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File

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RACK ANALYSIS (CYLINDRICAL GEAR)

Drawing or article number:

Gear 1: 0.000.0
 Gear 2: 0.000.0

Calculation method Plastic according to VDI 2545:1981-modified (YF Method C)
 Steel wheels: calculated roughly according to DIN 3990!

---- Pinion ----- Rack -

Power (W)	[P]	7.201
Speed (1/min)	[n]	191.0
Torque (Nm)	[T]	0.360
Application factor	[KA]	1.25
Required service life (h)	[H]	1000.00
Gear driving (+) / driven (-)		+ -
Working flank gear 1: Right flank		
Sense of rotation gear 1 clockwise		
Gearbox type: Gear with partly closed housing		

1. TOOTH GEOMETRY AND MATERIAL

(geometry calculation according to DIN 3960:1987)

---- Pinion ----- Rack -

Running center distance (mm)	[a]	29.000
Center distance tolerance	No backlash	
Rack height (mm)	[Hz]	15.000
Normal module (mm)	[mn]	1.0000
Pressure angle at normal section (°)	[alfn]	20.0000
Helix angle at reference circle (°)	[beta]	0.0000
Number of teeth	[z]	30 254.6480
Rack length (mm)	[l]	800.000
Facewidth (mm)	[b]	15.00 15.00
Hand of gear	Spur gear	
Accuracy grade	[Q-DIN3961:1978]	6 6
Inner diameter (mm)	[di]	8.00
Inner diameter of gear rim (mm)	[dbi]	0.00

Material

Gear 1: POM (VDI2736), Thermoplastic (POM, PPA, etc.), untreated
 VDI2736/VDI2545 [S B F Wd C]
 Woehler line tooth root stress from file Z014-POM_VDI2736.DAT
 S-N curve (Woehler line) Hertzian pressure from file Z014-POM_VDI2736.DAT

Gear 2: C45 (1), Through hardened steel, unalloyed, through hardened
 ISO 6336-5 Figure 5/6 (MQ)

----- GEAR 1 ----- GEAR 2 --

Surface hardness		HBW 0	HBW 186
Tooth root temperature (°C)	[TR]	70.0	70.0

Flank temperature (°C)	[TF]	70.0	70.0
Tooth root strength at NL (N/mm ²)	[σFadm]	29.10	238.74
Strength against Hertzian pressure at NL (N/mm ²)	[σHadm]	28.80	709.62
Tensile strength (N/mm ²)	[σB]	45.20	700.00
Yield point (N/mm ²)	[σS]	41.00	490.00
Young's modulus (N/mm ²)	[E]	2217	206000
Poisson's ratio	[ν]	0.440	0.300
Roughness average value DS, flank (μm)	[RAH]	0.00	1.05
Roughness average value DS, root (μm)	[RAF]	0.00	3.00
Mean roughness height, Rz, flank (μm)	[RZH]	0.00	8.00
Mean roughness height, Rz, root (μm)	[RZF]	0.00	20.00

Gear reference profile 1 :

Reference profile	1.25 / 0.38 / 1.0 ISO 53:1998 Profil A		
Dedendum coefficient	[hfP*]		1.250
Root radius factor	[rhofP*]		0.380 (rhofPmax*=0.472)
Addendum coefficient	[haP*]		1.000
Tip radius factor	[rhoaP*]		0.000
Protuberance height coefficient	[hprP*]		0.000
Protuberance angle	[alfprP]		0.000
Tip form height coefficient	[hFaP*]		0.000
Ramp angle	[alfKP]		0.000

not topping

Gear reference profile 2 :

Reference profile	1.25 / 0.38 / 1.0 ISO 53:1998 Profil A		
Dedendum coefficient	[hfP*]		1.250
Root radius factor	[rhofP*]		0.380 (rhofPmax*=0.472)
Addendum coefficient	[haP*]		1.000
Tip radius factor	[rhoaP*]		0.000
Protuberance height coefficient	[hprP*]		0.000
Protuberance angle	[alfprP]		0.000
Tip form height coefficient	[hFaP*]		0.000
Ramp angle	[alfKP]		0.000

not topping

Summary of reference profile gears:

Dedendum reference profile	[hfP*]	1.250	1.250
Tooth root radius Refer. profile	[rofP*]	0.380	0.380
Addendum Reference profile	[haP*]	1.000	1.000
Protuberance height coefficient	[hprP*]	0.000	0.000
Protuberance angle (°)	[alfprP]	0.000	0.000
Tip form height coefficient	[hFaP*]	0.000	0.000
Ramp angle (°)	[alfKP]	0.000	0.000

Type of profile modification: none (only running-in)

Tip relief (μm)	[Ca]	20.4	10.7
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Lubrication type Dry-running

Ambient temperature (°C)	[TU]	20.000	
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---- Pinion ----- Rack -

Transverse module (mm)	[mt]	1.000	
Pressure angle at pitch circle (°)	[alf]	20.000	
Working transverse pressure angle (°)	[alfwt]	20.000	
Working pressure angle at normal section (°)	[alfwn]	20.000	
Helix angle at operating pitch circle (°)	[betaw]	0.000	

Base helix angle (°)	[betab]		0.000	
Sum of profile shift coefficients	[Summexi]		0.0000	
Profile shift coefficient	[x]	0.0000		0.0000
Tooth thickness (Arc) (module) (module)	[sn*]	1.5708		1.5708
Tip alteration (mm)	[k*mn]	0.000		0.000
Reference diameter (mm)	[d]	30.000		14.000
Base diameter (mm)	[db]	28.191		
Tip diameter (mm)	[da,HZ]	32.000		15.000
(mm)	[da,HZ.e/i]	32.000 / 31.975		15.002 / 15.000
Tip diameter allowances (mm)	[Ada,AHZ.e/i]	0.000 / -0.025		0.002 / -0.000
Tip form diameter (mm)	[dFa]	32.000		15.000
(mm)	[dFa.e/i]	32.000 / 31.975		15.002 / 15.000
Active tip diameter (mm)	[dNa.e/i]	32.000 / 31.975		15.002 / 15.000
Operating pitch diameter (mm)	[dw]	30.000		14.000
Root diameter (mm)	[df]	27.500		12.750
Generating Profile shift coefficient	[xE.e/i]	-0.0742 / -0.1154		-0.0893 / -0.1305
Generated root diameter with xE (mm)	[df.e/i]	27.352 / 27.269		12.661 / 12.619
Theoretical tip clearance (mm)	[c]	0.250		0.250
Effective tip clearance (mm)	[c.e/i]	0.393/ 0.339		0.365/ 0.322
Active root diameter (mm)	[dNf]	28.532		13.163
(mm)	[dNf.e/i]	28.532 / 28.530		13.173 / 13.163
Root form diameter (mm)	[dFf]	28.534		13.087
(mm)	[dFf.e/i]	28.470 / 28.438		12.997 / 12.956
Reserve (dNf-dFf)/2 (mm)	[cF.e/i]	0.047 / 0.030		0.217 / 0.166
Addendum (mm)	[ha = mn * (haP*+x)]		1.000	1.000
(mm)	[ha.e/i]	1.000 / 0.988		1.002 / 1.000
Dedendum (mm)	[hf = mn * (hfP*-x)]		1.250	1.250
(mm)	[hf.e/i]	1.324 / 1.365		1.339 / 1.381
Roll angle at dFa (°)	[xsi_dFa.e/i]	30.775 / 30.668		
Roll angle to dNa (°)	[xsi_dNa.e/i]	30.775 / 30.668		
Roll angle to dNf (°)	[xsi_dNf.e/i]	8.939 / 8.915		
Roll angle at dFf (°)	[xsi_dFf.e/i]	8.088 / 7.598		
Tooth height (mm)	[h]	2.250		2.250
Virtual gear no. of teeth	[zn]	30.000		
Normal tooth thickness at tip circle (mm)	[san]	0.737		0.843
(mm)	[san.e/i]	0.693 / 0.648		0.778 / 0.746
Normal space width at root circle (mm)	[efn]	0.000		0.661
(mm)	[efn.e/i]	0.000 / 0.000		0.596 / 0.566
Max. sliding velocity at tip (m/s)	[vga]	0.048		0.058
Specific sliding at the tip	[zetaa]	0.319		0.569
Specific sliding at the root	[zetaf]	-1.320		-0.469
Sliding factor on tip	[Kga]	0.161		0.193
Sliding factor on root	[Kgf]	-0.193		-0.161
Pitch on reference circle (mm)	[pt]		3.142	
Base pitch (mm)	[pbt]		2.952	
Transverse pitch on contact-path (mm)	[pet]		2.952	
Length of path of contact (mm)	[ga, e/i]	5.372 (	5.378/	5.345)
Length T1-A (mm)	[T1A]	2.199 (	2.193/	2.199)
Length T1-B (mm)	[T1B]	4.619 (	4.619/	4.592)
Length T1-C (mm)	[T1C]	5.130 (	5.130/	5.130)
Length T1-D (mm)	[T1D]	5.151 (	5.145/	5.151)
Length T1-E (mm)	[T1E]	7.571 (	7.571/	7.545)
Diameter of single contact point B (mm)	[d-B]	29.666 (	29.666/	29.649)
Diameter of single contact point D (mm)	[d-D]	30.014 (	30.010/	30.014)
Transverse contact ratio	[eps_a]		1.820	
Transverse contact ratio with allowances	[eps_a.e/m/i]	1.822 /	1.816 /	1.811

Overlap ratio	[eps_b]	0.000
Total contact ratio	[eps_g]	1.820
Total contact ratio with allowances	[eps_g.e/m/i]	1.822 / 1.816 / 1.811

2. FACTORS OF GENERAL INFLUENCE

		---- Pinion -----	Rack -
Nominal circum. force at pitch circle (N)	[Ft]	24.0	
Axial force (N)	[Fa]	0.0	
Radial force (N)	[Fr]	8.7	
Normal force (N)	[Fnorm]	25.5	
Nominal circumferential force per mm (N/mm)	[w]	1.60	
Only as information: Forces at operating pitch circle:			
Nominal circumferential force (N)	[Ftw]	24.0	
Axial force (N)	[Faw]	0.0	
Radial force (N)	[Frw]	8.7	
Circumferential speed reference circle (m/s)	[v]	0.30	
Circumferential speed operating pitch circle (m/s)	[v(dw)]	0.30	
Correction factor	[CM]	0.800	
Gear blank factor	[CR]	1.000	
Basic rack factor	[CBS]	0.975	
Material coefficient	[E/Est]	0.021	
Singular tooth stiffness (N/mm/μm)	[c']	0.317	
Meshing stiffness (N/mm/μm)	[cg]	0.512	
Dynamic factor	[KV]	1.000	
User specified factor KHb:			
Face load factor - flank	[KHb]	1.000	
- Tooth root	[KFb]	1.000	
- Scuffing	[KBb]	1.000	
Transverse load factor - flank	[KH _a]	1.000	
- Tooth root	[KF _a]	1.000	
- Scuffing	[KB _a]	1.000	
Number of load cycles (in mio.)	[NL]	11.460	1.350
Rack length (mm)	[l]		800.000

3. TOOTH ROOT STRENGTH

Calculation of Tooth form coefficients according method: C

		---- Pinion -----	Rack -
Calculated with manufacturing profile shift	[xE.e]	-0.0742	-0.0893
Tooth form factor	[YF]	2.72	2.15
Stress correction factor	[YS]	1.57	1.94
Load application angle (°)	[alfFn]	27.02	20.00
Bending moment arm (mm)	[hF]	1.98	2.00
Tooth thickness at root (mm)	[sFn]	2.03	2.36
Tooth root radius (mm)	[roF]	0.57	0.38
(hF* = 1.977/ 1.998 sFn* = 2.033/ 2.359 roF* = 0.574/ 0.380)			
(den/hen (mm) =			
32.000/ 15.000 dsFn/hsFn(mm) = 27.767/ 12.849 alfsFn(°) = 30.00/ 30.00 qs = 1.772/ 3.104)			

Contact ratio factor	[Yeps]		0.550	
Helix angle factor	[Ybet]		1.000	
Effective facewidth (mm)	[beff]	15.00		15.00
Nominal stress at tooth root (N/mm ²)	[sigF0]	3.77		4.42
Tooth root stress (N/mm ²)	[sigF]	4.71		5.53
Permissible bending stress at root from data tables				
Notch sensitivity factor	[YdreIT]	1.000		1.040
Surface factor	[YRrelT]	1.000		0.963
size factor (Tooth root)	[YX]	1.000		1.000
Notice: When using Wohler lines from data files, the factors YdreIT, YRrelT, YX will be interpolated according to the breakpoints NLstatic and NLendurance following ISO.				
Finite life factor	[YNT]	1.000		1.137
	[YdreIT*YRrelT*YX*YNT]	1.000		1.138
Alternating bending factor (mean stress influence coefficient)	[YM]	1.000		1.000
Stress correction factor	[Yst]		2.00	
Yst*sigFlim (N/mm ²)	[sigFE]	58.20		420.00
Permissible tooth root stress (N/mm ²)	[sigFP=sigFG/SFmin]	48.50		398.44
Limit strength tooth root (N/mm ²)	[sigFG]	58.20		478.13
Required safety	[SFmin]	1.20		1.20
Safety for tooth root stress	[SF=sigFG/sigF]	12.36		86.50
Transmittable power (W)	[WRating]	74.17		519.02

4. SAFETY AGAINST PITTING (TOOTH FLANK)

				---- Pinion ----- Rack -
Zone factor	[ZH]		2.495	
Elasticity factor ($\sqrt{N/mm^2}$)	[ZE]		29.404	
Contact ratio factor	[Zeps]		0.853	
Helix angle factor	[Zbet]		1.000	
Effective facewidth (mm)	[beff]		15.00	
Nominal contact stress (N/mm ²)	[sigH0]		14.37	
Contact stress at operating pitch circle (N/mm ²)	[sigHw]		16.06	
Lubrication coefficient at NL	[ZL]	1.000		1.016
Speed coefficient at NL	[ZV]	1.000		0.947
Roughness coefficient at NL	[ZR]	1.000		1.000
Material pairing coefficient at NL	[ZW]	1.000		1.000
Notice: When using Wohler lines from data files, the factors ZL, ZV, ZR, ZW will be interpolated according to the breakpoints NLstatic and NLendurance following ISO.				
Finite life factor	[ZNT]	1.000		1.314
	[ZL*ZV*ZR*ZNT]	1.000		1.264
Limited pitting is permitted:	No			
Size factor (flank)	[ZX]	1.000		1.000
Permissible contact stress (N/mm ²)	[sigHP=sigHG/SHmin]	32.00		758.67
Pitting stress limit (N/mm ²)	[sigHG]	28.80		682.81
Required safety	[SHmin]	0.90		0.90
Safety factor for contact stress at operating pitch circle				
	[SHw]	1.79		42.50
Transmittable power (W)	[WRating]	14.34		16059.50

4a. WEAR

Line load at reference diameter (N/mm)	[w]		1.60
Line load at reference diameter (N/mm)	[KA*KV*KHβ*KHα*w]		2.00

Loss factor	[HV]	0.088
Calculation only for Gear 1		
Length of active flank (mm)	[lF]	1.86
Wear factor (mm ³ /Nm/10 ⁶)	[k _w]	3.40000
Data from file	k _w : Z014-POM_VDI2736.DAT	
Normal tooth thickness in pitch circle (mm)	[s _n]	1.57
Maximum permissible wear (%)	[W _{limit}]	15.00
Permissible wear on flank (mm)	[δW _{limn}]	0.24
Wear removal (mm)	[δW _n]	0.01158
Wear removal (mg)	[=lFL*b*z*ro*δW _n]	13.8
Required safety	[S _{Wmin}]	1.10
Safety against wear	[S _W]	20.34

Calculation for safety against shearing for plastics

Normal tooth thickness in the active root diameter (mm)	[s _{dNr} -δW _n]	1.82
Shear stress (N/mm ²)	[τ _{nom}]	0.88
Notch effect coefficient	[K _τ]	1.25
Permitted shearing strength (N/mm ²)	[τ _B]	16.21
Required safety	[S _{τmin}]	2.50
Safety shearing	[S _τ]	14.76

$$\tau_B = 0.557 * \sigma_{Fadm}; \quad S_{\tau} = \tau_B / (\tau_{nom} * K_{\tau})$$

Calculation of local wear with speeds and load distribution according to method A:

Calculation was not carried out. (Contact analysis under load is required.)

Important note:

the k_w wear coefficients are usually determined using a plastic/steel pairing..

The coefficients may be very different if pairings of other materials are used..

This calculation is designed to give an indication of possible service life,

however it has not yet been checked exhaustively in real life..

The wear for fiber-reinforced plastics depends highly on the length of the fibers in the material!

5. BENDING

According to VDI2545:1981

Tooth deformation (μm)	[fa]	7.477
Permissible tooth deformation (μm)	[fazul]	100.000
Required safety	[S _{del}]	1.000
Safety against deformation	[S _{delmin}]	13.375

Experimental method using tooth stiffness according ISO6336:2006:

Tooth deformation (μm)	[faExp]	7.497	0.080
Permissible tooth deformation (μm)	[fazulExp]	121.938	121.938
Required safety	[S _{del}]	1.000	
Safety against jamming	[S _{delExp}]	16.264	1517.374

6. MEASUREMENTS FOR TOOTH THICKNESS

		---- Pinion ----- Rack -
		DIN 3967 cd25 DIN 3967 c25
Tooth thickness tolerance		
Tooth thickness allowance (normal section) (mm)	[As.e/i]	-0.054 / -0.084 -0.065 / -0.095
Number of teeth spanned	[k]	4.000
(Internal toothing: k = (Measurement gap number)		

Base tangent length (no backlash) (mm)	[Wk]	10.753		
Actual base tangent length (span) (mm)	[Wk.e/i]	10.702 /	10.674	
(mm)	[ΔWk.e/i]	-0.051 /	-0.079	
Diameter of measuring circle (mm)	[dMWk.m]	30.149		
Theoretical diameter of ball/pin (mm)	[DM]	1.706		1.944
Effective diameter of ball/pin (mm)	[DMeff]	1.750		2.000
Radial single-ball measurement backlash free (mm)	[MrK]	16.244		15.766
Radial single-ball measurement (mm)	[MrK.e/i]	16.179 /	16.143	15.677 / 15.635
Diameter of measuring circle (mm)	[dMMr.m]	29.939		
Diametral measurement over two balls without clearance (mm)	[MdK]	32.488		
Diametral two ball measure (mm)	[MdK.e/i]	32.359 /	32.286	
Diametral measurement over pins without clearance (mm)	[MdR]	32.488		
Measurement over pins according to DIN 3960 (mm)	[MdR.e/i]	32.359 /	32.286	
Measurement over 3 pins (axial) according to AGMA 2002 (mm)	[dk3A.e/i]	32.359 /	32.286	
Chordal tooth thickness (no backlash) (mm)	[sc]	1.570		1.571
Actual chordal tooth thickness (mm)	[sc.e/i]	1.516 /	1.486	1.506 / 1.476
Reference chordal height from da.m (mm)	[ha]	1.014		1.001
Tooth thickness (Arc) (mm)	[sn]	1.571		1.571
(mm)	[sn.e/i]	1.517 /	1.487	1.506 / 1.476
Backlash free center distance (mm)	[aControl.e/i]	28.837 /	28.754	
Backlash free center distance, allowances (mm)	[jta]	-0.163 /	-0.246	
Tip clearance (mm)	[c0.i(aControl)]	0.094		0.076
Center distance allowances (mm)	[Aa.e/i]	0.000 /	0.000	
Circumferential backlash from Aa (mm)	[jtw_Aa.e/i]	0.000 /	0.000	
Radial backlash (mm)	[jrw.e/i]	0.246 /	0.163	
Circumferential backlash (transverse section) (mm)	[jtw.e/i]	0.179 /	0.119	
Normal backlash (mm)	[jn.e/i]	0.168 /	0.112	
Torsional angle for fixed rack:				
Entire torsional angle (°)	[j.tSys]			0.0068/0.0045

7. GEAR ACCURACY

---- Pinion ----- Rack -

According to DIN 3961:1978

Accuracy grade	[Q-DIN3961]	6	6
Profile form deviation (μm)	[ff]	6.00	6.00
Profile slope deviation (μm)	[fHa]	5.00	5.00
Total profile deviation (μm)	[Ff]	8.00	8.00
Helix form deviation (μm)	[fbf]	4.00	4.00
Helix slope deviation (μm)	[fHb]	8.00	8.00
Total helix deviation (μm)	[Fb]	9.00	9.00
Normal base pitch deviation (μm)	[fpe]	7.00	7.00
Single pitch deviation (μm)	[fp]	7.00	7.00
Adjacent pitch difference (μm)	[fu]	8.00	8.00
Total cumulative pitch deviation (μm)	[Fp]	19.00	19.00
Sector pitch deviation over z/8 pitches (μm)	[Fpz/8]	12.00	12.00
Runout (μm)	[Fr]	14.00	14.00
Tooth Thickness Variation (μm)	[Rs]	8.00	8.00
Single flank composite, total (μm)	[F'i]	22.00	22.00
Single flank composite, tooth-to-tooth (μm)	[f'i]	10.00	10.00
Radial composite, total (μm)	[F''i]	17.00	17.00
Radial composite, tooth-to-tooth (μm)	[f''i]	6.00	6.00

According to DIN 58405:1972 (Feinwerktechnik):

Tooth-to-tooth composite error (µm)	[fi"]	7.00	7.00
Composite error (µm)	[Fi"]	20.00	20.00
Axis alignment error (µm)	[fp]	4.93	4.93
Flank direction error (µm)	[fbeta]	5.00	5.00
Runout (µm)	[Trk, Fr]	21.00	21.00

(Tolerances of rack following DIN 3961:1978 mit der Zähnezah und dem Teilkreis des Ritzels berechnet)

Axis alignment tolerances (recommendation acc. to ISO TR 10064-3:1996, Quality

6)

Maximum value for deviation error of axis (µm)	[fSigbet]	17.00 (Fb= 17.00)
Maximum value for inclination error of axes (µm)	[fSigdel]	34.00

8. ADDITIONAL DATA

Exponent kappa (temperature calculation)	[ExpKappa]	0.400	
Coefficient of friction	[mum]	0.240	
Loss factor	[HV]	0.088	
Coefficient for frequency of running	[KstEDf]	1.000	
Casing surface (m²)	[Oberflache]	41.31000	
Gear power loss (W)	[PVZ]	0.152	
(Meshing efficiency (%)	[etaz]	97.886)	
Tooth root temperature (°C)	[TR]	70.0	70.0
Flank temperature (°C)	[TF]	70.0	70.0

9. MODIFICATIONS AND TOOTH FORM DEFINITION

Data for the tooth form calculation :

Data not available.

Please run the calculation in the "Tooth form" tab and open the main report again.

10. SERVICE LIFE, DAMAGE

Required safety for tooth root	[SFmin]	1.20
Required safety for tooth flank	[SHmin]	0.90
Required safety for wear	[SWmin]	1.10

Service life (calculated with required safeties):

System service life (h)	[Hatt]	18491
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Tooth root service life (h)	[HFatt]	1e+006	1e+006
Tooth flank service life (h)	[HHatt]	1e+006	1e+006
Wear service life (h)	[HWatt]	1.849e+004	1e+006

Note: The entry 1e+006 h means that the Service life > 1,000,000 h.

Damage calculated on the basis of the required service life [H] (1000.0 h)

F1%	F2%	H1%	H2%	W1%	W2%
0.00	0.0000	0.0947	0.0000	5.4082	0.0000

Damage calculated on basis of system service life [Hatt] (18490.5 h)

F1%	F2%	H1%	H2%	W1%	W2%
0.00	0.0000	1.7518	0.0000	100.0000	0.0000

Calculation of the factors required to define reliability R(t) according to B. Bertsche with Weibull distribution; t in (h):

$$R(t) = 100 * \text{Exp}(-((t^{\text{fac}} - t_0)/(T - t_0))^b) \%$$

Gear		fac	b	t0	T	R(H)%
1	Tooth root	11460	1.7	9.654e+029	1.484e+030	100.00
1	Tooth flank	11460	1.3	1.09e+010	5.195e+010	100.00
2	Tooth root	1350	1.7	9.654e+029	1.484e+030	100.00
2	Tooth flank	1350	1.3	9.014e+029	4.295e+030	100.00

Reliability of the configuration for required service life (%) 100.00 (Bertsche)

REMARKS:

- Specifications with [e/i] imply: Maximum [e] and Minimal value [i] with consideration of all tolerances
Specifications with [m] imply: Mean value within tolerance
- For the backlash tolerance, the center distance tolerances and the tooth thickness deviation are taken into account. Shown is the maximal and the minimal backlash corresponding the largest resp. the smallest allowances
The calculation is done for the operating pitch circle.
- Calculation of steel/plastic pair:
the steel gear's strength is calculated approximately, according to DIN 3990, to obtain an indication of the service life..

End of Report

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