

Gordons Reloading Tool

Interior ballistic simulation
for reloading cartridge ammunition

Version 2019.x
<https://www.grtools.de>



Documentation & User manual

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Gordons Reloading Tool

User manual & Handbook

This is the documentation and the user-manual for the inner-ballistic simulation software "**Gordons Reloading Tool**", in short "**GRT**".

Please do read carefully, before using this software!

What is GRT?

The **Gordons Reloading Tool "GRT"** is a software for handloaders and ammunition designers. It simulates combustion characteristics, pressures and bullet speeds through ballistic parameters and formulas.

GRT's purpose is to provide additional means to develop loads for handloaders and ammunition designers and to avoid excessive loads, weapons disintegration/fragmentation and/or injuries.



ADDITIONALLY

Manage, edit and create:

- individual loads
- bullet data
- powders
- caliber specifications with illustrative drawings
- individual reports on results and graphs

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-  Assistant "effective cross section"
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7. Manufacturer/Contact:

GORDONS RELOADING CHANNEL (Gordon, private person)

[✉gordon@grtools.de](mailto:gordon@grtools.de)

<https://www.grtools.de>

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Safety Notes & Warnings

The algorithms and data implemented in this program for the calculation/simulation of the burn-up behaviour are developed and tested with the greatest care, but are based on data and physical equations which for practical reasons contain theoretical assumptions as well as average values and approximations from empirical measurements.

Not every gun or component is the same! The components, from the chamber, barrel, case, bullet to the propellant powder vary from gun to gun and manufacturer and date of manufacture (lot). The results can therefore deviate greatly from the real conditions existing with them.

Compare the results with tested loading tables and/or manufacturer's recommendations. In case of doubt, e.g. if loading tables, manufacturer's specifications and simulation calculations all differ, you should have your hand-loaded ammunition tested by a institute!

- Check used dimensions, volumes and quantities
- Mark hand-loaded ammunition with sufficient information.
- Avoid confusion
- Do not use loading data of other reloaders unchecked
- Compare with loading boards and manufacturer's specifications
- Do not use hand-loaded ammunition in weapons for which the manufacturer refuses to do so, or which provide inadequate safety features and/or do not fully support the cartridge in the chamber. For example, there are guns where, in the event of failure, the breech can be blown back towards the face of the shooter (e.g. certain straight-pull rifles), causing serious injury to the shooter or bystanders!

As a reloader you act on your own responsibility!

Preamble

WHY DID THE GRT COME INTO BEING?

An internal ballistics (IB) program has the potential to remove a lot of guess work and can be an invaluable tool for reloaders. A private initiative was started. Initially out of pure interest, the author (Gordon) of GORDONS RELOADING CHANNEL decided to deal with the topic of interior ballistic simulation calculation and to develop his own software after studying the relevant literature. Experience in thermodynamics, physics and also software development from his professional career were helpful. The author built a development team from a couple of reloading/programming enthusiasts, and created an IB program called Gordon's Reloading Tool, GRT for short. GRT is supplied for free, community supported, and is a cross platform application.

ALGORITHMS

After the dry reading, many examples were first reproduced, tried out and implemented in evaluation software. The algorithms could then be better understood and extended bit by bit. Through the development of a comprehensive formalism, all possibilities were now open.

The GRT is the result of this research, study and work on the interior ballistic calculation on the basis of a mathematical simulation model - not to forget also thanks to the numerous data collectors, sponsors of the measurement data and the testers who participate in this project.

ALTERNATIVE

The commercially available software "QuickLoad" was our standard. We support and respect the outstanding performance of Mr. Brömel with this software.

We still have many ideas for the GRT. Our intention was and is not only to create an alternative, but also a platform that can grow by a community.

IMPORTANT TOOL

From our point of view, in-ballistic simulation software is an important, *supplementary* tool which, when used correctly, can increase safety and reduce the risk of "blowing yourself up" and/or others. In this respect, an alternative from our point of view is an enrichment for reloaders.

Formalism, Sources & Powder model

Formalism

The formalism used in the GRT is a custom development on the basis of the information given in the book "*Waffentechnisches Taschenbuch*" by Rheinmetall ASIN: B002FOOB8G and in the books "*Ballistik - Theorie und Praxis*" by Beat P. Kneubuehl¹⁾, as well as "*Ballistik*" by Richard Emil Kutterer²⁾.

The "Waffentechnisches Taschenbuch" (weapon technical pocketbook) on page 70 explains the internal ballistic calculation in detail including a *simplified* example. The differential equations given there are to be understood **as basis** for the calculations. They cover the case of a propellant powder that burns evenly because the equations are much simpler. The explanations in the weapon technical pocketbook made it possible for me to understand the formalisms and to compile the basics.

In the books of *Beat P. Kneubuehl* and *R. E. Kutterer* the equations are presented in much more detail; they also deal with modern considerations and mathematic methods for calculating internal ballistic effects. Also calculations and basic principles for measuring powder constants using the manometric bomb are included (for a brief insight see below).

□ The book by *Beat P. Kneubuehl* has currently been published in a new edition and is highly recommended to anyone interested.

DIFFERENT BURNING CHARACTERISTICS

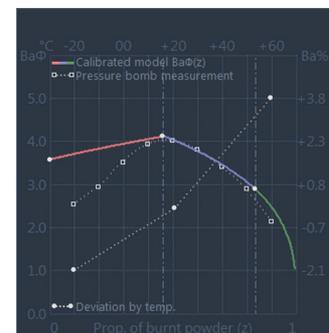
The various propellants or powders have different burning characteristics, i.e. depending on the manufacturer and type, the powder burns at **different** speeds during pressure development! Such powders behave either progressive, degressive or a specific combination of both. The traditional terms used to advertise powder behavior – e.g. "progressive" and "offensive" do not contradict this, because even offensive powders can be very progressive.

To differentiate burn behavior for propellant selection, creates opportunities to increase projectile acceleration in a longer barrel and keep pressures low at the same time.

FORM FUNCTIONS & MAPPING

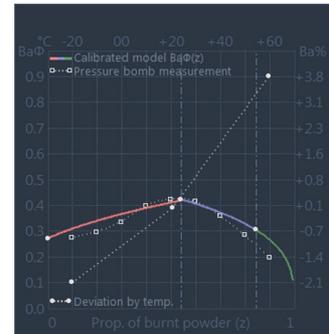
This powder burn-up characteristic is mathematically simulated in the simulation calculation by so-called form functions. This form function mathematically represents and approximates the behaviour of the powder during the burning process. Unfortunately it is not sufficient to use the differential equations from the literature 1:1, they had to be solved again or numerically approximated, new equations had to be compiled.

The mathematical representation of a powder characteristic is based on a standardized measurement, e.g. with a calorimeter bomb or manometric bomb (pressure bomb), which has a specific volume. Several measurements are then taken and recorded with a fixed test quantity Δ of a propellant powder.



The parameters of the form functions are changed so that they model the measurement curve. Subsequently, a calibration with ballistic data is performed.

After adaptation and calibration, the mathematical representation does not necessarily correspond to the original measurement data, since the propellant charge behaves dynamically differently than in the pressure bomb. Without a pressure bomb measurement, it is possible to create an approximated model using ballistic data over a large calibre spectrum, but the data generated in this way are still often very inaccurate.



The pressure bomb measurement is therefore one of the most important initial data for a powder model. As a rule, powder manufacturers perform this measurement for research and quality control purposes.

The value **Ba** given in the powder data is the **start** of this curve, which is composed of two or more sections. In contrast to the "QuickLoad" software, **the GRT** has a **three-step** representation of the burn-up behavior.

DETERMINATION OF POWDER CHARACTERISTICS

The calculations of internal ballistics depend on these powder characteristics. To determine the powder characteristics there is either the possibility of thermodynamic calculation ³⁾, or experimental determination. The experimental determination of most powder characteristics can be performed using a *manometric bomb*.

THE MANOMETRIC BOMB

Pressure in the manometric bomb

The basic idea behind the manometric bomb is that a certain amount of propellant powder **mc** is burnt in a fixed volume **V_mb**. At *combustion* a maximum pressure **p_mb** depending on powder and quantity is reached.

$$p_{mb} * (V_{mb} - b * mc) = mc * R * T_{ex}$$

mc is the powder mass, **b** is the covolume, **R** the gas constant and **T_ex** the explosion temperature (flame temperature) of the combustion gases (usually calculated thermodynamically).

Powder constant, specific energy

The *specific energy* **F_se** is obtained from the product of gas constant **R** and explosion temperature **T_ex**:

$$F_{se} = R * T_{ex}$$

This specific energy represents the pressure energy during the burning of the powder, which is available for conversion into mechanical energy.

Abel's equation

The English chemist *F. A. Abel* released investigations and an equation published in 1874, proposing to use the general equation of state at high pressures. This is the reason, why the Van-der-Waals equation are not used here. In the case of conditions occurring in ballistics and explosives, the intrinsic volume of

the gas molecules must be also considered (covolume **b**). If the charge density **delta** is calculated from the ratio of powder mass **mc** and combustion chamber **V_mb (mc/V_mb)**, the equation known in ballistics as *Abel's equation* is obtained:

$$p_{mb} = (\text{delta} * F_{se}) / (1 - \text{delta} * b)$$

Measurements

Charge density in the combustion chamber of a manometric bomb must not exceed a maximum value in order to achieve uniform combustion from measurement to measurement and thus an evaluable pressure curve. The maximum value itself depends on the specific explosion heat **Qex** of the powder used. After the investigations of *Gallwitz* experience has shown that about **delta * Qex = 545 kcal/dm³** has to be.⁴⁾

In practice, however, due to ubiquitous and unavoidable scattering, measurements must be carried out with different charge densities. Specific energy and covolume are then determined by linear regression.

The reciprocal values of the measurements performed form pairs of values. The slope of the regression line gives the reciprocal of the specific energy **F_se**, from which the covolume **b** can be determined.

In the measurement, the pressure is recorded as a function of time, where **z(t)** is the proportion of the converted charge (see figure/diagram above, X-axis).

If the law of combustion is used instead of **z(t)**, it can be resolved according to the product of *dynamic vivacity* and *form function phi(z)* (see image/diagram above, Y-axis).

$$\left(Ba * \phi(z) \right) / p_0 = \left(p_{punkt}(t) / p(t) \right) * \left((1 - b * z(t)) * \text{delta} - (1 - z(t)) * \text{delta} / \rho_c \right)^2 / \left(\text{delta} * F_{se} * (1 - \text{delta} / \rho_c) \right)$$

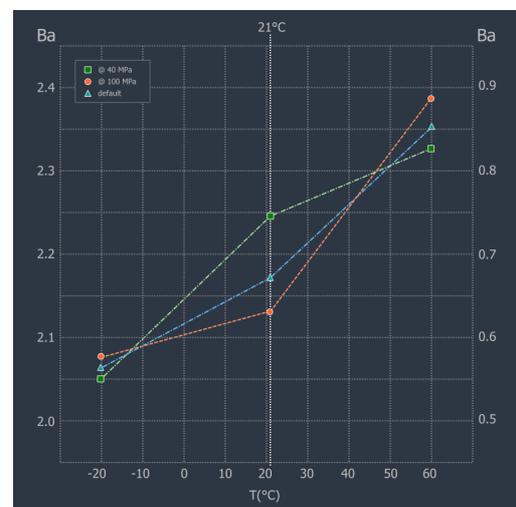
b is the covolume, **delta** the ratio of powder mass and combustion chamber **mc/V_mb** and **pc** the density (mass density) of the powder substance.

TEMPERATURE INFLUENCE ON PROPELLANTS

In the GRT, the change in the combustion behaviour due to the influence of powder temperature is represented by temperature coefficients, which separately represent the range below and above the default temperature of 21°C (see picture on the right, not to scale).

The user has the possibility to change the propellant temperature from the default value within a limited range in order to take account of environmental influences.

In general, the temperature drift of the propellants is represented by generally accepted analyses and algorithms.⁵⁾⁶⁾⁷⁾⁸⁾ Some manufacturers give temperature coefficients from specific measurements for their propellant powders, which improves the results, otherwise the internal default coefficients are used.



To determine the coefficients, the vivacity measurements are repeated at a given temperature and then calculated as follows:

Cold Temperature Coefficient (tcc)

$$tcc = (Ba(T= +21^{\circ}C) - Ba(T= -20^{\circ}C)) / (21+20)$$

Hot Temperature Coefficient (tch)

$$tch = (Ba(T= +60^{\circ}C) - Ba(T= +21^{\circ}C)) / (60-21)$$

ENERGIES AT THE SHOT

The chemical energy released by the conversion of the propellant charge is essentially divided into the following quantities when the shot is fired:

- translational projectile energy
- rotatory projectile energy
- Flow energy of powder gases
- Internal energy of the powder gases
- Heat losses at tube, bullet and sleeve
- Gas losses, friction and acoustics (vibration behavior)
- Work against the pull-out resistance
- Work pressing the bullet into the trains
- Energy of the returning weapon parts
- Energy for propulsion of (semi-)automatic weapons

LOSSES

The portion of the gun recoil, as well as the propulsion energy of automatic weapons, if any, accounts for less than 1% of the total energy and is therefore neglected.

The gas and friction losses at the projectile are represented in the algorithm by models, whereby the user is given the possibility to set different projectile material specifications. These influence the friction coefficient and consider the gas losses due to different sealing capabilities of the different projectile materials on the basis of physical and empirically determined coefficients/constants.

The flow energy of the powder gases can be calculated by adding a proportion of the charge (carrying factor, Sebert-factor) to the bullet mass to be accelerated. As is usual in other areas of physics, an effective mass is calculated. Also other energy losses can be considered here in the effective mass, e.g. the energy losses by heat input.

The gas losses due to constructive conditions such as the annular gap of revolvers can amount to **up to 20%**. They are part of the formalism, but are currently **not used**, since a setting option for this can greatly reduce the displayed/calculated gas pressure and incorrect entries can lead to potentially dangerous (incorrect) results. The implementation for the user is therefore still being discussed & evaluated (status: 03/2019).

Data

The caliber, bullet and propellant powder data provided by the GRT are laboriously created by the GRT development team and the community and manually entered data, whereby the data of the propellant powders are based on the measurement data provided by the respective manufacturers, as well as data which have been and will be determined by the community on the basis of its own commissioned measurements.

Special thanks go to the companies (in alphabetical order):

- NITROCHEMIE - <https://www.nitrochemie.com>^{en}
- Reload Swiss - <https://www.reload-swiss.com>^{en}
- RHEINMETALL - <https://www.rheinmetall.com>^{en}
- RUAG - <https://www.ruag.com>^{en}
- SOMCHEM - <https://www.somchemreload.com/>^{en}
- VIHTAVUORI - <https://www.vihtavuori.com>^{en}

IMPORTANT NOTE

Due to manufacturing fluctuations and tolerances, it is important to compare the data provided with the real conditions and adjust them if necessary. In particular: case volume and bullet length must always be checked and measured. No guarantee is given for the correctness of the data provided!

- 1) "Ballistik - Theorie und Praxis", Beat P. Kneubuehl, ISBN: 978-3-662-58299-2
- 2) "Ballistik", Richard Emil Kutterer, ISBN: 978-3-663-02335-7
- 3) Köhler et al., 2008, Akhavan, 2008
- 4) "Explosivstoffe", J. Köhler, R. Meyer, ISBN: 9783527660070
- 5) Karim et al. (2015). "Influence of Firing Temperature on Properties of Gun Propellants."
- 6) STANAG 4115. 1997. "Definition and Determination of Ballistic Properties of Gun Propellants. North Atlantic Council."
- 7) STANAG 4489. 1999. "Explosives, Impact Sensitivity Tests. NATO Standardization Agreement."
- 8) Clifford, W. 1982. "Temperature Sensitivity of Aircraft Cannon Propellants. AFATL-TR-82-72."

Usage

Installation & First start

The Gordons Reloading Tool (GRT) is a [portable Software](#) and is delivered in an archive. The archive contains all necessary files and components.

INSTALLATION

Unpack the archive into a folder of your choice, e.g. into your user directory. It is also possible to copy the unpacked archive to a mobile memory, e.g. to a USB stick, and run the program from there.

Settings that you make in the program are stored in the file *GordonsReloadingTool.cfg* in the program directory of the GRT.

GRT ARCHIVE FILE (DOWNLOAD FILE)

The GRT archive file usually has the following structure (using Windows as an example):

- **GordonsReloadingTool-**
 - **/doku** - Directory for documentation files and templates used by the program.
 - **/libs** - Directory of program libraries
 - **/loads** - Directory of (sample) laboratory files/loaded data files
 - **/Resources** - Directory of program language files
 - *GordonsReloadingTool.cfg* - Configuration file, in this file the program saves its settings.
 - *GordonsReloadingTool.db* - local Database
 - *GordonsReloadingTool.exe* - program file
 - *LICENSE.TXT* - License (english)
 - *LIESMICH.TXT*
 - *LIZENZ.TXT* - Original License (german)
 - *README.TXT*

SYSTEM REQUIREMENTS

Resolution:	HD 1080p
Memory:	100 MB
Work Memory (RAM):	1 GB
Operating system:	Windows oder Linux (x86/x86_64)

WINDOWS:

Windows 7 SP1, Vista, 8.1, 10 in 32 or 64 Bit.

LINUX:

Recommended: Linux Mint 19.1 - 32/64 Bit (Debian)

It may be necessary to install required dependencies (execute commands one after the other):

```
$ sudo dpkg --add-architecture i386
$ sudo apt-get update
$ sudo apt-get install libgtk-3-0:i386 libwebkitgtk-3.0-0:i386
$ sudo apt-get install libgtk2.0-0:i386
$ sudo apt-get install gtk2-engines-pixbuf:i386
```

If you want to identify necessary libraries, the command **ldd** can help. You can run this command from Terminal in the GordonsReloadingTool directory to return a list of the libraries required by the GordonsReloadingTool and their status on the system:

```
ldd GordonsReloadingTool
```

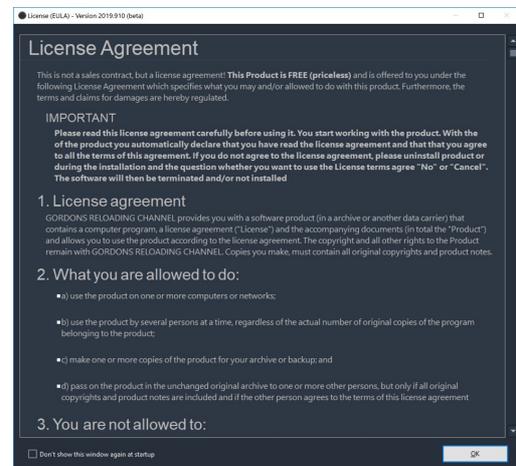
First program start

License

When the program is started for the first time a window with the license agreement appears. You must agree to the terms & conditions of the licence agreement in order to continue. **Read the license agreement carefully before proceeding!**

If you do not agree, select the button "[Cancel]", the program will not continue.

If you agree with the license agreement, check the box "[] Understood and Accepted " which will release the button "[OK]" to continue.



Arrangement selection

Then, an dialogue to select the preferred layout/arrangement appears. The arrangement can be changed at any time in the program itself. Two modes are available: Compact Mode or Expert mode

■ Compact Mode:

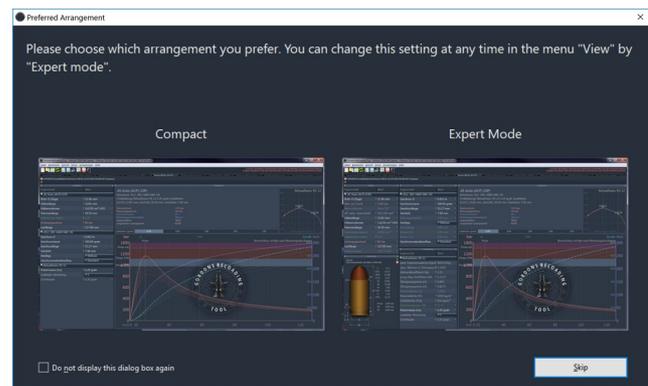
The compact layout is best for beginners, who have little experience with internal ballistic simulation software, or users who prefer a more compact presentation.

Newcomers tend to choose this mode, in

order are not to get overwhelmed. **However, the compact display hides many details**

■ Expert Mode:

The expert mode is the regular **full view** with all input data & options. This mode is useful if you are already experienced and if you have already got to know other internal ballistic simulation software.

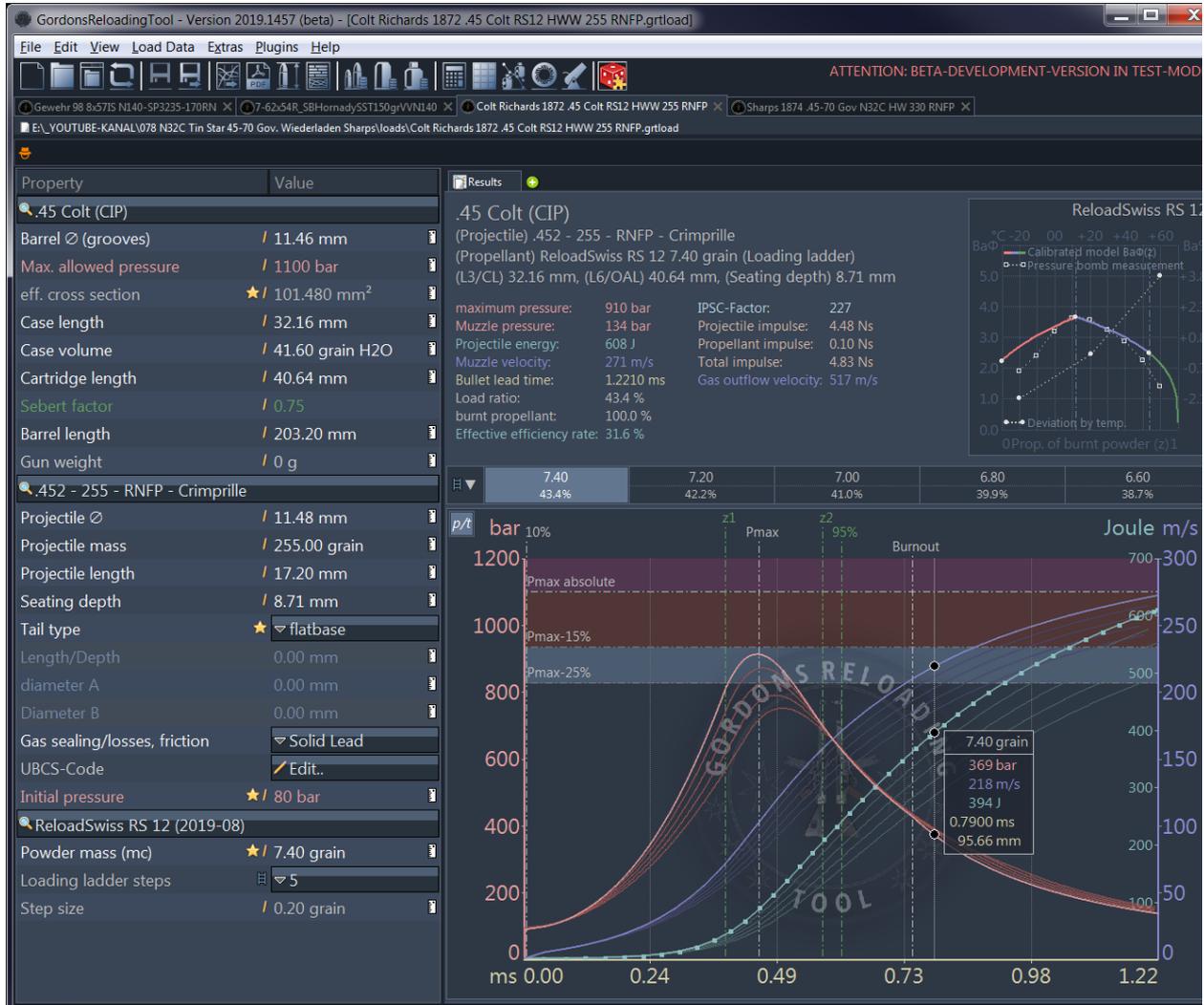


Click on one of the pictures to select the desired arrangement.

If you check "[] Do not display this dialog box again", the selection will not be shown at the next program start. You can also change this setting in the main program.

Overview compact mode

In compact mode, the most important input options are summarized in a single input window (left).



Detailed value entries, such as powder-specific coefficients and constants, are **hidden** in this mode.

INPUT WINDOW (LEFT)

Use the buttons with the magnifying glass to select or search for calibre, bullet and propellant powder.

Input fields in which you can enter or change values are marked with a small **pen symbol**. **Click in the input field** to edit a value. If you have made a mistake and want to restore the original value, press the **ESC** key or the **Ctrl-Z** key combination for a step-by-step undo. To confirm the entered value, you can click outside the input field or press the **ENTER/RETURN** key.

A **small ruler symbol** is located to the right at the edge of a field. By clicking on this symbol, you can switch the displayed units. The setting is saved and therefore remains in this position.



As soon as you have accepted/changed a value, a new simulation calculation is automatically performed and displayed in the output window.

More detailed information and important notes on the input fields and the values to be entered can be found in chapter Input fields & values.

OUTPUT WINDOW (RIGHT)

In the output window the simulation results as well as helpful additional information are displayed. **Safety instructions & error messages** also appear here if the input parameters appear implausible, wrong or dangerous to the program.

Do not blindly rely on error messages! It is possible to enter nonsensical values, which lead to wrong results!

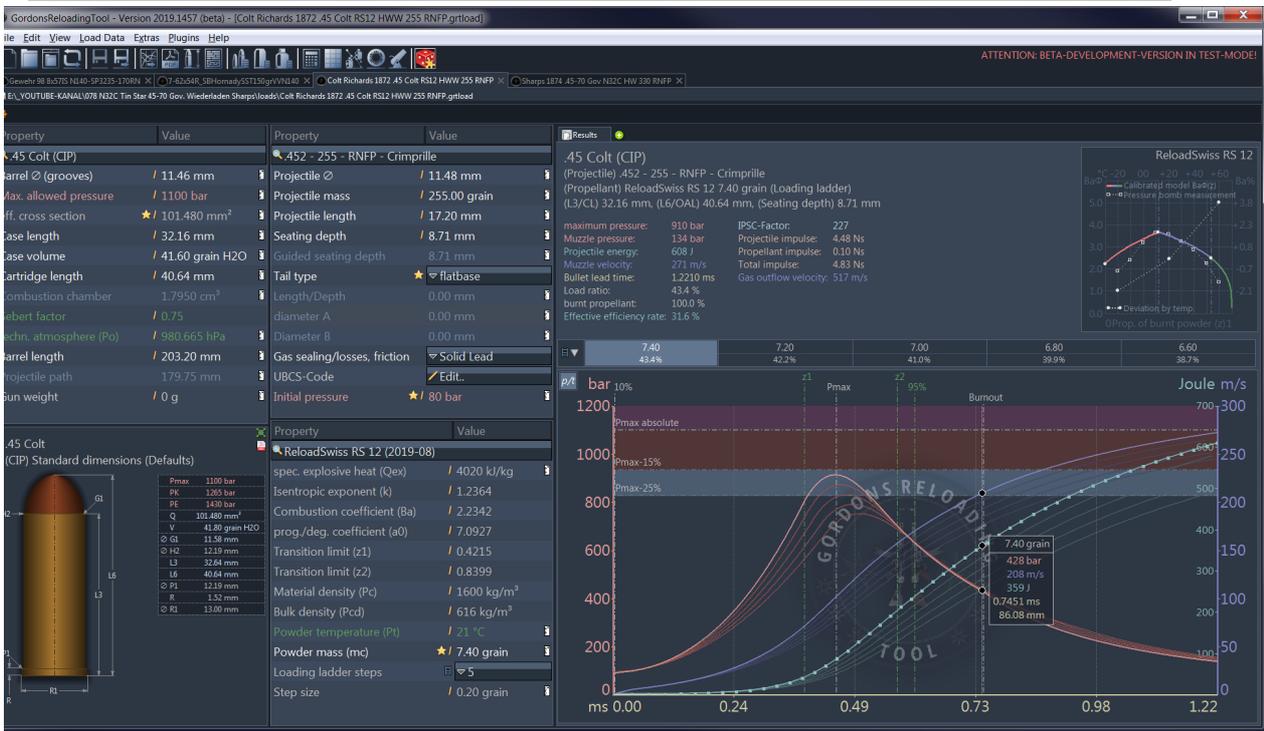
- Therefore, check your entries several times.
- Measure it!** e.g. case volume and bullet length from the database are **average values**. They vary from manufacturer, lot and in case of used cases also by the weapon used and processing of the case.



A detailed description of the output window can be found in chapter Result & Output Field.

Overview Expert Mode

In expert mode, **all** input parameters/options are displayed in separate input windows.



Each input window provides and/or displays all **detailed value entries**, such as all powder-specific coefficients and constants. In addition, the cartridge drawing of the original **(CIP-) caliber specification** including all dimensions is visible in a separate window.

INPUT WINDOW (CALIBER, PROJECTILE, PROPELLANT CHARGE)

 **Use the buttons with the magnifying glass** to select or search for calibre, bullet and propellant powder.

 **Input fields** in which you can enter or change values are marked with a small **pen symbol**. **Click in the input field** to edit a value. If you made a mistake and want to restore the original value, press the key **ESC**, or for a step-by-step undo, press the key combination **Ctrl-Z**. To confirm the entered value, you can click outside the input field or press the **ENTER/RETURN** key.

 **A small ruler symbol is located to the right of the edge** of a field. By clicking on this symbol, you can switch the displayed units. The setting made is saved and therefore remains in this position.

Note: If the window is too small to display all list entries, a scroll bar appears that can hide the icon. You can resize the columns at the top to make them visible again.





The **yellow star** indicates that an input assistant is available for the current and any subsequent associated values (see paragraph "Tools & Assistants" at the [main page](#)).

AUTOMATIC REFRESH

As soon as you have accepted/changed a value, a new simulation calculation is **automatically** performed and displayed in the output window.

- **More detailed information** and important notes on the input fields and the values to be entered can be found in chapter [Input fields & values](#)].

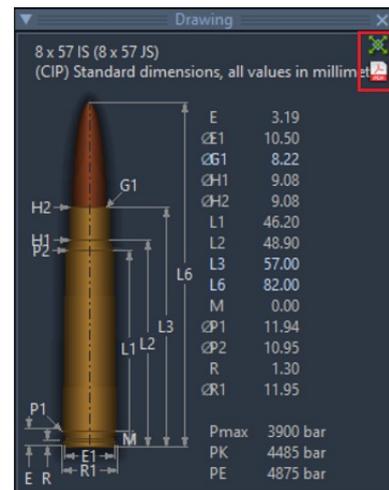
CARTRIDGE DRAWING

The **cartridge drawing** in the area of the input window shows the **original specification** incl. all **original dimensions** in reduced view.

In the **upper right corner** you will find two symbols. The upper one opens the large view of the drawing in a separate window. The lower (PDF symbol) is the PDF document provided by the standardization organization (e.g. CIP).

Note that the PDF documents are only (automatically) downloaded from the organization's website if the document has not yet been cached locally.

Once you have downloaded/displayed the document, it will be stored in the folder */pdf* in the GRT program directory and will be available the next time you call it up.



OUTPUT WINDOW (RIGHT)

In the **output window** the simulation results as well as helpful additional information are displayed. **Safety instructions & error messages** also appear here if the input parameters appear implausible, wrong or dangerous to the program.

- **Do not blindly rely on error messages! It is possible to enter nonsensical values that lead to wrong results!**
- Therefore, check your entries several times.
- Measure it! e.g. case volume and bullet length from the database are **average values**. They vary from manufacturer, lot and in case of used cases also by the weapon used and processing of the case.



- **A detailed description** of the output window can be found in chapter [Result & output field](#)].

Toolbar

We designed and consider the main menu mostly self-explanatory, so only the toolbar icons are explained here in greater detail:



The toolbar is used to select the most frequently used functions and is located below the main menu.

Let the mouse hover over an icon for a short description of its function. All icon functions are also available through the main menu.

FUNCTIONS (FROM LEFT TO RIGHT)

FILE FUNCTIONS

(Functions from the "File" menu)

-  Create New File (Loading Data)
-  Load/open existing file in new tab
-  Load/open an existing file in a completely new window
-  Reread current file, unsaved changes will be discarded
-  Save current file
-  Save current file under a (new) name

FUNCTIONS FOR THE CURRENT FILE (LOADING DATA)

(Functions from the "Loading data" menu)

-  Perform simulation calculation again manually (usually not necessary, since this occurs automatically when parameters are changed).
-  Open the PDF document provided by the standardization organization (e.g. CIP).
 - **Note** that PDF documents are only downloaded from the organization's website (after manual confirmation) if the document has not been already downloaded in the past and stored locally.
 - **Once you have downloaded/displayed** the pdf document, it will be stored in the folder **/pdf** in the GRT program directory and will be available the next time you call it up.
-  Open the large view of the cartridge drawing. **The cartridge drawing** shows the **original**

specification including all **original dimensions**.

-  Results-Report open (printout and customization possible).

GENERAL TOOLS

(Functions from the "Extras" menu)

-  Open the caliber database for viewing. Full text search, edit, create new.
-  Open the projectile database for viewing. Full text search, edit, create new.
-  Open the propellant database for viewing. Full text search, Edit, Create new.

-  Convert units of measurement
-  Table of propellant relative burn ratio
-  Parametric powder search and generic tolerance synthesis
-  Calculator for effective cross section of the caliber/barrel
-  Black powder calculator

File tab (tabs)

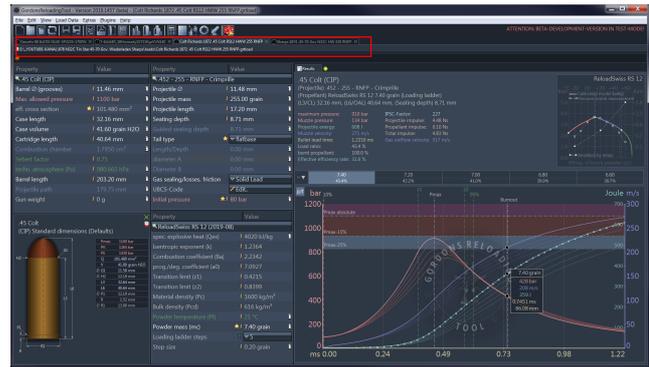
Several files can be opened in parallel in each GRT main window, which then appear next to each other in their own tab.

To change simply click on the desired tab.

To close each tab has a small (x)-symbol. This allows you to close the tab (and thus the opened file). If there are still unsaved changes, a corresponding warning appears. The last tab, i.e. if only a tab is still open, cannot be closed for technical reasons.

To rearrange the tabs, click on a tab and keep the mouse button pressed. Now you can move the tab to another position.

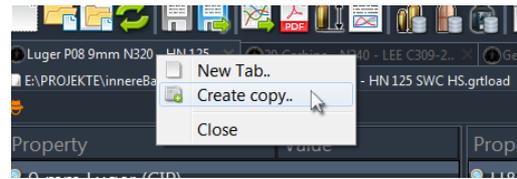
Below the tabs, the file path of the current file is displayed.



CONTEXT MENU

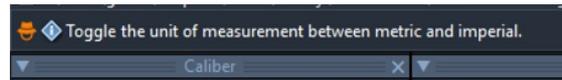
A right click on a tab opens a context menu.

The context menu offers functions for creating a new charge, or for creating a copy of the current charge file.



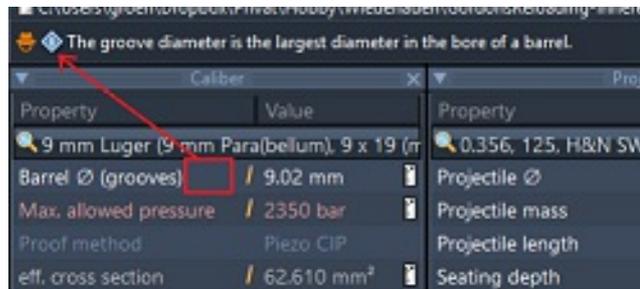
Inspector

The inspector is a text line below the tabs. It shows helpful information about input fields or general short notes.



BRIEF DESCRIPTIONS

Hold (hover) the mouse over a field for about 1/2 second. A short description will be displayed in the text line of the inspector.



Data Entry- & Overview

There are four windows in this view in expert mode. Data entry fields are contained in three of them:

- Caliber
- Projectile
- Propellant

An additional window contains:

- Drawing (a caliber illustration)

*edit windows contain two columns: **Property** and **Value***

The property column lists all input field parameters. The value column contains the corresponding value along with its dimension. Fields marked with a "pen" symbol can be edited. Fields without a "pen" symbol contain computed or non-editable values. The "ruler" can be used for switching through alternative dimensions (metric / imperial) and / or modes of calculation.

Different colors are used for these entry fields. Parameter, fields and values for pressure are marked red. Temperature and Sebert-factor ("Sebert'scher Faktor") in green. Any user entry will change the fields color to yellow and the font to italic, if there was no save to the changes. In this case, the tab header will change the name of the charge to red. After saving changes, the fields will return to their original color and font. Values in dark grey cannot be changed. Values in white identify a value of major importance, while those in light grey correspond to them as minor factors or details. Decimal delimiter is always a dot, even when an input field is in metric mode.

Caliber Window

Most caliber data are derived from official standardization bodies, such as CIP (COMMISSION INTERNATIONALE PERMANENTE POUR L'EPREUVE DES ARMES A FEU PORTATIVES, [CIP](#)). Values shown contain maximum and minimum values for physical dimensions and pressueres.

The following input fiels are contained in the caliber window:

- **Caliber Selection (first drop down)**

By selecting a caliber from the caliber database, all values will be set to default as provided for the individual caliber. If necessary, the following values can be changed:

- **Barrel-Diameter (Groove Diameter)**

This value represents the groove diameter of a rifled barrel in the given diameter according to spec. If your barrel happens to have an out-of-spec / different from average groove diameter, the measured out-of-spec value can be entered here.

- **Max. Allowed Pressure**

This value contains the max. pressure specified for the selected caliber. This should not be altered, as the value is used to automatically generate Pmax allowed (and above), Pmax allowed until Pmax-15%, and Pmax-15% until Pmax-25%, and possible warnings in the diagram.

Property	Value
8 x 57 IS (8 x 57 JS)	
Barrel Ø (grooves)	/ 8.20 mm
Max. allowed pressure	/ 3900 bar
eff. cross section	★ / 51.780 mm ²
Case length	/ 56.79 mm
Case volume	/ 63.01 grain H2O
Cartridge length	/ 71.80 mm
Combustion chamber	/ 3.6343 cm ³
Sebert factor	/ 0.5
techn. atmosphere (Po)	/ 980.665 hPa
Barrel length	/ 740.00 mm
Projectile path	/ 691.69 mm
Gun weight	/ 4900 g

- **Proof Method**

This relates to the method used to measure the max. pressure for the given caliber. For most modern calibers this will be "Piezo". This value cannot be changed for calibers taken from the caliber database.

- **Effective Crosssection**

The effective diameter of the surface, affected by propellant used for the ballistic calculation. This value is predetermined by the specification for the caliber. Light bullets with a high effective surface can reach very high velocities. The opposite is naturally also true. It is however not exactly the same as the bullet diameter.

- **Case Length**

This value represents the maximum length for the cases allowed by the specification for the caliber.

This value needs regularly to be replaced by own measures of the reloader, as new commercial brass or spent cases will be undersized to this length in almost all cases. This parameter directly influences the case volume. Only, if correct measured values are applied, GRT's simulations will calculate accurate results.

- **Case Volume**

This value represents the average case volume similar to case length, **this value needs regularly to be replaced by own measures of the reloader**. Only, if measured correctly, GRT's simulations will calculate accurate results.

- **Cartridge Length**

Over-All Length (OAL) of the Round. The total length (e.g. "OAL", or "L6" according to CIP) is the distance between the tip of the bullet and the base of the case of a given cartridge. This value is calculated based on actual case length, the length of the projectile minus the seating depth of the bullet into the mouth of the case.

- **Combustion Chamber**

This volume defines the available space, available for powder gases, inside the cartridge with a seated bullet.

- **Sebert Factor**

The Sebert factor defines the amount of powder gases flowing together with the bullet through the barrel. Depending on caliber it is a value between 0.1 und 1.0.

- **techn. air pressure**

The *techn. air pressure* for the internal ballistic equations is a physical constant for the standard air pressure.

The value "*technical air pressure*" is present in the expert view because, like the *Sebert Factor*, it is intended for situations where, with appropriate background knowledge, the behavior of the interior ballistic simulation

can be changed. The *technical air pressure* is like other constants in physics, e.g. the *gas constant* etc. are part of the simulation equations and some of them can be influenced as parameters, but **not**, that you must adapt them to local conditions.

- **Barrel Length**

The length of the barrel of the gun, the simulation is calculated for.

- **Projectile Path**

The distance, traveled by the projectile, until it leaves the barrel.

Projectile Window

The projectile window has the following fields:

All measurements in the original database were either submitted by the respective manufacturer or measured by contributing hand loaders.

Projectiles of the same brand and/or model can and will have different geometries (depending on weight)

- **Projectile Selection (first dropdown)**

By selecting a projectile from the database, all values will be set to standard values for the given bullet.



Property	Value
.323, 170, Hornady RN 3235	
Projectile Ø	/ 8.20 mm
Projectile mass	/ 170.00 grain
Projectile length	/ 23.39 mm
Seating depth	/ 8.48 mm
Guided seating depth	8.48 mm
Tail type	★ flatbase
Length/Depth	0.00 mm
diameter A	0.00 mm
Diameter B	0.00 mm
Gas sealing/losses, friction	▼ Standard
UBCS-Code	✓ H05ZF-254N3
Initial pressure	★ / 250 bar

- **Projectile Diameter**

The (ideally self-measured) average diameter for the bullet on its widest part

- **Projectile Mass**

The average weight of the bullet (best results, if measured by the hand loader)

- **Projectile Length**

The average length of the bullet **please take your own measurements!**

- **Seating Depth**

The total seating depth of the bullet into the case - that is the distance of the bullet's tail to the mouth of the case.

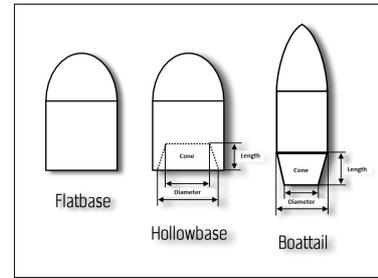
- **Guided Seating Depth**

If measured for flat or hollow tailed bullets, this value is identical to the seating depth. If the bullet features a boattail, it is the distance from the widest point of the boattail to the case mouth.

- **Tail Type**

GRT recognizes different tail configurations/features for bullets (this will influence the available combustion volume in some cases):

"flatbase" (flat tail / base of the bullet - not influencing cartridge combustion volume), **"hollowbase"** (Tail with an cone shaped insert (cavity) into the bullet's tail (similar to open lead core bullets) - this will increase the available cartridge combustion volume inside the case. Finally **"boattail"** (a bullet with a prolonged cone tail, with decreasing diameter. - this will decrease the available cartridge combustion volume inside the case. For accurate simulation results with bullets featuring hollowbase or boattail configurations, the following parameters are essential:



- **Cone Length**

The length of the cone or depth of the cavity

- **Cone Diameter A & B**

If *boattail* this is the diameter, defining the begin or the end of the cone. If *hollowbase* it is the diameter of the surface marking the begin or end of the cavity. Entering larger or smaller value as A or B is to the discretion of the hand loader, as GRT will calculate the appropriate cone or cavity automatically.

- **Gas sealing/losses, Friction**

GRT differentiates between different bullet types:	
Standard	for standard jacketed bullets with soft core.
Solid Lead	for projectiles which consist completely of lead, incl. such with polymer coating and/or thin, electrically applied copper layer.
Solid Brass	for projectiles which consist entirely of brass (so-called "solids"), also those with grooved rings acting as relief valves , or projectiles with a strong jacket and/or centre bar (so-called dual-core projectiles, such as the "Swift A-Frame").
Solid Brass driving bands	as above, but with thin driving bands, the actual projectile body having lands diameter . Projectiles with grooved rings as relief valves are NOT such projectiles!
Solid Copper	for projectiles which consist entirely of brass (so-called "solids"), also those with grooved rings acting as relief valves , or projectiles with a strong jacket and/or centre bar (so-called dual-core projectiles, such as the "Swift A-Frame").
Solid Copper driving bands	as above, but with thin driving bands, the actual projectile body having lands diameter . Projectiles with grooved rings as relief valves are NOT such projectiles!

- **UBCS-Code**

The Universal Bullet Classification Scheme [UBCS-Code](#) (follow link for more information) is a scheme to classify bullets by purpose, geometry, external and internal features. It is used to simplify the task of finding alternative bullet types by application and/or intended purpose.

- **Initial Pressure**

The initial pressure to be taken into the simulation, before the projectile starts moving. It considers primer type, extraction forces, and resistance while entering the rifling of the barrel. The amount considered for primer is distinguished by the primer characteristics, which are: large and small, pistol or rifle and standard or magnum.

STARTING PRESSURE PRESETS

Pistol-/Revolver Ammunition	
Jacketed Hollow Point (JHP) / Full Metal Jacket (FMJ) Bullets	80-150 bar
Lead Bullets (standard)	50-80 bar
Lead Bullets (soft)	20-50 bar
with Magnum Primer	+ 40—80 bar (please add)
Rifle Caliber	
Jacketed Hollow Point (JHP) / Full Metal Jacket (FMJ) Bullets	250 bar
Lead Bullets (soft)	20-80 bar
Lead Bullets (standard to brittle)	80-150 bar
Copper/-Brass (Solid), also those with grooved rings as relief valves	250-750 bar
Copper/-Brass (Solid), bullets with thin driving bands and a bullet body diameter equal to the lands diameter Projectiles with grooved rings as relief valves are NOT such projectiles!	150 bar
Copper/-Brass (Solid), bullets with wide driving bands and a bullet body diameter equal to the lands diameter Projectiles with grooved rings as relief valves are NOT such projectiles!	200 bar
with Magnum Primer	+ 50—110 bar (please add)
Slugs/Shotgun Shells	
with shot cup/ sabot	20-60 bar
Full-Bore-Slugs	50-80 bar

Propellant Window

The data provided contains all necessary values to describe the characteristics of a given propellant. All fields are editable, but it is highly recommended to refrain from doing so.

The propellant window contains the following fields:

- **Propellant (Powder) Selection (first drop-down)**

By selecting a powder from the propellants database, all values are set to manufacturers standards.

- **Spec. Explosive Heat (Qex)**

This value (Qex) describes the total contained amount of explosive energy of the powder taken by

Property	Value
Vihtavuori N140 (2018-12)	
spec. explosive heat (Qex)	3700 kJ/kg
isentropic exponent (k)	1.2275
Combustion coefficient (Ba)	0.6235
prog./deg. coefficient (a0)	0.8999
Transition limit (z1)	0.4803
Transition limit (z2)	0.8363
Material density (Pc)	1600 kg/m ³
Bulk density (Pcd)	910 kg/m ³
Powder temperature (Pt)	21 °C
Powder mass (mc)	48.51 grain
Loading ladder steps	5
Step size	0.30 grain

calorimetric measurements.

- **Isotropic Exponent (k)**

This value (?) describes the heat-capacity of gases created by the powder at constant pressure (Cp) and volume (Cv)

- **Combustion Coefficient (Ba)**

This value (Ba) describes the "vitality" of the powder during the ignition process.

- **prog./degr. Coefficient (a0)**

This value (a0) is a reference, whether the powder reacts progressive or degressive when combusted.

- **Transition Limit (z1)**

This value (z1) is the boundary, where the powders progressive combustion translates into *primary-degressive* combustion.

- **Transition Limit (z2)**

This value (z2) is the boundary, where the powders *primary-degressive* combustion translates into *secondary-degressive* combustion

- **Material Density (Pc)**

The density of material (pc) describes the mass/density of the material, the powder is made from.

- **Bulk Density (Pcd)**

Bulk density (pcd) describes the mass/density of the powder, in its final physical appearance per volume (including air pockets in cavities and between flakes or filaments)

- **Powder Temperature (Pt)**

The temperature of the propellant. This temperature has some influence of the combustion behaviour of the propellant itself.

- **Powder Mass (mc)**

The amount of powder dispensed into a case/round. This is the central editable field to explore changes in pressure, velocity and muzzle energy in the output diagrams to acquire a suitable charge.

- **Loading Ladder**

This field is used to tell GRT, if multiple graphs for pressure, velocity and energy should be used in the main output diagram as a load development ladder. If no stepping (=1) is applied selected, only single graphs (corresponding to the selected powder mass) for pressure, energy and velocity will be drawn. If stepping (n>1) is applied, multiple graphs are generated. Those reflect the maximum charge, based on the selected powder mass and additional n graphs for n times reduced amounts of powder (see step size).

- **Step Size**

This defines the offset for the reduced charges in load development ladder mode

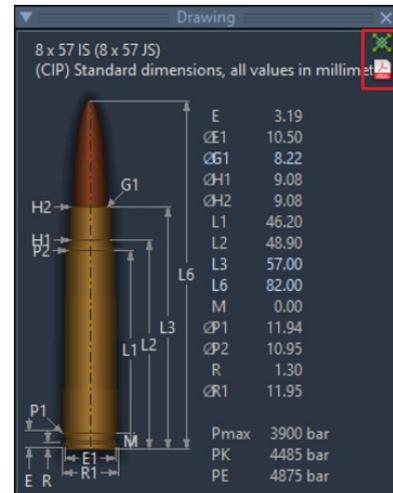
Drawing Window

Illustration of a round in the selected caliber this window also contains the original specifications for measures (lengths, radius, angels and pressures) in a compact view.

In the **upper right corner**, two symbols are shown to open either a full-size view in another window (upper symbol) or to open a .pdf document containing the original specs from the originating body (lower symbol).

Please Note: original specification documents will be loaded automatically from the respective website and stored in the **/pdf** folder, if they have not previously been stored locally.

Once retrieved the original specification documents will be stored locally and be available for future reference without reoccurring download.



Results and output fields

Window: Results

The result and output fields contain multiple information (starting top left to bottom right):* Summaries / description of substantial simulation data (caliber, powder type, powder mass, OAL and seating depth, specific and representative [max] values of the simulation* A characteristic diagram to display the "vivaciousness" of the powder in its three simulation phases* A combined diagram including the calculated values of pressure, energy and projectile velocity (selection fields for the load development ladder)



NOTES, IMAGES & FILES:

The result and output field has a **tab bar** at the top. By clicking on the "+" symbol, **notes, images and files** can be added to the current load file (*.grtload). The added data is stored in the load file.

AREA: SUMMARY

First, the caliber is being picked from the caliber database. This choice is independent from the CIP maximal values assigned to the relevant caliber which may have been changed (e.g. pressure)

- **projectile**
The next label determines the projectile picked from the projectile database including the description stored in the database (manufacturer, product name, bullet weight in grain).
- **propellant charge**
This label describes the powder picked from the powder database including the relevant description stored in the database (manufacturer, product name). These data sets are completed by maximal powder mass provided in the powder load window (in grain).
- **load development ladder**
Contains no further information but an indication that the diagram includes a load development ladder.
- **L3/CL**
Displays the inserted case length.
- **L6/OAL**
Provides the inserted or calculated overall length of the cartridge.
- **seating debth**
Contains inserted or calculated seating depth (depending on L3 and L6)

AREA: RESULT

- **Maximal pressure:**
The highest relevant value calculated is displayed in the diagram split into the chosen steps (in case that a load development ladder is being used)
- **Muzzle pressure:**

The calculated value of the muzzle pressure in the determined load development ladder steps (if applicable). The calculated value depends strongly on the inserted barrel length.

- **Projectile energy:**

The calculated energy level of the projectile when exiting the barrel in the steps chosen (if a load development ladder is being used) depending on the specific barrel length inserted.

- **Muzzle velocity:**

The calculated speed of the projectile when exiting the barrel in the steps chosen (if a load development ladder is being used) depending on the specific barrel length inserted.

- **Bullet throughput time:**

The calculated time between ignition and moment which the projectile exits the barrel in the steps chosen (if a load development ladder is being used) depending on the specific barrel length inserted.

- **Load ratio:**

The ratio of the volume of the powder charge over the inserted inner case volume in the diagram depending on the caliber and chosen steps (if a load development ladder is being used)

- **realized load percentage:**

The burned powder load percentage in the diagram which is used for the acceleration of the bullet before it leaves the barrel in the chosen steps (if a load ladder is being used).

- **Effective efficiency:**

The ratio of the kinetic energy contained at the muzzle in the projectile and the theoretically available energy of the powder mass used.

- **IPSC factor:**

The IPSC factor is calculated from the product of bullet weight (grains) multiplied by the average muzzle velocity (feet per second) divided by 1000

AREA: POWDER DIAGRAM

The powder burn-up characteristics are mathematically simulated with so called form functions. The GRT uses a three-stage image for the display. Each step is colorized individually in the vivaciousness diagram. The powder burn-up characteristics and vivaciousness of each powder type are taken from validated data sets provided by the original powder manufacturers and form the base for the diagram calculation. The illustrated graph is the result of a GRT-specific simulation taking the previously mentioned data sets as an input. The hereby calculated figures represent the powder values used for the following inner-ballistic simulations.

See also: [Formalismus & Quellen](#)

AREA: LOAD DEVELOPMENT LADDER (GRAIN)

A point-and-click tab-sequence which (if selected) shows the powder volumes (in grain values) of the load development ladder in the chosen steps. When clicking on the volume values, the corresponding graph in the diagram below is selected.

AREA: SIMULATION DIAGRAM

Responsive diagrams (multiple graphs if a load development ladder was chosen) displaying pressure in the barrel, bullet energy and velocity as a result of the inner-ballistic simulation. Caliber, projectile and powder values determine the results of the previous simulation. Corresponding values are being displayed in a context menu when hovering over the graphs.

Tools & Assistants

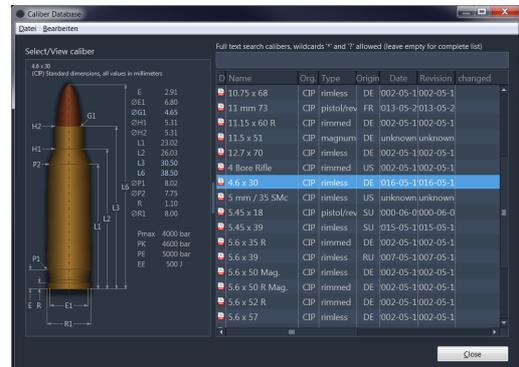
Caliber Database

Caliber Database is an archive of all calibers and their respective specifications, released by official bodies (such as CIP). After GRT installation, a default set is included.

This can however be extended or edited.

There are two main windows and a search-form:

- Select/View caliber
- Search-Form: "full-text search"
- List of Calibers



SELECT/VIEW CALIBER

This is an automatically generated drawing (illustration) of the cartridge of the selected caliber. It contains all relevant measurements.

SEARCH-FORM

This can be used for searching for any text in the caliber database. Wildcards are "*" for any number of letters and "?" for single letters.

List of Calibers

■ Datasheet

This icon represents the datasheet for the caliber. It will be opened, when clicked and available locally. If no version of the datasheet is found locally, the sheet will be automatically downloaded from the official website.

■ Name

Designated name for the given caliber (chosen by official standardization bodies, such as CIP)

■ Org.

Official standardization body for the caliber

■ Type

Type of caliber: "rimmed", "rimless", "rimfire", "magnum", "pistol / revolver" or "shotshell"

■ Origin

The country of origin of the caliber

■ Date

Date, the specification was published

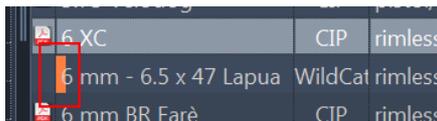
- **Revision**

Revision of the published information

- **Changes**

Date, the data was altered (changed) locally in the database.

User files



Files that have been modified or newly created by the user are marked with a color. They are also stored as a backup in the user directory of the system. When a newer GRT version is started, the data is automatically imported/restored.

The files are normal XML files that contain the data records changed or newly created by the user.

Depending on the system, the files are located in the following directory:

- **Windows:**

"C:\Users\AppData\Roaming\GordonsReloadingTool\"

- **Linux:**

"home//GordonsReloadingTool/"

Call from curr. loading file

If you access the caliber database using the button in your load instead of the tool icon in the toolbar, you can also apply a selected caliber to your current load.

By double-clicking, the caliber can be selected and applied with all data to the load file.

In addition, buttons appear in the window for transferring to the load file:

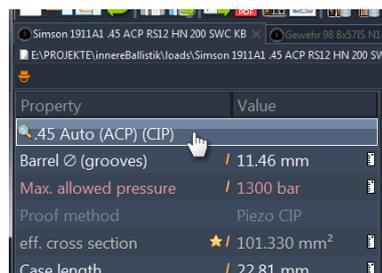
[Apply to loading data]

The selected caliber is completely applied to the load file as if you were double-clicking on a list entry.

[Apply to loading data (Select values)]

Click on this button displays the dialog "Select values to be applied..." with a list. The desired values to be transferred to the load file can be selected by checkboxes.

The "Cancel" button closes the dialog for caliber selection without applying data.

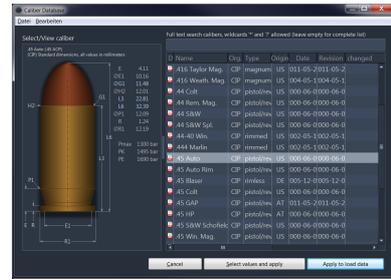


Context Menu

Right-clicking the caliber offers the following functions:

- **New** - create new (local) caliber entry
- **Neu with copy** - create new (local) caliber entry, based on the selected caliber
- **Edit** - Edit any of the calibers values
- **Delete** - Delete the selected caliber from the (local) database.

There will be a dialog requesting a confirmation, if this was really intended "OK" or not "Cancel".

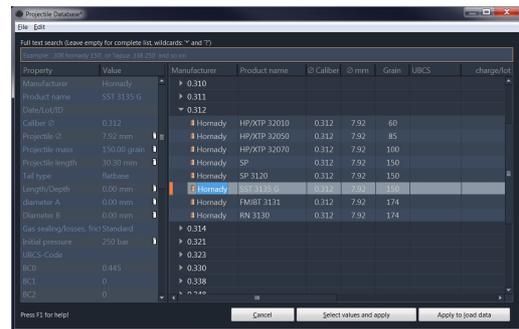


Projectile Database

This is an archive for all available projectiles (bullets), which have been contributed by manufacturer and hand loaders to the project. During installation, the most current version is installed and can then be edited or extended.

The Projectile Database's main window contains a menu bar, a search dialog, and two vertically arranged list areas:

- Menu "File"
- Form: "Full text search"
- List of Bullets - select / view bullet
- Properties



MENU FILE

this Menu offers all functions offered by right -clicking into the **List of bullets** (New, New with copy, Export, Edit, Delete- see below).

Additionally, the following functions are available:

- Save changes - this becomes available, after changes were made to the database, which have not been saved yet. If selected, all changes to the database will be saved.
- Export - export bullet data to an XML-file in GRT-format

FULL TEXT SEARCH

This can be used for searching for any text in the projectile database. Wildcards are "*" for any number of letters and "?" for single letters.

List of Bullets

This contains a list of all available bullets, sorted by their manufacturer's names. Clicking on a manufacturer, reveals all bullet diameters, available by that specific manufacturer. The list can be further expanded by clicking on a specific diameter to view the manufacturers designated bullet/product names and the following information

- **Manufacturer**
the name of the manufacturer
- **Product name**
the product name / manufacturer'S designation of the bullet
- **Ø Caliber**
the diameter of the caliber, the bullet is intended for in inch

- **Ø mm**
the diameter of the projectile in mm

- **Grain**
the weight of the projectile in grains

- **UBCS**
UBCS-Code of the bullet

- **charge/lot**
the lot number / ID of the measurements taken

- **created**
date of the dataset where created/update into the database

- **changed**
the name of the author, applying any changes (grtuser will show up, if something was manually edited or changed)

User files



Files that have been modified or newly created by the user are marked with a color. They are also stored as a backup in the user directory of the system. When a newer GRT version is started, the data is automatically imported/restored.

The files are normal XML files that contain the data records changed or newly created by the user.

Depending on the system, the files are located in the following directory:

- **Windows:**
"C:\Users\\AppData\Roaming\GordonsReloadingTool\"
- **Linux:**
"home//GordonsReloadingTool/"

By clicking on the "Cancel" button, the projectile selection is canceled.

By clicking on the "Apply to load data" button, the associated values are returned to the main window of the simulation.

By clicking on the "Apply to load data (select values)" button, the values to be returned to the main window of the simulation can be selected.

Context Menu

Right-clicking a entry offers the following functions in a context menu:

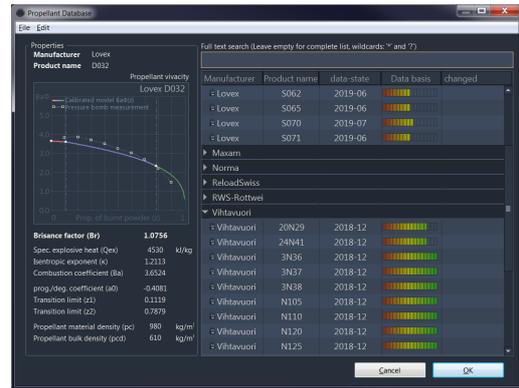
- New - create new (local) projectile entry
- Neu with copy - create new (local) projectile entry, based on the selected projectile
- Export - export selected projectile data in an XML-file in GRT-format
- Edit - Edit any of the projectile values
- Delete - Delete the selected projectile from the (local) database. There will be a dialog requesting a confirmation, if this was really intended "OK" or not "Cancel".

Propellant Database

The propellant database is an archive of all propellant powders available in GRT. The powder data can be extended and modified.

The propellant's database main window contains a menu bar, a search dialog, and two horizontally arranged areas:

- Menu "File"
- Form: "Search"
- Properties with Propellant brisance diagram and details
- List of propellants (powders) view / edit



MENU FILE

This menu provides all functions which are also available in the window **List of powders** with a right click (New, New with copy, Export, Edit, Delete - see below). Additionally, the following functions are available:

- Save changes - this becomes available, after changes were made to the database, which have not been saved yet. If selected, all changes to the database will be saved.
- Import - import powder data from an XML file in GRT format
- Import from QL file - Import powder data from a QL file (IMPORTANT: please read and understand the following warning for importing and transferring QL data to the GRT)

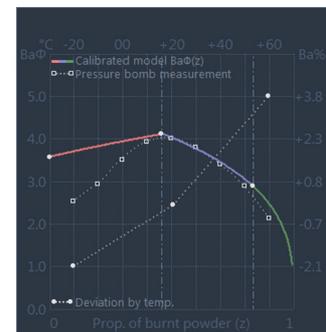
SEARCH-FORM

This can be used for searching for any text in the projectile database. Wildcards are "*" for any number of letters and "?" for single letters.

VIVACITY DIAGRAM / POWDER MODEL DATA

The **powder burn-up characteristic** in the simulation calculation is determined by so-called form functions. The GRT implements a three-level representation for this purpose. These three steps are colored in the vivacity diagram. The measured data of the powder manufacturers on the burning characteristics and vivacity of the respective powder form the basis.

If a **closed bomb** (manometric bomb, pressure bomb) measurement is available, an additional, dotted, monochrome diagram line of this measurement is displayed.



Note, that this is just a visual representation and not a mathematically usable diagram. The graphic powder diagram is not intended to derive exact measured values for licensing reasons, e.g. with regard to the closed bomb measurement. The pressure bomb measured values (dotted line) are only schematically contained.

See also: Formalism, Sources & Powder Model

List of Propellants

This contains a list of all available propellants (powders), sorted by their manufacturer's names. Clicking on a manufacturer, reveals all powders, available by that specific manufacturer, sorted by their respective product designation/name and the following information in columns:

- **Manufacturer** - Name of manufacturer
- **Product name** - Trade name / designation of the powder
- **data-state** - the age of the record, should be as current as possible.
- **calibration** - Colored progress-bar of the underlying data-basis for the powder model development/calibration process.
A powder model is mathematically created on the basis of the (pressure bomb) measurement and ballistics data. The model is then continuously further calibrated on the basis of new ballistics data. The more ballistics data there are, the more accurate the model will be.



- [red] = data basis urgently requires real-life measurements of your loads to calibrate the powder-model,
 - [yellow] = the data basis requires further measurement data of your loads,
 - [green] = good to very good data basis and representation
- **modified** - Name and date of the last user modification

User files

Name	Date Modified
ReloadSwiss	RS 12
ReloadSwiss	RS 12 modified
ReloadSwiss	RS 20

Files that have been modified or newly created by the user are marked with a color. They are also stored as a backup in the user directory of the system. When a newer GRT version is started, the data is automatically imported/restored.

The files are normal XML files that contain the data records changed or newly created by the user.

Depending on the system, the files are located in the following directory:

- **Windows:**
"C:\Users\Roaming\GordonsReloadingTool\"
- **Linux:**
"home//GordonsReloadingTool/"

By clicking on the "Cancel" or "Close" button, the propellant selection is canceled, and the database is closed. By clicking on the "OK" button, the associated values are returned to the main window of the simulation. Right-clicking the propellant offers the following functions:

- New - create new (local) propellant entry
- Neu with copy - create new (local) propellant entry, based on the selected caliber
- Export - export selected propellant data in an XML-file in GRT-format
- Edit - Edit any of the propellant values
- Delete - Delete the selected propellant from the (local) database. There will be a dialog requesting a confirmation, if this was really intended "OK" or not "Cancel".

Unit-of-measure calculator

With this tool you can convert the frequently used units of measurement to each other.

To do this, select the desired source and target unit of measurement on the right and then type the value in the input fields that you want to convert into the other unit.

Selecting the number of decimal places allows you to round the result to a certain number of decimal places.

The window of the unit of measurement calculator under Windows is a so-called "floating" window, i.e. it always remains in the foreground in the program while you are working. This way you can convert a unit during operation without having to search for the window.

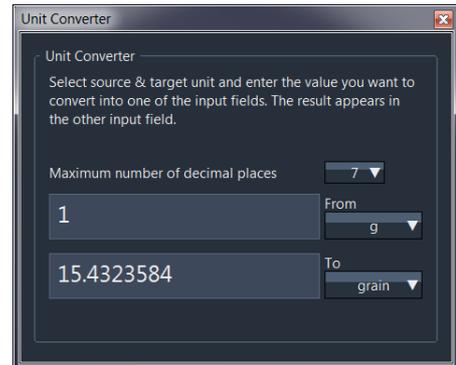


Table for relative burning rate

The table shows the relative combustion of all propellant powders in the database.

There is no standard for sorting such a table. In the published tables of different powder manufacturers or dealers, it is often very different, depending on the preference of the manufacturer. The most frequently used sorting method is **progressivity**.

The table therefore allows different sorting according to different factors, which you can select above the table with buttons.



Important Note

The table for the relative burning rate serves only as a rough overview between the different manufacturers. The table makes no statement about how vivacious a powder actually is in the pressure characteristic!

A powder listed in the table at the same level does not therefore mean that it is a 1:1 substitute for a specific powder! It only means that it is probably suitable for a similar application.

SORTS

PROGRESSIVITY

Sorts the table by the progressivity factor **Bp** of a propellant powder. The progressivity factor and its equation is GRT specific and calculated:

$$B_p = \sqrt{(2 * (k - 1)) * \text{pow}(B_a * \text{phi}(z_1) * Q_{ex,2})} / 10000;$$

BRISANCE

Sorts the table by the (initial) explosive factor **Br** of a propellant powder. The explosive factor and its equation is GRT-specific and calculated:

$$B_r = \sqrt{(2 * (k - 1)) * \text{pow}(B_a * Q_{ex,2})} / 10000;$$

BRISANCE & PROGRESSIVITY (COMBINED)

Sorts the table using the combined Brisance & Progressivity factor **Brp** of a propellant powder. The combined factor and its equation is GRT specific and is the *second absolute moment*¹⁾ of both single factors:

$$B_p = \sqrt{(\text{pow}(B_r,2) + \text{pow}(B_p,2)) / 2};$$

By combining both factors, a more practicable approximation of the behavior of different propellant powders should be achieved.

1) the quadratic mean

Parametric powder search & generic tolerance synthesis

This powerful tool consists of two parts, the **Parametric Powder Search** and the **Generic Tolerance Synthesis**. In combination, you can search for propellant powders based on your **current load file** in real time using various criteria and/or perform internal ballistic simulations with different propellant powders. Here you specify the tolerance ranges.

NOTE

If you call this tool, the data of your current load file in the foreground will be used, e.g. the current powder is already preselected.

Parametric Powder Search

Parametric Powder Search is used to find propellant powders that have similarities to the currently selected powder within the specified tolerance ranges. This is comparable to the table for the relative burning rate, with the difference that you also have the possibility to select and set detailed tolerance windows for individual factors of a powder.

If you click on the button with the currently selected propellant powder, you can specify another powder as the base for the search.

Use the button above the sliders to select the maximum range of the tolerance window. Here you can specify whether the search should be carried out in both directions or only in the positive or negative range.

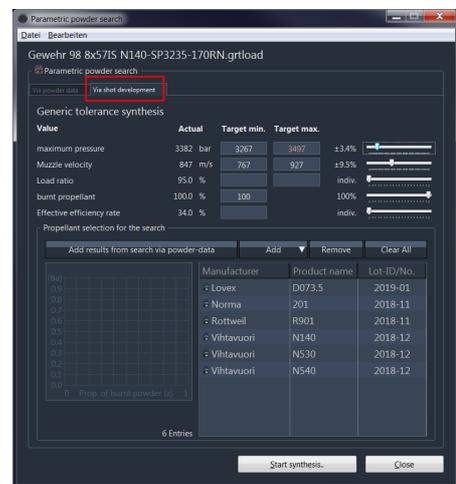
The sliders below can be used to set the tolerance windows of the respective values or factors individually. The result of the search is automatically displayed at the bottom of the list.

For a similarity search the selection "[x] Similarity search" with the factor "Brisance/Progressivity (Brp)" is recommended.

Note that "similar" propellant powders can exhibit completely different behavior. In this case, each of the selected powders would have to be tested individually for suitability, which means that the charge of each propellant powder would have to be adjusted accordingly, **but:**

to simplify this work, there is the Generic Tolerance Synthesis.

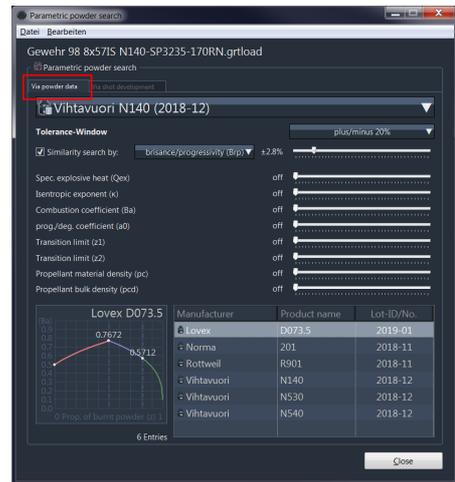
Generic Tolerance Synthesis



Generic tolerance synthesis performs internal ballistic simulations based on the selected powders and tolerance windows and uses recursive generic adaptation to determine the next possible charge to the selected powder depending on all set criteria **simultaneously!**

I.e. you define in which pressure range and/or e.g. muzzle velocity the charge should move and the synthesis calculates for all powders listed below the charge which best meets the criteria.

Depending on the selection of the limiting tolerance windows and the selected propellant powders, the charges can exceed the specified maximum pressures, or represent no sensible charge or even a dangerous one!



TOLERANCE WINDOW

In order to perform the synthesis, certain tolerance windows must be specified. If an incomplete or incorrect input is detected, the corresponding input field is framed in red.

If you do not enter a minimum value for the loading ratio, this can **slow down the calculation considerably**, especially for long gun calibers, since the synthesis then has to pass through a larger powder range. Keep in mind that many internal ballistic calculations are performed for each individual propellant powder.

If the maximum pressure tolerance window is selected and the limit of -15% or the maximum specified pressure is exceeded, the text is automatically highlighted.

Above the list of propellants you will find the buttons and functions to make your choice. Here you also have the possibility to add the propellants found with the *Parametric Powder Search* to the list.

START SYNTHESIS

With a click on the button [Start synthesis], the generic tolerance synthesis is started. Now many individual internal ballistic calculations are performed for all powders selected in the list in conjunction with the desired tolerance parameters on the basis of their current charge with the specified case volume, projectile etc., the simulation results are set in relation to the specified tolerances and restarted with modified powder quantity. All this until as many criteria as possible have been met at the same time.

The results of each individual synthesis are then written to a list in the Results tab (see picture on the right) and the current calculation is displayed graphically in real time during the process.



After completion, you can click on an entry to display a short preview of the results above. By clicking on the small diagram image of a list entry, the complete result diagram is displayed. Detailed warnings can be found as usual in the diagram screen and also in the results list after the export.

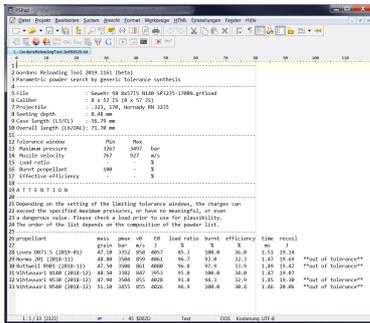
LOAD/SAVE CONFIGURATION

You can save and load the configuration of your current settings with the corresponding functions from the menu. In combination with your load file (*.grtload) you can restore and restart the synthesis later using the stored parameters.

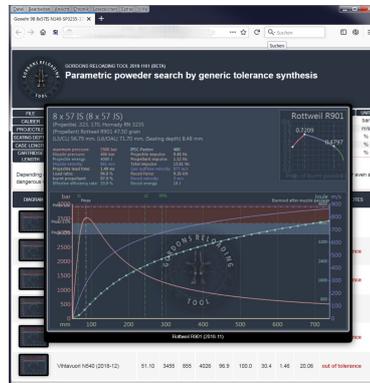
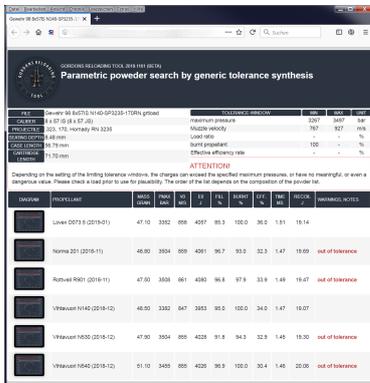
RESULT EXPORT

To export the results you can select the export formats Text, HTML and Image from the menu, where HTML contains a complete result list, including all diagram images. The graphics are stored in the HTML document itself, i.e. it is only a single file which you can share.

EXPORT AS TEXT



EXPORT AS HTML



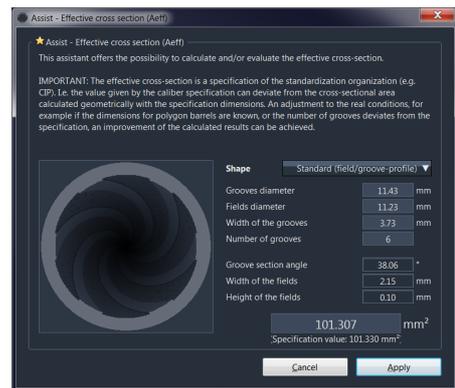
Calculator for the effective cross-section

This tool or assistant, helps in calculating the effective cross-sectional area of a caliber or barrel based on your own measurements. Effective cross-section means the physically effective area of the projectile on which the combustion pressure acts while the projectile is moving through the barrel.

The effective cross-section is in many cases specified by the standardization body / organization (e.g. CIP). In this case, the value given by the caliber specification can deviate from the result calculated with this assistant.

An adjustment to actual measurements, for example the dimensions for a polygon barrel or the individual number of grooves in your guns barrel, will improve the calculated results.

If started from the current load **via the star symbol** , the assistants input fields are automatically prefilled with values matching the selected caliber specification (see picture above).



Black Powder Calculator

Internal ballistic simulation calculations with black powder are unknown, therefore only estimates can be made. The black powder calculator provides the functions for estimating the muzzle velocity.

The equations for estimation are a further development of the calculation bases presented by Don Miller in the magazine "Black Powder Cartridge News" #76 (2011, pp. 27-30). The GRT further development of the respective equations includes an adjustment of the factors on the basis of own measurements, including additional bullet variants and black powder varieties.

- **Formula**

Here you select the equation to be used.

- **Powder type**

Here you select the used black powder.

- **Barrel length**

Enter the length of the barrel in inches here.

- **Projectile weight**

Enter the bullet weight in grain here.

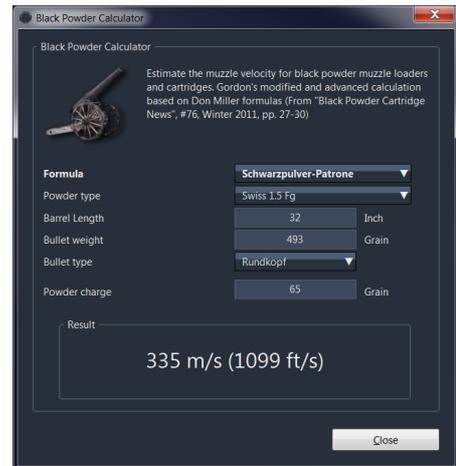
- **Projectile type**

Select the projectile type used here. For example, it is also permissible to set a minié bullet or a round bullet for a black powder cartridge.

- **Pulverladung**

Enter your powder charge in grain here.

The calculation takes place automatically after changing a parameter.



Plugins

Plugin-API

The GRT has a dynamic plug-in interface for add-on functions.

WHAT ARE GRT PLUGINS?

GRT plugins are standalone, executable programs or scripts. At startup, all activated plugins from the plugin folder are integrated into the main program.

For this purpose a communication channel between the GRT and each plugin is established via **IPC** (Inter Process Communication). IPC is a common type of connection between different programs on a system. It does not require an Internet connection for plug-ins or the GRT. With IPC, the connection is limited to the local computer.

The plug-ins are therefore only loosely connected to the GRT via a communication channel. If a plugin author so wishes, he can also design his plugin so that it can be used independently of the GRT.

WHERE ARE THE PLUGINS STORED/INSTALLED?

The *subdirectory* in which the GRT plugins must be located to be recognized: "**plugins**". So the plugins are located e.g. in

- *C:/Applications/GordonsReloadingTool/plugins/*

WHAT REQUIREMENTS DOES A PLUGIN NEED?

- The plugin must be executable. I.e. it must be able to run independently as a program or script.
- The plugin must be able to recognize and process the **command line parameters** specified at startup.
- The plugin must be able to establish a **Socket connection** for the communication with the GRT.
 - **under Linux:** a Unix domain socket
 - **under Windows:** TCP-Socket

Because there are no Unix domain sockets under Windows, a normal TCP socket is used. The GRT opens a specially configured TCP socket, which does not allow Internet connections and therefore does not provoke a firewall warning.

DIRECTORY STRUCTURE OF A PLUGIN

Each plugin is located in a separate folder. The name of the folder should be unique to avoid conflicts with other plugins, but it has no other meaning.

A plugin directory usually has the following files and folders:

- **/media**
Subdirectory for media files like icons or images (optional, name is a recommendation)

- ***com.grt.plugin.xml***

This file is the so called **Manifest** of the plugin. **The name of this file is a default and always the same.** The plugin manifest contains the specification of the plugin. It also contains the definition of e.g. menus and toolbar icons which should be provided automatically in the GRT for the plugin.

- ***plugin.exe***

The plugin itself as an executable file (any name), here for Windows. A plugin can also support multiple platforms and the location of the executable files is defined in the plugin manifest. Where the executable plugin files are stored within the plugin folder is therefore freely selectable.

Integration of plugins into the GRT

When a plugin is stored in the GRT plugin folder, the *Plugin Manifest* of all plugins is read by the GRT at startup. Depending on the configuration in the plugin manifest, all defined and desired behaviors, menu items and toolbar icons will be created or configured by the GRT for the plugin.

Menus defined by the plugin appear in the GRT in the menu "Plugins" with the name of the plugin and as submenus all menu items defined by the plugin. The menus defined by the plugin can be nested as deep as desired.

Then, depending on the operating system, the executable file defined in the plugin manifest is launched with a command line parameter. With the connection parameters specified in the command line, the plugin must then connect to the GRT with a **Socket-Connect**. A **Timeout** can be specified in the plugin manifest, which cancels the connection attempt on the part of the GRT in the event of an error.

See: The plugin manifest

COMMAND LINE PARAMETER FOR PLUGIN START

Windows

```
plugin.exe --ipcport <port number>
```

Under Windows the port for the TCP socket. If, for example, the port number **49771** is specified, the connection address to the GRT is: **localhost:49771** or **127.0.0.1:49771**.

Linux

```
plugin --ipcfile <filepath>
```

Under Linux the path of the connection file for the Unix domain socket.

CONNECTION TYPES

A plugin can be configured so that it either remains **continuously** connected to the GRT, or is only started during **user interaction**. For plugins that are permanently connected to the GRT, toolbar icons **will be disabled** (gray) if a plugin terminates the connection and menu items of the plugin are functionless.

As long as the GRT is running, the plugin can reconnect to the GRT automatically after a connection loss with the last specified connection information. Toolbar icons and menus are then automatically reactivated.

Note: currently only the *launch-type "permanent"* is functional.

Communication (API)

The communication between the plugins and the GRT takes place via data packets which are exchanged via a socket connection. The data encapsulation is done in plain text via [JSON-Notation](#) with corresponding specifications to the structure.

- **Number values** are specified **decimal**.
- **Strings** are specified in plain text in [UTF8-Format](#). They may also be [URL-encoded](#) if necessary.

Important

It may happen that a package is lost due to technical circumstances. This means that the plugin must ensure that the **response packets** are **evaluated** by the GRT for a command sent by the plugin. If no response is received, the plugin can recognize this and execute the command again.

Failed packets

The GRT reports back to the plugin packets detected as faulty with an error message and description.

Events & Functions

The GRT sends all **events activated in the plugin manifest** to the plugin. I.e. if the plugin has activated the event for tab change (tab clicked/changed by the user), an event message is automatically sent to the plugin as soon as the user has clicked a tab in the GRT.

LIST OF EVENTS

The events do **not** expect any confirmation from the plugin. No response message is necessary for events. When an event occurs, it is sent to all plugins that have activated the event in their manifest.

Note: "Tab" denotes the tab or the corresponding load file in the GRT.

- [Event_Attached](#) - Plugin integrated
- [Event_ColorPresetChange](#) - color scheme changed
- [Event_MenuAction](#) - Menu item clicked
- [Event_ToolbarAction](#) - Toolbar icon clicked on
- [Event_TabClosed](#) - Tab was closed by user
- [Event_TabComputed](#) - Simulation recalculated
- [Event_TabDataChange](#) - Data of a tab changed
- [Event_TabSwitch](#) - the user has clicked on a (different) tab
- [Event_TabUnitChange](#) - a unit of measurement has been changed
- [Event_WindowActivate](#) - a GRT main window (the one with tabs) has been activated/put in the foreground
- [Event_WindowClosed](#) - a GRT main window was closed
- [Event_WindowDeactivate](#) - a GRT main window was placed in the background
- [Event_WindowMaximize](#) - a GRT main window was maximized

- Event_WindowMinimize - a GRT main window was minimized
- Event_WindowMoved - a GRT main window was moved
- Event_WindowResized - a GRT main window has been resized
- Event_WindowRestore - a GRT main window was restored after maximizing/minimizing

LIST OF FUNCTIONS (COMMANDS)

CLOSE

- Close_ChunkStream - close data stream

FIND

- Find_Caliber - find calibers
- Find_Projectile - find bullets
- Find_Propellant - find propellants

GET

- Get_Chunk - read part of a data stream
- Get_ColorPresets - list of all color schemes
- Get_ColorPreset - read color scheme
- Get_Tab - read properties of a specific tab
- Get_TabData - read load data of a specific tab
- Get_TabList - read list with properties of all tabs
- Get_TabOnTop - read properties of the active (focus) tab
- Get_TabResults - read simulation results of a specific tab

SET

- Set_MenuItem - change menuitem properties

THE PLUGIN-MANIFEST

The plugin manifest is a file in XML format with a fixed filename (all lowercase letters):

com.grt.plugin.xml

A common plugin manifest has the following structure:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<GordonsReloadingTool>
<!--
GRT plugin manifest

Plugin configuration <plugin>
The attribute "id" must be begin with the domain "com.grt.plugin" and is
usually extended by a unique, alphanumeric name without spaces for your plugin.

The attribute "enabled" activates or deactivates the plugin. If "false" the
plugin is ignored at startup.

The attributes "launch-windows" and "launch-linux" defines the executable of
the plugin. The executables can be placed in a sub-folder also. In this case
just add the local directory path like "bin\plugin.exe" for windows or
"bin/plugin" for linux. At least ONE of both attributes must contain a valid
executable file. The Plugin fails to load if no file for the specific OS is
specified.

The attribute "launch-type" configures the launch method for the plugin.
With value "permanent" the plugin is executed at startup and permanent attached
to the GRT (default). With Value "onDemand", the plugin is launched if a
user-action take place and it is not yet running. The plugin can terminate
itself after finish a process and will be then launched again on next
user-action.

If you are using a script language that runs on windows and linux e.g. python,
then just enter in BOTH attributes the same file.

The attribute "launch-args" are the custom commandline for the plugin where
the placeholder "{PLUGIN_COMMANDLINE}" can be used ti implement the original
commandline from the GRT (holds the specific connection infos).
"launch_args" replaces the original commandline that are passed at plugin start.

-->

<plugin
name           = "GRT Example Plugin"
id             = "com.grt.plugin.example"
version        = "1.0.0"
provider       = "Test Provider"
description    = "This is a plugin example"
launch-windows = "plugin.exe"
launch-linux   = "plugin"
launch-type    = "permanent"
launch-args    = ""
start-timeout = "2.0"
enabled        = "false"
>
<!--
Registering to GRT events
each event you turn on with value "true" will be sent to your plugin when the
the event occurs.
```

NOTE: ONLY TURN EVENTS ON THAT YOU ARE REALLY NEED, OTHERWISE IT CAN AFFECT THE PERFORMANCE OF THE GRT IN **CASE** OF MANY PLUGINS ACTIVE.

The events here are only **for** example purpose all activated.

```
-->
<registerevent>
  <event name="ColorPresetChange" enabled="true" />
  <event name="TabSwitch" enabled="true" />
  <event name="TabDataChange" enabled="true" />
  <event name="TabUnitChange" enabled="true" />
  <event name="TabClosed" enabled="true" />
  <event name="WindowActivate" enabled="true" />
  <event name="WindowDeactivate" enabled="true" />
  <event name="WindowMaximize" enabled="true" />
  <event name="WindowMinimize" enabled="true" />
  <event name="WindowRestore" enabled="true" />
  <event name="WindowMoved" enabled="true" />
  <event name="WindowResized" enabled="true" />
  <event name="WindowClosed" enabled="true" />
</registerevent>
```

<!--

Menu integration

You can **as** many menuitems **and** submenus define **as** you want.

The main tag `<menu>` is the main menuitem only that are created with the name of your plugin defined above. `<menu>` has the attributes `"autoenable"` and `"icon"` only. **If** `autoenable="true"` the GRT auto-enables the menu items in the GRT menu integration **for** you. Otherwise you have **to** alter each menuitem yourself **to** enable/disable it (using the menuitem command).

Each `<menuitem>` can be a submenu by inserting more `<menuitem>`-tags.

Each `<menuitem>` must have the attributes `"id"` and `"label"`.

The attribute `"id"` is appended **to** the plugin-id defined above **and** will be sent **to** the plugin **if** a menuaction **event** occurs.

(same **for** toolbar-icons/buttons down below)

-->

```
<menu autoenable="true" icon="media/icons/icn_about_16x16.png">
  <menuitem id="menu1" label="Menu 1">
    <menuitem id="entry1" label="Entry 1" icon="media/icons/icn_plugin_16x16.png" />
    <separator />
    <menuitem id="entry2" label="Entry 2" icon="media/icons/icn_plugin_go_16x16.png" />
    <menuitem id="entry3" label="Entry 3" icon="media/icons/icn_plugin_edit_16x16.png" />
  </menuitem>
  <menuitem id="menu2" label="Menu 2">
    <menuitem id="entry1" label="Entry 1" icon="media/icons/icn_plugin_16x16.png" />
    <menuitem id="entry2" label="Entry 2" enabled="true" checked="true"/>
  </menuitem>
  <menuitem id="about" label="About" icon="media/icons/icn_about_16x16.png" enabled="true" />
  <menuitem id="version" label="Version" enabled="true" checked="false"/>
</menu>
```

<!--

Toolbar integration

You can **as** many toolbar-icons/buttons define **as** you want.

Also separators can be added with `<separator />`.

Each Toolbar-Icon have **to** be 32 x 32 pixels **and** the GRT overlays a small plugin-icon **right** bottom corner **to** indicate the toolbar-icon/button **as** plugin.

-->

```
<toolbar>
  <toolbaritem
    id           = "toolbar_button1"
    label        = "Plugin example"
    tooltip     = "press to show this plugin"
    icon         = "media/icons/icn_about_32x32.png"
    enabled      = "true"
  />
```

```
</toolbar>  
  
</plugin>  
</GordonsReloadingTool>
```

EVENT_ATTACHED

This event is sent to the plugin after each implementation/start of the plugin.

The event cannot be disabled.

VALUES

- **(integer) windowhandle** - Window handle of the current GRT main window
- **(string) languagecode** - language code of the language that GRT is running in

JSON-SOURCE (EXAMPLE)

```
{
  "Event_Attached":{
    "windowhandle":"531876"
    "languagecode":"en"
  }
}
```

EVENT_COLORPRESETCHANGE

This event is sent after each change of the color scheme.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) ColorPresetId** - ID of the new/changed color scheme

JSON-SOURCE (EXAMPLE)

```
{
  "Event_Attached":{
    "ColorPresetId":133424
  }
}
```

EVENT_MENUACTION

This event is sent to the plugin when clicking on a menu entry of the plugin.

The event cannot be switched off.

===Values=====

- **(integer) *windowhandle*** - Windowhandle of the current GRT main window
- **(string) *id*** - ID of the clicked menu item
- **(string) *label*** - Menu text of the clicked menu item
- **(boolean) *checked*** - Menu entry with check mark (true) or without (false)

JSON-SOURCE (EXAMPLE)

```
{
  "Event_MenuAction":{
    "windowhandle":531876,
    "id":"com.grt.plugin.testers.menu.version",
    "label":"Version",
    "checked":false
  }
}
```

EVENT_TOOLBARACTION

This event is sent to the plugin when clicking on a toolbar button of the plugin.

The event cannot be switched off.

VALUES

- **(integer) *windowhandle*** - Windowhandle of the current GRT main window
- **(string) *id*** - ID of the clicked button
- **(string) *label*** - text of the clicked button

JSON SOURCE (EXAMPLE)

```
{
  "Event_ToolbarAction":{
    "windowhandle":531876,
    "id":"com.grt.plugin.tester.toolbar_button1",
    "label":"Example Plugin"
  }
}
```

EVENT_TABCLOSED

This event is sent to the plugin after closing a tab.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) windowhandle** - Windowhandle of the current GRT main window
- **(integer) tabhandle** - Tabhandle of the closed tab (load file)

JSON SOURCE (EXAMPLE)

```
{
  "Event_TabClosed":{
    "windowhandle":531876,
    "tabhandle":4922491
  }
}
```

EVENT_TABCOMPUTED

This event is sent to the plugin after a recalculation of the simulation.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) *windowhandle*** - Windowhandle of the current GRT main window
- **(integer) *tabhandle*** - Tabhandle of the currently activated tab (load file)

JSON SOURCE (EXAMPLE)

```
{
  "Event_TabComputed":{
    "windowhandle":531876,
    "tabhandle":130662912
  }
}
```

EVENT_TABDATACHANGE

This event is sent to the plugin after a change of an input value in the tab.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) windowhandle** - Windowhandle of the current GRT main window
- **(integer) tabhandle** - Tabhandle of the currently activated tab (load file)
- **(string) varname** - the name of the value changed

JSON SOURCE (EXAMPLE)

```
{
  "Event_TabDataChange":{
    "windowhandle":531876,
    "tabhandle":120858727,
    "varname":"gdepth"
  }
}
```

EVENT_TABSWITCH

This event is sent to the plugin after a click on a (different) tab.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) windowhandle** - Windowhandle of the current GRT main window
- **(integer) tabhandle** - Tabhandle of the currently activated tab (load file)

JSON SOURCE (EXAMPLE)

```
{
  "Event_TabSwitch":{
    "windowhandle":531876,
    "tabhandle":120858727,
  }
}
```

EVENT_TABUNITCHANGE

This event is sent to the plugin after a change of a unit of measurement in the tab.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) windowhandle** - Windowhandle of the current GRT main window
- **(integer) tabhandle** - Tabhandle of the currently activated tab (load file)
- **(string) varname** - the name of the value changed

JSON SOURCE (EXAMPLE)

```
{
  "Event_TabUnitChange":{
    "windowhandle":531876,
    "tabhandle":120858727,
    "varname":"glen"
  }
}
```

EVENT_WINDOWACTIVATE

This event is sent to the plugin when a GRT main window is activated.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) windowhandle** - Windowhandle of the current GRT main window
- **(integer) tabhandle** - Tabhandle of the currently activated tab (load file)

JSON SOURCE (EXAMPLE)

```
{
  "Event_WindowActivate":{
    "windowhandle":531876,
    "tabhandle":130662912
  }
}
```

EVENT_WINDOWCLOSED

This event is sent to the plugin when a GRT main window is closed.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) *windowhandle*** - Windowhandle of the current GRT main window

JSON SOURCE (EXAMPLE)

```
{
  "Event_WindowClosed":{
    "windowhandle":531876
  }
}
```

EVENT_WINDOWDEACTIVATE

This event is sent to the plugin when a GRT main window is deactivated (window goes into the background).

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) *windowhandle*** - Windowhandle of the current GRT main window

JSON SOURCE (EXAMPLE)

```
{
  "Event_WindowDeactivate":{
    "windowhandle":531876
  }
}
```

EVENT_WINDOWMAXIMIZE

This event is sent to the plugin after maximizing a GRT main window.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) windowhandle** - Windowhandle of the current GRT main window
- **(integer) left** - window position left on the screen
- **(integer) top** - window position at the top of the screen
- **(integer) width** - Window width
- **(integer) height** - Height of the window

JSON SOURCE (EXAMPLE)

```
{
  "Event_WindowMaximize":{
    "windowhandle":531876,
    "left":944,
    "top":108,
    "width":1871,
    "height":1118
  }
}
```

EVENT_WINDOWMINIMIZE

This event is sent to the plugin after minimizing a main GRT window.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) *windowhandle*** - Windowhandle of the current GRT main window

JSON SOURCE (EXAMPLE)

```
{
  "Event_WindowMinimize":{
    "windowhandle":531876,
  }
}
```

EVENT_WINDOWMOVED

This event is sent to the plugin after moving a GRT main window.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) windowhandle** - Windowhandle of the current GRT main window
- **(integer) left** - window position left on the screen
- **(integer) top** - window position at the top of the screen
- **(integer) width** - Window width
- **(integer) height** - Height of the window

JSON SOURCE (EXAMPLE)

```
{
  "Event_WindowMoved":{
    "windowhandle":531876,
    "left":944,
    "top":108,
    "width":1871,
    "height":1118
  }
}
```

EVENT_WINDOWRESIZED

This event is sent to the plugin after resizing a GRT main window.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) windowhandle** - Windowhandle of the current GRT main window
- **(integer) left** - window position left on the screen
- **(integer) top** - window position at the top of the screen
- **(integer) width** - Window width
- **(integer) height** - Height of the window

JSON SOURCE (EXAMPLE)

```
{
  "Event_WindowResized":{
    "windowhandle":531876,
    "left":944,
    "top":108,
    "width":1871,
    "height":1118
  }
}
```

EVENT_WINDOWRESTORE

This event is sent to the plugin after restoring from the maximized or minimized position of a GRT main window.

The event can be activated/deactivated in the plugin manifest.

VALUES

- **(integer) windowhandle** - Windowhandle of the current GRT main window
- **(integer) left** - window position left on the screen
- **(integer) top** - window position at the top of the screen
- **(integer) width** - Window width
- **(integer) height** - Height of the window

JSON SOURCE (EXAMPLE)

```
{
  "Event_WindowRestore":{
    "windowhandle":531876,
    "left":944,
    "top":108,
    "width":1871,
    "height":1118
  }
}
```

GET_TABONTOP

Read properties of the current tab.

PARAMETER

- (*without*)

JSON-SOURCE

COMMAND

```
{  
  "Get_TabOnTop": {}  
}
```

RESULT (EXAMPLE)

```
{  
  "Result": {  
    "command": "Get_TabOnTop",  
    "status": "success",  
    "values": {  
      "tabhandle": 245977421,  
      "ontop": true,  
      "changed": false,  
      "locked": false,  
      "caption": "357 Magnum",  
      "file": "C:/files/357 Magnum.grtload"  
    }  
  }  
}
```

Report & Doku

Results-Report

The result report displays the input data, calculated results and diagrams in a summary.

You can customize the report document according to your own requirements or build a start page that contains a selection of different reports and/or additional documents.

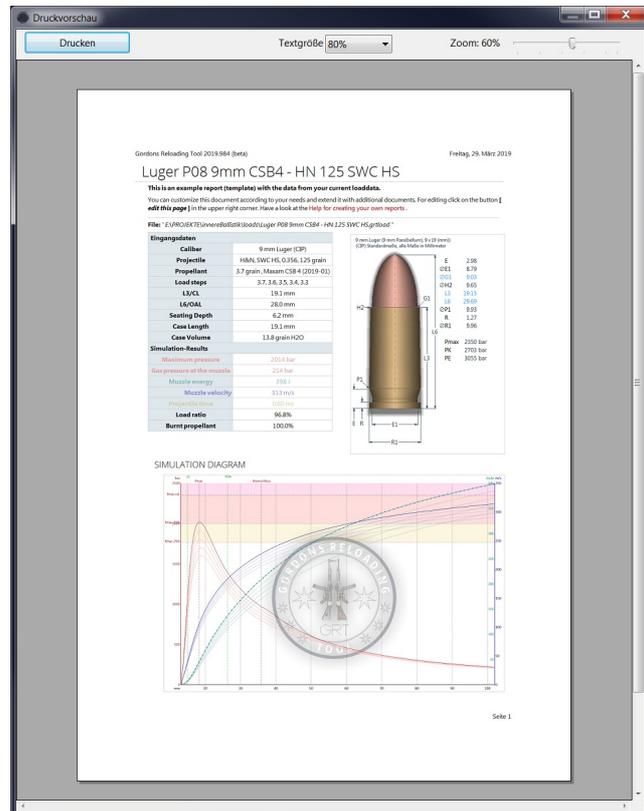
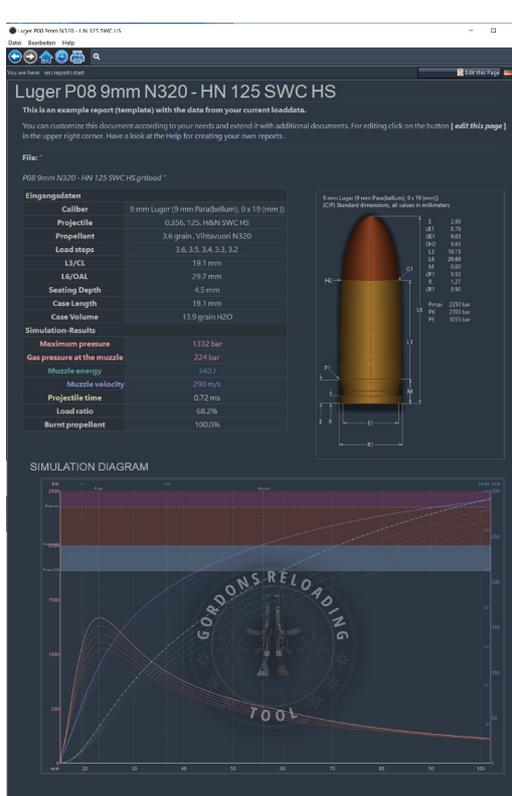
To edit, click **in the report window** on the button **[edit this page]** in the upper right corner.

Have a look at the Help for creating your own reports.

Example

This is what a report looks like.

On the left the view when calling the report in the GRT and on the right the print preview of a report.

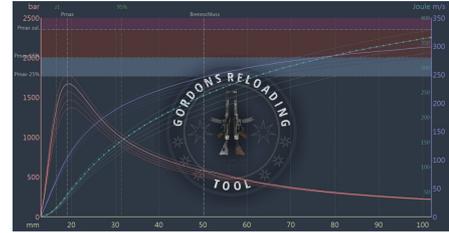


Custom Reports

GENERAL

These pages are available as text files (*.txt) in the folder **doku//report/**. is the respective ISO code, e.g. **"en"**. English files in the folder **doku/en/report/**.

Changes to the pages are also saved in the respective files. When creating new pages, the corresponding folder structure is created automatically (if possible).



New pages can be created by simply writing a link to the (not yet) existing page in a current page and then calling this link. After that edit and save. **To delete a page, simply save it empty.**

Images and other media files should be stored in a subfolder **media**. For reports therefore e.g. under **doku/en/report/media/**

This **doku system** is of course also be used for other things than reports, e.g. help pages, or tips & tricks.

- [Displaying and Trying Syntax Descriptions](#)

HOW DOES IT WORK?

These document pages are dynamically drawn documents, similar to an HTML page, only with a much *simpler syntax*. Click on the link to the page [Syntax](#) to see the examples. You can see the source code of each page and also edit.

For editing click on the button **[edit this page]** in the upper right corner.

VALUES & RESULTS FROM THE CURRENT LOADDATA

The values from the current loaddata and their results can be embedded in document pages. A value is read out with a so-called **"Pragma"**. A pragma is an instruction enclosed by double tilde symbols ("~~").

The values are arranged in *sources*. Each source has different *properties/* (values) which can be read out. To read a provided value, specify the **source** followed by a **point** and the **property name**:

SOURCE CODE

```
~~source.property~~
```

The values provide either *text* or *number values*. Values that provide *number values* can be formatted in the output. If a number formatting is desired, the **Format string** are additionally specified as parameter in *parentheses* and *quotes*:

SOURCE CODE

```
~~source.property~~ //automatisch, Ggf. inkl. Maßeinheit  
~~source.property("#.000")~~ //nach Vorgabe, ohne Ausgabe der Maßeinheit  
~~source.property("#.000 mm²")~~ //mit gewünschter Maßeinheit, automatische Umrechung
```

SOURCES AND PROPERTIES

- Source "File"
- Source "Work"
- Source "Result"
- Source "Caliber"

NOTE

Please note that numerical values are output according to the **ISO** standard, i.e. the decimal point is actually a **point!** The so called notation with "comma" as decimal point is **not** used here.

Quelle "File"

The source "File" are file information on the current loaddata.

Source.Property	Description	Type
Caption	The file name <i>without</i> file extension	text
Name	The file name with file extension	text
Path	The complete file path	text

Format string

The number formatting is controlled by the following placeholders (characters)

Character	Description
#	Placeholder that displays the digit of the value, if any. If fewer placeholders are used than the result is rounded.
0	Placeholder indicating the digit of the value, if any. If no digit is present, 0 (zero) is displayed in its place
.	Placeholder for the position of the decimal point
,	Placeholder specifying that the number is to be formatted with thousands separators.
%	Displays the number multiplied by 100.
(Displays an open parenthesis.
)	Displays a closing parenthesis.
+	Displays the plus sign to the left of the number if the number is positive, or a minus sign if the number is negative.
-	Displays a minus sign to the left of the number if the number is negative. No effect for positive numbers.
E	Displays the number in scientific notation.

Source "Work"

The source "Work " are all current input values set by the user from the input fields "Caliber", "Projectile" and "Propellant".

Source.Property	Description	Type
Field "Caliber"		
work.CaliberName	Calibre designation	text
work.Dz	Bore diameter	number
work.pmaxZul	Max. all. pressure	number
work.Aeff	Eff. cross section	number
work.caselen	Case length (L3/CL)	number
work.casevol	Case volume	number
work.oal	Cartridge length (L6/OAL)	number
work.Vb	Combustion chamber eff.	number
work.sebert	Sebert-Factor	number
work.xe	Barrel length	number
work.xeEff	Projectile path	number
Field "Projectile"		
work.ProjectileName	Manufacturer/Name	text
work.caliber	Caliber (numeric designation)	number
work.Dbul	Diameter	number
work.mp	Mass	number
work.ps	Initial pressure	number
work.glen	Length	number
work.gdepth	Seating depth	number
work.gtailtype	Tail type	text
work.gtailh	Tail length	number
work.gtaildiaA	Cone dia A	number
work.gtaildiaB	Cone dia B	number
work.gmaterial	Material	text
work.gUBCS	Univ. identification code	text
work.gBC0	BC	number
work.gBC1	BC 1	number
work.gBC2	BC 2	number
work.gBC3	BC 3	number
work.gBC4	BC 4	number
work.gV0	Velocity related to BC 0	number
work.gV1	Velocity related to BC 1	number
work.gV2	Velocity related to BC 2	number

work.gV3	Velocity related to BC 3	number
work.gV4	Velocity related to BC 4	number
Field "Propellant"		
work.PropellantName	Manufacturer/Name	text
work.Qex	Spec. explosive heat	number
work.k	Isentropic exponent	number
work.Ba	Combustion coefficient	number
work.a0	prog./deg. coefficient	number
work.z1	Transition limit 1	number
work.z2	Transition limit 2	number
work.pc	Material density	number
work.pcd	Bulk density	number
work.pt	Powder temperature	number
work.mc	Poweder mass (charge)	number
work.laddercnt	Loading ladder steps	number
work.laddermc	Step size	number

Source "Result"

The source "Result " are selected values from the simulation calculation of the current laboratory.

Source.Property	Description	Type
Result.MaxPressure	Maximum pressure	number
Result.MuzzlePressure	Gas pressure at the muzzle	number
Result.MuzzleEnergy	Projectile energy at the muzzle	number
Result.MuzzleVelocity	Projectile velocity at the muzzle	number
Result.MuzzleTime	Projectile lead time	number
Result.LoadRatio	Load ratio	number
Result.BurnRatio	Burnt propellant	number
Graphics		
Result.diagramm.png	complete result diagram	image
Result.diagramCurves.png	only curve diagram	image
Result.diagramPropellant.png	only propellant diagramm	image
Notes from result field appendix		
Result.Notes	insert all notes	text
Result.Note("mynote")	insert note only with titel " mynote "	text
Pictures from the gallery of the result field appendix		
Result.picture. <i>imagenam</i> e	insert picture from the gallery of result the field appendix. "imagenam" is the file name of the picture in the gallery.	image

Source "Caliber"

The source "Caliber " is the unchanged original caliber data from the database. The values are only available if the selection has been made from the database. For *imported* loading data, the assignment is tried automatically, but may not contain an assignment to the database.

The source "Caliber" is available so that additional information is available, e.g. special individual dimensions stored in the database, the link to the CIP data sheet or the cartridge drawing created by the GRT from the standard dimensions.

Source.Property	Description	Type
mname	Manufacturer	text
pname	Product name	text
drawing.png	Cartridge drawing	image

UBCS

Universal Bullet Classification Scheme (UBCS)

Request for comments (RFC) for an Universal Bullet Classification Scheme (UBCS) v1.1b 190129

(by Andi & Barney from GRT Development Team)

A bullet is a kinetic projectile and the component of firearm ammunition that is expelled from the gun barrel during shooting.

Handloading or reloading is the process of loading firearm cartridges or shotgun shells by assembling the individual components (case/hull, primer, powder, and bullet/shot), rather than purchasing completely assembled, factory-loaded ammunition.

As there is a million of different bullet types and constructions available for different calibres and physical parameters, such as weight, diameter, length and aspects of external/internal construction and composition, there is a need to classify them to provide a solution for the means of searching, identifying and comparison for the modern handloader.

Bullets are manufactured for different purposes and processes by a variety of commercial producers and still as of today, some are produced by handloaders themselves. This variety and more often than sometimes conflicting commercial interests lead to a nomenclature which is all but consistent and useful to identify specific types and construction of a bullet for a given purpose.

This RFC takes on to the challenge to provide means of identifying bullets solely by geometric and constructional features without taking individual calibre-specific parameters (such as weight, calibre, external or internal dimensions) into account. It's purpose only needs to suit the needs to identify a TYPE of bullet over the individual specifications of a given bullet for a individual application in a given calibre.

When taking up to this challenge, some obvious general parameters come up without being too specific to a certain bullet type manufactured and branded by individuals or commercial operations. These are:

- **Purpose**

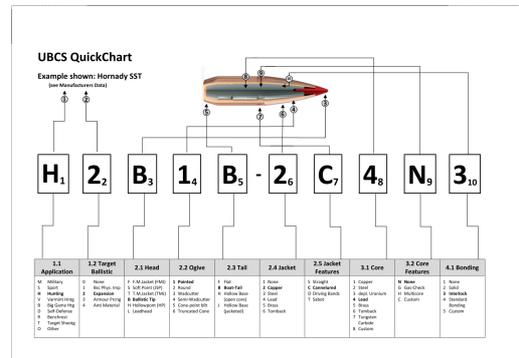
Is this bullet intended for hunting or target shooting? Is it designed and enhanced to produce special target ballistic effects or solely for a precision flight path?

- **Geometry**

How and why are different physical parameters chosen, which make up the outer appearance of the bullet

- **Construction**

What is the recipe, which assembles the bullets components in a designated way? (Jacket, core, bonding mechanism, materials)



RFC DOCUMENT (PDF)

Please read the RFC for details about the current specification: [UBCS-RFC_v1.1b.pdf](#)

File Formats

File format: Caliber (*.xml, *.caliber)

The caliber file is a file formatted in the universal exchange format XML.

The regular structure is as follows:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<GordonsReloadingTool>
  <caliberfile>
    <var name="Name of the property" value="Value of the property" />
    [...]
  </caliberfile>
</GordonsReloadingTool>
```

- **Strings** are entered in plain text or URL encoded.
- **Number values** are indicated with the dot "." as decimal separator.
- **Multiple caliber entries** are possible by multiple presence of the block .

EXAMPLE: .45 AUTO

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<GordonsReloadingTool>
  <caliberfile>
    <var name="cipname" value=".45%20Auto" />
    <var name="altname" value=".45%20ACP" />
    <var name="standard" value="CIP" />
    <var name="ciporigin" value="US" />
    <var name="ciptype" value="4%20pistol%2Frevolver" />
    <var name="cipdate" value="1984-06-14" />
    <var name="ciprevdate" value="2000-06-07" />
    <var name="cippdf" value="tabivcal-de-page76.pdf" />
    <var name="L1" value="0.00" />
    <var name="L2" value="0.00" />
    <var name="L3" value="22.81" />
    <var name="L4" value="0.00" />
    <var name="L5" value="0.00" />
    <var name="L6" value="32.39" />
    <var name="R" value="1.24" />
    <var name="R1" value="12.19" />
    <var name="R3" value="0.00" />
    <var name="E" value="4.11" />
    <var name="E1" value="10.16" />
    <var name="Emin" value="0.89" />
    <var name="Delta" value="26.00" />
    <var name="FG" value="0.00" />
    <var name="Beta" value="35.00" />
    <var name="P1" value="12.09" />
    <var name="P2" value="0.00" />
    <var name="Alpha" value="0.00" />
    <var name="S" value="0.00" />
    <var name="r1min" value="0.00" />
    <var name="R2" value="0.00" />
    <var name="H1" value="0.00" />
    <var name="H2" value="12.01" />
    <var name="G1" value="11.48" />
```

```
<var name="G2" value="0.00" />
<var name="f" value="0.38" />
<var name="L3G" value="25.58" />
<var name="Pmax" value="1300.00" />
<var name="PK" value="1495.00" />
<var name="PE" value="1690.00" />
<var name="M" value="12.50" />
<var name="EE" value="0.00" />
<var name="FLauf" value="11.23" />
<var name="ZLauf" value="11.43" />
<var name="b" value="3.73" />
<var name="N" value="6.00" />
<var name="u" value="406.00" />
<var name="Q" value="101.33" />
<var name="V" value="26.00" />
<var name="L0" value="0.00" />
<var name="R0" value="0.00" />
<var name="P0" value="0.00" />
<var name="shot_alpha1" value="0.00" />
<var name="shot_B" value="0.00" />
<var name="shot_D" value="0.00" />
<var name="shot_G" value="0.00" />
<var name="shot_H" value="0.00" />
<var name="shot_L" value="0.00" />
<var name="shot_M" value="0" />
<var name="shot_T" value="0.00" />
<var name="sebert" value="0.75" />
<var name="cdate" value="2019-05-03" />
<var name="cby" value="GRT" />
<var name="mdate" value="" />
<var name="mby" value="" />
<var name="type" value="" />
<var name="mode" value="" />
<var name="status" value="" />
<var name="origin" value="cip-bobp.org" />
<var name="descr" value="" />
</caliberfile>
</GordonsReloadingTool>
```

File format: Bullet (*.xml, *.projectile)

The bullet file is a file formatted in the universal exchange format XML.

The regular structure is as follows:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<GordonsReloadingTool>
  <projectilefile>
    <var name="Name of the property" value="Value of the property" />
    [...]
  </projectilefile>
</GordonsReloadingTool>
```

- **Character strings** are entered in plain text or URL encoded.
- **Number values** are indicated with the dot "." as decimal separator.
- **Multiple projectile entries** are possible by multiple presence of the block .

EXAMPLE: HORNADY RN 3235

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<GordonsReloadingTool>
  <projectilefile>
    <var name="mname" value="Hornady" />
    <var name="pname" value="RN 3235" />
    <var name="lotid" value="" />
    <var name="caliber" value="0.323" />
    <var name="gBC0" value="0.217" />
    <var name="gBC1" value="0" />
    <var name="gBC2" value="0" />
    <var name="gBC3" value="0" />
    <var name="gBC4" value="0" />
    <var name="gdia" value="8.20" />
    <var name="glen" value="21.8" />
    <var name="gmass" value="170.0" />
    <var name="gmaterial" value="" />
    <var name="gpressure" value="0" />
    <var name="gtailDiaA" value="0.0" />
    <var name="gtailDiaB" value="0.0" />
    <var name="gtailh" value="0.0" />
    <var name="gtailType" value="0" />
    <var name="gUBCS" value="H0S2F2S4N3" />
    <var name="gV0" value="0" />
    <var name="gV1" value="0" />
    <var name="gV2" value="0" />
    <var name="gV3" value="0" />
    <var name="gV4" value="0" />
    <var name="cdate" value="2019-05-03" />
    <var name="cby" value="GRT" />
    <var name="mdate" value="" />
    <var name="mby" value="" />
    <var name="type" value="" />
    <var name="mode" value="" />
    <var name="status" value="import" />
    <var name="origin" value="" />
    <var name="descr" value="" />
  </projectilefile>
```

</GordonsReloadingTool>

File format: Propellant (*.xml, *.projectile)

The propellant file is a file formatted in the universal exchange format XML.

The regular structure is as follows:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<GordonsReloadingTool>
  <propellantfile>
    <var name="Name of the property" value="Value of the property" />
    [...]
  </propellantfile>
</GordonsReloadingTool>
```

- **Character strings** are entered in plain text or URL encoded.
- **Number values** are indicated with the dot "." as decimal separator.
- **Multiple propellant entries** are possible by multiple presence of the block .

EXAMPLE: VIHTAVUORI N340

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<GordonsReloadingTool>
  <propellantfile>
    <var name="mname" value="Vihtavuori" unit="" type="string" descr="propellant mar
    <var name="pname" value="N340" unit="" type="string" descr="propellant product r
    <var name="lotid" value="2018-12" unit="" type="string" descr="lot-id/no." />
    <var name="Bp" value="0.8757" unit="" type="decimal" descr="progressivity factor
    <var name="Br" value="0.8023" unit="" type="decimal" descr="brisance factor" />
    <var name="Brp" value="0.8398" unit="" type="decimal" descr="combined brisance/p
    <var name="Ba" value="2.9203" unit="" type="decimal" descr="burn coefficient" />
    <var name="Qex" value="4100" unit="kJ/kg" type="decimal" descr="specific explosi
    <var name="k" value="1.2245" unit="" type="decimal" descr="ratio of the specific
    <var name="a0" value="0.9701" unit="" type="decimal" descr="burn coefficient" />
    <var name="z1" value="0.2863" unit="" type="decimal" descr="burn-up limit z1" />
    <var name="z2" value="0.8148" unit="" type="decimal" descr="burn-up limit z2" />
    <var name="pc" value="1390" unit="kg/m3" type="decimal" descr="material density"
    <var name="pcd" value="620" unit="kg/m3" type="decimal" descr="bulk density" />
    <var name="pt" value="21" unit="Cel" type="decimal" descr="propellant temperatur
    <var name="cdate" value="2019-01-20" unit="" type="string" descr="creation date"
    <var name="cby" value="GRT" unit="" type="string" descr="created by" />
    <var name="mdate" value="2019-01-20" unit="" type="string" descr="last modificat
    <var name="mby" value="2019-01-20" unit="" type="string" descr="last modified by
    <var name="origin" value="GRT" unit="" type="string" descr="data origin" />
    <var name="descr" value="" unit="" type="string" descr="note/description" />
  </propellantfile>
</GordonsReloadingTool>
```

File format: Simulation Results (*.xml)

The simulation result file is a file formatted in the universal exchange format XML.

Load the file into a text editor to see the value descriptions. Each value has the attribute "descr" in which a short description is stored.

- **Strings** are entered in plain text or URL encoded.
- **Number values** are indicated with the dot "." as decimal separator.
- **Multiple simulation result entries** are possible by multiple presence of the block .

EXAMPLE:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<GordonsReloadingTool>
  <InnerBallistikResult>

    <BurnoutInBarrel value="true" unit="" type="boolean" descr="flag is true if burr
    <MaxPressure value="3425.2889360089803" unit="bar" type="decimal" descr="maximum
    <PointIdxBurnedEnergy95 value="740" unit="index" type="integer" descr="point inc
    <PointIdxBurnout value="2077" unit="index" type="integer" descr="point index of
    <PointIdxPmax value="132" unit="index" type="integer" descr="point index max pea
    <PointIdxZ1 value="115" unit="index" type="integer" descr="point index Z1 positi
    <z value="1" unit="" type="decimal" descr="amount of burned propellant, 1=100%"
    <EndEnergy value="3990.7852079488966" unit="joule" type="decimal" descr="project
    <EndPressure value="461.69285453629368" unit="bar" type="decimal" descr="pressur
    <EndVelocity value="851.20832757070048" unit="m/s" type="decimal" descr="velocit
    <EndTime value="1.464324275006306" unit="ms" type="decimal" descr="projectile tr
    <Ekin value="4543" unit="joule" type="integer" descr="theoretical kinetic energy
    <Eprop value="0" unit="joule" type="integer" descr="theoretical energy content c

    <InnerBallistikResultPointUnits>
      <def name="x" unit="mm" type="decimal" descr="pressure diagram position" />
      <def name="xp" unit="mm" type="decimal" descr="corrected projectile diagram pc
      <def name="z" unit="" type="decimal" descr="amount of burned propellant, 1=100
      <def name="p" unit="bar" type="decimal" descr="combustion pressure" />
      <def name="v" unit="m/s" type="decimal" descr="projectile velocity" />
      <def name="t" unit="ms" type="decimal" descr="time" />
    </InnerBallistikResultPointUnits>

    <InnerBallistikResultPointGroup>
      <point idx="0" x="0" xp="0" z="0" p="299.02447646591941" v="0" e="0" t="0" />
      <point idx="1" x="0.322488388431654" xp="0" z="0.00552976188127" p="367.844946
      <point idx="2" x="0.644976776863308" xp="0" z="0.011044113531568" p="443.72996

    [...]

      <point idx="2186" x="739.46587467379561" xp="0" z="1" p="461.69285453629368" v
    </InnerBallistikResultPointGroup>

  </InnerBallistikResult>
</GordonsReloadingTool>
```

Team

The Developer Team

DEVELOPMENT, PROJECT RELATIONS & SUPPORT

Gordon	Team leader/main developer, Interior ballistics formalism & algorithms, programming of the GUI & server applications, Web-PHP-API programming, Project management, GUI-design
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Charlie Sears, Casper Nienaber	project relations, ballistic measurements
DerMozart (Johannes)	Web-Userinterface, Head of distribution and Community Management
Barney, Andi	Concepts for user interface, development, management and support of the subproject <i>"Universal Bullet Classification Scheme" (UBCS)</i>
Hackstock (Stefan)	Database tools, data acquisition, software-based data evaluation
Hannes	Support in the development of mathematical models
Heiko	Java API Programming for Core Services
Johannes Rappich	Vector graphic Mono-Icons for the GUI

DATA ACQUISITION, EVALUATION & TEST

- Ausbilder (Christian)
- Berni84
- cox (Ralf)
- Darkness (Tassilo)
- Estragon78
- FiberMan
- Flojoe
- Fritz109
- Hunter19
- in Glock we trust
- JoHo (Joachim)
- Kustus
- MasterToSch
- Mfg
- M.Hopeman
- cox (Ralf)
- michi6383 (Michael)

- Nukular (Klaus)
- pgj (Peter)
- Raik
- ruiz124
- scorpac
- shkrauh
- SintoraZ (Dominik)
- SRM (Sirko)
- Stefan
- test85 (Constantin)
- torsi
- WiederladerTV (Markus)
- Wolverine
- Veerplant (Sören)
- zottelhase (Markus)
- ...

..and many helpers and supporters more!

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