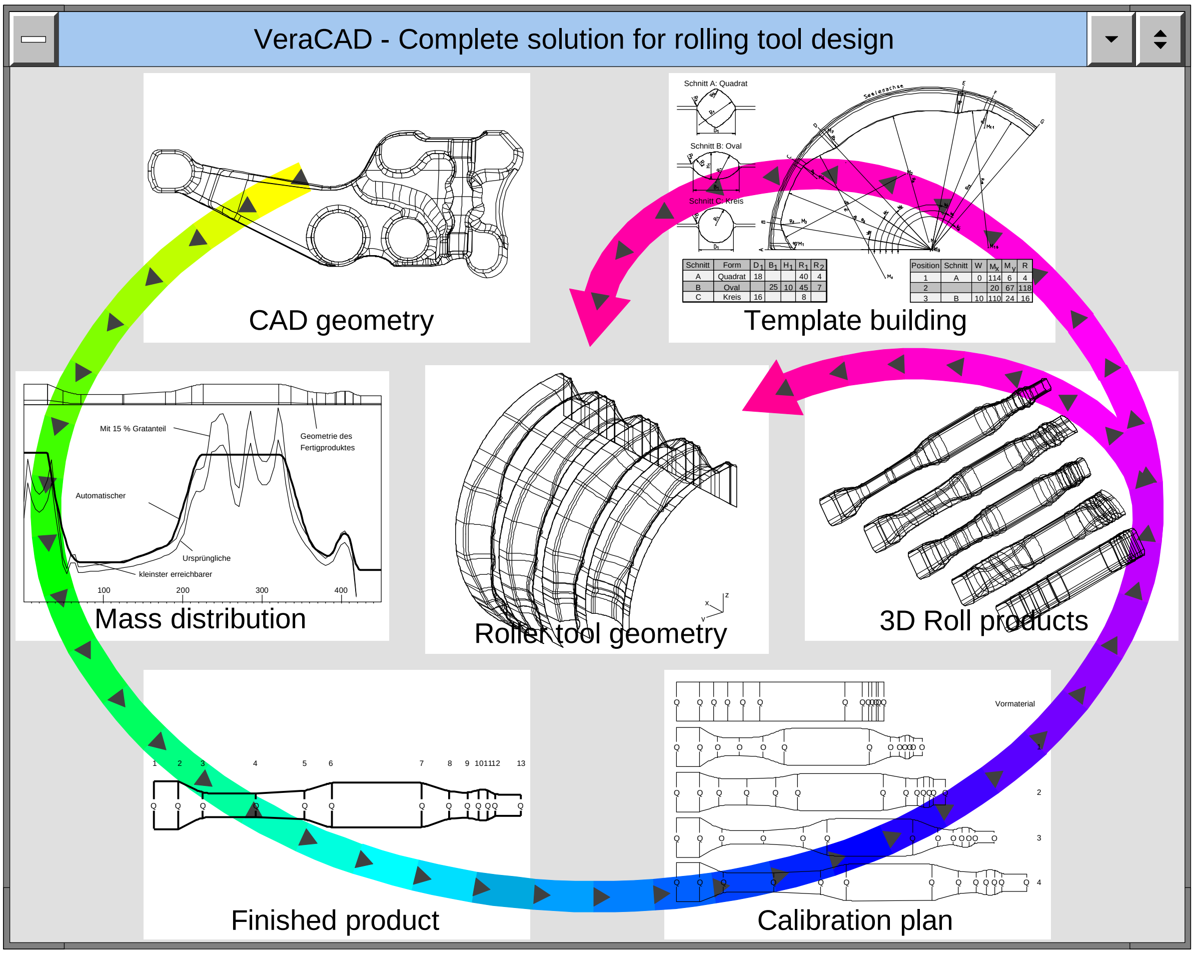
Ingenieurbüro ErAtz




This brochure introduces the main features of VeraCAD. VeraCAD is a graphic interactive engineering program for rolling machine segment design. The PC program was developed in Germany by ERATZ-Ingenieurbuero and DGN GmbH in partnership with SMS Eumuco GmbH in Leverkusen. Eumuco is an internationally renowned designer and manufacturer of rolling machines and tool segments. VeraCAD stands for:

**Volume-exact reducer roll analysis on CAD data**

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# Contents



# Applications Overview

The use of VeraCAD in the forging industry saves a significant amount of time in the development of reducer roll machine segments.
The option to run the design program automatically, and to control it interactively, minimises the number of passes in the rolling process. This reduces the tool costs. The exact calculation of volume, the use of fundamental calculation rules, and the consideration of technology and process parameters ensure a rolling sequence in which the individual passes correlate with each other. As a result, product errors are excluded and a high success rate for the process is guaranteed.

VeraCAD enables the immediate graphic interactive presentation of calibration plans for the rolling process as well as for the derivation of the necessary CAD tool geometry's it is based on. The lengthy process of designing the final roller product with a pre-set complex mass distribution is minimised by VeraCAD's effective input and design tools. The calculation of the necessary number of passes and the calibration sequence is done in seconds and then graphically displayed. A variety of options for automatic and manual modification help to quickly optimise the complete rolling job. VeraCAD responds to physical and technological input parameters such as thermal expansion and contraction, relative motion, losses due to oxidation, milling radius, critical reduction values, etc.

The main advantage of VeraCAD is its design process which is closely connected to geometry. In every phase of the presentation it works with an exact geometric description. This is necessary in order to establish the exact volume for the parts at all times, and to keep it consistent throughout the reshaping process. This way production errors are eliminated that occur if volumes of free form surfaces with a complicated design are only calculated as estimates. VeraCAD's built-in geometrical description is based on modern CAD technology. As a result you receive not only the exact rolling segment geometry but also all the intermediate products in a standard CAD format at the end of the design process.

VeraCAD even helps users who do not have access to a CNC controlled milling machine. It provides a “Template Building” function which is specifically designed for such users. This feature generates complete 2D-technical-drawings with dimensioned Views and cross-sections for manual tool production. All drawings can be exported to your CAD-system via an IGES-interface or directly plotted.

VeraCAD automates the whole design process from the given geometry of any forging part to the finished roller Pre-product. With the enhanced “Mass distribution” feature an already existing 3D-CAD geometry can be imported and the mass distribution analysed. Additions for flash areas and zones with fill problems can be added interactively to the mass diagram. Based on this data VeraCAD calculates the final roller product automatically.

VeraCAD is easy to use. It’s operation uses reducer machine conventions. Time consuming calculations and complex CAD handling are eliminated. At the same time, work results are accomplished in a structured way. Powerful control and modification options allow VeraCAD to interactively manipulate the design process. VeraCAD understands the terminology of the rolling tool developer and also the user’s native language (the program is available in the German, English and French versions). Working in the Microsoft Windows™ environment provides for an intuitive an economical operation.

## Hardware and software requirements

VeraCAD can be operated on basic PC hardware. No special requirements are necessary for the CAD functions.
Personal Computers starting with Pentium 200 MHz, 32 MB memory, Hard drive (300 MB), mouse and serial interface are sufficient.
VeraCAD can be operated under Microsoft Windows 95™, 98™, ME™ or Windows NT™, 2000™. We recommend working with the operating system Windows 2000™.

## Modules of VeraCAD

VeraCAD is available in two modules. The **Basic System** includes the following components:

- Manual input, design, and modification of the final roller product (finished part).
- Automatic calculation of the calibration plan with the number of passes, calibration sequences, and geometry of intermediate roller products.
- Output of the calibration plan and the roller products in graphical form and as a chart.
- Generation of the 3D-geometry for the tool segments (impression).
- Output of all roller products and the segments in general CAD interface formats (IGES, VDAFS, EDX).
- 2D-Template building for roller tool production without CNC-milling machines or for quality checks. Export of completely dimensioned technical drawings with a standard IGES-interface.
- Project management.

The **Upgraded Mass Distribution** module includes the option to create and edit mass distributions:

- Import of complex CAD geometry such as connecting rod, crank shaft, etc. through different interface formats.
- Deriving the mass distribution diagrams of any CAD-geometry.
- Creating mass distribution diagrams by importing data from other programs.
- Defining mass distribution diagrams by manually input of simple data pairs.
- Graphic interactive manipulation of mass distribution (e.g., flash area)
- Automatic generation of the final finished part geometry based on the mass distribution.

# Operation

The general design procedure of a reducer roll project is described for the design of a steering arm.

The steering arm exists as a CAD data file (figure 1) on which the automatic generation of the final roller product is based.

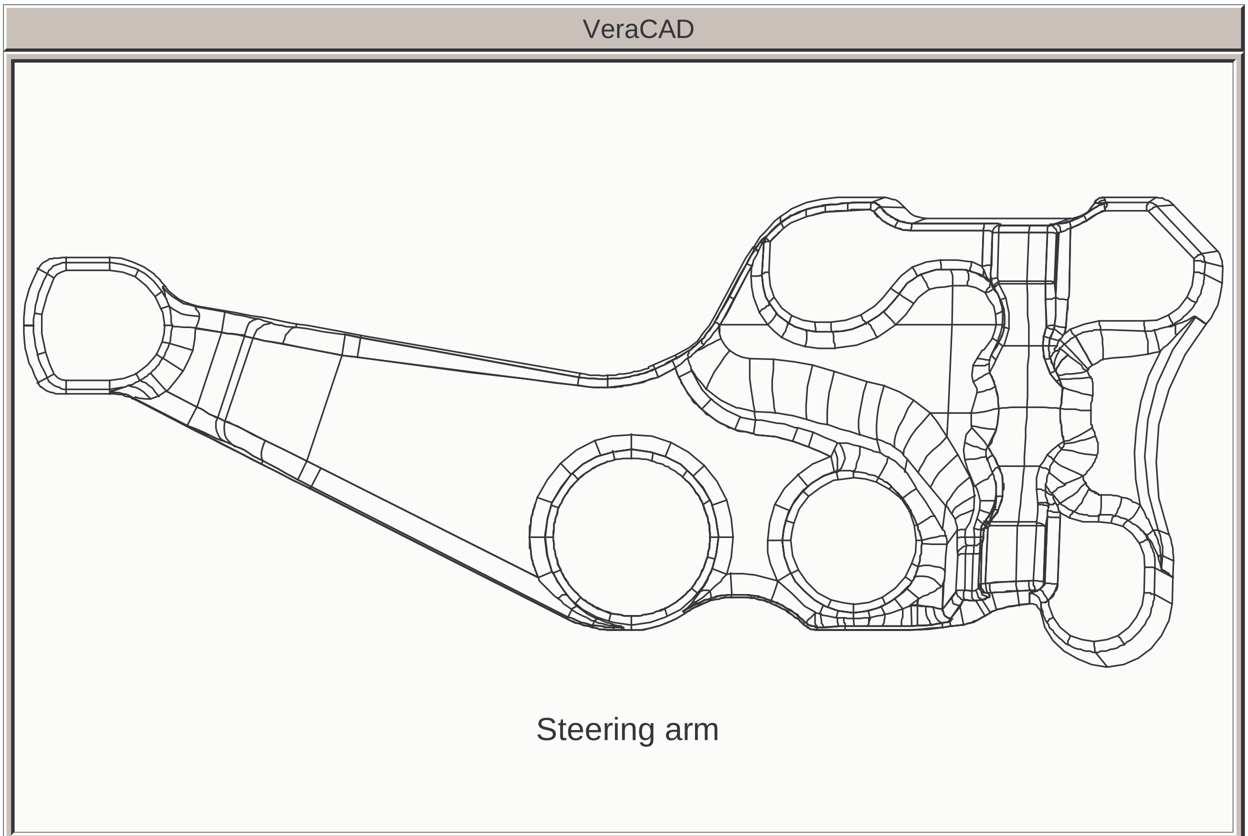



Fig. 1 Existing CAD-geometry of a forging part given by IGES-Data H. Eratz 10.2.94

The geometry can be imported into VeraCAD through three different interfaces (IGES, VDAFS, EDX) and then edited. For example, if a complete forging die is incorporated, parts of the flash and the die-block must be deleted before a mass distribution diagram can be created. That way only the volume of the impression will be calculated. The recalculation of cold measurements into warm measurements is available as an option. Even in complex geometry's (for example a large crankshaft) the time needed to generate the mass distribution diagram is only a few seconds (Pentium PC, 200 MHz → 60 seconds).

Interactively certain additions can be made to the mass distribution. For example, the mass can be increased evenly by 15 % to form the flash area. Constant offsets or local mass additions for zones with filling problems are also possible.

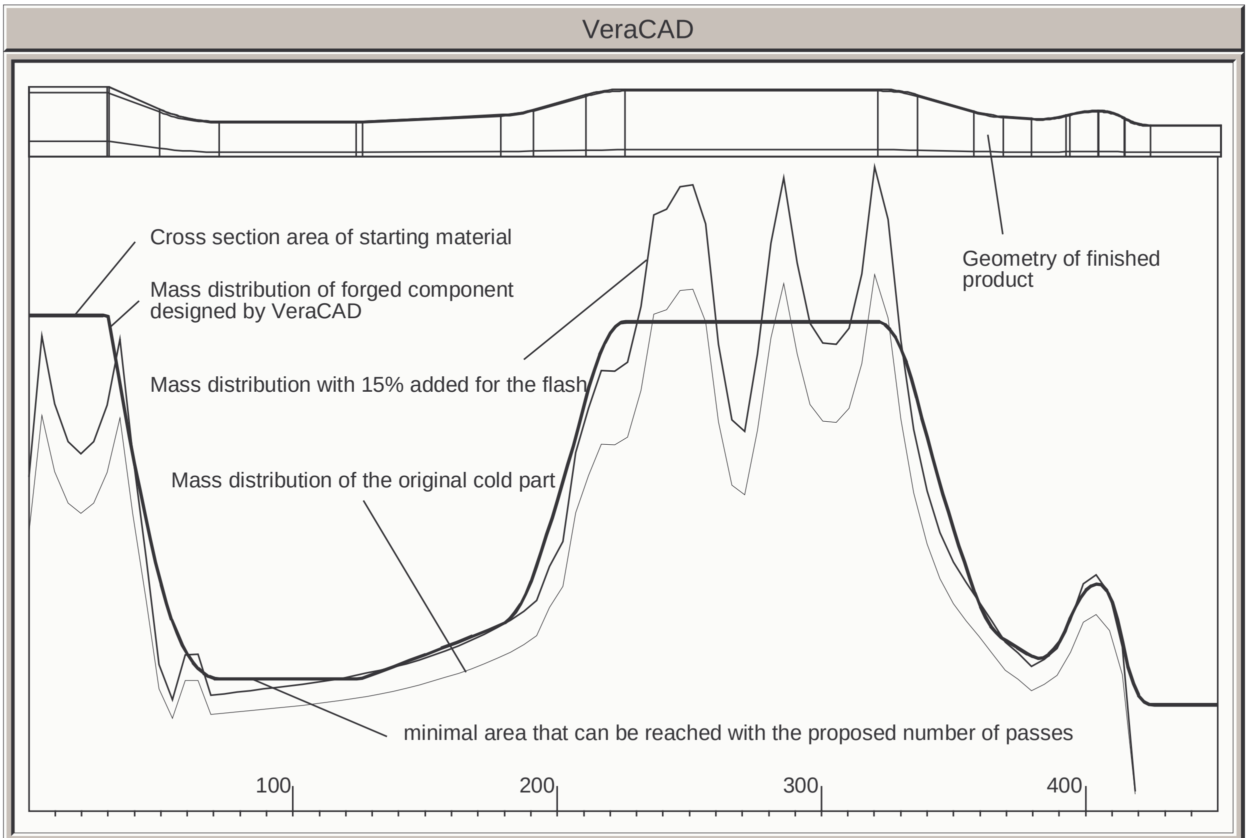



Fig. 2 | Mass distribution of the original part and of proposed finished component | H. Eratz 10.2.94

After the final mass distribution has been generated (figure 2), VeraCAD makes a suggestion for the final rolling product and includes its final mass distribution into the actual diagram (bold line). The suggestion includes the following components:

- Size and form of the raw material that is necessary.
- Number of necessary rolling passes (this defines the smallest reachable cross section).
- Complete geometry of the final roller product with all relevant dimensions.

To make these suggestions minimum calculation time is necessary. This enables the user to quickly consider alternative suggestions and come up with the best possible final roller product.
This product will be loaded into the second phase of the process in order to generate the appropriate calibration sequence. All the following modules and features are included in the basic VeraCAD package.

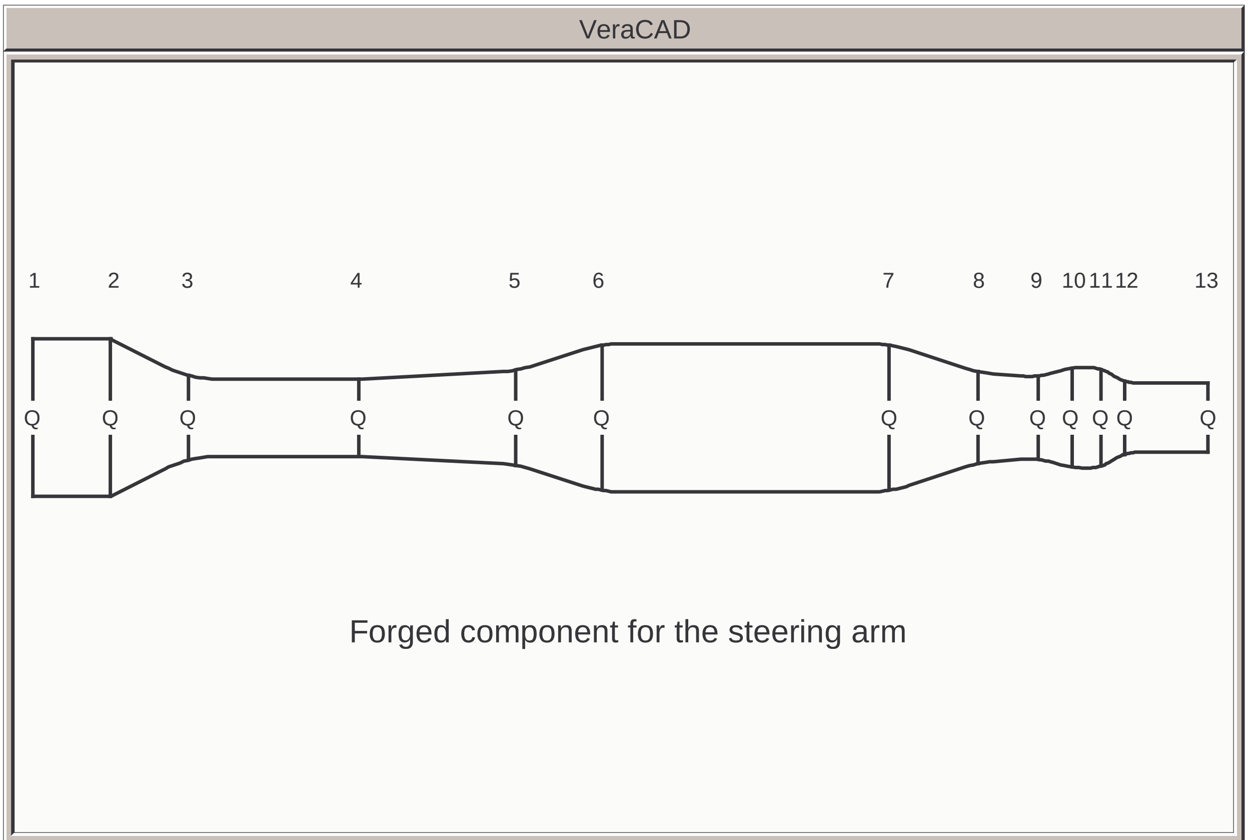



Fig. 3 | Forged component given by manual input or automatic calculation by VeraCAD | H. Eratz 10.2.94

Further editing is based on the existing final roller product (figure 3). If you do not have the additional "Mass distribution" module the final product will be described manually with the “Editor” which is part of the basic package. For each rolling position (cross-section) the following measurements can be given:

- Shape of cross-section at the ends of each position (square: diamond or flat, oval, circle, lens, rhomb, rectangle)
- For a square cross-section: Edge length or diagonal or cross-section area
- For a circular cross-section: Diameter or cross-section area
- For an oval cross-section: Height and width or area and height or width
- Length of position
- Fillet radius to the neighbouring position

The “Finished-Product-Editor” can copy, insert, delete, modify, mirror or list specific cross-sections. The correlating graphic always is updated. It is possible to describe the finished product in its warm or cold dimensions.

Before a calibration plan is created, several different process and technology parameters can be set. These are:

- Form and size of the raw material.
- Material related thermal expansion from room to rolling temperature.
- Thermal contraction as a result of cooling during rolling operations.
- Layer thickness lost due to oxidation.
- Minimum and maximum allowed reduction due to the reshaping. Default values such as EUMUCO guidelines and factory defaults can be implemented.
- Smallest considered milling radius for the tool production.
- Leading groove depth.
- Draft angles

Considering all those parameters, VeraCAD calculates a stretched calibration sequence (figure 4). This process assumes that all the cross sections are completely filled at all times. For all the steps a three dimensional geometry of the intermediate roller product as a free form surface is generated. This data is used to adjust the position volume to the target volume of the finished product. Within this process thermal effects will be considered as well as losses due to oxidation. The result is a calibration plan with a low number of roll passes. This plan will be given as graphically and as a chart.

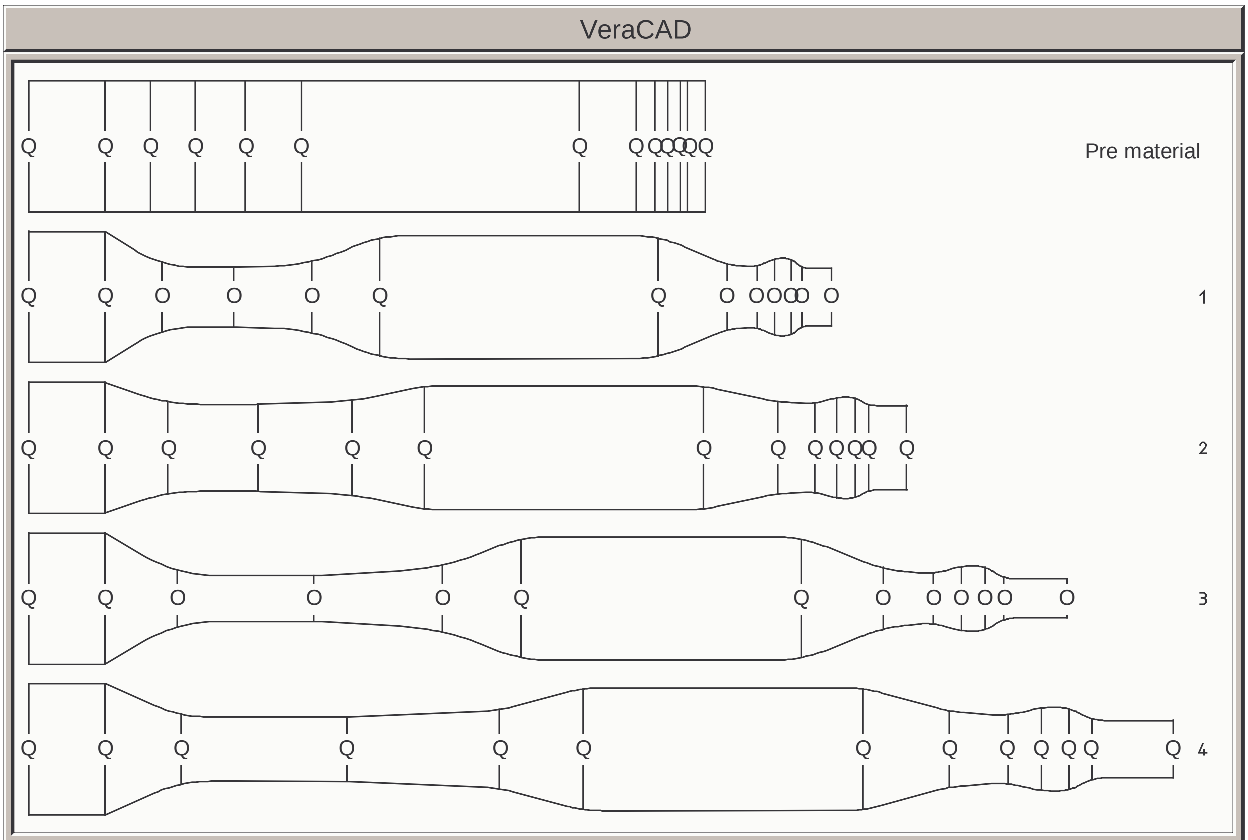



Fig. 4 Calibration plan for the steering arm with 4 passes H. Eratz 10.2.94

If necessary the calibration plan generated by VeraCAD can be modified. The feature "Calibration Plan>Edit..." permits changes in the reshaping sequence for specific cross sections/positions, and also to adjust the reduction rates in percentage of each position. Reduction rates and cross-section areas are displayed continuously for all passes. A warning message is generated when a critical value is reached and shows the possibility of rolling defects.

The calibration plan with all important measurements is given as graphically and as a chart.

For the production of error-free rolling parts it is very important to consider the correct relative motion. Depending on cross-section type and degree of reduction VeraCAD calculates automatically the necessary relative motion factors for each position and pass. The option to overwrite these factors with individual values is still available.

The automatically generation of 3D-geometries for intermediate roller parts (figure 5) and roll segments (figure 6) completes the design process. Stretched intermediate products are of considerably use when checking for potential rolling faults. By displaying shaded 3D-geometries of intermediate parts quickly the sharp bends or extremely flat ovals are identified. These disharmonies in surface representation often lead to reduced process stability and can be avoided in an early state of the planning stage.
It makes also sense to export the stretched geometry of the finished product, if for example a preform is needed for a forging simulation with model-materials or Finite Element analysis. A corresponding die/piece for the finished product can be manufactured by means of this data.

VeraCAD

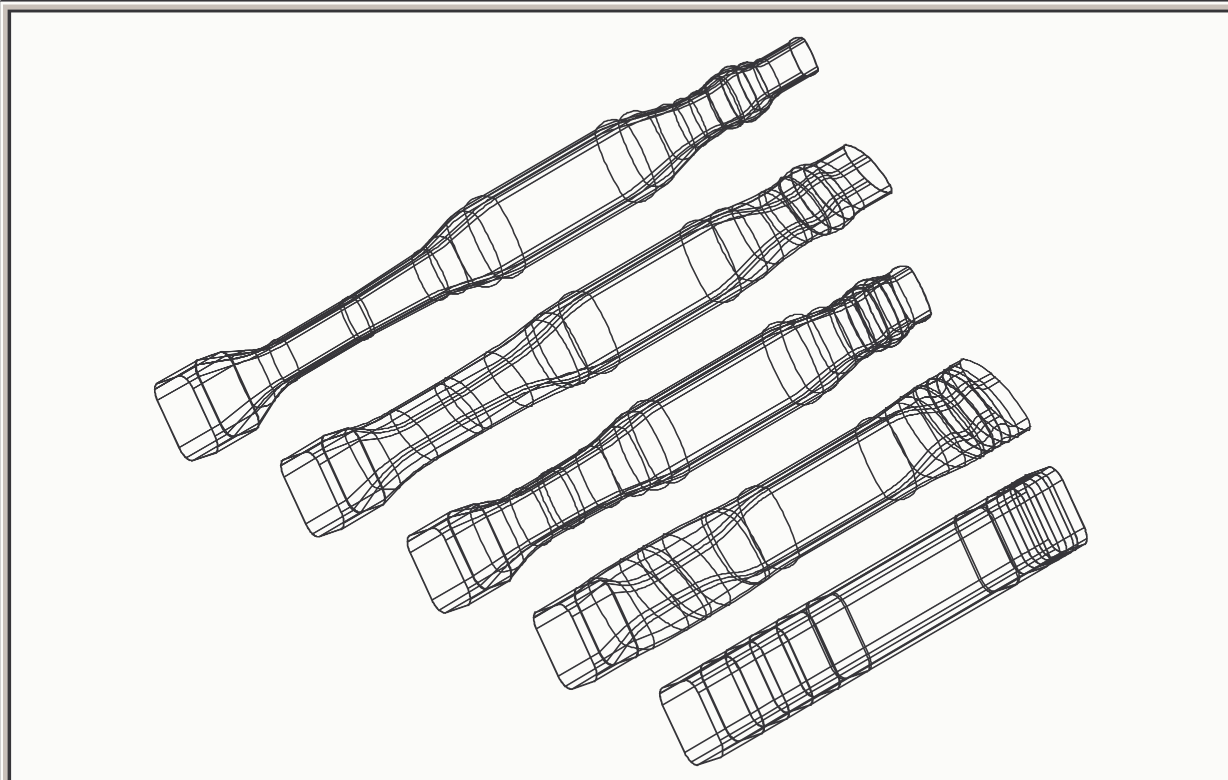


Fig. 5 | Intermediate products of the 4 pass operation for the steering arm | H. Eratz 10.2.94

It is very efficient to use the generated geometry data directly for CNC controlled production. The geometry for the necessary roller segment is derived from the final calibration plan. (figure 6). For that task the following additional parameters need to be given:

- Diameter of the roll segments (theoretical centreline)
- Width of individual tool segment
- Thickness of a flash gap
- Rounding radius from impression to flash and the tool mouth

With this data VeraCAD calculates the surface of the tool segment, displays it and writes it in the desired interface format (IGES, VDAFS, EDX) to disk. The creation of CNC programs or control data for a milling machine is not supported by VeraCAD .

VeraCAD

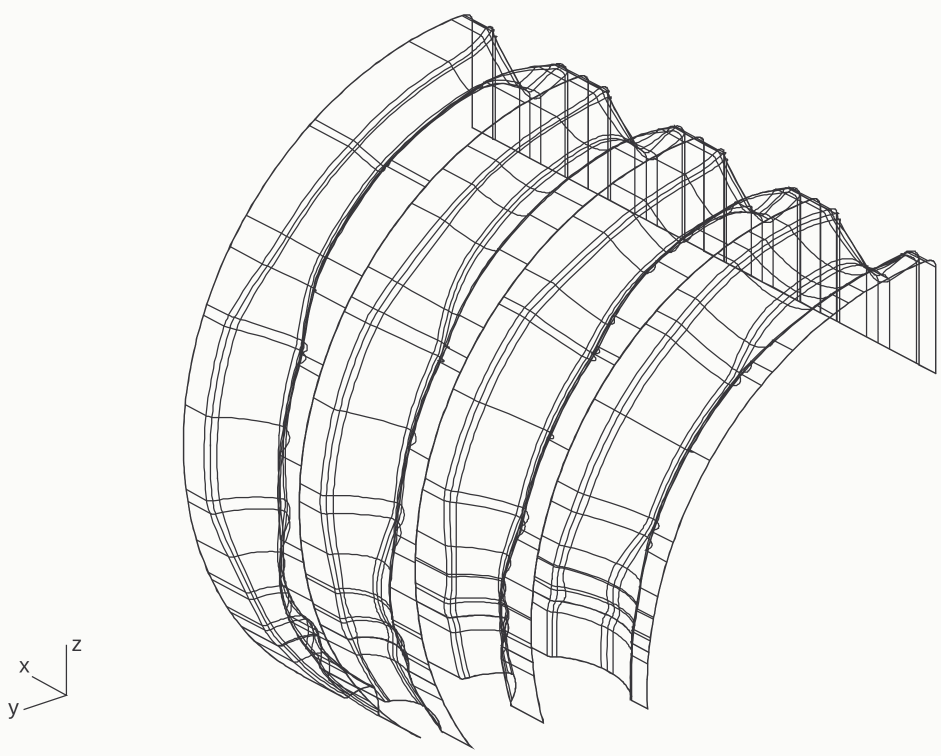



Fig. 6 | Result of the roller tool design process for the steering arm | H. Eratz 10.2.94

For tool segment manufacturing without CNC-milling, VeraCAD supports the conventional production with the feature “Template Building”.
With this module for each segment a 2D-technical-drawing with all necessary views, dimensioned cross-sections, complete annotation, titleblock and so on can be generated (figure 7). Additional charts can be printed in which measurements (angle, length, radius, etc.) are presented in a clear fashion. The complete set of drawings can be either plotted or exported via the IGES-interface. Thus it is possible to include further drawing elements or company standards like an other titleblock into the technical drawing.

VeraCAD

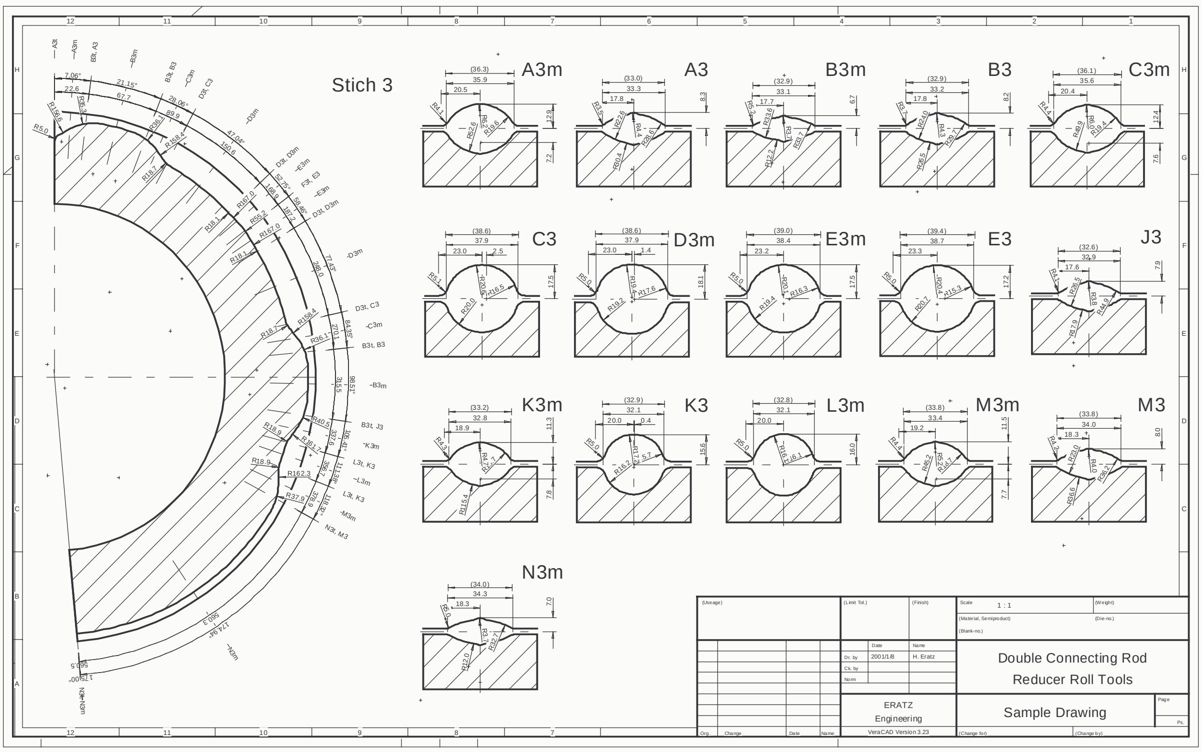



Fig. 7 Technical drawing for conventional manufacturing of the roll segments H. Eratz 18.6.01

## Medal Award 2001

**International Institute of Forging Technology**

Dear Ladies and Gentlemen,

We are pleased to inform you that your submission to the IIFT Medal Awards has been nominated for this year's award.

The awards will be announced at the Annual General Meeting and dinner on Monday 23 April 2001, and copies of your submission will appear in a future copy of the IIFT journal.

If you can be present at the AGM and dinner, the Chairman will be pleased to make the award to you personally, otherwise we will post it to you.

Thank you very much for your support of the IIFT.

Yours sincerely
Dr. Gianni Martinelli, IIFT


**VeraCAD** did win the Medal Award from the International Institute of Forging Technology for the best Forging Innovation in 2001. The picture shows the presentation of the Award to Mr. H. Eratz by the Chairman Dr. G. Martinelli.

# Using CAD to Develop Precision Roller Tools

By Dipl.-Ing. Hermann Eratz

Only experienced forgers have the knowledge for developing reducer roller tools. Now VeraCAD, a software using empirically based forging rules, allows complete reducer roller tool design using 3D CAD. VeraCAD dramatically cuts down the development costs and design cycle time, while increasing the final design precision and process stability.

CAD is excellently qualified for the design and development of roller tools. An integrated solution has to use geometry modules for processing complex free form surfaces as wells as powerful technology components. VeraCAD's technology components contain all deformation rules for determining suitable calibration sequences and algorithms that can learn company specific strategies. ERATZ Engineering in cooperation with SMS EUMUCO AG, the leader in industrial roller technology, developed the CAD-System VeraCAD for reducer roll tool design. After being implemented at about 20 forges and practical experience in the last six years, users are playing an important role in the continuous improvement of the software by providing valuable feedback based on specific customer requirements.

VeraCAD is composed of three main modules:

1. Mass distribution
2. Calibration plan
3. Tool calculation and technical drawing generation

The VeraCAD design process starts with importing the forging piece's geometry using a standard interface (IGES, VDA-FS, STL, or EDX). A 3D geometry is cut into many panes, and their volumes distributed over the central axis yield the mass distribution diagram. For bent parts the curved spine line is first entered interactively. If the geometry data set contains no flash area, a filter and offset function adds the necessary flash material amount. Usually the resulting mass distribution is too complex for direct derivation of the final roller piece. Equalizing the local volume balance at all times supports the design of an ideal roller blank. If no 3D geometry exists, an alternate input method based on a sketch of the final roller piece is available.

VeraCAD calculates suitable calibration sequences as well as the size of raw material and number of necessary passes. Therefore a variety of shapes are offered: circle, oval, lens, diamond, square, rhombus and rectangle. Standard rolling algorithms like "linked reduction rates"; "limit reduction", "cross-section spreading" or "priority calibration sequences" are automatically applied. These are based on a SMS EUMUCO database that is continuously improved and updated with the analysis of a wide variety of rolling results. The automatic calculation of motion in advance ranks among the outstanding features of the calibration module.

In addition to the automatic proposal of calibration plans, the practitioner possesses extensive interactive control options. Of course the reduction rate and calibration shape can be altered. If desired, the cross-section can receive a draft angle, leading groove, round edges, or a filling degree correction. Customer feedback has resulted in the continuous refining and increasing of manipulation options. Logically such interactive features require powerful graphic visualisation. The monitor function presents an exact calibration sequence in 2D and continuously updates the image for each change in deformation or geometry parameter.

In 3D the CAD surfaces of roller products help to assess the calibration plan. The shaded image or the wire frame model can quickly reveal possible rolling problems. With the spline surfaces of products also the indispensable volume calculation in each die sections is performed. VeraCAD's name was derived from this important feature (<u>**V**</u>olume <u>**E**</u>xact <u>**R**</u>educer roll <u>**A**</u>nalysis based on <u>**CAD**</u>).

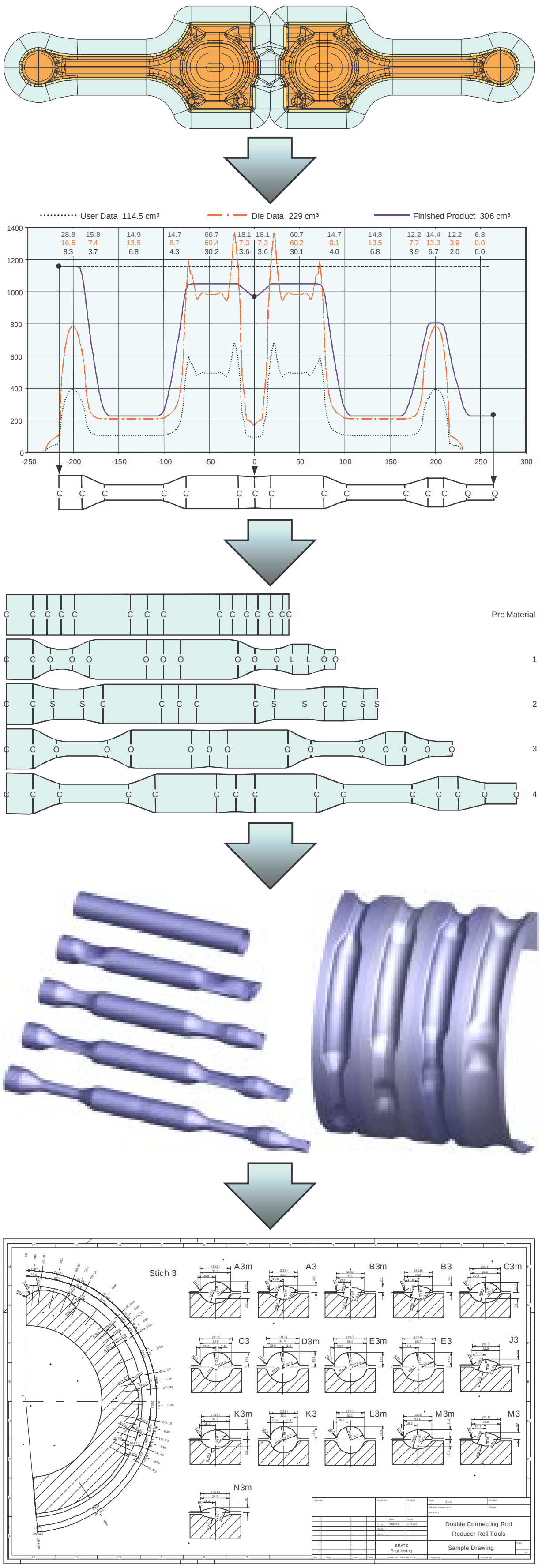
The last step in the design sequence is the conversion of the calibration plan into the final tool surface. After entering the main roller measurements the intermediate product is coiled up to the segment. Phenomena like "relative motion", "true working roll diameter" or "variable roll-off radius" are automatically incorporated during calculations. In addition the software generates a fully dimensioned technical drawing for the die shop. The drawing is part of the project documentation and can be used to note any tool adjustments after the first test run.

Naturally it is possible to incorporate the manual tool adjustments into the original 3D surface representation. Functions therefore range from inputting simple changes to lengths, angles or radii to ones used for "reverse engineering" strategies where scattered data scanned from the surface is input. Updated tool representation is thereby retained as a CAD data set and can be used for manufacturing subsequent tools or tool renewal. This way high repeatability and quality control becomes a given in the manufacturing process.

The 3D geometry of segments and products is exported through one of the four interface formats mentioned above. Basic CNC machining (i.e. the generation of cutter paths) follows in a different CAD system. Due to the simple surface data structure, machining the tools principally is no problem. Currently an IGES interface is available to export technical drawings. After reading the drawing into any 2D system, this is further detailed or completed (e.g. with the company's own title block).

The close connection between program modules could only be realised as a "stand alone" solution. Therefore VeraCAD does not make use of other CAD packages. Versions are currently available in English, French and German and run on MS Windows™ 95, 98, NT, 2000. A detailed user manual is available, and 10 video summaries on CD provide an introduction to roll forging technology and the user interface.

**Working Steps in VeraCAD**




*H. Eratz*

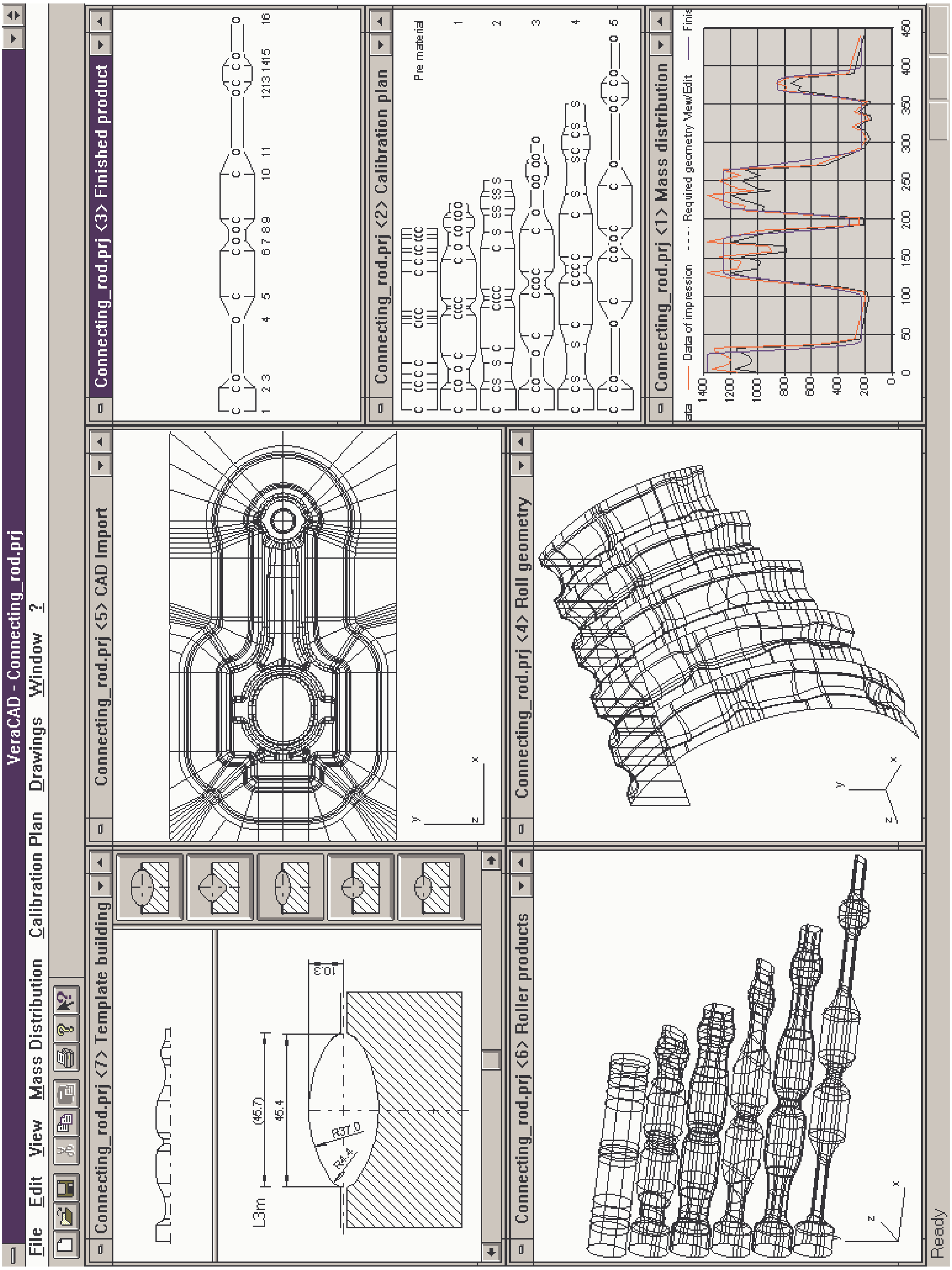
VeraCAD closely models the traditional roller tool design process and uses the same empirically based rules-of-thumb used by the experts. In addition VeraCAD's powerful geometry component provides an exact graphic of the current calibration plan and the 3D geometry during all design phases. This allows input errors or illogical calibration sequences to be recognised immediately. Only through the constant visualisation the full optimisation potential is revealed to the designer.

While the traditional design process requires laborious calculations and extensive drawing work to develop one single set of rolling equipment, VeraCAD can tremendously shorten the development cycle. Engineering resources now can be utilised for more complex decisions such as comparison and assessment of different designs, checking borderline cases, like whether a roll operation is meaningful with 2 or 4 passes. This way tool costs can be set against process stability. The optimisation leads to a final roller product that just can meet all manufacturing requirements with the least amount of material inputs.

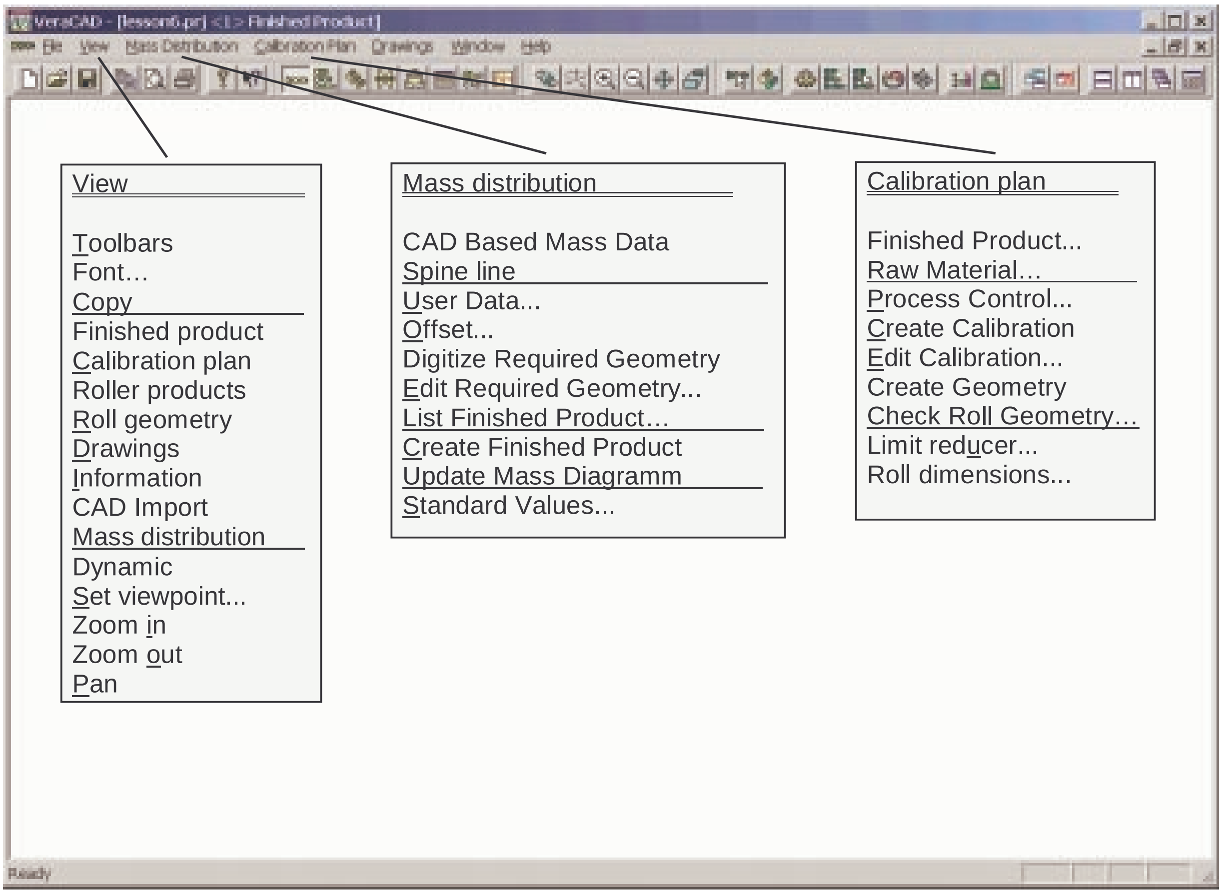
VeraCAD is installed at large forging plants and automotive manufacturers worldwide. Initial results have led to improvements in the database, but roller parts produced during the last three years exceed all our expectations. In most cases the VeraCAD designed roller tools have worked perfectly from the beginning with either no, or only minimal, reworking necessary. Consequently the tool development process has rationalized, and the reliability of the manufacturing process has increased. In addition users, not trained in traditional design methods, have gone on to successfully develop reliable roller tools after 2-3 days of technology training.

Even with VeraCAD's comprehensive solution for reducer roll design and the numerous outstanding results, a broad potential exists to further expanding features and functionality. From adapting to future operating systems, the addition of new interface formats, improved user comfort, an essential point is to come closer to the manufacturing process limits. By means of forecasting local material flow and exact observance of deformation rules, VeraCAD will avoid rolling defects and can reach the process limits. The goals to be achieved are higher reduction rates, fewer roll segments or steeper mass ascents. These finally will result in lower tool, material and energy costs.

Contents of VeraCAD-screen with different windows.



The main application menus and available commands.



# VeraCAD Sample

The following pages are an overview about the calculation process and the results of a VeraCAD working example.
All sheets were directly printed or plotted with VeraCAD. The technical drawings that are included, normally are plotted with large scale (1:1) on a pen or Inkjet plotter. In addition the three dimensional surfaces for roll products and segments are generated in general CAD interface formats (IGES, VDAFS, EDX) and can easily be used for a CNC-milling of the tool segments.

designed by:

## VeraCAD 1.60

For more questions please contact:

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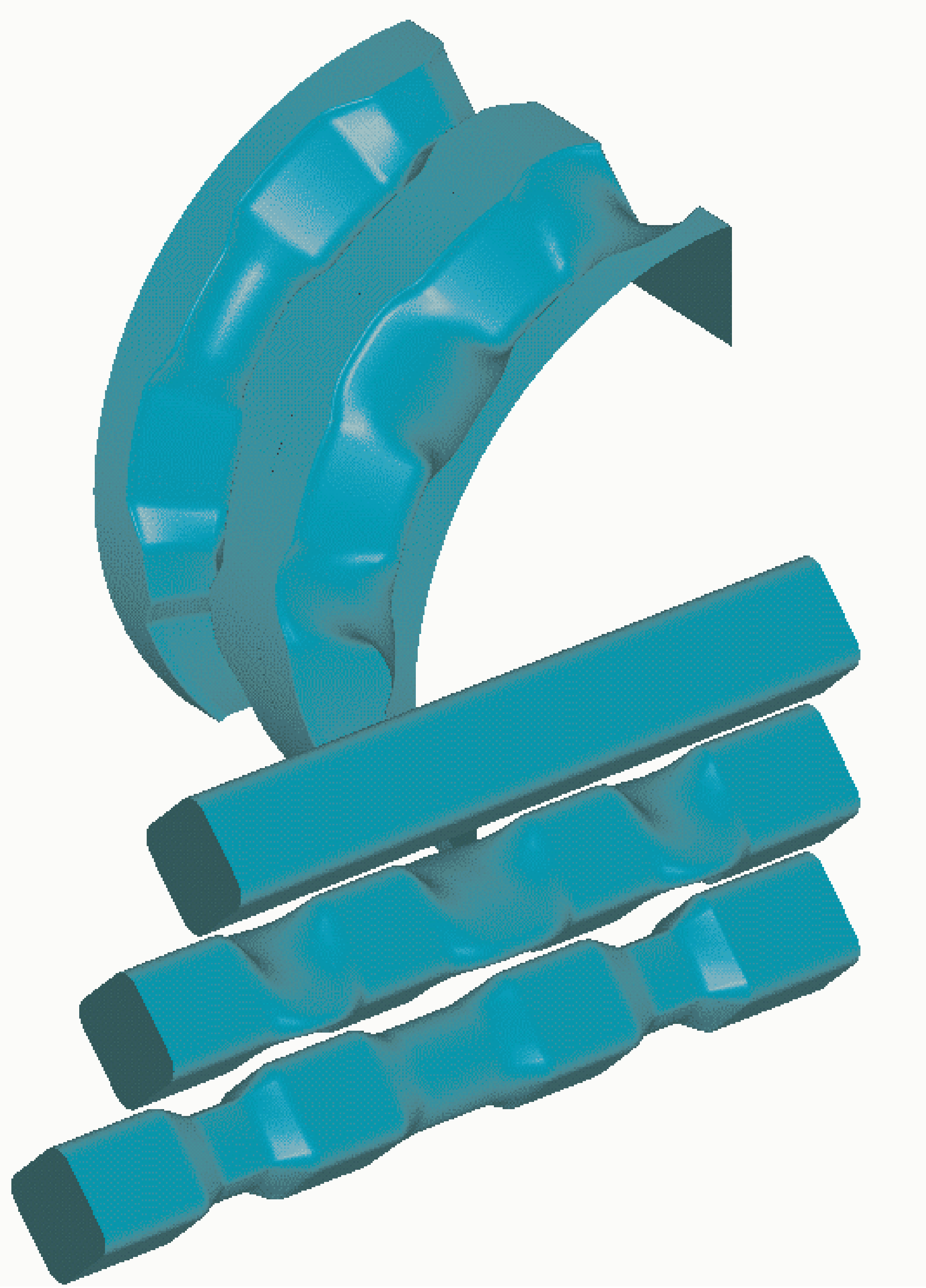
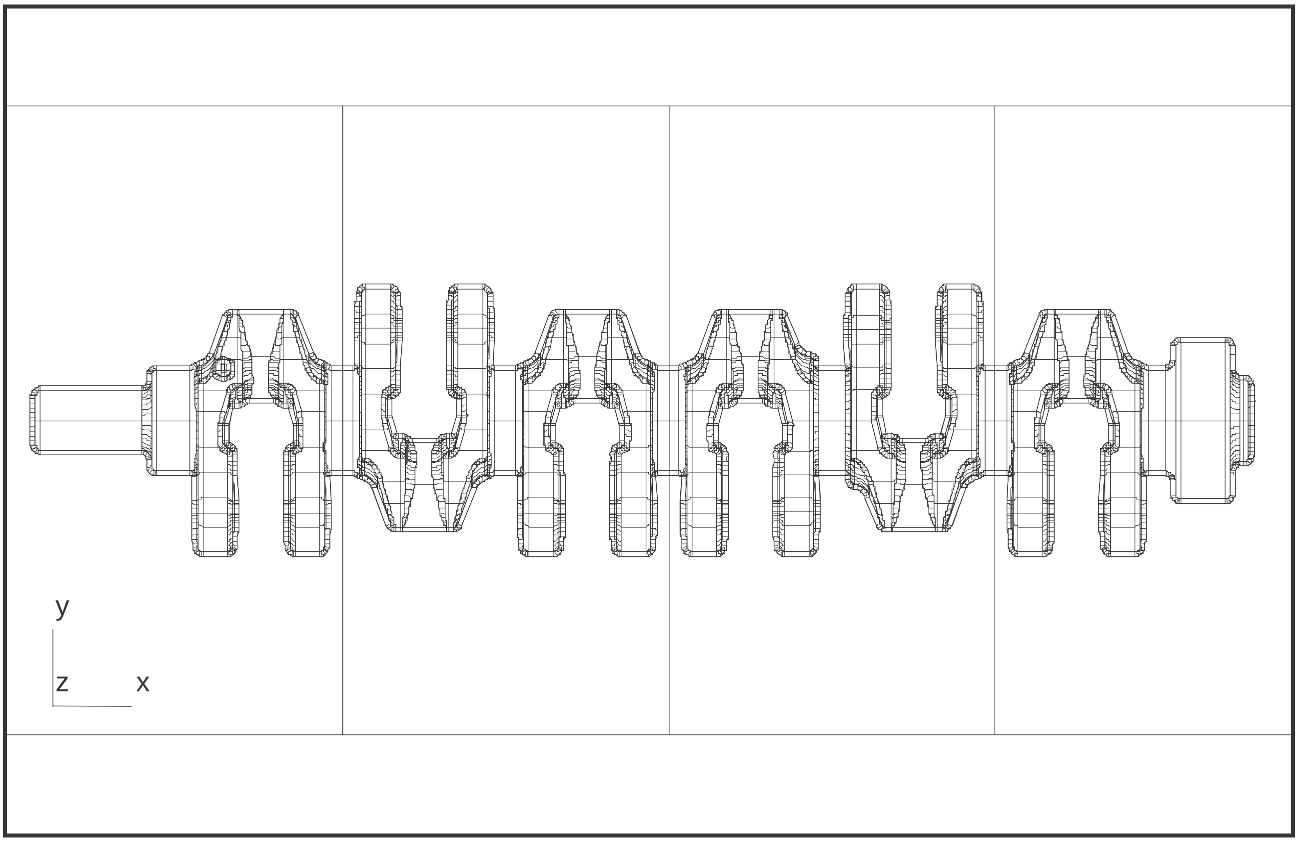
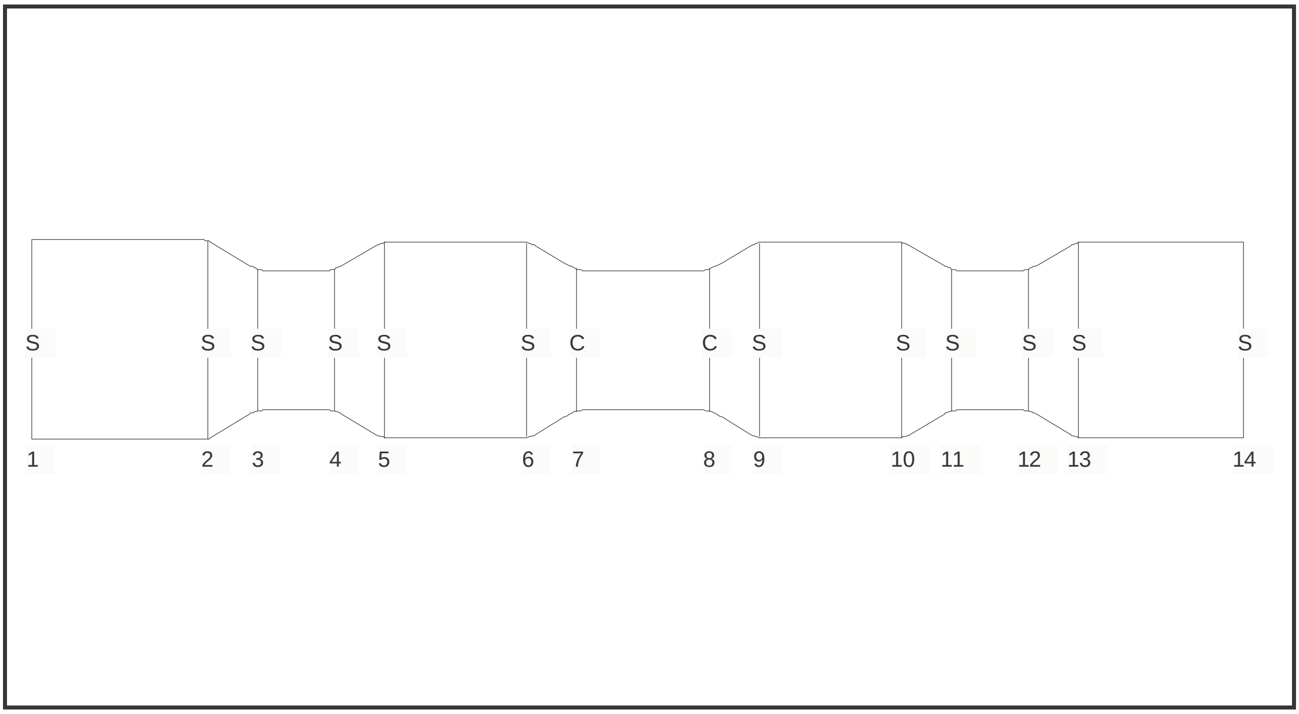
## Two roll segments for a crankshaft and correlating products

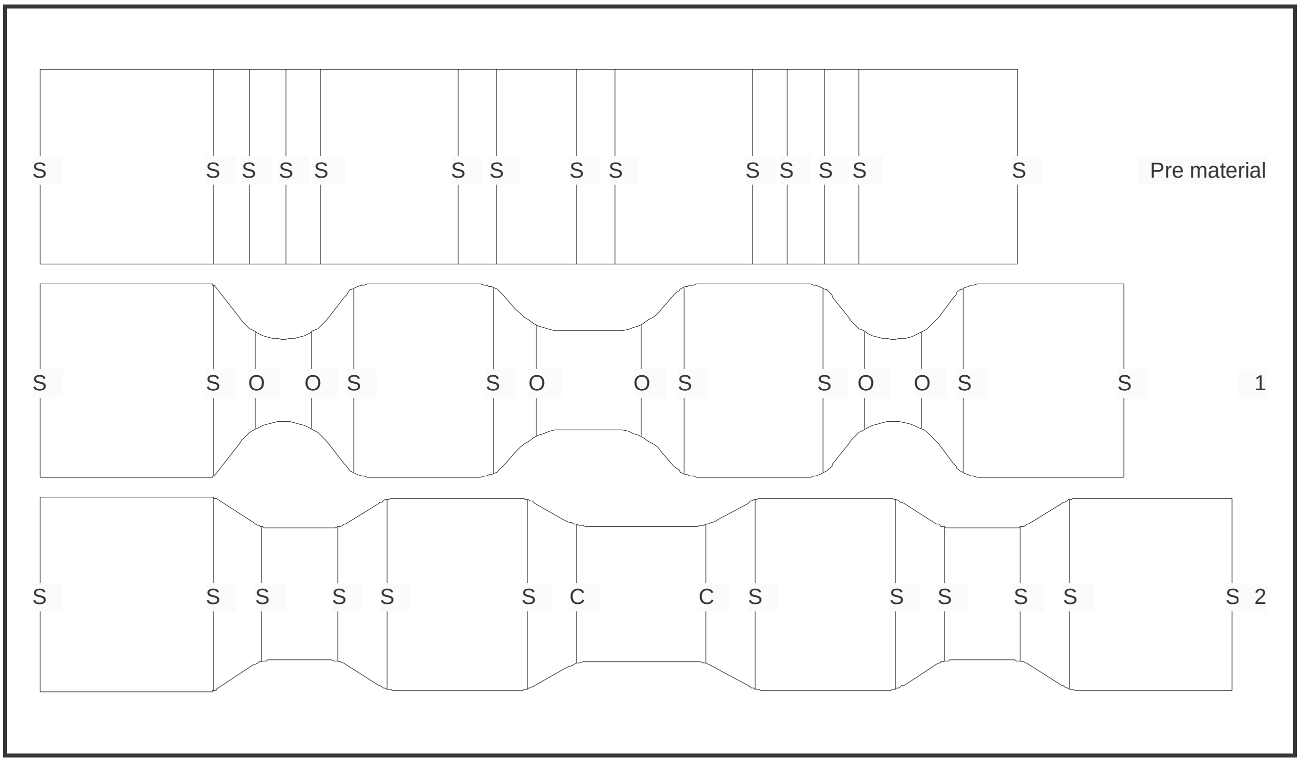




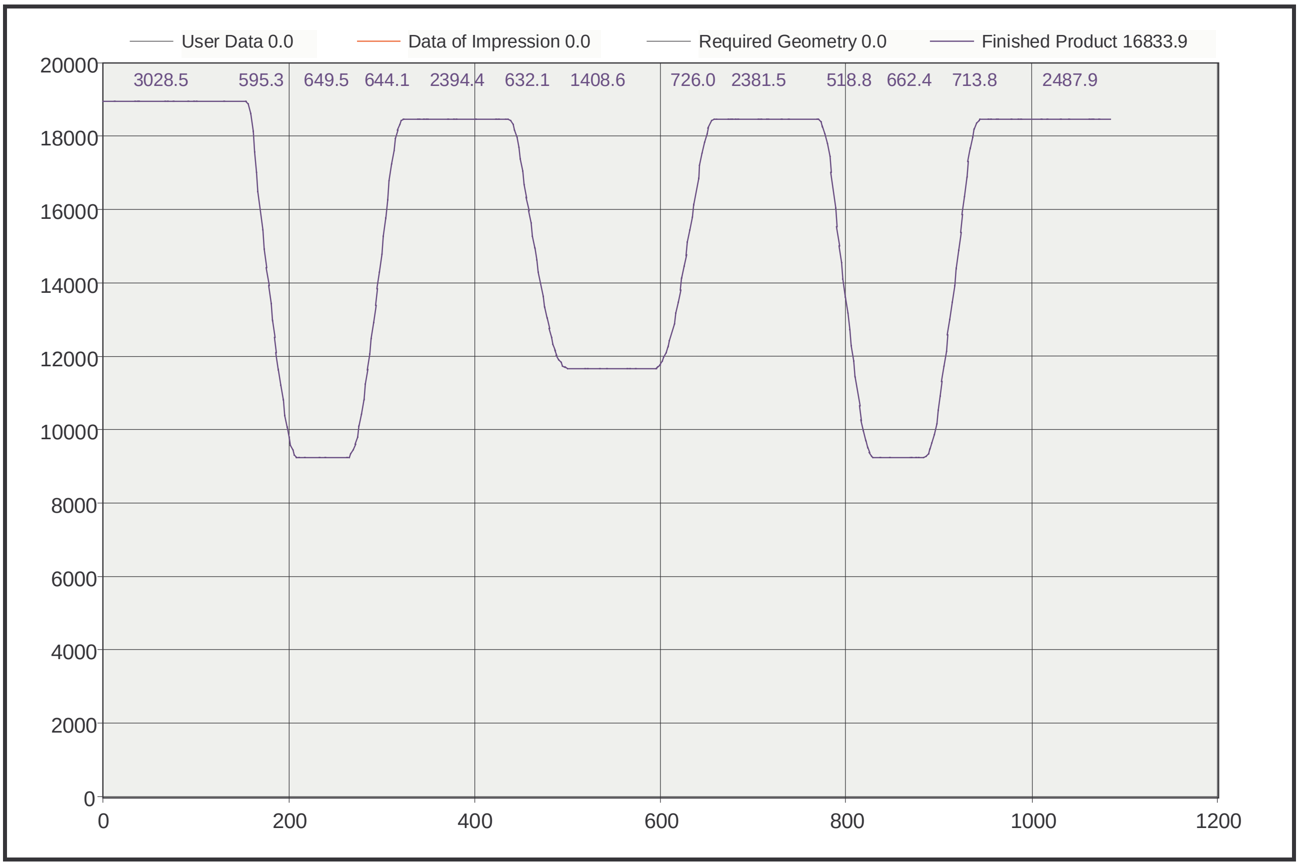

Window: Original basic CAD-geometry of the crankshaft



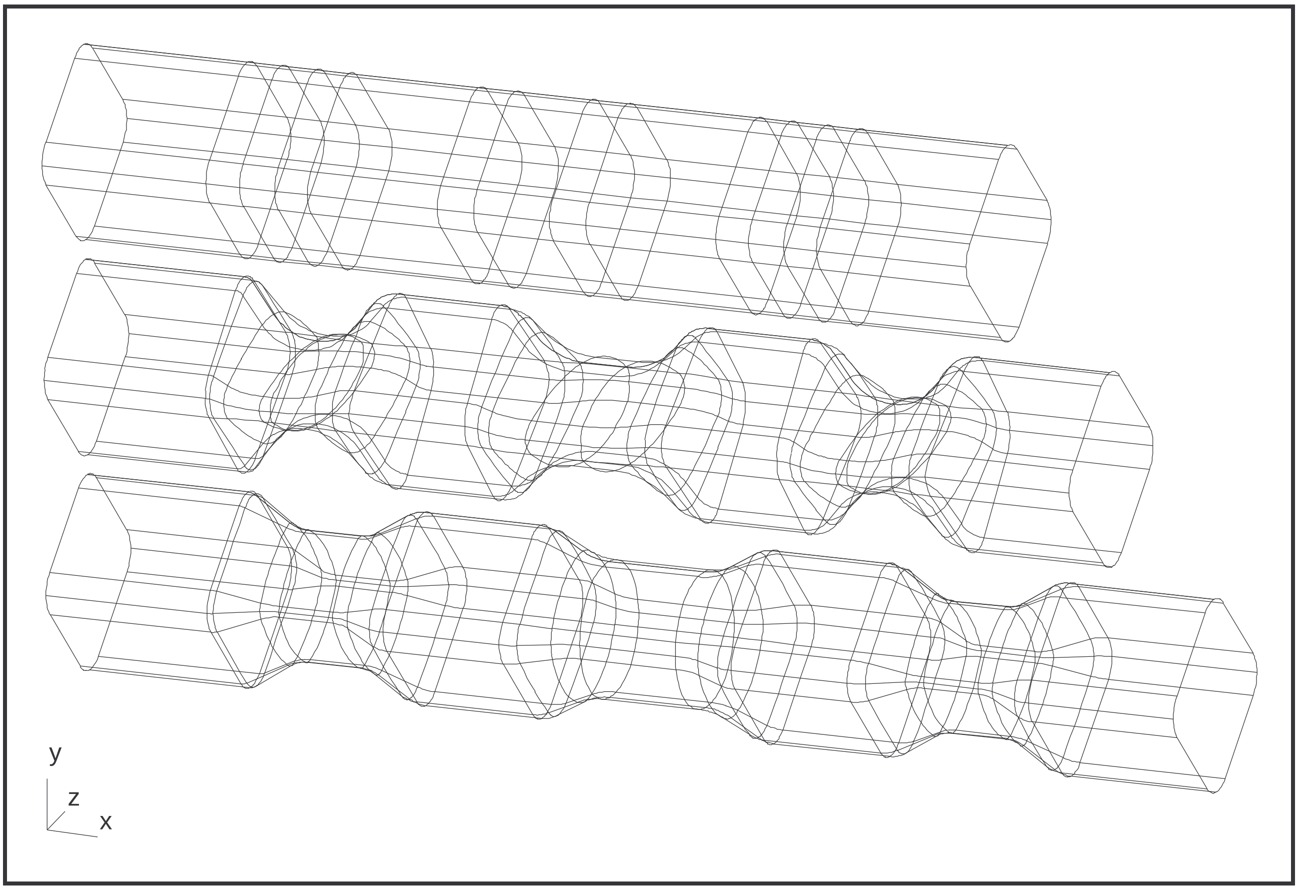

Window: Finished product (S – Square, C – Circle)



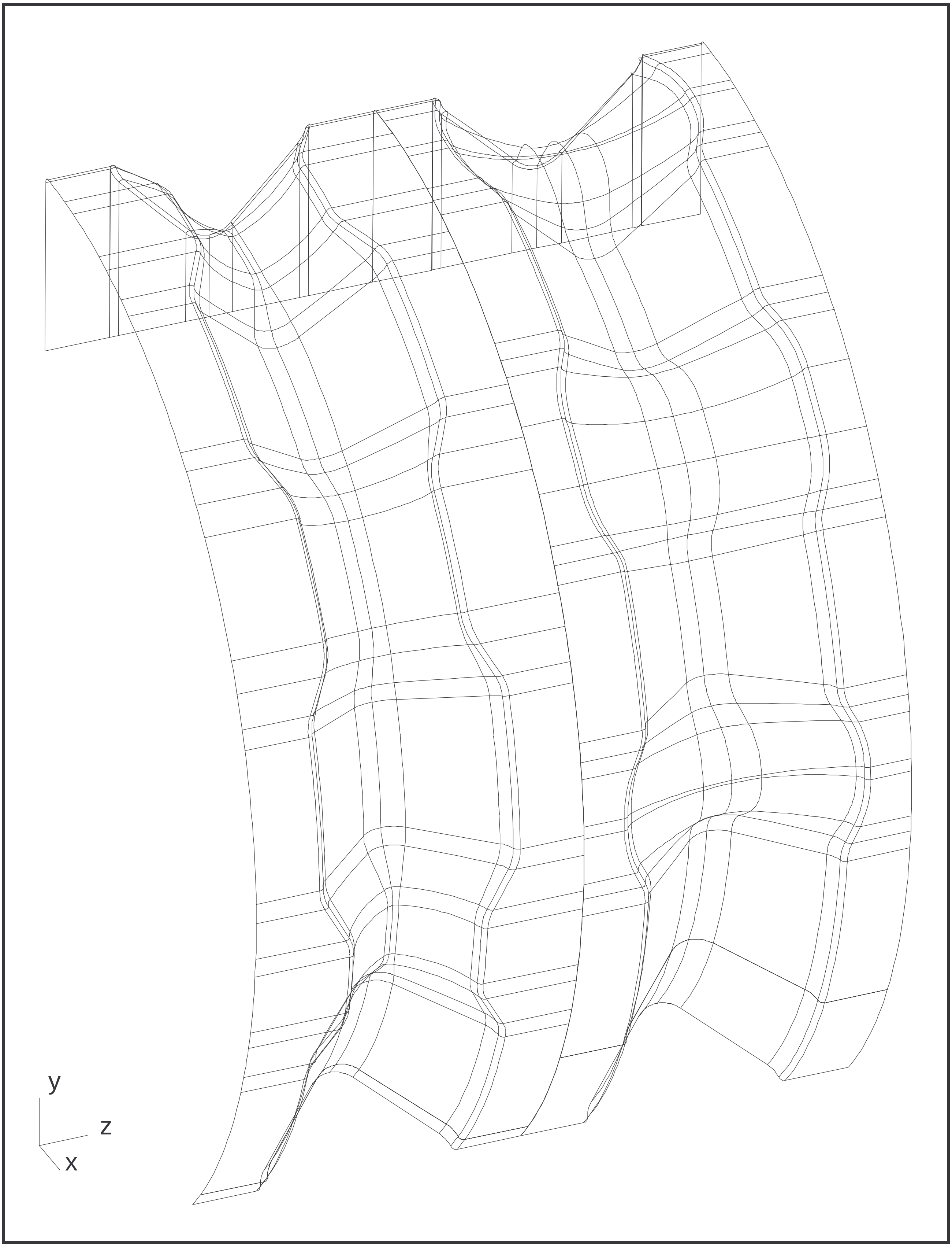

Window: Calibration plan (S – Square, C – Circle, O – Oval)




Window: Mass distribution




Window: 3D intermediate roller products




Window: Geometry of tool segments (impression only)

# VeraCAD - Calibration plan

| | |
|---|---|
| Design of rolling tool: | SampleSession1.PRJ |
| Presented on: | 30 Oct 1996 |
| Software Version: | VeraCAD Version 1.60 |

## Rolling tool and milling tool measurements

| | | |
|---|---|---|
| Outer diameter (theoretical centre): | 930.0 | mm |
| Outer diameter of the roll segments: | 924.0 | mm |
| Inner diameter or the roll segments: | 600.0 | mm |
| Width of one roll segment (without spring): | 300.0 | mm |
| Complete flash gap between two rolls: | 6.0 | mm |
| Rounding radius at the mouth of the groove: | 5.0 | mm |
| Radius of transition from impression to flash: | 5.0 | mm |
| Circumferential angle for one segment: | 135.0 | ° |
| Narrowest milling radius for finishing: | 5.1 | mm |

## Technology parameters

| | | |
|---|---|---|
| Thickness of oxide layer: | 0.10 | mm |
| Thermal expansion of raw material: | 1.50 | % |
| Thermal contraction during operation: | 0.15 | % |

## Critical reduction values

| | Minimal | Maximal |
|---|---|---|
| Circle - Circle: | 0.5 | 5.0 |
| Circle - Square: | 6.0 | 20.0 |
| Circle - Oval: | 7.0 | 38.0 |
| Square - Circle: | 4.0 | 6.0 |
| Square - Square: | 0.5 | 5.0 |
| Square - Oval: | 12.0 | 38.0 |
| Oval - Circle: | 12.0 | 23.0 |
| Oval - Square: | 12.0 | 23.0 |

## Pre material information

| | | |
|---|---|---|
| Edge-length of raw material: | 140.0 | mm |
| Cross-section area of raw material: | 18978.0 | mm |
| Length of raw material (cold part): | 889.4 | mm |
| Length of raw material (hot part): | 902.8 | mm |
| Density of raw material: | 7885.0 | kg/m³ |
| Weight of raw material: | 133097.1 | g |

## Rolling process parameters

| | | |
|---|---|---|
| Number of necessary passes: | 2 | |
| Narrowest cross-section is no.: | 3 | |
| Maximum total reduction: | 51.3 | % |

**Calibration plan for cross-section no.: 1 (all values in warm state)**

| Pass: | 0 | 1 | 2 |
|---|---|---|---|
| Type of cross-section: | S-f | S-f | S-f |
| Cross-section area [mm²]: | 19507.75 | 19498.14 | 19488.54 |
| Volume of position [cm³]; | 0.00 | 0.00 | 0.00 |
| Height [mm]; | 178.12 | 178.08 | 178.04 |
| Width [mm]; | 178.12 | 178.08 | 178.04 |
| Relative motion [%]: | | | |
| Reduction [%]: | | | |
| Below/exceeding bounds: | | | |
| Rounding radius [mm]: | 0.00 | 0.00 | 0.00 |
| Length of Position [mm]: | 0.00 | 0.00 | 0.00 |
| Cradle roll motion [mm]: | | 0.00 | 0.00 |
| Rolling angle [°]: | | 0.00 | 0.00 |

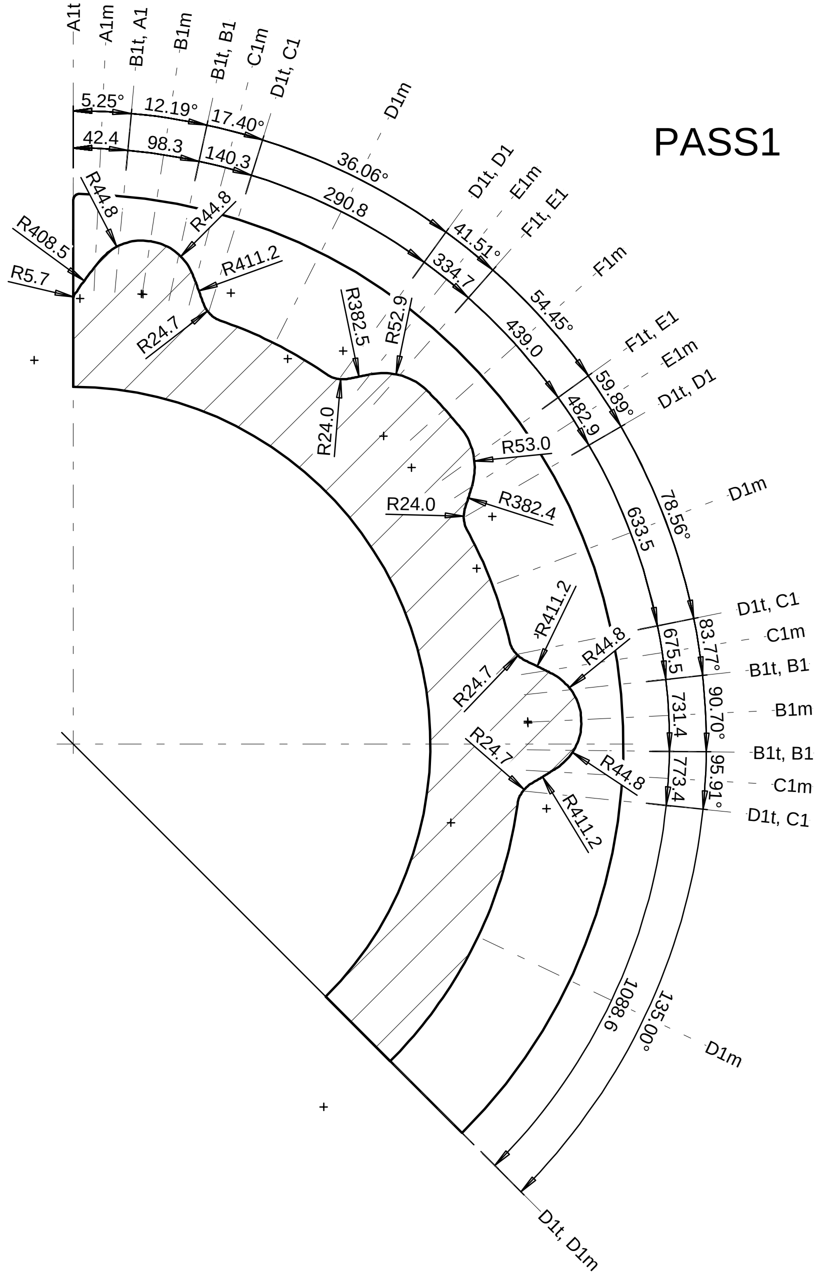
**Calibration plan for cross-section no.: 2 (all values in warm state)**

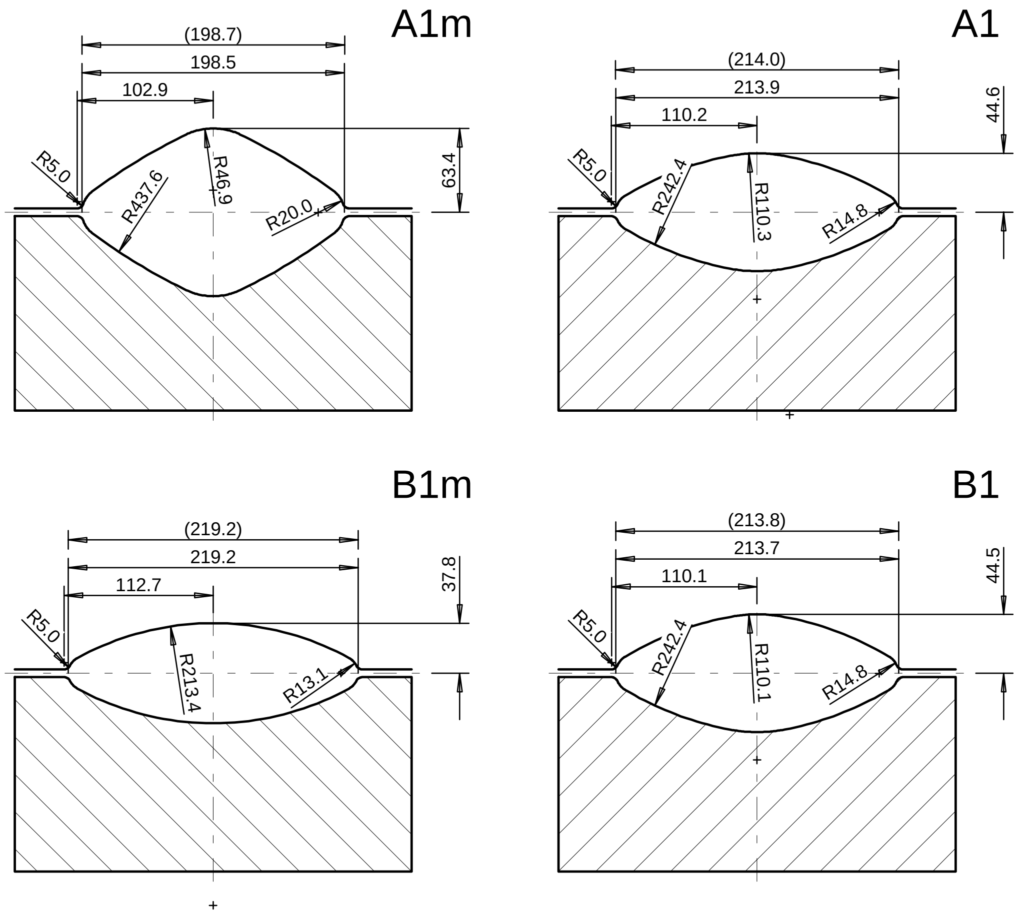
| Pass: | 0 | 1 | 2 |
|---|---|---|---|
| Type of cross-section: | S-f | S-f | S-f |
| Cross-section area [mm²]: | 19507.75 | 19498.14 | 19488.54 |
| Volume of position [cm³]; | 3122.58 | 3120.28 | 3117.97 |
| Height [mm]; | 178.12 | 178.08 | 178.04 |
| Width [mm]; | 178.12 | 178.08 | 178.04 |
| Relative motion [%]: | | | |
| Reduction [%]: | | | |
| Below/exceeding bounds: | | | |
| Rounding radius [mm]: | 10.00 | 10.00 | 10.00 |
| Length of Position [mm]: | 160.08 | 160.04 | 160.00 |
| Cradle roll motion [mm]: | | 0.00 | 0.00 |
| Rolling angle [°]: | | 0.00 | 0.00 |

**Calibration plan for cross-section no.: 3 (all values in warm state)**

| Pass: | 0 | 1 | 2 |
|---|---|---|---|
| Type of cross-section: | S-f | O | S-r |
| Cross-section area [mm²]: | 19507.75 | 12261.75 | 9500.00 |
| Volume of position [cm³]; | 637.69 | 637.21 | 636.74 |
| Height [mm]; | 178.12 | 75.70 | 120.14 |
| Width [mm]; | 178.12 | 219.15 | 120.14 |
| Relative motion [%]: | 0.00 | 0.0 | 0.0 |
| Reduction [%]: | | 37.14 | 22.52 |
| Below/exceeding bounds: | | | |
| Rounding radius [mm]: | 100.00 | 50.28 | 30.00 |
| Length of Position [mm]: | 32.69 | 38.57 | 45.00 |
| Cradle roll motion [mm]: | | 42.34 | 50.08 |
| Rolling angle [°]: | | 5.22 | 6.17 |

and so on




| | | | | |
|---|---|---|---|---|
| (Useage) Demo | (Limit Tol.) DIN 1504 | (Finish) DIN 1302 | Scale 1 : 5 | (Weight) 100 kg |
| | | | (Material, Semiproduct) 56NiCrMoV7 | (Die-no.) |
| | | | (Blank-no.) Part 01 | 1000 |

| | Date | Name |
|---|---|---|
| Dr. by | 6 Mar 98 | Eratz |
| Ck. by | | |
| Norm | | |

Crankshaft

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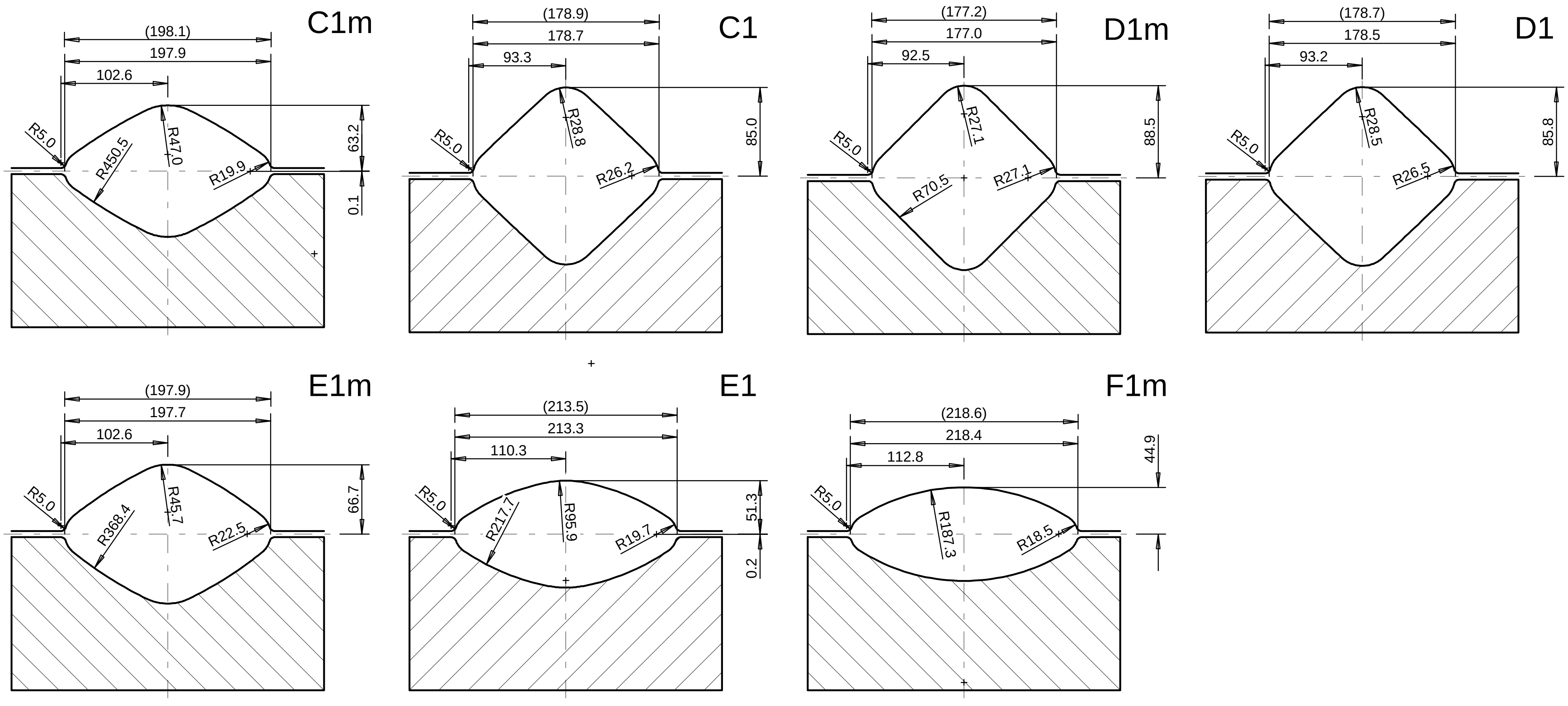


| (Useage) | (Limit Tol.) | (Finish) | Scale | (Weight) |
|---|---|---|---|---|
| Demo | DIN 1504 | DIN 1302 | 1 : 5 | 100 kg |
| | | | (Material, Semiproduct) 56NiCrMoV7 | (Die-no.) 1000 |
| | | | (Blank-no.) Part 01 | |

| | Date | Name |
|---|---|---|
| Dr. by | 6 Mar 98 | Eratz |
| Ck. by | | |
| Norm | | |

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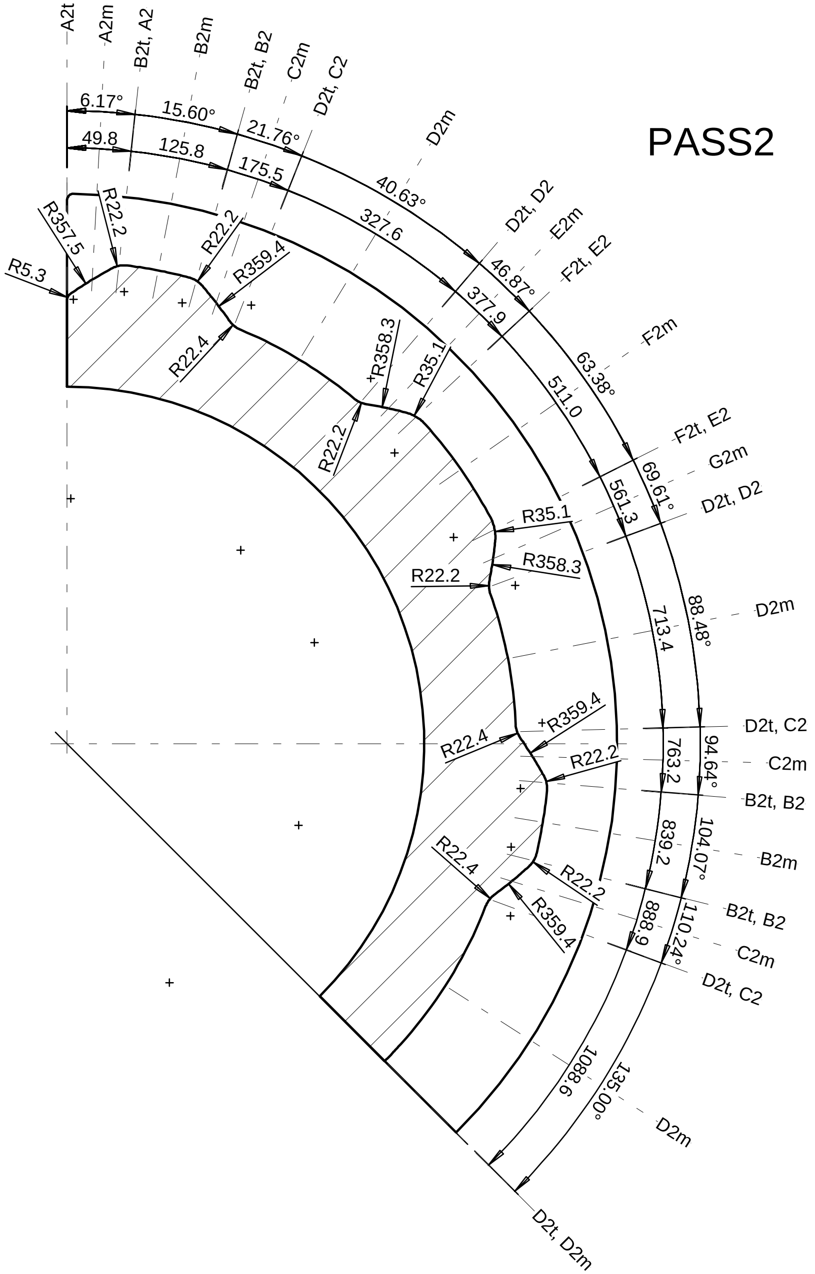
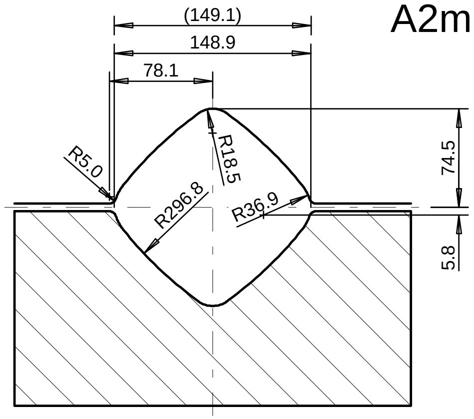
|---|---|---|---|---|---|---|

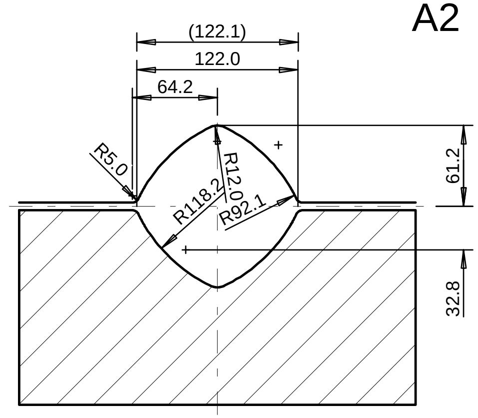
# PASS2



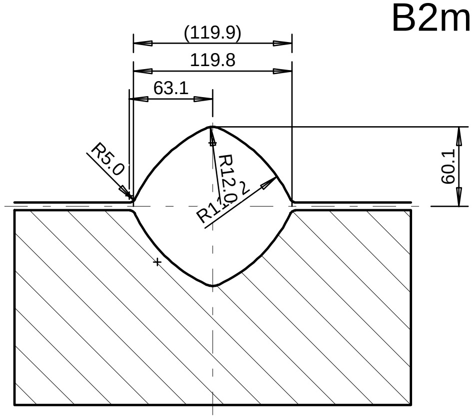

## A2m



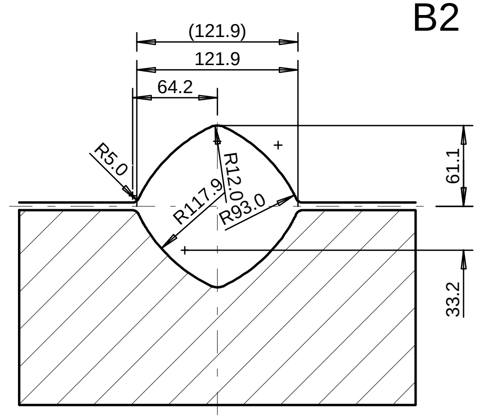

## A2




## B2m




## B2




(Useage) Demo
(Limit Tol.) DIN 1504
(Finish) DIN 1302
Scale 1 : 5
(Weight) 100 kg
(Material, Semiproduct) 56NiCrMoV7
(Die-no.) 1000
(Blank-no.) Part 01

| | Date | Name |
|---|---|---|
| Dr. by | 6 Mar 98 | Eratz |
| Ck. by | | |
| Norm | | |

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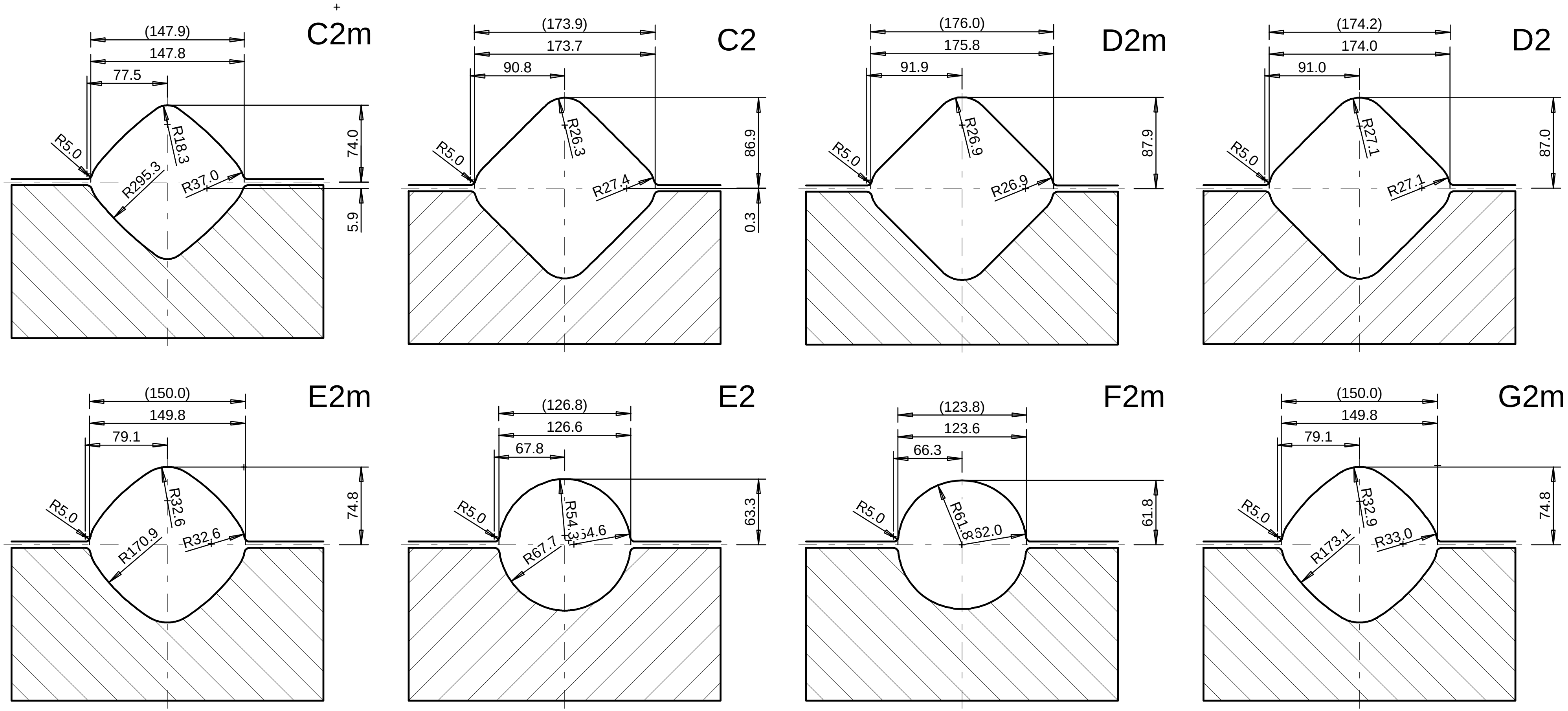


(Useage) Demo

(Limit Tol.) DIN 1504

(Finish) DIN 1302

Scale 1 : 5

(Weight) 100 kg

(Material, Semiproduct) 56NiCrMoV7

(Die-no.)

(Blank-no.) Part 01 1000

| | Date | Name |
|---|---|---|
| Dr. by | 6 Mar 98 | Eratz |
| Ck. by | | |
| Norm | | |

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