W. W. SCHAEFER ENGINEERING & CONSULTING, P.A.
CALCULATIONS

By: W.W.S. Date: 07/07/14 Subject: PELLA CORP. Sheet 1 of 1
ANCHOR COMPARISONS
(DESIGNER CLAD DOUBLE HUNG WINDOW)

NO. 10 FRAME SCREWS

ANCHOR CONDITIONS:

TESTED: NO. 10 SCREWS INTO WOOD BUCK (EMBED = 1 1/4")
SUBSTITUTES: NO. 10 SCREW INTO 1/8" THICK ALUMINUM OR STEEL
NO. 10 SCREWS INTO 18 GA. STUD
1/4" CONCRETE SCREW INTO C-90 BLOCK (1 1/4" EMBED)

ALLOWABLE ANCHOR LOADS:

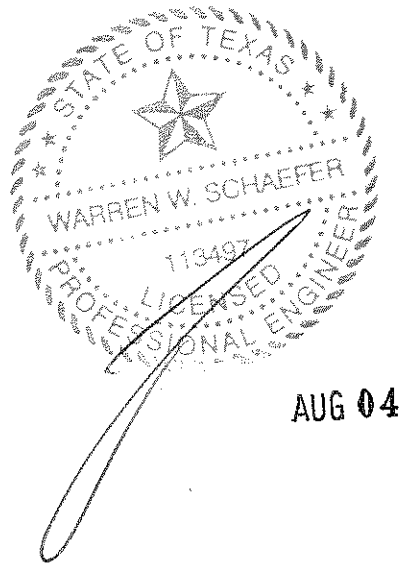
NO. 10 SCREW INTO WOOD: 139 LBS (SEE NDS SHEET)
NO. 10 SCREW INTO 1/8" THICK ALUMINUM OR STEEL:
23000 PSI X 0.125" X 0.17" X 1.95/3 = 318 LBS BEARING; Fu X A X 0.4/SQRT(3) = 419 LBS SHEAR
NO. 10 SCREW INTO 18 GA. STUD: 260 LBS (SEE DALE INCOR SPEC SHEET)
1/4" CONCRETE SCREW INTO BLOCK (1 1/4" EMBED, 2" ED & 3" SPACING):
RED HEAD TAPCON (C.S. & S.S.): 1000 LBS X 0.25 X 0.8 X 0.905 = 181 LBS
HILTI KWIK-CON II (C.S. & S.S.): 316 LBS
ELCO ULTRACON (C.S.): (900 LBS + (2/3 X 586)) X 0.25 X 3/3 = 323 LBS
ELCO CRETE-FLEX SS4 (S.S.): (424 LBS + (2/3 X 900)) X 0.25 X 3/3 X 1900/2070 = 235 LBS

ACTUAL ANCHIOR LOADS (MAXIMUM TESTED)

MAXIMUM ACTUAL ANCHOR LOAD = 120 LBS
* BASED ON WORSE CASE WINDOW CONDITION TESTED (45X77 TO 40 PSF WITH 4 ANCHORS/SIDE)
* CONSIDERS LOAD AREA OF INDIVIDUAL ANCHORS = (45/2 X 77)/(144 X 4 ANCHORS) = 3.0 SF

COMPARISON RESULT:

* THE SUBSTRATE SUBSTITUTES HAVE HIGHER ALLOWABLE VALUES THAN THE WOOD & THUS ARE ACCEPTABLE.
* ALL ALLOWABLE LOADS EXCEED THE ACTUAL AND THUS ALL ANCHORS ARE ACCEPTABLE.



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W. W. SCHAEFER ENGINEERING & CONSULTING, P.A.
CALCULATIONS

By: W.W.S. Date: 07/07/14 Subject: PELLA CORP. Sheet 1 of 1
ANCHOR COMPARISONS
(DESIGNER CLAD DOUBLE HUNG WINDOW)

NAIL FIN ANCHORS

ANCHOR CONDITIONS:

TESTED: 2" X 11 GAGE ROOFING NAILS INTO WOOD (SHAFT EMBED = 1 3/8")
SUBSTITUTES: NO. 8 X 1 1/2" SMS INTO WOOD (THREAD EMBED = 1 1/8")
NO. 8 X 1 1/2" SMS INTO 1/8" THICK ALUMINUM OR STEEL

ALLOWABLE ANCHOR LOADS:

11 GAGE FIN NAILS: 41 LBS X 1.25 X 1.6 = 82 LBS
NO. 8 FIN SCREW INTO WOOD: 141 LBS X 1.125 X 1.6 = 254 LBS
NO. 8 FIN SCREW INTO ALUM/STEEL: 595 LBS X 0.125/0.333 = 223 LBS

COMPARISON RESULT:

THE NO. 8 SCREW SUBSTITUTES HAS HIGHER ALLOWABLE VALUES THAN THE NAILS & THUS ARE ACCEPTABLE PROVIDING THE SCREW IS EITHER A WAFFLE HEAD SCREW OR THE SCREWS ARE INSTALLED WITH A WASHER.

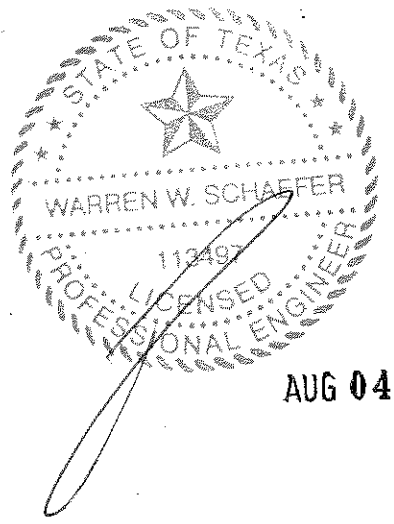
NOTE: THE NAIL FIN NAILS CONSIDERED AS TESTED ARE THE LONGEST USED BY PELLA IN TESTING, THUS GIVING THE HIGHEST POSSIBLE ALLOWABLE NAIL LOADS FOR THE MOST CONSERVATIVE COMPARISON WITH THE SUBSTITUTES.

ACTUAL ANCHIOR LOADS (MAXIMUM TESTED)

MAXIMUM ACTUAL ANCHOR LOAD = 55 LBS
* BASED ON WORSE CASE WINDOW CONDITION TESTED (45" WIDE WINDOW TO 50 PSF)
* CONSIDERS LOAD AREA OF INDIVIDUAL ANCHORS = (45/2 X 7)/144 = 1.09 SF

COMPARISON RESULT:

* THE SUBSTRATE SUBSTITUTES HAVE HIGHER ALLOWABLE VALUES THAN THE WOOD & THUS ARE ACCEPTABLE.
* ALL ALLOWABLE LOADS EXCEED THE ACTUAL AND THUS ALL ANCHORS ARE ACCEPTABLE.



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W. W. SCHAEFER ENGINEERING & CONSULTING, P.A.
CALCULATIONS

By: W.W.S. Date: 07/07/14 Subject: PELLA CORP. Sheet 1 of 1
ANCHOR COMPARISONS
(DESIGNER CLAD DOUBLE HUNG WINDOW)

FRAME CLIP MOUNT CONDITION (FLAT CLIP)

ANCHOR CONDITIONS:

TESTED: NO. 8 SCREWS INTO WOOD (EMBED = 1 1/4")
SUBSTITUTES: NO. 8 SCREW INTO 1/8" THICK ALUMINUM OR STEEL
NO. 8 SCREW INTO 18 GA. METAL STUD

ALLOWABLE ANCHOR LOADS:

NO. 8 SCREW INTO WOOD: 165 LBS (SEE NDS SHEET)
NO. 8 SCREW INTO ALUMINUM OR STEEL:
23000 PSI X 0.125" X 0.15" X 1.95/3 = 280 LBS BEARING; Fu X A X 0.4/SQRT(3) = 344 LBS SHEAR
NO. 8 SCREW INTO 18 GA. STUD: 240 LBS (SEE DALE INCOR SPEC SHEET)

ACTUAL ANCHIOR LOADS (MAXIMUM TESTED)

MAXIMUM ACTUAL ANCHOR LOAD = 120 LBS
* BASED ON WORSE CASE WINDOW CONDITION TESTED (45X77 TO 40 PSF WITH 4 ANCHORS/SIDE)
* CONSIDERS LOAD AREA OF INDIVIDUAL ANCHORS = (45/2 X 77)/(144 X 4 ANCHORS) = 3.0 SF

COMPARISON RESULT:

* THE SUBSTRATE SUBSTITUTES HAVE HIGHER ALLOWABLE VALUES THAN THE WOOD & THUS ARE ACCEPTABLE.
* ALL ALLOWABLE LOADS EXCEED THE ACTUAL AND THUS ALL ANCHORS ARE ACCEPTABLE.

STATE OF TEXAS
WARREN W. SCHAEFER
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LICENSED
PROFESSIONAL ENGINEER

AUG 04 2014

2012 NDS WOOD SCREW CALCULATION (WOOD TO WOOD)

NO. 10 SCREW INTO BUCK

5/8" THICK FRAMES

Z1 = (D X Lm X Fem)/Rd
Z2 = (D X Ls X Fes)/Rd
Z3 = (K1 X D X Ls X Fes)/Rd
Z4 = (K2 X D X Lm X Fem)/((1 + 2Re) X Rd)
Z5 = (K3 X D X Ls X Fem)/((2 + Re) X Rd)
Z6 = (D^2/Rd) X SQRT((2 X Fem X Fyb)/((3 X (1 + Re)))

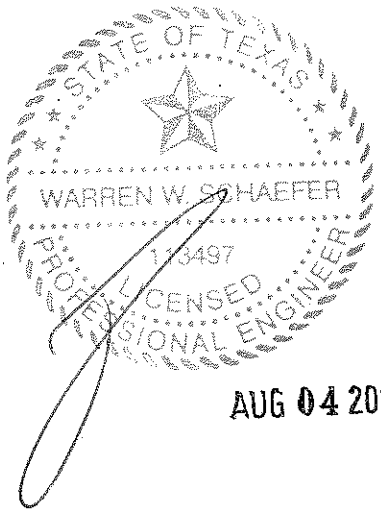
NOTES:
1. D IS THE ROOT DIAMETER DUE TO CONSIDERING ROLLED THREAD SCREWS
2. Z1 THRU Z6 ARE UNFACTORED LOADS. THE RESULTANT ALLOWABLE LATERAL LOAD (Z') WILL BE THE LESSER VALUE OF Z1 THRU Z6 MULTIPLIED BY DURATION AND EMBEDMENT FACTORS.
3. DURATION FACTOR = 1.6
4. PER NDS, WITH TRUE Lm BEING CONSIDERED, THERE IS NO REQUIRED EMBEDMENT FACTOR

D = Dr = ROOT DIAMETER
Lm = 10 X Dr = SCREW BEARING LENGTH IN MAIN MEMBER
Ls = SIDE MEMBER THICKNESS (SCREW BEARING LENGTH IN SIDE MEMBER)
Fyb = SCREW YIELD STRESS (100,000 PSI FOR #6 & 7 SCREWS; 90,000 PSI FOR #8 & 9 SCREWS; 80,000 PSI FOR #10 & 12 SCREWS; 70,000 PSI FOR #14 & 16 SCREWS; 60,000 PSI FOR #18 SCREWS)
Fem = ALLOWABLE BEARING STRESS ON MAIN MEMBER
Fes = ALLOWABLE BEARING STRESS ON SIDE MEMBER
Rd = REDUCTION TERM = 2.2 FOR #6 THRU 10 SCREWS; 10D + 0.5 FOR #12 THRU #18
Re = Fem/Fes
Rt = Lm/Ls
K1 = (SQRT(Re + 2Re^2(1 + Rt + Rt^2) + (Rt^2)(Re^3)) - Re(1 + Rt))/(1 + Re)
K2 = (SQRT(2Fyb(1 + 2Re)D^2/(3FemLm^2) +2(1 + Re)) -1
K3 = (SQRT(2Fyb(2 + Re)D^2/(3FemLs^2) +2(1 + Re)/Re) -1

FACTOR	VALUE
Dr	0.152
Lm	1.125
Ls	0.625
Fyb	80000
Fem	5550
Fes	3500
Rd	2.2
Re	1.586
Rt	1.800
K1	0.874
K2	1.430
K3	1.302
KD	1.6

Z1 =	431	LBS
Z2 =	151	LBS
Z3 =	132	LBS
Z4 =	148	LBS
Z5 =	87	LBS
Z6 =	112	LBS
Z =	87	LBS
Z' =	**139**	**LBS**

SCREW SIZE CONSIDERED: NO. 10
SIDE MEMBER CONSIDERED: PONDEROSA PINE (G = 0.43)
MAIN MEMBER CONSIDERED: SOUTHERN PINE (G = 0.55)



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2012 NDS WOOD SCREW CALCULATION (METAL TO WOOD)

NO. 8 CLIP SCREW INTO BUCK

Z1 = (D X Lm X Fem)/Rd
Z2 = (D X Ls X Fes)/Rd
Z3 = (K1 X D X Ls X Fes)/Rd
Z4 = (K2 X D X Lm X Fem)/((1 + 2Re) X Rd)
Z5 = (K3 X D X Ls X Fem)/((2 + Re) X Rd)
Z6 = (D^2/Rd) X SQRT((2 X Fem X Fyb)/((3 X (1 + Re)))

NOTES:
1. D IS THE ROOT DIAMETER DUE TO CONSIDERING ROLLED THREAD SCREWS
2. Z1 THRU Z6 ARE UNFACTORED LOADS. THE RESULTANT ALLOWABLE LATERAL LOAD (Z') WILL BE THE LESSER VALUE OF Z1 THRU Z6 MULTIPLIED BY DURATION AND EMBEDMENT FACTORS.
3. DURATION FACTOR = 1.6
4. PER NDS, WITH TRUE Lm BEING CONSIDERED, THERE IS NO REQUIRED EMBEDMENT FACTOR

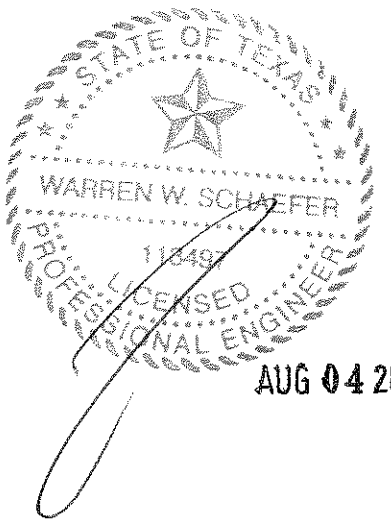
D = Dr = ROOT DIAMETER
Lm = SCREW BEARING LENGTH IN MAIN MEMBER
Ls = SIDE MEMBER THICKNESS (SCREW BEARING LENGTH IN SIDE MEMBER)
Fyb = SCREW YIELD STRESS (100,000 PSI FOR #6 & 7 SCREWS; 90,000 PSI FOR #8 & 9 SCREWS; 80,000 PSI FOR #10 & 12 SCREWS; 70,000 PSI FOR #14 & 16 SCREWS; 60,000 PSI FOR #18 SCREWS)
Fem = ULTIMATE BEARING STRESS ON MAIN MEMBER
Fes = ULTIMATE BEARING STRESS ON SIDE MEMBER
Rd = REDUCTION TERM = 2.2 FOR #6 THRU 10 SCREWS; 10D + 0.5 FOR #12 THRU #18
Re = Fem/Fes
Rt = Lm/Ls
K1 = (SQRT(Re + 2Re^2(1 + Rt + Rt^2) + (Rt^2)(Re^3)) - Re(1 + Rt))/(1 + Re)
K2 = (SQRT(2Fyb(1 + 2Re)D^2/(3FemLm^2) +2(1 + Re)) -1
K3 = (SQRT(2Fyb(2 + Re)D^2/(3FemLs^2) +2(1 + Re)/Re) -1

FACTOR	VALUE
Dr	0.131
Lm	1.25
Ls	0.052
Fyb	90000
Fem	5500
Fes	100000
Rd	2.2
Re	0.055
Rt	24.038
K1	0.542
K2	0.498
K3	12.440
KD	1.6

Z1 =	409	LBS
Z2 =	310	LBS
Z3 =	168	LBS
Z4 =	184	LBS
Z5 =	103	LBS
Z6 =	138	LBS
Z =	103	LBS
Z' =	**165**	**LBS**

Fes VALUES FOR METALS	
MATERIAL	Fes
36 KIS STEEL	87000
33 KSI STEEL	61850
50KSI STEEL	100000
6063-T5 ALUMINUM	31625
6063-T6 ALUMINUM	42625
6061-T6 ALUMINUM	59125

SCREW SIZE CONSIDERED: NO. 8
SIDE MEMBER CONSIDERED: 0.052" THICK 50 KSI STEEL
MAIN MEMBER CONSIDERED: SOUTHERN PINE (G = 0.55)



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,STENER LOAD TABLES

Spaced Threads

The following notes apply to Tables 23 thru 31:

Spaced Threads (Type AB, B or BP Self-Tapping Screws)

Allowable Bearing for Steel = (1.2)(0.125)(F_u)(D)
Allowable Bearing for Aluminum = Allowable Bearing Stress (D)(0.125)
Allowable Bearing Stress for Aluminum from Table 5.1.1a in, "Specifications for Aluminum Structures," by The Aluminum Association

$$\text{Minimum Thickness to Equal Allowable Tension of Fastener} = \left[\frac{\text{Allowable Tension}}{\text{Allowable Shear Stress } [TSA(I)][N]}\right] + \frac{1}{N}$$

Where:
F_u = Minimum Ultimate Tensile Strength of Steel or Stainless Steel as Applicable
TSA(I) = The Thread Stripping Area for Steel or Aluminum as Applicable

The values of TSA(I) and N for Unified Coarse Threads from Table 4 and the allowable tension calculated from the Thread Root Area, A(R), are used to determine the minimum thickness. These values are conservative.

The effectiveness of the length of engagement beyond the minimum required diminishes as the length increases. Little added strength is gained by exceeding length equal to twice the nominal thread diameter. The portion of the load carried by the threads most distant from the bearing surface is quite low.

Interaction Equation (Combined Stress Ratio): $$CSR = \left(\frac{f_v}{F_v}\right)^2 + \left(\frac{f_t}{F_t}\right)^2 \le 1$$

A 1/3 allowable increase in stress for wind loads has not been used to calculate the allowable values shown in these tables. Whether or not to use the increase is left to the discretion of the structural engineer on the job.

TABLE 23

STEEL - SAE Grade 2

Nominal Thread Diameter & Thread/Inch	D Nominal Thread Diameter (Inch)	K Basic Minor Diameter (Inch)	A(R) Thread Root Area (Sq. In.)	Allowable Tension (Pounds)	Allowable Shear		Bearing (Pounds)			Minimum Material Thickness to Equal Tensile Capacity of Fastener (In.)		
					Single (Pounds)	Double (Pounds)	1/8" St. A36	1/8" Al. 6063-T5	1/8" Al. 6063-T6	A36	6063-T5	6063-T6
#6-20	0.1380	0.0997	0.0078	231	133	267	1201	276	414	0.091	0.185	0.137
#8-18	0.1640	0.1257	0.0124	367	212	424	1427	328	492	0.117	0.252	0.182
#10-16	0.1900	0.1389	0.0152	450	260	520	1653	380	570	0.124	0.254	0.187
#12-14	0.2160	0.1649	0.0214	633	366	731	1879	432	648	0.145	0.309	0.224
1/4-14	0.2500	0.1887	0.0280	829	479	957	2175	500	750	0.165	0.345	0.252
5/16-12	0.3125	0.2443	0.0469	1388	802	1603	2719	625	938	0.207	0.446	0.323
3/8-12	0.3750	0.2983	0.0699	2069	1195	2389	3262	750	1125	0.248	0.581	0.390

F_u (Min. Ultimate Tensile Strength) 74,000 psi
F_y (Minimum Tensile Yield Strength) 57,000 psi

$A(R) = .7854K^2$

Where: A(R) = Thread Root Area, sq. in.
K = Basic Minor Diameter, in.

$F_t = 0.40F_u$

Allowable tension = $0.40F_u\,[A(R)]$

$F_v = \frac{0.40}{\sqrt{3}}F_u$

Allowable shear (Single) = $\frac{0.40}{\sqrt{3}}F_u[A(R)]$

TABLE 24

STEEL - SAE Grade 5

Nominal Thread Diameter & Thread/Inch	D Nominal Thread Diameter (Inch)	K Basic Minor Diameter (Inch)	A(R) Thread Root Area (Sq. In.)	Allowable Tension (Pounds)	Allowable Shear		Bearing (Pounds)			Minimum Material Thickness to Equal Tensile Capacity of Fastener (In.)		
					Single (Pounds)	Double (Pounds)	1/8" St. A36	1/8" Al. 6063-T5	1/8" Al. 6063-T6	A36	6063-T5	6063-T6
#6-20	0.1380	0.0997	0.0078	374	216	432	1201	276	414	0.128	0.281	0.202
#8-18	0.1640	0.1257	0.0124	595	344	687	1427	328	492	0.170	---	0.276
#10-16	0.1900	0.1389	0.0152	730	421	842	1653	380	570	0.175	0.386	0.277
#12-14	0.2160	0.1649	0.0214	1027	593	1186	1879	432	648	0.210	0.475	0.338
1/4-14	0.2500	0.1887	0.0280	1344	776	1552	2175	500	750	0.236	---	0.377
5/16-12	0.3125	0.2443	0.0469	2251	1300	2599	2719	625	938	0.301	---	0.489
3/8-12	0.3750	0.2983	0.0699	3355	1937	3874	3262	750	1125	0.364	---	0.593

0.333

F_u (Minimum Ultimate Tensile Strength) 120,000 psi
F_y (Minimum Tensile Yield Strength) 92,000 psi

$A(R) = .7854K^2$

Where: A(R) = Thread Root Area, sq. in.
K = Basic Minor Diameter, in.

$F_t = 0.40F_u$

Allowable tension = $0.40F_u\,[A(R)]$

$F_v = \frac{0.40}{\sqrt{3}}F_u$

Allowable shear (Single) = $\frac{0.40}{\sqrt{3}}F_u[A(R)]$

Suggested design loads for screw connections (pounds)

Steel Thickness (Gauge)	No. 12-14 (D = .160"; T = .177")		NO. 10-16 (D = .138"; T = .153")		NO. 8-18 (D = .120"; T = .125")		No. 6, S-12 (D = .100"; T = .106")	
	Type of Loading							
	Shear or Bearing	Pullout	Shear or Bearing	Pullout	Shear or Bearing	Pullout	Shear or Bearing	Pullout
12	890	280	780	245	675	210	560	175
14	555	195	520	170	470	145	395	125
16	390	155	370	135	340	115	310	95
18	280	120	260	105	240	90	220	75
20	185	95	175	80	165	70	150	60

NOTES:
1. Design values are based on CCFSS Technical Bulletin Vol. 2, No. 1 which outlines the proposed AISI specification provisions for screw connections
2. Minimum screw spacing and distance from edge shall not be less than 1 1/2 D nor less than P/Fyt where D is the screw shank diameter and P is the shear load.
3. When connecting materials of different gage, use loads shown for the lighter gage.
4. Screw capabilities are based on a minimum connected material strength of Fy = 33,000 PSI.

Suggested design loads for Powder driven fasteners in concrete

TABLE A

suggested capacity in stone aggregate concrete (pounds)

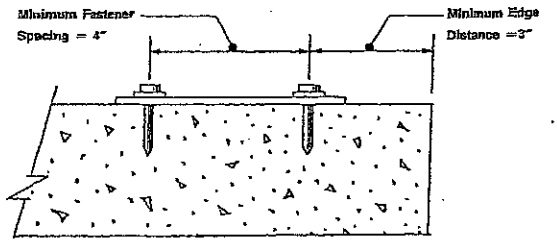
Shank Diameter	Minimum Penetration	Type of Loading	Concrete Compression Strength (PSI) 2000	3000	4000
0.145"	1⅛"	Pullout	90	115	145
		Shear	160	225	265
0.177"	1⅜"	Pullout	150	150	150
		Shear	250	285	330
0.205"	1¼"	Pullout	150	150	150
		Shear	390	445	500

TABLE B

suggested bearing capacity when used to connect gage thickness steel (pounds)

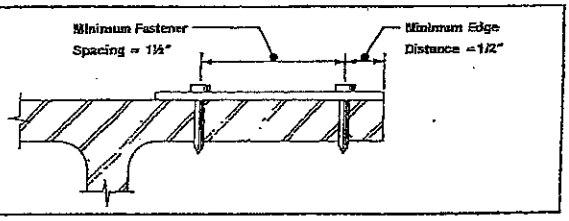
Shank Diameter	Steel Gage Thickness 16 Gage	18 Gage	20 Gage
0.145"	—	—	—
	—	—	198
0.177"	—	—	—
	—	321	241
0.205"	—	—	—
	485	372	279

NOTES:
1. Capacities shown are for stone aggregate concrete and are based on a low velocity shot.
2. Minimum fastener spacing — 4"; minimum fastener edge distance — 3".
3. Shear values are per Hilti ICBO Research Report #2388.
4. Bearing capacity is based on Bearing Area x 1.15 x 33,000 psi. Allowable bearing capacity per Section 4.5.6 of the 1986 A.I.S.I. "Specification for the Design of Cold Formed Steel Structural Members."
5. Pullout values per DALE/INCOR recommendations.



Suggested design loads in pull-out or shear for Powder driven fasteners in structural steel (pounds)

Cold Rolled Steel Gage	0.145" Shank Diameter			0.177" Shank Diameter			0.205" Shank Diameter		
	Hot Rolled Steel Thickness			Hot Rolled Steel Thickness			Hot Rolled Steel Thickness		
	¼"	⅜"	½"	¼"	⅜"	½"	¼"	⅜"	½"
12	210	210	210	335	395	395	485	525	660
14	210	210	210	335	395	395	485	525	581
16	210	210	210	335	395	395	465	465	465
18	210	210	210	321	321	321	372	372	372
20	197	197	197	241	241	241	279	279	279



NOTES:
1. Tests were conducted with the fastener point driven completely through the back side of the hot rolled steel member. This was necessary to obtain proper gripping force.
2. Bearing strength is based on Bearing Area x 1.15 x 33,000 psi for cold formed steel.
3. Shear values are per Hilti ICBO Research Report #2388.

Suggested design loads for fillet and flare-bevel groove welds

Steel Gage	Design Thickness (inches)	Weld Size (inches)	Allowable Load (Lb./In.)
12	.1017	5/32	1370
14	.0713	1/8	960
16	.0566	1/8	760
18	.0451	1/8	605

NOTES:
1. Values listed may be increased by 1/3 for wind or seismic loading (check codes for application).
2. Welds may be positioned so they are subject to either shear or tensile stress.
3. When joning materials of different gage, use loads shown for the lighter gage.
4. Flare-bevel groove welds are welds that occur between the out side radius of one member and the flat of an adjacent member radius of one member and the flat of an adjacent member.

Technical Assistance - Welding

A wire feed type welder is recommended for fastest and most uniform welding in the shop. Good welds are also obtained with a 3/32" or ⅛" AWS type 6013 or 7014 rod with a welding heat of 60-110 amperes depending on the gage of material and the fit of the parts.

Performance Data

Dia.	Hollow Block 1,924 PSI				Concrete 2,730 PSI				Wood			
	Depth of Embedment	Edge Distance	Pull-out	Shear	Depth of Embedment	Edge Distance	Pull-out	Shear	Depth of Embedment	Edge Distance	Pull-out	Shear
3/16"	1-1/4"	1"	421	546	1"	1"	422	692	~~837~~	@ 1½	EMBED	–
					1-3/8"		884	782	–	–	–	–
					1-3/4"		1,096	856	–	–	–	–
		2-1/2"	427	575	1"	2-1/2"	444	639	~~893~~	@ 1½	EMBED	–
					1-3/8"		750	866	–	–	–	–
					1-3/4"		1,271	~~781~~ 947	–	–	–	–
1/4"	1-1/4"	1"	998	900	1"	1"	688	632	~~1104~~	@ 1-1/2	EMBED	–
					1-3/8"		1,166	1,070	–	–	–	–
					1-3/4"		1,857	~~919~~ 1171	–	–	–	–
		2-1/2"	709	1,486	1"	2-1/2"	809	1,153	~~1649~~	@ 1½"	EMBED	–
					1-3/8"		1,507	1,583	–	–	–	–
					1-3/4"		1,908	1,780	–	–	–	–

	Hollow Block 1,872 PSI				Concrete 3,513 PSI				Wood #2 SYP Specific Gravity .55			
5/16"	1-1/4"	1- 9/16"	1,049	708	1"	1-1/4"	737	879	1"	5d	1,423	1,095
					1-3/4"		2,105	1,324	1-1/2"		2,471	1,617
					1"	2-3/16"	836	1,500	2"		2,912	2,367
		3-1/8"	1,149	1,454	1-3/4"	2-3/16"	2,413	3,158	–	–	–	–
					1"	3-1/8"	851	1,801	1"	10d	1,454	1,188
					1-3/4"		2,643	3,404	1-1/2"		2,472	1,677
					2"		3,347	–	2"		3,233	2,407

NOTE: Indicated pull-out and shear failure values were obtained in tests witnessed by independent test labs (see below). These figures are offered only as a guide and are not guaranteed in any way by Elco Construction Products. A safety factor of 4:1, or 25% of ultimate pull-out value, is generally accepted as a safe working load; however, reference should always be made to applicable codes for the specific safe working ratio.

Test report cross reference information

Concrete

UltraCon® Dia.	Test report no.*
3/16"	HETI 03-1127
1/4"	HETI 03-1136
5/16"	HETI 01-5013

Block

UltraCon® Dia.	Test report no.*
3/16"	HETI 05-1501
1/4"	HETI 03-1159
5/16"	HETI 01-5069

Wood

UltraCon® Dia.	Test report no.*
3/16"	–
1/4"	–
5/16"	HETI 01-5063

* Testing by Hurricane Engineering & Testing, Inc. (HETI).

Additional testing has been done in other materials and conditions and is available upon request.

Contact Elco Construction Products or your Elco® distributor for more information on our entire line of quality fastening systems for masonry applications.

Distributed By:

SPACING = 12 d AT MAX. LOAD PER ENGINEER AT ELCO.

An Acument® Global Technologies Company

Elco Construction Products

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800.435.7213

Fax 815.397.8986

www.elcoconstruction.com

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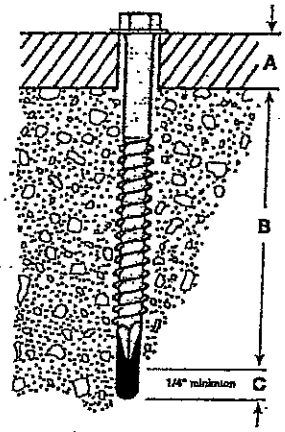
Installation Instructions

The Crete-Flex® Masonry Fastening System consists of Crete-Flex® anchors and Elco® carbide-tipped drill bits.

To determine the proper length Crete-Flex anchor for an application, combine the thickness of the attachment (A) with the desired depth of embedment in the masonry material (B). It is recommended that a minimum of 1" and a maximum of 2" embedment be used in determining fastener length. (Refer to Selection Guide on other side).

Use of 7/32" carbide drill bit should be used for optimum performance. Elco drill bits for Ultracon® applications, with a smaller diameter (.204"), should not be substituted.



Consistent performance and maximum pull-out values can be assured only when genuine Elco drill bits are used along with a 1000 tool (Elco Cat. No. ELP100) or a Crete-Flex® tool (Elco Cat. No. EMC900). With the Elco® drill bit installed in the drill or rotary hammer, drill the depth of (A) + (B) + (C).

With the drill tool still in its hammer mode, drive the Crete-Flex® anchor using an appropriate hex or phillips drive tool until properly seated with the work surface. For installations using a rotary hammer drill, Elco offers two hex-shanked SDS masonry drill bits that can be used in conjunction with the 1000 installation tool: EMC120 for fasteners up to 2-1/4" in length, and EMC130 for lengths up to 4".

Performance and Technical Data

Testing in Concrete Beam

COMPRESSIVE STRENGTH = 3350 PSI
TEST REPORT NO.: HETI-98-3023
Hurricane Engineering & Testing, Inc., Miami, FL

Test	Edge Distance	Embedment	Ultimate Load Lbs.
Pull-out	2.5"	1.00"	762
Pull-out	2.5"	1.75"	2505
Shear	2.5"	2.00"	2729
Shear	2.5"	1.75"	2591

Testing in Concrete Block

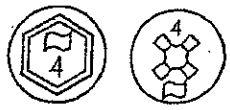
Compressive Strength = 2070 PSI
Test Report No.: 98-039 Construction Testing Corp., Miami, FL

Test	Edge Distance	Embedment	Ultimate Load Lbs.
Pull-out	1.0"	1.25"	780
Pull-out	2.5"	1.25"	1216
Shear	1.0"	1.25"	424
Shear	2.5"	1.25"	1324

These values are offered only as a guide, therefore, an appropriate safety factor should be applied to these values. For additional details and information, call 800.435.7213.

Inspection

In-place inspection can be made by identifying the special Crete-Flex® head marking. This marking consists of an Elco® logo along with a "4" as shown to the right.



Important Product and Warranty Information!

- As with all cutting tools and fasteners, normal safety precautions should be observed to avoid electrical installations, other utilities and reinforcement bars. Careful use will provide the utmost in safety and reliability.
- The wearing of safety glasses by users and persons in the vicinity is required by Federal Law.
- Complete Crete-Flex® product information, code approvals and technical application assistance is available from Elco Construction Products by calling 800.435.7213.

This literature was prepared as a summary of the Crete-Flex® Masonry Fastening System and is not therefore, intended to describe all hazards, limitations, warnings, precautions, etc., pertaining to the use of the product. The information and data presented herein are believed to be accurate and reliable. However, due to the wide variety of possible intervening factors, the suitability of the product for the use intended is the sole responsibility of the user. Specifications and other information contained herein supersede all previously published material and are subject to change without notice.

All Crete-Flex® anchors are warranted to be manufactured free from defects in material and workmanship. Under this warranty, Elco Construction Products will provide, at no charge, replacement product for any Crete-Flex® anchor proven to be defective when installed in accordance with our published recommendations and in applications considered obvious as suitable for this product. This warranty is in lieu of any and all warranties, express or implied and in no case will Elco Construction Products be liable for incidental, liquidated or consequential damages.

Crete-Flex'SS4
Stainless Steel Masonry Fastening System

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Elco Construction Products
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www.elcoconstruction.com

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Warren Schaefer, P.E., C.P.E.

From: Hansen, Randee [rlhansen@acument.com]
Sent: Wednesday, September 17, 2008 9:50 AM
To: Warren Schaefer, P.E., C.P.E.
Cc: Glidden, Bruce
Subject: RE: CreteFlex & Ultracon
Importance: High

CONCRETE SCREW SPACING FOR ELCO

He said he just received the charts days ago. It is 12 inches on center for 100%. It is 6 inches on center for 50%. I don't think there is other testing info for other diameters on center. I will make sure he e-mails you today. Thanks for your patience,

Randee Hansen
Elco Construction Products
5110 Falcon Rd.
Rockford, IL, 61109
800-435-7213, ext.5430
815-391-5430 direct
815-397-8986 fax
rlhansen@acument.com

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From: Warren Schaefer, P.E., C.P.E. [mailto:warren@wwschaefer.net]
Sent: Wednesday, September 17, 2008 8:14 AM
To: Hansen, Randee
Subject: RE: CreteFlex & Ultracon

No & I am growing a bit impatient. This is something that should be in your tables and should be easily obtained. Please have him e-mail me with the proper info today.
Thank you.

From: Hansen, Randee [mailto:rlhansen@acument.com]
Sent: Tuesday, September 16, 2008 4:18 PM
To: Warren Schaefer, P.E., C.P.E.
Subject: RE: CreteFlex & Ultracon

Did he e-mail or call yet?

Randee Hansen
Elco Construction Products
5110 Falcon Rd.
Rockford, IL, 61109
800-435-7213, ext.5430
815-391-5430 direct
815-397-8986 fax
rlhansen@acument.com

KWIK-CON II+ Fastening System 4.3.12

4.3.12.3 Technical Data

Tension and Shear Allowable Loads in Concrete [1,2]

Anchor Dia. in.	Embedment Depth in. (mm)	2000 psi (13.8 MPa) Tension lb (kN)	2000 psi (13.8 MPa) Shear lb (kN)	4000 psi (27.6 MPa) Tension lb (kN)	4000 psi (27.6 MPa) Shear lb (kN)	6000 psi (41.4 MPa) Tension lb (kN)	6000 psi (41.4 MPa) Shear lb (kN)
3/16	1 (25)	100 (0.44)	260 (1.16)	125 (0.56)	260 (1.16)	185 (0.82)	280 (1.25)
3/16	1-3/4 (44)	275 (1.22)	260 (1.16)	295 (1.31)	265 (1.18)	325 (1.45)	300 (1.33)
1/4	1 (25)	190 (0.85)	325 (1.45)	240 (1.07)	390 (1.73)	275 (1.22)	540 (2.40)
1/4	1-3/4 (44)	425 (1.89)	560 (2.49)	625 (2.78)	600 (2.82)	650 (2.89)	600 (2.67)

1 Published load values represent the average test results of testing conducted in local base materials using Hilti matched-tolerance drill bits. Because of variations in materials, on-site testing is necessary to determine actual performance at any specific site.

2 Allowable working loads are based on a safety factor of 4.0.

Tension and Shear Ultimate Loads in Concrete[1]

Anchor Dia. in.	Embedment Depth in. (mm)	2000 psi (13.8 MPa) Tension lb (kN)	2000 psi (13.8 MPa) Shear lb (kN)	4000 psi (27.6 MPa) Tension lb (kN)	4000 psi (27.6 MPa) Shear lb (kN)	6000 psi (41.4 MPa) Tension lb (kN)	6000 psi (41.4 MPa) Shear lb (kN)
3/16	1 (25)	400 (1.78)	1050 (4.67)	500 (2.22)	1050 (4.67)	750 (3.34)	1150 (5.12)
3/16	1-3/4 (44)	1100 (4.89)	1050 (4.67)	1180 (5.25)	1070 (4.76)	1300 (5.78)	1200 (5.34)
1/4	1 (25)	760 (3.38)	1300 (5.78)	970 (4.31)	1575 (7.01)	1100 (4.89)	2175 (9.68)
1/4	1-3/4 (44)	1700 (7.56)	2250 (10.0)	2500 (11.1)	2400 (11.3)	2600 (11.6)	2400 (10.7)

Tension and Shear Allowable Loads in Hollow Block[1,2]

Anchor Dia. in.	Embed. Depth in. (mm)	Tension lb (kN)	Shear lb (kN)
3/16	1 (25)	150 (0.67)	225 (1.00)
3/16	1-3/4 (44)	290 (1.29)	300 (1.33)
1/4	1 (25)	165 (0.73)	275 (1.22)
1/4	1-3/4 (44)	310 (1.38)	400 (1.78)

1 ASTM Specification C90 Grade N, Type II pilot holes drilled with TKB matched tolerance bits for concrete blocks.

2 Allowable working loads are based on a safety factor of 4.0.

Tension and Shear Allowable Loads in Red Brick[1,2]

Anchor Dia. in.	Embed. Depth in. (mm)	Tension lb (kN)	Shear lb (kN)
3/16	1 (25)	125 (0.56)	235 (1.05)
3/16	1-3/4 (44)	350 (1.56)	300 (1.33)
1/4	1 (25)	205 (0.91)	415 (1.85)
1/4	1-3/4 (44)	350 (1.56)	500 (2.22)

1 This test was performed on individual specimens of ASTM C62 common red brick. Due to the wide variations encountered in the compressive strength of brick, these values should be considered Guide Values.

2 Allowable working loads are based on a safety factor of 4.0.

The anchors are installed a minimum of 12 diameters on center with a minimum edge distance of six diameters for 100 percent anchor efficiency. Spacing and edge distance may be reduced to six diameter spacing and three diameter edge distance providing values are reduced 50 percent. Linear interpolation may be used for intermediate spacing and edge margins.

Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_{rec}}\right) + \left(\frac{V_d}{V_{rec}}\right) \leq 1.0 \text{ (Ref. Section 4.1.2.7)}$$

PERFORMANCE TABLE

* STEEL & STAINLESS STEEL

Tapcon Anchors — Ultimate Shear and Tension Values (Lbs/kN) in Concrete

ANCHOR DIA. In. (mm)	MIN. DEPTH OF EMBEDMENT In. (mm)	f'c = 2000 PSI (13.8 MPa)		f'c = 3000 PSI (20.7 MPa)		f'c = 4000 PSI (27.6 MPa)		f'c = 5000 PSI (34.5 MPa)	
		TENSION Lbs. (kN)	SHEAR Lbs. (kN)	TENSION Lbs. (kN)	SHEAR Lbs. (kN)	TENSION Lbs. (kN)	SHEAR Lbs. (kN)	TENSION Lbs. (kN)	SHEAR Lbs. (kN)
3/16 (4.8)	1 (25.4)	600 (2.7)	720 (3.2)	625 (2.8)	720 (3.2)	650 (2.9)	720 (3.2)	800 (3.6)	860 (3.8)
	1-1/4 (31.8)	845 (3.7)	720 (3.2)	858 (3.8)	720 (3.2)	870 (3.9)	720 (3.2)	1,010 (4.5)	860 (3.8)
	1-1/2 (38.1)	1,090 (4.8)	860 (3.8)	1,090 (4.8)	860 (3.8)	1,090 (4.8)	860 (3.8)	1,220 (5.4)	860 (3.8)
	1-3/4 (44.5)	1,450 (6.5)	870 (3.9)	1,455 (6.5)	870 (3.9)	1,460 (6.5)	990 (4.4)	1,730 (7.7)	990 (4.4)
1/4 (6.4)	1 (25.4)	750 (3.3)	900 (4.0)	775 (3.4)	900 (4.0)	800 (3.6)	1,360 (6.1)	950 (4.2)	1,440 (6.4)
	1-1/4 (31.8)	1,050 (4.7)	900 (4.0)	1,160 (5.2)	900 (4.0)	1,270 (5.6)	1,360 (6.1)	1,515 (6.7)	1,440 (6.4)
	1-1/2 (38.1)	1,380 (6.1)	1,200 (5.3)	1,600 (7.2)	1,200 (5.3)	1,820 (8.1)	1,380 (6.1)	2,170 (9.7)	1,670 (7.4)
	1-3/4 (44.5)	2,020 (9.0)	1,670 (7.4)	2,200 (9.8)	1,670 (7.4)	2,380 (10.6)	1,670 (7.4)	2,770 (12.3)	1,670 (7.4)

Safe working loads for single installation under static loading should not exceed 25% of the ultimate load capacity.

PERFORMANCE TABLE

Tapcon Anchors — Ultimate Shear and Tension Values (Lbs/kN) in Hollow Block

ANCHOR DIA. In. (mm)	ANCHOR EMBEDMENT In. (mm)	LIGHTWEIGHT BLOCK		MEDIUM WEIGHT BLOCK	
		TENSION Lbs. (kN)	SHEAR Lbs. (kN)	TENSION Lbs. (kN)	SHEAR Lbs. (kN)
3/16 (4.8)	1 (25.4)	220 (1.0)	400 (1.8)	340 (1.5)	730 (3.2)
1/4 (6.4)	1 (25.4)	250 (1.1)	620 (2.8)	500 (2.2)	1,000 (4.4)

Safe working loads for single installation under static loading should not exceed 25% of the ultimate load capacity.

NOTE: 3/16" Tapcon requires 5/32" bit, 1/4" Tapcon requires 3/16" bit.

PERFORMANCE TABLE

Tapcon® Anchors — Allowable Spacing and Edge Distances

PARAMETER	ANCHOR DIA. Inch	NORMAL WEIGHT CONCRETE			CONCRETE MASONRY UNITS (CMU)		
		FULL CAPACITY (Critical Distance Inches)	REDUCED CAPACITY (Minimal Distance Inches)	LOAD REDUCTION FACTOR	FULL CAPACITY (Critical Distance Inches)	REDUCED CAPACITY (Minimal Distance Inches)	LOAD REDUCTION FACTOR
Spacing Between Anchors - Tension	3/16	3	1-1/2	0.73	3	1-1/2	1.00
	1/4	4	2	0.66	4	2	0.84
Spacing Between Anchors - Shear	3/16	3	1-1/2	0.83	3	1-1/2	1.00
	1/4	4	2	0.82	4	2	0.81
Edge Distance - Tension	3/16	1-7/8	1	0.71	4	2	0.91
	1/4	2-1/2	1-1/4	0.78	4	2	0.88
Edge Distance - Shear	3/16	2-1/4	1-1/8	0.70	4	2	0.93
	1/4	3	1-1/2	0.59	4	2	0.80

For SI: 1 inch = 25.4 mm

W. W. SCHAEFER ENGINEERING & CONSULTING, P.A.
CALCULATIONS

By: W.W.S. Date: 09/11/08 Subject: RED HEAD TAPCON
EDGE DISTANCE FACTORS
Sheet 1 of 1

E.D. REDUCTION FACTORS FOR CONCRETE (SHEAR)		
ANCHOR DIA. (IN.)	MINIMUM EDGE DISTANCE (IN.)	LOAD REDUCTION FACTOR
3/16	2 1/4	1.000
3/16	2	0.933
3/16	1 3/4	0.840
3/16	1 1/2	0.800
3/16	1 1/4	0.733
3/16	1 1/8	0.700
1/4	3	1.000
1/4	2 3/4	0.932
1/4	2 1/2	0.863
1/4	2 1/4	0.795
1/4	2	0.727
1/4	1 3/4	0.658
1/4	1 1/2	0.590

E.D. REDUCTION FACTORS FOR BLOCK (SHEAR)		
ANCHOR DIA. (IN.)	MINIMUM EDGE DISTANCE (IN.)	LOAD REDUCTION FACTOR
3/16	4	1.000
3/16	3 1/2	0.983
3/16	3	0.965
3/16	2 1/2	0.948
3/16	2 1/4	0.939
3/16	2	0.930
3/16	1 3/4	0.814
3/16	1 1/2	0.698
1/4	4	1.000
1/4	3 1/2	0.846
1/4	3	0.830
1/4	2 1/2	0.815
1/4	2 1/4	0.808
1/4	2	0.800
1/4	1 3/4	0.700
1/4	1 1/2	0.600

ALL FACTORS HAVE BEEN CALCULATED USING COMPARISON TO FACTORS SHOWN IN RED HEAD DATA TABLES.

W. W. SCHAEFER ENGINEERING & CONSULTING, P.A.
CALCULATIONS

By: W.W.S. Date: 09/11/08 Subject: RED HEAD TAPCON SPACING FACTORS Sheet 1 of 1

SPACING REDUCTION FACTORS FOR CONCRETE (SHEAR)		
ANCHOR DIA. (IN.)	MINIMUM SPACING (IN.)	LOAD REDUCTION FACTOR
3/16	3	1.000
3/16	2 7/8	0.986
3/16	2 3/4	0.972
3/16	2 5/8	0.958
3/16	2 1/2	0.943
3/16	2 3/8	0.929
3/16	2 1/4	0.915
3/16	2 1/8	0.900
3/16	2	0.887
3/16	1 7/8	0.873
3/16	1 3/4	0.858
3/16	1 5/8	0.844
3/16	1 1/2	0.830
3/16	1 3/8	0.760
3/16	1 1/4	0.692
3/16	1 1/8	0.623
3/16	1	0.553
1/4	4	1.000
1/4	3 3/4	0.978
1/4	3 1/2	0.955
1/4	3 1/4	0.933
1/4	3	0.910
1/4	2 7/8	0.899
1/4	2 3/4	0.888
1/4	2 5/8	0.876
1/4	2 1/2	0.865
1/4	2 3/8	0.854
1/4	2 1/4	0.843
1/4	2 1/8	0.831
1/4	2	0.820
1/4	1 7/8	0.769
1/4	1 3/4	0.717
1/4	1 5/8	0.666
1/4	1 1/2	0.615

SPACING REDUCTION FACTORS FOR BLOCK (SHEAR)		
ANCHOR DIA. (IN.)	MINIMUM SPACING (IN.)	LOAD REDUCTION FACTOR
3/16	1 1/2	1.000
3/16	1 3/8	0.917
3/16	1 1/4	0.833
3/16	1 1/8	0.750
3/16	1	0.667
1/4	4	1.000
1/4	3 3/4	0.976
1/4	3 1/2	0.953
1/4	3 1/4	0.929
1/4	3	0.905
1/4	2 7/8	0.893
1/4	2 3/4	0.881
1/4	2 5/8	0.869
1/4	2 1/2	0.858
1/4	2 3/8	0.846
1/4	2 1/4	0.834
1/4	2 1/8	0.822
1/4	2	0.810
1/4	1 7/8	0.759
1/4	1 3/4	0.709
1/4	1 5/8	0.658
1/4	1 1/2	0.608

ALL FACTORS HAVE BEEN CALCULATED USING COMPARISON TO FACTORS SHOWN IN RED HEAD DATA TABLES.