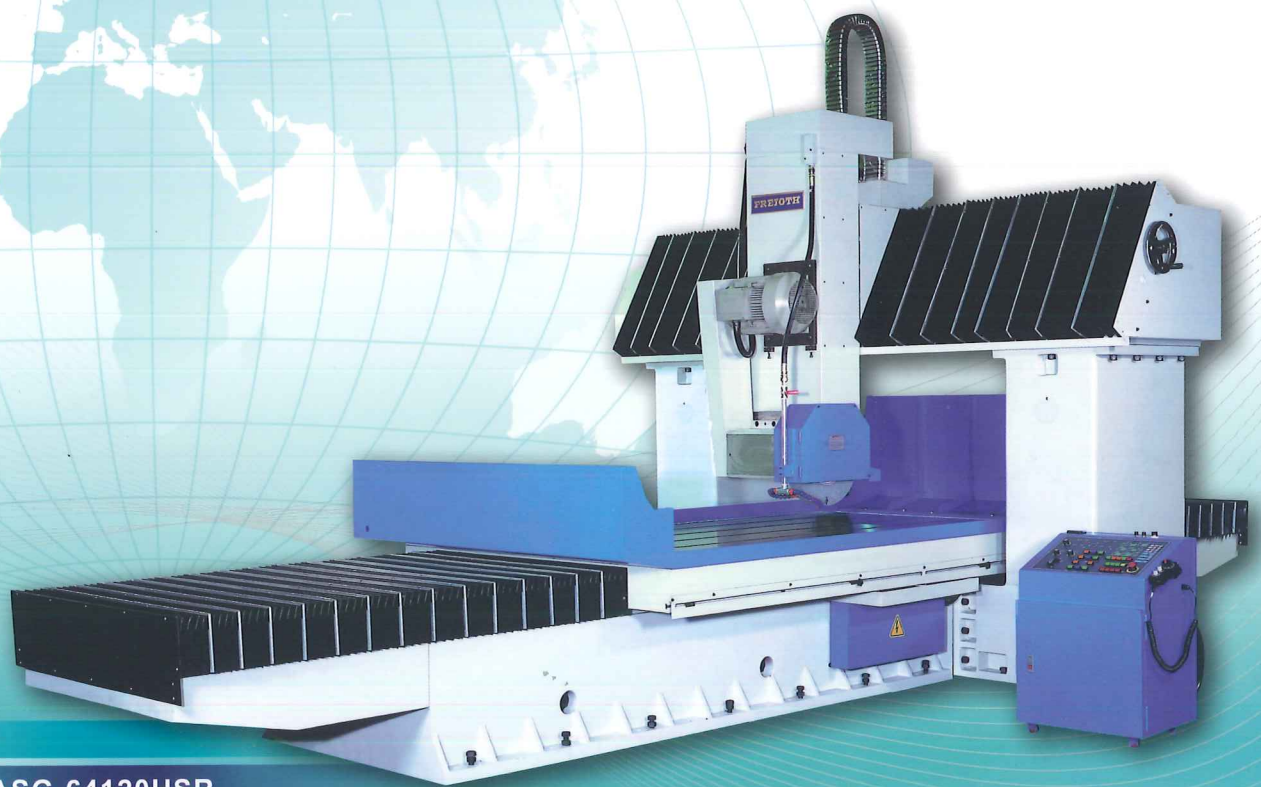


# HIGH PRECISION SURFACE GRINDERS



ASG-64120HSR

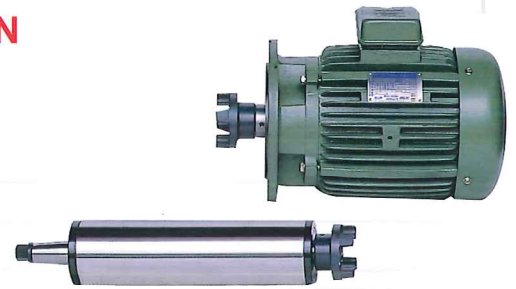
<http://www.frejoth.com.tw>

## Reliability And Versatility With Comprehensive Specification.

### OUTSTANDING FEATURES AND CONSTRUCTION

#### HIGH PRECISION CARTRIDGE - TYPE SPINDLE :

- Spindle is supported by 4 pieces preloaded super precision angular contact ball bearing to assure excellent accuracy, and this outstanding designed spindle suitable for heavy duty grinding jobs.



• To ensure the round out within 0.002 mm

#### DOUBLE WALL AND STRESS RELIEVED MAIN CASTINGS

- The main machine parts - base and column are made of high quality "double wall" cast iron with annealing treatment to eliminate the internal stress and also with ribs to give high stiffness and stability for all kind of grinding jobs.



#### LOW - FRICTION TURCITE - B COATED SURFACE :

- The slideways consist of one piece cast iron, surface contact with "TURCITE-B" surface of longitudinal table ways are precision hand scraped, and guarantee the contact points over 60-70 percent, ensure very high accuracy and high resistance.



#### MICRO - PROCESSOR BASED CONTROL :

- Micro-processor based control provides powerful function, trouble free operation and easy maintenance.
- Crossfeed microfeed vertical micro-feed 0.00001"/gra.



• micro feed

#### AUTO - DOWN FEED - 3 AXIS AUTOMATIC TYPE :

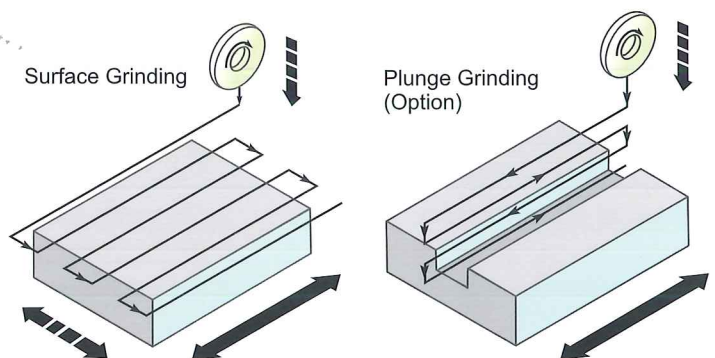
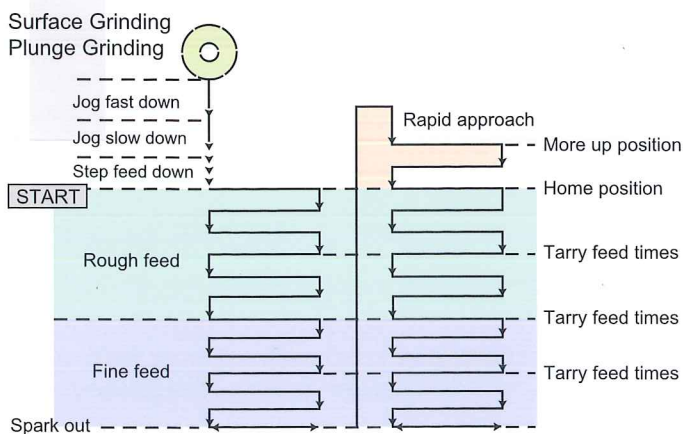
- Vertical driven by "STEPPING MOTOR", easily setting for rough grinding, fine grinding and sparkout grinding feeds.
- And intermitted setting tarrytime for rough grinding, fine grinding and sparkout grinding.



## Feature

- 1. Optimized Structure** - The major parts are manufactured from high quality cast iron combined with an outstanding structural design. Major parts are stress relieved to ensure maximum rigidity, stability and machining accuracy.
- 2. Precision Spindle Design** - The spindle runs in a class P4 high precision angular contact bearing, assuring run-out accuracy in 2  $\mu\text{m}$ . The cartridge-type spindle is completely sealed and lubricated for long working lifetime, providing high accuracy grinding and a long service life.
- 3. Ball bearing slideway** - The saddle type M series employs "AA" grade steel balls on longitudinal guide ways for easier operation and saving labor.
- 4. Turcite-B on Slideways** - The X, Z axes slideways are coated with Turcite-B for stable movement and long term accuracy.
- 5. Heavy Duty Linear Guide Ways** - The beam surface of double column type is equipped with two heavy duty linear guide ways with great span for extra smooth movement and high rigidity.
- 6. Precision Feed on Vertical-axis** - The vertical axis of cantilever type and double column type, are equipped with high precision linear guide ways combined with high precision ball screw transmission, assuring outstanding feed accuracy and maximum stability.
- 7. M.P.G. handwheel** - Except for the saddle type, the vertical feed are controlled by an M.P.G. handwheel instead of a conventional handwheel. Feed is driven by an AC servomotor for effortless operation and high accuracy.
- 8. Crisscross grinding function (option)** - Crisscross feed speed is infinitely variable, a very wide range of cross feed can be obtained. This grinding method is invaluable for grinding thin workpiece and can increase the efficiency significantly. (M & H series can't be installed) (This function is a standard function of the cantilever and double column series)
- 9. NC auto down feed system (AD5 type) (option)** - Except for the M & H series, the HS, and HSR models are available to equip with an optional NC auto down feed system (AD5 type) to become 3 axes fully automated for greatly increasing operational convenience. (This function is a standard function of the cantilever and double column series)
- 10. NC auto parallel dressing & compensating system (option)** - The optional NC auto parallel dressing & compensating system is available to equip with an optional NC auto down feed system (AD5 type), greatly increasing the grinding efficiency.
- 11. Variable Table Speed** - The variable feed speed of the cantilever & double column type table is controlled by a proportional hydraulic valve, allowing for feed speed adjustment according to the workpiece type for increased convenience of operation.
- 12. Vertical Wheel Head (option)** - Upon request, the double column type is available to equip with a vertical wheel head. It is suitable for grinding box slideways and dovetailed slideways.

## TYPE-AD5



## High Precision Saddle Type Surface Grinder



### ASG-618M

150 x 450 mm Table surface

- + Digital readout (Option)
- 3 axes manual



### ASG-618H

150 x 450 mm Table surface

- + Micro feed for cross & vertical feed (Option)
- Hydraulic longitudinal feed
- Manual cross & vertical feed



### ASG-1020HS

250 x 500 mm Table surface

- + Max. distance from center spindle to table: 600
- Hydraulic longitudinal feed
- Auto cross feed
- Manual vertical feed



### ASG-1224HS

300 x 600 mm Table surface

- Hydraulic longitudinal feed
- Auto cross feed
- Manual vertical feed



### ASG-1632HS

400 x 800 mm Table surface

- + Auto down feed (AD5) (Option)
- + Back water splash shield (Option)
- + Parall dress (manual) (Option)
- Hydraulic longitudinal feed
- Auto cross feed
- Manual vertical feed
- Table longitudinal travel is controlled by sensor and solenoid valve
- Continuous lubrication

■ Saddle type

Specifications		ASG-618M	ASG-618H / HS	ASG-1020H / HS	ASG-1224HS	ASG-1632HS
		ASG-818M	ASG-818H / HS			
Grinding surface of table	mm	150 x 450 150 x 450		250 x 500	300 x 600	400 x 800
Max. grinding surface	mm	150 x 450 150 x 450		250 x 500	300 x 600	400 x 800
Max. distance center of spindle to table	mm	450		600	600	650
Total Max. safety table load	kgs	114 120	144 150	250	300	400
Table speed approx.	M / min	manual	5 ~ 25		5 ~ 25	
Table guideway		Ball bearing slideway	V & Flat way		V & Flat way	
Auto. Cross feed increment approx.	mm	manual	manual (for H series) 0.1 ~ 12 (for HS series)		0.5 ~ 20	
Rapid power cross feed	mm / min	manual	manual (for H series) 1100 [60 HZ] / 900 [50 HZ] (for HS series)		1100 [60 HZ] / 900 [50 HZ]	
Cross feed on hand wheel	mm	5 / rev. ; 0.02 / gra.			5 / rev. ; 0.02 / gra.	
Rapid power head elevation	mm / min	550 [60 HZ] / 450 [50 HZ] (Power rapid up / down system) [Option] 350 (NC Auto down feed system) [Option]		550 [60 HZ] / 450 [50 HZ] (Power rapid up / down system) [Option] 350 (NC Auto down feed system) [Option]		
Vertical feed on hand wheel	mm	2 / rev. ; 0.01 / gra.			2 / rev. ; 0.01 / gra.	
Auto down feed	mm / time	0.001 ~ 0.999 [2 / rev. ; 0.005 / gra.] [Option]		0.001 ~ 0.999 [2 / rev. ; 0.005 / gra.] [Option]		
Wheel speed	R. P. M	3500 [60 HZ] 2900 [50 HZ]			1750 [60 HZ] 1450 [50 HZ]	
Wheel dimension	mm	180 x 13 x 31.75 [Max. 200 x 20 x 31.75]			355 x 38 x 127	405 x 50 x 127
Spindle motor	HP	2			5	5
Hydraulic pump motor	HP	None	1		1	2
Auto Cross feed motor		None	25 W (for HS)	1 / 5 HP	1 / 5 HP	
Rapid head elevation motor	HP	1 / 5			1 / 5	
Coolant pump [Option]	HP	1 / 8			1 / 8	
Machine net weight	Kgs	870 920	900 950	1350	1950	3320
Packing gross weight	Kgs	970 1020	1100 1150	1550	2200	3570
Machine dimensions (L x W x H)	mm	1900 x 1200 x 1700 2100 x 1300 x 1700	1900 x 1300 x 1700 2250 x 1400 x 1800	2250 x 1400 x 1950	2650 x 1550 x 1950	3450 x 2050 x 1980
Packing dimension (L x W x H)	cm	182 x 128 x 195	212 x 146 x 195	212 x 146 x 200	228 x 179 x 225	276 x 228 x 225

\* The manufacturer reserves the right to modify the mechanism specifications, etc. without prior notice.

**M:** M series are 3 axes by Manual.

**H:** H series are longitudinal by Hydraulic and cross feed/vertical axes are manual.

**HS:** HS series are Auto Cross feed, longitudinal by Hydraulic and vertical axis is manual.

**HSR:** HSR series are Auto Cross feed, longitudinal by Hydraulic, vertical axis travel is by AC servo motor, power Rapid up / down.

## High Precision Column Type Surface Grinders

### ASG-2440HSR

600 x 1000 mm Table surface

+ NC Auto down feed system & NC Auto parallel dressing and compensating system (Option)

- Hydraulic longitudinal feed
- Auto cross feed
- Vertical feed is driven by AC servo motor
- Table longitudinal travel is controlled by sensor and solenoid valve



### Column Type

Specifications		ASG-2040HSR ASG-2440HSR ASG-2840HSR	ASG-2060HSR ASG-2460HSR ASG-2860HSR	ASG-2080HSR ASG-2480HSR ASG-2880HSR
Grinding surface of table	mm	500 x 1000 600 x 1000 700 x 1000	500 x 1500 600 x 1500 700 x 1500	500 x 2000 600 x 2000 700 x 2000
Max. grinding surface	mm	500 x 1000 600 x 1000 700 x 1000	500 x 1500 600 x 1500 700 x 1500	500 x 2000 600 x 2000 700 x 2000
Max. distance center of spindle to table	mm	* 600 [Option : 800 & 1000]		
Total Max. safety table load	kgs	800 1000 1000	1200 1400 1400	1500 1700 1700
Table speed approx.	M / min	5 ~ 25		
Table guideway		V & Flat way		
Auto. Cross feed increment approx.	mm	0.5 ~ 20		
Rapid power cross feed	mm / min	1100 [60 HZ] / 900 [50 HZ]		
Cross feed on hand wheel	mm	5 / rev. ; 0.02 / gra.		
Rapid power head elevation	mm / min	300		
Vertical feed on hand wheel	mm	(x 1) 0.1 (x 1) 0.001	(x 5) 0.5 (x 5) 0.005	(x 10) 1 (x 10) 0.01
Auto down feed	mm / time	0.001 ~ 0.999 [Option]		
Wheel speed	R. P. M	1750 [60 HZ] / 1450 [50 HZ]		
Wheel dimension	mm	405 x 50 x 127		
Spindle motor	HP	10 [Option : 15]		
Hydraulic pump motor	HP	3	5	
Auto Cross feed motor		1 / 5 HP		
Rapid head elevation motor		1 KW AC servo motor		
Coolant pump [Option]	HP	1 / 4		
Machine net weight	Kgs	6000 6300 6600	7200 7500 7800	8400 8700 9000
Packing gross weight	Kgs	6800 7100 7400	8100 8400 8700	9400 9700 10000
Machine dimensions (L x W x H)	mm	4600 x 2300 x 2040 4600 x 2450 x 2040 4600 x 2550 x 2040	4800 x 2300 x 2040 4800 x 2450 x 2040 4800 x 2550 x 2040	6000 x 2300 x 2040 6000 x 2450 x 2040 6000 x 2550 x 2040
Packing dimension (L x W x H)	cm	376 x 230 x 228	391 x 230 x 228	477 x 230 x 228
		* 20' General Container : Max. distance center of spindle to table : 600mm * 40' High Container : Max. distance center of spindle to table : 800mm * 20' Flat rack : Max. distance center of spindle to table : 1000mm		

\* The manufacturer reserves the right to modify the mechanism specifications, etc. without prior notice.

# Cantilever Type Surface Grinders

## ASG-4080HSR

1000 x 2000 mm Table surface

+ NC Auto parallel dressing and compensating system (Option)

- Stepless variable proportional valve hydraulic system
- Auto cross feed
- Vertical feed is driven by AC servo motor
- NC Auto down feed system



### ■ Cantilever type

Specifications	ASG-3260HSR ASG-4060HSR		ASG-3280HSR ASG-4080HSR		ASG-32120HSR ASG-40120HSR		ASG-32160HSR ASG-40160HSR		
	Grinding surface of table	mm 800 x 1500 1000 x 1500		800 x 2000 1000 x 2000		800 x 3000 1000 x 3000		800 x 4000 1000 x 4000	
Max. grinding surface	mm 800 x 1500 1000 x 1500		800 x 2000 1000 x 2000		800 x 3000 1000 x 3000		800 x 4000 1000 x 4000		
Max. distance center of spindle to table	mm		800 [Option : 1000]				700 [Option : 900]		
Total Max. safety table load	kgs 2000 2400		2650 3200		3950 4800		5000 5500		
Table speed approx.	M / min		3 ~ 25						
Table guideway			V & V way						
Auto. Cross feed increment approx.	mm		0.5 ~ 20						
Rapid power cross feed	mm / min		900						
Cross feed on hand wheel	mm		5 / rev. ; 0.02 / gra.						
Rapid power hand elevation	mm / min		240						
Vertical feed on hand wheel	mm		(x 1) 0.1 (x 1) 0.001		(x 5) 0.5 (x 1) 0.005		(x 10) 1 (x 10) 0.01		
Auto down feed	mm / time		0.001 ~ 0.999						
Wheel speed	R. P. M		1750 [60 HZ] / 1450 [50 HZ]						
Wheel dimension	mm		405 x 50 x 127 [Max. 405 x 75 x 127]						
Spindle motor	HP		10 [Option : 15]						
Hydraulic pump motor	HP		7.5		10		15		
Auto Cross feed motor	HP		80 W						
Rapid head elevation motor			1 KW AC servo motor						
Coolant pump [Option]	HP		1 / 2						
Machine net weight	Kgs		12800 13800		14300 15300		17300 18800		20300 21300
Packing gross weight	Kgs		13800 14800		15500 16500		17800 19800		21800 22800
Machine dimensions (L x W x H)	mm		5160 x 2400 x 2555 5160 x 2660 x 2555		6260 x 2400 x 2555 6260 x 2660 x 2555		8460 x 2400 x 2555 8460 x 2600 x 2555		10660 x 2400 x 2555 10660 x 2660 x 2555
Packing dimension (L x W x H)	C / NO.1		439 x 230 x 297		546 x 230 x 297		750 x 230 x 297		850 x 230 x 297
	C / NO.2		439 x 276 x 297		546 x 276 x 297		750 x 276 x 297		850 x 276 x 297
			167 x 167 x 206 (NW : 630kgs / GW : 730 kgs) * Shipping by 40' Flat rack						

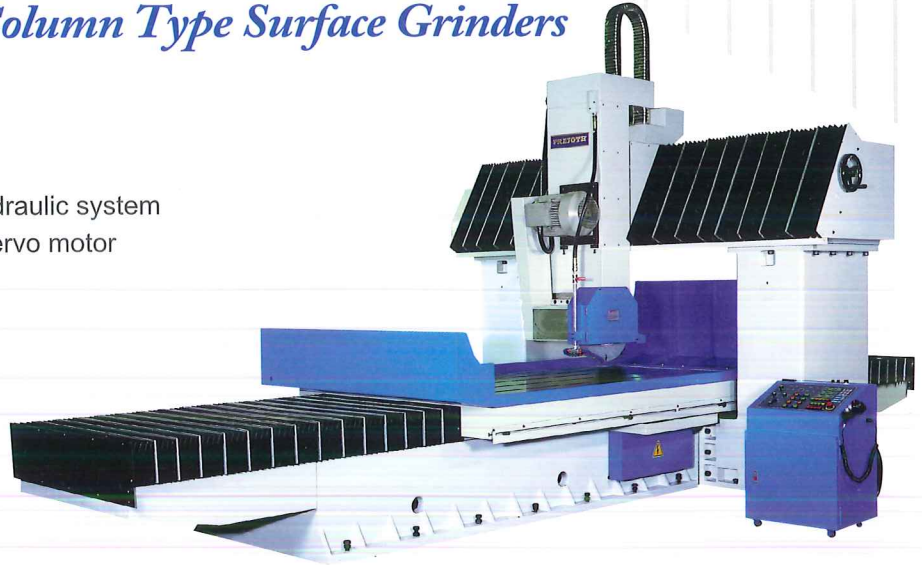
\* The manufacturer reserves the right to modify the mechanism specifications, etc. without prior notice.

## High Precision double Column Type Surface Grinders

### ASG-64120HSR

1600 x 3000 mm Table surface

- Stepless variable proportional valve hydraulic system
- Cross & Vertical feed is driven by AC servo motor
- NC Auto down feed system



### Double Column type

Specifications		ASG-4880HSR	ASG-48120HSR	ASG-48160HSR	ASG-48200HSR	ASG-48240HSR
		ASG-6480HSR	ASG-64120HSR	ASG-64160HSR	ASG-64200HSR	ASG-64240HSR
Grinding surface of table	mm	1200 x 2000 1600 x 2000	1200 x 3000 1600 x 3000	1200 x 4000 1600 x 4000	1200 x 5000 1600 x 5000	1200 x 6000 1600 x 6000
Max. grinding surface	mm	1200 x 2000 1600 x 2000	1200 x 3000 1600 x 3000	1200 x 4000 1600 x 4000	1200 x 5000 1600 x 5000	1200 x 6000 1600 x 6000
Max. distance center of spindle to table	mm	1000 [Option : 1200]			900 [Option : 1100]	
Total Max. safety table load	kgs	5200 6000	6340 7300	7600 9000	8700 10700	9880 12400
Table speed approx.	M / min	1 ~ 25				
Table guideway		V & V way				
Auto. Cross feed increment approx.	mm	0.1 ~ 40				
Rapid power cross feed	mm / min	900				
Cross feed on hand wheel	mm	(x 1) 0.1 (x 1) 0.001	(x 5) 0.5 (x 1) 0.005	(x 10) 1 (x 10) 0.01		
Rapid power head elevation	mm / min	300				
Vertical feed on hand wheel	mm	0.001 ~ 0.999				
Auto down feed	mm / time	(x 1) 0.1 (x 1) 0.001	(x 5) 0.5 (x 5) 0.005	(x 10) 1 (x 10) 0.01		
Wheel speed	R. P. M	1100				
Wheel dimension	mm	508 x 76 x 203				
Spindle motor	HP	20 [Option : 30]				
Hydraulic pump motor	HP	15		20		25
Auto Cross feed motor		1 KW AC servo motor				
Rapid head elevation motor		1 KW AC servo motor				
Coolant pump [Option]	HP	1 / 2				
Machine net weight	Kgs	20000 23000	24000 28000	28500 33000	33000 38000	37500 43000
Packing gross weight	Kgs	22000 25500	26300 30800	31000 36000	36000 41500	41500 48000
Machine dimensions (L x W x H)	cm	660 x 370 x 400 660 x 410 x 400	880 x 370 x 400 880 x 410 x 400	1100 x 370 x 400 1100 x 410 x 400	1320 x 370 x 400 1320 x 410 x 400	1540 x 370 x 400 1540 x 410 x 400
Packing dimension (L x W x H)		40' HQ x 1	40' HQ x 1 + 20' x 1	40' HQ x 1 + 20' x 1	40' HQ x 2	40' HQ x 1 + 40' FR x 1

\* The manufacturer reserves the right to modify the mechanism specifications, etc. without prior notice.



## Feature - For Adp Type

- 01** Optimized Structure - The major parts of FREJOTH grinders are manufactured from high quality cast iron combined with an outstanding structural design by Finite Element Analysis (FEA). Major parts are stress relieved to ensure maximum rigidity, stability and machining accuracy.
- 02** Turcite-B on Slideways - The X and Z axes slideways are coated with Turcite-B for stable movement and long term accuracy.
- 03** Precision Spindle Design - The spindle runs in a class P4 high precision angular contact bearing, assuring run-out accuracy in 2  $\mu\text{m}$ . The cartridge-type spindle is completely sealed and lubricated for long working lifetime, providing high accuracy grinding and a long service life.
- 04** X axis driven by Stepless Variable Proportional Valve Hydraulic System - Allowing for feed speed adjustment according to the workpiece type for increased convenience of operation.
- 05** Y & Z axes driven by AC servomotor + MPG hand wheel - Providing high accuracy and convenient operating.
- 06** Semi enclosed splash shield (right side open) - More safety and more cleaning.
- 07** Crossing stroke adjustment for X & Z axes - Travel setting by joystick, more convenient.



- 08** Spindle motor inverter - Variable spindle speed adjustment for different material.
- 09** Auto dressing and compensation (Diamond dresser on the table) function for increasing more processing efficiency.
- 10** Grinding mode : Surface, Crisscross, Plunge, and Pitch (same pitch and same depth).
- 11** Position display (for Y & Z axes).
- 12** 8-inch LCD touch screen panel (PLC controller) and Graphical HMI Interface. Operating more easier, friendly and efficiency.
- 13** [Option] Auto balancing system - Providing superior grinding accuracy and finishing.
- 14** [Option] NC Auto parallel dressing and compensating device (over spindle head) function for increasing more processing efficiency and saving grinding time.

## Adp-Saddle Type Series



Option



**ASG-1632ADP**

Specifications		ASG-1020ADP	ASG-1224ADP	ASG-1632ADP
Grinding surface of table	mm	250 x 500	300 x 600	400 x 800
Max. distance center of spindle to table	mm	500		550
Table speed approx.	M / min	5 ~ 25		
Rapid power cross feed	mm / min	900		
Rapid power hand elevation	mm / min	450		
Auto Cross feed motor	w	750 (AC servo motor)		
Rapid head elevation motor	kw	1 (AC servo motor)		
Cross & Vertical feed by M.P.G	1 rev	mm	(x 1) 0.1    (x 5) 0.5    (x 10) 1	(x 1) 0.1    (x 5) 0.5    (x 10) 1
	1 gra	mm	(x 1) 0.001    (x 5) 0.005    (x 10) 0.01	(x 1) 0.001    (x 5) 0.005    (x 10) 0.01
Wheel dimension	mm	180 x 13 x 31.75	355 x 38 x 127	450 x 50 x 127
Wheel speed	R. P. M	2900	1450	
Spindle motor	HP	2	5	
Hydraulic motor	HP	1	2	
Machine net weight	kg	2000	2500	3700
Packing gross weight	kg	2380	3000	4500
Machine dimensions (L x W x H)	mm	2680 x 2350 x 2000	3000 x 2350 x 2460	3300 x 2650 x 2540
Packing dimension (L x W x H)	cm	312 x 222 x 252	350 x 226 x 252	373 x 228 x 252

\* The manufacturer reserves the right to modify the mechanism specifications, etc. without prior notice.

# Adp-Column Type Series



**ASG-2880ADP**

Specifications		ASG-2040ADP ASG-2440ADP ASG-2840ADP		ASG-2060ADP ASG-2460ADP ASG-2860ADP		ASG-2080ADP ASG-2480ADP ASG-2880ADP	
		Grinding surface of table	mm	500 x 1000 600 x 1000 700 x 1000		500 x 1500 600 x 1500 700 x 1500	
Max. distance center of spindle to table	mm			600			
Table speed approx.	M / min			5 ~ 25			
Rapid power cross feed	mm / min			900			
Rapid power hand elevation	mm / min			300			
Auto Cross feed motor	kw			1.5 (AC servo motor)			
Rapid head elevation motor	kw			1 (AC servo motor)			
Cross & Vertical feed by M.P.G	1 rev	mm		(x 1) 0.1	(x 5) 0.5	(x 10) 1	
	1 gra	mm		(x 1) 0.001	(x 5) 0.005	(x 10) 0.01	
Wheel dimension	mm			450 x 50 x 127			
Wheel speed	R. P. M			1450			
Spindle motor	HP			10			
Hydraulic motor	HP			5			
Machine net weight	kg		6870		7870		9070
			7170		8170		9370
			7470		8470		9670
Packing gross weight	C / NO.1	kg	6800		8100		9400
		kg	7100		8400		9700
	C / NO.2	kg	7400		8700		10000
		kg	830		850		900
Machine dimensions (L x W x H)	mm		4800 x 2500 x 2040		5000 x 2500 x 2040		6200 x 2500 x 2040
			4800 x 2600 x 2040		5000 x 2600 x 2040		6200 x 2600 x 2040
			4800 x 2700 x 2040		5000 x 2700 x 2040		6200 x 2700 x 2040
Packing dimension (L x W x H)	C / NO.1	cm	365 x 230 x 235		385 x 230 x 235		475 x 230 x 235
	C / NO.2	cm	228 x 147 x 147		228 x 167 x 147		228 x 217 x 147

PS. C/NO.1 is machine, C/NO.2 is parts for semi-enclosed splash guard

\*\* The manufacturer reserves the right to modify the mechanism specifications, etc. without prior notice.

# HIGH PRECISION SURFACE GRINDERS

## ■ STANDARD ACCESSORIES

- |                               |  |
|-------------------------------|--|
| 1. Grinding wheel             | 7. Leveling screw and plates   |
| 2. Wheel flange               | 8. Tool box and tools  |
| 3. Flange extractor           | 9. Working lamp (Saddle type only)   |
| 4. Wheel balancing arbor      | 10. Parallel dresser (Manual) (Cantilever and Double column type only)     |
| 5. Wheel balancing base       | 11. NC Automatic down feed system (Cantilever and Double column type only) |
| 6. Wheel dresser with diamond |  |

## ■ OPTIONAL ACCESSORIES

- |   |  |
|---|--|
| 1. Electro / Permanent magnetic chuck                     | 13. Auto paper strip filter and magnetic separator with coolant system |
| 2. Automatic demagnetizer for Electro magnetic chuck      | 14. Automatic crossing stroke adjustment by control panel switch       |
| 3. Micro feed for Cross / vertical feed (0.001 mm / gra.) | 15. Back water splash shield   |
| 4. Power Rapid up / down system                           | 16. Enclosed splash shield   |
| 5. NC Auto down feed system (AD5 type)                    | 17. Spindle motor inverter   |
| 6. Parallel dresser (Manual)                              | 18. Wheel flange   |
| 7. NC auto parallel dressing & compensating system        | 19. Tool makers vise   |
| 8. Coolant system   | 20. Auto balancing device  |
| 9. (Dust) suction system (1 / 2 HP)                       | 21. Digital readout unit   |
| 10. (Dust) suction with coolant system                    | 22. Crisscross grinding function                                       |
| 11. Magnetic separator with coolant system                |  |
| 12. Auto paper strip filter with coolant system           |  |

\*\* REMARK : FOR ADP TYPE, PLEASE CHOOSE ONLY #1 ~ 2, #8 ~ 13 AND #18 ~ 20 OPTIONS.



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