Report

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Global simulation of copper canister – final deposition

Background

The aim is to have a probabilistic measure for validation of the canister design. A first step is to make a number of deterministic simulations with a carefully chosen variation of important parameters. Examples of such parameters are:

- Location of shear plane caused by an earthquake
- Buffer density which affects the stiffness
- Yield stress for the insert
- Ultimate stress for the insert

All simulations are based on the BWR-design since this case have results for current material properties for the nodular cast iron used for the insert. Eventually a similar study for the PWR-design will be performed later.

Summary

A large number of analyses with rock shearing has been performed to have input for a following probabilistic analysis of stresses and strains for the BWR-insert. Horizontal shearing planes have earlier been judged to be most probable and can, of course, occur at arbitrarily vertical coordinates and therefore a number (4) of different shear planes have been defined. For each shearing plane the material models used for buffer and insert have been varied within the most probable values for yield and ultimate stress limit for the nodular cast iron.

For each analysis the maximum values for plastic equivalent strain (PPEQ), Mises equivalent stress and the axial stress (S33) in the insert have been summarized for 9 preselected regions.

Sammanfattning

Ett stort antal analyser med bergskjuvning har genomförts för att ge indata till en efterföljande statistisk analys av påkänningar i BWR-insatsen. Horisontella skjuvplan har tidigare bedömts vara mest sannolika och kan naturligtvis inträffa på godtyckliga vertikala koordinater varför ett antal (4) olika skjuvplan definierats. För varje skjuvplan har därefter materialmodellerna för både buffert och insats varierats inom de mest troliga värden för sträck- och brottgräns.

För varje analys sammanfattas för insatsen maximala värden för plastisk equivalent töjning (PEEQ), Mises jämförelsespänning samt maximal dragspänning i axiell led (S33). För kopparskalet redovisas maximal plastisk equivalent töjning samt Mises jämförelsespänning för 9 delområden.

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1 Introduction

The canister has to be designed for earthquake induced rock shear corresponding to 5 centimeters displacement for a horizontal plane which seems to be most severe shear plane due to previous studies (Börgesson and Hernelind 2006). Since there are some uncertainties regarding parameters affecting the solution a probabilistic study will be performed. As a first step a number of deterministic analyses will be performed, see "PM Probalistisk analys av skjuvlastfallet" (SKBdoc 1336557).

1.1 Context for this report

One important function of the buffer material in a deposition hole in a repository for nuclear waste disposal is to reduce the damage of rock movements on the canister. The worst case of rock movements is a very fast shear that takes place along a fracture and occurs as a result of an earthquake. The consequences of such rock shear have been investigated earlier, both by laboratory tests (Börgesson et al. 2004), laboratory simulations in the scale 1:10 and finite element modelling (Börgesson et al. 1995, 2004, Börgesson and Hernelind 2006). Those investigations were focussed on a base case with a horizontal shear plane and Na-bentonite as buffer material. Also the influence of the shear angle was studied with 45 and 22.5 degrees inclination between the shear plane and the canister. A sequence of analyses has previously been performed for earthquake induced rock shear. The outcome of these analyses is described by Börgesson and Hernelind (2006). A final deterministic sequence of analyses have been summarized in Hernelind (2010) where the buffer material properties are based on Ca-bentonite instead of Na-bentonite since Na-bentonite normally will be transformed to Ca-bentonite (Ca-bentonite is stiffer than Na-bentonite and will therefore be a more severe case for the insert. Also copper shell, insert (iron) and steel lid (steel) material properties were based on the most recent experimental results.

This report summarizes the results for a sequence of parameter variations as:

- Location of shear plane caused by an earthquake
- Buffer density which affects the stiffness
- Yield stress for the insert
- Ultimate stress for the insert

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2 Simulation strategy

The performed simulations are all based on the same geometry (since the following probabilistic analyses don't include the geometry as a parameter) and consists of a copper shell, canister (iron) , lid (steel) and steel tube cassette (steel) surrounded by the buffer (bentonite). One parameter to vary is the location of the horizontal shear plane in the axial direction measured as the ratio between axial distance from the bottom of the insert and insert height. The mesh is focused close to each location of the shear plane for the buffer. The material definitions (low, mean and high) are described in section 4.1 and 4.4.

Table 2-1. Definition of simulation cases.

Case	Shear plane location	Insert		Buffer
		Yield stress	Ultimate stress	Density
N1	50%	mean	mean	low
N2	75%	mean	mean	low
N3	90%	mean	mean	low
N4	50%	mean	mean	mean
N5	75%	mean	mean	mean
N6	90%	mean	mean	mean
N7	50%	mean	mean	high
N8	75%	mean	mean	high
N8b_	75%	mean	mean	high
N9	90%	mean	mean	high
N10	50%	sensitivity	mean	mean
N11	50%	sensitivity	sensitivity	mean
N12	50%	low	low	low
N13	50%	high	low	low
N14	50%	low	high	low
N15	50%	high	high	low
N16	90%	low	low	low
N17	90%	high	low	low
N18	90%	low	high	low
N19	90%	high	high	low
N20	75%	low	mean	mean
N21	75%	high	mean	mean
N22	75%	mean	low	mean
N23	75%	mean	high	mean
N24	50%	low	low	high
N25	50%	high	low	high
N26	50%	low	high	high
N27	50%	high	high	high
N28	90%	low	low	high
N29	90%	high	low	high
N30	90%	low	high	high
N31	90%	high	high	high
N32	lid	low	low	low
N33	lid	mean	mean	mean
N34	lid	high	high	high

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N35	25%	mean	mean	high
N36	75%	low	low	low
N37	75%	high	low	low
N38	75%	low	high	low
N39	75%	high	high	low
N40	75%	low	low	high
N41	75%	high	low	high
N42	75%	low	high	high
N43	75%	high	high	high
N44	90%	low	low	mean
N45	90%	high	low	mean
N46	90%	low	high	mean
N47	90%	high	high	mean

	Shear plane position in axial direction			
Buffer density	25%	50%	75%	90%
1950		**N1** N12 N13 N14 N15	**N2** N36 N37 N38 N39	**N3** N16 N17 N18 N19b
2000		**N4** N10 N11	**N5** N20 N21 N22 N23	**N6** N44 N45 N46 N47
2050	**N35**	**N7** N24 N25 N26 N27	**N8** N40 N41 N42 N43	**N9** N28 N29 N30 N31

Figur 2-1. Matrix of simulation cases.

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3 Geometry definitions and meshes

3.1 General

The geometry used for analysis of the impact of earthquake induced rock shear consists of the insert (made of nodular cast iron), the insert lid (made of steel) and the copper shell surrounded by buffer material (bentonite). The geometry is based on CAD-geometries received from SKB, "Ritningsförteckning för kapselkomponenter" (SKBdoc 1203875) and should therefore correspond to the current design.

Due to symmetry only one half has been modelled. The mesh is then generated by 3-dimensional solid elements, mainly 8-noded hexahedral (most of them using full integration technique) and a few 6-noded wedge elements. The model size is defined by about 126,000 elements and 160,000 nodes (total number of variables about 650,000). Since several models have been executed with different mesh densities it has been possible to compare and the conclusion is that the mesh in a global sense is accurate.

The buffer has been partitioned at four different positions defining the rock shear perpendicular to the axis of the canister measured from the base (50%, 75%, 90% and at the top of the insert lid), Fig 3.1. These are assumed to be most critical ones.

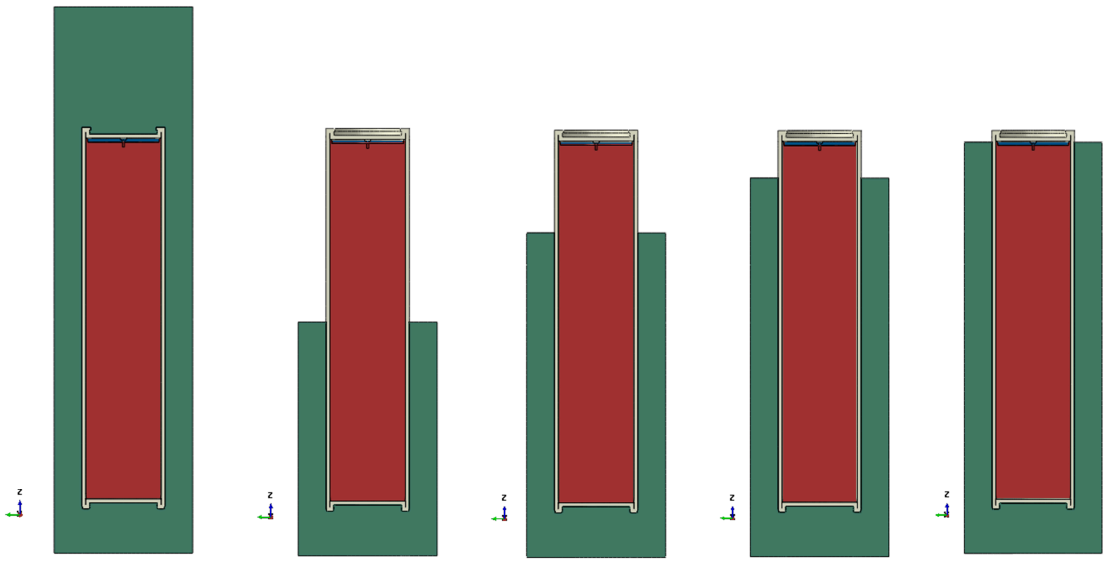

Figure 3-1. From left to right plot of geometry for rock shear perpendicular to axis of canister and shearing plane distance from base of the insert at 50%, 75%, 90% and at the top of the insert lid.

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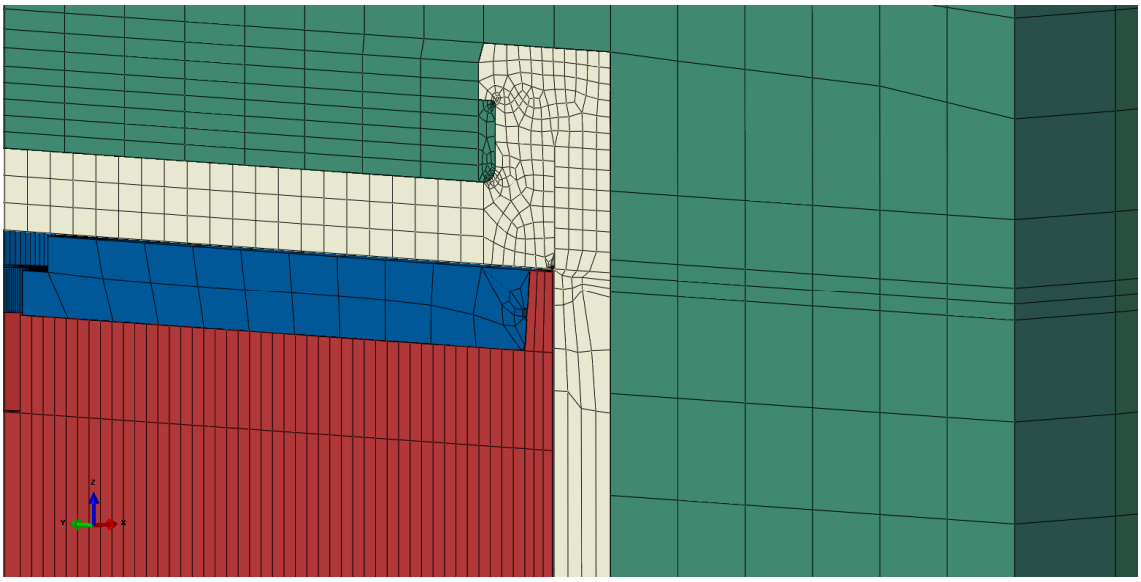

Figure 3-2. Detail of upper corner showing bentonite (green), copper shell (white), insert lid (blue) and insert (red).

3.2 Geometry of parts

3.2.1 Deposition hole

The model of the deposition hole has a diameter of 1.75 m and a length of 6.9 m. The canister is placed about 0.5 m above the bottom and about 1.5 m below the top of the deposition hole. Buffer material (bentonite) surrounds the canister and will fill out the deposition hole. The rock shear is then simulated by prescribing boundary conditions at the buffer envelope.

3.2.2 Insert (BWR)

The insert is made of nodular cast iron and has been simplified regarding the channel tubes which are assumed to be tied to the nodular cast iron insert and thus these contribute as added material to the insert. This simplification will probably overestimate stresses and strains in this region.

The insert is modeled as a homogeneous part with 3D solids, see Figure 3-3.

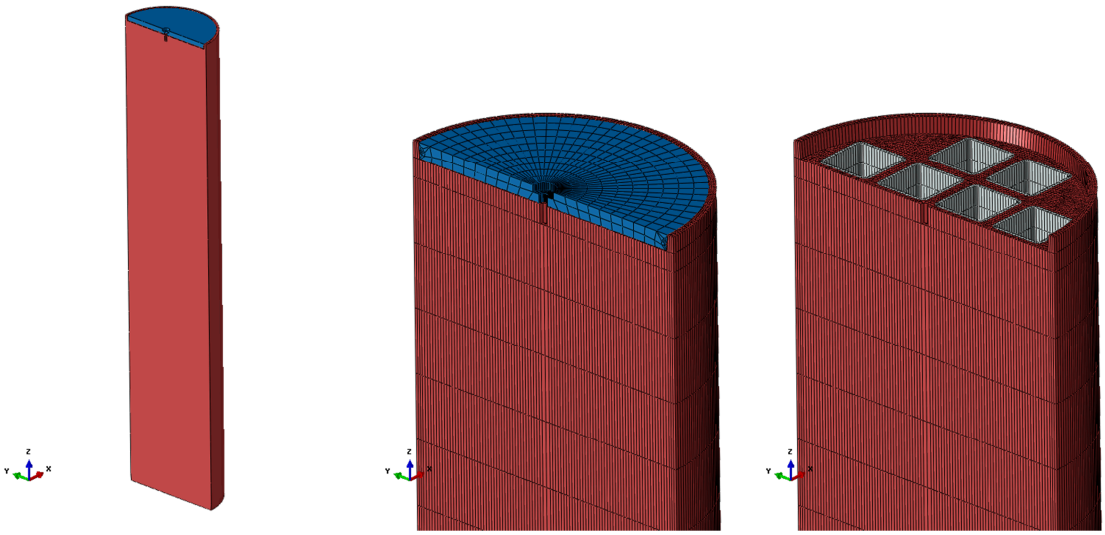

Figure 3-3. Insert BWR geometry (left), mesh with lid (mid) and without lid (right).

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However, the effect of modeling the channels as a separate part and defining contact conditions between the insert and the channels has also been analyzed in one analysis N8b_b. Figure 3-4 shows the channel tubes. However, the design also contains stiffeners between the cassettes which not are included in this model which means that this model probably will overestimate the stresses and strains in the cassettes.

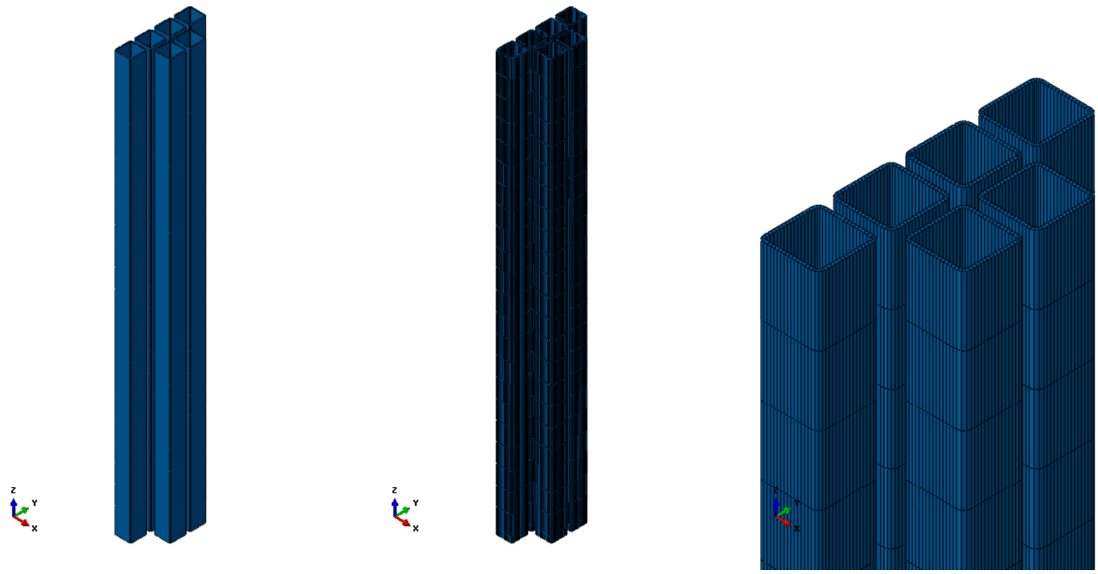

Figure 3-4. Insert channel tubes BWR geometry (left), mesh (mid) and detailed mesh (right).

3.2.3 Insert lid

The insert lid is made of steel and is modelled with 3D solids, see Figure 3-5.

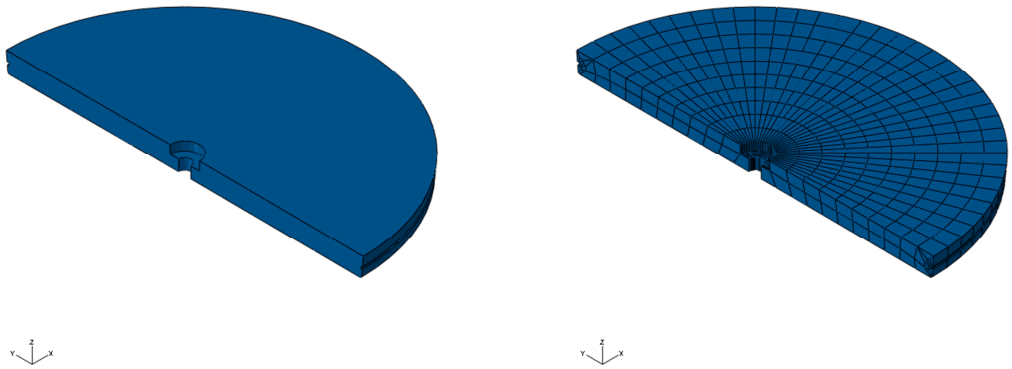

Figure 3-5. Insert lid geometry (left) and mesh (right).

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3.2.4 Copper shell

The copper shell surrounds the insert and interacts with the buffer and the insert. The canister has been modelled rather accurately in order to catch “hot spots” where large strains are expected, e.g. the fillets at the base and the top (the lid). The lid is welded to the flange and lid and canister will act as one part, see Figure 3-6.

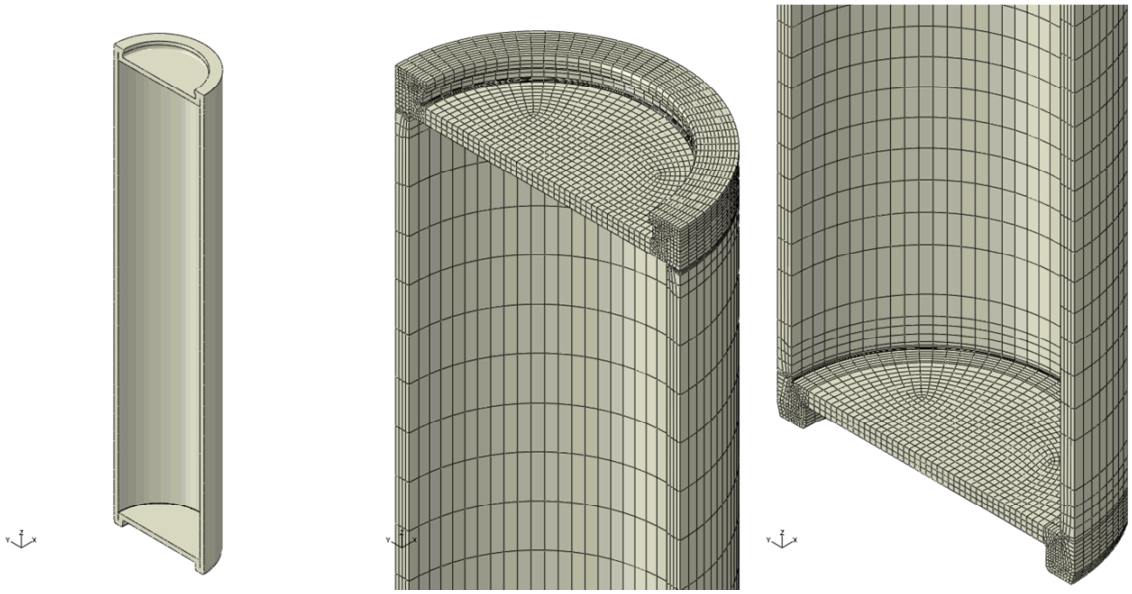

Figure 3-6. Copper shell geometry (left), mesh top (mid) and mesh base (right).

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4 Material models

The finite element code ABAQUS was used for the calculations. The materials have been modelled as elastic-plastic with stress-strain properties that correspond to each material and the applied shear load induced strain rate, when applicable.

4.1 Nodular cast iron (used by the insert)

The material model for the insert is based on a von Mises material model with elastic behaviour defined by Young's modulus and the Poisson's ratio and the plastic behaviour defined through yield surface (true stress) versus plastic strain (defined as logarithmic strain), see Table 4-1 and Figs 4-1 – 4-4 , "PM Probabilistisk analys av skjuvlastfallet" (SKBdoc 1336557). The last column contains the strain rate factor calculated from measurements of the base material, "Dragprovning av gjutjärn" (SKBdoc 1201865). The last row is arbitrarily defined at 10 MPa and is used only as an indication of failure even though none of the performed analyses did reach such a high plastic strain level. The von Mises plasticity theory is an isotropic model and will not treat tensile and compressive stresses differently and is tuned for tensile stresses which are assumed to be the most severe ones.

The experiments were performed at 20° C (room temperature).

Table 4-1. Stress-strain definition for insert at tension (but used also in compression).

Plastic Strain (%)	True stress (MPa) at low strain rate										
	low-low	mean-mean	high-high	s212-mean	s212-s356	high-low	low-mean	mean-high	mean -low	high-mean	Strain rate factor at strain rate=0.5
0	246.3	280.4	314.2	212.7	212.7	314.2	246.3	280.4	280.4	314.2	1.19
1.79	289.0	322.6	355.9	271.9	255.9	339.9	297.0	330.6	314.6	347.9	1.13
3.70	327.9	361.0	393.9	325.7	295.1	363.3	343.2	376.3	345.7	378.6	1.10
5.59	359.6	392.3	424.9	369.6	327.1	382.4	380.9	413.6	371.0	403.6	1.10
7.45	382.2	414.6	447.0	400.9	349.9	396.0	407.7	440.1	389.1	421.5	1.09
9.27	399.3	431.5	463.7	424.5	367.2	406.3	428.0	460.2	402.8	435.0	1.09
11.83	416.8	448.8	480.8	448.8	384.9	416.8	448.8	480.8	416.8	448.8	1.08
12.99	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	1.08

The strain rate dependency is defined by assuming that the yield surface is proportional to the strain rate factor (at the strain rate 0.5 1/s the factor 1.08 has been chosen and at strain rate 0 1/s the factor is 1.0).The instantaneous strain rate factor is then linearly interpolated between 1 and 1.08 using the instantaneous strain rate.

Furthermore, Young's modulus E = 166 GPa and Poisson's ratio ν = 0.32, see Raiko et al. (2010).

The simulations are using variation of yield stress and ultimate stress. The following values are used for the yield stress (technical stress/true stress), "PM Probalisitisk analys av skjuvlastfallet" (SKBdoc 1336557):

- Low yield stress 246/246.3 MPa
- Mean yield stress 279.8/280.3 MPa
- High yield stress 313.6/314.2 MPa
- Sensitivity yield stress 212.2/212.5 MPa

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Also the ultimate stress is varied:

- Low ultimate stress 377.1/437.4 MPa
- Mean ultimate stress 397.7/461.3 MPa
- High ultimate stress 418.3/485.2 MPa
- Sensitivity ultimate stress 356.5/384.9 MPa

Table 4-2 is then scaled linearly for all intermediate values assuming that the plastic equivalent strain is valid.

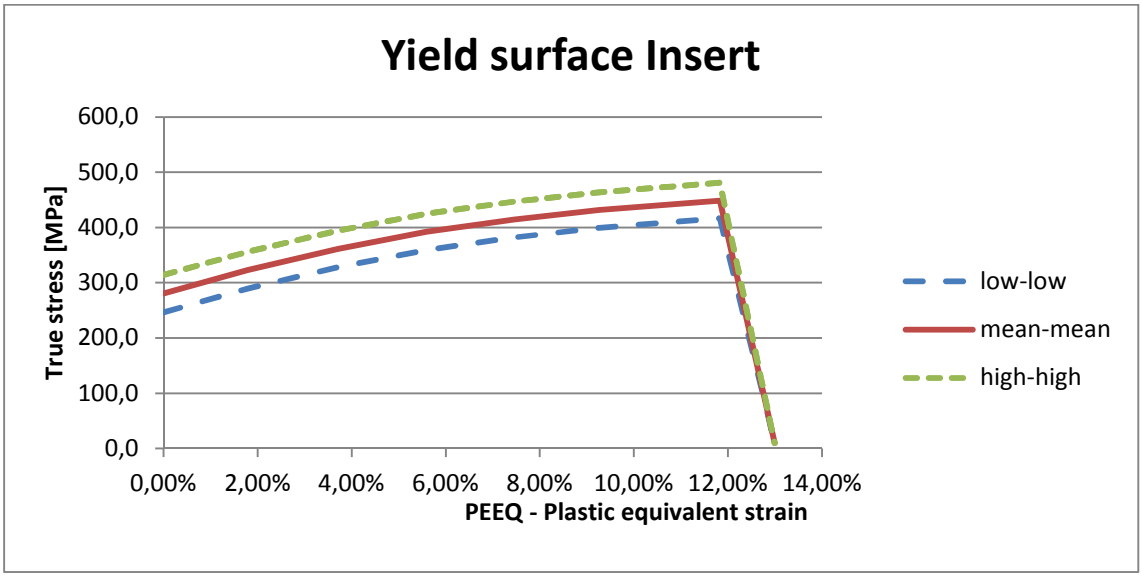

Figure 4-1. Yield surface [MPa] versus plastic strain [%] for low/mean/high yield stress and low/mean/high ultimate stress at low strain rate.

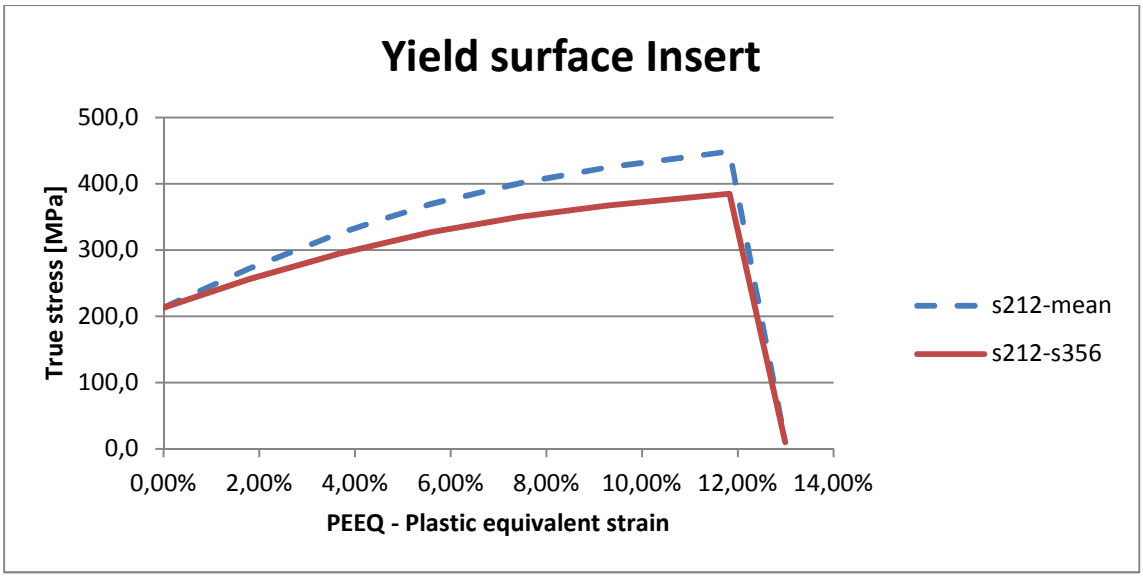

Figure 4-2. Yield surface [MPa] versus plastic strain [%] for yield stress 212.7 MPa and for mean and 384.9 MPa ultimate stress at low strain rate.

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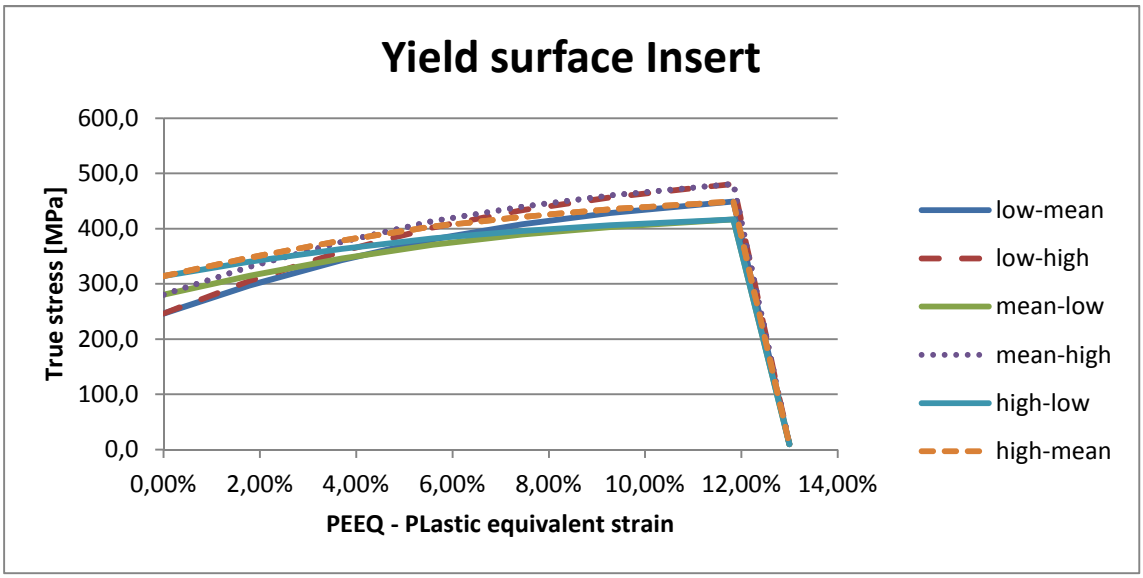

Figure 4-3. Yield surface [MPa] versus plastic strain [%] for low/mean/high yield stress and low/mean/high ultimate stress at low strain rate.

4.2 Steel (used by the channel tubes in the insert)

The material model for the channel tubes in the insert is based on a von Mises material model with elastic behaviour defined by Young's modulus and the Poisson's ratio. The plastic behaviour is defined through yield surface (true stress) versus plastic strain (using logarithmic strain).

The steel cassette tubes are manufactured by steel S355J2H, for example Domex 355 MC B. SKB has earlier supplied test data for the yield point of their material, however no stress-strain data to be used in a plastic analysis. The stress-strain curve for Domex 355 MC B (SSABDirect 2008) can be scaled using the yield stress and tensile ultimate strength measured by SKB, *Re* = 412 MPa (yield stress) and *Rm* = 511MPa (ultimate stress). With this procedure a simplified stress-strain curve is obtained and described by Table 4-2, see Raikko et al. (2010) (Table 4-3).

Table 4-2. Stress-strain definition for channel tubes used in the insert.

Strain (%)	Stress (MPa)	Log Strain (%)	True Stress (MPa)
0	0	0	0
0.196	412	0.196	412
15	509	14.3	587
20	511	18.5	613

Furthermore, Young's modulus E = 210 GPa and Poisson's ratio ν = 0.3.

The data with lowest value from the experiment has been chosen for the yield surface. However, the plasticity definition for the steel channel tubes has minor influence on the overall results due to almost elastic behavior.

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4.3 Steel (used by the insert lid)

The material model for the insert lid is based on a von Mises material model with elastic behaviour defined by Young's modulus and the Poisson's ratio. The plastic behaviour is defined through yield surface (true stress) versus plastic strain (calculated as logarithmic strain).

Manufacturing drawings for the lid specify steel S355J2G3. Strain versus stress for steel Domex 355 MC B with *Re* = 389 MPa (yield stress) and *Rm* = 484 MPa (ultimate stress) can be found from SSABDirect (2008). According to SS-EN 10025-2:2004 the material S355 with nominal thickness 40-63 mm has *Re* = 335 MPa (yield stress) and *Rm* = 470-630 MPa (ultimate stress). Scaling stress-strain curves for Domex 355 by the minimum values given in SS-EN 10025-2 implies the simplified material definition (engineering data) shown in Table 4-3.

Table 4-3. Stress-strain definition for the insert lid

Strain (%)	Stress (MPa)	Log Strain (%)	True Stress (MPa)
0	0	0	0
0.1595	335	0.1593	335
15	470	13.98	540
20	470	18.2	564

Furthermore, Young's modulus E = 210 GPa and Poisson's ratio ν = 0.3.

The data with lowest value from the experiments (SS-EN 10025-2:2004) has been chosen for the yield surface. However, the plasticity definition for the insert lid has very minor influence on the overall results.

4.4 Bentonite model (used for the buffer)

The bentonite is modelled based on recent experiments, see Börgesson et al. (2010) and adapted to the actual density of the bentonite. The bentonite buffer is modelled using only total stresses that do not include the pore water pressure, the reason being the very fast compression and shear.

The most important properties of the bentonite for the rock shear are the stiffness and the shear strength. These properties vary with bentonite type, density and rate of strain. Ca-bentonite has higher shear strength than Na-bentonite and the shear strength increases with increasing density and strain rate. Since it cannot be excluded that the Na-bentonite MX-80 will be ion-exchanged to Ca-bentonite the properties of Ca-bentonite is used in the modelling. The acceptable density at saturation of the buffer material is 1950 kg/m^3 - 2050 kg/m^3 which is covered by the models below.
The material model is in ABAQUS expressed with the von Mises' stress σ_j that describes the "shear stress" in three dimensions according to Equation 4-1.

$$\sigma_j=(((\sigma_1- \sigma_3)^2 + (\sigma_1- \sigma_2)^2 + (\sigma_2- \sigma_3)^2)/2)^{1/2} \qquad (4\text{-}1)$$

where σ_1, σ_2 and σ_3 are the principal stress components.

The material model defines the relation between the stress and the strain and is partitioned in elastic and plastic parts. For details regarding definition of the shear strength and the influence of density, pressure and rate of shear see Börgesson et al. (1995, 2004).

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Rate dependent elastic-plastic stress-strain relation

The elastic-plastic stress strain relations used for the three different densities are derived according to the description above in an identical way as the relations used in all previous calculations.

The bentonite is modelled as linear elastic combined with the von Mises plastic hardening - Table 4-4 shows the elastic constants. The plastic hardening curve is made a function of the strain rate of the material. The reason for the latter relation is that the shear strength of bentonite is rather sensitive to the strain rate. It increases with about 10 % for every 10 times increase in strain rate. Since the rock shear at an earthquake is very fast (1 m/s) the influence is strong and the resulting shear strength will be different at different parts of the buffer. Figure 4-4 shows the material model. The stress-strain relation is plotted at different strain rates.

Table 4-4. Elastic material data for the bentonite buffer Na converted to Ca.

Density/Swelling pressure	Elastic part	
	E (MPa)	ν
Low - 1950/5.3	243	0.49
Mean - 2000/8	307	0.49
High - 2050/12.3	462	0.49

The experiments (Börgesson et al. 2010) show that also Young's modulus (E) is dependent on strain rate but in the calculations this has been neglected and a representative stiffness has been chosen (sensitivity analyses did show minor changes of the results when varying Young's modulus between maximum and minimum values achieved from the experiments).

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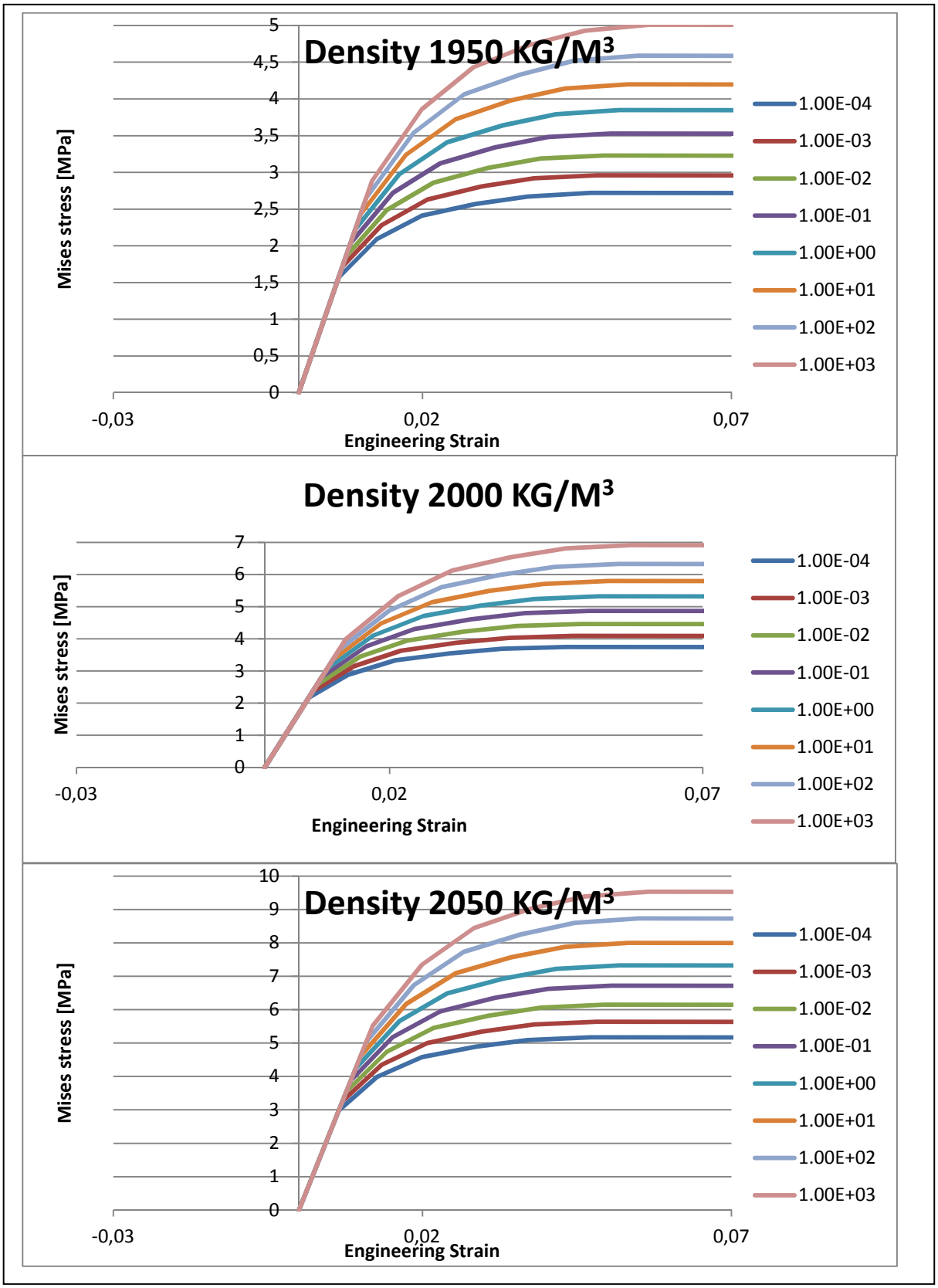

Figure 4-4. Plot of material definition for the bentonite buffer for different densities [KG/M^3] and strain rates (Mises stress [MPa] versus engineering strain). The strain rates are shown by legends from 0.0001 to 1000/s.

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4.5 Copper model

4.5.1 Kimab material

The stress-strain properties of the copper in the copper shell were investigated by the Corrosion and metals research institute Swerea Kimab and the results are then represented by a creep material model developed by Rolf Sandström, see Sandström and Andersson (2008), Jin and Sandström (2008) and Sandström et al. (2009).

The material model for the short duration rock shear analysis is based on a simplified elastic-plastic material model, see Table 4-5, using data from the creep model assuming a strain rate of 0.005/s which is considered as conservative.

The flow curve data has been calculated from Sandström et al. (2009) wherein eq.(17) has been used together with the parameter values defined in the corresponding Table 4-2, (Sandström et al. 2009) as well as $m = 3.06$, $\alpha = 0.19$, $\omega = 14.66$.

The copper model data is shown in Figure 4-5.

Table 4-5. Elastic-plastic material data for the copper at strain rate 0.005/s.

Elastic part		Plastic part: von Mises stress σ_j (MPa) at the following plastic strains (ε_p)					
E (MPa)	ν	0	0.10	0.20	0.30	0.40	0.50
$1.2 \cdot 10^5$	0.308	72	178	235	269	288	300

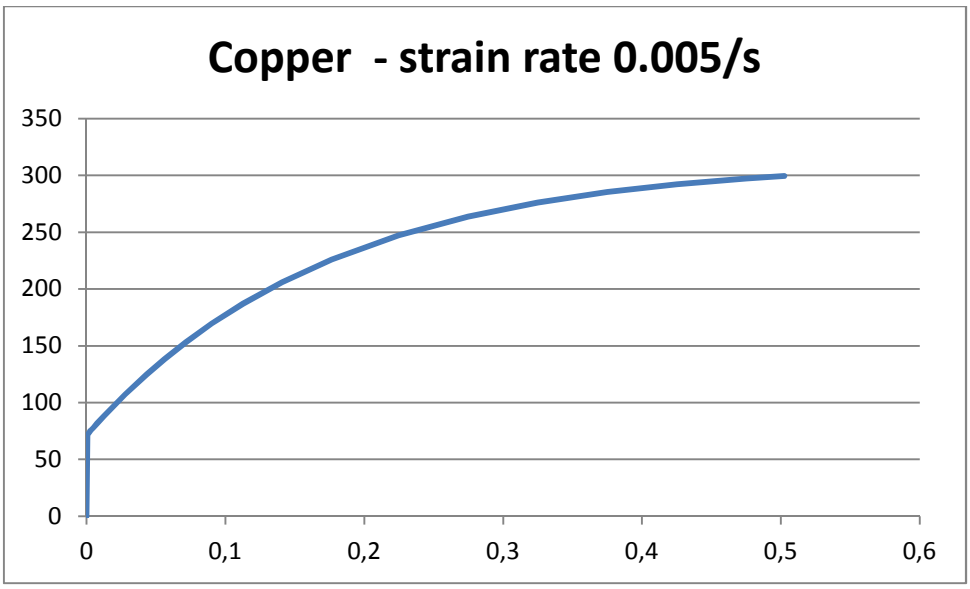

Figure 4-5. Copper shell material model gives the Mises stress [MPa] as a function of the engineering strain at strain rate 0.005/s.

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5 Contact definitions

All the boundaries of the buffer, the copper shell, the insert and the insert lid interact through contact surfaces allowing finite sliding. All contact surfaces have friction at sliding with no cohesion and the friction coefficient 0.1, i.e. the friction angle (ϕ) is 5.7˚ and the cohesion (c) is 0 kPa.

The contact is released when the contact pressure is lost.

A few contact pairs are tied together (tied means that the surfaces are constrained together and will not allow for opening/closing or sliding) in order to improve the numerical convergence rate. This applies at the contact pairs between the insert and insert lid and also at the base of insert and copper shell base.

The interaction between the buffer and the rock (not modelled) is assumed to be tied through prescribed boundary conditions and will not allow for opening/closing or sliding.

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6 Initial conditions

Initial conditions are defined as:

- Temperature for all nodes in the model is defined as 300 K but is not used in this study.

- Total pressure for the buffer is defined to simulate the swelling pressure (5.25, 8.04 and 12.3 MPa for density 1950, 2000 respectively 2050 kg/m^3) plus 500 meter water pressure (5 MPa) when using an elastic-plastic material model without pore pressure. The magnitude depends on the density of the and the stiffness of canister. The initial pressure has to be tuned to have a resulting pressure of 10.25, 13.04 respectively 17.3 MPa for the different densities and 22, 28 respectively 40.2 MPa has therefore been applied as initial pressure which gives about the right total pressure before the shearing starts.

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7 Boundary conditions

Symmetry conditions have been specified for the symmetry plane (displacements in the normal direction to the symmetry plane prescribed to zero), see Fig 7-1.

The surrounding rock has been simulated by prescribing the corresponding displacements at the outer surface of the buffer and depends also on type of simulation.

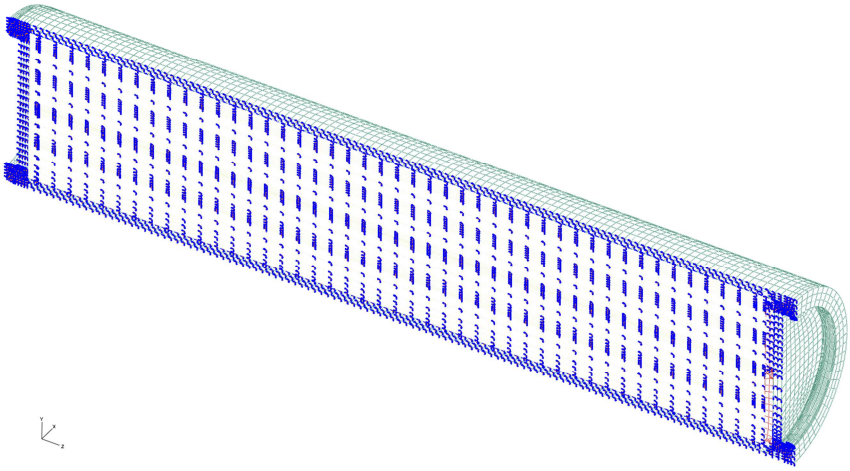

Figure 7-1. Prescribed symmetry conditions.

8 Calculations

8.1 General

8.1.1 Rock shear calculation cases

The reference case for BWR is based on Na-bentonite converted to Ca-bentonite with density 2050 kg/m^3. Also Ca-bentonite with densities 2000 kg/m^3 and 1950 kg/m^3 have been analyzed. Four cases of rock shear positions perpendicular to the axis of the canister have been analyzed (see also Table 2-1):

- at 50% of the height from the base
- at 75% of the height from the base
- at 90% of the height from the base
- at top of the steel lid

One additional case at 25% of the height from the base (N35) has been performed to check that there is no need for analyzing the corresponding positions at the lower part f the canister.

8.1.2 Analysis approach

The numerical calculations are performed using the FE-code ABAQUS (ABAQUS Manuals) version 6.11 assuming non-linear geometry and material definitions. This means that all non-linearities defined by the input will be considered such as large displacements, large deformations, non-linear interactions (contact) and non-linear materials. All non-linear contributions will be used when forming the equations to be solved for each equilibrium iteration. Short term analysis is based on static response but the results will depend on the time used for the simulation except since rate-dependent material data is used. The code will choose suitable time-increments for the loading based on (in most cases) default convergence tolerances.

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8.2 Short term analyses

The short term analyses (few seconds) consist of three steps where the shearing is prescribed by boundary conditions. In the first step initial stresses corresponding to the swelling pressure plus the 5 MPa hydrostatic pressure (the deposition is made about 500 meters below the surface) in the bentonite is applied. However, since the canister deforms when the initial stresses are applied the actual magnitude of the swelling pressure will decrease. For that reason the initial pressure for bentonite with density 2050 kg/m^3 (and measured swelling pressure of 12.3+5 MPa) is given as 40.2 MPa. For bentonite with density 2000 kg/m^3 (and measured swelling pressure of 8 MPa) the initial pressure is given as 28 MPa and for bentonite with density 1950 (and measured swelling pressure of 5.25 MPa) the initial pressure is given as 22 MPa. As expected the loss of initially defined pressure increases with increased stiffness of the bentonite. Another observation is that the swelling pressure will vary both in the axial and radial direction which means that it's not possible to have the correct swelling pressure without using elements with pore pressure as a degree of freedom (ABAQUS have those elements but the material model is tuned to total stresses and not effective stresses).

In the second step 5 cm is used for the shearing magnitude and finally the third step defines additional 5 cm shearing since the following probabilistic analyses needs results up to 10 cm shearing.

Two different shearing rates have been used, 5 cm/sec and 1 m/sec.

A sequence of analyses is performed for different material and shearing positions.

The results for BWR are shown in Appendix 1-6 for density 2050 kg/m^3.

9 Results

For each analysis a large amount of results are available and to have an indication only a few values are reported.

9.1 Results for rock shear

For the short term rock shear analyses the peak values for Mises' stress, axial stress and plastic strain (PEEQ) are summarized in Tables 9-1 – 9-24 and Figs 9-6 - 9-29. For each case two different shear velocities have been used, the first (e.g. N1b) is using 5 cm/sec and the second (e.g. N1b_finer_1sekm) is using 1 m/sec.

The steel channels have been defined by partitioning and thus uses common nodes with the cast iron insert except for cases N8b_b and N8b_b_1sekm have. For these two cases the steel channels are modelled as separate parts and thus also contain contact definition with friction between the steel channels and the cast iron insert.

Cast iron insert

The highest value for Mises stress, 458 MPa, occurs for case N8b_b_finer_1sekm (steel channels modelled as a separate part, stiff bentonite and mean values for yield and ultimate stress and shearing position 75% from base) at 10 cm shearing. Shearing position 75% implies the highest values. See Figs 9-1 and 9-6. Also the highest value for PEEQ, 7%, occurs for the same case; see Figs 9-1 and 9-8.

For the cast iron insert the failure criteria is based on stress level (maximum axial tension stress, S33) and thus Table 9-5 also contains the corresponding global stresses. As can be seen the highest value is about 378 MPa and occurs for case N43, see Fig 9-10.

Appendix 15 shows sorted values at 5 cm shearing for the cast iron insert.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

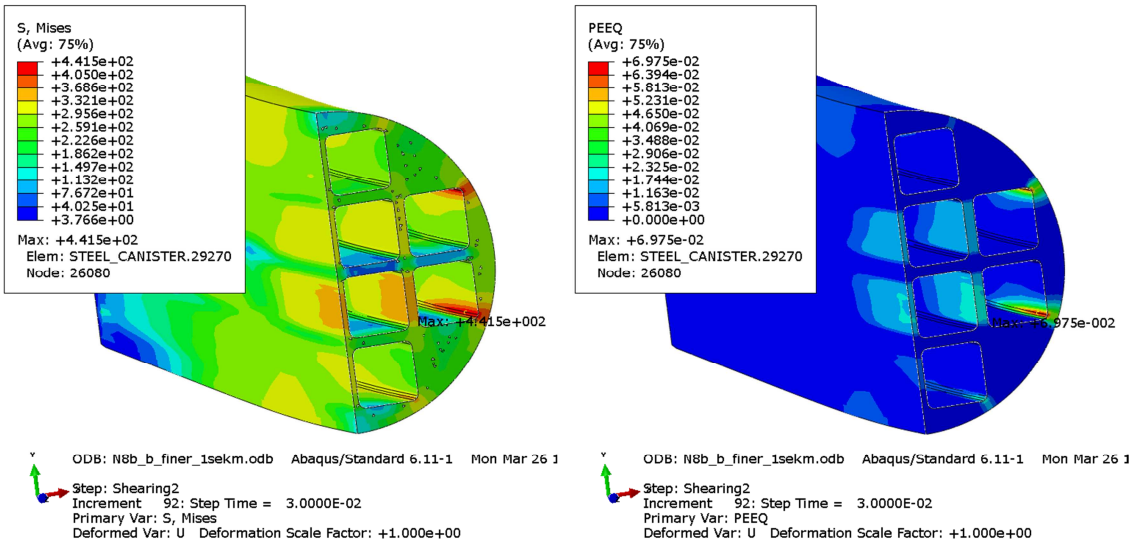

Figure 9-1. Plot of maximum Mises stress [MPa] (left) and PEEQ (right) in the cast iron insert. Shearing magnitude is 10 cm.

Steel channel tubes

The highest value for the Mises stress, 783 MPa, occurs also for case N8b_b_finer_1sekm; see Figs 9-2 and 9.7. Highest value for PEEQ, 3.53%, occurs for case N40_finer1sekm (channels modelled as glued to the cast iron insert), see Figs 9-2 and 9-9.

The axial stress, S33, reach about 470 MPa for several cases with shearing position equal to 75%. Another observation is the sensitivity of shearing velocity for case N5b_finer_1sekm, see Fig 9-11.

Appendix 15 shows sorted values for the steel channels at 5 cm shearing.

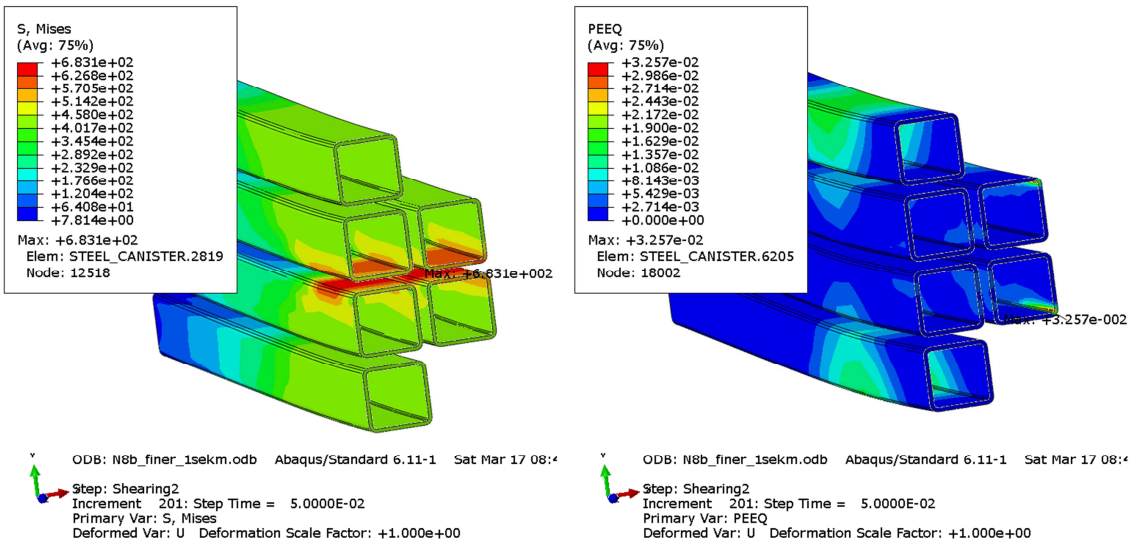

Figure 9-2. Plot of maximum Mises stress [MPa] (left) and PEEQ (right) in the steel channels. Shearing magnitude is 10 cm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Output regions copper shell

The peak values for Mises stress and plastic strain occur at a few “hot spots” and therefore the results for the copper shell are reported for nine regions (in the cylindrical part, in areas containing the welds (top and base), in areas containing geometric discontinuity (top and base), the fillet regions (top and base) and finally the remaining regions (top and base), see Fig 9-3.

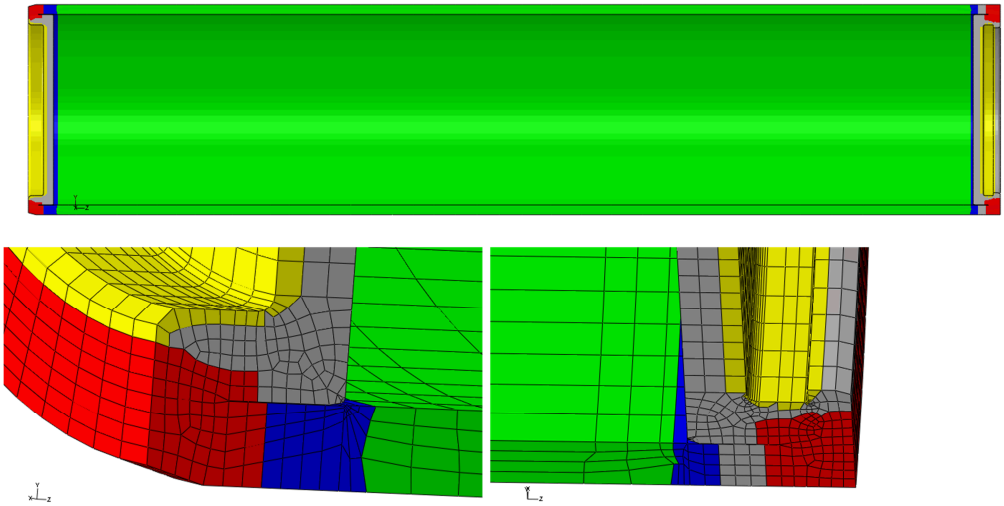

Figure 9-3. Output regions for copper shell. Region 1 - mid canister (green). Region 2 – top weld (red, lower right). Region 3 – base weld (red, lower left). Region 4 – top discontinuous geometry (blue, lower right). Region 5 – base discontinuous geometry (blue, lower left). Region 6 – top fillet (yellow, lower right). Region 7 – base fillet (yellow, lower left). Region 8 – top reminding (grey, lower right). Region 9 – base reminding (grey, lower left).

Copper shell

The maximum Mises stress, 295 MPa, is shown in Figs 9.12 – 9.20 and occurs for case N47b_finer_1sekm (Region 4, which has a discontinuous geometry) at 10 cm shearing. One observation is that the maximum value in each region occurs for different cases.

The highest value for PEEQ in the copper shell, 69.5% (Fig 9-4), occurs when the rock shear location is at 90%, case N31b_finer_1sekm at 10 cm shearing. However, the largest values are at the top (Region 4) where the geometry is discontinuous and where the maximum value strongly depends on the mesh density. The peak value mainly is in a compressive state. Besides the singular regions the highest value occurs at the top fillet (Region 6), 17% (Fig 9-5), and occurs also for case N27b_finer_1sekm. The numbers in Tables 9-11 – 9-27 are for copper shell shown at nine regions, see Fig 9-3. The values should be used with care and in combination with the corresponding plots.

Appendix 14 shows sorted values at 5 cm shearing.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

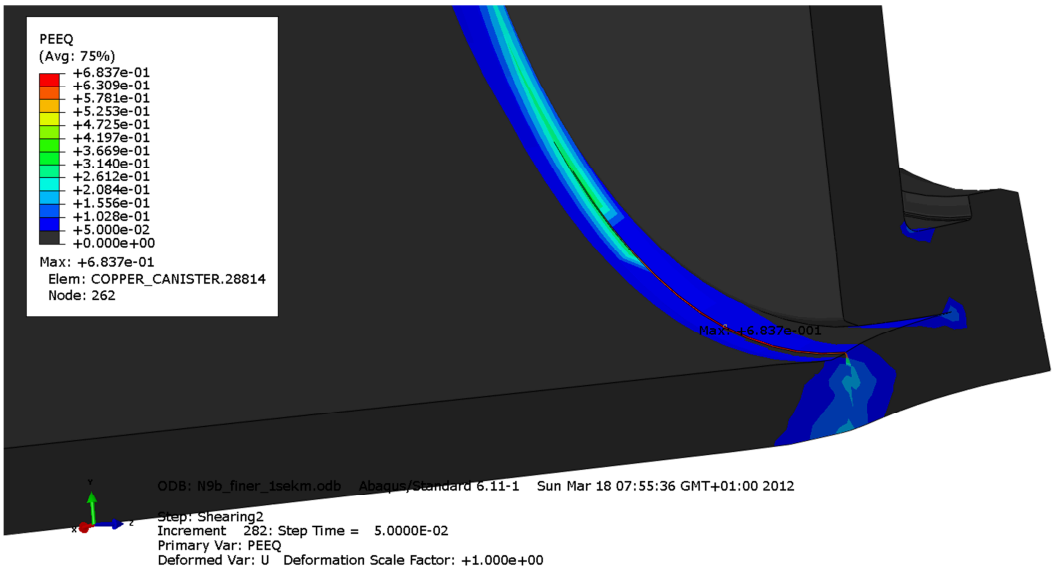

Figure 9-4. Plot of maximum PEEQ (plastic equivalent strain) in the copper shell where the geometry has a discontinuity (only values above 5% are plotted).

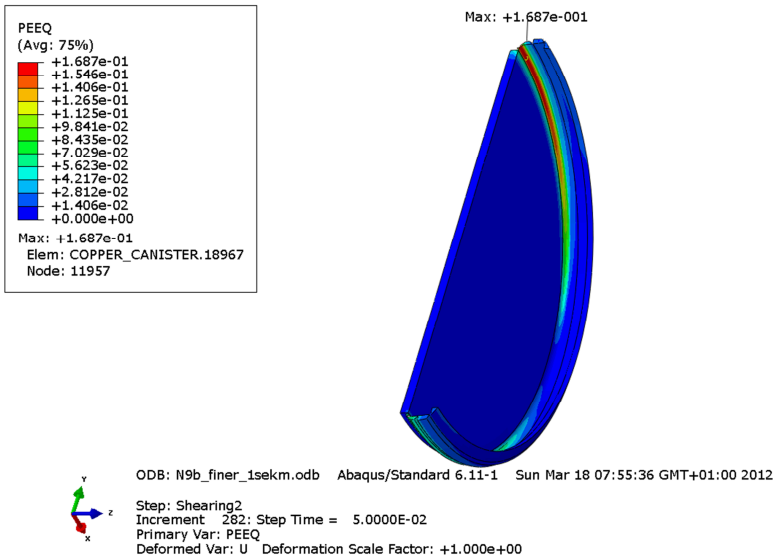

Figure 9-5. Plot of maximum PEEQ (plastic equivalent strain) in copper shell top fillet.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-1. Maximum Mises stress [MPa] for the insert at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	148.1	116.4	137.0	149.4	156.9	162.0	165.8	168.8	171.4	173.7
2 - N1b_finer_1sekm	82.7	122.5	146.9	161.8	171.0	177.2	181.8	185.5	188.6	191.5
3 - N2b	144.1	241.9	281.7	283.1	284.6	286.4	288.8	291.6	294.7	297.8
4 - N2b_finer_1sekm	148.4	252.5	284.7	287.1	289.4	293.0	297.6	302.0	306.1	310.1
5 - N3b	115.8	116.4	117.1	117.6	118.3	123.6	136.5	148.5	159.7	170.0
6 - N3b_finer_1sekm	64.6	65.1	80.2	98.0	114.3	129.1	143.2	156.1	168.3	180.0
7 - N4b	83.9	134.2	165.2	185.2	198.3	207.2	213.8	219.1	223.9	228.0
8 - N4b_finer_1sekm	85.5	140.4	176.6	201.0	217.6	229.6	239.4	247.8	255.4	261.1
9 - N5b	151.3	258.2	282.0	284.4	287.3	291.3	296.0	300.8	305.6	310.2
10 - N5b_finer_1sekm	155.7	268.1	286.2	289.7	294.5	300.8	306.3	311.4	316.4	321.1
11 - N6b_finer	122.6	199.6	260.1	280.9	281.9	282.9	283.9	285.0	286.1	287.4
12 - N6b_finer_1sekm	123.9	204.4	268.4	282.9	284.1	285.3	286.6	288.0	289.9	292.3
13 - N7b	151.7	209.7	256.3	280.7	281.5	282.3	283.4	284.5	285.7	287.0
14 - N7b_finer_1sekm	141.2	218.4	276.5	284.5	289.0	293.1	296.2	298.9	301.9	303.5
15 - N8b	188.5	281.4	284.8	289.3	295.0	300.8	306.5	312.0	317.5	322.8
16 - N8b_finer_1sekm	193.8	286.5	292.0	298.9	306.1	312.1	318.0	323.7	329.3	334.6
17 - N8b_b	263.3	287.3	314.3	337.5	354.9	264.5	373.6	381.2	387.9	393.6
18 - N8b_b_finer_1sekm	305.2	327.7	362.2	387.8	405.6	420.1	431.8	441.5		
19 - N9b_finer	160.7	256.6	282.3	283.6	284.9	286.8	289.3	292.2	295.3	298.6
20 - N9b_finer_1sekm	162.7	262.2	284.4	286.6	288.7	291.6	295.4	299.1	302.9	306.3

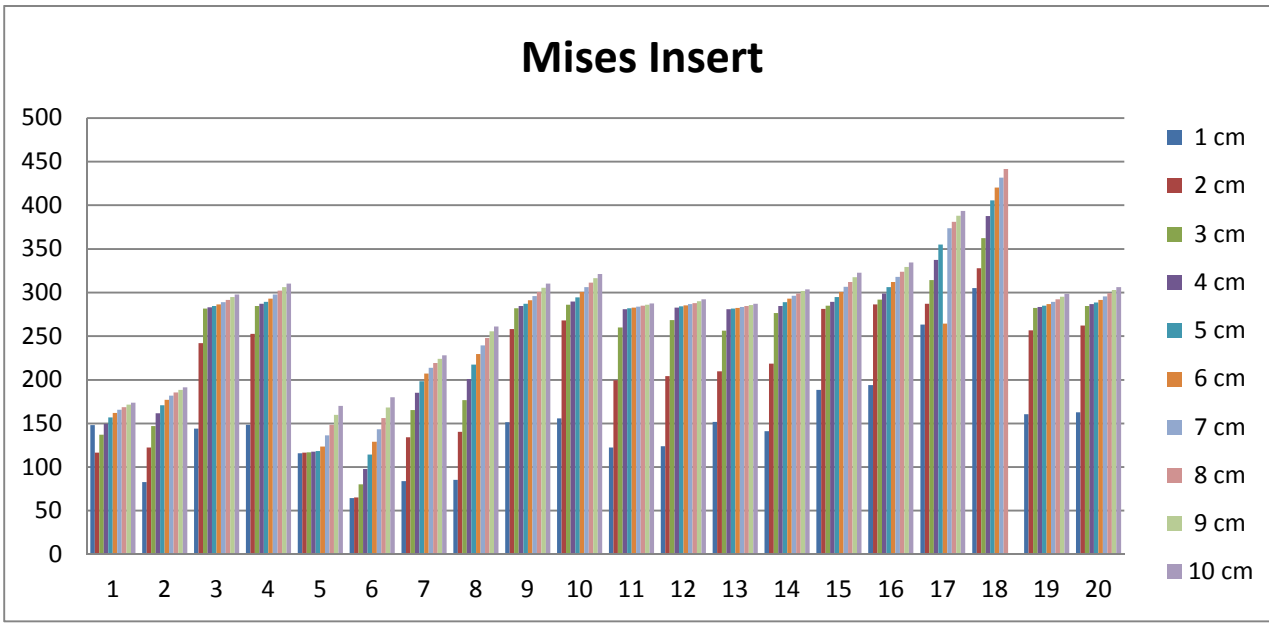

Figure 9-6. Maximum Mises stress [MPa] for the insert at 1 to 10 cm shearing. Case numbering follows Table 9-1

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-2. Maximum Mises stress [MPa] for the steel channels at 1 to 10 cm shearing.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	167.8	242.5	284.4	309.7	325.4	336.2	344.4	351.3	357.2	362.5
2 - N1b_finer_1sekm	171.3	254.8	303.9	334.2	353.5	366.3	376.0	384.0	390.9	397.4
3 - N2b	190.0	298.0	384.8	434.2	448.0	455.1	454.1	451.6	468.8	488.3
4 - N2b_finer_1sekm	193.1	309.0	400.7	447.7	455.5	452.8	453.1	467.0	494.1	527.2
5 - N3b	113.2	152.2	182.2	191.1	205.0	216.0	224.7	231.1	243.2	254.0
6 - N3b_finer_1sekm	116.3	150.2	180.8	204.7	207.1	219.7	228.7	240.9	253.5	264.4
7 - N4b	173.2	277.1	340.5	381.9	409.1	427.4	441.0	447.9	446.3	445.6
8 - N4b_finer_1sekm	176.1	289.7	363.7	413.7	447.3	446.0	450.5	448.1	447.4	445.3
9 - N5b	190.8	320.2	429.8	455.9	450.9	452.7	474.4	509.2	559.2	617.4
10 - N5b_finer_1sekm	193.3	331.5	439.2	454.8	450.3	453.8	481.1	520.0	575.0	621.0
11 - N6b_finer	210.5	281.0	342.0	389.2	433.4	452.4	456.0	458.0	462.1	468.3
12 - N6b_finer_1sekm	214.0	291.8	358.6	411.2	452.7	456.5	465.8	465.8	471.1	474.9
13 - N7b	293.0	436.7	451.4	451.5	451.3	450.1	454.4	462.0	465.4	468.1
14 - N7b_finer_1sekm	296.6	451.2	446.1	449.1	464.7	469.4	468.0	467.2	468.2	468.5
15 - N8b	291.8	452.2	451.3	467.0	465.7	496.0	559.3	609.1	655.5	673.3
16 - N8b_finer_1sekm	295.0	451.0	459.4	464.6	464.8	496.1	562.2	606.0	657.3	683.1
17 - N8b_b	379.2	485.6	598.7	668.8	700.4	719.7	729.1	735.5	748.9	758.3
18 - N8b_b_finer_1sekm	734.2	710.5	720.1	733.4	753.4	778.5	768.8	778.2		
19 - N9b_finer	313.2	419.3	470.9	486.7	473.9	472.3	476.8	485.6	489.2	491.7
20 - N9b_finer_1sekm	315.7	427.8	477.7	474.5	470.8	486.6	492.8	498.5	501.0	501.9

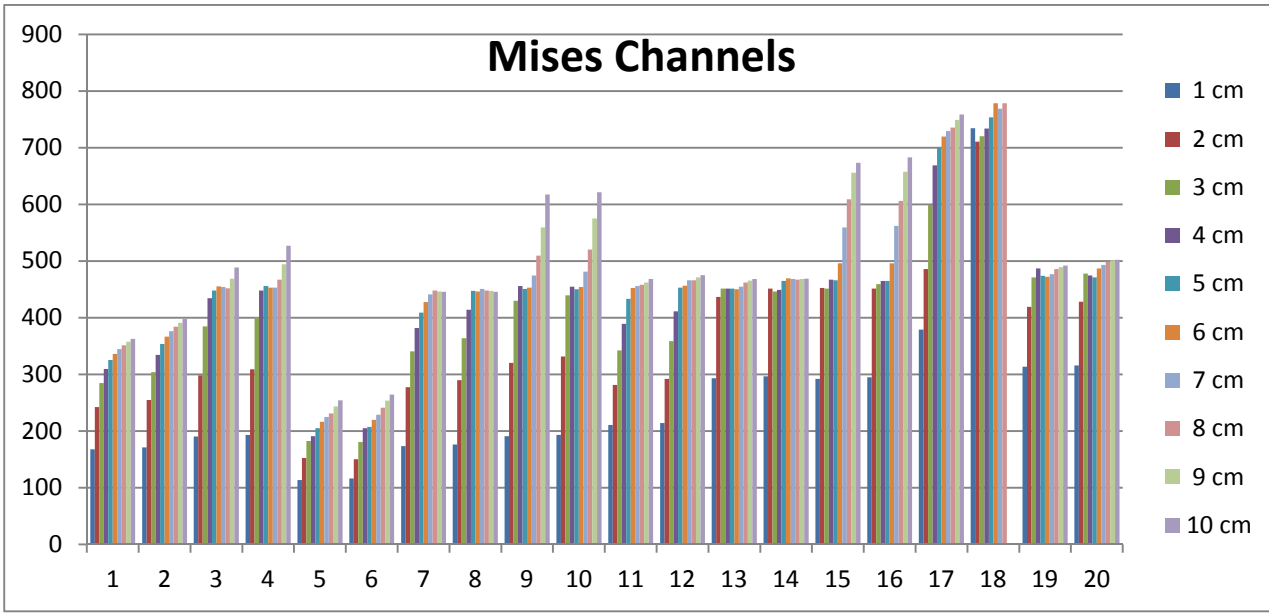

Figure 9-7. Maximum Mises stress [MPa] for the steel channels at 1 to 10 cm shearing. Case numbering follows Table 9-2.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-3. Maximum Plastic equivalent strain (PEEQ [%]) for the insert at 1 to 10 cm shearing.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 - N1b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 - N2b	0.00	0.00	0.03	0.10	0.17	0.25	0.34	0.46	0.59	0.72
4 - N2b_finer_1sekm	0.00	0.00	0.04	0.12	0.21	0.31	0.44	0.59	0.76	0.92
5 - N3b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 - N3b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 - N4b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8 - N4b_finer_1sekm	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
9 - N5b	0.00	0.00	0.06	0.16	0.28	0.44	0.64	0.84	1.04	1.24
10 - N5b_finer_1sekm	0.00	0.00	0.07	0.18	0.30	0.48	0.68	0.89	1.10	1.30
11 - N6b_finer	0.00	0.00	0.00	0.02	0.06	0.10	0.14	0.19	0.24	0.29
12 - N6b_finer_1sekm	0.00	0.00	0.00	0.03	0.07	0.12	0.17	0.22	0.28	0.35
13 - N7b	0.00	0.00	0.00	0.02	0.05	0.08	0.14	0.20	0.26	0.33
14 - N7b_finer_1sekm	0.00	0.00	0.00	0.06	0.15	0.32	0.47	0.62	0.75	0.88
15 - N8b	0.00	0.04	0.17	0.36	0.59	0.84	1.08	1.31	1.55	1.77
16 - N8b_finer_1sekm	0.00	0.04	0.18	0.36	0.60	0.84	1.09	1.33	1.57	1.80
17 - N8b_b	0.01	0.29	1.35	2.58	3.29	3.83	4.37	4.84	5.26	5.65
18 - N8b_b_finer_1sekm	0.36	1.01	2.52	3.62	4.58	5.42	6.22	6.98		
19 - N9b_finer	0.00	0.00	0.04	0.11	0.18	0.26	0.36	0.49	0.62	0.76
20 - N9b_finer_1sekm	0.00	0.00	0.04	0.12	0.19	0.28	0.39	0.52	0.66	0.81

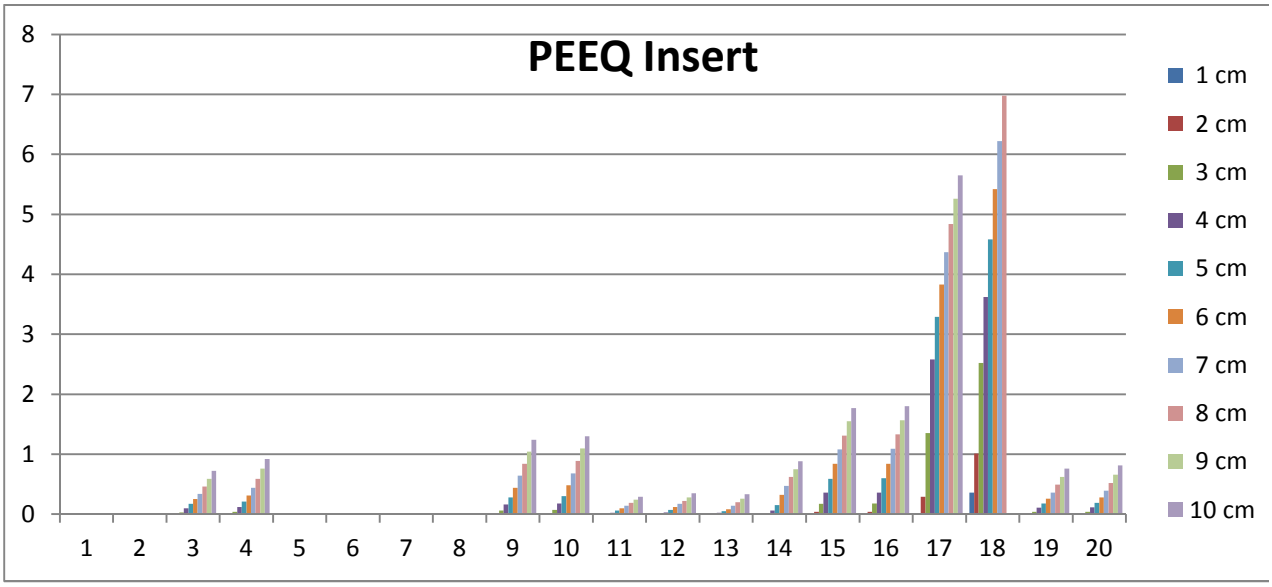

Figure 9-8. Maximum Plastic equivalent strain (PEEQ [%]) for the insert at 1 to 10 cm shearing. Case numbering follows Table 9-3.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-4. Maximum Plastic equivalent strain (PEEQ [%]) for the steel channels at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 - N1b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 - N2b	0.00	0.00	0.00	0.05	0.12	0.20	0.31	0.43	0.57	0.71
4 - N2b_finer_1sekm	0.00	0.00	0.00	0.06	0.15	0.26	0.40	0.56	0.73	0.90
5 - N3b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 - N3b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 - N4b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.04
8 - N4b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.05	0.08	0.09	0.10	0.09
9 - N5b	0.00	0.00	0.01	0.11	0.23	0.41	0.62	0.84	1.05	1.26
10 - N5b_finer_1sekm	0.00	0.00	0.01	0.12	0.25	0.44	0.65	0.86	1.08	1.29
11 - N6b_finer	0.00	0.00	0.00	0.00	0.00	0.05	0.08	0.13	0.18	0.23
12 - N6b_finer_1sekm	0.00	0.00	0.00	0.00	0.03	0.08	0.11	0.16	0.22	0.30
13 - N7b	0.00	0.00	0.08	0.14	0.22	0.30	0.42	0.54	0.66	0.79
14 - N7b_finer_1sekm	0.00	0.01	0.10	0.24	0.46	0.79	1.06	1.33	1.60	1.86
15 - N8b	0.00	0.02	0.14	0.41	0.83	1.24	1.66	1.98	2.35	2.67
16 - N8b_finer_1sekm	0.00	0.04	0.16	0.48	1.02	1.53	2.04	2.48	2.89	3.26
17 - N8b_b	0.00	0.00	0.08	0.25	0.44	0.63	0.84	1.11	1.41	1.70
18 - N8b_b_finer_1sekm	0.10	0.16	0.22	0.32	0.48	0.68	0.90	1.12		
19 - N9b_finer	0.00	0.00	0.08	0.10	0.18	0.29	0.47	0.63	0.79	0.96
20 - N9b_finer_1sekm	0.00	0.00	0.09	0.12	0.23	0.40	0.65	0.90	1.19	1.50

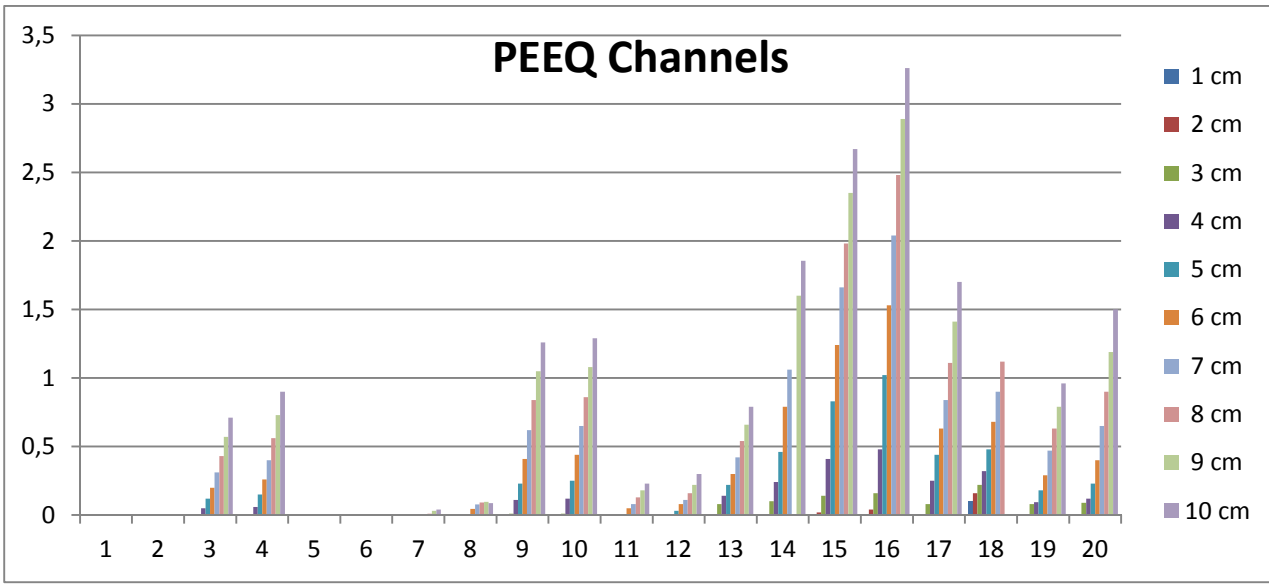

Figure 9-9. Maximum Plastic equivalent strain (PEEQ [%]) for the steel channels at 1 to 10 cm shearing. Case numbering follows Table 9-4.

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Table 9-5. Maximum Axial stress (S33) [MPa] for the insert at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	39.6	70.6	88.3	99.7	107.8	113.6	118.0	121.6	124.5	127.1
2 - N1b_finer_1sekm	63.4	77.2	98.2	111.9	121.9	128.9	134.3	138.6	142.1	145.2
3 - N2b	113.9	219.1	286.1	290.2	293.3	296.8	300.7	303.7	306.1	308.3
4 - N2b_finer_1sekm	118.1	229.6	290.9	296.4	300.4	305.5	310.6	314.7	318.3	322.0
5 - N3b	23.1	23.4	41.5	60.2	76.9	91.9	106.0	119.2	131.5	142.9
6 - N3b_finer_1sekm	37.8	39.5	44.7	64.1	81.8	97.6	112.5	126.6	139.7	152.1
7 - N4b	44.1	85.0	111.5	129.3	141.9	151.6	158.9	164.7	169.5	173.7
8 - N4b_finer_1sekm	85.5	91.1	122.4	144.7	160.8	173.2	182.6	190.0	196.3	201.3
9 - N5b	119.7	233.9	288.8	295.3	303.2	309.5	313.8	317.8	321.8	325.7
10 - N5b_finer_1sekm	123.3	243.4	294.1	300.8	309.9	317.2	322.0	326.3	330.5	335.0
11 - N6b_finer	89.7	172.0	237.0	285.1	289.1	291.3	293.4	295.2	297.0	298.8
12 - N6b_finer_1sekm	90.9	176.3	244.3	288.2	292.1	294.6	296.8	298.9	301.8	304.9
13 - N7b	61.1	121.2	161.5	188.1	206.7	219.6	229.4	237.3	244.1	250.3
14 - N7b_finer_1sekm	89.5	131.6	177.4	209.7	233.0	249.8	262.7	273.4	282.8	286.8
15 - N8b	132.2	278.0	293.2	302.4	309.8	314.4	319.0	323.4	327.9	332.3
16 - N8b_finer_1sekm	138.1	286.3	302.1	310.5	318.4	323.4	328.5	334.1	339.8	345.0
17 - N8b_b	131.4	280.5	303.2	314.0	323.1	329.4	335.3	340.4	345.2	349.7
18 - N8b_b_finer_1sekm	87.8	228.1	302.7	312.3	319.4	326.5	332.3	337.3		
19 - N9b_finer	104.5	210.0	281.0	285.8	289.4	292.4	295.8	298.9	301.8	304.7
20 - N9b_finer_1sekm	106.4	215.2	284.5	290.5	294.2	297.8	302.4	306.4	309.8	312.9

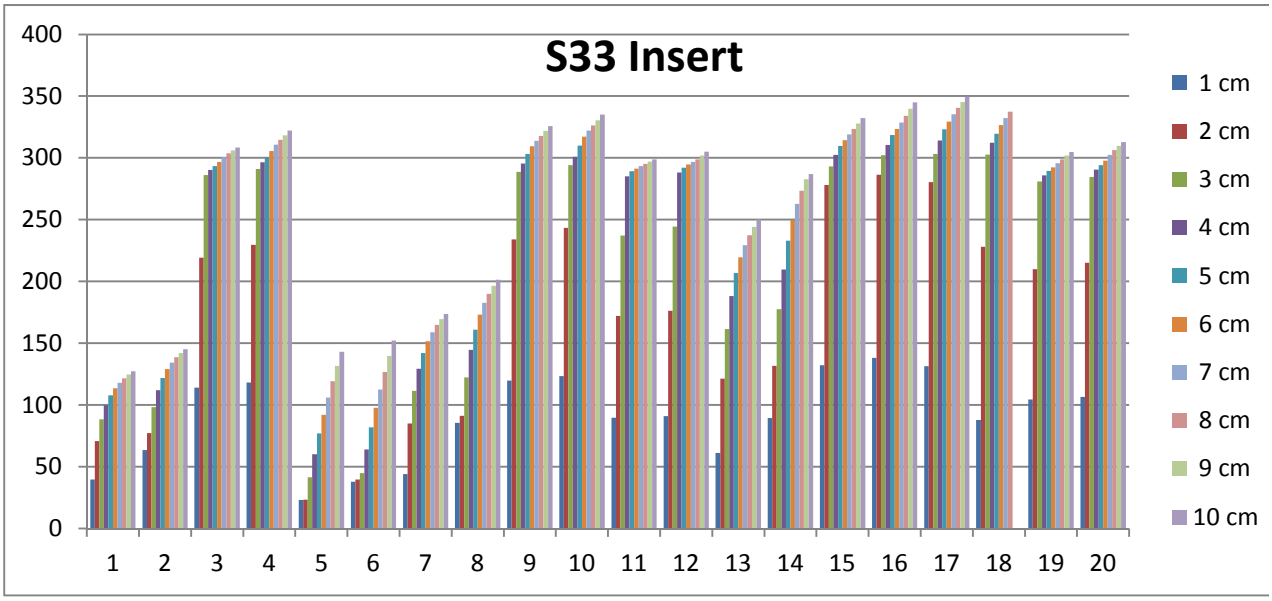

Figure 9-10. Maximum axial stress (S33) [MPa] for the insert at 1 to 10 cm shearing. Case numbering follows Table 9-5.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-6. Maximum axial stress (S33) [MPa] for the steel channels at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	37.6	73.2	93.7	106.4	114.5	120.3	124.5	128.2	131.4	134.2
2 - N1b_finer_1sekm	38.8	77.5	101.2	116.6	126.4	133.1	138.6	143.3	147.1	150.3
3 - N2b	117.6	232.6	324.6	410.7	423.4	431.1	438.6	443.4	446.0	446.9
4 - N2b_finer_1sekm	118.7	237.7	339.3	415.7	429.7	439.9	446.3	449.7	451.5	452.9
5 - N3b	6.5	19.9	40.5	60.2	77.9	94.2	109.2	123.1	136.1	148.1
6 - N3b_finer_1sekm	6.1	20.3	41.6	61.6	80.3	97.0	112.7	127.1	140.4	153.2
7 - N4b	45.1	90.5	120.0	140.1	153.7	163.3	171.1	177.5	182.9	187.5
8 - N4b_finer_1sekm	45.2	93.8	127.9	152.3	169.3	181.5	191.4	199.5	206.3	211.6
9 - N5b	119.7	233.9	288.8	295.3	303.2	309.5	313.8	317.8	321.8	325.7
10 - N5b_finer_1sekm	127.7	256.1	389.2	429.9	444.8	453.2	457.4	459.9	461.7	463.3
11 - N6b_finer	91.5	178.0	247.1	303.3	363.5	410.7	417.3	423.9	429.2	434.1
12 - N6b_finer_1sekm	92.9	183.0	255.1	314.8	386.6	415.2	424.2	430.3	435.3	440.4
13 - N7b	53.6	121.2	166.6	195.6	215.6	230.1	240.7	249.2	256.4	262.8
14 - N7b_finer_1sekm	54.7	127.4	178.3	213.1	237.4	255.2	268.8	279.7	289.3	297.4
15 - N8b	134.0	289.3	417.3	440.0	451.7	456.1	458.4	459.9	463.9	466.2
16 - N8b_finer_1sekm	134.9	293.8	418.3	441.3	451.3	455.4	460.3	464.3	467.3	468.9
17 - N8b_b	105.1	203.6	319.2	365.5	370.5	380.6	386.8	390.8	394.0	396.5
18 - N8b_b_finer_1sekm	156.1	177.7	277.8	376.5	383.1	388.1	387.9	385.6		
19 - N9b_finer	101.6	209.0	292.3	396.5	406.0	414.2	422.1	427.6	430.6	432.8
20 - N9b_finer_1sekm	103.5	214.4	301.4	399.4	408.1	417.3	425.3	430.1	432.7	434.4

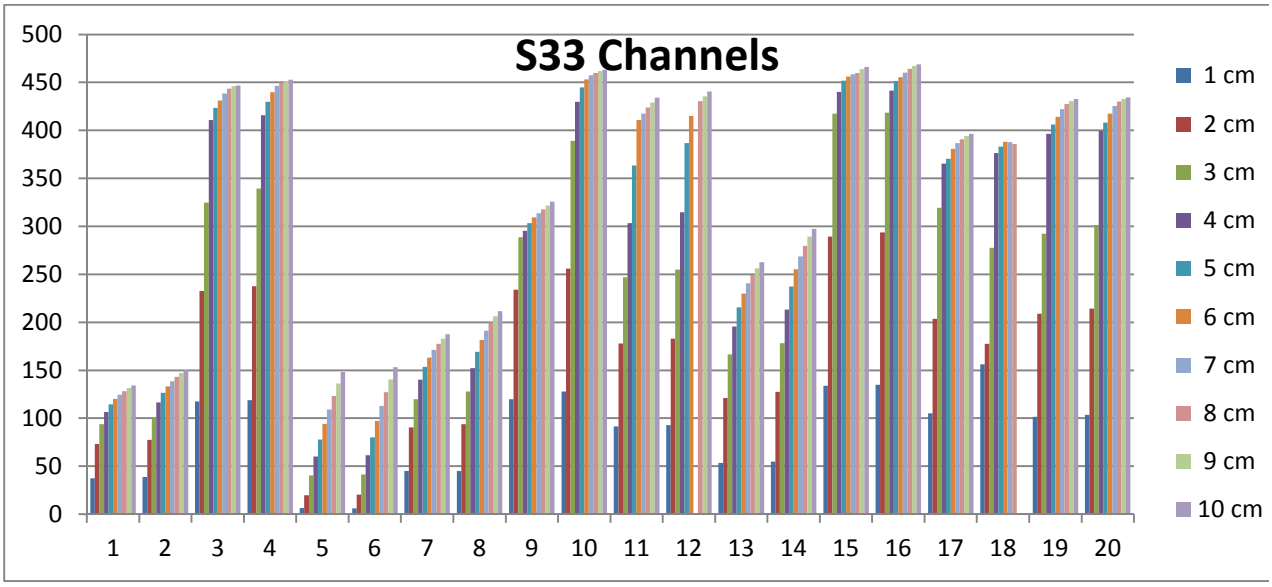

Figure 9-11. Maximum axial stress (S33) [MPa] for the steel channels at 1 to 10 cm shearing. Case numbering follows Table 9-6.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-7. Maximum Mises stress [MPa] for the copper shell, Region 1, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	96.5	93.4	129.3	118	119.6	109.4	108.4	108	107.8	107.7
2 - N1b_finer_1sekm	96.6	92.7	126.1	114.6	108.6	107.6	107.5	107.6	107.6	107.5
3 - N2b	89.8	92,0	94.1	96.8	129	111	112.2	112.7	112.4	113.2
4 - N2b_finer_1sekm	90.2	91.8	94.1	98.7	128	119.3	109.6	109.8	115.1	120.1
5 - N3b	86.7	101.1	100.8	96.3	125.3	111.3	115.4	117.6	115.1	113.7
6 - N3b_finer_1sekm	86.5	100.1	94.1	98.5	129.2	111.4	116.2	115.1	113.3	111.6
7 - N4b	87.2	94.1	105	104	104.3	104.9	104.8	109.5	107.9	107.8
8 - N4b_finer_1sekm	87.5	93.2	105.1	103.7	104.9	108.4	108.1	108.8	107.8	106.8
9 - N5b	86.9	89.7	93.8	100.4	100.9	114.6	116.8	116.8	123.4	128.7
10 - N5b_finer_1sekm	86.9	89.7	93.2	102.1	102.9	103.9	115.6	119.1	125.9	130.5
11 - N6b_finer	119.9	115.9	108.6	120.7	124.8	125.8	129.3	133.6	141.5	149.4
12 - N6b_finer_1sekm	104.1	112.8	109.4	124	130.7	138.2	148	158.8	169.1	178.1
13 - N7b	94.9	109.5	108.5	115.5	143.2	130.6	140.1	136.5	134.2	135.7
14 - N7b_finer_1sekm	94.8	110.9	109	116.7	143.3	142.2	132.3	135.2	136.9	138
15 - N8b	91.6	90.1	90.2	92.7	108.9	120.2	119.2	120.2	125.4	128.3
16 - N8b_finer_1sekm	91.6	89.8	90.1	103.1	108.5	119.2	117.9	119.2	123.9	126.2
17 - N8b_b	92.2	91.2	92.1	95.2	98.5	103.4	109	110.9	114.1	115.4
18 - N8b_b_finer_1sekm	109.7	109	108.4	112.4	119.5	118	118.3	123.6		
19 - N9b_finer	108.7	119.1	131.5	147.2	155.4	164.7	172.5	179.3	187.8	198.1
20 - N9b_finer_1sekm	108.7	131.3	137.4	155.3	165.1	176.6	186.3	194.7	202.1	213

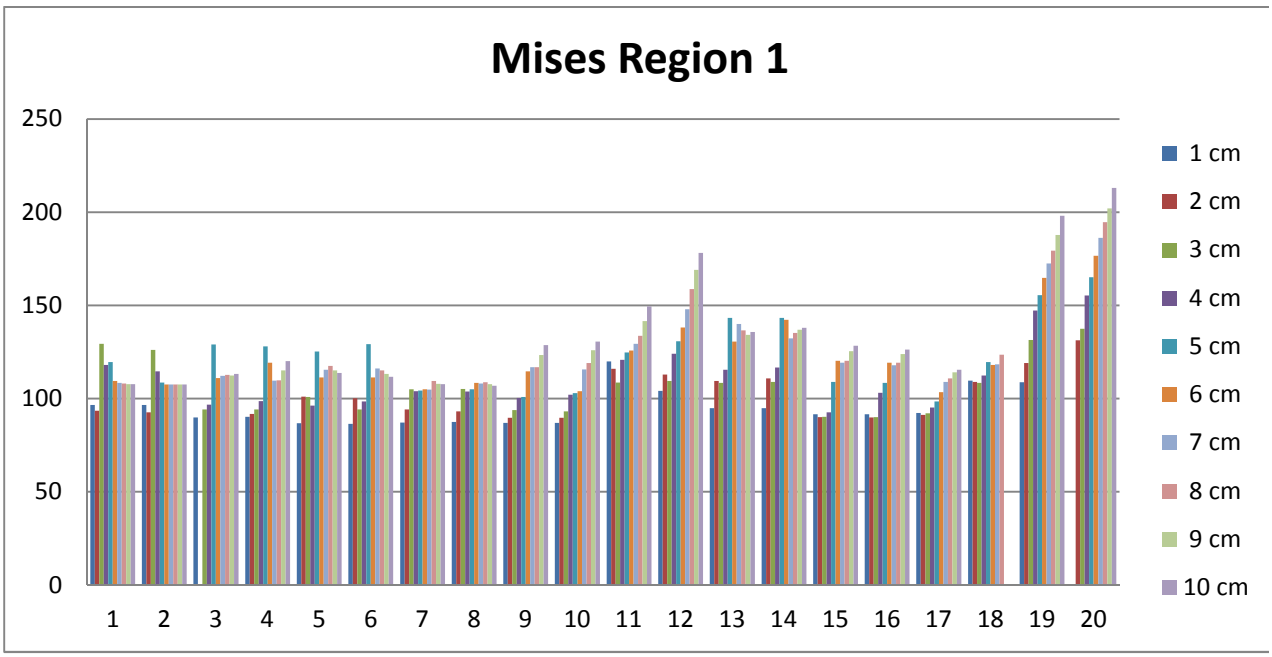

Figure 9-12. Maximum Mises stress [MPa] for the copper shell, Region 1, at 1 to 10 cm shearing. Case numbering follows Table 9-7.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-8. Maximum Mises stress [MPa] for the copper shell, Region 2, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	89.4	90.4	91.8	93	93.6	93.9	94.3	94.7	95	95.3
2 - N1b_finer_1sekm	89.5	90.6	92.2	93.4	94	94.6	95.1	95.5	95.9	96.3
3 - N2b	85.7	84.7	134.3	133.3	130.7	128.4	126.6	125.5	92.7	92.6
4 - N2b_finer_1sekm	90.2	91.8	94.1	98.7	128	119.3	109.6	109.8	115.1	120.1
5 - N3b	88.1	88.9	89.8	90.5	90.8	92	92.4	93.3	94.1	95.3
6 - N3b_finer_1sekm	88.1	89	89.8	90.9	90.9	91.9	92.5	93.4	94.5	96.1
7 - N4b	87.9	90.3	92.3	92.2	94	95.5	96.8	97.9	99	99.9
8 - N4b_finer_1sekm	87.8	91.1	94.9	93.5	95.9	98.1	100.1	101.9	103.7	105.3
9 - N5b	79.2	94.3	137.8	134.7	133.7	134.4	134.8	135.8	135.6	146.7
10 - N5b_finer_1sekm	79.1	93.8	139.5	138.2	138.5	139.1	140.2	144.1	143.6	146.5
11 - N6b_finer	89.7	95.1	101.3	108.8	115.7	121.9	126.9	131.2	134.5	140.2
12 - N6b_finer_1sekm	89.7	95.7	104.3	114.4	125.4	135.6	143.7	150	155.2	159.3
13 - N7b	90.7	97.2	93.9	94	96.7	99.9	103.1	106.3	109.1	111.6
14 - N7b_finer_1sekm	90.3	96.8	94.1	94.9	98.5	102.4	106.6	110.4	114	117.4
15 - N8b	89.6	88.4	89.2	88.7	89.6	149.2	144.7	123.4	100.3	101.8
16 - N8b_finer_1sekm	147.4	89.2	88.95	89.6	92.05	99.1	107	118.7	105.8	105.5
17 - N8b_b	81.5	186.4	189.6	186.6	187.6	185.8	184.5	176.1	173.7	183.4
18 - N8b_b_finer_1sekm	183.5	220.1	212.5	223.3	224	205.7	181.7	183.4		
19 - N9b_finer	96.2	96.7	108.4	124.1	141	156.4	169.2	179.4	188	194.6
20 - N9b_finer_1sekm	96.2	97.7	111.9	131.1	151	169.2	184.5	196.9	207.2	215.7

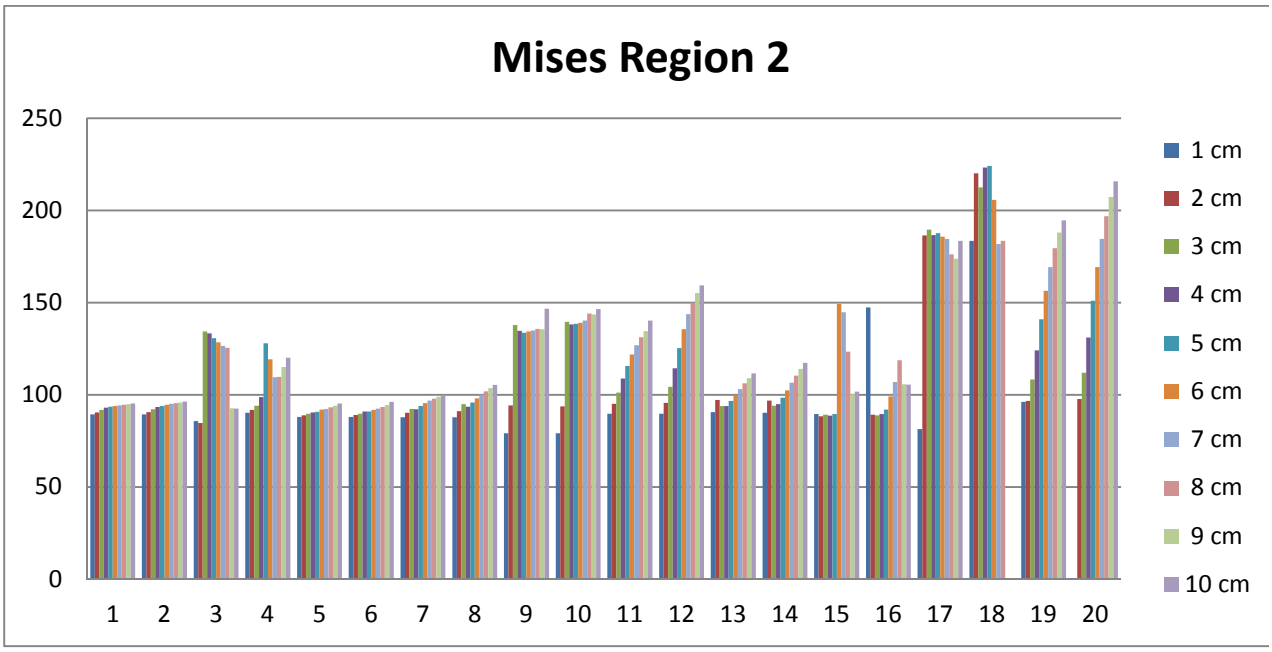

Figure 9-13. Maximum Mises stress [MPa] for the copper shell, Region 2, at 1 to 10 cm shearing. Case numbering follows Table 9-8.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-9. Maximum Mises stress [MPa] for the copper shell, Region 3, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	92.6	95.5	95.2	97.3	99.3	100.6	101.4	101.1	101.1	100.9
2 - N1b_finer_1sekm	93	95.5	95.5	98.5	100.9	100.9	100.5	103.4	114.1	126.9
3 - N2b	88	95.2	99.3	100.1	101.3	102.8	101.9	102.3	101.6	101.4
4 - N2b_finer_1sekm	88.1	95	99.4	100.1	101.5	102.2	101.5	101.4	101.5	101.4
5 - N3b	87.9	87.6	87.3	87	86.7	86.4	86.4	86.5	86.7	86.7
6 - N3b_finer_1sekm	87.9	87.6	87.2	86.9	86.6	86.4	86.5	86.6	86.7	86.9
7 - N4b	90.4	95.9	98.7	100.6	100.3	102.6	118.5	139.6	158.5	166.2
8 - N4b_finer_1sekm	91.1	95.5	100.4	99.6	99.7	109.8	127	149	166.8	175
9 - N5b	88.1	97.7	98.5	100.2	99.9	99.5	99.3	99.1	99.1	99
10 - N5b_finer_1sekm	89.2	97.5	98.2	99.9	99.8	99.25	99.1	98.8	98.7	98.6
11 - N6b_finer	88	87.5	93.6	96.9	97.2	97.1	97.4	97.4	97.4	97.4
12 - N6b_finer_1sekm	88	87.4	94.5	96.8	151.7	96.9	96.3	96	96.2	96.4
13 - N7b	98.2	99.6	149.8	150.1	150.2	150.1	161.2	180.8	201.5	217.3
14 - N7b_finer_1sekm	98.2	99.5	149.7	149.8	149.8	149.8	169.1	189	208.9	223.2
15 - N8b	96.3	97.2	147.6	147.3	146.2	145.3	143.7	141.8	139.6	137.4
16 - N8b_finer_1sekm	96.4	97.4	147.7	147.9	146.3	144.9	143.1	140.9	138.3	135.8
17 - N8b_b	96.9	141.6	139.9	139.7	138.9	137	136.5	136.1	135.1	133.6
18 - N8b_b_finer_1sekm	96.3	142.9	140.1	136.6	134.2	132.9	132.1	131.8		
19 - N9b_finer	95	95.6	96.1	96.4	96.3	96.3	96.6	96.7	96.4	96.1
20 - N9b_finer_1sekm	95	95.55	96.1	96.3	96.2	96.4	96.2	96.2	96	95.6

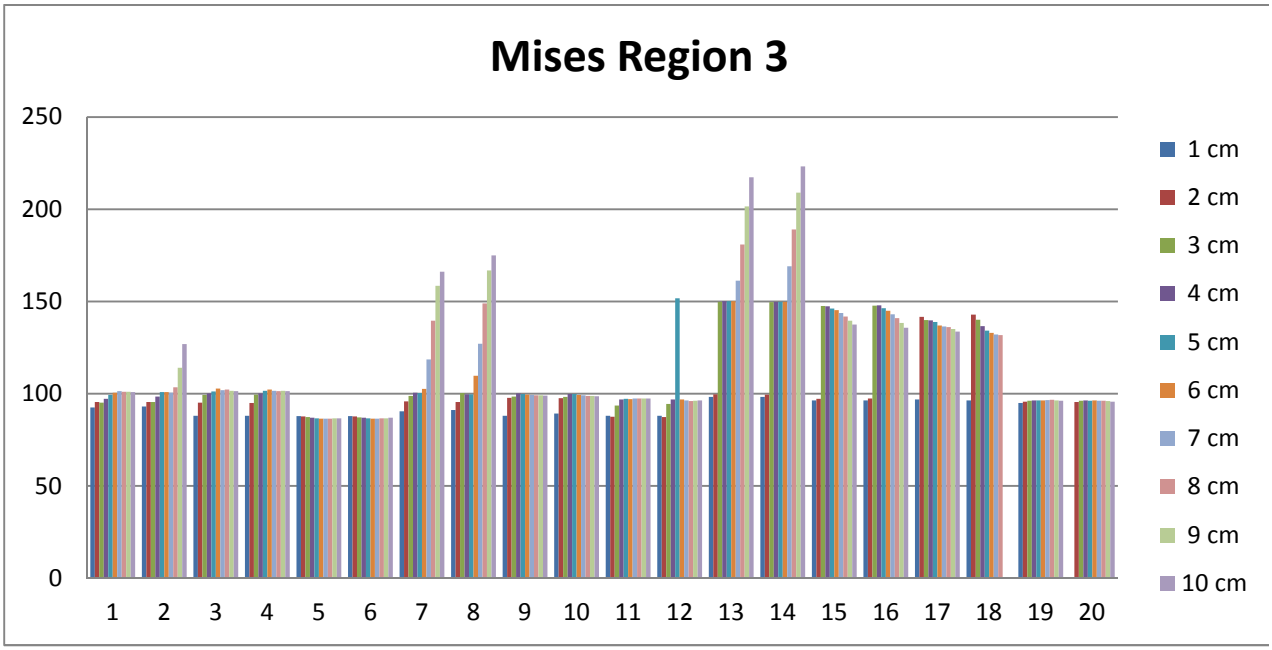

Figure 9-14. Maximum Mises stress [MPa] for the copper shell, Region 3, at 1 to 10 cm shearing. Case numbering follows Table 9-9.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-10. Maximum Mises stress [MPa] for the copper shell, Region 4, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	107.1	110.6	111.6	111.6	111.2	110.6	109.8	109.1	108.4	107.7
2 - N1b_finer_1sekm	107.3	110.9	111.8	111.6	110.6	109.6	108.6	107.6	106.7	105.8
3 - N2b	107.3	104.6	105.5	106.3	104	102.8	101.6	100.6	99.8	100.2
4 - N2b_finer_1sekm	108.3	104.4	105.3	106.4	104.4	103.2	102.2	101.2	100.3	100.5
5 - N3b	105.6	107.6	110.2	111.5	110.8	111.2	111.1	110.8	110.3	112.4
6 - N3b_finer_1sekm	105.4	107.6	110.1	110	111	111.4	111.1	110.3	114.3	116.8
7 - N4b	100.6	102	106.8	107.5	106.5	105.2	103.7	103.7	104.7	105.6
8 - N4b_finer_1sekm	100.8	103.3	108.1	108.5	106.9	105	107.2	116.8	129.5	137.5
9 - N5b	100.2	101.6	100	100.8	102	102.4	102.8	102.9	103	103
10 - N5b_finer_1sekm	100.2	102.6	100.8	101.3	102.2	102.9	103.4	103.7	104.3	104.8
11 - N6b_finer	103.1	106.6	129.1	208.6	226.8	238.5	245.5	251.2	256.4	261.1
12 - N6b_finer_1sekm	103.4	104.5	148	228.9	247	260	268	273.8	280.1	285.5
13 - N7b	130.5	109.9	118.8	121.1	115.7	139.4	150.7	156.8	160.4	162.6
14 - N7b_finer_1sekm	111.9	121	125.1	123.5	131.9	148.4	155.4	159.1	211.5	218.6
15 - N8b	128	106.8	121.9	120.7	120.2	119.6	118.5	118.6	118.2	117.7
16 - N8b_finer_1sekm	101.7	112.9	121.1	120.6	119.6	119.5	118	118.1	117.3	133.2
17 - N8b_b	92.6	92.5	94.7	104.3	107.4	107.5	108.4	109.1	109.6	109.9
18 - N8b_b_finer_1sekm	135,2	143.4	148.8	148.7	146.9	145.1	143.3	141.3		
19 - N9b_finer	116.8	122.1	221.5	262.4	219.8	229.7	235.6	239.1	242.3	244.2
20 - N9b_finer_1sekm	115.1	128.5	236.8	214.8	231.7	243	249.6	253.7	256	260.9

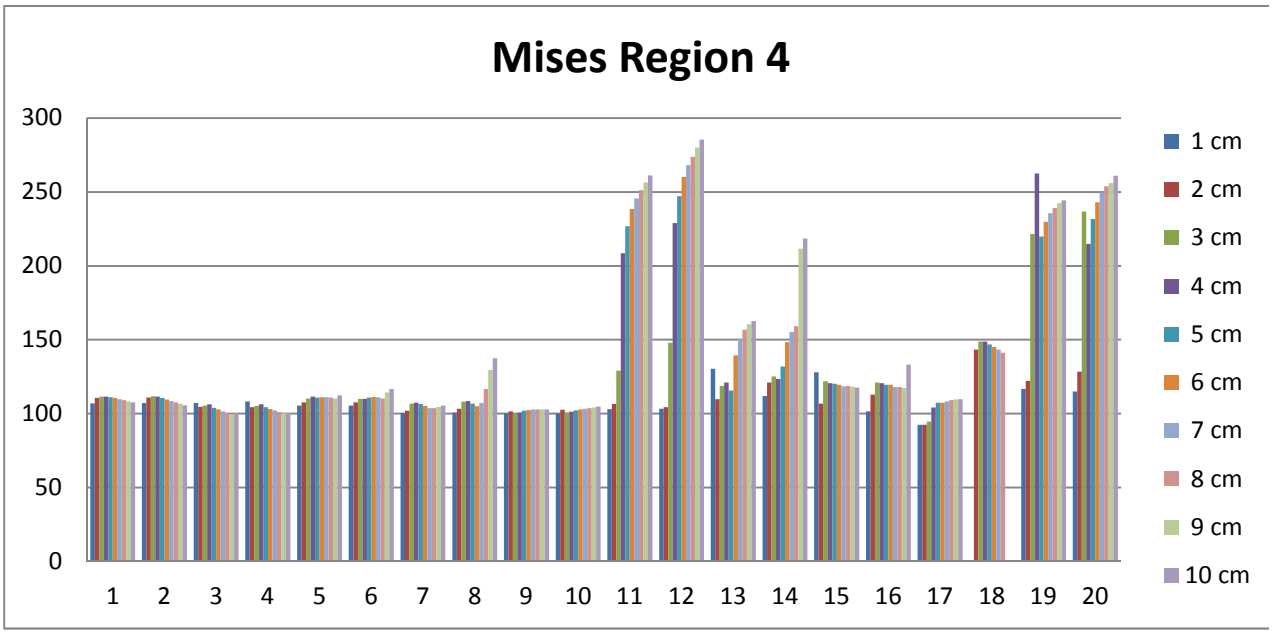

Figure 9-15. Maximum Mises stress [MPa] for the copper shell, Region 4, at 1 to 10 cm shearing. Case numbering follows Table 9-10.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-11. Maximum Mises stress [MPa] for the copper shell, Region 5, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	155.9	157.5	163.3	167.2	170.2	172.7	172.8	172.2	170.7	170.3
2 - N1b_finer_1sekm	155.7	159.6	166.3	171.5	174.1	173.7	175	176.5	177.1	177.4
3 - N2b	156.8	159.6	168.3	179.4	183.3	184.6	185.2	185	186	184.7
4 - N2b_finer_1sekm	156.9	159.8	168.2	179.1	182.5	184.1	184.4	184.5	183.6	184.2
5 - N3b	136.9	138.3	139.6	141	142.4	143.8	145.3	146.9	148.4	149.8
6 - N3b_finer_1sekm	137.4	138.7	140	141.4	142.7	142.7	144	145.5	146.9	148.4
7 - N4b	146.7	150.9	160.6	170.1	173.1	173.6	174.1	174.3	174.4	176.2
8 - N4b_finer_1sekm	147.5	151.5	164.3	172.7	173.7	173.8	177.3	181.1	184.9	188.5
9 - N5b	137.1	160.5	158.5	171.1	180.9	183.3	184.3	184.4	184.6	184.8
10 - N5b_finer_1sekm	136.9	161.3	159.6	171.6	181.1	183.1	183.3	183.3	183.5	183.7
11 - N6b_finer	121.3	129.2	137.9	147.5	158.2	161.4	160.2	159.5	159.4	160.2
12 - N6b_finer_1sekm	121.3	129.3	138.2	147.8	158.7	162	161.1	160.6	160.2	160.2
13 - N7b	194.5	199.9	206.9	219.3	225.6	229.8	233.5	236.9	239.8	242.7
14 - N7b_finer_1sekm	194.9	201.3	212.2	226.3	234.4	241.3	246.6	250.3	254.7	259.2
15 - N8b	193.3	199.5	200.3	201.2	201.6	200.9	199.7	198.1	196	193.7
16 - N8b_finer_1sekm	192.7	199.4	201	202.1	201.9	200.8	199	196.8	194.4	192
17 - N8b_b	191.2	195.1	196.6	195.3	192.9	189.1	188.3	187.4	185.4	182.6
18 - N8b_b_finer_1sekm	189.7	192.5	196.9	201.5	204.3	204	202.8	201.7		
19 - N9b_finer	185.8	188.5	191.6	193.5	194.7	195.9	196.9	197.2	197.3	197.3
20 - N9b_finer_1sekm	185.7	188.3	191.2	193	194.2	195.4	195.8	195.9	195.8	195.6

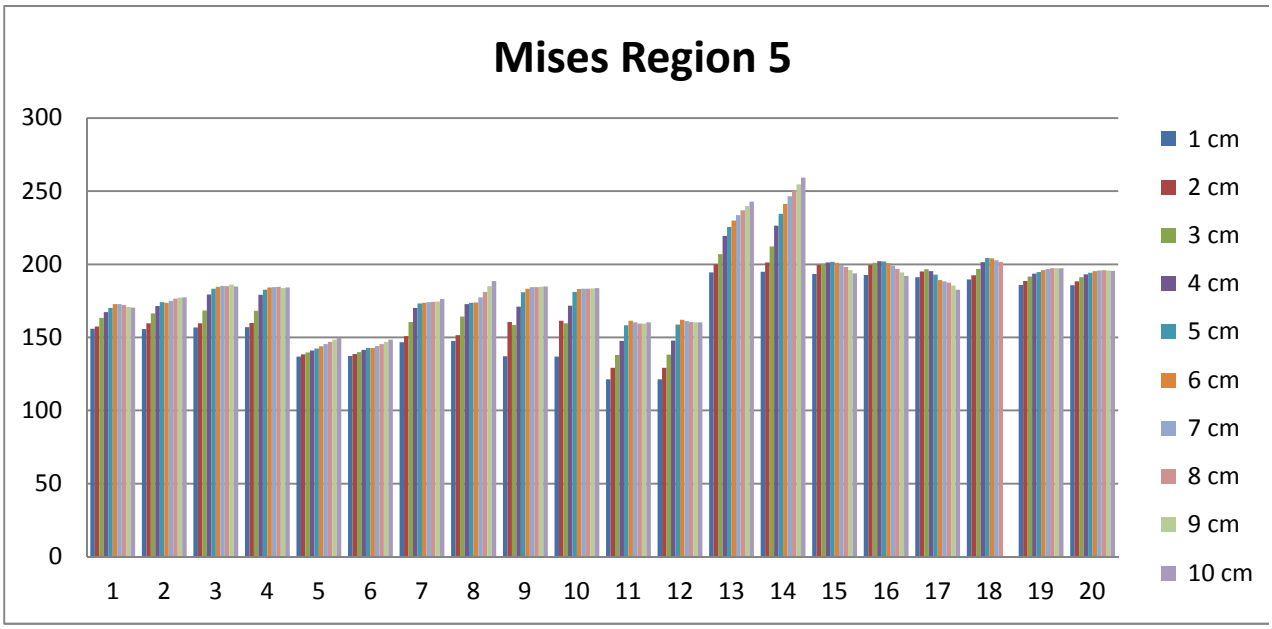

Figure 9-16. Maximum Mises stress [MPa] for the copper shell, Region 5, at 1 to 10 cm shearing. Case numbering follows Table 9-11.

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Table 9-12. Maximum Mises stress [MPa] for the copper shell, Region 6, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	84.5	84.1	86.1	88	90	91.7	93.1	94.2	95.1	95.9
2 - N1b_finer_1sekm	84.6	84.2	86.7	89.7	92.5	94.5	95.7	96.8	97.7	98.5
3 - N2b	85	85	85	85.4	85.2	85	84.7	85	85.2	85.4
4 - N2b_finer_1sekm	85	85.1	84.8	84.6	85.3	84.5	84.1	83.8	83.8	83.9
5 - N3b	84.8	84.9	85.6	85.5	85.9	86.9	89	92	94.7	97.2
6 - N3b_finer_1sekm	84.9	84.95	85.6	85.2	85.9	97.3	90	93.5	96.3	99
7 - N4b	83.9	83.9	87.3	91.1	93.7	96.1	98.6	100.9	103.4	105.9
8 - N4b_finer_1sekm	83.9	84.1	88.1	92.6	96.35	100.5	104.8	109.3	113.1	116.7
9 - N5b	84.7	84.5	84.2	83.7	82.5	82.3	82.9	82.6	82.8	82.2
10 - N5b_finer_1sekm	84.6	84.5	84.1	83.5	83.1	82.8	83.3	82.4	82	82.25
11 - N6b_finer	85.9	91	101	113.3	124.1	133.2	140.6	147.1	152.9	158.7
12 - N6b_finer_1sekm	86.3	91.6	104.2	120.2	135.5	147	156.3	163.9	170.5	176.7
13 - N7b	88.9	87.1	101.3	114	123.5	132.3	139.9	146.2	151.5	155.7
14 - N7b_finer_1sekm	88.1	87.5	103.4	118.3	130.7	142	150.9	158.7	164.9	170.5
15 - N8b	83.7	81.7	81.8	81.1	80.8	89.7	86.5	86	87.3	87.7
16 - N8b_finer_1sekm	83.4	82.9	82.4	89.1	83.8	81.5	81	80.7	81.1	82.2
17 - N8b_b	92.2	92.6	92.5	92.6	92.2	91.9	92.2	92.5	92.6	92.7
18 - N8b_b_finer_1sekm	91.7	94.8	94.7	95.3	91.9	92.4	92.4	92.3		
19 - N9b_finer	87.8	100	127.7	150.9	168.5	181	190.9	198.8	205	210.5
20 - N9b_finer_1sekm	87.4	101.7	131.5	155.9	173.9	187.2	199.7	210	217.5	223.9

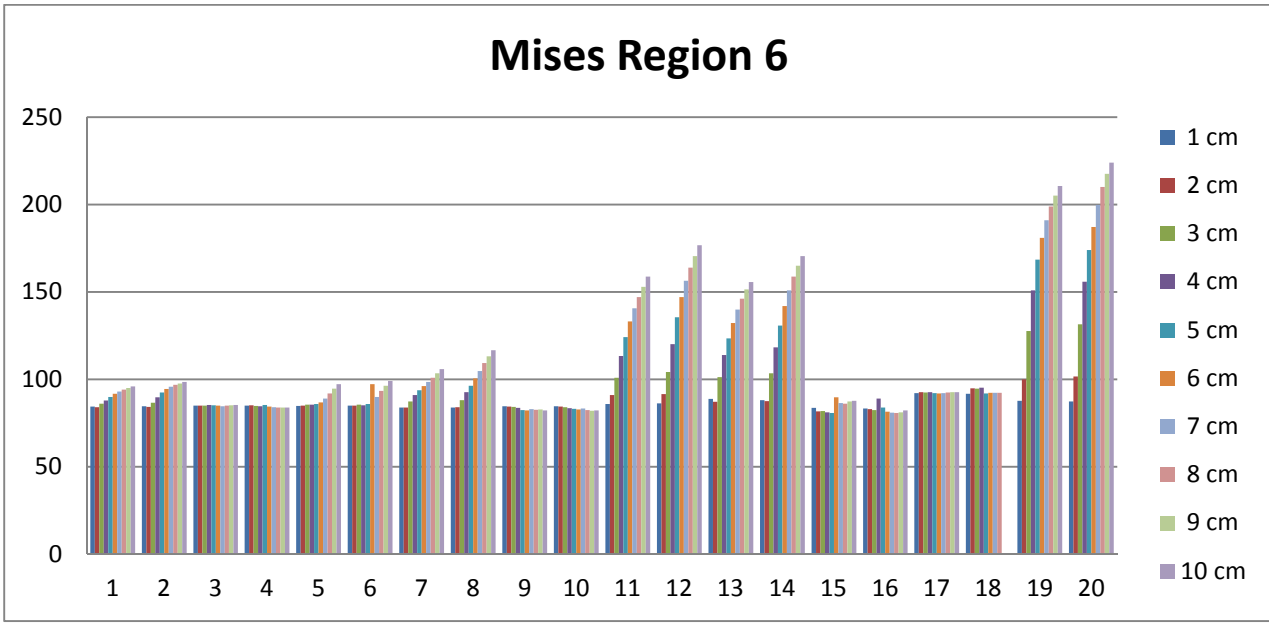

Figure 9-17. Maximum Mises stress [MPa] for the copper shell, Region 6, at 1 to 10 cm shearing. Case numbering follows Table 9-12.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-13. Maximum Mises stress [MPa] for the copper shell, Region 7, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	76.4	86.8	85.2	83.1	82.2	81.7	82	82.3	82.8	82.7
2 - N1b_finer_1sekm	77.4	86.4	84.3	82.4	82.2	82.6	82.5	83	83.4	83.7
3 - N2b	38.1	69.3	85.6	84.5	83.1	80.9	81.9	82.8	82.6	82.6
4 - N2b_finer_1sekm	37.5	68.3	85.3	84.4	82.5	83.1	82.4	82.1	82.7	82.5
5 - N3b	30.1	30	30	30.1	30.3	30.6	30.9	31.2	31.5	31.9
6 - N3b_finer_1sekm	30.1	29.9	29.9	30.05	30.2	30.4	30.7	30.9	31.2	31.5
7 - N4b	79.2	86.4	82.3	83.7	84.7	85.2	86.1	86.9	87.8	88.7
8 - N4b_finer_1sekm	79.25	84	82.3	85.8	87.2	88.6	90	91.3	92.7	94.2
9 - N5b	36.3	63.2	85.7	83.6	82	82	81.9	82	82	82.1
10 - N5b_finer_1sekm	37.4	61.4	85.7	83.5	81.9	81.8	81.8	81.8	81.65	82.1
11 - N6b_finer	25.2	30.4	37.3	44.3	51.1	60.1	70.3	79.1	84	86.4
12 - N6b_finer_1sekm	25.1	31	38.25	45.6	52.7	58.6	63.9	71.3	77.3	81.4
13 - N7b	84.6	80.7	82.3	85.5	88.3	91.2	94.1	96.9	99.8	102.8
14 - N7b_finer_1sekm	84.7	81.6	84.5	89.1	94.2	98.95	103.5	107.9	112.5	117.1
15 - N8b	70.7	81.5	81.3	86.1	84.4	84.9	84.5	83.9	83.4	83.8
16 - N8b_finer_1sekm	70.3	81.6	81.7	85.4	85.4	85.65	84.9	84.4	84.8	84.9
17 - N8b_b	73.5	82.2	80.6	79.5	84.2	86.3	85.8	83.9	83.1	83.2
18 - N8b_b_finer_1sekm	57.9	81.5	81.2	81.6	80.8	80.8	81.4	80.4		
19 - N9b_finer	55.3	59.3	64.1	68.9	72.9	75.7	76.8	76.6	75.6	74.4
20 - N9b_finer_1sekm	55.2	58.9	63.4	68	71.7	74.2	74.9	74.5	73.5	72

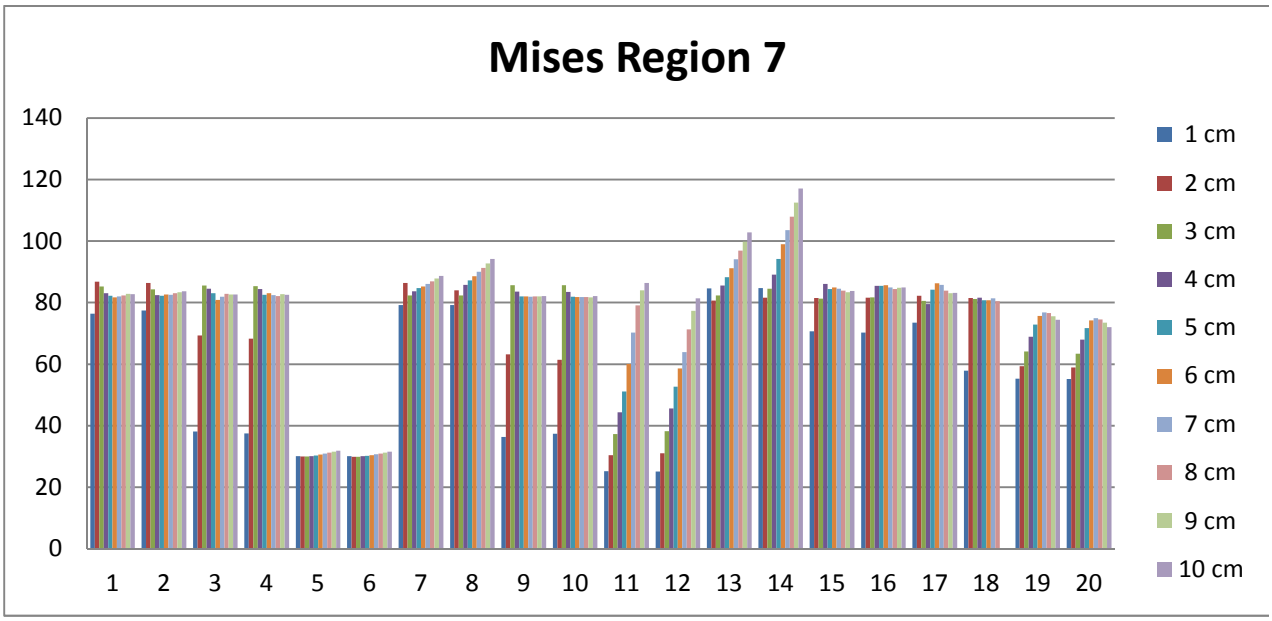

Figure 9-18. Maximum Mises stress [MPa] for the copper shell, Region 7, at 1 to 10 cm shearing. Case numbering follows Table 9-13.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-14. Maximum Mises stress [MPa] for the copper shell, Region 8, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	99.5	95.6	94	94.5	100.5	107.9	108.6	108.2	107	105.2
2 - N1b_finer_1sekm	99.2	95.5	93.6	100.5	109.6	110.2	107.9	104.9	101.9	99
3 - N2b	93.6	121.8	121.6	120.2	121.2	119.5	119.7	119.5	119.6	120.5
4 - N2b_finer_1sekm	93.7	121	120.9	119.1	120.2	119.5	117.8	119.3	117.5	94
5 - N3b	99.2	99.9	98.4	96.4	123.9	97.6	122.4	96.8	105.8	100.7
6 - N3b_finer_1sekm	99	99.9	99.6	98.2	124.8	96.7	97.1	104.4	103.9	97.2
7 - N4b	109.8	111.6	111.9	105.9	112	109	101.7	94.4	92.9	109.8
8 - N4b_finer_1sekm	109.7	107.4	103.7	110.6	111.5	100.4	95	94.7	97.3	99.1
9 - N5b	109.9	109.8	109.2	116.4	116.3	115.3	111.9	109.8	109.7	110.2
10 - N5b_finer_1sekm	109.7	109.1	109.5	109.4	111.5	108.7	108.9	109.7	110.1	109.3
11 - N6b_finer	122.2	117.6	114.8	100.1	125.4	160	182.7	182.1	172.1	152.3
12 - N6b_finer_1sekm	122.4	114.7	112.1	126.7	182.2	162.8	133.9	134.6	132.6	136.3
13 - N7b	113.9	110.3	110.2	107	110.6	116.3	121.3	125.5	182	274.5
14 - N7b_finer_1sekm	114.8	106.6	104.1	103	111.4	119.5	126.8	132.7	142.6	142.2
15 - N8b	114.8	113.7	132.2	111.3	113	115.3	140.9	117.2	117.9	118.7
16 - N8b_finer_1sekm	121.3	119.4	117.9	113.9	115.6	116.8	117.9	119	121.4	123.6
17 - N8b_b	129.5	112.6	115.8	110	111.2	110.1	112.3	114.8	113.9	115.1
18 - N8b_b_finer_1sekm	127.4	144.9	129.4	154.4	128.3	127.9	128.1	128.8		
19 - N9b_finer	118	103.1	109.6	142.3	172.6	157	160	166.3	198.9	197.2
20 - N9b_finer_1sekm	116.9	101.3	116.4	145.7	145.4	157.4	195	197.2	197.9	196.8

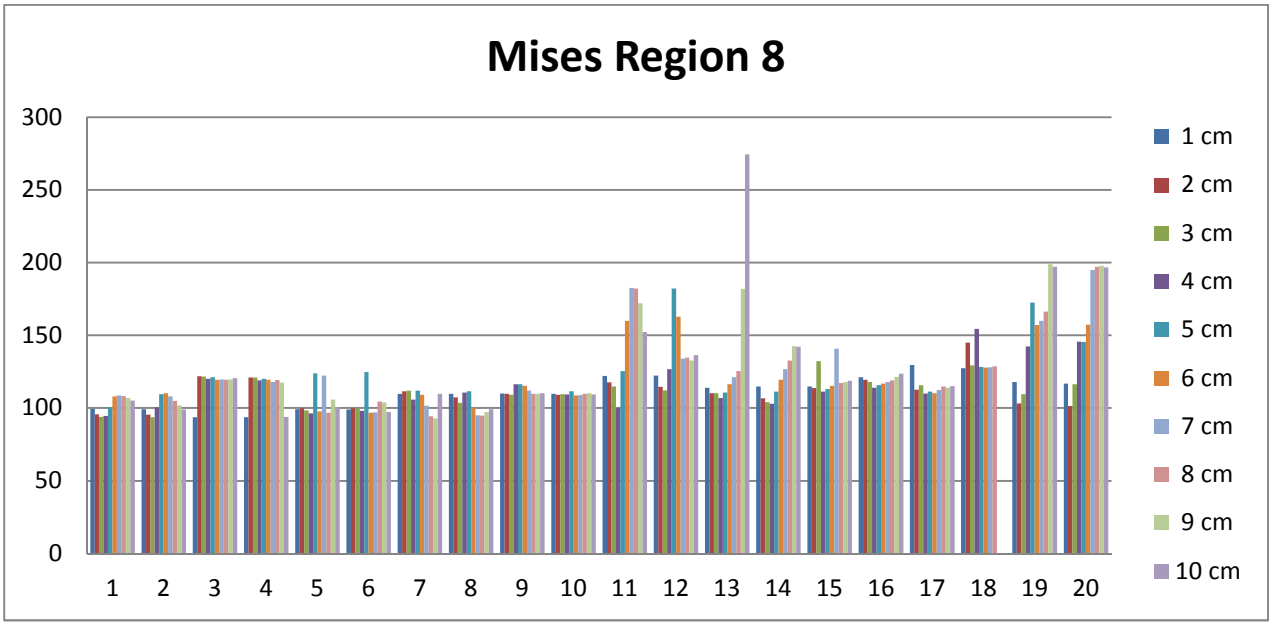

Figure 9-19. Maximum Mises stress [MPa] for the copper shell, Region 8, at 1 to 10 cm shearing. Case numbering follows Table 9-14.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-15. Maximum Mises stress [MPa] for the copper shell, Region 9, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	81.8	83.8	87.6	87.1	87	87.4	87.6	87.7	87.8	88
2 - N1b_finer_1sekm	81.6	83.7	86.7	86.9	87.3	87.7	88.1	101.6	98.6	98.8
3 - N2b	83	106.1	104.9	101.3	88.1	87.3	87.2	87.5	87.7	87.8
4 - N2b_finer_1sekm	82.9	105.9	102.4	101.7	87.1	86.8	86.7	87.1	87.5	87.8
5 - N3b	79.9	80.1	80.5	80	80.5	80.1	80.9	80.3	80.4	80.8
6 - N3b_finer_1sekm	79.7	80.1	80.5	79.9	80.6	80	80.8	80.5	79.8	79.6
7 - N4b	97.5	96.1	87.7	89.3	96	97.4	97.8	98.2	97.3	91.8
8 - N4b_finer_1sekm	97	95.3	88.4	91.6	101.4	98.5	100.6	99.9	100	105.4
9 - N5b	97.6	113.3	114	109.8	87.6	108.4	111.2	110.6	109.4	110.1
10 - N5b_finer_1sekm	97.25	111.1	113.1	110.8	109.9	111.8	113.2	113.9	112.9	111.4
11 - N6b_finer	96.9	96.7	96.9	96.6	108.7	110.8	111.2	112.9	112.5	112.4
12 - N6b_finer_1sekm	97	97.2	97.2	97.3	109.4	110.8	111.4	112.5	112.3	111.3
13 - N7b	108.6	87.7	86.4	88.2	90.9	93.1	94.9	96.5	98.2	99.9
14 - N7b_finer_1sekm	105.3	86.3	88.6	93.9	98.5	102.8	106.2	109	111.4	113.9
15 - N8b	108.8	105.2	102.9	102.1	88.6	88.6	88.5	88.2	88	87.7
16 - N8b_finer_1sekm	105.1	102.8	81.9	88.9	88.8	88.7	88.5	88.2	88.2	87.9
17 - N8b_b	94.7	99	102.8	102	101.1	101.3	89.1	88.8	88	87.2
18 - N8b_b_finer_1sekm	89.4	103.8	105.3	106.1	107	107.6	108.1	108.3		
19 - N9b_finer	107.5	106.5	104.8	104.8	105.1	105.2	105.2	104.6	103.8	103.1
20 - N9b_finer_1sekm	107.5	106.5	105	105.1	105.2	105	104.3	103.9	103.8	103.8

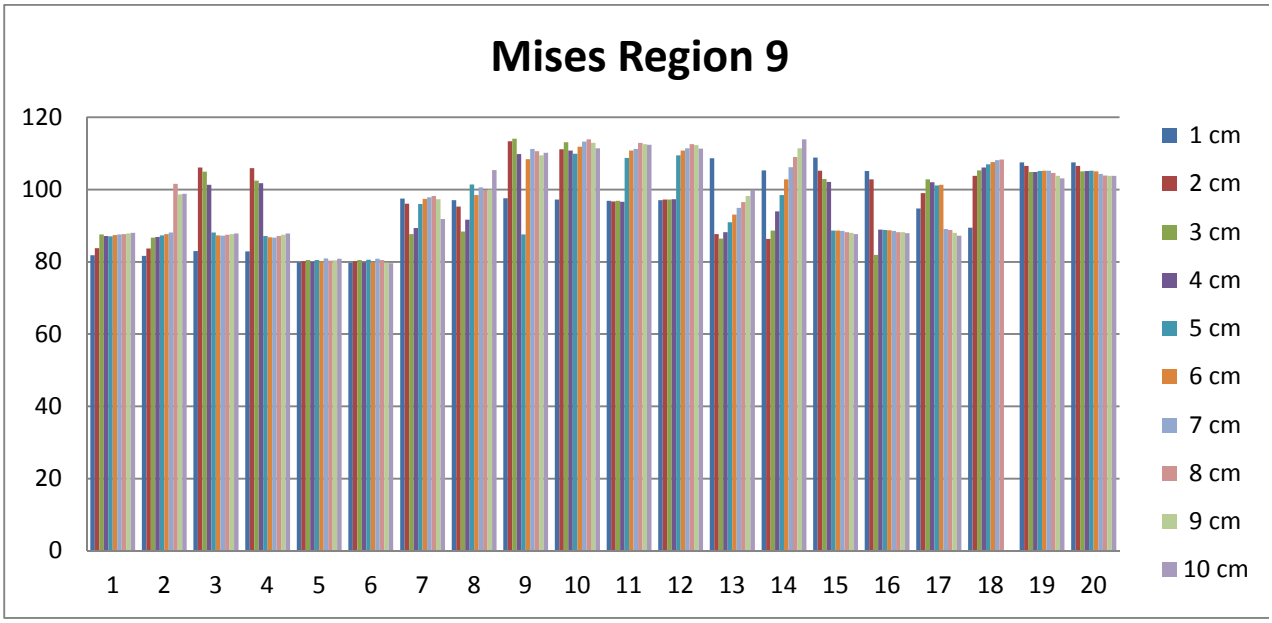

Figure 9-20. Maximum Mises stress [MPa] for the copper shell, Region 9, at 1 to 10 cm shearing. Case numbering follows Table 9-15.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-16. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 1, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	0.48	0.63	0.72	0.79	0.82	0.85	0.86	0.88	0.88	0.89
2 - N1b_finer_1sekm	0.5	0.65	0.76	0.84	0.88	0.91	0.93	0.95	0.96	0.97
3 - N2b	0.49	0.56	0.57	0.59	0.66	0.74	0.84	0.95	1.08	1.22
4 - N2b_finer_1sekm	0.4	0.61	0.83	1.02	1.1	1.18	1.23	1.27	1.31	1.34
5 - N3b	0.41	0.47	0.6	0.69	0.75	0.83	0.91	0.99	1.08	1.18
6 - N3b_finer_1sekm	0.41	0.48	0.62	0.71	0.77	0.86	0.95	1.06	1.19	1.29
7 - N4b	0.48	0.57	0.63	0.7	0.76	0.82	0.88	0.94	0.98	1.03
8 - N4b_finer_1sekm	0.48	0.58	0.66	0.75	0.85	0.95	1.05	1.14	1.32	1.55
9 - N5b	0.47	0.55	0.6	0.63	0.74	0.91	1.11	1.31	1.52	1.71
10 - N5b_finer_1sekm	0.48	0.57	0.62	0.65	0.76	0.93	1.13	1.34	1.55	1.74
11 - N6b_finer	0.65	0.94	1.26	2.04	2.99	3.74	4.35	4.84	5.24	5.59
12 - N6b_finer_1sekm	0.65	0.97	1.38	2.87	4.2	5.28	6.13	6.82	7.4	7.87
13 - N7b	0.86	1.11	1.34	1.57	1.77	1.99	2.21	2.4	2.67	3.01
14 - N7b_finer_1sekm	0.85	1.08	1.295	1.55	1.81	2.1	2.45	3.05	3.6	4.09
15 - N8b	0.71	0.72	0.72	0.81	1.03	1.26	1.47	1.67	1.86	2.05
16 - N8b_finer_1sekm	0.72	0.72	0.72	0.81	1.02	1.23	1.43	1.62	1.81	1.99
17 - N8b_b	0.96	0.96	0.96	1.01	1.15	1.25	1.38	1.51	1.66	1.83
18 - N8b_b_finer_1sekm	1.58	1.58	1.58	1.58	1.58	1.72	1.96	2.19		
19 - N9b_finer	1.1	1.58	2.47	3.99	5.62	7.1	8.4	9.5	10.46	11.28
20 - N9b_finer_1sekm	1.09	1.6	2.91	4.68	6.63	8.4	10	11.42	12.71	13.84

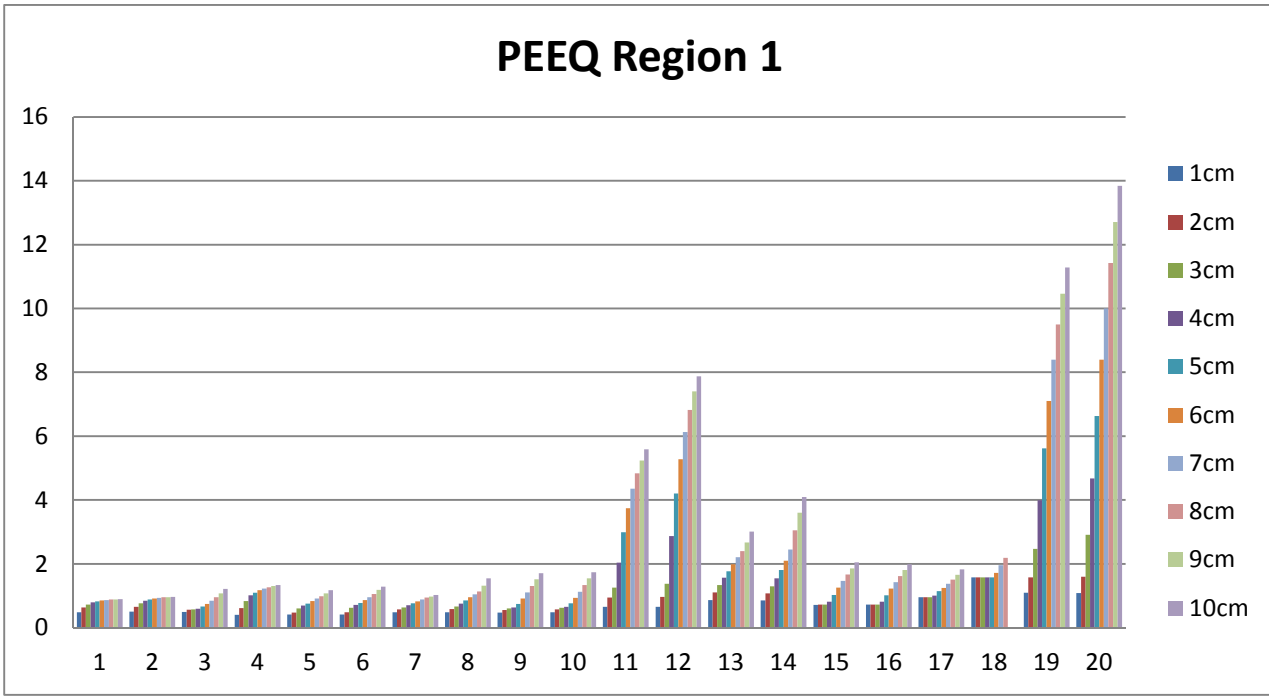

Figure 9-21. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 1, at 1 to 10 cm shearing. Case numbering follows Table 9-16.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-17. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 2, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	2.45	2.57	2.78	3.02	3.17	3.28	3.38	3.44	3.5	3.55
2 - N1b_finer_1sekm	2.44	2.6	2.88	3.15	3.34	3.47	3.56	3.64	3.72	3.78
3 - N2b	2.3	2.3	2.3	2.34	2.39	2.47	2.52	2.55	2.57	2.58
4 - N2b_finer_1sekm	2.32	2.32	2.36	2.42	2.46	2.49	2.51	2.52	2.53	2.54
5 - N3b	2.38	2.47	2.54	2.67	2.78	2.89	2.99	3.08	3.17	3.39
6 - N3b_finer_1sekm	2.4	2.48	2.55	2.68	2.8	2.92	3.025	3.13	3.325	3.58
7 - N4b	2.11	2.39	2.8	3.14	3.5	3.8	4.07	4.29	4.48	4.65
8 - N4b_finer_1sekm	2.14	2.47	2.93	3.41	3.9	4.34	4.72	5.09	5.44	5.75
9 - N5b	1.98	1.98	2.15	2.27	2.34	2.41	2.46	2.5	2.53	2.55
10 - N5b_finer_1sekm	2.01	2.025	2.24	2.39	2.5	2.59	2.69	2.76	2.81	2.84
11 - N6b_finer	2.6	3.41	4.9	6.47	7.87	9.12	10.2	11.1	11.8	12.5
12 - N6b_finer_1sekm	2.57	3.65	5.51	7.56	9.835	12.1	14.04	15.65	17	18.12
13 - N7b	2.19	2.46	2.82	3.39	3.98	4.68	5.35	6.01	6.61	7.11
14 - N7b_finer_1sekm	2.19	2.47	2.87	3.49	4.27	5.16	6.05	6.89	7.66	8.37
15 - N8b	2.2	2.62	3	3.22	3.38	3.52	3.65	3.74	3.8	3.83
16 - N8b_finer_1sekm	2.21	2.69	3.1	3.35	3.57	3.8	4	4.14	4.23	4.3
17 - N8b_b	6.03	6.29	6.63	6.91	7.11	7.24	7.34	7.42	7.48	7.53
18 - N8b_b_finer_1sekm	8.14	8.46	8.62	8.67	8.75	8.79	8.82	8.83		
19 - N9b_finer	2.46	3.61	5.88	9.08	12.87	16.86	20.7	24.16	27.29	30
20 - N9b_finer_1sekm	2.47	3.825	6.54	10.52	15.4	20.72	26.14	31.4	37.16	43.34

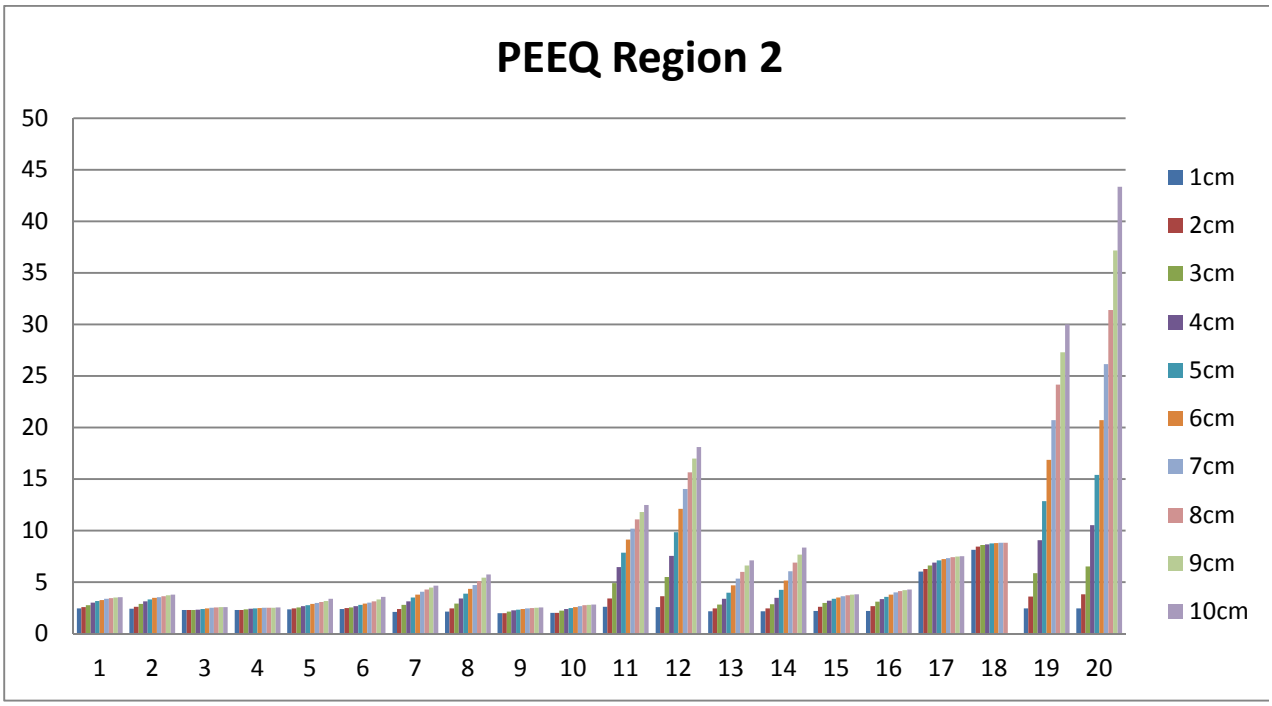

Figure 9-22. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 2, at 1 to 10 cm shearing. Case numbering follows Table 9-17.

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Table 9-18. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 3, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	2.45	2.45	2.46	2.6	2.73	2.84	2.94	3.09	3.3	3.51
2 - N1b_finer_1sekm	2.45	2.45	2.45	2.58	2.7	2.81	2.95	3.1	3.27	3.48
3 - N2b	2.45	2.45	2.45	2.45	2.45	2.48	2.53	2.57	2.61	2.63
4 - N2b_finer_1sekm	2.45	2.45	2.45	2.45	2.45	2.47	2.49	2.5	2.53	2.56
5 - N3b	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45
6 - N3b_finer_1sekm	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45
7 - N4b	2.5	2.5	2.5	2.52	2.65	2.79	2.92	4.56	6.31	7.14
8 - N4b_finer_1sekm	2.5	2.5	2.5	2.54	2.7	2.86	3.46	5.4	7.19	7.86
9 - N5b	2.5	2.5	2.52	2.52	2.52	2.52	2.53	2.56	2.58	2.61
10 - N5b_finer_1sekm	2.5	2.51	2.53	2.53	2.53	2.53	2.53	2.53	2.54	2.56
11 - N6b_finer	2.5	2.5	2.5	2.5	2.5	2.52	2.53	2.53	2.53	2.53
12 - N6b_finer_1sekm	2.5	2.5	2.5	2.5	2.51	2.53	2.54	2.54	2.54	2.54
13 - N7b	2.58	2.67	2.72	2.75	2.82	4.63	6.57	8.7	11.25	13.31
14 - N7b_finer_1sekm	2.58	2.67	2.72	2.79	3.36	5.4	7.41	9.67	12.25	14.32
15 - N8b	2.54	2.63	2.69	2.7	2.7	2.7	2.7	2.7	2.7	2.7
16 - N8b_finer_1sekm	2.54	2.64	2.69	2.7	2.7	2.7	2.7	2.7	2.7	2.7
17 - N8b_b	1.92	1.94	2.03	2.05	2.07	2.1	2.12	2.13	2.13	2.13
18 - N8b_b_finer_1sekm	1.92	1.94	2.12	2.2	2.24	2.25	2.26	2.26		
19 - N9b_finer	2.53	2.53	2.54	2.56	2.58	2.59	2.6	2.6	2.6	2.6
20 - N9b_finer_1sekm	2.53	2.53	2.54	2.56	2.58	2.59	2.6	2.6	2.6	2.6

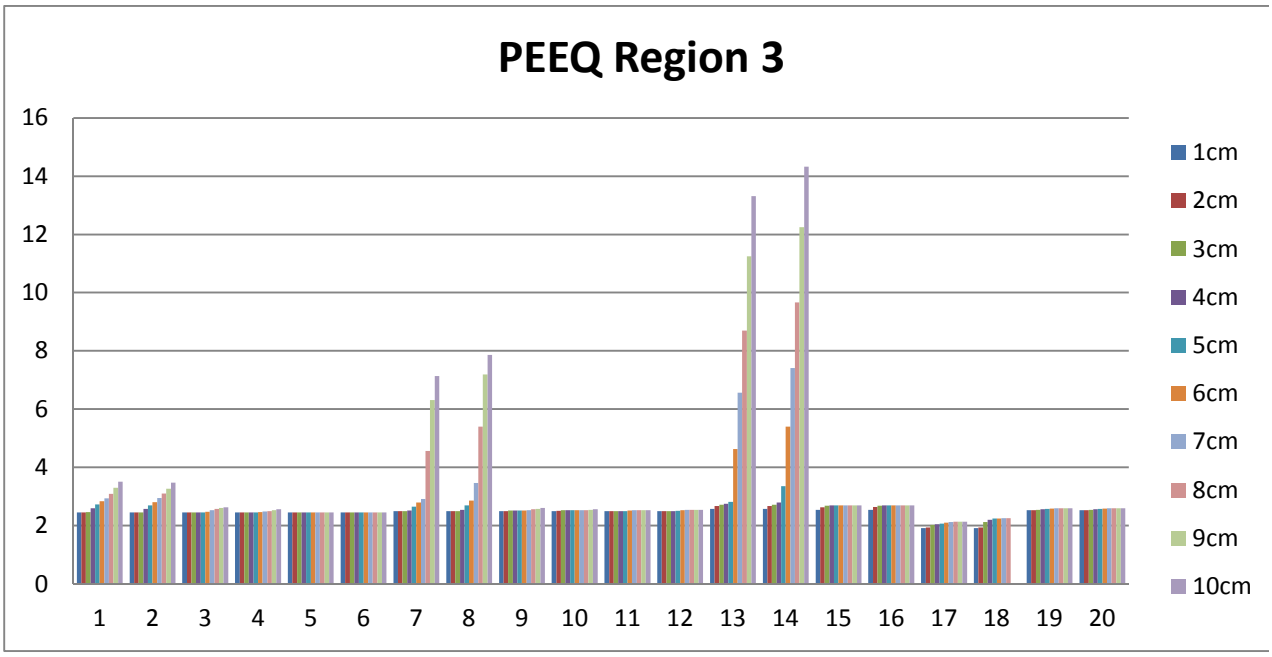

Figure 9-23. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 3, at 1 to 10 cm shearing. Case numbering follows Table 9-18.

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Table 9-19. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 4, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	1.13	1.44	1.61	1.72	1.79	1.83	1.86	1.89	1.91	1.92
2 - N1b_finer_1sekm	1.15	1.48	1.68	1.81	1.89	1.94	1.98	2.01	2.03	2.05
3 - N2b	1.05	1.07	1.07	1.13	1.24	1.33	1.41	1.46	1.5	1.52
4 - N2b_finer_1sekm	1.13	1.14	1.14	1.14	1.17	1.25	1.3	1.33	1.36	1.38
5 - N3b	1	1.16	1.43	1.62	1.76	1.89	2.02	2.16	2.32	2.49
6 - N3b_finer_1sekm	1	1.17	1.45	1.67	1.8	1.95	2.11	2.29	2.5	2.725
7 - N4b	0.75	1.13	1.38	1.52	1.64	1.74	1.84	2.51	3.21	3.82
8 - N4b_finer_1sekm	0.78	1.17	1.44	1.62	1.79	1.96	3.95	5.33	6.41	7.22
9 - N5b	0.64	0.74	0.76	0.76	0.76	0.79	0.81	0.82	0.83	0.85
10 - N5b_finer_1sekm	0.67	0.77	0.8	0.8	0.8	0.8	0.81	0.82	0.82	0.83
11 - N6b_finer	1.41	1.9	7.93	13.03	15.81	17.72	19.12	20.24	21.13	21.9
12 - N6b_finer_1sekm	1.4	1.96	10.57	16.1	19.5	21.92	23.99	25.77	27.3	28.57
13 - N7b	1.64	1.92	2.08	2.32	2.5	7.15	9.11	10.39	11.34	12.03
14 - N7b_finer_1sekm	1.67	2	2.23	2.535	5.82	9.09	10.99	12.35	13.44	14.33
15 - N8b	1.43	1.45	1.47	1.49	1.49	1.51	1.52	1.53	1.54	1.55
16 - N8b_finer_1sekm	1.42	1.45	1.47	1.485	1.51	1.53	1.55	1.56	1.57	1.61
17 - N8b_b	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.24	2.24	2.24
18 - N8b_b_finer_1sekm	3.28	3.28	3.29	3.29	3.3	3.31	3.33	3.34		
19 - N9b_finer	2.36	3.18	14.91	22.67	28.41	33.41	38.17	42.52	46,52	50.09
20 - N9b_finer_1sekm	2.33	6.17	17.4	26.24	33.32	40.49	47.71	54.69	61.72	68.37

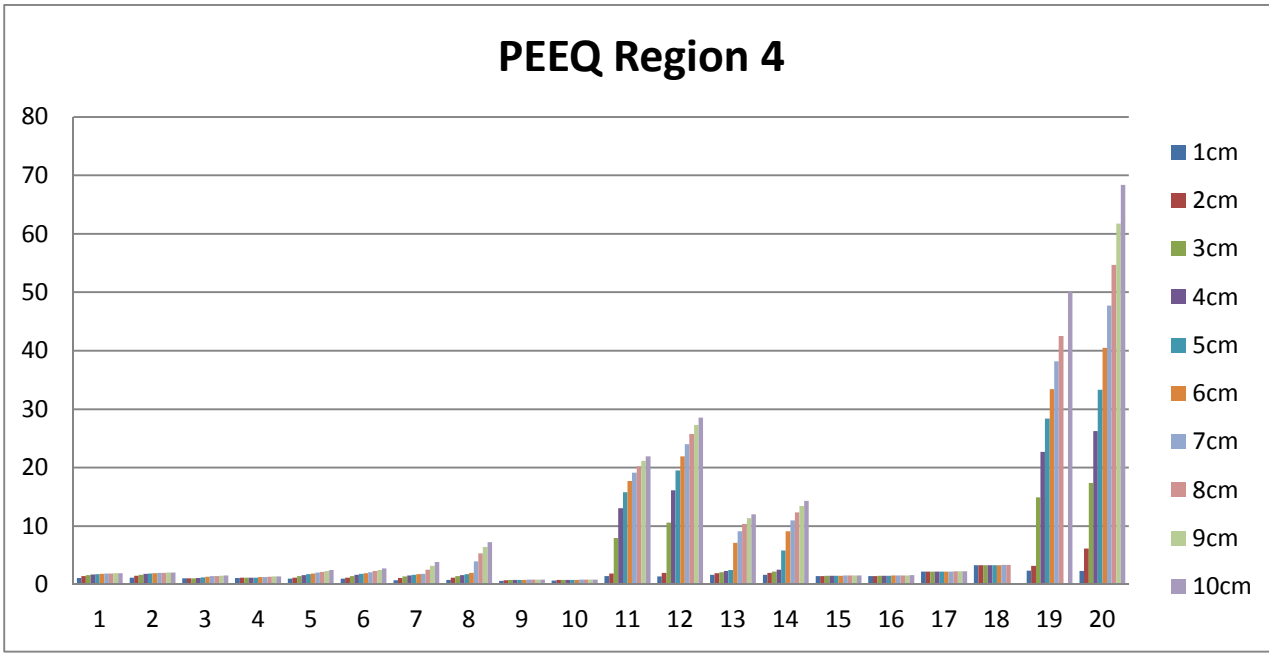

Figure 9-24. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 4, at 1 to 10 cm shearing. Case numbering follows Table 8-19.

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Table 9-20. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 5, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	10.18	10.48	10.88	11.22	11.48	11.62	11.63	11.63	11.63	11.63
2 - N1b_finer_1sekm	10.21	10.49	10.99	11.43	11.48	11.48	11.48	11.48	11.48	11.48
3 - N2b	10.02	11.34	12.12	12.86	12.89	12.89	12.88	12.88	12.89	12.9
4 - N2b_finer_1sekm	10.03	11.32	12	12.75	12.76	12.76	12.76	12.76	12.76	12.76
5 - N3b	6.81	6.98	7.15	7.33	7.53	7.74	7.96	8.2	8.46	8.71
6 - N3b_finer_1sekm	6.92	7.08	7.24	7.41	7.595	7.78	7.99	8.22	8.46	8.71
7 - N4b	8.24	9.41	9.98	10.64	10.69	10.71	10.76	10.81	10.87	10.95
8 - N4b_finer_1sekm	8.4	9.4	10.1	10.5	10.59	10.7	10.84	10.99	11.21	11.46
9 - N5b	6.52	10.82	11.2	11.98	12.54	12.57	12.57	12.57	12.57	12.57
10 - N5b_finer_1sekm	6.475	10.96	11.25	11.92	12.48	12.52	12.52	12.52	12.52	12.52
11 - N6b_finer	4.38	5.3	6.57	8.21	10.29	11.05	11.13	11.25	11.38	11.52
12 - N6b_finer_1sekm	4.38	5.32	6.6	8.26	10.36	11.18	11.26	11.37	11.49	11.61
13 - N7b	15.77	15.91	16.57	17.38	18.32	19.38	20.54	21.67	22.63	23.64
14 - N7b_finer_1sekm	15.83	15.98	16.78	18.13	20.1	22.15	23.99	25.86	27.82	29.85
15 - N8b	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
16 - N8b_finer_1sekm	15.87	15.87	15.87	15.87	15.87	15.87	15.87	15.87	15.87	15.87
17 - N8b_b	16.15	16.16	16.16	16.16	16.16	16.16	16.16	16.16	16.16	16.16
18 - N8b_b_finer_1sekm	16.15	16.15	16.19	16.22	16.27	16.35	16.42	16.46		
19 - N9b_finer	15.31	15.46	15.73	15.84	15.84	15.84	15.84	15.84	15.84	15.84
20 - N9b_finer_1sekm	15.45	15.7	15.84	15.84	15.84	15.84	15.84	15.84	15.84	15.84

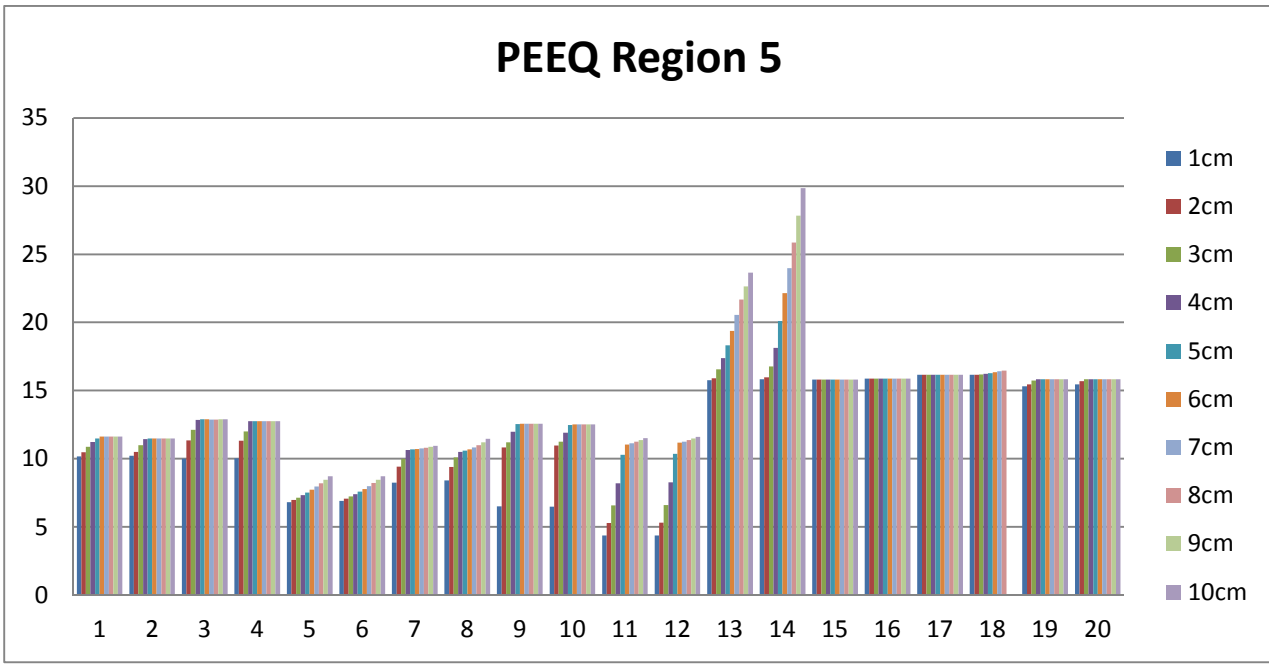

Figure 9-25. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 5, at 1 to 10 cm shearing. Case numbering follows Table 9-20.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-21. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 6, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	0.41	0.62	0.84	1.04	1.22	1.36	1.48	1.57	1.65	1.71
2 - N1b_finer_1sekm	0.41	0.64	0.91	1.18	1.41	1.58	1.69	1.78	1.86	1.93
3 - N2b	0.34	0.43	0.53	0.64	0.72	0.8	0.86	0.89	0.91	0.93
4 - N2b_finer_1sekm	0.34	0.42	0.49	0.58	0.65	0.71	0.74	0.76	0.76	0.77
5 - N3b	0.34	0.42	0.54	0.65	0.77	0.93	1.12	1.36	1.59	1.81
6 - N3b_finer_1sekm	0.34	0.42	0.54	0.655	0.78	0.96	1.19	1.48	1.73	1.95
7 - N4b	0.39	0.62	0.96	1.28	1.52	1.74	1.95	2.16	2.37	2.56
8 - N4b_finer_1sekm	0.38	0.64	1.03	1.41	1.75	2.12	2.48	2.83	3.16	3.48
9 - N5b	0.32	0.35	0.38	0.44	0.47	0.48	0.48	0.48	0.48	0.48
10 - N5b_finer_1sekm	0.31	0.34	0.35	0.39	0.4	0.4	0.4	0.4	0.4	0.4
11 - N6b_finer	0.76	1.35	2.13	3.1	4.05	4.89	5.64	6.31	6.92	7.51
12 - N6b_finer_1sekm	0.78	1.39	2.375	3.71	5.12	6.25	7.22	8.06	8.82	9.525
13 - N7b	0.68	1.06	2.21	3.25	4.08	4.85	5.56	6.18	6.73	7.15
14 - N7b_finer_1sekm	0.68	1.04	2.37	3.62	4.73	5.8	6.74	7.55	8.27	8.9
15 - N8b	0.41	0.42	0.42	0.42	0.42	0.44	0.45	0.46	0.48	0.49
16 - N8b_finer_1sekm	0.42	0.42	0.43	0.44	0.455	0.47	0.5	0.53	0.56	0.6
17 - N8b_b	0.44	0.46	0.48	0.52	0.56	0.59	0.62	0.64	0.65	0.67
18 - N8b_b_finer_1sekm	0.68	0.68	0.68	0.69	0.72	0.76	0.81	0.85		
19 - N9b_finer	0.92	2.1	4.44	6.74	8.67	10.22	11.49	12.6	13.56	14.38
20 - N9b_finer_1sekm	0.93	2.23	4.81	7.24	9.28	11.02	12.75	14.33	15.66	16.87

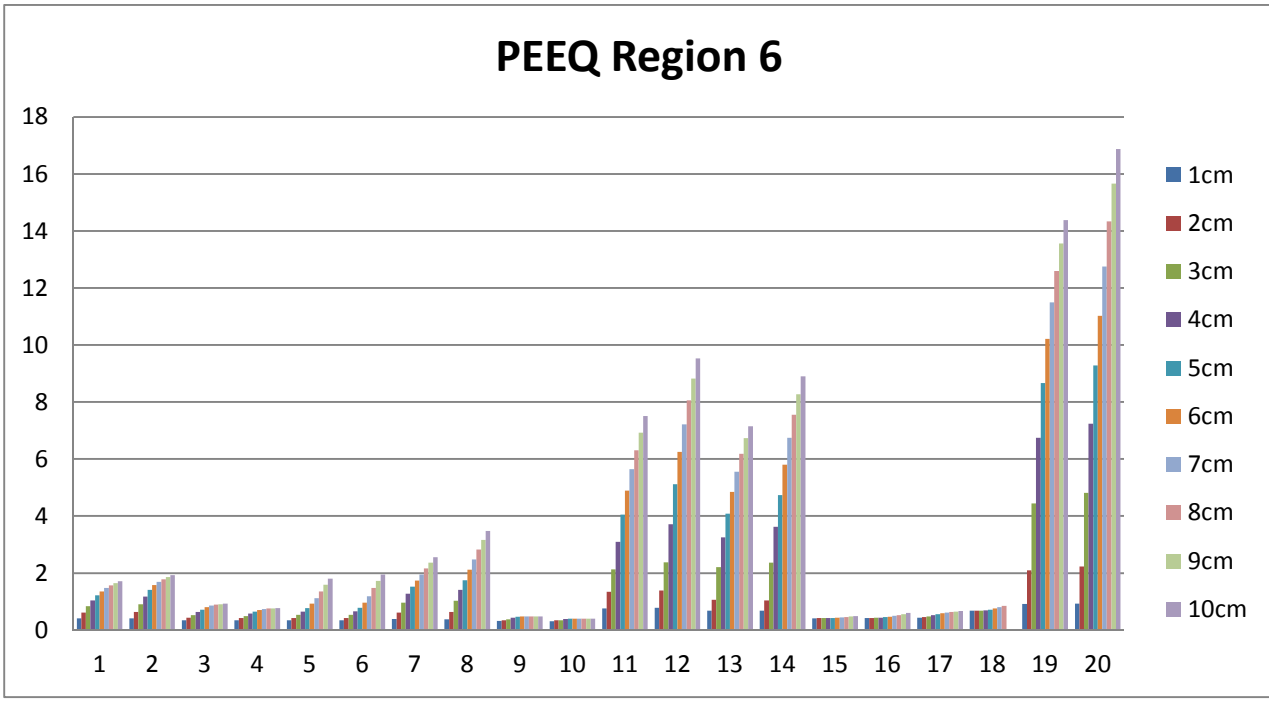

Figure 9-26. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 6, at 1 to 10 cm shearing. Case numbering follows Table 9-21.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-22. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 7, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	0	0.04	0.08	0.13	0.18	0.22	0.26	0.3	0.34	0.38
2 - N1b_finer_1sekm	0	0.05	0.12	0.21	0.27	0.32	0.37	0.42	0.47	0.53
3 - N2b	0	0	0.025	0.07	0.12	0.19	0.25	0.29	0.33	0.36
4 - N2b_finer_1sekm	0	0	0.026	0.076	0.14	0.21	0.27	0.31	0.35	0.38
5 - N3b	0	0	0	0	0	0	0	0	0	0
6 - N3b_finer_1sekm	0	0		0	0	0	0	0	0	0
7 - N4b	0	0.07	0.24	0.44	0.58	0.67	0.76	0.83	0.91	0.99
8 - N4b_finer_1sekm	0	0.09	0.34	0.6	0.78	0.92	1.05	1.17	1.29	1.42
9 - N5b	0	0	0.02	0.09	0.19	0.25	0.29	0.32	0.35	0.38
10 - N5b_finer_1sekm	0	0	0.02	0.08	0.18	0.24	0.28	0.31	0.33	0.35
11 - N6b_finer	0	0	0	0	0	0	0	0	0.01	0.02
12 - N6b_finer_1sekm	0	0	0	0	0	0	0	0	0	0
13 - N7b	0.06	0.19	0.45	0.71	0.95	1.19	1.43	1.67	1.91	2.16
14 - N7b_finer_1sekm	0.06	0.21	0.58	0.97	1.4	1.82	2.2	2.565	2.94	3.33
15 - N8b	0	0.03	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05
16 - N8b_finer_1sekm	0	0.02	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05
17 - N8b_b	0	0.03	0.04	0.05	0.05	0.06	0.06	0.06	0.06	0.06
18 - N8b_b_finer_1sekm	0	0.018	0.045	0.084	0.11	0.14	0.16	0.18		
19 - N9b_finer	0	0	0	0	0	0	0	0	0	0
20 - N9b_finer_1sekm	0	0	0	0	0	0	0	0	0	0

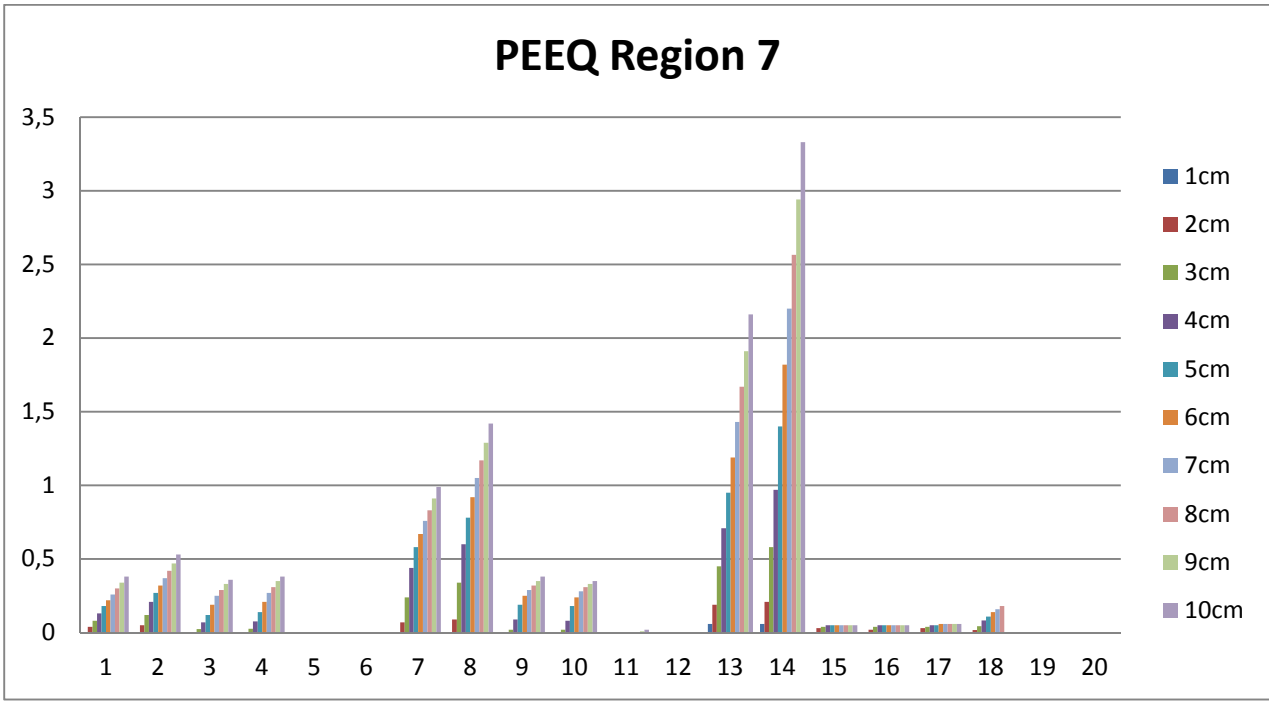

Figure 9-27. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 7, at 1 to 10 cm shearing. Case numbering follows Table 9-22.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table 9-23. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 8, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	0.68	0.71	0.74	0.76	0.77	0.79	0.82	0.88	0.93	0.97
2 - N1b_finer_1sekm	0.68	0.71	0.74	0.76	0.78	0.88	0.95	1	1.05	1.1
3 - N2b	0.61	0.61	0.61	0.61	0.61	0.61	0.62	0.62	0.62	0.63
4 - N2b_finer_1sekm	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
5 - N3b	0.63	0.66	0.7	0.73	0.75	0.77	0.79	0.81	0.88	0.99
6 - N3b_finer_1sekm	0.63	0.66	0.7	0.73	0.755	0.78	0.8	0.82	0.95	1.06
7 - N4b	0.54	0.6	0.63	0.67	0.84	0.99	1.12	1.25	1.36	1.45
8 - N4b_finer_1sekm	0.55	0.61	0.65	0.75	0.99	1.21	1.41	1.58	1.73	1.87
9 - N5b	0.5	0.5	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
10 - N5b_finer_1sekm	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
11 - N6b_finer	0.65	0.76	1.08	1.65	2.3	2.81	3.24	3.61	3.93	4.23
12 - N6b_finer_1sekm	0.64	0.76	1.19	2.07	2.93	3.55	4.07	4.52	4.91	5.26
13 - N7b	0.76	0.77	1.63	2.36	2.92	3.43	3.85	4.22	7.27	3.02
14 - N7b_finer_1sekm	0.74	1.18	2.1	2.675	3.17	3.71	4.33	4.89	5.38	5.8
15 - N8b	0.76	0.86	1.63	1.99	2.31	2.53	2.66	2.73	2.77	2.8
16 - N8b_finer_1sekm	0.77	1.01	1.93	2.61	3.05	3.31	3.495	3.66	3.795	3.9
17 - N8b_b	1.1	1.1	1.1	1.2	1.65	1.68	1.96	2.17	2.3	2.39
18 - N8b_b_finer_1sekm	1.45	1.45	1.58	1.88	3.5	3.95	4.39	4.83		
19 - N9b_finer	0.87	1.32	2.84	4.33	5.65	6.72	7.63	8.39	9.02	9.56
20 - N9b_finer_1sekm	0.87	1.39	3.09	4.7	6.11	7.36	8.55	9.6	10.5	11.34

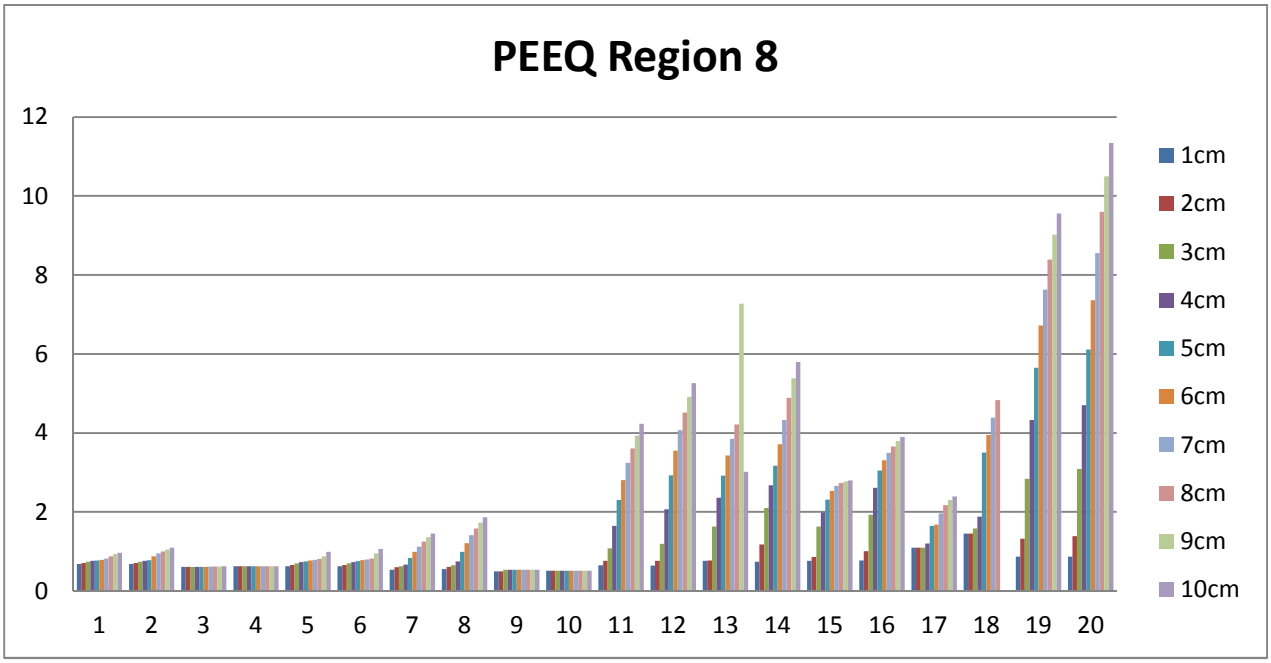

Figure 9-28. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 8, at 1 to 10 cm shearing. Case numbering follows Table 9-23.

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Table 9-24. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 9, at 1 to 10 cm shearing

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b	0.59	0.75	0.86	0.94	1	1.04	1.06	1.08	1.1	1.12
2 - N1b_finer_1sekm	0.59	0.81	0.99	1.15	1.21	1.26	1.3	1.34	1.39	1.43
3 - N2b	0.41	0.63	0.83	0.97	1.02	1.06	1.09	1.12	1.14	1.15
4 - N2b_finer_1sekm	0.39	0.61	0.83	1.02	1.1	1.18	1.23	1.27	1.31	1.34
5 - N3b	0.17	0.18	0.2	0.22	0.24	0.26	0.28	0.3	0.33	0.3
6 - N3b_finer_1sekm	0.17	0.185	0.2	0.22	0.24	0.22	0.24	0.26	0.28	0.3
7 - N4b	0.51	0.81	1.01	1.19	1.26	1.31	1.35	1.39	1.44	1.48
8 - N4b_finer_1sekm	0.53	0.89	1.29	1.6	1.75	1.88	1.99	2.09	2.19	2.28
9 - N5b	0.25	0.59	0.82	1.01	1.13	1.17	1.2	1.21	1.23	1.25
10 - N5b_finer_1sekm	0.24	0.55	0.79	1.02	1.2	1.27	1.31	1.34	1.36	1.39
11 - N6b_finer	0.11	0.16	0.24	0.37	0.47	0.56	0.63	0.69	0.74	0.78
12 - N6b_finer_1sekm	0.11	0.16	0.24	0.36	0.45	0.54	0.61	0.66	0.7	0.73
13 - N7b	0.76	0.94	1.1	1.26	1.43	1.6	1.76	1.92	2.06	2.19
14 - N7b_finer_1sekm	0.76	1.06	1.36	1.71	2.095	2.445	2.73	2.97	3.18	3.38
15 - N8b	0.66	0.76	0.84	0.84	0.86	0.87	0.88	0.88	0.89	0.89
16 - N8b_finer_1sekm	0.63	0.72	0.8	0.85	0.85	0.86	0.86	0.87	0.875	0.88
17 - N8b_b	0.53	0.6	0.61	0.65	0.68	0.7	0.71	0.72	0.73	0.74
18 - N8b_b_finer_1sekm	0.46	0.55	0.61	0.67	0.72	0.75	0.78	0.8		
19 - N9b_finer	0.51	0.57	0.62	0.65	0.67	0.69	0.7	0.71	0.71	0.71
20 - N9b_finer_1sekm	0.51	0.57	0.61	0.64	0.66	0.68	0.69	0.69	0.69	0.69

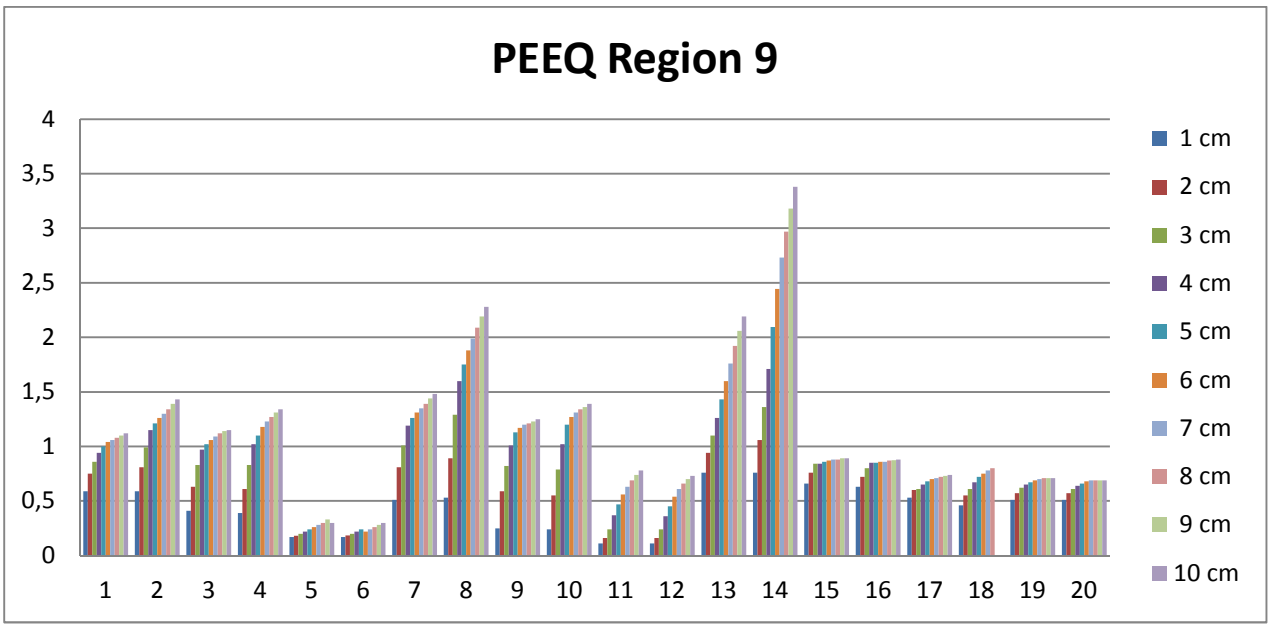

Figure 9-29. Maximum plastic equivalent strain (PEEQ [%]) for the copper shell, Region 9, at 1 to 10 cm shearing. Case numbering follows Table 9-24.

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9.2 Copper shell – most extreme cases

For the copper shell the plastic equivalent strain (PEEQ) is used as a measure to select the most extreme cases. Table 9-26 shows the 5 cases having the greatest magnitudes of PEEQ at 10 cm shearing. As can be noticed the same cases are listed for mid and top regions (shear plane 90% from the base). Another list (shear plane 50% from the base) occurs for the base regions.

Another observation is that the most extreme values are found at the region "top singular" where the results are very local and strongly dependent on mesh density. More relevant results are those reported for the region "top fillets". Appendix 3 – 7 shows plots for cases N29, N31, N9, N7 and N27 respectively.

Table 9-26. Cases sorted after maximum plastic equivalent strain, PEEQ [%] in the copper shell at 10 cm shearing

mid		top weld		bottom weld		top singular		bottom singular		top fillets		bottom fillets		rest top		rest bottom	
N31	15.374	N31	51.548	N7	14.320	N31	69.565	N17	30.641	N29	17.334	N27	4.533	N9	11.340	N27	4.035
N29	15.358	N29	51.522	N27	11.848	N29	69.473	N7	29.850	N31	17.311	N25	4.532	N29	8.727	N25	4.035
N30	13.863	N30	46.160	N25	11.848	N9	68.370	N35	24.820	N9	16.870	N26	4.494	N31	8.721	N26	4.016
N9	13.840	N28	45.899	N26	11.727	N30	60.602	N27	18.460	N30	16.644	N24	4.438	N30	8.435	N24	3.984

9.3 Iron insert and steel channels – most extreme cases

For the iron insert the most extreme cases are based on maximum principal stress which is similar to the axial stress S33, Table 9-27. However, different material models have been used and thus the maximum equivalent plastic strain, PEEQ is used to select the most extreme cases at 10 cm shearing. The case N8_b represents a special case where the channels are modeled as a separate part. Appendix 8 – 12 shows plots for cases N8, N8_b, N21, N20 respectively N22. All selected cases have the shear plane at the distance of 75% from the base.

Appendix 15 shows sorted values at 5 cm shearing.

Table 9-27. Cases sorted after maximum values for Mises [MPa], S33 [MPa] and PEEQ [%] at 10 cm shearing

Insert Mises		Channels Mises		Insert PEEQ		Channels PEEQ		Insert S33		Channels S33	
N8_b	458.4	N8_b	782.7	N8_b	8.53	N40	3.53	N43	378.7	N41	472.3
N43	366.4	N40	689.2	N40	1.90	N42	3.39	N41	368.6	N43	469.1
N41	353.4	N42	687.3	N35	1.81	N8	3.26	N21	365.4	N8	468.9
N21	347.4	N8	683.1	N8	1.80	N35	3.11	N39	355.2	N35	468.3
N39	340.9	N35	679.3	N42	1.79	N41	3.00	N31	351.0	N40	466.9

10 Uncertainties

The obtained results are based on several assumptions regarding loads and material properties. Also the discretization in the computer model will affect the results. Some of these influencing factors are addressed below:

- All experiments used for material calibration have a spread which will imply a range for the properties defining each material model.

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- Swelling pressure for the bentonite will affect the material stiffness. The experimental results have a spread in the results and the used data should be conservative in the sense that the obtained stress and strain magnitudes are overestimated.

- Element mesh is rather fine but nevertheless it is too coarse in some regions, especially at the welds and regions with geometric discontinuities. A more refined mesh will probably increase the maximum stress and strain levels. Fortunately, the use of non-linear material properties (such as plasticity and creep) will decrease the sensitivity on the used mesh. The used mesh has been judged to be accurate enough considering also the required computer resources to obtain the results.

11 Evaluation and conclusions

The results obtained from the rock shear analyses could be summarized as:

- The results should vary smoothly with shearing magnitude. However, the obtained results show sometimes a discontinuous variation, see e.g. case N7 and stress results reported in Figs 9-12 – 9-20. This could be explained by the FE-discretization where e.g. the contact conditions sometimes suddenly changes. Another reason is the averaging method when the results are plotted, where large gradients could affect the calculated nodal values in non-smooth way.

- The stiffness of the buffer has a great effect on stress and strain levels both for the copper shell and the insert (increased stiffness implies increased stress levels)

- The maximum plastic strain in copper shell occurs in fillets (besides regions containing singularities). The maximum plastic strains in the insert occur at the corners of a specific channel. However, the magnitude is small compared to ultimate strains and is considered not to cause any severe damage.

- Maximum principal stress in the insert mainly comes from bending of the shell – the level depends mainly on material properties for the insert (and dimensions) and buffer.

- Strain rate effects for bentonite, copper and iron will affect the results. Strain rate dependency is included for the buffer and the cast iron. Copper shell will have the strain rate effect included when the creep model is used but in this study all analyzes have been performed by using plasticity theory.

- Increasing shearing velocity will increase the stiffness and will in most cases increase the stresses. For the cast iron insert a typical increase of the Mises stress is about 10% (Table 9-1). The same conclusion holds also for the Mises stress for the steel channels. The plastic equivalent strain shows also a corresponding increase and the case with separate parts for the steel channel shows an even higher increase compared to the case when the channels are glued (welded) to the cast iron insert. For the copper shell the maximum Mises stress shows small variations and is less dependent on analyzed case (Figs 9-8 – 9-16) with a few exceptions. The same holds also for the equivalent plastic strain.

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Unpublished documents

SKBdoc id, version	Title	Issuer, year
1201865 ver 1.0	Dragprovning av gjutjärn. (In Swedish.)	KTH, 2009
1203875 ver 1.0	Ritningsförteckning för kapselkomponenter. (In Swedish.)	SKB, 2009
1336557 ver 2.0	PM Probalistisk analys av skjuvlastfallet. (In Swedish.)	Inspecta Technology AB, 2012

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Appendix 1 – Displaced geometry with axial stress, S33

Plots showing deformed geometry as contour plot of S33 at shearing magnitude 10 cm for all cases. The view shows the symmetry plane and the deformations are multiplied by factor two.

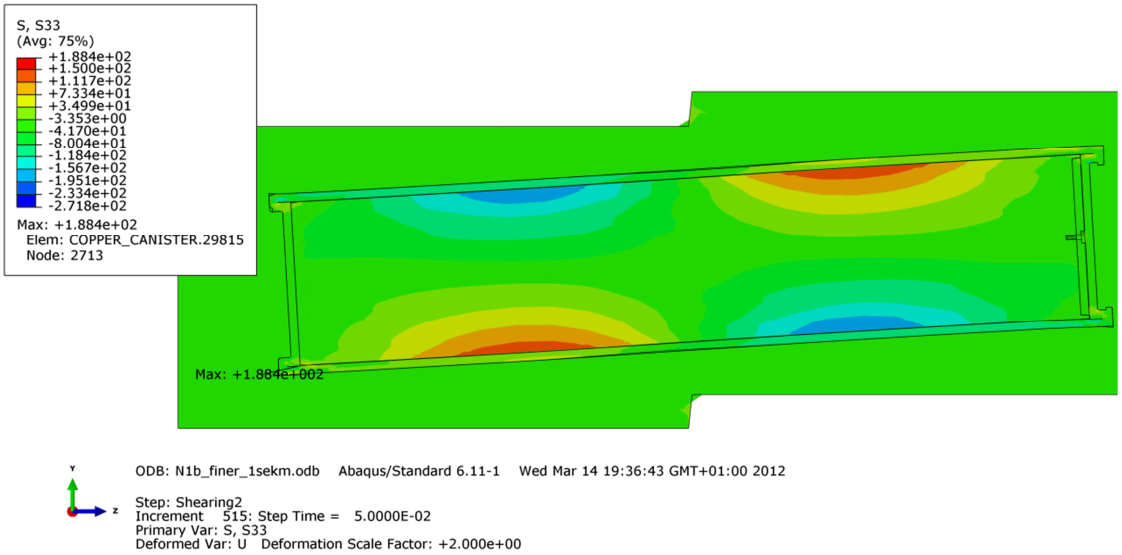

Figure A1-1. Deformed plot - 10 cm shearing magnitude, case N1b_finer_1sekm.

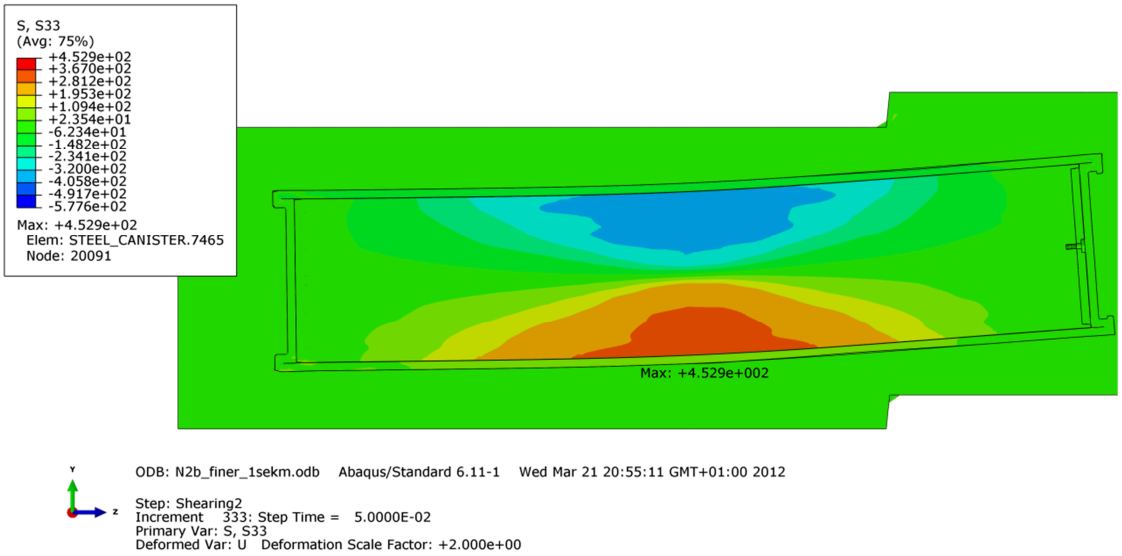

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Figure A1-2. Deformed plot - 10 cm shearing magnitude, case N2b_finer_1sekm.

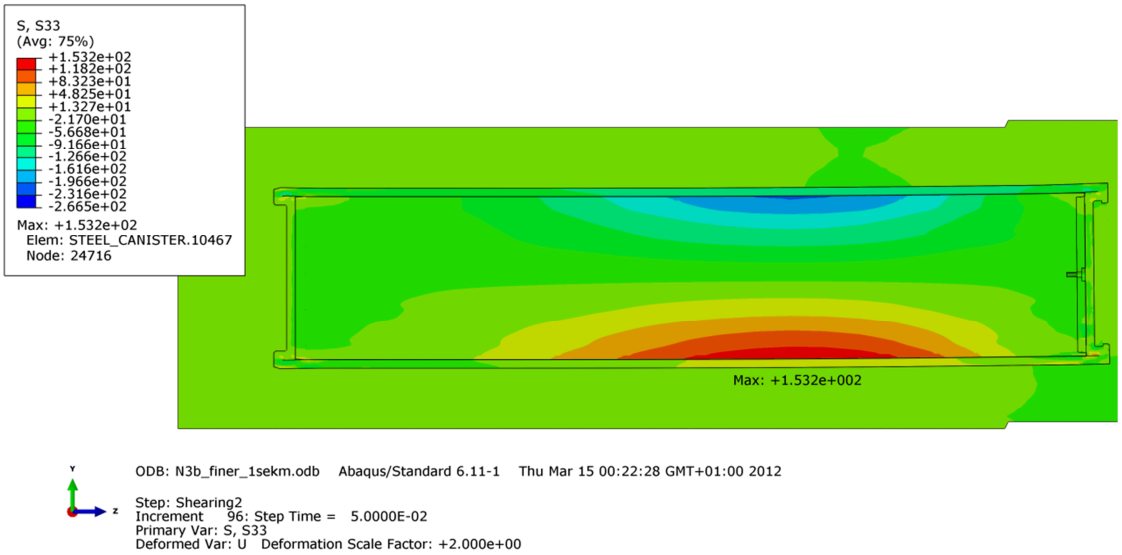

Figure A1-3. Deformed plot - 10 cm shearing magnitude, case N3b_finer_1sekm.

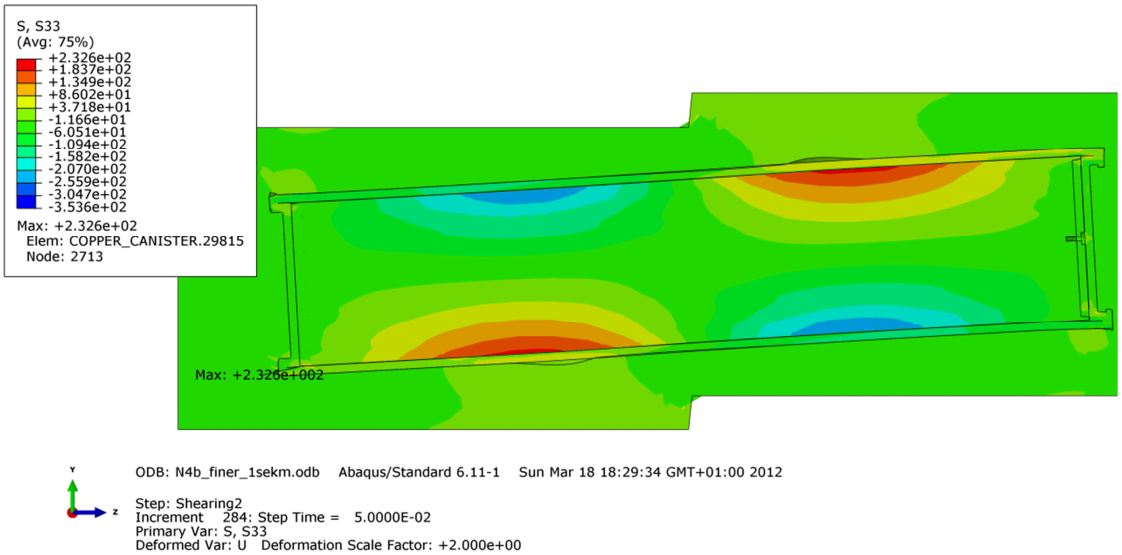

Figure A1-4. Deformed plot - 10 cm shearing magnitude, case N4b_finer_1sekm.

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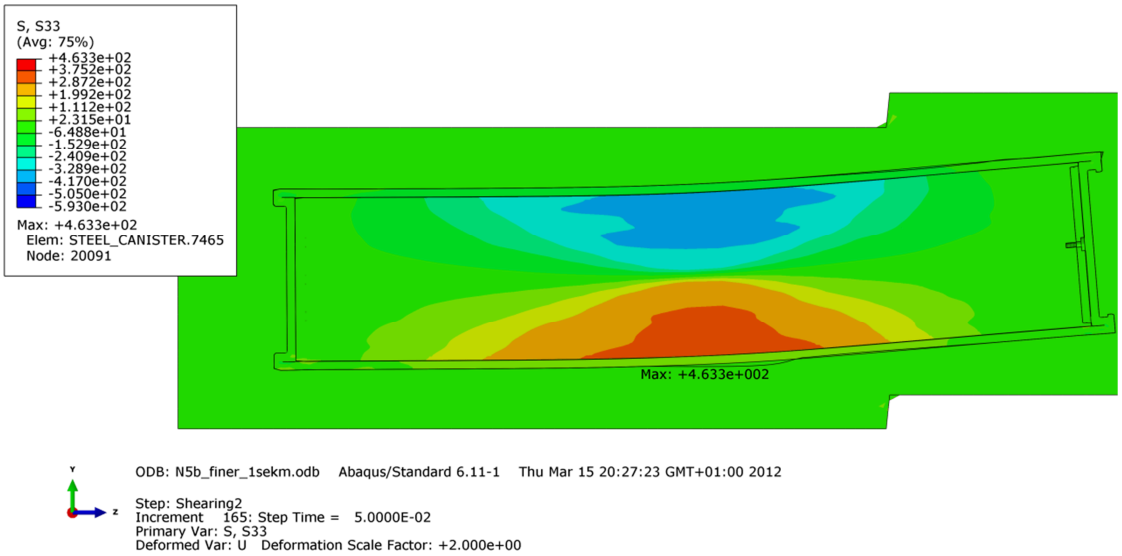

Figure A1-5. Deformed plot - 10 cm shearing magnitude, case N5b_finer_1sekm.

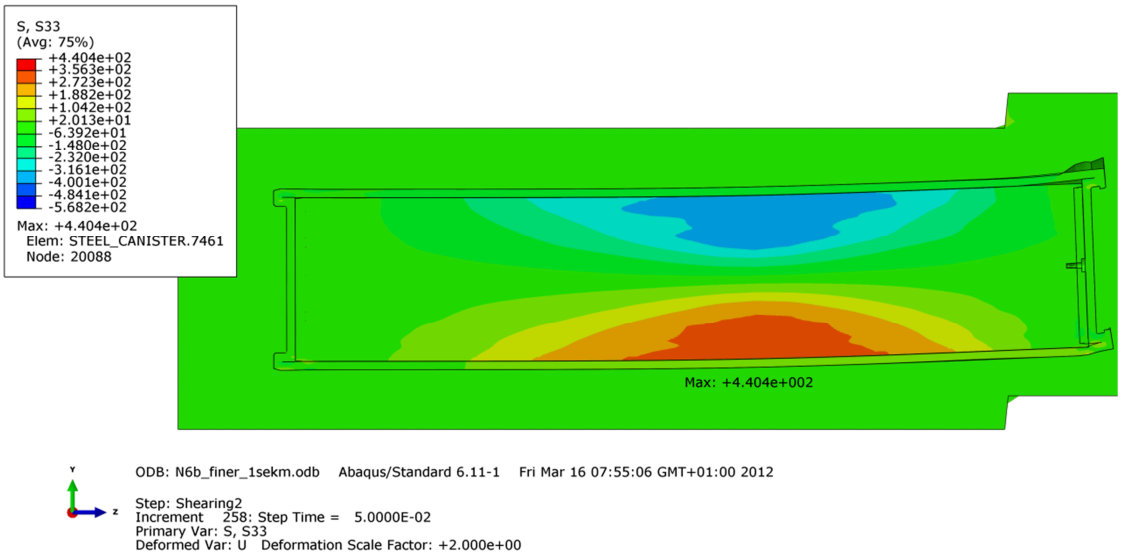

Figure A1-6. Deformed plot - 10 cm shearing magnitude, case N6b_finer_1sekm.

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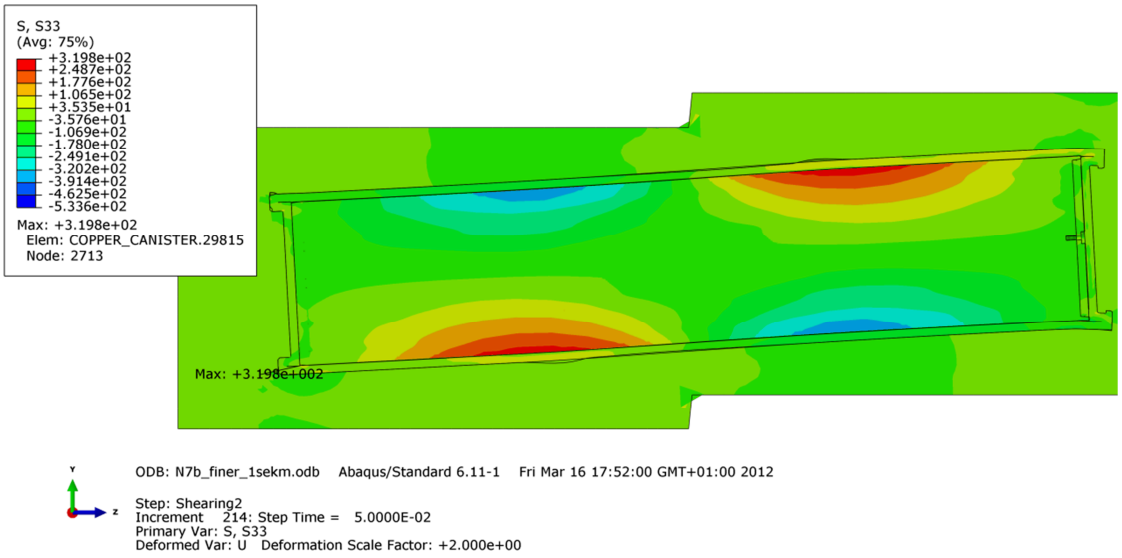

Figure A1-7. Deformed plot - 10 cm shearing magnitude, case N7b_finer_1sekm.

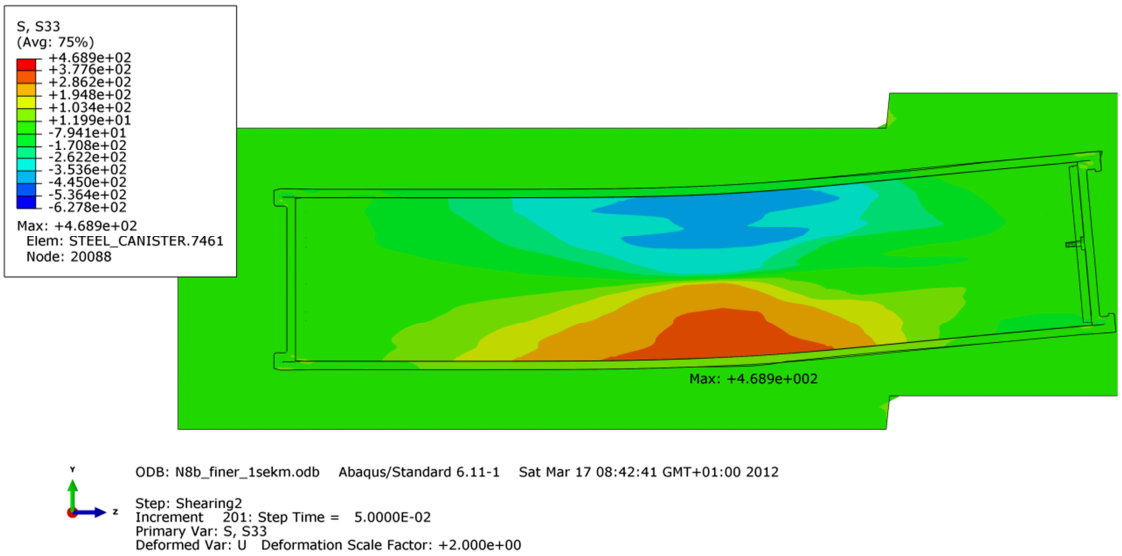

Figure A1-8. Deformed plot - 10 cm shearing magnitude, case N8b_finer_1sekm.

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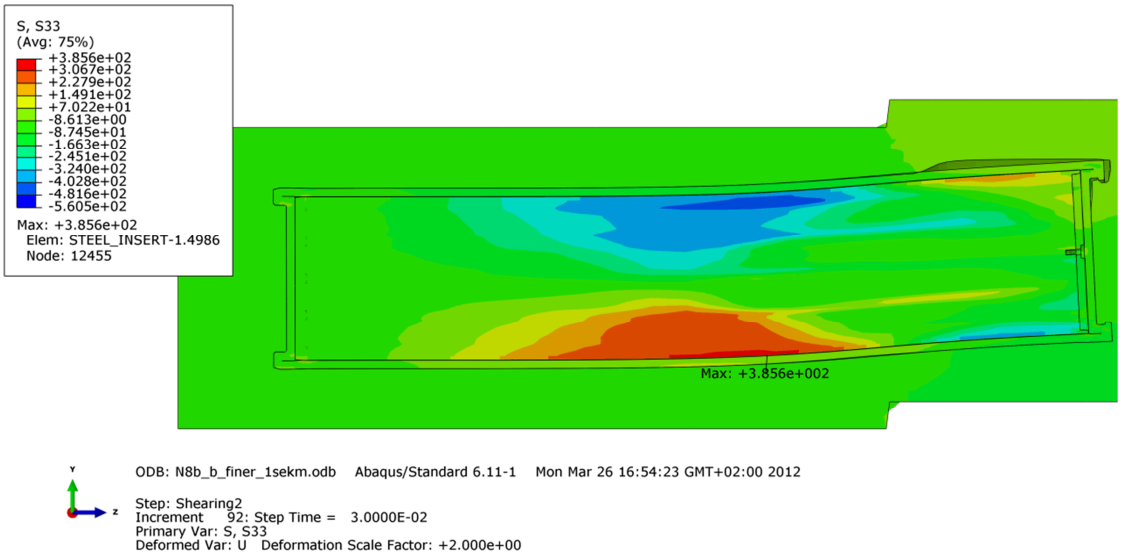

Figure A1-9. Deformed plot - 10 cm shearing magnitude, case N8b_b_finer_1sekm.

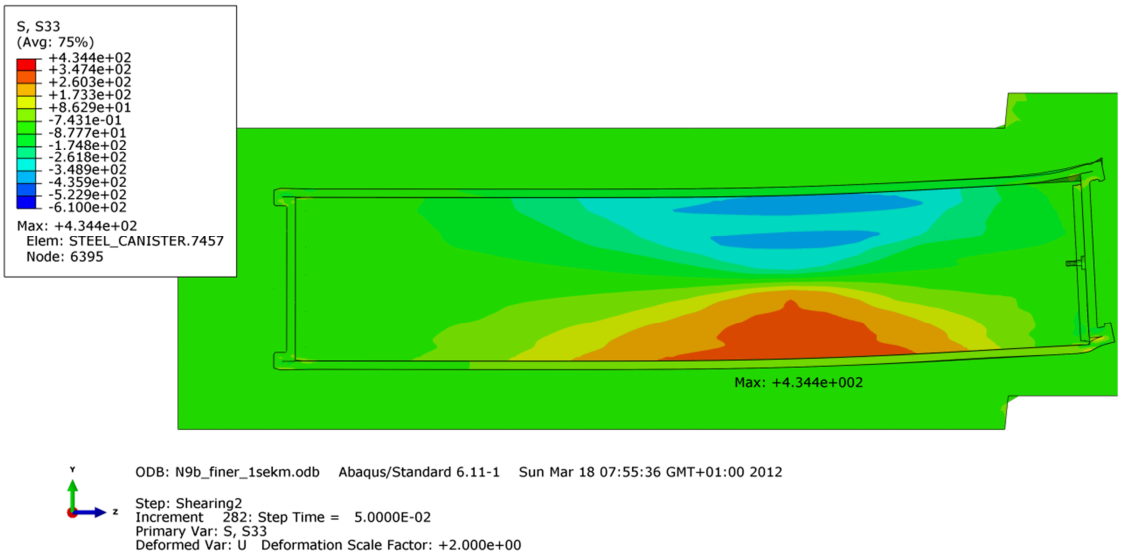

Figure A1-10. Deformed plot - 10 cm shearing magnitude, case N9b_finer_1sekm.

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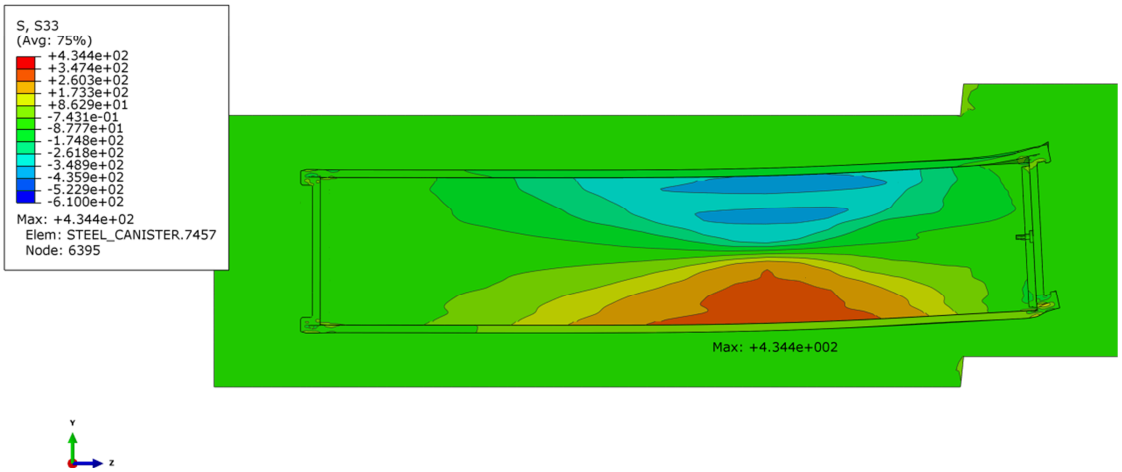

Figure A1-11. Deformed plot - 10 cm shearing magnitude, case N9b_finer_1sekm.

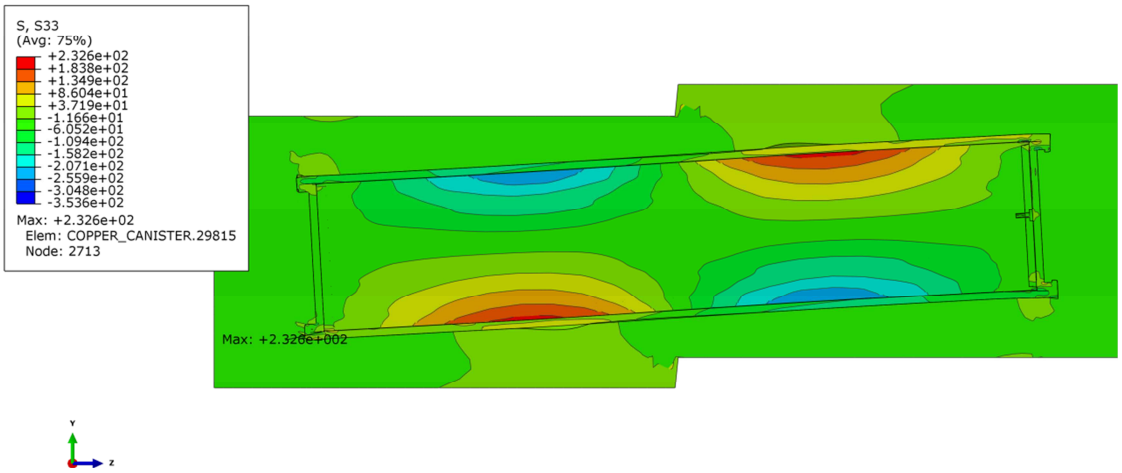

Figure A1-12. Deformed plot - 10 cm shearing magnitude, case N10b_finer_1sekm.

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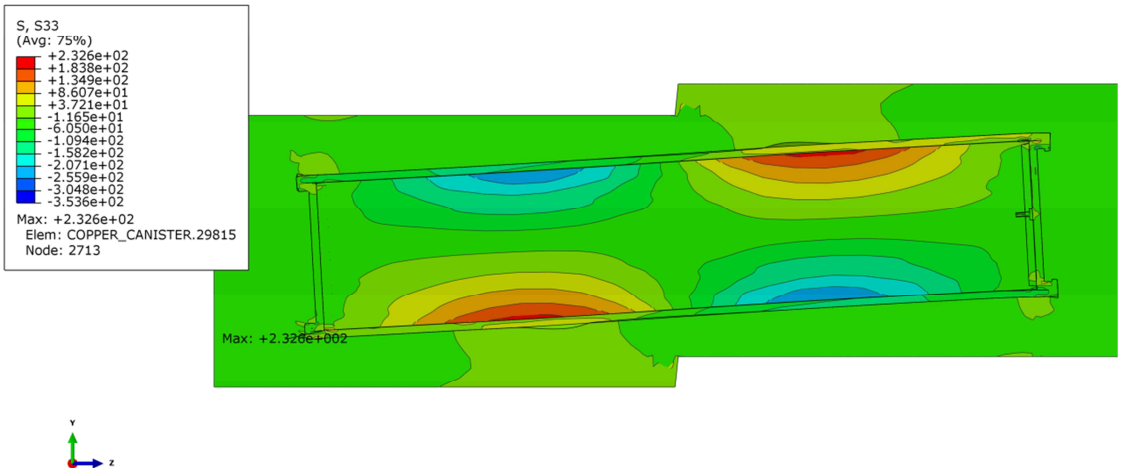

Figure A1-13. Deformed plot - 10 cm shearing magnitude, case N11b_finer_1sekm.

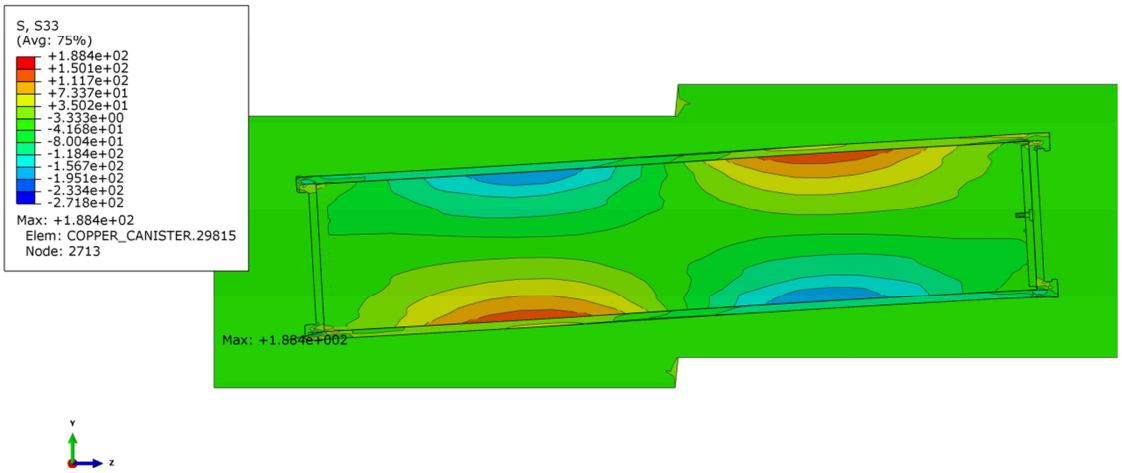

Figure A1-14. Deformed plot - 10 cm shearing magnitude, case N12b_finer_1sekm.

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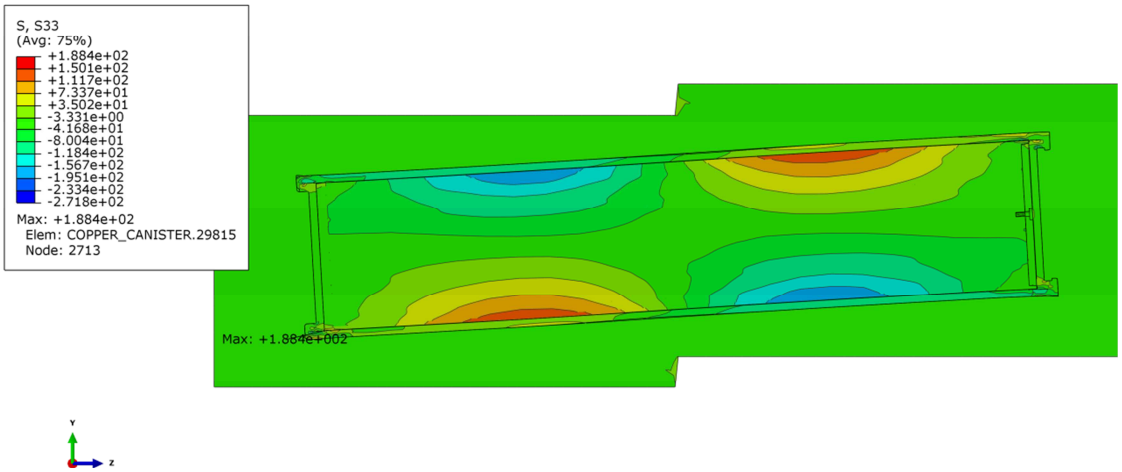

Figure A1-15. Deformed plot - 10 cm shearing magnitude, case N13b_finer_1sekm.

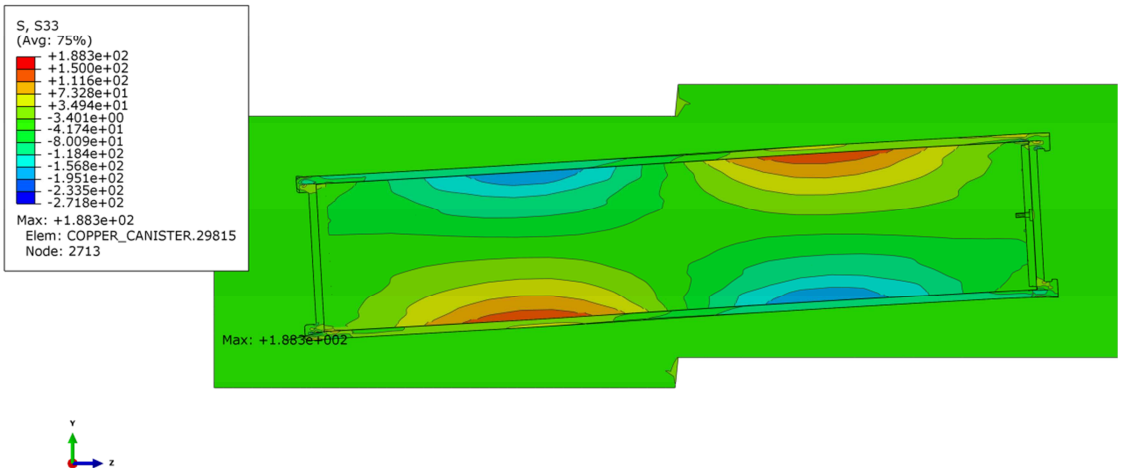

Figure A1-16. Deformed plot - 10 cm shearing magnitude, case N14b_finer_1sekm.

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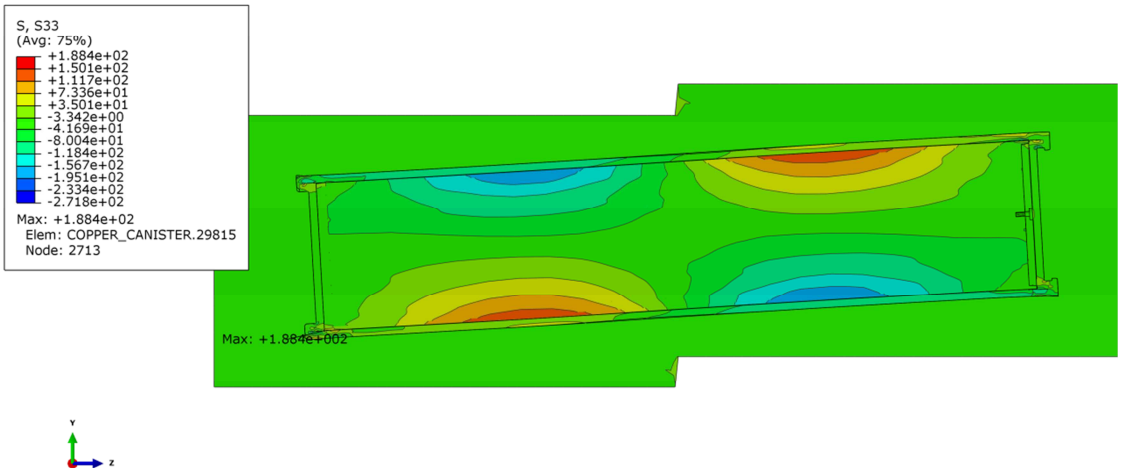

Figure A1-17. Deformed plot - 10 cm shearing magnitude, case N15b_finer_1sekm.

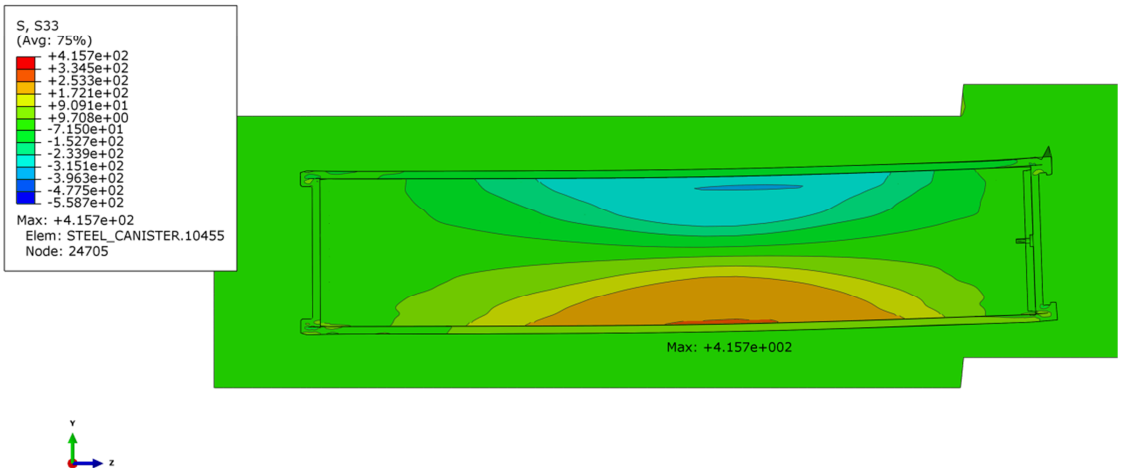

Figure A1-18. Deformed plot - 10 cm shearing magnitude, case N16b_finer_1sekm.

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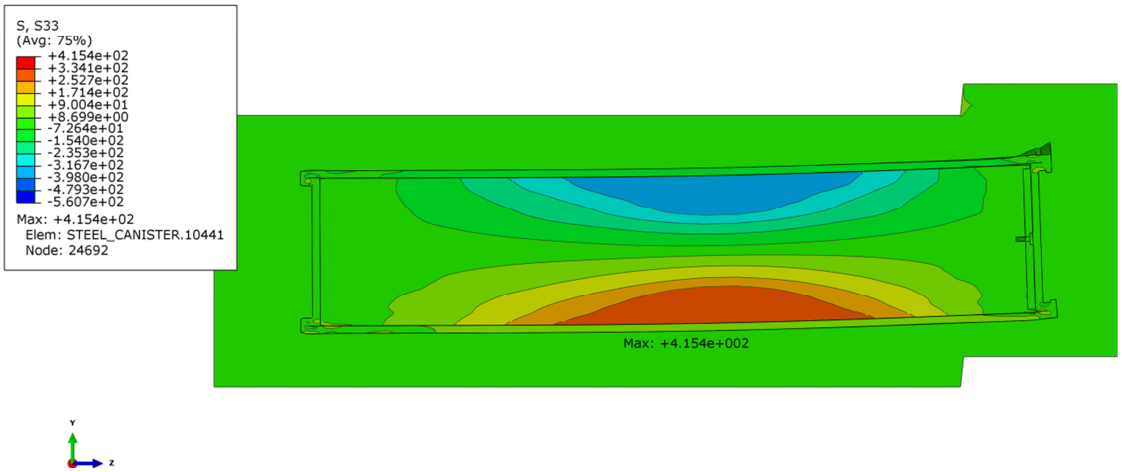


Figure A1-19. Deformed plot - 10 cm shearing magnitude, case N17b_finer_1sekm.

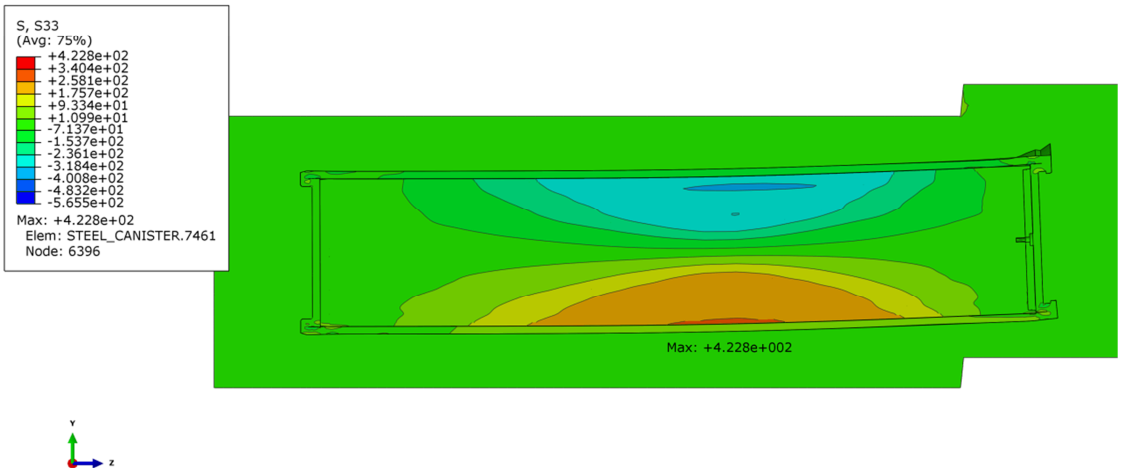


Figure A1-20. Deformed plot - 10 cm shearing magnitude, case N18b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

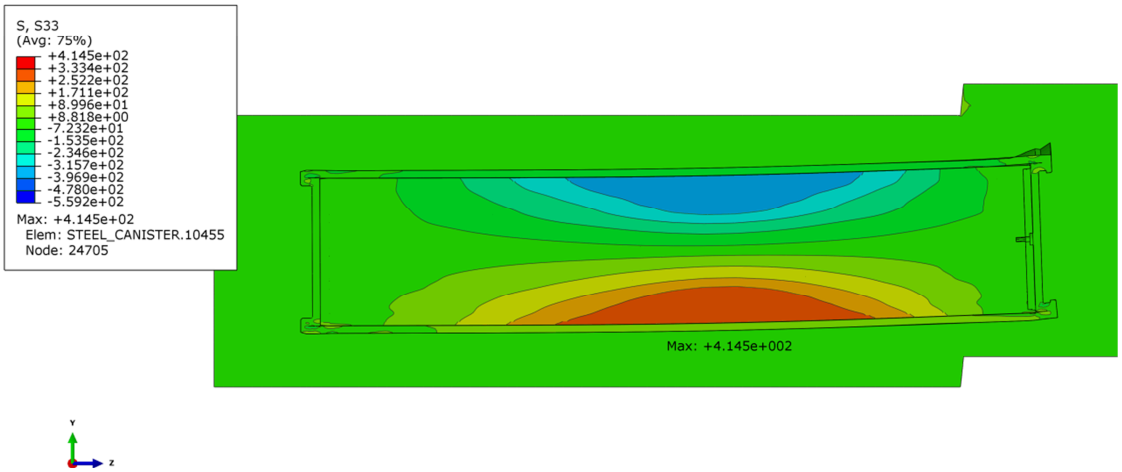


Figure A1-21. Deformed plot - 10 cm shearing magnitude, case N19b_finer_1sekm.

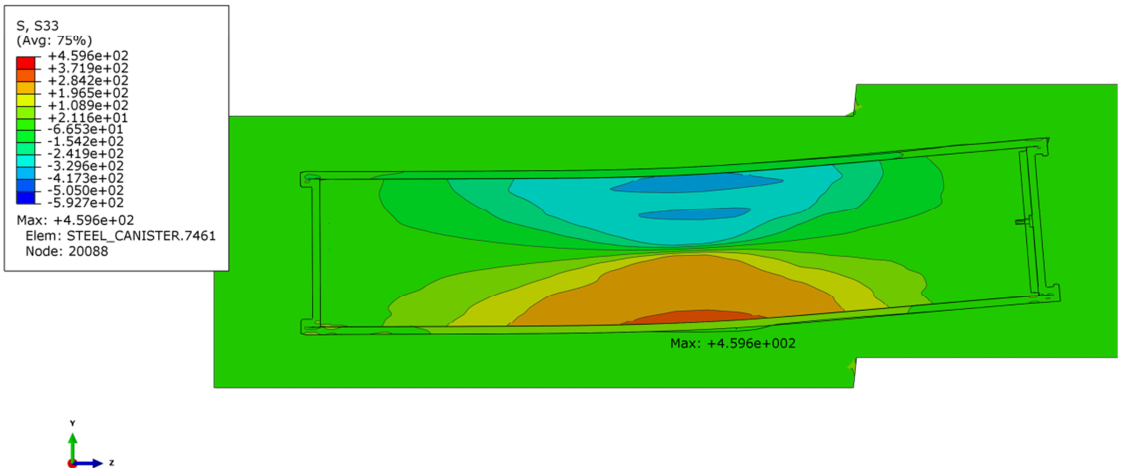


Figure A1-22. Deformed plot - 10 cm shearing magnitude, case N20b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

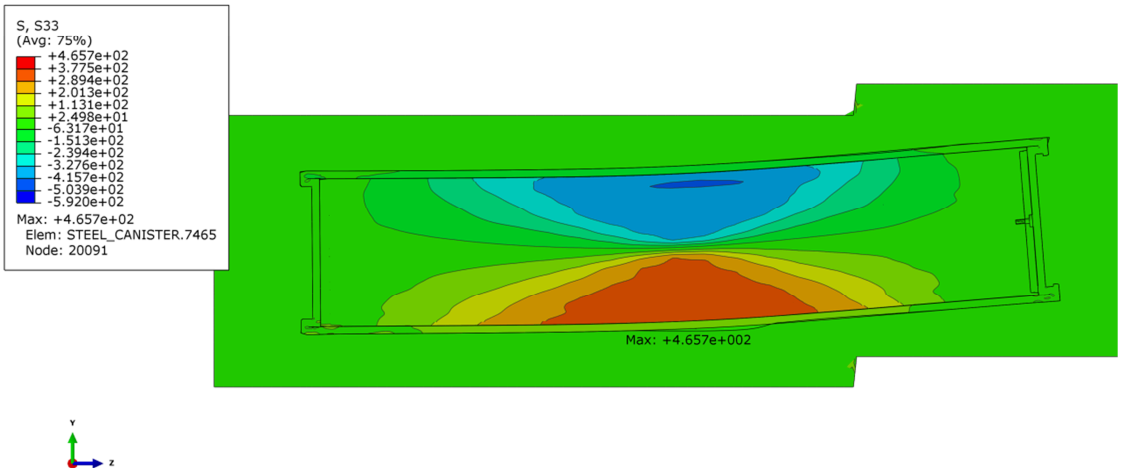


Figure A1-23. Deformed plot - 10 cm shearing magnitude, case N21b_finer_1sekm.

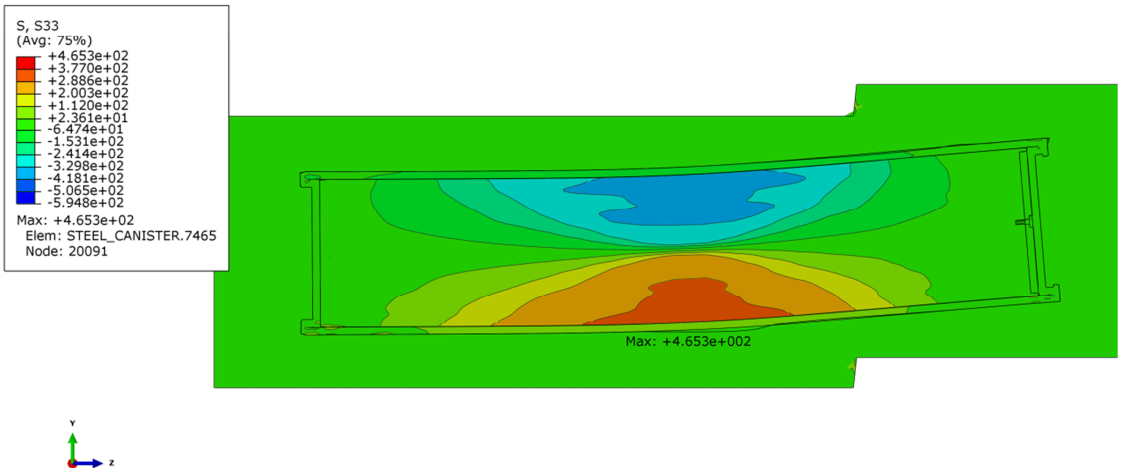


Figure A1-24. Deformed plot - 10 cm shearing magnitude, case N22b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

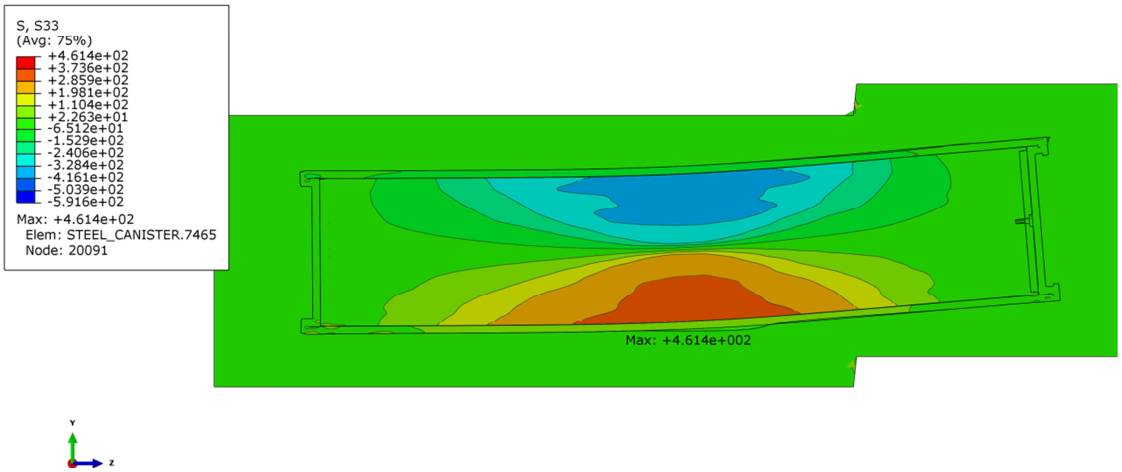


Figure A1-25. Deformed plot - 10 cm shearing magnitude, case N23b_finer_1sekm.

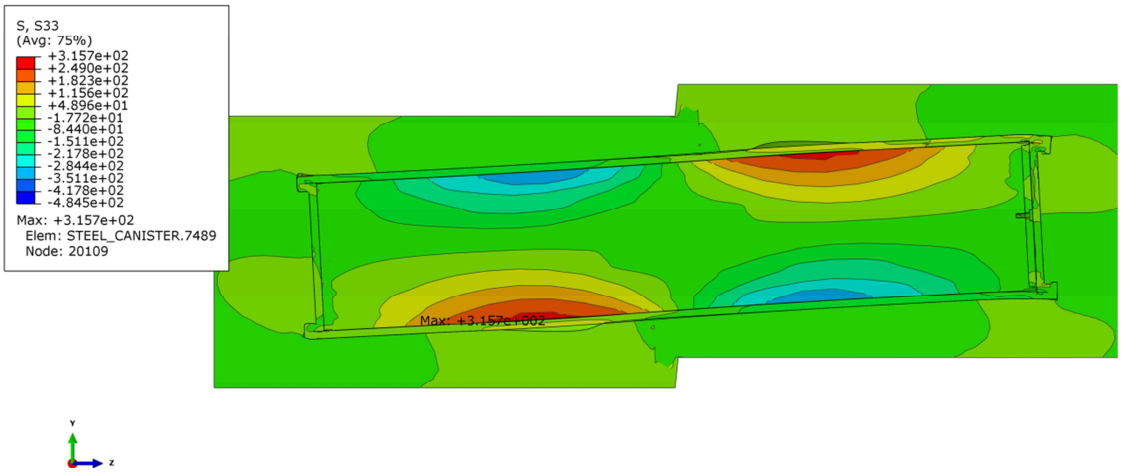


Figure A1-26. Deformed plot - 10 cm shearing magnitude, case N24b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

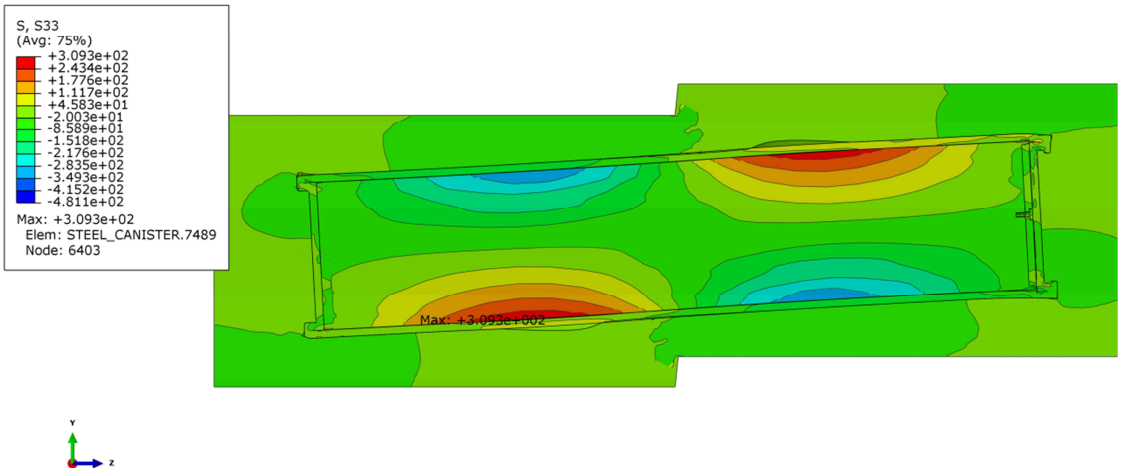


Figure A1-27. Deformed plot - 10 cm shearing magnitude, case N25b_finer_1sekm.

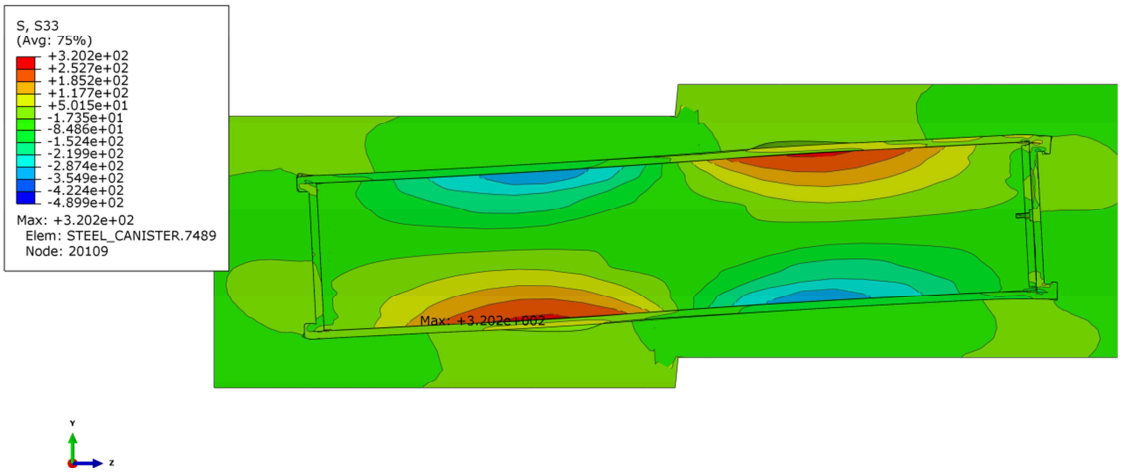


Figure A1-28. Deformed plot - 10 cm shearing magnitude, case N26b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

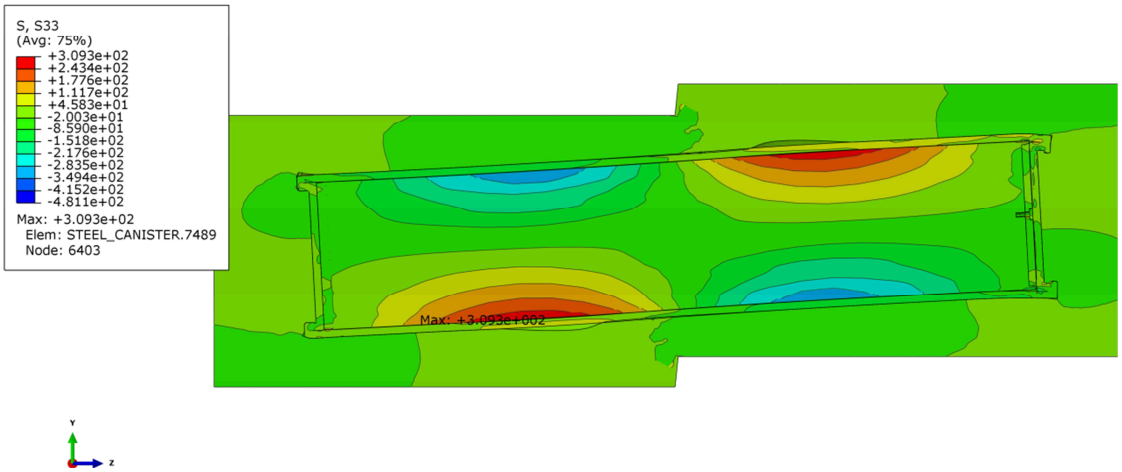


Figure A1-29. Deformed plot - 10 cm shearing magnitude, case N27b_finer_1sekm.

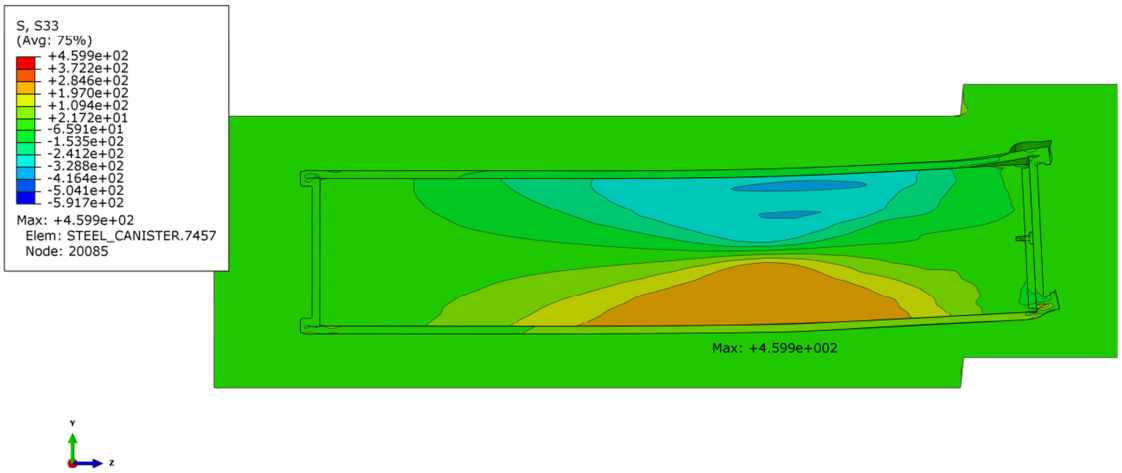


Figure A1-30. Deformed plot - 10 cm shearing magnitude, case N28b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

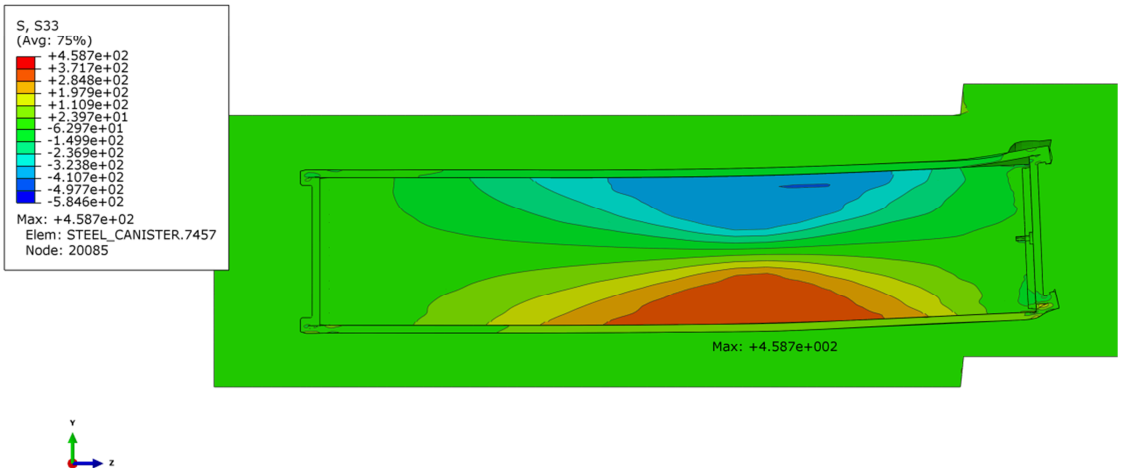


Figure A1-31. Deformed plot - 10 cm shearing magnitude, case N29b_finer_1sekm.

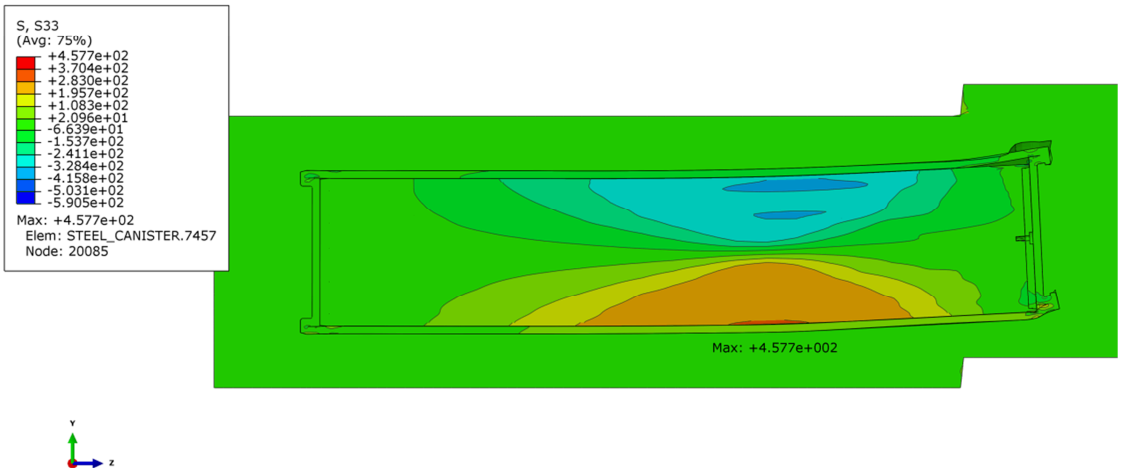


Figure A1-32. Deformed plot - 10 cm shearing magnitude, case N30b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

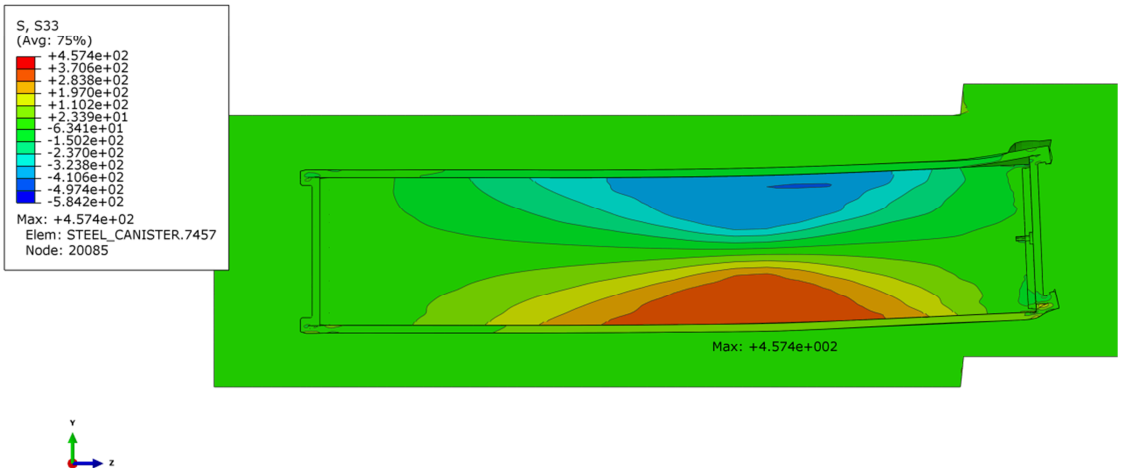


Figure A1-33. Deformed plot - 10 cm shearing magnitude, case N31b_finer_1sekm.

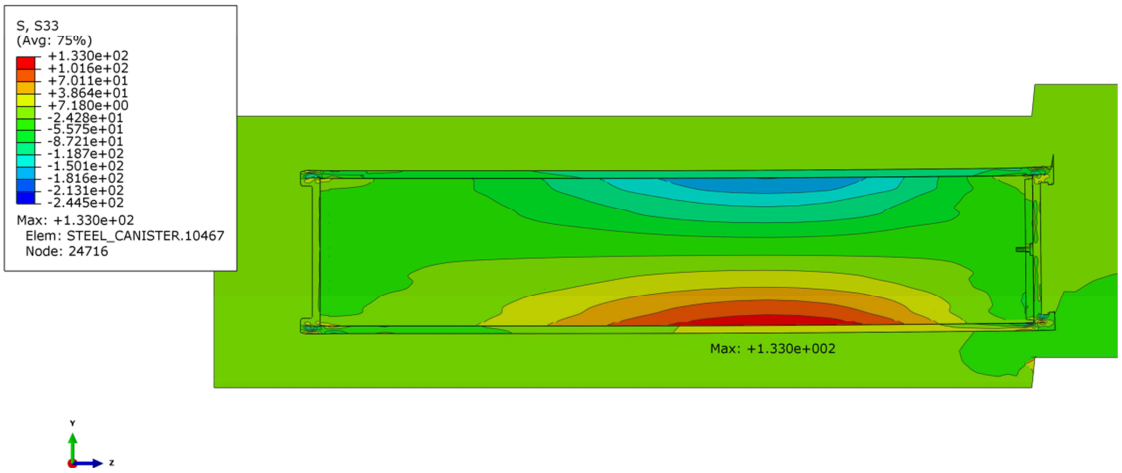


Figure A1-34. Deformed plot - 10 cm shearing magnitude, case N32b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

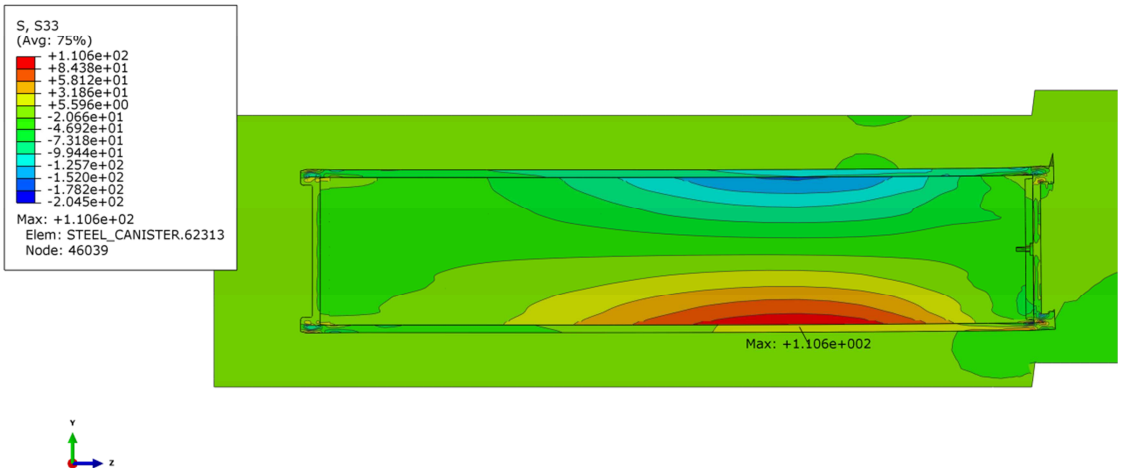


Figure A1-35. Deformed plot - 10 cm shearing magnitude, case N33b_finer_1sekm.

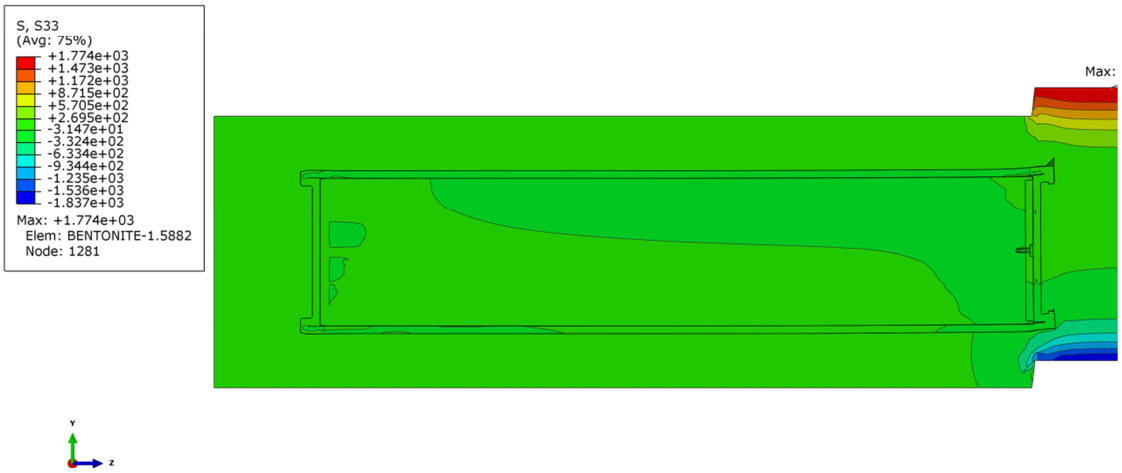


Figure A1-36. Deformed plot - 10 cm shearing magnitude, case N34b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

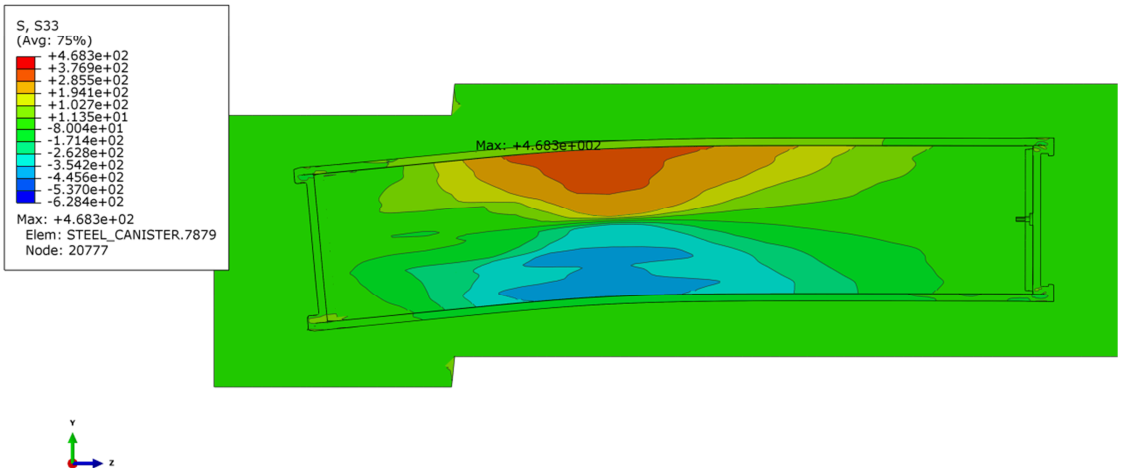


Figure A1-37. Deformed plot - 10 cm shearing magnitude, case N35b_finer_1sekm.

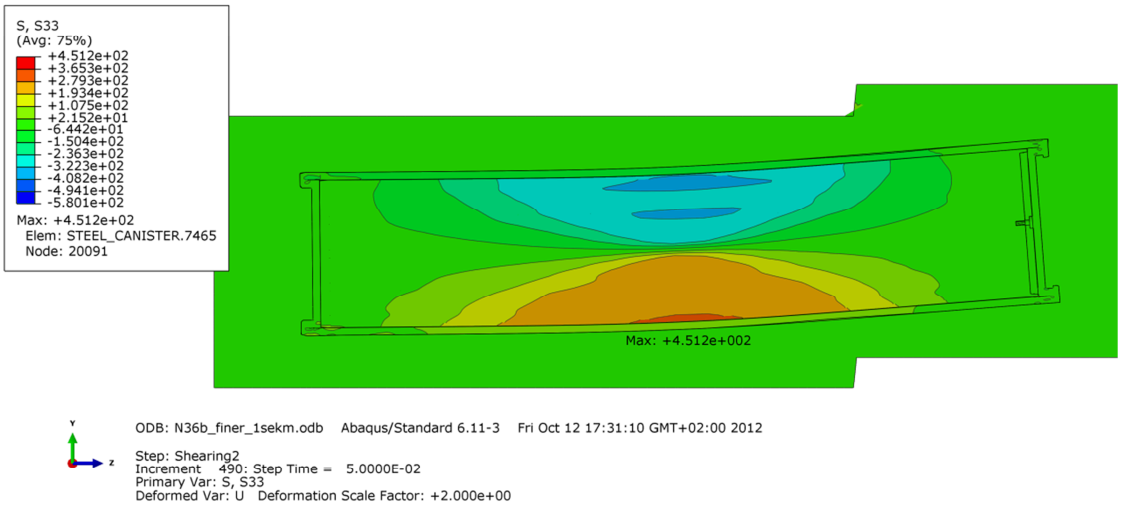


Figure A1-38. Deformed plot - 10 cm shearing magnitude, case N36b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

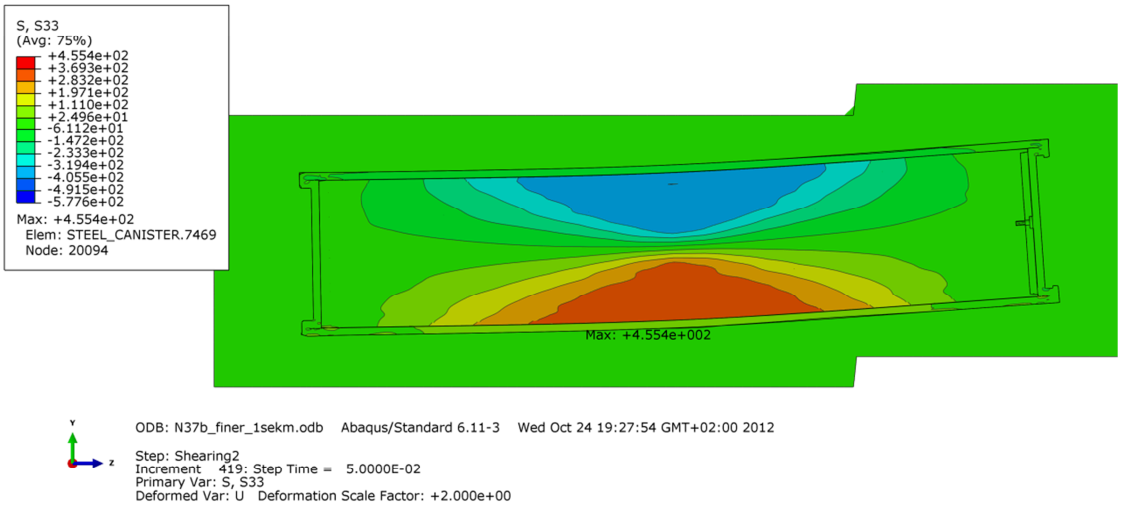


Figure A1-39. Deformed plot - 10 cm shearing magnitude, case N37b_finer_1sekm.

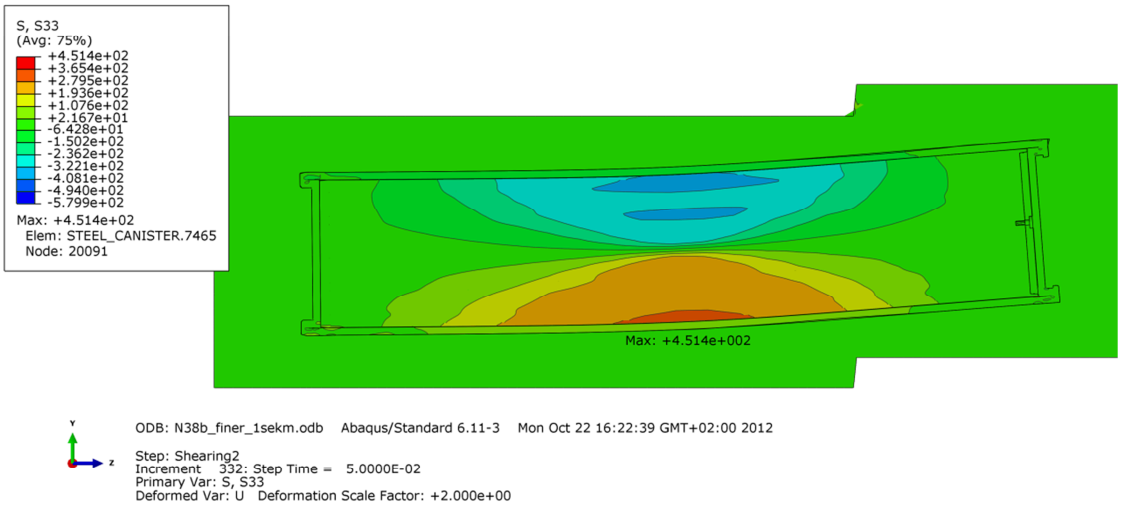


Figure A1-40. Deformed plot - 10 cm shearing magnitude, case N38b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

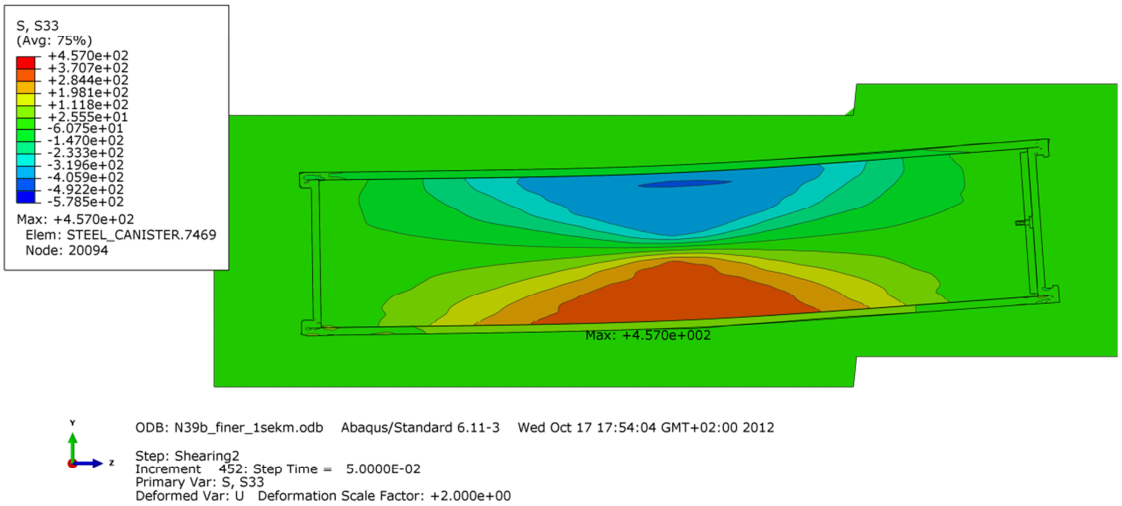


Figure A1-41. Deformed plot - 10 cm shearing magnitude, case N39b_finer_1sekm.

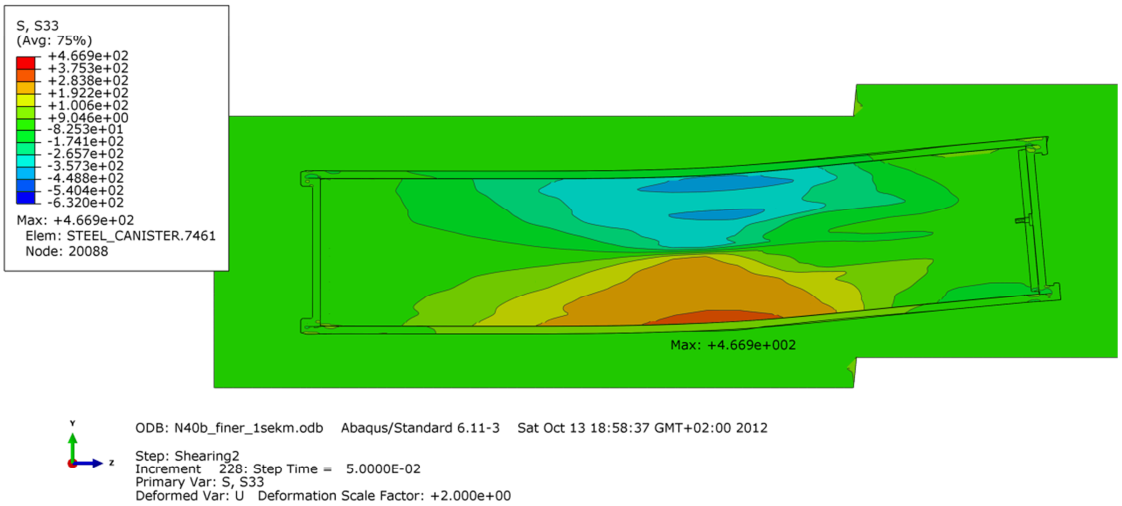


Figure A1-42. Deformed plot - 10 cm shearing magnitude, case N40b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

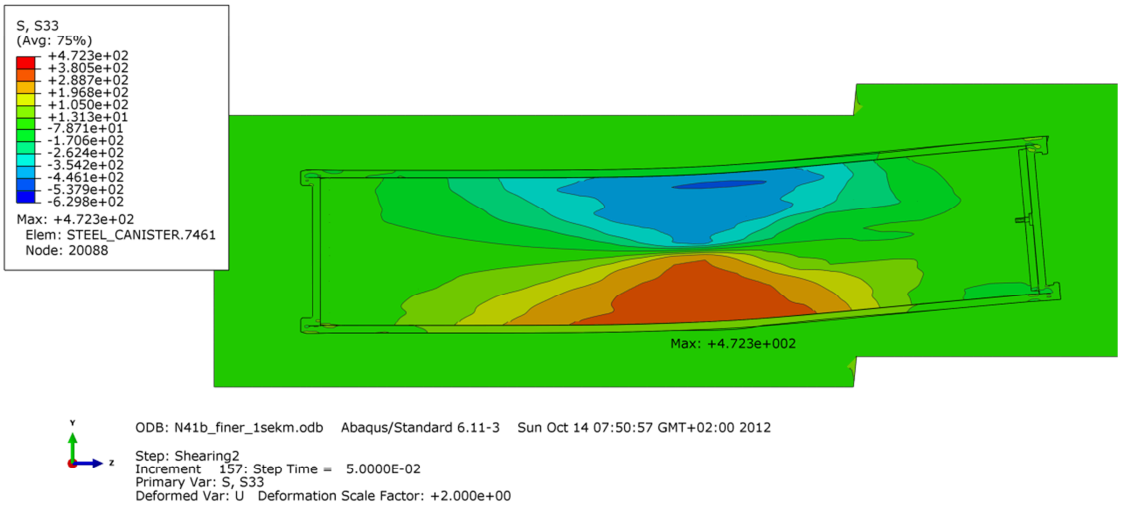


Figure A1-43. Deformed plot - 10 cm shearing magnitude, case N8b_b_finer_1sekm.

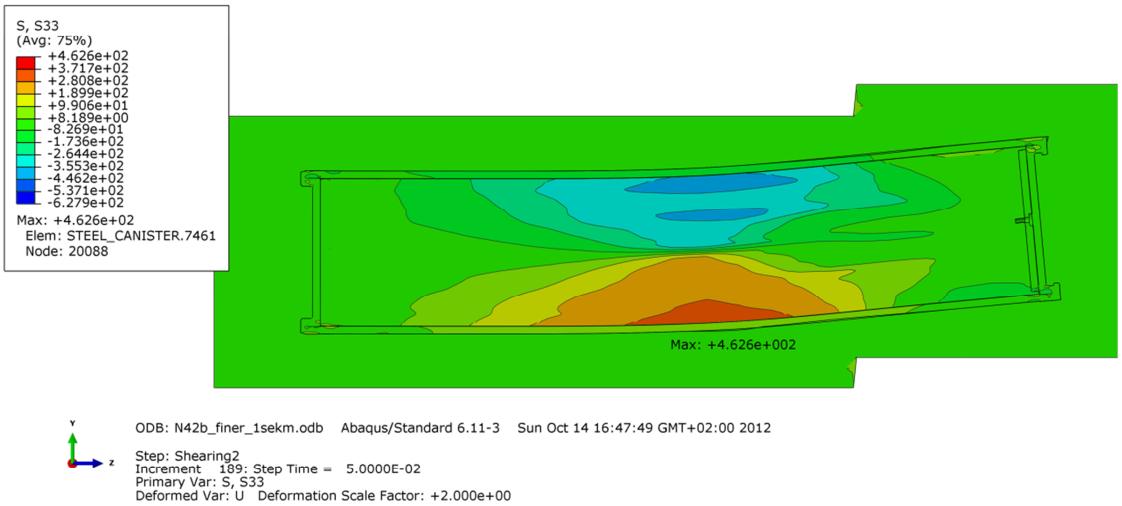


Figure A1-44. Deformed plot - 10 cm shearing magnitude, case N9b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

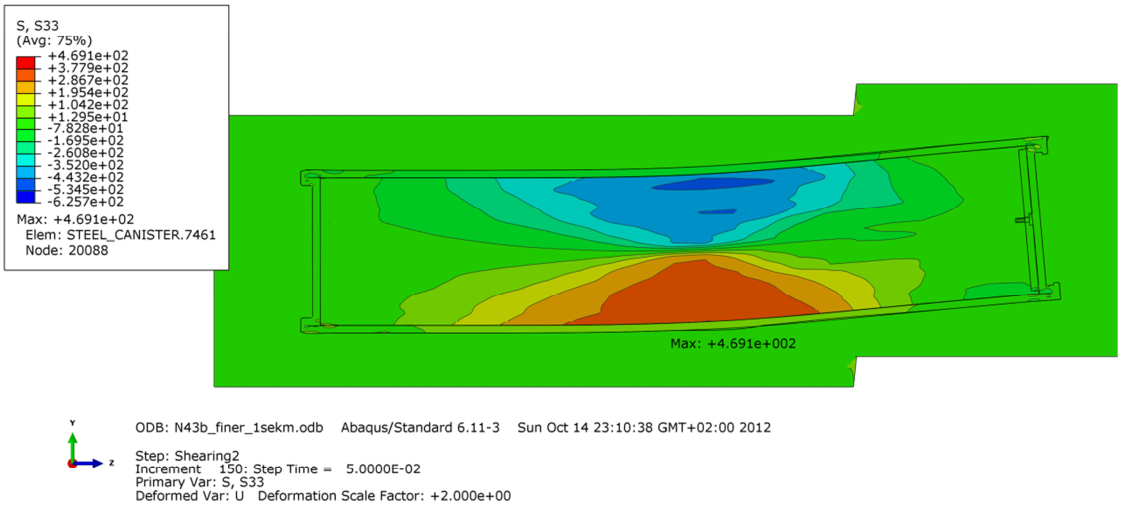


Figure A1-45. Deformed plot - 10 cm shearing magnitude, case N43b_finer_1sekm.

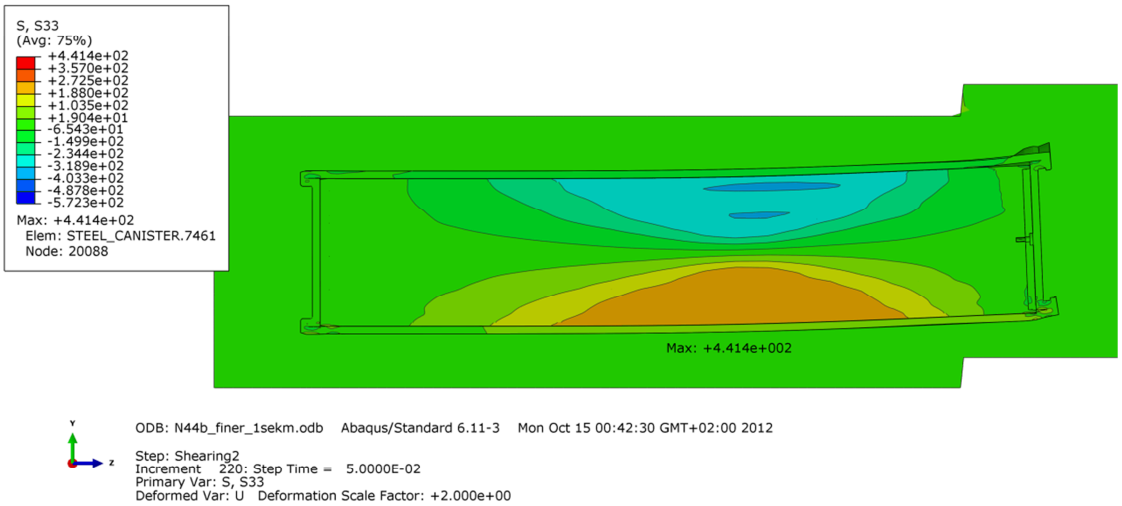


Figure A1-46. Deformed plot - 10 cm shearing magnitude, case N44b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

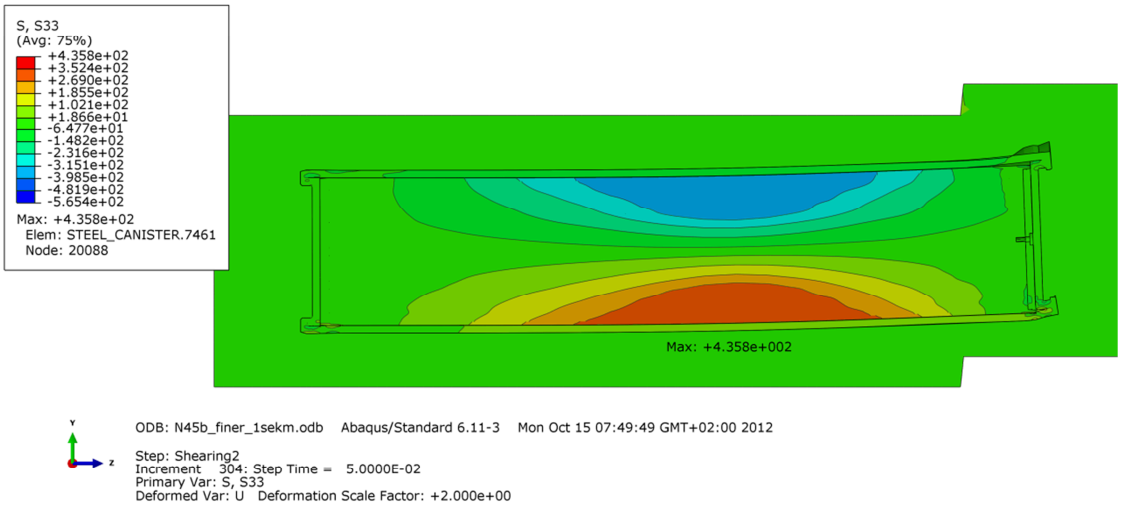


Figure A1-47. Deformed plot - 10 cm shearing magnitude, case N45b_finer_1sekm.

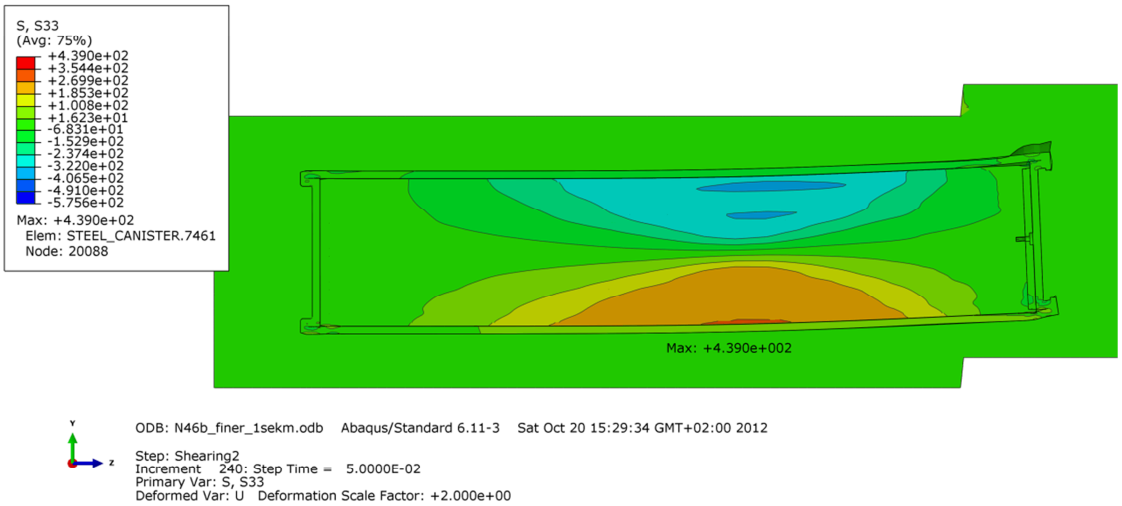


Figure A1-48. Deformed plot - 10 cm shearing magnitude, case N46b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

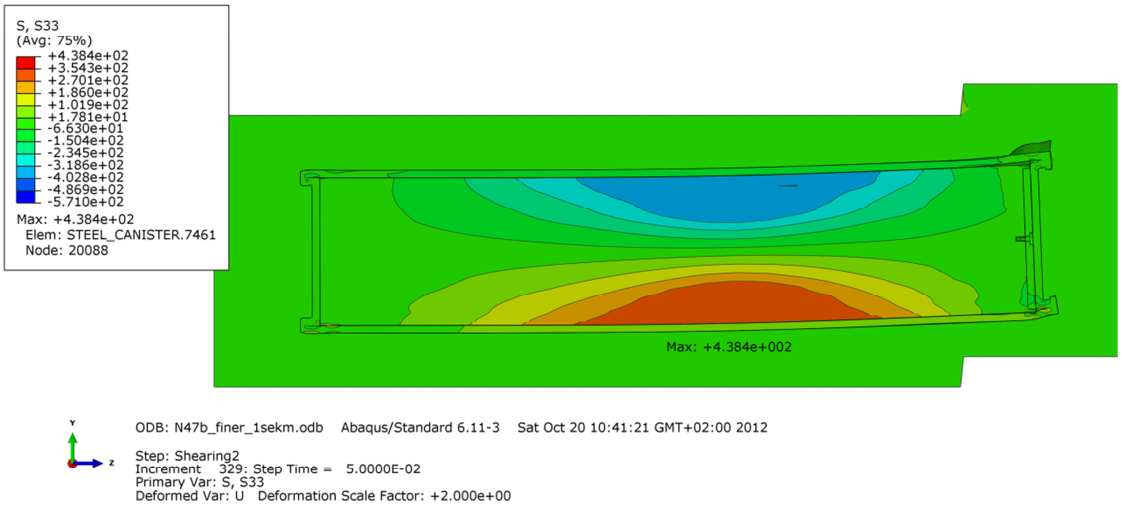


Figure A1-49. Deformed plot - 10 cm shearing magnitude, case N47b_finer_1sekm.

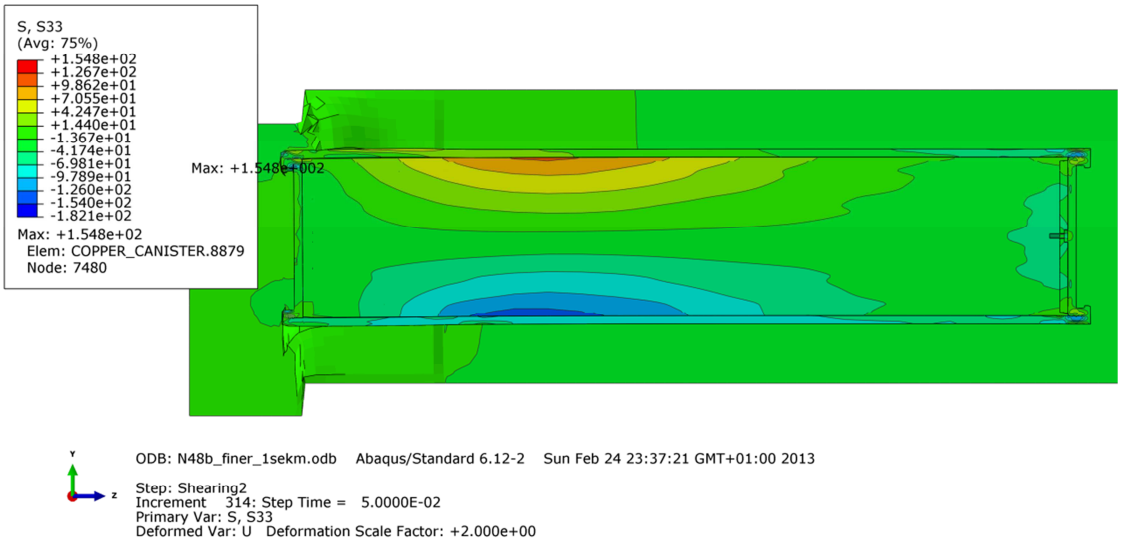


Figure A1-50. Deformed plot - 10 cm shearing magnitude, case N48b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 2 – Plots for N8b_finer_1sekm

Plots showing deformed geometry as contour plots for all parts at shearing magnitude 5 and 10 cm for case N8b_finer_1sekm. The view shows the symmetry plane and all deformations are scaled by a factor of two.

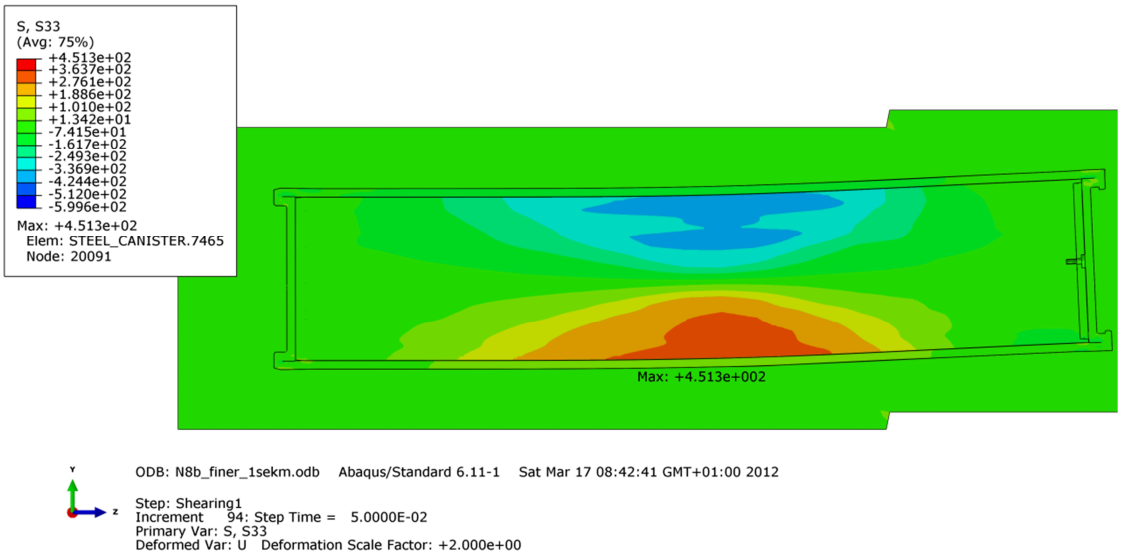
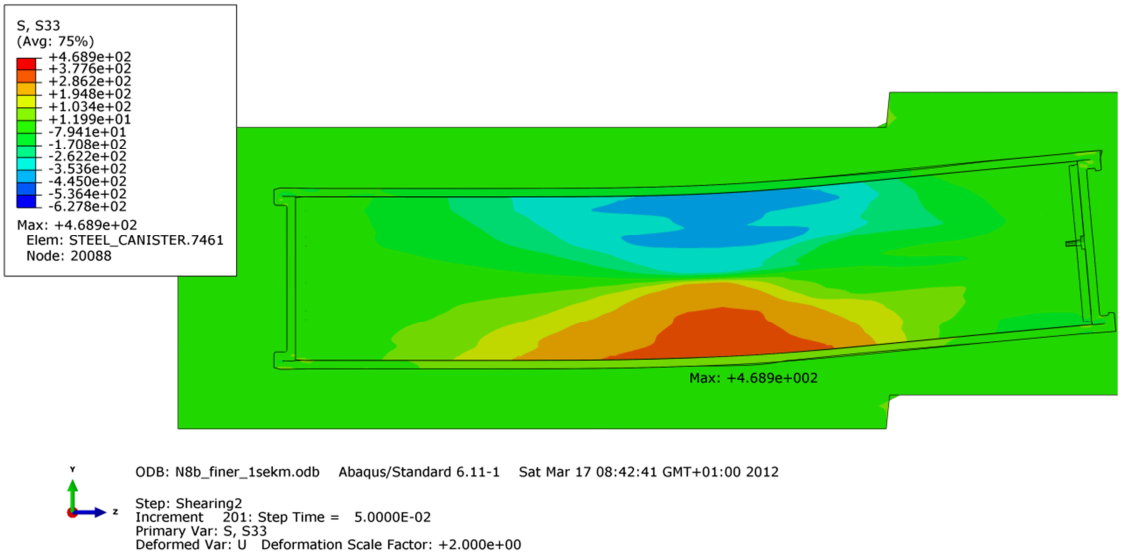


Figure A2-1. Deformed plot with S33 - 5 cm shearing magnitude, case N8b_finer_1sekm.



PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Figure A2-2. Deformed plot with S33 - 10 cm shearing magnitude, case N8b_finer_1sekm.

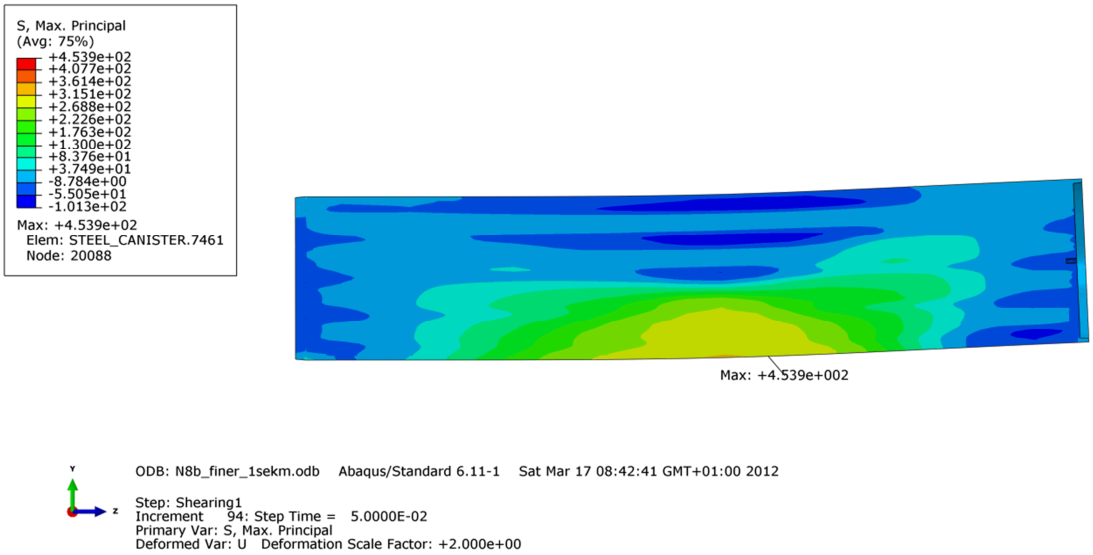


Figure A2-3. Deformed plot with max principal stress for insert- 5 cm shearing magnitude, case N8b_finer_1sekm.

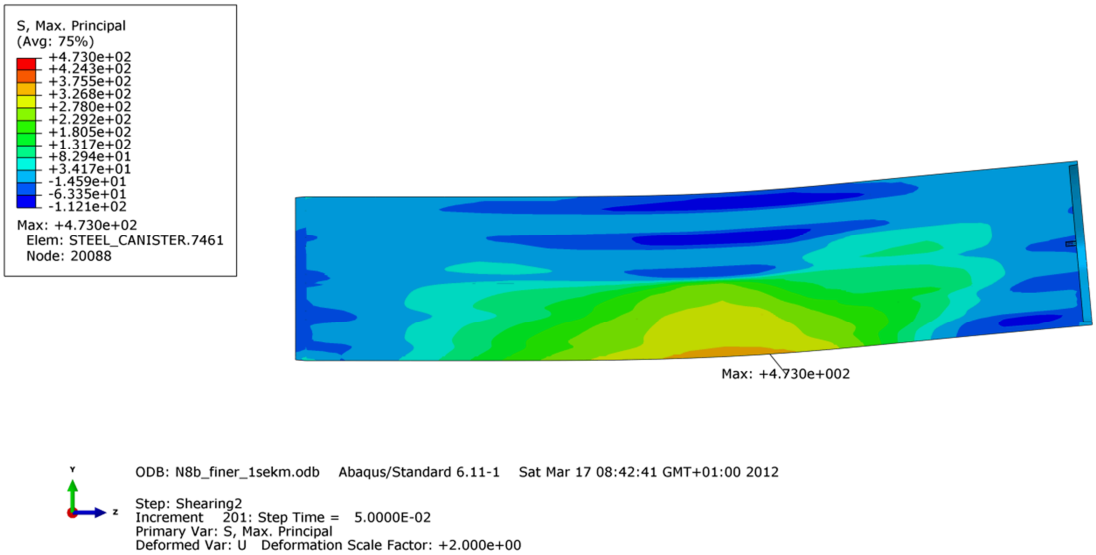


Figure A2-4. Deformed plot with max principal stress for insert - 10 cm shearing magnitude, case N8b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

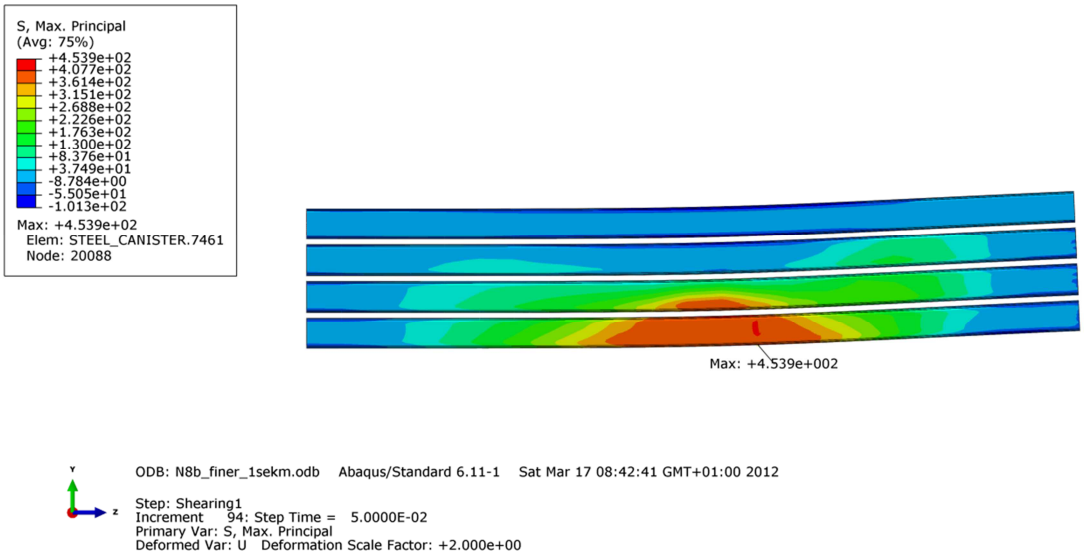


Figure A2-5. Deformed plot with max principal stress for channels - 5 cm shearing magnitude, case N8b_finer_1sekm.

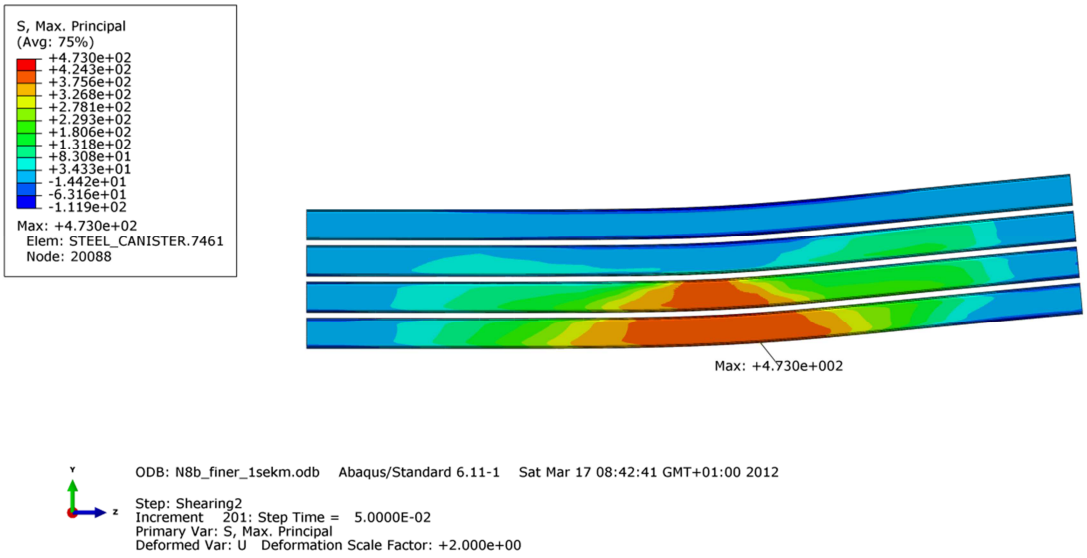


Figure A2-6. Deformed plot with max principal stress for channels - 10 cm shearing magnitude, case N8b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

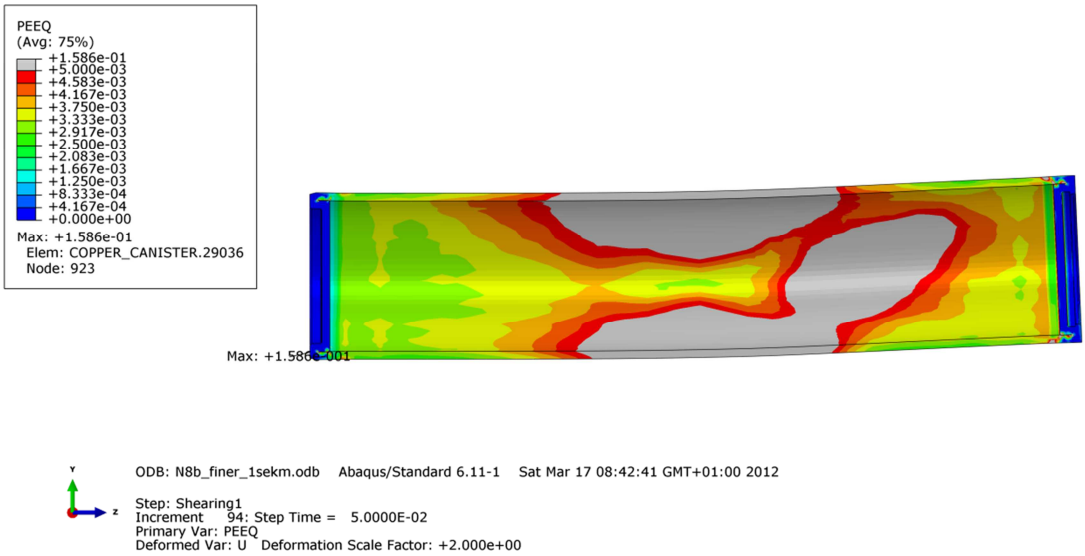


Figure A2-7. Deformed plot with plastic strain for copper shell - 5 cm shearing magnitude, case N8b_finer_1sekm.

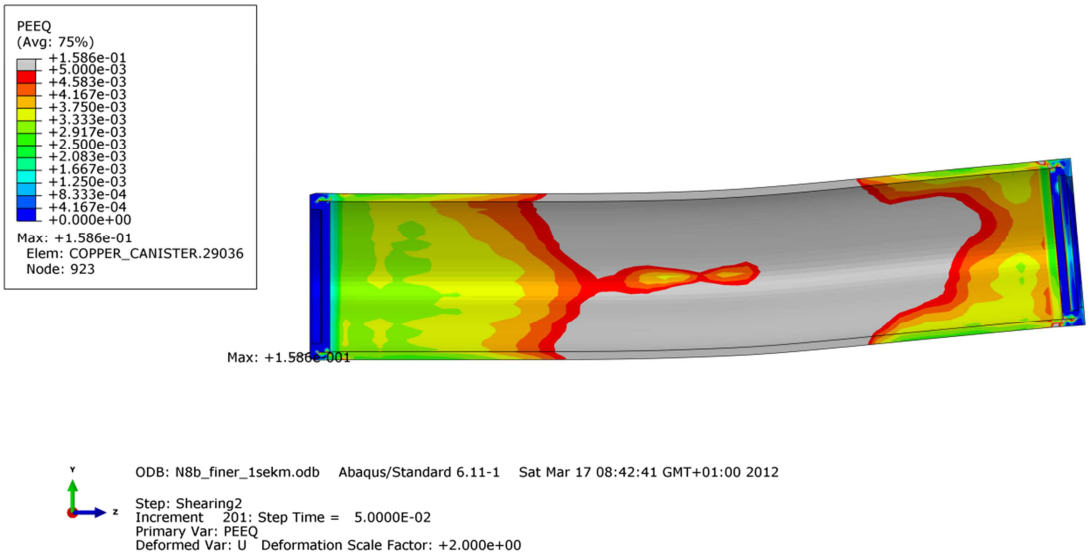


Figure A2-8. Deformed plot with plastic strain for copper shell - 10 cm shearing magnitude, case N8b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

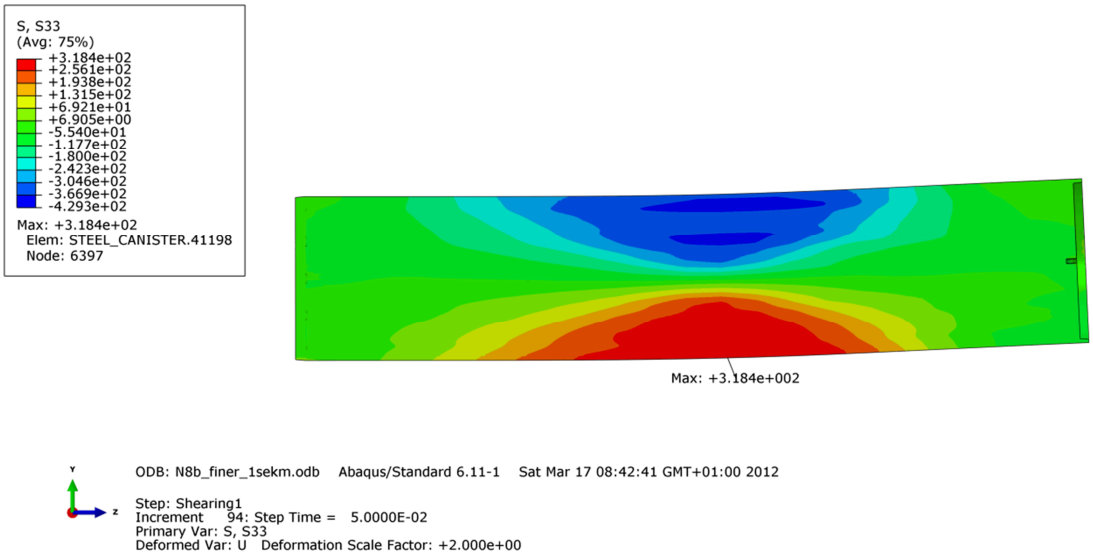


Figure A2-9. Deformed plot with axial stress for cast iron insert - 5 cm shearing magnitude, case N8b_finer_1sekm.

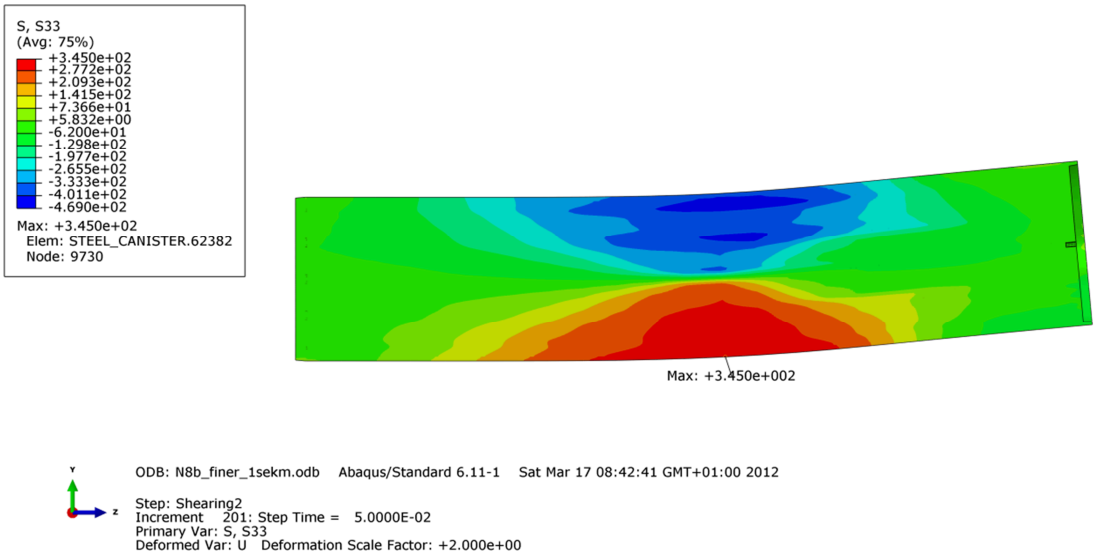


Figure A2-10. Deformed plot with axial stress for cast iron insert - 10 cm shearing magnitude, case N8b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

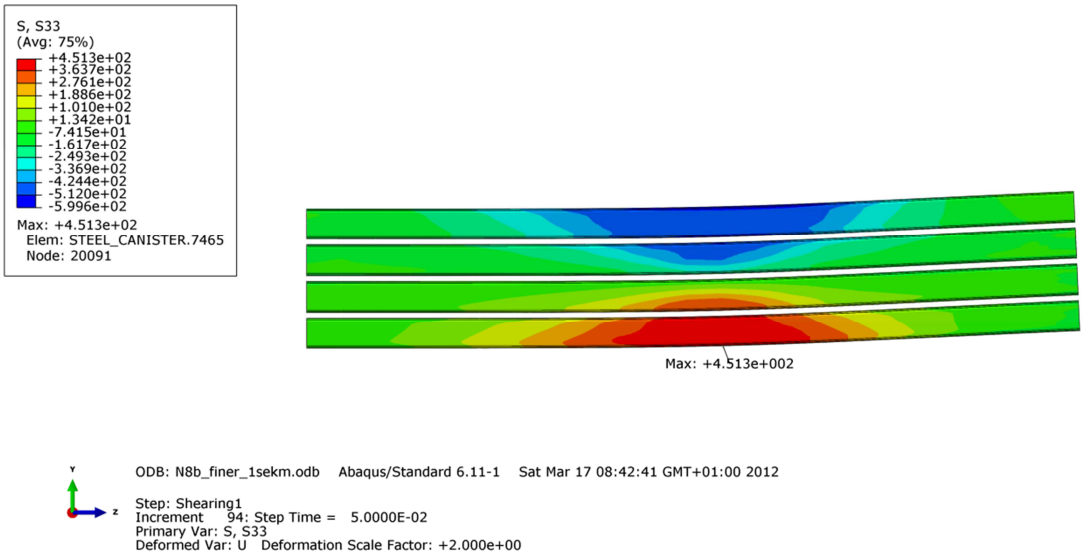


Figure A2-11. Deformed plot with axial stress for steel channels - 5 cm shearing magnitude, case N8b_finer_1sekm.

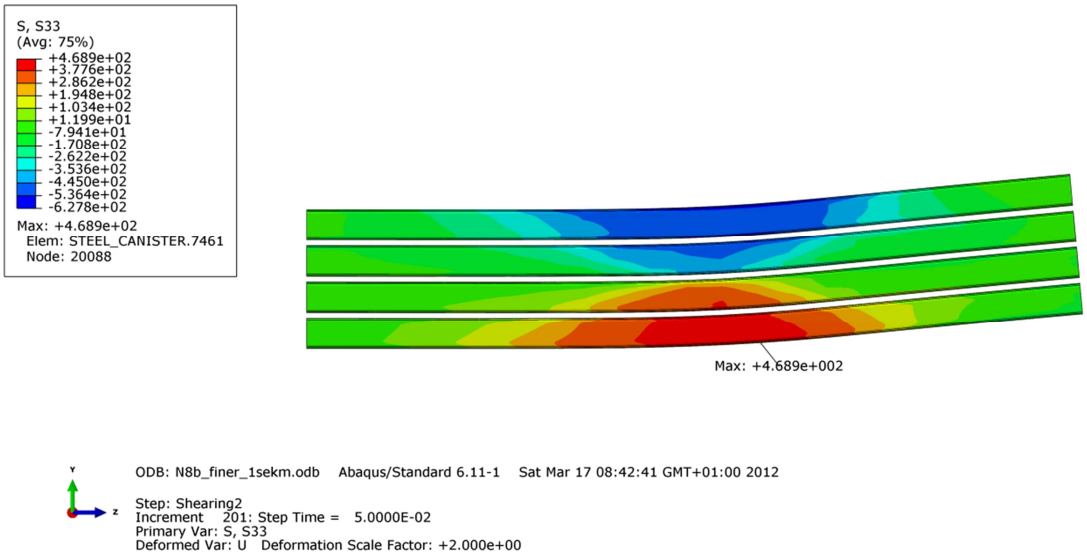


Figure A2-12. Deformed plot with axial stress for steel channels - 10 cm shearing magnitude, case N8b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

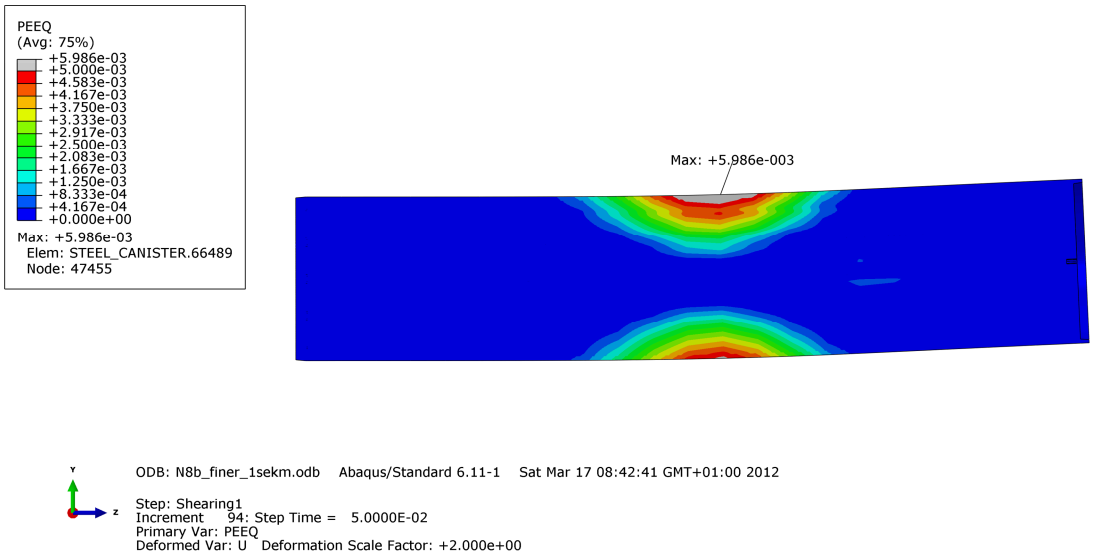


Figure A2-13. Deformed plot with plastic strain for cast iron insert - 5 cm shearing magnitude, case N8b_finer_1sekm.

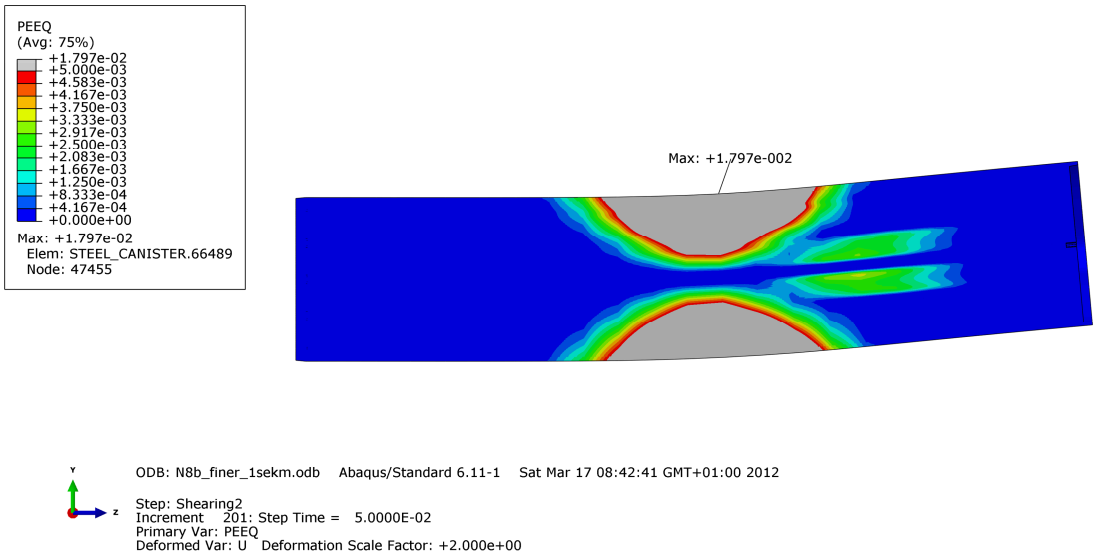


Figure A2-14. Deformed plot with plastic strain for cast iron insert - 10 cm shearing magnitude, case N8b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

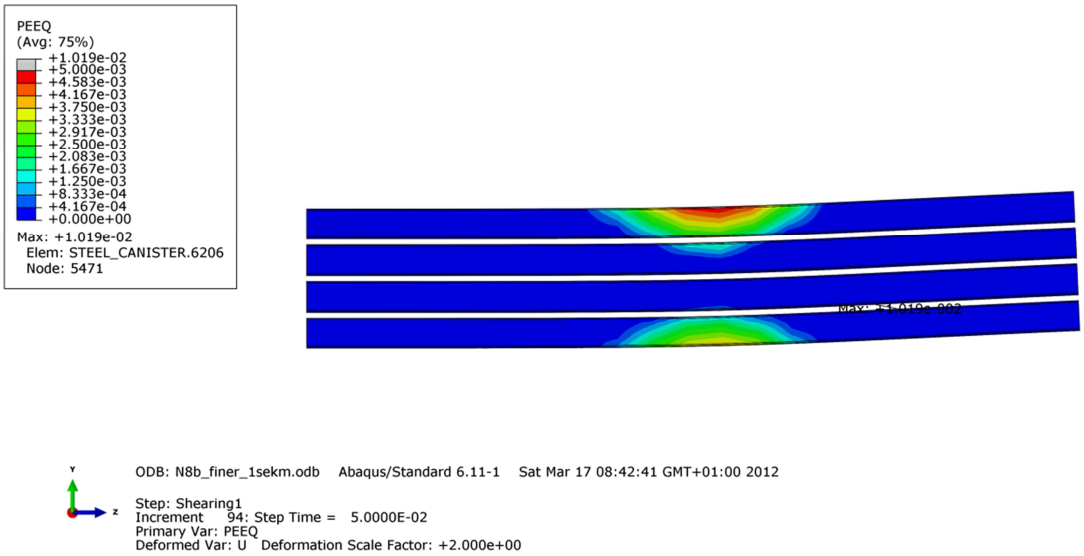


Figure A2-15. Deformed plot with plastic strain for steel channels - 5 cm shearing magnitude, case N8b_finer_1sekm.

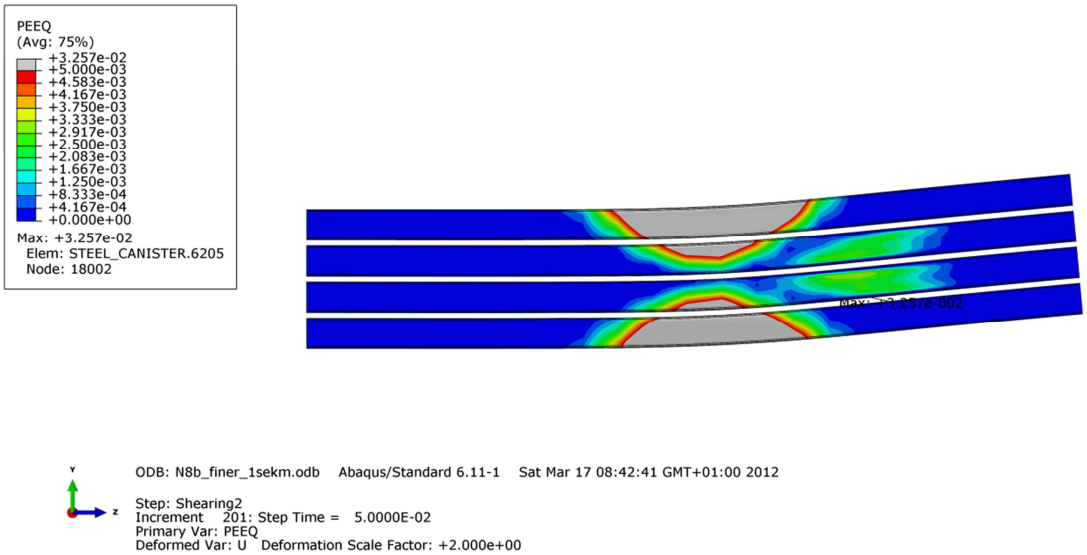


Figure A2-16. Deformed plot with plastic strain for steel channels - 10 cm shearing magnitude, case N8b_finer_1sekm.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 3 – Copper N29b_finer_1sekm

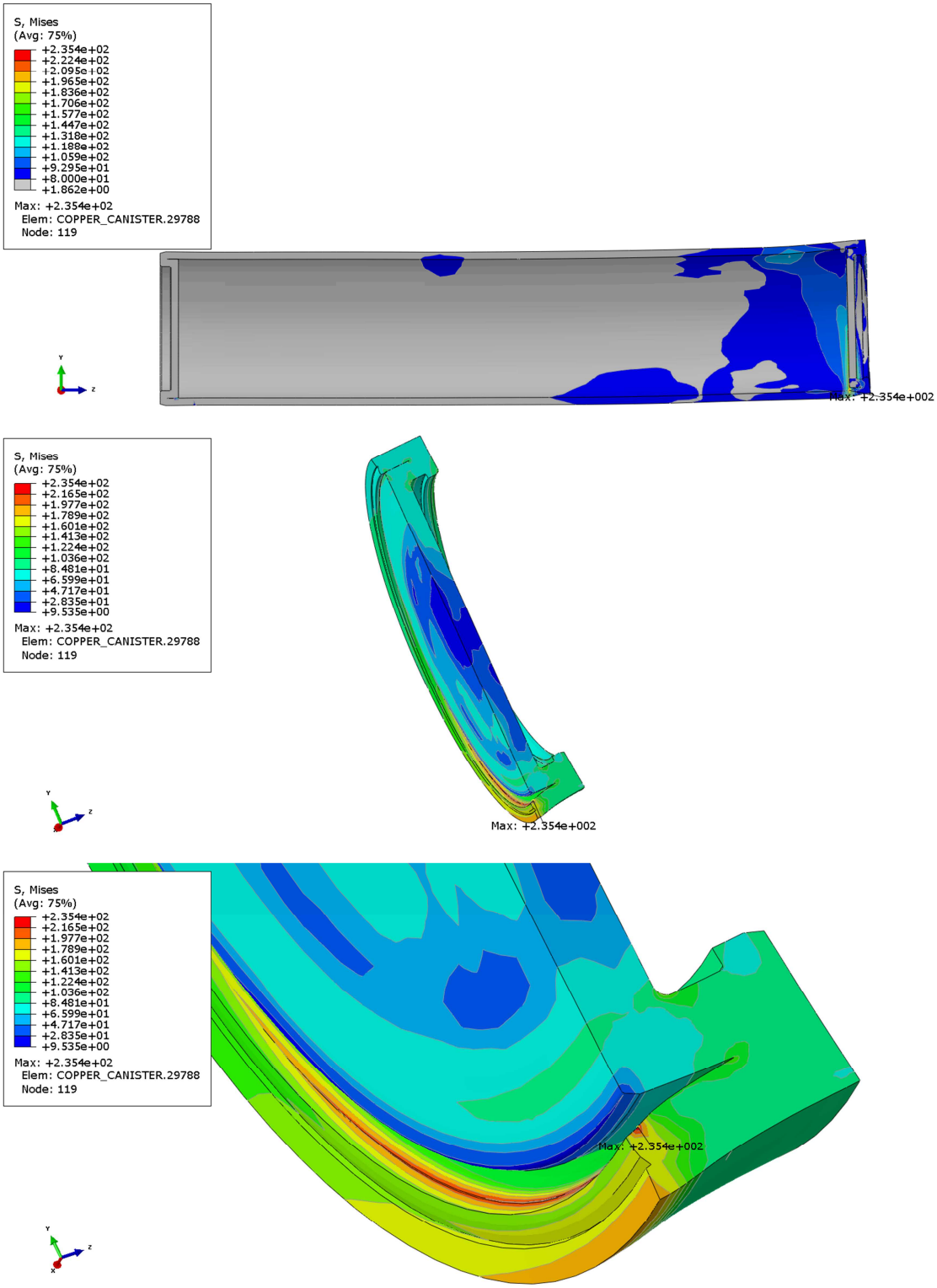


Figure A3-1. Plot of Mises [MPa] at 5 cm shearing for case N29b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

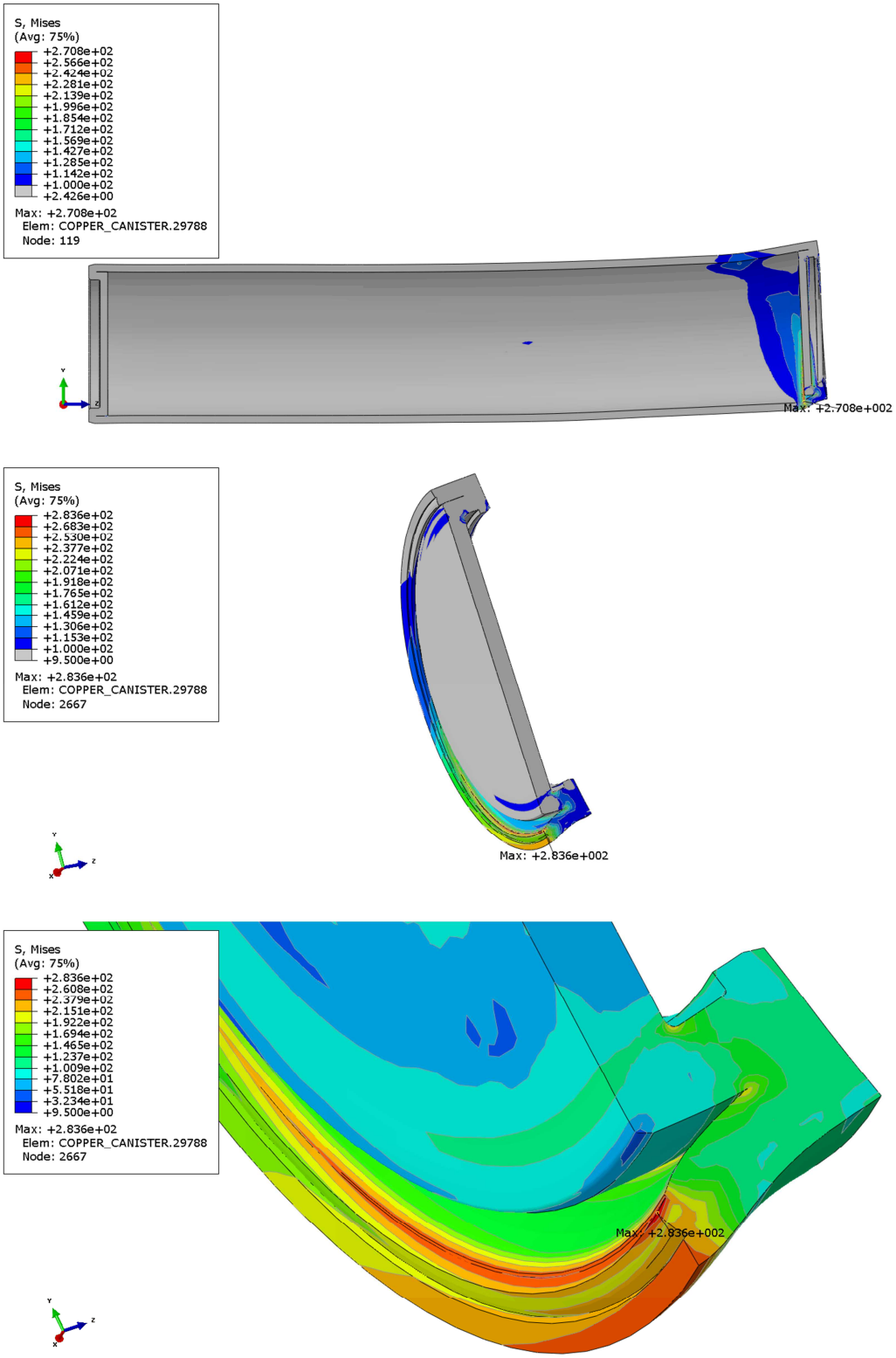


Figure A3-2. Plot of Mises [MPa] at 10 cm shearing for case N29b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

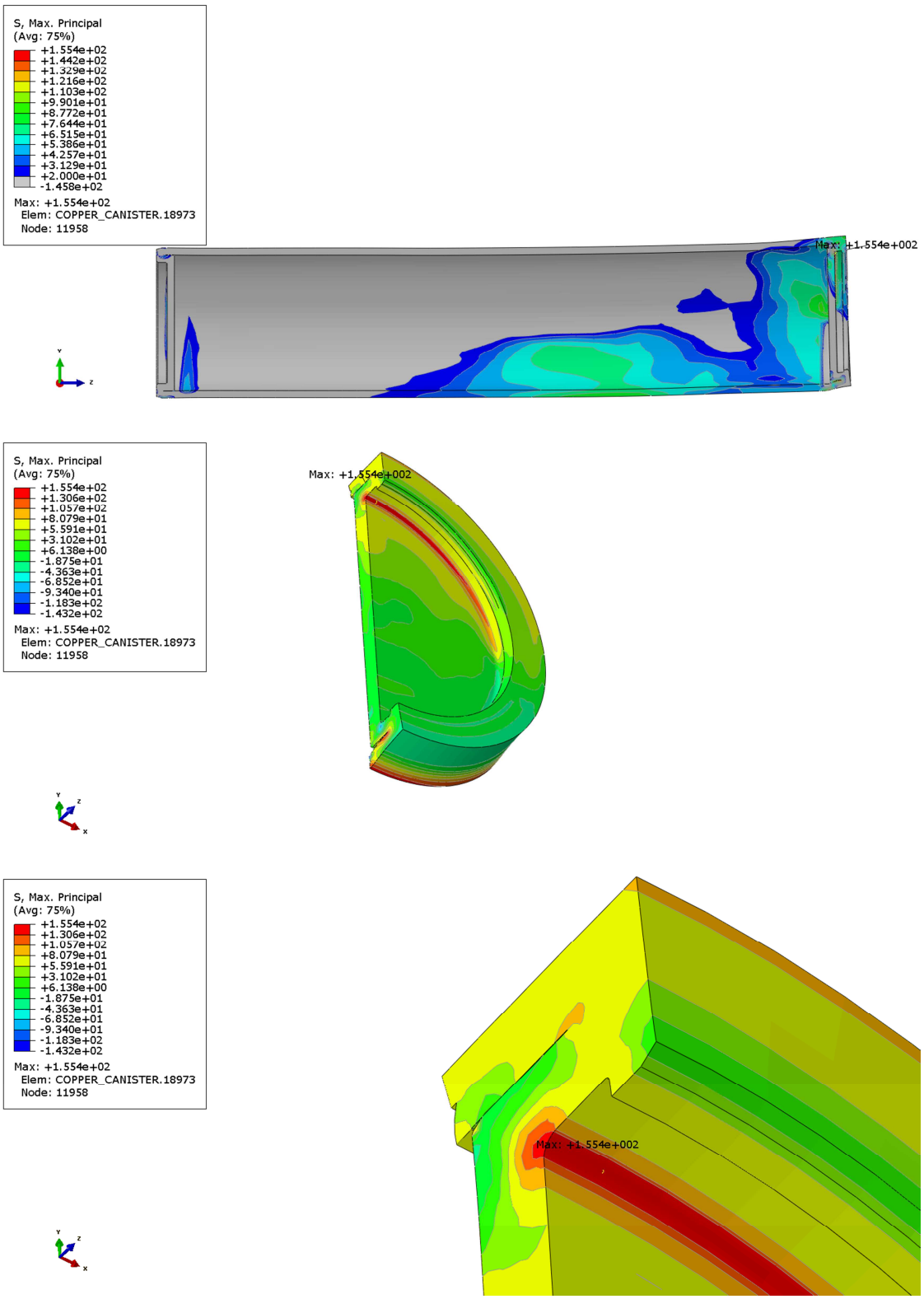


Figure A3-3. Plot of Max principal stress [MPa] at 5 cm shearing for case N29b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

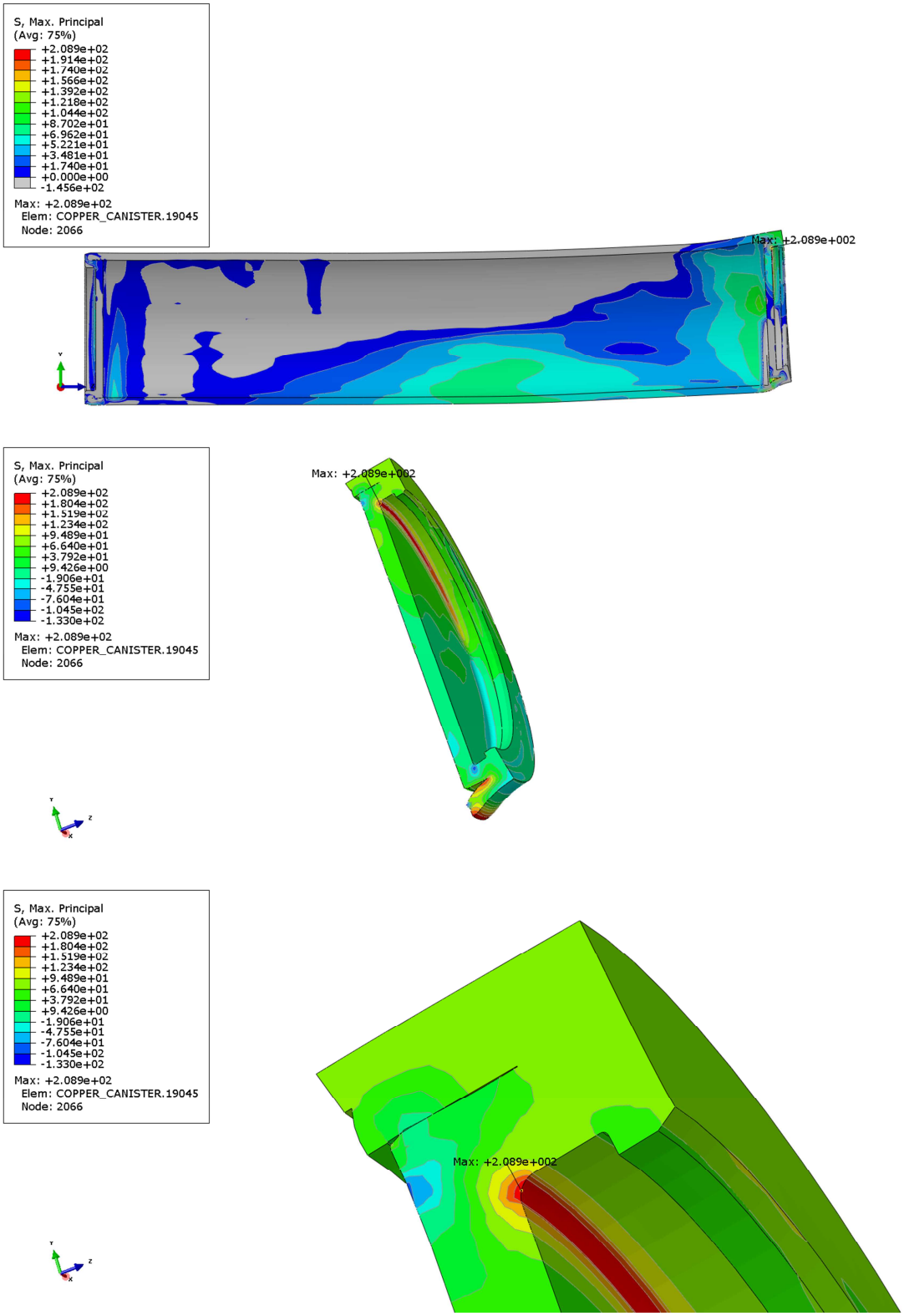


Figure A3-4. Plot of Max principal stress [MPa] at 10 cm shearing for case N29b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

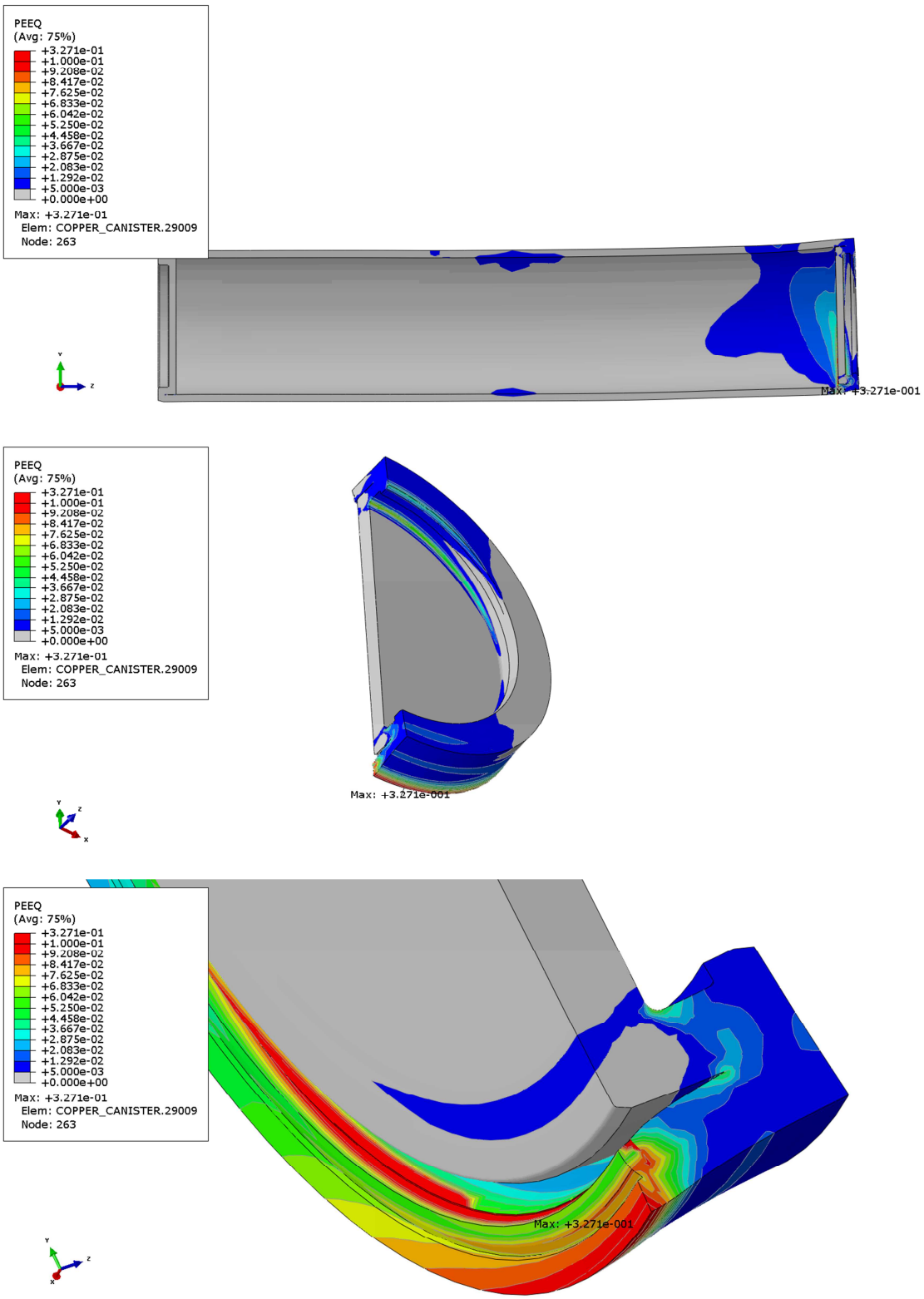


Figure A3-5. Plot of plastic equivalent strain, PEEQ, at 5 cm shearing for case N29b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

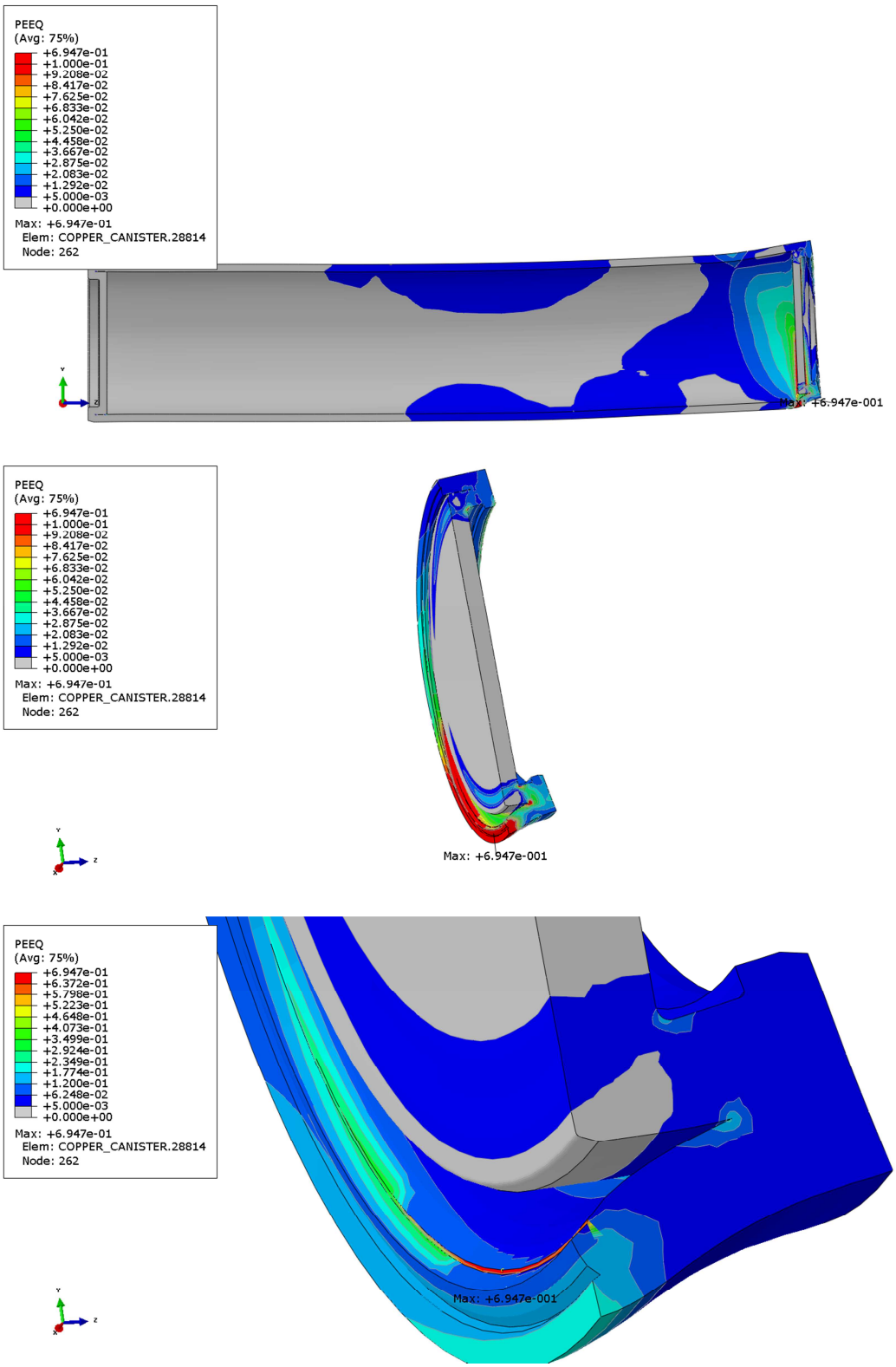


Figure A3-6. Plot of plastic equivalent strain, PEEQ, at 10 cm shearing for case N29b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 4 – Copper N31b_finer_1sekm

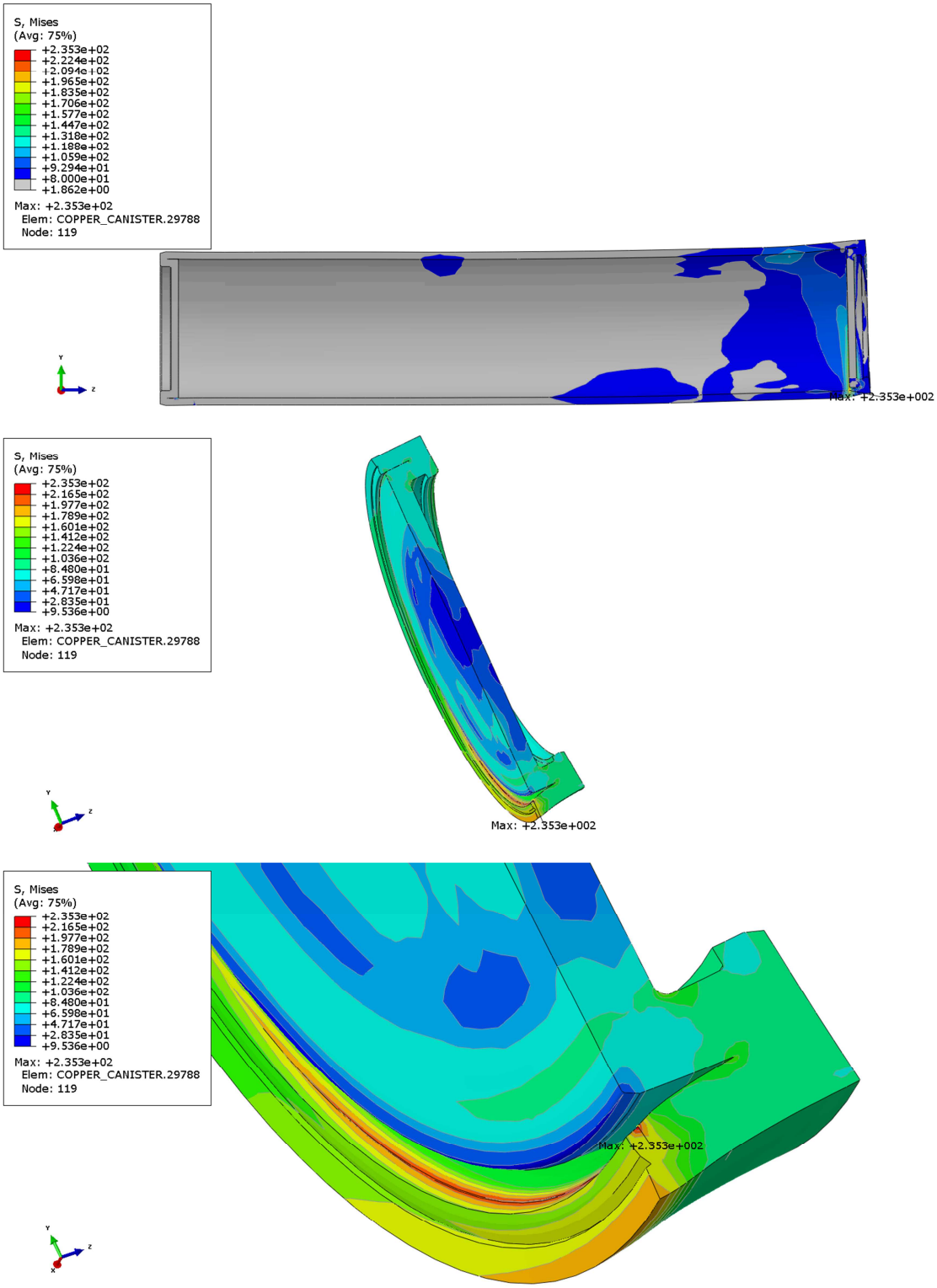


Figure A4-1. Plot of Mises [MPa] at 5 cm shearing for case N31b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

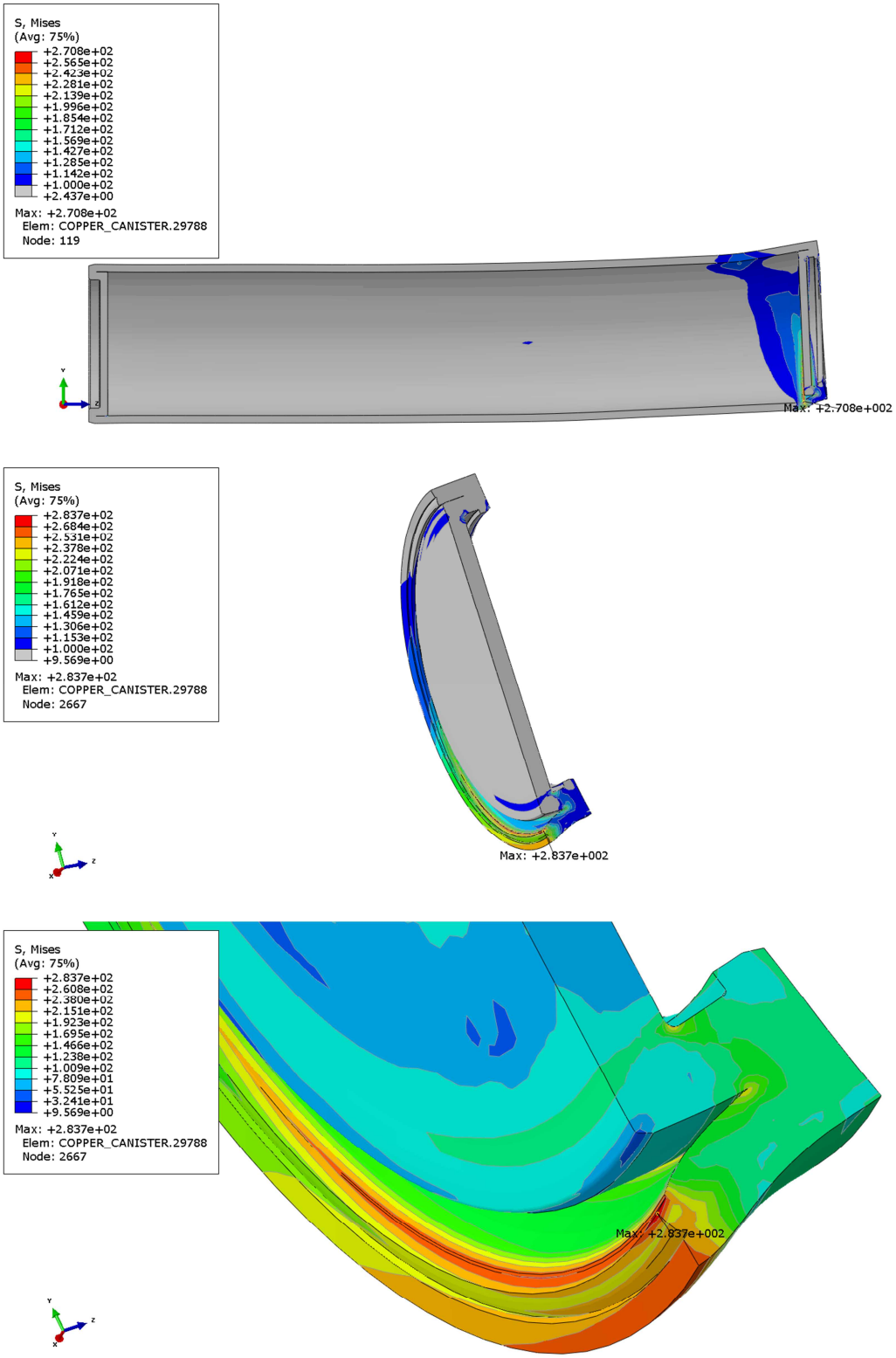


Figure A4-2. Plot of Mises [MPa] at 10 cm shearing for case N31b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

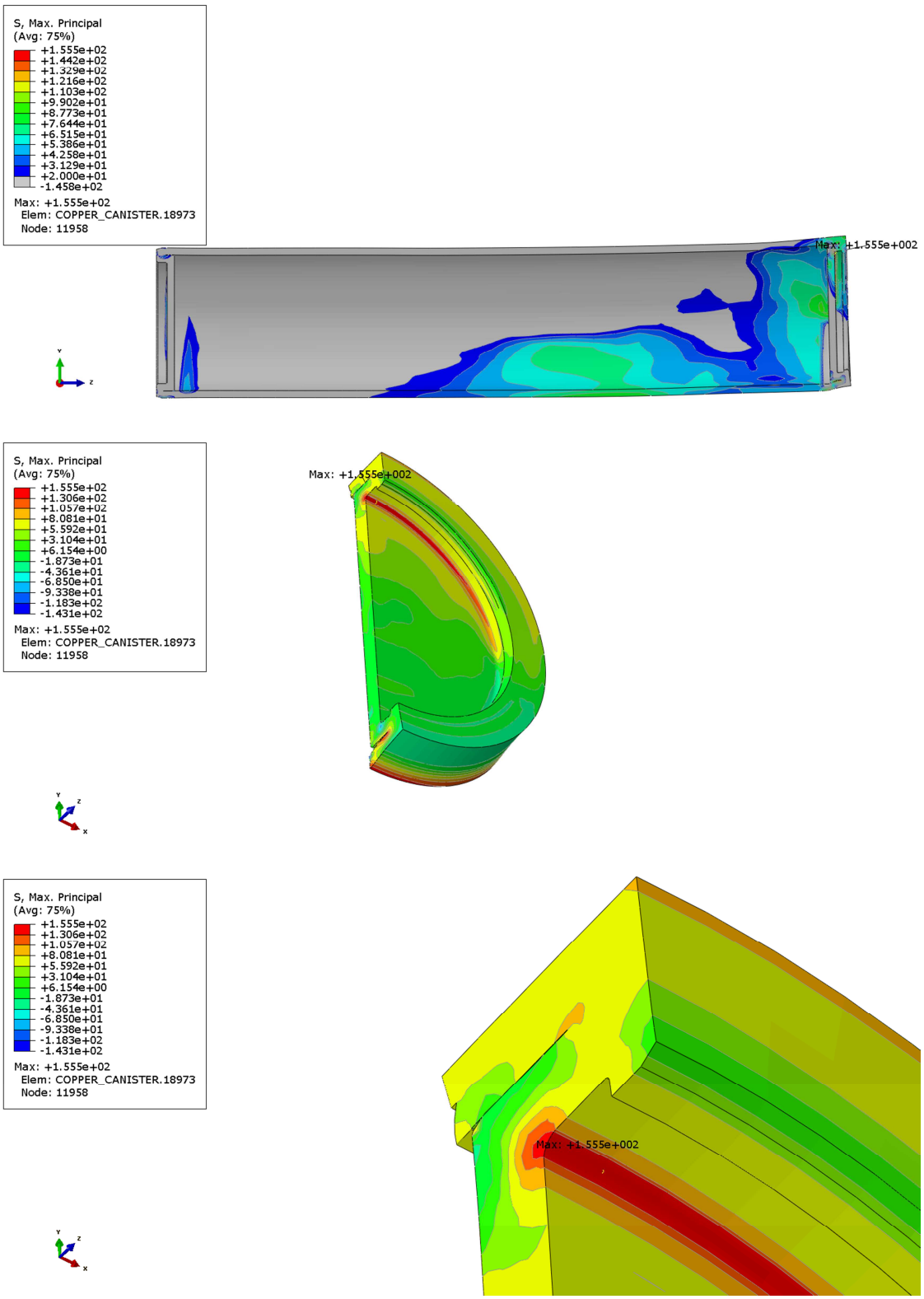


Figure A4-3. Plot of Max principal stress[MPa] at 5 cm shearing for case N31b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

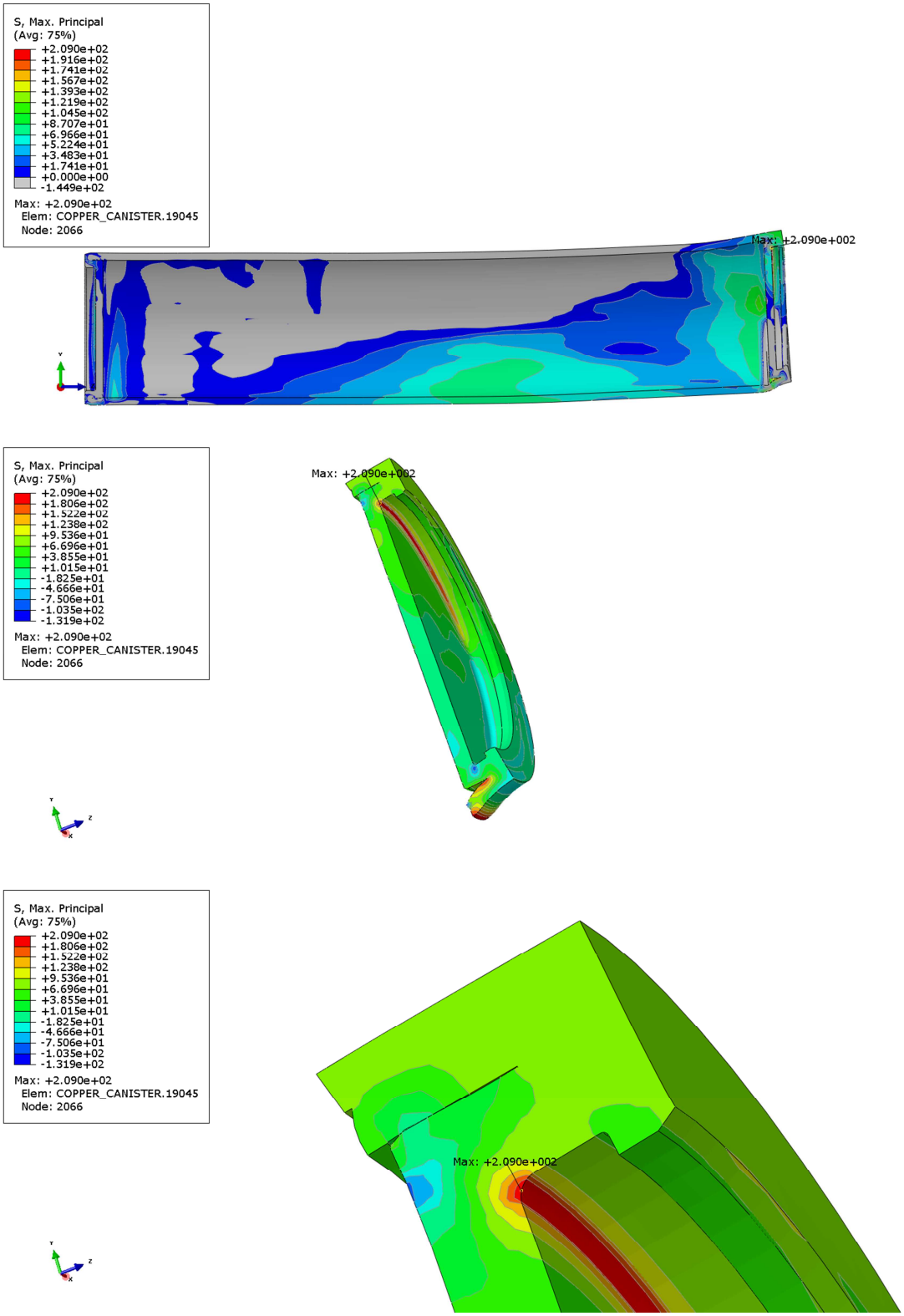


Figure A4-4. Plot of Max principal stress [MPa] at 10 cm shearing for case N31b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

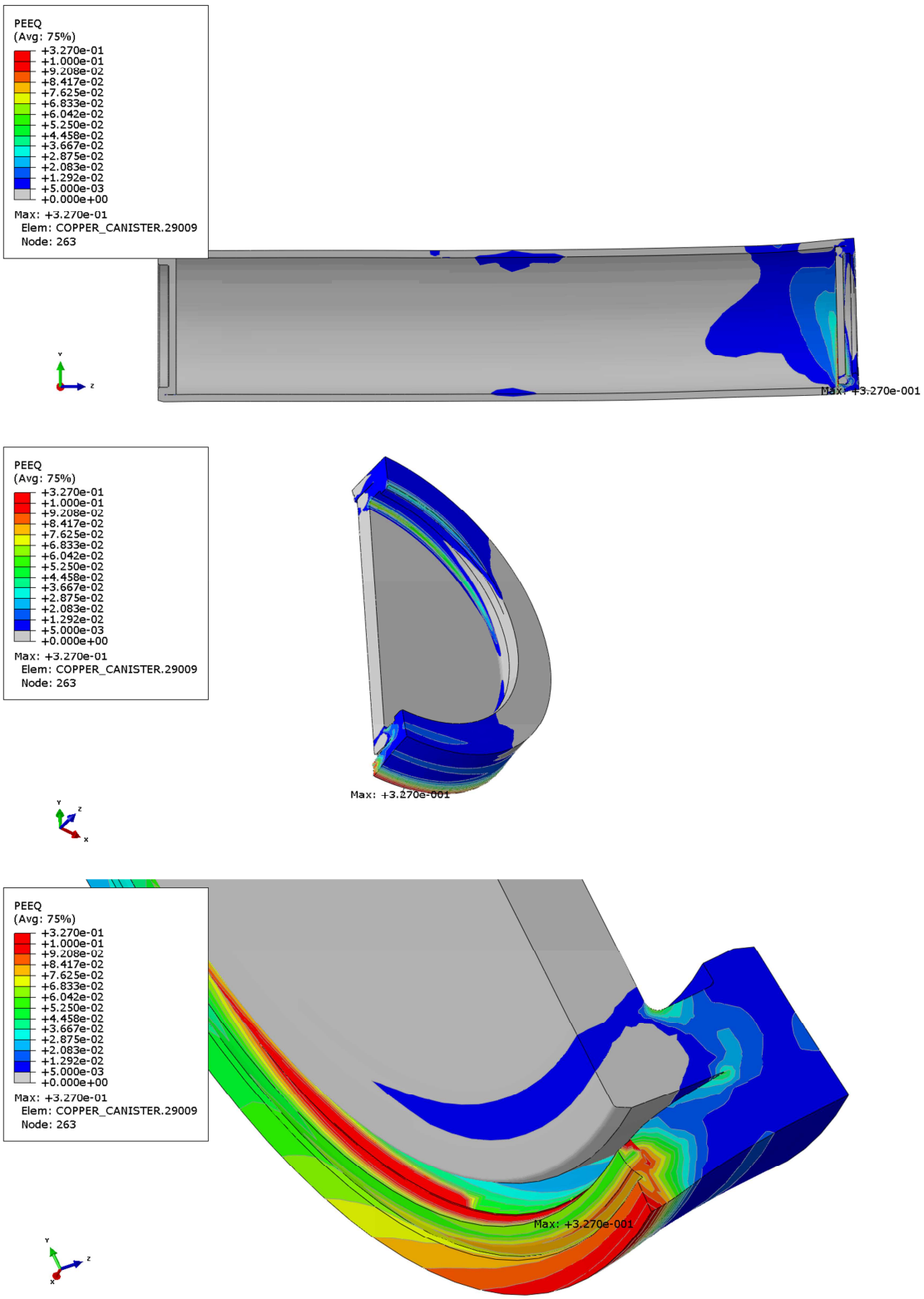


Figure A4-5. Plot of plastic equivalent strain, PEEQ, at 5 cm shearing for case N31b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

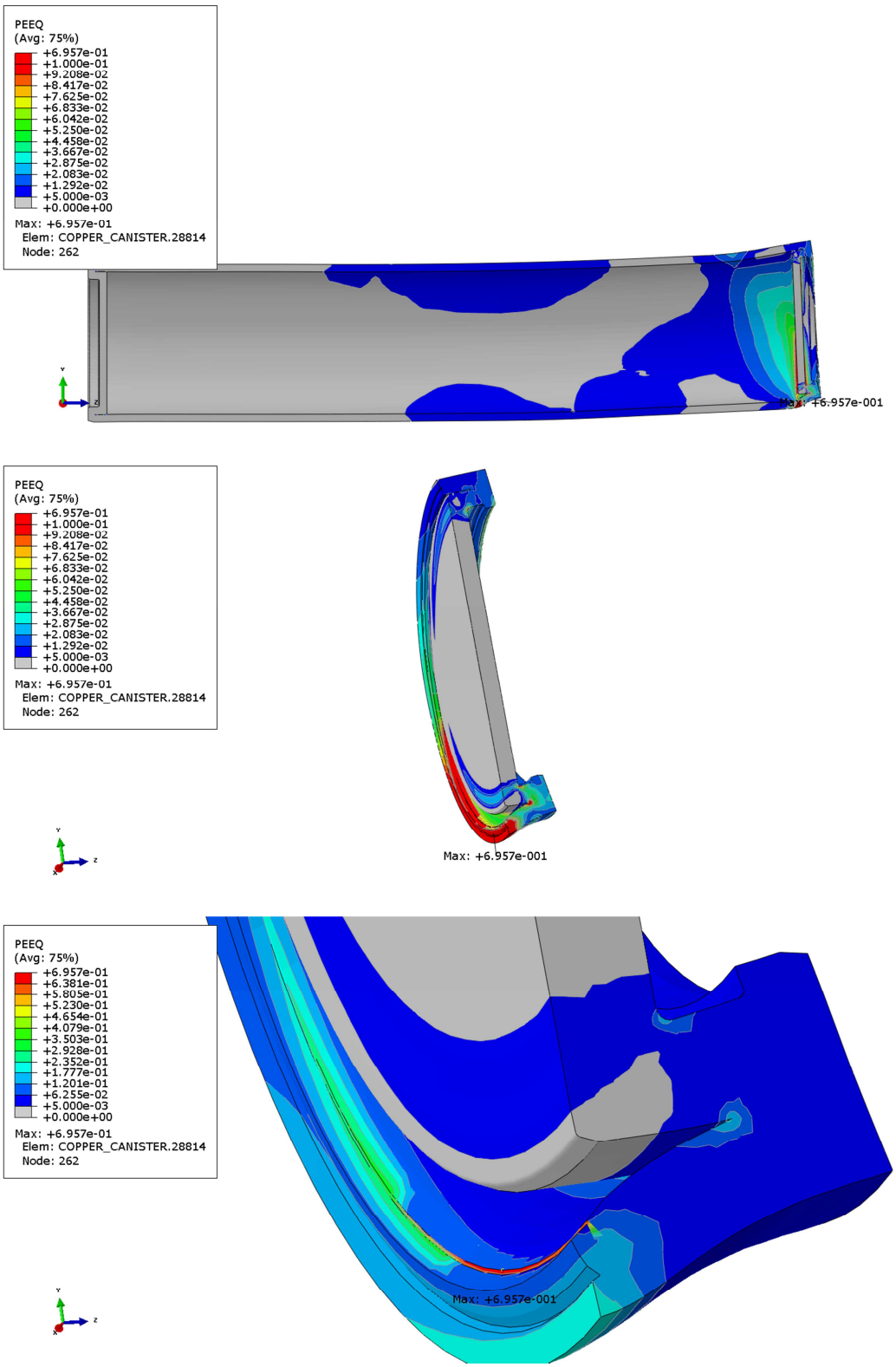


Figure A4-6. Plot of plastic equivalent strain, PEEQ, at 10 cm shearing for case N31b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 5 – Copper N9b_finer_1sekm

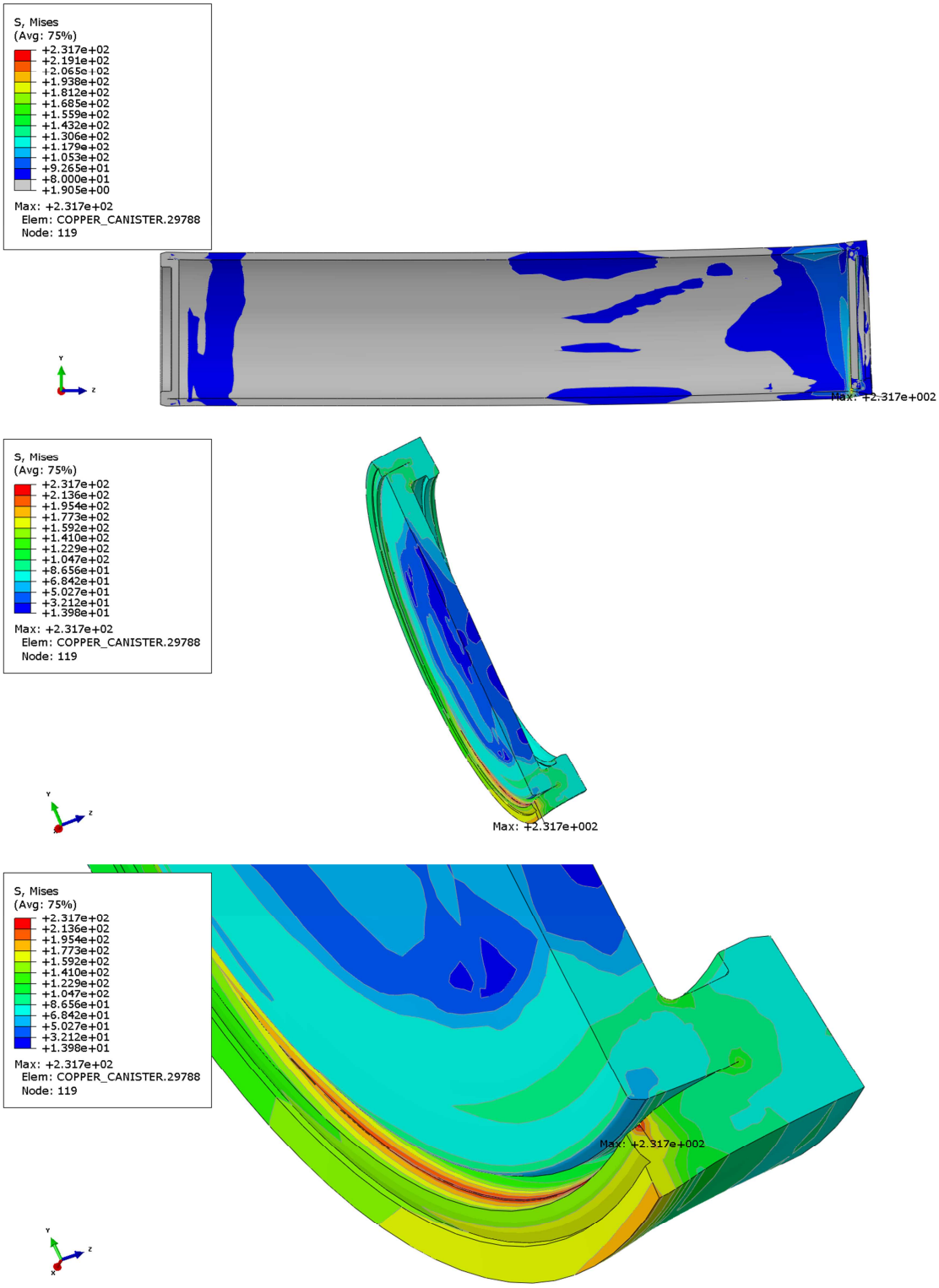


Figure A5-1. Plot of Mises [MPa] at 5 cm shearing for case N9b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

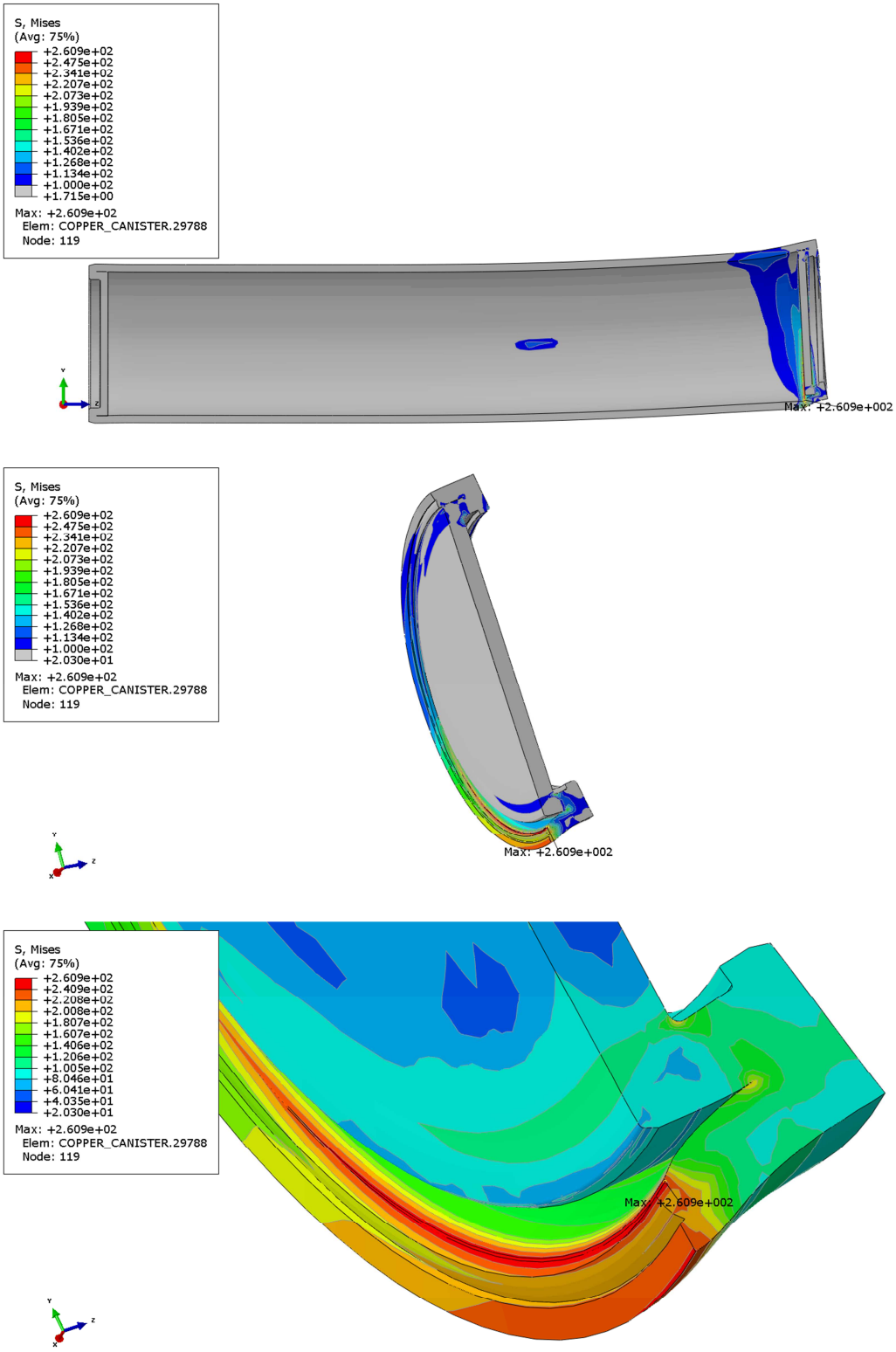


Figure A5-2. Plot of Mises [MPa] at 10 cm shearing for case N9b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

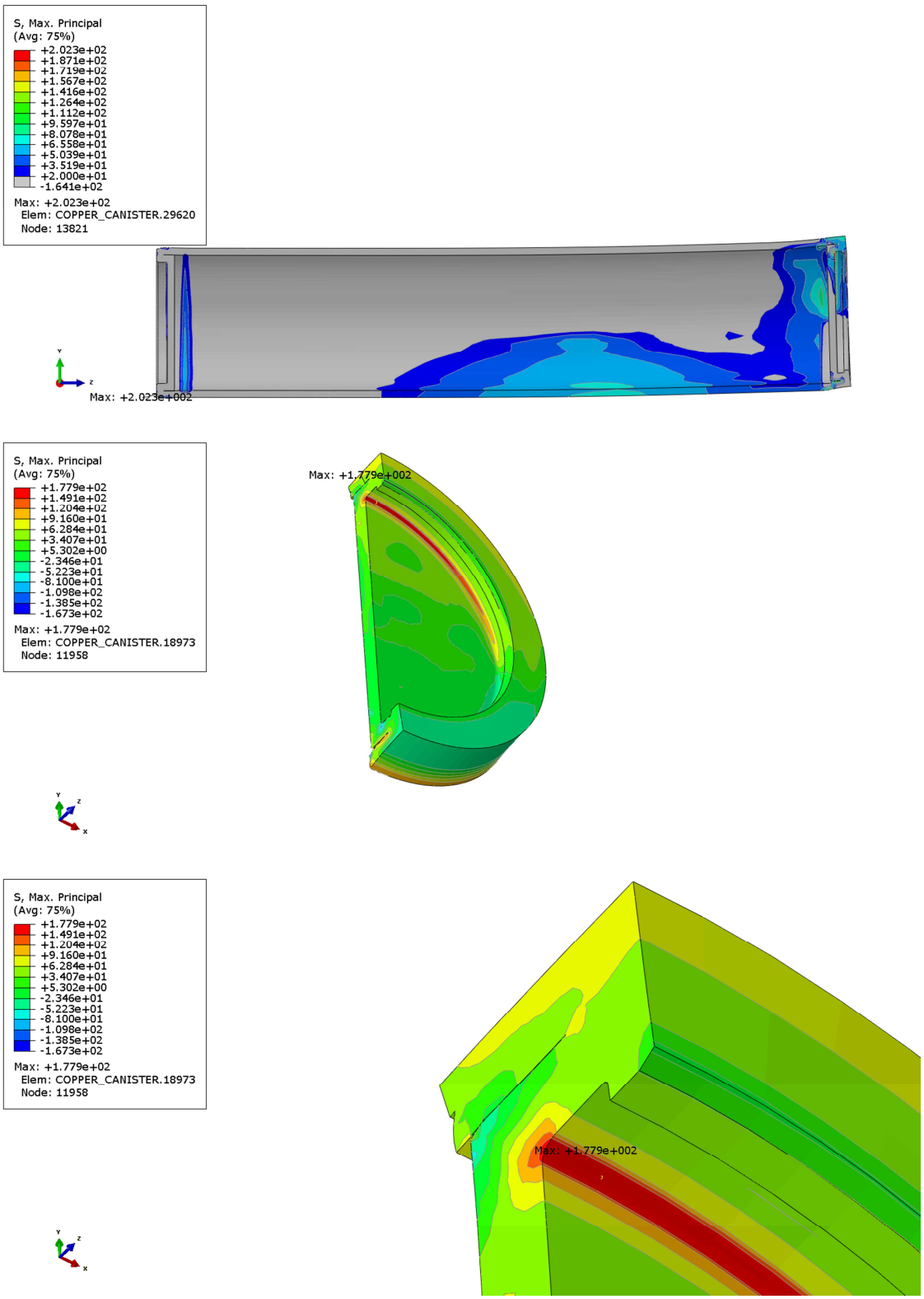


Figure A5-3. Plot of Max principal stress [MPa] at 5 cm shearing for case N9b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

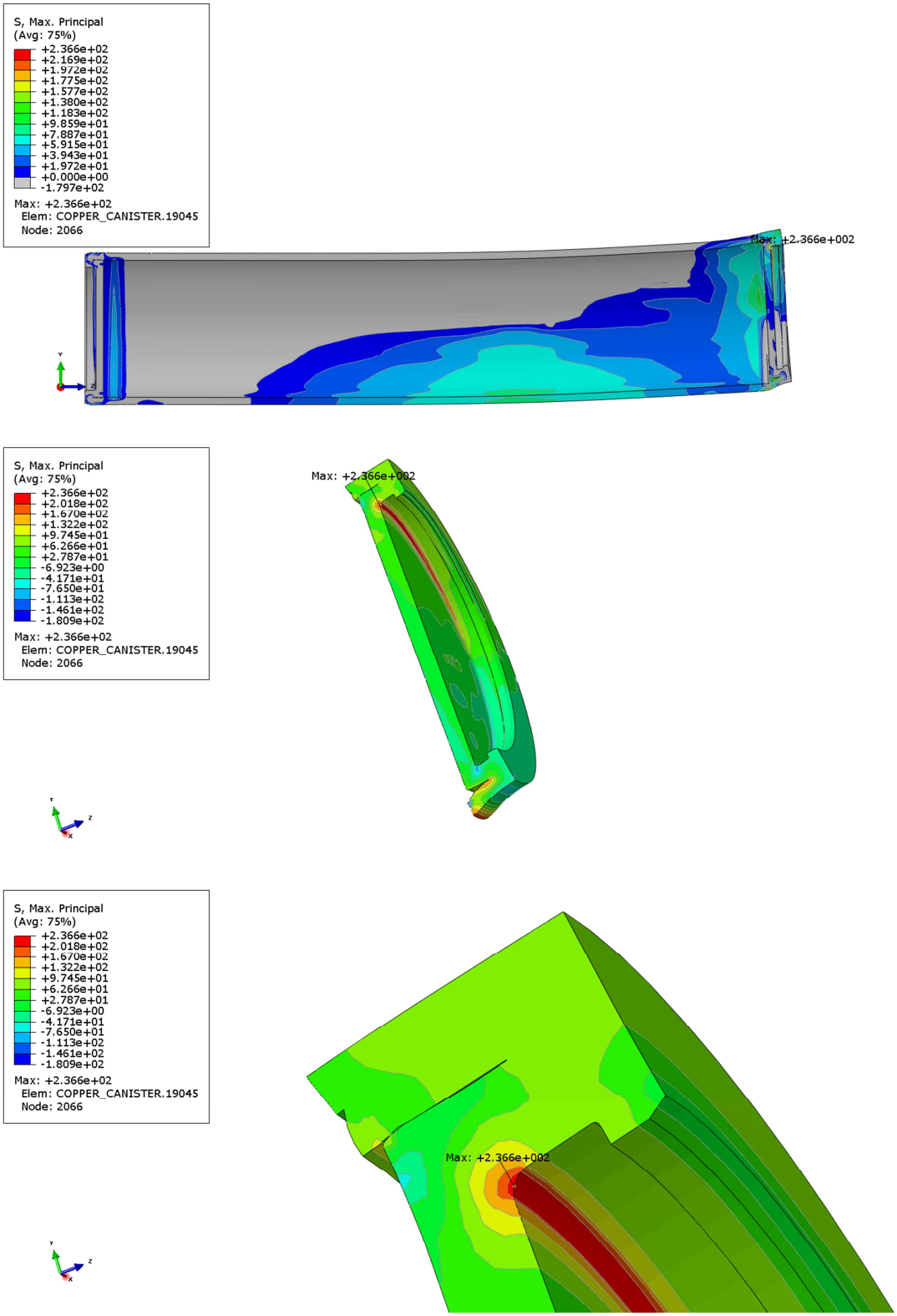


Figure A5-4. Plot of Max principal stress [MPa] at 10 cm shearing for case N9b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

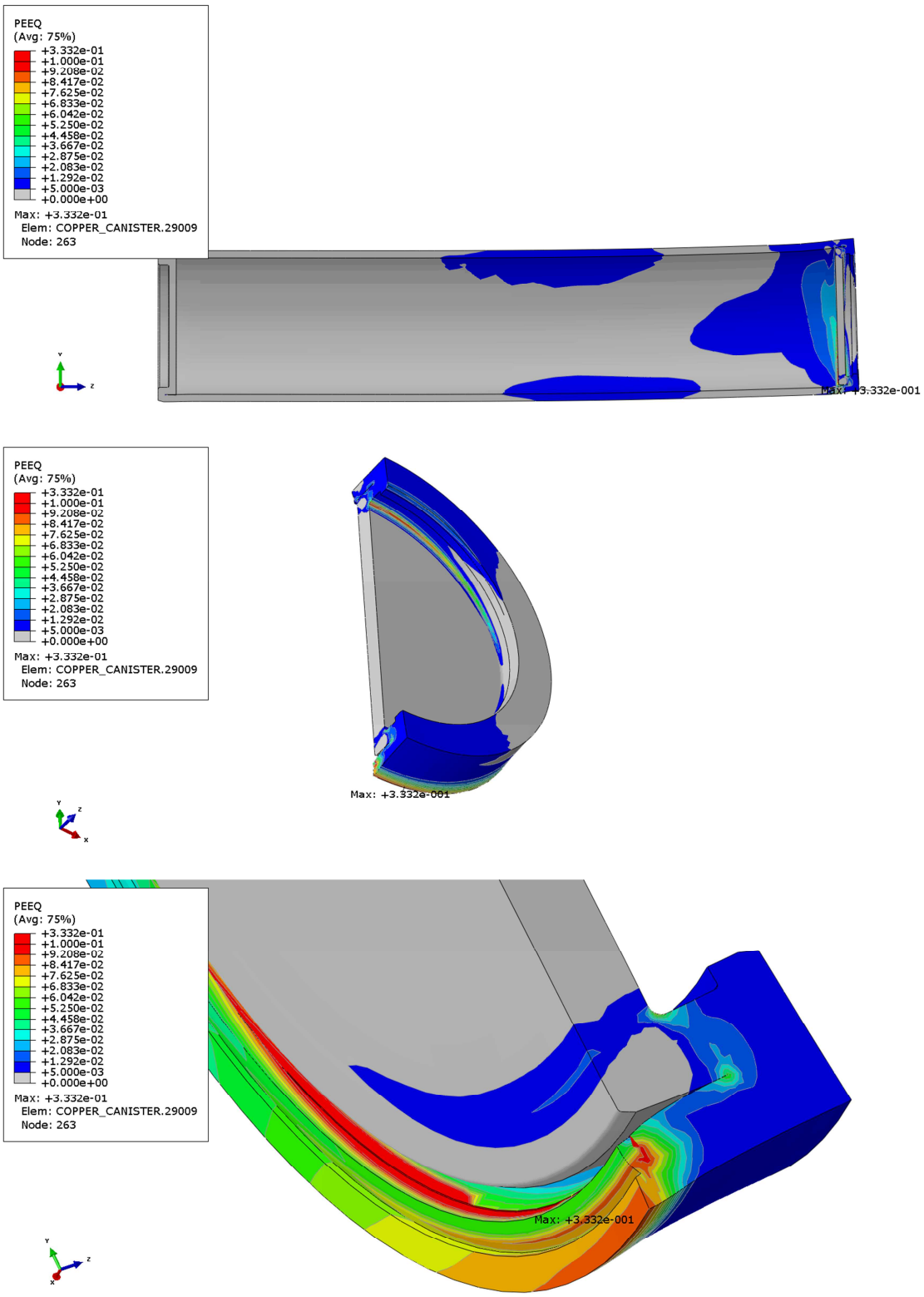


Figure A5-5. Plot of plastic equivalent strain, PEEQ, at 5 cm shearing for case N9b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

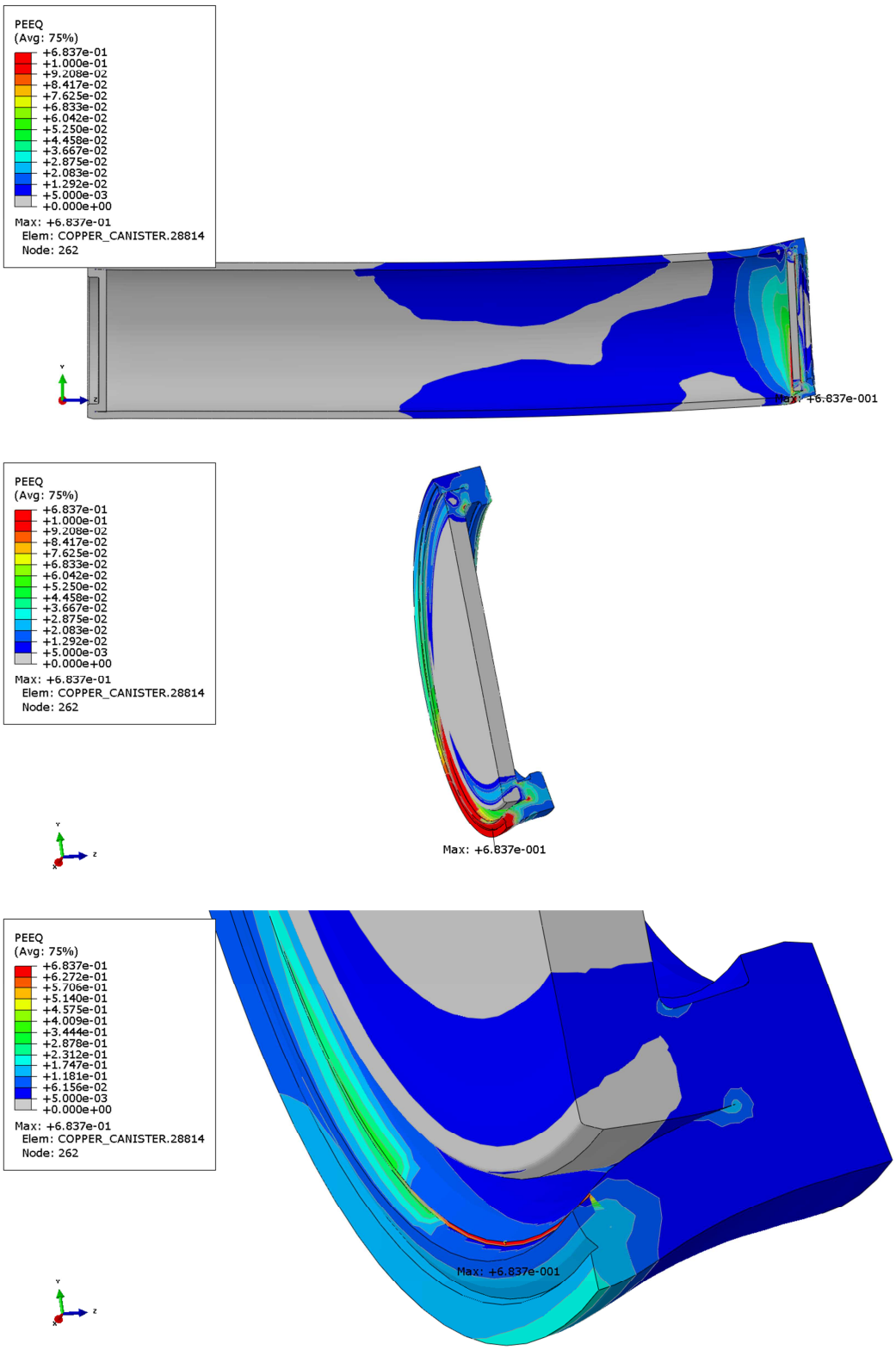


Figure A5-6. Plot of plastic equivalent strain, PEEQ, at 10 cm shearing for case N9b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 6 – Copper N7b_finer_1sekm

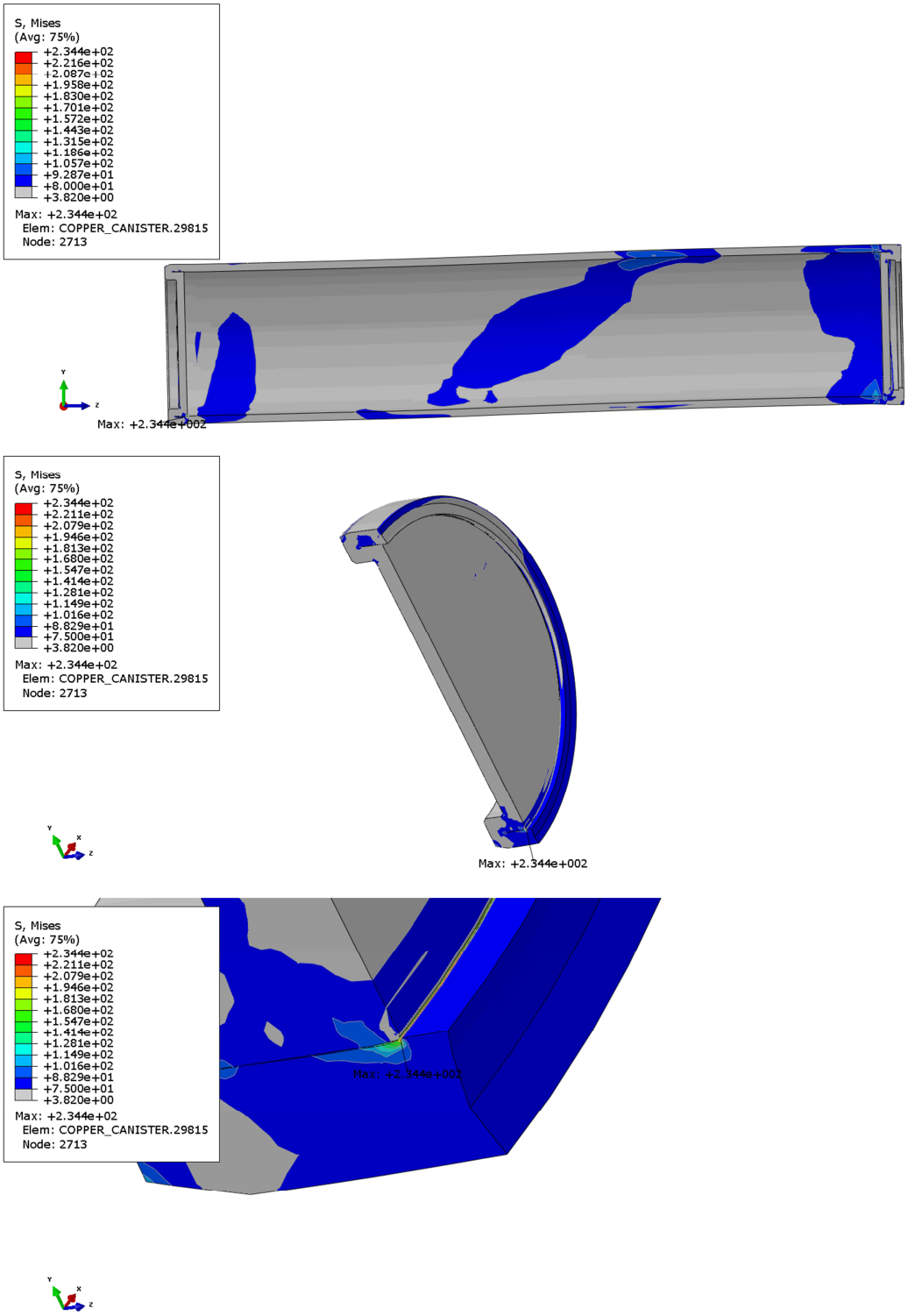


Figure A6-1. Plot of Mises [MPa] at 5 cm shearing for case N7b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

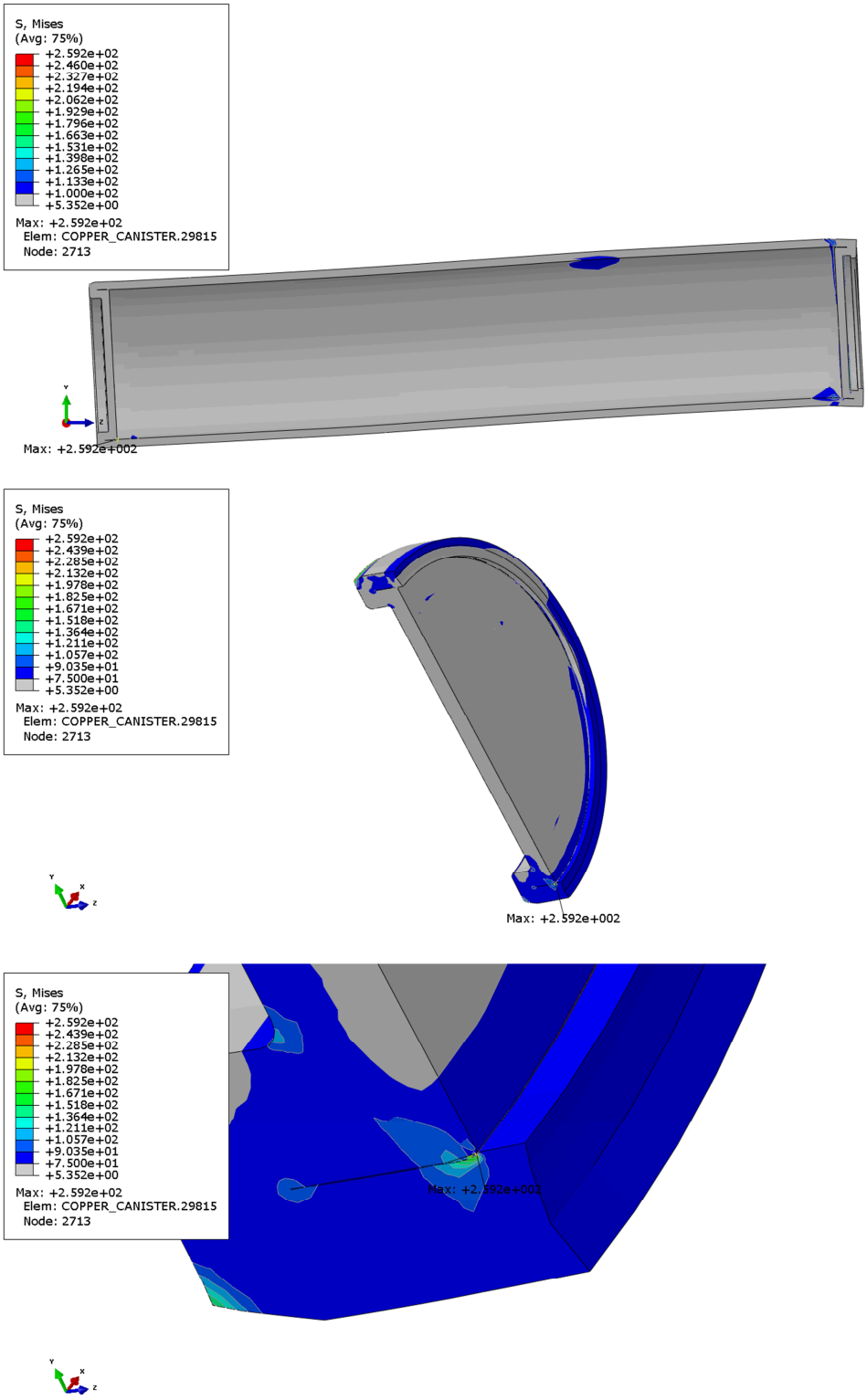


Figure A6-2. Plot of Mises [MPa] at 10 cm shearing for case N7b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

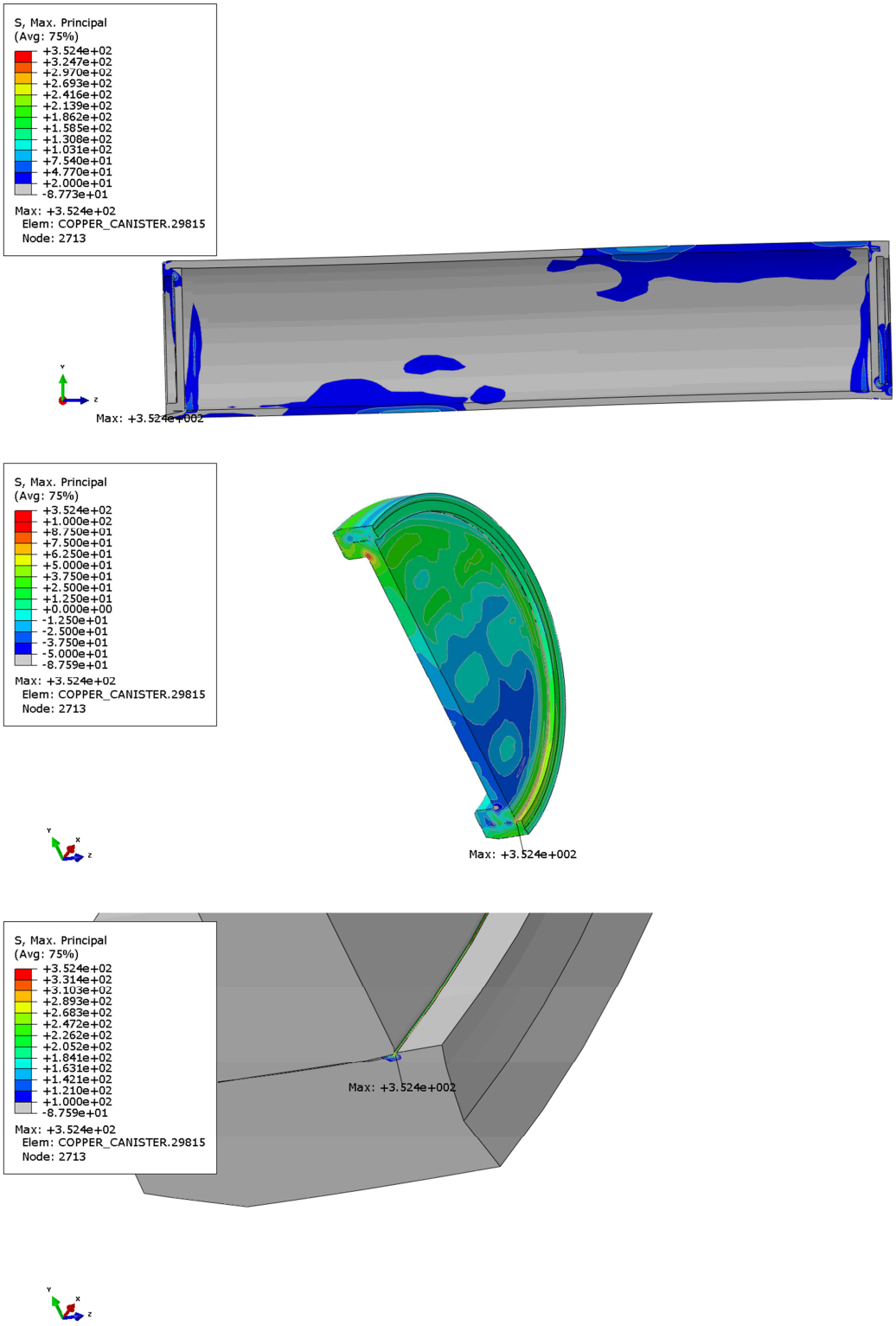


Figure A6-3. Plot of Max principal stress [MPa] at 5 cm shearing for case N7b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

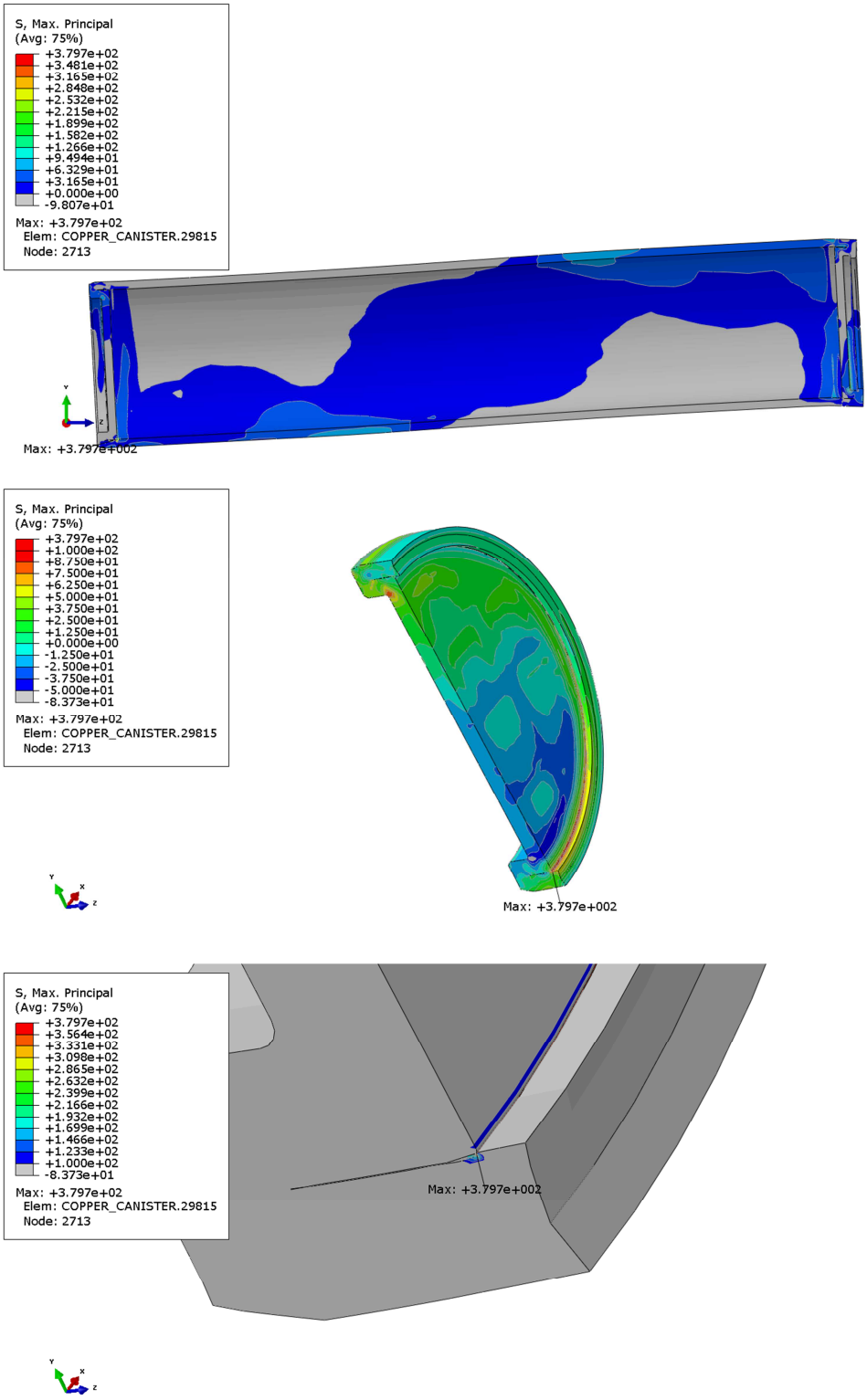


Figure A6-4. Plot of Max principal stress [MPa] at 10 cm shearing for case N7b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

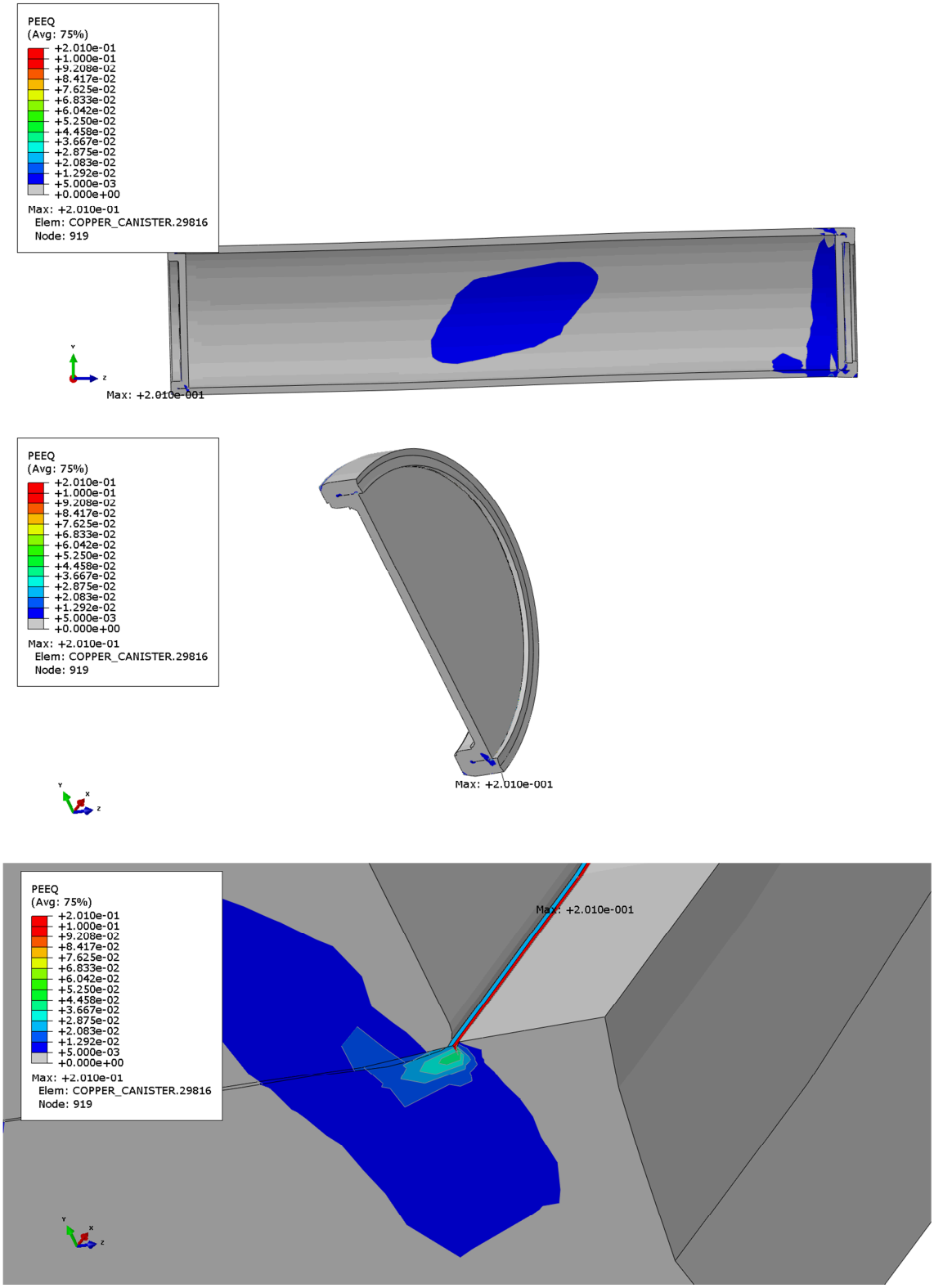


Figure A6-5. Plot of plastic equivalent strain at 5 cm shearing for case N7b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

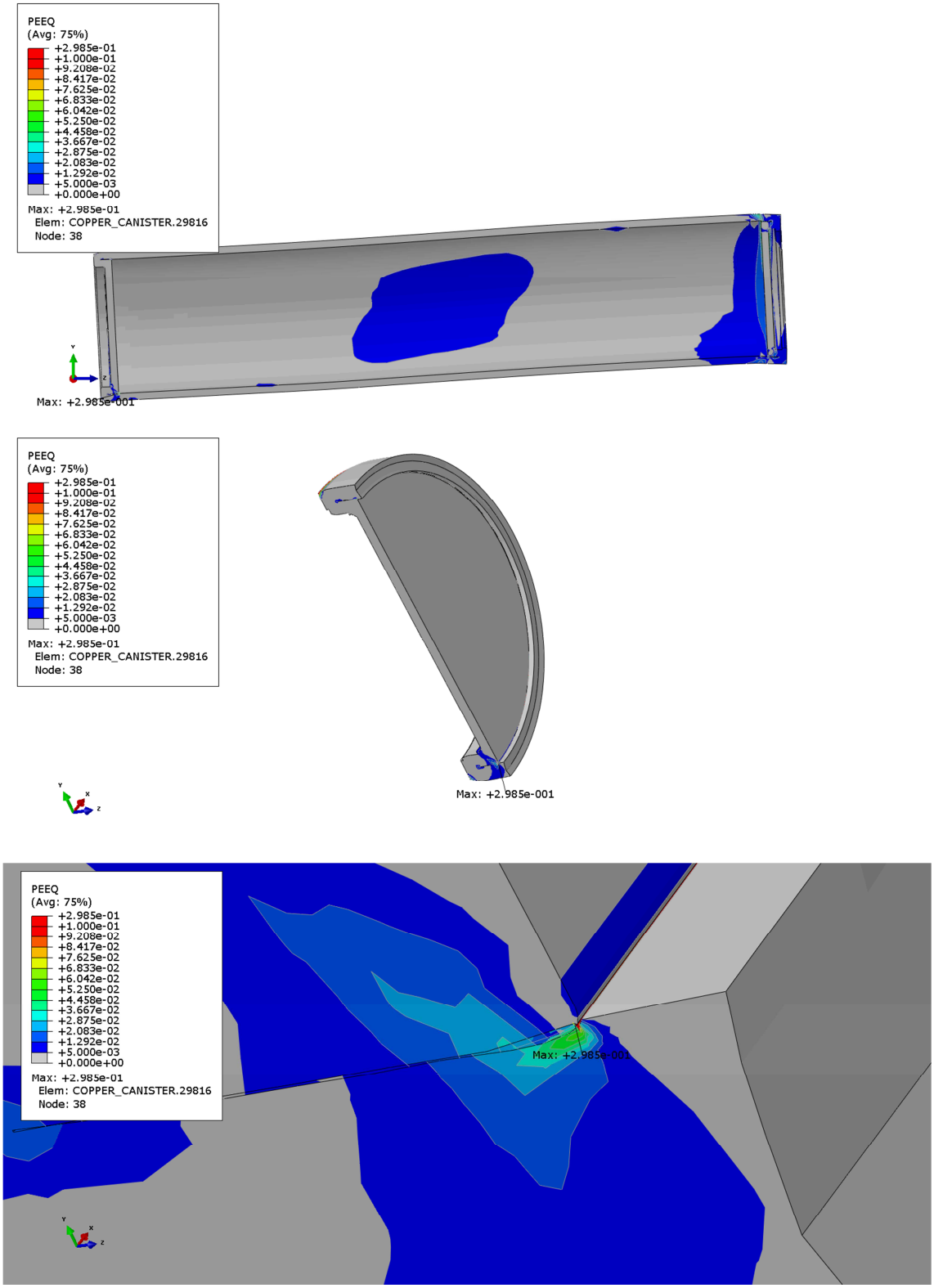


Figure A6-6. Plot of plastic equivalent strain, PEEQ, at 10 cm shearing for case N7b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 7 – Copper N27b_finer_1sekm

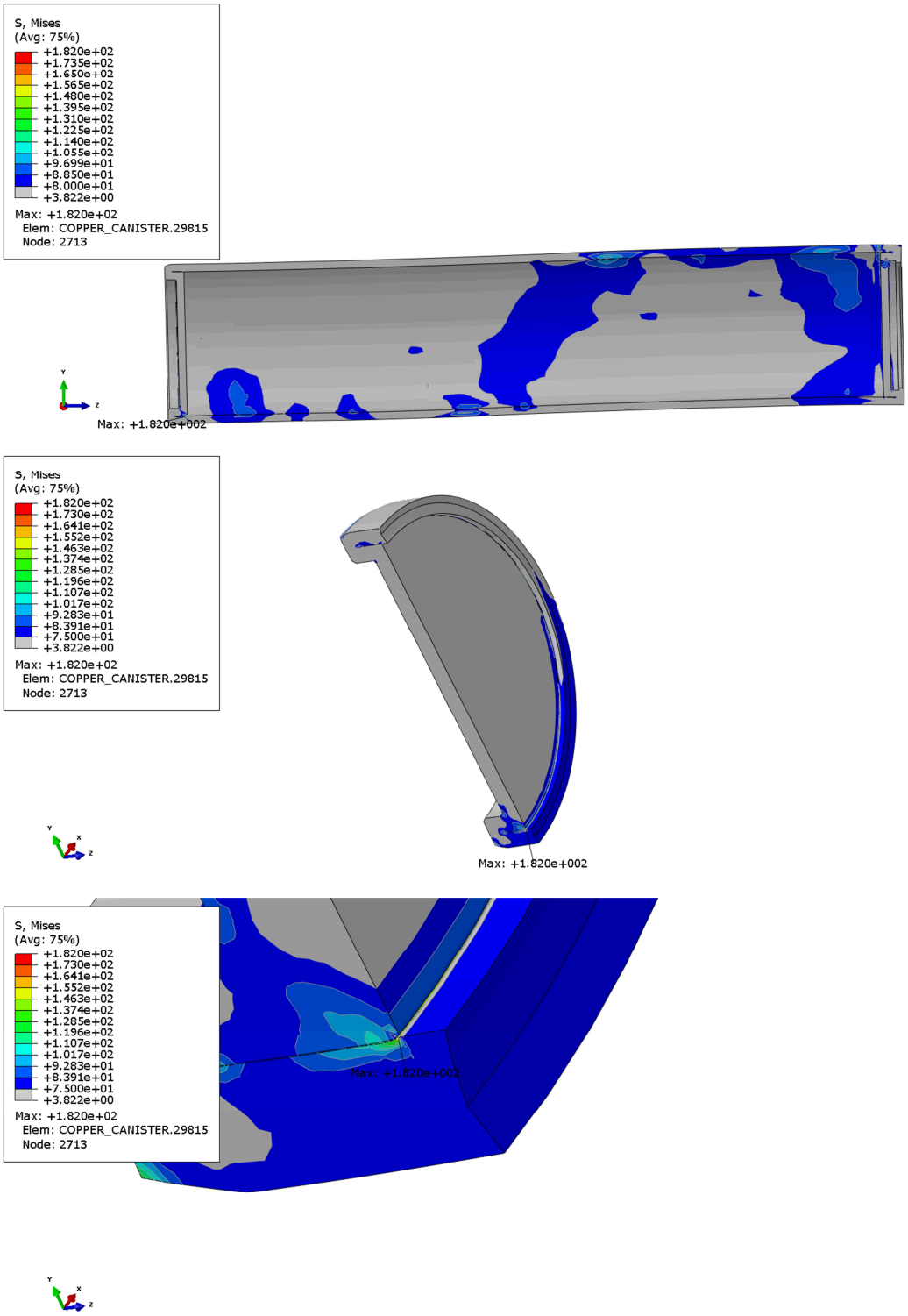


Figure A7-1. Plot of Mises [MPa] at 5 cm shearing for case N27b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

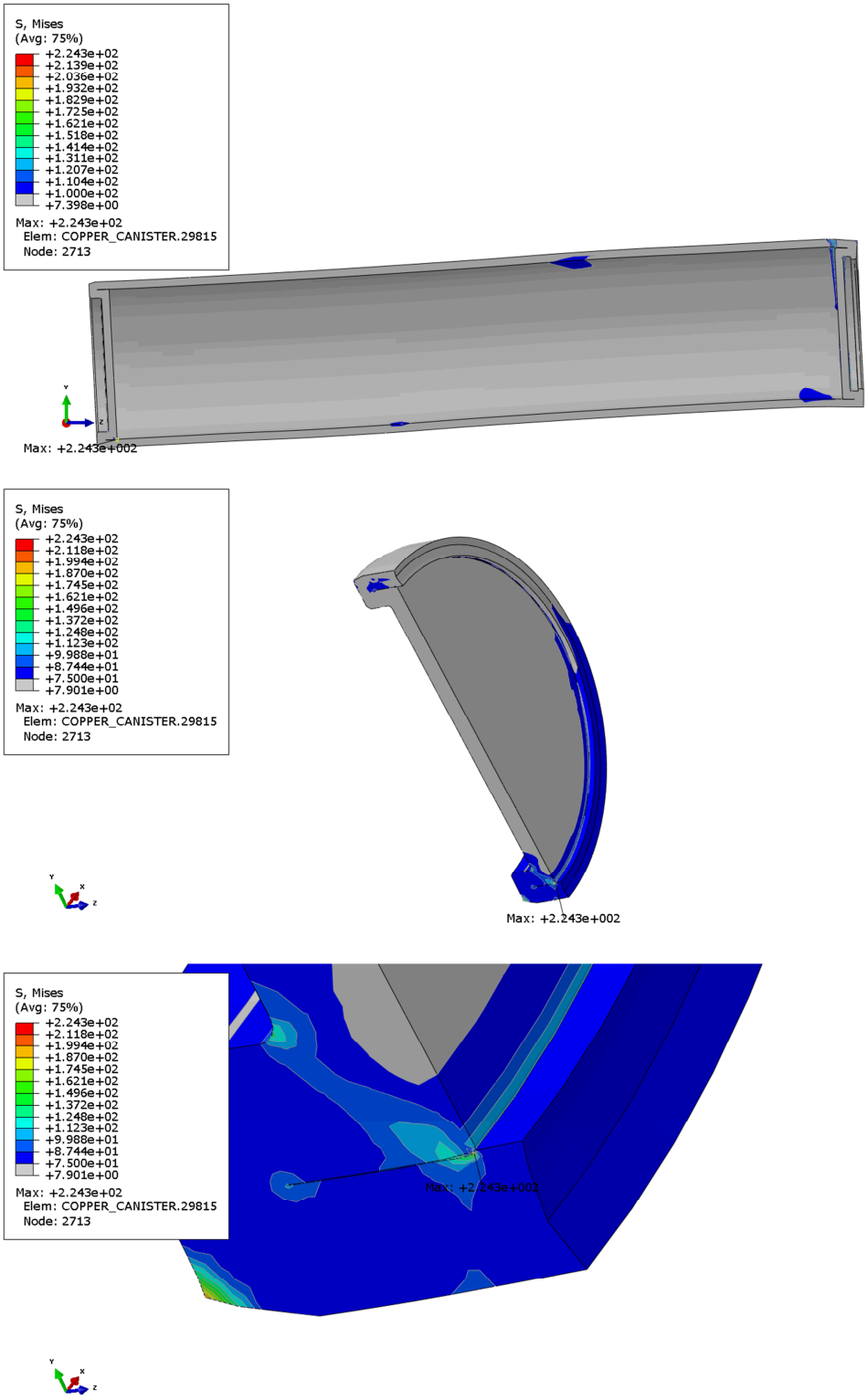


Figure A7-2. Plot of Mises [MPa] at 10 cm shearing for case N27b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

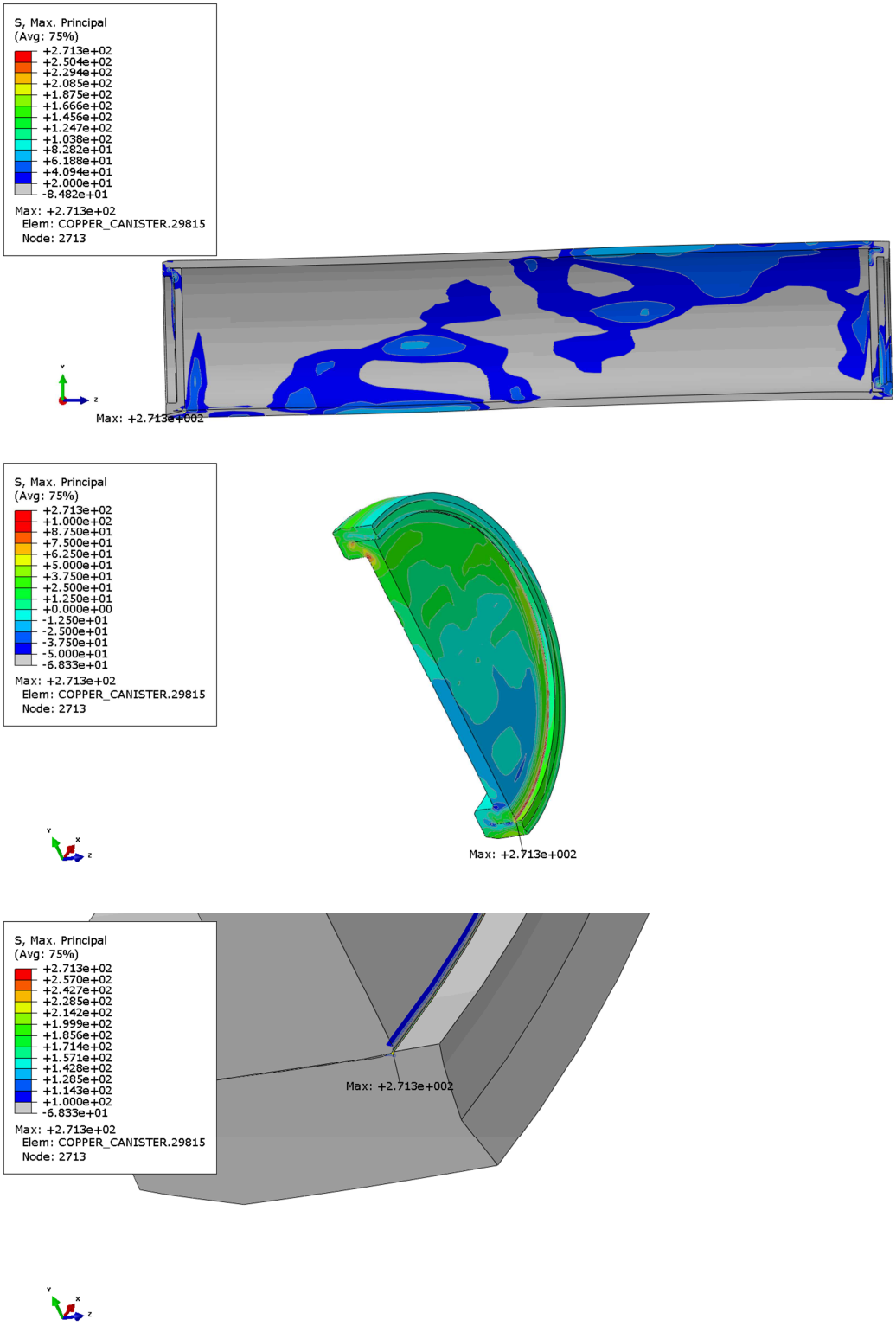


Figure A7-3. Plot of Max principal stress [MPa] at 5 cm shearing for case N27b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

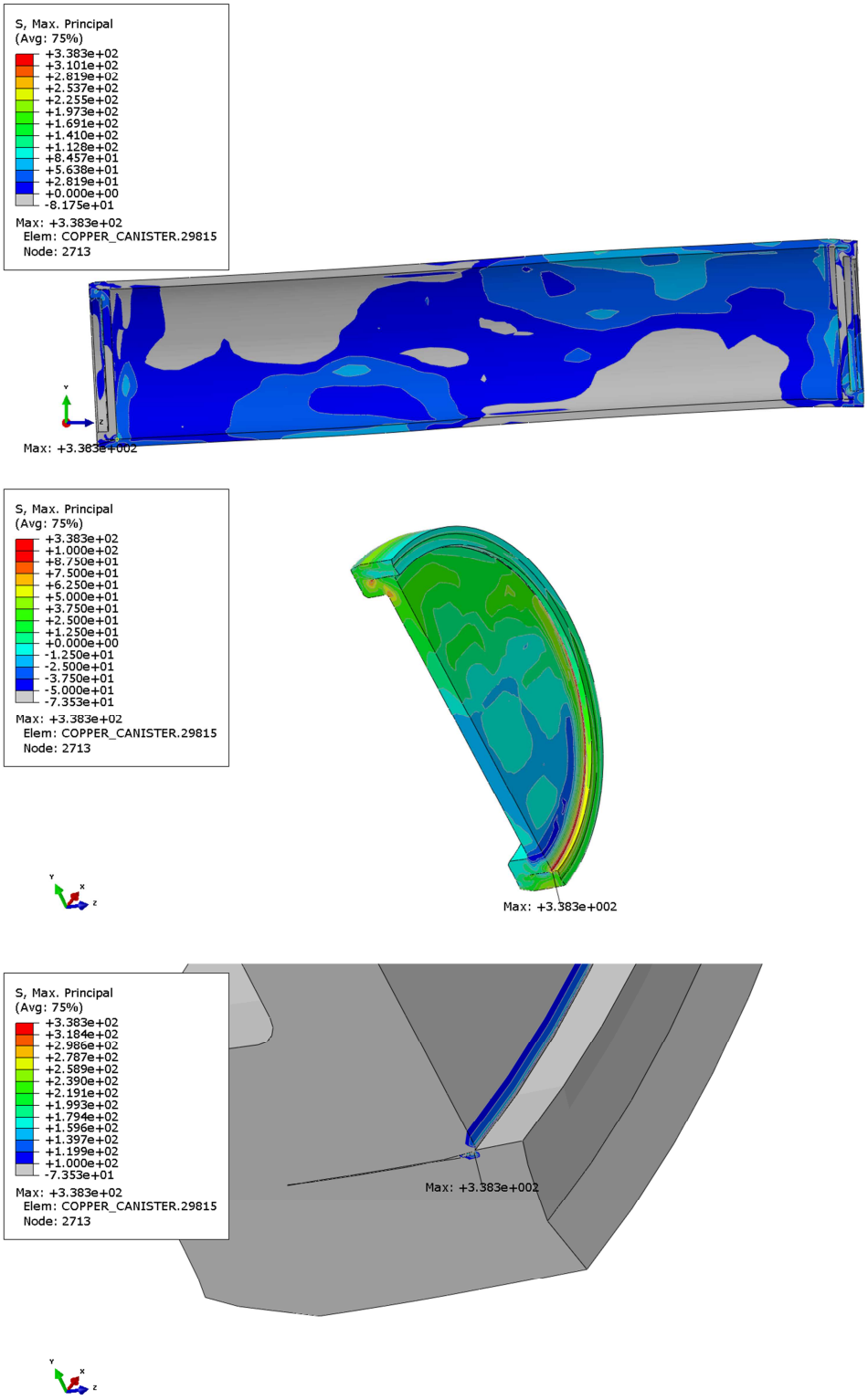


Figure A7-4. Plot of Max principal stress [MPa] at 10 cm shearing for case N27b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

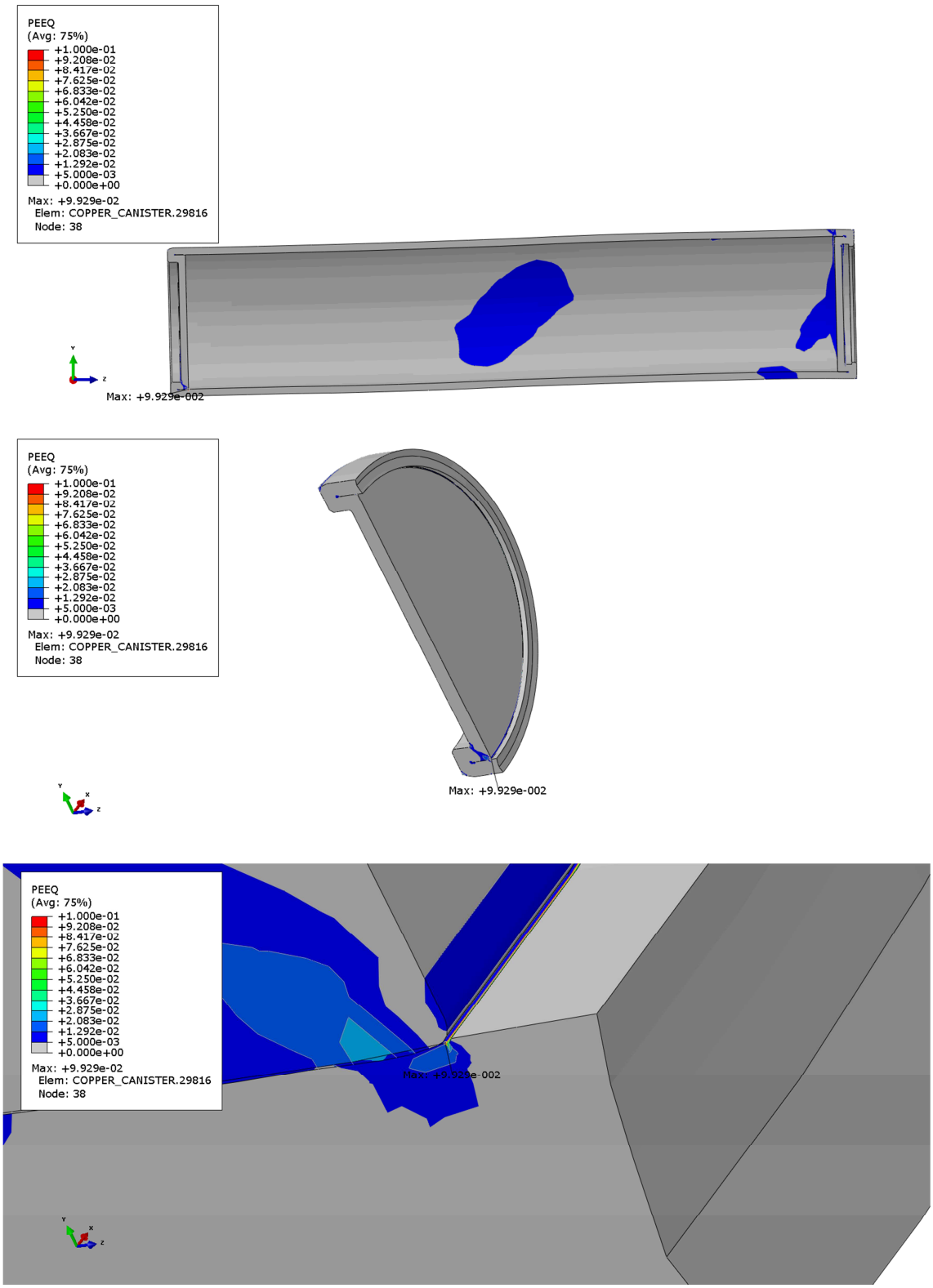


Figure A7-5. Plot of plastic equivalent strain, PEEQ, at 5 cm shearing for case N27b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

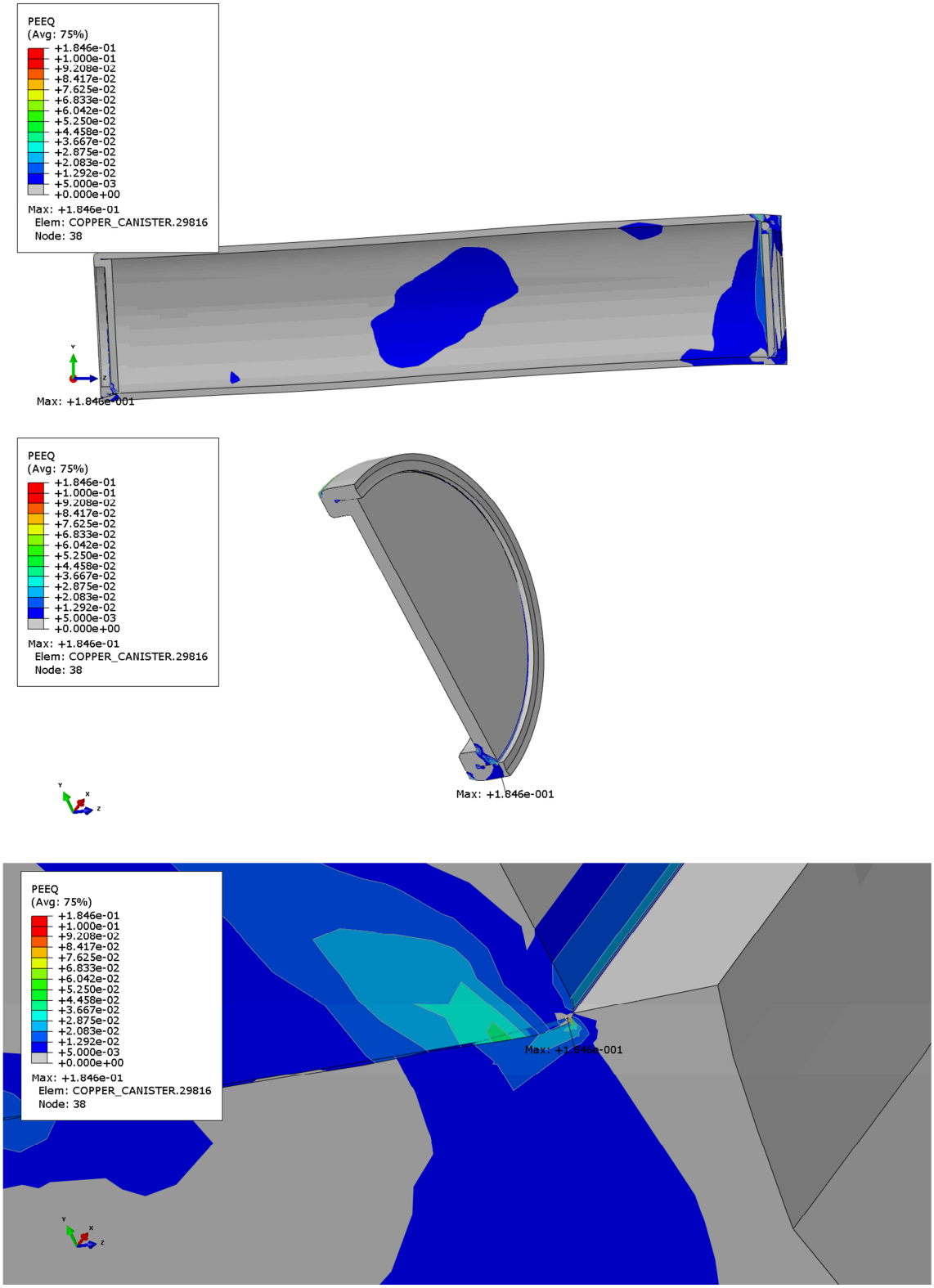


Figure A7-6. Plot of plastic equivalent strain, PEEQ, at 10 cm shearing for case N27b_finer_1sekm (copper shell).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 8 – Iron insert N8b_finer_1sekm

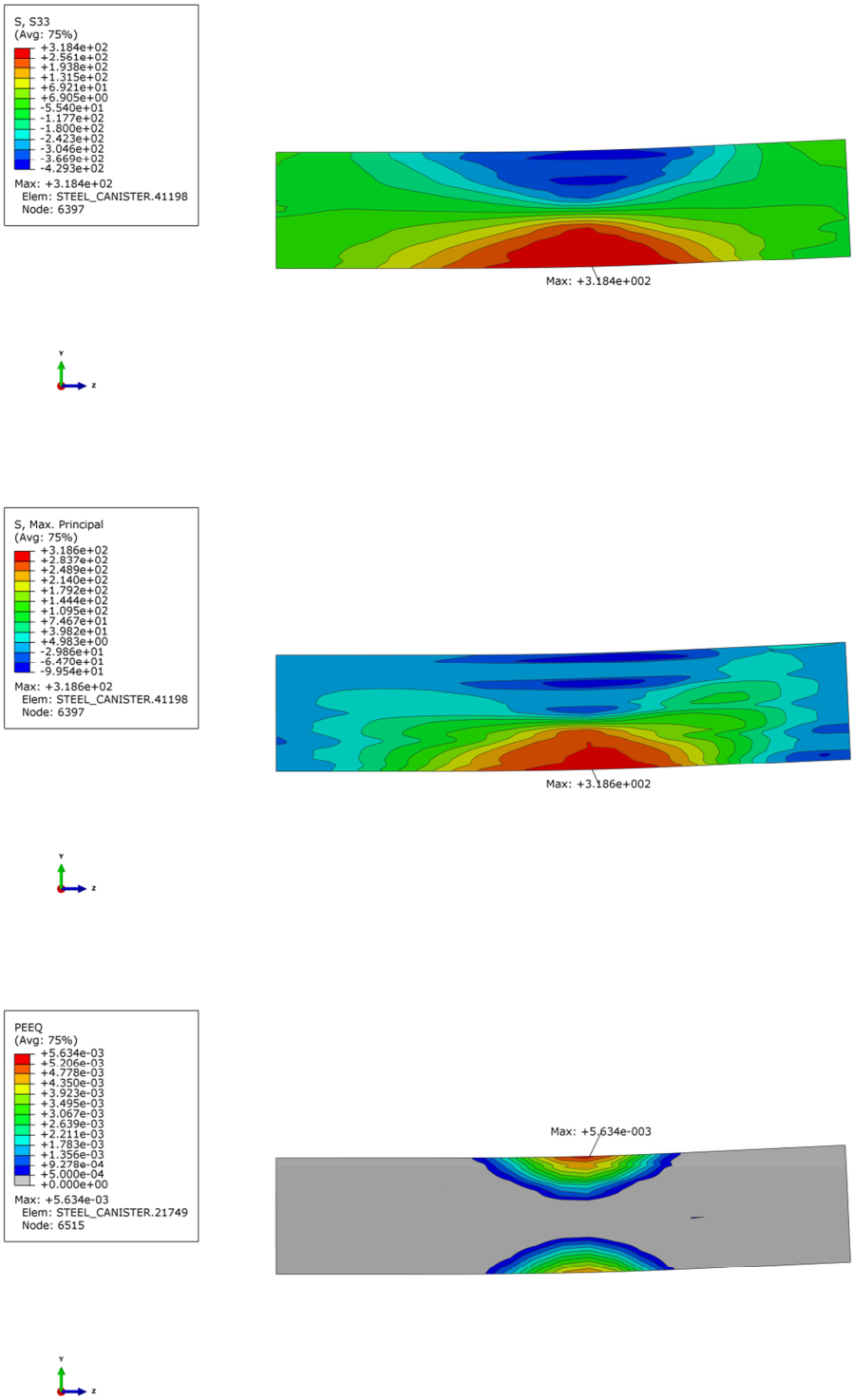


Figure A8-1. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N8b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

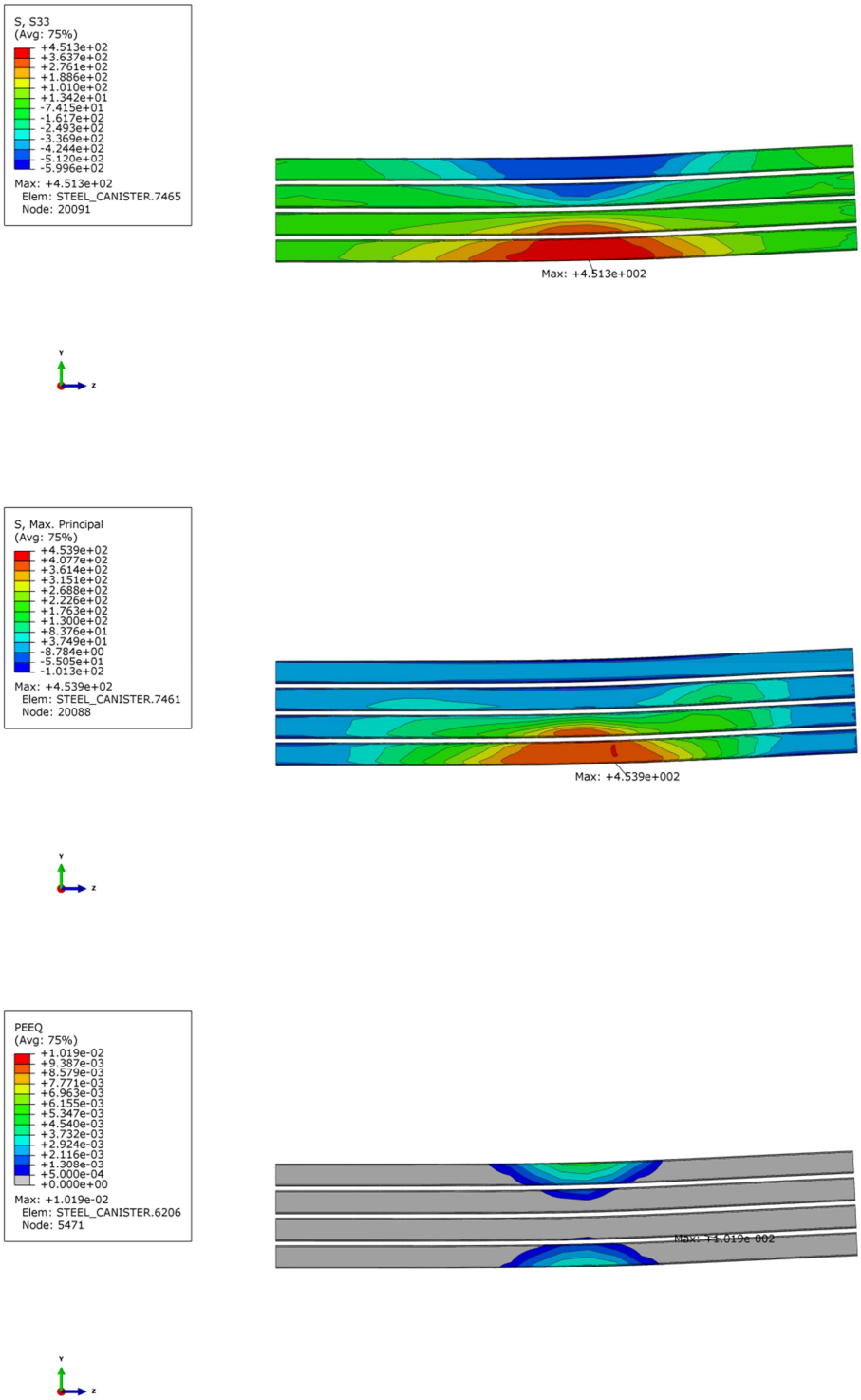


Figure A8-2. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N8b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

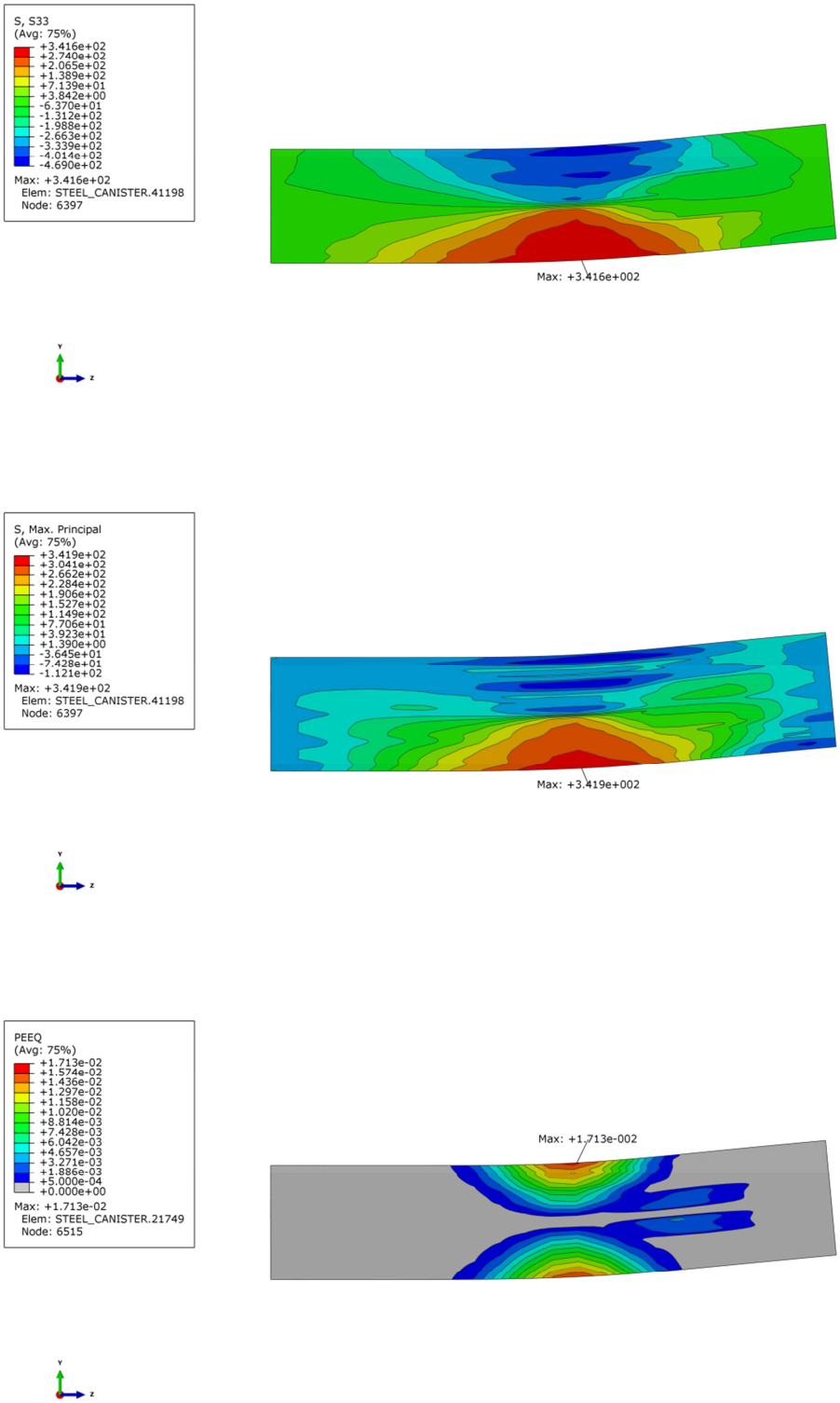


Figure A8-3. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N8b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

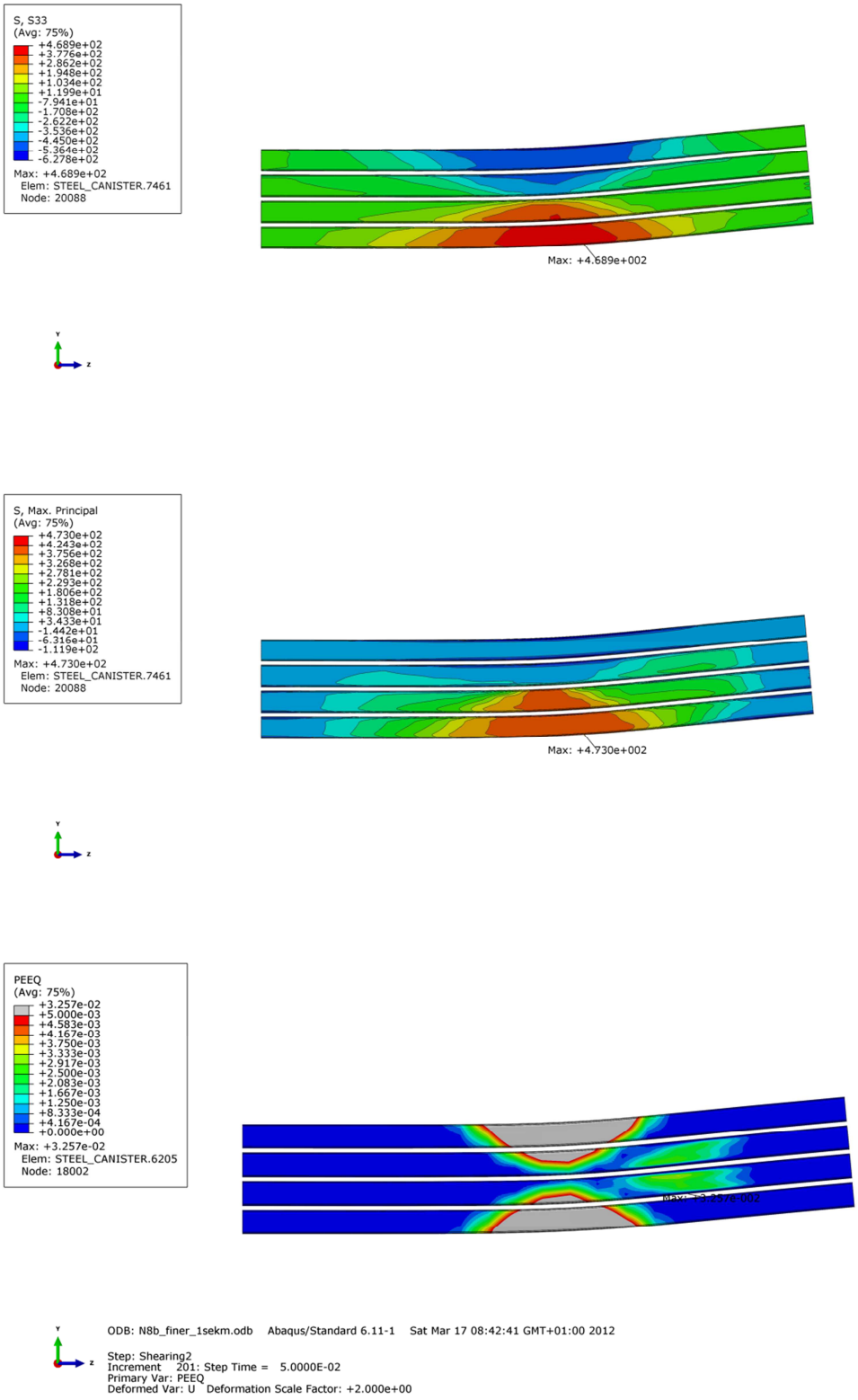


Figure A8-4. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N8b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 9 – Iron insert N8b_b_finer_1sekm

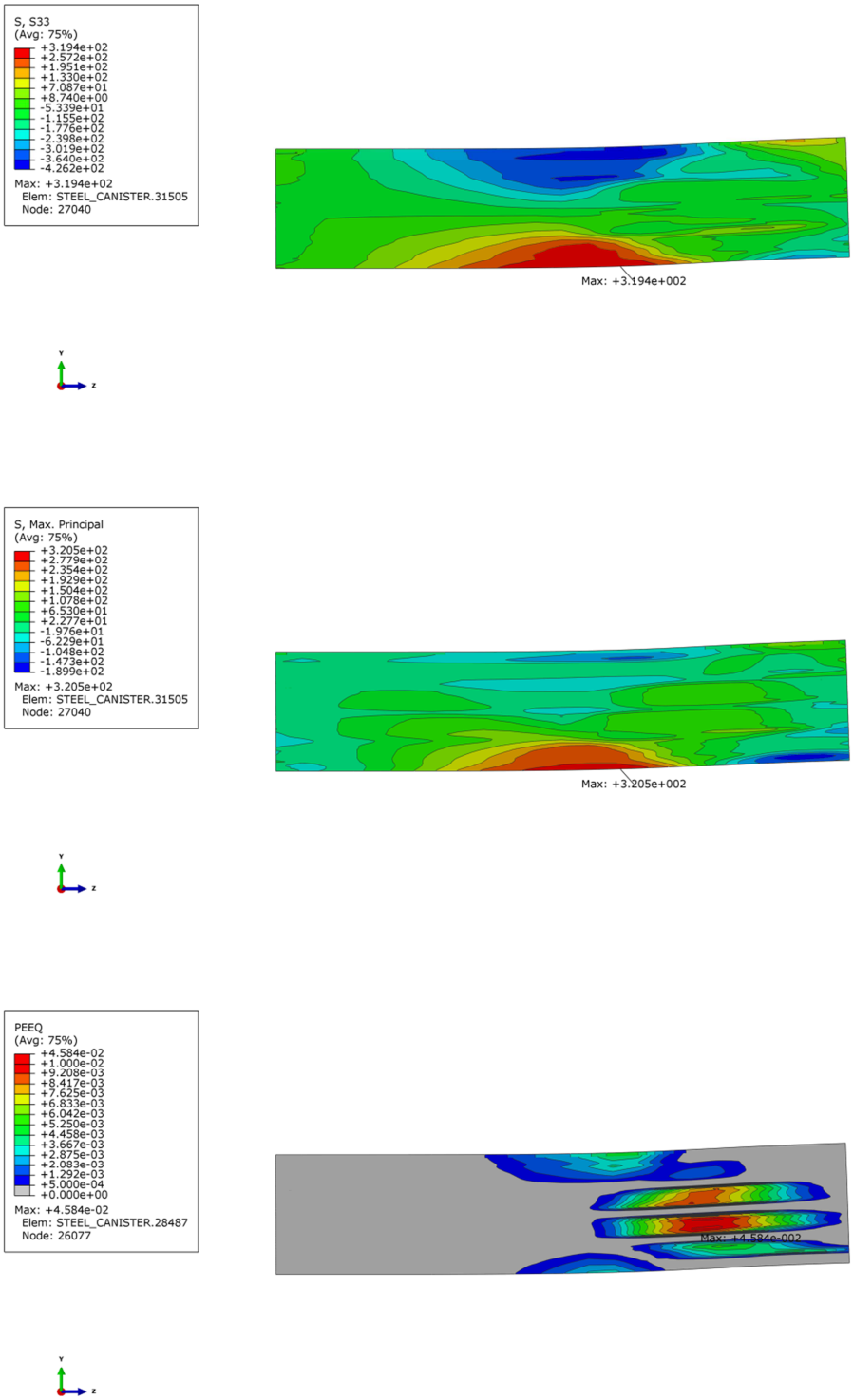


Figure A9-1. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N8b_b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

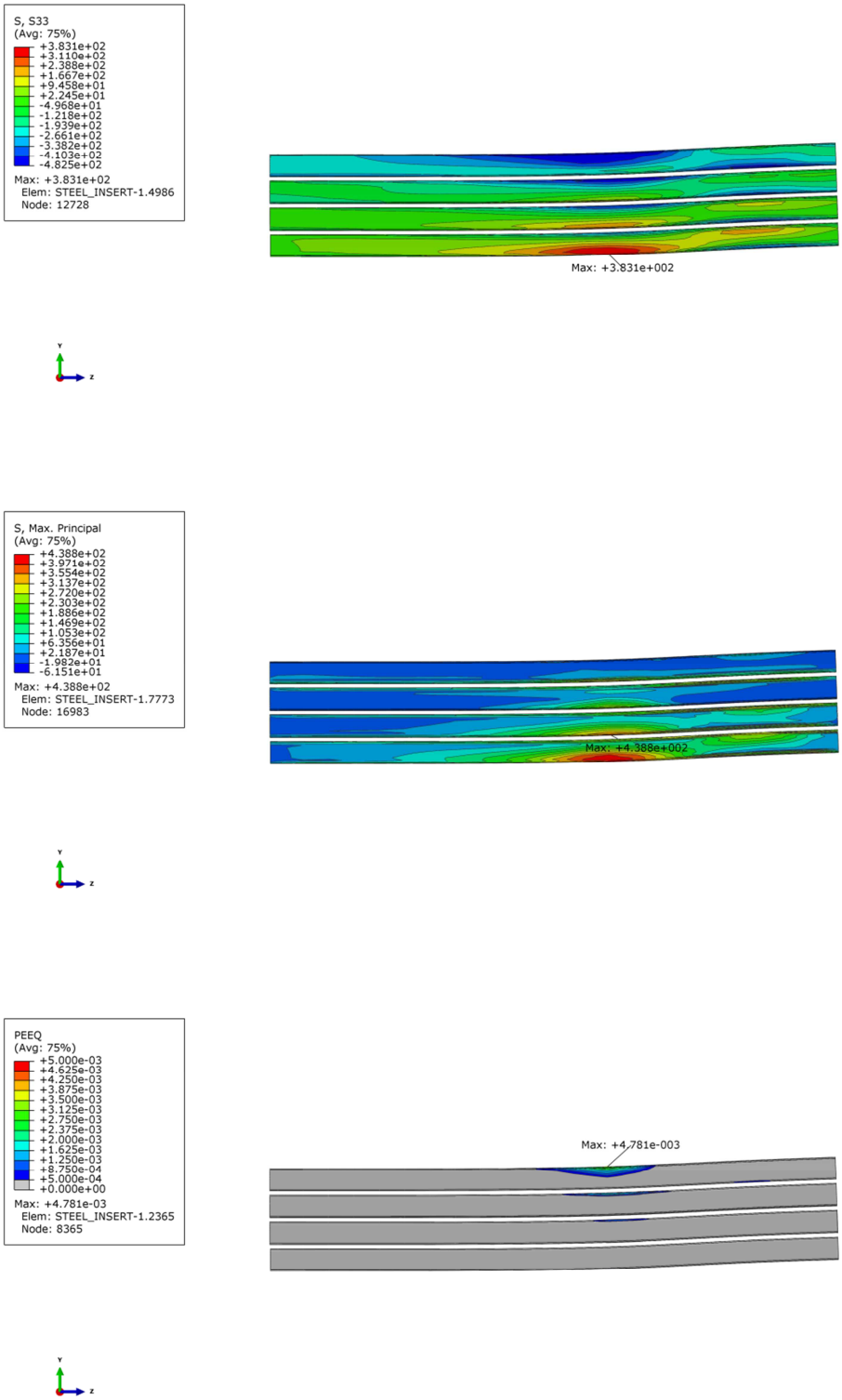


Figure A9-2. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N8b_b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

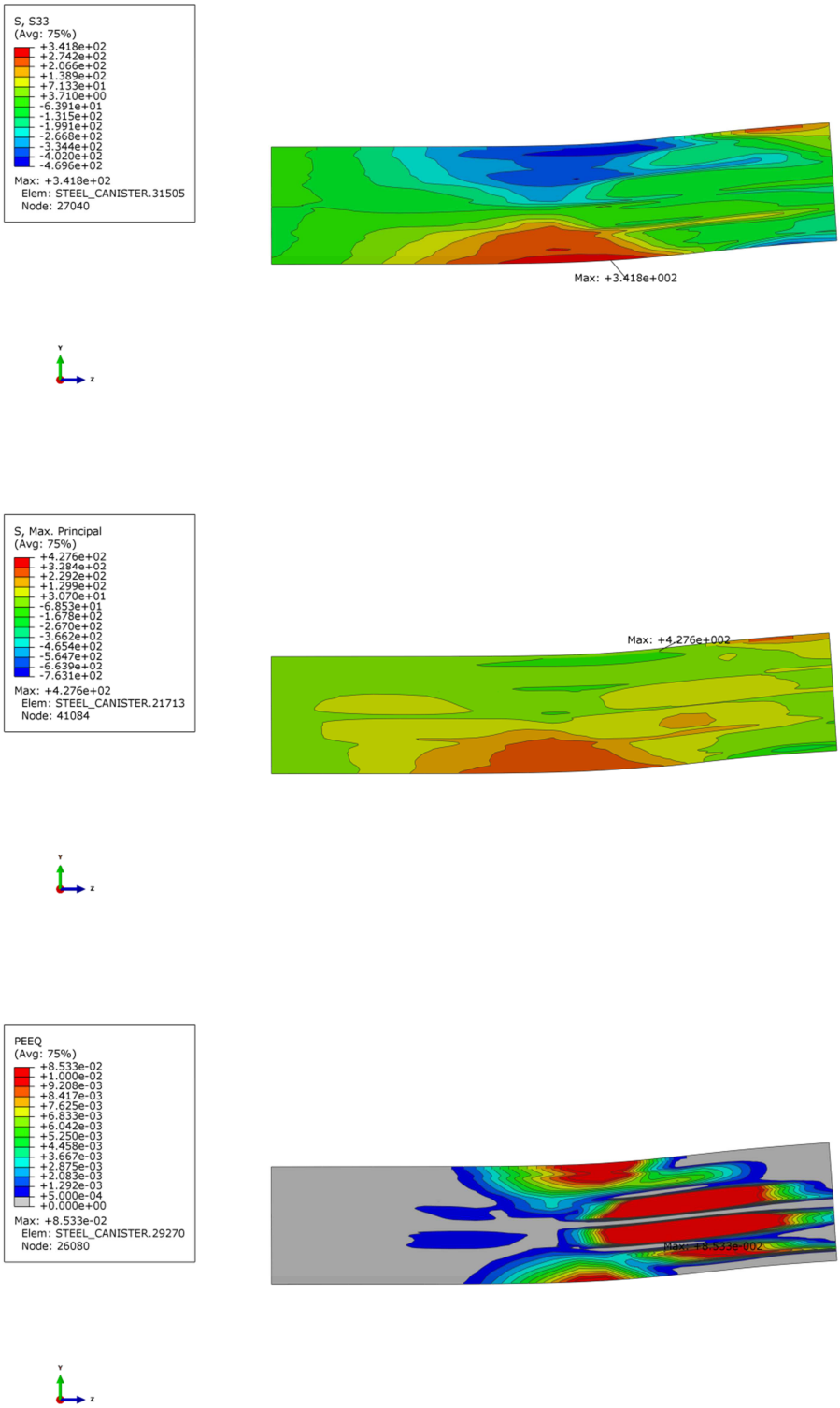


Figure A9-3. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N8b_b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

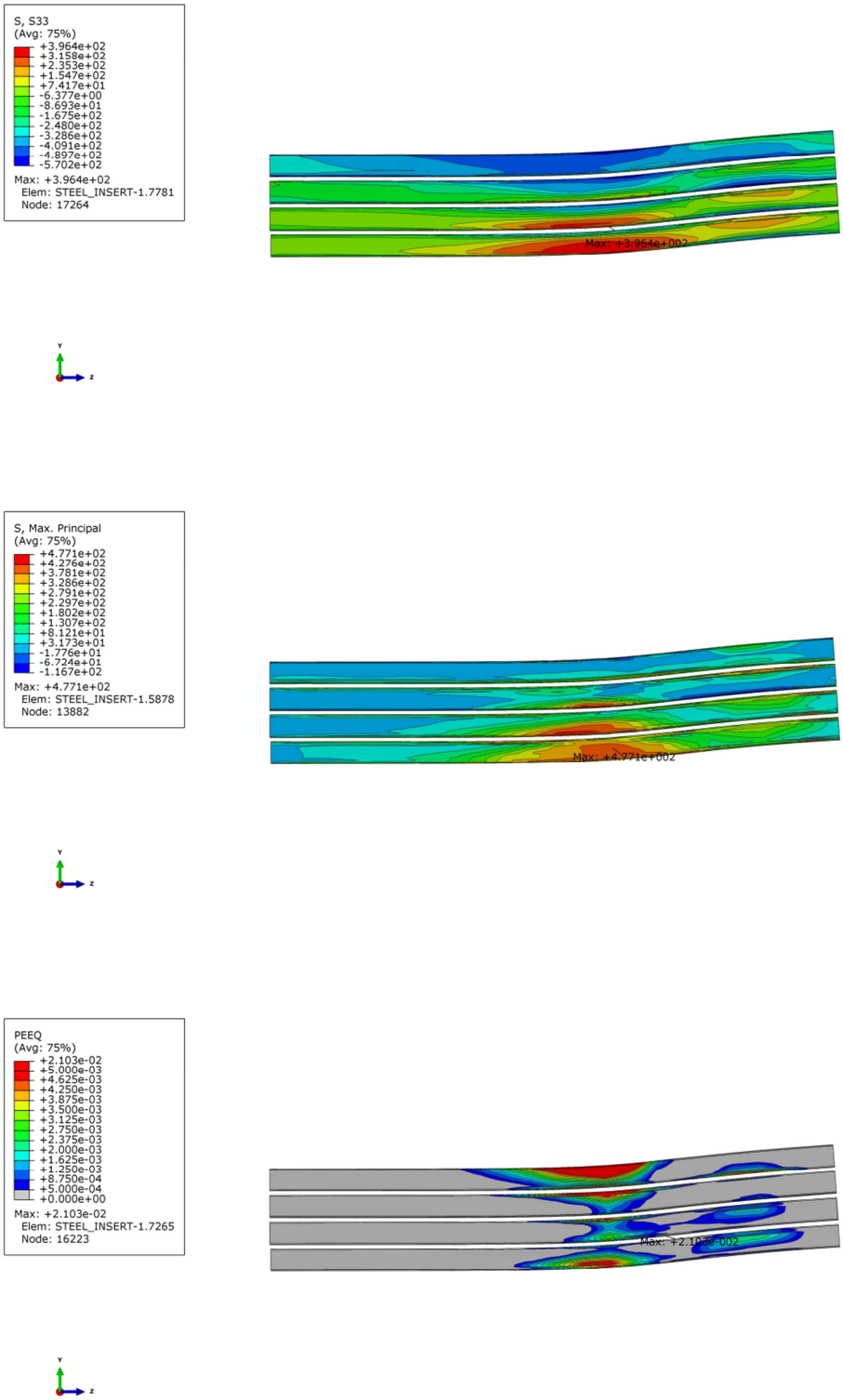


Figure A9-4. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N8b_b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 10 – Iron insert N21b_finer_1sekm

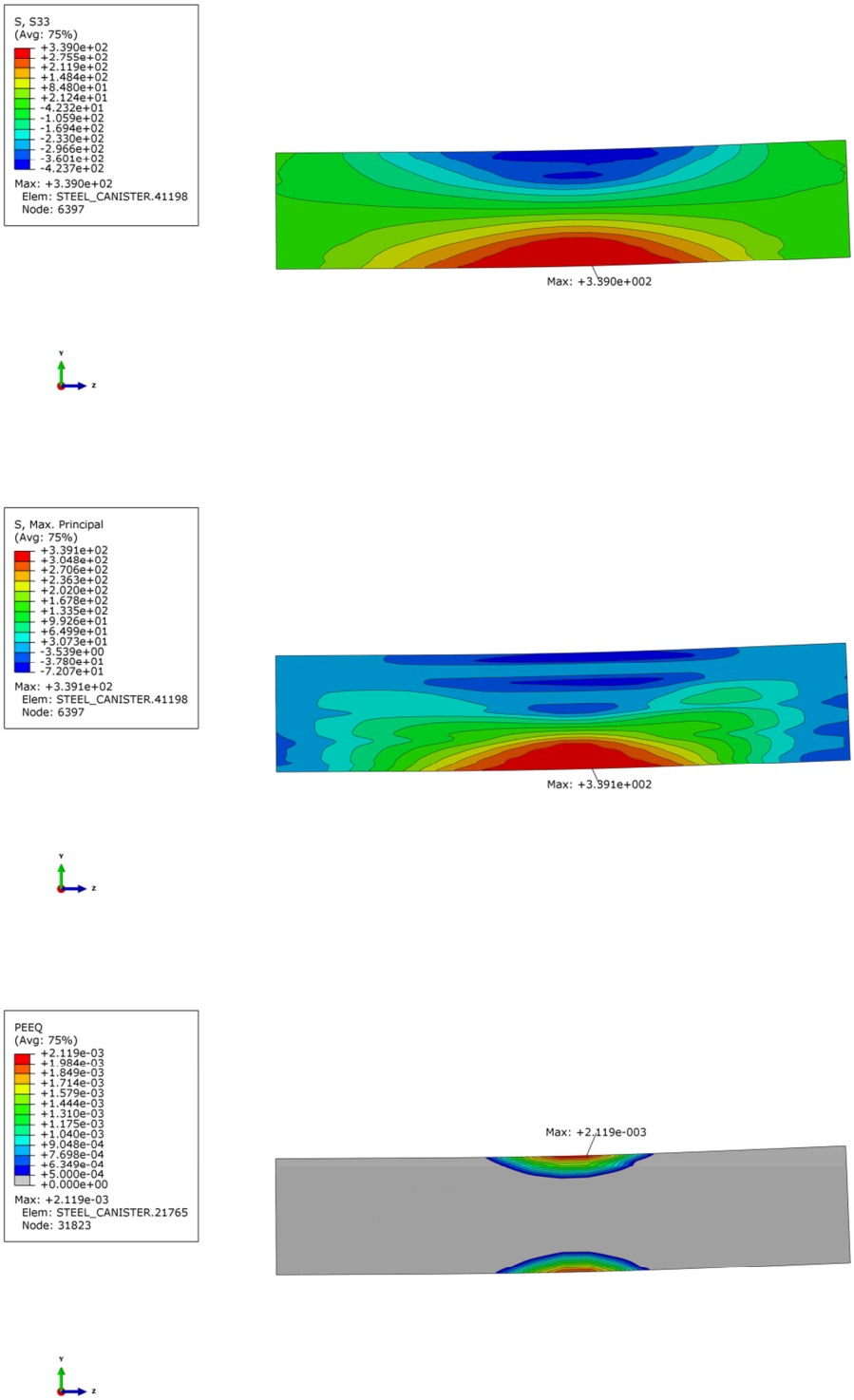


Figure A10-1. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N21b_b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

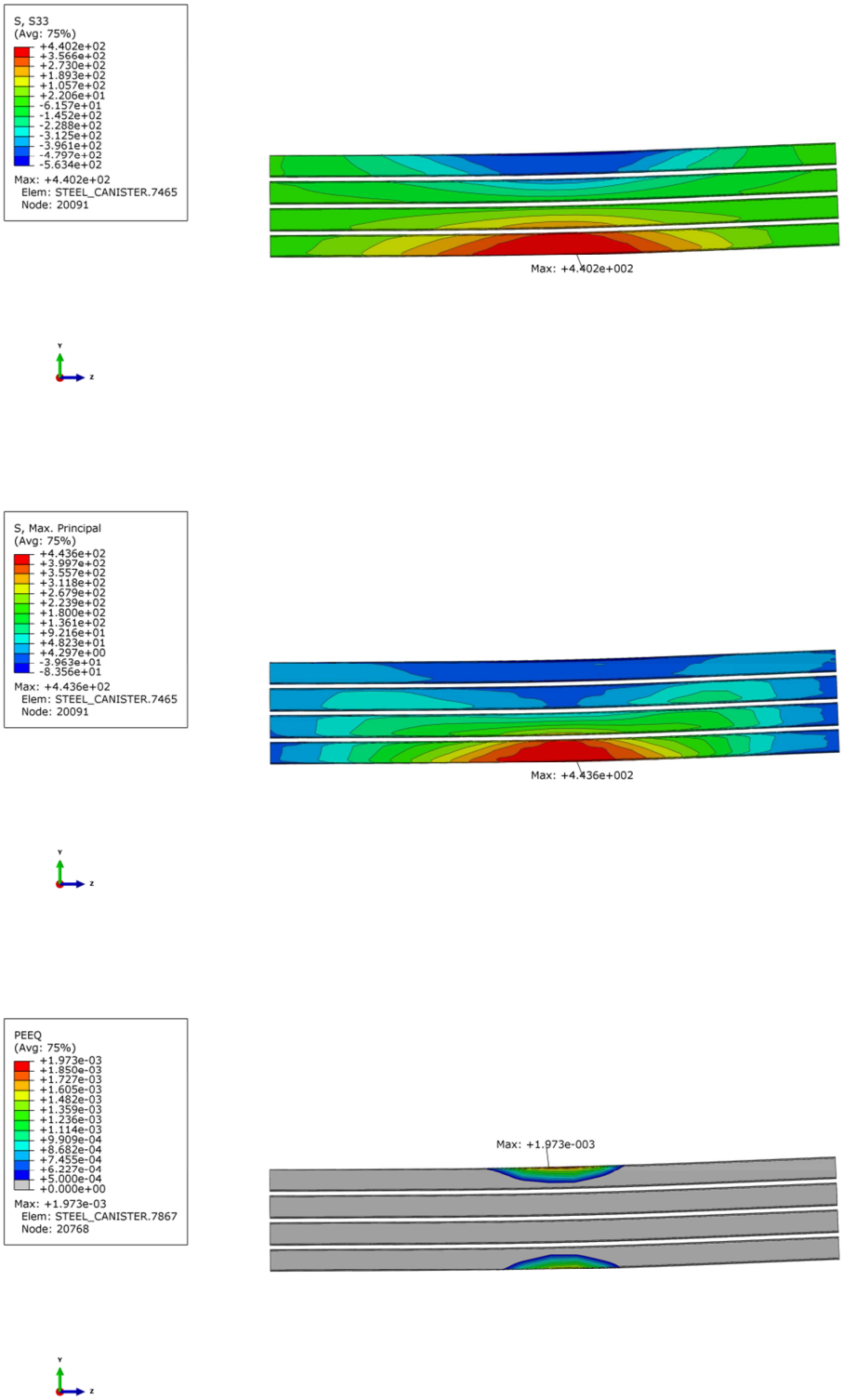


Figure A10-2. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N21b_b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

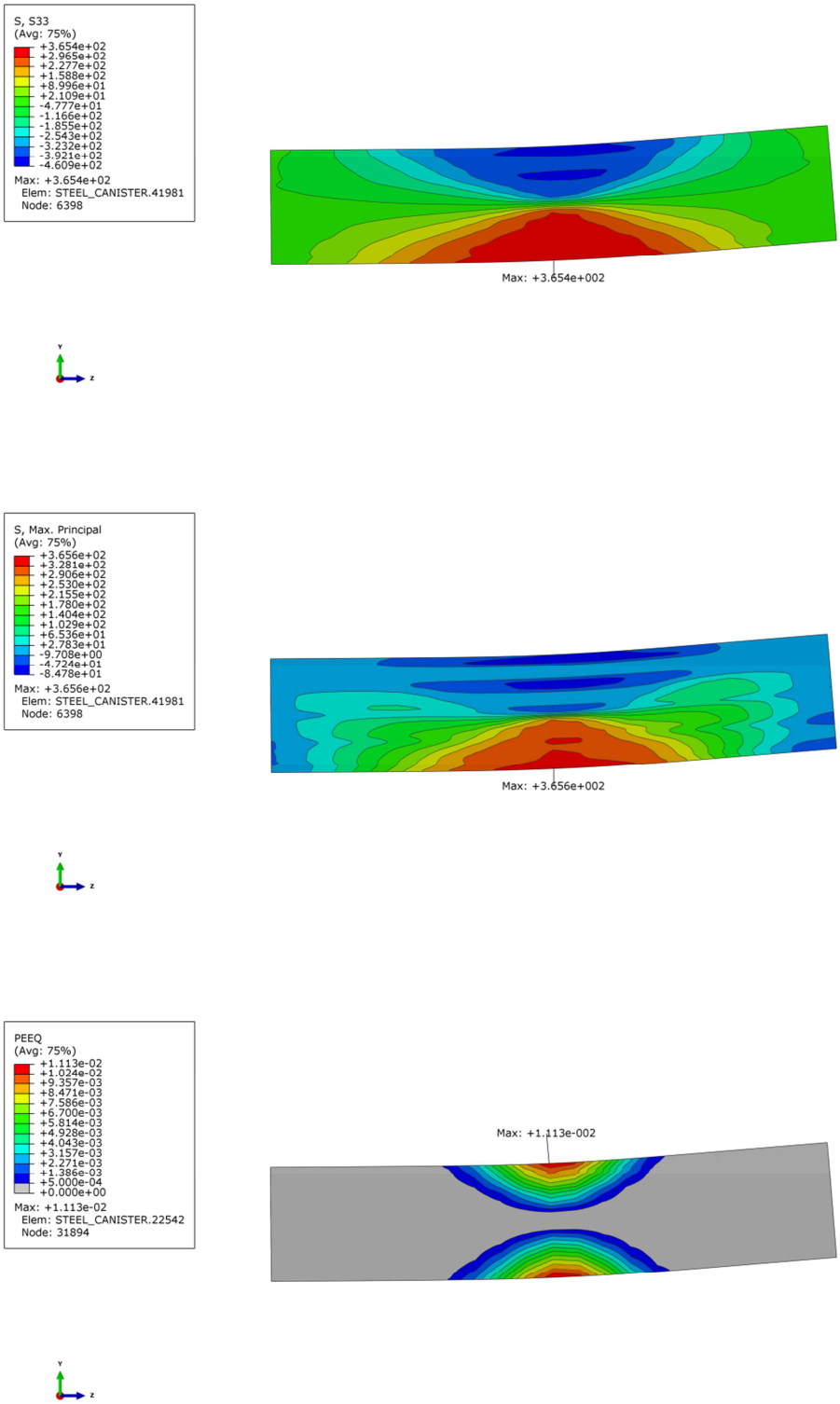


Figure A10-3. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N21b_b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

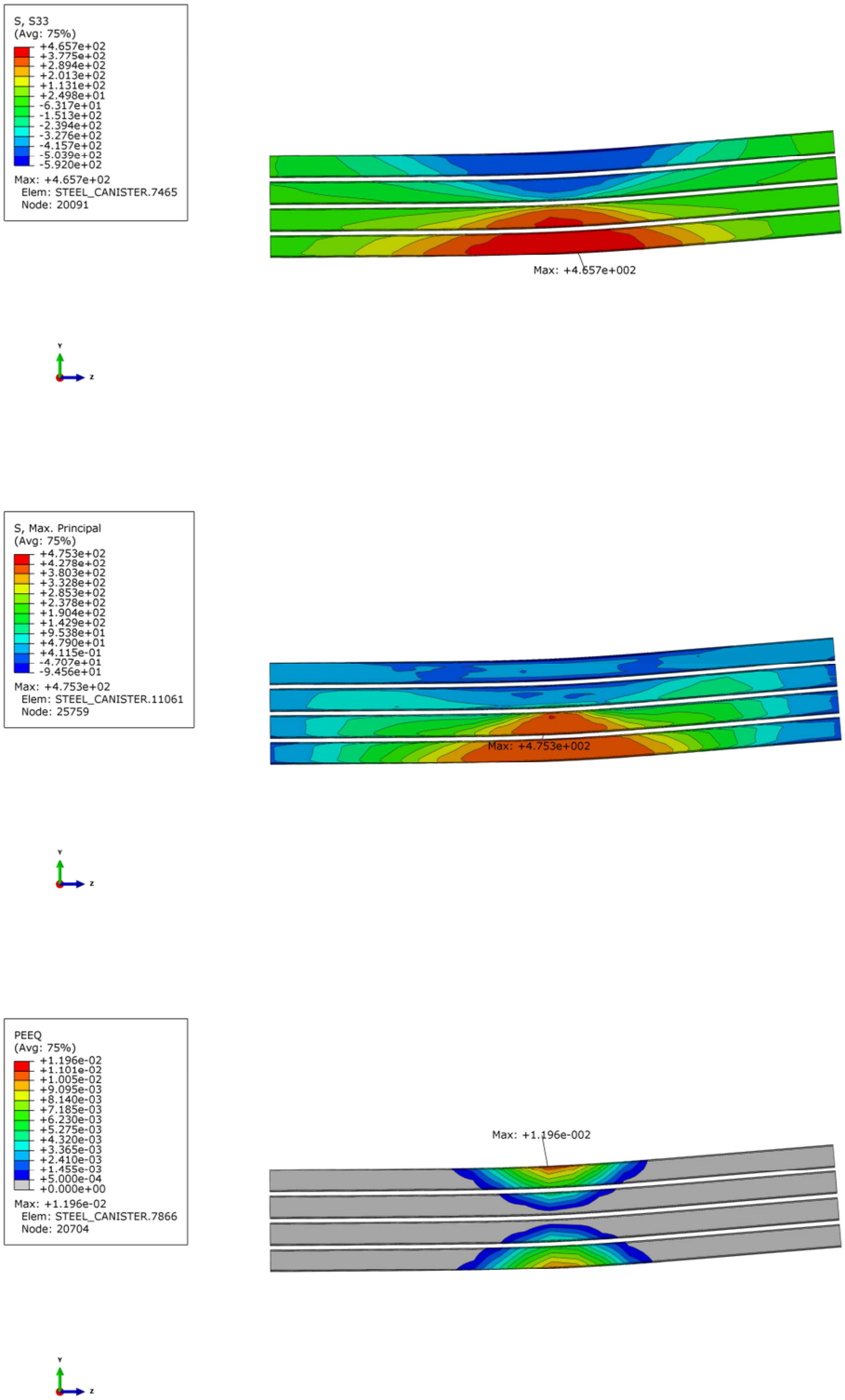


Figure A10-4. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N21b_b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 11 – Iron insert N20b_finer_1sekm

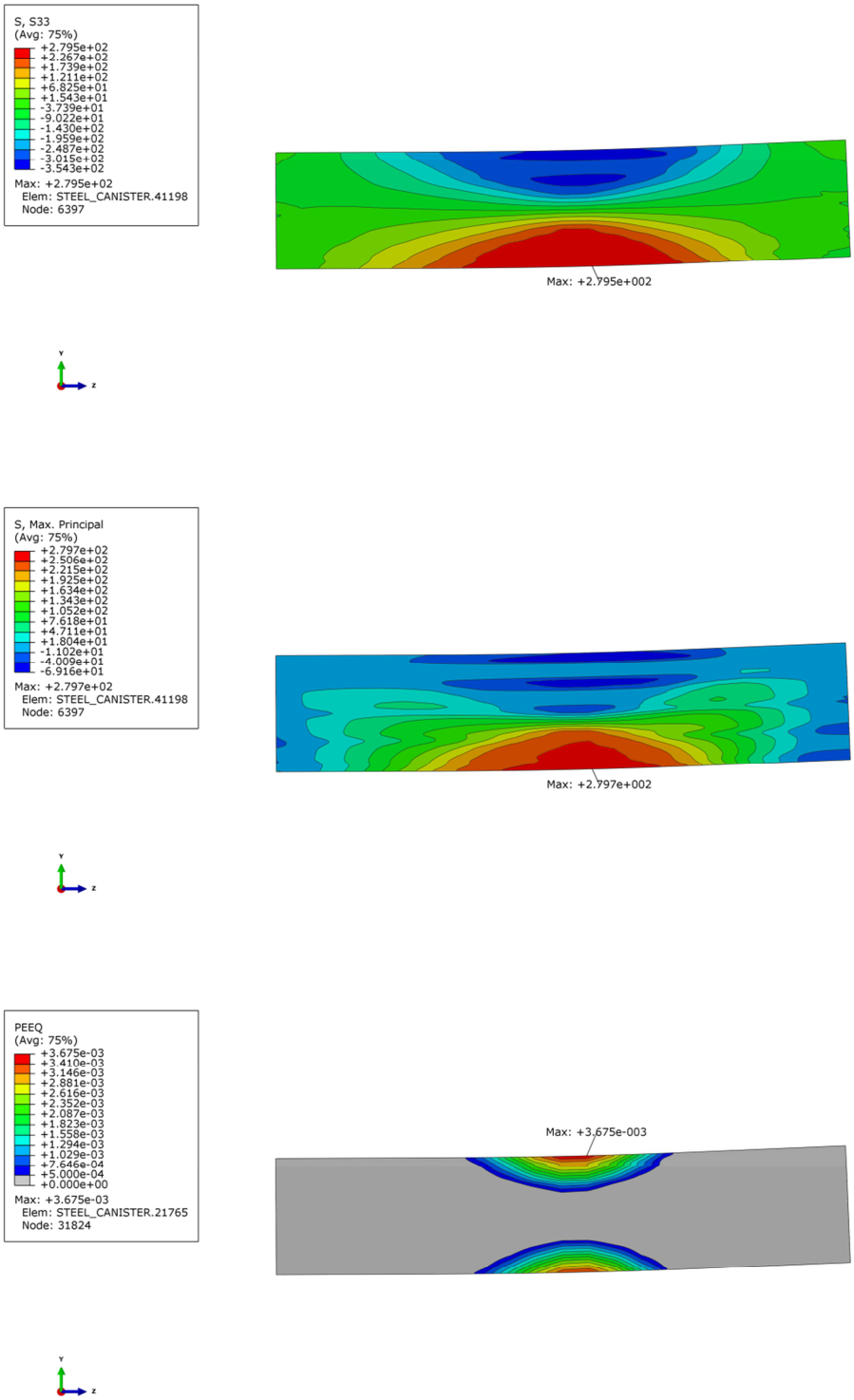


Figure A11-1. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N20b_b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

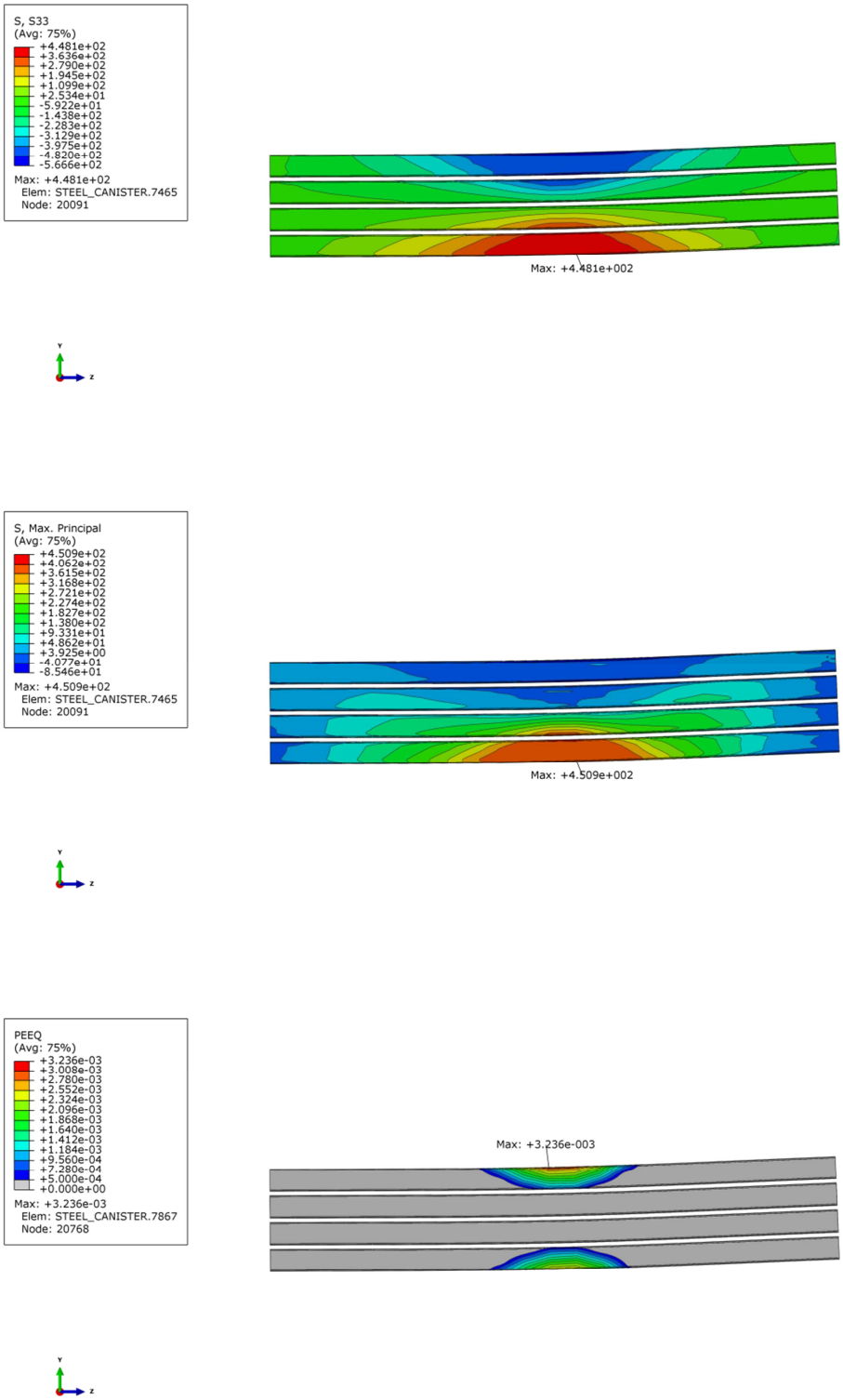


Figure A11-2. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N20b_b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

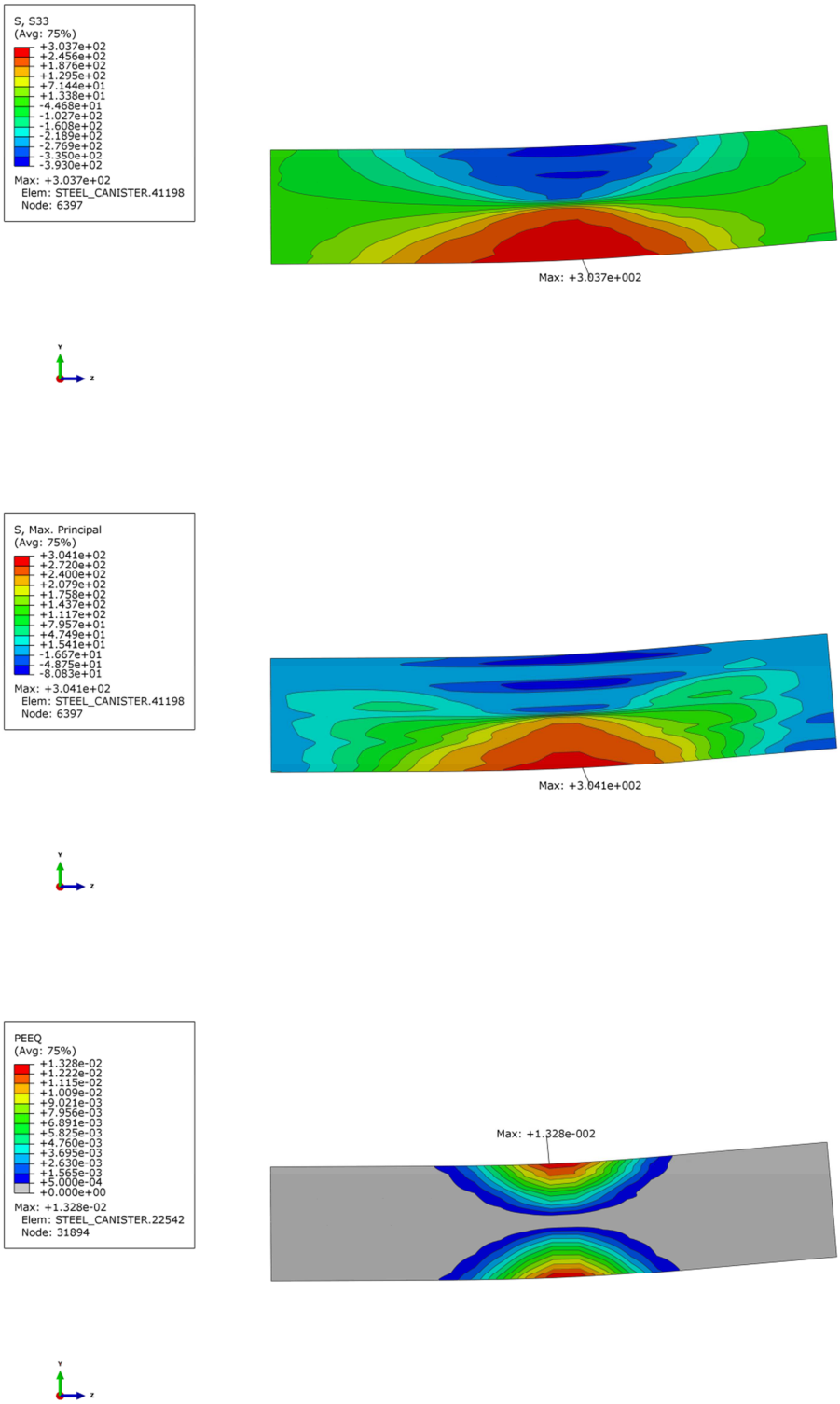


Figure A11-3. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N20b_b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

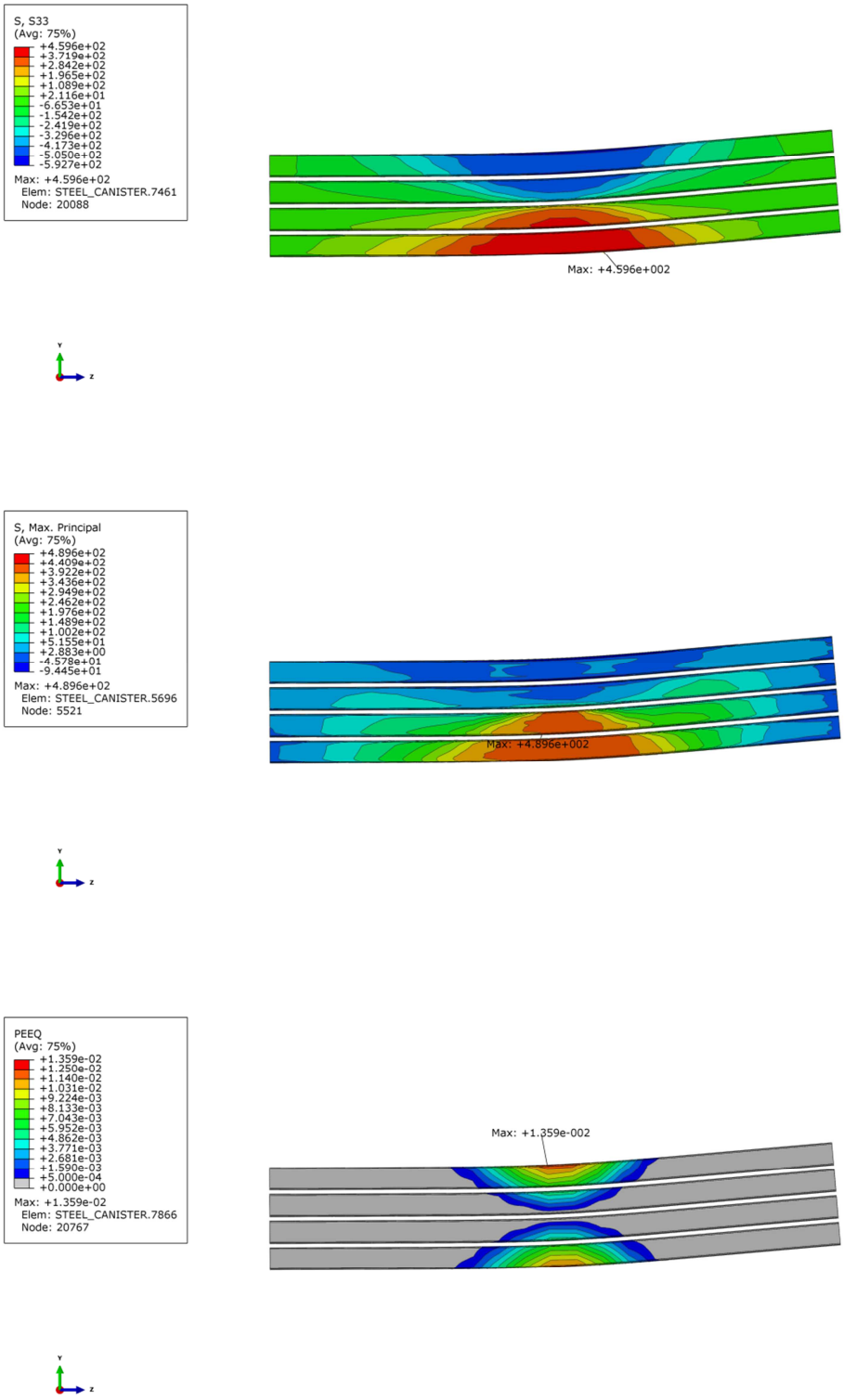


Figure A11-4. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N20b_b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 12 – Iron insert N22b_finer_1sekm

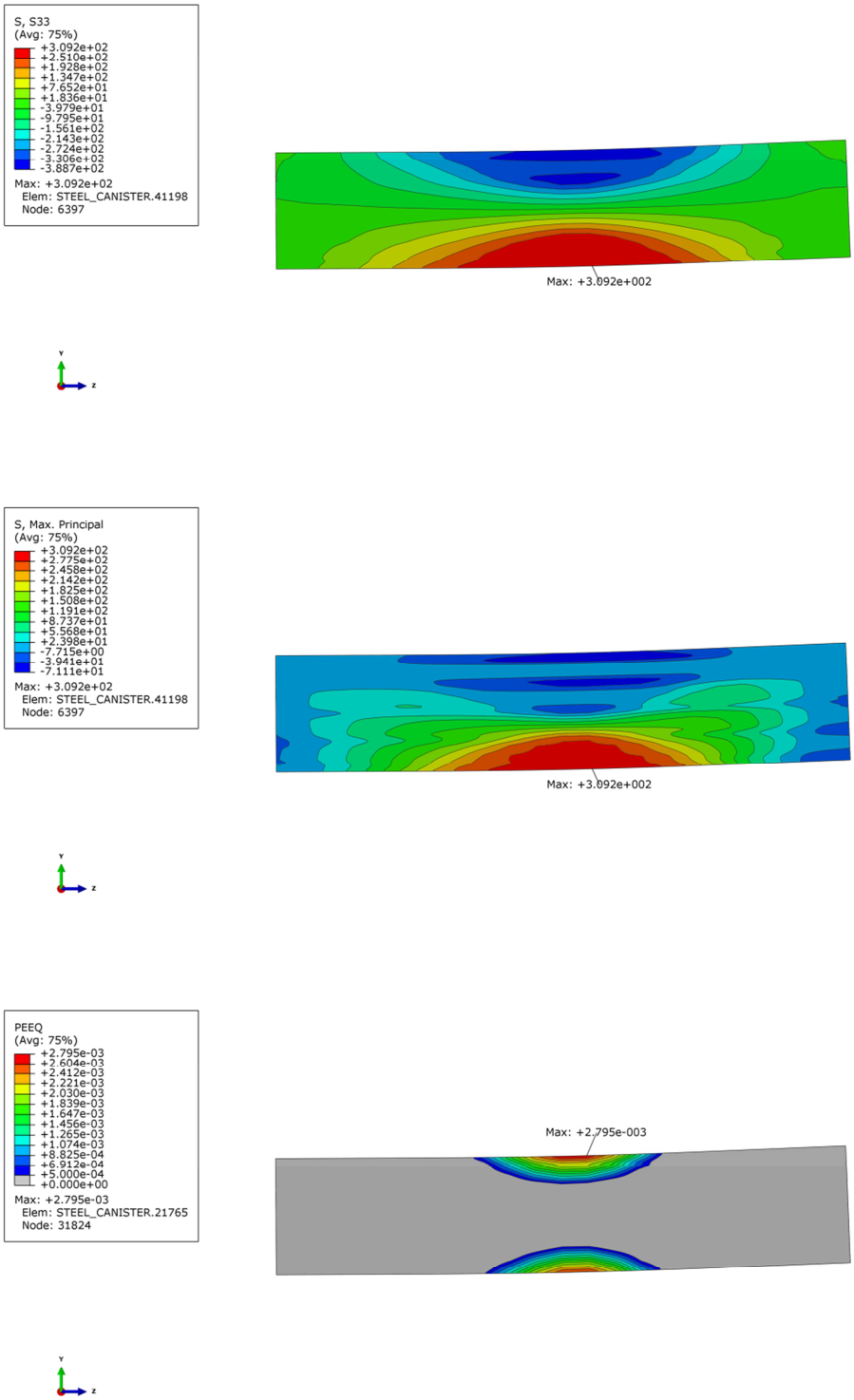


Figure A12-1. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N22b_b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

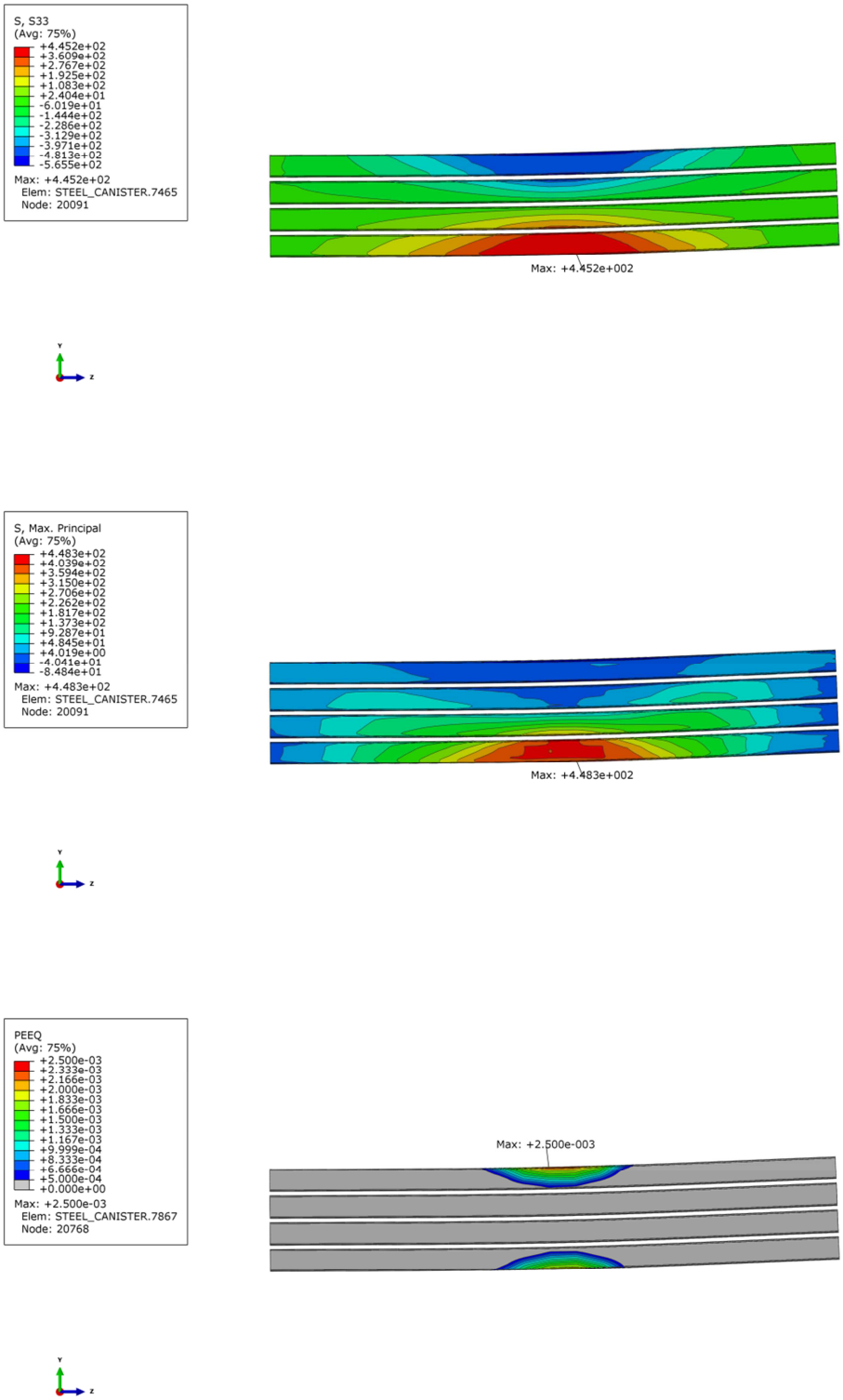


Figure A12-2. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 5 cm shearing for case N22b_b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

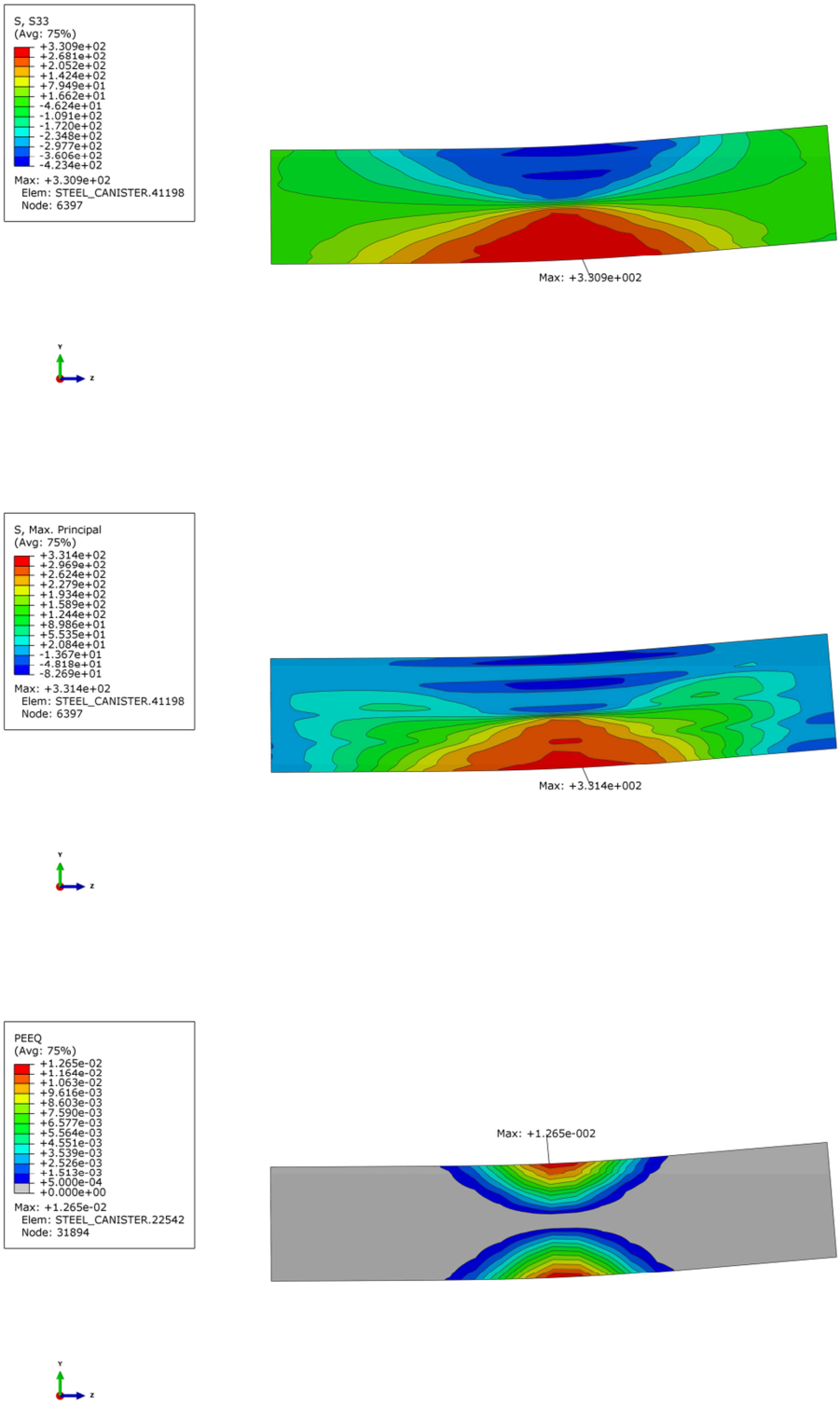


Figure A12-3. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N22b_b_finer_1sekm (iron insert).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

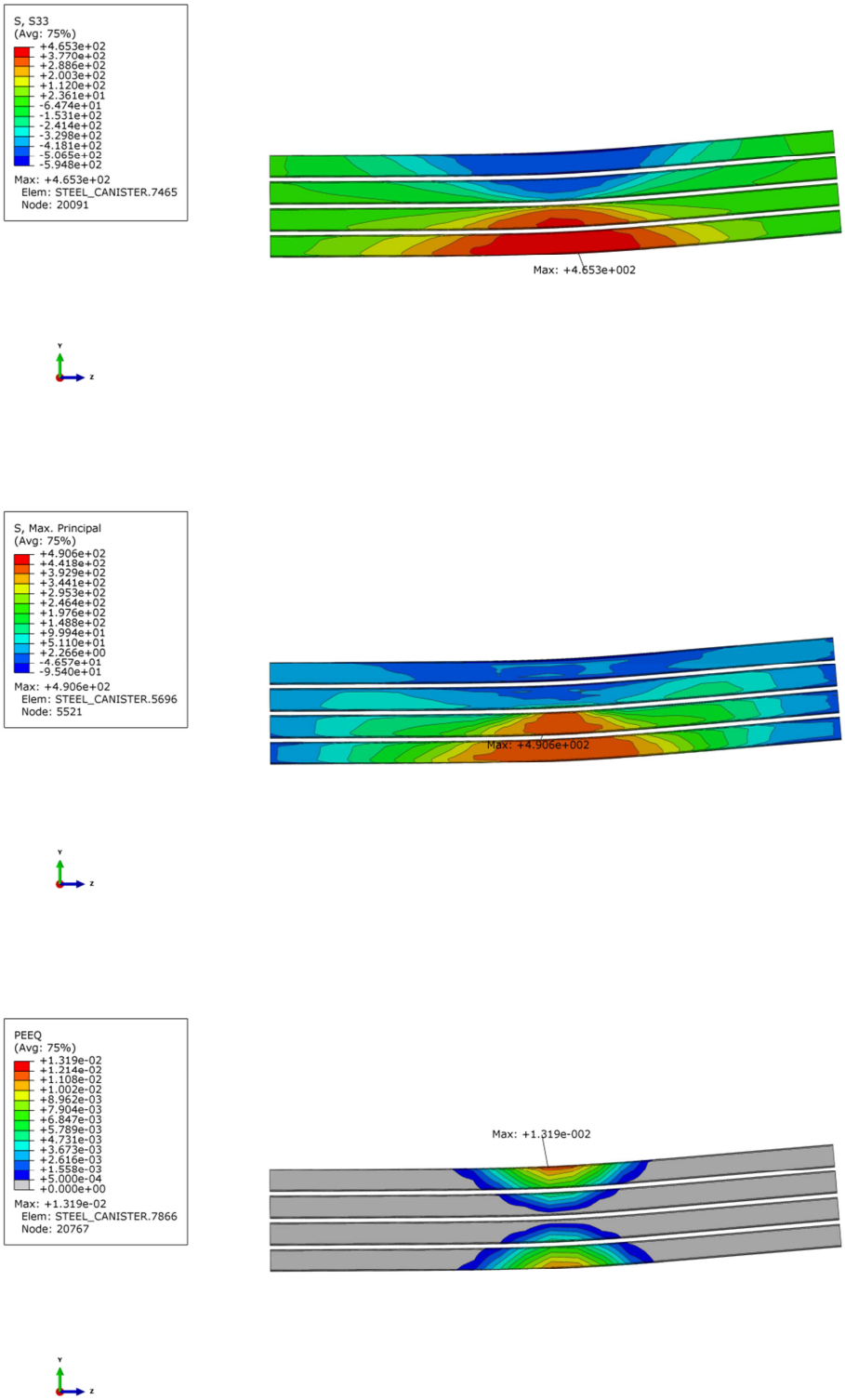


Figure A12-4. Plot of axial stress (S33) [MPa], max principal stress [MPa] and plastic equivalent strain, PEEQ, at 10 cm shearing for case N22b_b_finer_1sekm (steel channels).

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 13 – results at 10 cm shearing

Below are results for all analyses (Mises [MPa], PEEQ, Plastic equivalent strain, [%] and S33 [MPa] for the copper shell and the cast iron insert.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table A13-1. Mises stress [MPa] for region 1 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	96.60	92.70	126.10	114.60	108.60	107.60	107.50	107.60	107.60	107.50
2 - N2b_finer_1sekm	90.20	91.80	94.10	98.70	128.00	119.30	109.60	109.80	115.10	120.10
3 - N3b_finer_1sekm	100.19	108.80	107.54	112.64	113.68	121.32	127.08	129.41	129.23	129.39
4 - N4b_finer_1sekm	87.50	93.20	105.10	103.70	104.90	108.40	108.10	108.80	107.80	106.80
5 - N5b_finer_1sekm	86.90	89.70	93.20	102.10	102.90	103.90	115.60	119.10	125.90	130.50
6 - N6b_finer_1sekm	104.10	112.80	109.40	124.00	130.70	138.20	148.00	158.80	169.10	178.10
7 - N7b_finer_1sekm	94.80	110.90	109.00	116.70	143.30	142.20	132.30	135.20	136.90	138.00
8 - N8b_finer_1sekm	91.60	89.80	90.10	103.10	108.50	119.20	117.90	119.20	123.90	126.20
9 - N8b_b_finer_1sekm+r1	109.70	109.00	108.40	112.40	119.50	117.66	117.53	123.85	124.14	126.45
10 - N9b_finer_1sekm	108.70	131.30	137.40	155.30	165.10	176.60	186.30	194.70	202.10	213.00
11- N10b_finer_1sekm	87.50	93.20	105.10	103.70	104.90	108.40	108.20	108.80	107.80	106.90
12 - N11b_finer_1sekm	87.50	93.20	105.10	103.70	104.90	108.40	108.20	108.80	107.80	106.90
13 - N12b_finer_1sekm	96.63	92.68	126.07	114.63	108.62	107.59	107.54	107.58	107.56	107.54
14 - N13b_finer_1sekm	96.63	92.68	126.05	126.05	108.61	107.58	107.54	107.58	107.57	107.54
15 - N14b_finer_1sekm	96.63	92.68	126.05	114.61	108.60	107.57	107.54	107.58	107.57	107.54
16 - N15b_finer_1sekm	96.63	92.68	126.07	114.62	108.61	107.58	107.54	107.58	107.56	107.54
17 - N16b_finer_1sekm+r1	127.00	109.55	107.87	110.82	113.74	114.57	112.41	116.79	120.66	122.99
18 - N17b_finer_1sekm+r1	110.09	111.88	142.97	118.43	120.86	126.25	127.60	130.19	132.03	133.21
19 - N18b_finer_1sekm	129.17	110.39	121.50	109.81	114.33	114.63	121.69	126.59	130.28	129.83
20 - N19b_finer_1sekm	129.17	110.39	121.49	109.81	114.32	116.92	124.51	129.83	128.98	128.60
21 - N20b_finer_1sekm	86.97	89.74	93.19	94.27	96.59	111.26	120.64	120.19	126.78	131.46
22 - N21b_finer_1sekm	86.97	89.75	93.28	101.03	101.57	122.26	121.79	120.38	124.83	129.23
23 - N22b_finer_1sekm	86.96	89.72	93.20	102.09	102.93	104.05	115.72	118.69	125.57	130.23
24 - N23b_finer_1sekm	86.96	89.72	93.21	102.06	102.86	103.61	115.48	119.12	125.87	130.52
25 - N24b_finer_1sekm	93.46	105.00	102.36	105.90	111.11	123.16	123.98	128.79	135.08	140.83
26 - N25b_finer_1sekm	93.46	105.00	102.36	105.90	110.85	123.15	124.05	129.45	135.74	141.41
27 - N26b_finer_1sekm	93.46	105.00	102.36	105.90	111.10	123.12	124.04	129.34	135.64	141.45
28 - N27b_finer_1sekm	93.46	105.00	102.36	105.90	110.84	123.14	124.05	129.45	135.74	141.41
29 - N28b_finer_1sekm	96.75	102.48	128.27	141.32	162.93	180.02	197.94	210.09	222.43	231.13
30 - N29b_finer_1sekm	96.75	102.48	128.20	141.42	167.00	187.32	208.09	224.69	238.05	245.36
31 - N30b_finer_1sekm	96.75	102.48	128.33	141.33	162.98	180.14	198.23	210.60	223.28	232.13
32 - N31b_finer_1sekm	96.75	102.48	128.28	141.39	167.07	187.35	208.16	224.79	238.18	245.72
33 - N32b_finer_1sekm	99.10	131.10	116.70	128.40	123.10	115.20	113.10	113.60	113.70	112.90
34 - N33b_finer_1sekm+r1	99.54	120.68	116.58	118.80	119.89	120.157	119.756	119.945		
35 - N34b_finer_1sekm+r1	106.61	120.62	113.20	116.15	122.04	120.8	127.9	133.8	184.6	
36 - N35b_finer_1sekm	92.25	93.09	93.50	95.53	101.50	114.74	118.27	125.16	129.77	130.87
37 - N36b_finer_1sekm	90.24	91.80	94.12	98.70	105.44	125.03	125.85	126.13	125.47	124.65
38 - N37b_finer_1sekm	93.05	94.05	96.40	95.41	94.76	102.84	104.58	104.25	107.35	113.30
39 - N38b_finer_1sekm	90.24	91.80	94.12	98.68	106.58	123.50	124.74	123.57	121.43	120.82
40 - N39b_finer_1sekm	92.56	92.73	92.59	109.42	94.99	104.24	105.99	105.40	110.96	116.64
41 - N40b_finer_1sekm	91.61	89.82	91.38	105.76	109.70	118.53	116.80	117.48	121.75	123.83
42 - N41b_finer_1sekm	91.61	89.80	90.03	98.91	104.31	119.84	118.90	119.35	124.39	127.78
43 - N42b_finer_1sekm	91.61	89.82	91.24	105.74	109.56	118.71	117.25	117.84	122.28	124.80
44 - N43b_finer_1sekm	91.61	89.80	90.03	98.79	104.19	119.99	119.15	119.43	124.55	128.12
45 - N44b_finer_1sekm	104.12	112.85	109.35	124.12	130.42	136.95	146.00	155.82	164.80	172.78
46 - N45b_finer_1sekm	104.12	112.85	109.37	124.00	130.75	138.90	150.02	161.59	172.50	182.24
47 - N46b_finer_1sekm	104.12	112.85	109.35	124.14	130.42	138.15	144.49	150.84	159.76	167.40
48 - N47b_finer_1sekm	104.12	112.85	109.37	123.99	130.76	139.12	148.48	157.31	170.13	182.77

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

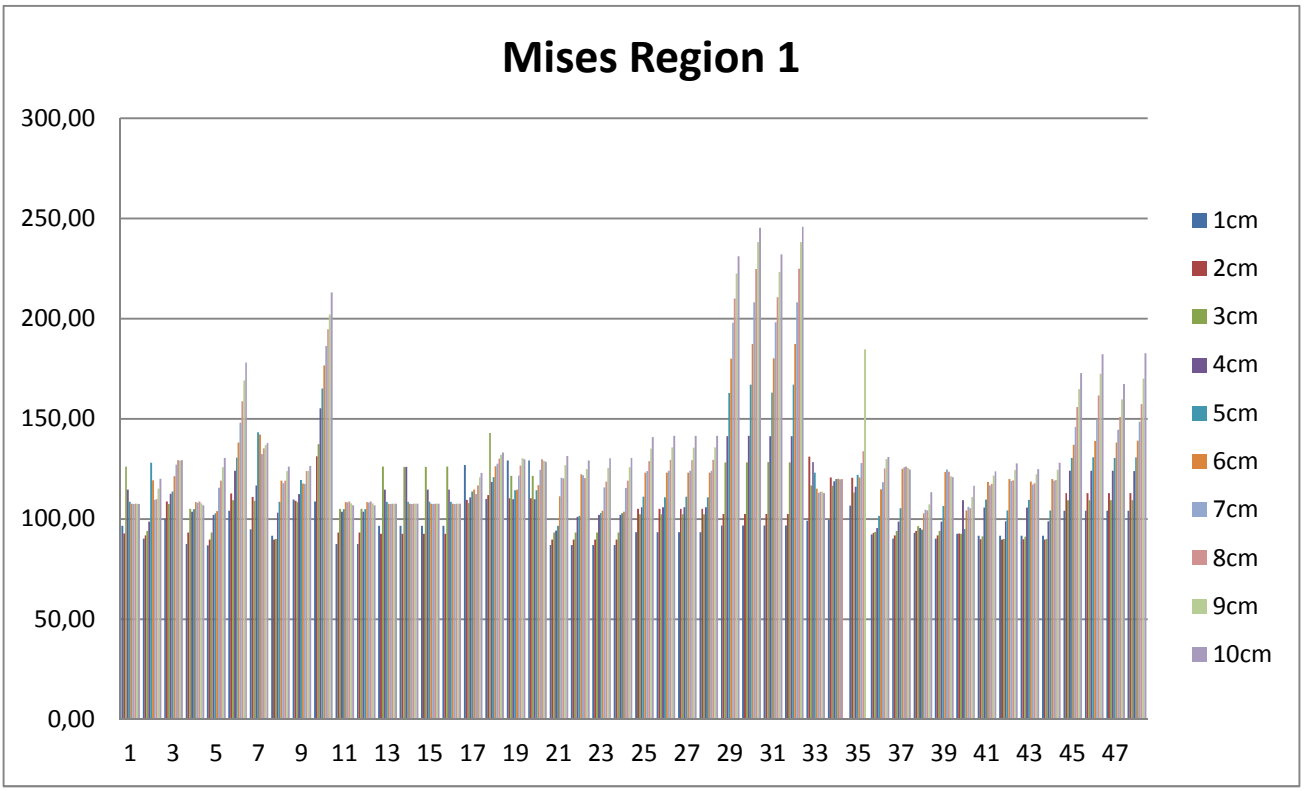


Figure A13-1. Mises stress [MPa] in copper shell, region 1, versus case number as specified in table A13-1.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table A13-2. Mises stress [MPa] for region 2 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	89.50	90.60	92.20	93.40	94.00	94.60	95.10	95.50	95.90	96.30
2 - N2b_finer_1sekm	90.20	91.80	94.10	98.70	128.00	119.30	109.60	109.80	115.10	120.10
3 - N3b_finer_1sekm	92.61	92.76	97.55	101.07	104.42	107.40	110.08	112.49	132.69	150.56
4 - N4b_finer_1sekm	87.80	91.10	94.90	93.50	95.90	98.10	100.10	101.90	103.70	105.30
5 - N5b_finer_1sekm	79.10	93.80	139.50	138.20	138.50	139.10	140.20	144.10	143.60	146.50
6 - N6b_finer_1sekm	89.70	95.70	104.30	114.40	125.40	135.60	143.70	150.00	155.20	159.30
7 - N7b_finer_1sekm	90.30	96.80	94.10	94.90	98.50	102.40	106.60	110.40	114.00	117.40
8 - N8b_finer_1sekm	147.40	89.20	88.95	89.60	92.05	99.10	107.00	118.70	105.80	105.50
9 - N8b_b_finer_1sekm+r1	183.50	220.10	212.50	223.30	224.00	205.58	180.48	185.96	166.87	178.04
10 - N9b_finer_1sekm	96.20	97.70	111.90	131.10	151.00	169.20	184.50	196.90	207.20	215.70
11- N10b_finer_1sekm	87.80	91.10	94.90	93.50	95.90	98.10	100.10	101.90	103.70	105.30
12 - N11b_finer_1sekm	87.80	91.10	94.90	93.50	95.90	98.10	100.10	101.90	103.70	105.30
13 - N12b_finer_1sekm	89.48	90.55	92.15	93.36	93.95	94.59	95.08	95.49	95.92	96.33
14 - N13b_finer_1sekm	89.48	90.55	92.15	93.37	93.95	94.59	95.08	95.49	95.92	96.33
15 - N14b_finer_1sekm	89.48	90.55	92.15	93.37	93.95	94.59	95.08	95.49	95.92	96.33
16 - N15b_finer_1sekm	89.48	90.55	92.15	93.37	93.95	94.59	95.08	95.49	95.92	96.33
17 - N16b_finer_1sekm+r1	90.94	92.82	96.24	98.97	101.14	103.26	105.31	144.71	176.28	206.44
18 - N17b_finer_1sekm+r1	93.65	94.46	98.98	102.32	105.86	109.34	112.67	115.77	133.51	154.03
19 - N18b_finer_1sekm	90.95	92.81	96.47	99.26	101.55	105.61	108.38	110.68	112.73	114.54
20 - N19b_finer_1sekm	90.95	92.81	96.47	99.28	101.69	106.19	109.47	112.28	114.83	136.70
21 - N20b_finer_1sekm	79.13	93.69	140.23	140.22	141.27	143.64	142.99	141.89	142.04	142.14
22 - N21b_finer_1sekm	79.13	93.70	139.26	136.76	135.85	135.10	135.12	137.08	147.22	147.67
23 - N22b_finer_1sekm	79.15	93.76	139.56	138.22	138.23	139.12	140.30	144.01	146.68	146.35
24 - N23b_finer_1sekm	79.15	93.76	139.51	138.23	138.49	138.92	140.05	143.41	143.11	146.54
25 - N24b_finer_1sekm	89.01	94.30	94.26	99.70	105.32	110.47	115.41	120.28	124.61	128.83
26 - N25b_finer_1sekm	89.01	94.30	94.26	99.72	105.33	110.76	115.81	120.78	125.20	129.55
27 - N26b_finer_1sekm	89.01	94.30	94.26	99.70	105.32	110.71	115.70	120.61	124.97	129.26
28 - N27b_finer_1sekm	89.01	94.30	94.26	99.72	105.33	110.76	115.81	120.78	125.20	129.55
29 - N28b_finer_1sekm	88.98	103.04	115.64	135.25	156.16	175.06	190.36	202.71	211.42	217.26
30 - N29b_finer_1sekm	88.98	103.04	115.69	135.93	158.17	177.88	194.73	208.49	218.38	224.37
31 - N30b_finer_1sekm	88.98	103.04	115.62	135.25	156.19	175.12	190.47	202.91	211.67	217.64
32 - N31b_finer_1sekm	88.98	103.03	115.67	135.90	158.15	177.88	194.75	208.53	218.47	224.42
33 - N32b_finer_1sekm	91.45	93.40	94.55	95.30	95.80	97.00	97.05	97.70	98.20	98.60
34 - N33b_finer_1sekm+r1	90.79	93.87	96.52	99.30	101.77	104.224	105.970	107.720		
35 - N34b_finer_1sekm+r1	91.69	104.46	116.40	124.55	130.34	129.9	142.4	165.4	212.5	
36 - N35b_finer_1sekm	90.57	90.14	89.79	89.54	89.42	89.30	89.18	89.07	88.90	88.78
37 - N36b_finer_1sekm	85.20	87.59	140.77	139.23	136.51	135.44	135.24	135.36	135.54	135.76
38 - N37b_finer_1sekm	87.99	156.69	152.96	158.82	158.83	98.13	94.25	92.24	92.36	92.40
39 - N38b_finer_1sekm	85.20	87.59	140.67	139.12	136.29	149.24	155.14	155.35	155.66	155.43
40 - N39b_finer_1sekm	86.65	149.72	145.91	140.05	132.91	151.28	159.80	156.73	157.86	153.47
41 - N40b_finer_1sekm	147.40	89.23	89.32	89.91	94.72	105.74	106.39	105.95	104.98	104.64
42 - N41b_finer_1sekm	147.40	89.05	88.75	89.42	90.87	96.20	101.90	121.50	106.53	106.17
43 - N42b_finer_1sekm	147.40	89.23	89.30	89.90	94.53	104.94	106.86	105.82	105.33	104.86
44 - N43b_finer_1sekm	147.40	89.05	88.75	89.42	90.86	96.03	101.23	121.26	106.29	105.98
45 - N44b_finer_1sekm	89.67	95.73	104.24	114.18	124.78	134.52	142.22	148.25	152.78	156.58
46 - N45b_finer_1sekm	89.67	95.73	104.25	114.44	125.73	136.15	144.69	151.22	156.71	161.09
47 - N46b_finer_1sekm	89.67	95.73	104.24	114.18	124.79	133.26	142.28	149.79	155.48	159.07
48 - N47b_finer_1sekm	89.67	95.73	104.25	114.42	125.72	135.18	145.72	154.29	161.46	166.68

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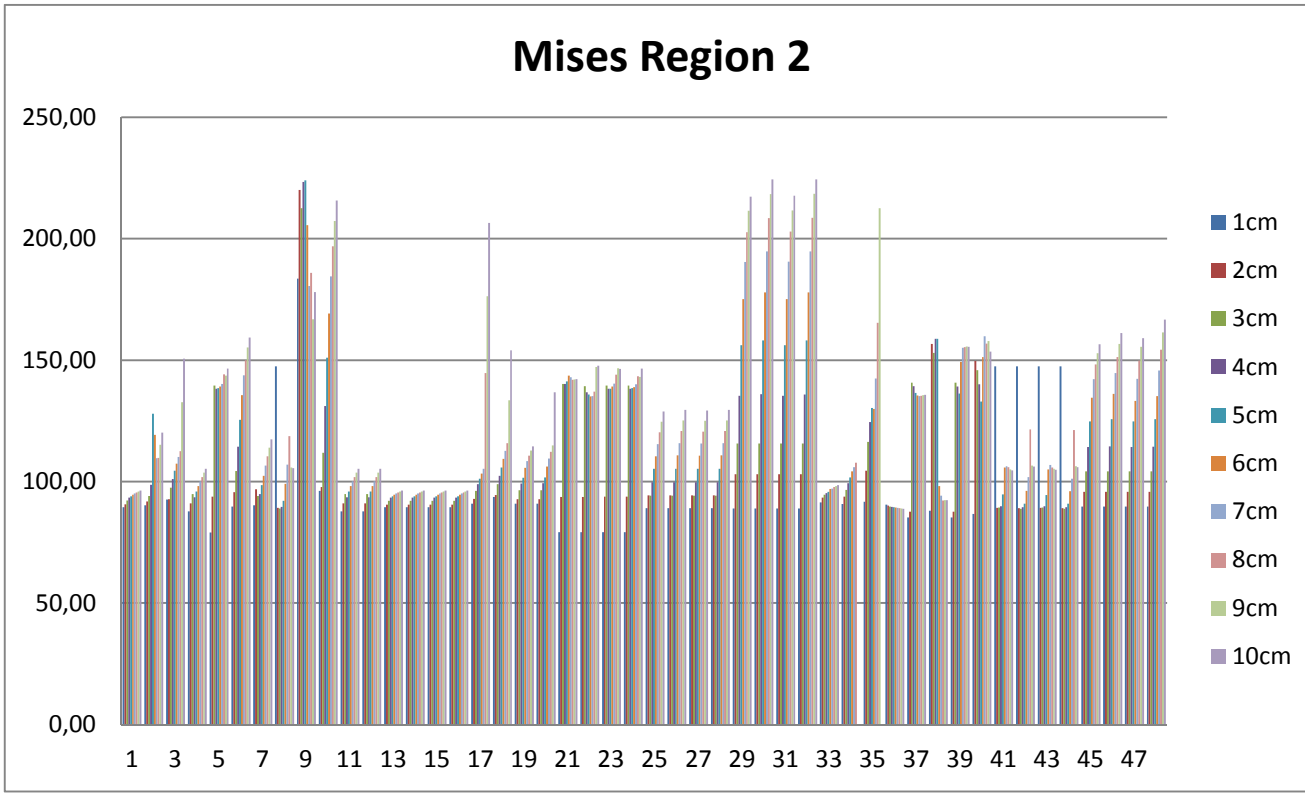

Figure A13-2. Mises stress [MPa] in copper shell, region 2, versus case number as specified in table A13-2.

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Table A13-3. Mises stress [MPa] for region 3 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	93.00	95.50	95.50	98.50	100.90	100.90	100.50	103.40	114.10	126.90
2 - N2b_finer_1sekm	88.10	95.00	99.40	100.10	101.50	102.20	101.50	101.40	101.50	101.40
3 - N3b_finer_1sekm	86.66	86.92	89.78	93.34	95.85	97.73	98.55	98.53	98.73	98.94
4 - N4b_finer_1sekm	91.10	95.50	100.40	99.60	99.70	109.80	127.00	149.00	166.80	175.00
5 - N5b_finer_1sekm	89.20	97.50	98.20	99.90	99.80	99.25	99.10	98.80	98.70	98.60
6 - N6b_finer_1sekm	88.00	87.40	94.50	96.80	151.70	96.90	96.30	96.00	96.20	96.40
7 - N7b_finer_1sekm	98.20	99.50	149.70	149.80	149.80	149.80	169.10	189.00	208.90	223.20
8 - N8b_finer_1sekm	96.40	97.40	147.70	147.90	146.30	144.90	143.10	140.90	138.30	135.80
9 - N8b_b_finer_1sekm+r1	96.30	142.90	140.10	136.60	134.20	132.86	132.13	131.74	131.45	131.28
10 - N9b_finer_1sekm	95.00	95.55	96.10	96.30	96.20	96.40	96.20	96.20	96.00	95.60
11- N10b_finer_1sekm	91.10	95.50	100.40	99.60	99.70	109.80	127.00	149.00	166.80	175.00
12 - N11b_finer_1sekm	91.10	95.50	100.40	99.60	99.75	109.80	127.00	149.00	166.80	175.00
13 - N12b_finer_1sekm	92.98	95.47	95.54	98.54	100.92	100.90	100.54	103.42	114.13	126.93
14 - N13b_finer_1sekm	92.98	95.47	95.54	98.55	100.92	100.90	100.54	103.42	114.12	126.91
15 - N14b_finer_1sekm	92.98	95.47	95.54	98.49	100.93	100.90	100.55	103.41	114.12	126.91
16 - N15b_finer_1sekm	92.98	95.47	95.54	98.54	100.92	100.90	100.54	103.42	114.13	126.93
17 - N16b_finer_1sekm+r1	86.60	86.90	88.04	91.31	93.49	95.14	96.24	96.75	97.68	98.40
18 - N17b_finer_1sekm+r1	86.67	86.94	89.75	97.03	98.39	101.13	100.78	100.79	100.62	100.83
19 - N18b_finer_1sekm	86.60	86.91	88.10	91.56	93.75	96.63	98.14	98.67	98.50	98.54
20 - N19b_finer_1sekm	86.60	86.91	88.10	91.61	94.01	97.26	98.53	98.59	98.80	99.06
21 - N20b_finer_1sekm	89.22	97.46	97.96	98.75	99.57	99.27	99.25	99.23	99.14	99.03
22 - N21b_finer_1sekm	89.22	97.46	98.32	100.12	99.34	99.04	98.97	98.56	98.44	98.63
23 - N22b_finer_1sekm	89.19	97.45	98.20	99.84	99.75	99.32	99.12	98.90	98.77	98.64
24 - N23b_finer_1sekm	89.19	97.45	98.21	99.86	99.73	99.30	99.01	98.81	98.79	98.74
25 - N24b_finer_1sekm	153.96	154.03	138.89	129.39	128.51	146.71	163.74	179.10	191.20	203.70
26 - N25b_finer_1sekm	153.96	154.03	138.89	129.35	128.55	146.90	164.19	179.74	192.13	204.77
27 - N26b_finer_1sekm	153.96	154.03	138.89	129.39	128.51	146.74	163.87	179.20	191.41	203.90
28 - N27b_finer_1sekm	153.96	154.03	138.89	129.35	128.55	146.91	164.19	179.74	192.14	204.78
29 - N28b_finer_1sekm	93.47	148.10	138.96	134.16	130.95	129.07	128.08	127.68	127.52	127.64
30 - N29b_finer_1sekm	93.47	148.10	138.63	133.63	130.14	127.60	126.05	125.03	124.17	123.81
31 - N30b_finer_1sekm	93.47	148.10	138.96	134.16	130.94	129.04	128.01	127.56	127.33	127.38
32 - N31b_finer_1sekm	93.47	148.11	138.63	133.62	130.13	127.59	126.04	125.01	124.14	123.75
33 - N32b_finer_1sekm	87.70	87.45	87.25	87.10	86.90	86.60	86.50	86.55	86.70	86.80
34 - N33b_finer_1sekm+r1	88.14	88.13	88.19	88.18	88.16	88.156	88.125	88.066		
35 - N34b_finer_1sekm+r1	83.86	84.14	85.31	95.39	152.87	152.9	152.9	152.9	152.9	
36 - N35b_finer_1sekm	96.06	97.51	101.36	105.67	108.52	110.07	110.10	109.11	108.81	109.18
37 - N36b_finer_1sekm	88.05	95.02	99.38	100.09	101.10	101.79	101.84	101.66	101.62	101.53
38 - N37b_finer_1sekm	87.61	96.07	98.13	99.22	100.32	101.86	101.30	101.31	101.17	100.60
39 - N38b_finer_1sekm	88.05	95.02	99.39	100.09	101.14	101.08	101.99	102.54	101.98	101.62
40 - N39b_finer_1sekm	87.86	95.57	98.71	100.06	101.66	102.01	101.34	101.59	101.24	101.00
41 - N40b_finer_1sekm	96.39	97.17	148.48	147.97	146.45	144.16	141.37	138.28	134.82	96.59
42 - N41b_finer_1sekm	96.39	97.29	148.38	146.86	145.31	143.87	142.16	140.27	137.97	135.78
43 - N42b_finer_1sekm	96.39	97.17	148.46	148.02	146.72	144.90	142.58	140.02	137.04	96.65
44 - N43b_finer_1sekm	96.39	97.29	148.44	146.83	145.42	143.99	142.55	140.92	138.97	136.99
45 - N44b_finer_1sekm	88.02	87.42	94.53	96.65	150.47	96.71	96.52	96.36	96.10	95.95
46 - N45b_finer_1sekm	88.02	87.42	94.54	96.70	150.94	96.56	96.10	96.24	96.61	96.93
47 - N46b_finer_1sekm	88.02	87.42	94.53	96.65	150.47	95.77	94.86	94.88	94.84	148.60
48 - N47b_finer_1sekm	88.02	87.42	94.54	96.70	150.94	95.16	95.28	148.67	147.76	147.18

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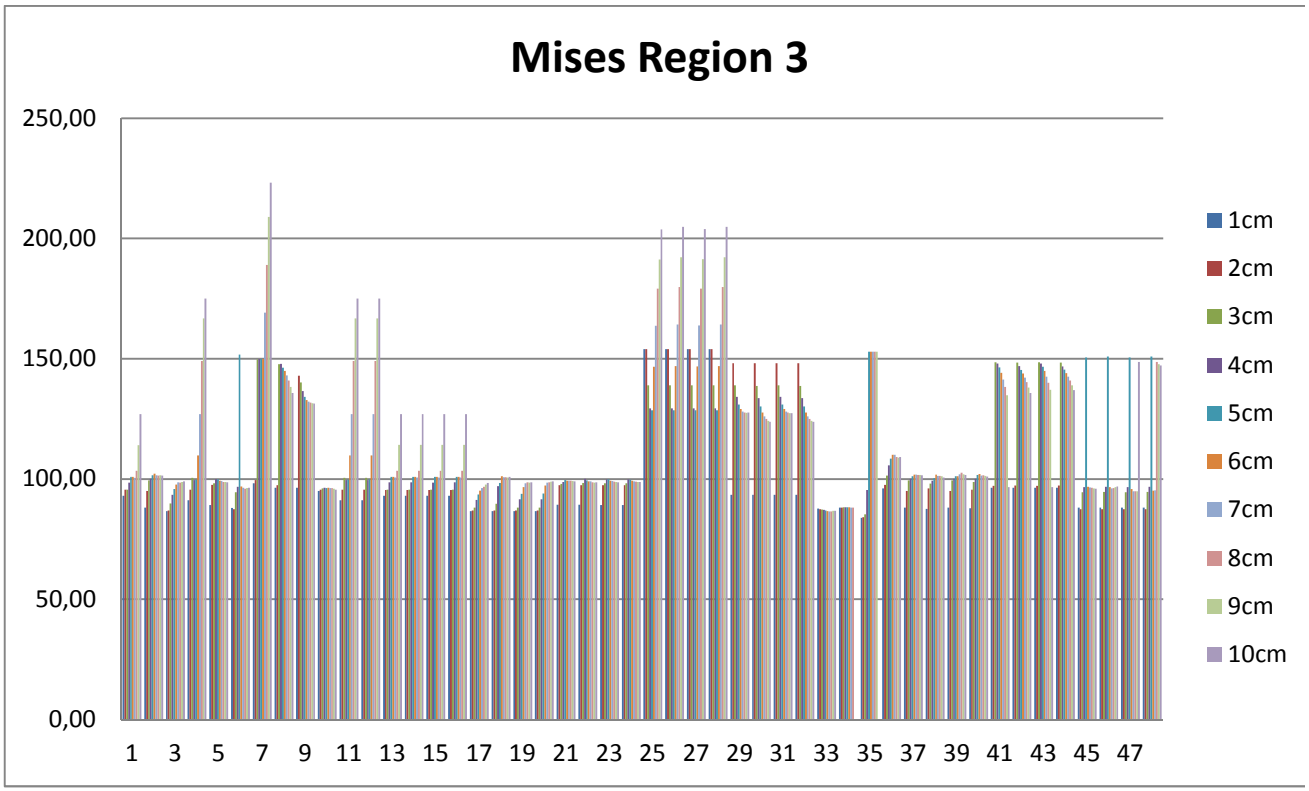

Figure A13-3. Mises stress [MPa] in copper shell, region 3, versus case number as specified in table A13-3.

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Table A13-4. Mises stress [MPa] for region 4 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	107.30	110.90	111.80	111.60	110.60	109.60	108.60	107.60	106.70	105.80
2 - N2b_finer_1sekm	108.30	104.40	105.30	106.40	104.40	103.20	102.20	101.20	100.30	100.50
3 - N3b_finer_1sekm	110.37	106.59	107.38	125.52	142.09	200.58	211.56	220.03	226.06	231.03
4 - N4b_finer_1sekm	100.80	103.30	108.10	108.50	106.90	105.00	107.20	116.80	129.50	137.50
5 - N5b_finer_1sekm	100.20	102.60	100.80	101.30	102.20	102.90	103.40	103.70	104.30	104.80
6 - N6b_finer_1sekm	103.40	104.50	148.00	228.90	247.00	260.00	268.00	273.80	280.10	285.50
7 - N7b_finer_1sekm	111.90	121.00	125.10	123.50	131.90	148.40	155.40	159.10	211.50	218.60
8 - N8b_finer_1sekm	101.70	112.90	121.10	120.60	119.60	119.50	118.00	118.10	117.30	133.20
9 - N8b_b_finer_1sekm+r1	135.20	143.40	148.80	148.70	146.90	145.12	143.36	141.31	139.08	136.54
10 - N9b_finer_1sekm	115.10	128.50	236.80	214.80	231.70	243.00	249.60	253.70	256.00	260.90
11- N10b_finer_1sekm	100.80	103.30	108.10	108.50	106.90	105.00	107.20	116.90	129.60	137.60
12 - N11b_finer_1sekm	100.80	103.30	108.10	108.50	106.90	105.00	107.20	116.90	129.60	137.60
13 - N12b_finer_1sekm	107.33	110.90	111.85	111.59	110.62	109.58	108.57	107.56	106.66	105.83
14 - N13b_finer_1sekm	107.33	110.90	111.85	111.59	110.62	109.58	108.57	107.56	106.66	105.83
15 - N14b_finer_1sekm	107.33	110.90	111.85	111.59	110.62	109.58	108.57	107.56	106.66	105.84
16 - N15b_finer_1sekm	107.33	110.90	111.85	111.59	110.62	109.58	108.57	107.57	106.66	105.83
17 - N16b_finer_1sekm+r1	109.73	106.25	109.48	112.73	121.89	131.73	143.49	151.55	156.93	159.94
18 - N17b_finer_1sekm+r1	111.39	121.45	122.37	137.48	158.42	216.13	227.81	235.39	241.74	247.53
19 - N18b_finer_1sekm	109.75	105.93	109.22	112.83	124.44	152.40	162.17	169.53	222.91	227.34
20 - N19b_finer_1sekm	109.75	105.93	109.22	112.85	125.08	155.56	166.72	222.32	229.00	234.92
21 - N20b_finer_1sekm	100.25	102.60	100.72	101.54	103.73	102.93	103.50	104.52	105.66	107.03
22 - N21b_finer_1sekm	100.25	102.60	100.83	101.36	101.93	101.89	101.94	101.93	101.85	101.66
23 - N22b_finer_1sekm	100.21	102.57	100.77	101.33	102.24	103.03	103.46	103.85	104.53	105.00
24 - N23b_finer_1sekm	100.21	102.57	100.76	101.34	102.22	102.91	103.37	103.70	104.32	104.67
25 - N24b_finer_1sekm	90.05	98.88	105.40	102.46	132.59	154.68	158.18	205.28	212.45	218.46
26 - N25b_finer_1sekm	90.05	98.88	105.40	102.50	132.80	154.66	158.04	205.51	212.76	218.79
27 - N26b_finer_1sekm	90.05	98.88	105.40	102.46	132.51	154.56	158.03	205.18	212.33	218.32
28 - N27b_finer_1sekm	90.05	98.88	105.40	102.50	132.75	154.66	158.04	205.51	212.76	218.79
29 - N28b_finer_1sekm	101.48	138.01	247.23	273.15	292.89	307.51	249.39	255.02	258.63	262.12
30 - N29b_finer_1sekm	101.48	138.01	247.24	274.41	295.62	310.36	251.89	260.23	273.55	283.60
31 - N30b_finer_1sekm	101.48	138.01	247.28	273.15	292.93	307.58	249.44	255.18	258.87	262.63
32 - N31b_finer_1sekm	101.48	138.00	247.29	274.37	295.59	310.35	251.89	260.26	273.92	283.67
33 - N32b_finer_1sekm	120.90	121.60	120.50	118.50	119.70	121.80	122.60	123.20	123.70	124.40
34 - N33b_finer_1sekm+r1	121.71	122.06	119.51	122.02	125.00	128.369	132.263	141.862		
35 - N34b_finer_1sekm+r1	120.75	115.80	132.65	201.48	221.57	223.2	186.4	215.0	254.2	
36 - N35b_finer_1sekm	130.58	131.09	108.61	108.31	108.06	107.84	107.62	107.66	108.00	108.15
37 - N36b_finer_1sekm	108.27	104.42	105.35	106.41	105.83	104.89	104.28	103.91	103.58	103.24
38 - N37b_finer_1sekm	110.84	106.34	102.67	103.90	110.02	104.32	107.34	106.64	106.20	106.12
39 - N38b_finer_1sekm	108.27	104.42	105.34	106.41	105.79	103.62	103.77	103.78	103.72	103.64
40 - N39b_finer_1sekm	110.70	106.00	102.83	104.37	103.92	105.39	105.90	104.55	103.29	103.17
41 - N40b_finer_1sekm	101.85	112.56	120.99	119.95	119.02	117.98	117.81	117.07	115.82	115.29
42 - N41b_finer_1sekm	101.85	112.97	120.93	120.67	119.61	119.18	119.51	118.24	134.48	135.19
43 - N42b_finer_1sekm	101.85	112.56	121.00	119.97	119.17	118.30	118.12	116.72	116.46	114.63
44 - N43b_finer_1sekm	101.85	112.97	120.96	120.67	119.63	119.16	119.53	118.61	134.50	134.83
45 - N44b_finer_1sekm	103.54	104.59	148.23	228.34	245.87	258.12	266.56	271.58	276.66	281.15
46 - N45b_finer_1sekm	103.54	104.59	148.21	228.97	247.56	261.24	269.27	275.70	283.67	287.57
47 - N46b_finer_1sekm	103.54	104.59	148.28	228.32	245.89	261.62	270.96	279.07	284.69	286.57
48 - N47b_finer_1sekm	103.54	104.59	148.21	228.98	247.57	264.29	275.69	285.59	291.26	295.35

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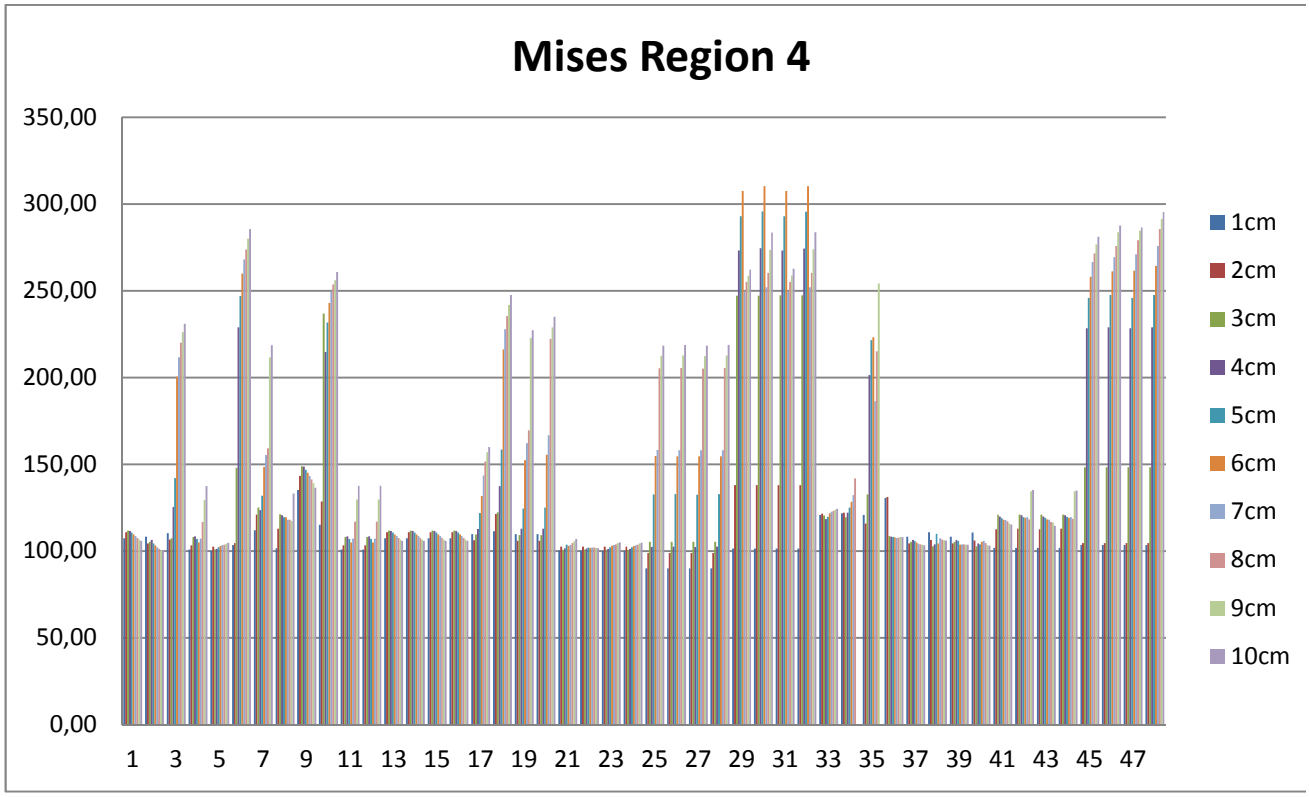

Figure A13-4. Mises stress [MPa] in copper shell, region 4, versus case number as specified in table A13-4.

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Table A13-5. Mises stress [MPa] for region 5 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	155.70	159.60	166.30	171.50	174.10	173.70	175.00	176.50	177.10	177.40
2 - N2b_finer_1sekm	156.90	159.80	168.20	179.10	182.50	184.10	184.40	184.50	183.60	184.20
3 - N3b_finer_1sekm	142.83	151.36	160.90	161.82	160.44	160.42	164.06	167.87	171.42	174.62
4 - N4b_finer_1sekm	147.50	151.50	164.30	172.70	173.70	173.80	177.30	181.10	184.90	188.50
5 - N5b_finer_1sekm	136.90	161.30	159.60	171.60	181.10	183.10	183.30	183.30	183.50	183.70
6 - N6b_finer_1sekm	121.30	129.30	138.20	147.80	158.70	162.00	161.10	160.60	160.20	160.20
7 - N7b_finer_1sekm	194.90	201.30	212.20	226.30	234.40	241.30	246.60	250.30	254.70	259.20
8 - N8b_finer_1sekm	192.70	199.40	201.00	202.10	201.90	200.80	199.00	196.80	194.40	192.00
9 - N8b_b_finer_1sekm+r1	189.70	192.50	196.90	201.50	204.30	203.96	202.83	201.70	201.58	201.56
10 - N9b_finer_1sekm	185.70	188.30	191.20	193.00	194.20	195.40	195.80	195.90	195.80	195.60
11- N10b_finer_1sekm	147.50	151.50	164.30	172.70	173.70	173.80	177.30	181.10	185.00	188.50
12 - N11b_finer_1sekm	147.50	151.50	164.30	172.70	173.70	173.80	177.30	181.20	185.00	188.50
13 - N12b_finer_1sekm	155.68	159.64	166.30	171.50	174.10	173.74	175.03	176.47	177.04	177.40
14 - N13b_finer_1sekm	155.68	159.64	166.32	171.49	174.03	173.79	175.05	176.41	177.14	177.36
15 - N14b_finer_1sekm	155.68	159.64	166.32	171.46	174.03	173.80	174.48	176.41	177.02	177.40
16 - N15b_finer_1sekm	155.68	159.64	166.30	171.50	174.10	173.75	175.02	176.45	177.04	177.40
17 - N16b_finer_1sekm+r1	142.66	150.33	158.83	161.46	160.25	162.87	166.13	169.67	172.34	174.38
18 - N17b_finer_1sekm+r1	142.76	151.41	160.94	171.47	181.83	191.80	201.31	209.98	221.01	230.76
19 - N18b_finer_1sekm	142.69	150.45	159.12	161.50	160.26	160.13	161.16	164.14	166.93	169.27
20 - N19b_finer_1sekm	142.69	150.45	159.12	161.49	160.16	160.33	163.26	167.75	172.09	176.30
21 - N20b_finer_1sekm	136.93	161.29	158.48	167.94	174.72	178.17	179.76	180.69	181.18	180.91
22 - N21b_finer_1sekm	136.93	161.28	160.12	174.35	183.10	184.98	184.72	184.79	185.12	185.27
23 - N22b_finer_1sekm	136.93	161.28	159.57	171.59	181.03	183.05	183.39	183.39	183.26	183.55
24 - N23b_finer_1sekm	136.93	161.28	159.56	171.65	181.22	183.22	183.42	183.41	183.66	183.69
25 - N24b_finer_1sekm	113.68	135.01	152.46	164.82	181.92	193.07	201.91	209.19	216.03	222.70
26 - N25b_finer_1sekm	113.68	135.01	152.46	164.77	181.95	193.55	202.59	210.16	217.19	224.29
27 - N26b_finer_1sekm	113.68	135.01	152.46	164.82	181.93	193.42	202.36	209.80	216.67	223.51
28 - N27b_finer_1sekm	113.68	135.01	152.46	164.77	181.96	193.55	202.59	210.16	217.19	224.29
29 - N28b_finer_1sekm	107.24	124.08	137.44	136.57	147.00	156.40	162.69	163.22	163.49	163.72
30 - N29b_finer_1sekm	107.24	124.08	138.49	138.24	153.05	163.08	162.82	162.75	162.83	162.85
31 - N30b_finer_1sekm	107.24	124.08	137.50	136.59	147.08	156.63	163.05	163.38	163.60	163.63
32 - N31b_finer_1sekm	107.24	124.08	138.53	138.24	153.06	163.09	162.82	162.84	162.81	163.13
33 - N32b_finer_1sekm	137.30	138.30	139.30	140.30	141.40	143.90	145.70	147.50	149.20	150.80
34 - N33b_finer_1sekm+r1	116.49	117.34	118.10	118.93	119.90	120.898	121.820	122.866		
35 - N34b_finer_1sekm+r1	105.62	103.62	105.18	106.09	106.48	106.5	106.5	106.4	106.3	
36 - N35b_finer_1sekm	198.39	198.83	254.28	253.47	254.77	259.03	247.59	245.34	257.79	242.44
37 - N36b_finer_1sekm	156.88	159.71	167.55	177.79	180.96	181.70	182.72	183.32	183.38	183.53
38 - N37b_finer_1sekm	154.20	160.85	186.42	179.88	184.25	185.15	184.62	185.85	184.68	183.44
39 - N38b_finer_1sekm	156.88	159.71	167.55	177.83	181.02	182.68	183.51	183.82	184.42	184.72
40 - N39b_finer_1sekm	155.69	160.11	188.59	179.98	183.71	184.84	185.33	183.76	185.26	182.40
41 - N40b_finer_1sekm	192.75	199.12	201.73	201.75	200.80	199.20	197.32	195.31	193.66	192.75
42 - N41b_finer_1sekm	192.75	199.28	200.70	201.53	201.58	201.19	200.13	198.43	196.18	193.74
43 - N42b_finer_1sekm	192.75	199.13	201.70	201.75	201.01	199.78	198.06	196.15	195.89	195.36
44 - N43b_finer_1sekm	192.75	199.28	200.71	201.57	201.21	200.83	200.19	198.90	196.85	194.67
45 - N44b_finer_1sekm	121.34	129.34	138.14	147.11	156.43	161.87	161.91	161.52	161.33	161.06
46 - N45b_finer_1sekm	121.34	129.34	138.16	147.93	159.59	161.88	160.79	160.30	160.20	162.48
47 - N46b_finer_1sekm	121.34	129.34	138.14	147.12	156.46	163.06	162.92	162.72	162.80	163.24
48 - N47b_finer_1sekm	121.34	129.34	138.16	147.93	159.59	162.64	161.99	162.01	161.76	164.23

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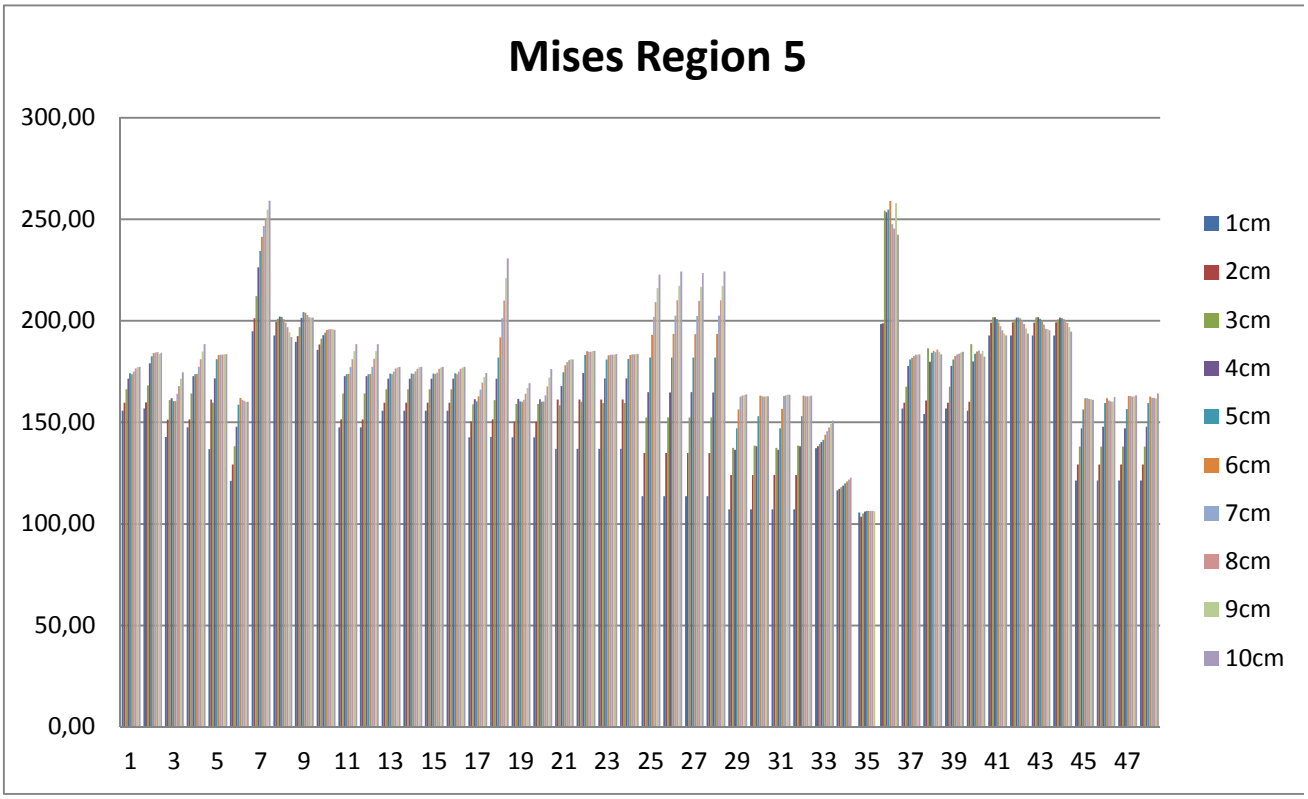

Figure A13-5. Mises stress [MPa] in copper shell, region 5, versus case number as specified in table A13-5.

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Table A13-6. Mises stress [MPa] for region 6 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	84.60	84.20	86.70	89.70	92.50	94.50	95.70	96.80	97.70	98.50
2 - N2b_finer_1sekm	85.00	85.10	84.80	84.60	85.30	84.50	84.10	83.80	83.80	83.90
3 - N3b_finer_1sekm	85.81	90.79	95.85	102.94	109.35	114.62	119.64	124.75	130.13	135.36
4 - N4b_finer_1sekm	83.90	84.10	88.10	92.60	96.35	100.50	104.80	109.30	113.10	116.70
5 - N5b_finer_1sekm	84.60	84.50	84.10	83.50	83.10	82.80	83.30	82.40	82.00	82.25
6 - N6b_finer_1sekm	86.30	91.60	104.20	120.20	135.50	147.00	156.30	163.90	170.50	176.70
7 - N7b_finer_1sekm	88.10	87.50	103.40	118.30	130.70	142.00	150.90	158.70	164.90	170.50
8 - N8b_finer_1sekm	83.40	82.90	82.40	89.10	83.80	81.50	81.00	80.70	81.10	82.20
9 - N8b_b_finer_1sekm+r1	91.70	94.80	94.70	95.30	91.90	92.44	92.45	92.20	91.50	90.76
10 - N9b_finer_1sekm	87.40	101.70	131.50	155.90	173.90	187.20	199.70	210.00	217.50	223.90
11- N10b_finer_1sekm	83.90	84.10	88.10	92.60	96.35	100.50	104.90	109.30	113.10	116.80
12 - N11b_finer_1sekm	83.90	84.10	88.10	92.60	96.35	100.50	104.90	109.30	113.10	116.80
13 - N12b_finer_1sekm	84.64	84.16	86.74	89.65	92.46	94.45	95.72	96.75	97.65	98.48
14 - N13b_finer_1sekm	84.64	84.16	86.74	89.66	92.46	94.45	95.73	96.75	97.65	98.49
15 - N14b_finer_1sekm	84.64	84.16	86.74	89.66	92.46	94.45	95.73	96.76	97.65	98.49
16 - N15b_finer_1sekm	84.64	84.16	86.74	89.65	92.46	94.45	95.73	96.75	97.65	98.49
17 - N16b_finer_1sekm+r1	85.86	93.45	96.64	100.29	104.42	108.32	112.03	115.45	118.87	121.64
18 - N17b_finer_1sekm+r1	85.93	90.82	96.20	102.97	109.17	114.94	120.82	126.81	132.58	138.78
19 - N18b_finer_1sekm	86.53	93.53	96.62	100.41	104.93	115.92	122.80	127.85	132.10	136.34
20 - N19b_finer_1sekm	86.53	93.53	96.63	100.44	105.17	116.96	124.83	130.48	135.71	141.44
21 - N20b_finer_1sekm	84.62	84.51	84.67	83.99	83.45	83.64	82.47	81.90	82.22	82.32
22 - N21b_finer_1sekm	84.62	84.51	84.22	83.53	82.95	82.29	82.49	82.44	82.34	82.13
23 - N22b_finer_1sekm	84.61	84.53	84.15	83.45	83.11	82.94	82.92	82.62	81.89	82.38
24 - N23b_finer_1sekm	84.61	84.53	84.12	83.48	83.11	82.85	83.30	82.40	82.26	82.23
25 - N24b_finer_1sekm	84.27	83.16	86.62	95.27	105.61	115.61	125.58	134.40	142.78	150.14
26 - N25b_finer_1sekm	84.27	83.16	86.62	95.26	105.64	115.80	125.99	135.00	143.56	151.15
27 - N26b_finer_1sekm	84.27	83.16	86.62	95.27	105.60	115.71	125.77	134.70	143.19	150.66
28 - N27b_finer_1sekm	84.27	83.16	86.62	95.26	105.63	115.80	125.99	135.00	143.56	151.15
29 - N28b_finer_1sekm	86.09	94.33	110.52	129.52	148.50	167.38	182.47	198.35	213.39	223.11
30 - N29b_finer_1sekm	86.09	94.33	110.56	130.11	150.13	170.32	187.07	203.68	217.46	227.43
31 - N30b_finer_1sekm	86.09	94.33	110.51	129.53	148.52	167.44	182.54	198.54	213.67	223.79
32 - N31b_finer_1sekm	86.09	94.33	110.55	130.10	150.12	170.33	187.10	203.71	217.50	227.31
33 - N32b_finer_1sekm	85.40	88.70	92.70	96.40	99.10	98.50	100.10	101.30	102.70	104.30
34 - N33b_finer_1sekm+r1	86.37	92.96	97.16	101.00	105.71	112.131	119.216	127.220		
35 - N34b_finer_1sekm+r1	87.86	104.04	123.94	142.61	160.04	160.7	169.0	185.4	210.9	
36 - N35b_finer_1sekm	84.84	84.00	83.62	83.18	83.04	82.44	81.80	82.19	82.59	82.76
37 - N36b_finer_1sekm	85.03	85.06	84.88	84.37	84.76	84.93	84.98	84.61	83.86	83.70
38 - N37b_finer_1sekm	83.91	84.08	84.54	84.26	84.17	82.92	83.53	84.27	84.69	84.94
39 - N38b_finer_1sekm	85.03	85.06	84.88	84.36	84.79	83.98	84.55	83.78	83.68	83.85
40 - N39b_finer_1sekm	84.40	84.38	84.50	84.90	84.04	84.34	84.52	84.56	84.55	84.54
41 - N40b_finer_1sekm	83.37	83.09	83.67	85.32	82.21	80.73	81.17	82.20	83.12	83.81
42 - N41b_finer_1sekm	83.37	82.91	82.47	81.50	89.34	86.17	80.60	82.38	82.54	81.70
43 - N42b_finer_1sekm	83.37	83.09	83.31	85.82	82.31	80.89	80.87	81.82	82.64	83.25
44 - N43b_finer_1sekm	83.37	82.91	82.47	81.50	89.94	87.25	81.41	81.62	82.63	82.94
45 - N44b_finer_1sekm	86.33	91.64	104.18	119.91	134.70	145.62	154.68	162.08	167.91	173.32
46 - N45b_finer_1sekm	86.33	91.64	104.19	120.23	135.79	147.71	157.56	165.46	172.44	178.76
47 - N46b_finer_1sekm	86.33	91.64	104.18	119.91	134.71	148.90	160.50	169.86	178.13	184.07
48 - N47b_finer_1sekm	86.33	91.64	104.19	120.23	135.79	151.50	164.22	175.18	184.21	192.41

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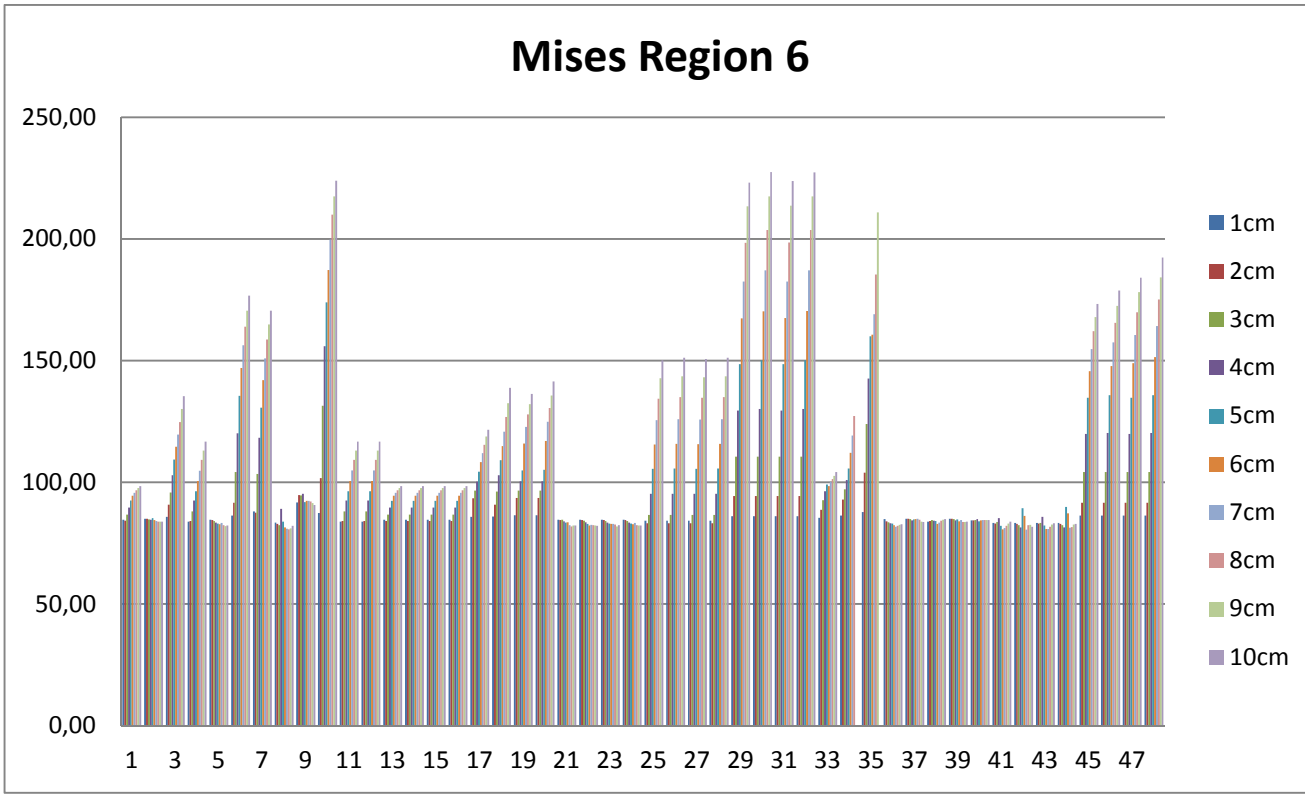

Figure A13-6. Mises stress [MPa] in copper shell, region 6, versus case number as specified in table A13-6.

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Table A13-7. Mises stress [MPa] for region 7 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	84.60	84.20	86.70	89.70	92.50	94.50	95.70	96.80	97.70	98.50
2 - N2b_finer_1sekm	85.00	85.10	84.80	84.60	85.30	84.50	84.10	83.80	83.80	83.90
3 - N3b_finer_1sekm	85.81	90.79	95.85	102.94	109.35	114.62	119.64	124.75	130.13	135.36
4 - N4b_finer_1sekm	83.90	84.10	88.10	92.60	96.35	100.50	104.80	109.30	113.10	116.70
5 - N5b_finer_1sekm	84.60	84.50	84.10	83.50	83.10	82.80	83.30	82.40	82.00	82.25
6 - N6b_finer_1sekm	86.30	91.60	104.20	120.20	135.50	147.00	156.30	163.90	170.50	176.70
7 - N7b_finer_1sekm	88.10	87.50	103.40	118.30	130.70	142.00	150.90	158.70	164.90	170.50
8 - N8b_finer_1sekm	83.40	82.90	82.40	89.10	83.80	81.50	81.00	80.70	81.10	82.20
9 - N8b_b_finer_1sekm+r1	91.70	94.80	94.70	95.30	91.90	92.44	92.45	92.20	91.50	90.76
10 - N9b_finer_1sekm	87.40	101.70	131.50	155.90	173.90	187.20	199.70	210.00	217.50	223.90
11- N10b_finer_1sekm	83.90	84.10	88.10	92.60	96.35	100.50	104.90	109.30	113.10	116.80
12 - N11b_finer_1sekm	83.90	84.10	88.10	92.60	96.35	100.50	104.90	109.30	113.10	116.80
13 - N12b_finer_1sekm	84.64	84.16	86.74	89.65	92.46	94.45	95.72	96.75	97.65	98.48
14 - N13b_finer_1sekm	84.64	84.16	86.74	89.66	92.46	94.45	95.73	96.75	97.65	98.49
15 - N14b_finer_1sekm	84.64	84.16	86.74	89.66	92.46	94.45	95.73	96.76	97.65	98.49
16 - N15b_finer_1sekm	84.64	84.16	86.74	89.65	92.46	94.45	95.73	96.75	97.65	98.49
17 - N16b_finer_1sekm+r1	85.86	93.45	96.64	100.29	104.42	108.32	112.03	115.45	118.87	121.64
18 - N17b_finer_1sekm+r1	85.93	90.82	96.20	102.97	109.17	114.94	120.82	126.81	132.58	138.78
19 - N18b_finer_1sekm	86.53	93.53	96.62	100.41	104.93	115.92	122.80	127.85	132.10	136.34
20 - N19b_finer_1sekm	86.53	93.53	96.63	100.44	105.17	116.96	124.83	130.48	135.71	141.44
21 - N20b_finer_1sekm	84.62	84.51	84.67	83.99	83.45	83.64	82.47	81.90	82.22	82.32
22 - N21b_finer_1sekm	84.62	84.51	84.22	83.53	82.95	82.29	82.49	82.44	82.34	82.13
23 - N22b_finer_1sekm	84.61	84.53	84.15	83.45	83.11	82.94	82.92	82.62	81.89	82.38
24 - N23b_finer_1sekm	84.61	84.53	84.12	83.48	83.11	82.85	83.30	82.40	82.26	82.23
25 - N24b_finer_1sekm	84.27	83.16	86.62	95.27	105.61	115.61	125.58	134.40	142.78	150.14
26 - N25b_finer_1sekm	84.27	83.16	86.62	95.26	105.64	115.80	125.99	135.00	143.56	151.15
27 - N26b_finer_1sekm	84.27	83.16	86.62	95.27	105.60	115.71	125.77	134.70	143.19	150.66
28 - N27b_finer_1sekm	84.27	83.16	86.62	95.26	105.63	115.80	125.99	135.00	143.56	151.15
29 - N28b_finer_1sekm	86.09	94.33	110.52	129.52	148.50	167.38	182.47	198.35	213.39	223.11
30 - N29b_finer_1sekm	86.09	94.33	110.56	130.11	150.13	170.32	187.07	203.68	217.46	227.43
31 - N30b_finer_1sekm	86.09	94.33	110.51	129.53	148.52	167.44	182.54	198.54	213.67	223.79
32 - N31b_finer_1sekm	86.09	94.33	110.55	130.10	150.12	170.33	187.10	203.71	217.50	227.31
33 - N32b_finer_1sekm	85.40	88.70	92.70	96.40	99.10	98.50	100.10	101.30	102.70	104.30
34 - N33b_finer_1sekm+r1	86.37	92.96	97.16	101.00	105.71	112.131	119.216	127.220		
35 - N34b_finer_1sekm+r1	87.86	104.04	123.94	142.61	160.04	160.7	169.0	185.4	210.9	
36 - N35b_finer_1sekm	84.84	84.00	83.62	83.18	83.04	82.44	81.80	82.19	82.59	82.76
37 - N36b_finer_1sekm	85.03	85.06	84.88	84.37	84.76	84.93	84.98	84.61	83.86	83.70
38 - N37b_finer_1sekm	83.91	84.08	84.54	84.26	84.17	82.92	83.53	84.27	84.69	84.94
39 - N38b_finer_1sekm	85.03	85.06	84.88	84.36	84.79	83.98	84.55	83.78	83.68	83.85
40 - N39b_finer_1sekm	84.40	84.38	84.50	84.90	84.04	84.34	84.52	84.56	84.55	84.54
41 - N40b_finer_1sekm	83.37	83.09	83.67	85.32	82.21	80.73	81.17	82.20	83.12	83.81
42 - N41b_finer_1sekm	83.37	82.91	82.47	81.50	89.34	86.17	80.60	82.38	82.54	81.70
43 - N42b_finer_1sekm	83.37	83.09	83.31	85.82	82.31	80.89	80.87	81.82	82.64	83.25
44 - N43b_finer_1sekm	83.37	82.91	82.47	81.50	89.94	87.25	81.41	81.62	82.63	82.94
45 - N44b_finer_1sekm	86.33	91.64	104.18	119.91	134.70	145.62	154.68	162.08	167.91	173.32
46 - N45b_finer_1sekm	86.33	91.64	104.19	120.23	135.79	147.71	157.56	165.46	172.44	178.76
47 - N46b_finer_1sekm	86.33	91.64	104.18	119.91	134.71	148.90	160.50	169.86	178.13	184.07
48 - N47b_finer_1sekm	86.33	91.64	104.19	120.23	135.79	151.50	164.22	175.18	184.21	192.41

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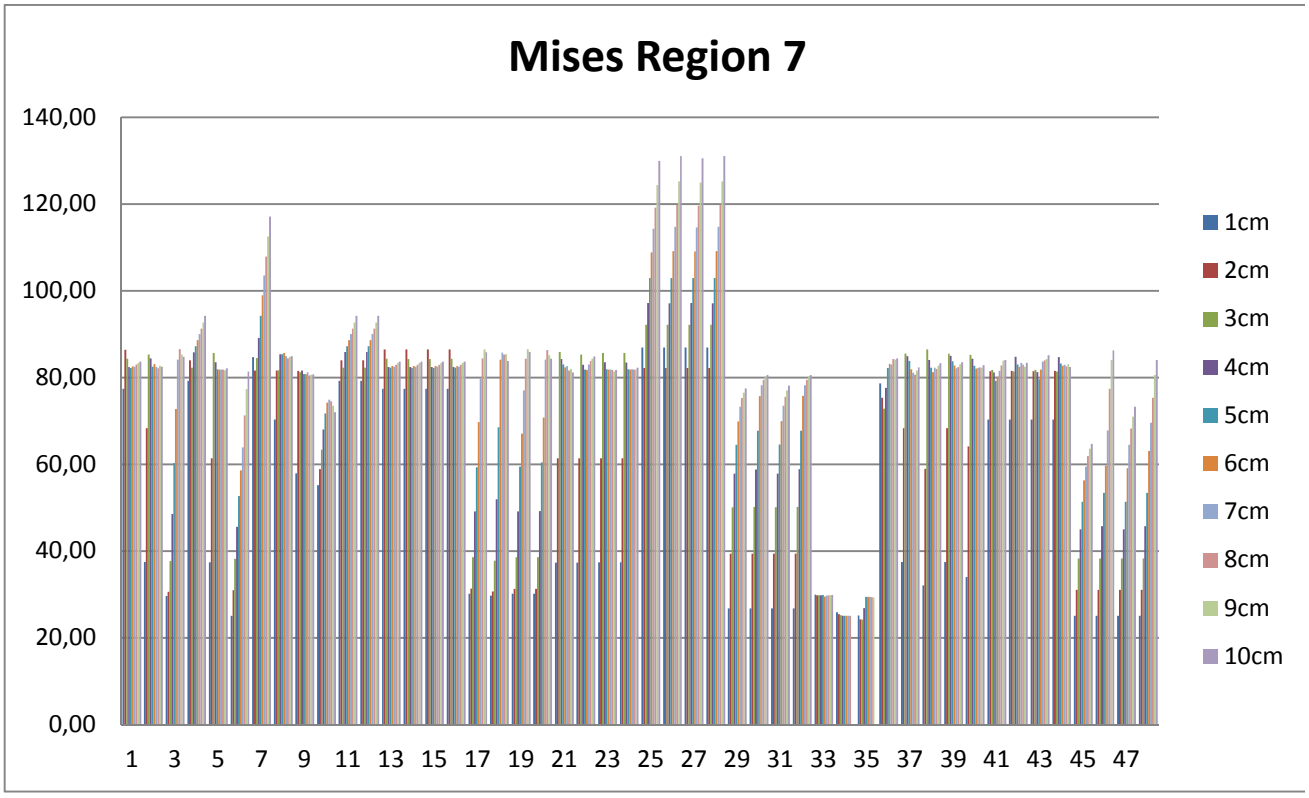

Figure A13-7. Mises stress [MPa] in copper shell, region 7, versus case number as specified in table A13-7.

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Table A13-8. Mises stress [MPa] for region 8 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	77.40	86.40	84.30	82.40	82.20	82.60	82.50	83.00	83.40	83.70
2 - N2b_finer_1sekm	37.50	68.30	85.30	84.40	82.50	83.10	82.40	82.10	82.70	82.50
3 - N3b_finer_1sekm	29.66	30.61	37.71	48.56	60.30	72.72	84.10	86.58	85.30	84.79
4 - N4b_finer_1sekm	79.25	84.00	82.30	85.80	87.20	88.60	90.00	91.30	92.70	94.20
5 - N5b_finer_1sekm	37.40	61.40	85.70	83.50	81.90	81.80	81.80	81.80	81.65	82.10
6 - N6b_finer_1sekm	25.10	31.00	38.25	45.60	52.70	58.60	63.90	71.30	77.30	81.40
7 - N7b_finer_1sekm	84.70	81.60	84.50	89.10	94.20	98.95	103.50	107.90	112.50	117.10
8 - N8b_finer_1sekm	70.30	81.60	81.70	85.40	85.40	85.65	84.90	84.40	84.80	84.90
9 - N8b_b_finer_1sekm+r1	57.90	81.50	81.20	81.60	80.80	80.80	81.22	80.50	80.67	80.75
10 - N9b_finer_1sekm	55.20	58.90	63.40	68.00	71.70	74.20	74.90	74.50	73.50	72.00
11- N10b_finer_1sekm	79.25	84.00	82.30	85.85	87.20	88.65	90.00	91.30	92.70	94.20
12 - N11b_finer_1sekm	79.25	84.00	82.30	85.85	87.20	88.65	90.00	91.30	92.70	94.20
13 - N12b_finer_1sekm	77.39	86.44	84.30	82.42	82.23	82.63	82.48	82.97	83.40	83.70
14 - N13b_finer_1sekm	77.39	86.44	84.30	82.42	82.23	82.63	82.47	82.96	83.40	83.70
15 - N14b_finer_1sekm	77.39	86.44	84.30	82.42	82.23	82.62	82.47	82.96	83.40	83.70
16 - N15b_finer_1sekm	77.39	86.44	84.30	82.42	82.23	82.63	82.48	82.97	83.40	83.70
17 - N16b_finer_1sekm+r1	30.19	31.36	38.55	49.12	59.32	69.74	79.72	84.44	86.47	85.78
18 - N17b_finer_1sekm+r1	29.74	30.69	37.78	51.95	68.52	84.10	85.74	85.32	85.38	83.83
19 - N18b_finer_1sekm	30.15	31.30	38.56	49.15	59.46	67.07	77.02	84.30	86.58	85.88
20 - N19b_finer_1sekm	30.15	31.30	38.56	49.23	60.41	70.74	84.11	86.33	85.18	84.30
21 - N20b_finer_1sekm	37.36	61.36	85.89	84.29	82.97	82.31	82.60	81.63	81.94	81.13
22 - N21b_finer_1sekm	37.36	61.38	85.32	82.92	81.81	81.78	82.98	83.81	84.35	84.83
23 - N22b_finer_1sekm	37.39	61.39	85.69	83.50	81.88	81.82	81.84	81.72	81.40	81.76
24 - N23b_finer_1sekm	37.39	61.39	85.69	83.47	81.90	81.80	81.87	81.82	81.80	82.29
25 - N24b_finer_1sekm	86.94	82.17	92.19	97.14	102.92	108.82	114.27	119.15	124.37	129.90
26 - N25b_finer_1sekm	86.94	82.17	92.19	97.14	102.93	109.13	114.75	119.80	125.24	131.02
27 - N26b_finer_1sekm	86.94	82.17	92.19	97.14	102.92	109.07	114.61	119.59	124.91	130.56
28 - N27b_finer_1sekm	86.94	82.17	92.19	97.14	102.93	109.13	114.75	119.80	125.24	131.02
29 - N28b_finer_1sekm	26.77	39.42	50.08	57.86	64.51	69.85	73.27	75.23	76.50	77.45
30 - N29b_finer_1sekm	26.77	39.42	50.18	58.84	67.76	75.72	78.20	79.45	80.24	80.58
31 - N30b_finer_1sekm	26.77	39.42	50.09	57.87	64.55	69.96	73.48	75.58	77.03	78.13
32 - N31b_finer_1sekm	26.77	39.42	50.18	58.84	67.77	75.74	78.20	79.47	80.30	80.60
33 - N32b_finer_1sekm	29.95	29.80	29.80	29.80	29.90	29.50	29.70	29.80	29.80	29.90
34 - N33b_finer_1sekm+r1	25.91	25.43	25.24	25.06	25.05	25.046	25.109	25.067		
35 - N34b_finer_1sekm+r1	25.19	24.24	24.23	26.82	29.43	29.4	29.4	29.4	29.3	
36 - N35b_finer_1sekm	78.68	75.33	72.82	77.61	82.21	83.13	83.03	84.25	84.09	84.42
37 - N36b_finer_1sekm	37.46	68.32	85.50	84.95	83.84	81.87	81.10	80.65	81.61	82.36
38 - N37b_finer_1sekm	32.07	58.95	86.50	84.04	82.25	81.21	82.24	81.96	82.73	83.29
39 - N38b_finer_1sekm	37.46	68.32	85.51	85.00	83.74	82.76	82.13	82.40	83.08	83.54
40 - N39b_finer_1sekm	33.97	64.14	85.20	84.33	82.70	82.05	82.18	82.36	82.30	82.86
41 - N40b_finer_1sekm	70.30	81.46	81.78	81.16	79.24	80.24	81.54	82.76	83.86	84.03
42 - N41b_finer_1sekm	70.30	81.55	81.39	84.74	83.03	82.48	83.38	82.95	82.52	83.35
43 - N42b_finer_1sekm	70.30	81.46	81.77	81.21	79.61	81.82	83.65	83.97	84.23	85.17
44 - N43b_finer_1sekm	70.30	81.55	81.37	84.68	83.22	82.74	82.97	82.55	83.11	82.41
45 - N44b_finer_1sekm	25.11	31.07	38.26	44.97	51.33	56.31	59.50	61.92	63.61	64.73
46 - N45b_finer_1sekm	25.11	31.07	38.28	45.72	53.44	59.69	67.81	77.39	84.01	86.25
47 - N46b_finer_1sekm	25.11	31.07	38.26	44.98	51.35	59.13	64.46	68.23	71.02	73.30
48 - N47b_finer_1sekm	25.11	31.07	38.28	45.72	53.44	63.07	69.61	75.36	80.55	84.01

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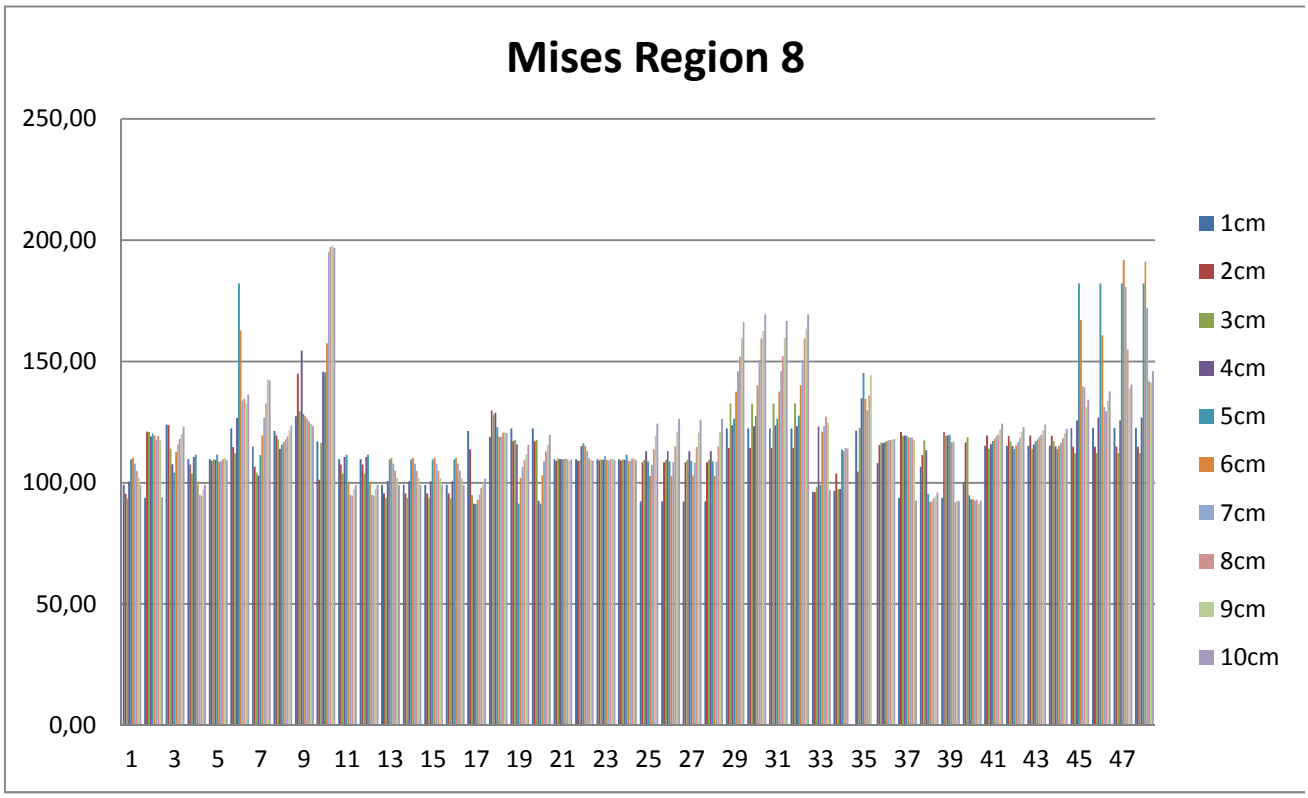

Figure A13-8. Mises stress [MPa] in copper shell, region 8, versus case number as specified in table A13-8.

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Table A13-9. Mises stress [MPa] for region 9 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	99.20	95.50	93.60	100.50	109.60	110.20	107.90	104.90	101.90	99.00
2 - N2b_finer_1sekm	93.70	121.00	120.90	119.10	120.20	119.50	117.80	119.30	117.50	94.00
3 - N3b_finer_1sekm	123.96	123.74	114.00	107.58	104.15	112.71	115.82	118.06	120.04	123.21
4 - N4b_finer_1sekm	109.70	107.40	103.70	110.60	111.50	100.40	95.00	94.70	97.30	99.10
5 - N5b_finer_1sekm	109.70	109.10	109.50	109.40	111.50	108.70	108.90	109.70	110.10	109.30
6 - N6b_finer_1sekm	122.40	114.70	112.10	126.70	182.20	162.80	133.90	134.60	132.60	136.30
7 - N7b_finer_1sekm	114.80	106.60	104.10	103.00	111.40	119.50	126.80	132.70	142.60	142.20
8 - N8b_finer_1sekm	121.30	119.40	117.90	113.90	115.60	116.80	117.90	119.00	121.40	123.60
9 - N8b_b_finer_1sekm+r1	127.40	144.90	129.40	154.40	128.30	127.38	126.33	125.27	124.18	123.22
10 - N9b_finer_1sekm	116.90	101.30	116.40	145.70	145.40	157.40	195.00	197.20	197.90	196.80
11- N10b_finer_1sekm	109.70	107.40	103.70	110.60	111.50	100.40	95.05	94.70	97.30	99.15
12 - N11b_finer_1sekm	109.70	107.40	103.70	110.60	111.50	100.40	95.10	94.70	97.30	99.16
13 - N12b_finer_1sekm	99.16	95.53	93.64	100.53	109.61	110.21	107.89	104.91	101.95	99.02
14 - N13b_finer_1sekm	99.16	95.53	93.65	100.53	109.60	110.20	107.88	104.91	101.94	99.01
15 - N14b_finer_1sekm	99.16	95.53	93.65	100.54	109.60	110.19	107.88	104.90	101.94	99.02
16 - N15b_finer_1sekm	99.16	95.53	93.64	100.53	109.61	110.21	107.88	104.91	101.96	99.02
17 - N16b_finer_1sekm+r1	121.33	113.82	94.89	91.42	91.23	93.00	95.13	97.94	99.76	101.59
18 - N17b_finer_1sekm+r1	118.77	129.80	128.01	128.84	122.96	118.94	118.87	120.69	120.75	120.51
19 - N18b_finer_1sekm	122.31	117.03	117.61	115.83	91.31	102.04	106.54	109.47	111.83	115.67
20 - N19b_finer_1sekm	122.31	117.03	117.61	92.55	91.42	103.08	108.85	112.85	115.67	119.79
21 - N20b_finer_1sekm	109.66	109.09	109.92	109.68	109.74	109.73	109.99	109.50	109.01	109.60
22 - N21b_finer_1sekm	109.66	109.09	109.20	115.14	116.27	115.17	112.93	110.07	109.30	109.23
23 - N22b_finer_1sekm	109.67	109.12	109.51	109.41	110.83	109.42	109.16	109.75	109.91	109.26
24 - N23b_finer_1sekm	109.67	109.12	109.50	109.39	111.51	108.99	108.94	109.90	109.98	109.27
25 - N24b_finer_1sekm	92.33	108.44	109.42	112.94	108.81	102.79	107.28	113.73	119.29	124.40
26 - N25b_finer_1sekm	92.33	108.44	109.42	113.01	108.73	102.90	108.47	115.01	120.94	126.32
27 - N26b_finer_1sekm	92.33	108.44	109.42	112.94	108.84	102.92	108.27	114.76	120.59	125.89
28 - N27b_finer_1sekm	92.33	108.44	109.42	113.01	108.78	102.90	108.46	115.01	120.94	126.32
29 - N28b_finer_1sekm	122.42	114.25	132.60	123.75	126.44	137.54	145.85	151.91	159.58	166.21
30 - N29b_finer_1sekm	122.42	114.25	132.57	123.34	127.57	140.20	150.60	159.43	162.54	169.44
31 - N30b_finer_1sekm	122.42	114.25	132.63	123.74	126.44	137.57	145.97	152.13	159.74	166.64
32 - N31b_finer_1sekm	122.42	114.25	132.62	123.30	127.58	140.22	150.63	159.49	163.53	169.38
33 - N32b_finer_1sekm	96.20	96.10	98.20	123.10	99.20	121.10	123.40	127.20	124.70	97.00
34 - N33b_finer_1sekm+r1	96.67	103.82	97.31	97.46	113.65	113.040	114.279	114.038		
35 - N34b_finer_1sekm+r1	121.41	104.49	122.50	134.79	145.18	134.6	129.9	135.9	144.2	
36 - N35b_finer_1sekm	108.06	115.49	116.53	116.35	116.63	117.10	117.51	117.67	117.81	117.97
37 - N36b_finer_1sekm	93.67	120.85	119.35	119.52	119.45	118.68	118.72	118.52	117.54	92.49
38 - N37b_finer_1sekm	106.58	111.45	117.35	113.34	95.34	92.09	92.33	93.42	94.38	95.94
39 - N38b_finer_1sekm	93.67	120.85	119.36	119.49	119.79	116.64	116.98	91.89	92.64	92.35
40 - N39b_finer_1sekm	100.16	116.56	118.67	94.76	93.07	93.16	92.63	92.97	91.42	92.49
41 - N40b_finer_1sekm	115.24	119.52	114.00	115.87	117.18	118.05	119.04	119.86	121.90	124.33
42 - N41b_finer_1sekm	115.24	119.36	117.06	115.04	113.90	115.31	116.63	118.57	120.90	122.86
43 - N42b_finer_1sekm	115.24	119.52	113.97	115.77	117.07	117.92	118.88	119.67	121.74	124.06
44 - N43b_finer_1sekm	115.24	119.36	117.08	115.01	113.73	115.18	116.44	118.27	120.43	122.25
45 - N44b_finer_1sekm	122.46	114.84	112.18	125.61	182.18	167.04	139.74	139.25	131.01	134.21
46 - N45b_finer_1sekm	122.46	114.84	112.18	126.91	182.17	160.82	131.15	129.54	133.67	137.69
47 - N46b_finer_1sekm	122.46	114.84	112.16	125.62	182.17	191.74	180.64	154.81	138.90	140.43
48 - N47b_finer_1sekm	122.46	114.84	112.18	126.90	182.19	191.08	172.04	141.77	141.23	145.96

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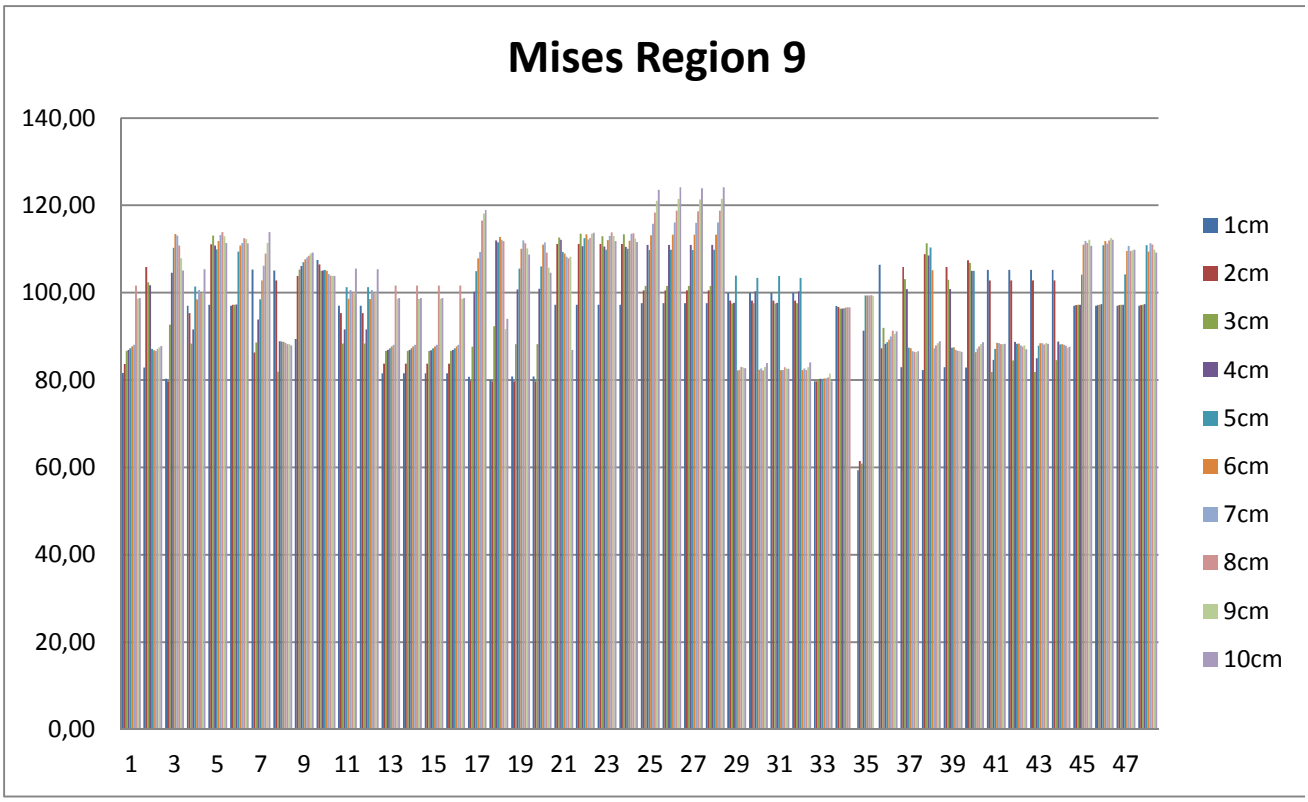

Figure A13-9. Mises stress [MPa] in copper shell, region 9, versus case number as specified in table A13-9.

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Table A13-10. Plastic equivalent strain, PEEQ, [%] for region 1 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	0.500	0.650	0.760	0.840	0.880	0.910	0.930	0.950	0.960	0.970
2 - N2b_finer_1sekm	0.400	0.610	0.830	1.020	1.100	1.180	1.230	1.270	1.310	1.340
3 - N3b_finer_1sekm	0.686	1.068	1.245	1.301	1.589	1.907	2.175	2.464	2.772	3.071
4 - N4b_finer_1sekm	0.480	0.580	0.660	0.750	0.850	0.950	1.050	1.140	1.320	1.550
5 - N5b_finer_1sekm	0.480	0.570	0.620	0.650	0.760	0.930	1.130	1.340	1.550	1.740
6 - N6b_finer_1sekm	0.650	0.970	1.380	2.870	4.200	5.280	6.130	6.820	7.400	7.870
7 - N7b_finer_1sekm	0.850	1.080	1.295	1.550	1.810	2.100	2.450	3.050	3.600	4.090
8 - N8b_finer_1sekm	0.720	0.720	0.720	0.810	1.020	1.230	1.430	1.620	1.810	1.990
9 - N8b_b_finer_1sekm+r1	1.580	1.580	1.580	1.580	1.580	1.720	1.957	2.192	2.427	2.662
10 - N9b_finer_1sekm	1.090	1.600	2.910	4.680	6.630	8.400	10.000	11.420	12.710	13.840
11- N10b_finer_1sekm	0.480	0.580	0.660	0.750	0.850	0.950	1.050	1.145	1.330	1.550
12 - N11b_finer_1sekm	0.480	0.580	0.660	0.750	0.850	0.950	1.050	1.145	1.330	1.550
13 - N12b_finer_1sekm	0.495	0.651	0.761	0.837	0.882	0.914	0.934	0.949	0.960	0.969
14 - N13b_finer_1sekm	0.495	0.651	0.761	0.761	0.882	0.914	0.934	0.949	0.960	0.969
15 - N14b_finer_1sekm	0.495	0.651	0.761	0.837	0.882	0.914	0.934	0.949	0.960	0.969
16 - N15b_finer_1sekm	0.495	0.651	0.761	0.837	0.882	0.914	0.934	0.949	0.960	0.969
17 - N16b_finer_1sekm+r1	0.741	1.004	1.153	1.274	1.369	1.443	1.505	1.700	1.913	2.050
18 - N17b_finer_1sekm+r1	0.743	1.231	1.526	1.610	1.689	2.034	2.353	2.663	3.017	3.363
19 - N18b_finer_1sekm	0.729	0.997	1.152	1.280	1.380	1.601	1.993	2.313	2.594	2.843
20 - N19b_finer_1sekm	0.729	0.997	1.152	1.281	1.385	1.695	2.163	2.557	2.920	3.257
21 - N20b_finer_1sekm	0.478	0.573	0.623	0.663	0.829	1.026	1.228	1.440	1.643	1.832
22 - N21b_finer_1sekm	0.478	0.573	0.622	0.651	0.708	0.845	1.025	1.221	1.432	1.634
23 - N22b_finer_1sekm	0.478	0.573	0.622	0.653	0.757	0.938	1.137	1.350	1.562	1.761
24 - N23b_finer_1sekm	0.478	0.573	0.622	0.653	0.753	0.929	1.121	1.326	1.531	1.724
25 - N24b_finer_1sekm	0.552	0.704	0.779	0.819	1.552	2.341	3.070	3.756	4.385	4.961
26 - N25b_finer_1sekm	0.552	0.704	0.779	0.819	1.554	2.375	3.119	3.817	4.461	5.056
27 - N26b_finer_1sekm	0.552	0.704	0.779	0.819	1.551	2.367	3.103	3.793	4.428	5.014
28 - N27b_finer_1sekm	0.552	0.704	0.779	0.819	1.553	2.375	3.119	3.817	4.462	5.056
29 - N28b_finer_1sekm	0.514	0.979	2.897	5.245	7.340	9.150	10.760	12.106	13.047	13.781
30 - N29b_finer_1sekm	0.514	0.979	2.901	5.324	7.572	9.584	11.468	13.141	14.540	15.358
31 - N30b_finer_1sekm	0.514	0.979	2.897	5.246	7.342	9.158	10.778	12.139	13.102	13.863
32 - N31b_finer_1sekm	0.514	0.979	2.902	5.325	7.573	9.587	11.473	13.149	14.559	15.374
33 - N32b_finer_1sekm	0.920	1.200	1.330	1.420	1.490	1.550	1.590	1.620	1.650	1.690
34 - N33b_finer_1sekm+r1	0.959	1.288	1.444	1.581	1.730	1.878	2.002	2.112		
35 - N34b_finer_1sekm+r1	0.934	1.411	1.846	2.192	3.108	3.124	3.184	4.816	10.169	
36 - N35b_finer_1sekm	0.694	0.718	0.737	0.794	0.997	1.205	1.414	1.618	1.813	2.006
37 - N36b_finer_1sekm	0.542	0.597	0.597	0.632	0.747	0.894	1.064	1.241	1.425	1.614
38 - N37b_finer_1sekm	0.771	0.771	0.771	0.771	0.771	0.771	0.814	0.926	1.058	1.200
39 - N38b_finer_1sekm	0.542	0.597	0.597	0.631	0.743	0.900	1.071	1.241	1.420	1.599
40 - N39b_finer_1sekm	0.735	0.735	0.735	0.735	0.735	0.761	0.866	0.997	1.138	1.285
41 - N40b_finer_1sekm	0.720	0.720	0.722	0.871	1.080	1.287	1.482	1.672	1.855	2.032
42 - N41b_finer_1sekm	0.720	0.720	0.721	0.770	0.965	1.180	1.390	1.585	1.779	1.966
43 - N42b_finer_1sekm	0.720	0.720	0.722	0.865	1.069	1.268	1.460	1.644	1.822	1.992
44 - N43b_finer_1sekm	0.720	0.720	0.721	0.768	0.958	1.166	1.371	1.561	1.749	1.931
45 - N44b_finer_1sekm	0.646	0.965	1.375	2.839	4.117	5.144	5.964	6.601	7.103	7.519
46 - N45b_finer_1sekm	0.646	0.965	1.376	2.874	4.237	5.354	6.249	6.982	7.602	8.131
47 - N46b_finer_1sekm	0.646	0.965	1.375	2.839	4.118	4.986	5.849	6.531	6.993	7.258
48 - N47b_finer_1sekm	0.646	0.965	1.376	2.874	4.237	5.234	6.255	7.110	7.840	8.276

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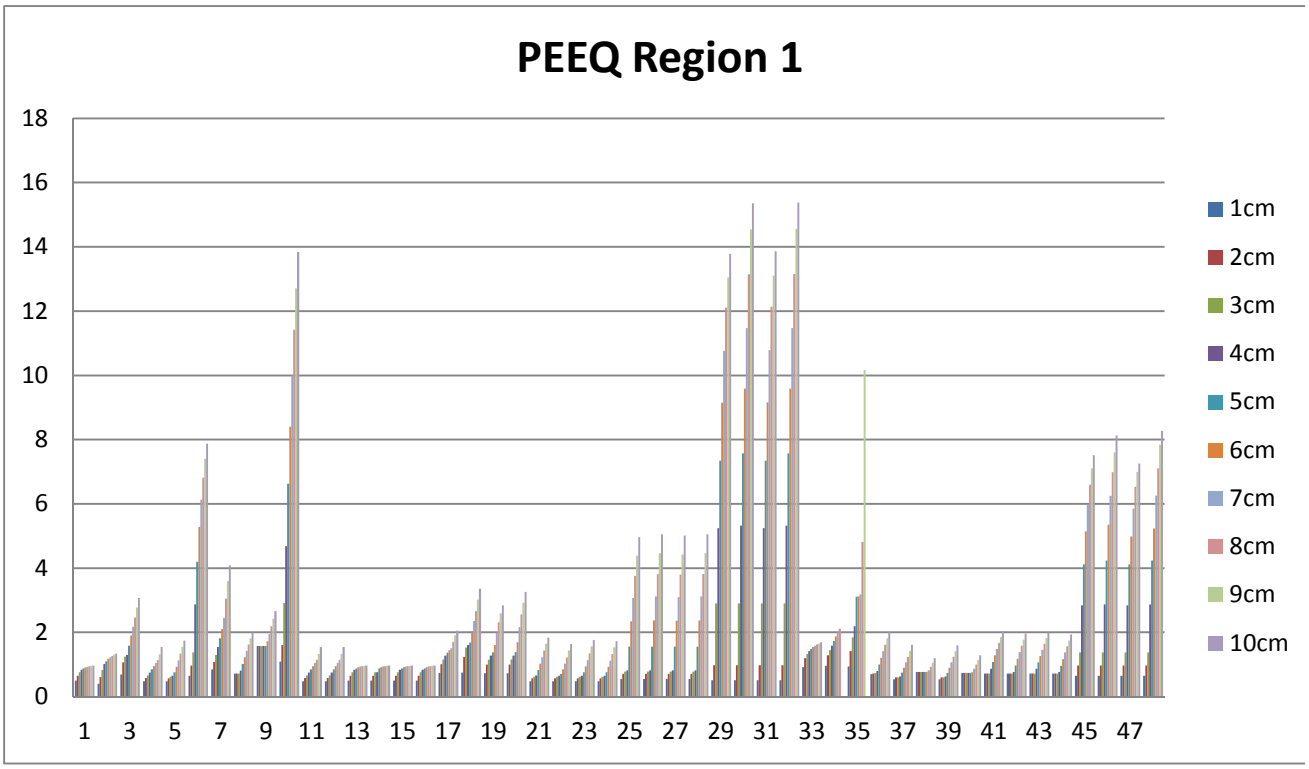

Figure A13-10. Plastic equivalent strain, PEEQ, [%] in copper shell, region 1, versus case number as specified in table A13-10.

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Table A13-11. Plastic equivalent strain, PEEQ, [%] for region 2 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	2.440	2.600	2.880	3.150	3.340	3.470	3.560	3.640	3.720	3.780
2 - N2b_finer_1sekm	2.320	2.320	2.360	2.420	2.460	2.490	2.510	2.520	2.530	2.540
3 - N3b_finer_1sekm	2.701	3.126	3.922	4.691	5.367	5.951	6.456	6.897	7.315	7.744
4 - N4b_finer_1sekm	2.140	2.470	2.930	3.410	3.900	4.340	4.720	5.090	5.440	5.750
5 - N5b_finer_1sekm	2.010	2.025	2.240	2.390	2.500	2.590	2.690	2.760	2.810	2.840
6 - N6b_finer_1sekm	2.570	3.650	5.510	7.560	9.835	12.100	14.040	15.650	17.000	18.120
7 - N7b_finer_1sekm	2.190	2.470	2.870	3.490	4.270	5.160	6.050	6.890	7.660	8.370
8 - N8b_finer_1sekm	2.210	2.690	3.100	3.350	3.570	3.800	4.000	4.140	4.230	4.300
9 - N8b_b_finer_1sekm+r1	8.140	8.460	8.620	8.670	8.750	8.792	8.813	8.824	8.825	8.825
10 - N9b_finer_1sekm	2.470	3.825	6.540	10.520	15.400	20.720	26.140	31.400	37.160	43.340
11- N10b_finer_1sekm	2.140	2.470	2.925	3.405	3.895	4.350	4.720	5.095	5.440	5.750
12 - N11b_finer_1sekm	2.140	2.470	2.925	3.405	3.895	4.350	4.720	5.095	5.440	5.750
13 - N12b_finer_1sekm	2.438	2.601	2.881	3.145	3.341	3.474	3.563	3.643	3.715	3.784
14 - N13b_finer_1sekm	2.438	2.601	2.881	3.145	3.341	3.474	3.563	3.643	3.715	3.784
15 - N14b_finer_1sekm	2.438	2.601	2.881	3.145	3.341	3.473	3.563	3.643	3.715	3.784
16 - N15b_finer_1sekm	2.438	2.601	2.881	3.145	3.341	3.473	3.563	3.643	3.715	3.784
17 - N16b_finer_1sekm+r1	2.800	3.258	3.747	4.311	4.781	5.216	5.628	5.996	6.434	6.485
18 - N17b_finer_1sekm+r1	2.718	3.193	4.136	4.947	5.648	6.327	6.965	7.549	8.119	8.707
19 - N18b_finer_1sekm	2.793	3.256	3.771	4.360	4.860	5.626	6.153	6.571	6.933	7.263
20 - N19b_finer_1sekm	2.793	3.256	3.771	4.365	4.888	5.737	6.358	6.870	7.341	7.807
21 - N20b_finer_1sekm	2.009	2.027	2.261	2.451	2.604	2.757	2.873	2.944	2.989	3.020
22 - N21b_finer_1sekm	2.009	2.027	2.237	2.369	2.453	2.513	2.565	2.612	2.646	2.669
23 - N22b_finer_1sekm	2.009	2.026	2.240	2.395	2.498	2.615	2.715	2.790	2.837	2.867
24 - N23b_finer_1sekm	2.009	2.026	2.239	2.395	2.497	2.590	2.684	2.756	2.803	2.830
25 - N24b_finer_1sekm	2.045	2.605	3.695	4.849	5.957	7.100	8.168	9.233	10.205	11.110
26 - N25b_finer_1sekm	2.045	2.605	3.695	4.848	5.960	7.167	8.267	9.351	10.349	11.278
27 - N26b_finer_1sekm	2.045	2.605	3.695	4.849	5.957	7.156	8.241	9.314	10.300	11.221
28 - N27b_finer_1sekm	2.045	2.605	3.695	4.848	5.959	7.167	8.267	9.351	10.349	11.279
29 - N28b_finer_1sekm	2.542	5.104	7.676	11.776	17.204	23.360	29.552	35.891	41.038	45.899
30 - N29b_finer_1sekm	2.542	5.104	7.685	11.939	17.728	24.364	31.448	38.769	45.762	51.522
31 - N30b_finer_1sekm	2.542	5.104	7.671	11.777	17.210	23.379	29.599	35.998	41.184	46.160
32 - N31b_finer_1sekm	2.542	5.104	7.682	11.934	17.726	24.367	31.460	38.792	45.825	51.548
33 - N32b_finer_1sekm	3.000	3.400	3.600	3.750	3.830	3.860	3.895	3.930	3.990	4.100
34 - N33b_finer_1sekm+r1	2.934	3.554	4.083	4.623	5.072	5.511	5.881	6.195		
35 - N34b_finer_1sekm+r1	3.214	5.840	8.439	10.263	11.440	11.441	11.969	13.917	18.307	
36 - N35b_finer_1sekm	2.120	2.120	2.120	2.120	2.120	2.120	2.120	2.120	2.120	2.120
37 - N36b_finer_1sekm	2.319	2.319	2.366	2.433	2.478	2.516	2.555	2.587	2.610	2.626
38 - N37b_finer_1sekm	2.681	2.872	3.102	3.174	3.215	3.266	3.263	3.261	3.260	3.259
39 - N38b_finer_1sekm	2.319	2.319	2.365	2.433	2.478	2.617	2.679	2.723	2.754	2.773
40 - N39b_finer_1sekm	2.526	2.591	2.784	2.856	2.898	2.915	2.920	2.936	2.952	2.962
41 - N40b_finer_1sekm	2.213	2.688	3.109	3.367	3.659	3.938	4.157	4.322	4.437	4.528
42 - N41b_finer_1sekm	2.213	2.690	3.096	3.340	3.517	3.694	3.861	3.993	4.076	4.136
43 - N42b_finer_1sekm	2.213	2.688	3.109	3.367	3.653	3.925	4.137	4.294	4.399	4.480
44 - N43b_finer_1sekm	2.213	2.690	3.096	3.340	3.516	3.687	3.849	3.972	4.048	4.099
45 - N44b_finer_1sekm	2.573	3.647	5.501	7.507	9.693	11.842	13.699	15.196	16.388	17.395
46 - N45b_finer_1sekm	2.573	3.647	5.502	7.560	9.896	12.232	14.262	15.956	17.388	18.611
47 - N46b_finer_1sekm	2.573	3.647	5.501	7.508	9.695	11.553	13.743	15.661	17.158	18.111
48 - N47b_finer_1sekm	2.573	3.647	5.502	7.557	9.894	12.001	14.528	16.827	18.860	20.303

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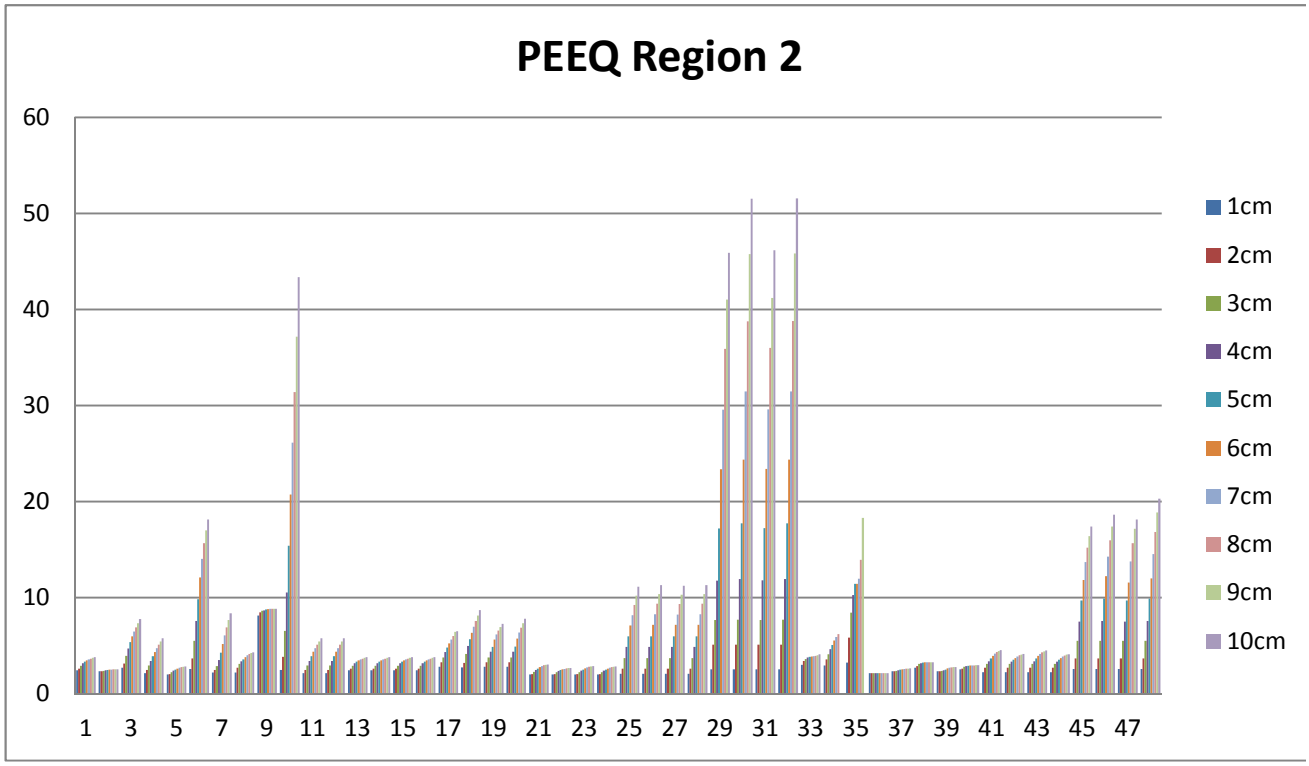

Figure A13-11. Plastic equivalent strain, PEEQ, [%] in copper shell, region 2, versus case number as specified in table A13-11.

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Table A13-12. Plastic equivalent strain, PEEQ, [%] for region 3 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	2.450	2.450	2.450	2.580	2.700	2.810	2.950	3.100	3.270	3.480
2 - N2b_finer_1sekm	2.450	2.450	2.450	2.450	2.450	2.470	2.490	2.500	2.530	2.560
3 - N3b_finer_1sekm	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450
4 - N4b_finer_1sekm	2.500	2.500	2.500	2.540	2.700	2.860	3.460	5.400	7.190	7.860
5 - N5b_finer_1sekm	2.500	2.510	2.530	2.530	2.530	2.530	2.530	2.530	2.540	2.560
6 - N6b_finer_1sekm	2.500	2.500	2.500	2.500	2.510	2.530	2.540	2.540	2.540	2.540
7 - N7b_finer_1sekm	2.580	2.670	2.720	2.790	3.360	5.400	7.410	9.670	12.250	14.320
8 - N8b_finer_1sekm	2.540	2.640	2.690	2.700	2.700	2.700	2.700	2.700	2.700	2.700
9 - N8b_b_finer_1sekm+r1	1.920	1.940	2.120	2.200	2.240	2.250	2.256	2.262	2.268	2.272
10 - N9b_finer_1sekm	2.530	2.530	2.540	2.560	2.580	2.590	2.600	2.600	2.600	2.600
11- N10b_finer_1sekm	2.500	2.500	2.500	2.540	2.700	2.860	3.450	5.390	7.190	7.860
12 - N11b_finer_1sekm	2.500	2.500	2.500	2.540	2.700	2.860	3.450	5.390	7.190	7.860
13 - N12b_finer_1sekm	2.450	2.450	2.453	2.579	2.704	2.813	2.949	3.097	3.266	3.482
14 - N13b_finer_1sekm	2.450	2.450	2.453	2.579	2.704	2.813	2.949	3.097	3.266	3.482
15 - N14b_finer_1sekm	2.450	2.450	2.453	2.579	2.704	2.813	2.949	3.097	3.266	3.482
16 - N15b_finer_1sekm	2.450	2.450	2.453	2.579	2.704	2.813	2.949	3.097	3.266	3.482
17 - N16b_finer_1sekm+r1	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450
18 - N17b_finer_1sekm+r1	2.450	2.450	2.450	2.450	2.450	2.461	2.479	2.492	2.504	2.526
19 - N18b_finer_1sekm	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450
20 - N19b_finer_1sekm	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450
21 - N20b_finer_1sekm	2.500	2.510	2.526	2.526	2.526	2.526	2.526	2.526	2.526	2.526
22 - N21b_finer_1sekm	2.500	2.510	2.526	2.526	2.526	2.554	2.594	2.619	2.638	2.658
23 - N22b_finer_1sekm	2.500	2.510	2.526	2.526	2.526	2.526	2.526	2.526	2.526	2.540
24 - N23b_finer_1sekm	2.500	2.510	2.526	2.526	2.526	2.526	2.526	2.527	2.544	2.565
25 - N24b_finer_1sekm	2.615	2.615	2.682	2.808	3.675	5.221	6.897	8.480	10.019	11.701
26 - N25b_finer_1sekm	2.615	2.615	2.682	2.808	3.679	5.244	6.950	8.563	10.130	11.848
27 - N26b_finer_1sekm	2.615	2.615	2.682	2.808	3.675	5.228	6.913	8.492	10.044	11.727
28 - N27b_finer_1sekm	2.615	2.615	2.682	2.808	3.679	5.244	6.950	8.562	10.130	11.848
29 - N28b_finer_1sekm	2.615	2.831	2.980	3.065	3.121	3.153	3.173	3.185	3.195	3.202
30 - N29b_finer_1sekm	2.615	2.831	2.981	3.070	3.125	3.157	3.178	3.194	3.204	3.212
31 - N30b_finer_1sekm	2.615	2.831	2.980	3.065	3.121	3.153	3.173	3.186	3.196	3.204
32 - N31b_finer_1sekm	2.615	2.831	2.981	3.071	3.125	3.157	3.178	3.194	3.205	3.213
33 - N32b_finer_1sekm	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450
34 - N33b_finer_1sekm+r1	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500		
35 - N34b_finer_1sekm+r1	2.615	2.615	2.615	2.615	2.631	2.631	2.631	2.631	2.631	
36 - N35b_finer_1sekm	3.025	4.743	5.596	5.816	5.993	6.107	6.219	6.357	6.520	6.744
37 - N36b_finer_1sekm	2.450	2.450	2.450	2.450	2.450	2.452	2.461	2.468	2.472	2.476
38 - N37b_finer_1sekm	2.450	2.450	2.449	2.449	2.467	2.494	2.514	2.545	2.595	2.634
39 - N38b_finer_1sekm	2.450	2.450	2.450	2.450	2.450	2.455	2.466	2.475	2.482	2.487
40 - N39b_finer_1sekm	2.450	2.450	2.450	2.450	2.461	2.489	2.510	2.525	2.537	2.546
41 - N40b_finer_1sekm	2.544	2.631	2.676	2.681	2.681	2.681	2.681	2.681	2.681	2.681
42 - N41b_finer_1sekm	2.544	2.637	2.699	2.719	2.721	2.721	2.721	2.721	2.721	2.721
43 - N42b_finer_1sekm	2.544	2.631	2.677	2.682	2.682	2.682	2.682	2.682	2.682	2.682
44 - N43b_finer_1sekm	2.544	2.637	2.699	2.720	2.722	2.722	2.722	2.722	2.722	2.722
45 - N44b_finer_1sekm	2.500	2.500	2.500	2.500	2.507	2.522	2.532	2.536	2.538	2.538
46 - N45b_finer_1sekm	2.500	2.500	2.500	2.500	2.514	2.533	2.540	2.543	2.544	2.544
47 - N46b_finer_1sekm	2.500	2.500	2.500	2.500	2.507	2.539	2.553	2.561	2.565	2.570
48 - N47b_finer_1sekm	2.500	2.500	2.500	2.500	2.514	2.550	2.561	2.569	2.573	2.575

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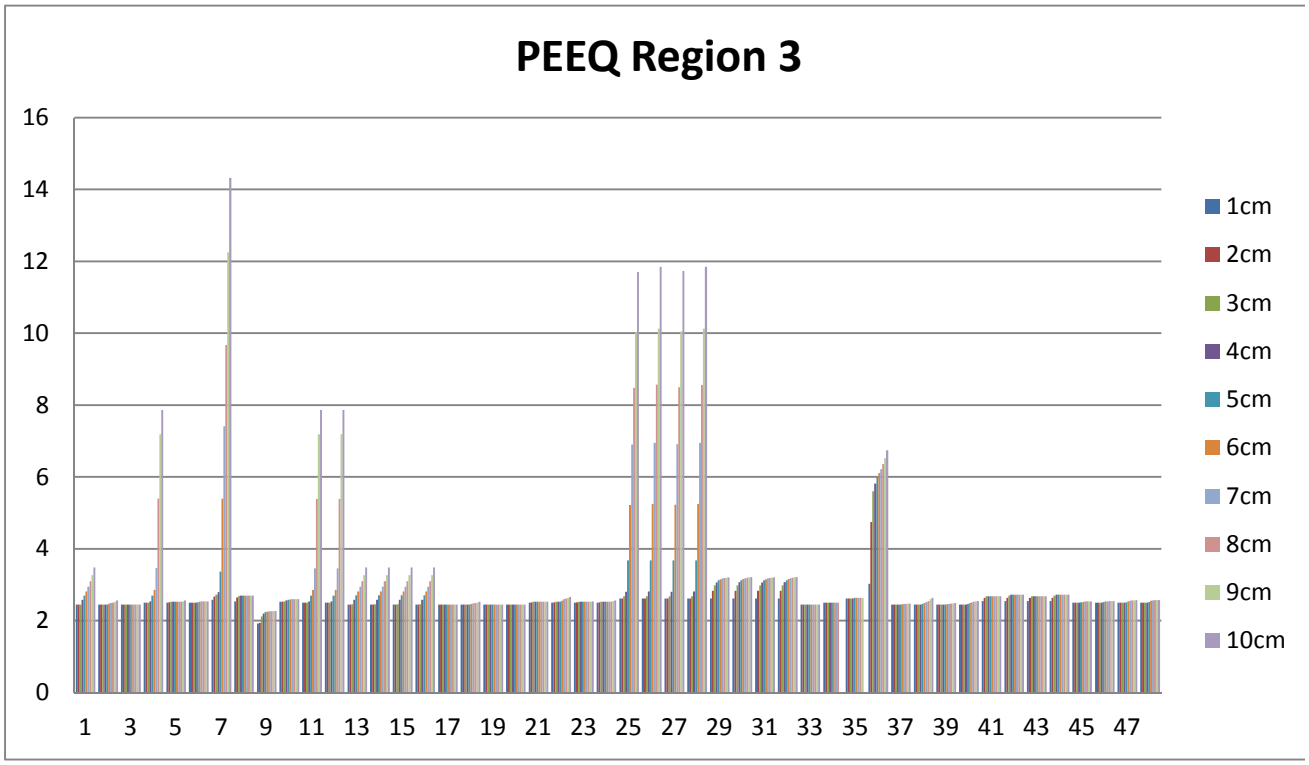

Figure A13-12. Plastic equivalent strain, PEEQ, [%] in copper shell, region 3, versus case number as specified in table A13-12.

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Table A13-13. Plastic equivalent strain, PEEQ, [%] for region 4 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	1.150	1.480	1.680	1.810	1.890	1.940	1.980	2.010	2.030	2.050
2 - N2b_finer_1sekm	1.130	1.140	1.140	1.140	1.170	1.250	1.300	1.330	1.360	1.380
3 - N3b_finer_1sekm	1.630	2.013	2.279	6.862	9.890	11.958	13.479	14.684	15.692	16.663
4 - N4b_finer_1sekm	0.780	1.170	1.440	1.620	1.790	1.960	3.950	5.330	6.410	7.220
5 - N5b_finer_1sekm	0.670	0.770	0.800	0.800	0.800	0.800	0.810	0.820	0.820	0.830
6 - N6b_finer_1sekm	1.400	1.960	10.570	16.100	19.500	21.920	23.990	25.770	27.300	28.570
7 - N7b_finer_1sekm	1.670	2.000	2.230	2.535	5.820	9.090	10.990	12.350	13.440	14.330
8 - N8b_finer_1sekm	1.420	1.450	1.470	1.485	1.510	1.530	1.550	1.560	1.570	1.610
9 - N8b_b_finer_1sekm+r1	3.280	3.280	3.290	3.290	3.300	3.314	3.326	3.341	3.360	3.384
10 - N9b_finer_1sekm	2.330	6.170	17.400	26.240	33.320	40.490	47.710	54.690	61.720	68.370
11- N10b_finer_1sekm	0.780	1.170	1.440	1.620	1.790	1.960	3.960	5.350	6.420	7.230
12 - N11b_finer_1sekm	0.780	1.170	1.440	1.620	1.790	1.960	3.960	5.350	6.425	7.230
13 - N12b_finer_1sekm	1.153	1.476	1.675	1.807	1.886	1.942	1.979	2.008	2.032	2.053
14 - N13b_finer_1sekm	1.153	1.476	1.675	1.807	1.886	1.942	1.979	2.008	2.032	2.053
15 - N14b_finer_1sekm	1.153	1.476	1.675	1.807	1.886	1.942	1.979	2.008	2.032	2.053
16 - N15b_finer_1sekm	1.153	1.476	1.675	1.807	1.886	1.942	1.979	2.008	2.032	2.053
17 - N16b_finer_1sekm+r1	1.728	2.126	2.370	4.533	6.538	8.064	9.325	10.281	11.029	11.489
18 - N17b_finer_1sekm+r1	1.683	2.045	2.937	9.273	11.888	14.003	15.713	17.079	18.172	19.100
19 - N18b_finer_1sekm	1.708	2.108	2.360	4.846	6.921	11.102	12.906	14.172	15.155	15.916
20 - N19b_finer_1sekm	1.708	2.108	2.360	4.857	7.027	11.556	13.600	15.052	16.175	17.194
21 - N20b_finer_1sekm	0.670	0.771	0.806	0.806	0.811	0.836	0.859	0.880	0.898	0.915
22 - N21b_finer_1sekm	0.670	0.771	0.801	0.801	0.801	0.827	0.857	0.874	0.884	0.893
23 - N22b_finer_1sekm	0.670	0.769	0.802	0.802	0.802	0.808	0.818	0.826	0.833	0.839
24 - N23b_finer_1sekm	0.670	0.769	0.802	0.802	0.802	0.804	0.813	0.819	0.825	0.834
25 - N24b_finer_1sekm	0.371	0.710	1.041	3.273	7.103	9.549	11.076	12.224	13.133	13.897
26 - N25b_finer_1sekm	0.371	0.710	1.041	3.264	7.111	9.566	11.095	12.240	13.158	13.944
27 - N26b_finer_1sekm	0.371	0.710	1.041	3.273	7.096	9.543	11.060	12.195	13.099	13.875
28 - N27b_finer_1sekm	0.371	0.710	1.041	3.264	7.104	9.564	11.095	12.240	13.157	13.944
29 - N28b_finer_1sekm	0.992	9.379	19.327	25.492	31.712	38.671	45.740	52.128	56.607	60.155
30 - N29b_finer_1sekm	0.992	9.379	19.329	25.790	32.708	40.712	49.381	57.837	65.224	69.473
31 - N30b_finer_1sekm	0.992	9.379	19.341	25.494	31.726	38.710	45.833	52.311	56.917	60.602
32 - N31b_finer_1sekm	0.992	9.378	19.340	25.782	32.696	40.705	49.385	57.868	65.321	69.565
33 - N32b_finer_1sekm	2.130	2.610	2.830	2.970	3.080	3.220	3.280	3.340	3.390	3.460
34 - N33b_finer_1sekm+r1	2.102	2.675	2.933	3.177	3.462	6.429	8.421	10.269		
35 - N34b_finer_1sekm+r1	1.919	2.682	8.001	11.870	14.744	15.086	18.308	28.226	57.463	
36 - N35b_finer_1sekm	1.435	1.446	1.456	1.468	1.476	1.481	1.486	1.491	1.496	1.501
37 - N36b_finer_1sekm	1.129	1.141	1.141	1.141	1.141	1.169	1.192	1.210	1.224	1.236
38 - N37b_finer_1sekm	1.597	1.597	1.597	1.597	1.597	1.596	1.598	1.601	1.601	1.601
39 - N38b_finer_1sekm	1.129	1.141	1.141	1.141	1.141	1.141	1.141	1.143	1.145	1.147
40 - N39b_finer_1sekm	1.546	1.546	1.546	1.546	1.546	1.547	1.551	1.553	1.554	1.555
41 - N40b_finer_1sekm	1.419	1.444	1.466	1.481	1.510	1.533	1.554	1.570	1.581	1.638
42 - N41b_finer_1sekm	1.419	1.444	1.470	1.486	1.514	1.531	1.545	1.556	1.563	1.583
43 - N42b_finer_1sekm	1.419	1.444	1.466	1.481	1.510	1.533	1.553	1.568	1.579	1.633
44 - N43b_finer_1sekm	1.419	1.444	1.470	1.486	1.515	1.532	1.545	1.555	1.562	1.579
45 - N44b_finer_1sekm	1.396	1.958	10.577	16.006	19.267	21.586	23.596	25.196	26.480	27.559
46 - N45b_finer_1sekm	1.396	1.958	10.579	16.110	19.600	22.128	24.324	26.218	27.871	29.309
47 - N46b_finer_1sekm	1.396	1.958	10.580	16.003	19.270	22.419	24.968	26.968	28.340	29.136
48 - N47b_finer_1sekm	1.396	1.958	10.579	16.111	19.601	23.143	26.145	28.746	31.073	32.484

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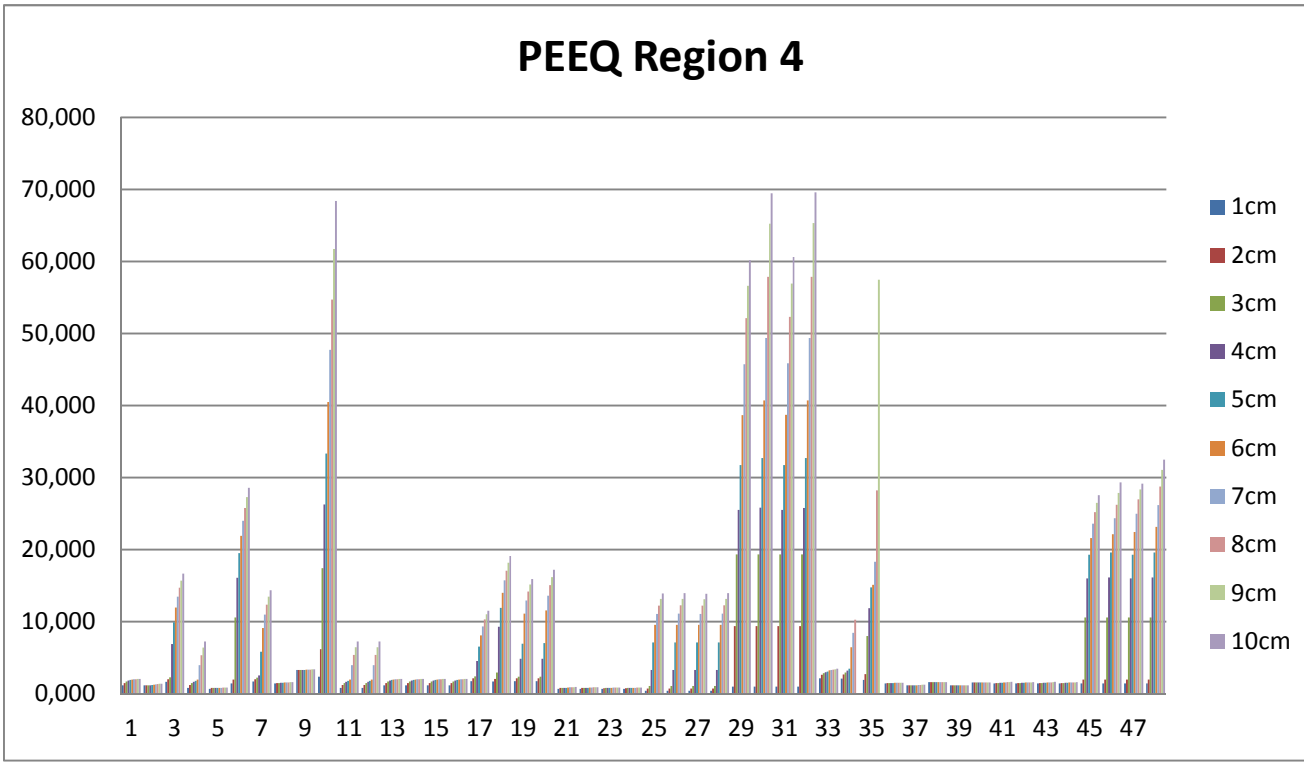

Figure A13-13. Plastic equivalent strain, PEEQ, [%] in copper shell, region 4, versus case number as specified in table A13-13.

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Table A13-14. Plastic equivalent strain, PEEQ, [%] for region 5 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	10.210	10.490	10.990	11.430	11.480	11.480	11.480	11.480	11.480	11.480
2 - N2b_finer_1sekm	10.030	11.320	12.000	12.750	12.760	12.760	12.760	12.760	12.760	12.760
3 - N3b_finer_1sekm	7.614	8.974	10.801	11.286	11.445	11.647	11.887	12.172	12.484	12.801
4 - N4b_finer_1sekm	8.400	9.400	10.100	10.500	10.590	10.700	10.840	10.990	11.210	11.460
5 - N5b_finer_1sekm	6.475	10.960	11.250	11.920	12.480	12.520	12.520	12.520	12.520	12.520
6 - N6b_finer_1sekm	4.380	5.320	6.600	8.260	10.360	11.180	11.260	11.370	11.490	11.610
7 - N7b_finer_1sekm	15.830	15.980	16.780	18.130	20.100	22.150	23.990	25.860	27.820	29.850
8 - N8b_finer_1sekm	15.870	15.870	15.870	15.870	15.870	15.870	15.870	15.870	15.870	15.870
9 - N8b_b_finer_1sekm+r1	16.150	16.150	16.190	16.220	16.270	16.353	16.416	16.463	16.501	16.533
10 - N9b_finer_1sekm	15.450	15.700	15.840	15.840	15.840	15.840	15.840	15.840	15.840	15.840
11- N10b_finer_1sekm	8.395	9.400	10.100	10.500	10.590	10.700	10.840	10.990	11.210	11.460
12 - N11b_finer_1sekm	8.395	9.400	10.100	10.500	10.590	10.700	10.840	10.990	11.210	11.460
13 - N12b_finer_1sekm	10.205	10.495	10.986	11.427	11.478	11.478	11.478	11.478	11.478	11.477
14 - N13b_finer_1sekm	10.205	10.495	10.985	11.427	11.479	11.479	11.479	11.479	11.479	11.478
15 - N14b_finer_1sekm	10.205	10.495	10.985	11.426	11.477	11.477	11.477	11.477	11.478	11.477
16 - N15b_finer_1sekm	10.205	10.495	10.986	11.427	11.478	11.478	11.478	11.478	11.479	11.478
17 - N16b_finer_1sekm+r1	7.594	8.802	10.378	11.122	11.241	11.384	12.107	12.861	13.550	14.120
18 - N17b_finer_1sekm+r1	7.602	8.980	10.805	13.109	15.735	18.613	21.583	24.593	27.620	30.641
19 - N18b_finer_1sekm	7.598	8.823	10.430	11.139	11.262	11.486	11.692	11.911	12.124	12.327
20 - N19b_finer_1sekm	7.598	8.823	10.430	11.140	11.275	11.543	11.821	12.149	12.528	12.911
21 - N20b_finer_1sekm	6.472	10.962	11.212	11.692	12.160	12.405	12.493	12.535	12.552	12.552
22 - N21b_finer_1sekm	6.472	10.961	11.271	12.094	12.524	12.524	12.523	12.521	12.519	12.517
23 - N22b_finer_1sekm	6.475	10.960	11.248	11.920	12.477	12.524	12.524	12.524	12.524	12.524
24 - N23b_finer_1sekm	6.475	10.960	11.249	11.921	12.480	12.518	12.518	12.518	12.518	12.518
25 - N24b_finer_1sekm	3.623	6.608	8.179	8.857	9.925	11.280	12.751	14.391	16.172	18.071
26 - N25b_finer_1sekm	3.623	6.608	8.179	8.855	9.929	11.342	12.886	14.607	16.473	18.459
27 - N26b_finer_1sekm	3.623	6.608	8.179	8.857	9.927	11.325	12.835	14.517	16.330	18.266
28 - N27b_finer_1sekm	3.623	6.608	8.179	8.855	9.929	11.343	12.886	14.607	16.473	18.460
29 - N28b_finer_1sekm	2.268	3.177	4.419	6.185	8.049	9.867	11.157	11.293	11.334	11.355
30 - N29b_finer_1sekm	2.268	3.177	4.433	6.459	9.244	11.301	11.439	11.560	11.656	11.721
31 - N30b_finer_1sekm	2.268	3.177	4.418	6.187	8.063	9.911	11.239	11.311	11.342	11.360
32 - N31b_finer_1sekm	2.268	3.177	4.432	6.459	9.245	11.303	11.436	11.559	11.658	11.728
33 - N32b_finer_1sekm	6.890	7.000	7.130	7.270	7.420	7.770	8.040	8.310	8.595	8.880
34 - N33b_finer_1sekm+r1	3.935	3.989	4.061	4.144	4.241	4.346	4.448	4.561		
35 - N34b_finer_1sekm+r1	1.718	1.778	1.864	1.972	2.089	2.088	2.088	2.088	2.088	
36 - N35b_finer_1sekm	15.974	17.420	20.468	21.959	22.840	23.512	24.003	24.372	24.618	24.820
37 - N36b_finer_1sekm	10.033	11.321	11.954	12.700	12.763	12.763	12.763	12.763	12.763	12.763
38 - N37b_finer_1sekm	9.524	11.494	12.145	12.963	12.990	12.989	12.984	12.994	13.027	13.057
39 - N38b_finer_1sekm	10.033	11.321	11.956	12.701	12.763	12.763	12.763	12.762	12.761	12.761
40 - N39b_finer_1sekm	9.807	11.399	12.075	12.838	12.847	12.845	12.840	12.856	12.891	12.932
41 - N40b_finer_1sekm	15.863	15.863	15.862	15.862	15.862	15.862	15.862	15.862	15.862	15.862
42 - N41b_finer_1sekm	15.863	15.863	15.858	15.889	15.923	15.932	15.932	15.932	15.932	15.932
43 - N42b_finer_1sekm	15.863	15.863	15.862	15.861	15.861	15.861	15.861	15.861	15.861	15.861
44 - N43b_finer_1sekm	15.863	15.863	15.858	15.890	15.927	15.939	15.942	15.942	15.942	15.942
45 - N44b_finer_1sekm	4.384	5.319	6.598	8.136	9.929	11.090	11.202	11.277	11.341	11.402
46 - N45b_finer_1sekm	4.384	5.319	6.601	8.275	10.545	11.182	11.293	11.441	11.602	11.778
47 - N46b_finer_1sekm	4.384	5.319	6.598	8.137	9.935	11.322	11.438	11.558	11.670	11.773
48 - N47b_finer_1sekm	4.384	5.319	6.601	8.274	10.545	11.346	11.519	11.714	11.942	12.177

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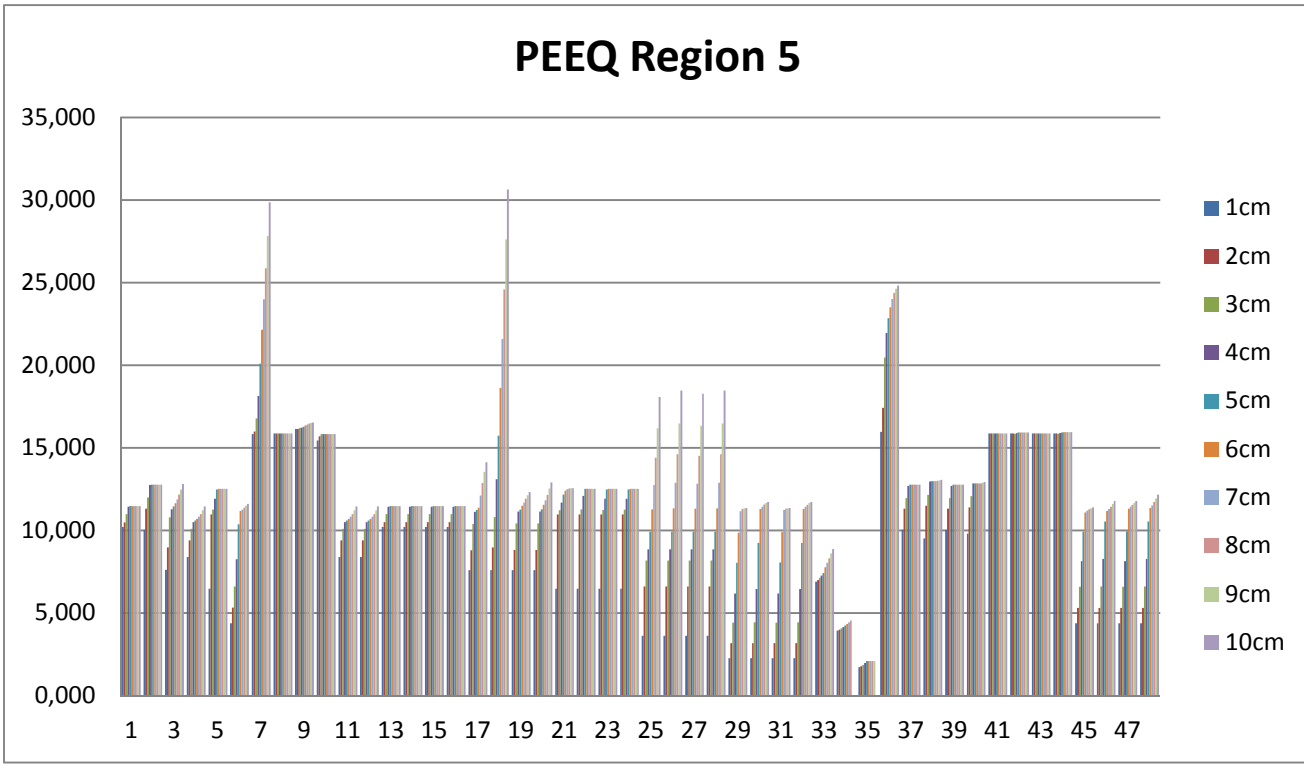

Figure A13-14. Plastic equivalent strain, PEEQ, [%] in copper shell, region 5, versus case number as specified in table A13-14.

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Table A13-15. Plastic equivalent strain, PEEQ, [%] for region 6 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	0.410	0.640	0.910	1.180	1.410	1.580	1.690	1.780	1.860	1.930
2 - N2b_finer_1sekm	0.340	0.420	0.490	0.580	0.650	0.710	0.740	0.760	0.760	0.770
3 - N3b_finer_1sekm	0.832	1.345	1.706	2.262	2.808	3.259	3.687	4.134	4.604	5.109
4 - N4b_finer_1sekm	0.380	0.640	1.030	1.410	1.750	2.120	2.480	2.830	3.160	3.480
5 - N5b_finer_1sekm	0.310	0.340	0.350	0.390	0.400	0.400	0.400	0.400	0.400	0.400
6 - N6b_finer_1sekm	0.780	1.390	2.375	3.710	5.120	6.250	7.220	8.060	8.820	9.525
7 - N7b_finer_1sekm	0.680	1.040	2.370	3.620	4.730	5.800	6.740	7.550	8.270	8.900
8 - N8b_finer_1sekm	0.420	0.420	0.430	0.440	0.455	0.470	0.500	0.530	0.560	0.600
9 - N8b_b_finer_1sekm+r1	0.680	0.680	0.680	0.690	0.720	0.763	0.806	0.855	0.908	0.981
10 - N9b_finer_1sekm	0.930	2.230	4.810	7.240	9.280	11.020	12.750	14.330	15.660	16.870
11- N10b_finer_1sekm	0.380	0.640	1.030	1.410	1.750	2.120	2.480	2.830	3.160	3.480
12 - N11b_finer_1sekm	0.380	0.635	1.030	1.410	1.750	2.120	2.480	2.830	3.160	3.480
13 - N12b_finer_1sekm	0.411	0.643	0.913	1.178	1.407	1.579	1.689	1.778	1.858	1.933
14 - N13b_finer_1sekm	0.411	0.643	0.913	1.178	1.407	1.579	1.689	1.778	1.858	1.933
15 - N14b_finer_1sekm	0.411	0.643	0.913	1.178	1.407	1.579	1.689	1.778	1.858	1.933
16 - N15b_finer_1sekm	0.411	0.643	0.913	1.178	1.407	1.579	1.689	1.778	1.858	1.933
17 - N16b_finer_1sekm+r1	0.783	1.492	1.768	2.081	2.396	2.699	3.000	3.304	3.614	3.864
18 - N17b_finer_1sekm+r1	0.939	1.355	1.770	2.287	2.796	3.305	3.817	4.336	4.878	5.469
19 - N18b_finer_1sekm	0.792	1.497	1.755	2.084	2.434	3.383	3.983	4.417	4.819	5.228
20 - N19b_finer_1sekm	0.792	1.497	1.755	2.086	2.452	3.474	4.159	4.665	5.171	5.712
21 - N20b_finer_1sekm	0.311	0.340	0.341	0.346	0.346	0.346	0.350	0.355	0.359	0.362
22 - N21b_finer_1sekm	0.311	0.340	0.357	0.414	0.453	0.473	0.474	0.474	0.474	0.474
23 - N22b_finer_1sekm	0.311	0.340	0.352	0.389	0.401	0.401	0.401	0.401	0.401	0.401
24 - N23b_finer_1sekm	0.311	0.340	0.352	0.389	0.403	0.403	0.403	0.403	0.403	0.403
25 - N24b_finer_1sekm	0.302	0.541	0.886	1.666	2.548	3.397	4.253	5.083	5.879	6.655
26 - N25b_finer_1sekm	0.302	0.541	0.886	1.666	2.550	3.414	4.289	5.141	5.960	6.759
27 - N26b_finer_1sekm	0.302	0.541	0.886	1.666	2.547	3.406	4.270	5.112	5.921	6.710
28 - N27b_finer_1sekm	0.302	0.541	0.886	1.666	2.549	3.414	4.289	5.141	5.961	6.760
29 - N28b_finer_1sekm	0.666	1.615	2.875	4.529	6.393	8.454	10.290	12.458	14.748	16.518
30 - N29b_finer_1sekm	0.666	1.615	2.879	4.588	6.561	8.795	10.896	13.252	15.483	17.334
31 - N30b_finer_1sekm	0.666	1.615	2.874	4.530	6.395	8.459	10.300	12.485	14.789	16.644
32 - N31b_finer_1sekm	0.666	1.615	2.878	4.587	6.561	8.796	10.900	13.257	15.488	17.311
33 - N32b_finer_1sekm	0.730	1.120	1.450	1.750	1.980	2.030	2.030	2.060	2.145	2.340
34 - N33b_finer_1sekm+r1	0.854	1.477	1.844	2.139	2.504	3.031	3.650	4.335		
35 - N34b_finer_1sekm+r1	1.026	2.395	4.110	5.790	7.592	7.683	8.527	10.435	13.977	
36 - N35b_finer_1sekm	0.415	0.482	0.538	0.569	0.577	0.577	0.577	0.577	0.577	0.577
37 - N36b_finer_1sekm	0.344	0.418	0.481	0.547	0.593	0.613	0.617	0.617	0.617	0.617
38 - N37b_finer_1sekm	0.371	0.400	0.428	0.485	0.566	0.739	0.819	0.873	0.903	0.919
39 - N38b_finer_1sekm	0.344	0.418	0.481	0.547	0.595	0.602	0.602	0.602	0.602	0.602
40 - N39b_finer_1sekm	0.358	0.396	0.444	0.533	0.618	0.701	0.763	0.801	0.822	0.836
41 - N40b_finer_1sekm	0.420	0.424	0.438	0.458	0.479	0.531	0.587	0.640	0.691	0.734
42 - N41b_finer_1sekm	0.420	0.422	0.422	0.426	0.435	0.451	0.463	0.487	0.518	0.549
43 - N42b_finer_1sekm	0.420	0.424	0.438	0.457	0.477	0.521	0.573	0.621	0.661	0.697
44 - N43b_finer_1sekm	0.420	0.422	0.422	0.426	0.435	0.449	0.460	0.481	0.510	0.539
45 - N44b_finer_1sekm	0.778	1.391	2.375	3.682	5.042	6.109	7.050	7.839	8.518	9.144
46 - N45b_finer_1sekm	0.778	1.391	2.375	3.711	5.148	6.329	7.342	8.232	9.039	9.797
47 - N46b_finer_1sekm	0.778	1.391	2.374	3.682	5.043	6.481	7.692	8.770	9.730	10.510
48 - N47b_finer_1sekm	0.778	1.391	2.375	3.711	5.148	6.754	8.127	9.375	10.526	11.598

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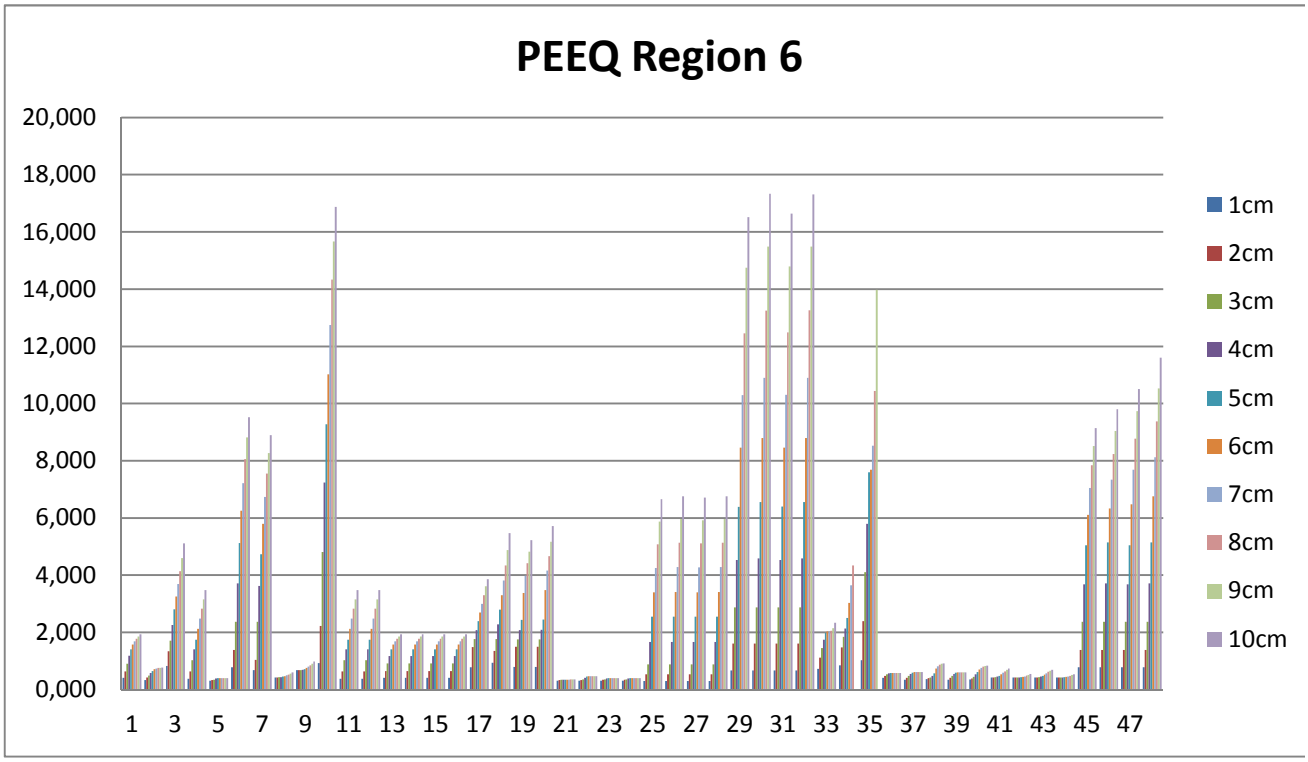

Figure A13-15. Plastic equivalent strain, PEEQ, [%] in copper shell, region 6, versus case number as specified in table A13-15.

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Table A13-16. Plastic equivalent strain, PEEQ, [%] for region 7 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	0.000	0.050	0.120	0.210	0.270	0.320	0.370	0.420	0.470	0.530
2 - N2b_finer_1sekm	0.000	0.000	0.026	0.076	0.140	0.210	0.270	0.310	0.350	0.380
3 - N3b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.018	0.026	0.039
4 - N4b_finer_1sekm	0.000	0.090	0.340	0.600	0.780	0.920	1.050	1.170	1.290	1.420
5 - N5b_finer_1sekm	0.000	0.000	0.020	0.080	0.180	0.240	0.280	0.310	0.330	0.350
6 - N6b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7 - N7b_finer_1sekm	0.060	0.210	0.580	0.970	1.400	1.820	2.200	2.565	2.940	3.330
8 - N8b_finer_1sekm	0.000	0.020	0.040	0.050	0.050	0.050	0.050	0.050	0.050	0.050
9 - N8b_b_finer_1sekm+r1	0.000	0.018	0.045	0.084	0.110	0.138	0.157	0.175	0.193	0.210
10 - N9b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11- N10b_finer_1sekm	0.000	0.090	0.340	0.600	0.780	0.920	1.050	1.170	1.290	1.415
12 - N11b_finer_1sekm	0.000	0.090	0.340	0.600	0.780	0.920	1.050	1.170	1.290	1.420
13 - N12b_finer_1sekm	0.000	0.049	0.118	0.210	0.270	0.321	0.369	0.419	0.472	0.527
14 - N13b_finer_1sekm	0.000	0.049	0.118	0.210	0.270	0.320	0.369	0.419	0.472	0.527
15 - N14b_finer_1sekm	0.000	0.049	0.118	0.210	0.270	0.320	0.369	0.419	0.472	0.527
16 - N15b_finer_1sekm	0.000	0.049	0.118	0.210	0.270	0.321	0.369	0.419	0.472	0.527
17 - N16b_finer_1sekm+r1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.013	0.024
18 - N17b_finer_1sekm+r1	0.000	0.000	0.000	0.000	0.000	0.005	0.023	0.047	0.069	0.101
19 - N18b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.014	0.016
20 - N19b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.031	0.047
21 - N20b_finer_1sekm	0.000	0.000	0.016	0.062	0.107	0.142	0.162	0.178	0.192	0.207
22 - N21b_finer_1sekm	0.000	0.000	0.024	0.105	0.241	0.346	0.411	0.456	0.491	0.523
23 - N22b_finer_1sekm	0.000	0.000	0.021	0.084	0.183	0.239	0.272	0.296	0.315	0.333
24 - N23b_finer_1sekm	0.000	0.000	0.021	0.085	0.185	0.246	0.285	0.315	0.339	0.363
25 - N24b_finer_1sekm	0.026	0.343	1.069	1.633	2.152	2.634	3.076	3.512	3.966	4.438
26 - N25b_finer_1sekm	0.026	0.343	1.069	1.633	2.153	2.659	3.116	3.570	4.042	4.532
27 - N26b_finer_1sekm	0.026	0.343	1.069	1.633	2.152	2.654	3.105	3.551	4.013	4.494
28 - N27b_finer_1sekm	0.026	0.343	1.069	1.633	2.153	2.659	3.116	3.570	4.042	4.533
29 - N28b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30 - N29b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.020	0.027	0.029
31 - N30b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32 - N31b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.020	0.027	0.030
33 - N32b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34 - N33b_finer_1sekm+r1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
35 - N34b_finer_1sekm+r1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
36 - N35b_finer_1sekm	0.000	0.000	0.000	0.000	0.010	0.018	0.025	0.029	0.031	0.032
37 - N36b_finer_1sekm	0.000	0.000	0.023	0.067	0.104	0.146	0.178	0.206	0.231	0.256
38 - N37b_finer_1sekm	0.000	0.000	0.012	0.066	0.126	0.245	0.332	0.400	0.455	0.500
39 - N38b_finer_1sekm	0.000	0.000	0.023	0.067	0.105	0.132	0.162	0.187	0.211	0.235
40 - N39b_finer_1sekm	0.000	0.000	0.021	0.075	0.148	0.235	0.313	0.371	0.418	0.460
41 - N40b_finer_1sekm	0.000	0.023	0.029	0.032	0.032	0.032	0.032	0.032	0.032	0.032
42 - N41b_finer_1sekm	0.000	0.026	0.041	0.062	0.069	0.069	0.069	0.069	0.069	0.069
43 - N42b_finer_1sekm	0.000	0.023	0.029	0.033	0.033	0.033	0.033	0.033	0.033	0.033
44 - N43b_finer_1sekm	0.000	0.026	0.042	0.063	0.070	0.070	0.070	0.070	0.070	0.070
45 - N44b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46 - N45b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.015
47 - N46b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48 - N47b_finer_1sekm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.010

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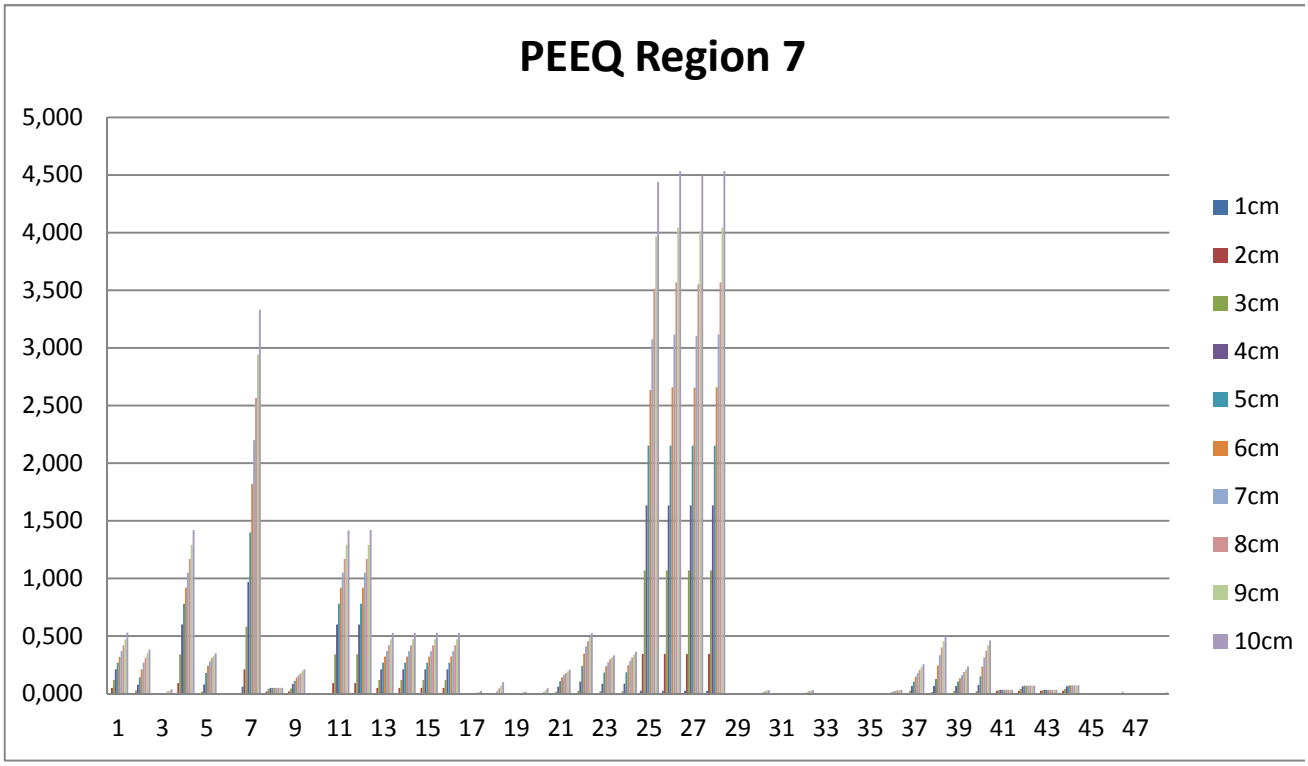

Figure A13-16. Plastic equivalent strain, PEEQ, [%] in copper shell, region 7, versus case number as specified in table A13-16.

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Table A13-17. Plastic equivalent strain, PEEQ, [%] for region 8 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	0.680	0.710	0.740	0.760	0.780	0.880	0.950	1.000	1.050	1.100
2 - N2b_finer_1sekm	0.630	0.630	0.630	0.630	0.630	0.630	0.630	0.630	0.630	0.630
3 - N3b_finer_1sekm	0.733	0.802	0.915	1.261	1.594	1.832	2.051	2.280	2.518	2.763
4 - N4b_finer_1sekm	0.550	0.610	0.650	0.750	0.990	1.210	1.410	1.580	1.730	1.870
5 - N5b_finer_1sekm	0.510	0.510	0.510	0.510	0.510	0.510	0.510	0.510	0.510	0.510
6 - N6b_finer_1sekm	0.640	0.760	1.190	2.070	2.930	3.550	4.070	4.520	4.910	5.260
7 - N7b_finer_1sekm	0.740	1.180	2.100	2.675	3.170	3.710	4.330	4.890	5.380	5.800
8 - N8b_finer_1sekm	0.770	1.010	1.930	2.610	3.050	3.310	3.495	3.660	3.795	3.900
9 - N8b_b_finer_1sekm+r1	1.450	1.450	1.580	1.880	3.500	3.937	4.370	4.815	5.306	5.812
10 - N9b_finer_1sekm	0.870	1.390	3.090	4.700	6.110	7.360	8.550	9.600	10.500	11.340
11- N10b_finer_1sekm	0.550	0.610	0.650	0.750	0.990	1.210	1.410	1.580	1.730	1.870
12 - N11b_finer_1sekm	0.550	0.610	0.645	0.750	0.990	1.210	1.410	1.580	1.730	1.875
13 - N12b_finer_1sekm	0.678	0.708	0.738	0.760	0.777	0.879	0.946	1.003	1.053	1.098
14 - N13b_finer_1sekm	0.678	0.708	0.738	0.760	0.777	0.879	0.947	1.003	1.053	1.098
15 - N14b_finer_1sekm	0.678	0.708	0.738	0.760	0.777	0.879	0.947	1.003	1.053	1.098
16 - N15b_finer_1sekm	0.678	0.708	0.738	0.760	0.777	0.879	0.946	1.003	1.053	1.098
17 - N16b_finer_1sekm+r1	0.749	0.879	1.038	1.181	1.326	1.485	1.661	1.847	2.033	2.165
18 - N17b_finer_1sekm+r1	1.119	1.119	1.119	1.426	1.725	2.020	2.313	2.603	2.893	3.196
19 - N18b_finer_1sekm	0.740	0.885	1.014	1.168	1.336	1.974	2.298	2.501	2.688	2.876
20 - N19b_finer_1sekm	0.740	0.885	1.014	1.169	1.345	2.025	2.395	2.635	2.875	3.135
21 - N20b_finer_1sekm	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.522	0.533	0.542
22 - N21b_finer_1sekm	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.511
23 - N22b_finer_1sekm	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.511
24 - N23b_finer_1sekm	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.511	0.511
25 - N24b_finer_1sekm	0.465	0.535	0.585	0.909	1.469	2.052	2.636	3.179	3.675	4.119
26 - N25b_finer_1sekm	0.465	0.535	0.585	0.909	1.470	2.120	2.731	3.299	3.819	4.286
27 - N26b_finer_1sekm	0.465	0.535	0.585	0.909	1.468	2.113	2.716	3.276	3.788	4.249
28 - N27b_finer_1sekm	0.465	0.535	0.585	0.909	1.469	2.120	2.731	3.299	3.819	4.286
29 - N28b_finer_1sekm	0.562	0.744	1.631	2.901	4.225	5.293	6.142	6.810	7.609	8.385
30 - N29b_finer_1sekm	0.562	0.744	1.633	2.960	4.390	5.596	6.663	7.579	8.216	8.727
31 - N30b_finer_1sekm	0.562	0.744	1.632	2.901	4.227	5.299	6.155	6.834	7.629	8.435
32 - N31b_finer_1sekm	0.562	0.744	1.633	2.960	4.390	5.597	6.666	7.585	8.230	8.721
33 - N32b_finer_1sekm	0.810	0.890	0.940	0.990	1.090	1.115	1.130	1.150	1.190	1.260
34 - N33b_finer_1sekm+r1	0.766	0.882	1.065	1.232	1.400	1.630	1.963	2.377		
35 - N34b_finer_1sekm+r1	0.715	2.060	3.483	4.585	5.540	5.540	5.540	5.540	5.859	
36 - N35b_finer_1sekm	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739
37 - N36b_finer_1sekm	0.633	0.633	0.633	0.633	0.633	0.633	0.633	0.633	0.633	0.633
38 - N37b_finer_1sekm	0.808	0.808	0.808	0.808	0.808	0.808	0.808	0.808	0.808	0.808
39 - N38b_finer_1sekm	0.633	0.633	0.633	0.633	0.633	0.633	0.633	0.633	0.633	0.633
40 - N39b_finer_1sekm	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771
41 - N40b_finer_1sekm	0.765	1.018	1.979	2.693	3.147	3.452	3.711	3.928	4.114	4.271
42 - N41b_finer_1sekm	0.765	1.016	1.189	1.601	1.867	2.036	2.133	2.205	2.258	2.315
43 - N42b_finer_1sekm	0.765	1.018	1.978	2.692	3.142	3.432	3.681	3.877	4.047	4.181
44 - N43b_finer_1sekm	0.765	1.016	1.189	1.601	1.865	2.034	2.131	2.200	2.243	2.285
45 - N44b_finer_1sekm	0.641	0.764	1.192	2.054	2.891	3.468	3.977	4.399	4.751	5.068
46 - N45b_finer_1sekm	0.641	0.764	1.192	2.072	2.949	3.590	4.136	4.604	5.017	5.388
47 - N46b_finer_1sekm	0.641	0.764	1.191	2.054	2.891	3.654	4.286	4.839	5.305	5.641
48 - N47b_finer_1sekm	0.641	0.764	1.192	2.072	2.949	3.800	4.518	5.156	5.725	6.197

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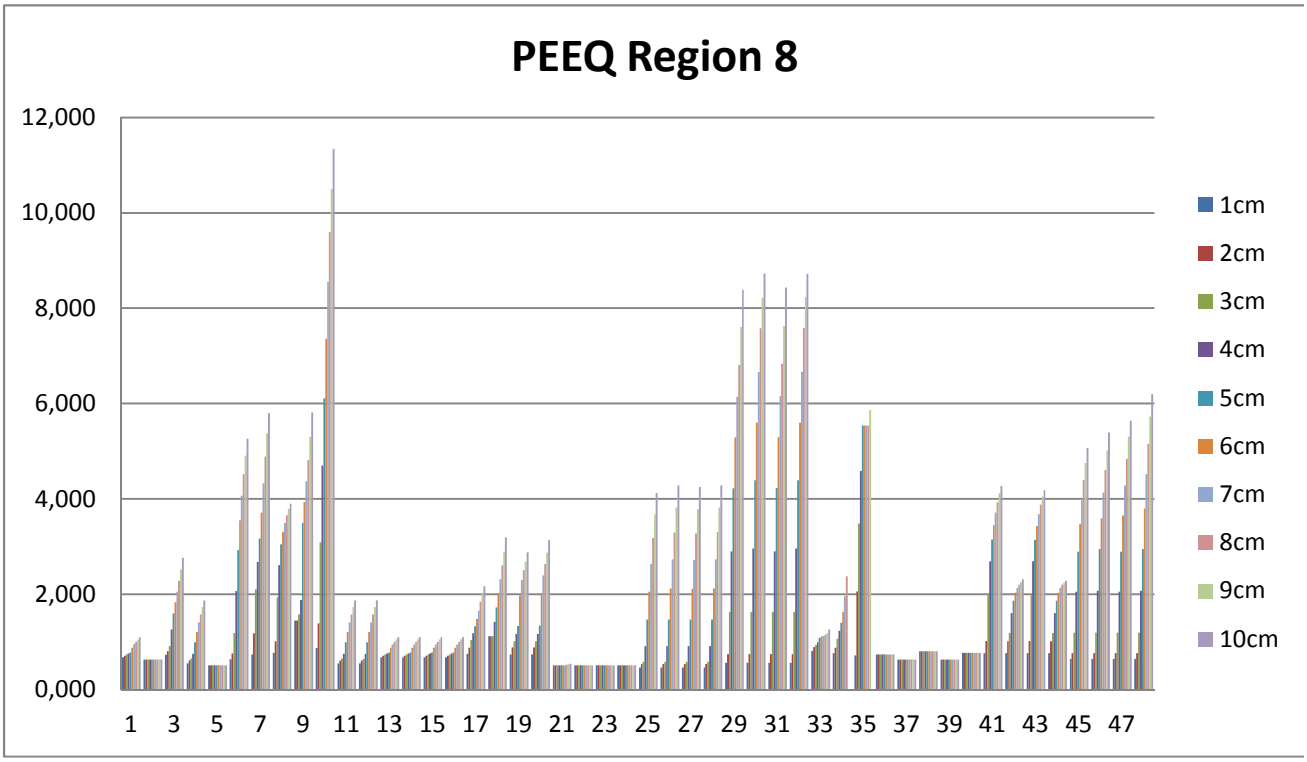

Figure A13-17. Plastic equivalent strain, PEEQ, [%] in copper shell, region 8, versus case number as specified in table A13-17.

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Table A13-18. Plastic equivalent strain, PEEQ, [%] for region 9 in copper shell.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	0.590	0.810	0.990	1.150	1.210	1.260	1.300	1.340	1.390	1.430
2 - N2b_finer_1sekm	0.390	0.610	0.830	1.020	1.100	1.180	1.230	1.270	1.310	1.340
3 - N3b_finer_1sekm	0.232	0.297	0.433	0.511	0.586	0.661	0.733	0.802	0.869	0.932
4 - N4b_finer_1sekm	0.530	0.890	1.290	1.600	1.750	1.880	1.990	2.090	2.190	2.280
5 - N5b_finer_1sekm	0.240	0.550	0.790	1.020	1.200	1.270	1.310	1.340	1.360	1.390
6 - N6b_finer_1sekm	0.110	0.160	0.240	0.360	0.450	0.540	0.610	0.660	0.700	0.730
7 - N7b_finer_1sekm	0.760	1.060	1.360	1.710	2.095	2.445	2.730	2.970	3.180	3.380
8 - N8b_finer_1sekm	0.630	0.720	0.800	0.850	0.850	0.860	0.860	0.870	0.875	0.880
9 - N8b_b_finer_1sekm+r1	0.460	0.550	0.610	0.670	0.720	0.751	0.776	0.796	0.812	0.826
10 - N9b_finer_1sekm	0.510	0.570	0.610	0.640	0.660	0.680	0.690	0.690	0.690	0.690
11- N10b_finer_1sekm	0.530	0.890	1.290	1.600	1.750	1.880	1.990	2.090	2.190	2.280
12 - N11b_finer_1sekm	0.530	0.890	1.290	1.600	1.750	1.880	1.990	2.090	2.190	2.280
13 - N12b_finer_1sekm	0.585	0.808	0.988	1.152	1.209	1.256	1.299	1.341	1.385	1.429
14 - N13b_finer_1sekm	0.585	0.808	0.989	1.152	1.209	1.256	1.299	1.341	1.385	1.429
15 - N14b_finer_1sekm	0.585	0.808	0.989	1.151	1.208	1.255	1.298	1.341	1.384	1.429
16 - N15b_finer_1sekm	0.585	0.808	0.988	1.152	1.209	1.256	1.299	1.341	1.385	1.429
17 - N16b_finer_1sekm+r1	0.237	0.293	0.419	0.501	0.566	0.627	0.686	0.739	0.787	0.830
18 - N17b_finer_1sekm+r1	0.231	0.297	0.431	0.592	0.784	1.009	1.238	1.472	1.707	1.947
19 - N18b_finer_1sekm	0.237	0.294	0.421	0.503	0.568	0.625	0.687	0.743	0.791	0.832
20 - N19b_finer_1sekm	0.237	0.294	0.421	0.503	0.573	0.645	0.728	0.810	0.893	0.967
21 - N20b_finer_1sekm	0.243	0.554	0.772	0.950	1.084	1.154	1.181	1.201	1.219	1.238
22 - N21b_finer_1sekm	0.243	0.554	0.802	1.072	1.263	1.374	1.444	1.492	1.530	1.562
23 - N22b_finer_1sekm	0.244	0.555	0.793	1.019	1.202	1.262	1.299	1.326	1.347	1.368
24 - N23b_finer_1sekm	0.244	0.555	0.793	1.021	1.204	1.270	1.312	1.345	1.371	1.399
25 - N24b_finer_1sekm	0.203	1.004	2.017	2.524	2.702	3.030	3.298	3.535	3.763	3.984
26 - N25b_finer_1sekm	0.203	1.004	2.017	2.525	2.703	3.049	3.325	3.570	3.805	4.035
27 - N26b_finer_1sekm	0.203	1.004	2.017	2.524	2.702	3.045	3.317	3.560	3.791	4.016
28 - N27b_finer_1sekm	0.203	1.004	2.017	2.525	2.703	3.049	3.325	3.570	3.805	4.035
29 - N28b_finer_1sekm	0.044	0.121	0.184	0.263	0.351	0.416	0.461	0.484	0.497	0.508
30 - N29b_finer_1sekm	0.044	0.121	0.184	0.274	0.392	0.502	0.570	0.628	0.670	0.696
31 - N30b_finer_1sekm	0.044	0.121	0.184	0.263	0.351	0.417	0.464	0.488	0.502	0.515
32 - N31b_finer_1sekm	0.044	0.121	0.184	0.274	0.392	0.503	0.571	0.629	0.673	0.699
33 - N32b_finer_1sekm	0.170	0.180	0.190	0.200	0.220	0.240	0.270	0.290	0.310	0.330
34 - N33b_finer_1sekm+r1	0.079	0.085	0.091	0.096	0.103	0.109	0.114	0.120		
35 - N34b_finer_1sekm+r1	0.005	0.005	0.017	0.029	0.041	0.041	0.042	0.042	0.043	
36 - N35b_finer_1sekm	0.950	1.303	1.517	1.534	1.568	1.602	1.627	1.640	1.647	1.648
37 - N36b_finer_1sekm	0.398	0.614	0.823	1.001	1.063	1.109	1.144	1.173	1.198	1.221
38 - N37b_finer_1sekm	0.336	0.574	0.793	0.997	1.090	1.212	1.295	1.358	1.408	1.444
39 - N38b_finer_1sekm	0.398	0.614	0.823	1.001	1.064	1.095	1.128	1.156	1.181	1.205
40 - N39b_finer_1sekm	0.370	0.595	0.816	1.013	1.112	1.206	1.283	1.339	1.385	1.424
41 - N40b_finer_1sekm	0.626	0.721	0.784	0.815	0.825	0.829	0.832	0.835	0.803	0.806
42 - N41b_finer_1sekm	0.626	0.725	0.817	0.859	0.903	0.921	0.931	0.938	0.943	0.950
43 - N42b_finer_1sekm	0.626	0.721	0.785	0.817	0.828	0.834	0.839	0.809	0.813	0.817
44 - N43b_finer_1sekm	0.626	0.725	0.817	0.860	0.906	0.927	0.938	0.948	0.956	0.965
45 - N44b_finer_1sekm	0.111	0.163	0.242	0.354	0.423	0.518	0.560	0.594	0.616	0.627
46 - N45b_finer_1sekm	0.111	0.163	0.242	0.362	0.463	0.559	0.632	0.696	0.752	0.801
47 - N46b_finer_1sekm	0.111	0.163	0.242	0.354	0.424	0.504	0.553	0.589	0.613	0.627
48 - N47b_finer_1sekm	0.111	0.163	0.242	0.362	0.463	0.548	0.624	0.693	0.750	0.800

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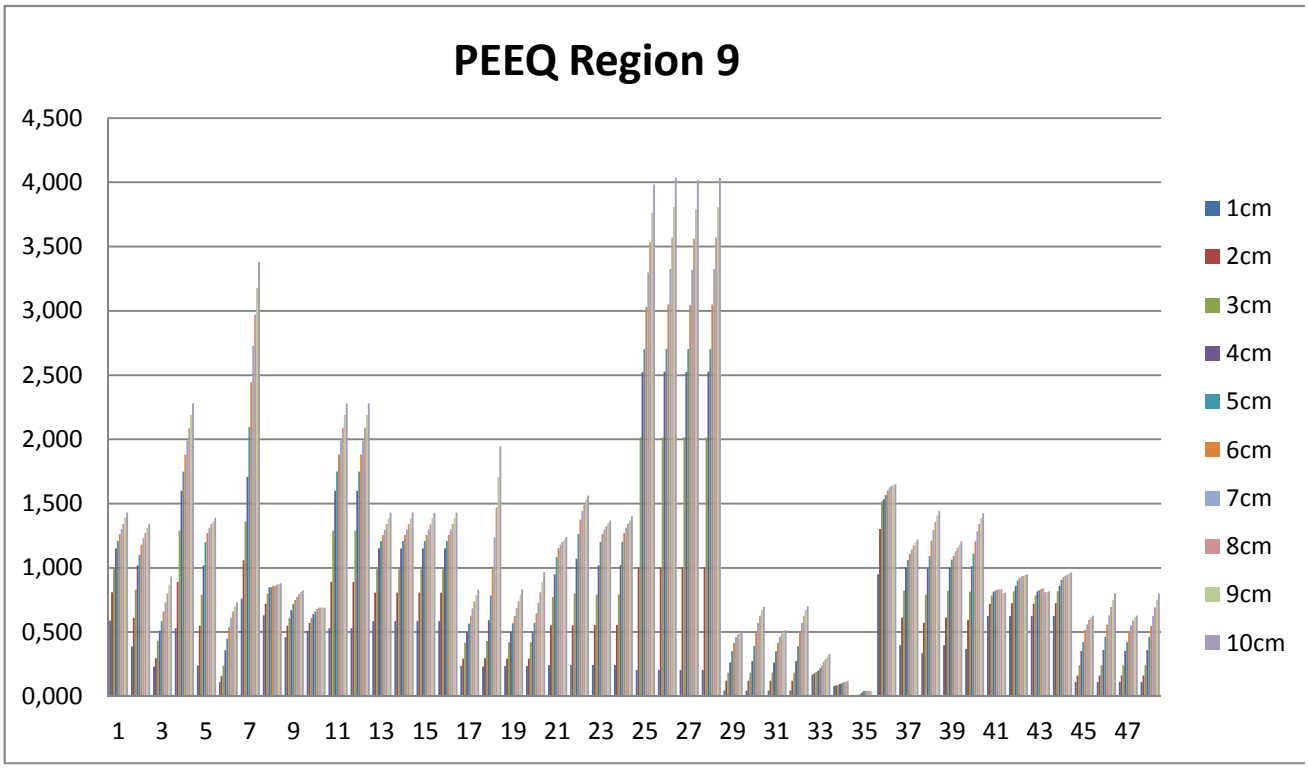

Figure A13-18. Plastic equivalent strain, PEEQ, [%] in copper shell, region 9, versus case number as specified in table A13-18.

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Table A13-19. Mises stress [MPa] för cast iron insert.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	82.7	122.5	146.9	161.8	171.0	177.2	181.8	185.5	188.6	191.5
2 - N2b_finer_1sekm	148.4	252.5	284.7	287.1	289.4	293.0	297.6	302.0	306.1	310.1
3 - N3b_finer_1sekm	117.0	192.0	251.7	282.2	283.3	284.3	285.3	286.2	287.3	288.6
4 - N4b_finer_1sekm	85.5	140.4	176.6	201.0	217.6	229.6	239.4	247.8	255.4	261.1
5 - N5b_finer_1sekm	155.7	268.1	286.2	289.7	294.5	300.8	306.3	311.4	316.4	321.1
6 - N6b_finer_1sekm	123.9	204.4	268.4	282.9	284.1	285.3	286.6	288.0	289.9	292.3
7 - N7b_finer_1sekm	141.2	218.4	276.5	284.5	289.0	293.1	296.2	298.9	301.9	303.5
8 - N8b_finer_1sekm	193.8	286.5	292.0	298.9	306.1	312.1	318.0	323.7	329.3	334.6
9 - N8b_b_finer_1sekm+r1	305.2	327.7	362.2	387.8	405.6	420.0	432.1	442.1	450.8	458.4
10 - N9b_finer_1sekm	162.7	262.2	284.4	286.6	288.7	291.6	295.4	299.1	302.9	306.3
11- N10b_finer_1sekm	85.5	140.4	176.6	201.0	213.1	213.4	213.6	213.9	214.5	215.1
12 - N11b_finer_1sekm	85.5	140.4	176.6	201.0	213.1	213.3	213.5	213.7	214.2	214.6
13 - N12b_finer_1sekm	82.6	122.5	146.9	161.8	171.0	177.2	181.8	185.5	188.6	191.5
14 - N13b_finer_1sekm	82.6	122.5	146.9	161.8	171.0	177.2	181.8	185.5	188.6	191.5
15 - N14b_finer_1sekm	82.6	122.5	146.9	161.8	171.0	177.2	181.8	185.5	188.6	191.5
16 - N15b_finer_1sekm	82.6	122.5	146.9	161.8	171.0	177.2	181.8	185.5	188.6	191.5
17 - N16b_finer_1sekm+r1	107.6	171.9	221.2	248.3	249.1	249.9	251.0	251.9	252.8	254.0
18 - N17b_finer_1sekm+r1	117.9	192.7	252.6	303.3	316.0	316.9	317.4	317.8	318.3	318.9
19 - N18b_finer_1sekm	115.1	185.1	239.3	248.6	249.7	252.1	253.8	255.5	257.8	260.2
20 - N19b_finer_1sekm	115.1	185.1	239.3	283.3	315.4	317.1	318.0	318.7	319.5	320.3
21 - N20b_finer_1sekm	155.7	249.4	253.6	258.5	265.3	271.8	277.9	283.8	289.5	295.0
22 - N21b_finer_1sekm	155.7	268.1	318.9	321.8	324.4	329.6	334.8	339.3	343.5	347.4
23 - N22b_finer_1sekm	155.7	268.1	286.0	289.0	293.3	298.9	303.6	308.0	312.2	316.2
24 - N23b_finer_1sekm	155.7	268.1	286.5	290.5	295.7	302.7	308.9	314.8	320.5	325.9
25 - N24b_finer_1sekm	86.2	165.0	221.0	247.9	253.4	258.6	263.5	263.5	270.8	272.9
26 - N25b_finer_1sekm	86.2	165.0	221.0	267.7	311.4	316.4	317.1	318.4	321.3	322.1
27 - N26b_finer_1sekm	86.2	165.0	221.0	248.0	254.1	261.4	267.4	271.9	277.1	280.2
28 - N27b_finer_1sekm	86.2	165.0	221.0	267.7	311.4	316.7	317.7	319.3	322.7	324.1
29 - N28b_finer_1sekm	117.7	210.9	249.0	250.3	252.8	255.4	258.8	262.6	266.4	269.9
30 - N29b_finer_1sekm	117.7	210.9	282.6	316.5	318.0	319.2	320.2	321.6	324.1	326.5
31 - N30b_finer_1sekm	117.7	210.9	249.2	251.0	254.1	257.2	261.4	266.1	270.9	275.4
32 - N31b_finer_1sekm	117.7	210.9	282.7	316.6	318.6	320.1	321.8	323.8	326.8	330.0
33 - N32b_finer_1sekm	64.1	67.3	77.5	88.7	98.7	117.9	130.6	141.9	152.1	161.4
34 - N33b_finer_1sekm+r1	52.8	72.5	87.2	112.0	129.6	144.6	156.6	167.9		
35 - N34b_finer_1sekm+r1	56.8	145.4	187.2	213.1	228.5	239.0	317.5	329.6	352.1	
36 - N35b_finer_1sekm	196.4	286.7	291.9	299.0	306.4	312.5	318.4	324.0	329.6	334.8
37 - N36b_finer_1sekm	148.4	247.6	251.2	254.5	258.4	263.4	268.2	272.8	277.2	281.5
38 - N37b_finer_1sekm	146.0	257.6	318.0	320.4	321.7	321.3	323.7	326.7	329.4	332.0
39 - N38b_finer_1sekm	148.4	247.6	251.8	255.8	260.7	267.9	273.9	279.8	285.6	291.2
40 - N39b_finer_1sekm	147.7	255.8	317.8	320.8	322.6	325.0	328.9	333.1	337.0	340.9
41 - N40b_finer_1sekm	193.7	253.0	259.4	267.0	273.7	279.7	285.5	291.3	296.9	301.8
42 - N41b_finer_1sekm	193.7	318.3	323.7	327.4	333.8	338.2	342.1	345.9	349.8	353.4
43 - N42b_finer_1sekm	193.7	253.6	261.3	270.5	279.0	286.8	294.3	301.6	308.6	315.3
44 - N43b_finer_1sekm	193.7	318.3	324.8	329.8	337.7	344.0	349.8	355.4	361.1	366.4
45 - N44b_finer_1sekm	123.8	204.3	248.3	249.5	251.0	252.6	254.6	257.0	259.7	262.4
46 - N45b_finer_1sekm	123.8	204.3	268.4	315.4	316.7	317.6	318.2	318.8	319.6	320.5
47 - N46b_finer_1sekm	123.8	204.3	248.4	250.0	251.9	254.6	257.3	260.6	264.2	268.0
48 - N47b_finer_1sekm	123.8	204.3	268.4	315.5	317.0	318.9	319.9	321.1	322.6	324.5

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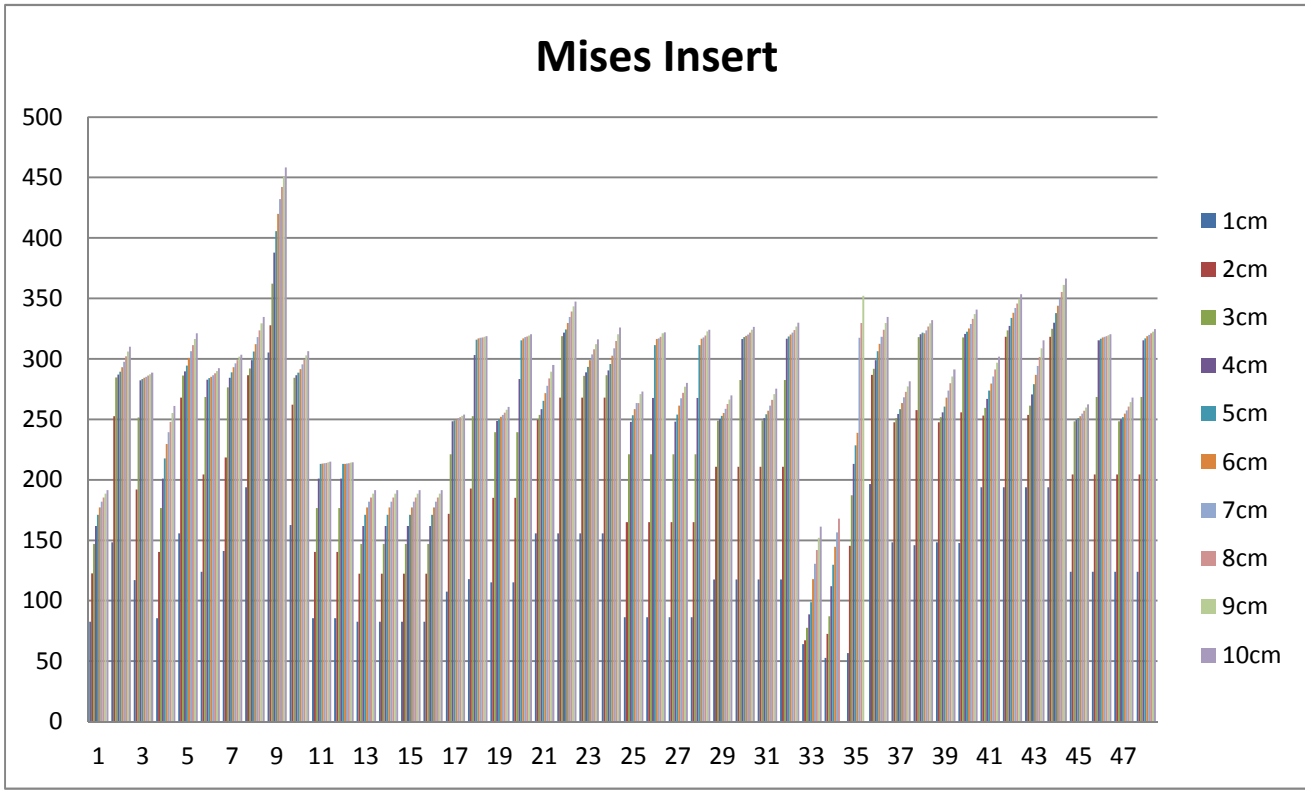

Figure A13-19. Mises stress [MPa] in cast iron insert, versus case number as specified in table A13-19.

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Table A13-20. Mises stress [MPa] for insert channels.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	171.3	254.8	303.9	334.2	353.5	366.3	376.0	384.0	390.9	397.4
2 - N2b_finer_1sekm	193.1	309.0	400.7	447.7	455.5	452.8	453.1	467.0	494.1	527.2
3 - N3b_finer_1sekm	223.2	281.4	342.1	391.6	433.0	448.6	457.9	457.8	458.8	457.7
4 - N4b_finer_1sekm	176.1	289.7	363.7	413.7	447.3	446.0	450.5	448.1	447.4	445.3
5 - N5b_finer_1sekm	193.3	331.5	439.2	454.8	450.3	453.8	481.1	520.0	575.0	621.0
6 - N6b_finer_1sekm	214.0	291.8	358.6	411.2	452.7	456.5	465.8	465.8	471.1	474.9
7 - N7b_finer_1sekm	296.6	451.2	446.1	449.1	464.7	469.4	468.0	467.2	468.2	468.5
8 - N8b_finer_1sekm	295.0	451.0	459.4	464.6	464.8	496.1	562.2	606.0	657.3	683.1
9 - N8b_b_finer_1sekm+r1	734.2	710.5	720.1	733.4	753.4	778.5	766.7	771.6	780.0	782.7
10 - N9b_finer_1sekm	315.7	427.8	477.7	474.5	470.8	486.6	492.8	498.5	501.0	501.9
11- N10b_finer_1sekm	176.1	289.7	363.7	413.7	447.7	447.0	449.8	448.9	445.0	441.5
12 - N11b_finer_1sekm	176.1	289.7	363.7	413.7	447.7	447.0	449.8	448.9	444.9	441.4
13 - N12b_finer_1sekm	171.3	254.8	303.9	334.2	353.5	366.4	376.1	384.1	390.9	397.4
14 - N13b_finer_1sekm	171.3	254.8	304.0	334.2	353.5	366.4	376.1	384.1	390.9	397.4
15 - N14b_finer_1sekm	171.3	254.8	304.0	334.2	353.5	366.4	376.1	384.1	390.9	397.4
16 - N15b_finer_1sekm	171.3	254.8	303.9	334.2	353.5	366.4	376.1	384.1	390.9	397.4
17 - N16b_finer_1sekm+r1	211.8	265.5	316.3	359.4	394.2	435.4	444.7	449.7	451.8	457.0
18 - N17b_finer_1sekm+r1	231.0	287.0	340.5	391.7	433.7	450.3	458.3	459.2	456.9	454.8
19 - N18b_finer_1sekm	212.1	267.4	319.0	363.0	398.4	448.7	457.5	457.1	459.7	459.6
20 - N19b_finer_1sekm	212.1	267.4	319.1	362.9	398.9	448.4	457.6	458.7	457.9	461.9
21 - N20b_finer_1sekm	193.3	331.6	437.0	456.9	450.2	463.0	494.9	537.2	600.2	643.1
22 - N21b_finer_1sekm	193.3	331.6	439.8	454.2	449.5	456.5	465.1	495.6	537.0	588.5
23 - N22b_finer_1sekm	193.3	331.6	439.2	454.8	450.3	453.8	481.3	523.5	583.1	627.2
24 - N23b_finer_1sekm	193.3	331.6	439.2	454.7	450.3	453.7	480.3	514.2	565.6	618.5
25 - N24b_finer_1sekm	173.2	336.2	448.2	446.5	446.6	451.2	457.3	465.6	466.6	469.4
26 - N25b_finer_1sekm	173.2	336.2	448.2	446.3	448.8	455.6	465.9	470.6	470.7	468.7
27 - N26b_finer_1sekm	173.2	336.2	448.2	446.5	446.6	453.9	459.6	468.2	466.8	470.4
28 - N27b_finer_1sekm	173.2	336.2	448.2	446.3	448.8	455.6	465.9	470.6	470.8	468.8
29 - N28b_finer_1sekm	199.9	316.3	399.4	453.5	471.8	482.8	480.0	474.8	474.8	487.5
30 - N29b_finer_1sekm	199.9	316.3	399.3	453.8	476.8	484.6	473.7	473.1	481.0	487.2
31 - N30b_finer_1sekm	199.9	316.3	399.4	453.5	471.9	482.8	479.7	474.6	474.8	486.3
32 - N31b_finer_1sekm	199.9	316.2	399.4	453.8	476.8	484.6	473.7	473.0	481.2	487.5
33 - N32b_finer_1sekm	10.7	25.2	40.1	53.3	64.9	84.2	98.5	111.3	122.8	133.0
34 - N33b_finer_1sekm+r1	127.9	150.8	163.8	185.2	205.0	220.1	233.1	245.4		
35 - N34b_finer_1sekm+r1	121.3	158.2	179.4	199.2	215.5	217.3	243.2	392.0	498.9	
36 - N35b_finer_1sekm	303.4	457.8	458.2	468.3	470.7	502.9	575.8	623.3	669.2	679.3
37 - N36b_finer_1sekm	193.1	308.9	427.9	448.5	456.5	454.3	463.8	494.4	523.2	587.6
38 - N37b_finer_1sekm	222.6	346.3	444.4	455.4	452.2	451.6	455.9	455.8	465.0	485.0
39 - N38b_finer_1sekm	193.1	308.9	427.5	448.5	456.4	452.5	465.6	495.2	528.4	577.8
40 - N39b_finer_1sekm	207.8	328.3	420.6	456.7	449.9	454.2	455.3	454.7	478.0	505.9
41 - N40b_finer_1sekm	294.9	451.2	450.7	467.4	470.5	511.7	574.8	630.9	665.6	689.2
42 - N41b_finer_1sekm	294.9	451.0	462.0	463.7	472.3	485.9	536.1	597.2	655.7	678.9
43 - N42b_finer_1sekm	294.9	451.2	450.9	467.9	468.9	508.1	568.1	611.5	661.2	687.3
44 - N43b_finer_1sekm	294.9	451.0	462.1	463.8	472.4	486.0	531.2	589.7	649.4	671.5
45 - N44b_finer_1sekm	213.9	291.7	358.6	410.5	451.4	456.2	465.4	465.8	464.4	474.4
46 - N45b_finer_1sekm	213.9	291.7	358.6	411.2	453.1	456.6	468.2	465.4	474.0	476.4
47 - N46b_finer_1sekm	213.9	291.7	358.6	410.5	451.4	463.2	469.1	478.3	482.2	486.7
48 - N47b_finer_1sekm	213.9	291.7	358.6	411.2	453.1	468.5	478.0	481.5	482.9	476.2

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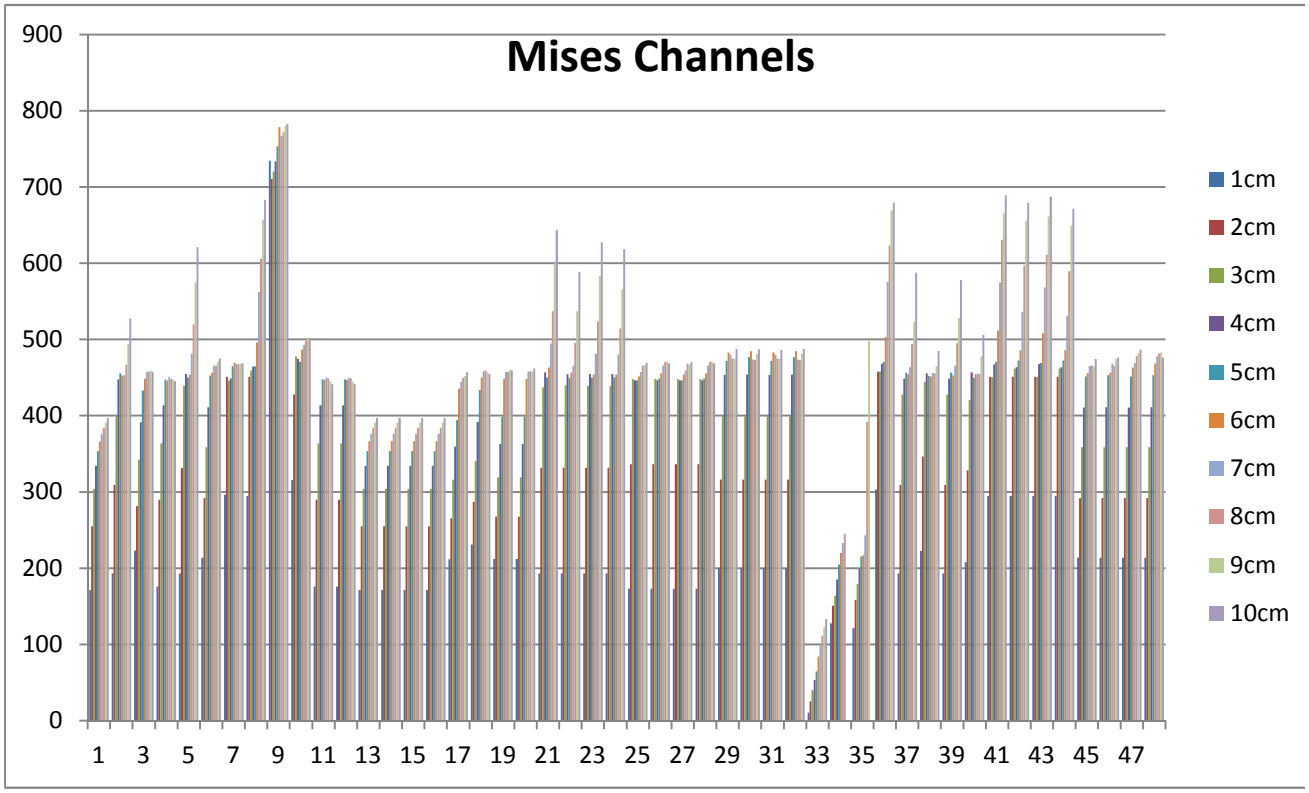

Figure A13-20. Mises stress [MPa] in insert channels, versus case number as specified in table A13-20.

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Table A13-21. Plastic equivalent strain, PEEQ, [%] for cast iron insert.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 - N2b_finer_1sekm	0.00	0.00	0.04	0.12	0.21	0.31	0.44	0.59	0.76	0.92
3 - N3b_finer_1sekm	0.00	0.00	0.00	0.02	0.05	0.09	0.13	0.17	0.21	0.25
4 - N4b_finer_1sekm	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
5 - N5b_finer_1sekm	0.00	0.00	0.07	0.18	0.30	0.48	0.68	0.89	1.10	1.30
6 - N6b_finer_1sekm	0.00	0.00	0.00	0.03	0.07	0.12	0.17	0.22	0.28	0.35
7 - N7b_finer_1sekm	0.00	0.00	0.00	0.06	0.15	0.32	0.47	0.62	0.75	0.88
8 - N8b_finer_1sekm	0.00	0.04	0.18	0.36	0.60	0.84	1.09	1.33	1.57	1.80
9 - N8b_b_finer_1sekm+r1	0.36	1.01	2.52	3.62	4.58	5.42	6.24	7.04	7.79	8.53
10 - N9b_finer_1sekm	0.00	0.00	0.04	0.12	0.19	0.28	0.39	0.52	0.66	0.81
11- N10b_finer_1sekm	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.07
12 - N11b_finer_1sekm	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.07
13 - N12b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14 - N13b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15 - N14b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16 - N15b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 - N16b_finer_1sekm+r1	0.00	0.00	0.00	0.02	0.06	0.09	0.13	0.17	0.21	0.25
18 - N17b_finer_1sekm+r1	0.00	0.00	0.00	0.00	0.02	0.05	0.09	0.13	0.16	0.20
19 - N18b_finer_1sekm	0.00	0.00	0.00	0.03	0.06	0.11	0.17	0.22	0.27	0.34
20 - N19b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.12	0.15	0.18
21 - N20b_finer_1sekm	0.00	0.01	0.11	0.23	0.39	0.59	0.80	1.00	1.21	1.40
22 - N21b_finer_1sekm	0.00	0.00	0.04	0.13	0.24	0.37	0.55	0.75	0.96	1.17
23 - N22b_finer_1sekm	0.00	0.00	0.07	0.18	0.30	0.48	0.69	0.91	1.12	1.33
24 - N23b_finer_1sekm	0.00	0.00	0.07	0.17	0.30	0.47	0.67	0.87	1.07	1.27
25 - N24b_finer_1sekm	0.00	0.00	0.00	0.02	0.10	0.28	0.48	0.67	0.84	0.98
26 - N25b_finer_1sekm	0.00	0.00	0.00	0.00	0.01	0.06	0.10	0.13	0.20	0.29
27 - N26b_finer_1sekm	0.00	0.00	0.00	0.02	0.10	0.29	0.49	0.66	0.81	0.94
28 - N27b_finer_1sekm	0.00	0.00	0.00	0.00	0.01	0.06	0.09	0.13	0.20	0.28
29 - N28b_finer_1sekm	0.00	0.00	0.03	0.08	0.15	0.23	0.33	0.45	0.59	0.74
30 - N29b_finer_1sekm	0.00	0.00	0.00	0.02	0.07	0.13	0.19	0.26	0.34	0.45
31 - N30b_finer_1sekm	0.00	0.00	0.03	0.08	0.15	0.23	0.32	0.44	0.57	0.71
32 - N31b_finer_1sekm	0.00	0.00	0.00	0.02	0.07	0.12	0.19	0.25	0.33	0.44
33 - N32b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34 - N33b_finer_1sekm+r1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
35 - N34b_finer_1sekm+r1	0.00	0.00	0.00	0.00	0.00	0.000	0.004	0.162	0.518	
36 - N35b_finer_1sekm	0.00	0.04	0.18	0.37	0.60	0.85	1.10	1.34	1.58	1.81
37 - N36b_finer_1sekm	0.00	0.00	0.08	0.17	0.28	0.43	0.60	0.78	0.97	1.15
38 - N37b_finer_1sekm	0.00	0.00	0.03	0.11	0.20	0.24	0.32	0.43	0.56	0.70
39 - N38b_finer_1sekm	0.00	0.00	0.08	0.17	0.28	0.44	0.61	0.79	0.96	1.13
40 - N39b_finer_1sekm	0.00	0.00	0.02	0.10	0.18	0.27	0.37	0.50	0.64	0.79
41 - N40b_finer_1sekm	0.00	0.07	0.23	0.45	0.70	0.95	1.20	1.44	1.67	1.90
42 - N41b_finer_1sekm	0.00	0.01	0.14	0.30	0.51	0.76	1.01	1.26	1.52	1.77
43 - N42b_finer_1sekm	0.00	0.07	0.23	0.44	0.68	0.92	1.15	1.37	1.58	1.79
44 - N43b_finer_1sekm	0.00	0.01	0.14	0.29	0.50	0.73	0.97	1.21	1.45	1.68
45 - N44b_finer_1sekm	0.00	0.00	0.02	0.06	0.11	0.16	0.23	0.31	0.40	0.50
46 - N45b_finer_1sekm	0.00	0.00	0.00	0.01	0.04	0.08	0.12	0.17	0.21	0.26
47 - N46b_finer_1sekm	0.00	0.00	0.02	0.06	0.11	0.17	0.24	0.32	0.42	0.52
48 - N47b_finer_1sekm	0.00	0.00	0.00	0.01	0.04	0.09	0.14	0.19	0.24	0.30

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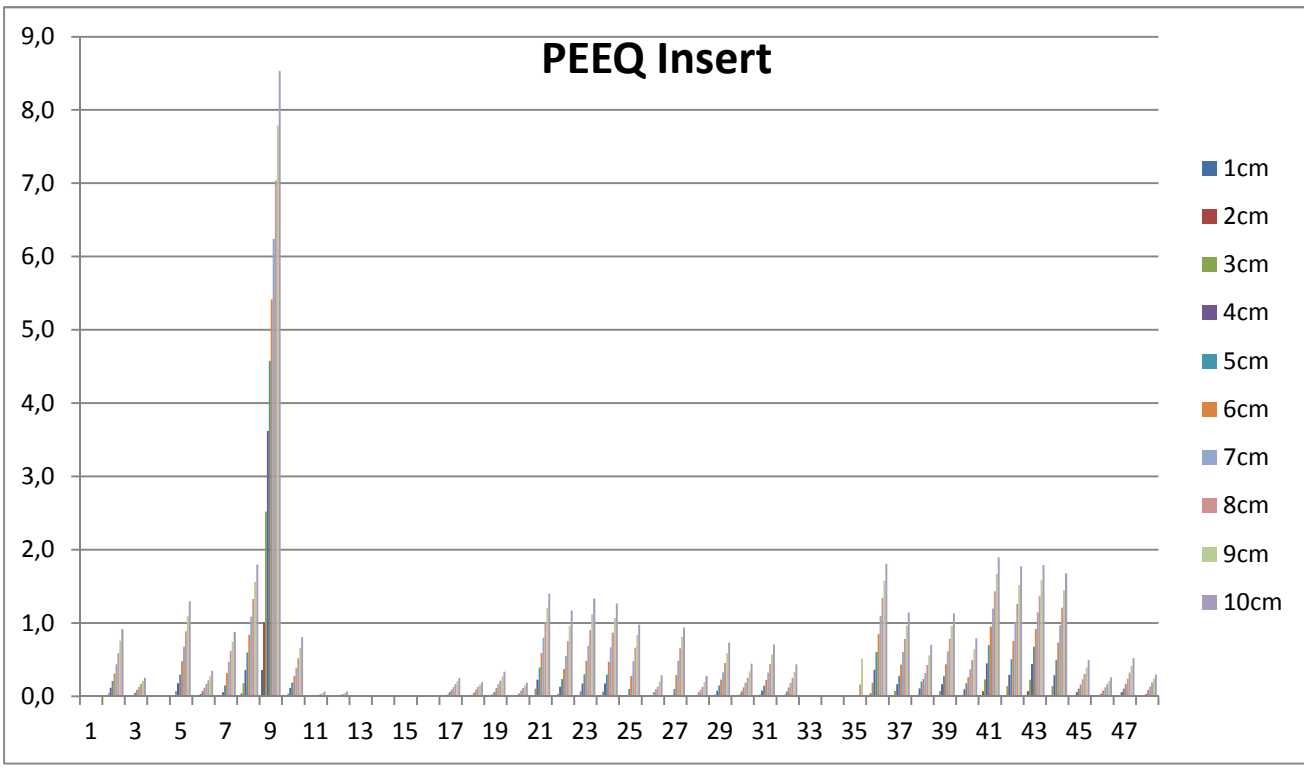

Figure A13-21. Plastic equivalent strain, PEEQ, [%] in cast iron insert, versus case number as specified in table A13-21.

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Table A13-22. Plastic equivalent strain, PEEQ, [%] for insert channels.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 - N2b_finer_1sekm	0.00	0.00	0.00	0.06	0.15	0.26	0.40	0.56	0.73	0.90
3 - N3b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.11	0.15	0.20
4 - N4b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.05	0.08	0.09	0.10	0.09
5 - N5b_finer_1sekm	0.00	0.00	0.01	0.12	0.25	0.44	0.65	0.86	1.08	1.29
6 - N6b_finer_1sekm	0.00	0.00	0.00	0.00	0.03	0.08	0.11	0.16	0.22	0.30
7 - N7b_finer_1sekm	0.00	0.01	0.10	0.24	0.46	0.79	1.06	1.33	1.60	1.86
8 - N8b_finer_1sekm	0.00	0.04	0.16	0.48	1.02	1.53	2.04	2.48	2.89	3.26
9 - N8b_b_finer_1sekm+r1	0.10	0.16	0.22	0.32	0.48	0.74	1.05	1.37	1.71	2.10
10 - N9b_finer_1sekm	0.00	0.00	0.09	0.12	0.23	0.40	0.65	0.90	1.19	1.50
11- N10b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.05	0.09	0.10	0.11	0.16
12 - N11b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.05	0.09	0.11	0.11	0.16
13 - N12b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14 - N13b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15 - N14b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16 - N15b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 - N16b_finer_1sekm+r1	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.09	0.13	0.17
18 - N17b_finer_1sekm+r1	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.10	0.12	0.15
19 - N18b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.04	0.09	0.14	0.20	0.27
20 - N19b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.10	0.11	0.14
21 - N20b_finer_1sekm	0.00	0.00	0.03	0.15	0.32	0.53	0.74	0.95	1.16	1.36
22 - N21b_finer_1sekm	0.00	0.00	0.02	0.10	0.20	0.34	0.54	0.75	0.97	1.20
23 - N22b_finer_1sekm	0.00	0.00	0.01	0.12	0.25	0.44	0.66	0.88	1.10	1.32
24 - N23b_finer_1sekm	0.00	0.00	0.01	0.12	0.25	0.43	0.64	0.85	1.06	1.26
25 - N24b_finer_1sekm	0.00	0.00	0.01	0.10	0.31	0.73	1.08	1.42	1.77	2.05
26 - N25b_finer_1sekm	0.00	0.00	0.01	0.10	0.16	0.25	0.33	0.42	0.62	0.82
27 - N26b_finer_1sekm	0.00	0.00	0.01	0.10	0.31	0.76	1.07	1.40	1.72	1.99
28 - N27b_finer_1sekm	0.00	0.00	0.01	0.10	0.16	0.25	0.33	0.42	0.61	0.80
29 - N28b_finer_1sekm	0.00	0.00	0.00	0.04	0.11	0.20	0.42	0.63	0.85	1.06
30 - N29b_finer_1sekm	0.00	0.00	0.00	0.04	0.11	0.13	0.20	0.27	0.38	0.51
31 - N30b_finer_1sekm	0.00	0.00	0.00	0.04	0.11	0.20	0.42	0.63	0.83	1.04
32 - N31b_finer_1sekm	0.00	0.00	0.00	0.04	0.11	0.13	0.20	0.27	0.38	0.51
33 - N32b_finer_1sekm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34 - N33b_finer_1sekm+r1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
35 - N34b_finer_1sekm+r1	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.122	
36 - N35b_finer_1sekm	0.00	0.06	0.19	0.58	1.06	1.51	1.95	2.37	2.76	3.11
37 - N36b_finer_1sekm	0.00	0.00	0.00	0.09	0.21	0.37	0.54	0.73	0.91	1.09
38 - N37b_finer_1sekm	0.00	0.00	0.01	0.10	0.16	0.20	0.29	0.40	0.55	0.70
39 - N38b_finer_1sekm	0.00	0.00	0.00	0.09	0.21	0.37	0.55	0.73	0.91	1.08
40 - N39b_finer_1sekm	0.00	0.00	0.00	0.08	0.14	0.23	0.34	0.48	0.63	0.80
41 - N40b_finer_1sekm	0.00	0.04	0.20	0.78	1.30	1.87	2.36	2.79	3.18	3.53
42 - N41b_finer_1sekm	0.00	0.04	0.15	0.34	0.73	1.24	1.75	2.16	2.60	3.00
43 - N42b_finer_1sekm	0.00	0.04	0.20	0.77	1.27	1.81	2.28	2.68	3.06	3.39
44 - N43b_finer_1sekm	0.00	0.04	0.15	0.34	0.73	1.22	1.68	2.12	2.54	2.92
45 - N44b_finer_1sekm	0.00	0.00	0.00	0.00	0.03	0.08	0.16	0.24	0.33	0.43
46 - N45b_finer_1sekm	0.00	0.00	0.00	0.00	0.03	0.09	0.10	0.12	0.17	0.22
47 - N46b_finer_1sekm	0.00	0.00	0.00	0.00	0.03	0.10	0.17	0.26	0.35	0.46
48 - N47b_finer_1sekm	0.00	0.00	0.00	0.00	0.03	0.09	0.10	0.15	0.20	0.27

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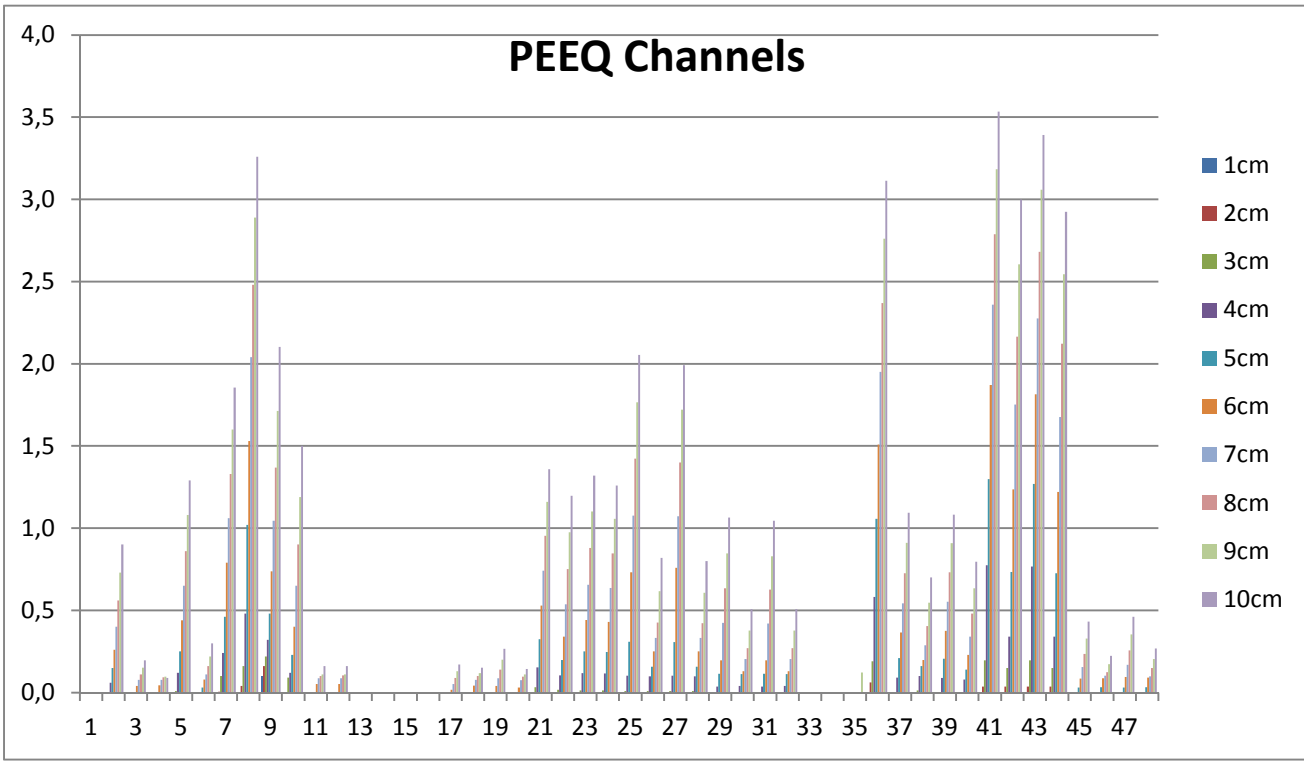

Figure A13-22. Plastic equivalent strain, PEEQ, [%] in insert channels, versus case number as specified in table A13-22.

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Table A13-23. Axial stress, S33, [MPa] for cast iron insert.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	63.4	77.2	98.2	111.9	121.9	128.9	134.3	138.6	142.1	145.2
2 - N2b_finer_1sekm	118.1	229.6	290.9	296.4	300.4	305.5	310.6	314.7	318.3	322.0
3 - N3b_finer_1sekm	84.3	164.5	228.1	279.2	287.7	290.2	292.3	293.8	295.1	296.7
4 - N4b_finer_1sekm	85.5	91.1	122.4	144.7	160.8	173.2	182.6	190.0	196.3	201.3
5 - N5b_finer_1sekm	123.3	243.4	294.1	300.8	309.9	317.2	322.0	326.3	330.5	335.0
6 - N6b_finer_1sekm	90.9	176.3	244.3	288.2	292.1	294.6	296.8	298.9	301.8	304.9
7 - N7b_finer_1sekm	89.5	131.6	177.4	209.7	233.0	249.8	262.7	273.4	282.8	286.8
8 - N8b_finer_1sekm	138.1	286.3	302.1	310.5	318.4	323.4	328.5	334.1	339.8	345.0
9 - N8b_b_finer_1sekm+r1	87.8	228.1	302.7	312.3	319.4	326.3	331.4	335.1	338.5	341.8
10 - N9b_finer_1sekm	106.4	215.2	284.5	290.5	294.2	297.8	302.4	306.4	309.8	312.9
11- N10b_finer_1sekm	52.6	91.1	122.4	144.7	160.8	173.3	182.6	190.0	196.3	201.4
12 - N11b_finer_1sekm	52.6	91.1	122.4	144.7	160.8	173.3	182.6	190.0	196.3	201.4
13 - N12b_finer_1sekm	63.4	77.2	98.2	111.9	121.9	129.0	134.3	138.6	142.2	145.2
14 - N13b_finer_1sekm	63.4	77.2	98.2	111.9	121.9	129.0	134.3	138.6	142.2	145.2
15 - N14b_finer_1sekm	63.4	77.2	98.2	111.9	121.9	129.0	134.3	138.6	142.2	145.2
16 - N15b_finer_1sekm	63.4	77.2	98.2	111.9	121.9	129.0	134.3	138.6	142.2	145.2
17 - N16b_finer_1sekm+r1	82.6	156.7	214.5	250.2	252.9	254.6	256.8	258.4	259.8	261.3
18 - N17b_finer_1sekm+r1	85.1	164.8	228.4	279.1	318.8	322.2	324.5	325.6	326.3	327.2
19 - N18b_finer_1sekm	83.0	157.8	216.3	250.7	253.5	257.7	260.5	262.7	265.1	267.5
20 - N19b_finer_1sekm	83.0	157.8	216.3	262.4	301.9	321.2	324.2	325.7	326.7	327.8
21 - N20b_finer_1sekm	123.3	243.5	261.7	270.6	279.5	285.1	289.8	295.5	301.3	306.9
22 - N21b_finer_1sekm	123.3	243.4	324.9	332.5	339.0	347.1	353.4	358.0	361.9	365.4
23 - N22b_finer_1sekm	123.3	243.4	294.0	300.5	309.2	316.0	320.3	324.0	327.7	330.9
24 - N23b_finer_1sekm	123.3	243.4	294.3	301.3	310.6	318.3	323.7	328.6	334.0	339.6
25 - N24b_finer_1sekm	53.4	115.0	163.6	200.0	226.1	245.7	254.4	255.1	255.6	255.8
26 - N25b_finer_1sekm	43.9	115.0	163.6	200.1	226.1	247.6	262.6	274.3	284.2	291.1
27 - N26b_finer_1sekm	53.4	115.0	163.6	200.0	226.1	247.6	254.7	255.4	256.0	256.4
28 - N27b_finer_1sekm	53.4	115.0	163.6	200.1	226.1	247.6	262.6	274.3	284.2	291.1
29 - N28b_finer_1sekm	89.0	187.4	254.4	259.8	264.4	270.1	275.9	279.9	283.0	285.5
30 - N29b_finer_1sekm	89.0	187.4	261.0	321.4	328.1	331.5	335.8	340.0	344.7	348.8
31 - N30b_finer_1sekm	89.0	187.4	254.5	260.3	265.5	271.1	277.5	282.2	286.1	289.4
32 - N31b_finer_1sekm	89.0	187.4	261.0	321.5	328.4	332.4	336.6	341.2	346.3	351.0
33 - N32b_finer_1sekm	37.5	37.4	42.2	55.0	66.4	85.7	99.1	111.3	122.4	132.2
34 - N33b_finer_1sekm+r1	23.1	35.7	52.0	66.2	79.3	91.0	101.2	110.6		
35 - N34b_finer_1sekm+r1	29.0	70.0	94.0	107.1	112.0	117.5	153.5	118.6	112.7	
36 - N35b_finer_1sekm	144.1	288.0	302.0	310.7	318.5	323.9	329.3	335.0	340.9	346.4
37 - N36b_finer_1sekm	118.1	229.5	259.2	264.5	269.6	274.9	279.0	282.8	286.9	291.2
38 - N37b_finer_1sekm	113.1	229.6	322.4	330.3	333.4	333.3	337.0	341.1	344.3	346.8
39 - N38b_finer_1sekm	118.1	229.5	259.6	265.6	271.5	279.2	284.6	289.9	295.2	300.7
40 - N39b_finer_1sekm	116.6	230.6	321.3	329.9	333.6	337.5	342.8	347.7	351.6	355.2
41 - N40b_finer_1sekm	138.1	258.2	269.0	277.5	283.2	288.2	293.7	299.4	305.2	310.5
42 - N41b_finer_1sekm	138.1	289.4	334.2	340.4	350.5	355.7	359.1	362.2	365.5	368.6
43 - N42b_finer_1sekm	138.1	258.4	270.4	280.4	287.7	294.4	301.5	308.8	316.0	322.8
44 - N43b_finer_1sekm	138.1	289.4	335.0	342.1	352.7	359.2	363.9	368.4	373.5	378.7
45 - N44b_finer_1sekm	90.8	176.3	244.5	256.8	259.7	262.8	265.6	269.1	270.9	272.8
46 - N45b_finer_1sekm	90.8	176.3	244.3	299.2	323.3	326.2	328.0	329.6	330.9	332.6
47 - N46b_finer_1sekm	90.8	176.3	244.5	257.1	260.4	265.0	268.2	271.7	274.5	277.0
48 - N47b_finer_1sekm	90.8	176.3	244.3	299.2	323.4	327.8	330.1	332.2	334.2	336.9

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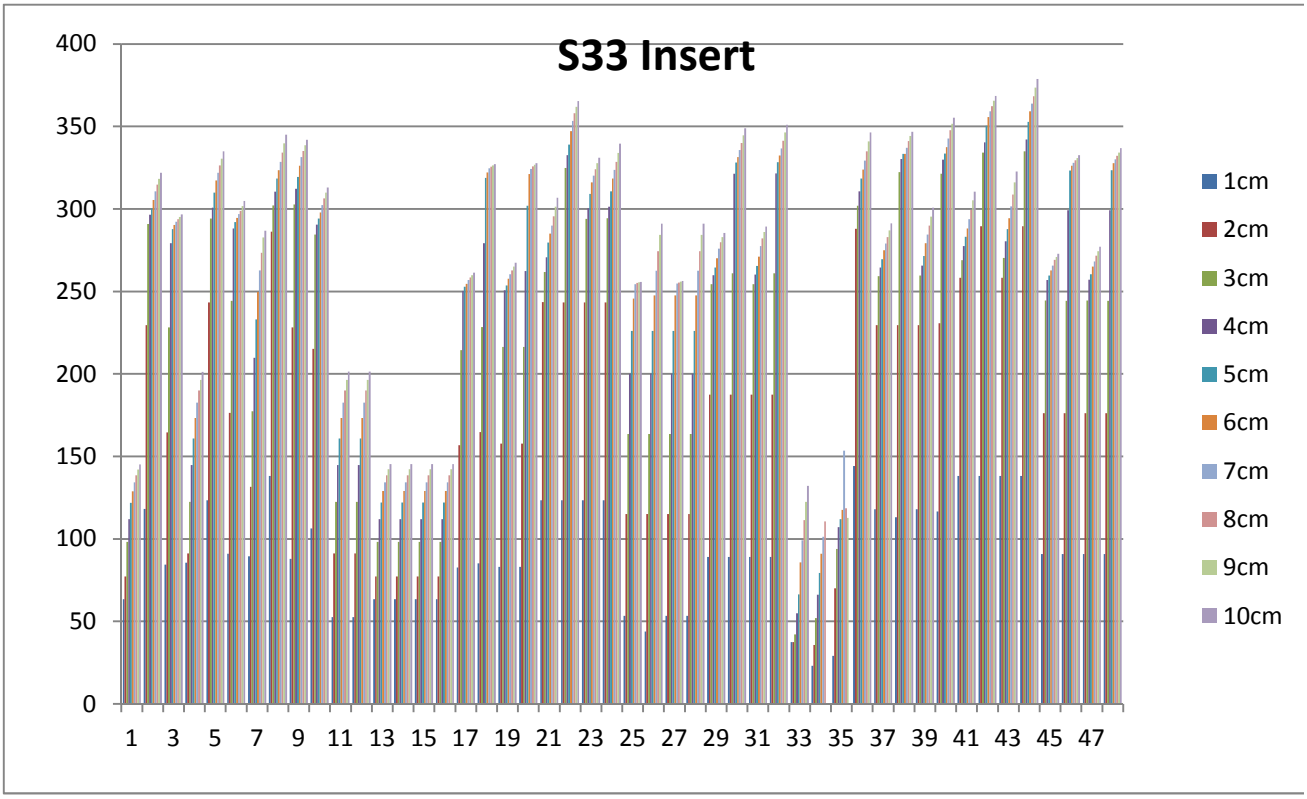

Figure A13-23. Axial stress, S33, [MPa] in cast iron insert, versus case number as specified in table A13-19.

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Table A13-24. Axial stress, S33, [MPa] for insert channels.

Case	1cm	2cm	3cm	4cm	5cm	6cm	7cm	8cm	9cm	10cm
1 - N1b_finer_1sekm	38.8	77.5	101.2	116.6	126.4	133.1	138.6	143.3	147.1	150.3
2 - N2b_finer_1sekm	118.7	237.7	339.3	415.7	429.7	439.9	446.3	449.7	451.5	452.9
3 - N3b_finer_1sekm	82.8	166.4	233.4	287.2	343.6	401.1	406.6	410.9	415.2	419.3
4 - N4b_finer_1sekm	45.2	93.8	127.9	152.3	169.3	181.5	191.4	199.5	206.3	211.6
5 - N5b_finer_1sekm	127.7	256.1	389.2	429.9	444.8	453.2	457.4	459.9	461.7	463.3
6 - N6b_finer_1sekm	92.9	183.0	255.1	314.8	386.6	415.2	424.2	430.3	435.3	440.4
7 - N7b_finer_1sekm	54.7	127.4	178.3	213.1	237.4	255.2	268.8	279.7	289.3	297.4
8 - N8b_finer_1sekm	134.9	293.8	418.3	441.3	451.3	455.4	460.3	464.3	467.3	468.9
9 - N8b_b_finer_1sekm+r1	156.1	177.7	277.8	376.5	383.1	387.4	390.1	392.9	394.8	396.4
10 - N9b_finer_1sekm	103.5	214.4	301.4	399.4	408.1	417.3	425.3	430.1	432.7	434.4
11- N10b_finer_1sekm	45.2	93.8	127.9	152.3	169.3	181.6	191.4	199.5	206.3	211.7
12 - N11b_finer_1sekm	45.2	93.8	127.9	152.3	169.3	181.6	191.5	199.5	206.3	211.7
13 - N12b_finer_1sekm	38.8	77.5	101.2	116.6	126.4	133.1	138.7	143.3	147.1	150.4
14 - N13b_finer_1sekm	38.8	77.5	101.3	116.6	126.4	133.1	138.7	143.3	147.1	150.3
15 - N14b_finer_1sekm	38.8	77.5	101.3	116.6	126.4	133.1	138.7	143.3	147.1	150.3
16 - N15b_finer_1sekm	38.8	77.5	101.2	116.6	126.4	133.1	138.7	143.3	147.1	150.3
17 - N16b_finer_1sekm+r1	81.2	158.7	219.5	268.2	329.0	388.8	402.0	406.9	411.5	415.7
18 - N17b_finer_1sekm+r1	84.0	166.9	233.9	287.3	334.6	385.2	406.2	409.3	412.3	415.4
19 - N18b_finer_1sekm	81.6	159.7	221.4	271.0	334.1	399.9	406.8	413.2	418.7	422.8
20 - N19b_finer_1sekm	81.6	159.7	221.4	269.8	311.8	369.9	404.6	408.5	411.6	414.5
21 - N20b_finer_1sekm	127.7	256.2	412.9	434.6	448.1	453.3	456.0	457.4	458.4	459.6
22 - N21b_finer_1sekm	127.7	256.1	368.9	426.5	440.2	450.6	457.1	460.8	463.4	465.7
23 - N22b_finer_1sekm	127.6	256.1	389.3	430.0	445.2	454.0	458.5	461.3	463.4	465.3
24 - N23b_finer_1sekm	127.6	256.1	389.1	429.7	444.4	452.6	456.5	458.7	460.1	461.4
25 - N24b_finer_1sekm	51.2	120.9	173.3	211.5	239.7	260.7	276.6	290.4	304.0	315.7
26 - N25b_finer_1sekm	51.2	120.9	173.3	211.6	239.7	262.9	278.9	291.4	301.9	309.3
27 - N26b_finer_1sekm	51.2	120.9	173.3	211.5	239.7	262.7	279.2	293.4	307.7	320.2
28 - N27b_finer_1sekm	51.2	120.9	173.3	211.6	239.7	262.9	278.9	291.4	301.9	309.3
29 - N28b_finer_1sekm	92.6	197.2	278.2	380.1	425.1	438.4	449.6	455.8	458.7	459.9
30 - N29b_finer_1sekm	92.6	197.2	277.3	344.6	417.8	431.1	439.2	446.9	453.4	458.7
31 - N30b_finer_1sekm	92.6	197.2	278.2	379.7	424.9	437.8	448.7	454.5	457.0	457.7
32 - N31b_finer_1sekm	92.6	197.2	277.4	344.6	417.8	430.8	438.7	446.2	452.5	457.4
33 - N32b_finer_1sekm	10.7	25.2	40.1	53.3	64.9	84.2	98.5	111.3	122.8	133.0
34 - N33b_finer_1sekm+r1	10.1	32.0	49.3	64.2	77.9	90.1	100.7	110.4		
35 - N34b_finer_1sekm+r1	7.9	32.3	50.0	66.4	81.6	81.6	80.9	81.6	83.0	
36 - N35b_finer_1sekm	140.9	302.6	416.8	441.0	450.8	456.2	460.6	464.1	466.7	468.3
37 - N36b_finer_1sekm	118.7	237.7	364.2	420.4	435.4	443.8	447.0	448.9	450.4	451.2
38 - N37b_finer_1sekm	113.5	238.9	345.8	418.7	433.7	435.4	442.6	448.4	453.1	455.4
39 - N38b_finer_1sekm	118.7	237.7	363.6	420.1	434.7	445.2	448.9	450.4	451.1	451.4
40 - N39b_finer_1sekm	117.1	239.5	341.3	415.6	430.0	439.8	447.2	452.4	455.4	457.0
41 - N40b_finer_1sekm	134.8	302.9	420.1	441.9	450.7	456.3	460.6	463.8	465.9	466.9
42 - N41b_finer_1sekm	134.8	292.8	416.4	439.4	453.7	460.1	463.3	465.3	469.0	472.3
43 - N42b_finer_1sekm	134.8	302.8	419.7	441.5	449.9	454.8	458.5	460.9	462.3	462.6
44 - N43b_finer_1sekm	134.8	292.8	416.3	438.8	452.6	458.2	460.5	462.8	466.6	469.1
45 - N44b_finer_1sekm	92.9	182.9	255.2	332.3	409.0	420.2	430.7	437.9	440.7	441.4
46 - N45b_finer_1sekm	92.9	182.9	255.1	313.7	365.7	411.6	419.6	426.3	430.6	435.8
47 - N46b_finer_1sekm	92.9	182.9	255.2	332.0	409.0	422.4	431.8	437.6	438.2	439.0
48 - N47b_finer_1sekm	92.9	182.9	255.1	313.7	365.7	414.1	423.2	429.7	433.4	438.4

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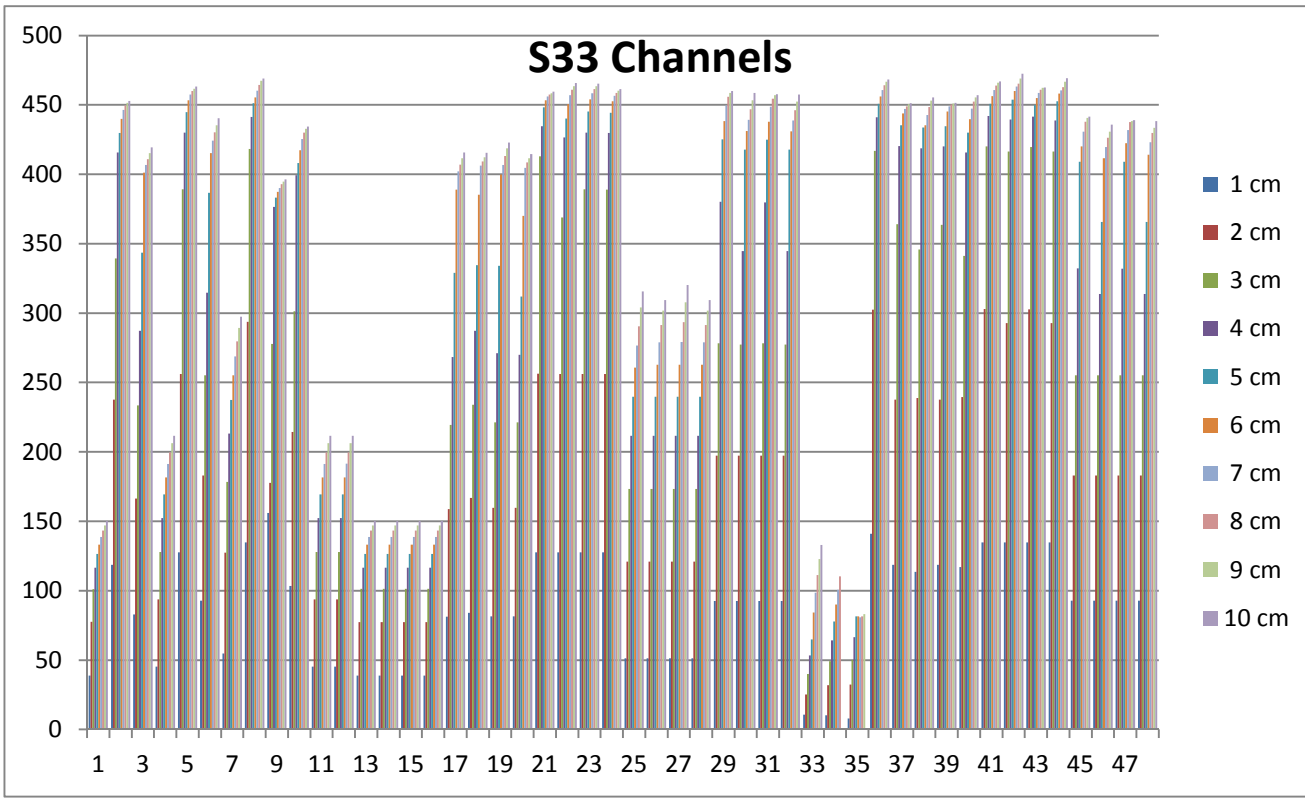

Figure A13-24. Axial stress, S33, [MPa] in insert channels, versus case number as specified in table A13-24.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 14 – sorted results for the copper shell

Mises stress and plastic equivalent strain for 9 regions in the copper shell at 5 cm shearing

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table A14-1. Mises stress [MPa] for copper shell sorted for each region at 5 cm shearing

Case	region 1	Case	region 2	Case	region 3	Case	region 4	Case	region 5	Case	region 6	Case	region 7	Case	region 8	Case	region 9
N31	167.07	N8_b	224.00	N34	152.87	N29	295.62	N35	254.77	N9	173.90	N27	102.93	N6	182.20	N21	112.50
N29	167.00	N37	158.83	N6	151.70	N31	295.59	N7	234.40	N34	160.04	N25	102.93	N47	182.19	N17	111.51
N9	165.10	N29	158.17	N45	150.94	N30	292.93	N8_b	204.30	N29	150.13	N26	102.92	N44	182.18	N45	110.84
N30	162.98	N31	158.15	N47	150.94	N28	292.89	N8	201.90	N31	150.12	N24	102.92	N45	182.17	N47	110.84
N28	162.93	N30	156.19	N44	150.47	N47	247.57	N41	201.58	N30	148.52	N7	94.20	N46	182.17	N37	110.36
N7	143.30	N28	156.16	N46	150.47	N45	247.56	N43	201.21	N28	148.50	N4	87.20	N9	145.40	N3	110.27
N47	130.76	N9	151.00	N7	149.80	N6	247.00	N42	201.01	N45	135.79	N10	87.20	N34	145.18	N23	110.10
N45	130.75	N20	141.27	N42	146.72	N46	245.89	N40	200.80	N47	135.79	N11	87.20	N8_b	128.30	N5	109.90
N6	130.70	N5	138.50	N40	146.45	N44	245.87	N9	194.20	N6	135.50	N8	85.40	N31	127.58	N25	109.86
N46	130.42	N23	138.49	N8	146.30	N9	231.70	N37	184.25	N46	134.71	N36	83.84	N29	127.57	N27	109.85
N44	130.42	N22	138.23	N43	145.42	N34	221.57	N39	183.71	N44	134.70	N38	83.74	N30	126.44	N22	109.82
N2	128.00	N36	136.51	N41	145.31	N17	158.42	N21	183.10	N7	130.70	N43	83.22	N28	126.44	N24	109.78
N32	123.10	N38	136.29	N8_b	134.20	N8_b	146.90	N2	182.50	N3	109.35	N41	83.03	N17	122.96	N26	109.78
N34	122.04	N21	135.85	N28	130.95	N3	142.09	N27	181.96	N17	109.17	N20	82.97	N2	120.20	N6	109.40
N17	120.86	N39	132.91	N30	130.94	N25	132.80	N25	181.95	N33	105.71	N39	82.70	N38	119.79	N20	109.30
N33	119.89	N34	130.34	N29	130.14	N27	132.75	N26	181.93	N25	105.64	N2	82.50	N36	119.45	N8_b	107.00
N8_b	119.50	N2	128.00	N31	130.13	N24	132.59	N24	181.92	N27	105.63	N37	82.25	N40	117.18	N19	106.04
N18	114.33	N45	125.73	N27	128.55	N26	132.51	N17	181.83	N24	105.61	N12	82.23	N42	117.07	N18	105.55
N19	114.32	N47	125.72	N25	128.55	N7	131.90	N23	181.22	N26	105.60	N15	82.23	N35	116.63	N9	105.20
N16	113.74	N6	125.40	N26	128.51	N19	125.08	N5	181.10	N19	105.17	N13	82.23	N21	116.27	N39	105.02
N3	113.68	N46	124.79	N24	128.51	N33	125.00	N22	181.03	N18	104.93	N14	82.23	N8	115.60	N16	104.96
N24	111.11	N44	124.78	N35	108.52	N18	124.44	N38	181.02	N16	104.42	N35	82.21	N41	113.90	N46	104.22
N26	111.10	N17	105.86	N39	101.66	N16	121.89	N36	180.96	N32	99.10	N1	82.20	N43	113.73	N44	104.15
N25	110.85	N25	105.33	N2	101.50	N32	119.70	N20	174.72	N4	96.35	N5	81.90	N33	113.65	N28	103.90
N27	110.84	N27	105.33	N38	101.14	N43	119.63	N15	174.10	N10	96.35	N23	81.90	N23	111.51	N30	103.82
N40	109.70	N24	105.32	N36	101.10	N41	119.61	N1	174.10	N11	96.35	N22	81.88	N4	111.50	N29	103.36
N42	109.56	N26	105.32	N14	100.93	N8	119.60	N12	174.10	N1	92.50	N21	81.81	N5	111.50	N31	103.36
N12	108.62	N3	104.42	N13	100.92	N42	119.17	N14	174.03	N13	92.46	N8_b	80.80	N10	111.50	N4	101.40
N15	108.61	N33	101.77	N15	100.92	N40	119.02	N13	174.03	N14	92.46	N42	79.61	N11	111.50	N10	101.30
N13	108.61	N19	101.69	N12	100.92	N12	110.62	N4	173.70	N15	92.46	N40	79.24	N7	111.40	N11	101.30
N14	108.60	N18	101.55	N1	100.90	N15	110.62	N10	173.70	N12	92.46	N9	71.70	N22	110.83	N34	99.37
N1	108.60	N16	101.14	N37	100.32	N13	110.62	N11	173.70	N8_b	91.90	N17	68.52	N20	109.74	N7	98.50
N8	108.50	N7	98.50	N5	99.80	N14	110.62	N3	160.44	N43	89.94	N31	67.77	N12	109.61	N33	96.45
N38	106.58	N4	95.90	N22	99.75	N1	110.60	N18	160.26	N41	89.34	N29	67.76	N15	109.61	N8	88.80
N36	105.44	N10	95.90	N11	99.75	N37	110.02	N16	160.25	N2	85.30	N30	64.55	N13	109.60	N35	88.67
N4	104.90	N11	95.90	N23	99.73	N35	108.06	N19	160.16	N38	84.79	N28	64.51	N14	109.60	N41	88.28
N10	104.90	N32	95.80	N4	99.70	N4	106.90	N47	159.59	N36	84.76	N19	60.41	N1	109.60	N43	88.16
N11	104.90	N40	94.72	N10	99.70	N10	106.90	N45	159.59	N37	84.17	N3	60.30	N26	108.84	N42	87.84
N41	104.31	N42	94.53	N20	99.57	N11	106.90	N6	158.70	N39	84.04	N18	59.46	N24	108.81	N36	87.44
N43	104.19	N1	94.00	N21	99.34	N36	105.83	N46	156.46	N8	83.80	N16	59.32	N27	108.78	N38	87.42
N22	102.93	N13	93.95	N17	98.39	N38	105.79	N44	156.43	N20	83.45	N47	53.44	N25	108.73	N1	87.30
N5	102.90	N14	93.95	N9	96.20	N2	104.40	N31	153.06	N23	83.11	N45	53.44	N3	104.15	N12	87.30
N23	102.86	N12	93.95	N3	95.85	N39	103.92	N29	153.05	N22	83.11	N6	52.70	N32	99.20	N15	87.30
N21	101.57	N15	93.95	N19	94.01	N20	103.73	N30	147.08	N5	83.10	N46	51.35	N37	95.34	N13	87.30
N35	101.50	N8	92.05	N18	93.75	N22	102.24	N28	147.00	N35	83.04	N44	51.33	N39	93.07	N14	87.29
N20	96.59	N41	90.87	N16	93.49	N23	102.22	N32	141.40	N21	82.95	N32	29.90	N19	91.42	N40	87.14
N39	94.99	N43	90.86	N33	88.16	N5	102.20	N33	119.90	N42	82.31	N34	29.43	N18	91.31	N2	87.10
N37	94.76	N35	89.42	N32	86.90	N21	101.93	N34	106.48	N40	82.21	N33	25.05	N16	91.23	N32	80.20

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Table A14-2. Plastic equivalent strain, PEEQ, [%] for copper shell sorted for each region at 5 cm shearing.

Case	region 1	Case	region 2	Case	region 3	Case	region 4	Case	region 5	Case	region 6	Case	region 7	Case	region 8	Case	region 9
N31	7.573	N29	17.728	N35	5.993	N9	33.320	N35	22.840	N9	9.280	N27	2.153	N9	6.110	N25	2.703
N29	7.572	N31	17.726	N27	3.679	N29	32.708	N7	20.100	N34	7.592	N25	2.153	N34	5.540	N27	2.703
N30	7.342	N30	17.210	N25	3.679	N31	32.696	N8_b	16.270	N29	6.561	N26	2.152	N31	4.390	N24	2.702
N28	7.340	N28	17.204	N26	3.675	N30	31.726	N43	15.927	N31	6.561	N24	2.152	N29	4.390	N26	2.702
N9	6.630	N9	15.400	N24	3.675	N28	31.712	N41	15.923	N30	6.395	N7	1.400	N30	4.227	N7	2.095
N47	4.237	N34	11.440	N7	3.360	N47	19.601	N8	15.870	N28	6.393	N4	0.780	N28	4.225	N4	1.750
N45	4.237	N45	9.896	N31	3.125	N45	19.600	N40	15.862	N47	5.148	N10	0.780	N8_b	3.500	N10	1.750
N6	4.200	N47	9.894	N29	3.125	N6	19.500	N42	15.861	N45	5.148	N11	0.780	N7	3.170	N11	1.750
N46	4.118	N6	9.835	N30	3.121	N46	19.270	N9	15.840	N6	5.120	N1	0.270	N40	3.147	N35	1.568
N44	4.117	N46	9.695	N28	3.121	N44	19.267	N17	15.735	N46	5.043	N12	0.270	N42	3.142	N21	1.263
N34	3.108	N44	9.693	N43	2.722	N34	14.744	N37	12.990	N44	5.042	N15	0.270	N8	3.050	N1	1.210
N7	1.810	N8_b	8.750	N41	2.721	N17	11.888	N39	12.847	N7	4.730	N13	0.270	N47	2.949	N12	1.209
N33	1.730	N25	5.960	N13	2.704	N3	9.890	N36	12.763	N3	2.808	N14	0.270	N45	2.949	N15	1.209
N17	1.689	N27	5.959	N14	2.704	N25	7.111	N38	12.763	N17	2.796	N21	0.241	N6	2.930	N13	1.209
N3	1.589	N24	5.957	N12	2.704	N27	7.104	N2	12.760	N25	2.550	N23	0.185	N46	2.891	N14	1.208
N8_b	1.580	N26	5.957	N15	2.704	N24	7.103	N21	12.524	N27	2.549	N22	0.183	N44	2.891	N23	1.204
N25	1.554	N17	5.648	N1	2.700	N26	7.096	N5	12.480	N24	2.548	N5	0.180	N41	1.867	N22	1.202
N27	1.553	N3	5.367	N4	2.700	N19	7.027	N23	12.480	N26	2.547	N39	0.148	N43	1.865	N5	1.200
N24	1.552	N33	5.072	N8	2.700	N18	6.921	N22	12.477	N33	2.504	N2	0.140	N17	1.725	N39	1.112
N26	1.551	N19	4.888	N10	2.700	N16	6.538	N20	12.160	N19	2.452	N37	0.126	N3	1.594	N2	1.100
N32	1.490	N18	4.860	N11	2.700	N7	5.820	N1	11.480	N18	2.434	N8_b	0.110	N25	1.470	N37	1.090
N19	1.385	N16	4.781	N42	2.682	N33	3.462	N13	11.479	N16	2.396	N20	0.107	N27	1.469	N20	1.084
N18	1.380	N7	4.270	N40	2.681	N8_b	3.300	N15	11.478	N32	1.980	N38	0.105	N24	1.469	N38	1.064
N16	1.369	N4	3.900	N34	2.631	N32	3.080	N12	11.478	N4	1.750	N36	0.104	N26	1.468	N36	1.063
N2	1.100	N10	3.895	N9	2.580	N1	1.890	N14	11.477	N10	1.750	N43	0.070	N33	1.400	N43	0.906
N40	1.080	N11	3.895	N5	2.530	N13	1.886	N3	11.445	N11	1.750	N41	0.069	N19	1.345	N41	0.903
N42	1.069	N32	3.830	N21	2.526	N14	1.886	N19	11.275	N1	1.410	N8	0.050	N18	1.336	N8	0.850
N8	1.020	N40	3.659	N22	2.526	N12	1.886	N18	11.262	N13	1.407	N42	0.033	N16	1.326	N42	0.828
N35	0.997	N42	3.653	N23	2.526	N15	1.886	N16	11.241	N12	1.407	N40	0.032	N32	1.090	N40	0.825
N41	0.965	N8	3.570	N20	2.526	N4	1.790	N4	10.590	N15	1.407	N35	0.010	N4	0.990	N17	0.784
N43	0.958	N41	3.517	N47	2.514	N10	1.790	N10	10.590	N14	1.407	N3	0.000	N10	0.990	N8_b	0.720
N13	0.882	N43	3.516	N45	2.514	N11	1.790	N11	10.590	N8_b	0.720	N6	0.000	N11	0.990	N9	0.660
N14	0.882	N12	3.341	N6	2.510	N37	1.597	N47	10.545	N2	0.650	N9	0.000	N37	0.808	N3	0.586
N12	0.882	N13	3.341	N46	2.507	N39	1.546	N45	10.545	N39	0.618	N16	0.000	N1	0.780	N19	0.573
N15	0.882	N15	3.341	N44	2.507	N43	1.515	N6	10.360	N38	0.595	N17	0.000	N13	0.777	N18	0.568
N1	0.880	N14	3.341	N33	2.500	N41	1.514	N46	9.935	N36	0.593	N18	0.000	N14	0.777	N16	0.566
N4	0.850	N1	3.340	N37	2.467	N8	1.510	N27	9.929	N35	0.577	N19	0.000	N12	0.777	N47	0.463
N10	0.850	N37	3.215	N39	2.461	N42	1.510	N44	9.929	N37	0.566	N28	0.000	N15	0.777	N45	0.463
N11	0.850	N39	2.898	N17	2.450	N40	1.510	N25	9.929	N40	0.479	N29	0.000	N39	0.771	N6	0.450
N20	0.829	N20	2.604	N2	2.450	N35	1.476	N26	9.927	N42	0.477	N30	0.000	N35	0.739	N46	0.424
N37	0.771	N5	2.500	N32	2.450	N2	1.170	N24	9.925	N8	0.455	N31	0.000	N36	0.633	N44	0.423
N5	0.760	N22	2.498	N16	2.450	N36	1.141	N31	9.245	N21	0.453	N32	0.000	N38	0.633	N31	0.392
N22	0.757	N23	2.497	N18	2.450	N38	1.141	N29	9.244	N41	0.435	N33	0.000	N2	0.630	N29	0.392
N23	0.753	N36	2.478	N19	2.450	N20	0.811	N30	8.063	N43	0.435	N34	0.000	N20	0.511	N30	0.351
N36	0.747	N38	2.478	N3	2.450	N22	0.802	N28	8.049	N23	0.403	N44	0.000	N21	0.511	N28	0.351
N38	0.743	N2	2.460	N36	2.450	N23	0.802	N32	7.420	N22	0.401	N45	0.000	N22	0.511	N32	0.220
N39	0.735	N21	2.453	N38	2.450	N21	0.801	N33	4.241	N5	0.400	N46	0.000	N23	0.511	N33	0.103
N21	0.708	N35	2.120	N8_b	2.240	N5	0.800	N34	2.089	N20	0.346	N47	0.000	N5	0.510	N34	0.041

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Appendix 15 – sorted results for the cast iron insert

Mises stress [MPa], axial stress [MPa] and equivalent plastic strain, PEEQ, [%] sorted at 5 cm shearing.

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Table A15-1. Sorted results for the cast iron insert at 5 cm shearing..

Case	Mises Insert	Case	Mises channels	Case	peeq insert %	Case	peeq channels %	Case	s33 insert	Case	s33 channels
N8_b	405.6	N8_b	753.4	N8_b	4.58	N40	1.30	N43	352.7	N41	453.7
N43	337.7	N29	476.8	N40	0.70	N42	1.27	N41	350.5	N43	452.6
N41	333.8	N31	476.8	N42	0.68	N35	1.06	N21	339.0	N8	451.3
N21	324.4	N43	472.4	N35	0.60	N8	1.02	N39	333.6	N35	450.8
N39	322.6	N41	472.3	N8	0.60	N41	0.73	N37	333.4	N40	450.7
N37	321.7	N30	471.9	N41	0.51	N43	0.73	N31	328.4	N42	449.9
N31	318.6	N28	471.8	N43	0.50	N8_b	0.48	N29	328.1	N20	448.1
N29	318.0	N9	470.8	N20	0.39	N7	0.46	N47	323.4	N22	445.2
N47	317.0	N35	470.7	N22	0.30	N20	0.32	N45	323.3	N5	444.8
N45	316.7	N40	470.5	N5	0.30	N24	0.31	N8_b	319.4	N23	444.4
N17	316.0	N42	468.9	N23	0.30	N26	0.31	N17	318.8	N21	440.2
N19	315.4	N8	464.8	N36	0.28	N5	0.25	N35	318.5	N36	435.4
N25	311.4	N7	464.7	N38	0.28	N22	0.25	N8	318.4	N38	434.7
N27	311.4	N36	456.5	N21	0.24	N23	0.25	N23	310.6	N37	433.7
N35	306.4	N38	456.4	N2	0.21	N9	0.23	N5	309.9	N39	430.0
N8	306.1	N2	455.5	N37	0.20	N36	0.21	N22	309.2	N2	429.7
N23	295.7	N45	453.1	N9	0.19	N38	0.21	N19	301.9	N28	425.1
N5	294.5	N47	453.1	N39	0.18	N21	0.20	N2	300.4	N30	424.9
N22	293.3	N6	452.7	N7	0.15	N37	0.16	N9	294.2	N29	417.8
N2	289.4	N37	452.2	N28	0.15	N25	0.16	N6	292.1	N31	417.8
N7	289.0	N46	451.4	N30	0.15	N27	0.16	N3	287.7	N44	409.0
N9	288.7	N44	451.4	N44	0.11	N2	0.15	N42	287.7	N46	409.0
N6	284.1	N5	450.3	N46	0.11	N39	0.14	N40	283.2	N9	408.1
N3	283.3	N22	450.3	N24	0.10	N30	0.11	N20	279.5	N6	386.6
N42	279.0	N23	450.3	N26	0.10	N28	0.11	N38	271.5	N8_b	383.1
N40	273.7	N20	450.2	N6	0.07	N31	0.11	N36	269.6	N45	365.7
N20	265.3	N39	449.9	N29	0.07	N29	0.11	N30	265.5	N47	365.7
N38	260.7	N21	449.5	N31	0.07	N47	0.03	N28	264.4	N3	343.6
N36	258.4	N27	448.8	N18	0.06	N45	0.03	N46	260.4	N17	334.6
N30	254.1	N25	448.8	N16	0.06	N46	0.03	N44	259.7	N18	334.1
N26	254.1	N10	447.7	N3	0.05	N44	0.03	N18	253.5	N16	329.0
N24	253.4	N11	447.7	N45	0.04	N6	0.03	N16	252.9	N19	311.8
N28	252.8	N4	447.3	N47	0.04	N11	0.00	N7	233.0	N27	239.7
N46	251.9	N26	446.6	N17	0.02	N10	0.00	N25	226.1	N25	239.7
N44	251.0	N24	446.6	N25	0.01	N4	0.00	N27	226.1	N24	239.7
N18	249.7	N17	433.7	N27	0.01	N1	0.00	N24	226.1	N26	239.7
N16	249.1	N3	433.0	N11	0.01	N3	0.00	N26	226.1	N7	237.4
N34	228.5	N19	398.9	N4	0.01	N12	0.00	N4	160.8	N4	169.3
N4	217.6	N18	398.4	N10	0.01	N13	0.00	N10	160.8	N10	169.3
N10	213.1	N16	394.2	N19	0.00	N14	0.00	N11	160.8	N11	169.3
N11	213.1	N1	353.5	N1	0.00	N15	0.00	N12	121.9	N13	126.4
N13	171.0	N13	353.5	N12	0.00	N16	0.00	N13	121.9	N14	126.4
N14	171.0	N14	353.5	N13	0.00	N17	0.00	N15	121.9	N12	126.4
N12	171.0	N12	353.5	N14	0.00	N18	0.00	N14	121.9	N15	126.4
N15	171.0	N15	353.5	N15	0.00	N19	0.00	N1	121.9	N1	126.4
N1	171.0	N34	215.5	N32	0.00	N32	0.00	N34	112.0	N34	81.6
N33	129.6	N33	205.0	N33	0.00	N33	0.00	N33	79.3	N33	77.9
N32	98.7	N32	64.9	N34	0.00	N34	0.00	N32	66.4	N32	64.9

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Appendix 16 – Storage of files

This report is based on the results from a lot of FE-simulations using ABAQUS which is a commercial available code and is thus not stored as part of the work. Below is a short description of files used in the project and directories for storage of these. These files are also stored at SKB.

The files are stored in directories as:

geometry
Input-files
plots
Global analysis.docx - this report
scripts
subroutines

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

1 – Plot-files used in the report Contents in C:\Users\jhd\mappar\skb\Global\plots

Fig3-1.png	
Fig3-1.eps	
Fig3-2.png	
Fig3-2.eps	
Fig3-3.png	
Fig3-3.eps	
model6g_lid_mesh	- Fig 3-4
Fig3-5.png	
Fig3-5.eps	
Fig3-5.tif	
model6g_copper_mesh	- Fig 3-6
Fig9-1.png	
Fig9-1.eps	
Fig9-2.png	
Fig9-2.eps	
model6g_copper_output_regions	- Fig 9-3
N9b_finer_1sekm-copper-peeq_max.png	- Fig 9-4
N9b_finer_1sekm-copper_top_fillet-peeq_max.png	- Fig 9-5

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Plot files used in the report

Appendix 1

```
N1b_finer_1sekm 10cm deformed.png
N2b_finer_1sekm 10cm deformed.png
N3b_finer_1sekm 10cm deformed.png
N4b_finer_1sekm 10cm deformed.png
N5b_finer_1sekm 10cm deformed.png
N6b_finer_1sekm 10cm deformed.png
N7b_finer_1sekm 10cm deformed.png
N8b_finer_1sekm 10cm deformed.png
N8b_b_finer_1sekm 10cm deformed.png
N9b_finer_1sekm 10cm deformed.png
N10b_finer_1sekm 10cm deformed.png
N11b_finer_1sekm 10cm deformed.png
N12b_finer_1sekm 10cm deformed.png
N13b_finer_1sekm 10cm deformed.png
N14b_finer_1sekm 10cm deformed.png
N15b_finer_1sekm 10cm deformed.png
N16b_finer_1sekm 10cm deformed.png
N17b_finer_1sekm 10cm deformed.png
N18b_finer_1sekm 10cm deformed.png
N19b_finer_1sekm 10cm deformed.png
N20b_finer_1sekm 10cm deformed.png
N21b_finer_1sekm 10cm deformed.png
N22b_finer_1sekm 10cm deformed.png
N23b_finer_1sekm 10cm deformed.png
N24b_finer_1sekm 10cm deformed.png
N25b_finer_1sekm 10cm deformed.png
N26b_finer_1sekm 10cm deformed.png
N27b_finer_1sekm 10cm deformed.png
N28b_finer_1sekm 10cm deformed.png
N29b_finer_1sekm 10cm deformed.png
N30b_finer_1sekm 10cm deformed.png
N31b_finer_1sekm 10cm deformed.png
N32b_finer_1sekm 10cm deformed.png
N33b_finer_1sekm_r1 8cm deformed.png
N34b_finer_1sekm_r1 9cm deformed.png
N35b_finer_1sekm 10cm deformed.png
N36b_finer_1sekm 10cm deformed.png
N37b_finer_1sekm 10cm deformed.png
N38b_finer_1sekm 10cm deformed.png
N39b_finer_1sekm 10cm deformed.png
N40b_finer_1sekm 10cm deformed.png
N41b_finer_1sekm 10cm deformed.png
N42b_finer_1sekm 10cm deformed.png
N43b_finer_1sekm 10cm deformed.png
N44b_finer_1sekm 10cm deformed.png
N45b_finer_1sekm 10cm deformed.png
N46b_finer_1sekm 10cm deformed.png
N47b_finer_1sekm 10cm deformed.png
N48b_finer_1sekm 10cm deformed.png
```

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 2

```
N8b_finer_1sekm  5cm deformed.png
N8b_finer_1sekm  5cm maxPrin insert.png
N8b_finer_1sekm  5cm maxPrin insert_nochannels.png
N8b_finer_1sekm  5cm maxPrin insert_nochannels1.png
N8b_finer_1sekm  5cm maxPrin insert_nochannels2.png
N8b_finer_1sekm  5cm mises copper.png
N8b_finer_1sekm  5cm mises insert_channels.png
N8b_finer_1sekm  5cm mises insert_nochannels.png
N8b_finer_1sekm  5cm mises insert_nochannels1.png
N8b_finer_1sekm  5cm mises insert_nochannels2.png
N8b_finer_1sekm  5cm peeq copper.png
N8b_finer_1sekm  5cm peeq insert_channels.png
N8b_finer_1sekm  5cm peeq insert_nochannels.png
N8b_finer_1sekm  5cm peeq insert_nochannels1.png
N8b_finer_1sekm  5cm peeq insert_nochannels2.png
N8b_finer_1sekm  5cm S33 insert_channels.png
N8b_finer_1sekm  5cm S33 insert_nochannels.png
N8b_finer_1sekm  5cm S33 insert_nochannels1.png
N8b_finer_1sekm 10cm deformed.png
N8b_finer_1sekm 10cm maxPrin insert_channels.png
N8b_finer_1sekm 10cm maxPrin insert_nochannels.png
N8b_finer_1sekm 10cm maxPrin insert_nochannels1.png
N8b_finer_1sekm 10cm maxPrin insert_nochannels2.png
N8b_finer_1sekm 10cm mises copper.png
N8b_finer_1sekm 10cm mises insert_channels.png
N8b_finer_1sekm 10cm mises insert_nochannels.png
N8b_finer_1sekm 10cm mises insert_nochannels1.png
N8b_finer_1sekm 10cm mises insert_nochannels2.png
N8b_finer_1sekm 10cm peeq copper.png
N8b_finer_1sekm 10cm peeq insert_channels.png
N8b_finer_1sekm 10cm peeq insert_nochannels.png
N8b_finer_1sekm 10cm peeq insert_nochannels1.png
N8b_finer_1sekm 10cm peeq insert_nochannels2.png
N8b_finer_1sekm 10cm S33 insert_channels.png
N8b_finer_1sekm 10cm S33 insert_nochannels.png
N8b_finer_1sekm 10cm S33 insert_nochannels1.png
```

Appendix 3

```
N29b_finer_1sekm-copper-10cm-mises1.png
N29b_finer_1sekm-copper-10cm-mises2.png
N29b_finer_1sekm-copper-10cm-mises3.png
N29b_finer_1sekm-copper-10cm-peeq1.png
N29b_finer_1sekm-copper-10cm-peeq2.png
N29b_finer_1sekm-copper-10cm-peeq3.png
N29b_finer_1sekm-copper-10cm-s_max_prin1.png
N29b_finer_1sekm-copper-10cm-s_max_prin2.png
N29b_finer_1sekm-copper-10cm-s_max_prin3.png
N29b_finer_1sekm-copper-5cm-mises1.png
N29b_finer_1sekm-copper-5cm-mises2.png
N29b_finer_1sekm-copper-5cm-mises3.png
N29b_finer_1sekm-copper-5cm-peeq1.png
N29b_finer_1sekm-copper-5cm-peeq2.png
N29b_finer_1sekm-copper-5cm-peeq3.png
N29b_finer_1sekm-copper-5cm-s_max_prin1.png
N29b_finer_1sekm-copper-5cm-s_max_prin2.png
N29b_finer_1sekm-copper-5cm-s_max_prin3.png
```

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 4

N31b_finer_1sekm-copper-10cm-mises1.png
N31b_finer_1sekm-copper-10cm-mises2.png
N31b_finer_1sekm-copper-10cm-mises3.png
N31b_finer_1sekm-copper-10cm-peeq1.png
N31b_finer_1sekm-copper-10cm-peeq2.png
N31b_finer_1sekm-copper-10cm-peeq3.png
N31b_finer_1sekm-copper-10cm-s_max_prin1.png
N31b_finer_1sekm-copper-10cm-s_max_prin2.png
N31b_finer_1sekm-copper-10cm-s_max_prin3.png
N31b_finer_1sekm-copper-5cm-mises1.png
N31b_finer_1sekm-copper-5cm-mises2.png
N31b_finer_1sekm-copper-5cm-mises3.png
N31b_finer_1sekm-copper-5cm-peeq1.png
N31b_finer_1sekm-copper-5cm-peeq2.png
N31b_finer_1sekm-copper-5cm-peeq3.png
N31b_finer_1sekm-copper-5cm-s_max_prin1.png
N31b_finer_1sekm-copper-5cm-s_max_prin2.png
N31b_finer_1sekm-copper-5cm-s_max_prin3.png

Appendix 5

N9b_finer_1sekm-copper-10cm-mises1.png
N9b_finer_1sekm-copper-10cm-mises2.png
N9b_finer_1sekm-copper-10cm-mises3.png
N9b_finer_1sekm-copper-10cm-peeq1.png
N9b_finer_1sekm-copper-10cm-peeq2.png
N9b_finer_1sekm-copper-10cm-peeq3.png
N9b_finer_1sekm-copper-10cm-s_max_prin1.png
N9b_finer_1sekm-copper-10cm-s_max_prin2.png
N9b_finer_1sekm-copper-10cm-s_max_prin3.png
N9b_finer_1sekm-copper-5cm-mises1.png
N9b_finer_1sekm-copper-5cm-mises2.png
N9b_finer_1sekm-copper-5cm-mises3.png
N9b_finer_1sekm-copper-5cm-peeq1.png
N9b_finer_1sekm-copper-5cm-peeq2.png
N9b_finer_1sekm-copper-5cm-peeq3.png
N9b_finer_1sekm-copper-5cm-s_max_prin1.png
N9b_finer_1sekm-copper-5cm-s_max_prin2.png
N9b_finer_1sekm-copper-5cm-s_max_prin3.png

Appendix 6

N7b_finer_1sekm-copper-10cm-mises1.png
N7b_finer_1sekm-copper-10cm-mises2.png
N7b_finer_1sekm-copper-10cm-mises3.png
N7b_finer_1sekm-copper-10cm-peeq1.png
N7b_finer_1sekm-copper-10cm-peeq2.png
N7b_finer_1sekm-copper-10cm-peeq3.png
N7b_finer_1sekm-copper-10cm-s_max_prin1.png
N7b_finer_1sekm-copper-10cm-s_max_prin2.png
N7b_finer_1sekm-copper-10cm-s_max_prin3.png
N7b_finer_1sekm-copper-5cm-mises1.png
N7b_finer_1sekm-copper-5cm-mises2.png
N7b_finer_1sekm-copper-5cm-mises3.png
N7b_finer_1sekm-copper-5cm-peeq1.png
N7b_finer_1sekm-copper-5cm-peeq2.png
N7b_finer_1sekm-copper-5cm-peeq3.png
N7b_finer_1sekm-copper-5cm-s_max_prin1.png
N7b_finer_1sekm-copper-5cm-s_max_prin2.png
N7b_finer_1sekm-copper-5cm-s_max_prin3.png

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Appendix 7

N27b_finer_1sekm-copper-10cm-mises1.png
N27b_finer_1sekm-copper-10cm-mises2.png
N27b_finer_1sekm-copper-10cm-mises3.png
N27b_finer_1sekm-copper-10cm-peeq1.png
N27b_finer_1sekm-copper-10cm-peeq2.png
N27b_finer_1sekm-copper-10cm-peeq3.png
N27b_finer_1sekm-copper-10cm-s_max_prin1.png
N27b_finer_1sekm-copper-10cm-s_max_prin2.png
N27b_finer_1sekm-copper-10cm-s_max_prin3.png
N27b_finer_1sekm-copper-5cm-mises1.png
N27b_finer_1sekm-copper-5cm-mises2.png
N27b_finer_1sekm-copper-5cm-mises3.png
N27b_finer_1sekm-copper-5cm-peeq1.png
N27b_finer_1sekm-copper-5cm-peeq2.png
N27b_finer_1sekm-copper-5cm-peeq3.png
N27b_finer_1sekm-copper-5cm-s_max_prin1.png
N27b_finer_1sekm-copper-5cm-s_max_prin2.png
N27b_finer_1sekm-copper-5cm-s_max_prin3.png

Appendix 8

N8b_finer_1sekm 5cm maxPrin insert_nochannels.png
N8b_finer_1sekm 5cm mises insert_channels.png
N8b_finer_1sekm 5cm mises insert_nochannels.png
N8b_finer_1sekm 5cm peeq insert_channels.png
N8b_finer_1sekm 5cm peeq insert_nochannels.png
N8b_finer_1sekm 5cm S33 insert_channels.png
N8b_finer_1sekm 5cm S33 insert_nochannels.png
N8b_finer_1sekm 10cm maxPrin insert_channels.png
N8b_finer_1sekm 10cm maxPrin insert_nochannels.png
N8b_finer_1sekm 10cm mises insert_channels.png
N8b_finer_1sekm 10cm mises insert_nochannels.png
N8b_finer_1sekm 10cm peeq insert_channels.png
N8b_finer_1sekm 10cm peeq insert_nochannels.png
N8b_finer_1sekm 10cm S33 insert_channels.png
N8b_finer_1sekm 10cm S33 insert_nochannels.png

Appendix 9

N8b_b_finer_1sekm 5cm maxPrin insert_channels.png
N8b_b_finer_1sekm 5cm maxPrin insert_nochannels.png
N8b_b_finer_1sekm 5cm mises insert_channels.png
N8b_b_finer_1sekm 5cm mises insert_nochannels.png
N8b_b_finer_1sekm 5cm peeq insert_channels.png
N8b_b_finer_1sekm 5cm peeq insert_nochannels.png
N8b_b_finer_1sekm 5cm S33 insert_channels.png
N8b_b_finer_1sekm 5cm S33 insert_nochannels.png
N8b_b_finer_1sekm 10cm maxPrin insert_channels.png
N8b_b_finer_1sekm 10cm maxPrin insert_nochannels.png
N8b_b_finer_1sekm 10cm mises insert_channels.png
N8b_b_finer_1sekm 10cm mises insert_nochannels.png
N8b_b_finer_1sekm 10cm S33 insert_channels.png
N8b_b_finer_1sekm 10cm S33 insert_nochannels.png

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

PDF rendering: DokumentID 1339902, Version 1.0, Status Godkänt, Sekretessklass Öppen

Appendix 10

```
N21b_finer_1sekm  5cm maxPrin insert_channels.png
N21b_finer_1sekm  5cm maxPrin insert_nochannels.png
N21b_finer_1sekm  5cm mises insert_channels.png
N21b_finer_1sekm  5cm mises insert_nochannels.png
N21b_finer_1sekm  5cm peeq insert_channels.png
N21b_finer_1sekm  5cm peeq insert_nochannels.png
N21b_finer_1sekm  5cm S33 insert_channels.png
N21b_finer_1sekm  5cm S33 insert_nochannels.png
N21b_finer_1sekm 10cm maxPrin insert_channels.png
N21b_finer_1sekm 10cm maxPrin insert_nochannels.png
N21b_finer_1sekm 10cm mises insert_channels.png
N21b_finer_1sekm 10cm mises insert_nochannels.png
N21b_finer_1sekm 10cm peeq insert_channels.png
N21b_finer_1sekm 10cm peeq insert_nochannels.png
N21b_finer_1sekm 10cm S33 insert_channels.png
N21b_finer_1sekm 10cm S33 insert_nochannels.png
```

Appendix 11

```
N20b_finer_1sekm  5cm maxPrin insert_channels.png
N20b_finer_1sekm  5cm maxPrin insert_nochannels.png
N20b_finer_1sekm  5cm mises insert_channels.png
N20b_finer_1sekm  5cm mises insert_nochannels.png
N20b_finer_1sekm  5cm peeq insert_channels.png
N20b_finer_1sekm  5cm peeq insert_nochannels.png
N20b_finer_1sekm  5cm S33 insert_channels.png
N20b_finer_1sekm  5cm S33 insert_nochannels.png
N20b_finer_1sekm 10cm maxPrin insert_channels.png
N20b_finer_1sekm 10cm maxPrin insert_nochannels.png
N20b_finer_1sekm 10cm mises insert_channels.png
N20b_finer_1sekm 10cm mises insert_nochannels.png
N20b_finer_1sekm 10cm peeq insert_channels.png
N20b_finer_1sekm 10cm peeq insert_nochannels.png
N20b_finer_1sekm 10cm S33 insert_channels.png
N20b_finer_1sekm 10cm S33 insert_nochannels.png
```

Appendix 12

```
N22b_finer_1sekm  5cm maxPrin insert_channels.png
N22b_finer_1sekm  5cm maxPrin insert_nochannels.png
N22b_finer_1sekm  5cm mises insert_channels.png
N22b_finer_1sekm  5cm mises insert_nochannels.png
N22b_finer_1sekm  5cm peeq insert_channels.png
N22b_finer_1sekm  5cm peeq insert_nochannels.png
N22b_finer_1sekm  5cm S33 insert_channels.png
N22b_finer_1sekm  5cm S33 insert_nochannels.png
N22b_finer_1sekm 10cm maxPrin insert_channels.png
N22b_finer_1sekm 10cm maxPrin insert_nochannels.png
N22b_finer_1sekm 10cm mises insert_channels.png
N22b_finer_1sekm 10cm mises insert_nochannels.png
N22b_finer_1sekm 10cm peeq insert_channels.png
N22b_finer_1sekm 10cm peeq insert_nochannels.png
N22b_finer_1sekm 10cm S33 insert_channels.png
N22b_finer_1sekm 10cm S33 insert_nochannels.png
```

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2 – Input files used for the simulations

Each analysis is started by abaqus job=input-file (w/o .inp).

Files with extension “incl” are referenced by the input-files (extension “inp”).

Contents in C:\Users\jhd\mappar\skb\Global\Input-files

```
assembly2_finer.incl
assembly_b.incl
assembly_finer_25.incl
bentonite.incl
bentonite_25.incl
copper_canister.incl
insert.incl
insert_canister.incl
insert_canister_old.incl
insert_channels.incl
insert_finer.incl
insert_lid.incl
material_copper.incl
material_global.incl
material_global_old.incl
material_global_quasi.incl
```

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Contents in C:\Users\jhd\mappar\skb\Global\Input-files

```
N1b_finer_1sekm.inp
N2b_finer_1sekm.inp
N3b_finer_1sekm.inp
N4b_finer_1sekm.inp
N5b_finer_1sekm.inp
N6b_finer_1sekm.inp
N7b_finer_1sekm.inp
N8b_b_finer_1sekm.inp
N8b_b_finer_1sekm_r1.inp
N8b_finer_1sekm.inp
N9b_finer_1sekm.inp
N10b_finer_1sekm.inp
N11b_finer_1sekm.inp
N12b_finer_1sekm.inp
N13b_finer_1sekm.inp
N14b_finer_1sekm.inp
N15b_finer_1sekm.inp
N16b_finer_1sekm.inp
N16b_finer_1sekm_r1.inp
N17b_finer_1sekm.inp
N17b_finer_1sekm_r1.inp
N18b_finer_1sekm.inp
N19b_finer_1sekm.inp
N20b_finer_1sekm.inp
N21b_finer_1sekm.inp
N22b_finer_1sekm.inp
N23b_finer_1sekm.inp
N24b_finer_1sekm.inp
N25b_finer_1sekm.inp
N26b_finer_1sekm.inp
N27b_finer_1sekm.inp
N28b_finer_1sekm.inp
N29b_finer_1sekm.inp
N30b_finer_1sekm.inp
N31b_finer_1sekm.inp
N32b_finer_1sekm.inp
N33b_finer_1sekm.inp
N33b_finer_1sekm_r1.inp
N34b_finer_1sekm.inp
N34b_finer_1sekm_r1.inp
N35b_finer_1sekm.inp
N36b_finer_1sekm.inp
N37b_finer_1sekm.inp
N37b_finer_1sekm_r1.inp
N38b_finer_1sekm.inp
N38b_finer_1sekm_r1.inp
N39b_finer_1sekm.inp
N40b_finer_1sekm.inp
N41b_finer_1sekm.inp
N42b_finer_1sekm.inp
N43b_finer_1sekm.inp
N44b_finer_1sekm.inp
N45b_finer_1sekm.inp
N46b_finer_1sekm.inp
N47b_finer_1sekm.inp
N48b_finer_1sekm.inp
N48b_finer_1sekm_r1.inp
```

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4 – Scripts used for post-processing

Used inside ABAQUS/CAE or by abaqus cae startup=script.py after appropriate editing of job-name inside the script-file.

Contents in C:\Users\jhd\mappar\skb\Global\scripts

```
contour2_plots.py          - script for contour plots
contour_plots.py           - not used
copper_displacement.py     - script for boundary conditions
(submodelling)
copper_displacement_r1.py  - script for boundary conditions from
restart file
displaygroups.py           - create display-groups for regions
fig2-1.py
Figs.py
insert_special.py
max_values.py              - script to create extreme values
n7b_special.py
n9b_special.py
```

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5 – Geometry definitions

Contents in C:\Users\jhd\mappar\skb\Global\geometry

global_parameters.cae global_parameters.jnl - ABAQUS/CAE-database and journal files

CAD-geometries received from SKB:

IDE-00015-111-CALC_plan_top.igs
IDE-00015-111-CALC_plan_top.stp
IDE-00015-111-CALC_plan_top_R02.igs
IDE-00015-111-CALC_plan_top_R02.stp
IDE-00015-111-CALC_R03.stp

PWR_INSATS_CALK.stp
Ritningar_kapsel.pdf
sammanställning svetsad kopparcylinder_mått från IDE-00015_sheet 1.pdf
sammanställning svetsad kopparcylinder_mått från IDE-00015_sheet 2.pdf
sammanställning svetsad kopparcylinder_mått från IDE-00015_sheet 3.pdf

SKB00-IDE-00015-CALC.igs
SKB00-IDE-00015-CALC.stp
SKB00-IDE-00015-CALC_02.stp
SKB00-IDE-00015-CALC_old.stp
SKB00-IDE-00015.igs
SKB00-IDE-00015.stp
_0816123248_001.pdf
_0903090815_001.pdf

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