUS™

Boston SIMPLUS™ multi-action solution is an innovative one-bottle cleaning, disinfecting and conditioning product for GP lenses. Additionally, this solution removes protein daily. A multi-polymer cushioning system conditions the lens to provide comfort upon insertion and enhanced uniform wetting. A patented humectant maintains lens wettability. It also contains a preservative system proven effective in destroying harmful organisms.

Indications: This solution is effective both in cleaning and disinfecting, yet is compatible with the eye upon lens insertion. Approved for use with both fluoro silicone acrylate and silicone acrylate gas permeable contact lenses.

Actions: Boston SIMPLUS™ Multi-Action Solution removes protein and lipids from the lens surface and also helps keep stubborn deposits away from lenses.

Ingredients: A sterile, aqueous, buffered solution that contains poloxamine, hydroxyalkylphosphonate, boric acid, sodium borate, sodium chloride, hydroxypropylmethyl cellulose, Glucam, and preserved with chlorhexidine gluconate (0.003%), polyaminopropyl biguanide (0.0005%).

How supplied: 120ml bottle

FEATURES	PROVIDES	CLINICAL ATTRIBUTES*
Built-in protein remover	• Convenience, comfort	• Attaches to proteins and separates them from lens surface
2-bottle cleaning effectiveness	• Clear vision, comfort	• Non-abrasive cleaning agent removes dirt and repels deposits from the lens surface
Dual disinfection system (2 preservatives)	• Health, safety	• Proven effective in destroying a broad range of microorganisms
Wetting and cushioning system:		
Lubricating/wetting agent	• Comfort	• Retains moisture for lens-wearing comfort
Viscosifier	• Comfort, handling	• Provides extra thickness for cushioning and handling
No-evening-rub regimen	• Convenience, innovation	• Easy-to-use morning care regimen for convenience

* Data on file

Boston Advance™ System

The Boston Advance™ system is the number one doctor-recommended two-bottle lens care system. It provides exceptional performance and comfort for GP lenses.

The Boston Advance™ cleaner is specifically designed for fluoro silicone acrylate (FSA) lenses, which are more prone to lipid deposits.

Following thorough lens cleaning and rinsing, use of Boston Advance™ Comfort Formula Conditioning Solution provides disinfection and improved wettability for fluoro silicone acrylate lens surfaces (page 24).

Use of Boston™ rewetting drops as needed will help keep lenses free of deposits and comfortable (page 26).

Use of Boston™ One Step liquid enzymatic cleaner once a week will remove stubborn deposits and improve contact lens wearing comfort (page 26).

Boston Advance™ Cleaner: Visibly Tinted Formula

The addition of a visible tinting agent to Boston Advance™ Cleaner provides faster rinsing and assists the wearer to detect when the cleaner has been completely rinsed from the lens surfaces.

Indications: For cleaning fluoro silicone acrylate (FSA) GP contact lenses before conditioning (soaking, wetting and disinfecting)

Actions: Boston Advance™ Cleaner removes accumulated film, stubborn deposits (including proteins and lipids), and debris from FSA contact lenses.

Ingredients: Active: alkyl ether sulphate (9.8% w/v). Other: ethozylated alkyl phenol, sodium chloride, silica suspension, sodium phosphate dibasic, triquaternary cocoa based phospholipid, and titanium dioxide.

How supplied: 30ml bottle

FEATURES	PROVIDES	CLINICAL ATTRIBUTES*
Non-ionic surfactant	• Lipid-specific cleaner to remove lipid deposits	• Provides smooth, clean lens surfaces • Improved lens wettability • Enhanced patient comfort and visual acuity
Ultra-micronized friction enhancing agents	• Effective deposit removal • Protection of lens surface integrity	• Excellent patient comfort • Consistent visual acuity
Anionic surfactant	• Facilitates removal of protein deposits	• Greater patient comfort • Better visual acuity • Increased wearing time
Titanium dioxide	• Visibility indicator • Improved rinsing	• Easy cleaner removal • Easy detection of residual cleaner

* Data on file

Boston Advance™ Comfort Formula Conditioning Solution

Indications: For disinfecting and soaking after cleaning and rinsing of GP contact lenses.

Actions: Boston Advance™ Comfort Formula Conditioning Solution enhances the wettability of rigid contact lenses. It also helps reduce friction between the lens and the cornea that may cause irritation and discomfort. Boston Advance™ Comfort Formula Conditioning Solution also contains a disinfecting agent, which is effective in destroying harmful microorganisms on the surface of the lens and in contact lens cases.

Ingredients: Disinfectants: polyaminopropyl biguanide (0.0005% w/v), chlorhexidine gluconate (0.003% w/v), disodium edetate (0.05% w/v). Other: salts and buffering agents, polyquaternium 10, cellulosic viscosifier, polyvinyl alcohol, derivatized polyethylene glycol.

How supplied: 120ml bottle

FEATURES	PROVIDES	CLINICAL ATTRIBUTES*
Patented dual-preservative system	• Thorough biocidal efficacy • Rapid killing/no rebound • Low preservative levels	• Exceeds FDA requirements • Improved safety for noncompliant patients • Minimal irritation
Optimized viscosity	• Wetting agents and viscosity balanced	• Reduces blurring upon initial insertion
Improved lens conditioning	• Faster surface hydration • Faster mucin coating	• Better lens wetting • Improved comfort
Patented wetting agents	• Retain water on lens surfaces longer	• Decreased deposition • Longer wearing time • Better tear film stability
Unique multipolymer	• Improved comfort cushioning system	• Improved comfort

* Data on file

Boston™ Care System

The Boston™ care system starts with the Boston™ cleaner. This is a formula that combines friction enhancing agents and surfactants designed to remove stubborn protein deposits from rigid lens surfaces. Following thorough rinsing, use of the Boston™ conditioning solution disinfects and conditions the surfaces of lenses to maximize lens wettability and comfort. The use of Boston™ rewetting drops while lenses are being worn will help to maintain lens wettability and comfort (page 26). Use of Boston™ One Step liquid enzymatic cleaner once a week will remove stubborn deposits and improve contact lens wearing comfort (page 26).

Boston™ Original Formula Cleaner

Indications: For cleaning silicone acrylate lenses before conditioning (soaking, wetting and disinfecting).

Actions: Boston™ Cleaner removes accumulated film, stubborn deposits and debris from rigid contact lenses.

Ingredients: Active ingredients: alkyl ether sulphate (10.0% w/v).
Other: sodium chloride, silica gel, titanium dioxide and alpine scent.

How supplied: 30ml bottle

FEATURES	PROVIDES	CLINICAL ATTRIBUTES*
Unique friction-enhancing agents	• Breaks adhesive bonds between deposits and lens	• Excellent patient comfort • Consistent visual acuity
Contains patented anionic surfactant	• Facilitates protein removal • Prevents loosened debris from rebinding on lens surfaces	• Lenses stay cleaner, longer • Consistent visual acuity

Boston™ Conditioning Solution

Indications: For disinfecting and soaking after cleaning and rinsing of silicone acrylate (SA) contact lenses.

Actions: Boston™ Conditioning Solution enhances the wettability of GP lenses. It also reduces friction between the lens and the cornea by the cushioning effect it provides. Boston™ Conditioning Solution also serves as a soaking and disinfecting solution, following use of the Boston™ Cleaner to limit the growth of harmful microorganisms on the surface of the lens.

Ingredients: Active ingredients: a sterile, aqueous, buffered, slightly hypertonic solution containing a cationic cellulose derivative polymer, hydroxyethyl cellulose and polyvinyl alcohol as wetting agents; preserved with chlorhexidine gluconate (0.006%), and edetate disodium (0.05%).

How supplied: 120ml bottle

FEATURES	PROVIDES	CLINICAL ATTRIBUTES*
Incorporates a hydrophilic polyelectrolyte	• Promotes formation of natural hydrophilic tear components on lens surface • Promotes faster lens surface wetting	• Resists deposits • Provides cushioning for lens insertion
No benzalkonium chloride (BAK) or thimerosal	• Lower capability of inducing ocular reactions	• Decreased allergic/toxic sensitivity
Contains chlorhexidine gluconate and EDTA	• Preservative system known to cause least ocular reactions	• Better patient comfort • Less chance of ocular irritation • Effective bactericidal agent

* Data on file

Boston™ One Step Liquid Enzymatic Cleaner

Boston™ One Step liquid enzymatic cleaner is a unique cleaner that is simple and convenient to use. It is specifically designed to effectively remove protein deposits from GP lenses when used once a week. It is the only liquid enzymatic cleaner USFDA-approved for use with Boston™ solutions. This clear, odorless cleaner works together with the disinfecting step, right in the lens case, replacing enzymatic tablets and eliminating wasteful vials. The improved convenience of Boston™ One Step liquid enzymatic cleaner should promote patient compliance while increasing lens wearing comfort and overall patient satisfaction with GP lenses.

Ingredients: A sterile, aqueous, solution containing proteolytic enzyme (subtilisin) as the active ingredient, and glycerol. Preservative-free.

How supplied: 5ml dropper bottle

FEATURES	PROVIDES	CLINICAL ATTRIBUTES*
Cleaning efficacy	• Reduces the adherence of and helps remove deposits from lenses	• Provides clean lenses for clear vision • Delivers initial and long term wearing comfort
Simple, one step process	• Convenience, ease of use • Promotes patient compliance and satisfaction • Eliminates tablets and vials	• Liquid form eliminates dissolving time • Clear odorless formula • Clinically proven safe and effective

Boston™ Rewetting Drops

Boston™ rewetting drops coat the lens surface and remove particles that may cause irritation, discomfort, and blurring. They also provide soothing relief from dry, irritated eyes.

Indications: Use to rewet, lubricate and refresh GP lenses while they are being worn.

Actions: Coats lens surfaces to protect against surface drying and deposit adherence.

Ingredients: Cationic cellulose derivative polymer, polyvinyl alcohol, hydroxyethyl cellulose. Preservatives: chlorhexidine gluconate (0.006%), edetate disodium (0.05%).

How supplied: 10ml bottle

FEATURES	PROVIDES	CLINICAL ATTRIBUTES*
Unique polymer	• Keeps lens surfaces wettable • Longer-lasting wetting effect • Aids in debris removal while lenses are worn • Provides smooth, comfortable lenses	• Protects lenses from deposits • Extends lens comfort and wearing time • Less lens handling • Better comfort and visual acuity • Promotes reformation of natural tear layer

* Data on file

Bausch + Lomb Boston™ Professional Support Products

Introduction

As an aid to the GP lens fitter, Bausch + Lomb Boston offers several professional support products that are invaluable in the clinical environment.

Boston™ Diagnostic Case

This new case has been redesigned and offers several important improvements.

Configurations: 12 lenses (CP0698), 14 (CP0699), 26 (CP0700)

FEATURES	PROVIDES
Slimmer outer case available in 12-, 14-, and 26-lens configurations	• Case may be stored vertically on a shelf • One-piece molded plastic inserts into which lens vials snap securely are easy to clean
Staging area for selected right and left lenses	• Aids in the fitting process
Heat-shrink Boston-branded vial seals included	• Vials are sealed securely • Any current Boston wet-ship vial labels will work with this case
Case cover and interior are customizable	• Cover accommodates custom or Boston label • Interior recesses provide areas for custom labels, fitting guides, lab contact information, etc.

Boston™ Generic Wet Case

The current generic wet case (CP0638) will continue to be available.

Slit Lamp Filter Kits

The presence of UV absorbers in some GP materials may cause fluorescein pattern detail to be less visible when viewed with the white light and cobalt blue filter most common in slit lamps.

To aid in the evaluation of fluorescein pattern, these Wratten #12 filters attach unobtrusively to the front of the slit lamp using a small strip of Velcro (included). With the filter in place, the green glow of the illuminated fluorescein is enhanced for easier viewing.

Boston™ Laboratory Lens Cleaner

For laboratory and professional use only (not approved for patient use). Boston™ laboratory lens cleaner is a solvent-enhanced formulation that effectively and quickly removes manufacturing residuals (pitch, wax, solvent). This cleaner also removes lipids, body oils, and contaminants (found in personal skin care products) from the surfaces of all GP lenses. When used to prepare lenses prior to dispensing, Boston™ laboratory lens cleaner helps prevent or eliminate lens non-wetting and hazy vision of GP lenses. It is available in 4 oz. and 16 oz. bottles.

FEATURES	PROVIDES	CLINICAL ATTRIBUTES
Combination of powerful surfactants	• Quick, effective, cleaning of lens surfaces	• Clean, comfortable GP lenses • Helps lens surfaces to wet fast and completely
2-propanol 10%	• Thorough removal of manufacturing residuals • Removes stubborn deposits from difficult-to-clean lenses	• Ensures excellent initial wetting and good vision • Helps to resolve heavy deposit and lens contamination problems

Boston™ Professional Cleaning Polish and Manual Polishing Machine

The Boston™ professional cleaning kit contains a 60ml bottle of Boston™ professional cleaning polish, a velveteen cleaning pad, a reversible suction cup holder, and complete instructions for the safe cleaning of GP lenses.

Boston™ Professional Cleaning Polish

Boston™ professional cleaning polish is specially formulated to safely remove protein deposits and other debris from Boston™ GP lenses. When used in moderation by the eye care professional, the Boston™ professional cleaning polish can help maintain the surface of a patient's lenses without damaging the lens surface or adversely affecting the lens optics. Boston™ professional cleaning polish is available in 60ml and 1 gallon bottles.

Bausch + Lomb Boston™ Product Availability

Country	Boston™ Solutions	Boston™ Lenses	Country	Boston™ Solutions	Boston™ Lenses
Argentina	●	●	Lithuania	●	●
Aruba	●	●	Malaysia	●	●
Australia	●	●	Netherlands	●	●
Austria	●	●	New Zealand	●	●
Bahrain	●	●	Oman	●	
Barbados	●	●	Peru	●	●
Belgium	●	●	Poland	●	●
Bolivia	●		Portugal	●	●
Brazil	●	●	Puerto Rico	●	●
Canada	●	●	Qatar	●	
Chile	●	●	Russia	●	●
China	●	●	Saudi Arabia	●	●
Colombia	●	●	Serbia	●	●
Costa Rica	●	●	Singapore	●	●
Croatia	●	●	South Africa	●	●
Cyprus	●	●	South Korea	●	●
Denmark	●	●	Spain	●	●
France	●	●	Sri Lanka	●	
Germany	●	●	Sweden	●	●
Greece	●	●	Switzerland	●	●
Guatemala	●	●	Taiwan	●	●
Hong Kong	●	●	Thailand	●	●
Ireland	●	●	Trinidad and Tobago	●	●
Israel	●	●	Ukraine	●	
Italy	●	●	United Arab Emirates	●	
Japan	●	●	United Kingdom	●	●
Jordan	●	●	United States	●	●
Kazahkstan	●	●	US Virgin Islands	●	●
Kuwait	●	●	Uruguay	●	●
Latvia	●	●	Venezuela	●	●
Lebanon	●	●			

Since new markets are added continuously, the above table may not be current.

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Appendix

Historical Timeline

1500–1700

1508: Leonardo da Vinci experiments with concepts of contact lenses.

1637: René Descartes demonstrates the role of the cornea in astigmatism.

1800–1900

1823: Sir John F. W. Herschel describes the contact lens as a device.

1853: Johann J. Bausch and Henry Lomb (Rochester) found Bausch & Lomb.

1887–1888: Adolf E. Fick (Zurich), Eugene Kalt (Paris), and August Müller (Weisbaden) each fit glass scleral lenses.

1900–1969

1929: Josef Dallos (Budapest) fits contact lenses from impressions of living eyes.

1936: William Feinbloom (New York) and Theodore Obrig (New York) each use PMMA to manufacture scleral contact lenses.

1948: Kevin Tuohy (Los Angeles) develops and patents plastic corneal contact lens.

1950: George Butterfield (Oregon) designs a contact lens with peripheral curves to match the shape of the eye.

1961: Otto Wichterle and Drahslav Lim (Prague) develop the soft contact lens.

1970–1979

1971: Bausch & Lomb introduces soft contact lenses in the United States.

1972: Polymer Technology Corporation is founded by Ed Ellis, PhD, Lou Mager, Perry Rosenthal, MD, and Joe Salamone, PhD.

1977: CAB/silicone acrylate materials are introduced.

1978: Boston™ materials and solutions are first used in Canada.

1979: Gas permeable silicone acrylate lenses are introduced in the United States.

1980–1989

1981: Extended-wear soft lenses are introduced.

1983: Bausch & Lomb Incorporated acquires Polymer Technology Corporation.

1983: Boston™ II silicone acrylate material is introduced.

1983: Boston™ solutions are introduced in the United States.

1984: Boston™ IV silicone acrylate material is introduced.

1986: Polymer Technology Corporation introduces its first fluoro silicone acrylate material, Boston™ Equalens™.

1990–1999

1990: Boston RXD™ fluoro silicone acrylate lens material is introduced.

1990: Boston Advance™ System of cleaner and conditioner is introduced.

1991: Boston™ Equalens™ II fluoro silicone acrylate lens material is introduced.

1993: Boston Envision™ bi-aspheric back surface lens design is introduced, for ease in fitting and wearing comfort.

1994: Boston 7™ AERCOR™ low silicon/high stability fluoro silicone acrylate lens material is introduced.

1995: Boston ES™ with AERCOR™ architecture is introduced.

1995: Boston Simplicity™, the first one-bottle care system for GP lenses, is introduced.

1997: Boston XO™ with high Dk/high stability is introduced.

1998: Boston EO™ with AERCOR™ architecture is introduced.

1998: Boston MultiVision™ lens design aspheric multifocal lens design for presbyopia is introduced.

2000–Present

2003: Boston SIMPLUS™, the next generation one-bottle care system, is introduced.

2005: Bausch & Lomb Vision Shaping Treatment VST™ is introduced for overnight orthokeratology (U.S. market only).

2006: Plasma treatment is FDA approved for all Boston materials.

2007: Boston XO_2™, a hyper-Dk material, is introduced.

Extended Keratometer Range

Extended Keratometer Range with +1.25 D Lens	
Actual Drum Reading	Extended Value
43.00 D	50.13 D
43.25 D	50.42 D
43.50 D	50.72 D
43.75 D	51.01 D
44.00 D	51.30 D
44.25 D	51.59 D
44.50 D	51.88 D
44.75 D	52.17 D
45.00 D	52.46 D
45.25 D	52.76 D
45.50 D	53.05 D
45.75 D	53.34 D
46.00 D	53.63 D
46.25 D	53.92 D
46.50 D	54.21 D
46.75 D	54.51 D
47.00 D	54.80 D
47.25 D	55.09 D
47.50 D	55.38 D
47.75 D	55.67 D
48.00 D	55.96 D
48.25 D	56.25 D
48.50 D	56.55 D
48.75 D	56.84 D
49.00 D	57.13 D
49.25 D	57.42 D
49.50 D	57.71 D
49.75 D	58.00 D
50.00 D	58.30 D
50.25 D	58.59 D
50.50 D	58.88 D
50.75 D	59.17 D
51.00 D	59.46 D
51.25 D	59.75 D
51.50 D	60.04 D
51.75 D	60.33 D
52.00 D	60.63 D

Extended Keratometer Range with -1.00 D Lens	
Actual Drum Reading	Extended Value
36.00 D	30.87 D
36.25 D	31.09 D
36.50 D	31.30 D
36.75 D	31.51 D
37.00 D	31.73 D
37.25 D	31.95 D
37.50 D	32.16 D
37.75 D	32.37 D
38.00 D	32.59 D
38.25 D	32.80 D
38.50 D	33.02 D
38.75 D	33.23 D
39.00 D	33.45 D
39.25 D	33.66 D
39.50 D	33.88 D
39.75 D	34.09 D
40.00 D	34.30 D
40.25 D	34.52 D
40.50 D	34.73 D
40.75 D	34.95 D
41.00 D	35.16 D
41.25 D	35.38 D
41.50 D	35.59 D
41.75 D	35.81 D
42.00 D	36.02 D

Vertex* Conversion

–		+
-3.87	4.00	+4.25
-4.00	4.25	+4.50
-4.25	4.50	+4.75
-4.50	4.75	+5.00
-4.75	5.00	+5.25
-5.00	5.25	+5.62
-5.12	5.50	+5.87
-5.37	5.75	+6.12
-5.62	6.00	+6.50
-5.75	6.25	+6.75
-6.00	6.50	+7.00
-6.25	6.75	+7.37
-6.50	7.00	+7.62
-6.62	7.25	+8.00
-6.87	7.50	+8.25
-7.12	7.75	+8.50
-7.25	8.00	+8.87
-7.50	8.25	+9.12
-7.75	8.50	+9.50
-7.87	8.75	+9.75
-8.12	9.00	+10.12
-8.37	9.25	+10.37
-8.50	9.50	+10.75
-8.75	9.75	+11.00
-8.87	10.00	+11.37
-9.37	10.50	+12.00
-9.75	11.00	+12.75
-10.12	11.50	+13.37
-10.50	12.00	+14.00
-10.87	12.50	+14.75
-11.25	13.00	+15.50
-11.62	13.50	+16.12
-12.00	14.00	+16.75
-12.37	14.50	+17.50
-12.75	15.00	+18.25
-13.00	15.50	+19.00
-13.50	16.00	+19.75
-13.75	16.50	+20.50
-14.12	17.00	+21.50
-14.50	17.50	+22.25
-14.75	18.00	+23.00
-15.12	18.50	+23.75
-15.50	19.00	+24.75

* The distance between the lens and the cornea is 12mm.

Diopter to Radius (mm) Conversion

Diopter to Radius Conversion Formula 337.5/D = mm Radius to Diopter Conversion Formula 337.5/mm = D					
Diopter	**Radius**	**Diopter**	**Radius**	**Diopter**	**Radius**
23.00 D	14.67mm	39.00 D	8.65mm	49.00 D	6.89mm
24.00 D	14.06mm	39.25 D	8.60mm	49.25 D	6.85mm
25.00 D	13.50mm	39.50 D	8.54mm	49.50 D	6.82mm
26.00 D	12.98mm	39.75 D	8.49mm	49.75 D	6.78mm
27.00 D	12.50mm	40.00 D	8.44mm	50.00 D	6.75mm
28.00 D	12.05mm	40.25 D	8.39mm	50.25 D	6.72mm
29.00 D	11.63mm	40.50 D	8.33mm	50.50 D	6.68mm
30.00 D	11.25mm	40.75 D	8.28mm	50.75 D	6.65mm
31.00 D	10.88mm	41.00 D	8.23mm	51.00 D	6.62mm
31.25 D	10.80mm	41.25 D	8.18mm	51.25 D	6.58mm
31.50 D	10.71mm	41.50 D	8.13mm	51.50 D	6.55mm
31.75 D	10.63mm	41.75 D	8.08mm	51.75 D	6.52mm
32.00 D	10.54mm	42.00 D	8.04mm	52.00 D	6.49mm
32.25 D	10.46mm	42.25 D	7.99mm	52.25 D	6.45mm
32.50 D	10.38mm	42.50 D	7.94mm	52.50 D	6.42mm
32.75 D	10.30mm	42.75 D	7.89mm	52.75 D	6.39mm
33.00 D	10.22mm	43.00 D	7.85mm	53.00 D	6.36mm
33.25 D	10.15mm	43.25 D	7.80mm	53.25 D	6.34mm
33.50 D	10.07mm	43.50 D	7.76mm	53.50 D	6.31mm
33.75 D	10.00mm	43.75 D	7.71mm	53.75 D	6.28mm
34.00 D	9.92mm	44.00 D	7.67mm	54.00 D	6.25mm
34.25 D	9.85mm	44.25 D	7.63mm	54.25 D	6.22mm
34.50 D	9.78mm	44.50 D	7.58mm	54.50 D	6.19mm
34.75 D	9.71mm	44.75 D	7.54mm	54.75 D	6.16mm
35.00 D	9.64mm	45.00 D	7.50mm	55.00 D	6.13mm
35.25 D	9.57mm	45.25 D	7.46mm	55.25 D	6.10mm
35.50 D	9.50mm	45.50 D	7.42mm	55.50 D	6.08mm
35.75 D	9.44mm	45.75 D	7.38mm	55.75 D	6.05mm
36.00 D	9.37mm	46.00 D	7.34mm	56.00 D	6.03mm
36.25 D	9.31mm	46.25 D	7.30mm	56.25 D	6.00mm
36.50 D	9.24mm	46.50 D	7.26mm	56.50 D	5.97mm
36.75 D	9.18mm	46.75 D	7.22mm	56.75 D	5.95mm
37.00 D	9.12mm	47.00 D	7.18mm	57.00 D	5.93mm
37.25 D	9.06mm	47.25 D	7.14mm	57.25 D	5.90mm
37.50 D	9.00mm	47.50 D	7.11mm	57.50 D	5.88mm
37.75 D	8.94mm	47.75 D	7.07mm	57.75 D	5.85mm
38.00 D	8.88mm	48.00 D	7.03mm	58.00 D	5.83mm
38.25 D	8.82mm	48.25 D	6.99mm	58.25 D	5.80mm
38.50 D	8.76mm	48.50 D	6.96mm	58.50 D	5.77mm
38.75 D	8.70mm	48.75 D	6.92mm	58.75 D	5.75mm

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