

# MAG-GATE™ System for Molten Metal Flow Control

Under the Technology Roadmap Program for the American Iron and Steel Institute and the Department of Energy, Concept Engineering Group Inc. has developed MAG-GATE™, an electromagnetic system for active molten metal flow control.

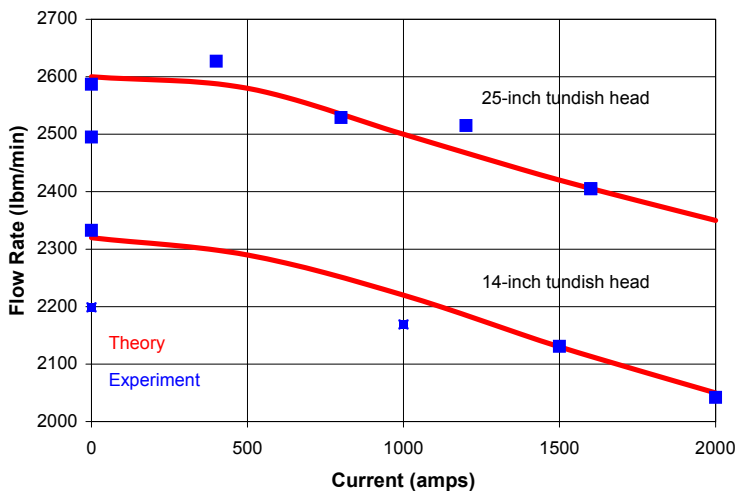
## Benefits

In a modern steel continuous caster, control of the flow of the molten metal from the tundish to the mold is a critical location. Active electromagnetic flow control can improve quality and yield, save energy, and reduce costs by:

- Eliminating wear and replacement of moving parts in slidegates and stopper rods
- Reducing stream roughness / turbulence, reoxidation, and impurity entrapment
- Providing an independent means to maintain constant mold level
- Countering refractory erosion or nozzle clogging
- Increasing sequence length

## Alpha Testing

Two successful tests with hot metal have been performed at the Whemco Foundry Division, Midland, PA. Approximately 110,000 pounds of 0.2% carbon steel were poured through the device subject to electromagnetic flow control. A very smooth steel stream was achieved. Temperatures of the device surrounding the molten steel were stable and extremely good cooling of the electric coils was achieved. Excellent agreement was seen between expected theoretical performance and actual test results.



Hot metal test stand at Whemco Foundry, Midland PA



Prototype MAG-GATE™ device mounted to bottom of test tundish



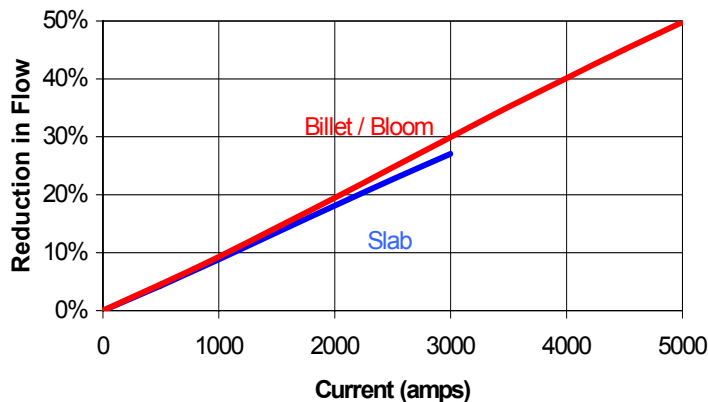
# MAG-GATE™ Information

A recent survey by AIM Market Research of North American continuous casters producing 89 million tons of steel in 2003 identified 18 casters as likely candidates for MAG-GATE™.

## Caster Average Design Specifications

Caster Type	Tundish Height (in)	Casting Rate (lbm/min)	Sequence Length (tons/strand)	Maximum Flow Reduction
Billet / Bloom	31	850	250	50%
Slab	39	5600	2900	25%

## Performance



Design Parameters	Billet / Bloom	Slab
Flow Reduction	50%	25%
Height (in)	16	24
Diameter (in)	9	22
Bore (in)	2	4
Coils	4	3
Pour Tube ID (in)	0.8	1.6
Current (amps)	4700	3100
Power (kw)	1400	330

## Pay back Comparison

Capital Costs per strand	Slab	Billet / bloom	Billet / bloom
Flow Reduction	25%	25%	50%
Mag-Gate™ device	\$ 15,000	\$ 18,000	\$ 18,000
Guillotine safety gate	\$ 5,000	\$ 5,000	\$ 5,000
Electric Power Supply	\$ 17,000	\$ 26,000	\$ 78,000
Water System	\$ 12,000	\$ 15,000	\$ 30,000
Hoses and cables	\$ 4,000	\$ 4,000	\$ 8,000
Computer Interface	\$ 2,000	\$ 2,000	\$ 2,000
Total	\$ 55,000	\$ 70,000	\$ 141,000

Flow Control	Caster types	Months
Slide-gate	Slab, bloom, & billet	6 to 12
Stopper rod	Slab	6 to 12
Stopper rod	Billet & bloom	18

Based on 25% flow reduction capability that most caster operator's commented dictating aborting a strand

## Open Pouring

- Double casting time using oversize bore
- Saves ~ \$6 / ton for a 4 strand billet caster producing 1000 ton / day

## Energy Savings

Mature use of MAG-GATE™ could save 400,000 barrels of oil per year

Per ton Operating Costs	Slab	Billet / bloom	Billet / bloom
Flow Reduction	25%	25%	50%
Electricity	\$ 0.04	\$ 0.40	\$ 1.20
Refractory	\$ 0.04	\$ 0.50	\$ 0.50
Total	\$ 0.08	\$ 0.90	\$ 1.70

Full report is available at the AISI web site

Mr. Richard Nathenson, P.E.  
 Concept Engineering Group Inc.  
 15 Plum Street, Verona, PA 15147  
 Phone: 412-826-8800 Fax: 412-826-8601  
 Email: ceg@air-spade.com www.air-spade.com

Messrs: Joe Vehec or Tom Stackrow  
 American Iron and Steel Institute  
 680 Anderson Drive, Pittsburgh, PA 15220  
 Phone: 412-922-2772 Fax: 412-922-3213  
 Email: aisiap@aol.com www.steel-trp.org