GAGEMAKERS TOLERANCE		WORKPIECE TOLERANCE	
Class	ISO Symbol*	IT Grade	Recommended Usage
ZM	0.05IT11	IT11	Low precision gages recommended used to inspect workpieces held to internal (hole) tolerances C11 and H11 (see Table 1) and to external (shaft) tolerances c11 and h11 (see Table 3).
YM	0.05IT9	IT9	Gages recommended used to inspect workpieces held to internal (hole) tolerances C9 and H9 (see Table 1) and to external (shaft) tolerances c9 and h9 (see Table 3).
XM	0.05IT8	IT8	Precision gages recommended used to inspect workpieces held to internal (hole) tolerances F8 and H8 (see Table 1).
XXM	0.05IT7	IT7	Recommended used for gages to inspect workpieces held to internal (hole) tolerances G7, H7, K7, P7, S7, and U7 (see Table 2) and to external (shaft) tolerances f7 and h7 (see Table 3).
XXXM	0.05IT6	IT6	High precision gages recommended used to inspect workpieces held to external (shaft) tolerances g6, h6, k6, n6, p6, s6, and u6 (see Table 4).

Rejection of Good Parts Increase

Gage Cost Increase

* Gagemakers tolerance is equal to 5% of workpiece tolerance or 5% of applicable IT grade value (see Fig. 4-3).

TABLE 2-4. SAMPLE GAGE TOLERANCE TABLE

This table applies to

1. Taper plug and ring gages (included angle up to and including 15 deg). Fixed snap gages and flat plug gages (excluding flat cyindrical type). Wear allowances are required.
2. Taper plug and ring gages (included angle greater than 15 deg). Wear allowances are not required.
3. Maximum and minimum gages—e.g., depth, length, and flush pin types. Wear allowance not required. "Go" tolerance should be used for both maximum and minimum gages.

Size Range (in.)		Component Tolerance	Wear Allowance	Tolerance	
Above	To and Including			"Go"	"Not Go"
.0	.825	.0005		.00004	.00004
.825	1.510			.00006	No "Not Go" Gage Used
1.510	2.510			.00008	
2.510	4.510			.00010	
4.510	6.510			.00013	
6.510	8.510			.00015	
8.510	10.510			.00017	
10.510	UP			.00020	
.0	.825	.001	.00010	.00005	.00005
.825	1.510		.00010	.00006	.00006
1.510	2.510			.00008	.00008
2.510	4.510			.00010	.00010
4.510	6.510			.00013	No "Not Go" Gage Used
6.510	8.510			.00015	
8.510	10.510			.00017	
10.510	UP			.00020	
.0	4.510	.002	.00010	.00010	.00010
4.510	6.510			.00020	.00013
6.510	8.510			.00020	.00016
8.510	UP			.00020	.00020
.0	.825	.003	.00010	.00010	.00010
.825	4.510		.00010	.00020	.00010
4.510	8.510		.00010	.00020	.00020
8.510	10.510			.00030	.00020
10.510	UP			.00030	.00030
.0	2.510	.004	.00020	.00020	.00010
2.510	4.510		.00020	.00020	.00020
4.510	8.510		.00020	.00030	.00020
8.510	12.510		.00010	.00040	.00020
12.510	UP		.00010	.00050	.00020
.0	2.510	.005	.00030	.00020	.00010
2.510	4.510		.00020	.00020	.00020
4.510	8.510		.00020	.00030	.00020
8.510	10.510		.00020	.00040	.00020
10.510	UP		.00010	.00050	.00030
.0	2.510	.006	.00030	.00020	.00010
2.510	4.510		.00030	.00020	.00020
4.510	6.510		.00020	.00030	.00020
6.510	8.510		.00020	.00030	.00030
8.510	10.510		.00020	.00040	.00030
10.510	12.510		.00020	.00050	.00040
12.510	UP		.00010	.00060	.00040
.0	1.510	.007	.00040	.00020	.00010
1.510	2.510		.00030	.00020	.00020
2.510	4.510		.00030	.00030	.00020
4.510	6.510		.00030	.00030	.00030
6.510	8.510		.00030	.00040	.00030
8.510	10.510		.00020	.00050	.00030
10.510	12.510		.00020	.00060	.00040
12.510	14.510		.00020	.00070	.00040
14.510	UP		.00010	.00080	.00050
.0	1.510	.008	.00040	.00020	.00010
1.510	2.510		.00040	.00020	.00020
2.510	4.510		.00030	.00030	.00030
4.510	6.510		.00030	.00040	.00030
6.510	8.510		.00030	.00040	.00040
8.510	10.510		.00030	.00050	.00040
10.510	12.510		.00020	.00060	.00050
12.510	14.510		.00020	.00070	.00050
14.510	UP		.00020	.00080	.00060
.0	.825	.009	.00040	.00020	.00010
.825	1.510		.00040	.00030	.00010
1.510	2.510		.00040	.00030	.00020
2.510	6.510		.00040	.00040	.00030
6.510	8.510		.00040	.00050	.00040
8.510	10.510		.00030	.00060	.00040
10.510	12.510		.00030	.00070	.00050
12.510	14.510		.00030	.00080	.00050
14.510	UP		.00030	.00090	.00060
.0	.825	.010	.00040	.00030	.00010
.825	1.510		.00040	.00030	.00020
1.510	4.510		.00040	.00040	.00030
4.510	6.510		.00040	.00050	.00040
6.510	8.510		.00040	.00060	.00040
8.510	10.510		.00040	.00070	.00050
10.510	12.510		.00040	.00080	.00050
12.510	14.510		.00030	.00090	.00060
14.510	UP		.00030	.00100	.00060
.0	1.510	.012	.00040	.00060	.00020
1.510	4.510		.00040	.00070	.00030
4.510	8.510		.00040	.00080	.00040
8.510	12.510		.00040	.00090	.00050
12.510	UP		.00030	.00100	.00060
.0	1.510	.014	.00040	.00060	.00020
1.510	4.510		.00040	.00080	.00030
4.510	8.510		.00040	.00100	.00040
8.510	12.510		.00040	.00120	.00050
12.510	UP		.00040	.00140	.00060
.0	2.510	.016	.00040	.00080	.00020
2.510	6.510		.00040	.00100	.00040
6.510	12.510		.00040	.00120	.00060
12.510	UP		.00040	.00140	.00080
.0	4.510	.020	.00040	.00100	.00040
4.510	6.510		.00040	.00100	.00060
6.510	12.510		.00040	.00150	.00080
12.510	UP		.00040	.00200	.00100
.0	4.510	.025 Up	.00040	.00100	.00080
4.510	6.510		.00040	.00100	.00100
6.510	12.510		.00040	.00150	.00150
12.510	UP		.00040	.00200	.00100

For component tolerance and/or size range not shown, use next smaller component tolerance.

2.5.6 CALIBRATION CONSIDERATIONS

An established accuracy is a fundamental requirement for all inspection equipment. Therefore, inspection equipment designs must provide for the establishment and verification of the accuracy necessary to accomplish the intended purpose. Calibration of standards and inspection equipment shall be conducted in accordance with the procedures in MIL-STD-45662 (Ref. 2). This standard

1. Provides for the establishment and maintenance of a calibration system to control the accuracy of the inspection equipment
2. Applies to all contracts involving the use of inspection equipment
3. Discusses calibration requirements, the need for a written system description, adequate accuracy of measuring equipment, environmental controls, calibration intervals and procedures, and traceability to the National Institute of Standards and Technology. Also included in the standard are discussions of adherence to national standards, recordkeeping, inspection equipment labeling, and storage and handling. Calibration of automatic inspection equipment requires special consideration and procedures, and these are discussed in detail in Chapter 10.

MIL-STD-45662 (Ref. 2) also stipulates that calibration should be conducted in an environment controlled to the extent necessary to assure measurements of the required accuracy. This general guidance may be amplified as in MIL-A-002550 (Ref. 6), which delineates specific temperature, humidity, vibration, and other requirements. Records that demonstrate adherence to the specific conditions must be maintained and be available for review by the Government.

Several specialized types of gages are used to insure accuracy. A *master gage* is used as a referee gage to accept or reject products that were initially rejected by acceptance gages. A master gage is made to one of the specified (maximum or minimum) product limits to a high degree of accuracy relative to the product tolerance. For noninterference-type mating parts, master gages simulate the minimum size of the female part and maximum size of the male part; this simulation permits inspection at a point at which interference should begin.

A *master check gage* or *set master gage* simulates the product dimensions to be gaged and usually is made either to a maximum or minimum condition. These gages are used for setting and monitoring other inspection equipment to include gages and master gages. The master check gage is a very accurate gage made to within 5% of the product tolerance.

Thread-setting gages are used for setting adjustable thread ring gages, thread snap gages, and thread comparators. These gages are made to tolerances contained in FED-STD-H28/6, *Screw Thread Standards for Federal Services* (Ref. 8). Detailed information about these gages is provided in Chapter 8.

The following guidance applies to inspection equipment calibration:

1. Master equipment used for checking inspection equipment should not be used for any other purpose. Other uses could affect accuracy through accumulated dirt, rust, scratches, nicks and dents, etc.
2. All features and surfaces used as references during calibration should be true to geometric form. The geometric requirements for gaging and precision functional surfaces should be in accordance with par. 3.2.2, MIL-G-10944 (Ref. 7).
3. Surface finish and hardness of masters should be adequate to meet the inspection requirements. Surface roughness can affect the accuracy. If the surfaces being used are not hard enough, they will be nicked and dented within a short period of use and rendered inaccurate.
4. Handling should be minimized while gages are being checked because heat transfer and sweat from hands can adversely affect readings. The use of gloves, tongs, etc., is advised whenever gages must be handled during checking.
5. A definite order of events or procedures is essential to insure repetitiveness of test conditions and to eliminate the possibility of error caused by step omissions.
6. Calibration should be accomplished in the following sequence:
   a. Isolate the values of all specified acceptance limits to be tested or inspected.
   b. Isolate all variables inherent in the inspection equipment design that can affect the accuracy of the results.