Quindos – the Ultimate Software package for Gears, Gear Tools and other Special Applications
Quindos gear packages

Gearings

• Cylindrical Gear
• Unknown Gear
• Involute & Lead Master
• Straight Bevel Gear
• Spiral Bevel Gear
• Cylindrical Worm
• Worm Wheel
• Double Evelop. Worm
• Extruder Worm
• Sprocket
• Curvic Coupling

Gear Tools

• Hob Cutter
• Cutter with single cutting plates
• Broach Shells
• Shaver Cutter
• Shaper Cutter
• Form cutter

Special Geometries

• Step Gearings
• Screw Compressor
• Camshaft
• Impeller
Inspection of Cylindrical Gears:

Hexagon CMMs and QUINDOS don’t need a Rotary Table! – but can be used if preferred!

Gears mounted on pallets

- High accuracy
- High throughput
- automatic execution

Other features:

- Gear diameter: 2mm up to 3700mm
- Module: $\geq 0.25$
- Max. Tooth height: not limited
- Max. Shaft length: not limited
- Max. Gear weight: not limited

Available Standards:

- DIN 3962 + VDI
- ISO 1328-1
- AGMA 2000-8
- AGMA 2015-1
- JIS 1702
- CNOMO-G

Customer spec.: Caterpillar, Daimler, Eurocopter.....
Measurement of 6 spur gear segments as pallet

- Alignment in gearing itself according to customer advice
- Pitch & Runout
- Tooth thickness, etc.
- Profile & Helix
- Tip circle
- Root circle
- Form & Position of Bores
- All Contours
- Wall thickness
- etc.
Automatic Gear Inspection on Pallets with PMM-C 700

View from top

Gear Tip Dia. 90mm:
35 helical gears can be fixed and measured fully automatic in one set up on a Leitz PMM-C 700.

Measuring range required in Y (for gear dia. 90 mm, with 5mm clearance for moving):
50 + 5 + (5 x 90) + 4 x (5 + 100 + 5) + 50 + 7 = 1000 mm

Table size 1250 x 1050 mm
Measuring range 1200 x 1000 mm

Scale: 1 : 10
Measurement of Large Gears

(CMM + Gear Software = CMM + Gear Tester)

Gantry Type CMM for
Gear Diameter up to 3700 mm

Accuracy up to
E = 2.4 + L / 400 [µm]
P = 1.9 µm
Measurement of small Gears

(CMM + Gear Software = CMM + Gear Tester)

Accuracy up to

E = 0.8 + L / 350 [µm]

P = 0.8 µm

CMM for Gear Diameter down to 2mm
Profile (involute)
- Profile slope deviation $f_{H\alpha}$
- Total profile deviation $F_{\alpha}$
- Profile form deviation $f_{f\alpha}$
- Profile crowning $C_{\alpha}$
- Tip relief (VDI/VDE 2607)
- Root relief (VDI/VDE 2607)
- K-chart evaluation
- Pressure angle modification

Helix
- Helix slope evaluation $f_{H\beta}$
- Total helix deviation $F_{\beta}$
- Helix form deviation $f_{f\beta}$
- Helix crowning $C_{\beta}$
- End relief (VDI/VDE 2607)
- K-chart Evaluation
- Helix angle modification
Pitch & Runout

- Cumulative pitch deviation $F_p$
- Individual pitch deviation $f_p$
- Adjacent pitch deviation $f_u$
- Variance of pitch deviation $R_p$
- Radial runout $F_r$
- Dimension over 2 balls
- Dimension over 1 ball
- Span over $n$ teeth
- Tooth thickness
- Evaluation with and without eccentricity
Quindos GEARHX – certified by PTB (German National Institute)
Determination of unknown Gear

**Strategy**
- Define gear axis
- 1x probing at tip circle
- 1x probing at root circle
- 1x probing at upper and lower face
- 6 points at gear flank
  - 5 at one flank
  - 1 point at opposite flank

**Results**
- Normal module
- Pressure angle
- Helix angle
- Addendum modification factor
- Crowning of profile and helix
- Tip circle diameter
- Root circle diameter
- Gear width
Inspection of Involute and Lead Masters

**Involute Master**
- Determination of $fH_\alpha$, $F_\alpha$, $ff_\alpha$ inside evaluation range
- Position and depth of flat areas (see plot)
- Determination of actual base circle diameter
- Evaluation with respect to actual or nominal base circle diameter
- Plot with respect to angle of roll or angle of roll

**Lead Master**
- analog
Quindos GEARSB

Measurement of Straight Bevel Gears according to DIN 3971

Measurement of external & internal Gearings, Dies and Electrodes

Topography Measurement
- with theoretical points (Octoid Gearing of the 1st kind)
- with Master Grid

Profile Measurement
- like cylindrical gear

Flank Trace Measurement
- like cylindrical gear

Pitch & Runout

Bestfit
- to improve alignment
Quindos GEARSB - Evaluation of Straight Bevel Gear

Topography

Pitch • Runout • Tooth Thickness
Flank trace evaluation according to Octoid geometry
Quindos GEARBV – Spiral Bevel Gears and Crown Gears

Spiral Bevel Gear

Crown Gear
Quindos GEARBV – Spiral Bevel Gear

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Quindos GEARBV - Evaluation

- Import of Master Files e.g. in Gleason, Klingelnberg (KEGMES), DMG Format
- Export of average result file e.g. in Gleason Format
- Measurement of a Master Gear
- Automatic generation of the moving path without rotary table
- Actual nominal comparison of topography with different fitting methods
- Evaluation of pitch, runout and tooth thickness
- Quality Grade according DIN or AGMA
- Large size Pinions measured with axis mounted horizontally
Quindos GEARBV – Interfaces to GLEASON, Klingelnberg, DMG

I.E. Correction of Machine Settings G-Age 4/WIN
Quindos WORMHX, WORMGL, WWHEEL

Cylindrical Worm, Double Env. Worm and Worm Wheel

Cylindrical Worm
Mounted horizontally
⇒ Any length can be measured!
Quindos WORMHX - Cylindrical Worm

- Cylindrical Worms of type ZA, ZI, ZN, ZK and ZC (DIN 3965)
- Single or multi start worms
- LH or RH lead
- Duplex Worms
- Mounted in vertical or horizontal position
Quindos WORMHX - Cylindrical Worm evaluation

- Worm types ZA, ZI, ZN, ZK and ZC (DIN 3965)
- Lead at selectable diameter (Fpz, -per, fHβ, ffβ)
- Profile at selectable Z height (Fα, ffα, fHα, Cα)
- Axial pitch (Fp, fp, fu)
- Runout (given or calculated ball diameter)
- Normal tooth thickness
- Topography
Several types of generation (inclined grinding disk or straight sided skiving wheel)

- 1 or multi-start worms
- LH or RH lead
- vertically or horizontally mounted
- Profile
- Lead
- Pitch
- Runout
- Axial bestfit independently for left and right flanks for improvement of machine setting
Quindos WWHEEL – Worm Wheel

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Worm Wheels for Cylindrical Worms of the types ZA, ZI, ZN, ZK and ZC (DIN 3965).

- Calculation as conjugate gearing to the mating worm
- No Master Grid necessary
- Pitch
- Runout
- Dimension over 2 Balls
- Profile
- Helix
- Topography
- Bestfit of axial Position
- Evaluation accord. to DIN, BSI and AGMA
Definition of Worm Wheel

Type (ZA, ZI, ZN, ZK, ZC)
No. of starts
Hand of lead (LH, RH)
- pressure angle
- grinding disk parameter
- etc.

No. of teeth
Tooth thickness
Generation of Worm Wheel Flanks

Worm point \((x^1, y^1, z^1)\)
Normal direction \((i^1, j^1, k^1)\)

Law of Gearing

Worm Wheel point \((x^2, y^2, z^2)\)
Normal direction \((i^2, j^2, k^2)\)
Quindos WWHEEL – Profile Evaluation

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Notation: QUINDOS

DIN 11/7 10/7 8/7

Quindos WWHEEL – Profile Evaluation

fHα
Fα
ffα
Ca

X 250
X 5.7

DIN
11/7 10/7 8/7
34.3 51.7 18.5
11.3 18.5 18.2
30.5 29.9 13.8
11.0 15.0 23.1
15.4 19.1 10.2
115.4 111.9 115.0
118.0 118.0 118.0
1/3 1/2 1/1
1/1 1/3 1/3

Tol. 1
FHA 11.0 FFA 15.0
15.0 10.2 10.2
-20.0 -20.0 0.0

Angle

18.0 22.4 13.7

No. of Teeth: 24
Module: 5.000
Pitch dia: 120.000

Profile
ZK WORM WHEEL

Notation: QUINDOS

Drawing No: 17-JAN-2004/14:2

Remarks: metric

Inspector/Dra: Roehr/2004/14:2

Press. angle: 20.000
Quindos WWHEEL – Helix Evaluation

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Reference Side | Right Flank | Tooth | Left Flank
--- | --- | --- | ---
19 | 13 | 7 | 1
19 | 13 | 7 | 1

Tol. Tol.
-22.5
-22.5

fHβ
FB
ffβ
CB

Notation: QUINDOS
Drawing No.: Roehr/17-JAN-2004/14:2
Module: 5.000
Inspection Date: 17-Jan-2004
Pres. angle: 20.000
Remarks: metric

FLANK TRACE
ZK WORM WHEEL
Quindos HOB – Hob cutter

- Measurement of all features as defined in DIN 3968.
- Additionally to DIN the Axial Pitch and the Tooth Height for topping hobs
- All measurement also for multi start hobs
- The flutes can be straight or helical
Quindos HOB – Hob Cutter Evaluation

- Radial and axial runout of test collars
- Radial runout of tooth tip
- Shape and position of cutting face
- Pitch of the flutes
- Deviation of flute lead over 100 mm
- Form deviation of cutting edge
- Tooth thickness
- Hob lead over cutting edge
- Base pitch deviations
- Axial pitch
- Tooth height
Hob Cutter for large gears (setup with cutting plates)

Determination of typical deviation parameters of the Hob with a special Quindos program
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Quindos BROACH Shell

Broach shells with ring type spaces as well as helical chip spaces can be inspected.

The gearing may be straight or helical with left hand or right hand lead.

Tools for hard broaching with negative face angles can also be inspected.
Quindos BROACH – Evaluation

- lead deviation / axial runout of chip space
- pitch of chip space
- radial runout outer / inner
- stepping of profile
- location to keyway
- transverse pitch in finishing area
- diameter inner / outer (single positions)
- dimension over 2 balls
Quindos BROACH – Evaluation

- radial stepping of inner / outer radius
- radial stepping of dimension over 1 ball
- face angle in normal plane
- back off angle (inner, outer, profile)
- transverse tooth profile
- form of tooth tip
The option Shaving Gear provides the tools for the complete inspection of shaving cutters.

The travel path of the CMM as well as all probing and scan lines required for the inspection are generated automatically.
Evaluation of Profile (involute)

- Profile slope deviation $f_{Ha}$
- Total profile deviation $F_α$
- Profile form deviation $f_{fa}$
- Profile crowning $C_α$
- Mean profile slope deviation $f_{Ha}$

Evaluation of Helix

- Helix slope deviation $f_{HB}$
- Tooth crowning $C_β$
- Mean helix slope deviation $f_{HBm}$
- Mean tooth crowning $C_β$
Evaluation of Runout and Pitch

- cumulative pitch deviation $F_p$
- individual pitch deviation $f_p$
- adjacent pitch deviation $f_u$
- variance of pitch deviation $R_p$
- radial runout $F_r$
- Dimension over balls
- Span over $n$ teeth
- Tooth thickness
- Elimination of eccentricity
Quindos SHAPER - Shaper Cutter

Inspection of spur and helical shaper cutters according to DIN 1829.

The cutting face can be conical or stepped.

**Following evaluations are considered**
- axial runout of cutting face
- radial runout at OD
- tooth thickness
- rake angle, clearance angle
- helix angle
- pitch and runout (fp, Fp, fu, Rp, Fr)
- dimension over balls
- profile \( (f_{H\alpha}, F_{\alpha}, f_{f\alpha}) \)
- helix \( (f_{H\beta}, F_{\beta}, f_{f\beta}) \)
Quindos STEPGR – Step Gears

Cam Bodies of any size and shape

Input: Transmission Law and a few basic parameters
Quindos STEPGR – Step Gear Evaluation

Surface Form Evaluation

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Quindos SCRCMP- Screw Compressor

Complete measurement on a pallet

QUINDOS:
Pairing of Rotors

Stand off

Clearance distance
Quindos SCRCMP - Screw Compressor

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Quindos Camshaft- Camshafts & Complementary CAMS

PowerTrain Solutions

Fully automatic inspection
Of up to 24 Camshafts
On 1 fixture!

Complementary Cams
**Quindos Curvic Coupling**

Toothed gears used for accurate mating & centering of rotating parts. Application: Turbine rotors, Crankshafts

The Quindos Curvic Coupling option can be used to calibrate Curvic Coupling gauges used to check Curvic Coupling parts. The actual geometry is compared to the theoretical geometry in order to determine the pairing characteristics of the Curvic Coupling.

**Features:**
- Axial runout of the tooth face
- Runout of the outside surface of the coupling.
- Pitch of the tooth flanks
- Topography of the tooth flanks
- Simulated pairing with a Curvic coupling master part
- Contact pattern measurement of paring Simulation with CC-Master
Quindos Curvic Coupling – Evaluation

Curvic coupling master model generated in QUINDOS using the curvic coupling data and Quindos CAD

Topography measurement & results representation on the CAD model.
Quindos Curvic Coupling - Evaluation

Topography measurement & contact representation

Sweep scanning of the topography is used to determine the contact pattern of the CC to be checked.

All of the flanks are measured in order to determine a true representation of the pairing quality of the curvic coupling with a master coupling. The result of the pairing is the eccentricity, axial runout & radial runout & pairing quality.
Ultimate Blade

- 2D Visualization and interactive evaluation tool for turbine profiles;
- Parameters can be defined interactive and saved for the CNC mode
Ultimate Blade
Ultimate Blade

Automatic edge radius recognition.
Ultimate Blade—Automatic path correction
Impeller
Impeller

PowerTrain Solutions