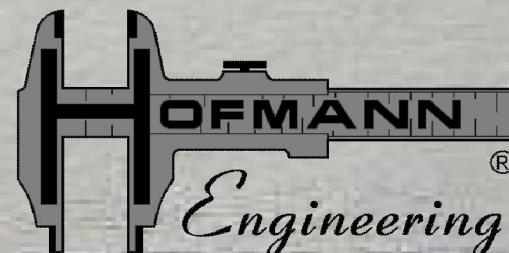


Australian Innovations in Roller Press and Large Grinding Mill and Kiln Gear Manufacture



Hofmann Engineering Pty Ltd

3 Alice Street, BASSENDEAN 6054

Western Australia

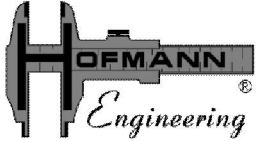
Ph: (+61 8) 9279 5522

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EMAIL: mail@hofmannengineering.com

www.hofmannengineering.com





Presented by

Jarrood Hofmann

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| Case Study 1 | Roller Press Innovations |
| Case Study 2 | Fast Tracked Manufacture of Mill Shells,
Heads & Kiln Tyres |
| Case Study 3 | Onsite Gear Metrology & Gear-Drive Mill
Designs to 44 ft. Diameter |



Company Overview

- 100% owned family business
- 5 manufacturing sites – Perth, Melbourne, Bendigo, Newcastle, South America (Chile)
Offices – QLD, USA, India, China, Peru
- 600 employees approximately
- 24 hours x 7 day week service



Hofmann Melbourne, VIC



Hofmann Newcastle,
NSW



Hofmann Bendigo, VIC

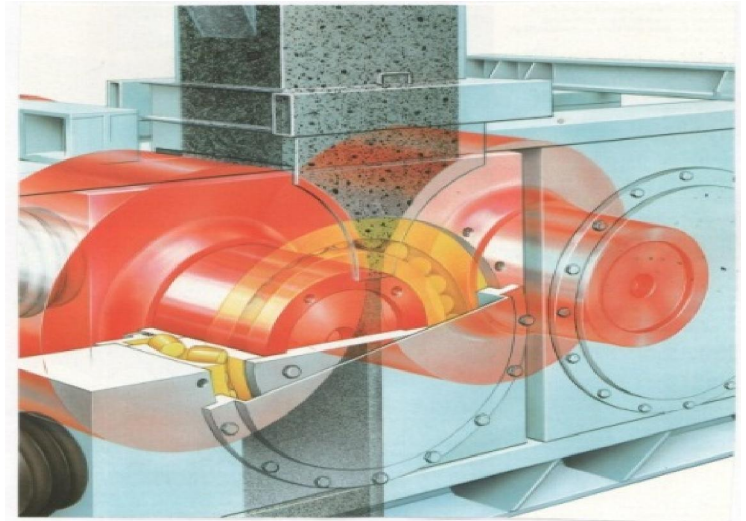


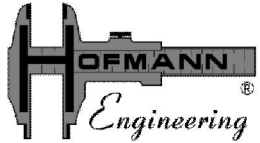
Corporate Headquarters Perth, WA

Case Study 1: Roller Press Tyres

Current Challenges Presented:

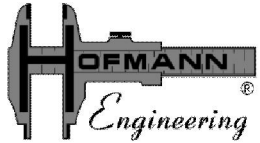
- Premature Wear on Rolls
- Damage to roll surface
- Short life of Tyres/Rolls
- Customers looking at reducing costs
- Increasing throughput requirements
- To achieve consistent product size P_{80}





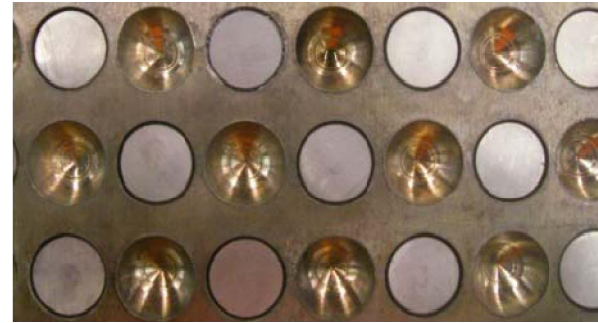
Issue: Maintaining Autogenous Layer





Solution: Modification to tyre design

- Improve feeding conditions of machine. I.e choke feed, moisture content, control of segregation
- Modify Stud pattern & design or chevron design for hard-faced tyres

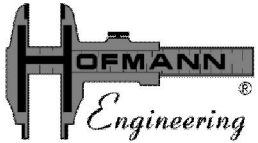




Positive Results

Regular Wear & Autogenous Layer after 35000 hrs - Cement Application



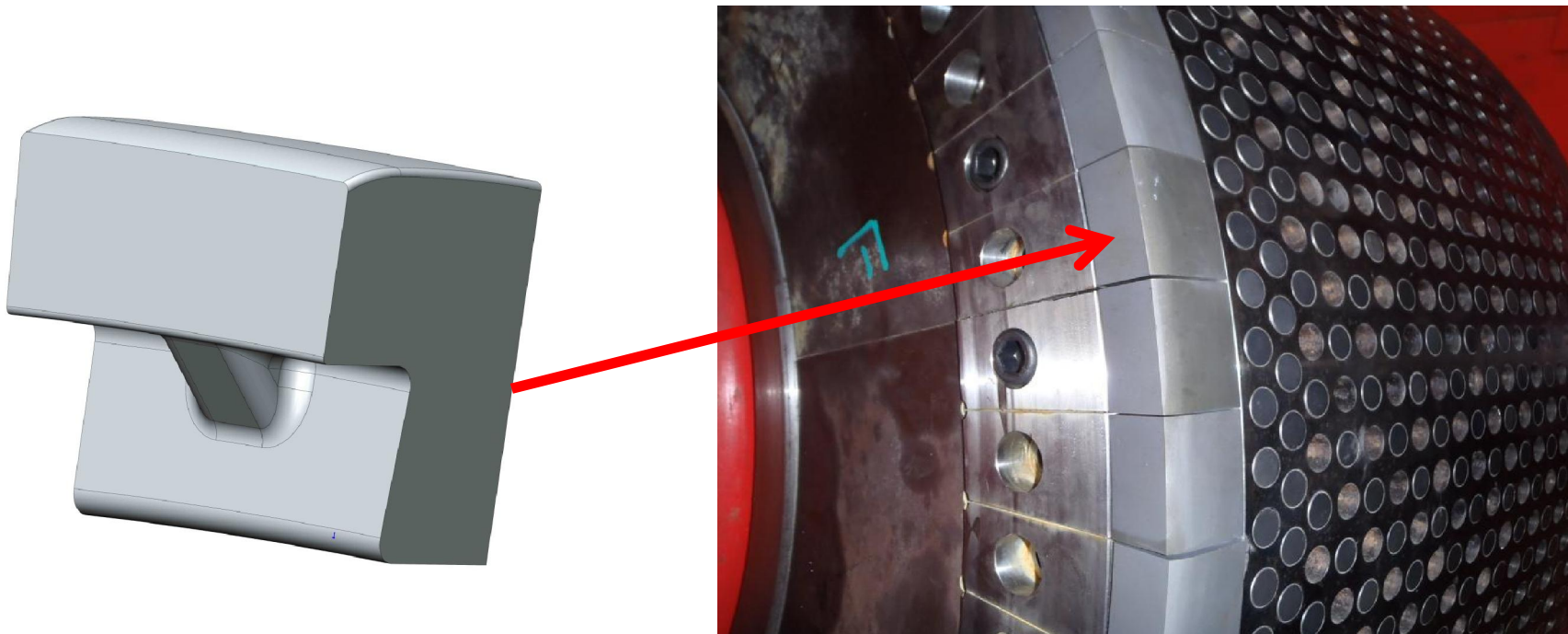


Issue: Edge Wear and breakage





Solution: Hofmann Patented Edge Protection



Cannot Break Off Causing Accelerated Wear

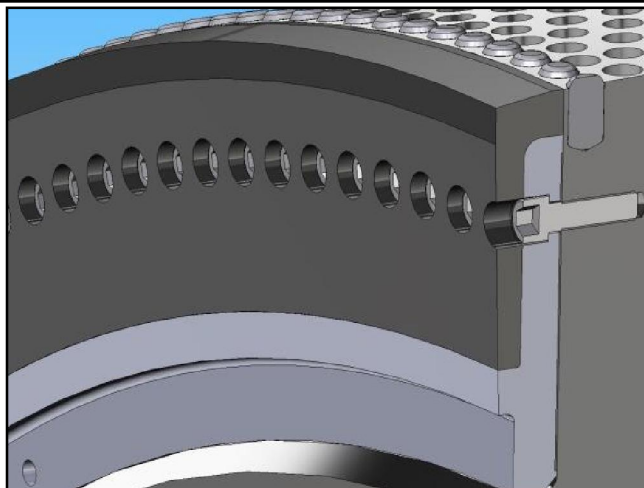


Bolt on Hofmann Hard-faced Segments



Conventional Side Face protection Solution
for Cement:

Hardfacing direct onto tyre



Hofmann Solution:

Bolt on Segments with tri-metallic hard
face consumable overlayed onto
quench & tempered plate.

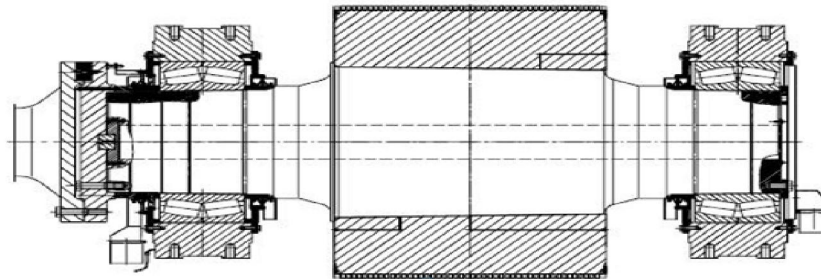
Can be replaced if damaged or worn.

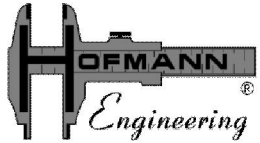
Overview of Assembly



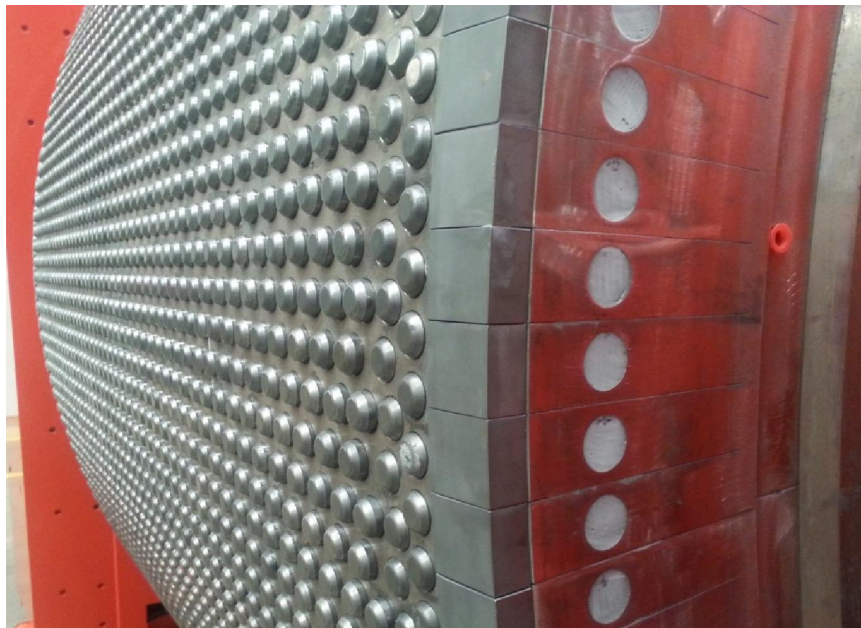
Tapered or Parallel Shaft

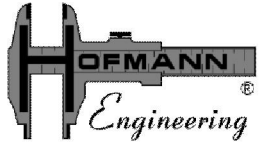
- Temperature Controlled
- Large Crane Capacity 200t
- 25m High building





Completed Roller Press





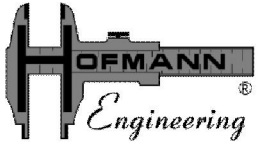
Hofmann Roller Press Installation





Case Study 2: Fast Tracked Manufacture of Mill Shells, Heads & Kiln Tyres





Mill Shell Material Options to Ø44 ft

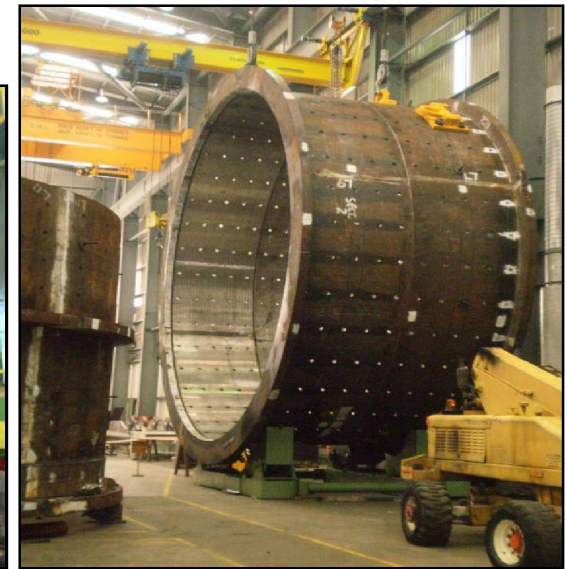
- Carbon Steel
- Carbon Steel with explosive bonded Stainless cladding
- Carbon Steel with welded Stainless strip cladding
- Solid duplex Stainless steel



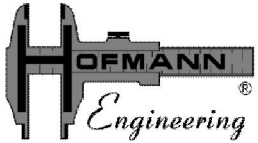
CARBON STEEL MILL SHELL



SOLID STAINLESS STEEL MILL SHELL



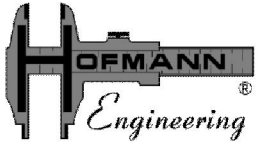
**STAINLESS STEEL CLAD
MILL SHELL**



Shell Plate Preparation

- Typical Grades: AS3678-Grade 250, EN S235JR, EN S275JR, ASTM A36 or Q235B (modified)
- Duplex STST and Stainless Steel Clad Material available
- Segments and plates profiled to shape with bevelling for weld preps
- Farley Plasma Cutter: 4m x 22m travel (Hofmann Bendigo)

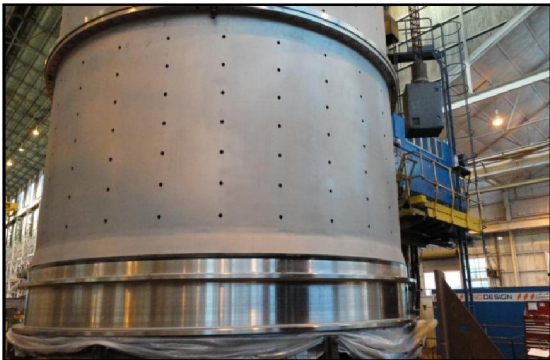


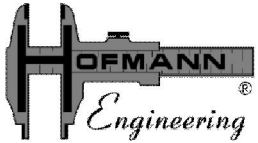


Manufacturing Capability

MACHINE CAPACITY

- Shell Size up to Ø13.4m (44ft.) diameter inside shell.
- 210 tonne (231ton) x 17m (55.7ft.) under crane hook lift.
- Large 15.3m (50ft.) x 5.0m (16ft.) high and 12m (39ft.) x 3.9m (12.8ft.) high Floor Borers.
- Szim Mill with Ø16m (52ft.) x 6m (19.7ft.) x 300 tonne (330ton) capacity rotary table.
- Heat Treatment: Stress Relieving to Ø14m x 4m high.
- Abrasive Blast / Paint Booths.



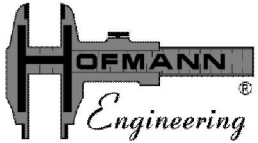


Vertical Presses 6,000t and 3,000t



- Max 6,000 Tonne Vertical Rolling Press
- Max thickness 220mm
- Width 3,650mm
- Hardness 390 BHN





Mill Heads Material Options

- Cast SG/Nodular Iron
- Cast Steel
- Fabricated Steel
- Fabricated Steel with welded duplex Stainless steel strip cladding





Finish Machining Processes

Machining and drilling

- Hofmann Engineering's machining facilities can accommodate sizes up to Ø15m





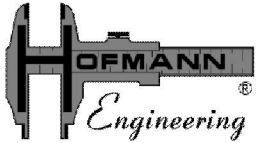
Despatch



Issue – Failed Mill Head

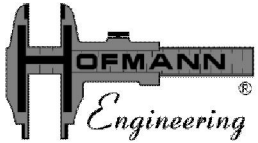


- Failed cast head. Cracking & washing out of flange interface surface



Replacement Options

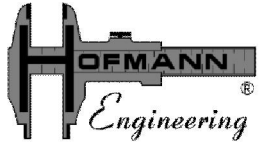
1. Cast Head (26 - 30 weeks delivery).
2. Fabricate head using forged plate & used roller press tyre for trunnion @ Hofmann Engineering (4 weeks delivery).



Fast Tracked Mill Head



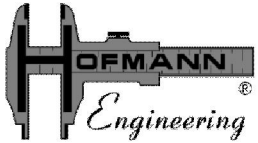
- High Strength forged plate
- Roller Press Tyre used for trunnion
- Full ultrasonic testing of materials & welds
- Controlled Weld process & stress relieving



Finish Machining & Despatch



- Final Machining & Transportation with Antonov aircraft to plant

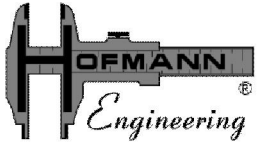


Purpose built facing machine



- Trial fitting of machine in workshop
- Installation and alignment of machine on-site





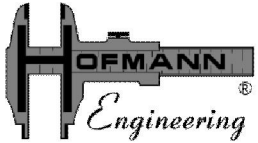
Machining of Mill Onsite



Completion

- Head successfully installed & Mill re-commissioned

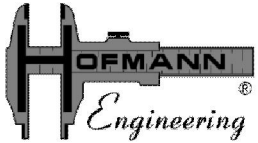




The Issue - Failed Kiln Tyre



Photo Courtesy of
Holcim New Zealand



Replacement Options

1. Source a second hand tyre and fit it to kiln (12 - 14 weeks delivery).
2. New Cast Tyre (14 - 18 weeks delivery).
3. Fabricate a tyre out of forged plate @ Hofmann Engineering (4 weeks delivery).

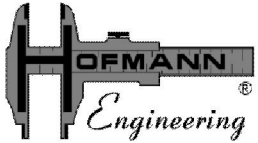
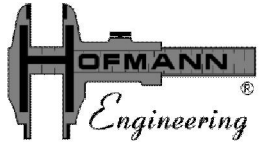


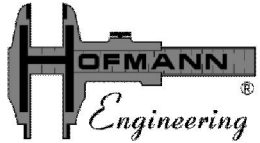
Plate Bending & Fabrication





Finish Machining





Successful Commissioning





- Completely portable: 1 item of luggage or
- 



EXAMPLES OF APPLICATIONS



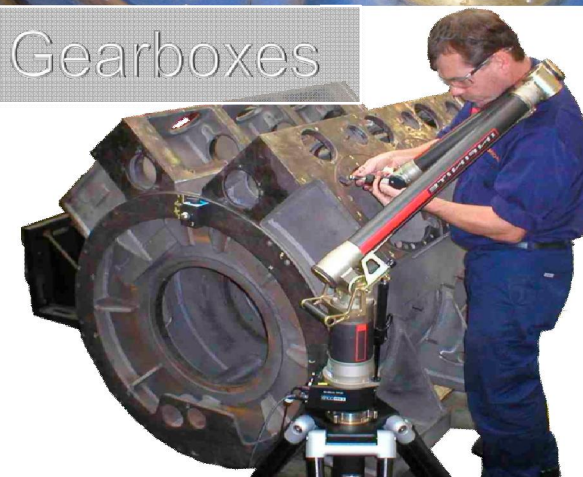
Mill Gearing



Shovels



Gearboxes



Onsite Metrology



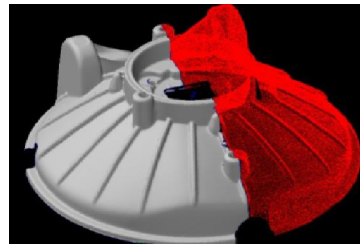
6-axis Portable CMM

- 3.0m Range in One Position
- Accuracy to 20µm



Laser Scanner

- Attaches to 6-axis PCMM's
- Scans a 3D image of the part into software to create a model



Laser Tracker

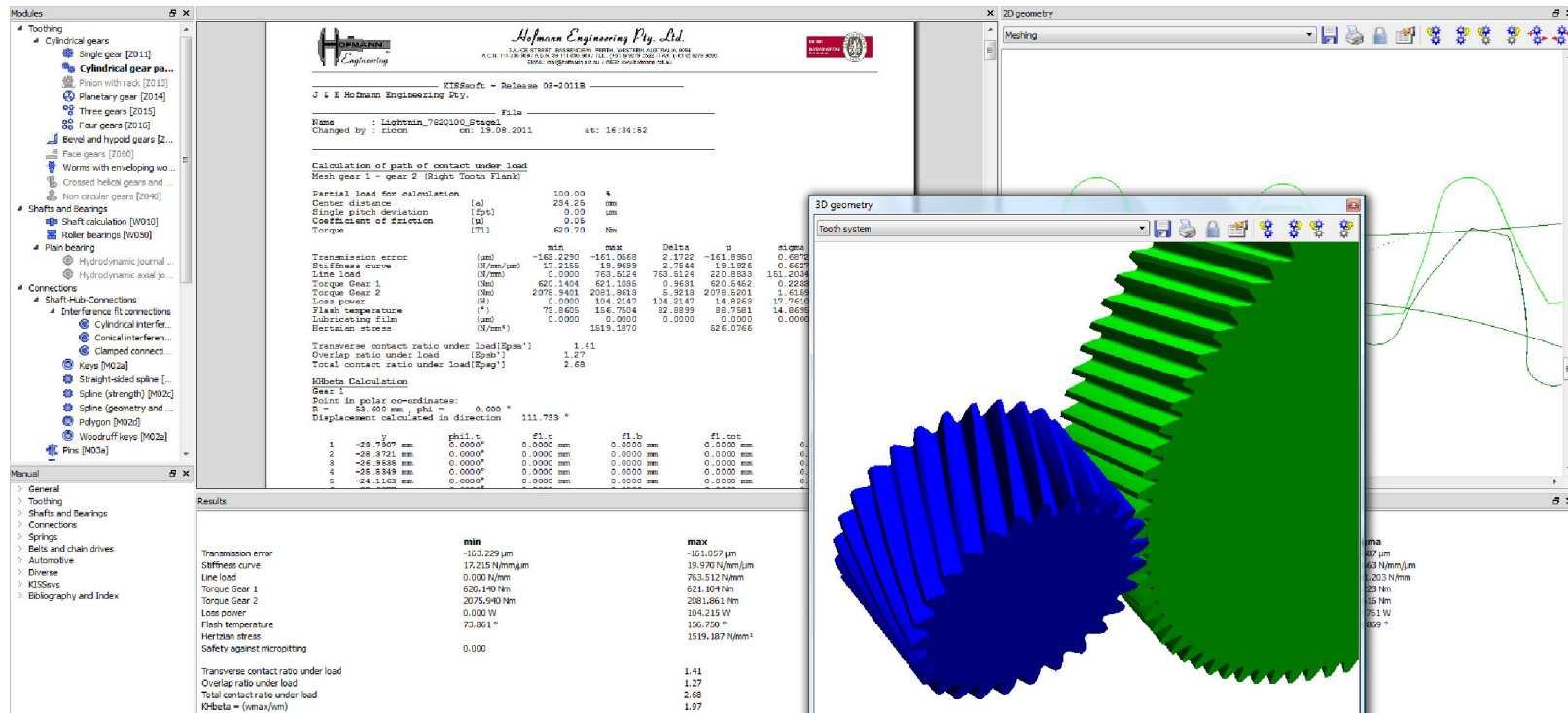
- $\pm 360^\circ$ Horizontal Rotation
- $\pm 145^\circ$ Vertical Rotation
- 320m Radial Measuring Volume
- Angular Accuracy of 45µm/10m



Design – Calculation Software

Mechanical Component and Gear Design using state-of-the art software

SPUR, HELICAL, DOUBLE HELICAL GEARS AND SPLINES

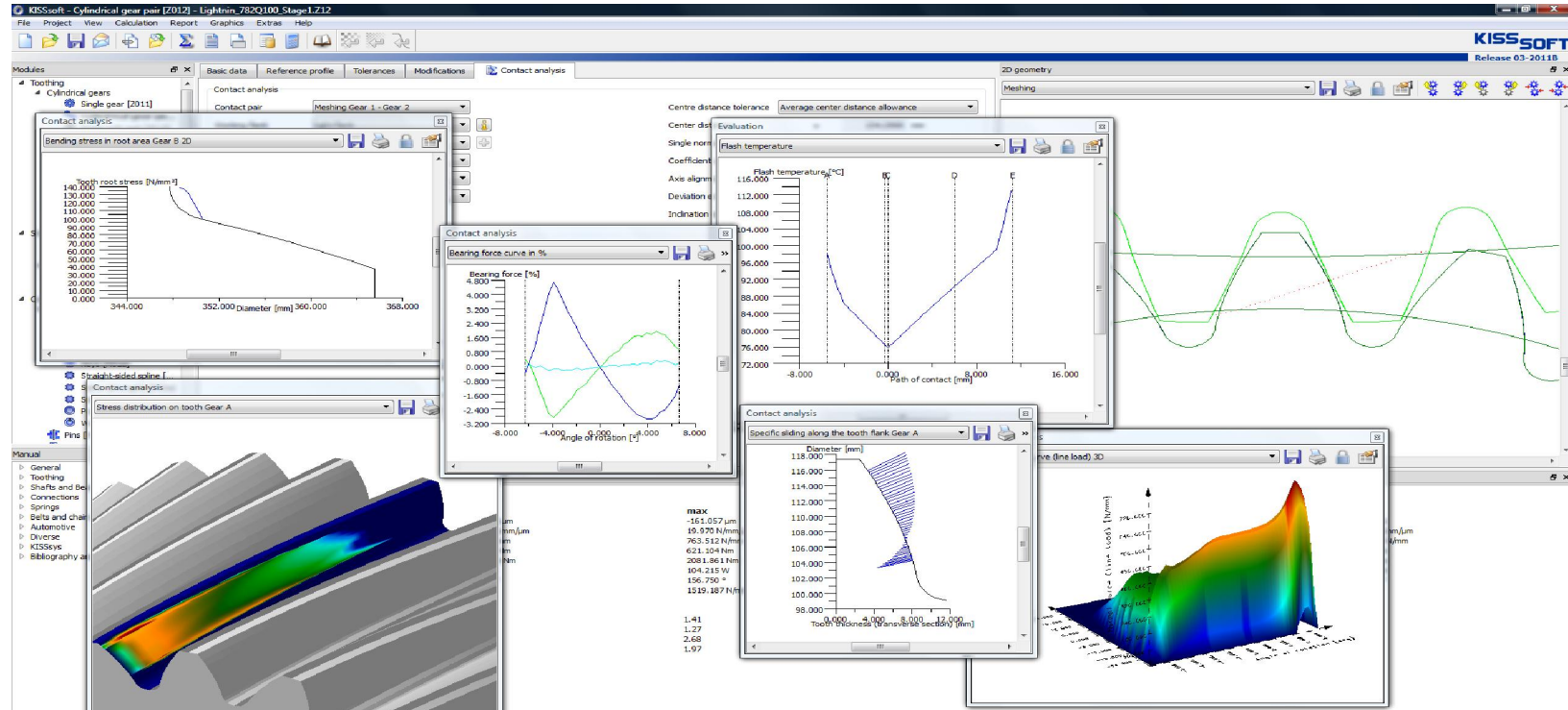




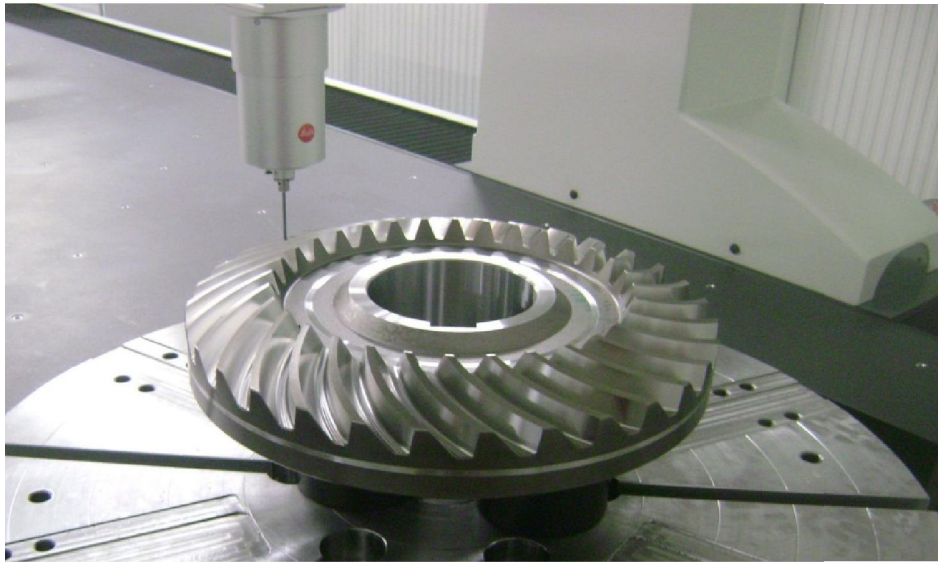
Design - Calculation Software

Mechanical Component and Gear Design using state-of-the art software

GEAR TOOTH OPTIMISATION – CONTACT ANALYSIS AND MODIFICATIONS

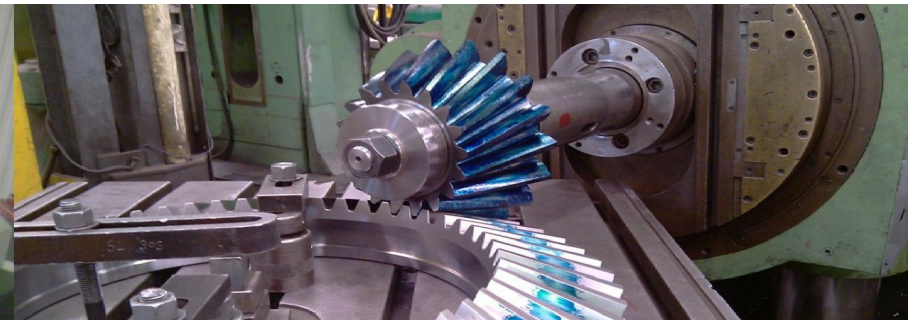


Qual Inspection



CMM Inspection

Gearbox Load Testing to
2,000kW



Mesh Testing





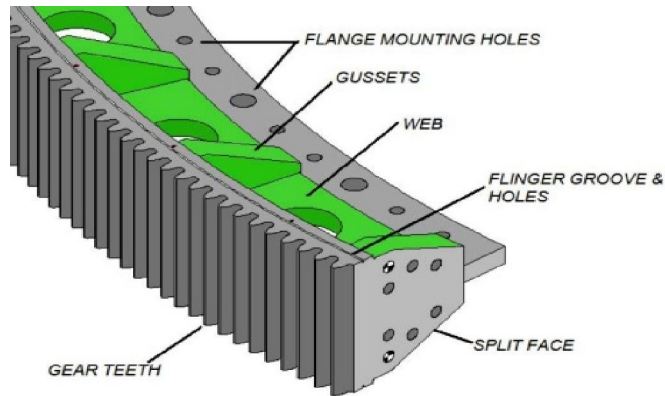
Largest Forged Fabricated Steel Gear

Ø13.2m (43.3ft) Diameter





Enabling Technology-Hofalloy Forged Steel Gears





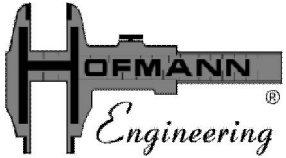
Hofalloy Gear Rim Plate

- AGMA 2001 - C95 Grade 2 Material
- Forged material with Reduction Ratio of minimum 3 : 1
- Quenched and Tempered to 320 BHN – 360 BHN
- Low total carbon equivalent – Ability to insitu weld repair in emergency situation
- Hardenability to 400+ BHN with Induction Hardening process

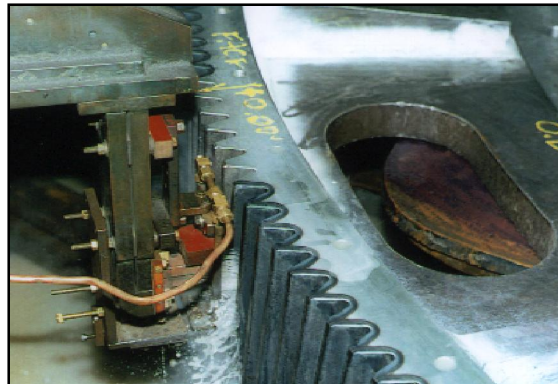
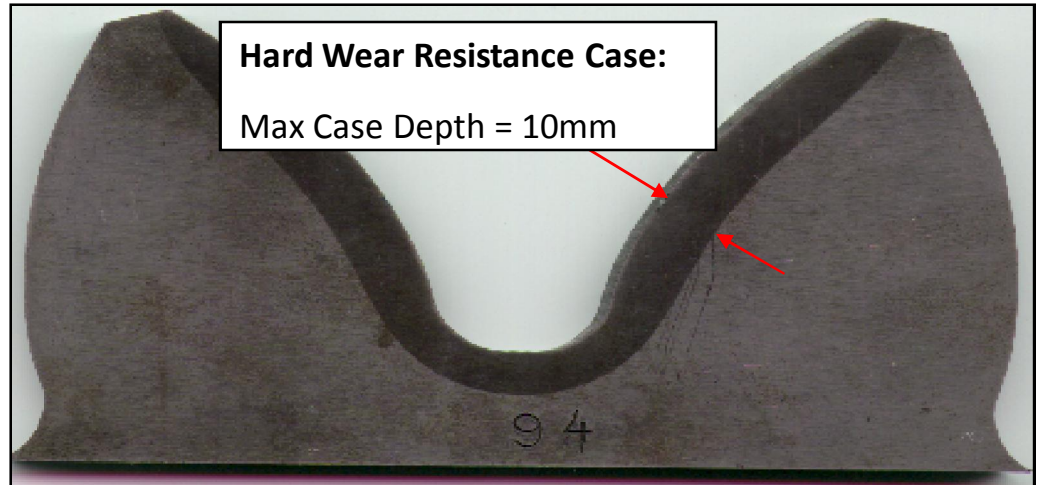
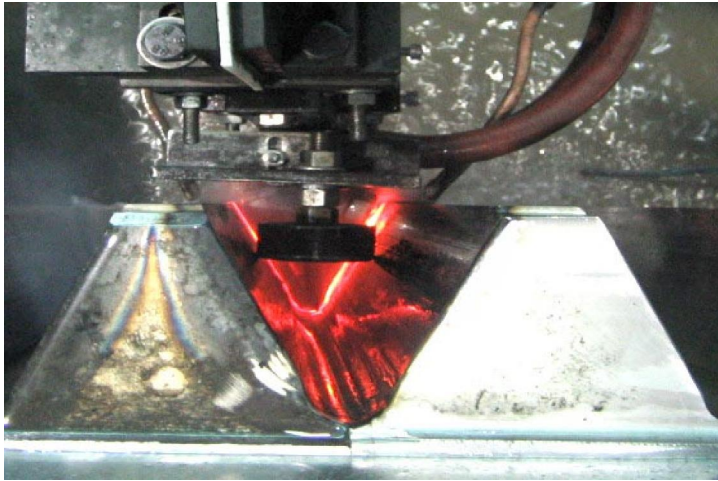
Currently **200** Hofalloy Gears

In service and on order; **20** years successful history

Comparative Data	Units	Cast Steel - Typical	Forged Steel - Hofalloy
Hardness (Min)	BHN	285	325 (up to 450BHN max)
Tensile Strength	MPa	880	1080
Elongation	Percent	8%	16%
Impact Resistance (0°C)	Joules	25	55



Induction Hardening of Hofalloy Gears





Hofalloy vs Cast Typical Steel Example Calculation

Input Parameters	
Power	4.1 MW/ 5,500 HP
SAG Mill Diameter	28 ft.
No. Of Pinions	1
Module	29.029 (7/8 DP)
Helix Angle	7° 15' 0"
Face Width	850 mm (33½")
Gear Diameter	10500 mm (34 ft.)

Calculated Service Factors to American Gear Manufacturers Standard, AGMA 2001		
	Cast Steel	Forged Fabricated Steel (Hofalloy)
Hardness (Brinell)	285	<u>320</u>
Csf Pitting/Durability S.F.	1.80	<u>2.25</u>
Ksf Strength/ Breakage S.F.	2.55	<u>2.80</u>

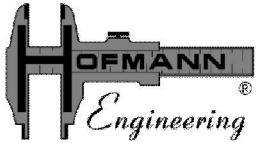
1. Maintain geometry of existing girth gear: **Increase durability** and **strength** service factors.
2. Maintain minimum required service factors: **Increase** the **power**, and therefore the throughput.
3. Maintain minimum required service factors: **Reduce** the face width and **weight** of new gears compared to cast steel gears.



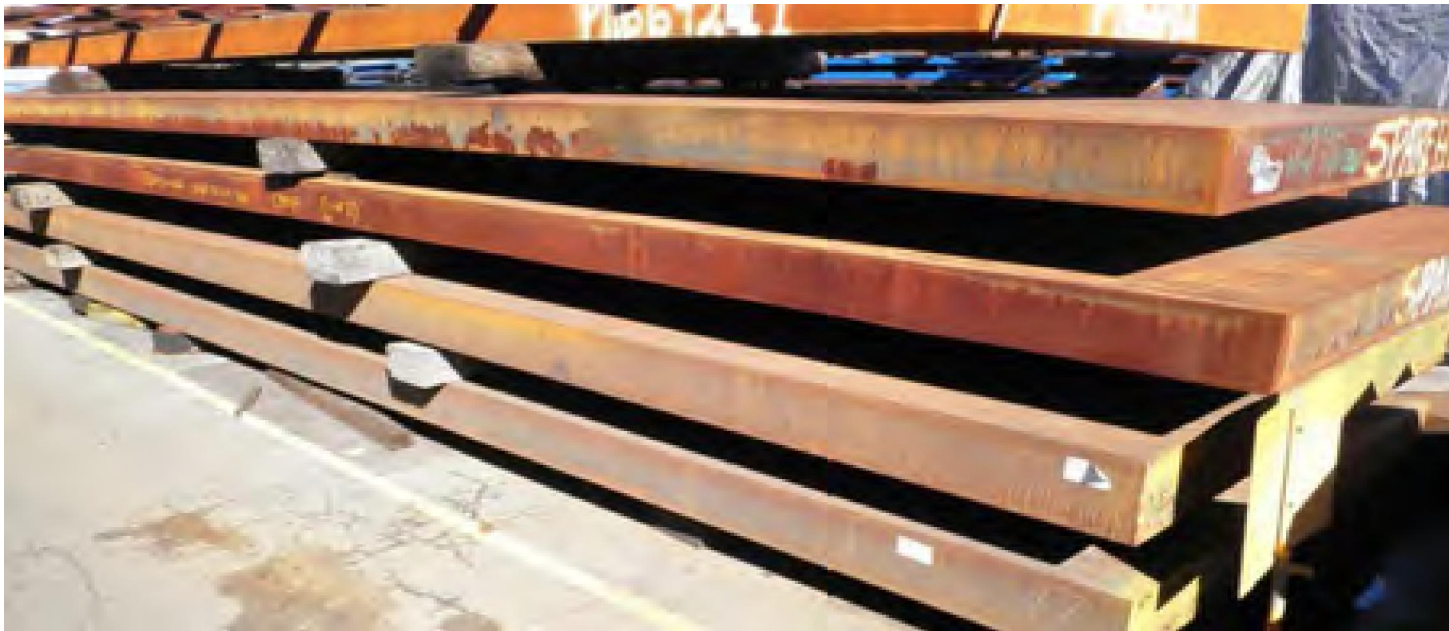
Ø15m Full CNC Gear Cutter

15m, 14m and 11m Gear Cutters





Insurance Spare Steel for Mill Fleets



Hofalloy Insurance Rim Plate Stocks up to 220mm thick

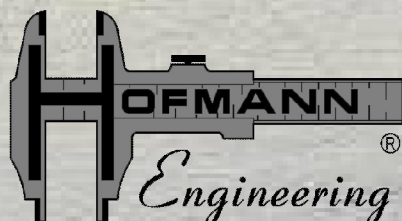
In excess of 350 tonnes of forged steel - 10 Corporate Clients

Delivery as fast as 10 weeks

Site Installation



Installation of induction hardened 420BHN forged steel gear on 36 ft. (11.0 m) Mill (2006)



Hofmann Engineering Pty Ltd (Head office)

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BASSENDEN 6054

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CAMBRIDGE ONTARIO

Ø **Hofmann Sudamerica**
Av. Pedro Aguirre Cerda 5802
ANTOFAGASTA CHILE



AS 9100

**BUREAU VERITAS
Certification**



ISO 9001

**BUREAU VERITAS
Certification**

