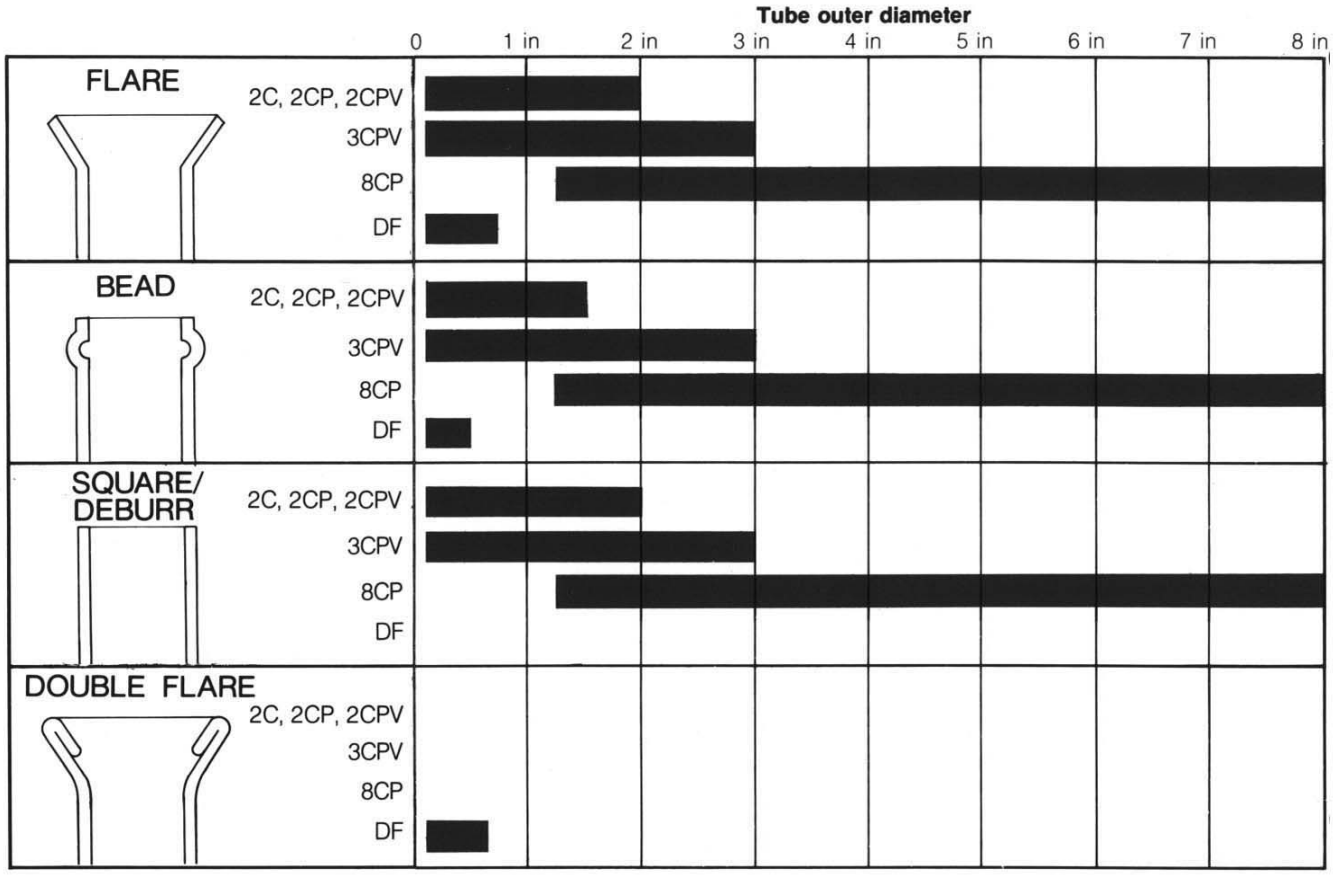
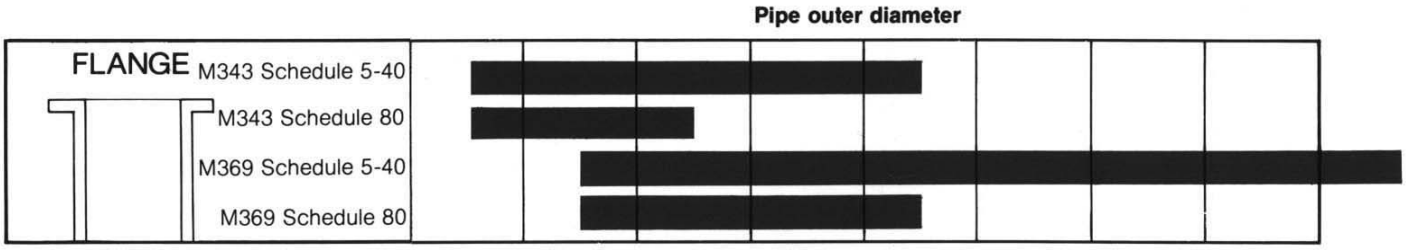
PHI TUBE/PIPE END-FINISHING EQUIPMENT AND TOOLING

CAPACITY RANGE FOR END-FINISHING MACHINES





PHI END-FINISHING MACHINES AND TOOLING

PHI end-finishing machines are the end result of more than forty years experience in producing tube-processing equipment (as Leonard Precision until 1969 and as Conrac's Machine Tool Division until 1985).

There is a standard machine in the PHI line for almost any tube or pipe end-finishing requirement—flaring, double flaring, beading, squaring, deburring, or flanging—for applications ranging from ⅛-inch light-wall tubing to heavy 8-inch pipe.

As labor saving devices, the PHI end-finishing machines can directly replace manual tools, which are appropriate only when extremely low output is required. Manual devices may, moreover, fail to form the material to specifications, or may be ineffective for tube or pipe sizes of 1-inch OD or up. This can require, in turn, mechanical fittings which are extremely expensive and do not form a sufficient joint to meet many military or federal specifications.

To increase efficiency, every PHI machine features simplified set-up procedures with minimum time loss in small-lot production changeover. The PHI designs also permit new operators to run the machines at near top efficiency after a very short training period.

All of PHI's production machinery and tooling are manufactured on our own premises, assuring you that our rigid quality specifications are met on every item we ship.

The tables on the opposite page briefly list the PHI machines and their areas of application. The balance of the catalog contains detailed specifications and descriptions of the various machines and their tooling.

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SAE AS4330
supercedes MS33584

FLARING

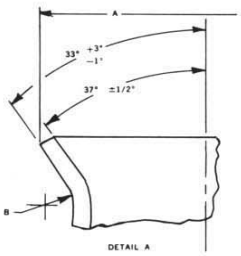
•MEETS SPECIFICATIONS OF ~~MS33583~~
SAE STANDARDS ALSO AVAILABLE

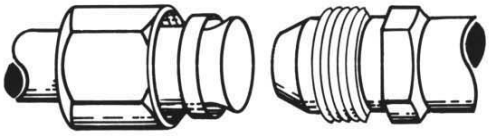
Squaring, Deburring, Flaring

Flared joints form liquid-tight, air-tight connections at the ends of tubing or pipe.

To obtain an effective, long-lasting seal, each end of the tube or pipe must be formed to the exact shape of the matching flare fittings.

Tooling supplied by PHI meets this objective. And in almost every case, the same end-finishing machine can be used to perform the required squaring and deburring of the cut end—before the flare is formed.





Typical Applications: Hydraulic systems and fuel lines in the aircraft, auto, heating and cooling industries.

STANDARD MS33584 DIMENSIONS FOR FLARED TUBING

Tube Size Nominal OD Inches	A Diameter: Aluminum Alloy Tubing Inches		A Diameter: Steel Tubing Inches		B ±.010 Radius Inches
1/8	.200		.200		
3/16	.302		.302		
1/4	.359		.359		.032
5/16	.421	+.000	.421	+.000	
3/8	.484	−.010	.484	−.010	.046
1/2	.656		.656		
5/8	.781		.781		.062
3/4	.937		.937		.078
1	1.187		1.187		
1-1/4	1.500		1.500		.093
1-1/2	1.721	+.000	1.721	+.000	
1-3/4	2.106	−.015	2.106	−.015	
2	2.356		2.356		
2-1/2	2.856		2.856		.109
3	3.356		3.356		

DOUBLE FLARING

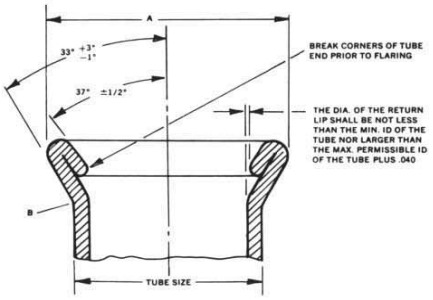
• MEETS SPECIFICATIONS OF ~~MS33584~~
SAE STANDARDS ALSO AVAILABLE

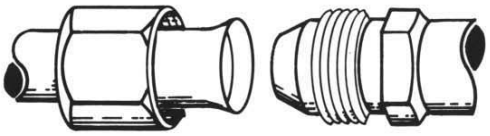
SAE AS33583 supercedes MS33583

Double-lap Flaring

Double-lap flares provide added-strength joints which are more resistant to fatigue and provide a better seal than single-thickness flares.

Douple-lap flares formed by PHI machinery and tooling are free of cracks and pitmarks. The joint is also designed so that the inside surface of the flare has a larger diameter than the inside diameter of the tube or pipe and, therefore, does not interfere with flow characteristics of the system.

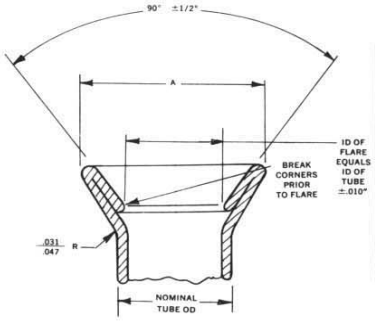




Typical Applications: Thin-wall tubing connections that are subject to shock, vibration, or high internal pressures such as automobile brake lines and critical aircraft hydraulic lines.

STANDARD MS33583 DIMENSIONS FOR 37° DOUBLE-FLARED TUBING

Tube Size Nominal OD Inches	A +.000 −.010 Dia. Inches	B ±.010 Rad Inches	Wall Thickness Inches	Min. ID Inches
1/8	.200			
3/16	.302	.032	.028 .035	.114 .100
1/4	.359		.028 .035	.178 .159
5/16	.421		.035 .049	.224 .198
3/8	.484	.046	.028 .035 .049	.310 .288 .261



STANDARD DIMENSIONS FOR 45° DOUBLE-FLARED TUBING

Nominal T—OD Inches	A—Dia. Inches ±.005
1/8	.187
3/16	.275
1/4	.355
5/16	.420
3/8	.495
7/16	.565
1/2	.635

MEETS SPECIFICATIONS OF SAE

BEADING

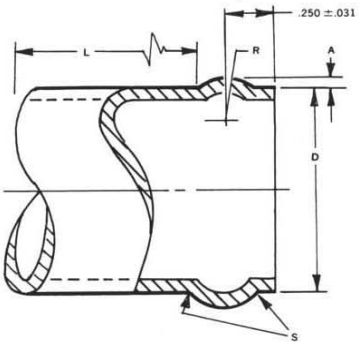
• MEETS SPECIFICATIONS OF MS33660
SAE STANDARDS ALSO AVAILABLE

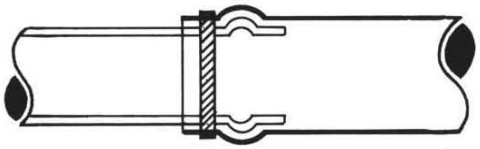
Beading

Beading is a versatile end-finishing technique that can be applied to a variety of industrial applications.

In conjunction with an O-ring, for example, beaded joints can be used to interconnect exhaust tubes or low-pressure fuel lines.

Beads can also be used to dampen vibration in solid lines, or to increase the effectiveness of the seal when a rubber or fabric sleeve is clamped to a metal duct.





Typical Applications: Low pressure air, exhaust, and liquid systems in the automotive, appliance and boating fields.

STANDARD MS33660 DIMENSIONS FOR BEADING

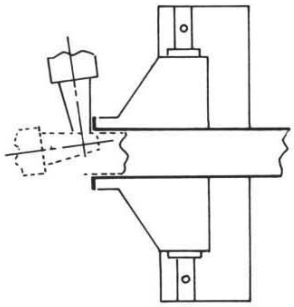
Size Number	D Tube OD Inches	D Tolerance for Length L Type A End Inches	A ±.003 Bead Height Inches	L Minimum Length	R Maximum Radius	S Maximum Radius
4	1/4	+.003 −.010	.031	.750	.125	.062
5	5/16		.033			
6	3/8		.035			
8	1/2		.038			
10	5/8					
12	3/4	+.004 −.010				
16	1	+.005 −.010	.062		.156	.093
20	1-1/4					
24	1-1/2		.072			
28	1-3/4					
32	2		.082			
40	2-1/2	+.006 −.010				
46	3					
52	3-1/4		.088			
56	3-1/2	+.008 −.010				
60	3-3/4					
64	4					
68	4-1/4					
72	4-1/2					
76	4-3/4					
80	5					
84	5-1/4					
88	5-1/2	±.010				
92	5-3/4					
96	6					

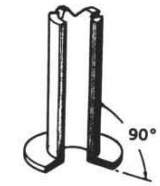
FLANGING

Flanging

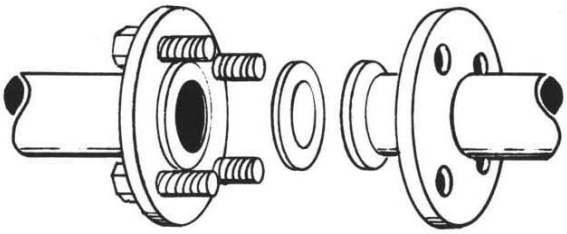
Pipe-flanging machines permit the joining of pipe sections without the need for costly welded flanges and the associated temporary tack welding, slag removal and x-ray inspection.

A prefabricated slip flange is placed against the assembly on an adjacent pipe section. A disc-shaped rubber seal placed between the two formed flanges prevents any leaks. Problems in lining-up bolt holes are eliminated with the use of slip flanges which rotate freely on the pipe. Standard flanges can still be used.





FLANGED TUBE



Typical Applications: Chemical plants, petroleum refineries, power plants, and pipelines.

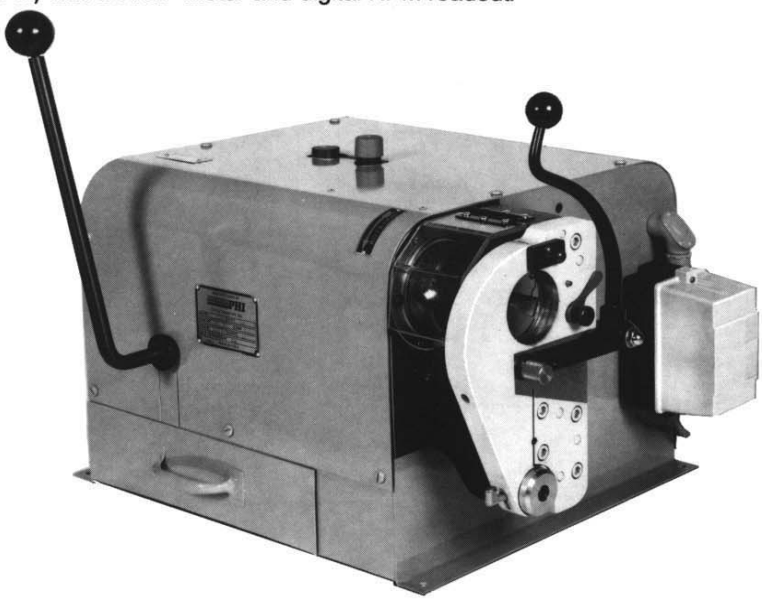
2C, 2CP & 2CPV

Models 2C, 2CP, 2CPV, 3CPV and 8CP form a family of machines for preparing the ends of tube or pipe for joining with other tube or pipe sections, valves, T-joints or machinery.

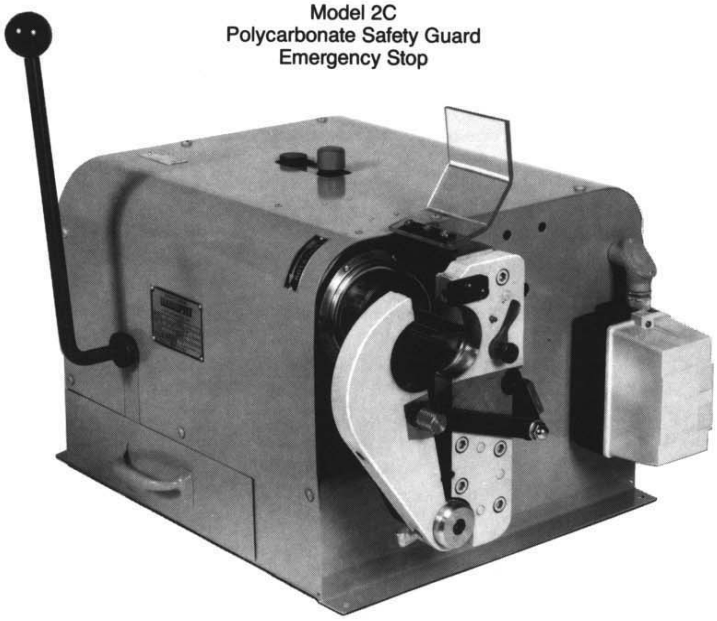
The ends can be prepared with a bead or flare, or simply deburred and squared. Each machine is capable of performing all of these functions; a change of tooling is all that is required to switch from one function to another.

2C, 2CP, and 2CPV SPECIFICATIONS	
Flaring	Annealed ferrous: ⅛" to 2" O.D. x .049" max. W.T. Nonferrous: ⅛" to 2" O.D. x .065" max. W.T. Stainless steel: ⅛" to 2" O.D. x .049" max. W.T.
Beading	Annealed ferrous: ¼" to ⅜" O.D. x .035" max. W.T. ½" to 1½" O.D. x .049" max. W.T. Nonferrous: ¼" to ⅜" O.D. x .035" max. W.T. ½" to 1½" O.D. x .065" max. W.T. Stainless steel: ½" to 1½" O.D. x .049" max. W.T.
Squaring & deburring	Annealed ferrous, nonferrous & stainless steel: ⅛" to 2" O.D.
Spindle Speed	2C & 2CP: Two speed spindle 500 & 1500 RPM 2CPV: Vari-speed motor 0-2000 RPM
Clamping	2C: Manual lever 2CP & 2CPV: Semi-automatic air cylinder clamping with "PROTEC JAWS" Air supply 1½ CFM at 75-100 PSI required
Electrical	2C & 2CP: ½ HP motor 2CPV: ¾ HP motor
Dimensions	Length, 28"—Width, 18"—Height, 15"
Shipping Weight	2C: 300 pounds 2CP & 2CPV: 350 pounds
Options	Cabinet stand

Models 2C, 2CP and 2CPV are designed for smaller-diameter tubes and pipes (see Specifications below). Model 2C features manual clamping for easy-to-form materials and low production requirements. Model 2CP has air-cylinder clamping for higher production rates and more difficult-to-form materials. Both models have two-speed spindles allowing you to choose the most efficient speed for the function you are performing. The 2CPV capacities are the same as the 2CP. In addition, the 2CPV has a varispeed drive (0-2000 RPM) with a ¾ HP motor and digital RPM readout.



Model 2C
Polycarbonate Safety Guard
Emergency Stop



Model 2CP
Pneumatic "PROTEC JAWS"
Emergency Stop
Polycarbonate Safety Guard

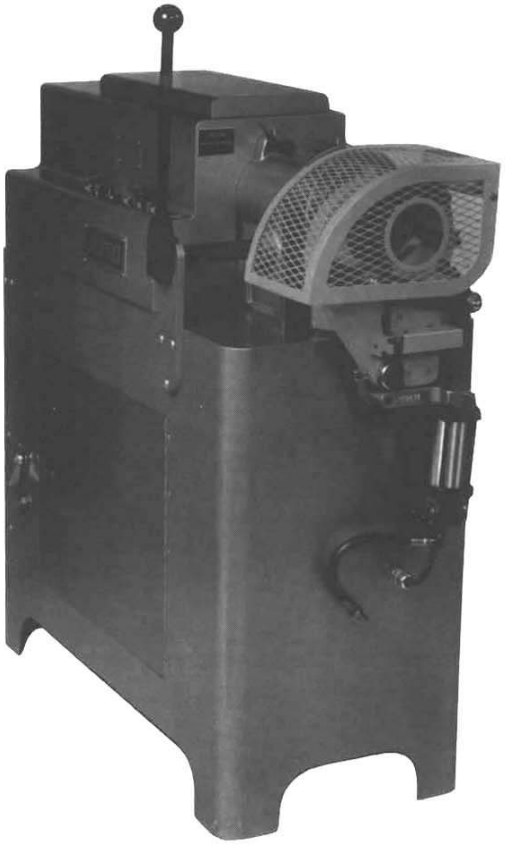
3CPV

The Model 3CPV extends the range of the PHI end-finishing machines to include tubes and pipes with outside diameters up to 3 inches.

As in the case of the other PHI models, flares are formed to standard 37° and 45° angles, meeting MS33584 and SAE specifications. Beads are formed within the tight specifications called for in Military Specification MS33660.

Features of the Model 3CPV include pneumatic clamping, cabinet stand with tooling shelf and lockable casters. A variable-speed motor allows the operator to select a slower speed for extended blade life when deburring stainless steel.

3CPV SPECIFICATIONS	
Flaring	Annealed ferrous: ⅛″ to 3″ O.D. x .125″ max. W.T. Nonferrous: ⅛″ to 3″ O.D. x .125″ max. W.T. Stainless steel: ⅜″ to 3″ O.D. x .125″ max. W.T.
Beading	Annealed ferrous: ¼″ to ⅜″ O.D. x .035″ max. W.T. ½″ to 1½″ O.D. x .065″ max. W.T. Nonferrous: ¼″ to ⅜″ O.D. x .035″ max. W.T. ½″ to 1½″ O.D. x .065″ max. W.T. Stainless steel: ½″ to 1½″ O.D. x .065″ max. W.T.
Squaring & deburring	Annealed ferrous, nonferrous, and stainless steel: ⅛″ to 3″ O.D.
Spindle Speed	Vari-speed motor, 50-500 RPM
Clamping	Semi-automatic air cylinder clamping with "PROTEC JAWS" Air supply 1½ CFM at 75-100 PSI required
Electrical	1 HP motor
Dimensions	Length, 39″—Width, 28″—Height, 45″
Shipping Weight	850 pounds
Accessories Furnished with Machine	35CP-1 (103645) Spindle adaptor 35CP-10 (103647) Heavy Duty Spindle Adaptor 35CP-2 (107713) Std. Die Adaptor
Options	Semi-automatic powered beading cycle to 3″ O.D. Manual beading cycle to 3″ O.D. Digital display to read motor RPM



Model 3CPV

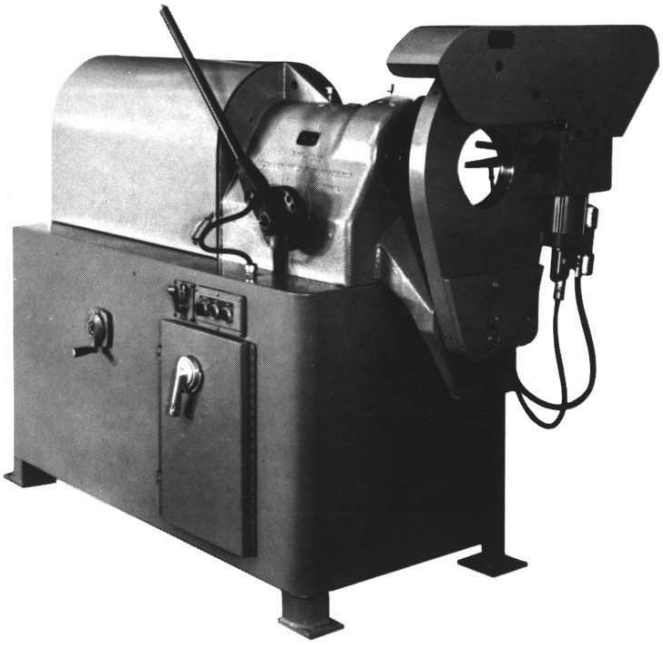
8CP

Model 8CP is the largest in the family of PHI end-finishing machines, and can be used to flare, bead, debur and square tubes or pipes with outside diameters up to 8 inches.

An air cylinder with heavy duty linkage holds the tube or pipe firmly in place during each operation, preventing slippage and ensuring that all forming is done within appropriate specifications.

The Model 8CP also features a variable-speed drive for efficient operation, regardless of material or wall thickness. Hard materials such as stainless steel can be deburred at slower speeds, for example, without undue wear of the blades. Other special features of the Model 8CP include an adjustable bead height and positive solenoid indexing.

8CP	
Flaring	Annealed ferrous, Nonferrous & Stainless steel: 1¼″ to 8″ O.D. x .125″ max. W.T.
Beading	Annealed ferrous, Nonferrous & Stainless steel: 1¼″ to 8″ O.D. x .065″ max. W.T.
Squaring & Deburring	Annealed ferrous, Nonferrous & Stainless steel: 1¼″ to 8″ O.D.
Spindle Speed	Vari-speed drive 70-550 RPM
Clamping	Pneumatic cylinder—heavy duty overhead jaw linkage
Electrical	2 HP motor, magnetic starter, fused disconnect.
Dimensions	Length, 68″—Width, 35″—Height, 54″ Floor to spindle C/L, 41″
Shipping Weight	2200 pounds
Features	Bead height adjustable ⅜″ maximum. Air cylinder powered—switch operated. Positive solenoid indexed bead positioning. Semi-automatic beading cycle 1¼″ O.D. and up.
Accessories Furnished With Machine	8CP-101 (108203) Die Adaptor 8CP-100 (104454) Spindle Adaptor
Optional Accessories Available	8CP-1045 Die Adaptor 108399 35CP-10 (103647) Spindle Adaptor 6CP-100 (104454) Spindle Adaptor 105338 F/C Head FCH-30 (105018) F/C Head 104998 F/C Head Auto Feed—Square and Deburring only



Model 8CP

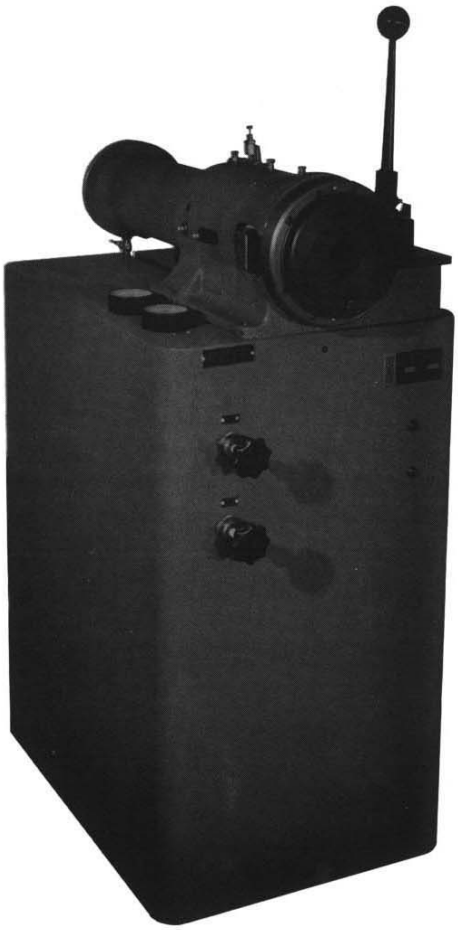
DF

The Model DF is a double-lap flaring machine which produces a double-thickness flare. It will also produce a single-thickness flare and an upset bead.

The machine forms double-lap flares to precise 37° and 45° dimensions within MS and SAE specifications. Single flares and beads are also done with precision and within specifications—everytime.

DF	
Capacity	Double Lap Flaring: ⅛" to ½" O.D., annealed ferrous or nonferrous tubing. Single Flaring: ⅛" to ¾" O.D., annealed ferrous or nonferrous tubing. Beading: 3/16" to ½" O.D., annealed ferrous or nonferrous tubing.
Operation	Single lever operated, entirely pneumatically powered.
Air Supply	75/100 psi, air supply required. Air consumption approximately 1½ cfm at 100 psig. No electrical connection.
Standard Tooling	For MS and SAE Flare Specifications.
Dimensions	Length, 28"—Width, 18"—Height, 42"
Shipping Weight	480 pounds

The Model DF is a high-production unit, allowing the production of up to 600 double flares per hour. The machine is operated by a single lever which activates the two steps required to form a double flare. No electricity is required. All operations are pneumatically powered.



Model DF

(aka DF-HD)

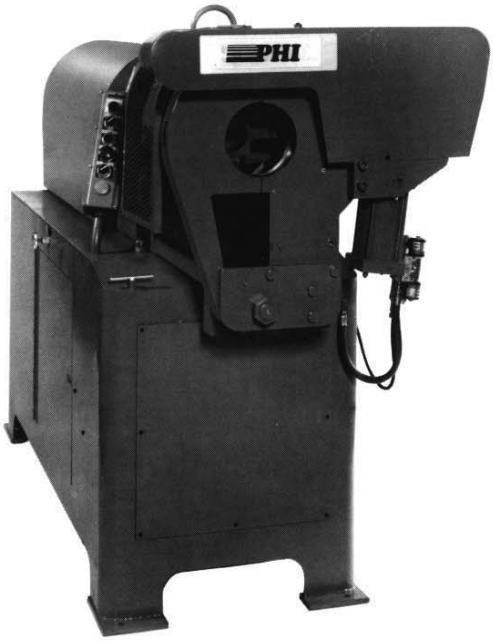
M343 & M369

Model M343 and M369 Flanging Machines cold-form pipe ends to a 90° flange. The machines are simple in design and simple to operate. Skilled labor is not needed to operate the machine, nor to bolt the flanges together—entirely eliminating the need for skilled labor in joining pipe sections.

M343	
Capacity	Pipe Schedules 5, 10 and 40 from ½" to 4" IPS. Schedule 80 from ½" to 2" IPS.
Power Drive & Control	5 HP, geared head motor with brake. Pneumatic operation, 3 cfm required.
Operation	Pipe is clamped in machine jaws and remains stationary while rotary spinner head forms flange.
Dimensions	Length, 60"—Width, 30"—Height, 58"
Shipping Weight	2200 pounds

M369	
Capacity	Pipe Schedules 5, 10 and 40 from 1½" to 8" IPS. Schedule 80 from 1½" to 4" IPS.
Power Drive & Control	15 HP, Self-contained hydraulic system.
Operation	Pipe is clamped in machine jaws and remains stationary while rotary spinner head forms flange.
Dimensions	Length, 102" Width, 44½" Height, 67¼"
Shipping Weight	4500 pounds

A complete tooling change can be performed in just minutes. Once the pipe is in place, the flange is formed in minutes. The whole operation—install tooling (if required), insert pipe, form the flange, remove the pipe—requires a maximum of 5 minutes. This compares favorably to the approximately 45 minutes required to weld a flange onto the pipe.



Model M343
½" to 4" IPS

TOOLING

PHI maintains a constant inventory of all popular sizes of tooling for end-finishing tubes and pipes to military and industry standards.

The company is also prepared to design and manufacture special tooling to the user's specifications. Consult the factory for costs and delivery schedules.

Standard tooling for PHI end-finishing machines is described on the following pages. Tools for Models 2C, 2CP, 2CPV, 3CPV, and 8CP are listed as a group, since a great deal of interchangeability can be achieved through the use of the adapters shown in the table below.

Complete tooling for each operation includes the following items:

Operation	Tooling Required
Flare	1 ea. flare die for each TOD. 1 ea. flare center for a range of TOD's. (In addition, a flare head may be required, and in some cases adapters are required.)
Square & Debur	1 ea. holding die for each TOD. 1 ea. squaring/deburring head for a range of TOD's. 1 ea. blades—set (inside, outside and squaring) or individual.
Bead	1 ea. bead die for each TOD. 1 ea. bead head for a range of TOD. 1 ea. bid tip, arbor or roller for each TOD and wall thickness combination.

STANDARD ADAPTORS FOR END-FINISHING MACHINE TOOLING

Die Adaptor No.	Machine	Adaption For	Bore Conversion Inches
107713	3CPV	B-C-2B-2C-CP-2CP-2CPV Dies*	4.5 to 3.0
108402-002	6CP	3CPV Dies	7.5 to 4.5
108402-001	6CP	B-C-2B-2C-CP-2CP-2CPV Dies*	7.5 to 3.0
108203	8CP	6CP Dies	10 to 7.5
108399	8CP	3CPV Dies	10 to 4.5

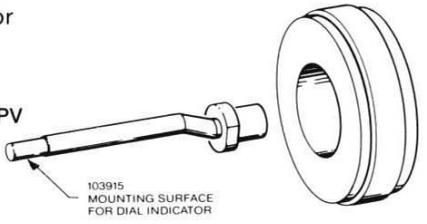
Spindle Adaptor No.	Machine	Adaption For
103645	3CPV	2C, 2CP, 2CPV Tooling
103647	3CPV	Heavy Duty Flare Centers
104454	6CP & 8CP	Accepts 3CPV Spindle Adaptors 103645 and 103647

*Models B, C, CP and 2B are obsolete machines

MASTER DIE AND ARBOR ~~SET~~

Solid, one-unit die and aligning arbor for checking jaw-spindle alignment

Die No.	Machine
101801-001	B-C-2B-2C-CP-2CP-2CPV
101801-002	3CP
101801-003	6CP
101801-005	8CP



Master Dies:

P/Ns as shown above for 2/3/6/8CX Machines

103837 (DF-70) For DF Machines

Master Arbors:

103915 (5M-30) For 2/3/6/8CX Machines

109105 (DF-75) For DF Machines

37° FLARING Models 2C, 2CP, 2CPV, 3CPV, 8CP

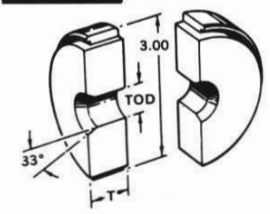
MEETS SPECIFICATIONS OF MS33584-37°

STANDARD FLARE DIES For soft material such as aluminum, brass, mild steel, etc.

30-3700 SERIES
(800000-XXX)

2C 2CP 2CPV

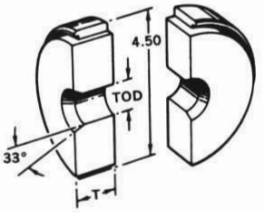
3CPV [1]



TOD-Inches	Part No.	T-Inches
1/8	800000-001	3/4
3/16	800000-002	3/4
1/4	800000-003	3/4
5/16	800000-004	3/4
3/8	800000-005	3/4
7/16	800000-006	3/4
1/2	800000-007	3/4
5/8	800000-008	3/4
3/4	800000-009	7/8
7/8	800000-010	7/8
1	800000-011	7/8
1-1/8	800000-012	1
1-1/4	800000-013	1
1-3/8	800000-014	1
1-1/2	800000-015	1
1-5/8	800000-016	1-1/4
1-3/4	800000-017	1-1/4
2	800000-018	1-1/4

45-3700 SERIES
(102195-XXX)

3CPV 8CP [2]



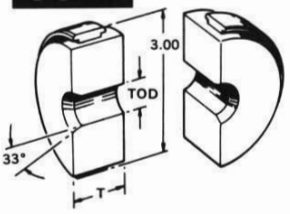
TOD-Inches	Part No.	T-Inches
1	102195-001	1-1/4
1-1/8	102195-002	1-1/4
1-1/4	102195-003	1-1/4
1-3/8	102195-004	1-1/4
1-1/2	102195-005	1-1/4
1-5/8	102195-006	1-1/4
1-3/4	102195-007	1-1/4
2	102195-008	1-1/4
2-1/4	102195-009	1-3/4
2-1/2	102195-010	1-3/4
2-3/4	102195-011	1-3/4
3	102195-012	1-3/4

HEAVY DUTY FLARE DIES For hard material such as stainless steel and titanium

30-3700HD SERIES
(800002-XXX)

2C 2CP 2CPV

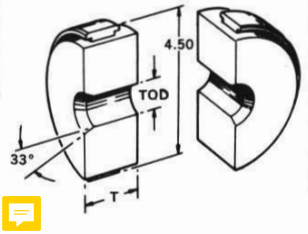
3CPV [1]



TOD-Inches	Part No.	T-Inches
1/4	800002-009	1-1/4
3/8	800002-001	1-1/4
7/16	800002-002	1-1/4
1/2	800002-003	1-3/4
5/8	800002-004	1-3/4
3/4	800002-005	2
7/8	800002-006	2
1	800002-007	2
1-1/8"	800002-015	3
1-1/4"	800002-011	3
1-3/8"	800002-016	3
1-1/2"	800002-014	3
1-5/8"	800002-017	3
1-3/4"	800002-018	3
2"	800002-019	3

45-3700HD SERIES
(102196-XXX)

3CPV 8CP [2]



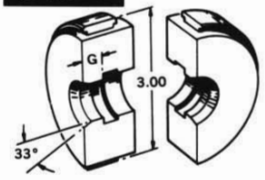
TOD-Inches	Part No.	T-Inches
7/8	102196-005	3
1	102196-002	3
1-1/8	102196-011	3
1-1/4	102196-006	3
1-3/8	102196-012	3
1-1/2	102196-003	3
1-5/8	102196-013	3
1-3/4	102196-014	3
2	102196-004	3
2-1/4	102196-009	3
2-1/2	102196-001	3
2-3/4	102196-010	3
3	102196-008	3

T-SLEEVE FLARE DIES For flaring when T-Sleeve is afixed

30-3700T SERIES
(800004-XXX)

2C 2CP 2CPV

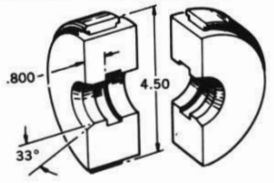
3CPV [1]



TOD-Inches	Part No.	T-Inches
1/8	800004-001	.335
3/16	800004-002	.350
1/4	800004-003	.340
5/16	800004-004	.340
3/8	800004-005	.340
7/16	800004-006	.340
1/2	800004-007	.375
5/8	800004-008	.375
3/4	800004-009	.405
7/8	800004-110	.405
1	800004-011	.405
1-1/8	800004-012	.428
1-1/4	800004-013	.450
1-3/8	800004-014	.440
1-1/2	800004-015	.425
1-3/4	800004-016	.675

45-3700T SERIES
(102197-XXX)

3CPV 8CP [2]



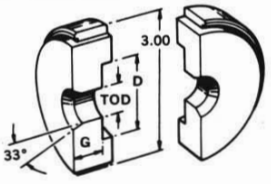
TOD-Inches	Part No.	T-Inches
2	102197-001	2.00
2-1/4	102197-002	2.06
2-1/2	102197-003	2.19
2-3/4	102197-004	2.19
3	102197-005	2.19

RECESSED FLARE DIES For tubes with short straight sections at the flare end

30-3700R SERIES
(109409-XXX)

2C 2CP 2CPV

3CPV [1]



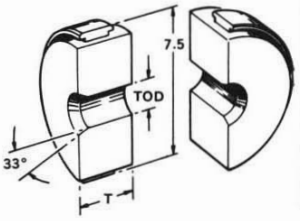
TOD-Inches	Part No.	G	D
1/8	109409-001	.475	1.00
3/16	109409-002	.475	1.00
1/4	109409-003	.475	1.00
5/16	109409-004	.475	1.00
3/8	109409-005	.475	1.00
7/16	109409-006	.475	1.00
1/2	109409-007	.475	1.00
5/8	109409-008	.475	1.00
3/4	109409-009	.525	1.50
7/8	109409-010	.525	1.50
1	109409-011	.525	1.50
1-1/8	109409-012	.525	2.00
1-1/4	109409-013	.575	2.00
1-3/8	109409-014	.575	2.00
1-1/2	109409-015	.575	2.00
1-5/8	109409-016	.575	2.00
1-3/4	109409-017	.750	2.00
2	109409-019	.750	2.00

1. For 3CPV use Die Adaptor 107713
2. For 8CP use Die Adaptor 108399

STANDARD FLARE DIES, LARGE DIAMETER For soft materials such as copper, aluminum, brass, mild steel, etc.

75-3700 SERIES
(800003-XXX)

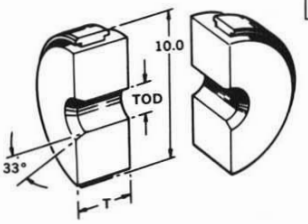
8CP



TOD-Inches	Part No.	T-Inches
2	800003-001	2.9
2-1/4	800003-002	2.9
2-1/2	800003-003	2.9
2-3/4	800003-004	2.9
3	800003-005	3.9
3-1/4	800003-006	3.9
3-1/2	800003-007	3.9
3-3/4	800003-008	3.9
4	800003-009	3.9
4-1/4	800003-010	3.9
4-1/2	800003-011	3.9
4-3/4	800003-012	3.9
5	800003-013	3.9
5-1/4	800003-014	3.9
5-1/2	800003-015	3.9
5-3/4	800003-016	3.9
6	800003-017	3.9

10-37100 SERIES
(800005-XXX)

8CP



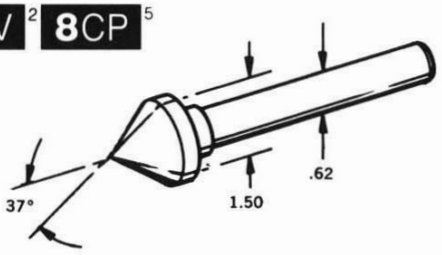
TOD-Inches	Part No.	T-Inches
6-1/4	800005-001	5.9
6-1/2	800005-002	5.9
6-3/4	800005-003	5.9
7	800005-004	5.9
7-1/2	800005-005	5.9
8	800005-006	5.9

STANDARD FLARE CENTERS For soft materials such as copper, aluminum, brass, mild steel, etc.

104995 TOD 1/8"-1 1/2" (FC 370)

2C **2CP** **2CPV**

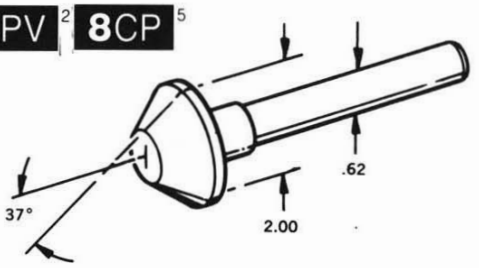
3CPV[2] **8CP**[5]



104972 TOD 1 5/8"-2" (FC 372)

2C **2CP** **2CPV**

3CPV[2] **8CP**[5]

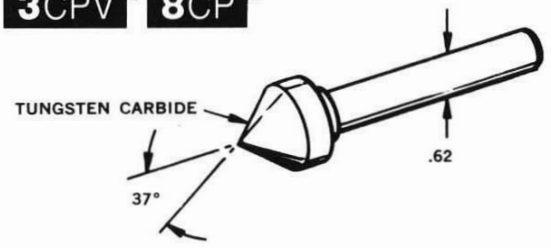


TUNGSTEN CARBIDE FLARE CENTER For thin wall hard materials such as stainless steel and titanium

104983 TOD 1/8"-1 1/2" (FC 3724TC)

2C **2CP** **2CPV**

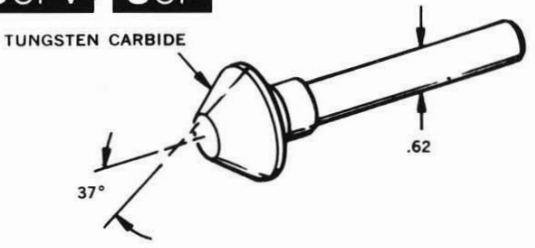
3CPV[2] **8CP**[5]



104992 TOD 1 5/8"-2" (FC 3732TC)

2C **2CP** **2CPV**

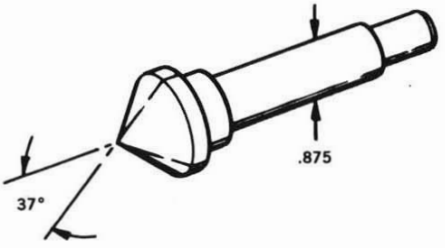
3CPV[2] **8CP**[5]



HEAVY DUTY TUNGSTEN CARBIDE FLARE CENTER For heavy wall hard materials such as stainless steel and titanium

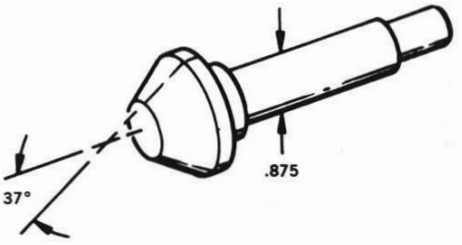
104985 TOD 1/8"-1 1/2" (FC 3724TCHD)

3CPV[3] **8CP**[4]



104987 TOD 1 5/8"-2" (FC 3732TCHD)

3CPV[2] **8CP**[4]



1. For 8CP use Die Adaptor 108203
2. For 3CPV use Spindle Adaptor 103645
3. For 3CPV use Spindle Adaptor ~~103645~~ 103647
4. For 8CP use Spindle Adaptor 104454
5. For 8CP use Spindle Adaptor 103645 & 104454

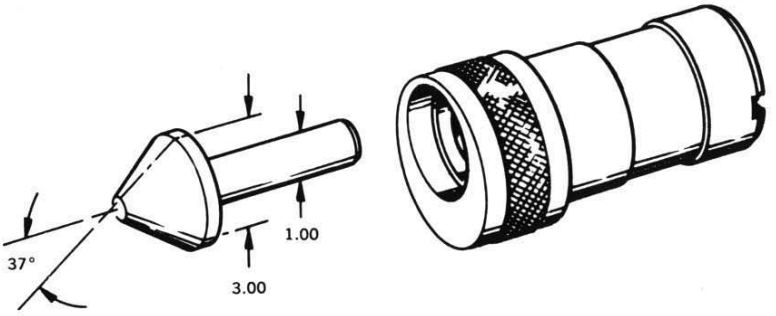
STANDARD FLARING CENTER & HEAD

For soft materials such as copper, aluminum, brass and mild steel

104999 flaring center and 105018 flaring center head (FC 373 & FCH 30)

TOD 1½"-3"

3CPV **8**CP[1]



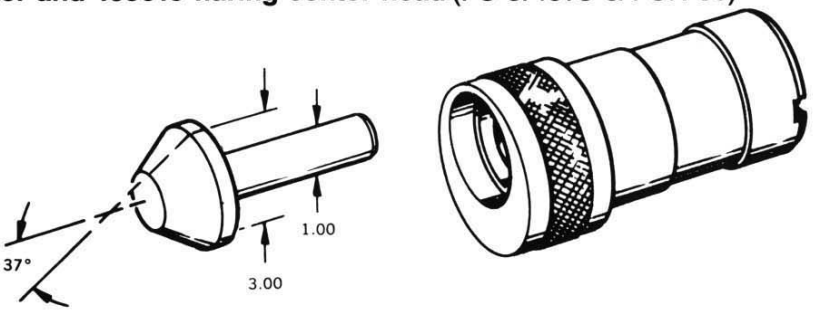
TUNGSTEN CARBIDE FLARING CENTER & HEAD

For hard material such as stainless steel and titanium

955381 flaring center and 105018 flaring center head (FC 3748TC & FCH 30)

TOD 1½"-3"

3CPV **8**CP[1]



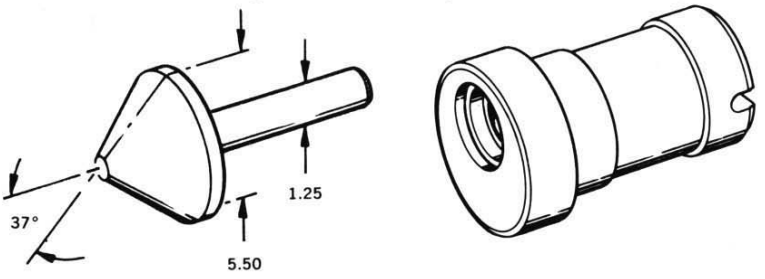
STANDARD FLARING CENTER & HEAD, MEDIUM DIAMETER

For soft materials such as copper, alumnum, brass and mild steel

104990 flaring center and 105338 flaring center head (FC 376 & FCH 60)

TOD 2½"-6"

8CP



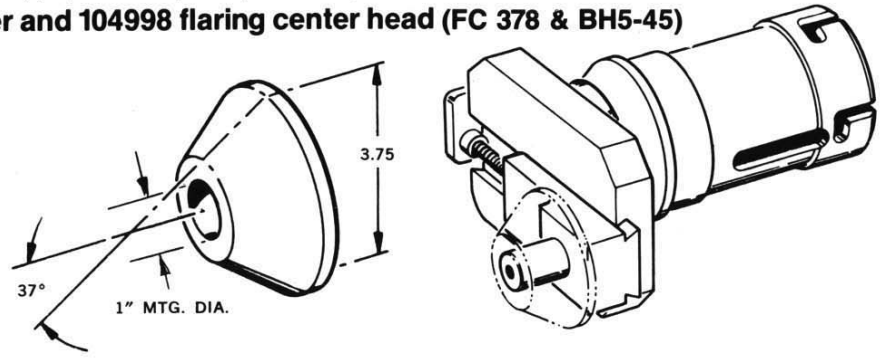
STANDARD FLARING CENTER & HEAD, LARGE DIAMETER

For soft materials such as copper, aluminum, brass, mild steel, etc.

104964 flaring center and 104998 flaring center head (FC 378 & BH5-45)

TOD 4"-8"

8CP



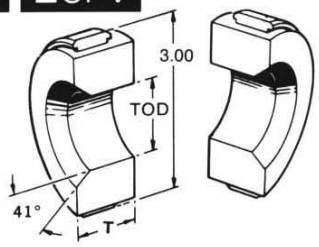
1. For 8CP use Spindle Adaptor 104454

STANDARD FLARE DIES

For soft material such as copper, aluminum, brass, mild steel, etc.

30-4500 SERIES
(800001-XXX)

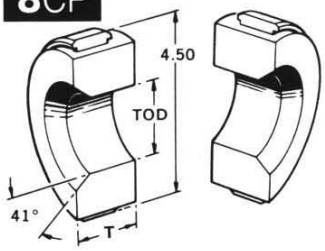
2C **2CP** **2CPV** **3CPV** [1]



TOD-Inches	Part No.	T-Inches
1/8	800001-001	3/4
3/16	800001-002	3/4
1/4	800001-003	3/4
5/16	800001-004	3/4
3/8	800001-005	3/4
7/6	800001-006	3/4
1/2	800001-007	3/4
5/8	800001-008	3/4
3/4	800001-009	7/8
7/8	800001-010	7/8
1	800001-011	7/8
1-1/8	800001-012	1
1-1/4	800001-013	1
1-3/8	800001-014	1
1-1/2	800001-015	1
1-5/8	800001-016	1-1/4
1-3/4	800001-017	1-1/4
2	800001-018	1-1/4

45-4500 SERIES
(102195-XXX)

3CPV **8CP** [2]



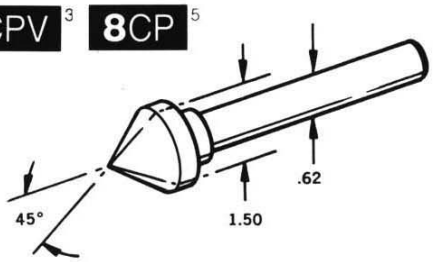
TOD-Inches	Part No.	T-Inches
1	102195-015	1-1/4
1-1/8	102195-016	1-1/4
1-1/4	102195-017	1-1/4
1-3/8	102195-018	1-1/4
1-1/2	102195-019	1-1/4
1-5/8	102195-020	1-1/4
1-3/4	102195-021	1-1/4
2	102195-022	1-1/4
2-1/4	102195-023	1-3/4
2-1/2	102195-024	1-3/4
2-3/4	102195-025	1-3/4
3	102195-026	1-3/4

STANDARD FLARE CENTERS

For soft material such as copper, aluminum, brass, mild steel, etc.

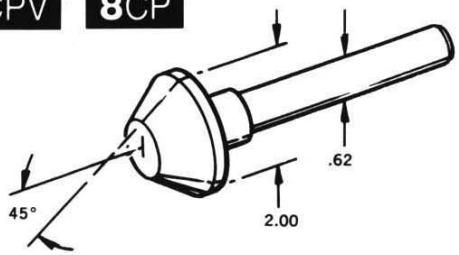
104979 TOD 1/8"-1 1/2" (FC 450)

2C **2CP** **2CPV** **3CPV** [3] **8CP** [5]



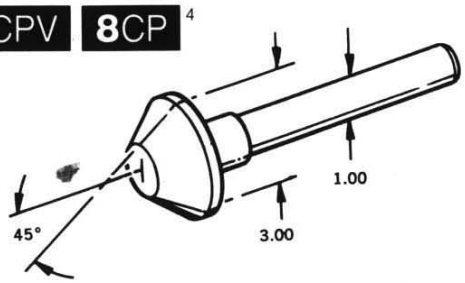
104568 TOD 1 1/2"-2"

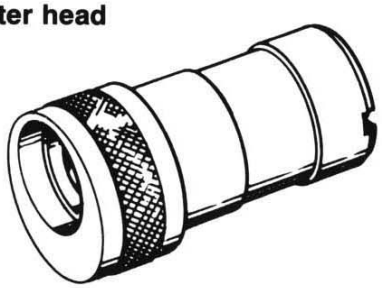
2C **2CP** **2CPV** **3CPV** [3] **8CP** [5]



955338 flare center and 105018 flare center head
TOD 1 1/2"-3" **(FC 453 & FCH 30)**

3CPV **8CP** [4]





1. For 3CPV use Die Adaptor 107713
2. For 8CP use Die Adaptor 108399
3. For 3CPV use Spindle Adaptor ~~103647~~ 103645
4. For 8CP use Spindle Adaptor 103645 & 104454
5. For 8CP use Spindle Adaptor 103645 & 104454

SQUARING / DEBURRING Models 2C, 2CP, 2CPV, 3CPV, 8CP

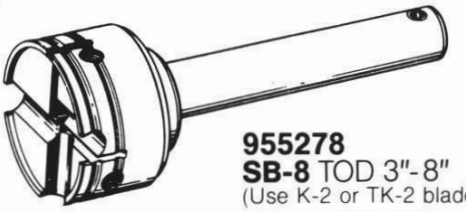
SQUARING & DEBURRING HEADS

105002 TOD ¼″-2″ (SB-1)
(Use K-1 or TK-1 blades.)

2C 2CP 2CPV 3CPV [1]

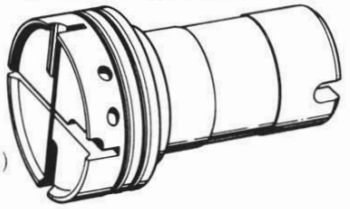
105003 TOD ⅝″-2″ (SB-2)
(Use K-2 or TK-2 blades.)

2C 2CP 2CPV 3CPV [2]



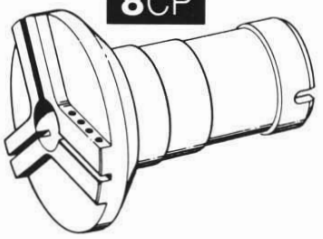
104930-1/16″ TOD 1¼″-3″ (SB-3)
(Use K-1 or TK-1 blades.)
107641 TOD 1¼″-3″ (SB-3)
(Use K-2 or TK-2 blades.)

3CPV 8CP [3]



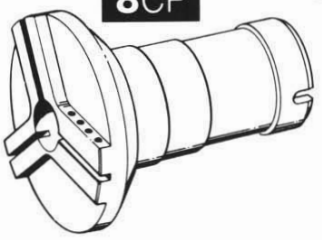
955300
SB-6 TOD 2¼″-6″
(Use K-2 or TK-2 blades.)

8CP



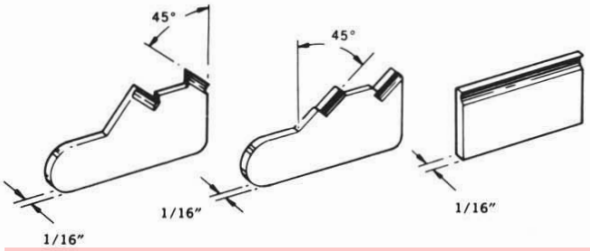
955278
SB-8 TOD 3″-8″
(Use K-2 or TK-2 blades.)

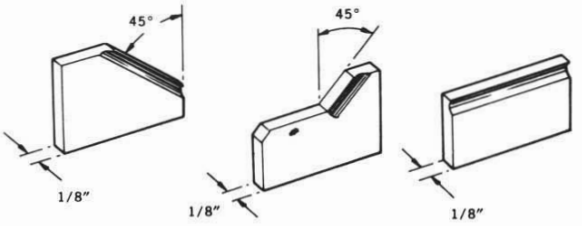
8CP



SQUARING & DEBURRING BLADES

Available in sets of 3 or individually. A set includes one outside, one inside and one squaring blade. Standard cutting angles are 45° and 37°. Other angles are available on special order.





K-1 High Speed Steel Blades 1/16″

Set 900020-45 or -37 ¼″ MIN. OD

Individual Outside Deburring Blade 900000-45 or -37
Inside Deburring Blade 900001-45 or -37
Squaring Blade 900002

K-2 High Speed Steel Blades ⅛″

Set 900022-45 or -37 ⅝″ MIN. OD

Individual Outside Deburring Bloade 900006-45 or -37
Inside Deburring Blade 900007-45 or -37
Squaring Blade 900008

TK-1 Cast Alloy Blades 1/16″

Set 900021-45 or -37 ¼″ MIN. OD

Individual Outside Deburring Blade 900003-45 or -37
Inside Deburring Blade 900004-45 or -37
Squaring Blade 900005

TK-2 Cast Alloy Blades ⅛″

Set 900023-45 or -37 ⅝″ MIN. OD

Individual Outside Deburring Blade 900009-45 or -37
Inside Deburring Blade 900010-45 or -37
Squaring Blade 900011

CK-1 Carbide Blades 1/16″

Set 900034-045 ¼″ MIN. OD

Individual Outside Deburring Blade 900031-045
Inside Deburring Blade 900032-045
Squaring Blade 900033

CK-1C Carbide TiN Coated*
1/16" 45°
Set 900040
Outside 900037-045
Inside 900038-045
Squaring 900039

CK-2 Carbide 1/8" 45°
Set 900077-045
Outside 900078-045
Inside 900079-045
Squaring 900080-045

CK-2 Carbide TiN Coated*
1/8" 45°
Set 900044-045
Outside 900041-045
Inside 900042-045
Squaring 900043-045

X

1. For 3CPV use Spindle Adaptor 103645
2. For 3CPV and 8CP use Spindle Adaptor 103645
3. For 8CP use Spindle Adaptor 104454

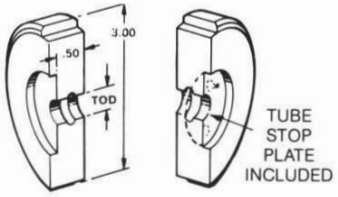
* TiN Coated = Titanium Nitride Coated for superior life and performance

BEADING DIES, HEAD and TIPS

2100 Series Beading Dies

2C **2CP** **2CPV** **3CPV** [1]

TOD-Inches	Part No.
1/4	202104
5/16	202105
3/8	202106

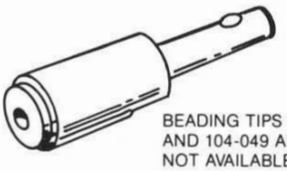


100 Series Beading Tips

2C **2CP** **2CPV** **3CPV**

TOD-Inches	TIP No.
1/4	104
5/16	105
3/8	106

NOTE:
Add to the tip no. the tube wall thickness in thousandths, i.e. 104-028.



BEADING TIPS 104-042 AND 104-049 ARE NOT AVAILABLE

104863 Beading Head TOD ¼"-⅜" (BH-1)

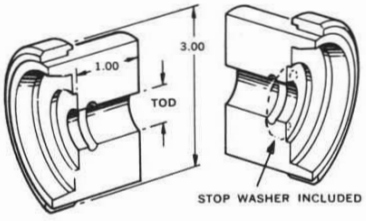
2C **2CP** **2CPV** **3CPV** [2]

BEADING DIES HEADS and ARBORS

2200 Series Beading Dies

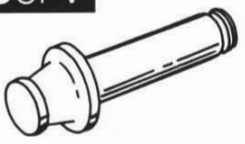
2C **2CP** **2CPV** **3CPV** [1]

TOD-Inches	Part No.
7/16	202107
1/2	202108
5/8	202110
3/4	202112
7/8	202114
1	202116
1-1/8	202118
1-1/4	202120
1-3/8	202122
1-1/2	202124



200 Series Beading Arbor

2C **2CP** **2CPV** **3CPV**



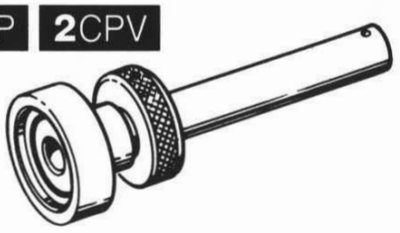
TOD-Inches	Arbor No.
7/16	207
1/2	208
5/8	210
3/4	212
7/8	214
1	216
1-1/8	218
1-1/4	220
1-3/8	222
1-1/2	224

NOTE:
Add to the arbor no. the tube wall thickness in thousandths, i.e. 207-028.

All 200 Series Arbors use retainer ring P.N. 109294.

102679 Beading Head (BH-2)

2C **2CP** **2CPV** **3CPV** [2]



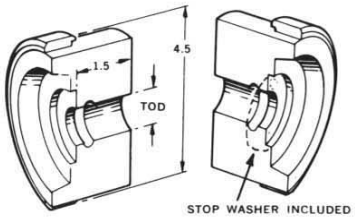
1. For 3CPV use Die Adaptor 107713
2. For 3CPV use Spindle Adaptor 103645

BEADING DIES, HEADS and ARBORS

3300 Series Beading Dies TOD 5/8"-1 1/2" (109429-XXX)

3CPV

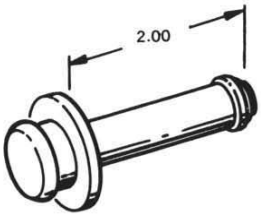
TOD-Inches	Part No.
5/8	109429-008
3/4	109429-001
7/8	109429-002
1	109429-003
1-1/8	109429-004
1-1/4	109429-005
1-3/8	109429-006
1-1/2	109429-007



300 Series Beading Arbor

3CPV

TOD-Inches	Arbor No.
5/8	310
3/4	312
7/8	314
1	316
1-1/8	318
1-1/4	320
1-3/8	322
1-1/2	324

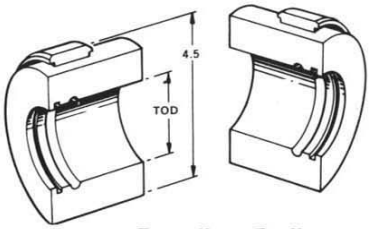


NOTE:
Add to the arbor no. the tube wall thickness in thousandths, i.e. 310-028

3400 Series Beading Dies TOD 1 5/8"-3" (109430-XXX)

3CPV

TOD-Inches	Part No.
1-5/8	109430-001
1-3/4	109430-002
2	109430-004
2-1/4	109430-005
2-1/2	109430-007
2-3/4	109430-008
3	109430-009



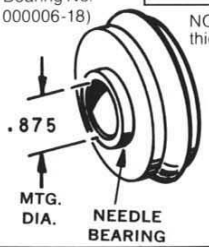
400 Series Beading Roller (109435-XXX)

3CPV

TOD-Inches	Roller No.
1-5/8	426
1-3/4	428
2	432
2-1/4	436
2-1/2	440
2-3/4	444
3	448

(Includes Bearing No. 000006-18)

NOTE: Add to the roller no. the tube wall thickness in thousandths, i.e. 426-028

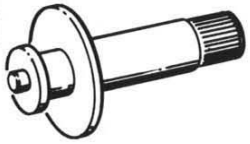


108393 Arbor Adaptor TOD 5/8"-1 1/2" (BHA-30)

3CPV

108392 Roller Adaptor TOD 1 5/8"-3" (BHA-35)

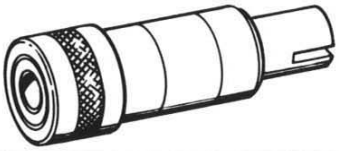
3CPV



955339 Beading Head TOD 5/8"-3" (BH-3)

These three pieces make up **104860** Bead Head Assembly.

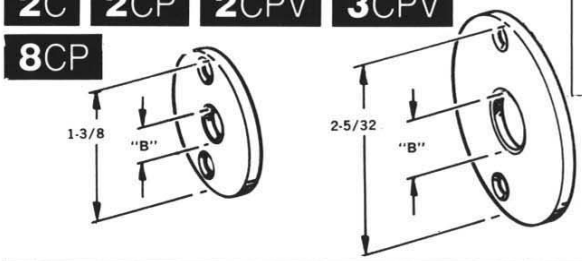
3CPV



TUBE STOP PLATES

2100 & 2200 Series (109327-XXX)

2C **2CP** **2CPV** **3CPV** **8CP**



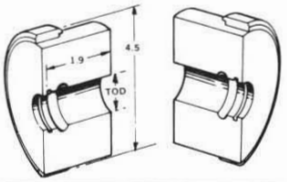
TOD-Inches	Part No.	B-Inches
1/4	109327-001	7/32
5/16	109327-002	17/64
3/8	109327-003	21/64
7/16	109327-004	25/64
1/2	109327-005	29/64
5/8	109327-006	37/64
3/4	109327-008	45/64

TOD-Inches	Part No.	B-Inches
7/8	109327-009	53/64
1	109327-010	61/64
1-1/8	109327-011	1-5/64
1-1/4	109327-012	1-13/64
1-3/8	109327-013	1-21/64
1-1/2	109327-014	1-29/64

BEADING DIES, HEADS and ROLLERS

TOD 1¼"-1¾" **8CP**[1]

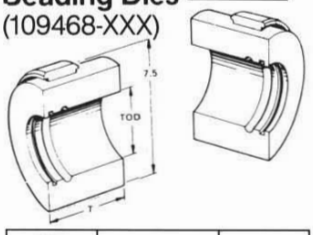
3500 Series
(109467-XXX)



TOD-Inches	Part No.
1-1/4	109467-020
1-3/8	109467-022
1-1/2	109467-024
1-5/8	109467-026
1-3/4	109467-028

NOTE: Add to the roller no. the tube wall thickness in thousandths, i.e. 520-028.

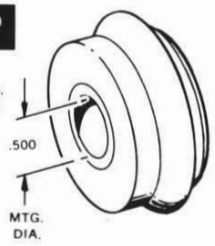
5500 Series Beading Dies
8CP[2]
(109468-XXX)



TOD Inches	Die No.	T-Inches
1-1/4	109468-020	2
1-1/2	109468-024	2
1-3/4	109468-028	2

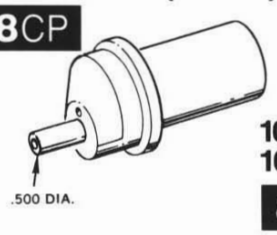
500 Series Roller
8CP

Includes bearing no. 000006-19



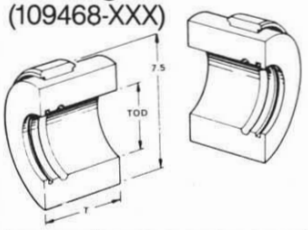
TOD-Inches	Roller No.
1-1/4	520
1-3/8	522
1-1/2	524
1-5/8	526
1-3/4	528

104838 Roller Adaptor
TOD 1¼"-1¾" **(BH5-20)**
8CP



TOD 2"-6" **8CP**[2]

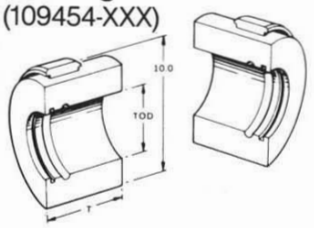
5600 Series Beading Dies
(109468-XXX)



TOD Inches	Die No.	T-Inches
2	109468-032	3.4
2-1/4	109468-036	3.4
2-1/2	109468-040	3.4
2-3/4	109468-044	3.4
3	109468-048	3.4
3-1/4	109468-052	3.9
3-1/2	109468-056	3.9
3-3/4	109468-060	3.9
4	109468-064	3.9
4-1/2	109468-072	3.9
5	109468-080	3.9
5-1/2	109468-088	3.9
6	109468-096	3.9

TOD 2"-6" **8CP**

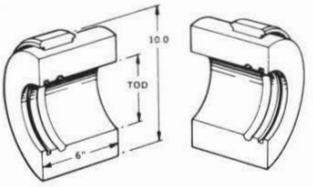
8600 Series Beading Dies
(109454-XXX)



TOD Inches	Die No.	T-Inches
2	109454-001	3.4
2-1/4	109454-002	3.4
2-1/2	109454-003	3.4
2-3/4	109454-004	3.4
3	109454-005	3.4
3-1/4	109454-006	3.9
3-1/2	109454-007	3.9
3-3/4	109454-008	3.9
4	109454-009	3.9
4-1/2	109454-010	3.9
5	109454-011	3.9
5-1/2	109454-012	3.9
6	109454-013	3.9

TOD 6¼"-8" **8CP**

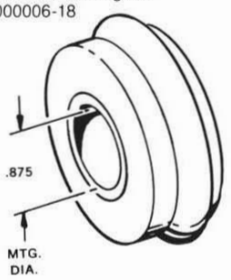
88100 Series Beading Dies



TOD-Inches	Die No.
6-1/4	88100
6-1/2	88104
6-3/4	88108
7	88112
7-1/4	88116
7-1/2	88120
7-3/4	88124
8	88128

600 Series Roller
8CP

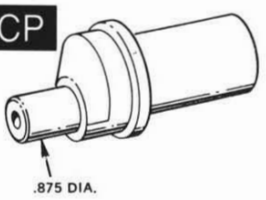
Includes bearing no. 000006-18



TOD-Inches	Roller No.
2	632
2-1/4	636
2-1/2	640
2-3/4	644
3	648
3-1/4	652
3-1/2	656
3-3/4	660
4	664
4-1/2	672
5	680
5-1/2	688
6	696

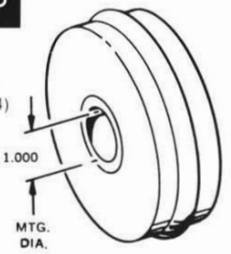
NOTE:
Add to the roller no. the tube wall thickness in thousandths, i.e. 632-028.

104842 Roller Adaptor (BH5-25)
TOD 2"-6"
8CP



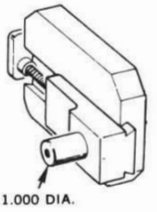
800 Beading Roller
8CP

(Includes bearings 000006-4 000006-14)

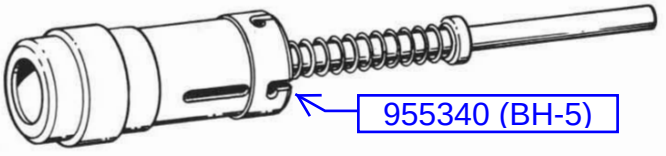


NOTE:
One #800 beading roller required for each tube wall thickness.
i.e. 800-028. 800-035 etc.

104998 Roller Adaptor (BH5-45)
TOD 6¼"-8"
8CP



104856 Beading Head Set (includes roller adaptors 104838 and 104842
104862 Beading Head Set (includes roller adaptors 104838, 104842 and BH5-45)
8CP



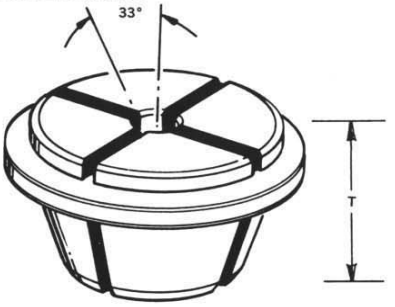
1. For 8CP use Die Adaptor 108399
2. For 8CP use Die Adaptor 104355

DOUBLE-FLARE TOOLING

MEETS SPECIFICATIONS OF
MS33583, MS33584 AND SAE

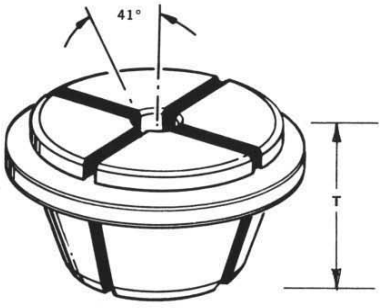
DOUBLE-FLARE DIES 37° (MS33583, MS33584) 101612 Series

Nominal TOD-Inches	Part No.	T-Inches
1/8	101612-001	2*
3/16	101612-002	2*
1/4	101612-003	2
5/16	101612-004	2
3/8	101612-005	2
7/16	101612-006	2-1/2
1/2	101612-007	2-1/2
5/8	101612-008	2-1/2 (Single Flare Only)
3/4	101612-009	2-1/2 (Single Flare Only)



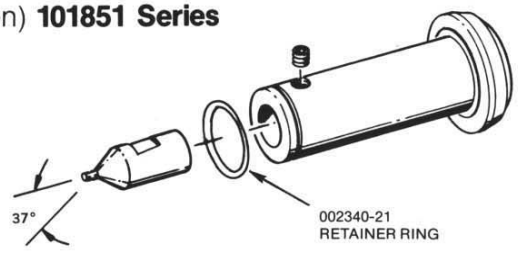
DOUBLE-FLARE DIES 45° (SAE) 101612 Series

Nominal TOD-Inches	Part No.	T-Inches
1/8	101612-010	2*
3/16	101612-011	2*
1/4	101612-012	2
5/16	101612-013	2
3/8	101612-014	2
7/16	101612-015	2-1/2
1/2	101612-016	2-1/2
5/8	101612-018	2-1/2 (Single Flare Only)
3/4	101612-019	2-1/2 (Single Flare Only)



FLARE PUNCH 37° TOD ⅛" (second operation) 101851 Series

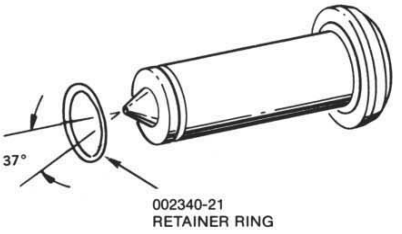
Complete Punch Assembly
237-28 for ⅛" OD x .028 WT
237-35 for ⅛" OD x .035 WT



FLARE PUNCH 37° TOD 3/16"-¾" (second operation) 101553 Series

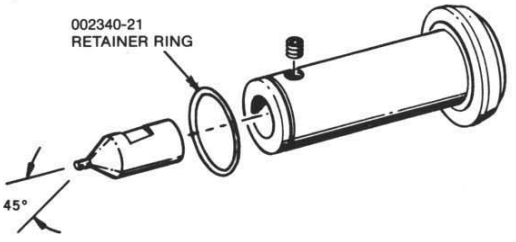
TOD Inches	Part No.	TOD Inches	Part No.
3/16	101553-001	7/16	101553-009
1/4	101553-003	1/2	101553-011
5/16	101553-005	5/8	105148-1037†
3/8	101553-007	3/4	105148-1237†

†Includes 101432 Ring



FLARE PUNCH 45° TOD ⅛" (second operation) 105148 Series

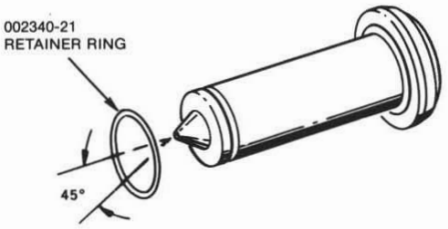
Complete Punch Assembly
245-28 for ⅛" OD x .028 WT
245-35 for ⅛" OD x .035 WT



* Grip Length 1 inch

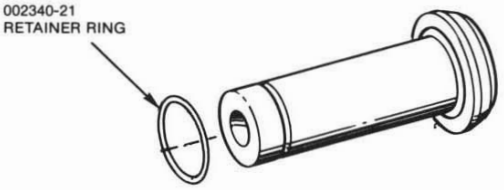
FLARE PUNCH 45° 101553 Series

TOD Inches	Part No.	TOD Inches	Part No.
3/16	101553-002	7/16	101553-010
1/4	101553-004	1/2	101553-012
5/16	101553-006	5/8	105148-1045
3/8	101553-008	3/4	105148-1245



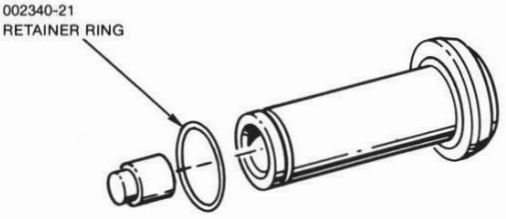
THIN-WALL UPSET PUNCH 101778 Series

TOD Inches	Part No.	Wall Thickness Inches
3/16	101778-300	.022 or less
1/4	101778-400	.022 or less
5/16	101778-500	.022 or less
3/8	101778-600	.022 or less



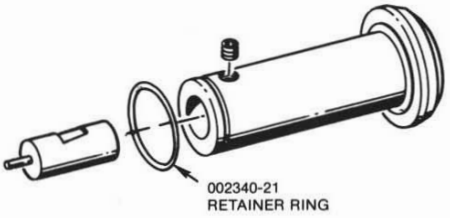
UPSET BEADING PUNCH 101854 Series

TOD Inches	Punch No.	.028	.035	.042	.049
3/16	366	-28	-35	-42	-49
1/4	466	-28	-35	-42	-49
5/16	566	-28	-35	-42	-49
3/8	666	-28	-35	-42	-49
7/16	766	-28	-35	-42	-49
1/2	866	-28	-35	-42	-49



UPSET PUNCH TOD ⅛" (first operation) 101857 Series

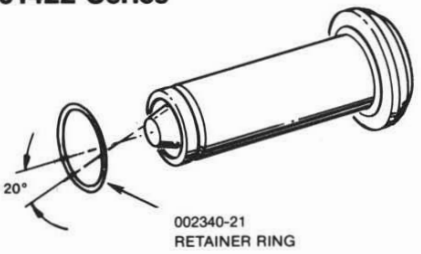
Complete Punch Assembly
220-28 for ⅛" OD x .028 WT
220-35 for ⅛" OD x .035 WT



UPSET PUNCH TOD 3/16"-½" (first operation) 101422 Series

TOD Inches	Punch No.	.028	.035	.042	.049
3/16	320	-28	-35	-42	-49
1/4	420	-28	-35	-42	-49
5/16	520	-28	-35	-42	-49
3/8	620	-28	-35	-42	-49
7/16	720	-28	-35	-42	-49
1/2	820	-28	-35	-42	-49
5/8	1020	-28	-35	-42	-49
3/4	1220	-28	-35	-42	-49

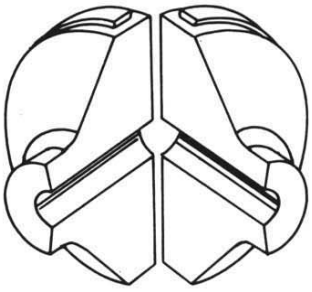
†Includes 101432 Ring



FLANGE TOOLING FOR M343

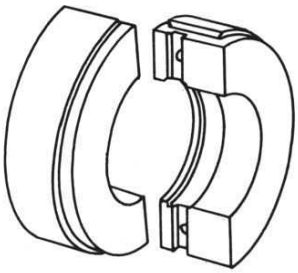
Capacity			Flange Die	Die Adaptor	Mandrel	Expanding Plug	Installation Tool
IPS	Inches	Schedule					
1/2	(.840)	5	510-1310	343-499	339	—	—
1/2	(.840)	10	510-1310	343-499	339	—	—
1/2	(.840)	40	510-1340	343-499	339	—	—
1/2	(.812)*	40	511-1340	343-499	339	—	—
1/2	(.840)	80	510-1380	343-499	339	—	—
1/2	(.812)*	80	511-1380	343-499	339	—	—
3/4	(1.050)	5	510-1710	343-499	339	700-090	343-730
3/4	(1.050)	10	510-1710	343-499	339	700-090	343-730
3/4	(1.050)	40	510-1740	343-499	339	—	—
3/4	(1.062)*	40	511-1740	343-499	339	—	—
3/4	(1.050)	80	510-1780	343-499	339	—	—
3/4	(1.062)*	80	511-1780	343-499	339	—	—
1	(1.315)	5	510-2110	343-499	339	700-116	343-730
1	(1.315)	10	510-2110	343-499	339	700-108	343-730
1	(1.315)	40	510-2140	343-499	339	—	—
1	(1.315)	80	510-2180	343-499	339	—	—
1	(1.312)*	80	511-2180	343-499	339	—	—
1-1/2	(1.900)	5	510-3010	343-499	339	710-175	343-745
1-1/2	(1.900)	10	510-3010	343-499	339	710-167	343-745
1-1/2	(1.900)	40	510-3040	343-499	339	—	—
1-1/2	(1.875)*	40	511-3040	343-499	339	—	—
1-1/2	(1.900)	80	510-3080	343-499	339	—	—
1-1/2	(1.875)*	80	511-3080	343-499	339	—	—
2	(2.375)	5	510-3810	343-499	339	715-223	343-750
2	(2.375)	10	510-3810	343-499	339	715-215	343-750
2	(2.375)	40	510-3840	343-499	339	—	—
2	(2.375)	80	510-3880	343-499	339	—	—
2-1/2	(2.875)	5	520-4610	—	329	715-271	343-750
2-1/2	(2.875)	10	520-4610	—	329	715-263	343-750
2-1/2	(2.875)	40	520-4640	—	329	—	—
3	(3.500)	5	520-5610	—	329	720-336	343-755
3	(3.500)	10	520-5610	—	329	720-324	343-755
3	(3.500)	40	520-5640	—	329	—	—
3-1/2	(4.00)	5	520-6410	—	329	720-386	343-755
3-1/2	(4.00)	10	520-6410	—	329	720-376	343-755
3-1/2	(4.00)	40	520-6440	—	329	—	—
4	(4.50)	5	520-7210	—	329	720-436	343-755
4	(4.50)	10	520-7210	—	329	720-426	343-755
4	(4.50)	40	520-7240	—	329	—	—

*Use with material type A587 ERW.



FLANGING DIE

EXPANDING PLUG AND INSTALLATION TOOL

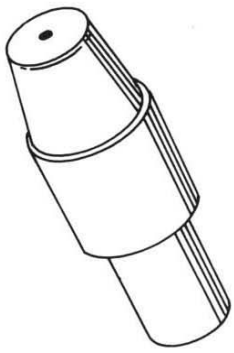


DIE ADAPTOR

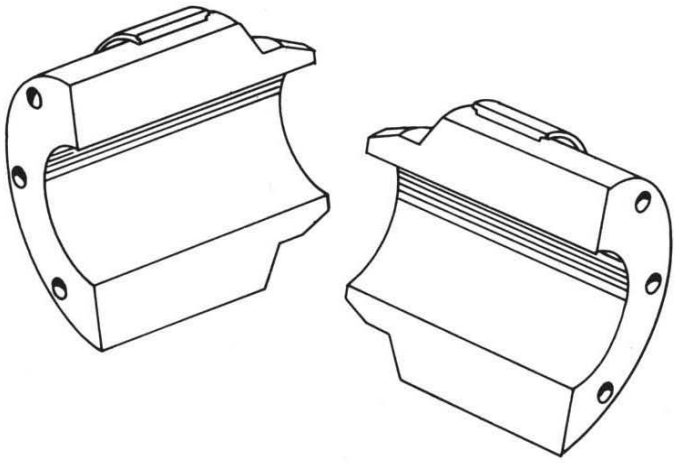
FLANGE TOOLING FOR M369

Capacity			Flange Die	Die Adaptor	Mandrel	Expanding Plug	Installation Tool
IPS	Inches	Schedule					
1-1/2	(1.90)	5	510-3010	343-499	354	710-175	343-745
1-1/2	(1.90)	10	510-3010	&	354	710-167	343-745
1-1/2	(1.90)	40	510-3040	369-502	354	—	—
1-1/2	(1.875)*	40	511-3040	each	354	—	—
1-1/2	(1.90)	80	510-3080	size to	354	—	—
1-1/2	(1.875)*	80	511-3080	2"	354	—	—
2	(2.375)	5	510-3810	343-499	354	715-223	343-750
2	(2.375)	10	510-3810	& 369-502	354	715-215	343-750
2	(2.375)	40	510-3840	each size	354	—	—
2	(2.375)	80	510-3880	to 2"	354	—	—
2-1/2	(2.875)	5	520-4610	369-502	354	715-271	343-750
2-1/2	(2.875)	10	520-4610	369-502	354	715-263	343-750
2-1/2	(2.875)	40	520-4640	369-502	354	—	—
2-1/2	(2.875)	80	520-4680	369-502	354	—	—
3	(3.500)	5	520-5610	369-502	354	720-336	343-755
3	(3.500)	10	520-5610	369-502	354	720-324	343-755
3	(3.500)	40	520-5640	369-502	344	—	—
3	(3.500)	80	520-5680	369-502	344	—	—
3-1/2	(4.0)	5	520-6410	369-502	344	720-386	343-755
3-1/2	(4.0)	10	520-6410	369-502	344	720-376	343-755
3-1/2	(4.0)	40	520-6440	369-502	344	—	—
3-1/2	(4.0)	80	520-6480	369-502	344	—	—
4	(4.5)	5	520-7210	369-502	344	720-436	343-755
4	(4.5)	10	520-7210	369-502	344	720-426	343-755
4	(4.5)	40	520-7240	369-502	344	—	—
4	(4.5)	80	520-7280	369-502	344	—	—
5	(5.562)	5	540-8910	—	344	700-532	369-720
5	(5.562)	10	540-8910	—	344	700-532	369-720
5	(5.562)	40	540-8940	—	344	—	—
6	(6.625)	5	540-10610	—	344	700-640	369-720
6	(6.625)	10	540-10610	—	344	700-640	369-720
6	(6.625)	40	540-10640	—	344	—	—
8	(8.625)	5	540-13810	—	344	700-838	369-730
8	(8.625)	10	540-13810	—	344	700-838	369-730
8	(8.625)	40	540-13840	—	344	—	—

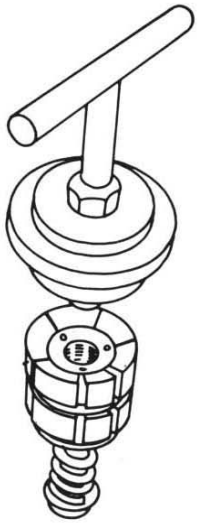
* Use with material type A587 ERW.



FLANGING MANDREL



FLANGING DIES



INTERNAL EXPANDING PLUG AND INSTALLATION TOOL

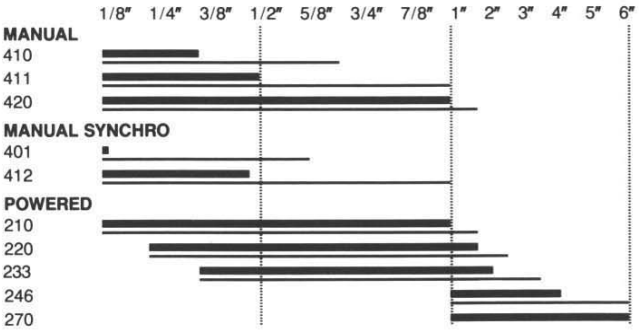
OPTIONAL SERRATED FLANGING MANDRELS ARE AVAILABLE. P.N. 369558 (3" THRU 8") AND P.N. 369559 (1.5" THRU 4").

TUBE AND PIPE BENDING MACHINES

In addition to end-finishing machinery, PHI offers the industry's most complete line of tube and pipe draw-bending machines. They are powered manually or hydraulically with computer, 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 4 inch IPS.

BENDING MACHINE CAPACITIES

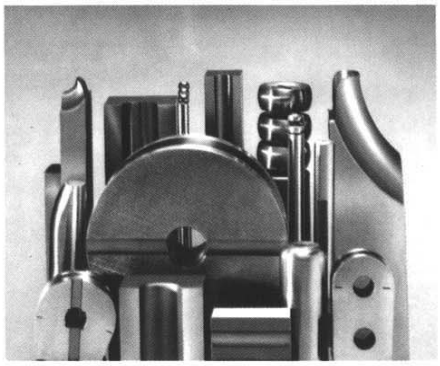


NOTE: Schedule of pipe, wall thickness of tubing, material elongation and center line radius of the bend may cause variances in the above chart.

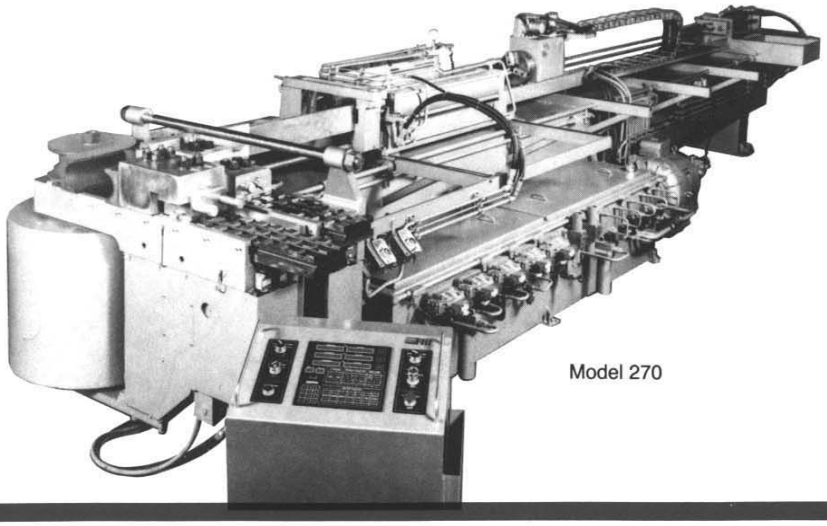
▬ PIPE
— TUBE

Model 410

Model 210



Tooling. PHI is now a full-time supplier of bender tooling for not only PHI benders, but also for any other bender you might have. Let us give you a quotation.



Model 270

(Formerly Conrac)

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Website: http://www.phihydraulics.com