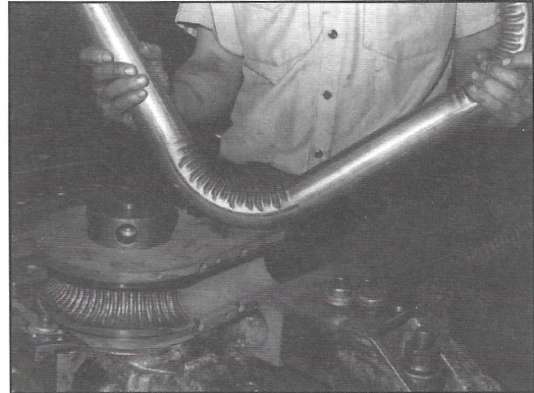
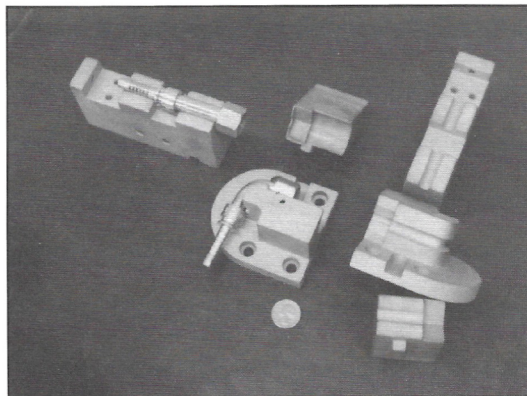


Empty-Bending for boiler tube 2.125 O.D. x .180 wall on 2.250 C.L.R. Note in-line pressure die advance cylinder reverse interlock.



Educated or controlled wrinkle set of tooling with Empty-Bending tube groove serrated grip section and reverse interlocking in Empty-Bending section.



Empty-Bending tool sets for one-piece fittings on conventional bender.



CAUTION

GENERIC TOOL HOUSES AND GARAGES HAVE ATTEMPTED TO FURNISH LOOK-ALIKE EMPTY-BENDING® TOOLS... WITH DISASTROUS RESULTS. ALWAYS DEMAND THE PATENTED EMPTY-BENDING® TOOLING MADE ONLY BY TOOLS FOR BENDING, INC.

CAUTION

TFB Empty-Bending® (Patent No. 4765168)

After years of research, TFB developed and patented a tube/pipe bending system that:

- requires fewer tools (only bend die, pressure & clamp, see Figure 6-1)
- lowers tooling costs
- improves production
- produces high quality bends
- has faster setup time
- needs no lubrication (or removal of lube)
- less wall thinning

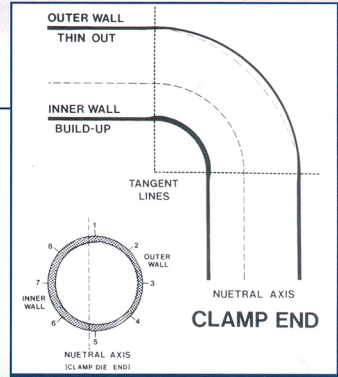


Figure 6-2. Cross-section illustration of bent tube, showing compression of inner wall and stretching of outer wall.

By eliminating the cost of a mandrel and wiper die, Empty-Bending® not only reduces initial startup costs, but also provides ongoing production savings, quicker setups, drop-on-tooling, and no internal tube scratches.

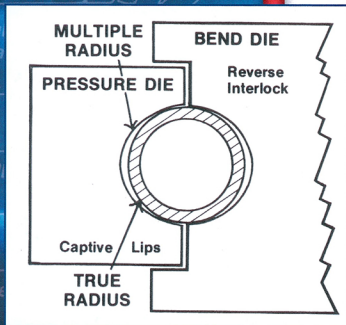


Figure 6-1. Empty-Bending® Dies

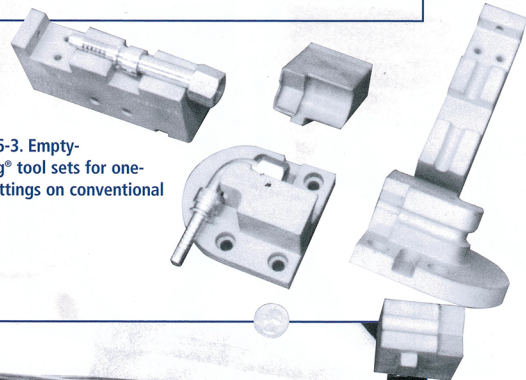


Figure 6-3. Empty-Bending® tool sets for one-piece fittings on conventional bender.

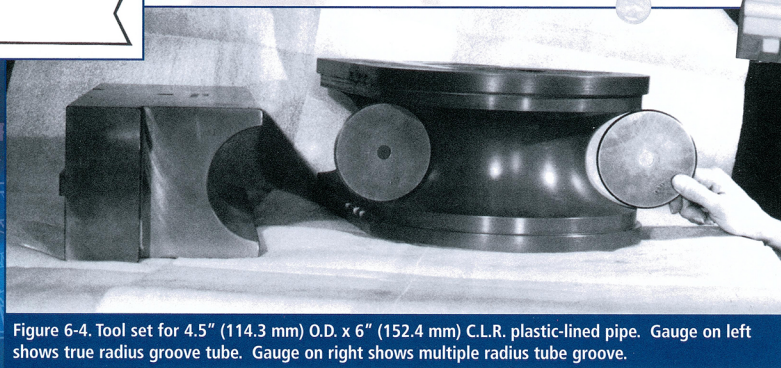


Figure 6-4. Tool set for 4.5" (114.3 mm) O.D. x 6" (152.4 mm) C.L.R. plastic-lined pipe. Gauge on left shows true radius groove tube. Gauge on right shows multiple radius tube groove.

EMPTY-BENDING® APPLICATIONS

$(O.D. \div \text{Wall} = \text{Wall Factor}) \div (\text{Center Line Radius} \div \text{Tube O.D.}) = \text{Empty-Bending Factor}$

INDUSTRY	O.D.	x Wall	x C.L.R.	Material	E-B Factor	Collapse Percent	Thin-out Percent
AIRCRAFT	.250	.020	.750	321-S.S. 3AL-2.5 Ti.	4.2	.8 to 1.5%	6%
	.250	.028	.750	6061-T6	3.0	2.5%	6%
	.375	.019	1.125	3AL-2.5 Ti. 321-S.S.	6.6	1.5%	8%
	.375	.020	1.125	21-6-9 S.S.	6.3	2.5%	8%
	.500	.028	1.50	321-S.S.	6.0	3.0%	8%
	.500	.035	1.50	6061-T6	4.8	2.5%	8%
	.625	.032	1.875	321-S.S.	6.5	2.7%	8%
	.625	.035	1.875	6061-T6	6.0	1.5%	8%
AIR	.375	.034	.750	COPPER	5.5	2.5%	7%
CONDITIONING & REFRIGERATION	.500	.028	.750	COPPER	11.9	3.0%	10%
	.500	.045	.750	COPPER	7.4	2.5%	10%
	.625	.035	1.125	COPPER	9.7	4.0%	10%
AUTOMOTIVE	.312	.028	.472	MILD STEEL	7.4	3.0%	9%
	.375	.028	.551	MILD STEEL	8.9	3.8%	10%
	.500	.035	.750	MILD STEEL	9.5	4.2%	11%
	.750	.049	1.500	MILD STEEL	10.0	4.1%	12%
BOILER TUBE	2.00	.227	2.0	321-S.S.	8.8	7.0%	13.5%
	2.00	.160	2.5	STEEL	12.0	7.0%	12.0%
	2.00	.110	3.0	STEEL	12.0	8.0%	11.0%
	2.125	.180	2.25	STEEL	10.7	11.5%	13.3%

