SENSOR CO LTD

SENSOR TOOL

SUPERFINISHING PROCESSING

DIAMOND AND ROLLER BURNISHING TOOLS

FOR MIRROR-FINISHING AND HARDENING PROCESSING

CATALOGUE OF TOOLS AND ACCESSORIES

Company history

1975 The first implementation of a burnishing tool at KORVET valve plant

2006 Development of the basic burnishing tool ST1-25 and implementation at Sensor Co Ltd

2008 D. thesis defense by Dr. Gorgots V.G. "Dynamic stabilization of high-performance burnishing for multipurpose machining of spindles and rods of pipeline valves".

2011 D. thesis defense by Ph. Dmitrieva O.V. "Multitransient formation of flat-vertical surfaces of parts with lubricated microcavities by burnishing and deforming profiling" (oil pockets)

2012 Implementation of the first production samples of burnishing tools at the plants of the Russian Federation

2013 Defense of the doctoral dissertation of Dr. Kuznetsov V.P. "Theoretical justification and realization of nanostructuring burnishing in the machining of precision parts of structural steels".

2016 Beginning of active sales of SENSOR-TOOL burnishing tools

2018 Defense of the dissertation of Skorobogatov A.S. Control of structure and properties of surface layer of martensitic steels at high speed nanostructuring burnishing with heat removal.

2019 Official representative of Wenaroll GMBH Tools and Systems (German manufacturer of roller burnishing tools) Increase of customer base

2020 Significant expansion of the range of tools and creation of dealer tool sales network

Specialists: 3 design engineers, 3 CNC machine tool setters, CNC machine programmer engineer, patent engineer, metal thermist, doctor of technical science, sales managers.

Machines: Okuma multus B300, Takisawa EX310, Okuma MA600, Okuma Genos, Millstar LMV800

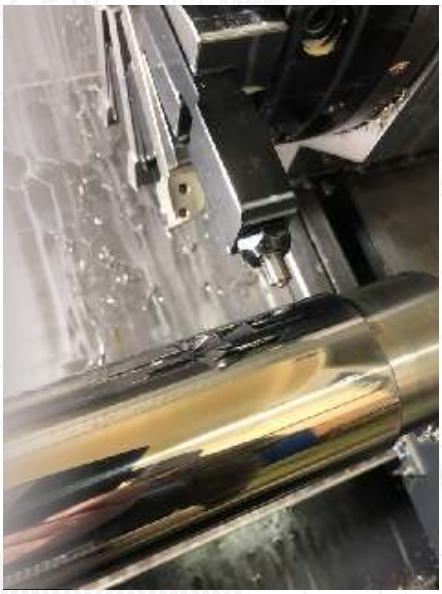
Metal laboratory: Veeco optical profilometer, Ahotec micro-hardness tester, MCAII v5 emission spectrometer.

Inventions and patents: More than 40 patents for invention and utility models in the field of diamond burnishing tools, nanostructuring tools, roller burnishing tools.

CONTENTS

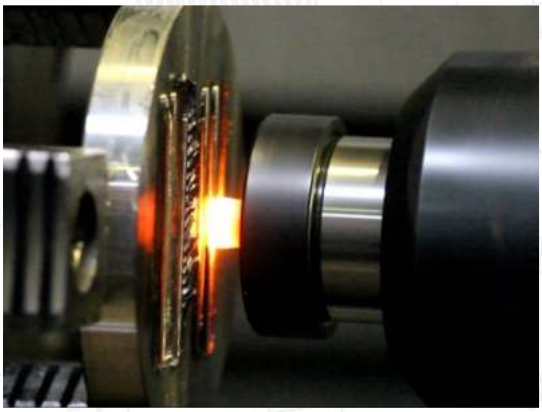
Overview of surface treatment with SPD methods

Diamond burnishing



External Roller burnishing

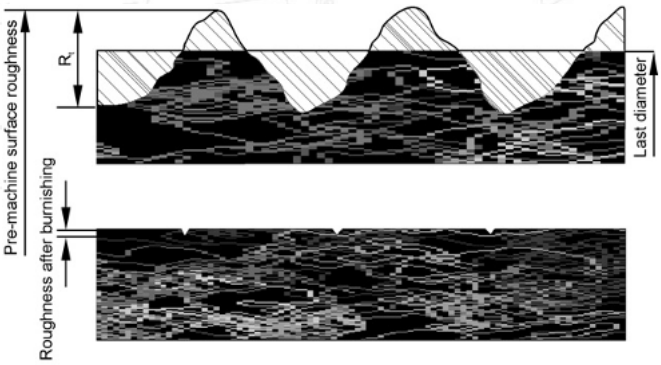
Friction stir processing

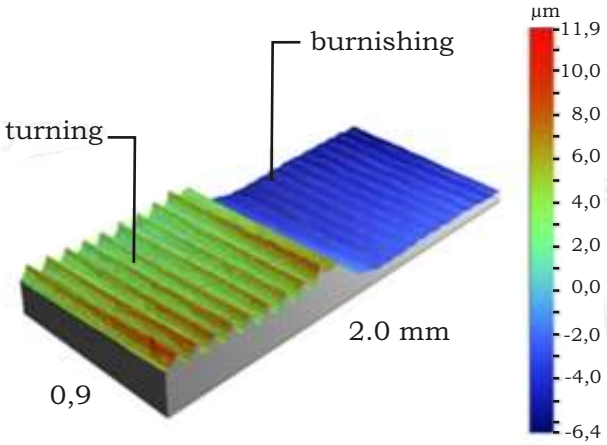


Internal roller burnishing

Nanostructuring burnishing

Surface quality change and new properties of workpiece surface





Surfaces after diamond and roller burnishing are characterized by a unique structure and have the following characteristics:

-Low (Ra<0.1 μm) or defined low (Ra<0.1 μm or a given roughness
-smooth microprofile,
-high contact coefficient,
-Low coefficient of friction,
-increased wear resistance,
-increased surface hardness-30-40%
-increase in corrosion resistance

Burnishing removes stress concentrators and smoothes out micro cracks in the surface, which can then develop into deep cracks.

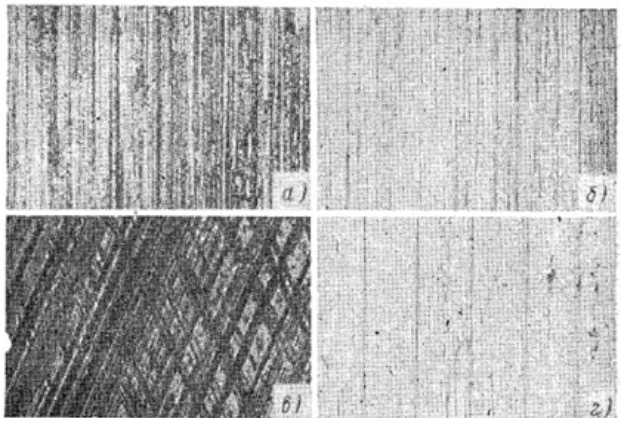
After elastic burnishing, the geometric dimensions and tolerances of the part obtained by pre-processing do not change. The roughness Ra is maximally reduced by 1...5 μm.

Metal grains in the surface layer of the smoothed part become one-dimensional and equally directed.The surface becomes homogeneous.

Burnishing hardens the surface, creates a notch on the layer depth up to 0,01 mm, increases the tensile strength and the yield strength. The riveting protects the subsurface layers of the part from penetration of moisture, sand, fat compounds, salts, acids, impurities from the external environment. Owing to this the ageing, corrosion and destruction of the workpiece is much slower, than on the ground, honed or any other abrasive processed surface.

A burnished surface differs from the surfaces processed by abrasive methods by its characteristic mirror shine.

The surface after burnishing is even with no tears or scuffs. The burnished surface is characterized by a smooth, rounded shape of irregularities.



View of the surface after:
a - grinding; b - polishing; c - superfinishing;
d - diamond burnishing (x300)

This surface has a higher bearing capacity and therefore better performance.

When burnished, the structure of the surface layer becomes finer-grained and receives an orientation-texture. The strength of the plastic deformed metal increases. Burnishing significantly reduces wear (on average by 35-45%) not only of the burnished part, but also of the mated part. Surface hardening by diamond burnishing at optimal modes sharply improves the quality of the surface layer, reducing the number of surface defects and eliminating structural stress concentrators. At the same time the probability of fatigue cracks nucleation decreases and their propagation resistance increases.

Diamond burnishing at optimal modes allows to reduce the number of premature failures of parts and significantly increase their durability. Fatigue tests show that diamond burnishing makes it possible to increase the endurance limit in the corrosive environment by about 3 times and durability by 30-40 times.

Cost and labor reduction using diamond burnishing technology

Basic technology:

1. Finishing turning 1 cycle
2. Grinding 3 cycles
3. Polishing 1 cycle

Diamond burnishing was applied

Cut down: preliminary grinding, finishing grinding, polishing.

Saving from 1 workpiece = 30 minutes

Monthly quantity = 250 pcs

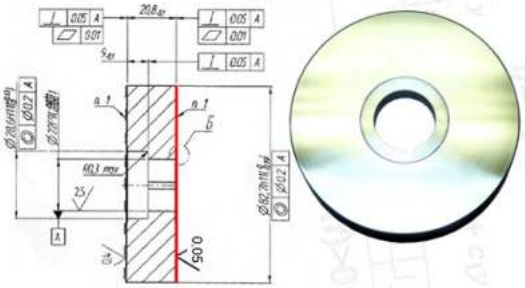
250 pcs x 30 min = 7500 minutes = 125 hours = economy of 5 full days machining time each month.

Achieved roughness Ra=0.02-0.03 um

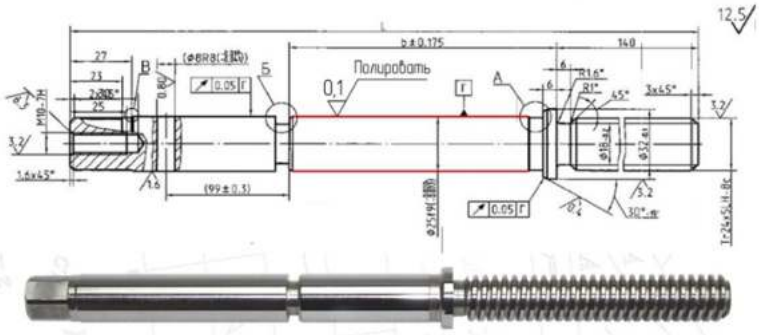
Factory applying SENSOR-TOOL burnisher	Labour reduction	Cost reduction
JSC KORVET, Kurgan	down by 27%	7,1 млн р./год
Sibtechoil LLC, Tyumen	down by 40%	4,5 млн р./год
Stankotehnika LLC, Tula	down by 26%	1,23 млн р./год
Sensor Co Ltd, Kurgan	down by 48%	3,07 млн р./год
Sibenergoresurs LLC, Leninsk-Kuznetsky	на 25%	5 млн р./год

COMPARISON OF THE EFFICIENCY OF THE BASIC AND PROPOSED TECHNOLOGY MANUFACTURING OF PRECISION PARTS WITH FINISHING BY NANOSTRUCTURING BURNISHING

Submersible oil pump heel 20Cr steel (HRC 55)



High pressure gate valve spindle steel 20Cr13(HB 460)



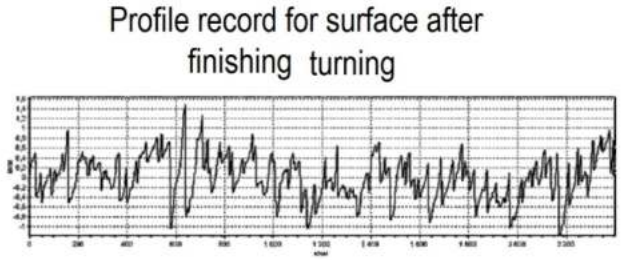
Workpiece	Basic technology with running-in, lapping and polishing operations		The proposed technology with nanostructuring burnishing	
	Quantity of machines	Labor intensity, min	Quantity of machines	Labor intensity, min
Heel 10066995	10	76,1	3	60,8
spindle PS - 21006-20	7	67,7	2	42,1

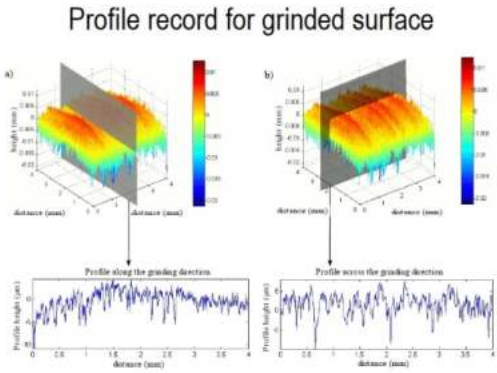
Optimal conditions for burnishing. Roughness and hardness. Comparison of roughness

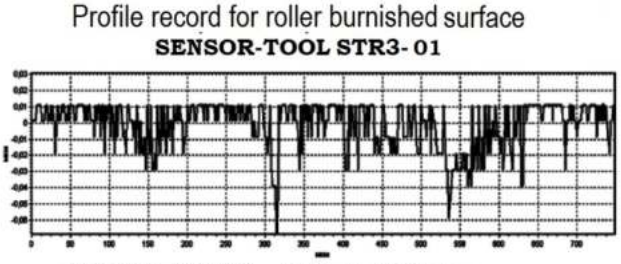
The rigidity of the "Machine-Fixture-Tool-Part" system is a major challenge in order to achieve a consistent result in the diamond burnishing and roller burnishing process. In terms of equipment requirements and process kinematics, diamond burnishing is comparable to finishing turning. That is, if your equipment can stably perform finish turning (dimensions with tolerance of the order of H8-H6 and roughness Ra=1.6...0.8), diamond and roller burnishing processes will be stable.

The main regularity - the less the initial roughness will be, the less will be the roughness after burnishing.

	The hardness of material, HRC	Initial roughness after turning Ra, μm	Roughness Ra, μm after burnishing
1	≥ 50	0,4...0,2	0,10...0,05
2	35... 50	0,8... 0,4 1,6...0,8	0,10... 0,05 0,40...0,20
3	≤35	1,6...0,8	0,40...0,20







Material: 20cr13 , S=0,1 мм/об, V=180 м/мин,

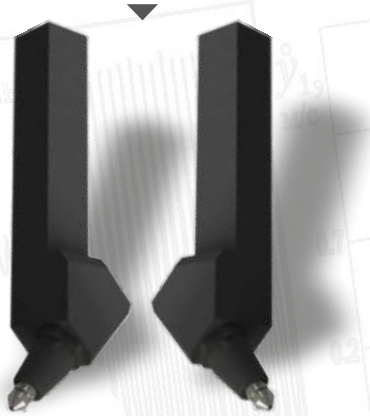
TOOLS MODEL RANGE

Tools for external diamond burnishing

ST-13 boring bar for ST-3-32 burnishing tool

ST-6-20
ST-6-32
ST-6-40
Tool for internal surfaces

ST7-25 burnishing tool for radius, angle and steplike surfaces



Tools for nano structuring burnishing

ST-3 diamond burnishing tool

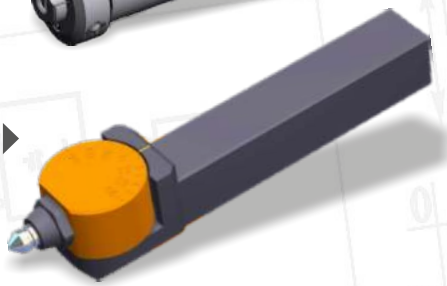
The tool for burnishing spheres using intersecting **ST8-75**

Burnishing tool with replaceable CNB insert **ST-10**

ST-12 modular system for burnishing sleeves of hydraulic cylinders

STR-1 ball burnishing tool

ST-21 universal rotatable diamond burnishing tool



STR-2 ball burnishing tool for holes

TOOLS MODEL RANGE

STR-5
single roller
universal
multipurpose
roller burnishing
tool

STR-4
single roller
burnishing tool

STR3-01
single roller burnishing tool
for external surfaces

single roller burnishing tool
for external angle surfaces
and radii

STR8
Multi roller
internal
burnishing
tool

Diamond
burnishing tool
for plain surfaces
ST-11

ST-9-20
diamond burnishing
tool for precise holes
with 2 inserts

STGA
tools for interior
skiviing and finishing
of cylinders
and pipes

Replaceable
inserts with
natural diamond
radius
R2,R4,R6

SENSOR-TUNE
Dynamometer device for off-machine
adjusting burnishing force in
Sensor-tool burnishers

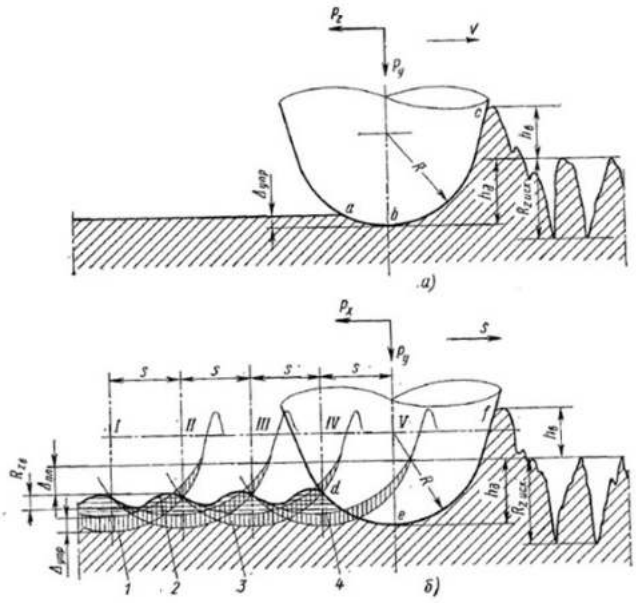
Replaceable
rollers
STR3-01-1.5
STR3-01-3

Diamond burnishing - description of process

Diamond burnishing is the process of plastic deformation of the original micro-profile under the action of the force applied to the diamond (or other superhard material).

The peculiarity of diamond burnishing in contrast to other methods of surface plastic deformation processing is the use of diamond as a damping element, which has the following properties: extremely high hardness, low friction coefficient on metal, high degree of purity with which diamond can be polished, high thermal conductivity.

The high hardness of diamond makes it possible to machine almost all plastically deformable metals, both soft and hardened up to the hardness of HRC 60-65. Small value of burnishing tool radius (2-4 mm) causes small value of smoothing force, which enables to work thin-walled and low-rigid parts and decreases requirements to hardness of technological equipment.

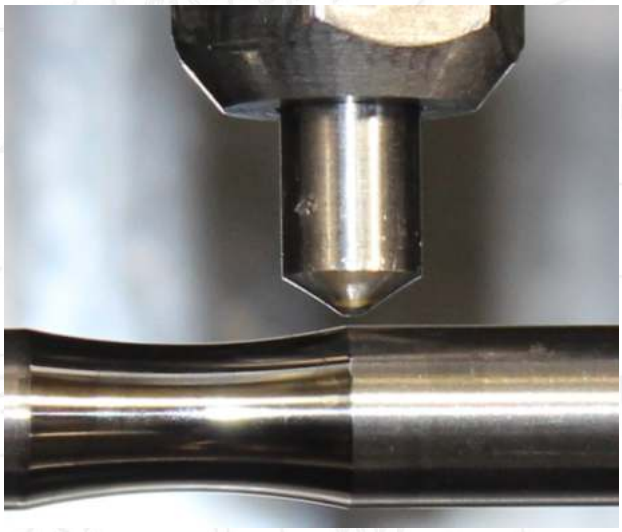


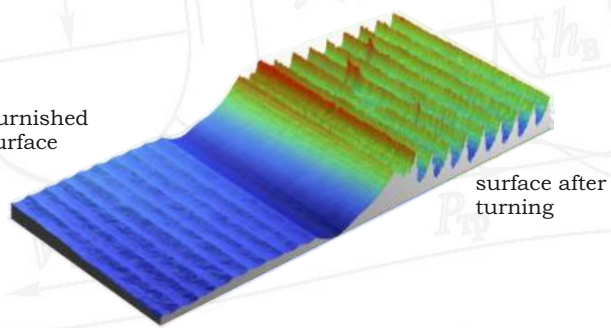
Scheme of surface deformation during burnishing

a - in direction coinciding with speed direction,
b - in feed direction, I-V - consecutive positions of the indentor after each revolution of the part, 1 - profile of the burnishing track, 2 - actual profile of burnished surface, 3 - elastic restoration of surface, 4 - plastic distortion of profile.

Burnishing is used to reduce surface roughness (finishing), harden the surface layer and improve the dimensional and shape accuracy of parts (calibration). Smoothing is most often used as a finishing-strengthening operation for critical parts surfaces.

Smoothing is one of the methods of finish-strengthening treatment by surface plastic deformation and consists in plastic deformation of surface by sliding on it tool - smoothener, fixed in mandrel by diamond crystal. In this case the surface irregularities from the previous treatment are smoothed out completely and the surface acquires a mirror shine, the microhardness of the surface layer increases, and compressive stresses are created in it. After smoothing, the surface remains clean, not scarred by fragments of abrasive grains, which usually occurs in abrasive blasting processes. The combination of properties of the smoothed surface predetermines its high performance properties - wear resistance, fatigue strength, etc.





Advantages of diamond burnishing

-Burnishing tool replaces 2 production sites - the grinding area and the polishing section.

-Saving on grinding and polishing machines

-Savings on consumables (abrasive)

-Saving on staff - nowadays finding a competent experienced grinder is a very hard task. No need to pay a salary to the grinder operator.

-No special skills are required from the machine operator.

-Saving machine time = cost savings: on average, time to finish machining parts is reduced by 3-4 times.

-Saving of auxiliary time - it is not necessary to rearrange the part from the machine to the machine, it is not necessary to base the part again --

-No additional tooling or other equipment.

- Roller burnishing tool process parts up to HRC 43. Diamond burnishing tools process parts up to 65 HRC.

-SENSOR-TOOL® meets international standards for surface processing at a lower price.

-Less defects - burnings are not possible during burnishing.

-Sharply reduced surface waviness as when polishing.

-Much less internal stress. Reduction of defects due to the human factor.

-Fatigue strength increases at least 10 times.

-Wear resistance increases by 40%

-Corrosion resistance 30-40%

-The performance of seals on the ironed surface increases by 2-3 times

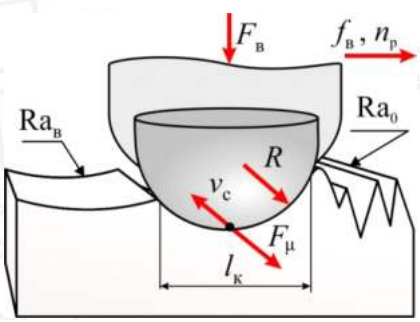
-The roughness of the burnished surface is lower than after the process of roller burnishing (polishing using rollers such as Ecoroll, Yamasa)

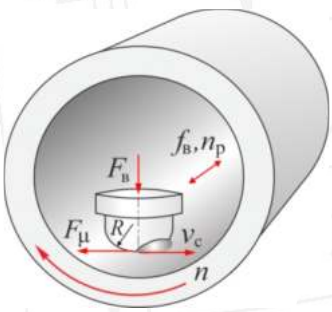
-During burnishing, stress concentrators are removed and microcracks in the surface are smoothed out, which then develop into deep cracks.

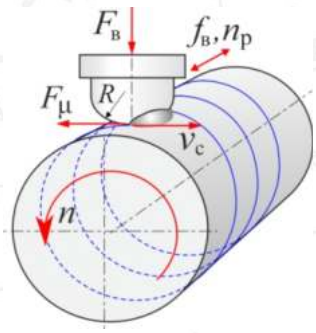
-Environmentally friendly processing - with diamond burnishing, no chips or metal dust remains. The part is clean, there are no fragments of abrasive grains on it, as when grinding.

-Economic benefit - material is not transferred to chips.

-Diamond burnishing - blends in harmoniously with the concept of "Lean Manufacturing, Lin Technology, Kaizen»







Tools for external application

ST-1 ST-2 ST-16


Diamond burnisher ST2-16R

Diamond Burnishing tool ST-1, ST-2 are used for finishing the surface of steels, stainless steels, cast iron, alloys. Supplied with adjustable burnishing force, for processing various parts.

Loading tuning device is purchased separately, or we can adjust loading for your single workpiece

Workpart shapes - cylinder, body of rotation, plain body, spherical part.

Smallest workpiece diameter 5 mm

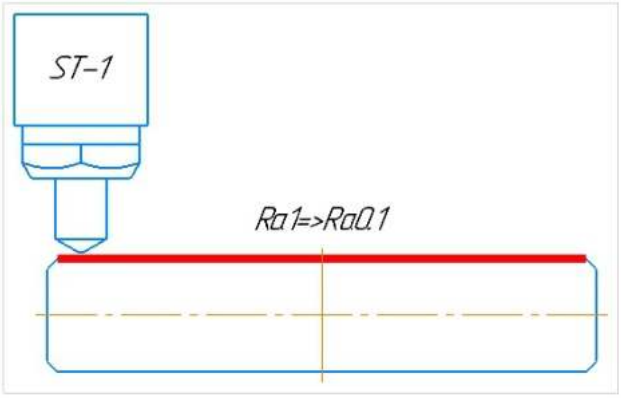
Toolholders 16x16, 20x20, 25x25, 32x32 (can be customized).Indenters made of natural diamond or tungsten carbide.

The tool completely replaces the grinding and polishing machines. Can be used on CNC machines/universal lathes. During processing, the roughness is smoothened to the level Ra = 0.2 ..... 0.05 um in one or two passes.

To obtain a stable micro profile of a surface we recommend to use ST-1 on machines that can provide finishing turning!

Materials: any steel grades max HRC 65

Roughness before processing: no more than Ra = 1.25 um. Example parts - hydraulic cylinder rods, gate valve spindle, shaft, shaft surfaces for bearings.



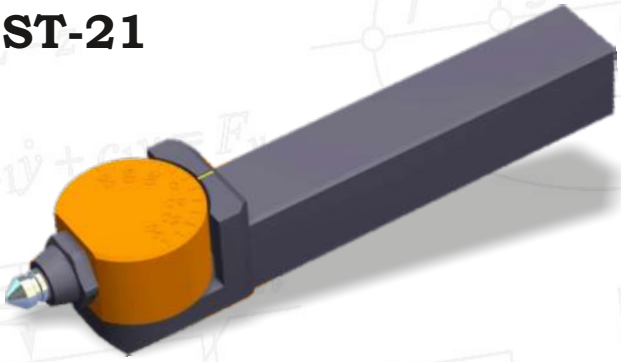
Universal rotatable diamond burnishing tool ST-21 is used for finishing and surface finishing of parts on universal machines and CNC machines. It is used for smoothing surfaces in hard-to-reach areas of parts, radii, cones, ends, holes, external surfaces.Version with adjustable burnishing force, for machining various parts.

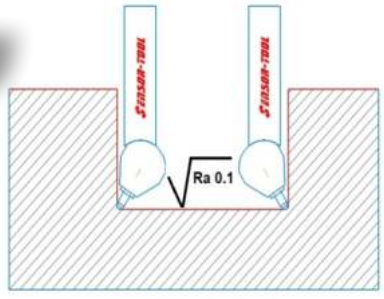
Part shape - cylinder, rotational bodies, cone, fillet.

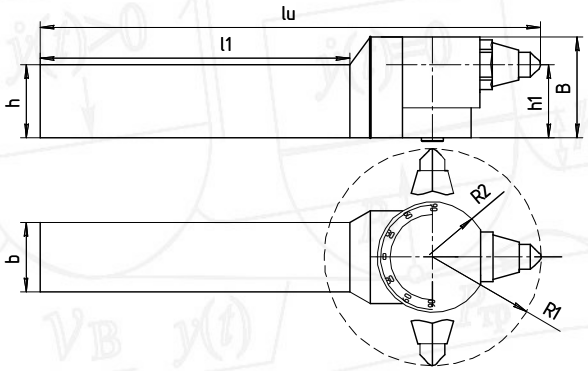
Smallest diameter of the workpiece 5 mm.

Toolholders 20x20, 25x25, 32x32 (as well as the size of the customer).Natural diamond indenters are used.

ST-21

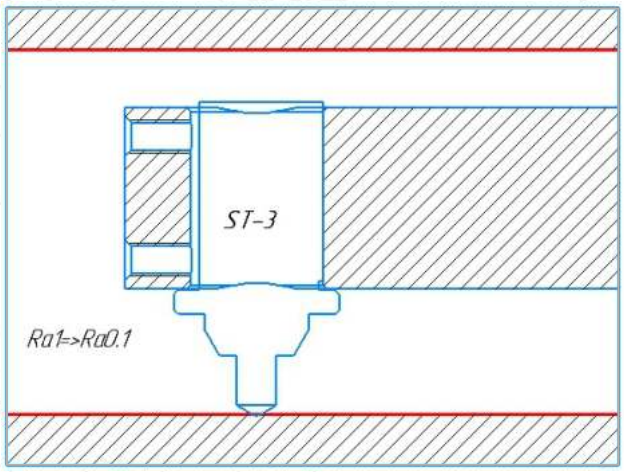






Tools for external application

ST-3



Diamond burnishing tool ST-3

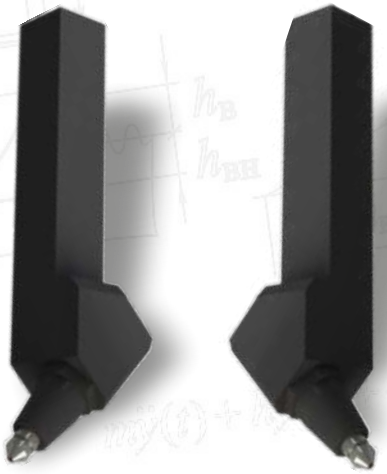
It is used for finishing on small-sized machines and CNC machines withround toolholder. ST-3 tool can also be used for burnishing holes if set on ST-13 boring bar. Version with adjustable burnishing force for machining parts of different hardness. Adjustment device is available separately. Shanks are round Ø25, Ø32 and Ø40. Burnishing of roughness to the level of Ra = 0.2...0.05 micron in one or two passes. In order to obtain a stable micro-profile of the surface without a wave, it is recommended to use ST-3 on machines that can provide finishing turning!Roughness before machining not more than Ra= 1,25 μm. Example parts - hydraulic cylinder rods, gate valve spindle, shaft, shaft surfaces for bearings.

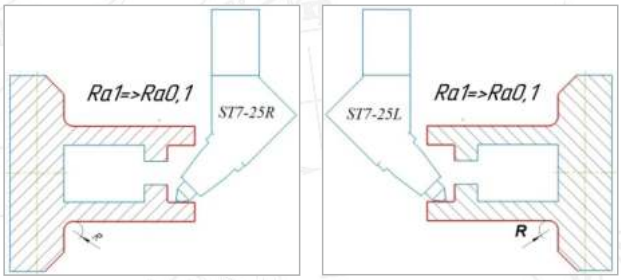
Burnishing force setting devise

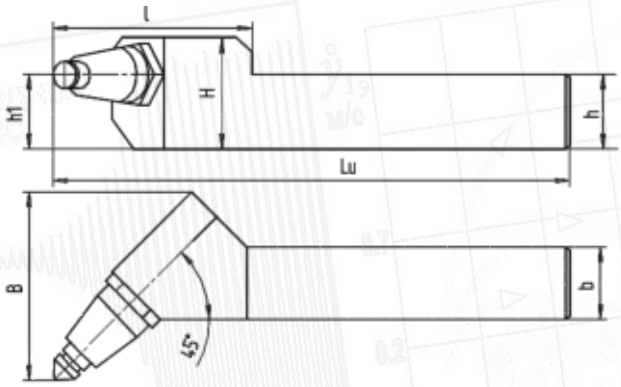
SENSOR-TUNE

DYNAMOMETER DEVICE FOR ADJUSTING OFF-MACHINE BURNISHING FORCE IN THE SENSOR-TOOL

The device is designed for off-machine adjustment of the burnishing force of the Sensor-tool. Adjustment range is from 50 to 1000N in increments of 10N. The setting device is used to adjust to the exact force of the spring. The setting device is also useful if you work at different hardnesses, and use indenters with different radii accordingly. The adjuster saves auxiliary time and allows you to obtain a lower surface roughness on your workpieces.







model \ size,mm	h	b	h_1	H	L	l	B
ST-7-25R(L)	25	25	25	38	178	69	65

ST7-25R

BURNISHING TOOL FOR PROCESSING STEP TRANSITIONS, RADII AND CORNER JOINTS

ST7-25R (Right) version for passage from the rear center to the chuck. Minimum radius at an angle of 3 mm. Supplied with square shanks 16*16, 20*20, 25*25, or on customer request. Supplied with square shanks 16*16, 20*20, 25*25 or on customer request. It is recommended to use tool on machines which are able to provide an initial roughness prior to burnishing not more than Ra 1,6 µm. Example parts: shafts, stepped rods of hydraulic and pneumatic cylinders, intake valve of an internal combustion engine, etc.

The depth of the hardened layer is 2 microns.

Materials of machining: any steels with hardness max HRC 65, stainless steels, heat-resistant steels, cast irons.

ST7-25L

BURNISHING TOOL FOR PROCESSING STEP TRANSITIONS, RADII AND CORNER JOINTS

ST7-25L (Left) version for the pass from the chuck to the rear center.

The tool can only be clamped vertically in the toolholder. Machining with horizontal clamping is not possible.

Please note the maximum tool extension from the toolholder when ordering!

ST-10

CBN INSERT BURNISHING TOOL WITH INCREASED TOOL LIFE

The tool for burnishing with many times longer service life of the working part.

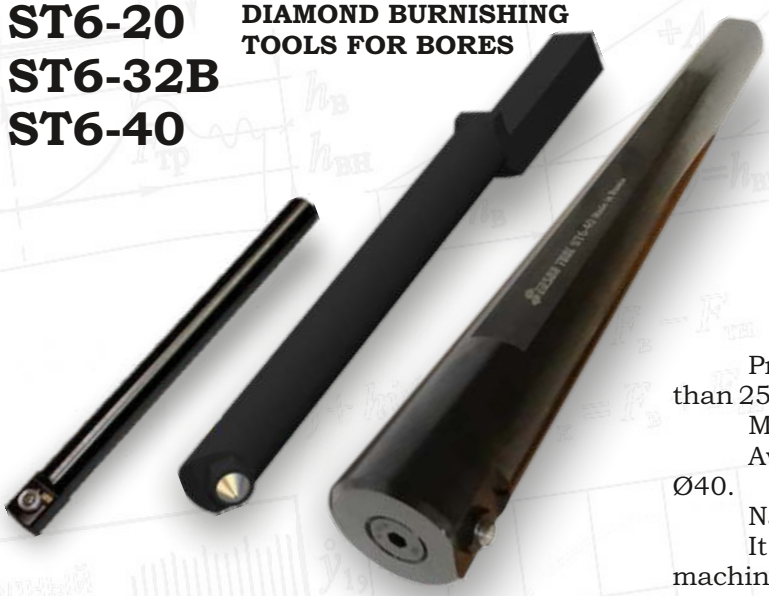
It is used for superfinishing of cylindrical and face surfaces of the parts.

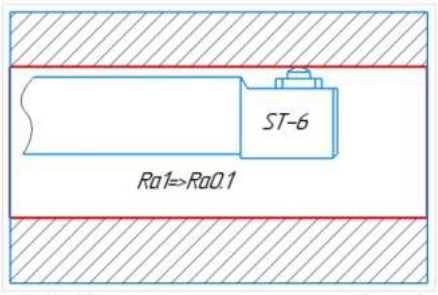
The tool uses a CBN plate with a radius on the cutting edge.

Insert can be ordered separately.

ST6-20
ST6-32B
ST6-40

DIAMOND BURNISHING TOOLS FOR BORES





Diamond burnishing tools series ST-6 are used for finishing and slight hardening inner surfaces of the bodies of rotation of holes, tubes, sleeves.

Minimal diameter of processed workpiece
ST6-20 - Ø25 mm. ST6-32 - Ø36mm.
ST6-40- Ø45mm.

Maximum burnishing depth of workpiece
ST6-20 - L170-180 mm
ST6-32 - L 300 mm
ST6-40 - L 400 mm

Processing restrictions - holes not less than 25 mm.

Mirror surface of the metal.

Available with round shank Ø20, Ø32, Ø40.

Natural diamond indenters are used.

It is recommended for universal and CNC machines, which are able to provide finishing turning (Ra 1,25 and higher).

Pre-machining roughness should not exceed Ra=1.25 µm.

Example of workpiece - hydraulic cylinders, seating surfaces in bearing housings. Internal coolant supply.

ST9-20

DIAMOND BURNISHING TOOL FOR PRECISION HOLES

The tool is used for superfinishing blind and through holes on parts of unlimited length.

Finishing in 2 passes only.

The tool can be produced with longer machining lengths (up to 1000 mm and more).

The diamond burnishing tool is used for finishing bores on universal and CNC machines.

The tool is based in 2 points and provides a perfect roughness and zero waviness.

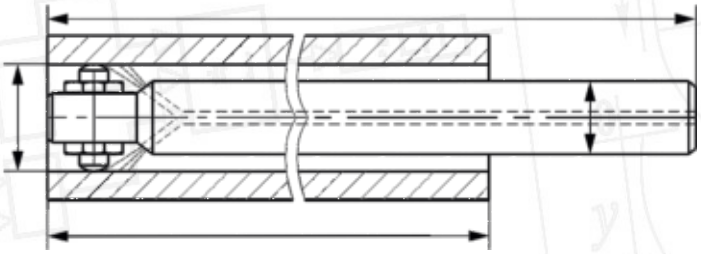
Shank Ø16 mm.

Internal coolant supply through tool.

Perform burnishing in one setup with finishing turning. Natural diamond indenters are used.

Tools ST-9 are produced for bores Ø21, Ø22, Ø23, Ø24 with the tolerance demanded by the customer.

Significant savings, reduction of labor intensity and improvement of quality in comparison with grinding, polishing, lapping and finishing.



ST-12

MODULAR SYSTEM FOR BURNISHING HYDRAULIC CYLINDER LINERS

The burnishing head allows the exact positioning of the tool relative to the workpiece due to the 3 indentors.

The runout of the workpiece or machine is compensated by a damping system.

Tool lengths are manufactured to the customer's requirements. Elongated tools are available.

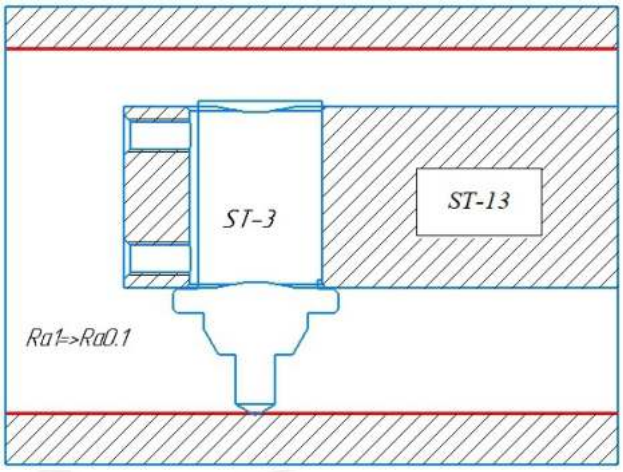
Type of connection as per customer's request. Internal coolant supply. Tool is used for burnishing on universal machines, CNC machines and deep hole drilling machines.

Adjustable tapping force available for workpieces of different hardness.

Diameter of the processed workpiece from 55 mm.

ST-13

BORING BAR FOR ST3-32 BURNISHING TOOL FOR DEEP HOLE BORES



Through-holes: Ø 50 - 400 mm
Blind holes: Ø 50 - 400 mm
Roughness Ra 0.1um

Machining of all metals with a tensile strength up to 1400 N/mm2 and a maximum hardness of HRC ≤ 45.

On universal and CNC machines.

Shank type according customer's request

ST-11

DIAMOND BURNISHING TOOL FOR PLAIN SURFACES

Diamond burnishing tools for finishing plane surfaces.

Diamond burnishing tool is used for finishing flat metal surfaces on CNC milling machines and general-purpose milling machines.

The ST-11 tools can be used in both large and small areas and are ideal for small batch production. Diamond milling-type burnishing tools can perform a quality finish on solid surfaces, the tool does not process discontinuous surfaces.

The tools come preloaded, but the spring pressure can be adjusted to ensure the same pressure on the surface of the part, guaranteeing repeatability from part to part.

Flatness and lack of height differences are ensured by multiple intersections of the indenter trajectories.

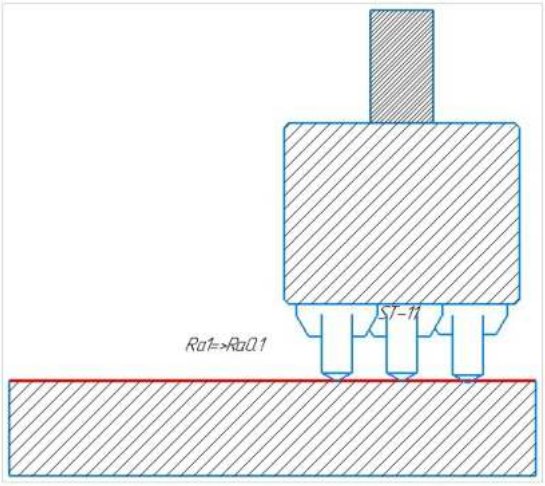
Shank Ø20 cylindrical for fastening in the chuck. Minimal width of burnished path is 8 mm.

Obligatory plentiful supply of liquid coolant. External coolant supply.

Burnishing is performed in one set-up with a finish milling. Indenters with natural technical diamond are used.

The recommended initial roughness after milling is Ra 1.0...0.8. Replacement diamond inserts are easy to replace and are available from stock.

The high quality replacement diamond insert is ground and polished for a superior superfinish finish and long tool life.



ST-11 range of tools
ST11-8 - burnished path width 8mm
ST11-47 - burnished path width 47mm
ST11-75 - burnished path width 47mm
Example of workpiece to be burnished - die mould surface, slide gate, tool body, accessory surface, machine bed guides, slide gate wedge.

Burnishing tools for spherical surfaces

ST8-75

TOOL FOR BURNISHING SPHERES BY THE INTERSECTING AXIS METHOD

Diamond burnishing tool ST8-75 for surface treatment of balls and spheres, ball bearings, ball pins. The part and the tool rotate at the same time. It is used on CNC turning and milling machines.

Burnishing by the intersecting axis method.

The tool is made for one ball diameter.

Machining is done on turning/milling machines.

Natural diamonds are used.

The ST-8 tool is only used for machining valve balls with the metal-on-PTFE seal type.

Metal-on-metal valve balls can only be machined by lapping!

An ample supply of coolant is mandatory.

Tool with adjustable burnishing force.

ERGK-45

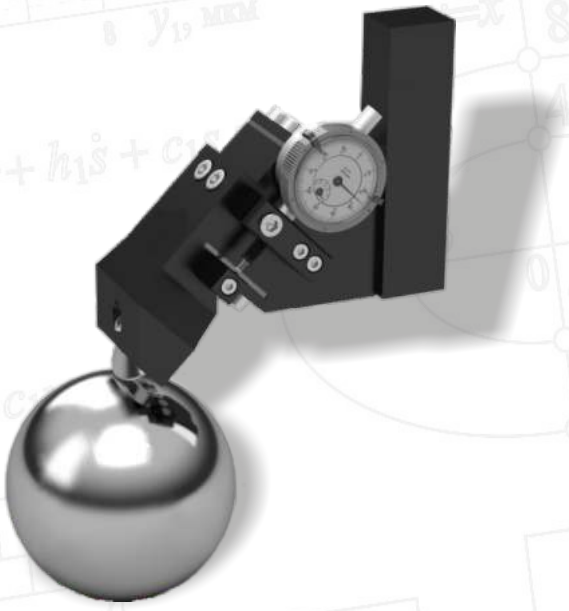
SINGLE ROLLER BURNISHING TOOL FOR PROCESSING BALLS AND SPHERES

The ERGK single roller tool is designed for cylindrical shafts, flat surfaces as well as spherical and conical parts.

ERGK tools have a roller with an angled profile especially designed for radius rolling.

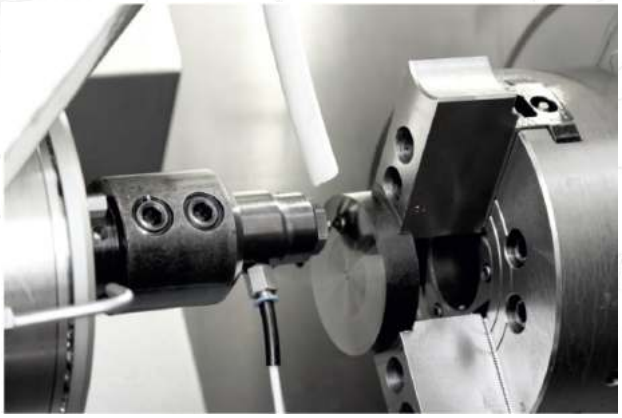
The angle of the roller can be 45° or 90° and allows to machine the whole radius of the workpiece.

The indicator with a circular scale allows you to monitor the burnishing force.



Tool body	Design	Version	Roller radii	Shank				
				VDI	Cylindrical		Square	
				DIN69880	DIN1835 A	DIN1835 B	SL	SLA
ERGK	45	1	0,8 1,2 1,6 2,5 4,0	VDI 20 (Ø20 x 40)	ZA 20 (Ø20 x 50)	ZS 20 (Ø20 x 50)	SL 16 (16 x 30 x 120)	SLA 16 (16 x 60 x 120)
				VDI 25 (Ø25 x 48)	ZA 25 (Ø25 x 56)	ZS 25 (Ø25 x 56)	SL 20 (20 x 30 x 120)	SLA 20 (20 x 60 x 120)
				VDI 30 (Ø30 x 55)	ZA 32 (Ø32 x 60)	ZS 32 (Ø32 x 60)	SL 25 (25 x 30 x 120)	SLA 25 (25 x 60 x 120)
				VDI 40 (Ø40 x 63)	ZA 40 (Ø40 x 70)	ZS 40 (Ø40 x 70)	SL 32 (32 x 30 x 120)	SLA 32 (32 x 60 x 120)

Fundamentals of nanostructuring hardening burnishing (NSB)



Nanostructuring Burnishing (NSB) is a surface layer forming technology with nanocrystalline structure and submicro-relief by controlling contact pressure and frictional load of sliding indenter of the tool.

The objective of nanostructuring burnishing is to increase strength and plasticity of the surface layer material and to significantly increase wear and fatigue resistance, thermal resistance and other operational properties of machine parts.

Properties of nanostructured surface.

Nanostructuring burnishing provides very high surface hardness in combination with increased elasticity.

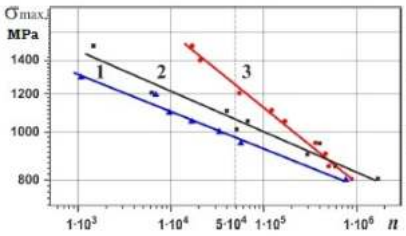
The nanostructured surface has the hardness of a file and the elasticity of rubber. The elasticity is provided by the crushed grain. The surface treated with ST-4, ST-5 performs well in tribocouplings, takes the shape of the reciprocal part.

The nanostructured surface is not brittle, unlike other superhard coatings.

In traumatology and surgery, very good bone growth to the nanostructured material is provided.

Strengthening of material in a thin surface layer of steels is carried out by formation of nanocrystalline structure with grain size less than 100 nm due to control of friction force of indentor and development of intensive plastic shear deformation.

It has been established that under conditions of low-cycle loading the samples processed by nanostructuring burnishing have multiple fatigue strength reserves in comparison with the samples processed by regular burnishing and grinding, which is explained by formation of nanocrystalline structures in a thin surface layer up to 10 μm and creation of high level of strength and plasticity of surface layer.



Graphs of fatigue life of 20Cr (HRC 55) samples
1. - grinding (Wheel 24A16HCM2K, V=35 m/min S= 0.02 mm/min)
2. Natural Dimond burnishing
3. Nanostructuring burnishing (NSB)

The surface layer after nanostructuring burnishing has microhardness up to $HV_{0.025}$1500...1600 (after previous finishing turning $HV_{0.025}$825...845).

HIT indentation hardness reaches 13 GPa, residual stresses σ_{ost}=-1950 MPa and nanoprofile with Ra=32...60 nm is formed.

The thickness of nanostructured layer is 8...12 μm. Nanostructuring burnishing at processing part type "heel" of submersible oil pumps has provided decrease in intensity of wear of a surface in 3,2 times in the conditions of the abrasive environment.

At processing of steel 1.3505 (HRC 54) in a nanostructured layer with depth of 5...8 microns microhardness $HV_{0,025}$ to 1100 is provided.

Roughness Ra= 0.25...0.27 μm.

Achievable quality parameters of the nanostructured layer of structural steels after machining with the SENSOR-TOOL ST-4 tool

	20Cr	1.3505	AISI304 (12X18H10T)
Microhardness HV0,025	1600	1200	450
Residual stresses MPa	-1950	-1900	-667
Rouchness Ra, um	0,09	0.20	0,05
Indentation Hardness H_{IT}, GPa	13	9,2	5,4
Specific contact hardness E_{IT}, GPa	0,061	0,041	0,025
Thickness of nanostructured layer, um	8...10	5...8	3...6

Tools for nanostructuring burnishing (NSB)

ST-4

The tool ST-4 is used for finishing and strengthening and nanostructuring burnishing.

The tool ST-4 is supplied with round shanks Ø25, Ø32, Ø40.

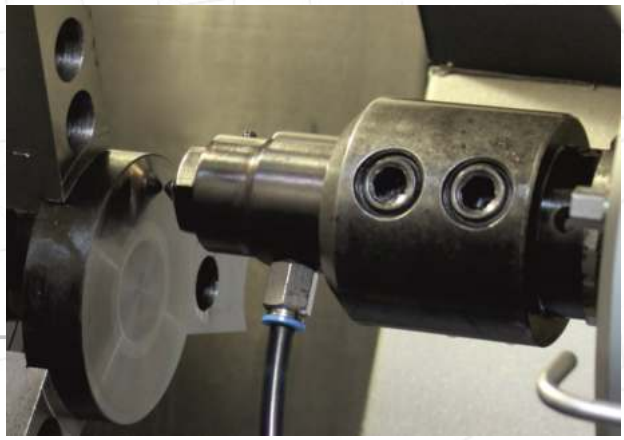
Natural Diamond, Synthetic Diamond (MCD), and ultrafinegrained Dense Boron Nitride (DBN) indenters are used.

The tool allows adjustment of the smoothing force. Adjustment is made in a dynamometer, which is purchased separately.

This tool allows to achieve a roughness level of Ra=0.05 μm and a significant increase in surface hardness.

It is used on CNC and general-purpose machine tools capable of performing finish turning.

The ST-4 tool uses the machine's internal coolant supply system.



ST-5

The tool ST-5 is used for finishing-strengthening and nanostructuring burnishing.

The tool ST-5 is made with round shanks Ø25, Ø32, Ø40 and with square shanks 16x16, 20x20, 25x25, 32x32.

Indenters made of natural diamond, synthetic diamond and ultrafine grained dense boron nitride (DBN) are used.

The tool allows adjustment of the burnishing force. Adjustment is made in a dynamometer, which is purchased separately.

This tool allows to achieve a roughness level of Ra=0.05μm and a significant increase in surface hardness.

It is used on CNC and general-purpose machines that can perform finishing turning.

Internal cooling system BOI-1 is used For tool indentor cooling. Supplied separately.

Roller burnishing and ball burnishing - process description

Rolling is a type of machining, the purpose of which is to harden the surface layer of a part, increase its wear resistance and achieve 8-10 surface accuracy.

Parts made of various ductile materials and steels with hardness not more than HRC 35-40 are processed by means of plastic deformation with roller or ball burnishing tools.

The process proceeds without chip removal by smoothing the roughness obtained after turning by reducing its size by the value of the residual strain, the rolled hole has a correspondingly larger size. The surface of the part is prepared for hardening by the method of finishing turning.

The roughness should be within the 5 to 6 surface finish classes. It is necessary to take into account that during hardening the surface diameter can change to 0,02-0,03 mm. Therefore, the outer surfaces of the part should be made according to the largest limiting dimension, and the inner ones - according to the smallest one.

The presence of a damping element ensures a constant rolling force at any point of the machined surface. Single roller toolholders are simple and versatile, but require a significant working force that is fully absorbed by the machine assemblies. The change in surface size during running-in and rolling-out is due to the buckling of microroughnesses and the plastic volume deformation of the workpiece. The reverse stroke should not be used as a working stroke, because repeated passes in opposite directions can result in excessive deformation of the surface layer.

Rolling hardens the surface in a short time, improves surface roughness and increases the service life of the part due to compressive residual stresses.

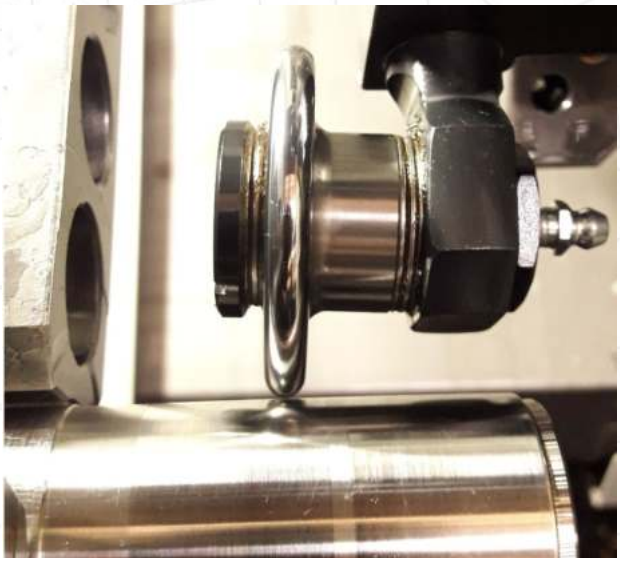
The change in the diameter of the workpiece occurs only by the size of the roller indentations into the surface of the workpiece. To ensure the required machining tolerances, it is important to keep the allowance before the machining process to account for the diameter change.

The accuracy of the preceding machining process directly affects the size after the burnishing process. The change in diameter depends on the material, hardness, and rollers.

Two to three experimental runs should be made to obtain the best machining parameters before flow machining a batch of parts.

Rolling is most expedient to perform in one working stroke, sometimes the second and third working strokes are used, which can slightly improve the surface condition.

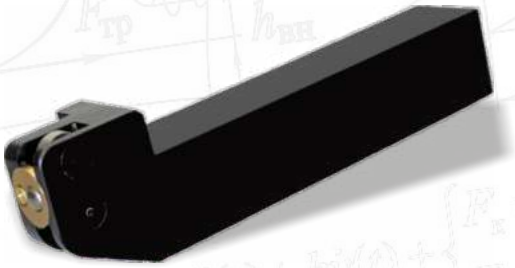
However, a larger number of working strokes is unacceptable, as it may lead to overbuckling of the surface due to a sharp increase in the multiplicity of force application.

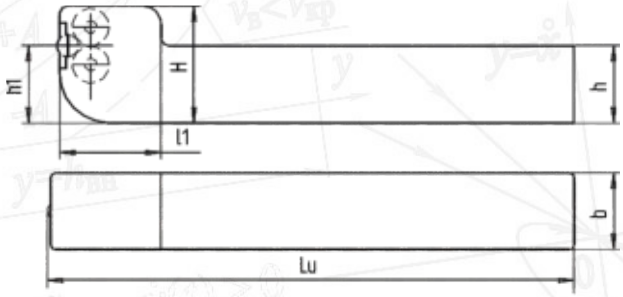


Ball burnishing tools

STR-1

EXTERNAL BALL BURNISHING TOOL





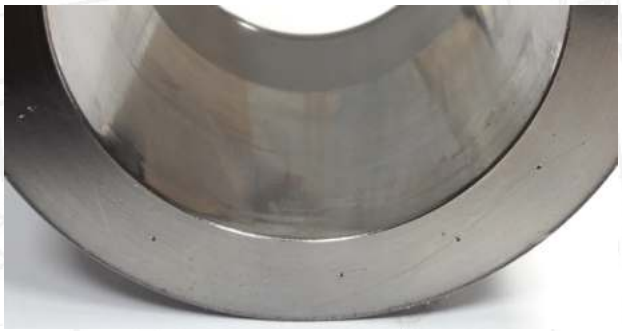
model \ size, mm	Lu	h	b	h_1	l_1	H
STR-1	171	25	25	25	122	39

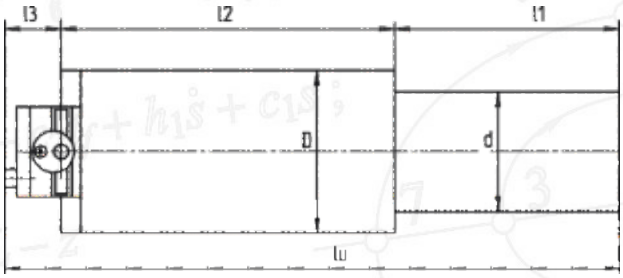
Tool for surface hardening and roller burnishing of cylindrical parts.

- shank size 25x25
- hardness of workpiece up to 40 HRC
- workpiece surface improvement
- surface hardening
- increased corrosion resistance
- increase in life time of the part
- Surface layer stress relief
- surface layer
- roughening to 0,1 um
- single set-up machining
- no material removal
- Roller burnishing does not change part's size

STR-2

INTERNAL BALL BURNISHING TOOL





model \ size, mm	Lu	D	d	l_1	l_2	l_3
STR-11	205	54	40	75	111	19

Ball burnishing tool STR-2 is designed for rolling over the holes of parts made of titanium alloys and other ductile hard-to-machine materials with hardness not exceeding 40HRC.

Adjustment of rolling force is performed by displacement of the tool (tension) relative to the surface by 0,1...0,3 mm depending on hardness of the part, initial and required roughness.

Examples of typical machined parts: hydraulic cylinder sleeves, bushings. It is used on universal machines and machines with CNC.

Single roller burnishing tools

STR3-01

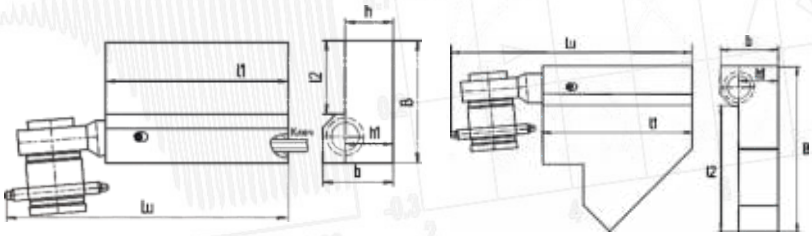
SINGLE ROLLER BURNISHING TOOL FOR EXTERNAL SURFACES

STR3-02

SINGLE ROLLER BURNISHING TOOL FOR EXTERNAL SURFACES, RADII AND ANGLE SURFACES

STR-4

UNIVERSAL SINGLE ROLLER BURNISHING TOOL FOR EXTERNAL SURFACES



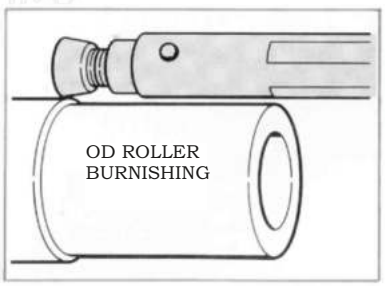
model \ size, mm	L_u	B	b	h_1	l_1	l_2
STR-3-01	150	63	37,5	25	100	38
STR-3-02	150	105	37,5	25	100	80

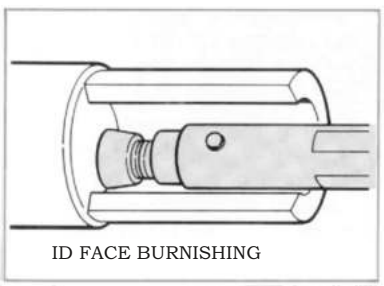
The tools for burnishing the outer surfaces with rollers of tool steel or carbide are installed in the turret of a CNC turning center or a tool stand on a universal lathe.

The workpiece surfaces are machined with roughness up to Ra 0.1 using speeds corresponding to the finishing methods.

STR-5

SINGLE-ROLLER UNIVERSAL ROLLING BURNISHING TOOL FOR MACHINING EXTERNAL SURFACES, FACES AND HOLES





Reduce machining costs

Eliminate auxiliary operations and machines

Burnish on CNC turning centers and universal lathes

Derive a surface finish of Ra 0.6 to Ra 0.1

Economical tool life with carbide rollers and roller reconditioning. Single roller burnishing tools do not have the advantage of the overlapping effect that multi-roller tools do, and for this reason, slower feeds and/or multiple passes over the part may be required to obtain the desired roughness.

Multi-roller burnishing tools

STR8

MULTI-ROLLER BURNISHING TOOL FOR BORES

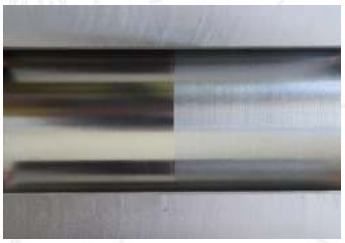
The multi-roller roller burnishing tool uses plastic deformation of metal at normal temperature to make the surface of the workpiece smooth, change the surface structure, mechanical properties, shape and size.

The tool is a form of machining that uses the principle of mechanical extrusion to produce a smooth, mirror-like metal surface.

It is a type of pressure machining that uses the cold-plastic characteristics of metal in its normal temperature state. A certain pressure is applied to the surface of the workpiece by a roller- burnishing tool, so that a plastic flow of metal occurs in the surface layer. It fills the existing hollows and reduces the surface roughness of the workpiece. Due to the plastic deformation of the metal surface, the surface microstructure is cold-hardened, the grain becomes fine-grained, forming a compact fibrous structure, and forming a residual stress layer.

Microhardness and strength are improved, wear resistance, corrosion resistance and surface stability of the workpiece are improved. Roller burnishing is a type of chipless plastic machining method. This method can be used for both surface finishing and hardening that cannot be achieved by grinding and turning.

The blind hole roller burnisher can smooth both through-hole and blind holes. Hole diameters of 6-200mm are the standard range of tools. Larger tool diameters can be manufactured to order.



Model	Adjusting component, model diameter and adjusting range		Effective working length/L				Shank/H			
ΦD	ΦG	Through/ blind bore	A	B	C	D	Round shank	H	Taper	H
Φ4.5-Φ5 no blind bore	HA0 30	-0.05/+0.15 no blind bore	50	80	–	–	Φ12*40 Φ16*40	78	MT2	68
Φ6-Φ8		-0.05/+0.25 -0.05/+0.25			100	–				
Φ9-Φ11		-0.05/+0.4 -0.05/+0.4				130				
Φ12-Φ16	HA1 35	-0.1/+0.5 -0.05/+0.5								
Φ17-Φ19			60	90	110	140				
Φ20-Φ25	HA2 39	-0.1/+0.5	70	100	120	150		88		78
Φ26-Φ39			80	130	180	230	Φ12*40 Φ16*40 Φ20*50		MT2 MT3 MT4	
Φ40-Φ45		0/+0.5	150	200	250	300				
Φ46-Φ68	HA3/45		160	210	260	310		100		88
Φ70-Φ200	HA2 39	-0.1/+0.5 0/+0.5					–	–	MT3/4/5	95

Roller burnishing machines for shafts and pins

WAM-1

ROLLER BURNISHING MACHINE

The machines of the WAM series are used for roller-burnishing of stepped shaft and regular shaft types.

In addition to low roughness, the machine provides surface strength and slight part calibration.

Reduced machining time through high productivity and high speed.

With these advantages, the machine is ideal for serial production.

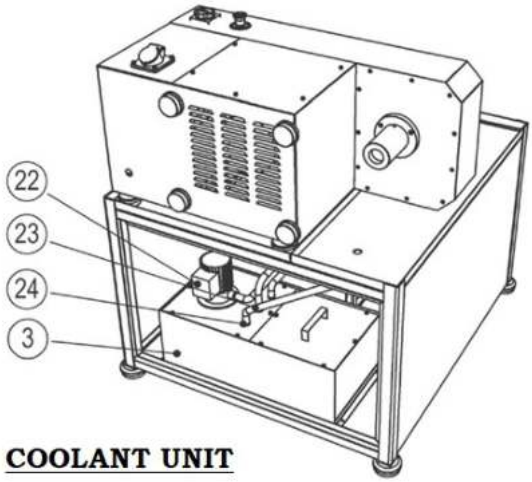
Our WAM-1 type roller burnishing machines are the ideal choice for the machining of all kinds of workpieces in medium batch to high batch production, which have high surface quality requirements.

Possible applications: plunger rods, shafts, pins, keys, and all kinds of workpieces and finished parts.

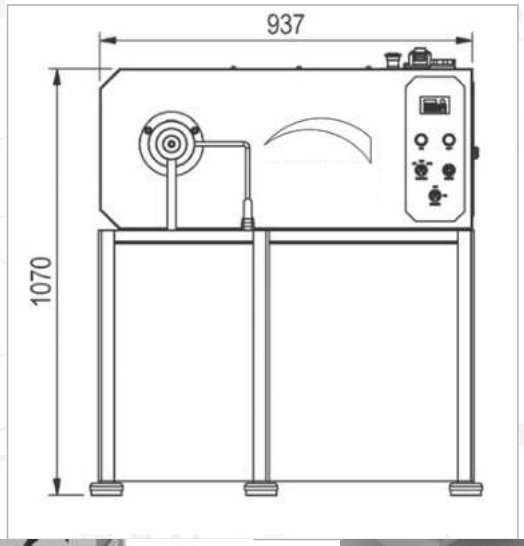
The machine not only provides an excellent external surface finish. It also has high machining speed, increased accuracy. Centerless.

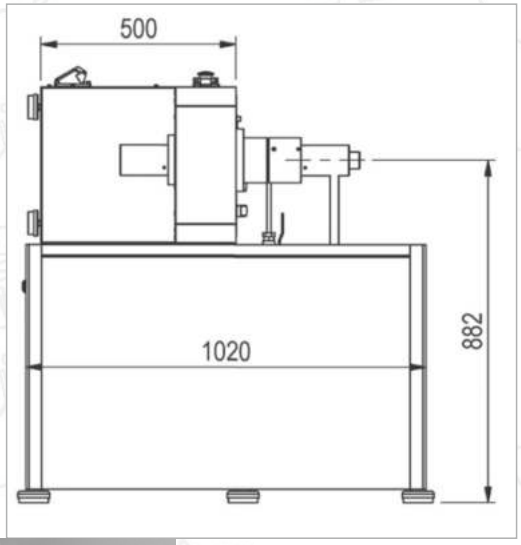
You can achieve surface roughness up to RA = 0.02 µm reliably and quickly.

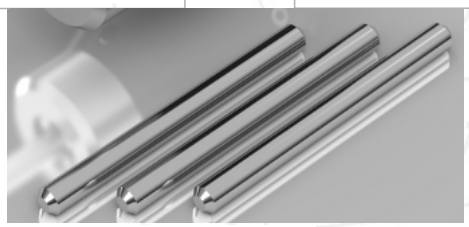
Our roller burnishing machines can machine all types of metals with yield strengths up to 1400 N/mm2 and a maximum hardness of 40 HRC.



COOLANT UNIT



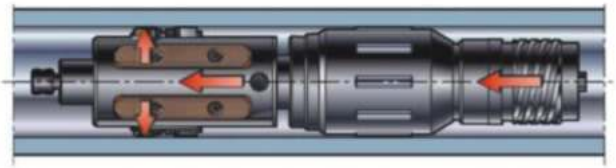




Tools for combined skiviing and burnishing of bores

STGA

SKIVIING AND ROLLER BURNISHING of BORES



Forward:

High feed skiving, preparation for hole burnishing.

Return:

Burnishing treatment is carried out when the scraping blade retracts to maintain high quality hole surface.

Finishing skiviing and roller-burnishing of cold-drawn, hot-rolled and bored tubes.

Two-stage combined skiviing and rolling with a sliding head using the STGA-T tool. These tools are used for internal finishing of cylinders and tubes.

The tool rolls out irregularities, such as waviness, that occur in the production of hydraulic cylinders. The tool also provides a perfect surface roughness during the roller-rolling process.

The STGA-T combination processes diameters from Ø 40 to Ø 250 mm in lengths up to 12 meters. For larger diameters the tool is developed on request.

Replacing plates is quick and easy. The STGA-T is equipped with three Viper inserts and three boring blade inserts.

The cutting capacity of the STGA-T tool is up to 3 mm in diameter. Chips are removed during reaming.

The boring section of the head removes the remaining material to the desired diameter and optimizes the surface for rolling.

Rollers placed in the housing around the circumference of the tool are introduced into the inner wall of the cylinder smoothing the surface of the cylindrical tube.

The forming process increases the surface hardness and increases the wear and fatigue resistance of the rolled tube.

The environmentally friendly treatment in a single installation reduces costs.

Environmentally friendly processing in a single installation reduces costs. The switching cylinder is integrated in the tool.

Boring plates and roller head: The rollers are placed in the housing around the circumference of the tool and embed themselves in the inner wall of the cylinder, rolling out the surface of the cylindrical tube.

The rolling process increases the surface hardness and increases the wear and fatigue resistance of the surface in relation to the dynamic loading.

Advantages

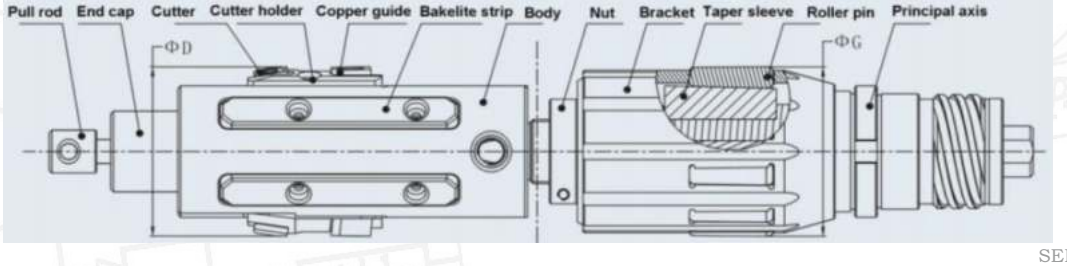
-Up to 90% shorter machining times compared to honing

-High dimensional and geometric accuracy

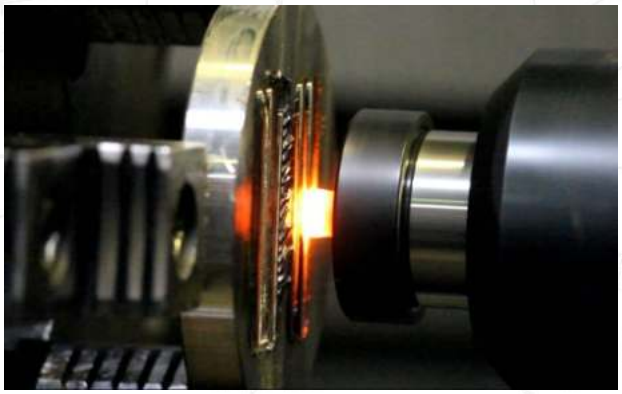
-Large cutting depths

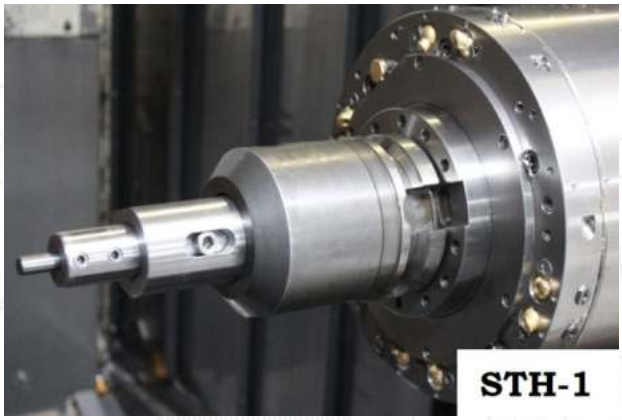
-Easy handling

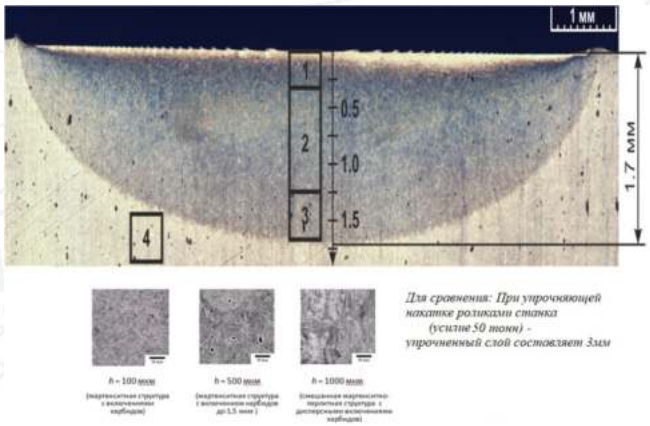
-Rapid replacement of spare parts from stock



Tools for friction stir processing (FSP)







Friction Stir Processing or friction surface hardening is a promising thermomechanical method for hardening the surface layer of metals by intense localized plastic deformation.

To achieve optimum hardening results it is necessary to select process parameters such as tool rotation speed, feed rate, tool design, axial force and kinematic diagram of tool movement. The hardened surface layer averages 1.7 mm.

Frictional Finishing by Rotating Tool (FSP), the surface layer of metals is based on the control of intense localized plastic deformation and high-speed thermal influence.

FSP is realized by hardening: copper, titanium and magnesium alloys, carbon steels, metal composites and other materials. Properties of surface layer formed after FSP depend on tool design and material.

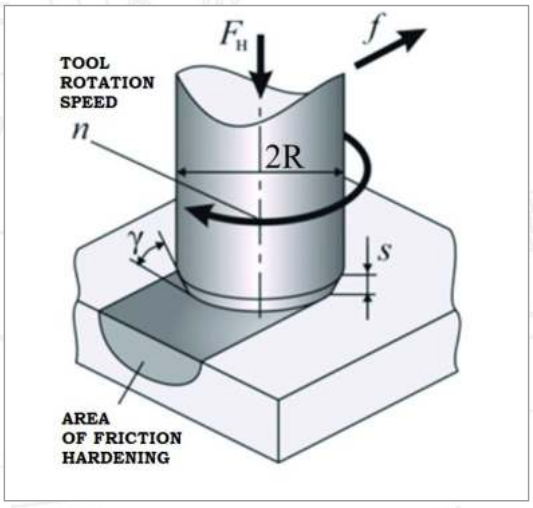
The hardening of the surface layer is achieved by forming the martensitic structure.

Friction Stir Processing is a promising thermomechanical method of hardening the surface layer of metals by intensive localized plastic deformation.

To achieve optimum hardening results, it is necessary to select process parameters, such as tool speed, feed rate, tool design, axial force and kinematic scheme of the tool movement. The average hardened surface layer is up to 2 mm.

Surface microhardness variation:

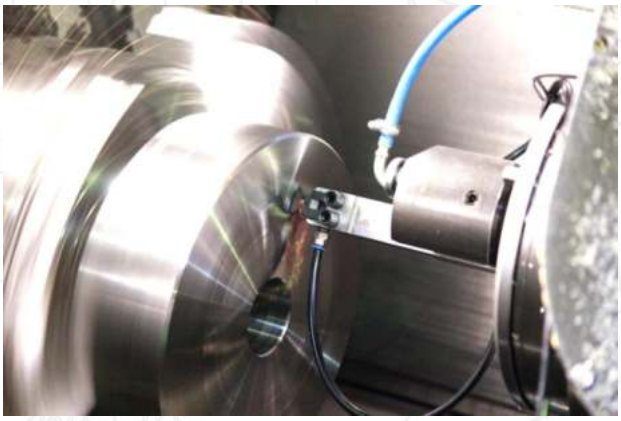
Initial 250HV - hardened 1020HV.

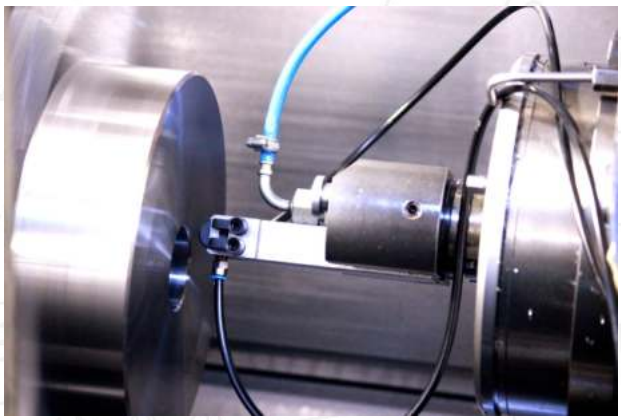


Tools for hard turning with heat sink for built-up surfaces

ST-22

TOOL FOR HARD TURNING





High intensity of heat removal is achieved by reducing the temperature of the coolant in a closed loop, provided by a heat exchanger with an assembly of four Peltier TEMs.

The cooling capacity of the TEM assembly was 400 W and ensured that the coolant temperature was maintained at 9 °C when the turning speed was increased to 300 m/min.

Application of the cooling system provides reduction of the maximum temperature in the cutting zone by 12% and the minimum temperature by 32%.

Studies have shown that the use of a closed cooling system contributes to improving the purity of the machined surface and increasing the durability of the replaceable insert.

To ensure high quality of machining and tool life while increasing the cutting speed, it is necessary to increase the proportion of heat that is removed from the cutting zone into the tool. Since external coolant cannot be used in hard turning and part cooling is ineffective, the only and promising direction is internal heat removal from the insert.

One of the main advantages of hard turning when machining parts, in comparison to grinding, is the high degree of flexibility and the ability to machine parts parts with complex geometries in a single setup.

This advantage is especially important when machining parts with a large number of short and irregularly shaped surfaces, and when machining internal and external surfaces. outer and inner surfaces. Particularly when it comes to boring Hole turning and the machining of planes and tapered surfaces.

The cost-effectiveness of the hard turning process is determined on the basis of calculation data, which also takes time into account.

The machining time for hard turning is always lower, than for grinding.

Hard turning is a viable alternative to grinding.

When boring holes, the intensity of machining with hard turning is considerably higher.

Machining of disc workpieces results in a substantial reduction of machining time.

The process satisfies the requirements on accuracy and surface finish quality.

Tools for deburring

Integrated cutting edges remove burr from the front of the hole as the tool enters the hole.

The slotted design allows the tool to "collapse" under load as the tool passes through the workpiece. The finished and polished top surface of the cutting edges will not damage the inside surface of the hole. The back of the hole is deburred on the reverse stroke.

Quick and easy adjustment.

The amount of edge breakage will vary depending on the hardness of the workpiece material.

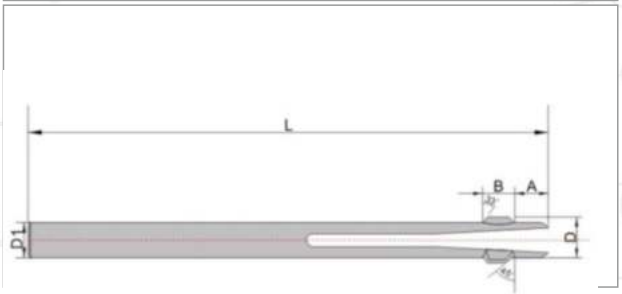
Loosen the screw on the sliding tension adjustment mechanism and move it up, or along the length of the slot for more or less material removal.

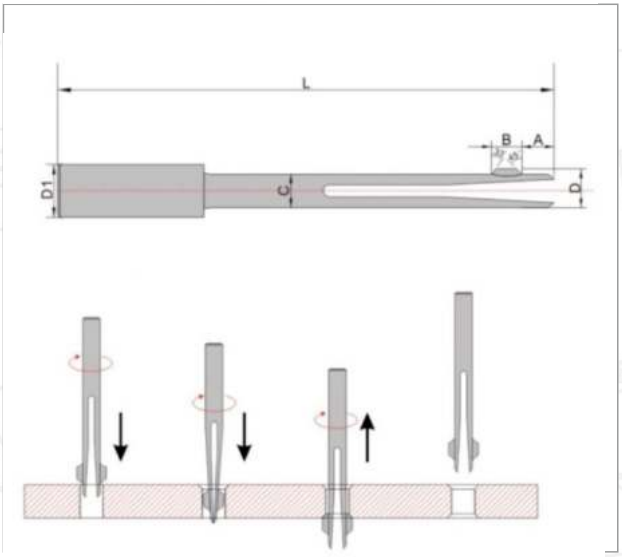
The speed of rotation and feed is about the same as that of a conventional HSS drill.

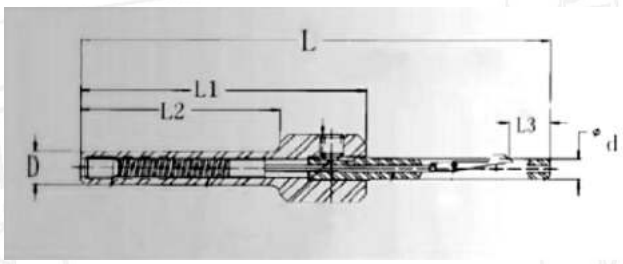
Tool maintenance and edge sharpening.

The tool should be checked periodically for grit and foreign matter, and cleaned if necessary.

Cutting edges may be resharpened up to four times to extend tool life.







Replaceable indentors and rollers

Peplaceable inserts

Replaceable indenters with natural diamond radius R2, R4, R6

Suitable for machining:

1. Structural and alloy steels (initial Ra < 0.8, required Ra < 0.1, hardness HB < 200 .... HRC> 62)

2. Stainless steels (initial Ra <0.6, required Ra<0.2)

Aluminium and non-ferrous alloys (baseline Ra <0.6, requirement Ra<0.1, HRC 25 ... 140)

4. Hardened steels (baseline Ra <0.4, requirement Ra<0.2, hardness > HRC 62)

Exchangeable indenter with synthetic diamond.

Made from CBN, PCD with radius R2, R4, R6.

Applicable for machining:

1. Constructed and alloyed steels (initial Ra<0.4....0.8 required Ra<0.1...0.2; hardness HB 200...HRC > 62)

2. Stainless steels (initial Ra<0.6; required Ra<0.2). 3.

3. cast irons (initial Ra<0.4 ... 0.6 required Ra<0.25; hardness HRC 25-140) 4.

Aluminium and non-ferrous alloys (initial Ra<0.8; required Ra<0.2; hardness HB 100-450).

5. Hardened steels (initial Ra<0.4 required Ra<0.2; hardness HB> 62).

Replaceable rollers

STR3-01-R3

STR3-01-R1.5

Replaceable roller for single roller knurling tool STR3-01 , STR3-02

The radius of the standard roller is P3 mm. Radius of narrow roller -P1,5 mm.
It is also possible (and recommended) to produce the roller in accordance with your production task
Material tool steel for cold deformation. Hardness 61...64 HRC.

Rolling-in is most expedient to make in one working stroke,
Sometimes the second and the third stroke are used, which can improve
state of the surface. However, a greater number of working strokes is inadmissible,
As it may lead to surface oversplitting owing to sharp increase of the multiplicity of force application.
multiplicity of force.

The tool for knurling polishing (running-in) of outer surfaces
The tool for roll-polishing the outer surfaces with hard metal rolls is installed in the turret of a NC turning center or a tool post.
CNC turret or a tool stand on a universal lathe.
The workpiece surfaces are machined to an accuracy of Ra 0.1 using
speeds appropriate for finish machining methods.

Industries of tooling application

Oil and Gas valve engineering

Hydroenergetics

Shipbuilding

Aircraft engineering

Machine tool engineering

Atomic and power engineering

Hydraulics and pneumatics

Defence industry

Mining equipment

General Machinery

Implants, surgery and traumatology

Automotive industry

Typical parts for diamond burnishing

Wheel hub

Thrust bearing

Valve cap

Ball pivot

Hydraulic-cylinder rod

Piston pin

Camshaft

Shank taper

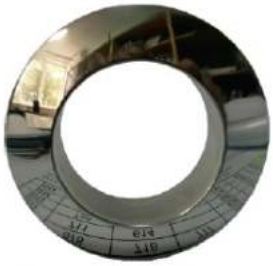
brake disc plate

Valve spindle

Stem

Inlet valve

Heel of submursible pump



Lense ring

Piston

Hydraulic cylinder barrel

Cylinder Block

Injector spray nozzle

Gland bushing

Pin bushing

Trunnion cross

Our clients


Schlumberger
Благовещенский арматурный завод
ГИДРОСИСТЕМЫ
РАЗМЕР
ММЗ
ПРОИЗВОДСТВЕННОЕ ОБЪЕДИНЕНИЕ ТУЛАМАШЗАВОД
группа компаний СИБЭНЕРГОРЕСУРС
РЕДУКТОР
СИЛОВЫЕ МАШИНЫ
SAMSON
БИРС АРМАТУРА
СибТехОйл
АРМАТУРНЫЙ ЗАВОД
ОКТЯБРЬСКИЙ ПАКЕР
ООО "СТАНКОТЕХНИКА"
НКМЗ ГРУПП
ПромАвтоматика
BELARUS
MINSK TRACTOR WORKS
Кубаньжелдормаш
СПЛАВ
Мозырский машиностроительный завод
СПЕЦИНДУСТРИЯ
VOLAT
МИНСКИЙ ЗАВОД КОЛЕСНЫХ ТЯГАЧЕЙ
ТОМЛЕСДРЕВ
атомэнергомаш
ЦКБМ
ГидроТехСнаб
IRS
BRASSCO
НАМС
ПРЕДПРИЯТИЕ «СЕНСОР»
HYDRO FORCE
ОЗНА
НПО «ЭЛЕКТРОМАШ»
NORDWEG
ЗАО "НЕВСКИЙ ЗАВОД"
ОВЕРХОЛ-ПРО
www.overhaul-pro.ru
КУБАНЬНЕФТЕМАШ
УВЗ
Уральский Завод Транспортного Машиностроения
СТИ
СДМ
СВС
МТК
УФАГИДРОМАШ
НПО "УРАЛЬСКИЙ МЕТАЛЛ"
Саратовский арматурный завод
Радиозавод имени А.С.Попова
НЕФТЕМАШ СЕРВИС
АКРОН СИСТЕМ
БЕЛОРУСЬЮГСЕРВИС
ТДМ группа компаний
CAMOZZI
ЧЕЛЯБИНСКИЙ КУЗНЕЧНО-ПРЕССОВЫЙ ЗАВОД
УЗМТМ
УРАЛЬСКИЙ ЗАВОД МЕТАЛЛООБРАБОТКИ И ТЯЖЕЛОГО МАШИНОСТРОЕНИЯ
ВНИИОФИ
ALPHA ENGINEERING
Завод "РМ"
ЗАО фирма Союз-01
ПТПА ПЕНЗТЯЖПРОМАРМАТУРА
РЕМСТАНКОМАШ
ИЗМЕРОН
ТАТ Инженер
Северсталь
ООО "МетаКрафт"
СибТЕХЦЕНТР

Checklist for ordering SENSOR-TOOL diamond burnishing and roller burnishing tools for surface superfinishing

1. Company name:

2. Date:

3. Processing material :

   3.1 _____ grade

   3.2 _____ Hardness

4. Drawing of the part with an indication of surfaces to be burnished (attach to the questionnaire in PDF or JPEG)

   4.1 Initial roughness before burnishing

   4.2 Required roughness after burnishing

5. Basic parameters of the machine/ machining center

   5.1 Machine model

   5.2 Availability of a coolant supply system ☐ yes ☐ no

   5.3 Shank type ☐ square ☐ round

   5.4 Shank size

   5.5 Maximum tool extension from the toolholder:

   5.6 Availability of rear centers and lunettes: ☐ yes ☐ no

6. Additional Information from customer :

7. Contacts of technologists : first and last name phone and email

8. Comments from the manager of Sensor-TOOL

Manager of SENSOR-TOOL :

Simon Kuznetsov +7 906 884 60 97 e-mail: **310182@inbox.ru**

OUR TEAM

SENSOR TOOL

Курганский
Территориально-
Отраслевой Кластер
НОВЫЕ ТЕХНОЛОГИИ
АРМАТУРОСТРОЕНИЯ

Russia, 640027, Kurgan city, Omskaya str, 78A
www.sensor-tool.ru
www.diamond-burnishing-tools.com
+7 906 884 60 97
e-mail: 310182@kst45.ru