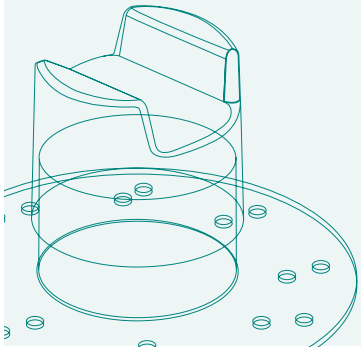
KnuckleHead

Technical Information

GREEN LINK ECO-ENGINEERING

LOAD & UPLIFT RESISTANCE & PIPE SUPPORT INTERVALS

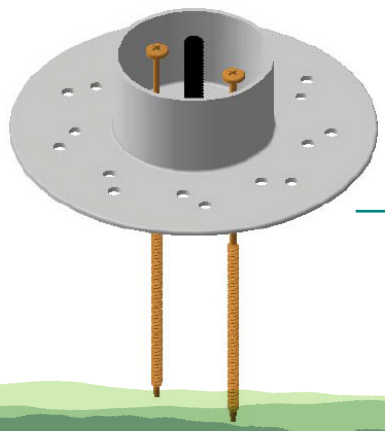
Updated April, 2017



The KnuckleHead Support System serves two critical functions: as a load-bearing system, it delivers the necessary support for pipes, struts, pavers and related roof-mounted equipment. As an attachment system, it provides stability under conditions of wind uplift and seismic events. The tables below summarize important data with respect to the load-bearing and uplift resistance capabilities of installed KnuckleHeads.

Load Support

The KnuckleHead System is engineered to safely support pipes and equipment without compromising the integrity of the roofing system. The minimum compressive strength of a low slope commercial roofing system depends on the type of component found underneath the membrane. Each KnuckleHead can support up to 600 lbs. of weight, but in some situations, the roof surface may be unable to withstand to that degree of load. For example when there is no cover board to protect insulation from damage, then polyiso (polyisocyanurate) insulation will come into direct contact with the roofing membrane (see *TABLE 1* for details). In this case, the KnuckleHead load-bearing properties will exceed the compressive strength of polyiso. *TABLE 4* provides suggested maximum allowable support load when installing KnuckleHeads directly onto insulation lacking a board layer.



PICTURE 1:

[P/N 2001] Universal Base and All-Purpose Fastener

***TABLE 1**: Compressive Strength of Polyiso Insulation*

POLYISO INSULATION		
Test Method	ASTM C 1289	
Minimum Compressive Strength	PSI	16.0
	Lbs./ft.^{2}	2304.0
	kPa	110.0

Attachment with Respect to Wind Uplift

The KnuckleHead System is engineered to be mechanically fastened, fully bonded using adhesive, or both. It can also be loose laid. Under conditions where wind uplift is a factor, loose laid KnuckleHeads are not recommended. Mechanically fastened KnuckleHeads require all-purpose screws to attach the Universal Base [P/N 2001] to the decking. *TABLE 2* summarizes important pullout information on a common all-purpose fastener when used on a variety of decks. Fully adhered KnuckleHeads require the use of M-1® Structural Adhesive/Sealant. The tensile strength of this sub-system is summarized in *TABLE 3*. One should be aware that on a fully adhered KnuckleHead application (omitting the

use of a mechanical fastener) the uplift value is limited by the tensile strength of the weakest component in a roofing assembly such as an insulation facer-to-insulation interface.

A hybrid system uses both mechanical fasteners and adhesives. In this case, the maximum allowable uplift force is based solely on the pullout strength of the fastener. See *TABLE 4* for details.

In the case of a hybrid system, fully adhered and mechanically fastened, the maximum allowable wind uplift force is exclusively based on pullout strength of the fastener. See *TABLE 4* for details.

PICTURE 2:
All-Purpose Fasterner and M-1® Structural Adhesive/ Sealant

Pipe Support Interval

Proper spacing of KnuckleHead assemblies to support piping will prevent problems caused by pipe sag, excessive load on joints and fittings, fluid-induced pipe vibrations and damage from thermal cycling. ASTM A53-86 specification for steel pipes suggests the maximum allowable spacing between supports (see *TABLE 5*). Plastic piping under thermal cycling is prone to sag, and proper support spacing is crucial. The photo below shows pipe sag issues resulting from improper spacing. Refer to *TABLE 6* for proper plastic piping support intervals.

PICTURE 3: *Inappropriately supported PVC pipe*

TABLE 2: *All-purpose Fastener Specifications*

ALL-PURPOSE FASTENER *		
Material	SAE 1022	
Thread Size	In.	0.2
	mm	6.5
PULLOUT IN NEW 22 GAUGE STEEL DECK		
Grade C	lbs.	360.0
	kN	1.6
Grade E	lbs.	400.0
	kN	1.8
Pullout in New 3/4" (19.0 mm) Plywood	lbs.	400.0
	kN	1.8

**Firestone (W56RAC4208)*

TABLE 3: *M-1® Structural Adhesive Specification*

M-1® STRUCTURAL ADHESIVE/SEALANT		
Tensile Strength*	PSI	370.0
Shear Strength**	PSI	390.0

***ASTM D1002*
**ASTM D412*

TABLE 4: *Suggested KnuckleHead Support and Uplift Resistance Values (per unit)*

UNIVERSAL BASE [P/N 2001]		
Base Diameter	In.	7.0
	mm	177.8
Maximum Allowable Support Load	lbs.	600.0
	kN	2.7
Maximum Allowable Uplift Force *(Using Fastener)*	lbs.	720.0
	kN	3.2
Maximum Allowable Uplift Force *(Using Adhesive)*	lbs.	720.0
	kN	3.2

TABLE 5: *Suggested Maximum Support Interval, Schedule 40 Steel Pipe per ASTM A53-86*

SCHEDULE 40 STEEL PIPE DATA							
Nominal Pipe Size	Pipe O.D.	Wall Thickness	Weight of Pipe	Weight of Pipe Filled with Water	Suggested Maximum Span	Weight of Span Filled with Water	Pressure on Deck *(7" base = 38.5 in²)*
In.	In.	In.	Lbs./Ft.	Lbs/Ft.	Ft.	Lbs.	PSI
3/8"	0.675	0.091	0.6	0.7	6	4.2	0.1
1/2"	0.84	0.109	0.8	0.9	6	5.4	0.2
3/4"	1.05	0.113	1.1	1.3	6	7.8	0.2
1"	1.315	0.133	1.7	2.1	6	12.6	0.4
1 1/4"	1.66	0.14	2.3	2.9	6	17.4	0.5
1 1/2"	1.9	0.145	2.7	3.6	9	32.4	0.8
2"	2.375	0.154	3.6	5	10	50	1.3
2 1/2"	2.875	0.203	5.8	7.9	11	86.9	2.3
3"	3.5	0.216	7.6	10.8	12	129.6	3.4
3 1/2"	4	0.226	9.1	13.4	13	174.2	4.5
4"	4.5	0.237	10.8	16.3	14	228.2	5.9
5"	5.563	0.258	14.6	23.2	16	371.2	9.6
6"	6.625	0.28	19	31.5	17	535.5	13.9

SCHEDULE 80 STEEL PIPE DATA							
Nominal Pipe Size	Pipe O.D.	Wall Thickness	Weight of Pipe	Weight of Pipe Filled with Water	Suggested Maximum Span	Weight of Span Filled with Water	Pressure on Deck *(7" base = 38.5 in²)*
In.	In.	In.	Lbs./Ft.	Lbs./Ft.	Ft.	Lbs.	PSI
3/8"	0.675	0.126	0.7	0.8	6	4.8	0.1
1/2"	0.84	0.147	1.1	1.2	6	7.2	0.2
3/4"	1.05	0.154	1.5	1.7	6	10.2	0.3
1"	1.315	0.179	2.2	2.5	6	15	0.4
1 1/4"	1.66	0.191	3	3.5	6	21	0.5
1 1/2"	1.9	0.2	3.6	4.3	9	38.7	1.0
2"	2.375	0.218	5	6.3	10	63	1.6
2 1/2"	2.875	0.276	7.6	9.4	11	103.4	2.7
3"	3.5	0.3	10.2	13	12	156	4.1
3 1/2"	4	0.318	12.5	16.3	13	211.9	5.5
4"	4.5	0.337	15	20	14	280	7.3
5"	5.563	0.375	20.8	28.7	16	459.2	11.9
6"	6.625	0.432	28.6	39.9	15	598.5	15.5

TABLE 6: *Suggested Maximum Support Interval for PVC Pipe.*

PVC PIPE MAXIMUM SUPPORT INTERVAL (FT.)										
Nominal Pipe Size In.	SCHEDULE 40					SCHEDULE 80				
	Temperature (°F)									
	60	80	100	120	140	60	80	100	120	140
1/4	4.0	3.5	3.5	2.0	2.0	4.0	4.0	3.5	2.5	2.0
3/8	4.0	4.0	3.5	2.5	2.0	4.5	4.5	4.0	2.5	2.5
1/2	4.5	4.5	4.0	2.5	2.5	5.0	4.5	4.5	3.0	2.5
3/4	5.0	4.5	4.0	2.5	2.5	5.5	5.0	4.5	3.0	2.5
1	5.5	5.0	4.5	3.0	2.5	6.0	5.5	5.0	3.5	3.0
1 1/4	5.5	5.5	5.0	3.0	3.0	6.0	6.0	5.5	3.5	3.0
1 1/2	6.0	5.5	5.0	3.5	3.0	6.5	6.0	5.5	3.5	3.5
2	6.0	5.5	5.0	3.5	3.0	7.0	6.5	6.0	4.0	3.5
2 1/2	7.0	6.5	6.0	4.0	3.5	7.5	7.5	6.5	4.5	4.0
3	7.0	7.0	6.0	4.0	3.5	8.0	7.5	7.0	4.5	4.0
3 1/2	7.5	7.0	6.5	4.0	4.0	8.5	8.0	7.5	5.0	4.5
4	7.5	7.0	6.5	4.5	4.0	9.0	8.5	7.5	5.0	4.5
5	8.0	7.5	7.0	4.5	4.0	9.5	9.0	8.0	5.5	5.0
6	8.5	8.0	7.5	5.0	4.5	10.0	9.5	9.0	6.0	5.0
8	9.0	8.5	8.0	5.0	4.5	11.0	10.5	9.5	6.5	5.5
10	10.0	9.0	8.5	5.5	5.0	12.0	11.0	10.0	7.0	6.0
12	11.5	10.5	9.5	6.5	5.5	13.0	12.0	10.5	7.5	6.5
14	12.0	11.0	10.0	7.0	6.0	13.5	13.0	11.0	8.0	7.0
16	12.5	11.5	10.5	7.5	6.5	14.0	13.5	11.5	8.5	7.5
18	13.0	12.0	11.0	8.0	7.0	14.5	14.0	12.0	11.0	9.0
20	14.0	12.5	11.5	10.0	8.5	15.5	14.5	12.5	11.5	9.5
24	15.0	13.0	12.5	11.0	9.5	17.0	15.0	14.0	12.5	10.5