VALE

Straight Grate Pelletization Solutions

Metso Minerals - Bulk Materials Handling
Meeting the World's Needs



Introduction

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- World Wide Straight Grate Pelletizing Experience
  - Client locations
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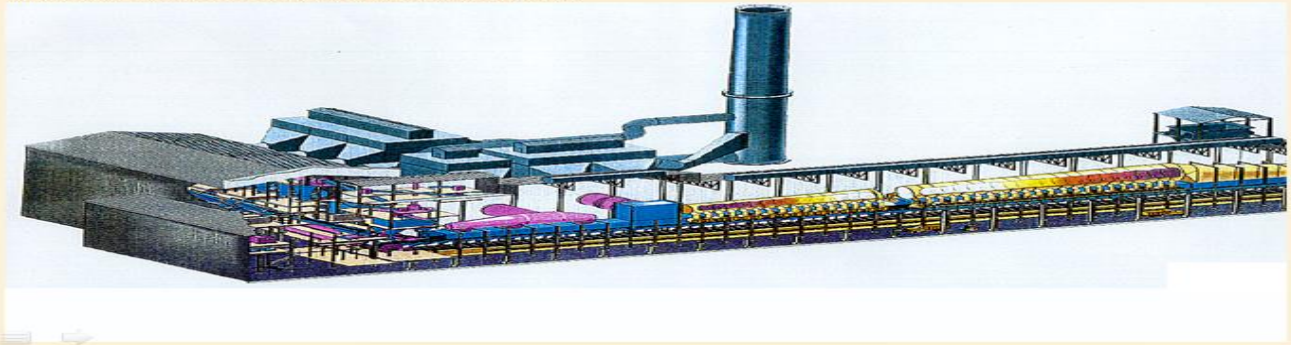
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Metso Minerals Industries Inc., Bulk Material Handling, Canonsburg, Pennsylvania, USA

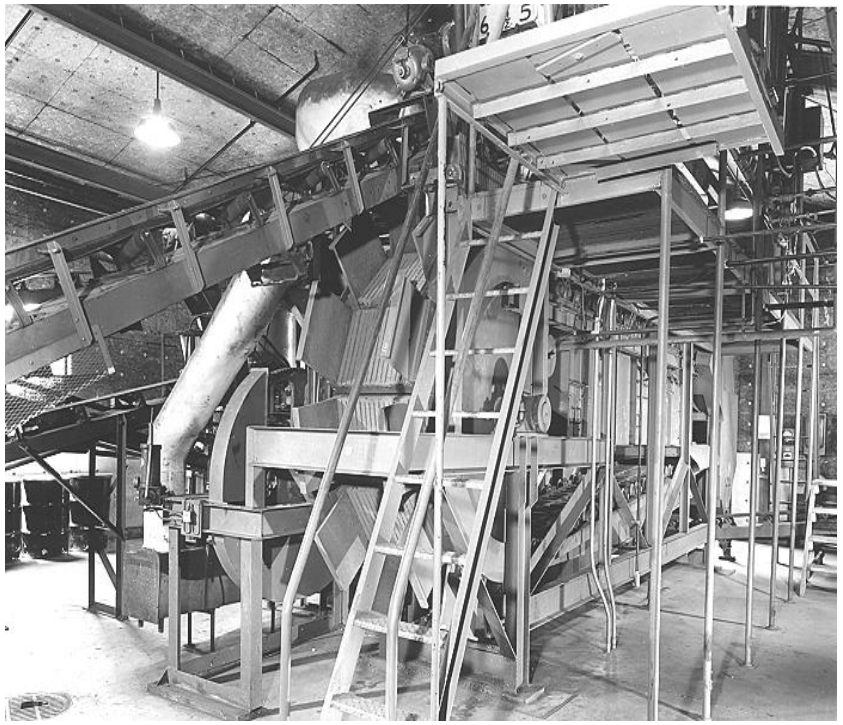
Metso's constituent companies in the bulk materials handling business area were established circa 1890. With a totally comprehensive product line and an unparalleled range of services, Metso customers, large and small, can expect complete solutions from as single supplier.

Metso Minerals has supported the iron ore and steel industries since the turn of the century with bulk materials handling equipment, since the 1950's with pelletizing and sintering (induration) equipment. You have known us in the past as Svedala Minerals Industries Inc., McNally Wellman, Dravo Corporation, Dravo Wellman Co., McDowell Wellman Co. and McNally Pittsburgh Co.



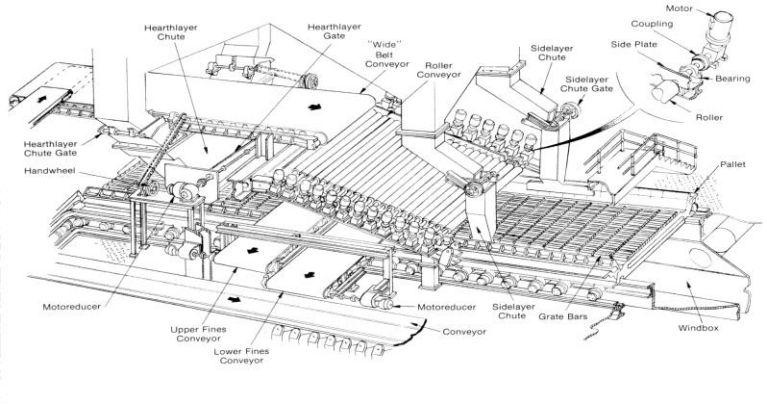
History of the Straight Grate

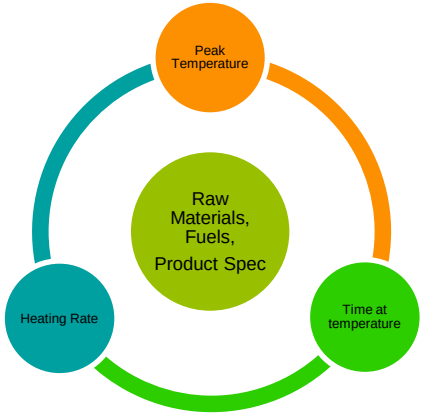
- Iron ore is used, primarily, in making steel. There are a series of processing steps the ore needs to go through to be usable as steel but the first step is to reduce (remove the oxygen from) the iron. Reduction is performed by heating the iron and treating it with gasses that pull oxygen from the iron.
- Much of the highest grade iron in the United States was used up to make steel in WWII so development started on processes that could use lower grade iron as feed for steel making.
- Pellet plants served as an answer to the low grade iron issue. The straight grate design was developed in the 1950's based on sintering machine designs.
- Several design changes were made to the sintering machines in order to make them practical to use as pelletizing machines.
- The design Metso purchased was originally owned by Dravo Engineering. The technology was split into two units, moving parts (pallets, rails, etc.) and the furnace (burners, fans, etc.). Svedala owned the technology for the moving parts for many years before becoming Metso and Metso recently purchased the design of the furnace area from Jacobs Engineering.
- The acquisition by Metso purchased both the design for the furnace area as well as the knowledge of the process and plant design.
- Dravo-Lurgi machine became the accepted straight grate technology from which all current machines evolved.



History of the Straight Grate: Cont.

- In 1989 Dravo Corporation dissolved. The pelletizing process (burners, fans, etc.) was sold along with other process businesses to Davey. The machinery portion (pallets, rails, drives, etc.) was sold to Metso. Both Metso and Davey (later Kavaerner and Jacobs) continued to work on pelletizing on an exclusive basis. Between 1989 and 20012 the exclusive arrangement resulted in 12 new pellet lines including Samarco 2 in Brazil. In 2012 Metso purchased the pellet process and staff from Jacobs. Thus both process and machinery are back together under one Company as they were in the beginning. This will result in a more unified approach to our Customers and one place to call to meet all your needs.





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Metso Minerals - Bulk Materials Handling



- Over 30 Product Lines
- 17 Major Brand Names

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WORLDWIDE STRAIGHT GRATE PELLETIZING EXPERIENCE

CLIENT LOCATION LISTING

No.	Plant Name	Location	Owner	Rated Tonnage (10^6 TPY)	Starting Date	No. Units	Operating Status
1.	Inco I Inco II	Copper Cliff, Ontario	International Nickel Co.	0.4 0.6	1956 1963	1 1	Closed
2.	Groveland	Randville, Michigan	Hanna Mining Co.	2.0	1963	1	Closed
3.	Carol I, II, III	Labrador City, Newfoundland	Iron Ore Co. of Canada	11.5	1963 through 1967	6	Operating
4.	Wabush	Pointe Noire, Quebec	Wabush Mines	6.0	1964	3	Operating
5.	Eagle Mountain	Eagle Mountain, California	Kaiser Steel Corp.	2.2	1965	1	Closed
6.	Caland	Atikokan, Ontario	Caland Ore Co. Ltd.	1.0	1965	1	Closed
7.	Marcona II	San Nicolas, Peru	Shougang Hierro Peru (Formerly: Marcona)	2.0	1966	1	Operating
8.	Steep Rock	Atikokan, Ontario	Steep Rock Iron Mines Ltd.	1.25	1967	1	Closed
9.	LAMCO	Buchanan, Liberia	Liberian American Mining	2.0	1967	1	Closed
10.	Pilot Knob	Pilot Knob, Missouri	Pilot Knob Pellet Co.	1.0	1968	1	Closed
11.	Hamersley	Dampier, W. Australia	Hamersley Iron Pty. Ltd.	3.0	1968	1	Closed
12.	Jackson County Iron	Black River Falls, Wisconsin	Jackson County Iron Co.	0.75	1969	1	Closed
13.	Hoogovens Ijmuiden	Ijmuiden, Netherlands	K.N.H.S.	3.5	1970	1	Operating
14.	Robe River	Cape Lambert, W. Australia	Cliffs Western Australia Mining Co.	5.0	1972	2	Closed
15.	Vitafores	Gallivare, Sweden	L.K.A.B.	2.5	1973	1	Operating
16.	Hibbing	Hibbing, Minnesota	Hibbing Taconite Corporation	8.1	1976	3	Operating
17.	Samarco I Samarco II	Ponta Do Ubu, Brazil	Samarco Mineracacao, S.A.	5.0 6.0	1976 1997	1 1	Operating Operating

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WORLDWIDE STRAIGHT GRATE PELLETIZING EXPERIENCE

CLIENT LOCATION LISTING

No.	Plant Name	Location	Owner	Rated Tonnage (10^6 TPY)	Starting Date	No. Units	Operating Status
18.	Minorca	Virginia, Minnesota	Inland Steel Mining Co.	2.6	1976	1	Operating
19.	Sidbec	Port Cartier, Quebec	Quebec Cartier Mining Co.	6.0	1977	2	Operating
20.	AHMSA	Monclova, Mexico	Altos Hornos de Mexico	3.0	1980	1	Operating
21.	Imexsa	Lazaro Cardenas, Mexico	Ispat Mexicana S.A. de C.V.	3.5	1996	1	Operating
22.	Jindal	Toranagallu Karnatoka, India	Jindal Vijayanagr Steel Ltd.	3.0	2000	1	Operating
23.	Jindal	Toranagallu Karnatoka, India	Jindal Steel Power & Light	3.0	2006	1	Operating
24.	Essar Paradeep	Orisa, India	Essar Steel Ltd.	6.0	2008	1	In Manufacture
25.	Essar Paradeep	Orisa, India	Essar Steel Ltd.	6.0	2008	1	In Manufacture
26.	Jindal Steel Works	Torangallu Karnatoka, India	Jindal Steel Works	3.0	2008	1	In Manufacture
27.	Essar Minnesota	Hibbing, MN	Essar Steel Minnesota Ltd.	6.0	2011	1	In Manufacture
28.	Monnet	Raigarh, Chattisgarh, India	Monnet Ispat and Energy Ltd	2.0	2011	1	In Manufacture
29.	JSPL Barbil	Barbil, Orissa, India	Jindal Steel Power & Light	4.0	2012	1	In Manufacture
30.	JSW Dolvi	Dolvia, India	Jindal Vijayanagr Steel Ltd.	3.0	2012	1	In Manufacture
31.	Magnetation	Indiana, USA	Magnetation LLC	3.0	2012	1	In Manufacture

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Strengths

Over sixty years of Straight Grate Pelletization Solutions

Known in the market as good engineering and design quality

Large Global installed base - track record.

Synergies with Metso Businesses

Supportive teamwork environment

Quality Global Manufacturing Facilities

Aftermarket

Replacement Parts

Divided into 5 sectors

- Engineered Products
- Coal Prep & Ash Handling
- Equipment & Systems
- Straight Grate Pelletization
- Cable Belt

Service

- Predominantly E&S
- small mixture of E/P
  Coal & Ash
- Refurbishment
- Upgrades
- Engineering Studies

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Aftermarket Comprehensive Services

- **Consignment Programs**
- **Equipment Inspections**
- **Troubleshooting Services**
- **Feasibility Services**
- **Breakdown Assistance**
- **Electrical Upgrades**
- **Annual Service Contracts**
- **Operation & Maintenance Training**
- **On-site Maintenance Contracts**
- **Life Extension Upgrades / Retrofits**
- **Outage Assistance**
- **Laser Alignment Services**
- **Dumper Barrel Replacements**
- **Emergency / 24-hour Service**

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Metso Solutions

1. ·Customer had short life of wheel bearings and effort was undertaken to lengthen the life. Metso utilized higher capacity bearings with wider stance and inclusion of AP Style Bearings and this added life and increased load handling.



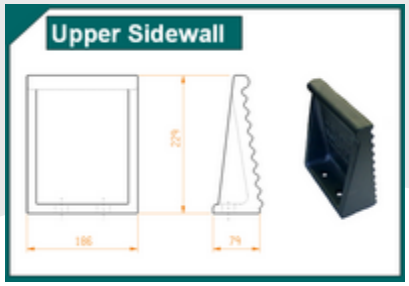
2. Customers slide seal bars were suffering from short life so in an joint customer and Metso effort we designed, integrated and utilized a new Slide Seal Bars now having a much harder surface offering longer running life.



3. Customer pallet end assemblies were suffering wear from adjacent pallet cars. Metso integrated a an integral wear hardened parts which enhanced the end assembly life and reduced maintenance time.



4.Customer Was suffering from reduced wear life on the upper side walls. Metso introduced a specific upper side wall design shape and alloy material that allowed longer life, and reduction in replacement costs.





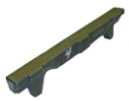


5. Customer noticed that the grate bars locking rod suffered from short life. Metso designed and integrated a grate bar locking rods on gas side which allowed longer life and replacement cost reduction.



End Bars

Revised end bars eliminate the need to carry both 30MM and 40MM spacer bars in inventory. The newly designed bars are reversible and thus one bar fits either the 30MM or 40MM dimension.





6. Customer desired off site pallet car servicing and assembly. Metso established a servicing location in Hibbing Mn.





7. Customer desired to increase grate bar life and Metso through material testing and alloy design implemented a special alloy steel bar to increase grate bar life.





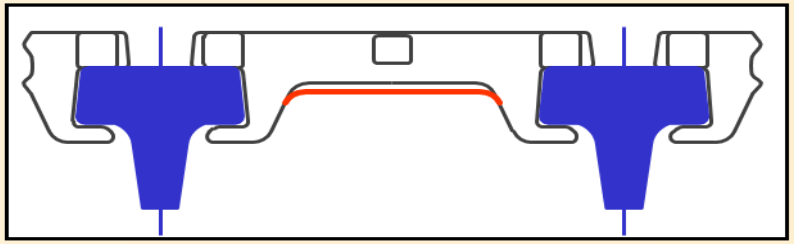
Straight Grate Machine Parts

Grate Bars

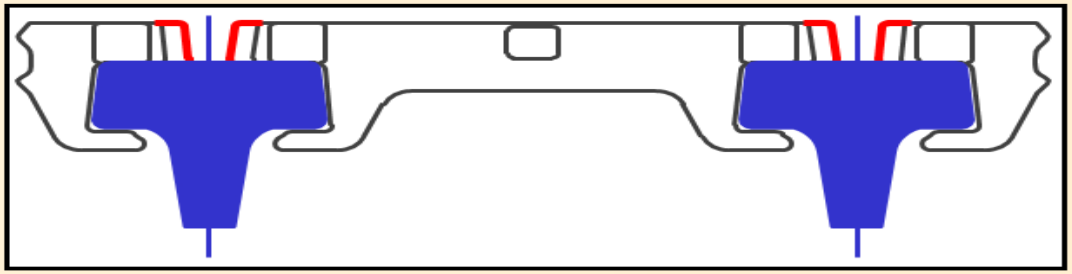
Grate Bar "2000"



The Metso Grate Bar "2000" offers increased strength, improved protection for pallet centers, more stability and improved airflow.

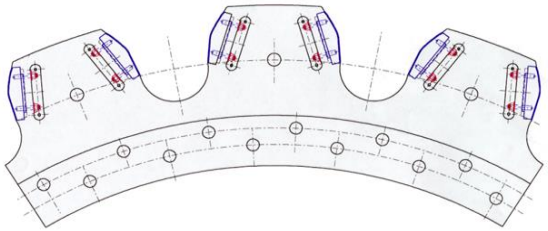


A 1/4" increase in bar depth over standard grate bar depths results in a 50% increase in bending strength which results in longer bar life when failure is caused by bowing.



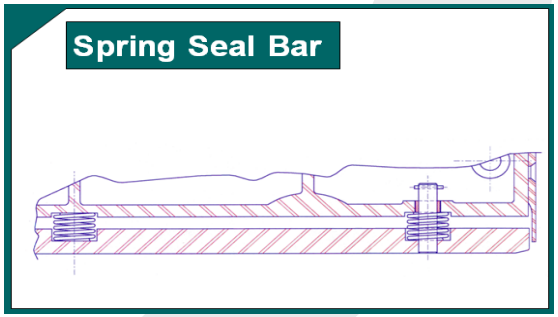
An increased bar length offers better stability and improved center casting protection.

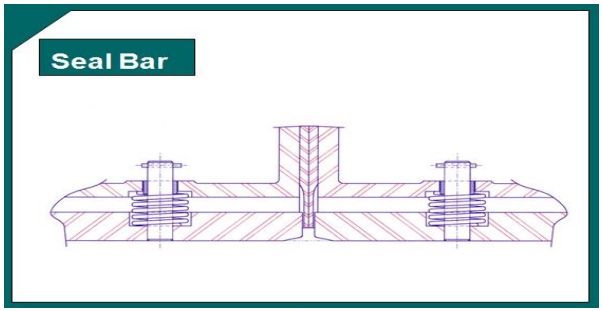
8. Customer requested a solution to wear issues and its associated loss of productivity with driving wheel sprocket replacement. Metso provided Insertable wear teeth in driving and tipping wheel sprockets



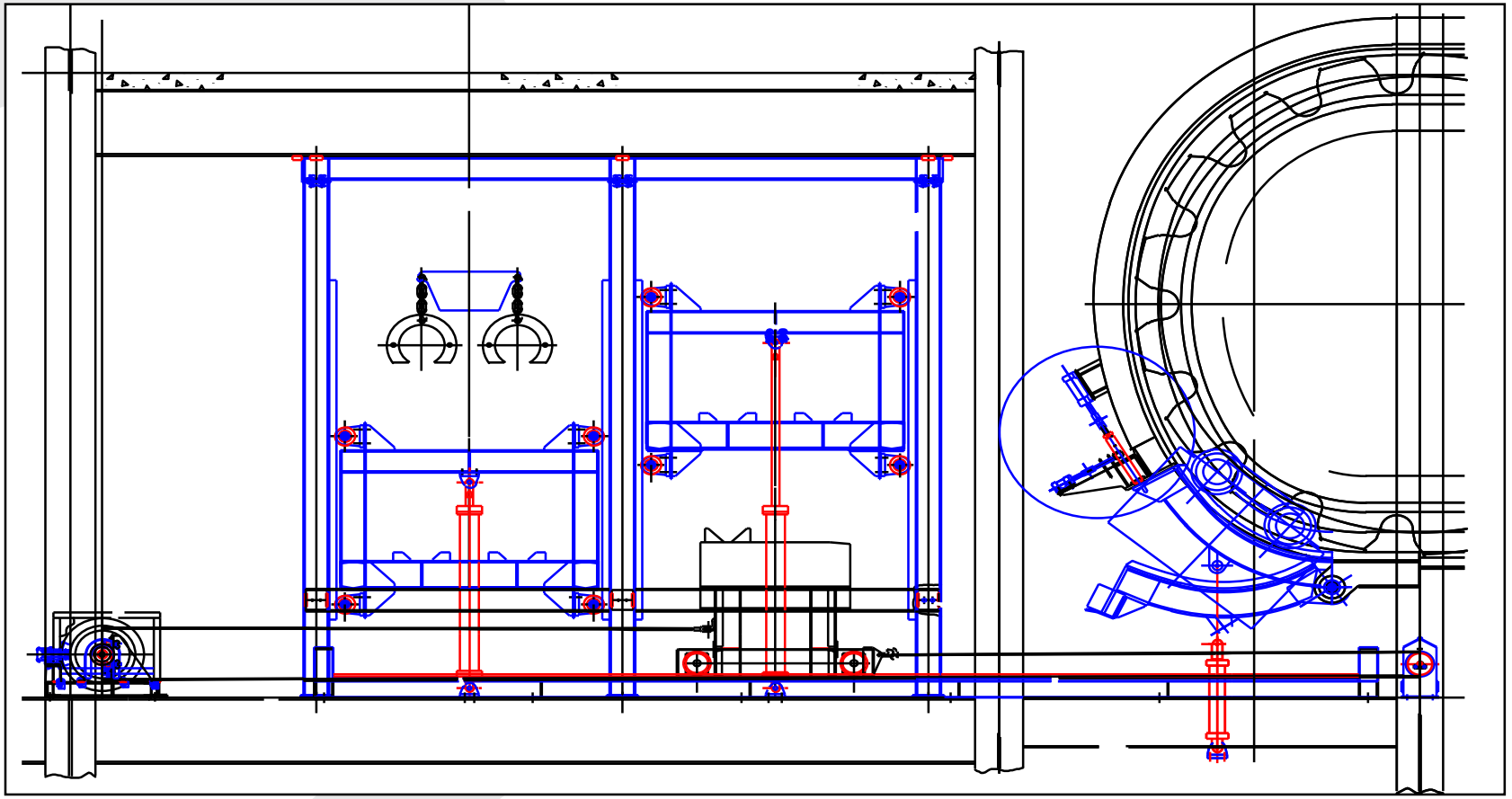


9. Customer noticed increased loss of process air. Metso designed and implemented a modified pallet car seal bar arrangement to reduce gas escape.

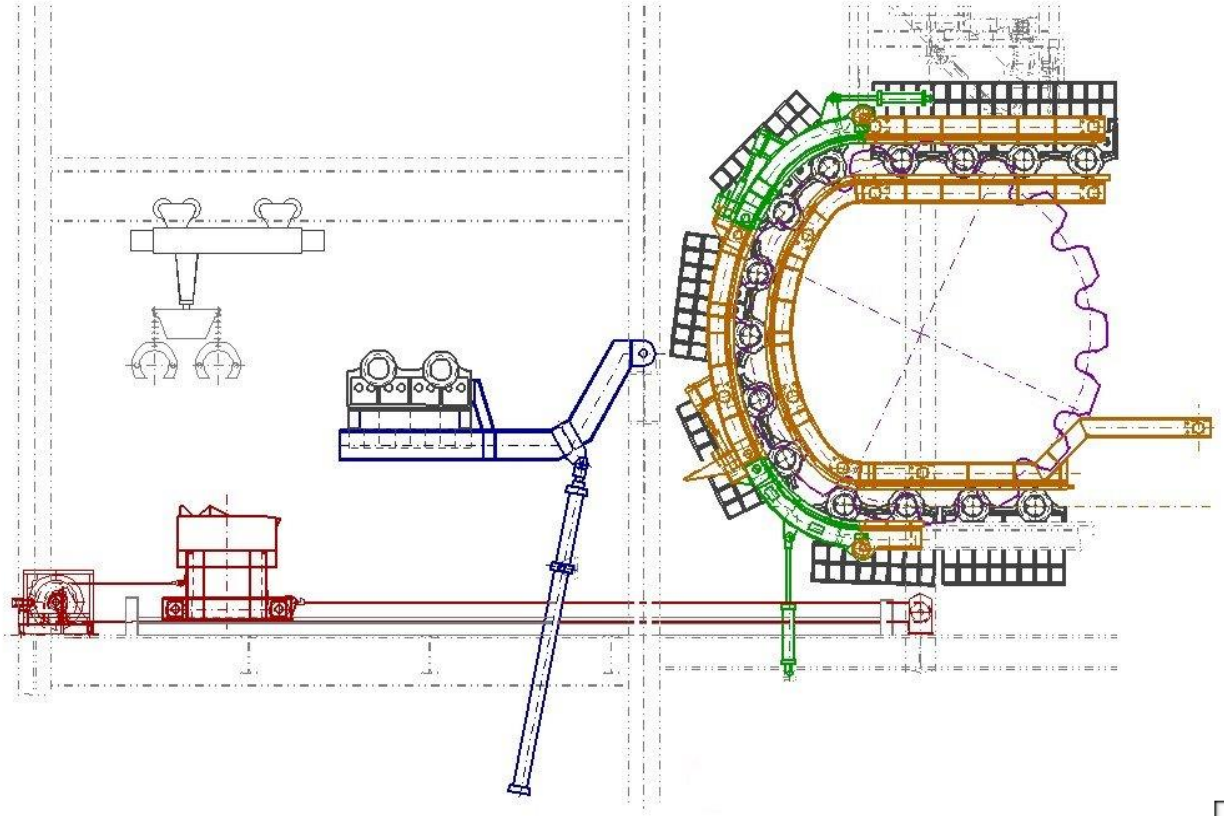




New Technology
Automated pallet Removal



Metso “On-The-Fly” Pallet Replacement System



Pallet Removal.avi

Why “On-The-Fly” Pallet Replacement System

- **Increased Production –** No production time lost in preparing for pallet removal, lost time spent in performing the replacement, or time lost getting back into full production
- **Improved Pellet Quality-** Process upset caused by the pallet replacement procedure will result in some deterioration of pellet quality and some size and quality effects related to disk or balling drum upset.

Why “On-The-Fly” Pallet Replacement System

- **Extended Pallet Component Life-** The most severe temperature condition for the grate bars, center casting, and upper sidewalls occurs when the pallets are stopped in the firing zone. This problem in pallet change-out, as you are probably aware, has destroyed pallets. By eliminating the requirement for stopping, component life will be increased as well as the time interval between reversing sagged .
- **Fuel Savings-** No fuel loss during the shut-down for replacement.
- **Safety -** With “On-the-Fly” Pallet Removal, it is not necessary for anyone to go near the pallet replacement area. Eliminating the possibility of personal injury caused by human error!

Summary

- Increased Production
- Extended Pallet Component Life
- Improved Pellet Quality
- Fuel Savings
- Improved Personnel Safety