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**PHI*****Machine Tools*****BENDER TOOLING****SELECTION GUIDE**

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**PHI*****Machine Tools***

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# LOOK TO PHI, THE INDUSTRY LEADER IN TUBE AND PIPE BENDING EQUIPMENT.

PHI has been a leading manufacturer of tube and pipe bending equipment for over forty years — first as Leonard Precision Products, then as Conrac Corp.—Machine Tool Division and now as PHI Machine Tools specializing in machinery, computer control systems, tooling and welding systems.

PHI was the first company to offer computer controlled tube and pipe benders. Other patented developments include detectors to measure and compensate for springback, and the “synchro” concept of preset controls for multiple-bend tubes and pipes.

The company has also led the industry in terms of such refinements as drop-away clamps to allow the bending of more complicated shapes,

and follow-block assists and pusher assemblies that provide the operator with more precise control over wall thickness.

As manufacturers of production equipment, PHI has taken special care to design safety and reliability into each tube or pipe bender. All hydraulically powered machines, for example, are equipped with safety plates on the bender arm. Rack-and-pinions and worm gears, rather than chains, are used on carrier drives.

Every PHI bending machine is warranted, parts and labor, for one year from date of delivery. Expert service specialists are available for travel to all parts of the world for consultation and service.

PHI is the leader in bending equipment — for a reason.

## 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.
- 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.
- PHI tooling is manufactured in the same plant as the machine.
- Clamp blocks are designed for maximum grip of the tube and have a typical length of four times the Tube Outside Diameter; large sizes, three times Tube Outside Diameter.
- All stock tooling subject to prior sale.

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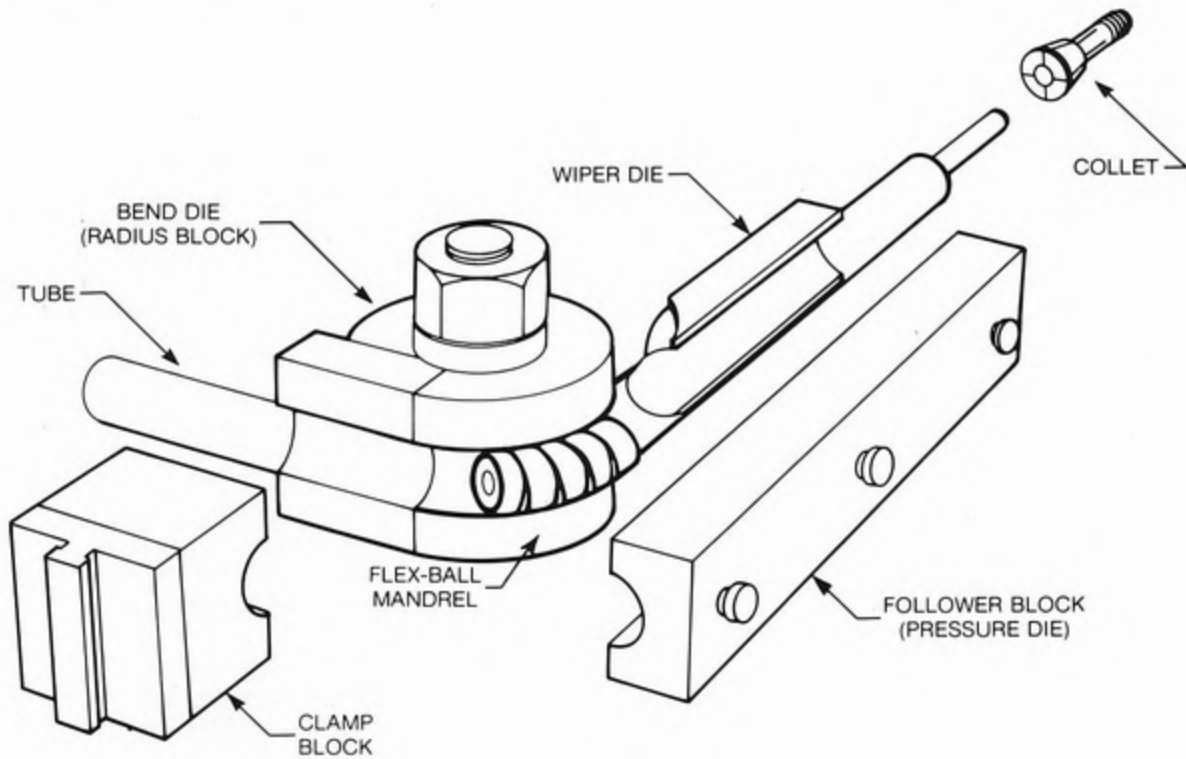
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## STANDARD TOOLING

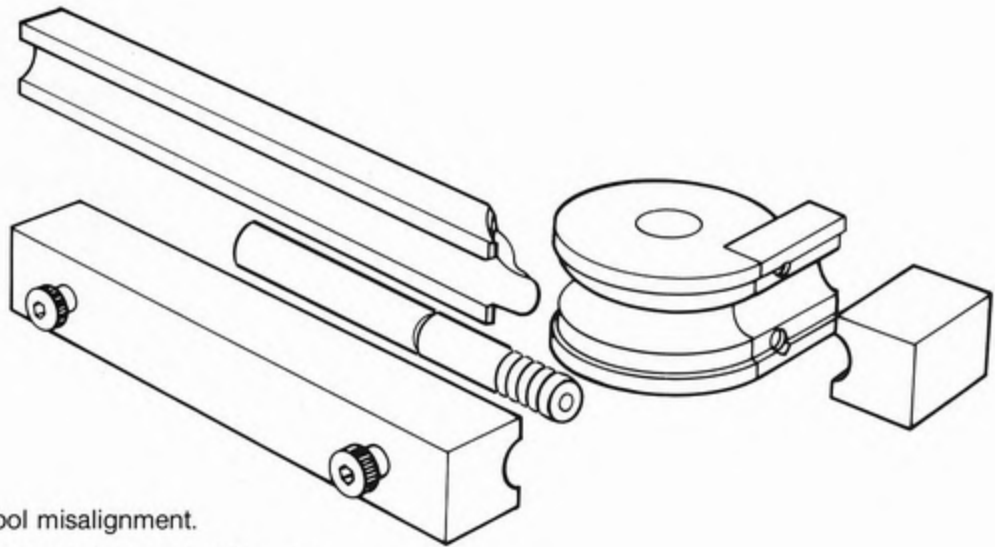
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- Tooling for every model PHI bender.
- Class I Tooling: Full hard: Core 24-30 Rc surface hardened to Rc 50 min.
- Class II Tooling: 24-30 Rc.
- Class III Tooling: Low carbon steel.
- Class IV Bronze wiper dies and mandrels available.
- Standard tooling — common sizes — Class II — available from stock.
- Special tooling supplied to order for shapes, extrusions, angles, channels, etc.
- All items available in IPS and metric sizes.
- Mandrel and wiper dies available with chrome or Krolon coating.

## STANDARD TOOLING



## SELF-ALIGNING TOOLING



- Reduced setup time.
- Eliminates scrap from tool misalignment.
- Remains in alignment for complete production run.
- No clamp marks on thin-wall soft material.

Self-aligning tooling available in types and sizes as defined in this catalog, Class I. Available in reversible design and can be furnished for most makes and types of bending machines.

# INDEX FOR SELECTION OF BENDING MACHINES

	Model Number	Old Model Number	Tube Capacity	Pipe Capacity	Method of Operation
			O.D. X WT X MIN CLR 35,000 psi yield	IPS X SCH X MIN CLR 35,000 psi yield	
Under 1" O.D. Capacity	401 SYNCHRO	10* SYNCHRO	5/8" x .049 x 2D** 1/2" x .049 x 2D***	1/2" x 40 x 3D	Manual synchro draw or compression bend
	410	HB-1*	3/4" x .065 x 2D	3/8" x 40 x 3D	Manual bench mount
	—	PTB* 101A 510* COMPU-BEND	3/4" x .089 x 2D	3/8" x 80 x 3D	Computerized numerically controlled with drop-away clamp and direct acting pressure die
1" O.D. To 1 1/2" Capacity	411	20*	1" x .065 x 2D	1/2" x 40 x 3D	Manual bench mount
	412 SYNCHRO	MB* SYNCHRO	1" x .065 x 2D	1/2" x 40 x 3D	Manual synchro control draw bend
	—	PTB* 101 511* COMPU-BEND	1 1/4" x .065 x 2D	3/4" x 80 x 3D	Computerized numerically controlled with drop-away clamp and direct acting pressure die
	420	30	1 1/2" x .049 x 2D	1" x 40 x 3D	Bench mount with manual gear drive
	—	110* SYNCHRO 211* SYNCHRO	1 1/4" x .065 x 2D	3/4" x 80 x 3D	Hydraulic synchro control with drop-away clamp and direct acting pressure die
	—	HPSB*	1 1/2" x .065 x 2D	1" x 40 x 3D	Hydraulic single bend with manual clamp and adjustable DOB stop
	210 SYNCHRO "Sidewinder"	HPB* SYNCHRO	1 1/2" x .065 x 2D	1" x 40 x 3D	Hydraulic synchro control with manual or Hydraulic clamp
2" O.D. Capacity	—	164* 221*	2" x .125 x 2D	1 1/2" x 40 x 3D	Hydraulic (7 RPM) with 10-position DOB selector
	—	163* SYNCHRO 222* SYNCHRO	2" x .125 x 2D	1 1/2" x 40 x 3D	Hydraulic synchro control (7 RPM)
	220 SYNCHRO	162* SYNCHRO	2" x .125 x 2D	1 1/2" 40 x 3D	Hydraulic synchro control (8 RPM) with drop-away clamp and direct acting pressure die
	—	PTB* 102 520* COMPU-BEND	2" x .125 x 2D	1 1/2" x 40 x 3D	Computerized numerically controlled with drop-away clamp and direct acting pressure die
3" O.D. Capacity	230	103*	3" x .187 x 2D	2 1/2" x 40 x 3D 2" x 80 x 3D	Hydraulic synchro control (8 RPM) with drop-away clamp, direct acting pressure die and 10-position DOB selector
	—	PTB* 103 530* COMPU-BEND	3" x .187 x 2D	2 1/2" x 40 x 3D	Computerized numerically controlled with drop-away clamp and direct acting pressure die
4" O.D. Capacity	—	74* 240*	4" x .250 x 2D	3" x 80 x 2D 4" x 40 x D	Hydraulic with directing acting pressure die and 5-position DOB selector. Power DBB and 3-axis digital readout for POB, DBB and DOB  (246 Digital Control Automatic Operation)
	—	74A* 242*	4 1/2" x .250 x 3D	4" x 80 x 3D	
	—	74B 244*	4 1/2" x .312 x 2D	4" x 80 x 2D	
	—	474*	4 1/2" x .250 x 1 1/2D	4" x 40 x 1 1/2D	
	—	255, 474A*	4 1/2" x .312 x 1 1/2D	4" x 80 x 1 1/2D	
6" O.D. Capacity	246	—	6" x .250 x 2D	4" x 80 x 2D	
	—	76A 260*	6 1/2" x .250 x 2D	6" x 80 x 3D	
	270	476A	6 1/2" x .250 x 1 1/2D	6" x 80 x 1 1/2D	

# BEND DIE TYPE TO MACHINE MODEL CROSS REFERENCE

BENDMASTER DESCRIPTION				BEND DIE TYPES							
Current Model Number	Previous Model Number	Max Tube O.D. Inches	Max. Bend Die Radius Inches	B1	B4	B6	B7	B8	B8A	B9	B10
401 SYNCHRO	10 SYNCHRO	5/8	4	D**							D***
410	HB-1	3/4	6	D							
—	510 COMPU-BEND PBT-101-A	3/4	6		D						
411	20	1	8	A	D						
412 SYNCHRO	MB SYNCHRO MBx, MB	1	6	A	D						
—	511 COMPU-BEND PTB-101	1 1/4	8		D						
—	110 SYNCHRO, 110 211 SYNCHRO	1 1/4	8		D						
420	30	1 1/2	8	A	D						
—	201, HPSB	1 1/2	8	A	D						
210 SYNCHRO	HPB, PB PBx, HPBx	1 1/2	8	A	D						
—	164 221	2	10		A	D					
—	163 SYNCHRO 222 SYNCHRO	2	10		A	D					
220 SYNCHRO	162 SYNCHRO	2	10		A	D					
—	520 COMPU-BEND PTB-102	2	10		A	D					
230	103, B72	3	18			A				D	
—	530 COMPU-BEND PTB-103	3	18			A				D	
—	74 240	4	24			A	D				
—	74A 242	4 1/2	24						D	A	
—	74B 244	4 1/2	24						D	A	
—	474 250	4 1/2	6						D		
—	255, 474A	4 1/2	6						D		
246	76A 260	6 1/2	24					D	A		
270	476A	6 1/2	18					D	A		
—	280	8	36			Made To Order					
—	290	8	18								

"A" Denotes mounting with an adapter plate  
 "D" Denotes mounting direct on machine die boss surface  
 \* Machine only obsolete, tooling available  
 \*\* Draw bend only  
 \*\*\* Draw and compression bend

# REVERSIBLE BEND DIE TYPE B1

## ORDERING INFORMATION

Specify Type—Class—O.D.—CLR

Example: 1/2" O.D. Tube x 1" CLR

Specify Catalog Number: B1-III-1/2-1

For non-specified sizes, insert tube O.D.  
and CLR as required.

Material: Class III: Low carbon steel  
For right or left hand  
Bending Machines

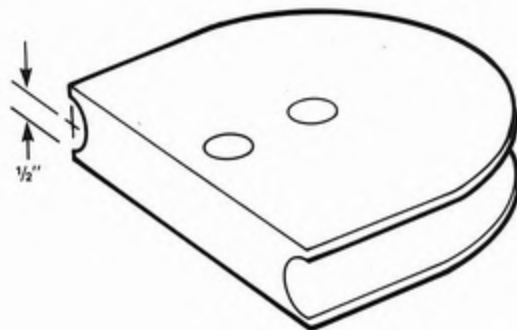
Max. Degree Bend: 180°

Dimension to Tube C/L: 1/2"

Max. Tube O.D.: 3/4"

Max. Bend Radius: 6" C/L

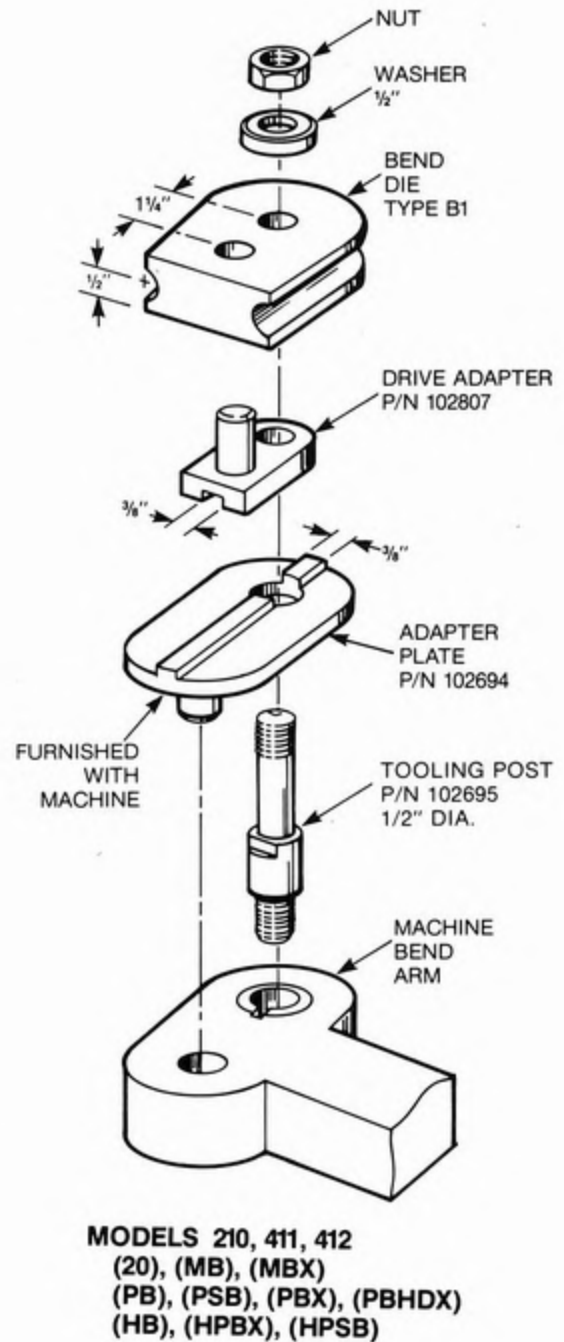
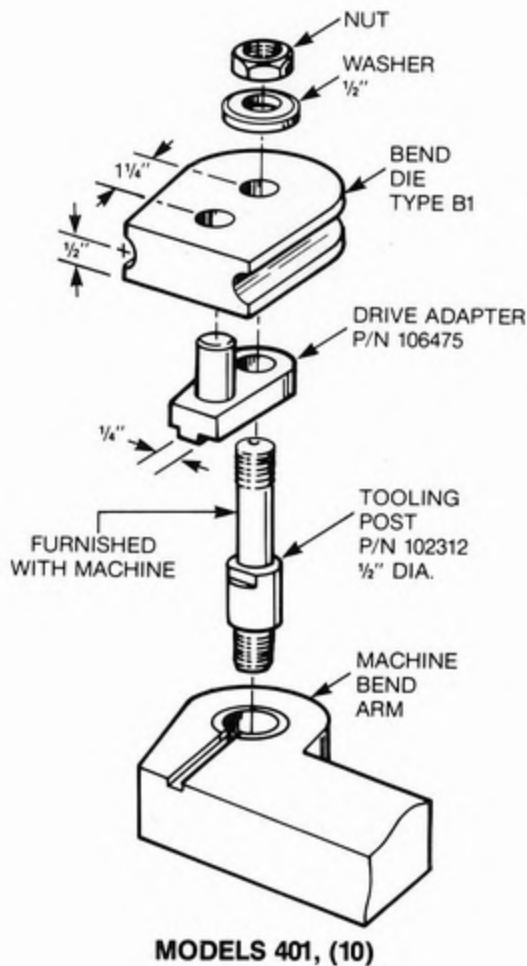
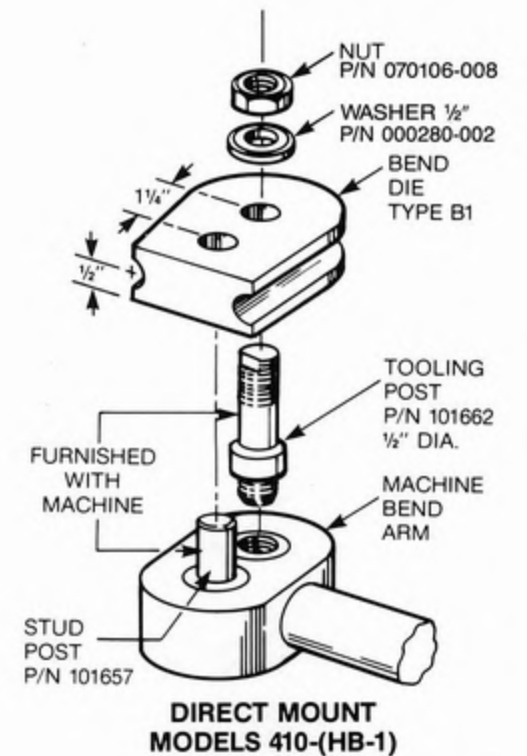
Mounting: Two posts 1/2" diameter  
1 1/4" center to center



## TYPE B1 BEND DIE SIZES AVAILABLE

Tube O.D. Inches		1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4
MIN. CLR	3/8	X							
	1/2	X	X	X	X				
	9/16	X	X	X	X	X			
	5/8	X	X	X	X	X	X		
	3/4	X	X	X	X	X	X	X	X

## TYPE B1 BEND DIES MOUNTED ON PHI BENDING MACHINES



# BEND DIE TYPE B4

## ORDERING INFORMATION

Specify Type—Class—O.D.—CLR

Example: 3/4" O.D. Tube x 1 1/2" CLR

Specify Catalog Number: B4-II-3/4-1 1/2

For non-specified sizes, insert tube O.D.  
and CLR radius as required.

Material: 4100 Series alloy steel

Class II: Medium hard 24-30 Rc

Standard: Clockwise (right hand)

Left hand supplied on special order.

Max. Degree Bend: 180° plus over bend

Dimension to Tube C/L: 1.0"

Max. Tube O.D.: 1 1/2"

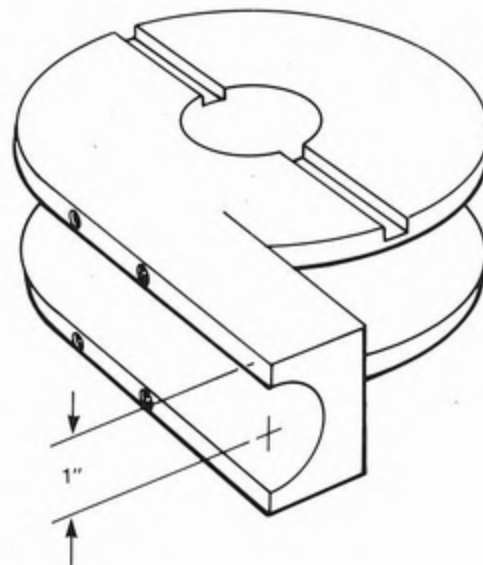
Max. Bend Radius: 8"

Mounting: 1" diameter center post

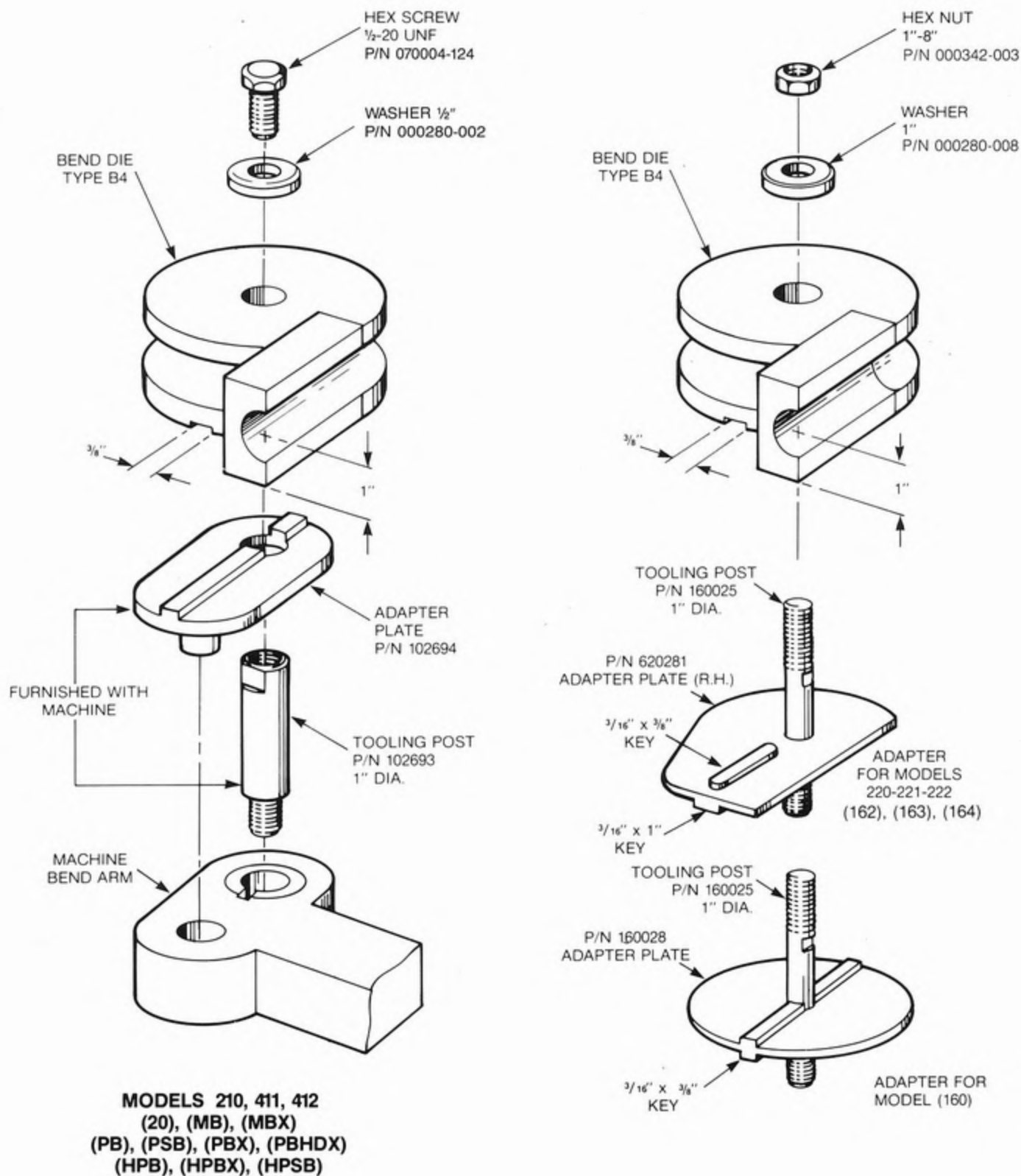
3/8" key drive

## TYPE B4 BEND DIE SIZES AVAILABLE

REMOVABLE INSERT								WELDED INSERT	
Tube O.D. Inches		3/8	1/2	5/8	3/4	7/8	1	1-1/4	1-1/2
MIN. CLR	1 1/8	X							
	1 1/4	X	X	X	X				
	1 1/2	X	X	X	X	X	X		
	1 3/4	X	X	X	X	X	X		
	1 7/8	X	X	X	X	X	X	X	X
	2	X	X	X	X	X	X	X	X



## TYPE B4 BEND DIES MOUNTED ON PHI BENDING MACHINES



# BEND DIE TYPE B6

## ORDERING INFORMATION

Specify Type—Class—O.D.—CLR

Example: 1½" O.D. Tube x 3" CLR

Specify Catalog Number: B6-II-1½-3

For non-specified sizes, insert tube O.D.  
and CLR as required.

Material: 4100 Series alloy steel

Class II: Medium hard 24-30 Rc

Standard: Clockwise (right hand)

Left hand supplied on special order.

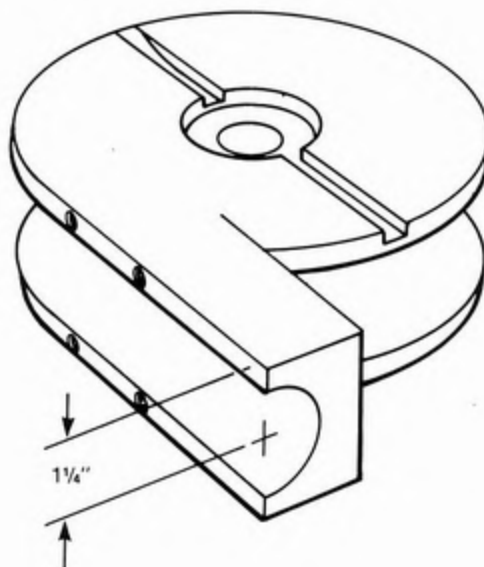
Max. Degree Bend: 180° plus over bend

Dimension to Tube C/L: 1¼"

Max. Tube O.D.: 2"

Max. Bend Radius: 12"

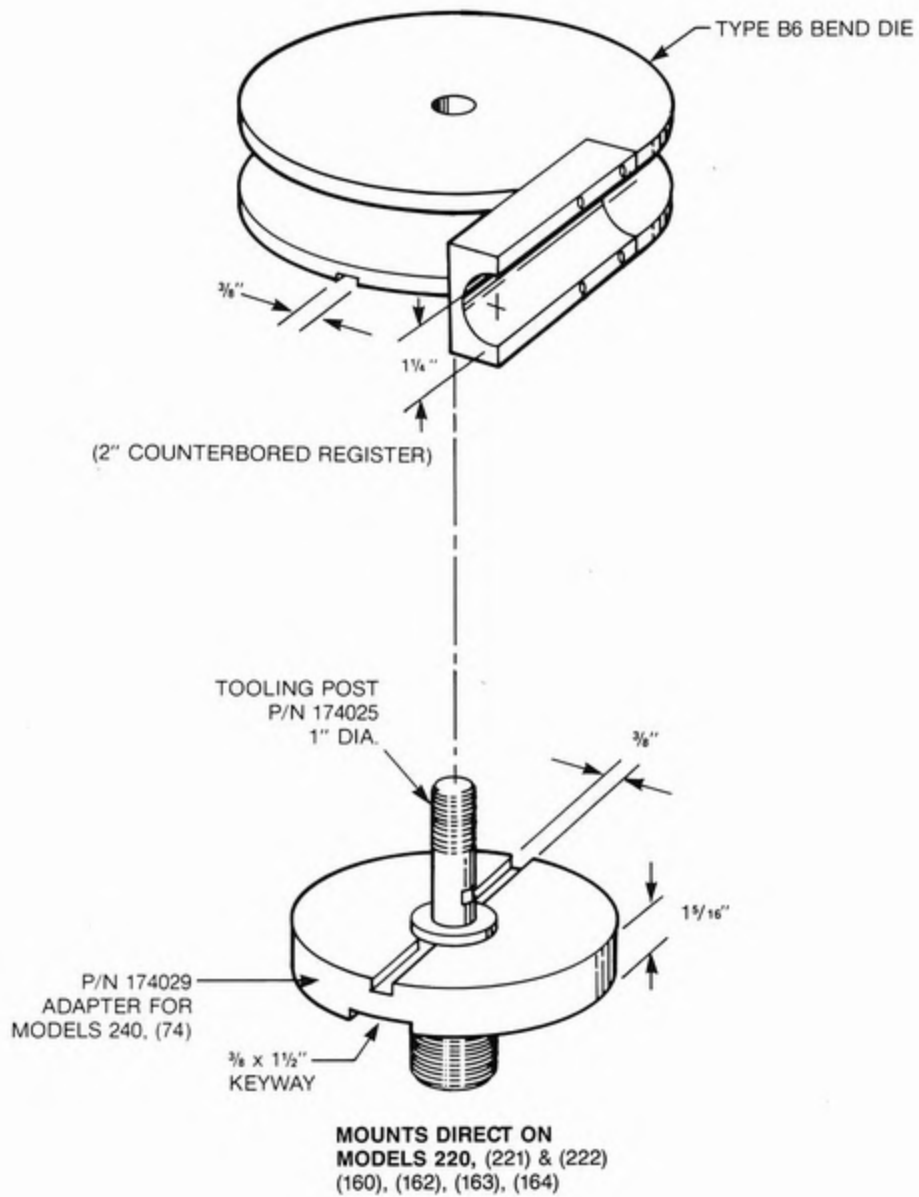
Mounting: 1" diameter center post  
⅜" key drive



## TYPE B6 BEND DIE SIZES AVAILABLE

REMOVABLE INSERT					WELDED INSERT		
Tube O.D. Inches		3/4	1	1-1/4	1-1/2	1-3/4	2
MIN. CLR	2	X	X				
	2¼	X	X				
	2½	X	X	X	X		
	3	X	X	X	X	X	X

## TYPE B6 BEND DIES MOUNTED ON PHI BENDING MACHINES



# BEND DIES TYPES B7, B8, B8A, B9

## ORDERING INFORMATION

By machine model, determine size and type number, specify class number, Tube O.D. and centerline radius.

Example: For Model 240, medium hard bend die  
3" Tube O.D. x 12" centerline

Specify Catalog Number: B7-II-3-12

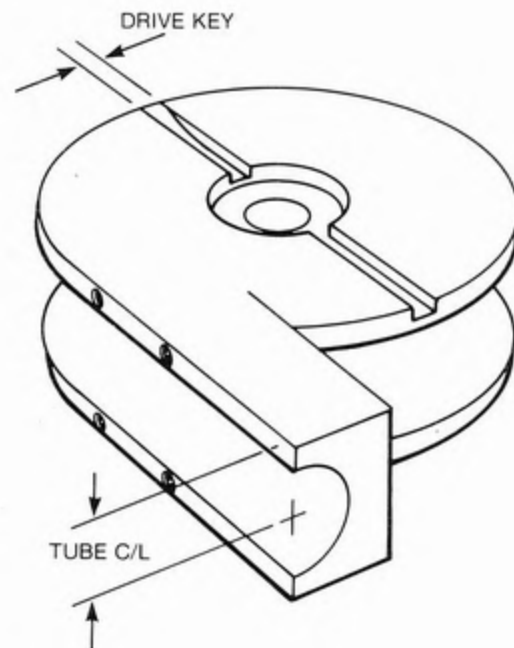
Material: Class II : Medium hard 24-30 Rc

Specify right hand (clockwise) or left hand (counterclockwise) when ordering.

## NON-STOCKED DIES — MADE TO ORDER ONLY

	TYPE B7 Mounts Direct on 240	TYPE B8 Mounts Direct on 270-260	TYPE B8A Mounts Direct on 242, 244, 250, 255	TYPE B9 Mounts Direct on 230 & 530
Dim. to Tube C/L	2½"	3 15/16"	3"	1 15/16"
Max. Tube O.D.	4"	6⅝"	4 IPS* (4½" O.D.)	3"
C/Bore Dia.	4⅞"	4⅞"	4⅞"	2½"
Max. Bend Radius	24"	24"	24"	18"
Post Dia.	2"	2½"	2"	1½"
Drive Key	1½"	1½"	1½"	1"

\*When ordering, specify actual outside diameter, in decimal, of material to be used.



# TUBE COLLETS AND INSERTS Part Numbers—Stock Sizes

## ORDERING INFORMATION

For tube collets and inserts, specify the part number tabulated for the machine model and tube outside diameter desired.

Example: Standard collet for 3/8" tube outside diameter for Model 210, or 412

Specify Catalog Number 103281-002

For custom sizes, specify tube outside diameter in decimal.

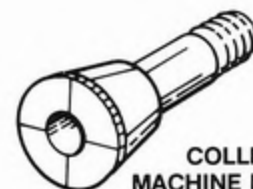
Example: Custom collet for 1.39 tube outside diameter for Model 210, or 412

Specify Catalog Number 103281-1.39

Tube O.D. Inches	COLLETS MACHINE MODELS			INSERTS MACHINE MODELS	
	401	210, 211, 412	510, 511	220, 222, 520	230, 530
1/8	102415-001	103281-020			
3/16	102415-002	103281-001			
1/4	102415-003	103281-002	112011-		
5/16	102415-004	103281-003	112011-		
3/8	102415-005	103281-004	112011-		
1/2	102415-007	103281-006	112011-	172072-015	
5/8	102415-009	103281-008	112011-	172072-017	
3/4		103281-010	112011-	172072-019	172087-218
7/8		103281-012	112011-	172072-021	172087-216
1		103281-013	112011-	172072-022	172087-215
1 1/4		103281-015		172072-024	172087-213
1 1/2		103281-017		172072-026	172087-211
1 3/4				172072-028	172087-209
1 7/8					172087-208
2					172087-207
2 1/4					172087-205
2 1/2					172087-203
2 3/4					172087-201

1  
Collets fit direct into collet  
chuck furnished with machine

3 4  
Inserts fit direct into master  
collet furnished with machine



**COLLETS**  
MACHINE MODELS  
401, 210, 211, 412



**INSERTS**  
MACHINE MODELS  
510, 511, 220,  
222, 520, 230, 530

- 1 Was Part Number 10011  
2 Was Part Number PMBX-070  
3 Was Part Number 72072  
4 Was Part Number 72087

# PIPE SIZE COLLET INSERTS Part Number—Stock Sizes

## ORDERING INFORMATION

For standard collet inserts, specify the part number tabulated for IPS size desired.

For custom size, specify pipe outside diameter in decimal.

Nominal IPS Size Inches	Pipe O.D.	MACHINE MODEL 255
1/2	.812	474072-081
	.840	474072-084
3/4	1.050	474072-105
	1.063	474072-106
1	1.315	474072-131
1 1/4	1.660	374072-166
1 1/2	1.875	474072-188
	1.900	474072-190
2	2.375	474072-237
2 1/2	2.875	474072-288
3	3.50	474072-350
3 1/2	4.00	474072-400

Fits Only  
Into 2 IPS Insert

Fits Directly  
Into Master Collet  
Furnished with Machine



1/2-1 1/2 IPS



2-3 1/2 IPS

# BEND DIE TYPE B10 AND B10R

## ORDERING INFORMATION

Specify Type — Class — Tube O.D. — CLR.

Example: 1/2" Tube O.D. x 1" CLR.

Order: Standard — B10- III -1/2-1

Reversible — B10R- III -1/2-1

For sizes not specified, insert tube O.D. and CLR.

Material: Class III —Low carbon steel

Standard: Right hand (clockwise)

Reversible: Combination right and left hand

Max. Degree of Bend: 180°

Dimension to Tube C/L: 1/2"

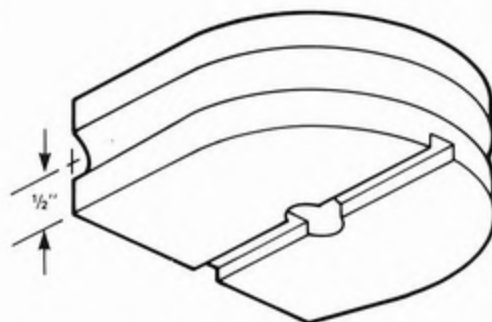
Maximum Tube O.D.: 5/8" (draw bending)  
1/2" (compression bending)

Maximum Bend Radius: 4"

Dual Purpose: Compression and draw bending dies.  
Use only on Model 401 SYNCHRO.

Dual Purpose DRAW BENDING  
Mounting: 1/2" Diameter Center Post  
1/4" Key Drive

COMPRESSION BENDING  
7/16" Square Center Post

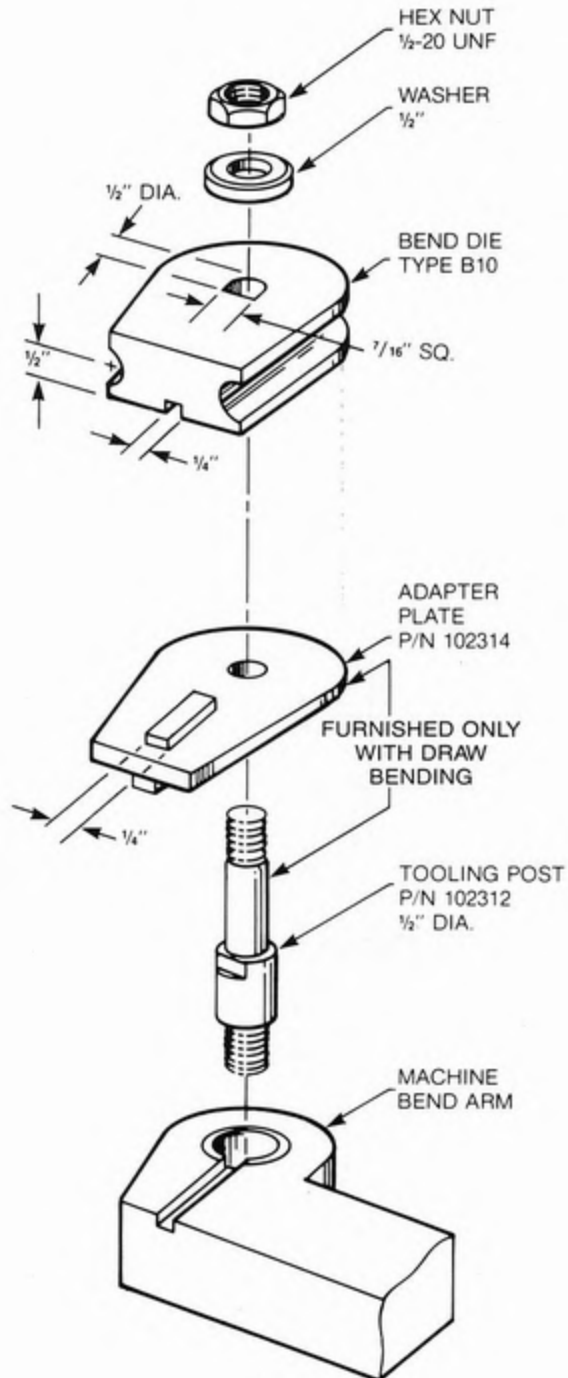


## TYPE B10 BEND DIE SIZES AVAILABLE

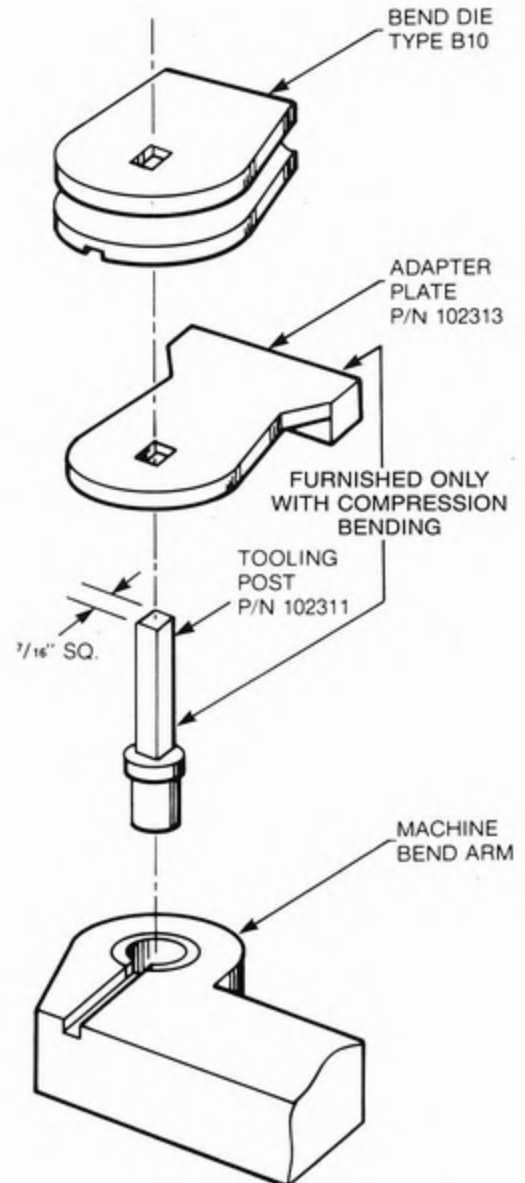
MIN. CLR	Tube O.D. Inches	1/8	3/16	1/4	5/16	3/8	1/2	5/8
	1/2	X	X	X	X			
	9/16	X	X	X	X	X		
	5/8	X	X	X	X	X	X	
	3/4	X	X	X	X	X	X	X

## TYPE B10 BEND DIES MOUNTED ON PHI BENDING MACHINES

### DRAW BEND MOUNTING



### COMPRESSION BEND MOUNTING



FOR B1 BEND DIE SET-UP  
SEE PAGE 9

DIRECT MOUNTS ON  
MODEL 401 (10) ONLY

# CLAMP BLOCKS TYPE C SERIES C1-C2-C4-C6-C10

## ORDERING INFORMATION

By machine model, determine size and type number, specify class number and tube O.D.

Example: Model 210, med. hard 24-30 Rc  $\frac{1}{8}$ " tube O.D.

Specify Catalog Number: C7-II- $\frac{1}{8}$ "

For custom size, insert tube O.D. desired. For IPS size, insert nominal pipe size or specify O.D. in decimal.

Material: 4100 Series alloy steel  
Class II: Medium hard 24-30 Rc

## REVERSIBLE FOR RIGHT OR LEFT HAND BENDING MACHINES

Clamp block lengths are four times tube outside diameter. Those greater than  $2\frac{3}{8}$ " O.D. are three times the tube outside diameter.

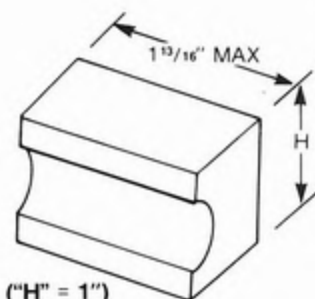
Custom lengths available upon request.

## TYPE C1-C2-C6-C10 CATALOG NUMBERS STOCK SIZES

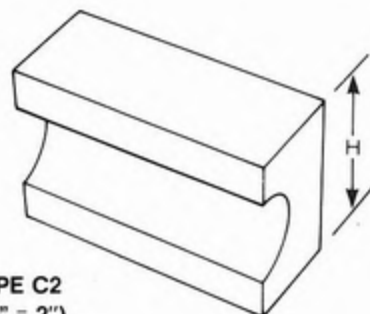
Tube O.D., Inches	MACHINE MODEL			
	401	410	420 Pre-'84	210, 411, 412, 420
$\frac{1}{8}$	C10- II - $\frac{1}{8}$	C1- II - $\frac{1}{8}$		
$\frac{3}{16}$	C10- II - $\frac{3}{16}$	C1- II - $\frac{3}{16}$		
$\frac{1}{4}$	C10- II - $\frac{1}{4}$	C1- II - $\frac{1}{4}$		
$\frac{5}{16}$	C10- II - $\frac{5}{16}$	C1- II - $\frac{5}{16}$		
$\frac{3}{8}$	C10- II - $\frac{3}{8}$	C1- II - $\frac{3}{8}$	C6- II - $\frac{3}{8}$	C2- II - $\frac{3}{8}$
$\frac{7}{16}$	C10- II - $\frac{7}{16}$	C1- II - $\frac{7}{16}$	C6- II - $\frac{7}{16}$	C2- II - $\frac{7}{16}$
$\frac{1}{2}$	C10- II - $\frac{1}{2}$	C1- II - $\frac{1}{2}$	C6- II - $\frac{1}{2}$	C2- II - $\frac{1}{2}$
$\frac{5}{8}$	C10- II - $\frac{5}{8}$	C1- II - $\frac{5}{8}$	C6- II - $\frac{5}{8}$	C2- II - $\frac{5}{8}$
$\frac{3}{4}$		C1- II - $\frac{3}{4}$	C6- II - $\frac{3}{4}$	C2- II - $\frac{3}{4}$
$\frac{7}{8}$			C6- II - $\frac{7}{8}$	C2- II - $\frac{7}{8}$
1			C6- II -1	C2- II -1
$1\frac{1}{8}$			C6- II - $1\frac{1}{8}$	C2- II - $1\frac{1}{8}$
$1\frac{1}{4}$			C6- II - $1\frac{1}{4}$	C2- II - $1\frac{1}{4}$
$1\frac{3}{8}$			C6- II - $1\frac{3}{8}$	C2- II - $1\frac{3}{8}$
$1\frac{1}{2}$			C6- II - $1\frac{1}{2}$	C2- II - $1\frac{1}{2}$

## TYPE C4 CATALOG NUMBER STOCK SIZES

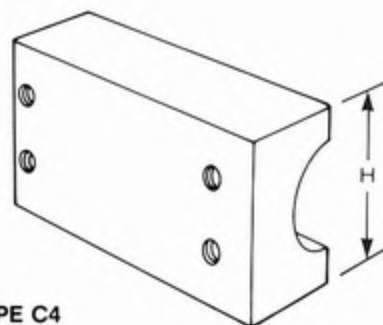
Tube O.D., Inches	MACHINE MODELS 240, 242, 244	"H" Inches
2	C4- II -2	$3\frac{3}{8}$
$2\frac{1}{4}$	C4- II - $2\frac{1}{4}$	
$2\frac{1}{2}$	C4- II - $2\frac{1}{2}$	
$2\frac{3}{4}$	C4- II - $2\frac{3}{4}$	4
3	C4- II -3	
$3\frac{1}{4}$	C4- II - $3\frac{1}{4}$	$4\frac{1}{2}$
$3\frac{1}{2}$	C4- II - $3\frac{1}{2}$	
$3\frac{3}{4}$	C4- II - $3\frac{3}{4}$	5
4	C4- II -4	



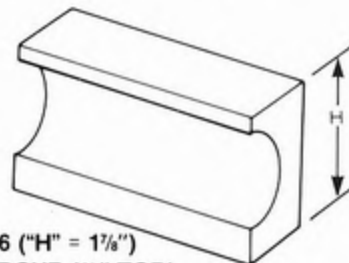
TYPE C1 ("H" = 1")



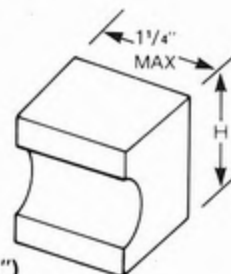
TYPE C2  
("H" = 2")



TYPE C4



TYPE C6 ("H" =  $1\frac{7}{8}$ ")  
(EXCEPT ABOVE  $1\frac{1}{4}$ " TOD)  
("H" = 2")



TYPE C10 ("H" = 1")

# CLAMP BLOCKS TYPE C SERIES C3-C5-C9-C11

## ORDERING INFORMATION

By machine model, determine size and type number, specify class number and tube O.D.

Example: Model 221, med. hard 24-30 Rc  $\frac{3}{8}$ " tube O.D.

Specify Catalog Number: C3-II- $\frac{3}{8}$

For custom size, insert tube O.D. desired. For IPS size, insert nominal pipe size or specify O.D. in decimal.

Material: 4100 Series alloy steel

Class II: Medium hard 24-30 Rc

Standard: Clockwise (right hand)

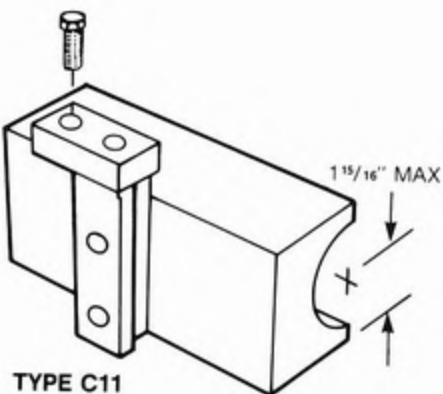
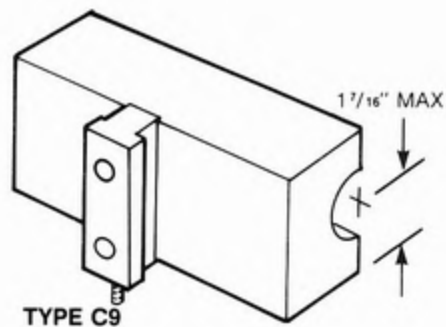
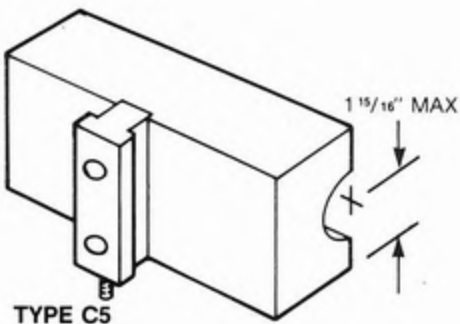
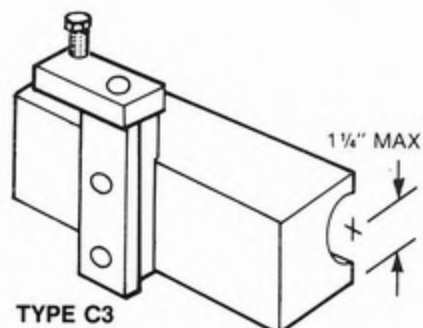
Left hand supplied on special order

Clamp block lengths are four times tube outside diameter. Those greater than  $2\frac{3}{8}$ " O.D. are three times the tube outside diameter.

Custom lengths available upon request.

## TYPE C3-C5-C9-C11 CATALOG NUMBERS

Tube O.D., Inches	221, 222	MACHINE MODEL			230
	220, 520	530			
$\frac{3}{8}$	C3- II - $\frac{3}{8}$	C5- II - $\frac{3}{8}$			
$\frac{1}{2}$	C3- II - $\frac{1}{2}$	C5- II - $\frac{1}{2}$			
$\frac{5}{8}$	C3- II - $\frac{5}{8}$	C5- II - $\frac{5}{8}$			
$\frac{3}{4}$	C3- II - $\frac{3}{4}$	C5- II - $\frac{3}{4}$	C9- II - $\frac{3}{4}$	C11- II - $\frac{3}{4}$	
$\frac{7}{8}$	C3- II - $\frac{7}{8}$	C5- II - $\frac{7}{8}$	C9- II - $\frac{7}{8}$	C11- II - $\frac{7}{8}$	
1	C3- II -1	C5- II -1	C9- II -1	C11- II -1	
1 $\frac{1}{8}$	C3- II -1 $\frac{1}{8}$	C5- II -1 $\frac{1}{8}$	C9- II -1 $\frac{1}{8}$	C11- II -1 $\frac{1}{8}$	
1 $\frac{1}{4}$	C3- II -1 $\frac{1}{4}$	C5- II -1 $\frac{1}{4}$	C9- II -1 $\frac{1}{4}$	C11- II -1 $\frac{1}{4}$	
1 $\frac{3}{8}$	C3- II -1 $\frac{3}{8}$	C5- II -1 $\frac{3}{8}$	C9- II -1 $\frac{3}{8}$	C11- II -1 $\frac{3}{8}$	
1 $\frac{1}{2}$	C3- II -1 $\frac{1}{2}$	C5- II -1 $\frac{1}{2}$	C9- II -1 $\frac{1}{2}$	C11- II -1 $\frac{1}{2}$	
1 $\frac{3}{4}$	C3- II -1 $\frac{3}{4}$	C5- II -1 $\frac{3}{4}$	C9- II -1 $\frac{3}{4}$	C11- II -1 $\frac{3}{4}$	
2	C3- II -2	C5- II -2	C9- II -2	C11- II -2	
2 $\frac{1}{4}$			C9- II -2 $\frac{1}{4}$	C11- II -2 $\frac{1}{4}$	
2 $\frac{1}{2}$			C9- II -2 $\frac{1}{2}$	C11- II -2 $\frac{1}{2}$	
2 $\frac{3}{4}$			C9- II -2 $\frac{3}{4}$	C11- II -2 $\frac{3}{4}$	
3			C9- II -3	C11- II -3	



# CLAMP BLOCKS TYPE C SERIES C7-C8

## ORDERING INFORMATION

By machine model, determine size and type number, specify class number and tube O.D.

Example: Model 211, med. hard 24-30 Rc

1/8" tube O.D.

Specify Catalog Number: C7-II-1/8

For custom size, insert tube O.D. desired. For IPS size, insert nominal pipe size or specify O.D. in decimal.

Material: 4100 Series alloy steel

Class I : Full Hard Core 24-30 Rc  
Surface hard 50 Rc min.

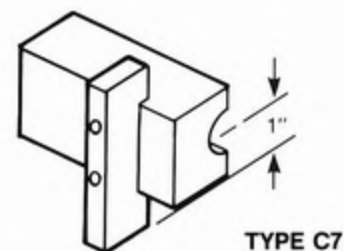
Class II : Medium hard 24-30 Rc

Standard: Clockwise (right hand).

Left hand supplied on special order.

Clamp block lengths are four times tube outside diameter. Those greater than 2-3/8" O.D. are three times the tube outside diameter.

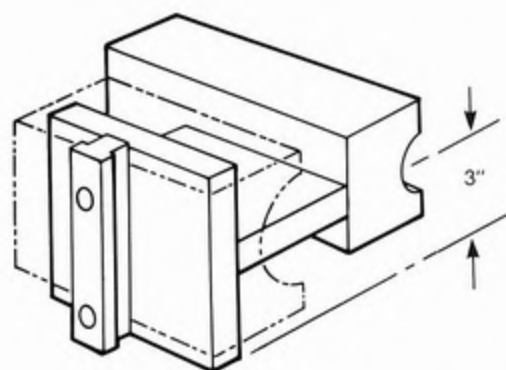
Custom lengths available upon request.



## TYPE C7-C8 CATALOG NUMBERS

### CLASS I ONLY

Nominal IPS Size	Pipe O.D. Inches	MACHINE MODEL 255
1/2	.812	C8- I -1/2 IPS (.812)
	.840	C8- I -1/2 IPS (.840)
3/4	1.050	C8- I -3/4 IPS (1.050)
	1.063	C8- I -3/4 IPS (1.063)
1	1.315	C8- I -1 IPS (1.315)
1 1/4	1.660	C8- I -1 1/4 IPS (1.660)
1 1/2	1.875	C8- I -1 1/2 IPS (1.875)
	1.900	C8- I -1 1/2 IPS (1.900)
2	2.375	C8- I -2 IPS (2.375)
2 1/2	2.875	C8- I -2 1/2 IPS (2.875)
3	3.500	C8- I -3 IPS (3.500)
3 1/2	4.000	C8- I -3 1/2 IPS (4.000)
4	4.500	C8- I -4 IPS (4.500)



TYPE C8  
SUPERIMPOSED OUTLINE INDICATES  
3", 3 1/2" & 4" IPS SIZE

### CLASS II

Tube O.D., Inches	MACHINE MODEL	
	211, 511	510
1/8	C7- II -1/8	C7- II -1/8
3/16	C7- II -3/16	C7- II -3/16
1/4	C7- II -1/4	C7- II -1/4
5/16	C7- II -5/16	C7- II -5/16
3/8	C7- II -3/8	C7- II -3/8
7/16	C7- II -7/16	C7- II -7/16
1/2	C7- II -1/2	C7- II -1/2
5/8	C7- II -5/8	C7- II -5/8
3/4	C7- II -3/4	C7- II -3/4
7/8	C7- II -7/8	
1	C7- II -1	
1 1/8	C7- II -1 1/8	
1 1/4	C7- II -1 1/4	

# TYPE C1 CLAMP BLOCK MOUNTING ADAPTERS

## ORDERING INFORMATION

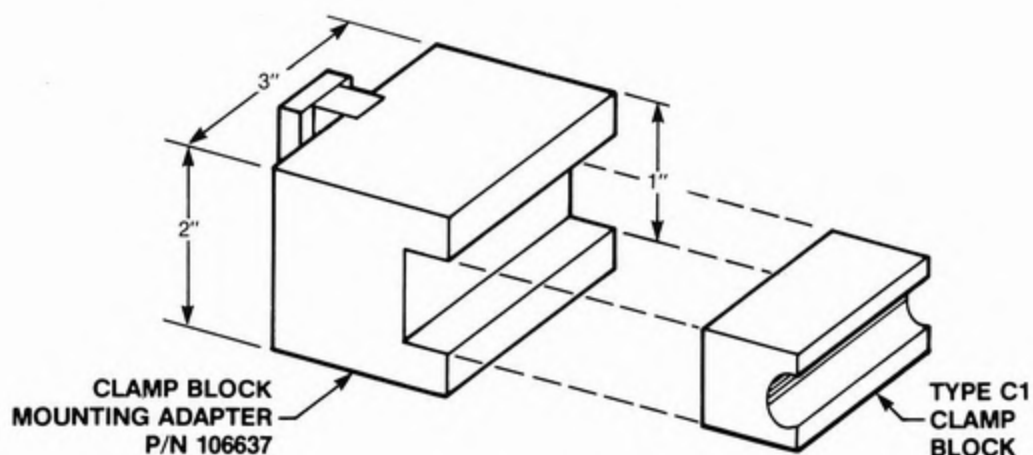
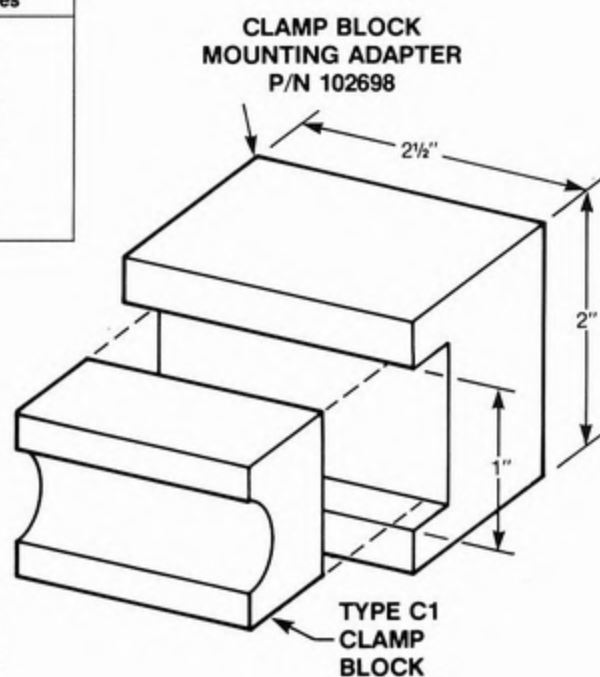
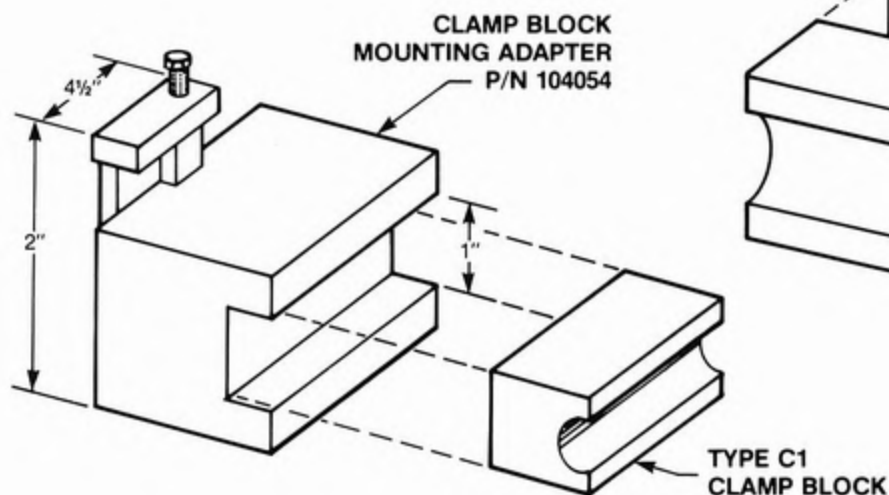
By machine model, determine adapter part number to be used within tube O.D. range.

Example: Model 210, right or left hand machine,  $\frac{3}{16}$ " tube O.D. using Type C1 clamp blocks.

Specify Catalog Number: 102698-RH (right hand) or 102698-LH (left hand)

## ADAPTION FOR TYPE C1 CLAMP BLOCKS

MACHINE MODELS	Use Adapter Number	Tube O.D. Inches
210 411, 412, 420	102698	$\frac{1}{8}$ $\frac{3}{16}$ $\frac{1}{4}$
221, 222	104054	$\frac{5}{16}$ $\frac{3}{8}$ $\frac{7}{16}$
220	106637	$\frac{1}{2}$ $\frac{5}{8}$ $\frac{3}{4}$



# FOLLOWER BLOCKS

## ORDERING INFORMATION

By machine model, determine size and type number.  
Select tube O.D. and length.

Example: Model 410, 1/2 tube O.D. x 10" lg.

Specify Catalog Number: F4A-1/2-10

For custom size, insert tube O.D. desired.

For IPS size, insert nominal pipe size or specify  
O.D. in decimal.

Material: 4100 Series alloy steel 24-30 Rc

## BASIC TYPE MOUNTING:

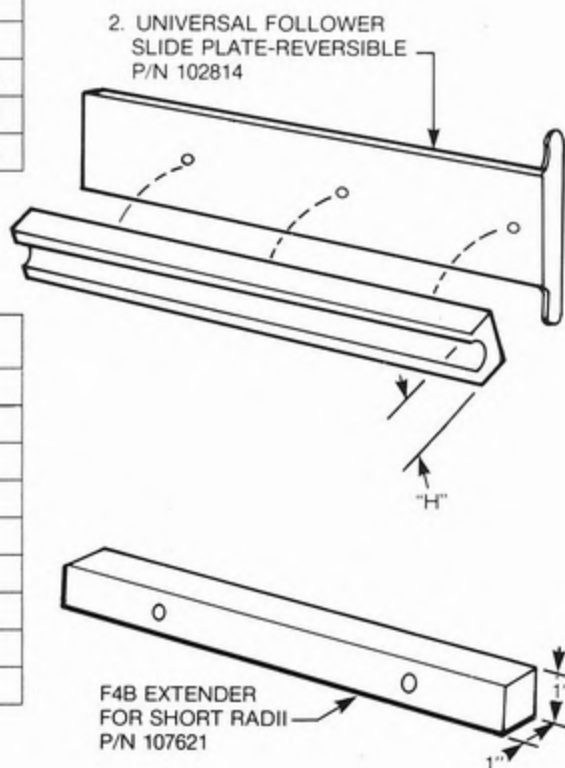
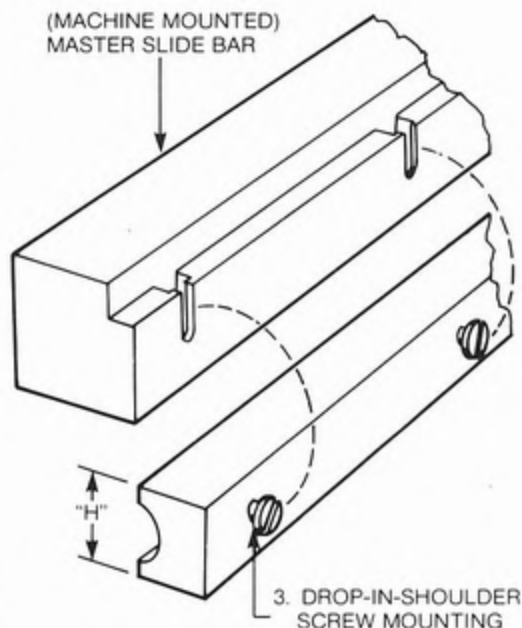
1. Direct on Machine (not shown) ..... "A" Type  
(no mounting, tapped holes or screws)
2. Bolt to Universal Follower Slide Plate ..... "B" Type
3. Drop-In Shoulder Screw ..... "C", "D" and "E" Type

## TYPE F4 ("H"=1") FOLLOWER BLOCK CATALOG NUMBERS

Machine Model	Min. Bend Die CLR	Size and Type Number	Tube O.D. Inches	Length - Inches			
				10	15	18	24
410	1/2	F4A	1/8	1/8-10			
			3/16	3/16-10			
			1/4	1/4-10			
210 411, 412 420	1 3/8	F4B	5/16	5/16-10			
			3/8	3/8-10			
			7/16	7/16-10			
211, 220 221, 222 510, 511 520	1 1/2	F4C	1/2	1/2-10	1/2-15	1/2-18	1/2-24
			5/8	5/8-10	5/8-15	5/8-18	5/8-24
			3/4	3/4-10	3/4-15	3/4-18	3/4-24
			7/8	7/8-10	7/8-15	7/8-18	7/8-24

## TYPE F401 ("H"=1") FOLLOWER BLOCK CATALOG NUMBERS

Machine Model	Min. Bend Die CLR	Size and Type Number	Tube O.D. Inches	Length - Inches		
				6	9	12
401	3/8	F401A	1/8	1/8-6	1/8-9	1/8-12
			3/16	3/16-6	3/16-9	3/16-12
			1/4	1/4-6	1/4-9	1/4-12
			5/16	5/16-6	5/16-9	5/16-12
			3/8	3/8-6	3/8-9	3/8-12
			7/16	7/16-6	7/16-9	7/16-12
			1/2	1/2-6	1/2-9	1/2-12
			5/8	5/8-6	5/8-9	5/8-12



# FOLLOWER BLOCKS

## TYPE F8 ("H" = 2")—FOLLOWER BLOCK CATALOG NUMBERS

MACHINE MODEL	Min. Bend Die CLR	Size and Type Number	Tube O.D. Inches	Length-Inches				
				10	15	18	24	30
210, 411, 412 420	1 1/8	F8B	3/4	3/4-10	3/4-15			
			7/8	7/8-10	7/8-15			
211, 220, 221, 222 230, 511, 520	1 1/8	F8C	1	1-10	1-15	1-18		
			1 1/8	1 1/8-10	1 1/8-15	1 1/8-18		
			1 1/4	1 1/4-10	1 1/4-15	1 1/4-18	1 1/4-24	1 1/4-30
530	1 1/8	F8D	1 3/8	1 3/8-10	1 3/8-15	1 3/8-18	1 3/8-24	1 3/8-30
			1 1/2	1 1/2-10	1 1/2-15	1 1/2-18	1 1/2-24	1 1/2-30

## TYPE F10 ("H" = 2 1/2"), F12 ("H" = 3"), F14 ("H" = 3 1/2"), F16 ("H" = 3 7/8") FOLLOWER BLOCK CATALOG NUMBERS

MACHINE MODEL	Min. Bend Die CLR	Size and Type Number	Tube O.D. Inches	Length-Inches							
				10	15	18	24	30	36	48	60
220, 221, 222 230, 520	3	F10C	1 1/4	1 1/4-10	1 1/4-15	1 1/4-18	1 1/4-24	1 1/4-30			
			2	2-10	2-15	2-18	2-24	2-30			
230	4 1/2	F12C	2 1/4								
240, 242	4 1/2	F12E			2 1/4-15	2 1/4-18	2 1/4-24	2 1/4-30	2 1/4-36		
530	4 1/2	F12D									
230	4 1/2	F14C	2 1/2		2 1/2-15	2 1/2-18	2 1/2-24	2 1/2-30	2 1/2-36	2 1/2-48	2 1/2-60
240, 242	4 1/2	F14E			2 1/2-15	2 1/2-18	2 1/2-24	2 1/2-30	2 1/2-36	2 1/2-48	2 1/2-60
530	4 1/2	F14D	3								
230	4 1/2	F16C									
240, 242	4 1/2	F16E			3-15	3-18	3-24	3-30	3-36	3-48	3-60
530	4 1/2	F16D									

## TYPE F18 ("H" = 4 1/2"), F20 ("H" = 4 7/8") FOLLOWER BLOCK CATALOG NUMBERS

MACHINE MODEL	Min. Bend Die CLR	Size and Type Number	Tube O.D. Inches	Length-Inches						
				15	18	24	30	36	48	60
240, 242	4 1/2	F18E	3 1/4							
			3 1/2							
240, 242	4 1/2	F20E	3 3/4							
			4							

NOTE: Followers blocks for Machine Models 244, 260, 270, 280, 290 available by factory inquiry.

# TYPE F4, F8 FOLLOWER BLOCK MOUNTING ADAPTERS

## ORDERING INFORMATION

By machine model, determine adapter part number to be used within tube O.D. range.

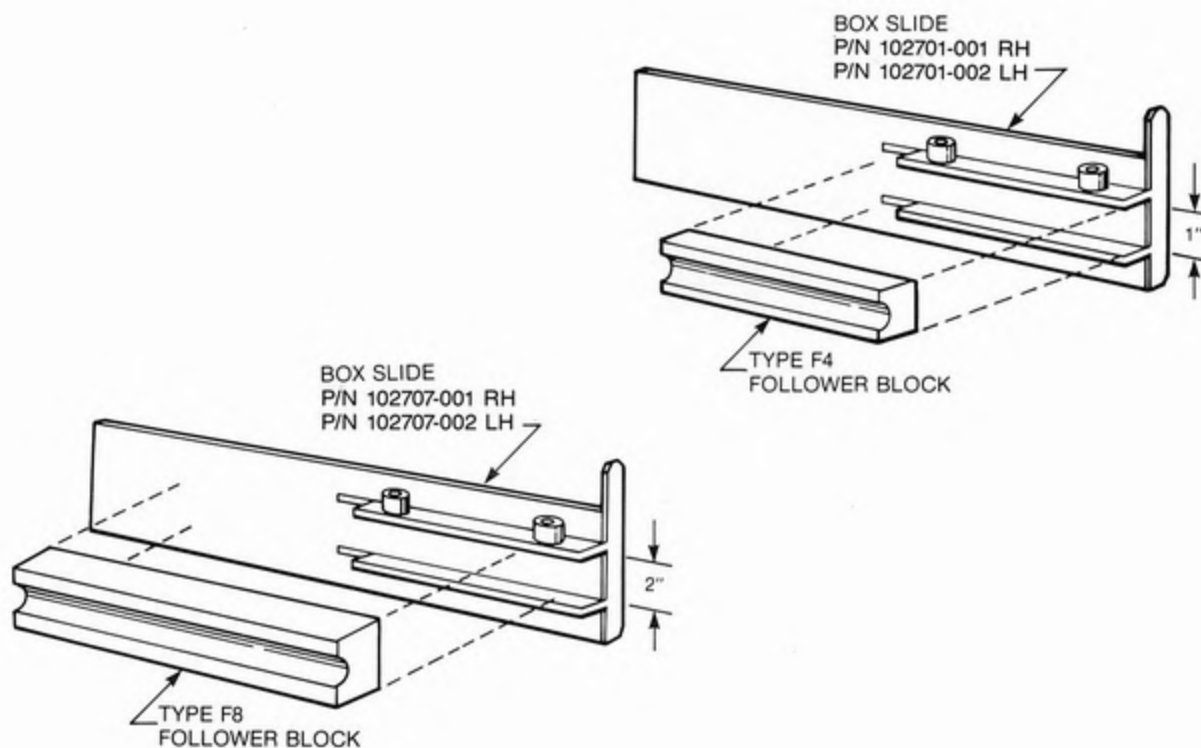
Example: Model 210, right or left hand machine, 3/16" tube O.D. using type F4 follower blocks.

Specify Catalog Number: 102701-001 (right hand)  
or 102701-002 (left hand)

Follower Block Mounting Adapters Allow Follower Blocks to Be Used Without the Use of Attaching Screws.

## Adaption for Type F4, F8 Follower Blocks

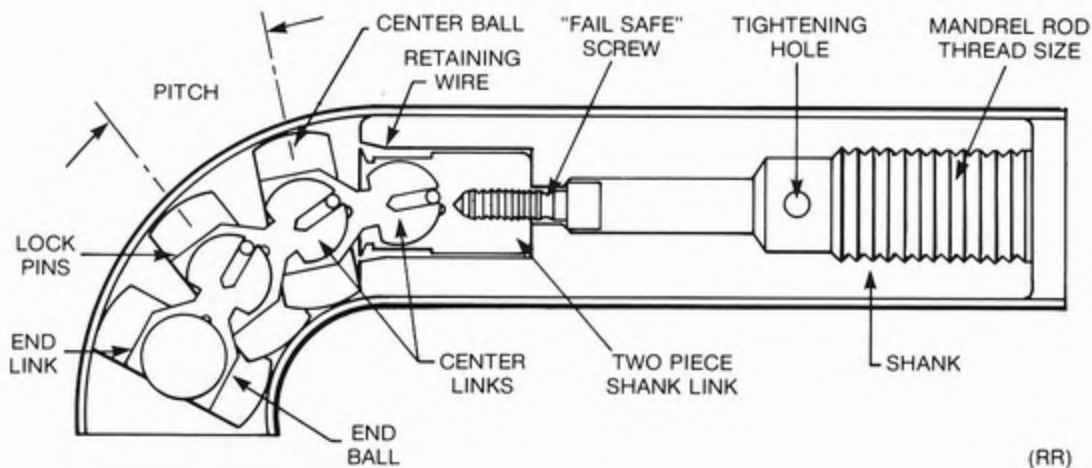
MACHINE MODELS	Use Adapter Number	Tube O.D. Inches	Type Follow Blk
210 411, 412	102701	1/8 3/16 1/4 5/16 3/8 7/16 1/2 5/8 3/4	F4
210 411, 412	102707	3/4 7/8 1 1 1/4 1 1/2	F8



# MANDREL SPECIFICATIONS

## SPECIFY

- Chrome plated
- Plain tool steel
- Other
- No. of balls
- Tube O.D. size
- Wall thickness
- Tube material
- Weld flash
- Rod size
- Center line radius of bend



## TUBE SIZES AVAILABLE (Inches)

Tube Sizes	Shank Length	Rod Thread Size
3/8	6	10-32
1/2-7/8	6	5/16-18
1-1 1/4	6	1/2-13
1 3/8-2	9	3/4-10
2 1/8-3 3/4	9	1-8
4-6	12	1 3/4-10

## PIPE SIZES AVAILABLE (Inches)

Pipe Sizes	Shank Length	Thread Size
1/2	6	5/16-18
3/4	6	1/2-13
1	9	3/4-10
1 1/4	9	3/4-10
1 1/2	9	1-8
2	9	1-8
2 1/2	9	1-8
3	12	1 3/4-10
3 1/2	12	1 3/4-10
4	12	1 3/4-10
5	12	1 3/4-10
6	12	1 3/4-10

# MANDREL AND WIPER DIE SELECTION CHART

## SELECTION CHART

CENTERLINE RADIUS TO O.D. FACTOR ("D" OF BEND)									
	WALL FACTOR	1	1.25	1.50	2	2.50	3	4	5
SEE NOTE 1	10	F	F	F	F	P	P		
	15	M1W	M1W	M1	M1	P	P		
	20	M2W	M1W	M1W	M1	F	F	P	
	25	M3W	M2W	M1W	M1W	M1	F	F	
	30	M3W	M3W	M2W	M2W	M1W	M1	F	F
	35	M3W	M3W	M3W	M2W	M2W	M2W	M2	M1
	40	M4W	M3W	M3W	M3W	M3W	M3W	M2W	M2
	45	M4W	M3W	M3W	M3W	M3W	M3W	M2W	M2W
	50	M4W	M3W	M3W	M3W	M3W	M3W	M2W	M2W
	60	M4W	M4W	M3W	M3W	M3W	M3W	M2W	M2W
SEE NOTE 2	70	M5W	M5W	M5W	M3W	M3W	M3W	M3W	M2W
	80	M5W	M5W	M5W	M5W	M3W	M3W	M3W	M2W
	90	M5W	M5W	M5W	M5W	M3W	M3W	M3W	M3W
	100	M5W	M5W	M5W	M5W	M5W	M3W	M3W	M3W
	125	M5W	M5W	M5W	M5W	M5W	M5W	M4W	M4W
	150	M6W	M6W	M6W	M6W	M5W	M5W	M4W	M4W
SEE NOTE 3	175	M6W	M7W	M8W	M7W	M7W	M6W	M6W	M6W
	200	M6W	M8W	M10W	M10W	M9W	M9W	M8W	M8W
	225		M9W	M10W	M10W	M10W	M10W	M10W	M10W
	250			M10W	M10W	M10W	M10W	M10W	M10W
	275			M10W	M10W	M10W	M10W	M10W	M10W

Add (1) ball for over 90 degree bending

Double wall factor for calculating square or rectangular tube

Add (1) ball when bending brass.

**This chart is your guide** to determining when a mandrel or wiper die is generally required, plus the mandrel type and number of balls recommended for high quality, wrinkle-free bends with maximum 2½% flattening.

### KEY TO CHART

Wall Factor =  $\frac{\text{Tube Outside Diameter}}{\text{Wall Thickness}}$

Radius to O.D. Factor =  $\frac{\text{Bend Centerline Radius}}{\text{Tube Outside Diameter}}$

Tooling Identification:

P = Plug Mandrel

F = Form Mandrel

M = Ball Mandrel

Figure—Number of Balls on Mandrel

Example: Bend 3" O.D. Tube with .049" wall on 6" C.L. Radius

$$\text{Wall Factor} = \frac{3}{.049} = 61.2$$

$$\text{Radius to O.D. Factor} = \frac{6}{3} = 2$$

Read down to closest wall factor (60), across to fourth column (2D).

Answer:

M 3 W

Wiper Die

Three Ball

OR:

Mandrel

Three ball mandrel with wiper die.

**NOTE:** 1. Light shaded area at top of table—No wiper die is required when bending brass or copper.

2. Light shaded area, factors 70 to 175—Use Thin Wall type mandrel.

3. Darker shaded area, factors 200 to 275—Use Super-Thin Wall type mandrel.

# BALL MANDRELS FOR PIPE SIZES Centerline Radius 1½ D or Greater

All IPS Mandrels Furnished with Lube Holes — All Sizes Made to Order

Nominal IPS Size	Schedule	Outside Diameter	Wall Thickness	Shank M'tg Thread Size	Min. Centerline Radius of Bend (Inches)
½	40	.840	.109	⅝-16-18	1½
	80	.840	.147	⅝-16-18	
	40*	.812	.101	⅝-16-18	
	80*	.812	.137	⅝-16-18	
	S/S 10	.840	.083	⅝-16-18	
	S/S 40	.840	.109	⅝-16-18	
¾	40	1.050	.113	½-13	1½
	80	1.050	.154	½-13	
	40*	1.063	.105	½-13	
	80*	1.063	.143	½-13	
	S/S 5	1.050	.065	½-13	
	S/S 10	1.050	.083	½-13	
1	40	1.315	.133	¾-10	2
	80	1.315	.179	¾-10	
	40*	1.312	.125	¾-10	1½
	80*	1.312	.162	¾-10	
	S/S 5	1.315	.065	¾-10	
	S/S 10	1.315	.109	¾-10	
1¼	40	1.660	.140	¾-10	2½
	80	1.660	.191	¾-10	
1½	40	1.900	.145	1-8	3
	80	1.900	.200	1-8	
	40*	1.875	.135	1-8	2¼
	80*	1.875	.181	1-8	
	S/S 5	1.900	.065	1-8	
	S/S 10	1.900	.109	1-8	
2	40	2.375	.154	1-8	4
	80	2.375	.218	1-8	
	40*	2.375	.144	1-8	3
	80*	2.375	.197	1-8	
	SS/5	2.375	.065	1-8	
	S/S 10	2.375	.109	1-8	
2½	40	2.875	.203	1-8	5
	80		.276	1-8	
3	40	3.500	.216	1¾-10	6
	80	3.500	.300	1¾-10	
	40*	3.500	.196	1¾-10	4½
	S/S 5	3.500	.083	1¾-10	
	S/S 10	3.500	.120	1¾-10	
3½	40	4.000	.226	1¾-10	7
	80		.318	1¾-10	
4	40	4.500	.237	1¾-10	8
	80	4.500	.337	1¾-10	
	40*	4.500	.215	1¾-10	6
	S/S 5	4.500	.083	1¾-10	
	S/S 10	4.500	.120	1¾-10	
5	Made to order				
6					

S/S denotes stainless steel.

\*Denotes ASTM A-587 ERW.

Shank length is 6" for ½ IPS and ¾ IPS, 9" length for 1 IPS through 3 IPS, and 12" length for 3½ IPS and 4 IPS. Flex section, shank, balls and links may be ordered separately. Specify mandrel type, IPS size, schedule, and wall thickness.

## PLAIN END MANDRELS Lube Holes Available Upon Request

### ORDERING INFORMATION

Plain end mandrel for any tube O.D. and wall thickness.

Specify: Type, class, tube O.D. and wall thickness.

Catalog Number Example: PM-I-3/8-016 (plain end mandrel made of alloy steel, heat treated for 3/8" O.D. x .016 wall tubing)

Material: Class I: Alloy steel heat treated 59-61 Rc

\*Class IV: Bronze — non-stocked item  
(Suggested for stainless steel tube)

### CLASS I STOCK SIZES

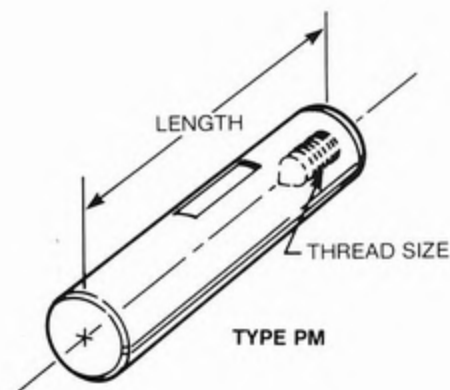
Tube O.D. Inches	Nominal Wall Thickness	Shank Lengths Inches	Shank Mts Thrd Size
3/8	.016 .020 .028 .035 .042 .049 .065	4	10-32
1/2		4	1/4-20
5/8		4	5/16-18
3/4		4	3/8-16
1		4	1/2-13
1 1/4		4	1/2-13
1 1/2		4	1/2-13
1 3/4 *		9	3/4-10
2*		9	3/4-10

\* Made To Order Item not stocked

### REFERENCE CHART

#### MINIMUM BEND CENTERLINE RADIUS INCHES

Wall Thickness	Tube O.D. - Inches						
	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2
.016	1 1/2	2 1/4	4 3/8	6	—	—	—
.020	1 5/16	2 1/2	3 3/4	5 1/4	—	—	—
.028	1 5/16	1 3/4	2 1/2	3 3/4	7	—	—
.035	3/4	1 1/2	2 1/16	3	6	—	—
.042	3/4	1 1/4	1 7/8	2 5/8	5	7 1/2	—
.049	3/4	1	1 1/16	2 1/4	4	6 1/4	9
.065	3/4	1	1 1/4	1 7/8	3	5	6 3/4



To produce a good 90° bend, the suggested minimum bend CLR is listed when used with a plain end mandrel. However, greater degree of bend and some reduction in CLR can be accomplished with use of a formed end mandrel.

All other combinations of tube O.D., wall thickness, and centerline radius can be accomplished with use of a flexible, cable type mandrel.

## FORMED END MANDRELS Lube Holes Available Upon Request

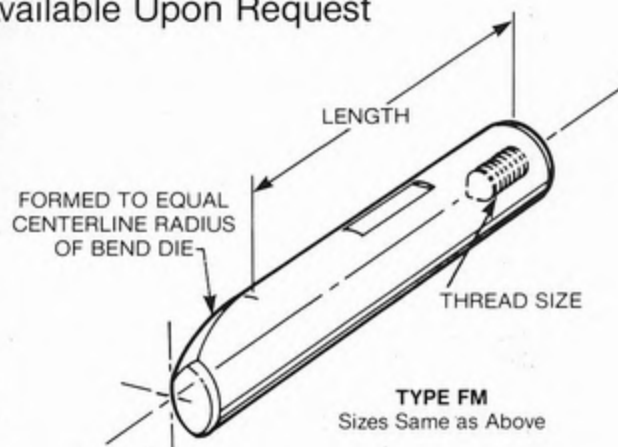
### ORDERING INFORMATION

All formed end mandrels are made to order to your specified centerline radius.

Specify: Type, class, tube O.D., wall thickness, and centerline radius desired.

Catalog Number Example: FM-I-3/8-016-1 1/4  
(Formed end mandrel made of alloy steel heat treated for 3/8" O.D. x .016 wall tubing to be used with a 1 1/4" CLR bend die).

Formed end mandrels should be not used with a bend die of lesser radius than stamped on the mandrel.



Material: Class I: Alloy steel heat treated 59-61 Rc  
Class IV: Bronze (Suggested for stainless steel tube).

# ROLLER ASSEMBLY AND TUBE CLAMP FOR COMPRESSION BENDING

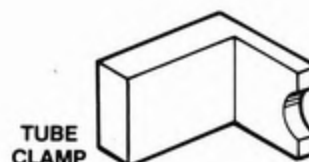
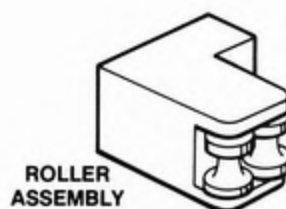
## ORDERING INFORMATION

For standard roller assembly or tube clamp, specify the part number tabulated for tube O.D. desired.

For custom size, specify tube O.D. (.500 max.) in decimal.

## FOR MACHINE MODEL 401

Tube O.D. Inches	Roller Assembly Part Number	Tube Clamp Part Number
1/8	106586-001	104868-001
3/16"	106586-002	104868-002
1/4	106586-003	104868-003
5/16"	106586-004	104868-004
3/8	106586-005	104868-005
1/2	106586-006	104868-007



## PUSHER CLAMP AND FOLLOWER BLOCK PART NUMBERS

For 1 1/2 D 4 IPS Machines

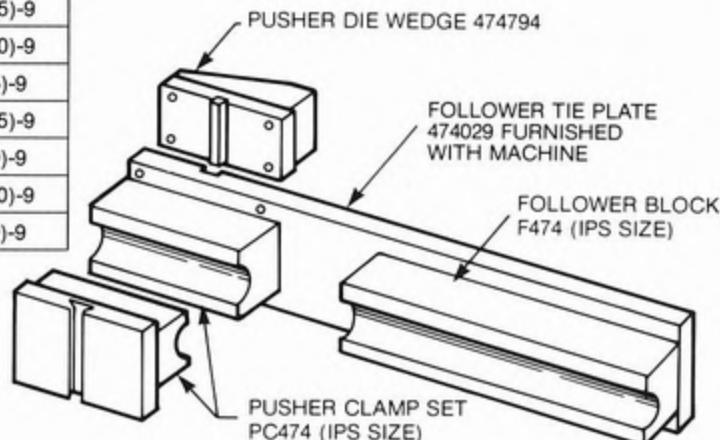
## MACHINE MODEL 255

## ORDERING INFORMATION

For standard pusher clamp or follower block, specify the part number tabulated for IPS size desired. For custom size, specify pipe O.D. in decimal.

Nominal IPS Size Inches	FOLLOWER BLOCK Part Number	PUSHER CLAMP SET Part Number
1/2*	F474-1/2 IPS(.812)-15	PC474-1/2 IPS(.812)-6
	F474-1/2 IPS(.840)-15	PC474-1/2 IPS(.840)-6
3/4*	F474-3/4 IPS(1.050)-15	PC474-3/4 IPS(1.050)-6
	F474-3/4 IPS(1.063)-15	PC474-3/4 IPS(1.063)-6
1*	F474-1 IPS(1.315)-15	PC474-1 IPS(1.315)-6
1 1/4*	F474-1 1/4 IPS(1.660)-15	PC474-1 1/4 IPS(1.660)-6
1 1/2*	F474-1 1/2 IPS(1.875)-15	PC474-1 1/2 IPS(1.875)-9
	F474-1 1/2 IPS(1.900)-15	PC474-1 1/2 IPS(1.900)-9
2*	F474-2 IPS(2.375)-15	PC474-2 IPS(2.375)-9
2 1/2**	F474-2 1/2 IPS(2.875)-32	PC474-2 1/2 IPS(2.875)-9
3**	F474-3 IPS(3.500)-32	PC474-3 IPS(3.500)-9
3 1/2**	F474-3 1/2 IPS(4.000)-32	PC474-3 1/2 IPS(4.000)-9
4**	F474-4 IPS(4.500)-32	PC474-4 IPS(4.500)-9

Part Number	FOLLOWER TIE PLATE (for 1/2 IPS through 2 IPS sizes)
474029	
Part Number	PUSHER DIE WEDGE
474794	



\*Follower block and one-half of pusher clamp set bolts to follower tie plate #474029 furnished with machine.

\*\*Follower block and one-half of pusher clamp set is one piece. No tie plate required.

# WIPER DIES TYPE W SERIES W4-W5

## ORDERING INFORMATION

By machine model, determine size and type number.

Select class number, tube O.D. and centerline radius (see chart).

Example: Model 210, alloy steel material, 3/4" tube O.D.  
1 1/2 centerline radius.

Specify Catalog Number: W5A-II-3/4-1 1/2

For custom size, insert tube O.D. not listed. For IPS size, insert nominal pipe size or specify O.D. in decimal.

Material: Class II: 4100 Series alloy tool steel 24-30 Rc  
Class IV: Bronze — non-stocked item

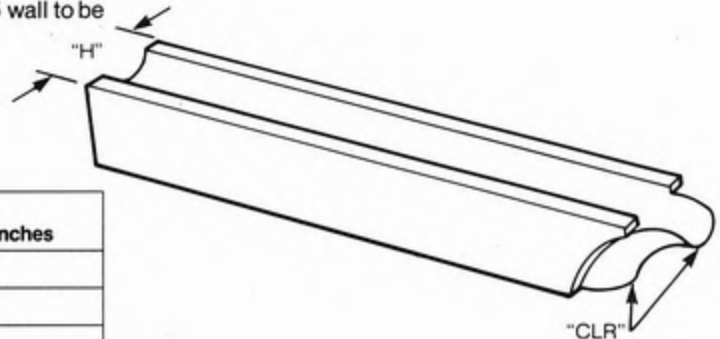
## TUBE FORMING USUALLY REQUIRING A WIPER DIE

Example: By using the ratios shown on the chart, 1/2" O.D. x .025 wall to be bent on 1 1/2 centerline radius

$$\frac{.500}{.025} = 20 \quad \frac{1\frac{1}{2}}{\frac{1}{2}} = 3$$

## WIPER DIE STANDARD LENGTHS

Types	Max. CLR Inches	Lengths, Inches
A, B, C, & G	7	11
D	5	8 3/4
E	4	6 1/2
F	7	13
Larger Radii Require Longer Wiper Dies		



TUBE O.D. RATIO = TUBE WALL THICKNESS	Ratio = Bend Die Radius Tube O.D.				
		1	2	3	4
	5	No	No	No	No
	10	Yes	Yes	No	No
	15	Yes	Yes	Yes	No
	20	Yes	Yes	Yes	Yes
	25 or More	Yes	Yes	Yes	Yes

MACHINE MODEL	Type Number	Tube O.D., Inches
210, 411, 412	W4A	3/8, 1/2, 3/4
220, 221, 222, 520	W4B	
240, 242	W4C	
420	W4D	
211, 510, 511	W4E	
230, 530	W4F	

TYPE W4  
"H" = 1"

210, 411, 412	W5A	3/4, 7/8
220, 221, 222, 520	W5B	
240, 242	W5C	
420	W5D	
211, 510, 511	W5E	
230, 530	W5F	
244, 250, 255	W5G	

TYPE W5  
"H" = 1 1/4"

# WIPER DIES TYPE W SERIES W6-W8-W10-W12-W-14

MACHINE MODEL	Type Number	Tube O.D., Inches	
210, 411, 412	W6A	1, 1½	TYPE W6 "H" = 1½"
220, 221, 222, 520	W6B		
240, 242	W6C		
420	W6D		
211, 511	W6E		
230, 530	W6F		
244, 250, 255	W6G		

210	W8A	1¼, 1½ 1½	TYPE W8 "H" = 2"
220, 221, 222, 520	W8B		
240, 242	W8C		
420	W8D		
211, 511	W8E		
230, 530	W8F		
244, 250, 255	W8G		

220, 221, 222, 520	W10B	1¾, 2	TYPE W10 "H" = 2½"
240, 242	W10C		
230, 530	W10F		
244, 250, 255	W10G		

230, 530	W12F	2¾, 2½	TYPE W12 "H" = 3"
244, 250, 255	W12G		

240, 242	W14C	2¾, 3	TYPE W14 "H" = 3½"
230, 530	W14F		
244, 250, 255	W14G		

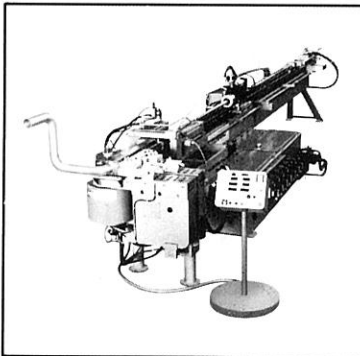
**PHI****Machine Tools**

## TUBE AND PIPE BENDING MACHINES

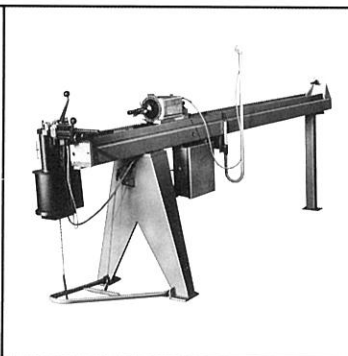
PHI offers the industry's most complete line of tube and pipe draw-bending machines. They are powered manually or hydraulically with automatic, semi-automatic or manual controls.

PHI equipment can produce precision bends in tube from 1/8 inch to 6 inches OD and in pipe from 1/4 inch to 6 inch IPS.

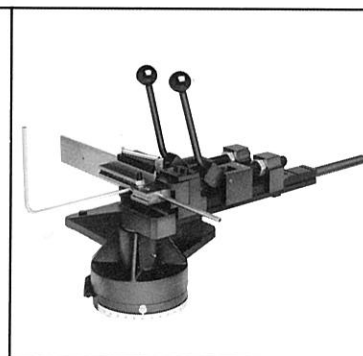
# TAKE A LOOK AT THESE OTHER PHI PRODUCTS DESIGNED TO HELP YOUR PRODUCTIVITY



**BENDMASTER BENDING MACHINES.**  
Powerful, hydraulic benders for pipe up to 6" IPS and tube up to 6" OD, offers maximum control over wall thickness and ovality.



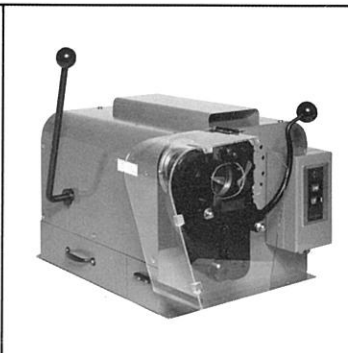
**SYNCHRO BENDING MACHINES.**  
Hydraulic or manual power for automatic bends, as many as 10 bends per pipe or tube, up to 3"OD.



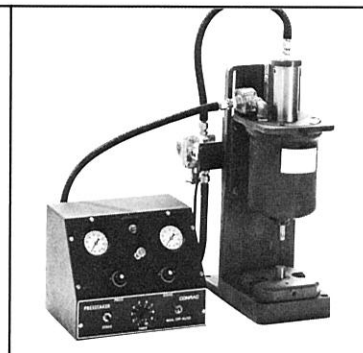
**BENCHMASTER BENDING MACHINES.**  
Compact, manually-powered, bench-mounted machines for precision bending of smaller diameter tube and pipe, up to 1"OD.



**BENDING MACHINES TOOLING.**  
Manufactured by PHI, under strict quality control specifications, to produce tooling for consistent precision bends.



**END FINISHING.** Broad line of end finishing machines will flare, doubleflare, bead, square, deburr, and flange... from 1/8" tube to 8" pipe, including all needed tooling.



**PRESSTAKER.** Join two or more parts together with the Press-taker machine. It will press and stake in one operation, with no change of tooling.

**PHI****Machine Tools**

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