

# **JUST HOW PRECISE IS YOUR 'PRECISION GEAR'**

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Much has been written over the last several years about 'precision gears' for clarifier drives. Of this outpouring of rhetoric, little hard description or definition has been put forth leaving the reader to either conceive his own definition or research the meaning in the technical literature.

As most of us do not have the luxury of an over abundance of spare time, we associate our previous knowledge and concepts with the undefined 'precision gear'. The first thought that must come to mind when discussing a 'precision gear' is that 'precision' must make the gear better. Another associated concept would be the transference of the 'precision' of the gear to the entire system including the integral or separate turntable bearing. Also, it would follow that those drives lacking the adjective 'precision' must be an inferior product.

In an effort to more clearly define 'precision' we can investigate the American National Standards Institute, ANSI, standards. The American Gear Manufacturers Association, AGMA, develops standards that are reviewed by both AGMA and ANSI members and prior to acceptance. In the ANSI/AGMA standards, there is a dramatic absence of any mention or definition of the term 'precision' or 'precision gear'. On the other hand, there is a great deal of discussion concerning Quality Classifications as found in ANSI/AGMA 2000-A88, AMERICAN NATIONAL STANDARD: Gear Classification And Inspection Handbook - Tolerances And Measuring Methods For Unassembled Spur And Helical Gears (Including Metric Equivalents). AGMA Quality Class 3 is the lowest quality level and Class 15 is the highest quality level assigned by this standard.

A clarifier drive manufacturer has made the claim that an internal spur gear cut to and AGMA Quality Class 6 and de-rated to an AGMA Quality Class 5 after heat treatment is a 'precision gear'. By the manufacturer's definition this may be true, as ANSI/AGMA has no definition of 'precision'. It is interesting to note that Walker Process Equipment clarifier drive split spur gears have an AGMA Quality Class 6 rating as a minimum final gear rating.

Perhaps, the much-touted 'precision' then resides in the bearing. ANSI and the American Bearing Manufacturers Association, ABMA, publish standards concerning rolling element bearings. The old Anti-Friction Bearing Manufacturers Association, AFBMA, Standard 1, Terminology for Anti-Friction Ball and Roller Bearing Parts defines internal clearance, axial clearance, radial clearance, and radial play. Standard 1 did not define 'precision', but did use precision in the definition of ABEC-1, ABEC-3, ABEC-5, ABEC-7, and ABEC-9 as the class or degree of precision of radial ball bearings.

ANSI/ABMA Standard 4, Tolerance Definitions and Gaging Practices for Ball and Roller Bearings, defines 'Tolerance Terms', 'Internal Clearance', and gives descriptions of methods of measuring commonly used that give accuracy sufficient for practical purposes. This standard however does not give ranges or recommended values for either tolerances or clearances for bearing design and does not refer to 'precision' at all.

ANSI/ABMA Standard 9, Load Ratings and Fatigue Life For Ball Bearings and ANSI/ABMA Standard 20, Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types, Metric Design do not include 4-point Gothic-Arch bearings within their scope. ANSI/ABMA Standard 20, Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types, Metric Design does define ABEC and RBEC Tolerance Classes, however the 4-point Gothic-Arch bearing is not within its scope.

The following chart presents the maximum bearing diameters for the various ABEC tolerance classes.

ABEC TOLERANCE CLASS	MAXIMUM BASIC BORE DIAMETER mm	MAXIMUM BASIC OUTSIDE DIAMETER mm	APPROXIMATE PITCH DIAMETER mm	APPROXIMATE PITCH DIAMETER inches
1	2,000	2,500	2,250	88.58
3	630	1,000	815	32.09
5	400	800	600	19.69
7	250	400	325	12.80
9	250	400	325	12.80

Clearly for any ball bearing having a pitch diameter above 32 inches only the ABEC-1 could apply. Thus the 'precision' of the 'precision gear' must not be endowed by the bearing tolerance and geometry, as ABEC-1 is the normal or customary tolerance.

The definition of 'precision' must then come from the manufacturer, and is not based on the gear Quality Classification Number and the tolerances associated with the bearing.

Avon Bearings Corporation and Rotek are the two of the major suppliers of slewing ring bearings and gears to clarifier drive manufacturers that purchase their turntable bearings and gears from an outside source.

Avon in its catalog indicates for its series M, medium, and H, heavy; as well as series T, made to order, slewing ring bearings tolerances of +0.000/-0.030 inches on the outside diameters, +0.030/-0.000 inches on the inside diameters, and +0.030/-0.030 inches on all other dimensions.

For a heavy series internal spur gear H 12 No. 8, the tolerances for a 54.80-inch pitch diameter gear and bearing are:

Bearing ID of 54.19/54.16 inches,  
Bearing OD of 66.00/65.97 inches  
Outer race land of 59.97/59.91 inches

Rotek has indicated tolerance levels of 0.010" to 0.030" for axial and radial runout on its typical bearings. This manufacturer does offer precision bearing and gear assemblies with runout tolerances of 0.0002" to 0.0006" with an integral AGMA Quality Class 10 gear. Rotek recommends these bearing and gear assemblies for test stands, medical diagnostic equipment, precision indexing tables and radar or radio telescope antennae. An AGMA Quality Class 5 or 6 gearing described by the above mentioned clarifier drive manufacturer would not be incorporated into a precision system.

Thus the manufacturer, mentioned above, refers to their clarifier drive as the 'precision gear'. In actuality their drive has an AGMA Quality Number lower than that of the Walker Process Equipment split internal spur gear and bearing runout tolerances substantially larger than the +0.016"/-0.000" runout tolerance of the Walker Process Equipment turntable bearing.

The 'precision gear' and 'precision bearing' as extolled by some clarifier drive manufacturers is not quite precise enough!