

20 HIGH CLUSTER MILL

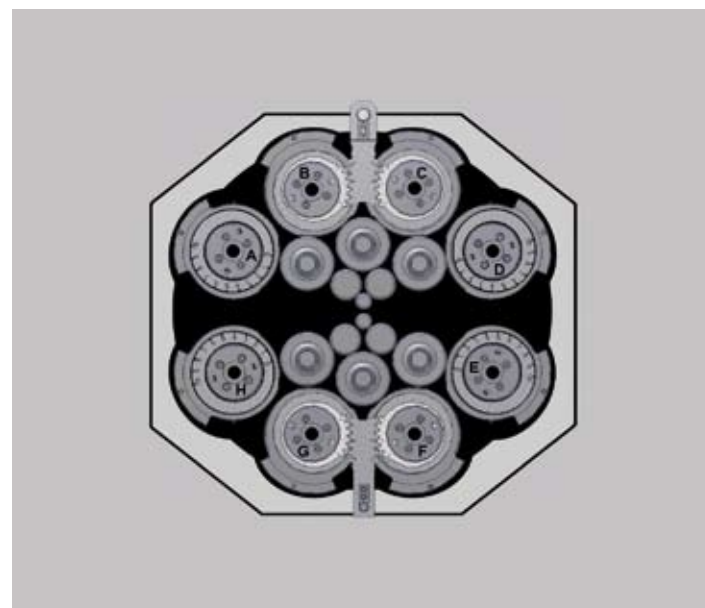
Roll Gap Adjustment is by two hydraulic cylinders mounted on top of the mill housing. The cylinder rods are fitted with gear racks which mesh with and rotate the gear segments mounted on the backing assemblies.

Dynamic Power Crown Adjustment is included on the backing assemblies to compensate for thickness variations (Shape) across the width of the strip as it is rolled. Actuation is by hydraulic cylinder with linear encoders at each position (corresponding to the bearing saddles) across the width of the mill. Also, provided are) digital bar graphs for mounting on the operator desk. These bar graphs indicate position of each crown.

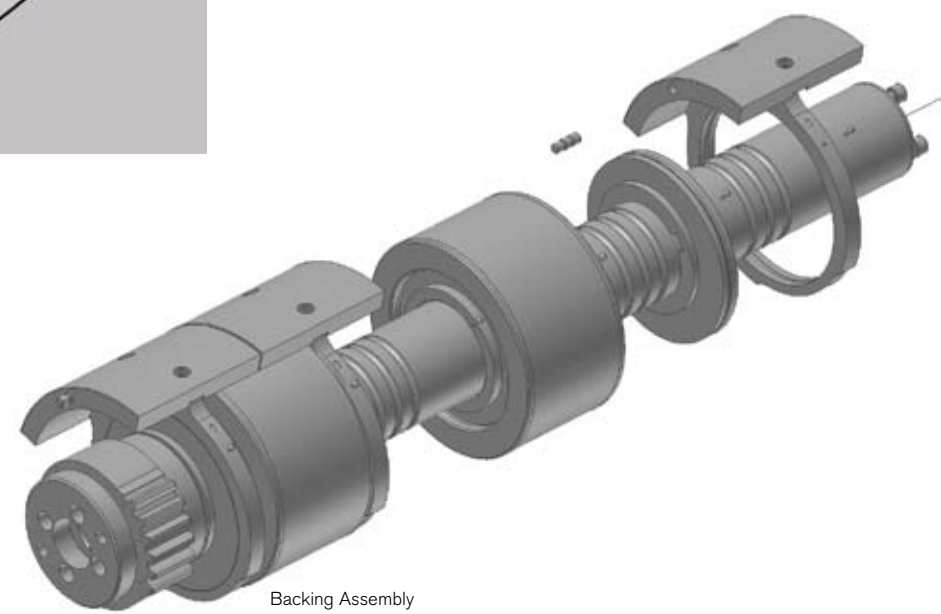
First Intermediate Rolls are Laterally Adjustable (both upper and both lower). These rolls have tapers at opposite ends, the effective flat position can be varied to control the shape of the strip edges. Lateral adjustment is power operated by hydraulic actuators; one for the two upper rolls and one for the two lower rolls.

Side Eccentric Rotation of backing assemblies provides adjustment which compensates for all roll sizes A, D, E and H is by hydraulic motors.

Pass Line Adjustment by the two lower backing shafts, F and G are used to locate the pass line by positioning the lower work roll. This lower roll position is also hydraulically operated but under "no load" condition.



Roll Cluster



Backing Assembly



Tenova I2S
I2S, LLC
475 Main Street
Yalesville, CT 06492-1723 - USA
Phone +1 203 265 5684
Fax +1 203 284 1819
sales@i2s.com

I2S Trade (Shanghai) Co. Ltd.
Apollo Building, Room #511
1440 Yan An Road (C)
Shanghai, 200040 - China
Phone +86 21 62483170
Fax +86 21 62483063
sales@i2strade.com

Tenova STRIP PROCESSING
Tenova SpA
Via Monte Rosa, 93
20149 Milan - Italy
Phone +39 02 43847785
Fax +39 02 43847621
stripprocessing@it.tenovagroup.com

POMINI Tenova
Tenova SpA
Via Leonardo da Vinci, 20
21053 Castellanza (VA) - Italy
Phone +39 0331 444356
Fax +39 0331 444390
pomini@it.tenovagroup.com

www.tenovagroup.com

TECHINT GROUP

Tenova CORE
Core Furnace Systems Corp.
Cherrington Corporate Center
100 Corporate Center Drive
Coraopolis, PA 15108-3185 - USA
Phone +1 412 262 2240
Fax +1 412 262 2055
info@corefurnace.com

Tenova LOI ITALIMPIANTI
LOI Thermprocess GmbH
Am Lichtbogen 29
45141 Essen - Germany
Phone +49 201 1891 1
Fax +49 201 1891 321
info@loi-italimpianti.de

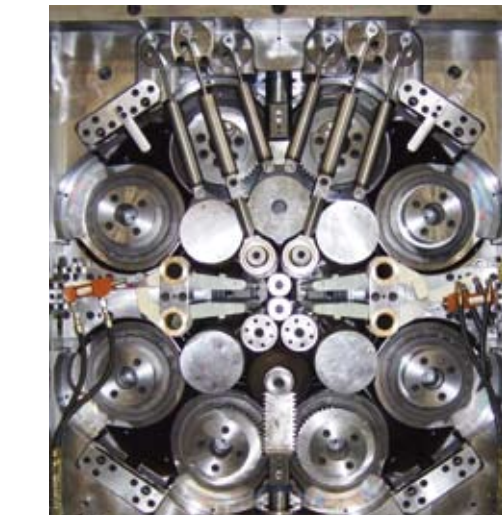


Tenova is a world-wide supplier of advanced technologies, products and services for the metal and mining industries providing innovative integrated solutions. Combined process automation and metallurgical know-how enhance the value delivered to the customers. Tenova is committed further to develop its technology in the areas that mostly impact the future of the industries it serves: quality of the products delivered by the customers, energy savings and environmental safeguard.

20 High Mills are used for high speed production of extremely fine strip for both ferrous and nonferrous metals. The systems impressive accuracy tolerances deliver performance levels unmatched by traditional mills.

The 20 High Cluster Mill is a multi-roll system having a unique roll configuration with adjustment capabilities to control strip shape and compensate for the effects of rolling a range of different strip widths. In addition, 20 High Cluster Mills utilize small diameter work rolls which allow higher percentage reductions on harder materials than other mill configurations.

Tenova I2S is one of a small group of companies with the world class ability licensed to produce T. Sendzimir Inc. 20 High Cluster Mills.



20 High Cluster Mill Sizes are referred to by standard nomenclature. The maximum thickness of the incoming strip and the minimum thickness of the finished product are factors affecting the determination of work roll diameter. Each type of metal to be cold rolled has a specific initial yield strength and characteristic increase in yield strength resulting from incremental thickness reductions. Yield strength, material width, work roll diameter and the amount of reduction determine the compressive force required to deform the specific metal to be processed. This ultimately results in selection of suitable backing bearings to transmit the forces to the mill housing, as well as, the housing dimensions required to withstand the forces. The nomenclature which references the mill section is therefore; a function of the backing bearing and since each bearing has a specific width, the nomenclature includes the width capacity in increments equal to the bearing width.

The following are typical mill sections and related data:

Mill Section	Possible Width Range		Incremental Width		Roll Separating Force	
	Inches	mm	Inches	mm	Lbs / In of Width	kN /mm
ZR 24	8.5" to 19.5"	215.9 to 495.3	2.75"	69.85	13,300	2.33
ZR 33	13.0" to 48.0"	330.2 to 1,219.2	3.37"	85.60	17,700	3.10
ZR 23	19.0" to 62.0"	482.6 to 1,574.8	6.00"	152.4	25,000	4.38
ZR 22	25.0" to 120.0"	635.0 to 3,048.0	8.0" or 8.5"	203.2 or 215.9	33,000	5.78
ZR 21	33.0" to 165.0"	838.2 to 4,191.0	11.0"	278.4	45,000	7.88

Mill Modernization by Tenova I2S target increased Mill operation efficiencies, improved productivity and strip quality. Our modernizations cover the full range of Mechanical, Electrical, Automation and Control systems. The typical Tenova I2S modernization scheme includes supply of Automation & Mill Control, AGC, SPC, HMI, PLC, Drives, Hydraulic Roll Force conversion, and mechanical upgrades.



20 High Cluster Mills

Advanced technologies for quality and performance

TENOVA is a world-wide supplier of advanced technologies, products and services for the metal and mining industries.



Entry section

- Coil Lift & Transfer
- Paper Take-up
- Payoff Reel with Driven Hold-down Roll, Coil Peeler, & Outboard Mandrel Support
- Strip Centering, Payoff Positioning
- Feeder/ Leveler
- Thread Table

Left Side

- Tension Reel with Stripper Plate, Hold-down Roll, & Outboard Mandrel Support
- Paper Handlers
- Coil Lift & Transfer
- Guide Table
- Pinch Roll
- Tensiometer with Load Cells
- Shape Measurement Roll
- Strip Thickness Gauge
- Strip Wipers

Mill Section

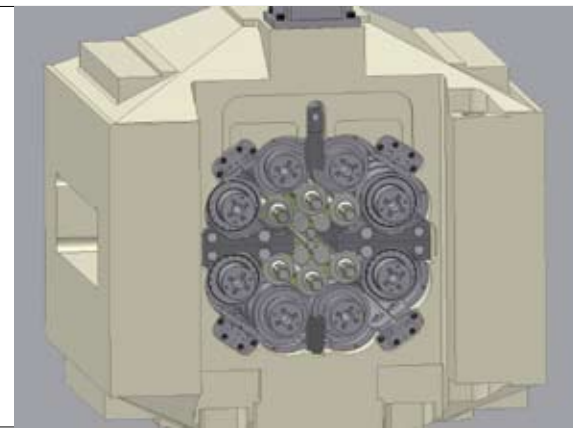
- 20 High Mill Reversing Mill with:
 - Roll Force Cylinders (HAGC)
 - Dynamic Power Crowns
 - Intermediate Roll Lateral Shifting
 - Side Eccentric Adjustment
 - Pass Line Adjustment
 - Coolant Sprays
 - Mill Panel

Right Side

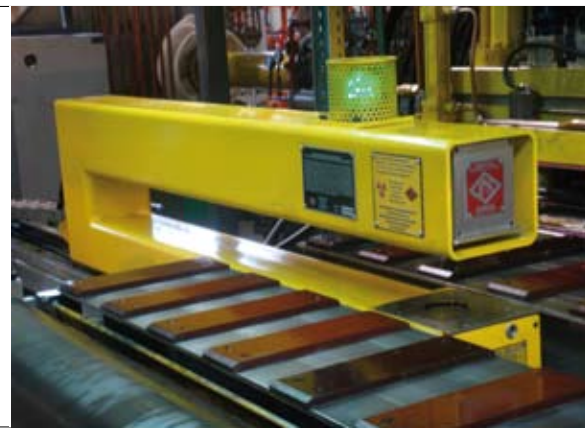
- Strip Wipers
- Strip Thickness Gauge
- Shape Measurement Roll with edge /center-line detection
- Tensiometer with Load Cells
- Pinch Roll
- Guide Table
- Tension Reel with Stripper Plate, Hold-down Roll, & Outboard Mandrel Support
- Automatic Belt Wrapper
- Paper Handlers
- Coil Lift & Transfer



Shape Measurement Roll



Monoblock Mill Housing



Strip Thickness Gauge



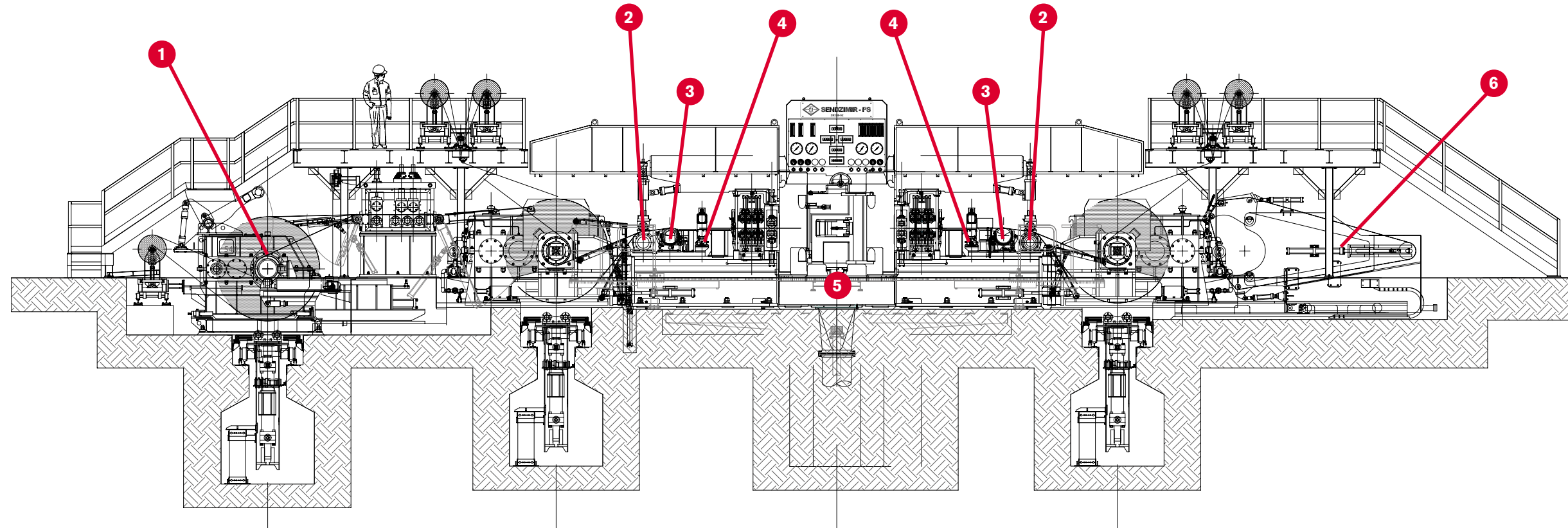
Mill power crowns



Main operators screen



Mill front panel



1. Payoff
Moveable with automatic center-guide system. Auto loading of coil onto mandrel

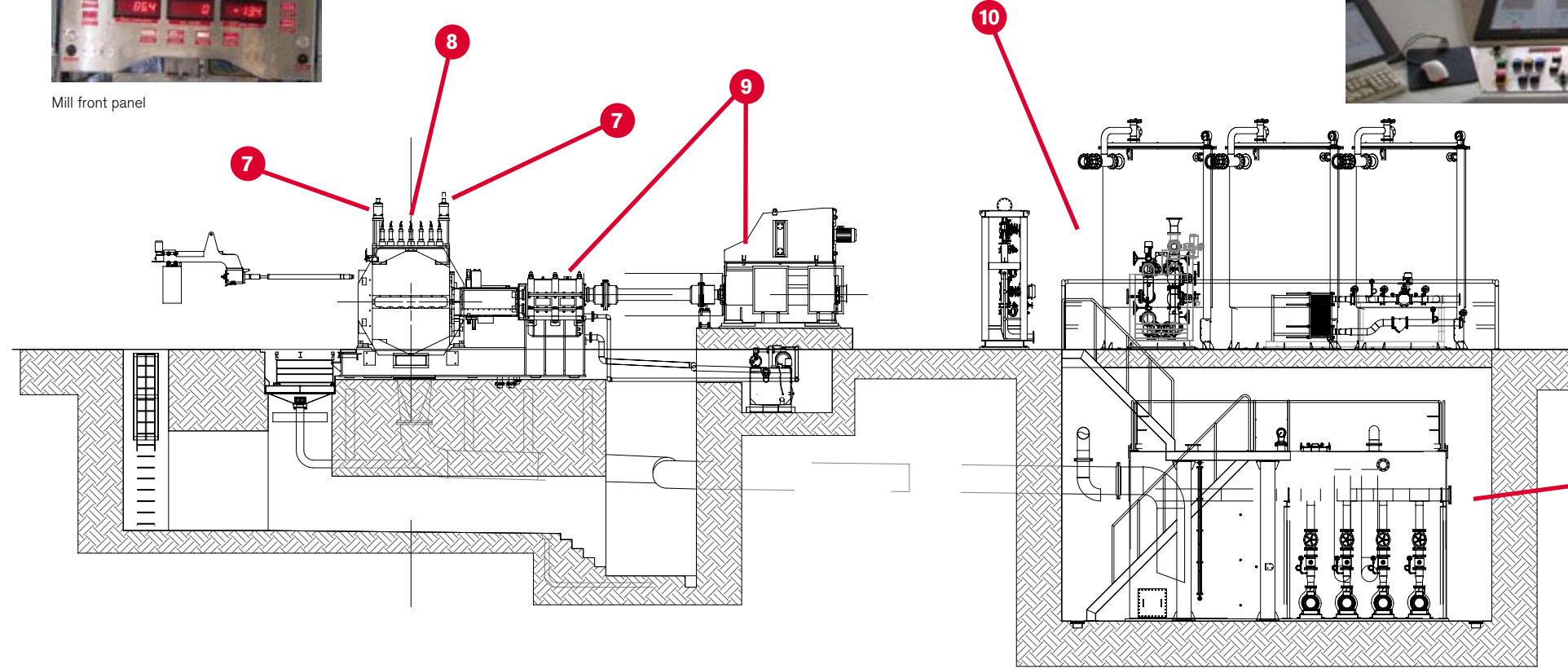
2. Deflector Roll
with Load Cell Tensiometer provides accurate regulation of strip tension

3. Shape Measurement Roll
Measures shape across the entire width of strip with edge centerline strip detection for accurate AFC application

4. Strip Thickness Gauges
Measures and control accurate strip thickness of strip for accurate AGC application

5. Monoblock Mill Housing
With Hydraulic Roll Gap System & Tenova I2S Automatic Gauge Control System. Hydraulic Power Crowns interfaced to Automatic Strip Shape System. Tenova I2S Mill Automation System Coolant Sprays Mill Panel

6. Belt Wrapper
Used for initially wrapping the leading end of thin strip around the Tension Reel



7. Hydraulic Roll Force Cylinders
Front & Rear Servo Controlled Hydraulic Cylinders (HAGC) Automatic Gauge Control System

8. Dynamic Power Crowns
Hydraulic Cylinders for shape control actuation. Interface to Automatic Flatness System

9. Pinion Stand & Mill Drive Motor
Four Spindles drive Intermediate Rolls Coordinated Digital Drive System

10. Coolant System
Mineral Oil or Emulsion System Designed to suit the specific mill and product application

Right Side View

The Tenova I2S mill automation systems are designed to offer a broad range of capabilities, from narrowly defined, surgical modernization projects to comprehensive, fully integrated control, automation and drive system, including high level production supervision, planning and support. Each system implementation is highly customized to facilitate the needs and requirements of the mill and end-user / customer.

The system architecture is based on a flexible / modular organization that is implemented by a network interconnected, multi-computer, distributed control system concept. The system hierarchy spans the classical Level 0 (instrumentation & actuation) through Level 2+ (operational management & production support), and offers sophisticated interfacing with Level 3+ systems.

The highly networked nature of this architecture provides extensive information sharing among the system's components, where these components have been designed for flexible application and interfacing, thereby allowing them to function in stand-alone operations to actively participating in fully integrated, comprehensive mill control and automation systems.



Typical components in a comprehensive, fully integrated mill control and automation system include:

Level 0

- Instrumentation, Sensing & Actuation
- Strip Thickness Measurement
- Strip Tension, Speed / Length Measurement
- Strip Shape / Flatness Measurement
- Power Conversion & Drive Systems

Level 1

- Mill Master Control
- Network Systems
- Automation Databases
- Drive Control / Coordination (Strip Transport & Tension Control)
- Precision Servo Controls
- Automatic Strip Thickness Control (AGC)
- Automatic Strip Shape / Flatness Control (AFC)
- Graphical User Interfaces (HMI)
- Engineering Data Logging & Analysis (IBA)
- Maintenance Support & Remote Accessibility

Level 2

- Mill Management
- Production Support
- Pass & Shape Target Scheduling
- Mathematical Modeling
- Performance & Engineering Reporting
- SPC / QC Quality Analysis & Reporting
- Production & Mill Operations Reporting
- Database Historian
- Roll Cluster Modeling & Set-Up
- Level 3+ Interfacing