



**AW MILLER**  
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**Mazak**

**INTEGREX AG**

[ Auto Gear ]

SERIES



# INTEGREX AG SERIES

The integration of INTEGREX multi-tasking with gear cutting and measurement



5-axis machining



Gear machining



Gear measurement

- Process integration for high accuracy machining, reduction of in-process time and initial cost
- 3 types of gear machining methods (gear skiving, hobbing and endmilling) can be performed for high-mix, small volume production to large volume production to meet your production requirements
- High speed and high accuracy gear skiving thanks to unique AG control technology
- After gear skiving or hobbing, 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 easily made in a short period of time



Shown with optional equipment

INTEGREX i-500 AG



Shown with optional equipment

INTEGREX i-630V/6

Productivity

Large volume production to high-mix,  
small volume production

Mass production with specialized tools



Gear Skiving

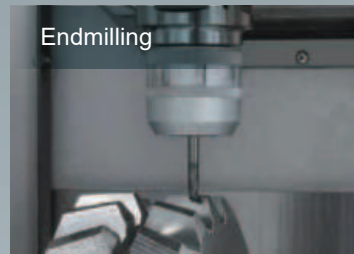
- . Internal gears
- . External gears
- . Chucking workpieces



Hobbing

- . External gears
- . Shaft workpieces

Flexible machining with  
general-purpose end mill



Endmilling

- . External gears
- . Large workpieces

Flexibility



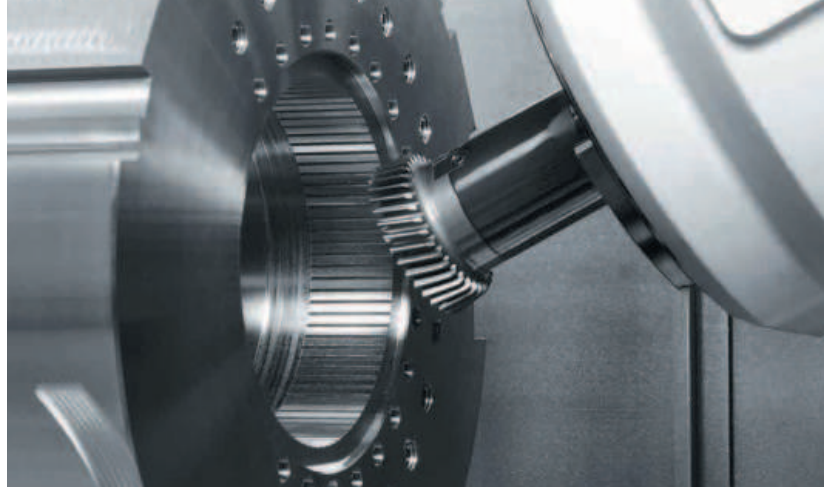
Example workpieces



## Improved productivity thanks to high speed gear 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-250H AG)

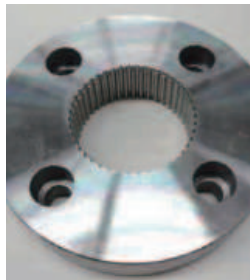
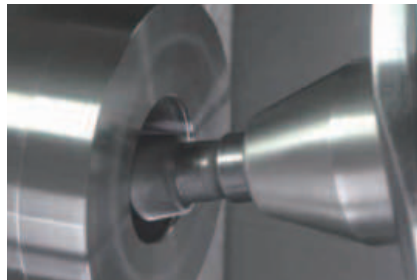
Internal gears up to module 3 are machined within ISO class 8. In addition, the synchronized control technology incorporated in the INTEGREX i-250H AG enables high-speed, high-efficiency gear skiving of small-diameter workpieces.

Module 3 Internal Gear Machining Performance

**ISO Class7 (AGMA11\*)**



Module 1 (DP25.4) spline cutting time



INTEGREX AG high speed synchronized control

**ISO Class8 (AGMA10\*)**

**48 seconds**

(example results)

|                      |            |
|----------------------|------------|
| Module               | 1 (DP25.4) |
| Number of gear teeth | 44         |
| Pressure angle       | 30°        |
| Material             | C45        |

INTEGREX AG high speed synchronized control cutting conditions

|                              |   |
|------------------------------|---|
| Tool speed                   | 6525 min <sup>-1</sup> (rpm)                            |
| Workpiece rotation speed     | 3410 min <sup>-1</sup> (rpm)                            |
| Feedrate (roughing)          | 0.2 mm/rev (0.0079 IPR) (C-axis)                        |
| Feedrate (Finishing)         | 0.01 mm/rev (0.0004 IPR) (C-axis)                       |
| Feed rate(roughing)          | 1305 mm/min (51 IPM)<br>(0.2 mm per workpiece rotation) |
| Feed rate (Finish machining) | 65 mm/min (3 IPM)<br>(0.1 mm per workpiece rotation)    |

\* Approximate equivalent class

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

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



- **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 automatically generated.

M : Pattern Of The Lead Modifications [0-6]

G310

|   | Front  | Rear   |
|---|--------|--------|
| 0 | No     | No     |
| 1 | No     | Circle |
| 2 | No     | Line   |
| 3 | Circle | No     |
| 4 | Circle | Circle |
| 5 | Circle | Line   |
| 6 | Line   | No     |
| 7 | Line   | Circle |
| 8 | Line   | Line   |

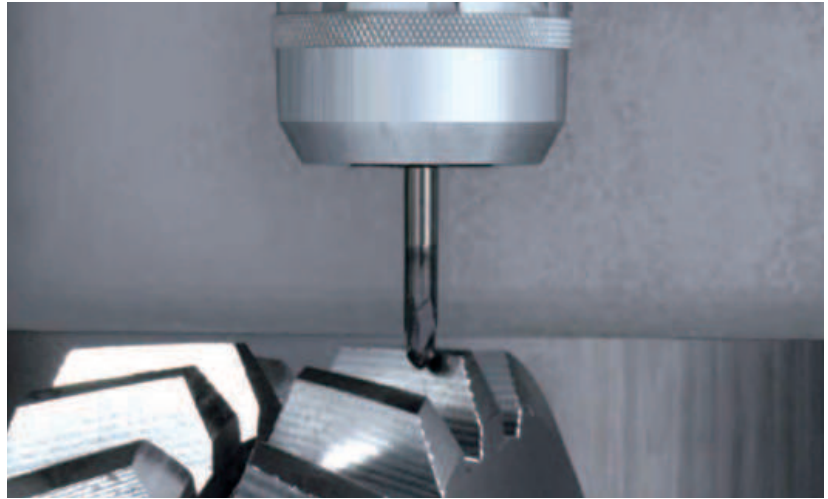
## Protection of workpiece, tool and spindle

### Escape button

The MAZATROL SmoothX and the MAZATROL SmoothAi have 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.

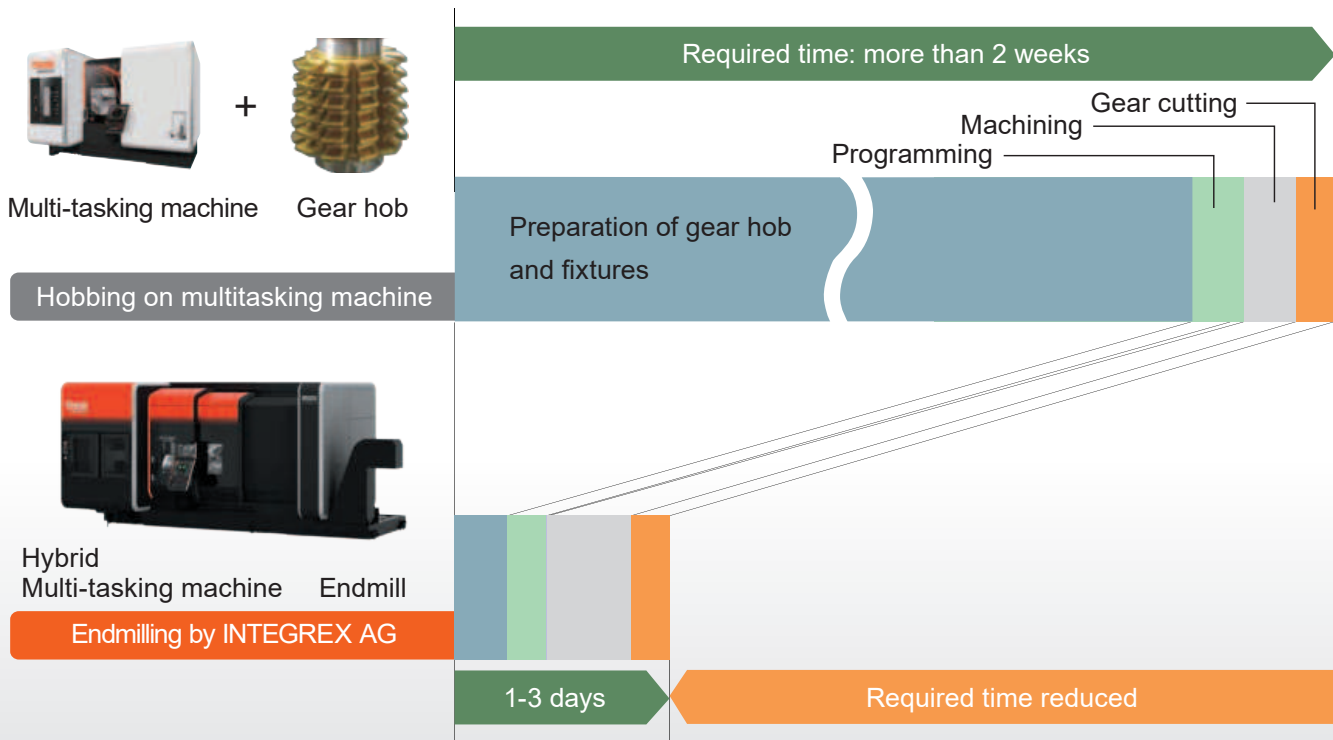


Using Smooth Gear Milling software, gear teeth can be cut one by one by a standard endmill. Gear specification data, including data for modified gears as well as modified gear lead and modified gear profile, are input to automatically generate the tool path.



## 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 endmills instead of a gear hob, this waiting time is eliminated. A wide range of types of gears can be cut by the INTEGREGX AG using standard endmills.

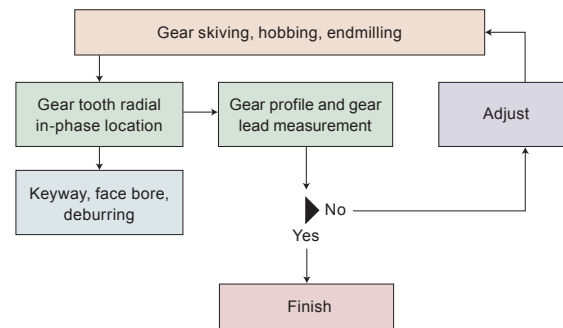


## Gear tooth radial in-phase location

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 can also be used to determine the in-phase positioning of other machined features, such as deburring using a ball endmill or locating a bore on a workpiece face.



Flow chart



## Gear profile and gear lead 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 are 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 setup 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 or the MAZATROL SmoothAi display

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



# Conversational programming of high accuracy gear cutting and gear measurement

Programs are easily made in a short period of time by just inputting gear data

INTEGREX AG software



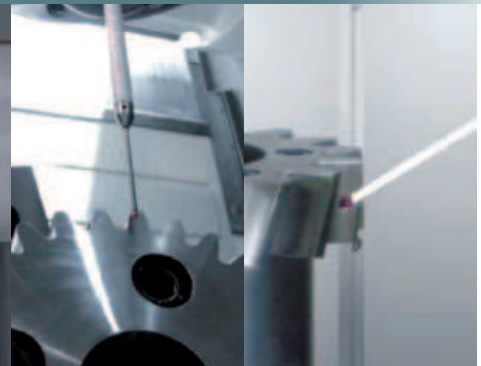
**SMOOTH**  
GEAR SKIVING

**SMOOTH**  
GEAR HOBBING



**SMOOTH**  
GEAR MILLING

**SMOOTH**  
GEAR CHECK



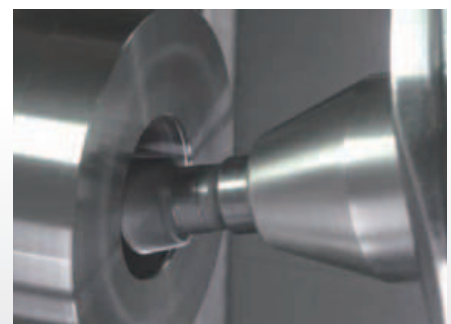
## Operation flow



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.

■ Gear cutting & measurement

○: Included - : N/A

|                             |   | External gears  |  |   |
|-----------------------------|---|---|--|---|
|                             |   | Spur gears  | Helical gears  | Involute spline gears   |
|                             |   |  |  |  |
| Gear cutting                | <b>SMOOTH</b><br>GEAR SKIVING                           | ○   | ○  | ○   |
|                             | <b>SMOOTH</b><br>GEAR HOBBING                           | ○   | ○  | ○   |
|                             | <b>SMOOTH</b><br>GEAR MILLING                           | ○   | ○  | -   |
| Deburring                   | <b>SMOOTH</b><br>GEAR DEBURRING                         | ○   | ○  | -   |
| <b>SMOOTH</b><br>GEAR CHECK | Gear tooth radial in-phase location                     | ○   | ○  | ○   |
|                             | Gear profile and gear lead measurement<br><b>OPTION</b> | ○   | ○  | ○   |

|                             |   | Internal gears  |  |   |
|-----------------------------|---|---|--|---|
|                             |   | Spur gears  | Helical gears  | Involute spline gears   |
|                             |   |  |  |  |
| Gear cutting                | <b>SMOOTH</b><br>GEAR SKIVING                           | ○   | ○  | ○   |
|                             | <b>SMOOTH</b><br>GEAR HOBBING                           | -   | -  | -   |
|                             | <b>SMOOTH</b><br>GEAR MILLING                           | -   | -  | -   |
| Deburring                   | <b>SMOOTH</b><br>GEAR DEBURRING                         | ○   | ○  | -   |
| <b>SMOOTH</b><br>GEAR CHECK | Gear tooth radial in-phase location                     | ○   | ○  | ○   |
|                             | Gear profile and gear lead measurement<br><b>OPTION</b> | ○   | -  | ○   |

Standard Machine Specifications

# INTEGREX i-H AG SERIES



INTEGREX i-450H S AG  
Shown with optional equipment

|   | INTEGREX i-250H AG  | INTEGREX i-250H S AG  | INTEGREX i-250H ST AG  |
|---|---|---|--|
| Universal   | 1000U-1500U   | 1000U-1500U   | 1500U  |
| Max. machining length*1                               | 1011 mm (39.80")-1519 mm (59.80")   | 1011 mm (39.80")-1519 mm (59.80")   | 1519 mm (59.80")   |
| Max. machining diameter (upper turret / lower turret) | Φ670 mm (Φ26.38") / -   | Φ670 mm (Φ26.38") / -   | Φ670 mm (Φ26.38") / Φ420 mm (Φ16.54")                              |
| Travel (X / Y / Z / B) (upper turret)                 | 695 mm (27.36") / 300 mm (11.81") / 1077 mm (42.40") / 1585 mm (62.40") / -30° ~ 210° | 695 mm (27.36") / 300 mm (11.81") / 1077 mm (42.40") / 1585 mm (62.40") / -30° ~ 210° | 695 mm (27.36") / 300 mm (11.81") / 1585 mm (62.40") / -30° ~ 210° |
| Travel (X2 / Z2) (lower turret)                       | -   | -   | 220 mm (8.66") / 1539 mm (60.59")                                  |
| Main spindle (40% ED (30 min. rating))                | 5000 min <sup>-1</sup> (rpm), 22 kW (30 HP)   | 5000 min <sup>-1</sup> (rpm), 22 kW (30 HP)   | 5000 min <sup>-1</sup> (rpm), 22 kW (30 HP)                        |
| Second spindle (40% ED (30 min. rating))              | -   | 5000 min <sup>-1</sup> (rpm), 18.5 kW (25 HP)   | 5000 min <sup>-1</sup> (rpm), 18.5 kW (25 HP)                      |
| Milling spindle (40% ED (30 min. rating))             | 12000 min <sup>-1</sup> (rpm), 24kW (32 HP)   | 12000 min <sup>-1</sup> (rpm), 24 kW (32 HP)  | 12000 min <sup>-1</sup> (rpm), 24 kW (32 HP)                       |
|   | INTEGREX i-350H AG  | INTEGREX i-350H S AG  | INTEGREX i-350H ST AG  |
| Universal   | 1000U-1500U   | 1500U   | 1500U  |
| Max. machining length*1                               | 1011 mm (39.80")-1519 mm (59.80")   | 1519 mm (59.80")  | 1519 mm (59.80")   |
| Max. machining diameter (upper turret / lower turret) | Φ670 mm (Φ26.38") / -   | Φ670 mm (Φ26.38") / -   | Φ670 mm (Φ26.38") / Φ420 mm (Φ16.54")                              |
| Travel (X / Y / Z / B) (upper turret)                 | 695 mm (27.36") / 300 mm (11.81") / 1077 mm (42.40") / 1585 mm (62.40") / -30° ~ 210° | 695 mm (27.36") / 300 mm (11.81") / 1585 mm (62.40") / -30° ~ 210°                    | 695 mm (27.36") / 300 mm (11.81") / 1585 mm (62.40") / -30° ~ 210° |
| Travel (X2 / Z2) (lower turret)                       | -   | -   | 220 mm (8.66") / 1539 mm (60.59")                                  |
| Main spindle (40% ED (30 min. rating))                | 4000 min <sup>-1</sup> (rpm), 30 kW (40 HP)   | 4000 min <sup>-1</sup> (rpm), 30 kW (40 HP)   | 4000 min <sup>-1</sup> (rpm), 30 kW (40 HP)                        |
| Second spindle (40% ED (30 min. rating))              | -   | 4000 min <sup>-1</sup> (rpm), 26 kW (35 HP)   | 4000 min <sup>-1</sup> (rpm), 26 kW (35 HP)                        |
| Milling spindle (40% ED (30 min. rating))             | 12000 min <sup>-1</sup> (rpm), 24kW (32 HP)   | 12000 min <sup>-1</sup> (rpm), 24 kW (32 HP)  | 12000 min <sup>-1</sup> (rpm), 24 kW (32 HP)                       |
|   | INTEGREX i-450H AG  | INTEGREX i-450H S AG  | INTEGREX i-450H ST AG  |
| Universal   | 1000U-1500U   | 1500U   | 1500U  |
| Max. machining length*1                               | 1011 mm (39.80")-1519 mm (59.80")   | 1519 mm (59.80")  | 1519 mm (59.80")   |
| Max. machining diameter (upper turret / lower turret) | Φ670 mm (Φ26.38") / -   | Φ670 mm (Φ26.38") / -   | Φ670 mm (Φ26.38") / Φ420 mm (Φ16.54")                              |
| Travel (X / Y / Z / B) (upper turret)                 | 695 mm (27.36") / 300 mm (11.81") / 1077 mm (42.40") / 1585 mm (62.40") / -30° ~ 210° | 695 mm (27.36") / 300 mm (11.81") / 1585 mm (62.40") / -30° ~ 210°                    | 695 mm (27.36") / 300 mm (11.81") / 1585 mm (62.40") / -30° ~ 210° |
| Travel (X2 / Z2) (lower turret)                       | -   | -   | 220 mm (8.66") / 1539 mm (60.59")                                  |
| Main spindle (40% ED (30 min. rating))                | 3300 min <sup>-1</sup> (rpm), 37 kW (50 HP)   | 3300 min <sup>-1</sup> (rpm), 37 kW (50 HP)   | 3300 min <sup>-1</sup> (rpm), 37 kW (50 HP)                        |
| Second spindle (40% ED (30 min. rating))              | -   | 4000 min <sup>-1</sup> (rpm), 26 kW (35 HP)   | 4000 min <sup>-1</sup> (rpm), 26 kW (35 HP)                        |
| Milling spindle (40% ED (30 min. rating))             | 12000 min <sup>-1</sup> (rpm), 24kW (32 HP)   | 12000 min <sup>-1</sup> (rpm), 24 kW (32 HP)  | 12000 min <sup>-1</sup> (rpm), 24 kW (32 HP)                       |

\*1 Depends on chuck specifications

# INTEGREX i-500 AG SERIES



INTEGREX i-500 AG  
Shown with optional equipment

|   | INTEGREX i-500 AG  | INTEGREX i-500S AG   | INTEGREX i-500ST AG  |
|---|--|--|--|
| Universal   | 1500U  | 1500U  | 1500U  |
| Max. machining length*1                               | 1529 mm (60.20")   | 1529 mm (60.20")   | 1529 mm (60.20")   |
| Max. machining diameter (upper turret / lower turret) | Φ700 mm (Φ27.56") / -  | Φ700 mm (Φ27.56") / -  | Φ700 mm (Φ27.56") / Φ490 mm (Φ19.29")                              |
| Travel (X / Y / Z / B) (upper turret)                 | 845 mm (33.27") / 430 mm (16.93") / 1640 mm (64.57") / -30° ~ 210° | 845 mm (33.27") / 430 mm (16.93") / 1640 mm (64.57") / -30° ~ 210° | 845 mm (33.27") / 430 mm (16.93") / 1640 mm (64.57") / -30° ~ 210° |
| Travel (X2 / Z2) (lower turret)                       | -  | -  | 267 mm / 1373 mm (10.51" / 54.06")                                 |
| Main spindle (40% ED (30 min. rating))                | 2500 min <sup>-1</sup> (rpm), 37 kW (50 HP)                        | 2500 min <sup>-1</sup> (rpm), 37 kW (50 HP)                        | 2500 min <sup>-1</sup> (rpm), 37 kW (50 HP)                        |
| Second spindle (40% ED (30 min. rating))              | -  | 2500 min <sup>-1</sup> (rpm), 37 kW (50 HP)                        | 2500 min <sup>-1</sup> (rpm), 37 kW (50 HP)                        |
| Milling spindle (40% ED (30 min. rating))             | 10000 min <sup>-1</sup> (rpm), 37kW (50 HP)                        | 10000 min <sup>-1</sup> (rpm), 37kW (50 HP)                        | 10000 min <sup>-1</sup> (rpm), 37kW (50 HP)                        |

\*1 Depends on chuck specifications