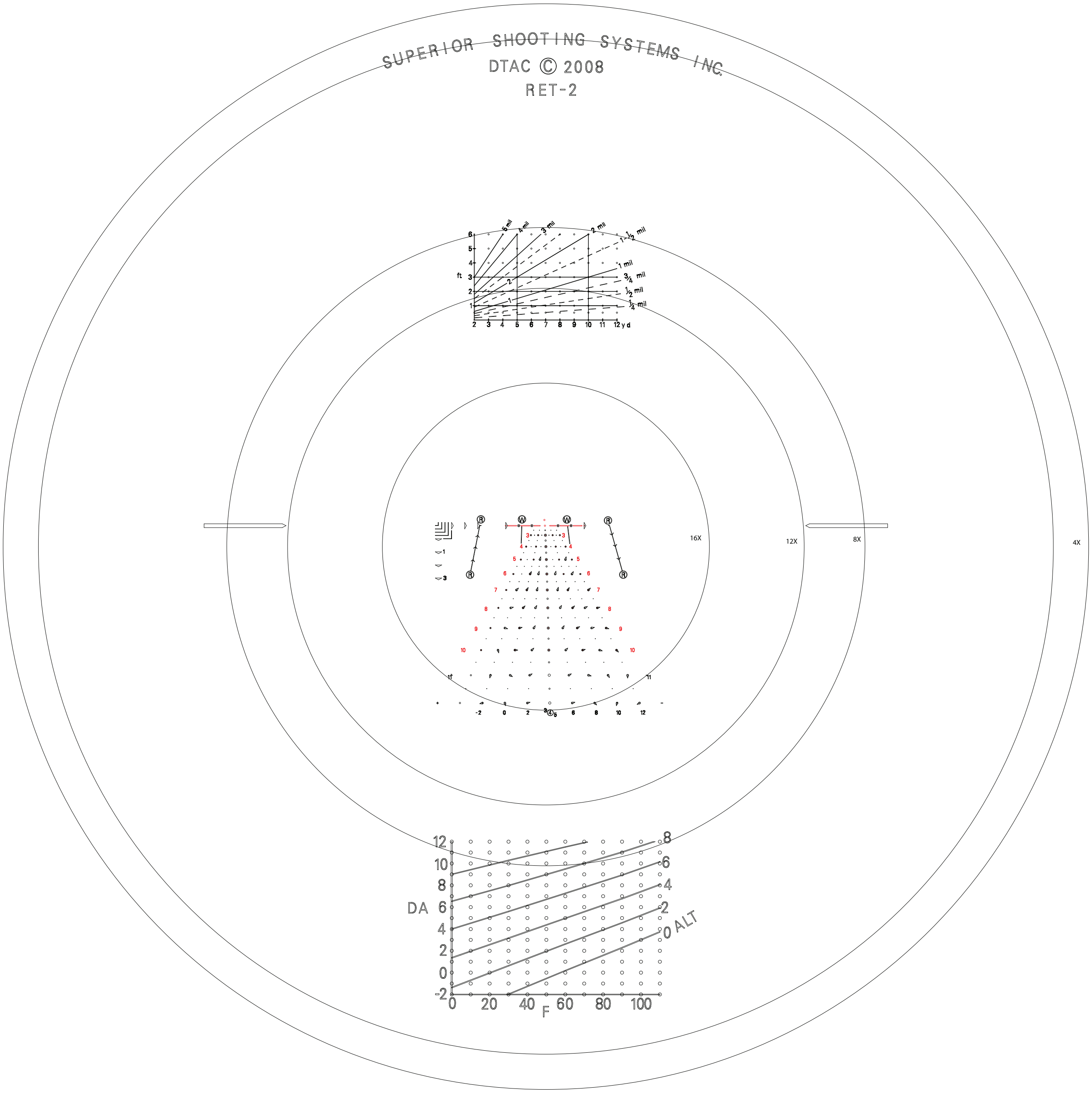
DTAC RETICLE



Instruction Manual

US PATENT
#7325353

DTAC Reticle
Instruction Manual

Contents

Appendix

US PATENT #7325353

Design Philosophy

The goal was to create a telescopic sighting system for field shooting that encompassed the following attributes:

1. A system that is very quick to use, and allows for shots from point blank range to well beyond 1000 yards. Time element was a huge factor in this design. Time is what wins most engagements.

2. A system that does not require an auxiliary computer or data book whose loss or failure would leave you stranded, and whose use in general is slow and takes the shooter's attention away from the target.

3. A system that adapts to changing atmospheric conditions, allowing its use in any reasonable geographic location.

4. A system that provides the means to actually determine range to target, not just measure it in MILS or MOA (minutes of angle).

5. A system that requires little or no mathematic calculations of the user.

6. Use of miles per hour (mph) for windage — no MILS or MOA conversion conversion needed (call in mph and hold in mph)

Meeting all six goals was accomplished by employing two concepts:

1. Each DTAC scope is set up for a bullet with a specific ballistic coefficient (BC) and muzzle velocity (MV) under a given set of atmospheric conditions.*

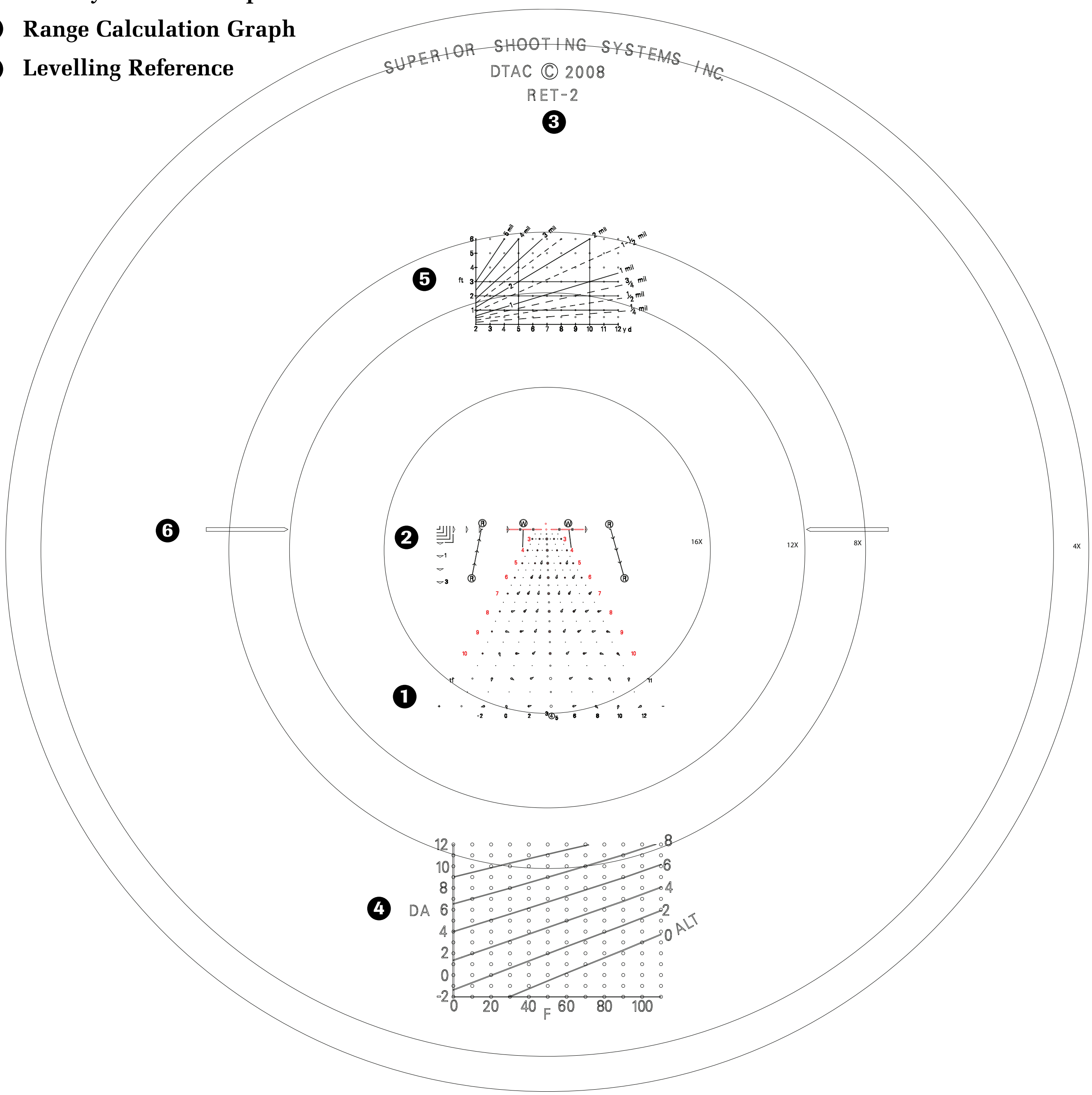
2. Provide graphs *in* the reticle to facilitate most ranging and ballistic computations. This allows the user to make accurate compensations for varying shooting conditions without looking away from the scope. Graphs are very powerful tools to display reference data and perform "no math" computations.

**While each DTAC Reticle is optimized for a specific caliber, any of our reticles can be used for many similar BC/MV combinations with excellent results. This is discussed in this manual.*

DTAC Reticle Overview

The composite DTAC Reticle is shown here. This is how the reticle appears when viewed through the scope at minimum power. Following are identifications of its specific components.

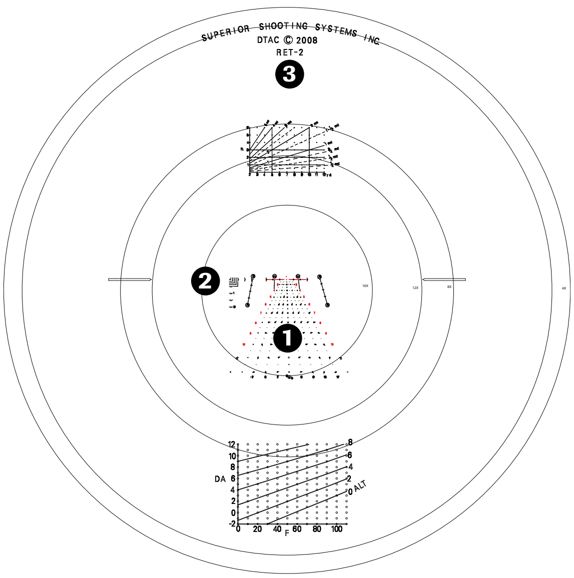
1. **Aiming Dots and Correction Pointers**
   (pointers located on aiming dots)
2. **MIL Measuring Stadia**
3. **Scope Legend**
4. **Density Altitude Graph**
5. **Range Calculation Graph**
6. **Levelling Reference**



DTAC Reticle Overview

Now lets look at each component in this system in more detail.

❶ **Aiming Dots and Correction Pointers** (CP details shown on page 11.)
A row of aiming dots is available for each 100-yard increment. We have also included central 50-yard aiming dots for all but very close distances.

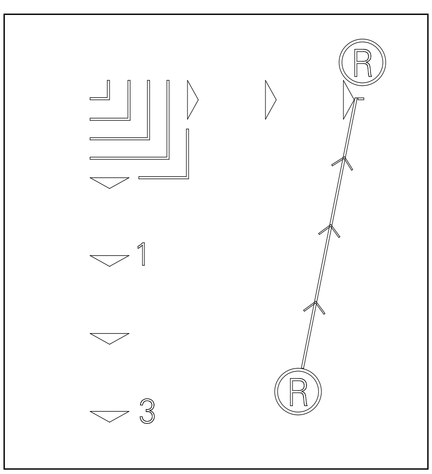


Windage dots are placed in 5 mile per hour (mph) increments. A number, starting at 300, representing the 100s of yards for a given row of aiming dots, also functions as the final crosswind dot. Use the center (or when present, the 0 or circular part) of the number as the aiming point. There are dots for 5, 10, 15, and 20 mph crosswinds. Notice that the central aiming dots do not go straight down (as do those in other reticles). They curve off to the right* to correct for spin drift of the bullet. At maximum range, this correction can equal several MOA.

At an appropriate range, on some DTAC Reticles the rows of dots are no longer numbered. This corresponds to the approximate position downrange when the bullet is trans-sonic or sub-sonic. The rows of dots are still spaced in 100-yard increments for use as desired, but be aware that ballistically you may not be able to count on consistency in bullet drop at these ranges. Also, above the central horizontal stadia line you will see an “R” and a “W” in circles. These are approximate hold points for a running (R) or walking (W) target out to 600 yards. Actual target movement speed, angle of target movement, and your reaction time all affect how accurate these will be for any given shot. These also help to engage close targets at lower power settings.

***The reticle is designed for right-hand rifling twist.**

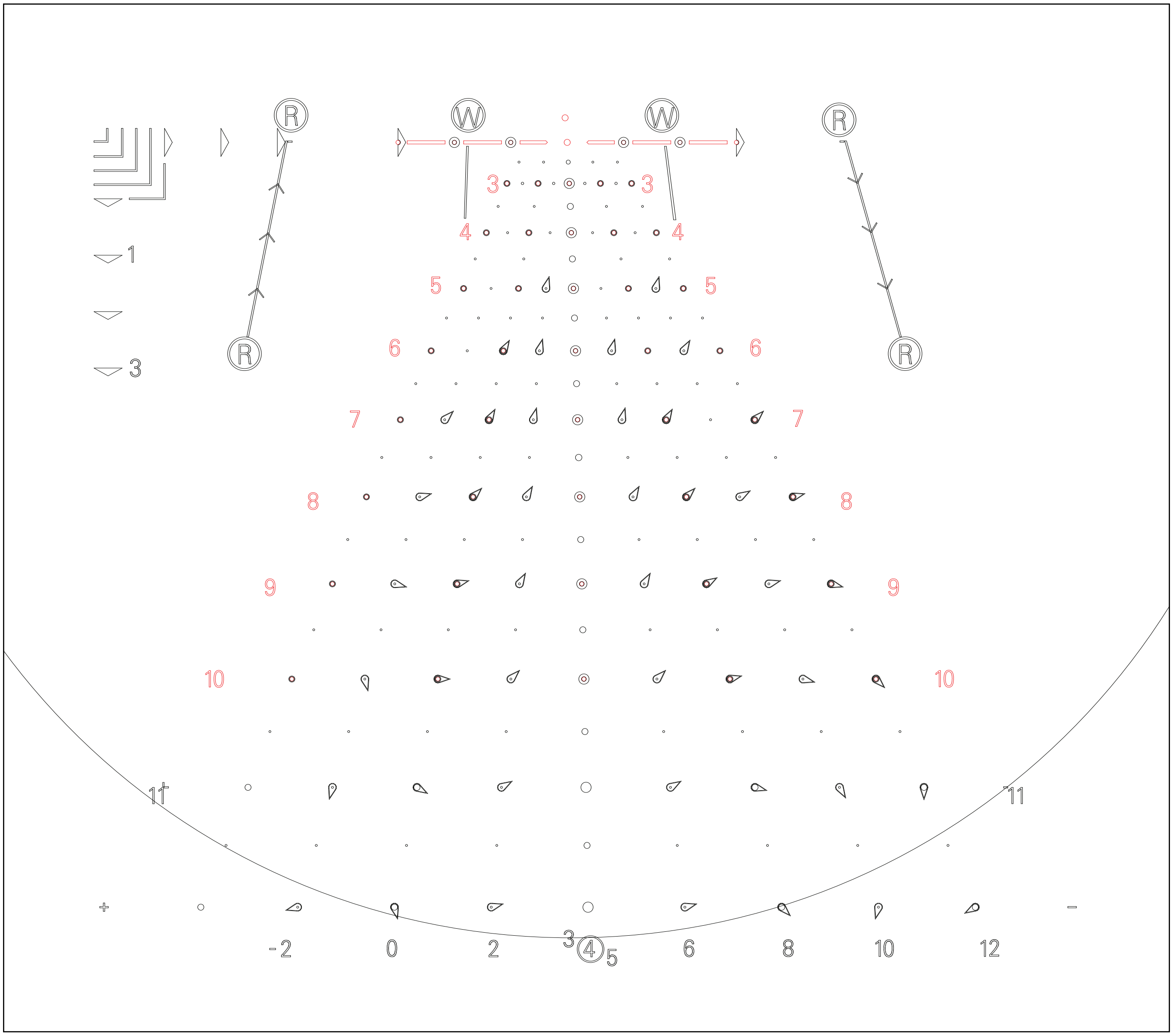
❷ **MIL Measuring Stadia**

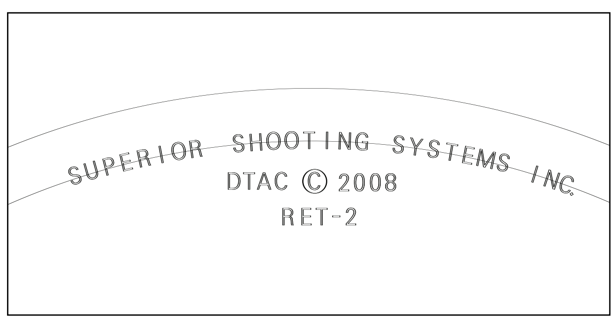


Horizontal stadia line with MIL markers (triangles) and vertically oriented MIL markers. These are all set at 1.0 MIL spacing. We used this style of marker for improved accuracy over a “dot” or “football” style MIL mark. Our marks can be gauged with greater precision.

At the corner where the vertical and horizontal axes meet, we have devised a method of determining fractions of MILS. Each axis has four lines, each of which is spaced in 1/4 MIL increments. These allow good estimation of smaller targets subtending less than 1 MIL, and also function to increase accuracy of all target measurements. These allow you to measure your target to 1/8 MIL resolution, or better (in between 1/4 MILS = 1/8 MIL resolution).

DTAC Reticle Overview





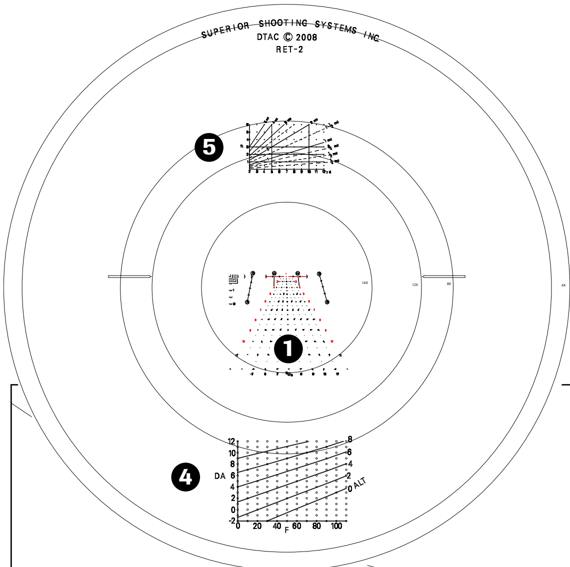
❸ Scope Legend

Zoom the scope to its lowest power. The scope legend is visible in the top center of the reticle. This tells you the specific version of the DTAC Reticle. On the scope used in this manual, the reticle is calibrated for a .308 caliber 175 grain bullet load at 2650 feet per second and a scope center 2.5 inches over bore centerline. It is calibrated for a 4000 foot density altitude.* 4000 ft. DA provides the best solution for the following two parameters: a majority of shooting occurs in that vicinity; and it minimizes the range of adjustment required for the density correction system.

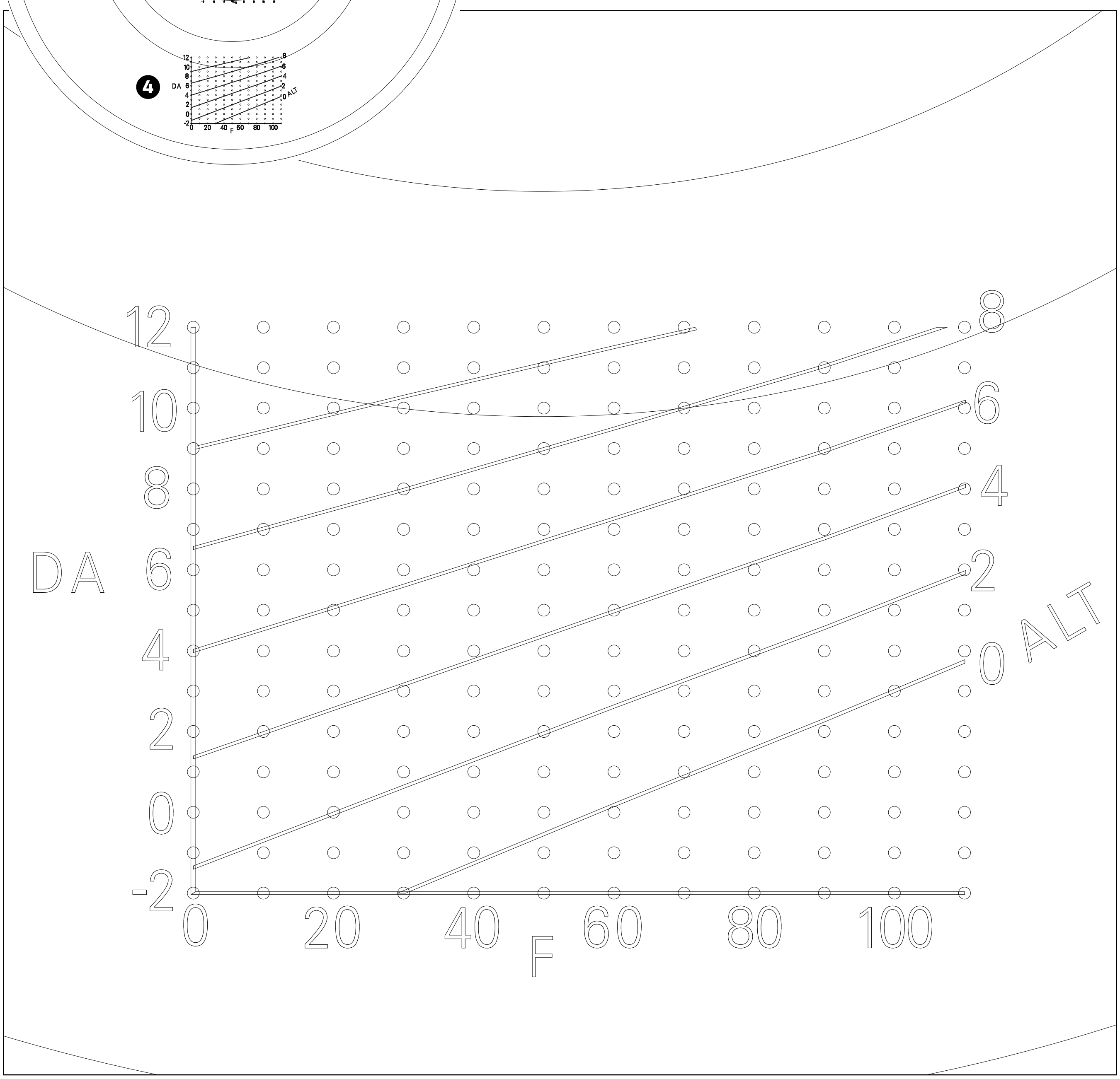
**Depending on muzzle velocity (25 fps above or below 2650 fps) this reticle can also easily adapt for use as a 3000 ft. DA or 5000 ft. DA main reticle with no other compensation. Refer to page 23 for more detailed information.*

❹ Density Altitude

The large graph below the aiming dots allows you to estimate your Density Altitude. We recommend using a *Kestrel 4000* to provide this information, but should it become damaged or inoperative we have provided this graph for failsafe use.

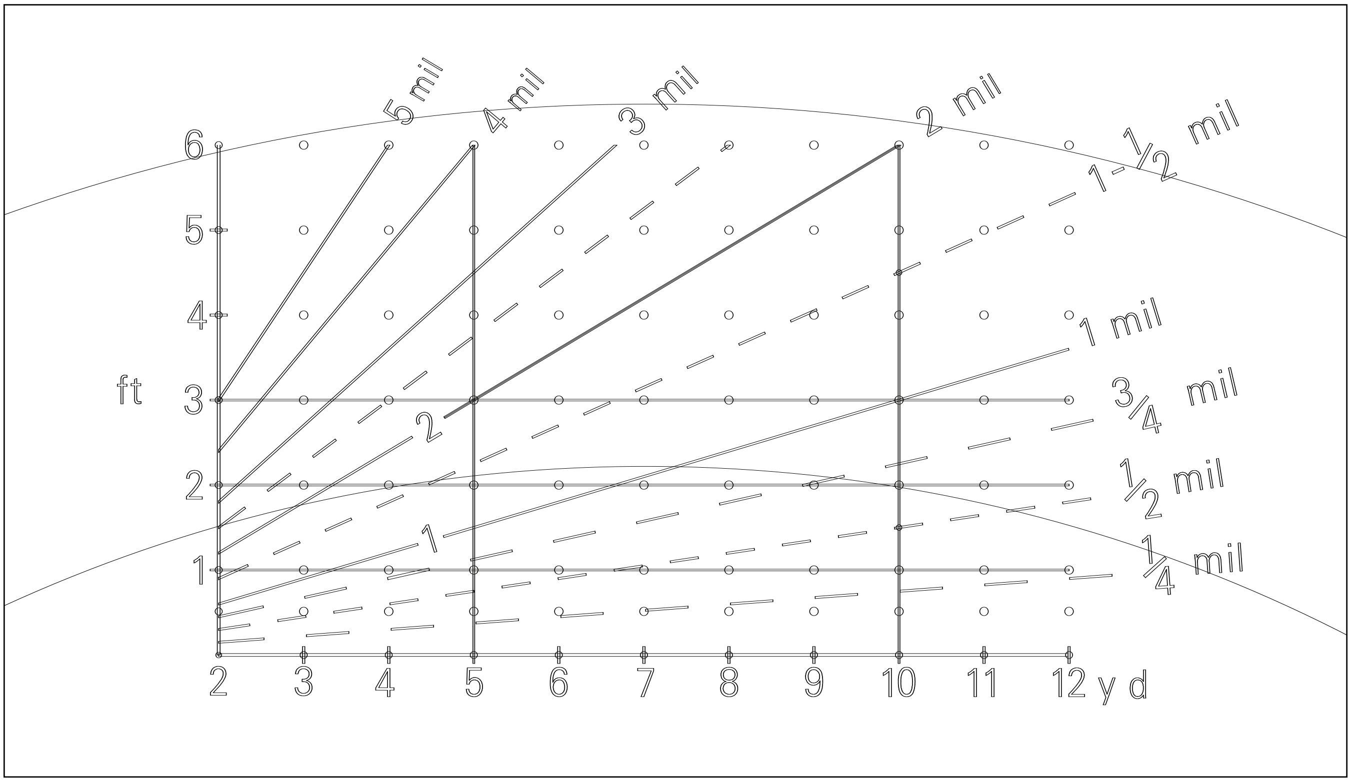


Density Altitude is further discussed throughout these instructions and in the Appendix under “Atmosphere.” It is a key concept you must understand to get the most from your DTAC Reticle.



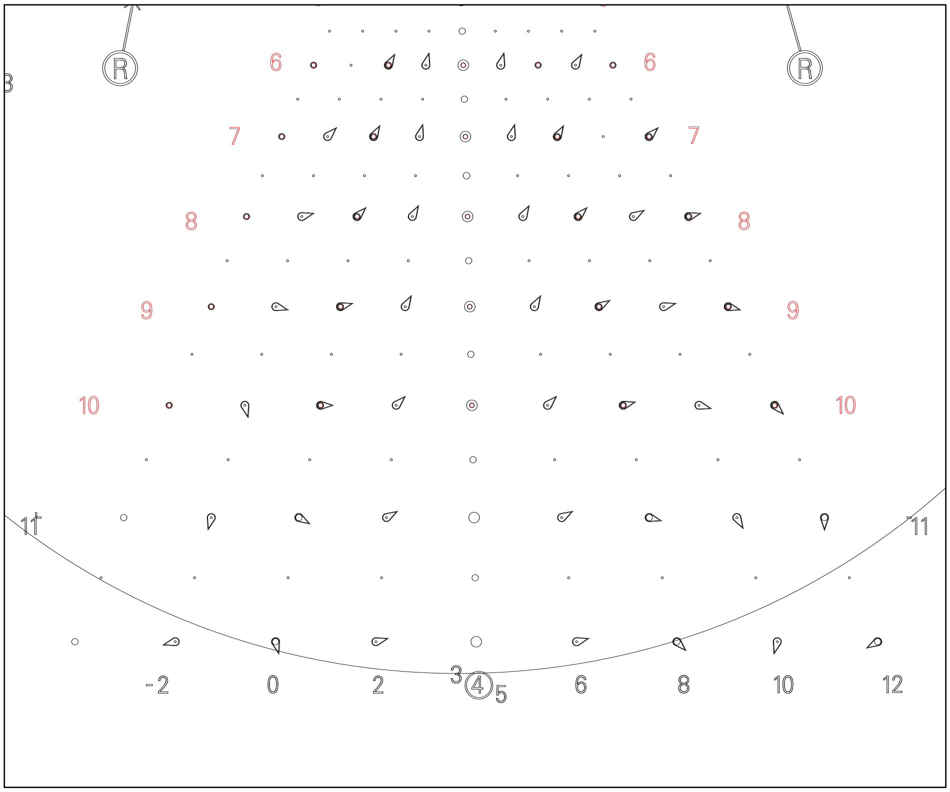
DTAC Reticle Overview

❺ **Range Calculation**
Located directly above the aiming dots, the MIL Calc Graph allows you to calculate the range after you have estimated the target size (in feet) and "MIL'd it" using the measuring stadia discussed earlier.



❶ **Density Correction Pointer**
These Correction Pointers (CP) are on the aiming dots themselves and allow you to refine your hold point for various atmospheric conditions, based on Density Altitude. They indicate a correction value in MOA that you may dial into your scope (either up or down) or you may simply "hold off" on your target to compensate.

We suggest that you now read the Appendix materials (starting on page 23) to learn more about the "science" behind the DTAC Reticle.

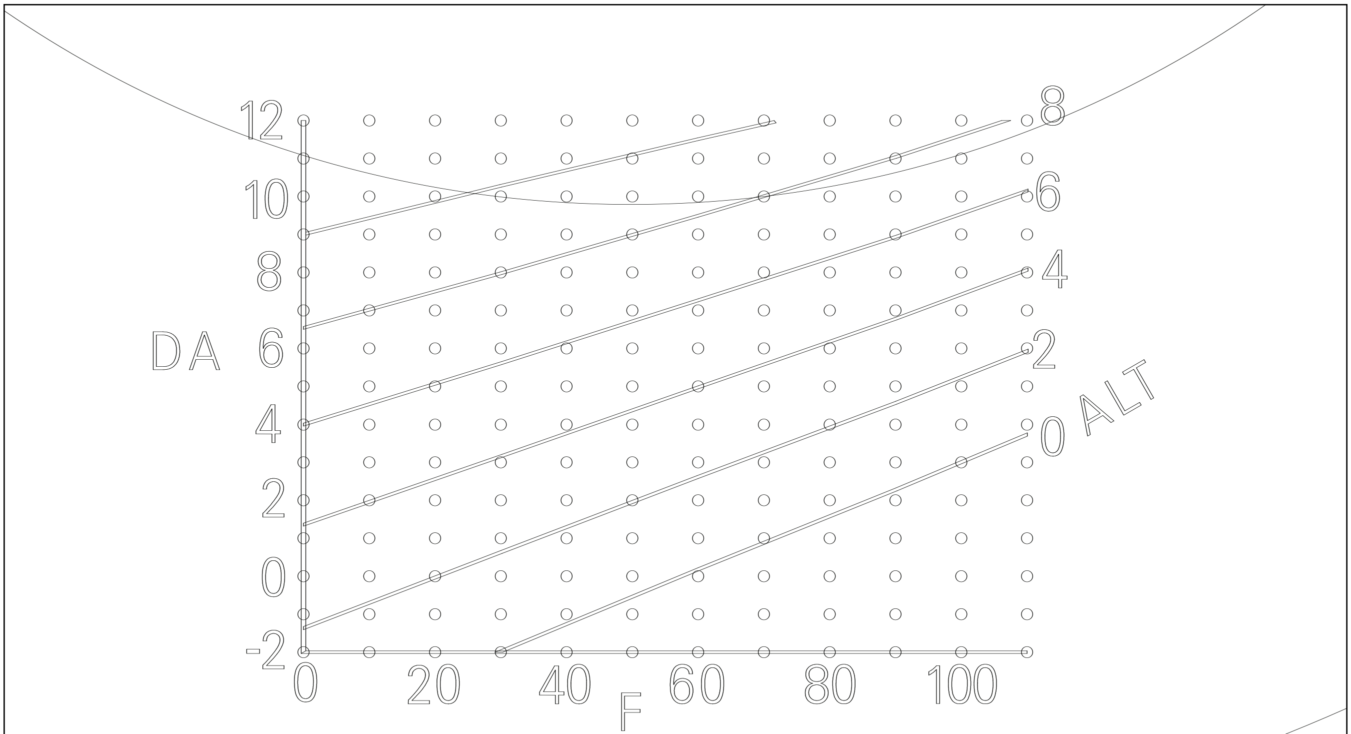


Using Your DTAC Reticle

Now that you are familiar with the components contained in the DTAC Reticle, and their function, following is a step-by-step guide that will take you through their use. We'll also reveal a few other features built into your DTAC Reticle. There is more information contained in the appendix

Preparation

To accurately employ the DTAC Reticle, you must be aware of your Density Altitude (DA). We recommend the use of a *Kestrel 4000* "Pocket Weather Station" since it will give very accurate results. Should you not have one or it becomes inoperative, we have included a graph in the reticle which allows excel-



Note: Above 45 degrees, if 100 humidity add 500 feet DA; if 0 humidity subtract 500 feet DA.

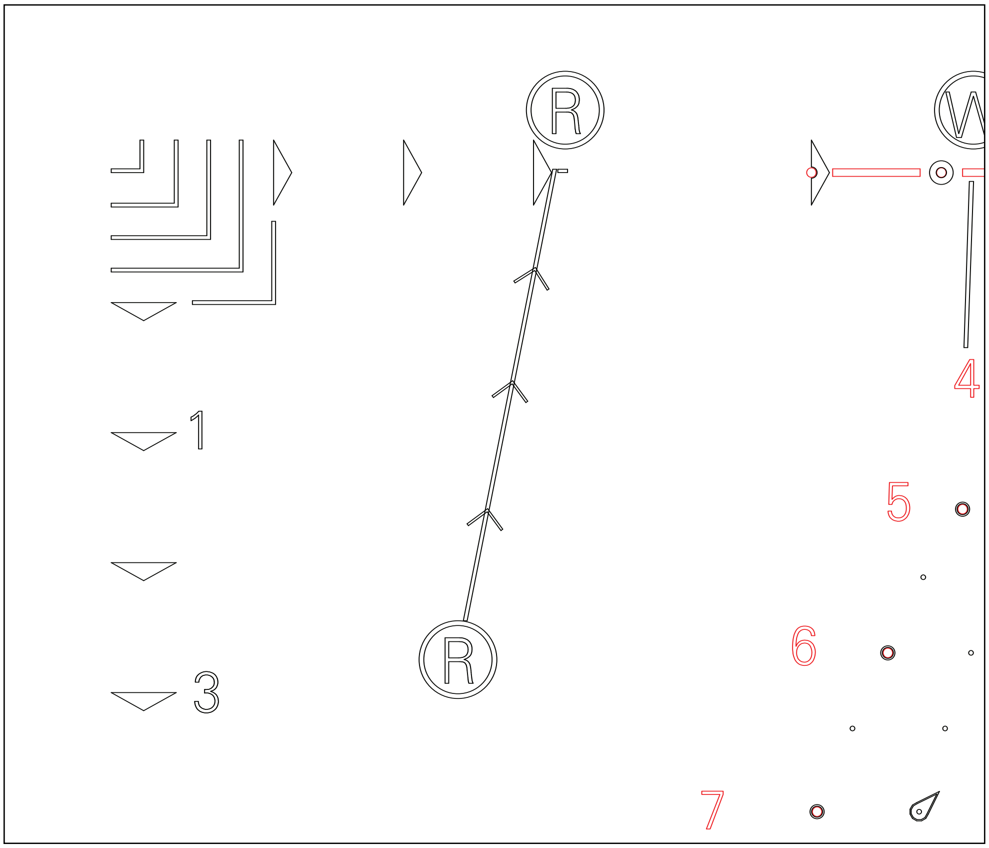
lent estimation of your Density Altitude. It is located below the drop dots and is fully visible when you zoom out to minimum power on your scope. To use it, you locate your current temperature along the bottom axis (in degrees Fahrenheit) then move straight UP until you come to your current Elevation above sea level (SL) as depicted by the angled lines. These are drawn every 2000 feet of elevation, so just "interpolate" between the lines to estimate your specific elevation. You now move straight across to the left axis to read your estimated DA. In the early mornings you will have a lower DA since the temperature is lower, and as the temperature increases your DA will increase. Below 45°F humidity has minimum effect on DA, but above 45°F if humidity is 100% add 500 feet DA; if it's 0% subtract 500 feet DA. A 500 foot DA change isn't a large impact move, but a 2000 foot DA change is a significant move. DA should be monitored throughout the day. DA changes as temperatures change, and the longer the shooting distance the more influence DA has.

Step One

Determine target distance. A laser rangefinder will provide the most accurate information. Otherwise, use the MIL Measuring Stadia.

Using Your DTAC Reticle

A MIL is an angular measure and subtends 3.6 inches for every 100 yards of range. Thus, 1 MIL at 200 yards subtends 2 x 3.6 = 7.2 inches. 1 MOA subtends 1.047 inches for every 100 yards, so 1 MIL equals 3.438 MOA. There are a couple of points that will help you be more accurate at ranging —



1. Always MIL as large of an object of known size as you can. For example, if your target is a coyote with a chest height of 10 inches, but he is next to a fence you know is 4 feet tall, then you will be more accurate if you MIL the fence post and not the coyote

2. Always try to MIL a vertical target rather than a horizontal target. This is because, usually, the uphill/downhill angle is less of a factor than whether the target angle is perpendicular to you. For example, let's say you have a windmill and you know the diameter of the blades is 6 feet. Thus, we know the object we are going to MIL Is 6 feet tall and 6 feet wide. Suppose the wind is coming over your right shoulder. This turns the blades so we see it being taller than it is wide. Thus, the width of an object in a perspective view is not the true dimension. A severe uphill or downhill target will present the same problem in a vertical direction.

When you MIL an object with the DTAC Reticle, you position the top (vertical target) or left edge (horizontal target) somewhere into the 1/4 MIL stadia lines, and then look at the bottom or right edge of the target. Move the scope so the bottom or right edge exactly coincides with the proper whole MIL mark then read the fractional portion of your MIL measurement at the top.

Step Two

Take the number of MILS derived from Step One and go to the MIL Graph. This is located directly above the central aiming dots. Find the known size of the object (ft) on the left vertical axis and then follow that to the right until you intersect the MIL measurement found in Step One (these are indicated by the angled lines). You may or may not be directly on a MIL reference line so you must use your judgement to interpolate the correct point. From this point go straight down to read the distance in yards to the target. Again, judgement is necessary to estimate location along the scale and determine the reading. Milling past 1200 yards is futile since small errors mean misses.

Step Three

Now, if applicable, correct for an uphill or downhill shot.* Use the Angle Firing Number (AFN) card (included with the scope). Locate the distance initially measured in yards along the top line on the card.

Angle Firing Numbers SL Thru 12K DA [+/- 1-25yds to nearest #]

ANGLE

	300	350	400	450	500	550	600	650	700	750	800	850	900
10	290	340	390	440	490	539	588	636	683	731	780	829	878
15	285	335	385	434	484	532	581	628	675	721	768	816	865
20	280	330	380	429	478	525	574	621	668	711	754	803	852
25	275	322	370	418	468	511	554	602	649	694	740	785	831
30	270	315	360	408	459	497	535	582	630	677	725	768	810
35	265	310	355	398	442	480	518	562	607	653	700	742	785
40	260	305	350	382	425	462	500	543	585	630	675	718	760
45	250	287	325	358	400	440	480	520	560	600	640	680	720

Use Current DA For Firing Solution Boxes Shaded in Black Require 10K DA or Higher

ANGLE

	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
10	927	977	1025	1075	1123	1172	1220	1271	1320	1370	1417	1468
15	915	965	1014	1064	1114	1163	1212	1260	1307	1358	1405	1456
20	899	950	1000	1050	1099	1148	1194	1240	1289	1338	1387	1436
25	879	928	978	1027	1073	1120	1164	1207	1256	1306	1347	1400
30	855	900	950	1000	1045	1090	1132	1175	1222	1270	1315	1360
35	830	875	918	960	1005	1050	1092	1135	1180	1225	1270	1317
40	805	850	885	920	965	1010	1055	1100	1135	1176	1225	1275
45	760	800	832	910.4	954	997.6	1039	1080	1119	1161	1207	1210

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**You must estimate the angle from a horizontal line.*

Step Four (illustration on next page)

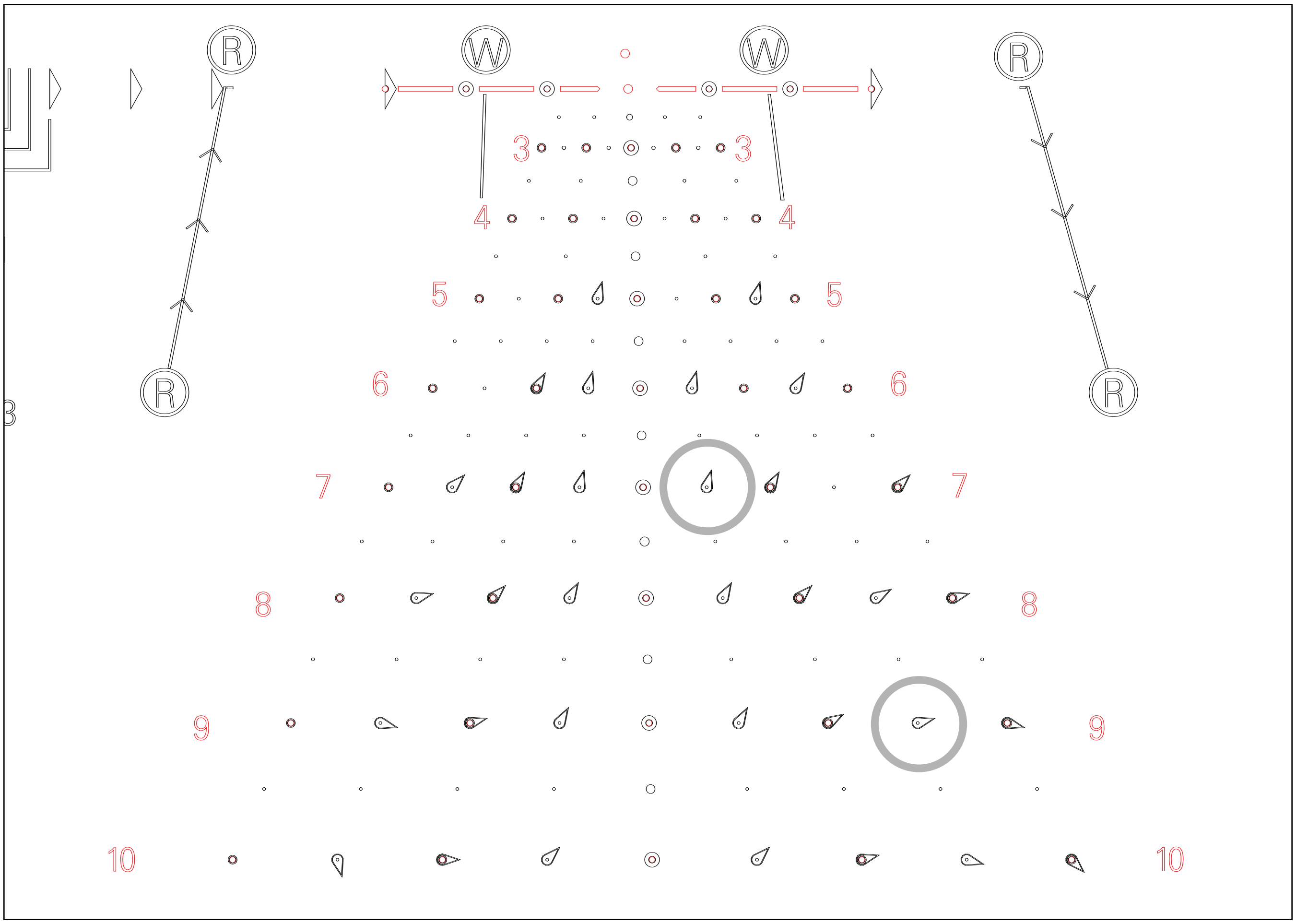
Factor in Density Altitude using instrumentation or the graph contained within your DTAC Reticle. Then locate the appropriate aiming dot and read the Density Correction Pointer (CP) to correct for present Density Altitude. The aiming dot pointer indicates the value in 1/2 or whole MOA (elevation only) that will result in an accurate shot based on existing atmospheric conditions. The dots as viewed are based on the standard 4000 DA. To the right of that central row all corrections (pointers) come down, or hold low; to the left all corrections come up, or hold high. For easy reference directional arrows on the "running target" hold off show which direction corrections follow, as well as the numbers above 1000 (#10) have + or - in front of the number. That is the direction you either dial or hold.

To find the correct line of dots to correct for DA, look to the bottommost line of aiming dots and locate your current DA number, travel straight up on that row of windage dots to your range, and look at the corresponding dot. The pointer indicates the correction for DA. For example "8" is two rows to the right of center and shows the correction needed for a DA of 8000 ft.

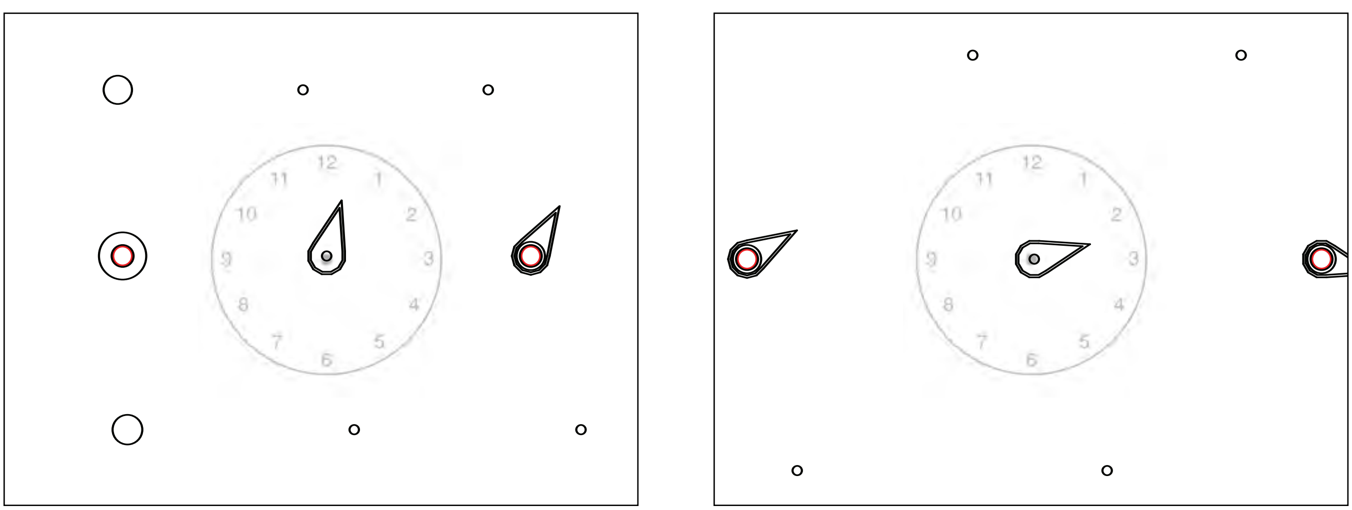
Think of a clock face. The pointer will locate a point on that clock face that is simply translated directly to MOA and applied to the calculations.

For instance, a CP indicating "1:30" is read as 1-1/2 minutes of angle. If current DA is along a line right of center, then come down or hold low 1-1/2 MOA. The pointers indicate 1/2 and 1 MOA values, and it's easy to look at adjacent pointers to quickly determine small differences in the pointer position. The CP

Using Your DTAC Reticle



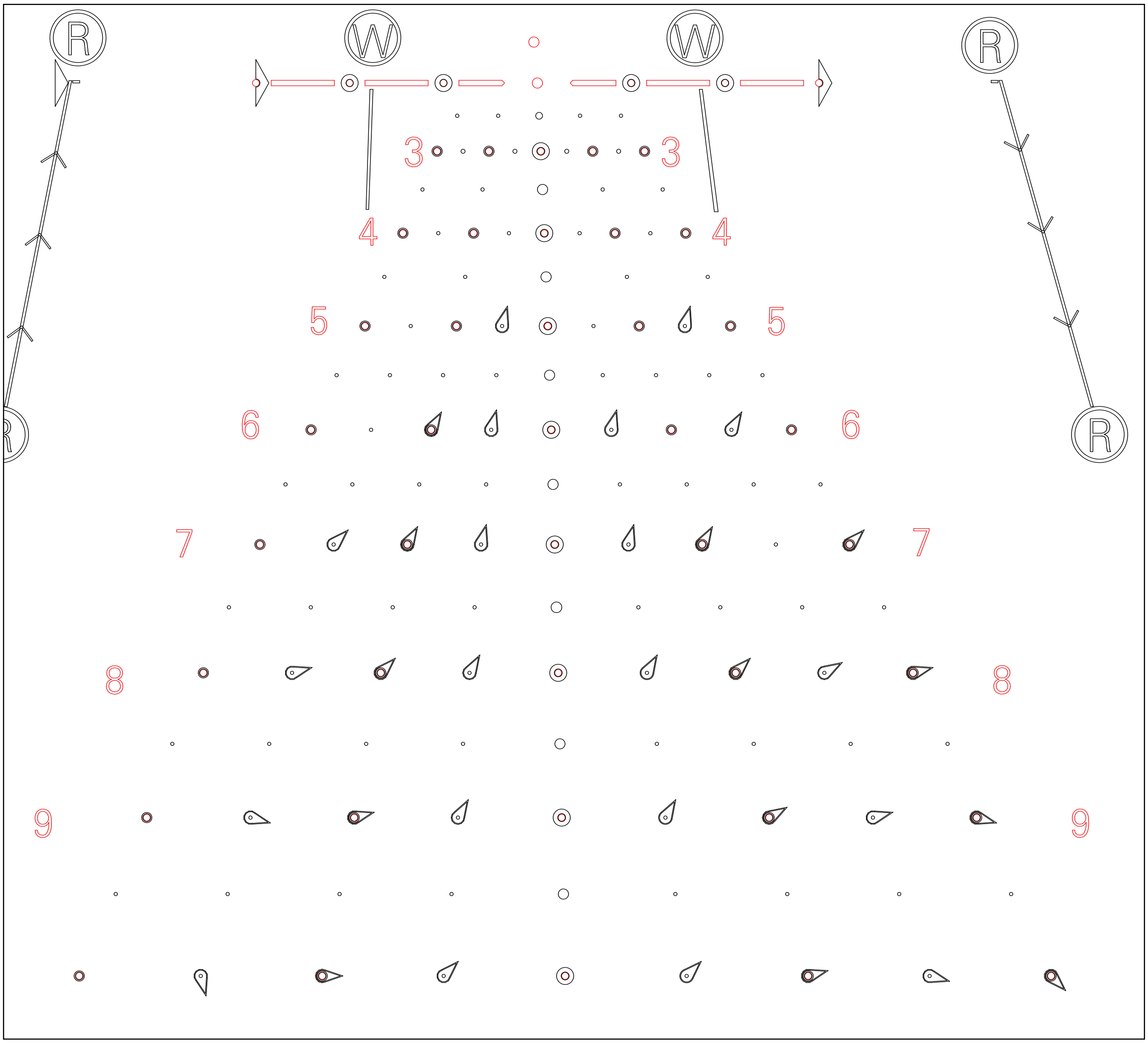
isolated in the illustration below indicates a value of "12:30," 1/2 MOA. The one shown on the right indicates a value of "2:30," 2-1/2 MOA. The gray circles above show each pointer. It doesn't take long to get used to this system, and you'll find that with a little practice you are able to quickly interpolate pointer positions. We have found that for shots up to 700 yards, there is no need to make scope adjustments. Extremely precise shots can be easily made by simply holding off.



[CONTINUED]

Using Your DTAC Reticle

Not all dots have pointers! This was done to uncomplicate the viewing area. If there is no CP value indicated on an aiming dot, then that dot will have the same value as the one immediately inward. Whenever a CP value is given it continues outward (either right or left) until a new CP value is given. This only applies out to 700 yards; beyond that distance there are corrections indicated all the way across.



For an example, referring to the illustration above, note that on the 500 yard row, the CP on the first dot left of center on the 2K DA line indicates a 1/2 MOA correction. This CP value also applies to the next two dots going outward toward the left (SL or "O" DA and -2K DA).

Step Five

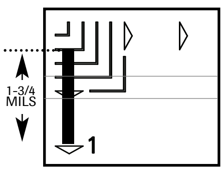
Estimate wind and find the correct windage dot. There is more material on this topic later in the manual. Always remember to hold into the wind.

Usage Example

Now we'll look at an example shooting condition to help you put the DTAC Reticle to use in the field. Come up with examples on your own. You'll soon be running through this process quickly and accurately.

Circumstance & Conditions

We are in New Mexico hunting coyotes at 4200 feet elevation and the temperature is 95° F. We see a coyote next to a fence we know is 4 feet tall, and we are on a hill looking down at about a 20 degree angle.



Step One

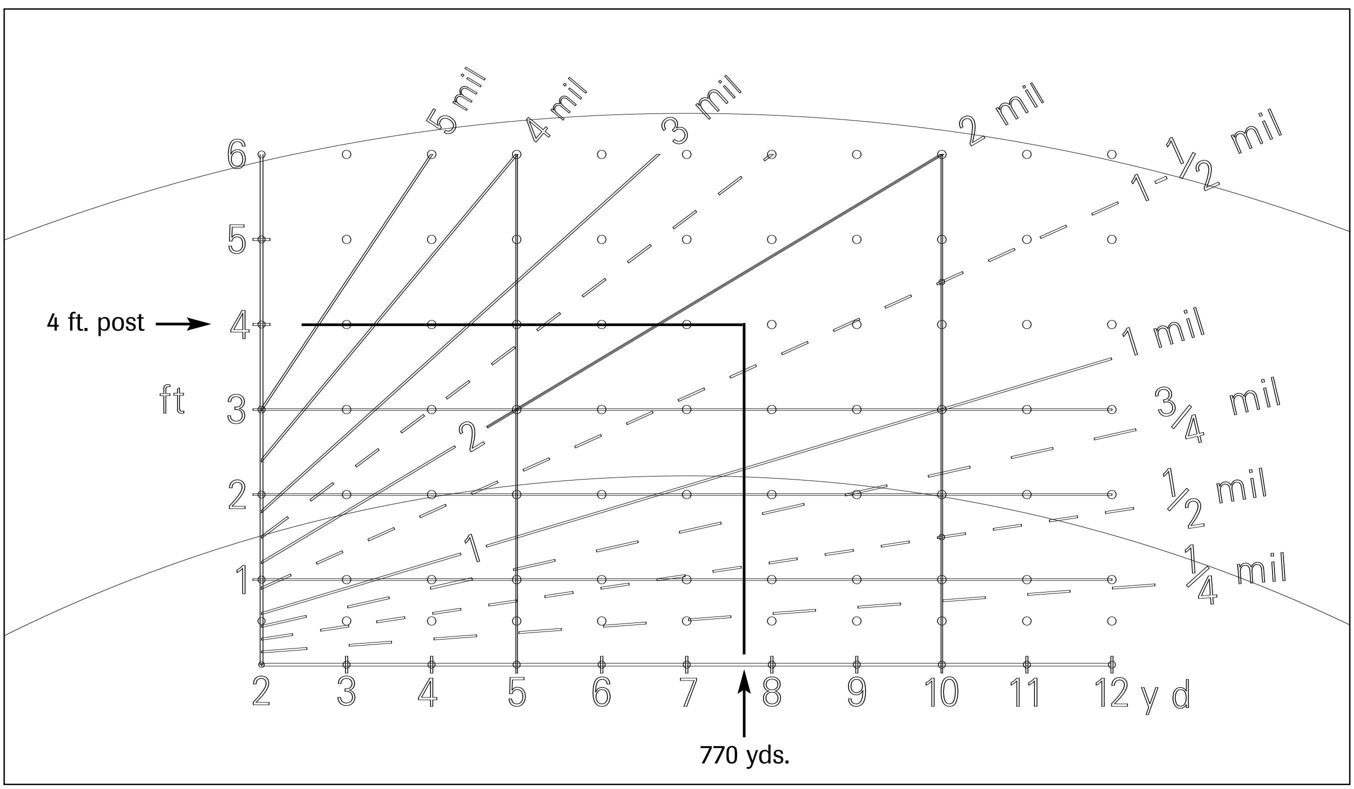
The fence is bigger than the coyote so range the fence posts.

MIL the fence… = approximately **1-3/4 MIL**

Fence post = 4 ft. tall

1. Put bottom of post directly on next whole MIL line, in this case "1MIL line."
2. Put top of post into fractional measuring stadia.
3. Read fractional measurement plus whole measurement = **1-3/4 MIL**

Step Two



Determine the range to the fence [see MIL Graph]
Find 4 feet (height of fence post) on the TGT axis and go to the right until you are at 1-3/4 MIL location found in Step One, which is halfway between the 1-1/2 MIL line and the 2 MIL line, then go straight down to read the range — **770 yards**.

Usage Example

Step Three

Correct for angle [Angle Firing Number card]

Angle Firing Numbers SL Thru 12K DA [+/- 1-25yds to nearest #]

ANGLE	300	350	400	450	500	550	600	650	700	750	800	850	900
10	290	340	390	440	490	539	588	636	683	731	780	829	878
15	285	335	385	434	484	532	581	628	675	721	768	816	865
20	280	330	380	429	478	525	574	621	668	711	754	803	852
25	275	322	370	418	468	511	554	602	649	694	740	785	831
30	270	315	360	408	459	497	535	582	630	677	725	768	810
35	265	310	355	398	442	480	518	562	607	653	700	742	785
40	260	305	350	382	425	462	500	543	585	630	675	718	760
45	250	287	325	358	400	440	480	520	560	600	640	680	720

Use Current DA For Firing Solution Boxes Shaded in Black Require 10K DA or Higher

ANGLE	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
10	927	977	1025	1075	1123	1172	1220	1271	1320	1370	1417	1468
15	915	965	1014	1064	1114	1163	1212	1260	1307	1358	1405	1456
20	899	950	1000	1050	1099	1148	1194	1240	1289	1338	1387	1436
25	879	928	978	1027	1073	1120	1164	1207	1256	1306	1347	1400
30	855	900	950	1000	1045	1090	1132	1175	1222	1270	1315	1360
35	830	875	918	960	1005	1050	1092	1135	1180	1225	1270	1317
40	805	850	885	920	965	1010	1055	1100	1135	1176	1225	1275
45	760	800	832	910.4	954	997.6	1039	1080	1119	1161	1207	1210

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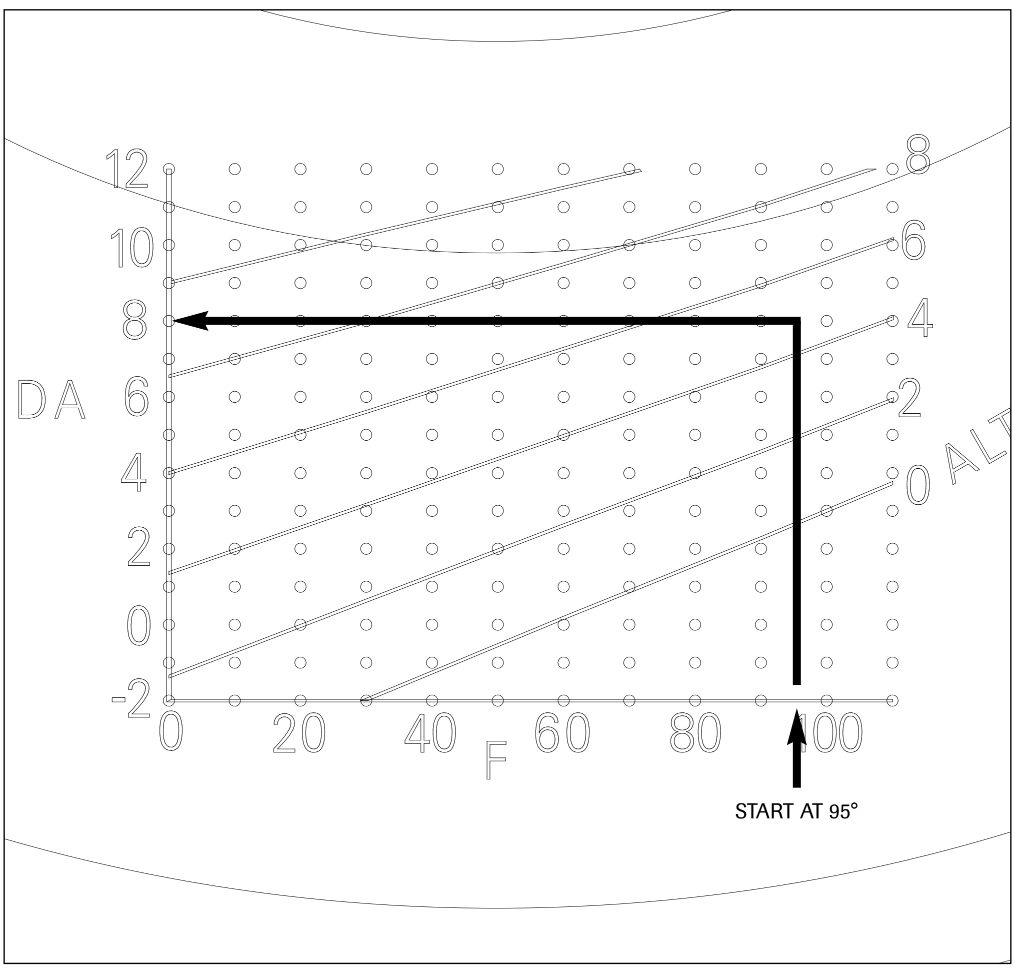
Since we are on a hill looking down at the coyote at approximately a 20 degree angle, we need to correct the range. Use the AFN card, look to the nearest distance, 750 yards and 20 degree intersection and you will see 711 yards. The card is marked every 50 yards so either add or subtract from 1-25 yards to the closest actual distance. 770 is closer to 750 than 800 is to 770. So add 20 yards, which equals a 731 yard target.



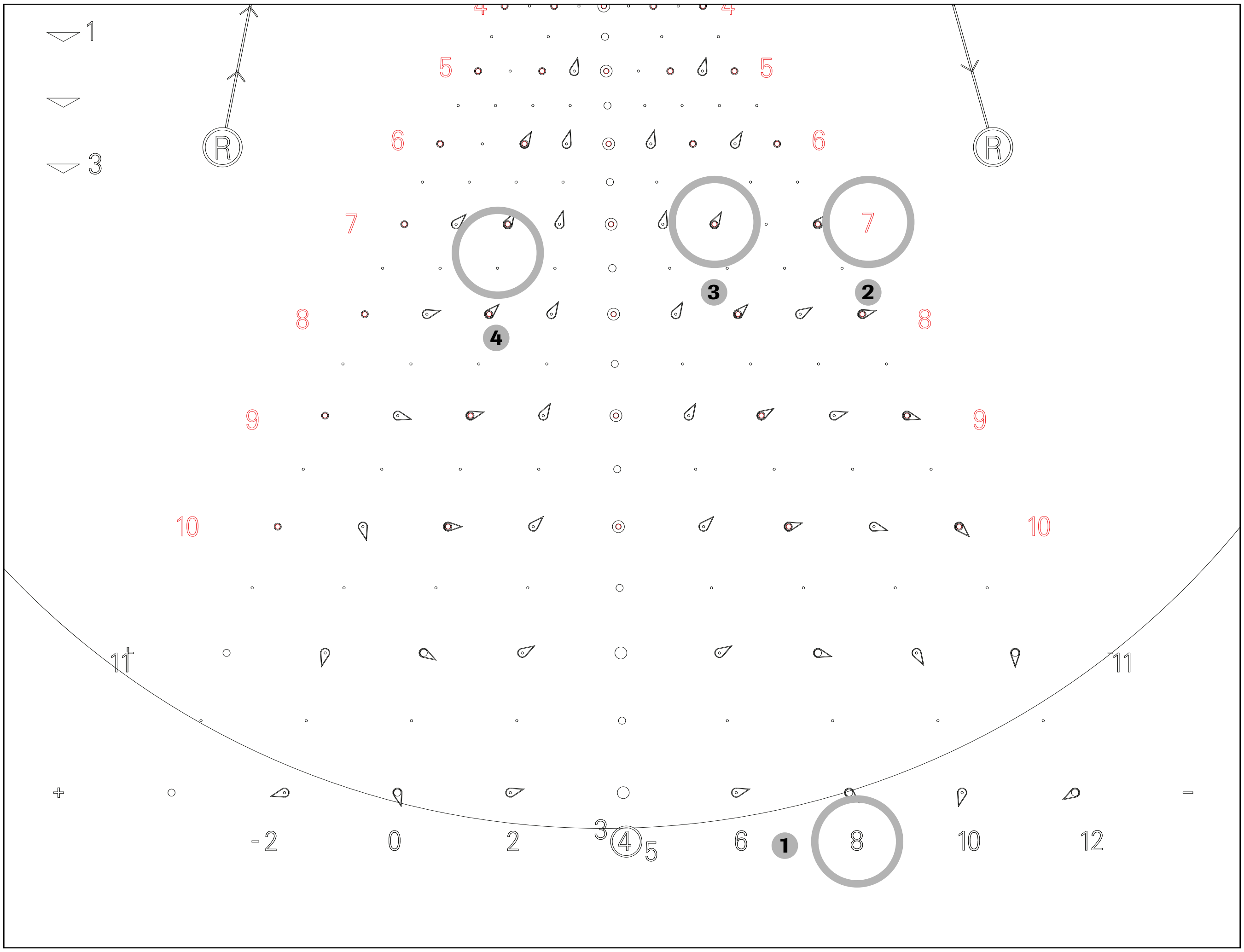
Step Four

Correct for Density Altitude

If you have a *Kestrel 4000*, it reads density altitude directly. Otherwise, go to the Density Altitude Graph contained within your DTAC Reticle. *You should already know density altitude!* DA should be calculated and mentally noted throughout the day.

- Temp. is 95° so find that on the bottom of the graph.
- Now go straight up to your actual altitude – 4200 feet
- Then go straight left to read DA – **8K DA**

Usage Example



Step Five

Now locate appropriate **Correction Pointer (CP)**

Range = 731 yards at Density Altitude = 8000 feet

1. Locate "8" on bottom row indicating 8000 ft. DA
2. Follow that line up to "7" horizontal dot row, representing 700 yards
3. Locate nearest **CP** (left) and see it is indicating "1:00" on clock face. MOA correction = 1 MOA
4. **Since the 8K DA row is to the right of center, correction amount for this shot = -1 MOA** (minus) Dial elevation knob down 1 MOA (1 MOA at 700 yards = approximately 7 inches) and then hold for a 731 yard shot, which is in between the 700 and 750 dots (you will have to interpolate the 731 yard hold point). Estimate wind and use correct windage hold point. You estimate the wind is 10 mph moving from right to left. This means you'll use the second dot to the left of center on the "7" row and hold that dot at the 731 yard hold point to make your shot.

This reticle sometimes requires you to triangulate or interpolate between 2, 3, or even 4 hold points to accommodate such "in between" shots. It's easy and very fast with just a little practice.

Angle Firing Number card

Angle Firing [AFN card]

Angle Firing Numbers SL Thru 12K DA [+/- 1-25yds to nearest #]

ANGLE	300	350	400	450	500	550	600	650	700	750	800	850	900
10	290	340	390	440	490	539	588	636	683	731	780	829	878
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20	899	950	1000	1050	1099	1148	1194	1240	1289	1338	1387	1436
25	879	928	978	1027	1073	1120	1164	1207	1256	1306	1347	1400
30	855	900	950	1000	1045	1090	1132	1175	1222	1270	1315	1360
35	830	875	918	960	1005	1050	1092	1135	1180	1225	1270	1317
40	805	850	885	920	965	1010	1055	1100	1135	1176	1225	1275
45	760	800	832	910.4	954	997.6	1039	1080	1119	1161	1207	1210

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Accurate uphill and downhill shooting requires use of the laminated **Angle Firing Number** (AFN) card which comes with your scope. The AFN card provides quick and easy calculations requiring virtually no math skills. Though not as precise as a modern ballistics calculator, it is, however, very quick and easy to use in the field. The AFN card's data is derived from a (slightly modified) cosine of the MOA elevation (NOT THE COSINE OF THE DISTANCE) from 300 to 1500 yards and then converted back to a yardage to correspond with your DTAC reticle.

99% percent of the time –

The Cosine of 5 degrees is .996 so if your target is 1000 yards away and either uphill or downhill (there is a slight difference between the two) the shot you are making is very close to 996 yards. The great majority of all shots made are less than 5 degrees of angle which effectively eliminates the need for the AFN card. However when you need it, here is how to use it.

First one needs an accurate distance to the target and a specific angle. There are several Cosine indicators which attach to the scope (these typically read to about 5 degrees of accuracy). There is an angle estimator on the back of the AFN card. You can sight down the top edge of the AFN card (or place the edge of the AFN card on a level portion of your rifle – typically the stock edge) and get a very good reading for downhill shooting – or you can turn the card upside down and use it on the off side (left hand shooter) and read an uphill angle with just a little more effort. There are different ways we have found successful in using this indicator. One is to simply aim the “0” line (bottom of the card) at the target then move your head to see the card face; find the line that appears to be level and read that number. Another way is to turn the card over so “0” line is on top and held level; moving your head slightly to see the lines, then look down the lines to read the angle. (Reverse the card and these procedures for uphill shots.)

The AFN card uses the COS of the amount of elevation for the original measured distance converted for use and correlated to the yardage distances in your DTAC Reticle. This gives you the correct distance on the DTAC Reticle for an elevation hold.

Once the actual distance is determined you will then need to hold that specific yardage correction along with the (if needed) Density Altitude (DA) correction for that distance. You will also need to interpolate what your wind hold will be based on the original distance. Not only is the bullet’s elevation impact being affected by gravity on the angle shot but also by wind movement for the entire distance (wind correction is to be determined by the original distance – not the angle distance – so use the original distance mph dots when judging for your wind call).

After you have determined the distance and angle you look at the numbered side of the AFN card and find the distance along the top (you will need to interpolate between 50 yard distances and 5 degree angle differences). A useable solution for the distances is to take the 50 yard splits and just add or subtract the actual difference (1 though 25 yds) to the closest 50 yard increment – using the card is straightforward. Most angle measuring repeatability tests show a 5 degrees range for experienced users – there are some rangefinders on the market which will give exact readings but are expensive.

Four different problems follow – repeat them until you are comfortable.

1st Example

You have the distance and the angle – 900 yards and 30 degrees – so now intersect the X/Y axis (900 yards on top, 30 degrees on the side) on the AFN card and read 810 yards. This distance answer will then need to account for the DA firing solution for the 810 yards based on your current DA condition. You now have the elevation set. You then need to ascertain the amount of wind correction you will need to be holding for a 900 yard wind deflection shot.

2nd Example

Distance 715 yds at 41 degrees. Go to the closest match, which is 700 yds and 40 degrees. Take that number (585 yds) and look to the then next closest angle – 45 degrees and you can see a 560 yard range, which is a minus-25-yard difference (down or minus – subtract; up or plus – add) depending on which direction you go on the AFN card. There are 5 degrees between 40 and 45 so divide the difference of 25 yds (the difference between 40 and 45 degrees) by the 5 degrees of difference (5 yds per 1 degree). Subtract 5 yds from the original 585 yds then add the difference between 700 and 715 (15 yds) to the answer and you have 595 yds using the card. Using the Sierra *Infinity* ballistics software the answer is all but the same – 594 yds. Remember to hold the wind for 715 yards and correct for current DA.

Angle Firing Number card

3rd Example

Same example again ignoring 1 degree angle difference – 715 yds at 41 degrees. Go to 700 yds by 40 degrees – answer 585 yds then add the additional 15 yds Answer 600 yds – using Sierra Infinity (594 yds), a difference of 6 yds or 1.2 inches difference at 600 yds. Hold the wind for 715 yds and correct for the current DA.

4th Example

1124 yards at 25 degrees. AFN card 1100 x 25 degrees is 1027 yards then add the difference of 24 yards to the answer 1027 + 24 = 1051 yards. Sierra *Infinity* answer – 1048 yds. Difference of .2 MOA or slightly more than 2 inches at that distance. Don't forget to hold the wind for 1124 yards and current DA.

The AFN card has a working range from 0 DA to 12000 DA basis when calculated using the Sierra *Infinity* ballistics program and typically is +/- 1/2 MOA out to a distance of 1000 yds. This begins to change over 1000 yards and steeper angles. This AFN card is usable for all altitudes out to 1000 yards – past that the numbers are calculated for elevations above 5500 feet. Most anywhere you will be angle shooting will be at least that altitude.

Angle Firing Numbers SL Thru 12K DA [+/- 1-25yds to nearest #]

ANGLE	300	350	400	450	500	550	600	650	700	750	800	850	900
10	290	340	390	440	490	539	588	636	683	731	780	829	878
15	285	335	385	434	484	532	581	628	675	721	768	816	865
20	280	330	380	429	478	525	574	621	668	711	754	803	852
25	275	322	370	418	468	511	554	602	649	694	740	785	831
30	270	315	360	408	459	497	535	582	630	677	725	768	810
35	265	310	355	398	442	480	518	562	607	653	700	742	785
40	260	305	350	382	425	462	500	543	585	630	675	718	760
45	250	287	325	358	400	440	480	520	560	600	640	680	720

Use Current DA For Firing Solution Boxes Shaded in Black Require 10K DA or Higher

ANGLE	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
10	927	977	1025	1075	1123	1172	1220	1271	1320	1370	1417	1468
15	915	965	1014	1064	1114	1163	1212	1260	1307	1358	1405	1456
20	899	950	1000	1050	1099	1148	1194	1240	1289	1338	1387	1436
25	879	928	978	1027	1073	1120	1164	1207	1256	1306	1347	1400
30	855	900	950	1000	1045	1090	1132	1175	1222	1270	1315	1360
35	830	875	918	960	1005	1050	1092	1135	1180	1225	1270	1317
40	805	850	885	920	965	1010	1055	1100	1135	1176	1225	1275
45	760	800	832	910.4	954	997.6	1039	1080	1119	1161	1207	1210

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Once again –

The Cosine of 5 degrees is .996 so if your target is 1000 yards away the shot you are making is very close to 996 yards. The majority of all shots made are less than 5 +/- degrees of angle which allows one to basically ignore small angles correction.

Dissimilar Combination Use

Using your DTAC reticle with a dissimilar bullet cartridge combination.

DTAC RET 2 RETICLE LAYOUT					
10 mph	**YD**	**MOA**	**10 mph**	**YD**	**MOA**
0.6 moa	**100** yd dot	**0**	**5.8**	**700**	**18.4**
1	150	0.75	6.3	750	20.7
1.4	**200**	**1.5**	**6.8**	**800**	**23.1**
1.7	250	2.7	7.5	850	25.7
2	**300**	**4**	**8.2**	**900**	**28.4**
2.5	350	5.5	8.8	950	31.2
3	**400**	**7**	**9.4**	**1000**	**34.2**
3.4	450	8.7	10	1050	37.4
3.8	**500**	**10.4**	**10.6**	**1100**	**40.8**
4.3	550	12.3	11.3	1150	44.3
4.8	**600**	**14.2**	**12**	**1200**	**48.1**
5.3	650	16.3	**© DTUBB Superior Shooting Systems**		
DTAC RET 2 Windage Dots are in increments of 5 MPH					

Your DTAC reticle also comes with its own MOA Drop Dots laminated card which represents the actual ballistics of your specific BC bullet and velocity (RET 1, RET 2, etc). This allows one to makes a grid of sorts to work with when shooting completely different cartridges.

Call Superior Shooting Systems to order a DTAC Ballistic Card System for your dissimilar bullet/cartridge combination. Such a card is shown below and will be our source for the following examples.

YDS/MOA   87 gr @ 2590fps

Density Altitude   ZERO = 100   SH 2.45

10/MPH X-W	mph/ Mil	YDS	-3K	-2K	-1K	SL	1K	2K	3K	4K	5K	6K
1.6	21.5	200	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.7	1.7	1.7
		50	3.3	3.3	3.2	3.2	3.2	3.1	3.1	3.1	3.0	3.0
2.6	13.2	300	4.9	4.9	4.8	4.8	4.7	4.7	4.6	4.6	4.6	4.5
		50	6.8	6.7	6.6	6.6	6.5	6.4	6.3	6.3	6.2	6.1
3.6	9.6	400	8.8	8.7	8.6	8.5	8.4	8.3	8.2	8.1	8.0	7.9
		50	11.0	10.9	10.8	10.6	10.4	10.3	10.2	10.0	9.9	9.8
4.8	7.2	500	13.5	13.3	13.1	12.9	12.7	12.5	12.3	12.1	12.0	11.8
		50	16.2	16.0	15.7	15.4	15.1	14.9	14.6	14.4	14.2	14.0
6.1	5.6	600	19.2	18.8	18.5	18.1	17.8	17.4	17.1	16.9	16.6	16.3
		50	22.4	22.0	21.5	21.1	20.6	20.2	19.8	19.5	19.1	18.8
7.5	4.6	700	26.0	25.5	24.9	24.3	23.8	23.3	22.8	22.4	21.9	21.5
		50	29.9	29.3	28.6	27.9	27.2	26.6	26.0	25.4	24.9	24.4
9.0	3.8	800	34.2	33.4	32.6	31.7	30.9	30.1	29.4	28.8	28.1	27.5
		50	38.9	37.9	36.9	35.9	34.9	34.0	33.1	32.3	31.5	30.8
10.7	3.2	900	43.9	42.7	41.5	40.4	39.2	38.1	37.1	36.2	35.3	34.4
		50	49.3	47.9	46.5	45.2	43.9	42.6	41.4	40.4	39.2	38.2
12.3	2.8	1000	55.0	53.4	51.9	50.4	48.9	47.4	46.1	44.8	43.5	42.3

Velocity Compensation (25fps = 1KDA change) Slower MV use Lower DA (15 degree change = 1KDA)

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All of these examples below are using a trajectory from a DTAC Ballistic Card that lists firing solutions from -3K to 12K DA on a single card (front and back). This basically provides a firing solution for any atmospheric condition you will ever encounter. You can use the RET 2 hold points and a DA card for the dissimilar cartridge and do an excellent job of getting the elevation correct. One must give the 5mph dots (RET 1 and RET 2) a different value because of dissimilar wind drift data (instead of a 5 mph the windage dots may represent 4 mph incremental increases). So 4/8/12/16 mph dots instead of the regular 5/10/15/20 mph.

Examples begin on the next page.

Dissimilar Combination Use

RET 2 –

The central aiming dots of RET 2 fit the 175/2650 at 4K DA. The 22/80 (4K DA) used out to 1000 yds is off by an average of .6 MOA from 400 to 800 yds. Certainly a usable difference when taking into account the knowledge that your bullet is going hit a bit low and the Correction Pointers for DA corrections are usable.

The 22/77 is a different story. You would need a RET 2 card with the MOA dot spacings along with a 22/77/2600fps DTAC Ballistic Card. You can then match the correct hold point based on the 22/77 DTAC Ballistic Card data. Note how the value of each wind dot in RET 2 changes with the different combinations.

In examining the table on the right, the 22/77 needs about 50 yards additional elevation out to 600 and then one would refer to the cards in order to match up the correct hold point. Might seem a bit cumbersome but once you do it a couple of times it is quite easy and pretty fast.

What this illustrates is that you can use this DTAC Reticle for a variety of bullet/velocity combinations – not as good as what it was exactly designed for but a lot better than a regular crosshair or mil-dot scope – from a simple point that, if nothing else, you have a wind drift dot(s).

	175/2650	**80/2800**	**77/2600**
Wind dot value	5mph	4mph	3mph
Range (Yards)	Bullet Path (1 MOA)	Bullet Path (1 MOA)	Bullet Path (1 MOA)
0	0	0	0
50	-1.1	-1.3	-1.0
100	-0.0	-0.0	-0.0
150	-0.5	-0.4	-0.6
200	-1.5	-1.3	-1.7
250	-2.7	-2.3	-3.1
300	-4.0	-3.6	-4.6
350	-5.5	-4.9	-6.4
400	-7.0	-6.4	-8.2
450	-8.7	-8.0	-10.2
500	-10.4	-9.6	-12.4
550	-12.3	-11.4	-14.8
600	-14.2	-13.4	-17.3
650	-16.3	-15.4	-20.1
700	-18.4	-17.6	-23.1
750	-20.7	-20.0	-26.3
800	-23.1	-22.5	-29.8
850	-25.7	-25.2	-33.5
900	-28.4	-28.1	-37.6
950	-31.2	-31.2	-42.0
1000	-34.2	-34.5	-46.6
1050	-37.4		
1100	-40.8		
1150	-44.3		
1200	-48.1		

The DTAC Ballistic Card shown for use with the following examples is a 22/87/2590, plus, of course, the RET 2 Ballistic Card that matches the RET 2 reticle (175/2650). Rifle is sighted in at 100 yards.

1st Example
Target at sea level (SL) at 600 yards. Using the dissimilar cartridge/bullet combination card (shown top of next page), elevation correction is 18.1 MOA. On RET 2 card underneath it, find the nearest figure, which is 700 yards (18.4 MOA). Come down one click or hold low. Next factor in a 10 mph wind. Locate 10 mph on the dissimilar card and see 6.1 MOA. Compare to RET 2 card at 700 yards (remember, this is the RET 2 line we're using to compare with) and see 2.9 MOA. RET 2 wind increments are 5 mph, so double them or hold two wind dots, or the 10 mph dot. 2.9 + 2.9 = 5.8 MOA, pretty close to the 6.1 MOA.

Dissimilar Combination Use

YDS/MOA 10/MPH X-W	mph/ Mil	YDS	87 gr @ 2590fps Density Altitude -3K	-2K	-1K	SL	1K	ZERO = 100 2K	3K	4K	SH 2.45 5K	6K
1.6	21.5	200	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.7	1.7	1.7
		50	3.3	3.3	3.2	3.2	3.2	3.1	3.1	3.1	3.0	3.0
2.6	13.2	300	4.9	4.9	4.8	4.8	4.7	4.7	4.6	4.6	4.6	4.5
		50	6.8	6.7	6.6	6.6	6.5	6.4	6.3	6.3	6.2	6.1
3.6	9.6	400	8.8	8.7	8.6	8.5	8.4	8.3	8.2	8.1	8.0	7.9
		50	11.0	10.9	10.8	10.6	10.4	10.3	10.2	10.0	9.9	9.8
4.8	7.2	500	13.5	13.3	13.1	12.9	12.7	12.5	12.3	12.1	12.0	11.8
		50	16.2	16.0	15.7	15.4	15.1	14.9	14.6	14.4	14.2	14.0
6.1	5.6	600	19.2	18.8	18.5	18.1	17.8	17.4	17.1	16.9	16.6	16.3
		50	22.4	22.0	21.5	21.1	20.6	20.2	19.8	19.5	19.1	18.8
7.5	4.6	700	26.0	25.5	24.9	24.3	23.8	23.3	22.8	22.4	21.9	21.5
		50	29.9	29.3	28.6	27.9	27.2	26.6	26.0	25.4	24.9	24.4
9.0	3.8	800	34.2	33.4	32.6	31.7	30.9	30.1	29.4	28.8	28.1	27.5
		50	38.9	37.9	36.9	35.9	34.9	34.0	33.1	32.3	31.5	30.8
10.7	3.2	900	43.9	42.7	41.5	40.4	39.2	38.1	37.1	36.2	35.3	34.4
		50	49.3	47.9	46.5	45.2	43.9	42.6	41.4	40.4	39.2	38.2
12.3	2.8	1000	55.0	53.4	51.9	50.4	48.9	47.4	46.1	44.8	43.5	42.3

Velocity Compensation (25fps = 1KDA change) Slower MV use Lower DA (15 degree change = 1KDA)
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DTAC RET 2 RETICLE LAYOUT

10 mph	YD	MOA	10 mph	YD	MOA
0.6 moa	**100** yd dot	**0**	**5.8**	**700**	**18.4**
1	150	0.75	6.3	750	20.7
1.4	**200**	**1.5**	**6.8**	**800**	**23.1**
1.7	250	2.7	7.5	850	25.7
2	**300**	**4**	**8.2**	**900**	**28.4**
2.5	350	5.5	8.8	950	31.2
3	**400**	**7**	**9.4**	**1000**	**34.2**
3.4	450	8.7	10	1050	37.4
3.8	**500**	**10.4**	**10.6**	**1100**	**40.8**
4.3	550	12.3	11.3	1150	44.3
4.8	**600**	**14.2**	**12**	**1200**	**48.1**
5.3	650	16.3	© DTUBB Superior Shooting Systems		

DTAC RET 2 Windage Dots are in increments of 5 MPH

2nd Example
4K DA at 800 yards. 87/2590 card shows 28.8. That corresponds most closely to 900 yds on RET 2 card, 28.4, (dial or hold) plus .5 MOA vertical hold for that 800 yard shot. Wind for this shot requires 9.0 MOA for a full-value 10 mph wind, or 4.5 for 5 mph wind. Indication on RET 2 for wind at 900 yards is 4.1 MOA per 5 mph, so double to 8.2 MOA for 10 mph dot and add 8 MOA or 7.2 inches (essentially an 11 mph hold).

3rd Example
6K DA at 1000 yards. Top card shows 42.3 MOA. The nearest on RET 2 card is the 40.8 for 1100 yards and plus (up) 1.5 MOA. Compare with 12.3 MOA correction for 10 mph wind on dissimilar card. The RET 2 1100 yd second dot out is 10.6 MOA, which is 1.7 MOA off. Hold the second wind dot and an additional 1.7 MOA (17 inches), approximately 12.5 mph.

4th Example
3K DA at 650 yards. Dissimilar card shows 19.8. Go to RET 2 and see 20.7 at 750 yards as the nearest match, come down 1 MOA. Wind on dissimilar card indicates 6.1 MOA per 10 mph; RET2 shows 6.3. Hold is slightly less than second wind dot, if full-value 10 mph.

Important!
Now that you've seen the AFN card, RET 2 card, and dissimilar cartridge/bullet combination card use, keep in mind that you must use the current DA firing solution for AFN and the measured distance for wind. For example, at 1000 yards actual and 45° angle firing solution, use the 800 yard solution for AFN and the 1000 yard solution for wind.

DA Adaptability

As you know by now, the DTAC reticle as seen through the scope is designed for a 4K DA firing solution (a specific velocity and BC).

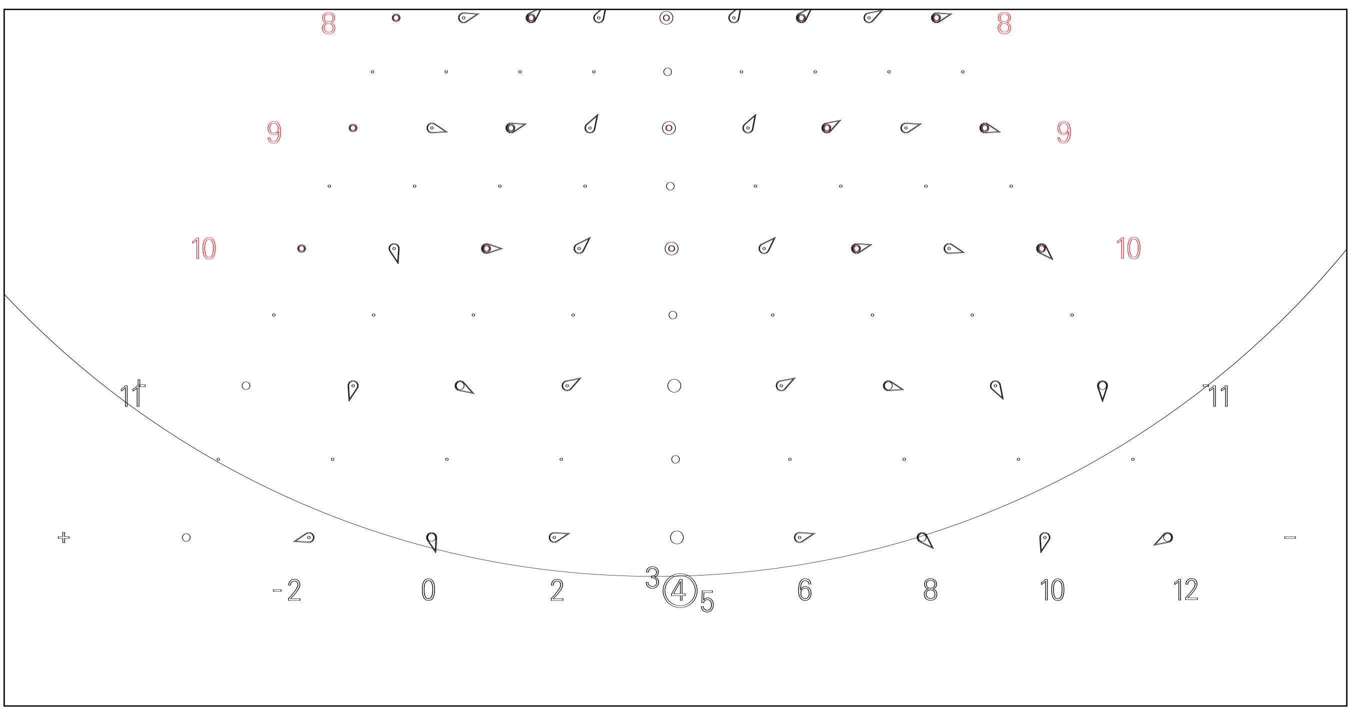
If you look across the bottom of the reticle and see the 2K DA range of corrections (-2K DA to 12K DA) shown by each row of 5 mph windage dots with correction pointers on specific 100 yd increments. The central set of dots shows a circle 4 with a 3 and a 5 at 10 and 4 o'clock respectively.

The 3 and 5 represent a useable change of 1K DA to the entire reticle based on a 25 fps velocity change of the rifle.

The change to a 3K DA reticle represents a -25 fps change in velocity. The change to a 5K DA reticle represents a +25 fps change in velocity.

The Correction Pointers are still correct but now must have a plus or minus one digit change to their DA value.

The 3K DA (-25 fps) changes all the bottom numbers to 1 less than listed. The 5K DA (+25 fps) changes all the bottom numbers to + 1 more than listed.



This is a very useful option since it allows the rifle's velocity to be within 50 fps of the DTAC reticle (+/- 25 fps) and work as intended using the DA correction shown by the Correction Pointers.

If you load your own ammunition and are going to a destination where you know the central DA number (don't forget your DA changes 1K for every 15 degrees of temperature) is 3K DA or 5K DA then you can actually load the ammo to influence your reticle use.

Appendix Materials

A. Atmosphere

This material will further your understanding of the concepts behind the DTAC reticle. We believe that without a good working understanding of the science that supports DTAC methodology you will not fully realize the potential of your scope, or master its use.

First, a few definitions:

Troposphere – This is the portion of the atmosphere extending from sea level up to 36,000 feet. In "standard atmosphere" models, the temperature at sea level (SL) is 59° F and decreases 3.56° per 1000 feet altitude. The air pressure decreases with altitude also. The mathematical model is not simple, but as a rough estimate the pressure decreases approximately 1.0 inHg (inches of mercury) per 1000 feet altitude increase.

Standard Atmosphere Models

ICAO standard
- Altitude = 0 ft. (SL)
- Temp = 59° F
- Pressure = 29.92 inHg (inches of mercury)
- Relative Humidity (RH) = 0%

U.S. Army METRO standard
- Altitude = 0 ft.
- Temp = 59° F
- Pressure = 29.53 inHg
- RH = 78%

The Army METRO standard was used by the military from 1905 up to the early 1960s, when they converted to the ICAO atmosphere. However, shooting sports vendors in the U.S. continue to use the Army METRO even today. This means a commercial ballistics computer program is based on the Army METRO model. Aviation and meteorology use the ICAO model, and this is the model that is used in a *Kestrel 4000*, or any other commercial barometric device.

If you compare standard values of the two models, you will see they differ only in SL pressure and RH. The pressure difference has the biggest effect and is approximately a 500 foot difference in altitude for equal pressure.

Your DTAC Reticle is all based on the ICAO model, but you need to use Army METRO in a ballistics program. How do you convert between the two models? The exact conversion is mathematically complicated, but an approximation is rather easy – let's call the altitude you input into your ballistics program the "Ballistic Altitude," or BA. The formula is simple: Ballistic Altitude equals Density Altitude minus 500 feet.

BA = DA - 500 This means, if you want to compute your trajectory for 2000 ft. Density Altitude, you simply input (2000-500) = 1500 ft into your computer program. Again, the DTAC Reticle is based on ICAO Density Altitude, while computer ballistic programs are based on the Army METRO model. The only time ICAO to Army METRO conversions are necessary is when you are using a computer ballistics program. You should leave all other variables, except altitude, as standard values.

Appendix Materials

Pressure

The actual terms and mathematical models regarding pressure can be very confusing. We will try to present here a simplified summary of the basics, and how to get various information from a Kestrel 4000 or similar data source.

Station Pressure (SP)
This is the actual pressure at your location. Station pressure is affected by altitude and prevailing weather conditions (high/low pressure systems). Standard pressure in the ICAO model is approximately: 29.92 inHg – (1.0)(Altitude[ft]/1000)

Barometric Pressure (BP) "sea level pressure"
This is the pressure reported in weather reports. Barometric Pressure (BP) is SP corrected to sea level (SL) altitude under the ICAO model.

All weather is reported this way so that no matter at what altitude you live you have a frame of reference to know if the pressure is high or low that day. Say you live in Denver at 6000 feet elevation. Your station pressure will likely be around 24 inHg on any given day. Someone hearing the same weather report a couple hundred miles away and a few thousand feet lower would think there is an extreme low-pressure front in the area, when, in reality, the pressure is perfectly normal. Similarly, a weather map showing isobar lines (constant pressure) would be affected by any hills or mountains when the purpose is to show weather patterns, not elevations.

Altimeter Settings (AS)
An Altimeter Setting (AS) is generated from SP corrected for non-standard conditions. AS is the pressure setting a pilot adjusts his altimeter to in order for it to display his actual altitude. (An altimeter is simply a barometer calibrated in units of altitude.)

Altitudes

True Altitude (TA)
True Altitude (TA) is the actual height above (mean) SL. The most accurate data source for determining TA is a topographic map; next is GPS; and the least accurate means is using an altimeter.

Pressure Altitude (PA)
Pressure Altitude (PA) is the altitude in the ICAO model that corresponds to a particular pressure. It would be your altitude if the atmosphere that day was "standard" with 29.92 inHg at SL.

Density Altitude (DA)
This is key to the performance of the DTAC reticle. Think of Density Altitude (DA) as, "The altitude the bullet thinks it is flying at in the ICAO standard model."

In other words, DA is the altitude in the standard model where air density is equivalent to the air density where you are.

[CONTINUED]

There are two aspects to its utility –

1. DA is a single term that adequately describes all other variables typically used in ballistic calculations, which are pressure, temperature, and relative humidity.

2. Density Altitude is easily available from a *Kestrel 4000* “Pocket Weather Tracker” or similar device, or can be reasonably estimated quite simply.

Reducing all atmospheric variables into a single, essentially equivalent variable is a very powerful method which will actually let you become much more aware of how your bullet trajectory is altered by atmospheric changes. For example, if you kept a shooting log book, how would you answer if someone asked, “How much is your trajectory altered if the temperature goes up 10° F?” How about if you climbed up 2000 feet? These questions are hard to answer, but using the concept of Density Altitude and your DTAC reticle you will easily be able to answer those same questions.

DA = PA corrected for non-standard conditions
Hot and/or humid conditions reduce air density and increase density altitude.

B. *Kestrel 4000*

This product by Nielsen-Kellerman (www.**nkhome**.com) and available from Superior Shooting Systems Inc., is the suggested accessory to fully utilize your DTAC scope. They call it a “pocket weather tracker.” Read the *Kestrel 4000* instruction manual thoroughly. The wind meter will get a lot of use, as will the thermometer, and both are straightforward. We need only to discuss three screens –

BARO, ALTITUDE, DENS ALT (Density Altitude)

Here are some suggestions on how to get the most from the unit.

Verify the BARO calibration. At least once a year would be a good idea. Here’s how: (See page 12 of your Kestrel manual.)

1. Go to a local airport where you can get actual altitude and pressure
2. In **BARO** screen, set **REF ALT** to actual altitude
3. With unit on, press the ON/OFF button to get **MAIN SETUP MENU**
4. Scroll down to **SYSTEM** and select it
5. Scroll down to **BARO CAL** and select it
6. Use left/right arrows to adjust pressure to **ACTUAL PRESSURE**

The end result you need is the Density Altitude, and this reading is all calculated out for you and is accurate provided your BARO calibration is proper. The other two screens will prove helpful in other things, such as land navigation, etc., so they should be discussed.

BARO and ALT screens
These two screens are independent of each other (a value in one screen does not affect values in the other screen) for the following reason: A barometer is simply a device that measures air pressure. The air pressure decreases as we go up in altitude. We also know that pressure rises or falls due to weather conditions. An altimeter is simply a barometer whose scale reads altitude instead of pressure. Suppose we have an altimeter and a low pressure front moves in. Since the altimeter is really a barometer that reads in units of altitude, if we watch it we will see our altitude rises even though we haven't moved. What do you do? You need some kind of fixed reference to "set" the unit to correspond to the weather that day (or hour). This is totally unrelated to the BARO CAL discussed earlier. To "set" the Kestrel one must know either actual pressure OR actual altitude.

Known Pressure
Go to **ALT** screen and set **REF PRESSURE = KNOWN PRESSURE**.

Known Altitude
Go to **BARO** screen and set **REF = KNOWN ALT**. This gives you a BP (barometric pressure)
Go to **ALT** screen and input this BP value as **REF**. You now have a functional altimeter that is only "set" until the weather changes.

If the weather is stable you may be good until the next day, but if any front is moving in (or out) you may need to re-set these on an hourly basis.

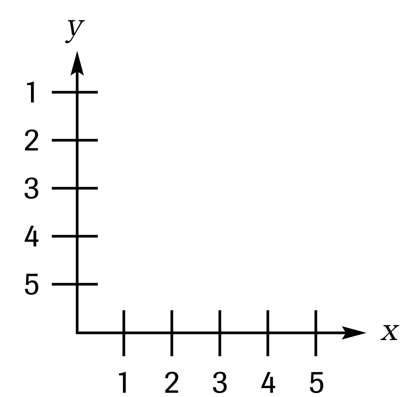
If you have no idea of either actual ALT or actual P, go to ALT screen and set ref to 29.92. If you track weather a bit you may be able to "fudge" the number according to what the weather is doing, but this is still only a guess.

C. Graphs

A graph is a solution set to an equation plotted in a coordinate system. Sounds complex, but it's really easy. Let's build one step by step.

Coordinate System

All DTAC graphs are based on a simple Cartesian System.
One axis goes horizontal (*x*)
One axis goes vertical (*y*)
Both axes have numbered increments
Think of two rulers, sitting 90 degrees apart



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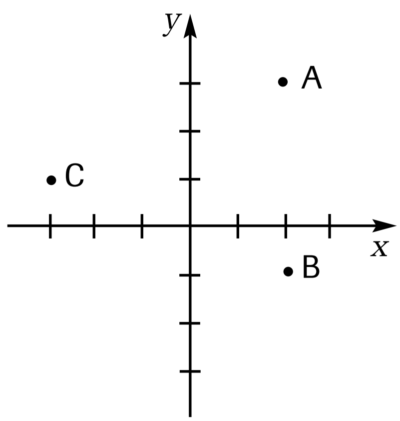
Appendix Materials

Data Points

How do you read or describe a coordinate location? Any point in the graph can be located by two numbers. The first is the "x" value; the second is the "y" value. In written calculations, data points are typically enclosed by parentheses.



A = (2, 3) = over 2, up 3
B = (2, -1) = over 2, down 1
C = (-3, 1) = left 3, up 1

Equations tell how the variables are related. This is the equation used when we built the MIL Calc Graph:

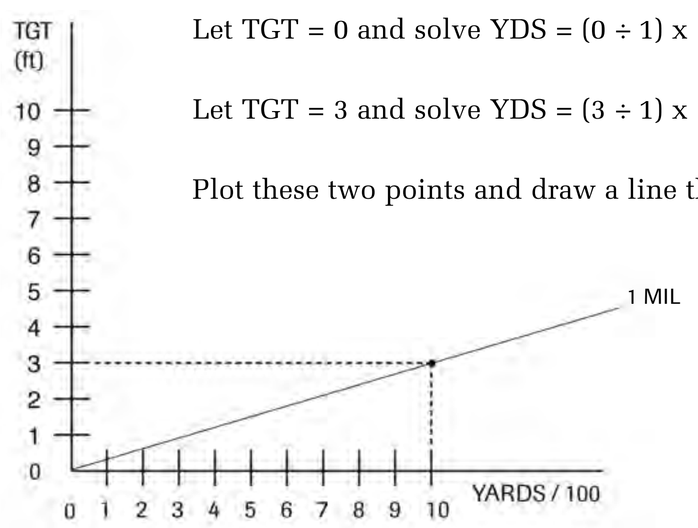
MIL ranging equation –
YDS = (TGT [ft] / MILS) x 333

First, draw the coordinate system –
Now plot the line for all solutions where MILS = 1

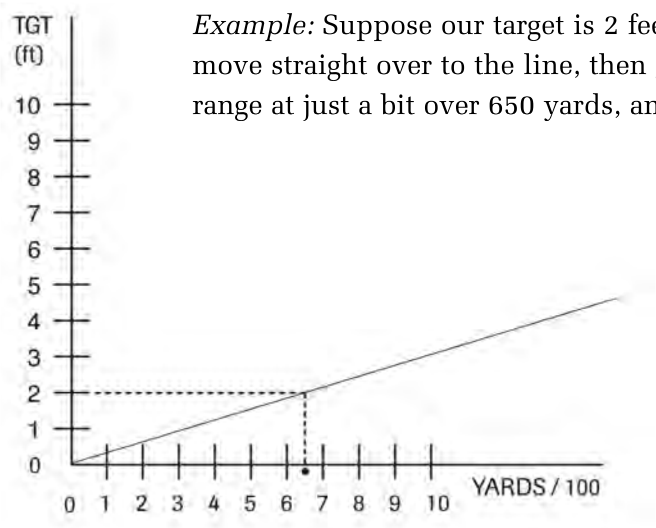
Let TGT = 0 and solve YDS = (0 ÷ 1) x 333 = 0 (0, 0)

Let TGT = 3 and solve YDS = (3 ÷ 1) x 333 = 1000 (1000, 3)

Plot these two points and draw a line through them, then label it "1 MIL."

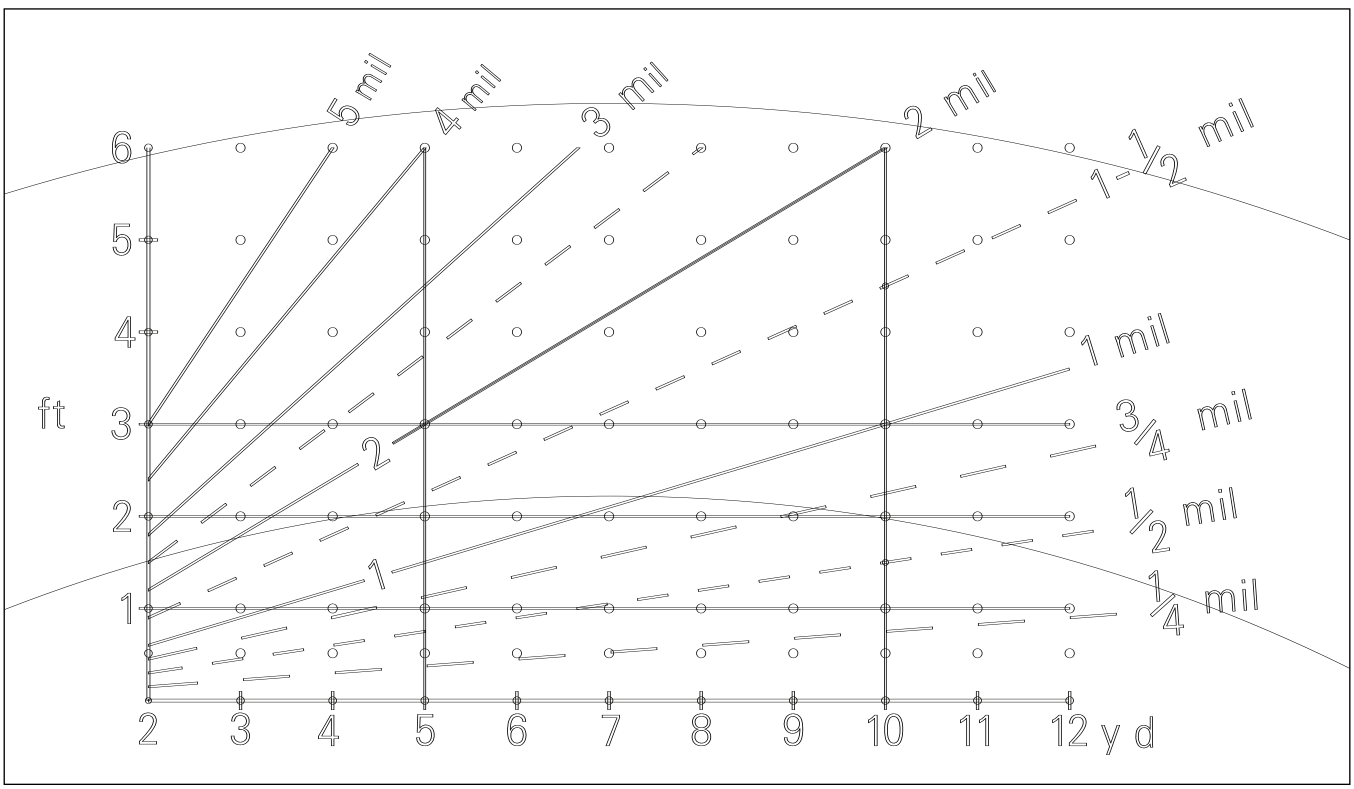


For any range calculation where MILs = 1, we don't have to do any math, just look at the graph.



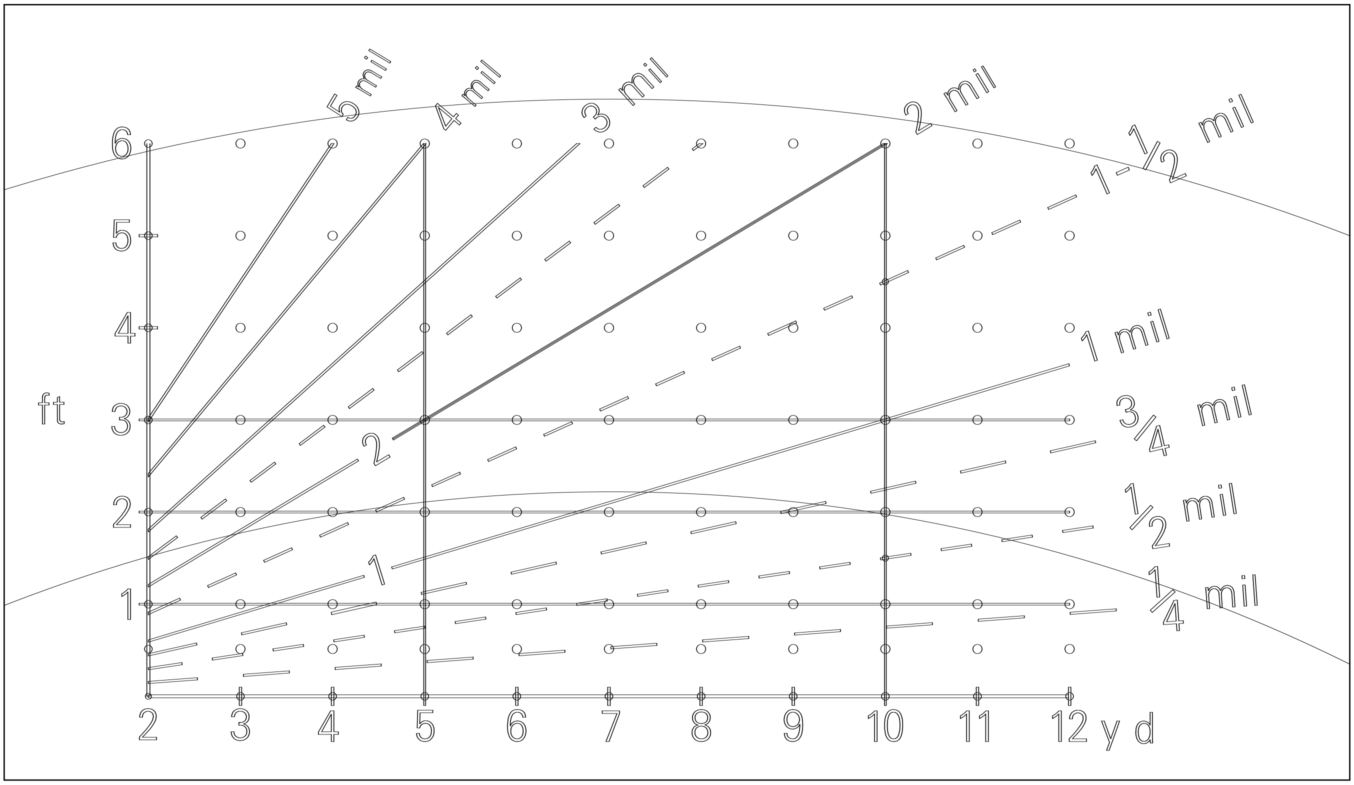
Example: Suppose our target is 2 feet tall. From the "2" on the target size axis (vertical), move straight over to the line, then go straight down to read the range. You should see the range at just a bit over 650 yards, and in fact the exact answer is 666 yards.

If you now plot the lines where MILs = 2, then 3, 4, and 5, you will have a complete graph. Notice we also plotted 1/4, 1/2, 3/4, and 1-1/2 MILS. These are plotted with dashed lines so you know they are fractional MILS.



You will notice all DTAC Reticle graphs have a grid of small circles to allow your eye to move vertically or sideways and helps you to accurately read the graphs.

"Interpolation" is a key skill to develop to maximize your effectiveness with the DTAC reticle. It simply means to (visually) estimate where a certain value would lie on a curve, or what the value is at a



point on a curve. Not only can you interpolate where a MIL line would lie, you can also interpolate target sizes that are not a whole number of feet.

Suppose your situation involves a target whose MIL size is not plotted. You solve this by interpolation. You visually estimate where the line would actually be if it was plotted. For example, let's solve a 1 foot target that is 3/8 MILs. We don't have a 3/8 MIL line, but we know it would lie halfway between the 1/4 and the 1/2. First we find the 1 FT. TGT point on the vertical axis, then follow that row of dots to the right until you are between the 1/2 and 1/4 MIL lines. Since 3/8 is exactly halfway between the two lines, estimate where the row of dots for a 1 ft. TGT is exactly halfway between the lines. Looks like 900 YDS is pretty good. Exact solution is YDS = (1 ÷ 3/8) x 333 = 888 YDS

Example: Say your target is 2-1/2 feet tall and 1 MIL. Looking at the graph, we estimate range is a little under 850 yards.
Exact: YDS = (2.5/1)333 = 833 YDS

It is even possible to interpolate both values.
Example: 3-1/2 ft TGT at 1-3/4 MILS. Looks like a bit over 650.
Exact: (3.5/1.75)333 = 666 YDS
An alternative method is to double or triple all of your values.

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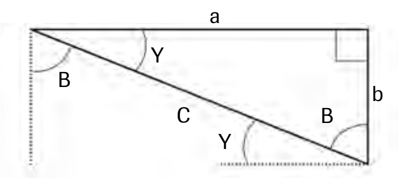
D. Trig

A **Right Triangle** is a triangle with one angle equal to 90°, indicated by ☐ in that corner.
Length of sides = a, b, C

The key concept is that for given angles, the ratio of the lengths are always equal, no matter the particular length. These ratios are called the Sine (SIN), Cosine (COS), and Tangent (TAN).



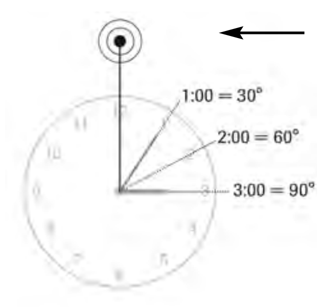
SIN Y = b/C = COS B TAN Y = b/a
COS Y = a/C = SIN B TAN B = a/b

All angles in a right triangle add up to 180°, so angles Y + B = 90°

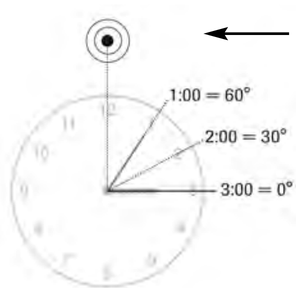
If you have an uphill/downhill shot, imagine C = slant range to target, so horizontal distance to target = a, and COS Y = a/C, so by rearranging then: a = C x COS Y

X-W (crosswind)

Most people find it easiest to estimate wind direction via the "clock" method. Look at the two drawings below and you will see that each "hour" on the clock face represents 30°. The drawing also show two different reference lines, that is the line of your reference "0" angle. Let's assume the wind is from 2:00. If your reference line is from you to the target, the angle of the wind is 60° which is more than the 45° that the SIN/COS Graph reads. So we must use the 3:00 reference line, and the angle of the 2:00 wind is 30°.



Reference line is the line from you to the target.
X-W (crosswind) = (mph)SIN(angle)



Reference line is the line of direct crosswind.
X-W (crosswind) = (mph)COS(angle)

The reference line you must choose is the one closest to the direction the wind is coming from. Your reference line now dictates how you use the SIN/COS Graph, that is whether you must use the SIN or COS.

Wind = 12:00 to 1:30 then use SIN
Wind = 1:30 to 3:00 then use COS

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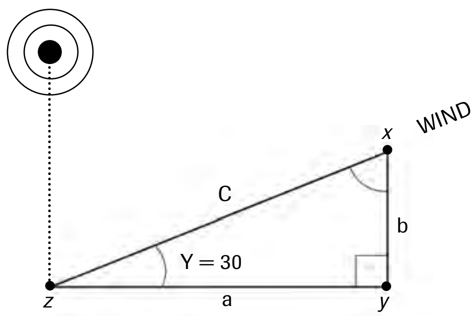
If the wind is from 1:30, this is a 45° angle from either reference line, thus you can use either the SIN or COS. Similarly, wind from 3:00 to 4:30 uses COS; wind from 4:30 to 6:00 uses SIN. Winds from other directions around the clock face follow suit. Again, use the reference line that is closest to the direction the wind is coming from. This line will then show you whether to use the graph to solve for SIN or COS.

Following are a few example problems to illustrate the concepts used to derive the coordinates on the DTAC Reticle COS/SIN Calc Graph.

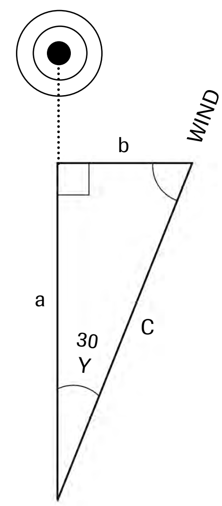
1. Look at X-W (crosswind) with reference angle from 3:00



Wind = 10 mph @ 2:00 = 30° ... so, C = 10, Y = 30
Direct X-W value = a, so solve for a ...

COS Y = a/C, so a = C x COS Y
= 10 x COS 30
= 8.6 mph

The key concept is that wind is a vector force. This means it has magnitude (mph) and direction (angle). The wind blows along line C. We have broken the vector C into two equivalent vectors a and b that when added together equal C. Think of walking from point *x* to point *z*. You can follow line C but equivalently you can walk from *x* to *y*, then from *y* to *z*. In X-W, the portion of C represented by length b is a minor headwind or tailwind which we can ignore, thus effective X-W = a.

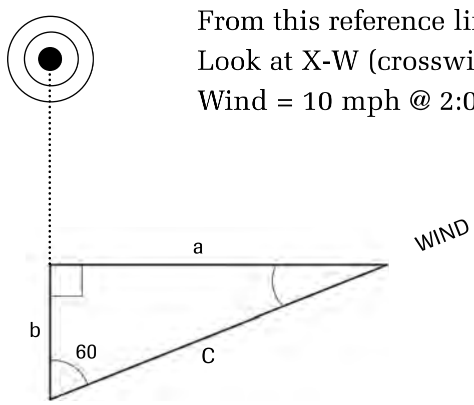


2. Same basic problem but different reference line. 10 mph wind @ 1:00 = 30°. Here, effective X-W is b. SIN Y = b/C so b = C x SIN Y, if C = 10, Y = 30, then b = 5 mph.

Back to problem 1., but with a different reference line —

From this reference line, the angle equals 60°
Look at X-W (crosswind) with reference angle from 2:00
Wind = 10 mph @ 2:00 = 60° ...

SIN Y = a/C so, a = C x SIN Y
= 10 x SIN 60
= 8.6 mph
SAME ANSWER



In the field, all that is necessary to employ the DTAC Reticle is knowing whether to use the SIN or COS function.

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E. Atmospheric Effects on Bullet Flight

When the bullet leaves the muzzle gravity starts pulling it downward, and at the same time we know the velocity starts to decrease. Nothing new here, but why does the velocity decrease? The answer to this is DRAG, and the amount of drag depends on how dense the air is. How is it that the AIR DENSITY is the cause of drag? Imagine you have two buckets with a dollar bill in the bottom of each and you fill one bucket with popcorn and the other with sand. Which dollar bill will be easiest to reach through the material and grab? We know it's the bucket filled with popcorn, but why? The reason is that in order to push your hand to the bottom of the bucket your hand must push aside any material in its path. We all know it is easier to move a light object than a heavy object, and for a given volume (the amount of space our hand and arm displace in the bucket), the weight of popcorn our hand displaces is lighter than the equal volume of sand.

Density is simply the weight of material occupying a specific volume of space. Air is comprised of many billions of tiny lightweight molecules the bullet must push aside on its way to the target. Each molecule the bullet hits robs the bullet of a tiny fraction of its energy, and thus the bullet slows down. So if the air is less dense in one condition our bullet does not experience as much drag force against it and so it slows down at a lower rate and is traveling faster than normally expected when it arrives at the target. This means its time of flight is shorter, and hence gravity does not have as much time to pull it downward and thus your shot goes higher than you would see in a denser air condition.

How do atmospheric conditions alter the density of air? If you have used Sierra's Infinity program you know it has inputs for the following variables in the "Environmental Parameters" input window :
1) Barometric Pressure
2) Altitude
3) Temperature
4) Humidity

The atmosphere changes all the time. We have storm fronts, cold fronts, warm fronts, Hi's and Lo's, etc. This makes it impossible to derive a set of equations that positively states what the density, pressure or temperature will be at X foot altitude. Yet we need some reasonable estimate of these things for many reasons, among them ballistics, aviation, weather forecasting and defense systems. What was done was to create a 'Standard Atmosphere Model'. This is like an 'average' atmosphere, and actually there are many different models. The US Army, around 1905, created what is called the 'Standard Metro' model and it was used by the military for ballistics until the early 1960's. It is still used by the shooting industry to this day because of all the accumulated data created using it as the standard. The aviation industry and weathermen use an atmospheric model called the 'ICAO' which stands for International Civil Aviation Organization. These models are simply a set of sea level reference measurements and equations that 'predict' how the variables change with altitude that describe the 'standard' atmosphere on an 'average' day.

Let's now look at our parameters. The first we will address is actually the most complex since there are several ways to input the data, and that is PRESSURE. Let's start out by looking at the primary cause of atmospheric pressure. Imagine you have a plastic tube 1 ft in diameter and for example 15 miles tall.

We now fill the tube with ping-pong balls, with each ball representing a molecule of air. The balls at the bottom of the tube have the weight of all the balls above them pushing down and squishing them into a tightly packed mass. Towards the top of the tube there are not many balls pushing down on them so they don't get squished as tightly together. Not only that, but the higher you go the force of gravity pulls down less on the top balls than it does the lower balls (remember that in space you are 'weightless'), so the top balls actually 'weigh' less than the bottom balls. This is an analogy of what causes pressure in our atmosphere, and as a point of interest, three fourths of the weight of the entire atmosphere lies in the bottom 7 miles, while what we define as the atmosphere extends several hundred miles above the earth. So we know conceptually that we need to input pressure but here is where it can get confusing. We don't always have a means of measuring the pressure or have access to the weather report, but we almost always have a rough idea of our altitude, or if we are traveling to shoot we can look up the altitude we will be at. So, inputting altitude is one means of inputting your 'pressure' data, since we have seen via the tube of ping-pong balls that as we go up the pressure decreases. Infinity then uses the equations of an atmospheric model to calculate what the 'standard' pressure should be. Alternatively, suppose we hear the weather report, which gives us the 'Barometric pressure'. Even this has to go through a calculation inside Sierra’s Infinity before it is used because it is still not the actual pressure at our location. The reason is that the term 'barometric pressure', actually means 'what the pressure would be if our air mass was at sea level altitude'. Since we may or may not be at sea level it has to be corrected for our altitude before we can calculate the air density and thus the ballistics of our bullet. The actual pressure is usually referred to as 'Station Pressure'. That is the pressure we would see if we had an instrument at the range with us that measured the specific pressure where we are. To summarize all this let's define them again.

1) Station pressure is what we really need to know. It is the actual pressure at our location.
2) Barometric pressure is what the weather report gives us. It is the pressure our air mass would have if it were located at sea level where the altitude is '0' feet.
3) Altitude can be used with the mathematical model for a 'standard atmosphere' to predict what the actual pressure ought to be under standard conditions.

Our next input is TEMPERATURE. Most of you already understand that hot air expands, so a given amount (weight) of hot air will occupy more volume than cold air which means hot air is less dense. An interesting experiment is to blow up a balloon and measure it's diameter. Now put it in your freezer for a while to chill the air inside the balloon. Measure it when cold and it will have a smaller diameter, which means less volume. We know the same number of air molecules are still inside the balloon (discounting the inevitable slow leak), so the air still weighs the same. Since it has less volume for the same weight that means the colder air has more density than the warmer air. Many of you also know the temperature decreases as altitude increases which indicates the density should increase with altitude. It does slightly, due to this effect, but the pressure decrease with altitude has a much greater effect on air density so the net effect is decreasing density with increasing altitude. Where temperature is important to us is to realize that for a given pressure, an increase in temperature leads to a decrease in air density.

The final input is HUMIDITY. It is counter-intuitive but humid air is LESS dense than dry air. Let's take a look at what AIR is comprised of to start understanding why this is so:

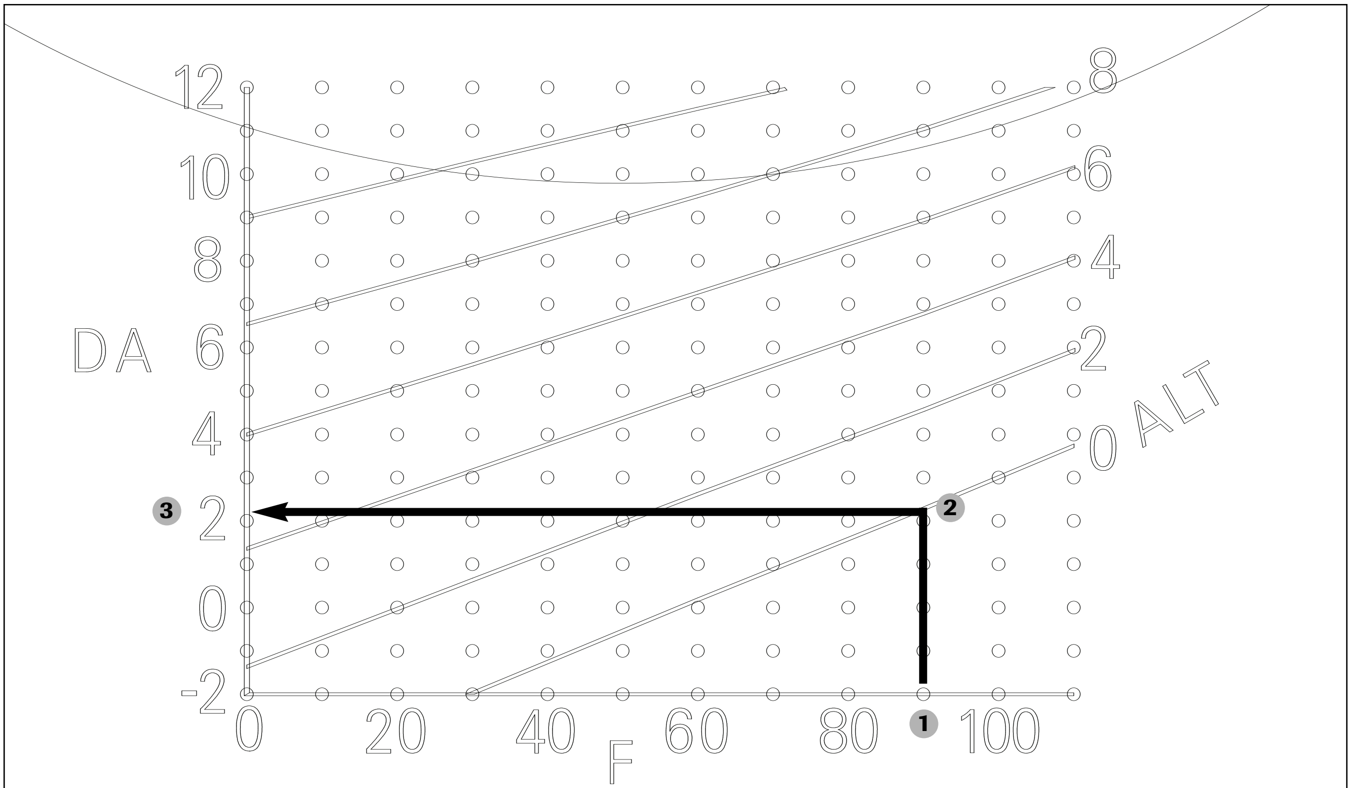
1) Nitrogen = 78%, atomic weight of 14 and molecular weight of 28
2) Oxygen = 21%, atomic weight of 16 and molecular weight of 32
3) Trace elements comprise the final 1% and are not important here.
4) Water vapor, or water molecules in a gaseous state.

A molecule of either nitrogen or oxygen has 2 of their respective atoms in that molecule, so that is why the molecular weight is simply twice the atomic weight. We now need to know what the molecular weight of air is. We will just use nitrogen as 80% and oxygen as 20% so:

(0.80) * (28) + (0.20) * (32) = 28.8 but let's call it 29 for simplicity. This is the molecular weight of air. Now we need the molecular weight of water, which has 2 Hydrogen atoms (atomic weight = 1) and 1 atom of oxygen with atomic weight 16. This gives us an atomic weight of 18 for a water molecule. Putting it into a table form: (if you didn't follow the above, all you need to know is the following)
1) Air molecule weight 29
2) Water molecule weight 18

Here is the last piece of the puzzle. There is a physical principle called the 'Ideal Gas Law' which states that for a given temperature and pressure, there is a constant number of gas molecules in a specific volume of space. Let's take a look at a cube of air in the atmosphere 1 foot per side. It is at a constant temperature and pressure and is full of only air molecules because the humidity is 0%. Now, without changing anything else, let's say the humidity increases to some percentage. This means a bunch of water molecules come into our 1 cubic foot of space and following the ideal gas law that means they kick some of the air molecules out of our cube. Now look at how much the cube of air weighs…it used to be full of only air molecules which each weigh 29, but now it has the same number of molecules and some of them only weigh 18 so the entire cube of air now weighs LESS. It still has the same volume so that means the density is LOWER when we have some humidity in our cube.

We have now explored how and why atmospheric variables affect our trajectory. Everything points back to the air density. The parameters we have discussed are the basic, standard measurements that are made to quantify the air density. Pilots have need of this same information as well, since the air density effects the performance of aircraft such as how long of a runway do they need for takeoff in a given air density condition. Rather than have equations to calculate the actual air density they have long used a simple graphical chart that gives them a value they call 'DENSITY ALTITUDE'. This is simply the altitude in the standard atmospheric model at which point the air has the same density as the air that we are flying- or shooting- in. Using this single term makes it much easier to understand the performance they can expect and we shooters can use it the same way. Why is it easier? The easy answer is because now you have only one variable to account for all other parameters you normally have to factor in. Let's suppose you want to sit down in front of Infinity and compute your ballistic charts for EVERY reasonable situation you could find yourself shooting in. Whether you live in Florida and shoot in warm humid weather or you will be in the Rockies at 7,000 ft in freezing cold. How many tables will it take you to encapsulate all of this data? Well, we know we don't need to make a chart for every single degree of temperature change or every single foot of altitude and every percentage point of humidity, but let's say every 10 degrees from 0 F to 100 F and every 1000 ft from sea level to 7000 ft, and every 25% change in humidity. That requires 440 charts you need to compute and carry around with you, but you will be prepared! It is unlikely anyone would go to that trouble. Now suppose we utilize the concept of density altitude. We will make a ballistic table for every 1000 ft of density altitude from sea level to 8000 ft and put that data in columns on one single sheet of paper. We have just reduced 440 charts to a single page, and our information is just as accurate and complete! What does that simplification cost us in effort? We simply need to get the density altitude. In recent years small hand held wind meters have grown more sophisticated and there are units available that will tell you the density altitude simply by turning them on. It's that easy. But wait, suppose you are on an expensive hunting trip and your weather meter breaks or the batteries go dead? It is always good to have a plan, and we will simply do what pilots did for years and years before electronic widgets. We'll have a simple graph with us that performs all the messy math. Let's have a look at this mysterious graph and we'll see how simple it is.



Note: Above 45 degrees, if 100 humidity add 500 feet DA; if 0 humidity subtract 500 feet DA.

First just take a look at the graph to get your bearings:
- temperature scale along the bottom axis
- angled lines of "elevation" that are labeled on the right hand side
- the density altitude is labeled on the left vertical axis of the graph

Let's do a calculation. We are at sea level and the temperature is 90 F. Step one is to find our temperature on the bottom axis where it says "90". Now we follow the line straight upwards until we get to the angled line at point "1" Notice it is labeled "0" out to the right of that angled line to tell us what elevation that line represents. So from point "2" we now go straight left all the way to the left axis where we read the density altitude at point "3" as just slightly more than "2K." The symbol "K" just represents "1000," so in this condition the air where we are has the same density as the air in the standard model does at 2000 ft.

Let's now look at why this system enables us to replace our 440 ballistic charts so effectively. Our first example above gave us an answer of 2000 ft density altitude (I'll just abbreviate it by DA from here on). How many other ways can we get an answer for the DA of 2000 ft? How about 10F at 4000 ft elevation? Same with 30F at 3000 ft elevation, 50F at 2000 ft elevation, and 70F at 1000 ft elevation. This tells us that many of the 440 charts we made for every possible condition are actually the same ballistic data with just a different set of conditions that yielded the SAME air density or density altitude. The concept of DA allows us to organize all of these various conditions under one simple label so we can find and reference it very simply and quickly.

As a parting thought, how many of us make errors or have to stop and think things through when inputting our conditions into a ballistic program. I doubt anyone is confused on how to enter the temperature or humidity, but that still leaves pressure and altitude. Have you ever wondered which one to change? Do I change both? Unless you have a good understanding of how these parameters interact and how the code was written, there is likely some ambiguity and you are not sure if you put the correct data in. How about just inputting one number, and that is your density altitude? It will decrease the likelihood for errors on getting the ballistic information you desire under your specific conditions.

Appendix Materials

F. Mounting the Scope

If you zoom out you will see horizontal levelling marks at the 3:00 and 9:00 positions at the outer edge of the scope. Use these marks against a known horizontal line to align your scope. *The drop dots are not vertical and thus should not be used for this purpose.*

You really should have some sort of leveling device on your rifle. If you go to the 1000 yard line, get zeroed in, then shoot a shot with the rifle noticeably canted, you will see impact a few feet to the side of your aiming point. This does matter. Most levels are made to mount to your scope tube or Picatinny rail. These require you to refocus your eyes to use the level. The TUBB 2000 level (available from Superior Shooting Systems Inc.) is mounted at the muzzle and can be seen with the off eye as you look through the scope and does not require you to change focus (allows one to keep their infinity stare).

All T2K shooters: You should get the rifle fitted to you for cant and buttstock dimensions, then set your level to your specific position, before you even mount the scope.

G. Alternate Calibers

Superior Shooting Systems offers a DA Card system (as illustrated on page 22) that corresponds to a different caliber/muzzle velocity which can be used with your DTAC reticle. This DA Card system expands the utility of your scope. Check www.SuperiorShootingSystems.com or www.DavidTubb.com for more information.

H. Zeroing Your Rifle

We recommend you get a very good 200 yard zero, and then verify your 500 yard dot. This can be done without too much concern for Density Altitude as the corrections for widely varying DAs are less than 1 MOA at 500 yards (for a 6XC). It does present good opportunity to get started learning about DA though, by comparing any point of impact error you may see in this test.

I. Tips & Tricks

Your DTAC Reticle can actually teach you to be a better wind reader. The windage dots are very accurately placed, so if you call it a 10 mph wind and use the correct wind dot and still miss, you get instant feedback so you can gauge what the effective wind really was. The reticle will also help you determine how accurately you must judge both wind and range. Let's say you're not sure if the wind is 5 mph or 10 mph. If BOTH windage dots cover the target, it does not matter. This concept also works in ranging. You think the target is around 550 yards, but both the 500 and 600 yard dots are on target; then you have at least that much room for error in your range calculation/estimate.