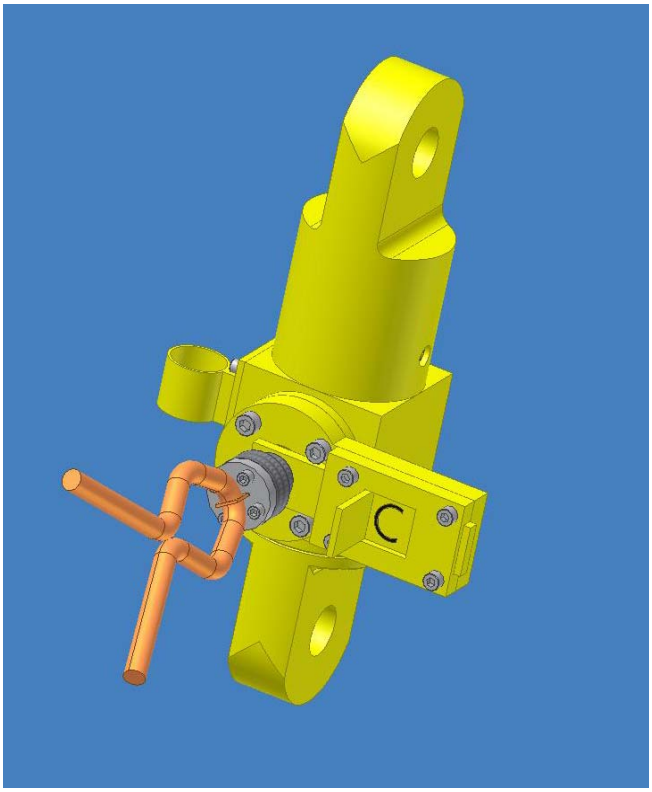
HØGSKOLEN STORD/HAUGESUND

Weak-link Sikkerhetsanordninger for undervanns løfteoperasjoner. Del 2 av 2



BachelorOppgave utført ved

Høgskolen Stord/Haugesund – Studie for ingeniørfag

Maskin, Energi- og Prosessteknikk

Av: Stud Espen Mjånes *Kand.nr.* 34

Stud Espen Nordahl *Kand.nr.* 42

(Stryk det som ikke passer)

Haugesund *Våren 2008*

Vedlegg

Produktblad for materialer
- Rustfritt seigherdet akselstål
- Aluminium bronze
- Stainless steel for casting S165M

Ansys rapporter
- Hann
- Hunn

2D tegninger
- Weaklink ”weaklinkmode”
- Weaklink ”safemode”
- Hann
- Hunn
- Låsebolt
- Brakett
- Fishtail adapter
- Fishtail
- Låsepin
- Lås holder
- Låsesleide
- Lås flens
- Styrehylse
- Brytepinne

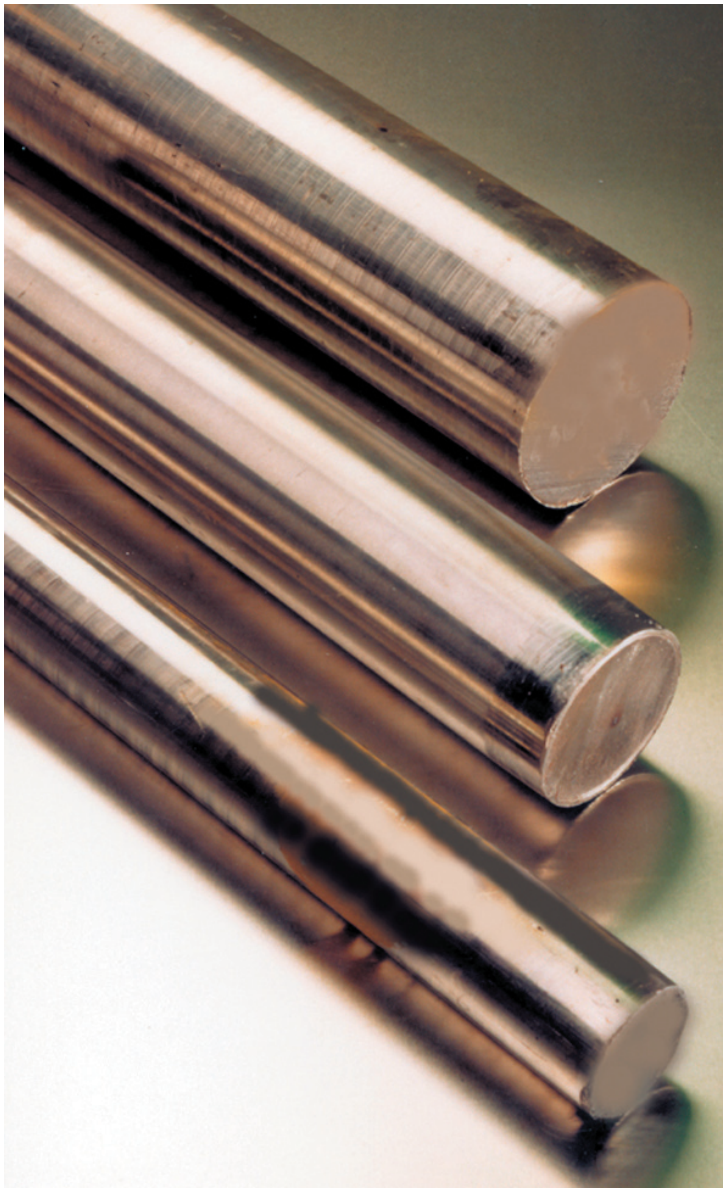
ESPEN MJÅNES
ESPEN NORDAHL

2008

KVALITET, MANGFOLD OG GODT SAMARBEID

astrup

Rusfritt seigherdet akselstål



- SS2387
- EN 1.4418
- S165M

Rustfritt seigherdet akselstål

Standarder

SS	EN	DIN	NS	Annet
2387	1.4418	X4CrNiMo 16-5	14240/SS119	S165M

Kjemisk sammensetning

Cr	C	Ni	Mo	Annet
Maks. 0,05	15-16	5-6	0,8-1,5	< 0,02 N

Strekkfasthet: 900 - 1050 N/mm^2
Flytegrense$_{0,2}$: min. 700 N/mm^2
Forlengelse$_{A5}$: min. 14%
Hardhet HB: 270-330

Lagerførte dimensjoner

Slipt h9:
12 mm • 16 mm • 20 mm • 25 mm • 30 mm • 32 mm • 35 mm • 40 mm • 45 mm
50 mm • 55 mm • 60 mm • 65 mm • 70 mm • 80 mm • 85 mm • 90 mm • 100 mm

Valset/Smidd k12:
81,4 mm • 96,4 mm • 102 mm • 112 mm • 122 mm • 127 mm • 132 mm •143 mm • 153 mm
165 mm • 173 mm • 184 mm • 206 mm • 226 mm • 256 mm • 306 mm • 360 mm

Lengder: 5,5 - 6,0 meter
Sertifikater: EN 10204/3,1
Emballasje, verk: Trekasser, distanseringer rundt hver stang for slipt utførelse
Retthet: Avvik maks. 0,2 mm/m for slipt / 1,0 mm/m for valset/smidd utførelse
Fremstilling: Dia. 12 - 100 mm er slipt. Dia. 112 - 153 mm er valset. Dia. 165 - 360 mm er smidd.

For mer informasjon om våre rustfrie og syrefaste produkter, ring avdeling Rustfritt stål, telefon 22 79 15 00, e-post rustfritt@astrup.no, eller ta kontakt med ditt nærmeste salgskontor.

Salgskontorer:
Oslo: telefon 22 79 15 00 - e-post: astrup@astrup.no • **Skien:** telefon 48 99 88 95 - e-post jni@astrup.no
Stavanger: telefon 51 85 46 46 - e-post: stavanger@astrup.no • **Bergen:** telefon 55 50 61 00 - e-post bergen@astrup.no
Ålesund: telefon 70 15 36 60 - e-post aalesund@astrup.no • **Trondheim:** telefon 73 82 96 10 - e-post trondheim@astrup.no

astrup

ASTRUP AS
Postboks 8 Haugenstua, N-0915 Oslo
Haavard Martinsens vei 34, N-0978 Oslo
Tlf.: 22 79 15 00 Fax: 22 10 72 93
E-post: astrup@astrup.no

www.astrup.no

Technical Data Sheet

CuAl10Ni5Fe4

Aluminium bronze
Extruded rods

Nominal composition:

Aluminium	(Al)	8.5 - 11.0 %
Nickel	(Ni)	4.0 - 6.0%
Iron	(Fe)	2.0 - 5.0 %
Manganese	(Mn)	1.5% max.
Copper	(Cu)	balance

Specifications:

D	DIN 17665 CuAl10Ni5Fe4	2.0966
F	AFNOR	CuAl9Ni5Fe3M1
GB	BS	CA104
USA	CDA	C63000

Mechanical and physical properties	Units	Extruded rods
1) Tensile strength R_m	MPa	640
2) Yield strength $R_{p0,2}$	MPa	270
3) Elongation A_5	%	15
4) Brinell hardness	HB 10	180
5) Modulus of elasticity E	GPa	121
6) Density ρ	g / cm^3	7.6
7) Coefficient of expansion α	10^{-6} / K	16.2
8) Thermal conductivity λ	W / m · K	40
9a) Electrical conductivity γ	m / Ω · mm^2	4
9b) Electrical conductivity	% I.A.C.S	7
10) Specific heat c_p	J / g · K	0.45

Indicated values are nominals. Assurances given with respect to properties or uses are subject to written approval from AMPCO.

APPLICATIONS:
Construction material with good strength properties, sea water resistant. Endless screws with high tooth pressures and good lubrication.

Scana Steel Stavanger as

Rev. 1

Quality no.	Quality group	Quality
8060	STAINLESS STEEL FOR CASTING	S165M

Chemical analysis :

	C	Si	Mn	S	P	Cr	Ni	Mo
min						15,0	4,50	0,80
max	0,05	1,00	1,50	0,025	0,035	17,0	6,00	1,50

Castings may also be delivered according to these comparable standards:

EN 10213-2 GX4CrNiMo 16-5	**M.no. 1.4405**
SEW 410 GX5CrNiMo 16 5	**W.nr. 1.4405**
ASTM A743 CB-6	**J91804**
SS 14 2387	**NS14240 (no longer in use)**

Applications : **S165M is a ferritic martensitic stainless steel, with excellent mechanical properties including ductility. General applications are propellers, shafts, spindels, bolts, etc.**

Minimum mechanical properties:

Yield Strength Rp 0.2 [MPa]	Tensile Strength Rm [MPa]	Elongation [%]	Contraction [%]	Impact Charpy-V 20 ° [J]
620	830-1030	15	45	60

Heat treatment : **Hardening at 1000 °C and cooled in air followed by Tempering between 580 °C-640 °C, cooled in air.**

Weldability : **Good**

Specific weight : **7,79 g / cm³**

Coefficent of thermal expansion :

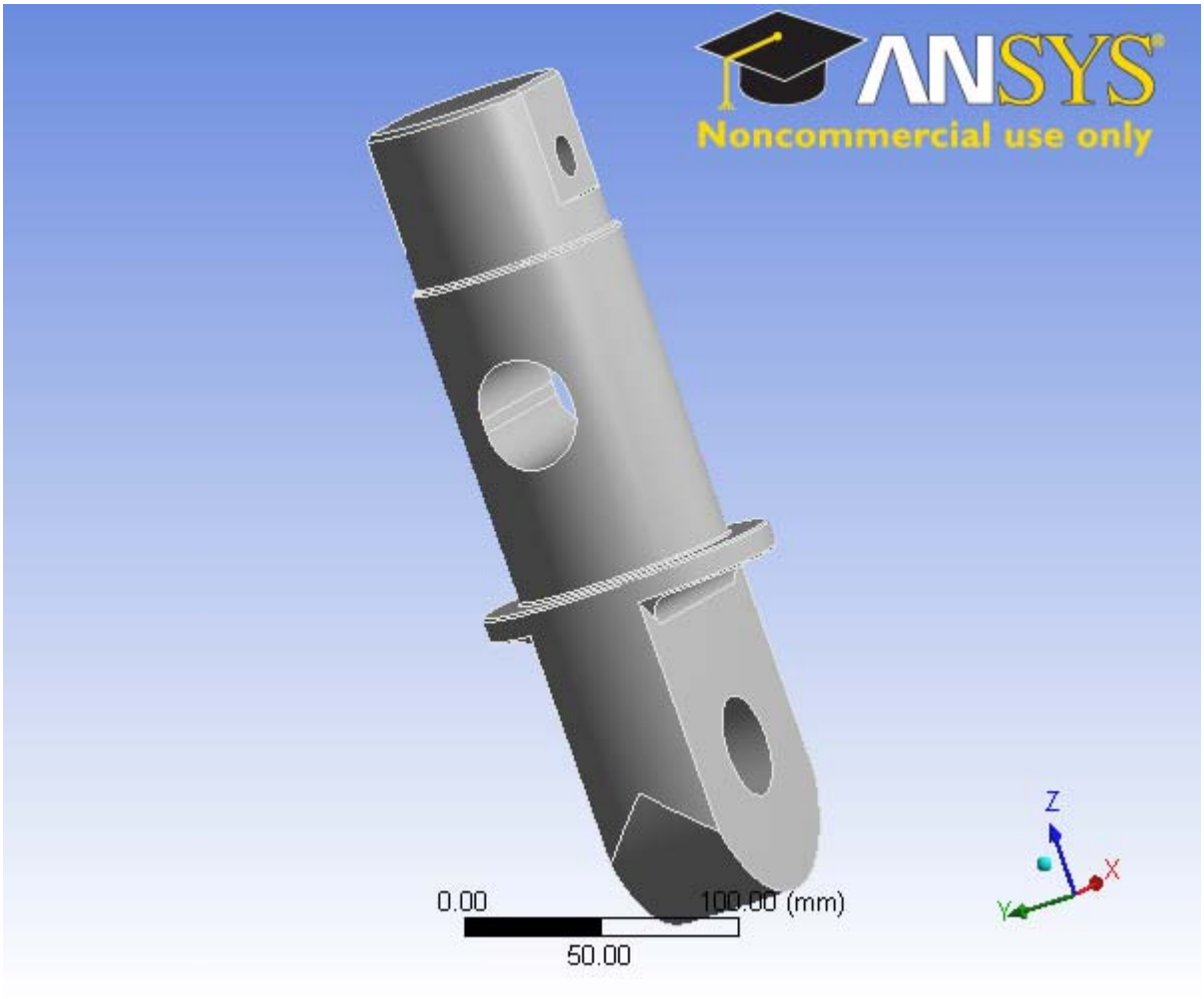
20-100 ºC	**11,0 x 10^{-6} K^{-1}**
20-300 ºC	**12,5 x 10^{-6} K^{-1}**
20-500 ºC	**13,5 x 10^{-6} K^{-1}**

Pattern: **Additional allowance for contraction: 2,5 %**

DAP, 15.02.01

Hovedprosjekt

First Saved	Tuesday, April 29, 2008
Last Saved	Tuesday, April 29, 2008
Product Version	11.0 Release



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, °C, s, mV, mA)
Angle	Degrees
Rotational Velocity	rad/s

Hann

Geometry

TABLE 2
Hann > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	H:\Inventor\HP\Weaklink\Ansys\hann.sat
Type	ACIS
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Part Color
Bounding Box	
Length X	110, mm
Length Y	110, mm
Length Z	309,7 mm
Properties	
Volume	1,3183e+006 mm³
Mass	10,217 kg
Statistics	
Bodies	1

Active Bodies	1
Nodes	14999
Elements	8106
Preferences	
Import Solid Bodies	Yes
Import Surface Bodies	Yes
Import Line Bodies	Yes
Parameter Processing	Yes
Personal Parameter Key	DS
CAD Attribute Transfer	No
Named Selection Processing	No
Material Properties Transfer	No
CAD Associativity	Yes
Import Coordinate Systems	No
Reader Save Part File	No
Import Using Instances	Yes
Do Smart Update	No
Attach File Via Temp File	No
Analysis Type	3-D
Mixed Import Resolution	None
Enclosure and Symmetry Processing	Yes

TABLE 3
Hann > Geometry > Parts

Object Name	*Part 1*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Material	Stainless Steel
Stiffness Behavior	Flexible
Nonlinear Material Effects	Yes
Bounding Box	
Length X	110, mm
Length Y	110, mm
Length Z	309,7 mm
Properties	
Volume	1,3183e+006 mm³
Mass	10,217 kg
Centroid X	6,5861e-004 mm
Centroid Y	-1,6615e-002 mm
Centroid Z	36,348 mm
Moment of Inertia Ip1	76356 kg·mm²
Moment of Inertia Ip2	79040 kg·mm²
Moment of Inertia Ip3	9775,9 kg·mm²
Statistics	
Nodes	14999

Elements	8106

Mesh

TABLE 4
Hann > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Advanced	
Relevance Center	Coarse
Element Size	Default
Shape Checking	Standard Mechanical
Solid Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Initial Size Seed	Active Assembly
Smoothing	Low
Transition	Fast
Statistics	
Nodes	14999
Elements	8106

Static Structural

TABLE 5
Hann > Analysis

Object Name	*Static Structural*
State	Fully Defined
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Options	
Reference Temp	22, °C

TABLE 6
Hann > Static Structural > Analysis Settings

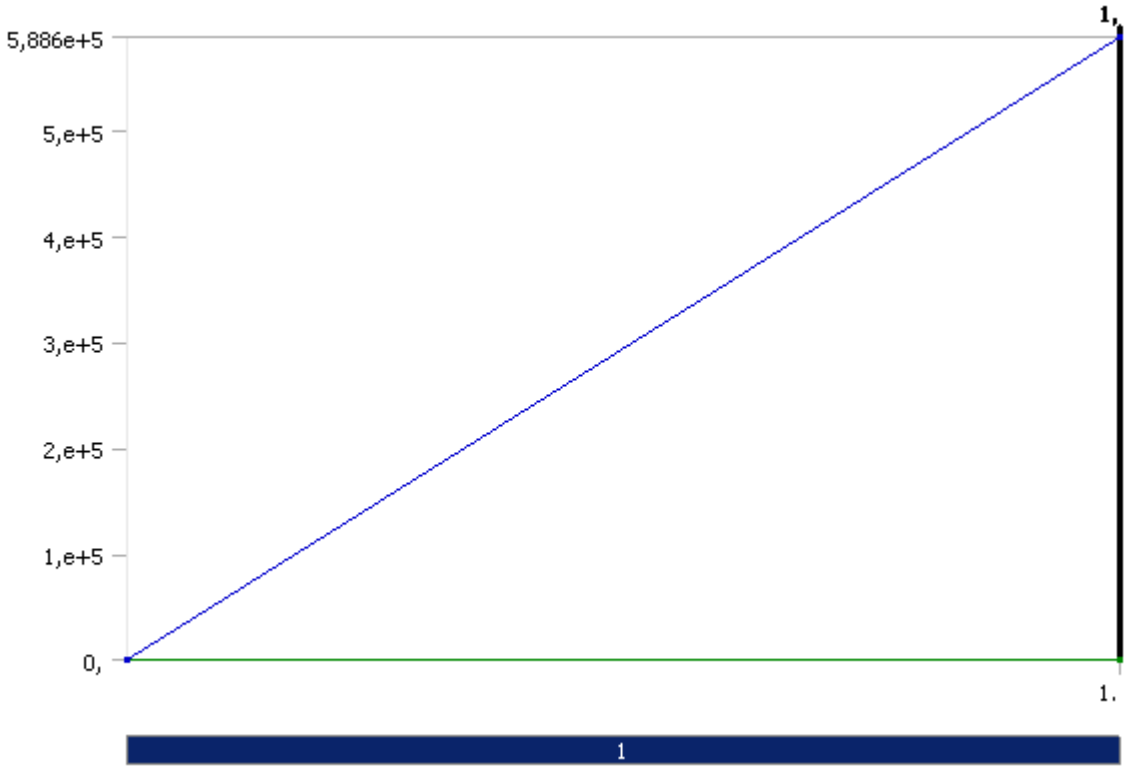
Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled

Large Deflection	Off
Inertia Relief	Off
Nonlinear Controls	
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Output Controls	
Calculate Stress	Yes
Calculate Strain	Yes
Calculate Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Documents and Settings\124957\desktop\hpansys\hann.final Simulation Files\Static Structural\
Future Analysis	None
Save ANSYS db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No

TABLE 7
Hann > Static Structural > Loads

Object Name	*Force*	*Cylindrical Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Define By	Components	
Type	Force	Cylindrical Support
X Component	0, N (ramped)	
Y Component	0, N (ramped)	
Z Component	5,886e+005 N (ramped)	
Suppressed	No	
Radial		Fixed
Axial		Fixed
Tangential		Free

FIGURE 1
Hann > Static Structural > Force



Solution

TABLE 8
Hann > Static Structural > Solution

Object Name	*Solution*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,

TABLE 9
Hann > Static Structural > Solution > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2,5 s
Display Points	All

TABLE 10
Hann > Static Structural > Solution > Results

Object Name	*Equivalent Stress*	*Maximum Shear Stress*	*Total Deformation*
State	Solved		
Scope			

Geometry	All Bodies		
Definition			
Type	Equivalent (von-Mises) Stress	Maximum Shear Stress	Total Deformation
Display Time	End Time		
Results			
Minimum	0,1364 MPa	7,4204e-002 MPa	9,7674e-006 mm
Maximum	620,52 MPa	322,87 MPa	1,3257e-004 mm
Information			
Time	1, s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 11
Hann > Static Structural > Solution > Stress Safety Tools

Object Name	*Max Equivalent Stress*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 12
Hann > Static Structural > Solution > Max Equivalent Stress > Results

Object Name	*Safety Factor*	*Safety Margin*
State	Solved	
Scope		
Geometry	All Bodies	
Definition		
Type	Safety Factor	Safety Margin
Display Time	End Time	
Results		
Minimum	0,99916	-8,4307e-004
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 13
Hann > Static Structural > Solution > Stress Safety Tools

Object Name	*Max Shear Stress*
State	Solved
Definition	
Theory	Max Shear Stress
Factor	0,5
Stress Limit Type	Tensile Yield Per Material

TABLE 14
Hann > Static Structural > Solution > Max Shear Stress > Results

Object Name	*Safety Factor*	*Safety Margin*
State	Solved	
Scope		
Geometry	All Bodies	
Definition		
Type	Safety Factor	Safety Margin
Display Time	End Time	
Results		
Minimum	0,96015	-3,9847e-002
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	

Material Data

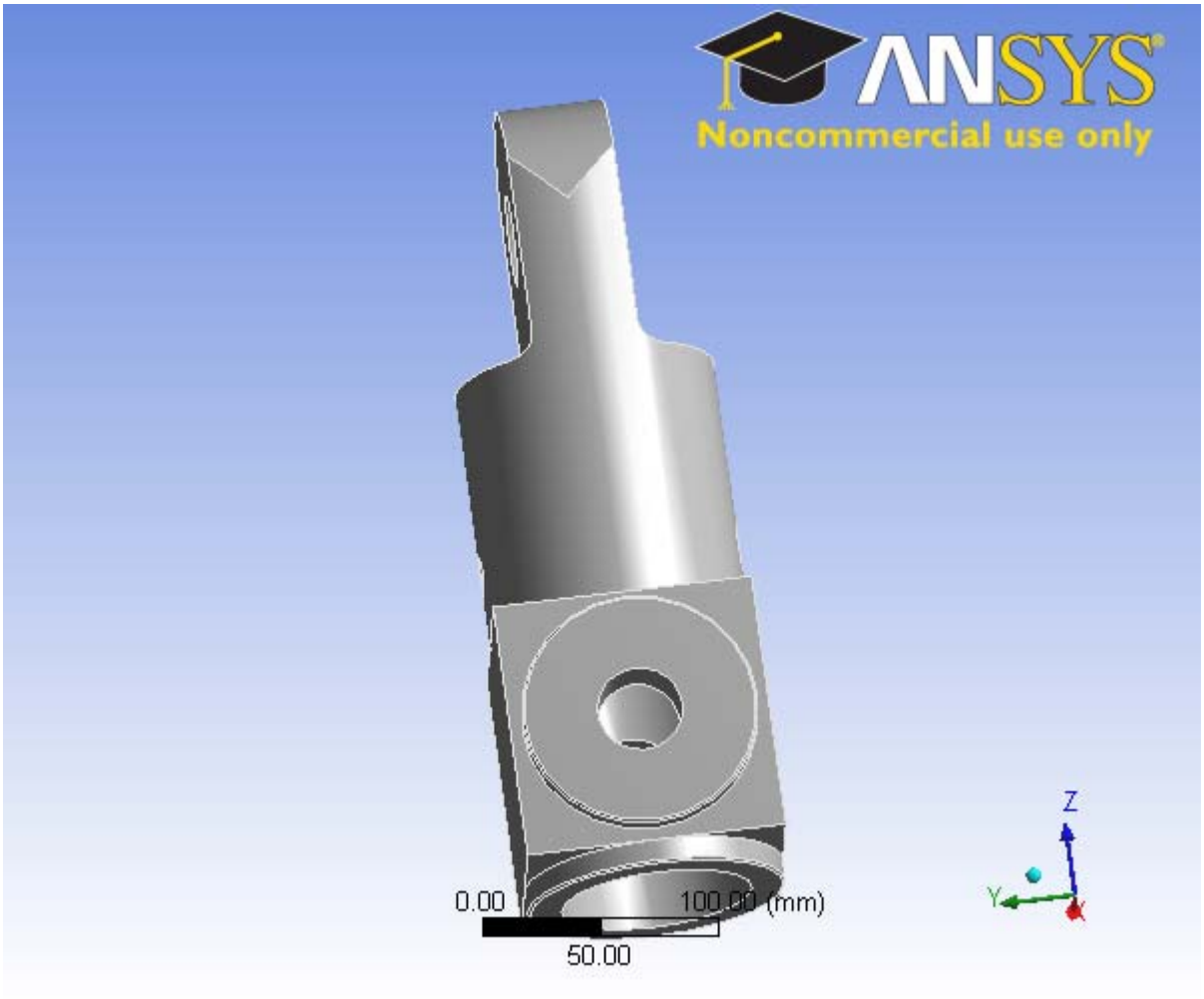
Stainless Steel

TABLE 15
Stainless Steel > Constants

Structural	
Young's Modulus	2,1e+011 MPa
Poisson's Ratio	0,3
Density	7,75e-006 kg/mm³
Thermal Expansion	1,7e-005 1/°C
Tensile Yield Strength	620, MPa
Tensile Ultimate Strength	900, MPa
Thermal	
Thermal Conductivity	1,51e-002 W/mm·°C
Specific Heat	480, J/kg·°C
Electromagnetics	
Relative Permeability	10000
Resistivity	7,7e-004 Ohm·mm

Hovedprosjekt

First Saved	Tuesday, April 29, 2008
Last Saved	Tuesday, April 29, 2008
Product Version	11.0 Release



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, °C, s, mV, mA)
Angle	Degrees
Rotational Velocity	rad/s

Hunn

Geometry

TABLE 2
Hunn > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	H:\Inventor\HP\Weaklink\Ansys\hunn.sat
Type	ACIS
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Part Color
Bounding Box	
Length X	130, mm
Length Y	110, mm
Length Z	350, mm
Properties	
Volume	2,0959e+006 mm³
Mass	16,244 kg
Statistics	

Bodies	1
Active Bodies	1
Nodes	13610
Elements	6983
Preferences	
Import Solid Bodies	Yes
Import Surface Bodies	Yes
Import Line Bodies	Yes
Parameter Processing	Yes
Personal Parameter Key	DS
CAD Attribute Transfer	No
Named Selection Processing	No
Material Properties Transfer	No
CAD Associativity	Yes
Import Coordinate Systems	No
Reader Save Part File	No
Import Using Instances	Yes
Do Smart Update	No
Attach File Via Temp File	No
Analysis Type	3-D
Mixed Import Resolution	None
Enclosure and Symmetry Processing	Yes

TABLE 3
Hunn > Geometry > Parts

Object Name	*Part 1*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Material	Stainless Steel
Stiffness Behavior	Flexible
Nonlinear Material Effects	Yes
Bounding Box	
Length X	130, mm
Length Y	110, mm
Length Z	350, mm
Properties	
Volume	2,0959e+006 mm³
Mass	16,244 kg
Centroid X	-920,24 mm
Centroid Y	3,1528e-002 mm
Centroid Z	-35,967 mm
Moment of Inertia Ip1	1,5896e+005 kg·mm²
Moment of Inertia Ip2	1,6428e+005 kg·mm²
Moment of Inertia Ip3	35973 kg·mm²
Statistics	

Nodes	13610
Elements	6983

Mesh

TABLE 4
Hunn > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Advanced	
Relevance Center	Coarse
Element Size	Default
Shape Checking	Standard Mechanical
Solid Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Initial Size Seed	Active Assembly
Smoothing	Low
Transition	Fast
Statistics	
Nodes	13610
Elements	6983

TABLE 5
Hunn > Mesh > Mesh Controls

Object Name	*Mapped Face Meshing*
State	Fully Defined
Scope	
Scoping Method	Geometry Selection
Geometry	3 Faces
Definition	
Suppressed	No
Radial Number of Divisions	Default

Static Structural

TABLE 6
Hunn > Analysis

Object Name	*Static Structural*
State	Fully Defined
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Options	
Reference Temp	22, °C

TABLE 7
Hunn > Static Structural > Analysis Settings

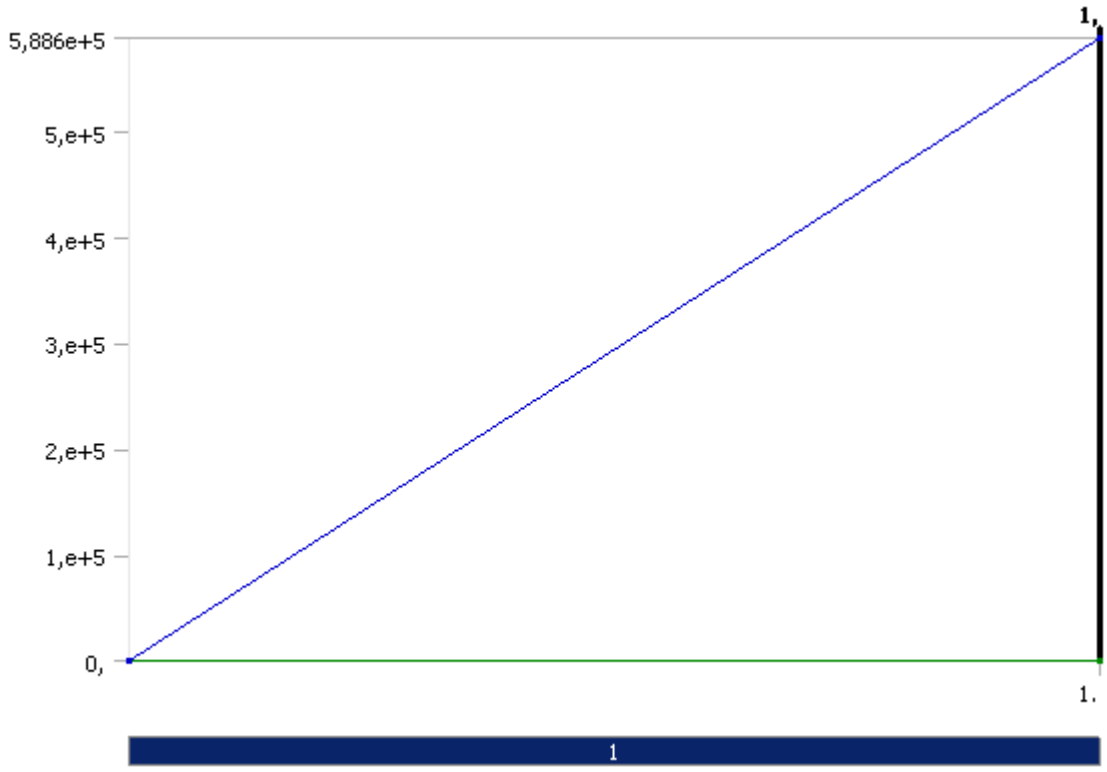
Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Nonlinear Controls	
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Output Controls	
Calculate Stress	Yes
Calculate Strain	Yes
Calculate Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\DOCUME~1\124957\LOKALE~1\Temp\Project Simulation Files\Static Structural (2)\
Future Analysis	None
Save ANSYS db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No

TABLE 8
Hunn > Static Structural > Loads

Object Name	*Force*	*Cylindrical Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	2 Faces
Definition		
Define By	Components	
Type	Force	Cylindrical Support
X Component	0, N (ramped)	
Y Component	0, N (ramped)	
Z Component	5,886e+005 N (ramped)	
Suppressed	No	
Radial		Fixed
Axial		Fixed

Tangential		Free

FIGURE 1
Hunn > Static Structural > Force



Solution

TABLE 9
Hunn > Static Structural > Solution

Object Name	*Solution*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,

TABLE 10
Hunn > Static Structural > Solution > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2,5 s
Display Points	All

TABLE 11
Hunn > Static Structural > Solution > Results

Object Name	*Equivalent Stress*	*Maximum Shear Stress*	*Total Deformation*
State	Solved		
Scope			
Geometry	All Bodies		
Definition			
Type	Equivalent (von-Mises) Stress	Maximum Shear Stress	Total Deformation
Display Time	End Time		
Results			
Minimum	1,063 MPa	0,60854 MPa	4,6383e-005 mm
Maximum	317,73 MPa	176,41 MPa	7,3808e-004 mm
Information			
Time	1, s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 12
Hunn > Static Structural > Solution > Stress Safety Tools

Object Name	*Max Equivalent Stress*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 13
Hunn > Static Structural > Solution > Max Equivalent Stress > Results

Object Name	*Safety Factor*	*Safety Margin*
State	Solved	
Scope		
Geometry	All Bodies	
Definition		
Type	Safety Factor	Safety Margin
Display Time	End Time	
Results		
Minimum	0,65149	-0,34851
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 14
Hunn > Static Structural > Solution > Stress Safety Tools

Object Name	*Max Shear Stress*
State	Solved
Definition	
Theory	Max Shear Stress

Factor	0,5
Stress Limit Type	Tensile Yield Per Material

TABLE 15
Hunn > Static Structural > Solution > Max Shear Stress > Results

Object Name	*Safety Factor*	*Safety Margin*
State	Solved	
Scope		
Geometry	All Bodies	
Definition		
Type	Safety Factor	Safety Margin
Display Time	End Time	
Results		
Minimum	0,58671	-0,41329
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	

Material Data

Stainless Steel

TABLE 16
Stainless Steel > Constants

Structural	
Young's Modulus	2,1e+011 MPa
Poisson's Ratio	0,31
Density	7,75e-006 kg/mm³
Thermal Expansion	1,7e-005 1/°C
Tensile Yield Strength	207, MPa
Compressive Yield Strength	207, MPa
Tensile Ultimate Strength	586, MPa
Compressive Ultimate Strength	0, MPa
Thermal	
Thermal Conductivity	1,51e-002 W/mm·°C
Specific Heat	480, J/kg·°C
Electromagnetics	
Relative Permeability	10000
Resistivity	7,7e-004 Ohm·mm