



www.gms-ftrsteel.com



THE CONCEPT



The basis of our partnership is environmentally friendly and sustainable engineering solutions for future generations.



FTR MAKİNA KİMYA METALURJİ A.Ş.

FTR MAKİNA KİMYA METALURJİ A.Ş. was established in 2003 based in Istanbul active mainly in cement, mining, mineral industries as well as lignite fired power plants.

Our expert team members having on-field experiences are one the key points of sustainable energy efficient and environmentally friendly solutions towards customers needs due to the fact that understanding and implementing what is needed at actual need expertise, thus right engineering solutions come true consequently.

Certain foundry products to fight against wear mechanisms seen in crushing, grinding and pyro-processing are in the scope of GMS-FTRsteel supply. Grinding media is the core business completed by mill internals and its design according to process requirements.

Major grinding media types supplied by GMS-FTRsteel;

Hi Cr grinding balls

Low or High Cr Cylpebs, Boulpebs, Miniballs

Ceramic Balls

Ceramic Beads

GMS-FTRsteel is a worldwide supplier by offering quality products as well as the necessary resources to fulfill it's customers needs such as optimization of technical and/or economic performances, service(s) as requested, and much more, hence is the best suited "on-time solution partner".



The grinding balls are hardened in order of special heating in furnace and quenching in polymer liquid (oil).

| Hi Cr GRINDING BALLS | |
|----------------------|--|
| Ball Diameters (mm) | 13 - 15 - 17 - 20 - 25 - 30 - 40 - 50 - 50 - 70 - 80 - 90 - 100 |
| Cr % | 3% to 32% |
| Heat Treatment | <p>Balls are subjected to hardening by being austenitized to a temperature that ensures solubility of alloying elements in austenite and precipitation of secondary carbides. Holding time at the austenitizing temperature is sufficient to condition the austenite to facilitate transformation to martensite upon quench.</p> <p>Balls are hardened by quenching in polymer liquid (oil).</p> |

| Place of use | BALL MILL 2ND CHAMBER | | | |
|----------------|-----------------------|---------------|---------------|---------------|
| Ball Diameters | ≤ 40 mm | 50, 60 mm | ≤ 40 mm | ≤ 40 mm |
| Alloy Code* | FTR-12 CR Max | FTR-11 CR Max | FTR-42 CR Max | FTR-19 CR Max |
| Cr % | 11,00 - 14,00 | 11,00 - 14,00 | 19,00 - 22,00 | 18,00 - 20,00 |
| C % | 2,90 - 3,40 | 2,50 - 2,90 | 2,80 - 3,10 | 2,50 - 2,90 |
| Si % | 1,00 max | 1,00 max | 1,00 max | 1,00 max |
| Mn % | 1,00 max | 1,00 max | 1,00 max | 1,00 max |
| S % | 0,05 max | 0,05 max | 0,05 max | 0,05 max |
| P % | 0,05 max | 0,05 max | 0,05 max | 0,05 max |

| Place of use | BALL MILL 1ST CHAMBER | BALL MILL 1ST & 2ND CHAMBERS | BALL MILL 1ST & 2ND CHAMBERS (Coal Mill) |
|----------------|-----------------------|------------------------------|--|
| Ball Diameters | 50 - 100 mm | 50 - 100 mm | ≤ 90 mm |
| Alloy Code* | FTR-17 CR Max | FTR-22 CR Max | FTR-27 CR Max |
| Cr % | 17,00 - 19,00 | 19,00 - 22,00 | 25,00 - 28,00 |
| C % | 2,10 - 2,50 | 2,80 - 3,10 | 2,50 - 2,80 |
| Si % | 1,00 max | 1,00 max | 1,00 max |
| Mn % | 1,00 max | 1,40 max | 1,40 max |
| S % | 0,05 max | 0,05 max | 0,05 max |
| P % | 0,05 max | 0,05 max | 0,05 max |

*Alloy Code: These alloys are most common ones used in the industries. GMS-FTRsteel also supplies variety of different alloyed and microstructured grinding balls depending on the mill process and the material to be ground.

HARDNESS in HRc

| | | | | |
|-------------------------|----------------------|----------------------|----------------------|----------------------|
| Ball Size (mm) | ≤ 40 mm | 50, 60 mm | ≤ 40 mm | ≤ 40 mm |
| Alloy Code | FTR-12 CR Max | FTR-11 CR Max | FTR-42 CR Max | FTR-19 CR Max |
| Surface Hardness | 62 - 67 HRc | 60 - 65 HRc | 62 - 67 HRc | 60 - 66 HRc |

| | | | | |
|-------------------------|----------------------|----------------------|----------------------|----------------------|
| Ball Size (mm) | 50 - 100 mm | 50 - 100 mm | ≤ 90 mm | ≤ 80 mm |
| Alloy Code | FTR-17 CR Max | FTR-22 CR Max | FTR-27 CR Max | FTR-70 CR Max |
| Surface Hardness | 58 - 62 HRc | 59 - 63 HRc | 59 - 63 HRc | 59 - 64 HRc |

| | | | | |
|------------------------|--|--|--|--|
| Center Hardness | GMS-FTRsteel grinding balls present almost a uniform hardness. The hardness throughout the cross section at the time of supply is limited with maximum 1,5 HRc from surface to the center. | | | |
|------------------------|--|--|--|--|

| | | | | |
|-----------------------|--|--|--|--|
| Work Hardening | The hardness values at the time of supply are for new and unused grinding balls. Once the balls start to work inside the ball mill, a work hardening occurs due to impacts during operation and the hardness increases up to following values; for diameters from 90 to 60 mm is up to 64 to 67 HRc, for diameters from 50 to 15 mm is up to 69 to 73 HRc according to the impact level. | | | |
|-----------------------|--|--|--|--|

TYPICAL APPLICATIONS FTR-ALLOYS

FTR-11 CR Max, FTR-12 CR Max are recommended when conditions of high wear coupled with no or low impacts prevail in second compartment of cement and raw mills.

FTR-19 CR Max are recommended when conditions of high wear coupled with medium to high impacts prevail in second compartment of cement and raw mills.

FTR-17 CR Max is recommended when conditions of high wear coupled with high impacts prevail in first compartment of cement and raw mills.

FTR-22 CR Max & FTR-42 CR Max are recommended when superior wear resistance coupled with high impact resistance are needed in first and second compartments respectively of cement and raw mills.

FTR-70 CR Max is applied for coal mills grinding media of $\varnothing \leq 80$ mm.

FTR-27 CR Max is applied for wet mills grinding media of ≤ 90 mm.



GMS-FTRsteel offers quite wide range of grinding media in cylpebs and boulepebs. The dimensions given below are the general ones and it is possible to manufacture different external sizes according to new patterns generated.

| SIZE mm | SHAPE | PRODUCTION TECHNOLOGY | Cr% | HARDNESS in HRc |
|----------|---------------------|-----------------------|-----------------------|-----------------|
| Ø20 x 25 | Cylindrical cylpebs | Rolling | 0,5% to %0,7% | 60 to 63 HRc |
| Ø30 x 35 | Cylindrical cylpebs | Rolling | 0,5% to %0,7% | 60 to 63 HRc |
| Ø30 x 40 | Cylindrical cylpebs | Rolling | 0,5% to %0,7% | 60 to 63 HRc |
| Ø40 x 50 | Cylindrical cylpebs | Rolling | 0,5% to %0,7% | 60 to 63 HRc |
| Ø50 x 60 | Cylindrical cylpebs | Rolling | 0,5% to %0,7% | 60 to 63 HRc |
| Ø70 x 80 | Cylindrical cylpebs | Rolling | 0,5% to %0,7% | 60 to 63 HRc |
| Ø16 x 16 | Cylindrical cylpebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø19 x 19 | Cylindrical cylpebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø20 x 20 | Cylindrical cylpebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø22 x 22 | Cylindrical cylpebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø25 x 25 | Cylindrical cylpebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø25 x 30 | Cylindrical cylpebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø35 x 35 | Cylindrical cylpebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø35 x 40 | Cylindrical cylpebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø40 x 40 | Cylindrical cylpebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø13 x 16 | Boulepebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø16 x 20 | Boulepebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø19 x 24 | Boulepebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø22 x 28 | Boulepebs | Cast | 12% - 19% - 22% - 27% | 67-66-65-63 HRc |
| Ø13 x 16 | Boulepebs | Cast | 12% | 63 to 67 HRc |
| Ø16 x 20 | Boulepebs | Cast | 12% | 63 to 67 HRc |
| Ø19 x 24 | Boulepebs | Cast | 12% | 63 to 67 HRc |
| Ø22 x 28 | Boulepebs | Cast | 12% | 63 to 67 HRc |
| Ø25 x 32 | Boulepebs | Cast | 12% | 63 to 67 HRc |
| Ø29 x 39 | Boulepebs | Cast | 12% | 63 to 67 HRc |
| Ø8 x 8 | Cylindrical cylpebs | Cast | 1% to 3% | >45HRc |

THE CHOICE OF GRINDING MEDIA DEPENDS ON;

- The grinding circuit and its parameters
- The material/ore characteristics to be ground
- The reasons triggering the wear mechanisms (abrasion, corrosion, impact etc)



BALL MILL INSPECTIONS & PROCESS AUDITS

Regular inspections, audits, and modernization of mill internals are crucial for optimizing performance and ensuring a short return on investment. These strategies ensure efficient grinding, minimize energy consumption, and enhance product quality.

OUR PROCESS EXPERTS INSPECT THE TUBE BALL MILLS;

MONO CHAMBER MILLS WITH OR WITHOUT HPGR (Roller Press)

TWO CHAMBER MILLS WITH OR WITHOUT HPGR (Roller Press)

CHECK THE SEPARATOR EFFICIENCY AND DEVELOP TROMP CURVES

FINALLY;

**REPORT PRESENT INEFFICIENT POINTS IN THE CIRCUIT,

**REPORT PROPER SOLUTIONS TO INCREASE GRINDING EFFICIENCY IN TPH , kWh/ton, AND SO ON,

**PREPARE BALL MILL INTERNALS REPLACEMENT PROGRAM WITH THE COMMERCIAL DETAILS.

GMS-FTRsteel expert team is ready to work with you to find the most efficient and cost effective solutions.



ONLY BY
THE RIGHT PRODUCT FOR THE APPLICATION
CAN WE
ACHIEVE

GMS-FTRsteel engineering team is always available to listen to customer needs in order to define the most efficient, economical and environmental friendly solution, from grinding balls to ball mill optimisation.



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