BACK TO SYNOPSES

TTRL
Tightness Testing and Research Laboratory

ROOM TEMPERATURE CRUSH RESISTANCE TIGHTNESS TESTS ON THE PIKOTEK 4" cl 300 lb VCS GASKET STYLE

Report
prepared for

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by

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TESTED MATERIALS

A PIKOTEK 4" cl 300 lb VCS gasket style was tested at the TTRL, Ecole Polytechnique of Montreal. The gasket style is a NPS 4 cl 300 lb with a SS metal carrier covered with an epoxy resin layer on both sides. The sealing is provided with a spring energized Teflon and an O-Ring located each in a groove on both sides of the gasket.

The gaskets were provided by PIKOTEK for testing. Our laboratory test code for this material is MB01.

TEST PROGRAM

Three room temperature CRUSH resistance tightness tests were conducted on the gasket samples. The CRUSH test is performed after the ROTT (ROom Temperature Tightness) test has already been conducted on the specimen. The ROTT test results are documented in a separate report.

PROCEDURE

The CRUSH test consists of applying very high compression loads on a gasket specimen in order to evaluate both its mechanical and leakage resistance to excessive compression. The maximum applied compressive stress is approximately 40000 psi (nominal).

The procedure consists of cycling the gasket from a minimum stress of 1025 psi (S1 stress level of the ROTT procedure) up to the required maximum stress of 40000 psi in increments of 5000 psi with Helium at a pressure of 400 psig . Gasket deflection and leakage are measured after every 5000 psi stress increment. The CRUSH test procedure, when performed as a continuity of a ROTT test, is as follows:

(1) At the end of the ROTT test, the gasket is at the S1 stress level and the pressure is at 800 psig. The pressure is set to 400 psig and a leakage measurement is taken.

(2) The gasket specimen is then loaded to a stress level of S5 (≈ 10000 psi for soft procedure and 15000 for standard procedure) + 5000 psi. Gasket deflection and leakage measurements are then taken.

(3) The gasket specimen is unloaded to a stress level of 1025 psi. Gasket deflection and leakage measurements are recorded.

(4) The compressive stress is then increased to the value of the previous highest stress level incremented by 5000 psi (For example, if the previous highest stress level was 15000 psi in step 2, the gasket stress is increased to 20000 psi.) Gasket deflection and leakage are recorded.

(5) Steps 3 and 4 are repeated up to the required maximum gasket stress (40000 psi when possible).

TEST SPECIFICS

Dimensions of specimens

The PIKOTEK 4" cl 300 lb VCS gasket samples were provided with the dimensions of an NPS 4 class 150 lb in accordance with the definitions specified in the proposed ASTM Draft No. 9 for ROTT testing of non-sheet gasketing materials: 4.5 in. ID x 6.875 in. OD.

Computation of gasket stress

Gasket stress is computed based on the initial gasket area (before loading and defined below). The increase in gasket area due to Poisson's effect of the gasket materials is not taken into account in the computation.

Gasket stress values in the ROTT/Crush test are computed based on the initial gasket area (before loading). For this gasket type the stress calculations were based on a loaded area of 8.44 in^2. The initial loaded area of the PIKOTEK gasket specimen is based on 5.25 in. ID and 6.19 in. OD. Based on this area, loads of 8650 lb up to 337600 lb were applied which correspond to the S1 stress level and the maximum 40000 psi stress level respectively.

TEST RESULTS

Gasket deflection, leakage and tightness results are presented graphically, for the test, according to the following:

- A plot of Gasket Stress, Sg, vs Gasket Deflection (gasket thickness loss), Dg, on a linear scale

- A plot of Gasket Stress, Sg, vs the Tightness Parameter, T_p, on logarithmic scales (this type of plot is called an Sg-T_p graph). See appendix 1 for the definition of the Tightness Parameter, T_p

The CRUSH test sequence has been identified (from step 1 to step 11) on all Sg-Tp plots. A rapid and direct comparison of the results between two tests can be done by superimposing the corresponding plots.

ANALYSIS OF RESULTS

- The Sg-Dg graph shows that all gasket specimens resisted the crush test very well.

- The three Sg-Tp graphs indicate that the gasket specimens maintained tightness at high stresses during the crush testing. In effect, from these same graphs, points 2,4,6,8 and 10 show that tightness under high loads is effectively maintained up to the maximum compressive stress of 40000 psi. Also, the specimens maintained their tightness during the unloadings to S1 stress levels (1024 psi).

Appendix 1 - Tightness Parameter, T_p : Definition

Any specific measure of mass leak rate is strongly correlated to the applied fluid pressure. To permit the comparison of the leakage behaviour of gaskets tested at different fluid pressures, the effect of pressure must be taken into account. This has led to the definition of a non-dimensional Tightness Parameter, T_p, which relates a given measured value of leak rate to the pressure at which this leak rate was actually obtained:

$$Tp = \frac{P}{P^*}\left(\frac{Lrm^*}{Lrm}\right)^{0.5}$$

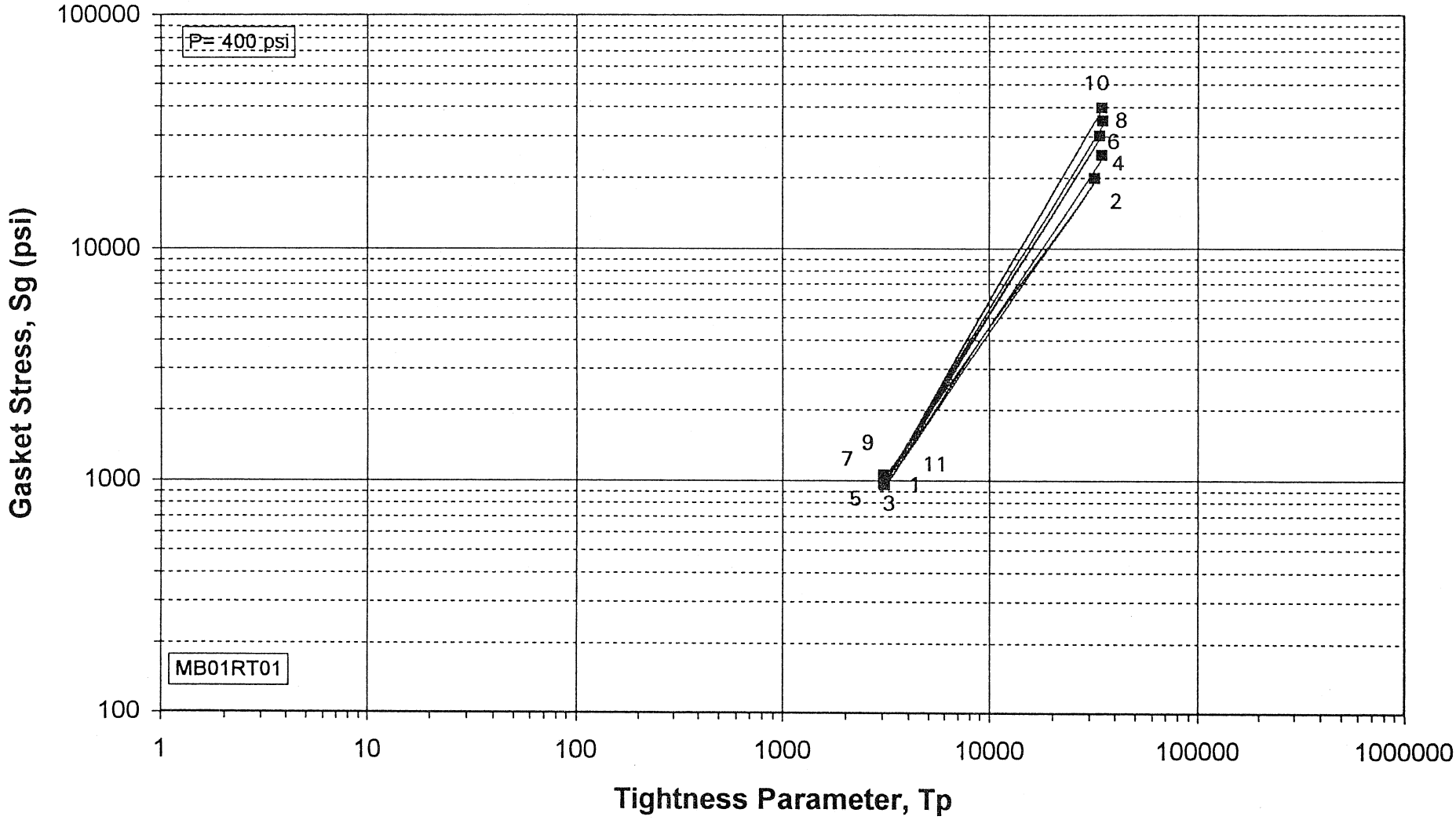
where: P = Fluid pressure (MPa or psig)
P^* = Reference pressure (0.101 MPa or 14.7 psig)
Lrm = Mass Leak Rate (mg/s)
Lrm^* = Unit Mass Leak Rate (1 mg/s for a 150 mm OD gasket in a joint).

In other words, T_p was developed so that at a given state of condition of a gasket, the same tightness value be obtained whether leakage is measured with fluid pressurized at 200, 400, 800 psig or any other pressure.

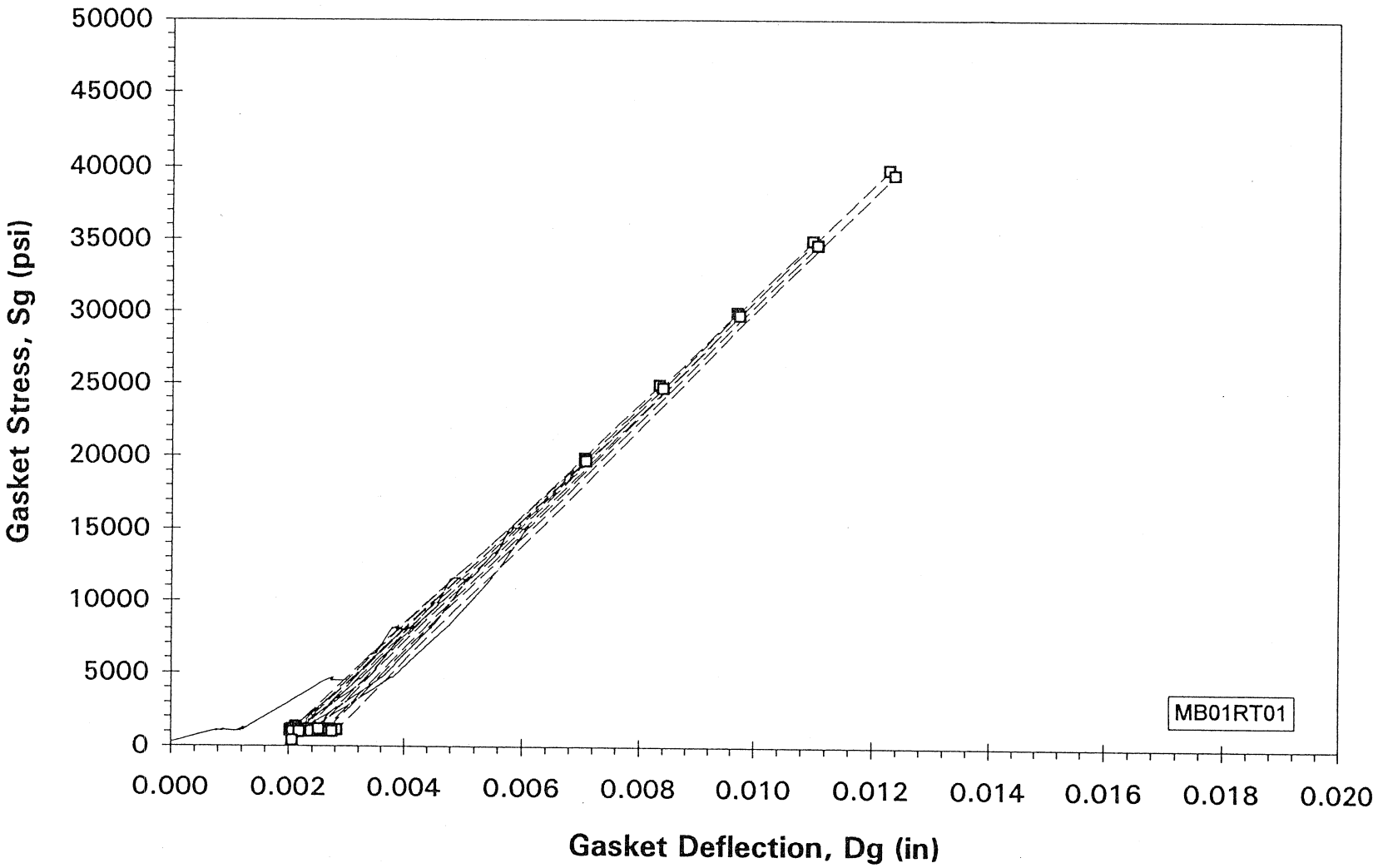
T_p is proportional to pressure and inversely proportional to the square root of leak rate. More precisely, T_p can be thought of as the number of atmospheres required to cause a helium leak of 1 mg/sec for a 150 mm gasket OD in a joint. Since this is about the same as the OD an NPS 4 in. joint, the pressure to cause a leak of 1 mg/sec of helium for that joint is its tightness. A higher value of T_p means a tighter joint. Because of the square root, a joint that is 10 times tighter leaks 100 times less.

CRUSH TEST ON PIKOTEK 4" cl 300 lb VCS

4.75 x 5.77 x 0.295 in.

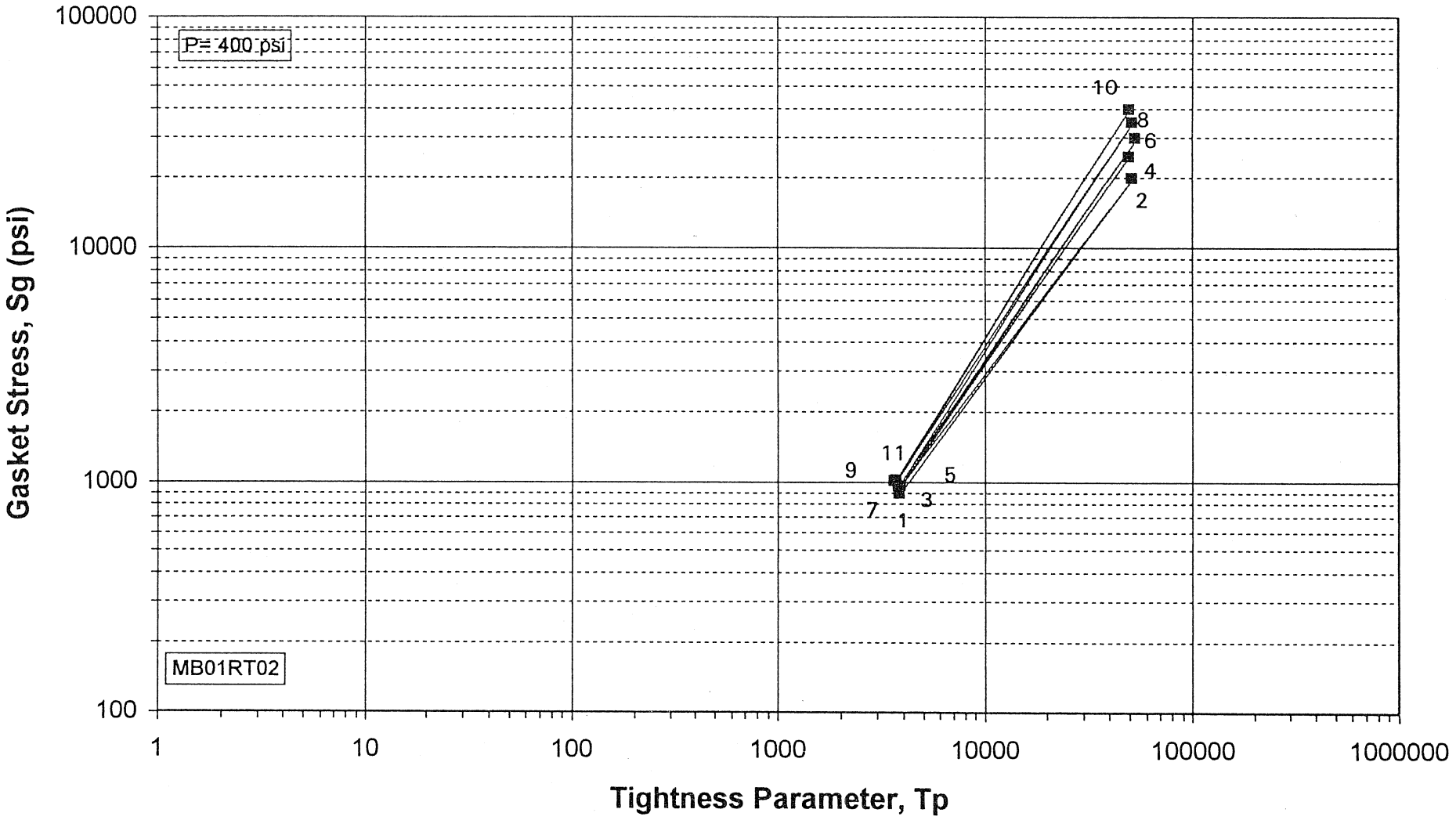


ROTT TEST ON PIKOTEK 4" cl 300 lb VCS
4.75 x 5.77 x 0.295 in.



CRUSH TEST ON ON PIKOTEK 4" cl 300 lb VCS

4.75 x 5.77 x 0.295 in.



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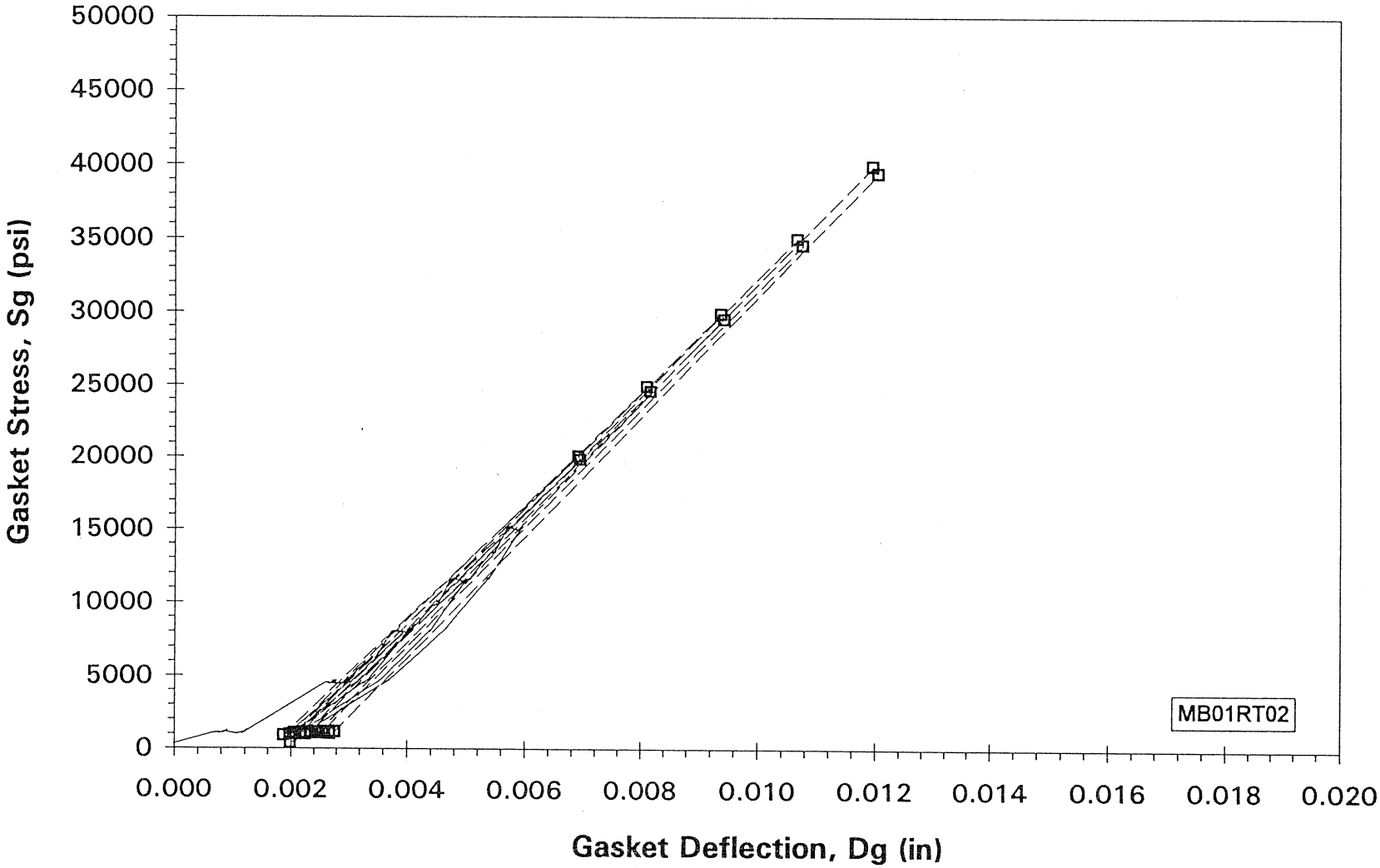

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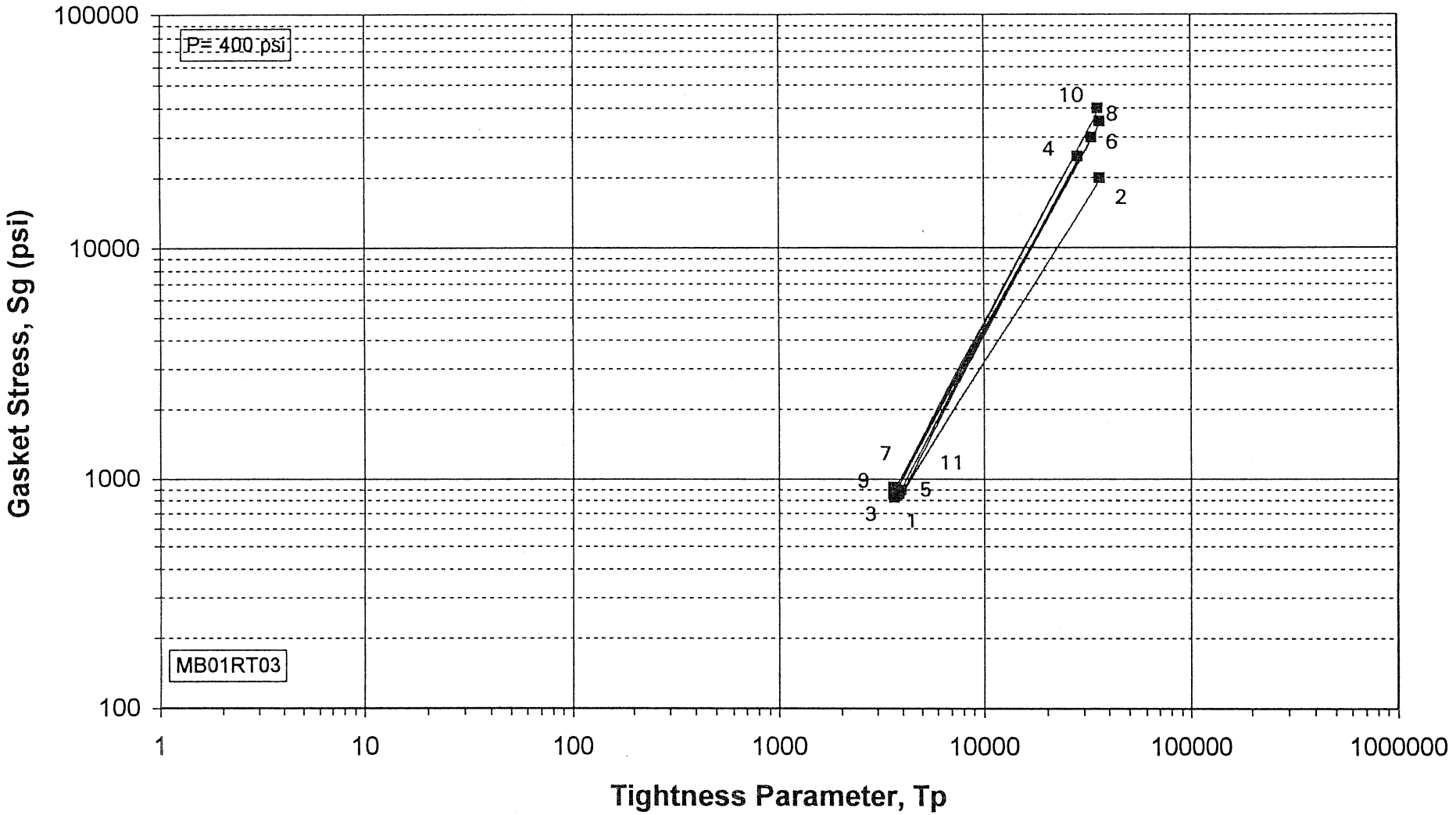

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