RUSKIN MANUFACTURING DIVISION

PHILIPS INDUSTRIAL COMPONENTS, INC.

HORIZONTAL SPRING BRACKET ANALYSIS

FEBRUARY 25, 1985

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CALCULATION NO. 1101

REVISIONS

REV. NO.	DATE	REVISED BY	REVIEWED BY	APPROVED BY

DOCUMENT CONTROL

PAGE	ORIG.	REV. 1	REV. 2	REV. 3		PAGE	ORIG.	REV. 1	REV. 2	REV. 3
1	✓									
1A	✓									
2	✓									
3	✓									
4	✓									
5	✓									
6	✓									
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13	✓									
14	✓									
15	✓									
16	✓									
17	✓									

Introduction

This analysis will verify the adequacy of the new horizontal spring bracket assembly to perform its required function during a generic seismic event. The required function of a N18D23 Fire Damper is to remain in the open position until the temperature sensor (i.e. fuse link, ETL, etc.) releases and allows the damper to close in the event of a fire.

RUSKIN Manufacturing Division
air handling specialties

CALCULATION SHEET

PAGE NO.	4
CALC. NO.	1101
DAMPER TYPE	N1BD23

CLIENT | SIZE

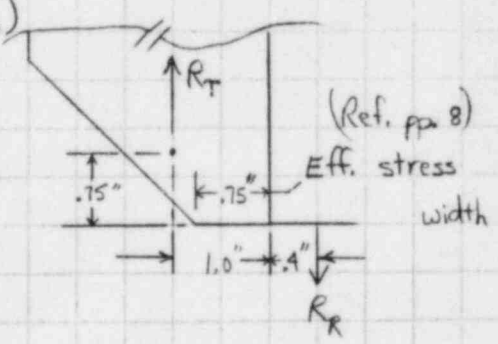
SUBJECT New Horizontal Spring Bracket Assembly | REVISED | BY

Spring Bracket (Ref. pp. 5, Dwg. N9-31)

The directions of the forces due to normal conditions will be the same for both the new and old (previously qualified by seismic test) spring brackets. The old spring bracket (Ref. pp. 7, Dwg. N9-13) is made of 16 ga. material compared to 14 ga. material in the new spring bracket. For seismic loading, the spring bracket weight is negligible compared to the spring tension (T_s). The blade load is absorbed by the fuse link strap assembly.

T_s = spring tension = 11 lb $T_s >> W_{sb}$, $\therefore R_T = T_s$

$W_{sb} \approx (5)(5)(.075)(.2833) = .5$ lb (new brkt, pg 6)



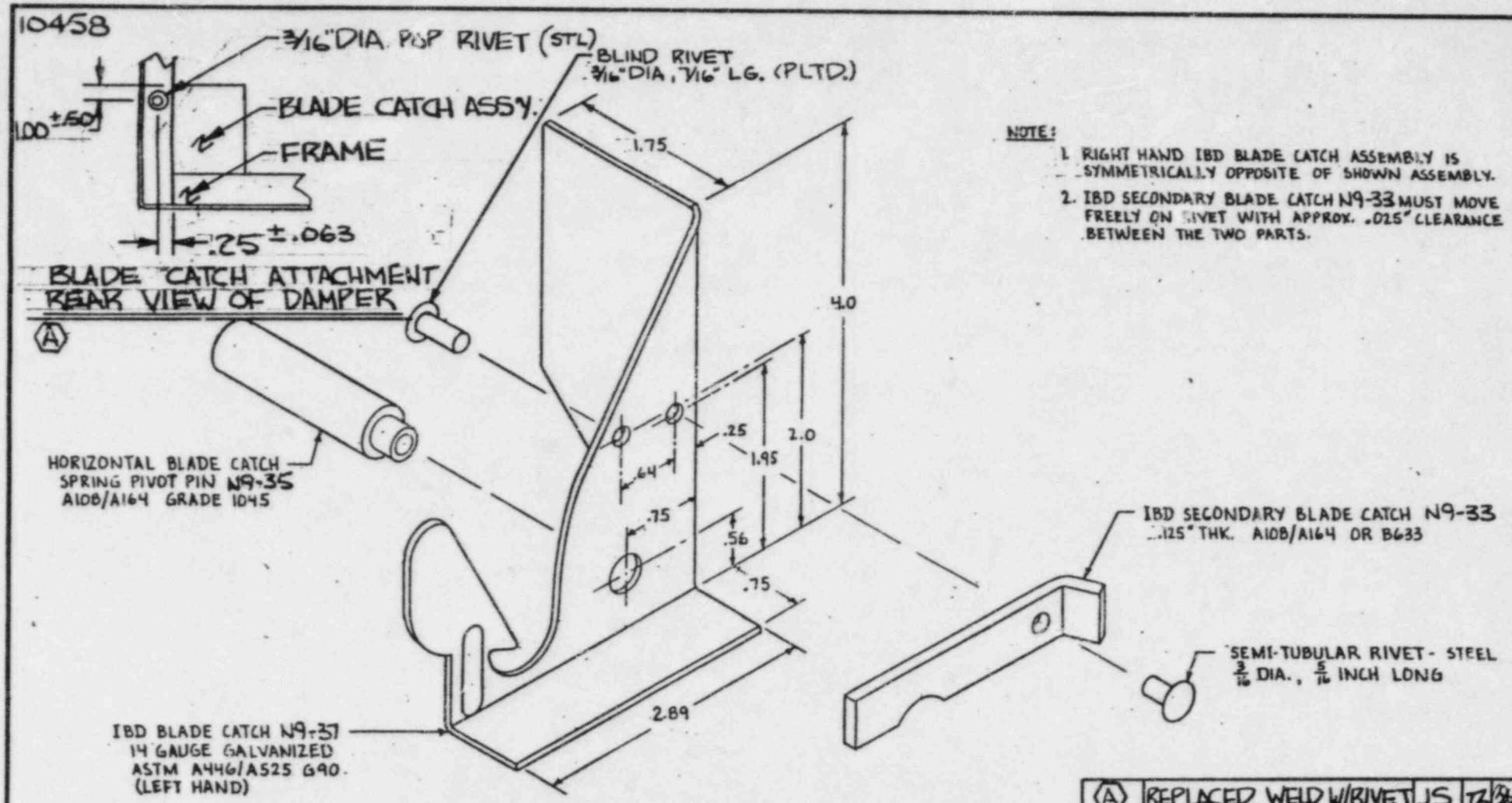
Total Load $R_T = T_s = 11$ lb

Assume a net effective stress width of .75 in in 16 ga. material.

Tensile Stress $f_t = \frac{R_T}{A} = \frac{11}{.75(.061)} = 240$ psi (old spring bracket)

Rivet Pullout $R_p = R_T/2 = 11/2 = 5.5$ lb/rivet

10458



NOTE:

1. RIGHT HAND IBD BLADE CATCH ASSEMBLY IS SYMMETRICALLY OPPOSITE OF SHOWN ASSEMBLY.
2. IBD SECONDARY BLADE CATCH N9-33 MUST MOVE FREELY ON RIVET WITH APPROX. .025" CLEARANCE BETWEEN THE TWO PARTS.

CHANGE LETTER	REVISION DESCRIPTION	DWN BY	APP'V'D. BY	DATE
A	REPLACED WELD W/RIVET	JS	TZ	12/5/85

DWN. BY:	CK'D. BY:	APP'V'D BY:
JS	4	TZ
DATE 2-6-85	DATE 2-7-85	DATE 2-8-85

RUSKIN
DIVISION OF FIGEN INDUSTRIAL EQUIPMENTS, INC.
P.O. BOX 129 GRANDVIEW, MO. 64030

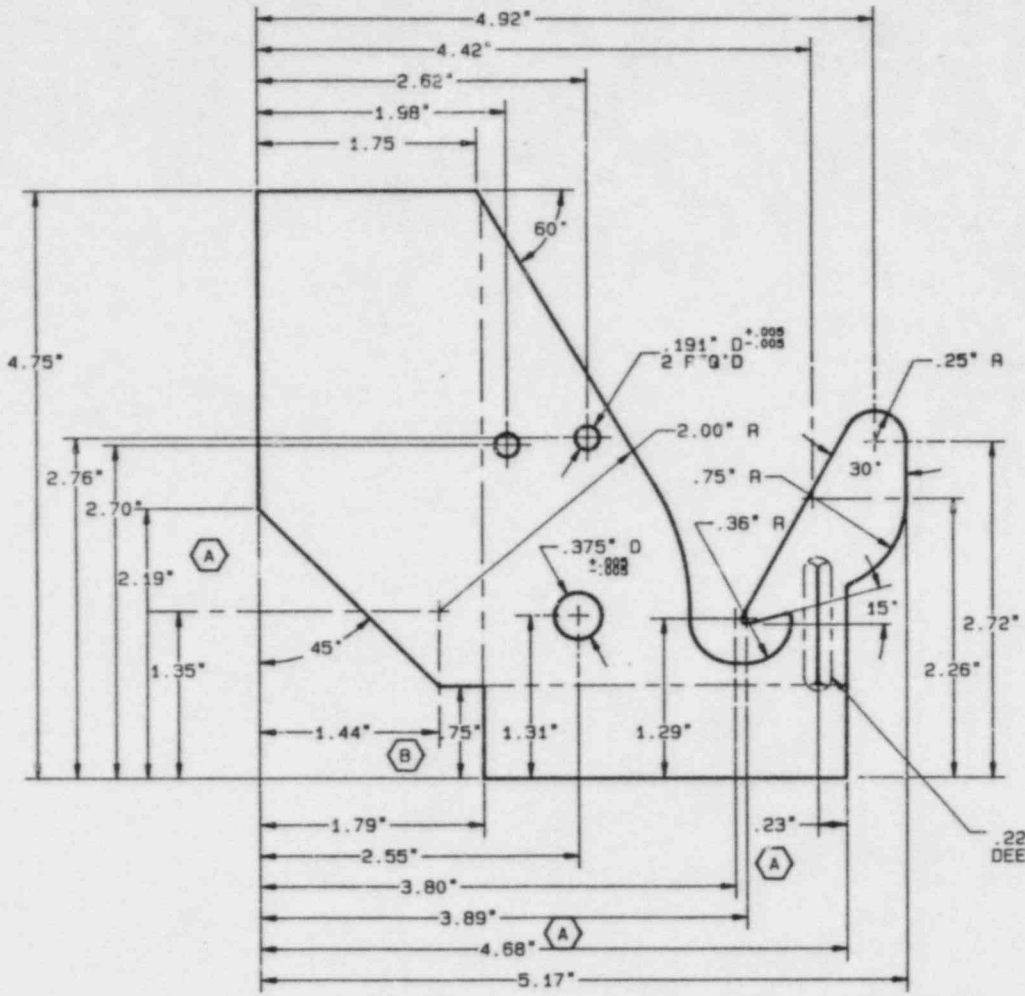
SCALE N/A | ISSUE A

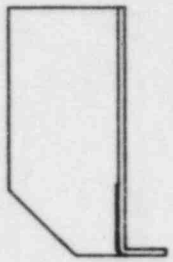
TITLE: IBD 23 HORIZONTAL BLADE CATCH ASSEMBLY

DWG. NO. N9-31

GALV. CONSTRUCTION

UNLESS OTHERWISE SPECIFIED USE STANDARD ENGINEERING TOLERANCES





LEFT HAND

RIGHT HAND

NOTE:
1. ALL UNSPECIFIED RADII ARE .04".
2. UNLESS OTHERWISE SPECIFIED USE +.010, -.010 TOLERANCE.
3. WHEN ORDERING SPECIFY RIGHT HAND OR LEFT HAND.

CHANGE LETTER	REVISION DESCRIPTION	DWN BY:	APP'V'D. BY:	DATE
(B)	ADDED DIMENSION .75"	KJ	WSB	12-03-84
(A)	12 GA TO 14 GA. .26" TO .23" 1.88" TO 2.19", 4.73" TO 4.68"	KJ	WSB	11-29-84

DWN. BY: KJ — DATE 11/20/84
CHK. BY: WSB — DATE 11-20-84
APP'V'D. BY: KJ — DATE 11-26-84 11-28-84

RUSKIN
DIVISION OF HOLDEN INDUSTRIES, INC.
P.O. BOX 129 GRANDVIEW, MO. 64030

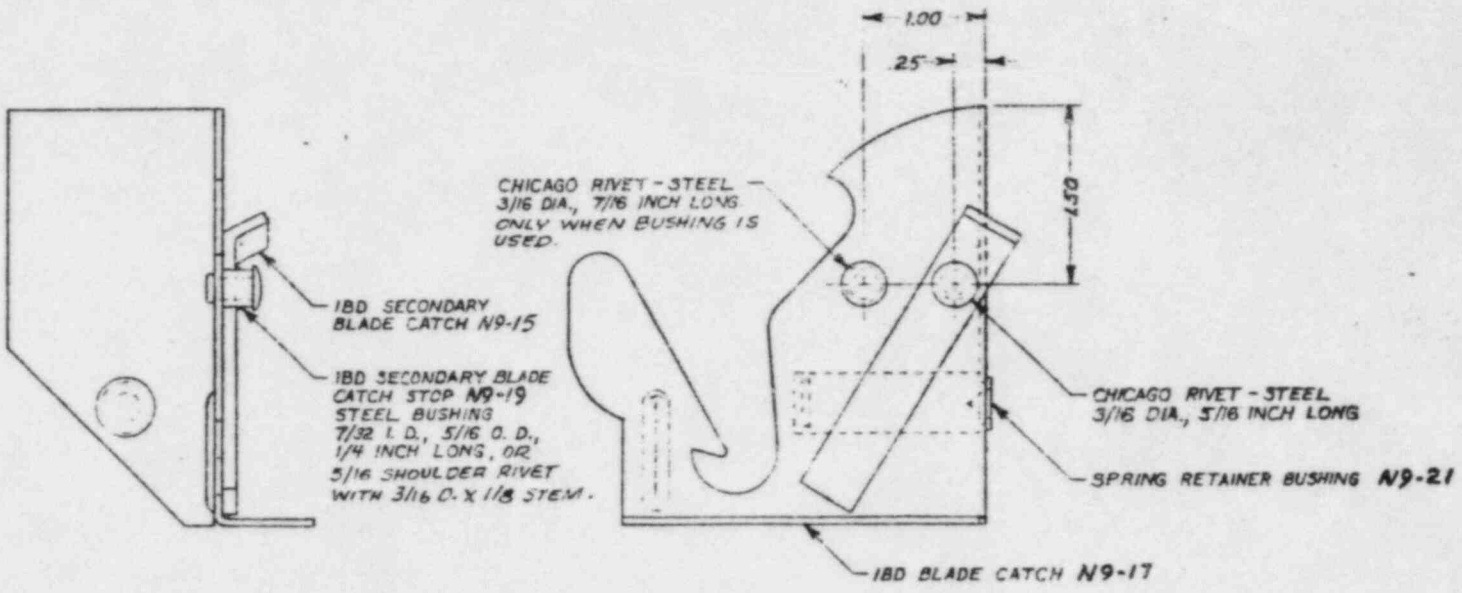
SCALE 1"=1" — ISSUE B

MATERIAL: 14 GAUGE GALVANIZED
ASTM A446/525 G90
(A)

TITLE
IBD BLADE CATCH
FLAT CUT

DWG. NO.
10404

4376



NOTE:

1. IBD SECONDARY BLADE CATCH N9-15 MUST MOVE FREELY ON RIVET WITH APPROX. .025 CLEARANCE BETWEEN TWO PARTS.

CHANGE LETTER	REVISION DESCRIPTION	DWN. BY	APP'D. BY	DATE

DWN. BY: G	CKD. BY: M	APP'D BY: TL	
DATE 6-18-82	DATE 6-18-82	DATE 6-18-82	6/18/82

RUSKIN Mfg. Co.
P.O. Box 129 • Grandview, Mo. 64030

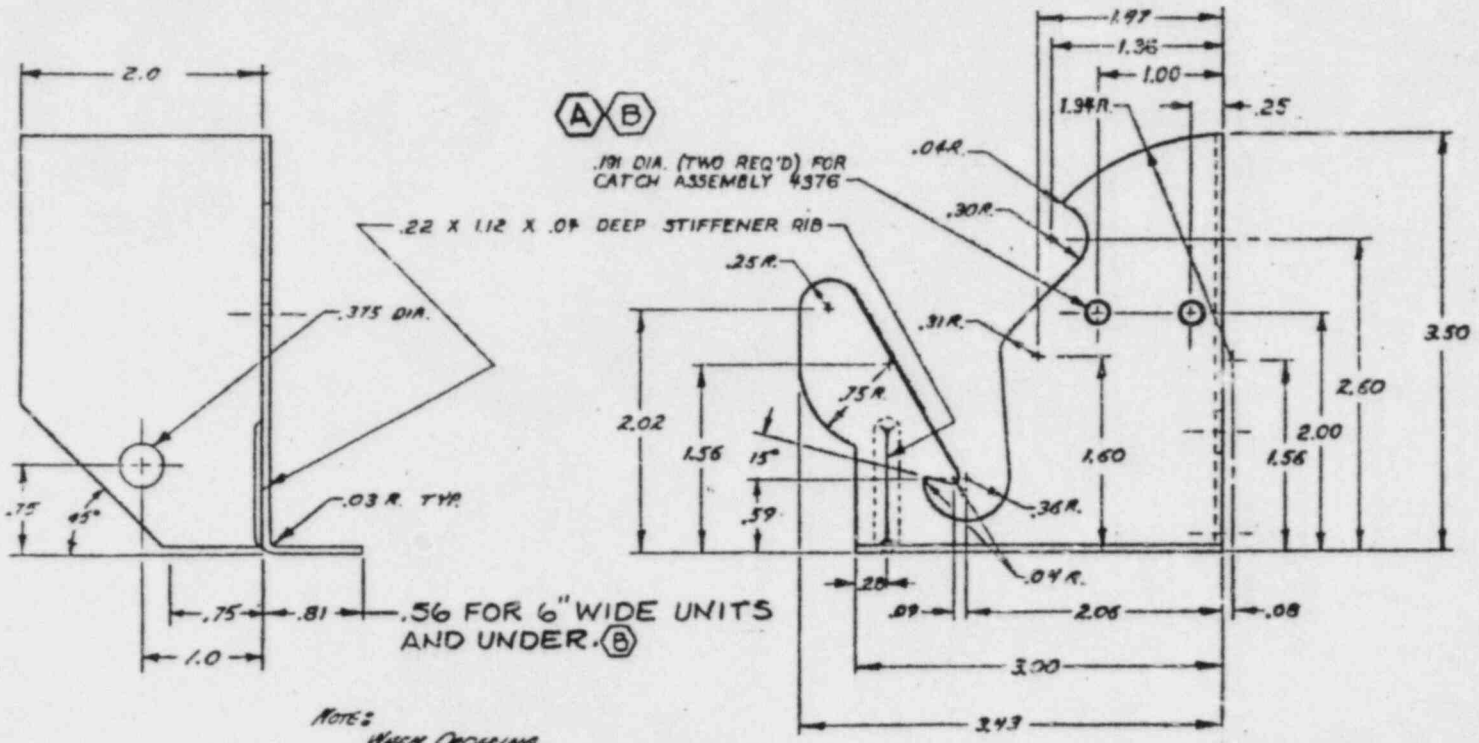
SCALE N | ISSUE

1SD23 SECONDARY BLADE CATCH ASSEMBLY

DWG. NO. N9-13

2080

RIGHT HAND SHOWN



NOTE:
WHEN ORDERING SPECIFY RIGHT HAND OR LEFT HAND (2080 R. OR 2080 L.).
RIGHT HAND SHOWN. LEFT HAND MIRROR IMAGE.

CHANGE LETTER	REVISION DESCRIPTION	DWN BY	APP'D BY	DATE
B	REVISED DIM'S.	44	TZ	8/4 9/14/82
A	ADDED 1 3/4" DIM.	GC	TZ	SB 2/24/83

DWN. BY GC DATE 6-18-82 | CK'D BY. 44 DATE 6-18-82 | APP'D. BY TZ DATE 6/18/82 | RUSKIN Mfg. Co. P.O. Box 129 • Grandview, Mo. 64030 | SCALE N | ISSUE B

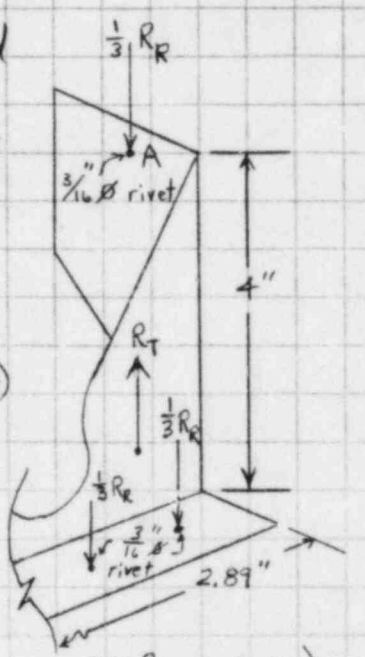
MAT'L: 16 GA. (.059) GALV. STL. ASTM A446/A525

TITLE: 18D BLADE CATCH

DWG. NO. N9-17

TOLERANCES: UNLESS OTHERWISE SPECIFIED DIMENSIONS WITH 2 DECIMAL PLACES ±.02 WITH 3 DECIMAL PLACES ±.010 FRACTIONAL DIMENSION AS MARKED

The net effective stress width will be assumed to be .75 in (even though it is substantially larger) in 14 ga. material:



(Ref. pp. 5 & 6)

Tensile Stress $f_{t_{new}} = \frac{R_T}{A} = \frac{11}{.75(.075)} = \underline{196 \text{ psi}} < f_t$ (pp. 4) O.K.

(new spring bracket)

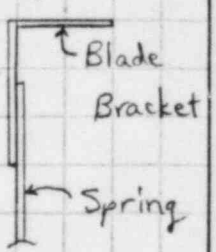
Rivet Pullout $R_{p_{new}} = \frac{R_T}{3} = \frac{11}{3} = \underline{4 \text{ lb/rivet}} < R_p$ (pp. 4) O.K.

Rivet Shear $\tau_s = \frac{(R_T/3)}{A} = \frac{(11/3)}{(\pi(.1875)^2/4)} = \underline{133 \text{ psi}} << F_s \approx 8800 \text{ psi}$ O.K.

Note: The rivets used in the new and old assemblies are identical. The old spring bracket was not attached to the frame at point A (see sketch above) while the new spring bracket is attached as shown on page 5. The rivet at point A may be replaced by a #10 Tek screw ($F_s \approx 10$ ksi) or a $\frac{1}{16}$" x $\frac{3}{8}$" fillet weld ($V_{allow} = .707(.0625)(.375)(13{,}600) = 225$ lb >> 4 lb) along the top edge of the spring bracket.

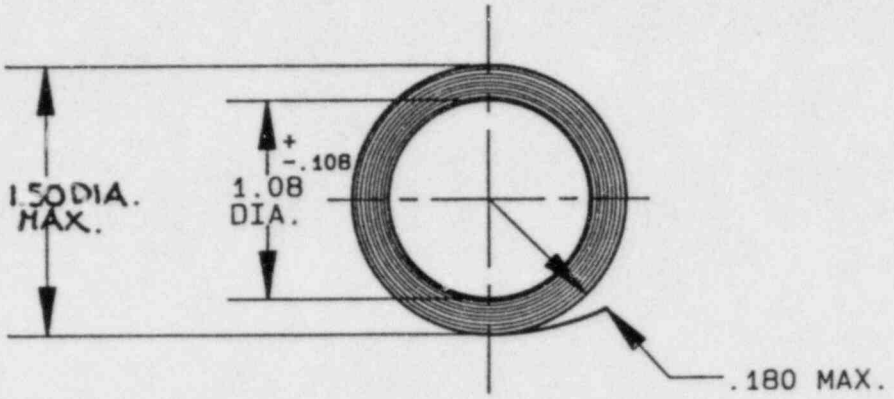
Closure Springs (pp. 11)

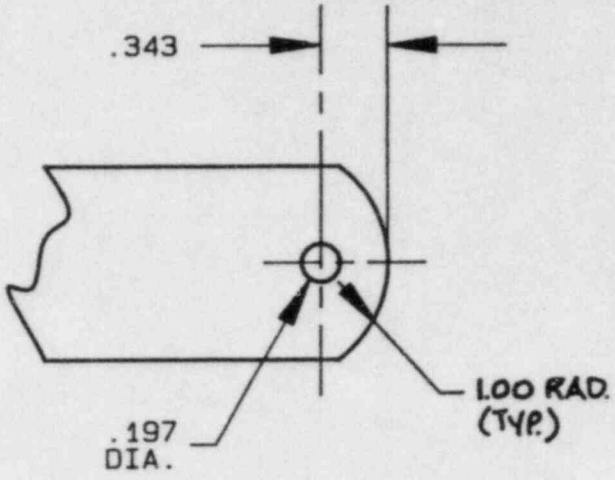
The closure springs have not been changed from the tested types other than the location on the new spring bracket (compare pp. 5 & 7) and the attachment to the bottom blade (the spring attachment to the blade was modified as shown on page 16). The new location on the spring bracket will have no effect on the seismic qualification since there is no additional spring extension required. The new method of attachment to the bottom blade is less critical than the old method. The new method allows the spring to maintain a radius (r) approximately the same as the spring has when it arrives from the manufacturer. The old method requires the end of the spring to be plastically deformed to a flat position (shown at right) to enable it to be attached to the blade bracket.

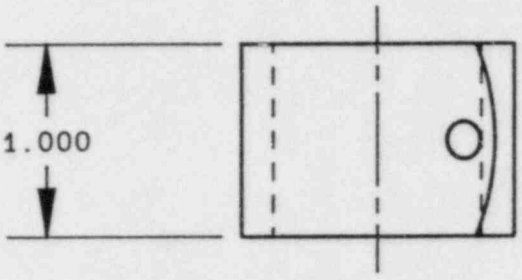


(see pp. 16)

2156







CHANGE LETTER	REVISION DESCRIPTION	DWN BY:	APP'V'D. BY:	DATE
A	REV. & REDRAWN	PTG	[illegible]	11-19-84

DWN. BY:	CHK. BY:	APP'V'D. BY:	RUSKIN	SCALE	ISSUE
PTG	4	RUB	P.O. BOX 129 GRANDVIEW, MO. 64030		A
DATE 11-16-84	DATE 11-16-84	DATE 11-19-84			

MAT'L: .016 ± .0005 S.S.

TITLE: VULCAN SH16P46 NEGATOR SPRING

DWG. NO.: N9-8

UNLESS OTHERWISE SPECIFIED, USE STANDARD ENGINEERING TOLERANCES

RUSKIN Manufacturing Division
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CALCULATION SHEET

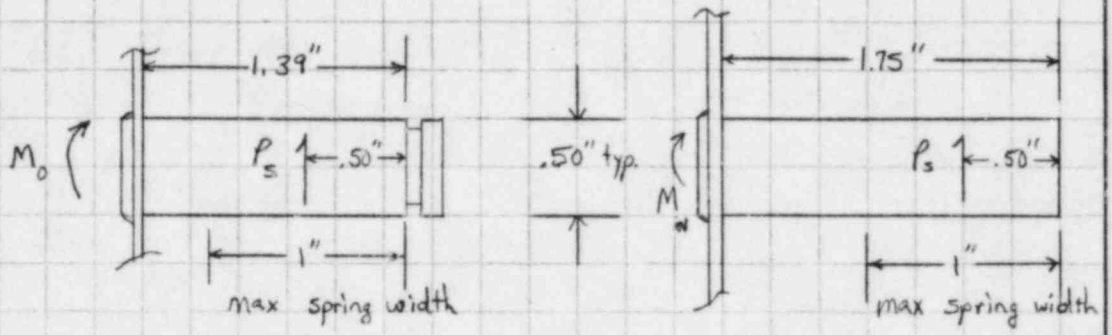
PAGE NO.	12
CALC. NO.	1101
DAMPER TYPE	N18D23

CLIENT — SIZE

SUBJECT New Horizontal Spring Bracket Assembly — REVISED — BY

Closure Spring Pivot Pin

The old style pivot pin (pp. 13) is shorter than the new style pivot pin (pp. 14). The pivot pin length was the only significant part change.



Old Style — New Style

P_s = spring force = 11 lb (unchanged)

$M_o = P_s(1.39-.50) = .89\,P_s$ $\qquad$ $M_N = P_s(1.75-.50) = 1.25\,P_s$

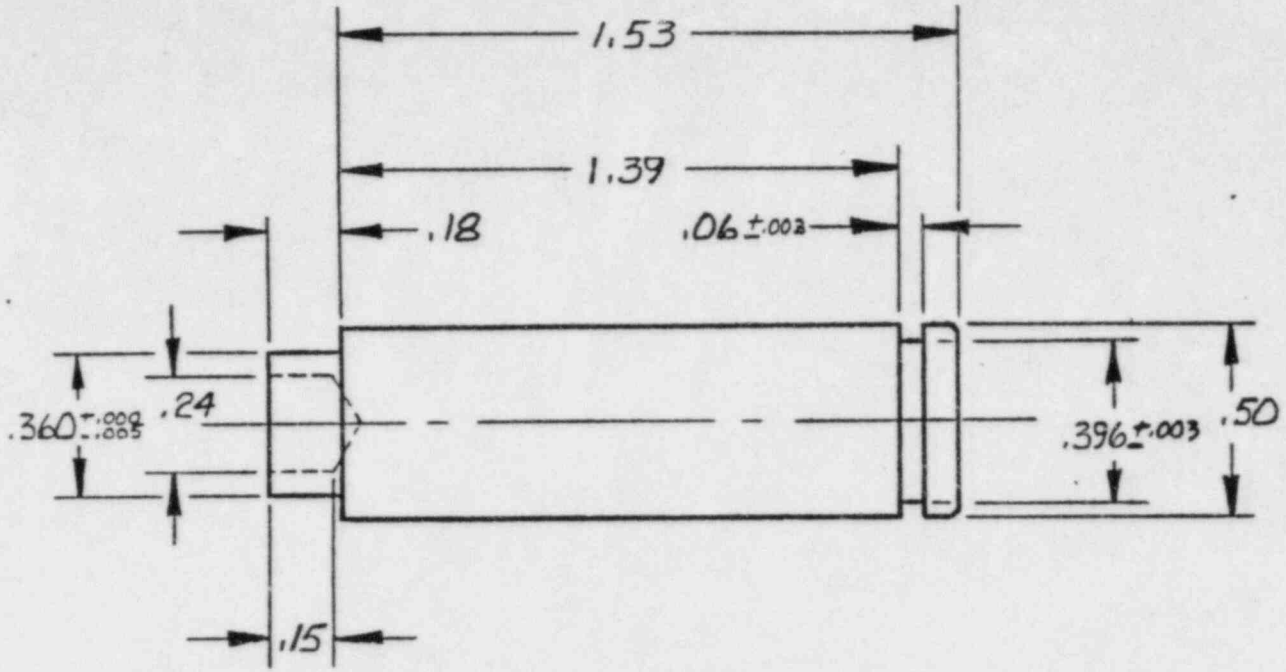
Old Style Bending Stress $\sigma_{b_o} = \frac{M_o}{S} = \frac{.89(11)(32)}{\pi(.50)^3} = 798$ psi $<<$ $.6F_y = 21{,}600$ psi O.K.

New Style Bending Stress $\sigma_{b_N} = \frac{M_N}{S} = \frac{1.25(11)(32)}{\pi(.50)^3} = 1120$ psi $<<$ $.6F_y = 21{,}600$ psi O.K.

Assume a net effective stress area of .75 in the old and new style spring bracket (see pp. 4+5).

$S_b = bt^2/6 = .75t^2/6$ (spring bracket section modulus)

2221



CHANGE LETTER	REVISION DESCRIPTION	DWN. BY	APP'V'D. BY	DATE

UNLESS OTHERWISE SPECIFIED USE STAND. ENGINEERING TOLERANCES.

DWN. BY: GC	CKD. BY: 4	APP'V'D. BY: TL	IKVV
DATE 6-17-82	DATE 6-18-82	DATE 6-18-82	6/18/82

MATERIAL: CRS, ZINC PLTD YELLOW DICROMATE DIP ASTM A108 / B633

RUSKIN Mfg. Co.
P.O. Box 129 • Grandview, Mo. 64030

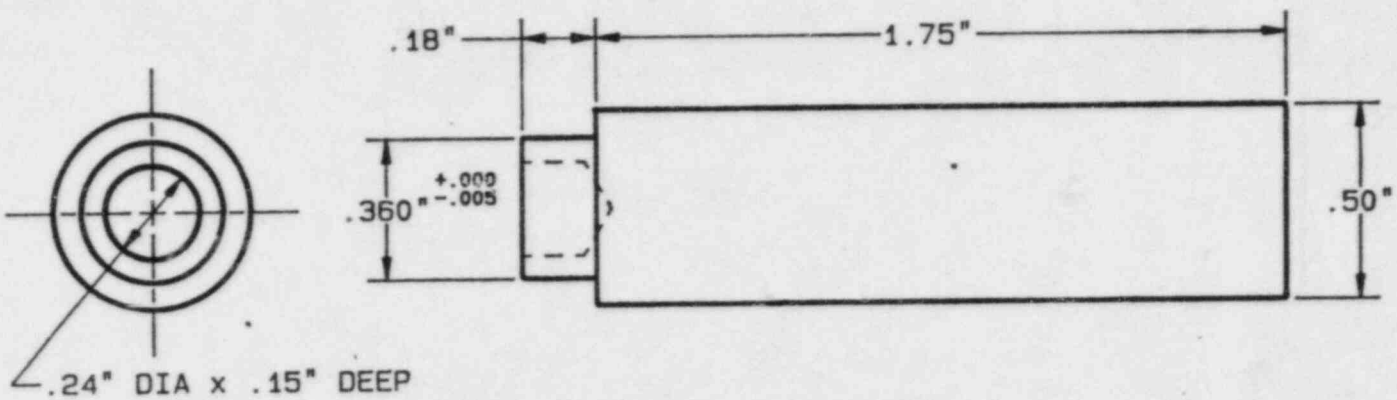
SCALE: N | ISSUE:

TITLE: BUSHING, SPRING RETURN IBD FIRE DAMPER

DWG. NO. N9-21

BRUNING 40-534 48423

10413



NOTE:

Ⓐ 1. ROUNDED OR CHAMFERED EDGES ARE ACCEPTABLE (1/32" MAX.)

CHANGE LETTER	REVISION DESCRIPTION	DWN BY:	APP'V'D. BY:	DATE
Ⓐ	ADDED NOTE #1	JS	TR	12/19/85

DWN. BY: JS	CHK. BY: TR	APP'V'D. BY:
DATE 2-11-85	DATE 2-15-85	DATE 2-15-85

RUSKIN
SPECIALTY BY HOLDEN ENGINEERING, INC.
P.O. BOX 128 GRANDVIEW, MO. 64030

SCALE	ISSUE
2"=1"	A

MATERIAL: A108/A164 GRADE 1045

TITLE: HORIZONTAL BLADE CATCH SPRING PIVOT PIN

DWG. NO. N9-35

UNLESS OTHERWISE SPECIFIED USE STANDARD ENGINEERING TOLERANCES

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air handling specialties

CALCULATION SHEET

PAGE NO.	15
CALC. NO.	1101
DAMPER TYPE	N1BD23

CLIENT | SIZE

SUBJECT New Horizontal Spring Bracket Assembly | REVISED | BY

Old Style
Bending Stress $\sigma_{b_O} = \frac{M_O}{S_b} = \frac{.89(11)(6)}{.75(.061)^2} = 21,048 \text{ psi} < .6F_y = 21,600 \text{ psi}$ O.K.

New Style
Bending Stress $\sigma_{b_N} = \frac{M_N}{S_b} = \frac{1.25(11)(6)}{.75(.075)^2} = 19,556 \text{ psi} < .6F_y = 21,600 \text{ psi}$ O.K.

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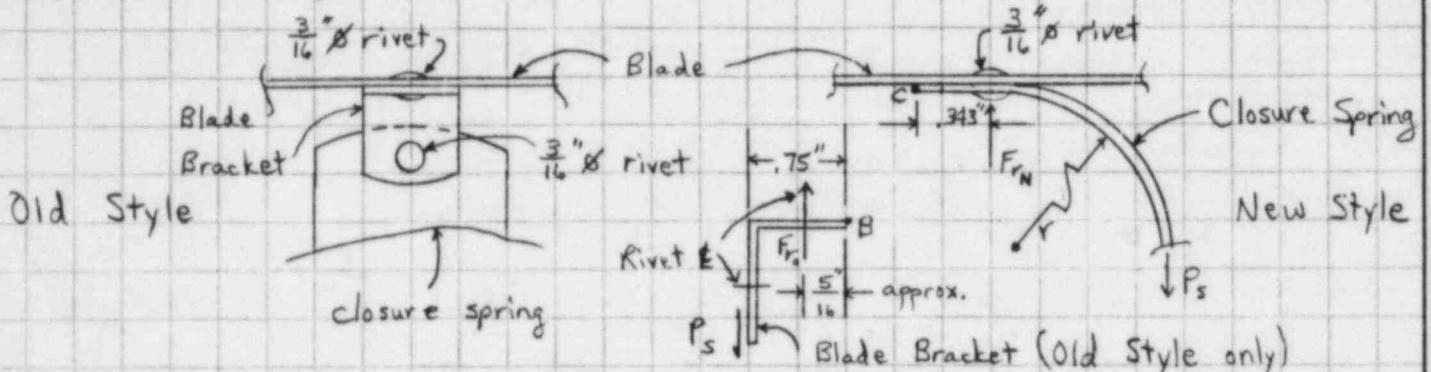
CALCULATION SHEET

PAGE NO.	16
CALC. NO.	1181
DAMPER TYPE	N18D23

CLIENT | SIZE

SUBJECT New Horizontal Spring Bracket Assembly | REVISED | BY

Closure Spring - Bottom Blade Connection



From the above sketches it can be easily shown that the load on the rivet in the blade is not substantially different than the tested load.

$\circlearrowleft + \Sigma M_B = 0 \quad .3125 F_{r_o} - .75 P_s = 0$ For $P_s = 11\ lb$:

$$F_{r_o} = .75(11)/.3125 = \underline{26.40\ lb}$$

Since the closure spring is flexible no moment can exist around point C on the new style connection. Therefore,

$\uparrow + \Sigma F = 0 \quad F_{r_N} - P_s = 0 \quad \therefore F_{r_N} = \underline{11\ lb}$ for $P_s = 11\ lb$

$F_{r_o} > F_{r_N}$, therefore, the closure spring - bottom blade connection is satisfactory.

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CALCULATION SHEET

PAGE NO.	17
CALC. NO.	1101
DAMPER TYPE	N18D23
SIZE	

CLIENT

SUBJECT New Horizontal Spring Bracket Assembly REVISED BY

Conclusion

The preceding analysis verifies the adequacy of each component of the new horizontal spring bracket assembly to perform its required function during a generic seismic event. The preceding analysis shows the old style spring bracket to be a weaker assembly than the new style spring bracket.