



KnuckleHead

TECHNICAL INFORMATION

Load and Uplift Resistance | Pipe Support Intervals | Physical Properties

THE KNUCKLEHEAD SUPPORT SYSTEM SERVES CRITICAL ROOFTOP 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 following tables summarize important data with respect to the load-bearing and uplift resistance capabilities of installed KnuckleHeads.

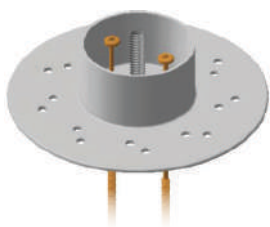
KnuckleHead TECHNICAL INFORMATION

LOAD SUPPORT

The KnuckleHead System is engineered to safely support pipes and heavy equipment. The minimum compressive strength of a low-slope commercial roof system depends on the type of material under the membrane. Widely used Type II Class 2 polyiso board has a compressive strength of 20 psi (**TABLE 1**) while KnuckleHeads can support up to 16 psi. Given that KnuckleHeads have a 38-square-inch base, each can support up to 600 lbs. of weight, but in some situations, the roof surface may be unable to withstand that degree of load. For example, when there is no recovery board to protect insulation from damage, then the polyiso board will come into direct contact with the roof membrane (see **TABLE 1** for details). In this case, the KnuckleHead load-bearing properties will exceed the compressive strength of polyiso. **TABLE 4** provides the suggested maximum allowable support load when installing KnuckleHeads directly onto insulation lacking a board layer.



*All-Purpose Fastener
and Green Link Structural
Adhesive/Sealant*



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

WIND UPLIFT & ATTACHMENT

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 GreenLink 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. 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.

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 exposed to thermal cycling is prone to sag, and proper support spacing is crucial. The photo at left shows pipe sag issues resulting from improper spacing. Refer to **TABLE 6** for proper plastic piping support intervals.



Pipe Sag

TABLE 1*Compressive Strength of Polyiso Insulation*

POLYISO INSULATION -TYPE II CLASS 2		
Test Method	ASTM C 1289	
Minimum Compressive Strength	PSI	20.0
	lbs./ft. ²	2304.0
	kPa	138.0

TABLE 3*Suggested KnuckleHead Support & 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.	7.2
	kN	3.2
Maximum Allowable Uplift Force (Using Adhesive)	lbs.	800.0
	kN	3.56

TABLE 5*Suggested Maximum Support Interval*

SCHEDULE 40 STEEL PIPE DATA*									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**		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**
In.	In.	In.	Lbs./Ft.	Lbs./Ft.	Ft.	Lbs.	PSI		In.	In.	Lbs./Ft.	Lbs./Ft.	Ft.	Lbs.	PSI
3/8"	0.675	0.091	0.6	0.7	6	4.2	0.1		0.675	0.126	0.7	0.8	6	4.8	0.1
1/2"	0.84	0.109	0.8	0.9	6	5.4	0.2		0.84	0.147	1.1	1.2	6	7.2	0.2
3/4"	1.05	0.113	1.1	1.3	6	7.8	0.2		1.05	0.154	1.5	1.7	6	10.2	0.3
1"	1.315	0.133	1.7	2.1	6	12.6	0.4		1.315	0.179	2.2	2.5	6	15	0.4
1 1/4"	1.66	0.14	2.3	2.9	6	17.4	0.5		1.66	0.191	3	3.5	6	21	0.5
1 1/2"	1.9	0.145	2.7	3.6	9	32.4	0.8		1.9	0.2	3.6	4.3	9	38.7	1.0
2"	2.375	0.154	3.6	5	10	50	1.3		2.375	0.218	5	6.3	10	63	1.6
2 1/2"	2.875	0.203	5.8	7.9	11	86.9	2.3		2.875	0.276	7.6	9.4	11	103.4	2.7
3"	3.5	0.216	7.6	10.8	12	129.6	3.4		3.5	0.3	10.2	13	12	156	4.1
3 1/2"	4	0.226	9.1	13.4	13	174.2	4.5		4	0.318	12.5	16.3	13	211.9	5.5
4"	4.5	0.237	10.8	16.3	14	228.2	5.9		4.5	0.337	15	20	14	280	7.3
5"	5.563	0.258	14.6	23.2	16	371.2	9.6		5.563	0.375	20.8	28.7	16	459.2	11.9
6"	6.625	0.28	19	31.5	17	535.5	13.9		6.625	0.432	28.6	39.9	15	598.5	15.5

* ASTM A53-86

** 7" base = 38.5 in²**TABLE 2***All-purpose Fastener Specifications*

ALL-PURPOSE FASTENER *		
Material	SAE 1022	
Thread Size	In.	0.2
PULLOUT		
New 22 Gauge Steel Deck	lbs.	800.0
	kN	3.56
New 3/4" (19 mm) Wood	lbs.	400.0
	kN	1.8

*Firestone (W56RAC4208)

TABLE 4

GREEN LINK ADHESIVE/SEALANT		
Tensile Strength*	PSI	370.0
Shear Strength**	PSI	390.0

*ASTM D412

**ASTM D1002

TABLE 6*Suggested Maximum Support Interval (ft.)*

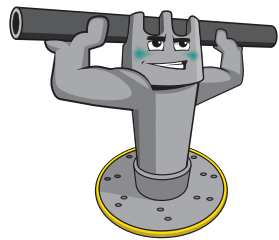
SCHEDULE 40 PVC PIPE						SCHEDULE 80 PVC PIPE				
Nominal Pipe Size In.	Temperature (°F)					Temperature (°F)				
	60°	80°	100°	120°	140°	60°	80°	100°	120°	140°
1/4	4	3.5	3.5	2	2	4.5	4.5	4	2.5	2.5
3/8	4	4	3.5	2.5	2	5	4.5	4.5	3	2.5
1/2	4.5	4.5	4	2.5	2.5	5.5	5	4.5	3	2.5
3/4	5	4.5	4	2.5	2.5	6	5.5	5	3.5	3
1	5.5	5	4.5	3	2.5	6	6	5.5	3.5	3
1 1/4	5.5	5.5	5	3	3	6.5	6	5.5	3.5	3.5
1 1/2	6	5.5	5	3.5	3	7	6.5	6	4	3.5
2	6	5.5	5	3.5	3	7.5	7.5	6.5	4.5	4
2 1/2	7	6.5	6	4	3.5	8	7.5	7	4.5	4
3	7	7	6	4	3.5	8.5	8	7.5	5	4.5
3 1/2	7.5	7	6.5	4	4	9	8.5	7.5	5	4.5
4	7.5	7	6.5	4.5	4	9.5	9	8	5.5	5
5	8	7.5	7	4.5	4	10	9.5	9	6	5
6	8.5	8	7.5	5	4.5	11	10.5	9.5	6.5	5.5
8	9	8.5	8	5	4.5	12	11	10	7	6
10	10	9	8.5	5.5	5	13	12	10.5	7.5	6.5
12	11.5	10.5	9.5	6.5	5.5	13.5	13	11	8	7
14	12	11	10	7	6	14	13.5	11.5	8.5	7.5
16	12.5	11.5	10.5	7.5	6.5	14.5	14	12	11	9
18	13	12	11	8	7	15.5	14.5	12.5	11.5	9.5
20	14	12.5	11.5	10	8.5	17	15	14	12.5	10.5
24	15	13	12.5	11	9.5	17	15	14	12.5	10.5

PHYSICAL PROPERTIES

KnuckleHeads are composed of injection-molded, military-grade nylon. This nylon possesses properties that make it ideal for the conditions a rooftop support must endure: the heavy weight of equipment, harsh weather cycles, continual UV exposure, seismic events, ongoing equipment vibration and even impact. This grade of reinforced nylon is used where excellent mechanical strength, rigidity, good stability under heat and/or chemical resistance are required. The polymer lends itself well to making structural objects usually involving the injection molding process. It is used extensively in auto and military applications, such as under-the-hood components, structural elements such as hinges, various machine parts, and polymer-framed weapons. **TABLE 7** summarizes typical physical properties and testing data.

TABLE 7	
Density	.0507 g/cm3
Continuous Service Temperature	275 F
Melt Temperature	500 F
Flexural Modulus	942,745 psi
Flexural Stress	29,000 psi
Tensile Strain	5%
Tensile Stress (Break 70 F)	21,030
Tensile of Base Thread - Pullout	1,700 lbf
Tensile of Base Thread - Push Through	1,200 lbf
Tensile of Head Threads	1,000 lbf
Notched Izod Impact Strength	5.7 ft. Lbs./in.
Water Absorption @ 70F, 50%, R.H.	70F, 50% R.H. = 1.7%

KNUCKLE UP!



GREEN LINK, Inc. was established to develop innovative solutions to higher performing, more sustainable construction. We focus on designing and producing innovative polymeric architectural products, which include the KnuckleHead Rooftop Support System, and related accessories. *GREEN LINK* works with contractors, architects, building owners, roofing consultants and facility managers to engineer and manufacture the best possible solutions to meet the construction challenges of the 21st century. *GREEN LINK* is committed to processes and products that cause no harm to the environment or human life.



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