



High Technology Grinders



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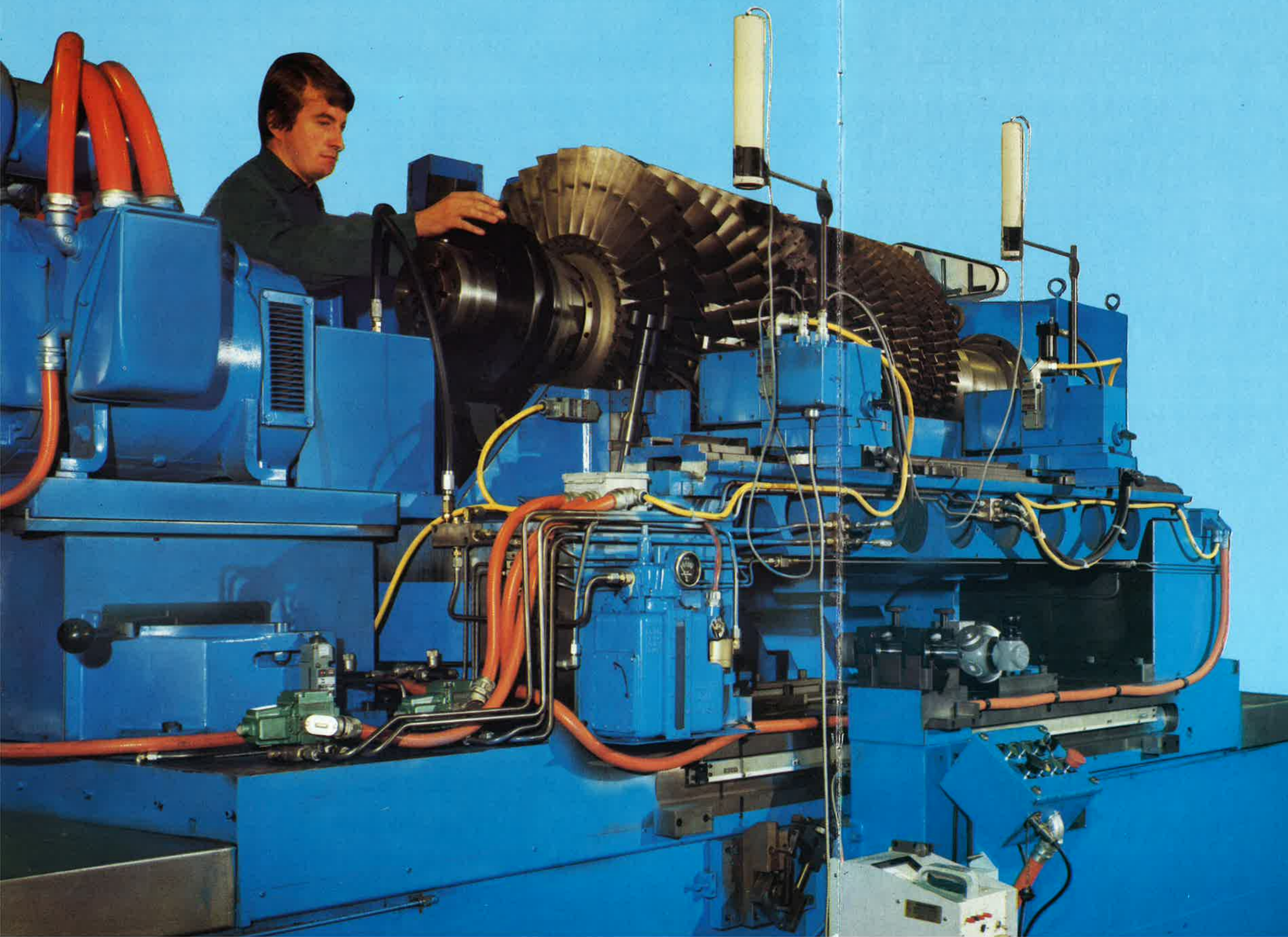
High Technology Grinding

For 80 years the name Butler Newall has been associated with innovative engineering and the Company's present product range includes some of the most technically advanced grinding machines in the world.

Two of these are described in this leaflet; the CNC machine which represents a major step forward in computer controlled cylindrical grinding for general work and the BTG, a machine designed specifically to solve a difficult problem in the manufacture of jet engine compressor rotor assemblies and turbines.

Even though these machines are examples of the most advanced grinding technology in the world, they are built to achieve down-to-earth objectives – maximum output with minimum set up times and simple operation – the true purpose of a modern machine tool.

Loading the Butler Newall BTG turbine blade tip grinder.



CNC 500, 600, 1000 & 1500

Cylindrical grinders

Base

A ruggedly built and heavily ribbed unit designed to give stability to the machine upper units. A totally enclosed channel carries electrical wiring around the base with obvious safety advantages.

Worktable

The table is located on the base by generously proportioned vee and flat slideways, which are coated with PTFE compound to minimise stick-slip. A d.c. servo motor, operating directly on to a ball leadscrew assembly, provides fast and accurate table movements.

Workhead & tailstock

Both are heavy duty types. The workhead incorporating a d.c. motor providing programmed workspeeds.

The tailstock is lever operated and has taper correction adjustment. On larger machines hydraulic operation is provided.

Wheelhead

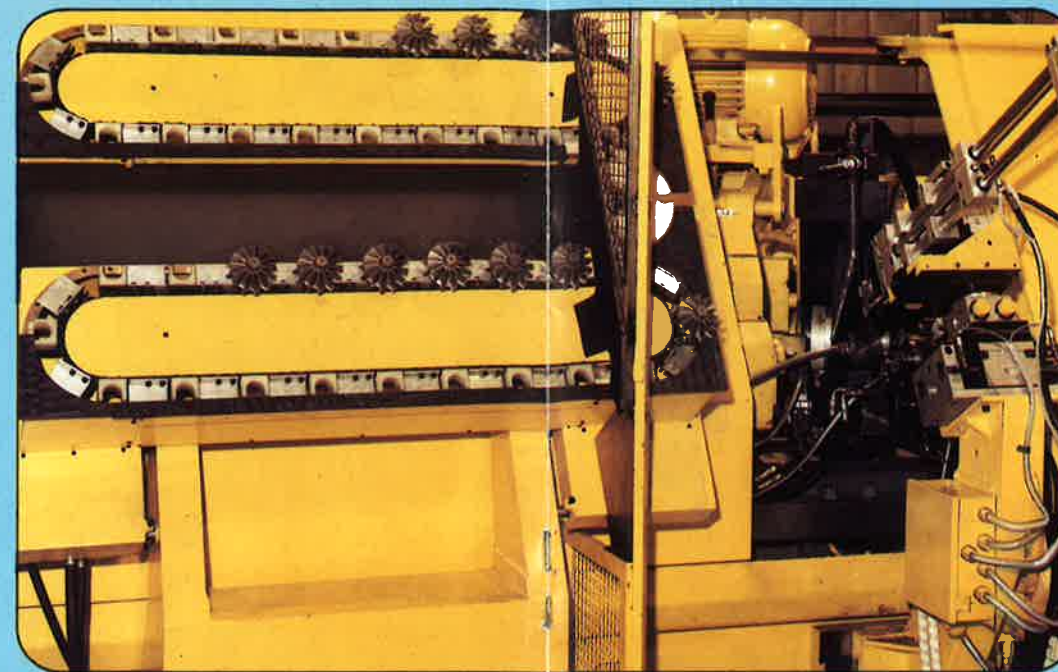
Depending on the application for which the machines are intended, the range can be supplied with the wheelhead arranged as straight approach or 30° (angle approach).

A heavily built one piece unit, the wheelhead is supported on a sub-slide, which is bolted direct to the machine base. As with other units, the wheelhead slideways are coated with the PTFE compound.

The wheelspindle is of cartridge construction incorporating pre-loaded high precision parallel roller bearings, which are grease-packed for life. No maintenance is required.

A feature of the wheelhead is that the design allows wheelwear throughout the life of the wheel without machine re-setting, thus saving considerable time. Lubrication to the wheelhead is automatically applied from the central machine system.

As an alternative to the above, a variable angle wheelhead can be provided to permit both straight approach and angle approach.



Wheeldresser

Programmed dressing from the table mounted dressing device is fitted as standard.

An extremely neat and compact unit, the dresser accurately reinstates the wheel profile as this becomes worn during grinding. The dressing cycle is automatically activated by the program and wheelwear compensation is also automatically applied.

As an alternative to the above, a wheelhead mounted form dresser can be supplied.

Automatic loading

This can be supplied as an option to customer's requirements.

Control system

GE 2000 microprocessor type having VDU display. This unit provides microprocessor control facilities with keyboard data entry for programming and editing in an easily digestible format.



Gauging

The machine is suitable for interrupted and non-interrupted gauge systems.

Feed system

In keeping with the overall concept of the machine, the feed system to the wheelhead is direct and employs remarkably few mechanical components. The system consists of a d.c. servo motor driving high precision re-circulating ball feedscrew, providing fast and accurate wheelhead movement. The feedscrew axis is arranged so as to be on approximately the same centre line as the wheelhead spindle.

The use of a precision ballscrew and nut ensures minimum frictional resistance, accurate location and repeatability.

Specification

All dimensions in mm unless otherwise stated				
	CNC 500	CNC 600	CNC 1000	CNC 1500
Capacity				
Distance between centres	500	600	1000	1500
Height of centres	154	165 or 215		
Maximum diameter ground	150	300 or 400		
Maximum diameter swing	300	300 or 400		
Wheelhead				
Wheelhead configuration	Straight approach or angle approach			
Wheel diameter	600	750		
Wheel width	100 maximum. (Note: with wheelhead swivel and internal grinding facility fitted, max. width = 60mm)			
Wheel bore	304.8			
Wheel speed	43 metres per second			
Wheel feed distance	Adjustable to suit program			
Wheelhead rapid approach	Adjustable to suit program			
Repeatability of wheelhead	0.008 on diameter (with gauge 0.003 on diameter)			
Worktable				
Table speed	12.7 metres per minute maximum			
Repeatability of table	0.012			
Workhead				
Work speed	up to 1000 r.p.m.	20-500 r.p.m.		
Programmed into microprocessor to give automatic speed change on multi-diameter components				
Accuracy of feeds				
± 0.001 (on diameter)				
Gauging systems				
Machine suitable for electronic in-process gauge for interrupted and non-interrupted diameters				
Motors				
Wheelhead	15kW	15kW		
Workhead	2.2kW	3.0kW		
Hydraulic	0.75kW	0.75kW		
Wheelhead feed motor	d.c. servo			
Table traverse motor	d.c. servo			
Electrical supply				
415 ± 6% volts, 50Hz, 3-phase or to meet specification				
Floor space	3600 × 2800	3660 × 3930	5660 × 2855	6220 × 2855
Approximate shipping specification				
Nett weight (kg)	5800	9500	10 820	11 795
Gross weight (kg)	7000	10 700	12 100	13 598
Case size (metres)	3.7 × 2.7 × 2.6	4.47 × 2.72 × 2.56 (or 20ft container 15.5m ³)	4.52 × 2.92 × 2.35	6.35 × 3.04 × 2.31
Research and development				
Specifications given are subject to change without notice				



BTG

CNC blade tip grinding machine

For the efficient, speedy and accurate finish grinding of jet engine compressor rotor assemblies and HP and LP turbines, Butler Newall have developed and patented a new range of machines – designated type BTG.

Problem

The problem of effectively grinding both the blade stage angle and radii (finished diameter) on complete blade assemblies has been known for some time and previous methods using conventional or universal grinding machines are extremely time consuming, being limited to 'one at a time' procedures.

A normal grinder is not suitable due to the fact that the wheelhead pivot axis is remote from the periphery of the grinding wheel, resulting in angular adjustment to a higher order of accuracy to establish the correction required in both radial and longitudinal axes for the various stage angles. The problem is further amplified by the fact that blade assemblies are referenced to a longitudinal dimension from a datum and minimum angular accuracies called for to be held within $\pm 1'$ (1 minute of arc).

Solution

The machine is arranged to position the grinding wheel relative to the rotor to produce the three major dimensions which provide the blade tip envelope for each stage of blades.

1. Axial distance from a datum shoulder to the reference position.
2. Blade tip radius measured at the above reference position.
3. Blade tip angle referred to centre line.

The wheelhead is carried on a special compound slide. The lower (feed) slide carries a vertical axis pivot point about which the wheelhead underslide is swivelled to obtain the required angle. This slide enables the radial position of the vertical axis to be fed into the given tip radius (distance from the rotor centre line).

The wheelhead slide has two main functions —

1. To maintain the wheel periphery tangential to the vertical (pivot) axis at all times, by advancing to compensate for wheelwear after dressing.
2. To retract, allowing the de-burr brush to replace the grinding wheel, (i.e. tangential to the vertical axis).

The axial grinding position is obtained by traversing the worktable to align the stage reference position with the vertical axis.

When all stages have been ground to the required radii, an impregnated nylon brush driven by an air motor is automatically substituted for the grinding wheel and follows the same 3-axis program to de-burr the tips, brush rotation in both directions in turn ensures complete removal of any burr present from either leading or trailing blade edges.

Many in-built safety features are fitted as standard to ensure as complete a safe operation of the machine as possible. Both physical and electrical interlocks prevent the operator from accidentally using or moving any part of the machine out of sequence.

Construction

Of advanced design, the BTG grinder makes full use of present day technology, combined with proven methods, to achieve a high level of output and precision with minimum attention.

The use of high quality cast iron is employed for the production of all major components of the machine. These are of substantial rigid box section design and provide the necessary damping and stability required for this type of high technology application.

All major slideways are provided with PTFE coating and have wiper and telescoping guard protection.

Worktable

A traversing worktable fitted with low friction guides is operated by a precision ballscrew and d.c. servo drive with positioning control from the CNC unit.

Work fixture

The rotor is normally mounted in a work fixture which is bolted directly on to the worktable.

Work drive

An integral part of the machine having a d.c. variable speed drive and coupling arrangement to suit the particular application. Axial movement of the motor by a hand lever allows the drive to be readily engaged/disengaged. Speed is controlled by the NC system. Included are meters showing the work speed and load absorbed.



Wheelhead — heavy duty

A heavily built unit is carried on a subslide which pivots about a vertical axis to suit the angle to be ground. The subslide is mounted on a slide which is positioned so that the vertical axis is tangential to the required tip radius.

Wheelwear compensation and retraction for the de-burring operation is obtained by movement of the wheelhead on its subslide.

Wheelhead spindle

The large diameter nitrided steel spindle is of cartridge construction, incorporating grease packed, high precision bearings, which are pre-loaded to give optimum operating conditions. The spindle is driven by a single speed a.c. motor with a vee belt and pulley drive arrangement.

Wheel truing unit

This is mounted on the side of the wheelhead and can be either diamond roller or single point form type.

Machine system control

A 4-axis CNC unit (to suit customer's requirements/specification) with closed loop inductosyn feedback on 3 axes and resolver feedback on 4th axis; (i.e. angle), arranged to position the grinding wheel relative to each stage.

The automatic sequence will include the following:

Position the worktable axially to the given dimension from the datum shoulder.

Feed the lower slide until the vertical axis is tangential to the given stage finish size radius.

Position the wheelhead about the vertical axis to the given tip angle.

Facility for positioning a measuring gauge to the given radius.

All 4 axes have d.c. servo and recirculating ball screw drive.

The CNC unit also controls auxiliary functions, work speed, feed initiate, de-burr cycle.

Additional message for operator guidance can be incorporated and displayed for action.

Rapid advance, rough, fine and micro feeds can be engaged, in conjunction with an in-process gauge. Final size can be achieved without in-process gauging if required, or 'deadstop' sizing if in-process gauging is not fitted.

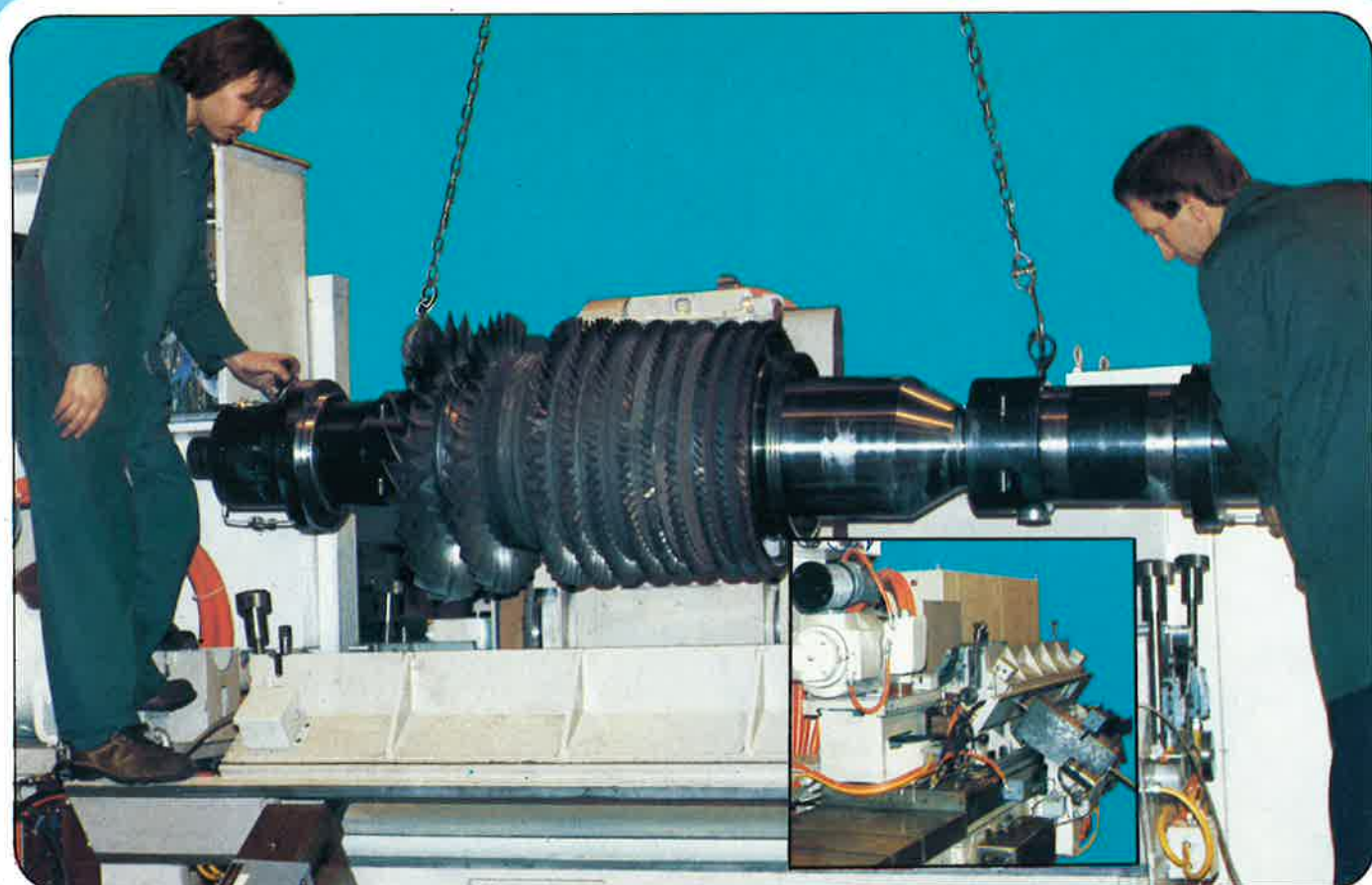


Lubrication

Supplied in accordance with required specifications. The machine incorporates a Trabon automatically operating lubricating system, which meters out the correct amount of lubrication to the wheelhead, table and dresser slideways.

Specification

	mm	in
Capacity		
Height of centres	635	25
Maximum diameter ground	915	36
Maximum table stroke	1525	60
Wheelhead		
Grinding wheel (maximum)	750 × 65 × 304.8	30 × 2½ × 12
Wheel speed	43 or 60 m/s (to suit requirements)	
Plunge feed rates	Steplessly variable (min 0.06 mm on dia)	
Maximum angle movement	0° to +16°	
Workdrive unit		
Speed range	100 rpm to 4200 rpm (depending on rotor size)	
Table		
Maximum stroke	1525	60
Maximum speed per minute	3000	120
Electric motors		
Table	Servo	
Wheelhead	15kW	20hp
Angle movement	Servo	
Work rotation (d.c.)	To suit	
Wheelhead feed	Servo	
Gauge position	Servo	
Standard electrics to suit 380V, 50Hz, 3-phase		
Machine control system (programmable)		
Work location for each stage of rotor		
Wheelhead angular position		
Gauging head, radial position (when applicable)		
Wheelhead feed including over-run limit		
Wheelwear compensation		
Wheelhead retraction for de-burr brush clearance		
Dresser infeed single point or roller		



Also available in the High Technology range:

KG300 General purpose cylindrical grinding machine suitable for either straight or angle approach applications



KG150

For smaller part production this is a more compact version of the KG 300

