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KAPA™ FAQs

What does "KAPA™" stand for?

"KAPA™" is an acronym for "Kiefner and Associates Pipe Assessment".

What does KAPA™ do?

KAPA™ calculates an estimated failure pressure of a pipe affected by either a blunt metal-loss defect or a crack-like defect in accordance with several published methodologies widely used in the industry.

What method does KAPA™ use to estimate the failure pressure?

For blunt metal-loss defects, such as those caused by corrosion or removal of damaged metal by grinding, KAPA™ calculates the estimated failure pressure according to three methods: ASME B31G, the "Modified B31G" method also known as the "0.85-dL" method, and the "Effective Area" method. These last two were published in the public domain as a two-part series of articles on August 6 and August 20, 1990 issues of the *Oil & Gas Journal*. They have also been described in various other industry reports. All three methods are covered in the ASME B31G-2012 standard as Level 1a (B31G), Level 1b (modified B31G), and Level 2 (effective area).

For crack-like defects, such as those caused by SCC, KAPA™ calculates the estimated failure pressure according to the modified log-secant formula as published in the public domain "Modified Equation Aids Integrity Management", Kiefner, J. F., Oil and Gas Journal Oct. 6, 2008, pgs. 78-82. This equation is modified from the original "log-secant" formula, also known as the "NG-18" equation, which has been published in the public domain in "Failure Stress Levels of Flaws in Pressurized Cylinders", Kiefner, J. F., Maxey, W. A., Eiber, R. J., and Duffy, A. R., ASTM STP 536, 1973. KAPA™ accomplishes further innovation by combining the Effective Area Method with the modified log-secant equation.

Does KAPA™ give different results from RSTRENG?

KAPA™ internally calculates the same failure pressure for blunt metal loss defects as RSTRENG. However, it reports the results very differently from RSTRENG (also see Why doesn't KAPA™ give the Safe Operating Pressure?) RSTRENG cannot be used to calculate the failure pressure of a crack-like defect.

Does OPS approve KAPA™?

The Office of Pipeline Safety (OPS), being a governmental regulatory body, does not rate or "approve" any methods or products. However, using KAPA™ by a pipeline operator to evaluate

metal loss due to corrosion certainly conforms to 49 CFR Part 192 and 195 provisions. (Also see Does KAPA™ comply with 49 CFR Part 192 or Part 195?)

Does KAPA™ comply with 49 CFR Part 192 or Part 195?
Yes. The operator's use of KAPA™ to evaluate flaws such as corrosion conforms to Federal regulations. Paragraph 192.485(c) states

> "…the strength of pipe based on actual remaining wall thickness may be determined by the procedure in ASME/ANSI B31G or the procedure in AGA Pipeline Research Committee Project PR3-805 (with RSTRENG Disk)".

Paragraph 195.587 contains the same provision.

Does the use of KAPA™ comply with IMP regulations for HCA's?
Yes. Paragraph 195.452(h) cites the same methods that KAPA™ uses as suitable methods for calculating the pipe's remaining strength.

Does the use of KAPA™ conform to ASME B31.4 and B31.8?
Yes. Both documents refer to ASME B31G for evaluating the pipe's remaining strength. B31G-2012 incorporates all three methods.

Why doesn't KAPA™ give the Safe Operating Pressure?
Kiefner and Associates, Inc. (Kiefner) believe that no single definition of "Safe Operating Pressure" is uniformly suitable for all pipelines, all categories of construction or location, and all circumstances. We believe that using the term "Safe Operating Pressure" in B31G and RSTRENG is widely misunderstood and leads to potentially non-optimal decisions by the pipeline operator.

We believe the foregoing definition of "Safe Operating Pressure" may be appropriate for many pipelines but not necessarily for all. The benchmark for assessment of a pipeline's integrity remains the hydrostatic pressure test. If a corrosion flaw passes a hydrostatic test at the pressure required for its location and category of service, then it is regarded to be "safe" for all intents and practical purposes. The presence of a "safe" corrosion flaw in the pipeline will not generally be known to the pipeline operator unless they also conduct an in-line inspection (ILI). Most pipelines were never required to be tested to 100 percent of SMYS prior to commissioning or later in service. The minimum hydrostatic test pressure for liquid and gas pipelines in Class 1 areas (operating at hoop stress of 72 percent of SMYS) is 1.25 times the maximum operating pressure or a test pressure of 90 percent of SMYS. However, many pipelines operate at a pressure well below this level. The test pressure requirements for gas lines in other locations are to lower pressure levels (75 percent of SMYS in Classes 2 and 3 and 60 percent in Class 4). It may be unnecessarily conservative to require that all corrosion flaws be capable of passing a test to 100 percent of SMYS when no other portion of the line is or historically was required to meet this requirement.

Instead of a "Safe Operating Pressure", KAPA™ reports the Predicted Failure Pressure and the Factor of Safety with respect to the maximum operating pressure. The operator can establish his company policy requiring that in order to accept continued operation without repairing, the

Predicted Failure Pressure must exceed the operating pressure with a Factor of Safety suitable for the pipeline location and construction in accordance with the operator's risk targets. We believe that the choice of a "Safe Operating Pressure" is an important engineering and management decision that must take into account a number of factors, including the category of construction and location of the pipeline, the operating stress level, future assessment plans and intervals, the operator's tolerance for risk, whether a repair can be made in a convenient and timely manner, and the overall scope and extent of other short-term and long-term mitigation measures, all factors that a simple spreadsheet cannot consider.

How much does KAPA™ cost?
KAPA™ is free. It may be downloaded, copied, and distributed freely and without restriction or licensing fees. Why? Because the pipeline industry already paid for the research to develop the underlying assessment theory (the NG-18 log-secant equation) and then paid for the development of various methodologies subsequently derived from it (ASME B31G, Modified B31G, and the Effective Area Method, which is the concept behind RSTRENG). We believe it is unfair to expect operators to then pay high costs to use tools they have already paid for and that have been described at length in the public domain.

Can I get a customized version of KAPA™?
Yes. Some pipeline operators still want to calculate a "Safe Operating Pressure" or another parameter consistent with the operating company's pipeline attributes and integrity management policies. Upon request, we will provide a customized version with the pipeline operator's requested modifications and the company logo prominently displayed to identify it as the operator's special version. We will charge you for the cost of making these modifications. Usually, these modifications involve only a couple of days of staff time to accomplish, so the costs are not significant.

What do negative numbers in the results mean?
This circumstance could arise with incorrect input, typically in the metal loss grid. Ensure that the profile gives position coordinates in ascending order, that the units selected are consistent with the data entered, and that there is an entry in the metal-loss column for each profile spacing entry.

Does the grid spacing have to be uniform?
No. Spacing between the metal loss measurement points can be uniform or irregular. However, the longitudinal positions of the metal loss measurements must be in ascending order.

What if I don't know the toughness of the material?
It is not necessary to enter the toughness to perform an assessment of blunt metal loss, such as corrosion. The toughness is required to evaluate a crack-like flaw.

Can I run an analysis for metal loss deeper than 80% of the nominal wall?
We have set up KAPA™ to give a warning when the depth of metal loss exceeds 80% of the pipe wall thickness. It is generally the practice to repair the pipe when the metal loss exceeds 80% of the pipe wall rather than try to make an assessment because, in most cases, this

amount of metal loss leaves very little remaining material as a pressure boundary. However, if one proceeds past the warning message, KAPA™ will still run the calculations and produce an accurate assessment even for metal loss deeper than 80% of the pipe wall thickness.

Can I use KAPA™ to evaluate internal corrosion?
Yes. The assessment principles are the same for internal and external corrosion. However, the user should recognize that the depth and extent of metal loss might be more difficult to determine with the same accuracy and confidence as with external corrosion if corrosion measurements are made from outside the pipe because the internal corrosion is not visually accessible. Also, it is assumed that with external corrosion, the corrosion process will be halted by repairing the coating even if the pipe is still sound. In contrast, the internal corrosion process may continue over time.

Can I use KAPA™ to evaluate corrosion on bends?
Yes. Metal loss on field bends, induction bends, and elbows can also be evaluated similarly to metal loss on straight pipe.

Can I use KAPA™ to evaluate how corrosion affects welds?
Yes. Metal loss affecting or intersecting DSAW longitudinal seams and high-frequency ERW seams can be evaluated similarly to corrosion in the pipe body, provided no selective corrosion mechanism or SCC is present. If selective corrosion or SCC is present, such features should be evaluated as crack-like flaws (see Can I use KAPA™ to evaluate SCC?). Metal loss affecting SMAW girth welds can be evaluated similarly to metal loss in the base metal. Still, it would be prudent to ensure by inspection that significant workmanship flaws are not present in or near the corroded portion. KAPA™ or any other method for assessing metal loss affecting acetylene girth welds is not recommended if uncertainty is associated with overall weld quality and properties.

Can I use KAPA™ to evaluate MIC?
KAPA™ can be used to evaluate the remaining strength of a pipe affected by microbe-induced corrosion (MIC) if the remaining wall thickness can be accurately ascertained. Note that MIC can result in metal loss that is highly irregular in profile, such that difficulties may arise with obtaining accurate measurements of the depth and extent of metal loss. If accurate measurements cannot be made, a valid assessment is not possible by any method.

Can I use KAPA™ to evaluate SCC?
Crack-like features such as SCC can be assessed using KAPA™ if the depth and length of the SCC feature or colony are known, along with the material toughness. While this is also true in principle for features on ERW bond lines, one must use an appropriate value for the toughness of the bond line, which may be exceedingly low. Such features should generally be repaired rather than relying on an assessment.

Can I use KAPA™ to evaluate dents?
Corrosion associated with a rock indentation can be evaluated similarly to corrosion in a straight, unindented pipe. Mechanical damage in the form of a scrape or gouge that has been completely

ground out to a smooth contour, leaving a remaining wall thickness of at least 60% of the pipe wall thickness, and where the indentation was not severe, can be evaluated using the B31G result. Neither KAPA™ nor any other assessment technique is suitable for evaluating severe mechanical damage where the damage has not been treated by grinding.

Can I use KAPA™ for other forms of metal loss?
Yes. Blunt, smooth metal loss from other causes can also be evaluated using KAPA™. Such causes include the removal of imperfections by grinding, such as laminations, arc burns, minor scrapes, or pits from arc gouges or lightning strikes.

Many situations concerning ERW seam flaws, SCC, mechanical damage, or other forms of damage require some experience, specialized knowledge, and accurate data to properly recognize and assess their severity. If there is any question about the safety of such features, it may be most prudent to repair the pipe or contact Kiefner at (614) 888-8220 for further guidance.

Why will KAPA™ not run even when macros are enabled?
Make certain macros are allowed to execute in your version of Excel. In addition, recent updates from Microsoft appear to have permanently disabled macros in some installations of Excel. We have found a patch from Microsoft that may fix the problem. Your IT department should locate and install the patch for you.