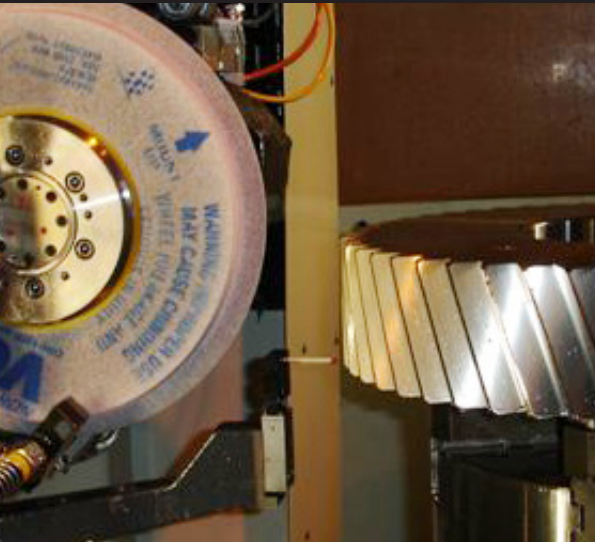


MACHINING TO GRINDING FOR LARGE GEAR AND TRANSMISSION MANUFACTURE



- Machining to grinding eliminates rough cutting the gears (through the use of formed cutters, broaching or hobbing)
- Grinding from solid eliminates the need for a cutting machine and all the complementary tooling and equipment required to start and maintain the rough cutting operation
- Typically a rough-ground gear will be of higher quality than a hobbed, near-net, or cut gear – particularly larger spur gears and gear sets
- Norton Machining to Grinding (MTG) wheel specifications create the flexibility to combine grinding in the soft state from solid, to hard finishing – with only 1 grinder



APPLICATION ENGINEER CONTACT: **Phil Plainte**

MTG case history

Spur and Helix Gear Sets

Grinding spur and helix gear sets from solid at a large gear manufacturer

Customer Assessment

- Norton engineers were approached by a customer interested in improving grind cycle times on large gears
- This customer typically manufactures and repairs 2,500+ large gears and gear boxes per year
- A large backlog at the customer's cutting machine was creating late ship dates and preventing the customer from accepting new orders
- Customer contacted OEM and Norton for assistance in speeding up grind cycle and to explore the possibility of grinding gears from a solid
- Development work by OEM and Norton application engineer proved that gears could be efficiently ground from solid, and then finish-ground on the same machine after heat treat as required

Test Data

Wheel Size: 457mm x 45mm x 127mm
Wheel Type: 01, face bevel 2 sides 30 degrees
Wheel Specification: TG2-80-VPAP
Workpiece Material: 4340, Hardness: 38-42 Rc
Spur/Helix Gear: 115 teeth
 58.370" OD, 8" face width
 30° helix angle, whole depth .990"
 D.P. 2.3, 25 degree P.A., AGMA 12
Machine Model: Hofler Grinder, 50 hp
Wheel Speed: 5,500 SFPM
Coolant: Straight oil, high pressure system – chilled and filtered 70 GPM @ 75-80 PSI
MTG Rate of Cut: 3.0 cubic inches per minute
Dresser Type: Rotary
Truing/Dressing: Dress every 5 teeth; dress .0009" x 4 passes
Peak Power Steady State: 11 hp

Test Results

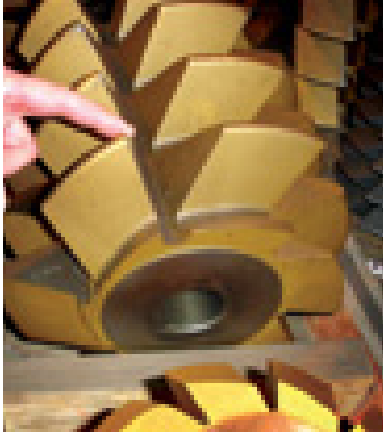
	HOBBIING AND GRINDING	GRINDING ONLY
Cutting Time/Part	1200	532.9829
Process Time/Part	1200	949.6119
Tooling Cost/Part	\$568.25	\$244.76
Total Cost/Part	\$2968.25	\$2618.79

SUMMARY	TRADITIONAL SHAPING PROCESS	MACHINING TO GRINDING PROCESS	MTG BENEFIT
Parts Per Day	0.8	1.0	0.2
Parts Potential Per Annum	200	253	53
Tooling and Wheel Costs Per Annum	\$113,650.00	\$61,924.00	-\$51,726.00
Labor and Overhead Costs Per Annum	\$480,000.00	\$600,630.00	\$120,630.00
Coolant Cost Per Annum	–	–	–
Heat-Treat Cost Per Annum	–	–	–
Total Cost Per Annum	\$593,650.00	\$662,554.00	\$68,904.00
Annual Savings	–	–	12% more to produce 27% more gears

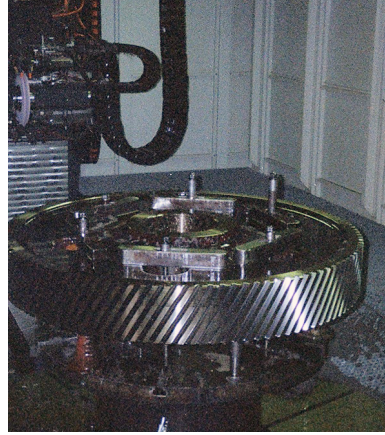
THIS ANALYSIS IS BASED ON 16 WORKING HOURS/DAY AND 250 WORKING DAYS/YEAR

MACHINING TO GRINDING FOR LARGE GEAR AND TRANSMISSION MANUFACTURE

Traditional Process



Machining to Grinding



Targa Wheel Grain After Grinding from Solid

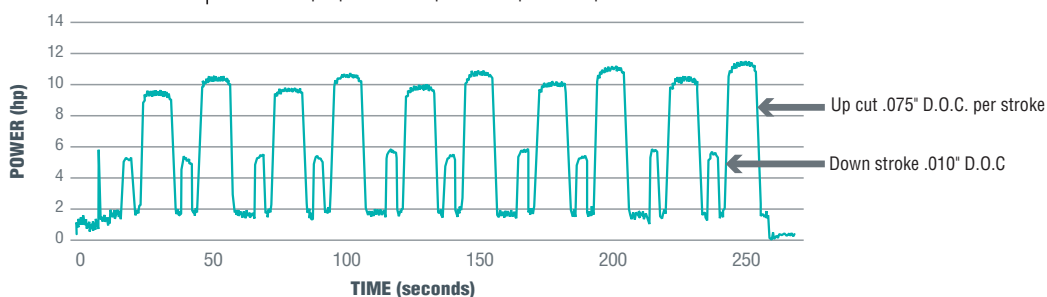


Economic Analysis of Costs

	TRADITIONAL SHAPING PROCESS	MACHINING TO GRINDING PROCESS	MTG BENEFIT
Cost/Tool Set (includes regrinds + dress rolls)	\$2,983.33	\$1,284.93	\$1,698.40
Cutting Time (minutes/part)	–	532.98 minutes	
Dressing Time (minutes/part)	–	285.20 minutes	
Tool Changing Time (minutes/part)	–	11.43 minutes	
Loading/Unloading Time (minutes/part)	–	120 minutes	
Total Processing Time (minutes/part)	1,200 minutes	949.61 minutes	250.4 minutes
Tool Set (\$/part)	\$568.25	\$244.76	\$323.49
Labor and Overhead Cost (\$/part)	\$2,400.00	\$2,374.03	\$25.97
Scrap Rate	–	–	–
Scrap Cost/Year	–	–	–
Total Cost/Part (including cost of scrap)	\$2,968.25	\$2,618.79	11.8%

Spindle Power

Grinding at .617" D.O.C. double stroke » .010" per pass down stroke and .075" per pass on the up cut. Peak power 11hp.



BEST

For most abrasive applications, Norton offers up to three product performance levels – GOOD, BETTER and BEST. Norton Targa wheels are in the BEST tier. They represent products that are unmatched in the industry and provide the lowest total cost for the application.

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