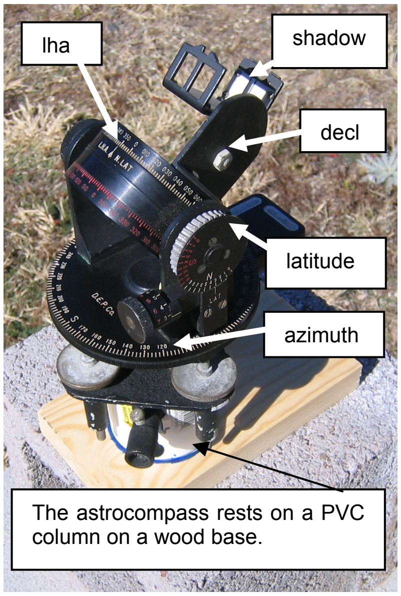
TRUE NORTH – THE ASTRO COMPASS WAY – method one – all done with time

The astro-compass can be used as an accurate solar compass. It fits into a base, not supplied, which can be made from a 2.25 inch long PVC sprinkler pipe couplings whose inner diameter is 1.9 inches, and whose outer diameter is 2.25 inches. Two slits will need to be cut into it. For accurate time measurement, a clock showing hours, minutes, and seconds updated by an atomic clock such as the one in Colorado is needed. However, understand its use of summer time and that such clocks may drift substantially if the update fails. In this case we switch formula elements around, we need the L.A.T. (local apparent time) to calculate the sun's hour angle:



The astrocompass rests on a PVC column on a wood base.

L.A.T. = standard time – [corrections] = L.A.T.

The astro compass is placed on a surface and leveled with the leveling knobs. Leveling only works when the compass is in its base. Then set the lowest adjustment (azimuth) so the lubber line marker is on N for north or S for south. Set the second adjustment up to your latitude. Set the third adjustment up (hour angle) until the sight is pointing roughly at the sun. Set the top adjustment (declination) to the sun's declination to enhance the shadow. Then calculate the corrections valid for the day. **HINT:** Don't use summer time.

	EXAMPLE	ACTUAL
LONGITUDE CORRECTION:		
your location:	108.2	
reference location:	105.0	
difference:	3.2	
times 4°	+ 12m 48s	
EOT CORRECTION:	Sept 26	
chart A2.1	– 8m 41s	
NET CORRECTION	+ 4m 7s	
NOTE: we will reverse the sign when we apply this to clock time	- 4m 7s	

Next: select a time about 5 minutes hence and calculate the L.A.T. for that clock time: For September 26, longitude 108.2, the net correction is + 4 minutes, 7 seconds which is subtracted from the clock indicated time because we desire L.A.T. Simplify work by using standard time.

Then: calculate the hour angle from noon for the L.A.T., this is 15° per hour, and 1° for four minutes (table A2.3).

Standard clock (not summer) for reading:	9:30	
clock to L.A.T. correction:	- 4m 7s	
L.A.T. (clock – correction):	9:26	
L.A.T. from noon 12:00	2h 34m	
Degrees from noon:	38.5°	

Set the astrocompass hour angle dial, third adjustment up, in this example to 38.5 degrees from noon, or 321.5 which is 360-38.5.

Last: derive true north: At exactly the selected clock time, 10:30 in this example, slowly rotate the entire device until the sun's shadow is indicated in the declination adjustment's shadow box. The device is set, and the bottom or azimuth ring indicates true north or south. Appendix 2 has the above boxed work areas replicated several times as an easy to use work sheet.

HINT: simplify your life and use standard time even in the summer, it saves confusion.

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ASTRO COMPASS TRUE NORTH DETERMINATION – method two – done with degrees

This uses the same theory as backing off or advancing the clock time for a sighting, but instead of adjusting the time of the sighting, the hour angle is adjusted by advancing it or retarding it based on a degree equivalent (as opposed to a time equivalent) of the sum of the longitude and equation of time (EOT) corrections. Also, standard time is used, rather than considering daylight saving time in mid-calculation.

EOT from table A2.1 mm.ss

	Mar	Apr	May
1	12.31	4.06	-2.48
2	12.19	3.49	-2.56
3	12.07	3.31	-3.02
25	6.13	-1.54	-3.10
26	5.55	-2.04	-3.04
27	5.37	-2.14	-2.57
28	5.19	-2.23	-2.50
29	5.00	-2.32	-2.43
30	4.42	-2.40	-2.35
31	4.24		-2.27

First, get the equation of time for the day, the EOT is in table A2.1 in the appendices. For March 27, this is +5.37 (mm.ss), meaning that this is added to a sundial reading. Convert this to degrees, using 4 minutes per degree. This is 5m 37s, or 5.6 minutes and that becomes 1.4 degrees, positive when divided by four.

Next, derive the longitude correction for the dial's location, which is the location's longitude minus the legal time zone's meridian longitude. For a dial at location W108.2 and a legal time zone meridian of W105, the number is 3.2 degrees. A positive number.

Next, add the EOT in degrees and longitude correction in degrees giving 3.2 plus 1.4, in other words 4.6 degrees positive.

Next, look at your accurate watch and pick the nearest time whose minutes is a multiple of 4. In this case it was 12:43 daylight savings, thus this is 11:43 standard time. The 11:48 daylight saving time simplifies calculations.

This was 12 minutes before noon, or at 4 minutes per degree, this was 357° (3° before noon).

Finally, the sun's hour angle (in this case 357° or 3° before noon) is adjusted by the total EOT and longitude correction. Since the time was before noon, the 3 degrees is backed off by (has subtracted from it) the 4.6 degrees. This results in 7. 6 degrees as the correct solar hour angle for 12:48. **Note**: 7.6° is less than 3° when you consider them to be 352.4° and 357° respectively. The astro compass having been set, it is used as described on the previous page.

DATE:	Mar 27	good for the day	
Longitude	– Legal Meridian	= Location correction	
108.2 w	– 105 w	= + 3.2°	
EOT for the day mm.ss	EOT for the day mm.mm	EOT/4	Total correction
+ 5m 37s	+ 5.6	= + 1.4°	+ 4.6°

1 Calculate the correction in degrees
2. Pick a time whose minutes are a multiple of 4
3. Calculate the hour angle from noon
3. Set the astro compass to the hour angle from noon in step 3, but subtract the correction from step 1

Time of day	astro compass final hour angle
1248 summer, 1148 mst	352.4° (or 7.6 from noon on morning side)
do several times	

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This table allows for a very quick conversion from legal standard time (not summer time) to an hour angle, and these are the same hour angles marked on the astro-compass.

	6	7	8	9	10	11	12	13	14	15	16	17
0	270	285	300	315	330	345	0	15	30	45	60	75
4	271	286	301	316	331	346	1	16	31	46	61	76
8	272	287	302	317	332	347	2	17	32	47	62	77
12	273	288	303	318	333	348	3	18	33	48	63	78
16	274	289	304	319	334	349	4	19	34	49	64	79
20	275	290	305	320	335	350	5	20	35	50	65	80
24	276	291	306	321	336	351	6	21	36	51	66	81
28	277	292	307	322	337	352	7	22	37	52	67	82
32	278	293	308	323	338	353	8	23	38	53	68	83
36	279	294	309	324	339	354	9	24	39	54	69	84
40	280	295	310	325	340	355	10	25	40	55	70	85
44	281	296	311	326	341	356	11	26	41	56	71	86
48	282	297	312	327	342	357	12	27	42	57	72	87
52	283	298	313	328	343	358	13	28	43	58	73	88
56	284	299	314	329	344	359	14	29	44	59	74	89
60	285	300	315	330	345	360	15	30	45	60	75	90

The spreadsheet: illustrating-shadows.xls has this as a work sheet and even takes the days correction for the EOT as well as the longitude correction and provides the above table for that day.

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