

STS Mc¹¹ - the next generation of Coperion's STS twin screw extruders. Featuring a specific torque of 11.3 Nm/cm³.



>> STS Mc¹¹ - advancing into a new dimension of processing technology. With its specific torque of 11.3 Nm/cm³, the STS Mc¹¹ boasts a considerable increase in throughput with improved product quality.

With its specific torque of 11.3 Nm/cm³ the STS Mc¹¹ sets new standards: it features up to 27% higher throughput rates than the preceding model, while the higher degree of screw fill results in a decrease of melt temperature, thus improving compound quality. It incorporates the full process and quality know-how of Coperion. The STS Mc¹¹ series is exclusively equipped with European, Coperion branded gearboxes. Maximum screw speed has been increased from 800 to 900 min⁻¹. To improve cleaning and facilitate quick changovers for masterbatch applications, the STS also features hoppers with inserts and a redesigned die head. The screw shaft coupling is similar to the one long proven in the ZSK Mc¹⁸ series. The optimized base frame withstands torsion under maximum stress.

The STS Mc¹¹ series covers most standard applications in process technology. It offers high productivity at an attractive price-performance ratio. Production of the STS Mc¹¹ is in Nanjing, China, in compliance with CE directives. The result: A high-performance compounding system with low investment costs which ensures a fast return on investment. The modular design of the process section allows maximum flexibility in production at process lengths of 24 to 68 D.



AREAS OF APPLICATION OF THE STS Mc¹¹ COMPOUNDER

Filling and reinforcing of engineering plastics

Alloying and filling of polyolefins/TPE

Coloring of polyolefins and engineering plastics

Production of color masterbatch, flame retardant masterbatch, filler masterbatch and additive masterbatch

Recycling of regrind plastics, etc.

Cable compounds, incl. PVC, HFFR, XLPE

Bioplastics

Battery materials

Other applications

MODULAR DESIGN

The process section of the STS Mc¹¹ is designed as a modular system. It consists of several barrels in which the co-rotating screws operate. The advantage of this modular principle is maximum flexibility in compounding and extrusion processes. Our process engineers configure the barrels and screw elements individually to meet your application's specific requirements. Different process zones are created as required for conveying, plasticizing, mixing and shearing, homogenizing, devolatilizing and pressure increase in order to achieve highest product quality and maximum throughput rates.

The temperature of every barrel can be controlled separately. Heating is usually achieved by means of heater shells, the cooling is achieved by water. Standard barrels and screw elements are made of nitrided steel. Special high-alloy wear-protected steels are used in the enhanced wear and corrosion protected version.

SELF-CLEANING SCREW PROFILE

The closely intermeshing twin screws of the STS Mc^{11} series eliminate stagnant zones over the whole length of the process section thanks to their tight, self-wiping profile. The result is a consistently high degree of process reliability and optimal selfcleaning throughout the process section.



>> The STS Mc¹¹ compounder dominates in its class: Best price-performance ratio, high quality components, easy installation and operation, European safety standards and much more.

THE ADVANTAGES OF THE STS Mc11 TWIN SCREW COMPOUNDER

- >Proven Coperion manufacturing standards
- >CE certificate
- >Optimized base frame to withstand torsion under maximum stress
- >Screw speeds of up to 900 min⁻¹ depending on the machine configuration and application
- >Two operation and maintenance friendly machine control concepts - BasicMaster (relay control) and TouchMaster (PLC control)
- > European, Coperion branded, high-performance gearboxes with high-tech safety clutch for safe transmission of high torque to the screw elements via involute splined shafts

- >Die head with improved heating system and optimized flow geometry
- >4 D individual barrel with precision single zone tempering
- >High performance brass heater shells and water flash cooling with flexible connection to water manifold for optimal processing conditions in every heating zone
- >Self-wiping, co-rotating screw shafts for fast, easy changes in product and color
- >A variety of materials available for the process section: nitrided steel for the basic version, special high-alloy wear-protected steels for demanding processes with a high stress level

Technical data

| STS Mc ¹¹ | Max. specific torque Md/a³ [Nm/cm³] | Max. torque per shaft [Nm] | Max. screw speed [min ⁻¹] | Max. motor power [kW Hp] | Max. throughput [kg/h lbs/h] |
|----------------------|---|-------------------------------|--|-------------------------------|-----------------------------------|
| 25 | 11.3 | 106 | 1.200 | 30 40 | 110 243 |
| 35 | 11.3 | 305 | 900 | 60 81 | 260 573 |
| 50 | 11.3 | 835 | 900 | 165 221 | 800 1,764 |
| 65 | 11.3 | 1,590 | 900 | 315 422 | 1,400 3,086 |
| 75 | 11.3 | 2,440 | 900 | 483 648 | 2,200 4,850 |
| 96 | 11.3 | 5,350 | 600 | 706 947 | 4,200 9,259 |
| 125 | 11.3 | 11,600 | 600 | 1,530 2,051 | 8,000 19,030 |

Wear and corrosion resistant screw elements

| | Material code | Material | Design | Area of application | |
|----------------|---------------|-----------------------|--------------------|---------------------|-----------|
| | | | | Wear | Corrosion |
| SCREW ELEMENTS | CE 00 | Nitrided steel | Surface hardened | • | • |
| | CE 50 | High-speed tool steel | Through hardened | ••• | • |
| | CE 150 | PM composite material | Composite material | ••••• | • |
| | CE 250 | PM material | Composite material | •••• | •••• |
| SCREW BARRELS | CB 00 | Nitrided steel | Surface hardened | • | • |
| | CB 50 | Bimetallic liner | Two-piece bushings | ••• | • |
| | CB 71 | Chromium steel | Oval liner | ••(•) | •• |
| | CB 150 | Cast chromium steel | Oval liner | •••• | •• |
| | CB 250 | Ni-based PM material | Oval liner | •••• | ••••• |

>>Laboratory extruder STS 25 Mc¹¹. High performances even for smallest batch sizes.



>Laboratory extruder STS 25 Mc¹¹

The laboratory extruder STS 25 Mc^{η} is based on the successful STS technology. It was developed especially for the processing of smallest batch sizes. The reliable scale-up to larger STS extruders makes it the ideal compounding system for research and development tasks.

Special Features

- >Small batches from 2 kg
- >Throughput rates of up to 110 kg/h
- >Precise scale up within STS family
- >Element flight depth of 4.55 mm enables good pellet feeding performance
- >Modular structure with exchangeable 4D barrels and all standard screw elements
- >Easy cleaning
- >Heater cartridges ensure uniform heating and energy savings
- >Small space requirement and movable wherever needed
- $>\!\mathsf{Easy}$ to operate by PLC and touch screen as option

Technical data

| D _o /D _i | 1.55 |
|--|---------------------|
| Flight depth [mm] | 4.55 |
| Barrel length [mm] | 100 |
| Centerline height [mm] | 1,100 |
| Nm/shaft [Nm] | 106 |
| Specific torque Md/a³ [Nm/cm³] | 11.3 |
| Max. output speed [min ⁻¹] | 1,200 |
| Drive power [kW] | 30 |
| Overall dimensions (L x W x H) [mm] | 2,570 x 550 x 1,455 |

>> Tailor-made solutions for a wide range of processes. With our comprehensive process know-how and long years of experience we design every single process step of the STS Mc¹¹ extrusion systems to meet your individual product requirements.

PRODUCTION OF ENGINEERING PLASTICS

Coperion's STS co-rotating twin screw extruders are widely used for the production of engineering plastics. The extruder covers process steps such as reinforcing, coloring, alloying, incorporating organic and inorganic fillers, etc. Each compounding system features smoothly interacting process steps and gentle handling of the product with maximum productivity. The quality of the end product is always the center of focus of our compounding systems: From feeding, conveying, melting, dispersing, homogenizing, devolatilizing, pressure increase to filtering and pelletizing, we design every process step to meet the exact requirements of your application. This makes the STS Mc¹¹ compounding systems the optimal solution for the production of engineering plastics.



>TYPICAL SET-UP FOR THE PRODUCTION OF ENGINEERING PLASTICS

PRODUCTION OF MASTERBATCH

Masterbatch production makes great demands on the compounding process: the pigments and additives must be mixed into the base polymer absolutely homogeneously. The STS Mc¹¹ twin screw extruders are particularly suited to masterbatch production because of their excellent mixing properties and gentle product handling at a very attractive price-performance ratio. With its high specific torque of 11.3 Nm/cm^3 the STS Mc^{11} achieves better dispersion of pigments and lower specific energy input. The series provides a variety of special features for masterbatch compounding such as hoppers with inserts that improve cleaning and facilitate quick product changes.

>TYPICAL SET-UP FOR COLOR MASTERBATCH PRODUCTION (PREMIX PROCESS)

In the premix process, all components are combined in a mixer and then conveyed via a volumetric feeder into the STS $\rm Mc^n$ extrusion system.

Advantages

- >No loss of product during start-up
- >Simple operation of all system components
- >Very good shearing behavior to distribute pigment agglomerates
- >Quick cleaning when changing colors
- >Low investment costs

Recipe ingredents

Base polymers: PE, PP, PS, EVA, PET, PA, PC, SAN, PMMA, ABS, TPE, POM, etc.

Pigments/additives

| Organic pigments | 20-40% |
|--|--------|
| Inorganic pigments | 40-60% |
| Carbon black | 15-40% |
| TiO ₂ | 50-70% |
| Synthetic SiO ₂ | 10-30% |
| Natural SiO ₂ | 30-50% |
| Low melt substances such as additives (UV, antifog, antistat, etc.) | 10-20% |



>TYPICAL SET-UP FOR MASTERBATCH PRODUCTION (SPLIT-FEED PROCESS)

In the split-feed process, the polymer is metered into the upstream portion of the STS Mc^{11} twin screw extruder. After it has been melted, the additional pigments or additives are fed via a twin screw side feeder into the extruder. Gravimetric feeders are generally used in this step.

Advantages

- >Good product quality >Low wear >High pigment or additive loading possible
- >Gentle product handling

Recipe ingredents

Base polymers: PE, PP, PS, EVA, PET, PA, PC, SAN, PMMA, ABS, TPE, POM, etc.



Pigments/additives

Organic pigments

Inorganic pigments

Low melt substances such as additives

(UV, antifog, antistat, etc.)

Carbon black

Synthetic SiO

Natural SiO,

TiO,

>TYPICAL SET-UP FOR MASTERBATCH PRODUCTION (COLOR MATCHING)

Both the premix and the split-feed process can be used to manufacture masterbatch with a single pigment type. This product is known as a monobatch, SPC or SPD. Within the colormatching process different monobatches are premixed or fed separately into the extruder. The STS Mc¹¹ extruder plasticizes and mixes them, so that the product obtained is a masterbatch with the desired color. Monobatches based on all common carrier polymers are used for this process.

40-60%

50-80%

20-50%

60-80%

20-50%

40-60%

30-60%



- 1 Preload hoppers for masterbatch
 - Gravimetric feeders
- Twin screw extruder STS Mc^{11} 3
- 4 Degassing (vacuum pump)
- 5 Die head

2

- 6 Water bath To Pelletizer



QUICK CLEANING DIE HEAD

- >Simple, quick opening by loosening a few bolts
- >User-friendly assembly due to pivoting arm >Insertion of screens possible by using
- breaker plates
- >Optimized flow geometry with minimal dead space for safe strand discharge, even with highly filled products



FEED HOPPER IN QUICK-CHANGE DESIGN

The feed hopper is simply clamped to the inlet barrel and can be quickly removed by loosening the bolts. The quick-release insert which protects the barrel wall from contamination can then be changed very easily.



STS SIDE FEEDER: WITH SWIVEL ARM

- >Swivel arm allows easy docking and optimal alignment to adjacent barrels
- >Engineered by Coperion Stuttgart, Germany, equipped with European gearbox, final
- assembly at Coperion Nanjing, China >High torque, deep cut screw channels and $D_o/D_i \sim 2$ to achieve high throughput rates >High pressure built up to 30 bar
- >High-low speed motor or frequency control motor
- >High manufacturing precision, only 2 mm clearance between side feeder screws and twin screws of STS Mc¹¹

PRODUCTION OF HIGHLY FILLED COMPOUNDS

The STS has proven itself for the production of highly filled compounds. The main area of application is the manufactur-

ing of highly filled polyolefins with different fillers like calcium carbonate, talc or TiO_2 .

| STS Mc ¹¹ | Throughput at 600 min ⁻¹ [kg/h lbs/h] | | | | | |
|----------------------|---|--|--|--|--|--|
| | LLDPE (MFR25) + 80%wt Omyafilm 707: 450-600 min ⁻¹ | LLDPE (MFR1) + 80%wt Omyafilm 707: 450-600 min-1 | | | | |
| 25 | 35 77 | 25 55 | | | | |
| 35 | 150 330 | 100 220 | | | | |
| 50 | 400 882 | 300 661 | | | | |
| 65 | 750 1,653 | 550 1,213 | | | | |
| 75 | 1,200 2,646 | 850 1,874 | | | | |
| 96 | 2,000 4,409 | 1,600 3,527 | | | | |
| 125 | 4,300 9,500 | 3,500 7,700 | | | | |



- 1 Polymer pellets
- 2 CaCO₃ powder
- Additive powder
- 4 Atmospheric vent
- CaCO₃ powder
- Vacuum degassing
 Twin screw extruder STS Mcⁿ
- B Diverter valve
- 9 Waterring pelletizer

PRODUCTION OF CABLE COMPOUNDS

Top quality PVC, cables and special compounds can only be processed economically with reliable compounding and pelletizing technology. For the Non-European market Coperion has designed a STS Mc¹¹ two-stage compounding system specifically for the production of temperature and shear sensitive plastics. This two-stage processing system with the STS Mc¹¹ twin screw extruder and a single discharge screw ensures both high product quality and maximum economic efficiency in the processing of PVC, cables and special compounds. Thanks to Coperion's high standard manufacturing know-how this two-stage compounding system ensures consistency and

repeatability of product quality, high throughput rates, more rentability and flexibility.

PRINCIPLE OF THE STS Mc¹¹ TWO-STAGE COMPOUNDER

- 1 Feeding
- 2 Plasticizing, mixing and homogenizing in the twin screw process section
- **3** Open, pressureless product transfer into the single screw with the possibility of degassing
- 4 Gentle discharge through single screw
- Air-cooling pelletizing or eccentric pelletizing optionally available with other pelletizing methods







>KNIFE AND DIE PLATE OF STS Mc¹¹ TWO-STAGE COMPOUNDER

THE ADVANTAGES OF THE STS Mc¹¹ TWO-STAGE

- >Excellent feeding properties, even for difficult to feed powders and hot premixes
- >Gentle product handling, especially in the pressure build-up zone before the die plate
- >Short, defined residence time
- >Uniform product flow through the die plate
- >Precise temperature control
- >Low specific energy input
- >Effective degassing
- >Easily adaptable to new requirements
- >Fast, convenient cleaning
- >Wide range of application







>TRANSFER FROM TWIN SCREW TO SINGLE SCREW PROCESS SECTION



>DIE PLATE OF STS Mc¹¹ TWO-STAGE COMPOUNDER

>TYPICAL SET-UP FOR PVC PRODUCTION

- 1 PVC powder
- Fillers 2
- 3 Additives
- 4 5 Hot/cool mixer Dryblend
- 6 Feeder
- 7 Twin screw extruder STS Mc¹¹
- 8 Degassing
- 9 Single screw 10 Pelletizing system



>TYPICAL SET-UP FOR XLPE CABLE COMPOUND PRODUCTION

- 1 ΡE
- ATH/MDH 2
- Peroxide 3
- 4 Twin screw extruder STS Mc¹¹
- 5 6 7 Degassing Single screw
- Pelletizing system



>TYPICAL SET-UP FOR HFFR CABLE COMPOUND PRODUCTION

- EVA/PE 1
- 2 Additives
- 3 20% ATH/MDH
- 40% ATH/MDH 4
- 5 Silane
- 6 Twin screw side feeder
- 7 Vacuum pump
- Twin screw extruder STS Mc¹¹ 8
- Single screw 9 10 Pelletizer
- 11 Pellet cooler



TYPICAL AREAS OF APPLICATION OF THE STS MC^{11} TWO-STAGE COMPOUNDER

| Soft PVC >PVC cables: insulation material, sheathing and bedding compounds >Materials for shoes and shoe soles (also PVC-P with foaming agent) >Materials for the extrusion of profiles and hoses (including medical applications) >Injection molding compounds >Films and sheets for flooring | Rigid PVC Materials for the extrusion of profiles for interior and exterior uses Injection molding grades for fittings, etc. Blow molding grades for bottles, containers, etc. Alloys and blends Films (calender feeding) |
|--|--|
| Crosslinkable polyethylene > PEX pipe material > Silane crosslinking cable compounds for low voltage applications > Peroxide crosslinking cable compounds for middle and low voltage applications | <pre>Special compounds >Halogen-free, self-extinguishing formulations for cables (HFFR) >Elastomer-based compounds for low, medium and high voltage cables >Crosslinkable PE (incorporating peroxide)</pre> |

Technical data of the STS Mc¹¹ two-stage

| | Max. motor power [kW Hp] | | Max. screw speed [min ⁻¹] | | Max. throughput [kg/h lbs/h] | | | | |
|--------|-------------------------------|-----------------|--|-----------------|-----------------------------------|------------------------------|----------------------------|--|--|
| | Twin screw | Single screw | Twin screw | Single screw | HFFR | PVC-P | PVC-U | XLPE (DCP) low/medium voltage cables | XLPE (Silane) low voltage cables |
| 35/120 | 40 54 | 22 30 | 600 | 75 | 35-85 77-187 | 105-200 231-441 | 50-105 110-231 | 35-100 77-220 | 35-85 77-187 |
| 50/150 | 110 148 | 37 50 | 600 | 75 | 100-260 220-573 | 310-600 683-1,323 | 150-320 331-705 | 100-300 220-661 | 100-250 220-551 |
| 65/180 | 210 282 | 55 74 | 600 | 75 | 200-480 441-1,058 | 590-1,000 1,301-2,205 | 300-700 661-1,543 | 220-600 485-1,323 | 220-500 485-1,102 |
| 75/200 | 322 432 | 75 101 | 600 | 75 | 300-700 661-1,543 | 900-1,800 1,984-3,968 | 450-1,050 992-2,315 | 300-1,000 661-2,205 | 330-700 728-1,543 |
| 96/250 | 708 949 | 110 148 | 600 | 75 | 630-1,450 1,389-3,197 | 1,850-3,460 4,079-7,628 | 950-2,200 2,094-4,850 | 700-1,700 1,543-3748 | 700-1,500 1,543-3,307 |



>> Quality is our benchmark. Significant improvements in the quality standards at Coperion in Nanjing prove our commitment.

During the development process of the STS Mc¹¹ series Coperion Nanjing, China, the production site of the STS series, has undertaken comprehensive initiatives to significantly improve its quality standards. Coperion Nanjing now uses state-of-the-art German machining centers and long-proven Coperion quality production norms have been implemented. The production process is very closely monitored, using German high-precision, high-level production and quality measuring machinery and equipment. The Quality Check Plan together with Factory Acceptance Tests (FAT) make every step of manufacturing and assembly traceable to ensure the high quality of our extruders. Coperion Nanjing manufactures all key components in-house. This includes barrels, screw elements and screw shafts as well as the assembly of control cabinets.

In-house production ensures that every single component of the STS Mc^{11} twin screw extruder is an example of top class technology – so that you can rely on maximum throughput rates and highest product quality.





BARREL MANUFACTURING WITH HELLER CNC MACHINE

The barrels of the STS Mc¹¹ are manufactured on a machining center of Gebr. Heller Maschinenfabrik, Germany, the leading CNC manufacturer in the world – to ensure high precision machinery parts.

WELDING ROBOT

Coperion Nanjing uses advanced, time-tested and reliable technology for the welding of the extruder barrel cooling channel. The fully automatic welding operation ensures stable welding quality for an energy-efficient temperature control of the barrels.

| | A |
|--|--|
| | CERTIFICATE TUVRheinland |
| | of Conformity EC Council Directive 2006/42/EC Machinery |
| | Registration No.: AM 50389608 0001 |
| | Report No.: 50087838 002 |
| Holder: | Coperion (Nanjing) Machinery Co., Ltd. No. 1296, Jlyin Avenue, Jiangning Economic & Technology Development Zone Nanjing P. R. China |
| Product: | Entructur (Twin: Screw Extrudur) |
| Identification: | Type Susignation: FTEIS-Lis (THES-Lis STARS-16) ETETS-200 STARS-155 CTENS-160 CTEO-149 CTESS-155 CTENS-168 CTESS-000 CTESS-1000perimit Secial Russer : SOSIA01(STMTS-200) |
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CE CERTIFICATE

The STS Mc¹¹ series features a CE certificate issued by TÜV (German Technical Inspection Association). The extruder conforms to European safety regulations, the regulations for the prevention of accidents, the EC Machine Directive 2006/42/EC and the Low Voltage Directive 2014/35/EU.





MANUFACTURING OF SCREW ELEMENTS WITH DMG MACHINE

For the manufacturing of screw elements Coperion Nanjing uses a machining center from DMG Gildemeister, Germany. It is a one-step production process to ensure perfectly intermeshing screw profiles.

ASSEMBLY OF CONTROL CABINETS

Coperion Nanjing assembles all control cabinets in-house – according to European standards and regulations. Main electrical components are of world-renowned brands. Relay control, PLC control as well as IPC control systems are available.

>> Measurements for quality check.





CARL ZEISS 3-DIMENSIONAL BARREL AND GEARBOX INSPECTION CENTER

The 3-dimensional inspection center by Carl Zeiss AG, Germany, checks the dimension range at micron level. A specially designed temperature sensor offers extremely reliable temperature compensation to ensure highest precision. The quality of every single barrel and gearbox is assured and closely monitored.

FARO 3-DIMENSIONAL CHECK EQUIPMENT FOR ASSEMBLY ALIGNMENT

During assembly Coperion Nanjing aligns each extruder using a portable arm measuring system. It is a 3-dimensional test instrument of Faro, Switzerland, that ensures high precision, reliable operation under high speed and high torque and minimizes abnormal wear of barrels and elements.



QUALITY-CHECK OF SCREW ELEMENTS

A special instrument checks the timing and the crest width of screw elements at highest precision.







LASER INSTRUMENT FOR ALIGNMENT OF SAFETY CLUTCH

With a non-contact measuring laser instrument, Coperion Nanjing checks the alignment of the safety clutch at micron level - to ensure reliable power transmission.

QUALITY CHECK OF RAW MATERIAL COMPOSITES

The metallic composition of raw materials is checked and recorded by an atomic emission spectrometer. A Vickers hardness tester checks the hardness of the material after heat treatment to strictly control product quality.



>> We design optimal solutions for your compounding plants using state-of-the-art technology. In addition to our simulation and scale-up expertise, we have excellent facilities for extensive testing and further process development of products under realistic production conditions: the Coperion test labs.

Coperion has the world's most extensive test labs for compounding and extrusion systems. They support the development of the optimal designs for compounding plants under realistic production conditions, while further enhancing our processing technology through internal tests. The modular design of our twin screw extruders permits them to be set up to the exact specifications of each test. Depending on the processing task, the latest Coperion developments are integrated into the test set-ups. This allows processes with throughput rates from just a few kg/h up to a medium production scale to be developed or optimized. Coperion experts transpose the test results to production scale with proven scale-up methods.

TEST LABS FOR COMPOUNDING & EXTRUSION

Test labs in Stuttgart (D), Pitman (USA) and Nanjing (CN)

A total of 30 ZSK and STS compounding systems worldwide permanently available for testing – from laboratory to large-scale extruder

Throughput rates from 1 kg/h to 2 t/h $\,$

Affiliated laboratories for real-time analyses of product quality

Over 60 specialists permanently assigned to process development and application optimization for our customers, including 30 process engineers

Simulation programs to calculate flow processes, optimize existing processes and the design of individual components

EQUIPMENT OF COPERION'S TEST LAB IN NANJING, CHINA

STS 35 Mc¹¹

STS 50 Mc¹¹

ZSK 32 Mc18

Comprehensive peripheral equipment for feeding, conveying and pelletizing



>> It feels like a safety net. That's what we mean when we say "confidence through partnership".

Service means more to us than someone stopping by to repair equipment. Our service structure offers much more than that. It consists of a global network to ensure direct contact with our customers. With a total of over 40 locations, 2,500 employees and numerous representative agencies worldwide, we are able to act quickly, providing support where needed. The Coperion Nanjing service team is comprised of more than 30 highly skilled on-site service engineers and spare parts sales persons to provide comprehensive services. Our specialists and local partners speak your language and are extremely familiar with local customs – because confidence is born when you understand your partner.

COMPREHENSIVE SERVICES

| Spare parts services |
|-------------------------|
| Barrel bore measurement |
| Vibration measurement |
| Gearbox overhaul |
| Exchange of gearboxes |
| Modernization |
| Operator training |
| Maintenance contracts |

>BARREL BORE MEASUREMENT OF A STS BARREL



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