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Technical Bulletin

To: Sales Force Date: September 8, 2004

From: Applications Engineering

Subject: Gasket Constants for the Layman

The following is an overview of Gasket Constants (sometimes called **ROTT constants**): **Gb, a, Gs**. This guide might be used as a reference material, since it is not always necessary to know this material by heart. Some familiarity with the terms would probably be useful, and customers can then be referred to this explanation if they want more details.

It is probably impossible to create a simple document that explains this subject; it is simply not very simple. (How's that for a sentence?) However, many manufacturers will attempt to sell a product based on discussions of their Gasket Constants, so we do need to be at least a little familiar with these values, and what they mean.

ROTT test: This is the test used to determine the ASME gasket constants. There is a draft in progress in ASTM committee F3.

Flange Design: This is the actual intended purpose of the constants: to replace m&y's to design flanges. The purpose is to design flange assemblies for ASME Code vessels using leak rate as a design criteria. M&Y values are not typically based on any type of design leak rate. A flanged joint was considered sealed if it was not dripping. Today we recognize that vapors and gases can permeate through a gasketed joint, and that the amount of permeation decreases when we increase the load (stress) on the gasket. The new ASME and European flange design rules (if adopted) will require that designers select maximum allowable leak rates and choose gaskets accordingly.

Flange design (gasket compressive stress) is affected by the designer's choice of the **tightness class:**

Standard class, T2
Water/Air class, T1
Tight class, T3

These classes reflect the max leak rate tolerable, related to the cost of the fluid or toxicity. Tightness is pretty much the opposite of leakage; a higher tightness value (Tp) means less expected leakage. Selection of a gasket material **WILL AFFECT SOME FLANGE DESIGNS**, because of the changes in required compressive stress.

Gasket Comparison: This was not the intended use of the constants, but is very prevalent in industry. Simply put, the problems with comparisons are two fold: The ROTT method is not as precise as some would like, so that unless the calculations show differences on the order of 10 times, the gaskets may actually be quite similar. Second,

comparison of each of the three values is not straightforward, since all three values affect the flange design and leakage calculation. (See "Leak Calculator" section of this document for a better method to compare constants)

This graph might help explain the three constants and what they mean.

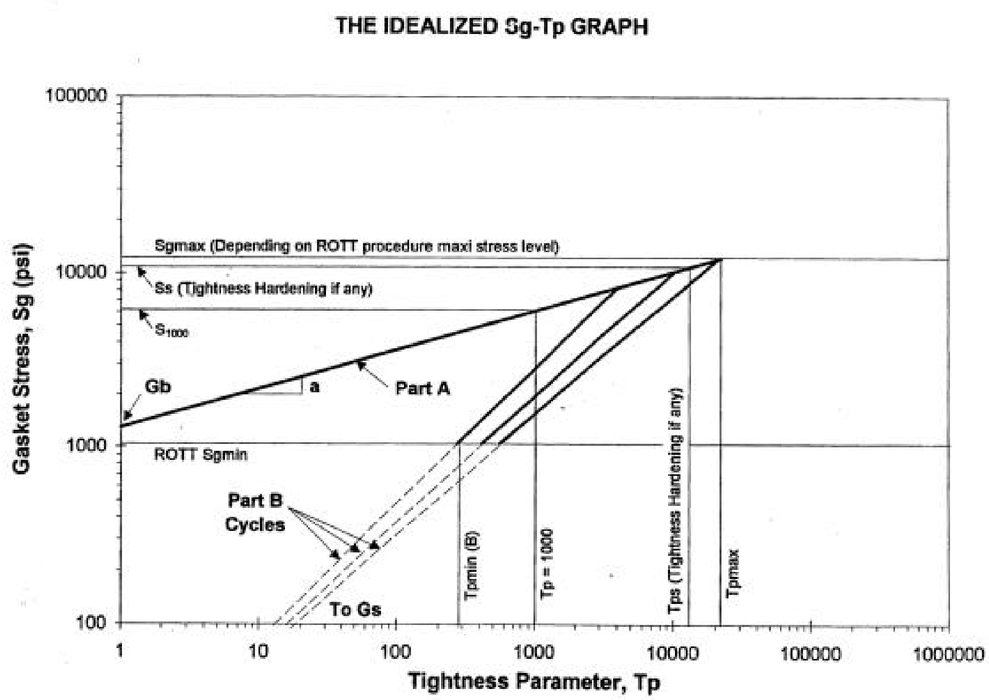

Figure 1

Gb and a: The upper line is the loading line, when the gasket is being compressed. It represents the relationship between the compressive stress applied and the leak rate found at each load. Since it is a Tightness graph, as opposed to leakage, the tightness increases with increasing load. Gb and a are simply the way the line is represented with numbers, so that they can be used in calculations. Gb is the intercept, where the line hits the vertical axis, and a is the slope of the line.

Since "a" is the slope of the line, a higher “a” value = steeper line (flanges will need more or larger bolts to achieve a tighter seal)

A lower “a” = more level line (flanges will require less bolting)

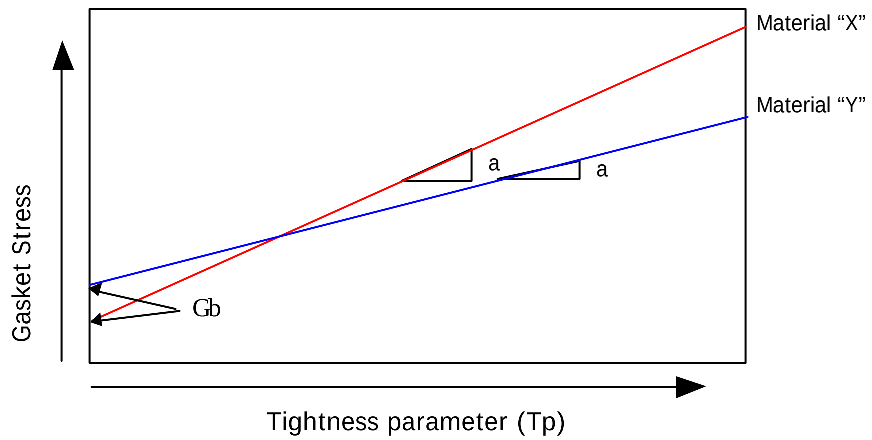

Figure 2

EXAMPLE GRAPH: Even though material "X" has a lower "Gb", material "Y" is actually easier to seal at the higher tightness parameters (Tp).

Gs – This value has to do with what happens when the test unloads the gasket (simulating the loss of load when the unit is pressurized). Just keep in mind "the lower the 'Gs' the better".

During the ROTT test, the gasket is loaded to a certain point, then unloaded to see how it reacts, and then loaded more and unloaded again, for a total of three unloading lines. It is done three times because the gasket does not act the same each time; typically, the more you load a gasket, the more you can unload it without creating a leak. Why unload? To duplicate what happens when the vessel is pressurized.

Leak Calculator:

Since comparison of these constants is pretty difficult, we've created a calculation program to help with this. The program calculates expected leak rates for a given flange using the gasket constants for the selected gasket. The theoretical leak rate can be found once the flange information and gasket constants are known.

In order to find the expected tightness or leak rate from a particular design the program calculates the available compressive stress at installation, calculate the theoretical unloading from the hydrostatic end force when pressurized, and find the leakage at that unloaded point. Gb and a will determine the tightness at installation, and Gs determines the tightness when unloaded from that point.

As alluded to previously, these calculations are not precise, so that researchers have found actual leak rates are typically many times smaller than predicted, but that means the design will be conservative: it should seal better than predicted.

S100, S1000, etc: These values are calculated from Gb and a, without regard to Gs. They show the necessary stress for a particular gasket to hit a certain Tightness Parameter

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(Tp value). For our purposes, let's just consider that a tighter, less leaky gasket will have a higher **Tightness Parameter, or Tp**. The various "S-values" are helpful when comparing

the seating stress requirements of gaskets, but they ignore the operating condition found with Gs. The formula, for very curious people, is:
$S(Tp) = Gb \times (Tp)^a$ (Gb multiplied by Tp to the power of a)

For example, S100, which is the stress needed to achieve a Tightness Parameter of 100, = $Gb \times 100^a$
Therefore $S1000 = Gb \times 1000^a$
Therefore $S3000 = Gb \times 3000^a$

Low values of S1000 or S 3000, etc, are favorable, since these are the stress levels needed to achieve a particular level of tightness.

"SO WHAT DOES THIS ALL MEAN?"

There's a new way of designing flanges on the horizon, and it will probably be with the gasket constants discussed in this bulletin. Therefore, you need to know the following:

1. Be familiar with the terms discussed in this bulletin
2. When choosing materials based on gasket constants, the user must consider all three values.
3. The Applications Engineering department has a leak rate calculator. If you have a customer that is looking for this detailed information pertaining to anticipated leak rates, or any other questions please give us a call 800-448-6688.