



ROLLS

SS silvan rolls



silvan rolls

Silvan Rolls, is one of the well-established and experienced foundries of Turkey and has a production capacity of 10.000 tons per year. It's established on a closed area of 8.000 m², an open area of 10.000 m², with a total area of 18.000 m² in Kocaeli city of Turkey.

Being the first roll producer of Turkey, Silvan Rolls has acquired an extensive information and technology know how, and continues to develop this technology.

Silvan Rolls roll production capabilities offer a wide range of selection to its customers. Silvan Rolls, especially specializes in manufacture of high alloy steel and sphero ROLLS and RINGS for hot section, rail, bar and wire rod mills where long products are being rolled. We produce many different types of rolls and rings for numerous applications offering superior technical capabilities and lowest cost per hour operating parameters. Silvan Rolls, while making efforts to develop its products and services for rolling mill industry, at the same time maintains an effective communication with the roll users in the mills to get and utilize their feedback.

Qualified and competent technical staff using the most modern and updated technology has brought Silvan Rolls to an important position in steel production with their R & D programs in steel foundry technologies. High quality steel production, reliability and effective technical assistance have been justifying Silvan's well deserved reputation in domestic and international markets.

Silvan Rolls plant was taken over along with its know-how, production policy and technical & sales staff by **Vergili Group** in 2019. Production activity of Silvan Rolls has been going on continuously with 64 years of experience and excellence.

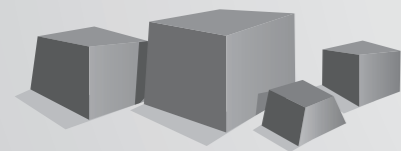


OUR QUALITY POLICY

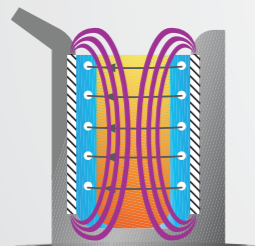
- Ensuring customer satisfaction by means of meeting the requests and expectations of our customers on time and completely.
- Importance on training and development of our employees.
- Follow-up of global technological developments and implementation of these developments within our production process.
- Developing relationships with suppliers, which are based on mutual benefits.
- Measuring and analyzing data and ensuring the continuous improvement and development of our products.
- Realizing an environmental friendly production.



PRODUCTION FLOW CHART



Raw Material



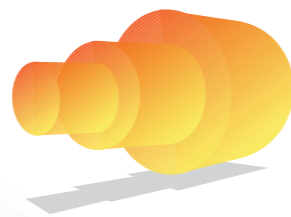
**Melting
(induction
furnace)**

Spectral analysis



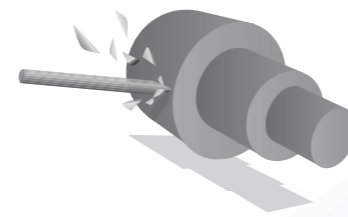
Casting

Ladle analysis



**Heat
Treatment**

Furnace charge
report



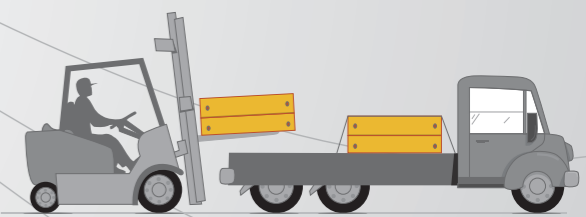
Machining

Ultrasonic testing
Hardness depth control
Metallographic inspection
Surface hardness control



**Quality
Control**

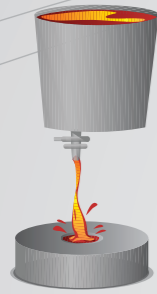
Hardness control
Ultrasonic testing
Liquid penetrant inspection
Surface roughness measurement
Reporting and certification



**Packaging and
Shipment**



CASTING



In our Gebze plant, melting operations are carried out by 2 double pot induction furnaces. 22 tons of melting in total can be done within a single operation.

Silvan Rolls has continuously been increasing its casting quality by combining years of experience with employment of new technologies. In our modern foundry, the product quality is guaranteed with the automation systems used from moulding to foundry operations.

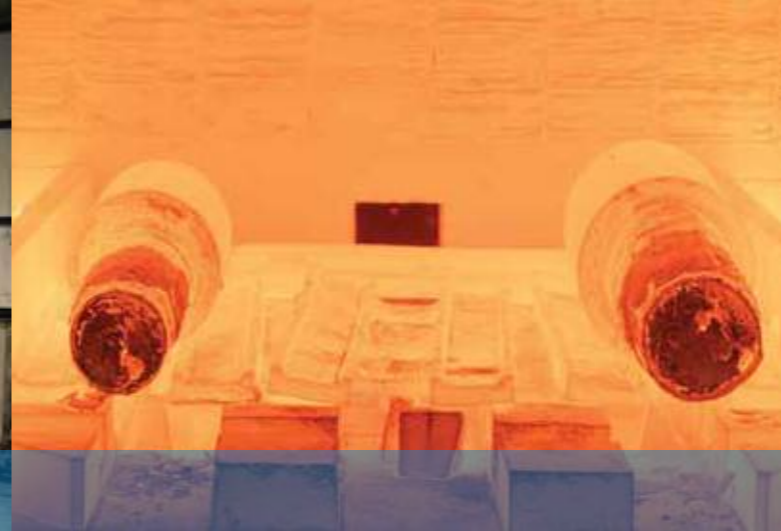
By making the three-dimensional solid modelling of the parts to be produced, the failures that may originate from casting are minimized with the involvement of foundry simulation programs.

As an environmentally conscious organization, we have special design ventilation and filtration systems in our furnaces so that dust and smoke formed during melting is eliminated.

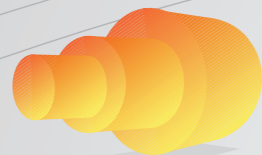


High efficiency, fully electronic furnaces regulate the power output according to the conditions of melt, and allow instant controls during melting process.

In every melting operation, controlling of temperature of the chemical analysis and charges is one of the most important factors of achieving quality castings.



HEAT TREATMENT



To obtain the required physical and mechanical properties and metallographic structures in various types of steel, heat treatment process is indispensable.

Silvan Rolls uses modern electric and natural gas furnaces, each equipped with sensitive power regulators and temperature control units. There are totally 4 furnaces in the heat treatment department. The maximum length of an item that can be handled is 6 meters.

Temperature control of the furnaces is made with PLC devices hence involvement of human factor has been minimized through

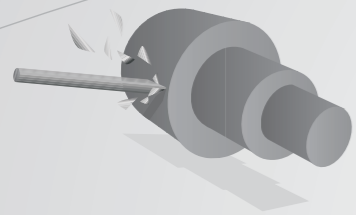


All heat treatment furnaces are connected to recording devices and the furnace time-temperature controls are monitored on line from the computer and immediate intervention can be made in case any deviation from the process occurs.

Furthermore, heat treatment programs have been defined for each roll in accordance with its quality and the process is followed closely.



MACHINING



Silvan Rolls has a wide range of machinery in its machine shop to be able to carry out the machining processes required for any type of roll. Machining capacity has been increased by three times through several investments in the last ten years.

Variety of the machines in our machine shop (Hercules CNC finishing lathes and universal heavy duty roughing lathes, Poreba CNC finishing lathe and universal heavy duty roughing lathes, Zayer TNC milling machines, bohrwerk boring/milling machines, Hercules NC grinding machines and milling machines for wobbler cutting) allow us to achieve the best performance in machining.



Our machines operated by our qualified staff and engineers meet customer requests by paying utmost attention to every detail and accuracy requirement. B

ecause of its high quality products and machining operations, Silvan Rolls has established trustworthy customer relationships both in domestic and international markets.



Required machining processes of all customer orders are scheduled by our technical staff for on time production.

As soon as an order is received, the technical drawings are reviewed prior to machining operations. Rough machining drawings and drawings for CNC CAD/CAM programs are made according to these technical drawings.

Machining starts with rough turning of cast rolls and advances with finish turning on CNC machines. Roll lengths are adjusted in universal custom lathes and then drive sides are machined on the milling machines. As the final operation, rolls are grinded on cylindrical grinding machines for their final dimensions and tolerances indicated in their drawings.

Furthermore, all steps of machining process are monitored carefully.



CNC machining programs prepared by our project engineers specialized in this area are uploaded to the CNC machine tools.



QUALITY CONTROL



High quality and reliability of Silvan Rolls castings is a result of the consistent quality control applications carried out by this department.

Quality control process in roll production starts with the selection of the proper material grade required for melting, and is consistently followed by our qualified and experienced staff at every stage of production until shipment.

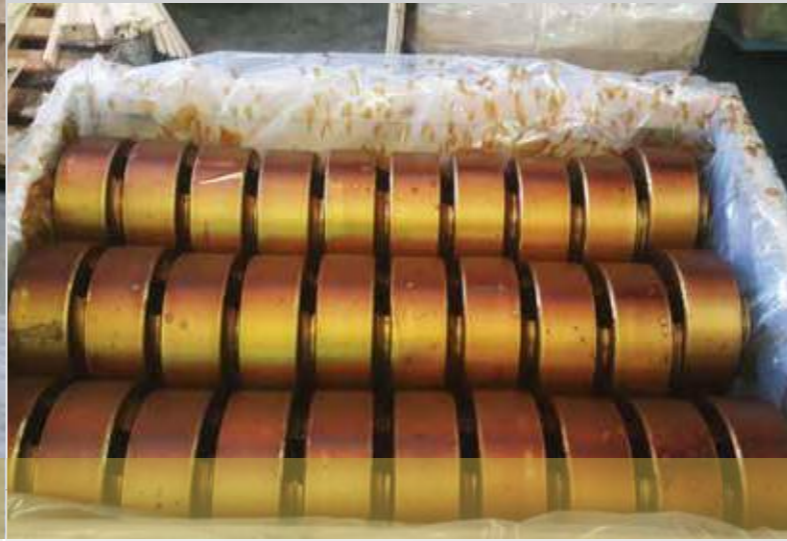
During order processing, a specific quality control number is assigned to each roll and whole production cycle of the roll can be then traced with this number. Furnace and casting temperatures of molten metal before casting are also monitored accurately.

Hardness depth measurement and metallographic inspection over the samples removed from each roll are performed with great care by our quality control engineers. In addition, surface hardness measurement and crack control tests are carried out for each roll. Internal defect detection for each roll is done with an ultrasonic testing equipment before, during and after machining.



The content of alloy materials in molten steel is analyzed by our computerized spectrometer in less than a minute and results can be monitored on line in the melting section.

Full dimensional and surface roughness controls are implemented for every finished roll and following marking and coding operations, inspection certificate for each roll is issued, which enables the traceability of the rolls through their service life cycle.



PACKAGING and SHIPMENT



Our goal is to ensure on time delivery of our products which have been manufactured with utmost care and subjected to strict quality control.

Rolls and rings past our final inspection are sent to our packaging and shipment department.

As an initial operation, quality control numbers are engraved on the rings and necks of the rolls. To prevent corrosion, rolls and rings are coated with a special grease which has high resistance to external factors. After the grease layer dries up, rolls and rings are wrapped with nylon and poly ethylene foam sheets with special insulation characteristics and finally placed in wooden cases. Following labelling, rolls and rings are ready for shipment.



For each product, the inspection certificate is also inserted in the packing and according to our delivery plan the goods are loaded carefully on to the trucks to be shipped to the customers.



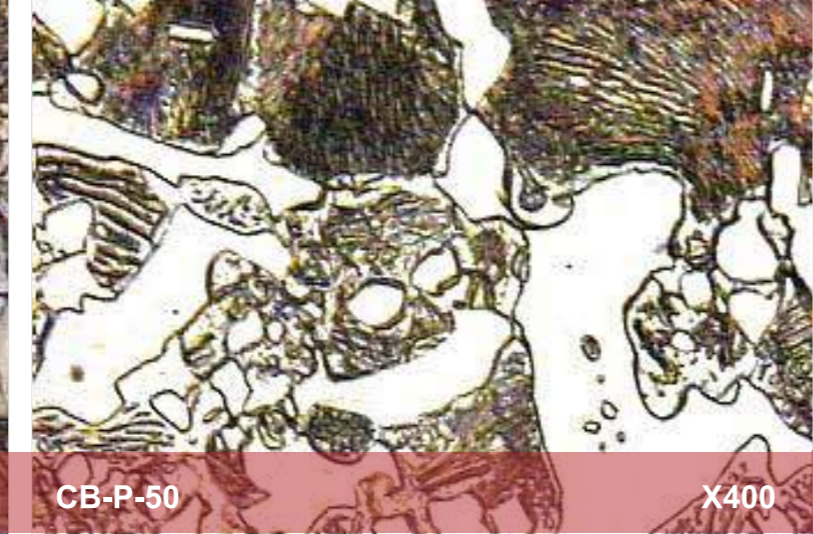
ROLL SELECTION TABLE

| | Medium Sections | | | Light Sections | | | Rounds | | |
|---------|-----------------|---------------|------------------|-----------------|---------------|------------------|-----------------|---------------|------------------|
| | Roughing Stands | Intern Stands | Finishing Stands | Roughing Stands | Intern Stands | Finishing Stands | Roughing Stands | Intern Stands | Finishing Stands |
| CB-P-42 | Green | | | Blue | | | Blue | | |
| CB-P-45 | Blue | Green | | Green | Blue | | Green | | |
| CB-P-47 | | | Green | | Green | Blue | Blue | | |
| CB-P-50 | | Blue | Green | | Green | | | Blue | |
| CB-P-52 | | | Blue | | | Green | | Green | |
| CB-P-54 | | | Blue | | Blue | Green | | | |
| CB-P-58 | | | Blue | | Blue | Green | | | |
| GC-P-50 | Green | | Blue | Blue | | | Blue | | |
| GC-P-56 | | | Green | | Blue | Green | Green | Blue | |
| GC-P-58 | | | Blue | | Blue | Green | | | |
| SD-P-48 | Green | Blue | Blue | Green | | | Blue | | |
| SD-P-55 | | Blue | Green | Green | | | Green | | |
| SD-P-58 | | | Blue | Green | Blue | | Green | | |

First Priority ■ Second Priority ■

| | Medium Sections | | | Light Sections | | | Rounds | | |
|-----------|-----------------|---------------|------------------|-----------------|---------------|------------------|-----------------|---------------|------------------|
| | Roughing Stands | Intern Stands | Finishing Stands | Roughing Stands | Intern Stands | Finishing Stands | Roughing Stands | Intern Stands | Finishing Stands |
| SD-P-61 | | | Blue | | Green | Blue | Green | Blue | |
| SD-P-64 | | | | | | Green | | Green | Blue |
| SD-P-67 | | | | | | | | Green | Blue |
| SD-PB-70 | | | | | | | | Green | Blue |
| SD-B-64 | | | | | | | | Green | Blue |
| SD-B-Cr64 | | | | | Blue | Green | | Blue | |
| SD-B-67 | | | | | | | | Green | Blue |
| SD-B-70 | | | | | | | | Green | Blue |
| SD-BM-73 | | | | | | | | Blue | Green |
| SD-BM-73S | | | | | | | | Blue | Green |
| SD-MB-77 | | | | | | | | | Green |
| SD-MB-80 | | | | | | | | | Green |

First Priority ■ Second Priority ■



CB-P-42

X400

CB-P-50

X400

STEEL BASE ADAMITE CAST ROLLS

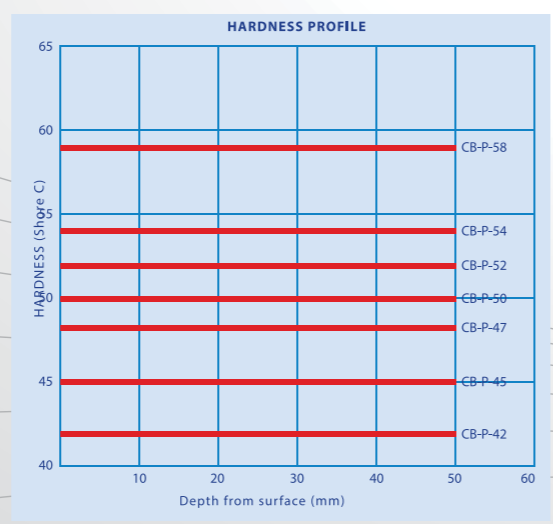
Adamite rolls are produced from alloyed (Cr-Ni-Mo) steel of pearlitic microstructure.

Rolls are subjected to heat treatment after casting to provide the best microstructure and mechanical properties for rolling conditions.



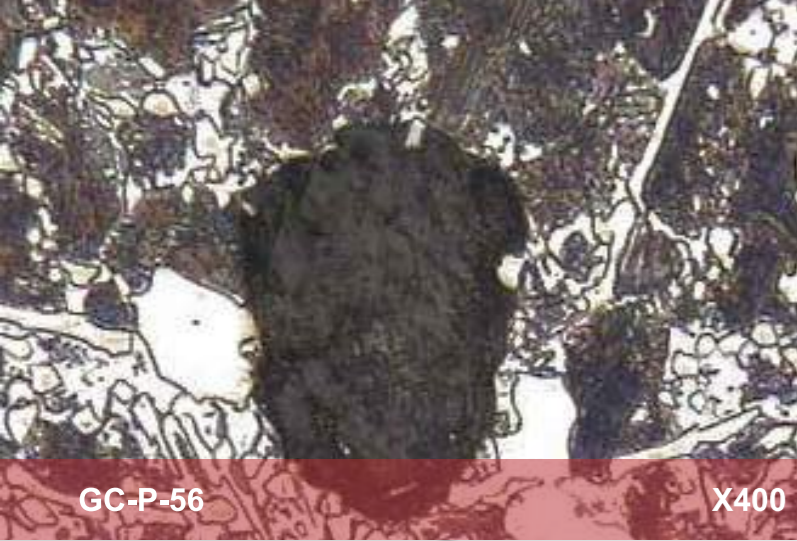
CB-P-45

X400



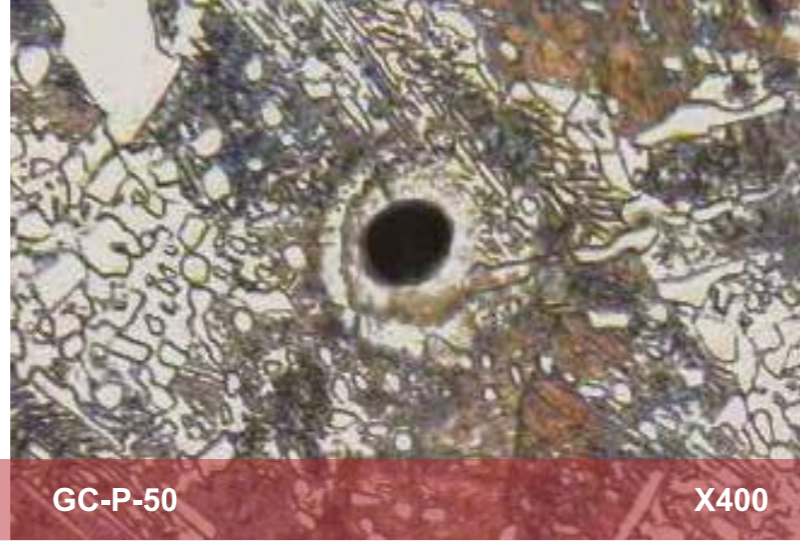
| ROLL MATERIAL | HARDNESS (SHORE C) | CHEMICAL ANALYSIS | | | | | |
|---------------|--------------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | | C % | Si % | Mn % | Cr % | Ni % | Mo % |
| CB-P-42 | 40 - 45 | 1.0 - 1.5 | 0.2 - 0.7 | 0.5 - 1.2 | 0.5 - 1.5 | 0.2 - 1.5 | 0.2 - 0.8 |
| CB-P-45 | 43 - 48 | 1.2 - 1.7 | 0.2 - 0.7 | 0.6 - 1.2 | 0.5 - 1.5 | 0.2 - 1.5 | 0.2 - 0.8 |
| CB-P-47 | 45 - 50 | 1.4 - 1.9 | 0.2 - 0.7 | 0.6 - 1.2 | 0.5 - 1.5 | 0.2 - 1.5 | 0.2 - 0.8 |
| CB-P-50 | 47 - 52 | 1.5 - 2.0 | 0.2 - 0.7 | 0.6 - 1.2 | 0.5 - 1.5 | 0.2 - 1.5 | 0.2 - 0.8 |
| CB-P-52 | 48 - 53 | 1.7 - 2.2 | 0.2 - 0.7 | 0.6 - 1.2 | 0.5 - 1.5 | 0.2 - 1.5 | 0.2 - 0.8 |
| CB-P-54 | 50 - 54 | 1.3 - 1.8 | 0.2 - 0.7 | 0.8 - 1.6 | 0.9 - 1.8 | 1.0 - 2.0 | 0.2 - 0.8 |
| CB-P-58 | 55 - 60 | 1.3 - 1.8 | 0.2 - 0.7 | 1.0 - 1.8 | 1.0 - 2.0 | 1.5 - 2.5 | 0.2 - 0.8 |

| MECHANICAL PROPERTIES | | | |
|-----------------------|-------------------------|-------------------------|--------------------|
| | Tensile Strength (N/mm) | Bending Strength (N/mm) | Microstructure |
| CB-P-42 | 600 - 700 | 900 - 1200 | Pearlite + Carbide |
| CB-P-45 | 500 - 650 | 850 - 1050 | Pearlite + Carbide |
| CB-P-47 | 500 - 650 | 800 - 1050 | Pearlite + Carbide |
| CB-P-50 | 400 - 600 | 750 - 1000 | Pearlite + Carbide |
| CB-P-52 | 400 - 600 | 700 - 950 | Pearlite + Carbide |
| CB-P-54 | 350 - 500 | 600 - 750 | Pearlite + Carbide |
| CB-P-58 | 350 - 500 | 600 - 750 | Pearlite + Carbide |



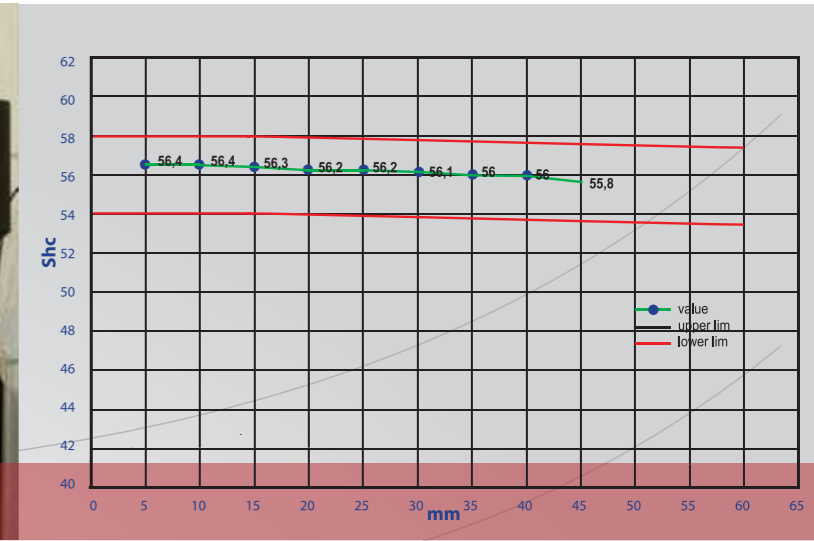
GC-P-56

X400



GC-P-50

X400



GRAPHITIC STEEL CAST ROLLS



Graphitic steel rolls include carbide and spherulite within the pearlitic matrix of their structure.

In working conditions where high reduction ratios exist, our graphitic steel quality meets the requirements of light and medium section mills because of its high resistance against breakage and wear.

Rolls of this quality are also subjected to heat treatment after casting to provide the best microstructure and mechanical properties for rolling conditions.

| ROLL MATERIAL | HARDNESS (SHORE C) | CHEMICAL ANALYSIS | | | | | |
|---------------|--------------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | | C % | Si % | Mn % | Cr % | Ni % | Mo % |
| GC-P-50 | 47 - 52 | 1.5 - 2.0 | 0.7 - 1.4 | 0.6 - 1.2 | 0.5 - 1.5 | 1.5 - 2.5 | 0.2 - 0.8 |
| GC-P-56 | 52 - 57 | 1.5 - 2.0 | 0.7 - 1.4 | 0.6 - 1.2 | 0.5 - 1.5 | 2.0 - 3.0 | 0.2 - 0.8 |
| GC-P-58 | 57 - 62 | 1.7 - 2.2 | 0.7 - 1.4 | 0.6 - 1.2 | 1.0 - 2.0 | 2.5 - 3.5 | 0.2 - 0.8 |

| MECHANICAL PROPERTIES | | | |
|-----------------------|---------------------------------------|---------------------------------------|---|
| | Tensile Strength (N/mm ²) | Bending Strength (N/mm ²) | Microstructure |
| GC-P-50 | 550 - 750 | 900 - 1250 | Carbides + spherulite in pearlitic matrix |
| GC-P-56 | 550 - 750 | 900 - 1150 | Carbides + spherulite in pearlitic matrix |
| GC-P-58 | 500 - 650 | 800 - 1000 | Carbides + spherulite in pearlitic matrix |



SD-P-55

X400

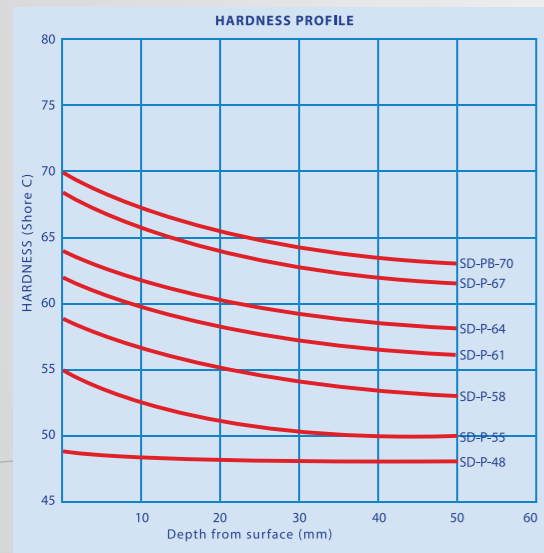


SD-P-61

X400



NODULAR GRAPHITE (PEARLITIC SPHERO) ROLLS



Nodular graphite cast iron rolls are produced from alloy cast iron with spheroidal graphite material that has high resistance to wear.

Softer grades of these rolls are more resistant to heat cracks and harder ones resistant to wear.

As a result of our research and studies, we have developed solutions for the problems like sharp hardness falls, minimization of heat cracks due to thermal shocks and keeping the roll life decline at minimum levels in cases where welding is unavoidable.

| ROLL MATERIAL | HARDNESS (SHORE C) | CHEMICAL ANALYSIS | | | | | |
|---------------|--------------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | | C % | Si % | Mn % | Cr % | Ni % | Mo % |
| SD-P-48 | 46 - 50 | 3.0 - 3.5 | 1.2 - 1.8 | 0.3 - 0.8 | 0.0 - 0.2 | 2.0 - 3.0 | 0.6 - 1.0 |
| SD-P-55 | 52 - 57 | 3.0 - 3.5 | 1.6 - 2.2 | 0.3 - 0.8 | 0.3 - 0.8 | 1.8 - 3.0 | 0.2 - 0.6 |
| SD-P-58 | 55 - 60 | 3.0 - 3.5 | 1.6 - 2.2 | 0.3 - 0.8 | 0.3 - 0.8 | 2.0 - 3.0 | 0.2 - 0.6 |
| SD-P-61 | 59 - 64 | 3.0 - 3.5 | 1.4 - 2.0 | 0.3 - 0.8 | 0.3 - 0.8 | 2.0 - 3.0 | 0.2 - 0.6 |
| SD-P-64 | 61 - 66 | 3.2 - 3.6 | 1.2 - 1.8 | 0.3 - 0.8 | 0.3 - 0.8 | 2.0 - 3.0 | 0.2 - 0.6 |
| SD-P-67 | 64 - 69 | 3.2 - 3.6 | 1.2 - 1.8 | 0.3 - 0.8 | 0.3 - 0.8 | 2.0 - 3.0 | 0.2 - 0.6 |
| SD-PB-70 | 67 - 72 | 3.2 - 3.6 | 1.2 - 1.8 | 0.3 - 0.8 | 0.3 - 0.8 | 2.0 - 3.0 | 0.2 - 0.6 |

| MECHANICAL PROPERTIES | | | |
|-----------------------|---------------------------------------|---------------------------------------|--|
| | Tensile Strength (N/mm ²) | Bending Strength (N/mm ²) | Microstructure |
| SD-P-48 | 575 - 750 | 950 - 1300 | Carbides + Spherolite in pearlitic matrix |
| SD-P-55 | 450 - 600 | 900 - 1200 | Carbides + Spherolite in pearlitic matrix |
| SD-P-58 | 450 - 600 | 800 - 1100 | Carbides + Spherolite in pearlitic matrix |
| SD-P-61 | 450 - 600 | 800 - 1100 | Carbides + Spherolite in pearlitic matrix |
| SD-P-64 | 400 - 600 | 800 - 1000 | Carbides + Spherolite in pearlitic matrix |
| SD-P-67 | 400 - 600 | 800 - 1000 | Carbides + Spherolite in pearlitic matrix |
| | | | Carbides + Spherolite in pearlitic + Bainitic matrix |



SD-B-67

X-400

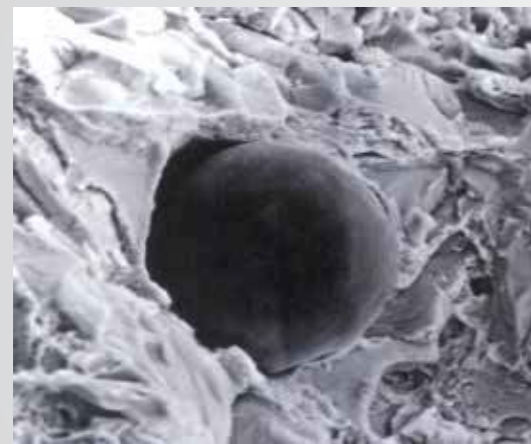


SD-B-70

X-400



NODULAR GRAPHITE (ACICULAR SPHERO) ROLLS



SD-MB-77

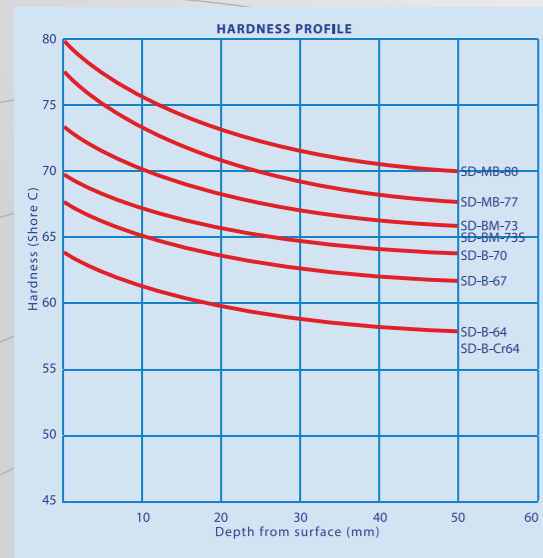
X1500

Acicular sphero rolls are produced from high alloy spheroidal graphite cast iron material.

After casting, these rolls are treated through a long-time, low-temperature annealing process which is primarily applied for the purpose of relieving the internal stresses, as well as to ensure the complete transformation of possibly retained austenitic phase in the microstructure.

This microstructure named as acicular structure is obtained through formation of bainitic and needle structured martensitic carbides.

The demand for special quality of rolls with resistance to thermal shocks and wear, required for slitting systems which have now wider use in rolling mills are met with SD-BM-73S quality.

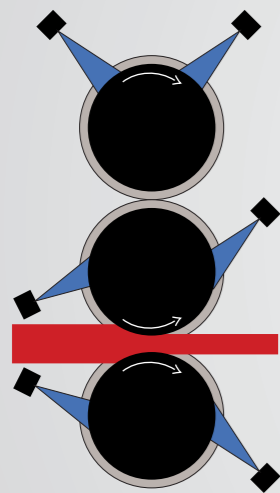


| ROLL MATERIAL | HARDNESS (SHORE C) | CHEMICAL ANALYSIS | | | | | |
|---------------|--------------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | | C % | Si % | Mn % | Cr % | Ni % | Mo % |
| SD-B-64 | 61 - 66 | 3.1 - 3.6 | 1.2 - 1.8 | 0.3 - 0.8 | 0.2 - 0.6 | 2.5 - 3.5 | 0.5 - 1.0 |
| SD-B-Cr64 | 62 - 67 | 3.0 - 3.5 | 1.2 - 1.8 | 0.3 - 0.8 | 0.6 - 1.2 | 3.0 - 4.0 | 0.5 - 1.0 |
| SD-B-67 | 64 - 69 | 3.1 - 3.6 | 1.2 - 1.8 | 0.3 - 0.8 | 0.2 - 0.6 | 2.5 - 3.5 | 0.5 - 1.0 |
| SD-B-70 | 67 - 72 | 3.2 - 3.7 | 1.0 - 1.6 | 0.3 - 0.8 | 0.3 - 0.8 | 3.0 - 4.0 | 0.5 - 1.0 |
| SD-BM-73S | 68 - 73 | 3.2 - 3.7 | 1.0 - 1.6 | 0.3 - 0.8 | 0.3 - 0.8 | 3.5 - 4.5 | 0.5 - 1.0 |
| SD-BM-73 | 70 - 75 | 3.2 - 3.7 | 1.0 - 1.6 | 0.3 - 0.8 | 0.3 - 0.8 | 3.5 - 4.5 | 0.5 - 1.0 |
| SD-MB-77 | 72 - 77 | 3.2 - 3.7 | 1.0 - 1.6 | 0.3 - 0.8 | 0.3 - 0.8 | 3.5 - 4.5 | 0.5 - 1.0 |
| SD-MB-80 | 75 - 80 | 3.2 - 3.7 | 1.0 - 1.6 | 0.3 - 0.8 | 0.4 - 1.0 | 3.5 - 4.5 | 0.5 - 1.0 |

| MECHANICAL PROPERTIES | | | |
|-----------------------|---------------------------------------|---------------------------------------|--|
| | Tensile Strength (N/mm ²) | Bending Strength (N/mm ²) | Microstructure |
| SD-B-64 | 550 - 750 | 900 - 1050 | Carbides + spherolite in bainitic matrix |
| SD-B-Cr64 | 400 - 600 | 750 - 900 | Carbides + spherolite in bainitic matrix |
| SD-B-67 | 500 - 700 | 800 - 1000 | Carbides + spherolite in bainitic matrix |
| SD-B-70 | 500 - 700 | 800 - 1000 | Carbides + spherolite in bainitic matrix |
| SD-BM-73S | 500 - 700 | 800 - 1000 | Carbides + spherolite in bainitic + martensitic matrix |
| SD-BM-73 | 500 - 700 | 800 - 1000 | Carbides + spherolite in bainitic + martensitic matrix |
| SD-MB-77 | 500 - 700 | 700 - 950 | Carbides + spherolite in martensitic + bainitic matrix |
| SD-MB-80 | 500 - 700 | 700 - 950 | Carbides + spherolite in martensitic + bainitic matrix |



ROLL PERFORMANCE

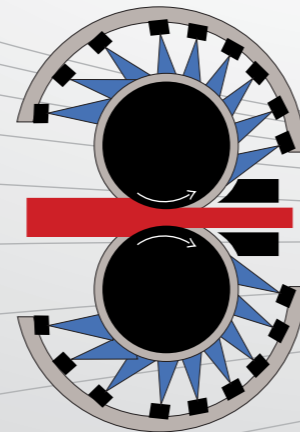
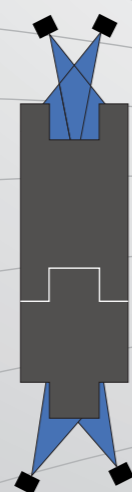
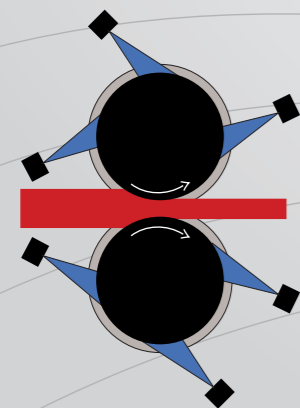


COOLING

Cooling is the primary and most important factor that affects the roll performance.

During rolling, some areas of the rolls may be cooled sufficiently, but some other areas may be subjected to insufficient or overcooling or sudden temperature changes, which are the most common reasons of roll breakages.

Even if the roll is cooled evenly, roll life may still decrease in cases where the roll temperature reaches an upper limit. Occurrence of any abrupt changes in the roll temperature creates thermal stresses which result in roll breakages. Preventing thermal shocks becomes a much more important issue in case of alloyed steel rolls.



FACTORS THAT AFFECT THE ROLL PERFORMANCE

- 1 - Each roll must be cooled individually.
- 2 - Cooling water must not be too cold.
- 3 - Cooling must be done from the exit direction of the rolled material.
- 4 - Water supply should be stopped when rolls are not running.
- 5 - What is more important than the amount of water is how cooling is done and which areas of the rolls are cooled.
 - Besides the roll itself, as the most heat affected areas,
 - a) The working groove on the roll and,
 - b) The overheated zone of the groove must be cooled effectively.
- 6 - Cooling water pressure must not be too low or too high. In sprinkler systems, 2–4 bar gives good results. The water pressure should be increased from roughing to finishing stands in relation with rolling speed and roll rpm to be able to cool the rolls properly. For slitting, dog bone and finishing stands a pressure of 5 bar can be recommended.
- 7 - In short shutdowns, roll is continued to be cooled. In long shutdowns, water supply is continued by decreasing the amount. However, water amount for the necks should not be decreased. If water supply for barrel cooling is interrupted but the necks continue to be cooled, thermal stresses may build up within the barrel.
- 8 - Fiber bearings should be cooled properly. However, cold water should be prevented to contact the roll barrel.
- 9 - If a water interruption happens during rolling process, valves must be shut off immediately so that hot rolls are avoided to contact with cooler water when the supply restarts. If rolling starts before the water supply is switched on, rolling cycle should be completed without water supply. In both of the above cases, the rolls must be cooled by running idle.
- 10 - In case of twining, water supply is cut immediately and the rolls are detached quickly.
- 11 - For cooling water, pH – hardness value of 7 to 8 is recommended.
- 12 - For separating oil and scales from cooling water, it is generally recommended for the cooling water to rest a minimum of 1 hour in the main tanks before being re-pumped into the system.

The characteristic appearance of poor cooling over the rolls is the capillary crack formations within the grooves which are parallel to the axis. These parallel cracks later connect with each other and form cracks which are vertical to the axis and consequently lead roll breakage. If propagation and deepening of such cracks can not be prevented, the groove should not be used until next dressing.



HARDNESS CONVERSION TABLE

| Rockwell C (HRC) | Shore (ShC) | Vickers (HV) | Equotip (LE) | Equotip (LD) |
|------------------|-------------|--------------|--------------|--------------|
| 25,0 | 38 | 268 | 514 | 537 |
| 26,5 | 39 | 275 | 520 | 544 |
| 28,0 | 40 | 283 | 526 | 551 |
| 29,0 | 41 | 290 | 532 | 558 |
| 30,0 | 42 | 298 | 539 | 565 |
| 31,0 | 43 | 306 | 546 | 572 |
| 32,0 | 44 | 314 | 553 | 579 |
| 32,5 | 45 | 322 | 559 | 586 |
| 33,0 | 46 | 331 | 566 | 593 |
| 34,0 | 47 | 340 | 572 | 600 |
| 35,0 | 48 | 349 | 578 | 607 |
| 36,0 | 49 | 358 | 584 | 613 |
| 37,5 | 50 | 366 | 590 | 620 |
| 38,0 | 51 | 374 | 596 | 626 |
| 38,5 | 52 | 382 | 602 | 633 |
| 39,0 | 53 | 390 | 608 | 639 |
| 40,0 | 54 | 399 | 614 | 646 |
| 41,0 | 55 | 407 | 620 | 652 |
| 42,0 | 56 | 416 | 626 | 659 |
| 43,0 | 57 | 425 | 633 | 665 |
| 43,5 | 58 | 434 | 639 | 671 |
| 44,0 | 59 | 443 | 645 | 677 |
| 45,0 | 60 | 452 | 650 | 683 |
| 45,5 | 61 | 461 | 655 | 688 |
| 46,0 | 62 | 470 | 660 | 694 |

HARDNESS CONVERSION TABLE

| Rockwell C (HRC) | Shore (ShC) | Vickers (HV) | Equotip (LE) | Equotip (LD) |
|------------------|-------------|--------------|--------------|--------------|
| 47,0 | 63 | 479 | 666 | 699 |
| 47,5 | 64 | 488 | 672 | 705 |
| 48,0 | 65 | 497 | 677 | 710 |
| 49,0 | 66 | 506 | 682 | 716 |
| 49,5 | 67 | 515 | 688 | 721 |
| 50,0 | 68 | 525 | 693 | 727 |
| 51,0 | 69 | 535 | 698 | 732 |
| 51,5 | 70 | 546 | 703 | 738 |
| 52,0 | 71 | 556 | 709 | 743 |
| 52,5 | 72 | 567 | 714 | 749 |
| 53,0 | 73 | 577 | 720 | 754 |
| 53,5 | 74 | 588 | 725 | 759 |
| 54,0 | 75 | 598 | 730 | 764 |
| 54,5 | 76 | 609 | 735 | 769 |
| 55,0 | 77 | 619 | 740 | 774 |
| 55,5 | 78 | 630 | 745 | 779 |
| 56,0 | 79 | 641 | 750 | 784 |
| 57,0 | 80 | 653 | 755 | 789 |
| 57,5 | 81 | 664 | 760 | 794 |
| 58,0 | 82 | 676 | 765 | 799 |
| 58,5 | 83 | 688 | 770 | 804 |
| 59,0 | 84 | 701 | 775 | 809 |
| 60,0 | 85 | 713 | 780 | 814 |
| 61,0 | 86 | 726 | 785 | 819 |
| 61,5 | 87 | 738 | 790 | 824 |
| 62,0 | 88 | 752 | 795 | 829 |



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