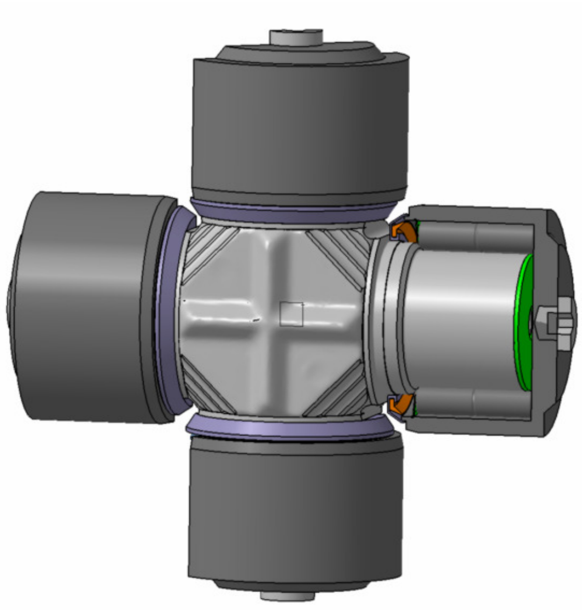
Sicit High Performance Universal Joints



In a typical Cardan joint, the yoke is the basic torque and motion input and output member, while the Universal Joint is the intermediate drive member which has four equally spaced trunnions with needle or roller bearing cups in the same plane. The ultimate strength of the UJ must be safely in excess of the maximum torque applied. The bearing configuration must have the dynamic capacity to transmit power for a required period of time at various torques, speed, and joint angles.

For a proper balanced-designed cardan shaft the Universal Joint should be the weakest component, and thus the quality of the Universal Joint is determining the operational life of the cardanshaft.

The majority of premature failure of cardanshafts, excluding misuse, is resulting due to an early breakdown of the UJ- for a variety of reasons. The service life is limited in case of an optimal lubrication by fatigue of the material after millions of operations, and on the other hand in case of inadequate sealing by corrosion and by abrasive wear as result of contamination.

A high quality UJ must consider all aspects and provide a sound solution and mixture of all features – for the benefits of a long cardan shaft service life.

Important to consider: the Universal joint as a major part of the cardan shaft is a precision component – it has to be seen through the eyes of a bearing manufacturer!

SICIT Universal Joints make this difference!

Cross body design and nominal strength

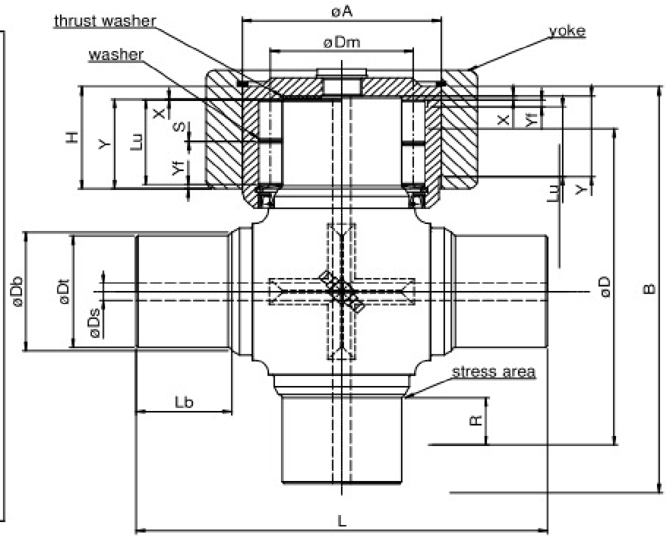
A well designed cross body geometry, with a focus on stress concentration areas in combination with a strong material creates a powerful Universal Joint. All round up with the accurate heat treatment and machining and the utilization of a high precision bearing cup leads to high performance rating capacity of a Sicit Universal Joint.

U.J. Rating Data

Article number: UJ.178.01.57x152-K

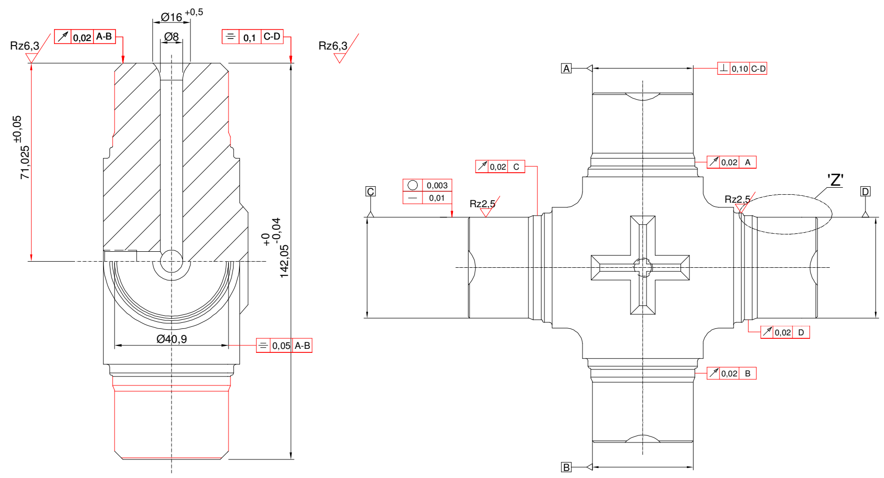
CARDANWORKS by SICIT

Remarks:
UJ.178.01.57x152-K
Description: Universal joint
Swing diameter: 178 mm
U.J. execution: External circlips
central lubrication (middle)
Cap Ø x Span: 57x152 mm
Drawing: 1620-K

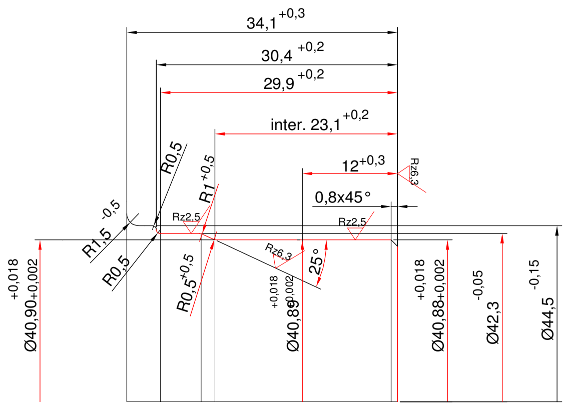


Data inputs:			
Bearing cap execution:	C	Roller element:	c
	Roller bearing, single or multiple rows, spring loaded		cylindrical roller with flat face
Length between snap rings [B]:	152,00 mm	Roller face to trunion face [X] +/-:	0,30 mm
Bearing cap Ø [A]:	57,00 mm	Trunion Ø [Dt]:	40,90 mm
Yoke bore coverage [H]:	27,80 mm	Stress section Ø [Db]:	42,30 mm
Roller Ø [Dw]:	5,36 mm	Trunion grease bore Ø [Ds]:	8,00 mm
Roller length [Lw]:	11,00 mm	Trunion face to stress section [Lb]:	29,72 mm
Rollers per row [Z]:	27	Cross overall length face to face [L]:	142,05 mm
Numbers of roller rows [i]:	2	Cross body material:	20MnCr5
Washer thickness (between rows) [S]:	0,00 mm	Bending fatigue strength [σbw]:	510 N/mm^2
Roller face to covered area [Yf]:	0,50 mm	Stress concentration factor [ßk]:	1,5
Output geometry data:		**Output bearing data:**	
Covered bearing area (length yoke bore) [Y]:	22,83 mm	Load rating constant [ϑ]:	0,83
Assembly overlapping - cap is	full covered	Geometry coefficient [f1]:	118,94
Ø of center roller to center roller [Dm]:	46,26 mm	Static load coefficient [fo]:	38,90185906
Calc. bearing corner radius [Lk]:	0,2	Dynamic load coefficient [fc]:	98,7202
Net contact length [Lu]:	20,90 mm	Static load rating [Co]:	117.700 N
Load Ø [D]:	119,15 mm	Dynamic load rating [C]:	75.500 N
Stress arm [R]:	18,27 mm		
Output Universal Joint capacity:		**Reversing, dynamic / fatigue torque [TFAT]**	**8.182 Nm**
U.-Joint life torque capacity [ULT]:	**4.500 Nm**	*Pulsating one way fatigue torque [T P] = 1,4 x T FAT:*	**11.455 Nm**
Lc:	2,26E-01	*Maximum static / nominal torque [T MAX] = 2 x T FAT:*	**16.365 Nm**
		Functional limiting torque [T F] = 1,3 x T MAX:	**21.274 Nm**

Computation of the U.J. strength and dynamic capacity



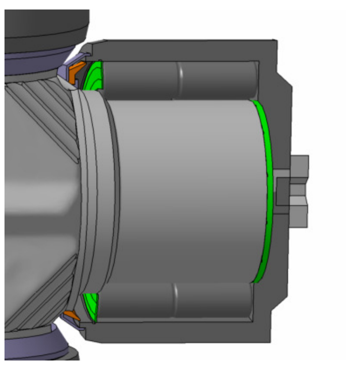
Geometric dimensioning and tolerancing of the cross body



Surface- and dimensional tolerances of the trunnion

Needle and roller design

Contour of rolling elements for comparative stress patterns for ideal bearing – bearing life increases when using relieved end rollers because the stress concentration at the roller ends are decreased. The effects of manufacturing inaccuracies or misalignment caused by deflection due to transmitted torque are minimized.

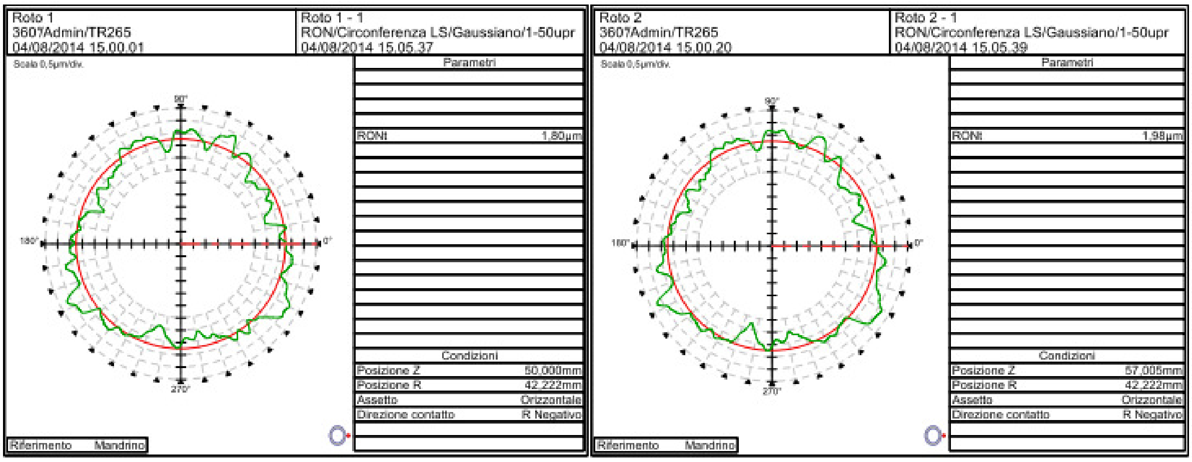


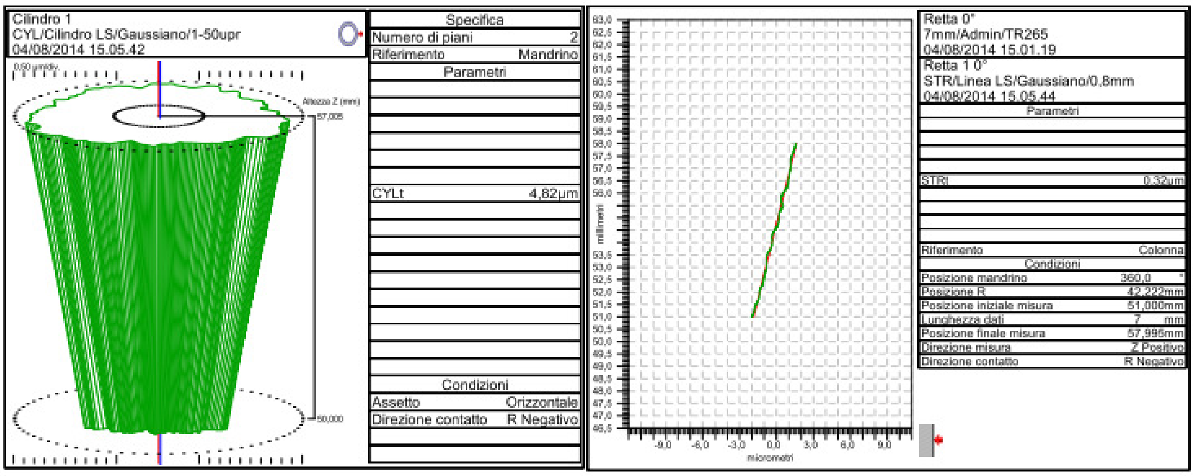
Two-row / contoured rollers bearing cup

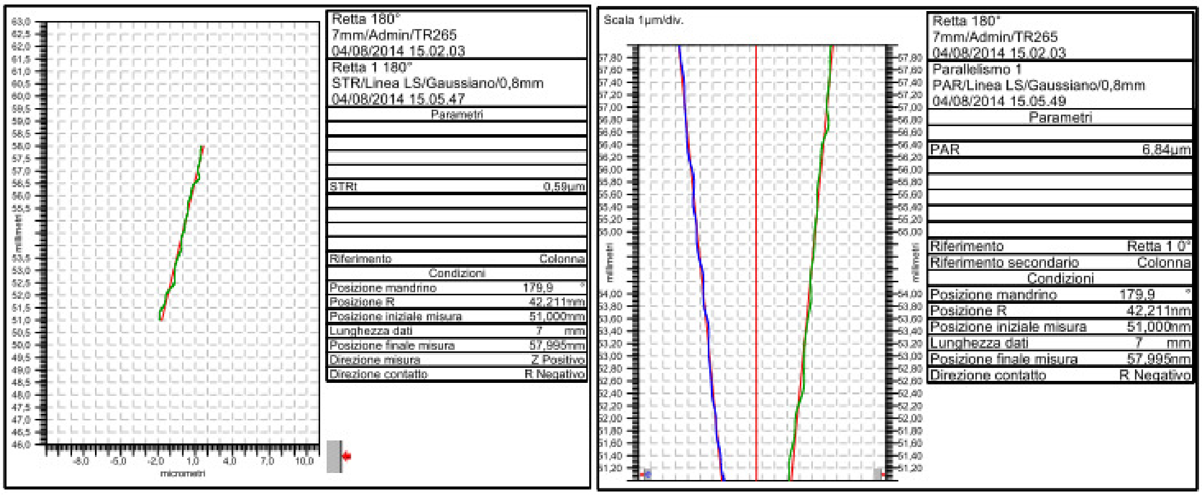
Optimal length to diameter ratio –the minimum permissible length of the roller is determined by its compressive strength value – the maximum length by the allowed geometry. Theoretically, UJ capacity increases with roller length, but practical limitations are imposed by cross and yoke deflections and by geometrical clearance limitations – the UJ rotational swing diameter.

Finish

Bearing life is affected by the surface finish used on cross trunion and bearing cup bore – with a certain finish based on economic considerations. A finer finish means better bearing performance, and insofar as it diminishes the progress of fretting corrosion, results in longer bearing life.







Testing results of the trunnion geometry

Material and heat treatment

To take full advantage of the relatively high radial load capacity of the rollers, the bearing components must be made of proper materials and have optimum metallurgical structures. The surface hardness, case hardness gradient and core hardness range of the cross trunnion as well as the bearing cup must be adequate.

oerlikon graziano — Stabilimento di Cervere, Frazione Grinzano 12040 (CN)

Inspection Certificate (UNI EN 10204:2005 type 3.1)

Part number 1624/T — CORPO CROCERA 1624/TOR M65
Packing list n° 380 of: 03/06/2014
Material: 20MnCr5
cast code: 40416 n°: 340416
Heat Treatament: CARBURIZING and QUENCHING

Messrs. SICIT
VIA PINEROLO,34
10060 FROSSASCO TO

Specifications	Tolerances	Results	Laboratory inspection results
Surface hardness -HRc- After grinding 60-64 HRc	61 - 64 HRc Stand. UNI EN ISO 6508-1	61 - 62 HRc	
Core hardness-HRc- @ half diameter	30 - 47 HRc Stand. UNI EN ISO 6508-1		41 HRc HV30
Microstructure inspection	Stand. UNI 4227		OK
Effective case depth @ diameter 41,05 (After grinding 1,0/1,4 mm)	1,1 - 1,5 mm Stand. UNI 11153-1		1,43 mm HV1=525
Effective case depth @ flat surface	1,1 - 1,5 mm Stand. UNI 11153-1	1,27 - 1,29 mm BRIRO E (tab.525)	

The results reported above, are average values of more measurements. These results are influenced by repeatability extended standard deviation to +/-3 Sigma: HV hardness s.d.=0,50 HR hardness s.d.=0,20 HB hardness s.d.=0,50 Effective Case Depth by HV s.d.=0,010

Traceability: lot n° 8553 / Batch n° 896148 / Sub-Batch n°

Q.ty: 31 parts Total weight 92,07 Kg.

RESULT *In compliance with the specification*

Customer ref. n° UAD2
Notes:
Attached:

Cervere: 17/06/2014 **Quality Control:** (MRZ)

This document is approved by electronic signature

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Certificate for the heat treatment of the cross body

AENOR ER Empresa Registrada UNE-EN ISO 9001 ER-1048/2010 | AENOR ER Calidad de Automoción UNE-ISO/TS 16949 RA02-0010/2010 IATF:0110321

ArcelorMittal

CERTIFICADO DE INSPECCIÓN

EN-10204 3.1

SIDERIA, S.R.L.
CORSO UNIONE SOVIETICA, 153
10134 TORINO
ITALIA

Nref: 79408
Sref: 893 BUS

Barras de acero de seccion redonda

Calidad: 20MNCRS5
Norma: EN 10084:2008
Estado de suministro: Bruto de Laminación

Colada: **340416**
Largo: 6,9 m
Bultos: 3
Kilos: 6322

COMPOSICION QUIMICA (% en peso)

C (%)	Mn (%)	Si (%)	S (%)	P (%)	Cr (%)	Ni (%)	Mo (%)	Cu (%)	Sn (%)	Al (%)	N (%)	V (%)	Ti (%)	Ca (%)	O total (%)
0,198	1,272	0,230	0,023	0,008	1,170	0,114	0,027	0,139	0,011	0,006	0,0100	0,003	0,001	0,0014	0,0043

CARACTERISTICAS GEOMETRICAS/MECANICAS

Diám nom (mm)	Ovalidad (mm)	L.Elástico 0.2-r (MPa)	R. Tracción-r(MPa)	Alargam. 5D(%)	Dureza Brinell	Rel. Area I./A.F
65,0	0,30	553	786	19	230,0	6,79

N=Normalizada BL=Bruto Laminación TR=Temple y Revenido T=Transversal L=Longitudinal RI=Recocido Isotérmico

TEMPLABILIDAD JOMINY

J. 1.5 mm	J.3 mm	J.5 mm	J.7 mm	J.9 mm	J.11 mm	J.13 mm	J.15 mm	J.20 mm	J.25 mm	J.30 mm	J.35 mm	J.40 mm
46	45	44	41	38	36	34	32	30	29	27	25	25

MICROINCLUSIONES/TAMANO DE GRANO/PROFUNDIDAD DE DECARBURACION

Inclusiones K3	T.G. Austenítico
1	8,5

ENSAYOS ESPECIALES Y NOTAS

Ensayo Radiactividad: OK
Control antimezcla: Ausencia de mezclas
Defectos superficiales: Detección mediante EDDYCHEK

Directora de Calidad y Servicio Técnico al Cliente
AMAGOIA LEKUONA
FECHA: 20-MAR-2014

ArcelorMittal Gipuzkoa, S.L.U.
Barrio Artiz, 34
20700 Zumarraga (Guipúzcoa)

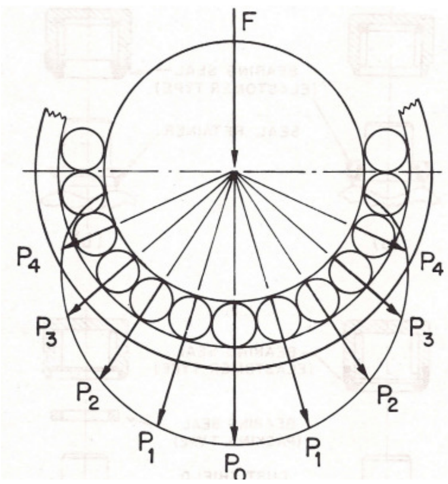
(943) 72.00.11
www.ris.arcelormittal.net

Certificamos que los materiales relacionados han sido fabricados y ensayados de conformidad con las condiciones de venta convenidas

Metallurgical test report of the cross body material

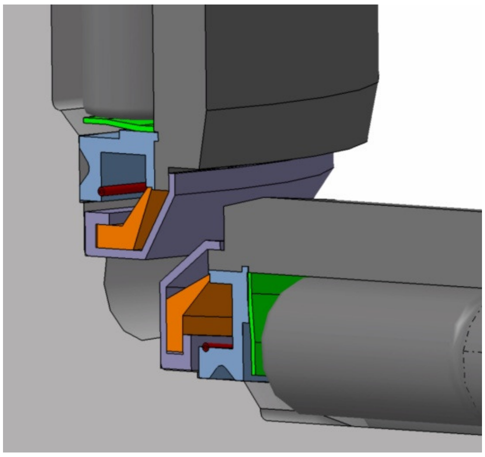
Hertz contact stresses and precession

Hertz contact stresses between the rolling elements and cross trunnion, and between the rollers and the bearing cup bore. In general the contact stress between the roller and the trunnion is higher than between the roller and the bearing cup bore. The load acting on the rollers is not evenly distributed, with a peak in radial direction, and values to zero at angle less than 90° on either side, leading to completely unloaded rollers. Since the bearing motion is oscillatory the main load is more or less carried by a few rolling members, influencing the life of the bearing negative.



Needle roller radial load distribution

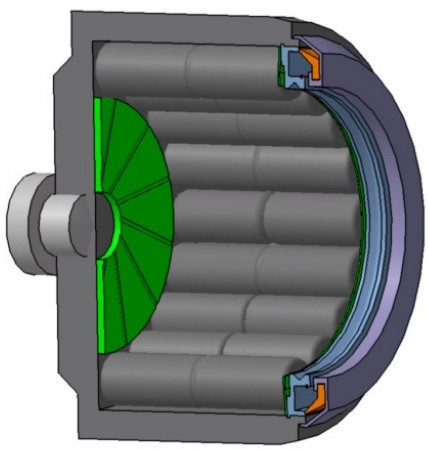
This leads to another characteristic which can add significantly to bearing life - precession. This term, as used in universal joint oscillatory bearing terminology, describes a condition where the rollers continually change position with respect to the bearing cup bore and the trunnion. Certain elements like spring washer pre-load the rollers allowing the required movement.



Spring loaded (green) rollers

Thrust washer

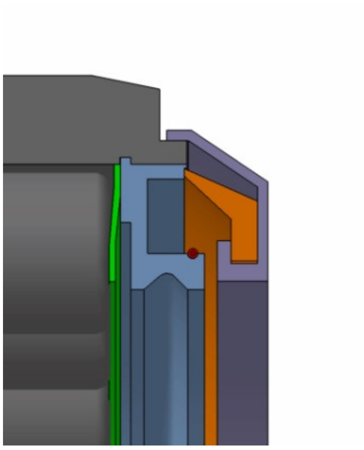
Also contribution significantly to the bearing life are the use of proper design techniques in the area of the bearing configuration containing the cup bore grind relief and the trunnion chamfer and face. Polyamide thrust washer in the bottom of the cup prevents the elements from contact and circumvent stress concentration and friction as source for premature failure.



Thrust washer (green)

Sealing

An additional important factor contributing to optimum bearing life is the provision of an adequate sealing. The principal function of the bearing seal is to prevent the escape of lubrificating fluid from or entry of foreign matter into the bearing. In addition the bearing seal which is a flexible member must be capable of operating under varying environmental conditions at various speeds, joint angles, and its design depends on joint usage. Studies show that minimum ¾ of cardan shaft failures are subject to poor, incorrect or missing lubrication. As a matter of fact the standard cardan shaft has to be lubricated frequently due to grease loss and / or grease contamination in its operation. This occurs since the re-greasable Universal joint with its lubrication nipples and the corresponding sealing is not a closed system. The sealing design must allow the passing of grease for the lubricating process. Centrifugal forces, temperature changes and hydrodynamic circumstances let the U.J. "breath". As an effect the Universal Joint consequently looses lubricant by its sealing or contaminating material like water or dust penetrates, or is absorbed from outside – leading often to a premature failure.



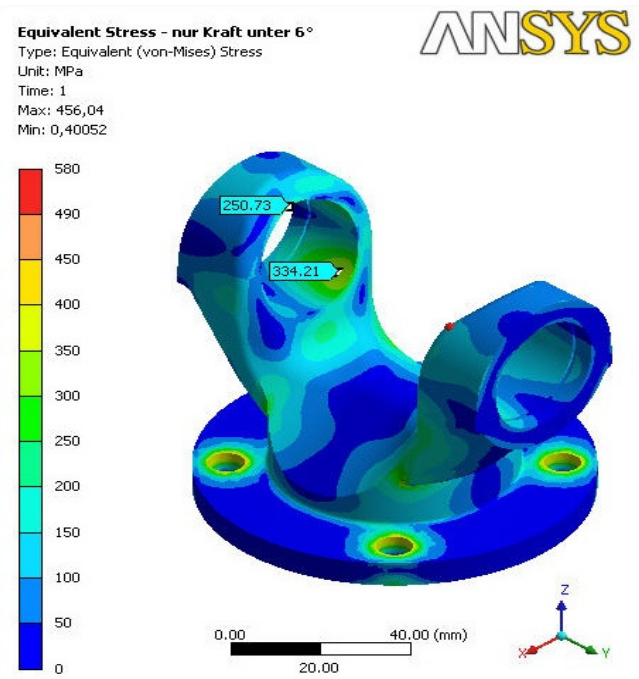
Sealing system for bearing cup

Special sealing solutions allow to design and manufacture lube for life Universal Joints. These closed systems avoid the negative influences on the service life. The specially designed sealing system perfectly protects the thus encapsulated bearing internals.

Bearing retention and yoke design

Bearing life is further influenced by the bearing retention means employed. Misalignment of the bearing cup with respect to the cross and end clearance between the cross and bearing cup thrust surfaces must be controlled to close tolerances to prevent premature bearing failure or unsatisfactory functioning of the joint. Also, if the fit between component parts is too tight, detrimental results will occur.

In general, the design of the yoke ears requires special attention. The important load –deflection characteristics of the Cardan joint components and their effect on bearing life are often overlooked. The yoke ears will deflect due to the applied torque and the centrifugal force effects caused by the high rotational speeds. For adequate bearing life, it is highly desirable to provide for balanced yoke and cross deflection under torque loads so that the needle rollers are uniformly loaded along their active length.



Optimized yoke geometry for balanced deflection under high loads

As a result the best and highest quality Universal Joint will not perform to its potential with the assembly and usage of “poor” quality yokes.