



LIMITED LIABILITY COMPANY

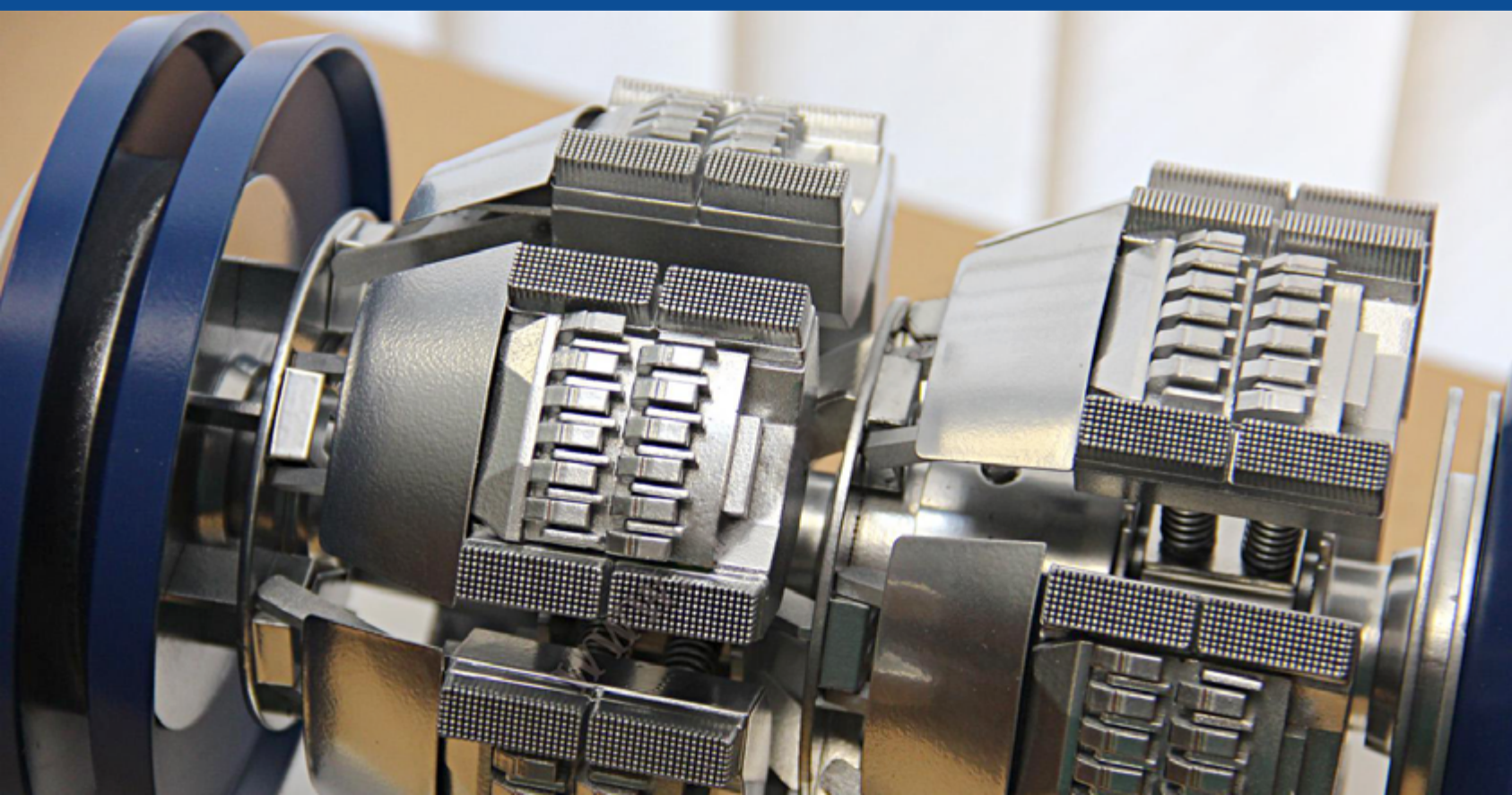
**VOSTOK***neftegaz*

Science-Technical Company

MORE THAN **20** YEARS  
OF PROFESSIONAL AND INNOVATIVE SOLUTIONS FOR  
THE OIL AND GAS INDUSTRY

TECHNOLOGIES • PRODUCTS • SERVICES

UFA 2022





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VOSTOKNEFTEGAZ STC LLC,  
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Equipment for Oil and Gas Fields"  
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Honored worker in the oil and  
gas industry of the Russian  
Federation  
Fanzil M. Mugallimov**

Our strategy is to ensure the safe operation and efficiency of customers' gas, oil and product pipelines.

The main goal of the company: realizing our potential, helping Customers to solve the problems of pipeline systems, providing comprehensive innovative solutions.

The innovative activity of the company is implemented in accordance with the adopted development program, focused on achieving strategic goals and aimed at efficiency, sustainable growth, transparency, social responsibility and innovation.

The program provides the formation of a set of measures aimed at:

- development and implementation of new technologies for cleaning and diagnostics of pipelines;
- development, production and market launch of new innovative products and services corresponding to international standards;
- increasing the capitalization and competitiveness of the company.

The information presented in the catalogue is patented and already proven technologies and devices that ensure the energy efficiency of pipeline operation.

Yours faithfully, **Fanzil M. Mugallimov**

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## MAIN AREAS AND ACTIVITIES

### **1. Production of equipment for cleaning the internal cavity of pipelines and devices for monitoring parameters for various purposes.**

1.1. Production of pigs (scrapers and pistons) for cleaning the internal cavity of pipelines with a diameter of 89...1420 mm.

1.2 Production of the devices for search and maintenance of pigs in the pipeline, devices for measuring parameters of pumping and pumped product, pipeline parameters.

### **2. Cleaning and technical diagnostics of pipelines.**

2.1. Cleaning of pipeline cavities (including those not cleaned for a long time according to the technologies developed by us).

2.2. Release the product from decommissioned pipelines with control of the scrapers location.

2.3. External inspection of pipelines

2.4. Inspection of pipelines using inspection pigs (gauging, geometry scanning and flaw detection).

### **3. Examination of industrial safety for hazardous production facilities.**

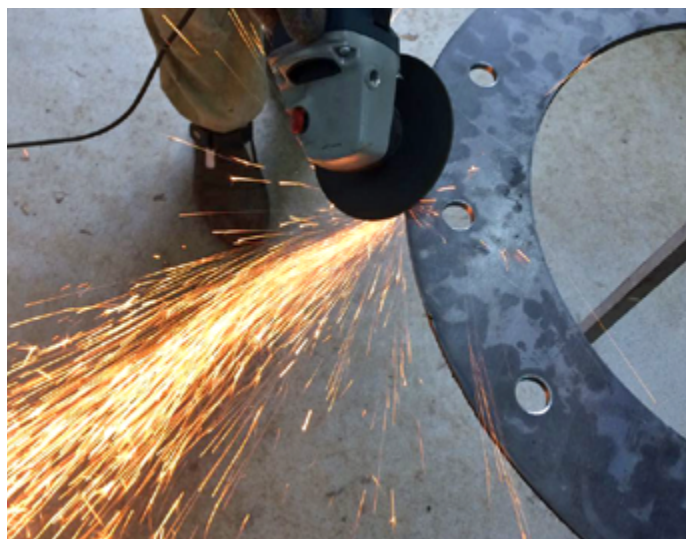
3.1. Examination of industrial safety of pipelines according to the results of external and intelligent pigging with calculations for strength and durability.

3.2. Justification of industrial safety for hazardous production facilities with risk assessment.

### **4. R&D of intelligent pigging and pipeline cleaning, safe emergency and repair works on pipelines.**

### **5. Training of specialists in cleaning technology and intelligent pigging of pipelines.**

ALL PRODUCTS ARE CERTIFIED ACCORDING TO GOST R.





**FOAM PIGS** Patents No. 2296015, 2296632, 64536, 2779837

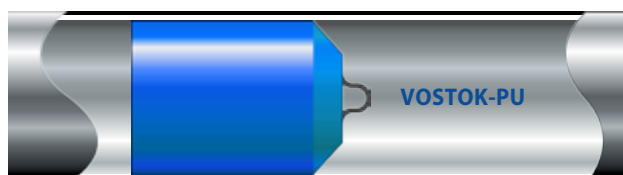
Foam pigs are designed to clean the internal cavity of main and field pipelines with a diameter of 89 to 1420 mm from asphalt-resinous, dirt-paraffin and other deposits, as well as to displace the product from the internal cavity of pipelines, are able to undergo defects in pipeline geometry up to 45% of the outer diameter and 90-degree bends with a bend radius of 1.5DN or more.



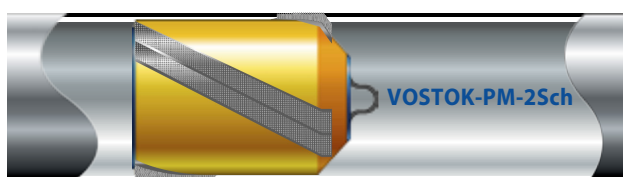
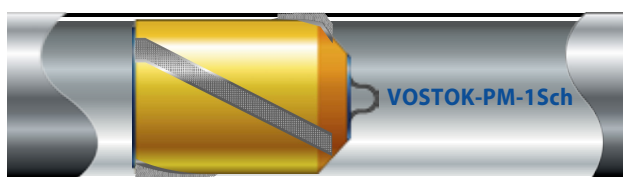
VOSTOK-PM is a foam pig with a density of 40 to 200 kg/m<sup>3</sup>.



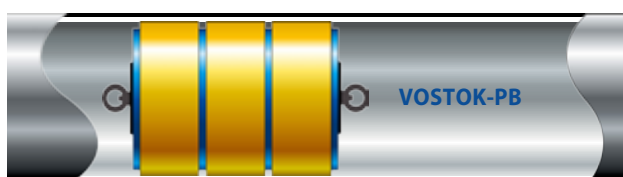
VOSTOK-PM is a foam pig with a density of 40 to 200 kg/m<sup>3</sup>, reinforced at the ends with polyurethane.



VOSTOK-PU is a foam pig with a density of 40 to 200 kg/m<sup>3</sup>, reinforced with polyurethane over the entire outer surface.



"VOSTOK-PM-XSch" is a foam pig with a density of 70 to 200 kg/m<sup>3</sup> possessing metal brushes installed in shallow-depth ducts on the cylindrical surface of the pig, designed to clean the pipeline from hard asphalt-resinous, paraffin and other deposits and scale. The pig is reinforced at the ends with polyurethane (patent №2779837). Placing the brush units on the cylindrical part of the device allows to enhance its wear resistance, as well as ensure higher quality and efficiency of cleaning the pipeline from hard deposits and scale. There is an increase in duration of the device's operation while cleaning the pipelines of greater length. This design allows to preserve the pig's integrity and use it repeatedly.

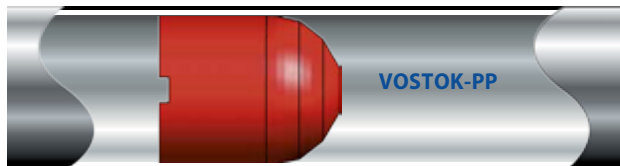


VOSTOK-PB - "Barrel" foam pig, made of 2 alternating materials (foam rubber and sheet oil-and-gasoline-resistant rubber or polyurethane).

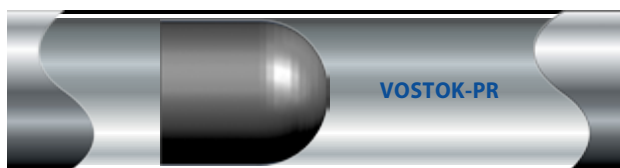
Applying polyurethane to the body of the foam pig, increasing the density of the foam itself increases the resource of the pig, resistance to aggressive environment, abrasion resistance, and also improves the quality of pipeline cleaning.

## PIGS

### VOSTOK-PP, VOSTOK-PR, VOSTOK-SHP ALL-CAST PIGS FOR PIPELINES WITH A DIAMETER OF 57...377 MM Patent No. 127331



VOSTOK-PP – polyurethane pig, made of solid polyurethane.



VOSTOK-PR is a rubber pig made of oil-and-gasoline-resistant rubber.



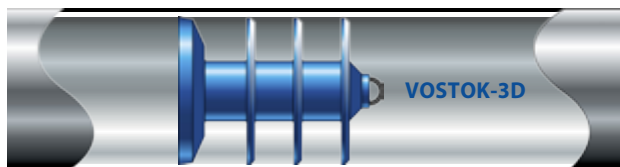
VOSTOK-SHP – polyurethane ball, shore A hardness:

- 45-55 units. especially soft – deformation up to 30% in diameter;
- 55-65 units. soft – deformation up to 30% in diameter;
- 65-75 units. semi-solid – deformation up to 20%;
- over 75 units. solid – deformation up to 15%;

Outer diameters of balls: 55, 64, 70, 75, 81, 95, 98, 100, 102, 106, 123, 128, 134, 138, 142, 147, 155, 175, 200, 207 and 253 mm

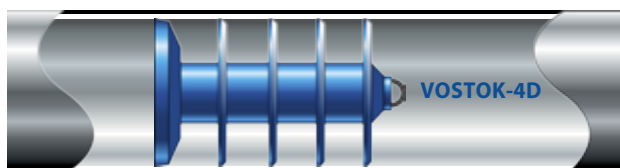
The combination of the shape and material of the ball allowed to increase its wear resistance. When passing through the pipeline, the ball rotates and wears out along the perimeter evenly. With proper operation, the average mileage of the ball is 200-300 km. The balls have a low risk of getting stuck in the pipeline.

### SOLID CAST POLYURETHANE PIGS (DO NOT HAVE METAL ELEMENTS) FOR PIPELINES WITH A DIAMETER OF 89...325 MM

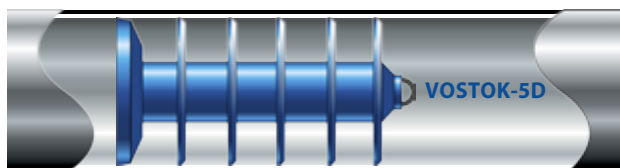


VOSTOK-XD - solid cast pig, does not have a metal frame. It consists of non-removable cleaning polyurethane discs (3, 4, 5 pcs. at the customer's choice) and a polyurethane cup, for pipelines with a diameter of 89...325 mm.

X is the number of cleaning polyurethane discs.



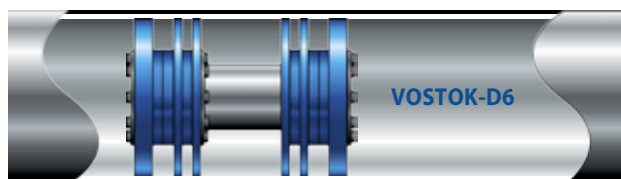
The cavity in the body of solid pigs allows the use of a transmitter (pig search device) for diameters of 159, 219, 273, 325 mm. In this case, the designation of the pigs will be "VOSTOK-XD-T".



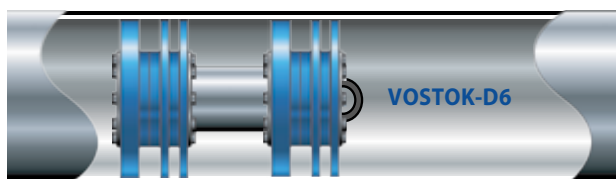
Compared to foam pigs, solid cast polyurethane pigs have a higher wear resistance and have better piggability, compared to pigs that have a metal frame. Solid cast polyurethane pigs provide a higher degree of pipeline cleaning compared to foam pigs.



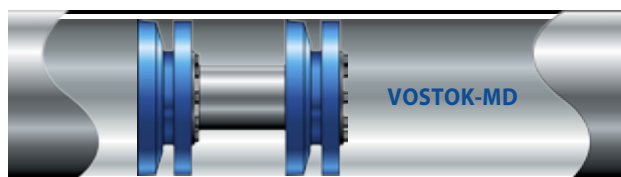
### VOSTOK-D DISC PIGS, VOSTOK-MD CUP-DISC PIGS AND VOSTOK-M CUP PIGS FOR PIPELINES WITH A DIAMETER OF 89...1420 MM



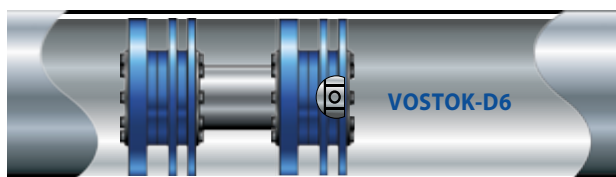
VOSTOK-D6 is a polyurethane disc pig.  
Used as cleaning elements:  
– cleaning disc – 4 pcs;  
– leading disc – 2 pcs.



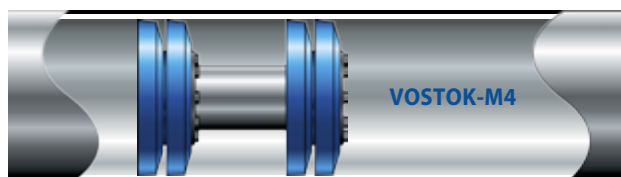
Loop for insert and remove of pigs (for pipelines with a diameter of 89...530 mm)



VOSTOK-MD is a polyurethane cup-disc pig.  
Used as cleaning elements:  
– leading disc – 2 pcs.  
– polyurethane cup – 2 pcs.



Hole for insert and remove of pigs (for pipelines with a diameter of 630...1420 mm)



VOSTOK-M4 is a polyurethane cup pig.  
Used as cleaning elements:  
– polyurethane cup – 4 pcs.

The number of discs and cups may vary depending on the order.

To fix the cleaning elements on the pig body, polyurethane spacers are installed, the number of which may vary depending on the diameter of the pig.

Of the additional attachments, it is possible to install **brush, magnetic or gauging units** on them if it is necessary to clean the internal cavity of the pipeline from incrustation, dense asphalt-resin deposits, scale, electrodes and gauging of the pipeline.

**Pigs with a transmitter (with a slot for transmitter) or mounted on the transmitter body have the letter T (transmitter) in the designation, for example, VOSTOK-MDT.**



Vostok-D pigs with brush units are designed to clean the internal cavity of pipelines from foreign objects, hard asphalt-resinous and paraffin deposits and scale. Capable to pass defects in pipeline geometry up to 25% of the outer diameter of the pipeline and 90-degree bends with a bend radius of 1.5DN or more. Diameters of cleaned pipelines from 114 mm to 1420 mm.

The operating elements of the brush units are made of spring high-carbon wire with a diameter of 0.7-0.8 mm or pieces of steel cable.

The number of discs and brush units may vary depending on the order.



Vostok-D4 (LPS) pigs are designed to clean the internal cavity of pipelines of various purposes with a diameter of 114 mm to 325 mm from hard (for example, lime) deposits, contaminants, corrosion products and foreign objects. The maximum thickness of the cleaned deposits is not more than 15% of the nominal diameter of the pipeline. Able to pass 90-degree bends with a bend radius of 1.5DN or more.

Cleaning of the pipeline is carried out by running the pig through the pipeline with a winch.

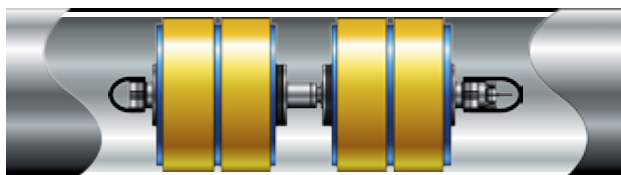
VOSTOK-D4 (LPS) pigs consist of a metal case and polyurethane disks mounted on it, the first disk is equipped with metal petals made of spring steel.



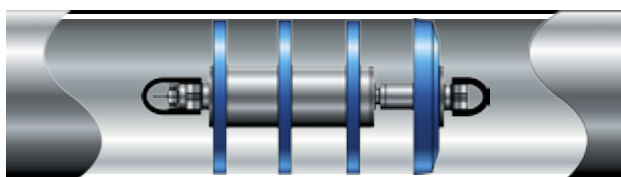
## PIGS

**VOSTOK-KSK, VOSTOK-KS, VOSTOK-PS HIGH PIGGABILITY COMBINED PIGS  
FOR PIPELINES WITH A DIAMETER OF 89...530 MM** Patents No. 2277983, 2324551

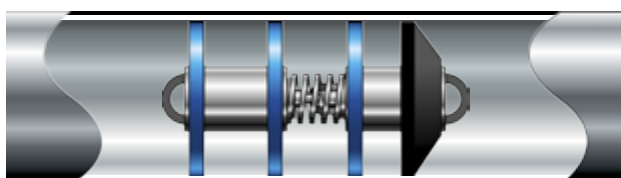
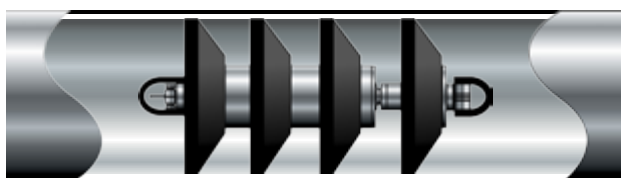
Pigs with high piggability are different in that the pig frame is made of a flexible element (steel cable), on which the cleaning elements are mounted, which allows bending along the axis of the pig when passing turns and narrowings of the pipeline and passing them unhindered. Capable to pass defects in pipeline geometry up to 45% of the pipeline outer diameter and 90-degree bends with a bend radius of 1.5DN or more as well as equal tees without grating.



VOSTOK-KSK is a high piggability combined pig. Cleaning discs made of oil-and-gasoline-resistant rubber or polyurethane and foam inserts are used as cleaning elements.



«VOSTOK-KSK is a pig with high piggability. Polyurethane or rubber discs and cups are used as cleaning elements. The first cone cup is the leading one, in the next 3 discs or cups cylindrical holes are made to equalize the pressure of the pumped product between them.

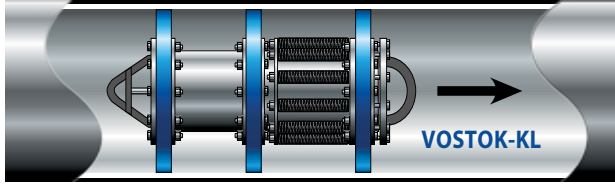


VOSTOK-PS consists of two sections connected to each other with hinges with a spring that allows the cleaning device to bend and return to its original position when passing bends and turns for pipelines with a diameter of 89...530 mm. The first cone cup is the leading one, in the next 3 discs or cups cylindrical holes are made to equalize the pressure of the pumped product between them.



## PIGS

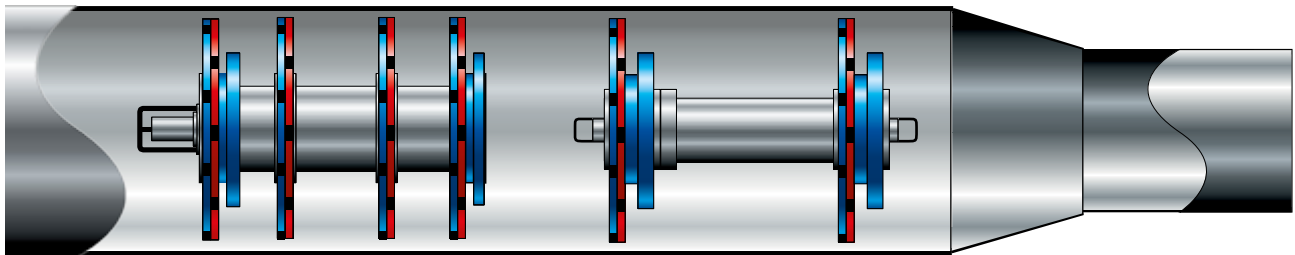
### VOSTOK-KL (TORNADO) WITH PRODUCT PASSTHROUGH FOR PIPELINES WITH A DIAMETER OF 219...530 MM Patent No. 2324550



VOSTOK-KL (tornado) is a pig that can pass (flow) the pumped product through itself (up to 20%) with an increase in the pressure drop "before" and "after" the pig in the event of a significant accumulation of deposits of asphalts, resins, and paraffins in front of it or its stopping. At the same time, the valve of the device opens (the front flange moves forward), then the deposits of asphalts, resins, and paraffins accumulated in front of the device become eroded, crush and are removed by the flow of pumped product.

VOSTOK-KL is capable to pass defects in pipeline geometry up to 20% of the outer diameter of the pipeline and 90-degree bends with a turning radius of 1.5DN or more as well as equal tees without grating. VOSTOK-KL "Tornado" type can be used in conjunction with a transmitter. A transmitter with cups of the appropriate diameter is attached to VOSTOK-KL with a hinge. If the device stops in the pipeline, it is possible to determine its location by the electromagnetic signals of the transmitter.

### VOSTOK-PD VARIABLE DIAMETER PIG Patent No. 125104



VOSTOK-PD is a pig of variable diameter from 89 to 720 mm, is distinguished by the ability to pass and clean sections of pipelines, the diameter difference of which is not more than 110 mm and to overcome 90-degree bends with a bend radius of 1.5DN or more, as well as equal-passage tees without a grate.

Double (mounted tightly to each other) rubber or polyurethane discs with segmental cutouts are used as cleaning elements.

Moreover, the segment cutouts of one disk overlap with the petals of the neighboring disk. When the diameter of the pipeline decreases during the pig run, the petals of the disks are folded, which allows the pig to pass the section of the pipeline with a smaller diameter, and when the diameter increases, they return to their original position. As additional leading discs, discs for pipelines of smaller diameter are used.

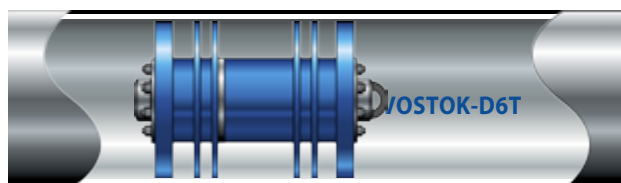
**Pigs with a transmitter or mounted on the transmitter body have the letter T (transmitter) in the designation - VOSTOK-PDT.**



## PIGS COMBINED WITH A TRANSMITTER

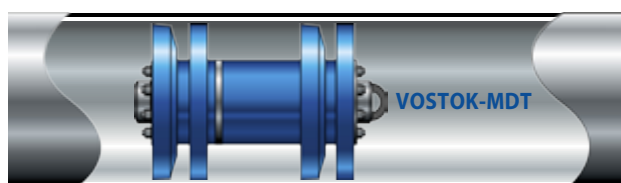
### VOSTOK-DT, VOSTOK-MDT, VOSTOK-MT PIGS

FOR PIPELINES WITH A DIAMETER OF 89...325 MM Patent No. 2110729



VOSTOK-D6T is a polyurethane disc pig with the transmitter.  
Used as cleaning elements:

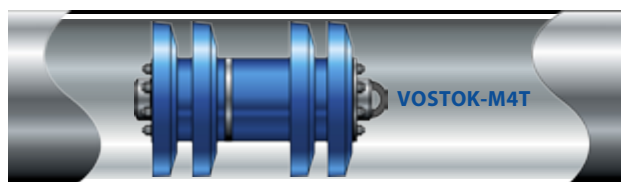
- cleaning disc – 4 pcs;
- leading disc – 2 pcs.



VOSTOK-MDT is a polyurethane cup disc pig with the transmitter.

Used as cleaning elements:

- leading disc – 2 pcs.
- polyurethane cup – 2 pcs.



VOSTOK-M4T is a polyurethane cup pig with the transmitter.

Used as cleaning elements:

- polyurethane cup – 4 pcs.

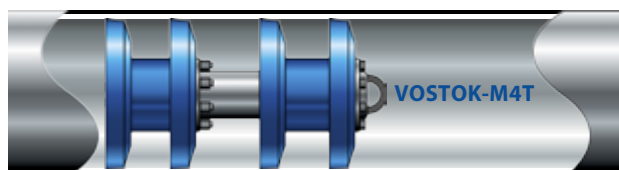
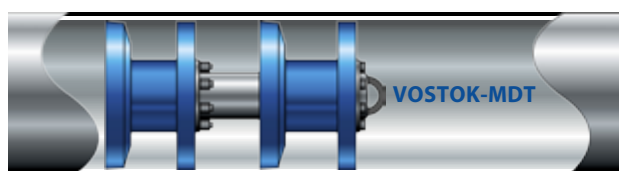
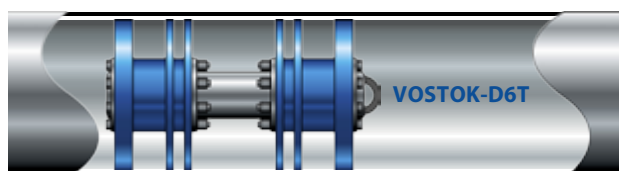
The number of discs and cups may vary depending on the order.

Pigs as VOSTOK-DT, VOSTOK-MDT and VOSTOK-MT are designed for cleaning and gauging (determining the flow section) of pipelines with a diameter of 89, 114, 159, 168, 219, 273, 325 mm. The transmitter of the device is the case of the pig for pipelines with a diameter of 89 to 325 mm, which allows the device to control the pig run through the pipeline, search for it and determine its location from the ground surface when it gets stuck. The pigs pass 90-degree bends with a bend radius of 1.5DN or more as well as equal tees without grating.

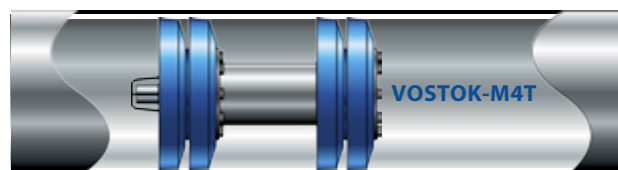
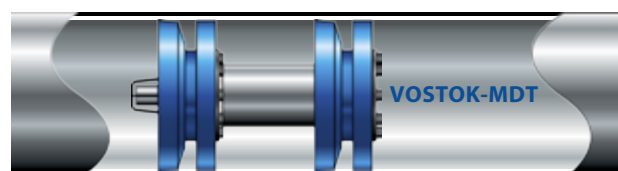
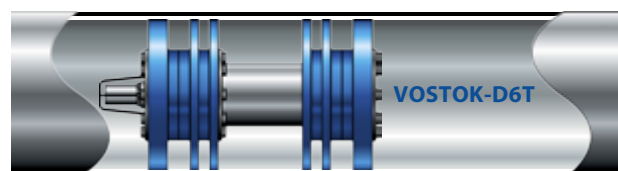
## PIGS COMBINED WITH A TRANSMITTER

### VOSTOK-D6T, VOSTOK-MDT, VOSTOK-M4T PIGS FOR PIPELINES WITH A DIAMETER OF 219...530 MM

Patent No. 2110729

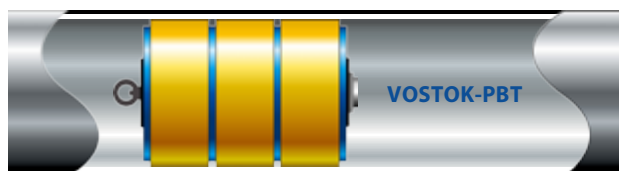


### VOSTOK-D6T, VOSTOK-MDT, VOSTOK-M4T PIGS FOR PIPELINES WITH A DIAMETER OF 630...1420 MM



For pipelines with a diameter of 219 mm, 273 mm and 325 mm, VOSTOK-T40 transmitter is built into the case of a pig, and for pipelines with a diameter of 377 mm to 1420 mm, VOSTOK-T80 transmitter is built in, which allows you to control the pig run through the pipeline, search for it and determine its location from the ground surface when its stuck.

### VOSTOK-PBT FOAM PIG Patents No. 2110729, 2369453



VOSTOK-PBT (“Barrel”) with a transmitter is designed for cleaning pipelines with a diameter of 159 to 720 mm, including those which had not been cleaned for a long time.

VOSTOK-PBT consists of a pig with a built-in transmitter with discs corresponding to the diameter of the pipe and foam inserts.



# DEVICES FOR TRACKING AND MOVEMENT CONTROL OF CLEANING AND DIAGNOSTIC PIGS IN PIPELINES

## VOSTOK-AL ACOUSTIC LOCATOR

Patent No. 2137977

VOSTOK-AL is designed to control the movement of cleaning and diagnostic pigs at arbitrary points of the pipeline route from the ground surface above the pipeline, as well as on gate valves, valves, tapping valves, open sections of the pipeline.

### The device includes:

- Electronic Control Unit,
- Head Phone,
- Geophone with Extension Cable;
- Cone Pin,
- Magnet Holder,
- Battery Charger,
- Power Cord with car's lighter socket connector,
- Suitcase.



## Main Technical Specifications

Parameter name	Value
Mass of the device in the suitcase, kg	2.2
Overall dimensions, mm	390 x 365 x 80
Time of continuous operation via internal power source at an ambient temperature of +20°C, h	Not less than 100
Maximum detection distance from the control point to the moving pig, m	2,500 (depending on pig design and sensor mounting method)
Extension Cable Length, m	8...10
Pig Traveling Speed	Unlimited
Power supply (included in the delivery set) - 1.2 V batteries, pcs.	5, AA type
Operating temperature (excluding operating temperature of power supplies)	-40°C to +50°C

The geophone is to be installed in vertical position, by sticking a cone spike in the ground above the pipeline or by attaching the magnetic holder to the case of valve or pipe body. The pig run is monitored by hearing through the head phone and/or visually by the led indicator. Pig Traveling Speed is unlimited

# DEVICES FOR TRACKING AND MONITORING THE LOCATION OF PIGS IN PIPELINES VOSTOK-NL LOW-FREQUENCY LOCATOR

## VOSTOK-NL LOW-FREQUENCY LOCATOR

Patent No. 2110729

VOSTOK-NL low-frequency locator is designed to receive electromagnetic signals generated by VOSTOK-T series transmitters, which allow to determine the location of pigs. Locator operation principle is based on the reception and decoding of 13 and 22 Hz infra-low frequency electromagnetic waves in the form of pulses – "signal/pause" or in a continuous mode from transmitters installed on pigs. It allows you to monitor the movement and determine the location of the stopped pig in the pipeline with an accuracy of  $\pm 0.5$  m.

**VOSTOK-NL is compatible with all modifications of VOSTOK-T series transmitters, transmitters for scrapers manufactured by TRANSNEFT-DIASCAN JSC, low-frequency transmitters manufactured by APRODIT LLC, transmitters manufactured by ROSEN Group and with transmitters of other manufacturers which generate signals with 13 and 22 Hz frequency.**

Vostok-NL low-frequency locator is built as a portable unit. This stand-alone device is built in a durable housing. Equipped with an antenna with connecting cable.



### Characteristics of VOSTOK-NL low-frequency locator

Parameter name	Value
The air distance at which the antenna of the low-frequency locator (receiver) steadily receives the transmitter signal (with the coaxial arrangement of the locator and transmitter antennas and the absence of interference), m	Up to 25
Duration of operation at ambient temperature: -20...+40°C, h	125
Power supply (Alkaline batteries 1.5 V), pcs.	4, type "C"
Operating temperature range (excluding operating temperature of power supplies)	- 40 ... + 50°C
Net weight with antenna, no more than, kg	5
Overall dimensions: – Low-frequency locator (width x height x length) – Antenna (diameter x length)	204 x 110 x 41 mm 50 x 310 mm
Pig location accuracy	$\pm 0.5$ m
Possibility to receive the transmitter signal in the "moving antenna" position (when the operator moves along the route)	Yes
Display of transmitter signal reception on:	– LED display
Control of locator operation (setting the operation mode, viewing memory data, etc.)	– locator keyboard

# DEVICES FOR LOCATION TRACKING AND CONTROL OF PIGS IN PIPELINES

## VOSTOK-NL LOW-FREQUENCY LOCATOR WITH BUILT-IN WI-FI MODULE

Patent No. 2110729

VOSTOK-NL low-frequency locator is designed to receive electromagnetic signals generated by VOSTOK-T series transmitters, which allow to determine the location of pigs. Locator operation principle is based on the reception and decoding of 13 and 22 Hz infra-low frequency electromagnetic waves in the form of pulses – "signal/pause" or in a continuous mode from transmitters installed on pigs. It allows you to monitor the movement and determine the location of the stopped pig in the pipeline with an accuracy of  $\pm 0.5$  m.

**VOSTOK-NL is compatible with all modifications of VOSTOK-T series transmitters, transmitters for scrapers manufactured by TRANSNEFT-DIASCAN JSC, low-frequency transmitters manufactured by APRODIT LLC, transmitters manufactured by ROSEN Group and with transmitters of other manufacturers which generate signals with 13 and 22 Hz frequency.**

The locator model with the Wi-Fi module allows you to remotely monitor the passage of scrapers with a transmitter. This is especially convenient in bad weather (winter time), when you can install a low-frequency locator on the pipeline, and control the pig passage from the vehicle.

Using an external gadget (smartphone or tablet with the Android operating system) with the installed software in the locator, you can set the time and mode of operation (13 or 22 Hz) at a distance. The gadget screen shows the battery level and the Wi-Fi signal level. The connection range of the locator with the gadget in line of sight is 700 meters. The moment of signal detection from the low-frequency transmitter is shown on the gadget via color and sound signal simultaneously with the locator.

At the request of the customer, the locator can be equipped with a smartphone with the Android operating system.



## VOSTOK-NL Low-Frequency Locator with built-in Wi-Fi Module Characteristics

Parameter name	Value
The air distance at which the antenna of the low-frequency locator (receiver) steadily receives the transmitter signal (with the coaxial arrangement of the locator and transmitter antennas and the absence of interference), m	Up to 25
Duration of operation at ambient temperature: -20...+40°C, h	125
Power supply (Alkaline batteries 1.5 V), pcs.	4, type "C"
Operating temperature range	- 40 ... + 50°C
Net weight with antenna, no more than, kg	5
Overall dimensions: – Low-frequency locator (width x height x length) – Antenna (diameter x length)	204 x 110 x 41 mm 50 x 310 mm
Pig location accuracy	$\pm 0.5$ m
Possibility to receive the transmitter signal in the "moving antenna" position (when the operator moves along the route)	Yes
Display of transmitter signal reception on:	– LED display, – on the gadget screen via Wi-Fi.
Control of locator operation (setting the operation mode, viewing memory data, etc.)	– locator keyboard, – with the gadget via Wi-Fi.
Wi-Fi communication range, m	Up to 700



# DEVICES FOR LOCATION TRACKING AND CONTROL OF PIGS IN PIPELINES

VOSTOK-T transmitters are designed to generate electromagnetic signals that allow to determine the location of pigs using a low-frequency locator (receiver). The operation principle of the transmitters is based on the transmission of 13 and 22 Hz infra-low frequency electromagnetic waves and Semigor Code as pulses – "signal/pause" or in a continuous mode.

The transmitters allow you to monitor the movement and determine the location of the stopped pig in the pipeline. Are installed on pipeline pigs.

**VOSTOK-T is compatible with VOSTOK-NL low-frequency locators, with low-frequency locator manufactured by TRANSNEFT-DIASCAN JSC, with all modifications of NPR low-frequency locators manufactured by APRODIT LLC, with low-frequency locator manufactured by ROSEN Group and with low-frequency locators of other manufacturers operating at 13 and 22 Hz and Semigor code.**

## VOSTOK-T40-89B TRANSMITTER

(the number 40 nominally corresponds to the diameter of the case equal to 42 mm)

Based on the transmitter of the VOSTOK-T40-89B modification, VOSTOK-DT, VOSTOK-MT and VOSTOK-MDT pigs are produced for pipelines with a diameter of 89 mm.

## VOSTOK-T40-114 TRANSMITTER

(the number 40 nominally corresponds to the diameter of the case equal to 42 mm)

Based on the transmitter of the VOSTOK-T40-114 modification with flange, VOSTOK-DT, VOSTOK-MT and VOSTOK-MDT pigs are produced for pipelines with a diameter of 114 mm.

The transmitter of the VOSTOK-T40-114B modification is also installed on VOSTOK-PBT pigs for pipelines with a diameter of 159 (168), 219, 273 and 325 mm ("Barrel").

## VOSTOK-T40 TRANSMITTER

(the number 40 nominally corresponds to the diameter of the case equal to 42 mm)

Based on the transmitter of the VOSTOK-T40 modification with flange, VOSTOK-DT, VOSTOK-MT and VOSTOK-MDT pigs are produced for pipelines with a diameter of 159 (168) mm. VOSTOK-T40 transmitter is installed on the pipeline pigs with a diameter of 219-325 mm.

The transmitter of the VOSTOK-T40B modification can also be installed on VOSTOK-3DT, VOSTOK-4DT and VOSTOK-5DT solid-cast pipelines pigs with a diameter of 159, 219, 273 and 325 mm.

## VOSTOK-T80 TRANSMITTER

(the number 80 corresponds to the diameter of the case equal to 80 mm)

Based on the transmitter of the VOSTOK-T80-2 modification with two flanges, VOSTOK-DT, VOSTOK-MT and VOSTOK-MDT pigs are produced for pipelines with a diameter of 219 (273) mm. VOSTOK-T80 transmitter with flange is installed on the pipeline pigs with a diameter of 325-1420 mm.

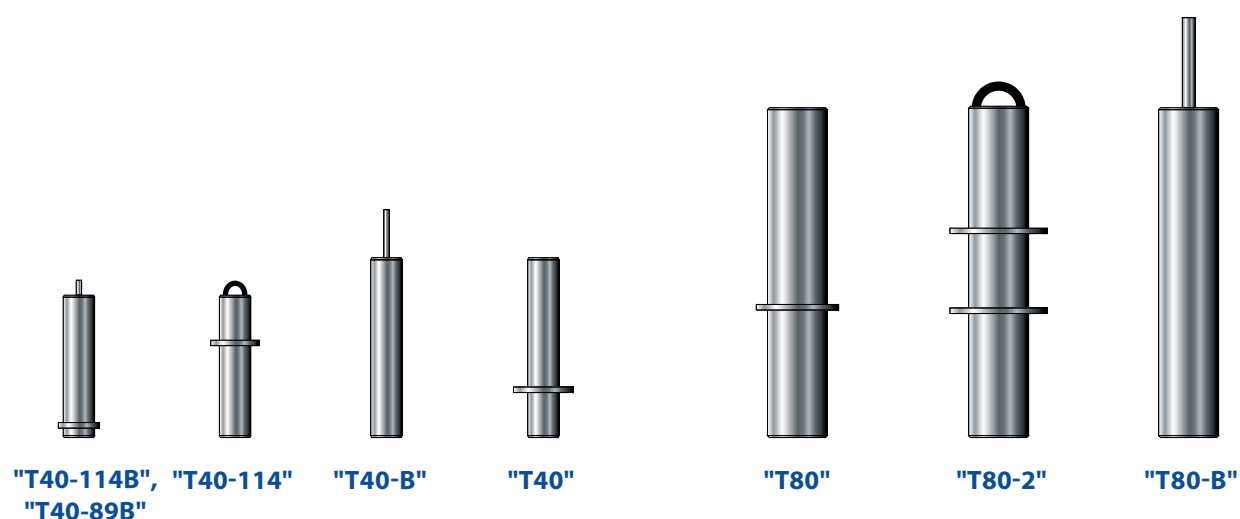
## VOSTOK-T80-B TRANSMITTER

(the number 80 nominally corresponds to the diameter of the case equal to 80 mm)

The transmitter of the VOSTOK-3DT, VOSTOK-4DT, VOSTOK-5DT modification for pipelines with a diameter of 273 and 325 mm.

## Characteristics of VOSTOK-T transmitters Patent No. 2110729

Parameter name	Transmitter Modification			
	T40		T80	
Maximum medium pressure, MPa	10 (20 by special order)			
Frequency of emitted electromagnetic signals, Hz	13,22 and Semigor Code			
Period of electromagnetic signal bursts (set before launching into the pipeline)	1:1, 1:2, 1:3, 1:6 (by special order) doubled capacity 1:1, 1:2, 1:3, 1:6 (by special order) continuous, continuous doubled capacity			
The air distance at which the low-frequency locator (receiver) steadily receives the transmitter signal (with the coaxial arrangement of the locator and transmitter antennas and the absence of interference), m	10/12		25	
Time of continuous operation of the transmitter (receiver) at an ambient temperature of +20°C, h	180		1000	
Power supply (Alkaline batteries 1.5 V), pcs.	3/4		6	
Battery Type	910A/AA type		D type	
Operating Temperature	-40 ... +50°C			
Net weight (without discs and cups), no more than, kg	1,1/2,1		9,0/10,6	
Overall dimensions, diameter x length, without flange (with flange), mm	T40-89B T40-114 T40 T40-114B T40-B	42 (52) x 157 42 (65) x 207 42 (80) x 240 42 (55) x 210 42 x 304	T80 T80-2 T80-B	80 (110) x 440 80 (130) x 475 80 x 545
Power on without opening the transmitter cover	no		is present	
Range of the pig movement speed along the pipeline, m/s	Up to 6			



### PIGGABILITY OF PIPELINE PIGS THROUGH BENDS (BEND RADII) ( $R=xDN$ )

#### Solid-cast pigs with transmitters

Pig Types	Transmitter Modifications	Pipeline diameters, mm			
		159 (168)	219	273	325
VOSTOK-3DT	VOSTOK-T40B	1,5	1,5	1,5	1,5
VOSTOK-4DT		1,5	1,5	1,5	1,5
VOSTOK-5DT		3,0	3,0	3,0	3,0
VOSTOK-3DT	VOSTOK-T80B			3,0	3,0
VOSTOK-4DT				3,0	3,0
VOSTOK-5DT				3,0	3,0

#### Pigs with a transmitter

Pig Types	Transmitter modification on which the discs/cups are mounted	Pipeline diameters, mm					
		89	114	159 (168)	219	273	325
VOSTOK-DT	VOSTOK-T40-89B	1.5	1.5	1.5			
VOSTOK-MT	VOSTOK-T40-114	1.5	1.5	1.5			
VOSTOK-MDT	VOSTOK-T40	1.5	1.5	1.5			
VOSTOK-DT	VOSTOK-T80-2				1.5	1.5	1.5
VOSTOK-MT					1.5	1.5	1.5
VOSTOK-MDT					1.5	1.5	1.5

#### Metal case pigs with a transmitter

Pig Types	Transmitter modification, which is mounted on the pig	Pipeline diameters, mm				
		219 (8")	273 (10")	325 (12")	377 (14")	426 (16") and more
VOSTOK-DT	VOSTOK-T40	1.5	1.5	1.5		
VOSTOK-MT		1.5	1.5	1.5		
VOSTOK-MDT		1.5	1.5	1.5		
VOSTOK-DT	VOSTOK-T80			3.0	3.0	1.5
VOSTOK-MT				3.0	3.0	1.5
VOSTOK-MDT				3.0	3.0	1.5

## INTERNAL RECORDER FOR PUMPING AND PUMPED PRODUCT PARAMETERS DURING CLEANING OF INTERNAL CAVITY OF PIPELINES VOSTOK-BP



VOSTOK-MD cup-and-disk pig with front-mounted VOSTOK-VR recorder installed before the testing.

The pumping and pumped product parameters recorder is designed to measure and record electronic memory data for temperature (T), pressure (P), differential pressure ( $\Delta P$ ) of the pig (scraper) throughout the pipeline section in real time with a predetermined resolution from 3 measurements per 1 second.

It is used to detect and localize deposits (contaminants) and narrowing in the pipeline, monitor the pig run, control the cleaning process, check the operating parameters of the pipeline and pumped product.

VOSTOK-VR recorder is installed on the front part of the pig.

It is equipped with a temperature sensor and 2 pressure sensors and is designed to record data on pipeline sections up to 500 km long and for gaps of more than 30 days. It operates without maintenance (without replacing the power supply) for 2 years with the main technical characteristics of the measurements resolution of 10 seconds or more. The upper level software shows the

recorded data in a visual graphics form and in tabular form.

### Data View:

- product temperature graph along the entire length of the pipeline (minimum, average and maximum);
- product absolute pressure graph along the entire length of the pipeline (minimum, average and maximum);
- differential pressure graph of the pig when it moves along the entire length of the pipeline (minimum, average and maximum);
- time of the pig movement in the pipeline from the start-up chamber to the receiving chamber;
- acceleration chart in three directions (if necessary);
- linking the real time scale to the distance travelled by the pig, based on data of product consumption, external odometers or built-in accelerometers.

Application of VOSTOK-BP pipeline data recorder allows you to study the deposit formation mechanism and determine the location of deposits in the pipelines, their accumulation rate during periodic inspection.

The parameters of the transported product (temperature T and pressure P) and the differential pressure  $\Delta P$  can be applied to the pig in any section of the pipeline together with hydraulic calculations and physicochemical studies of the transported products and internal deposits. That will allow to conduct a more comprehensive analysis of the actual deposits in the pipeline, as well as to determine the impact of the product transportation mode and product composition on the possibility and rate of formation of internal deposits.

### Main Technical Specifications

Name of the characteristic, unit of measurement	Value
Instrument Channels	Pressure, Temperature, Acceleration*, Distance*
Type of pressure sensing element	Silicon on sapphire
Battery life at a measurement resolution of 10 s, years	2
Data exchange port	USB 2.0
Memory life, number of pressure and temperature points	559000*
Measurement resolution setting range, sec	0.18 ... 15300* (4.25 hours)
Pressure limit value, MPa	20
Reduced error along the pressure channel in the normalized temperature range, % URL	0,15*
Pressure channel resolution, % URL	0.0003
Pressure drift, no more than %/year	0,05
Operating temperature range, °C	–20 ... +85
Absolute error along the temperature channel, °C	±0,5
Resolution on the channel temperature is not higher, °C	0.01
Weight, kg	3.5

\* variations of the parameter are possible when ordering

# ACCESSORIES FOR PIGS

## CUPS AND DISCS

The cups and discs are made of polyurethane or oil and gasoline resistant rubber of various hardnesses.

Material	Life-time, km			
	in a dry pipe	in the aquatic environment	in petroleum products	in oil
Polyurethane	55-75	140-160	160-180	200-220
Rubber	50-70	100-120	120-140	120-160
Polyurethane with solid inserts	180	200	200	200



## OPTIONAL ATTACHMENTS

The attachments extend the functionality of the pigs.

**The brush unit** is used when it is necessary to clean the internal cavity of the pipeline from scale, incrustation, dense asphalt resin deposits.

**The magnet unit** is used when it is necessary to clean the internal cavity of the pipeline from incrustation, electrode residues and metal particles.

**The gauging disc** is used to assess (determine) the minimum flow area (maximum narrowing) of the pipeline section.





## EXTERNAL INSPECTION OF PIPELINES



**The technology of external inspection provides for the following stages of work:**

**Stage 1** – examination of insulation faults (through damages) and inspection of the pipeline with a non-contact magnetometric method (identification of

anomalous magnetic field spots in the pipeline and their coordinates according to RD 102-008-2002).

**Stage 2** – pipeline boring in spots of insulation disturbances and abnormal magnetic fields.

**Stage 3** – determination of the spatial position of the pipeline.

**Stage 4** – visual and measuring method (insulation state during visual inspection, insulation thickness and adhesion, protective properties of insulation during integral assessment based on non-contact measurements of currents in the pipe.

**Stage 5** – measurement of pipe wall thickness (selectively) and hardness.

**Stage 6** – geometric parameters of circumferential welds during visual and dimensional inspection (selectively) and parameters of circumferential welds during ultrasonic inspection (selectively).

**Stage 7** – preparation of a technical report, calculation of residual life and industrial safety expertise.

The technology for monitoring the integrity of the outer insulation and monitoring the condition of the pipeline by the non-contact magnetometric method is carried out by bypassing the operators along the route above the pipeline. Monitoring of other parameters (except for acoustic emission control) by measurements and inspection in bore pits.

## INTELLIGENT PIGGING TECHNOLOGY (FOR PIPELINES WITH DIAMETER OF 159...1420 mm)

**Intelligent pigging technology includes the following main stages:**

**Stage 1** – repeated cleaning of the pipeline internal cavity with pigs (with brush and magnet units, pigs for coarse and fine cleaning) from foreign objects, scale, electrodes, deposits. Pigs are equipped with a transmitter to control their movement and find their location when stuck.

**Stage 2** – gauging of the pipeline with a scraper-gauger with a gauging unit (gauging discs of different diameters) with the issuance of a conclusion whether the geometry scanning is possible.

Markers shall be installed along the pipeline route before the inspection pigs are launched. Minimum distance between markers 1-2 km.

**Stage 3** – pipeline geometry scanning with a multichannel geometry pig, issuing a rapid report on geometry scanning and a conclusion on the possibility of diagnostics with magnetic flaw detectors of longitudinal



(MFL) and transverse (TFI) magnetization and recommendations on the elimination of geometry defects that prevent the passage of magnetic flaw detectors.

**Stage 4** – flaw detection of the pipeline wall, transverse and longitudinal welds using magnetic flaw detectors of longitudinal (MFL) and transverse (TFI) magnetization or ultrasonic flaw detectors WM and CD, issue the express report on diagnostics by flaw detectors for unacceptable defects requiring urgent repair (elimination).



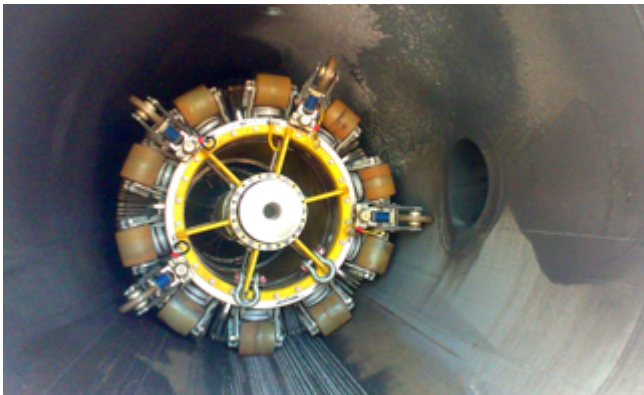
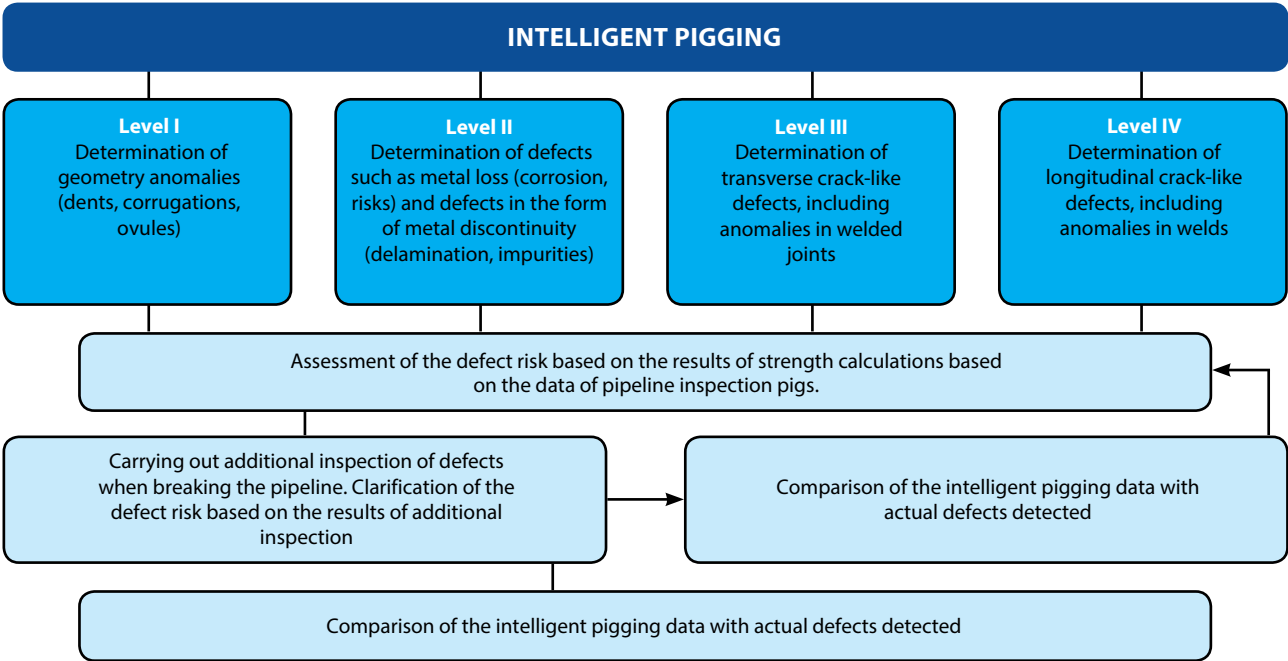
Quality and completeness control of information recording on the site is carried out during the field work immediately after each pass. Based on the results,

a decision is made on the need for a check run of inspection pigs. All pig runs shall be documented by acts.

**Stage 5** – preparation of a technical report on the results of intelligent pigging with recommendations, determination of residual life and industrial safety expertise (if necessary).

A preliminary report on the results of the intelligent pigging is sent to the customer after 15 calendar days, containing a pipe layout log, the coordinates of the marker points and a list of the most dangerous defects.

The final report is sent to the customer after 30-45 working days, indicating all the elements of the pipeline, the identified longitudinal and transverse welded joints, as well as all the identified defects, indicating the type, geometric dimensions with an assessment of the danger level. Recommendations are also given on the timing of the external examination and repair methods. Defect hazard assessment is carried out according to the main Russian and international standards. If necessary, the GPS coordinates of the defects are provided.



Joint work on geometry scanning and flaw detection with “New Diagnostic Technologies” LLC.

## FOUR-LEVEL PIPELINE DIAGNOSTIC SYSTEM

Intelligent pigging of pipelines uses a 4-level pipeline diagnostic system.

**At the 1st level** of diagnostics, a multi-channel geometry pig is used to monitor the geometry of the pipeline: detection, identification and measurement of the defect parameters in the geometry and angles of deflection points, as well as the presence of features - spacer rings and other elements protruding inside the pipeline, measurement of navigation coordinates of welded ring joints and detected defects.

**At the 2nd level**, a magnetic flaw detector of longitudinal magnetization (MFL) or an ultrasonic flaw detector WM is used to inspect the pipeline wall: detection, identification and measurement of metal loss parameters from the outside and inside (solid, point corrosion), grooves, scratches, tearing, delaminations, including exposure to the surface, dents, corrugations, connecting and structural parts.

**At the 3rd level**, a magnetic flaw detector of longitudinal (MFL) magnetization is used to inspect the transverse weld of the pipeline: detection, identification and measurement of parameters of cracks and crack-like defects in the weld and heat-affected zone, inclusions, pores and other weld defects.

**At the 4th level**, a magnetic flaw detector of transverse (TFI) magnetization or an ultrasonic flaw detector CD is used to inspect the longitudinal weld of the pipeline: detection, identification and measurement of parameters of cracks and crack-like defects in the weld and heat-affected zone, inclusions, pores and other weld defects.

**Note:** The 2nd and 3rd levels of diagnostics are implemented during the run of magnetic flaw detector of longitudinal magnetization.

If necessary, a calculation for durability (residual life), a calculation for strength (maximum permissible operating pressures) and an examination of industrial safety are carried out.

Since 2006, we have performed intelligent pigging and examination of industrial safety of pipelines (including underwater crossings) in ANK Bashneft JSC (Bashneft-Dobycha LLC), Udmurtneft OJSC, Belkamstroy LLC, Belkamneft OJSC, Naftatrans CJSC, Surgutneftegaz OJSC, BPO-Otradny LLC, Sayanskkhimplast OJSC, TransstroyService LLC, Stroyneftetrans LLC, SNPS-Aktobemunaigas LLP, Noyabrsk Gas Electric Company LLC, etc.

## TECHNICAL TOOLS FOR INTELLIGENT PIGGING

### MULTI-CHANNEL GEOMETRY PIG

It is designed to measure the value of the internal flow area and the turning radius of the pipeline of various diameters. The use of a strapdown inertial navigation system makes it possible to measure the bending radii and coordinates of the pipeline axis with high accuracy.

### ULTRASONIC FLAW DETECTOR OF USK SERIES (WM)

Designed for non-destructive testing (thickness measurement) of pipelines by ultrasonic scanning of the pipe wall when the flaw detector moves in the flow of the pumped product.

### MAGNETIC FLAW DETECTOR OF MSK SERIES (MFL)

Designed to control pipelines by determining the leakage of magnetic flux at longitudinal magnetization in the pipeline material and transverse welds when the flaw detector moves in the flow of the pumped product.

### ULTRASONIC FLAW DETECTOR FOR MULTI-ANGLE EXAMINATION OF THE PIPELINE WALL

Designed to detect arbitrarily oriented defects in the pipe wall and welds (longitudinal, transverse and spiral). Two high-resolution ultrasonic measuring systems are used. The device for the first time used sensors that have several angles of input for the ultrasonic signal into the pipe wall, which allows you to obtain additional information about defects.





### COMBINED MAGNETIC FLAW DETECTOR (MFL+TFI)

Through the use of both longitudinal and transverse magnetization, it allows more efficient and accurate detection of various types of defects, including unauthorized cut-ins and weld defects.

### COMBINED MAGNETIC-ULTRASONIC FLAW DETECTOR (MFL + WM + CD)

Designed to control pipelines by determining the leakage of magnetic flux during transverse magnetization in the pipeline material and longitudinal welds when the flaw detector moves in the flow of the pumped product.

### MAGNETIC FLAW DETECTOR OF MSK SERIES (TFI)

Designed to determine the minimum flow area of a pipeline with a diameter of 159...1420 mm for making a decision on the geometry pig run.



## TECHNICAL TOOLS OF INTELLIGENT PIGGING

### SCRAPER-GAUGER WITH GAUGING UNIT

Designed to determine the minimum flow area of a pipeline with a diameter of 159...1420 mm for making a decision on the geometry pig run.

### PRT GEOMETRY PIGS for pipelines with diameter from 159 mm to 1420 mm

Electronic geometry pigs of the "PRT" type are used to measure the pipeline internal diameter and detect defects in the pipeline geometry (dents, corrugation, ovalization, etc.). There are modifications of these geometry pigs with built-in geographic mapping systems of the pipeline and with built-in systems for quantitative measurement of deposits on the inner walls of pipelines.



### DMT FLAW DETECTORS (MFL – Longitudinal Magnetization) and MFL+ INTROSCOPES for pipelines with diameters from 159 mm to 1420 mm

High-resolution magnetic flaw detectors of the "DMT" type are used to register and measure the signals of the longitudinal magnetic leakage flux at the locations of defects in the pipeline walls. They are designed to identify, locate and assess the size of defects in general and pitting corrosion, defects of circumferential welds, transverse cracks, other defects of transverse orientation, elements of the pipeline structure.

Magnetic introsopes of the MFL+ type are able to detect with photographic accuracy all defects of any orientation on the inner surface of the pipe walls, including defects in the geometry of the pipeline. The accuracy of detecting defects and assessing their dimensions on the inner surface of pipes does not depend on the thickness of the pipe walls.



### DMTP FLAW DETECTORS (TFL– Transverse Magnetization) for pipelines with diameters from 159 mm to 1420 mm

High-resolution magnetic flaw detectors of the "DMTP" type are used to register and measure the signals of the transverse magnetic leakage flux at the locations of defects in the pipeline walls.

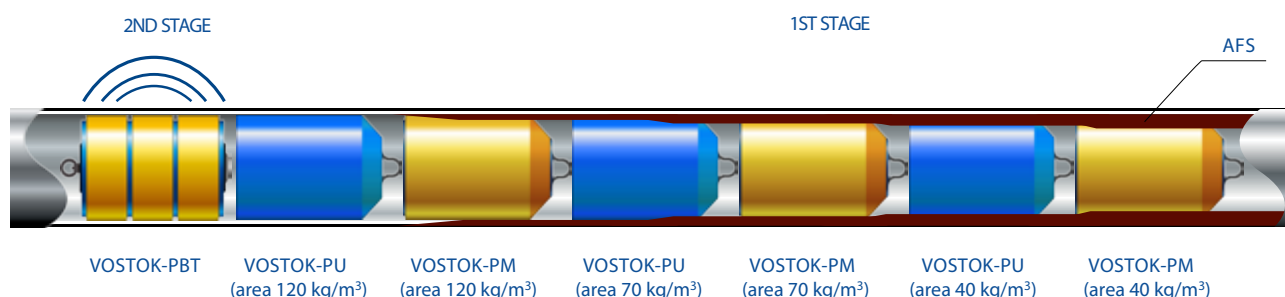
They are designed to identify, locate and assess the dimensions of all defects in longitudinal orientation, including individual longitudinal elements of the pipeline structure and other defects of the longitudinal orientation pipeline, including stress corrosion cracking (SCC defects).





# TECHNOLOGY FOR CLEANING PIPELINES WHICH HAVEN'T BEEN CLEANED FOR A LONG TIME

## SEQUENTIAL (STAGED) CLEANING



The basic principle of cleaning is not to clog the oil pipeline with deposits. To study the degree of AFS deposition on the wall of the oil pipeline along the entire length and to mount temporary chambers for the launch and reception of pigs.

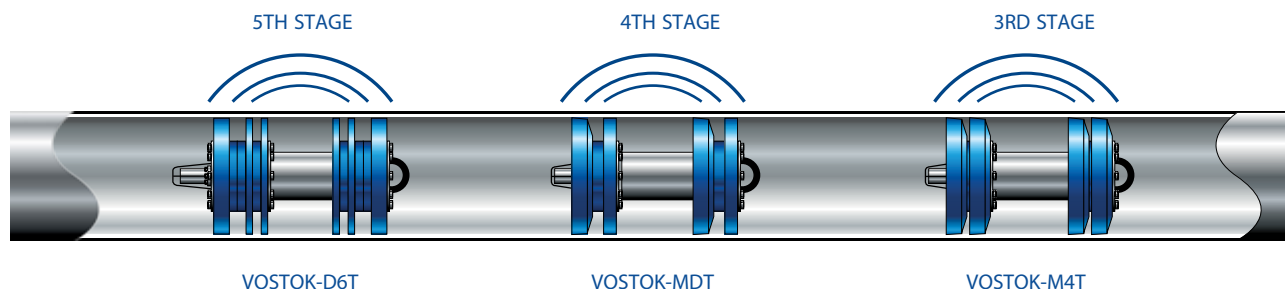
**Stage 1** – multiple cleaning with **soft (M)** and **hardened (U)** foam pigs.

At the first pass, it is necessary to run VOSTOK-PM pig of a smaller diameter than the diameter of the pipeline being cleaned, with a density of 30-40 kg / m<sup>3</sup>, to accompany the pig with VOSTOK-AL acoustic locator.

In the future, the diameter and density of foam pigs each time should be selected according to the results of the previous pig run, i.e. information should be analyzed about the state (degree and nature of damage) of the run pig after removal from the pipeline, as well as the type, quantity and composition of foreign objects and deposits extracted from the pipeline.

**Cleaning of the oil pipeline with foam pigs should be carried out until the degree of change (damage) of the removed pigs is minimal.**

**Stage 2** – repeated cleaning with the help of **VOSTOK-PBT foam pig of the "Barrel" type**, mounted on the transmitter body.



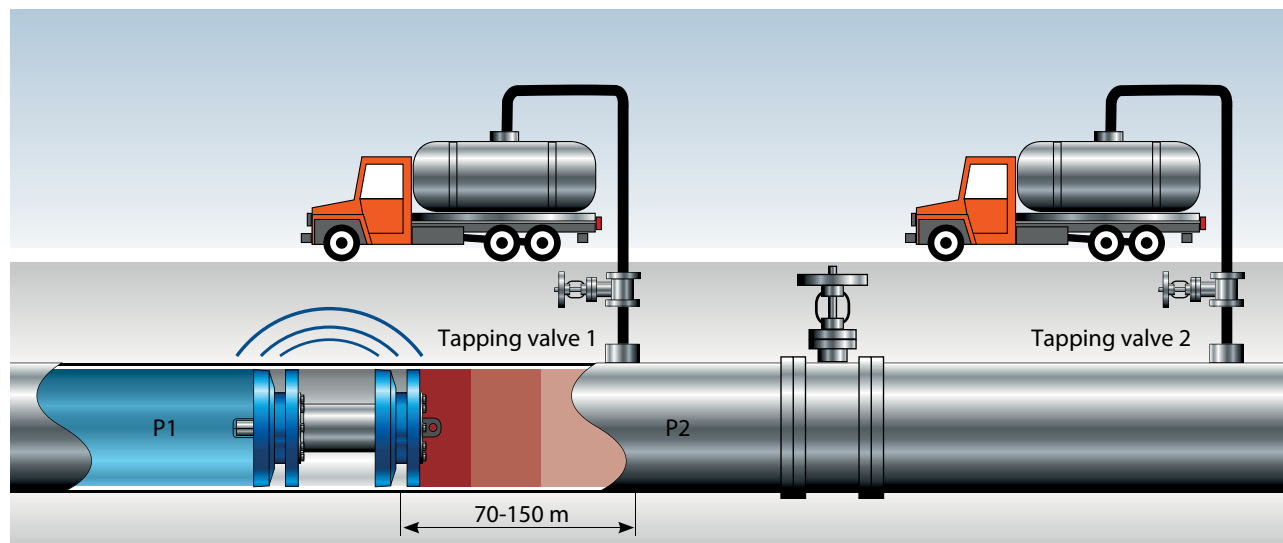
**Stages 3-5** – cleaning with the help of VOSTOK-M4T, VOSTOK-MDT and VOSTOK-D6T pigs **with conical and straight polyurethane cups and disks** (between runs the cone cups are replaced by straight discs).

**Stage 6** – control run of the pig with polyurethane discs and with a brush unit.

At all stages of oil pipeline cleaning, pistons and pigs must be accompanied with VOSTOK-AL acoustic locator and VOSTOK-NL low-frequency locator.

# CLEANING TECHNOLOGY WITH PERIODIC REMOVAL OF DEPOSITS THROUGH THE TAPPING VALVES

Patent No. 2400315



**Stage 1** – launch VOSTOK-MDT pig (with a transmitter) into the oil pipeline and monitor its location by electromagnetic signals of the transmitter and VOSTOK-AL, the performance of the oil pipeline (Q), the pressure at the start of the oil pipeline (P1) and the pressure drop ( $\Delta P$ ).

**Stage 2** – with a decrease in productivity by 30-50% and an increase in the pressure of P1 to the maximum allowable pressure, stop oil pumping.

**Stage 3** – by the method of "cold tie-in" mount the tapping valve 1 at a distance of 70...150 m from the location of VOSTOK-MDT, mount the process pipeline, prepare oil tankers for receiving oil and paraffin.

**Stage 4** – start pumping and displace paraffin until the release of pure oil.

**Stage 5** – repeat the previously described operations until the arrival of VOSTOK-MDT pig in the reception chamber of the oil pipeline.

**Stage 6** – make a VOSTOK-MDT check run or a standard rigid VOSTOK-D6T pig with polyurethane disks and with a brush unit.

At all stages of oil pipeline cleaning, pigs are accompanied by an acoustic locator VOSTOK-AL or VOSTOK-ALR for movement control, as well as VOSTOK-NL low-frequency locator for searching and locating pigs.

The technologies were developed taking into account practical experience in cleaning of oil pipelines which haven't been cleaned for a long time for Rosneft-Stavropolneftegaz OJSC, ANK Bashneft OJSC, Tatneft OJSC, Belkamneft OJSC, LUKOIL-Perm LLC, Varyeganneftegaz OJSC, LUKOIL-Komi LLC, Orenburgneft OJSC, TNK-Nyagan OJSC, Slavneft-Megionneftegaz OJSC, etc.



# PIPELINE CLEANING AND GAUGING TECHNOLOGY AFTER CONSTRUCTION

The basic principle is a thorough cleaning of the constructed pipeline from construction debris, remnants of electrodes and foreign objects, as well as the determination of the minimum flow area, i.e. gauging of the pipeline.

The technology provides for mechanical cleaning of the pipeline using pigs, run by the flow of air or process water (in agreement with the customer). An electromagnetic transmitter shall be installed on the pig or, for pipelines with a diameter of 114, 159, 219, 273 and 325 mm, a pig combined with a transmitter shall be used. In addition, the cleaning process and the pig run are controlled by VOSTOK-AL or VOSTOK-ALR acoustic locator.

Pigs may be equipped with brush, magnetic or gauging units for cleaning the internal cavity of the pipeline from scale, electrode residues and metal particles and determining the minimum flow area of the pipeline.

The works include the preparatory stage, the main stage of work and the preparation of a technical report (if necessary).

## 1. PREPARATORY STAGE OF WORK

- 1.1. Study of technical documentation for the pipeline.
- 1.2. Study of the route, selection of control points to monitor the pig runs.
- 1.3. Time calculation of the pig run through the pipeline.
- 1.4. Preparation of pigs and control devices for pipeline work.
- 1.5. Transportation of pigs and control devices to the work site.
- 1.6. Checking the performance of equipment at the work site.

## 2. MAIN STAGE OF WORK

- 2.1. Inserting the pig into the start chamber, crimping the chamber, checking the performance of the transmitter after crimping the chamber.
- 2.2. Launching the pig and controlling the exit from the launch chamber and starting tracking along the route.
- 2.3. Tracking the movement of the pig in the pipeline, recording the time of passing through the control points.
- 2.4. Control of pig arrival into the reception chamber and determination of its location in the chamber.
- 2.5. Removing the pig from the receiving chamber, cleaning the pig.
- 2.6. Transportation of equipment to the base.



## CLEANING AND GAUGING OF PIPELINES

**Stage 1** – cleaning of the pipeline using the scrapers and pistons of various designs, depending on the condition of the internal surface of the pipeline.

**Stage 2** – gauging (determination of the minimum flow area) of the pipeline using a scraper-gauge.

Cleaning and gauging works are carried out with the tracking and location control of the scrapers (pistons) and the scraper-gauge.

## CLEANING OF PIPELINES WITH INTERNAL COATING AND CELER BUSHINGS

Cleaning of pipelines with internal coating and Celer bushings from AFS is carried out using pigs. The technology was developed taking into account practical experience in cleaning oil pipelines with internal coating and Celer bushings.

According to the proposed technology, oil pipelines were cleaned for TNK-Nyagan OJSC, LUKOIL-Ukhtaneftgaz LLC, SANEKO OJSC, etc. We have more than 20 years of experience in cleaning pipelines from deposits.

## CLEANING OF PIPELINES UNCLEARED FOR A LONG TIME

During operation, deposits consisting of sand, salts, paraffin, asphaltene and resins, corrosion products, hydrates, pyrophores and emulsions arise in the pipelines, which can lead to a narrowing of the flow diameter, an increase in operating pressure and provoke accelerated corrosion.

We provide a wide range of specialized piping cleaning methods designed to address all of the above complications.

We perform the following scope of works:

- standard cleaning with pigs;
- cleaning with pigs of increasing diameter;
- cleaning with mechanical scrapers;
- cleaning of mechanical impurities using scrapers in combination with gel pistons;
- removal of salt deposits;
- removal of paraffin deposits;
- removal of pyrophoric deposits and hydrates;
- removal of corrosion products;
- cleaning before intelligent pigging;
- post-construction cleaning;
- cleaning when changing the purpose of the pipeline;
- cleaning for pipeline decommissioning.

The basic principle in cleaning is not to clog the pipeline with deposits.

When performing such work, it is often necessary to apply the technology of step-by-step cleaning, especially when cleaning oil pipelines which haven't been cleaned for a long time. The technology was developed by specialists of our company back in 1996 for cleaning the underwater crossing of the Vyatka-Ashit oil pipeline (with a diameter of 325 mm) through the river Kama for ANK "Bashneft JSC, which has not been cleaned for 23 years.

The technology was improved taking into account practical experience in cleaning of oil pipelines which haven't been cleaned for a long time for Rosneft-Stavropolneftgaz OJSC, ANK Bashneft OJSC, Tatneft OJSC, Belkamneft OJSC, LUKOIL-Perm LLC, Varyeganneftgaz OJSC, LUKOIL-Komi LLC, Orenburgneft OJSC, TNK-Nyagan OJSC, Slavneft-Megionneftgaz OJSC, etc.

## LOCATING STUCK PIGS IN THE PIPELINE

Determining the location of stuck scrapers is carried out using the following technologies:

1. Control by the operator with the help of the ZONDSCAN device from the ground surface (above the pipeline, on which the scraper is supposedly stuck) of the magnetogram (magnetic anomalies) of the pipeline section showing magnetogram on the display online with simultaneous recording of the path traveled by the operator using the built-in GPS navigator in automatic mode, issuing GPS coordinates of the stuck scraper location in the pipeline.

2. Launching the second scraper (piston) into the pipeline with a transmitter installed on it, tracking the movement of the second scraper through selected control points, searching for the place where the second scraper stopped using a low-frequency locator, based on the assumption that the second scraper will stop in the same place as the first (stuck) scraper.

## INTELLIGENT PIGGING OF OIL AND GAS PIPELINES, OIL PRODUCT PIPELINES AND WATER PIPELINES

We have cleaned and examined with smart flaw detectors more than 4000 kilometers of pipelines with a diameter of 159 mm or more.



**Goal:**

1. Inspection of the technical condition of the pipeline.
2. Calculations for strength (maximum permitted pressure) and durability (residual life) based on the results of the inspection.
3. Industrial safety expertise.

**Stages of intelligent pigging technology (see technology section):**

1. Preparatory work - determination (according to the data sheet) and ensuring the testability of the inspected pipeline.
2. Cleaning of the internal cavity of the pipeline from foreign objects, scale, electrode residues, asphalt resinous, paraffin and pyrophoric deposits.
3. Pipeline gauging – determination of pipeline minimum flow area and ensuring 70% of the patency of the outer diameter (i.e. elimination of all geometry defects exceeding 30% of the outer diameter).
4. Inspection of the pipeline with a geometry pig – identification of defects in the geometry of the pipeline (dents, corrugation, ovalization) and measurement of the pipe bend radius. Ensuring the passability of the pipeline in 85% of the outer diameter (elimination of all geometry defects exceeding 15% of the outer diameter) and the minimum pipe bend radius equal to 1.5DN or 3DN (R<sub>surf</sub> must be more than or equal to 1.5DN or 3DN, depending on the flaw detector used after geometry scanning).
5. Inspection of the pipeline with internal magnetic (MFL and TFI) and / or ultrasonic flaw detectors - detection of such defects as: corrosion (internal, external, point and continuous), stress corrosion under tension, delaminations, inclusions, multi-oriented cracks and other defects of the pipeline wall.
6. Calculation of strength and durability (residual life) and examination of industrial safety. Since 2006, we have performed intelligent pigging and examination of industrial safety of pipelines (including underwater crossings) in ANK Bashneft LLC, Udmurtneft OJSC, Belkamstroy LLC, Belkamneft OJSC, Naftatrans CJSC, Surgutneftegaz OJSC, BPO-Otradny LLC, etc.

We have 10 years experience in intelligent pigging of oil and gas pipelines.



## DIAGNOSTICS OF PIPELINES BY NON-CONTACT MAGNETOMETRIC METHOD

Diagnostics of the technical condition of pipelines by non-contact magnetometric method (according to RD 102008-2002) using the ZOND-SCAN complex.

ZOND-SCAN is an automated device for detecting defects, unauthorized tie-ins and plugs in the existing pipeline from the ground surface by a non-contact method.

Non-contact (from the ground surface) detection of pipeline sections with defects in metal and welded joints (cracks and crack-like defects, defects of welds, corrosion defects, changes in the thickness of the pipe walls, dents, corrugations, etc.), as well as plugs and unauthorized tie-ins, is performed with ZOND-SCAN highly sensitive magnetometer, which has been tested in Uraltransnefteprodukt JSC and in other companies.

The scope is underground steel pipelines of any purpose with a diameter of 4-58 inches (114-1420 mm).

ZOND-SCAN allows you to automatically monitor and record the magnetogram of the pipeline with the simultaneous recording of the path traveled using the built-in GPS navigator (geographical and metric coordinates). Information is recorded on a flash card with a USB connector. The program has a built-in expert system for detecting magnetic anomalies, which, based on the results of scanning, is able to interpret data located in the area of such an anomaly with a high degree of probability.

Investigation of the pipeline using ZONDSKAN is performed by one operator and does not require a change in the operating mode of the pipeline.

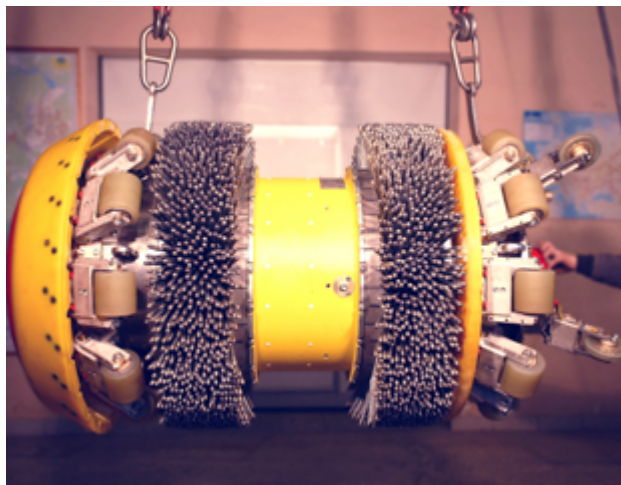
## EXTERNAL DYAGNOSTICS OF PIPELINES

**Goal:**

1. Obtaining diagnostic information on wall thickness, insulation coating, transverse welds, chemical composition, mechanical properties of pipe material and welded joints.
2. Determination of residual life based on the results of the inspection.
3. Examination of industrial safety with registration in the regional office of Russian Federal Service for Ecological, Technological and Nuclear Supervision.

**Defined (measured) parameters:**

1. The actual spatial position of the pipeline.
2. Pipeline wall thickness (optional).
3. Adhesion of pipeline insulation.
4. The state of insulation under visual inspection and the thickness of the insulation.



5. Protective properties of insulation in integral evaluation based on non-contact measurements of currents in the pipe.
6. Insulation leaks (through damage).
7. The actual thickness of the pipeline pipe in the heat affected zone (optional).
8. Geometric parameters of circumferential seams during visual-measuring control (selectively).
9. Parameters of circumferential seams during ultrasonic testing (selectively).

**Types (methods) of nondestructive testing and diagnostics:**

- ultrasonic thickness measurement and flaw detection;
- magnetic control;
- visual and measurement inspection;
- non-contact magnetometry;
- acoustic emission control;
- hardness measurement;
- metal magnetic memory;
- non-contact control of the external insulation continuity.

Inspection of the pipeline is performed by non-destructive methods of control (except for monitoring the condition of the pipe metal and examining the chemical composition and mechanical properties of the pipe).

## SAFETY JUSTIFICATION OF A HAZARDOUS PRODUCTION FACILITY

The safety justification of a hazardous production facility is a document that contains information on the results of assessment of HPF accident risk and the threats associated with the accident and describes the conditions of safe operation of the HPF, requirements to the operation, preservation and termination of the HPF. Justification of the HPF safety is necessary in cases of deviation from the requirements of the industrial safety established by federal norms and rules in the field of industrial safety, in cases of insufficiency of existing rules and regulations. The need for a justification for the safety of the HPF at the enterprise is established by paragraph 4 of Article

3 of the Federal Law-116. The developed HPF safety justification is subject to mandatory examination of industrial safety. A safety justification for five hazardous production facilities of Orenburgneft JSC has been developed.

## PIPELINE INDUSTRIAL SAFETY EXPERTISE

Examination of the industrial safety of hazardous production facilities (HPF) is performed according to the rules for conducting an examination of specific facilities on the basis of diagnostic data of the examined facility and the calculation of the residual life of the facility. We have license Number DE-00013475 for the examination of industrial safety on HPF.

## DISPLACEMENT OF THE PRODUCT FROM DECOMMISSIONED PIPELINES

**Work stages:**

**Stage 1** – mount (if necessary) temporary chambers for launching and receiving pigs.

**Stage 2** – depending on the product in the pipeline, select a pig for displacing the product and devices for monitoring the location and tracking the pig movement through the pipeline.

**Stage 3** – prepare and tie technologically technical tools (compressor, pump) to run the pig in the pipeline, select the points of control of the pig movement along the pipeline route.

**Stage 4** – insert the pig into the launch chamber and launch it into the pipeline, control the exit of the pig from the launch chamber.

**Stage 5** – monitor the movement and location of the pig in the process of movement in the pipeline at the control points.

**Stage 6** – receive the pig into the receiving chamber, clarify the pig location in the chamber, remove the pig from the receiving chamber.





## CERTIFICATES OF CONFORMITY GOST R



## LICENSES AND CERTIFICATES



## PATENTS FOR OUR DEVELOPMENTS



OUR TEAM OF EMPLOYEES HAS OBTAINED MORE THAN 30 PATENTS OF THE RUSSIAN FEDERATION AND AUTHOR'S CERTIFICATES OF THE USSR, WHICH ARE PRACTICALLY IMPLEMENTED IN TECHNOLOGIES, INSTRUMENTS AND DEVICES FOR CLEANING AND DIAGNOSIS OF PIPELINES



# VOSTOKNEFTEGAZ

[www.vostokoil.ru](http://www.vostokoil.ru)

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