

START® – THE PIPE FLEXIBILITY AND STRESS ANALYSIS

First introduced in 1969

The Russian codes pipe stress analysis de facto standard

Summary

START evaluates the structural responses and stresses of the different-purpose piping systems at static and cyclic loadings. The first edition of the START software has been introduced in 1969.

Today START is the most widely used pipe stress analysis software in Russia and CIS countries. It has become a pipe flexibility and stress analysis *de facto* standard for process and power piping, gas and oil transmission, district heating piping systems in these countries.

START is used by more than 800 companies in Russia, Ukraine, Belarus, Kazakhstan, Turkmenistan, Uzbekistan, Lithuania, Czech Republic, Serbia, Finland, Germany and United Kingdom. The total number of the licenses exceeds 1500. START is widely used by major plants and design companies in chemical, oil & gas, power, metallurgy and other industries.

Due to ongoing feedback from a lot of users and cross-testing with other equivalent software, it is well verified.

The START software is fully certified according to Russian standards.

Codes and Standards

START performs stress computations according to various piping codes. The Russian piping codes currently incorporated into START are:

- **RD 10-249-98** Power piping systems
- **RD 10-400-01** District heating systems (out-of-date)
- **STO 10.001-2009** District heating systems
- **RTM 38.001-94** Process piping systems (out-of-date)
- **SA (CA) 03-003-07** Process piping systems
- **SNiP 2.05.06-85** Gas & oil transmission and distribution piping systems

Types of Pipelines

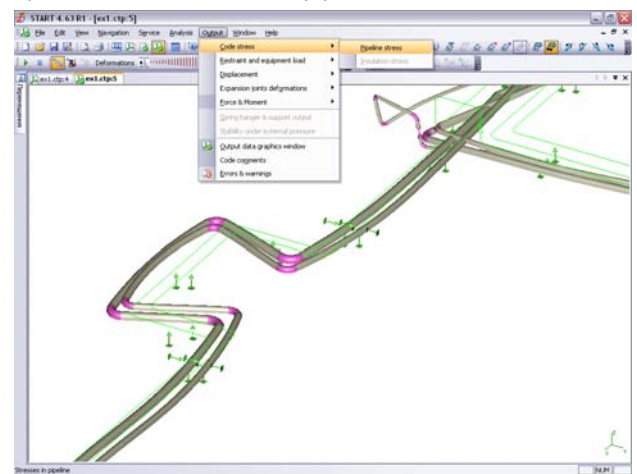
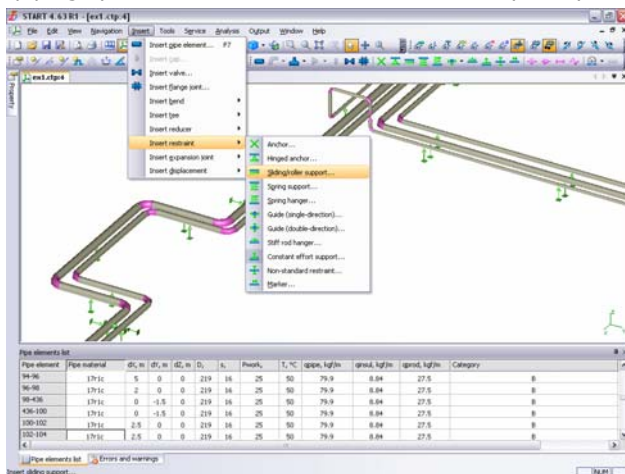
The following types of pipelines are covered:

- Above-ground, underground and buried pipelines
- Branched and closed contour pipelines
- With different types of expansion joints
- With various types of restraints and boundary conditions
- With different external loads (thermal expansion, dead weight, pressure, concentrated and distributed forces, supports displacement, hanger settlement, pre-stretch, etc.)
- Operating at low and high temperatures. For high temperature pipelines the creep and stress relaxation effects are analyzed.
- With internal and external pressure (vacuum). For vacuum pipelines a local stability analysis of walls is performed

Databases

The software includes five databases:

- "Materials": includes physical properties of pipeline elements and materials
- "Springs": includes properties of spring hanger tables as per OST 108.764.01-80, OST 24.125.109-01, MVN 049-63, MN 3958-62, LISEGA
- "Soils": includes mechanical and physical properties of soils for buried pipelines modelling
- "Expansion joints": includes properties of axial expansion joints
- "Insulation": includes insulation weight values depending on the insulation structure, temperature and pipe diameter



START® user interface. On the left — input data, On the right — output data (deformed shape)

START-Express — Pipeline Designer's Tool

Besides analysis of arbitrary configuration pipelines, we have implemented a working tool for a pipeline designer — a START-Elements option distributed as a stand-alone START-Express software. Start software is designed for rapid flexibility estimation of separate pipeline fittings, their strength and stability analysis. Using START-Express, one can do the following:

- Analyze stress of L, Z and U-shaped piping loops (buried and above-ground)
- Calculate wall thickness or maximum pressure for pipes, bends, reducers, tees, caps, according to the code selected
- Calculate maximum allowable distances between supports via strength and stiffness analysis
- Check general and local stability of straight and curved pipe elements under the thermal expansion, external pressure (vacuum) and soil pressure loads
- Calculate minimum pipeline laying depth for buried pipelines using stability analysis
- Calculate maximum pipeline laying depth for buried pipelines by polyurethane insulation stress analysis
- Calculate allowable load on saddle support for large-diameter pipes
- Calculate allowable distances between single action (one time) compensators and their closing temperature
- Calculate bellows stiffness if the manufacturer's data are absent

- Check leak tightness of flange joints

START Offers

- User friendly interface
- Object-oriented data input
- Input data error checking and reports. The error checker analyzes the user input and checks for consistency from both engineering and geometrical point of view
- Context-sensitive help system and detailed user manual
- Automatic on-the-fly checking of all pipes and fittings allowable pressure
- Check and selection of typical piping assembly parameters (different types of expansion joints, stub-ins, tees, flange joints)
- Analysis of multipurpose pipelines with various location (including vacuum lines) in accordance with different codes and standards
- Vessel nozzles flexibility calculation
- Integration with different 3D design software, Nozzle-FEM, export to AutoCAD, MicroStation, Kompas-Graphic
- Integration with Hydrosystem software
- Training by our certified specialists that can be provided at your location or in one of our training centers for additional fee
- Wide reliable network of distributors throughout Russia, Europe and Central Asia
- Technical support from START developers

Analysis and Design Features

- Nonlinear effects by friction in sliding, guide and spring supports, large-rotational rods and hangers, one-directional restraints
- Interaction between pipeline and soil in buried pipelines, taking into account nonlinear soil flexibility, PUR insulation layer and expansion cushions
- PUR insulation stress analysis
- Automatic selection and tightening of spring supports and hangers
- Bourdon effect in pipeline and bends having initial ovality
- Equipment and vessel nozzle flexibility effect (only with START-Nozzle option)
- Prestressed long radius curved pipes analysis
- Vacuum line walls stability analysis considering stiffening rings reinforcement.
- Analysis results include code stress tables, support & nozzle loads, displacements, forces, deformations of expansion joints and vacuum line walls stability factors
- Pipeline deformed shape view
- Colour illustration of code criteria in piping output

Pricing Options

There are 4 START suites different by their cost and content:

- START — for common users
- START-Prof — for professionals dealing with very big pipeline systems, and for analysis of long buried pipelines
- START-Light — simplified version designed only for educational purpose
- START-Express — budget-priced software designed for preliminary short-cut calculations at the pipeline design stage

Those versions differ in maximum permissible degrees of freedom (DOF) value and other features.

START version	Minimum (entry-level) configuration	Permissible value of DOF	Approximate maximum length of buried pipeline, L, m*
START	START-Basic START-Elements	1000	$L < 4.6 \cdot D$
START-Prof	START-Prof Basic START-Elements	32000	$L < 145 \cdot D$
START-Light	START-Light Basic START-Soil START-Word START-DXF	150	$L < 0.7 \cdot D$
START-Express	START-Elements	-	-

*Note: D — outside diameter, mm

START-Basic module makes it possible to analyze arbitrary configuration pipelines without buried elements

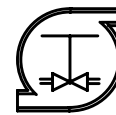
START and START-Prof suites may include the following additional advanced options:

- "START-Soil" - analyzes buried pipelines and polyurethane insulation stress;
- "Start-flexible pipes" — stress analysis and estimation of loads on supports for flexible polymeric pipes "Isoproflex" and "Isoproflex-A" and steel corrugated pipes "Kasafex"
- "Start-Dxf" - export of pipeline model to dxf file for further processing by AutoCAD, MicroStation etc.
- "Start-Rejection thickness" — analysis of process pipelines rejection thicknesses per CA-03-005-07
- "Start-Operational life" — operational life analysis of designed process pipelines considering fatigue strength and corrosion, as per RTM 38.001-94 and CA 03-003-07
- "START-Nozzle" — equipment and vessel nozzle flexibility calculation
- "START-Plant4D" — import from Plant-4D data. Standard package includes templates used for converting data created by Plant4D on the basis of the Russian pipes, fittings and valves databases
- "START-Word" — exports input data and analysis results to Microsoft Word
- "CTAPT-PCF" — imports pipeline models from PCF format files (provided by CEA Plant4D, Bentley AutoPlant, PlantSpace, Autodesk Plant3D, Coade CADWorx, Intergraph SmartPlant and other systems).
- "START-PDMS" — import from the reports created by PDMS software
- "Start-Kompas" - export of analysis model to ASCON Kompas-Graphic 5.x and higher
- "START-Neutral file" - import from the neutral format file, export of input data and analysis results to the neutral file. Neutral file is a text file for data exchange with other software

Additional options require the basic module (START-Basic, START Prof-Basic or START Light-Basic).

Recommended configuration for different types of pipelines:

Pipeline type	Recommended configuration
District heating systems	START, START-Soil, START-Word, START-DXF
Power piping systems	START, START-Word, START-DXF
Oil and gas transmission pipelines	START-Prof, START-Soil, START-Word, START-DXF
Process piping systems	START, START-Nozzle, START-Word, START-DXF, Start-Rejection thickness, Start-Operational life



Reference Users of START Software

Power and Heating Supply Industries: OÜ Aither (Estonia), UAB Bioprojektas (Lithuania), Gandras Ebergoeffektas (Lithuania), Regional engineering centres and energy generation companies: Institute TeploElektroProekt (Moscow), Ural Power Engineering Centre (PEC), Volga region PEC, VNIPIenergoprom (Moscow), BelNIPIenergoprom (Belarus), KazNIPIenergoprom (Kazakhstan), TatNIPIenergoprom; All-Russian Thermal Engineering Institute – VTI (Moscow), Project-Engineering Center New Generation (Moscow); Atomenergoprom design institutes: Atomenergoproekt (Moscow), Atomenergoproekt (Nizhniy Novgorod), VNIPIET (St. Petersburg), KGPII VNIPIET (Zheleznogorsk), UPII VNIPIET (Ozyorsk); Zarubezhenergoproekt (Ivanovo), E4-SibCOTES, SibENTC, Teploproekt, Moscow Intergated Power Company, MosInzhProekt, TVEL-Teploross Corporation, MosFlowline, SPKB RR MosEnergo, MosTeploEnergo, Moscow Heat Distribution Company, CNIIEP of housing, KanalStroyProject, etc.

Oil and gas industry, oil and gas refining, petrochemistry: JOHN Brown Engineering (UK); Key Industry Engineering Group s.r.o. (Czech Republic); TECHNIP (Moscow); VNIPIneft (Moscow); Giprokauchuk (Moscow); Surgutneftegaz design institutes: SurgutNIPIneft, Lengiproneftekhim (St. Petersburg); Rosneft design institutes: Samaraneftehimproekt, SakhalinNIPImorneft, Rosneft-NTC; LUKOIL-Rostovneftekhimproject; Angarskneftekhimproekt; GAZPROM design institutes: Giprogazcenter (Nizhny Novgorod), VNIPIgazdobycha (Saratov), Gazproektengineering (Voronezh), TyumenNIIgiprogas; Giprotyumenneftegaz, Tyumenneftegazproject, Giprogazoochistka (Moscow), Omskneftekhimproject, Bashgiproneftekhim (Ufa), Ukrneftekhimproject (Ukraine), Belorusneft-NeftekhimProject (Belorus, Minsk), NIICHIMMASH (Moscow), IrkutskNIIhimmash, Tyumengiprotruboprovod, VNIIST-Neftegasproject (Moscow), Giprovostokneft (Samara), VNIPITRANSGAZ (Ukraine, Kiev), LUKOIL-Permnefteorgsintez, LUKOIL-Nizhegorodnefteorgsintez, Nizhnekamskneftekhim, Moscow Oil Refinery, Rosneft Tuapse Refinery, Rosneft Kuibyshev Refinery, Rosneft Achinsk Refinery, Kirishinefteorgsintez, Alliance Oil Company Khabarovsk Refinery, SIBUR Tolyattikauchuk, LUKOIL-UNP (Uhta), Neftgaz Sanoat Lohiya (Uzbekistan) etc.

Chemistry: Poyry Industry Oy (Finland), ACRON (Veliky Novgorod), Sayanskkhimplast, SIBUR Kemerovo Azot, TogliattiAzot, GIAP (Moscow), GIAP (Grodno, Belarus), Design Institute of Russian Scientific Center Applied Chemistry (St. Petersburg), Giprosintez (Volgograd), NIIK (Dzerzhinsk), EuroChem Tulagiprohim, Giprokislorod (Moscow), Sterlitamak Petrochemical Plant, EuroChem Nevinnomyssky Azot, EuroChem Azot (Novomoskovsk), URALCHEM Azot (Berezniki), PhosAgro Cherepovetsky Azot, PhosAgro Ammophos (Cherepovets), Bashkirian Chemistry – Kaustik (Sterlitamak), Plastpolymer (St. Petersburg), Grodno Khimvolokno (Belarus) etc.

Metallurgy: Uralgiprommez (Ekaterinburg), Chelyabgiprommez (Chelyabinsk), Giprommez (Magnitogorsk), RUSAL VAMI (St. Petersburg), Evraz – Zapsib Steel Mill (Novokuznetsk), MECHEL Chelyabinsk Metallurgical Plant, MECHEL Izhstal (Izhevsk), Ashinskiy Metallurgical Works (Asha), Ukgiprommez (Ukraine, Dnepropetrovsk), UralEnergochermet (Ekaterinburg), Vyksa Steel Works etc.

The above list is far from being complete. At present time START is used by more than 800 companies.