Gear Quality

Causes of Noise and Vibration

Some causes of gear noise (but not limited to)

Tooth profile error
Lead error
Tooth pitch error
Pitch line runout
Surface finish
Wear
Gear, shaft or housing resonance

Things that can control noise:

Higher quality gearsets
generate less
vibration and noise!

Gear Quality

Establishes precise tolerrance

Variations from theoretical perfect
Specifications based on design of gears

Industry standard is AGMA

Quality expressed in numbers
AGMA 3 - 15
Higher numbers mean higher quality

Typical AGMA Quality Range

Hobbed gears = AGMA 7 - 10

Shaved gears = AGMA 9 - 11

Ground gears = AGMA 10 - 15

*Lapping gears **DOES NOT** increase quality*

ISO Vs AGMA Quality Numbers

"Rule of 17"

ISO Qn = 17 - AGMA Qn

ISO quality numbers 0 to 12 in decreasing quality

AGMA quality numbers 3 to 15 in increasing quality

AGMA Gear Quality

Quality and performance based on four factors:

Gear tooth profile
Gear tooth lead
Gear tooth pitch
Pitch line runout

Gear Quality

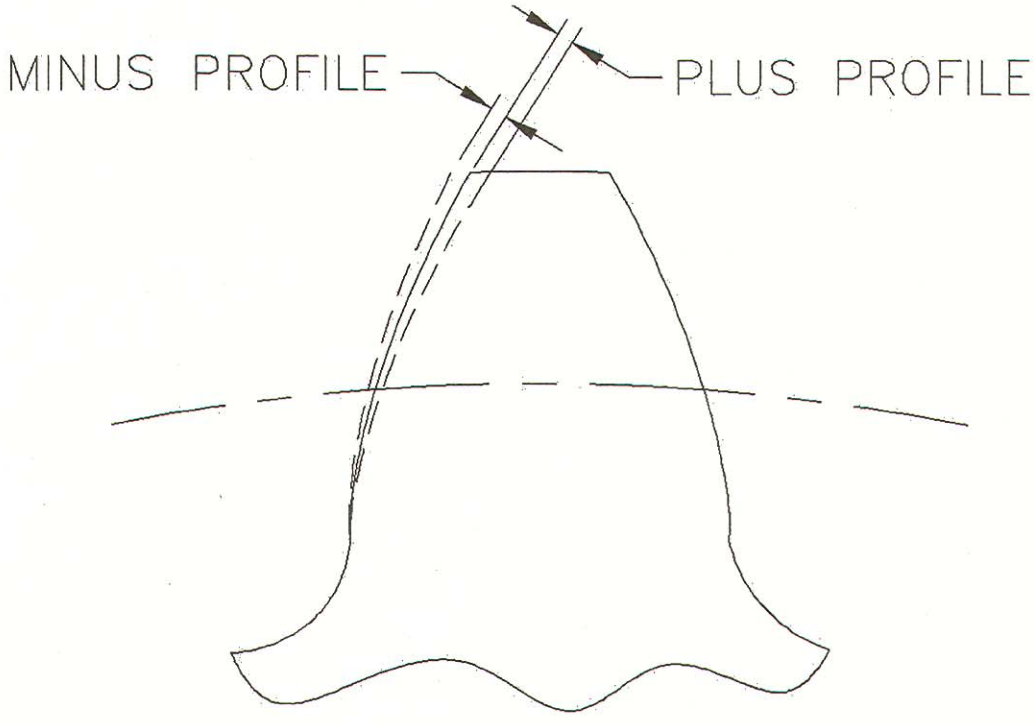
Gear Tooth Profile

Profile is the shape of the gear tooth

The tooth profile is an involute curve

Greater variations from theoretical yield higher vibration and inconsistant loading

Gear Tooth Profile



Gear Quality

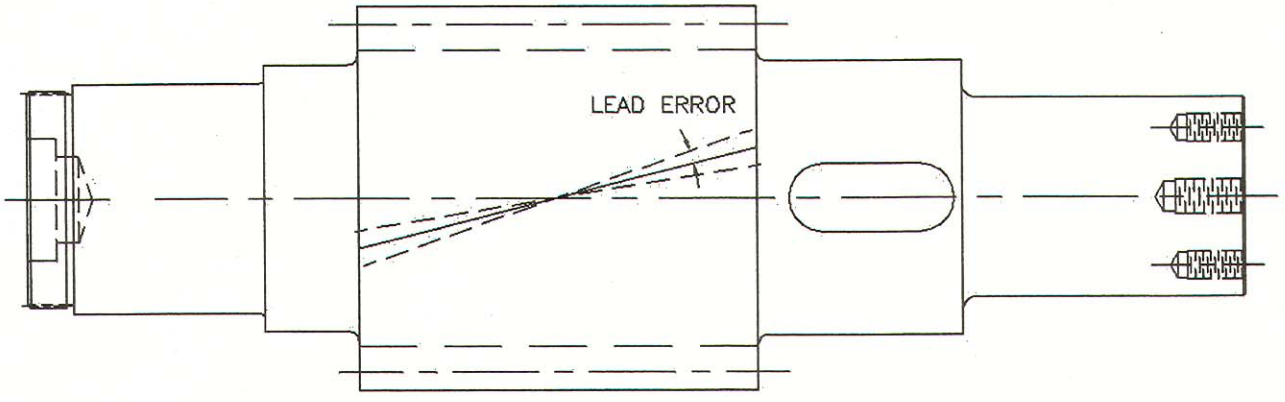
Gear Tooth Lead

Lead is the measurement of the accuracy of the helix angle

The angle may be anything from 0 degress for spur to 30 degrees or more for double helical gears

Excessive variation in lead angles will adversely affect gear performance

Gear Tooth Lead



Gear Quality

Gear Tooth Pitch

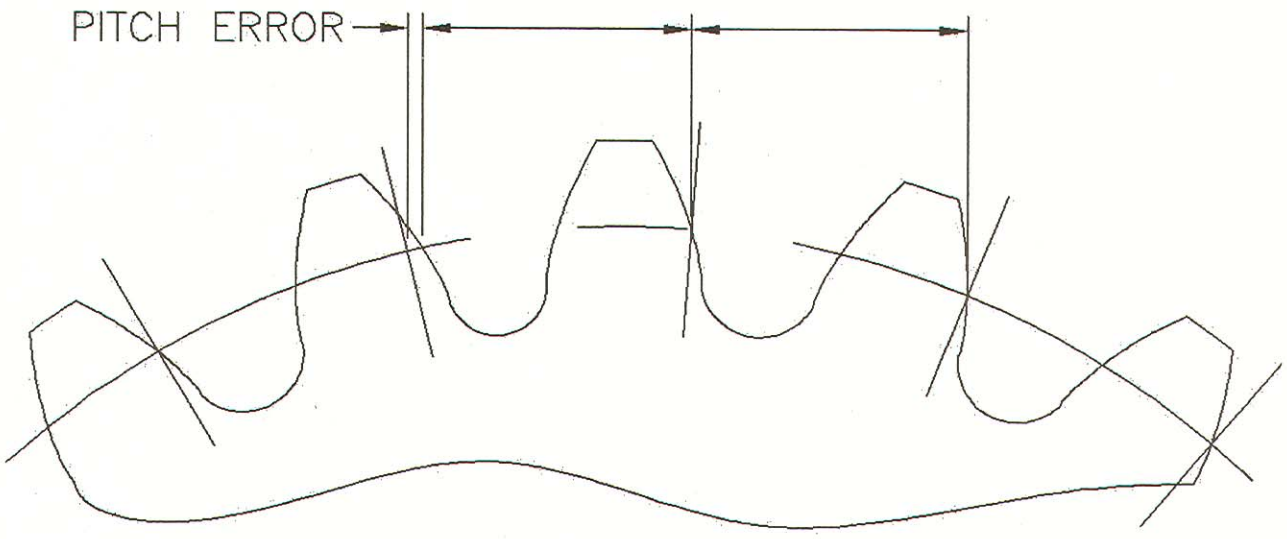
Pitch is the distance between teeth

Measured from a point on the side of one tooth to the corresponding poin on the same side of the next tooth

Pitch variation is the difference from the theoretical position to the actual position

Accurate tooth spacing is vital to performance

Gear Tooth Pitch



Gear Quality

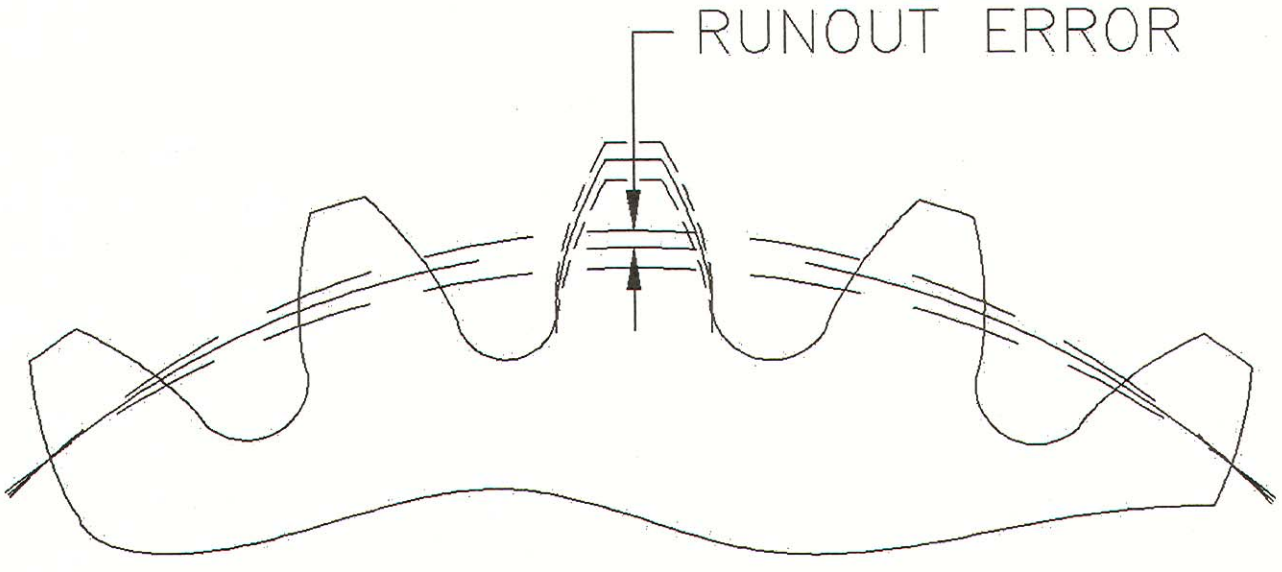
Gear pitch line runout

Runout is a function of concentricity, or roundness of the gear

Excessive runout causes pitch variation

Excessive runout is a major cause of noise gear operation

Pitch Line Runout



Comparing Quality

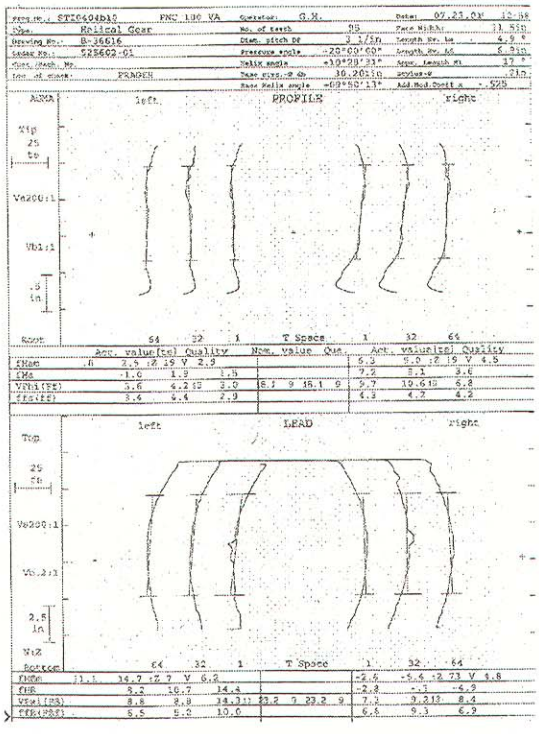
Sample: 4DP gearset

AGMA Quality	Pitch Tolerance		Profile Tolerance	
	Pinion PD = 6.0"	Gear PD = 25.0"	Pinion PD = 6.0"	Gear PD = 25.0"
8	11	14	16	20
12	2.6	3.4	4.1	5.0

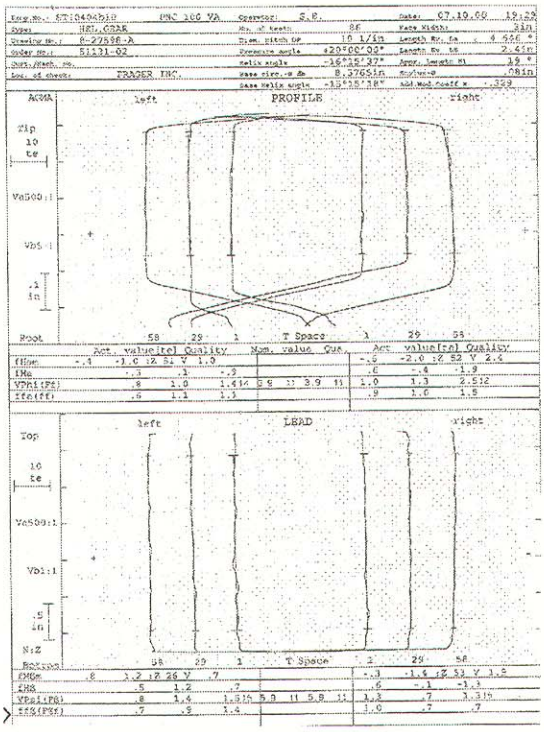
Tolerances in Ten-Thousandths of an Inch

Extracted from AGMA Standard 2000-A88, *Gear Classification and Inspection Handbook, Tolerances and Measuring Methods for Unassembled Spur and Helical Gears*

Documented Results

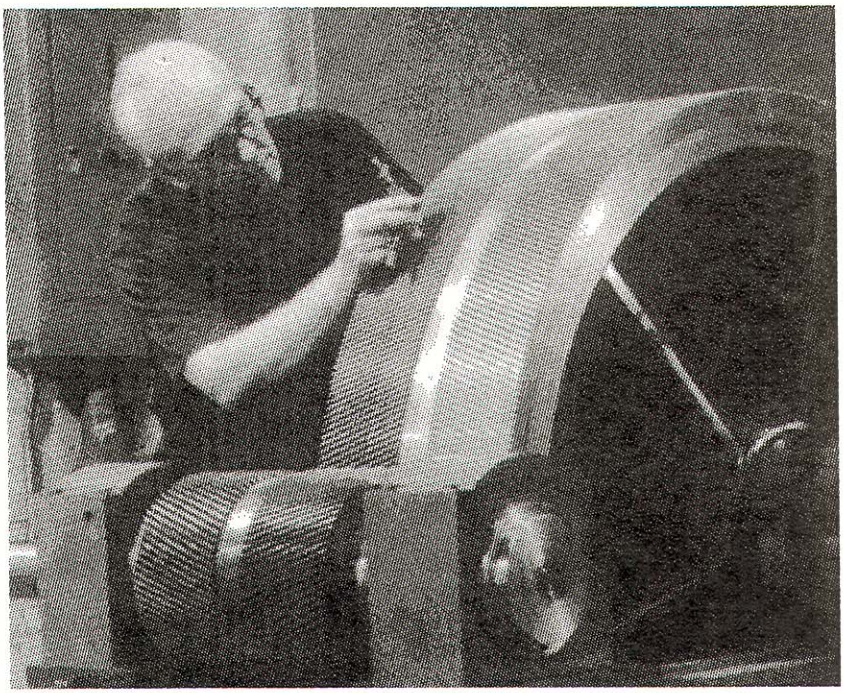


Hobbed Gear



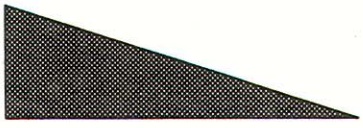
Ground Gear

Contact Checker



This objective

Not This



Quality - Confirming Results

AGMA standards (spin test)

Run box for 1 hour at actual or near actual operation speed and monitor:

Noise level
Temperature
Oil tightness
Lubrication system performance
Contact pattern of meshes
No load

Quality - Confirming Results

API Standards

Includes all AGMA plus the following data taken every 15 minutes at 100% and 110% of rated speed

Inlet temperature and pressure
Outlet oil (drain) temperature
Shaft vibration (frequency and amplitude)filter and unfiltered
At partial load and no load