

## 410/411 MANUAL BENDING MACHINES



### Two bench-mounted machines for economical bends of tube up to 1" OD and pipe 1/2" IPS

PHI's draw bending machines let you bend tube and pipe at extremely low cost. When you only need to make one or two bends per piece, you can save time and energy by using these efficient bench-mounted manual machines.



The compact design permits a great deal of mobility, as well as flexibility of location. They're light-weight and require less than four square feet of bench space - including the bend arm sweep.

The tube or pipe length capacity is unlimited, allowing you to use longer lengths with fewer joints.

That means another savings on labor and material costs required to join sections.

Both models give you precision bends with minimal wall thinning and ovality, particularly when optional mandrels are used.

The 410 and 411 benders are the ideal machines for prototype departments, small machine shops, and operations where cost is a factor and when only a few bends are needed per piece.



#### RELIABLE PERFORMANCE.

Few moving parts, all mechanical operation.

#### HIGHLY MOBILE.

These light-weight machines can be set-up-anywhere. There is no electrical or hydraulic hook-up required.

#### COMPACT SIZE.

Less than 4 sq. ft. (1.1m<sup>2</sup>) of bench space required.

#### PRECISE BENDS.

The DOB dial, in 1° increments, permits accurate bends within 1°.

#### REVERSIBLE DIRECTION.

You can bend clockwise and counter-clockwise, permitting the production of complex parts (Model 410 only).

#### Tooling Offers the User These Benefits

- The PHI Adaptive Tooling System permits bending a wider range of material diameters on one machine. Conversely, it makes a single item of tooling usable on a number of different PHI bending machines.
- Wiper dies are machined to achieve best tangential fit with bend dies (Model 411 only).
- Follower blocks are designed for precise alignment with the radius block.
- PHI tooling is manufactured in conformance with the requirements of military specifications MIL-I-45208A and MIL-C-45662A.
- Clamp blocks are designed for maximum grip of the tube and have a typical length of four times the Tube Outside Diameter.



	MODEL 410	MODEL 411
Capacity - Tube	3/4" (10 mm) OD X .065 (1.65 mm) WT maximum X 2D minimum CLR	1" (25 mm) OD X .065 (1.65 mm) WT maximum X 2D minimum CLR
- Pipe	3/8" (10 mm) IPS X Sched 40 max. X 3D minimum CLR	1/2" IPS (13 mm) IPS X Sched 40 max. X 3D minimum CLR
Material - Tube	35,000 psi (930 M Pa) yield	35,000 psi (930 M Pa) yield
Direction of Bend	Reversible (clockwise or counter-clockwise)	Clockwise standard, counter-clockwise if specified
Radius of Bend (CLR)	Minimum 2D - Maximum 6" (152 mm)	Minimum 2D - Maximum 6" (152 mm)
Maximum Bend Arm Movement	195°	195°
Tube Length	Unlimited	Unlimited
Machine Bench Space (including bend arm sweep)	20" X 13" (508 mm X 330 mm)	24" X 21" (610 mm X 533 mm)
Shipping Weight	100 lb (45 kg)	175 lb (79 kg)
Tooling Post	1/2" diameter (13 mm)	1" diameter (25 mm)
Mandrel Rods Available	Specify thread size	Specify thread size
Mandrel Rod Bracket Available	Machine or bench mounted	Bench mounted only

All necessary wrenches and one appropriately sized tooling post are furnished with each machine. Other sizes are available.

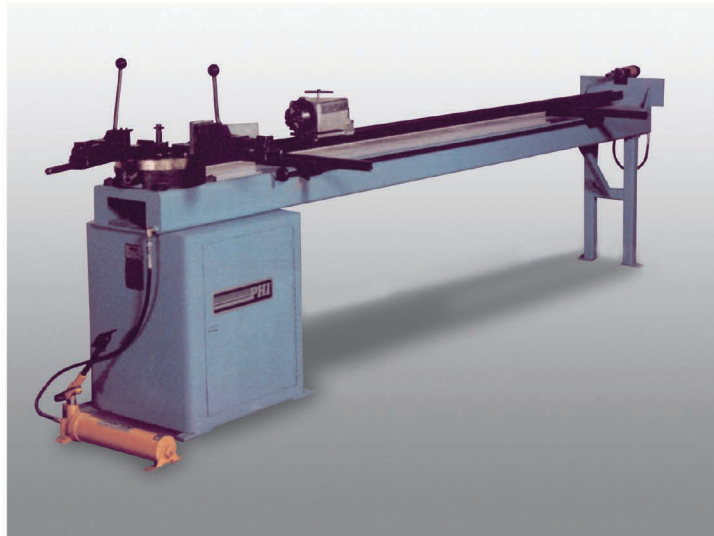
A universal pressure die slide-plate is furnished with the Model 411. A wiper-die support bracket can be furnished with the Model 411.





## 420 PRECISION BENDING MACHINES

Designed and Engineered for the needs of Aircraft Maintenance



### SPECIAL FEATURES

- Self-contained - needs no outside power source.
- Hydraulic foot operated mandrel extractor.
- Precision bends - equipped for wiper die and ball mandrel capabilities.
- Plane of bend carriage with adjustable chuck.
- 1/2" and 1" diameter tool post. All necessary wrenches and one operator's manual are included with the machine.

MODEL 420	
Capacity- Tube - Pipe	1-1/2" (37.5 mm) OD X .065 wall thickness X 2D minimum CLR 1" (25 mm) OD X schedule 80 X 2D minimum CLR
Material - Tube - Pipe	35,000 psi (930 M Pa) yield, 35% elongation ASTM A-587 or equivalent
Direction of Bend	Reversible (clockwise or counter-clockwise)
Center Line Radius (CLR) Maximum Bend Arm Movement	Maximum 8" (200 mm) standard, 12" (300 mm) optional 195°
Maximum Over-Mandrel Tube Length	10 feet (3.3 m)
Machine Floor Space	12 feet (3.6 m) long X 40" (100 cm) wide 40" (100 cm) high
Shipping Weight	900 lb (409 kg) approximately

Our Model 420 is a totally flexible and precise manually-operated "draw" or "rotary die" type machine. It has a special gear-operated bend arm that will increase leverage 4 to 1 when bending heavier tubes. The bender head is bolted to a machine table which is mounted on a tooling storage cabinet. The Model 420 may be set up for either right or left hand bending. Since it requires no outside power source, your maintenance team can now make precise and accurate bends anywhere in the field.

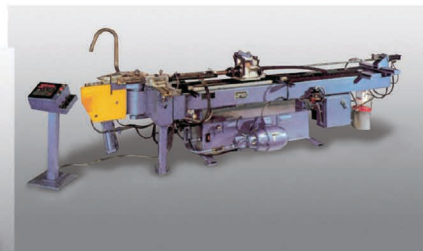
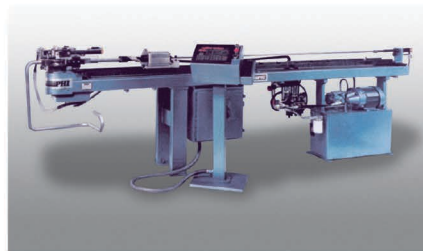




## SYNCHRO BENDING MACHINE



### Synchronized bending machine with microprocessor/programmable digital controller for semi-automatic bends up to 3" OD



PHI's synchronized bending machine, Model 210, 220 and 233, offers three-axis bending with one powered axis for the degree of bend (DOB). When configured as shown, the 200 Series provides high-speed production of simple and complex bent tube shapes up to 3" outside diameter (OD) and pipes up to 2" OD.

Configurations range from a slim head and bed profile with spacious underbed clearance to minimize bending interference, a drop-away clamp (Models 220 & 233 only) which speeds production of complex parts by dropping the clamp away from the bend head prior to retracting the clamp and positioning it for the next bend. This eliminates the problem of pipe getting in the way of the clamp and bend die in its retraction cycle. Our modular design – a basic machine with many

options – allows each machine to be custom fitted to best meet your needs.

PHI's user-friendly programmable digital controller, is specifically designed for bending and is logically laid out for proper bending sequencing. It has a capacity for 100 programs consisting of 1 to 10 bends (DOB's) per program.

The optional carriage allows mechanical presetting of up to 10 planes of bend (POB) and distance between bends (DBB). When incorporated with the controller, the machine will synchronize and interlock all three positions (POB, DOB and DBB) to ensure correct tube alignment before bending can occur. This ensures easily repeatable bent tube shapes and scrap free production.

#### QUALITY OUTPUT.

Perfect part duplication, scrap-free production, quality tooling, positive POB stops and DBB stops.

#### LABOR SAVINGS.

Single setup for multiple bend parts.

#### RELIABLE PERFORMANCE.

Heavy-duty construction and extra-large electric motors.

#### PERFORMANCE-ENHANCING FEATURES.

Precision PHI tooling to help reduce wall thinning and ovality. Synchronized interlock positioning for accurate, scrap-free parts.

	MODEL 210	MODEL 220	MODEL 233
Capacity	- Tube 2" (50mm) OD x .035" (.88mm) wall thickness x 3D minimum CLR or 1 1/2" (37.5mm) OD x .065" (1.63mm) wall thickness x 2D minimum CLR	2" (50mm) OD x .125" (3.17mm) wall thickness x 2D minimum CLR	3" (75mm) OD x .188 (4.7mm) wall thickness x 2D minimum CLR
Material	- Pipe 1" (25mm) OD x schedule 40 x 3D minimum CLR	1 1/2" (37.5mm) OD x schedule 40 x 3D minimum CLR	2" IPS (60mm) OD x schedule 80 x 3D minimum CLR
	- Tube 35,000 psi (930 MPa) yield, 35% elongation	35,000 psi (930 MPa) yield, 35% elongation	35,000 psi (930 MPa) yield, 35% elongation
	- Pipe ASTM A-587 or equivalent	ASTM A-587 or equivalent	ASTM A-587 or equivalent
Direction of Bend	Clockwise (Counter-clockwise rotation is available on special order)	Clockwise (Counter-clockwise rotation is available on special order)	Clockwise (Counter-clockwise rotation is available on special order)
Center Line Radius (CLR)	8" (200mm) standard, 12" (300mm) optional	10" (254mm) standard,	15" (381mm) standard
Maximum Bend Arm Movement	195°	180° and springback allowance	195°
Maximum Over-Mandrel Tube Length	10 feet (3.0m) standard, Longer lengths optional	10 feet (3.0m) standard, Longer lengths optional	10 feet (3.0m) standard, Longer lengths optional
Machine Floor Space	15 feet (4.5m) long x 44" (110cm) wide x 49" (122.5cm) high	15 feet (4.5m) long x 51" (110cm) wide x 49" (122cm) high	18 feet (5.5m) long x 73" (183cm) wide x 52" (130cm) high
Shipping Weight	1400 lbs. (636 kg), approximate	3500 lbs. (1588 kg), approximate	6600 lbs. (3000 kg), approximate

