Books in my own library permit me to trace the rules of thumb for maximum useful magnification back over a hundred years. Maximum values of 30 through 100 per inch have generally been advocated throughout that period, with most of the recommendations in the range 50 through 60 per inch.

Presented here in alphabetical order by author, are citations and text from some of the books that I own. I have plenty more, and there are many other books and authors whos works should also be consulted.

I have attempted to type carefully, but I caution all to refer to the original sources for definitive accuracy.

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Bell, Louis, 1922. _The_Telescope_, McGraw-Hill. Unabridged republication, Dover, 1981. Pagination refers to the Dover edition.

Bell's book is sufficiently a classic that the original is still in many libraries. I have seen it cited frequently in subsequent literature dealing with amateur astronomy.

Bell's Chapter 13 (pp. 253-277) has a lengthy discussion on the use and abuse of high magnification, with data from several sources and with additional calculation, from which I quote in part as follows:

p. 273:

> With respect to magnifying powers what has already been said is sufficient to indicate that on the lowest power which discloses to the eye the detail within the reach of the resolving power of the objective is the most satisfactory.
>
> Every increase above this magnifies all the optical faults of the telescope and the atmospheric difficulties as well, besides decreasing the diameter of the emergent pencil which enters the eye, and thereby causing serious loss of acuity. ...

pp. 275-6:

> ... one can readily estimate the magnification that for any telescope will take full advantage of its resolving power. ... about 65 to the inch of aperture ... pushing the emergent pencil down to little more than 0.02 inch [50 per inch -- JRF], -- rather further than is physiologically desirable. Except for these extreme stunts of separation, half to two thirds this power is preferable and conditions under which one can advantageously

go above this limit are very rare indeed. ...

In the actual practice of experienced observers the indications of theory are well borne out. Data of the habits of many observers of double stars are of record and the accomplished veteran editor of _The_Observatory_, Mr. T. Lewis, took the trouble in one of his admirable papers on "Double Star Astronomy" (Obs. _36_, 426) to tabulate from the original sources the practice of a large group of experts. The general result was to show the habitual use with telescopes of moderate size of powers around 50 per inch of aperture, now and then on special occasions raised to the neighborhood of 70 per inch. ...

Analyzing the data more completely in this respect Mr. Lewis found that the best practise of the skilled observerse studied was approximately represented by the empirical equation

$$m = 140 \sqrt{A}$$

[The original used the typeset symbol for "square root" which I cannot duplicate in this computer document; note also that A is the aperture in inches. -- JRF]

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Couteau, Paul, 1981, _Observing_Visual_Double_Stars_, M.I.T.Press.
From the french _L'Observation_des_etoiles_doubles_visuelles_ (Flammarion, Paris, 1978), translation by Alan Batten.

Couteau is a highly regarded professional astronomer who has specialized in the visual observation of double stars. On p. 33, following a quite technical discussion of the size and nature of the diffraction image of a star produced by a telescope, Couteau concludes that the "resolving magnification", that "just makes the diffraction image visible" is "numerically equal to the radius of the aperture R expressed in millimeters". He continues

To see it in detail (for example, while observing a close binary), one must use a higher magnification, called the _useful_ _magnification_ [italics are the original author's -- JRF], which is usually three to four times and may be up to five times the resolving magnification. With still higher magnifications, the edges of the image are badly defined and the eye cannot transmit information.

I note that four or five times Couteau's resolving magnification is two or two-and-a-half times the _diameter_ of the aperture in millimeters, or 50 to 63 times the diameter of the aperture in inches.

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Dimitroff, George Z., and James G. Baker, 1945. _Telescopes_and_
Accessories, The Blakiston Company.G

Dimitroff and Baker's work is one of the celebrated Harvard Books on Astronomy. On p. 38 the authors simply state "A useful upper limit to the magnifying power may be taken as 50 times the aperture in inches."

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Price, Fred W., 1994. _The_Planet_Observer's_Handbook_, Cambridge
University Press.

p. 46:

> What magnification range is best for observing the planets? Under average seeing conditions a power of about 20D-30D, where D is the aperture of the telescope in inches, should give optimum results. ... It is best to use higher magnification than this minimum, however, because this gives a more comfortable view of the detail resolved by the objective. No further detail is revealed by increasing the magnification so any further increase is termed 'empty magnification'. The experienced planetary observer uses only the minimum magnification necessary to reveal the finest planetary features that are being studied. ... Excellent seeing will permit magnifications of 40D or even 50D but the occasions when this can be done are rare.

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Royal Astronomical Society of Canada, Roy Bishop, ed., annual publication.
_Observer's_Handbook_, University of Toronto Press.

Since 1982, this well-regarded annual handbook has included a brief section on telescope performance, which contains a discussion of useful magnification. It is noteworthy that the highest magnification recommended has _declined_ over the years. The 1982 recommendation (p. 10) was for an upper limit of twice the telescope aperture in millimeters -- 51 per inch -- with the additional comment that "For examination of double stars, magnifications up to 4D are sometimes useful." In 1999 (p. 33), the basic recommendation was still the same, but the comment had become "For examination of double stars, detection of faint stars, and studying structure in bright nebulae, magnifications of up to 3D are sometimes useful." 4D and 3D are respectively 102 and 76 per inch.

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Sidgwick, J. B., 1971. _Amateur_Astronomer's_Handbook_, Faber and Faber, republished by Dover, 1980. Pagination refers to the Dover edition.

On p. 56, Sidgwick gives an upper limit of useful magnification of 30 times the aperture in inches, then elaborates:

> It should be emphasized that these 'limits' especially the upper, are not hard and fast. Vision is not affected so adversely as to prohibit observation with magnifications at least double those indicated by [30 per inch] -- with small instruments, anyway. ...

Sidgwick tabulates and plots the upper limits of useful magnification as recommended by several sources, including his own calculation, in Figure 6, p. 58. For apertures below approximately five inches, the largest of the several recommendations compiled is the 140 sqrt(A) attributed to Lewis by Bell (cited herein), and for apertures above approximately five inches, the largest of the several recommendations is the sixty per inch -- the "double those indicated" that Sidgwick himself advises.

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Sidgwick, J. B., 1971. _Observational_Astronomy_for_Amateurs_, Faber and Faber, republished by Dover, 1980. Pagination refers to the Dover edition.

In this companion volume to the Sigwick work just cited, Sidgwick tabulates recommended magnifications, per inch of aperture, for observation of several planets and satellites, in a table on p. 102. The highest recommendation given is 60 per inch, for observations with small aperture of Jupiter's satellites or of Uranus. The other table entries are broadly distributed in the range 10 through 50 per inch.

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Webb, T. W., 1859. _Celestial_Objects_for_Common_Telescopes_, Volume 1. Dover republication in 1962 of the sixth (1917) edition, which had been revised by T. E. Espin and published by Longman's, Green and Co. Pagination is for the Dover reprint.

On p. 7 appear the words "The best telescopes of either kind [refractors and reflectors -- JRF] will bear a power of 100 per inch of aperture on stars: for planets, or the moon, half that power will usually more than suffice." The preface states that new material in the text has

been added as footnotes, so this remark -- which is not a footnote -- presumably dates to 1859.

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