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Gage Section
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6 Sheets.

# THREAD FORM AND CLEARANCE OF THREAD GAGES.



One of the benefits to be realized as a result of the experience gained during the recent military preparations by American Engineers and Manufacturers is the more extensive and intelligent use of gages, particularly thread gages. We have become accustomed to using thread gages having certain clearances provided, but the requirements making these clearances desirable or necessary have not been generally understood. It is the purpose of this communication to present and discuss the conditions necessary for clearance as they may be attained in practice as well as the ideal conditions desirable in a system of "Go" and "Not Go" U.S. Standard thread gages. It is a further object to point out the utility of the Projection Lantern in determining clearance and thread form.

## 1. Ideal Form of the "Go" Thread Gage.

The thread form of the "Go" plug or ring thread gage which would best fulfill requirements is that of the perfect U.S. Standard thread, that is, a thread having an angle of 60° with sides straight, and the crest and root of the thread truncated at one-eighth the depth of the sharp V thread, as illustrated in Fig. 1. Work made to fit such a "Go" gage would not, on any of its diameters, extend beyond the limits established by that gage.

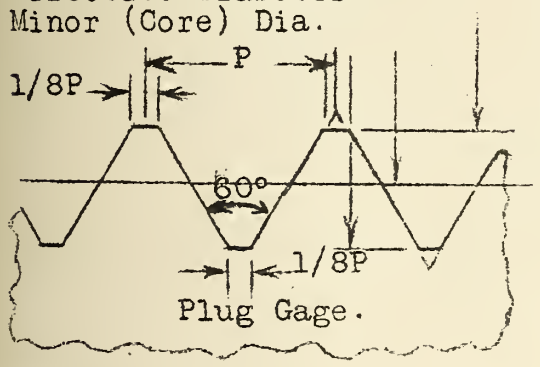


Fig. 1.

## 2. Usual Form for the "Go" Gage.

In the manufacture of a thread gage it is difficult to maintain an accurate form at the root of the thread and it is, therefore, the usual practice to clear out the root below the specified position of the U.S. Standard flat. This practice facilitates the lapping of the thread since it is practically impossible to lap the flat at the bottom of the thread shown in Fig. 1 and at the same time lap the sides of the thread accurately. If the root of the thread is cleared with a sharp 60° tool, the gage after lapping has the appearance shown in Fig. 2 at "A" since the lap wears away the sides of the thread with-

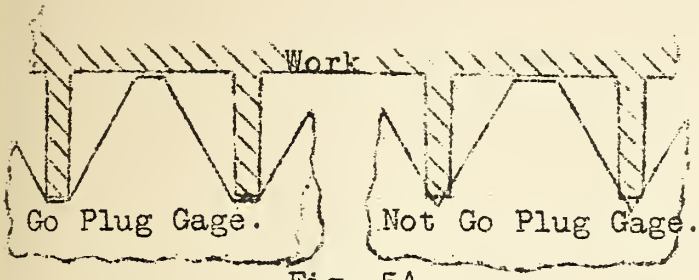

Fig. 5A.

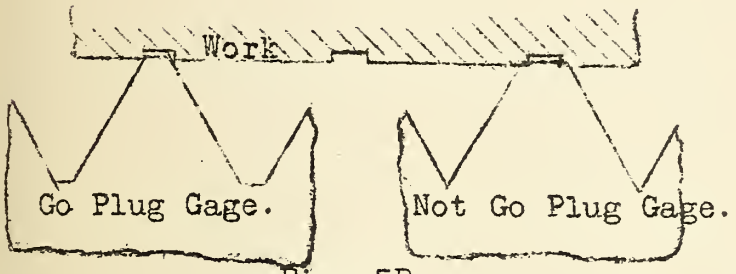

Fig. 5B.

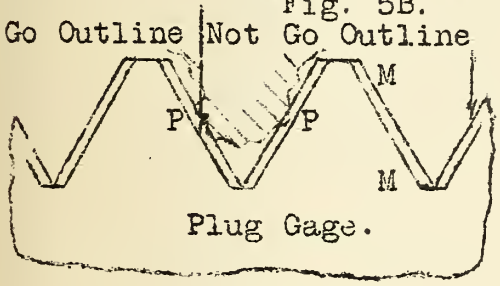

Fig. 5C.

ing diameters of the "Go" ring gage. The resulting form of thread is shown in Fig. 4. The objection to this form of thread is that the thread angle of the work may be considerably in error and yet the work be passed by gages made in accordance with the above practice. This may best be shown by the extreme cases given in Fig. 5. It may be seen that the threads having the forms shown in Figs. 5A and 5B may pass the gages, that is, the "Go" gage will enter and the "Not Go" gage will not enter the work. Further, a thread having any irregular form as shown in Fig. 5C and having only two points "P" which lie within the limits established by the "Go" and "Not Go" gages, that is within the areas MM will pass the gages.

## 5. Recommended Thread Form For "Not Go" Gage.

To overcome this difficulty the design for "Not Go" thread gages shown in Fig. 6 is recommended herewith, which is very easy to make and will therefore cost less than the present form, which embodies correct principles, and which will have a wearing life of sufficient length to meet shop conditions. The crest of the thread is located at about one-fourth the depth of the sharp V thread above the pitch diameter line and similarly at a distance of one-fourth the depth of the thread below the pitch diameter line the thread is cleared. This leaves sufficient gaging surface to provide against wear and the amount by which the thread in the work may deviate from the correct out-

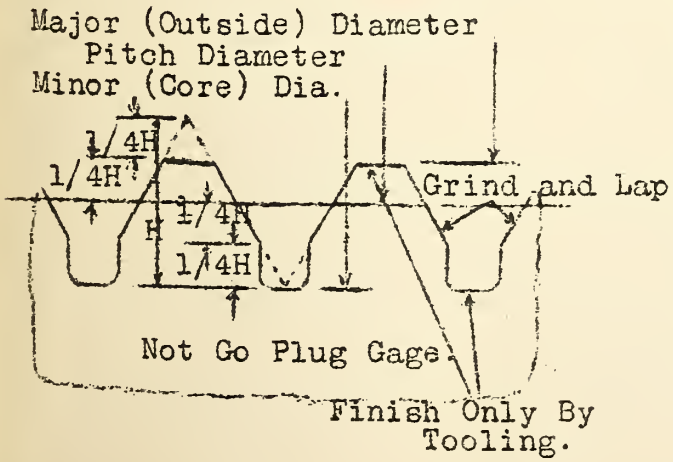

Fig. 6.

line is considerably reduced.

In making this form of gage the major (outside) diameter and the minor (core) diameter need not be kept within close limits and need not be finished by grinding and lapping after hardening. It is only necessary to finish, grind and lap the pitch diameter. It is suggested that the thread be cleared not below the bottom of the sharp V thread. See Fig. 6. The practice outlined is recommended for both "Not Go" plug and ring thread gages.

6. Master Check Plugs For Thread Ring Gages.

In order to determine the pitch diameter of a ring thread gage it is the customary practice to fit it to a threaded check plug made to the correct pitch diameter. It is recommended that the thread form of such a check be the same as that recommended for the "Not Go" thread gage illustrated in Fig. 6. To insure clearance of the thread ring gage at the major diameter, a cast of the thread should be examined by the Projection Lantern as explained in a later paragraph. If such a lantern is not available the clearance should be tested by means of a threaded check plug having the major diameter of the "Go" or maximum size and with angle relieved so that it will not have bearing in the ring gage on the sides of the thread but only at the crest. This check plug can be used to inspect the clearance of both the "Go" and "Not Go" thread ring gages, if the angle is sufficiently relieved. The core diameter of a "Go" ring gage should be checked by a plain plug gage. If the "Not Go" ring gage is made according to the practice recommended herein, it is not necessary to check its core diameter.

7. Clearance On Gages Having Other Thread Forms.

(A) Lowenherz Thread Gages.

The above considerations apply in the same way to thread gages having the Lowenherz thread form since this form differs essentially from the U.S. Standard form only in that the thread angle is 53° 8' instead of 60°.

(B) Briggs Standard Pipe Thread Gages.

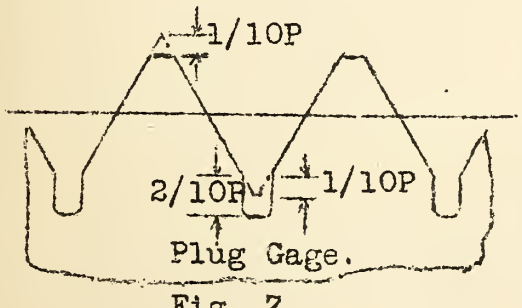

Fig. 7.

In order to insure a tight joint, that is, bearing on the sides of the thread, in fittings having the Briggs Standard Pipe Thread, the practice of reducing the crest and of clearing the root of the thread of the gage is recommended. For example, if the plug gage is made with the full form thread it may bear in the work at the crest or root and accordingly the gage will not enter until there is bearing on the sides of the thread. Thus the gage would indicate that the effective diameter of the fitting is smaller than its actual dimension. For general

practice it is recommended that the crest of the thread on the gage be removed to a depth of one-tenth the pitch, and that the root be cleared to a point one-tenth the pitch above the bottom of the sharp V thread as shown in Fig. 7. This practice has been recommended by the Committee of Manufacturers on Standardization of Fittings and Valves.

## 8. Application Of The Projection Lantern For Determining Clearance And Thread Form.

The Optical Projection Lantern affords a means by which the thread form and clearance of thread gages can be easily and quickly determined. The design and specifications of the projection lantern used by the Gage Section, Bureau of Standards, are available in Bureau of Standards Communication B510. A lantern of more simple design and cheaper construction especially adapted for use in manufacturing plants is being developed at the present time. The specifications for this lantern will be available in the near future.

By means of the lantern the thread form and clearance are best determined by a comparison of the projected, magnified, shadow with templets or charts on which are drawn the correct forms of threads. These charts are as many times enlarged over the exact thread form of a given pitch as the shadow projected by the Lantern is magnified. The magnification of the lantern can be determined by measuring the projected shadow of a wire or small plug of a known size.

The root of a thread is very often rounded out. If the points at which the curved portion is tangent to the straight sides of the thread are above the position at which the standard flat would be located, the thread is not clear.

The thread form and angle of a threaded ring gage may be inspected by examining a cast of the thread made by pouring a fused mixture of about 90% sulphur and 10% graphite into the thread. Unless the ring is very small the cast is readily removed after cooling.

The following table of U.S. Standard Screw Thread dimensions is useful in connection with the work dealt with in this communication:

COARSE THREADS.

| No. of Thds. per Inch. | h Single Depth | 2h Double Depth | Width of Flat | Depth of Truncation | Pitch |
|---|---|---|---|---|---|
| 4 | .1624 | .3248 | .0312 | .02702 | .2500 |
| 5 | .1299 | .2598 | .0250 | .02165 | .2000 |
| 6 | .1083 | .2165 | .0208 | .01801 | .1667 |
| 7 | .0928 | .1856 | .0179 | .01550 | .1430 |
| 8 | .0812 | .1624 | .0156 | .01351 | .1250 |
| 9 | .0722 | .1443 | .0139 | .01204 | .1111 |
| 10 | .0650 | .1299 | .0125 | .01082 | .1000 |
| 11 | .0590 | .1181 | .0114 | .00987 | .0909 |
| 12 | .0541 | .1083 | .0104 | .00900 | .0833 |
| 13 | .0500 | .0999 | .0096 | .00831 | .0769 |
| 14 | .0464 | .0928 | .0089 | .00770 | .0714 |
| 16 | .0406 | .0812 | .0078 | .00675 | .0625 |
| 18 | .0361 | .0722 | .0069 | .00597 | .0556 |

FINE THREADS.

| | | | | | |
|---|---|---|---|---|---|
| 20 | .0325 | .0650 | .0062 | .00537 | .0500 |
| 22 | .0295 | .0590 | .0057 | .00493 | .0454 |
| 24 | .0271 | .0541 | .0052 | .00456 | .0417 |
| 28 | .0232 | .0464 | .0045 | .00389 | .0357 |
| 30 | .0217 | .0433 | .0042 | .00363 | .0333 |
| 32 | .0203 | .0406 | .0039 | .00337 | .0312 |
| 36 | .0180 | .0361 | .0035 | .00303 | .0278 |
| 40 | .0162 | .0325 | .0031 | .00268 | .0250 |
| 44 | .0148 | .0295 | .0028 | .00242 | .0227 |
| 48 | .0135 | .0271 | .0026 | .00225 | .0208 |
| 56 | .0116 | .0232 | .0022 | .00190 | .0179 |
| 64 | .0101 | .0203 | .0020 | .00173 | .0156 |
| 72 | .0090 | .0180 | .0017 | .00147 | .0139 |
| 80 | .0081 | .0162 | .0016 | .00138 | .0125 |