Mazak

INTEGREX AG

[Auto Gear]

SERIES

The integration of INTEGREX Multi-Tasking with gear cutting and measurement

5-axis machining + **Gear machining** + **Gear measurement**

HYBRID Multi-Tasking machines

INTEGREX AG SERIES

- **Process integration for high-accuracy machining, reduction of in-process time and initial cost**
- **3 types of gear machining methods (skiving, hobbing and end milling) can be performed for high-mix, small-volume production up to large-volume production to meet your workpiece requirements**
- **High-speed and high-accuracy skiving thanks to unique AG control technology**
- **After hobbing or gear skiving, a touch sensor probes a gear tooth location for in-phase positioning of other machined features**
- **Gear face scanning is optionally available for the measurement of the gear lead and profile**
- **Programs for cutting tool paths and measurement can be made quickly and easily**

Shown with optional equipment

INTEGREX i-200ST AG

Shown with optional equipment

INTEGREX e-1250V/8 AG

Large-volume production to high-mix, small-volume production

Productivity

Gear Skiving

- Internal gears
- External gear
- Chucking workpieces

Hobbing

- External gears
- Shaft workpieces

End milling

- Large workpieces

Flexibility

Example workpieces

Integration of Multi-Tasking machines with gear cutting and gear measurement provides high-accuracy gear cutting and reduced in-process time

INTEGREX

· Turning
· Milling
· 5-axis

+

Gear cutting

· Gear skiving
· Hobbing
· End milling
· Deburring

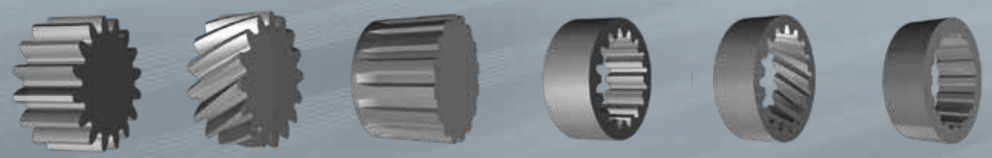
+

Gear measurement

· Gear tooth radial in-phase location
· Gear profile and lead measurement

High-accuracy cutting of a variety of gear types

External			Internal		
Spur	Helical	Involute spline	Spur	Helical	Involute spline



High-accuracy machining (example results)

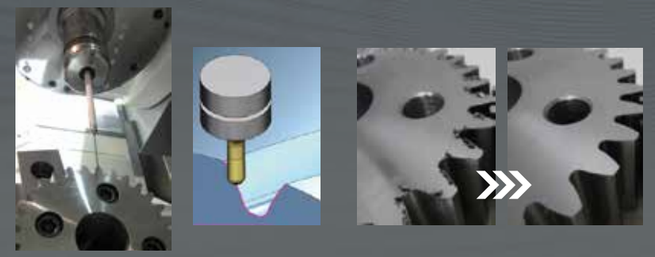
	Size	Accuracy	Machining time
Gear Skiving #40	~m4 (DP6.35)	ISO 7 ~ 8	2 minutes
Gear Skiving #50	~m6 (DP4.23)	ISO 7 ~ 8	2 minutes
Hobbing	m4 (DP6.35)	ISO 7 ~ 8	26 minutes
End mill	~m10 (DP2.54)	ISO 5 ~ 6	3 hours 50 minutes

Above results for reference only

Gear measurement

Gear tooth radial in-phase location

After using a new or reground tool, a gear tooth can be probed by a touch sensor to determine the required amount of compensation. This same process also can be used to determine the in-phase positioning of other machined features, such as deburring using a ball nose end mill or locating a bore on a workpiece face.



Gear profile and gear lead measurement OPTION

The gear profile and gear lead can be inspected on the machine by using an optional scanning probe.

Measurement results are shown on the CNC display by performing 3 clicks.

Gear Skiving

Improved productivity thanks to high-speed skiving

- High-accuracy gear skiving is realized thanks to unique INTEGREX AG control technology.
- Rotation of both the main spindle and the milling spindle is synchronized up to the top speed of both spindles to ensure high-accuracy gear skiving.

Internal spline cutting applications (INTEGREX i-200ST AG)

Thanks to INTEGREX i-200ST AG synchronized control technology, productivity is 6 times higher compared to conventional internal spline processing. Additionally, with higher speed operation, cutting resistance is reduced for higher accuracy.

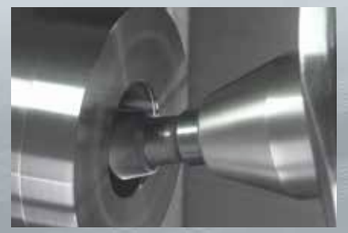
Module 1 (DP 25.4) spline cutting time

INTEGREX AG high-speed synchronized control

48 seconds

ISO 6 (example results)

Module	1
Number of gear teeth	44
Pressure angle	30°
Gear diameter (root to root)	40.205 mm (1.58")
Gear diameter (tooth top to tooth top)	43.130 mm (1.70")
Gear face width	20 mm (0.79")
Tooth height	1.0375 mm (0.04")
Material	S45C



INTEGREX AG high-speed synchronized control cutting conditions

Tool speed	6525 min^{-1} (rpm)
Workpiece rotation speed	3410 min^{-1} (rpm)
Feedrate (roughing)	0.2 mm/rev (0.01 inch/rev) (C-axis)
Feed (finishing)	0.01 mm/rev (0.01 inch/rev) (C-axis)
DOC 0.2075 mm/pass	5 passes (5×0.2075 mm)

End milling

Using SMOOTH Gear Milling software, gear teeth can be cut one by one with a standard end mill. Gear specification data, including data for modified gears as well as modified gear lead and modified gear profile, are input to generate the tool path automatically.

Hobbing

The hob arbor is held on one end by the heavy-duty #50 taper milling spindle, providing sufficient rigidity for high-accuracy gear hobbing.

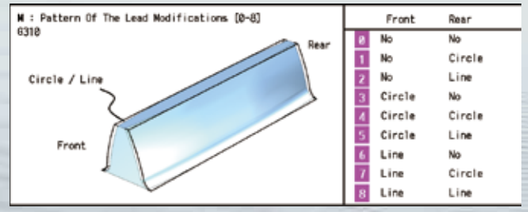
With SMOOTH Gear Hobbing, gear specification data are input to generate the tool path automatically.

● Hob shift

This function shifts the contact point of the hob and workpiece to extend tool life.

● Modified gear lead and gear crowning

By inputting data for a modified gear lead or gear crowning, the tool path for gear hobbing is generated automatically.



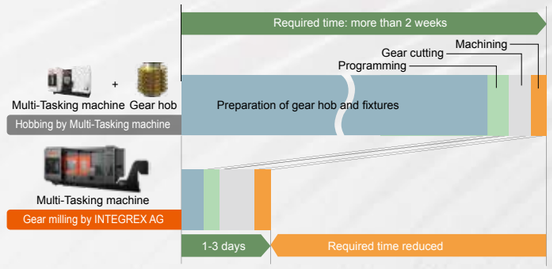
Protection of workpiece, tool and spindle

Escape button

The MAZATROL SmoothX has an escape button on the operation panel to remove the tool from the workpiece while maintaining synchronized rotation. By using this button during an emergency, the cutter, workpiece and milling spindle are protected.

Reduced in-process time

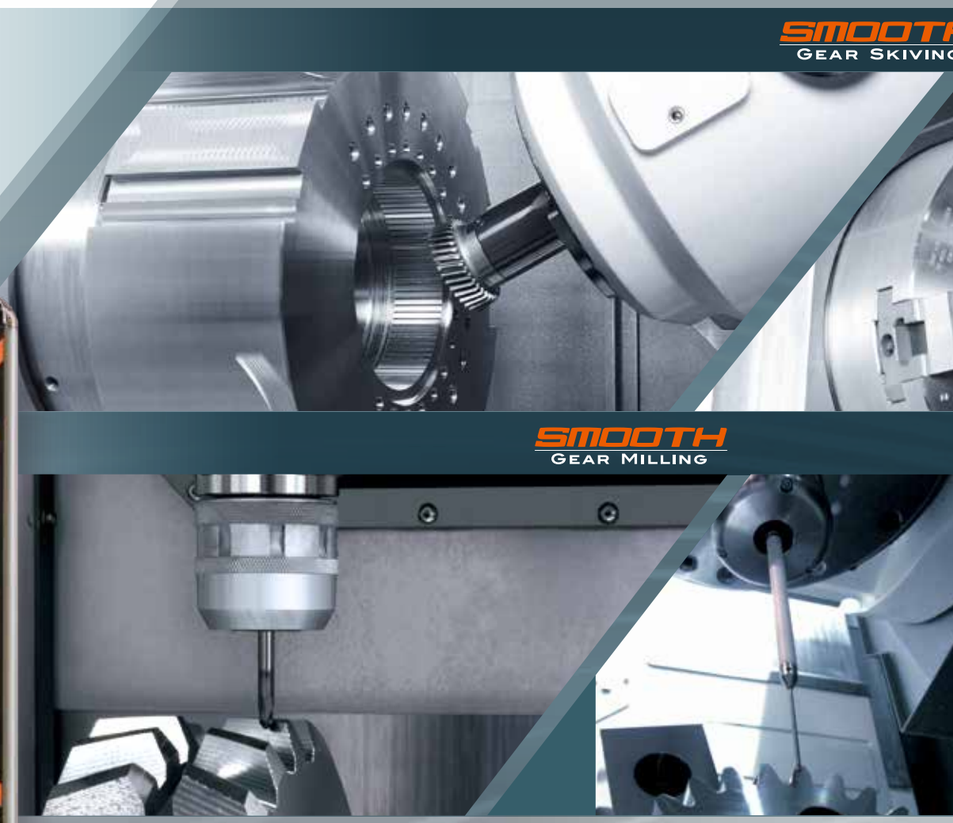
During high-mix, small-volume production, considerable time is required to prepare tools and fixtures, especially a gear hob. If a gear hob must be ordered, the lead time may be considerable. Since SMOOTH Gear Milling uses standard end mills instead of a gear hob, this waiting time is eliminated. A wide range of types of gears can be cut by the INTEGREX AG using standard end mills.



Conversational programming of high-accuracy gear cutting and gear measurement

Input gear data to make programs easily and quickly

INTEGREX AG software



Operation flow

Gear and spline data specifications, as well as cutting conditions and measurement data, are input using a conversational CNC display.

G-code program for cutting and measurement is generated.
Gear skiving G-code program made by SMOOTH Gear Skiving shown.

By pushing the cycle start button, gear cutting and measurement are performed.

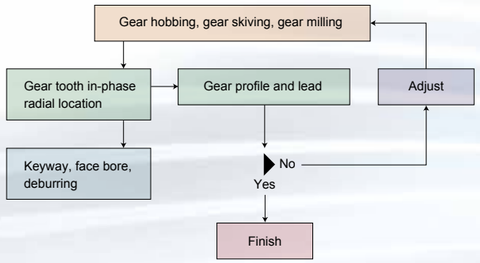
Measurement

SMOOTH GEAR CHECK

Gear tooth radial in-phase location PATENT PENDING

After using a new or reground tool, a gear tooth can be probed by a touch sensor to determine the required amount of compensation. This same process can also be used to determine the in-phase positioning of other machined features, such as deburring using a ball nose end mill or locating a bore on a workpiece face. Accuracy of the in-phase positioning is ± 0.005 degrees (16 µm (0.00063" on a 360 mm (14.17") diameter).

Flow chart



Gear profile and face measurement OPTION

The gear profile and gear face are inspected by a scanning probe after machining in the same workpiece setup. Conventionally, gears are machined on special-purpose gear-cutting machinery and then transferred to measurement equipment in another location. For large gears, considerable time is required to transfer them to the measurement area, mount them on the measurement equipment and then set up the measurement equipment. This is eliminated by the optional gear profile and gear lead measurement software.

Gear face measurement by scanning probe

Measurement results are displayed on the MAZATROL SmoothX CNC display

Measurement results shown on the CNC display can be output as a PNG file by pressing a single key.

Gear cutting & measurement

□: Included –: N / A

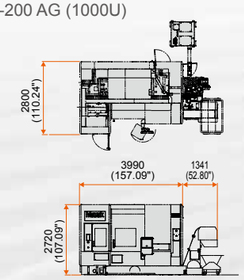
		External gears			Internal gears		
		Spur gears	Helical gears	Involute spline gears	Spur gears	Helical gears	Involute spline gears
							
Gear cutting	SMOOTH GEAR SKIVING	○	○	○	○	○	○
	SMOOTH GEAR HOBBING	○	○	○	-	-	-
	SMOOTH GEAR MILLING	○	○	-	-	-	-
Deburring	SMOOTH GEAR DEBURRING	○	○	-	○	○	-
SMOOTH GEAR CHECK	Gear tooth radial in-phase location	○	○	○	○	○	○
	Gear profile and gear lead measurement	○	○	○	○	-	○

Standard machine specifications & machine dimensions

	INTEGREX i-200ST AG
Max. workpiece dimensions	ø658 mm × 1519 mm (ø25.91" × 59.80")
X-axis travel	615 mm (24.12")
Y-axis travel	260 mm (10.24")
Z-axis travel	1585 mm (62.40")
B-axis travel	-30°~ 210°
X2-axis travel (lower turret)	230 mm (9.06")
Z2-axis travel (lower turret)	1388 mm (54.65")
Main spindle (40% ED (30-min. rating)	5000 min^{-1} (rpm), 22 kW (30 HP)
Second spindle (40% ED (30-min. rating)	5000 min^{-1} (rpm), 18.5 kW (25 HP)
Milling spindle (40% ED (30-min. rating)	12000 min^{-1} (rpm), 22 kW (30 HP)

INTEGREX i-200 AG (1000U)

Unit: mm (inch)

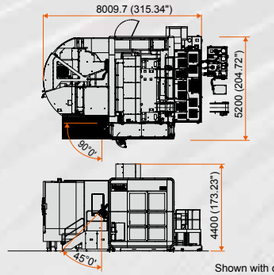


Shown with optional equipment

	INTEGREX e-1250V/8 AG
Max. workpiece dimensions	ø1450 mm × 1600 mm (ø57.09" × 62.99")
X-axis travel	1875 mm (73.82")
Y-axis travel	1250 mm (49.21")
Z-axis travel	1345 mm (52.95")
B-axis travel	150°
C-axis travel	360°
Milling spindle (40% ED (30-min. rating)	10000 min^{-1} (rpm), 37 kW (50 HP)
Turning spindle (cont. rating)	500 min^{-1} (rpm), 40 kW (53 HP)

INTEGREX e-1250V/8 AG

Unit: mm (inch)



Shown with optional equipment

INTEGREX AG SERIES

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INTEGREX AG Series 18.08.0 A 99J671218E0