STANLEY®
Engineered Fastening

HELI-COIL®
Tensile Strength of Threaded Insert Assembly

Technical Bulletin 68-2

HeliCoil®

TENSILE STRENGTH OF THREADED INSERT ASSEMBLIES

The subject of threaded insert assembly strength has been somewhat confusing to the product designer due to the various claims of insert manufacturers and their respective methods of publishing data. While some manufacturers advise what tensile strengths are achieved in a few sizes in certain materials, others show what insert nominal length is required to achieve the full bolt strength. In either case, the designer cannot easily compare the assembly strength of the various types of inserts nor can he readily determine the actual tensile strength (in pounds) for every size and length.

It is also appropriate that the designer be aware of the assembly strength comparison between wire type inserts and the solid bushing types. Data published by solid bushing manufacturers and extensive tests by Stanley Engineered Fastening Division of Stanley Black & Decker have proven that wire type inserts and solid bushings are essentially comparable in strength for equal insert lengths. In fact, for most sizes, the wire type insert of the same length as the solid bushing has superior tensile strength. The reason for the wire type insert superior tensile strength is that all high performance solid bushings require a secondary means of insert retention and it is the presence of either the rings or keys which offset the large outside diameters. While wire type inserts are not normally supplied in lengths exactly equal to those of solid bushings, these lengths can readily be made available on request.

Another important factor which must be considered by the designer is that the shear strength of the parent materials shown in these graphs are for room temperature only. At elevated temperatures, the shear strength of most light metals is decreased rather significantly, and the designer should consult a metals handbook to determine the actual shear strength at temperature.

This bulletin provides all the data required by a designer in simple chart form. The four variables shown on the attached graphs are:

1. Tensile strength of the insert assembly.
2. Insert nominal length.
3. Shear strength of typical parent materials.*
4. The tensile strength of common bolts.**

The chart graph method of presenting this data was selected primarily because it is easy to use and it also provides the greatest degree of flexibility.

Examples of the various ways that this graph method can be used are enumerated as follows:

1. Assume that a 2-56 is to be designed in 6061-T6 Aluminum of 30,000 psi shear strength. What is the insert length required to support a 500 pound load and what grade screw is required? On the 2-56 thread size graph find the vertical line for 30,000 psi shear strength parent material. The insert nominal length lines intersect this vertical line for 1 Diameter inserts at 470 lbs; for 1 1/2 Diameter insert at 810 lbs and for 2 Diameter inserts at 1120 lbs (these values for insert assembly strengths are listed on the left side of the graph). On the right side of the graph, notice that the screw material ultimate tensile strengths are directly convertible to pounds shown on the left side. It can be concluded that for 2-56 in 30,000 psi parent material a 1 1/2 diameter insert length and a 170,000 psi screw will safely support the 500 pound load. Note that the safety factor also can be easily calculated from the data available in these graphs.

* Shear strength values shown on these charts are average values. The engineer may wish to base his design on minimum, or some other, intermediate value. MIL-HDBK-5A is recommended as an excellent source for complete data on metallic materials.

** Tensile strengths of common bolts as shown on these charts are the minimum strengths as specified on the applicable covering specification. The actual tensile strength of any particular bolt will most usually be greater than these minimum values.

2. Assume that the 2-56 screw is known to be 125,000 psi ultimate tensile strength and the parent material is 356-T6 Aluminum of shear strength 26,000 psi. What insert length is required? Starting at the right side at 125,000 psi level more horizontally to the left to the point of intersection with the vertical line at 26,000 psi of the parent material shown on the bottom of the graph. The 1 Diameter rating of 400 lbs is not strong enough to support the full tensile rating of the screw which is 460 lbs. In this material, the 1 1/2 diameter insert achieves a tensile strength of 700 lbs and if adequate material thickness is available, this is the insert which should be used to provide a generous safety margin.

It is necessary for the designer to know only two of the four variables, and with the aid of these graphs the other two variables are easily determined. Another use of these graphs is to aid in selecting the combinations of thread size and bolt material which are possible when the designer knows the load in pounds and the parent material shear strength. For example:

1. Assume an assembly, strength of 1000 pounds is required and the parent material shear strength is 30,000 psi.

2. Examining charts for several sizes it I concluded:

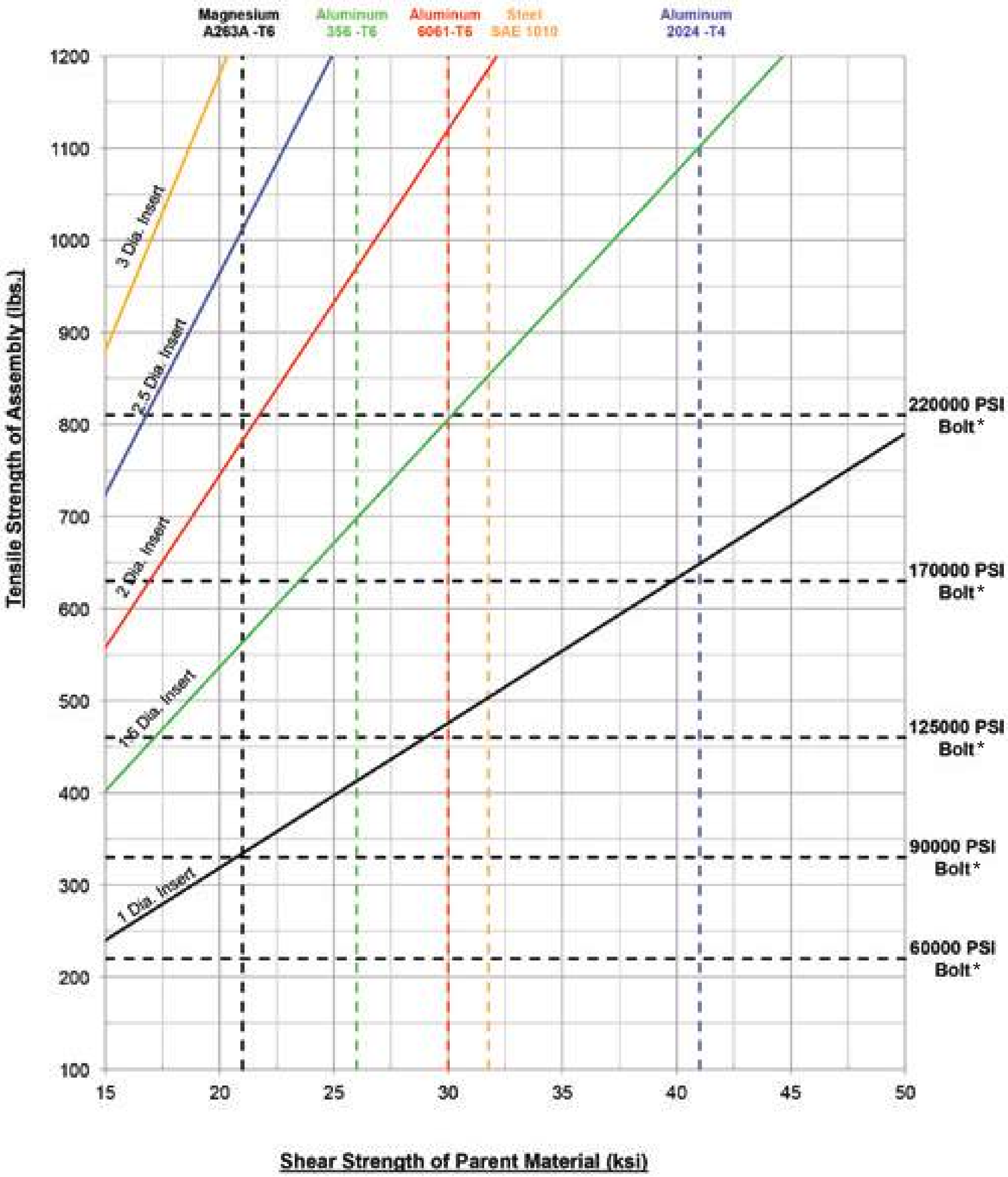
   a. 2-56 - even though 2 diameter inserts are satisfactory the 220,000 psi bolts are not adequate because they have an ultimate strength of only 810 lbs.
   b. 3-48- the 220,000 psi bolts are barely acceptable providing a very small safety margin.
   c. 4-40- a 1 1/2 diameter insert and a 220,000 psi bolt will suffice.
   d. If 170,000 psi bolts are desired, a 6-32 1 1/2 diameter insert would be required.
   e. If a 125,000 psi bolt is desired, then an 8-32 1 diameter insert would be more than adequate for this application.

As shown by the above listed possibilities, the designer is afforded a great degree of flexibility with regard to selection of insert sizes lengths and bolt strengths consistent with space availability and hardware cost. Also, another factor to consider is that it is consistent with good design practice to select insert lengths which provide assembly strengths greater than that of the screw, because if excessive torque is applied to the screw it should fail before the insert assembly.

For insert sizes or lengths not included on the attached graph or for special bolt or parent materials not shown please consult with a STANLEY Engineered Fastening Application Engineer.

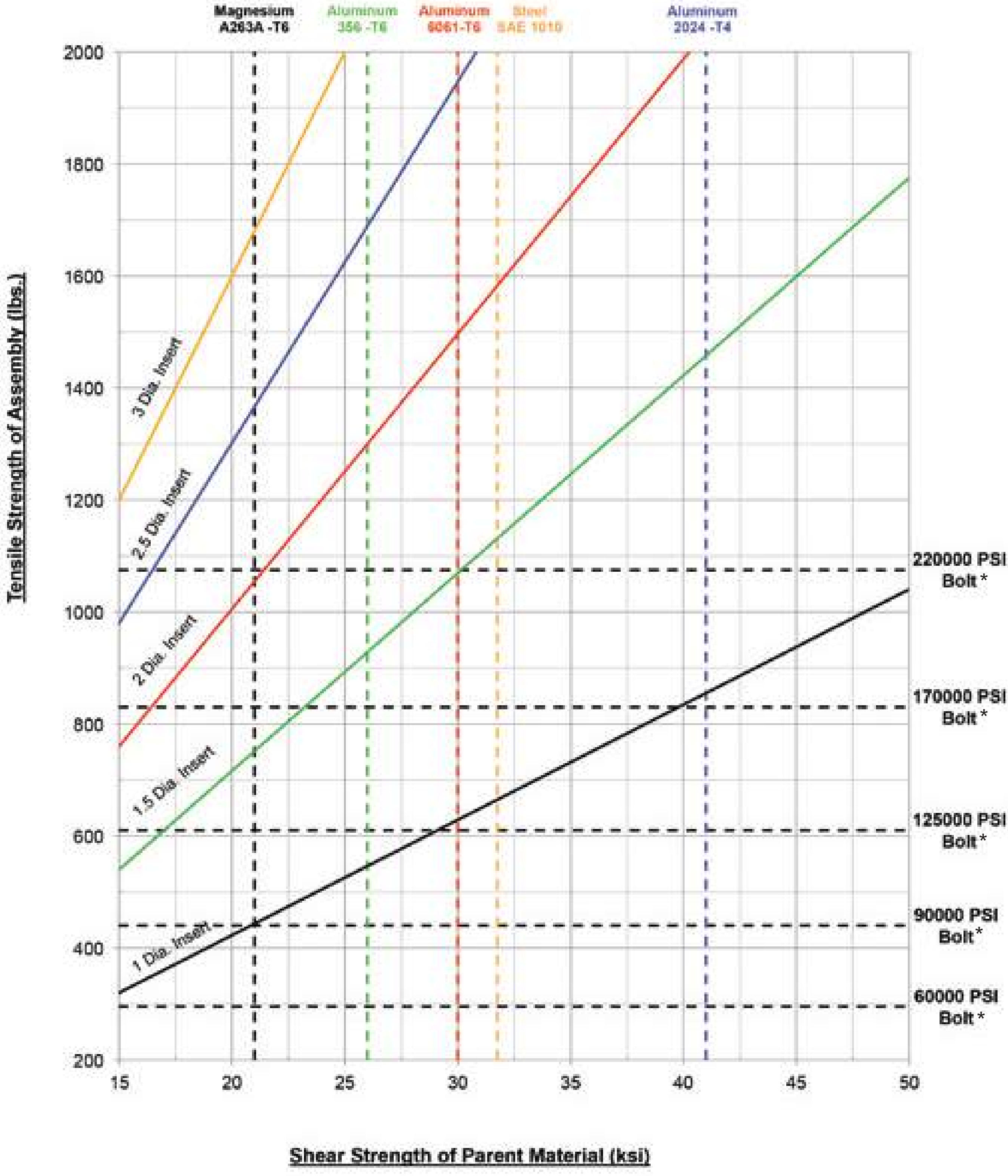
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 2-56 Size

(*) Bolt Material Ultimate Tensile Strength



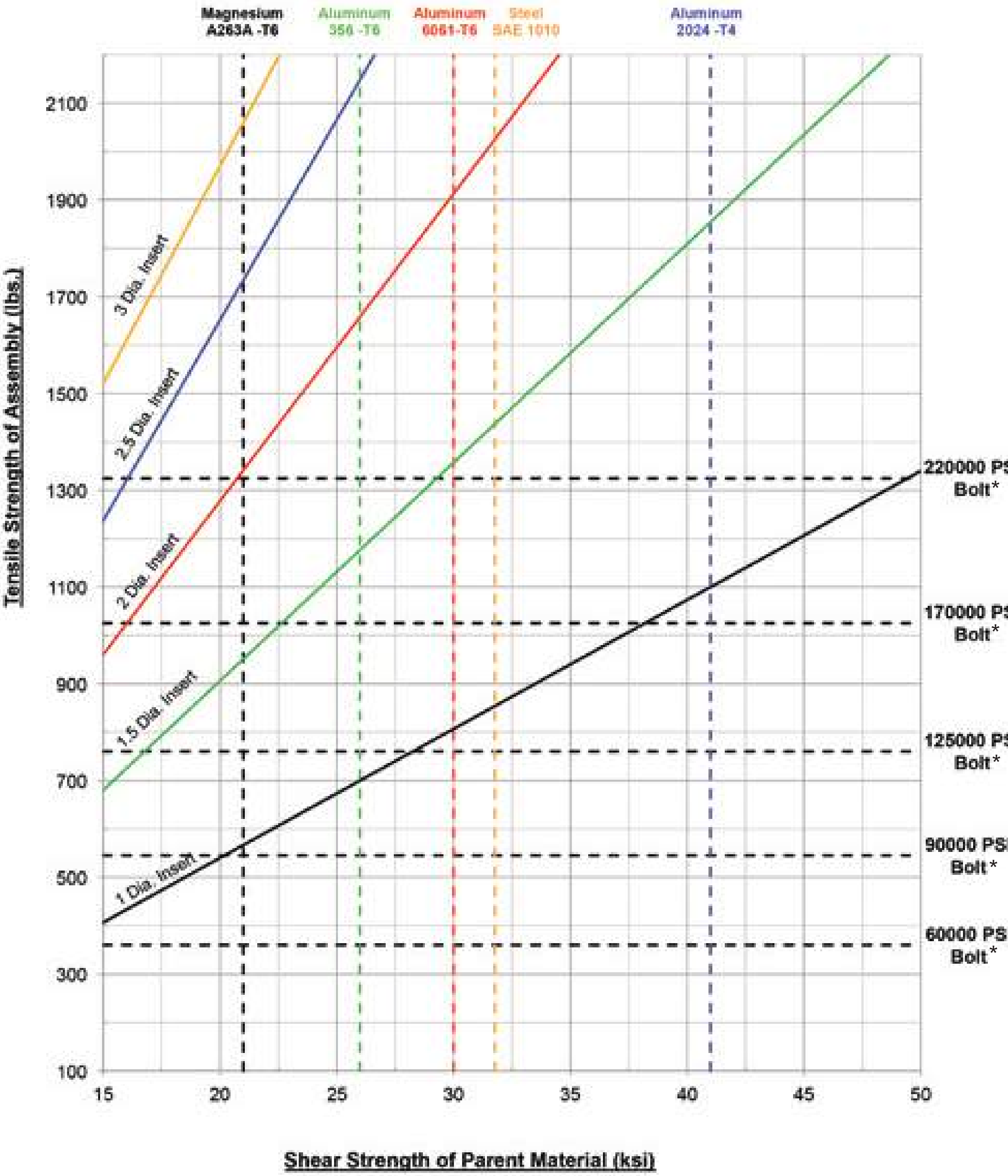
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 3-48 Size

(*) Bolt Material Ultimate Tensile Strength



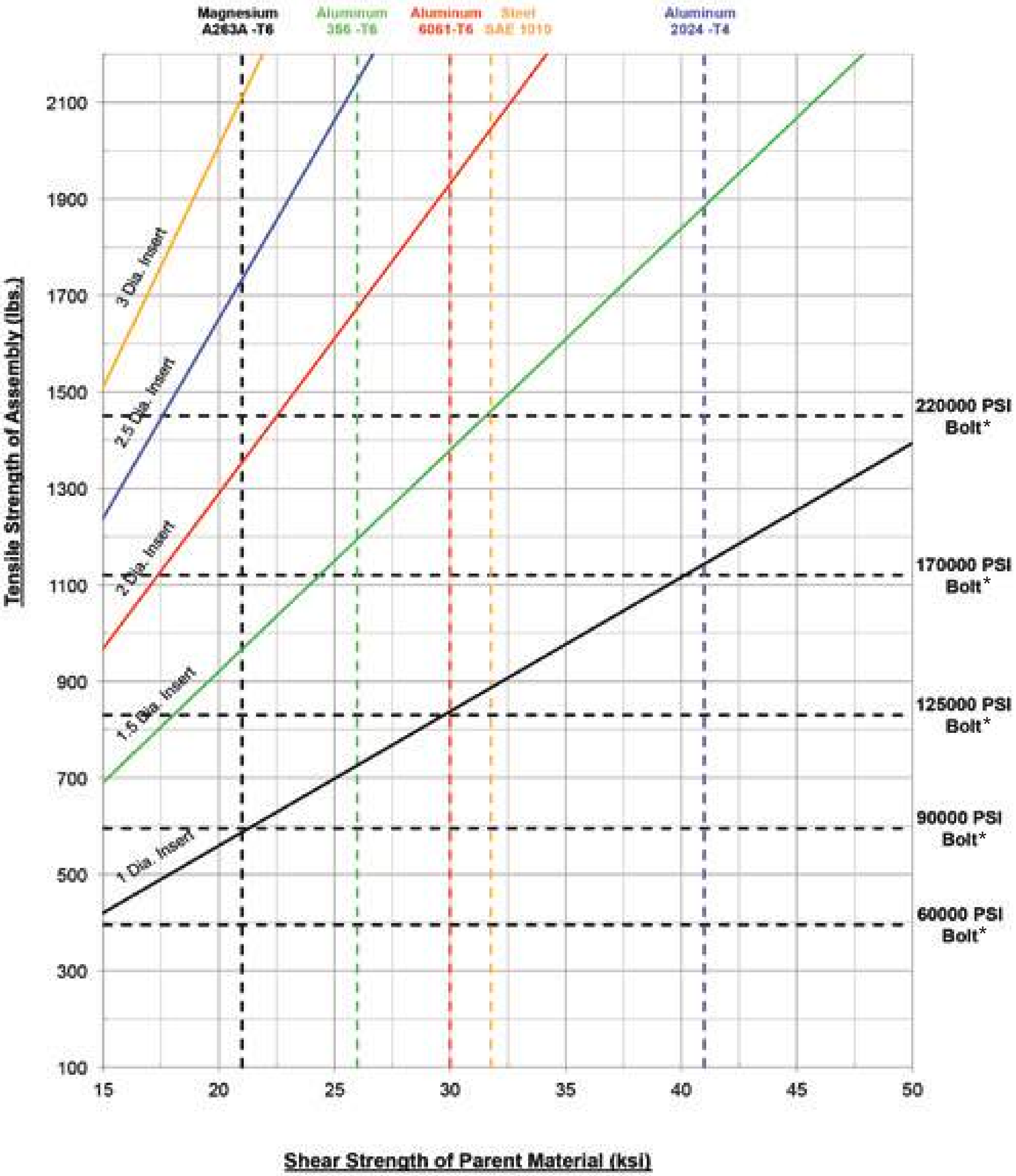
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 4-40 Size

(*) Bolt Material Ultimate Tensile Strength



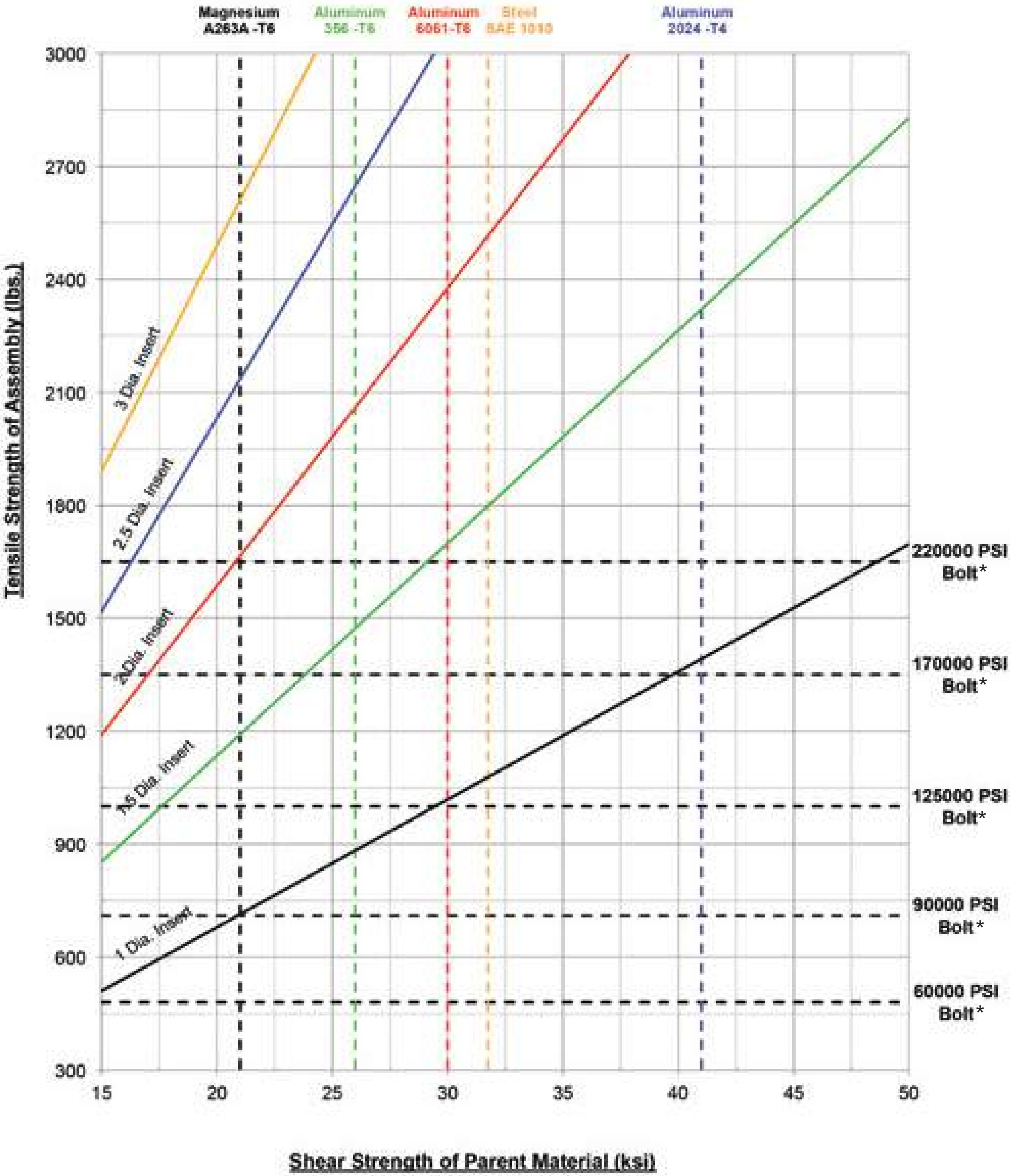
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 4-48 Size

(*) Bolt Material Ultimate Tensile Strength



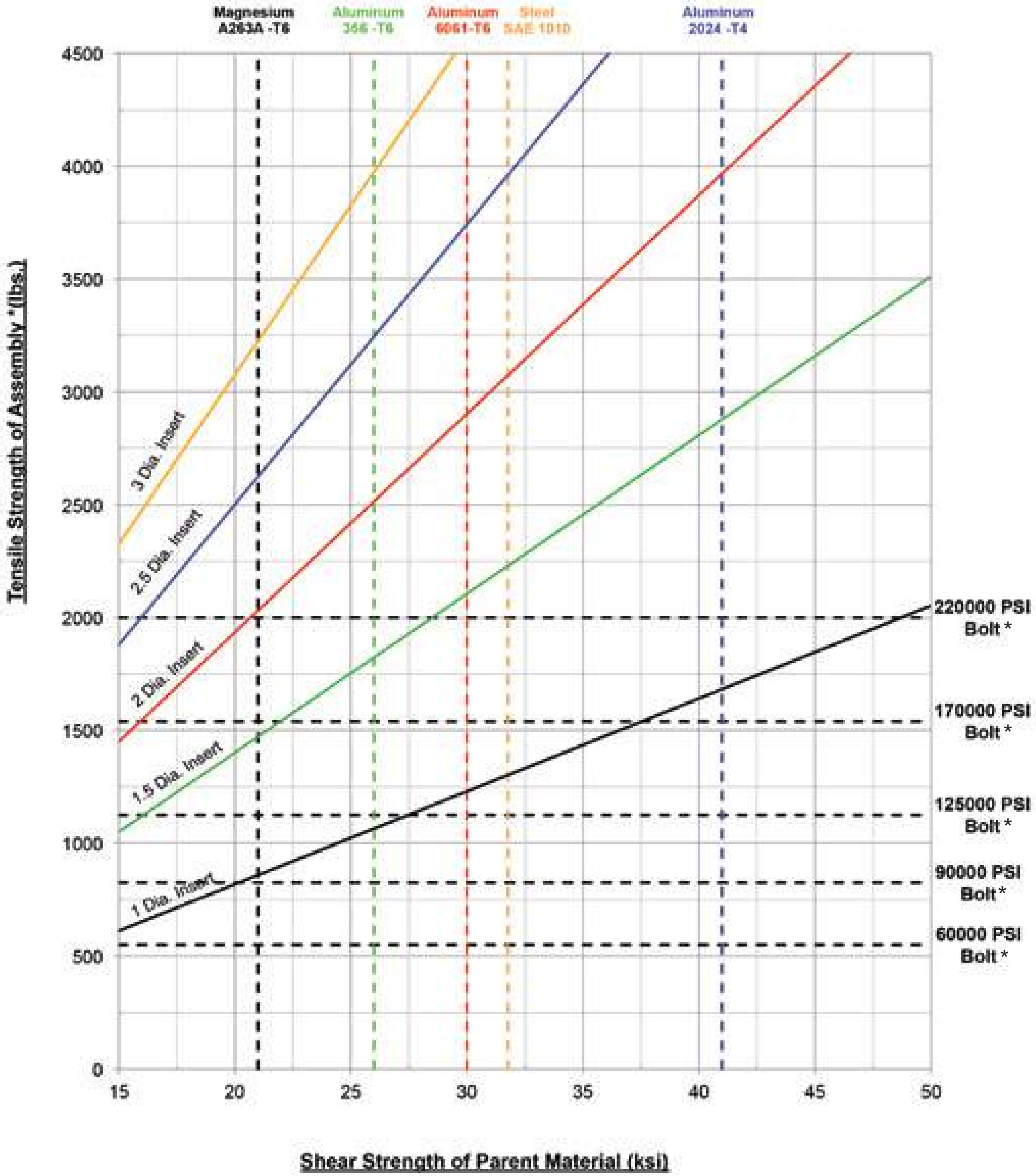
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 5-40 Size

(*) Bolt Material Ultimate Tensile Strength



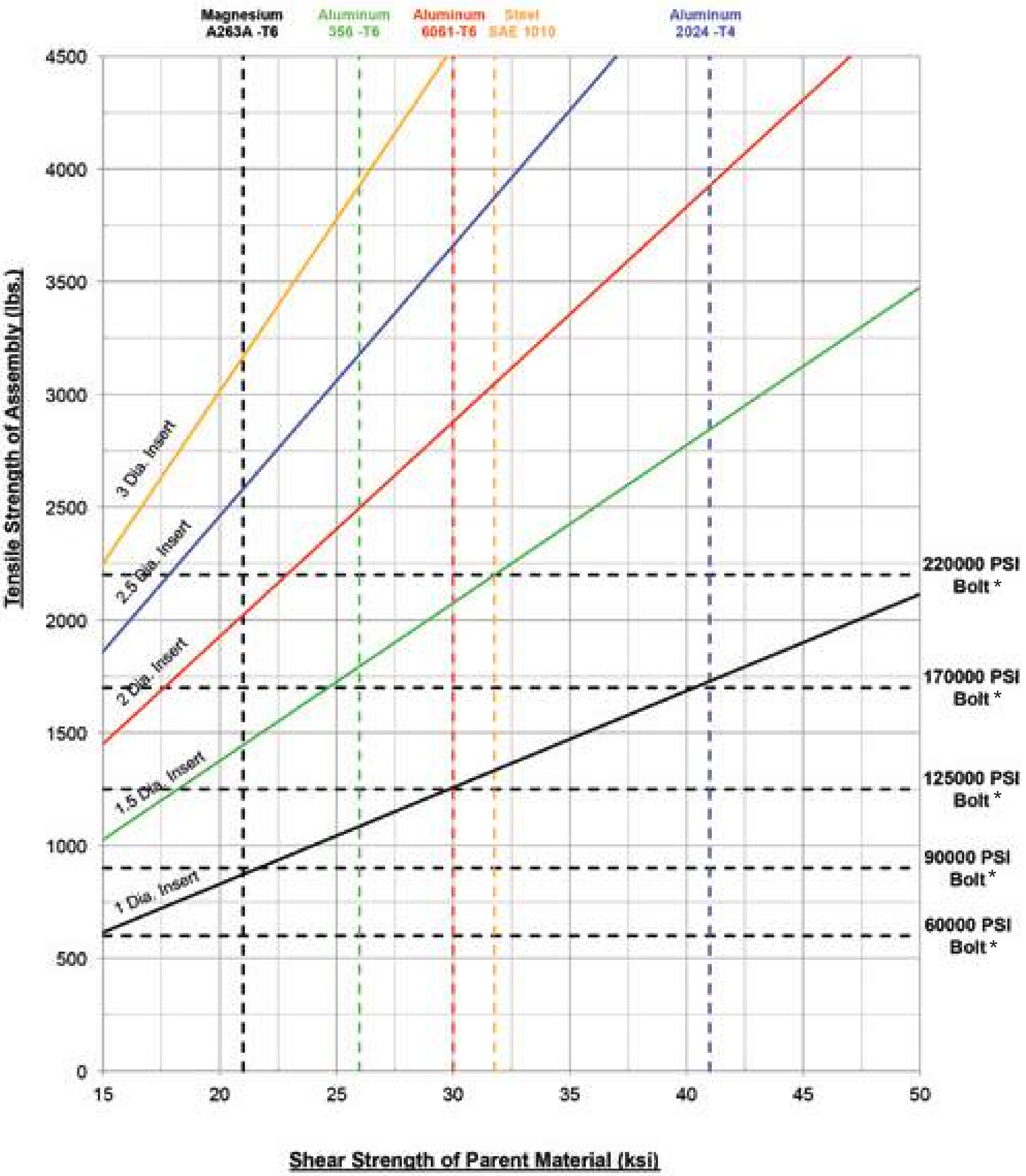
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 6-32 Size

(*) Bolt Material Ultimate Tensile Strength



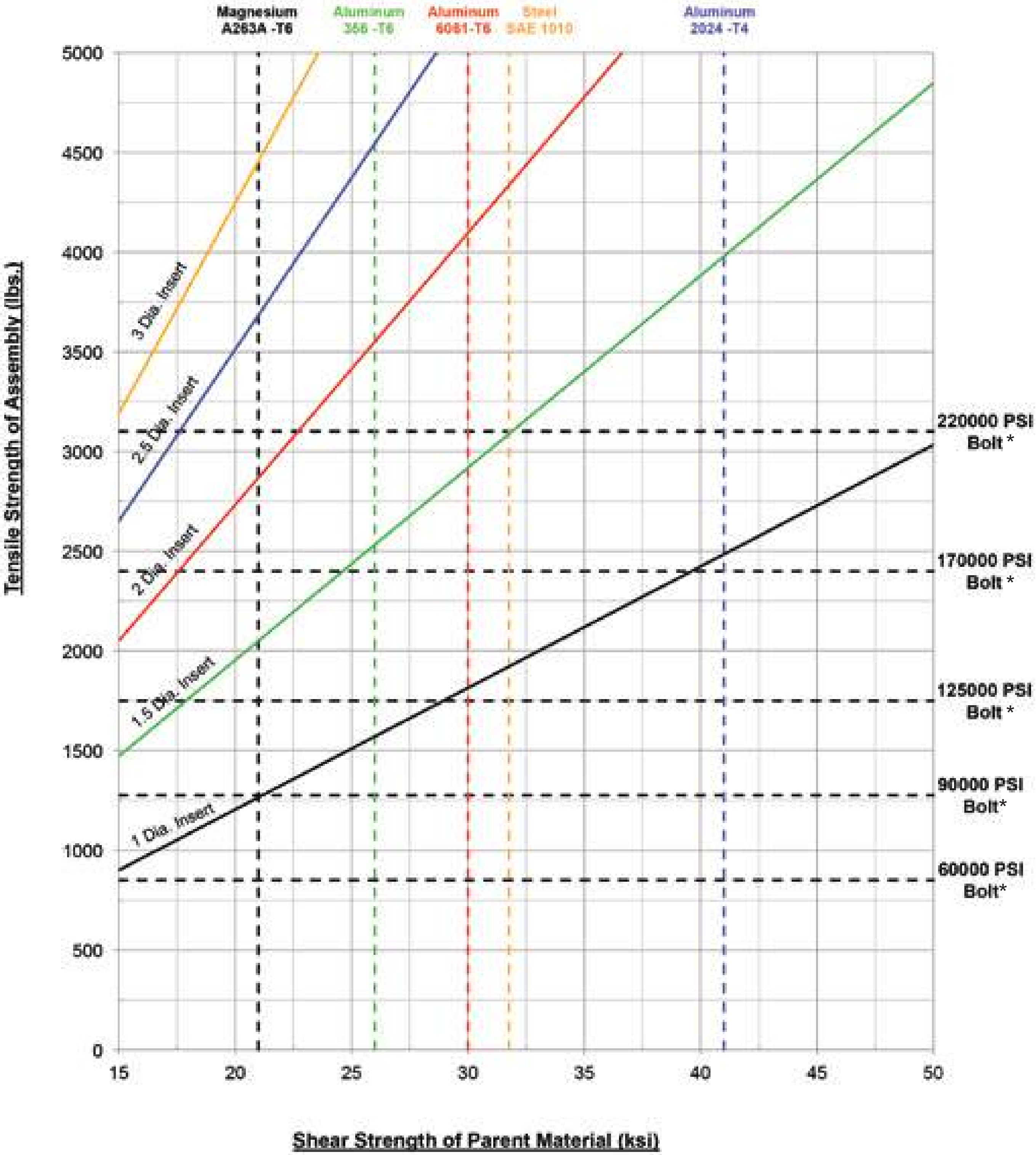
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 6-40 Size

(*) Bolt Material Ultimate Tensile Strength



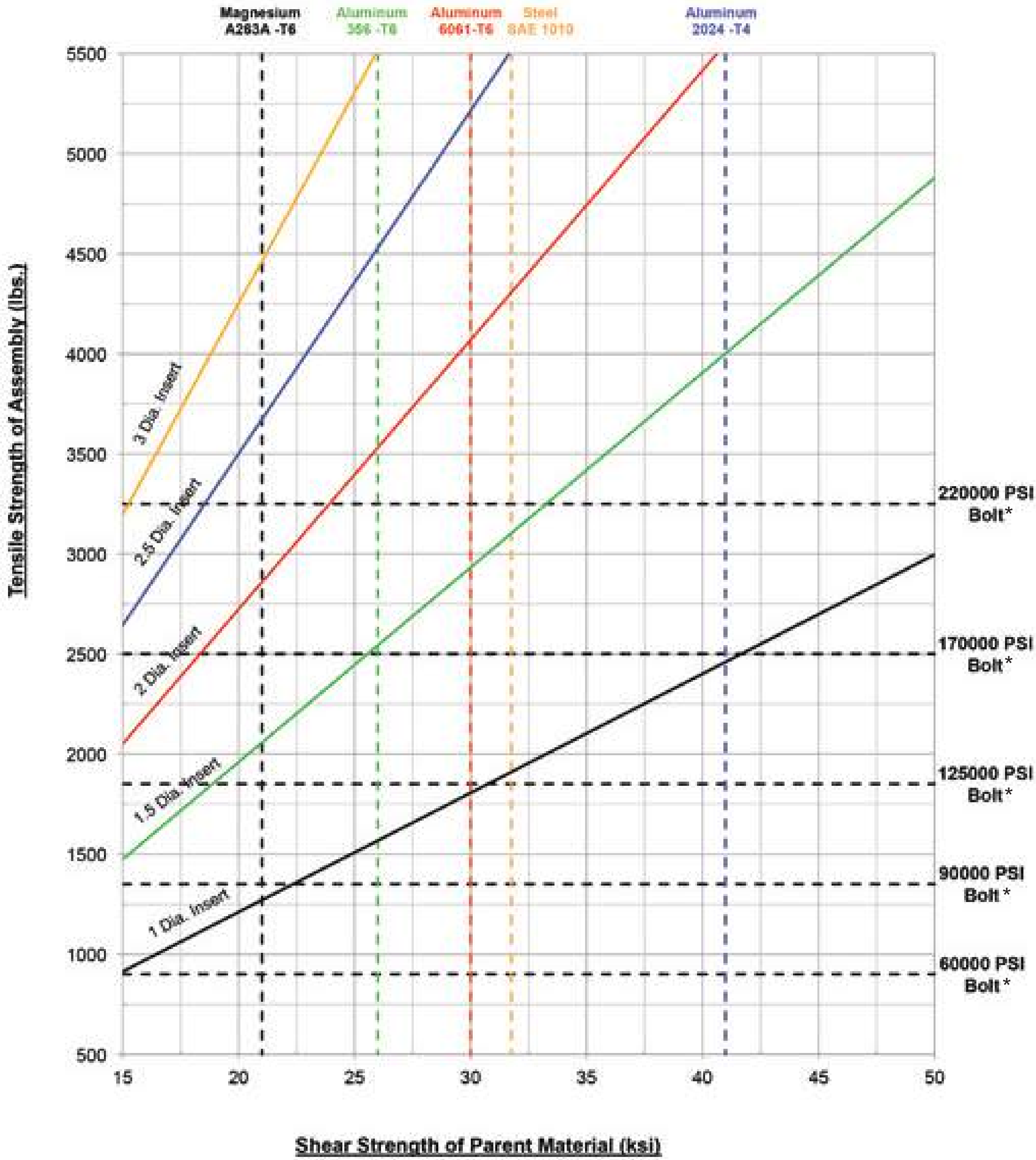
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 8-32 Size

(*) Bolt Material Ultimate Tensile Strength



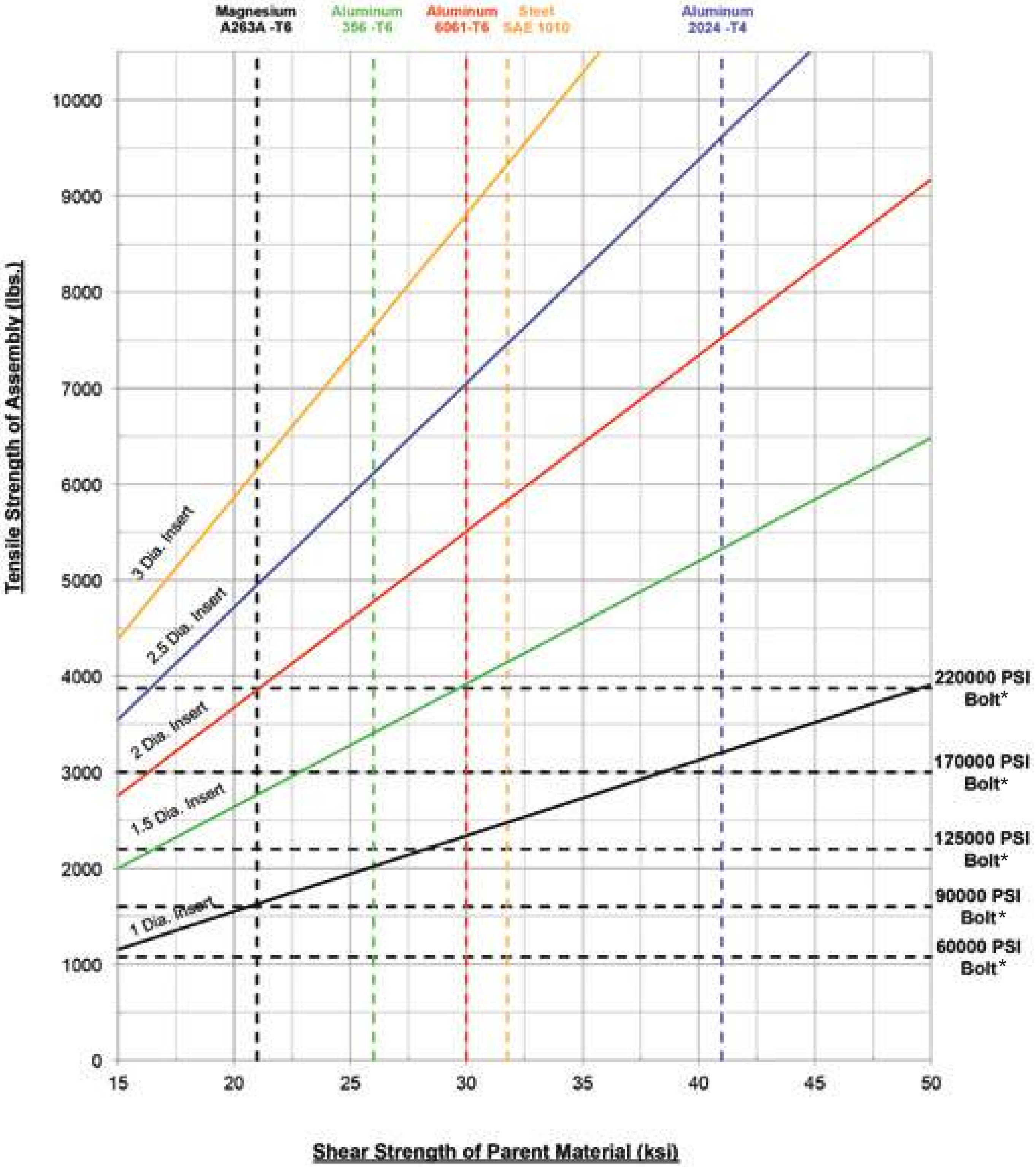
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 8-36 Size

(*) Bolt Material Ultimate Tensile Strength



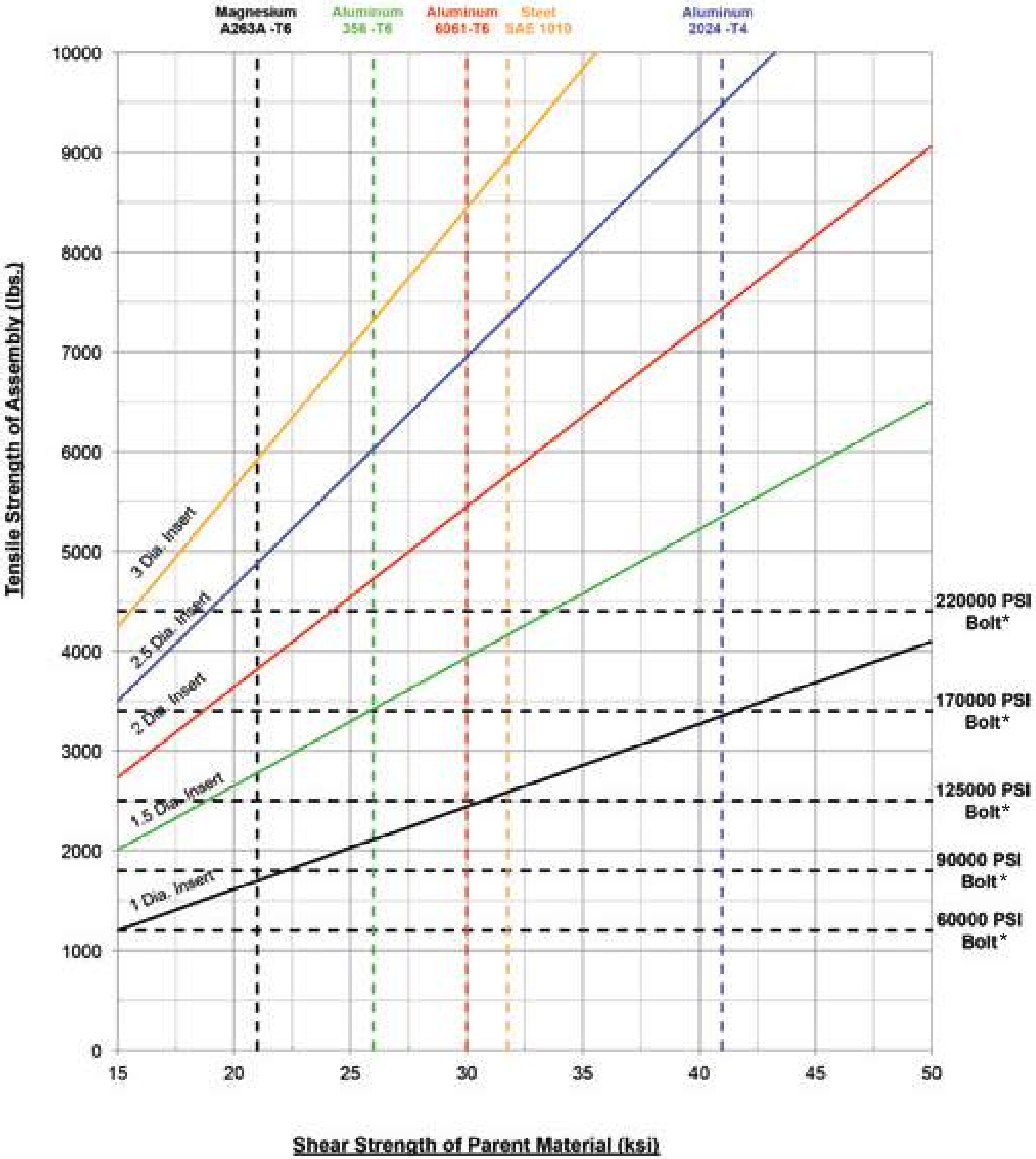
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 10-24 Size

(*) Bolt Material Ultimate Tensile Strength



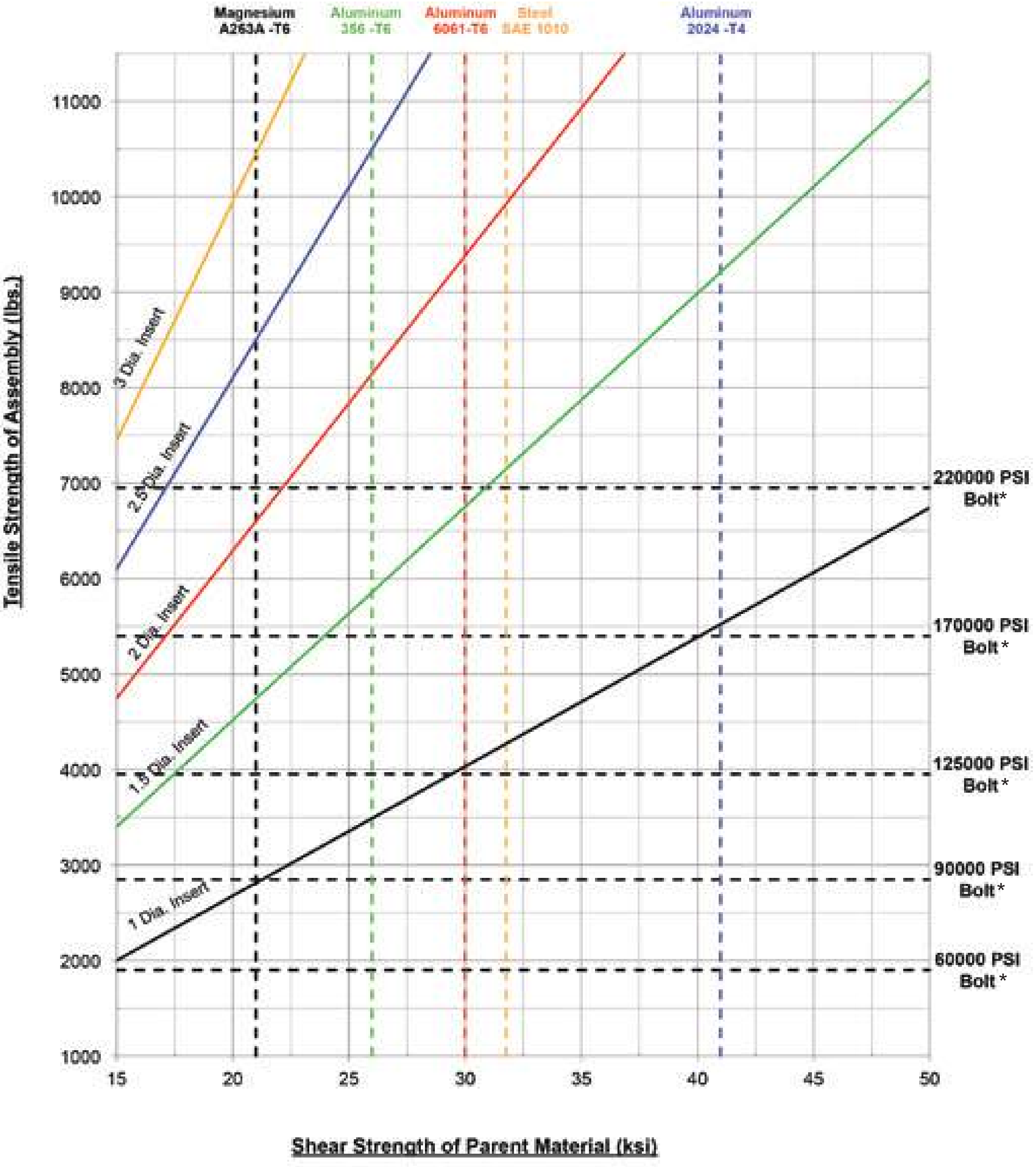
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 10-32 Size

(*) Bolt Material Ultimate Tensile Strength



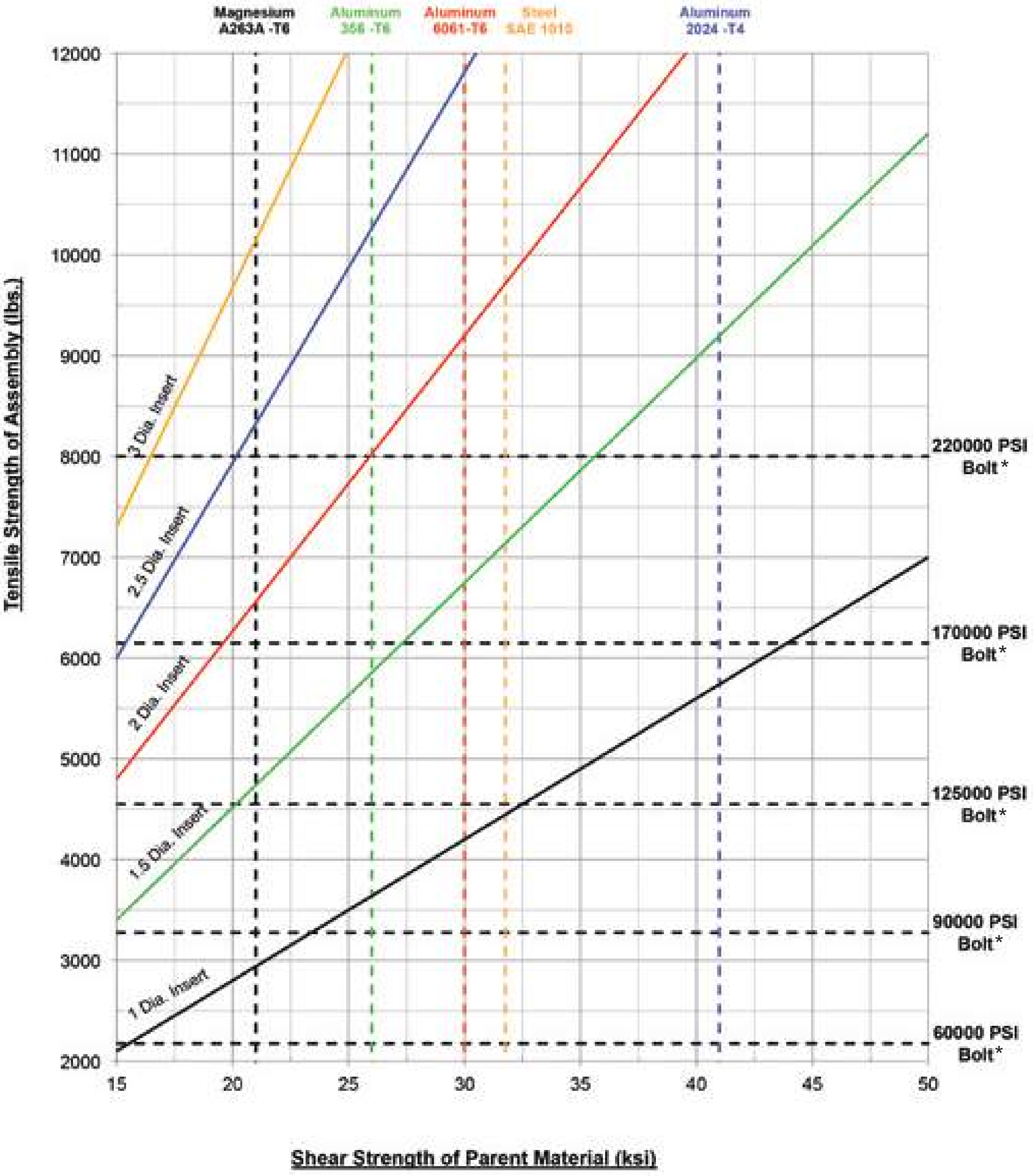
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 1/4-20 Size

(*) Bolt Material Ultimate Tensile Strength



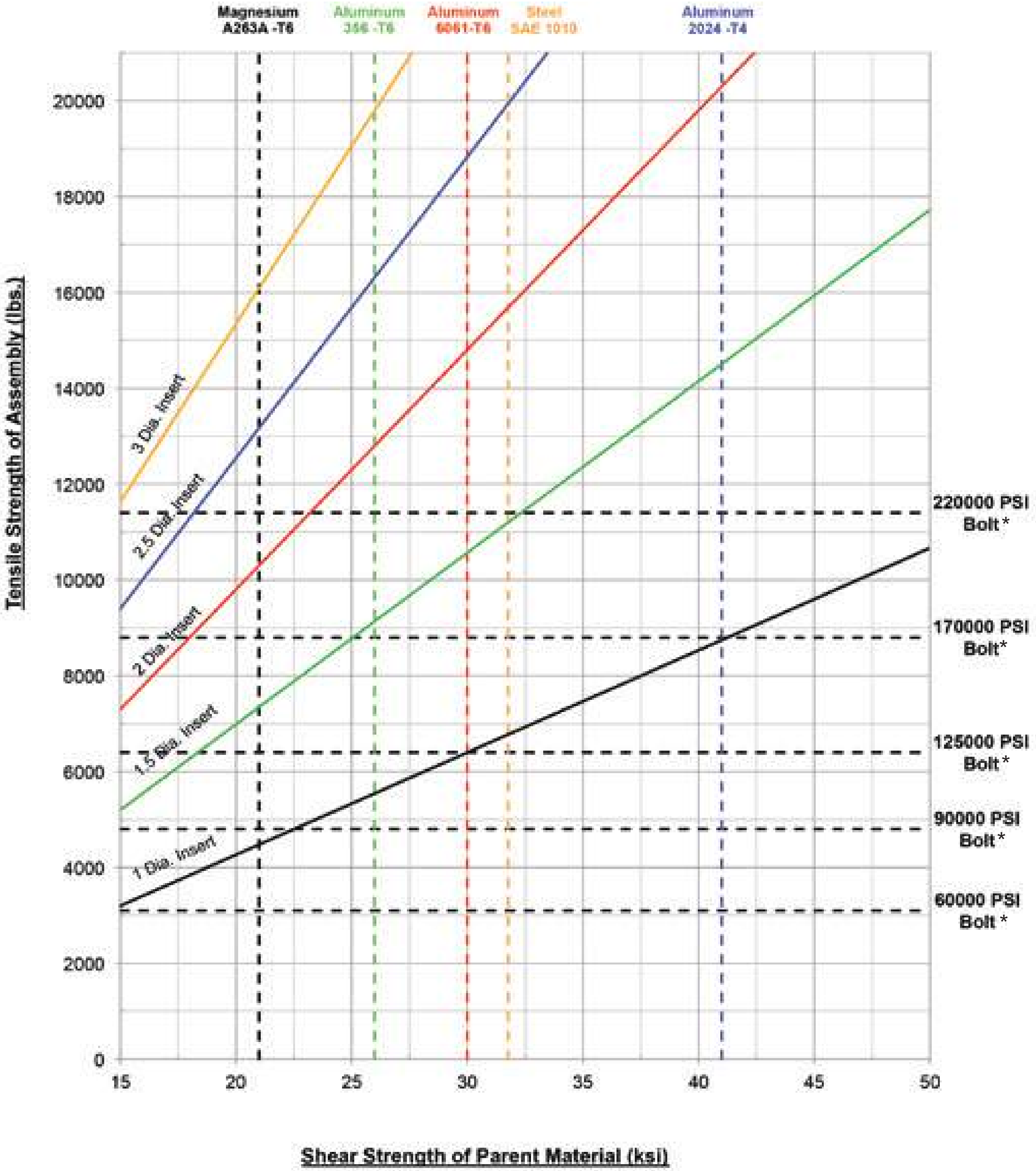
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 1/4-28 Size

(*) Bolt Material Ultimate Tensile Strength



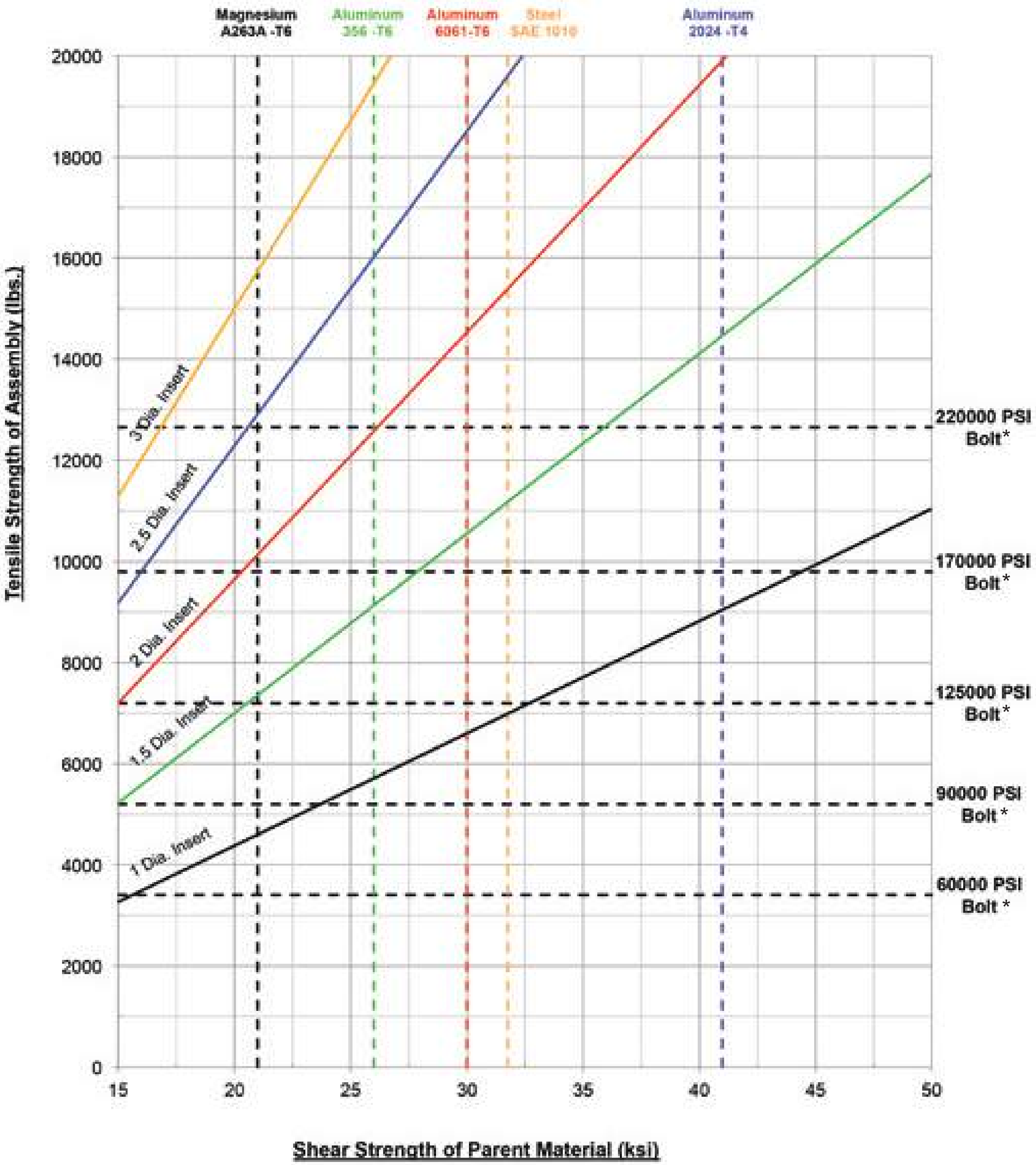
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 5/16-18 Size

(*) Bolt Material Ultimate Tensile Strength



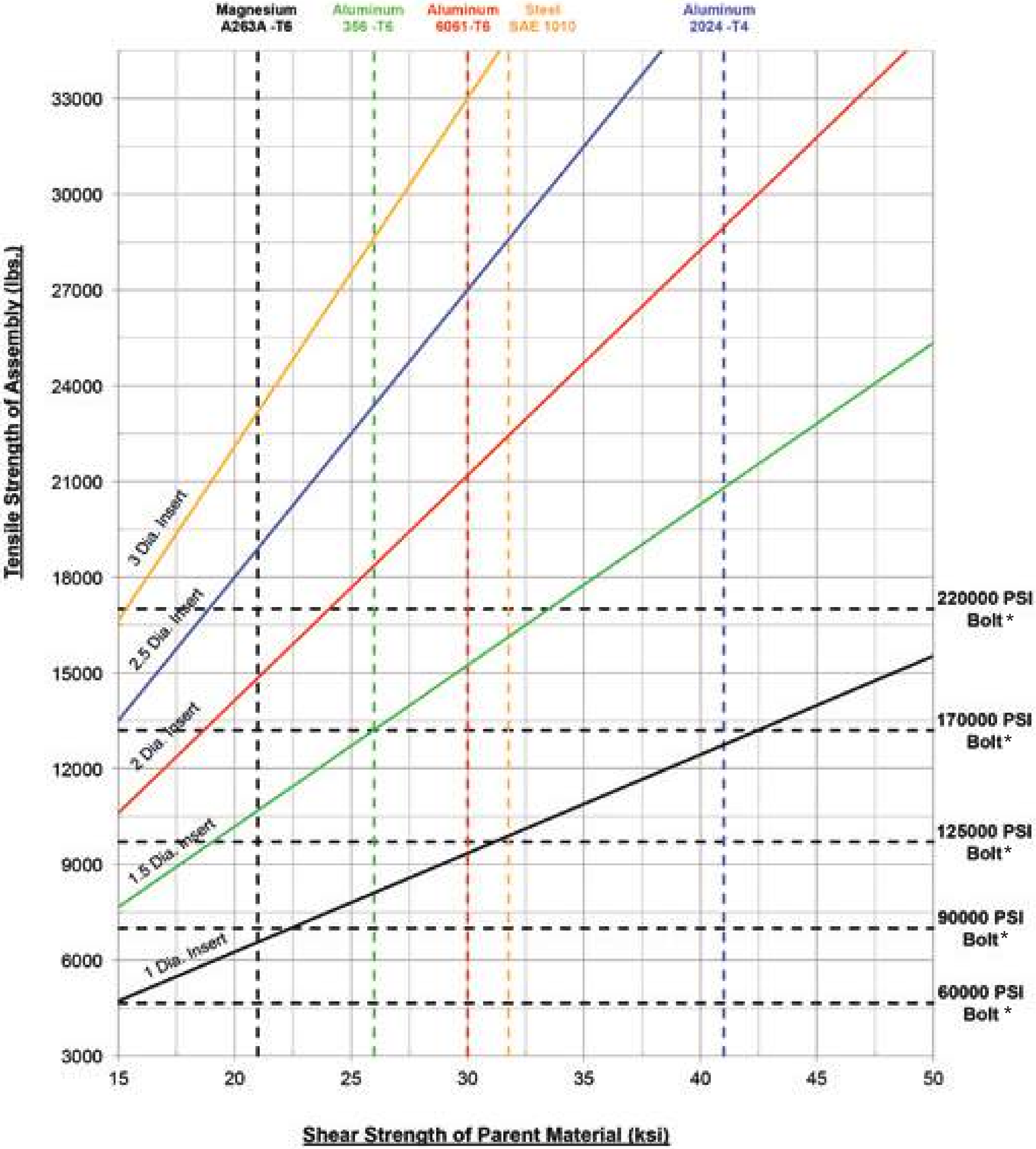
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 5/16-24 Size

(*) Bolt Material Ultimate Tensile Strength



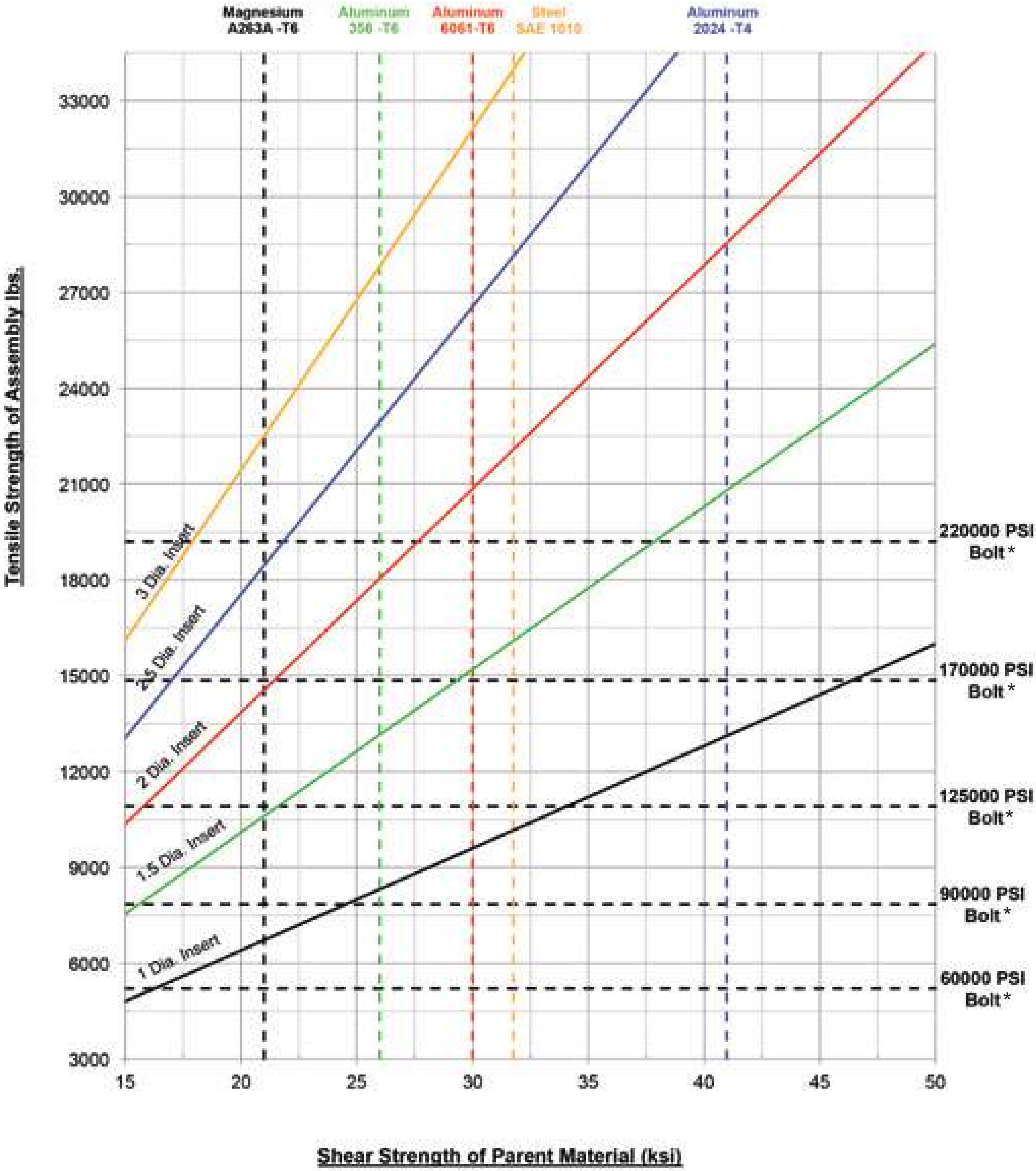
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 3/8-16 Size

(*) Bolt Material Ultimate Tensile Strength



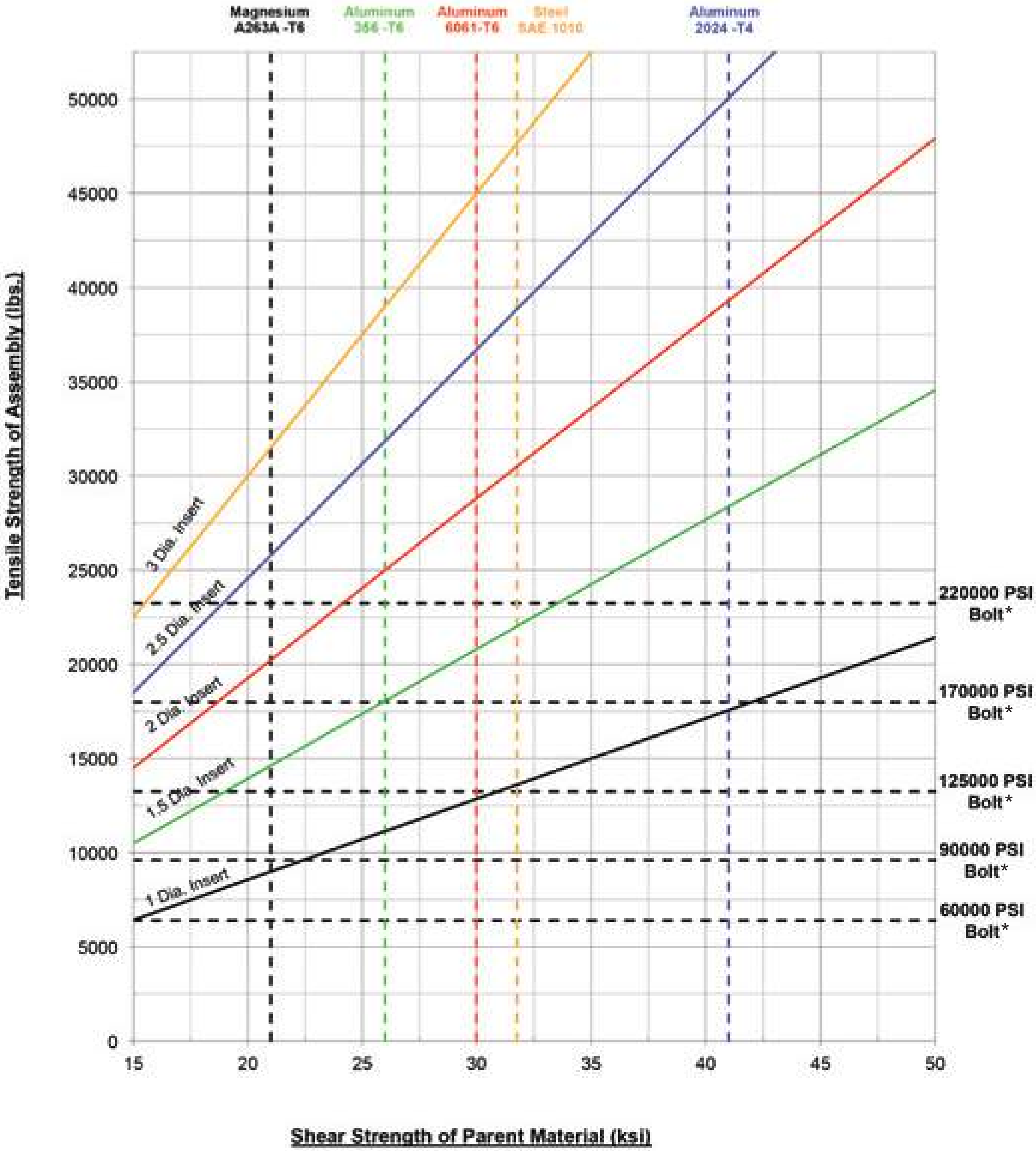
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 3/8-24 Size

(*) Bolt Material Ultimate Tensile Strength



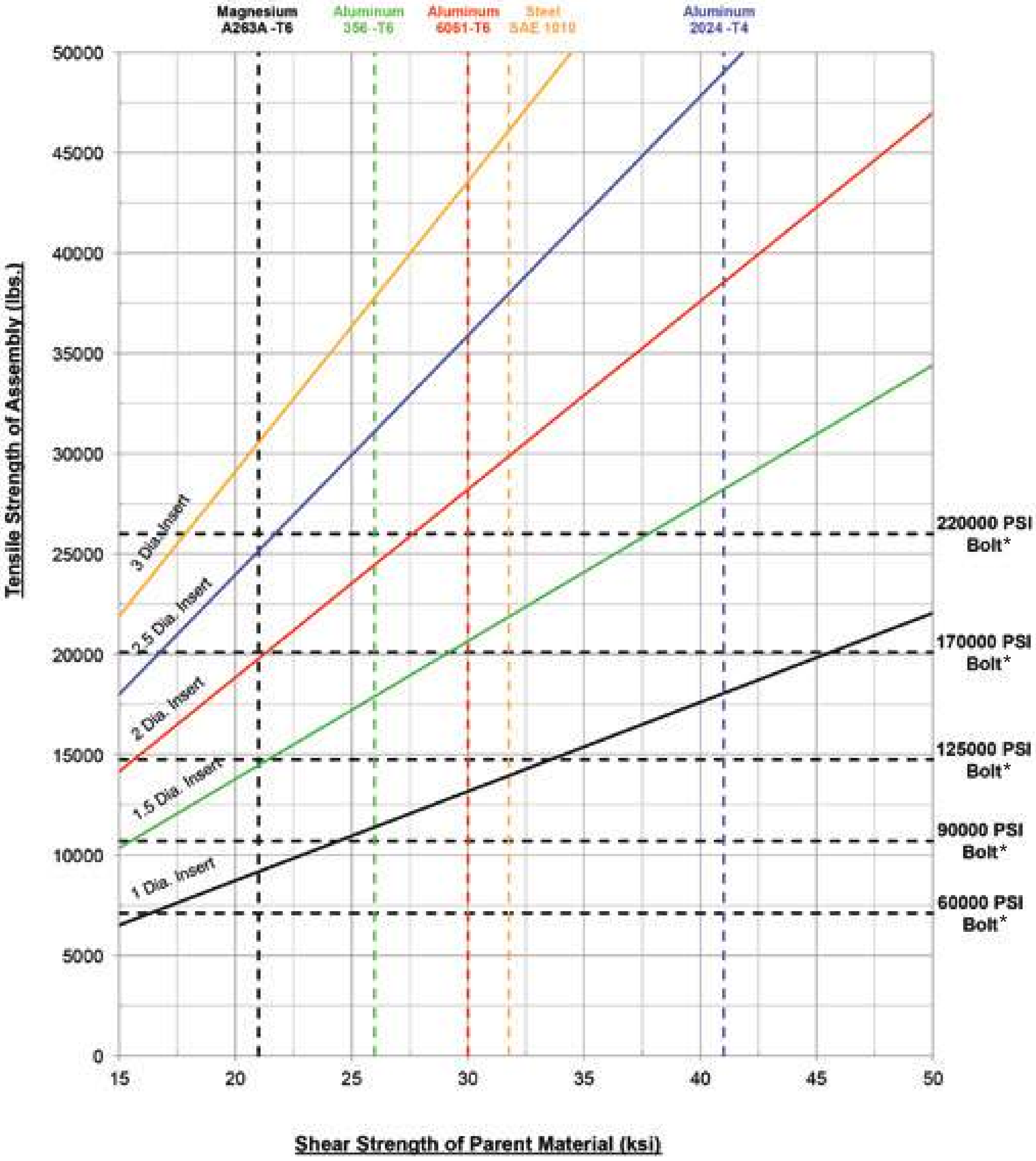
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 7/16-14 Size

(*) Bolt Material Ultimate Tensile Strength



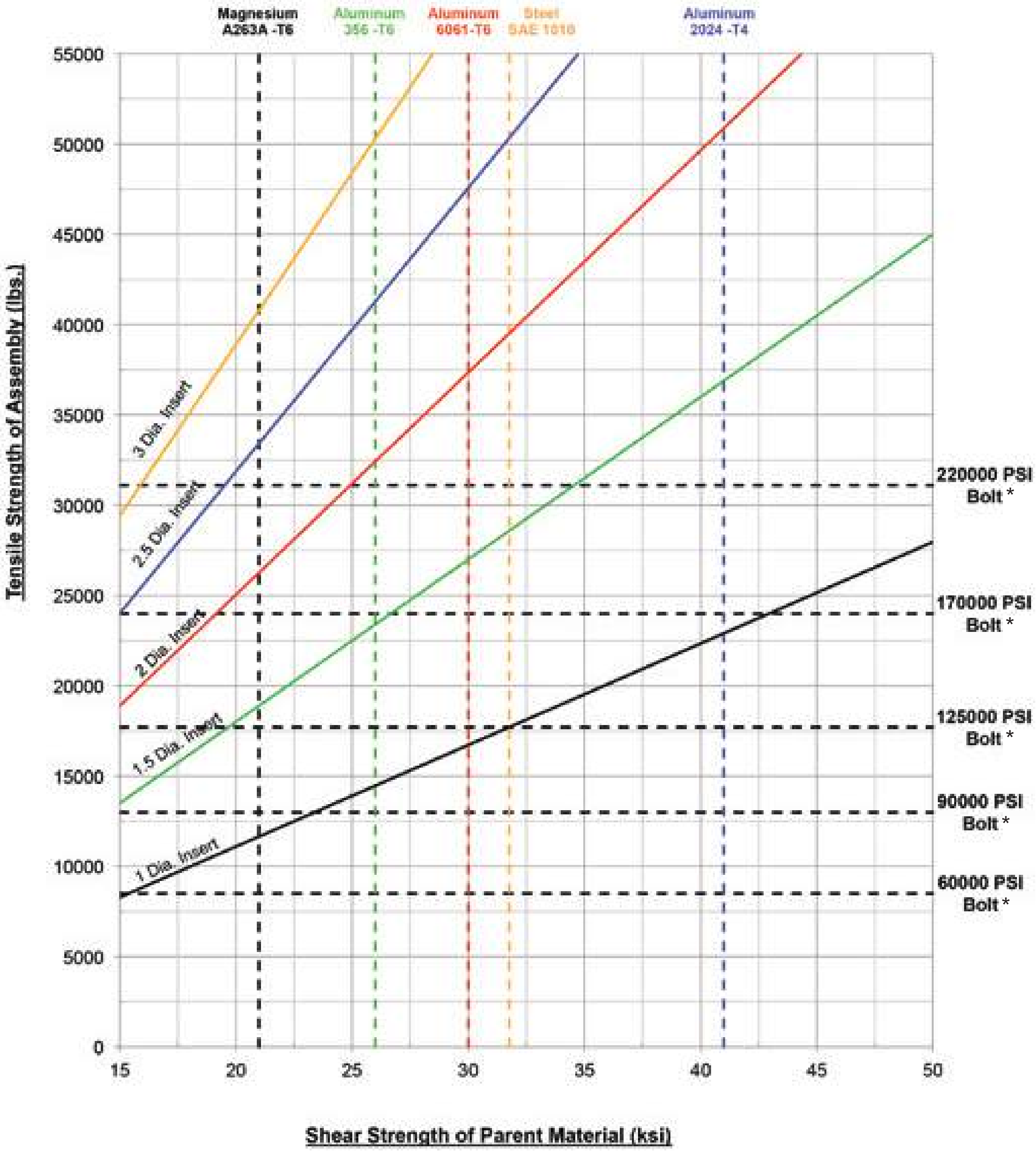
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 7/16-20 Size

(*) Bolt Material Ultimate Tensile Strength



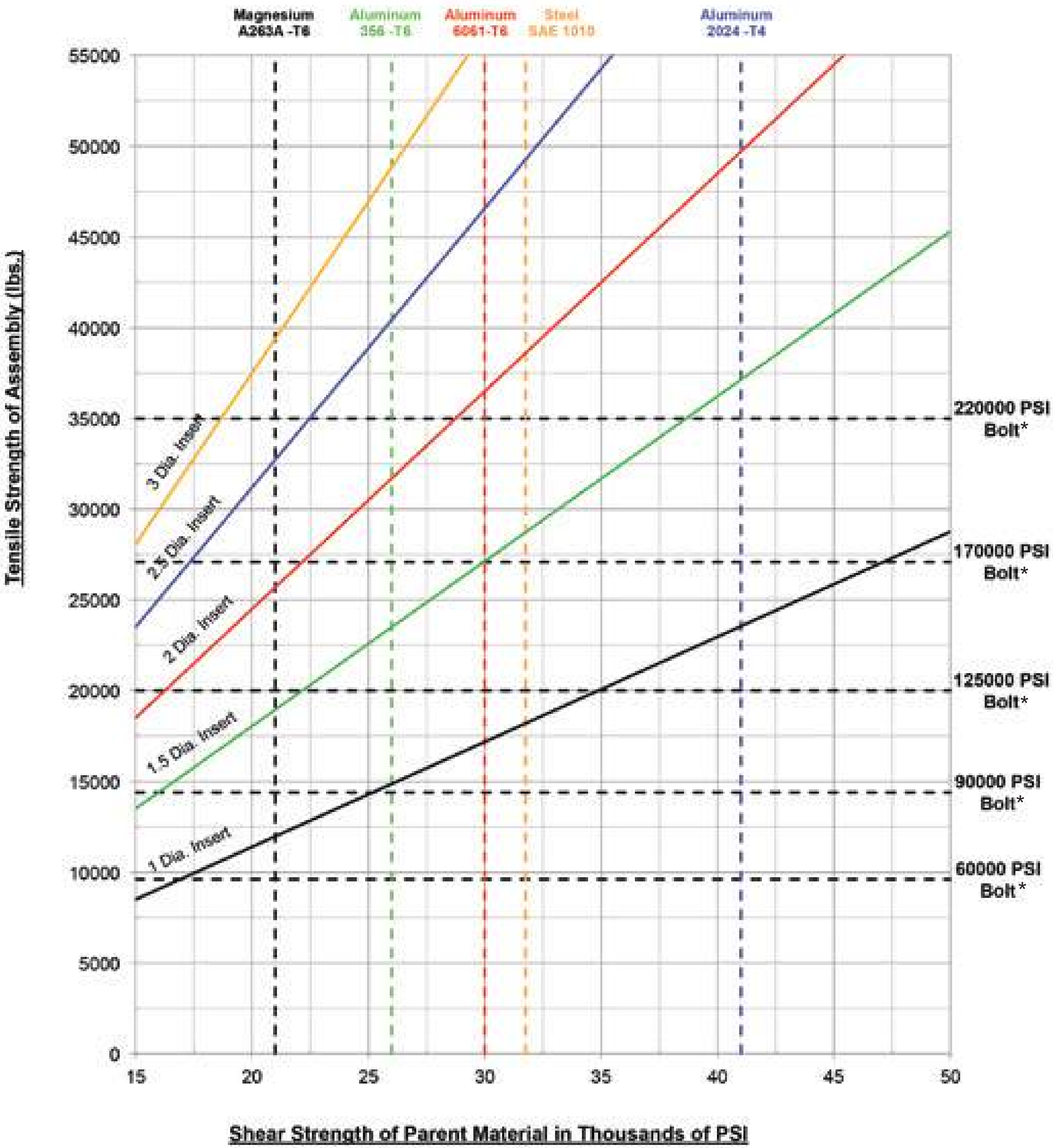
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 1/2-13 Size

(*) Bolt Material Ultimate Tensile Strength



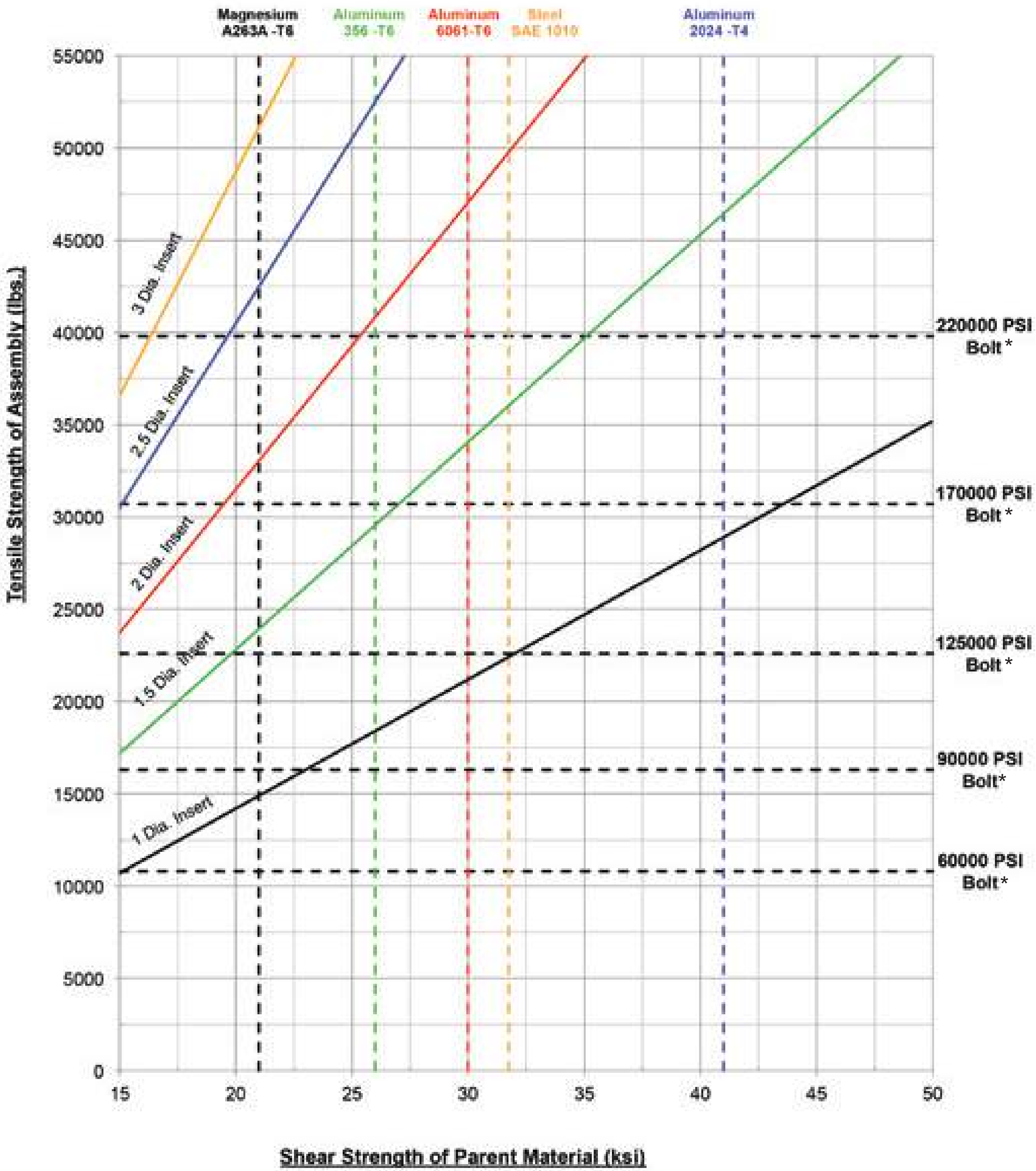
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 1/2-20 Size

(*) Bolt Material Ultimate Tensile Strength



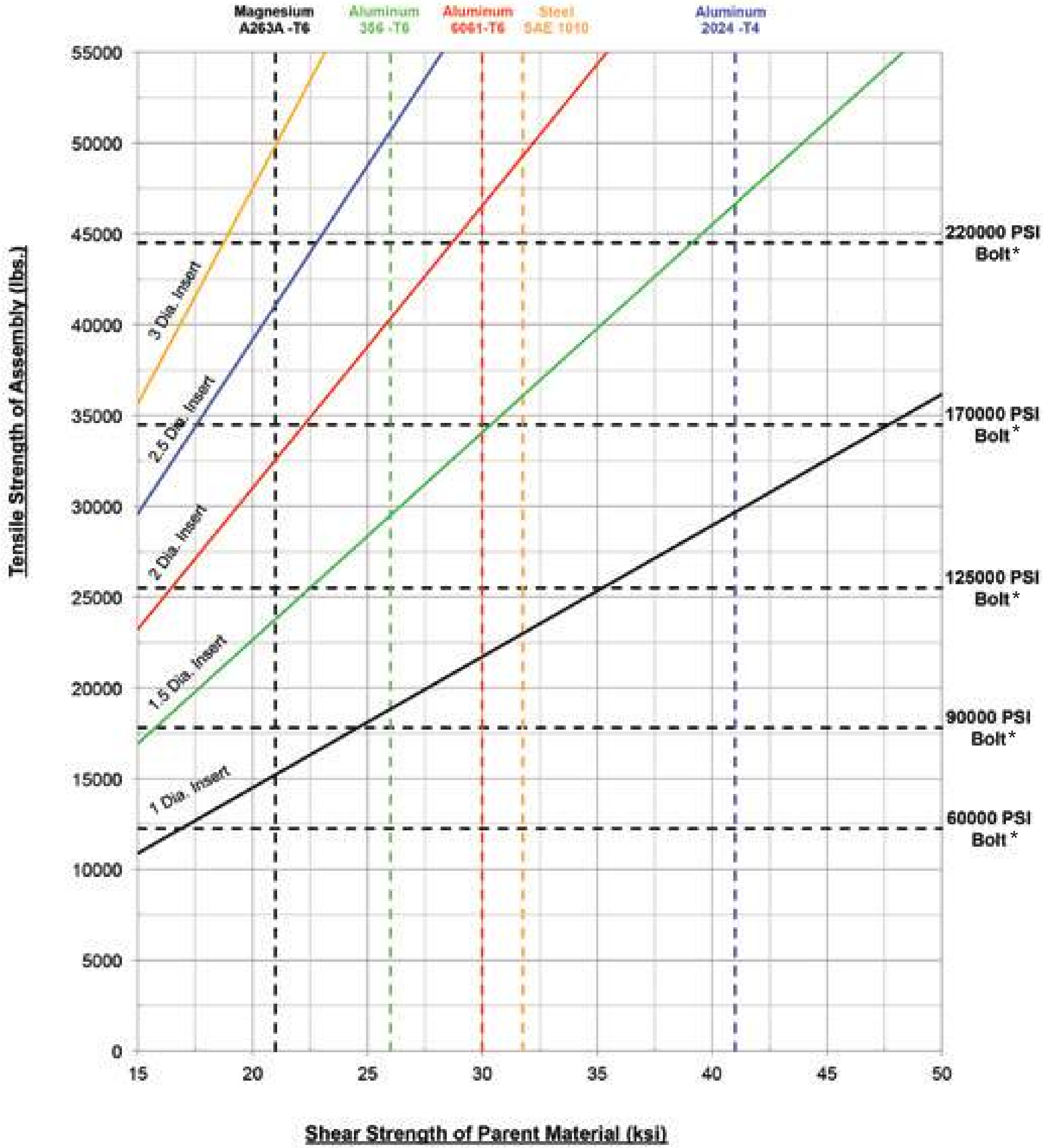
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 9/16-12 Size

(*) Bolt Material Ultimate Tensile Strength



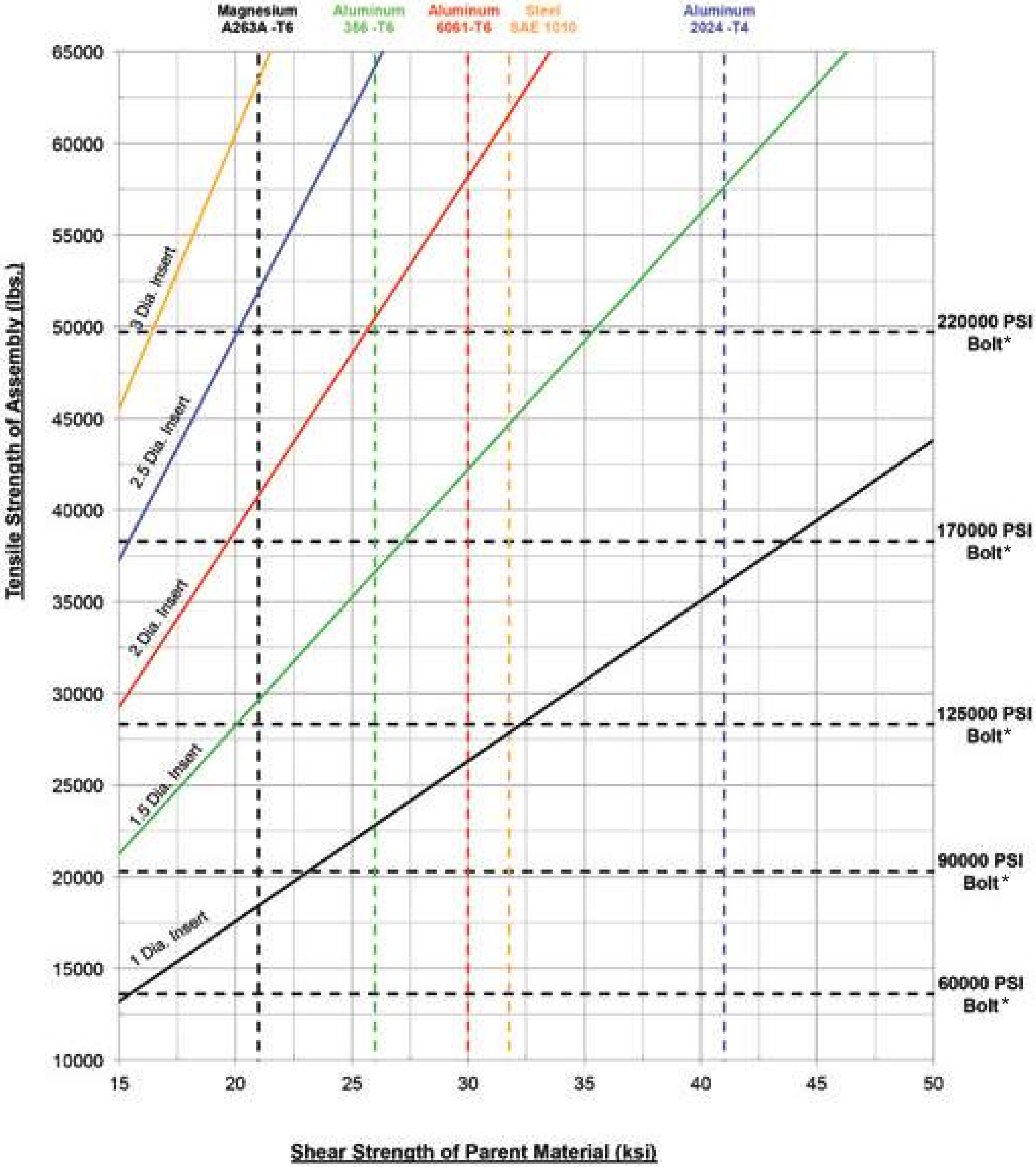
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 9/16-18 Size

(*) Bolt Material Ultimate Tensile Strength



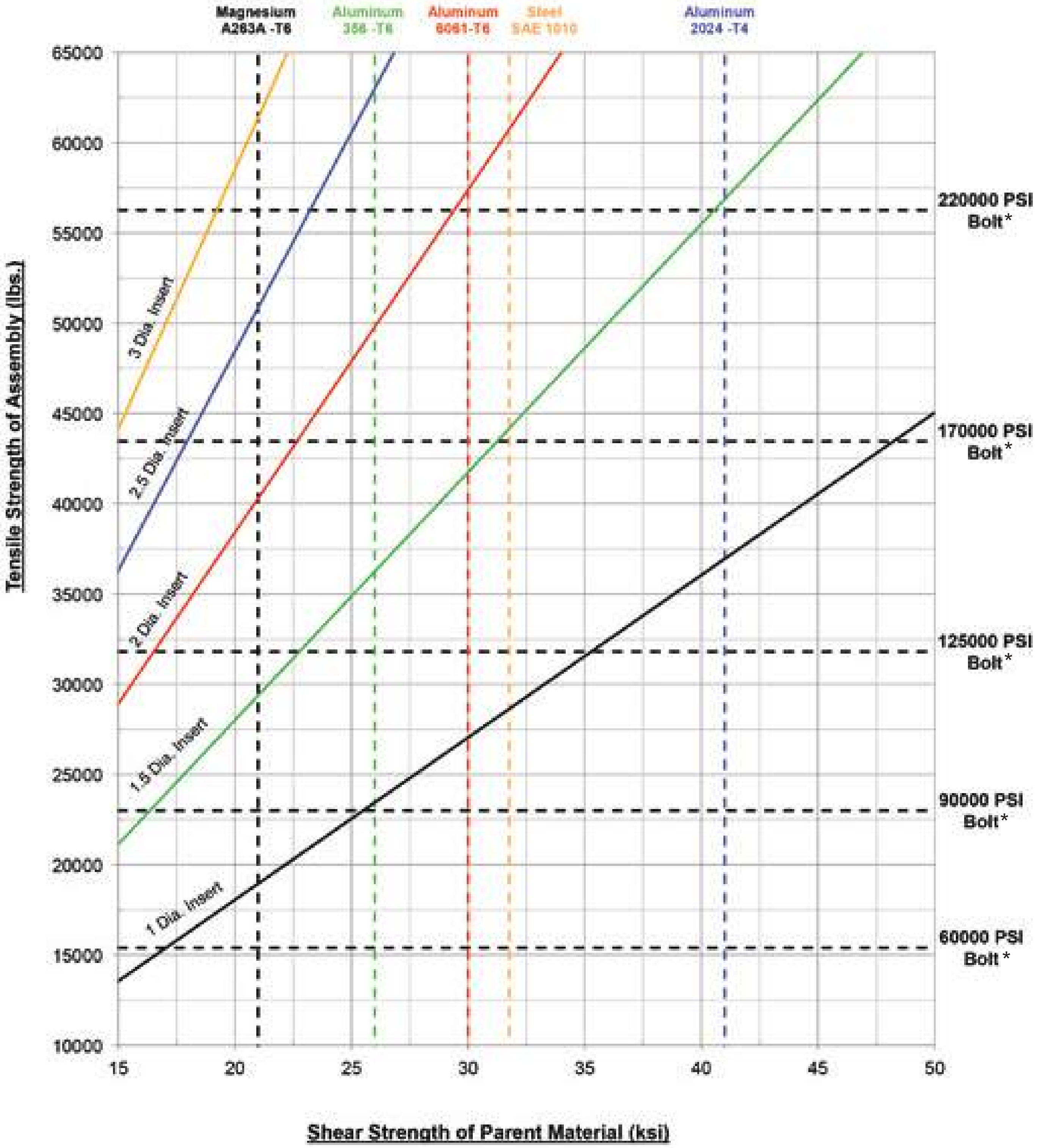
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 5/8-11 Size

(*) Bolt Material Ultimate Tensile Strength



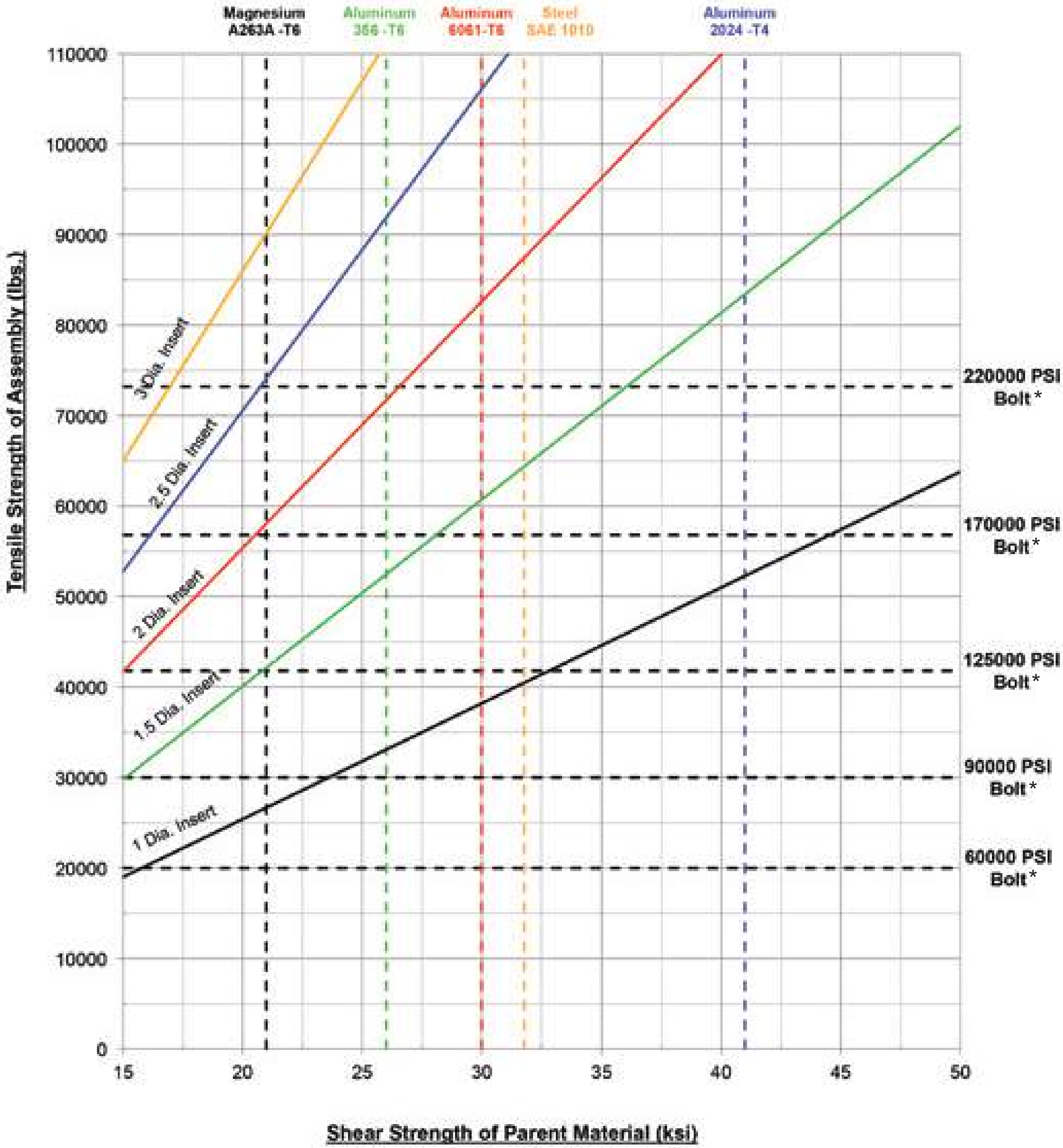
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 5/8-18 Size

(*) Bolt Material Ultimate Tensile Strength



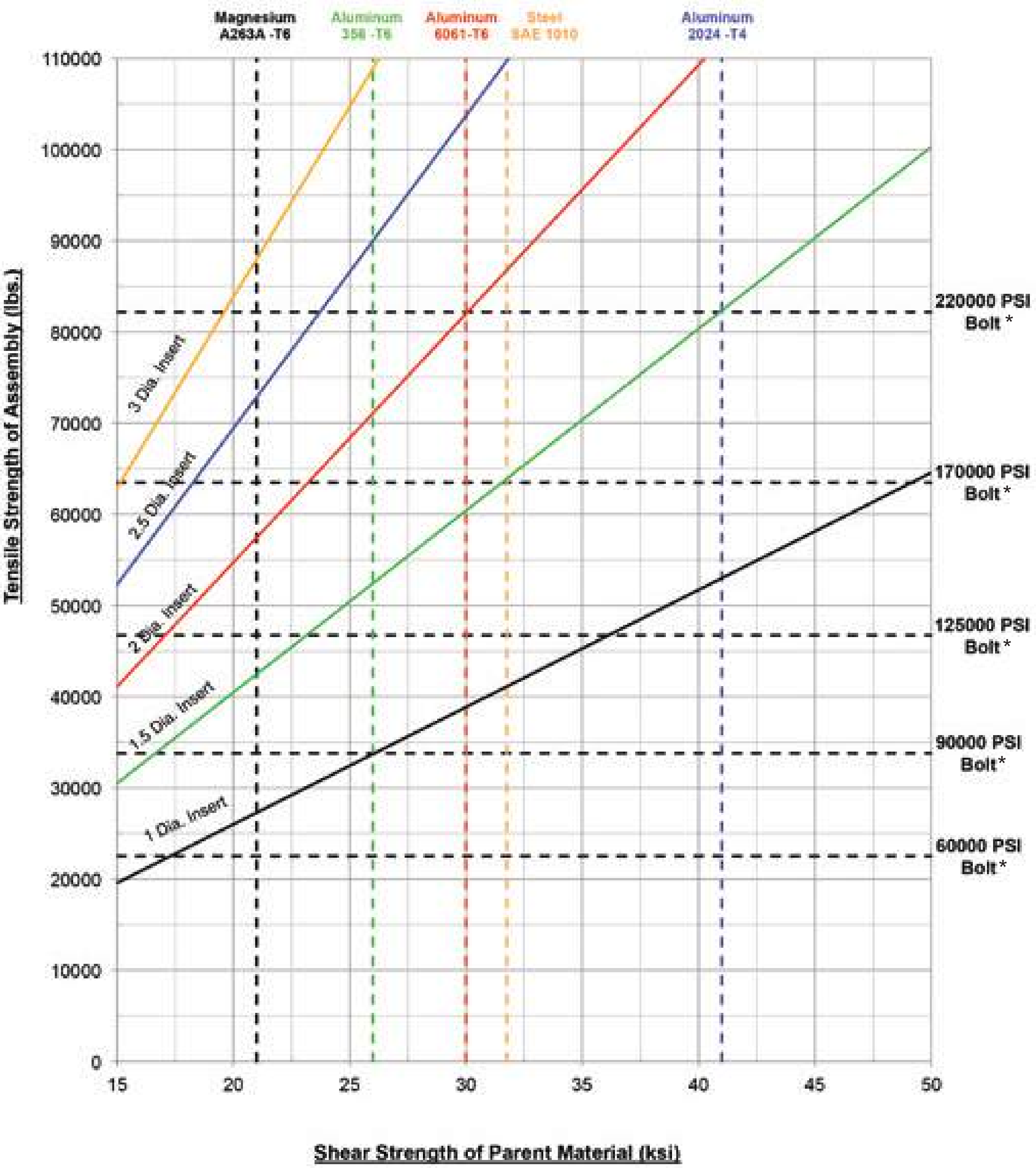
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 3/4-10 Size

(*) Bolt Material Ultimate Tensile Strength



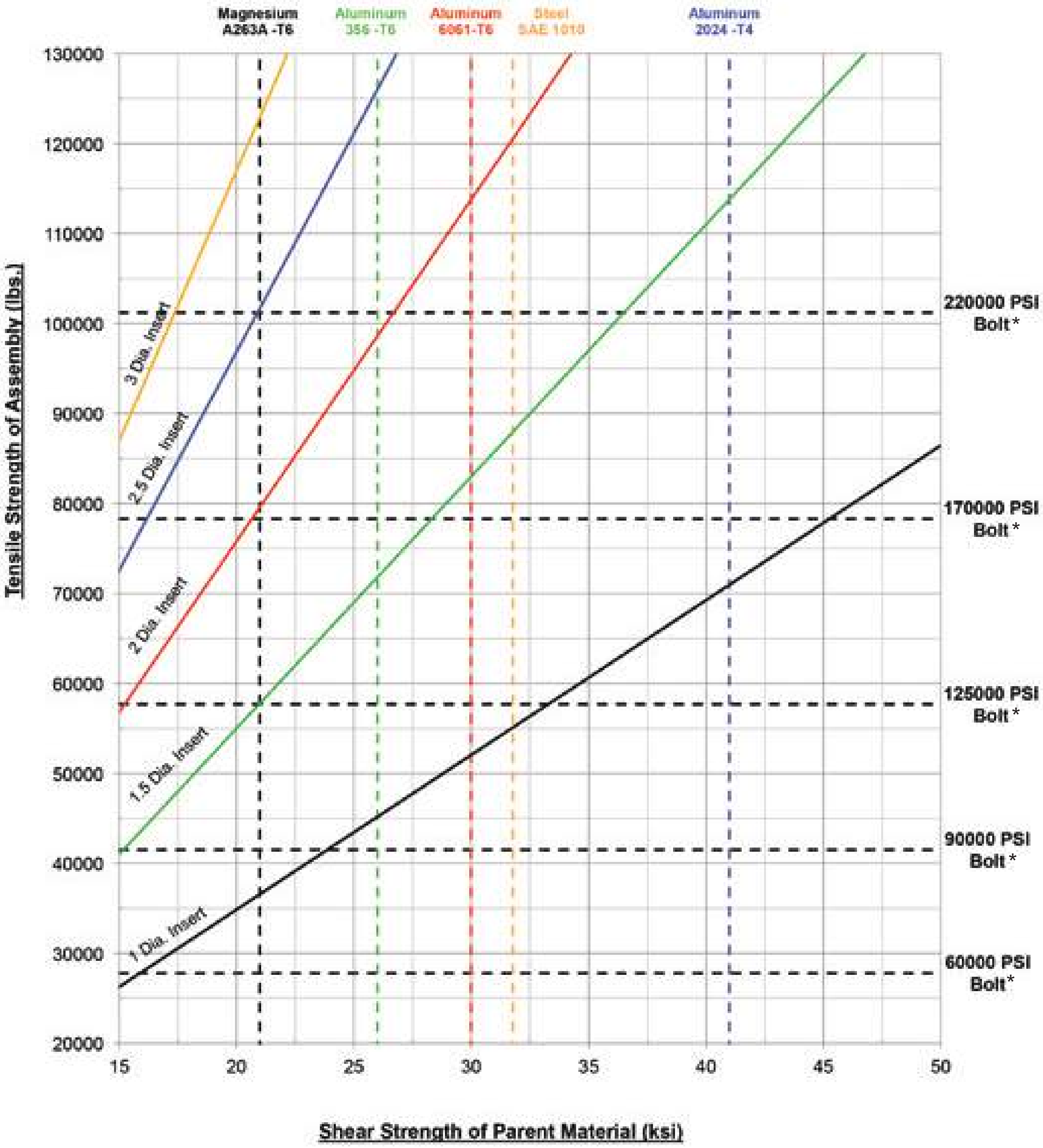
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 3/4-16 Size

(*) Bolt Material Ultimate Tensile Strength



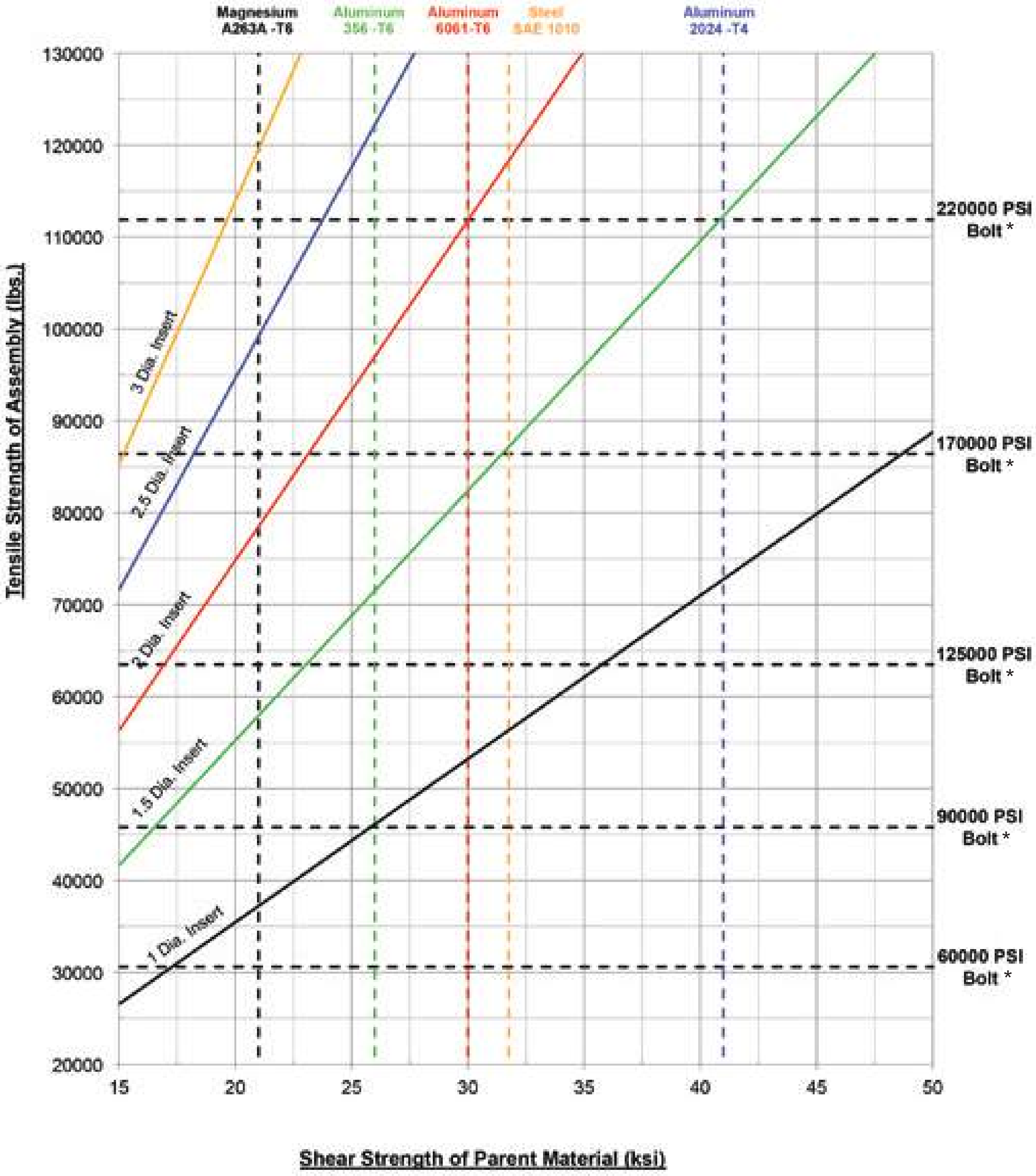
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 7/8-9 Size

(*) Bolt Material Ultimate Tensile Strength



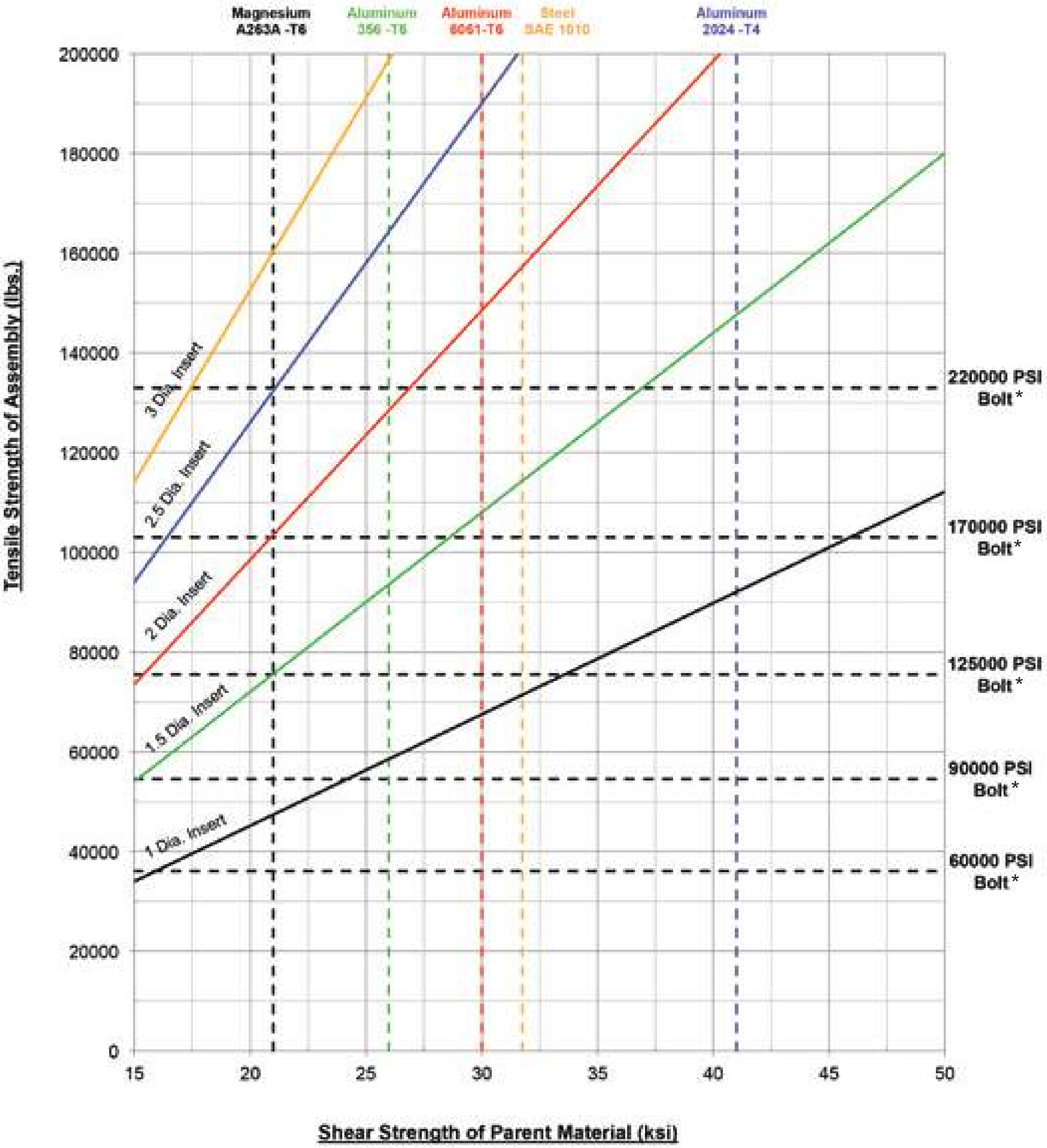
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 7/8-14 Size

(*) Bolt Material Ultimate Tensile Strength



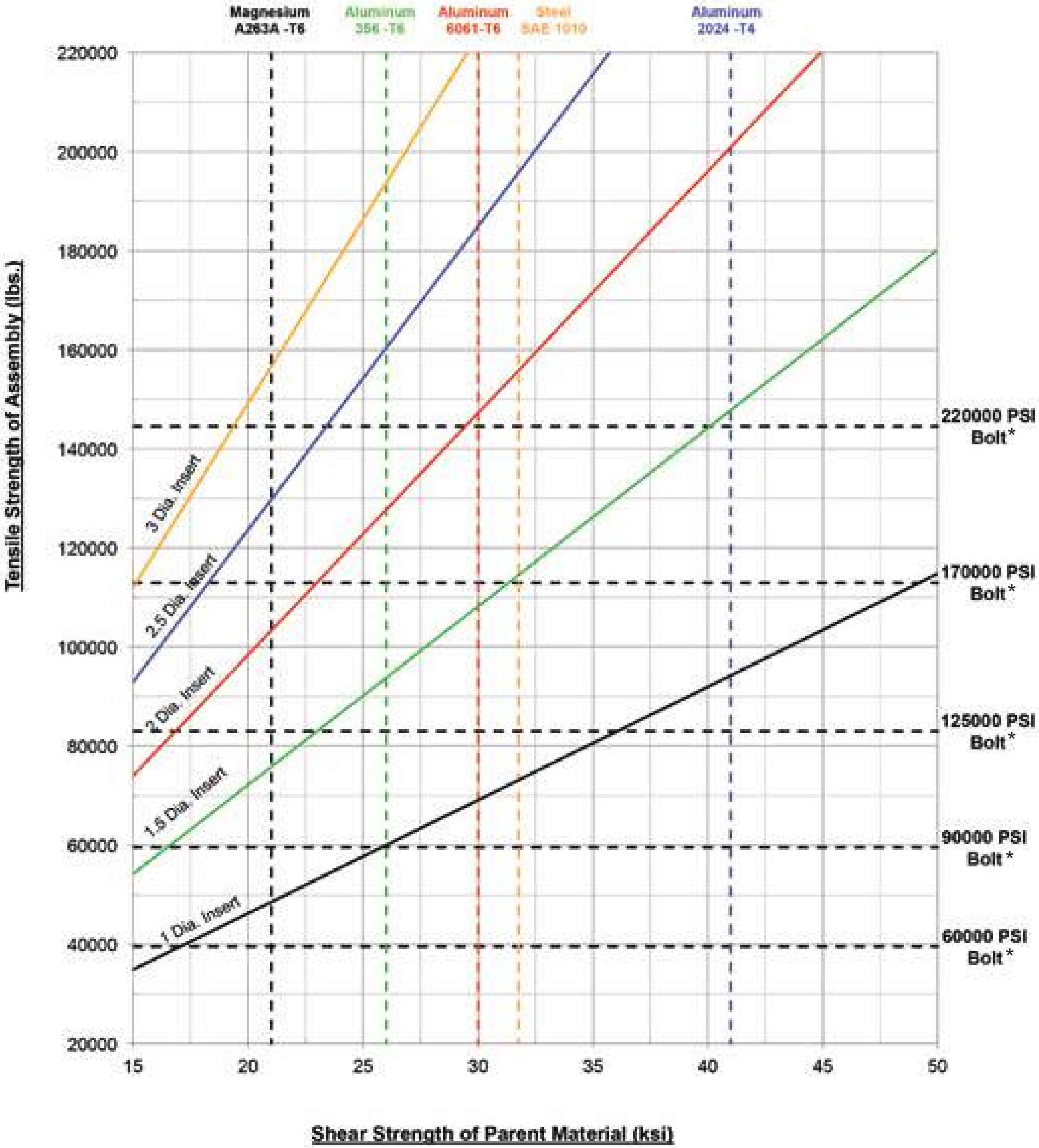
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 1”-8 Size

(*) Bolt Material Ultimate Tensile Strength



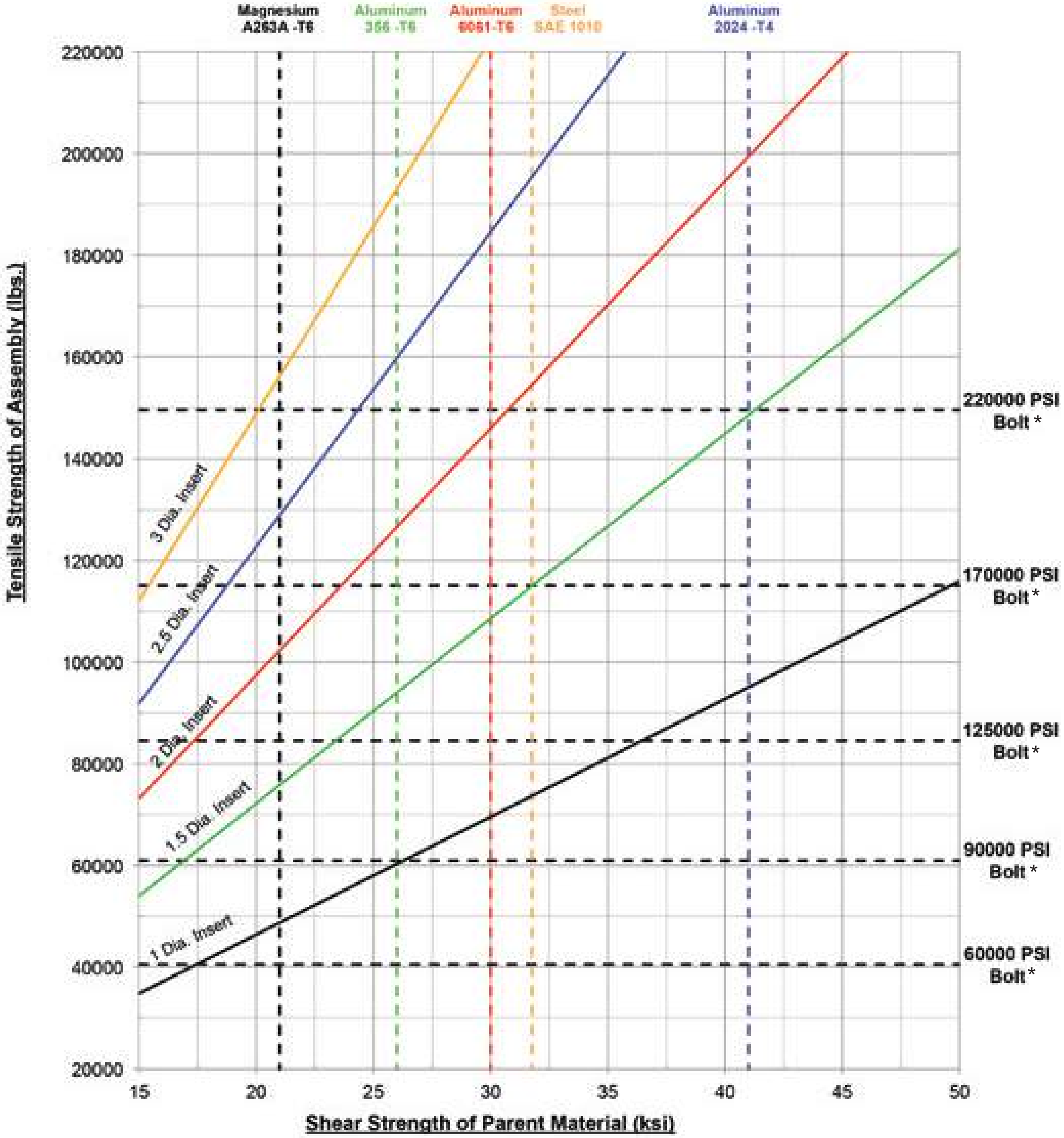
Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 1”-12 Size

(*) Bolt Material Ultimate Tensile Strength



Tensile Strength of Heli-Coil Assembly vs. Shear Strength of Parent Material for 1”-14 Size

(*) Bolt Material Ultimate Tensile Strength



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