Your dental dealer: As our products are subject to continuous development, product illustrations are intended only as examples.

Renfert offers a 3-year guarantee on all equipment provided it is used according to instructions. The original sales invoice of the dental supplier is required for a claim under guarantee. The guarantee excludes parts that are subject to normal wear and tear. Incorrect use, disregard of the operating, cleaning, maintenance and installation instructions, in-house repairs or repairs by unauthorised personnel, use of replacement parts from another manufacturer and exceptional factors not covered by the instructions for use render the guarantee invalid. A successful claim under the guarantee does not extend the guarantee period.

Model casting technique

Analysis, planning and manufacture

Step by step to success

Renfert Dental Technology Team
Dear reader,

The partial denture is worldwide one of the most utilized forms of therapy. It covers almost all the options for treating missing teeth with various degrees of complexity and different levels of treatment. Many books have already been written to illustrate the variety of this subject, most of them very comprehensive. That is good, as they are essential as reference or as speciality books.

However, because of that many people are intimidated by this subject. That is a pity and unnecessary, as partial denture work is no witchcraft. Renfert would like therefore to shed light on and bring you closer to an important area of dental laboratory practice in this handbook series. We consciously concentrate on the widespread area of the clasp-retained chrome cobalt denture. This is worldwide the basis of treatment that is varied, predictable and cost effective.

As in the previously published Renfert handbooks, the authors do not intend to show restorations and techniques far removed from the daily routine just to display exaggerated perfectionism. To us it is far more important to fit the frame of daily laboratory and practice timing.

The reader will get a step-by-step explanation, from analysis to planning and fabricating the denture, with many proven, mostly self-explanatory, detailed pictures.

As is so often the case, good planning is the basis for quick, precise fabrication of a partial denture. Therefore we especially emphasise this part.

We suggest the Renfert Cast-denture-system handbook to all those, who are just starting, to those who still feel somewhat insecure, but also to those who want to improve.

We wish you lots of fun reading

Your team of Renfert authors
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Kennedy Classes

The model in our example is a modification of Kennedy Class II.

For classification of the four main Kennedy Classes refer to Page 37.

Framework design

In our example the framework is designed as a transversal plate.

For other types of frameworks refer to Page 38.

Statics

The basic requirements of a CrCo denture are compensation of the forces, retention and stability. For different stages in analysis refer to Page 39.

① Lever arm ② Work arm

Types of clasps

This example uses a G-clasp and two E-clasps, which are variations of the double arm clasp.

For other types of clasps and their application refer to Page 42 – 43.
Use a Class IV dental stone for fabricating the working model and mix bubble-free in a vacuum mixer.

**Tip:**
Programmable vacuum mixers guarantee reproducible results.

Using a base former saves time when fabricating the model base.

Also refer to the guide on functional model fabrication (see Page 46).

**Tip:**
Trimming the model base at right angles facilitates removing it from the duplicate mould at a later stage.
Upper Kennedy Class II with an additional bounded saddle.

There is a bounded saddle in the first quadrant. The dentist has prepared rests next to the saddle on 14 and 17, the teeth to be clapsed.

There is a free-end saddle in the second quadrant.

A rest has also been prepared here. It is away from the saddle on the premolar 25.
The relineable saddles are marked on the model.

**Marking the CrCo framework**

First the centre of the palate is marked as a symmetrical reference point. This usually runs along the palatal suture starting at the incisive papilla.

To avoid the CrCo framework compressing the gingiva, allow adequate clearance at the gingival margin of the respective teeth.

The relineable saddles are marked on the model.
The average width of the transversal plate is about two-thirds of the length of the longest saddle. This rough guide ensures the necessary stability with minimum dimensions.

**Determining the path of insertion**

The model is securely clamped on a model table. A common path of insertion for the clasps is determined as follows using the surveying rod of the parallelometer.

Taking into account all the teeth to be clasped, the model is tipped out of the initial position ...

... to establish a suitable undercut. This produces the prosthetic equator of the individual teeth.

The model should be aligned so that the prosthetic equator is in the lower third of the tooth in the region of the clasp tip.
The deepest position of the retention arm in the retentive section is determined using a depth gauge. The depth gauge should be in contact with the tooth.

The prosthetic equator indicates the greatest circumference of a tooth in relation to the common path of insertion of all the teeth to be clasped.

The part of the tooth below the equator is the retentive section.

**OPTION A**

The prosthetic equator is marked with pencil lead.

**OPTION B**

The prosthetic equator can also be marked by placing occlusal foil against the tooth and moving the surveyor rod along the foil.

The deepest position of the retention arm in the retentive section is determined using a depth gauge. The depth gauge should be in contact with the tooth.

**Note:**
A Ney depth gauge size 1 (0.25 mm/0.0098 inch) is used with CrCo alloys, as shown in the example.
Ideally one-third of the retention arm should lie below the prosthetic equator, one third on the equator and one third above it.

The support arm, which should not be placed below the prosthetic equator, is used as a reciprocal arm to the clasp arm.

Marking the position of the clasp

The clasp contour can now be marked, preferably using a graphite-free pencil (Sakura), and should take the following aspects into consideration:

Blocking out undercuts

The undercuts are then blocked out with blockout wax (except for the areas used for retention).
The Casting Wax is then reduced to the marked contours of the saddle area. Position the scalpel so that the finishing edge is undercut, as this will provide better retention for the acrylic.

Deep areas in the palatal rugae and interdental spaces should also be blocked out. This facilitates subsequent removal from the duplicate mould.

Blocked out areas are carefully reduced to a minimum using a parallel carver (until the carver comes into contact with the tooth).

Tip: Tooth surfaces next to the saddle should be blocked out with a min. 2° angle.

Preparing the saddle area

Self-adhesive Casting Wax is applied to the surfaces of the marked saddle areas. The adhesive wax prevents duplicating silicone flowing underneath the wax.

The Casting Wax is then reduced to the marked contours of the saddle area. Position the scalpel so that the finishing edge is undercut, as this will provide better retention for the acrylic.
Preparing the finishing margins

The finishing margins of the transversal connector marked on the model are ground to a maximum depth of 0.5 mm/0.019 inch with a 1 mm/0.039 inch round bur. This increases the suction of the denture.

The prepared finishing margins ...

... are trimmed towards the plate to avoid any sharp edges or pressure points.

The finished prepared upper model can now be duplicated.
The lower model is prepared slightly differently from the upper model.

The planned sublingual bar has a convex design at the lingual frenum. This prevents irritation of the moveable lingual frenum.

The sublingual bar should be placed approx. 4 mm/0.157 inch (1) from the gingival margin without coming into contact with the moveable mucosa on the floor of the mouth.

In contrast to the upper palatal plate, the sublingual bar should be hollowed by 0.5 mm/0.019 inch to prevent pressure points. Another advantage of this is improved cleansing by the saliva and no apposition of food debris.
With free-end saddles a notch (metal stop) is cut out in the distal region of the casting wax spacer. This provides support and ensures that this region does not sink when pouring the acrylic and that the fit of the denture is maintained.

Lower model prepared for duplication.
Secure the model to the middle of the flask base with sticky wax.

Ensure that there is a uniform gap (approx. 1 cm/0.393 inch) between the model and the edge of the sleeve so that the silicone mould has adequate stability.

The duplicating silicone is mixed bubble free in a vacuum mixer.

Adhere to the manufacturer’s instructions for use!

**Tip:**
Use of a vacuum mixer guarantees that the silicone is bubble-free and homogeneous.
The duplicating silicone is poured slowly into the duplicating flask from a height of approx. 30 cm.

**Tip:**
To avoid bubbles forming, do not pour the duplicating silicone too quickly or directly onto the wax pattern.

Remove the sleeve after the duplicating silicone has set.

**Tip:**
Using compressed air facilitates removal of the model from the duplicate mould.

After loosening the stone model, it should be carefully removed from the duplicate mould.

**Tip:**
Ensure that no wax sections are left in the duplicate mould.
Spray the duplicate mould with silicone wetting agent to avoid bubbles forming in the investment model.

The CrCo investment is mixed bubble free in a vacuum mixer according to manufacturer’s instructions.

The investment is poured slowly into the duplicate mould with the aid of a vibrator.

It is important to use the correct oscillation mode for the material at the optimum level of vibration to ensure that the model is poured without bubbles.

The model can be carefully removed after the investment has set.

Tip:
A jet of compressed air also facilitates removal of the model here.
Finished investment models.

Investment model preparation

After removal, the models should be dried in the furnace at approx. 100°C / 212°F for 15 min.

The markings from the duplicate mould often transfer automatically onto the investment model. If this does not happen, the undercuts at the teeth to be clasped have to be surveyed again.

Lightly spray the model with model spray to smooth the surface and improve adaptation of the preformed wax patterns.
Before waxing up, heat the model until it is hand-hot (e.g. place on a steam cleaner) to facilitate adaptation of the wax.

First fill the post dams of the transversal connector and the beading at the saddle area with CrCo sculpting wax.

Adapt a 0.5 mm/0.019 inch wax wire to the middle of the transversal connector along the length of the plate as a strengthener.
The areas between the wax wire and post dams are filled with sculpting wax and smoothed. The layer thickness at the wax wire should be 0.5 mm/0.019 inch and taper thinly towards the post dam.

Round retention mesh is placed on the saddle and waxed onto the transversal connector.

Ensure that there is an adequate retention area for the acrylic.

The tip of the preformed clasp patterns are adapted first in the retention area and then placed along the marking.

The clasp is cut to the height of the rest using a scalpel.
The reciprocal clasp arm is placed using the same technique. Ensure that the clasp arm is not placed below the prosthetic equator so that there is no retention on this side of the tooth.

The wax-up of the rest and minor connector to the round retention mesh is completed with CrCo sculpting wax.

A thin waxing-up tip is recommended for use in intricate areas.

A 0.4 mm/0.015 inch thick stippled sheet of casting wax is cut in the shape of a triangle.

Slits in the stippled sheet casting wax prevent cracks when adapting it into the palate.
A soft sponge is recommended for adapting the wax, as this preserves the stippling and avoids pressure points.

A smooth wax band of approx. 1 mm/0.039 inch is prepared with a knife at the edge of the margins.

A 1 mm/0.039 inch wax wire is placed as beading at the saddle area and then filled with CrCo casting wax and smoothed.
Ensure that the contour of the sheet casting wax follows the contour of the acrylic saddle.

**Tip:**
Seal the contact areas between the wax pattern and investment model with a thin application of GEO Waxfinish. This prevents investment flowing underneath the pattern and reduces the subsequent preparation time by up to 10%.

Finished upper pattern on the investment model

In the lower, the preformed wax bar is adapted to the investment model following the contour of the marking.

The indent in the saddle prepared at an earlier stage is filled with wax.
When placing the round retainer, ensure that it is positioned in the centre of the alveolar ridge. The area towards the sublingual bar is filled with wax to strengthen it.

**Tip:**
Retention can be further reduced in this area if required.

Leave adequate space at the gingival margin to avoid pressure points.

The clasps and beading are placed in the same way as with the upper and waxed flush with CrCo casting wax.
3.5–4 mm/0.137–0.157 inch diameter sprues are used for casting.

The sprues should have a uniform contour without angles and the surface of the wax should be very smooth.

This allows the metal to flow freely and avoids miscasts.

When connecting the sprues to the pattern, ensure that flow path of the sprue into the pattern is continuous.
The sprues meet in the middle of the model:

A preformed crucible former is placed on the ends of the sprues and waxed flush to the sprues.

The distance between the bottom of the crucible former and the highest point of the pattern should be approx. 5–10 mm.

The investment model is secured to the middle of the flask base with sticky wax.
Check the height of the crucible former before pouring the investment.

**Tip:**
The sleeve should be lubricated with a little Vaseline beforehand so that it is easier to remove.

The lower is prepared in the same way as the upper.

Mix the investment bubble-free under vacuum according to the manufacturer’s instructions.

Pour the investment slowly and at a vibration level to suit the material.

**Tip:**
Too long or too powerful vibration can cause segregation of the investment material.
After the investment has completely set, the sleeve, base and crucible former are removed.

Sharp edges on the crucible and on the outer surface margins of the mould should be removed.

The crucible should be free from investment residue before placing the casting mould in the furnace.

The mould can now be placed in the preheat furnace with the crucible opening facing downwards.

The four-sided heating of the Magma preheat furnace guarantees uniform, rapid heating of all the moulds.

After casting, allow the mould to cool to room temperature.

**Tip:**
Do not quench hot moulds with cold water, as this causes stresses in the casting and impairs the accuracy of fit of the casting.
To avoid stresses in the CrCo framework, a pneumatic devesting chisel should be used for initial devesting.

Devesting with pliers or a hammer often causes distortion and stresses in the casting.

To avoid inhalation of hazardous quartz dust, castings should be devested in a dust extractor or in a suitable sandblasting unit.

After initial devesting, the CrCo framework can be sandblasted in a fully automatic recycling sandblaster to save time...
... or sandblasted manually, also in a recycling sandblaster.

An abrasive grit size of 250 µm/60 mesh (Al2O3 aluminium oxide) is ideal for sandblasting.

The CrCo framework should be free of investment and oxide after sandblasting.

Separate the sprues approx. 1 mm/0.039 inch from the framework with a fibreglass reinforced cut-off wheel.

The residual sprues can be quickly and efficiently removed and smoothed with an abrasive disc.
The margins of the transversal connector are prepared to a uniform contour with a coarse grit abrasive stone.

**Tip:**
The abrasive stone should not come into contact with the fitting surface of the post dams to ensure suction is maintained.

The non-fitting surface of the margins is also smoothed and tapered thinly with an abrasive stone.

A narrow rotary instrument is used to define the basal margins of the saddle.

This produces a flush junction between the metal and acrylic at a later stage.

Flash is carefully removed from the edges of the clasps with a fine grit rotary instrument.
A tapered tungsten carbide cutter is used for preparing areas that are difficult to access.

Microblows and sharp edges on the fitting surface (basal surface) should be carefully removed with an abrasive stone.

Any metal flash that is not part of the original pattern is also removed.

**POLISHING OPTION**

To reduce the time required for polishing, the entire metal framework is sandblasted with aluminium oxide (125 µm/115 mesh, 3–4 bar) and then electrolytically polished.
The manufacturer’s instructions on electrolytic polishing should be strictly followed to avoid any damage to the CrCo framework. Protective varnish can be applied to sensitive areas (clasp tips).

Fitting the framework

Before fitting the CrCo framework, wax residue should be completely removed from the master model.

Great care should be taken when fitting the CrCo framework to the master model.

High spots between the CrCo framework and the stone are best detected using a liquid marker.

This pinpoints the high spots to be removed.

A fine-grit stone point is used to remove the high spots.
Any casting beads under the rests can be removed with a tapered tungsten carbide cutter.

Accurately fitting upper CrCo framework before preparing the surface.

Accurately fitting lower CrCo framework before preparing the surface.

Polishing

Various types of rubber polishers can be used to ensure that the surface is properly prepolished.
The polishers can be easily trimmed to the required shape with a dressing stone.

The Polisoft A polishing wheel is ideal for prepolishing the finishing margins of the non-fitting surface of the palatal plate.

The polishing wheel is also used for prepolishing the non-fitting surfaces of the clasps.

The finishing margins of the palatal base and the non-fitting surfaces of the clasps are prepared with a rubber polishing cylinder to produce a higher polish.
The surface is prepolished with a Polisoft rubber polishing cylinder without applying excessive pressure.

The stippled surface is also prepolished with a rubber polishing cylinder using light pressure. Ensure that the stippling is preserved when prepolishing.

The shape of the rubber polishing cylinder is customized with the dressing stone for areas that are difficult to access.

The CrCo framework is polished to a high lustre on the polishing motor with a special brush for CrCo and Saphir polishing paste.
A narrow brush can be used for areas that are difficult to access.

A pleated buff made from fine cotton and green high-lustre polishing paste are used to produce a high-lustre finish.

Caution:
Hold the CrCo framework securely. Polishing brushes can easily become caught in the clasps.

Finished upper CrCo framework with clasps.

Finished lower CrCo framework with clasps.
We recommend using the Kennedy classification to facilitate model planning.

**Class I:**
Bilateral shortened dentition (free-end saddles).
2 support points (rests)

**Class II:**
Unilateral shortened dentition (free-end saddle).
3 support points (rests)

**Class III:**
Bilateral bounded saddle partially edentulous
4 support points (rests)

**Class IV:**
Crossing the midline, anterior bounded saddle partially edentulous.
4 support points (rests)
A skeletal framework is an option for anterior saddles (Cl. IV), possibly in combination with small bounded saddles in the posterior region.

A full plate is used if there is very little residual dentition. A large support surface prevents the denture sinking into the mucosa and undesired leverage.

A transversal connector is recommended with free-end saddles (Cl. I + II) and/or posterior bounded saddles (Cl. III).

A horseshoe plate is often used with anterior saddles (Cl. IV) in combination with a free-end saddle or posterior bounded saddle and also with V-shaped palates.
The statics of the framework alters with a reduced dentition. A well-planned design ensures stable positioning and compensation of the forces.

The axis of rotation, work arm and lever arm should be taken into account in the design.

**Axis of rotation:**

The axis of rotation connects the support points around which the denture pivots when loaded.
**Lever arm:**

The lever arm counteracts the tensile forces of the work arm. It runs from the axis of rotation at right angles to the furthest placed clasp tip.

**Work arm:**

The work arm transfers the leverage to the axis of rotation. It runs from the axis of rotation at right angles to the distal of the denture teeth.
**Class I:**

The forces applied in this case have to be supported by a wide base (snowshoe principle). (Rests are placed away from the saddle.)

**Class II:**

The longer the work arm, the greater the force that is applied to the premolar clasp tips. (Rests are placed away from the saddle.)

**Class III:**

If the support points are connected (thrust-lines), it produces a geometric area. Denture sections placed within this area are stable. (Rests are placed next to the saddle.)

**Class IV:**

With an anterior saddle the work arm runs from the axis of rotation to the outer edge of the dental arch. The clasp retention should be placed as far dorsally as possible (long lever arm).
The components of a cast clasp:

A Retention arm
B Support arm/Reciprocal arm
C Clasp shoulder
D Clasp rest
E Minor connector

Double arm clasps:

This is the type of clasp most commonly used. The rest can either be placed next to the saddle (E-clasp) ...

... or away from the saddle (G-clasp).
**Bonwill clasp:**
This clasp provides excellent retention. There should, however, be adequate space to allow for the opposing dentition.

**Ring clasps:**
These are frequently used with distal molars in the lower jaw.

**Bonyhard clasp:**
This type of clasp is mainly used if the arm of a double arm clasp would be visible (e.g. canine).
A palatal plate extending dorsally relieves the abutment teeth. The palatal metal backing design of 11 to 22 was required in this case due to a lack of space. The distal rest on 13 and the continuous clasp on 23 and 24 also relieve the free-end saddle.

Upper CrCo framework with large surface area support of the palatal plate. Placing a metal backing palatally (12; 22) is recommended when replacing single anterior teeth. The distal rests on 11 and 21 prevent the framework sinking into the mucosa. A continuous clasp was placed on 23 and 24 to relieve the free-end saddle.

The transversal connector can have a very slimline design in this case. The E-clasps on 14 and 17 provide excellent stability.
The excellent periodontal support allows a skeletal palatal plate design in this case. The occlusal surfaces of 14 and 15, the teeth to be replaced, were fabricated in metal due to a lack of space.

This is an unfavourable situation with regard to stability. Rests are placed mesially and distally on 33 and 43 to prevent the free-end saddle and the anterior bounded saddle sinking into the mucosa. Additional pin retention was placed to support the anterior teeth to be replaced.

It would have been preferable to place clasps on 33 and 43. Clasps were not, however, placed on these teeth for aesthetic reasons. Mesial and distal rests were placed on teeth 34 and 44 to improve stability.

The double arm clasp on 45 was extended mesially onto 44, as there was not sufficient retention. The Bonwill clasp on 35 and 36 ensures excellent stability.
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2.5 kg, art. no. 652-2500
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<th><strong>Instruments</strong></th>
<th><strong>Universal instrument</strong></th>
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| ![Universal instrument](image) | The high-quality instrument with clamp and 5 different inserts can be used in many aspects of dental technology.  
1 handle with 1 wide blade,  
1 smooth blade, 1 serrated blade,  
art. no. 1030-1000 |

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<th><strong>Sakura marking pen</strong></th>
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<td><strong>Sakura marking pen</strong></td>
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### GEO Casting Wax
Self-adhesive preparation wax for hollowing acrylic saddles.

- 0.3 mm, 32 pieces, art. no. 445-3003
- 0.4 mm, 32 pieces, art. no. 445-3004
- 0.5 mm, 32 pieces, art. no. 445-3005
- 0.6 mm, 32 pieces, art. no. 445-3006

### GEO lingual bars
Wax profiles for fabrication of lingual bars.

- 4 × 2 mm, approx. 65 g, art. no. 667-3042

### GEO clasps

- Normal, art. no. 688-30xx
- self-adhesive, art. no. 638-30xx

### GEO round-hole mesh
Hole diameter 2.0 mm. High stability to pressure, easily shaped.

- Normal, 20 pieces: art. no. 688-3009
- self-adhesive, 20 pieces: art. no. 638-3009
### GEO casting wax fine/coarse stippled

Turquoise-transparent sheet wax with fine and coarse surface structure in sheet thicknesses 0.3 to 0.6 mm.

- **fine 0.30–0.60 mm**, art. no. 641-30xx
- **coarse 0.30–0.60 mm**, art. no. 643-30xx

### GEO wax wire in rods

Wax profile for shaping marginal ridges or individual retentions. Easy deformation of wax with high pressure stability and low restoring force.

- 0.6–1.2 mm, art. no. 668-30xx

### GEO wax wire

With its special wax mixture GEO wax wire is tension-free and does not develop restoring forces.

- **turquoise, hard, 2.0–5.0 mm**: art. no. 676-20xx
- **blue, medium-hard, 2.0–5.0 mm**: art. no. 678-30

### GEO Waxfinish

For an even, smooth wax surface that makes subsequent finishing and polishing much easier.

Set with 15 ml lacquer and 30 ml thinner:
- art. no. 1553-0000
### Other accessories

<table>
<thead>
<tr>
<th>Glass-fibre-reinforced cutting discs</th>
<th>Grinding discs</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-quality and wear-resistant. Particularly good cutting performance with extreme break resistance. For separating casting sprues and processing model cast frameworks.</td>
<td>Ideal for processing cobalt-chromium frameworks with very aggressive grinding properties. The discs can be used very effectively with the fast grinder (e.g. <em>Demco</em>).</td>
</tr>
<tr>
<td>40 mm, 25 pieces, art. no. 59-1040</td>
<td>Ø 25 × 3 mm, 100 pieces:</td>
</tr>
<tr>
<td>22 mm, 25 pieces, art. no. 59-1022</td>
<td>art. no. 612-2000</td>
</tr>
<tr>
<td></td>
<td>Ø 35 × 3 mm, 100 pieces:</td>
</tr>
<tr>
<td></td>
<td>art. no. 615-2000</td>
</tr>
</tbody>
</table>

### Casting funnels

Prefabricated acrylic funnels for producing the casting funnel when investing models.

150 pieces, art. no. 1747-0000
## Other accessories

### Polisoft A
For soft polishing and strong smoothing of harder alloys. Finishing striations are removed and a matt lustre is produced on the surface.

50 pieces, art. no. 90-0000

### Polisoft cylinder
For soft polishing and strong smoothing of harder alloys. Generates a matt lustre and condenses the surface.

- Small, 12 pieces, art. no. 93-1000
- Large, 12 pieces, art. no. 93-2000

### Electrolyte
Liquid for electrolytic polishing of model frameworks. Special additives save time and increase effectiveness.

- 2 l, art. no. 1524-1000
- 10 l, art. no. 1524-2000

### Special brush for model casting
Particularly suitable for polishing cobalt-chrome frameworks with polishing paste.

- 12 pieces, art. no. 199-1000
- 100 pieces, art. no. 199-2000
**Other accessories**

**Slender brush**

The classical brush for polishing cobalt-chrome or hard precious-metal alloys with the polishing unit.

12 pieces, art. no. 787-1000

**Pleated buff of fine nettle cloth**

Ideal for high-lustre polishing of metals with polishing paste.

4 pieces, art. no. 210-0002

**Pico-Mark**

Quickly identify trouble spots on the contact area. Particularly suitable for systematic grinding of occlusal equilibration and for fitting all types of casting objects.

Set with 12 ml red varnish and 30 ml thinner:

art. no. 1934-0000

white varnish, 12 ml, art. no. 1934-0200
Service

3-year warranty on all equipment
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