



Standard Practice for Blowout Resistance of Room-Temperature Vulcanized Elastomers¹

This standard is issued under the fixed designation F2523; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides a means to determine the blowout resistance of a room-temperature vulcanized elastomer system (RTV) using a standard fixture.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D907 Terminology of Adhesives

D1566 Terminology Relating to Rubber

F2468 Classification for Specifying Silicone Adhesives and Sealants for Transportation Applications

2.2 *SAE Standard:*

SAE J1199 Mechanical and Material Requirements for Metric Externally Threaded Steel Fasteners³

3. Terminology

3.1 *Definitions*—Some terms in this practice are defined in Terminologies D907 and D1566.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *blowout, n*—disruption of the uncured RTV integrity in a joint from system pressurization resulting in sudden loss of pressure.

¹ This practice is under the jurisdiction of ASTM Committee F03 on Gaskets and is the direct responsibility of Subcommittee F03.70 on Formed in Place Gaskets.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

3.2.2 *T-joint, n*—interface created in a sealing surface where three structural components meet.

3.2.2.1 *Discussion*—This interface may exist as a small gap requiring a material such as room-temperature vulcanized elastomer (RTV) to seal.

3.3 *Acronyms:*

3.3.1 RTV—room-temperature vulcanized elastomer

4. Summary of Practice

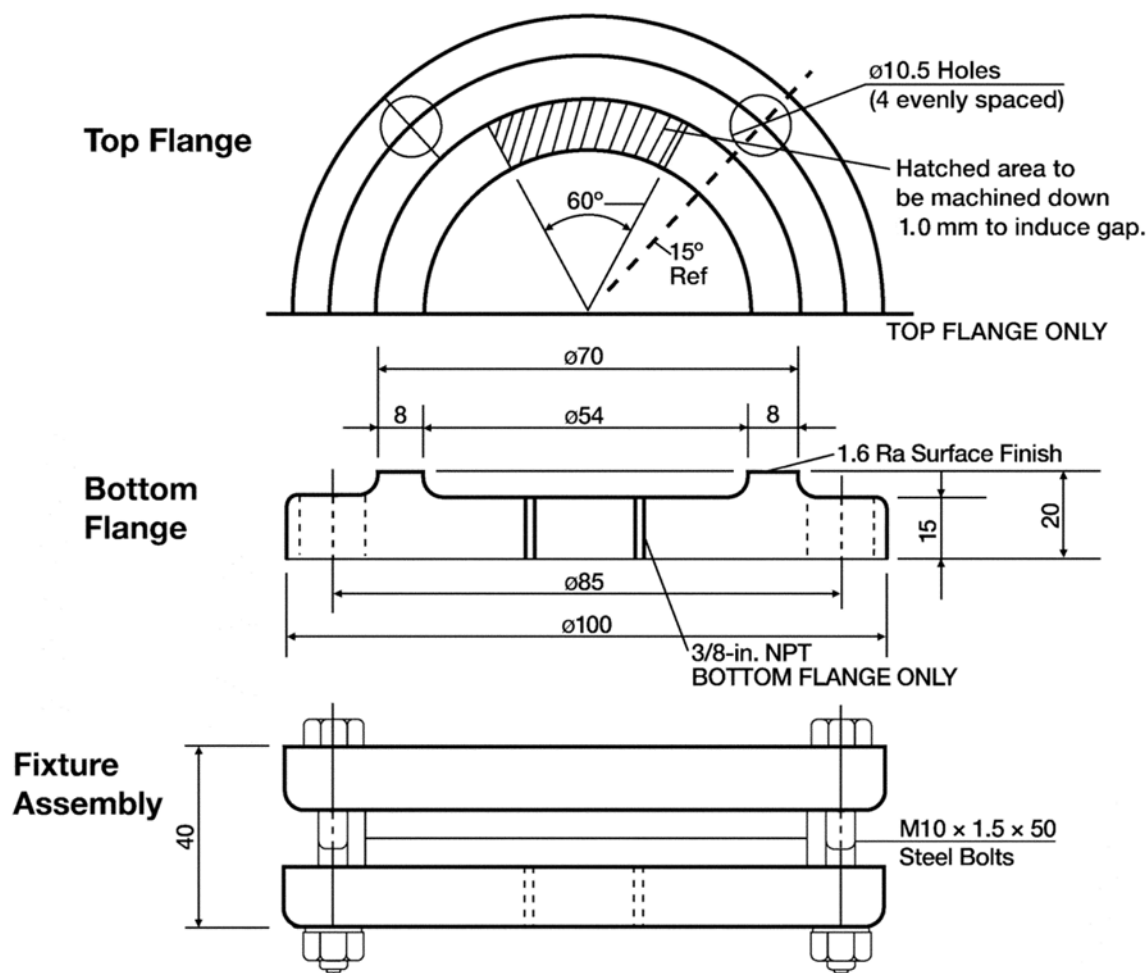
4.1 Condensation cures RTVs as a one-component system cure when exposed to moisture in the ambient air or as two-component systems when those components are mixed together. RTVs are often used to seal joints where three flanges meet (T joints) such as an automotive engine's front cover, engine block, and oil pan. Because of machining and assembly tolerance variations, these T joints may have a slight misalignment or gap. We also find gaps in the half-round area of the oil pan to block and in the valley between the intake manifold and block on certain V-engines as a result of manufacturing tolerances. The RTV is used to seal in fluids. In some assembly line applications, soon after the RTV is applied and the flanges fastened together, the system is subjected to an air decay test at a designated pressure. This test is used to determine an RTV's capability to withstand loss of integrity at this designated pressure.

4.2 When using this practice, one must first determine the maximum gap based on stack tolerances of the system. A two-piece round fixture uses the top portion to mirror the system gap (default gap is 1 mm), while the bottom half provides the mating flange and the connection for the pressure input. The gap is machined into the top half of the fixture in a "pie slice" 60° angle. A continuous bead of RTV is applied to the entire bottom portion of the fixture, the top half is carefully attached, and the fixture is pressurized to the prescribed limits and held for a specified time period. If the RTV is not capable of sealing at the pressure applied, a sudden loss of pressure will occur.

5. Significance and Use

5.1 This practice may be used to determine the viability of an RTV sealant to withstand pressure leak testing before cure at maximum gap conditions of a system. This practice may be

Units, mm



Top and bottom flange are identical except for 1.0-mm clearance and 3/8-in. NPT hole.

NOTE 1—Torque sequence shall be “crisscross” pattern.

FIG. 1 Aluminum Blowout Fixtures

used to indicate an RTV’s acceptability to undergo an assembly line leak check without causing a leak path due to material blow out.

6. Apparatus⁴

6.1 *Fixture—Aluminum*, see Fig. 1.

6.1.1 Aluminum casting, forging, or bar stock with 60 Brinell hardness, minimum.

6.1.2 Surface finish shall be in the range of 0.7 to 3.2 μm *Ra*.

⁴ The sole source of supply of the blowout fixtures in both materials known to the committee at this time is Kovil Manufacturing, 925 Sherman Ave., Hamden, CT 06514. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

6.1.3 Top half of fixture shall have a machined cutout to the desired gap depth (1.0 ± 0.025 mm default gap), per Fig. 1. The gap and flange width are critical dimensions and should be controlled to a tight tolerance (± 2.5 % is recommended). All other dimensions are allowed ± 10 %.

6.1.4 Four nut, bolt, and washer sets per SAE J1199 (4.8 hex head) or equivalent, M10 x 1.5 x 50.

6.2 Air supply and regulator.

6.3 Polyethylene tubing (or equivalent), polytetrafluoroethylene (PTFE) pipe tape, plastic, or brass tube fittings.

6.4 Inline pressure gage or equivalent, 0 to 138 kPa, accurate to ± 0.7 kPa.

6.5 Timing device with 1-s increments.

6.6 Measuring device, capable of measuring an adhesive bead height of 2 mm.

6.7 Environmentally controlled room (temperature, humidity monitoring, and control).

7. Reagents and Materials

7.1 *Cleaning Solvent*—Appropriate cleaning solvent as specified by RTV manufacturer.

7.2 Clean, lint-free cloth.

8. Conditioning

8.1 Sample containers shall be allowed to equilibrate to 21 to 25°C. Time required may vary depending on the size of container and previous storage conditions.

9. Initial Step

9.1 Connect air supply to regulator and to pressure gage using polyethylene tubing. Plastic or brass press fit fittings may be used for the connection points, depending on the adaptor connection on the three components. Fittings threads shall have pipe sealant applied before installing into fixtures.

9.2 Connect tube to bottom fixture with a brass fitting containing pipe sealant applied around threads.

9.3 Block off open hole of fixture with a properly secured rubber stopper or compress a soft silicone plaque against the hole. Check for leaks at the various connection points by spraying a dilute liquid soap and water solution⁵ while looking for air bubbles.

9.4 Test environment shall be set at 21 to 25°C and 40 ± 10 % relative humidity.

10. Procedure

10.1 Use either the default gap of 1 mm or choose a fixture with the desired machined gap.

10.2 Make sure all traces of cured or uncured RTV from previous test have been removed.

10.3 Following the initial setup instructions in Section 9, verify the system is free of leaks.

10.4 *Method A—Time to Blowout at a Specified Pressure:*

10.4.1 Preset pressure regulator to the applicable test pressure.

10.4.2 Open exhaust valve to prevent any pretest internal pressure and close inlet ball valve.

10.4.3 Apply a continuous 4-mm bead (based on default gap, user will have to determine proper bead size for alternate gaps) on the flange of the bottom fixture.

10.4.4 Apply the top half of the fixture, taking care not to move the fixture horizontally.

10.4.5 Tighten bolts to 1.0 kg·m ± 10 %.

10.4.6 Close exhaust valve.

10.4.7 Immediately after assembly (within 2 min of RTV application) open ball valve to pressurize the system quickly to the preset pressure.

10.4.8 Start the timer and record the time in seconds at which the sudden loss of pressure occurs. If no loss of pressure occurs after 1 min, report it as “>60 s.”

10.4.9 Disassemble and clean the fixture thoroughly, removing all traces of RTV.

10.4.10 Repeat Steps 10.4.1 to 10.4.9 a second time.

10.4.11 If the second result is within ±10 % of the first result, report the average blowout time to the nearest second.

10.4.12 If the second result is in excess of ±10 % of the first, repeat until a consistent value is obtained.

10.5 *Method B—Maximum Blowout Pressure Determination:*

10.5.1 Method B shall be done at or near maximum application/flow rate of the sealant.

10.5.2 Open exhaust valve to prevent any pretest internal pressure and close inlet ball valve.

10.5.3 Apply a continuous 4-mm bead (based on default gap, user will have to determine proper bead size for alternate gaps) on the flange of the bottom fixture.

10.5.4 Apply the top half of the fixture taking care not to move the fixture horizontally.

10.5.5 Tighten bolts to 1.0 kg·m ± 10 %.

10.5.6 Close exhaust valve.

10.5.7 Screen for approximate blow out pressure by opening the ball valve immediately after assembly (within 2 min of RTV application), so as to increase the pressure by 6.9 kPa every 10 s until blow out occurs. Subsequent iterations to determine blow out pressure may start 6.9 kPa below this screening pressure. If this screen pressure is at or below 20.7 kPa, the iterations shall use 3.45 kPa increments in this method; otherwise the increments shall be 6.9 kPa.

10.5.8 Immediately after assembly (within 2 min of RTV application), open the ball valve and start incrementally increasing the pressure every 5 s until the initial pressure of the screening pressure minus 6.89 kPa is reached.

10.5.9 Start the timer. If no loss of pressure occurs after 1 min, incrementally increase the pressure and start the timer. Repeat this process until failure occurs and record this value.

10.5.10 Disassemble and clean the fixture thoroughly, removing all traces of RTV.

10.5.11 Repeat the steps in 10.5.1 through 10.5.10, using the value obtained in 10.5.9. If this again results in a failure, clean the fixture and repeat the process using the value obtained in 10.5.9 minus 6.9 kPa.

10.5.12 If failure occurs, repeat the process of cleaning and applying fresh RTV and testing, each time reducing the pressure until a “pass” occurs, then record this pressure.

10.5.13 Repeat the test a second time at this pressure to verify a “pass.” Report this value as the maximum blowout pressure.

11. Potential Failure Modes of Test Procedure

11.1 Inconsistent results in the procedure may be due to several reasons and shall be reviewed. Some of these may be:

11.1.1 Inconsistent RTV bead applied. RTV should be applied in an amount sufficient to fill the gap when the fixture is assembled and bolts torqued. Insufficient RTV will result in voids within the fixture gap. These voids will result in

⁵ Commercially available products exist from a wide variety of distributors.

premature failure when running Method A, and possible lower pressure values when running Method B. Excessive RTV applied in the fixture gap will result in an internal and external dam of RTV that will resist movement of air by the applied pressure. This can result in artificially high time to blow out (Method A) and resistance to blow out pressure (Method B).

11.1.2 Misplacement of bead. RTV bead biased toward the inside or outside can result in non-fill of the fixture gap, resulting in lower time to blow out (Method A) and resistance to blow out pressure (Method B). Addition of RTV to compensate for this offset of the bead placement can result in an excessive amount of RTV, and is further discussed in 11.1.1.

11.1.3 Air entrapment in RTV bead. Entrapment of air or other contaminants that create voids in the RTV can create results similar to insufficient RTV application, and is further discussed in 11.1.1.

11.1.4 Improper gap. The induced gap should be machined precisely to the agreed dimension within the tolerance limit stated in 6.1.3 (1 mm is the default gap). Failure to properly set gap will result in correlation issues between laboratories. Use of fixtures with improperly low gaps can result in artificially high results. Use of fixtures with improperly high gaps can result in artificially low results.

11.1.5 Improper torque sequence or setting. Improper sequence can result in inconsistent gap fill or shifting of RTV bead, or both, thus providing inconsistent and imprecise results. Low bolt torque can result in shimming of fixture creating a slightly larger than desired gap, and artificially low data.

11.1.6 Contamination by improperly cleaned fixture. Improperly cleaned flanges in the non-gap areas can cause shimming of the fixture which may result in artificially low data. Improperly cleaned flanges in the gap area can result in either artificially high or low data, depending on how the contaminant acts on the fresh RTV bead during fixture assembly. Contaminants such as partially cured RTV encapsulated by the bead can cause air entrapment and voids which may result in artificially low data. Partially cured RTV carried on the inside edge of the fresh bead can act as a barrier to air movement through the bead resulting in artificially high data.

11.1.7 Faulty pressure regulator or pressure measurement device, or both. Faulty equipment will provide unreliable and un-correlatable data with other laboratories.

11.1.8 Air leaks within the system, some of which can vary via fixture handling and movement. Air leaks prior to the pressure regulator system may cause variations of available pressure between the source and the regulator. This could cause erratic data if the source setting is close to the pressure being applied by the regulator to the fixture. Air leaks between the regulator and the fixture will result in artificially high data.

11.1.9 Low-viscosity RTVs evaluated with large gaps may result in lower between lab correlation.

12. Report

12.1 Report shall consist of:

12.1.1 Material classification per Classification F2468,

12.1.2 Fixture type used in the evaluation,

12.1.3 Fixture gap used in the evaluation,

12.1.4 Laboratory test environment (temperature and relative humidity) and location,

12.1.5 Material supplier and product code,

12.1.6 Application rate(s) evaluated,

12.1.7 Method used, and

12.1.8 Average blowout time in seconds for Method A along with test pressure and maximum blowout resistance pressure for Method B.

13. Precision and Accuracy⁶

13.1 Statements are included for *Method B, Blow Out Pressure Determination* only.

13.1.1 *Repeatability*—Two test results obtained within one laboratory shall be judged not equivalent if they differ by more than the “*r*” value for that material; “*r*” is the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory.

13.1.2 *Reproducibility*—Two test results shall be judged not equivalent if they differ by more than the “*R*” value for that material; “*R*” is the interval representing the difference between two test results for the same material, obtained by different operators using different equipment in different laboratories.

13.1.3 Any judgment in accordance with these two statements would have an approximate 95 % probability of being correct.

13.2 Seven laboratories participated in round robin evaluation of this procedure. Three different cure system RTVs were evaluated. The intralaboratory consistency factor, *k*, was within acceptable limits in all but one instance (1 lab, 1 material). The interlaboratory consistency factor, *h*, was also within acceptable limits in all but one instance (1 lab, 1 material). The output of these factors is shown in Fig. 2 and Fig. 3.

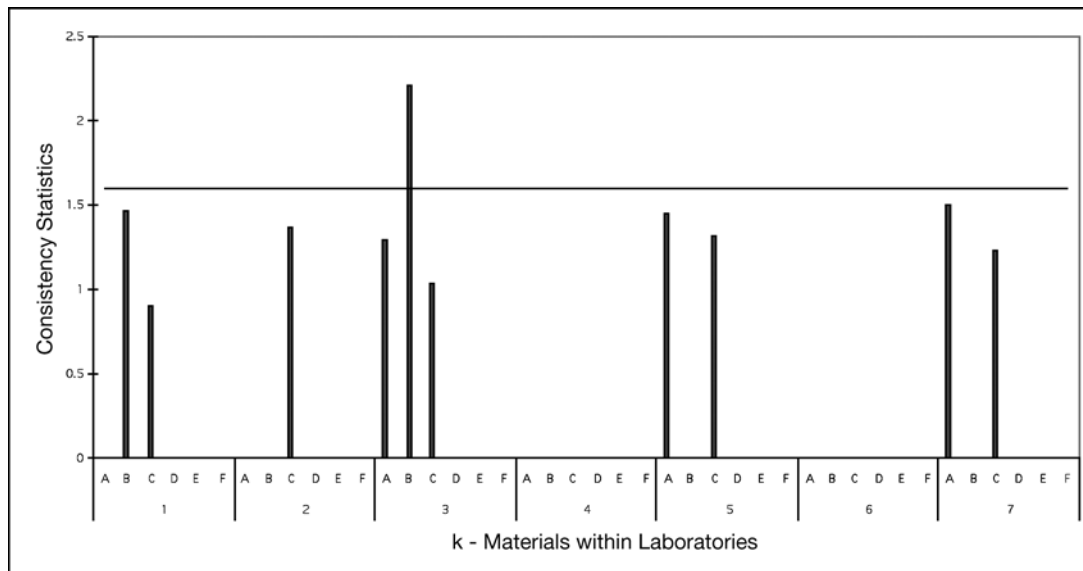
13.2.1 Laboratory 3 had high *k* values for the Low Flow Rate Oxime Cure RTV. The data was left in the statistical calculations. The pressure increments used for materials that blow out above 20.7 kPa can affect within laboratory consistency. The data was collected from the same RTV sample, from two experiments run several days apart. Storage of the RTV between data collection days may also affect consistency.

13.2.2 Laboratory 3 had a high “between laboratory consistency factor” (*h*-value) for the amine cure RTV. The data was left in the calculations, as the *h*-value obtained was at the borderline level. Also RTV storage conditions between experimental runs and pressure increments used could also have affected the data.

13.2.3 *Statistical Analysis*—Based on this series of round robin evaluations, the 95 % confidence limits for repeatability and reproducibility provides evidence that the method is sensitive to various potential external effects, which are covered in Section 11. These effects can create a large variation in results between laboratories or between technicians, or both. (See Fig. 4.)

⁶ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:F03-1016.

Lab	High Flow Rate Oxime Cure	Low Flow Rate Oxime Cure	Amine Cure RTV
1		1.4596	0.9007
2	0.0000	0.0000	1.3617
3	1.2940	2.2067	1.0400
4	0.0000	0.0000	0.0000
5	1.4467	0.0000	1.3185
6	0.0000	0.0000	0.0000
7	1.4942	0.0000	1.2306



NOTE 1—
Material A: High Flow Rate Oxime Cure
Material B: Low Flow Rate Oxime Cure
Material C: Amine Cure RTV

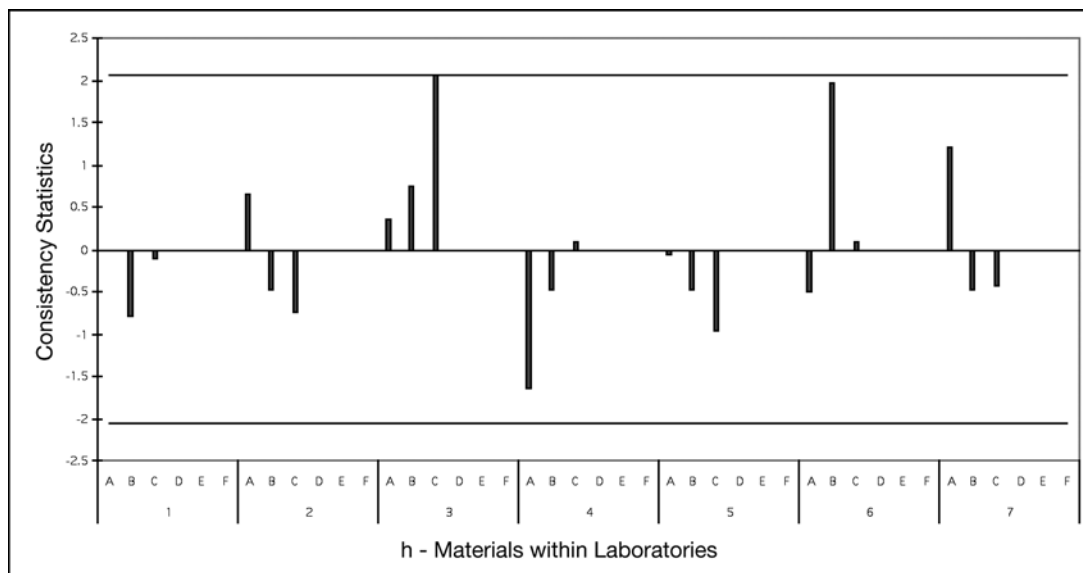
FIG. 2 k Values—Critical Value of $k = 1.6$

14. Keywords

14.1 blowout; room temperature vulcanizing; RTV; T-joint

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Lab	High Flow Rate Oxime Cure	Low Flow Rate Oxime Cure	Amine Cure RTV
1		-0.7891	-0.1191
2	0.6448	-0.4822	-0.7550
3	0.3582	0.7453	2.0713
4	-1.6479	-0.4822	0.0929
5	-0.0716	-0.4822	-0.9670
6	-0.5015	1.9727	0.0929
7	1.2180	-0.4822	-0.4159



NOTE 1—
Material A: High Flow Rate Oxime Cure
Material B: Low Flow Rate Oxime Cure
Material C: Amine Cure RTV

FIG. 3 *h* Values—Critical Value for *h* = 2.05

Material	Average Time to Blowout (seconds)	sXbar	sr	sR	r	R
High Flow Rate Oxime Cure	2.2188	0.4362	0.1789	0.4672	0.5008	1.3080
Low Flow Rate Oxime Cure	5.1964	0.4073	0.2422	0.4661	0.6782	1.3051
Amine Cure RTV	1.4726	0.2948	0.1963	0.3473	0.5495	0.9725

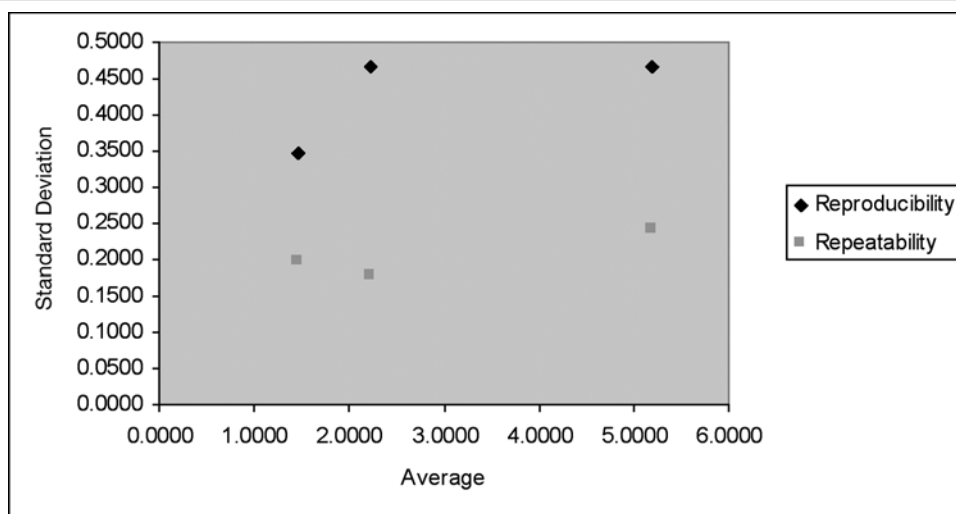


FIG. 4 Standard Deviations of Reproducibility and Repeatability Versus Average

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