

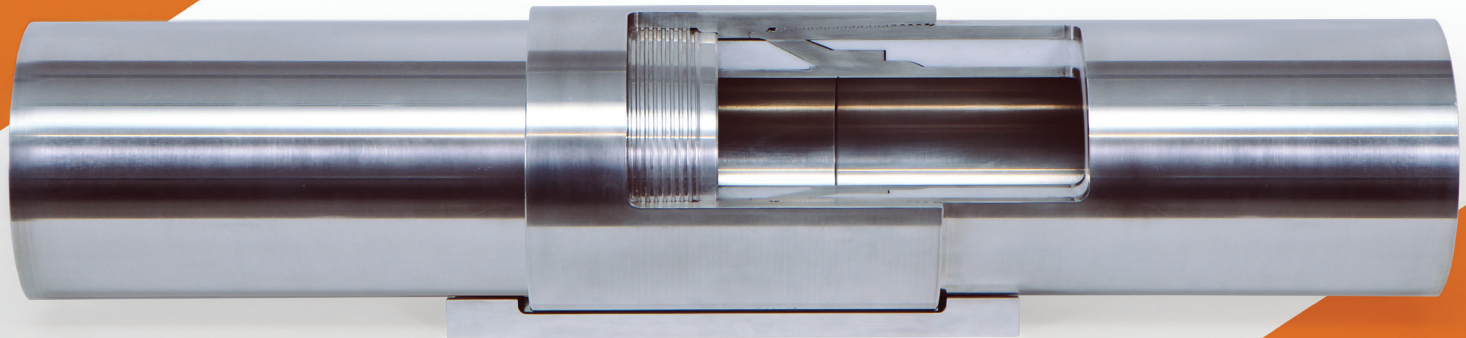


VACUUM INSULATED TUBING

VACUUM INSULATED TUBING



Vacuum Insulated Tubing (VIT) is designed to develop oil and gas fields located in the most challenging oil and gas production conditions in the permafrost and/or in zones characterized by high viscosity or paraffin deposition of extracted hydrocarbons.



TIMELINE OF VIT DEVELOPMENT IN TMK

Type of thermal insulation	Design features	Performance specifications
Since 2010		
<p>Vacuum Insulated Tubing</p> <p>Vacuum shield thermal insulation</p>	<p>In accordance with the design, a shield of foil and basalt fiber fabric (together with gas absorbers) is installed in the annular space.</p> <p>Vacuum is created in the annular space. A fluoroplastic coupling insert is placed inside the coupling.</p> <p>"Pre-stressing" of the internal pipe is performed in the VIT designed for operation at high temperatures.</p>	<p>Operating temperature: up to +350°C</p> <p>Operating pressure: up to 16MPa</p> <p>Thermal conductivity (K-factor) along the pipe body, W/(m*K): up to 0.012 (+220°C), up to 0.02 (+300°C), up to 0.04 (+350°C)</p> <p>Thermal conductivity (K-factor) of the fluoroplastic coupling insert, W/(m*K): up to 0.25</p> <p>The pipes are used for the following:</p> <ul style="list-style-type: none"> • Prevention of wellbore thawing in permafrost zones • Injection of superheated fluids into the reservoir in order to heat up high-viscosity oils during development by cyclic steam heating methods (including such as CSS and SAGD) • Prevention of formation of asphalt, resin, and paraffin depositions
Since 2015		
<p>Non-Vacuum Insulated Tubing</p> <p>Insulation with inorganic thermal insulation materials</p>	<p>In accordance with the design, a shield of foil and basalt fiber fabric is installed in the annular space. A fluoroplastic coupling insert is placed inside the coupling.</p> <p>The design was developed with account of additional requirements of our customers – oil companies.</p>	<p>Operating temperature: up to +300°C</p> <p>Operating pressure: up to 16MPa</p> <p>Thermal conductivity (K-factor) along the pipe body, W/(m*K): up to 0.03 (+50°C), up to 0.06 (+180°C)</p> <p>Thermal conductivity (K-factor) of the fluoroplastic coupling insert, W/(m*K): up to 0.25</p> <p>The pipes are used for the following:</p> <ul style="list-style-type: none"> • Prevention of wellbore thawing in permafrost zones • Injection of superheated fluids into the reservoir in order to heat up high-viscosity oils during development by cyclic steam heating methods (including such as CSS and SAGD) • Prevention of formation of asphalt, resin, and paraffin depositions

KEY PERFORMANCE AND TECHNICAL PARAMETERS OF VIT

Performance parameters	Limit value
Operating temperature, °C	up to +350
String length, max	determined by calculation and depends on the type of threaded connection
Thermal conductivity coefficient (k-factor) along the pipe body, max	see table below
Thermal conductivity coefficient (k-factor) of coupling insert, max, W/(m*K)	0.25

Indicator	Non-Vacuum		Vacuum		
	up to +50	up to +180	up to +220	up to +300	up to +350
VIT operating temperature, °C					
K-factor, W/(m*K)	0.03	0.06	0.012	0.02	0.04

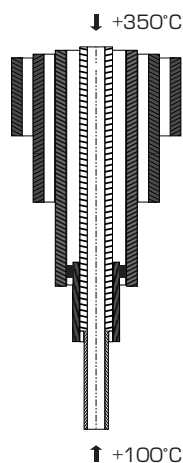
Technical parameters	Limit value
Residual air pressure in the annular space, max, mm Hg	$8 \cdot 10^{-2}$ Pa ($6 \cdot 10^{-4}$)
Pipe length, m	10–11.7*
Weld seam requirements	The seams should be heat treated
Hydrotesting	VIT with made up couplings is subjected to hydrotesting at $R = 0.8 \sigma_T$
Grades	Carbon (55–95 ksi); 13Cr (80 ksi)
Charpy test	Not less than 50 J/cm ² at –60°C

*based on customer requirements we can produce pipe with the length of 6–10 m

APPLICATION OF VACUUM INSULATED TUBING

↑ +100°C

- Prevent excessive heat transfer into the near-wellbore area of the well in permafrost zones
- Prevent deposition of asphalts, resins, and paraffins



↓ +350°C

- Inject superheated steam or hot water into the reservoir in order to heat high-viscosity oils
- Oil production by cyclic steam heating methods (including such as CSS and SAGD)

VIT PRODUCTION PROCESS

Rolling,
heat treatment,
testing,
measure cutting,
surface cleaning



Assembly of
the external
and the internal
pipe



Welding of the
external and
the internal
pipe with
vacuum-tight
seams



Inspection
of the
weld joints



Creation of vac-
uum in the VIT at
the exhaust cart
and tightness
testing of the
weld joints



Thermal conduc-
tivity testing and
finishing of VIT

PRODUCT MIX

VIT size	External supporting pipe		Internal pipe	
	OD, mm	WT, mm	OD, mm	WT, mm
9 5/8 x 0.395 – 6 5/8 x 0.352	9 5/8	0.395	6 5/8	0.352
7 x 0.317 – 5 1/2 x 0.304	7	0.317	5 1/2	0.304
7 x 0.408 – 5 x 0.296	7	0.408	5	0.296
7 x 0.362 – 5 x 0.296	7	0.362	5	0.296
6 5/8 x 0.352 – 5 x 0.296	6 5/8	0.352	5	0.296
6 5/8 x 0.352 – 4 1/2 x 0.290	6 5/8	0.352	4 1/2	0.290
6 5/8 x 0.352 – 4 1/2 x 0.271	6 5/8	0.352	4 1/2	0.271
6 5/8 x 0.352 – 4 x 0.262	6 5/8	0.352	4	0.262
6 5/8 x 0.352 – 4 x 0.226	6 5/8	0.352	4	0.226
5 3/4 x 0.374 – 4 x 0.262	5 3/4	0.374	4	0.262
5 3/4 x 0.374 – 4 x 0.226	5 3/4	0.374	4	0.226
5 1/2 x 0.361 – 4 x 0.262	5 1/2	0.361	4	0.262
5 1/2 x 0.361 – 4 x 0.226	5 1/2	0.361	4	0.226
5 1/2 x 0.361 – 3 1/2 x 0.254	5 1/2	0.361	3 1/2	0.254
5 x 0.362 – 3 1/2 x 0.254	5	0.362	3 1/2	0.254
5 x 0.296 – 3 1/2 x 0.254	5	0.296	3 1/2	0.254
4 1/2 x 0.271 – 3 1/2 x 0.254	4 1/2	0.271	3 1/2	0.254
4 1/2 x 0.271 – 2 7/8 x 0.217	4 1/2	0.271	2 7/8	0.217
4 1/2 x 0.250 – 3 1/2 x 0.254	4 1/2	0.250	3 1/2	0.254
4 1/2 x 0.250 – 2 7/8 x 0.217	4 1/2	0.250	2 7/8	0.217
4 x 0.262 – 2 7/8 x 0.217	4	0.262	2 7/8	0.217
4 x 0.226 – 2 7/8 x 0.217	4	0.226	2 7/8	0.217
3 1/2 x 0.256 – 2 3/8 x 0.197	3 1/2	0.256	2 3/8	0.197
3 1/2 x 0.254 – 2 3/8 x 0.190	3 1/2	0.254	2 3/8	0.190
3 1/2 x 0.256 – 1.900 x 0.157	3 1/2	0.256	1.900	0.157

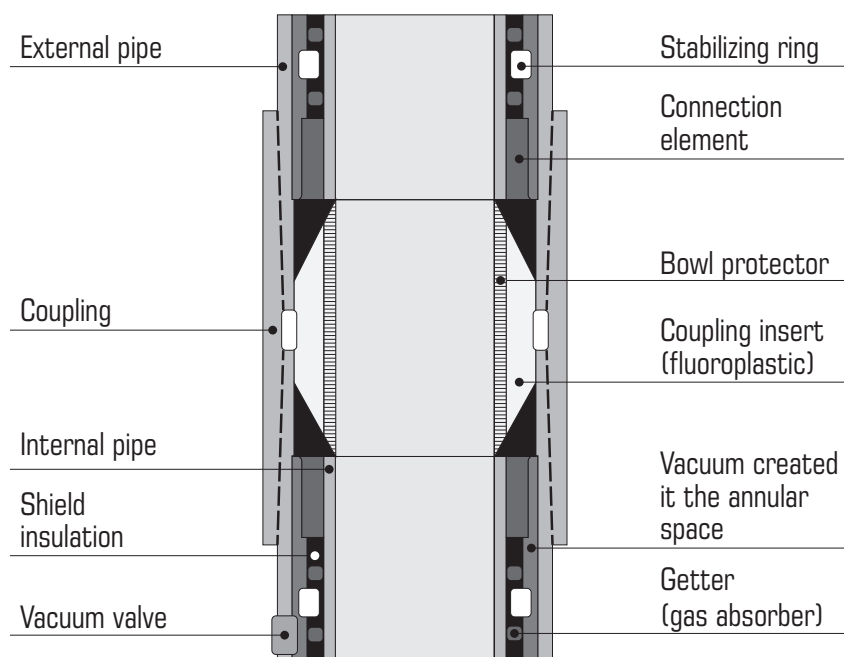


Developed product mix



Product mix that is currently being developed

BASIC VIT DESIGN (VACUUM SHIELD THERMAL INSULATION)



No representation or warranty (express or implied) is made as to, and no reliance should be placed on, the fairness, accuracy or completeness of the information contained herein and, accordingly, none of the Company, or any of its shareholders or subsidiaries or any of such person's officers or employees accepts any liability whatsoever arising directly or indirectly from the use of this document. This document contains certain forward-looking statements that involve known and unknown risks, uncertainties and other factors which may cause the Company's actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by such forward-looking statements. PAO TMK does not undertake any responsibility to update these forward-looking statements, whether as a result of new information, future events or otherwise.

This document contains statistics and other data on PAO TMK's industry, including market share information, that have been derived from both third party sources and from internal sources. Market statistics and industry data are subject to uncertainty and are not necessarily reflective of market conditions. Market statistics and industry data that are derived from third party sources have not been independently verified by PAO TMK. Market statistics and industry data that have been derived in whole or in part from internal sources have not been verified by third party sources and PAO TMK cannot guarantee that a third party would obtain or generate the same results.

SALES & MARKETING CONTACTS – RUSSIA & CIS

Trade House TMK

Trade House TMK
40, bld. 2a,
Pokrovka Street,
Moscow,
105062, Russia

Tel: +7 (495) 775-76-00
Fax: +7 (495) 775-76-01
E-mail: tmk@tmk-group.com

SALES & MARKETING CONTACTS – MIDDLE EAST

TMK Middle East

P.O. Box 293534, Office 120, Block
5EA, Dubai Airport Free Zone,
Dubai, United Arab Emirates

Tel: +971 (4) 609-11-30,
Fax: +971 (4) 609-11-40
E-mail: sales@tmkme.ae

SALES & MARKETING CONTACTS – NORTH AMERICA

TMK IPSCO US Sales Office

10120 Houston Oaks Dr.,
Houston, TX 77064, USA

Tel: +1 (281) 949-10-23
Fax: +1 (281) 949-10-65
E-mail: marketing@tmk-ipsco.com

TMK IPSCO Canada Sales Office

150 6-th Avenue SW #5100,
Calgary, AB T2P 3Y7, Canada

Tel: +1 (403) 538-21-85
Fax: +1 (403) 538-21-83
E-mail: nhagen@tmk-ipsco.com

