

## Operating manual Analogue refractometer

KERN ORA 1 SA Seawater salinity  
ORA 3 SA NaCl% Brix%

KERN & Sohn GmbH



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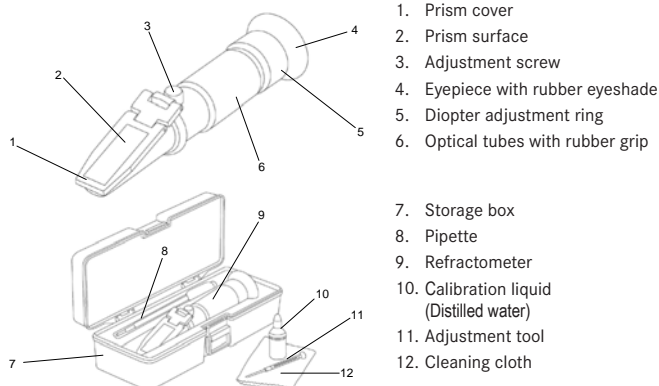
## 1. Technical data

Modell KERN	Measuring range and Scales	Scale graduations Accuracy	Dimensions Product	Net weight
ORA 1SA	0-100‰ salinity 1,000-1,070 sg	1‰ salinity 0,001 sg	198x40x40mm	0,155kg
ORA 3SA	0-28% Salz (NaCl) 0-32% Brix	0,2% (NaCl) 0,2% Brix	178x40x40mm	0,145kg

Example scale on  
ORA 2 SA



## 2. Description



1. Prism cover
2. Prism surface
3. Adjustment screw
4. Eyepiece with rubber eyeshade
5. Diopter adjustment ring
6. Optical tubes with rubber grip
7. Storage box
8. Pipette
9. Refractometer
10. Calibration liquid (Distilled water)
11. Adjustment tool
12. Cleaning cloth

## 3. General information

### 3.1 Intended use

The refractometer is a measuring instrument for determining the refractive index of transparent substances in the liquid or the solid state. It is used to observe the behaviour of light as it passes from a prism with known properties to the substance being tested.

Use of the refractometer for other purposes is contrary to its intended use and may be hazardous. The manufacturer shall not be liable for any damages caused by improper use.

### 3.2 Warranty

The warranty shall be void in the event of:

- Failure to observe the instructions in the operating manual
- Use for purposes other than those described
- Modifications or opening the device housing
- Mechanical damage and/or damage resulting from media, liquids, natural wear and tear

## 4. Basic safety information

### 4.1 Follow the instructions in the operating manual



- Carefully read through the operating manual even if you have prior experience with KERN refractometers.
- Every language version includes a non-authoritative translation. The original German document is the definitive version.

### 4.2 Warning

- Do not let acids come into contact with skin or eyes. If acid comes into contact with skin, flush with copious amounts of water. Shower if larger areas of skin are affected.
- If acid comes into contact with eyes, keep the eyelid open and flush the eye with running lukewarm water from the outer corner to the inner corner. Flush eyes for at least 15 minutes. Then consult a doctor or ophthalmologist immediately.
- Thoroughly clean the refractometer after each use.
- The refractometer must not be exposed to extreme temperatures, high mechanical stresses, strong direct sunlight or high humidity.
- This refractometer is not a toy. Keep out of reach of children.
- Make sure that you will not be hit by anything else while you are using the refractometer, as this could cause serious eye injuries
- The rubber eyeshade may cause irritation when in prolonged contact with the skin. If this happens, consult your doctor.
- Do not touch the lenses with your fingers.

## 5. Supplied items

After unpacking and before using the device for the first time, check that all listed parts have been supplied. Replace damaged or faulty parts immediately and do not put them into operation.

- Refractometer
- Storage box
- Pipette
- Adjustment tool
- Cleaning cloth
- Calibration liquid (Distilled water)

## 6. Before the first use

Remove the protective film (if present) from the prism surface [2] and check that the rubber eye-cup [4] is fitted correctly.

## 7. Use/measurement

The refractometer can be used to quickly and accurately determine the refractive index of transparent substances, liquid or solid ones. To ensure correct measurement, the measuring device should be adjusted before measurements are carried out. Please make sure your hands are dry before handling the measuring device.

7.1 Zero point calibration

- ▶ Hold up the refractometer against a sufficiently bright light source and look through the eyepiece [5], holding the rubber eyeshade [4] closely against your eye/glasses.
- ▶ Rotate the eyepiece [5] to adjust it for your eyesight, until you can see the scale sharply.
- ▶ Open the prism cover [1].
- ▶ Thoroughly clean the prism [2] and the underside of the prism cover [1] using a soft cloth or soft paper (with alcohol if necessary) and wipe dry.
- ▶ Now apply a few drops of the calibration liquid [10] onto the prism surface [2].
- ▶ Close the prism cover [1]. The amount of fluid should be sufficient to moisten most of the prism surface. There should not be any air bubbles between the measuring prism [2] and prism cover [1].
- ▶ Wait about 30 seconds to allow the temperatures of the fluid and prism to equalise.
- ▶ Look through the eyepiece [4] while pointing the refractometer's prism surface [2] at a bright light source.
- ▶ Through the eyepiece [4], you will see a bright and a blue field. The boundary line between them shows the measured value on the scale which is also visible through the eyepiece [4].

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- ▶ Use the supplied adjustment tool [11] to turn the adjustment screw [3] behind the prism surface [2] (under the rubber cap), and adjust the scale so that the measuring device is optimally set up by moving the boundary line upwards or downwards. Calibration value ORA 1SA: 0 ‰ (salinity) / 1,000 (sg)  
Calibration value ORA 3SA: 0 ‰ (NaCl) / 0 ‰ (Brix)
- ▶ Repeat step 4 (cleaning).

Important!

The ambient/room temperature and the sample temperature influence the refractometer measuring result. The scales of the refractometer models, which have "SB" in its name, are designed for an ambient temperature of +20 °C! If the measurements are carried out at a temperature other than +20 °C, the results must be correspondingly corrected. A correction table can be found in the annex, Point 14. Refractometer models, which have "SA" in its name, are equipped with an automatic temperature compensation (ATC). Between +10°C and +30°C measurement differences due to temperature changes are automatically compensated.



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7.2 Additional advice

It is important that the samples being measured are representative samples. For samples that evaporate easily, measurements should be carried out quickly. The samples should be at the same temperature as the measuring instrument in order to achieve an accurate result.

7.3 Measuring procedure

- ▶ Make sure your hands are dry before handling the refractometer.
- ▶ Open the prism cover [1] and use the supplied pipette [8] to apply a few drops of the sample liquid [8] onto the prism surface [2]. Close the prism cover [1]. Spread the liquid evenly by pressing down on the prism cover [1] and eliminate any air bubbles present.
- ▶ Hold the device horizontally and wait about 30 seconds (for optimal temperature equalisation between the sample and device).
- ▶ View the measurement scale through the eyepiece [4]. Point the prism surface [2] of the refractometer at a bright light source while doing this.
- ▶ Rotate the adjustment ring [5] on the eyepiece [4] to adjust the focus.
- ▶ The boundary line will move on the measurement scale depending on the concentration. This bright/dark boundary line shows the result on the scale.
- ▶ The ORA 2SA and ORA 3SA instruments have a marking on the scale for the liquid saturation point.
- ▶ If the temperature deviates from +20 °C and a refractometer without ATC is used, correct the measured result using the corresponding value from the temperature correction table [13].
- ▶ Carefully clean the supplied pipette [8] and the refractometer after carrying out the measurement.

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Important!

After every measurement, use a lint-free, absorbent cloth to remove the fluids from the prism surface [2] and prism cover [1]. Then carefully clean the prism and prism cover using a cloth moistened with water or if necessary alcohol, and dry both parts using a soft, dry and lint-free cloth. Avoid rubbing the prism [2].



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8. Cleaning and maintenance

Clean the refractometer using a soft, lint-free cloth moistened with either water or, if necessary, alcohol. Do not use any aggressive or abrasive cleaning agents. Never immerse the device in water or hold it under running water. Never handle the device with wet or damp hands.

Never touch the measuring prism [2] with hard tools made from plastic, wood, rubber, metal, glass etc. Hard objects can quickly damage the relatively soft prism glass, resulting in measurement errors.

The refractometer is maintenance-free.

Cleaning should be carried out immediately before and after each use of the refractometer to maximise its life and optimise measurement results.

9. Storage

Store the refractometer in a dry, non-corrosive environment, preferably between 10 °C and 30 °C.

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10. Service

After reading this operating manual, if you have any questions about setting up or using the refractometer, or if any unexpected problem occurs, please contact your dealer. The device housing may only be opened by trained service technicians authorised by KERN.

11. Disposal

The packaging consists of environmentally friendly materials which can be disposed of via local recycling facilities. The device and storage box should be disposed of by the operator in accordance with applicable national or regional regulations at the place of use.

12. Additional information

The product may differ slightly from the illustrations. Avoid exposing the refractometer to direct sunlight. Never bring the refractometer into contact with solvents.

13. Brix to refractive index (nD) conversion table

Data from „ICUMSA“ International Commission for Uniform Methods of Sugar Analysis, at 20 °C and 589 nm wavelength.

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Refractive index nD	Brix %		Refractive index nD	Brix %		Refractive index nD	Brix %	
	Brix %	nD		Brix %	nD		Brix %	nD
1.41493	60	1.41493	1.38115	30	1.38115	1.33299	0	1.33299
1.44420	61	1.44420	1.38296	31	1.38296	1.33442	1	1.33442
1.44450	62	1.44450	1.38478	32	1.38478	1.33586	2	1.33586
1.44881	63	1.44881	1.38661	33	1.38661	1.33732	3	1.33732
1.45113	64	1.45113	1.38846	34	1.38846	1.33879	4	1.33879
			1.39032	35	1.39032	1.34026	5	1.34026
1.45584	65	1.45584	1.39220	36	1.39220	1.34175	6	1.34175
1.45822	66	1.45822	1.39409	37	1.39409	1.34325	7	1.34325
1.46061	67	1.46061	1.39600	38	1.39600	1.34476	8	1.34476
1.46303	68	1.46303	1.39792	39	1.39792	1.34629	9	1.34629
1.46546	69	1.46546	1.39986	40	1.39986	1.34782	10	1.34782
1.46787	70	1.46787	1.40181	41	1.40181	1.34937	11	1.34937
			1.40378	42	1.40378	1.35093	12	1.35093
1.47037	72	1.47037	1.40576	43	1.40576	1.35250	13	1.35250
1.47285	73	1.47285	1.40776	44	1.40776	1.35408	14	1.35408
1.47435	74	1.47435	1.40978	45	1.40978	1.35568	15	1.35568
			1.41181	46	1.41181	1.35729	16	1.35729
1.48040	76	1.48040	1.41385	47	1.41385	1.35891	17	1.35891
1.48295	77	1.48295	1.41592	48	1.41592	1.36054	18	1.36054
1.48552	78	1.48552	1.41799	49	1.41799	1.36218	19	1.36218
1.48811	79	1.48811	1.42009	50	1.42009	1.36384	20	1.36384
1.49071	80	1.49071	1.42220	51	1.42220	1.36551	21	1.36551
1.49333	81	1.49333	1.42432	52	1.42432	1.36720	22	1.36720
1.49597	82	1.49597	1.42647	53	1.42647	1.36889	23	1.36889
1.49862	83	1.49862	1.42862	54	1.42862	1.37060	24	1.37060
1.50129	84	1.50129	1.43080	55	1.43080	1.37233	25	1.37233
1.50398	85	1.50398	1.43299	56	1.43299	1.37406	26	1.37406
			1.43520	57	1.43520	1.37582	27	1.37582
			1.43743	58	1.43743	1.37758	28	1.37758
			1.43967	59	1.43967	1.37936	29	1.37936

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14. Annex

Table 1: International Temperature Correction Table for °Brix (% sugar gradient)  
Correct the result by the following values (refractometer must be correctly adjusted at 20 °C).

Temperature °C	°F	% Brix reading																															
		10.0		15.0		20.0		25.0		30.0		35.0		40.0		45.0		50.0		55.0		60.0		65.0		70.0		75.0		80.0		85.0	
		0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	
10.0	50	-0.53	-0.56	-0.59	-0.62	-0.65	-0.67	-0.69	-0.71	-0.72	-0.73	-0.74	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	
11.0	49	-0.49	-0.52	-0.54	-0.57	-0.59	-0.61	-0.63	-0.64	-0.65	-0.66	-0.67	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	
12.0	48	-0.44	-0.47	-0.49	-0.51	-0.53	-0.55	-0.56	-0.57	-0.58	-0.59	-0.60	-0.60	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	
13.0	46	-0.40	-0.41	-0.43	-0.45	-0.47	-0.48	-0.50	-0.51	-0.52	-0.52	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	
14.0	45	-0.36	-0.38	-0.39	-0.40	-0.42	-0.43	-0.44	-0.44	-0.45	-0.45	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	
15.0	43	-0.29	-0.31	-0.32	-0.33	-0.34	-0.35	-0.36	-0.37	-0.37	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	
16.0	42	-0.24	-0.25	-0.26	-0.27	-0.28	-0.28	-0.29	-0.30	-0.30	-0.30	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	
17.0	41	-0.18	-0.19	-0.20	-0.20	-0.21	-0.21	-0.22	-0.22	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	
18.0	40	-0.12	-0.13	-0.13	-0.14	-0.14	-0.14	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	
19.0	39	-0.06	-0.06	-0.07	-0.07	-0.07	-0.07	-0.07	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	
20.0	38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
21.0	37	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	
22.0	36	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	
23.0	35	0.20	0.21	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
24.0	34	0.27	0.28	0.29	0.29	0.30	0.30	0.31	0.31	0.31	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	
25.0	33	0.34	0.35	0.36	0.37	0.38	0.38	0.39	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
26.0	32	0.42	0.43	0.44	0.45	0.46	0.46	0.47	0.47	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	
27.0	31	0.50	0.51	0.52	0.53	0.54	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	
28.0	30	0.58	0.59	0.60	0.61	0.62	0.63	0.64	0.64	0.64	0.65	0.65	0.64	0.64	0.65	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	
29.0	29	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.72	0.72	0.72	0.72	0.71	0.70	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	
30.0	28	0.74	0.75	0.77	0.78	0.79	0.80	0.81	0.81	0.81	0.82	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	