NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, WEST VIRGINIA

ELECTRONICS DIVISION TECHNICAL NOTE NO. 187

TITLE: Single-Step Right-Angle E-Plane Bend Geometry

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DATE: December 7, 1995

Simple Split-Block 90° E-Plane Bends for Low Power Applications

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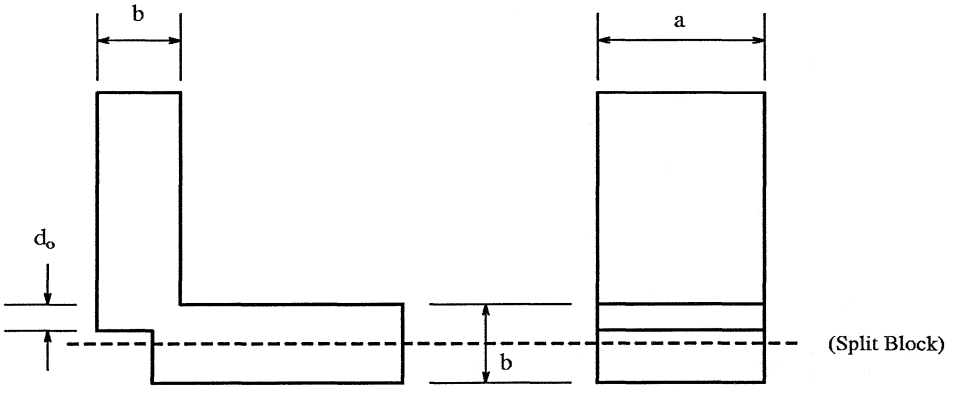

Figure 1. Single-Step Right-Angle E-Plane Bend Geometry.

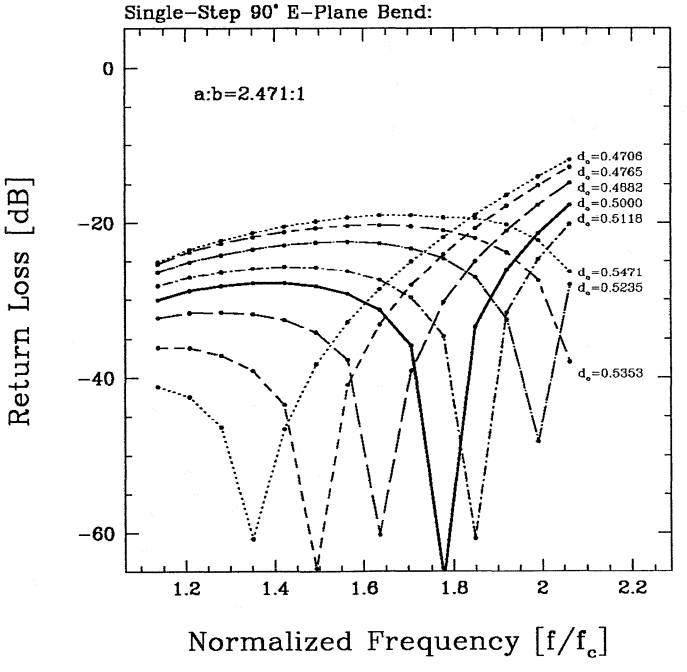

Figure 2. Modeled Single-Step Right-Angle E-Plane Bend Return Loss.

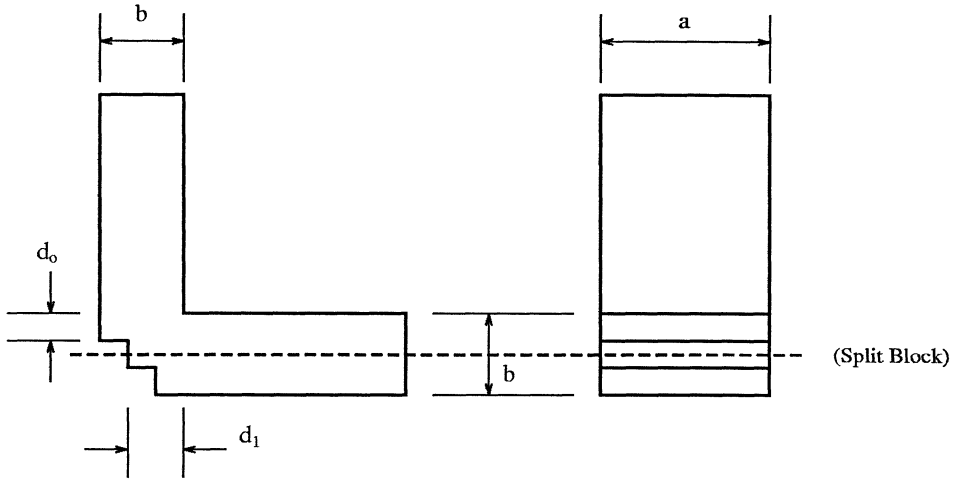

Figure 3. Two-Step Right-Angle E-Plane Bend Geometry.

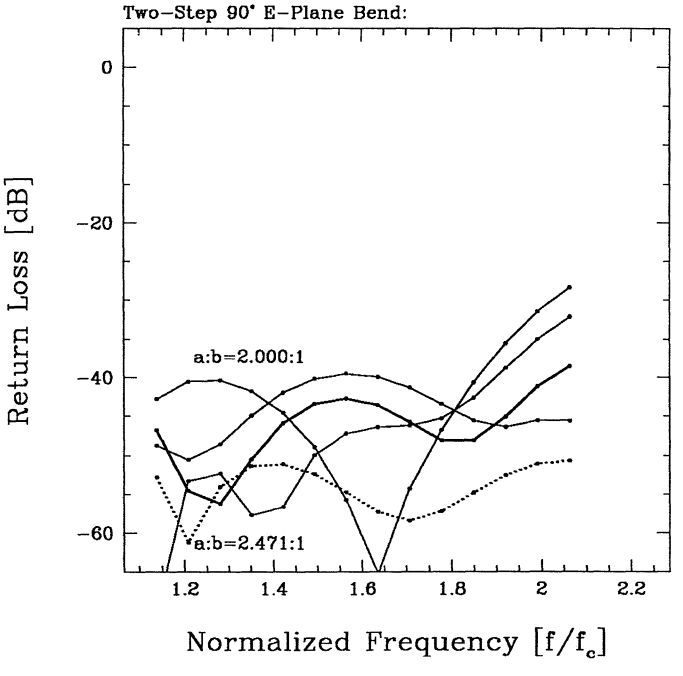

Figure 4. Modeled Two-Step Right-Angle E-Plane Bend Return Loss. For 2.0:1 guide, return loss curves representative of the tolerance range given in Table 1 are show. For 2.5:1 aspect ratio guide, the nominal design is designated by a dashed line.

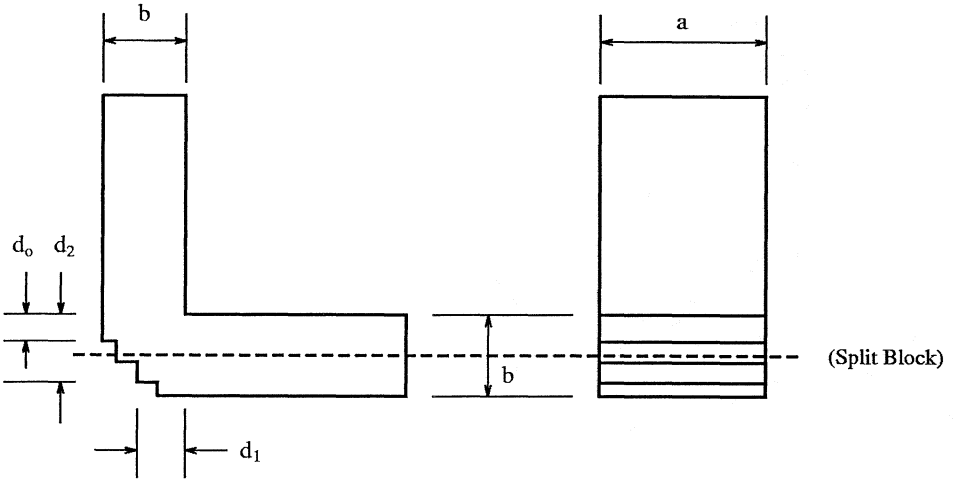

Figure 5. Three-Step Right-Angle E-Plane Bend Geometry.

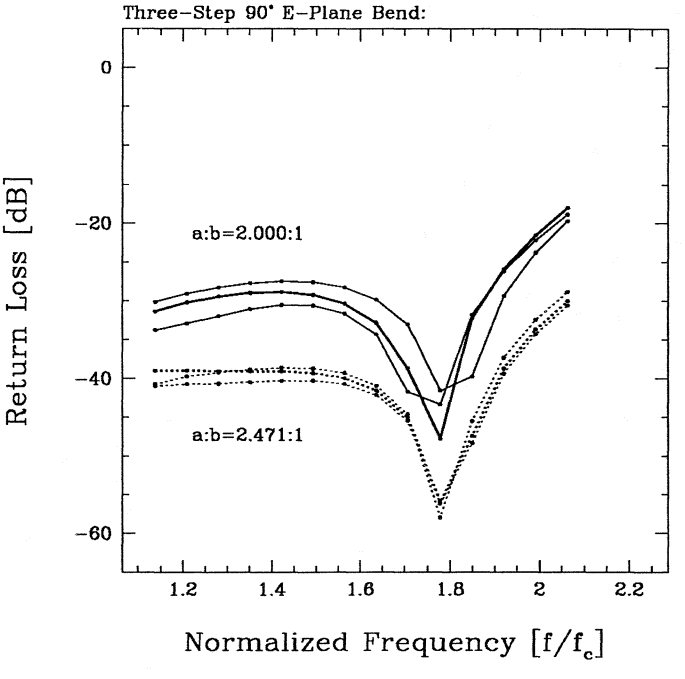

Figure 6. Modeled Three-Step Right-Angle E-Plane Bend Return Loss. The family of return loss curves displayed approximately outlines the bend performance for the designs given in Table 1.

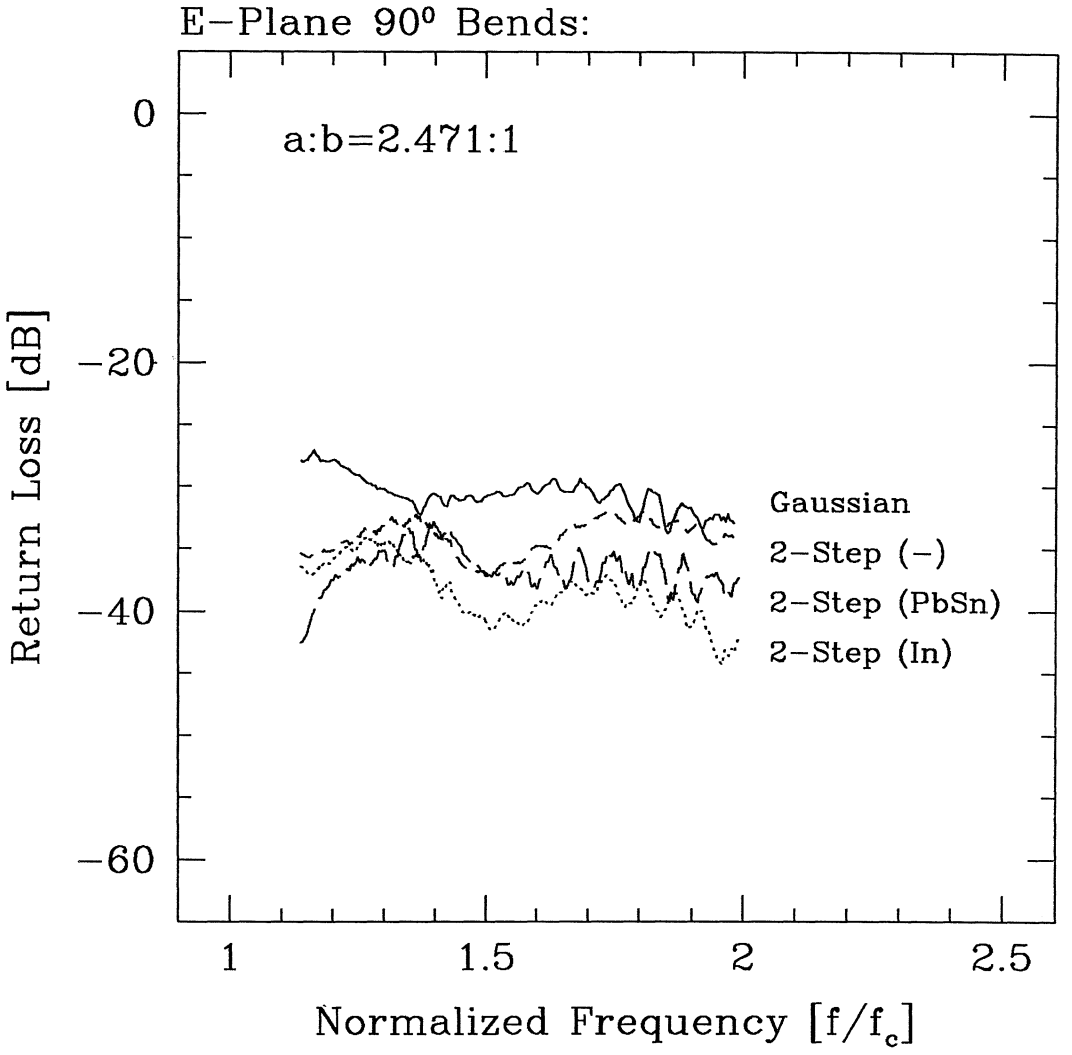

Figure 7. Measured Two-Step Right-Angle E-Plane Bend Return Loss. The two-step bend was manufactured as a centered split-block resulting in a $\sim 25\,\mu$m seam behind the upper tuning step. The upper split-block was broached to form the output waveguide. The two-step curves denoted '−', 'In', and 'PbSn' are respectively bolted split-block, indium packed seam, and soldered. The measured return loss of this bend is comparable to a electroformed single-mitre bend. Realizing the step bend as an off-center split block, casting, or electroform would reduce this perturbation on the modeled geometry and improve the bend performance. The curve labeled 'Gaussian' is a 3σ Gaussian curvature bend $3a$ in length which occupies approximately the same volume as a two-step bend with flanges.

TABLE 1

STEPPED RIGHT-ANGLE E-PLANE BEND SUMMARY

# Steps	Guide Aspect $[a:b]$	d_o $[d_o/b]$	d_1 $[d_1/b]$	d_2 $[d_2/b]$	VSWR
1	2.000 : 1	0.530 ± 0.010			1.2
	2.471 : 1	0.500 ± 0.005			1.1
2	2.000 : 1	0.235 ± 0.007	0.747 ± 0.005		1.04
	2.471 : 1	0.235 ± 0.007	0.748 ± 0.005		1.02
3	2.000 : 1	0.229 ± 0.006	0.548 ± 0.012	0.848 ± 0.012	1.05
	2.471 : 1	0.206 ± 0.006	0.541 ± 0.012	0.835 ± 0.012	1.03
Single	2.000 : 1	0.228 ± 0.010			1.12
Mitre	2.471 : 1	0.200 ± 0.005			1.05

A fractional bandwidth of $\Delta\nu/\nu \sim 0.4$ ($1.2f_c$ to $1.9f_c$) is used in estimating the VSWR. If the bend is fabricated with a split-block parallel to the broadwall, a tool diameter small compared to $\sim 0.2a$ should be used for the corners. A single-mitre bend (45° back mirror used for compensation of the bend discontinuity) is also included for reference. The dimensions in the table are normalized by the guide height, b. The simulations were performed with HFSS (Hewlett Packard High Frequency Structure Simulator).