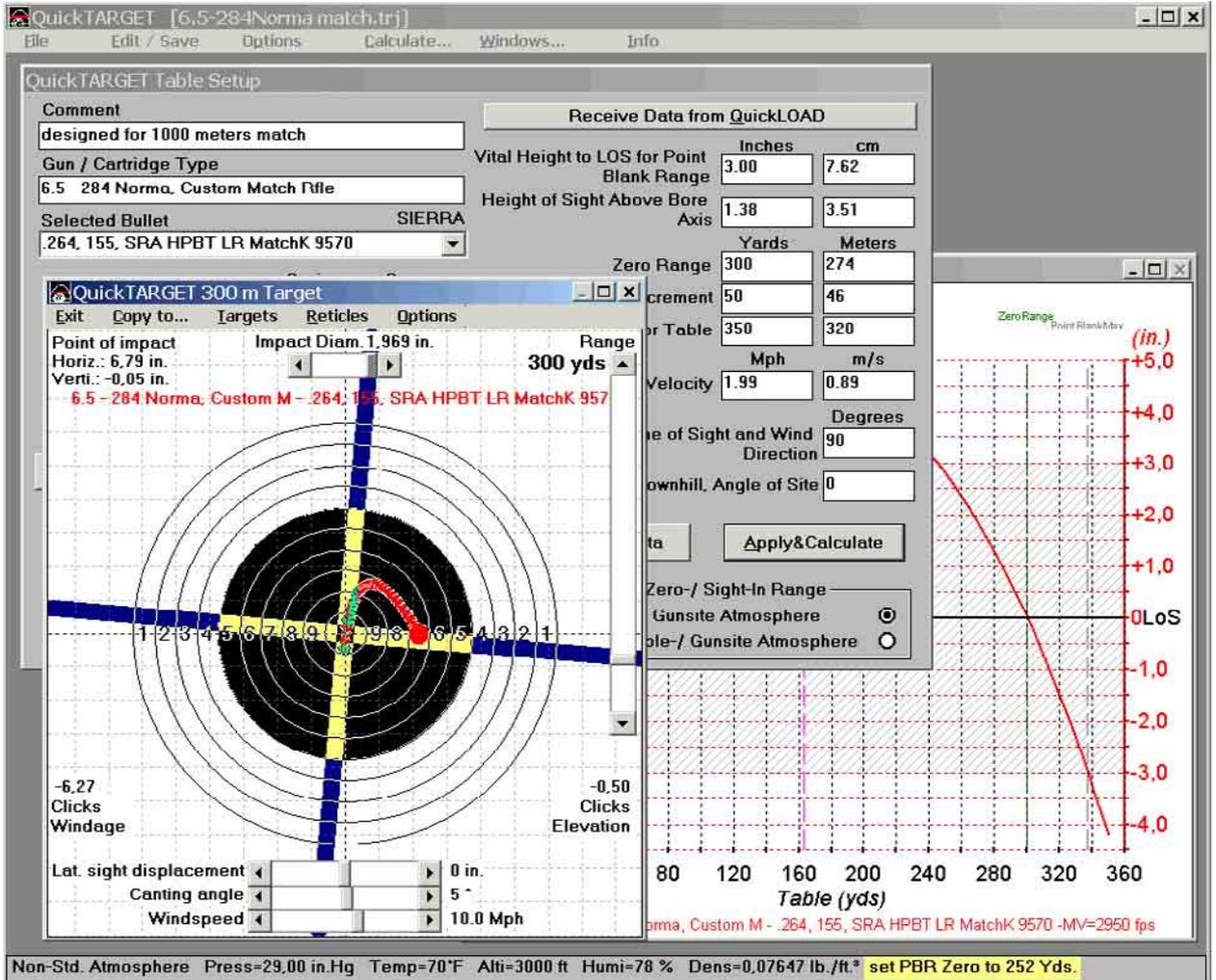


QuickTARGET

User's Manual



Exterior Ballistics Program

Calculation of horizontal trajectories corresponding to G1- or G7-Drag Function

Warning/Disclaimer:

SINCE WE HAVE NO CONTROL OVER EQUIPMENT, COMPONENTS, DATA HANDLOADING TECHNIQUES OR ANY OTHER VARIABLES THAT MIGHT BE USED WITH THIS PROGRAM, NO RESPONSIBILITY IS IMPLIED OR ASSUMED FOR ANY RESULTS OBTAINED THROUGH SUCH USE.

WE SPECIFICALLY DISCLAIM ANY AND ALL LIABILITY, INCLUDING CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER, WHETHER OR NOT ANY SUCH DAMAGES ARE DUE TO USER'S NEGLIGENCE OR BASED UPON STRICT PRODUCT LIABILITY OR PRINCIPLES OF INDEMNITY OR CONTRIBUTION. THE INDIVIDUAL MUST ASSUME THE ENTIRE RISK OF USING THIS PROGRAM AND ANY RESULTING DATA.

In this documentation, the naming of other manufacturer's products occurs exclusively for information purposes. This represents no trademark misuse.

Refer to *QuickLOAD* User's guide for complete information on the software license agreement, applicable laws and regulations.

No part of this document may be copied, reprinted, reproduced or transmitted in any forms or by any means, electronic, mechanical or optical, for any purpose, without the author's express written permission.

Due to continuous program updates, information in this document is subject to change without notice and can differ from the version of the program supplied. Be advised that the current version of *QuickTARGET* may contain useful functions that this manual does not reflect.

All *QuickTARGET* functions are available through standard menu item selections (review the *QuickLOAD* manual for information on choosing menu items).

© Copyright 1995 - 2010, Hartmut G. Broemel, D-64832 Babenhausen / Germany. Worldwide all rights reserved.

Program Installation

QuickTARGET program must be installed together with *QuickLOAD* to and run from a hard disk drive. *QuickTARGET* is automatically installed during installation of *QuickLOAD* and cannot be installed separately.

For Program installation instructions, refer to the appropriate section of *QuickLOAD Manual*.

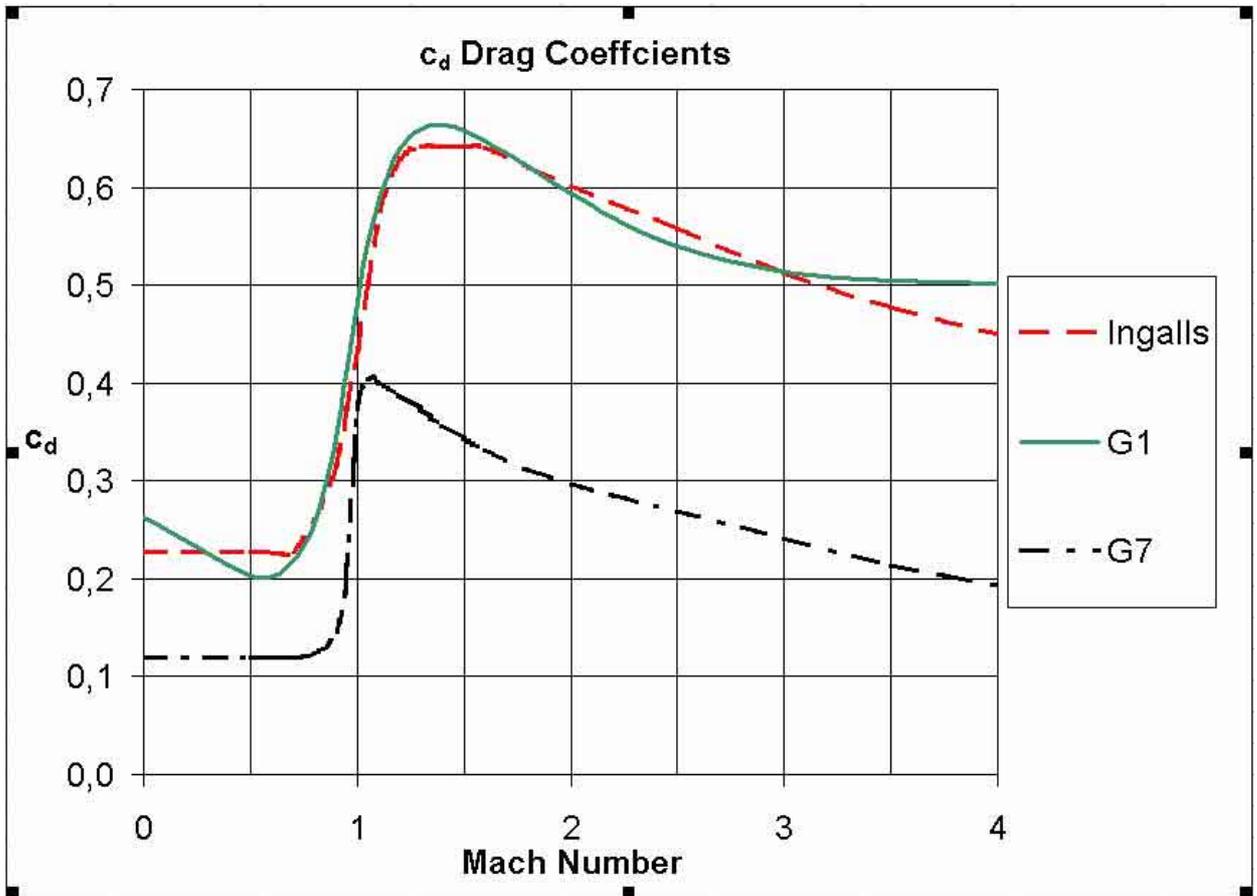
Contents

Warning/Disclaimer:.....	2
Program Installation.....	2
Cd – Drag Coefficient Graph.....	5
Foreword.....	6
Starting <i>QuickTARGET</i>	8
Important keyboard commands.....	9
Main Window.....	9
Table Setup Window.....	10
Main Menu Bar.....	12
Menu Info.....	12
Menu Windows.....	12
Menu Calculate.....	13
Calculate <i>Maximum Vertical range</i>	14
Calculate <i>Maximum Horizontal range</i>	15
Calculate <i>Various "Effectiveness" Estimates</i>	16
Power Functions Menu.....	16
Menu Options.....	17
Menu Options Sight adjustment setup.....	17
Menu Options Target speed setup.....	18
Menu Options Conversion of units.....	18
Menu Options <i>Output window displays...</i>	19
Menu Options <i>Targets</i>	19
Menu Options <i>Group and sight correction</i>	20
Menu Edit / Save.....	20
Menu File.....	21
Window Atmosphere.....	22
Comparison of ICAO to METRO Standard Sea Level Atmo.....	26
Window PVM Chronograph.....	27
PVM COM Port Settings.....	28
Meaning of PVM-Chronograph's Window Elements.....	30
Large display of single shot measurement.....	31
Menu PVM Chronograph File.....	32
Displaying the Results.....	33
Sub menu Copy to.....	33
Sub Menu Output Options.....	33
Output Window Table.....	34
Output Window Table of zero ranges.....	35
Displays Zero Range Table Clicks of correction.....	36
Output Diagram Momentum Graph.....	36
Output Diagram Drop.....	37
Output Diagram Line to Target.....	37
Output Diagram Line of Sight.....	38

Output Diagram Crosswind	39
Output Diagram V & E	40
Output Diagram Comparing Trajectories Graph.....	41
QuickTARGET Tools.....	42
Tools windows.....	42
Muzzle velocity from chronotached vel.....	42
Muzzle velocity from trajectory data (group centers)	43
BC from 2 velocities and distance	43
BC from trajectory data (group centers)	44
BC from time of flight and range (distance from muzzle and V_0)	44
Zero range using point of impact at one range	45
Calculation of distance to trajectory peak using zero range, V_0 & BC. ...	45
Muzzle velocity and BC using 2 flight times at two ranges.....	46
Gyroscopic Stability – Don Miller’s Rule.....	47
Target Window	48
Dark (red) point show target impact, crosswind from left side 5 mph.....	48
Target Window <i>Menu bar</i>.....	49
Target Window <i>Menu Targets</i>.....	49
Menu item <i>Load wmf file</i>	50
Target window submenu item Load Target file	50
Target window menu <i>Reticles</i>	50
Target Menu Options	51
Target Window <i>Set Aiming Point</i>.....	51
Target window with trail of impacts	52
Window Target Group and Sight correction	53
Bullet data window	54
Appendix	55
Target file (*.tgt).....	55
Bibliography	56
List of Illustrations	57

Cd - Drag Coefficient Graph

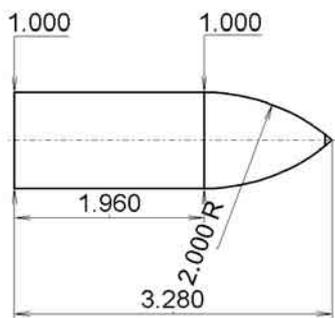
(Ingalls & G1 are very similar)



Picture 1: Drag Coefficient Graph

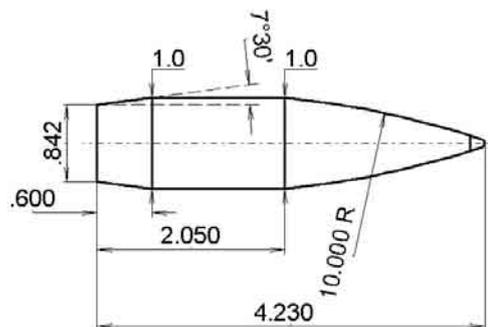
Many standardized drag-functions describing the drag acting on special bullets on their path through the atmosphere have emerged since 1890 and the following fifty years. For comparison the graph of some of the c_d drag coefficient functions is shown here.

The G1 has been the standard for civilian bullets for many years. But only with multiple BC's it can roughly fit the drag of an actual bullet. G7 is the appropriate model for all long ogive spitzer, boattailed bullets and is capable to model the bullet's drag of those bullets with only one single BC.



Picture 2: G1 Projectile

All dimensions in calibers



Picture 3: G7 Projectile

Foreword

QuickTARGET is linked to QuickLOAD, our powerful Interior Ballistics Predictor Program. This version of QuickTARGET provides accurate and complete solutions to many “real-world” external ballistic questions.

To keep exterior ballistics simple, we have made no particular effort toward trying to make QuickTARGET into the ultimate external ballistic predictor program, with all the complications that approach entails – programs that are more complex are often harder to use, like QuickTARGET Unlimited. Therefore, since QuickTARGET is written as a functional extension to QuickLOAD, it is designed to combine ease of use with sufficient power to satisfy the needs of most users.

QuickTARGET uses the G1- or G7- drag function together with Siacci’s solution. This method was used to develop the trajectory tables found in most handloader manuals in the USA. Meanwhile for spitzer, boat-tailed bullets the G7 function should be used. For more precise G7-calculations QuickTARGET-Unlimited should be used, because the only published G7 space- and time-coefficient tables are very inaccurate but used with QuickTARGET.

The original G1 projectile model was established as a spitzer pointed bullet with a flat base and a length 3.28 times its caliber (diameter). Length of ogive head was 1.32 times caliber with an ogival radius of 2-calibers. Testing was done from 1922 through 1926 at the *Aberdeen Proving Ground*, to evaluate G1, and other, G functions. Results of those extensive tests were published in tabular form. G-functions are slightly modified versions of the French Gâvre Commission drag function tables (published in 1898).

The Russian Colonel *Mayevskii* studied firings in Meppen 1881 (at *Krupp’s* proving ground). He expressed projectile retardation (air resistance) that was proportional to a power of velocity within a restricted velocity range. Using the *Krupp’s* projectile, he calculated ballistic tables using a constant factor (later called Ballistic Coefficient – BC) for a 3-caliber long, 2-caliber ogive projectile.

Note, this is unfortunate because Ballistic Coefficient (BC1) is linked to drag function (G1) and is not a constant but a variable and is related to bullet’s velocity relative to air. Nevertheless, the BC method was soon thereafter almost universally adopted for small arms external ballistic calculations. Normally, when developing ballistic equations for exterior ballistics, there is no such thing like BC is. BC it is an artificial coefficient, a crutch, to correct a known drag function to a projectile which has different drag function. To this day, among amateur ballisticians, there is considerable confusion about what BC is and what it does. Ballisticians fire bullets across modest ranges and then choose a drag function and BC that seem to fit the recorded results. However, since BC is velocity dependent, the value assigned is more or less approximately valid and then, only for a specified velocity range. Today’s radar instrumentation is the state of the art technology to record the bullet’s movement along its path through air. Radar utilizes the very exact determination of a specific drag function for each bullet as it is used in more modern programs used by military departments. With knowledge of the particular drag function of a bullet the BC becomes obsolete.

But for amateurs’ use it is easier and much cheaper to record bullet’s time of flight over specific range and then calculate a BC relative to a standard drag function.

Note that Sierra offers several, velocity dependent, BC values for most of the bullets in their extensive line. In reality, any reported BC value could not be precisely accurate at more than one specific velocity. These errors introduce minor inaccuracies into all calculated external ballistics tables.

Colonel *Ingalls* translated Colonel *Mayevski’s* tables into English units. These tables are still very popular. Since the *Mayevskii-Krupp*, *Gâvre* and *Ingalls* tables are all based upon the same projectile model (3-caliber length) and the G1-projectile differs only slightly (3.28-caliber length), all deliver similar results. Some manuals refer their BC to *Ingalls*, others to G1. There is no practical difference.

To calculate ordinary hunting bullets at supersonic velocities, Siacci’s solution of Exterior Ballistics produces usable trajectory tables out to about 1000-yards so long the trajectory

remains flat (Angle of departure below 10 degrees). Sufficient loss of correspondence with reality occurs when using G1 or Ingalls-tables to calculate external ballistic information at significantly longer ranges. with poor BCs or low velocities.

This creates a problem for those many competitors who participate in "long-range" target shooting. This is especially true when projectile velocity drops almost to the speed of sound. *QuickTARGET* can calculate trajectories for ranges out to 2000-meters. However, the user must consider that *QuickTARGET* will only produce useful predictions for supersonic projectiles in a relatively flat (level fire) trajectory.

For calculating long range ballistics for low drag (very long boattail) bullets, *QuickTARGET* utilizes a bullet-specific drag function. This allows use of up to five different BCs (for five velocity ranges), as an acceptably accurate substitute for the correct function.

For modern boattailed bullets with long spitzer ogive a G7 BC will be a more appropriate solution.

(Recall that BC is velocity dependent as drag function itself is, but it is assumed to be velocity independent in the calculations, so far only one overall BC is known.)

A program named *QuickTARGET-Unlimited* is included in this software package to accomplish more complicated tasks like above mentioned „Long Range“ shooting. This program solves the exterior ballistics equations of motion by numerical integration. This is independent of G-functions, but they are allowed to be used and can be handled. The program uses the drag of the bullet, environmental data, global firing position and firing direction. This utilizes more exact calculations of trajectories for unlimited ranges and trajectories with greater curvature.

Part of this code is partially implemented in the current version of *QuickTARGET*, a so called Modified Point Mass (MPM) model. For example, the user can calculate maximum projectile range, for horizontal fire, and maximum trajectory height, for vertical fire.

QuickTARGET G1 model returns acceptably accurate results to these interesting questions, but include always a slight error by using Siacci's model with the faulty BC1-G1 combination given for the bullet to compute the drag function needed and not a bullet specific drag function. Berger Bullets begins to publish more G7 BC's for their bullets. The long range shooter should use the G7 BC whenever it exists.

Hartmut G. Broemel, January 2010

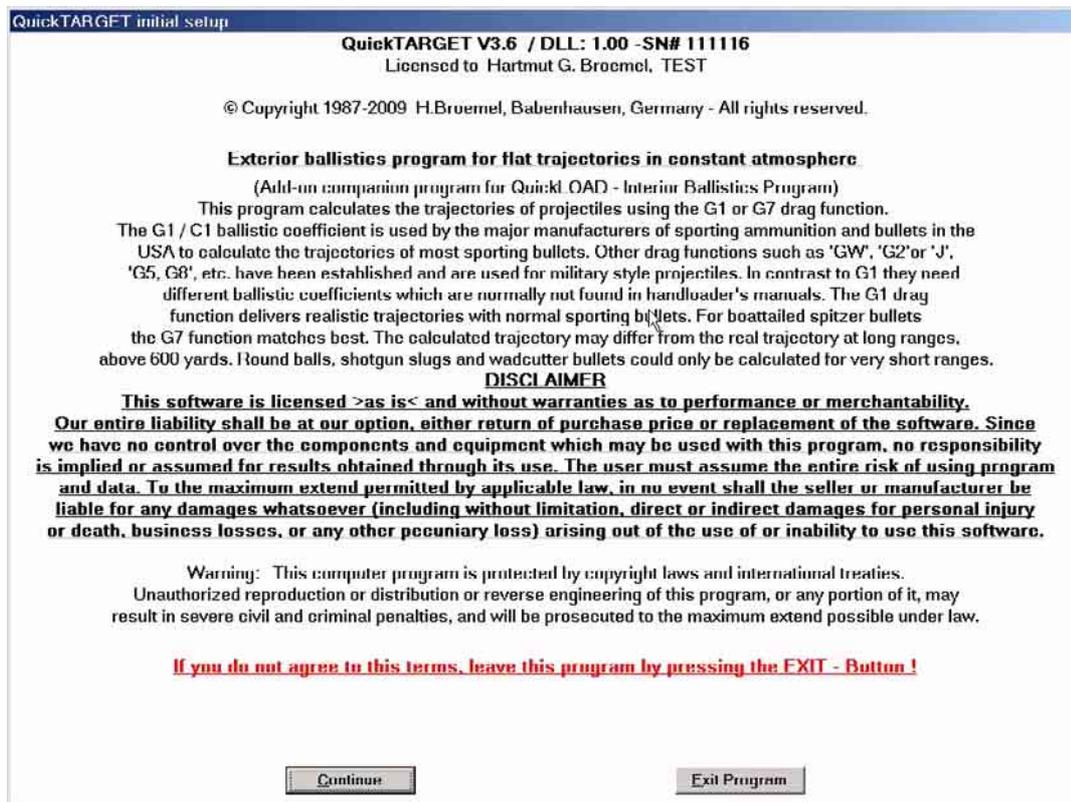
Starting QuickTARGET



Double-click program icon:

QuickTARGET

After a few seconds of load and check time a text window with useful hints and warnings appears. Please read this text carefully. When you understand what it says, select the appropriate button, according to your decision.



Picture 4: Start and Disclaimer window

The license agreement and important advisories, which you must necessarily read, are found on the first pages of the *QuickLOAD* portion of this manual. For additional timely and important information, please review the *readme.txt* file on CD.

If the program does not start or aborts without providing an error notification, the program code could be corrupted (perhaps by a virus). The program tests for such corruption and usually provides a Checksum Failure error message. In either case, uninstall program and try to reinstall it from the installation disk.

Error warnings during file loading (*QLOADFW.BUL* or *QLOADFW.INI*) indicate that the reported file is corrupt or does not exist in the program directory.

That result can occur when these files have been edited via text editor inserting or deleting characters. Unidentified characters in those files will also generate an error message. Frequently backup these files onto a floppy disk or into another directory, especially when generating new bullet, case or powder data records.

The file *QLOADFW.INI* contains inputs used in the last computation, option states and important constants that should never be altered. At restart, calculations continue using those values last entered and computed.

Important keyboard commands

To activate **main menu line**, press keyboard combination < ALT > + < PgUp >.

To activate and jump past **opened windows**, press keyboard combination < Ctrl > + < Tab >.

To select or bypass input fields, press < Tab >.

“Arrow” (cursor control) keys also select **input fields**.

To activate **drop-down fields**, press keyboard combination < Alt > + < ↓ > (e.g. Projectile).

Program exit is initiated by pressing < Alt > + < F4 >.

Main Window

When the user accepts the agreement window this window opens:

Picture 5: Main Window

This is where the user inserts all basic gun and load data.

This data entry window allows specification of all data that is essential to trajectory table calculations. The user can enter useful values into all fields. The button **Receive data from QuickLOAD** retrieves values entered in *QuickLOAD* (when that program is running, or the last data *QuickLOAD* has produced.).

All numerical fields automatically convert units. For example, changing bullet mass (weight) in the *grains* field changes bullet mass in the *grams* field and vice-versa.

NOTE: Input character of decimal point is the keyboard “period” character, even when user presses a comma it is converted. This is independent of Windows Operating System “Locale” settings. However, all printed outputs produce a period or comma, according to system settings

(country dependent).

Most fields for numerical inputs verify lower and upper limits for data entry. Violation of these limits produces a yellow field warning of entry error and indicating the valid input range. However, since this program cannot check for simply incorrect entries and because not every out of limit input is checked, it is possible to run calculations with spurious input values.

Table Setup Window

QuickTARGET Table Setup

Comment
Peter Poacher

Gun / Cartridge Type
Steyr Scout 300RCM .300 RCM

Selected Bullet BERGER
.308, 155.5, Berger M T BT #30416

Projectile Weight
Grains: 155.6
Grams: 10.08

Projectile Diameter
Inches: 0.308
mm: 7.82

Muzzle Velocity
fps: 2800
m/s: 853.4

Edit Multiple BCs G1
Std ICAO: 0.464
Std. Metro: 0.472

1. Factor of Form
0.506
0.497

Sectional Density
0.234 lb/sq.in.

Uphill / Downhill Firing
Set Zero Range Refers to Level Firing
Set Zero Range Refers to Slant Firing

Receive Data from QuickLOAD

Vital Height to LOS for Point Blank Range
Inches: 1.97
cm: 5.00

Height of Sight Above Bore Axis
Inches: 1.55
cm: 3.94

Zero Range
Yards: 208
Meters: 190

Range Increment
Yards: 50
Meters: 46

Last Range for Table
Yards: 350
Meters: 320

Wind Velocity
Mph: 5.01
m/s: 2.24

Angle Between Line of Sight and Wind Direction
Degrees: 90

Firing Uphill / Downhill, Angle of Site
0

New Atmo Data **Apply & Calculate**

Atmosphere for Zero-/ Sight-In Range
Equals Table-/ Gunsite Atmosphere
Differs from Table-/ Gunsite Atmosphere

Picture 6: Table Setup window

Entry fields in this window:

- ❖ **Comment:**
 - Information to appear on printout;
- ❖ **Gun / Cartridge type:**
 - Information to appear on printout;
- ❖ **Selected Bullet:**
 - Bullet type; Necessary input, to describe bullet. Drop-down list field enables selection of data from projectile. (Pressing <Alt-s> when cursor is in this field toggles search mode for the whole list, background of field changes to yellow when being in search mode).
- ❖ **Projectile weight:**
 - For calculation of energy;
- ❖ **Projectile diameter:**
 - For calculation of various effectiveness values;
- ❖ **Muzzle velocity (V_0):**
 - For calculations of all data; Range from about 100 m/s to 1370 m/s or 330 fps to 4500 fps.
- ❖ **Edit multiple BCs:** Button or entry fields
 - For calculations of ballistics; enter a single BC or press button for up to five BCs.
- ❖ **Drag Model Toggle-Button**
 - Select either G1 or G7 function. Is also set by selecting a new bullet according to info in bullet file.

BCs are listed in handbooks of projectile manufacturers. *QuickTARGET* can also recalculate BCs using trajectory tables. Please, refer to appropriate published bullet manufacturer's manual to determine reference atmosphere for given BCs.

- ❖ *1.Factor of form:*
 - Projectile sectional density divided by value of BC;
- ❖ Sectional density:
 - According to US-Standards: projectile mass divided by square of projectile diameter;
- ❖ *Uphill / downhill firing:*
 - Select level or slanted (uphill or downhill) firing; enabled when *angle of sight*>0
- ❖ *Vital height to LOS for Point Blank Range:*
 - Radius of "kill" zone on target;
- ❖ *Height of sight above bore axis:*
 - Distance from line of sight to line of bore (taken at muzzle);
- ❖ *Zero range:*
 - Second point where bullet path crosses LOS (maximum 2000-meters);
- ❖ *Range increment:*
 - Distance between table values (2-yards to 250-meters).
- ❖ *Last range for table:*
 - Input, maximum range (up to 2000-meters). Exact value is always a multiple of the chosen range increment.
- ❖ *Wind velocity:*
 - Wind speed in wind direction;
- ❖ *Angle between line of sight and wind direction:*
 - Angle difference between firing direction and wind direction;
- ❖ *Firing uphill / downhill, angle of sight:*
 - Difference between horizontal and angle of firing direction (0° – 90°). Entering an angle activates frame zero range obtained at ; Here you must specify if stated zero range (sight-in) was obtained through horizontal (level) firing. For example, if gun is sighted in when firing level, what happens when firing at the specified slant angle?
- ❖ *Atmosphere for zero / sight-in range:*
 - Choose;
 - Equal to table / gun sight-in atmosphere, no difference
 - Differs from table / gun sight-in atmosphere.

Selecting **OK button** starts new calculation.

Plausibility errors in input values result in a warning beep and a message box display. User must acknowledge and, usually, correct errors.

If zero-range is based upon an atmosphere differing from the atmosphere used for table calculation, two additional windows are opened. First, zero atmosphere window. Then, table atmosphere window.

Selecting **New Atmo.** button opens window to set atmosphere.

Selecting **Receive data from QuickLOAD** reads data from *QuickLOAD*, if available, and starts calculations.

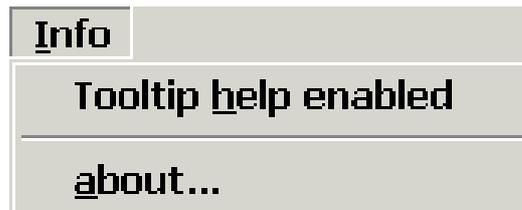
Main Menu Bar



Picture 7: Main Menu Bar

Main menu line contains sub-menus: **File**, **Edit / Save**, **Options**, **Calculate...**, **Windows** and **Info**.

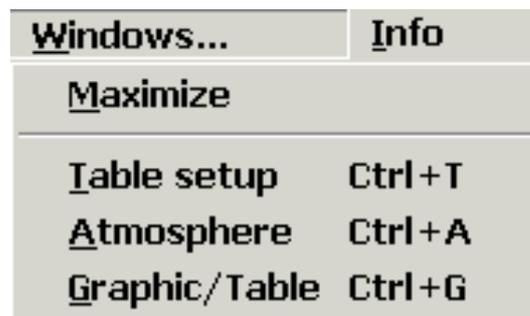
Menu Info



Picture 8: Menu Info...

- *Tooltip help* (enabled), a toggle function – shown enabled;
- *about...*, provides access to the *QuickTARGET* startup screen;

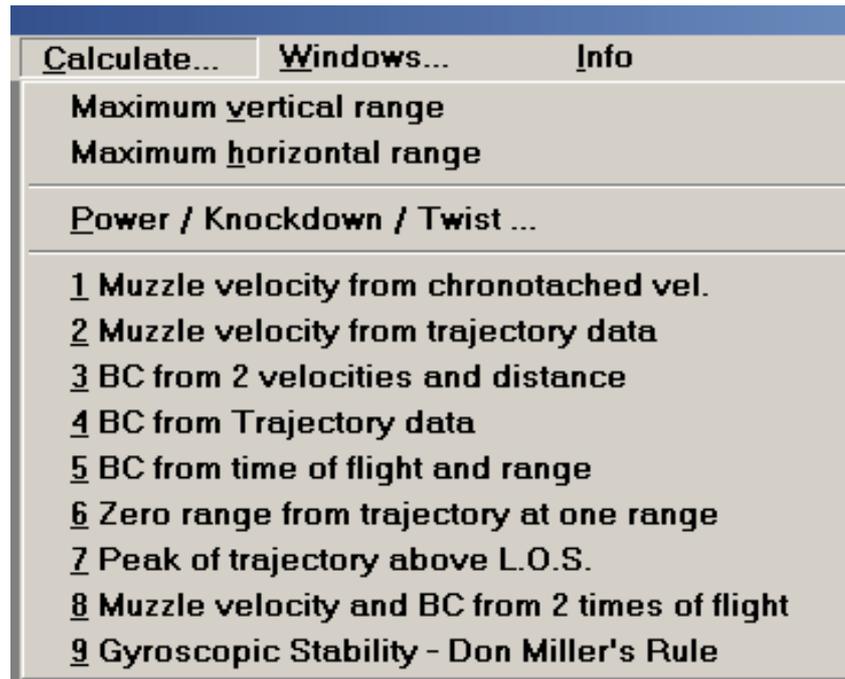
Menu Windows



Picture 9: Menu Windows...

- *Maximize*, enlarges main window to fit total screen;
- *Table setup*, opens basic input table; centers on main window
- *Atmosphere*, recalls basic input table; centers on main window
- *Graphic/Table*, opens or recalls tabular trajectory data table; centers on main window

Menu Calculate



Picture 10: Menu Calculate...

The numbered options open a tool window for calculating each of the following BC and trajectory related basic data:

- ❖ 1 Muzzle velocity form chronographed velocity
- ❖ 2 Muzzle velocity from trajectory data
- ❖ 3 BC from 2 velocities and distance
- ❖ 4 BC from trajectory data
- ❖ 5 BC from time of flight and range
- ❖ 6 Zero range from trajectory at one range
- ❖ 7 peak of trajectory above L.O.S. (line of sight)
- ❖ 8 Muzzle velocity and BC from 2 times of flight
- ❖ 9 Gyroscopic Stability – Don Miller’s Rule

Maximum vertical range, opens this tools window:

Calculate Maximum Vertical range

(Bullet returns tip forward)

QuickTARGET Tools

Calculate the maximum vertical range for this bullet by using an extended G1-drag function with MPM-ballistics model and numerical integration. Std. Atmosphere corrected for altitude only. No wind.

Muzzle velocity	<input type="text" value="2950"/>	fps	Maximum of	<input type="text" value="100"/>
Result: Ordinate of peak of trajectory	<input type="text" value="4194"/>	Yards	Iterations	
Result: Time of rise to peak	<input type="text" value="22.90"/>	sec	Units:	<input type="button" value="English"/>
Result: Time of drop back to gunsite	<input type="text" value="31.94"/>	sec		<input type="button" value="Set Atmo"/>
Result: Total time of flight	<input type="text" value="54.84"/>	sec		<input type="button" value="Cancel&Exit"/>
Result: Velocity at return to gunsite	<input type="text" value="611"/>	fps		
Result: Energy at return to gunsite	<input type="text" value="129"/>	ft.lbs.		

Bullet returns with base foreward

Atmo: Std. ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C -
Gunsite altitude= 0 m - Rel. humidity= 0 % - Calculations finished.

Picture 11: Input maximum vertical range

Calculates various parameters for the selected bullet, muzzle velocity and atmospheric conditions.

Energy of returning bullet, here 155 grains .264 Sierra HPBT is on par with muzzle energy of a .32 Auto pistol cartridge - absolutely dangerous condition!

Note that selection of the *Bullet returns...* box provides calculation for bullets that do not turn over at the maximum ordinate (which can happen with near vertical trajectories), see Picture 12: Maximum vertical range bullet returns base foreward. In this case terminal velocity is lower and time of drop is longer.

Calculate *Maximum Vertical range*
(Bullet returns base forward)

QuickTARGET Tools

Calculate the maximum vertical range for this bullet by using an extended G1-drag function with MPM-ballistics model and numerical integration. Std. Atmosphere corrected for altitude only. No wind.

Muzzle velocity	<input type="text" value="2950"/>	fps	Maximum of	<input type="text" value="100"/>
Result: Ordinate of peak of trajectory	<input type="text" value="4194"/>	Yards	Iterations	
Result: Time of rise to peak	<input type="text" value="22.90"/>	sec	Units:	<input type="text" value="English"/>
Result: Time of drop back to gunsite	<input type="text" value="34.87"/>	sec		<input type="text" value="Set Atmo"/>
Result: Total time of flight	<input type="text" value="57.77"/>	sec		<input type="text" value="Cancel&Exit"/>
Result: Velocity at return to gunsite	<input type="text" value="500"/>	fps		
Result: Energy at return to gunsite	<input type="text" value="86"/>	ft.lbs.		

Bullet returns with base forward

Atmo: Std. ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C - Gunsite altitude= 0 m - Rel. humidity= 0 % - Calculations finished.

Picture 12: Maximum vertical range bullet returns base forward

Maximum horizontal range, opens this tools window:

Calculate *Maximum Horizontal range*

QuickTARGET Tools

Calculate the maximum horizontal range for this bullet by using an extended G1-drag function with MPM-ballistics model and numerical integration. Std. Atmosphere corrected for altitude only. No wind. It is

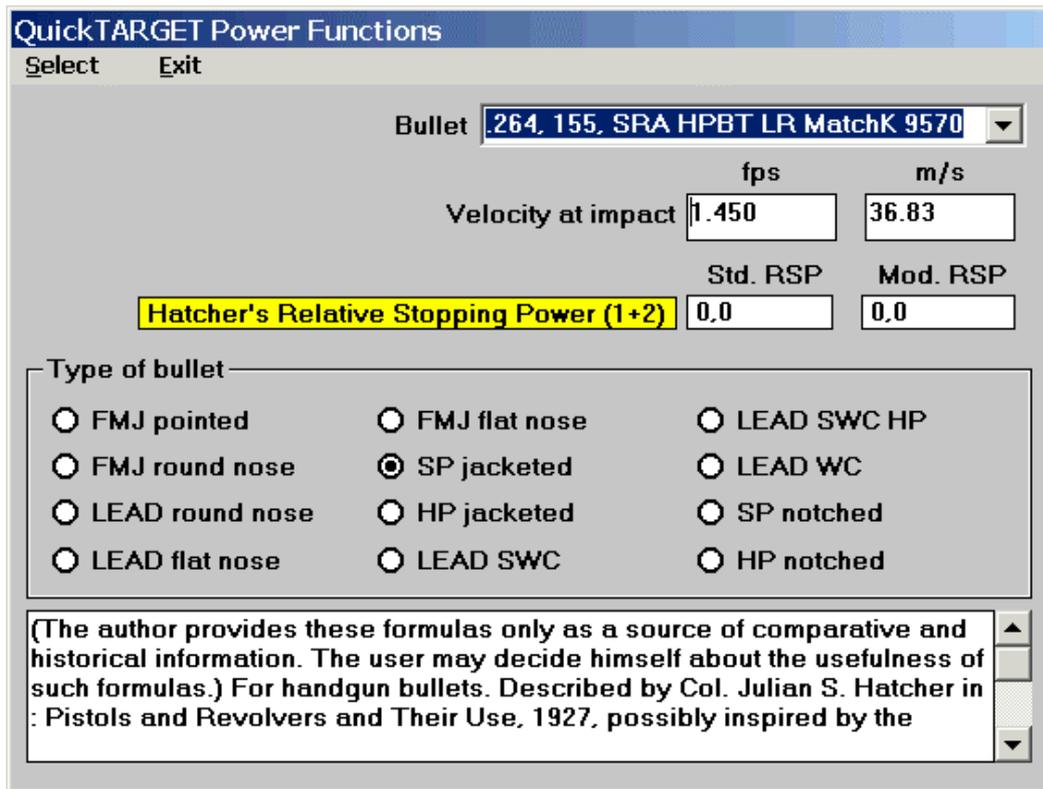
Muzzle velocity	<input type="text" value="2950"/>	fps	Maximum of	<input type="text" value="100"/>
Result: Maximum range	<input type="text" value="5970"/>	Yards	Iterations	
Result: Angle of departure	<input type="text" value="35.6"/>	deg.	Units:	<input type="text" value="English"/>
Result: Time of flight	<input type="text" value="35.0"/>	sec		<input type="text" value="Set Atmo"/>
Result: Angle of impact at max.range	<input type="text" value="-63.3"/>	deg.		<input type="text" value="Cancel&Exit"/>
Result: Velocity at max. range	<input type="text" value="522"/>	fps		
Result: Energy at max. range	<input type="text" value="94"/>	ft.lbs.		
Result: Height of trajectory summit	<input type="text" value="1796"/>	Yards		
Result: Range of trajectory summit	<input type="text" value="3657"/>	Yards		
Result: Velocity at trajectory summit	<input type="text" value="465"/>	fps		<input type="text" value="Calculate"/>

Atmo: Std. ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C - Gunsite altitude= 0 m - Rel. humidity= 0 % - Match found after 23

Calculates various parameters for the selected bullet, muzzle velocity and atmospheric conditions.

Power / Shock / Knockdown..., opens this tools window:

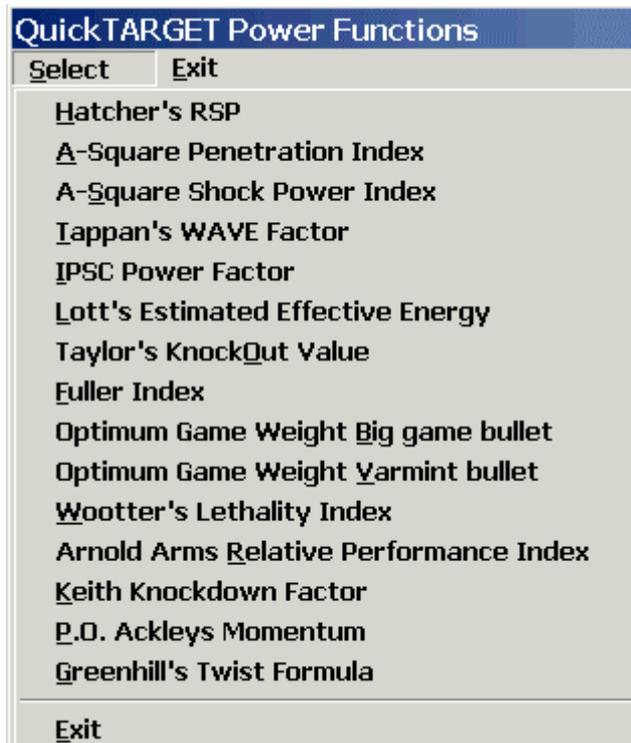
Calculate Various "Effectiveness" Estimates



Picture 13: Power Functions window

Calculates these values for specified bullet type, impact velocity and various other criteria. For history of function see text field in window.

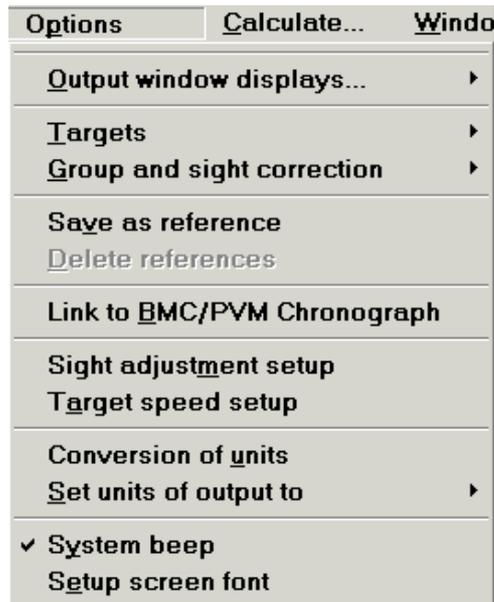
Power Functions Menu



Picture 14: Menu of Power Functions

A selection of various formulas which may be useful or not are provided.

Menu Options

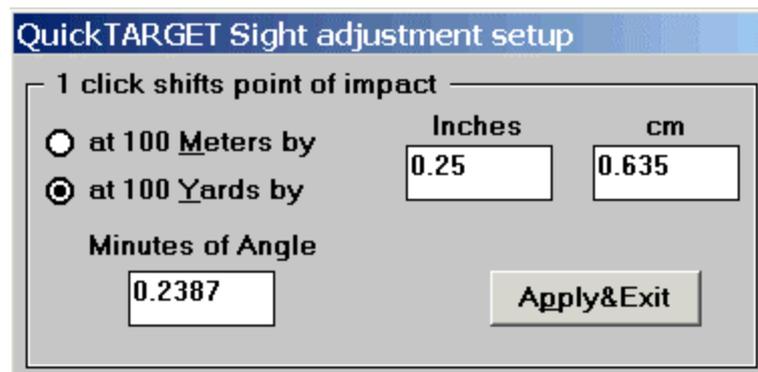


Picture 15: Menu Options

(Note that a valid calculation must exist to enable most of these options. When no valid calculation exists, many are disabled – as indicated by shadow font; for example, delete reference.)

- ❖ *Output window displays:*
 - A sub-menu (explained on subsequent page);
- ❖ *Targets:*
 - Shows selected targets and graph planes with points of impact based upon actual trajectory;
- ❖ *Group and sight correction:*
 - Shows targets where user can specify impact points; Such groups are evaluated and sight corrections calculated.
- ❖ *Save reference / Delete reference:*
 - User can temporarily save valid data; up to 5 traces can be displayed simultaneously; Saved (reference) data is always displayed with newly calculated data, allowing comparisons. function continues until user selects **Delete reference**, saves new data or exits **QuickTARGET**.
- ❖ *Link to BMC/PVM Chronograph*
 - User may connect a PVM Chronograph to read memory of chronograph. Window PVM Chronograph
- ❖ *Sight adjustment setup:*
 - Opens window where user sets scaling factor for adjustment of telescope or other sights

Menu Options Sight adjustment setup



Picture 16: Sight adjustment settings

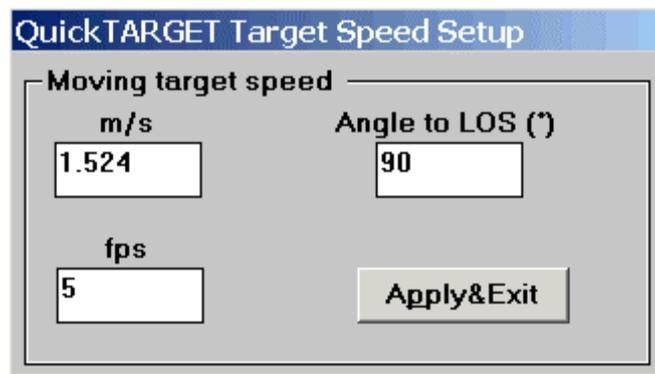
Serves to establish sight adjustment increments, in MOA or clicks, corresponding to graduation of sight adjustment (Windage and Elevation same). Input:

- ❖ 1 Click shifts point of impact:
 - Enter impact shift at selected range resulting from one click or one sight graduation mark (centimeters, inches or MOA);
- ❖ at 100 Meters - at 100 Yards:
 - Select appropriate range.
- ❖ Selecting **Apply&Exit** button closes Window.

In calculated trajectory tables, decimals of clicks are shown.

- ❖ *Target speed setup:*
 - Enter value to calculate target lead;

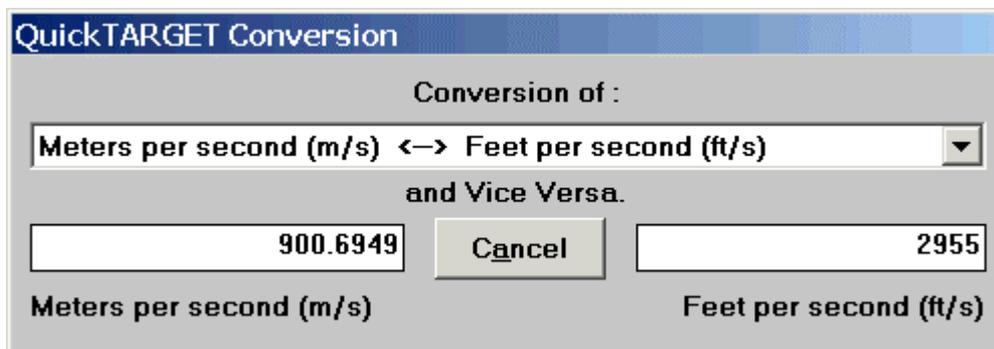
Menu Options Target speed setup



Picture 17: Target speed settings

- ❖ *Conversion of units:*
 - Open window for cross-calculation of various units;

Menu Options Conversion of units

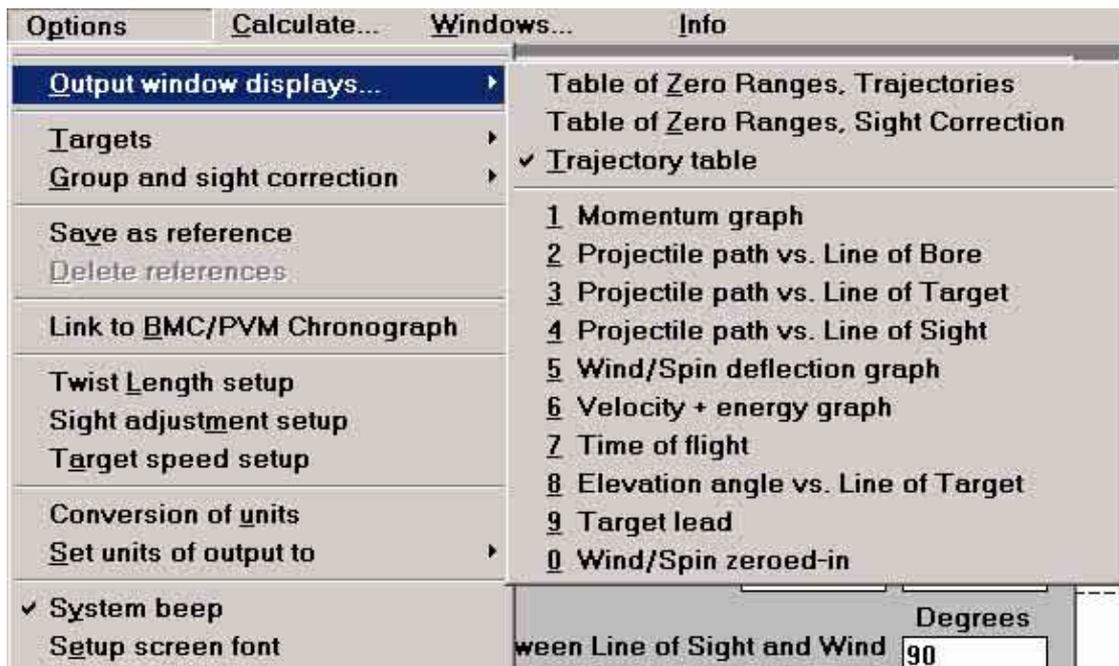


Picture 18: Conversion of Units window

This window provides bi-directional unit conversion. It makes no difference what field or what value is entered.

- ❖ *Set units of output to:*
 - Toggle, *English to Metric*;
- ❖ *System beep off /o n:*
 - Toggle, on to off and *vice versa*;
- ❖ *Setup screen font:*
 - Alters menu font. (Sometimes necessary to eliminate truncated characters., dependent on screen resolution)

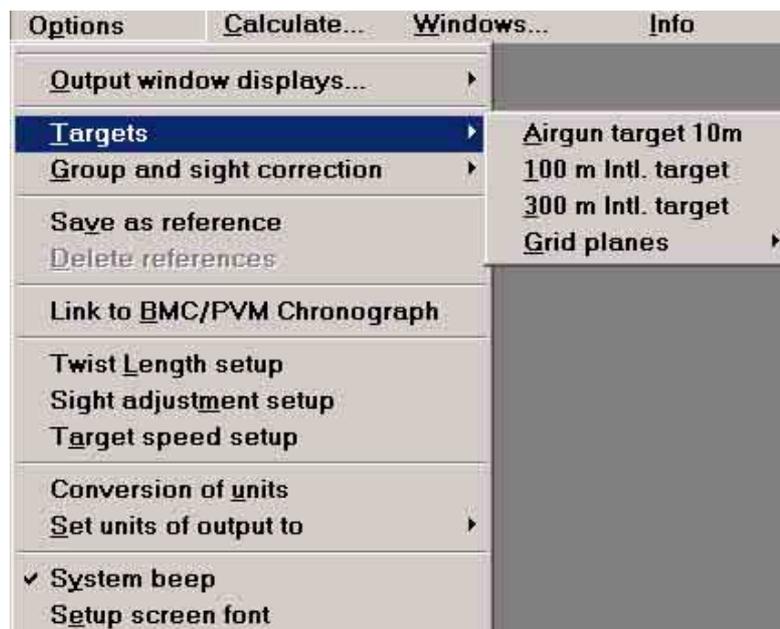
**Menu Options *Output window displays...*
to select from various output options**



Picture 19: Menu Options *Output window displays...*

Each selection provides useful trajectory related output tables or graphs, some of which are described later in this manual.

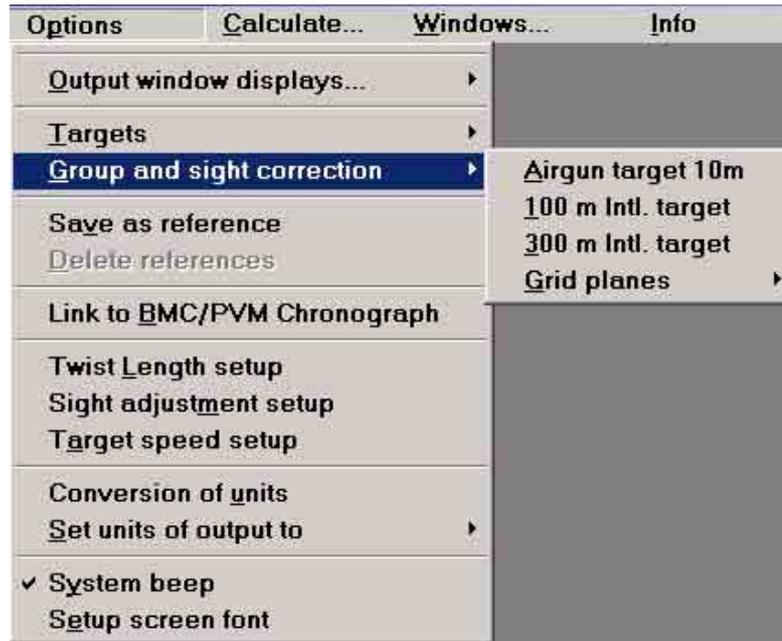
**Menu Options *Targets*
to select from various target options**



Picture 20: Menu Options *Targets*

Each selection provides a representative printable target to evaluate point of impact under various conditions.

Menu Options *Group and sight correction* to make various corrections

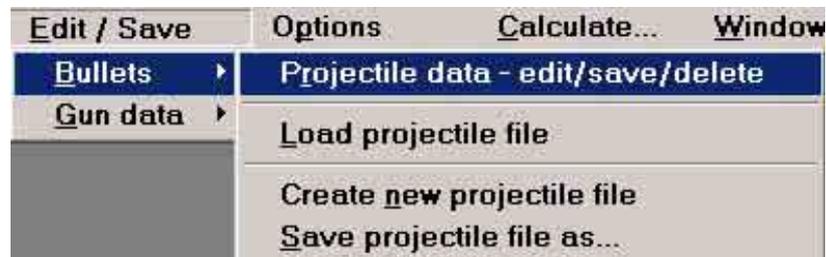


Picture 21: Menu Options *Group and sight correction*

Each selection provides a representative printable target where various virtual sight adjustments result in visual point of impact changes.

Similarly, the remaining options open windows for setting various gun, load and *QuickTARGET* parameters, as described elsewhere in this text.

Menu Edit / Save



Picture 22: Menu *Edit / Save*

For a complete discussion of these various sub-menu options, refer to these functions as described in the *QuickLOAD* users guide.

➤ *Projectile data edit/save/delete:*

- ◆ For opening a window to generate, store and delete projectile data; (Function of that window is explained separately in this text.)

Do not change data in bullet database file when *QuickTARGET* and *QuickLOAD* are running and both programs are using the same file. The file can be corrupted. Make any such changes, when running, in *QuickLOAD*, not *QuickTARGET*. Then in *QuickTARGET*, if necessary, load the altered file.

➤ *Load projectile file:*

- ◆ Activate a different file into *QuickTARGET* memory; After program installation **QLOADFW.BUL** is loaded by default, the user can load a different bullet file; e.g. *speer.bul*, *barnes.bul*, *hornady.bul*, *sierra.bul*, etc.; see *QuickLOAD* Appendix for all bullet files.

➤ *Create new projectile file:*

- ◆ Create a new and empty projectile file;

➤ *Save projectile file as:*

- ◆ User can save the loaded file under a new name.

The user may also select a different gun file and a gun. To create or edit a gun file the program QuickLOAD has to be used.

Menu File

File	Edit / Save	Options	Calculate...	Windows
Calculate Ballistics				
Save as file				
Save trajectory data				Ctrl+S
Load trajectory data				
Delete trajectory data				
Edit title line of printer form				
Printer setup				
Select Printer Font				
Print				▶
Set language to				▶
Exit program		Alt+F4		
Q C:\WINAPPS\vb5\QT_NEW\6.5-284Norma match.trj				

Picture 23: Menu File

- *Calculate ballistics* – sets focus on the *Table setup* window
For a complete discussion of these various save options, refer to the similar functions as described in the *QuickLOAD* users guide (see *QuickLOAD Index*).
- ❖ *Save as file:*
 - Stores all entered and calculated results in an ASCII text file; Opens file dialogue window. This menu point is disabled when no valid calculation results are available.
- ❖ *Save-; Load-; Delete trajectory data:*
 - Save or retrieve complete trajectory data set;
- ❖ *Edit title of printer form:*
 - Change printer form heading;
- ❖ *Printer setup:*
 - Opens window for printer **setup dialogue**; Changes made are valid only within *QuickTARGET*.
- ❖ *Select Printer Font:*
 - Select a font of your choice for printing datasheets;
- ❖ *Print:* User may print results in tables or as graphics
 - Opens sub-menu choices;
 - Two printout style selections are available. Print entered ballistic data with either:
 - Graph of trajectory compared to line of sight, crosswind deviation and a graph showing energy and velocity at various ranges,
 - Trajectory table using entered values and a zero-range table with zero ranges out to 2000-meters (or yards).

Choose number of lines according to paper size. About 30 lines of trajectory table fits on the first printout page. This menu point can be disabled when no valid calculations are available. Printing colors are black on white paper.
- ❖ *Exit program:*
 - Closes *QuickTARGET*, returns operations to Windows or other active program.

Window Atmosphere

(with button **Standard ICAO** selected)

QuickTARGET Atmosphere for table		
Air Density	lb./ft. ³ 0.076474	kg/m ³ 1.225
Altitude above Sea Level	Feet 0	Meters 0.0
Barometric Pressure	in. Hg 29.921	hPa 1013.25
Temperature	°F 59.0	°C 15.0
Relative Humidity	%	
	0	
choose table atmosphere		
Standard <u>M</u> etro, Sea level	<input type="radio"/>	
Standard <u>I</u> CAO, Sea level	<input checked="" type="radio"/>	
User, <u>F</u> ree, Press, Temp, Humid	<input type="radio"/>	
User, <u>A</u> ltitude Dependent	<input type="radio"/>	
Apply&Exit		

Picture 24: Atmosphere window

Establishes atmospheric conditions for table calculations. The user can choose between two fixed standard atmospheres, freely selectable data input or an altitude-dependent calculated atmosphere. According to program course, window **atmosphere for table** or **atmosphere for zero** is opened. Right part of window is only visible during altitude dependent calculations.

Sample shows Standard ICAO sea level atmosphere.

- Air density: Output only.
 - ◆ Shows value from standard data or calculated value;
- Altitude above sea level:
 - ◆ Altitude above or below sea level (Maximum 11,000-meters);
- Barometric pressure:
 - ◆ ICAO standard pressure;
- Temperature:
 - ◆ ICAO standard temperature;
- Relative humidity:
 - ◆ ICAO standard humidity.
- Selecting **Apply&Exit** Button closes window.

Atmosphere window

(with button *User Free, Press, Temp, Humidity* selected)

QuickTARGET Atmosphere for table		
	lb./ft. ³	kg/m ³
Air Density	0.077812	1.24644
	Feet	Meters
Altitude, only for information	2000	609.6
	in. Hg	hPa
Barometric Pressure	29.03	982.90
	°F	°C
Temperature	34.0	1.1
	%	
Relative Humidity	70	
choose table atmosphere		
Standard <u>M</u> etro, Sea level		<input type="radio"/>
Standard <u>I</u> CAO, Sea level		<input type="radio"/>
<u>U</u> ser, <u>F</u> ree; <u>P</u> ress, <u>T</u> emp, <u>H</u> umid		<input checked="" type="radio"/>
U <u>s</u> er, <u>A</u> ltitude Dependent		<input type="radio"/>
Apply&Exit		

Picture 25: Atmosphere window, user defined

Sample shows **User free defined atmosphere; apparently as it exists on sight in range.** Air density is calculated from pressure, temperature and humidity.

- Air density: Output only.
 - ◆ Shows calculated value; from below entered data, calculated according to ICAO formulas.
- Altitude above sea level:
 - ◆ Altitude above or below sea level (Maximum 11,000-meters); User entered value, but serves here only for informative purpose.
- Barometric pressure:
 - ◆ Barometric pressure as derived from weather station;
- Temperature:
 - ◆ Temperature from thermometer reading
- Relative humidity:
 - ◆ Humidity from hygro-meter
- Selecting *Apply&Exit* Button closes window.

Atmosphere window

(with button *User, Altitude dependent* selected)

QuickTARGET Atmosphere for table				
	lb./ft. ³	kg/m ³	table :	
Air density at selected altitude	0.06341	1.01573	Altitude for Calculation	
	Feet	Meters	Feet	Meters
Reference altitude for this atmosphere	2000	609.6	8500	2590.8
	in. Hg	hPa	in. Hg	hPa
Barometric Pressure	29.03	982.90	22.5422	763.36
	°F	°C	°F	°C
Temperature	34.0	1.1	10.8	-11.8
	%			
Relative Humidity	70			
choose table atmosphere				
	Standard Metro, Sea level			<input type="radio"/>
	Standard ICAO, Sea level			<input type="radio"/>
	User, Free; Press, Temp, Humid			<input type="radio"/>
	User, Altitude Dependent			<input checked="" type="radio"/>
Apply&Exit				

Picture 26: Atmosphere window, Altitude dependent

Here user can calculate and set the atmosphere, and therefore air density, for an altitude different from actual position. This sample uses as reference the values shown in previous page at 2000 feet and calculates from that data the corresponding data for an altitude of 8500 feet. Data is shifted about 6500 feet by ICAO formulas. Barometric pressure has dropped from 29.03 in.Hg to 22.54 in.Hg and temperature has fallen by 23.2 deg. F. Air density drops from 0.0778 lb./ft³ to 0.0634 lb./ft³ which is now applied to calculations for trajectory table.

Left side: Reference atmospheric conditions

- Air density:
 - ◆ Calculated value; according to right side entered altitude (Altitude for calculation)
- Reference altitude for this atmosphere (above sea level):
 - ◆ Altitude (Maximum 11,000-meters) to which entered pressure, temperature and humidity references;
- Barometric pressure:
 - ◆ Measured air pressure;
- Temperature:
 - ◆ Measured temperature;
- Relative humidity:
 - ◆ Measured relative humidity.

User may also enter on left side Standard ICAO or Standard Metro sea level data by first clicking to *Standard ICAO* or *Metro* button and then to *User, Altitude Dependent* button.

Right side: Calculated atmospheric conditions

- ❖ Table values at Altitude for calculation:
 - Enter Altitude above Sea Level, for which the data should be calculated
 - Result: Air (barometric) pressure at this altitude;
 - Result: Air Temperature at this altitude.
 - On left side Result: Air Density at this altitude.

Calculated values of air density are used for trajectory table.

- ❖ Selecting *Apply&Exit* Button closes window.

Atmosphere window for sight-in

QuickTARGET Atmosphere for Sighting-In		
Air Density	lb./ft. ³ 0.076474	kg/m ³ 1.225
Altitude above Sea Level	Feet 0	Meters 0.0
Barometric Pressure	in. Hg 29.921	hPa 1013.25
Temperature	°F 59.0	°C 15.0
Relative Humidity	%	
	0	
choose Sighting-In atmosphere		
Standard Metro, Sea level		<input type="radio"/>
Standard ICAO, Sea level		<input checked="" type="radio"/>
User, Free; Press, Temp, Humid		<input type="radio"/>
User, Altitude Dependent		<input type="radio"/>
Apply&Exit		

Picture 27: Atmosphere window for Sighting-In conditions

Many users are sighting-in their gun at their local shooting range and then want to drive to a competition shooting or went hunting under totally different atmospheric conditions. They want to calculate a table for these new conditions.

Therefore, user can select in frame *Atmosphere for zero / sight-in range*: Sight-in condition differ from table condition. So a second atmo window (in different color) is provided to set up sight-in atmosphere. Settings are described on preceding pages: Atmosphere settings for table.

Calculations of altitude effects always refer to *ICAO* atmosphere functions. This means that altitude and temperature corrections are made according to *ICAO* standards.

Many projectile manufacturers relate ballistic coefficient ratings to old US-Army Standard Metro Atmosphere, as established by the US-Department of Defense. This systems is, however, long-since obsolete.

In 1952 the *ICAO* atmosphere was standardized worldwide as the successor of the *CINA* atmosphere within international aeronautics. A new U.S. Standard Atmosphere '76 was established in 1976 by the National Geophysical Data Center, National Oceanic and Atmospheric Administration in Boulder, Colorado. This standard is identical with *ICAO* Standard up to 32 km altitude. (*ICAO* = International Civil Aviation Organization).

ICAO is also similar to *ISO* for *NATO*, *GOST 4401-64* and *WSA-60* of the former Warsaw Pact, especially in the lower layer which reaches up to 11000 meters.

Standard atmospheres have been specified at various elevations. The original standard *ICAO* table reaches from -5,000 to 20,000 geopotential meters. A geopotential altitude is proportional to the work, which is done, in lifting a 1-kilogram mass from sea level to the specified altitude (in meters) – the work required to overcome gravity. At low altitudes, setting geopotential altitude equal to geometric altitude provides sufficiently accurate results.

Military ballistic tables use other standards. These differ from area to area. These tables correspond to geographic location and among the various military branches (Navy, Army, Air Force). All are established to best suit the user's needs.

Comparison of ICAO to METRO Standard Sea Level Atmo

Datum	ICAO	METRO
Altitude above sea level	0 meters	0 meters
Temperature	15 °C	15 °C
Pressure	1013.25 hPa	1000 hPa
Air density	1,225 kg/m ³	1,20341 kg/m ³
Relative humidity	0 %	78 %
Speed of sound	340,43 m/s	341,45 m/s
Acceleration of gravity	9.80665 m/s ²	9.80 m/s ²

QuickTARGET uses ICAO gravity and makes no gravity corrections for differing altitude or geographic location. (Gravity corrections are made when calculating maximum vertical height.)

Standard METRO gives a higher Ballistic Coefficient value, compared to Standard ICAO. METRO-Coefficients spuriously suggest better product performance and are, therefore, often preferentially published.

To convert BCs from Std.METRO to Std.ICAO simply multiply the BC by 0.9824. This factor represents the ratio of both air densities.

The following atmospheric relations are found in reloading manuals (without guarantee):

Standard METRO: Hornady, Sierra, and Speer Manual N.12

Standard ICAO: Nosler, Speer Manual N.11

(Both Speer manuals show same BCs for all bullets....)

BCs refer to different drag functions, mostly G1 or Ingalls-Tables, which are very similar.

G1: Speer, Sierra, Berger

Ingalls: Nosler, Hornady

G7 Berger, partly

When it is unknown to user, which atmosphere is used for a bullet's BC he should examine a ballistic table from bullet manufacturer, enter the basic data from manufacturers table in QuickTARGET and re-calculate manufacturers table, by switching atmosphere from Standard Metro to ICAO and toggle BC from ICAO- to Metro entry field. The QuickTARGET table which comes closest to published data uses the correct atmosphere and the matching BC.

Window PVM Chronograph

QuickTARGET PVM Chrono

File Com Settings

Mean V fps Std. Dev. Select. Hi Lo ES Print List Detect Device Read PVM

1161.4 25.50 5 1192.6 1121.7 71.0 Toggle Display Read Status Clear PVM

Bullet Grains Grams BC ICAO Calculated Vo fps LS dist. ft. Totl. Rnd. Watch Shot

40.0 2.592 0.115 1168.0 6 22 Show DSB MIP Start PVM

Show IPSC Faktor Stop PVM

Set Gain, Beep, and Threshold

Gain % PVM Beep On Trigger Threshold % PVM Adr. LS-Base mm Clock Hz

95 50 0 345 1600000

Round	String	Counter	m/s	fps	MIP	IPSC	Joules	ft.lbs.	Date	Time
1	0	20762	265.9	872	68.9	34.9	91.6	67.6	09.06.2005	19:08:07
2	0	20668	267.1	876	69.2	35.0	92.5	68.2	09.06.2005	19:08:07
3	0	20553	268.6	881	69.6	35.2	93.5	69.0	09.06.2005	19:08:07
4	0	20307	271.8	892	70.5	35.7	95.8	70.6	09.06.2005	19:08:07
5	0	21066	262.0	860	67.9	34.4	89.0	65.6	09.06.2005	19:08:07
6	1	17826	309.7	1016	80.3	40.6	124.3	91.7	09.06.2005	19:08:07
7	1	18681	295.5	969	76.6	38.8	113.2	83.5	09.06.2005	19:08:07
8	1	18473	298.8	980	77.5	39.2	115.7	85.4	09.06.2005	19:08:08
9	1	18015	306.4	1005	79.4	40.2	121.7	89.8	09.06.2005	19:08:08
10	1	18705	295.1	968	76.5	38.7	112.9	83.3	09.06.2005	19:08:08
11	2	15185	363.5	1193	94.2	47.7	171.3	126.3	09.06.2005	19:08:08
12	2	15514	355.8	1167	92.2	46.7	164.1	121.0	09.06.2005	19:08:08
13	2	15552	354.9	1164	92.0	46.6	163.3	120.4	09.06.2005	19:08:08
14	2	15598	353.9	1161	91.7	46.4	162.3	119.7	09.06.2005	19:08:08
15	2	16146	341.9	1122	88.6	44.9	151.5	111.8	09.06.2005	19:08:08
16	3	15755	350.4	1149	90.8	46.0	159.1	117.4	09.06.2005	19:08:08
17	3	16201	340.7	1118	88.3	44.7	150.5	111.0	09.06.2005	19:08:08

☺ PVM-21 R1.02 COM 4 19200,n.8.1 22 Normal

Picture 28: Window PVM Chronograph

The window opens after being selected from *Main menu ...Options...Link to BMC/PVM Chronograph*. Program tests automatically for connection before the window appears. The chronograph PVM 21, BMC 18 or BMC 21 has to be connected to PC and its power supply must be on. The PVM device has to function properly with device's software. Therefore necessary drivers had to be installed previously. PVM 21 and BMC 18 are connected to USB Port and a virtual COM Port has to be set up. Please note COM port settings shown in PVM accompanying software.

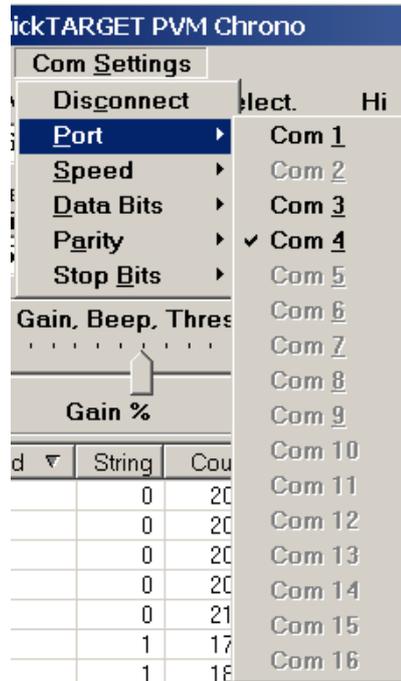
The automatic link being successful, displaying in the lower left corner of Status Bar a "Happy" Smiley followed by the PVM's name and firmware revision. If the memory of PVM is containing collected data of previous measurements, you'll find the number of shots in memory in field **Totl.Rnd** (up to 250). Memory can be read and displayed by pressing button *Read PVM*.

The Status Bar shows in the second field (from left) the COM port number, and in the third field shows the COM port settings.

The fourth field displays available shots in chronograph's memory. The fifth field shows device status and error messages. The sixth field shows the Single Shot's display mode: normal or mirrored.

When after invoking this window an error message appears and no connection to PVM is found, the user must check COM port settings and/or PVM device address settings:

PVM COM Port Settings

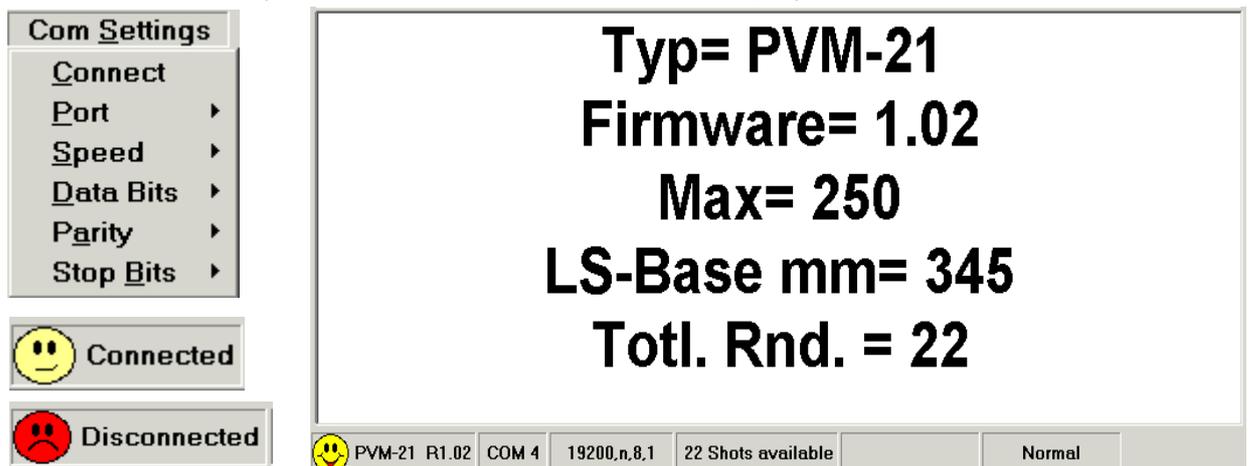


Picture 29: COM Port Settings

In this menu user selects the COM port number of the PVM in a range from 1 to 16. For all PVM21 / BMC18 the following settings apply:
 Speed = 19200, Data Bits = 8, Parity = n, Stop Bits = 1.

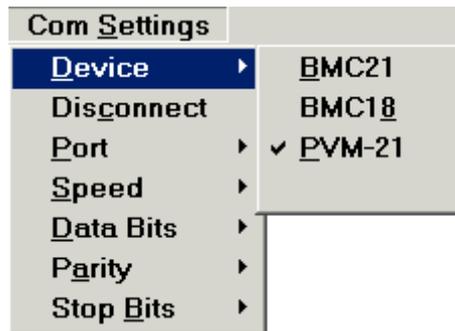
If you use a BMC 21, you must provide here the exact settings of the chronograph (controllable by infrared remote control).

After re-establishing the settings the menu item Connect has to be activated (or click onto the red disconnect smiley), after this, the status bar should display "Connected".



Picture 30: Example of chronograph's response

When "Connected" smiley is displayed, try to call PVM by pressing *Detect Device* button. Normally the PVM data should appear in display and a "Happy" smiley comes up in the status bar. Is there no or scrambled response, check COM port number and PVM address (0 = default address) and try again. (See PVM Manual).



Picture 31: Manual setting of device type

In case of auto-detect failure of chronograph, the user must set the device type manually under menu **Com Settings...Device...** and then selecting the appropriate device type.

After that, user should check COM **Port** number, set **PVM Adr.** field to zero and press **Detect Device** button again.

Setting of **PVM Adr.** field to zero selects all devices regardless of actual settings and returns if successful the actual address!

Meaning of PVM-Chronograph's Window Elements

The buttons:

- ❖ *Print List*
 - Prints listing of all rows or selected rows only containing measured data of shots like on the screen (same order of columns). Listing longer than one page is printed on several pages with page numbers in footers.
- ❖ *Toggle Display*
 - Switches between list view and single shot display.
- ❖ *Detect Device*
 - See previous page
- ❖ *Read Status*
 - Status request to chronograph. Status=0 means "Ready". Displayed in fifth field of status line.
- ❖ *Read PVM*
 - Reading of measurement data memory of chronograph and display in list view.
- ❖ *Clear PVM*
 - Data memory of chronograph is erased. Space for 250 shots available (PVM)

In Frame Watch Shot:

- ❖ *Start PVM*
 - Continuous scanning of PVM while firing through light screens. The PVM will be scanned 10 times per second for new data. A new velocity will be displayed on large display in f.p.s. or m/s, as settings read from *Main menu...Options...Set units of output to...: New data is appended to the end of list in list view (these data is not stored in PVM's memory !)*
- ❖ *Stop PVM*
 - Scanning of PVM is disabled. Shots happening now are stored in PVM's memory, so far free memory is available. (max. 250 shots)
- ❖ *Check Boxes : Show DSB MIP - Show IPSC Factor*
 - along with bullet's velocity the DSB MIP value (Deutscher Schützenbund Mindest Impuls) and/or the IPSC Factor will be displayed. **Therefore it is necessary, that in frame *Bullet* the appropriate bullet weight was entered before shooting.**

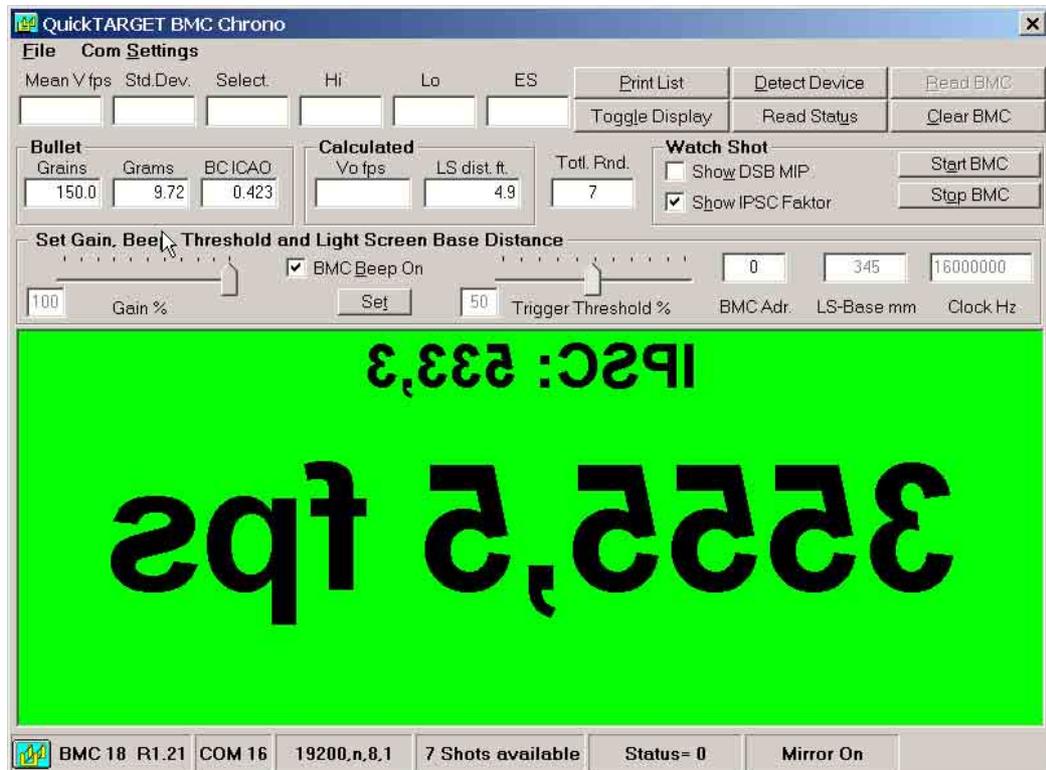
In Frame set Gain, Beep and Threshold:

- ❖ *Gain*
 - The setting of light screen amplification is set and shown (in percent). (See BMC/PVM Manual). Value can be adjusted by slider and transferred to PVM by pressing *Set* button. Values are re-read by *Read Status* button.
- ❖ *PVM Beep on*
 - The signal sound of PVM may be set on or off: Place check mark or remove check mark and press *Set* button. **Contrary to BMC 18 the PVM 21 signal sound cannot be switched by remote control. It is normally on. The F5 key of Infrared Remote Control will be used to assign a shot string number (valid numbers 0 to 99) to the following shots. So the user has better control over his measured data. The string number is displayed in the *list view*. In the above example all shots from string 2 are marked.**
- ❖ *Threshold*
 - The value of trigger threshold for light screen signal can be set up by for BMC 21: Move slider to desired value and press *Set* button. For PVM 21 and BMC 18 it is read only and is set to 50%.
- ❖ *PVM Adr.*
 - Device address (change address and press set button to change address in PVM's NVRAM) (See PVM Manual). Change address (without pressing *Set* button) if you changed address via Remote Control (otherwise program detects no PVM-device)
- ❖ *LS Base mm*
 - Display of distance from Start- to Stop- Light Screen in millimeters
- ❖ *Clock Hz*
 - Display of counter clock

Large display of single shot measurement



Picture 32: Large display normal



Picture 33: Large display mirrored

Mirroring will be toggled by pressing key combination **<Strg-Alt-m>** or by mouse click onto status bar field *Normal / Mirror On*.

Further data input or output fields:

- ❖ *Mean V fps*
 - Output, Mean value of velocity of selected rows in list view, in Picture. 21 rows from 11 to 15.
- ❖ *Std. Dev.*
 - Output, Standard deviation of selection.
- ❖ *Select.*
 - Output, Number of selected rows.
- ❖ *Hi.*
 - Output, Highest value of selection.
- ❖ *Lo.*
 - Output, Lowest value of selection.
- ❖ *ES.*
 - Output, Extreme spread, Difference between hi and Lo.

In Frame Bullet (Input and Output):

- ❖ *Grain*
 - Bullet weight in grains. Will be filled with data from *Table Setup* window when PVM window is opened. Used to calculated energy and impulse/momentum figures.
- ❖ *Grams*
 - Bullet weight in grams. Will be filled with data from *Table Setup* window when PVM window is opened. Used to calculated energy and impulse/momentum figures.
- ❖ *G1-BC, G7- BC*
 - Ballistic Coefficient. Will be filled with data from *Table Setup* window when PVM window is opened. Also multiple BC's will be used in background. Changes to this field erases possible existing multiple BC's, so only the shown value is used for calculations.

In Frame Calculated:

- ❖ *Vo fps*
 - Output, Calculated muzzle velocity from velocity mean value of selection, BC and distance from muzzle to center of light screens.
- ❖ *LS Dist.ft*
 - Input, Distance from muzzle to light screens center.

All shown units will also be displayed according to program settings in meters and meters per second. Energy- and Impulse/momentum data will be correct when the bullet weight relates to measured data. (see Frame Bullet)

The list view field containing data:

- Single rows are selected by single mouse click to the desired row. Some rows may be selected by single mouse click by simultaneously pressed (holding) <Ctrl> key. Whole areas can be selected by selecting the first row of area by single mouse click and by pressing <Shift> key while clicking to last row of area.(Just like Windows-Explorer or in a text document file).
- Clicking with right mouse button onto list view data area opens a menu where the user may select or deselect some columns.
- Columns might be dragged to other positions, and user may change column width. (Click and hold left mouse button to column header and drag columns)
- List can be sorted by clicking on column header. Sort order is toggled.

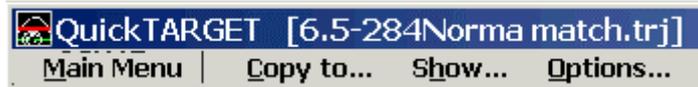
These settings will also be used by printing of list.

Menu PVM Chronograph File



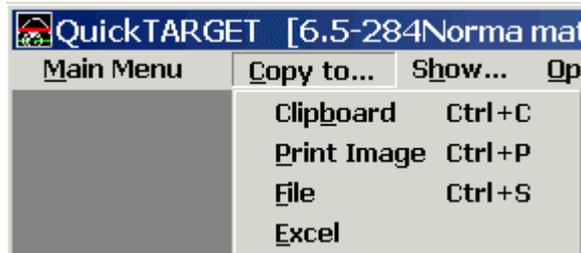
- ❖ *Save Selected*
 - Saves selected rows in a file
- ❖ *Load*
 - Saved file's data will be retrieved and shown in list view.

Displaying the Results



When *Output window Table* or *window Diagram* is positioned in foreground the main menu appearance changes to the above shown items. To return to standard Main Menu select Main Menu from this menu.

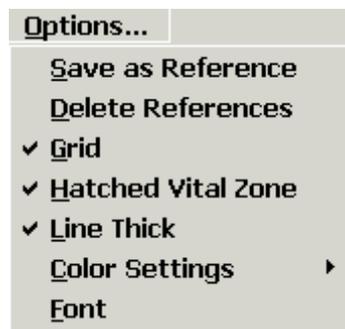
Sub menu Copy to...



Picture 34: Menu Copy to...

- ❖ *Clipboard*;
 - Copies the contents of output window to clipboard; you may use the Insert or Paste function of text- or graphics programs to paste it into foreign program.
- ❖ *Print Image*;
 - sends a bitmap (pixel) image of window to the default printer.
- ❖ *File*;
 - Opens File save... dialog; you may save window contents as bitmap- or as text file.
- ❖ *Excel*;
 - When Microsoft® Excel® is installed on your computer, Excel opens and the table is transferred to Excel's spreadsheet via 'Object automation'. Object automation must be properly installed for Excel (which is done by installation of MS-Office installer).

Sub Menu Output Options...



Picture 35: Output Menu Options...

- ❖ *Save as reference*;
 - Stores temporarily the results of calculation (Trajectory table) in an collection of results. Up to 5 calculations may be stored ad displayed in graph simultaneously.
- ❖ *Delete References*;
 - Deletes all temporarily stored calculations.
- ❖ *Grid*;
 - Axis' grid on / off
- ❖ *Hatched Vital Zone*;
 - Display zone defined in input window under "Vital height to LOS..." as gray hatched area on graph.
- ❖ *Color settings*;
 - Alter axis' colors. Colors selected will also be used for printing on color printers. (Sometimes colors visible on screen do not work with printers!)
- ❖ *Font*;
 - Select new font for graph or for window text.

Output Window Table

QuickTARGET Table

Tabular trajectory data at Std. ICAO Atmosphere

Gun / Ammunition : Steyr Scout 300RCM, .300 RCM
 Bullet Type : .308, 170, Sierra SPFN 30-30 2010
 Bullet Weight : 170 grains or 11,02 Grams
 Muzzle Velocity : 2800 fps
 Crosswind Speed : 5,0 Mph
 Ballistic Coefficient(s) (G1) :
 C1_1=0.201@V>2400 fps;
 C1_2=0.244@V>1800 fps;
 C1_3=0.288@V>0 fps;

Optimum trajectory information :
 Optimum sight-in range (X) = 187 Yds.
 with max. ordinate above LOS at range (M)= 111 Yds.
 and max. point blank range (P)= 217 Yds.

Sight-in clicks, 1 click = 1,0 cm/100 m or 0,394 in/100 m
 Height of sight above bore axis = 3,94 cm or 1,551 inch
 Gun is zeroed-in at 208 yds,
 by sighting-in at level firing

Range	Velo	Time of	Energy	Path	Spin / Wind-	Total	Sight correction	Target		
	city	flight		to	dage, Wind	drop	for setting new	lead		
				LOS	of 5,0 Mph		zero range	33 fps		
·Yards	fps	s	ft.lbs.	in.	in.	MOA	in.	Clicks	MOA	yds
0	2800	0,0000	2959	-1,6	0,0	-----	0,0	-----	-----	0,00
50	2575	0,0561	2503	+1,2	-0,2	-0,42	0,6	-6,5	-2,22	0,61
100	2368	0,1165	2116	+2,6	-0,8	-0,79	2,5	-7,1	-2,46	1,27
M 121	2296	0,1436	1989	+2,7	-1,2	-0,97	3,7	-6,2	-2,14	1,57
150	2199	0,1826	1825	+2,4	-1,9	-1,23	5,9	-4,5	-1,54	2,00
200	2036	0,2534	1565	+0,5	-3,4	-1,65	11,2	-0,7	-0,23	2,77
X 208	2011	0,2651	1526	0,0	-3,7	-1,71	12,2	0,0	0,00	2,90
P 234	1930	0,3041	1406	-1,9	-4,7	-1,92	15,8	+2,3	+0,78	3,33
250	1881	0,3292	1335	-3,4	-5,4	-2,07	18,4	+3,8	+1,31	3,60
300	1744	0,4130	1148	-10,0	-8,1	-2,57	28,3	+9,3	+3,19	4,52
350	1627	0,5030	999	-19,5	-11,3	-3,08	41,1	+15,5	+5,33	5,50

M = Peak vs. L.O.S., X = Set Zero, P = Max. Point Blank Range
 Elevation above Angle of Site (0,0 deg.) = 0,1051 deg.

Picture 36: Trajectory table window

Entered variable-dependent trajectory table results displayed in this window:

1. Atmosphere, Gun, Ammunition and bullet information
2. Ballistic Coefficient(s)
3. Suggested maximum Point Blank Range & corresponding zero range
4. Set zero range
5. Reference of zero range
6. Trajectory data in tabular form

Table columns:

1. Mark "M" shows peak bullet height above Line of Sight, Mark "X" shows zero range. (Not always equal to table zero!), Mark "P" shows maximum point blank range
2. Range, meters or yards
3. Velocity, m/s or fps
4. Time of flight, seconds
5. Energy, Joules or foot pounds (ft. lbs.)
6. Trajectory height above Line of Sight, cm or inches
7. Crosswind/Spin deflection (wind drift), cm or inches
8. Crosswind/Spin deflection (wind drift), MOA
9. Total drop from Line of Bore, cm or inches

10. Sight correction (clicks) to zero at specified range
11. Sight correction (MOA) to zero at specified range
12. Target lead for running target, yards or meters.

This table is not completely displayed within the window when using small range increments (e.g., 2-meters) and/or very large maximum table ranges (e.g., 2000-meters). In that case, an overflow-notification may follow at end of table. However that result can be completely printed (paper-consumptive) or stored as a text-file.

Output Window Table of zero ranges Displays Zero Range Table Trajectories

QuickTARGET Table of zero ranges
Tabular trajectory data at Std. ICAO Atmosphere

Gun / Ammunition : Steyr Scout 300RCM, .300 RCM
 Bullet Type : .308, 170, Sierra SPFN 30-30 2010
 Bullet Weight : 170 grains or 11,02 Grams
 Muzzle Velocity : 2800 fps
 Crosswind Speed : 5,0 Mph
 Ballistic Coefficient(s) (G1) :
 C1_1=0.201@V>2400 fps;
 C1_2=0.244@V>1800 fps;
 C1_3=0.288@V>0 fps;

Table of Various Zero Ranges - Trajectory Path to LOS in inches

Range	50 yd.	100 yd.	150 yd.	200 yd.	250 yd.	300 yd.	350 yd.	400 yd.	450 yd.	500 yd.	
50 yd. Zero	X	+0,3	-1,1	-4,2	-9,2	-17,0	-27,7	-41,4	-58,7	-80,8	
100 yd. Zero	-0,1	X	-1,4	-4,7	-9,9	-17,8	-28,6	-42,4	-59,9	-82,0	
150 yd. Zero	+0,4	+1,0	X	-2,7	-7,5	-14,9	-25,2	-38,5	-55,5	-77,2	
200 yd. Zero	+1,0	+2,3	+2,1	X	-4,0	-10,8	-20,4	-33,0	-49,4	-70,4	
250 yd. Zero	+1,8	+3,9	+4,5	+3,2	X	-5,9	-14,7	-26,6	-42,1	-62,3	
300 yd. Zero	+2,8	+5,9	+7,4	+7,2	+4,9	X	-7,8	-18,7	-33,2	-52,4	
350 yd. Zero	+4,0	+8,2	+10,8	+11,7	+10,5	+6,7	X	-9,7	-23,2	-41,2	
400 yd. Zero	+5,2	+10,6	+14,4	+16,5	+16,6	+14,0	+8,5	X	-12,2	-29,0	
450 yd. Zero	+6,5	+13,3	+18,5	+21,9	+23,4	+22,2	+18,0	+10,9	X	-15,5	
500 yd. Zero	+8,1	+16,4	+23,2	+28,1	+31,1	+31,5	+28,9	+23,2	+13,9	X	
187 yd. PB Zero	+0,9	+2,0	+1,5	-0,8	-5,0	-11,9	-21,7	-34,6	-51,1	-72,3	
Velocity	fps.	2575,1	2367,6	2198,6	2036,4	1880,7	1744,1	1626,8	1515,0	1411,9	1319,0
Energy	ft.lbs.	2503,8	2116,5	1825,2	1565,8	1335,6	1148,6	999,2	866,7	752,7	656,9
Deflection	in.	-0,2	-0,8	-1,9	-3,4	-5,4	-8,1	-11,3	-14,9	-19,2	-24,2
Correction	MOA/mph	-0,084	-0,158	-0,245	-0,329	-0,412	-0,513	-0,614	-0,712	-0,814	-0,923
Time	sec	0,056	0,117	0,183	0,253	0,329	0,413	0,503	0,598	0,700	0,810

Picture 37: Table of Zero-Ranges with trajectory data

Dependent upon muzzle velocity and maximum range settings, table extends to 2000-meters or yards. Table range increment is set to 1/10 of maximum range. Corresponding to table settings, units are meters or yards.

The "X"s in this table mark zero ranges for various settings. Velocity, energy, wind deflection and time figures are displayed according to the range specified.

The user can mark the contents of these text windows with the mouse, (press and hold the left mouse-button while moving the mouse). Then, using active menu, function **Copy to...** selected portion copied into a file, to the clipboard, printer or to MS-Excel (not supported on all systems). If mouse pointer resides on window text and the user single-clicks the right mouse-button, a menu opens to change the contents of this window.

Displays Zero Range Table Clicks of correction

QuickTARGET Table of zero ranges
 Tabular trajectory data at Std. ICAO Atmosphere

Gun / Ammunition : Steyr Scout 300RM, .300 RCM
 Bullet Type : .308, 170, Sierra SPFN 30-30 2010
 Bullet Weight : 170 grains or 11,02 Grams
 Muzzle Velocity : 2800 fps
 Crosswind Speed : 5,0 Mph
 Correction Factor of Elevation (MOA/Click) : 0,344
 Ballistic Coefficient(s) (G1) :
 C1_1=0.201@V>2400 fps;
 C1_2=0.244@V>1800 fps;
 C1_3=0.288@V>0 fps;

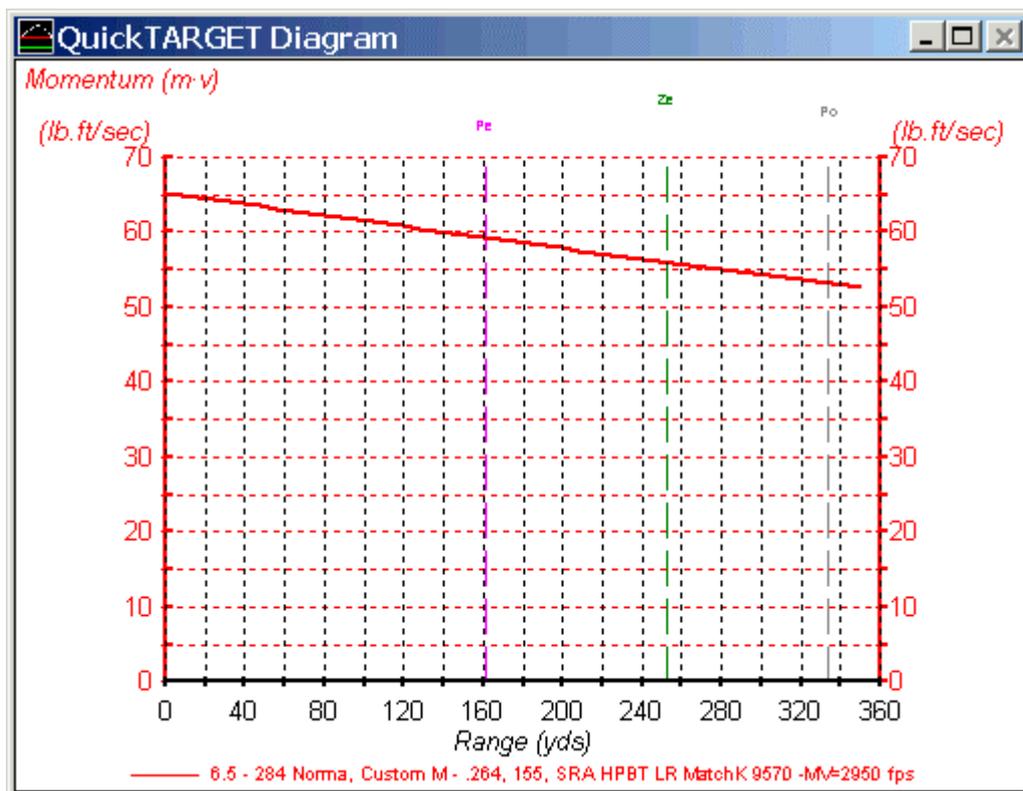
Table of Various Zero Ranges - New Zero-in Correction Values in Sight Adjustment Clicks

Range	50 yd.	100 yd.	150 yd.	200 yd.	250 yd.	300 yd.	350 yd.	400 yd.	450 yd.	500 yd.	
50 yd. Zero	X	-0,7	+2,0	+5,8	+10,3	+15,7	+22,0	+28,7	+36,3	+44,9	
100 yd. Zero	+0,7	X	+2,7	+6,5	+11,0	+16,4	+22,7	+29,4	+37,0	+45,6	
150 yd. Zero	-2,0	-2,7	X	+3,8	+8,3	+13,8	+20,0	+26,7	+34,3	+42,9	
200 yd. Zero	5,8	6,5	3,8	X	14,5	10,0	16,2	22,9	30,5	39,1	
250 yd. Zero	-10,3	-11,0	-8,3	-4,5	X	+5,5	+11,7	+18,5	+26,0	+34,6	
300 yd. Zero	-15,7	-16,4	-13,8	-10,0	-5,5	X	+6,2	+13,0	+20,5	+29,1	
350 yd. Zero	-22,0	-22,7	-20,0	-16,2	-11,7	-6,2	X	+6,8	+14,3	+22,9	
400 yd. Zero	-28,7	-29,4	-26,7	-22,9	-18,5	-13,0	-6,8	X	+7,5	+16,1	
450 yd. Zero	-36,3	-37,0	-34,3	-30,5	-26,0	-20,5	-14,3	-7,5	X	+8,6	
500 yd. Zero	-44,9	-45,6	-42,9	-39,1	-34,6	-29,1	-22,9	-16,1	-8,6	X	
187 yd. PB Zero	-4,7	-5,4	-2,7	+1,1	+5,6	+11,0	+17,2	+24,0	+31,5	+40,1	
Velocity	fps.	2575,1	2367,6	2190,6	2036,4	1900,7	1744,1	1626,0	1515,0	1411,9	1319,0
Energy	ft.lbs.	2503,8	2116,5	1825,2	1565,8	1335,6	1148,6	999,2	866,7	752,7	656,9
Deflection	in.	-0,2	-0,8	-1,9	-3,4	-5,4	-8,1	-11,3	-14,9	-19,2	-24,2
Correction	MOA/mph	-0,084	-0,158	-0,245	-0,329	-0,412	-0,513	-0,614	-0,712	-0,814	-0,923
Time	sec	0,056	0,117	0,183	0,253	0,329	0,413	0,503	0,598	0,700	0,810

Picture 38: Table of zero-ranges / Sight adjustment clicks

Contrary to previous shown table this table displays no trajectory data. Instead it displays the Sight adjustment clicks necessary to adjust to a new zero range. Example from 100 yd. zero, line 2, delivers: Gun zeroed-in at 100 yards, now it should be zeroed in for 300 yds. zero, therefore adjust elevation by 16.4 clicks upward.

Output Diagram Momentum Graph

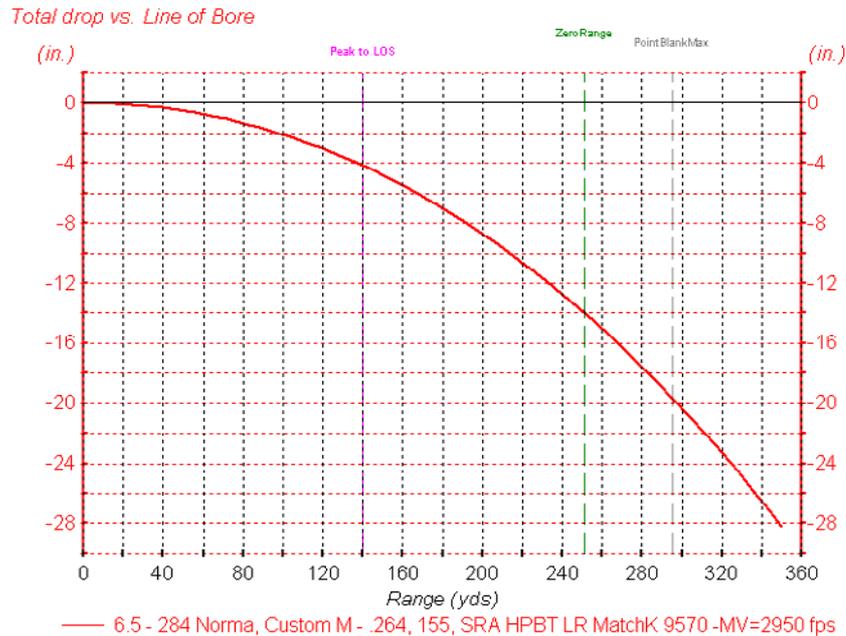


Picture 39: Momentum Graph

In all Output Diagrams, the user can toggle grid lines on and off under menu point *GRID on / off*. Contents are copied to a file, as bitmap to printer (when supported by printer driver) or to the clipboard by the function *Copy to...* For quality prints use always Main Menu *File ... Print*

This window displays a graph of projectile-impulse (momentum, which is simply mass times velocity). Units corresponding to program settings, either Newtons or pound seconds.

Output Diagram Drop

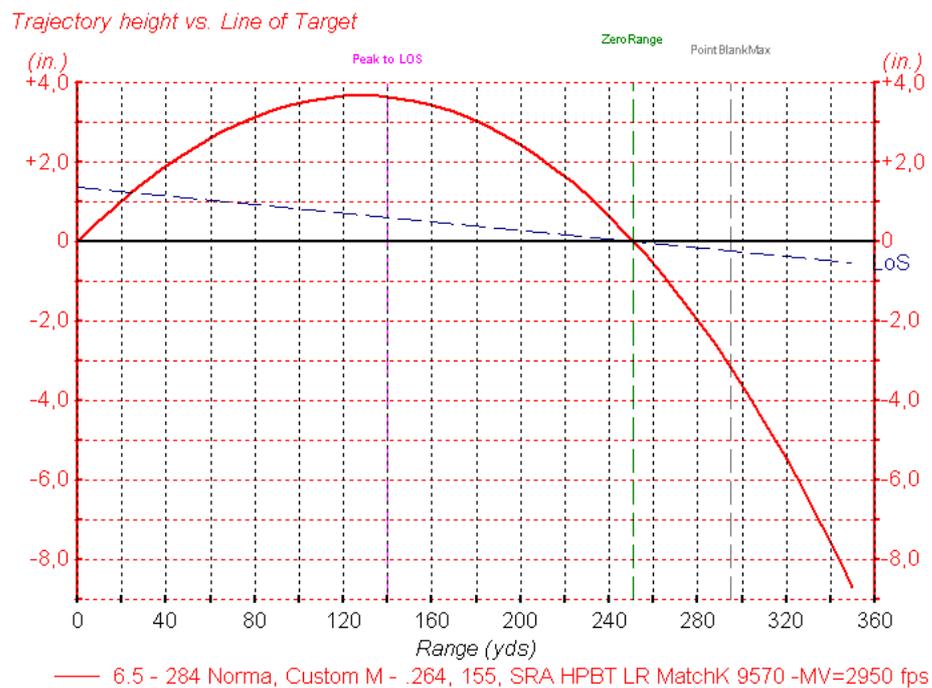


Picture 40: Total Drop Graph

This window displays a trajectory graph compared to the bullet departure direction (which is approximately equal to the static axis of the bore – *Line of Bore*). Departure values in cm or inches, depending upon settings.

Output Diagram Line to Target

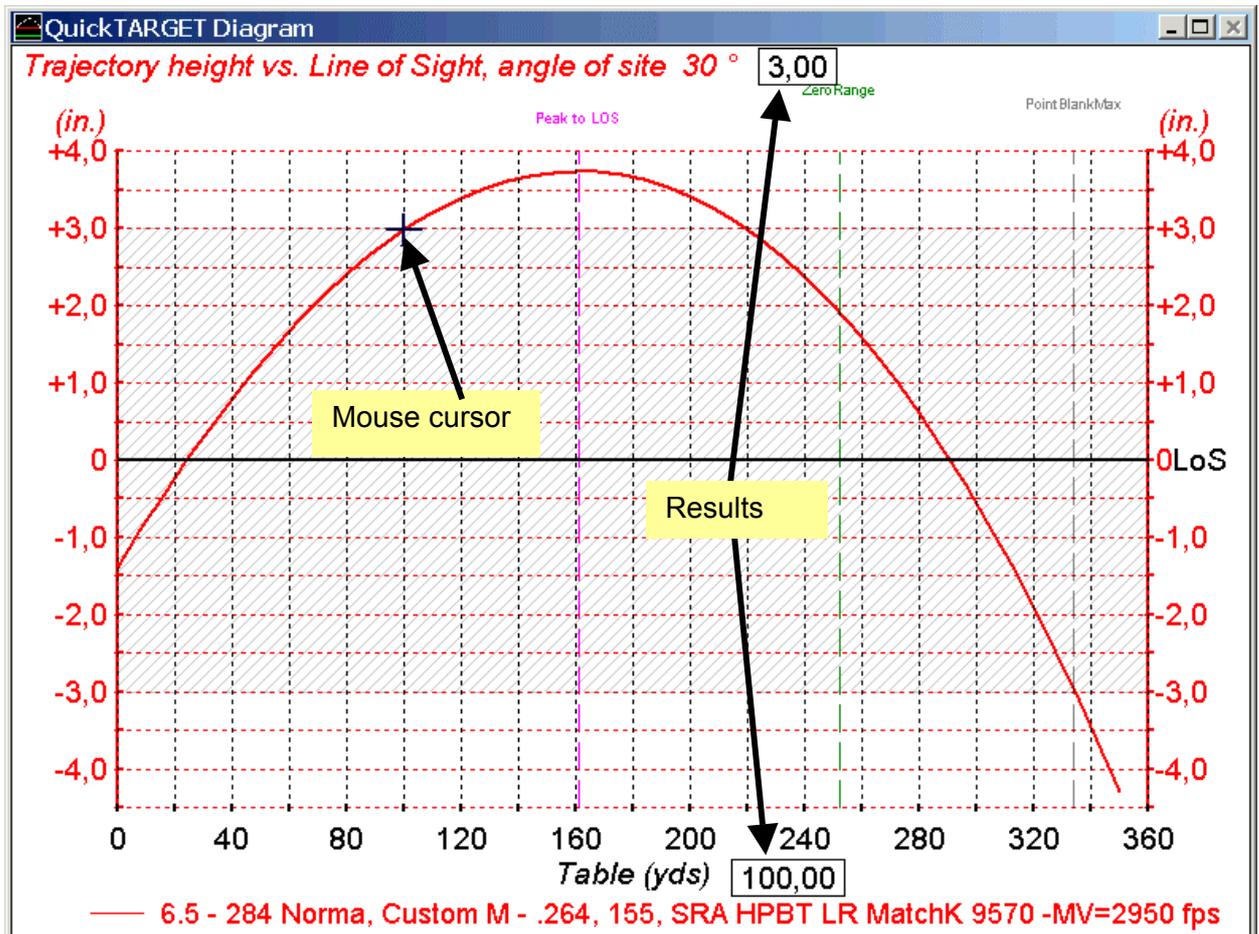
Trajectory to Firing Direction



Picture 41: Muzzle Horizon Graph, Line Muzzle-Target

This window displays a trajectory graph relative to the *Line to Target* (line between gun muzzle and target). Units are cm or inches, corresponding to program settings. Where Line of Sight falls within the window it is displayed with a dashed line (marked LoS).

Output Diagram Line of Sight

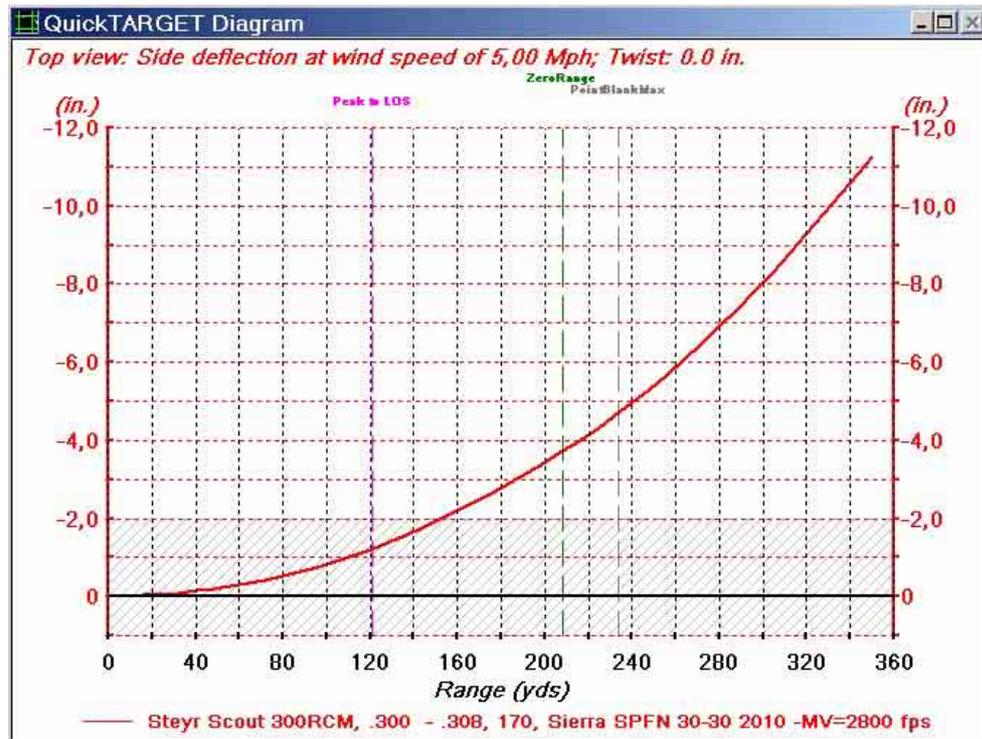


Trajectory to Line Of Sight
Picture 42: Trajectory to LOS Graph

This window displays trajectory graph compared to the *Line of Sight*. Units are cm or inches, depending upon program settings. Vital zone is displayed as gray hatched area. Markings showing trajectory summit, zero range and maximum point-blank-range are indicated.

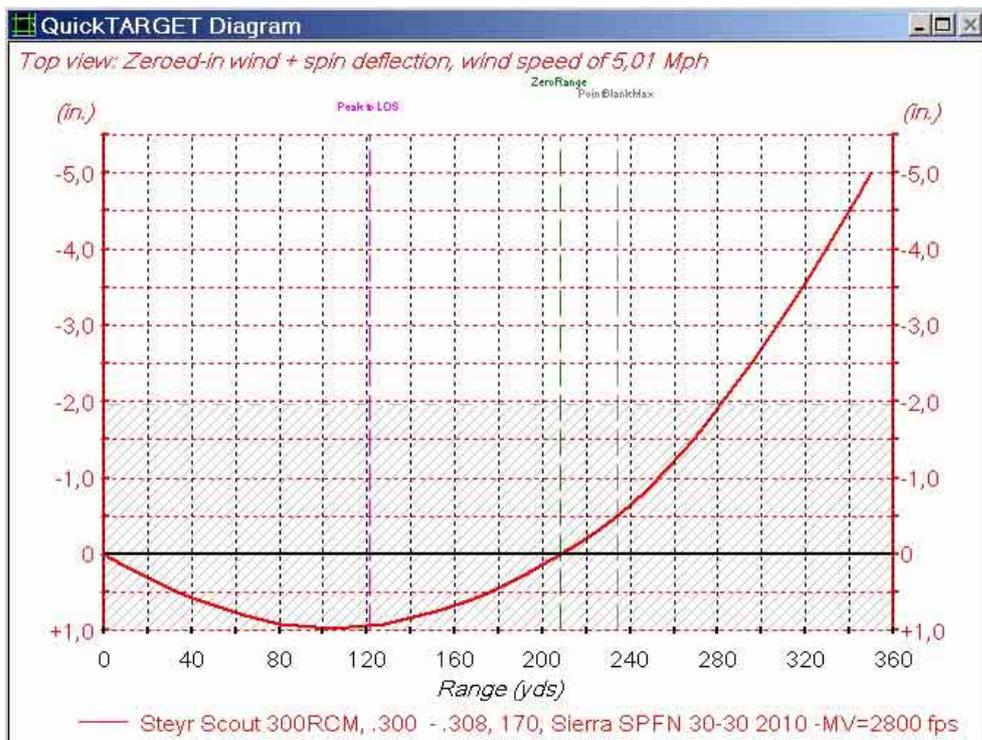
Similar to *QuickLOAD*, moving the mouse cursor's crosshair over the graph's area displays readouts of position of cursor in values and units displayed in graph.

Output Diagram Crosswind



Picture 43: Wind deflection versus range

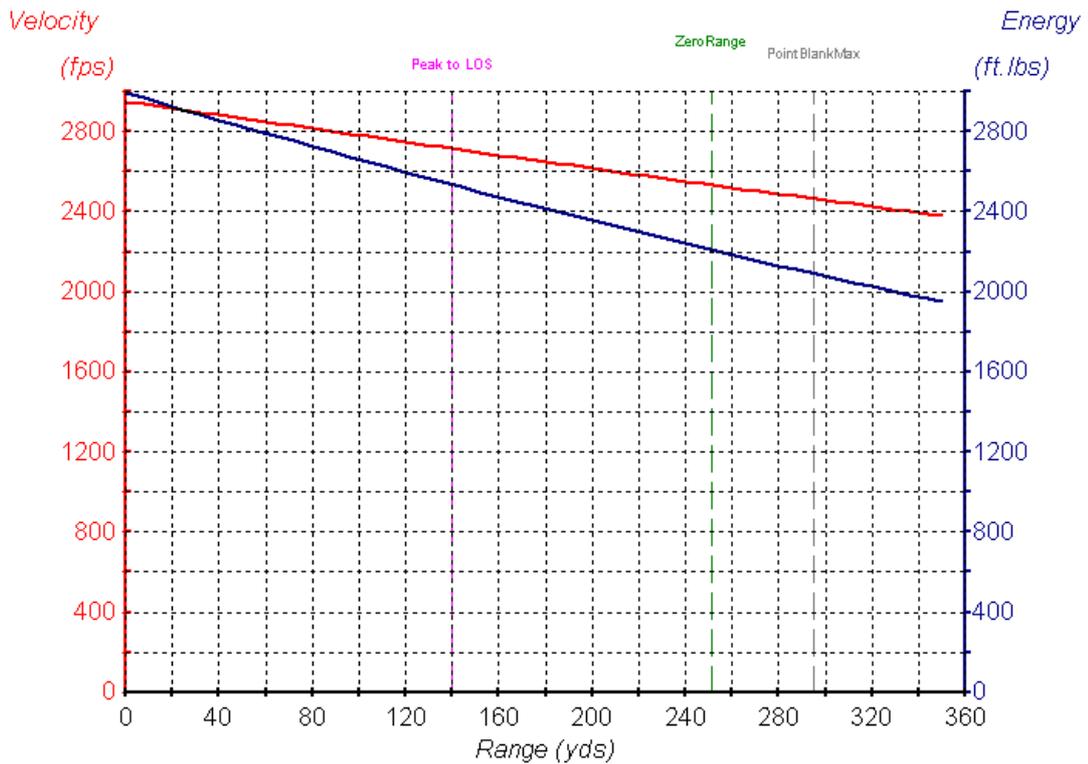
This window displays Projectile Deflection relative to entered crosswind velocity – overhead view. Units are cm or inches corresponding to program settings. Wind from 3 o'clock. No spin drift, because spin is set to zero.



Picture 44: Wind deflection zeroed in

Top view of path with compensated wind deflection at zero-range. Same wind as above.

Output Diagram V & E

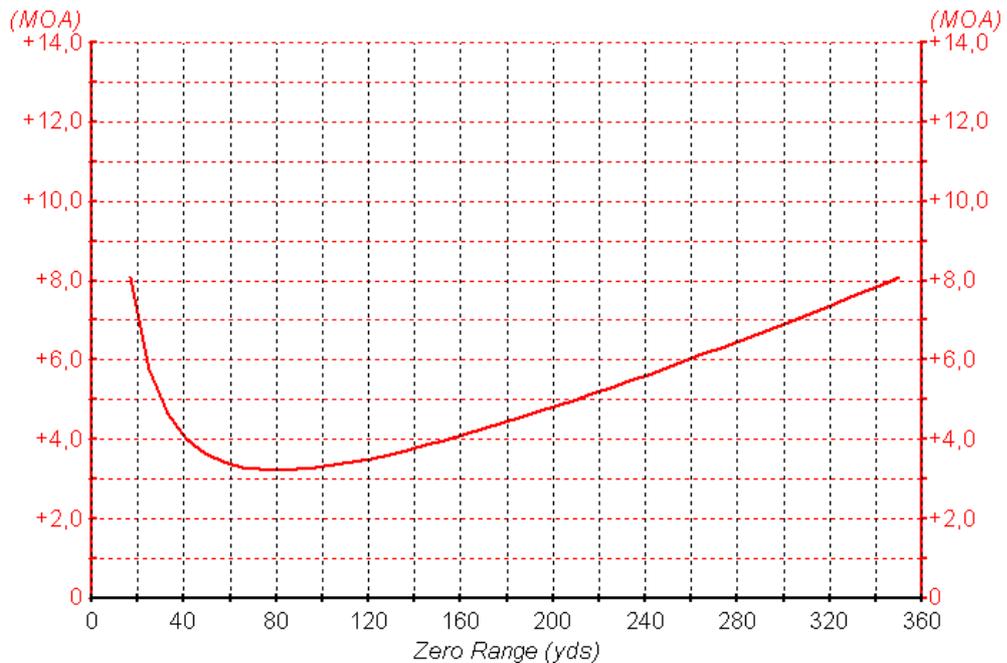


— 6.5 - 284 Norma, Custom M - .264, 155, SRA HPBT LR MatchK 9570 -MV=2950 fps

Picture 45: Velocity and energy versus range

This window shows a graphic representation of the bullet velocity (in RED) and energy (in BLUE). Units are m/s or fps and Joules or ft. lbs., depending upon program settings. This diagram looks somewhat crowdie when using several reference traces.

Elevation angle vs. zero range



— 6.5 - 284 Norma, Custom M - .264, 155, SRA HPBT LR MatchK 9570 -MV=2950 fps

Picture 46: Elevation angle vs. Elevation Graph

Output Diagram Comparing Trajectories Graph



Picture 47: Comparing four trajectories, same zero range



Picture 48: Comparing four trajectories, optimum zero ranges

This window compares the stored trajectory(ies) (in GREEN) and the currently calculated trajectory (in RED). Example shows trajectory over the *Line of Sight*. Each graphic window allows comparison of up to five same-type data sets. Units, metric or Imperial, depending upon program settings.

Up to five (5) traces are displayed. Each trace uses different line styles for drawing the line. A sample of the line style is placed at the beginning of each line of **legend**. User may **edit** corresponding text by clicking on legend, or pressing numeric keys from 1 to 5.

Window contents can be copied to a file, to the clipboard or make a bitmap copy to printer with **Copy to...** function.

QuickTARGET Tools

(through main menu *Calculate...*)

In the upper part of the following windows, a text-field displays hints on the type of calculation represented. At the bottom of these windows, a text field shows the atmosphere type used in calculation.

Set Atmo. button allows alterations of atmospheric conditions.

After calculation, text in lower text field is refreshed and the number of iterations is shown.

When insufficient accuracy or a consensus failure occurs, the user can increase the maximum number of iterations (up to 1000). This action automatically starts a new calculation.

Calculated Ballistic Coefficients (C1) always refers to Standard ICAO conditions.

Tools windows

opens through main menu *Calculate...*

Muzzle velocity from chronotached vel.

The screenshot shows a software window titled "QuickTARGET Tools". At the top, a text box contains the instruction: "Calculate muzzle velocity from chronographed velocity. Distance of screen from muzzle." Below this, there are several input fields and buttons. On the right side, there is a "Maximum of" field set to "100" with the label "Iterations" below it. Below that is a "Units:" field set to "English" with a "Set Atmo" button next to it. Further down is a "Cancel&Exit" button. At the bottom right is a "Calculate" button. The main area contains three rows of data: "Distance of measure device from" with a value of "5" and the unit "Yards"; "Result: Muzzle velocity" with a value of "2958.6" and the unit "fps"; "Measured velocity" with a value of "2950" and the unit "fps"; and "Ballistic coefficient C1" with a value of ".560" and the unit "(ICAO)". At the bottom of the window, a status bar displays atmospheric conditions: "Atmo: Std. ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C - Gunsite altitude= 0 m - Rel. humidity= 0 %".

Enter chronotached velocity, specify distance from muzzle – only works with an established BC.

Muzzle velocity from trajectory data (group centers)

QuickTARGET Tools

Calculate muzzle velocity from points of impact at 2 ranges.

First, shorter distance Yards Maximum of Iterations

Point of impact at 1. distance in.

Second, longer distance Yards Units:

Point of impact at 2. distance in.

Result: Muzzle velocity fps

Ballistic coefficient C1 (ICAO)

Height of sight above bore axis in.

Atmo: Std.ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C -
Gunsite altitude= 0 m - Rel. humidity= 0 % - 26 Iterations

(Two ranges – only works with an established BC.)

BC from 2 velocities and distance

QuickTARGET Tools

Calculate BC from 2 velocities at different ranges.

Distance Yards Maximum of Iterations

Lower velocity fps Units:

Higher velocity fps

Result: Ballistic coefficient C1 (ICAO)

Atmo: Std.ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C -
Gunsite altitude= 0 m - Rel. humidity= 0 % - 37 Iterations

(Input Data from other trajectory tables.)

BC from trajectory data (group centers)

(Two different ranges – only works with an established V_0 .)

QuickTARGET Tools

Calculate BC from points of impact at 2 ranges.

First, shorter distance Yards Maximum of Iterations

Point of impact at 1. distance in.

Second, longer distance Yards Units:

Point of impact at 2. distance in.

Muzzle velocity fps

Result: Ballistic coefficient C1 (ICAO)

Height of sight above bore axis in.

Atmo: Std.ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C -
 Gunsite altitude= 0 m - Rel. humidity= 0 % - 24 Iterations

(Or a group average for each measurement.)

BC from time of flight and range (distance from muzzle and V_0)

QuickTARGET Tools

Calculate BC from time of flight and range.

Distance Yards Maximum of Iterations

Muzzle velocity fps Units:

Result: Ballistic coefficient C1 (ICAO)

Time of flight sec

Atmo: Std.ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C -
 Gunsite altitude= 0 m - Rel. humidity= 0 % - 17 Iterations

Enter muzzle velocity, distance of time trigger device and measured time

Zero range using point of impact at one range

QuickTARGET Tools

Calculate zero range from point of impact at 1 range.

Target distance Yards Maximum of Iterations

Ordnate of Point of Impact at Target in.

Result: Zero range Yards Units:

Muzzle velocity fps

Ballistic coefficient C1 (ICAO)

Height of sight above bore axis in.

Atmo: Std.ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C -
Gunsite altitude= 0 m - Rel. humidity= 0 % - 35 Iterations

(Or group center – only works with established V_0 & BC.)

Calculation of distance to trajectory peak using zero range, V_0 & BC.

QuickTARGET Tools

Calculate summit height above line of sight from zero range

Zero range Yards Maximum of Iterations

Result: summit distance Yards Units:

Result: summit ordinate in.

Muzzle velocity fps

Ballistic coefficient C1 (ICAO)

Height of sight above bore axis in.

Atmo: Std.ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C -
Gunsite altitude= 0 m - Rel. humidity= 0 % - 11 Iterations

(Maximum bullet path above sight line.)

Muzzle velocity and BC using 2 flight times at two ranges.

QuickTARGET Tools

Ballistic coefficient C1 and muzzle velocity alculated from time of flight at 2 ranges.

First, shorter distance Yards Maximum of Iterations

Second, longer distance Yards Units:

Result: Muzzle velocity fps

Result: Ballistic coefficient C1 (ICAO)

First time of flight sec

Second time of flight sec

Approximation cancelled! Flight time error smaller than 0,000001 s - 101 Iterations

Enter two flight times at two ranges. BC and Muzzle Velocity will be calculated. Note that at sample above calculation has stopped at iteration number 100 as set in *Maximum of Iterations* field. The result seems acceptable because time error is smaller than one microsecond. Otherwise allowed number of iterations has to be increased.

QuickTARGET Tools

Ballistic coefficient C1 and muzzle velocity alculated from time of flight at 2 ranges.

First, shorter distance Yards Maximum of Iterations

Second, longer distance Yards Units:

Result: Muzzle velocity fps

Result: Ballistic coefficient C1 (ICAO)

First time of flight sec

Second time of flight sec

Atmo: Std.ICAO - Barom. pressure= 1013,25 hPa - Temp.= 15°C - Gunsite altitude= 0 m - Rel. humidity= 0 % - 221 Iterations

Now maximum iterations have been set to 1000. A match was found at iteration 221. The difference to previous picture is a increase in muzzle velocity of 0.1 fps.

Gyroscopic Stability – Don Miller’s Rule

QuickTARGET Tools

Calculate Gyroscopic Stability according to Don Miller's Rule published in 'Precision Shooting' Apr 2008/June 2009. Sg should be greater 1.4 and less than 2

Bullet Diameter in.

Bullet Weight Grains

Bullet O.A. Length in.

Rifling Twist Length per Turn in.

Muzzle velocity fps

Ambient Temperature deg F

Barometric Pressure in.Hg

Gyroscopic Stability, Sg

Units:

Select Bullet from List:

The gyroscopic stability of a bullet will be calculated according to rules developed by Dr. Don Miller. The articles regarding this matter have been published in *Precision Shooting* April 2008 and June 2009. A S_g value of above 1,4 is considered to be sufficient to stabilize a bullet properly. Above 2,0 the precision may decline. A longer and slower twist or lower muzzle velocity may then improve groupings. (One may also open menu **Calculate...Power/Knockdown/Twist** to use old Greenhill’s twist formula for historical purposes.)

Calculation according to Miller’s rule is more practical for modern bullet shapes. This stability factor S_g is used to calculate a close estimate of spin drift. Spin drift is calculated whenever the twist length is set to non-zero value. A positive entry means right-hand twist, a negative entry left-hand twist. You may open the twist length setup window by menu ...**Options... Twist Length setup**

QuickTARGET Rifling Twist Length

Twist Length per One Turn

Right Hand Twist = positive, Left Hand Twist = negative

Inches mm

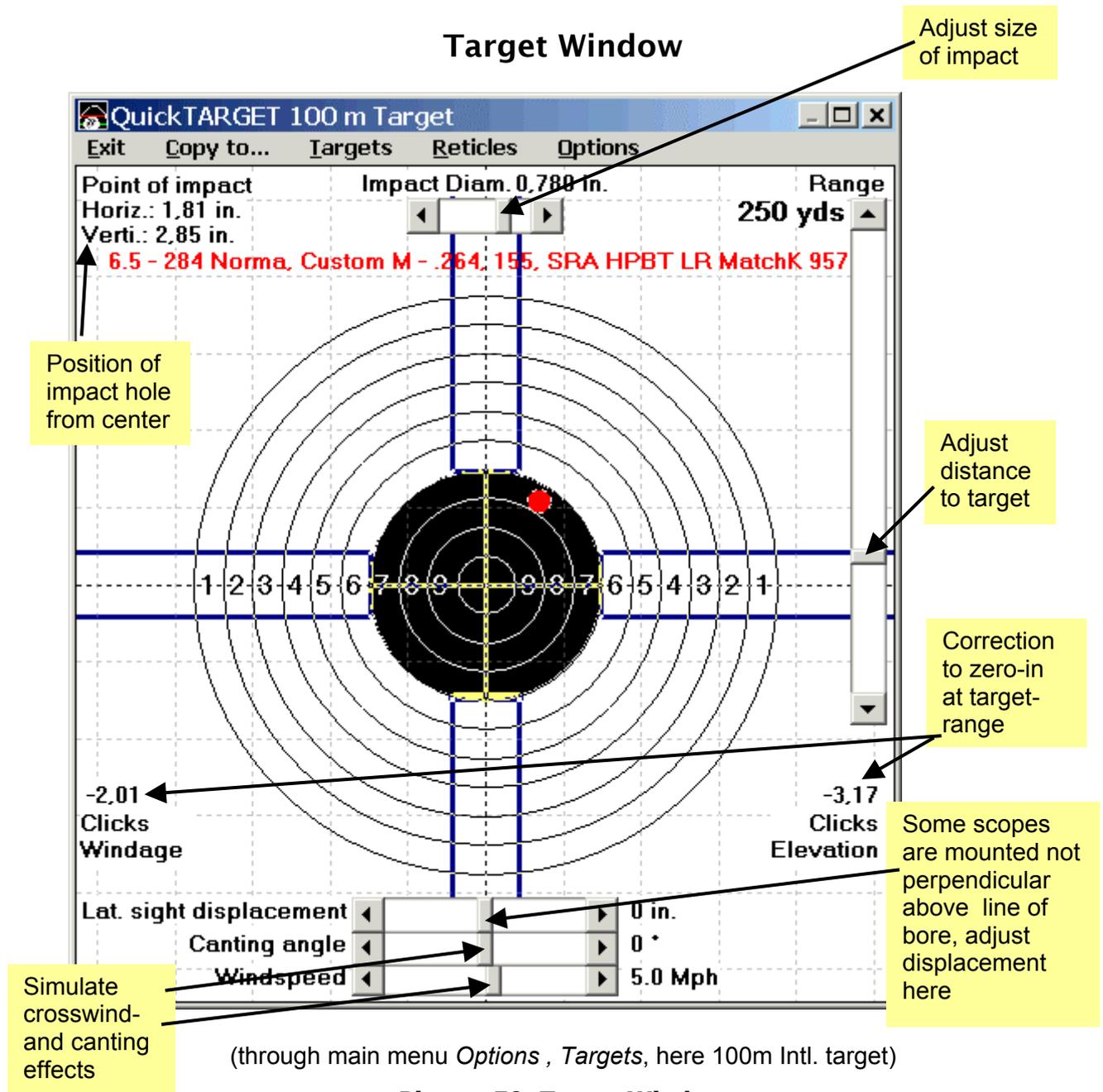
Picture 49: Rifling Twist Length window

A simple method to estimate spin drift is described in the book “Applied Ballistics For Long Range Shooting” by Brian Litz. The spin drift calculation he describes in his book is almost very close to reality. The error caused by this method is significantly small and depends on bullet in use. It is much better to use a 90% formula than omitting any spin drift correction.

On the other hand it is almost impossible to provide the necessary coefficients for hunting and sporting bullets to do a 4-DOF or “hi-fi” 6-DOF calculation..

I recommend every long range shooter to read Bryan Litz’ book.

His website is <http://www.appliedballisticsllc.com/>



(through main menu *Options* , *Targets*, here 100m Intl. target)

Picture 50: Target Window

Dark (red) point show target impact, crosswind from left side 5 mph.

Right slide varies *range* up to the maximum table range. Button and arrows: 1-step = 1 meter or yard; within slide field, 1-step = 10 meters or yards.

Sliders below target set **crosswind**, rifle **canting angle** and **lateral displacement of Line of Sight** from line of bore. Slider above target changes **bullet hole size**.

Refreshing picture: Click with mouse on target area or on menu item *Options ...Clear impacts* (or press space or ESC key). Impact trail is erased and only one (new) impact is displayed, according to settings.

With **saved reference traces** all traces (up to 5) show impacts of different color. Also a short legend of each reference is displayed in same colors. User can edit corresponding line by clicking on legend text, or pressing the numeric keys 1 to 5.

A hit outside of the rectangular picture area switches the *range* background color to yellow and also that border of the window where the impact moves out of that area.

Program calculates sight correction (in click-stop units) necessary to achieve zero range for given settings. Stated click stops correspond to user-entered sight adjustment settings.

The user can choose various targets. These include ring targets and several grid planes. The user can load digital pictures into target area (files must use .WMF format, otherwise they are not properly sized in window). The user can generate ring targets. For explanation text, please, open sample .tgt files with text editor (i.e. Notepad) and read the hints.

Bitmap of target window is copied into a file, to the clipboard or as bitmap copy to printer using the menu-item **Copy to...**

User can also apply these targets under menu **Group and sight corrections**. Here the user must place up to 15 impacts by setting those with the mouse cursor. This allows evaluation of any real group.

Clicking menu item **Exit** closes this window.

Target Window Menu bar



Picture 51: Target Menu bar

- **Targets:**
 - Select one of several targets or load a file with wmf-picture of a target or a ring target tgt-file, display a range-dependent MOA grid in the background of the target;

Target Window Menu Targets



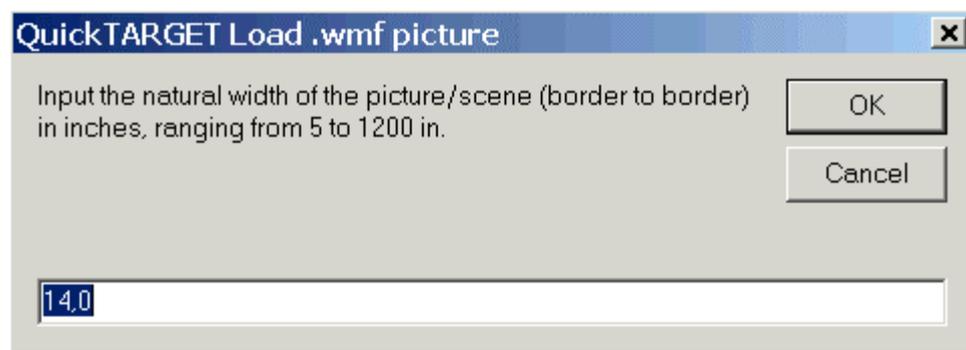
Picture 52: Menu Targets MOA grid selected

- ❖ **0 Clear impacts:**
 - Delete existing trails of impacts
- ❖ **1 10 m Airgun:**
 - select 10 m International airgun target
- ❖ **2 100 m 100 m rifle / 50 m pistol / B-17:**
 - select target NRA B-17 target
- ❖ **3 300 m rifle:**
 - select 300 m international rifle target
- ❖ **4 Grid planes:**
 - select one of 4 different spacing grid planes
- ❖ **5 pr-dog.wmf:**
 - select already loaded picture file as target
- ❖ **6 LR Palma:**
 - select already loaded ring target file
- ❖ **7 Load WMF-file:**

- select a new wmf-file holding a picture as target (wmf-files can be made with various paint programs)
- ❖ **8 Load target file:**
 - select a new tgt-file describing a ring target (files can be edited with simple text editor)
- ❖ **Show MOA grid:**
 - switch on/off o gray background grid representing MOA spacing (**grid disappears when range is so short**, that total width or height of target grid exceeds 40 MOA.)
- ❖ **Select Impact color:**
 - Select preferred color for impact hole;

Menu item *Load wmf file*

Invokes *load file* dialogue window. User selects a graphic file saved as WMF-file (windows meta file). The picture saved as file must be of square dimension (height and width being equal). This width of the picture in natural dimension must be known to the user. For example the prariedog (pr_dog.wmf) is approximately 14 inches wide. For other pictures you may measure an animal from head to tail from mouse cursor position, the reload file with new dimensions until size seems to be appropriate.



Picture 53: Specify size of picture

Target window submenu item *Load Target file*

There are some examples of target files on the disk. User may load for example a Palma match target. To examine the structure of a target file, the user should open a target file with NOTEPAD editor and look into it. Example see under Target file (*.tgt), Page 55 .

Target window menu *Reticles*



Picture 54: Target Window Menu Reticles
(Quad post x-hair and always visible selected)

- *Symbol:*
 - ◆ select a symbolic standard reticle
- *German #1, German #4, Crosshair, Quad post with x-hair, Duplex, heavy Duplex and Mil Dot:*

- ◆ select a reticle representing approximately shape and size of original reticle; if *Zoom size* is checked the reticle is zoomed relative to target and distance.
- *Always visible:*
 - ◆ Reticle is visible even without canting, otherwise reticle is displayed only with canting above zero degrees;
- *Zoom size:*
 - ◆ Reticle keeps always the same size or it is zoomed by changing the *range*;

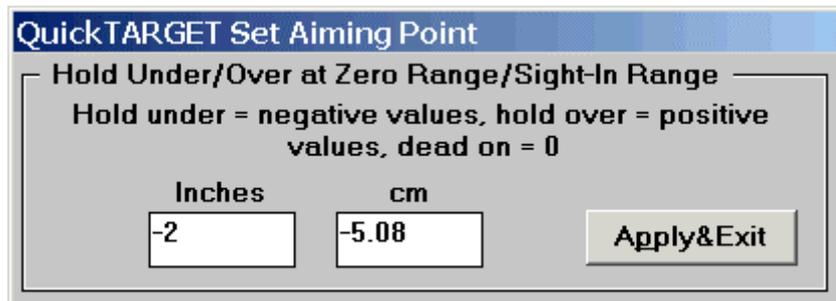
Target Menu Options



Picture 55: Target menu options

- ❖ *Hold on setup;*
 - Change or set Hold-on point of reticle, see below
- ❖ Sight adjustment clicks
 - (see description in main menu)

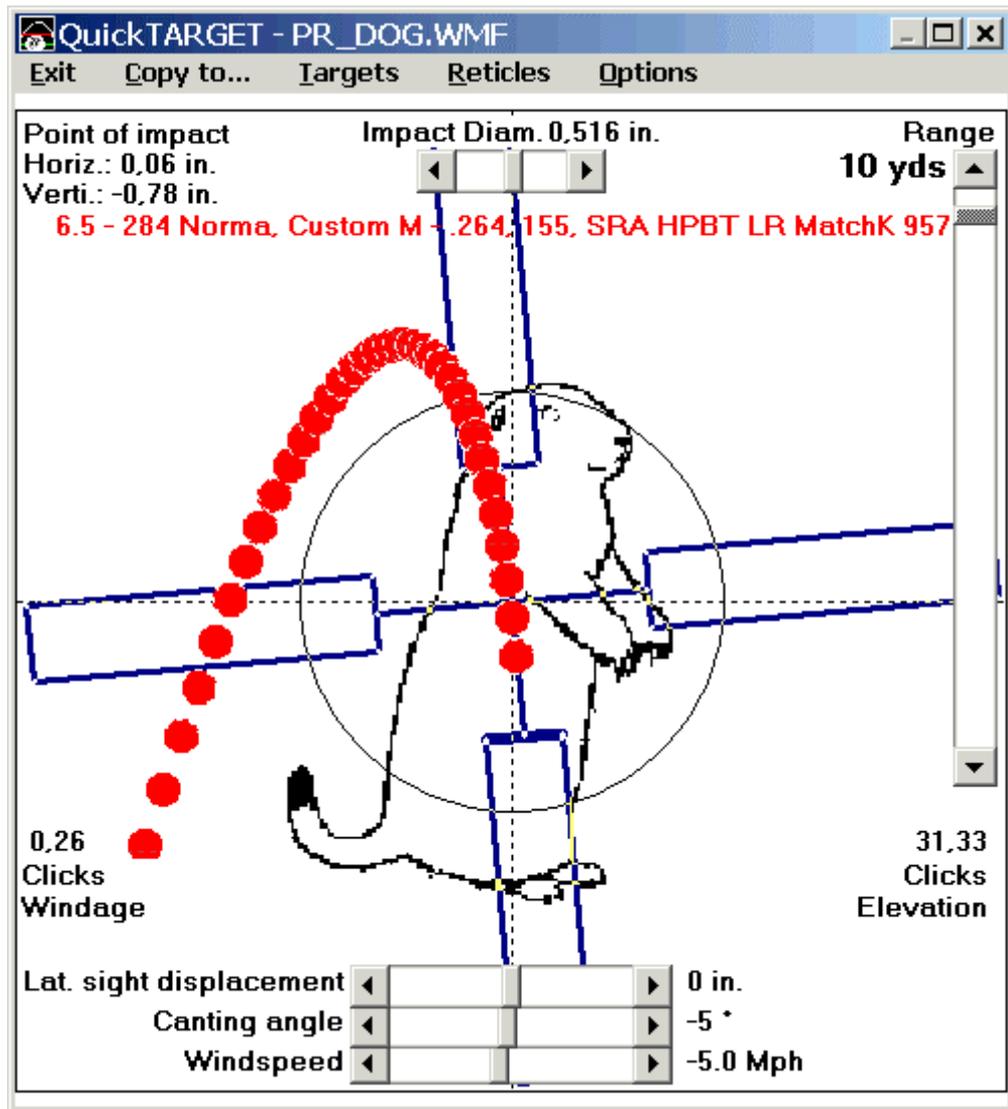
Target Window Set Aiming Point



Picture 56: Set aiming point window by Option Hold on Setup

Enter your hold on target. In this example 2 inches below center of target.

Target window with trail of impacts

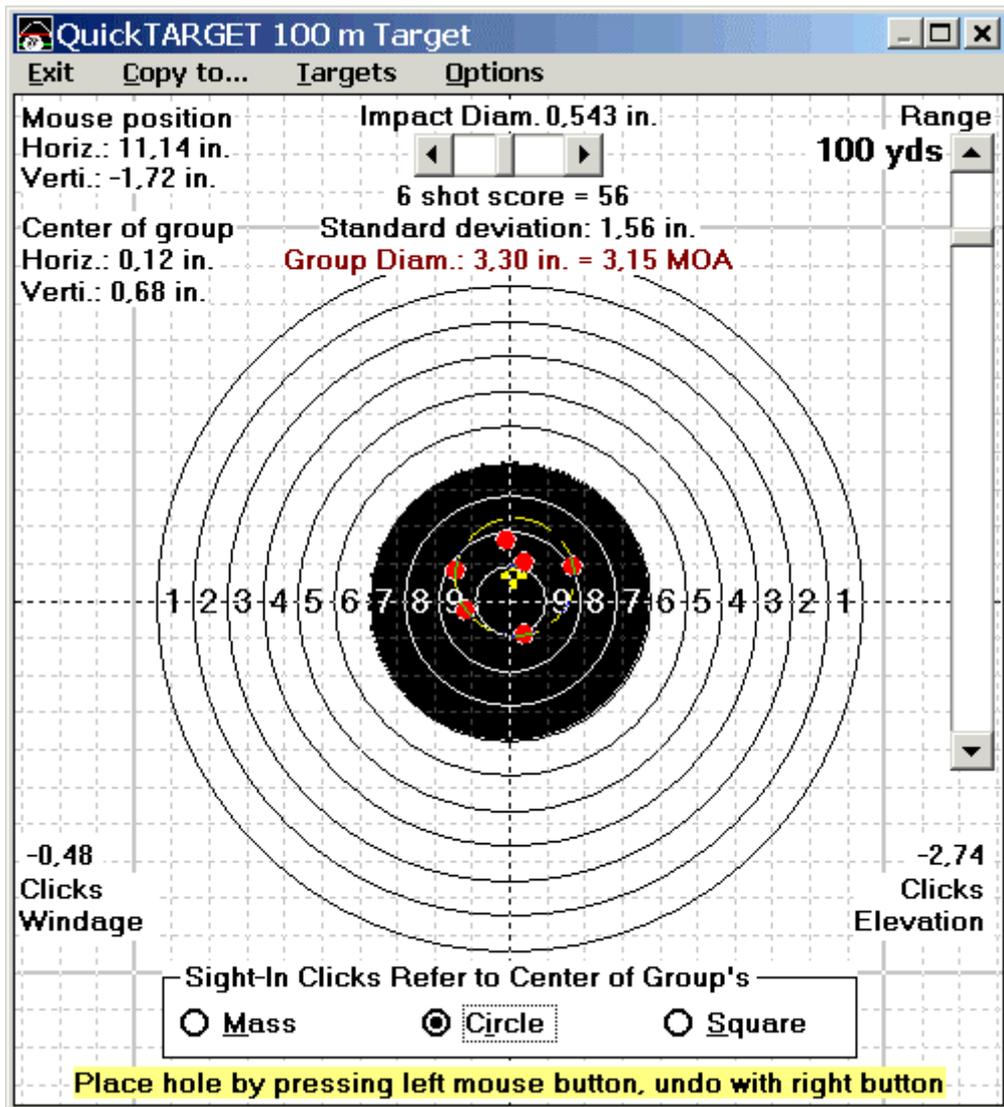


Picture 57: Target with impact trail

Target window with gun canted to left and crosswind from 3 o'clock after moving range slider from 300 yds. to 10 yds. Every 10 yards an impact is drawn representing trajectory. Trail is cleared by pressing <ESC> key or clicking on drawing's area. Picture is PR_DOG.WMF.

Remember: The crosswinds figures are always affected by spin drift, which is almost small compared to crosswind reactions. To switch-off spin drift, the twist length has to be set to zero. See Picture 49: Rifling Twist Length window

Window Target Group and Sight correction



Picture 58: Target with Group

This window is invoked by main menu *Options, Group and Sight correction*. It is the same window as under *Target* described, but displays no trajectory data or reticles.

Predefined targets can be used, as well as grids or pictures (wmf-files).

User can place impacts from real targets to displayed target by positioning mouse cursor at desired position and click left mouse button. Mouse position is displayed in upper right corner of window.

User may erase impacts backward in order of placement by pressing backspace key on keyboard. Delete single impact by pointing to impact with mouse cursor and then click with right mouse button. Mouse cursor changes to up-arrow indicating impact found.

Erase all impacts by pressing ESC key or double clicking on drawing area.

Maximum impact count is 15.

After placing impacts the group is evaluated by center of "mass", center of group's circle or center of groups square. The correction values for windage and elevation for calculated center are displayed. Mean Radius and Standard Deviation with respect to group center or center of group circle or center of group square is calculated.

Under menu *Options* user may

- ❖ change hold on position
- ❖ save placed groups in a file
- ❖ retrieve groups from a file or
- ❖ delete a group file.

Bullet data window

(through main menu *edit*)

QuickTARGET Bullet

Add New or Delete Data
in C:\...\QL_NEW35\data\bullets\SIERRA.bul

308, 170, Sierra SPFN 30-30 2010

	Inches	mm
Projectile O.A.Length	0.996	25.30
Projectile Diameter	0.308	7.82

	Grains	Gramm
Projectile Weight	170.1	11.02

	Std. ICAO	Std. Metro
	0.201	0.205

Shot Start / Init Pressure 3626

	Inches	mm
Small Diameter of Taper	0.000	0.000
Large Diameter of Taper	0.000	0.000
Length of Taper	0.000	0.000

Boattail / Hollow Base Angle 0°

Boattail Hollowbase Flatbase

Picture 59: Bullet data window

See *QuickLOAD* manual's text for information on the window design and the correct procedures for entering data. Refer to *QuickLOAD* for loading or saving bullet and other files.

Appendix

Target file (*.tgt)

Example of a target with non-equidistant ring spacing.

```
;If CircleDistance contains a value greater than zero the RingDiamX
;entries are neglected. This is for compatibility with older tgt-files.
;If CircleDistance is set to Zero, all RingDiam's must be filled
;corresponding to HighCircle and LowCircle count.
;commen = Comment, displayed at loading of file in comment window
;TargetName = Used in Target-Menu as text

[target_cm]
commen= Example for NRA Palma Target, Ring 6 omitted, Target for 800, 900 and 1000
Yards or 700, 800, 900 Meters
TargetName=LR Palma

HighCircle= 10      ; smallest diameter ring with highest score
LowCircle= 7        ; largest ring with lowest score
Outscore= 6         ; score for a hit out of rings, but on paper

RingDiam10= 50.8    ; diameter of 10 ring in centimeters
RingDiam9= 76.2     ; diameter of 9 ring in centimeters
RingDiam8= 111.76   ; diameter of 8 ring in centimeters
RingDiam7= 152.4    ; diameter of 7 ring in centimeters

X_radius= 12.7      ; RADIUS of x-ring in centimeters; when x-diameter is smaller than
                    ; highest ring
                    ; diameter, a X is printed on the target, otherwise not.
X_score= 10         ; special score of x-ring

CircleDistance= 0   ; equidistant ring spacing distance in cm, nonequidistant =0

CircleBlack= 111.76 ; black aiming area diameter in cm (at equidistant ring number)
CircleWhite= 0       ; white aiming point diameter in cm (at equidistant ring number)

TargetWidth= 240     ; width of paper area in centimeters ;182.88 is the correct val.

PrintNumber= 9       ; print ring number character up to this number
```

Example of a target with equidistant ring spacing.

```
;the settings are
;X_radius = Radius of 10 (or other max. number)
;CircleDistance= distance between rings in centimeters
;TargetWidth = Width of paper in centimeters. Please add 15% to display all rings
;CircleBlack = lowest ring black
;CircleWhite = to make for example a white 10, set to 10
;PrintNumber = show ring count up to this value
;HighCircle = maximum ring value, normally 10
;LowCircle = lowest ring value, normally 1
;commen = comment shown in load file menue
;TargetName = Headline of window target

[target_cm]
commen= Example for 200 yds Int.
TargetName= NRA C-2 200yd.

HighCircle= 10
LowCircle= 1

X_radius= 3.048
CircleDistance= 3.048

CircleBlack= 5
CircleWhite= 11

TargetWidth= 85 ;71.12 = correct val., 85 makes a smaller target to see all the rings
                ; (for zoom)

PrintNumber= 10
```

Bibliography

Books mentioned here contain useful information on Exterior Ballistics. We recommend also to read all available manuals and brochures of bullet manufacturers to collect information about their bullets.

- | | |
|-----------------------|---|
| Cranz, Carl | <i>Lehrbuch der Ballistik</i> , Erster Band, Äußere Ballistik, Springer Berlin, 1925 |
| Curti, Paul | <i>Äußere Ballistik</i> , Huber & Co., Frauenfeld, Switzerland, 1945 |
| McShane; Kelley; Reno | <i>Exterior Ballistics</i> , The University of Denver Press, 1953 |
| Athen, Hermann | <i>Ballistik</i> , Quelle & Meyer Heidelberg, 2.Aufl. 1958 |
| Molitz, Strobel | <i>Äußere Ballistik</i> , Springer-Verlag Berlin, 1963 |
| Hatcher, Julian S. | <i>Hatcher's Notebook</i> , The Stackpole Co., Harrisburg, 3.Edition, 1966 |
| Hauck, Günter | <i>Äußere Ballistik</i> , Militärverlag der DDR, 1.Aufl. 1972 |
| Oerlikon-Bührle AG | <i>Oerlikon Taschenbuch</i> , Oerlikon-Bührle AG, 2. Auflage 1981, Zurich, Switzerland |
| Rheinmetall GmbH | <i>Handbook on Weaponry</i> , Rheinmetall GmbH Düsseldorf, 2nd. Engl. Edition, 1982 |
| HMSO | <i>Textbook on Ballistics and Gunnery</i> , Volume One, Part I & II, London 1987 |
| Farrar; Leeming | <i>Military Ballistics. A Basic Manual</i> , Brassey's Publishers Ltd., Oxford 1995 |
| McCoy, Robert L. | <i>Modern Exterior Ballistics</i> , Schiffer Publishing Ltd., Atglen, PA, 1999 |
| Litz, Bryan | <i>Applied Ballistics for Long Range Shooting</i> , Applied Ballistics LLC, Cedar Springs, MI, 2009 |

List of Illustrations

Picture 1: Drag Coefficient Graph.....	5
Picture 2: G1 Projectile	5
Picture 3: G7 Projectile	5
Picture 4: Start and Disclaimer window	8
Picture 5: Main Window	9
Picture 6: Table Setup window	10
Picture 7: Main Menu Bar	12
Picture 8: Menu Info.....	12
Picture 9: Menu Windows.....	12
Picture 10: Menu Calculate.....	13
Picture 11: Input maximum vertical range	14
Picture 12: Maximum vertical range bullet returns base forward	15
Picture 13: Power Functions window.....	16
Picture 14: Menu of Power Functions.....	16
Picture 15: Menu Options	17
Picture 16: Sight adjustment settings	17
Picture 17: Target speed settings.....	18
Picture 18: Conversion of Units window	18
Picture 19: Menu Options <i>Output window displays</i>	19
Picture 20: Menu Options <i>Targets</i>	19
Picture 21: Menu Options <i>Group and sight correction</i>	20
Picture 22: Menu <i>Edit / Save</i>	20
Picture 23: Menu <i>File</i>	21
Picture 24: Atmosphere window	22
Picture 25: Atmosphere window, user defined	23
Picture 26: Atmosphere window, Altitude dependent	24
Picture 27: Atmosphere window for Sighting-In conditions.....	25
Picture 28: Window PVM Chronograph	27
Picture 29: COM Port Settings.....	28
Picture 30: Example of chronograph's response	28
Picture 31: Manual setting of device type	29
Picture 32: Large display normal	31
Picture 33: Large display mirrored.....	31
Picture 34: Menu Copy to...	33
Picture 35: Output Menu Options...	33
Picture 36: Trajectory table window.....	34
Picture 37: Table of Zero-Ranges with trajectory data	35
Picture 38: Table of zero-ranges / Sight adjustment clicks.....	36
Picture 39: Momentum Graph.....	36
Picture 40: Total Drop Graph.....	37
Picture 41: Muzzle Horizon Graph, Line Muzzle-Target.....	37
Picture 42: Trajectory to LOS Graph	38
Picture 43: Wind deflection versus range	39
Picture 44: Wind deflection zeroed in	39
Picture 45: Velocity and energy versus range	40
Picture 46: Elevation angle vs. Elevation Graph.....	40
Picture 47: Comparing four trajectories, same zero range	41
Picture 48: Comparing four trajectories, optimum zero ranges	41
Picture 49: Rifling Twist Length window	47
Picture 50: Target Window	48
Picture 51: Target Menu bar	49
Picture 52: Menu Targets MOA grid selected.....	49
Picture 53: Specify size of picture.....	50
Picture 54: Target Window <i>Menu Reticles</i>	50
Picture 55: Target menu options.....	51
Picture 56: Set aiming point window by Option Hold on Setup.....	51
Picture 57: Target with impact trail	52
Picture 58: Target with Group.....	53
Picture 59: Bullet data window.....	54

