## *Determining Time with the SALAH Sundial*

Using the diagrams, you can determine solar time by measuring the length and direction of the shadow.

Solar time, officially known as Local Apparent Time (LAT), is determined directly by the movement of the sun at your location. After rising in the morning, the sun steadily climbs until it reaches its highest point in the south. This is solar noon, and a sundial then shows 12:00 solar time. Solar noon actually divides the daylight period into two equal halves: from sunrise to solar noon and from solar noon to sunset take the same amount of time.

The diagrams on page 9 (summer/autumn) and page 10 (winter/spring) show the annual variation in the sun's altitude and direction (solar azimuth).

The sun's altitude directly determines the length of the shadow cast by the vertical gnomon onto the measuring scale of the SALAH Sundial. Conversely, the shadow length can therefore be used to determine solar time. In all diagrams, the hour lines are shown in red.

The procedure for determining the time is explained below:

### *1. Setting up the SALAH Sundial*

Follow the step-by-step instructions in the manual starting on page 8. The following steps also refer to information provided in the manual.

### *2. Measuring the shadow length*

The concentric scale is suitable for measuring the shadow length in any direction. It is best to read the shadow length when the shadow reaches one of the circles on the scale.

### *3. Using the diagram*

The eight shadow length–shadow direction diagrams on pages 1 to 8 are provided for the four gnomon heights (5, 10, 20 and 30 mm), with separate diagrams for summer/autumn and winter/spring. First, select the diagram corresponding to the chosen gnomon height and the season.

Since the shadow reaches the same length twice a day, you must now determine on which side of the curves you need to read the time. In the morning, the shadow is to the left (west) of the noon line and its length decreases. In the afternoon, the shadow moves to the right (east) of the noon line and its length increases.

Select the date line corresponding to the current date or the date closest to it. Follow the date line on the appropriate side until it reaches the measured shadow length on the ordinate (Y-axis). At this intersection, you can determine the solar time using the hour lines shown in red.

The diagram also allows you to read the shadow direction on the abscissa (X-axis). If this value does not yet correspond to the shadow direction indicated on the sundial, the sundial is not yet precisely aligned with north and can now be adjusted accordingly. An even more accurate method of alignment is described in the SALAH manual starting on page 10, in the section "Accurate Determination of the Noon Line".

When the sundial is precisely aligned with north, you always have the option of determining the time either from the shadow length or from the shadow direction. Around solar noon, determining the time from the shadow direction is more accurate because the shadow length changes very little.

### *4. Determining Central European Time*

The time difference table can be calculated for any zone time. Here, we use Central European Time (CET) as an example.

The time difference table is used to determine Central European Time (CET/CEST) from solar time. Add the daily value from the table to the solar time you have determined. This gives you Central European Time (CET), Central European Summer Time (CEST).

### *5. Determining Islamic Prayer Times*

The diagrams can be used to determine both the shadow length at solar noon and the shadow length at the beginning of the afternoon prayer, as well as the corresponding times.

### *Example of determining the time using the diagrams*

As an example, we have chosen a shadow measurement taken on March 20 in the morning, using the 10 mm high gnomon. Select the shadow length–shadow direction diagram for the 10 mm gnomon for winter and spring (December 21–June 21) on page 6 (Figure 3).

Now set up your SALAH Sundial as described in the manual and begin the measurement.

For example, you read a shadow length of 21 mm (Figure 1). Follow the horizontal line at 21 mm to the right until it intersects the date line for March 20. At the red line that also passes through this intersection, you can now read the solar time. In this example, it is 9:00 solar time in Berlin.

If you follow the line downward from the intersection, you can read the shadow direction. In this example, it is 308.5° from north. You can check this value using the pointer placed on the gnomon (Figure 2). If the value does not match, the sundial is not yet correctly aligned. You can correct this by rotating the sundial.

You can now use the time difference table to determine CET from solar time. In March, daylight saving time begins on the last Sunday of the month. Therefore, the March section of the table contains a column for CET and a column for CEST. On March 20, the first column (CET) shows a time difference of 14 minutes. Thus, when it is 9:00 solar time, it is already 9:14 CET.

The shadow lengths used to determine the prayer times (circled in blue) are 13 mm at solar noon and 23 mm (=13 mm+10 mm) at the beginning of the afternoon prayer. The beginning of the noon prayer (Dhuhr) is shortly after 12:00 solar time (12:14 CET), when the shadow has started to increase in length again. The afternoon prayer ('Asr) begins at 15:17 solar time (15:31 CET).

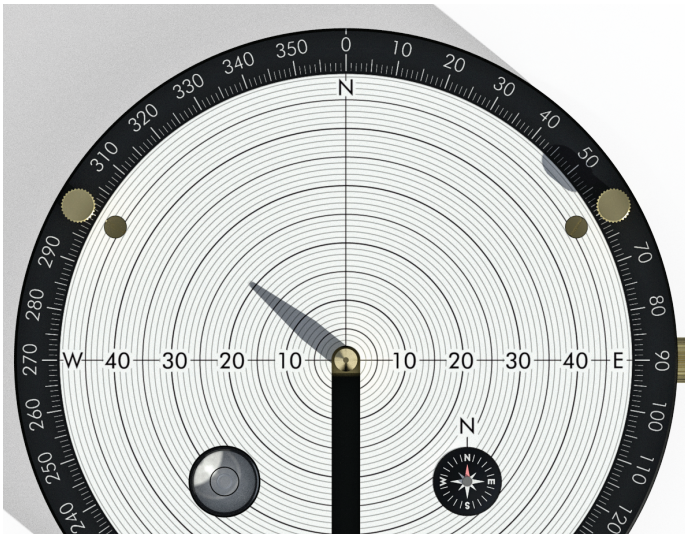


Figure 1: On March 20 in Berlin, the measured shadow length is 21 mm. The diagram can now be used to determine the solar time.

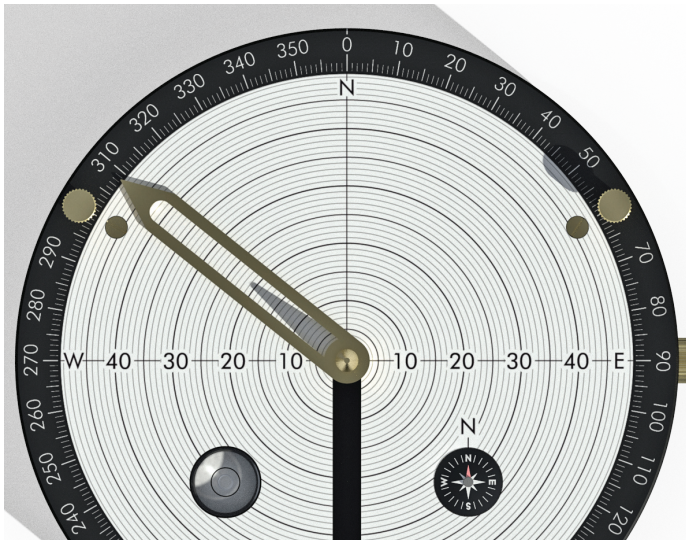


Figure 2: The direction of the shadow can be determined using the pointer placed on the gnomon. Here, it is 308.5° from north.

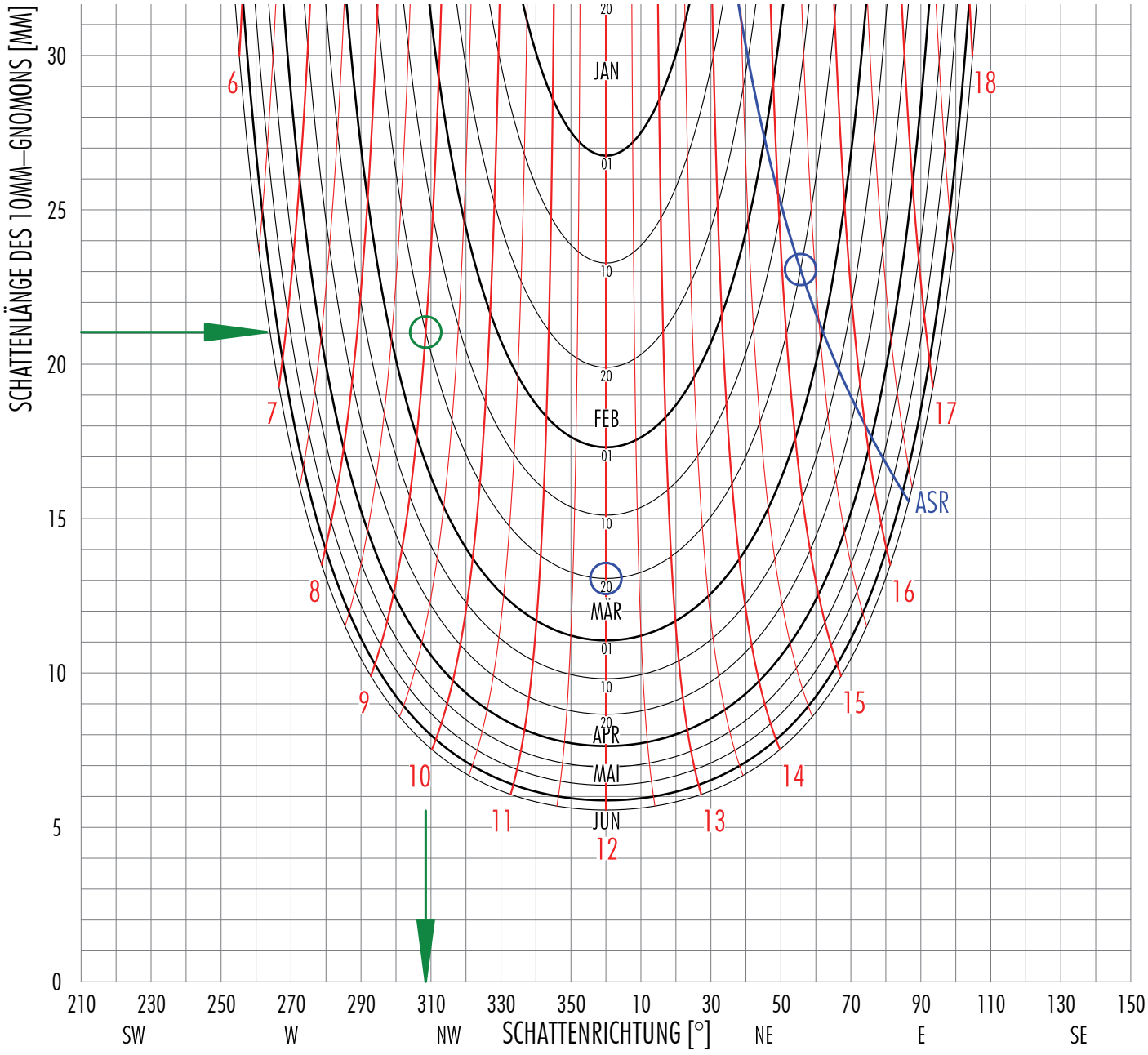




Figure 3: Diagram for determining the time using the 10 mm gnomon in winter and spring. Example for March 20: When the shadow length is 21 mm, it is 9:00 solar time. The shadow's direction is 308.5° from north. The shadow length at noon is 13 mm, and the shadow length at the start of the afternoon prayer time ('Asr) is 23 mm.