Expert Nailing System

Titanium Cannulated Humeral Nail

Surgical Technique
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**MR Information**
The Titanium Cannulated Humeral EXPERT NAIL® System has not been evaluated for safety and compatibility in the MR environment. It has not been tested for heating, migration or image artifact in the MR environment. The safety of the Titanium Cannulated Humeral EXPERT NAIL® System in the MR environment is unknown. Scanning a patient who has this device may result in patient injury.
The DePuy Synthes Humeral Nail–EX System permits intramedullary fixation of fractures of the humerus with either an antegrade or retrograde approach. The system features a series of cannulated nails, spiral blades, end caps and locking screws. All of the implants in the Humeral Nail–EX System are made of titanium alloy.*

The system consists of two titanium cannulated nail families: the Humeral Nail–EX and the Proximal Humeral Nail–EX.

**Humeral Nail–EX features**
- Universal design for right or left humerus, antegrade or retrograde insertion
- Cannulated with a round cross section
- Available in 7.0 mm, 9.0 mm and 11.0 mm shaft diameters with proximal ends of 9.0 mm, 9.0 mm and 11.0 mm, respectively
- Lengths from 190 mm to 320 mm in 10 mm increments
- Spiral blade, standard, and compression locking options
- 5° bend located 55 mm from the proximal end allows an off-axis entry site to help minimize damage to the articular surface
- Distal locking holes are angled 22.5° from each other for stable, multiplanar fixation anterolaterally, anteromedially and/or AP, and to reduce the possibility of skiving on the lateral supracondylar ridge. The use of two distal holes will minimize toggle of the nail’s distal end.

**Spiral Blades**
- Cutting flutes on front edges, and smooth surfaces along the length facilitate insertion through cortical and cancellous bone
- Avoids penetration of the medial cortex and risk to adjacent neurovascular structures
- Increased surface area helps minimize strain on trabecular bone
- Provides a fixed-angle construct when locked with an end cap
- Humeral shaft and head are reconstructed with minimal soft tissue stripping
- Proximal locking position avoids the axillary nerve
- Four 2.25 mm suture holes around the periphery of the spiral blade head accommodate suture needles up to 2.0 mm, and provide multiple suture anchoring sites for soft tissue reconstruction and fixation of small osseous fragments
- 13.0 mm head diameter provides a positive stop against the outer cortex
- Lengths from 34 mm to 54 mm in 2 mm increments for precise placement near subchondral bone

* Titanium-6% aluminum-7% niobium
Titanium Cannulated Humeral EXPERT NAIL® System

**Proximal Humeral Nail–EX features**
- Universal design for right or left humerus, antegrade insertion
- Cannulated with a round cross section
- Available in 7.0 mm, 9.0 mm and 11.0 mm midshaft diameters with proximal ends of 9.0 mm, 9.0 mm and 11.0 mm, respectively
- 150 mm length
- Spiral blade and standard locking options
- 5° bend located 55 mm from the proximal end allows an off-axis entry site to minimize damage to the articular surface
- Distal taper design dampens stress from the tip of the nail to the humeral shaft
- Distal locking holes permit locking through a safe anatomic window between the axillary and radial nerves
- Controlled distal targeting through the aiming arms

**End Caps (gold)**
- Secure Spiral Blade for Humeral Nail–EX in nail slot, creating a fixed-angle construct
- Protect nail threads from tissue ingrowth
- 0 mm, 5 mm, 10 mm and 15 mm extensions
- Nail height can be extended by 5 mm, 10 mm, or 15 mm if the nail is overinserted
- T25 StarDrive™ Recess
- Compatible with spiral blades and locking screws

**Nonlocking End Cap for locking screws only (blue)**
- Protect nail threads from tissue ingrowth
- 0 mm, 5 mm, 10 mm and 15 mm extensions
- Nail height can be extended by 5 mm, 10 mm, or 15 mm if the nail is overinserted
- T25 StarDrive Recess
- Available sterile only

*Also available
In 1958, the AO formulated four basic principles, which have become the guidelines for internal fixation.\cite{1,2}

**Anatomic reduction**
Fracture reduction and fixation to restore anatomical relationships.

**Stable fixation**
Fracture fixation providing absolute or relative stability, as required by the patient, the injury, and the personality of the fracture.

**Early, active mobilization**
Early and safe mobilization and rehabilitation of the injured part and the patient as a whole.

**Preservation of blood supply**
Preservation of the blood supply to soft tissues and bone by gentle reduction techniques and careful handling.

Indications

The Titanium Cannulated Humeral Nail–EX is indicated to aid in the alignment and stabilization of humeral fractures, including:

– Diaphyseal fractures of the humeral shaft
– Proximal humeral fractures with diaphyseal extension
– Impending pathologic fractures
Case 1—Antegrade insertion of Cannulated Humeral Nail–EX
For fractures of the humeral shaft, the Humeral Nail–EX may be inserted antegrade using one of three locking configurations.

Preoperative  Postoperative  Postoperative
Case 2—Retrograde insertion of Cannulated Humeral Nail–EX
For fractures of the mid- to proximal humeral shaft, the Humeral Nail–EX may be inserted retrograde using one of two locking configurations.
Case 3—Antegrade insertion of Cannulated Proximal Humeral Nail–EX
For fractures of the proximal humerus, the Proximal Humeral Nail–EX may be inserted antegrade using one of two locking configurations.
Antegrade Nail Insertion—Preoperative Planning

Use the preoperative planner template to estimate nail diameter, nail length and spiral blade length.

To estimate nail diameter, place the template on the AP or lateral x-ray of the uninjured humerus and measure the diameter of the medullary canal at the narrowest part that will contain the nail.

To estimate nail length, place the template on the AP or lateral x-ray of the uninjured humerus and select a nail length that ends 1 cm distal to the superior edge of the articular surface and at least 2.5 cm proximal to the superior edge of the olecranon fossa.

To estimate spiral blade length, place the template on the AP x-ray of the uninjured humeral head and select a spiral blade length that ends 5 mm from the articular surface.

When selecting implant size, consider canal diameter, fracture pattern, patient anatomy and postoperative protocol.

**Note:** Templates are available in two sizes: actual size and 115% magnification, in which the image is enlarged 15% to correspond to typical radiographic magnification; however, variations in magnification levels are common.
Antegrade Nail Insertion—Opening the Proximal Humerus

1  
Position patient

Position the patient in a modified lateral position on a completely radiolucent OR table. Position the C-arm to enable visualization of the entire humerus in the AP and lateral planes. Place the C-arm opposite the surgeon, perpendicular to the longitudinal axis of the humeral shaft in the AP view.

Obtain a scapular “Y” lateral view by bringing the C-arm through a 90° arc and projecting the beam directly at the glenoid.

C-arm in position for AP view.

C-arm in position for scapular “Y” lateral view.

Scapular “Y” lateral view.
2

Confirm nail length

Instrument

03.010.022 Radiographic Ruler

If a Titanium Cannulated Humeral Nail–EX is indicated during preoperative planning, position the C-arm to view the proximal humerus. When measuring the fractured humerus, apply gentle traction to restore length.

With long forceps, hold the radiographic ruler along the humerus, with the top approximately 1 cm distal to the superior edge of the articular surface. Mark the skin at the top of the ruler.

Move the C-arm to the distal humerus. Take an AP or lateral image of the distal humerus. Verify fracture reduction.

Place the proximal end of the ruler at the skin mark. Read the nail length directly from the ruler image, selecting the measurement that is at least 2.5 cm proximal to the superior edge of the olecranon fossa.
Confirm nail diameter

Instrument

03.010.023 Radiographic Canal Width Estimator

Position the C-arm and hold the radiographic canal width estimator over the humerus with the diameter gauge centered over the narrowest part of the medullary canal that will contain the nail. Read the diameter measurement on the circular indicator that fills the canal.

Note: The ruler is not at the same level as the humerus, which will affect the accuracy of the measurement.
Antegrade Nail Insertion—Opening the Proximal Humerus

4

Identify nail entry point

Instrument

| 292.26 | 2.5 mm Kirschner Wire |

The anterior acromial approach to the proximal humerus is recommended, to help minimize damage to the rotator cuff. The more traditional lateral acromial approach may transect the infraspinatus and teres minor, and it will also position the entry site posterolaterally, resulting in varus displacement of a proximal fragment and the possible fracture of the entry site in a more distal fracture.

Access the entry site through the raphe separating the anterior and middle third of the deltoid.

Insert 2.5 mm K-wires into the humeral head. Maneuver the humeral head using radiographic control, until the sulcus between the greater tuberosity and the margin of the articular cartilage is recognized.

For three- and four-part fractures, reconstruct the humeral head prior to insertion of a guide wire. For a three-part fracture involving the greater tuberosity, consider an open rotator cuff approach. Secure the greater tuberosity fragment with heavy nonabsorbable suture and/or K-wires positioned to reapproximate the fragment. For a four-part fracture, a deltopectoral approach may be more useful.

Precaution: In case of greater tubercle fracture (B Type) use a slightly more medial entry point in order to avoid insertion through the fracture and subsequent lateralization of the shaft to the proximal fragment.

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Antegrade Nail Insertion—Opening the Proximal Humerus

5

Insert guide wire

Instrument

292.26 2.5 mm Kirschner Wire

The insertion point is in line with the medullary canal in the lateral view and at the margin of the articular surface in the AP view. Verify the entry site, incise the supraspinatus longitudinally, and tag the margins with sutures. These sutures will help retract the edges of the supraspinatus during the procedure and assist in reapproximating the supraspinatus during final closure.

Insert another 2.5 mm K-wire through the insertion site and into the medullary canal to the level of the lesser tuberosity.
Open canal

Instruments

<table>
<thead>
<tr>
<th>Instrument Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.038</td>
<td>10.0 mm Protection Sleeve</td>
</tr>
<tr>
<td>03.010.039</td>
<td>10.0 mm Cannulated Awl</td>
</tr>
<tr>
<td>360.05</td>
<td>10.0 mm Cannulated Drill Bit</td>
</tr>
</tbody>
</table>

Pass the 10.0 mm cannulated drill bit over the guide wire and through the 10.0 mm protection sleeve to the bone. Drill to the depth of the medullary canal.

**Precaution:** Take care not to plunge the drill bit into the fracture site since this may displace the fracture.

Remove the drill bit and guide wire.

Dispose of the guide wire. Do not reuse.

Optionally, the 10.0 mm cannulated awl may be used to open the canal or expand the opening created by the drill bit. Place the awl over the guide wire and to the bone. Use a twisting motion to advance the awl.

**Precaution:** As with the drill bit, take care not to plunge the awl into the fracture site since this may displace the fracture.
# Reaming guidelines (optional technique)

## Instruments

<table>
<thead>
<tr>
<th>Instrument Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.093</td>
<td>Reaming Rod Push Rod</td>
</tr>
<tr>
<td>351.706S</td>
<td>2.5 mm Reaming Rod with ball tip</td>
</tr>
</tbody>
</table>

Using image intensification, ensure that fracture reduction has been maintained. Insert the 2.5 mm reaming rod with ball tip into the medullary canal to the desired insertion depth.

Ream to a diameter at least 1.0 mm greater than the nail diameter (see chart below) as determined by surgeon preference. Ream in 0.5 mm increments and advance the reamer with steady, moderate pressure. Do not force the reamer. Partially retract the reamer often to clear debris from the medullary canal.

**Note:** Do not force the reamer. Frequently retract the reamer partially to clear debris from the medullary canal.

Remove the reaming assembly, leaving the reaming rod in place. The 2.5 mm reaming rod can be extracted through the Humeral Nail–EX and the instrumentation. Reaming rod exchange is not required.

**Note:** Flush the surgical site after reaming to remove remaining debris and help minimize the chance of heterotopic ossification.

**Precaution:** Reaming should be avoided in case of comminution in the area where the radial nerve contacts the bone in the sulcus nervus radialis.

Use the additionally available reaming rod push rod to help retain the reaming rod during reamer extraction.

<table>
<thead>
<tr>
<th>Nail diameter midshaft</th>
<th>Nail diameter proximal end</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.0 mm and 9.0 mm</td>
<td>9.0 mm</td>
</tr>
<tr>
<td>11.0 mm</td>
<td>11.0 mm</td>
</tr>
</tbody>
</table>
**Antegraded Nail Insertion—Inserting the Nail**

1. **Assemble insertion instruments**

   **Instruments**
   - 03.010.053 Cannulated Connecting Screw
   - 03.010.054 Insertion Handle
   - 321.16 Combination Wrench, 11 mm

   Orient the insertion handle laterally and match the geometry of the handle to the nail. Pass the cannulated connecting screw through the insertion handle and into the nail. Secure using the 11 mm combination wrench.

   **Note:** Do not attach an aiming arm to the insertion handle until the nail is fully inserted. It may loosen during nail insertion.

   Tighten the cannulated connecting screw using the 11 mm combination wrench.

   Align the nail to the insertion handle and the cannulated connecting screw.

   **Note:** Confirm that the nail is tightly connected to the insertion handle. The 11 mm combination wrench may be used to retighten the connecting screw over the reaming rod as needed. If a reaming rod has been used, it should be removed once the nail has crossed the fracture site.
2

Insert nail

Instruments

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>321.16</td>
<td>Combination Wrench, 11 mm</td>
</tr>
<tr>
<td>321.17</td>
<td>4.5 mm Pin Wrench</td>
</tr>
</tbody>
</table>

Under image intensification, verify fracture reduction and insert the nail as far as possible by hand. Use the nail as a reduction tool while keeping the patient’s elbow steady to counter any distraction forces.

Insert the nail until the proximal end is slightly below the superior surface of the proximal humerus. The nail may be overinserted up to 15 mm, and nail length can be extended with an end cap.

Do not leave the nail proud as this may cause impingement of the rotator cuff.

View nail insertion under image intensification.

**Precaution:** The nail should not be hammered in since this increases the risk of iatrogenic fissures or fractures at the insertion site.

**Note:** Pressure against the elbow when advancing the nail helps prevent diastasis formation and potentially associated healing problems.
Retrograde Nail Insertion—Preoperative Planning

Use the preoperative planner template to estimate nail diameter and nail length.

To estimate nail diameter, place the template on the AP or lateral x-ray of the uninjured humerus and measure the diameter of the medullary canal at the narrowest part that will contain the nail.

To estimate nail length, place the template on the AP or lateral x-ray of the uninjured humerus and select a nail length that ends 2.5 cm proximal to the superior edge of the olecranon fossa and at least 1 cm distal to the lesser tuberosity.

When selecting implant size, consider canal diameter, fracture pattern, patient anatomy and postoperative protocol.

**Note:** Templates are available in two sizes: actual size and 115% magnification, in which the image is enlarged 15% to correspond to typical radiographic magnification; however, variations in magnification levels are common.
1

**Position patient**

Position the patient on a completely radiolucent OR table. Position the C-arm to enable visualization of the entire humerus in the AP and lateral planes. Place the C-arm opposite the surgeon, and perpendicular to the longitudinal axis of the humeral shaft. The elbow should be free to flex 120° to facilitate reduction and permit access to the retrograde insertion site.

For supine positioning, place the patient so the affected arm is draped freely to hang beyond the edge of the table. Flex the elbow and place the patient’s arm across the chest.

Alternatively, place the patient in the lateral decubitus position. With the elbow flexed 45° to 60°, apply manual traction and use gentle manipulation to ensure that the fracture can be reduced before proceeding.
2

Confirm nail length

Instrument

03.010.022 Radiographic Ruler

Position the C-arm to view the distal humerus. When measuring the fractured humerus, apply gentle traction to restore length.

With long forceps, hold the radiographic ruler along the humerus, with the top approximately 2.5 cm proximal to the superior edge of the olecranon fossa. Mark the skin at the top of the ruler.

Move the C-arm to the proximal humerus. Place the top of the ruler at the skin mark, and take an image of the proximal humerus. Verify fracture reduction.

Read the nail length directly from the ruler image, selecting the measurement that is at least 1 cm distal to the lesser tuberosity.
3 Confirm nail diameter

Instrument

03.010.023 Radiographic Canal Width Estimator

Position the C-arm to view the distal humerus. Hold the radiographic canal width estimator over the humerus, with the diameter gauge centered over the medullary canal at the narrowest part that will contain the nail. Read the diameter measurement on the circular indicator that fills the canal.

**Note:** The ruler is not at the same level as the humerus, which will affect the accuracy of the measurement.

4 Identify nail entry point

If traction is not used, flex the elbow approximately 120° and place the arm across the patient’s chest with an assistant holding the arm in this position. Expose the distal humerus with a triceps-splitting incision beginning approximately 1 cm proximal to the olecranon fossa and ending well distal to the spiral groove and radial nerve. Retract the triceps.

Identify the starting point at the superior edge of the olecranon fossa and in line with the axis of the medullary canal.

**Precaution:** Be sure to be exactly at the midline, since an eccentrically insertion point will cause excessive shearing forces during insertion, resulting in fissures or even fractures.
Retrograde Nail Insertion—Opening the Distal Humerus

5
Open canal

| Instrument |  
|------------|---|
| 310.44     | 4.5 mm Drill Bit |

Open the near cortex at the starting point with the 4.5 mm drill bit. Do not penetrate the far cortex.

Continue drilling and progressively lower the drill until the drill bit is in line with the medullary canal in the lateral view.
### Alternative techniques

**Alternative instruments**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>332.062</td>
<td>Router, quick coupling, 130 mm</td>
</tr>
<tr>
<td>358.682</td>
<td>9.5 mm Conical Burr, with quick coupling</td>
</tr>
</tbody>
</table>

Drill three holes perpendicular to the medullary canal, forming a triangle.

Use the router and 9.5 mm conical burr to shape the opening into a “trough” that leads directly into the medullary canal.

Use the router to enlarge the opening.

Use the conical burr to shape the opening.

**Precaution:** The opening of the medullary canal should be opened with great care; otherwise an iatrogenic fracture may easily occur.
5. Open canal continued

The trough must be large enough to accommodate the head of the nail and must be at least 2 cm long by 1 cm wide. Carve away the inner aspect of the posterior cortex, as well as the medial and lateral cortical walls, and create a distal bevel.

Path of the retrograde entry site. Note that undercutting the internal aspect of the posterior cortex is necessary.

Ream, if desired, using the technique shown on page 16.

**Note:** Care should be used when selecting reamer size to avoid damage to the posterior cortex.
Retrograde Nail Insertion—Inserting the Nail

1

Assemble insertion instruments

See “Antegrade Nail Insertion—Inserting the Nail” on page 17.

2

Insert nail

Under image intensification, verify fracture reduction and insert the nail as far as possible by hand. Use the nail as a reduction tool while keeping the patient’s elbow steady to counter any distraction forces.

If the nail does not pass through the insertion site, remove the nail and enlarge the trough with the router or conical burr until the nail can be inserted with relative ease. Forcing a nail through a retrograde insertion site may increase the risk of fracture. Consider the proximity of the radial nerve to the humerus and use a limited open reduction if necessary.

Insert the nail until the end is slightly countersunk beneath the insertion site. The nail may be overinserted up to 15 mm and nail length extended with an end cap.

Do not leave the nail proud because this may cause impingement.

Precautions:
The nail should not be hammered in since this increases the risk of iatrogenic fissures or fractures at the insertion site.

To avoid jeopardizing the trunk or branches of the axillary nerve after the skin incision, the underlying muscle should be prepared by blunt dissection and spread apart carefully.
2. Insert nail continued

**Instruments**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>321.16</td>
<td>Combination Wrench, 11 mm</td>
</tr>
<tr>
<td>321.17</td>
<td>4.5 mm Pin Wrench</td>
</tr>
</tbody>
</table>

**Note:** Confirm that the nail is tightly connected to the insertion handle. The 11 mm combination wrench may be used to retighten the connecting screw over the reaming rod, as needed.

If a reaming rod has been used, it should be removed once the nail has crossed the fracture sight.

Verify proximal positioning of the nail under image intensification.

Continue with Proximal Locking—Standard Locking or Compression Locking.
1

**Confirm fracture reduction**

Confirm fracture reduction with AP and lateral images, keeping the insertion handle oriented laterally.

**Note:** Once reduction is performed, do not move the patient’s arm until locking is completed since it may result in a loss of reduction.

2

**Assemble spiral blade insertion instruments**

<table>
<thead>
<tr>
<th>Instruments</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spiral Blade Aiming Arm</td>
<td>03.010.055</td>
</tr>
<tr>
<td>14.0 mm/8.0 mm Drill Sleeve</td>
<td>03.010.086</td>
</tr>
<tr>
<td>8.0 mm/2.0 mm Wire Guide</td>
<td>03.010.087</td>
</tr>
<tr>
<td>2.0 mm Trocar</td>
<td>03.010.088</td>
</tr>
</tbody>
</table>

Attach the spiral blade aiming arm to the insertion handle. Assemble the 14.0 mm/8.0 mm drill sleeve, 8.0 mm/2.0 mm wire guide and 2.0 mm trocar. Pass the assembly through the hole marked “SPIRAL BLADE” in the spiral blade aiming arm. Create a lateral incision adjacent to the tip of the trocar and bluntly spread the fibers of the deltoid. Bring the sleeves into contact with the bone.

**Precaution:** Only incise the skin and then perform blunt dissection to avoid injuring the axillary nerve and its branches.
3

Insert guide wire

Instrument
03.010.025 2.0 mm Guide Wire

Remove the trocar and insert a 2.0 mm guide wire through the wire guide so that the final placement of the spiral blade tip will be at or slightly below the equator of the humeral head.

4

Measure for spiral blade length

Instrument
03.010.090 Spiral Blade Measuring Device

Advance the guide wire to a position approximately 5 mm from the articular surface of the humeral head. Verify that the position of the guide wire is correct in both AP and lateral views. Confirm that the sleeves are in contact with the bone. Determine the length of the spiral blade by placing the spiral blade measuring device over the guide wire and advancing it until the nose rests against the collar of the drill sleeve. Read the graduation of the spiral blade measuring device at the end of the guide wire.
5

Insert spiral blade

Instruments

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.089</td>
<td>4.5 mm Cannulated Drill Bit</td>
</tr>
<tr>
<td>358.696</td>
<td>Spiral Blade Inserter</td>
</tr>
<tr>
<td>358.697</td>
<td>Spiral Blade Coupling Screw</td>
</tr>
</tbody>
</table>

Remove the wire guide and perforate the lateral cortex using the 4.5 mm cannulated drill bit. Remove the drill sleeve.

Attach the selected spiral blade to the spiral blade inserter using the spiral blade coupling screw.
5. Insert spiral blade continued

**Instrument**

| 03.010.058 Slide/Fixed Hammer |

Pass the cannulated tip of the spiral blade over the guide wire. Advance the spiral blade inserter through the aiming arm and the longitudinal split in the deltoid until the tip of the spiral blade rests in the perforation of the lateral cortex created with the 4.5 mm cannulated drill bit.

The starting orientation of the T-handle of the spiral blade inserter relative to the aiming arm depends on patient anatomy. If the distance from the lateral cortex to the nail is less than 10 mm, start the T-handle slightly clockwise from parallel. If the distance from the lateral cortex to the nail is more than 10 mm, start the T-handle slightly counter-clockwise from parallel.

Advance the spiral blade through the nail, using light, controlled blows of the slide/fixed hammer in a fixed position. Advancement of the spiral blade should be monitored radiographically. If using tension sutures, pause approximately 1.5 cm to 2.0 cm before seating the spiral blade so that the suture ends can be provisionally placed through the suture portals.

**Precaution:** When locking with a spiral blade, an end cap must always be inserted into the nail; otherwise the spiral blade will not be properly secured.
If there is lateral incompetence because of tumor, fracture pattern, or bone loss (gunshot wound, etc), heavy sutures can be placed through the supraspinatus muscle insertion and secured to the fixed-angle spiral blade and help minimize the possibility of fixation failure by lateral translation.

**Notes:**
Failure to secure the spiral blade with an end cap prior to tying the sutures will cause the spiral blade to displace. See “End Cap Insertion” on page 47.

If a 0 mm end cap has been indicated during preoperative planning, refer to the technique for insertion of a 0 mm end cap on page 47.

An optional 4.0 mm titanium locking screw may be used in the proximal transverse locking hole. See “Proximal Locking—Standard Locking” on page 33. This locking screw may be bicortical or unicortical depending upon its placement relative to the articular surface. To insert a transverse locking screw, the spiral blade insertion assembly must be removed.
Confirm fracture reduction

Confirm fracture reduction with AP and lateral images, keeping the insertion handle and aiming arm oriented laterally. Standard proximal locking can be accomplished by locking through the proximal locking hole, and optionally, the superior end of the proximal slot.

Place the arm in neutral rotation to minimize tension on the axillary nerve.

Drill

Instruments

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.060</td>
<td>3.2 mm Three-Fluted Drill Bit</td>
</tr>
<tr>
<td>03.010.063</td>
<td>12.0 mm/8.0 mm Protection Sleeve</td>
</tr>
<tr>
<td>03.010.064</td>
<td>8.0 mm/3.2 mm Drill Sleeve</td>
</tr>
<tr>
<td>03.010.069</td>
<td>3.2 mm Trocar</td>
</tr>
<tr>
<td>03.010.072</td>
<td>Depth Gauge, for Locking Screws</td>
</tr>
<tr>
<td>03.010.091</td>
<td>Standard Aiming Arm</td>
</tr>
</tbody>
</table>

Attach the standard aiming arm to the insertion handle.

To lock through the transverse locking hole, insert the 12.0 mm/8.0 mm protection sleeve, 8.0 mm/3.2 mm drill sleeve and 3.2 mm trocar through the hole in the standard aiming arm marked “STATIC.” Dimple the skin with the trocar tip. Slightly retract the trocar assembly to permit skin incision. Dissect carefully to the bone, to avoid injury to the surrounding neurovascular structures and soft tissue. Advance the trocar assembly to the bone. Remove the trocar.

Precaution: Only incise the skin and then perform blunt dissection to avoid injuring the axillary nerve and its branches.

Drill through the lateral cortex with the calibrated 3.2 mm three-fluted drill bit. Monitor drill bit insertion radiographically, since the position of the drill bit tip directly represents locking screw tip position in the bone. This locking screw may be bicortical or unicortical depending upon its placement relative to the articular surface. Careful attention is important to prevent neurovascular injury.
Read the locking screw length directly from the drill bit at the back of the drill sleeve. Press the drill sleeve firmly to the cortex to avoid measurement errors.

Alternatively, for bicortical screws, use the depth gauge for locking screws. Remove the scaled probe portion from its outer housing and remove the drill sleeve from the protection sleeve. Insert the scaled probe through the protection sleeve so that the hook of the depth gauge grasps the far cortex of the bone. Read the scale against the edge of the protection sleeve to determine the appropriate locking screw length.

In order to pass the hook through the protection sleeve, the sleeve of the depth gauge must be removed.

**Precaution:** Avoid deep perforation as this might cause radial nerve injury.

3

**Insert locking screw**

**Instruments**

03.010.107 StarDrive Screwdriver, T25

Insert the appropriate length 4.0 mm titanium locking screw through the protection sleeve using the T25 StarDrive Screwdriver. A second transverse locking screw may be inserted through the superior end of the slot by repeating this procedure through the hole in the standard aiming arm marked “COMP.”
Proximal Locking—Compression Locking

Compression locking of a Titanium Cannulated Humeral Nail–EX can help close a transverse or short oblique fracture gap that is up to 8 mm wide. It may also be used to create a limited amount of interfragmentary compression to increase the torsional stiffness and bending strength of the nail-bone construct.

Compression locking should be planned preoperatively to address the following considerations before and during surgery:

– Compression locking may be used for transverse and short oblique fractures.
– Compression locking should not be used for patients with poor bone quality because a secure screw-cortex interface is needed.
– Compression locking should be used with great care when radial nerve impingement is suspected or possible. In these cases, the nerve should be explored and isolated prior to nailing or locking.
– The nail must be overinserted by the same amount of interfragmentary travel that is anticipated because, as compression is applied, the nail will back out at the insertion site.
1
Open humerus and insert nail using standard technique

See “Antegrade Nail Insertion,” page 10, or “Retrograde Nail Insertion,” page 20, for technique for opening the humerus, assembling the insertion instruments, and inserting the nail.

**Note:** Overinsert the nail over the 2.5 mm reaming rod, if used, until the proximal end is beneath the superior surface of the proximal humerus the anticipated amount of interfragmentary travel. The maximum amount of travel produced by the compression device is 8 mm.

**Precaution:** Ensure that the nail is not left proud after compression because this may cause impingement.

2
Insert distal locking screws

Determine locking screw length and insert one or two 4.0 mm titanium locking screws through the nail tip using technique of choice. See “Distal Locking—Freehand Locking,” page 40.
3

Insert proximal locking screw

Instrument

03.010.091 Standard Aiming Arm

Insert the locking screw through the hole in the standard aiming arm marked “COMP,” which targets the superior end of the nail slot, using standard insertion technique. See “Proximal Locking—Standard Locking,” page 33.
4

**Compress fracture**

**Instruments**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>03.010.053</td>
<td>Cannulated Connecting Screw</td>
</tr>
<tr>
<td>03.010.113</td>
<td>Compression Device</td>
</tr>
<tr>
<td>321.16</td>
<td>Combination Wrench, 11 mm</td>
</tr>
</tbody>
</table>

Insert the compression device into the cannulated connecting screw. Advance the compression device with the 11 mm combination wrench. The tip of the compression device will contact the proximal locking screw, pulling the nail up and moving the interlocked far fragment toward the near fragment to compress the fracture.

Continue to advance the compression device, monitoring interfragmentary travel under image intensification, until the desired amount of compression is achieved.

Monitor both the fracture site and the proximal locking screw during the procedure. If the fragments do not compress and/or the proximal locking screw migrates or deforms excessively, discontinue the compression locking procedure.

**Precaution:** Ensure that the nail is not left proud after compression because this may cause impingement.
Insert static locking screw

5

To maintain compression, a second proximal locking screw must be inserted through the transverse hole. Insert the 12.0 mm/8.0 mm protection sleeve, 8.0 mm/3.2 mm drill sleeve and 3.2 mm trocar through the standard aiming arm hole marked “STATIC” and insert the transverse locking screw using standard insertion technique. See “Proximal Locking—Standard Locking,” page 33.

The proximal slot in the nail should not be used alone to lock the fracture in dynamic mode due to the risk of nail migration.
Distal Locking—Freehand Locking

1
Confirm fracture reduction

Confirm fracture reduction with AP and lateral images.

2
Align image

Align the C-arm with the hole in the nail until a perfect circle is visible in the center of the screen.

- Oblique hole—incorrect
- Round hole—correct
3
Determine incision point

Identify the center of the hole to mark the incision point and make a stab incision. Dissect the soft tissues to create a clear view of the bone. Use spreaders or retractors to avoid injury to neurovascular structures.

**Precaution:** Only incise the skin and then perform blunt dissection down to the bone to avoid injuring the brachial artery or median nerve.

---

4
Center drill bit in locking hole

**Instruments**

<table>
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<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.100</td>
<td>3.2 mm Three-fluted Drill Bit, for Radiolucent Drive</td>
</tr>
<tr>
<td>03.010.103</td>
<td>3.2 mm Three-Fluted Drill Bit</td>
</tr>
</tbody>
</table>

Under image intensification, insert the tip of the 3.2 mm three-fluted drill bit or 3.2 mm three-fluted drill bit for radiolucent drive through the incision and onto the bone. Keep the drill bit oblique to the x-ray beam until the tip is centered in the locking hole. Be sure to use a sharp drill bit to prevent slippage and ensure accuracy.
5
Drill

Tilt the drill until the drill bit is in line with the beam and centered in the outer ring. The drill bit will nearly fill the locking hole image. Hold the drill firmly in this position and drill through both cortices. Monitor drill bit insertion radiographically, as the position of the drill bit tip directly represents locking screw position in the bone.

Note: For greater drill bit control, discontinue power after perforating the near cortex. Manually guide the drill bit through the nail before resuming power to drill the far cortex.

6
Measure

Instrument

03.010.106 Direct Measuring Device

Leaving the drill bit in place, detach the drill. Place the direct measuring device against the drill bit, with the tip of the direct measuring device against the bone. Read the graduation against the end of the drill bit to determine locking screw length.
6. Measure continued

**Instrument**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.072</td>
<td>Depth Gauge, for Locking Screws</td>
</tr>
</tbody>
</table>

Alternatively, use the depth gauge for locking screws by removing the drill bit and inserting the scaled probe to grasp the far cortex of the bone with the hook. Read the scale against the edge of the outer housing to determine locking screw length.

7

**Insert locking screw**

**Instruments**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.107</td>
<td>StarDrive Screwdriver, T25</td>
</tr>
<tr>
<td>03.010.112</td>
<td>Holding Sleeve, with Locking Device</td>
</tr>
</tbody>
</table>

Insert the appropriate length 4.0 mm titanium locking screw using the T25 StarDrive Screwdriver and holding sleeve with locking device.

- Verify locking screw length under image intensification. If needed, a second distal locking screw may be inserted using the same technique.

**Note:** It is recommended that one of the superior distal hole be locked prior to locking the inferior distal hole.
Targeted distal locking of the Proximal Humeral Nail–EX can be accomplished through either the standard aiming arm or the spiral blade aiming arm.

1
Confirm fracture reduction

Confirm fracture reduction with AP and lateral images, keeping the insertion handle and aiming arm oriented laterally.
2
Drill

Instruments

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.060</td>
<td>3.2 mm Three-Fluted Drill Bit</td>
</tr>
<tr>
<td>03.010.063</td>
<td>12.0 mm/8.0 mm Protection Sleeve</td>
</tr>
<tr>
<td>03.010.064</td>
<td>8.0 mm/3.2 mm Drill Sleeve</td>
</tr>
<tr>
<td>03.010.069</td>
<td>3.2 mm Trocar</td>
</tr>
<tr>
<td>03.010.072</td>
<td>Depth Gauge, for Locking Screws</td>
</tr>
</tbody>
</table>

Insert the 12.0 mm/8.0 mm protection sleeve, 8.0 mm/3.2 mm drill sleeve and 3.2 mm trocar through one of the distal holes in the aiming arm.

Dimple the skin with the trocar tip. Slightly retract the trocar assembly to permit skin incision. Dissect carefully to the bone to avoid injury to the surrounding neurovascular structures and soft tissue. Advance the trocar assembly to the bone. Remove the trocar.

Drill through both cortices with the calibrated 3.2 mm three-fluted drill bit, stopping the drill immediately after penetrating the far cortex. Monitor drill bit insertion radiographically, since the position of the drill bit tip directly represents locking screw tip position in the bone. Careful attention is important, to prevent neurovascular injury.

Read the locking screw length directly from the drill bit at the back of the drill sleeve. Press the drill sleeve firmly to the cortex to avoid measurement errors.

Alternatively, use the depth gauge for locking screws. Remove the scaled probe portion from its outer housing and remove the drill sleeve from the protection sleeve. Insert the scaled probe through the protection sleeve so that the hook of the depth gauge grasps the far cortex of the bone. Read the scale against the edge of the protection sleeve to determine the appropriate locking screw length.

**Note:** In order to pass the hook through the protection sleeve, the sleeve of the depth gauge must be removed.

**Precaution:** Avoid deep perforation as this might cause radial nerve injury.
Insert locking screw

**Instruments**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.055</td>
<td>Spiral Blade Aiming Arm</td>
</tr>
<tr>
<td>03.010.091</td>
<td>Standard Aiming Arm</td>
</tr>
<tr>
<td>03.010.107</td>
<td>StarDrive Screwdriver, T25</td>
</tr>
</tbody>
</table>

Insert the appropriate length 4.0 mm titanium locking screw through the protection sleeve using the T25 StarDrive Screwdriver.

A second distal locking screw may be inserted by repeating this procedure through the adjacent hole in the standard aiming arm or the spiral blade aiming arm.
Use of an end cap is recommended if bony ingrowth into the proximal end of the nail is of concern, or if the nail has been overinserted.

**Precaution:** When locking with a spiral blade, an end cap must always be inserted into the nail; otherwise the spiral blade will not be properly secured.

End caps are available with 0 mm, 5 mm, 10 mm and 15 mm extensions and have detented threads that will provide some resistance upon insertion.

### For 0 mm end cap

**Instrument**

| 03.010.107 StarDrive Screwdriver, T25 |

If the nail has not been overinserted, use an end cap with 0 mm extension. Align the end cap with the nail axis to prevent cross-threading. Fully seat the end cap using the T25 StarDrive Screwdriver. The 0 mm extension end cap can be inserted through the insertion handle for additional control. If a spiral blade has been used, keep the spiral blade insertion assembly attached to the spiral blade, to help maintain alignment. Carefully remove the connecting screw from the nail.

**Note:** If the spiral blade insertion assembly has been removed to insert the proximal transverse locking screw, reattach it to the spiral blade before inserting a 0 mm end cap.
For 5 mm, 10 mm, and 15 mm end caps

Instruments

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.010.055</td>
<td>Spiral Blade Aiming Arm</td>
</tr>
<tr>
<td>03.010.091</td>
<td>Standard Aiming Arm</td>
</tr>
<tr>
<td>03.010.107</td>
<td>StarDrive Screwdriver, T25</td>
</tr>
<tr>
<td>292.26</td>
<td>2.5 mm Kirschner Wire</td>
</tr>
</tbody>
</table>

If the nail has been overinserted, insert a 2.5 mm K-wire through one of the small hole(s) in the standard aiming arm or spiral blade aiming arm and estimate extension length using an AP image of the nail end. The end cap should not protrude beyond the insertion site.

Align the end cap with the nail axis to prevent cross-threading. Fully seat the end cap using the T25 StarDrive Screwdriver.

**Note:** Moving the patient’s arm before the end cap is completely seated may translate the nail from the entry site. This displaced alignment may cause difficulty in placing the end cap.
Implant Removal

1
Remove end cap

Instrument

03.010.107  StarDrive Screwdriver, T25

Use the T25 StarDrive Screwdriver to remove the end cap.

2
Remove spiral blade

Instruments

03.010.058  Slide/Fixed Hammer
358.696      Spiral Blade Inserter
358.697      Spiral Blade Connecting Screw

Connect the spiral blade inserter and spiral blade connecting screw to the spiral blade. Manually turn the spiral blade inserter counterclockwise, removing the spiral blade.

If resistance is encountered, the spiral blade connecting screw may be used alone. Use light, controlled blows of the slide/fixed hammer to remove the spiral blade.
3

Remove locking screws

Instruments

- 03.010.053 Cannulated Connecting Screw
- 03.010.107 StarDrive Screwdriver, T25
- 03.010.112 Holding Sleeve, with Locking Device

**Precaution:** Always mount the connecting screw prior to the removal of the screws. This will prevent the nail from rotating in the medullary canal.

Use the T25 StarDrive Screwdriver and the holding sleeve with locking device to remove the locking screws.

**Note:** Care should be taken to partially disassemble and distract the holding sleeve with locking device during cleaning before placing it in the graphic case for sterilization.

4

Remove nail

Instruments

- 03.010.058 Slide/ Fixed Hammer
- 03.010.059 Hammer Guide

Remove the nail.

If resistance is encountered, thread the hammer guide onto the end of the connecting screw and use light, controlled blows of the slide/fixed hammer to remove the nail.
Alternative Technique—Extraction Hook

For removal of broken nail

**Instruments**

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>355.399◊</td>
<td>Extraction Hook, for Titanium Cannulated Nails</td>
</tr>
<tr>
<td>393.10</td>
<td>Universal Chuck with T-Handle</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>393.105</td>
<td>Small Universal Chuck with T-Handle</td>
</tr>
</tbody>
</table>

1
Clear tissue from the end of the nail and remove the end cap.

2
Remove the spiral blade and locking screws with the appropriate screwdriver.

3
Insert the extraction hook into the universal chuck with T-handle. The hook should be parallel with the T-handle. This facilitates visualization of the hook position in the bone.

◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.
4. Attach appropriate extraction bolt or connecting screw to the nail. Remove the near nail fragment using the extraction bolt or connecting screw.

**Note:** The extraction hook can be used as an alternative to extraction instrumentation.

5. Ream the medullary canal 1 mm larger than the diameter to clear a path for the distant nail fragment.

6. Insert the extraction hook and explanted, near nail fragment into the medullary canal. The near nail fragment aligns the extraction hook with the cannulation of the distant nail fragment.

7. Pass the extraction hook through the cannula of the distant nail fragment.

**Note:** Under image intensification, verify that the hook has passed through and engaged the distant end of the nail.

8. Extract both nail fragments.

**Note:** Keep the patient’s limb restrained to increase the efficiency of the extraction force.
## For removal of an intact nail

### Instruments

<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
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<tbody>
<tr>
<td>355.399◊</td>
<td>Extraction Hook, for Titanium Cannulated Nails</td>
</tr>
<tr>
<td>393.10 or 393.105</td>
<td>Universal Chuck with T-Handle or Small Universal Chuck with T-Handle</td>
</tr>
</tbody>
</table>

1
Clear tissue from the end of the nail and remove the end cap.

2
Remove the spiral blade and locking screws with the appropriate screwdriver.

3
Insert the extraction hook into the universal chuck with T-handle. The hook should be parallel with the T-handle. This facilitates visualization of the hook position in the bone.

4
Insert the extraction hook through the nail cannula.

**Note:** Under image intensification, verify that the hook has passed through and engaged the distant end of the nail.

5
Extract the nail.

**Note:** Keep the patient’s limb restrained to increase the efficiency of the extraction force.

◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.
Titanium Cannulated Humeral Nail–EX
– Universal design for the left or right humerus

Material:
– Titanium-6% aluminum-7% niobium alloy

Diameters:
– 7.0 mm, 9.0 mm (with a 9.0 mm proximal diameter)
– 11.0 mm (with an 11.0 mm proximal diameter)

Color:
– Blue

Lengths:
– 190 mm to 320 mm in 10 mm increments

Cross Section:
– Round

Transverse slot for spiral blade locking, standard locking or compression locking (should not be used for dynamic locking)
Distal locking holes oriented 22.5° to each other for stable fixation and to reduce skiving on lateral supracondylar ridge
Countersunk locking holes accept 4.0 mm Titanium Locking Screws
5° nail bend
Transverse locking hole
Locking hole locations
0 mm
19 mm
34 mm
44 mm
29 mm
14 mm
0 mm
Titanium Cannulated Proximal Humeral Nail–EX
- Universal design for the left or right humerus

Material:
- Titanium-6% aluminum-7% niobium alloy

Diameters:
- 7.0 mm, 9.0 mm (with a 9.0 mm proximal diameter)
- 11.0 mm (with an 11.0 mm proximal diameter)

Color:
- Blue

Length:
- 150 mm

Cross Section:
- Round

Locking hole locations

0 mm
19 mm
34 mm
76 mm
90 mm
150 mm

Transverse slot for spiral blade locking or standard locking (should not be used for dynamic locking)
Transverse locking hole
5° nail bend
Targeted distal locking holes
Countersunk locking holes accept 4.0 mm Titanium Locking Screws
### Titanium Cannulated Humeral Nails–EX, sterile

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>7.0 mm diameter</th>
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### Titanium Cannulated Proximal Humeral Nails–EX, sterile

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<td>04.001.410S</td>
<td>04.001.610S</td>
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</table>
Titanium Spiral Blades◊ for Humeral Nails (gold)

Material:
– Titanium-6% aluminum-7% niobium alloy

Dimensions:
– 34 mm to 54 mm lengths in 2 mm increments
– 3.9 mm core diameter with a 2.2 mm cannulation
– 10.5 mm blade for use through a 12.0 mm nail slot
– 3.9 mm blade thickness and 13.0 mm head diameter

<table>
<thead>
<tr>
<th>Length (mm)</th>
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◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.

4.0 mm Titanium Locking Screws◊ with T25 StarDrive Recess, for IM Nails (blue)

Material:
– Titanium-6% aluminum-7% niobium alloy

Dimensions:
– 18 mm to 60 mm lengths in 2 mm increments
– 3.3 mm core diameter
– Self-tapping, blunt tip
– T25 StarDrive Recess

<table>
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<tbody>
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<tr>
<td>04.005.450</td>
<td>60</td>
</tr>
</tbody>
</table>
Titanium End Caps,◊ with T25 StarDrive Recess, for Humeral Nails–EX (gold)

Can be used with spiral blades or locking screws

Material:
– Titanium-6% aluminum-7% niobium alloy

0 mm extension
– Securely locks spiral blade
– Protects nail threads from tissue ingrowth
– T25 StarDrive Recess

5 mm, 10 mm or 15 mm extension
– Extends nail height if nail is overinserted
– Securely locks spiral blade
– Protects nail threads from tissue ingrowth
– T25 StarDrive Recess

<table>
<thead>
<tr>
<th>Extension (mm)</th>
<th>Catalog Number</th>
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</table>

◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.

Titanium End Caps, with T25 StarDrive Recess, nonlocking, for Humeral Nails–EX (blue)

For use with locking screws only

Material:
– Titanium-6% aluminum-7% niobium alloy

0 mm, 5 mm, 10 mm or 15 mm extension
– Do not lock the most proximal screw
– Available sterile only
– Extends nail height if nail is overinserted
– Protects nail threads from tissue ingrowth
– T25 StarDrive Recess

<table>
<thead>
<tr>
<th>Extension (mm)</th>
<th>Catalog Number</th>
</tr>
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<tbody>
<tr>
<td>0</td>
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<td>04.001.008S</td>
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<td>04.001.010S</td>
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Instruments

03.010.022  Radiographic Ruler

03.010.023  Radiographic Canal Width Estimator

03.010.025  2.0 mm Guide Wire, 240 mm

03.010.038  10.0 mm Protection Sleeve

03.010.039  10.0 mm Cannulated Awl

03.010.053  Cannulated Connecting Screw

03.010.054  Insertion Handle
## Instruments

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>03.010.055</td>
<td>Spiral Blade Aiming Arm</td>
</tr>
<tr>
<td>03.010.058</td>
<td>Slide/Fixed Hammer, 400 grams</td>
</tr>
<tr>
<td>03.010.059</td>
<td>Hammer Guide, for Slide/Fixed Hammer</td>
</tr>
<tr>
<td>03.010.060◊</td>
<td>3.2 mm Three-Fluted Drill Bit, quick coupling 330 mm, 100 mm calibration</td>
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<tr>
<td>03.010.063</td>
<td>12.0 mm/8.0 mm Protection Sleeve</td>
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<tr>
<td>03.010.064</td>
<td>8.0 mm/3.2 mm Drill Sleeve</td>
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<tr>
<td>03.010.069</td>
<td>3.2 mm Trocar</td>
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◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.
<table>
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<th>Instrument ID</th>
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<tbody>
<tr>
<td>03.010.072</td>
<td>Depth Gauge</td>
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<tr>
<td>03.010.086</td>
<td>14.0 mm/8.0 mm Drill Sleeve</td>
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<tr>
<td>03.010.087</td>
<td>8.0 mm/2.0 mm Wire Guide</td>
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<tr>
<td>03.010.088</td>
<td>2.0 mm Trocar</td>
</tr>
<tr>
<td>03.010.089◊</td>
<td>4.5 mm Cannulated Drill Bit</td>
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<tr>
<td>03.010.090</td>
<td>Spiral Blade Measuring Device</td>
</tr>
<tr>
<td>03.010.091</td>
<td>Standard Aiming Arm</td>
</tr>
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</table>

◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.
Instruments

03.010.103◊ 3.2 mm Three-Fluted Drill Bit, quick coupling, 145 mm

03.010.106 Direct Measuring Device

03.010.107 StarDrive Screwdriver, T25, self-retaining

03.010.112 Holding Sleeve, with Locking Device

03.010.113 Compression Device

292.26 2.5 mm Kirschner Wire

310.44◊ 4.5 mm Drill Bit

◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.
## Instruments

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>319.97</td>
<td>Screw Forceps</td>
</tr>
<tr>
<td>321.16</td>
<td>Combination Wrench</td>
</tr>
<tr>
<td>321.17</td>
<td>4.5 mm Pin Wrench</td>
</tr>
<tr>
<td>332.062</td>
<td>Router, quick coupling, 130 mm</td>
</tr>
<tr>
<td>358.682</td>
<td>9.5 mm Conical Burr with quick coupling</td>
</tr>
<tr>
<td>358.696</td>
<td>Spiral Blade Inserter</td>
</tr>
<tr>
<td>358.697</td>
<td>Spiral Blade Coupling Screw</td>
</tr>
</tbody>
</table>
Instruments

360.05◊ 10.0 mm Cannulated Drill Bit, large quick coupling, 190 mm, 2.7 mm cannulation

393.105 Small Universal Chuck with T-Handle

◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.
Humeral Nail–EX Instrument and Titanium Implant Set (01.001.300)

<table>
<thead>
<tr>
<th>Graphic Case</th>
<th>Humeral Nail–EX Instrument and Implant Set Graphic Case</th>
</tr>
</thead>
</table>

**Instruments**

03.010.022 Radiographic Ruler, for Titanium Cannulated Humeral Nails
03.010.023 Radiographic Canal Width Estimator, for IM Nails
03.010.024 Holding Device, for guide wires and reaming rods
03.010.025 2.0 mm Guide Wire, 240 mm, 3 ea.
03.010.028 10.0 mm Protection Sleeve
03.010.029 10.0 mm Cannulated Awl
03.010.030 Cannulated Connecting Screw, for Titanium Cannulated Humeral Nails–EX
03.010.031 Insertion Handle, for Titanium Cannulated Humeral Nails–EX
03.010.032 Spiral Blade Aiming Arm, for Titanium Cannulated Humeral Nails–EX
03.010.033 Slide/Fixed Hammer, 400 grams
03.010.034 Hammer Guide, for Slide/Fixed Hammer
03.010.035◊ 3.2 mm Three-Fluted Drill Bit, quick coupling, 330 mm, 100 mm calibration, 2 ea.
03.010.036 12.0 mm/8.0 mm Protection Sleeve, 188 mm
03.010.037 8.0 mm/3.2 mm Drill Sleeve, 200 mm
03.010.038 3.2 mm Trocar, 210 mm
03.010.039 Depth Gauge, for Locking Screws to 100 mm for IM Nails
03.010.040 14.0 mm/8.0 mm Drill Sleeve, 130 mm
03.010.041 8.0 mm/2.0 mm Wire Guide, 140 mm
03.010.042 2.0 mm Trocar, 150 mm
03.010.043◊ 4.5 mm Cannulated Drill Bit, Jacobs chuck, 165 mm, with 135 mm Stop, 2 ea.
03.010.044◊ Spiral Blade Measuring Device, for Titanium Cannulated Humeral Nails–EX
03.010.045◊ Standard Aiming Arm, for Titanium Cannulated Humeral Nails–EX
03.010.046◊ 3.2 mm Three-Fluted Drill Bit, quick coupling, 145 mm, 2 ea.

For detailed cleaning and sterilization instructions, please refer to www.synthes.com/cleaning-sterilization or sterilization instructions, if provided.
Instruments continued

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Description</th>
<th>Length</th>
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<tbody>
<tr>
<td>03.010.106</td>
<td>Direct Measuring Device, for Locking Screws to 100 mm for IM Nails</td>
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<tr>
<td>03.010.107</td>
<td>StarDrive Screwdriver, T25, self-retaining</td>
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<td>03.010.112</td>
<td>Holding Sleeve, with Locking Device</td>
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<tr>
<td>03.010.113</td>
<td>Compression Device for Titanium Cannulated Humeral Nails–EX</td>
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<tr>
<td>292.26</td>
<td>2.5 mm Kirschner Wire, 285 mm, trocar point, 1 pkg. of 10</td>
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<tr>
<td>310.44◊</td>
<td>4.5 mm Drill Bit, quick coupling, 145 mm, 2 ea.</td>
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<tr>
<td>319.97</td>
<td>Screw Forceps</td>
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<tr>
<td>321.16</td>
<td>Combination Wrench, 11 mm width across flats, 2 ea.</td>
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<tr>
<td>321.17</td>
<td>4.5 mm Pin Wrench, 120 mm</td>
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<tr>
<td>332.062</td>
<td>Router, quick coupling, 130 mm</td>
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<tr>
<td>358.682</td>
<td>9.5 mm Conical Burr with quick coupling</td>
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<tr>
<td>358.696</td>
<td>Spiral Blade Inserter, for Titanium Humeral Nails</td>
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<tr>
<td>358.697</td>
<td>Spiral Blade Coupling Screw, for Titanium Humeral Nails</td>
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<tr>
<td>360.05◊</td>
<td>10.0 mm Cannulated Drill Bit, large quick coupling, 190 mm, 2.7 mm cannulation</td>
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<tr>
<td>393.105</td>
<td>Small Universal Chuck with T-Handle</td>
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Implants continued

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Titanium End Caps, with T25 StarDrive Recess,◊ for Humeral Nails–EX, 2 ea.

<table>
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<th>Description</th>
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Implants

Titanium Spiral Blades,◊ for Titanium Humeral Nails, 2 ea.

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◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.
## Sets
- **105.955** Small Battery Drive Set
- **150.060** Flexible Reamer Set for IM Nails

## Instruments
- **03.010.093** Reaming Rod Push Rod
- **03.010.100◊** 3.2 mm Three-Fluted Drill Bit, quick coupling, 145 mm, for Radiolucent Drive
- **03.010.121** Large Hexagonal Screwdriver, 3.5 mm width across flats
- **314.119** StarDrive Screwdriver Shaft, T25, self-retaining, 165 mm
- **319.24** 2.9 mm Cleaning Brush
- **319.27** 2.1 mm Cleaning Brush
- **319.36** 2.0 mm Cleaning Stylet
- **319.461** 2.5 mm Cleaning Stylet
- **351.706S** 2.5 mm Reaming Rod with ball tip, 950 mm, sterile
- **355.399◊** Extraction Hook for Titanium Cannulated Nails
- **357.408** 3.2 mm Cleaning Stylet
- **357.409** 3.2 mm Cleaning Brush
- **358.681** 3.5 mm/8.5 mm Conical Burr, with quick coupling, 110 mm
- **399.41** Hammer, 350 grams

## Power Equipment
- **511.30** Radiolucent Drive
- **532.010** Small Battery Drive
- **532.013** Quick Coupling for Drill Bits
- **532.014** Large Jacobs Chuck with key
- **532.015** Large Quick Coupling
- **532.016** Small Jacobs Chuck with key
- **532.017** AO Reduction Drive Unit
- **532.022** Quick Coupling for K-Wires
- **532.032** Small Battery Drive Battery Casing, for 14.4 V Battery
- **532.033** Small Battery Drive 14.4 V Battery

## Implants
Titanium End Caps, for Humeral Nails–EX, with T25 StarDrive Recess, nonlocking, sterile
- **Extension**
  - **04.001.007S** 0 mm
  - **04.001.008S** 5 mm
  - **04.001.009S** 10 mm
  - **04.001.010S** 15 mm

◊ Available nonsterile or sterile-packed. Add “S” to catalog number to order sterile product.
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