Weatherford®

Improve drilling reliability and well integrity with liner systems

Hang Tough

Delivering a comprehensive portfolio, engineering and execution expertise to get you to total depth safely and efficiently.

Weatherford®

Aligning our Liner Systems technologies and expertise with your objectives.

We prepared this document to explain our liner hanger capabilities and expertise, demonstrate the synergies with our integrated well construction product and services portfolio, and how we can work together to reduce operational risks and costs and assure reliability, safety, and efficiency to get you to total depth.

In today's complex operational environment, it's imperative for operators and service companies to continually collaborate. This collaboration begins with an alignment of our technologies and expertise to your objectives. At Weatherford, our liner systems product portfolio and service organization has been driven by the reservoir and its life cycle. And our knowledge and experience has enabled us to accommodate applications over a wide range of operating conditions. We can reduce well construction costs by improving drilling reliability and lengthen productive life by delivering life-of-well integrity.

We invest heavily in liner systems—expandable, conventional and high-pressure/high-temperature (HP/HT)—and drilling-with-liner (DwL™) technologies. Our R&D, financial and engineering resources are dedicated to enhancing liner technologies and developing new products and services aimed at reducing the risk and cost of failure in liner installations.

As we continue to advance our technology and services we look forward to the opportunity to partner with you to minimize risk, deliver cost-effective solutions, and ultimately exploit more challenging reservoirs.

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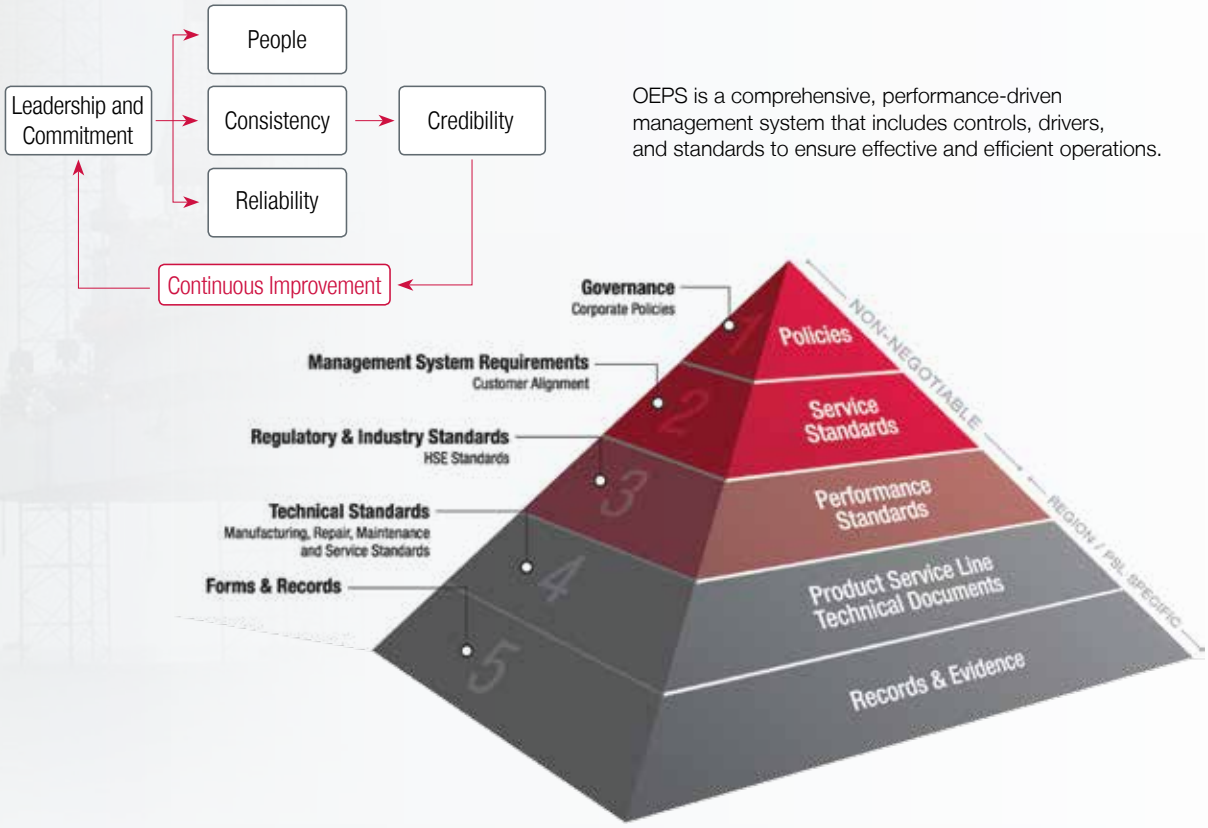
Operational Excellence and Performance

We understand your commitment to operational excellence, reliability and efficiency and your principles regarding health, safety, and the environment. We have evolved our Excellence Enterprise Policy to a client-focused, center-led and globally deployed Operational Excellence and Performance System (OEPS). This system is a comprehensive, performance-driven management system that has a number of performance controls, assurance drivers and standards. Our expectations exceed the basic ISO 9001, ISO 29001 (API Q1), ISO 14001 and OHSAS 18001 standards as well as the newly developed API Q2 standards.

Our system includes the controls necessary to ensure effective and efficient operations while maximizing our performance in service quality, health, safety, and the environment (QHSE). In addition to QHSE, OEPS includes all support functions, including security, HR, IT, procurement, real estate and contracts, as well as business-excellence controls that ensure our services and service-related products meet your reliability expectations—a critical step to delivering drilling reliability and well integrity.

Weatherford's OEPS System



OEPS is a comprehensive, performance-driven management system that includes controls, drivers, and standards to ensure effective and efficient operations.

Our approach to partnership—**Explore, Engineer, Execute.**

We recognize that our role as a service provider in today's market is about more than technology alone. It is about acquiring a deep understanding of your challenges and using sound engineering principles to develop technical solutions specific to each project. This process allows for informed decision making, proper well planning, and service delivery.

Explore: Understanding the Objectives and Challenges of Your Well

We collaborate with you to gain a thorough understanding of the objectives and challenges of your wells. Collaborating in the developmental stages of well construction enhances process safety and ensures wellbore integrity. You can take comfort in knowing that we understand how every aspect of the liner job fits together and use sound engineering principles to develop technical, fit-for-purpose solutions.

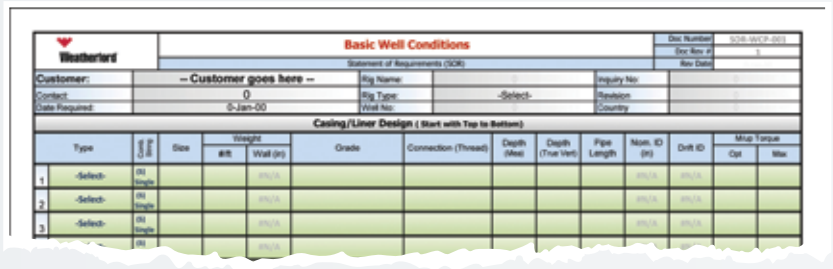
Our engineering capabilities include:

- Well engineering and well design for critical and complex wells
  - Land (conventional and unconventional)
  - Inland waters
  - Deep water
- Drilling and production engineering
- Technology application engineering and integration
- Risk analysis and management

Engineer: Matching Technology to Objectives and Well Challenges

We leverage internal synergies and expertise to design an optimized well plan. By combining up-front engineering with the best-matched well-construction technology, Weatherford provides the level of risk mitigation and economic value necessary to ensure operational success in difficult applications.

Our experienced liner systems technical support group provides pre-job planning, written procedures and job installation services. They work with you to gather information, develop a well plan and coordinate installation at the job site to ensure optimal results. Through this process of collaboration, we provide well-specific job planning and documentation by using a Statement of Requirements (SOR). The SOR contains all relevant well data and equipment details, including job plans and updates to any changes in equipment in relation to changing well conditions and job parameters.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Basic Well Conditions

Statement of Requirements (SOR)

Customer:	-- Customer goes here --	Rig Name:		Inquiry No:	
Contact:	0	Rig Type:	-Select-	Revision	
Date Required:	0-Jan-00	Well No:		Country	

Casing/Liner Design (Start with Top to Bottom)

	Type	Size	Weight #/ft	Weight Wall (in)	Grade	Connection (Thread)	Depth (Meas)	Depth (True Vert)	Pipe Length	Nom. ID (in)	Drift ID	Mup Torque Opt	Mup Torque Max
1	-Select-												
2	-Select-												
3	-Select-												

Execute: Regional Support and Infrastructure

As a true, single-source, liner hanger provider with equipment for virtually any application, we coordinate and manage a cross-product-line team to efficiently execute the installation plan and ensure consistent service delivery.

Our global infrastructure of dedicated specialists has the experience to install liners successfully and address any problems that may occur. If you need to go back and isolate the top of the liner, we can handle it. Some providers call on us specifically for this service.

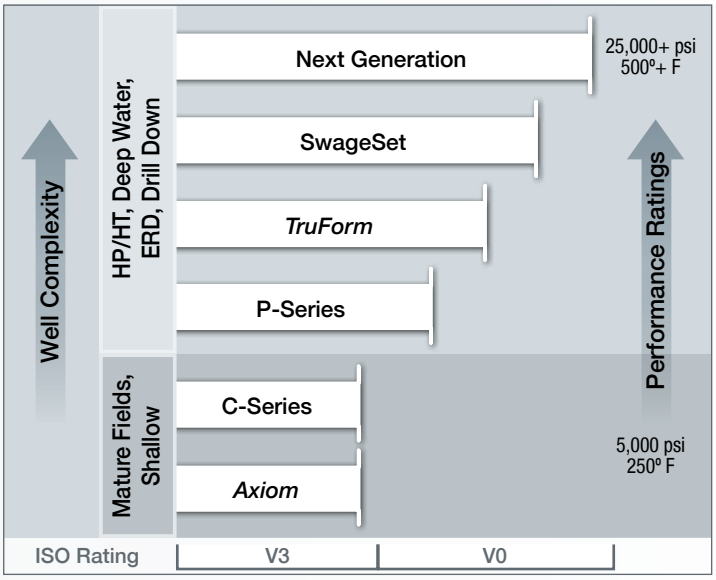
Our success is the result of a comprehensive, global operations system that includes technical and training competency standards. We develop, document and distribute all assembly, testing, redress requirements and field-installation procedures to ensure quality, reliable installation.

Total Portfolio to get to Total Depth

We initially developed durable liner systems for harsh, North Sea conditions. Our liner systems have since been used successfully worldwide in quality-critical applications such as deepwater, shale, HP/HT, extended-reach wells and other difficult environments.

Shallow, Mature Fields: Maximizing production and minimizing operating expenses are important when operating in shallow, mature fields. These applications require economical and efficiently designed liner hanger systems such as our AXIOM™ Series and C-Series, which assure cost-effective well construction.

HP/HT, Deep Water, Extended-Reach Drilling, Drill Down: The decline of conventional oil and gas sources has pushed operators to drill in more undeveloped areas such as deep water or extremely hot, high-pressure reservoirs. The challenges in these environments are complex, and require robust, reliable liner systems like our TruForm® expandable system or the SwageSet liner-top packer that can perform in these extreme conditions.



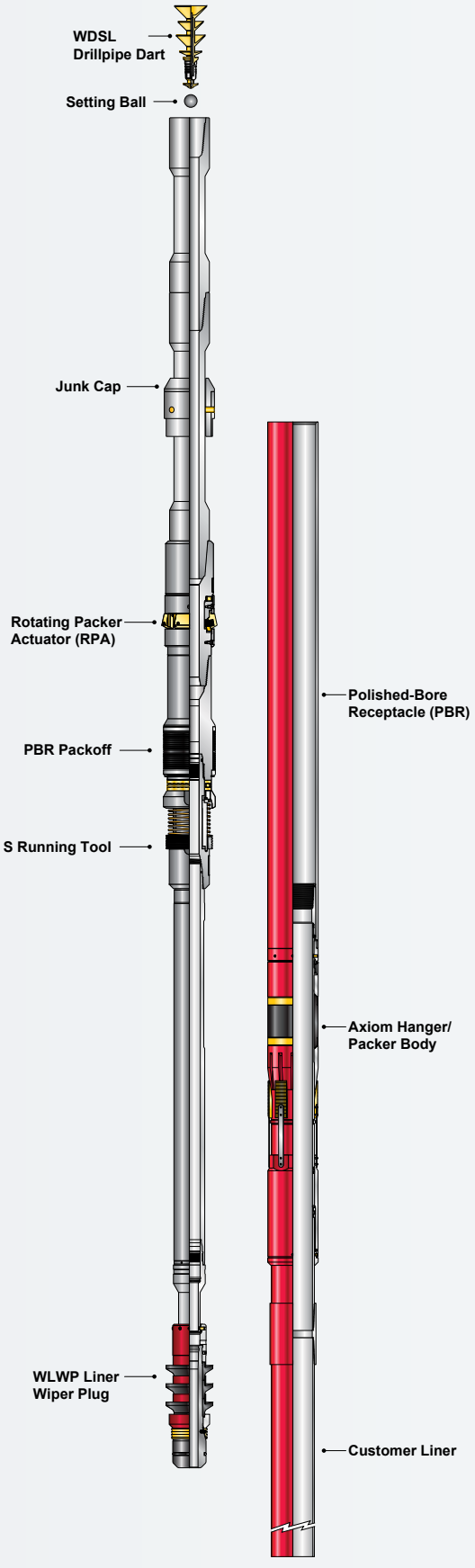
Our liner systems are designed with performance ratings suitable for a range of conditions and applications from routine to extreme.

Technologies for Shallow, Mature Fields and Conventional Onshore Applications

Axiom™ Series Liner Hanger System

The *Axiom* Series optimizes performance with its efficient, streamlined design. Hydraulically-set, it is ideal for basic well geometries with moderate temperature/pressure profiles, requiring short- to medium-length liners that do not require rotation.

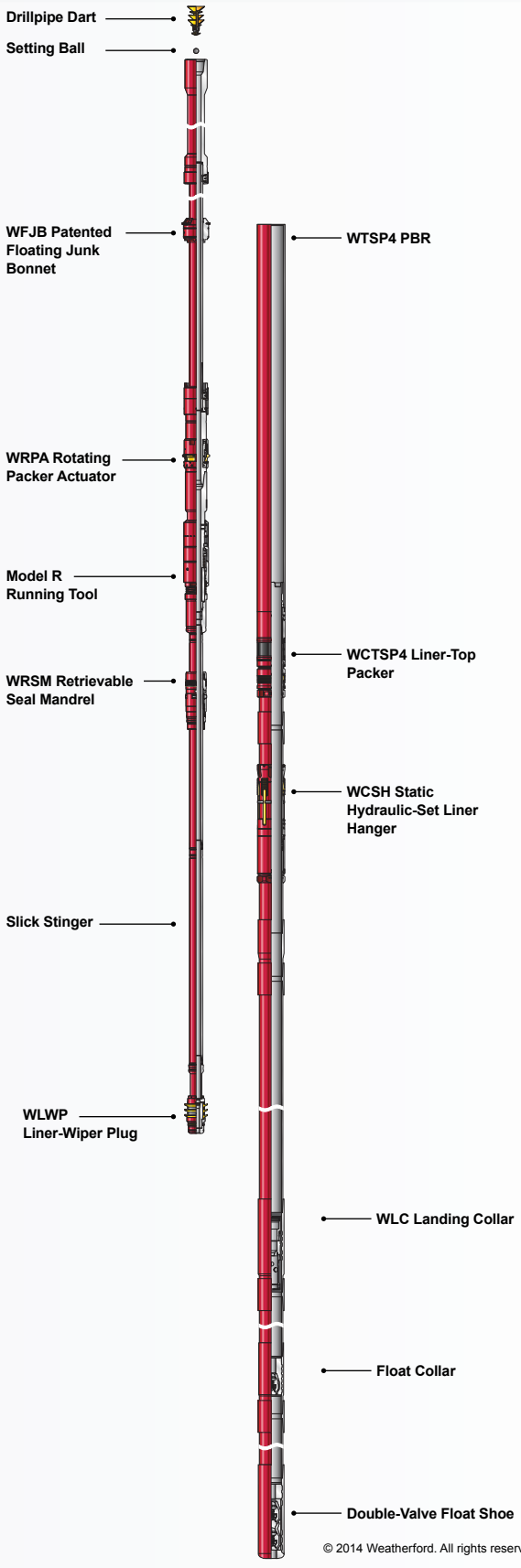
A one-piece body, integral to both the hanger and packer, eliminates potential leak paths. This design is shorter and more compact than its conventional counterparts, thereby reducing costs and maximizing performance. To support exceptional loads, the hanger incorporates a single-cone design with six slips—the same number found on typical tandem-cone hangers.



C-Series Liner Hanger System

Our C-Series system is economical without compromising on performance. It can be used with any liner that does not have to be reamed or drilled down. Rotating and non-rotating hangers are available to meet the rotation requirements of the liner during cementing.

Unlike competitor models, which typically feature three slips per cone, the C-Series hangers feature a single cone with six carburized slips that are wire-locked to the body. The design of competitive three slip-hangers causes internal forces to triangulate, which can lead to hanger failure and host casing damage. Our single-cone design with six slips results in a more robust liner hanger, enabling support for exceptional loads.



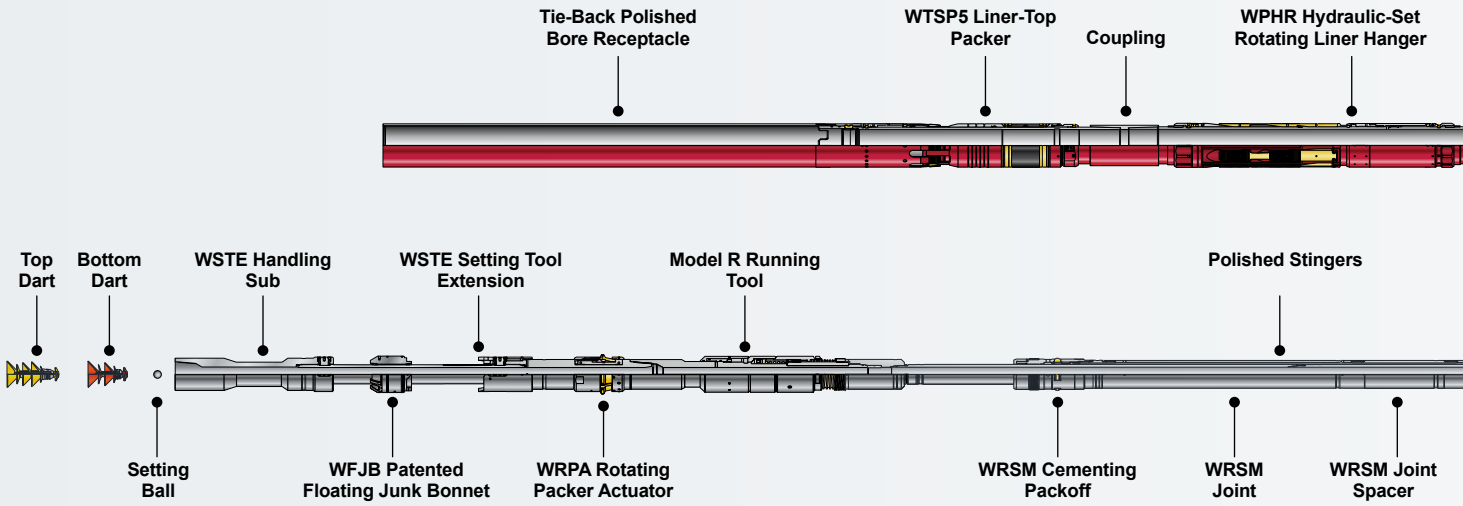
Deepwater, HP/HT, ERD and Drill-Down Technologies

P-Series Liner Hanger System

Our standard size premium P-Series liner hanger systems are protected from top to bottom against presetting and dropping, even in the harshest conditions.

The P-Series is ideal for applications such as

- cemented liners that can be rotated after setting;
- drill-down liners that can be hydraulically or mechanically set;
- liners that must be reamed down.

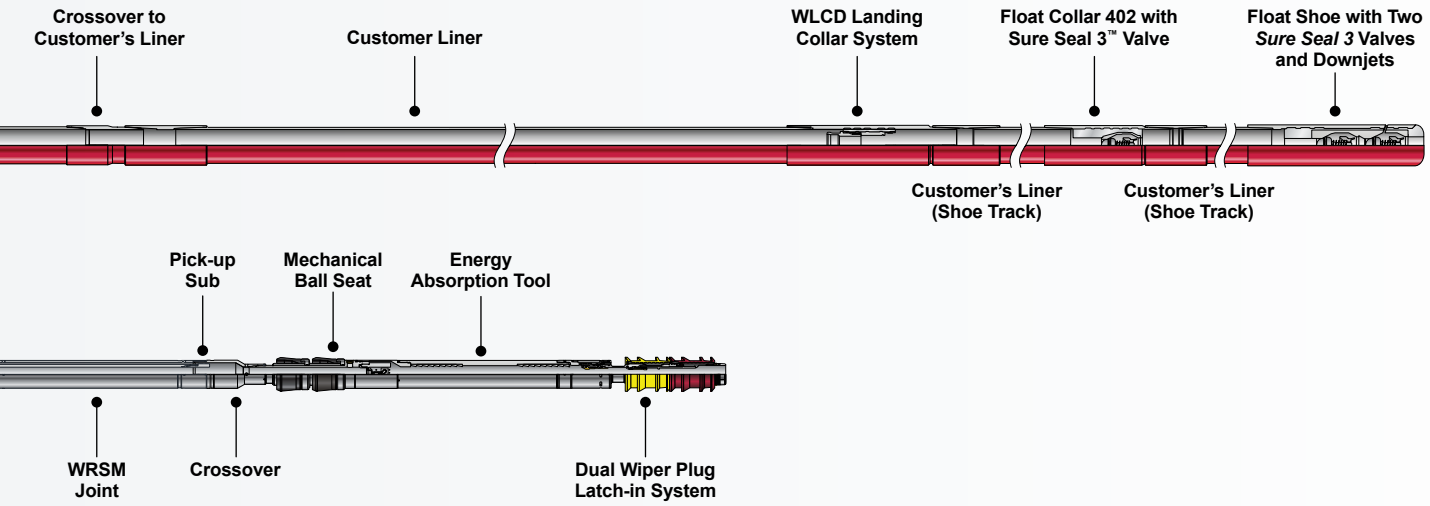


The liner-top packer can be used as a tieback completion or production packer. It is mechanically set with weight after the hanger is set and cementing operations are completed. It has been qualified up to 10,000 psi (68.9 MPa) and 350°F (176°C). Liner-top packers are run as an integral part of the liner-hanger assembly to provide a protective seal between the liner OD and host-casing ID.

This packer can be used to isolate the liner top for many types of applications, including isolating

- formation pressure below the liner top from the casing ID above;
- treating pressures below the liner top during fracture or acid work;
- formation fluids to eliminate gas migration while the cement sets;
- lost-circulation zones.

The P-Series liner hanger has the highest hanging capacity of all Weatherford liner hangers. It has outstanding rotation, push, and pull capabilities—proven in deep, highly deviated wells and in drill-down and reaming-with-liner applications. Its rotating capability is critical in achieving zonal isolation during primary cement jobs. This liner hanger is hydraulically set and is available in WPHR (rotation) and WPHS (static) configurations.



Deepwater, HP/HT, ERD and Drill-Down Technologies

TruForm® expandable liner hanger system

The *TruForm* system has been tested to rigorous ISO 14310 (API 11D1) standards and is V0 qualified up to 12,000 psi (82.7 MPa). The *TruForm* design uses a unique, thick-walled hanger body to achieve this rating without requiring additional support mechanisms to improve performance. In addition, this system has equal pressure ratings from above and below the seal elements, overcoming a common limitation in other expandable systems on the market.

Solid one-piece, thick-walled expandable body

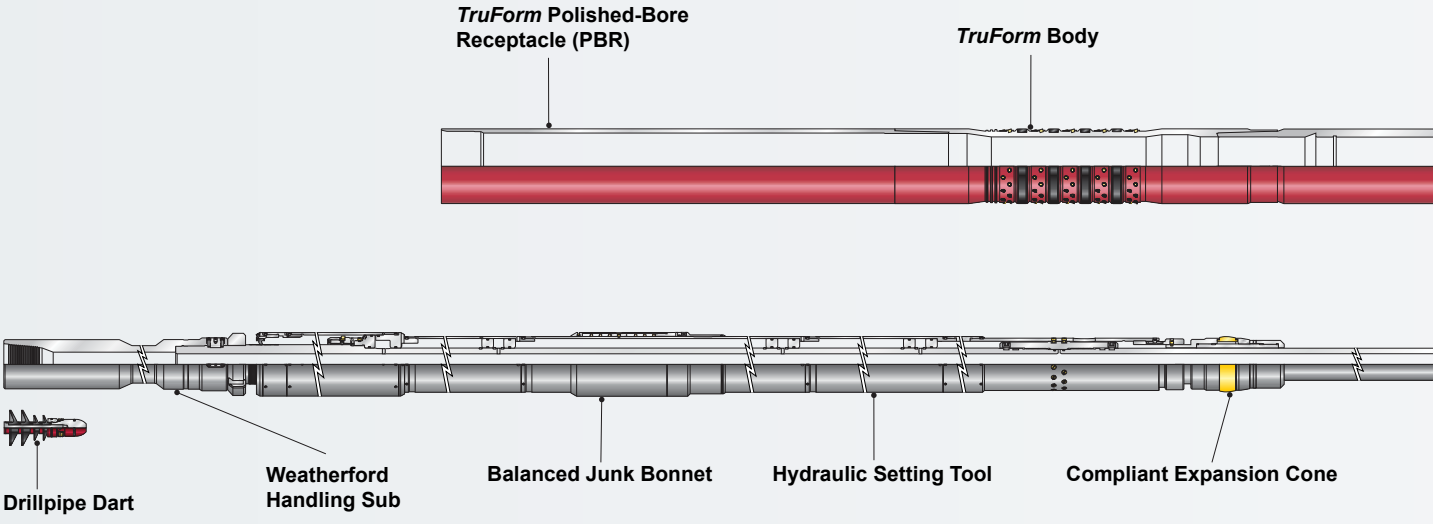
The *TruForm* system is precisely engineered and built from a thick-walled, single-piece body to provide a superior performance envelope with high burst and collapse ratings. The solid-body design integrates and protects independent anchor and seal sections, which distinguishes it from other expandable systems on the market.

Higher hanging capacity with tungsten-carbide inserts

The *TruForm* system's hanging capacity and reliability are enhanced by precision placement of tungsten-carbide inserts that are recessed to protect the casing from damage while running in the hole. When expanded, the inserts provide holding power and life-of-well durability not found in hangers that rely on rubber elements for hanging capacity.

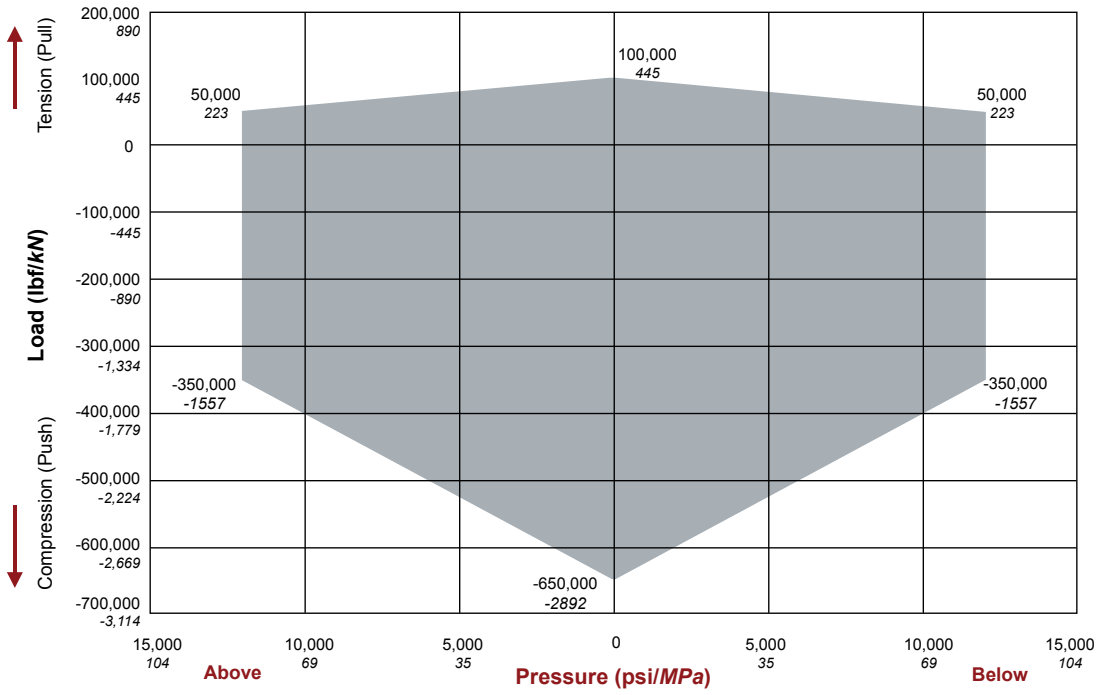
Multiple, redundant, elastomeric packer elements

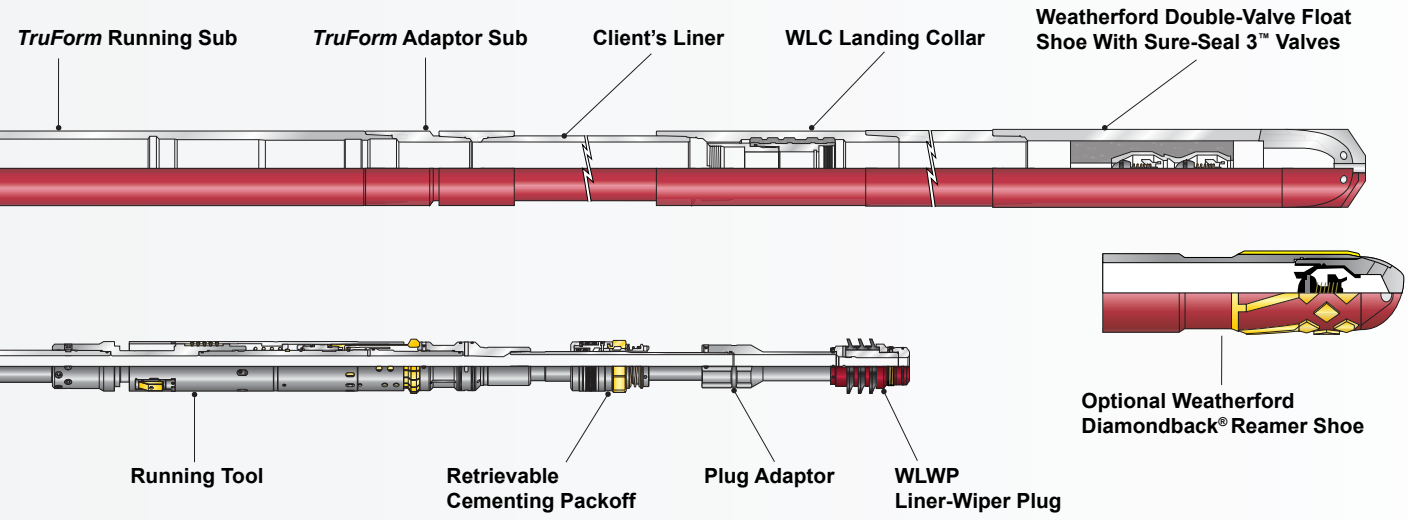
The packer system has multiple, redundant, elastomeric elements flanked with solid, anti-extrusion barriers that deform during expansion to eliminate extrusion gaps. This process creates a positive seal between the expanded liner hanger and host casing, providing maximum differential pressure capability after expansion. The elastomers are bonded to the body to resist high flow rates and swabbing during run-in and circulation.



TruForm Performance Envelope

7-in., 26.0 lb/ft (38.7 kg/m) × 9.625-in., 47.0 to 53.5 lb (69.9 to 79.6 kg/m),
ISO 14310 Level V0 Qualifications 300°F (149°C) Maximum Temperature; 200°F (93°C) Minimum Temperature





Deepwater, HP/HT, ERD and Drill-Down Technologies

SwageSet Series Liner-Top Packer

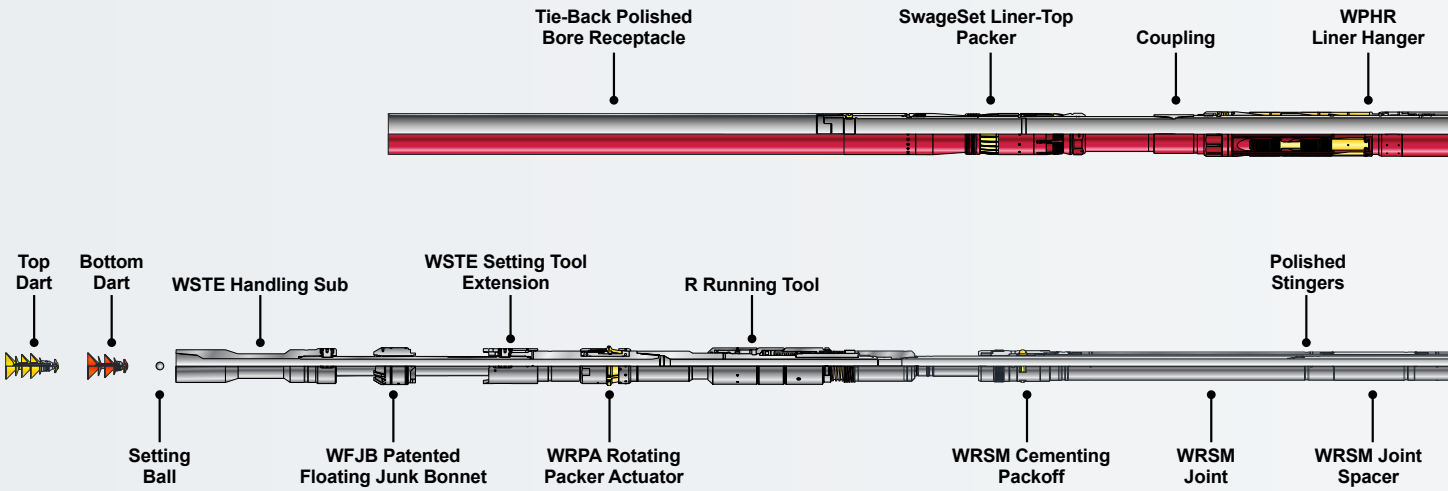
Our high-performance SwageSet liner-top packer is run as part of a liner-hanger assembly to form a permanent, anti-extrusion element between the liner OD and host-casing ID. It features a proprietary, SwageSet element that serves as a positive annular-pressure barrier at the liner top. With standard service ratings up to 15,000 psi (103 MPa) and 403°F (206°C), the SwageSet packer meets ISO 14310 standards and is V0 qualified for the most common production liner sizes. When compared to conventional liner-top packers, the SwageSet packer's patented seal element delivers high performance that also stands up to high circulation rates while running in the well.

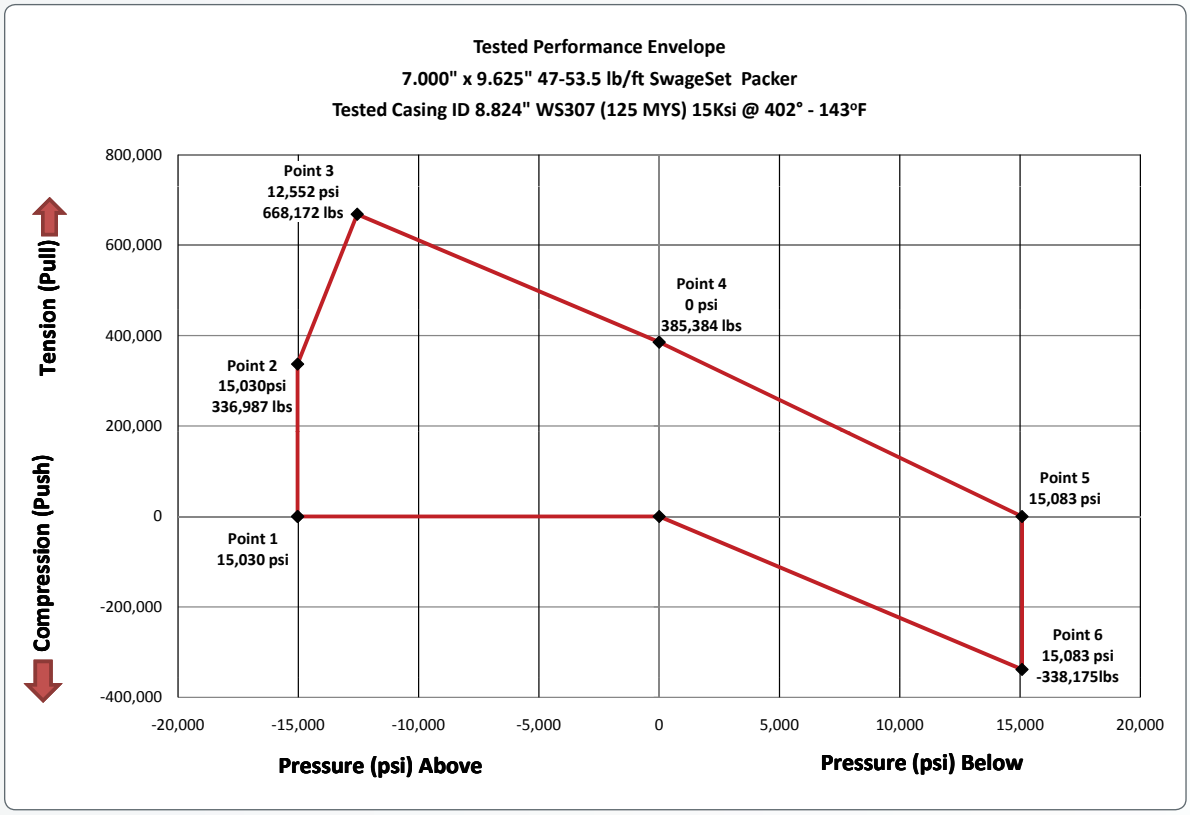
Swage-set for maximum reliability

The unique SwageSet element consists of ridge-shaped elastomers bonded to an expandable metal ring. The seal is formed by transferring set-down weight through the PBR and into the integral swage, firmly sealing the packer element against the host-casing ID. Setting force is permanently locked into the element with integral body lock rings.

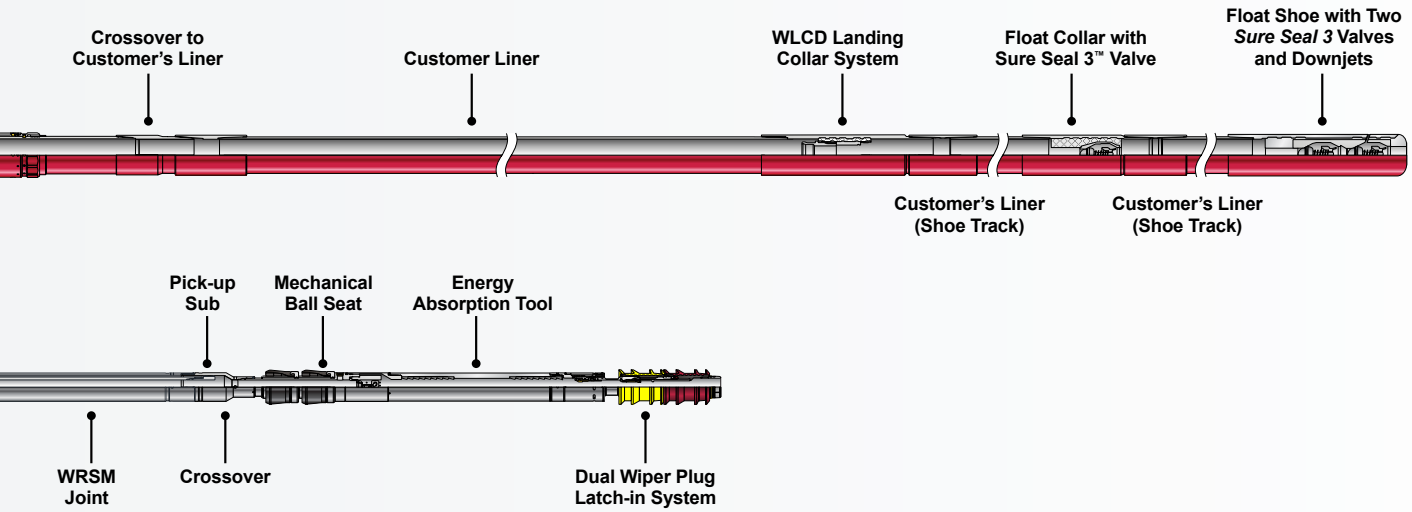
In addition to preventing gas migration and isolating annular pressures, the SwageSet seal is significantly less susceptible to swabbing off than conventional, all-elastomer seals when running in the hole, drilling, reaming or circulating at high flow rates during well cleanup or cementing, contributing to its reliability.

We offer a full suite of liner system products, including PBRs and P-Series premium hangers, which can be run in conjunction with the SwageSet packer.





The operating performance envelope illustrates the packer's ability to withstand combined loading conditions while maintaining seal integrity under the specified conditions.



System Compatibility

As part of Weatherford's Total Depth℠ services, we combine our liner systems with a vast array of well-construction technologies including tubular running services, cementing products, drilling tools, and more. We are the only company to house this expertise under one roof. This diversified selection enables us to ensure system compatibility and to accommodate a wide range of operating scenarios, getting your casing string to total depth safely and efficiently.

Complimentary Products and Services

Drilling Tools

Defyer™ Series Drillable Casing Bits provide cost-effective solutions for drilling-with-casing (DwC™) and drilling-with-liner (DwL™) systems in soft, medium or hard formations. *Defyer* series bits are made up directly onto the casing or liner, which is used as the drillstring. They enable the casing or liner to be drilled to planned depth, reducing wellbore exposure and isolating drilling hazards so that cementing operations can begin immediately. In contrast, competing casing-while-drilling systems that do not operate on rotating casing are complex and involve substantial sophisticated downhole equipment.

The **LoTAD™ Mechanical Friction-Reduction System** reduces mechanical friction independent of drilling or completion mud. The small contact area of the rollers with the borehole wall significantly reduces friction in overbalanced conditions where the risk of differential sticking is high. *LoTAD* systems are used most often in extended-reach wells where the objective is to reduce torque, drag, casing wear, tool-joint wear and differential sticking while improving directional control, rates of penetration and hole cleaning.

Wellbore Cleaning

Wellbore Cleaning Services minimize formation damage while reducing nonproductive time with a one-trip solution to safely and effectively remove wellbore debris. Remnants of drilling fluid and other debris can damage equipment, jeopardize the completion of your well and even shorten its life span. A cost-effective alternative to workovers, Weatherford's CLEARMAX™ wellbore cleaning tools incorporate specialized chemical, hydraulic and mechanical technologies to remove lingering debris, safely and efficiently.

Running Tools

Big Advantage (BA) running tools are 6 5/8-in. full-hole running equipment specifically designed for large-bore liner hanger systems 9 5/8-in. and larger that have the strength to withstand high tensile and torque loading. BA running tools include a remotely controlled top-drive cementing head for high-pressure, high-torque conditions that enables the release of setting balls and drillpipe darts without interruption of operations.

The **Mechanical Ball Seat (MBS)** is a patented device that temporarily plugs the running string to provide the pressure-tight chamber necessary to hydraulically activate the liner hanger or release the running tools. The setting ball lands in a steel ball seat and when sheared, cams over to the side retaining the ball, providing full ID through the tool. The MBS can operate in horizontal and vertical wells and is recommended for pressure-sensitive formations and casing designs with close-tolerance annuli. Our energy absorption tool is run just below the mechanical ball seat, redirecting the fluid surge to the center, away from plug mechanisms and stabilizing pressure spikes.

Cementing Products

The **Remote-Control Top-Drive Cementing Head (RC-TDH)** allows the release of setting balls and drillpipe darts without breaking connections. The RC-TDH is pre-loaded with the setting ball, drillpipe dart(s), or full-length wiper plug(s) and can be racked in the derrick for easy access. The well can be circulated through the RC-TDH using a top-drive or cement unit with the darts and setting-ball loaded, simplifying operations and saving rig time when the cementing head is being used. The ball and darts are released by using a remote-control panel specifically designed to release them in the correct order, even while rotating and reciprocating the drillstring. This eliminates any connection breaks, enhances cementing efficiency and increases safety.

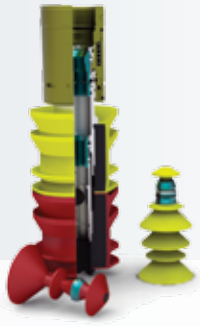
The **Large-Bore Auto-Fill II Float Collar** is used in primary cementing for pressure-sensitive formations, close-tolerance annuli or vertical and high-angle wells. The collar features two large-diameter valves held open by a unique auto-fill sleeve and tube mechanism. This debris-tolerant, auto-fill collar reduces surge pressure, allowing casing and liner runs at higher speeds while reducing mud losses and formation damage, especially where close casing tolerances exist. Its large-diameter, two-valve system provides added security.

The **SurgeMaster™ II Multiple-Opening Diverter Tool** reduces surge pressure and mud loss while increasing casing and liner running speeds. The tool operates by directing mud into the annulus above any restrictions. It has large bypass ports that move from *closed* to *open* positions automatically while pipe is run in both vertical and horizontal wellbores, increasing running speed. It can open and close ports as many times as necessary without dropping a ball. The cyclic function of the tool is disabled by increasing the running string's internal pressure to a preset amount, saving time and enhancing safety by eliminating the need for operator intervention.

The **Bow-Spring Centralizer Sub** has a unique centralizer that recesses completely into the sub body to permit passage through the tightest restrictions. The centralizer then expands into underreamed or openhole sections to provide excellent centralization while cement slurry is pumped between the casing and the wellbore. The centralizer sub is ideal for use in casing strings with ultra-tight clearance. Available in non-rotating (Model 541) and rotating (Model 541R) versions, the centralizer sub meets special drilling requirements, such as running casing inside previous casing or openhole sections with extremely close annular clearances.

Stage Cementing Tools allow cementing of casing strings or liners in two or three stages. Their compact, simple design minimizes the number of moving parts, making the tools more reliable. These tools include the Eliminator® series, with smaller ODs to create increased fluid bypass and locking and anti-rotation devices that accelerate drillout to save rig time; and a hydraulic Model 754PD for primary cementing in vertical or highly deviated wells that are not conducive to free-fall opening plugs. Designed specifically for horizontal completion in today's complex formations, the Model 754PD can be placed anywhere in the casing string.

The **Sub-Surface Release™ Plug System** with integral pressure equalizer reduces surge pressures and reduces drill-out time up to 75%. The system provides superior primary cement placement when run with our subsea casing or liner-hanger systems to separate fluids while cementing. The system works in conjunction with our other surge-reducing components to protect pressure-sensitive formations.



Zonal Isolation

The BULLDOG™ ACP™ annulus casing packer provides immediate, reliable zonal isolation. When inflated, the packer provides an annular seal between the casing and the wellbore or a previously installed casing string. You can use water, cement, or drilling fluid to inflate the packer. Cement inflation provides a high-pressure, permanent annular barrier.

The Micro-Seal™ isolation system safeguards long-term production integrity by preventing the unwanted migration of well fluids through microannulus leak paths between the casing and cement sheath. The system incorporates our proprietary hybrid-swellable elastomer technology, which causes the element to swell when immersed in any combination of water/hydrocarbon-based wellbore fluids and/or wet gases. The element swells against the OD of the casing and the ID of the cement sheath to effectively seal any potential microannulus. This system offers a low-risk, cost-effective alternative to expensive and time-consuming remedial cementing operations, often necessitated by microannulus pressure migration.

To find out more about how Weatherford can improve drilling reliability and well integrity with our liner systems, contact an authorized Weatherford representative, or visit **weatherford.com.**

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