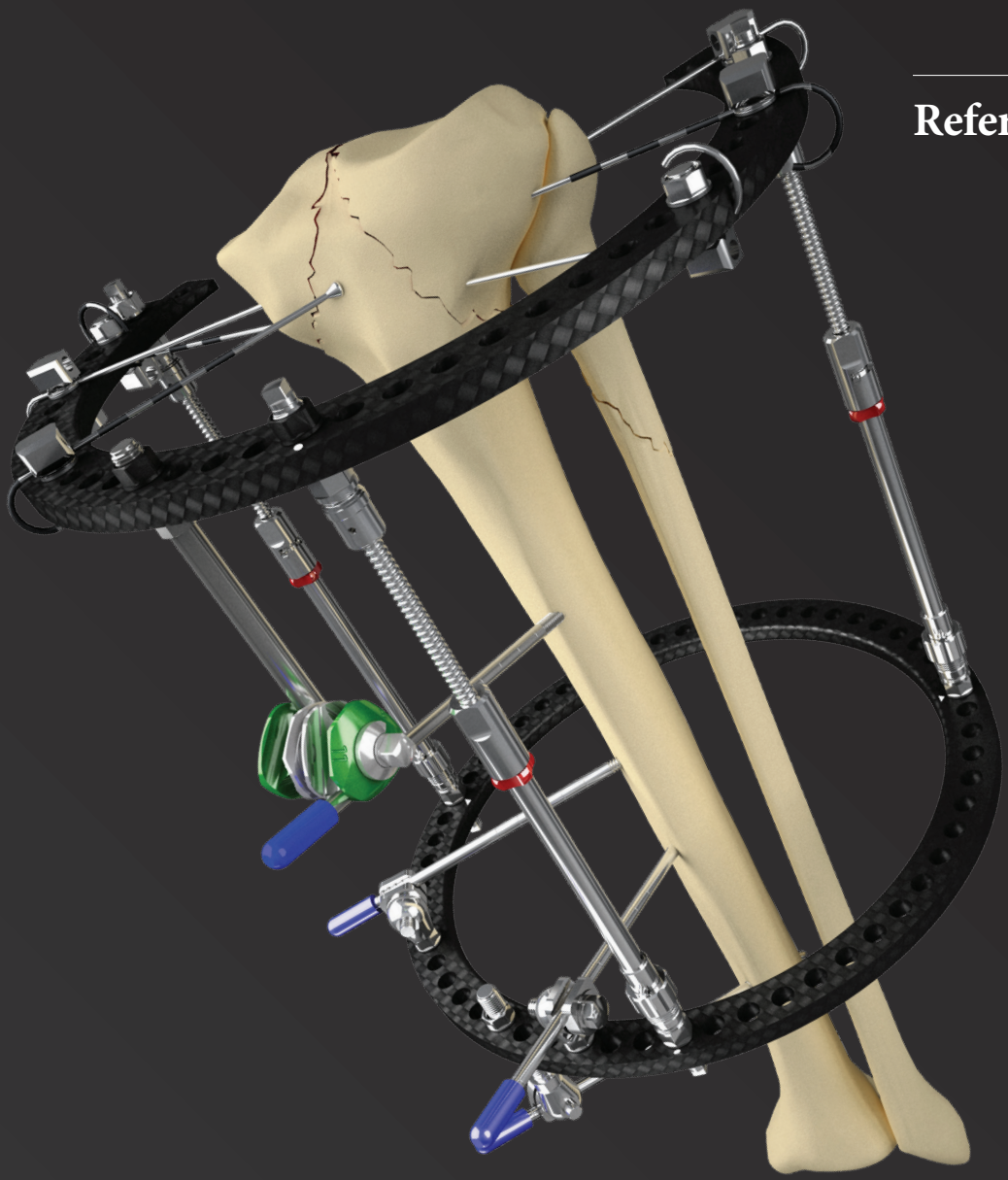
stryker®

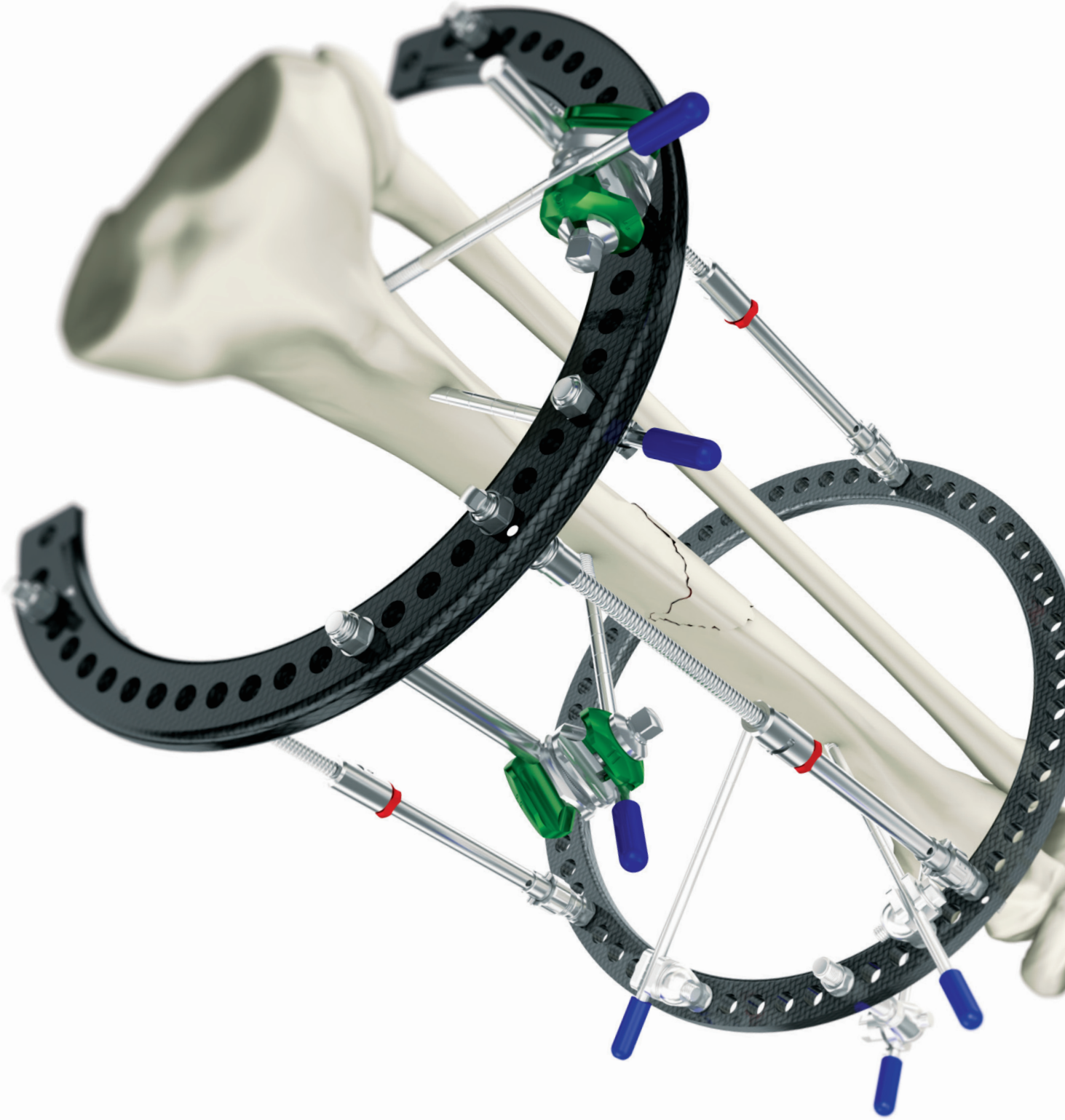
Hoffmann® LRF®

Circular External Fixation



Reference Guide

Hoffmann LRF



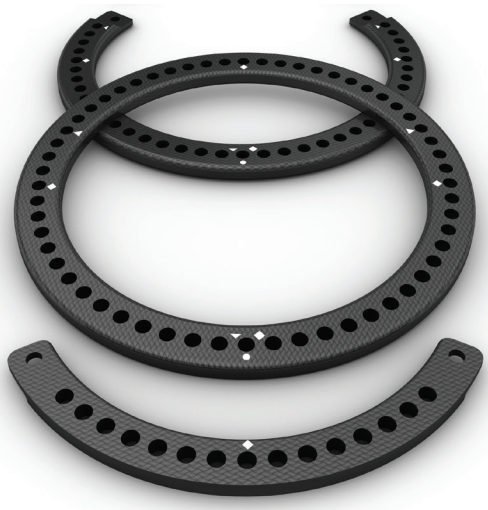
Contents

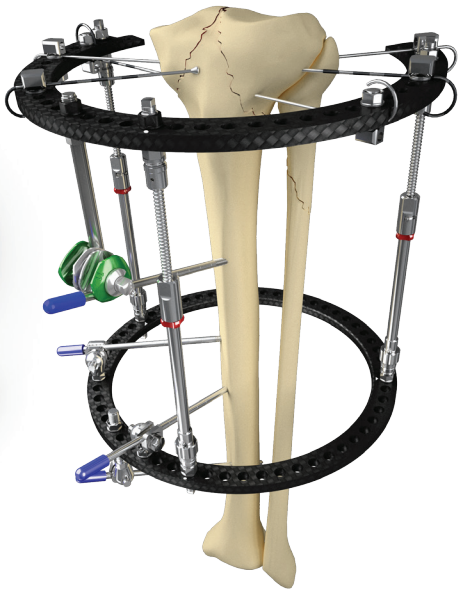
Hoffmann LRF Reference Guide

Rings

Description

The LRF Rings are available in aluminum and braided carbon fiber-reinforced polymer. The aluminum rings are lower profile with a 9mm thickness, while the carbon fiber rings are slightly more robust with a 10.5mm thickness. This slight profile increase allows the carbon fiber rings to have greater stiffness compared to the aluminum rings while still maintaining radiolucency*. Both the aluminum and carbon fiber rings are available in full, open, and segment types. Carbon fiber full rings range in size from 80-210mm. Carbon fiber open rings & segments range from 100-210mm. Aluminum full rings range from 80-270mm. Aluminum open rings & segments range from 100-240mm. You can close off an open ring with the corresponding ring segment using a connection bolt with an M6 nut.





Key Notes

- All carbon fiber rings have a 10.5mm thickness, making them too thick for the short wire bolts. Although short wire bolts will seat directly into the carbon ring, there are an insufficient number of exposed wire bolt threads to fully engage an M8 connecting nut.

  Only medium and long wire bolts can be used directly through carbon fiber rings and foot arches.

  Short wire bolts can still be utilized during the case, but should only be used in conjunction with wire bolt adaptors. If your surgeon is predominately using carbon fiber, consider stocking your set with medium and long wire bolts only.

- When connecting a ring segment to an open ring, make the connection before tensioning any wires. Tensioning a wire across an open ring prior to making the connection may possibly allow the ring to deform, which may make it hard for the ring segment to align and connect to the open ring.

- LRF Rings are marked with suggested strut placement indicators for both 3 and 4-struted constructs. Strict adherence to these locations is not mandatory. These reference markers are designed to help the user equidistantly space struts around the ring, which is important for stable frame construction. Follow triangle markers (▲) for a 3-strutted frame. Follow diamond markers (◆) for a 4-strutted frame.
- Be sure to monitor the condition of carbon fiber parts. After 50 autoclave cycles, they may start to degrade. Do not maintain "odd" (less commonly used) carbon fiber rings in your "common" ring set.

Features & Benefits

Feature
LRF Rings include reference markers that identify equidistant strut placement locations for 3 and 4-strutted frames.

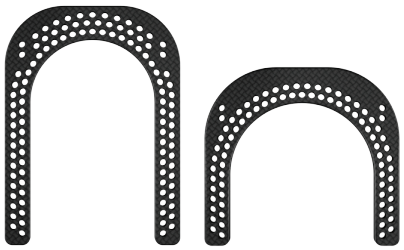
Benefit
These reference markers take the guess work out of evenly spacing the frame's struts, but still allow the user complete freedom in choosing optimal strut location per the indication.

Feature
The LRF System includes a full range of carbon fiber and aluminum rings.

Benefit
Carbon fiber rings are radiolucent and are designed to offer greater stiffness compared to market-leading carbon fiber and aluminum rings*. Enhanced ring stiffness is designed to promote overall construct stability and may also help reduce ring deformation during wire tensioning**.

**,* Comprehensive Report of the Verification Tests Performed on the Hoffmann LRF System 2013, pages 22-25

Hoffmann LRF Reference Guide



Foot Rings

Description

Foot rings come in aluminum & carbon fiber. They range in diameter from 100-210mm. For each diameter and material style there is a corresponding long & short version available.

Aluminum foot rings are 9mm thick while carbon fiber foot rings are 10.5mm thick.

Foot rings include two rows of holes for additional construct versatility and component placement freedom.

Key Notes

- Carbon fiber foot rings are 10.5mm thick making them too thick for short wire fixation bolts. When using carbon fiber foot rings, use medium or long wire fixation bolts.
- Be sure to monitor the condition of carbon fiber parts. After 50 autoclave cycles, they may start to degrade. Do not maintain "odd" (less commonly used) carbon fiber rings in your "common" ring set.
- Foot rings must be closed off with a foot arch before wires are tensioned across them ("closing the box"). Although the LRF Foot Rings are designed for enhanced stiffness, slight deformation may be possible (especially at the open end of the Foot Ring) during wire tensioning. If wires are tensioned prior to closing the box, it may be difficult to align and attach a foot arch. Closing the box with a foot arch prior to wire tensioning may help prevent ring deflection under high wire tension.
- Be sure to plan ahead if foot arches and/or rocker shoes are to be used on the frame. When these components are indicated, it is critical that holes needed for attachment are free and accessible. Also be mindful of the space needed for wrench access during final tightening. In some instances, it may be prudent to temporarily fill these holes with "dummy" components (ie. extra wire bolt and long M8 connecting nut) to protect the space.
- Due to the double row of holes featured on foot rings, the short Wire Tensioner nose may be too short to engage the Wire Bolt. The LRF Instrument Set also includes a long tensioner nose to engage wire bolts used on foot rings.

Foot Arches

Description

Foot arches are designed to aid in construct stability and are primarily used to close foot rings. This is done to reduce foot ring deflection under wire tension and provide the user with a versatile ring surface that can be used for additional fixation or additional weight bearing support when linked to a tibial ring.

Foot arches are available in 100, 120, 140, 155, 180 and 210mm diameters. Foot arches are attached to foot rings with M8 connecting nuts.

Key Notes

- Prior to tensioning, a foot arch may be angled in the down or flat position to allow for better access to the foot.
- Carbon fiber foot arches must be mounted to foot rings prior to tensioning wires. Tensioning wires across an open foot ring before mounting the arch may deform the ring, which may make arch attachment difficult or impossible. If the mounting posts of the Foot Arch do not align with the ring holes, loosening the arch's hinged connections may provide some play to ease the component into the Foot Ring.

Before the surgery ends, confirm that all foot arch's hinge connections are securely tightened down.

Features & Benefits

Feature
Modular, one-piece foot arch design.

Benefit
Quick and easy application.

Feature
Built-in hinged connection bolts.

Benefit
Versatile angular adjustment allows for construct versatility.

Feature
Made of proprietary carbon fiber reinforced polymer.

Benefit
Greater stiffness and radiolucency.*

* Comprehensive Report of the Verification Tests Performed on the Hoffmann LRF System 2013,pages 22-25.

Rocker Shoes

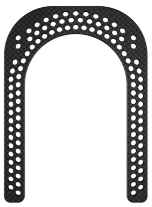
Description

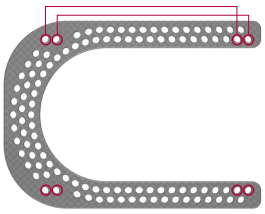
Rocker shoes are attached to the bottom of a foot frame and are designed to protect and prevent the patient's foot and foot ring from touching the ground. The durable, treaded rubber sole includes 15 degree slopes on both ends to help allow for normal gait. Rocker shoes are available in six sizes and are packaged in pairs. They are preloaded with M6 connection nuts for ring attachment.

Key Notes

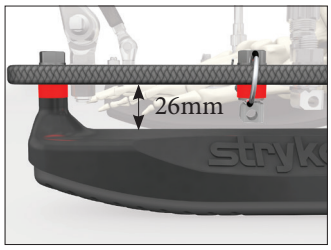
- Rocker shoes are NOT STERILE and are NOT STERILIZABLE. Although they are typically billed for at the time of surgery, rocker shoes cannot be applied in the OR. Rocker shoes are usually applied post operatively in recovery or clinic.
- Be sure to plan ahead if foot arches and/or rocker shoes are to be used during treatment. When these components are indicated, it is critical that holes needed for attachment are free and accessible. Also, be mindful of the space needed for wrench access during final tightening. Some users may be accustomed to temporarily filling these holes with "dummy" components (ie. extra wire bolt) to protect the space.
- The closed end of a foot ring features dedicated rocker shoe mounting holes. Do not obstruct these holes if rocker shoes are indicated in the procedure. The Rocker Shoe is designed to mount onto a foot ring's inner row of holes.
- The maximum amount of space that can be achieved between the distal surface of a foot ring and the top surface of a rocker shoe is 26mm. Components that drop more than 26mm from the ring's surface will not allow ample clearance for rocker shoe attachment.
- The attachment posts of a rocker shoe are 6mm in diameter and the holes of the ring are 8mm in diameter, allowing some flexibility when seating rocker shoes in the ring.

Rocker Shoe Sizing

Long Foot Rings	Dia (mm)	Long Rocker Shoe Size	
	100	Small Rocker Shoe Pair **Long (4934-8-100)**	
	120		
	140	Medium Rocker Shoe Pair **Long (4934-8-140)**	
	155		
	180	Large Rocker Shoe Pair **Long (4934-8-180)**	
	210		
Short Foot Rings	**Dia (mm)**	**Short Rocker Shoe Size**	
	100	Small Rocker Shoe Pair **Short (4934-7-100)**	
	120		
	140	Medium Rocker Shoe Pair **Short (4934-7-140)**	
	155		
	180	Large Rocker Shoe Pair **Short (4934-7-180)**	
	210		



In many cases, this play will be critical when other frame components are placed directly adjacent to rocker shoe mounting holes. Because a foot arch typically occupies the first or second hole of a foot ring, it is recommended that the user secures this end of the Rocker Shoe first. If the posterior post of the Rocker Shoe is tightened down first, it may restrict the play needed to seat the anterior post of the Rocker Shoe that is in close proximity to a foot arch connection.



Features & Benefits

Feature
Independent shoe design.

Benefit
Allows for side-specific shoe height adjustment to compensate for angled distal foot ring.

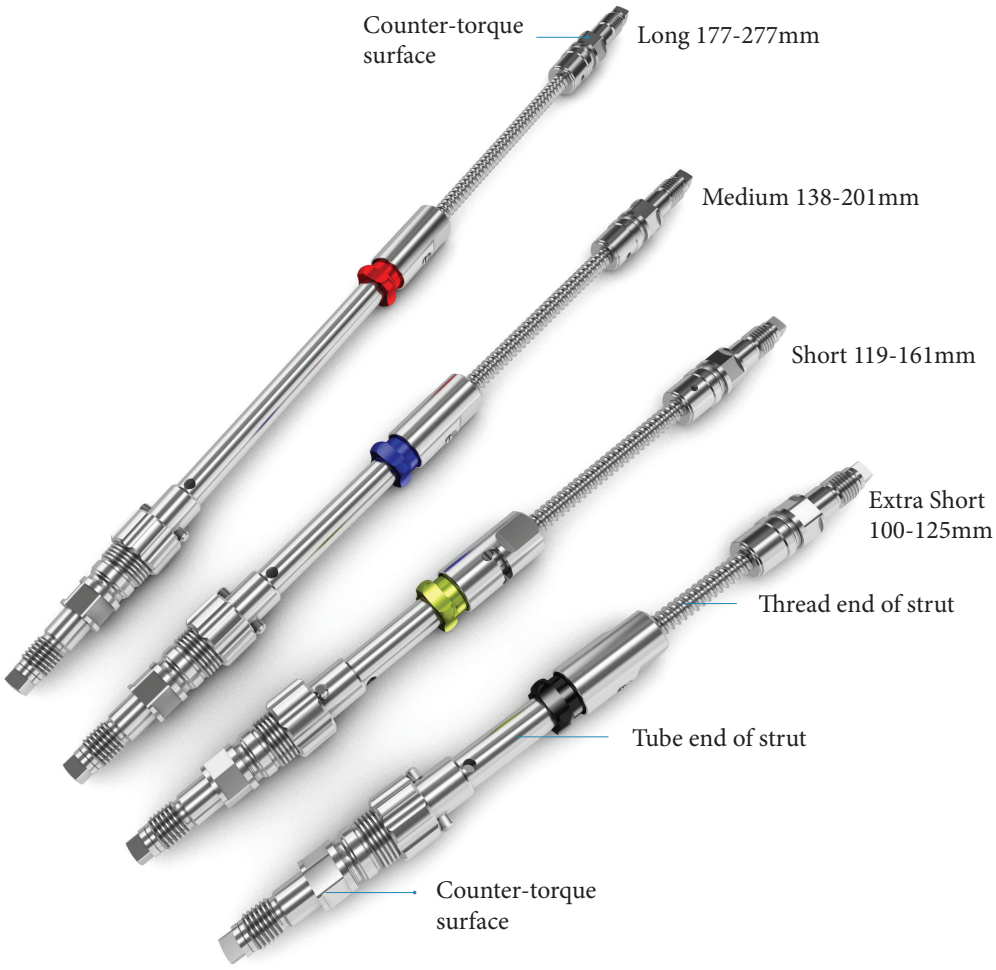
Feature
Anterior and posterior shoe ends feature a 15° slope.

Benefit
Rocker bottom design helps allow for normal gait.

Telescopic Struts

Description

The Universal Telescopic Struts are designed with multiplanar, ball-jointed fixation bolts and a central quick release mechanism for gross length adjustment. Once the frame is mounted, the Telescopic Struts can be unlocked and used as a fracture reduction tool. Once proper gross alignment is achieved, fine tuning can ensue followed by final locking. In addition to the quick release mechanisms, all ball joints must be unlocked to achieve full range of motion. The strut's ball joints allow for easy assembly to rings of different diameters and/or non-parallel rings. Built-in dynamization wheel permits 0 to 5mm of controlled micromotion. Available in four overlapping sizes.



Key Notes

Frame Assembly

- The user may either pre-build a construct or use the "rings first" method. Determine your surgeon's preference and adapt your preparation for the case accordingly.

  1. Rings First: With this approach, the surgeon mounts the two rings to the bone independently and then connects the two rings with the appropriate length telescopic strut. The advantage of this approach is that the surgeon has 100% accessibility to the ring's holes to mount pin/wire fixation components. This allows them to place fixation exactly where they want it without having to work around the frame's struts. This approach also helps customize the frame specifically to the patient's anatomy as opposed to applying a pre-built frame with struts that may limit pin/wire fixation placement options.

  2. Pre-assembled Frame: With this approach, the "core frame" (ie. telescopic struts and rings only) is assembled in advance and applied to the patient. The main advantage of this approach is ease and speed of application as well as the ability to use the frame to template pin/wire fixation components. Caveats to this approach include the occasional need to relocate a strut to accommodate a pin or wire. A key advantage to the LRF System, however, is that struts can be located and relocated to accommodate pin and wire fixation. Contrary to a threaded rod, only one end of a telescopic strut may have to be relocated, since the ball joints allow the struts to be placed at an angle. If pin/wire fixation lands over a hole that is occupied by a telescopic strut, it may be possible to relocate the strut (or one end of it) to an open adjacent hole. This can be accomplished by first unlocking the ball joints and quick release mechanism. Secondly, the end of the strut that is being relocated is detached by taking off the M8 Connecting Nut. Next, the strut is compressed out of the current hole and re-inserted into a free adjacent hole.

Telescopic Struts

Key Notes

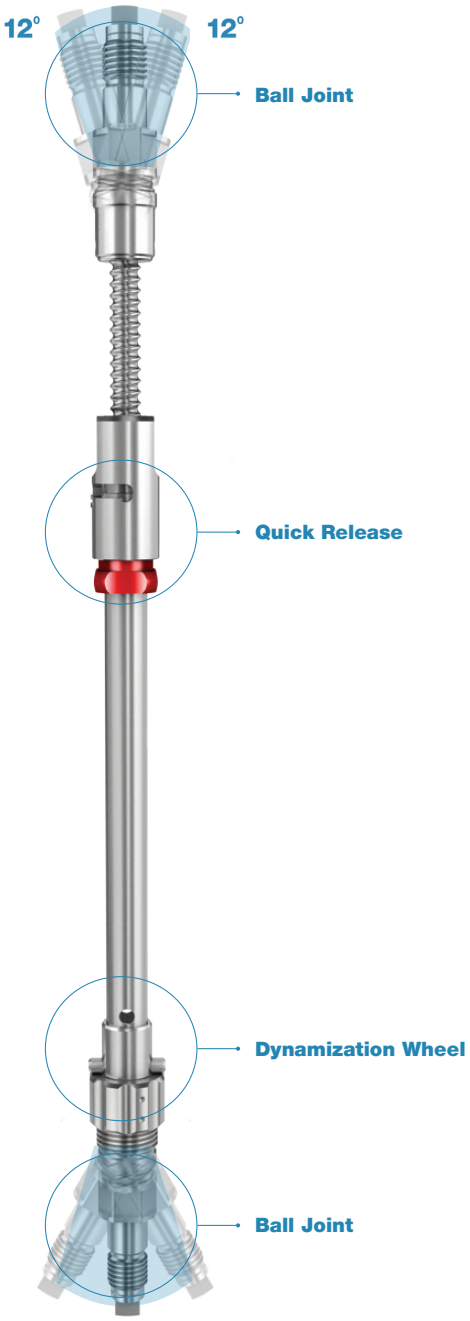
The ball-jointed fixation bolts on the Telescopic Struts are designed to make it possible to connect rings that are not perfectly parallel. With the rings first approach, it may be unlikely that the two rings and their respective mounting holes align perfectly. The ball joint flexibility of the Telescopic Struts are designed to allow for seamless connection of rings that are not perfectly parallel. The ideal frame is intimately matched to the anatomy and ring size should be considered for both the reference and moving fragments. Another key advantage of the ball joints is that rings of different diameters can be connected.

Note:

When connecting rings with different diameters, some of the ball joint's range of motion is consumed. When this occurs, the amount of gross angular adjustment (fracture reduction range) the frame can accomplish is limited. Only 1 or 2 sizes of difference between rings can be connected with the range of motion permitted by the ball joints.

Preparing for a "Rings First" Frame Application

- After the two rings are mounted, the LRF Ruler can be utilized to estimate the appropriate length strut. The LRF Universal Telescopic Struts come out of the package with the ball joints locked in the neutral or straight position. Assuming the initially mounted rings are not perfectly parallel, the strut should be handed to the surgeon with both ball joints unlocked and the quick release mechanism in the unlocked position. The Dynamization Wheel should remain fully closed during the surgery. **When unlocking ball joints, do not over-loosen. A half turn is all that is needed to unlock the ball joints. Over-loosening may cause the ball joint to bind up or disassemble.**



- Having the ball joints and quick release mechanism unlocked is designed to allow for the play and flexibility needed to span/connect non-parallel rings or rings of different diameters. This approach is much more complicated with static threaded rods or struts rigidly locked in the neutral position.

Telescopic Struts

Preparing for a Preassembled Frame Application

- Based on pre-operative planning, the core frame components indicated for the case are assembled. **Before the preassembled frame is applied, make sure that the struts are securely tightened to the rings and that the ball joints and quick release mechanisms are securely locked.** The Dynamization Wheel should also be in the fully closed position. If the surgeon is handed a pre-assembled frame with the ball joints and quick release mechanisms unlocked, it may be very difficult to control and apply as free motion is enabled at several junctions of the frame.
- Before making any ball joint or strut length adjustments, it is imperative that struts are securely tightened to the rings first. **Two wrenches are needed to properly attach a strut. One wrench is applied to the counter-torque surface of the strut just beneath the ring and the other is used to fasten a short M8 connecting nut.**

- Black laser markings are located on the threaded part of the strut. These markings indicate how much compression travel should be left in the strut when it's applied. Compressing the strut beyond this line may potentially pose some challenges at a later time. For example, if additional compression is warranted, the struts may not have sufficient travel left to adequately compress as needed. Additionally, if struts are compressed beyond this indicator line, removal of a single strut is difficult, as there is not enough travel left to compress the strut to the point where it can be removed from between the two rings. If the strut is compressed beyond this indicator, consider switching to a shorter strut before proceeding.
- Strut lockup: When struts are in the max-compressed or max-distracted position, impingement on the quick release mechanism may make it difficult to align the locking pin into the locked position. **If this happens, do not try to force rotation of the quick release mechanism.** In the case of a max-distracted strut, a slight manual compression of the frame/strut will help free the quick release and allow the locking pin to align in the locked position. Light manual distraction force will alleviate struts that are fully compressed. If the ball joint at the threaded end of the strut can be unlocked, swiveling the threaded portion of the strut by hand may also help free the impingement and allow the locking pin to align within the quick release mechanism.
- Long M8 nuts cannot be used to attach telescopic struts to rings because their height blocks access to the ball joint's locking bolt.
- It is possible to over-tighten the ball joint during locking. Over-torqueing the ball joint's locking bolt may cause it to deform. This is why a linear, "teardrop" driver style wrench is used instead of a traditional spanner wrench. In the case of a closely stacked ring block, access to the ball joint's locking bolt may be too limited to seat the Yellow Teardrop Wrench. The back up 5mm Spanner Wrench is designed very small to fit in tight places. Its small size also limits the amount of torque the user can apply while locking the ball joint.
- Before leaving the OR, the user must confirm that each strut's ball joints and quick release mechanisms are locked. A thorough review of the entire frame is recommended to ensure that all other components and connections are securely tightened.
- **The colored safety nut does NOT lock the quick release mechanism and it is possible to close the safety nut while the quick release is in the unlocked position. Take caution to not confuse the safety nut's closure as locking the quick release mechanism. To lock, the quick release's pin must be aligned in the closed padlock position. The safety nut is closed afterward to prevent inadvertent rotation/ unlocking of the quick release mechanism post-operatively.**

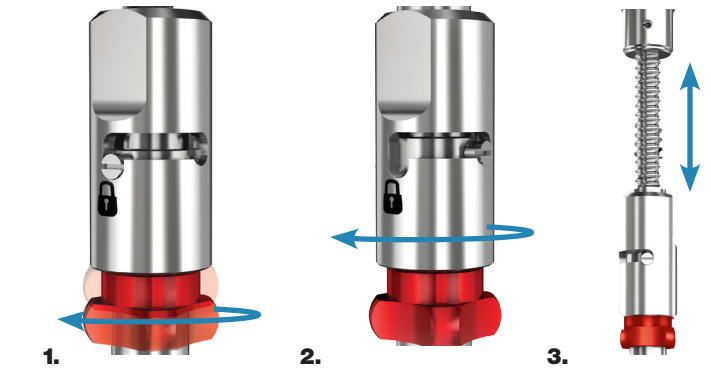
Telescopic Strut Adjustment

Gross Length

1. Unthread the safety nut down to the line (groove). Do not unthread the safety nut beyond the groove, as this may cause the quick release mechanism to disassemble. In the event that this happens, hold the quick release mechanism and screw the colored safety nut back up to the grooved ring.
2. Unlock quick release mechanism by aligning the pin in the unlocked position.
3. Adjust strut to desired length.
4. Once proper length is achieved, lock the quick release mechanism by aligning pin with locked padlock symbol.
5. Hand tighten the colored safety nut.
6. When frame is not perfectly aligned and the length of the construct needs to be adjusted, unlocking the ball joints at the threaded end of the strut will help ease travel of the ring.

Fine Tuning Length of Telescopic Struts

1. Lock quick release mechanism by aligning the pin in the locked padlock position.
2. Tighten the ball joint on the threaded end of the strut
3. Unlock the ball joint on the tube end of the strut
4. The clawed end of the “Telescopic Strut Wrench" (“Slingshot Wrench”) can be used to engage the horizontal pin just above the Dynamization Wheel if fine tuning cannot be done with fingers. One full rotation of the tube end of the strut is equal to 2mm of travel. There are directional arrows located on the end of the strut that indicate which way for distraction or compression. (+ distraction/ - compression).
5. Once fine tuning length is complete, the ball joint at the tube end of the strut is securely locked.



Fine Tuning | **Closed Dynamization Wheel** | **Open Dynamization Wheel**

6. **Do not apply wrenches to the flats located on the quick release mechanism. These are for finger tightening only. Using a wrench may shear off the quick release’s locking pin, destroying the strut.**
7. Always confirm that struts are securely attached to rings with M8 connecting nuts before manipulating ball joints to adjust the length.
8. To avoid inadvertent stress on the construct during fine length adjustments, do not make substantial adjustments to a single strut all at once. Doing so may cause other struts to bend. When large amounts of compression or distration need to be applied, it is recommended that small incremental adjustments be made across all struts (similar to tightening lug nuts on a car tire).

Frame Dynamization

- The Universal Telescopic Struts feature built-in dynamization wheels that can be opened to allow for a specified amount of controlled micro-motion in the frame. The Dynamization Wheel can usually be adjusted by hand. If additional grip is needed, the wide end of the Telescopic Strut Wrench can be used.

- Anywhere from 0 to 5mm of dynamization can be introduced as indicated. Each full revolution of the Dynamization Wheel is equivalent to 1mm of dynamization. The micro-motion enabled by the Dynamization Wheel is focused purely in the axial plane and is only compressive. No shear forces are introduced.
- Confirm that struts are fully tightened to rings and that quick release mechanisms and ball joints are securely locked before enabling dynamization. If any of these connections are loose, you may unintentionally spin the entire strut around in place without actually opening the Dynamization Wheel. Furthermore, it may be possible to make inadvertant length adjustments if the ball joint at the tube end of the strut is unlocked.

Telescopic Strut Adjustment

Features & Benefits:

Feature
Ball-jointed fixation bolts are located at each end of the Telescopic Strut.

Benefit A
The ball joints incorporated in the Telescopic Strut are designed to allow the user to connect rings that are not perfectly parallel or rings that are of different diameters. This may be especially beneficial to surgeons who prefer a rings first approach when applying circular frames. This is not easily accomplished with traditional, static threaded rod systems that require offset plate adaptors and additional subcomponents to connect non-parallel or different size rings.

Benefit B
The ball joints are designed to allow the user to easily relocate the position of one end of the strut to accommodate other frame components. Because the ball joints can angulate 12 degrees from neutral, one end of the strut can remain anchored and still allow the other end of the strut freedom to reinsert into an open adjacent hole. This benefit may be appealing to the surgeon who is accustomed to applying pre-assembled frames and wants the option of easily being able to modify the core construct (struts and rings) to make room for pin/wire fixation components if need be.

Benefit C "Sticky Tight"
Once the frame is assembled, the ball joints on both ends of the Telescopic Struts can be partially tightened to the point where they can still be moved, but are not completely locked (sticky tight). By tightening the ball joints' locking bolts just enough to meet some initial resistance, the prebuilt frame can be moved and manipulated into the ideal position without having to fully unlock and relock specific ball joints each time a small gross adjustment is made. This cannot be accomplished with threaded rod systems or struts that utilize universal hinge joints like the traditional hexapod style fixator.

Feature
The strut's ball joint surfaces are grooved with small serrations.

Benefit
This textured surface is designed to better withstand ball joint slippage.

Feature
Quick release mechanism coupled with wider thread pitch on the threaded end of the strut. 1 full revolution is equal to 2mm of + distraction/ - compression travel.

Benefit
Rapid length adjustment of the struts can be accomplished by unlocking the quick release mechanisms. Once locked, the strut can be finely tuned twice as fast as competitive systems that compress/distract at a rate of 1 turn = 1mm. This may allow the user to precisely adjust at a faster rate. Note: The wide thread pitch is designed for speed, not for gradual adjustments that are typically deployed in .25mm increments. The LRF Telescopic Struts also lack a built-in measuring scale to monitor incremental adjustments.

Feature
The Hoffmann LRF has advanced, built-in dynamization mechanisms.

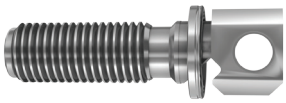
Benefit
The LRF construct is designed to be very stable. In cases where some micromotion is warranted to promote callus formation, the user can introduce a specified amount of controlled dynamization (0-5mm) into the struts. Shear forces, which may be detrimental to the health of the regenerate bone, are inhibited and compressive micromotion is solely focused in the axial plane.

Feature
Low profile, open frame design with reduced subcomponents.

Benefit
The LRF only requires 3-4 struts depending on the indication. In addition to potentially longer assembly time, hexapod style systems that require a minimum of 6 struts may obstruct radiographic assessment and physical access to the surgical site. By minimizing the number of strut subcomponents needed, assembly may be faster and visualization and access may be improved. Furthermore, the struts can be positioned virtually anywhere on the ring for optimized visualization and access to soft tissues. Hexapod based systems require struts to be connected to rings in very specific locations and will not work if struts are attached out of place. This may potentially limit the surgeon's pin/wire placement freedom, especially in smaller diameter rings.

Hoffmann LRF Reference Guide

Wire Bolt



Description

Wire bolts are used to anchor wires to rings and are available in short, medium, and long sizes. The medium and long sizes allow the user to add washers beneath the head of the wire bolt to capture wires hovering above or below the ring's surface. A chamfer on the Wire Bolt head serves as sight indictor for the Wire Bolt's slotted side, which can accommodate 1.5, 1.8, and 2.0mm diameter wires. Built-in grooved washer is designed to improve wire pullout strength. The cannulated Wire Bolt head is designed to accommodate the Wire Bolt Wrench and Tensioner Nose.

Key Notes

- All carbon fiber rings have a 10.5mm thickness, making them too thick for the short wire bolts. Although you will be able to seat short wire bolts directly into the carbon ring, there are an insufficient number of exposed wire bolt threads to fully engage the M8 connecting nut. Only the medium and long wire bolts can be used directly through the carbon fiber rings.

- The built-in grooved washers on wire bolts are designed to improve wire-holding power. Competitive wire bolts typically compress the wire directly into the ring's surface. Certain materials/finishes (ie. carbon fiber) are more prone to slippage and wire tension may degrade slowly over time. Weight bearing on the frame may also impact tension levels.

- **Take caution not to apply excessive torque when tightening the LRF Wire Bolts. If significantly over-tightened, the washer grooves may deeply notch into the wire, creating a weak point and a higher risk of breakage.**

- **The design of the LRF Wire Bolt is not conducive to bent wire compression techniques. Wires should pass through the Wire Bolt slot on a straight trajectory. Any kink or bend in the wire, especially at the Wire Bolt interface, may increase the risk of wire breakage.**

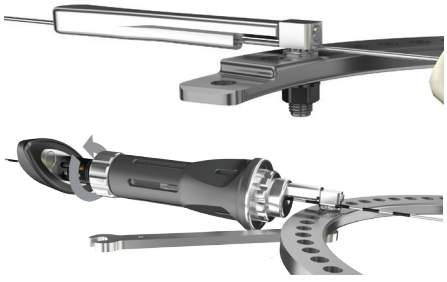
Features & Benefits

Feature
Built-in grooved stainless steel washer.

Benefit
Designed for improved wire holding power, which may reduce wire slippage and tension loss throughout the course of treatment.

Feature
Cannulated wire bolt head.

Benefit
The cannulation is designed to better engage and retain these instruments directly within a wire bolt, which may reduce the risk of dropping instrumentation during surgery. Engaging these instruments through the cannulation is designed to allow the user to control proper wire/wire bolt alignment during tightening and maintain a straight trajectory of the wire.



Wire Bolt Adaptor

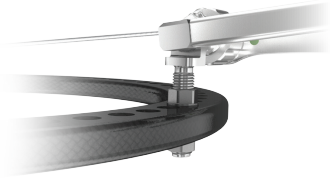
Description

Wire bolt adaptors are used in conjunction with wire bolts to capture obliquely inserted wires or wires inserted above or below the ring's surface. Wire bolt adaptors are available in long and short versions and are attached to rings using M8 connection nuts.

Key Notes

- Short wire bolts feature a built-in retention clip for provisional snapfit connection to rings without the need for using nuts. Wire bolts are inserted into the cradle side of the adaptor and connected with an M8 connecting nut. If a wire bolt is attached on the outside of the adaptor's cradle, the wire will no longer be in line with the center axis of the Wire Bolt shaft. This offset placement may cause the entire wire bolt/wire bolt adaptor assembly to slip and rotate within the hole of the ring. When this occurs, wire tension is usually lost.

- Utilize counter torque instrumentation (wire bolt wrench) to avoid bending/kinking of wires during tightening.



- Long wire bolt adaptors are attached to rings using (2) M8 connecting nuts. An M8 connecting nut is required on both sides of ring and (2) wrenches (one serving as a counter-torque) are needed to properly attach a wire bolt adaptor to the ring. Colored washers can also be used to achieve the proper height off the ring.
  - Washer 1mm, Black
  - Washer 2mm, Yellow
  - Washer 4mm, Blue
  - Washer 7mm, Red

Wire Bolt Adaptor

Features & Benefits

Feature
Long wire bolt adaptors are not fixed-length components.

Benefit
The post of a long wire bolt adaptor is fully threaded and is designed to allow for the length of the assembly to be adjusted to the wire's exact location above or below the ring. This feature may reduce the potential need to force wires into place, which may bend and compromise the wire's longevity.
Competitive, fixed length adaptors lack this level of precision, which may result in wires being forced into alignment with a wire bolt's wire slot. Additionally, competitive, fixed length adaptor systems need to include numerous sizes to accommodate various height offsets.

Feature
Short wire bolt adaptors with built-in retention clip.

Benefit
The built-in retention clips on short wire bolt adaptors allow for a provisional snap-fit connection to a ring without the need for using an M8 nut. This may reduce the incidence of dropping components, especially if placed underneath the ring.

Recommended Tension Levels

50kg Tension

- Wire Bolt Offset Adaptor, Long (4933-1-005) used with Wire Bolt Short (4933-1-001)

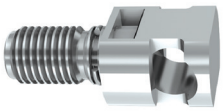
90kg Tension

- Wire Bolt Offset Adaptor, Short (4933-1-005) used with Wire Bolt Short (4933-1-001)
- Wires used on Foot Rings

130kg Tension

- Wire Bolt, Short (4933-1-001)
- Wire Bolt, Medium (4933-1-002)
- Wire Bolt, Long (4933-1-003)

Apex Pin Bolt



Description

Apex pin bolts are designed to connect half pins directly parallel and close to the ring. One piece design is compatible with 3, 4, 5, & 6mm pins. Apex pin bolts are attached to rings with M8 connecting nuts.

Key Notes

- Pin bolt should be provisionally tightened around soft tissue protector sleeve with thumbwheel. If spanner wrenches are used be careful not to over-tighten because sleeves may deform and prevent passage of the drill guide and/or half pin. Provisionally tightening the pin bolt around sleeve may help prevent the pin from translating and bending during final tightening.
- Built-in retention clip allows for provisional snapfit connection to ring without nuts.

Features & Benefits

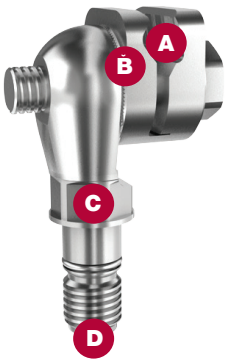
Feature
The LRF Apex Pin Bolt will accept a 3, 4, 5 or 6mm pin.

Benefit
Having one bolt for multiple pin sizes instead of one bolt for each pin size reduces inventory and may simplify the procedure.

Feature
Built-in retention clip.

Benefit
Allows for provisional, snapfit connection to rings without nuts. This may lessen the incidence of dropped components and also allows the user to evaluate a potential pin site without completely attaching the clamp to the ring.

Apex Pin Adaptors



A Snapfit retention of 3, 4, 5, 6mm pin diameters

B Interdigitating serrations **C**

Built-in 10mm hex surface

D Retention clip

Description

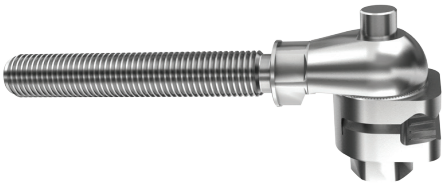
Apex pin adaptors are designed to connect half pins to rings at varying distances and angles. One piece design allows for snapfit retention of 3, 4, 5 & 6mm diameter pins. Apex pin adaptors are attached to rings with M8 nuts. They are available in long and short versions.

Key Notes

- Apex pin adaptors may be provisionally tightened around soft tissue protector sleeve with thumbwheel. If spanner wrenches are used, be careful not to over-tighten because sleeves may deform. Provisionally tightening bolt around sleeve may help prevent the pin from translating and bending during final tightening.
- Built-in retention clip allows for provisional snapfit connection to rings without nuts (short adaptor only).
- Built-in hex nut allows for a counter-torque surface for tightening assistance.
- Long apex pin adaptors are attached to rings using (2) M8 connecting nuts.

Colored washers can also be used to achieve proper height off the ring.

- Washer 1mm, Black
- Washer 2mm, Yellow
- Washer 4mm, Blue
- Washer 7mm, Red



Features & Benefits

Feature
Highly adjustable design. Capable of multiplanar pin placement. Long adaptor is not a fixed height.

Benefit
Half pins inserted in a divergent fashion may enhance construct stability more than pins inserted directly perpendicular into the bone. The Apex Pin Adaptor is designed specifically to allow for freedom of pin placement in multiple planes. Similar to a long wire bolt adaptor, a long apex pin adaptor's post is fully threaded and allows for exact pin placement above or below the ring. Pin insertion and attachment is not dictated at a fixed distance from the ring, offering more overall freedom.

Feature
Fully integrated pin clamp assembly. Capable of capturing 3, 4, 5, 6mm pin diameters in the same clamp.

Benefit
Apex pin adaptors are one-piece assemblies (excluding the connection nuts). With minimized subcomponents to connect, there is a potential to reduce frame assembly time and overall case duration. The ability to capture multiple pin diameters in the same clamp is designed to allow the user to implant the appropriate diameter pin for the anatomy without having to utilize various size centering sleeves and set screws to anchor the pin within the clamp.

Feature
Built-in retention clip (short adaptor only).

Benefit
Allows for provisional, snapfit connection to rings without nuts. This may lessen the incidence of dropped components and also allows the user to evaluate a potential pin site without completely attaching the clamp to the ring.

Feature
Intuitive, built-in counter-torque surfaces.

Benefit
Poker chip serrations between the pin clamp-to-post interface are designed to serve as an interdigitating counter-torque surface that prevents pins from bending when final tightening forces are deployed in the coronal and sagittal planes.

The integrated 10mm hex surface on the neck of the pin adaptor allows for the use of counter-torque wrenches, minimizing unwanted torque and potential pin bending when final tightening forces are deployed in the transverse plan.

Hoffmann LRF Reference Guide

Static Strut

Description

Static struts are commonly used to create double-stacked ring "blocks". Static struts are 8mm in diameter and come in 20, 30, 40 & 60mm fixed lengths. They are designed with a built-in counter-torque hex for tightening assistance and are attached to rings using connection bolts.

Key Notes

- Static struts are a faster, easier means of creating a ring block when compared to traditional threaded rods that require numerous connecting nuts and more assembly time. The LRF Static Struts are 8mm in diameter, making them mechanically compatible with Hoffmann modular pin-to-bar clamps.

Features & Benefits

Feature
8mm shaft diameter. Mechanically compatible with Hoffmann pin-to-bar fixation.

Benefit
With this feature, static struts can also serve as anchor points for half pins, which may be useful when using small rings or when available ring space for pin fixation is limited.

Feature
Fixed lengths.

Benefit
A fixed-length static struts is advantageous because it makes it easy to build a parallel ring block without having to measure the distance between the rings.

Posts

Description

8mm Hoffmann posts come in short (44mm) and long (88mm) versions and feature a built-in retention clips for snap fit connection into rings without nuts. These posts are commonly used to add supplemental fixation, including additional pins that can be added to the construct using the Hoffmann modular fixation couplings. Both versions include a built-in counter-torque hex surface for tightening assistance.

Key Notes

- 8mm Hoffmann posts are a fast and easy way to add supplemental fixation to a frame. These posts also allow the use of Hoffmann bar-to-bar clamps, which may further increase construct flexibility and customization.

  The 7mm end of the spanner wrench can be used to tighten Hoffmann II and 3 couplings on posts.

  (4) Hoffmann 3 pin-to-bar couplings are included in the Universal Components Tray of the LRF set. **Hoffmann rods are not included in the LRF set.**

Features & Benefits

Feature
Long Hoffmann post is 88mm in length.

Benefit
The length of a long post makes it easy to add a half pin high above or below the ring. Of all the pin fixation options in the LRF System, this post allows the most distance from the ring. This may help the surgeon achieve a good spread of fixation while keeping the core construct compact.

Feature
Non-threaded post.

Benefit
The surface of the post is non-threaded, allowing attachment of supplemental clamps virtually anywhere on the post. There is no need to adjust the height of the post in relation to the ring, as clamps can be attached in the ideal location and plane. It is also possible to attach multiple, independent pins in different planes to the same post.

Feature
Posts have built-in retention clips.

Benefit
Built-in retention clips allow posts to be provisionally snapped into the rings without the use of nuts. This reduces the incidence of components being dropped during surgery and also allows the surgeon to assess pin placement without fully attaching the post to the ring.

Connection Bolt

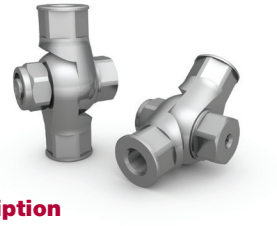
Description

Connection bolts are used to attach static struts to rings and are also used to attach open and ring segments to create a full ring. Additionally, they are used to attach hinge couplings directly to rings and foot arches.

When used to connect open and ring segments, the connection bolts are used with M6 connecting nuts.

Hoffmann LRF Reference Guide

Hinge Coupling



Description

Hinge couplings can be connected to threaded rods to create a wide range of hinged constructs and assemblies. They are constrained, offering motion in a single plane and can be locked to inhibit motion as indicated. Hinge couplings are desinged with built-in counter-torque surfaces for tightening assistance as well as a cannulation for guide wire targeting.

Key Notes

- It is recommended that hinge couplings be reinforced with M6 nuts when attaching to threaded rods. This may help prevent connections from loosening throughout the course of treatment.

Features & Benefits

Feature
Wire cannulation.

Benefit
The Hinge Coupling's wire cannulation is designed to help align the pivot point of the hinge in a specific plane or axis of rotation. After identifying the center axis of rotation with a guide wire, a hinge coupling can be slid over the wire to properly align the pivot point so that motion can occur in the proper plane around the targeted axis of rotation.

Washers

Description

Washers are used to build up to wires & pins. They are used in conjunction with wire bolts, wire bolt adaptors & apex pin adaptors. LRF washers come in 1, 2, 4 & 7mm.

M8 Nuts

Description

M8 connecting nuts are used to attach wire bolts, wire bolt adapters, pin bolts, and struts to the rings. They are coated with nickel teflon and are available in long and short versions.

Key Notes

- Long M8 nuts cannot be used to attached the telescopic struts to rings because their height blocks wrench access to the ball joint's locking bolt.

Features & Benefits

Feature
Built-in washer.

Benefit
The built-in washers on the M8 connecting nuts are designed to allow for more surface area at the component interface to reduce the incidence of loosening.

Feature
Long M8 connecting nut.

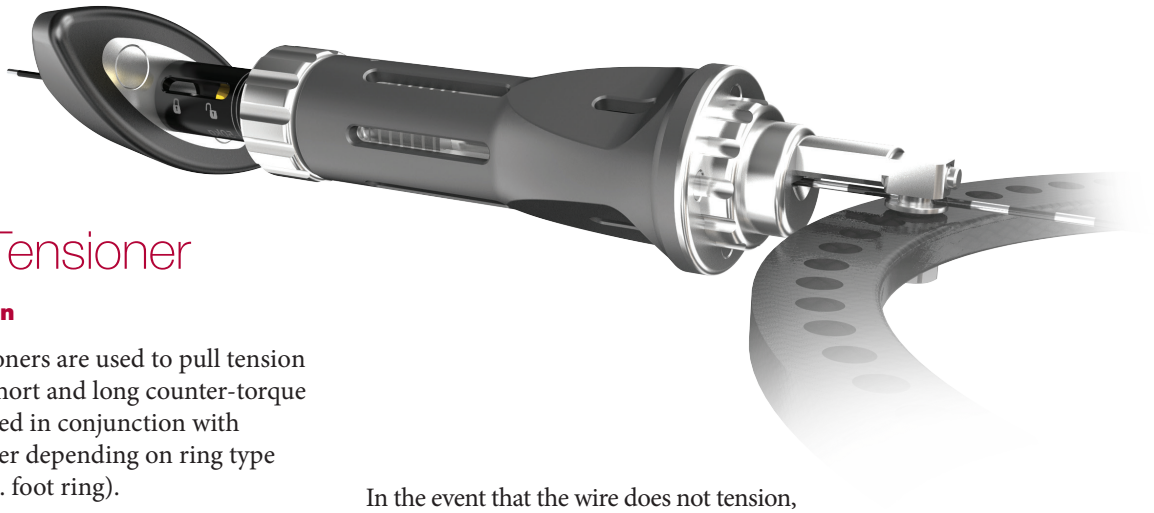
Benefit
The Long M8 Connecting Nut is designed to allow for ease of wrench access when components are placed close together.

Feature
Nickel teflon coating

Benefit
Nickel teflon creates a hardened surface area on the nut. This hardened surface area reduces friction and inhibits cold welding and allows nuts to be tightened down farther with less force. This may help reduce the risk of frame components loosening throughout the course of treatment. It may also help wires to maintain their tension for a longer period of time.

Note:
Take caution not to over-tighten M8 connection nuts on wire bolts. Because the coating allows for greater amounts of torque to be applied, over-tighening may crimp and weaken wires.

Hoffmann LRF Reference Guide



Wire Tensioner

Description

Wire tensioners are used to pull tension on wires. Short and long counter-torque nose are used in conjunction with the tensioner depending on ring type (circular vs. foot ring).

Wire Tensioner Directions

Select the appropriate tensioner nose depending on the ring type and attach to the tensioner using the red-tipped Tensioner Wrench.

Make sure that the opposing wire/wire bolt is definitively tightened. Failure to do so will cause the tensioner to pull the wire out of the opposing wire bolt without introducing tension.

Before introducing wire into tensioner, ensure that gold indicator on tensioner is on the open padlock (counter-clockwise turn on black handle).

Slide the tensioner over the wire, feeding the wire through the tensioner's cannulation just below the counter-torque's nose. Simultaneously, insert the nose of the tensioner into the hole in the Wire Bolt.

Turn black handle clockwise to tension wire to the desired level. Clearly visible tension level indicators aid in dialing in precise amount of tension. Once appropriate tension level is achieved, tighten M8 nut with the appropriate 10mm wrench.

Once wire bolt is definitively tightened on wire, the tensioner is removed off the wire by rotating the black handle counter clockwise until the gold indicator is in the open padlock position. Once in the open position slide off the wire.

In the event that the wire does not tension, pull tensioner off wire and confirm tensioner is completely open (indicator is on the open padlock position) and repeat wire tensioning steps.

Trim or curl excess wire from both sides of frame.

Recommended Wire Tension Levels

130Kg Tension

- Wire Bolt, Short
- Wire Bolt, Medium
- Wire Bolt, Long

90Kg Tension

- Wire Bolt Adapter, Short used with Wire Bolt, Short
- Wires used on foot rings

50Kg Tension

- Wire Bolt Adaper, Long used with Wire Bolt, Short

Key Notes

- Trust the tensioner. The LRF Wire Tensioner has a very strong mechanical advantage, making it easy to tension wires with little exertion. Surgeons may not be accustomed to how easy it is to apply tension with this device, and may be want to apply more tension then necessary. Advise surgeons to reference the tension levels indicated on the tensioner and to avoid applying excess tension. **Do not bottom out the tensioner.**
- The long tensioner nose is used on foot rings, most commonly in the back corners where there is more distance between the edge of the ring and the ring holes.
- Before introducing wire into tensioner confirm that the gold indicator on tensioner is set on open padlock. Having the tensioner not fully open may prevent wire from not passing through tensioner or tensioning properly.
- The counter-torque nose on the tensioner can be used to help "steer" and guide the wire during tensioning so that it maintains a straight trajectory out of the wire bolt. Before definitively tightening down the Wire Bolt, ensure that there is no bending or kinking of the wire as it exits the Wire Bolt.

Features & Benefits

Feature
Modular counter-torque tensioner noses.

Benefit
The modular counter-torque noses allow the user to tension directly off of the Wire Bolt while using the device to steer and maintain a straight wire trajectory during tensioning and final tightening. This eliminates the need to use a separate counter-torque wrench to prevent the Wire Bolt from rotating within the hole during tensioning and tightening.

Hoffmann LRF Reference Guide

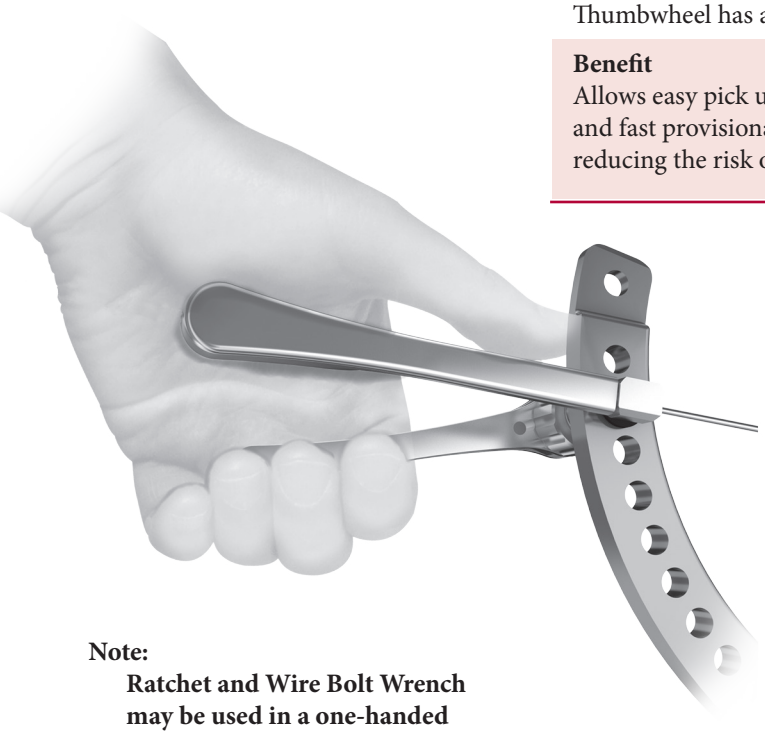
Wire Bolt Wrench

Description

Wire bolt wrench is designed to provide counter-torque to wire bolt when tightening down M8 nuts so the wire does not bend or kink. Wire bolt wrench is cannulated to capture the wire and protect the surgeon's hand.

Key Notes

- Wire bolt wrench is designed to sit inside the cannulation of the Wire Bolt head. This is designed to help retain the wrench within a wire bolt and reduces the incidence of dropping during surgery.



Note:
Ratchet and Wire Bolt Wrench may be used in a one-handed technique.

Thumbwheel for Ratchet Wrench

Description

The Thumbwheel for Ratchet Wrench can be used in conjunction with the Ratchet Wrench to gain better access when tightening nuts and bolts. It has the same 10mm size as the Ratchet Wrench. When used separately from the Ratchet Wrench, the Thumbwheel can be used for provisional tightening of nuts, bolts & apex pin adaptors.

Key Notes

- Retention clip inside thumbwheel is designed to capture and hold short M8 & M6 nuts.
- The Ratchet Wrench with Thumbwheel used in conjunction with the Wire Bolt Wrench allows for one handed tightening.

Features & Benefits

Feature
Thumbwheel has a built in retention clip.

Benefit
Allows easy pick up of M8 & M6 nuts and fast provisional tightening, while reducing the risk of dropping them.

Ratchet Wrench

Description

The Ratchet Wrench can be used to tighten connection bolts, M8 & M6 nuts. The Ratchet Wrench size is 10mm.

Key Notes

Red dot facing ring will tighten & green dot facing ring will loosen.

5mm Yellow Tear Drop Wrench

Description

The Yellow Tear Drop Wrench is used to lock and unlock ball joints on the Telescopic Struts.

Key Notes

- It is possible to over-tighten the ball joint during locking. Over-torquing the ball joint's locking bolt may cause it to deform. This is why a linear, "teardrop" driver style wrench is used instead of a traditional spanner wrench. In the case of a closely stacked ring block, access to the ball joint's locking bolt may be too limited to seat the Yellow Teardrop Wrench. The 5mm Spanner Wrench is designed very small to fit in tight places. Its small size also limits the amount of torque the user can apply while locking the ball joint.

Thumbwheel for Telescopic Struts

Description

Telescopic struts are delivered with the ball joints locked in neutral position. If ball joints are loosened, the neutral position can be restored using the dedicated Thumbwheel for Telescopic Struts in following order:

Step 1:
Provisionally hand-tighten the ball joint in as close to neutral position as possible.

Step 2:
Align the two buit-in flats within the thumbwheel with the two flat surfaces on the built-in hex at the end of the Telescopic Strut.

Step 3:
Slide the Thumbwheel over the ball joint. Slight rotational movements might be necessary to fully seat it in place. Once properly seated, the ball joint locking bolt should be fully exposed at the end of the Thumbwheel.

Step 4:
Apply the Spanner Wrench on the counter-torque surface of the Telescopic Strut Wrench while using the Yellow Teardrop Wrench to lock the ball joint.

Step 5:
Remove the thumbwheel leaving the locked ball joint in neutral position.

Telescopic Strut Wrench "Slingshot Wrench"

Description

The Telescopic Strut Wrench also known as the "Slingshot Wrench" has two functions. The first being is to turn the Dynamization Wheel of the strut. This is done by using the larger side of the Slingshot Wrench to grab the ridges on the Dynamization Wheel.

The clawed end of the Slingshot Wrench is used to engage the horizontal pin just above the Dynamization Wheel if fine tuning (+ distraction/ - compression) cannot be accomplished by hand.

Split Wire Sleeve

Description

The Split Wire Sleeve is used as a soft tissue protector for wire insertion. Sleeve can split to allow passage of an olive wire.

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