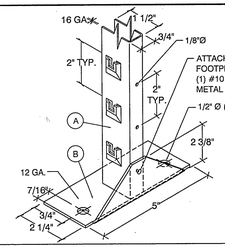
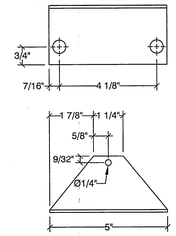
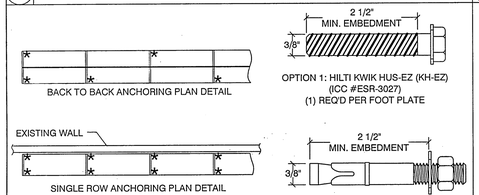


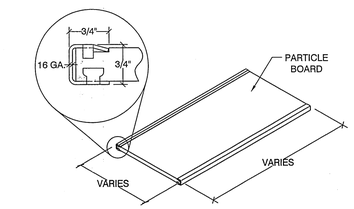
A COLUMN



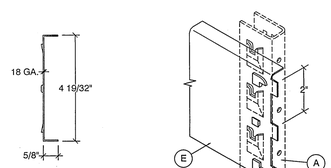
B FOOT PLATE



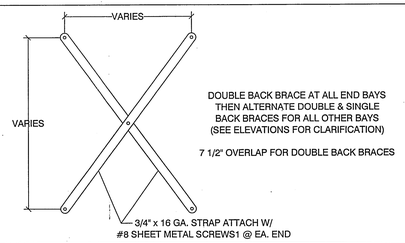
C ANCHOR



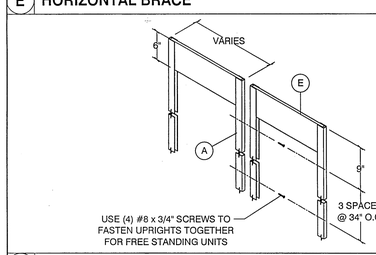
D SHELF



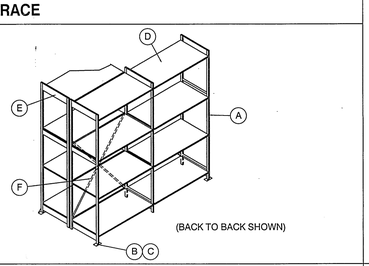
E HORIZONTAL BRACE



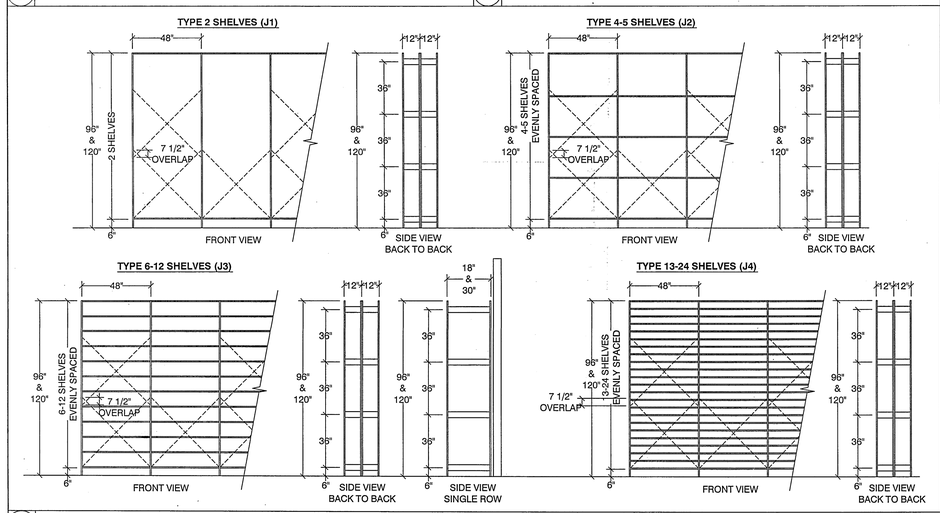
F REAR X-BRACE



G BACK TO BACK ASSEMBLY



H GENERAL CONFIGURATION



J LIGHT DUTY STORAGE FIXTURE ELEVATIONS (96" SIMILAR, MOST CRITICAL SHOWN)

LIGHT DUTY SHELVING ANALYSIS

SCOPE:
THE PURPOSE OF THIS ANALYSIS IS TO SHOW THAT THE FOLLOWING LIGHT DUTY STORAGE FIXTURE COMPLIES WITH SECTION 1613 OF THE 2010 OSSC WHERE LATERAL FORCES ARE DETERMINED IN ACCORDANCE WITH SECTION 15.5 OF THE ASCE 7-05.

PARAMETERS:
STABILITY OF THE LIGHT DUTY STORAGE FIXTURE UNITS IS PROVIDED BY METAL SPRINGER BRACES IN THE TRANSVERSE DIRECTION AND X-BRACES IN THE LONGITUDINAL DIRECTION.

STORAGE FIXTURES WILL BE ANALYZED UTILIZING THE FOLLOWING FORMULA:
LATERAL FORCE:

$V = Cs * Ws$ WHERE $Cs = S_{DS}/(R/I)$
$= [(2/3) * Fa * Ss * (I/R)] * Ws$

SPECIFICATIONS:
- MAIN STEEL — Fy = 36000 PSI MIN. YIELD STEEL
- BOLTS — A307 (UNLESS OTHERWISE NOTED)
- ANCHORS — 3/8"Ø x 2-1/2" MIN. EMBED. HILTI KH-EZ SCREW ANCHOR (ICC ESR-3027) OR 3/8"Ø x 2-1/2" MIN. EMBED. POWERS POWER STUD SD2 (ICC ESR-2502) **PERIODIC SPECIAL INSPECTION REQUIRED FOR ANCHOR INSTALLATIONS.**
- SLAB — 4 IN (minimum required) x 2500 PSI (minimum required)
- SOIL — 500 PSF

MAXIMUM PERMISSIBLE STORAGE LOAD:
1200 LB MAX. PER BAY
240 LB MAX. PER SHELF

SHELVING PROFILES:

TYPES	LEVELS	MAX. PER BAY
1. TYPE 2 SHELVES	2	480 LB
2. TYPE 4-5 SHELVES	4-5	960 LB
3. TYPE 6-12 SHELVES	6-12	1200 LB
4. TYPE 13-24 SHELVES	13-24	1200 LB

CRITICAL CONFIGURATIONS:
12" DEEP SINGLE ROW
(2) 12" DEEP BACK-TO-BACK ROWS

ANALYSIS WILL BE DONE ON CRITICAL CONFIGURATIONS ONLY.
THE REST OF TYPES CAN BE VERIFIED BY SIMPLE REVIEW.

LOADS & DISTRIBUTION: TYPE 6-12 SHELVES (SINGLE ROW) (SEE DETAIL J SIDE VIEW)

ANALYZE PER SECTION 1613 OF THE 2010 OSSC WHERE LATERAL FORCES ARE DETERMINED IN ACCORDANCE WITH SECTION 15.5 OF THE ASCE 7-05:

SITE CLASS = D
$V = Cs * Ws$ WHERE $Cs = S_{DS}/(R/I)$
AND Ws = OPERATING WEIGHT
$S_{DS} = 2/3*Fa*Ss$ WHERE Fa = 1.16 & Ss = 0.86
= 0.665
I = 1.00 <=== NO PUBLIC ACCESS
R = 4
REDUCTION = 0.7 <=== WORKING STRESS
NO. OF LEVELS = 6 LVL
PRODUCT LOAD, wPL = 200 LB **(1200 LB MAX. PER BAY)**
DEAD LOAD, wDL = 5 LB
DEPTH= 12 IN
HEIGHT= 120 IN

LONGITUDINAL & TRANSVERSE DIRECTION

FULLY LOADED
V = 0.7*[0.665*1*(0.67*1200 LB + 30 LB)/4]
= 97 LB

LATERAL FORCE DISTRIBUTION

h	LEVEL	WEIGHT	HEIGHT	W x H	Fi	Mot
6.0 IN	1	139 LB	6.0 IN	834.0 IN-LB	1.5 LB	9.2 IN-LB
22.8 IN	2	139 LB	28.8 IN	4003.2 IN-LB	7.4 LB	213.0 IN-LB
22.8 IN	3	139 LB	51.6 IN	7172.4 IN-LB	13.3 LB	683.7 IN-LB
22.8 IN	4	139 LB	74.4 IN	10341.6 IN-LB	19.1 LB	1421.4 IN-LB
22.8 IN	5	139 LB	97.2 IN	13510.8 IN-LB	25.0 LB	2426.1 IN-LB
22.8 IN	6	139 LB	120.0 IN	16680.0 IN-LB	30.8 LB	3697.8 IN-LB
120.0 IN			∑ =	52542 IN-LB	97 LB	8451 IN-LB

TOP SHELF LOADED ONLY
Vtop = 0.7*[0.665*1*(200 LB + 30 LB)/4]
= 27 LB

LATERAL FORCE DISTRIBUTION

h	LEVEL	WEIGHT	HEIGHT	W x H	Fi	Mot
6.0 IN	1	5 LB	6.0 IN	30.0 IN-LB	0.0 LB	0.2 IN-LB
22.8 IN	2	5 LB	28.8 IN	144.0 IN-LB	0.1 LB	4.3 IN-LB
22.8 IN	3	5 LB	51.6 IN	258.0 IN-LB	0.3 LB	13.8 IN-LB
22.8 IN	4	5 LB	74.4 IN	372.0 IN-LB	0.4 LB	28.6 IN-LB
22.8 IN	5	5 LB	97.2 IN	486.0 IN-LB	0.5 LB	48.8 IN-LB
22.8 IN	6	205 LB	120.0 IN	24600.0 IN-LB	25.4 LB	3052.2 IN-LB
120.0 IN			∑ =	25890 IN-LB	27 LB	3148 IN-LB

TRANSVERSE SEISMIC LOADS: TYPE 6-12 SHELVES (SINGLE ROW) (SEE DETAIL J SIDE VIEW)

THE FRAME SHALL BE ANALYZED AS A BRACED FRAME IN THE LONGITUDINAL DIRECTION, AND A MOMENT RESISTING FRAME IN THE TRANSVERSE DIRECTION, UTILIZING MOMENT RESISTING SPREADER TO COLUMN CONNECTIONS.

Vtransv= 97 LB
Vcol= 49 LB

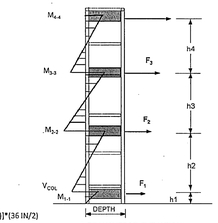
TRANSVERSE SEISMIC
F1 @ 6" = 5 LB
F2 @ 42" = 17 LB
F3 @ 78" = 32 LB
F4 @ 114" = 43 LB

M_{1-1}= Vcol * h1
= 48.5 LB * 6 IN
= 291 IN-LB

M_{2-2}= [Vcol-(F1/2) * h2/2
= (48.5 LB - (5.2 LB/2)*(36 IN)/2
= 826 IN-LB

M_{3-3}= [Vcol-(F2/2)-(F1/2)] * h3/2
= (48.5 LB - (5.2 LB/2) - (16.9 LB/2))*(36 IN/2)
= 674 IN-LB

M_{4-4}= [Vcol-(F3/2)-(F2/2)-(F1/2)] * h4/2
= (48.5 LB - (5.2 LB/2) - (16.9 LB/2) - (31.6 LB/2))*(36 IN/2)
= 390 IN-LB



TRANSVERSE ELEVATION

CONNECTION MOMENT
$Mconn_{1-1}$= [(M_{1-1})+(M_{2-2})]
= 1,118 IN-LB

$Mconn_{2-2}$= [(M_{2-2})+(M_{3-3})]
= 1,500 IN-LB

h1= 6.0 IN
h2= 36.0 IN
h3= 36.0 IN
h4= 36.0 IN

depth= 12.0 IN

VERIFY ADEQUACY OF CONNECTION
Mconn = 1,500 IN-LB

VERIFY ADEQUACY OF COLUMN
Mcol= 826 IN-LB

1

COLUMN ANALYSIS: TYPE 6-12 SHELVES (SINGLE ROW) (SEE DETAIL A)

TRANSVERSE DIRECTION
ANALYZED PER AISI COLD FORM STEEL MANUAL.
[1+0.115S_{DS}] Pstatic + 0.75 Pseismic= 968 LB
0.75 Mcol= 620 IN-LB

Kxlx/rx= 1.2*31.5 IN/0.4736 IN
= 79.5 <==== (Kl/r)max
Kyly/ry = 1*22.8 IN/0.3272 IN
= 69.7

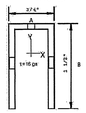
AXIAL
Fe= π^2E/(Kl/r)max^2
= 46.1 KSI
Fy/2= 18.0 KSI
SINCE, Fe > Fy/2
THEN, Fn= Fy(1-Fy/4Fe)
= 36 KSI*[1-36 KSI/(4*46.1 KSI)]
= 29.0 KSI
Pn= Aeff*Fn
= 5,497 LB
Ωc= 1.92

Pa= Pn/Ωc
= 5497 LB/1.92
= 2,863 LB
P/Pa= 0.34 > 0.15

FLEXURE
CHECK: P/Pa + (Cmx*Mx)/(Max*μx) ≤ 1.0
P/Pao + Mx/Max ≤ 1.0
Pno= Ae*Fy
= 0.19 IN^2 *36000 PSI
= 6,831 LB
Pao= Pno/Ωc
= 6831 LB/1.92
= 3,558 LB
Myield=My= Sx*Fy
= 0.0531 IN^3 * 36000 PSI
= 1,910 IN-LB
Max= My/Ωf
= 1910 IN-LB/1.67
= 1,144 IN-LB
Pcr= π^2EI/(Kl)^2
= π^2*29500 KSI * 0.043 IN^4 /(1.2*31.5 IN)^2
= 8,746 LB
μx= (1/[1-(Ωc*P/Pcr)])^-1
= (1/[1-(1.92*968 LB/8746 LB)])^-1
= 0.79

THUS,
(968 LB/2863 LB) + (0.85*620 IN-LB)/(1144 IN-LB*0.79) = 0.92 < 1.0 OK
(968 LB/3558 LB) + (620 IN-LB/1144 IN-LB) = 0.81 < 1.0 OK

Pstatic= # OF LEVELS*(wPL+wDL)
= 4 LEVELS * (200 LB + 5 LB)/2
= 410 LB
Pseismic= ∑ (I*Pin)/depth=(Movt/d)
= 704 LB



SECTION PROPERTIES
A= 0.75 IN
B= 1.5 IN
t = 0.060 IN
Aeff = 0.190 IN^2
Ix = 0.043 IN^4
Sx = 0.053 IN^3
rx = 0.476 IN
Iy = 0.020 IN^4
Sy = 0.054 IN^3
ry = 0.327 IN
Rx = 1.2
Lx = 31.5 IN
Ky = 1.0
Ly = 22.8 IN
Fy= 36 KSI
E= 29,500 KSI
Ωf= 1.67
Cmx= 0.85
Cb= 1.0

2

TRANSVERSE MOMENT CONNECTION ANALYSIS: TYPE 6-12 SHELVES (SINGLE ROW) (SEE DETAIL E)

Mconn, max= **0.75 Mconn**
= 1,125 IN-LB

(A) MOMENT CAPACITY OF METAL STRINGER:
fb = Mconn,max / Sx
= 1125 IN-LB / 0.265 IN^3
= 4,246 PSI

Sx = 0.265 IN^3
Fy= 36,000 PSI

fb/Fb = fb/(0.6*Fy)
= 4246 PSI/21600 PSI
= **0.20** < **1.0 OK**

MAXIMUM LOADS ON TABS:
Pmax = Mconn, max/Tab Distance
= 281 LB

(B) SHEAR CAPACITY OF CONNECTOR TABS:

Area = 2 * t1 * d
= 0.1 IN * 0.285 IN
= 0.028 IN^2

Pallow = Area * (0.4Fy)
= 410 LB **> Pmax, OK**

TAB PROPERTIES
Height, h = 0.281 IN
Depth, d = 0.285 IN
Thickness, t1 = 0.05 IN
Tab Distance = 4.0 IN

(C) BEARING ON COLUMN:
Fu= 58,000 PSI
16ga column, t = 0.06 IN

Abrg.= 2 * t1 * t
= 0.1 IN * 0.06 IN
= .006 IN^2

Pallow = Area * Fbearing
= 348 LB **> Pmax, OK**

3

LONGITUDINAL BRACING ANALYSIS: REAR X-BRACE (BACK-TO-BACK ROWS) (SEE DETAIL F & J)

BRACING CAPACITY IS GOVERNED BY TENSION CAPACITY OF CROSS BRACING, AND SHEAR CAPACITY OF CONNECTION SCREW.

0.75*Vlong= 0.75 * Vlongit *2 BAYS/1 X-BRACE
= 72.75 LB * 2 BAYS/1 X-BRACE SETS
= **146 LB** <=== 2 BAY TRIBUTARY TO X-BRACES.

Vdiag= Vtot(Ldiag/Lhoriz)
= 243 LB <=== SEISMIC LOAD IN TENSION

TENSION CAPACITY OF STRAP
Tallow= 0.6 * Fy * AREA(gross)
= **972 LB** **> Vdiag OK IN TENSION**
OR
Tallow= 0.5 * Fu * AREA(net)
= **1018 LB** **> Vdiag OK IN TENSION**

SHEAR CAPACITY OF #8 SHEET METAL SCREW TAKEN AS LEAST OF Pns:

Pns= 4.2*(t2*3*d)^0.5*Fu2
= 4.2 * [(0.06 IN)^3 * 0.165 IN]^0.5 * 58000 PSI
= 1,454 LB
Pns= 2.7*t1*d*Fu1
= 2.7 * 0.06 IN * 0.165 IN * 58000 PSI
= 1,550 LB
Pns= 2.7*t2*d*Fu2
= 2.7 * 0.06 IN * 0.165 IN * 58000 PSI
= 1,550 LB

(3/4"x16 GA. STRAP)
AREA(gross)= 0.0450 IN^2
AREA(net)= 0.0351 IN^2
Lhoriz= 48.0 IN
Lvert= 64.0 IN
Ldiag= 80.0 IN
Fy= 36,000 PSI
Fu= 58,000 PSI

Pns-eff/Ω= (1454 LB/3)
= **485 LB** **> 243 LB Vdiag OK IN SHEAR**

ASD safety factor for screw, Ω= 3

4

OVERTURNING ANALYSIS: TYPE 6-12 SHELVES (SINGLE ROW) (SEE DETAIL C)

DEPTH OF SINGLE UNIT = 12 IN
TOP SHELF HEIGHT = 120 IN
LEVELS= 6 LVL

(A) FULLY LOADED:
Vtotal = 97 LB

Mot = ∑(Fp*h)*0.75
= 6,338 IN-LB

Mst = ∑[(0.6-0.115S_{DS})wDL +0.75*(0.6-0.145S_{DS})*0.67wPL] x Depth / 2
= 1,929 IN-LB

Puplift = (Mot - Mst)/D
= 367 LB <= UPLIFT

(B) TOP SHELF LOADED

Vtop = 27 LB

Mot = ∑(Fp*h)*0.75
= 2,361 IN-LB

Mst = ∑[(0.6-0.115S_{DS})wDL + 0.75*(0.6-0.145S_{DS})wPL] x Depth / 2
= 551 IN-LB

Puplift = (Mot - Mst)/D
= 151 LB <= UPLIFT

ANCHOR:
QUANTITY= 1 PULLOUT = 750 LB SHEAR = 800 LB
OCCURRENCE = 1

Ps/Pt + Vs/Vt ≤ 1.2
COMBINED STRESS(A) = (367 LB/(1*750 LB)) + (49 LB/(1*800 LB))
= **0.55** **< 1.2 OK**

COMBINED STRESS(B) = (151 LB/(1*750 LB)) + (13 LB/(1*800 LB))
= **0.22** **< 1.2 OK**

USE (1) 3/8"Ø x 2-1/2" MIN. EMBED. HILTI KH-EZ SCREW ANCHOR (ICC ESR-3027) PER FOOT PLATE
ANCHORAGE REQUIRED AT EVERY BAY
USE 3/8"Ø x 2-1/2" MIN. EMBED. POWERS POWER STUD SD2 (ICC ESR-2502) AS AN OPTION.
(PULLOUT CAPACITY=750 LB, SHEAR CAPACITY=900 LB, OK BY SIMPLE REVIEW)

5

OVERTURNING ANALYSIS: TYPE 6-12 SHELVES (BACK-TO-BACK ROWS) (SEE DETAIL C)

DEPTH OF BACK-TO-BACK UNIT = 24 IN
TOP SHELF HEIGHT = 120 IN
LEVELS= 6 LVL

(A) FULLY LOADED:
Vtotal = 194 LB

Mot = ∑(Fp*h*2 UNITS)*0.75
= 12,677 IN-LB

Mst = ∑[(0.6-0.115S_{DS})wDL +0.75*(0.6-0.145S_{DS})*0.67wPL] x Depth / 2
= 7,715 IN-LB

Puplift = (Mot - Mst)/D
= 207 LB <= UPLIFT

(B) TOP SHELF LOADED

Vtop = 54 LB

Mot = ∑(Fp*h*2 UNITS)*0.75
= 4,722 IN-LB

Mst = ∑[(0.6-0.115S_{DS})wDL + 0.75*(0.6-0.145S_{DS})wPL] x Depth / 2
= 2,204 IN-LB

Puplift = (Mot - Mst)/D
= 105 LB <= UPLIFT

ANCHOR:
QUANTITY= 1 PULLOUT = 750 LB SHEAR = 800 LB
OCCURRENCE = 2

Ps/Pt + Vs/Vt ≤ 1.2
COMBINED STRESS(A) = (414 LB/(1*750 LB)) + (194 LB/(1*800 LB))
= **0.79** **< 1.2 OK**

COMBINED STRESS(B) = (210 LB/(1*750 LB)) + (54 LB/(1*800 LB))
= **0.35** **< 1.2 OK**

USE (1) 3/8"Ø x 2-1/2" MIN. EMBED. HILTI KH-EZ SCREW ANCHOR (ICC ESR-3027) PER FOOT PLATE
ANCHORAGE REQUIRED AT EVERY OTHER BAY AND AT ENDS, PERIMETER POST ONLY
USE 3/8"Ø x 2-1/2" MIN. EMBED. POWERS POWER STUD SD2 (ICC ESR-2502) AS AN OPTION.
(PULLOUT CAPACITY=750 LB, SHEAR CAPACITY=900 LB, OK BY SIMPLE REVIEW)

6

SLAB & SOIL ANALYSIS: TYPE 6-12 SHELVES (SINGLE ROW)

[1.2+0.25S_{DS}]DL+[0.85+0.25S_{DS}]*PL+1.5*EL= 1,666 LB

(A) PUNCTURE
Pmax = 1666 LB

BASE PLATE WIDTH (W)= 5.00 IN
BASE PLATE DEPTH (B)= 2.25 IN

Fpunct = 2.66*sqrt(f'c)
= 133 PSI

Apunct = (W+B+t)*2*t
= 90. IN^2

fv/Fv = Pmax/(Apunct * Fpunct)
= **0.14** **< 1.0 OK**

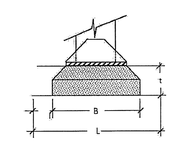
(B) SLAB TENSION
Asoil = Pmax * 144/fsoil
= 479.9 IN^2
L= (Asoil)^.5
= 21.9 IN
B = sqrt(B*W) + t
= 7.4 IN
l = (L-B)/2
= 7.3 IN

Mconc = w*l^2/8 = (fsoil*l^2) / (144*2)
= 91.9 IN-LB

Sconc = 1 in * t^2 / 6
= 2.67 IN^3

fconc = .5Ø* sqrt(f'c) WHERE Ø=0.55
= 138 PSI

fb/Fb = Mconc/(Sconc*fconc)
= **0.25** **< 1.0 OK**



SLAB:
t = 4.0 IN
f'c = 2,500 PSI
Ø = 0.55

SOIL:
fs = 500 PSF

7 8 9

ADDRESS:
O'REILLY AUTO
489 WEST 5TH AVENUE
JUNCTION CITY, OR

REV.	DATE	BY	DESCRIPTION

SEIZMIC
EST. 1985
SEIZMIC ENGINEERING, INC.
161 Atlantic Street
Pomona, California 91768
Tel.(909)869-0989
Fax (909)869-0981

DRAWN BY:	A.N./T.C.
DATE:	08/27/13
LAST REV. BY:	
REV. DATE:	
TYPE:	LOZ.
SCALE:	N.T.S.
APRV'D BY:	SAL E. FATEEN

REGISTERED PROFESSIONAL ENGINEER 12303 OREGON JULY 15, 1983 MICHAEL M. OBI

EXPIRATION DATE: DEC. 31, 2014

DESCRIPTION:
LIGHT DUTY STORAGE (FIXTURE #1A)

DRAWING NUMBER:
13-1274-A