36-04 Skillman Avenue
Long Island City, NY 11101
Tel (800) 832- 4300
Fax (718) 482-8909
www.proppermfg.com

Microscope Slides Evaluation Study *Prepared by: Daniel Zou*
Technical Bulletin *Propper Manufacturing Company*

Background

Many applications within the biomedical industry have routine uses for microscope slides. However, despite the risks involved in purchasing faulty slides for expensive and error-sensitive tests, few consumers are aware that there may be a vast spectrum of quality in microscope slides available on the market. While it is the cautionary practice of some labs to avoid using low-end products, the actual degree of difference between economical slides and their premium counterparts remains a debatable subject. Our review of scientific literatures has yielded no study documenting a direct comparison of microscope slides from different manufacturers. Therefore, it is the goal of this study to provide quantitative assessment for the question at hand, so that more laboratory professionals can gain the perspective needed to acquire the right product that meet or exceed their individual requirements.

Materials and Methods

Six brands of commercially available microscope slides (see Table I) were obtained in new condition. While one of the six brands came from Propper Manufacturing Company, selection criterion for the other five brands, aside from controlling their respective retail prices, was kept completely random. The qualities of these brands were compared by the amount of extant surface residuals and cracks observed on individual slide pieces. These distinguishable defects were counted systematically, and photographs of representative portions were taken for further analysis. No physical or chemical treatments were applied to any slide during the course of this study.

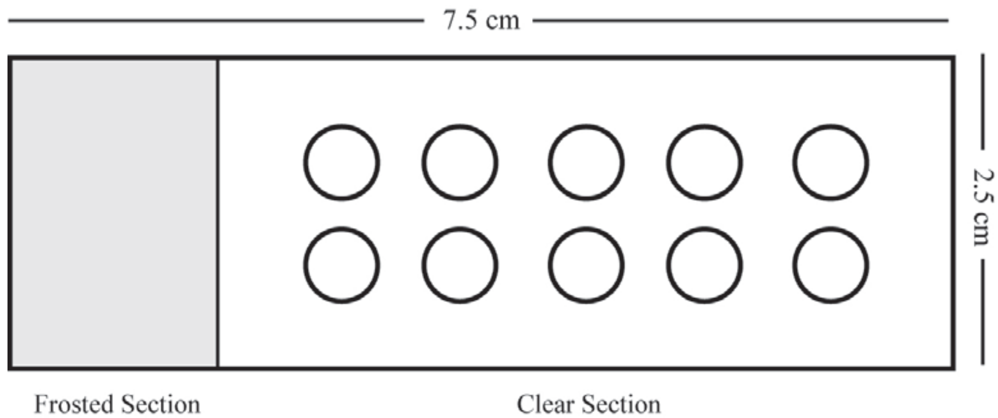
Microscope slides were packaged in standard boxes containing 72 pieces each. Each brand was coded from the onset of this study to minimize experimental bias.* Table I provides the alpha numeric designations used in this study as well as other basic information pertaining to the microscope slides.

Brand Designation	**Basic Information**	**Retail Price Range**
TS 1 (Test Set 1)	Ground; Pre-cleaned	Medium Range
TS 2	Ground; Pre-cleaned	High-End
TS 3	Ground; Pre-cleaned	Medium Range
TS 4	Ground; Pre-cleaned	High-End
TS 5	Ground; Pre-cleaned	Low-End
TS 6	Ground; Pre-cleaned	Low-End

Table I – Test Sets, Six Brands

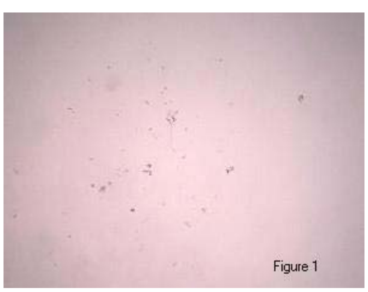
* Brand name for each test set is on file at Propper Manufacturing Company, Inc.

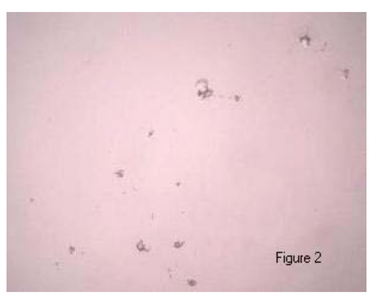
Ten microscope slides were randomly sampled from each box. They were carefully handled and placed under an optical microscope with 50x total magnification. Twenty visual fields (on both sides of the slide piece, along the central horizontal axis) were sequentially examined (see drawing below). Quantitative data were recorded as the summation of extant surface residuals and cracks (under the general designation of “surface defects”) observed in all twenty visual fields.

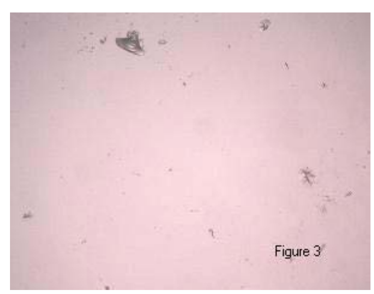


Top-down view of a frosted microscope slide - Each circular region encompass the approximate area of a visual field. A total of twenty visual fields on both sides (front and back) of the slide piece are examined. Dimensions of an actual microscope slide may vary. Not all brands have identical slide dimensions. Figure is not drawn to scale.

The following five images illustrate the appearance of typical surface defects. All images were photographed from the actual slides in this study, at 50x total magnification.







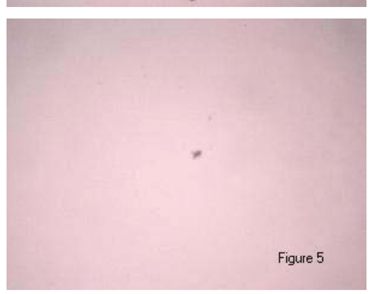
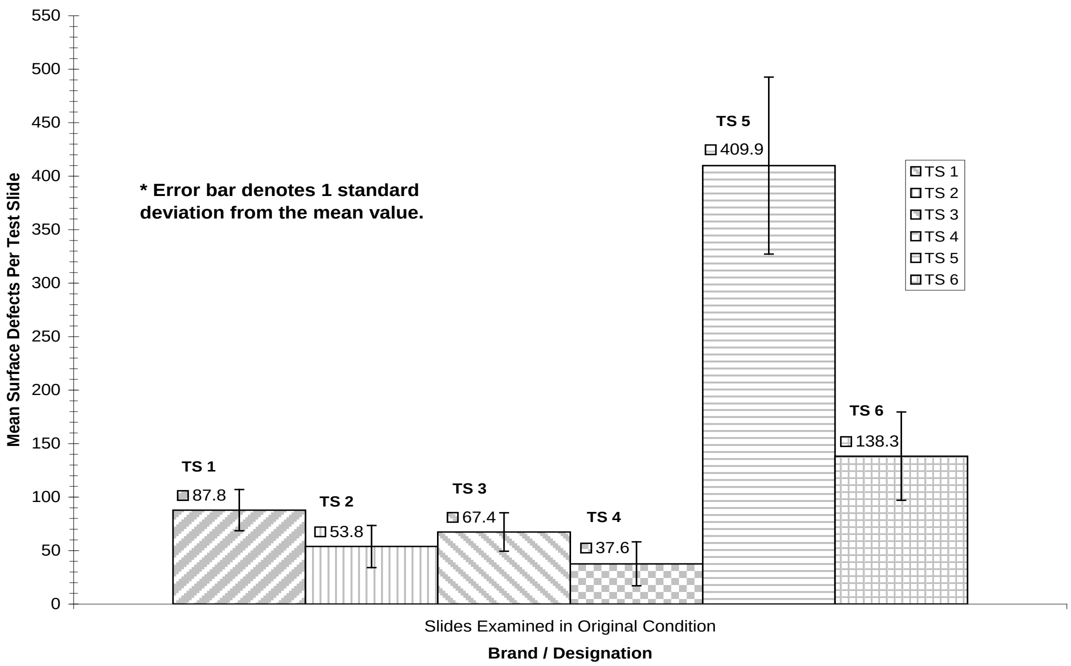


Figure 1 – Mostly surface residuals
Figure 2 – Mostly glass cracks
Figure 3 – Mostly glass cracks
Figure 4 – Both surface residuals and glass cracks
Figure 5 – Relatively blemish-free surface.

Mean surface defects associated with the six brands studied were statistically analyzed using the Student's t-Test[1], (assuming unequal variance of sample populations). Data from TS 1 to TS 6 were individually tested against each other to verify the null hypothesis that differences observed in the number of surface defects were caused by chance. As is generally accepted, an unverifiable null hypothesis must yield probability value, or "p-value" below 0.05 (5%).

Results

Data obtained from this study are summarized below.



Graph I – Average of Surface Defects on New Microscope Slides

Table II provides a matrix of probability values derived from the Student's t-Test.

Set A / Set B	TS 1	TS 2	TS 3	TS 4	TS 5	TS 6
TS 1		1.0×10^{-3}	2.4×10^{-2}	2.4×10^{-5}	3.0×10^{-7}	4.0×10^{-3}
TS 2	1.0×10^{-3}		**1.2×10^{-1}**	**8.8×10^{-2}**	1.1×10^{-7}	6.0×10^{-5}
TS 3	2.4×10^{-2}	**1.2×10^{-1}**		2.8×10^{-3}	1.9×10^{-7}	3.0×10^{-4}
TS 4	2.4×10^{-5}	**8.8×10^{-2}**	2.8×10^{-3}		6.8×10^{-8}	1.0×10^{-5}
TS 5	3.0×10^{-7}	1.1×10^{-7}	1.9×10^{-7}	6.8×10^{-8}		3.6×10^{-7}
TS 6	4.0×10^{-3}	6.0×10^{-5}	3.0×10^{-4}	1.0×10^{-5}	3.6×10^{-7}	

Table II –Student's t-Test, P-values of Null Hypothesis

[1] Callin, John I, (2007) *Principles and Practices of Clinical Research, 2nd Edition.* Elsevier, ISBN 012369440X.

Highlighted cells denote values of 0.05 or more, (statistically significant similarity). Values in Table II are calculated using two distribution tails, unpaired, and assuming unequal variance.

Discussion

All slides examined in this study are "pre-cleaned", as suggested by their box claims. The packaging themselves consist of plastic wrapping and look quite satisfactory to the naked eye. However, data from this study indicate a large variation among the qualities of microscope slides obtained from different sources. Although one may assume that good packaging and claims of pre-cleaning always guarantee slide quality, TS 5 and TS 6, along with their numerous surface defects, illustrate a telling exception. Since all slides for this study were obtained from new, unopened boxes, variations in the amount of surface residuals should not be caused by post-production soiling but are inherent to how slides are manufactured themselves. In the end, different levels of manufacturing refinement, care, and quality management that permeate every step of microscope slide production may help explain the results presented herein.

Glass slides from Propper Manufacturing Company (TS 4) and TS 2 are both made from naturally occurring water white, iron-free glass. Physically, water white glass is denser, and more resistant to stress-related deformations than items made from the average kinds of glass (i.e. those containing higher amount of Fe_2O_3)[2 3]. In optics, water white glass has the unique advantage over other forms of glass because of its transparency, as opposed to the commonly light-green appearance. Because of its superior clarity, water white glass is capable of permitting over 90% transmittance between 400 and 2000 nanometers in wavelength. Glass with higher iron content, on the other hand, permits a much lower transmittance of light overall[4]. Data from Graph I and Tables II indicate that as a whole, TS 4 and TS 2 look better than any other microscope slides studied. Whether the raw material employed in making TS 4 and TS 2 has anything to contribute to improved slide quality is still speculative. Future studies will provide more evidence on this subject.

Conclusion

Under close analysis, not all microscope slides look or perform the same in spite of their relatively simple structure. In this study, we have observed a significant difference in quality among microscope slides commensurate with their respective retail price range. Such difference is particularly obvious when compared against TS 4, which, with its superior clarity and surface polish, is undoubtedly one of the highest quality brands to use in the contemporary market of increasingly demanding applications involving microscopy.

---

2 Wang, F. Y. Li, J. Xu, and H. S. Xie, J. High Pressure Physics. 8, 177, (1994). (in Chinese).

3 Wang, Wei-Hua. *Elastic constants and Their Pressure Dependence of Zr41Ti14Cu12.5Ni9Be22.5C1Bulk Metallic Glass.* Applied Physics Vol 74, 13. (1999)

4 Hazeltine, Barrett. (2003) *Field Guide to Appropriate Technology*. Elsevier, ISBN 0123351855.