10 April 2014

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SUBJ: STAINLESS STEEL SPIDER FITTINGS
LOAD RATINGS

I have evaluated the strengths of the CRL stainless steel spider fittings in accordance with the 2006, 2009 and 2012 International Building Code. The cast stainless steel components conform to ASTM A 743.

The structural properties and fitting strengths shown in this report are provided for reference purposes. The Specifier or Engineer-of-Record shall be responsible to determine that the fittings are appropriate for the application and the design of the supporting structure.

| | | Allowable Load per Arm | | | $\sqrt{(F_x^2+F_y^2+F_x^2)}$ |
|---|---|---|---|---|---|
| Contents: | Page | $F_x$ | $F_y$ | $F_z$ | Total resultant load on Fitting |
| FMH | 4 - 5 | 135# | 135# | 491# | 1,354# |
| GRF | 6 - 7 | 135# | 135# | 759# | 1,886# |
| GRP | 8 - 9 | 135# | 135# | 632# | 2,528# 412# total for $F_x$, $F_y$ |
| PMH | 10 - 11 | 224# | 224# | 942# | 1,237# for unbalanced fittings<br>2,804# for balanced fittings |
| PMR | 12-13 | 141# | 141# | 298# | 1,192# |
| | | | | | |
| Glass Fittings: | | | | | |
| RRF10 | 14 | 139# | 139# | 715# | 765# |
| RSF10 | 15 | 135# | 135# | 715# | 742# |
| HRF14 | 16 | 592# | 592# | 1,430# | 1,430# |
| HSF14 | 17 | 592# | 592# | 1,430# | 1,430# |
| HSFEX14 | 18 | 710# | 710# | 1,324# | 1,500# |

Resultant load = $\sqrt{[F_x^2+F_y^2+F_z^2]}$

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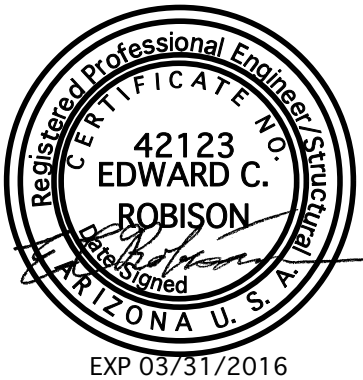
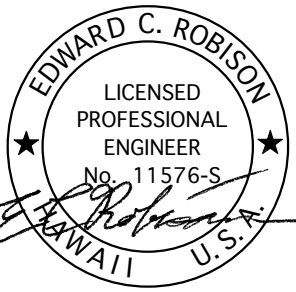
Signed 04/10/2014




EXP 03/31/2016

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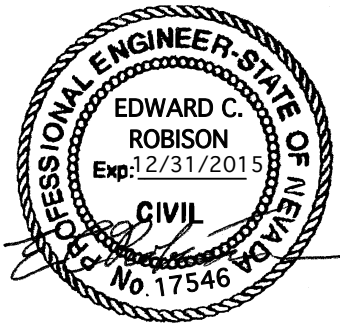
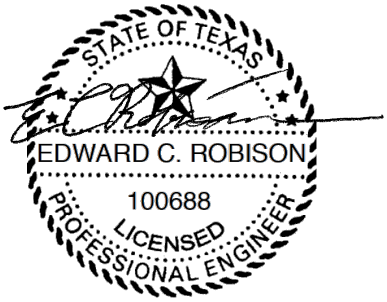




EXP 12/31/2015


EXP 09/30/2015

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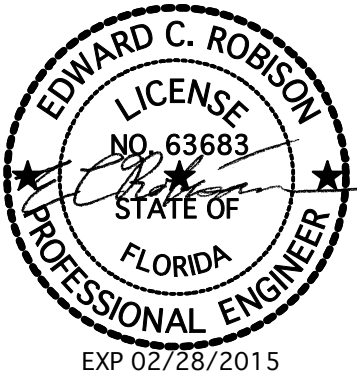


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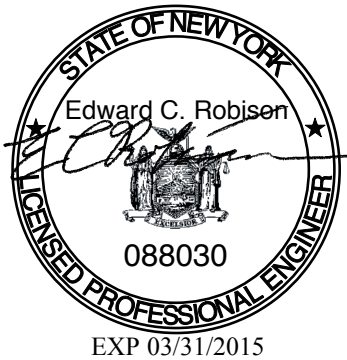


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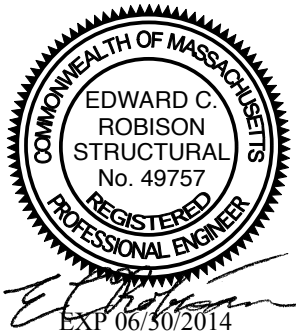
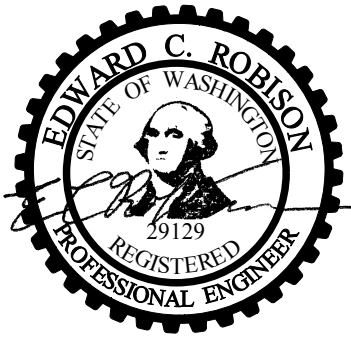
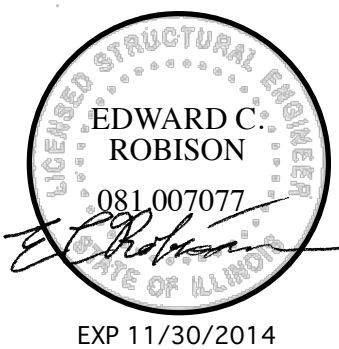



EXP 06/30/2014


EXP 12/31/2014

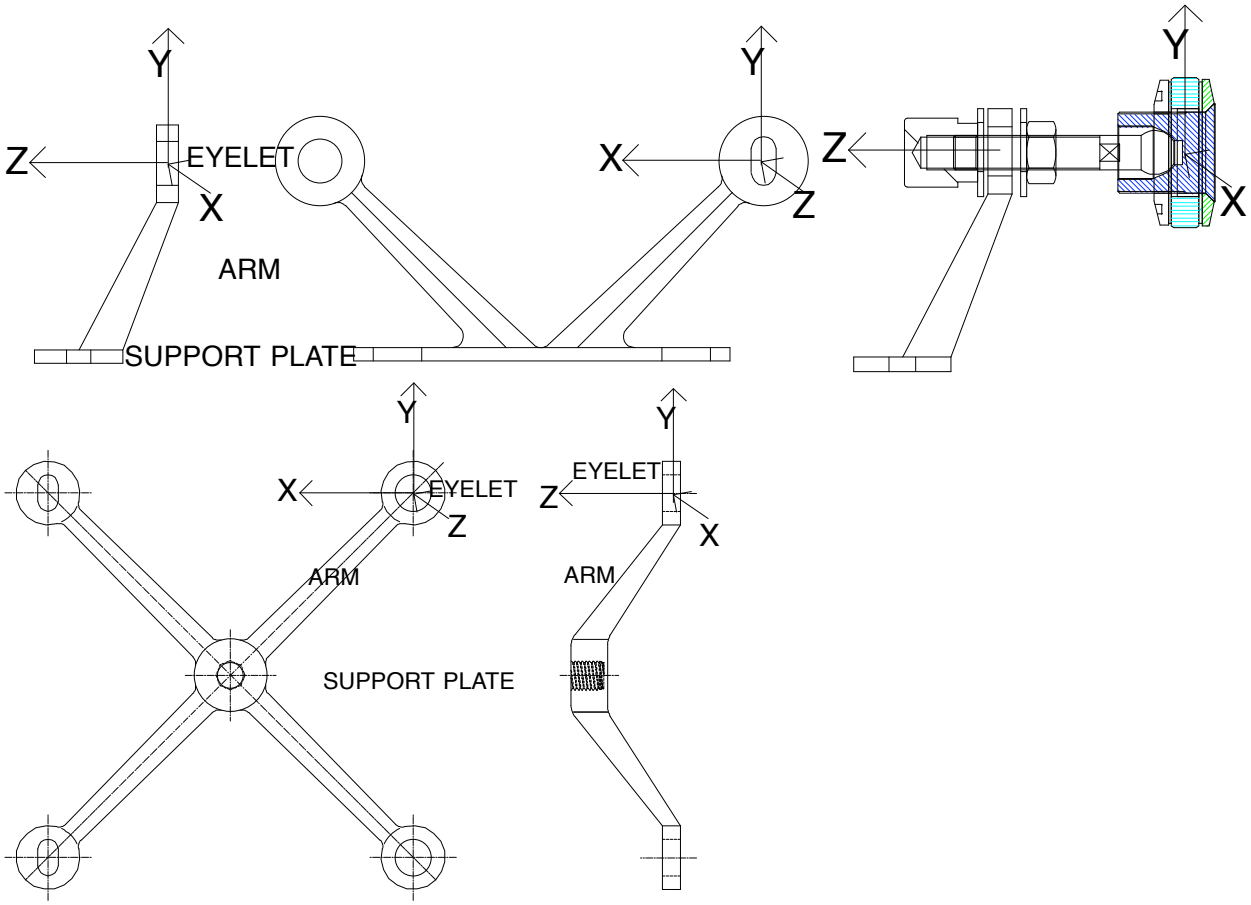



EXP 11/30/2014

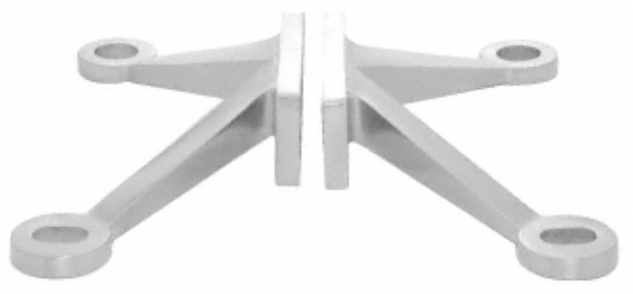
CAST STAINLESS STEEL STRENGTH: Design yield strength, $F_y \geq 45$ ksi used for calculations based on 0.02% offset at 30 ksi and $F_u \geq 70$ ksi. Part geometry allows for rapid strain hardening of the part at the base of the fitting arms so that part yield strength in use increases to over 45 ksi, For ultimate strength use $F_u = 70$ksi.
b/t = 0.625/4.24 < 33.9 thus $C_y = 3.0$, $E_0 = 28x10^6$ psi, $E_{30} = 14.45x10^6$ psi (at 30 ksi)
$F_{yeff} = C_y*E_{30}/E_0*F_y = 3*14.45/28*30ksi = 46.4$ ksi: Use 45 ksi.

SPIDER FITTING NOMENCLATURE

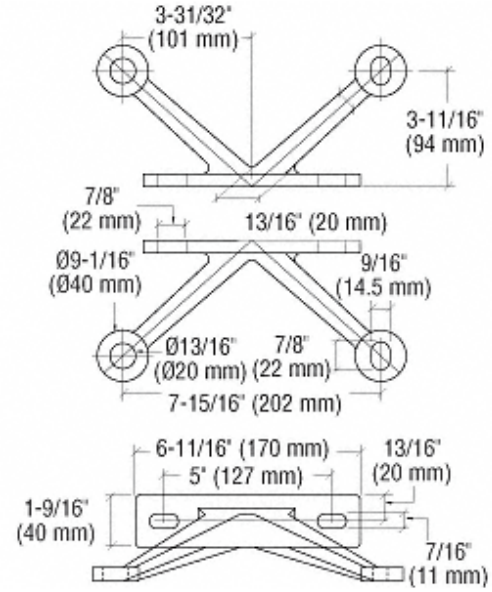



X and Y are loads in glass plane - typically dead load for vertical glass and in plane seismic loads.
Z represents loads perpendicular to the glass face. - Wind load and out of plane seismic loads for all glass orientations. All gravity loads for horizontal glass.
For sloped glass gravity loads must be resolved into the in plane and perpendicular components.

**FMH SPIDER FITTINGS**
**FMH4**

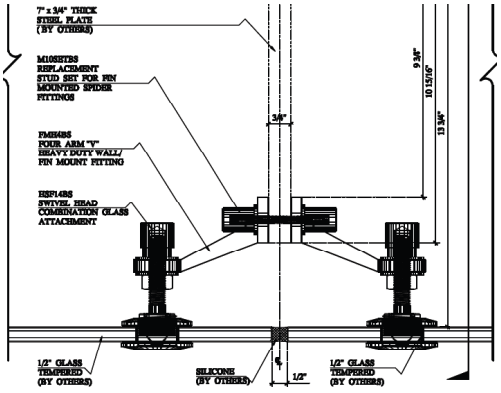


Determine standoff strength:
M = P*2.5" where P = V or H
Shear on screw = Z = H or V
C = T = M/(1.75"/2) = P*(2.5"/0.875") = 2.86P
STRENGTH OF BOLTS TO SUPPORTS
Strength of bolts into support plate
screw 316 Condition CW ASTM F593-98
size 10 mm
$A_t = 57.99mm^2 = 0.0899in^2$
$A_v = 78.54mm^2 = 0.1217in^2$
$øV_n = 0.65*0.1217in^2*42.8\ ksi = 3{,}386\#$
$øT_n = 0.75*0.0899in^2*71.2\ ksi = 4{,}800\#$




Moment resistance of connection:
For vertical parallel loading
$øM_n = 3{,}386\#*(5") = 16{,}930\#"$
$M_s = øM_n/1.6 = 16{,}930/1.6 = 10{,}581\#"$
$V_s = øV_n/1.6 = 2*3{,}386/1.6 = 4{,}232.5\#$
Determine allowable horizontal load:
$V = \sqrt{[4{,}232.5^2-(10{,}581\#"/4")^2]} = 3{,}304\#$
$3{,}304 < 2*(10{,}581/4) = 5{,}290\#$

For Horizontal load:
$øM_n = 4{,}800\#*(1.5625"/2) = 3{,}750\#"$
$M_s = øM_n/1.6 = 3{,}750/1.6 = 2{,}344\#"$
$H_s = 2{,}344\#"/3.6875 = 636\#$
$V_s = øV_n/1.6 = 2*3{,}386/1.6 = 4{,}232.5\#$
Determine service load of standoff from interaction equation where:




$(M/M_s)^2+(Z/Z_s)^2 \le 1.0$
$P = \sqrt{(H^2+V^2)} = Z$ and $M = 3.6875"*P$
substituting using P:
$(3.6875P/2{,}344)^2 + (P/4{,}232.5)^2 = 1$ then solving for P

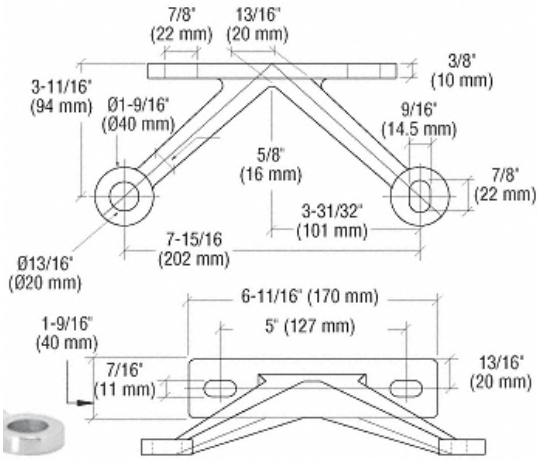
$P = \{1/[(3.6875/2{,}344)^2 + 1/4{,}232.5^2]\}^{1/2}$
P = 629# = Maximum horizontal load

Vertical (dead load) will not reduce the allowable horizontal load until it is over:
0.2*2*3,386 = 1,354#
This greatly exceeds the maximum light weight because of other limitations.

**FMH (continued)**

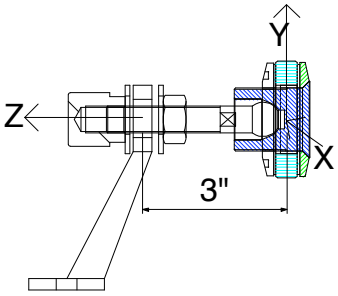
Check strength of spider fitting arm
horizontal bending strength:
Fy ≥ 45 ksi, For ultimate strength use $F_u$ = 70ksi.
Bending of arm base at support plate:

$Z_{yy} = 5/8*0.75^2/4 = 0.0879\ in^3$
$M_{sx} = M_{sx} = øM_n/1.6 = 0.9*0.0879*45/1.6 = 2{,}225\#"$
$H_{sx} = 2{,}225\#"/4.533" = 491\#$ perpendicular to glass




$Z_{xx} = Z_{yy} = (⅝)^2*0.75/4 = 0.0732\ in^3$
$M_{sx} = M_{sx} = øM_n/1.6 = 0.9*0.0732*45/1.6 = 1{,}854\#"$
$H_{sx} = 1{,}854\#"/3.3125 = 560\#$
$H_{sy} = 1{,}854\#"/3.85 = 482\#$

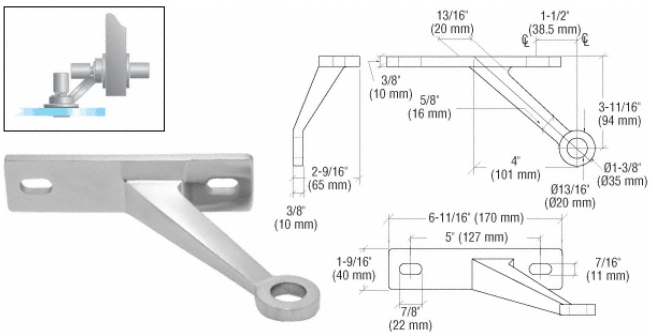
Check strength of eyelet attachment to arm for loads in the glass plane with a maximum offset of 3".
Offset from glass fitting causes torsion at the eyelet to arm
b = 0.482" ; = c = 0.375"; α = 0.221
$\tau_{max} = F_y\alpha bc^2 = 45ksi*0.221*0.482*0.375^2 = 674"\#$
$P_{ax} = P_{ay} = (674/1.67)/3" = 135\#$




Allowable horizontal load on glass light (perpendicular to glass) each fitting arm-
H = 491#*4 fittings = 1,964#
For loads in the glass plane (dead load and seismic load for vertical glass):
V = 135# per fitting

Fitting variations:
FMH2
Fitting is identical to the FMH4 except only installed on one side of the support fin.
Same allowable load per arm.
Same allowable load on fitting.

FMH1
single arm allowable vertical load per fitting:
Check eccentricity in fin plate:
$Z = 1.5625*0.375^2/4$
$Z = 0.0549 in^3$
$øM_n = 0.9*0.0549*45ksi = 2{,}225\#"$
$V_s = 2{,}225\#"/(1.2*3.3125) = 560\#$




Bending in fin plate will limit vertical/dead load to 560# maximum.

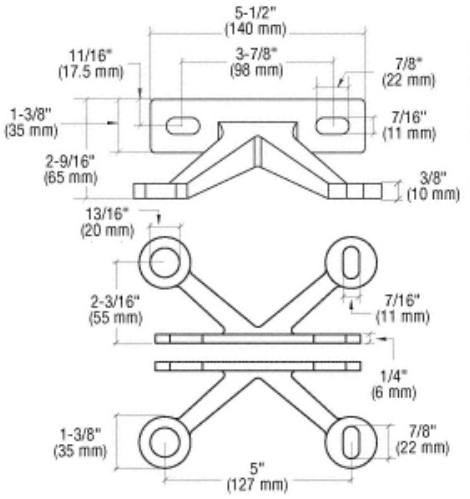
**FOR FMH FITTING LIMIT TOTAL RESULTANT LOAD ON A SINGLE ARM TO 491#**

**GRF SPIDER FITTINGS**

Check strength of spider fitting arm
horizontal bending strength at face of connection plate
$Z_z = (13/16)^2*0.575/4 = 0.0949\ in^3$
$M_{nz} = ZF_y$
$M_{sz} = øM_n/1.6 = 0.9*0.0949*45/1.6 = 2{,}402\#"$
$H_{sz} = 2{,}402\#"/3.163" = 759\#$

$Z_x = Z_y = 13/16*0.575^2/4 = 0.0672\ in^3$
$M_{nx} = M_{ny} = ZF_y$
$M_{sx} = M_{sy} = øM_n/1.6 = 0.9*0.0672*45/1.6 = 1{,}700\#"$
$H_{sx} = 1{,}700\#"/1.9375" = 877\#$
$H_{sy} = 1{,}700\#"/2.5" = 680\#$

For interaction between vertical and horizontal:
$Z/759+X/877+Y/680 \le 1.0$




Check strength of eyelet attachment to arm for loads in the glass plane with a maximum offset of 3".
Offset from glass fitting causes torsion at the eyelet to arm
$b = 0.482"$ ; $= c = 0.375"$; $\alpha = 0.221$
$\tau_{max} = F_y\alpha bc^2 = 45ksi*0.221*0.482*0.375^2 = 674"\#$
$P_{ax} = P_{ay} = (674/1.67)/3" = 135\#$

Determine connection strength to support post:
Loads on fasteners
M = P*2 3/16" where P = V or H
Shear on fasteners = Z = 1/2*(H or V)
$C = T = M/(1.375"/2) = P*(2.1875"/0.6875") = 3.182P$

Strength of bolt into support
screw 316 Condition CW ASTM F593-86a
size 10 mm
$A_t = 57.99mm^2 = 0.0899in^2$
$A_v = 78.54mm^2 = 0.1217in^2$
$øV_n = 0.65*0.1217in^2*42.8\ ksi = 3{,}386\#$
$øT_n = 0.75*0.0899in^2*71.2\ ksi = 4{,}800\#$

For GRF4
Moment resistance of connection:
For horizontal loads:
$øM_n = 2*4{,}800\#*(1.375"/2) = 6{,}600\#"$
$M_s = øM_n/1.6 = 6{,}600/1.6 = 4{,}125\#"$
$V_s = øV_n/1.6 = 2*3{,}386/1.6 = 4{,}232\#$

GRF (continued)
For vertical loads:
$\phi M_n = 3{,}386\#*(3.875) = 13{,}121\#$”
$M_s = \phi M_n/1.6 = 13{,}121/1.6 = 8{,}200\#$”

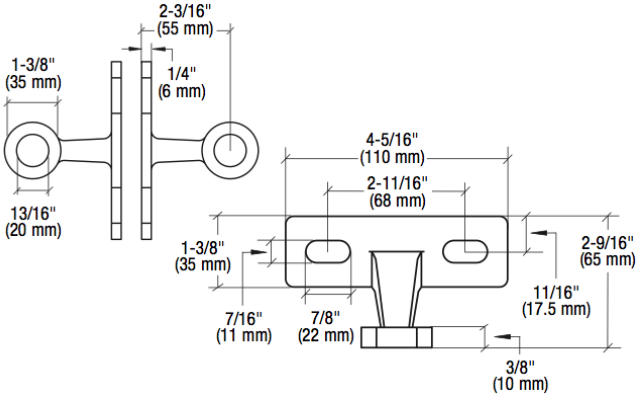
For Horizontal Loads:
M = 2.1875P $P_{sh} = 4{,}125\#/2.1875 = 1{,}886$
For Vertical loads:
M = 2.125P $P_{sv} = 8{,}200\#$”$/2.125 = 3{,}859\#$

GRF2
Arm and bolt strength is the same.

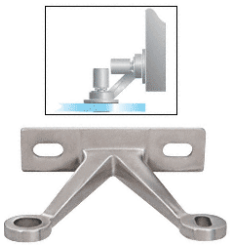
For vertical loads:
$\phi M_n = 3{,}386\#*(2.6875) = 9{,}100\#$”
$M_s = \phi M_n/1.6 = 9{,}100/1.6 = 5{,}687\#$”

For Horizontal Loads:
M = 2.1875P
$P_{sh} = 4{,}125\#/2.1875 = 1{,}886$

For Vertical loads:
M = 2.125P
$P_{sv} = 5{,}687\#$”$/2.125 = 2{,}676\#$

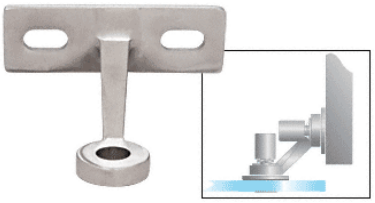



LOADS ARE LIMITED BY THE ARM STRENGTH
Allowable load on arm for the GRF2 fitting:
$M_s = 0.9*0.1342*45/1.6 = 3{,}397\#$”
$H_s = 3{,}397\#$”$/1.9375$” $= 1{,}753\#$
$V_s = H_s = 1{,}753\#$ or vertical or horizontal load acting alone
For interaction between vertical and horizontal:
$\sqrt{[H_s^2+V_s^2]} = 1{,}753\#$
For balanced load case $V_s = H_s = 1{,}753\#/\sqrt{2} = 1{,}240\#$



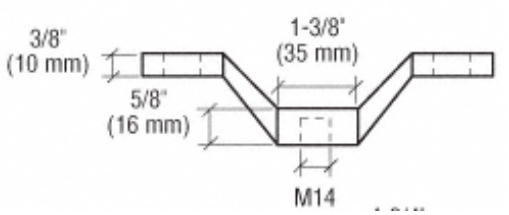
GRF2V
Same strength as the GRF4 fitting except is mounted to only one side.

GRF1
Same strength as the GRF2 fitting except is mounted to only one side.

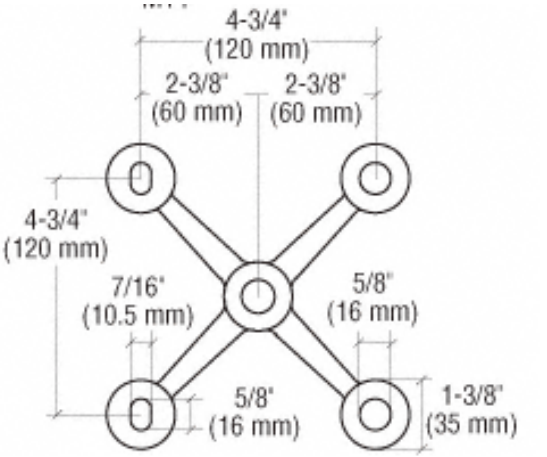


**GRP SPIDER FITTINGS**

Check strength of spider fitting arm
horizontal bending strength at face of connection hub
$Z_x=Z_y=Z_z = 5/8^3/4 = 0.061$ in$^3$
$M_n = ZF_y$
$M_s = øM_n/1.6$ =
$M_s = 0.9*0.061*45/1.6 = 1{,}545$"#
$H_{sx} = H_{sx} = 1{,}545$"#/1.6875" = 916#
$H_{sz} = 1{,}545$"#/2.386" = 647#
$V_s = H_s = 460$# or vertical or horizontal load acting alone
For interaction between vertical and horizontal:
$\sqrt{[H_s^2+V_s^2]} = 647$#




Check strength of eyelet attachment to arm for loads in the glass plane with a maximum offset of 3".
Offset from glass fitting causes torsion at the eyelet to arm
b = 0.482" ; = c = 0.375"; α = 0.221
$\tau_{max} = F_y\alpha bc^2 = 45$ksi$*0.221*0.482*0.375^2 = 674$"#
$P_{ax} = P_{ay} = (674/1.67)/3$" = 135#

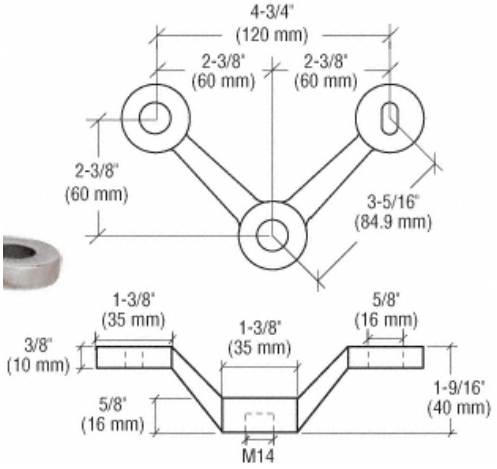


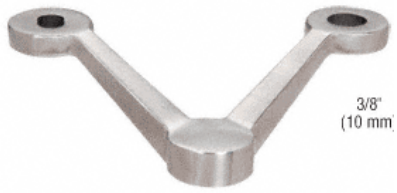

For maximum dead load case $V_s = 135$#
$H_s = [647\#^2 - 135^2]^{½} = 632$#
Determine connection strength to support post:
Loads on fasteners
M = P*3.359" where P = V or H
Shear on fasteners = Z = 1/2*(H or V)
C = T = M/(1.375"/2) = P*(3.359"/0.6875") = 4.886P
Assumes unbalanced horizontal loads (all horizontal load concentrated on a single arm.

Strength of bolt into support
screw 316 Condition CW ASTM F593-98
M14 threaded rod 316 Stainless steel
Shear strength:
$A_t = 115.44$mm$^2 = 0.1789$in$^2$
$A_v = 153.94$mm$^2 = 0.2386$in$^2$
$øV_n = 0.65*0.238$in$^2*42.8$ ksi = 6,621#
$øT_n = 0.75*0.1789$in$^2*71.2$ ksi = 9,553#
Strength of threads into cap
$øV_n = 0.85*57$ksi$*0.79"*0.25" = 9{,}569$#

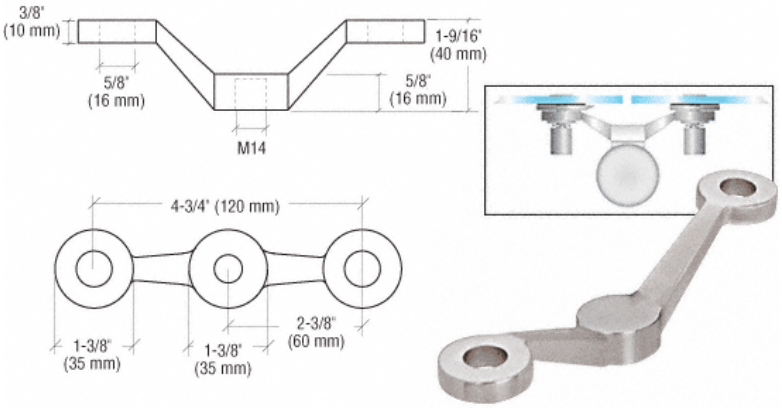
GRP (continued)
Moment resistance of connection:
For horizontal loads:
$\phi M_n = 0.9*9{,}553\#*(1.375"/2) = 5{,}910\#"$
$M_s = \phi M_n/1.6 = 5{,}910/1.6 = 3{,}694\#"$
$V_s = \phi V_n/1.6 = 6{,}621/1.6 = 4{,}138\#$

Check bending strength of stud for pure bending:
Applicable t vertical loads only
$Z = 0.55"^3/6 = 0.0277in^3$
$\phi M_n = 0.9*71.2ksi*0.0277in^3 = 1{,}777\#"$
for typical eccentricity = 1 3/16" = 1.1875"
$P_n = 1{,}777\#"/1.1875" = 1{,}496\#$
Determine allowable load:
$P_{sv} = 1{,}496\#/1.6 = 935\#$
X or Y (in glass plane):
Vx = Vy = [1,777"#/4.3125"] = 412# total
These strength parameters are applicable to all configurations:

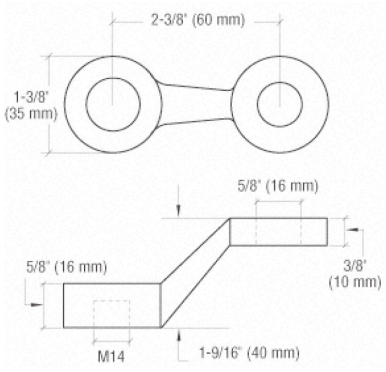


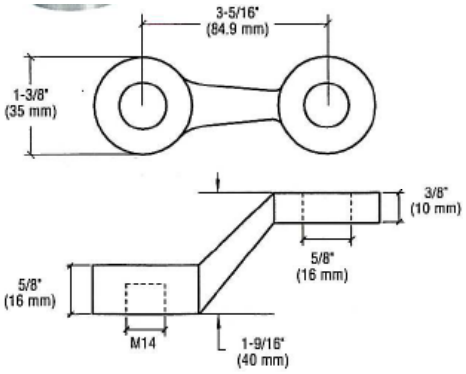




GRP2V




GRP2



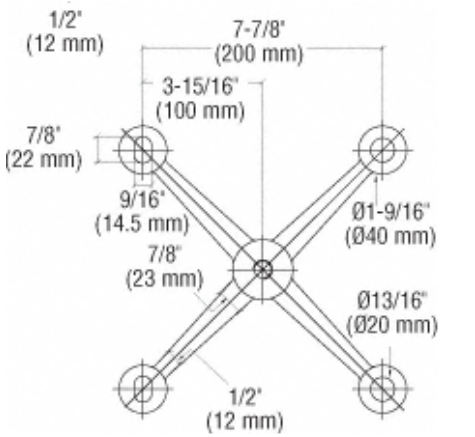

GRP1 (single arm) GRP1L

**FOR GRP FITTING LIMIT TOTAL LOAD ON A SINGLE ARM TO 460# AND 935# TOTAL ON THE FULL FITTING.**

**PMH SPIDER FITTINGS**
**PMH4**

Determine standoff strength:
Loads on anchor screw
M = P*2.5" where P = V or H
Shear on screw = Z = H or V
C = T = M/(1.75"/2) = P*(2.5"/0.875") = 2.86P

Strength of bolt into support
screw 316 Condition CW ASTM F593-98
size 16mm $A_t = 156.67mm^2 = 0.2428in^2$
$A_v = 201.06mm^2 = 0.3116in^2$
$øT_n = 0.75*71.2\ ksi*0.2428in^2 = 12{,}966\#$
$øV_n = 0.65*42.8\ ksi*0.3116in^2 = 8{,}668\#$




Moment resistance of connection:
$øM_n = 12{,}966\#*(1.75"/2) = 11{,}345\#"$
$M_s = øM_n/1.6 = 11{,}345/1.6 = 7{,}090\#"$
$V_s = øV_n/1.6 = 8{,}668/1.6 = 5{,}418\#$
for typical eccentricity for in plane forces (X or Y) = 5.75"
For vertical load:
Determine service load of standoff from interaction equation where:

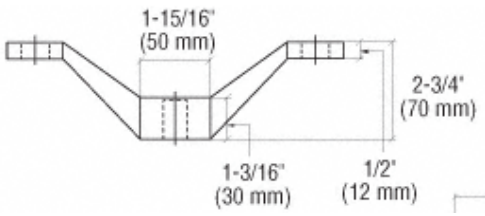
$(M/M_s)^2+(Z/Z_s)^2 \le 1.0$

$P = \sqrt{(H^2+V^2)} = Z$ and $M = 5.75"*P$
substituting using P:

$(5.75P/7{,}090)^2 + (P/5{,}418)^2 = 1$ then solving for P

$P = \{1/[(5.75/7{,}090)^2 + 1/5{,}418^2]\}^{1/2}$

$P_{x,y} = 1{,}202\#$ = maximum load for $\sqrt{(X^2+Y^2)}$




$P_z = \sqrt{[7{,}090^2 - (5.75*4*224)^2]}/3.9375 = 1{,}237\#$ For unbalanced load

Allowable horizontal load based on standoff strength can be taken as the same as vertical load.
Check bending strength of stud for pure bending:
Applicable t vertical loads only
$Z = 0.63"^3/6 = 0.0417in^3$
$øM_n = 0.9*71.2ksi*0.0417in^3 = 2{,}671\#"$

Check strength of spider fitting arm
horizontal bending strength
$Z_x = Z_y = 1.1875*0.893^2/4 = 0.237\ in^3$
$M_{sx,y} = øM_n/1.6 = 0.9*0.237*45/1.6 = 5{,}993\#"$
$H_{sx,y} = 5{,}993\#"/(3.031") = 1{,}977\#$

PMH (continued)

$Z_z = 0.893*1.1875^2/4 = 0.315\ in^3$

$M_{sz} = øM_n/1.6 = 0.9*0.315*45/1.6 = 7{,}969\#"$

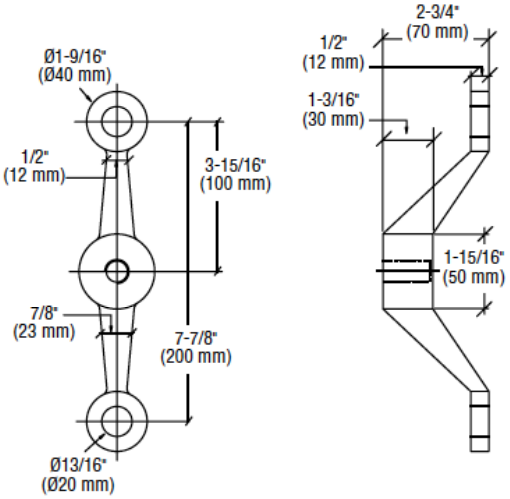
$H_{sz} = 7{,}969\#"/(5.585") = 1{,}427\#$

Bending at eyelet to arm:

$Z_z = 0.5253*0.472^2/4 = 0.0293$

$M_{sz} = 0.9*0.0293*45ksi/1.6 = 742"\#$

$P_z = 742\#/(1.575/2) = 942\#$




Check strength of eyelet attachment to arm for loads in the glass plane with an offset of 3".

Offset from glass fitting causes torsion at the eyelet to arm

$b = 0.5253"$ ; $= c = 0.472"$; $\alpha = 0.213$

$\tau_{max} = F_y \alpha b c^2 = 45ksi*0.213*0.5253*0.472^2 = 1{,}122"\#$

$P_{ax} = P_{ay} = (1{,}122/1.67)/3" = 224\#$

Fitting variations:

Same load per arm.

Total allowable load for all configurations is the same.

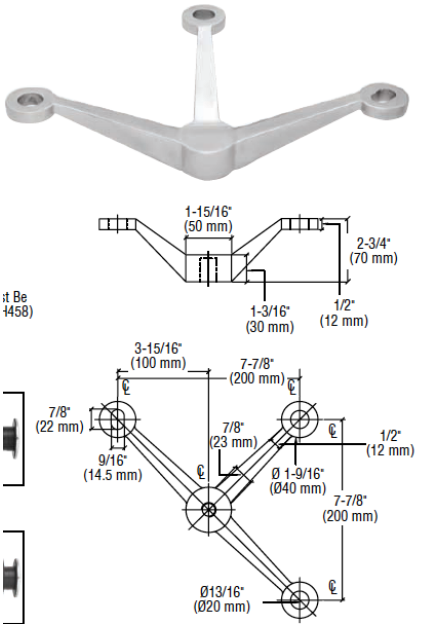
PMH2

Same allowable load per arm

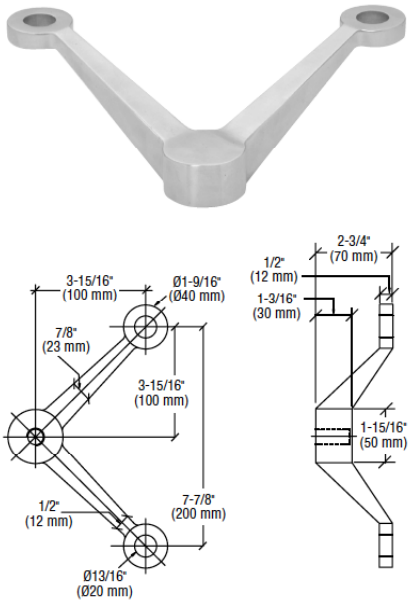
1/2 the allowable load per fitting.

Unbalanced load moment strength is same as for

Will always be unbalanced load




PMH3

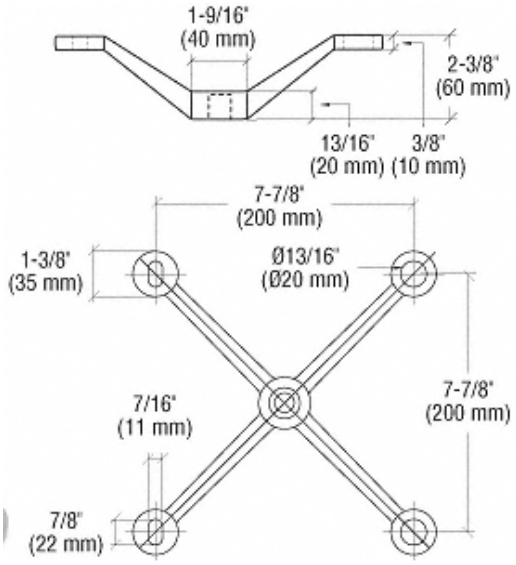



PMH2V

**PMR SPIDER FITTINGS**
**PMR4**

Determine standoff strength:
Loads on anchor screw
M = P*2.375" where P = V or H
Shear on screw = Z = H or V
C = T = M/(1 9/16"/2) = P*(2.375"/0.781") = 3.04P

Strength of bolt into support
screw 316 Condition CW ASTM F593-98
size 16mm $A_t$ = 156.67mm$^2$ = 0.2428in$^2$
$A_v$ = 201.06mm$^2$ = 0.3116in$^2$
ø$T_n$ = 0.75*71.2 ksi*0.2428in$^2$ = 12,966#
ø$V_n$ = 0.65*42.8 ksi*0.3116in$^2$ = 8,668#




Moment resistance of connection:
ø$M_n$ = 12,966#*(0.781") = 10,126#"
$M_s$ = ø$M_n$/1.6 = 10,126#"/1.6 = 6,329#"
$V_s$ = ø$V_n$/1.6 = 8,668#/1.6 = 5,418#

For vertical load:

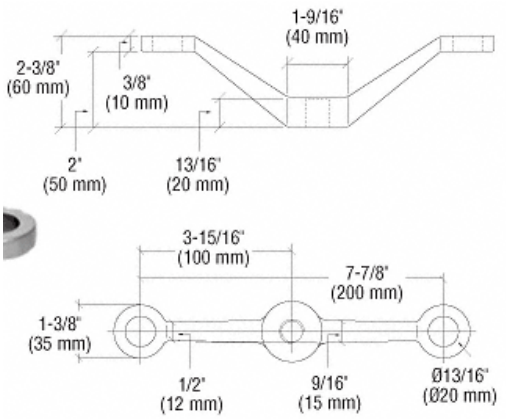
Determine service load of standoff from interaction equation where:
$(M/M_s)^2+(Z/Z_s)^2 \leq 1.0$
$P = \sqrt{(H^2+V^2)} = Z$ and M = 5.375"*P
substituting using P:
$(5.375P/6,329)^2 + (P/10,836)^2 = 1$ then solving for P
$P = \{1/[(5.375/6,329)^2 + 1/5,418^2]\}^{1/2}$
P = 1,151# = V for unbalanced load

Allowable horizontal load based on standoff strength can be taken as the same as vertical load.

Check strength of spider fitting arm
horizontal bending strength at hub
$Z = 9/16*0.575^2/4 = 0.0464$ in$^3$
$M_s$ = ø$M_n$/1.6 = 0.9*0.0464*45/1.6 = 1,175#"
$H_s$ = 1,175#"/3 15/16" = 298#
Bending at eyelet to arm:
$Z_z = 0.5*0.375^2/4 = 0.0176$in$^3$
$M_{sz}$ = 0.9*0.0176*45ksi/1.6 = 445"#
$P_Z$ = 445#/(1.375/2) = 647#

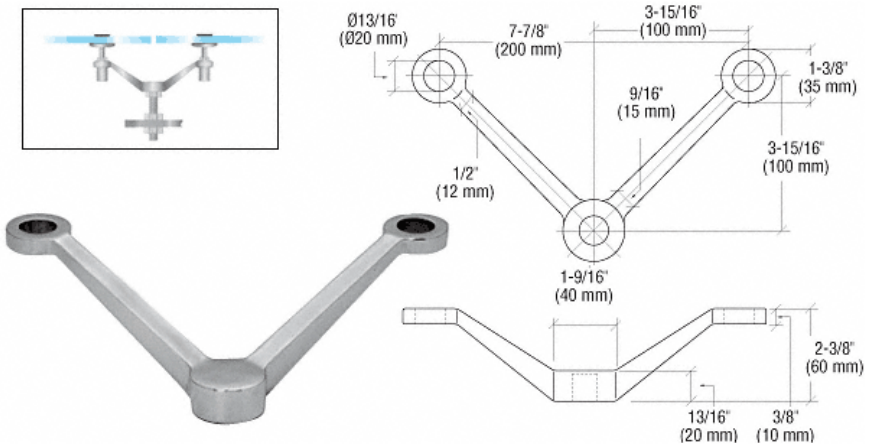
PMR (continued)
Check strength of eyelet attachment to arm for loads in the glass plane with an offset of 3".
Offset from glass fitting causes torsion at the eyelet to arm
b = 0.5" ; = c = 0.375"; $\alpha = 0.223$
$\tau_{max} = F_y \alpha b c^2 = 45ksi*0.223*0.5*0.375^2 = 706"\#$
$P_{ax} = P_{ay} = (706/1.67)/3" = 141\#$

Allowable horizontal load on glass lite each corner
H = 298#*4 fittings = 1,192#<1,541#
Fitting load limited by arm bending

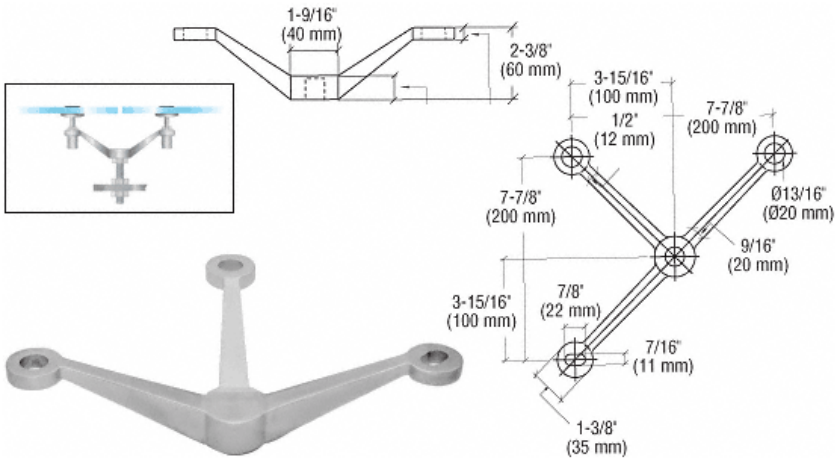



Fitting variations:
Same load per arm.
Total allowable load for all configurations is the number of arms times 298# < 1,541#

PMR2 or PMR2V
Same allowable load per arm
H= 298#,
Total = 2*298=596#
Unbalanced load moment strength is same as for PMR4

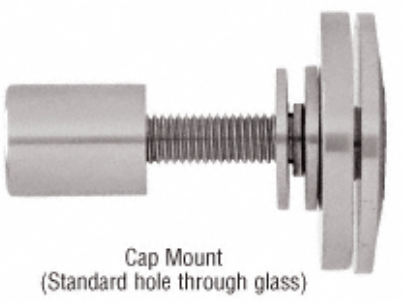



PMR3
Same allowable load per arm
H= 298#,
Total = 3*298=994#
Unbalanced load, moment strength is same as for PMR4

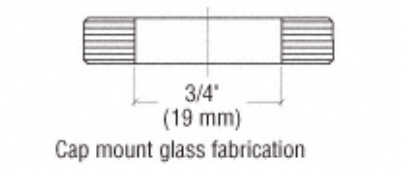



**MAXIMUM LOAD ON PMR FITTING IS 298# PER ARM**

**RRF10BS/PS**
Rigid fixed head
Mount to spider fitting

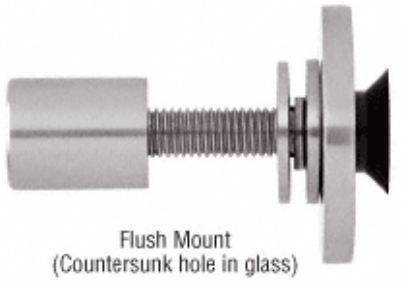

Cap Mount
(Standard hole through glass)

Fitting strength:
M10 threaded rod 316 Stainless steel
Shear strength:
$A_t = 57.99mm^2 = 0.0899in^2$
$A_v = 78.54mm^2 = 0.1217in^2$
$øV_n = 0.65*0.1217in^2*42.8\ ksi = 3{,}386\#$
$øT_n = 0.75*0.0899in^2*71.2\ ksi = 4{,}800\#$
For typical installation
$øM_n = 0.9*4{,}800\#*0.39" = 1{,}691\#"$ (based on rod in tension couple)
or for pure bending in rod:
$Z = 0.39"^3/6 = 0.00989in^3$
$øM_n = 0.9*71.2ksi*0.00989in^3 = 634\#"$
for typical eccentricity = 1/4"+3/16" = 0.4375
$P_n = 634\#"/0.4375" = 1{,}449\#$
Determine allowable load

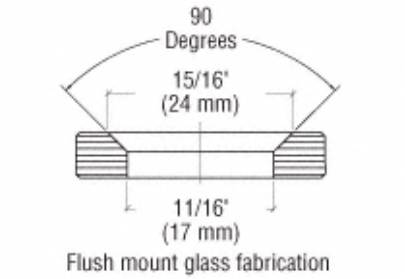


Cap mount glass fabrication

$(M/M_s)+(Z/Z_s) \le 1.2$
Typical will be L = 200# or W = 350# and D = 100#
$P_u = 1.6*200+1.2*100 = 440\#$ or $1.6*350\#+1.2*100 = 680\#$
$M_u = 680\#*0.4375" = 297.5\#"$
combined:
$(680\#/4{,}800\#)+(297.5\#"/634\#") = 0.61 < 1.2$ okay
Max allowable: $F_R = 765\#$ $F_x = F_y = 139\#$
FITTING SUPPORTS
Fittings are supported by steel with a minimum thickness of 1/4" designed for the concentrated load on the fitting.


Flush Mount
(Countersunk hole in glass)

STRENGTH OF COUNTERSUNK FITTING:
Check failure of bearing ring:
$øV_n = 0.65*(3/16"*0.9375"*\pi*25\ ksi = 8.97k$
Will not control



Flush mount glass fabrication

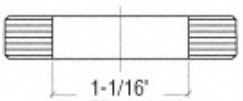
Check for glass stress:
$\sigma = P_n/(0.5t*0.6875\pi) = P_n/(1.08t)$
Using maximum from above with 3/8" glass:
$\sigma = 906\#/(1.08*0.375) = 2236$ psi

Bearing area:
$A = (1/4)*13/16\pi = 0.638\ in^2$
FITTING REQUIRES TEMPERED GLASS

**RSF10BS/PS**
Combination Swivel head
Mount to spider fitting

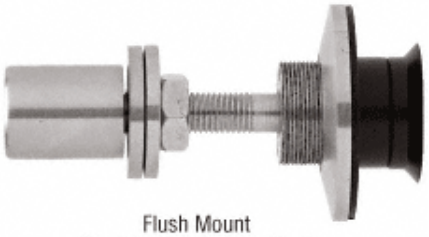

Cap Mount
(Standard hole through glass)

Fitting strength:
M10 threaded rod 316 Stainless steel
Shear strength:
$A_t = 57.99mm^2 = 0.0899in^2$
$A_v = 78.54mm^2 = 0.1217in^2$
$øV_n = 0.65*0.1217in^2*42.8\ ksi = 3{,}386\#$
$øT_n = 0.75*0.0899in^2*71.2\ ksi = 4{,}800\#$
Strength of swivel ball joint: Shear failure around socket rim:
$øV_n = 0.85*42ksi*0.95*0.55"*\pi*0.065" = 3{,}809\#$
For typical installation
$øM_n = 0.9*3{,}809\#*0.39" = 1{,}337\#"$ (based on rod in tension couple)
or for pure bending in rod:
$Z = 0.39"^3/6 = 0.00989in^3$
$øM_n = 0.9*71.2ksi*0.00989in^3 = 634\#"$
for typical eccentricity = 1/4"+3/16" = 0.4375
$P_n = 634\#"/0.4375" = 1{,}449\#$
Determine allowable load



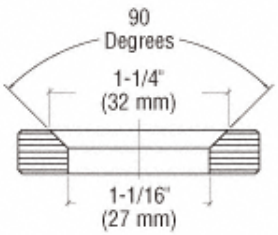
Cap mount glass fabrication

$(M/M_s)+(Z/Z_s) \le 1.2$
Typical will be L = 200# or W = 350# and D = 100#
$P_u = 1.6*200+1.2*100 = 440\#$ or $1.6*350\#+1.2*100 = 680\#$
$M_u = 680\#*0.4375" = 297.5\#"$
combined:
$(680\#/3{,}809\#)+(297.5\#"/634\#") = 0.65 < 1.2$ okay
Max allowable: $F_R = 550*1.35=742\ \#\ \ F_x = F_y = 135\#$
STRENGTH OF COUNTERSUNK FITTING:
Check failure of bearing ring:
$øV_n = 0.65*(3/16"*0.9375"*\pi*25\ ksi = 8.97k$


Flush Mount
(Countersunk hole in glass)

Check for glass stress:
$\sigma = P_n/(0.5t*0.6875\pi) = P_n/(1.08t)$
Using maximum from above with 3/8" glass:
$\sigma = 906\#/(1.08*0.375) = 2236\ psi$

Bearing area:
$A = (1/4)*13/16\pi = 0.638\ in^2$
FITTING REQUIRES TEMPERED GLASS



Flush mount glass fabrication

**HRF14BS/PS**
Fixed head
Mount to spider fitting


Cap Mount
(Standard hole through glass)

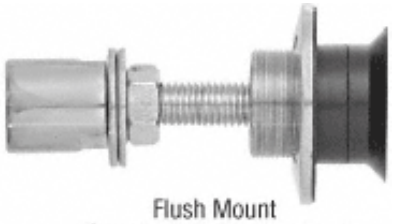
Fitting strength:
M14 threaded rod 316 Stainless steel
Shear strength:
$A_t = 115.44mm^2 = 0.1789in^2$
$A_v = 153.94mm^2 = 0.2386in^2$
$øV_n = 0.65*0.238in^2*42.8\ ksi = 6{,}621\#$
$øT_n = 0.75*0.1789in^2*71.2\ ksi = 9{,}553\#$
Strength of threads into cap
$øV_n = 0.85*57ksi*0.79"*0.25" = 9{,}569\#$

Cap mount glass fabrication

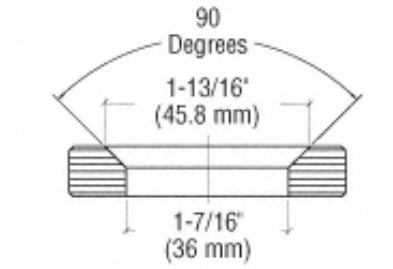
For typical installation
$øM_n = 0.9*9{,}553\#*0.55" = 4{,}713\#"$ (based on rod in tension couple)
or for pure bending in rod:
$Z = 0.55"^3/6 = 0.0277in^3$
$øM_n = 0.9*71.2ksi*0.0277in^3 = 1{,}777\#"$
for typical eccentricity = 1/4"+3/8" = 0.625
$P_n = 1{,}777\#"/0.625" = 2{,}843\#$
Determine allowable load

$(M/M_s)+(Z/Z_s) \leq 1.2$

Typical will be L = 200# or W = 350# and D = 100#
$P_u = 1.6*200+1.2*100 = 440\#$ or $1.6*350\#+1.2*100 = 680\#$
$M_u = 680\#*0.625" = 425\#"$
combined:
$(680\#/6{,}621\#)+(425\#"/1{,}777\#") = 0.34 < 1.2$ okay
$F_x = F_y = 1{,}777/3 = 592\#$


Flush Mount
(Countersunk hole in glass)

STRENGTH OF COUNTERSUNK FITTING:
Check failure of bearing ring:
$øV_n = 0.65*(3/16"*1.4375"*\pi*25\ ksi = 13.76k$
Will not control



Flush mount glass fabrication

Check for glass stress:
$\sigma = P_n/(0.5t*1.4375\pi)$
Using maximum from above with 1/2" glass:
$\sigma = 1{,}252/(0.5*0.5*1.4375\pi) = 1{,}110\ psi$

Bearing area:
$A = (3/16)^2*1.4375\pi = 0.847\ in^2$

FITTING REQUIRES TEMPERED GLASS

**HSF14BS/PS**
Combination Swivel head
Mount to spider fitting


Cap Mount
(Standard hole through glass)

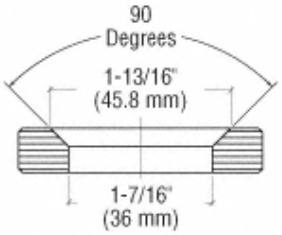
Fitting strength:
M14 threaded rod 316 Stainless steel
Shear strength:
$A_t = 115.44mm^2 = 0.1789in^2$
$A_v = 153.94mm^2 = 0.2386in^2$
$øV_n = 0.65*0.238in^2*42.8\ ksi = 6{,}621\#$
$øT_n = 0.75*0.1789in^2*71.2\ ksi = 9{,}553\#$
Strength of swivel ball joint: Shear failure around socket rim:
$øV_n = 0.85*42ksi*0.95*0.59"*\pi*0.18" = 11{,}315\#$

For typical installation
$øM_n = 0.9*9{,}553\#*0.55" = 4{,}713\#"$ (based on rod in tension couple)
or for pure bending in rod:
$Z = 0.55"^3/6 = 0.0277in^3$
$øM_n = 0.9*71.2ksi*0.0277in^3 = 1{,}777\#"$
for typical eccentricity = 1/4"+3/8" = 0.625
$P_n = 1{,}777\#"/0.625" = 2{,}843\#$
Determine allowable load

$(M/M_s)+(Z/Z_s) \leq 1.2$

Typical will be L = 200# or W = 350# and D = 100#
$P_u = 1.6*200+1.2*100 = 440\#$ or $1.6*350\#+1.2*100 = 680\#$
$M_u = 680\#*0.625" = 425\#"$
combined:
$(680\#/6{,}621\#)+(425\#"/1{,}777\#") = 0.34 < 1.2$ okay
$F_x = F_y = 1{,}777"\#/3" = 592\#$


Flush Mount
(Countersunk hole in glass)



Flush mount glass fabrication

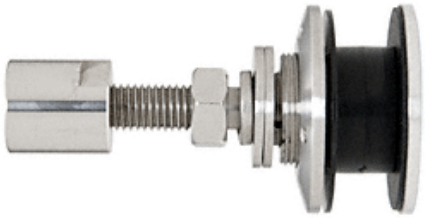
STRENGTH OF COUNTERSUNK FITTING:
Check failure of bearing ring:
$øV_n = 0.65*(3/16"*1.4375"*\pi*25\ ksi = 13.76k$
Will not control

Check for glass stress:
$\sigma = P_n/(0.5t*1.4375\pi)$
Using maximum from above with 1/2" glass:
$\sigma = 1{,}252/(0.5*0.5*1.4375\pi) = 1{,}110\ psi$

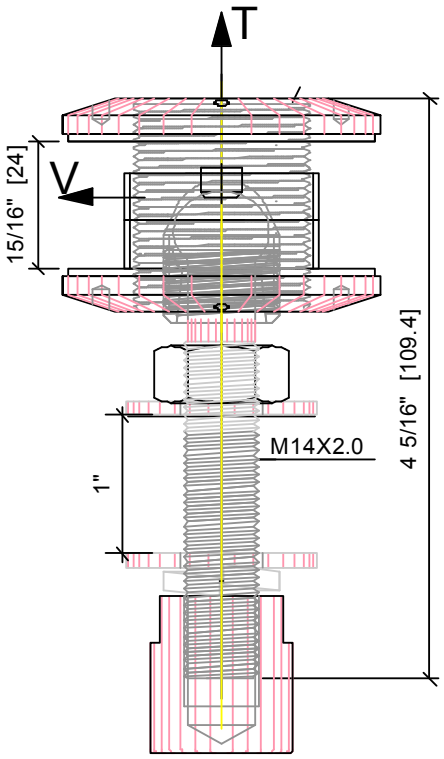
Bearing area:
$A = (3/16)^2*1.4375\pi = 0.847\ in^2$

FITTING REQUIRES TEMPERED GLASS

**HSFEX14BS**
Combination Swivel head
Mount to spider fitting



Fitting strength:
M14 threaded rod 316 Stainless steel
Shear strength:
$A_t = 115.44mm^2 = 0.1789in^2$
$A_v = 153.94mm^2 = 0.2386in^2$
$øV_n = 0.65*0.238in^2*42.8\ ksi = 6{,}621\#$
$øT_n = 0.75*0.1789in^2*71.2\ ksi = 9{,}553\#$
Strength of swivel ball joint: Shear failure around socket rim:
$øV_n = 0.85*42ksi*0.95*0.59"*\pi*0.18" = 11{,}315\#$




For typical installation
$øM_n = 0.9*9{,}553\#*0.55" = 4{,}713\#"$ (based on rod in tension couple)
or for pure bending in rod:
$Z = 0.55"^3/6 = 0.0277in^3$
$øM_n = 0.9*71.2ksi*0.0277in^3 = 1{,}777\#"$
for typical eccentricity = 1/4"+3/8" = 0.625
$P_n = 1{,}777\#"/0.625" = 2{,}843\#$
Determine allowable load
$(M/M_s)+(Z/Z_s) \leq 1.2$
Typical will be L = 200# or W = 350# and D = 100#
$P_u = 1.6*200+1.2*100 = 440\#$ or $1.6*350\#+1.2*100 = 680\#$
$M_u = 680\#*0.625" = 425\#"$
combined:
$(680\#/6{,}621\#)+(425\#"/1{,}777\#") = 0.34 < 1.0$ okay

Maximum shear load V when T = 0.2*6,621# = 1,324#
$V_a = (1{,}777"\#/2.5")/2 = 355\#$ at $T_a = 1{,}324/2 = 662\#$

Maximum glass thickness 7/8".
Maximum thickness of supporting material 1".

FITTING REQUIRES TEMPERED GLASS