GRINDING

FGC 2

Flexible Grinding Center

TURNING MILLING GRINDING WORKHOLDING ROTARY

www.hardinge.com

BRIDGEPORT®

FGC 2 Flexible Grinding Center offers ultra-productive 5-axis grinding technology

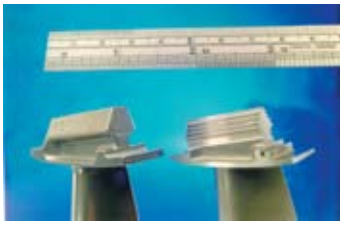
The revolutionary creep-feed grinder that thinks its a high-performance VMC

The Bridgeport FGC 2 machine is in a creep-feed class all by itself to achieve higher levels of productivity and profitability not attainable with conventional creep-feed machines. And because we built the FGC 2 with many of the performance features of a vertical machining center, the option to undertake milling and drilling operations is available within the cycle, eliminating futher tooling and handling costs. Simply put—a "done-in-one" philosophy only from Bridgeport! The similarity between running a FGC 2 machine and a VMC makes the FGC a great addition to a shop with experienced machining center operators. Cross use of their machining knowledge can be now applied to the creep-feed grinding process, further adding profitability to your bottom line.

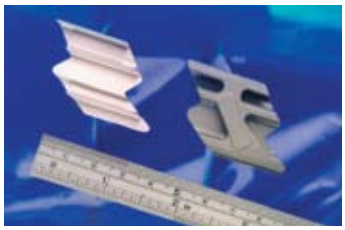
FGC 2 machine shown with coolant filtration system option..

Typical components

- Small gas turbine components
- Turbine blades
- Compressor blades
- Stator blades
- NGVs—Nozzle guide vanes



Turbine blade root forms.



Blade tip—"Z" notch.

Radial root form.

FGC 2

- Travels
  - X-axis - 31.4" (800mm)
  - Y-axis - 23.6" (600mm)
  - Z-axis - 20" (510mm)
  - A-axis - 360-degree rotary
  - B-axis - ±110-degrees tilt
- Worktable capacity—551b (25kg)
- Rapid rates (X/Y/Z)—1,260ipm (32m/min)
- Spindle horsepower—50-hp/38-kW
- Spindle speeds—10 to 8,000-rpm
- Automatic Tool Changer (ATC) with 48 grinding wheel positions for
  - Twelve 10"/250mm OD wheels or
  - Sixteen 8.6"/220mm OD wheels
- Heidenhain iTNC 530 control

Rapid advances in blade and vane grinding over conventional creep-feed grinding

Nozzle guide vane.

Bridgeport's flexible grinding center has set a new standard in productivity and process reliability for machining high-temperature super alloys—Inconel, Nimonic, Udimet, Waspalloy and stainless steels—plus pre-hardened tool steels. This high-performance 5-axis machine is specified and used extensively by the world's leading aircraft and power unit manufacturers, tier-one suppliers to the aero-engine industry, as well as industrial turbine and compressor blade and vane manufacturers.

The FGC 2 redefines the creep-feed grinding process

The Bridgeport FGC 2 machine was designed and built to address operational limitations and reduce costs associated with traditional creep-feed grinding methods and processes, thus increasing productivity and improving competitiveness. Bridgeport's flexible grinding center's multi-axis capability and inherent versatility makes it ideally suited for a diverse range of grinding applications, including the simultaneous machining of complex shapes and forms. It also delivers appreciable cost savings and manufacturing efficiencies.

With the FGC 2 machine, multiple machining operations can be achieved in one setup; workholding, part handling and changeover times are reduced to a minimum. Consequently, component part accuracy is maintained. The multi-axis capability also enables the cost-efficient manufacture of single components or small batch production. Previously with conventional grinding machines, the high costs of fixturing and workholding for such jobs would have been cost prohibitive. This reduction in workholding and fixturing also means that the whole machining process is less labor intensive, that work-in-progress can be controlled and managed much more effectively, that machine cycle times become reduced, and that work throughput is maximized.

In addition, the Bridgeport machine's automatic wheel change capability, in-cycle wheel dressing facility, use of low-cost small diameter Aluminium Oxide wheels, and the integration of a high-pressure/high-flow coolant delivery system combines to improve operational efficiencies, optimize the machining process and reduce costs even further.

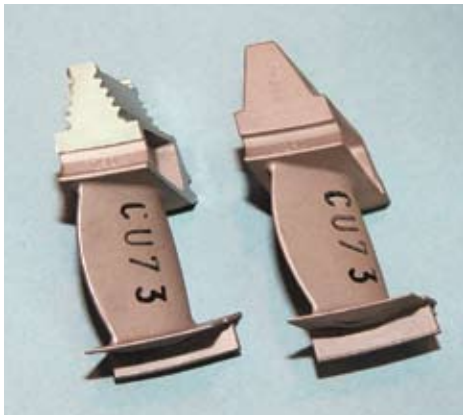
Turbine blade machining.

Traditional creep-feed grinding limitations:

- Machine intensive—i.e.: one machine per operation
- Labor intensive
- Accuracy compromised due to multiple set-ups
- Work in progress too high
- Work throughput affected, making cost of blade manufacture too high

Bridgeport's Flexible Grinding Machine's advantages:

- Multiple operations achieved in a single set-up
- Multiple machine manning
- Greater accuracy due to less work handling
- Work in progress reduced
- Multiple wheels with automatic tool changer provides lower cost per part



High-pressure rotor blade manufactured by Demag Delaval.

FGC 2 Flexible Grinding Center

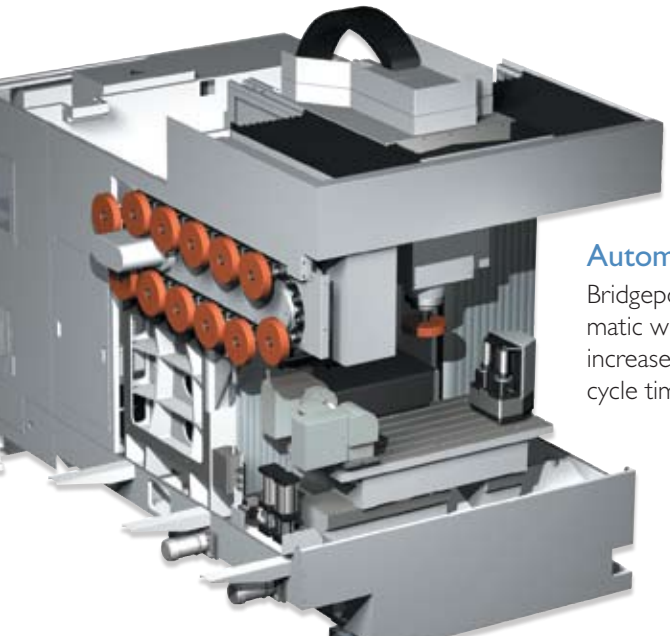
Unique, integrated technical features for outstanding performance

4- and 5-Axis capability

The FGC 2 has 4- and 5-axis capability, facilitating the manufacture of complex components and forms—quickly and simply. Performance benefits include reduced setup time, improved part accuracy and reduced cycle times. Bridgeport's flexible grinding center provides overall manufacturing versatility and capability. The rigid trunnion-type 4-/5-axis capability gives the machine increased stability, enabling the use of either encapsulation or hard point fixturing to further optimize its grinding versatility. Extended wheel life and increased cutting performance and accuracy are also realized.

Diamond roll wheel dressing

The FGC 2 machine features both profiled diamond roll and rotary diameter disk dressing capability, providing quick and efficient setup. The FGC 2 can be equipped with a double dresser capability for multiple and extended machining operations, thus providing even greater productivity. The dressing facility enables the economic and precise dressing of complex fir tree root forms and shroud end features—from initial profile dressing through to in-cycle wheel dressing.



Automatic wheel change

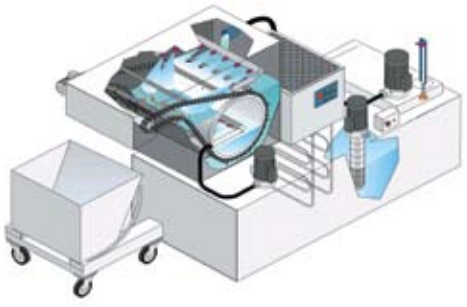
Bridgeport's FGC 2 machine has automatic wheel change capability to further increase productivity and reduce machine cycle times.

High-pressure/high-flow coolant

The FGC 2 is supplied with a high-pressure/high-flow programmable coolant facility to ensure that grinding wheels are consistently clean and sharp. This unique feature maintains cool cutting conditions that reduces wheel wear and extends wheel life. The twin nozzle facility delivers 1,015 psi @ 26.4 gal (70 bar @ 100L) through its wheel cleaning nozzle and 580 psi @ 31.7 gal (40 bar @ 120L) through its grinding/cooling nozzle.

Coolant filtration system

Bridgeport's grinding center can be supplied with a unique media-free coolant filtration system. The coolant system is both environmentally friendly, highly efficient and helps reduce operational and overhead costs. The media-free capability Option totally eliminates filter paper consumption.



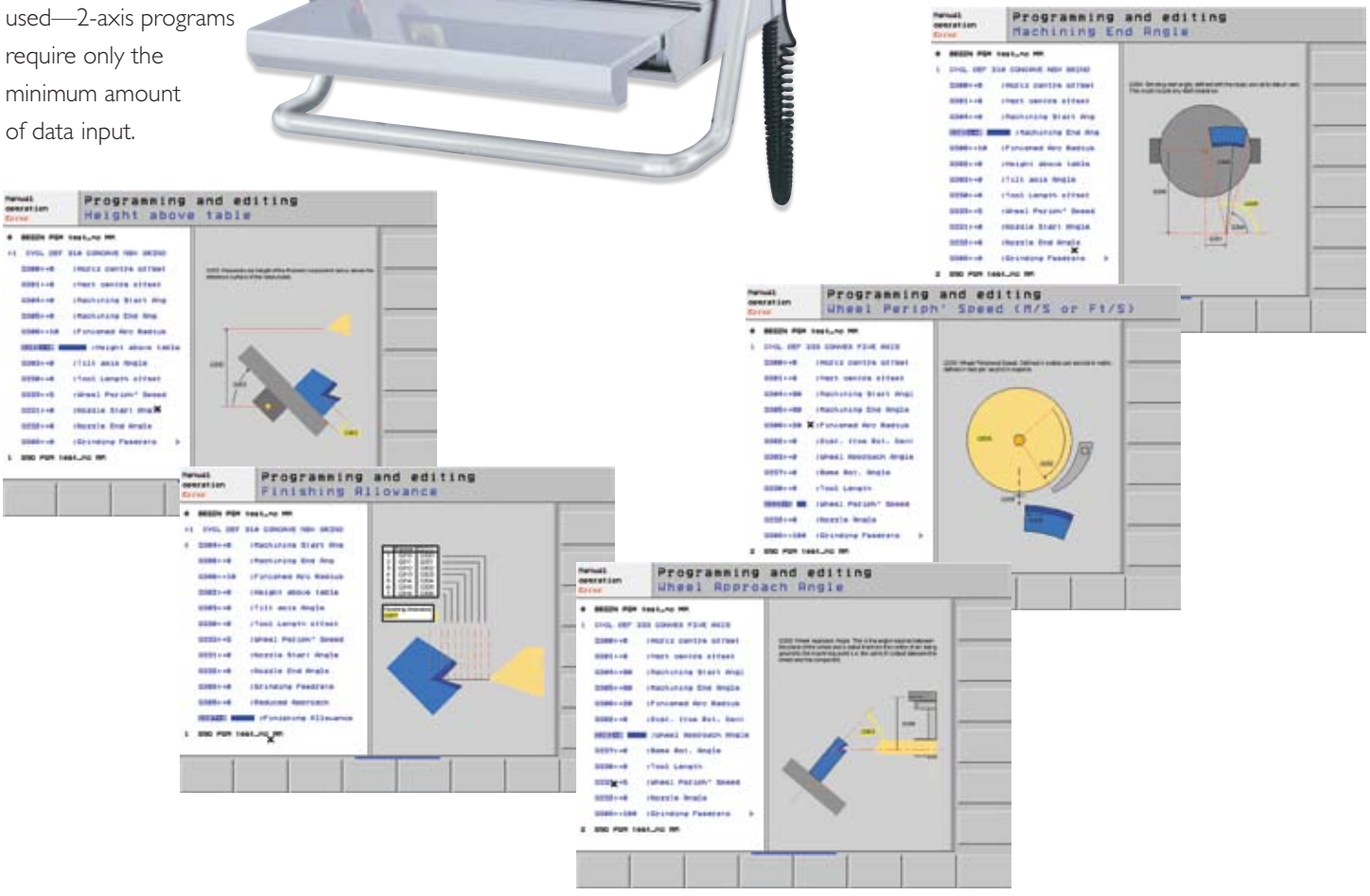
The integration of a high-pressure pump, chiller and filtration drum enables the economic recycling of temperature controlled coolant.

Advanced Heidenhain digital control system to unleash your productivity

From simple 2-axis machining to 4- or 5-axis simultaneous machining, the versatility of the software enables all parts to be easily programmed at the machine by the operator. On-screen graphics provide the structure for program input to build up even the most complicated parts easily and quickly. For nozzle guide vanes and radial dovetails on compressor blades, the graphics shown below were used—2-axis programs require only the minimum amount of data input.

Bridgeport's FGC 2 flexible grinding center is equipped with the powerful and user-friendly Heidenhain iTNC 530 control, incorporating unique Bridgeport-designed grinding cycles for ease of programming. Coupled with specific Nozzle Guide Vane (NGV) grinding software, the Heidenhain control system manages the entire machining operation:

- Machining cycles and sequences
- Dressing operations
- Wheel changing
- Coolant delivery
- 5-Axis simultaneous software



The Hardinge® Group

Bridgeport® grinding and milling machines, Hardinge turning centers, Hauser jig grinding machines, Kellenberger® and Tschudin universal and production cylindrical ID/OD grinding machines, and Workholding and industrial products

Hardinge produces more than just the FGC 2 flexible grinding machine shown in this brochure…we build a full range of value-packed and high-precision turning centers; vertical and horizontal machining centers; high-speed and 5-axis milling machines; jig, universal cylindrical and ID/OD grinding machines; and workholding systems and equipment. Hardinge machine tool technology is not only the most comprehensive on the market, it's also creating new benchmarks as a solutions provider for quality, productivity and reliability.

Whether you are an OEM or sub-contract precision engineering company—regardless of the sectors you serve (aerospace, automotive, medical, autosport, mold, tool and die or general engineering)—the Hardinge product portfolio will interest you.

Our advanced manufacturing technologies in combination with our range of after-sales and support services (maintenance and service contracts; operator training; technical and applications support) have been designed to help you improve your performance and maintain your competitive advantage.

If you would like to know more about our manufacturing solutions, call us at 607.734.2281. You can also e-mail us at info@hardinge.com or visit our web site at www.hardinge.com.

Hardinge precision and SUPER-PRECISION® CNC turning centers

We can help you turn your business around. From our competitively-priced Series range of quick-changeover bar and chucking machines right through to our high-productivity RS-Series and multi-tasking turning centers and QUEST® GT gang tool machines, we can provide you with the optimum turning solution.

Milling machines and machining centers

Our comprehensive line of Bridgeport milling machines have been designed to meet any manufacturing challenge you might be facing today or in the future. Our market-leading XR range of vertical machining centers continue to grow in popularity—as does our GX-Series VMC's which are competitively priced. For heavy-duty, high metal removal we offer our HMC range of Horizontal Machining Centers and for increased manufacturing flexibility and improved productivity there's our 5-axis (5AX) model that is well worthy of consideration. If you are making your first step up to CNC machining, you will find that our entry-level GX 480 and GX 710 machines provide the ideal solution.

Grinding machines

The Hardinge grinding companies include Hauser, Kellenberger, Tschudin and, most recently, Bridgeport. Collectively we have all the technology, experience and know-how you need to transform your manufacturing operations. From high-performance cylindrical and jig grinding machines through to multi-functional ID/OD and universal machines—not to mention Bridgeport's state-of-the-art Flexible Grinding Center (FGC 2). It doesn't get more comprehensive than this.

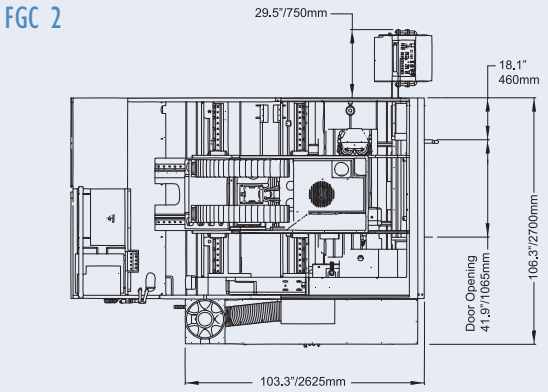
Workholding

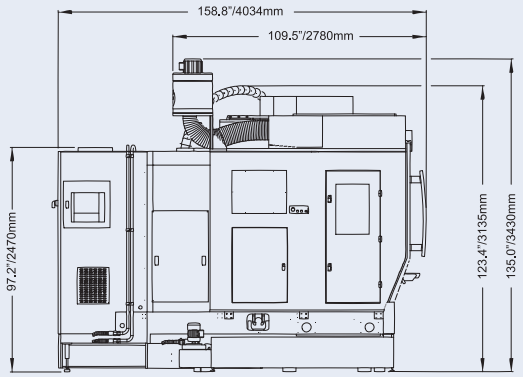
Because we design and manufacture market-leading, technically-excellent machine tools it's no surprise that we know more than a thing or two about workholding solutions. From our extensive portfolio of CNC toolholders, collets and chucks—right through to our 5C Indexing systems—our workholding and fixturing technology will improve your performance when and where it matters most.

Specifications

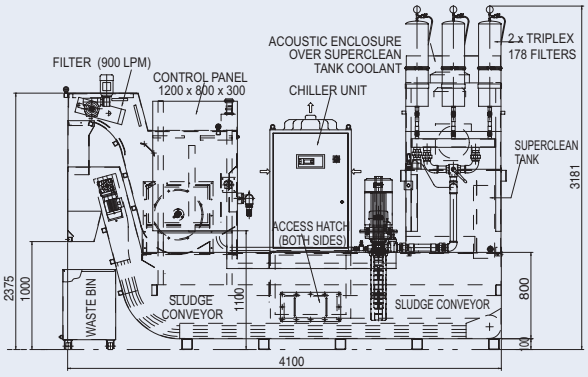
Floor plan

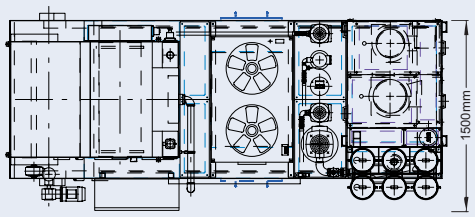
FGC 2





Coolant Filtration System





	FGC 2
Axis Travel	
X axis	31.4"/800mm
Y axis	23.6"/600mm
Z axis	20"/510mm
A axis (rotary)	360°
B axis (tilt)	±110°
Feedrate	
Rapid Traverse (X, Y and Z axes)	1,260ipm / 32m/min
Acceleration (X, Y and Z axes)	196in/sec²/5m/sec²
Table	
Working Surface	55 x 25.5"/1400 x 650mm
Load Capacity	55lb/25kg
Slots	Seven on 3.937"/100mm centers
Spindle	
Max. Speed	8,000 rpm
Motor HP Rating (S6-60%)	50hp/38kW
Spindle Taper	Only BT40 supplied
Dual Contact Method	Face and Taper
Control—Heidenhain	iTNC 530
Automatic Tool Changer (ATC)	
Type of Tool Shank	Only BT40 supplied
Tool Storage Capacity	Twelve (12) 10"/250mm OD wheels
	Sixteen (16) 8.6"/220mm OD wheels
Max. Tool Diameter (milling)	2.9"/75mm
Max. Tool Diameter (grinding)	9.8"/250mm
Max. Tool Length (milling)	11.8"/300mm
Max. Tool Weight	15.6lb/7kg
Max. Weight (all tools)	529lb/240kg
Random Change Time	
Tool-to-tool	3.5 sec.
Chip-to-chip	8.0 sec.
Coolant and Chip Management [A]	
Pressure	
Grinding	580psi/40bar
Wheel Cleaning	1,015psi/70bar
Coolant Flow	
Grinding—standard coolant	31.7gal/min / 120L/min
Wheel Cleaning—standard coolant	26.4gal/min / 100L/min
Accuracy—ISO 230-2	
Positioning (X, Y and Z axes)	Ap 0.00040" (0.010mm)
Repeatability (X, Y and Z axes)	Ru 0.00016" (0.004mm)
Machine Size	
Machine Dimensions (WxD)	106.3" x 158.8"/2700 x 4034mm
Height	135.0"/3430mm
Coolant Tank Dimensions (WxD)	73.0" x 153.5"/1855 x 3900mm
Height	113.4"/2880mm
Mass of Machine	30,500lb/14,000kg
Installation Specifications	
Electrical Supply (Input)	
Structure	Balanced 3-phase
Cycles	50Hz/60Hz
Power	90KVA
Voltage	208-230 volt/380-440 volt
Compressed Air (Pressure / Flow)	80psi/5.5bar

A—Specifications listed are for FGC 2 machines equipped with the coolant filtration system option.

HARDINGE GROUP™

Over the years, The Hardinge Group™ steadily diversified both its product offerings and operations. Today, the company has grown into a globally diversified player with manufacturing operations in North America, Europe and Asia. In addition to designing and building turning centers and collets, Hardinge is a world leader in grinding solutions with the addition of the Kellenberger, Hauser, and Tschudin brands to the Hardinge family. The company also manufactures Bridgeport machining centers and other industrial products for a wide range of material cutting, turnkey automation and workholding needs.

Expect more from your Hardinge products. Choose Hardinge precision and reliability for increased productivity and value!

Call us today, we've got your answer.

Hardinge Companies Worldwide

North America
Hardinge Inc.
One Hardinge Drive
Elmira, NY 14902-1507 USA
General Information: 607-734-2281
Workholding Fax: 607.734.3886
web site: www.hardinge.com

In Canada:
Canadian Hardinge Machine Tools Ltd.
Phone: 800.468.5946
Fax: 607.734.8819

China
Hardinge Machine (Shanghai) Co. Ltd.
Hardinge China Limited
No.1388 Kangqiao Road (East)
Pudong , Shanghai 201319
Tel : 0086 21 38108686
Fax: 0086 21 38108681

Germany
Hardinge GmbH
Fichtenhain A 13 c
D-47807 Krefeld
Germany
Phone: (49) 2151 496490
Fax: (49) 2151 4964999

Holland
Hardinge Machine Tools B.V.
Oeverkruid 2
4941 VV Raamsdonkveer
Holland
Phone: +31 (0) 1625 19565
Fax: +31 (0) 1625 19575
e-mail: info@hardinge.nl

Switzerland
L. Kellenberger & Co. AG
Heiligkreuzstrasse 28
CH-9009 St. Gallen
Switzerland
Phone: +41 (0)71 242 91 11
Fax: +41 (0)71 242 92 22
e-mail: info@kellenberger.net
web site: www.kellenberger.com

L. Kellenberger & Co. AG
Längfeldweg 107
CH-2500 Biel/Bienne 8
Switzerland
Phone: +41 (0)32 344 11 52
Fax - Sales Department:
+41 (0)32 341 13 93
Fax - Service Department:
+41 (0)32 342 25 36
e-mail: info@kellenberger.net

Taiwan
Hardinge Machine Tools B.V., Taiwan Branch
4 Tzu Chiang 3rd Rd.
Nan Tou City, 540 Taiwan
Phone: 886 49 2260536
Fax: 886 49 2252203
e-mail: cs@hardinge.com.tw

United Kingdom
Hardinge Machine Tools, Ltd.
Whiteacres
Cambridge Road
Whetstone
Leicester
LE8 6BD England
Tel: +44 (0)116 2869900
Fax: +44 (0)116 2869901
Hardinge e-mail: sales@hardinge.co.uk
Hardinge web site: www.hardinge.co.uk

FSC
Mixed Sources
Product group from well-managed forests and other controlled sources
Cert no. BV-COC-054711
www.fsc.org
© 1996 Forest Stewardship Council

Brochure #1362 • Litho in USA • ©Hardinge Inc. 2008 • January 2010