LOGAN

SUP-R-JAR

Double-Acting Hydraulic Drilling Jar

Company Overview

Sup-R-Jar was founded in August 1988. The manufacture and rental of mechanical drilling jars was the principal business.

In 1998, Sup-R-Jar began developing a double-acting hydraulic drilling jar. The result was the Sup-R-Jar Drilling Jar that incorporated new technology and surpassed the performance of all existing jars. It hit harder, lasted longer, could be run in both tension and compression, and could be run in all types of wells. It was put into service in early 2000.

Sup-R-Jar was acquired and renamed Logan Sup-R-Jar by Logan International Inc. in Q2 2013

Drilling Jars

Mechanical Jar

The most basic jar is the mechanical jar. A mechanical jar consists of a sliding mandrel that can be thought of as being a hammer. This mandrel is set inside a shrouded sleeve and it would be considered the anvil. The hammer is connected to one end of the drill string and the anvil at the other end. The hammer and anvil are held apart by a cam-lock that is set to release when a specific weight load is reached.

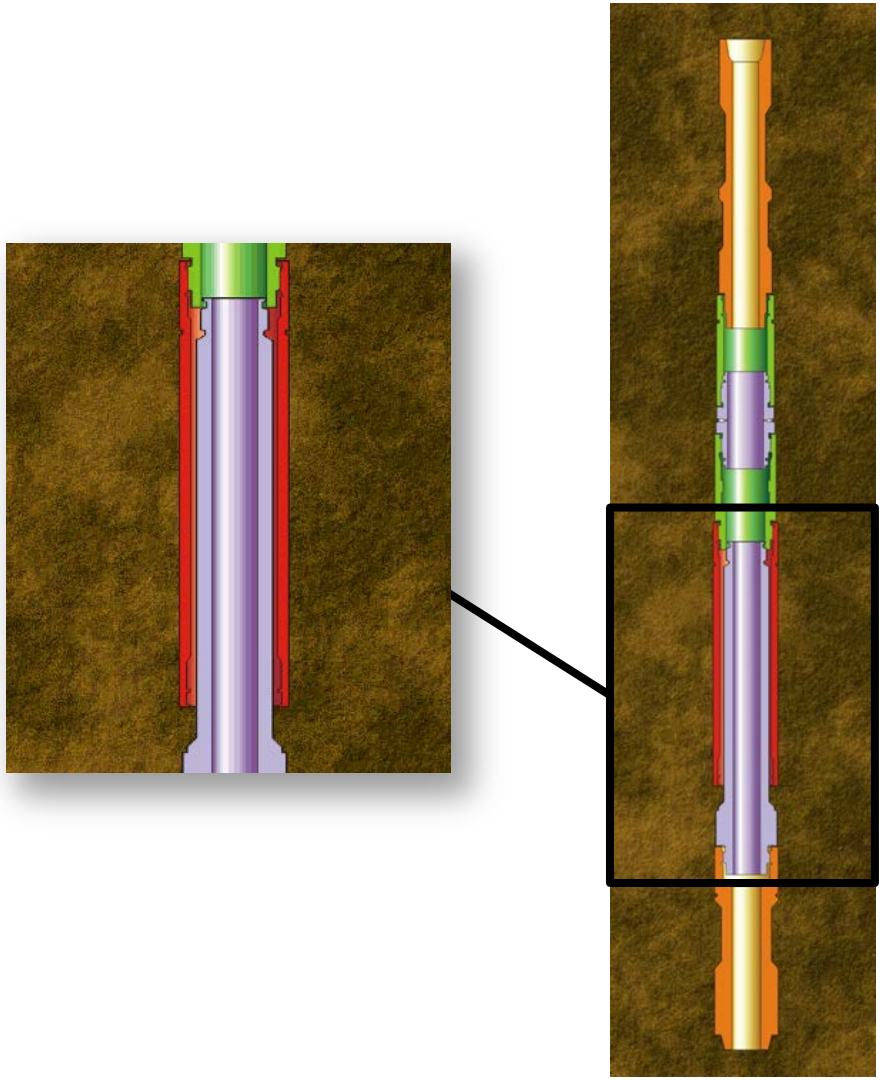
Hydraulic Jar

A hydraulic jar is much like a mechanical jar, with one exception. The hydraulic jar has a feature that dramatically influences the way the jar reacts. Instead of using a cam-lock device to fire, the jar uses its hydraulics as the delay mechanism.

Drilling Applications

The Logan Sup-R-Jar is suitable for:

- Straight Hole
- Directional Hole
- Fishing
- Workover

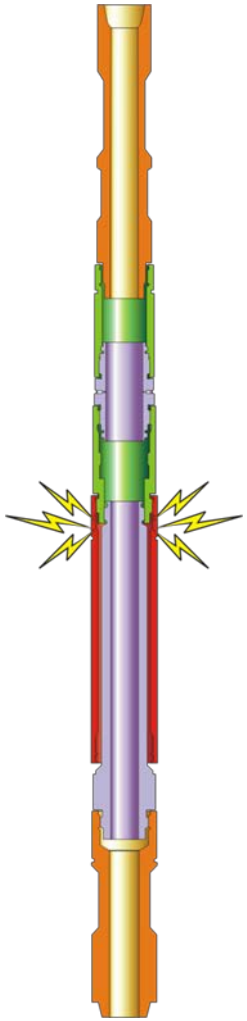


Hydraulic Jar Methodology

The hydraulic jar utilizes an oil reservoir with some type of metering orifice and a bypass area. When the string becomes stuck, over-pull is applied. As force is applied, the sliding mandrel will begin to compress the oil in the reservoir, forcing the oil to bleed off slowly through the metering orifice. This allows time for the drill string to establish the strain energy required for the jarring effect. When the piston on the mandrel comes to the bypass area, the oil bleeds off almost instantly. The hammer then speeds toward the anvil to impact and transfer the drill string's stored energy to the stuck point.

The Logan Sup-R-Jar is a double-acting hydraulic drilling jar. It is delivered to the location in the OPEN position (with approximately 2.43 feet of mandrel exposed) and usually will be open when it is pulled out of the hole.

The Logan Sup-R-Jar can be run in tension or compression. When in tension, the Sup-R-Jar should be run above the weight transition zone. *NOTE: Always allow 20% available bit weight below the jar.*



Hydraulic Jar Operation

UP STROKE: Pull on string until jar setting is reached and jar will trip.

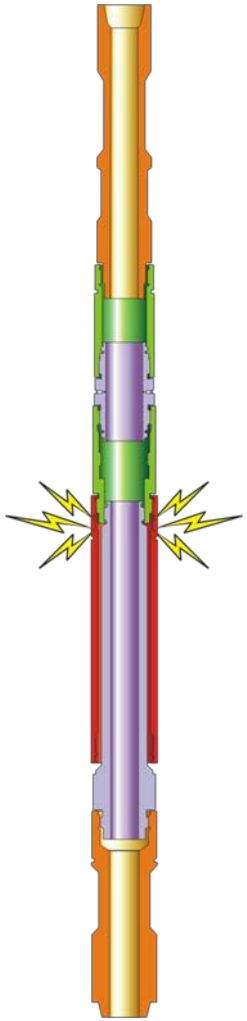
RE-COCK JAR: Slack off on drill string until the neutral position is reached. This should be slightly below the weight of the string above the jars (approximately 10,000 lbs). There usually will be a noticeable sign such as a bobble on the weight indicator needle when the neutral position is reached.

UPWARD TRIPPING OF JAR EXAMPLE

BASIS = 260,000 lbs. = Total indicator weight (string, block, hook, swivel)

-40,000	Bottom hole assembly below the jar
220,000	Weight of string above the jar
+96,000	Over pull
316,000	
+20,000	Hole drag picking up
336,000	Indicator reading to trip jar

NOTE: Slack off to 200,000 or 220,000 to cock or engage the neutral position of the jar for another upward blow.



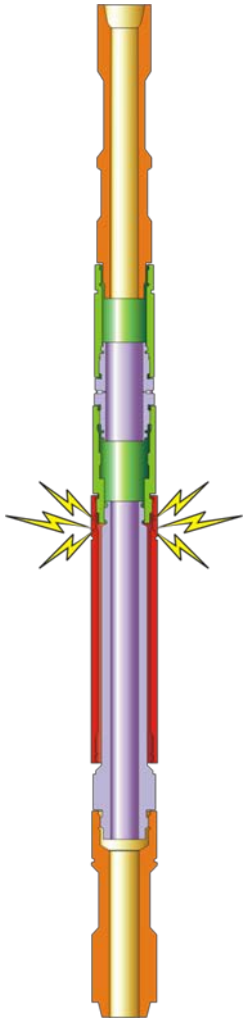
Hydraulic Jar Operation

DOWNWARD TRIPPING OF JAR EXAMPLE

BASIS = 260,000 lbs. = Total indicator weight (string, block, hook, swivel)

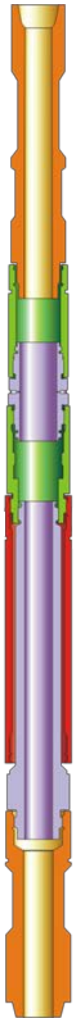
260,000	Total indicator weight
-40,000	Weight below jar
220,000	Weight above the jar
-38,000	Jar setting for downward blow
182,000	
-20,000	Hole drag
162,000	Indicator reading to trip jar downward

NOTE: Pick up to 230,000 to 250,000 to re-cock the jar. The down-stroke to reach neutral position is not as noticeable in most cases as the up-stroke of the jar. In many cases, particularly in deep holes and with small jars, the down-tripping can be detected by the weight indicator only when the jar's neutral position is reached. Also, pump pressure affects the downward jar motion. Reduce pumps before attempting to jar down.



Sup-R-Jar Advantages

- High over-pull capability (with additional safety factor)
  - Greater than conventional jars of the same size
- Longer free stroke
  - No other jar has a greater free stroke
- Higher impact capability
  - Can hit harder than any other jar the same size
- Hydraulic timer is self-compensating for hole temperature
  - Results in more consistent pull times



Features & Benefits

- Proprietary metering mechanism is self-flushing, thus enables drill string activation for maximum operational efficiency
- Flex subs provide tool joint adaptability
- Can be run in tension or compression
- Large pump open area prevents automatic cocking or firing while pumps are operating normally
- Proprietary detent design protects the tool from affects of temperature
- Endures operating temperatures of up to 400°F and higher with optional high-temperature seal kits
- Can be effectively and efficiently integrated into stuck situations

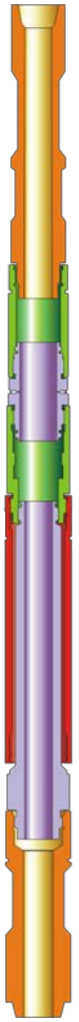
Sup-R-Jar Comparison

Compared to our nearest competitors' published data, Logan Sup-R-Jar:

- Averages a 9.3% increased maximum working load
- Weight of tool weighs similar with regards to shipping
- Averages 7.8% higher tolerance of maximum temperature

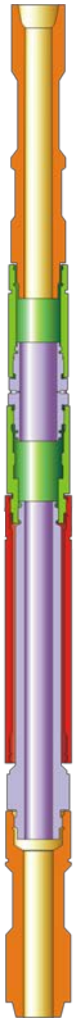
Sup-R-Jar Advantages

- Hydrostatic pressure strengthens jar
  - More over-pull capability with increasing hole depth
- Splines are constantly engaged
  - No rotary slack to cause directional drilling problems
- Straight push and pull operation for easy jar operation
  - Torque trapped in drill-string doesn't affect jar operation
- Large through bore for passage of instruments
  - Negligible pressure drop through jar
- Redundant dynamic packing to prevent washouts and provide long downhole service
- Massive over-pull failure results on internal washpipe collapse
  - No parting of tool and no washout (jar acts as a bumper sub)



Sup-R-Jar Advantages

- Packing is preloaded to prevent low pressure leakage and seal compression set problems
    - Seals maintain sealing capability at any pressure (including zero pressure)
- All connections, shoulders, and tensile/torque carrying parts are a fatigue resistant design. Additionally, the parts are cold worked to provide additional fatigue resistance (shot peened)
- The mandrel down style reduces the “junk basket” effect during drilling
- The OD wall thickness is greater than comparable tools on the market, thus reducing temperature effects during jarring operation
- The Jar does not require a cool-down period during continuous jarring cycles



Tech Specs Comparison

Technical Specifications					
	Sup-R-Jar	HE	Dailey	Griffith	PowerStroke
Outside Diameter (in)	**4¾**	4¾	4¾	4¾	4¾
Inside Diameter (in)	**2¼**	2¼	2¼	2¼	2¼
Up Stroke (in)	**8**	8	5½	4	8
Down Stroke (in)	**8**	7	5½	4	8
Locks	**No**	No	No	Pre-set	No
Maximum Tensile	**525,737**	492,284	500,000	354,000	482,000
Max Pull Load (lbs)	**90,000**	80,000	85,000	75,000	90,000
Total Stroke (in)	**29**	25	15	10	24 (approx)
Type	**Hyd**	Hyd	Hyd	Hyd/Mech	Hyd
Length (ft)	**31**	30	32	12.7 Latched	30

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SUP-R-JAR

Tech Specs Comparison

Technical Specifications					
	Sup-R-Jar	HE	Dailey	Griffith	Powerstroke
Outside Diameter (in)	**6½**	6½	6½	6½	6½
Inside Diameter (in)	**2¾**	2¾	2¾	2¾	2¾
Up Stroke (in)	**8**	8	6½	6	8
Down Stroke (in)	**8**	7	6	6	7
Locks	**No**	No	No	Pre-set	No
Maximum Tensile	**916,152**	964,207	934,000	865,000	848,000
Pump Open Area (sq in)	**20.60**	9.60	19.60	11.00	12.20
Max. Pull Load (lbs)	**200,000**	175,000	175,000	180,000	170,000
Total Stroke (in)	**29**	25	17	15	28
Type	**Hyd**	Hyd	Hyd	Hyd/Mech	Hyd
Length (ft)	**33**	31	33	18.5 Latched	30

Tech Specs Comparison

Technical Specifications					
	Sup-R-Jar	HE	Dailey	Griffith	PowerStroke
Outside Diameter (in)	**8**	8	8	8	8
Inside Diameter (in)	**3**	3	3	3	3-1/16
Up Stroke (in)	**8**	8	7	5	8
Down Stroke (in)	**8**	7	7	6	7
Locks	**No**	No	No	Pre-set	No
Maximum Tensile	**1,302,363**	1,621,565	1,700,000	965,000	1,472,000
Max. Pull Load (lbs)	**300,000**	300,000	300,000	220,000	300,000
Total Stroke (in)	**29**	25	19.5	15	30
Type	**Hyd**	Hyd	Hyd	Hyd/Mech	Hyd
Length (ft)	**34**	32	33	15 Latched	31

Tool Data

Logan Sup-R-Jar Specifications			
Tool Size OD in (mm)	4.75 (120.65)	6.50 (165.10)	8.00 (203.20)
Inside Diameter in (mm)	2.25 (57.15)	2.75 (69.85)	3.00 (76.20)
Tool Joint Connection *	3½ IF	4½ IF 4½ X-Hole	6⅝ Reg
Max. Detent Working Load lbf (N)	90,000 (400,340)	200,000 (889,644)	300,000 (1,334,466)
Tensile Yield Strength lbf (N)	452,737 (2,013,875)	916,152 (4,075,247)	1,302,363 (5,793,199)
Torsional Yield Strength ft-lb (N-m)	35,744 (48, 462)	76,129 (103,217)	102,056 (138,369)
Tool Weight lb (kg)	1,800 (816)	2,600 (1,179)	3,800 (1,723)
Tool Length ft (m)	31 (9.4)	33 (10.1)	34 (10.4)

** Tool joints cut to customer request*

Placement Recommendations

TOOL IN TENSION	TOOL IN COMPRESSION
• Neutral point is below the jar.	• Neutral point is above the jar
• Drilling jar remains “open” and cocked for down jarring while drilling	• Drilling jar remains “closed and cocked for up jarring while drilling
• No risk of premature firing of drilling jar when picking up off bottom.	• Drilling jar may fire prematurely if drill string is picked up off bottom too quickly.
• Pump-open force will help extend the drilling jar open while drilling.	• Drilling jar must be picked up off bottom and allowed to bleed through detent before tripping out or setting the slips to prevent accidental firing.
• Generally used in low angle wellbores when BHA below the optimal jar position provides sufficient weight to drill	• Unavoidable in highly deviated wellbores when BHA below the optimal jar position provides insufficient WOB.

The cost-effective answer to stuck pipe.

LOGAN
Sup-R-Jar
HYDRAULIC DRILLING JAR

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