MATHYS
European Orthopaedics

## Surgical technique

# Modular Revision Stem

*Preservation in motion*

*Building on our heritage*
*Moving technology forward*
*Step by step with our clinical partners*
*Towards a goal of preserving mobility*

# ***Preservation** in motion*

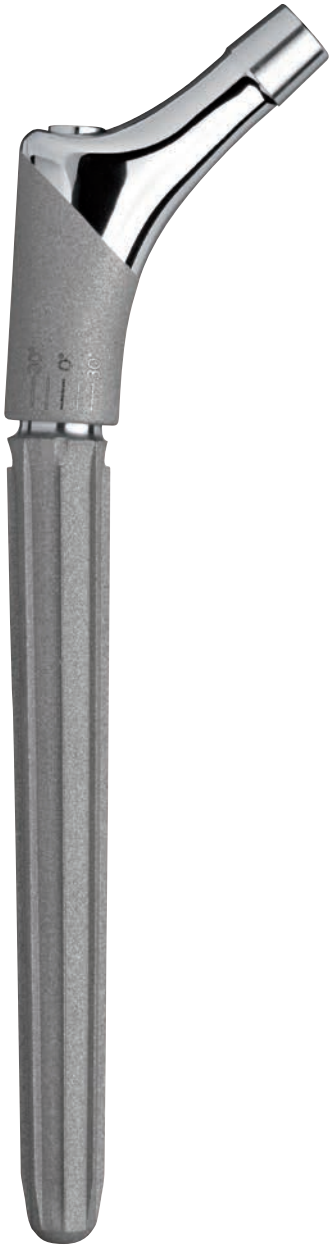
*As a Swiss company, Mathys is committed to this guiding principle and pursues a product portfolio with the goal of further developing traditional philosophies with respect to materials or design in order to address existing clinical challenges. This is reflected in our imagery: traditional Swiss activities in conjunction with continuously evolving sporting equipment.*

# Table of contents



**Remarks**
Please make yourself familiar with the handling of the instruments, the product-related surgical technique and the warnings, the safety notes as well as the recommendations of the instruction leaflet before using an implant manufactured by Mathys Ltd Bettlach. It is absolutely necessary to adhere to the training plan and surgical technique specified by Mathys.

# Introduction



The Modular Revision Stem is made up of a coupled stem and neck system used for revision surgery of uncemented and cemented femoral implants. The philosophy of this implant system goes back to the proven Wagner cone stem. It is particularly intended to be used in revision cases containing a significant bone loss and/or an abnormal metaphyseal anatomy of the femur.

The aim of the modular revision system is to offer primary stable fixation of the stem component as well as the possibility of an intraoperative variation or adaptation of the femoral length, femoral ante-and retroversion, the neck length and the mediolateral offset, which can be reached based on the variable combinations of the modular components. A press-fit at the implant-bone interface allows for good primary stability of the Modular Revision Stem that is anchored in the isthmus femoris.

# 1. Indications and contraindications

**Indications**

- Advanced articular destruction combined with congenital or acquired deformity
- Proximal femoral bone deficiency requiring hip arthroplasty:
  – Fracture (primary fracture in sub-trochanteric region, periprosthetic fracture)
  – Failure of medical devices, after hip prosthesis or osteosynthesis
  – Correction of rotational malalignment, trochanteric osteotomy, dysplasia

**Contraindications**

- Presence of factors jeopardising stable anchoring of the implant in the diaphysis:
  – Insufficient bone substance and/or poor bone quality
  – Lack of rotational and/or subsidence stability
  – Diameter of medullary canal exceeding largest available implant diameter
- Presence of factors preventing osseointegration:
  – Irradiated bone (exception: preoperative irradiation for ossification prophylaxis)
  – Devascularisation
- Lack of osseous support at the modular implant interface including proximal femur resection
- Congenital or acquired deformity including small inner diameter of medullary canal that does not allow for stem insertion and anterior/posterior curvature and femur shape that cannot be corrected
- Presence of further implant hardware at the level of the distal femur
- Local or systemic infection
- Hypersensitivity to any of the materials used
- Severe soft tissue, nerve or vessel insufficiency that could jeopardise the function and long term performance of the implant
- Patients for whom a different type of reconstruction surgery or treatment is likely to be successful

***Attention***
*Patients who are overweight (BMI > 25 kg/m²) or have high activity levels may not be candidates for a modular hip replacement.*

# 2. Preoperative planning

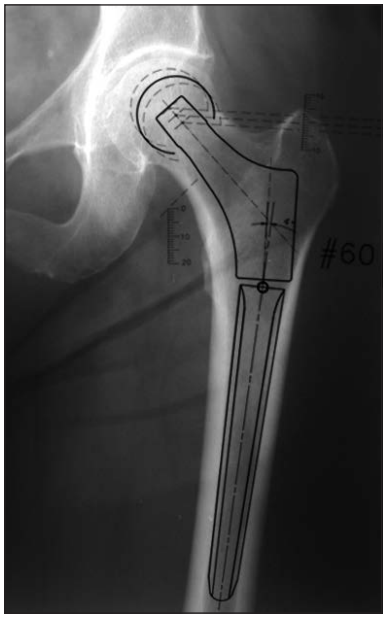



**Fig. 1**

Preoperative planning is of fundamental importance for establishing the length of the implant and the correct stem diameter to be used.

**Stem diameter**
Position the pre-surgical templates on the X-rays of the implant to be replaced so that the fins around the circumference of the stem penetrate into the endosteal cortical bone to a depth of about 1 mm.

**Stem length**
In order to accurately assess how deep the stem should be set into the femur, the preoperative planning should also include a lateral view X-ray of the femur. This way the distal end of the stem can be positioned taking the curvature of the femur inside the medullary canal into account.

It is essential for the distal end of the implant to be positioned in the femur to a depth of at least 70 – 100 mm.

Thus, for optimum fixation by means of fins according to Wagner, **a stem with an even diameter one size larger than the last even diameter reamer used should always be selected**. In any case, use of intermediate (odd-diameter) reamers is suggested for the purpose of minimal calibration in order to achieve better adaptation to the femoral canal when necessary.

**Neck height and offset**
Once the template of the stem is properly positioned on a frontal X-ray, select the appropriate neck size by lining up the tip of the greater trochanter with the center of the femoral head.

When choosing the neck, bear in mind it may be necessary to correct the length of the limb or the lever arm offset.

Decisions made in the planning stage can always be changed during surgery.

If using the trans-femoral approach, it is advisable to measure the length of the stem to be removed accurately (as a rule, X-ray images are magnified by 13 – 15 %, divide the result by 1.13 to 1.15 after measuring the length of the stem).

This measurement will be useful to determine the length of the diaphysectomy, if any (Fig. 1).

# 3. Surgical technique

**Fig. 2**

### 3.1 Reaming the femoral canal

After removing the old stem, and in the event of a transfermoral approach, a cerclage may be applied close to the femoral osteotomy as a precaution in order to avoid accidental longitudinal splitting of the bone (Fig. 2).

**Fig. 3**

Start with a size 12 Reamer. A small diameter facilitates drilling through bone plugs, smoothing out any unevennesses and avoiding taking a wrong direction.

Then change to progressively larger diameter reamers until actually scraping the cortical walls. If possible, X-ray monitoring is suggested.

In the event of a trans-femoral approach, the reamers must drill deep enough to ensure a distal hold of the stem of at least 7 – 10 cm below the window, and such that the distal end of the reamer comes into contact, if possible, with the anatomical curvature of the femur (Fig. 3).

In this position it is possible to assess the size of the stem and modular neck to be used for the final implant.

**As far as the stem diameter is concerned, as a rule choose the next largest even diameter from the last even-sized reamer used, e. g. if the size of the last reamer used was 16 mm, the stem diameter should be 18 mm.**
If penetration of the fins of the stem is hampered by marked trophism of the bone, intermediate sized reamers may be used to finish off preparation of the canal. With reference to the example of a stem diameter of 18 mm, this means using the odd-sized 17 mm reamer.

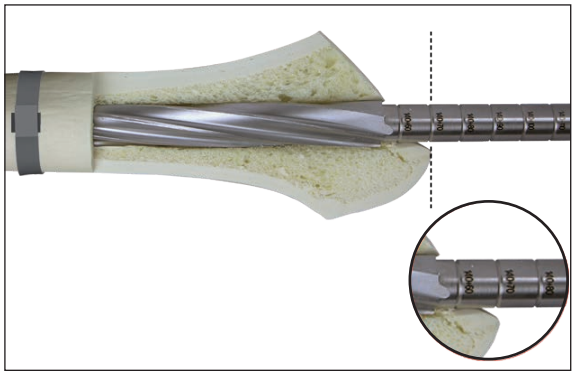


**Fig. 4**

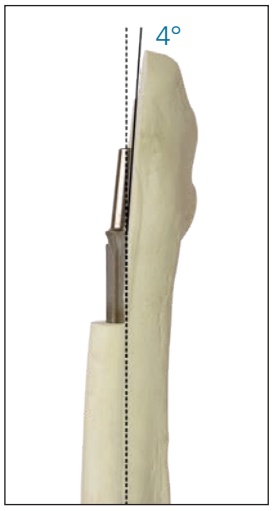



**Fig. 5**

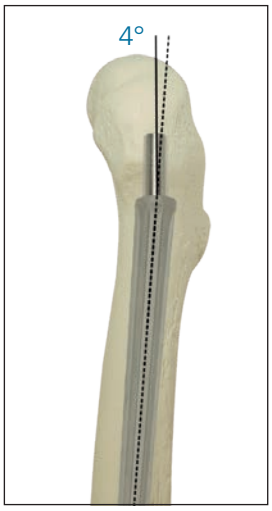



**Fig. 6**

To determine the stem and neck lengths, refer to the marking on the reamer shaft at the height of the greater trochanter (Fig. 4).

Two numbers can be seen at this height. The first refers to the length of the stem and the second to the height of the neck.

For example, a reading of «200+80» means that the 200 mm long stem should be used with an 80 mm high trial neck.

The reamer shaft also provides a useful indication of how to make the best use of the 4° angle of the implant.

If using the trans-femoral approach, the reamer shaft will usually be in an anterior position with respect of the ideal neck axis (Fig. 5) so that the cone will be fitted onto the stem (usually long) with a posterior tilt, thus restoring the ideal neck axis.

If the trans-femoral approach is not used, the shaft of the reamer will normally be in a posterior position in respect of the ideal neck axis so that in this case the cone will be fitted onto the stem (usually short) with an anterior tilt (Fig. 6).

It is of course also possible to place the stem with the neck in a varus or valgus position.

This choice must be made on a case by case basis after comparing the reamer shaft with the shape of the metaphyseal part of the femur.

**Dynamic Impactor**
Item no. 9038.10.100

**Impactor**
Item no. 9038.10.110

**Fig. 7**

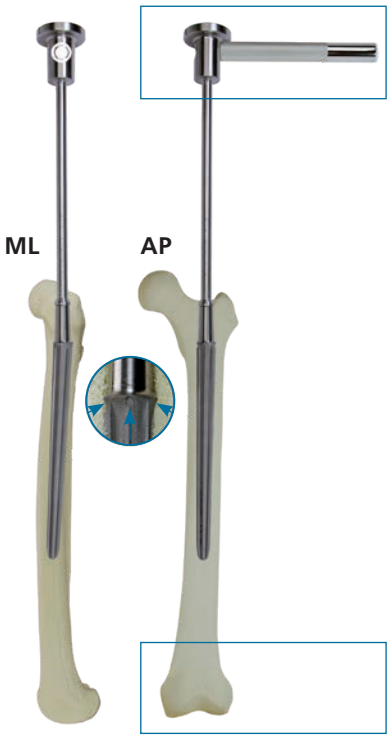



**Fig. 8**

### 3.2 Inserting the stem

Choose a stem with a diameter one size larger than that of the last reamer used (e.g. 18 mm stem following the 16 mm reamer; the stem diameter to be used is marked on the reamer) and remove it from its sterile packaging.

Two different impactors may be used to fit the stem into the diaphyseal canal: a Dynamic Impactor and a normal Impactor (Fig. 7) with a hammer.

Screw the impactor onto the stem.

Use the four grooves at the base of the cone as reference points corresponding to the positions of the stem (depending on its procurvature or antecurvature, or its varus or valgus position) as already described (Figs. 5 and 6).

Push the stem into the diaphyseal canal and strike it into place (Fig. 8).


**Fig. 9**

There is a scale marked on the impactors for determining the depth to which the stem has to be driven in (Fig. 9). The scale shows the neck sizes.

Using the tip of the greater trochanter as a reference point, insert the stem until it reaches the height of the neck, selected during the reaming stage (in our example, 80 mm).

If it is too difficult to introduce the stem, stop short of the planned depth (provided that the chosen neck height is not the minimum height of 50 mm).

The odd-sized reamers can, however, be used to finish the canal so as to enable the stem to be inserted in as required. Considering the example of a size 18 mm stem, the odd-sized 17 mm reamer could be used to correct the size of the cavity in the diaphysis.

If, on the other hand, the stem reaches the preestablished level but does not give the impression of a good hold, seat it in to a deeper level (given the chosen neck height is not the maximum height of 110 mm).

Should you find it to easy to insert the stem – which could be the case in bone trophism – it might be preferable to use a stem with a larger diameter, taking special care when inserting it.

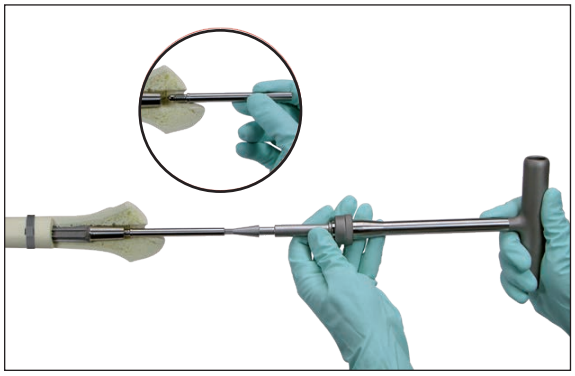


**Fig. 10**

### 3.3 Preparing the neck seating

To prepare the seating for the femoral neck, carry out proximal reaming with the Proximal Reamer.

Screw the Guide for Proximal Reamer tightly into the Morse taper of the stem using the Screw Driver hexagonal fitted with the T-Handle (Fig. 10).

| **Proximal Reamer** | **T-Handle** |
|---|---|
| Item no. 9038.10.120 | Item no. 9095.10.110 |

**Fig. 11**

Fit the T-handle onto the Proximal Reamer and insert the reamer over the guide (Figs. 11 and 12).

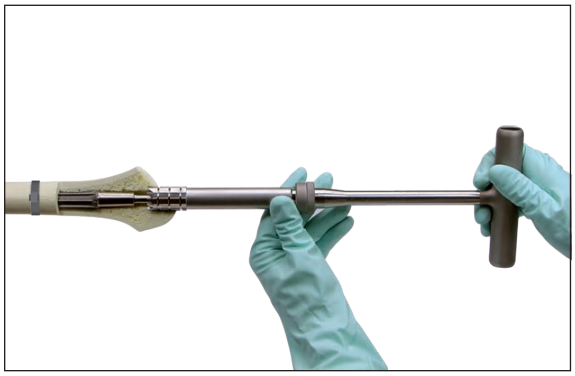


**Fig. 12**

Introduce the reamer into the metaphyseal cavity of the femur by rotating it until the final position is reached.

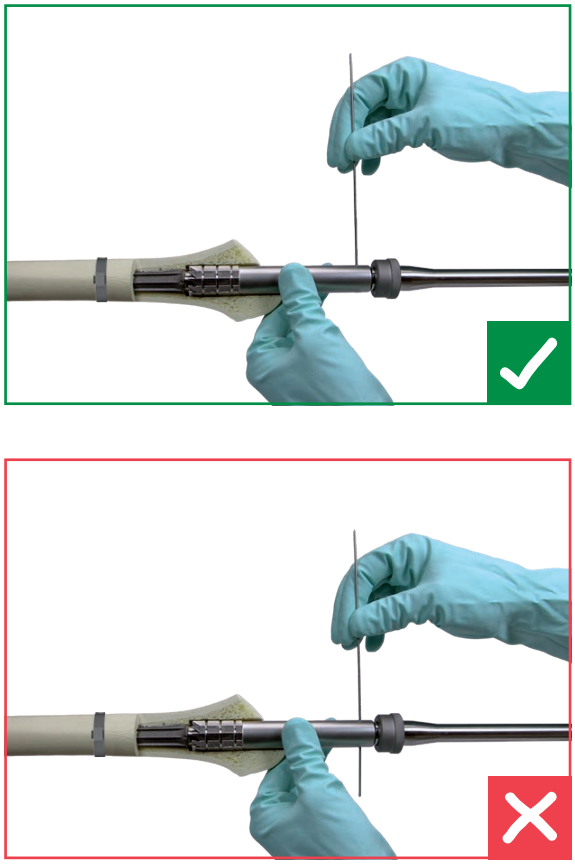


Fig. 13

***Remarks***

*There is an inspection hole in the shaft of the Proximal Reamer to check (with a wire or suture needle) if the Proximal Reamer is at its final position (Fig. 13).*

Then remove Proximal Reamer and Reamer Guide.

**Fig. 14**

### 3.4 Trial reductions

After washing the stem cone thoroughly to remove any bone debris left from the previous stage, fit the Trial Neck with Screw onto it choosing the size that was read previously on the scale of the stem impactor (Fig. 14) and a standard neck with a CCD angle of 135°.

**Fig. 15**

Select the neck anteversion with care; then tighten the locking screw to fix the neck into place, using the Screw Driver hexagonal (Fig. 15).

It is usually unnecessary to use the Neck Stopper at this stage, although you may decide to use it for additional safety.

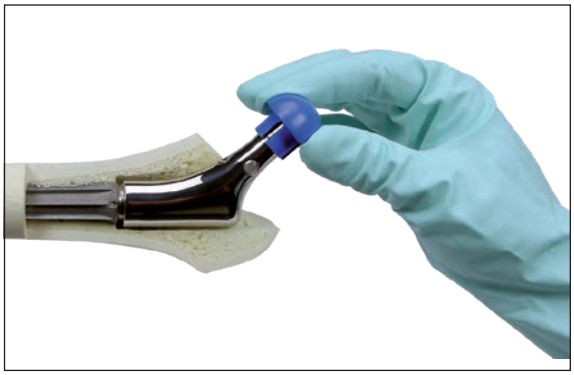


**Fig. 16**

Insert the Trial Head into place and check reduction of the implant (Fig. 16).

If the implant length is not found to be satisfactory with any Trial Head, replace the Trial Neck with one of a different height.

Since the neck heights feature increments of one centimetre each, a correctly sized implant can be achieved easily.

If the height seems to be excessive even using the smallest Trial Neck (50 mm), drive in the stem a little further. If the stem cannot be set in sufficiently, remove it and use the next largest odd-sized reamer to increase the diameter of the cavity.

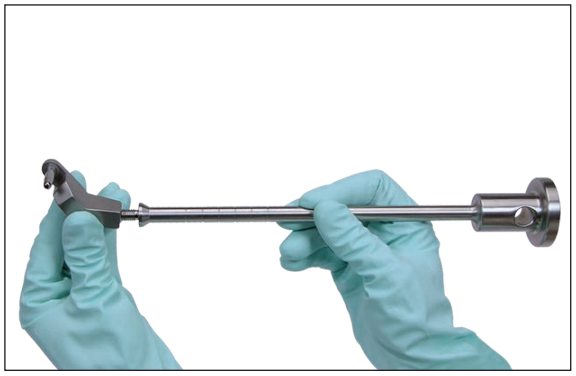


**Fig. 17**

If the neck with a standard offset does not give rise to an adequate joint ratio, remove it and replace it with the lateralised Trial Neck with a CCD angle of 131°.

***Restriction***

1) *Modular necks may be combined only with femoral heads in neck length size S, M and L.*
2) *Modular necks lateral must not be combined with modular stem size 14 (smallest stem size).*

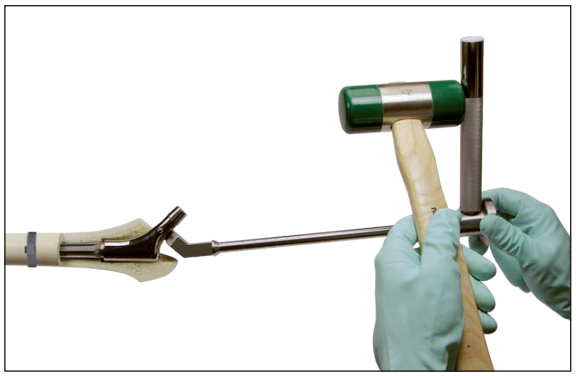


**Fig. 18**

Once the sizes of the head and neck have been selected, remove the trial neck by unscrewing the locking screw.

If it proves to be difficult to remove the trial neck, use the Trial Neck Extractor, screwing it onto the Impactor (Fig. 17), to which the Neck Stopper can be fitted (Fig. 18).

***Remarks***

*The Trial Neck size 50 cannot be removed with the help of the Trial Neck Extractor. The removal of this trial neck size 50 requires a standard extractor. This instrument is not included in the set.*

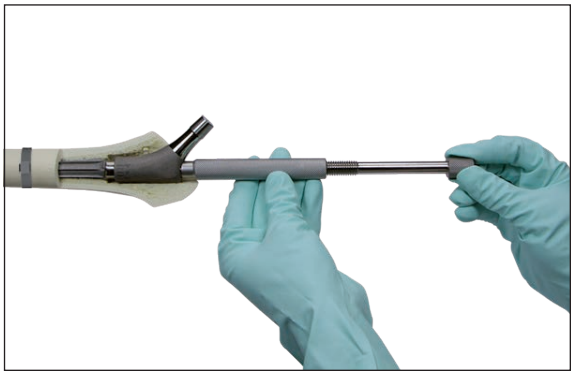


**Fig. 19**

**Fig. 20**

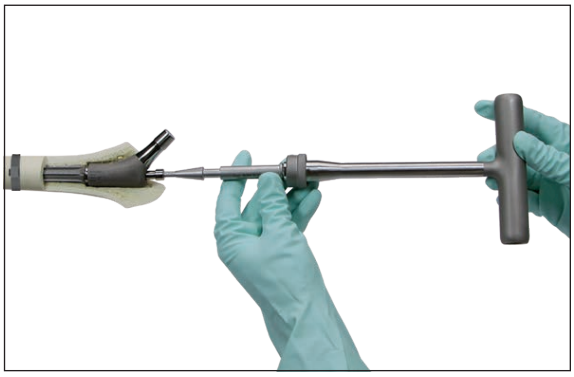


**Fig. 21**

### 3.5 Fitting the final neck

Remove the final neck of the size selected in the previous stage from its sterile packaging. (***Caution!*** The packaging of the neck also contains the locking screw.)

Screw the Neck Impactor/Extractor into the thread on the neck after removing the long coaxial screw (this is used only for removing the neck, if necessary) (Fig. 19).

After washing and drying the stem cone thoroughly, fit the neck onto the stem with the previously chosen anteversion.

***Attention***
*All component coupling surfaces must be clean and dry before assembly.*

Tap the Neck Impactor/Extractor gently along its axis using a hammer to fit the two cones together (Fig. 20).

Then unscrew the Impactor from the neck.

***Remarks***
*The final neck size 50 cannot be set with the help of the Neck Impactor/Extractor. It needs to be positioned by hand.*

***Restriction***
*Modular necks lateral are not allowed to be combined with modular stem size 14 (smallest stem size).*

Now, insert the locking screw into the hole in the neck and tighten with the Screw Driver hexagonal with the T-Handle fitted to it (Fig. 21).

**Fig. 22**

**Fig. 23**

To tighten the screw firmly in place, insert the Neck Stopper into the cone of the neck (Fig. 22).

The combined action of the Screw Driver hexagonal for tightening the screw and of the Neck Stopper will prevent any torque load from being transmitted to the femur.

If a piece of bone was removed in order to use the transfemoral approach, put it back into its original place to close the femoral window, fixing it with a wire cerclage, taking care to avoid direct contact between the wire and the implant.

The cone is then carefully cleaned and dried and the definitive prosthesis head carefully inserted, to avoid complications at the stem/head interface (Fig. 23).

***Restriction***
*Modular necks are only allowed to be combined with femoral heads in neck length size S, M and L.*

**Fig. 24**

### 3.6 Removing the final neck

Should it be necessary to remove the final neck, proceed as follows:

Remove the locking screw using the Screw Driver hexagonal with the T-Handle (including the Neck Stopper).

Screw the Neck Impactor/Extractor tightly onto the neck from where the long screw was removed previously.

Screw the rod into the neck extractor and continue screwing until the rod comes into contact with the stem (Fig. 24).

Keep the Neck Stopper in its proper position during this procedure.

An immediate reduction of the load being transmitted by the Screw Driver hexagonal will be noticed.

At this point, both the stem and the neck are disassembled.

***Remarks***

*The final neck size 50 cannot be removed with the help of the Neck Impactor/Extractor. The removal of this final neck size 50 requires a standard extractor. This instrument is not included in the set.*

# 4. Implants

## 4.1 Modular Revision Stem

***Restriction***

*1) Modular necks may be combined only with femoral heads in neck length size S, M and L.*

*2) Modular necks lateral must not be combined with modular stem size 14 (smallest stem size).*

**Modular Neck with Screw**

| Item no. | Height |
|---|---|
| 52.34.0013 | 50 mm |
| 52.34.0014 | 60 mm |
| 52.34.0015 | 70 mm |
| 52.34.0016 | 80 mm |
| 52.34.0017 | 90 mm |
| 52.34.0018 | 100 mm |
| 52.34.0019 | 110 mm |

**Material:** Ti6Al4V
**Cone:** 12/14 mm

**Modular lat. Neck with Screw**

| Item no. | Height |
|---|---|
| 52.34.0020 | 50 mm |
| 52.34.0021 | 60 mm |
| 52.34.0022 | 70 mm |
| 52.34.0023 | 80 mm |
| 52.34.0024 | 90 mm |
| 52.34.0025 | 100 mm |
| 52.34.0026 | 110 mm |

**Material:** Ti6Al4V
**Cone:** 12/14 mm

**Stem Distal**

| Item no. | Diameter | Length |
|---|---|---|
| 52.34.0001 | 14 mm* | 140 mm |
| 52.34.0002 | 14 mm* | 200 mm |
| 52.34.0003 | 16 mm | 140 mm |
| 52.34.0004 | 16 mm | 200 mm |
| 52.34.0005 | 18 mm | 140 mm |
| 52.34.0006 | 18 mm | 200 mm |
| 52.34.0007 | 20 mm | 140 mm |
| 52.34.0008 | 20 mm | 200 mm |
| 52.34.0009 | 22 mm | 140 mm |
| 52.34.0010 | 22 mm | 200 mm |
| 52.34.0011 | 24 mm | 140 mm |
| 52.34.0012 | 24 mm | 200 mm |

**Material:** Ti6Al4V

* Size 14 stems cannot be combined with lateralizing necks

## 4.2 Femoral Heads

The following femoral head items are intended to be combined with the Modular Revision Stem.

**Stainless Steel**

| Neck | Ø 22.2 mm | Ø 28 mm | Ø 32 mm |
|---|---|---|---|
| S | 54.11.1031 | 2.30.410 | 2.30.400 |
| M | 54.11.1032 | 2.30.411 | 2.30.401 |
| L | 54.11.1033 | 2.30.412 | 2.30.402 |

**Material:** FeCrNiMnMoNbN
**Cone:** 12/14 mm

**CoCrMo**

| Neck | Ø 22.2 mm | Ø 28 mm | Ø 32 mm | Ø 36 mm |
|---|---|---|---|---|
| S | 52.34.0125 | 2.30.010 | 2.30.020 | 52.34.0686 |
| M | 52.34.0126 | 2.30.011 | 2.30.021 | 52.34.0687 |
| L | 52.34.0127 | 2.30.012 | 2.30.022 | 52.34.0688 |

**Material:** CoCrMo
**Cone:** 12/14 mm

### ceramys

| Neck | Ø 28 mm | Ø 32 mm | Ø 36 mm |
|---|---|---|---|
| S | 54.47.0010 | 54.47.0110 | 54.47.0210 |
| M | 54.47.0011 | 54.47.0111 | 54.47.0211 |
| L | 54.47.0012 | 54.47.0112 | 54.47.0212 |

**Material:** $ZrO_2$ – $Al_2O_3$
**Cone:** 12/14 mm

### symarec

| Neck | Ø 28 mm | Ø 32 mm | Ø 36 mm |
|---|---|---|---|
| S | 54.48.0010 | 54.48.0110 | 54.48.0210 |
| M | 54.48.0011 | 54.48.0111 | 54.48.0211 |
| L | 54.48.0012 | 54.48.0112 | 54.48.0212 |

**Material:** $Al_2O_3$ – $ZrO_2$
**Cone:** 12/14 mm

### Bionit2

| Neck | Ø 28 mm | Ø 32 mm | Ø 36 mm |
|---|---|---|---|
| S | 5.30.010L | 5.30.020L | 5.30.030 |
| M | 5.30.011L | 5.30.021L | 5.30.031 |
| L | 5.30.012L | 5.30.022L | 5.30.032 |

**Material:** $Al_2O_3$
**Cone:** 12/14 mm

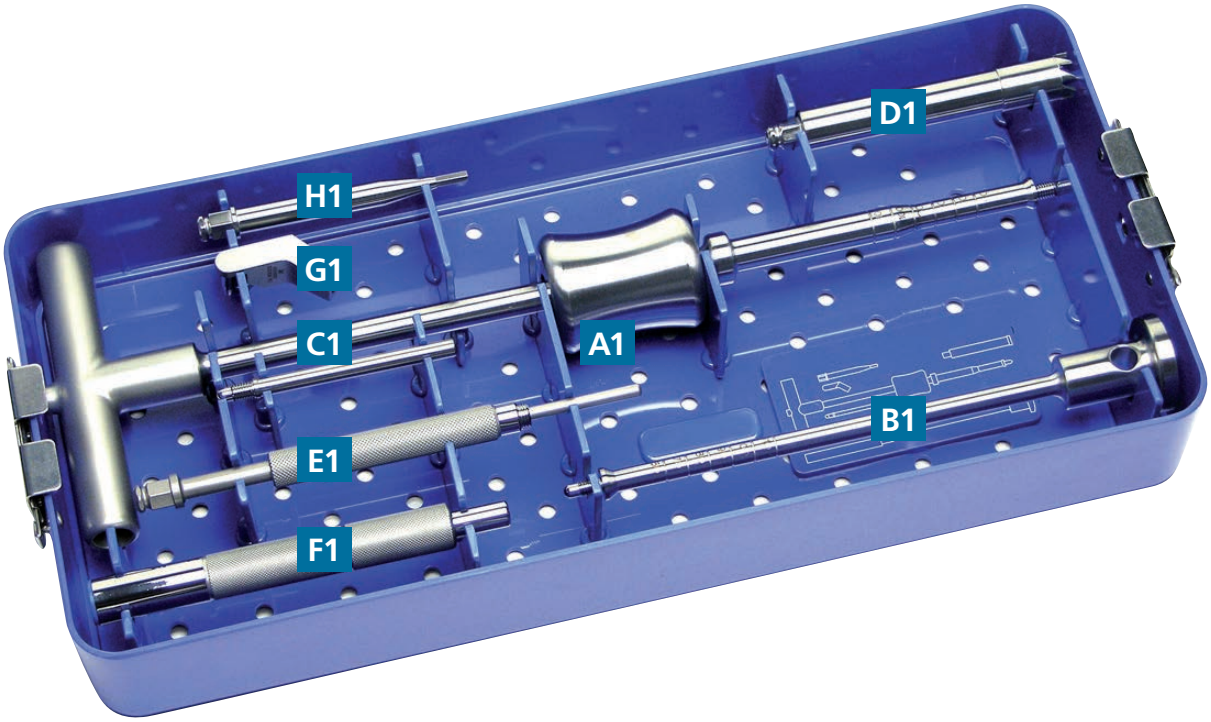
### Revision Head, ceramys

| Neck | Ø 28 mm | Ø 32 mm | Ø 36 mm |
|---|---|---|---|
| S | 54.47.2010 | 54.47.2110 | 54.47.2210 |
| M | 54.47.2020 | 54.47.2120 | 54.47.2220 |
| L | 54.47.2030 | 54.47.2130 | 54.47.2230 |

**Material:** $ZrO_2$ – $Al_2O_3$, Ti6Al4V
**Cone:** 12/14 mm

# 5. Instruments

## 5.1 Modular Revision Stem Instrument Set: Miscellaneous Instruments – 51.34.0024A

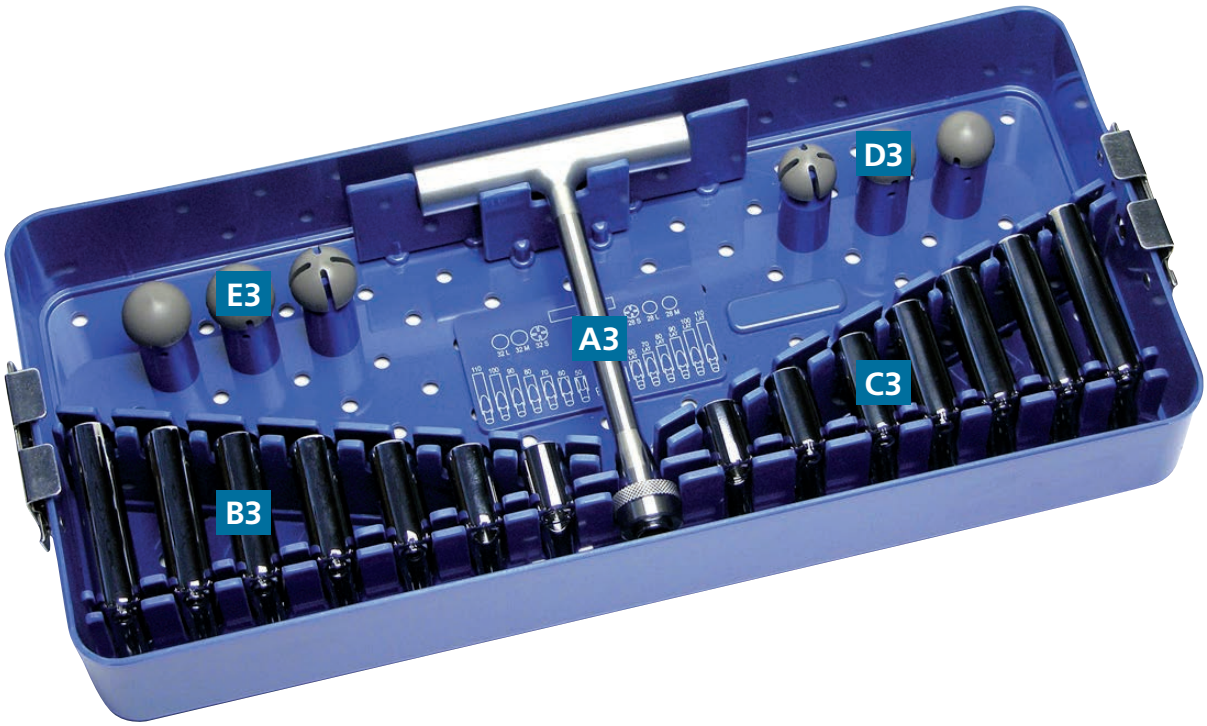



| Item no. | Ref. | Description | Qty. |
|---|---|---|---|
| 9038.10.100 | A1 | Dynamic Impactor | 1 |
| 9038.10.110 | B1 | Impactor | 1 |
| 9038.10.115 | C1 | Guide for Proximal Reamer | 1 |
| 9038.10.120 | D1 | Proximal Reamer | 1 |
| 9038.10.230 | E1 | Neck Impactor/Extractor | 1 |
| 9038.10.240 | F1 | Neck Stopper | 1 |
| 9038.10.250 | G1 | Trial Neck Extractor | 1 |
| 9095.10.117 | H1 | Screw Driver hexagonal | 1 |
| 51.34.0027 | | Tray f/misc. Modular Revision Stem instruments | 1 |
| 51.34.0028 | | Tray Lid f/Modular Revision Stem | 1 |

## 5.2 Modular Revision Stem Instrument Set: Reamer – 51.34.0022A

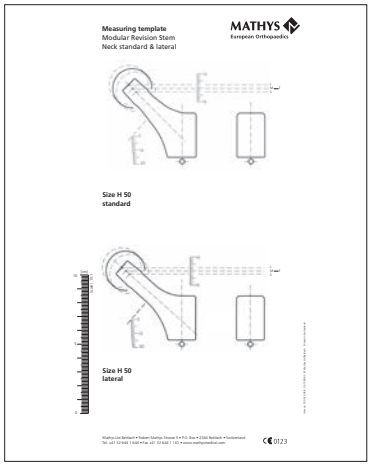

| Item no. | Ref. | Description | Qty. |
|---|---|---|---|
| 9038.10.010 | A2 | Reamer 12 mm | 1 |
| 9038.10.015 | A2 | Reamer 13 mm | 1 |
| 9038.10.020 | A2 | Reamer 14 mm | 1 |
| 9038.10.025 | A2 | Reamer 15 mm | 1 |
| 9038.10.030 | A2 | Reamer 16 mm | 1 |
| 9038.10.035 | A2 | Reamer 17 mm | 1 |
| 9038.10.040 | A2 | Reamer 18 mm | 1 |
| 9038.10.045 | A2 | Reamer 19 mm | 1 |
| 9038.10.050 | A2 | Reamer 20 mm | 1 |
| 9038.10.055 | A2 | Reamer 21 mm | 1 |
| 9038.10.060 | A2 | Reamer 22 mm | 1 |
| 9038.10.065 | A2 | Reamer 23 mm | 1 |
| 51.34.0025 | | Tray f/Modular Revision Stem Reamers | 1 |
| 51.34.0028 | | Tray lid f/Modular Revision Stem | 1 |

## 5.3 Modular Revision Stem Instrument Set: Trial Necks – 51.34.0023A

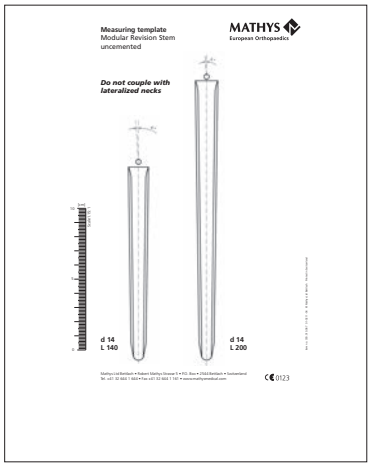



| Item no. | Ref. | Description | Qty. |
|---|---|---|---|
| 9095.10.110 | A3 | T-Handle | 1 |
| 9038.10.150 | B3 | Trial Neck with Screw 50 | 1 |
| 9038.10.160 | B3 | Trial Neck with Screw 60 | 1 |
| 9038.10.170 | B3 | Trial Neck with Screw 70 | 1 |
| 9038.10.180 | B3 | Trial Neck with Screw 80 | 1 |
| 9038.10.190 | B3 | Trial Neck with Screw 90 | 1 |
| 9038.10.200 | B3 | Trial Neck with Screw 100 | 1 |
| 9038.10.210 | B3 | Trial Neck with Screw 110 | 1 |
| 9038.10.310 | C3 | Trial Neck lat. with Screw 50 | 1 |
| 9038.10.320 | C3 | Trial Neck lat. with Screw 60 | 1 |
| 9038.10.330 | C3 | Trial Neck lat. with Screw 70 | 1 |
| 9038.10.340 | C3 | Trial Neck lat. with Screw 80 | 1 |
| 9038.10.350 | C3 | Trial Neck lat. with Screw 90 | 1 |
| 9038.10.360 | C3 | Trial Neck lat. with Screw 100 | 1 |
| 9038.10.370 | C3 | Trial Neck lat. with Screw 110 | 1 |
| 9095.10.511 | D3 | Trial Head 28 S | 1 |
| 9095.10.512 | D3 | Trial Head 28 M | 1 |
| 9095.10.513 | D3 | Trial Head 28 L | 1 |
| 9095.10.521 | E3 | Trial Head 32 S | 1 |
| 9095.10.522 | E3 | Trial Head 32 M | 1 |
| 9095.10.523 | E3 | Trial Head 32 L | 1 |
| 51.34.0026 | | Tray f/Modular Revision Stem Trial Necks | 1 |
| 51.34.0028 | | Tray Lid f/Modular Revision Stem | 1 |

# 5.4 Measuring Template




| Item no. | Description |
|---|---|
| 330.010.068 | Modular Revision Stem Neck standard & lateral |




| Item no. | Description |
|---|---|
| 330.010.067 | Modular Revision Stem uncemented |

# 6. Symbols


Manufacturer


Correct


Incorrect


Caution

# Notes

MATHYS
European Orthopaedics


**Australia**
Mathys Orthopaedics Pty Ltd
Lane Cove West, NSW 2066
Tel: +61 2 9417 9200
info.au@mathysmedical.com

**Austria**
Mathys Orthopädie GmbH
2351 Wiener Neudorf
Tel: +43 2236 860 999
info.at@mathysmedical.com

**Belgium**
Mathys Orthopaedics Belux N.V.-S.A.
3001 Leuven
Tel: +32 16 38 81 20
info.be@mathysmedical.com

**France**
Mathys Orthopédie S.A.S
63360 Gerzat
Tel: +33 4 73 23 95 95
info.fr@mathysmedical.com

**Germany**
Mathys Orthopädie GmbH
«Centre of Excellence Sales» Bochum
44809 Bochum
Tel: +49 234 588 59 0
sales.de@mathysmedical.com

«Centre of Excellence Ceramics» Mörsdorf
07646 Mörsdorf/Thür.
Tel: +49 364 284 94 0
info.de@mathysmedical.com

«Centre of Excellence Production» Hermsdorf
07629 Hermsdorf
Tel: +49 364 284 94 110
info.de@mathysmedical.com

**Italy**
Mathys Ortopedia S.r.l.
20141 Milan
Tel: +39 02 5354 2305
info.it@mathysmedical.com

**Japan**
Mathys KK
Tokyo 108-0075
Tel: +81 3 3474 6900
info.jp@mathysmedical.com

**New Zealand**
Mathys Ltd.
Auckland
Tel: +64 9 478 39 00
info.nz@mathysmedical.com

**Netherlands**
Mathys Orthopaedics B.V.
3001 Leuven
Tel: +31 88 1300 500
info.nl@mathysmedical.com

**P. R. China**
Mathys (Shanghai) Medical Device Trading Co., Ltd
Shanghai, 200041
Tel: +86 21 6170 2655
info.cn@mathysmedical.com

**Switzerland**
Mathys (Schweiz) GmbH
2544 Bettlach
Tel: +41 32 644 1 458
info@mathysmedical.com

**United Kingdom**
Mathys Orthopaedics Ltd
Alton, Hampshire GU34 2QL
Tel: +44 8450 580 938
info.uk@mathysmedical.com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