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Standard
Recommended Practice

Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape

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Foreword

Prior to the application of protective coatings to steel surfaces, the surfaces are frequently cleaned by abrasive impact. Such abrasive cleaning roughens the steel surface, providing a surface profile. The resulting degree of surface roughness is affected by many variables, including the type, size, and shape of the abrasive used, velocity of impact, etc.

Many techniques and instruments are currently used to measure the surface texture or surface profile; however, those that provide a high degree of precision are suitable only for laboratory use. Because a surface profile range is frequently specified and the recommended surface profile is different for various types of coatings, a means of surface profile measurement at the work site is desirable.

The purpose of this standard recommended practice is to provide a procedure to measure the surface profile of abrasive blast cleaned steel. The measurement technique utilizes a tape that replicates the surface profile. The thickness of the tape (with the profile replicate) is then measured with a dial micrometer to determine the surface profile. Other common methods of measuring surface profile are not discussed. The procedure described in this standard is limited to the measurement of surface profile with a profile defined as being between 38 and 114 μm (1.5 and 4.5 mils) prepared to a white metal,[1] near-white metal,[2] or commercial[3] blast-cleaned surface finish.

The determination of surface profile depends on its definition. This procedure determines surface profile only as it is defined in this standard (see Paragraph 1.2.1). If surface profile is defined differently, the procedures outlined in this standard may not provide accurate results. Individual measurements of the surface profile of an abrasive blast-cleaned metal surface vary significantly from area to area over a given surface.

Appendix A presents the results of a round-robin series of measurements by several individuals, and illustrates the degree of accuracy of the procedure described in this standard. Appendix B statistically summarizes the data shown graphically in Appendix A. Panels used in the tests shown in Appendix A were hot-rolled and nonrusted. The extraneous profile of severely rusted surfaces reduces the accuracy of the procedure. Measurements are taken on relatively flat areas where the surface appears to be continuous and uniform.

This standard is intended for use by persons, usually in an inspection capacity, who have a requirement to measure the surface profile of abrasive blast-cleaned steel prior to the application of a protective coating.

This standard was originally prepared in 1987 by NACE International Task Group T-6G-19, a component of Unit Committee T-6G on Surface Preparation for Protective Coatings. The standard was reaffirmed in 1991 and 1995 by Unit Committee T-6G, and in 2002 by Specific Technology Group (STG) 04 on Protective Coatings and Linings—Surface Preparation. This standard is issued by NACE International under the auspices of STG 04.

In NACE standards, the terms *shall*, *must*, *should*, and *may* are used in accordance with the definitions of these terms in the *NACE Publications Style Manual*, 4th ed., Paragraph 7.4.1.9. *Shall* and *must* are used to state mandatory requirements. The term *should* is used to state something considered good and is recommended but is not mandatory. The term *may* is used to state something considered optional.

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Contents

Section 1: General

1.1 This standard describes a procedure for on-site measurement of the surface profile of abrasive blast-cleaned steel surfaces that have a surface profile, as defined in Section 2, between 38 and 114 μm (1.5 and 4.5 mils). The procedure has been demonstrated to correlate well with the measurements obtained by the defined laboratory procedure on nonrusted panels prepared to NACE No. 1/SSPC[(1)]-SP 5,[1] NACE No. 2/SSPC-SP 10,[2] or NACE No. 3/SSPC-SP 6.[3] Suggestions are given regarding the implementation and use of this procedure.

Section 2: Definitions

Surface Profile: For the purposes of this standard, surface profile is defined as that value obtained when the profile of a surface is measured using an optical microscope as described in NACE Publication 6G176.[4] The laboratory procedure described in 6G176 entails averaging a statistically significant number of readings (20 to 30) using an optical microscope, magnification of 250 to 280X, with a field of 0.41 to 0.46 mm (0.016 to 0.018 in.) diameter, and recording the distance measured from the top of the highest peak to the bottom of the lowest valley in the field of view.

Section 3: Equipment

3.1 Replica Tape

3.1.1 The replica tape consists of a compressible foam containing microscopic bubbles attached to a polyester film 50 μm (2 mils) thick. The film has a circular cut-out 9.5 mm (0.38 in.) in diameter that exposes the underlying foam.

3.2 Calibrated spring-loaded dial micrometer, precise to within 3 μm (0.1 mils). The anvil feet should be flat and approximately 6.6 mm (0.25 in.) in diameter.

Section 4: Procedure

4.1 A clean representative surface site shall be identified. Surface dirt and dust shall have been removed from the surface, because contaminants distort the results. The tape shall not be used on surfaces with a temperature higher than 54°C (130°F).

4.2 The micrometer shall be adjusted to zero with the anvils closed.

4.3 The wax paper backing shall be removed from the replica tape. The specimen of replica tape shall be inspected; the tape should not be used if it is visually damaged or distorted. The unexposed compressible foam in the circular cut-out shall be measured with the spring micrometer, because its thickness may vary. The thickness of the compressible foam is the micrometer reading minus 50 μm (2 mils) for the polyester film. The premeasured thickness of the compressible foam is the maximum profile height for which the replica tape may be used.

4.4 The replica tape film shall be placed on the blast-cleaned surface, dull side down. The tape shall be held firmly to avoid movement. A burnishing tool (a hard plastic rod with a spherical end could be used) shall be rubbed over the circular cut-out portion of the replica tape. The tape shall be rubbed repeatedly until the entire circular area has uniformly darkened. Excessively hard rubbing should be avoided because the polyester film could become distorted.

4.5 The replica shall be removed and placed between the anvils of the micrometer. The profile measurement is the gauge reading minus 50 μm (2 mils) to compensate for the polyester film. If most of the profile measurements closely approach the premeasured thickness of the compressible foam, alternative procedures should be considered because the accuracy of the procedure may be affected.

4.6 If desired, and if the dial micrometer can be so adjusted, the micrometer may be set at -50 μm (-2 mils) with the anvils closed, and subsequent readings of the compressible foam may be made directly.

(1) SSPC: The Society for Protective Coatings, 40 24th St., Pittsburgh, PA 15222.

4.7 If a reading exceeds the thickness of the compressible foam found in Paragraph 3.3, it shall be disregarded. Such a reading indicates that contaminant (dirt, abrasive, etc.) is attached to the compressible foam.

4.8 Three individual readings should be taken on any given local area and averaged to determine the surface profile measurement. The number of such measurements to be taken on a given area should be as agreed or specified by contracting parties.

4.9 This procedure should be routinely verified using a surface with a known surface profile, such as a visual comparator. While a comparator cannot be used for exact calibration because of design differences, verification should ensure consistent, reproducible results.

References

1. NACE No. 1/SSPC-SP 5 (latest revision), "White Metal Blast Cleaning" (Houston, TX: NACE and Pittsburgh, PA: SSPC).

2. NACE No. 2/SSPC-SP 10 (latest revision), "Near-White Metal Blast Cleaning" (Houston, TX: NACE and Pittsburgh, PA: SSPC).

3. NACE No. 3/SSPC-SP 6 (latest revision), "Commercial Blast Cleaning" (Houston, TX: NACE and Pittsburgh, PA: SSPC).

4. NACE Publication 6G176 (withdrawn), "Cleanliness and Anchor Patterns Available Through Centrifugal Blast Cleaning of New Steel" (Houston, TX: NACE International). (Available from NACE International as an historical document only.)

Appendix A: Results of NACE Task Group T-6G-19 Round-Robin Tests

Figures A1 through A14 depict the results of the NACE Task Group T-6G-19 round-robin tests. The solid line represents the profile as determined by NACE Technical Committee Report 6G176.

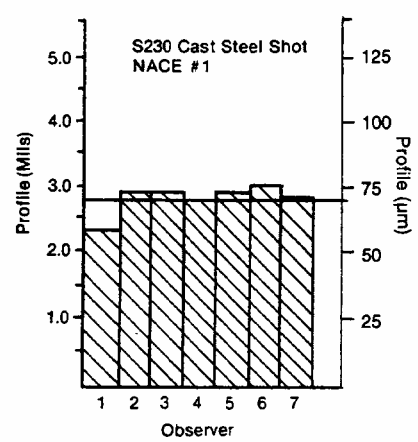
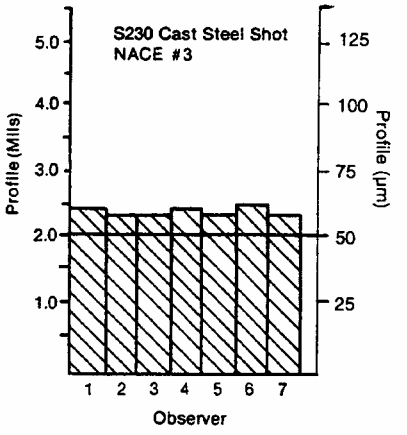


Figure A1



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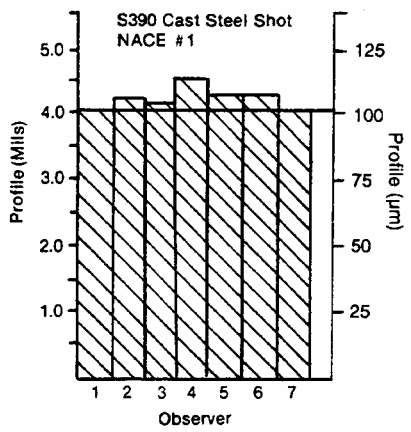
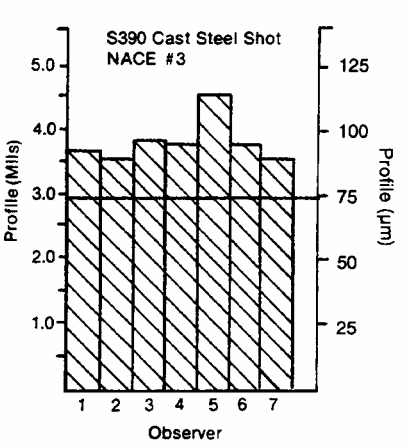


Figure A3



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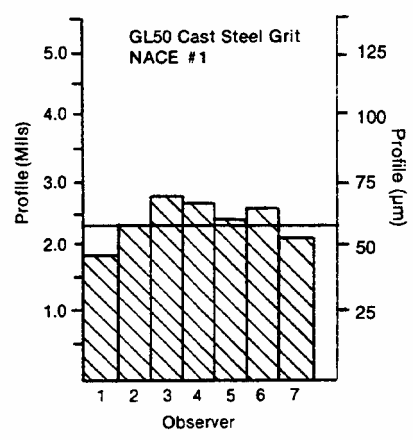

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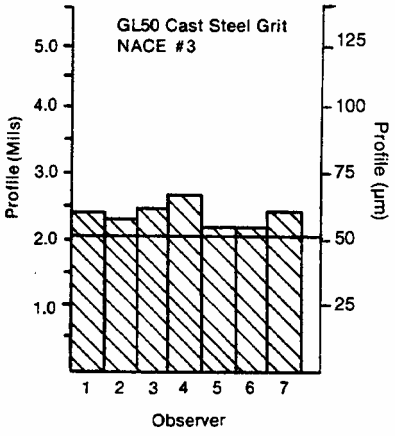

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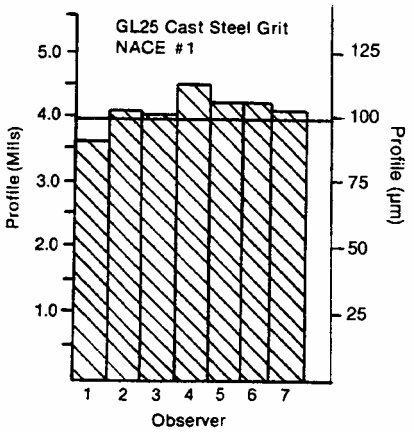

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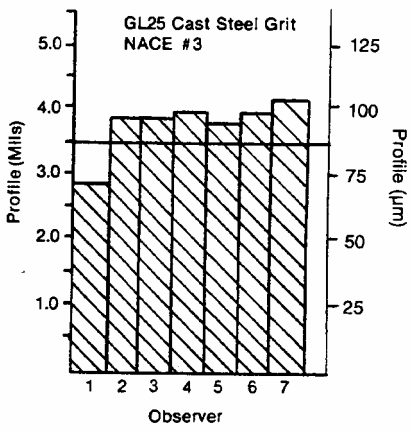

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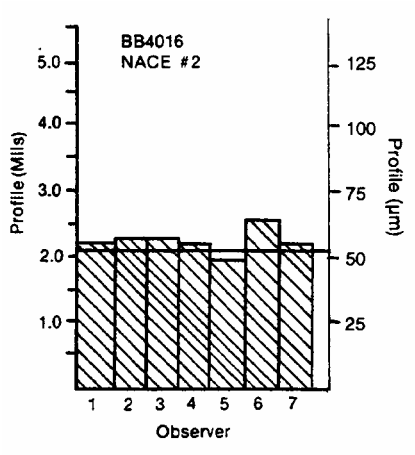

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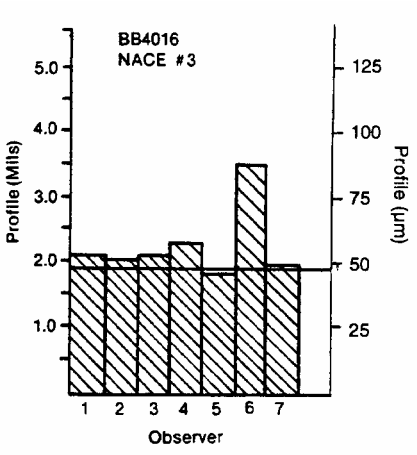

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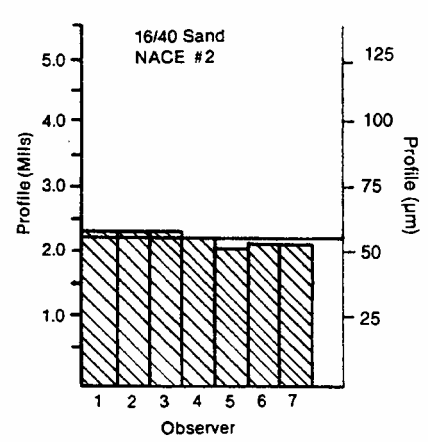

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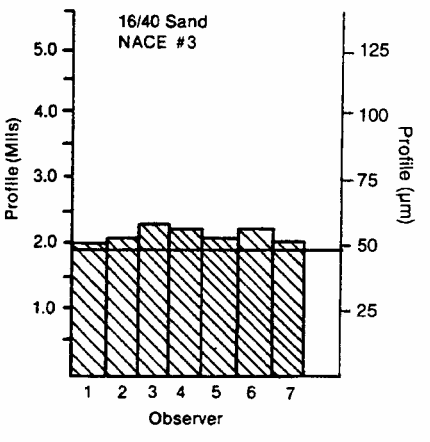

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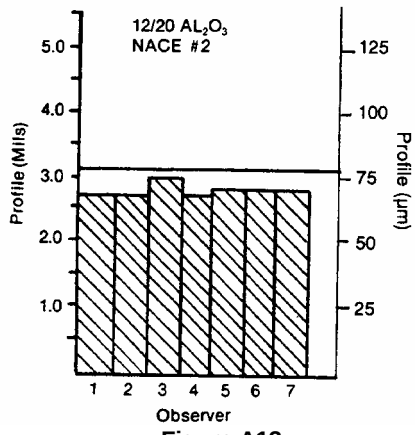

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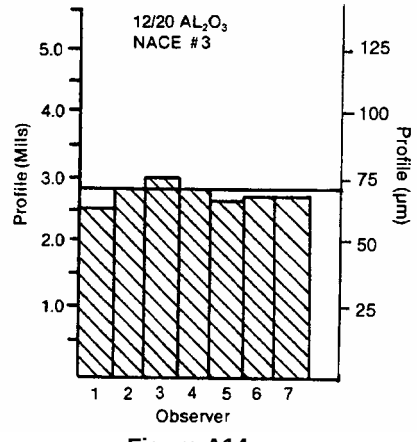

Figure A14

Appendix B: Statistical Summary

Table B1 gives a statistical summary of the results of the T-6G-19 round-robin tests. Figure B1 compares the surface profile measurements obtained using a microscope with those obtained using replica tape.

TABLE B1
Statistical Summary[A]

		Microscope Readings			Replica Tape Readings		
			95% Confidence Limits[B]			95% Confidence Limits[B]	
Number		Avg.	Low	High	Avg.	Low	High
1. S230	NACE No. 1/SSPC-SP 5	2.72	2.41	3.03	2.79	2.57	3.00
2. S230	NACE No. 3/SSPC-SP 6	2.02	1.54	2.49	2.36	2.28	2.43
3. S390	NACE No. 1/SSPC-SP 5	4.05	3.47	4.63	4.17	4.01	4.33
4. S390	NACE No. 3/SSPC-SP 6	2.85	2.38	3.33	3.76	3.44	40.8
5. GL-50	NACE No. 1/SSPC-SP 5	2.31	2.15	2.48	2.39	2.06	2.71
6. GL-50	NACE No. 3/SSPC-SP 6	2.00	1.81	2.19	2.39	2.22	2.55
7. GL-25	NACE No. 1/SSPC-SP 5	3.94	3.41	4.47	4.10	3.85	4.35
8. GL-25	NACE No. 3/SSPC-SP 6	3.46	2.88	4.04	3.71	3.32	4.10
9. BB4016	NACE No. 2/SSPC-SP 10	2.14	1.93	2.35	2.24	1.71	2.78
10. BB4016	NACE No. 3/SSPC-SP 6	1.87	1.74	1.99	2.24	2.05	2.43
11. 16/40 Sand	NACE No. 2/SSPC-SP 10	2.22	2.04	2.41	1.93	1.74	2.18
12. 16/40 Sand	NACE No. 3/SSPC-SP 6	1.89	1.72	2.05	1.90	1.72	2.08
13. 12/20 Al_2O_3	NACE No. 2/SSPC-SP 10	3.18	2.93	3.44	2.79	2.69	2.88
14. 12/30 Al_2O_3	NACE No. 3/SSPC-SP 6	2.85	2.59	3.11	2.73	2.58	2.88

[A] This statistical summary was conducted using standard U.S. units of measure. To convert to metric units, use 1 mil = 25.4 µm.
[B] 95% confidence limits. Example: Panel 1 microscope data, average = 2.72; 95% lower limit = 2.41; 95% upper limit = 3.03. This indicates 95% confidence that the average of an infinite number of microscope readings on Panel 1 would be between 2.41 and 3.03 mils.

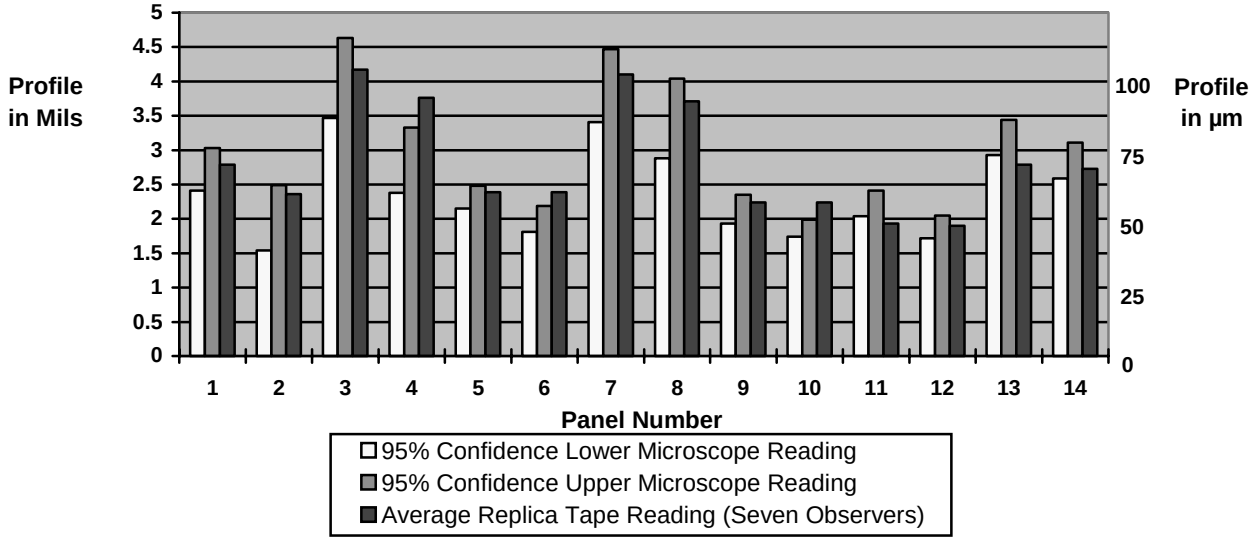

Figure B1
Microscope vs. Replica Tape Measurements