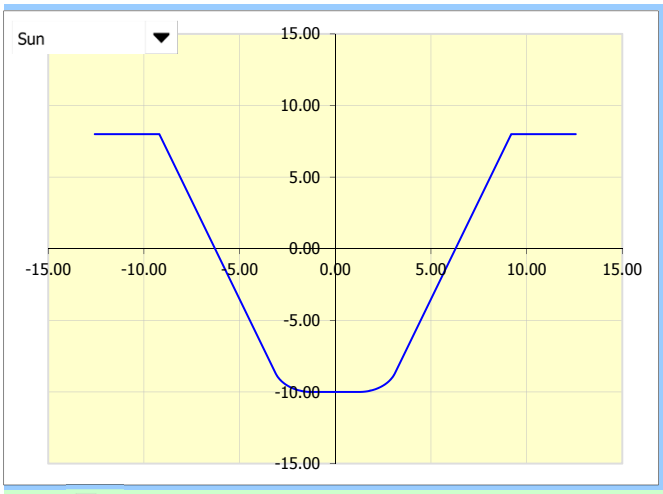
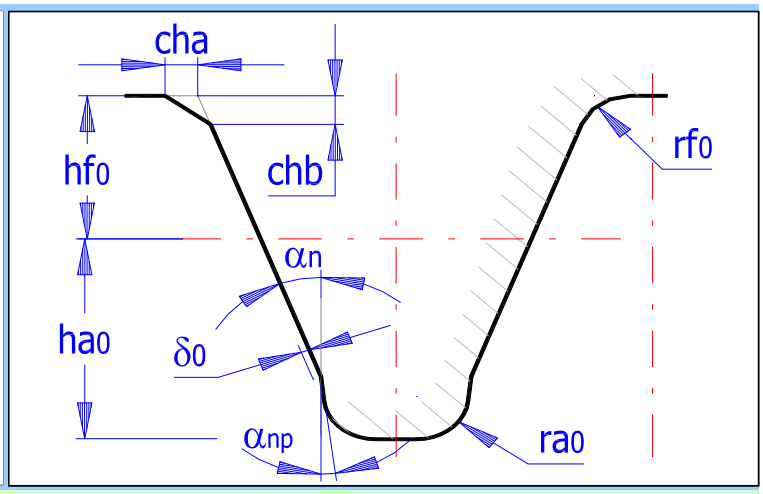
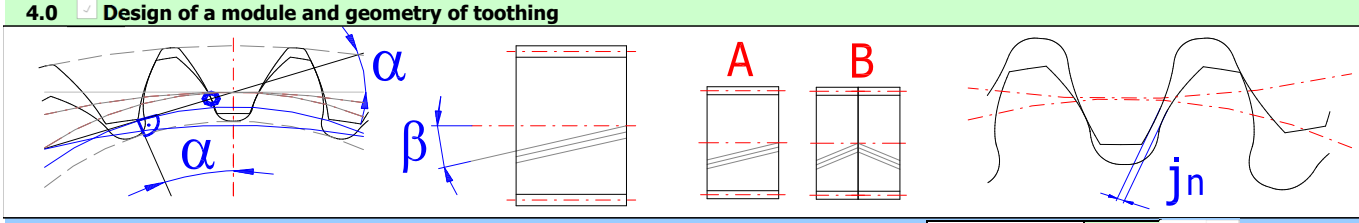
Planetary gearing

			Sun	Planet	Ring gear	
i	**Calculation without errors.**					
ii	**Project information**					
?	**Input section**					
1.0	**Options of basic input parameters**					
1.1	Calculation units		SI Units (N, mm, kW...)			
1.2	Transmission type (input/output)		Sun	=> Planet Carrier		
1.3	Transferred power	Pw [kW]	100.00	-100.00	0.00	
1.4	Speed (Sun, Planet Carrier, Ring Gear)	n	1000.00	**202.38**	0.00	[/min]
1.5	Requested speed for the: Planet Carrier	n	200.00	84.58 ~ 250		
1.6	Torsional moment (Sun, Planet Carrier, Ring Gear)	Mk	955.00	-4718.82	3763.82	[Nm]
1.7	Speed (Planet in Planet Carrier)	n		-542.38		[/min]
1.8	Transmission ratio z1/z0, z2/z1, (z2/z0)	i	1.471	-2.680	(-3.941)	
2.0	**Options of material, loading conditions, operational and production parameters**					
2.1	Material identification according standard :		ISO			
2.2	Material of the pinion :		D...Alloy structural steel 31 NiCr 14 (Rm=932 MPa) heat treated			
2.3	Material of the planet :		D...Alloy structural steel 31 NiCr 14 (Rm=932 MPa) heat treated			
2.4	Material of the ring gear :		D...Alloy structural steel 31 NiCr 14 (Rm=932 MPa) heat treated			
2.5	Loading of the gearbox, driving machine - examples		A...Continuous			
2.6	Loading of gearbox, driven machine - examples		A...Continuous			
2.7	Type of gearing mounting		Double-sided symmetrically supported gearing - type 1			
2.8	Accuracy grade - ISO1328 |Ra max|v max		6.....(Ra max.= 0.8 / v max.= 15)			
2.9	Desired service life	Lh	20000		[h]	
2.10	Coefficient of safety (contact/bend)	SH / SF	1.30	1.60		
2.11	Automatic design					
3.0	**Parameters of the cutting tool and tooth profile**					
3.1	Standardized tool		2. DIN 867 (a=20deg, ha0=1.25, hf0=1.0, ra0=0.25, d0=0deg, anp=0deg, ca=0.25)			
3.2	Addendum of tool	ha0*	1.2500	1.2500	1.2500	[modul]
3.3	Dedendum of tool	hf0*	1.0000	1.0000	1.2000	[modul]
3.4	Fillet radius of tool	ra0*	0.2500	0.2500	0.1500	[modul]
3.5	Root fillet radius of tool	rf0*	0.0000	0.0000	0.3800	[modul]
3.6	Chamfer of root	cha*	0.0000	0.0000	0.0000	[modul]
3.7	Chamfer of root	chb*	0.0000	0.0000	0.0000	[modul]
3.8	Protuberance hight	δ0*	0.0000	0.0000	0.0000	[modul]
3.9	Protuberance angle	αnp	0.0000	0.0000	0.0000	[°]
3.10	Min. unit head clearance	ca*min	0.2500	0.2500	0.1000	[modul]
3.11	Unit head clearance	ca*	0.2500	0.3000		[modul]
3.12	Unit head clearance	ca*		0.3000	0.2500	[modul]
3.13	Number of Teeth of the cutting tool	z0			25	
3.14	Addendum modification coefficient	x0*			0.00	[modul]
3.15	Tip diameter of the tool	da0			220.000	[mm]

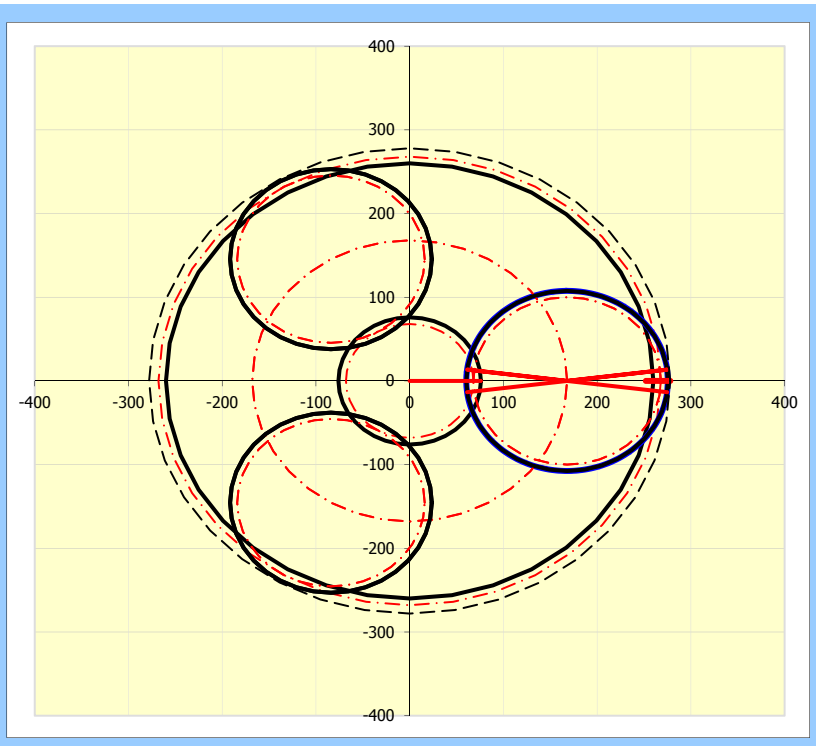


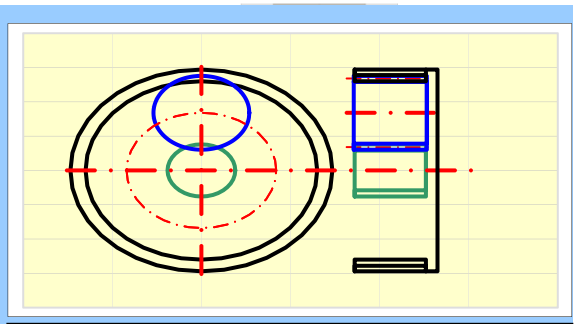


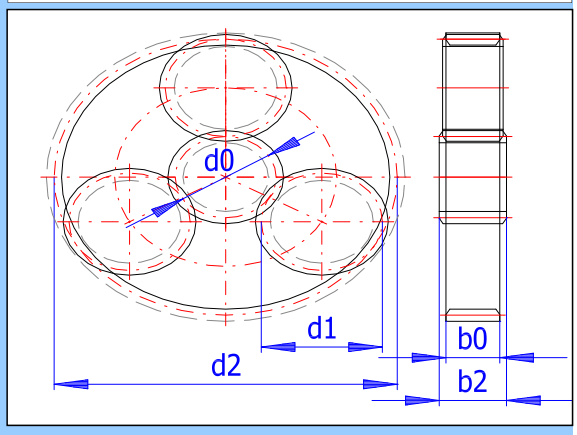
4.0 Design of a module and geometry of toothing



4.1	Number of Planets			3	<= 4 3	
4.2	Number of teeth - setting			Optimal (25)		
4.3	Number of teeth (Sun, Planet, Ring Gear)	z	17	25	-67	
4.4	Speed (Sun, Planet Carrier, Ring Gear)	n	1000.00	**202.38**	0.00	[/min]
4.5	Normal pressure angle	α		20.00		[°]
4.6	Helix angle	β		0.00		[°]
4.7	Setting of the ratio of the width of the sun to its diameter					
4.8	The ratio of the sun width to its diameter	$\psi_{d\ /\ max}$		1.18	< 1.4	
4.9	Module / Standardized value	mn		8.00	◉	[mm]
4.10	Diametral Pitch (Citrcular Pitch)	P		3.0000	○	
4.11	Reference diameter	d0/d1/d2	136.000	200.000	-536.000	[mm]
4.12	Recommended width of gearing			76 - 190		[mm]
4.13	Face width (Sun, Planet, Ring Gear)	b0/b1/b2	160.000	164.000	160.000	[mm]
4.14	Working face width	bw		160.000	160.000	[mm]
4.15	The ratio of the gear width to its diameter	ψ_d	1.18	0.82	0.30	
4.16	Working center distance	aw		168.000	-168.000	[mm]
4.17	Approximate weight of the gearing	m	17.758	3 * 31.37	103.783	[kg]
4.18	Minimum coefficient of safety	SH / SF		1.49	10.40	
4.19	Movement of gears (step and current angle)		1.00	0.00		[°]



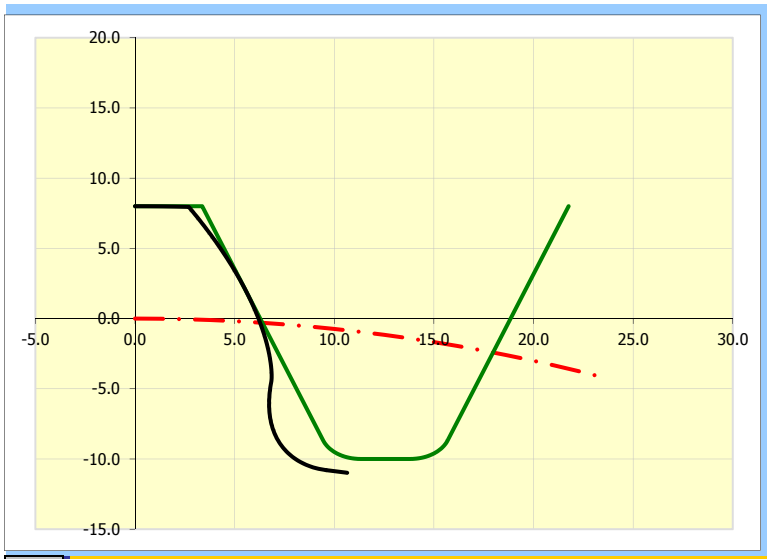


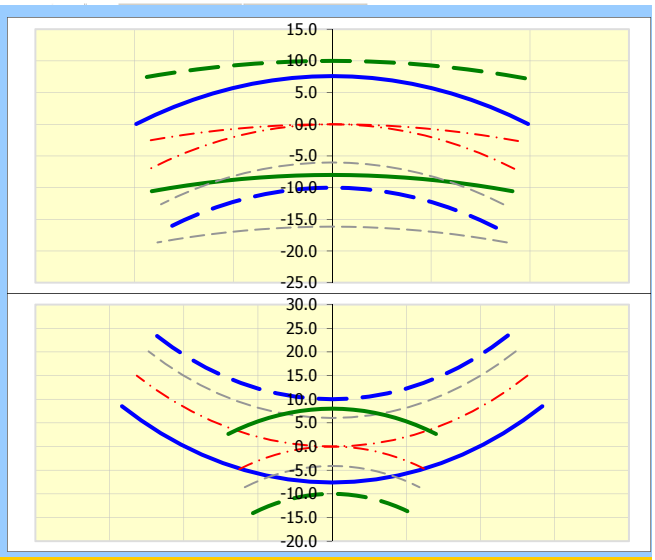


4.20	**Normal backlash**					
4.21	- Recommended min. | max. value		0.0778	0.3111		[mm]
4.22	- Selected normal backlash	jn	0.0000	0.0000		[mm]

5.0 Correction of toothing (Addendum modification)

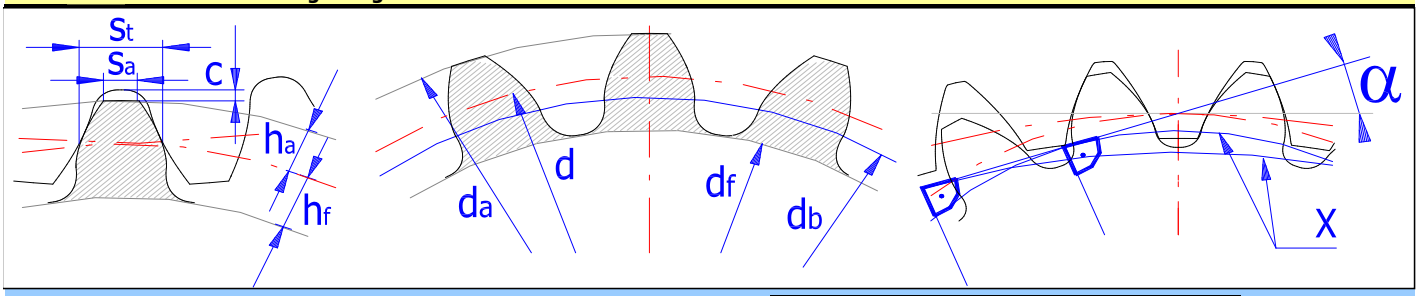
5.1	**Types**					
5.2	- Permissible undercutting of teeth (min. value)		-0.118	-0.400		[modul]
5.3	- Preventing undercutting of teeth (min. value)		0.118	-0.240		[modul]
5.4	- Prevents tapering of teeth (min. value)		0.407	-0.058		[modul]
5.5	Planet addendum modification coefficient setting					x1min >-1.0203
5.6	Addendum modification coefficient (Sun, Planet, Ring Gear)	x0,x1,x2	0.0000	0.0000	0.0000	
5.7	Sum of addendum modification coefficients - limit	Σx [modul]		>-0.8599	<0.8599	
5.8	Sum of addendum modification coefficients (x0+x1, x1+x2)	Σx [modul]		0.0000	0.0000	
5.9	Center distance (working)	aw [mm]		167.9999	-167.9999	
5.10	Required axis distance	aw [mm]	168.0000	160 ~ 176		
5.11	Transverse contact ratio	εα		1.5287	1.9156	
5.12	Total contact ratio	εγ		1.5287	1.9156	
5.13	Unit tooth thickness on the tip diameter	sa*	0.6741	0.7733	0.9076	[modul]
5.14	Specific sliding on tooth root	ϑA0/ϑE1	-6.0689	-2.7088		
5.15	Specific sliding on tooth tip	ϑE0/ϑA1	0.7304	0.8585		
5.16	Specific sliding on tooth root	ϑA1/ϑE2		-2.3606	-0.2785	
5.17	Specific sliding on tooth tip	ϑE1/ϑA2		0.2178	0.7024	
5.18	Sum of all specific slidings	Sum|ϑ|		10.3666	3.5594	Sum = 13.926
5.19	Safety coefficient for surface durability	SH	1.49	1.66	2.96	
5.20	Safety coefficient for bending durability	SF	16.74	10.40	10.70	
5.21	Display of tooth and tool turn for:		Sun		0	[°]





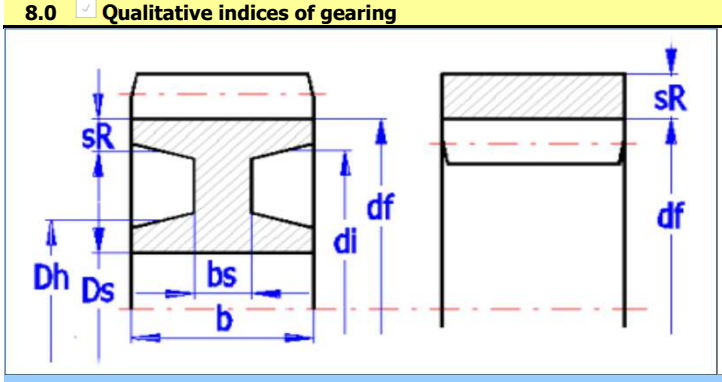
Results section

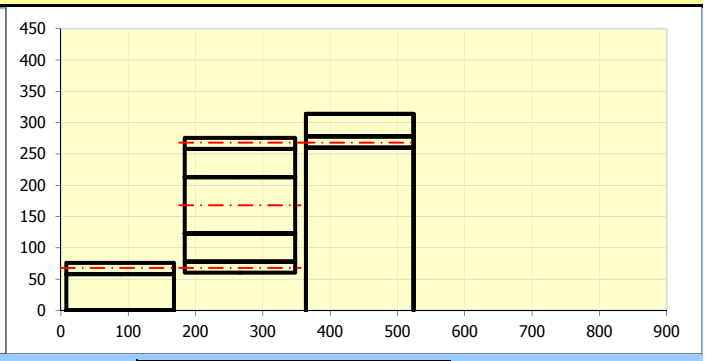
6.0 Basic dimensions of gearing



6.1	Number of teeth (Sun, Planet, Ring Gear)	z	17	25	-67	
6.2	Face width (Sun, Planet, Ring Gear)	b	160.0000	164.0000	160.0000	[mm]
6.3	Normal module	mn	8.0000	8.0000		[mm]
6.4	Transverse module	mt	8.0000	8.0000		[mm]
6.5	Circular pitch	p	25.1327	25.1327		[mm]
6.6	Transverse circular pitch	pt	25.1327	25.1327		[mm]
6.7	Base circular pitch	ptb	23.6171	23.6171		[mm]
6.8	Center distance (pitch)	a	168.0000	-168.0000		[mm]
6.9	Center distance (production)	av	168.0000	-168.0000		[mm]
6.10	Center distance (working)	aw	167.9999	-167.9999		[mm]
6.11	Pressure angle	α	20.0000	20.0000		[°]
6.12	Transverse pressure angle	αt	20.0000	20.0000		[°]
6.13	Pressure angle at the operating pitch cylinder	αwn	19.9999	19.9999		[°]
6.14	Transverse pressure angle at the operating pitch cylinder	αwt	19.9999	19.9999		[°]
6.15	Helix angle	β	0.0000	0.0000		[°]
6.16	Base helix angle	β b	0.0000	0.0000		[°]
6.17	Tip diameter	da	151.9999	215.2000	-519.9999	[mm]
6.18	Reference diameter	d	136.0000	200.0000	-536.0000	[mm]
6.19	Base diameter	db	127.7982	187.9385	-503.6752	[mm]
6.20	Root diameter	df	115.9999	180.0000	-555.9999	[mm]
6.21	Operating pitch diameter	dw	136.0000	199.9999		[mm]
6.22	Operating pitch diameter	dw		199.9999	-535.9998	[mm]
6.23	Addendum	ha	7.9999	7.6000	8.0001	[mm]
6.24	Dedendum	hf	10.0000	10.0000	10.0000	[mm]
6.25	Tooth thickness on the tip diameter	sna	5.3927	6.1861	7.2608	[mm]
6.26	Tooth thickness on the tip diameter (transverse)	sta	5.3927	6.1861	7.2608	[mm]
6.27	Tooth thickness on the pitch diameter	sn	12.5663	12.5664	12.5664	[mm]
6.28	Tooth thickness on the pitch diameter (transverse)	st	12.5663	12.5664	12.5664	[mm]
6.29	Tooth thickness on the root diameter	sb	12.4473	13.9925	21.5342	[mm]
6.30	Unit tooth thickness on the tip diameter	sa*	0.6741	0.7733	0.9076	[modul]
6.31	Unit head clearance	ca*	0.2500	0.3 / 0.3	0.2500	[modul]
6.32	Head clearance	ca	2.0000	2.4 / 2.4	2.0000	[mm]

6.33	Unit correction	ΔY		0.0000	0.0000		[modul]
6.34	Sum of addendum modification coefficients	Σx01/Σx12		0.0000	0.0000		[modul]
6.35	Addendum modification coefficient	x	0.0000	0.0000	0.0000		[modul]
6.36	**Achieve the requested tip diameter with change the unit head clearance ca* [3.11]**						
6.37	Unit head clearance	ca*	0.2500	0.3000	0.2500		[modul]
6.38	Tip diameter can be varied from-to	da min/max	148/152	212/216	-517.6/-524		[mm]
6.39	Requested tip diameter	da req	**161.290**	**171.450**	**-444.500**		
7.0	**Supplemental parameters of gearing**						
7.1	Number of teeth	z	17	25	-67		
7.2	Virtual number of teeth of a helical gear	zn	17.000	25.000	-67.000		
	Minimum number of teeth:						
7.3	- Permissible undercutting	zmin1	15	15	16		
7.4	- Without undercutting	zmin2	19	19	20		
7.5	- Without tapering	zmin3	24	24	26		
8.0	**Qualitative indices of gearing**						





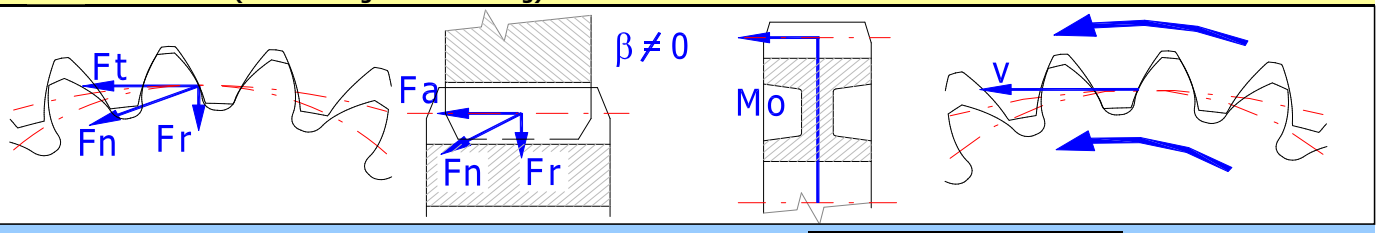
8.1	Transverse contact ratio	ε_α		1.5287	1.9156		
8.2	Transverse overlap ratio	ε_β		0.0000	0.0000		
8.3	Total contact ratio	$\varepsilon\gamma$		1.5287	1.9156		
8.4	**Definition of wheel dimensions**						
8.5	Coefficient of gear unloading (max)	di/df;(sR)	86.00%	91.00%	10.00		[%df,(h)]
8.6	Coefficient of gear unloading	di/df;(sR)	0.00%	50.00%	2.00		[%df,(h)]
8.7	Diameter of the hole in the wheel	Ds	0.000	90.000	(520)		[mm]
8.8	Gear rim thickness	sR	58.00	45.00	36.00		[mm]
8.9	Gear weight	m	17.76	31.37	103.78		[kg]
8.10	Relative individual gear mass per unit face width	m*	6.1010E-02	1.2766E-01	8.7422E-01		[kg/mm]
8.11	Moment of inertia	J	3.9858E-02	1.8487E-01	8.8712E+00		[kg*m²]
8.12	Moment of inertia per unit face width	J*	2.4911E+02	1.1272E+03	5.5445E+04		[kg*mm²/mm]
8.13	Reduced mass of gear set	mred		1.7542E-02	1.2766E-01		[kg/mm]
8.14	Peripheral speed on the pitch diameter	v | vmax		5.680	< 15		[m/s]
8.15	Tangential load per unit tooth width	wt		29.259	29.26		[N/mm]
8.16	Resonance speed	nE1,nE2		14364.35	4548.61		[/min]
8.17	Resonance ratio / lover limit	N1, N2 | NS	0.0555	0.1192	0.689		[/min]
8.18	Losses in the gearing	ζ		0.95%	0.66%		
8.19	Losses (gearing, bearings, total)	ζ	1.284	0.209	1.493		[kW]

9.0 Coefficients for safety calculation

9.1	**Setting the parameters for calculation**						
9.2	Dynamic factor KV (max. value)	KV_{max}	5.00	KV (B) ..2006			
9.3	Face load factor contact stress KHbeta (max. value)	$KH\beta_{max}$	5.00	Calculation ISO6336-1(2006)			
9.4	Reversals of the load (factor YA)		Without reversals (YA=1)				
9.5	Calculation of "Work hardening factor ZW"		Automatic				
9.6	Tooth profile modification (KHalfa, KHbeta)		Optimum profile modification				
9.7	Oil type (ZL)			Synthetic oil			
9.8	Used / Recomended lubricant viscosity	v50		86	86		[mm²/sec]
9.9	Tooth roughness (factor ZR)	Ra	Auto (0.8 µm)	Auto (0.8 µm)	Auto (0.8 µm)		[µm]
9.10	Roughness in the tooth root fillets (factor YR)	Ra	Auto (1.6 µm)	Auto (1.6 µm)	Auto (1.6 µm)		[µm]
9.11	**Common for the gearing**						
9.12	Theoretical single stiffness	c'_{th}		14.994	18.709		[N/(µm*mm)]
9.13	Stiffness of a tooth pair	c'		8.214	10.733		[N/(µm*mm)]
9.14	Meshing stiffness per unit face width	cγ		11.471	18.103		[N/(µm*mm)]
9.15	Application factor	KA		1.000			
9.16	Dynamic factor	KV		1.113	1.336		
9.17	Number of cycles	NK	2.87E+09	6.51E+08	7.29E+08		
9.18	**For pitting safety calculation**						
9.19	Face load factor (contact stress)	$K_{H\beta}$		1.994	2.522		
9.20	Transverse load factor (contact stress)	$K_{H\alpha}$		1.000	1.103		
9.21	Total factor of additional loads	KH		2.219	3.718		
9.22	Elasticity factor	ZE		189.81	189.81		
9.23	Zone factor	ZH		2.495	2.495		
9.24	Helix angle factor	Z_β		1.000	1.000		
9.25	Contact ratio factor	Z_ε		0.908	0.834		
9.26	Work hardening factor	ZW	1.000	1.000	1.000		
9.27	Lubricant factor	ZL		1.078	1.078		
9.28	Peripheral speed factor	ZV		0.968	0.968		
9.29	Roughness factor affecting surface durability	ZR		0.947	1.014		
9.30	Size factor	ZX		1.000	1.000		
9.31	Life factor for contact stress	ZNT	0.883	0.924	0.921	n=∞; ZNT=0.85	
9.32	Single pair tooth contact factor	ZB		1.066	1.123		
9.33	Single pair tooth contact factor	ZD		1.000	1.000		
9.34	**For bending safety calculation**						
9.35	Face load factor (root stress)	$K_{F\beta}$		1.847	2.275		
9.36	Transverse load factor (root stress)	$K_{F\alpha}$		1.000	1.103		
9.37	Total factor of additional loads	KF		2.055	3.354		
9.38	Helix angle factor	Y_β		1.000	1.000		
9.39	Rim thickness factor	YB	1.000	1.000	1.000		
9.40	Deep tooth factor	YDT		1.000	1.000		
9.41	Notch sensitivity factor	Y_δ	0.990	0.994	1.045		
9.42	Size factor	YX	0.982	0.982	0.982		
9.43	Tooth-root surface factor	YR	1.004	1.004	1.004		
9.44	Alternating load factor	YA	1.000	0.700	1.000		
9.45	Production technology factor	YT	1.000	1.000	1.000		
9.46	Life factor for bending stress	YNT	0.872	0.898	0.896	n=∞; YNT=0.85	
9.47	Stress correction factor	YST	1.000	1.000	1.000		
9.48	Form factor (bending)	YF	1.963	1.165	1.070		
9.49	Stress correction factor	YS	1.785	2.199	3.405		
9.50	Stress correction factor for gears with notches in fillets	YSg	2.043	2.575	4.290		

10.0	**Stress and safety coefficients**					
10.1	Safety coefficient for surface durability	SH (S-P)	**1.49**	**1.66**		
10.2	Safety coefficient for surface durability	SH (P-R)		**2.65**	**2.96**	
10.3	Safety coefficient for bending durability	SF (S-P)	**16.74**	**16.98**		
10.4	Safety coefficient for bending durability	SF (P-R)		**10.40**	**10.70**	
10.5	Nominal contact stress	SigmaH0		258.37	119.52	[MPa]
10.6	Contact stress	SigmaH	410.27	384.85		[MPa]
10.7	Contact stress			258.88	230.46	[MPa]
10.8	Pitting stress limit	SigmaHG	611.13	639.60		[MPa]
10.9	Pitting stress limit			684.99	682.63	[MPa]
10.10	Permissible contact stress	SigmaHP	470.10	492.00		[MPa]
10.11	Permissible contact stress			526.92	525.10	[MPa]
10.12	Nominal tooth-root stress	SigmaF0	12.81	9.14		[MPa]
10.13	Nominal tooth-root stress			9.14	13.32	[MPa]
10.14	Tooth-root stress	SigmaF	26.33	18.79		[MPa]
10.15	Tooth-root stress			30.67	44.67	[MPa]
10.16	Tooth-root stress limit	SigmaFG	440.73	319.08		[MPa]
10.17	Tooth-root stress limit			319.08	477.99	[MPa]
10.18	Permissible bending stress	SigmaFP	275.45	199.42		[MPa]
10.19	Permissible bending stress			199.42	298.74	[MPa]
11.0	**Check dimensions of gearing, ISO 1328 system of accuracy**					
11.1	**Check dimensions of gearing**					
11.2	Number of measured teeth	zw	3	4	7	
11.3	Number of measured teeth	zw	3	4	7	
11.4	Chordal dimension	W	60.9474	85.4608	184.6348	[mm]
11.5	Pin/Ball diameter	dt	14.0000	14.0000	14.0000	[mm]
11.6	Pin/Ball diameter	dt	14.0000	14.0000	14.0000	[mm]
11.7	Dimension over pins/balls	M	155.0273	219.4176	515.1116	[mm]
11.8	**Achieve the requested W and M with change the addendum modification coefficient x1 and sumX**					
11.9	Chordal dimension can be varied from-to	Wmin/max	60.3/69.16	83.27/93.67	176.4/190.1	[mm]
11.10	Requested chordal dimension	W req	67.0000	90.0000	185.0000	
11.11	Dimension over pins/balls can be varied from-to	Mmin/max	153.5/170.9	213.6/236.5	506.5/530.9	[mm]
11.12	Requested dimension over pins/balls	M req	160.0000	225.0000	520.0000	
11.13	**Cylindrical gears - ISO 1328 system of accuracy - Part 1**					
11.14	Accuracy grade	Q	6.....(Ra max.= 0.8 / v max.= 15)			
11.15	Module	mn	8.000			[mm]
11.16	Reference diameter	d	136.000	200.000	536.000	[mm]
11.17	Face width	b	160.000	164.000	160.000	[mm]
11.18	Total contact ratio	εγ		1.5287	1.9156	
11.19	Single pitch deviation	fpt	11.0	11.0	12.0	[µm]
11.20	Number of teeth for cumulative pitch deviation (1...z1,z2)	k	2	2	2	
11.21	Cumulative pitch deviation	Fpk	22.0	22.0	24.0	[µm]
11.22	Total cumulative pitch deviation	Fp	37.0	37.0	48.0	[µm]
11.23	Total profile deviation	Fα	18.0	18.0	20.0	[µm]
11.24	Total helix deviation	Fβ	17.0	20.0	18.0	[µm]
11.25	Tooth-to-tooth tangential composite deviation	f'i	25.0	22.0	24.0	[µm]
11.26	Total tangential composite deviation	F'i	63.0	59.0	72.0	[µm]
11.27	Profile form deviation	ffα	14.0	14.0	15.0	[µm]
11.28	Profile slope deviation	fHα	11.0	11.0	13.0	[µm]
11.29	Helix form deviation	ffβ	12.0	15.0	13.0	[µm]
11.30	Helix slope deviation	fHβ	12.0	15.0	13.0	[µm]
11.31	Cylindrical gears ISO1328 - 2 system of accuracy					
11.32	Tooth-to-tooth radial composite deviation	f''i	34.0	34.0	34.0	[µm]
11.33	Total radial composite deviation	F''i	64.0	64.0	73.0	[µm]
11.34	Run out tolerance	Fr	30.0	30.0	39.0	[µm]

12.0 Force conditions (forces acting on the toothing)



12.1	Tangential force	Ft		4681.37	-4681.37		[N]
12.2	Normal force	Fn		4981.81	4981.81		[N]
12.3	Axial force	Fa	0.00	0.00	0.00		[N]
12.4	Radial force	Fr		1703.88	-1703.88		[N]
12.5	Force planet carrier -> planet	Fc-p		9362.75			[N]
12.6	Centrifugal force on the planet	Fc		2101.80			[N]
12.7	Radial force on the bearing in planet	Fb		9595.76			[N]
12.8	Rated torque	Mk	318.33	468.14	1254.61		[Nm]
12.9	Rated rotational speed	n	797.6	-542.4	202.4		[/min]
12.10	Bending moment (planet gear)	Mo	0.00	0.00	0.00		[Nm]
12.11	Peripheral speed on the pitch diameter	v | vmax		5.680	< 15		[m/s]
12.12	Specific load	wt		29.259	29.26		[N/mm]
12.13	Unit load	wt*		3.66	3.66		[MPa]

13.0 Parameters of the chosen material

13.1	Density	Ro	7870.00	7870.00	7870.00	[kg/m^3]
13.2	Young's Modulus (Modulus of Elasticity)	E	206.00	206.00	206.00	[GPa]
13.3	Tensile Strength, Ultimate	Rm	932.00	932.00	932.00	[MPa]
13.4	Tensile Strength, Yield	Rp0.2	785.00	785.00	785.00	[MPa]
13.5	Poison's Ratio		0.30	0.30	0.30	
13.6	Contact Fatigue Limit	SHlim	700.00	700.00	700.00	[MPa]
13.7	Bending Fatigue Limit	SFlim	518.00	518.00	518.00	[MPa]
13.8	Tooth Hardness - Side	VHV	290	290	290	[HV]
13.9	Tooth Hardness - Core	JHV	290	290	290	[HV]
13.10	Base Number of Load Cycles in Contact	NHlim	5.00E+07	5.00E+07	5.00E+07	
13.11	Wohler Curve Exponent for Contact	qH	10	10	10	
13.12	Base Number of Load Cycles in Bend	NFlim	3.00E+06	3.00E+06	3.00E+06	
13.13	Wohler Curve Exponent for Bend	qF	6	6	6	
13.14	Abbreviation for material designation		V	V	V	

Additions section

14.0 Design of the exact transmission ratio

14.1	Number of teeth (Sun, Planet, Ring Gear)	z	17	25	-67	
14.2	Speed (Sun, Planet Carrier, Ring Gear)	n [/min]	1000.00	**202.38**	0.00	
14.3	Number of teeth from:	z	15	15		
14.4	Number of teeth to:	z	50	50		
14.5	Requested speed for the: Planet Carrier	n [/min]	200.00	-176.99 z0=40 z1=37 z2=-113		
14.6	Run calculation, transmitting values					

15.0 Preliminary design of shaft diameters (steel)

15.1	**Recommended shaft diameter for:**		A...Common structural steel (Rm = 500)			
15.2	- Main power-transmitting shafts	DA	77.50	131.20	121.80	[mm]
15.3	- Small, short shafts	DB	63.80	108.10	100.30	[mm]

16.0 Approximate module calculation from the existing gear

16.1	Number of teeth	z	24	35	96	
16.2	Tip diameter	da	0.000	0.000	0.000	[mm]
16.3	Distance between teeth edges	u	0.000	0.000	0.000	[mm]
16.4	Helix angle	β	10.00	10.00	10.00	[°]
16.5	Module of tooth	mn	0.000	0.000	0.000	[mm]

17.0 Auxiliary calculations, calculation KHbeta, calculation YSg

17.1 Definition of the factor KHbeta (method C)

17.2	Mean transverse tangential load at the reference circle	Fm	5208.925	6255.901		[N]
17.3	Shaft diameter (sun, planet)	dsh	81.00	148.00		[mm]
17.4	Gear type		Spur and single helical gears			
17.5	Constant of the sun position (with/without stiffening)	K'sun	-0.48	B. with stiffening		
17.6	Constant of the planet position (with/without stiffening)	K'pla	-0.48	B. with stiffening		
17.7	Pitch of bearings	l	229.6	229.6		[mm]
17.8	Center of pinion distance (s/l < 0.3)	s	0.0	0.0		[mm]
17.9	Component of equivalent misatignment (pinion)	fsh	1.0	0.6		[µm]
17.10	Component of equivalent misatignment (wheel)	fsh2	0.0	0.0		[µm]
17.11	Mesh misalignment	fma	19.1	19.5		[µm]
17.12	Deformation of the gear case	fca	0.0	0.0		[µm]
17.13	Displacements of the bearings	fbe	0.0	0.0		[µm]
17.14	Helix modification	B1,B2	5. Helix correction+central crowning			
17.15	Initial equivalent misalignment (before running-in)	Fβx	12.2	14.5	3. Favourable position of the contact patt	
17.16	Running-in allowance (equivalent misalignment)	yβ	5.6	6.6		[µm]
17.17	Effective equivalent misalignment (after running-in)	Fβy	6.6	7.9		[µm]
17.18	Face load factor (contact stress)	$K_{H\beta}$	**1.994**	**2.522**		

17.19 Stress correction factor for gears with notches in fillets YSg

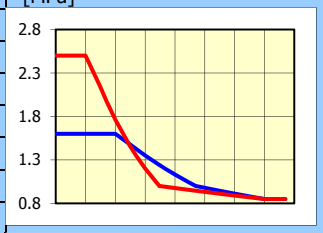
17.20	Maximum depth of grinding notch	tg	0.300	0.300	0.400	[mm]
17.21	Radius of grinding notch	rg	4.000	3.000	2.000	[mm]
17.22	Valid for ... (tg/rg)^0.5 < 2.0	$(tg/rg)^{0.5}$	0.274	0.316	0.447	
17.23	Stress correction factor for gears with notches in fillets	YSg	**2.043**	**2.575**	**4.290**	

18.0 Calculation of SHlim and SFlim based on ISO 6336-5, proposal of material properties

18.1 Material type

18.2 1. Normalized low carbon steels / cast steels (Wrought normalized low carbon steels) [St]

18.3	Requirements for material quality and heat treatment		MQ		
18.4	Surface hardness of calculated material (hardness range from - to)		160	HBW	110 - 210
18.5	Contact Fatigue Limit	SHlim	350.0	[MPa]	
18.6	Bending Fatigue Limit	SFlim	142.0	[MPa]	
18.7	Density	Ro	7870.0	[kg/m^3]	
18.8	Young's Modulus (Modulus of Elasticity)	E	206.0	[GPa]	
18.9	Tensile Strength, Ultimate	Rm	580.0	[MPa]	
18.10	Tensile Strength, Yield	Rp(0.2)	336.0	[MPa]	
18.11	Poison's Ratio		0.300		
18.12	Base Number of Load Cycles in Contact	NHlim	5.00E+07		
18.13	Wohler Curve Exponent for Contact	qH	13.00		
18.14	Maximum value	ZNT	1.60		
18.15	Base Number of Load Cycles in Bend	NFlim	3.00E+06		
18.16	Wohler Curve Exponent for Bend	qF	6.00		
18.17	Maximum value	YNT	2.50		



18.18	Abbreviation for material designation		St	St
18.19	Material name in the material table		Normalized low carbon steels / cast steels (Rm=580 [MPa])	
18.20	Transfer to a table of materials, to line number:		1	

19.0	**Graphical output, CAD systems**			
19.1	2D drawing output to:	DXF File		
19.2	2D Drawing scale	Automatic		
19.3	Detail:	Sun		
			β [°]...	30.00
19.4	**Detailed drawing of tooth and wheel**		a [modul]...	1.00
19.5	Number of drawn teeth	4		
19.6	Number of points of tooth tip	30		
19.7	Number of points of tooth flank	120		
19.8	Rolling (turning) of a tool between the bite	0.50	[°]	
19.9	Number of tooth copies in the picture of engagement check	12		
19.10	Turning of pinion during engagement check	0.50	[°]	
19.11	Gear angle	0.000	[°]	
19.12	**Text description (Information for BOM)**	**Sun**		
	Row 1 (BOM attribute 1)	Planet gear - Sun gear		
	Row 2 (BOM attribute 2)	z0=17, mn=8, beta=0		
	Row 3 (BOM attribute 3)	Material: 31 NiCr 14		
		Planet		
	Row 1 (BOM attribute 1)	Planet gear - Planet gear		
	Row 2 (BOM attribute 2)	z1=25, mn=8, beta=0		
	Row 3 (BOM attribute 3)	Material: T2(683/7-70)		
		Ring gear		
	Row 1 (BOM attribute 1)	Planet gear - Ring gear		
	Row 2 (BOM attribute 2)	z2=67, mn=8, beta=0		
	Row 3 (BOM attribute 3)	Material: 31 NiCr 14		
19.13	Table of parameters	Table of sun gear parameters		

Drawing without axes