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English Version

Paints and varnishes - Determination of hiding power - Part 1: Kubelka-Munk method for white and light-coloured paints (ISO 6504-1:2019)

Peintures et vernis - Détermination du pouvoir masquant - Partie 1: Méthode de Kubelka-Munk pour les peintures blanches et les peintures claires (ISO 6504-1:2019)

Beschichtungsstoffe - Bestimmung des Deckvermögens - Teil 1: Verfahren nach Kubelka-Munk für weiße und helle Beschichtungen (ISO 6504-1:2019)

This European Standard was approved by CEN on 13 May 2019.

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COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

This document (EN ISO 6504-1:2019) has been prepared by Technical Committee ISO/TC 35 "Paints and varnishes" in collaboration with Technical Committee CEN/TC 139 "Paints and varnishes" the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2019, and conflicting national standards shall be withdrawn at the latest by December 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 6504-1:2006.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 6504-1:2019 has been approved by CEN as EN ISO 6504-1:2019 without any modification.

Contents

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test method for paints and varnishes*.

This second edition cancels and replaces the first edition (ISO 6504-1:1983), which has been technically revised. The main changes compared to the previous edition are as follows:

a) the normative references in Clause 2 have been updated;

b) Clause 3 for terms and definitions has been added;

c) Clause 7 for limitations has been added;

d) the term "contrast ratio" has been changed to "hiding power" throughout the text;

e) it has been clarified that the reflectance R_g needs to be measured and that the graphs in Annex A and values in Table B.1 are only examples for R_g = 0,80.

A list of all parts in the ISO 6504 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 6504-3[1] specifies a method for determining the hiding power of paints at a fixed spreading rate, by applying paint films to black and white charts and to polyester film respectively. It depends on the observation that there is a linear relationship between hiding power and reciprocal film thickness, at least over a limited range of film thickness.

Hiding power of paints is generally defined as the spreading rate required to give a hiding power of 98 %. To determine this by the method specified in ISO 6504-3[1] would be time-consuming and require considerable extrapolation which often exceeds the limit of linearity of the relationship between hiding power and spreading rate. Therefore, this method for the determination of hiding power, involving the Kubelka-Munk (K-M) equations which relate scattering and absorption coefficients to optical properties, has also been standardized.

Paints and varnishes — Determination of hiding power —

Part 1: Kubelka-Munk method for white and light-coloured paints

1 Scope

This document specifies a method for determining the hiding power (spreading rate necessary to give a hiding power of 98 %) of white or light-coloured paints. It is applicable to paint films having the tri-stimulus value of $Y \geq 70$ and hiding power > 80 %. It is not applicable to fluorescent or metallic paints.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1513, *Paints and varnishes — Examination and preparation of test samples*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 2811-1, *Paints and varnishes — Determination of density — Part 1: Pycnometer method*

ISO 3251, *Paints, varnishes and plastics — Determination of non-volatile-matter content*

ISO 4618, *Paints and varnishes — Terms and definitions*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
light-coloured paint
coating with tristimulus values Y and Y_{10} greater than 25, measured with a spectrophotometer on a black and white substrate

4 Principle

The method is based on the Kubelka and Munk equations relating the scattering and absorption coefficients of pigmented films to their colour and opacity.

For the determination of hiding power, both the reflectance (R_B) of a paint film of thickness t on a black background and the reflectivity (R_∞) are required for introduction into the Kubelka-Munk equations (Clause 5).

5 Kubelka-Munk equations

The Kubelka-Munk (K-M) equations required are

$$a=\frac{1}{2}\left(R_\infty+\frac{1}{R_\infty}\right) \tag{1}$$

$$b=a-R_\infty \tag{2}$$

$$R_\mathrm{B}=\frac{1}{a+b\coth bSt} \tag{3}$$

$$R=\frac{1-R_\mathrm{g}\left(a-b\coth bSt\right)}{a+b\coth bSt-R_\mathrm{g}} \tag{4}$$

where

R_∞ is the reflectivity, i.e. the reflectance of a paint film of such thickness that further increase in thickness gives no further change in reflectance;

R_B is the reflectance of a paint film of thickness t applied over a black background;

R is the reflectance of a paint film of thickness t applied over a white background of determined reflectance R_g;

S is the scattering coefficient per micrometre (μm^{-1});

t is the thickness, in micrometres, of the paint film.

When using Formulae (1) to (4) with this method, the measured CIE tristimulus values Y divided by 100 are inserted for R, R_B and R_∞, respectively.

The hiding power $V_{0,98}$ is the spreading rate necessary to give a hiding power (R_B/R) of 0,98, and is determined via the equivalent film thickness $t_{0,98}$ according to the formula

$$V=\frac{1\,000}{t}$$

where

V is the hiding power, in square metres per litre;

t is the thickness, in micrometres, of the wet paint film.

From Formulae (3) and (4), when the hiding power (R_B/R) is equal to 0,98

$$\frac{a-0{,}8+b\coth bSt_{0{,}98}}{\left[a+b\coth bSt_{0{,}98}\right]\left\{1-0{,}8\left[a-b\coth bSt_{0{,}98}\right]\right\}}=0{,}98$$

or after, rearrangement

$$t_{0{,}98}=\frac{1}{bS}\operatorname{arcoth}\left(\frac{0{,}02+\sqrt{D}}{1{,}568\,b}\right) \tag{5}$$

where

$D = 3{,}136\, a\, [1 - 0{,}98(1 - 0{,}8a)] - 2{,}508\,4$

and

$$V=\frac{1\,000}{t}=\frac{1\,000\,bS}{\operatorname{arcoth}\left(\frac{0{,}02+\sqrt{D}}{1{,}568\,b}\right)}=\propto S \tag{6}$$

NOTE 1 If $y = \coth x$, $x = \operatorname{arcoth} y$.

NOTE 2 It can be seen that for constant values of R_g and hiding power ($V_{0{,}98}$), factor a is a function of R_∞.

The scattering coefficient S is determined from a rearrangement of Formula (3), the values of a and b being known by calculation from Formulae (1) and (2) respectively, as follows:

$$St=\frac{1}{b}\operatorname{arcoth}\left(\frac{1-aR_B}{bR_B}\right) \tag{7}$$

To simplify the calculations, graphs are available for the determination of the product St from measured values of R_g and R_∞.

The scattering coefficient S is calculated by dividing St by the film thickness t, and $V_{0{,}98}$ is obtained from Formulae (5) and (6). A table of values of a for various values of R_∞ (see Table B.1) simplifies the calculation.

NOTE 3 Suitable tables and graphs are for example referred to in ASTM D2805. Table B.1 is taken, with modifications, from ASTM D2805-80[2] and the graphs in Annex A are from Reference [3].

6 Apparatus and materials

6.1 Substrates

6.1.1 Determination of R_B

6.1.1.1 Glass plates, black, plane, polished, not less than 6 mm thick and of dimensions at least 200 mm × 200 mm, or

6.1.1.2 Polyester film, clear, untreated, transparent, of uniform thickness between 30 µm and 100 µm, and of dimensions at least 100 mm × 150 mm, together with a glass plate as specified in 6.1.1.1.

NOTE Commercially available polyester sheet has been found to be satisfactory.

6.1.2 Determination of R_∞

6.1.2.1 Smooth surfaced paper charts, readily wetted by, but impervious to, solvent and water thinned paints, and similar in reflectance to the paint to be tested.

Suitable chart colours are grey for paints of low reflectivity and white for paints of high reflectivity. Alternatively, ceramic tiles or glass may be used.

6.2 Film applicators

A series of film applicators giving films of uniform thickness within the range 40 µm to 150 µm is required. For application to glass, bar applicators are suitable. For application to polyester film or paper charts, wirewound applicators are more suitable.

The film laid down shall be at least 150 mm wide (using glass) or 70 mm wide (using polyester film) to cover areas, at a uniform thickness, of at least 100 mm × 125 mm or 60 mm × 60 mm respectively. The application of uniform films is facilitated by the use of automatic applicators, which are recommended.

6.3 Reflectometer

A photoelectric instrument is required, giving an indicated reading proportional to the intensity of light reflected from the surface under test to an accuracy of 0,1 % of full scale deflection, and having a spectral response approximating to the product of the relative spectral energy distribution of CIE standard illuminant D 65 and the colour matching function $\bar{y}(\lambda)$ of the CIE standard observer.

It is recognized that the relative geometrical arrangement of the illuminating beam and the light detector can affect the measurement of reflectance, but it is considered that variations arising from this factor in commercial reflectometers should be considerably less than the figures for reproducibility stated in 11.2. In the event of dispute, 8°/diffuse geometry, without gloss trap, should be used.

For other than reference purposes, CIE illuminant C may be used.

6.4 Template

A rectangular metal template with minimum dimensions of 100 mm × 125 mm is required for films applied to black glass. For films on polyester film, a metal template or die stamp with minimum dimensions of 60 mm × 60 mm is required.

7 Limitations

Temperature and humidity are important parameters affecting test results. Deviations from the requirements specified can lead to results that are not comparable. However, the interested parties may agree upon alternative parameters and these parameters shall be reported.

8 Sampling

Take a representative sample of the product to be tested as described in ISO 15528.

Examine and prepare the sample for testing as described in ISO 1513.

9 Procedure

9.1 Determination of R_∞

Measure the reflectance R_g of the uncoated paper substrate. Apply a few millilitres of the paint sample in a line across one end of a paper substrate and spread it immediately by drawing down a suitable applicator at a steady rate so as to give a uniform film thickness. Repeat the operation so as to provide uniform films having dry film thicknesses of about 75 µm, 100 µm, 125 µm and 150 µm. Dry the paint as described in 9.2.1.4. Measure the reflectance of each paint film at four positions on each coated paper. Record the value of reflectance which is independent of the film thickness as the reflectivity R_∞.

If the reflectance is still increasing when the film thickness reaches 150 µm, further coats should be applied until a constant reflectance is obtained.

9.2 Determination of R_B

9.2.1 Preparation of test films

9.2.1.1 General

Apply a film thickness that will give a dry film having a reflectance at least 0,02 lower than the reflectivity R_∞ of the paint sample.

9.2.1.2 Method using polyester film

Prepare the polyester film (6.1.1.2) for coating by either

a) spreading it on a black glass plate (6.1.1.1) which has first been moistened with just sufficient white spirit (a few drops), to hold the film in position by surface tension. Ensure that none of the liquid wets the upper surface of the film and that no air bubbles are trapped under it;

or, if wirewound applicators are to be used

b) by fixing the polyester film at one end and laying it over a flat rubber block.

Apply a few millilitres of the paint sample, according to the film thickness required, in a line across one end of the polyester film and spread it immediately by drawing down a suitable applicator at a steady rate to give a uniform film thickness. Prepare a total of four test films in this way.

9.2.1.3 Method using black glass plates

Apply a few millilitres of the paint sample in a line across one end of a black glass plate (6.1.1.1) and spread it immediately by drawing down a suitable applicator at a steady rate to give a uniform film thickness. Repeat the application with different black glass plates (6.1.1.1) until four uniform films of approximately the same thickness have been prepared.

9.2.1.4 Drying and conditioning

With the coated substrates in a horizontal position, dry the paint by the appropriate procedure for the type of paint or as agreed between the parties. Maintain the dried test films at a temperature of (23 ± 2) °C in a dust free atmosphere having a relative humidity of (50 ± 5) % for at least 24 h, but not more than 168 h, before carrying out the reflectance measurements.

9.2.2 Measurement of reflectance R_B

9.2.2.1 General

Variation in readings is likely to be the result of non-uniform application of the paint film and is dependent on the techniques used. If the precision (Clause 11) is not obtained, the technique should be re-examined.

9.2.2.2 Method using polyester film

Fix the coated polyester films over a black glass plate, introducing a few drops of white spirit between the underside of the film and the glass to ensure optical contact. Measure the reflectance of the test films at a minimum of four positions and calculate the mean reflectance R_B of each coated plate.

9.2.2.3 Method using black glass plates

Measure the reflectance R_B directly by means of the reflectometer (6.3), taking readings at a minimum of four positions on each coated plate, avoiding its edges, and calculate the mean reflectance R_B of each coated plate.

9.3 Determination of film thickness

9.3.1 General

The method using polyester film (see 9.3.2) is preferred. Other methods for measuring wet film thickness, based on those specified in ISO 2808, may also be found to be suitable.

9.3.2 Method using polyester film

By means of the metal template and a sharp knife or precision die stamp, cut equal areas of dimensions at least 60 mm × 60 mm from the centres of the coated polyester films.

Weigh the detached pieces to the nearest 0,1 mg. Remove the paint film by the use of a solvent which has been found to have no effect on the dry mass of the polyester film, and, after thorough drying, reweigh the film. Record the mass m of the paint film, i.e. the difference in mass between the coated and uncoated polyester film and repeat the procedure with the other three films tested.

If difficulty is experienced in removing the paint film with solvent, an approximation to the dry film mass may be obtained from the difference in mass between coated and uncoated polyester films of the same area.

9.3.3 Method using black glass plates

Cover the area of the film previously used for the measurement of reflectance R_B with the metal template (6.4), ensuring that the template is not within 20 mm of any edge of the film. Scrape away and discard the excess film around the template using a fresh razor blade in a holder. Remove the template and scrape the remaining film from the substrate on to a tared weighing dish. Manipulate the razor blade at all times so that the blade is almost flat on the glass and cannot nick or scratch the glass substrate. Record the mass m, to the nearest 0,1 mg, and repeat the procedure with the other three films tested.

10 Expression of results

10.1 Calculation of wet film thickness

Calculate the wet film thickness of each of the four films, from the formula

$$t = \frac{m}{A \times \rho \times \mathrm{NV}} \times 10^8$$

where

- *t* is the wet film thickness, in micrometres;
- *m* is the mass, in grams, of the paint film;
- *A* is the area, in square millimetres, of the template;
- *ρ* is the density, in grams per millilitre, of the paint, determined by the method specified in ISO 2811-1;
- NV is the non-volatile matter content, expressed as a percentage by mass, of the paint, determined by the method specified in ISO 3251.

10.2 Calculation of hiding power

Calculate the hiding power, $V_{0,98}$, using the formulae given in Clause 5, from the measured values of R_B and *t* for each film, and from the mean value of R_∞.

Examples of the calculations, using both the table and graphs and directly from the formulae, are given in Annex C.

11 Precision

11.1 Repeatability (*r*)

The value below which the absolute difference between two single test results on identical material, obtained by one operator in one laboratory using the same equipment within a short interval of time using the standardized test method, may be expected to lie with a 95 % probability, is 2 %.

11.2 Reproducibility (*R*)

The value below which the absolute difference between two single test results on identical material, obtained by operators in different laboratories, using the standardized test method, may be expected to lie with a 95 % probability, is 6 %.

12 Test report

The test report shall contain at least the following information:

a) all details necessary to identify the paint tested;

b) a reference to this document (i.e. ISO 6504-1);

c) the result of the test;

d) the paint density and the non-volatile matter content, expressed as a percentage by mass, used in the calculation of the test result;

e) the drying time (and/or stoving conditions);

f) whether black glass plates or polyester film were used as the substrate;

g) any deviation, by agreement or otherwise, from the procedure specified;

h) any unusual features (anomalies) observed during the test;

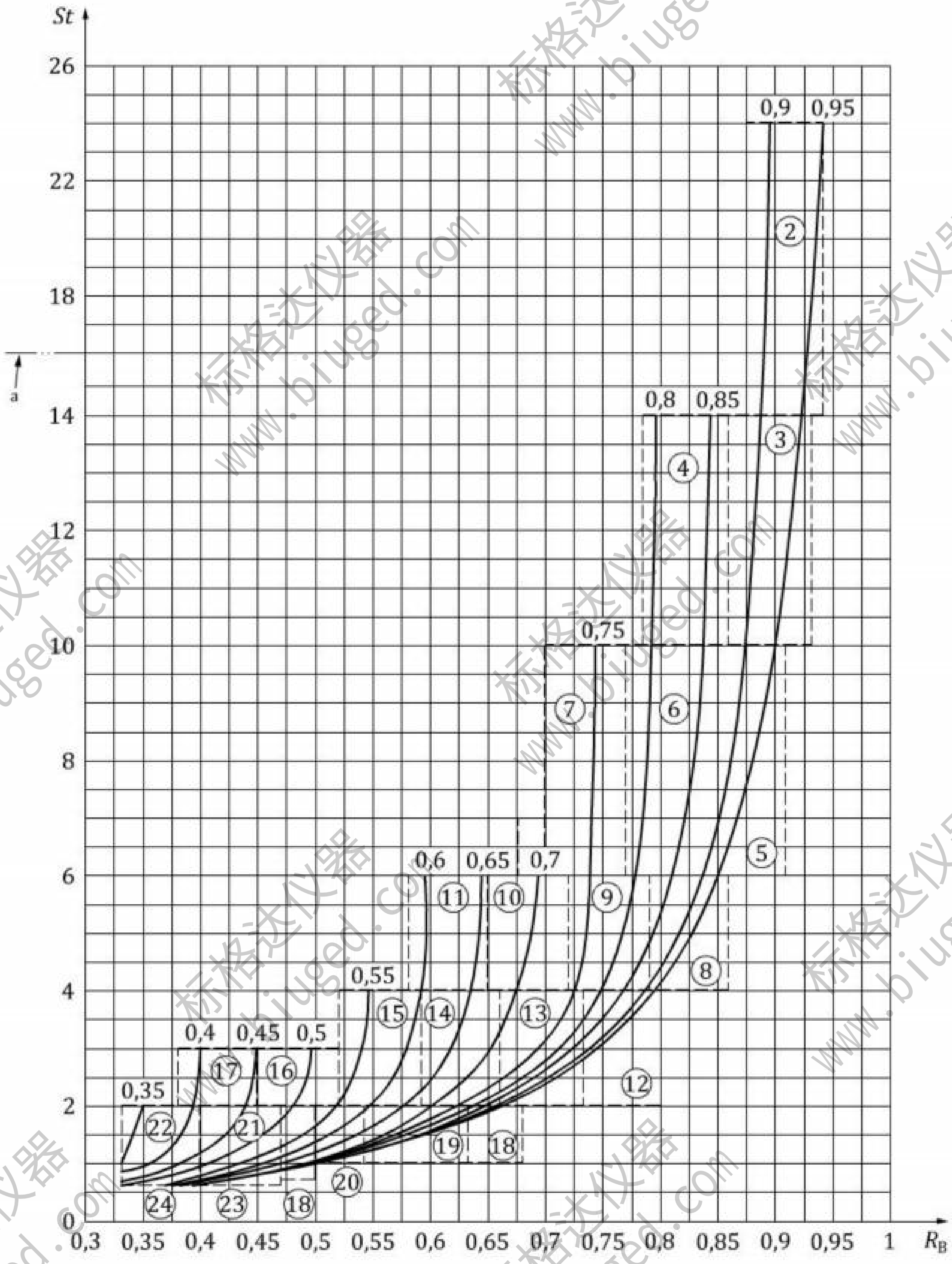
i) the date of the test.

Annex A
(informative)

Graphs for determination of *St* from R_B and R_∞ for R_g = 0,80

For R_g = 0,80, after determination of R_B for each film and the mean value of R_∞, refer to the graph in Figure A.1 to ascertain which of the larger scale graphs (Figure A.2 to Figure A.24) is appropriate (this is indicated by the encircled number).

In each of the graphs, *St* (the product of the scattering coefficient *S* and the film thickness *t*) is plotted against R_B (the reflectance of a paint film of thickness t applied over a black background) for a range of values of R_∞ (the reflectivity), which are recorded on each curve. An example of the use of these graphs is given in Annex C.



a Note the change in scale.

Figure A.1 — Index graph for determination of *St* from values of R_B and R_∞

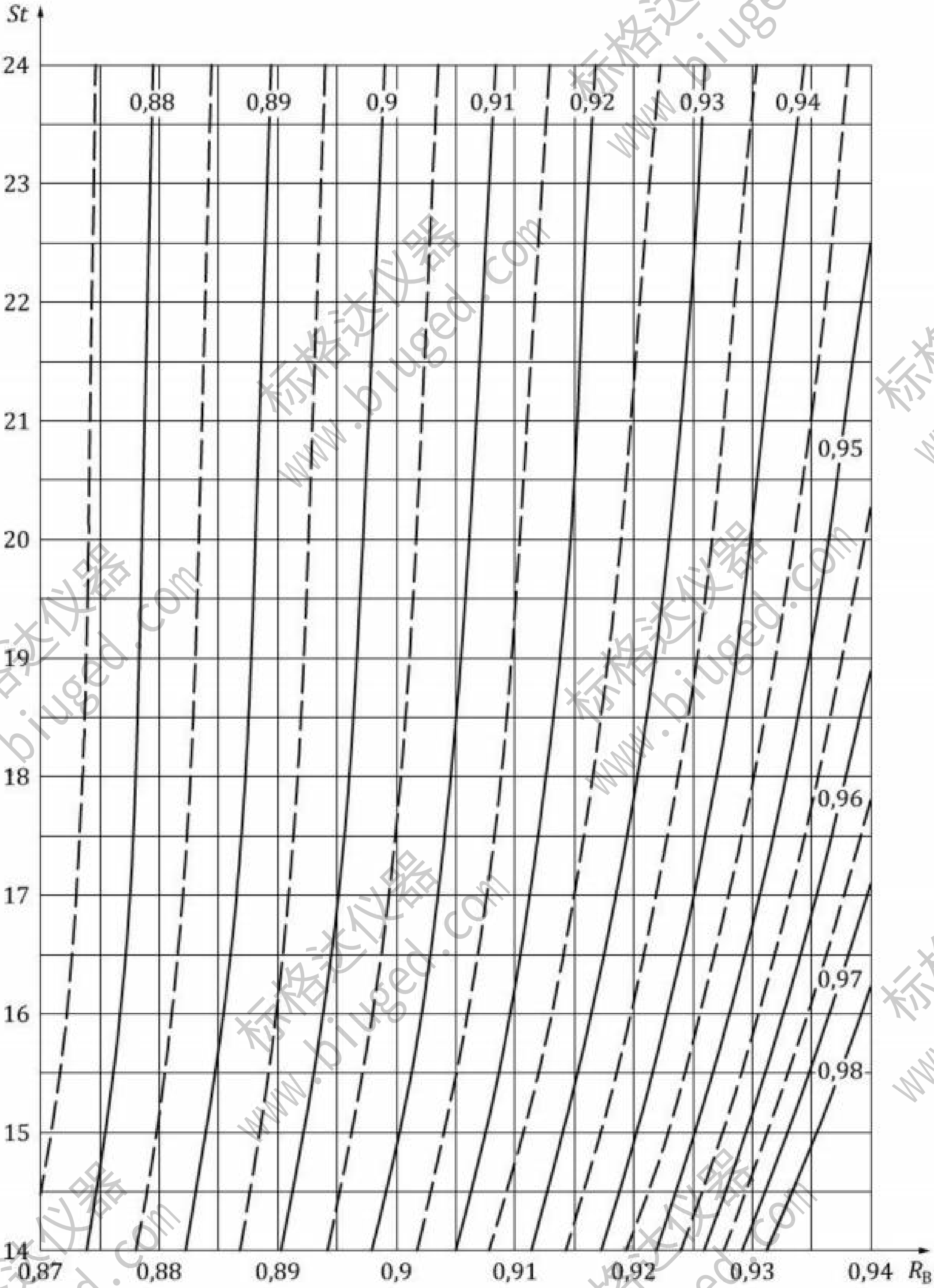


Figure A.2 — Values of *St* for the ranges
$0,87 \leq R_B \leq 0,94$
$0,88 \leq R_\infty \leq 0,98$

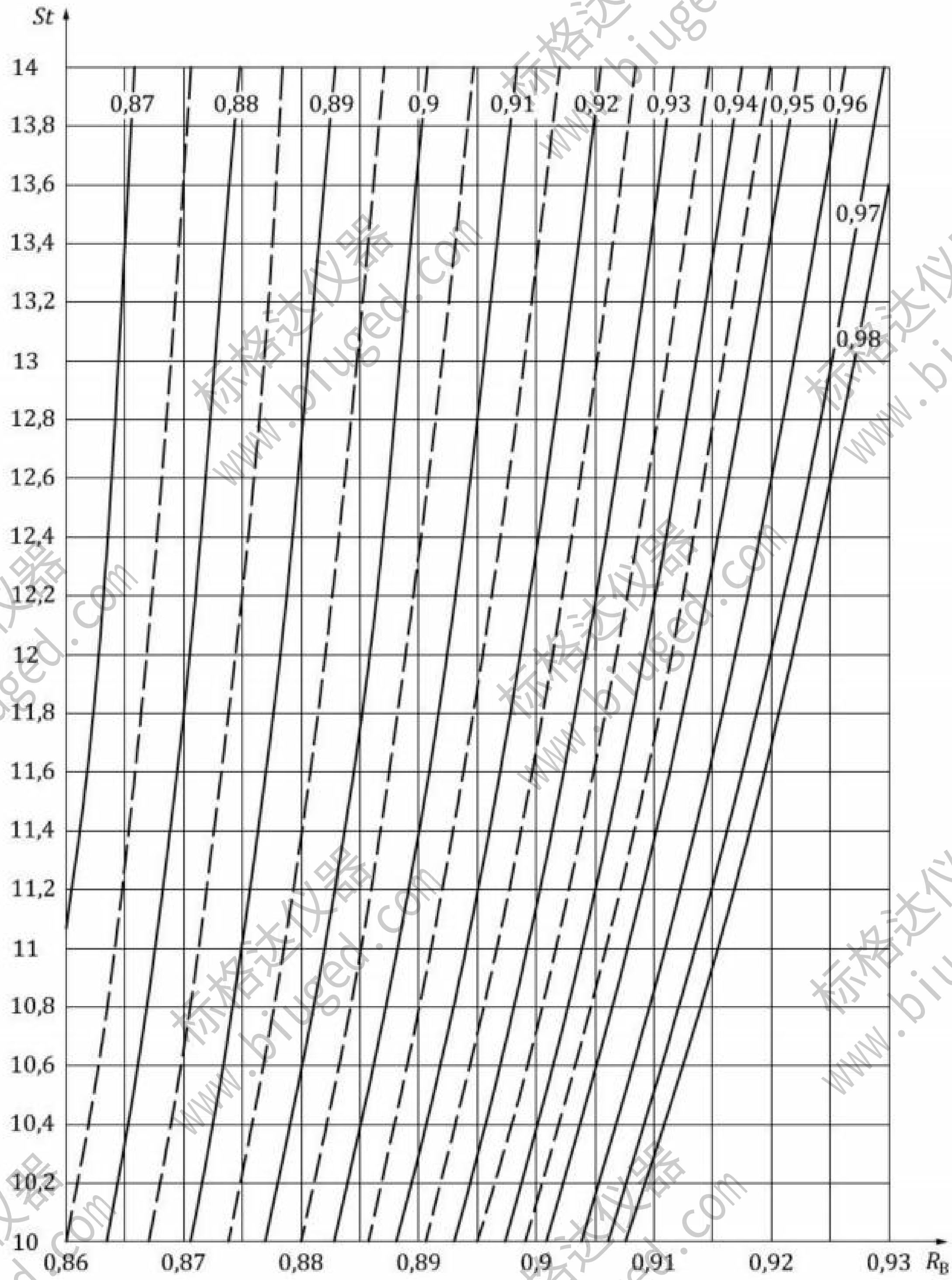


Figure A.3 — Values of *St* for the ranges
$0,86 \leq R_B \leq 0,93$
$0,87 \leq R_\infty \leq 0,98$

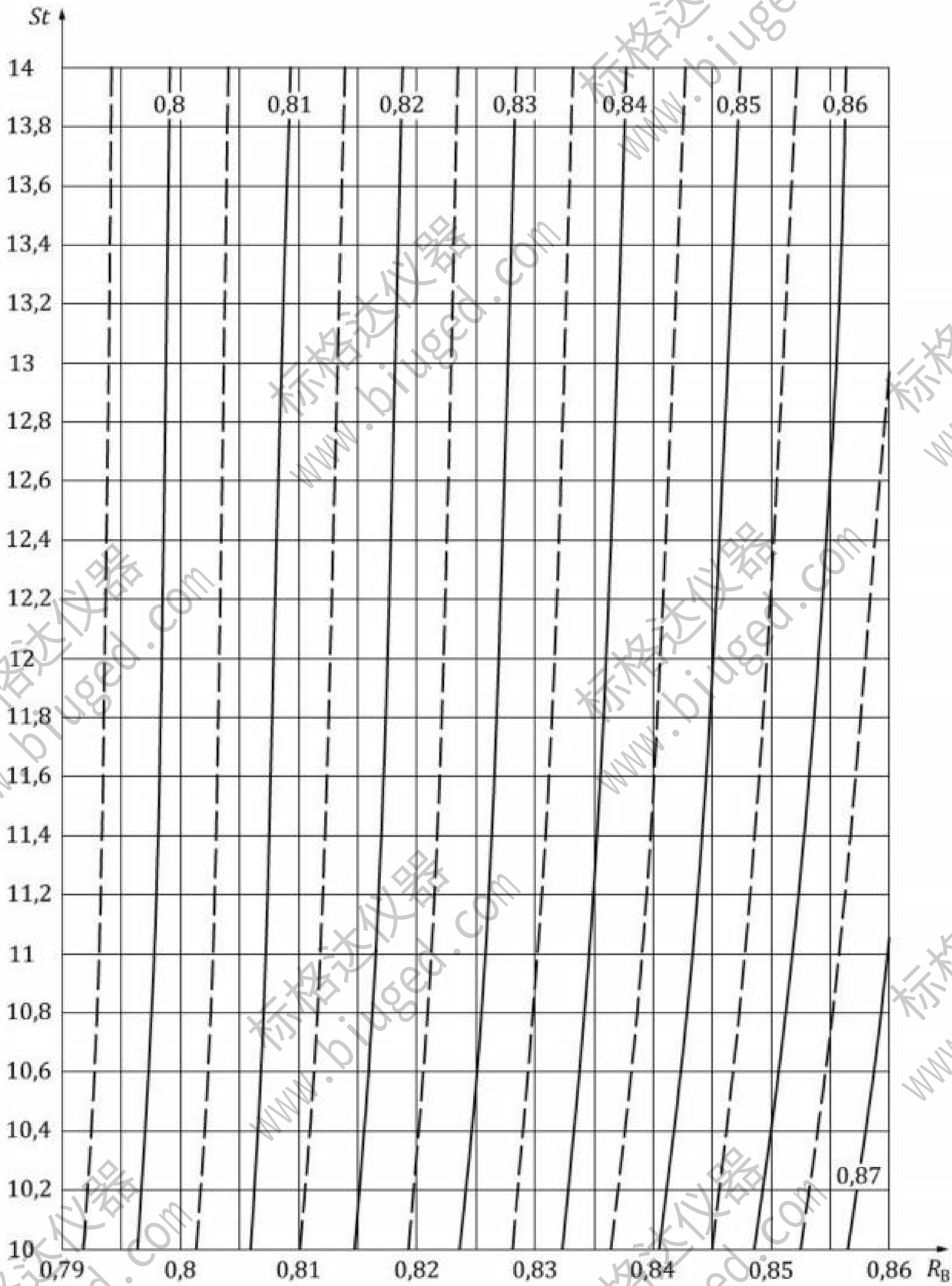


Figure A.4 — Values of *St* for the ranges
$0,79 \le R_B \le 0,86$
$0,80 \le R_\infty \le 0,86$

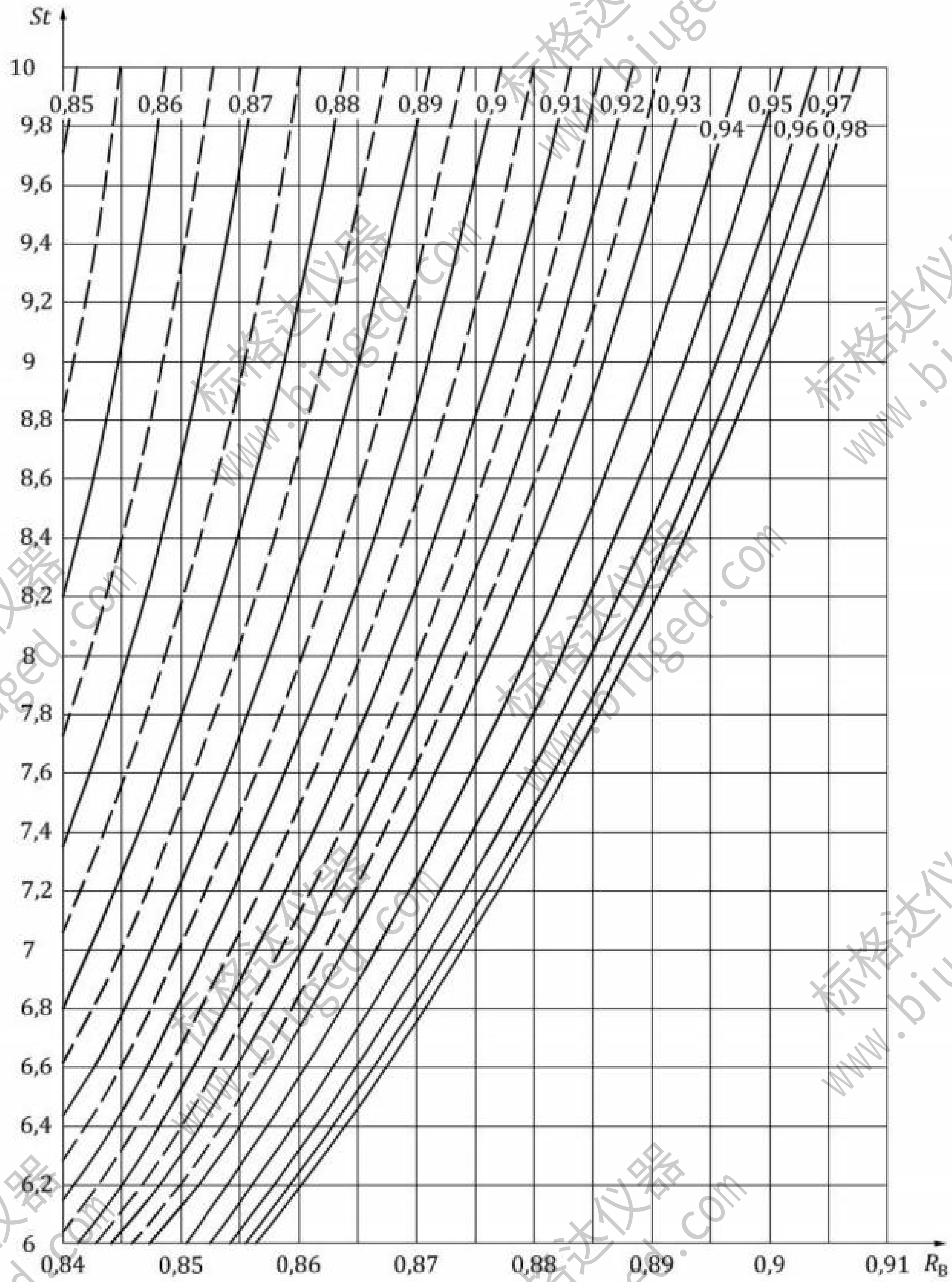


Figure A.5 — Values of *St* for the ranges
$0{,}84 \leq R_B \leq 0{,}91$
$0{,}85 \leq R_\infty \leq 0{,}98$

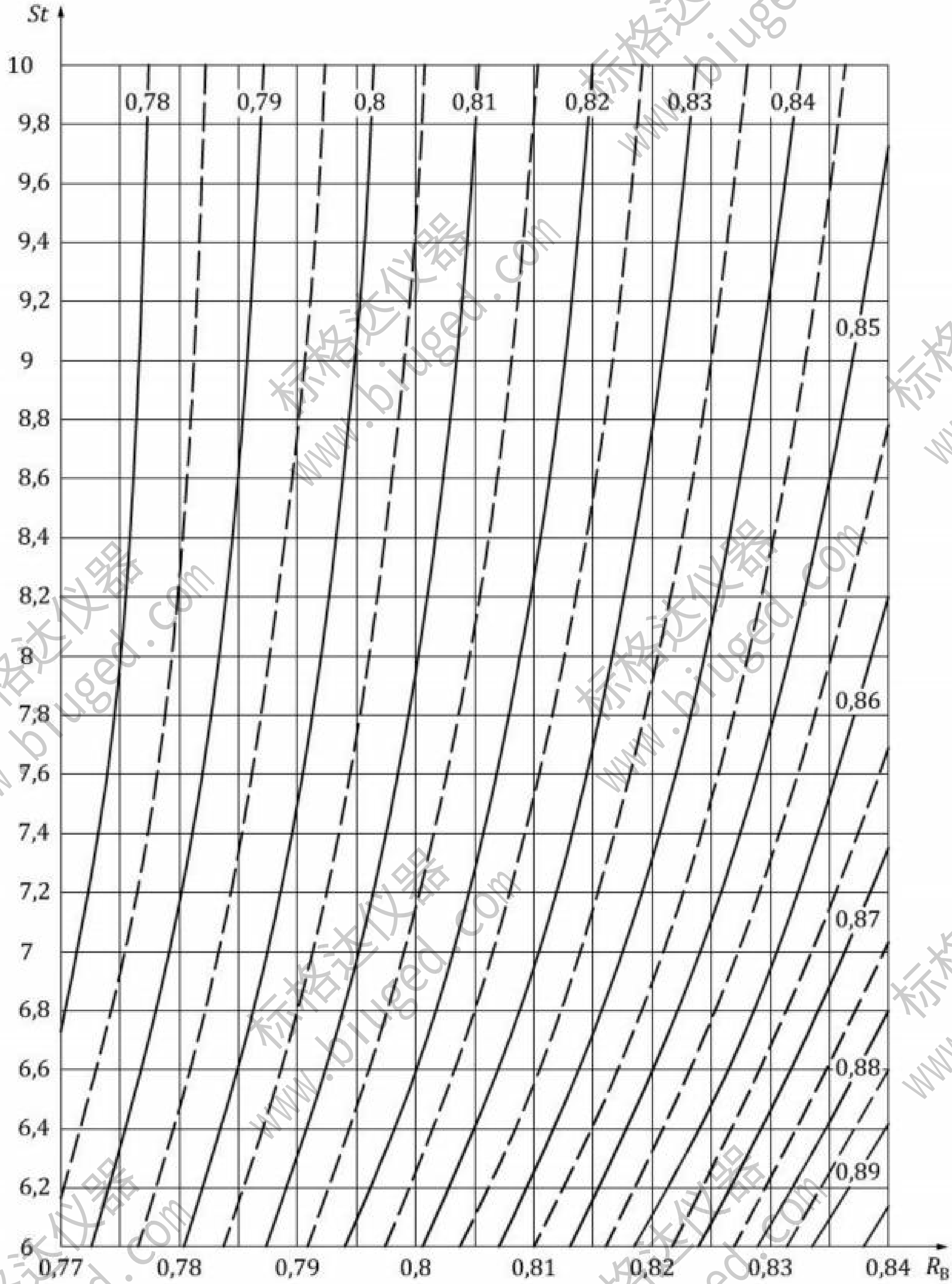


Figure A.6 — Values of *St* for the ranges
$0,77 \le R_B \le 0,84$
$0,78 \le R_\infty \le 0,89$

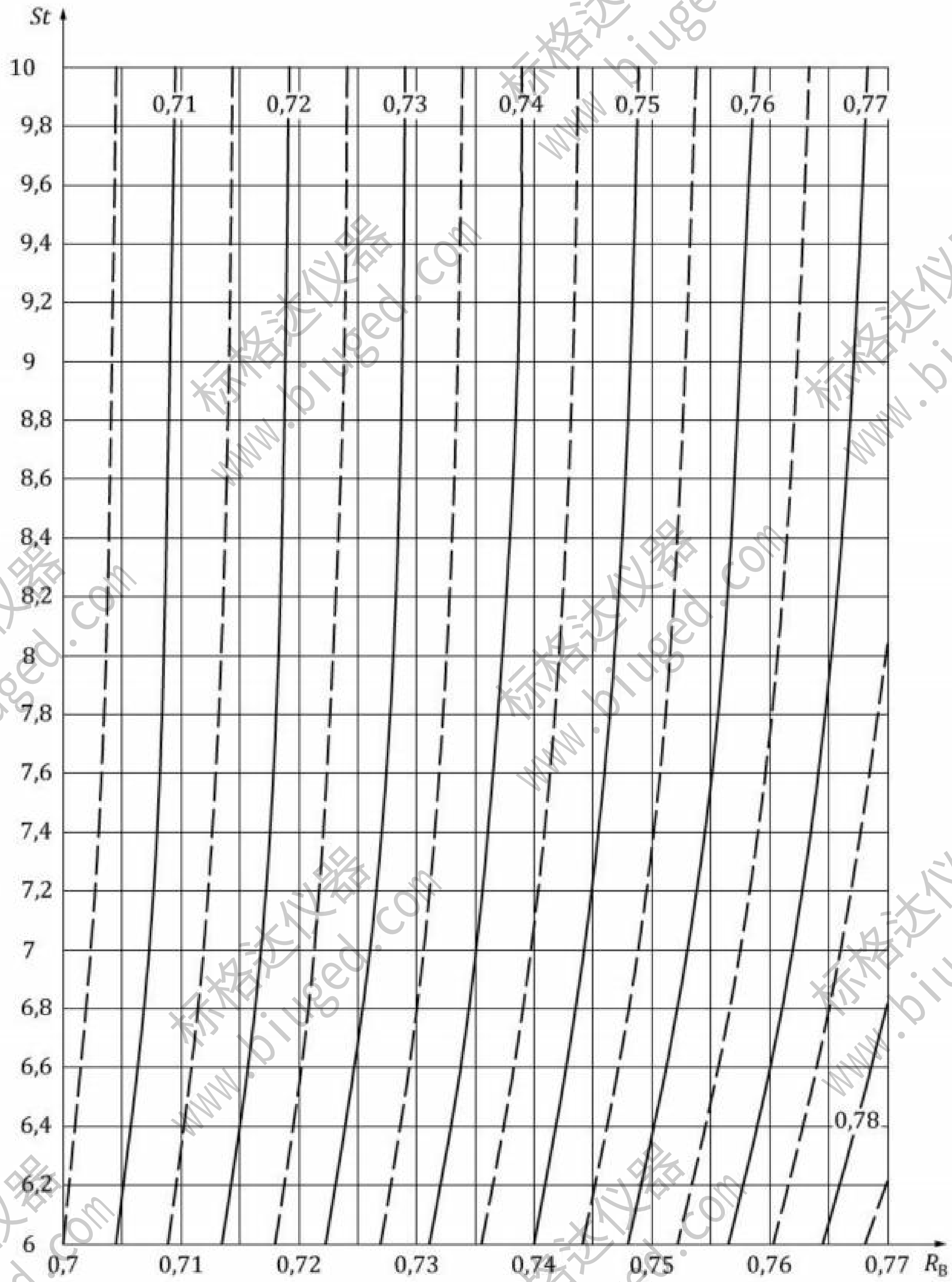


Figure A.7 — Values of *St* for the ranges
$0,70 \le R_B \le 0,77$
$0,71 \le R_\infty \le 0,77$

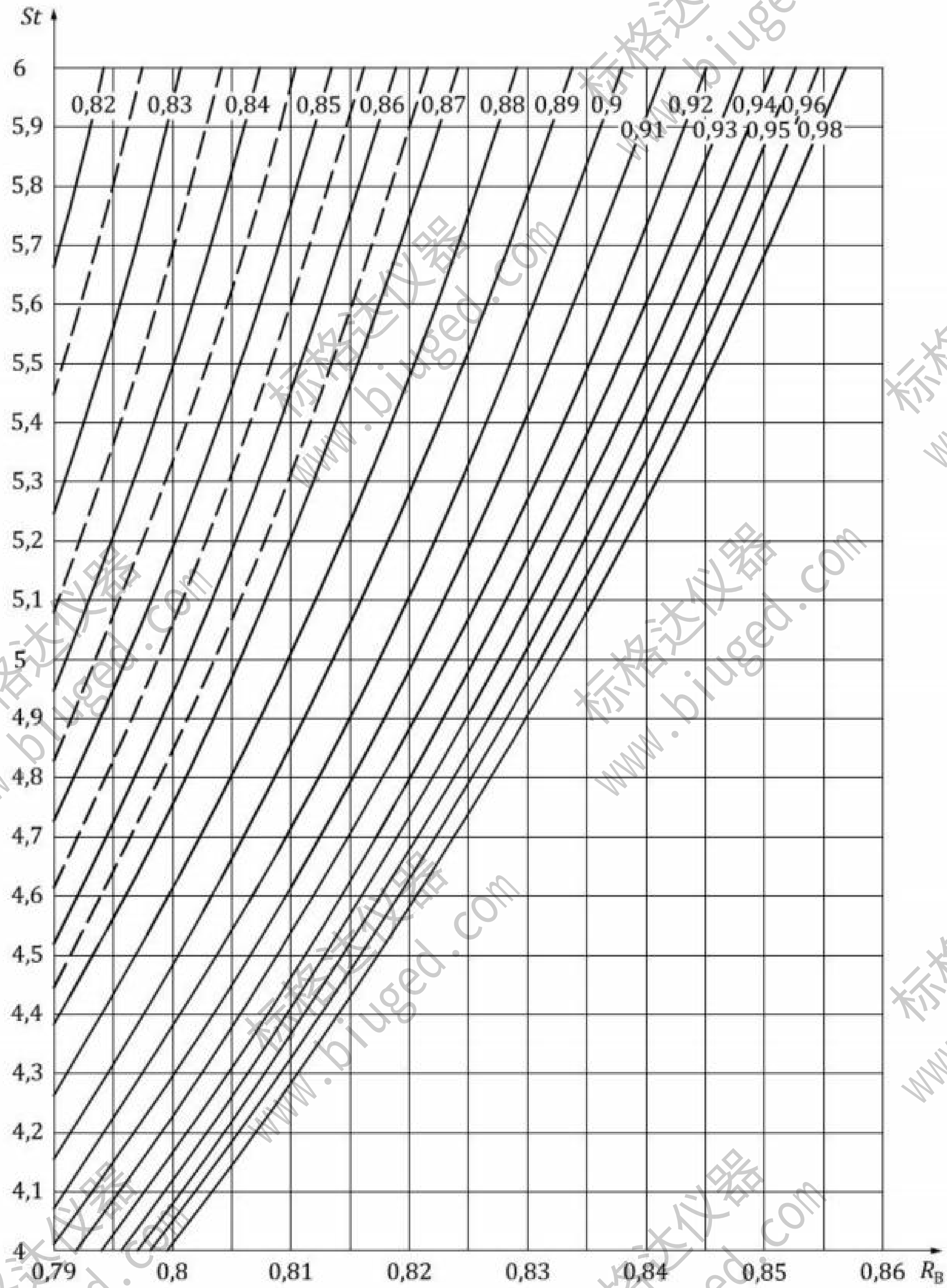


Figure A.8 — Values of *St* for the ranges
$0{,}79 \leq R_B \leq 0{,}86$
$0{,}82 \leq R_\infty \leq 0{,}98$

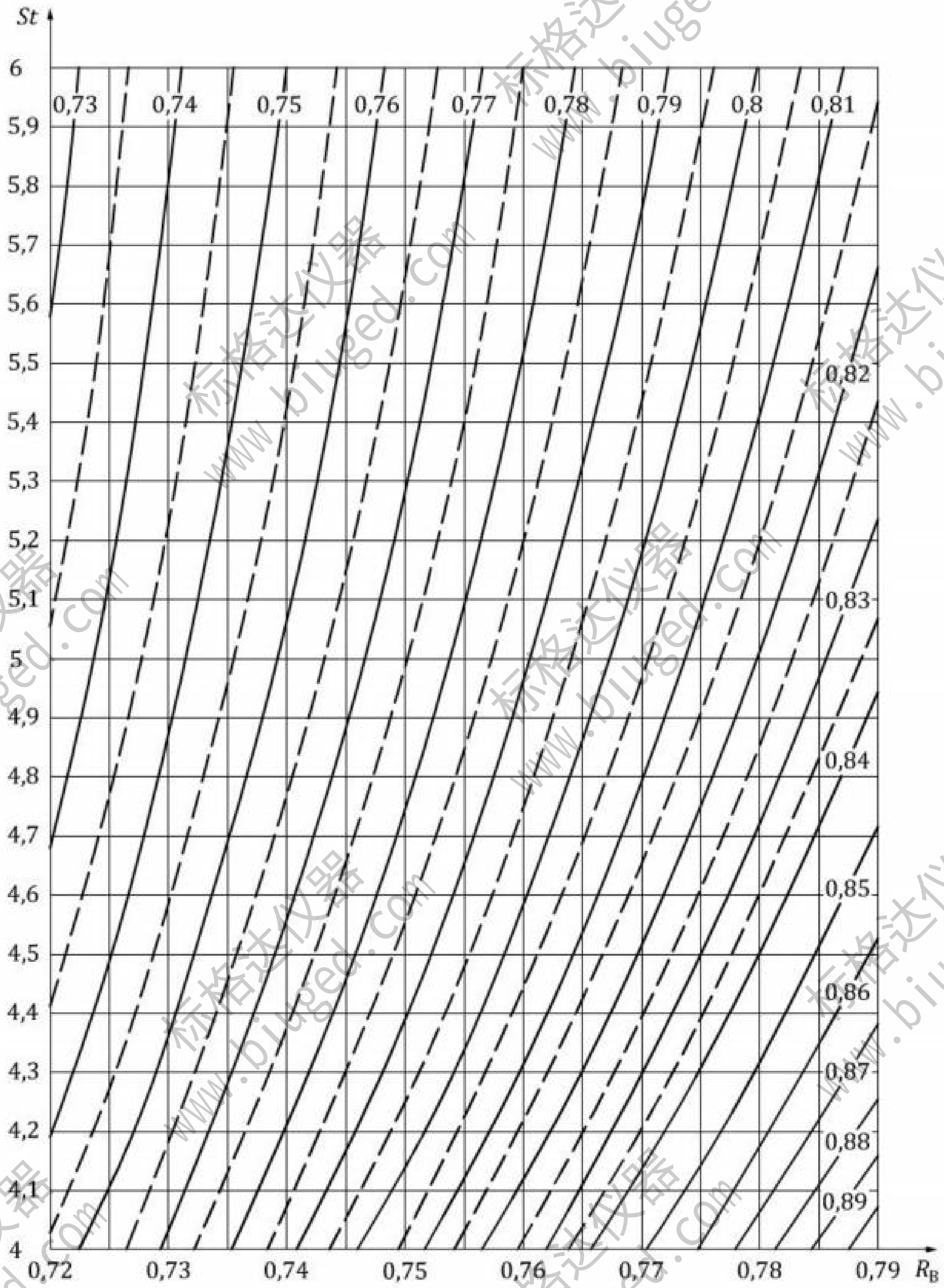


Figure A.9 — Values of *St* for the ranges
$0,72 \leq R_B \leq 0,79$
$0,73 \leq R_\infty \leq 0,89$

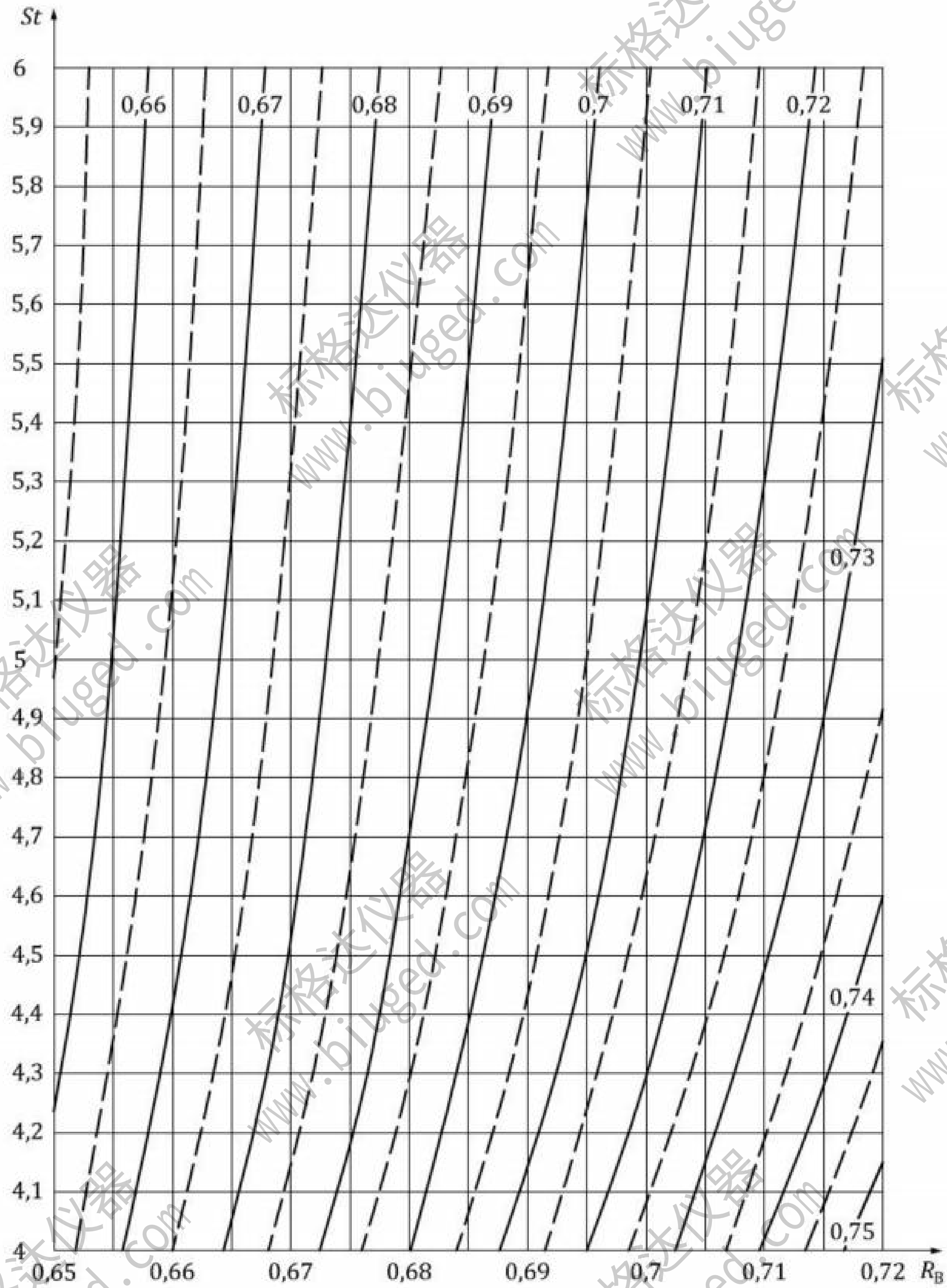


Figure A.10 — Values of *St* for the ranges
$0,65 \leq R_B \leq 0,72$
$0,66 \leq R_\infty \leq 0,75$

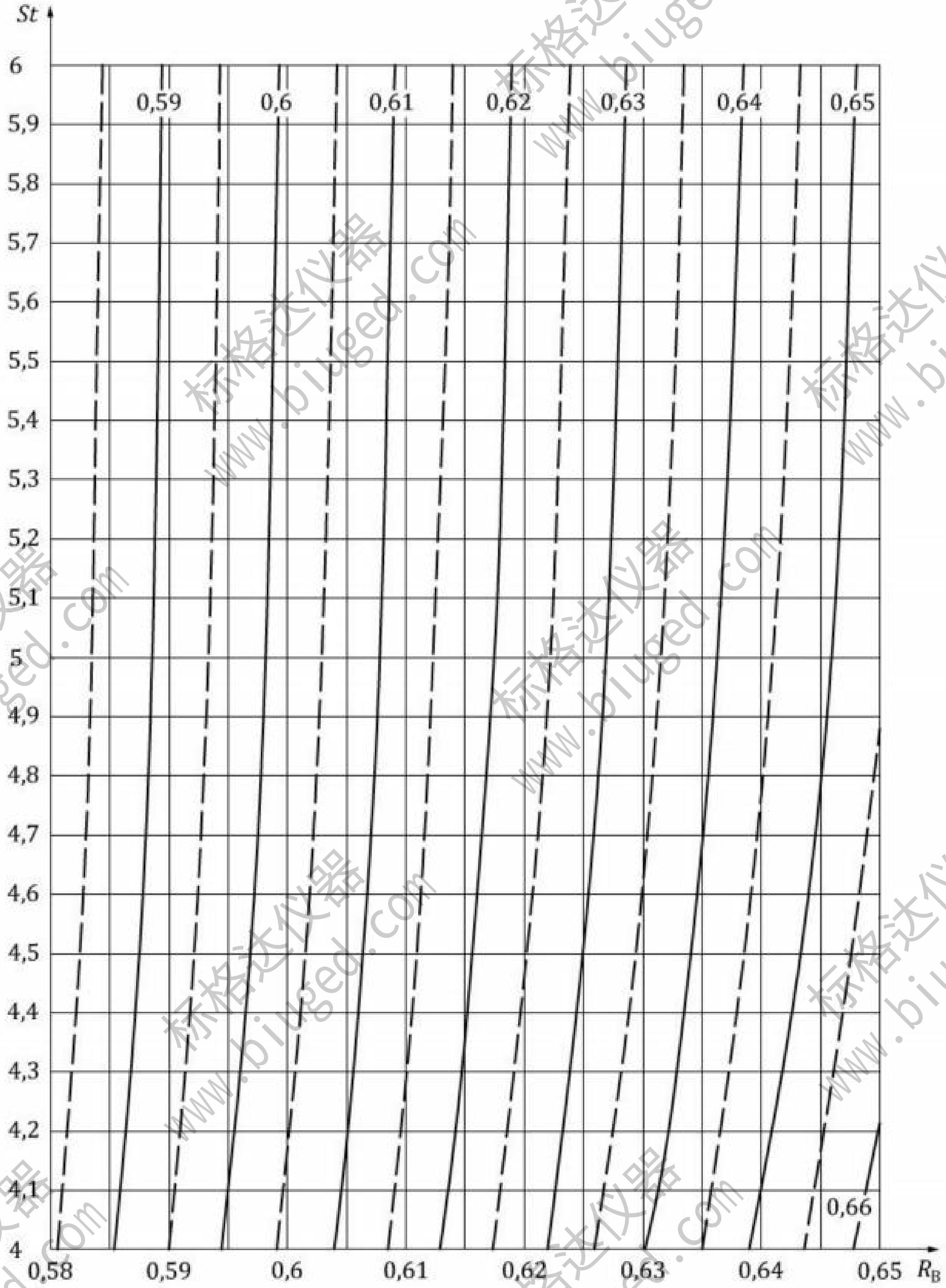


Figure A.11 — Values of *St* for the ranges
$0{,}58 \le R_B \le 0{,}65$
$0{,}59 \le R_\infty \le 0{,}66$

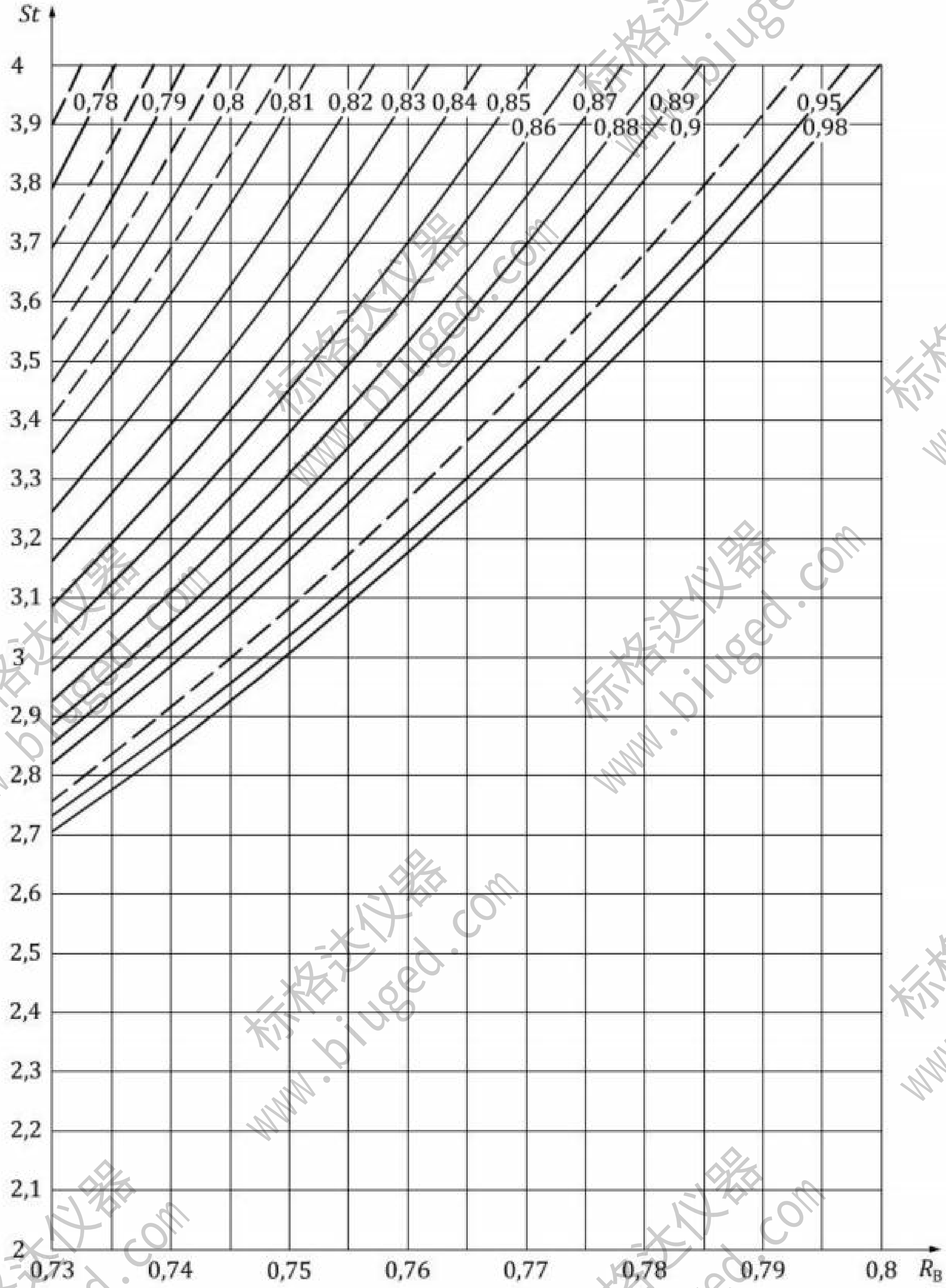


Figure A.12 — Values of *St* for the ranges
$0,73 \leq R_B \leq 0,80$
$0,78 \leq R_\infty \leq 0,98$

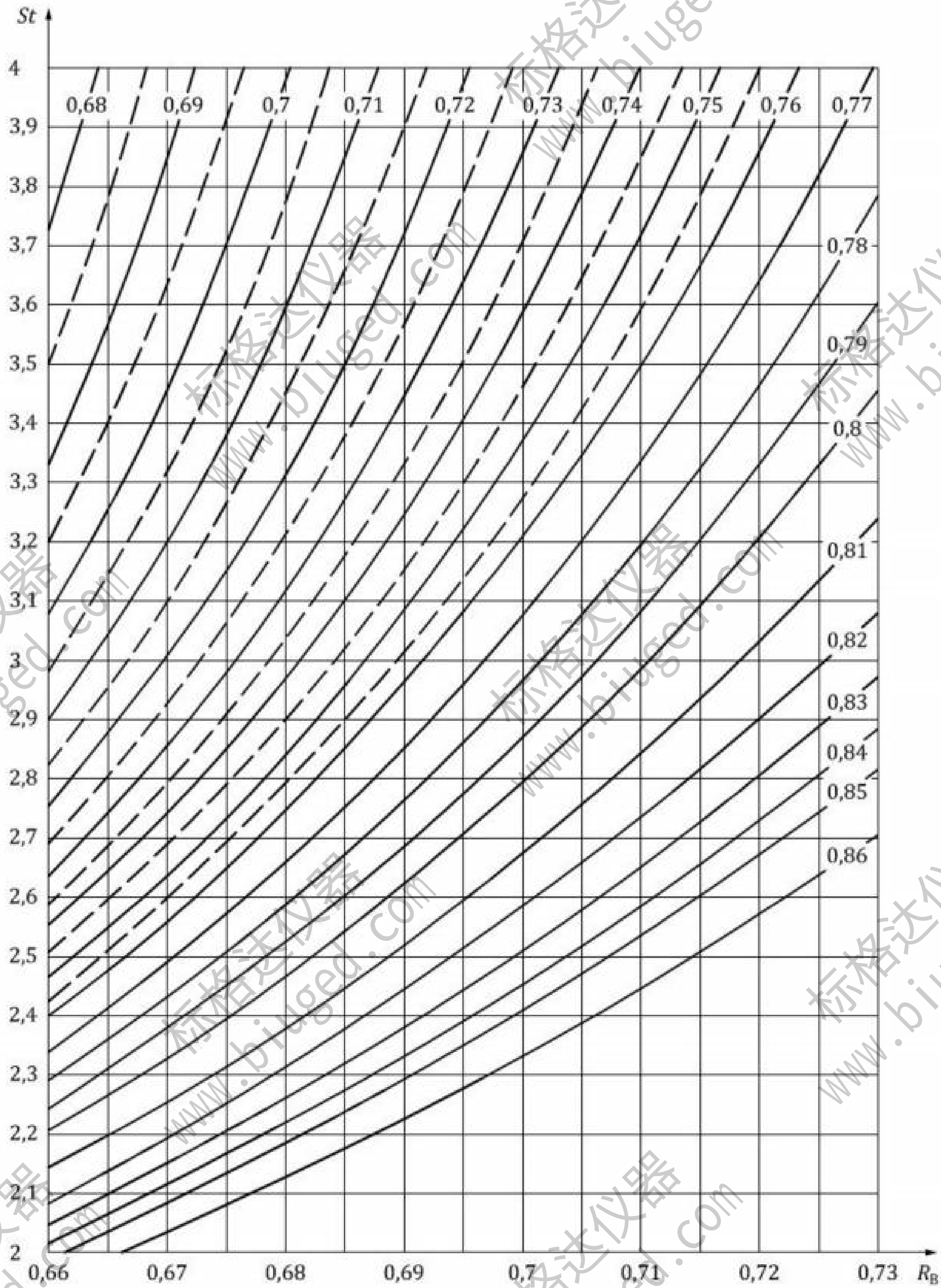


Figure A.13 — Values of *St* for the ranges
$0,66 \leq R_B \leq 0,73$
$0,68 \leq R_\infty \leq 0,98$

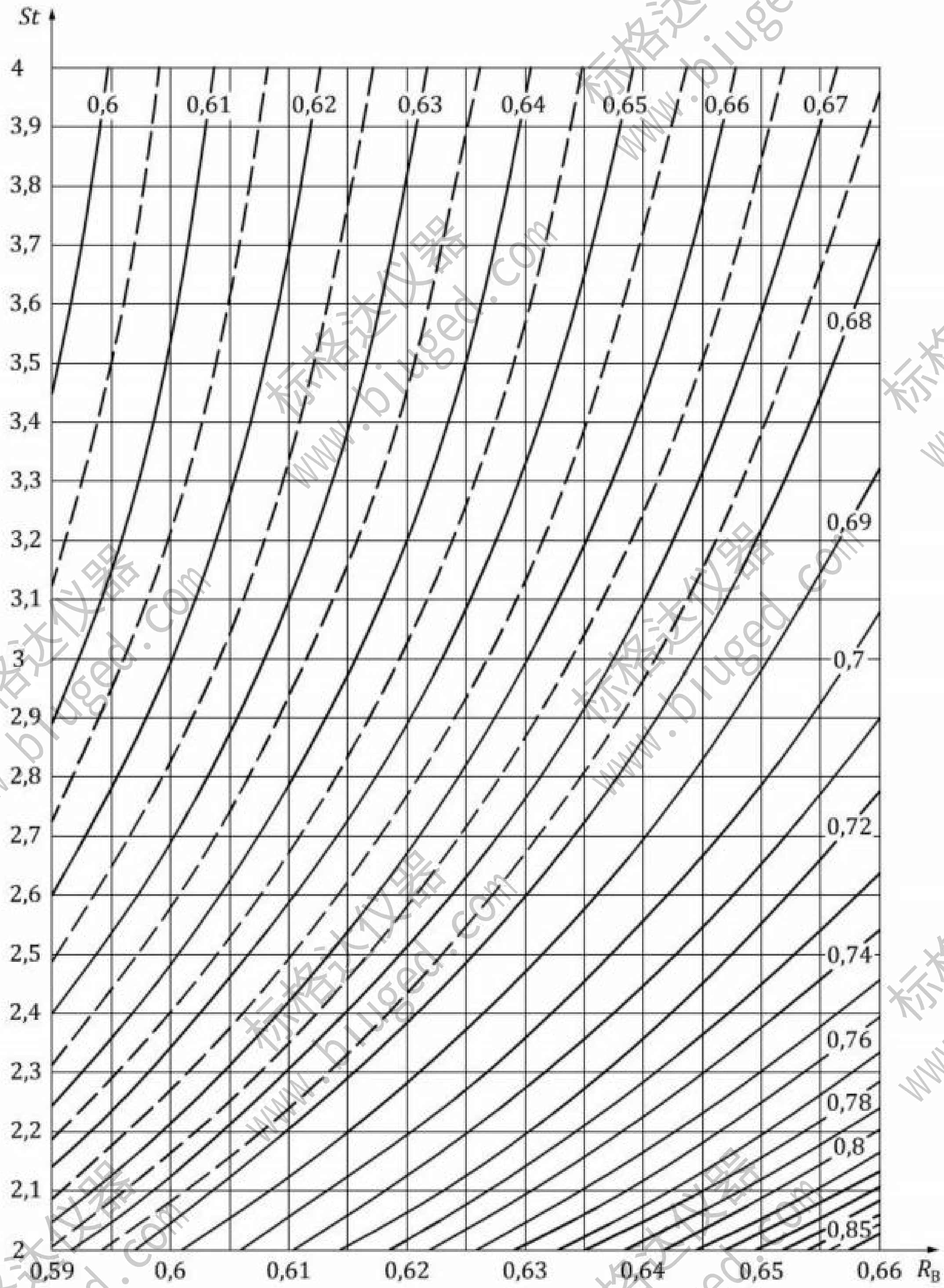


Figure A.14 — Values of *St* for the ranges
$0,59 \leq R_B \leq 0,66$
$0,60 \leq R_{co} \leq 0,85$

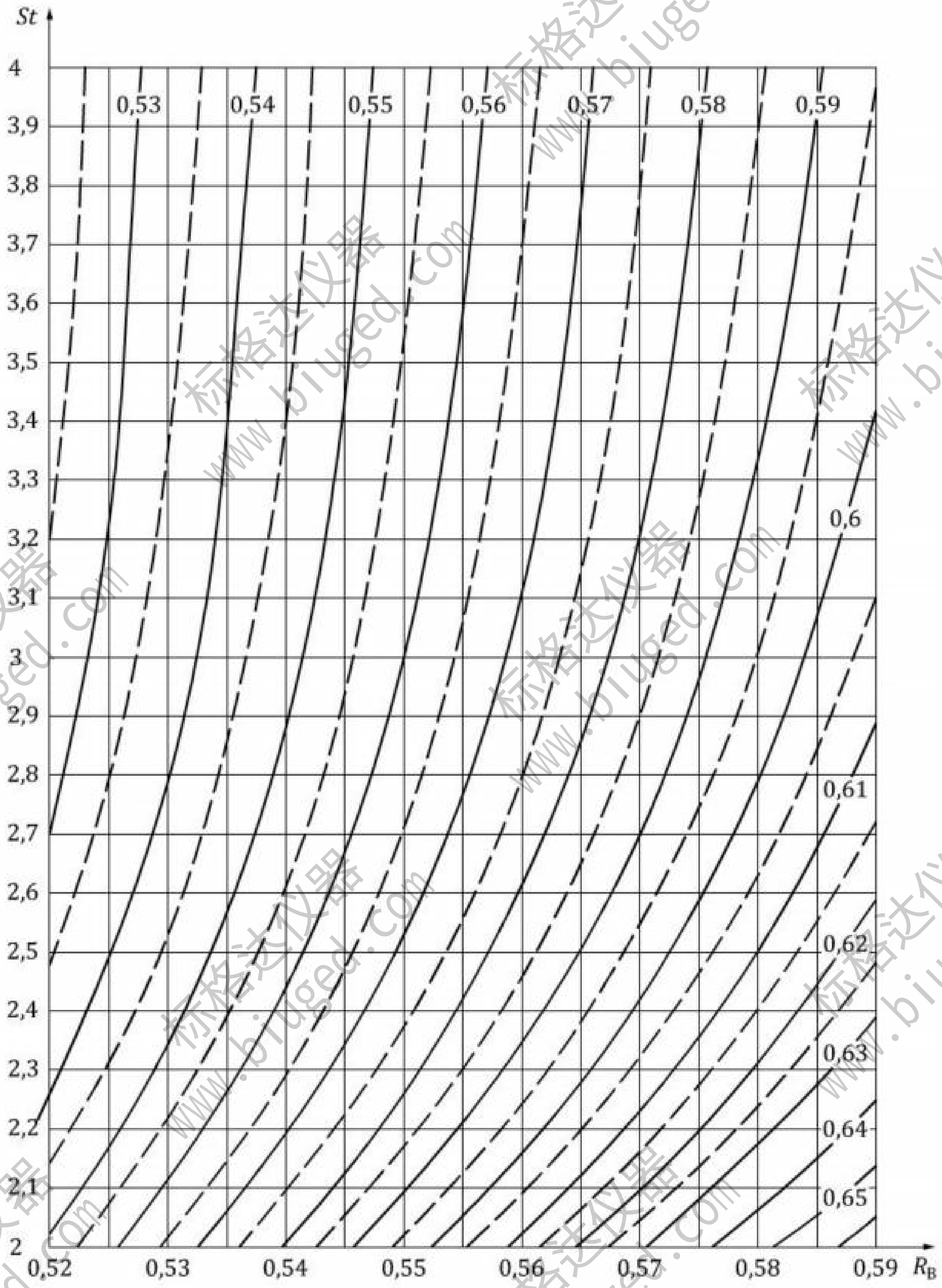


Figure A.15 — Values of St for the ranges
$0{,}52 \le R_B \le 0{,}59$
$0{,}53 \le R_\infty \le 0{,}65$

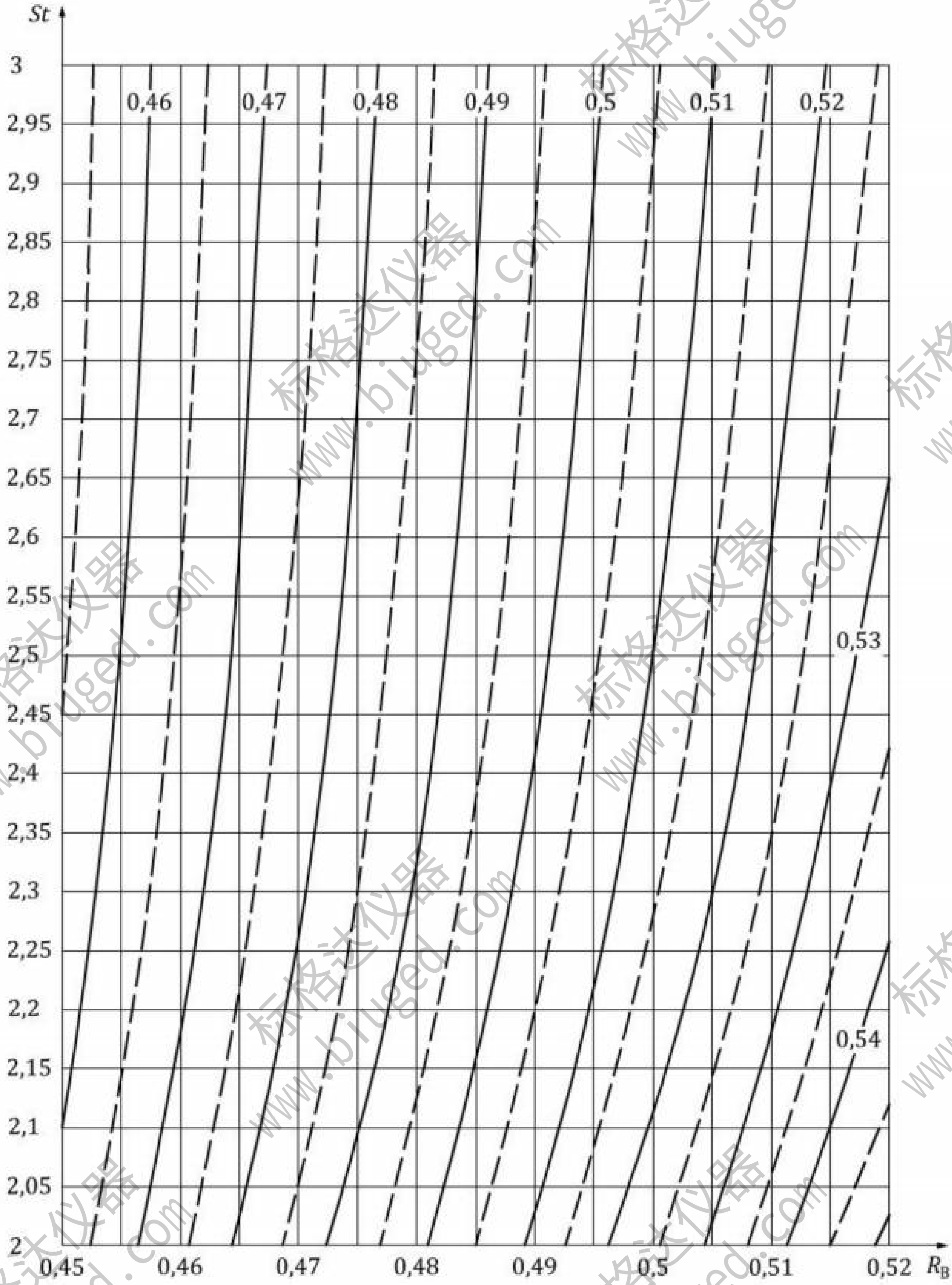


Figure A.16 — Values of *St* for the ranges
$0{,}45 \leq R_B \leq 0{,}52$
$0{,}46 \leq R_\infty \leq 0{,}54$

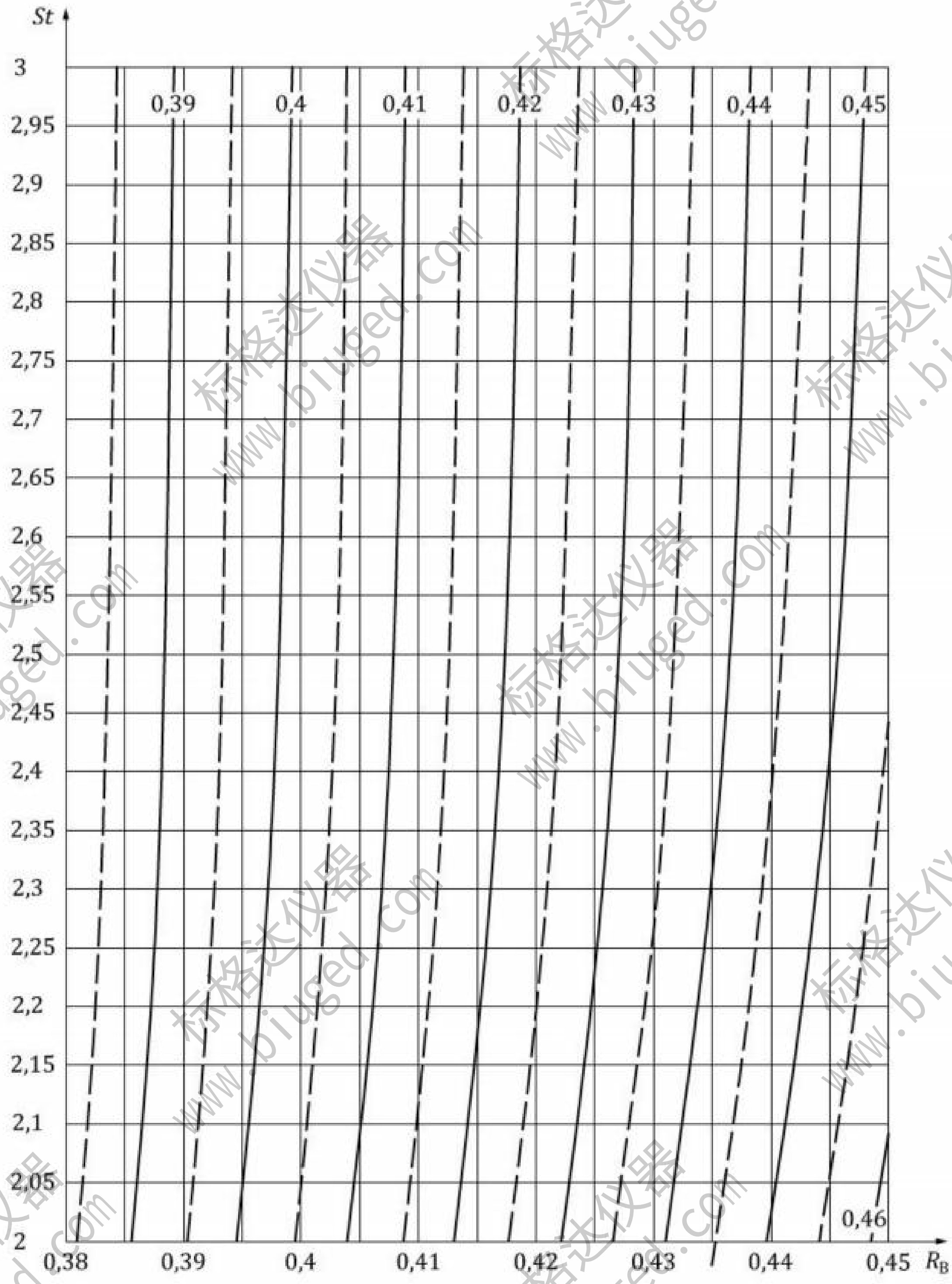


Figure A.17 — Values of *St* for the ranges
$0,38 \leq R_B \leq 0,45$
$0,39 \leq R_\infty \leq 0,46$

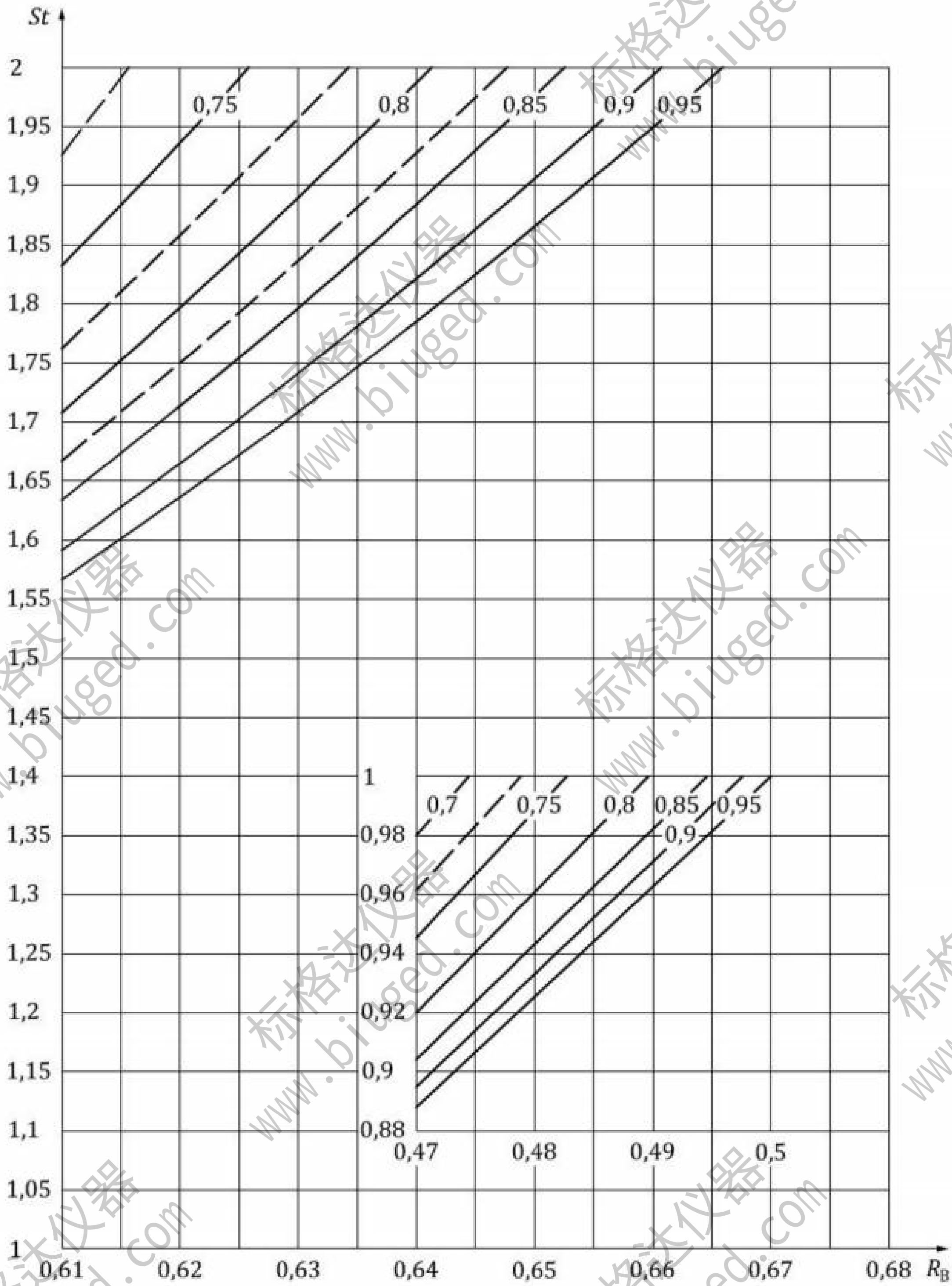


Figure A.18 — Values of *St* for the ranges
$0,61 \leq R_B \leq 0,68$ and $0,47 \leq R_B \leq 0,50$
$0,75 \leq R_\infty \leq 0,98$ and $0,70 \leq R_\infty \leq 0,98$

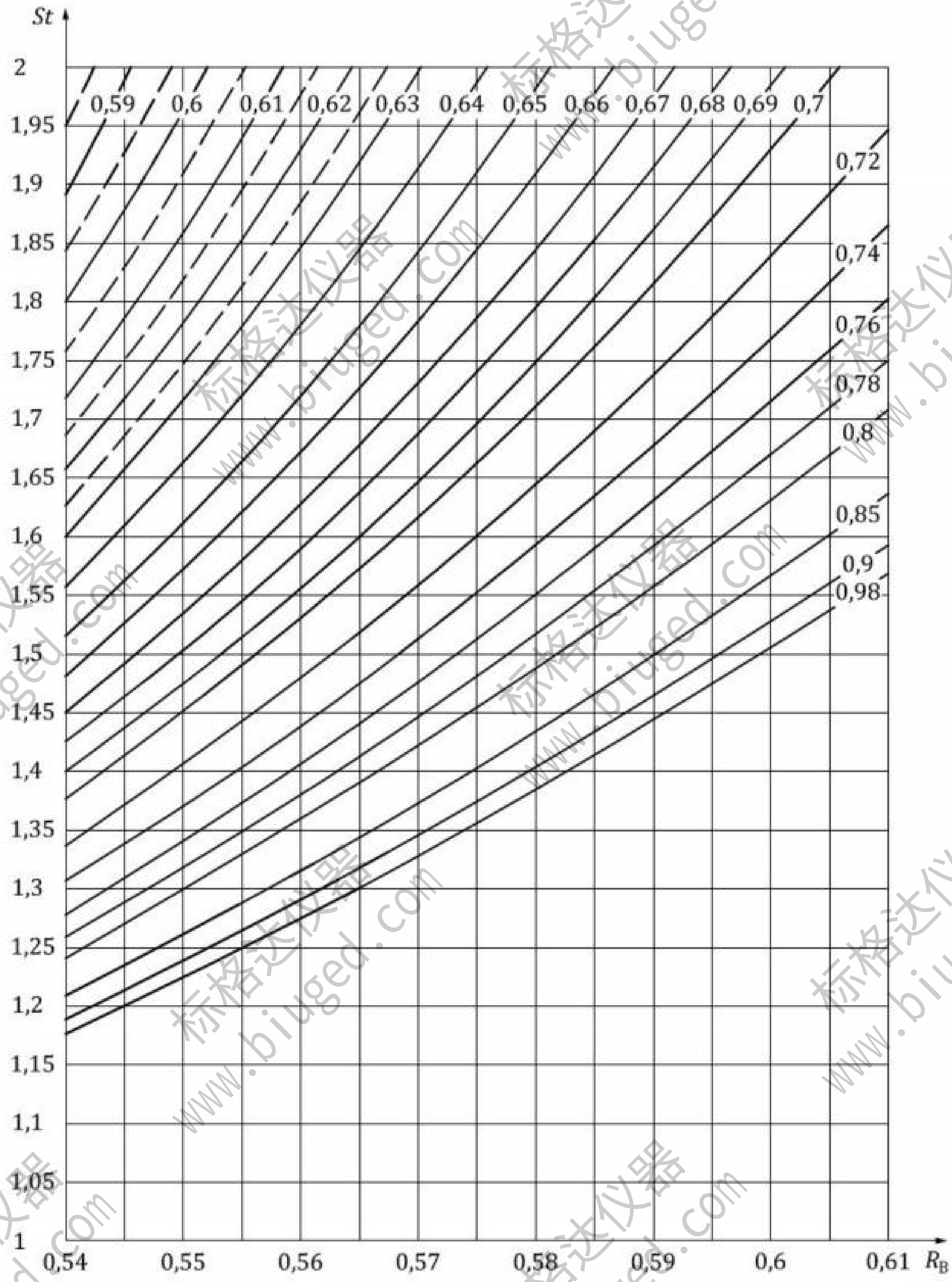


Figure A.19 — Values of *St* for the ranges
$0,54 \leq R_B \leq 0,61$
$0,59 \leq R_\infty \leq 0,98$

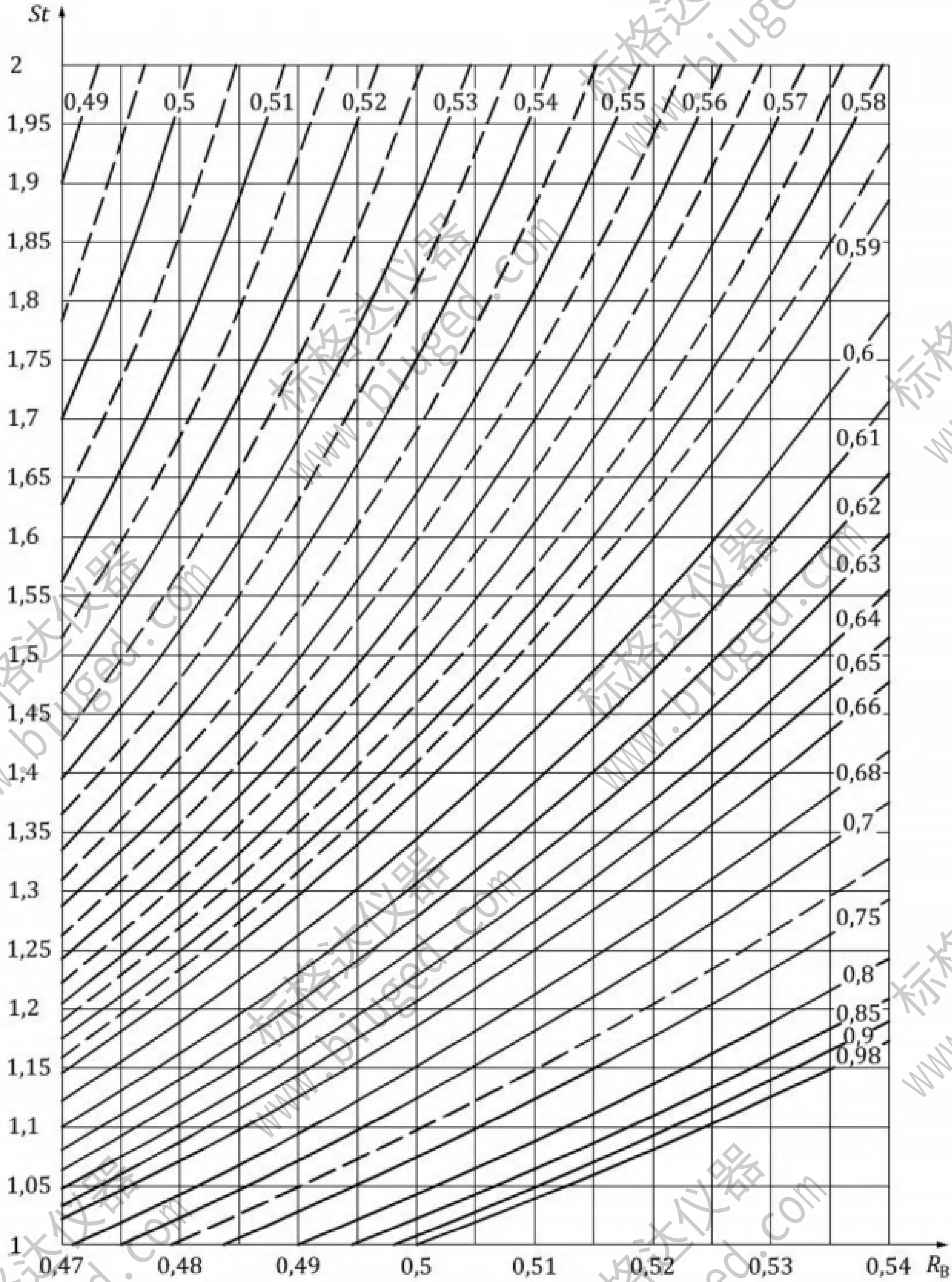


Figure A.20 — Values of *St* for the ranges
$0{,}47 \leq R_B \leq 0{,}54$
$0{,}49 \leq R_\infty \leq 0{,}98$

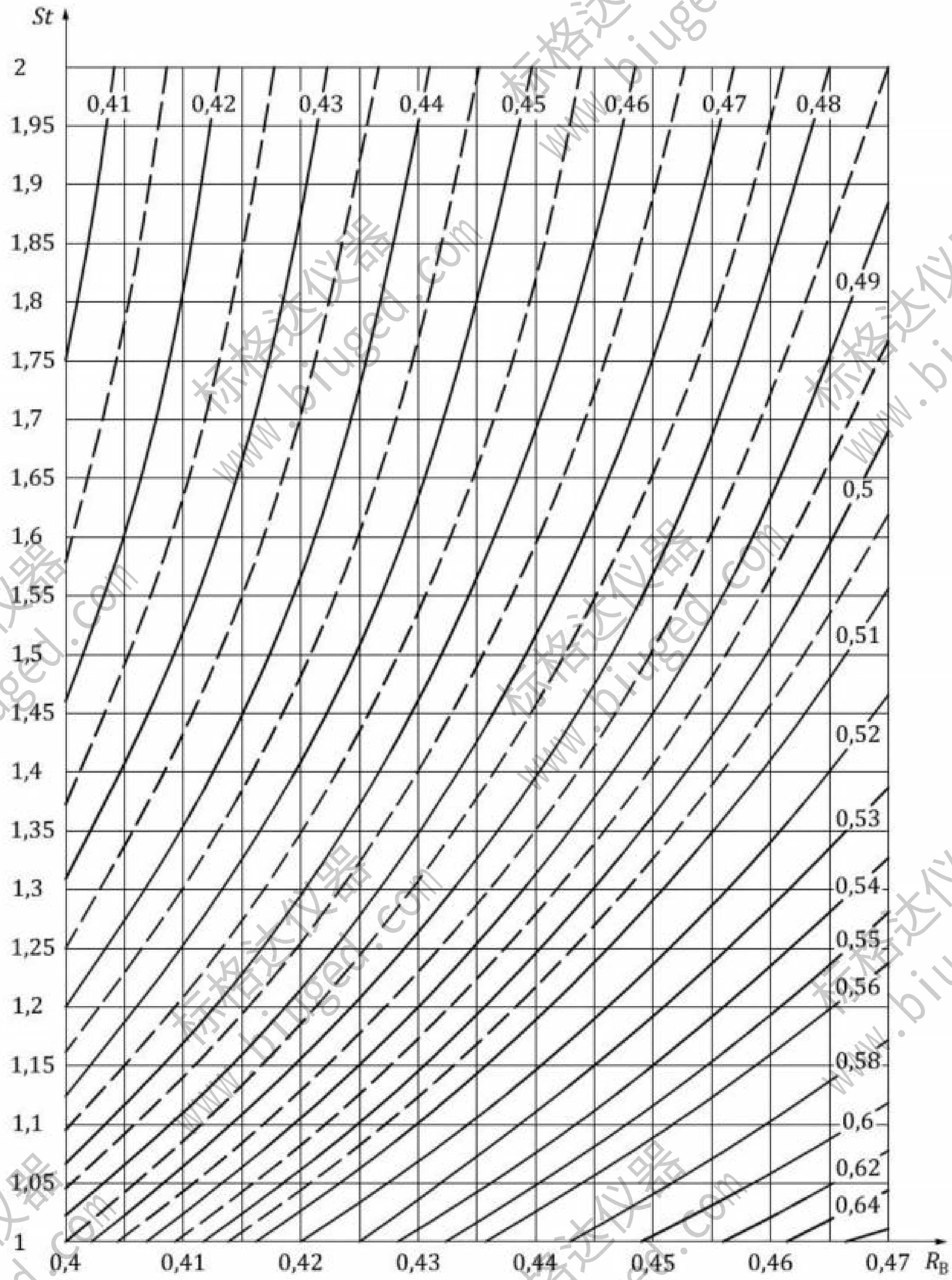


Figure A.21 — Values of St for the ranges
$0,40 \le R_B \le 0,47$
$0,41 \le R_\infty \le 0,64$

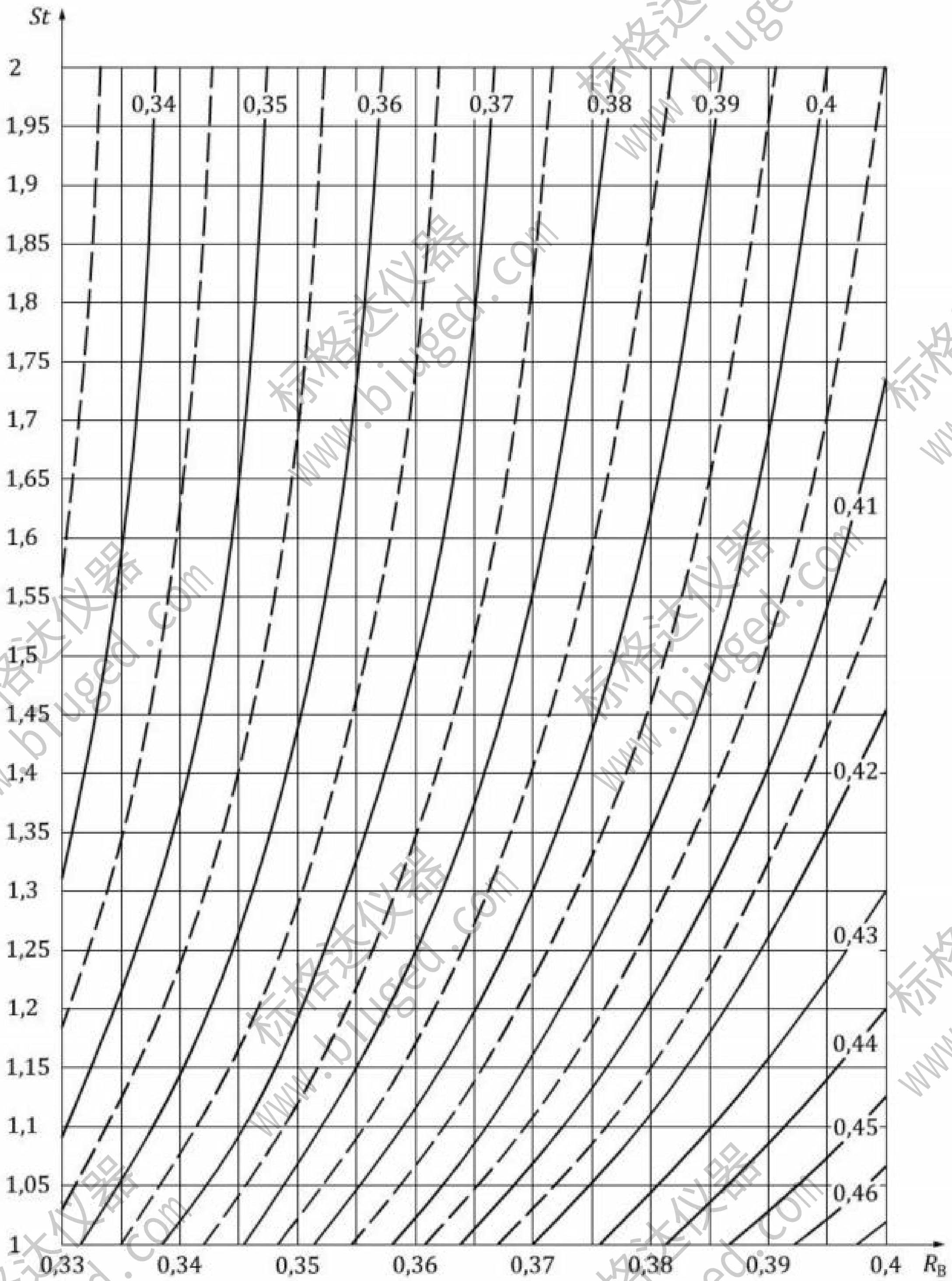


Figure A.22 — Values of *St* for the ranges
$0{,}33 \leq R_B \leq 0{,}40$
$0{,}34 \leq R_\infty \leq 0{,}46$

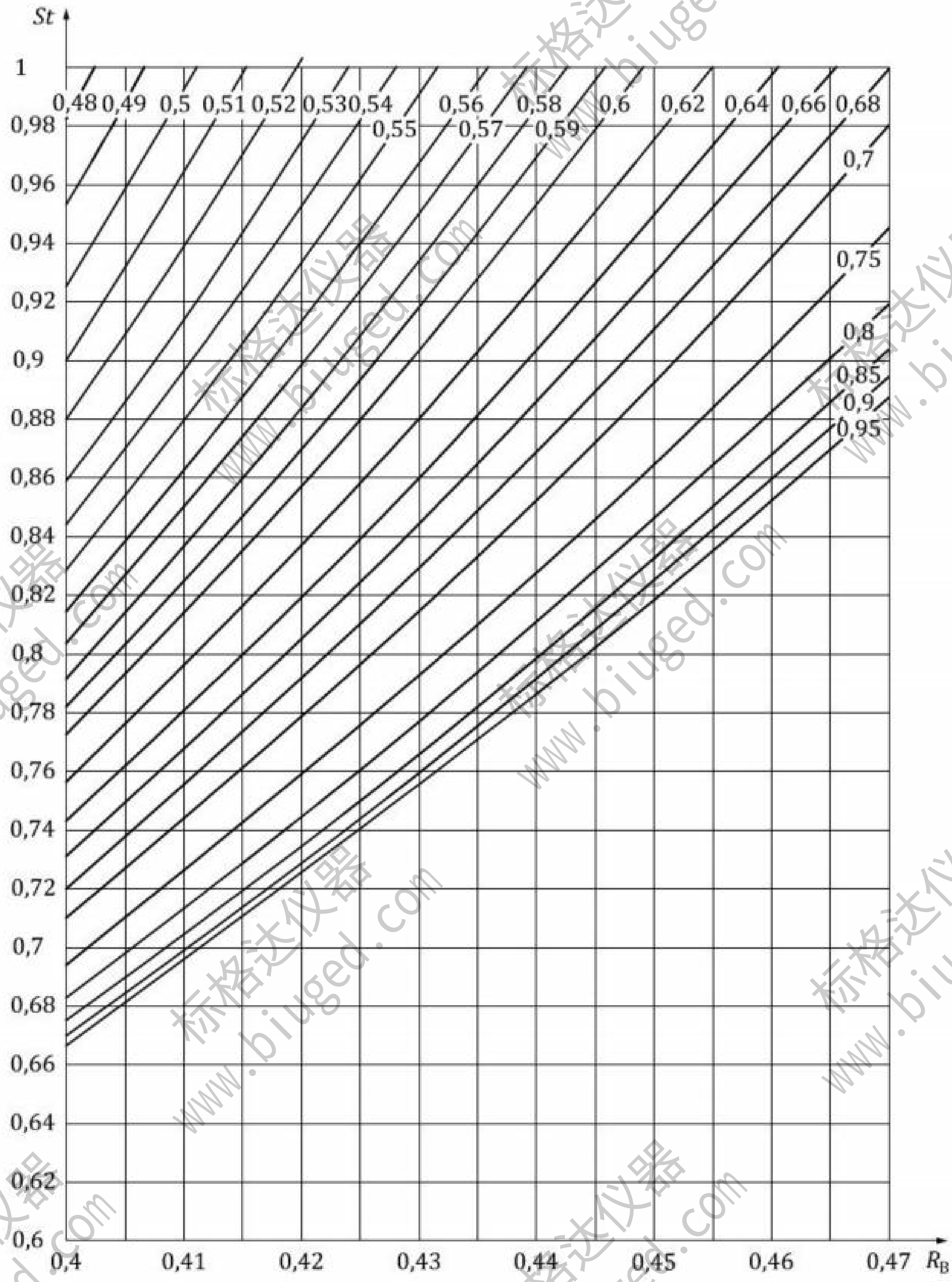


Figure A.23 — Values of *St* for the ranges
$0,40 \leq R_B \leq 0,47$
$0,48 \leq R_\infty \leq 0,98$

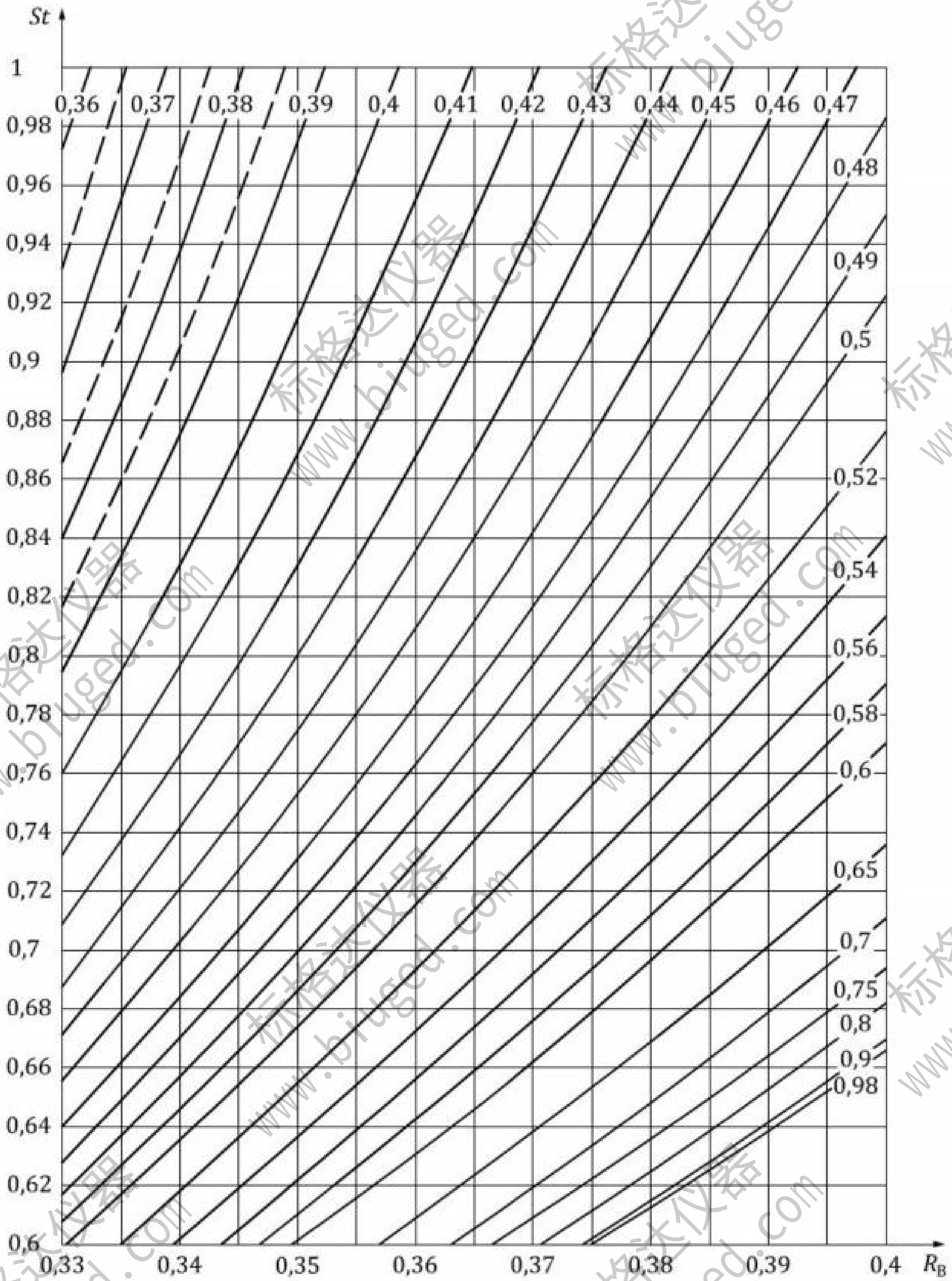


Figure A.24 — Values of *St* for the ranges
$0{,}33 \leq R_B \leq 0{,}40$
$0{,}36 \leq R_\infty \leq 0{,}98$

Annex B
(informative)

Table of values of reflectivity R_∞ and factor α for R_g = 0,80

Table B.1 — Values of reflectivity R_∞ and factor α for R_g = 0,80

R_∞	Factor α	R_∞	Factor α	R_∞	Factor α	R_∞	Factor α
0,125	1 352,1	0,450	391,3	0,630	249,4	0,805	151,4
0,150	1 153,1	0,460	386,3	0,635	246,2	0,810	149,0
0,175	1 006,5	0,465	381,2	0,640	243,0	0,815	146,6
0,200	893,1	0,470	376,3	0,645	239,8	0,820	144,1
0,225	802,3	0,475	371,4	0,650	236,6	0,825	141,9
0,250	727,6	0,480	366,7	0,655	233,5	0,830	139,5
0,275	664,8	0,485	361,9	0,660	230,5	0,835	137,2
0,300	611,0	0,490	357,3	0,665	227,4	0,840	135,0
0,310	591,6	0,495	352,7	0,670	224,3	0,845	132,7
0,320	573,2	0,500	348,3	0,675	221,3	0,850	130,4
0,330	555,2	0,505	343,8	0,680	218,4	0,855	128,2
0,335	546,8	0,510	339,4	0,685	215,4	0,860	126,0
0,340	538,8	0,515	335,1	0,690	212,5	0,865	123,8
0,345	530,9	0,520	330,8	0,695	209,6	0,870	121,7
0,350	523,2	0,525	326,7	0,700	206,7	0,875	119,6
0,355	515,5	0,530	322,5	0,705	203,8	0,880	117,4
0,360	508,0	0,535	318,4	0,710	201,0	0,885	115,4
0,365	500,7	0,540	314,4	0,715	198,2	0,890	113,3
0,370	493,5	0,545	310,5	0,720	195,3	0,895	111,3
0,375	486,6	0,550	306,5	0,725	192,6	0,900	109,4
0,380	479,7	0,555	302,6	0,730	189,9	0,905	107,5
0,385	473,0	0,560	298,9	0,735	187,2	0,910	105,5
0,390	466,4	0,565	295,0	0,740	184,6	0,915	103,7
0,395	459,9	0,570	291,2	0,745	181,8	0,920	101,9
0,400	453,6	0,575	287,5	0,750	179,2	0,925	100,2
0,405	447,4	0,580	283,8	0,755	176,6	0,930	98,5
0,410	441,4	0,585	280,3	0,760	174,0	0,935	96,9
0,415	435,4	0,590	276,7	0,765	171,4	0,940	95,4
0,420	429,5	0,595	273,2	0,770	168,8	0,945	93,9
0,425	423,4	0,600	296,6	0,775	166,3	0,950	92,5
0,430	418,0	0,605	266,2	0,780	163,8	0,955	91,3
0,435	412,6	0,610	262,8	0,785	161,2	0,960	90,0
0,440	407,1	0,615	295,4	0,790	158,7	0,965	88,9
0,445	401,8	0,620	256,0	0,795	156,3	0,970	88,0
0,450	369,5	0,625	252,7	0,800	153,9	0,975	87,2

Annex C
(informative)

Examples of the calculation of hiding power from measurements of R_B and R_∞

C.1 Determination of the scattering coefficient, S

C.1.1 Determine St from the appropriate graph relating R_B, R_∞, and St. For example, for a white paint with R_B = 0,78 and R_∞ = 0,92, reference to the graph in Figure A.1 indicates that the large scale graph required is that in Figure A.12. The intersection of the relevant lines gives St = 3,70.

C.1.2 Divide St by t (for example 18,7 µm; the scattering coefficient, S, is thus 0,198 µm^{-1}).

C.2 Determination of hiding power, V

C.2.1 Refer to Table B.1 to obtain the value of α for the determined value of R_∞. For R_∞ = 0,92, α = 101,9. Therefore,

$$V = \alpha S = 20{,}2\ \text{m}^2/\text{l}$$

C.2.2 If tables and graphs are not available, the calculations may be carried out as follows.

C.2.2.1 Determine a and b from R_∞, using Formulae (1) and (2), as follows:

$$a = \frac{1}{2}\left(R_\infty + \frac{1}{R_\infty}\right) = \frac{1}{2}(0{,}92 + 1{,}086\ 96) = 1{,}003\ 48$$

$$b = a - R_\infty = 1{,}003\ 48 - 0{,}92 = 0{,}083\ 48$$

C.2.2.2 Determine S from R_B and R_∞, using Formula (7), as follows

$$St = \frac{1}{b}\ \text{arcoth}\left(\frac{1 - aR_B}{bR_B}\right)$$

$$= \frac{1}{0{,}083\ 48}\ \text{arcoth}\left[\frac{1-(1{,}003\ 48 \times 0{,}78)}{0{,}083\ 48 \times 0{,}78}\right]$$

$$= \frac{1}{0{,}083\ 48}\ \text{arcoth}\left(\frac{0{,}217\ 29}{0{,}056\ 11}\right)$$

$$= \frac{1}{0{,}083\ 48}\ \text{arcoth}\ 3{,}337\ 2$$

$$=\frac{0{,}309\ 1}{0{,}083\ 48}=3{,}703$$

Using the value of t taken for the example in C.1.2, i.e. 18,7 µm,

$$S=\frac{3{,}703}{18{,}7}=0{,}198\ \mu\text{m}^{-1}$$

as in C.1.2.

C.2.2.3 Determine $t_{0,98}$ using Formula (5), as follows

$$t_{0,98}=\frac{1}{0{,}083\ 48\times 0{,}198}\text{arcoth}\left(\frac{0{,}02+\sqrt{D}}{1{,}568\times 0{,}083\ 48}\right)$$

Calculate D as follows

$$D=3{,}136\times 1{,}003\ 48\times\left\{1-0{,}98\left[1-(0{,}8\times 1{,}003\ 48)\right]\right\}-2{,}508\ 4$$

$$=0{,}030\ 3$$

Therefore

$$\sqrt{D}=0{,}174\ 1$$

and

$$t_{0,98}=\frac{1}{0{,}016\ 53}\text{arcoth}\left(\frac{0{,}02+0{,}174\ 1}{1{,}568\times 0{,}038\ 348}\right)=\frac{\text{arcoth}\ 1{,}483}{0{,}016\ 53}$$

$$=\frac{0{,}818}{0{,}016\ 53}=49{,}48\ \mu\text{m}$$

C.2.2.4 Determine V using Formula (6), as follows

$$V=\frac{1\ 000}{49{,}48}=20{,}2\ \text{m}^2/\text{l}$$

Bibliography

[1] ISO 6504-3, *Paints and varnishes — Determination of hiding power — Part 3: Determination of hiding power of paints for masonry, concrete and interior use*

[2] ASTM D2805–80, *Test Method for Hiding Power of Paints by Reflectometry*[1)]

[3] Official Digest **35**, 464, p. 1871 (1963)

1) Withdrawn. Replaced by ASTM D2805–11, *Standard Test Method for Hiding Power of Paints by Reflectometry*.