Thru-Tubing Systems

THRU TUBING COMPLETION AND INTERVENTION PRODUCTS AND SERVICES

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(TTS products are available through authorized service providers.)

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Foreword

Since its inception in 1997, Thru-Tubing Systems (TTS) has developed many innovative applications designed for interventions in slim hole (monobore) wells and through tubing completions. Additionally, TTS has designed a line of tubing and through tubing plugs. This has enabled oil and gas operators to successfully conduct rigless wellbore remedies. At TTS, all our Packer Systems, Tubing Plugs, Thru-Tubing Plugs and Sand Control Systems are proprietary designs, honed from over 250+ years of combined experience in well completions and interventions.

Today we are broadening our footprint to bring our unique products and capabilities to a global clientele. As part of this initiative we have:

- Been independently validated as a certified API Q1 manufacturer.
- Certified our packers and bridge plugs to conform with ISO 14310:2018 & API 11D1 Specifications.
- Established service centers in AsiaPac and the Middle East.
- Provided experienced service personnel with over 145+ years of combined experience to domestic and global clients.

The TTS Management team, Service Staff, Support Staff, and I are committed to supporting our global efforts. We assure you of our commitment to continue to provide and develop intervention systems for rigless interventions for our Clients wells.

Danny Teen
President
Thru-Tubing Systems, Inc.

Introduction

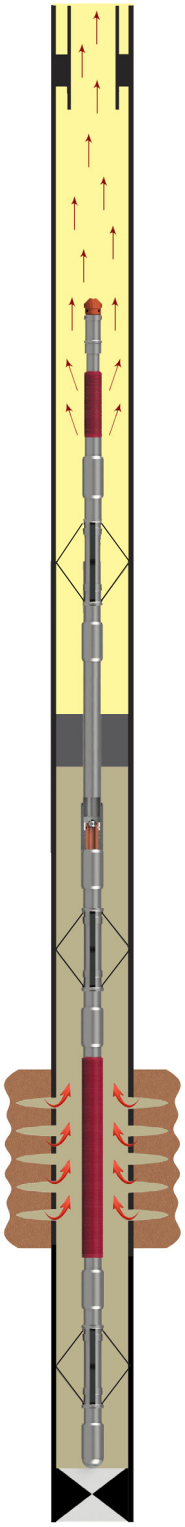
Thru-Tubing Systems, Inc. (TTS) specializes in designing and installing tools for rigless interventions and slim hole (monobore) wells. TTS has the ability to design, manufacture, test and install these systems. Coil Tubing, Electric Line and Slick Line, as well as rigs can deploy these systems into wells. There are applications for Rigless Intervention worldwide. Tools and systems are available to address numerous downhole conditions which can cause the production of oil and gas to slow down or cease.

Mission Statement

Thru-Tubing Systems, Inc. (TTS) will strengthen the Company's position as a valued leader in the field by continuing to develop innovative systems and services that lead the industry in the field of rigless intervention, thru-tubing and completion technologies. TTS will offer its customers sound advice along with innovative and cost-efficient services and equipment. This will be done to allow our customers to successfully take advantage of the cost savings these technologies offer.

Sand Control Systems

Vent Screen Gravel Pack with Cement Cap



Features/Benefits

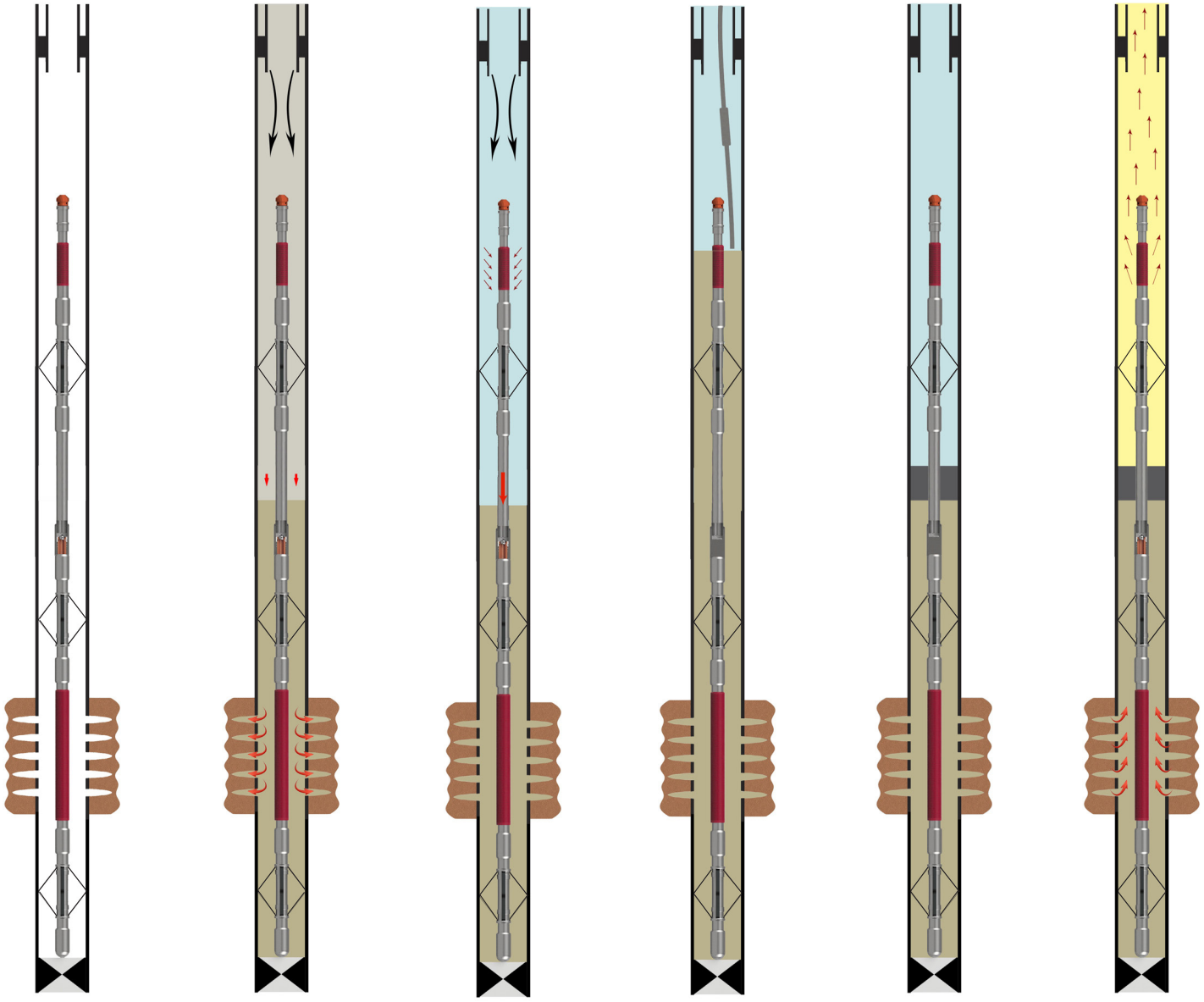
- Used when the top of the vent screen assembly is located in casing below the production tubing.
- Can be installed using only wireline intervention. Utilizes TTS's proprietary pump and place system. (See Page 8)
- Can be installed using a volumetric proppant placement system. (See Page 9)
- Allows high slurry displacement rates for high-rate water packs and frac-and-pack operations.
- Easily accommodates multiple future plug-backs without using a rig.
- Can be deployed on wireline, coiled tubing, or jointed pipe.
- Can be deployed in live wells using TTS's multiple-barrier deployment techniques:
  - Retrievable bridge plug deployment (coiled tubing); (See Page 16)
  - J-anchor deployment/Stackable *Patent Pending (slickline/e-line); (See Page 17)
  - Proprietary Surface deployment (slick/e-line/specialized BOP systems); (See Page 18)
  - Stackable systems for monobore wells (slickline/e-line) (See Page 20)
- Sand height control valve (SHCV) prevents flow into the vent screen during gravel placement and optimizes column height on blank pipe/casing annulus during high-rate water packs. It also provides positive sand-out indication when it shears.
- Cement cap prevents proppant column fluidization during production of wells, a common cause of vent screen gravel pack failures.
- Streamlined vent screen assembly allows clearance for coiled tubing and cement bailers.
- This system has performed successfully hundreds of times, in all tubing and casing sizes.
- Available to pass through all popular tubing sizes from $2^{1}/_{16}$" and up.
- Eliminates excessive pressure draw down due to long sections of blank pipe needed in some applications where distances are excessive between the end of the production tubing and the proposed completion interval.
- Can be deployed on coil tubing and gravel packed in one trip.

Applications

- Installed as primary sand control system thru tubing
- Installed as primary sand control system in monobores
- Installed as primary sand control system in casing/liners

Sand Control Systems

Vent Screen with Cement Cap - Frac Pack, High-Rate Water Pack



Deploy vent screen assembly at set depth.

Pump gravel slurry via production tubing or coiled tubing.

Gravel covers main screen. Pressure enters vent screen and shears the sand height control valve.

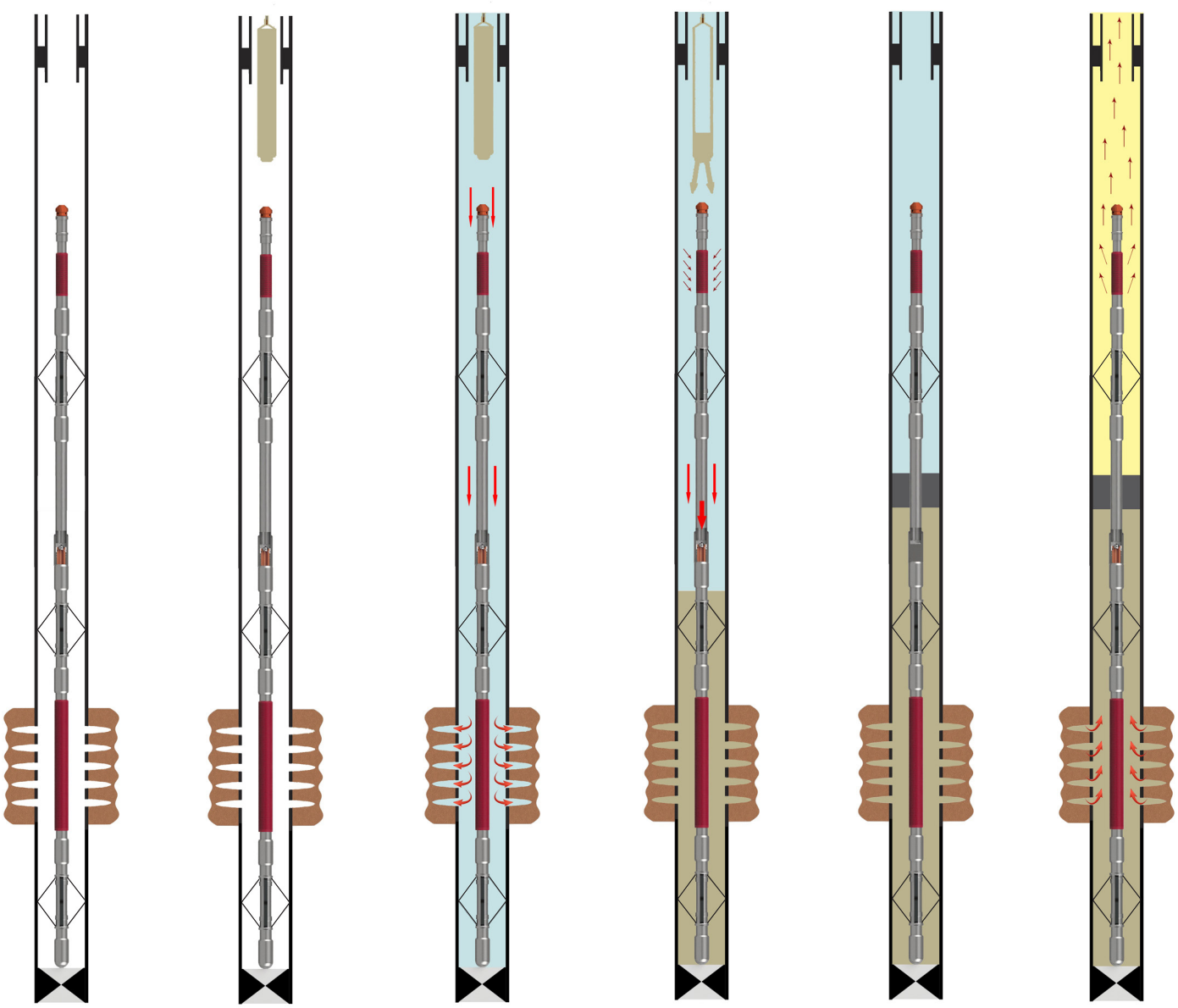
Use coiled tubing to circulate out excess gravel (optional).

Place cement cap using wireline bailer.

Produce well through vent screen.

Sand Control Systems

Pump and Place Vent Screen with Cement Cap - Wireline Deployed



Deploy vent screen assembly at set depth.

Deploy gravel carrier on slick or electric wireline and position above gravel pack assembly.

Begin fluid injection down production tubing using surface pumps.

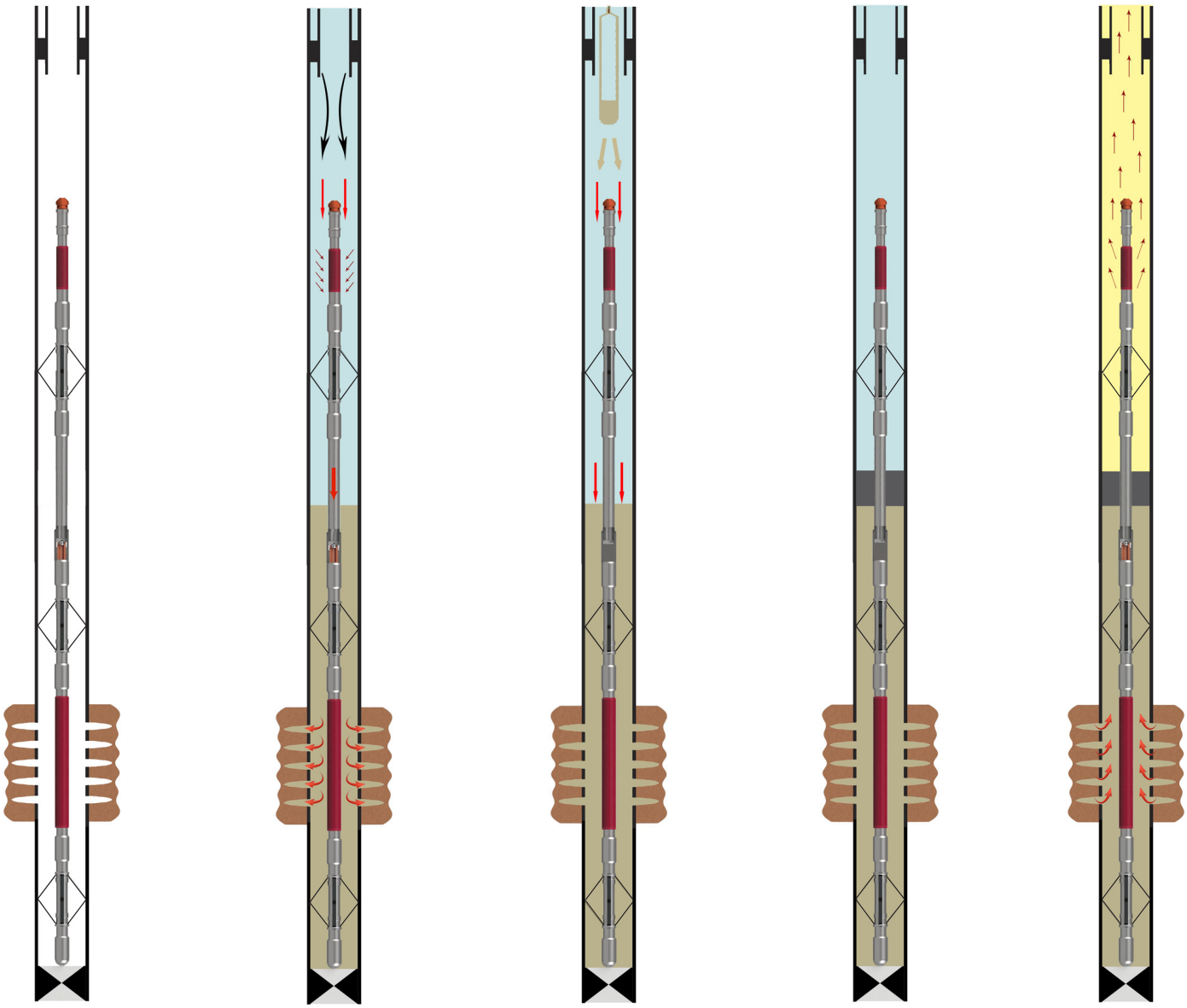
Open proppant carrier while pumping fluid from surface carries proppant into perforations.

Place cement cap using wireline bailer.

Produce well through vent screen.

Sand Control Systems

Volumetric Pumping Vent Screen with Cement Cap - Wireline Deployed



Deploy vent screen assembly at set depth.

Pump calculated gravel slurry via production tubing.

Top off with proppant carrier using wireline while pumping fluid from surface.

Place cement cap using wireline bailer.

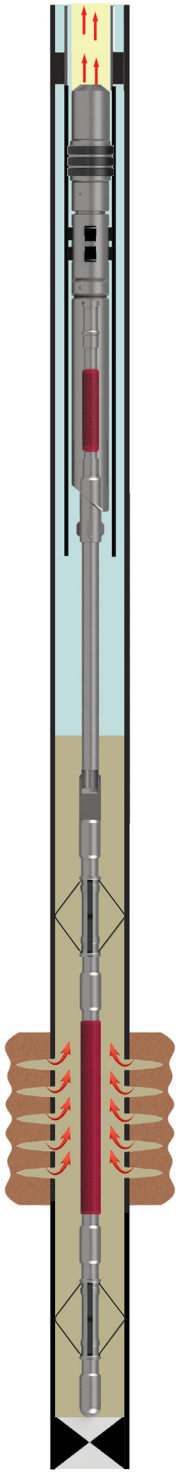
Produce well through vent screen.

Sand Control Systems

Vent Screen Gravel Pack with Isolation Packer and Overshot

Features/Benefits

- Used when the top of the vent screen assembly is tied back to the production tubing.
- Can be installed using only wireline intervention. Utilizes TTS's proprietary pump and place system. (See Page 12)
- Can be installed using a volumetric proppant placement system. (See Page 13)
- Allows high slurry displacement rates for high-rate water packs and frac-and-pack operations.
- Easily accommodates multiple future plug-backs without using a rig.
- Can be deployed on wireline, coiled tubing, or jointed pipe.
- Can be deployed in live wells using TTS's multiple-barrier deployment techniques.
  - Retrievable bridge plug deployment (coiled tubing) (See Page 16)
  - J-anchor deployment/Stackable *Patent Pending (slickline/e-line) (See Page 17)
  - Proprietary Surface deployment (slick/e-line/specialized BOP systems) (See Page 18)
  - Stackable systems for monobore wells (slickline/e-line) (See Page 20)
- Sand height control valve (SHCV) prevents flow into the vent screen during gravel placement and optimizes column height on blank pipe/casing annulus during high-rate water packs. It also provides positive sand out indication when it shears.
- Isolation Packer prevents proppant column fluidization during production of wells, a common cause of vent screen gravel pack failures.
- This system has performed successfully hundreds of times, in all tubing and casing sizes.
- Available to pass through all popular tubing sizes from 2-3/8" and up.
- Can be deployed on coil tubing and gravel packed in one trip.

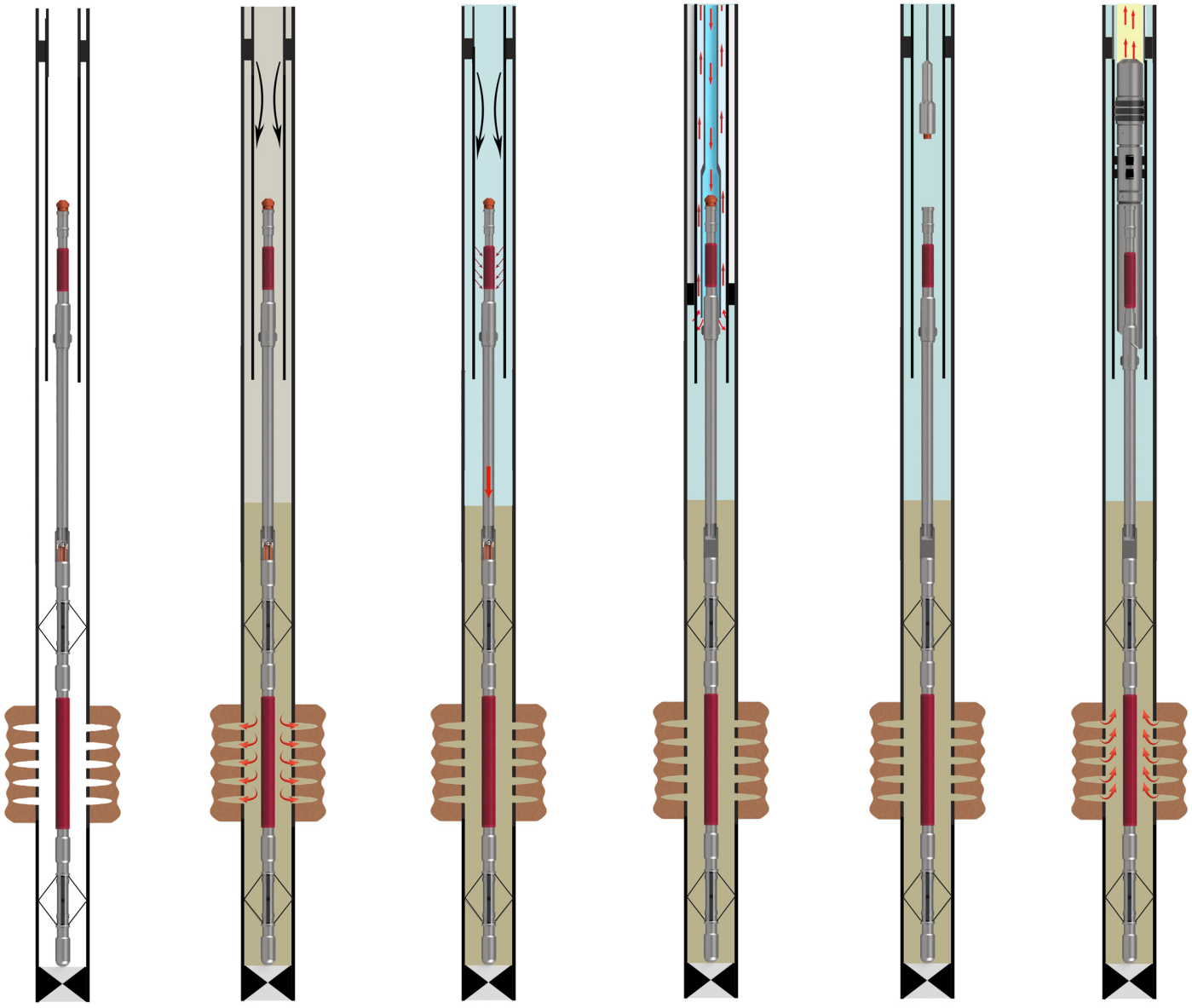


Applications

- Installed as primary sand control system thru tubing
- Installed as primary sand control system in monobores
- Installed as primary sand control system in casing/liners
- Installed to repair failed rig installed gravel pack systems

Sand Control Systems

Vent Screen with Isolation Packer and Overshot - Frac Pack, High-Rate Water Pack



Deploy vent screen assembly at set depth.

Pump gravel slurry down tubing.

Gravel covers main screen. Pressure enters vent screen and shears the sand height control valve.

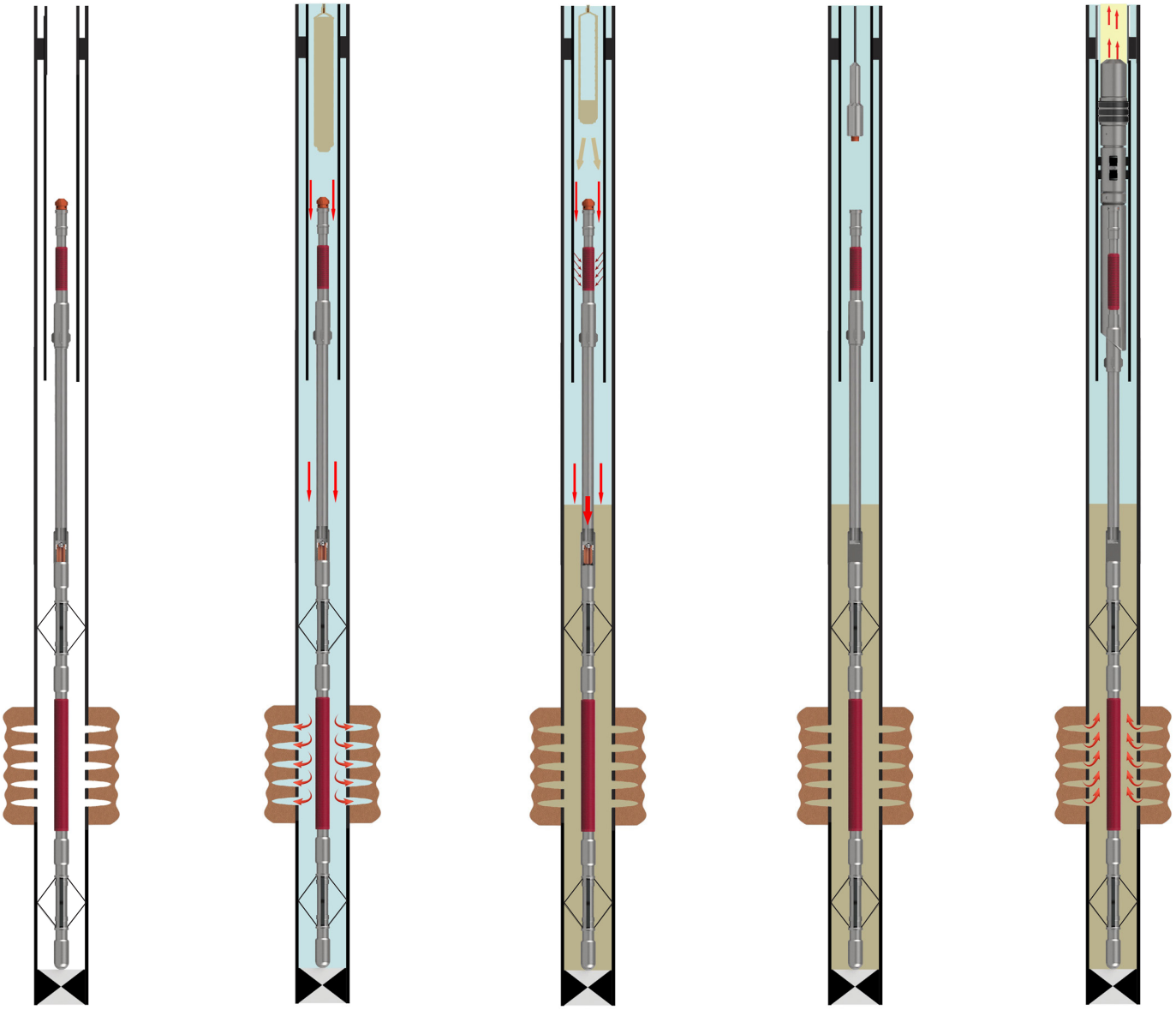
Use coiled tubing to circulate out excess gravel.

Remove vent screen cap using recovery tool on slick line.

Install isolation packer and overshot. Produce well.

Sand Control Systems

Pump and Place Vent Screen with Packer Isolation -- Wireline Deployed



Deploy vent screen assembly at set depth.

Begin fluid injection down production tubing using surface pumps.

Open proppant carrier while pumped fluid flow from surface carries proppant into perforations and screen annulus.

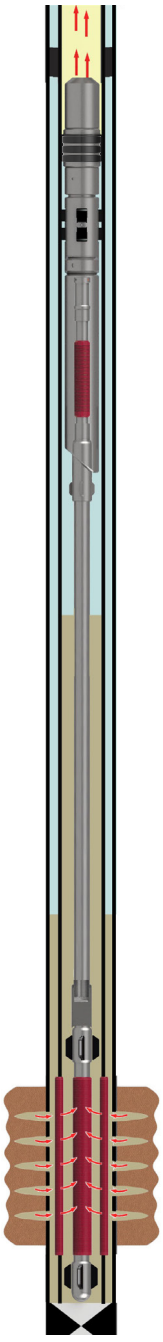
Remove vent screen cap using recovery tool on slick line.

Install isolation packer and overshot. Produce well.

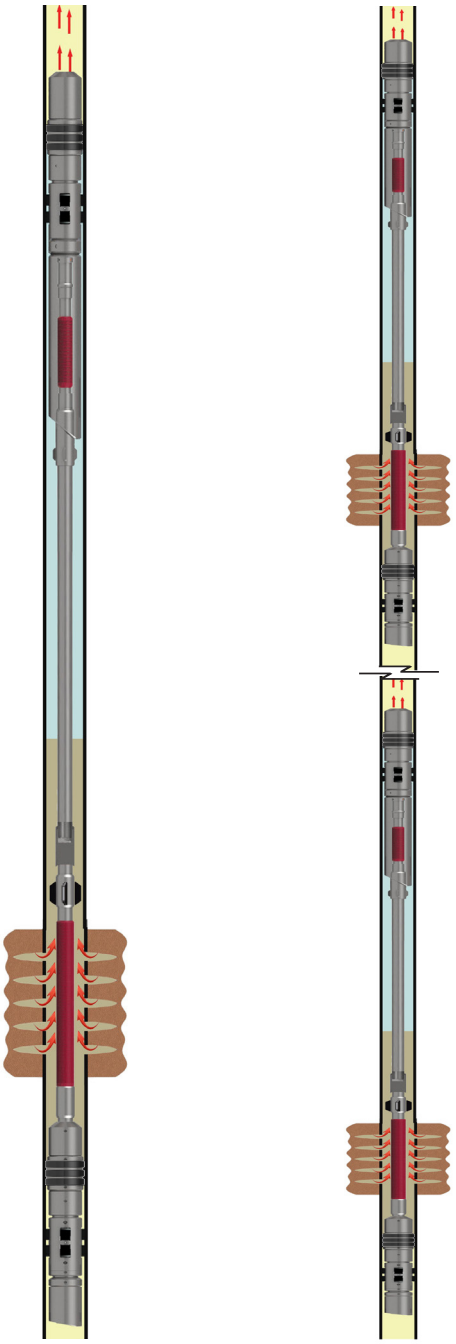
Sand Control Systems

Additional Vent Screen Gravel Pack with Packer Isolation Applications

Repair Failed Cased Hole Gravel Pack



Stackable Monobore Gravel Pack



Sand Control Systems

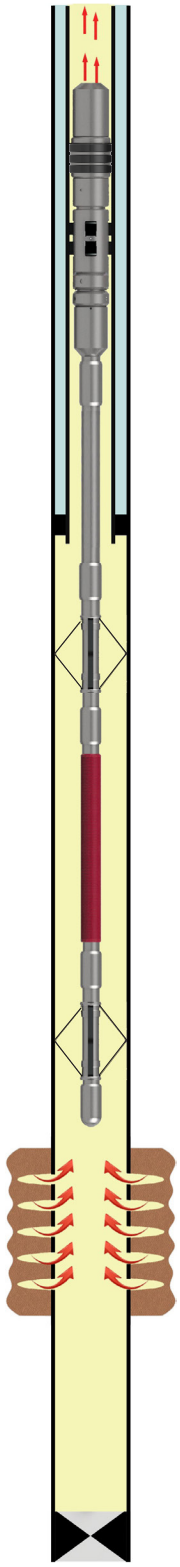
TTS Thru-Tubing Stand Alone Screen Hang-Off

Features/Benefits

- Available for tubing sizes from 2-3/8” and up. Most popular sizes are routinely stocked for customer convenience.
- Can be retrieved with coil tubing or slickline in one trip with standard wireline or coil tubing fishing tools. Allows for replacement and repair of failed components.
- Can be deployed in live wells using TTS’s multiple-barrier deployment techniques.
  - Retrievable bridge plug deployment (coiled tubing) (See Page 16)
  - J-anchor deployment/Stackable *Patent Pending (slickline/e-line) (See Page 17)
  - Proprietary Surface deployment (slick/e-line/specialized BOP systems) (See Page 18)
  - Stackable systems for monobore wells (slickline/e-line))See Page 20)

Applications

- For use in low to moderate sand producing wells
- Installed as primary sand control in open hole completions
- Installed as primary sand control in horizontal completions
- Used to control post-frac proppant flow back
- Installed to repair failed rig installed gravel pack systems



(TTS products are available through authorized service providers.)

Sand Control Systems

TTS Multiple Barrier Deployment Techniques and Systems

Quite often during non-rig well intervention operations it is necessary or desired to install long sections of tubulars into the well, such as sand screens and similar tubular assemblies. This necessity creates many challenges for operators and service companies with regards to maintaining well control during these installations.

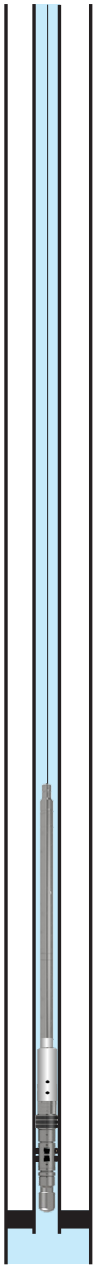
As most non-rig well interventions involve the use of coil tubing or wireline operations intervening through the existing production tubing on live wells, a means by which to install these long assemblies into the well while maintaining multiple barriers of well control becomes a necessity. Common practice has been to lubricate the assembly into the well by using either a wireline lubricator during wireline interventions or a riser assembly when coiled tubing is used for conveyance. Both systems limit the overall length of assembly that can be installed in the well. The limitation of overall lengths of these assemblies are relative to how much length of riser or lubricator that can be rigged up or installed on top of the well Christmas tree. Most well locations limit the total length of either lubricator or riser to < 100'.

During installation of TTS's Thru Tubing Gravel Pack Systems, it is a common requirement to install well tubular assemblies >200' in overall length, well outside the limits of conventional lubricator and riser systems used during coil tubing and wireline well interventions.

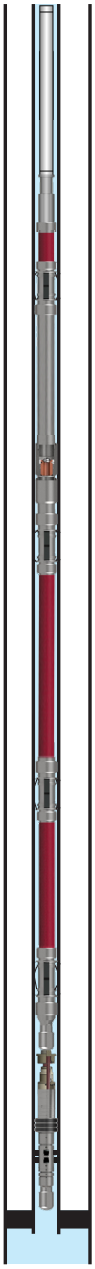
As a result, TTS has developed several systems/techniques along with proprietary tooling in order to accommodate this need. All these systems allow for the unlimited overall lengths of tubular assemblies to be installed into the well while maintaining multiple well control barriers. This is accomplished by breaking the assembly into short overall section lengths needed to accommodate the limits of common riser and lubricator systems. Once these short or fractional section lengths of subject tubular assemblies are installed or lubricated into the well one at a time, they are joined together either at the planned landing depth in the well or at an up-hole location of convenience and then lowered as one section to the planned landing depth. The following pages illustrate several of these Multiple Barrier Deployment Systems. For more information please contact any TTS representative or office.

Sand Control Systems

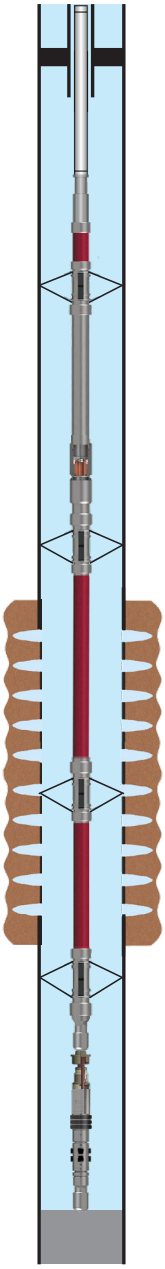
TTS Multiple Barrier Deployment Techniques
Retrievable Bridge Plug Deployment (Coiled Tubing)



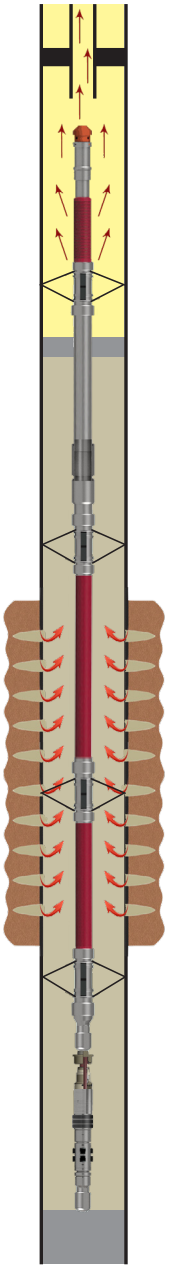
RIH with TTS Paragon Retrievable Bridge Plug on wireline. Set RBP near end of tubing. Once set, bleed well down to 0 psi.



Deploy Screen in well and attach to Coil Tubing. RIH and latch RBP and set down to equalize. Pick up to release RBP.



After unsetting RBP, RIH to PBTD with Coil. Release screen and perform gravel pack.

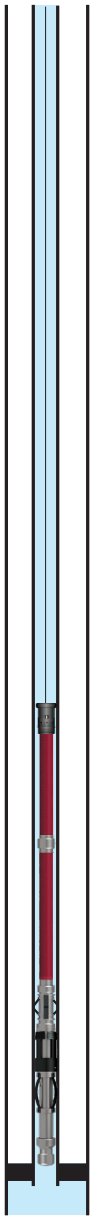


After gravel pack procedure, place well on production.

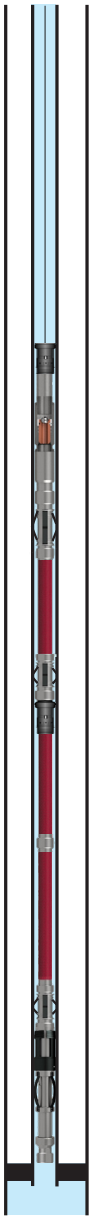
Sand Control Systems

TTS Multiple Barrier Deployment Techniques

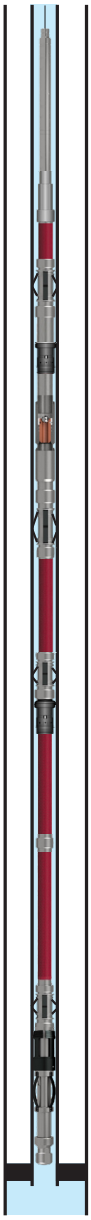
J-Anchor Deployment/Stackable **Patent Pending (slickline/e-line)*



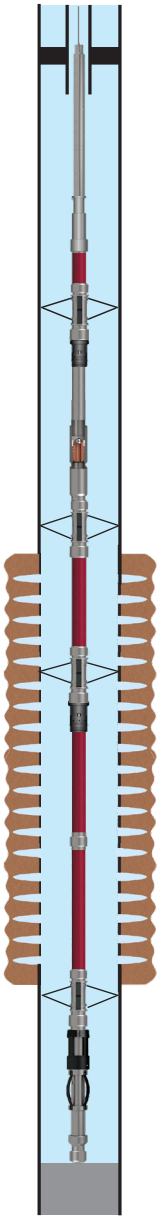
RIH with 1st section of screen with J-Anchor on bottom and PBR on slick line. Stop in tubing and pick up and slack off to set anchor then jar down to release PBR. POOH with SL



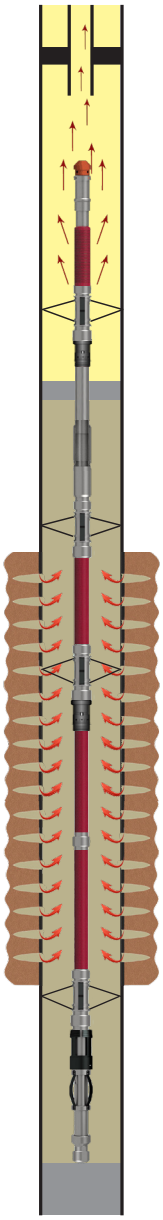
RIH with 2nd section of screen and blank on SL. Latch into PBR previously deployed and jar down to ensure latched. POOH with SL.



RIH with 3rd section of blank and vent screen on E-line. Latch into PBR previously deployed. Pickup to ensure latched with extra weight and unset J-anchor.



After picking up to unset J-anchor RIH with E-line and log screen on PBTD. Release screen assembly and POOH. Perform gravel pack.

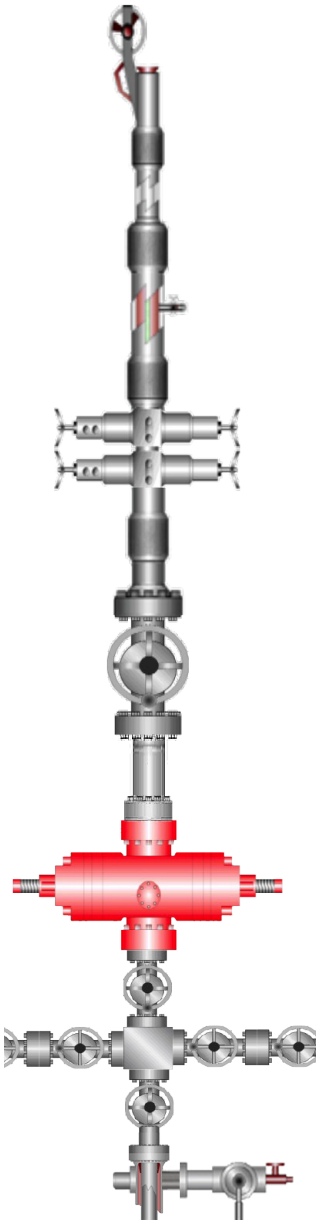


After gravel pack procedure place well on production.

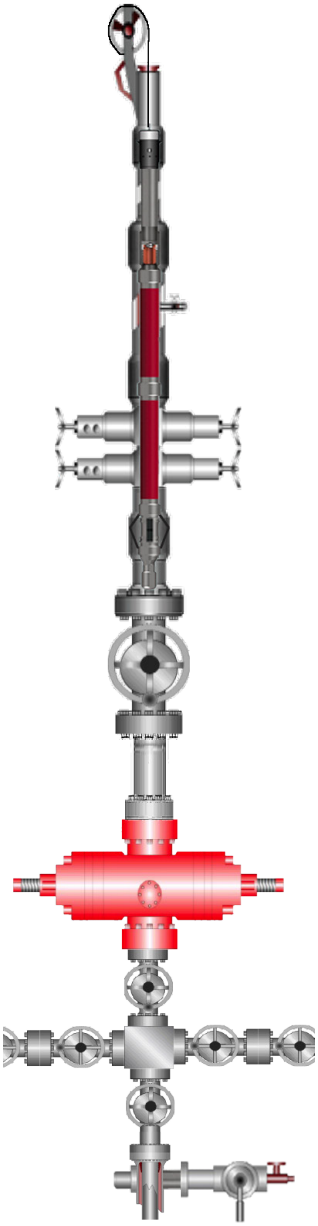
Sand Control Systems

TTS Multiple Barrier Deployment Techniques

Proprietary Surface Deployment (slick/e-line/specialized BOP systems)



Surface Rig up of tree, BOP slip rams for pipe, 4' spacer spool and gate valve. Rig up wire line BOP's and lubricator above gate valve.



Make up screen assembly and attach to wireline. Pick up assembly into lubricator and make up to gate valve. Pressure test lubricator and open gate valve.

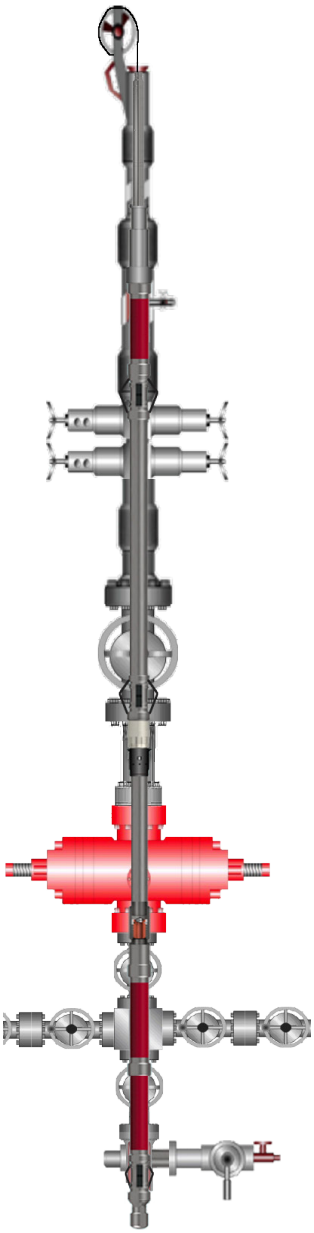
Lower wireline and place blank pipe across BOP slip rams. Ensure PBR is located in 4' spacer spool. Close slip rams then jar up to release PBR running tool. Pick up wireline above gate valve and close valve. Bleed lubricator to 0 psi and break connection for next assembly.

Sand Control Systems

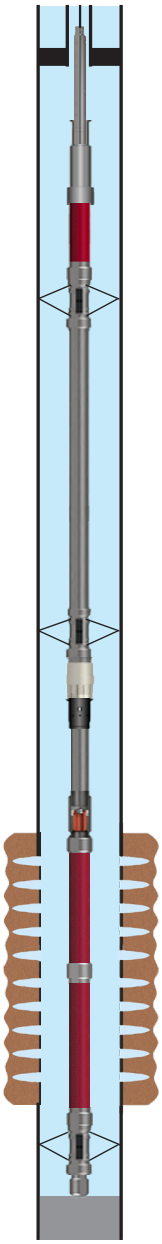
TTS Multiple Barrier Deployment Techniques

Proprietary Surface Deployment (slick/e-line/specialized BOP systems)

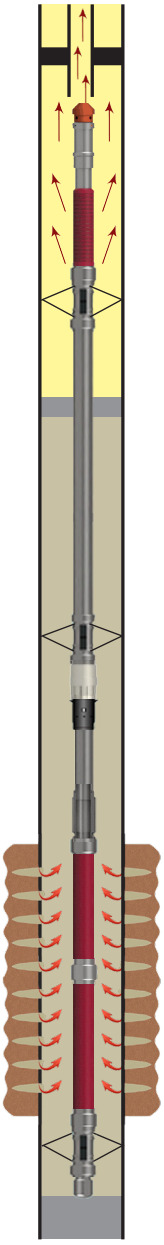
Make up screen assembly and attach to wireline. Pick up assembly into lubricator and make up to gate valve. Pressure test lubricator and open gate valve.



Lower screen assembly and latch anchor to PBR left in 4' spacer spool. Pick up to ensure latched. Once confirmed, open BOP rams. Once open, RIH with wireline.



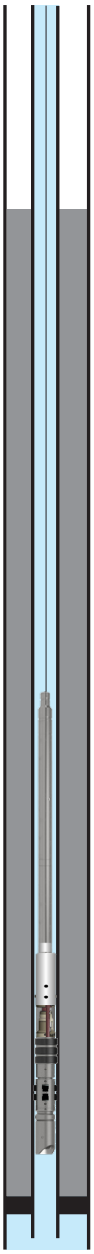
Continue to RIH and log screen on PBTD. Release screen and POOH with wireline. Perform gravel pack.



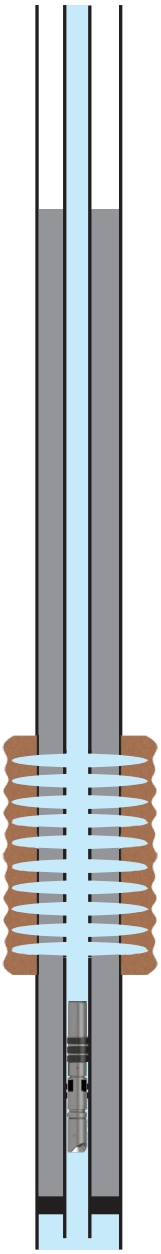
After gravel pack procedure, place well on production.

Sand Control Systems

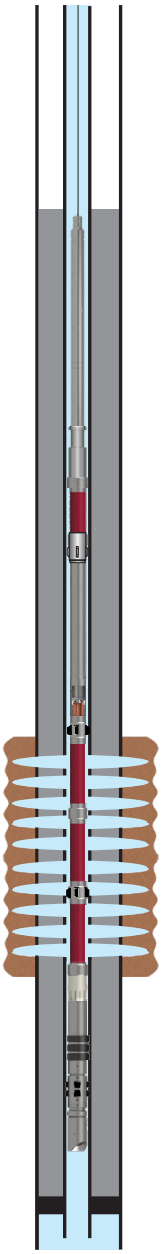
TTS Multiple Barrier Deployment Techniques
Stackable Systems for Mono-bore Wells (slickline/e-line)



RIH with wireline and set TTS Paragon II Sump Packer. After set POOH with wireline.



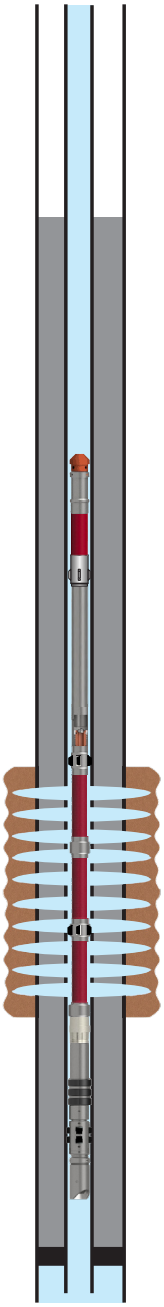
RIH with wireline and set TTS Paragon II Sump Packer. After set POOH with wireline. Perforate well for production.



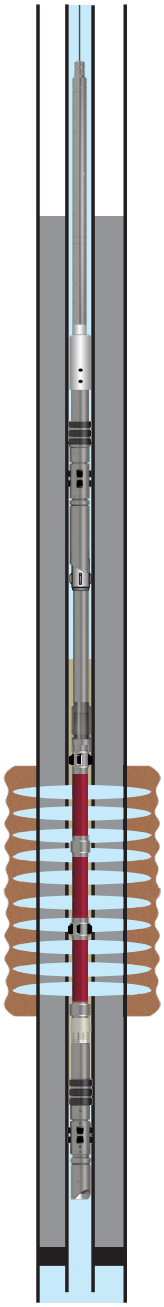
Pick up and RIH with screen sections using TTS Anchor latches and PBR's. Latching each anchor latch to each PBR and taking overpull to ensure latched.

Sand Control Systems

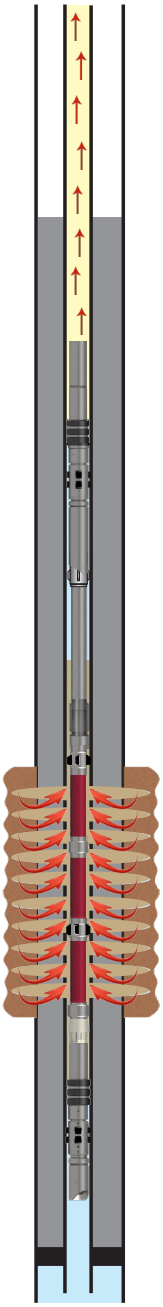
TTS Multiple Barrier Deployment Techniques
Stackable Systems for Mono-bore Wells (slickline/e-line)



Once required screen and blank sections deployed, perform gravel pack. After gravel pack, pull plug from top of assembly.



After removing vent plug RIH with TTS Paragon II Packer and overshot to seal on polished nipple for gravel pack isolation. POOH with wire line.



After gravel pack procedure place well on production.

Legacy Sand Control Systems

Legacy Sand Control System

Over the years TTS has developed and utilized numerous systems to meet our clients' needs to accomplish rigless sand control. While all of these systems satisfied the needs to provide sand free production, evolving technologies and experience showed us that there were ways to improve on these. The ever-changing economic picture also played a large part in our research and development of this product line. Expansion outside of the Gulf of Mexico and the fact that all types of services are not readily available everywhere also pushed us to develop rigless sand control systems to fit other markets.

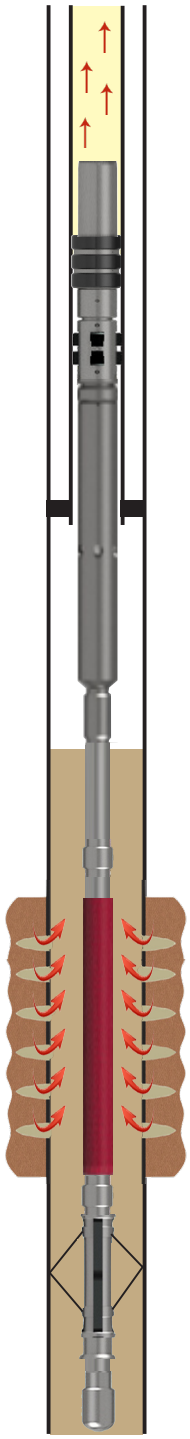
The rigless sand control systems exhibited in this section are still available through TTS but are not commonly kept in stock. The systems we provide today have evolved from these and provide the same quality gravel pack, but in an operationally and economically more efficient manner.

Should you feel that one of these systems is the right one for your well please let us know.

Sand Control Systems

Legacy Series 5012 One Trip Retrievable Squeeze Pack System

The TTS Series 5012 Retrievable Gravel Pack (GP) Packer System is a specialized packer designed to perform GP Operations in one trip. The system is deployed using coiled or jointed tubing. Packer sealing test and/or pumping of a pre-flush treatment is optional prior to pumping GP slurry.



Features/Benefits

- One-trip installation of packer and GP slurry.
- Crossover tool run in squeeze position, only slight pickup required to circulate out excess slurry.
- Positive seal of GP Port upon completion of GP slurry.
- Straight Pull Release, no downward manipulation required.
- Modular Gage Rings allow customized applications.
- Large ID/OD ratio for larger flow area.
- Bi-directional caged slips located below the packing system provide increased retrievability.
- Multi-durometer packing system increases sealing ability.
- Once Packer is released, the tool is locked in the release position allowing the ability to work up and down once released and not re-engage slips.

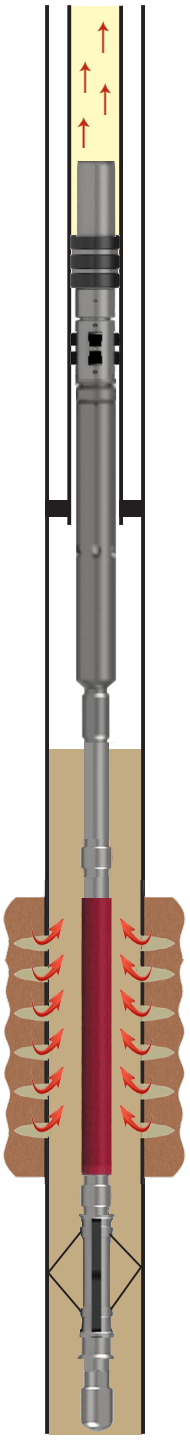
Applications

- Squeeze gravel packs on new and old zones
- Isolation straddles with pump-in port

Sand Control Systems

Legacy Series 5000 Thru-Tubing Frac Pack System

The TTS Series 5000 Thru-Tubing Frac Pack System utilizes a Retrievable Seal Bore Packer, (Model 5000); along with a perforated Frac Pack Extension which includes a closing sleeve and removable Frac Plug combination. The system allows for deployment in one trip via, coil tubing, jointed pipe, electric line or slickline. This system allows for the well to be frac packed thru tubing and still utilize a mechanical sealing and anchoring system. After deployed into the well and the Frac Pack or Gravel Pack applied, the well is then washed out with coil tubing if needed. The Frac Plug is then pulled simultaneously closing the Frac Sleeve. This can usually be done on slickline. The well is then put on production.



Features/Benefits

- Allows for the ability to frac pack or high rate gravel pack the well with a coil tubing or wireline deployed thru-tubing system. Cost saving over other systems requiring a work over rig.
- Employs use of mechanical sealing and anchoring device as opposed to most vent screen frac pack systems. Eliminates the complexity and uncertainty of proper gravel pack proppant isolation and subsequent proppant flow back associated with typical vent screen frac pack systems.
- System simplicity; contains no reciprocation crossover tools and work-string attachments. Eliminates the chance of sticking crossover tools and other work sting related risk.
- Frac pack or gravel pack slurry is pumped through the production string as opposed to coil tubing or small work-string which limit pump rate when deployed thru tubing. Allows for high rate pumping of frac pack or high rate gravel pack.

Applications

- Installed as primary sand control system thru tubing
- Installed as primary sand control system in monobores
- Installed as primary sand control system in casing
- Installed to repair existing failed sand control systems thru tubing

Sand Control Systems

Legacy Series 5100 Inflatable Circulating or Squeeze Gravel Pack System

The TTS Series 5100 Circulating Thru-Tubing Gravel Pack System utilizes a retrievable Inflatable Packer, Two-Position Crossover Tool, Lower Gravel Pack Perforated Extension with closing sleeve and wash pipe in order to accomplish a one trip coiled tubing deployed circulating Thru-Tubing Gravel Pack.

This system allows for deployment of the GP BHA on coiled tubing, as well as Setting and testing of packer prior to pumping of the gravel pack slurry.

The Two-Position Crossover Tool allows for circulating below the Packer (lower circulating or gravel packing position) and an upper circulating or reverse position for spotting fluids, reversing or circulating above the packer.

The upper position establishes isolation from the producing interval for guaranteed circulating above the Gravel Pack Packer for removing excess slurry from the work string, regardless of BHP. Upon completion of the gravel pack pumping operation, a closing sleeve is installed to isolate the ports in the Gravel Pack Perforated Extension. This is accomplished by removal of the Crossover Tool and Wash Pipe Assembly when POOH.

Features/Benefits

- Allows for repair of cased hole gravel pack without the expense of a workover rig. “Saves time and cost compared to conventional workovers”.
- Inflatable packer system allows for setting of TTGP packer below the end of the production tubing. Negates problems associated with production tubing movement. Does not interfere with future plug backs when production tubing removal is required. Enables shortening of TTGP assembly.
- One trip installation. Does not require additional trips in well to install anchoring or sealing accessories.
- Allows for a circulation or squeeze type Gravel Pack. Better accommodates inflow performance over typical pre-packed screen hang-off.
- Isolation sleeve positively closes and seals off GP Perforated Extension below packer. Eliminates time and cost associated with additional trips into the well needed to install additional sealing accessories.
- Ability to test all sealing and anchoring components prior to gravel packing. Allows for positive pressure test and assurance of proper packer placement.

Applications

- Repair of failed Cased Hole Gravel Pack
- Installation of Circulating or Squeeze Gravel Pack in wellbores where no sand control system currently exists
- Installation of Thru-Tubing Gravel Pack where wellbore restriction may exist
- Thru-Tubing Gravel Pack installation where installation is to be set in a larger I.D. tubing than deployed through

**Patent # 5,975,205*

Packers / Well Intervention

J-Anchor (Deployment System)

The TTS J-Anchor is a mechanical device designed to set in tubing. It is capable of multiple setting cycles in the same run in the well. It can be utilized as a deployment system for long tool assemblies allowing shorter sections GP Screens to be deployed and stacked in the wellbore with no need to kill well. Up and down movement is used to set and unset slips. Other possible uses include use as a tubing stop or suspension of heavy tool strings.

Features/Benefits

- Can be set multiple times with no need to redress.
- Deploy screens with no need to kill well
- Capable of setting in corrosion resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Capable of holding 2,000 lbs of weight
- Tools are rated to 15,000 psi at 400° F.

Applications

- Deployment system for long tools assemblies when riser length is limited.
- Tubing Stop
- Suspend heavy tools strings

TTS J-Anchor			
Description	**Tool OD (in)**	**Tool Length (in)**	**Top Connection**
2-7/8" J-Anchor	2.110	34.94	5/8" Sucker Rod Pin
3-1/2" J-Anchor	2.500	35.19	5/8" Sucker Rod Pin
4-1/2" J-Anchor	3.625	44.18	3/4" Sucker Rod Pin

Packers/Well Intervention

Paragon II Retrievable Dual Seal Bore Tubing Packer

The TTS Paragon II Retrievable Dual Seal Bore (RDSB) Tubing Packer is specifically designed to be installed inside of an oil or gas well's production tubing. Its high utility design makes it suitable for a wide variety of thru tubing packer applications, see below. This specialized packer is designed to drift through commonly used tubing features, such as safety valves and Landing Nipples and set anywhere in the production tubing or production liner in mono bore configured wells. It utilizes a specialized (RDSB) design that incorporates caged slips located below a multi-durometer sealing stack for enhanced retrievability. It is normally conveyed into the well using wireline, coil tubing, or jointed pipe. It can be retrieved by applying upward strain or jarring action using slick or braided wireline, coil tubing or jointed pipe. The Paragon Packer has been the feature tool in several thousand well interventions over the past 20 years. This version is currently rated API 11D1 V3 or V5, 5000 psi at 300 degrees Fahrenheit. It is currently offered for tubing sizes from 2 3/8"- 5 ½".

Features/Benefits

- Complies with API 11D1 specifications.
- One-trip installation, one-trip retrieve Tubing Packer.
- Straight pull to release, no downward manipulation required. (slickline retrievable)
- Packer element tested to API V5, V3, V0 testing validation.
- Capable of setting in corrosion resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Modular Gage Rings allow for optimizing seal gap.
- Large ID/OD ratio for larger flow area.
- Dual Bore design allows for full unrestricted ID on sealing accessories.
- Bi-directional caged slips located below the packing system provides increased retrievability.
- Multi-durometer packing system increases sealing ability.
- Release mechanism is not affected by hanging weight or differential pressures allowing reduction of the required release forces to aid wireline retrieving.
- Once Packer is released, the tool is locked in the release position allowing the ability to work up and down once released and not re-engage slips.

Applications

- Straddle packs (tubing patch). (See Page 35)
- Velocity string installations. (See Page 40)
- Thru-tubing gas lift system installations. (See Page 38)
- Gravel Pack Packer, Gage, Choke or Shut-in Valve hang-offs
- Thru-tubing cement retainer. (See Page 43)
- Retrievable Bridge Plug. (See Page 41)

Paragon II Retrievable Packer System

Tubing Size (in)	Tubing (wt)	Length (in)	Gage Ring *(in)	ID Bore (in)	Max Slip Range
2-3/8	4.70	42.62	1.810	1.000	2.020
2-7/8	7.80 – 8.60	43.94	2.166	1.250	2.310
2-7/8	6.50	39.97	2.290	1.380	2.450
3-1/2	9.30 – 10.20	45.54	2.725	1.625	3.000
3-1/2	12.70 – 12.95	42.87	2.531	1.380	2.760
4	9.50 – 10.90	50.40	3.110	1.625	3.548
4-1/2	10.50 – 13.50	53.27	3.750	2.000	4.100
4-1/2	15.10	53.27	3.650	2.000	4.100
4-1/2	17	53.27	3.590	2.000	3.823
5-1/2	17.0 – 23.0	67.22	4.531	2.812	4.900

NOTE: Other sizes available on request

Paragon II Retrievable High-Pressure (HP) Tubing Packer

The Paragon II High Pressure Tubing Packer is a high-pressure version of the standard Paragon II Packer. It contains all the same features that create the high utility and high performance of the original Paragon II Packer including the Retrievable Dual Seal Bore (RDSB) design, caged slips located below the multi-durometer sealing stack and release mechanism that is not loaded by hanging weight or pressure differentials. The TTS Paragon High Pressure Tubing Packer utilizes our newly developed Hercules Sealing Stack. It has been successfully tested to API 11D1 V0 and V3 criterion up to 7500 psi differential at 300 degrees Fahrenheit. The packer can be constructed from a variety of corrosion-resistant alloys and trimmed with premium elastomers. It is currently offered for tubing sizes from 2 3/8"-5 ½".

Features/Benefits

- Complies with API 11D1 specifications.
- One-trip installation, one-trip retrieve Tubing Packer.
- Straight pull to release, no downward manipulation required. (Slick Line Retrievable).
- Packer element tested to API V3 and V0 testing validation.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Modular Gage Rings allow for optimizing seal gap.
- Large ID/OD ratio for larger flow area.
- Dual Bore design allows for full unrestricted ID on sealing accessories.
- Bi-directional caged slips located below the packing system provides increased retrievability.
- Multi-durometer packing system increases sealing ability.
- Release mechanism is not affected by hanging weight or differential pressures allowing reduction of the required release forces to aid wireline retrieving.
- During retrieval, tool is locked in the release position allowing the ability to work up and down once released and not re-engage slips. Packing elements designed for easy retrievability thru restrictions.

Applications

- Straddle packs (tubing patch). (See Page 35)
- Velocity string installations. (See Page 40)
- Thru-tubing gas lift system installations. (See Page 38)
- Gravel Pack Packer, Gage, Choke or Shut-in Valve hang-offs
- Thru-tubing cement retainer. (See Page 43)
- Retrievable Bridge Plug. (See Page 41)

Paragon II Retrievable HP Tubing Packer

Tubing Size (in)	Tubing (wt)	Length (in)	Gage Ring *(in)	ID Bore (in)	Max Slip Range
2-3/8	4.70	42.62	1.810	1.000	2.020
2-7/8	6.50	39.97	2.290	1.380	2.450
3-1/2	9.30 – 10.20	45.54	2.725	1.625	3.000
4	9.50 – 10.90	50.40	3.110	1.625	3.548
4-1/2	10.50 – 13.50	53.27	3.750	2.000	4.100
4-1/2	15.10	53.27	3.650	2.000	4.100
4-1/2	17	53.27	3.590	2.000	3.823
5-1/2	17.0 – 23.0	67.22	4.531	2.812	4.900

NOTE: Other sizes available on request

Paragon II Retrievable Medium Expansion (ME) Tubing Packer

The Paragon II Retrievable Medium Expansion Tubing Packer is a higher expansion version of the standard Paragon Packer. It contains all the same features that create the high utility and high performance of the other versions of the Paragon Packer while offering a smaller run in hole outside diameter (OD). This packer version is used when there is a need to drift through smaller inside diameter (ID) tubing features that the standard Paragon Packer versions will not drift through. The TTS Medium Expansion Paragon Packer utilizes our newly developed Medium Expansion Hercules Sealing Stack. This sealing stack has been successfully tested to API 11D1 V3 specifications and is currently rated at 5000 psi at 300 degrees Fahrenheit. Other validation ratings may be available upon request.

Features/Benefits

- Complies with API 11D1 specifications.
- One-trip installation, one-trip retrieve Tubing Packer.
- Straight pull to release, no downward manipulation required. (Slick Line Retrievable).
- Packer element tested to API V3 testing validation.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Large ID/OD ratio for larger flow area.
- Dual Bore design allows for full unrestricted ID on sealing accessories.
- Bi-directional caged slips located below the packing system provides increased retrievability.
- Multi-durometer packing system increases sealing ability.
- Release mechanism is not affected by hanging weight or differential pressures allowing reduction of the required release forces to aid wireline retrieving.
- During retrieval, tool is locked in the release position allowing the ability to work up and down once released and not re-engage slips. Packing elements design for easy retrievability through restrictions.
- Smaller OD to pass through non-standard ID restrictions.

Applications

- Straddle packs (tubing patch). (See Page 35)
- Velocity string installations. (See Page 40)
- Thru-tubing gas lift system installations. (See Page 38)
- Gravel Pack Packer, Gage, Choke or Shut-in Valve hang-offs
- Thru-tubing cement retainer. (See Page 43)
- Retrievable Bridge Plug. (See Page 41)

Paragon II Retrievable ME Tubing Packer

Tubing Size (in)	Tubing (wt)	Length (in)	Gage Ring *(in)	ID Bore (in)	Max Slip Range
3-1/2	9.30 – 10.20	45.54	2.600	1.125	3.000
4	11 – 11.60	54.63	2.950	1.125	3.531
4-1/2	11.6 – 15.10	53.27	3.250	1.375	4.100
5-1/2	17 – 23.0	67.22	4.250	1.750	4.900
7	23 – 38	82.00	5.688	2.813	6.366
7-5/8	33.7	82.60	5.875	2.560	6.820

NOTE: Other sizes available on request

Packers/Well Intervention

Controlled Set High Expansion Permanent Tubing Packer

The TTS Controlled Set High Expansion Permanent Tubing Packer is a dual seal bore packer deployable via coiled tubing, jointed pipe, or wireline. Specifically designed for higher expansion ratios than standard packers. It utilizes patented bi-directional fixed slips. The differential pressure rating is 3,000 psi at 300^0 F. Customizations are available for custom sizes, corrosive environments. Currently available for tubing sizes 2-7/8" to 4".

Features/Benefits

- Complies with API 11D1 specifications.
- One-trip installation.
- Packer element tested to API V5 testing validation.
- Dual bore design allows for full unrestricted ID bore on Seal Bore accessories.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel
  - Q-125, S-135
- Patented Bi-Directional fixed slips located above and below the packing system.
- Patented controlled set feature.
- One-piece high expansion packing system increases sealing ability.
- Smaller OD to pass thru non-standard ID restriction.
- Utilizes standard Paragon II Packer accessories.

Applications

- Straddle packs (tubing patch). (See Page 35)
- Thru-tubing gas lift system installations. (See Page 40)
- Gravel Pack Packer, Gage, Choke or Shut-in Valve hang-offs
- Thru-tubing cement retainer. (See Page 44)

Controlled Set High Expansion Tubing Packer					
Tubing Size (in)	**Tubing (wt)**	**Length (in)**	**Gage Ring *(in)**	**ID Bore (in)**	**Max Slip Range**
2-7/8	6.5 – 8.6	44.20	1.810	0.750	2.471
3-1/2	9.3 – 12.95	44.75	2.190	1.063	3.060
4	13.2	41.09	2.500	1.125	3.350

NOTE: Other sizes available on request

**US Patent 7,578,353, 82*

Packers/Well Intervention

Packer Rating Charts

Paragon II Retrievable Packer System						
Tubing Size & Weight	**Packer OD (in)**	**ID Bore (in)**	**Max hanging load (lbs)**	***Testing Validation (API)**	**Pressure Differential (psi)**	**Temperature Rating (F)**
2-3/8" 4.70 lb/ft	1.810	1.000	19,000	V5	5,000	300
2-7/8" 7.80 – 8.60 lb/ft	2.166	1.250	25,000	V5	5,000	300
2-7/8" 6.4 – 6.5 lb/ft	2.290	1.380	29,000	V3 V0	7,500 5,000	300 300
3-1/2" 9.30 – 10.20 lb/ft	2.725	1.625	46,500	V0	7,500	300
3-1/2" 12.70 – 12.95 lb/ft	2.531	1.380	29,000	V5	5,000	300
4" 9.50 – 10.90 lb/ft	3.110	1.625	46,500	V3	5,000	300
4-1/2" 11.6 – 13.50 lb/ft	3.750	2.000	74,000	V3	7,500	300
4-1/2" 15.10 lb/ft	3.660	2.000	74,000	V3 V0	7,500 5,000	300 300
4-1/2" 11.6 – 13.50 lb/ft	3.660	2.000	74,000	V0	5,000	300
4-1/2" 17 lb/ft	3.590	2.000	74,000	V3	7,500	300
5-1/2" 17.0 – 23.0 lb/ft	4.531	2.812	98,212	V0	7,500	300

Paragon II Retrievable ME Tubing Packer						
Tubing Size & Weight	**Packer OD (in)**	**ID Bore (in)**	**Max hanging load (lbs)**	***Testing Validation (API)**	**Pressure Differential (psi)**	**Temperature Rating (F)**
3-1/2" 9.30 – 10.20 lb/ft	2.600	1.125	55,000	V3	5,000	300
4" 11.50 lb/ft	2.950	1.125	46,000	V3	2,500	200
4-1/2" 11.6 – 15.10 lb/ft	3.250	1.375	29,000	V3	5,000	300
5-1/2" 17 – 23 lb/ft	4.250	1.750	50,960	V3	5,000	300
7" 23 – 38 lb/ft	5.688	2.813	98,212	V3	5,000	300
7-5/8" 33.7 lb/ft	5.875	2.560	84,400	V3	5,000	300

Controlled Set High Expansion Tubing Packer						
Tubing Size & Weight	**Packer OD (in)**	**ID Bore (in)**	**Max hanging load (lbs)**	***Testing Validation (API)**	**Pressure Differential (psi)**	**Temperature Rating (F)**
2-7/8" 6.50 – 8.60 lb/ft	1.810	0.750	14,000	V5	3,000	300
3-1/2" 9.30 – 12.95 lb/ft	2.190	1.060	25,200	V5	3,000	300
4" 13.2 lb/ft	2.500	1.130	25,200	V5	1,500	300

*Other V Ratings Available Upon Request

Packers/Well Intervention

Paragon II Retrievable Packer Setting Assemblies

The TTS Paragon II Retrievable DSB Thru-Tubing Packer System offers numerous setting options to customize deployment of the Packer System for the specific application needs.

Single & Multi-stage Power Charge Wireline Setting Tool, Standard multi-stage power charge setting tool patterned after the original "GO" style tools. All TTS tools are adaptable to similar style tools available from vendors such as Owen Oil Tools, HPI, etc. Packers are also adaptable to Baker-style setting tools.

Hydraulic Setting Tool. Multi-stage hydraulic setting tool uses applied pressure to coil tubing and jointed pipe to generate required force to set:

Hydrostatic Setting Tool (Non-Explosive), a non-explosive setting tool used to provide the stroke and force required to set bridge plugs, packers, cement retainers, and other tension bolt/shear ring released tools. The tool utilizes a non-explosive actuator to allow bottom hole pressure (BHP) to enter the tool The BHP acting upon the internal piston area generates the required amount of force to sever tension bolts or shear rings that commonly attach the plug/packer to the setting tool, all without the use of explosives.

Hydrostatic, Hydraulic and Wireline pressure setting tools are used to set below TTS products and other products from other vendors.

- Paragon II Packers (hang-offs, straddles, isolations)
- Paragon II Retrievable Bridge Plug
- Paragon II Retrievable Retainers (one trip)
- Magna Range Bridge Plugs
- Controlled Set High Expansion Retainer (one trip)
- Cast Iron Bridge Plugs
- Cast Iron Retainers
- Knock Out Magna Range Bridge Plugs
- Spiral Thru Tubing Bridge Plugs

Wire Line Adapter Kits, for use when running explosive, hydrostatic, electro-mechanical setting tools such as:

- 1-11/16" and 2-1/8" "GO" style multi-stage explosive setting tools
- Baker 05, 10, and 20 explosive setting tools
- Halliburton DPU
- Electro-mechanical setting tools
- 1-11/16", 2-1/8", and 2-1/2" hydrostatic setting tools

Packers/Well Intervention

Annular Controlled Safety Valve (ACSV)

The TTS Annular Controlled Safety Valve (ACSV) gives the operator the ability to safely continue production when problems arise with a conventional Surface Control Sub-Surface Safety Valve (SCSSV). Normally, a damaged or malfunctioning SCSSV must be pulled and replaced requiring a rig operation with its associated cost. The ACSV provides the operator a solution to rectify this problem with a rig-less intervention using coiled tubing or wireline.

The ACSV is used as an integral part of a straddle isolation string. The string isolates the existing damaged SSCSV and provides a safety valve that can be opened and closed on demand using the pressure on the annulus. Longer straddle sections may also provide the ability to cover damaged sections of production tubing or velocity strings as needed.

Features/Benefits

- 10,000 psi differential from below.
- Able to open and close on demand with annulus pressure.
- Capable of opening with pressure from below to self-equalize.
- Operating pressure from 300 psi to 600 psi to fully open.
- Internal sleeve protects flapper while in open position.
- Smooth ID to prevent turbulent flow across valve.
- Installed with anchor latch for easy retrievability.
- Built-in shear sub to disconnect in case of catastrophic disaster at wellhead.
- Built-in fishing neck if shear sub is separated for easy retrieval.

Application

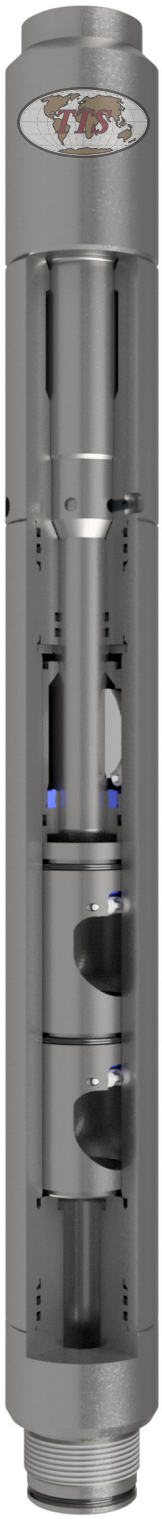
- Retrievable Tubing Patch for tubing leaks across existing SCSSV.
- Retrievable Straddle for Gas Lift Installation across existing SCSSV.
- Retrievable Velocity String Installation across existing SCSSV.
- Retrievable Jet Pump Installation across existing SCSSV.

TTS Annular Controlled Safety Valve						
Tubing Size (in)	Tubing (wt lb/ft)	Operating Pressure		Valve OD (in)	Valve ID (in)	Pulling Tool
		Min	Max			
2-7/8	6.4	300 psi	1,500 psi	2.380	0.810	2” “GS”
3-1/2	9.3 – 10.2	300 psi	1,500 psi	2.380	0.810	2” “GS”

**US Patent applied for.*

Packers/Well Intervention

Sub Surface Injection Valve (SSIV)



The TTS Sub Surface Injection Valve (SSIV) gives the operator the ability to safely continue pumping on injection wells when problems arise with a conventional Surface Controlled Sub-Surface Safety Valve (SCSSV). Normally, a damaged or malfunctioning SCSSV must be pulled and replaced requiring a rig operation with its associated cost. The SSIV provides the operator a solution to rectify this problem with a rig-less intervention using coiled tubing or wireline.

The SSIV is used as an integral part of a straddle isolation string. The string isolates the existing damaged SSCSV and provides a check valve that can be opened when pumping into well and checking from below if pressure build up after injecting. Longer straddle sections may also provide the ability to cover damaged sections of production tubing or velocity strings as needed.

Features/Benefits

- 10,000 psi differential from below.
- Able to open when injecting into well
- Closes automatically when injection stops
- Dual flappers for added protection
- Inverted flapper to prevent injection if sheared off from storm or damage to wellhead
- Smooth ID to prevent turbulent flow across valve
- Installed with anchor latch for easy retrievability
- Built in shear sub to disconnect in case of catastrophic disaster at wellhead
- Built in fishing neck if shear sub is separated for easy retrieval

Application

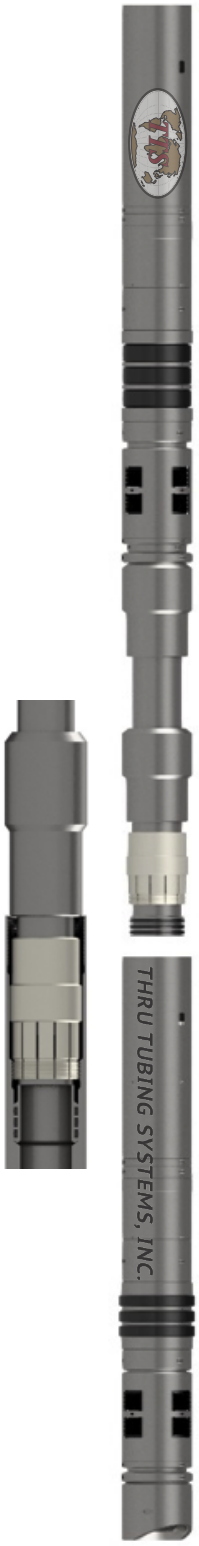
- Retrievable Tubing Patch for tubing leaks across existing SCSSV
- Retrievable Velocity String Installation across existing SCSSV
- Retrievable Jet Pump Installation across existing SCSSV

TTS Sub Surface Injection Valve					
Tubing Size (in)	Tubing (wt lb/ft)	Max Operating Pressure	Valve OD (in)	Valve ID (in)	Pulling Tool
2-7/8	6.4	10,000 psi	2.380	0.810	2” “GS”
3-1/2	9.3 – 10.2	10,000 psi	2.380	0.810	2” “GS”

Packers/Well Intervention

Paragon II Retrievable Straddle Pack System

Utilizing the TTS Paragon II Retrievable DSB Thru-Tubing Packer, an isolation straddle packer system can be installed via wireline, coiled tubing, or jointed pipe. When pressure control is required and/or lubricator height limits running length, modular latching seal extensions can be run in segments to achieve a straddle over a longer interval. This system can be used to patch holes in tubing, isolate zones, provide gas lift or jet pump installation.



Features/Benefits

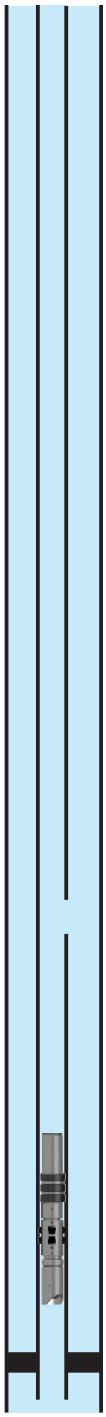
- Modular design allows adjustable and unlimited length with use of PBR and Anchor Latch.
- Dual Seal Bore design provides full opening ID thru Latch Seal.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Retrievable installation of any composite or polymer tubing
- Positive Indicating Latch Seal.
- Packers hold differential pressure from above and below.
- Requires only two trips to set or retrieve on slickline or wireline; one or two trips on coil tubing. Saves time and risk compared to conventional tubing stop and pack-off alternatives requiring several trips to install.
- Seal bore can be manufactured to accommodate tubing movements caused by downhole temperature changes due to injection and production operations. Allows for floating seals up to 17' of stroke.
- Each packer can be tested along with all connections of coil tubing as they are run into the well.
- Superior sealing and anchoring system. Multi-durometer packing system holds pressure from above or below.
- Paragon II packers available in 5,000 psi and 7,500 psi pressure ratings. See Pages 27-30.

Applications

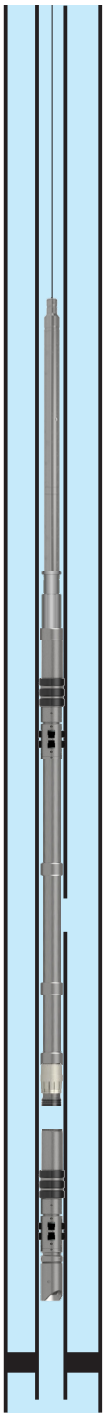
- Retrievable Tubing Patch for tubing leaks
- Retrievable Straddle for Zone Isolation
- Retrievable Straddle for Gas Lift Installation
- Retrievable Jet Pump Installation
- Retrievable Stand-Alone Screen Straddles

Packers/Well Intervention

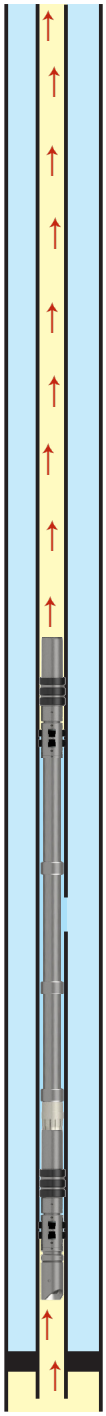
Retrievable Tubing Straddle for Tubing Leaks



Set Lower Packer



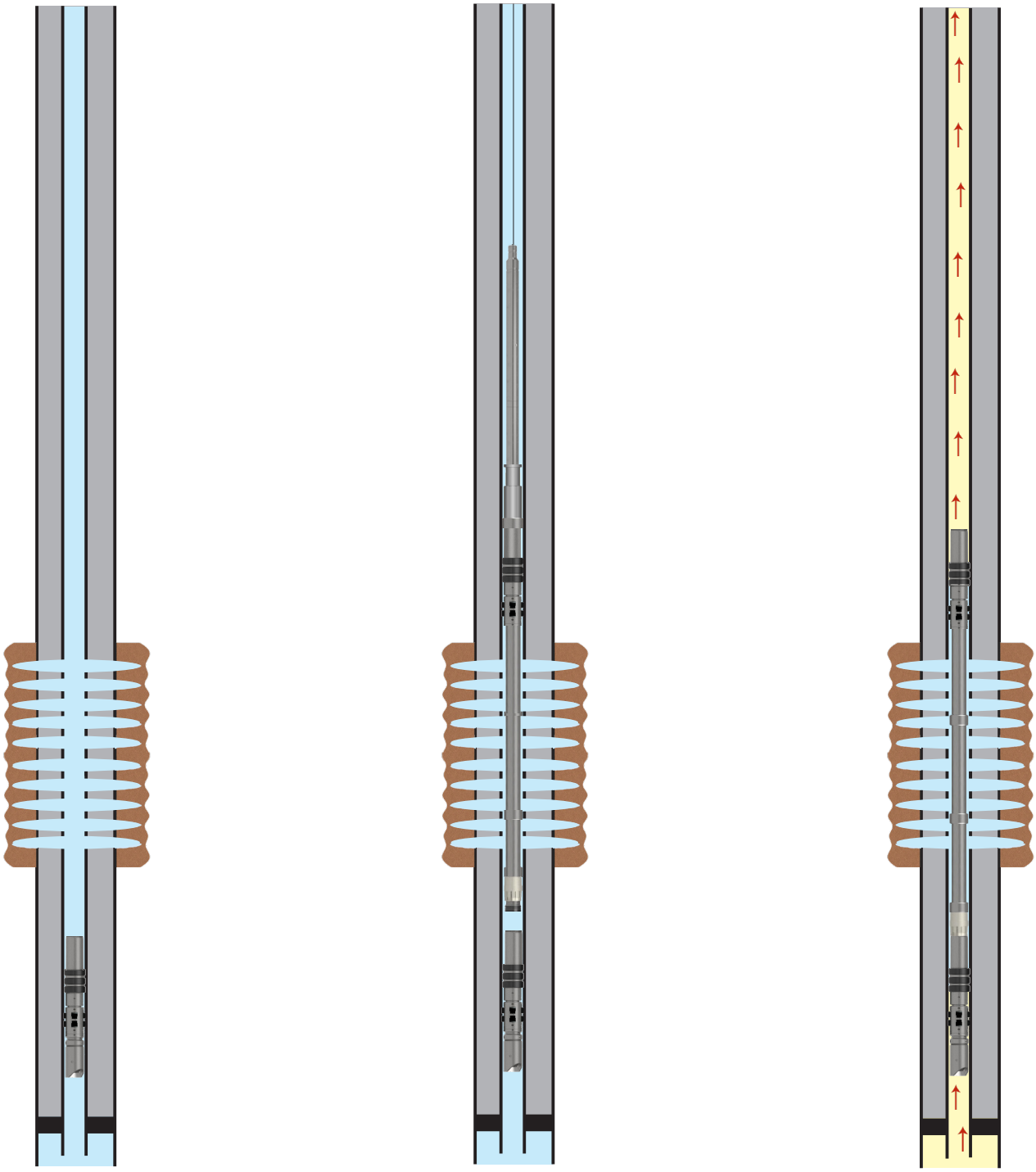
Locate Seals



Set Upper Packer

Packers/Well Intervention

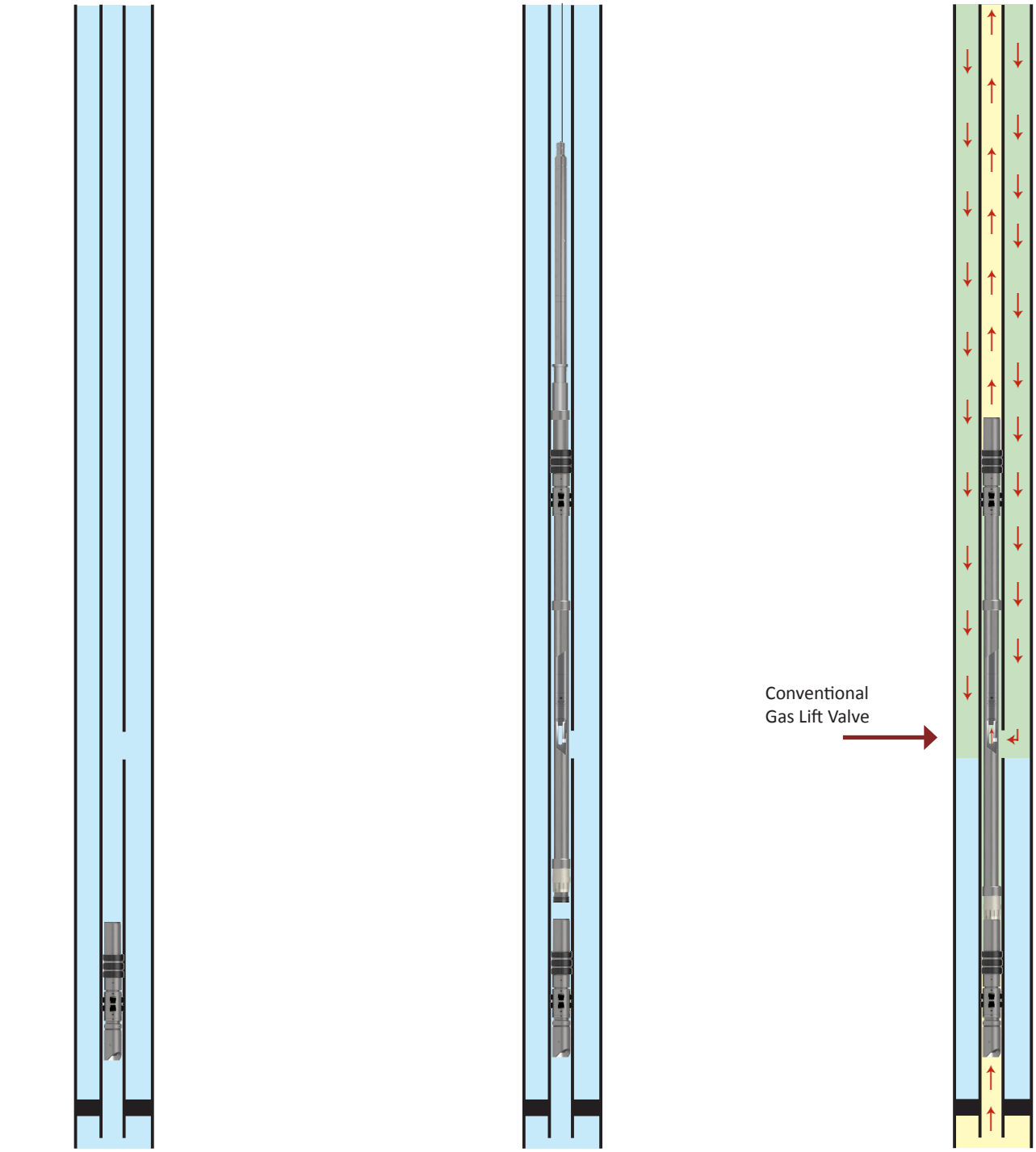
Retrievable Straddle for Zone Isolation



Set Lower Packer **Locate Seals** **Set Upper Packer**

Packers/Well Intervention

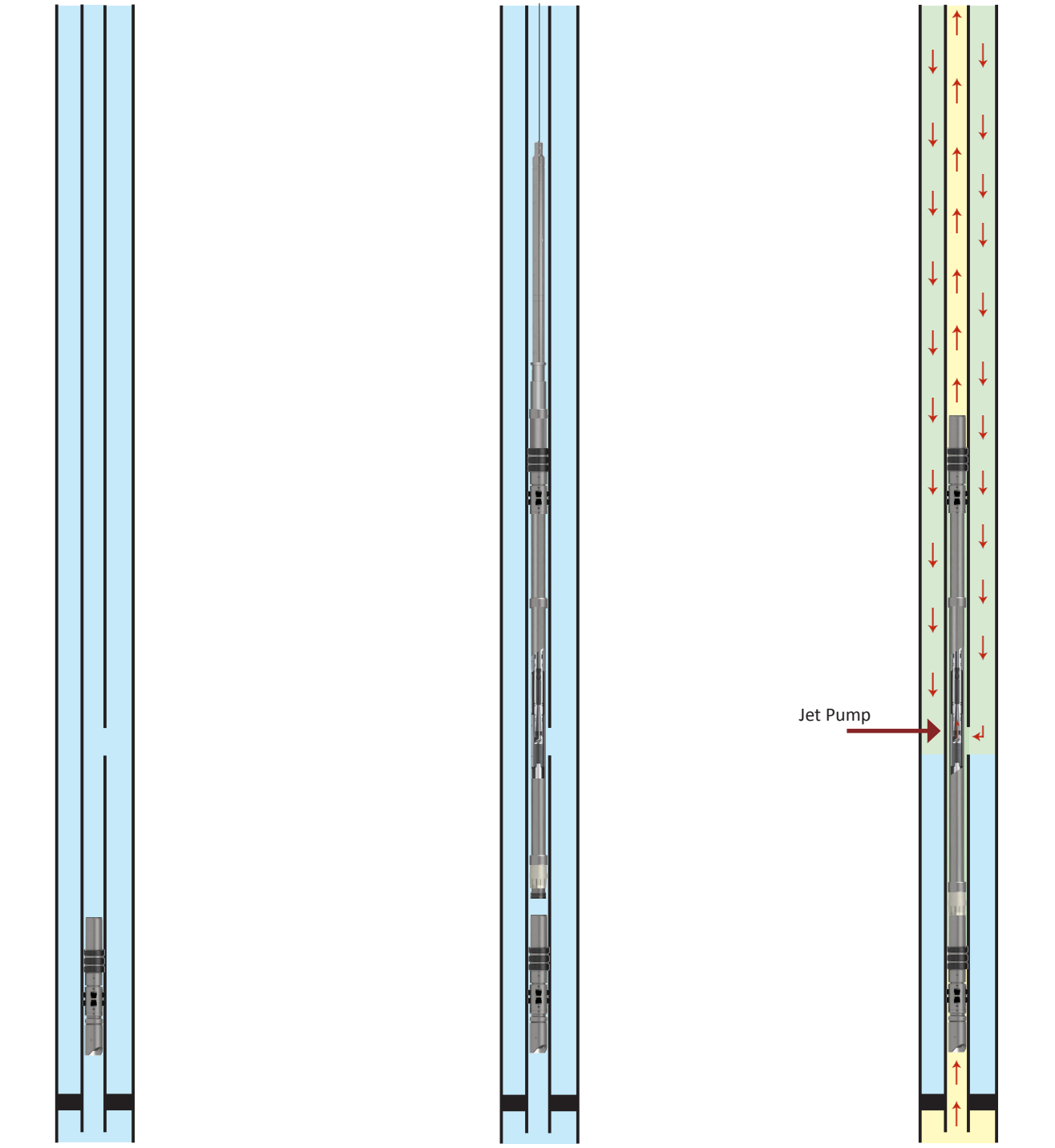
Retrievable Straddle for Gas Lift Installation



Punch Hole in Tubing **Set Straddle** **Gas Lift**

Packers/Well Intervention

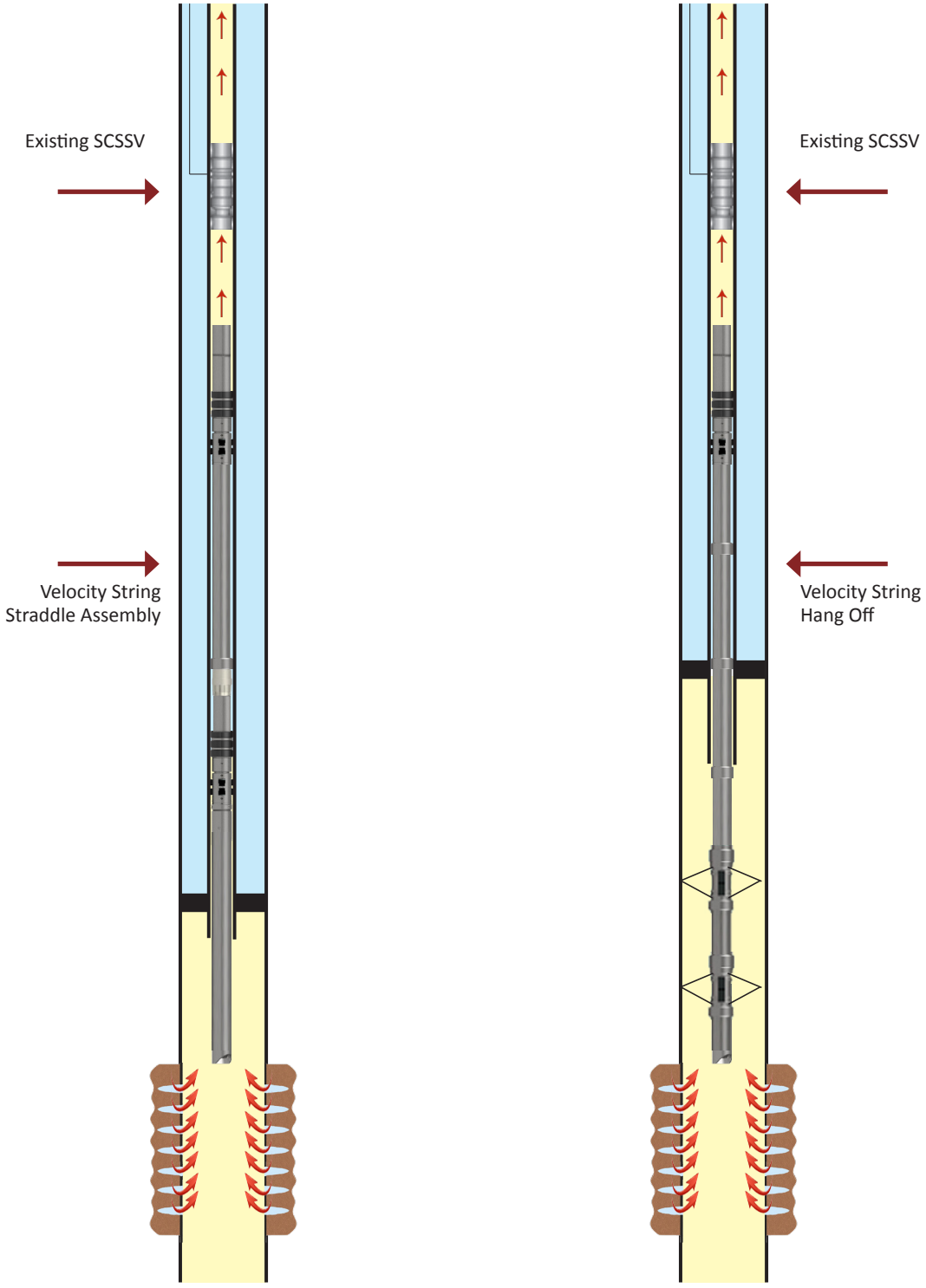
Retrievable Jet Pump Installation



Set Lower Packer **Locate Seals** **Set Upper Packer**

Packers/Well Intervention

TTS Velocity String Assemblies



(TTS products are available through authorized service providers.)

Packers/Well Intervention

Paragon II Retrievable Bridge Plug (RBP)

The Paragon II Retrievable Bridge Plug (RBP) is based off any version of the Paragon Retrievable Tubing Packers including; Standard, High Pressure and Medium Expansion versions. It utilizes a sleeve-type equalization valve assembly which is attached to the lower end of the packer. The sleeve valve is run in the well normally closed. Upon retrieval of the RBP the sleeve valve is opened to allow pressure to equalize across the RBP prior to retrieval attempts thus preventing the RBP from being inadvertently blown up or down in the well due to pressure differentials across the set RBP when retrieving with wireline. The valve is opened by applying downward forces or jarring action to the top of the sleeve valve. This is normally accomplished through the additions of a rod assembly attached to the lower end of the packer pulling tool where downward jarring action shifts the sleeve from the closed position to the open position. Once pressure across the RBP is equalized normal retrieval is commenced using up strain or upward jarring action. The Paragon RBP is offered in versions consistent with API 11D1 V5, V3 and V0 rating of up to 7500 psi at 300 degrees Fahrenheit.

Features/Benefits

- Complies with API 11D1 specifications.
- One-trip installation, one-trip retrieve Bridge Plug.
- Jar down to equalize and pull up to release.
- Modular Gage Rings allow for optimizing seal gap.
- Pressure Equalizing Valve opens before release occurs.
- Bi-directional caged slip design located below the packing system provides increased retrievability.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Multi-durometer packing system increases sealing ability.
- Standard external fishing neck for reliable latching.
- Release mechanism is not affected by differential pressures allowing reduction of the required release
  forces to aid wireline retrieving.
- Once RBP is released, the tool is locked in the release position allowing the ability to work up and down once released and not re-engage slips.

Applications

- Temporary abandonment
- Zonal Isolation
- Wellhead change out
- Deployment Plug
- Depth Locater for subsequent operations
- Selective testing/production

(See Pages 27-29)

Packers/Well Intervention

Paragon II 10K Retrievable Bridge Plug (RBP)

The TTS Paragon II 10K Retrievable Bridge Plug is deployable via coiled tubing, pipe, or wireline. It utilizes a proven multi-durometer packing system located above bi-directional slips. The differential pressure rating (V3) is 10,000 psi at 300^0 F. Customizations are available for special sizes, corrosive environments.

Features/Benefits

- Complies with API 11D1 specifications.
- One-trip installation, one-trip retrieval.
- Modular Gage Rings allow for optimizing annular seal gap.
- Bi-directional slip design located below the packing system provides increased retrievability.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Smaller OD Body above Packing Elements to aid in wash over.
- Standard external fishing neck for reliable latching.
- Pressure Equalizing Valve opens after Pulling Tool is latched.
- Release mechanism is not affected by differential pressures allowing reduced release force to aid wireline retrieving.
- Straight pull to release.
- During retrieval, tool is locked in the released position allowing the ability to work up and down during retrieval without re-engaging slips.

Applications

- Temporary abandonment
- Zonal Isolation
- Wellhead change out
- Storm Choke
- Deployment Plug
- Depth Locater for subsequent operations
- Selective testing/production

Retrievable Bridge Plug (RBP)

Tubing Size (in)	Tubing (wt)	Setting Range (in)		Plug OD (in)	Pulling Tool
		Min	Max		
2-7/8	6.4 – 6.5	2.373	2.480	2.290	2-1/2” JDS
3-1/2	9.3 – 10.2	2.919	3.047	2.725	2-1/2” JDS
4-1/2	10.5 – 15.1	3.752	4.118	3.660	3” JDS
5-1/2	15.5 – 23.0	4.578	4.976	4.470	3” JDS

NOTE: Other sizes available on request

Packers/Well Intervention

Paragon II Retrievable Cement Retainer (Sliding Sleeve)

The Paragon II Retrievable Cement Retainer is a cement retainer based off any version of the Paragon Packer. It contains a sleeve valve attached to the lower end that is designed to hold pressure from both above and below when closed. As with conventional sleeve valve retainers it can be run in the hole and cemented through in a single trip with a work-string including coil tubing or it can be deployed and set using wireline then stung into with a stinger assembly attached to a work-string. This retainer sleeve valve and stinger assemblies are specifically designed for use with coil tubing thus preventing hydraulic sticking commonly experienced when using conventional cast iron retainer products with coil tubing. Pressure ratings of up to 7500 psi are available. It is currently offered for tubing sizes from 2 3/8"-5 ½".

Features/Benefits

- Complies with API 11D1 specifications.
- One-trip installation/pumping on pipe. Separate trips using wireline.
- One-trip retrieve. Straight pull to release, no downward manipulation required.
- Modular Gage Rings allow for optimizing seal gap.
- Bi-directional caged slips located below the packing system provide increased retrievability.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Multi-durometer packing system increases sealing ability.
- Sliding Sleeve Valve System is positively closed by running tool removal to prevent cement flow back from below and hold excess hydrostatic head from above.
- Can sting in and out if needed.
- Release mechanism is not affected by hanging weight or differential pressures allowing reduction of the required release forces to aid wireline retrieving.
- Once Retainer is released, the tool is locked in the released position allowing the ability to work up and down once released and not re-engage slips.

Applications

- Cement Retainer
- Isolation Treatments (CaCo3, Acid, Sealtite)
- Designed for high cross-flows if used as an RBP

(See Pages 27-29)

Controlled Set High Expansion Permanent Cement Retainer

The TTS Controlled Set High Expansion Retainer is a dual seal bore retainer deployable via coiled tubing, jointed pipe, or wireline. Specifically designed for higher expansion ratios than standard retainers. It utilizes patented bi-directional fixed slips. The differential pressure rating is 3,000 psi at 300^0 Fahrenheit. Customizations are available for custom sizes, corrosive environments. Currently available for tubing sizes 2-7/8" to 4".

Features/Benefits

- Complies with API 11D1 specifications.
- One-trip installation/pumping on pipe. Separate trips using wireline.
- Packer element tested to API V5 testing validation.
- Dual bore design allows for larger flow areas through setting equipment
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel
  - Q-125, S-135
- Patented bi-directional fixed slips located above and below the packing system.
- Patented controlled set feature.
- One-piece high expansion packing system increases sealing ability.
- Smaller OD to pass thru non-standard ID restriction.
- Utilizes standard Paragon II Packer accessories.

Applications

- Cement Retainer
- Treatment Isolation

(See Page 30)

Zonal Isolation / Water Shutoff / Abandonment

Spiral Thru Tubing Bridge Plug

The TTS Spiral thru-tubing bridge plug consists of a heavy-duty anchor and an expanding steel frame covered by a high expansion elastomer. The anchor holds the plug system in place as the steel frame is expanded and engages the elastomer against the ID of the casing wall. Plug construction (seal element and anchor) is modular to allow the operator to adapt to multiple running conditions.

Features/Benefits

- Complies with API 11D1 specifications.
- Deployment of this patented plug system is accomplished using wireline or coiled tubing.
- Compatible with all wireline systems increasing setting options.
- Modular design increases operational efficiency.
- Short Overall Length increases ability to reach target zone.
- Robust design.
- Capable of setting in corrosion resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome;
  - Inconel; and
  - Q-125, S-135
- Designed to run through a smaller pipe ID or tubing restriction and set in larger ID casing below
- Total run in length is a maximum of 14.5' long

Applications

- Zonal isolation or abandonment
- Base for cement plug
- Depth control marker for subsequent gravel pack

Spiral Thru Tubing Plug

Casing Size	Weight (ppf)	ID Setting Range (working)		Tubing Size	Plug OD	Plug Length (left in hole)
		Min	Max			
3-1/2"	-	2.600"	3.340"	2-3/8"	1.81"	54.7"
4"	-	3.240"	3.640"	2-3/8"	1.81"	54.7"
4-1/2"	6.75 – 18.8	3.640"	4.216"	2-3/8"	1.81"	54.7"
5"	11.5 – 21	4.000"	4.560"	2-3/8"	1.81"	54.7"
5-1/2"	15.5 – 26	4.548"	4.960"	2-3/8"	1.81"	54.7"
4-1/2"	6.75 – 18.8	3.515"	4.216"	2-7/8"	2.19"	93.4"
5"	11.5 – 21	4.154"	4.560"	2-7/8"	2.19"	93.4"
5-1/2"	9 – 26	4.548"	5.192"	2-7/8"	2.19"	93.4"
6-5/8"	17 – 28	5.665"	6.135"	2-7/8"	2.19"	93.4"
7"	17 – 38	5.795"	6.538"	2-7/8"	2.19"	93.4"
7"	17 – 38	5.795"	6.538"	3-1/2"	2.63"	93.6"
7-5/8"	26.4 – 39	6.500"	6.969"	3-1/2"	2.63"	93.6"
7"	17 – 38	5.795"	6.538"	4-1/2"	3.41"	79.3"
9-5/8"	43.5 – 75.6	7.875"	8.755"	5-1/2"	4.25"	83.3"

The Spiral Plug can be utilized in any tubular ID that falls within the listed range.

**US Patent 7,104,323 B2*

Zonal Isolation / Water Shutoff / Abandonment

ACE Thru Tubing Umbrella Petal Basket

TTS's Positively Deployed ACE Thru Tubing Umbrella Petal Basket is designed to pass through small restrictions and set in a larger ID tubular below. The ACE Thru Tubing Umbrella Petal Basket firmly anchors into place a "metal petal" umbrella that functions as a cement basket to be utilized as a base for subsequent placement (dumping) of bridging material, cement, or resin.

Features/Benefits

- Double basket supports cement column and diverts migrating fluid to vent.
- The ACE Thru Tubing Umbrella Petal Basket uses overlapping spring steel petals to form a cone opening to the casing ID and provide a strong base to start the plugback operation. Metal petals are stronger than other cloth and Kevlar baskets and provide resistance to damage by corrosive wellbore fluids.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Slip segments have been designed to hold 1600# each to improve setting and holding ability.
- The unique setting mechanism positively deploys the bottom slips approximately 12" below the end of the running sleeve.
- A tool barrier is installed above the basket to help prevent accidental damage due to wireline tool string contact.
- A pressure balanced sliding sleeve vent valve maintains equalization across plug until it is closed, which is easily accomplished using wireline.
- Each petal basket is manufactured to accept the addition of a TTS Bow Spring Centralizer to assist entry of the running assembly into liner tops.
- Stocked for all API casing sizes (4-1/2" thru 9-5/8"). Special tubing, casing, and open hole sizes or corrosive service (H2S, CO2) models available on request.
- Standard tool running diameter is 1.63" for 7-5/8" and smaller casing; 2" for 8-5/8" and larger casing; standard length is 13' for vented, 6' 6" for non-vented (7'6" for 8-5/8" and larger).

Applications

- Zonal isolation or abandonment
- Straddle isolation
- Base for cement plug
- Depth control marker/base for subsequent gravel pack

Tool Series	Description
7850	Vented, Dual Basket
7803	Modular
7804	Straddle
7805	Non-Vented

*Petal baskets with custom features (e.g., length, slip range, etc.) available on order.

Zonal Isolation / Water Shutoff / Abandonment

Umbrella Petal Basket Specifications

Vented ACE Thru Tubing Umbrella Petal Basket				
Part Number	Pipe Size (in)	With Shot (WS)	Running Length (ft)	Running OD (in)
7850-163-450	4” / 4-1/2”	Y	13’	1.63”
7850-163-550	5” / 5-1/2”	Y	13’	1.63”
7850-163-663	6-5/8”	Y	13’	1.63”
7850-163-700	7”	Y	13’	1.63”
7850-163-763	7-5/8”	Y	13’	1.63”
7850-200-963	9-5/8”	N	13’	2”

Non-Vented ACE Thru Tubing Umbrella Petal Basket				
Part Number	Pipe Size (in)	With Shot (WS)	Running Length (ft)	Running OD (in)
7805-163-450	4” / 4-1/2”	N	6’6”	1.63”
7805-163-550	5” / 5-1/2”	N	6’6”	1.63”
7805-163-663	6-5/8”	N	6’6”	1.63”
7805-163-700	7”	N	6’6”	1.63”
7805-163-763	7-5/8”	N	6’6”	1.63”
7805-200-963	9-5/8”	N	7’6”	2”

*Petal baskets with custom features (e.g., length, slip range, etc.) available on order.

A ***Straddle*** version is available to shut-off unwanted production or communication zone(s). This version leaves the vent valve open to allow production/communication with zones(s) below the Straddle. The annular area between the basket and the vent valve is sealed off by cement. The length of this interval is custom designed for the particular well requirements.

When zone length requires additional length, a ***Modular*** version is available to allow multiple sections to be assembled on location. The total length is only limited by the length of deployable wireline tool string.

Zonal Isolation / Water Shutoff / Abandonment

Fixed Slip Magna-Range Plug (Pressure Rated)

TTS introduces the Fixed Slip Magna-Range Bridge Plug, designed to travel through tubing ID restriction(s) and set in a larger ID tubular below. The purpose of the new system is to have a mechanism for ensuring proper deployment of the slips and guarantee accurate compression of the seal elements. The Fixed Slip Magna-Range lower slip is not completely opened and set until the elastomer is sufficiently compressed. Proper placement and anchoring of the slips helps ensure proper retention of the elastomer seal elements in the proper position to establish and maintain a pressure tight seal.

Features/Benefits

- Complies with API 11D1 specifications.
- Designed to travel through smaller tubing ID/ restrictions and set in a larger ID tubular.
- Testing has proven the Fixed Slip Magna-Range is effective in holding pressure from both directions and capable of withstanding reverse pressure cycles.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr
  - Inconel; and
  - Q-125, S-135, Hyper chrome
- TTS is the first manufacturer to post a pressure rating on a “Magna-Range” plug.
- Proprietary method of attaching each slip segment to the plug body, holding the slips in a proper axial alignment.
- TTS’ unique slip attachment method also reduces frictional forces created by traditional slip designs.
- Can be made out of corrosive-resistant alloys.

Applications

- Zonal isolation
- Bottom for cement
- Depth control marker for subsequent gravel pack

Fixed Slip Magna Range Plug				
OD (in)	Setting Range (in)		Tension Stud (lbs)	Δ Pressure Rating (psi)
	Min	Max		
1.480	1.610	1.995	8,000	5000 @ 1.995 I.D.
1.750	1.905	2.441	13,000	5000 @ 2.441 I.D.
1.906	2.156	2.765	13,000	5000 @ 2.441 I.D.
2.187	2.375	3.000	13,000	5000 @ 2.992 I.D.
2.281	2.441	3.343	13,000	5000 @ 2.992 I.D.
2.500	2.875	3.500	25,000	5000 @ 3.500 I.D.
2.750	3.187	4.030	25,000	3000 @ 3.920 I.D.

US Patent # 7,578,353 and US Patent # 7,743,836

Zonal Isolation / Water Shutoff / Abandonment

TTS Knock Out Magna-Range Bridge Plug (KOMR)

TTS now introduces the Knock Out Magna-Range Bridge Plug. In addition to the benefits of the patented TTS "Fixed Slip" design system, the Knock Out Magna-Range also allows the plug to be removed from the tubing without requiring a milling operation.

Features/Benefits

- Complies with API 11D1 specifications.
- Plug may be removed via wireline eliminating milling operation.
- Capable of setting in corrosion resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Unique locking design allows the majority of a set plug to be removed via wireline, the remainder of the plug is dropped to the bottom of the well.
- Testing and field operations have proven the KOMR to be easily and reliably removed after setting.

Applications

- Zonal isolation
- Temporary abandonment
- Bottom for cement
- Wellhead Change-out
- Tubing Change-out
- Depth control marker for subsequent gravel pack

Knock Out Magna-Range Bridge Plug					
OD (in)	Setting Range (in)		Tension Stud (lbs)	Δ Pressure Rating (psi)	
	Min	Max		Above	Below
1.480	1.610	1.995	8,000	2000	5000
1.906	2.156	2.765	13,000	2000	5000
2.187	2.375	3.000	13,000	2000	5000

US Patent # 9,714,554 B1

(TTS products are available through authorized service providers.)

Zonal Isolation / Water Shutoff / Abandonment

TTS Tubing Bridge Plug (10K)

The TTS Tubing Bridge Plug is designed with a few defining features that differentiate it from the conventional cast iron plugs currently on the market. It utilizes a specially designed Ecner Array elastomer system to provide structural integrity within the sealing element to withstand the differential pressure. This eliminates the fragile slotted metal backups normally employed to support the sealing element in the annular area between the plug and the pipe wall, making for a more robust plug design.

Features/Benefits

- Complies with API 11D1 specifications.
- Small run-in OD, increases ability to deploy through and decreases possibility of sticking in tight spots or bends in tubing.
- Compact and dependable, the TTS Tubing Bridge Plug is easily set via wireline or pipe.
- No fragile exposed metal backups reduce chance of plug damage which could lead to sticking the plug/setting tool system during deployment.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel
  - Q-125, S-135
- Lab testing verified ability to withstand pressure differential of 10,000 psi from both directions while subjecting plug to pressure reversal cycles.
- Available with bottom adapter Bow Spring Centralizer or other wireline tools.
- Setting force is maintained by a ratcheting lock ring on top of the Bridge Plug.
- Can be made out of corrosive-resistant alloys.

Applications

- Zonal isolation
- Permanent abandonment
- Bottom for cement
- Depth control marker for subsequent gravel pack

TTS Tubing Bridge Plug (10K)					
Tubing Size	Weight (ppf)	Plug O.D. (in)	ID Setting Range (in)		Pressure Rating (psi)
			Min	Max	
2-3/8”	4.00 – 5.95	1.71	1.759	2.107	10,000psi @ 1.995” I.D.
2-7/8”	6.40 – 9.50	2.09	2.125	2.563	10,000psi @ 2.441” I.D.
3-1/2”	12.70 – 12.95	2.50	2.530	2.810	10,000psi @ 2.750” I.D.
3-1/2”	5.75 – 10.30	2.63	2.670	3.258	10,000psi @ 2.992” I.D.

Zonal Isolation / Water Shutoff / Abandonment

Cast Iron Bridge Plug

Compact and dependable, the Cast Iron Plug is easily set via wireline or pipe. Setting force is maintained by a Ratcheting Lock Ring on top of the plug.

Features/Benefits

- Complies with API 11D1 specifications.
- Rated for 300^0 F (Nitrile).
- Custom elastomers available upon request.
- Drillable
- Drilling out is easier due to the cast material.
- Available for tubing and casing sizes from 4” to 20”.
- Can be set in grades up to P-110.
- Custom slips available to set in higher grade material up to Q-125.
- Pressure rating dependent on OD.
- Can be made out of corrosive-resistant alloys.

Applications

- Zonal isolation
- Permanent abandonment
- Bottom for cement

Cast Iron Bridge Plug					
Pipe Size	Weight (ppf)	Plug O.D. (in)	ID Setting Range (in)		ΔP Rating
			Min	Max	
4”	5.6 - 14.0	3.120	3.340	3.732	10K
4-1/2”	9.5 – 16.60	3.500	3.826	4.090	10K
4-1/2”	9.5 – 13.5	3.710	3.920	4.560	10K
5”	11.5 – 21.0	3.710	3.920	4.560	10K
5-1/2”	13.0 - 25.0	4.240	4.580	5.047	10K
5-3/4”	22.5 - 25.2	4.240	4.580	5.047	10K
6-5/8”	34.0	4.750	5.140	5.595	10K
6-5/8”	17.0 - 34.0	5.340	5.595	6.366	10K
6-5/8”	17.0 – 22.0	5.610	5.989	6.655	10K
7”	23.0 – 40.0	5.340	5.595	6.366	10K
7”	17.0 – 35.0	5.610	5.989	6.655	10K
7-5/8”	20.0 - 39.0	6.090	6.625	7.263	10K
8-5/8”	24.0 - 49.0	6.960	7.511	8.248	10K
9-5/8”	29.3 - 53.5	7.710	8.435	9.063	8K
10-3/4”	32.7 – 51.0	9.500	9.850	11.150	5K
11-3/4”	38.0 - 65.0	9.500	9.850	11.150	4K
13-3/8”	48.0 – 72.0	12.000	12.347	12.715	3K
16”	65.0 – 128.0	14.125	14.438	15.250	2K
18-5/8”	76.0 – 96.5	17.250	17.655	18.730	2K
20”	94.0 – 133.0	18.375	18.730	19.124	2K

Zonal Isolation / Water Shutoff / Abandonment

TTS Tubing Cement Retainers

TTS Tubing Cement Retainers are designed as a cost-effective method for placing and retaining cement in a well tubular. Several models are available giving the operator multiple choices to select a retainer that meets the specific needs of the project. Cast Iron and other material components were selected to provide both the necessary strength and to reduce milling time required to remove the Cement Retainer, if it becomes necessary.

Models Available:

2110-xxx-AC-001	Poppet Valve, Wireline Set
2110-xxx-AC-002	Dual Flapper Valve, Wireline Set
2110-xxx-AC-003	Sliding Sleeve Valve, Wireline Set
2110-xxx-AC-004	Poppet Valve, Top Entry Guide, Tubing or W/L Set
2110-xxx-AC-005	Dual Flapper Valve, Top Entry Guide, Tubing or W/L Set
2110-xxx-AC-006	Sliding Sleeve Valve, Top Entry Guide, Tubing or W/L Set

"xxx" denotes Retainer OD (e.g. 209 = 2.09"), see chart below

Features/Benefits

- Complies with API 11D1 specifications.
- An upper receptacle option is available that also serves as a Top Entry Guide for subsequent Stinger operations.
- The retainers can be set via wireline, threaded pipe or coiled tubing.
- Models -004, -005, -006 can be run on pipe using a Hydraulic Setting Tool to allow "One-Trip" setting of the retainer and pumping of cement.
- Retainer bottom options available;
  - Poppet – for low cement volumes
  - Dual Flapper – for large cement volumes; and
  - Sliding Sleeve – for holding pressure from above and below.
- The retainers are capable of withstanding differential pressure from below once the setting equipment is removed from the Cement Retainer.
- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Sliding Valve is balanced therefore not affected by differential pressure from above.

Applications

- Zonal isolation (Squeeze Jobs)
- Isolated Treatments (CaCO3, Acid, Seal-tite)
- Permanent or Abandonment
- Cement Packer Placements

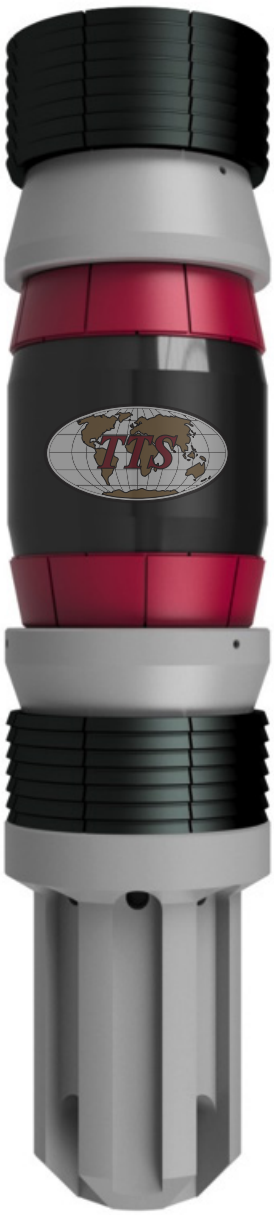
TTS Tubing Cement Retainers

Tubing Size	Retainer OD (in)	Setting Range (in)		Retainer Bottom Type	ΔP (psi) Below
		Min	Max		
2-3/8"	1.71	1.759	2.107	Dual Flapper, Poppet	10,000
2-7/8"	2.09	2.125	2.563	Sliding Sleeve, Dual Flapper,	10,000
3-1/2"	2.50	2.530	2.810	Sliding Sleeve, Dual Flapper,	10,000
3-1/2"	2.63	2.670	3.258	Sliding Sleeve, Dual Flapper,	10,000

Zonal Isolation / Water Shutoff / Abandonment

Cast Iron Cement Retainer

Compact and dependable, the Cast Cement Retainer is easily set via wireline or pipe. On tubing models (< 4-1/2”), the cement valve is a molded poppet seal. On casing models (≥ 4-1/2”), the cement valve uses a balanced sliding sleeve.



Features/Benefits

- Complies with API 11D1 specifications.
- Setting force is maintained by a Ratcheting Lock Ring on top of the cement retainer.
- Drillable
- Rotationally locked for easy drill out.
- Can be set in grades up to P-110.
- Custom slips available to set in higher grade material up to Q-125, V150.
- Poppet Seals hold from below after the pumping pressure is reduced.
- Balanced Seal Valve provides protection against re-opening and seals from both directions.
- Form-fitting metal back-ups prevent rubber extrusion.

Applications

- Zonal isolation (Squeeze Jobs)
- Isolated Treatments (CaCO3, Acid, Seal-tite)
- Permanent Abandonment
- Cement Packer Placements

Cast Iron Cement Retainer						
Pipe Size	Weight (ppf)	Plug O.D. (in)	ID Setting Range (in)		Valve Type	ΔP Rating
			Min	Max		
4"	5.6 – 14.0	3.120	3.340	3.732	Poppet	10K
4-1/2”	9.5 – 15.1	3.593	3.826	4.090	Sleeve	10K
5”	11.5 – 18.0	3.937	4.276	4.560	Sleeve	10K
5-1/2”	13.0 – 23.0	4.312	4.580	5.044	Sleeve	10K
6-5/8”	17.0 – 34.0	5.375	5.595	6.135	Sleeve	10K
7”	32.0 – 38.0	5.375	5.595	6.135	Sleeve	10K
7”	17.0 – 35.0	5.687	6.004	6.538	Sleeve	10K
7-5/8”	20.0 – 39.0	6.312	6.625	7.125	Sleeve	10K
8-5/8”	24.0 – 49.0	7.125	7.511	8.097	Sleeve	10K
9-5/8”	29.3 – 58.4	8.125	8.435	9.063	Sleeve	8K
10-3/4”	32.7 – 60.7	9.437	9.660	10.192	Sleeve	5K
10-3/4”	54.0 – 81.0	8.710	9.250	9.784	Sleeve	5K
11-3/4”	60.0 – 70.0	9.937	10.192	10.772	Sleeve	4K
13-3/8”	48.0 – 72.0	12.000	12.175	12.715	Sleeve	3K
13-3/8”	48.0 – 86.0	11.875	12.175	12.715	Sleeve	3K
16”	65.0 – 128	14.125	14.438	15.250	Sleeve	2K
16”	84.0 – 138.0	13.875	14.125	15.010	Sleeve	2K
18-5/8”	76.0 – 96.5	17.250	17.655	18.730	Sleeve	2K
20”	94.0 – 133	18.375	18.730	19.124	Sleeve	2K

Zonal Isolation / Water Shutoff / Abandonment

TTS Shoot and Squeeze Cement Retainer

The TTS Shoot and Squeeze Cement Retainer (SSCR) is a special adaptation of a conventional Sleeve Valve Cement Retainer (SVCR). The SSCR provides a means to deploy a cement retainer in combination with perforating guns, firing head, and shock absorber in a single run, usually via wireline. The SSCR is constructed of high strength alloy components to enable the SSCR to withstand the forces exerted by the initiation of the perforating gun. After setting the SSCR, the workstring is run with a sealing stinger that is used to open the sleeve valve, initiate perforating guns, pump cement, and close the sleeve valve before returning to the surface. Well control is maintained during the entire shoot/squeeze operation. The system can also be run on pipe.

Features/Benefits

- Integral design with Retainer/Perforating guns allow one-trip “Shoot and Squeeze.”
- Balanced Seal Sliding Valve prevents re-opening.
- Capable of up to 10,000 psi differential from below (size dependent).
- High strength construction to withstand perforating forces upon retainer.
- System design allows safe and simple vertical make at well-site.
- SSCR serves as a barrier and well control is maintained for entirety of the operation.

Application

- Squeeze perforating.
- P & A.

Shoot and Squeeze Cement Retainer (SSCR)

Pipe Size	Weight (ppf)	Plug O.D. (in)	ID Setting Range (in)		ΔP Rating
			Min	Max	
4-1/2”	9.5 – 15.1	3.593	3.826	4.090	10K
5”	11.5 – 18.0	3.937	4.276	4.560	10K
5-1/2”	13.0 – 23.0	4.312	4.580	5.044	10K
7”	32.0 – 38.0	5.375	5.595	6.135	10K
7”	17.0 – 35.0	5.687	6.004	6.538	10K
7-5/8”	20.0 – 39.0	6.312	6.625	7.125	10K
8-5/8”	24.0 – 49.0	7.125	7.511	8.097	10K
9-5/8”	29.3 – 58.4	8.125	8.435	9.063	8K
10-3/4”	54.0 – 81.0	8.710	9.250	9.784	5K
10-3/4”	32.7 – 60.7	9.437	9.660	10.192	5K
11-3/4”	60.0 – 70.0	9.937	10.192	10.772	4K
13-3/8”	77.0 – 102.0	11.560	11.633	12.464	3K
13-3/8”	48.0 – 72.0	12.000	12.175	12.715	3K
16”	84.0– 137.9	13.880	14.323	15.010	2K
16”	65.0 – 128	14.125	14.438	15.250	2K
18-5/8”	76.0 – 96.5	17.250	17.655	18.730	2K
20”	94.0 – 133	18.375	18.730	19.124	2K

(TTS products are available through authorized service providers.)

Wireline Products

TTS Gravity Bailer

TTS Gravity Bailers are thin wall carbon steel tubulars used to convey cement, resin, sand, and/or other materials into the wellbore via wireline. The standard bailer string version utilizes a blow-away aluminum bottom with blasting cap to open the lower end of the bailer string and "dump" the contents atop plugs, etc.

Features/Benefits

- Pulled tested to verify structural integrity of weld-on ends.
- Stainless steel material is available by special order.
- Optional actuators are available to make the system non-explosive.
- Uses Owen (p/n DMP-3500-025) or Titan (p/n 7100-000-039) Blasting Cap.
- Uses Owen (p/n DET-3050-115) or Austin (A-96L) Detonator.
- Custom lengths can be made upon request.

Applications

- Zonal Isolation (Resin, Cement, Sand, Shot)
- Pump and Place Gravel Packs
- Cement Cap for Gravel Packs
- Spotting Acid

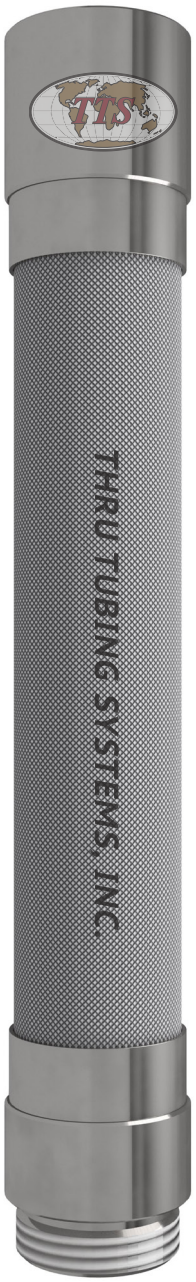
TTS Gravity Bailer	
Bailer OD	Capacity 10' Section
1"	0.33 Gal.
1-3/8"	0.67 Gal.
1-5/8"	0.95 Gal.
2"	1.37 Gal.
2-1/8"	1.52 Gal.
2-3/8"	1.86 Gal.

Other sizes available upon request, up to 5".

Wireline Products

TTS Flex Bailer Segment

The TTS Flex Bailer Segment is designed to run between gravity bailer joints to reduce the length of stiff tool string. Its purpose is to facilitate getting below tight spots or corkscrewed tubing that prevent slonger tool strings from passing through. This will allow the operator to run a full-length bailer.



Features/Benefits

- Reduces stiff hook-up length in gravity bailers, increases ability to deploy through tight spots or bends in tubing.
- Allows full length bailer to be run reducing required number of runs to carry required volume to complete job.

Applications

- High deviated wellbores
- High Dog-leg Severity

TTS Flex Bailer Segment				
Bailer Size	**Flex Joint O.D. (in)**	**Flex Joint I.D. (in)**	**Make-up Length (in)**	**Capacity/ 12" Section**
1-3/8"	1.380	0.630	12.00	0.016 gal
1-5/8"	1.690	0.750	12.00	0.023 gal
2", 2-1/8", 2-3/8"	2.000	1.110	12.00	0.050 gal

Wireline Products

TTS Electro-Hydraulic Bailer Bottom (EHBB)

The TTS Electro-hydraulic Bailer Bottom (EHBB) was designed to allow the use of a gravity dump bailer without requiring the use of explosives. The EHBB is a single operation valve designed to open a window at the bottom of a bailer string to allow the contents of the bailer to dump. By applying voltage/current at the tool down the wireline will allow for piston to lower by dumping oil and opening window.

Features/Benefits

- The EHBB system is operational at BHP of 15,000 psi and BHT of 400^0 F.
- Non-Explosive – increased operational safety.
- Non-Explosive - eliminates need for radio silence reducing down-time.
- Compatible with common bailer systems.
- Adaptable to slickline operated system.
- Sucker Rod bottom allows addition of Bow Spring, Impression Block, etc.

Applications

- Zonal Isolation (Resin, Cement, Sand, Shot)
- Pump and Place Gravel Packs
- Cement Cap for Gravel Packs
- Spotting Acid

Electro-hydraulic Bailer Bottom (EHBB)		
OD (in)	**Length (in)**	**Thread**
1.69	36.57	1.63” TTS Gravity Bailer
1.75	36.57	1.75” TTS PD Bailer
2.00	36.57	2” TTS Gravity Bailer
3.00	36.95	3” Titan Gravity Bailer
4.00	37.70	4” Titan Gravity Bailer
5.00	38.88	5” Titan Gravity Bailer

Wireline Products

TTS Positive Displacement Bailer (PDB)

The TTS Positive Displacement Bailer System is utilized to ensure placement of cement at a precise depth. The TTS system is constructed of a series of internally flush bailer sections used to carry the cement into the well. A weight bar is released directing a swab piston through the bailer ID completely swabbing the contents at the working depth.

Features/Benefits

- The contents of the bailer are effectively isolated from the wellbore fluids during trip time.
- When used with a suitable designed cement (kit) system, the PDB reduces the possibility of cement stringing up hole as wireline is returned to the surface.
- Total bailer length can be adjusted by varying the number of bailer sections to achieve the desired tool length or cement volume.
- Compatible with commonly used e-line equipment.
- Adaptable to slickline operated system.
- Optional actuator is available to make the system non-explosive.
- Sucker Rod bottom allows addition of Bow Spring, Impression Block, etc.

Applications

- Zonal Isolation (Resin or Cement)
- Cement Cap for Gravel Packs
- Spotting Acid

TTS Positive Displacement Bailer (PDB)	
OD (in)	**Capacity (Gals/ft)**
1.50	.051
1.75	.076
2.13	.125
2.50	.183
3.00	.280
3.25	.340

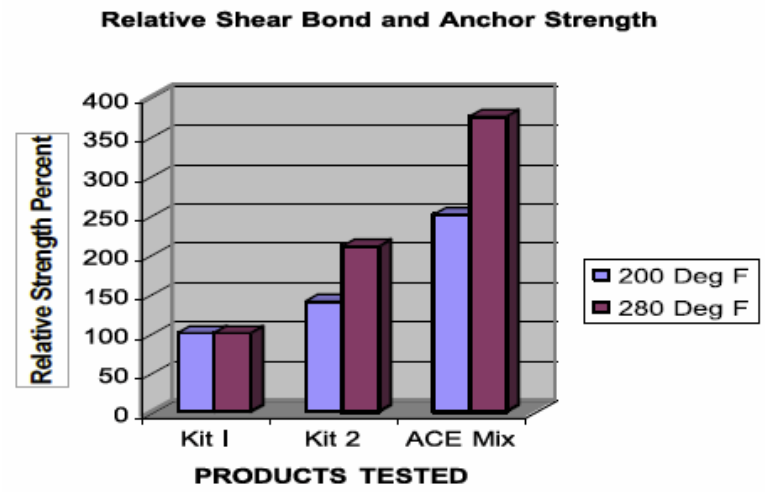
Wireline Products

TTS Ace Mix Cement Kits

TTS ACE Mix™ High Shear Bond Cement Kits are designed to maximize bonding and sealing ability under harsh down-hole conditions. They provide sufficient fluid time to "round-trip" a bailer, while maintaining reasonable initial set times and excellent API fluid loss properties as well.

The standard TTS ACE Mix™ kit is packaged in two pails (dry blend and mix water) to yield 6 gallons of 16.1-16.2 ppg cement slurry for BHT 100^0 F – 300^0 F (a single pail kit without water is available for export or remote locations). The dry blend portion of the kit is divided and packaged into two separate 3-gallon bags inside the dry blend pail. This allows the kit to be mixed and used as (2) 3-gallon batches, if preferred. The dry blend portion of the kit can be ordered packaged in a single 3-gallon pail to cut in half the weight to be lifted for safer handling operations.

The TTS ACE Mix™ product line is organized around a single base cement kit that provides a high density, high shear bond, expanding cement slurry. This expanding, high shear bond formula is now available as the "standard" kit, not special order. The performance of TTS ACE Mix™ exceeds performance of other standard kits available in head to head tests (see chart below).



The base TTS ACE Mix™ kit is also designed to allow for the addition of specific application add-ins or "wild cards." These add-ins specially enhance the performance of the kit for the unique condition. In this manner, the base cement kit adapts to the unique application requirement eliminating the need for numerous specialty kits. Simply select the proper Wild Card for the application and add to the base kit. For example, if the application is for 350^0 F, add the HTE wild card for Hi-Temp applications. There is no need to carry multiple kit versions and increase the amount of inventory. Wild Card add-ins are available for a wide variety of applications, with more under development as additional customer needs and requirements are encountered.

(TTS products are available through authorized service providers.)

Wireline Products

Description of Wild Card Add-ins Available For Use With TTS ACE Mix™ Kits:

- **HTE – High Temp Extender**
  - Additives for extending operating temperature range from 300^0 F to 400^0 F.
- **LTX – Low Temperature Expansion**
  - Standard expansion agents require minimal temperature of 200^0 F to cause expansion of cement during cure cycle. This patented additive causes ACE Mix to expand at low temperatures from 100^0 F to 200^0 F increasing Shear Bond.
- **SSW – Saturated Salt Water**
  - Certain brine and bromide fluids can cause problems for proper cement bailing, curing, and/or strength development. This additive prevents flash set in the bailer and regulates cure time in a high salinity environment. Slurry density is increased to 17.2 ppg using this additive.

Kits are manufactured using strict acceptance criteria for all material components. Each criterion is verified by laboratory testing and documented. Additionally, each batch of cement kits is manufactured according to specific quality control procedures for the manufacturing process. Again, laboratory testing of each batch of kits is performed and documented. Samples of each kit batch are maintained at the lab for an extended time period for future verification. Information is kept by Lot number to provide component traceability of individual chemical components used in the manufacture of the kits.

Additional Special Application Kits Available

- **LCM – Lost Circulation Material**
  - Bridging Material is added to the kit to assist bridging in slotted liners, etc.
- **LTC – Low Temp Cure**
  - Enables curing of slurry at BHT of 60^0 F-100^0 F.
- **XHT – Extreme High Temp**
  - Extends operating range to BHT to 425^0 F

(TTS products are available through authorized service providers.)

Wireline Products

TTS Thru Tubing Gauge Hanger (Retrievable)

The TTS Thru Tubing Gage Hanger is a slimline retrievable anchor designed to drift minimum ID's and set in larger pipe sizes below. Can be manufactured out of corrosive-resistant alloy.

Features/Benefits

- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Optimized design for maximum annular flow area.
- Slim design allows for minimal flow restriction.
- Designed for 4-1/2" to 7" casing.
- Conversion kits available for ID down to 3-1/2" or up to 9-5/8"
- Tool retrieval accomplished via wireline using standard pulling tools.
- 4,800 Ibs Setting Force/ 3,200 Ibs Retrieving Force
- 19,250 Ibs Tensile Strength
- 400 F BHT Rating

Applications

- Hanger for downhole tools (Gauges, fluid samplers, pack-offs)
- Barrier (debris, abandoned tools)
- Depth Marker

TTS Thru Tubing Gauge Hanger (Retrievable)						
Tool OD (in)	Length (in)	Setting Range (in)		Annular flow Area	Retrieving Profile	Retrieving Tool
		Min	Max			
2.000	63.90	3.920	6.570	76% in 7 in	1.75" External Fish-neck	2-1/2 JDC
2.000	75.50	6.630	9.310	86% in 9-5/8 in	1.75" External Fish-neck	2-1/2 JDC

*Flow area % varies for each casing ID

Wireline Products

TTS Wireline Pressure Setting Tool (Power Charge)

The TTS Wireline Pressure Setting Tool is used to provide the stroke and force required to set bridge plugs, packers, cement retainers, and other tension bolt/shear ring released devices via wireline. An electrically activated power charge (gas generator) produces a sufficient volume of high pressure gas. This gas pressure, acting upon the piston area, provides the required amount of force to sever tension bolts or shear rings that commonly attach the downhole tools to the setting tool.

Features/Benefits

- Self-Bleeding – relieves gas charge by-products downhole increasing safety and eliminating manual bleeding of trapped pressure on surface.
- Fluid Metered - reduces and controls speed of setting cycle.
- Long Stroke - sufficient length to set tools requiring additional stroke.
- Adaptable - fits most commonly available plugs.
- Treated Surface - all exposed surfaces of a tool are specially treated for increased durability and decreased friction.
- Rated to 15,000 psi at 400° F.
- Available in multi-staged version for higher tension bolt/ shear ring values using the same power charge.

Applications

- Set Magna-Range Bridge Plugs. (See Page 48)
- Set Knock Out Magna-Range Bridge Plugs. (See Page 49)
- Set Cast Iron Bridge Plugs and Retainers. (See Pages 50-54)
- Set TTS Paragon II Packers. (See Pages 27-29)
- Set TTS Spiral Bridge Plugs. (See Page 45)
- Set TTS Paragon II Retrievable Bridge Plugs. (See Pages 41-43)

TTS Wireline Pressure Setting Tool			
Description	**Tool Length (in)**	**Max. Stroke (in)**	**Max. Shear Value (lbs)**
1-1/2" Single Stage	52.56	6.00	13,000
1-11/16" Single Stage	78.19	10.31	13,000
1-11/16" Multi Stage	95.06	10.31	26,000
2-1/8" Single Stage	73.70	10.13	15,000
2-1/8" Multi Stage	91.06	10.13	30,000
Size 10	63.71	6	35,000
Size 20	74.79	10	55,000

Wireline Products

TTS Hydrostatic Setting Tool (Non-Explosive)

The TTS Hydrostatic Setting Tool is a non-explosive setting tool used to provide the stroke and force required to set bridge plugs, packers, cement retainers, and other tension bolt/shear ring released tools. The tool utilizes a non-explosive actuator to allow bottom hole pressure (BHP) to enter the tool. The BHP acting upon the internal piston area generates the required amount of force to sever tension bolts or shear rings that commonly attach the plug/packer to the setting tool, all without the use of explosives. The Hydrostatic Setting Tool eliminates the dangers associated with handling explosives and the lost time and inconvenience of the imposed radio silence required when explosives are utilized.

Features/Benefits

- The lower end of the setting tool emulates the explosive version allowing the same setting sleeves to be used for both models.
- Tools are designed as modular multi-stage version additional stages can be added to increase setting force.
- Non-Explosive - easily, legally transported anywhere in the world.
- Self-contained - tool carries its own clean fluid.
- Modular - allows variable number of stages to optimize BHP to force required.
- Fluid Metered - reduces speed of setting cycle.
- Long Stroke - sufficient length to set tools requiring additional stroke.
- Adaptable - fit most commonly available plugs.
- Rated to 15,000 psi at 400° F.

Non-Explosive Actuator Options

- Electro-Hydraulic: 7900-169-A-001. (See Page 64)
- J-Actuator: 5007-A-001, 5007-350-A-001. (See Page 65)

Applications

- Set Magna-Range Bridge Plugs. (See Page 48)
- Set Cast Iron Bridge Plugs and Retainers. (See Pages 50-54)
- Set TTS Paragon II Packers. (See Pages 27-29)
- Set TTS Spiral Bridge Plugs. (See Page 45)
- Set TTS Paragon II Retrievable Bridge Plugs. (See Pages 41-43)

TTS Hydrostatic Setting Tool			
Description	**Tool OD (in)**	**Stroke (in)**	**Max. Shear Value (lbs)**
1-11/16" Hydrostatic Setting Tool	1.690	10.38	26,000
2-1/8" Hydrostatic Setting Tool	2.130	10.13	35,000
2-1/2" Hydrostatic Setting Tool	2.500	10.36	35,000

*Standard stroke listed above, custom lengths available upon request.

Wireline Products

Electro-Hydraulic Actuator

The TTS Electro-Hydraulic Actuator is non-explosive tool used to open ports to flood hydrostatic setting tools. Allows wellbore fluids to enter in setting tools on demand when proper voltage is applied to the actuator.

Features/Benefits

- Self-Bleeding – allows for oil expansion to relief itself as temperature change while running in well
- Large ports to prevent plugging after actuating.
- Good for multiple runs by just pumping up with oil and no redressing.
- Non-Explosive – increased operational safety.
- Non-Explosive - eliminates need for radio silence, reducing down-time.
- Compatible with common setting tools systems.
- Adaptable to slickline operated system.

Applications with setting tool

- Activate Hydrostatic Setting Tool Non-Explosive
- Activate PDB System
- Activate Ace Push Tools

TTS Electro-Hydraulic Actuator				
Description	**Tool OD (in)**	**Tool Length (in)**	**Operating Voltage (DC)**	**Max Pressure (PSI)**
1-11/16" Electro-Hydraulic Actuator	1.690	21.95	24v - 32v	10,000

Wireline Products

J-Anchor Actuator

The TTS J-Anchor Actuator is a non-explosive mechanical device run in conjunction with and used to initiate various downhole tools systems (such as setting tools) which function by using the well BHP. Once the tool is properly positioned, up and down movement is used to set slips, once set jar down to activate tool. Isolation ports are opened allowing wellbore fluid to enter the tool string functioning the selected downhole tool.

Features/Benefits

- Capable of setting in corrosion-resistant alloys and high tensile tubulars such as:
  - 13Cr, Hyper chrome
  - Inconel; and
  - Q-125, S-135
- Capable of holding 2,000 lbs of weight
- Motion of setting tool unsets J-anchor Actuator upon completion of plug setting.
- Adjustable shear values for actuator
- Tools are rated to 15,000 psi at 400° F.

Applications

- Activate Hydrostatic Tool Non-Explosive
- Activate Sample Chamber

TTS J-Anchor Actuator				
Description	**Tool OD (in)**	**Tool Length (in)**	**Top Connection**	**Max. Shear Value (lbs)**
2-7/8" J-Anchor Actuator	2.110	37.19	5/8" Sucker Rod Pin	4,800
3-1/2" J-Anchor Actuator	2.500	37.44	5/8" Sucker Rod Pin	4,800
4-1/2" J-Anchor Actuator	3.625	43.81	3/4" Sucker Rod Pin	4,800

Wireline Products

TTS HPHT Wireline Pressure Setting Tool

The TTS HPHT Wireline Pressure Setting Tool is designed to provide the stroke and force required to set bridge plugs, cement retainers, packers, and other tension bolt/shear ring released devices via wireline. An electrically activated power charge (gas generator) produces a sufficient volume of high pressure gas. This gas pressure, acting upon the piston area, provides the required amount of force to sever tension bolts or shear rings that commonly attach the downhole tools to the setting tool.

Features/Benefits

- Self-Bleeding - relieves gas charge by-products downhole increasing safety and eliminating manual bleeding of trapped pressure on surface.
- Fluid Metered - reduces and controls speed of setting cycle.
- Long Stroke - sufficient length to set tools requiring additional stroke.
- Adaptable - fits most commonly available plugs.
- Tools are rated to 20,000 psi at 400° F.

Applications

- Set Magna-Range Bridge Plugs. (See Page 48)
- Set Cast Iron Bridge Plugs and Retainers. (See Pages 50-54)
- Set TTS Paragon II Packers. (See Pages 27-29)
- Set TTS Spiral Bridge Plugs. (See Page 45)
- Set TTS Paragon II Retrievable Bridge Plugs. (See Pages 41-43)

TTS HPHT Wireline Pressure Setting Tool				
Description	**Tool OD (in)**	**Tool Length (in)**	**Max. Stroke (in)**	**Max. Shear Value (lbs)**
2-1/8" Multi-Stage HPHT Pressure Setting Tool	2.130	134.70	10.30	30,000

Wireline Products

TTS Auto Release Tool

The TTS Auto Release Tool is designed for use with wireline deployed explosive or propellant tools. It is installed as an integral component in the tool string between the CCL and the firing sub attached to the top of the tool body. The purpose of the tool is to guarantee separation of the expended or used downhole tool from the basic wireline BHA (cable-head, sinker bars, CCL) used to deploy the downhole tool.

Features/Benefits

- Capable of carrying a tool load of up to 10,000 lbs. and will operate at a BHP of up to 15,000 psi.
- BHT is only limited to the explosives being utilized.
- Upper portion of the auto release tool is returned to surface and easily redressed for reuse.
- Unique positive separation feature of the wireline BHA from the expended tool.
- The distribution of the weight and applied forces on the tools components. Eliminates the possibility of accidental release during primary tool actuation.

Applications

- Perforating Guns
- Jet Cutters
- Chemical Cutters

TTS Auto Release Tool					
OD (in)	Length Overall (in)	Length Run-In (in)	Length Left in Hole (in)	Connection	
				Top	Bottom
1.690	15.570	14.190	4.710	1-3/16”-12	1-3/16”-12
1.690 (top fire)	18.500	15.860	6.390	1-3/16”-12	‘GO’ Button (long)

Wireline Products

TTS Selective Release Tool

The TTS Selective Release Tool is designed for use with wireline deployed explosive or propellant tools. It is installed as an integral component in the tool string between the CCL and the firing sub attached to the top of the tool body. The purpose of the tool is to guarantee separation of the expended or used downhole tool from the basic wireline BHA (cable-head, sinker bars, CCL) used to deploy the downhole tool.

Features/Benefits

- Can be released on demand.
- Capable of carrying a tool load of up to 10,000 lbs. and will operate at a BHP of up to 15,000 psi.
- BHT is only limited to the explosives being utilized.
- Upper portion of the auto release tool is returned to surface and easily redressed for reuse.
- Unique positive separation feature of the wireline BHA from the expended tool.
- The distribution of the weight and applied forces on the tools components. Eliminates the possibility of accidental release during primary tool actuation.

Applications

- Perforating Guns
- Jet Cutters
- Chemical Cutters
- Setting Tool Deployments

TTS Selective Release Tool					
OD (in)	Length Overall (in)	Length Run-In (in)	Length Left in Hole (in)	Connection	
				Top	Bottom
1.690	32.250	30.870	8.020	1-13/16” ‘GO’ Box	1-13/16” ‘GO’ Pin
1.690 (top fire)	31.320	29.240	6.390	1-13/16” ‘GO’ Box	‘GO’ Button (long)
2.750	31.110	31.110	12.570	1-5/8”– 6 Acme Box	1-5/8”– 6 Acme Box

(TTS products are available through authorized service providers.)

Wireline Products

TTS Wireline Bow Spring Centralizer

The TTS Wireline Bow Spring Centralizer is a modular Bow Spring Centralizer for use in various wireline applications. Modular end connections are threaded and interchangeable allowing for greater flexibility and range of usage. The threaded connections provide greater strength than other welded assemblies when jarring is required.

Features/Benefits

- Threaded End Connection - eliminates possible broken welds.
- Modular - End Connections are interchangeable. Springs are easily replaced.
- Adaptable - 5/8” sucker rod thread is standard, but other connections available on request.

Applications

- Provide centralization for wireline tools
- Center bridge plugs to assist proper setting
- Easy entry into liner tops, isolation packers, etc.

TTS Wireline Bow Spring Centralizer			
Description	**OD (in)***	**Length (in)****	**Range# (in)**
5/8” SR Pin x Bull Nose	1.50	25.12	2-3/8” to 9-5/8”
5/8” SR Pin x 5/8” SR Box	1.50	26.62	2-3/8” to 9-5/8”

*Tool OD without Bow Springs
** Tool length is make-up length
#Range denotes tubing or casing size

(TTS products are available through authorized service providers.)

Down-Hole Tool

TTS Hydraulic Setting Tool (HST)

The TTS Hydraulic Setting Tool (HST) deployable via coiled tubing or jointed pipe. The HST is a hydraulically actuated system used to set packers, bridge plugs, cement retainers, composite plugs / retainers when wireline setting methods are not practical or desirable. The HST features multiple pressure-amplified hydraulic cylinders that generate maximum setting force for a limited amount of setting pressure. Available for tubing sizes 2-3/8" to 20".

Features/Benefits

- Auto fill and drain while run in and out the hole.
- HST is balanced with wellbore pressure / fluid until ball is on seat.
- No pipe manipulation required.
- Large ID for increased flow area.
- Premature setting is prevented by means of shear screws in upper cylinder.
- Setting pressure that can be lowered by adding cylinders to the setting tool.
- Uses existing wireline adapter kits for Model E-4 #10 and #20.
- Cement can be pumped after setting plug / retainer in single trip.
- Availability of rotational release adapter kit for secondary release.
- Full opening after ball seat sheared allowing for circulation of fluids / cement.
- Optional ball seat pressures.
- Temperature rating 400° F.

Applications

- One trip Cast Iron Bridge Plug / Cement Retainer
- Tubing Set Paragon II Retrievable Bridge Plug
- Hang off GP Screen, Gage, Choke or Shut-in Valve
- Tubing Set Pump Thru Retainers
- One trip Cement Retainer
- Tubing Set Retrievable Bridge Plug (with accessory equalizing valve / plug)

TTS Hydraulic Setting Tool

Tool OD (in)	Top Connection (in)	Length (in)	Ball Size (in)	Stroke (in)	Setting Force (lbs)
1.710	1" CS Hydril	80.30	7/16 or 1/2	8.00	15,000
2.500	1-1/4" CS Hydril	90.21	1/2 or 5/8	8.00	35,000
3.650	2-7/8" EUE 8 Rd	111.6	1-1/4 or 1-1/2	10.30	80,000

Down-Hole Tool

Tension Packer Assembly

The Tension Packer Assembly is an easy set – easy release retrievable packer set by tension applied via the pipe string. It has a set of rocker arm slips that are activated by drag blocks or drag springs and a mating tapered cone. A Tension Packer is simple to use and does not require pipe weight which makes it ideal for shallow, low pressure applications. Multiple release mechanisms are incorporated to insure retrievability.

Features/Benefits

- Simple design provides for easy set and release.
- Set using pipe tension makes it ideal for shallow well applications.
- Multiple release options provide contingency and insure retrievability.

Applications

- Testing Tubing/ Casing integrity
- Test Cast Iron Bridge Plugs
- Pump Isolation Treatments
- Pump Cement Packers

Tension Packer Assembly							
Casing	Weight	Setting Range		OD (in)	Shear Value	Length	Thread
		Min	Max				
6-5/8”	24	5.830	5.921	5.656	50K	38.750	2-7/8” EU 8RD
6-5/8”	17 – 20	6.049	6.135	5.812	50K	42.320	2-7/8” EU 8RD
7”	38	5.830	5.921	5.656	50K	38.750	2-7/8” EU 8RD
7”	32 – 35	6.049	6.135	5.812	50K	42.320	2-7/8” EU 8RD
7”	26 – 29	6.184	6.276	5.968	50K	42.320	2-7/8” EU 8RD
7”	23 – 29	6.184	6.366	5.968	50K	38.750	3-1/2” EU 8RD
7-5/8”	33.7 – 39	6.625	6.765	6.453	50K	42.320	2-7/8” EU 8RD
7-5/8”	24 – 29.7	6.875	7.025	6.672	50K	42.320	2-7/8” EU 8RD
9-5/8”	47 – 53.5	8.535	8.681	8.218	50K	52.620	3-1/2” EU 8RD
9-5/8”	29.3-36	8.921	9.063	8.593	50K	52.620	3-1/2” EU 8RD
*10-3/4”	32.7 – 55.5	9.760	10.192	9.500	40K	44.812	3-1/2” EU 8RD
*13-3/8”	48 – 72	12.347	12.715	12.00	40K	49.375	3-1/2” EU 8RD

*These sizes use Drag Springs, not Drag Blocks.

(TTS products are available through authorized service providers.)

Down-Hole Tool

Mechanical Setting Tool (MST) Assembly

The Mechanical Setting Tool (MST) Assembly is designed to deploy Cement Retainers and Bridge Plugs mechanically on tubing or drill pipe. It is especially useful to handle the weight of the tools when running in larger casing diameters. It allows the operator to set a Cement Retainer or Bridge Plug and spot or squeeze cement in a single trip in the well.

Features/Benefits

- Insures positive opening and closing of cement valve.
- One-Trip Setting and Cementing capable.
- Easily removed with pipe manipulation.
- Contingency release mechanism (rotation or pull).
- BHT rating limited only by the Plug or Retainer being set.
- MST OD matches the Plug or Retainer being set.
- 5,000 lbs. Snap Out Force/ 2,500 lbs. Snap In Force

Applications

- Set Model B Bridge Plugs
- Set Model B Retainers

Mechanical Setting Tool (MST) Assembly

Description	Stinger OD (in)	Stinger ID (in)	Length (in)	Thread	Casing Range	
					Min	Max
2-3/8" EUE	1.320	0.750	58.25	2-3/8" EU 8RD Box	4-1/2"	5-1/2"
2-7/8" EUE	1.990	1.250	64.18	2-7/8" EU 8RD Box	6"	13-3/8"
4-1/2" IF	1.990	1.250	61.81	4-1/2" IF Box	16"	20"

*Length shown is with Stinger Configuration

Down-Hole Tool

TTS Fluid Loss Flapper Valve (FLFV)

The TTS Fluid Loss Flapper Valve (FLFV) is used to prevent fluid loss into the formation after setting a production or GP packer in the well. Undesirable fluid loss is controlled by a spring-operated frangible flapper. The flapper is held open during completion operation by wash-pipe or the setting tool stinger and closes upon removal of setting tool. The flapper can be removed later if desired.

Features/Benefits

- Flapper prevents fluid loss during completion operations.
- Flapper allows flow from below.
- Flapper can be removed hydraulically or mechanically (recommended) by production seal assembly, wireline, or coiled tubing.
- Flapper designed to break into small fragments.

Applications

- Gravel Pack Completions
- Fracpack Completions
- Low BHP wells

TTS Fluid Loss Flapper Valve (FLFV)			
Tubing Size (in)	**OD (in)**	**ID* (in)**	**Flapper Rating (psi)**
2-3/8”	3.90	2.00	2200
2-7/8”	4.25	2.31	2500
4” / 4-1/2”	5.56	3.25	2500
5” / 5-12”	7.91	4.50	1500

*Specify thread requirement. ID may vary dependent on thread type.

Down-Hole Tool

WIPER BALL

Wiper Balls are used to pump through pipe strings to assist in cleaning of the pipe ID. They are manufactured using a high elongation natural rubber allowing the ball to collapse to pass tubing restrictions and re-size to maintain contact with the pipe wall ID without damage to the Wiper Ball. The effective wiping range is approximately 40% to 80% of the nominal ball diameter. The standard temperature use range is 40^0 F to 300^0 F (4^0 C to 150^0 C). Standard sizes are readily available in approximately 1-inch (20-25 mm) increments ranging from 3" to 8" (80 mm to 380 mm). Special Order Customizations are available for larger (up to 15") or special sizes, lighter or heavier densities, or with an abrasive material exterior.

Features/Benefits

- Natural rubber provides good oil resistance.
- High elongation material squeezes through restrictions without damage.

Applications

- Drill pipe clean-out
- Tubular wiping
- Fluid separation
- Cement plug leader or chaser

Wiper Ball			
Nominal Ball Size	Recommended Wiping Range (in)		Minimum Restriction (in)
	Min	Max	
3" (80mm)	1.10	2.50	.63
4" (100mm)	1.38	3.12	.79
5" (125mm)	1.75	4.00	.98
6" (150mm)	2.00	4.75	1.18
7" (175mm)	2.38	5.50	1.38
8" (200mm)	3.00	7.00	1.73

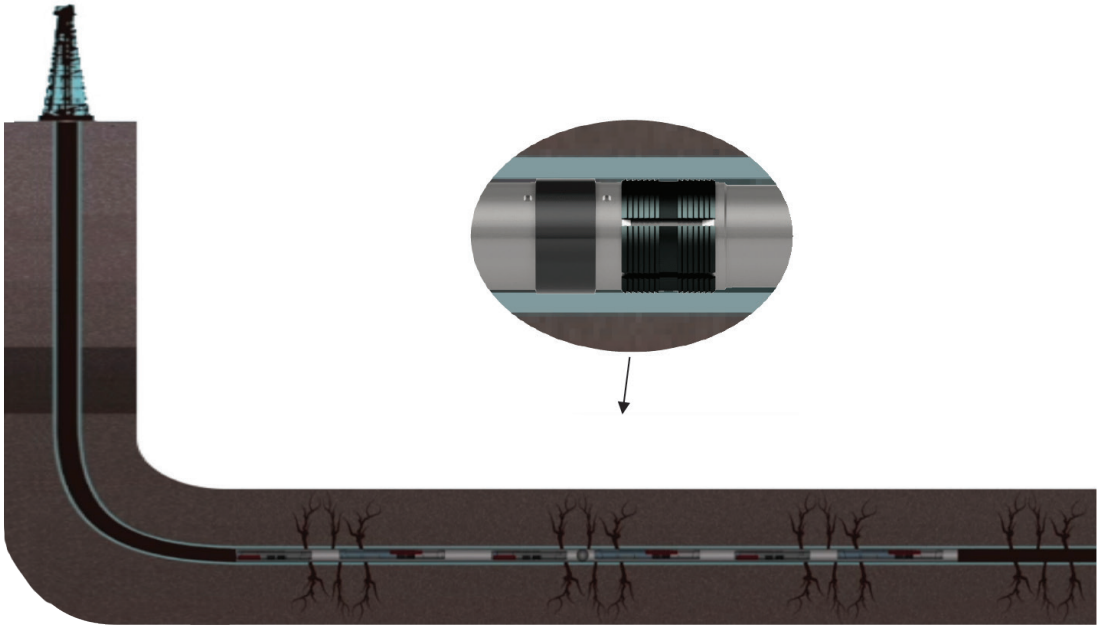
Liner Systems

Re-Frac Liner System

The TTS Re-Frac Liner System is a specialized isolation assembly that utilizes hydraulic set elements and anchors in single trip. Is used to re-line horizontal and vertical wells. Allows old clusters section to be isolated so new clusters can be perforated and frac operation can be applied. The new liner can be perforated in new clusters allowing for plug, perf and frac operations.

Features/Benefits

- Liner systems runs on rig to isolate existing perforations or sleeves for re-fracking.
- Mechanical hydraulic set large bore high pressure packer type sealing systems located at top, bottom and spaced out throughout liner, creates an annular seal isolating existing perforations or sleeves during re-frac operations.
- Annual sealing packer can be spaced as desired throughout liner.
- All annular sealing packers are set simultaneously by pressuring the liner prior to re-frac operations.
- Can be used with or without the addition of swell packers spaced throughout liner.
- Capable of flowing rates of 30 mmscf/day with 4,000’ of liner with 2.992” ID.
- Provides a set and continuous I.D. for setting plugs.
- Capable of pumping 30 bbl/min at 10,000 psi pump pressure on 5,000’ liner system.



TTS Re-Frac Liner System						
API Tubing Casing Dimensions				TTS Patch Dimensions		
Casing OD (in)	T&C (lb/ft)	Nominal ID (in)	Drift ID (in)	Element OD (in)	Element ID (in)	Spacer Pipe ID (in)
4-1/2"	15.1	3.826	3.700	3.600	2.813	2.992
	13.5	3.920	3.795	3.720	2.920	2.992
5-1/2”	23	4.670	4.545	4.345	2.992	2.992
	20	4.778	4.653	4.345	2.992	2.992
	17	4.892	4.767	4.530	2.992	2.992

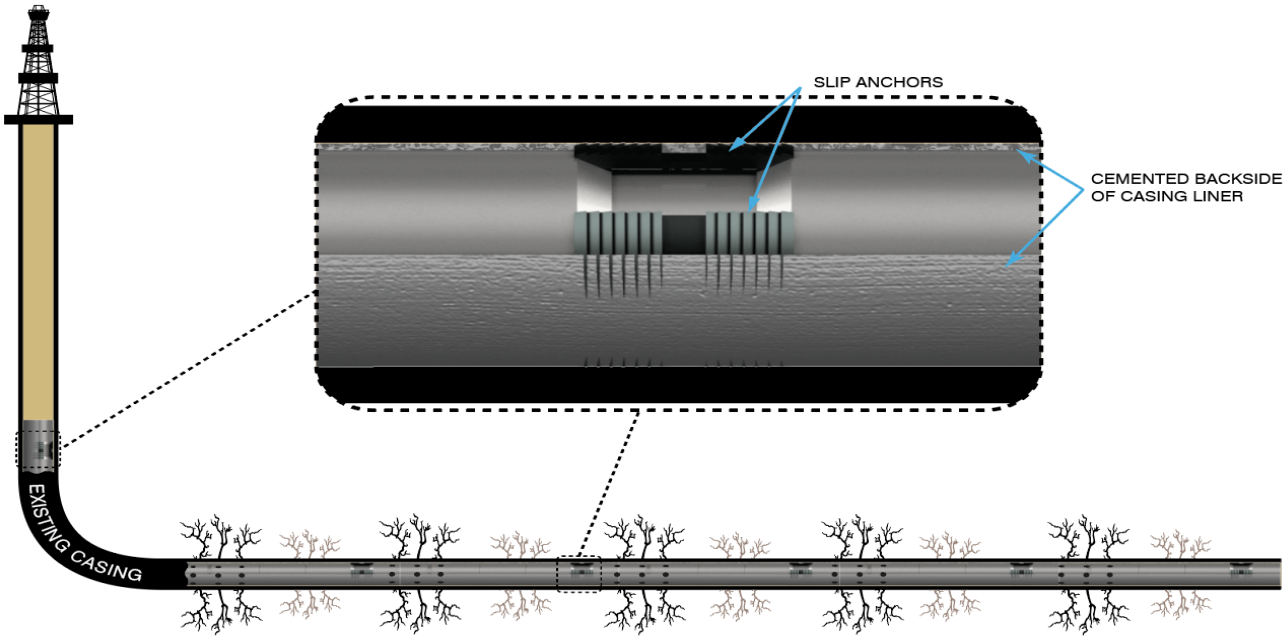
Liner Systems

Re-Frac Anchoring System

The TTS Re-Frac Anchoring System is a specialized anchor designed to perform cement operations in one trip. The system is deployed using coiled or jointed tubing. Multiple anchors can be ran to centralize liner to distribute weight and act as stabilizers for good cement coverage.

Features/Benefits

- Liner anchoring systems runs on rig to isolate existing perforations or sleeves for re-fracking.
- Can be used to lengthen existing wells .
- Hydraulic set large bore anchor systems located at top, bottom and spaced out throughout liner, creates clearance for pumping cement to isolation.
- No limit to number of anchors that can be deployed for centralization.
- All anchors are set simultaneously by pressuring the liner prior to cement operation.
- Helps limit liner stresses due to pressurization during cementing and fracking operations.
- Capable of flowing rates of 30 mmscf/day with 4,000’ of liner with 2.992” ID.



TTS Re-Frac Anchoring System						
API Tubing Casing Dimensions				TTS Anchor Dimensions		
Casing OD (in)	T&C (lb/ft)	Nominal ID (in)	Drift ID (in)	Anchor OD (in)	Anchor ID (in)	Spacer Pipe ID (in)
4-1/2”	15.1	3.826	3.700	3.600	2.813	2.992
	13.5	3.920	3.795	3.720	2.920	2.992
5-1/2”	23	4.670	4.545	4.345	2.992	2.992
	20	4.778	4.653	4.345	2.992	2.992
	17	4.892	4.767	4.530	2.992	2.992