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A Modified Constant-Stress Coupon for Enhanced Natural Crack Start during Fatigue Testing

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Aerospace Division
Defence Science and Technology Group

DST-Group-TR-3252

ABSTRACT

This report details the development of a modified constant-stress coupon for use in fatigue testing. This novel coupon design has a significantly greater surface area along the notch boundary that is subjected to the peak stress, and it is useful in studies of the probabilistic growth of in-service fatigue cracks where fatigue life is governed by the most severe defect. The extended region of uniform stress is achieved by shape optimisation of the notch boundary, resulting in the elimination of the highly-localised stress concentration that is a characteristic feature of a traditional dog-bone coupon. The presence of an extensive region of uniform stress increases the incidence of fatigue cracking from small naturally-occurring surface imperfections or discontinuities, as well as more uniformly distributing the fatigue cracking over the region of constant stress. Stress intensity factors have also been computed for simulated crack growth trajectories for edge cracks starting at various locations distributed along the notch boundary. Use of the constant-stress coupon reduces the number of coupons that need to be tested in order to attain desired statistical confidence levels, leading to significant time savings and greatly reduced costs in conducting fatigue testing programs studying the initiation and growth behaviour of small cracks.

RELEASE LIMITATION

Approved for public release

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Published by

*Aerospace Division
Defence Science and Technology Group
506 Lorimer Street
Fishermans Bend, Victoria 3207, Australia*

*Telephone: 1300 333 362
Fax: (03) 9626 7999*

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AR- 016-590
May 2016*

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Executive Summary

The Structural and Damage Mechanics Group in the Airframe Technology and Safety Branch of Aerospace Division has been deeply involved in research to develop and apply structural and damage mechanics methods and technologies to enhance the safety, availability, and reduce the cost of ownership of airframes in service with the Royal Australian Air Force. Included amongst its wide range of capabilities are a unique and novel shape optimisation technology for the repair and fatigue life enhancement of airframe components, advanced computational and analytical tools and methods for improved determination of fatigue and crack growth life of airframes, and integrated analytical and numerical modelling of both complete and local structures for the improved assessment of structural response and capability.

This report details the development of a modified constant-stress coupon for use in fatigue testing. A constant-stress coupon is a novel design that has a significantly greater surface area along the notch boundary that is subjected to the peak stress. This extensive region of uniform stress is achieved by shape optimisation of the boundary of the notch, resulting in the elimination of the highly-localised stress concentration that is a characteristic feature of a traditional dog-bone fatigue testing coupon. The shape optimisation method that has been used here is based on the advanced and powerful shape optimisation technique that has been pioneered by the Structural and Damage Mechanics Group, and which has recently been modified and ported to be used with the Abaqus finite element analysis software code.

As the constant-stress fatigue coupon design is being used in studies involving crack growth, an assessment of its performance from a fracture mechanics perspective was also conducted. This involved the detailed computation of crack-growth trajectories and stress intensity factors for through-thickness edge cracks emanating from points distributed along the shape-optimised notch boundary. An advanced two-dimensional boundary element analysis technique was used for these calculations. The results reported here will serve to permit comparison with the crack paths that occur during the fatigue testing of the coupons.

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The use of constant-stress fatigue coupons will significantly assist research into improving the fundamental understanding of the probabilistic growth of in-service fatigue cracks where the fatigue life is governed by the most severe defect. The presence of an extensive region of uniform stress will increase the incidence of fatigue cracking from small naturally-occurring surface imperfections or discontinuities, as well as potentially more uniformly distributing the fatigue cracking over the region of uniform stress. Use of the constant-stress coupon will reduce the number of coupons that need to be tested in order to attain desired statistical confidence levels, leading to significant time savings and greatly reduced costs in conducting fatigue testing programs to study the initiation and growth behaviour of small cracks. The outcomes of this research into fatigue cracking will be applied to the long-term structural integrity management of both ageing and new ADF airframes.

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Mr Witold Waldman completed a BEng (with distinction) in Aeronautical Engineering at the Royal Melbourne Institute of Technology in 1981. He commenced work in Structures Division in 1982, at what was then the Aeronautical Research Laboratory. He has published a number of papers and reports, and his experience has focussed on stress analysis using finite element and boundary element methods, structural mechanics, fracture mechanics, computational unsteady aerodynamics, structural dynamics testing, digital filtering of flight test data, nonlinear optimisation, and spectral analysis. His recent work has been in the areas of structural shape optimisation and the computation of stress intensity factors. He is currently a Senior Research Engineer in the Structural and Damage Mechanics Group in the Airframe Technology and Safety Branch of Aerospace Division within the Defence Science and Technology Group.

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Nomenclature

a	crack length
E	Young's modulus of the material
F	boundary correction factor (beta factor)
K	stress intensity factor
K_t	net-section stress concentration factor
K_{tg}	gross-section stress concentration factor
S	local tangential stress at notch surface
S_∞	remote uniaxial tension stress
x	x -coordinate
y	y -coordinate
σ	stress along notch boundary
σ_{\max}	maximum tangential stress
ν	Poisson's ratio of the material

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1. Introduction

Prior work in DST Group by McDonald (1999a) has involved the computation of stress concentration factors (SCFs) for various fatigue test coupon profiles composed of straight lines and circular arcs. These coupons were required for use in fatigue testing to aid in the fatigue life management of RAAF airframes. To help maximise test machine usage efficiency and to provide the necessary statistical data for accurate estimation of fatigue life, it was desirable to test many short cracks on a single specimen. To achieve this, a test coupon was required that had a notch with a relatively large surface area of uniform stress (where the stress is constant within a specified small range). This led McDonald (1999b) to establish the design of an aluminium coupon that maximised the length of uniform stress under uniaxial tensile loading.

Following on from the work of Mattheck et al. (1992), the Structural and Damage Mechanics Group within DST Group has successfully developed and employed shape optimisation technology for the reduction of peak stresses occurring at typical stress concentrations such as fillets and holes (Heller, Kaye and Rose 1999; Waldman, Heller and Chen 2001; Burchill and Heller 2004; Heller et al. 2009, Waldman 2015). In essence, the method relies on adding material where stresses are high and removing material where stresses are low. Waldman and Heller (2006, 2015) have also significantly extended this in-house shape optimisation capability in order to be able to address problems that involve the simultaneous reduction of multiple stress peaks. The implementation of the method for use with the MSC Nastran finite element analysis (FEA) code that was developed by Braemar (2005) has also recently been ported by Kaye and Waldman (2016) to make use of the Abaqus FEA code running on a Linux-based computer system.

A distinct characteristic of shape-optimal designs is the presence of one or more large regions of uniform stress along the stress concentrator boundary, where the stress is constant within a small tolerance. Hence, in DST Group, Westcott (2010) and Kaye (2010) have previously taken advantage of this feature by applying shape optimisation methods to design specialised fatigue test coupons that have extensive regions of uniform stress. These shape-optimised coupon geometries are characterised by having the desired extensive regions of nearly-constant stress along a large proportion of the notch boundary, with the peak stress in the coupon corresponding to the stress level that is associated with the region of uniform stress.

The advantage offered by a constant-stress fatigue coupon is that there is a much larger area along the notch surface that is subjected to the peak stress, as the highly-localised stress concentration produced by a traditional dog-bone coupon is eliminated. It is therefore anticipated that the incidence of fatigue cracking from small naturally-occurring surface imperfections or discontinuities will be duly increased, as well as potentially being more uniformly distributed over the region of constant stress. This can serve to reduce the number of coupons that need to be tested, resulting in significant time savings and greatly reduced costs in conducting fatigue testing programs. The desired outcome from such

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fatigue tests is to improve the fundamental understanding of the probabilistic growth of fatigue cracks from small naturally-occurring defects, where the in-service fatigue life of the component is assumed to be governed by the most severe defect that is present (Cetin, Härkegård and Naess 2013). In addition, Molent, Barter and Wanhill (2011) and Barter, Molent and Wanhill (2012) have noted that surface imperfections and discontinuities are features that are inherent to the material and the manner of production of the component, and that the existence of such defects in typical aircraft alloys leads to fatigue cracking in tests of both coupons and components.

As a result of the novel properties offered by a constant-stress fatigue test coupon, such designs have recently begun to be extensively utilised by the Aircraft Forensic and Metallic Technologies Group within DST Group (Shekhter et al. 2015; Loader, Shekhter and Turk 2015; Loader et al. 2016; Niclis and Harrison 2016; Shekhter et al. 2016; Turk 2016a; Turk 2016b; Turk and Niclis 2016). Prior to this, in conducting their fatigue test program on multiple coupons that have a low SCF (low- K_t), Yu et al. (2014) have noted that, over a region of low stress concentration, the lead crack that dictates the fatigue life is often the fastest growing crack that starts from one of the worst discontinuities. They referred to this phenomenon as “natural crack start”, which cannot be reproduced using traditional dog-bone coupons such as those defined in ASTM (2012), because the stress concentration that is inherent in the design of those coupons is significant enough to dictate the starting positions of the fatigue cracks. Yu et al. (2014) have also noted a further limitation, in that, by confining the crack starting locations to the area of higher stress, fewer initial discontinuities and local material properties are sampled, which affects the growth of small cracks. As a result, the largest crack that eventually results in failure may start from a less severe discontinuity or grow at a slower rate. Also, when the largest crack starts from a location that is next to, but not exactly at, the peak stress location, the use of nominal peak stress overestimates the actual fatigue driving force. Consequently, Yu et al. (2014) have concluded that the fatigue test results obtained from traditional types of dog-bone coupons will exhibit more scatter in total fatigue life, and any distribution of life data would be skewed to a longer life, when compared to those on an actual aircraft structure.

The effectiveness of the prior optimal coupon design has been confirmed by Yu et al. (2014) through experimental strain measurement as well as fatigue tests under spectrum loading. However, as designed, these coupons have on occasion experienced undesirable premature failures in the grip region during other subsequent test programs. These failures typically occurred while undertaking testing at low load levels, with commensurately long specimen fatigue lives. A significant factor contributing to these failures is considered to be the use of oversized test specimen grips, which affect the gripping action. This is thought to produce fretting damage, which then leads to instances of fatigue failure in the region where the coupon is being clamped by the grips. Therefore, it became apparent that a need exists for the design of a Modified Constant-Stress Coupon with a view to reducing the incidence of coupon failures originating in the grip area. The performance of the coupon whose design is reported on herein is expected to be better because of the increased width of the new coupon in the grip area. It must also be kept in

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mind that the previous fatigue testing work undertaken with the narrower specimen has already produced an extensive usable body of results. In order to maintain compatibility with those results, it is desirable that the length of the constant-stress region in the modified coupon be very similar to that of the original design. This Report documents the design of this new Modified Constant-Stress Coupon.

In order to provide some background that serves as a basis for comparison, Section 2 gives the results of analyses of a variety of typical non-optimal non-constant stress dog-bone coupon designs. One of those designs has in fact previously been used in a coupon fatigue testing program in the DST Group. Section 3 then goes on to provide the results of a stress analysis of the original constant-stress coupon design. The design of the new Modified Constant-Stress Coupon is then described in Section 4. The results of a detailed fracture mechanics analysis of potential cracking along the notch boundary of the new coupon are presented in Section 5, and it includes simulated crack-growth trajectories and associated stress intensity factors for through-thickness edge cracks of various lengths. Finally, the conclusion is presented in Section 6.

2. Stress analysis of typical dog-bone coupons with non-optimal notch profiles

It is considered useful to develop a better quantitative understanding of the stress distribution in the notch region of some typical dog-bone axial fatigue test coupon geometries. For this purpose, a number of two-dimensional $\frac{1}{4}$ -symmetry boundary element models of coupon designs are created here and analysed using the FADD2D boundary element code (Chang and Mear 1995; Newman et al. 2006). The assumed linear-elastic material properties for these aluminium coupons are a Young's Modulus of $E = 72.4$ GPa and a Poisson's ratio of $\nu = 0.33$. Each model is subjected to a uniform uniaxial tensile load of 100 MPa applied to the ends of the specimen, and this was deemed to be capable of providing stress results in the notch region (the area of interest) comparable to those that would be expected if the actual grip loading could be more accurately simulated. Plane stress conditions were assumed in the analysis, which was deemed to be reasonable as the thickness of these coupons is small relative to the other dimensions.

2.1 Notch with large 100-mm constant-radius arcs

In prior DST Group work reported much earlier by McDonald (1999a), a simple notch design was developed that utilised a circular arc of large constant radius to produce a notch profile. The purpose behind this design was to try to minimise the stress concentration effect associated with the notch. This type of notch design is shown in Figure 1, and the hatched areas represent the grip length of 40 mm that had been adopted. The coupon dimensions for this notch design were: notch radius = 100 mm, total coupon

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length = 160 mm, width = 40 mm, thickness = 6.35 mm, notch half-length = 38 mm, notch depth = 7.5 mm, and net section half-width = 12.5 mm.

A FADD2D $\frac{1}{4}$ -symmetry model was created and analysed using the previously specified linear elastic material properties for aluminium (see Appendix A for a listing of the input deck, which is also located in Objective folder fAV1044714). The FADD2D-computed normalised stress response along the notch boundary, σ/σ_{\max} , is shown in Figure 2. Here σ is the tangential stress, and σ_{\max} is the maximum tangential stress. The net-section SCF is $K_t = 1.081$ for this design, which compares very well with $K_t = 1.082$ obtained from a 3D analysis using the StressCheck finite element code (McDonald 1999a). The gross-section SCF is $K_{tg} = 1.730$. The stress response obtained here consists of a broad peak, centred on $x = 0$ mm. These results show that the stress changes by 8% over approximately 30 mm of the notch length ($-15 \text{ mm} \leq x \leq +15 \text{ mm}$), and by 33% over approximately 60 mm of the notch length ($-30 \text{ mm} \leq x \leq +30 \text{ mm}$). Hence, it is evident that the constant-radius specimen design cannot meet the requirement of having a significant region with uniform stress.

2.2 Notch with constant central width and large constant 100-mm radius fillets

An alternative dog-bone coupon notch design that is composed of a long constant-width centre section with transitioning fillets of large constant 100-mm radius is shown in Figure 3. This dog-bone coupon geometry was selected on the basis that it is similar to those that are used in many fatigue testing programs, often with circular through-thickness holes added to the centre section. The geometry shown in Figure 3 is expected to result in a considerable constant-stress zone in the central constant-width region. However, it is also anticipated that a significant stress concentration will occur in the fillet regions.

A $\frac{1}{4}$ -symmetry 2D model of the geometry shown in Figure 3 was created and analysed using the FADD2D boundary element program (see Appendix B for a listing of the input deck, which is also located in Objective folder fAV1044714). The previously specified linear elastic material properties for aluminium were used, and the applied load once again consisted of a uniform uniaxial tensile load of 100 MPa. The computed normalised stress response along the notch boundary, σ/σ_{\max} , is shown in Figure 4. The net-section SCF for this coupon design is $K_t = 1.071$, while the gross-section SCF is $K_{tg} = 1.714$. It is noted that the stress response has a broad peak, located at about $x = \pm 23.9$ mm. The stress is quite constant over approximately 30 mm of the notch length in the central region of the coupon ($-15 \text{ mm} \leq x \leq +15 \text{ mm}$), albeit at a value of about $\sigma/\sigma_{\max} = 0.93$, which is 7% lower than the peak stress. The left and right peaks (from symmetry) in the stress distribution along the notch boundary occupy about 40 mm of the total notch length ($-35 \text{ mm} \leq x \leq -15 \text{ mm}$ and $+15 \text{ mm} \leq x \leq +35 \text{ mm}$). Although this design has a considerable zone of constant stress in its central region, the presence of the significant peak in the stress distribution would be expected to result in crack growth in that particular area during fatigue testing, rather than in the zone of constant stress.

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2.3 Notch with constant central width and moderate constant 30-mm radius fillets

Another dog-bone coupon notch design, this time composed of a constant-width centre section with transitioning fillets of moderate constant 30-mm radius, is shown in Figure 5. These fillets have a much smaller radius than the 100-mm radius fillets used in the previous section and, as a result, they are expected to produce a more severe stress concentration effect.

A FADD2D $\frac{1}{4}$ -symmetry 2D model of this geometry was created and analysed using the previously specified linear elastic material properties for aluminium (see Appendix C for a listing of the input deck, which is also located in Objective folder fAV1044714). The applied load once again consisted of a uniform uniaxial pressure of 100 MPa. The computed normalised stress response along the notch boundary, σ/σ_{\max} , is shown in Figure 6. The net-section SCF for this design is $K_t = 1.240$, while the gross-section SCF is $K_{tg} = 1.984$. These values are considerably more severe than those obtained when the 100-mm radius fillets were used. The stress response has a broad peak, located at about $x = \pm 23.5$ mm. The stress is quite constant over approximately 30 mm of the notch length in the central region of the coupon ($-15 \text{ mm} \leq x \leq +15 \text{ mm}$), albeit at a value of about $\sigma/\sigma_{\max} = 0.80$, which is 20% lower than the peak stress. The left and right peaks (from symmetry) in the stress distribution occupy about 40 mm of the total notch length ($-31 \text{ mm} \leq x \leq -15 \text{ mm}$ and $+15 \text{ mm} \leq x \leq +31 \text{ mm}$). Although this design has a considerable zone of constant stress in its central region, the presence of the significant peak in the stress distribution would be expected to result in crack growth originating somewhere in that particular area during fatigue testing, rather than in the zone of constant stress.

3. Prior optimal constant-stress notch profile

Some years ago now, the original DST Group shape optimisation code was ported to work with the MSC Patran and Nastran finite element analysis software, and the specifics of this version of the code are covered by Braemar (2005). The process used for preparing an optimal shape for manufacture is described by Wescott and Heller (2009). Taken in combination, these procedures were used by Wescott, Jones and Heller (2010) and then Kaye (2010) to design the original constant-stress fatigue test coupon.

The first constant-stress specimen was designed by Wescott, Jones and Heller (2010) using 2D shape optimisation techniques, as the then implementation of the code was not working correctly for 3D open boundary problems. Their specimen was 6.35 mm thick and had a nominal grip area of 40×40 mm at each end. The grip load was modelled as a constant traction (tangential pressure) during the optimisation process, and was implemented using nodal forces. A short 5 mm buffer zone between the grip line and the end of the notched section was included. As the specimen is 160 mm in total length, this

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results in a notch length of 70 mm. The minimum section width was 24 mm at the centre of the specimen, corresponding to a notch depth of 8 mm. Minimum radius of curvature constraints in the range 5 mm to 25 mm were investigated, and a value of 20 mm was chosen for the production version of this design. The net-section K_t was 1.03 and the length of notch profile with up to 2% stress variation was 50 mm.

After correcting a bug in the code, Kaye (2010) subsequently ran a 3D version of the shape optimisation algorithm, which for the unsmoothed optimal notch shape produced a net-section K_t of 1.03. This specimen, which is shown in Figure 7, differed slightly from the earlier one, in that the depth of the notch was 7.5 mm rather than 8 mm. The total arc length of the constant-stress region along each notch is about 55.5 mm, falling within the region $-27.5 \text{ mm} \leq x \leq +27.5 \text{ mm}$. The uniformity of the stress in the constant-stress zone was found to be very good, to within a small fraction of one per cent.

As mentioned by Kaye (2010), the 5 mm buffer zone between the grip region and the end of the notch was chosen because a discontinuity occurs at the edge of the grip. The exact stress/strain state at this location is unknown, as it depends on the amount of surface yielding and/or slip that occurs over the grip area contact surface. Preliminary finite element analyses conducted by Wescott, Jones and Heller (2010) had also shown that excessive local stresses occur near the ends of the notch if a suitable buffer zone is not included.

A FADD2D $\frac{1}{4}$ -symmetry 2D model of the Kaye (2010) coupon was created and analysed using the previously specified linear elastic material properties for aluminium. An initial FADD2D input deck was created using a custom-written Fortran 90 program called CreateDogboneCouponModel (see Appendix D for the source code listing of this program, and Appendix E for the associated input deck, both of which are also located in Objective folder fAV1044714). Note that the coordinates of the notch profile that were used here were those that had been obtained after the radius-of-curvature coordinate-smoothing process described by Wescott and Heller (2009) had been applied. The applied load once again consisted of a uniform uniaxial pressure of 100 MPa. The initial input deck was manually edited to convert it from a full model to the desired $\frac{1}{4}$ -symmetry model.

The computed normalised stress response, σ/σ_{\max} , along the smoothed notch boundary is shown in Figure 8. The net-section SCF for this design is $K_t = 1.038$, which is in good agreement with the prior result of $K_t = 1.030$ that was reported by Kaye (2010), and the gross-section SCF is $K_{tg} = 1.660$. The normalised stress is quite constant over an arc length of approximately 54.4 mm along the notch in the central region of the coupon ($-27.0 \text{ mm} \leq x \leq +27.0 \text{ mm}$). Although the stress response is very flat, the stress level in this region is about 0.7% lower than the peak stress, which occurs at about $x = 25.5 \text{ mm}$. This is likely to be a consequence of a number of interacting factors. Firstly, the smoothing process, which has been applied to produce the smoothed notch boundary, has a small detrimental impact on the uniformity of the boundary stresses, as originally noted by Kaye (2010) and subsequently further investigated by Evans, Yu and Heller (2015). Secondly, first-order

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elements were used in the original Nastran-based shape optimisation, whereas the FADD2D code utilises 2nd-order boundary elements that are capable of more accurately resolving local stress variations associated with any given geometry. Finally, the optimal shape is based on a 3D finite element analysis, whereas the FADD2D analysis is 2D in nature.

4. Design of the modified coupon with optimal constant-stress notch profile

The prior constant-stress coupon design has experienced undesirable failures in the grip area during the fatigue test program, and a contributing factor is considered to be the use of oversized grips. By increasing the width of the coupon in the grip area, while maintaining the minimum width in the central region, it is expected that failures in the grip area will be avoided. As the previous fatigue testing work has already produced a quantity of results, it is required to create a new coupon design that maintains as much compatibility with those results as possible. In that respect, it is desired that the length of the constant-stress region in the modified coupon be very similar to that of the original design.

The previous MSC Patran/Nastran-based DST Group shape optimisation procedure has recently been modified for use with the Abaqus finite element analysis code by Kaye and Waldman (2016). This new version of the shape optimisation code was used here for designing the new Modified Constant-Stress Coupon. The Abaqus-based procedures are presently capable of performing a 2.5D optimisation analysis. This means that the y -displacement through the thickness of the model is maintained at each point on the notch profile while the profile is being optimised.

4.1 Nominal geometry and material properties

The nominal design of the Modified Constant-Stress Coupon is shown in Figure 9, and it is based on the previous design for a constant-stress coupon reported in Kaye (2010). As before, the new coupon is 6.35 mm thick, and has linear-elastic material properties typical of an aluminium alloy: $E = 72.4$ GPa and $\nu = 0.33$. To improve the performance in the grip area, the gross width of the new coupon has been increased to 60 mm, with a gripped area that is now 60 mm \times 60 mm at each end. The new design also includes a 25-mm buffer zone between the grip line and the end of the notched region, whereas it was 5 mm in the previous design described by Kaye (2010). The increased size of this buffer zone is expected to make the stresses less sensitive to different boundary conditions that might be utilised to simulate the grip loading. The total length of the new coupon is 244 mm. The minimum cross-sectional width in the notched region is the same as before (25 mm). As the notch depth in this Modified Constant-Stress Coupon is more severe than previously, the length of the notch region was increased from 70 mm to 74 mm. This will ostensibly

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provide additional room over which the constant stress zone can develop, thus offsetting to some degree the effects of the more severe stress concentration geometry.

4.2 Initial finite element mesh

In order to perform the shape optimisation, it is necessary to create an initial finite element model. A $\frac{1}{8}$ -symmetry model of the coupon was developed in order to reduce computation time and to avoid potential numerical errors. The model was created using the MSC Patran pre- and post-processing software, and then an Abaqus input deck was written out. Figure 10 shows a general view of the 3D finite element mesh that was created. The model utilised six layers of 8-noded hexagonal elements through the half-thickness.

A side view of the finite element model with the optimisation zone highlighted is shown in Figure 11. The assumed starting shape of the notch is a straight line, which was subdivided into 80 segments of equal length. The grip load was modelled as a uniformly-distributed constant traction force, and it was implemented using nodal forces. For this linear-elastic model, the applied uniaxial traction load was equivalent to a force of 50.02 kN (calculated by summing up the individual contributions of the forces applied at the nodes). This leads to a gross-section average stress of 131.3 MPa, and a net-section average stress of 315.1 MPa.

As we will be performing a linear elastic stress analysis, the load level can be scaled to obtain suitable stress levels in the notch zone to suit the particular requirements of the fatigue test.

4.3 Performing the shape optimisation

Prior to performing the shape optimisation, some further processing of the initial Abaqus input deck was conducted in accordance with the method described by Kaye and Waldman (2016) in order to prepare it for use by the shape optimisation code. The entire notch region was chosen as the movable boundary during the optimisation process (see Figure 11). The nodal movement at each point along the notch boundary was calculated using the maximum through-thickness stress. A minimum radius of curvature constraint of 20 mm was applied. All seven nodes through the thickness at each location on the notch boundary were moved by the same amount at each iterative step. The optimisation process was allowed to proceed for 400 iterations, whereupon it was manually terminated.

4.4 Raw results of shape optimisation

The resulting raw shape for the optimised constant-stress coupon that was produced by the shape optimisation process is shown in Figure 12. The contours of maximum principal stress from the finite element analysis are shown in Figure 13. The distribution of normalised principal stress, σ/σ_{\max} , along the notch boundary is shown in Figure 14, where σ is the largest principal stress through the thickness at each location, and σ_{\max} is the

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maximum value of the principal stress along the optimised notch boundary. The peak occurs at the centre of the notch boundary, and is $\sigma_{\max} = 330.3$ MPa. Using this value of stress, the gross-section SCF is $K_{tg} = 2.516$ for this configuration, while the net-section SCF is $K_t = 1.048$.

Referring to Figure 14, it is noted that, as expected, the normalised maximum principal stress in the central region of the optimised notch boundary is very uniform. This constant-stress zone extends over an arc length of approximately 51.2 mm, falling within the region $-25.3 \text{ mm} \leq x \leq +25.3 \text{ mm}$. The standard deviation of the normalised principal stress in the constant-stress region is only 0.006%, which is negligible, indicating the optimality of the solution. The arc length of the present constant-stress region is 7.7% less than that of the original constant-stress coupon.

In Figure 15, the maximum principal stress contour levels were adjusted to lie between a maximum of 330.3 MPa and a minimum of 310.5 MPa, with 12 contour bands in between. Each of these contour levels represents a 0.5% change in stress relative to the peak stress, for a total range of 6.0%. To provide some details of a higher resolution, Figure 16 shows contours of maximum principal stress that lie within 1.0% of the peak value.

As depicted in Figures 13–16, the distribution of the principal stress is very uniform along a large section of the notch surface of the optimised boundary contour, just as required. Furthermore, the variation of the maximum principal stress in the thickness direction is generally very low, this being particularly so at the centre of the coupon. Through-thickness variation in the maximum principal stress only becomes noticeable near the end of the constant stress zone. As expected, the through-the-thickness stress distribution peaks at the mid-plane of the coupon.

4.5 Preparation of raw optimal shape for manufacture

As described by Wescott and Heller (2009), and more recently by Evans, Yu and Heller (2015), past experience with the numerically-controlled machining of free-form notch shapes has indicated that it is desirable to process the notch coordinates so that the shape of the notch can be represented by a series of many short circular arcs. This conversion procedure also incorporates the facility for performing some smoothing of the raw notch shape in order to reduce the variability of the radius of curvature (ROC) along the notch boundary. In practice, the shape transformation process produces only very minor adjustments to the raw shape, and the resulting shape is still essentially free-form. In addition, the ROC-smoothing process has a very small effect on the stress distribution along the notch profile, which although noticeable is often negligible. Experience with some optimal shapes appears to indicate that the ROC-smoothing process can result in stresses that increase slightly near the end of the zone of constant stress (see Figure 8 for an example of this type of behaviour).

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A plot of the ROC distribution computed from the nodal coordinates along the entire (mirrored) raw unsmoothed as-optimised notch boundary is shown in Figure 17. The ROC at any given node was computed by a fitting circular arc through the three sets of coordinates comprised of that node and its immediate left and right neighbours (except at the start and end nodes along the boundary). The effect of the ROC constraint of 20 mm is clearly visible at the two ends of the notch boundary. From the response displayed in Figure 17, it is apparent that there are significant fluctuations in the ROC, with a large number of very high ROC values being present. These large fluctuations in ROC value have been found to cause difficulties during the manufacturing of optimal shapes using standard computer numerically-controlled machining techniques.

The rapid and high-amplitude oscillations in the radius-of-curvature of the as-optimised geometry are potentially caused by the use of first-order elements during the iterative finite element analysis. Prior shape optimisation using second-order elements did not appear to display this rather unsatisfactory behaviour. Further investigation is warranted in order to remediate this problem. It is considered that it would be better not to apply the previously-developed automated smoothing procedures in a brute force manner. It would be preferable to determine the cause of the radius-of-curvature problems and address them directly.

Upon subsequent closer investigation here, these rapid and high-amplitude oscillations in the computed ROC values have been identified as being associated with very small transitions in slope between the edges of some of the linear 8-noded hexahedral first-order finite elements. These cause the large calculated ROC values associated with pairs of elements whose connected edges are nearly collinear. This behaviour is depicted in Figure 18, where the shape of the raw optimal profile near $x = 0$ mm has been plotted (solid line). The presence of these “flat” areas, with their commensurately-high ROC values (based on a 3-point circular arc curve fit), is clearly evident in the plot of the raw unsmoothed optimal profile. It is believed that these “flat” regions are caused by the numerical approximations inherent in the use of first-order finite elements to obtain the optimal solution, as prior shape optimisation solutions obtained using second-order finite elements did not display the type of oscillatory ROC behaviour found here (see Waldman, Heller and Chen 2001; Waldman and Heller 2006; Waldman and Heller 2015). The dashed line shows the results of fitting a smooth curve through every second point of the original data set, resulting in a smooth line that accurately follows the underlying shape of the optimal profile.

Hence, as in the prior work performed by Kaye (2010), it is necessary here to undertake ROC smoothing of the raw geometric coordinates of the optimised boundary shape in order to make the notch suitable for manufacturing. Based on an assessment of the relevant information presented in Figure 17 and Figure 18, it was decided to accomplish this smoothing by using a two-phase process in order to produce a result of sufficiently high quality.

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In the first phase of the smoothing process, the raw optimal shape was curve fit using Microsoft Excel, with the problem coordinates that produced the high-amplitude ROC values omitted from the fit. Those points were then manually modified to lie closer to the interpolated shape, thus greatly reducing the severity of the local ROC variations. The result of this process is depicted in Figure 19. There it is evident that the extreme ROC variations have been reduced quite significantly, producing a much smoother overall behaviour. This result is now much more in keeping with our expectations for an optimal shape, but some further smoothing of the ROC variations is still desirable.

In the second phase of the radius of curvature smoothing process, the techniques reported by Wescott and Heller (2009) were applied to further smooth the notch shape. Two cycles of this automated smoothing were computed, and the ROC results obtained are depicted in Figure 20. The (x, y) coordinates at the two ends of the notch, as well as the (x, y) coordinate associated with the centre of the notch shape, were held fixed during the ROC smoothing process. Because of the manual adjustment of the node coordinates prior to undertaking the next phase of ROC smoothing, the automated ROC smoothing process has been very effective in further reducing the variations in ROC along the notch boundary, even with just two cycles.

Note that this level of ROC smoothing has a very small effect on the stresses in the constant-stress zone. This was checked by creating a new finite element model based on the smoothed coordinates of the optimal boundary. The normalised maximum principal stress for the smoothed notch geometry is shown in Figure 21. Compared to the results for the unsmoothed shape, the corner at approximately $x = 25$ mm is slightly more rounded, and the extent of the constant stress zone has been reduced a little bit (from $x = 25.3$ mm to $x = 24.8$ mm). The arc length of the constant-stress zone for the smoothed notch is 50.3 mm, and this is 1.8% shorter than for the unsmoothed notch.

The smoothed notch coordinates are supplied in Table 1. These were read into MSC Patran and used to generate an IGES file containing a representation of the smoothed optimal notch profile suitable for use in creating commands for computer numerically controlled machining of the coupons. The IGES file format is used to specify the notch boundary as a series of circular arcs and straight line segments. A listing of the contents of the IGES file corresponding to the notch contour for the Modified Constant-Stress Coupon is provided in Appendix G (a copy of this file can also be found in Objective folder fAV1044714, and the name of the file is Al_mod_optimal_3D_msmt_smoothed_002.igs).

It is instructive to compare the smoothing approach used above with the results that are obtained when the original raw unsmoothed coordinates for the Modified Constant-Stress Coupon have been passed through 20 cycles of the automated ROC smoothing algorithm. The resulting ROC variation in the notch region is shown in Figure 22. It is apparent that these results are clearly different from those presented in Figure 20, with the major differences being confined to the central region of the notch, $-7 \text{ mm} \leq x \leq +7 \text{ mm}$. The ROC results obtained using 20 cycles of automated smoothing have a peak ROC value that is

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about 15% greater. It is considered here that the application of manual plus automated smoothing has produced a smoother overall result, and it is expected that the resulting changes to the shape coordinates will be less than those produced by 20 cycles of automated smoothing.

5. 2D fracture mechanics assessment of modified constant-stress coupon

As the Modified Constant-Stress Coupon will be used in fatigue testing studies involving crack growth, it is instructive to assess its performance from a fracture mechanics perspective. The programs that were used for this analysis are located in Objective folder fAV1044714.

5.1 Analysis of uncracked coupon

Firstly, a full 2D model of the uncracked Modified Constant-Stress Coupon was created for analysis with FADD2D using the coordinates of the node locations in the original finite element model. A full model was needed as this forms the basis for subsequent stress intensity factor calculations associated with the placement of through-thickness edge cracks at various assumed locations distributed along the notch boundary.

The material properties corresponded to those for a typical aluminium alloy, and were the same as before ($E = 72.4$ GPa and $\nu = 0.33$). Plane stress conditions were specified as the thickness of the specimen is small compared to the other dimensions. The applied load consisted of a uniform tensile pressure applied to the vertical edges at the two ends. To prevent rotation of the grip ends, 6 points were chosen on the grip zone boundary and restrained from moving in the y -direction. Using the (x, y) coordinate system defined in Figure 9, these points were located at $(x, y) = (\pm 62 \text{ mm}, 20 \text{ mm})$, $(\pm 62 \text{ mm}, -20 \text{ mm})$ and $(\pm 122 \text{ mm}, 0 \text{ mm})$. In addition, in order to prevent rigid body motion of the coupon, the point on the boundary at $(x, y) = (-122 \text{ mm}, 0 \text{ mm})$ was restrained from moving in the x -direction.

The FADD2D model was created using the CreateDogboneCouponModel program (see Appendix D), and it was used to compute the maximum principal stress along the optimised notch boundary of the modified constant stress coupon. Figure 23 plots the normalised maximum principal stress obtained from the boundary element model, and compares it to the results obtained from the finite element model that was used during the shape optimisation process. It is evident that the two quite different computational approaches have produced results that are very similar. Using the FADD2D boundary element method, the gross-section SCF is $K_{tg} = 2.519$, which is almost identical to the value $K_{tg} = 2.516$ obtained using the finite element method.

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5.2 Computation of crack trajectories for edge-cracked coupon

Using the 2D model described above, an edge crack was inserted at various locations along the notch boundary. As a result of the 2D nature of the solution, the edge crack is assumed to be a through crack. In each case, the initial crack length set to be 0.1 mm, which can be regarded as being a very short crack relative to the size of the specimen. At each chosen location, the simulated crack was oriented to be perpendicular to the boundary. This essentially means that the crack was initially aligned to open in a Mode I dominant crack propagation mode, as this was assumed to be representative of what might happen in the coupon during fatigue testing.

For the purposes of this analysis, the cracks are located at different points along the notch boundary with the following x -coordinates: 0.00 mm, 4.24 mm, 8.51 mm, 12.74 mm, 16.95 mm, 21.11 mm, 23.17 mm, 25.26 mm, 29.45 mm, and 32.14 mm. These starting points correspond to node locations in the original finite element model. The FADD2D code was used to compute the crack trajectory for a single crack growing from each of these locations. A crack growth increment of 0.1 mm per iteration was used to compute the crack growth trajectory associated with each cracking scenario. For the purpose of this simulation, the cracks were allowed to grow until they had reached 20 mm in length.

The computed crack trajectories obtained for each of the cracks are shown in Figure 24. The trajectories become more curved as the starting location of the crack moves further away from the centre of the coupon. The crack trajectories remain relatively straight in the range of starting locations $0 \text{ mm} \leq x \leq 15 \text{ mm}$.

5.3 Computation of Beta factors for through-thickness edge-cracked coupon

When the crack trajectories were being computed, the FADD2D boundary element code was also calculating the corresponding stress intensity factors, K , for the particular crack geometry that was present at each crack growth increment. It is considered instructive to compare these stress intensity factors to those corresponding to an edge crack of equivalent length that is located in a semi-infinite plate.

For a through-thickness edge crack of length a in a semi-infinite plate subjected to a remote uniaxial tension stress, S_∞ , the equation for the stress intensity factor K is

$$K = S_\infty \sqrt{\pi a F} \quad (1)$$

where F is a boundary correction factor (also called a Beta factor). As its name implies, the boundary correction factor accounts for the influence of various boundaries, but it is also often a function of parameters such as crack geometry, crack length, plate width, plate thickness, hole radius (where present), angular position along a crack front, etc. However, for the semi-infinite plate geometry, the boundary correction factor is a constant value,

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and is simply $F = 1.1215$ (Tada, Paris and Irwin 2000; Broek 1978), which is also known as the free-edge correction factor.

For a through-thickness edge crack that is located at any point along the notch boundary of the Modified Constant-Stress Coupon, the stress intensity factor can be written as

$$K = S\sqrt{\pi a}F \quad (2)$$

where S is the local tangential stress at the notch surface, and a is the crack length as measured along the curved crack trajectory. In the constant stress region, S can be computed by using $S = K_{tg} S_\infty$, where K_{tg} is the local gross-section SCF and S_∞ is the remote uniform uniaxial tension stress applied to the ends of the coupon.

Figure 25 shows the boundary correction factors, F , plotted as a function of crack length, a , for a number of cracks starting from different points along the notch boundary. As a point of reference, the crack-length-independent boundary correction factor for a through-thickness edge crack in a semi-infinite plate is represented by the dashed horizontal line ($F = 1.1215$). For cracks located in the range $0 \text{ mm} \leq x \leq 16.95 \text{ mm}$ that have crack lengths $a \leq 2.5 \text{ mm}$, it is apparent that the geometry factor is within about 2% or so of $F = 1.1215$ for an edge crack in a semi-infinite plate.

The boundary correction factors as a function of distance along the notch boundary for edge cracks of varying lengths for the Modified Constant-Stress Coupon are plotted in Figure 26. The boundary correction factor for very short cracks, $a \leq 0.1 \text{ mm}$, is within 1.0% of the theoretical edge crack solution, $F = 1.1215$, over the entire length of the constant stress region. For short cracks, $a \leq 1.0 \text{ mm}$, the boundary correction factor is within 3.3% of $F = 1.1215$ along 84% of the constant-stress region, dropping by 7.5% at the end of the constant-stress zone.

5.4 Computation of Beta factors for other crack geometries

From the data presented in Figure 25 and Figure 26, the stress intensity factors for short through-thickness edge cracks for the constant stress specimen are largely in agreement with the solution for an edge crack in a semi-infinite plate. By analogy, it would therefore be expected that stress intensity factors for other types of short cracks (e.g. circular or elliptical corner cracks, circular or elliptical surface cracks, etc.) would be well represented by their nominal solutions computed for geometries that are similar to that of the constant-stress coupon. For example, if so desired, the stress intensity factor equations for planar semi-elliptical surface and corner flaws published by Broek could be utilised (Broek 1978, Section 3.6, Elliptical cracks). Hence, for many types of small (short) natural flaws, the body of existing stress intensity factor solutions can be taken advantage of, thus circumventing the need for computation of new sets of solutions that are specific to the present coupon geometry and loading.

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6. Conclusion

The coordinates of the smoothed notch profile for the new Modified Constant-Stress Coupon were presented in Table 1. These have also been made available as an IGES file, which can be utilised for manufacturing of the coupons using numerically-controlled machining equipment. A listing of the contents of the IGES file is given in Appendix G, and a copy of the file can be found in Objective folder fAV1044714 (the name of the file is A1_mod_optimal_3D_msmt_smoothed_002.igs).

A summary of the dimensions of the Modified Constant-Stress Coupon, together with those of the original design, is presented in Table 2. It is noted that the grip area of the Modified Constant-Stress Coupon has been increased by 225% over the original constant-stress coupon design. Together with the increase in gross-section SCF resulting from the increase in the total width of the coupon, the incidences of specimen failure in the grip zone are expected to be greatly reduced, if not entirely eliminated. The arc length of the constant-stress zone in the Modified Constant-Stress Coupon is approximately 7.5% less than that which was obtained for the original constant-stress coupon. If required, a closer match could be attained by increasing the length of the notch zone and/or reducing the depth of the notch.

Using a 2D boundary element model of the Modified Constant-Stress Coupon, a number of potential crack growth trajectories have been computed by using the FADD2D fracture analysis code to perform simulations of 2D through-thickness edge cracks. The starting locations of the edge cracks were distributed along the constant-stress zone of the notch boundary. As the cracking location moved away from the centre of the coupon, the computed crack trajectories progressively became more curved. In the event that cracks that develop in the coupons are allowed to grow to a long length, it would be interesting to compare the crack growth trajectories obtained from fatigue testing with their computationally-determined counterparts.

7. Acknowledgement

The author would like to thank Professor Mark E Mear, University of Texas at Austin, and Professor James C Newman Jr, Mississippi State University, for providing access to the FADD2D boundary element analysis code that was utilised for the fracture mechanics calculations in this report.

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Table 1: Coordinates of the smoothed optimal profile for Modified Constant-Stress Coupon. (See Figure 9 for definition of the x-y coordinate system.)

Point	x (mm)	y (mm)	Point	x (mm)	y (mm)
1	0.0000	12.5000	42	22.7246	15.0170
2	0.5594	12.5011	43	23.2598	15.1800
3	1.1188	12.5044	44	23.7921	15.3519
4	1.6782	12.5098	45	24.3211	15.5338
5	2.2376	12.5175	46	24.8464	15.7263
6	2.7969	12.5273	47	25.3673	15.9302
7	3.3562	12.5394	48	25.8825	16.1481
8	3.9154	12.5538	49	26.3911	16.3812
9	4.4746	12.5704	50	26.8926	16.6292
10	5.0337	12.5894	51	27.3867	16.8914
11	5.5927	12.6109	52	27.8732	17.1676
12	6.1516	12.6347	53	28.3515	17.4577
13	6.7104	12.6612	54	28.8213	17.7614
14	7.2691	12.6902	55	29.2822	18.0785
15	7.8276	12.7218	56	29.7337	18.4088
16	8.3860	12.7562	57	30.1754	18.7522
17	8.9442	12.7935	58	30.6069	19.1082
18	9.5021	12.8336	59	31.0278	19.4766
19	10.0599	12.8767	60	31.4378	19.8572
20	10.6174	12.9230	61	31.8365	20.2497
21	11.1746	12.9726	62	32.2235	20.6537
22	11.7315	13.0254	63	32.5984	21.0688
23	12.2881	13.0817	64	32.9610	21.4948
24	12.8443	13.1416	65	33.3110	21.9313
25	13.4001	13.2052	66	33.6479	22.3778
26	13.9554	13.2727	67	33.9717	22.8340
27	14.5103	13.3441	68	34.2819	23.2996
28	15.0646	13.4197	69	34.5783	23.7740
29	15.6182	13.4996	70	34.8608	24.2569
30	16.1713	13.5839	71	35.1291	24.7478
31	16.7236	13.6728	72	35.3830	25.2462
32	17.2751	13.7665	73	35.6224	25.7519
33	17.8257	13.8652	74	35.8470	26.2642
34	18.3754	13.9690	75	36.0569	26.7827
35	18.9241	14.0783	76	36.2519	27.3071
36	19.4715	14.1933	77	36.4318	27.8368
37	20.0178	14.3141	78	36.5966	28.3714
38	20.5626	14.4411	79	36.7463	28.9104
39	21.1059	14.5745	80	36.8808	29.4534
40	21.6474	14.7147	81	37.0000	30.0000
41	22.1871	14.8621			

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Table 2: Summary of the dimensions and K_t properties of the new Modified Constant-Stress Coupon, together with those of the original design.

	Original Constant-Stress Coupon	Modified Constant-Stress Coupon
Thickness (mm)	6.35	6.35
Total length (mm)	160	244
Total width (mm)	40	60
Notch length (mm)	70	74
Width of centre-section (mm)	25	25
Grip area (mm²)	40×40 = 1600	60×60 = 3600
Grip buffer zone (mm)	5	25
Arc length of notch boundary (mm)	73.9	89.5
Arc length of constant-stress zone (mm)	54.4	50.3
Net-section SCF K_t	1.038	1.048
Gross-section SCF K_{tg}	1.660	2.516

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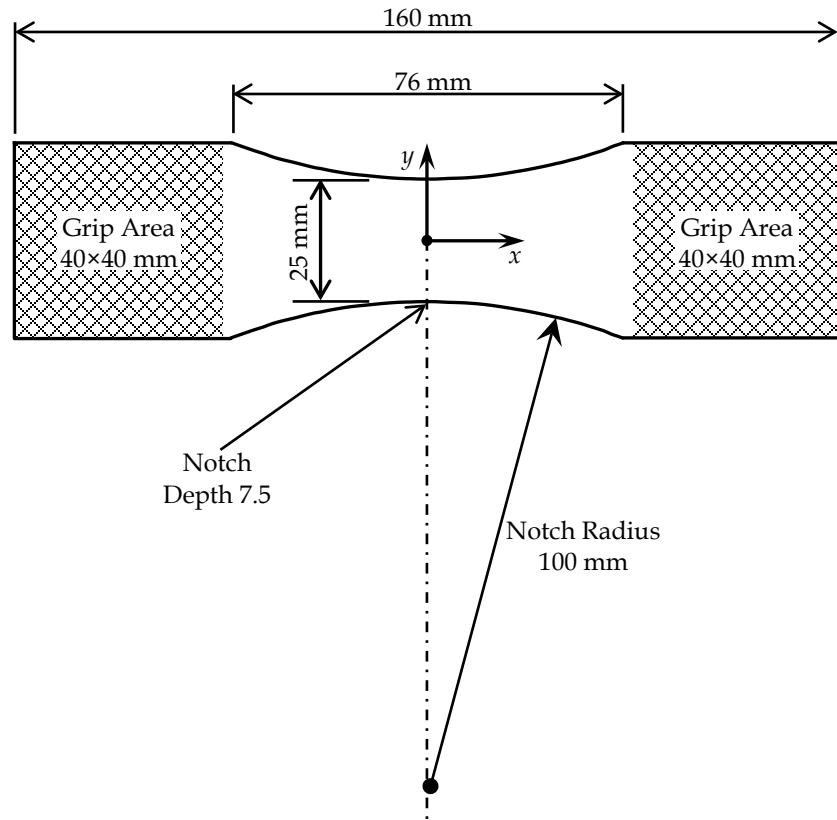


Figure 1: Dimensions of a fatigue test coupon with a constant-radius notch (McDonald 2009a).

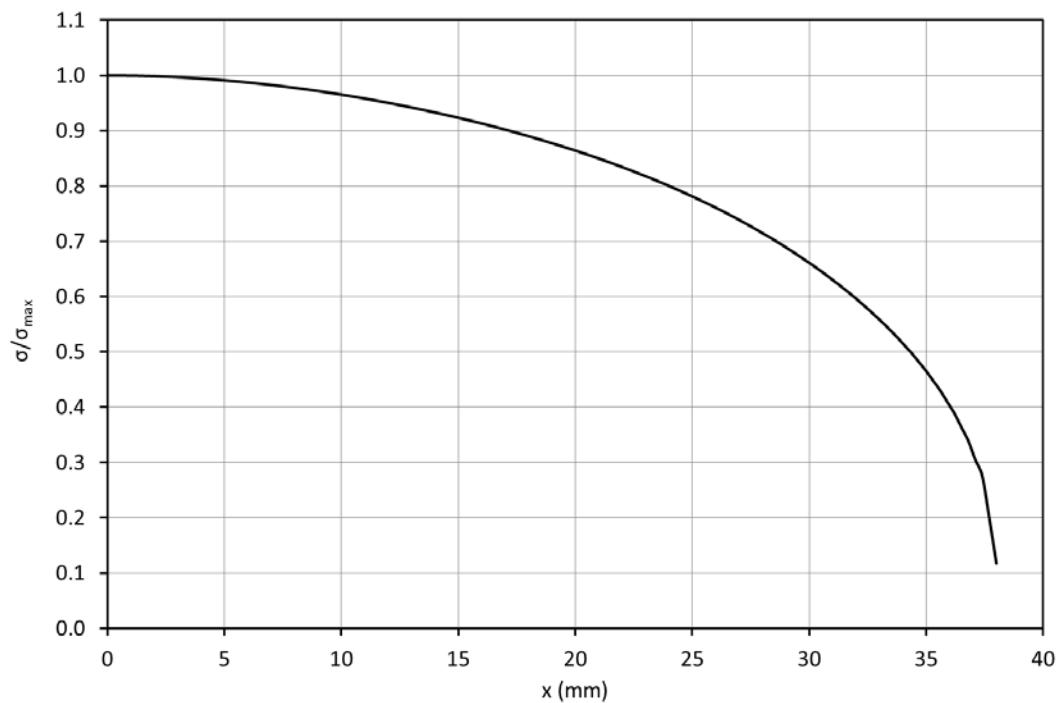


Figure 2: Tangential stress response over the notch region of a fatigue test coupon with a constant-radius notch.

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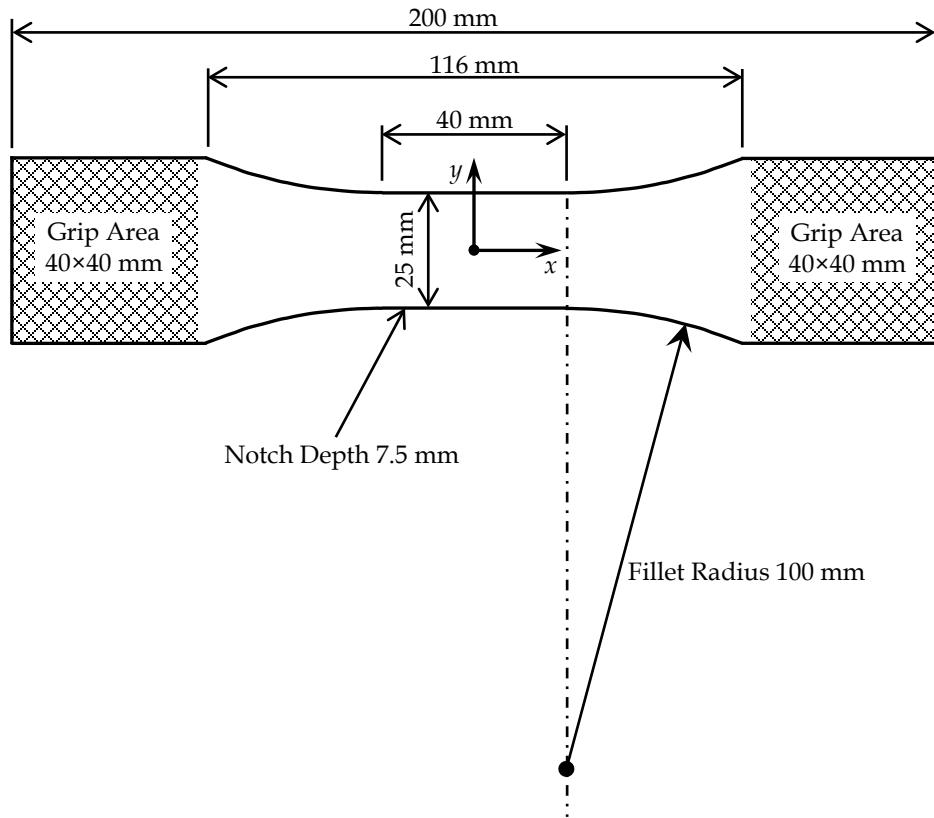


Figure 3: Dimensions of a fatigue test coupon with a central region of constant width and large constant-radius fillets.

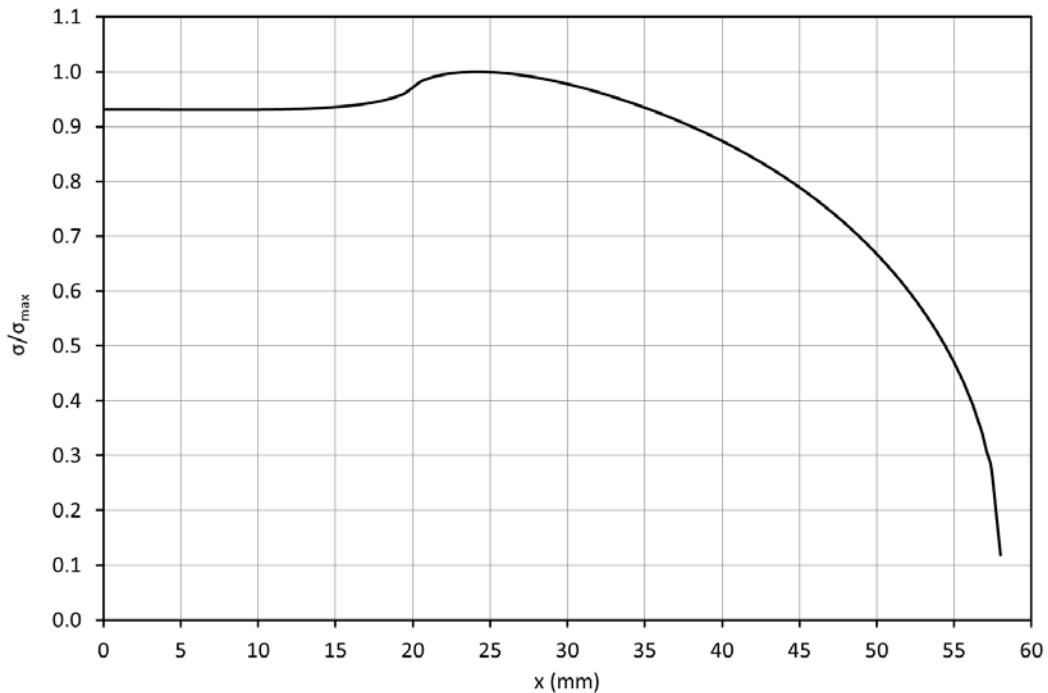


Figure 4: Tangential stress response over the notch region of a fatigue test coupon with a central region of constant width and large constant-radius fillets.

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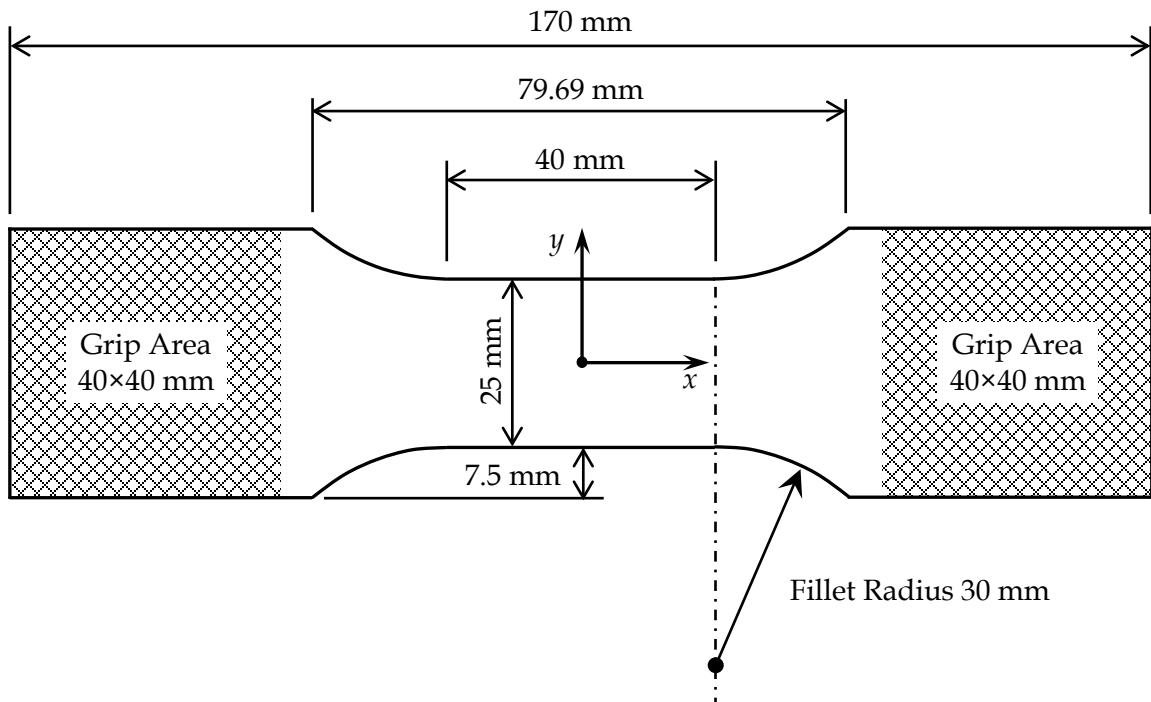


Figure 5: Dimensions of a fatigue test coupon with a central region of constant width and moderate constant-radius fillets.

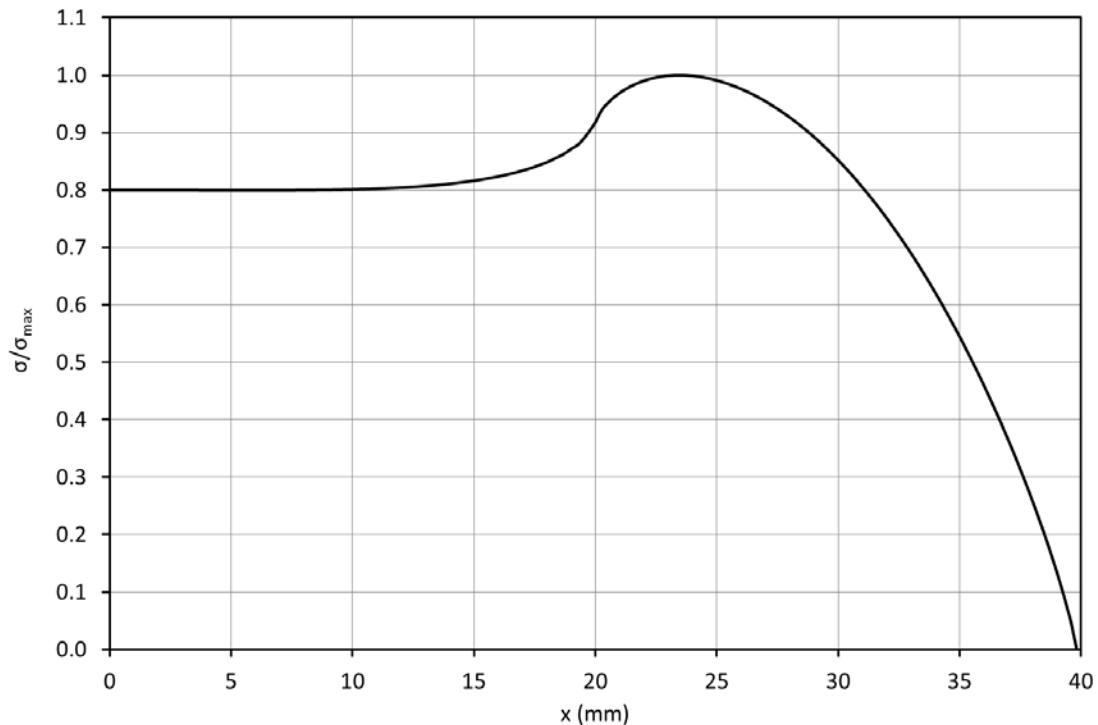


Figure 6: Tangential stress response over the notch region of a fatigue test coupon with a central region of constant width and moderate constant-radius fillets.

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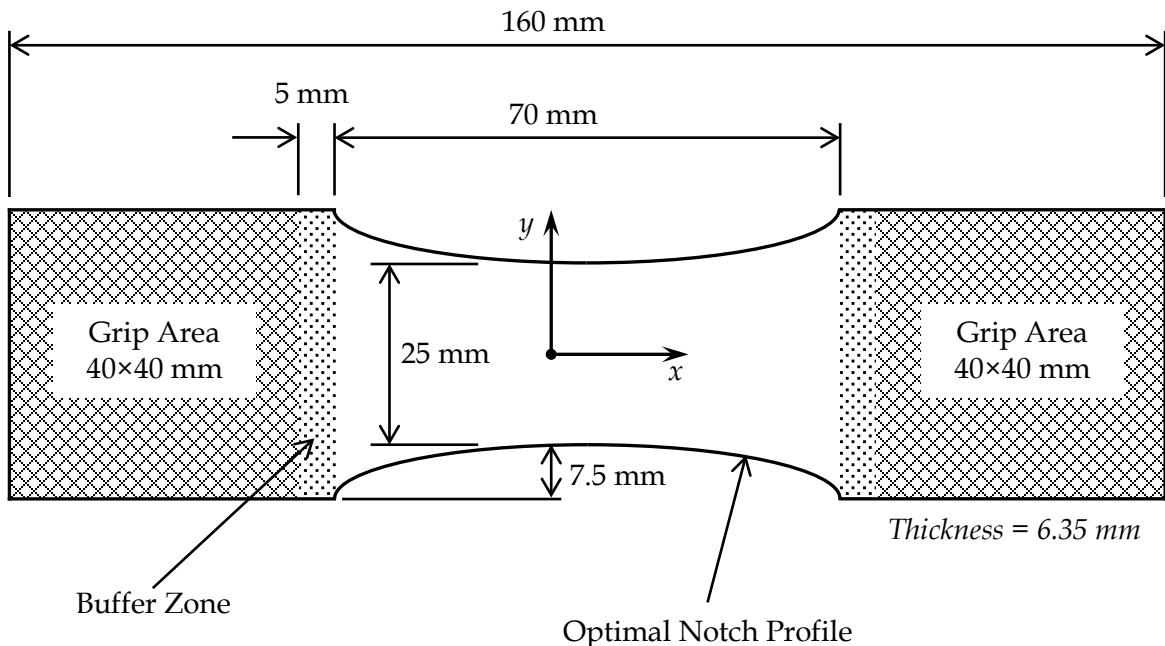


Figure 7: General shape and dimensions of original optimised constant-stress coupon.

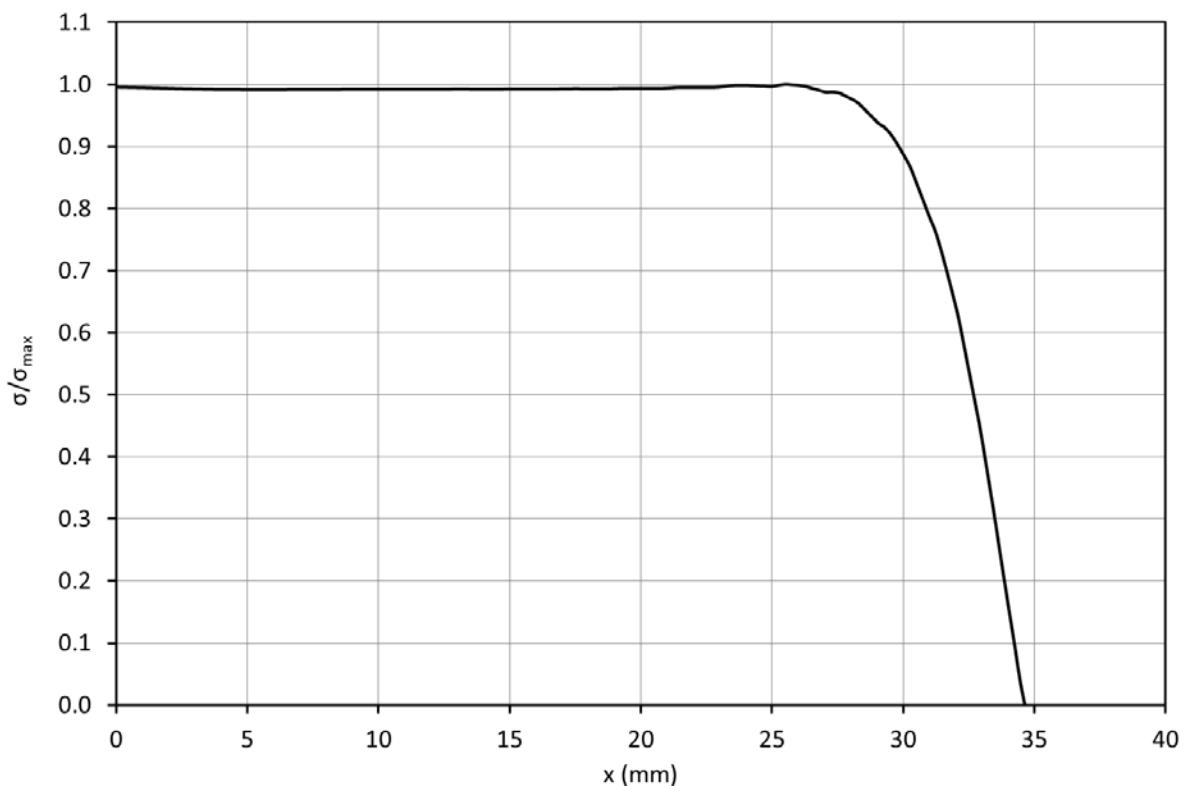


Figure 8: Tangential stress response over the notch region of original optimised constant-stress coupon.

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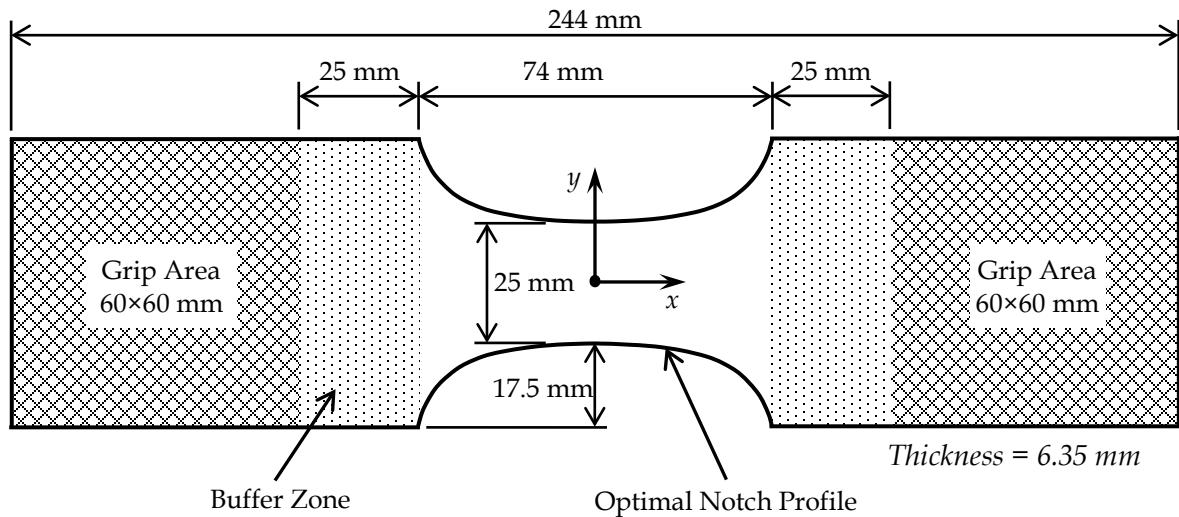


Figure 9: General shape and dimensions of the Modified Constant-Stress Coupon.

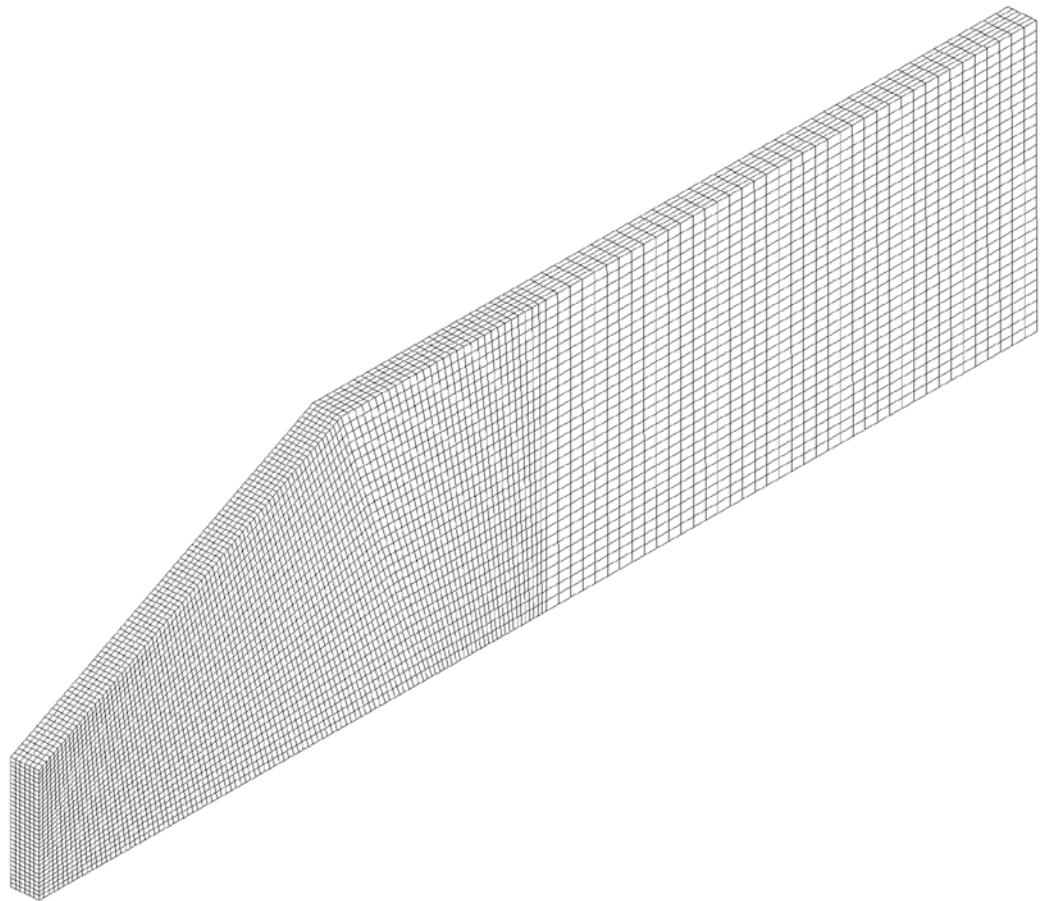


Figure 10: Initial finite element mesh for $\frac{1}{8}$ -symmetry model of the Modified Constant-Stress Coupon prior to shape optimisation.

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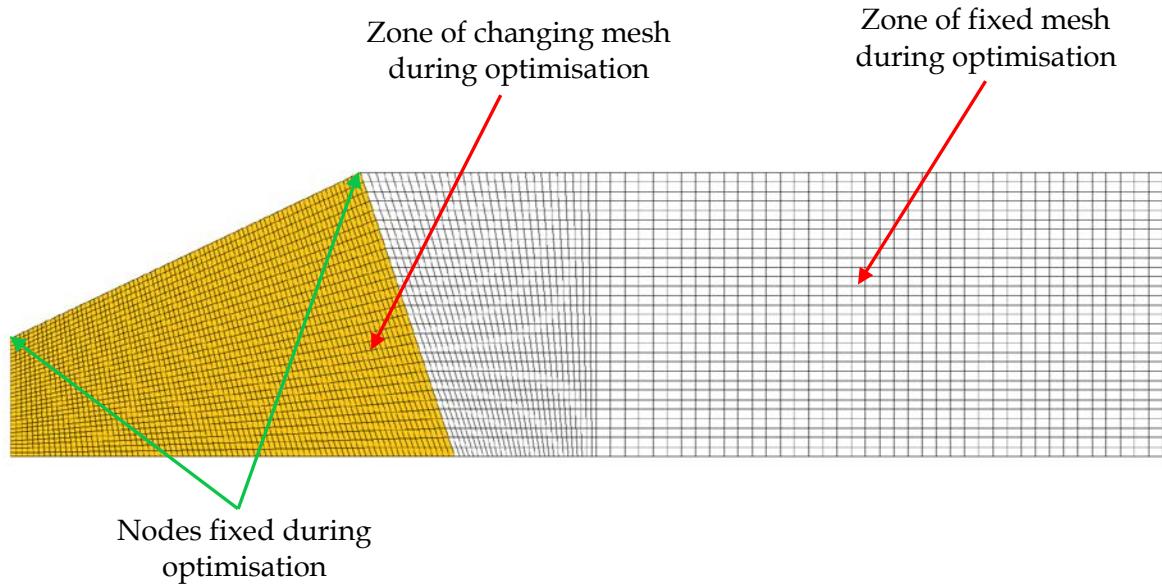


Figure 11: Side view of 3D mesh showing the assumed starting shape of the notch and the optimisation zone.

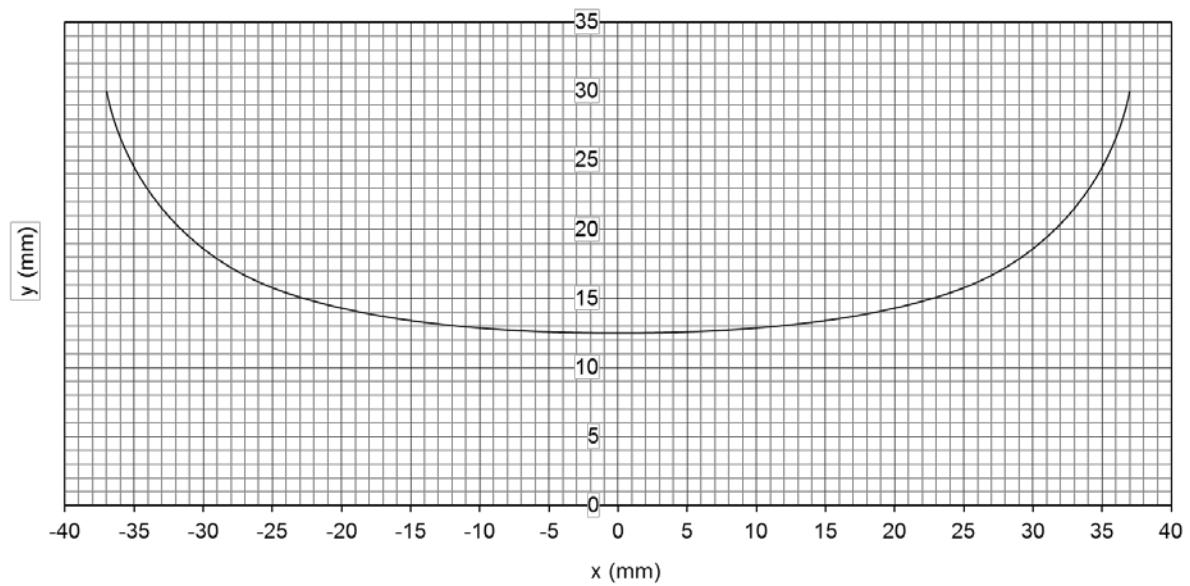


Figure 12: Notch profile optimal shape for the Modified Constant-Stress Coupon.

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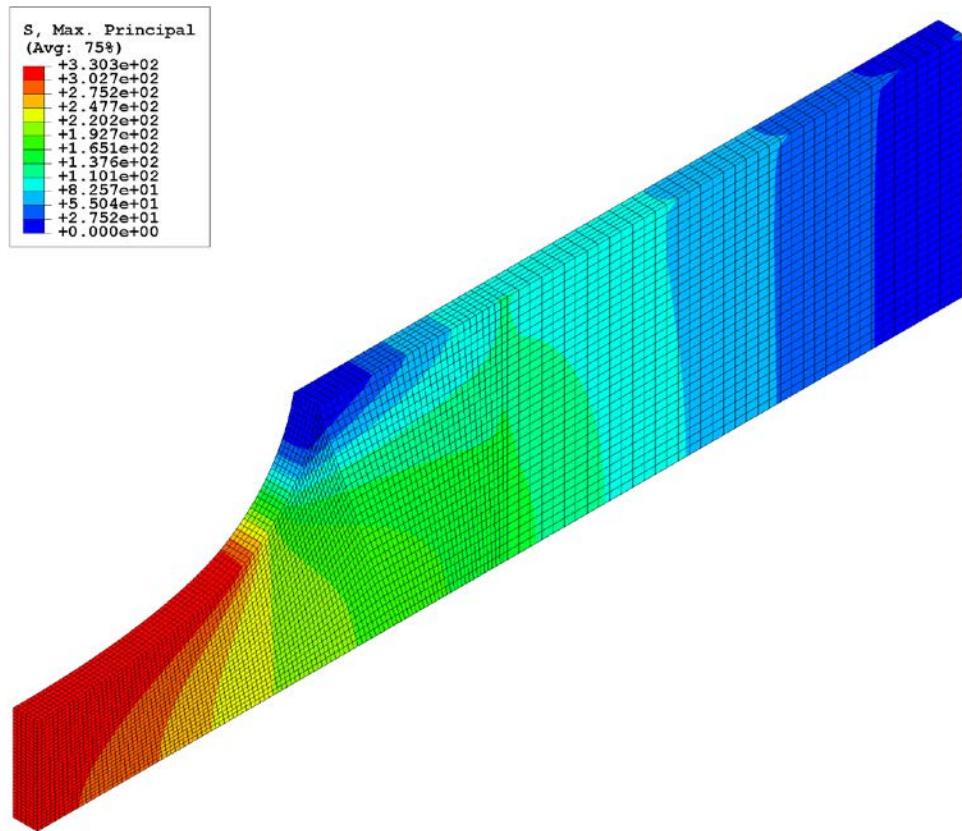


Figure 13: Contours of maximum principal stress for the optimised constant-stress coupon.

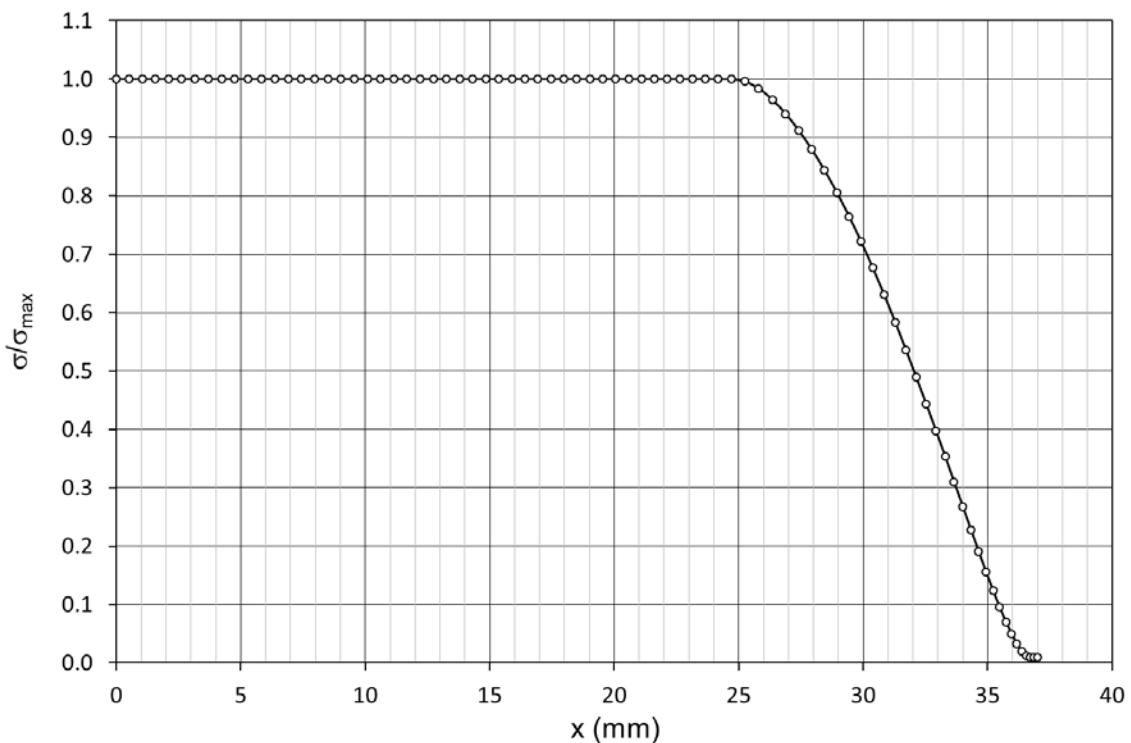


Figure 14: Normalised maximum principal stress along optimal notch boundary for the Modified Constant-Stress Coupon.

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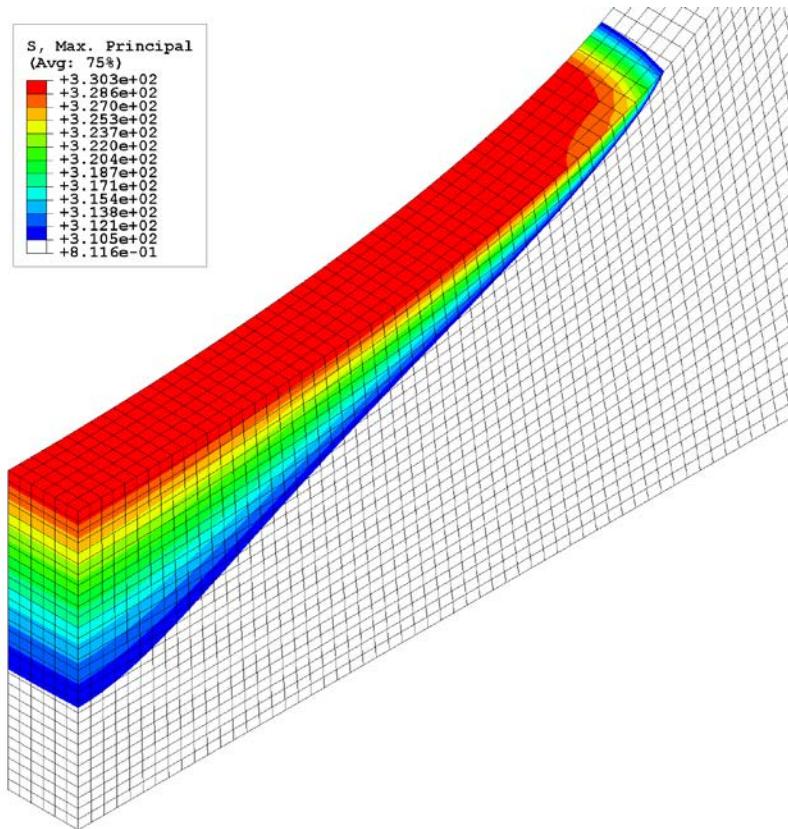


Figure 15: Contours of maximum principal stress in the vicinity of constant-stress region of the optimised Modified Constant-Stress Coupon that are within 6% of the maximum stress.

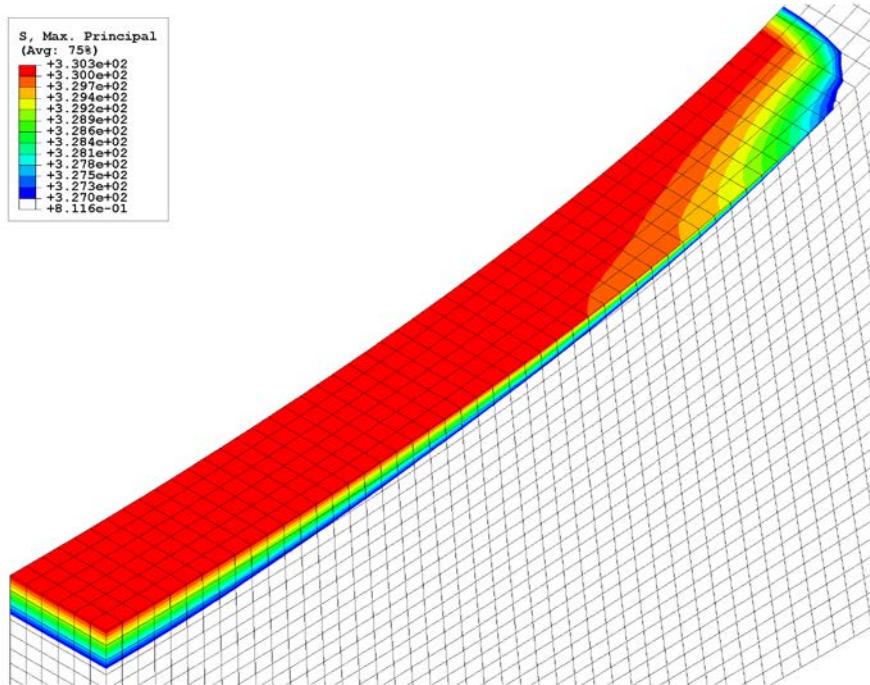


Figure 16: Contours of maximum principal stress in the vicinity of the constant-stress region of the optimised Modified Constant-Stress Coupon that are within 1% of the maximum stress.

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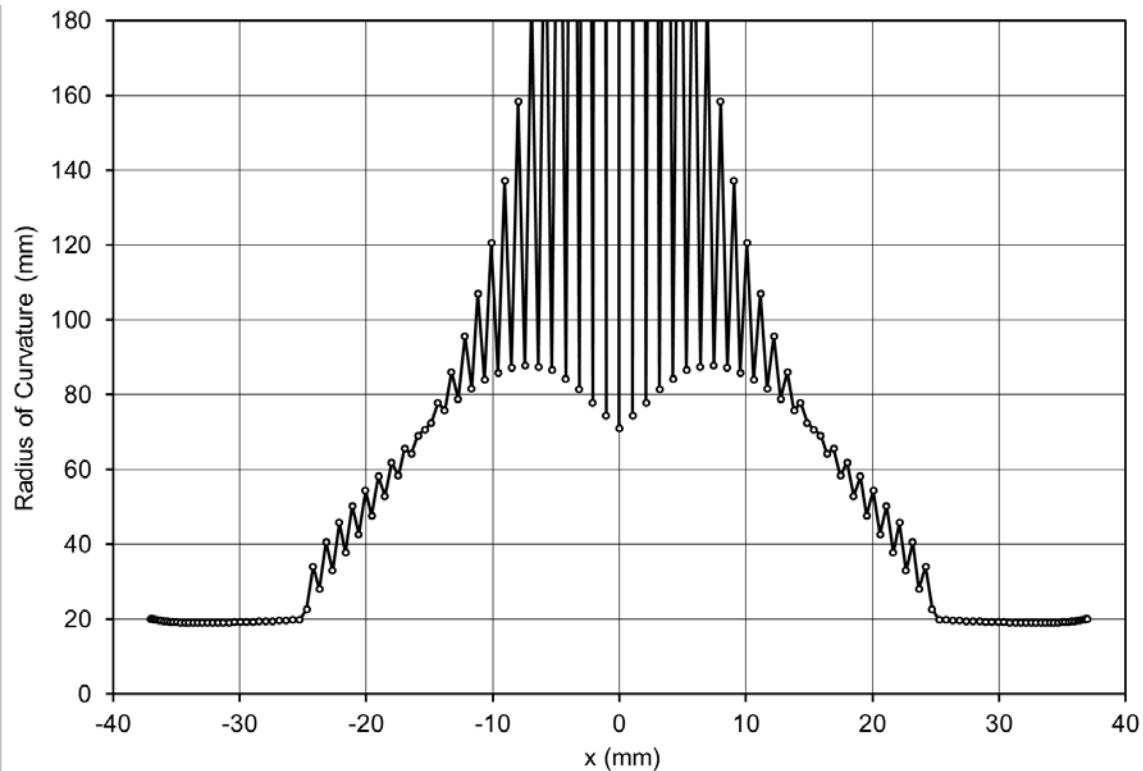


Figure 17: Computed radius of curvature along the raw unsmoothed optimal boundary of the Modified Constant-Stress Coupon.

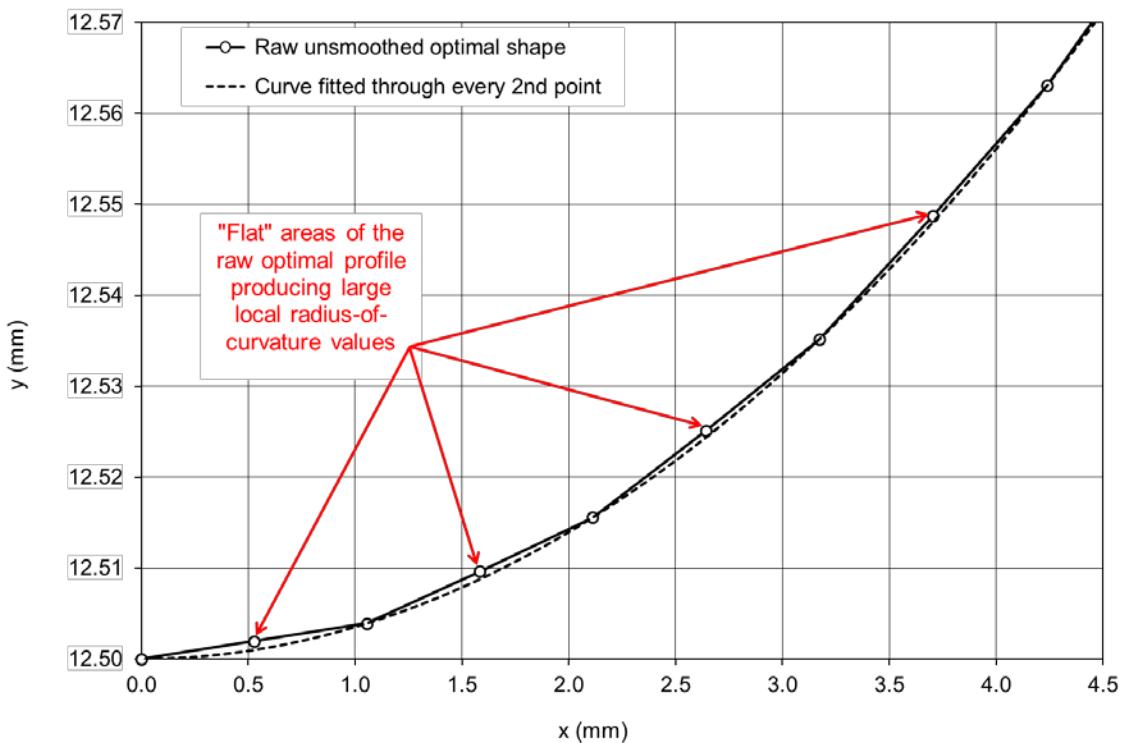


Figure 18: Section of raw unsmoothed optimal profile showing "flat" spots and a more representative smooth curve passing through every second point.

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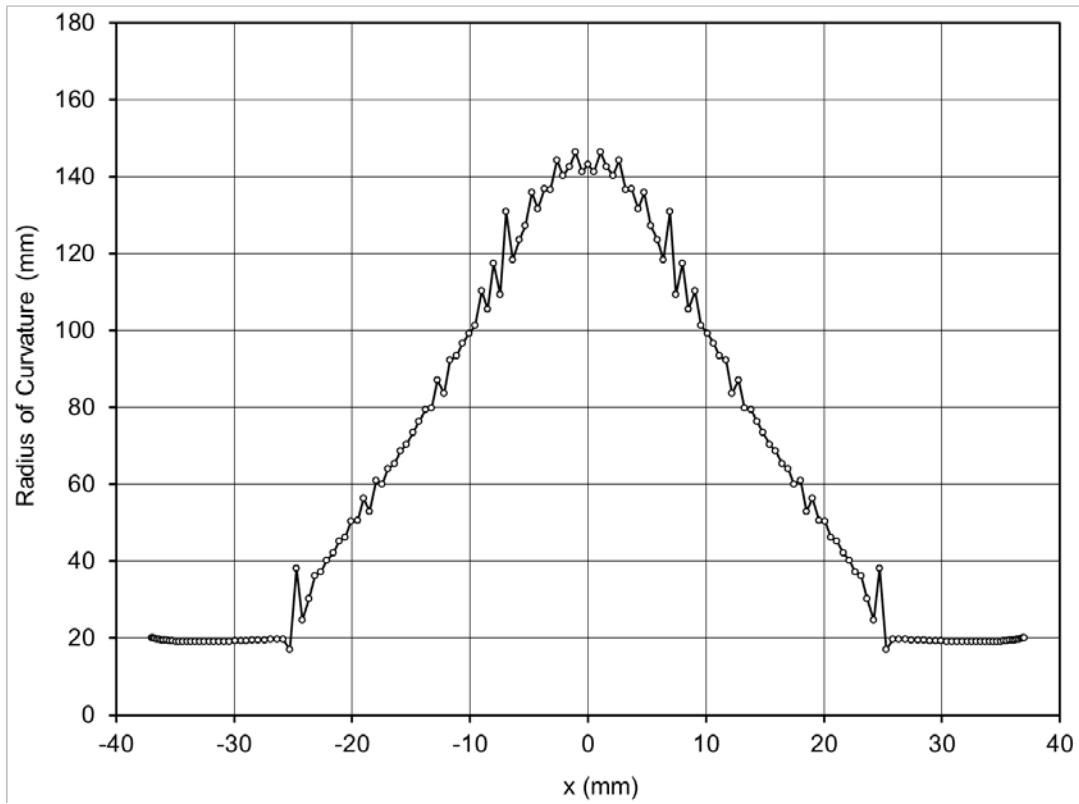


Figure 19: Radius of curvature along the notch boundary after completion of manual smoothing.

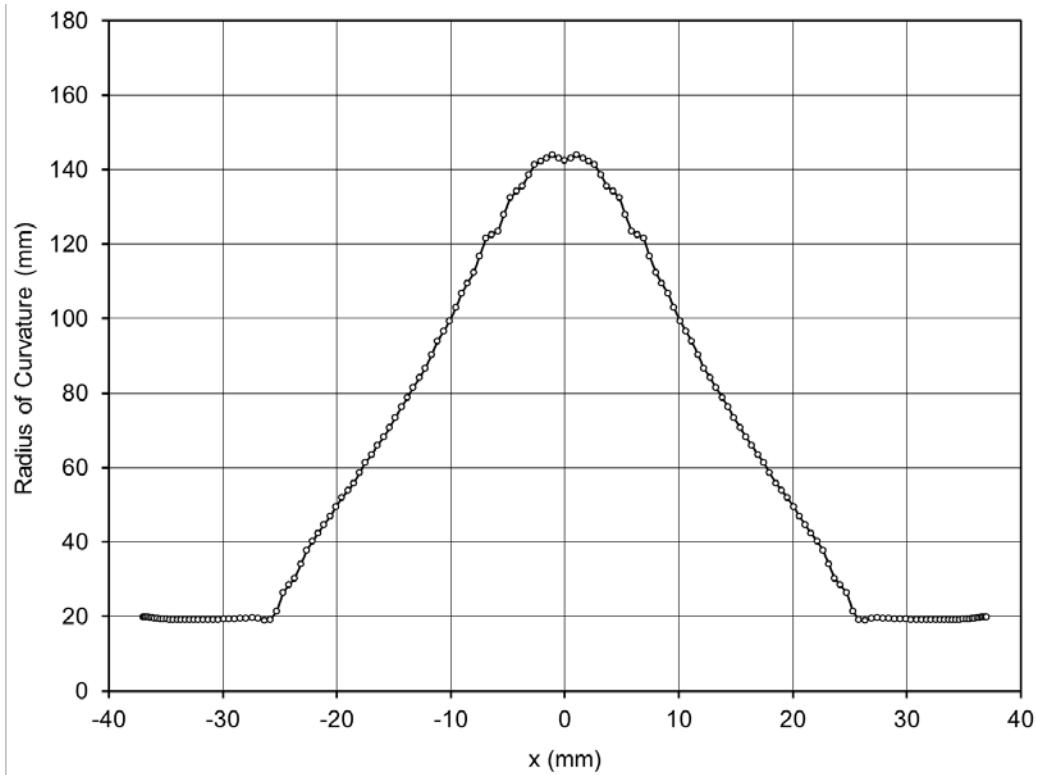


Figure 20: Radius of curvature along the notch boundary after completion of an additional two cycles of automated smoothing.

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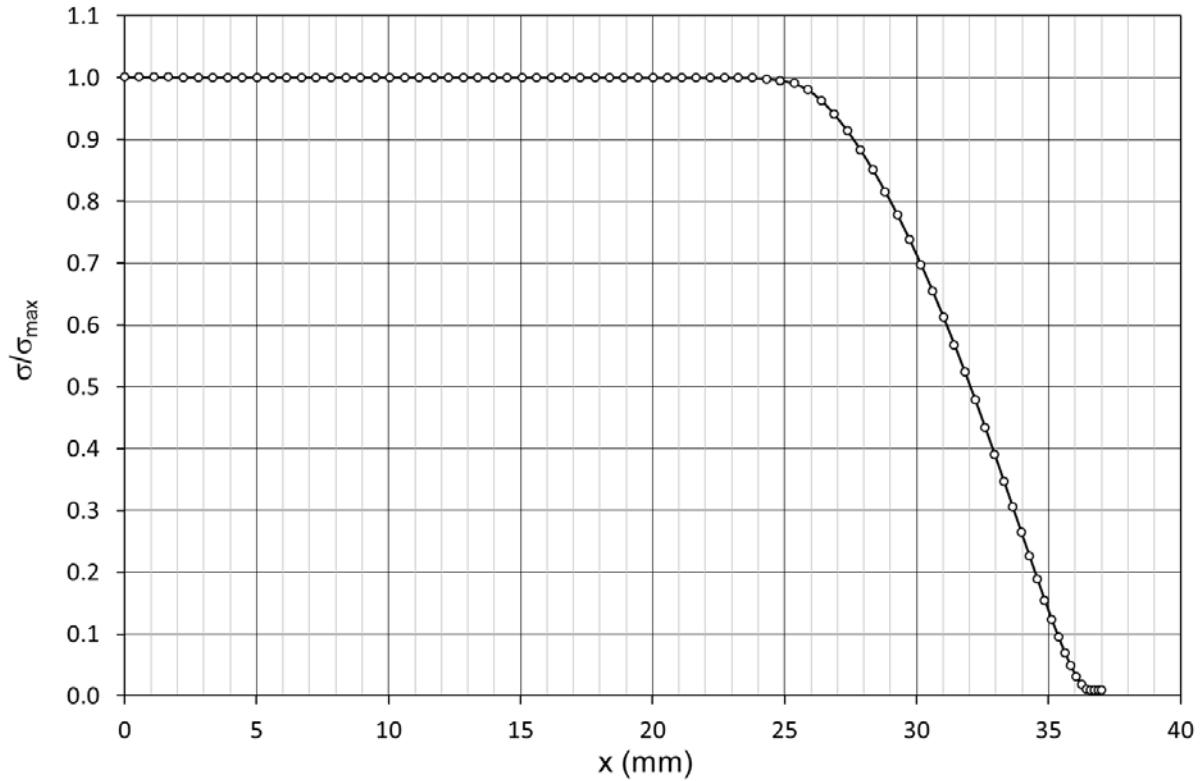


Figure 21: Normalised maximum principal stress along smoothed optimal notch boundary for the Modified Constant-Stress Coupon.

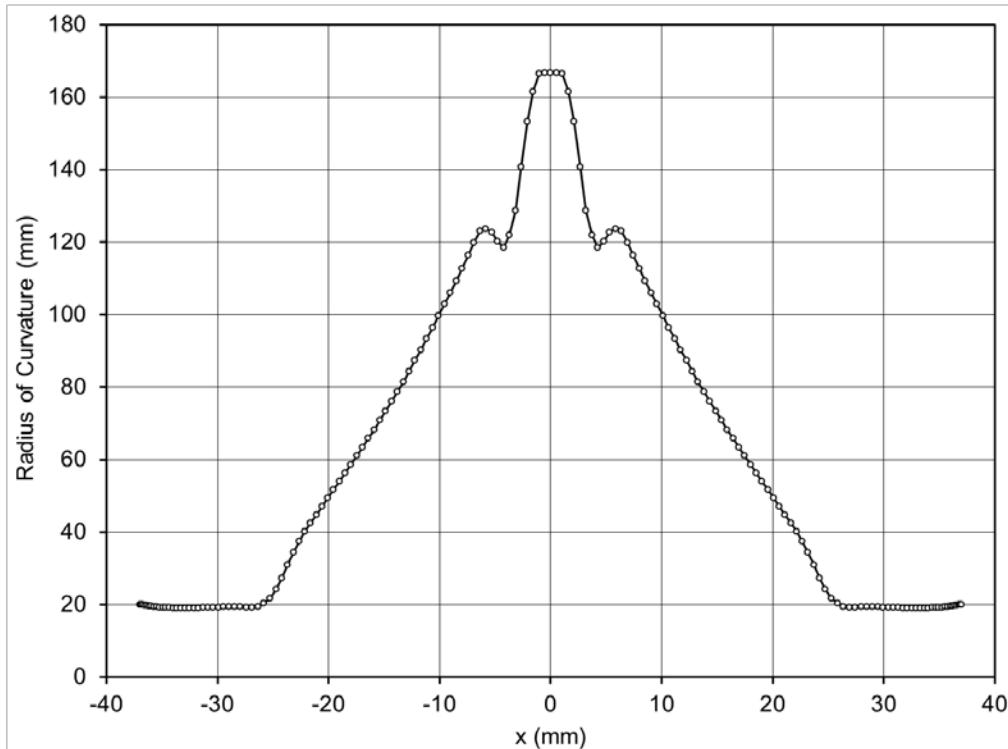


Figure 22: Radius of curvature along the notch boundary after completion of twenty cycles of automated smoothing without applying any prior manual smoothing.

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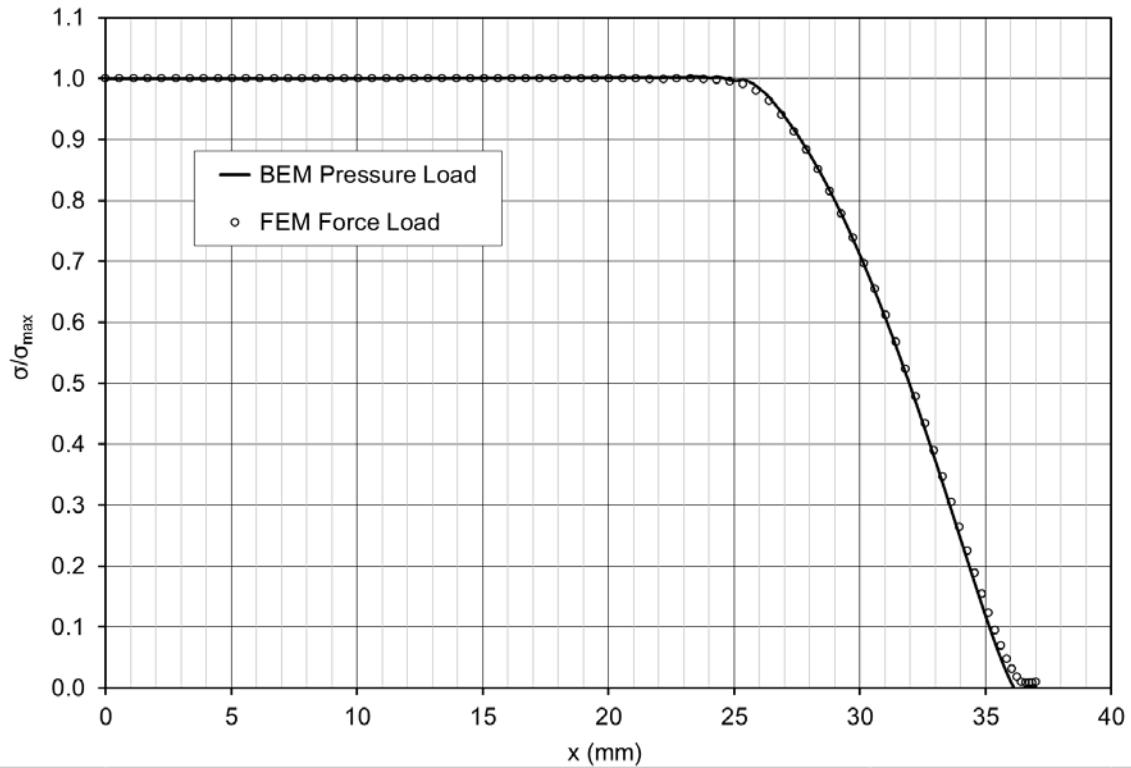


Figure 23: Normalised maximum principal stress along optimal notch boundary for the Modified Constant-Stress Coupon obtained using boundary element and finite element models.

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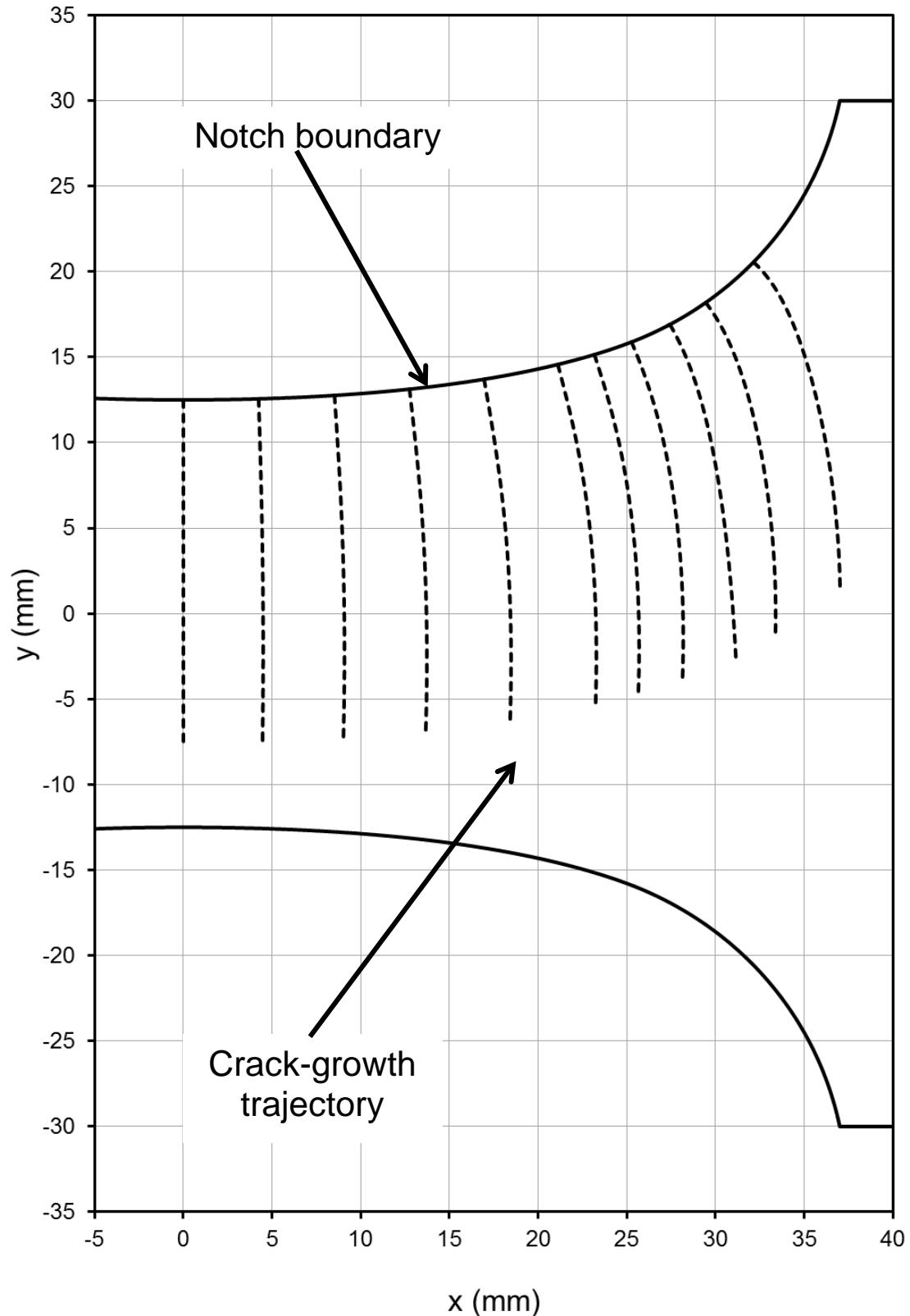


Figure 24: Simulated crack-growth trajectories for through-thickness edge cracks starting from different points along the notch boundary of the Modified Constant-Stress Coupon.

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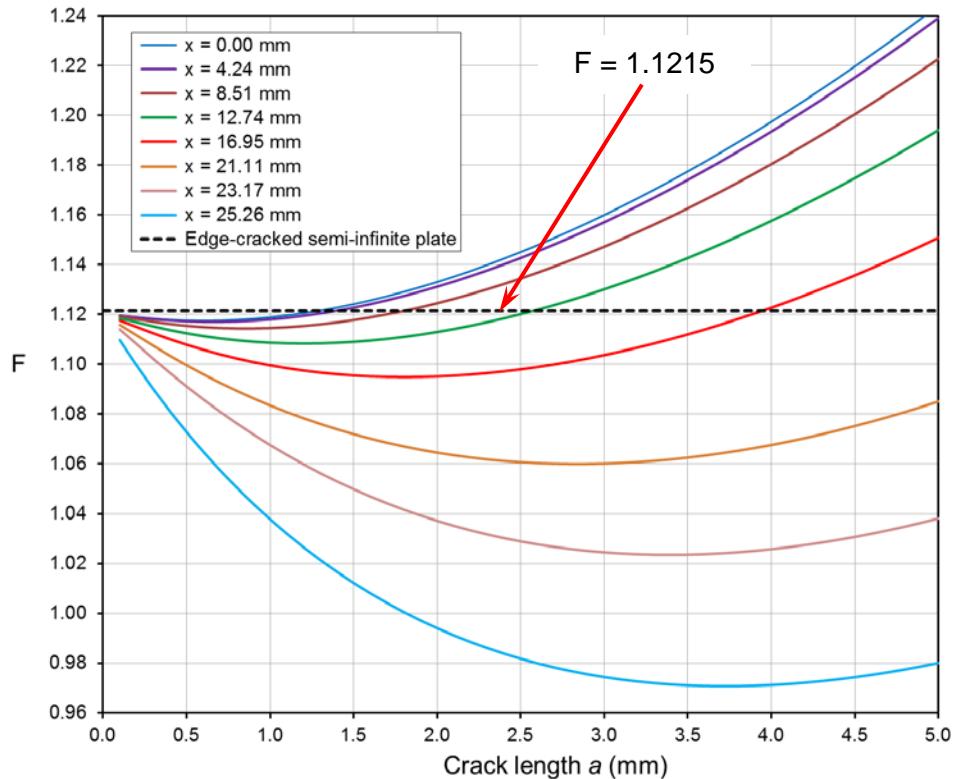


Figure 25: Boundary correction factors as a function of crack length for cracks starting at different points along the notch boundary of the Modified Constant-Stress Coupon.

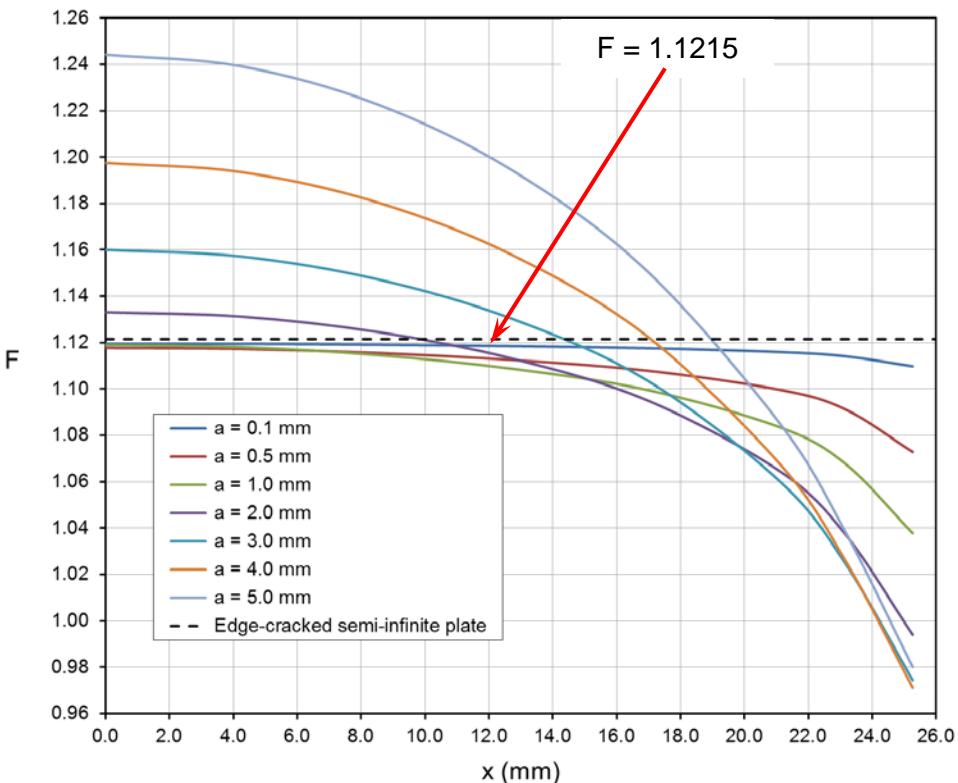


Figure 26: Boundary correction factors as a function of distance along the notch boundary for cracks of varying lengths for the Modified Constant-Stress Coupon.

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Appendix A:

FADD2D input file for uncracked notch composed of large 100-mm constant-radius arcs

The following input file can also be found stored in Objective folder fAV1044714.

```

FADD - Visual C++ Version 1.0 - 09/10/14
Dog-bone Fatigue Test Coupon
Constant R = 100 mm Radius Notch
-----
Problem Type, No of Materials
2 1
Materials, Elastic modulus, and Poisson's ratio
1 72400.000000 0.330000
Material, Cracks, Boundaries, and Point loads
1 0 1 0
Input echo, Boundary Stresses, and Displacements
1 1 1

-----
Definition of Boundary

1 1
0 0 5

1 0 0.000000 112.500000 100.000000 60
-90.000000 -1 0.000000 -1 0.000000 0
-101.165823 -1 0.000000 -1 0.000000 0
-112.331645 -1 0.000000 -1 0.000000 0

2 1 30
-37.996710 20.000000 -1 0.000000 -1 0.000000 0
-58.998355 20.000000 -1 0.000000 -1 0.000000 0
-80.000000 20.000000 -1 0.000000 -1 0.000000 0

3 1 30
-80.000000 20.000000 -1 -100.000000 -1 0.000000 0
-80.000000 10.000000 -1 -100.000000 -1 0.000000 0
-80.000000 0.000000 -1 -100.000000 -1 0.000000 0

4 1 40
-80.000000 0.000000 -1 0.000000 0 0.000000 0
-40.000000 0.000000 -1 0.000000 0 0.000000 0
0.000000 0.000000 -1 0.000000 0 0.000000 0

5 1 40
0.000000 0.000000 0 0.000000 -1 0.000000 0
0.000000 6.250000 0 0.000000 -1 0.000000 0
0.000000 12.500000 0 0.000000 -1 0.000000 0
-----
```

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Appendix B:

FADD2D input file for uncracked notch with constant central width and large 100-mm radius fillets

The following input file can also be found stored in Objective folder fAV1044714.

```
FADD - Visual C++ Version 1.0 - 09/10/14
Dog-bone Fatigue Test Coupon
40 mm Uniform Section With R = 100 mm Radius Fillets
-----
Problem Type, No of Materials
2 1
Materials, Elastic modulus, and Poisson's ratio
1 72400.00000 0.330000
Material, Cracks, Boundaries, and Point loads
1 0 1 0
Input echo, Boundary Stresses, and Displacements
1 1 1

-----
Definition of Boundary

1 1
0 0 6

1 1 30
0.000000 12.500000 -1 0.000000 -1 0.000000 0
-10.000000 12.500000 -1 0.000000 -1 0.000000 0
-20.000000 12.500000 -1 0.000000 -1 0.000000 0

2 0 -20.000000 112.500000 100.000000 60
-90.000000 -1 0.000000 -1 0.000000 0
-101.165823 -1 0.000000 -1 0.000000 0
-112.331645 -1 0.000000 -1 0.000000 0

3 1 30
-57.996710 20.000000 -1 0.000000 -1 0.000000 0
-78.998355 20.000000 -1 0.000000 -1 0.000000 0
-100.000000 20.000000 -1 0.000000 -1 0.000000 0

4 1 30
-100.000000 20.000000 -1 -100.000000 -1 0.000000 0
-100.000000 10.000000 -1 -100.000000 -1 0.000000 0
-100.000000 0.000000 -1 -100.000000 -1 0.000000 0

5 1 40
-100.000000 0.000000 -1 0.000000 0 0.000000 0
-50.000000 0.000000 -1 0.000000 0 0.000000 0
0.000000 0.000000 -1 0.000000 0 0.000000 0

6 1 40
0.000000 0.000000 0 0.000000 -1 0.000000 0
```

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0.000000 6.250000 0 0.000000 -1 0.000000 0
0.000000 12.500000 0 0.000000 -1 0.000000 0

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Appendix C:

FADD2D input file for uncracked notch with constant central width and medium 30-mm radius fillets

The following input file can also be found stored in Objective folder fAV1044714.

```
FADD - Visual C++ Version 1.0 - 09/10/14
Dog-bone Fatigue Test Coupon
40 mm Uniform Section With R = 100 mm Radius Fillets
-----
Problem Type, No of Materials
2 1
Materials, Elastic modulus, and Poisson's ratio
1 72400.00000 0.330000
Material, Cracks, Boundaries, and Point loads
1 0 1 0
Input echo, Boundary Stresses, and Displacements
1 1 1 1

-----
Definition of Boundary

1 1
0 0 6

1 1 30
0.000000 12.500000 -1 0.000000 -1 0.000000 0
-10.000000 12.500000 -1 0.000000 -1 0.000000 0
-20.000000 12.500000 -1 0.000000 -1 0.000000 0

2 0 -20.000000 42.500000 30.000000 60
-90.000000 -1 0.000000 -1 0.000000 0
-110.704811 -1 0.000000 -1 0.000000 0
-131.409622 -1 0.000000 -1 0.000000 0

3 1 30
-39.843134 20.000000 -1 0.000000 -1 0.000000 0
-62.421567 20.000000 -1 0.000000 -1 0.000000 0
-85.000000 20.000000 -1 0.000000 -1 0.000000 0

4 1 30
-85.000000 20.000000 -1 -100.000000 -1 0.000000 0
-85.000000 10.000000 -1 -100.000000 -1 0.000000 0
-85.000000 0.000000 -1 -100.000000 -1 0.000000 0

5 1 40
-85.000000 0.000000 -1 0.000000 0 0.000000 0
-42.500000 0.000000 -1 0.000000 0 0.000000 0
0.000000 0.000000 -1 0.000000 0 0.000000 0

6 1 40
0.000000 0.000000 0 0.000000 -1 0.000000 0
```

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0.000000 6.250000 0 0.000000 -1 0.000000 0
0.000000 12.500000 0 0.000000 -1 0.000000 0

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Appendix D:

Fortran 90 source code for the CreateDogboneCouponModel program

The following source code can also be found stored in Objective folder fAV1044714.

```
=====
!
! PROGRAM: CreateDogboneCouponModel
!
! PURPOSE: To take a set of points that define the curved boundary and outer
!           geometry of a dog-bone specimen and create a FADD2D model. Two
!           models are created, one with and the other without an edge crack.
!
! AUTHOR: Witold Waldman
!
! DATE: 2014-08-04
!
=====

program CreateDogboneCouponModel

call DogboneCouponModel(.TRUE.)
call DogboneCouponModel(.FALSE.)

end program CreateDogboneCouponModel

=====
subroutine DogboneCouponModel(cracked)

!
! |#----- 1 -----#|
!
!      B03      B02      B01          B14      B13      B12
!      <--- +-----Y-----+          +-----+-----Y-----+----->
!      <--- |           \          /Cn
!      <--- |           \          /C1
!      <--- |           +-----+
!      <--- |           +-----+ (x,y) origin
!      <--- XY B04
!      <--- |
!      <--- |           +-----+
!      <--- |           +-----\          Y-----+
!      <--- |           /          \          +-----+
!      <--- +-----Y-----+          B08      B09      B10
!      B05      B06      B07          B11      Y-----h
!
! implicit none

integer(4), parameter :: lui    = 1
```

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```

integer(4), parameter :: luo      = 2
integer(4), parameter :: nb       = 14
integer(4), parameter :: ndash    = 86
integer(4), parameter :: maxpts  = 1000
real(8)   , parameter :: px      = 100.0d0

logical(4) cracked

character str(100)*128,filedbi*32,filedbc*32,filedbu*32
integer(4) nc,ncracks,nelemcrack
real(8)   cx(maxpts),cy(maxpts)
real(8)   bx(nb),by(nb)
integer(4) id,ic,i,j,nelem
integer(4) icrackpoint(maxpts)
real(8)   ls,lg,hon2,lon2,dx,dy,a0,da,plexp
real(8)   ym,nu
complex(8) z1,z2,z3
integer(4) cn(maxpts)
real(8)   angletangent(maxpts),anglenormal(maxpts)
real(8)   xinwnv(maxpts),yinwnv(maxpts)
real(8)   cangletangent(maxpts),canglenormal(maxpts)
real(8)   cxinwnv(maxpts),cyinwnv(maxpts)
integer(4) nsteps

filedbi = 'dogbone.dat'
filedbc = 'dogbone_cracked.in'
filedbu = 'dogbone_uncracked.in'

do i = 1,maxpts
  icrackpoint(i) = 0
enddo

open(lui,file=filedbi,status='OLD')
read(lui,*) ym,nu
read(lui,*) ls,lg
read(lui,*) ncracks,a0,nsteps,da,plexp,(icrackpoint(i),i=1,ncracks)
read(lui,*) nc
do i = 1,nc
  read(lui,*) cx(i),cy(i)
end do
close(lui)

if (cracked) then
  if (ncracks.le.0) then
    write(*,*) 'No cracks were defined. Proceeding to place a crack'
    write(*,*) 'at the first node on the line of symmetry.'
    ncracks = 1
    icrackpoint(1) = 1
  endif
  open(unit=luo,file=filedbc,status='REPLACE')
else
  ncracks = 0
  do i = 1,maxpts
    icrackpoint(i) = 0
  enddo
  open(unit=luo,file=filedbu,status='REPLACE')

```

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endif

```
hon2 = cy(nc)
lon2 = ls/2.0d0
```

```
bx(01) = -cx(nc); by(01) = +hon2
bx(02) = -lon2+lg; by(02) = +hon2
bx(03) = -lon2; by(03) = +hon2
bx(04) = -lon2; by(04) = 0.0d0
bx(05) = -lon2; by(05) = -hon2
bx(06) = -lon2+lg; by(06) = -hon2
bx(07) = -cx(nc); by(07) = -hon2
bx(08) = +cx(nc); by(08) = -hon2
bx(09) = +lon2-lg; by(09) = -hon2
bx(10) = +lon2; by(10) = -hon2
bx(11) = +lon2; by(11) = 0.0d0
bx(12) = +lon2; by(12) = +hon2
bx(13) = +lon2-lg; by(13) = +hon2
bx(14) = +cx(nc); by(14) = +hon2
```

```
do i = 1,nc
  cn(i) = 0
enddo
```

```
do i = 1,ncracks
  cn(icrackpoint(i)) = i
enddo
```

```
call anglevector(nc,cx,cy,angletangent,anglenormal,xinwnv,yinwnv)
```

```
write(luo,'(a)') 'FADD2D input deck generated by CreateDogboneCouponModel'
write(luo,'(a)') 'Dogbone Fatigue Analysis Coupon'
```

```
if (cracked) then
  write(luo,'(a)') 'Edge cracked case'
else
  write(luo,'(a)') 'Uncracked case'
endif
```

```
call writedashedline(luo,ndash)
write(luo,'(a)') 'Problem Type, No of Materials'
write(luo,'(a)') '2 1'
write(luo,'(a)') 'Materials, Elastic modulus, and Poisson''s ratio'
write(luo,'(i1,f20.4,f17.4)') 1,ym,nu
write(luo,'(a)') 'Material, Cracks, Boundaries, and Point loads'
```

```
if (cracked) then
  write(luo,'(i1,i5.4,2i2)') 1,ncracks,1,0
  write(luo,'(a)') 'Crack-growth steps, increment, and Paris law exponent'
  write(luo,'(i4.4,2f12.4)') nsteps,da,plexp
else
  write(luo,'(a)') '1 0 1 0'
endif
```

```
write(luo,'(a)') 'Input echo, Boundary Stresses, and Displacements'
write(luo,'(a)') '1 1 1 1'
```

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```

write(luo,'(a)') ''

if (cracked) then
  call writedashedline(luo,ndash)
  write(luo,'(a)') 'Definition of Crack'
  write(luo,'(a)') ''
  nelemcrack = 8
  do i = 1,ncracks
    write(luo,'(i4.4,i2)') i,1
    write(luo,'(a)') ' 1 0 0 2 1'
    j = icrakpoint(i)
    if (mod(j,2) .eq. 0) then
      write(*,*)
      write(*,*) 'Error: Crack location index must be an odd number. Check your
input data.'
      write(*,*)
      stop
    endif
    dx = a0*xinwnv(j)
    dy = a0*yinwnv(j)
    write(luo,'(2i4,4f18.7,i6,f18.3)')
    1,1,cx(j),cy(j),cx(j)+dx,dy,nelemcrack,anglenormal(j)
    write(luo,'(a)') ''
  enddo
endif

call writedashedline(luo,ndash)
write(luo,'(a)') 'Definition of Boundary'
write(luo,'(a)') ''
write(luo,'(a)') '1 1'
write(luo,'(i4.4,i2,i6)') ncracks,0,4*(nc/2)+nb-2

! Initialise counter that gets incremented when each
! boundary segment is created.

id = 0

! Write out the LH upper quadrant of the curved boundary.

nelem = 2
do i = 1,nc/2
  ic = (i-1)*2+1
  if (i.eq.1 .and. cn(1).gt.0) then
    call segpara(-cx(ic),+cy(ic),-cx(ic+1),+cy(ic+1),-cx(ic+2),+cy(ic+2), &
                 cn(ic),0,0,luo,id,8*nelem)
  else
    call segpara(-cx(ic),+cy(ic),-cx(ic+1),+cy(ic+1),-cx(ic+2),+cy(ic+2), &
                 0,0,0,luo,id,nelem)
  endif
enddo

! Write out next line segments.

nelem = 4
call segline(bx(01),by(01),bx(02),by(02),luo,id,nelem,-1,0.0d0,-1,0.0d0,3,0,1)
call segline(bx(02),by(02),bx(03),by(03),luo,id,nelem,-1,0.0d0,-1,0.0d0,1,0,1)

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```
call segline(bx(03),by(03),bx(04),by(04),luo,id,nelem,-1, -px , -1,0.0d0,3,1,1)
call segline(bx(04),by(04),bx(05),by(05),luo,id,nelem,-1, -px , -1,0.0d0,1,1,1)
call segline(bx(05),by(05),bx(06),by(06),luo,id,nelem,-1,0.0d0,-1,0.0d0,3,0,1)
call segline(bx(06),by(06),bx(07),by(07),luo,id,nelem,-1,0.0d0,-1,0.0d0,1,0,1)
```

! Write out the LH lower quadrant of the curved boundary.

```
nelem = 1
do i = 1,nc/2
  ic = nc-(i-1)*2
  call segpara(-cx(ic),-cy(ic),-cx(ic-1),-cy(ic-1),-cx(ic-2),-cy(ic-2), &
               0,0,0,luo,id,nelem)
enddo
```

! Write out the RH lower quadrant of the curved boundary.

```
nelem = 1
do i = 1,nc/2
  ic = (i-1)*2+1
  call segpara(+cx(ic),-cy(ic),+cx(ic+1),-cy(ic+1),+cx(ic+2),-cy(ic+2), &
               0,0,0,luo,id,nelem)
enddo
```

! Write out next line segments.

```
nelem = 4
call segline(bx(08),by(08),bx(09),by(09),luo,id,nelem,-1,0.0d0,-1,0.0d0,3,0,1)
call segline(bx(09),by(09),bx(10),by(10),luo,id,nelem,-1,0.0d0,-1,0.0d0,1,0,1)
call segline(bx(10),by(10),bx(11),by(11),luo,id,nelem,-1, +px , -1,0.0d0,3,0,1)
call segline(bx(11),by(11),bx(12),by(12),luo,id,nelem,-1, +px , -1,0.0d0,1,0,1)
call segline(bx(12),by(12),bx(13),by(13),luo,id,nelem,-1,0.0d0,-1,0.0d0,3,0,1)
call segline(bx(13),by(13),bx(14),by(14),luo,id,nelem,-1,0.0d0,-1,0.0d0,1,0,1)
```

! Write out the RH upper quadrant of the curved boundary.

```
nelem = 2
do i = 1,nc/2
  ic = nc-(i-1)*2
  ! If a crack is located at either the start or end node of the
  ! parabolic segment, increase the mesh density for the segment.
  if (cn(ic).gt.0 .or. cn(ic-2).gt.0) then
    call segpara(+cx(ic),+cy(ic),+cx(ic-1),+cy(ic-1),+cx(ic-2),+cy(ic-2), &
                 cn(ic),cn(ic-1),cn(ic-2),luo,id,8*nelem)
  else
    call segpara(+cx(ic),+cy(ic),+cx(ic-1),+cy(ic-1),+cx(ic-2),+cy(ic-2), &
                 cn(ic),cn(ic-1),cn(ic-2),luo,id,nelem)
  endif
enddo

write(luo,'(a)') ' '
call writedashedline(luo,ndash)

close(luo)

end subroutine DogboneCouponModel
```

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```
=====
subroutine writedashedline(luo,ndash)
implicit none
integer(4) luo,ndash,i
write(luo,'(2000a)') ('-',i=1,ndash)
end subroutine writedashedline
=====
subroutine segpara(x1,y1,x2,y2,x3,y3,cn1,cn2,cn3,luo,id,nelem)
implicit none
real(8) x1,y1,x2,y2,x3,y3
integer(4) cn1,cn2,cn3
integer(4) luo,id,nelem
id = id + 1
write(luo,'(a)') ''
write(luo,'(i4.4,2i4)') id,1,nelem
write(luo,'(2f15.7,i4,f15.7,i4,f15.7,i4)') x1,y1,-1,0.0d0,-1,0.0d0,cn1
write(luo,'(2f15.7,i4,f15.7,i4,f15.7,i4)') x2,y2,-1,0.0d0,-1,0.0d0,cn2
write(luo,'(2f15.7,i4,f15.7,i4,f15.7,i4)') x3,y3,-1,0.0d0,-1,0.0d0,cn3
return
end subroutine segpara
=====
subroutine segline(x1,y1,x2,y2,luo,id,nelem,icx,vcx,icy,vcy,icn,icnx,icny)
implicit none
real(8) x1,y1,x2,y2,vcx,vcy
integer(4) luo,id,nelem,icx,icy,icn,icnx,icny
real(8) px
real(8) xm,ym
id = id + 1
xm = (x1+x2)/2.0d0
ym = (y1+y2)/2.0d0
write(luo,'(a)') ''
write(luo,'(i4.4,2i4)') id,1,nelem
if (icn.eq.0) then
  write(luo,100) x1,y1,icx,vcx,icy,vcy,0
  write(luo,100) xm,ym,icx,vcx,icy,vcy,0
  write(luo,100) x2,y2,icx,vcx,icy,vcy,0
  100 format(i4,2f15.7,i4,f15.7,i4,f15.7,i4)
```

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```
else
  if (icn.eq.1) then
    write(luo,100) x1,y1,icx,vcx,icy,vcy,-2,icnx,icny
  else
    write(luo,100) x1,y1,icx,vcx,icy,vcy,0
  end if
  if (icn.eq.2) then
    write(luo,100) xm,ym,icx,vcx,icy,vcy,-2,icnx,icny
  else
    write(luo,100) xm,ym,icx,vcx,icy,vcy,0
  end if
  if (icn.eq.3) then
    write(luo,100) x2,y2,icx,vcx,icy,vcy,-2,icnx,icny
  else
    write(luo,100) x2,y2,icx,vcx,icy,vcy,0
  end if
end if

return

100 format(2f15.7,i4,f15.7,i4,f15.7,3i4)

end subroutine segline

!=====
subroutine anglevector(n,xc,yc,angletangent,anglenormal,xinwnv,yinwnv)
! Determine the tangent angle, inward normal angle, and inward normal vector
! for points along the curved optimal boundary. It is assumed that the first
! point is mirrored about the y-axis.

implicit none

integer(4) n
real(8)    xc(n),yc(n),angletangent(n),anglenormal(n),xinwnv(n),yinwnv(n)
integer(4) i
real(8)    pi,pion2,twopi

pi      = 4.0d0*atan(1.0d0)
pion2  = pi/2.0d0
twopi  = 2.0d0*pi

do i=1,n
  ! Compute angle of slope of the curve at each point on the curve.
  if (i.eq.1) then
    angletangent(i)=atan2(0.0d0,xc(i+1)-(-xc(i+1)))
  else if (i.eq.n) then
    angletangent(i)=atan2(yc(i)-yc(i-1),xc(i)-xc(i-1))
  else
    ! This simple formula for calculating the slope of the
    ! curve is equivalent to what is obtained by using
    ! a second-order Lagrange polynomial approximation.
    angletangent(i)=atan2(yc(i+1)-yc(i-1),xc(i+1)-xc(i-1))
  endif
  ! Compute angle of the outward normal.
```

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```

anglenormal(i)=angletangent(i)-pion2
if (anglenormal(i).gt.pi) anglenormal(i)=anglenormal(i)-twopi
! Compute inward unit normal vector to boundary.
xinwnv(i)=cos(anglenormal(i))
yinwnv(i)=sin(anglenormal(i))
! Convert angles from radians to degrees.
anglenormal(i)=anglenormal(i)*180.0d0/pi
angletangent(i)=angletangent(i)*180.0d0/pi
enddo

return
end

=====
subroutine circle(x1,y1,x2,y2,x3,y3,xc,yc,r,det)

! Determine the centre coordinates (xc,yc) and radius r of a circle passing
! through three points, (x1,y1) (x2,y2) (x3,y3).
!
! If the value of det is zero, then a circle through the three given points
! does not exist. e.g. the three points are colinear.

implicit none

real*8 x1,y1,x2,y2,x3,y3,xc,yc,r,det

real*8 a1,a2,c1,c2,b1,b2

a1=2.0*(x2-x1)
a2=2.0*(x3-x2)
b1=2.0*(y2-y1)
b2=2.0*(y3-y2)
c1=x2**2+y2**2-x1**2-y1**2
c2=x3**2+y3**2-x2**2-y2**2

det=a1*b2-b1*a2

if (det.ne.0.0) then
  xc=(c1*b2-b1*c2)/det
  yc=(a1*c2-c1*a2)/det
  a1=xc-x1
  a2=yc-y1
  r=dsqrt(a1**2+a2**2)
else
  xc=0.0d0
  yc=0.0d0
  r=0.0d0
endif

return
end

=====
subroutine canglevector(n,xc,yc,angletangent,anglenormal,xinwnv,yinwnv)

```

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```
! Determine the tangent angle, inward normal angle, and inward normal vector
! for points along the curved optimal boundary. It is assumed that the first
! point is mirrored about the y-axis.

implicit none

integer(4) n
real(8)    xc(n),yc(n),angletangent(n),anglenormal(n),xinwnv(n),yinwnv(n)
integer(4) i
real(8)    pi,pion2,twopi,r,cx,cy,det

pi      = 4.0d0*atan(1.0d0)
pion2 = pi/2.0d0
twopi = 2.0d0*pi

do i=1,n
  ! Compute angle of slope of the curve at each point on the curve.
  if (i.eq.1) then
    call circle(-xc(i+1),yc(i+1),xc(i),yc(i),xc(i+1),yc(i+1),cx,cy,r,det)
    if (det.eq.0.0d0) then
      angletangent(i)=atan2(0.0d0,xc(i+1)-(-xc(i+1)))
    endif
  else if (i.eq.n) then
    call circle(xc(i-2),yc(i-2),xc(i-1),yc(i-1),xc(i),yc(i),cx,cy,r,det)
    if (det.eq.0.0d0) then
      angletangent(i)=atan2(yc(i)-yc(i-1),xc(i)-xc(i-1))
    endif
  else
    call circle(xc(i-1),yc(i-1),xc(i),yc(i),xc(i+1),yc(i+1),cx,cy,r,det)
    if (det.eq.0.0d0) then
      angletangent(i)=atan2(yc(i+1)-yc(i-1),xc(i+1)-xc(i-1))
    endif
  endif
  ! Compute angle of the outward normal.
  if (det.eq.0.0d0) then
    anglenormal(i)=angletangent(i)-pion2
  else
    anglenormal(i) = atan2(yc(i)-cy,xc(i)-cx)
    angletangent(i) = anglenormal(i)+pion2
  endif
  if (anglenormal(i).gt.pi) anglenormal(i)=anglenormal(i)-twopi
  ! Compute inward unit normal vector to boundary.
  xinwnv(i)=cos(anglenormal(i))
  yinwnv(i)=sin(anglenormal(i))
  ! Convert angles from radians to degrees.
  anglenormal(i)=anglenormal(i)*180.0d0/pi
  angletangent(i)=angletangent(i)*180.0d0/pi
enddo

return
end
```

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Appendix E:

Input deck used to create FADD2D model of original constant-stress coupon using CreateDogboneCouponModel program

The following input file can also be found stored in Objective folder fAV1044714.

```
72400.0 0.33
160.0 40.0
1 0.10 199 0.10 3.0 1
37
0.000000      12.500000
1.040013      12.502718
2.096924      12.510549
3.153789      12.523134
4.210584      12.540315
5.267295      12.562121
6.323909      12.588742
7.380377      12.620489
8.436671      12.657774
9.492742      12.700915
10.548531     12.750359
11.603993     12.806458
12.659052     12.869623
13.713637     12.940341
14.767647     13.019109
15.820983     13.106494
16.873507     13.203122
17.925085     13.309665
18.975613     13.426894
20.024801     13.555622
21.072376     13.696856
22.118006     13.851865
23.161242     14.022339
24.201506     14.210653
25.237661     14.420102
26.268244     14.655024
27.290857     14.921516
28.302109     15.226401
29.297739     15.579076
30.271200     15.988238
31.212088     16.463631
32.102810     17.007961
32.937607     17.631344
33.710354     18.341629
34.400757     19.132950
34.700379     19.566475
35.000000     20.000000
```

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Appendix F:

FADD2D input file for Modified Constant-Stress Coupon with one centrally-located through-thickness edge crack

The following input file can also be found stored in Objective folder fAV1044714.

```
FADD2D input deck generated by CreateDogboneCouponModel
Dog-bone Fatigue Analysis Coupon
Edge cracked case

-----
Problem Type, No of Materials
2 1
Materials, Elastic modulus, and Poisson's ratio
1      72400.0000      0.3000
Material, Cracks, Boundaries, and Point loads
1 0001 1 0
Crack-growth steps, increment, and Paris law exponent
0199      0.1000      3.0000
Input echo, Boundary Stresses, and Displacements
1 1 1 1

-----
Definition of Crack

0001 1
 1 0 0 2 1
 1   1    0.0000000    12.5000000    0.0000000    12.4000000     8    -90.000

-----
Definition of Boundary

1 1
0001 0    172

0001    1 16
 0.0000000    12.5000000    -1    0.0000000    -1    0.0000000    1
 -0.5269560    12.5009750    -1    0.0000000    -1    0.0000000    0
 -1.0548970    12.5038980    -1    0.0000000    -1    0.0000000    0

0002    1 2
 -1.0548970    12.5038980    -1    0.0000000    -1    0.0000000    0
 -1.5831520    12.5087610    -1    0.0000000    -1    0.0000000    0
 -2.1121110    12.5155840    -1    0.0000000    -1    0.0000000    0

0003    1 2
 -2.1121110    12.5155840    -1    0.0000000    -1    0.0000000    0
 -2.6419170    12.5243890    -1    0.0000000    -1    0.0000000    0
 -3.1729650    12.5352090    -1    0.0000000    -1    0.0000000    0

0004    1 2
 -3.1729650    12.5352090    -1    0.0000000    -1    0.0000000    0
 -3.7053990    12.5481030    -1    0.0000000    -1    0.0000000    0
 -4.2397240    12.5631460    -1    0.0000000    -1    0.0000000    0
```

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0005	1	2				
	-4.2397240	12.5631460	-1	0.0000000	-1	0.0000000
	-4.7759650	12.5803830	-1	0.0000000	-1	0.0000000
	-5.3146670	12.5998890	-1	0.0000000	-1	0.0000000
0006	1	2				
	-5.3146670	12.5998890	-1	0.0000000	-1	0.0000000
	-5.8545820	12.6217180	-1	0.0000000	-1	0.0000000
	-6.3876870	12.6455960	-1	0.0000000	-1	0.0000000
0007	1	2				
	-6.3876870	12.6455960	-1	0.0000000	-1	0.0000000
	-6.9200650	12.6717650	-1	0.0000000	-1	0.0000000
	-7.4515850	12.7002270	-1	0.0000000	-1	0.0000000
0008	1	2				
	-7.4515850	12.7002270	-1	0.0000000	-1	0.0000000
	-7.9827010	12.7310960	-1	0.0000000	-1	0.0000000
	-8.5133160	12.7644570	-1	0.0000000	-1	0.0000000
0009	1	2				
	-8.5133160	12.7644570	-1	0.0000000	-1	0.0000000
	-9.0435910	12.8003850	-1	0.0000000	-1	0.0000000
	-9.5734790	12.8389350	-1	0.0000000	-1	0.0000000
0010	1	2				
	-9.5734790	12.8389350	-1	0.0000000	-1	0.0000000
	-10.1029990	12.8802070	-1	0.0000000	-1	0.0000000
	-10.6321650	12.9243020	-1	0.0000000	-1	0.0000000
0011	1	2				
	-10.6321650	12.9243020	-1	0.0000000	-1	0.0000000
	-11.1609440	12.9712940	-1	0.0000000	-1	0.0000000
	-11.6893620	13.0212660	-1	0.0000000	-1	0.0000000
0012	1	2				
	-11.6893620	13.0212660	-1	0.0000000	-1	0.0000000
	-12.2173350	13.0743260	-1	0.0000000	-1	0.0000000
	-12.7449000	13.1306100	-1	0.0000000	-1	0.0000000
0013	1	2				
	-12.7449000	13.1306100	-1	0.0000000	-1	0.0000000
	-13.2720240	13.1902110	-1	0.0000000	-1	0.0000000
	-13.7986800	13.2532360	-1	0.0000000	-1	0.0000000
0014	1	2				
	-13.7986800	13.2532360	-1	0.0000000	-1	0.0000000
	-14.3248320	13.3197950	-1	0.0000000	-1	0.0000000
	-14.8504690	13.3900040	-1	0.0000000	-1	0.0000000
0015	1	2				
	-14.8504690	13.3900040	-1	0.0000000	-1	0.0000000
	-15.3755720	13.4640060	-1	0.0000000	-1	0.0000000
	-15.9001150	13.5419440	-1	0.0000000	-1	0.0000000
0016	1	2				
	-15.9001150	13.5419440	-1	0.0000000	-1	0.0000000
	-16.4240060	13.6239530	-1	0.0000000	-1	0.0000000
	-16.9472920	13.7101910	-1	0.0000000	-1	0.0000000
0017	1	2				
	-16.9472920	13.7101910	-1	0.0000000	-1	0.0000000

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-17.4698810	13.8008030	-1	0.0000000	-1	0.0000000	0
-17.9918290	13.8959670	-1	0.0000000	-1	0.0000000	0
0018 1 2						
-17.9918290	13.8959670	-1	0.0000000	-1	0.0000000	0
-18.5130540	13.9958890	-1	0.0000000	-1	0.0000000	0
-19.0334590	14.1008050	-1	0.0000000	-1	0.0000000	0
0019 1 2						
-19.0334590	14.1008050	-1	0.0000000	-1	0.0000000	0
-19.5530890	14.2109080	-1	0.0000000	-1	0.0000000	0
-20.0719290	14.3264120	-1	0.0000000	-1	0.0000000	0
0020 1 2						
-20.0719290	14.3264120	-1	0.0000000	-1	0.0000000	0
-20.5900300	14.4476180	-1	0.0000000	-1	0.0000000	0
-21.1072320	14.5748160	-1	0.0000000	-1	0.0000000	0
0021 1 2						
-21.1072320	14.5748160	-1	0.0000000	-1	0.0000000	0
-21.6237560	14.7084000	-1	0.0000000	-1	0.0000000	0
-22.1392270	14.8486600	-1	0.0000000	-1	0.0000000	0
0022 1 2						
-22.1392270	14.8486600	-1	0.0000000	-1	0.0000000	0
-22.6541940	14.9961780	-1	0.0000000	-1	0.0000000	0
-23.1680960	15.1513480	-1	0.0000000	-1	0.0000000	0
0023 1 2						
-23.1680960	15.1513480	-1	0.0000000	-1	0.0000000	0
-23.6814600	15.3152570	-1	0.0000000	-1	0.0000000	0
-24.1937660	15.4889750	-1	0.0000000	-1	0.0000000	0
0024 1 2						
-24.1937660	15.4889750	-1	0.0000000	-1	0.0000000	0
-24.7067210	15.6738580	-1	0.0000000	-1	0.0000000	0
-25.2644210	15.8886490	-1	0.0000000	-1	0.0000000	0
0025 1 2						
-25.2644210	15.8886490	-1	0.0000000	-1	0.0000000	0
-25.8168760	16.1193410	-1	0.0000000	-1	0.0000000	0
-26.3618170	16.3672470	-1	0.0000000	-1	0.0000000	0
0026 1 2						
-26.3618170	16.3672470	-1	0.0000000	-1	0.0000000	0
-26.8985910	16.6322690	-1	0.0000000	-1	0.0000000	0
-27.4269430	16.9135610	-1	0.0000000	-1	0.0000000	0
0027 1 2						
-27.4269430	16.9135610	-1	0.0000000	-1	0.0000000	0
-27.9463980	17.2108080	-1	0.0000000	-1	0.0000000	0
-28.4564090	17.5238130	-1	0.0000000	-1	0.0000000	0
0028 1 2						
-28.4564090	17.5238130	-1	0.0000000	-1	0.0000000	0
-28.9564640	17.8523280	-1	0.0000000	-1	0.0000000	0
-29.4460510	18.1960790	-1	0.0000000	-1	0.0000000	0
0029 1 2						
-29.4460510	18.1960790	-1	0.0000000	-1	0.0000000	0
-29.9246720	18.5547780	-1	0.0000000	-1	0.0000000	0
-30.3918430	18.9281140	-1	0.0000000	-1	0.0000000	0

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0030	1	2						
-30.3918430	18.9281140	-1	0.0000000	-1	0.0000000	0		
-30.8470810	19.3157570	-1	0.0000000	-1	0.0000000	0		
-31.2899290	19.7173620	-1	0.0000000	-1	0.0000000	0		
0031	1	2						
-31.2899290	19.7173620	-1	0.0000000	-1	0.0000000	0		
-31.7199390	20.1325620	-1	0.0000000	-1	0.0000000	0		
-32.1366780	20.5609680	-1	0.0000000	-1	0.0000000	0		
0032	1	2						
-32.1366780	20.5609680	-1	0.0000000	-1	0.0000000	0		
-32.5397330	21.0021790	-1	0.0000000	-1	0.0000000	0		
-32.9287130	21.4557740	-1	0.0000000	-1	0.0000000	0		
0033	1	2						
-32.9287130	21.4557740	-1	0.0000000	-1	0.0000000	0		
-33.3032360	21.9213120	-1	0.0000000	-1	0.0000000	0		
-33.6629540	22.3983410	-1	0.0000000	-1	0.0000000	0		
0034	1	2						
-33.6629540	22.3983410	-1	0.0000000	-1	0.0000000	0		
-34.0075320	22.8863920	-1	0.0000000	-1	0.0000000	0		
-34.3366610	23.3849790	-1	0.0000000	-1	0.0000000	0		
0035	1	2						
-34.3366610	23.3849790	-1	0.0000000	-1	0.0000000	0		
-34.6500560	23.8936100	-1	0.0000000	-1	0.0000000	0		
-34.9474520	24.4117710	-1	0.0000000	-1	0.0000000	0		
0036	1	2						
-34.9474520	24.4117710	-1	0.0000000	-1	0.0000000	0		
-35.2286050	24.9389450	-1	0.0000000	-1	0.0000000	0		
-35.4933050	25.4746060	-1	0.0000000	-1	0.0000000	0		
0037	1	2						
-35.4933050	25.4746060	-1	0.0000000	-1	0.0000000	0		
-35.7413540	26.0182160	-1	0.0000000	-1	0.0000000	0		
-35.9725840	26.5692330	-1	0.0000000	-1	0.0000000	0		
0038	1	2						
-35.9725840	26.5692330	-1	0.0000000	-1	0.0000000	0		
-36.1868470	27.1271100	-1	0.0000000	-1	0.0000000	0		
-36.3840200	27.6912950	-1	0.0000000	-1	0.0000000	0		
0039	1	2						
-36.3840200	27.6912950	-1	0.0000000	-1	0.0000000	0		
-36.5639950	28.2612320	-1	0.0000000	-1	0.0000000	0		
-36.7266910	28.8363660	-1	0.0000000	-1	0.0000000	0		
0040	1	2						
-36.7266910	28.8363660	-1	0.0000000	-1	0.0000000	0		
-36.8720530	29.4161390	-1	0.0000000	-1	0.0000000	0		
-37.0000000	30.0000000	-1	0.0000000	-1	0.0000000	0		
0041	1	4						
-37.0000000	30.0000000	-1	0.0000000	-1	0.0000000	0		
-49.5000000	30.0000000	-1	0.0000000	-1	0.0000000	0		
-62.0000000	30.0000000	-1	0.0000000	-1	0.0000000	-2	0	1
0042	1	4						

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-62.0000000	30.0000000	-1	0.0000000	-1	0.0000000	-2	0	1
-92.0000000	30.0000000	-1	0.0000000	-1	0.0000000	0		
-122.0000000	30.0000000	-1	0.0000000	-1	0.0000000	0		
0043 1 4								
-122.0000000	30.0000000	-1	-100.0000000	-1	0.0000000	0		
-122.0000000	15.0000000	-1	-100.0000000	-1	0.0000000	0		
-122.0000000	0.0000000	-1	-100.0000000	-1	0.0000000	-2	1	1
0044 1 4								
-122.0000000	0.0000000	-1	-100.0000000	-1	0.0000000	-2	1	1
-122.0000000	-15.0000000	-1	-100.0000000	-1	0.0000000	0		
-122.0000000	-30.0000000	-1	-100.0000000	-1	0.0000000	0		
0045 1 4								
-122.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	0		
-92.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	0		
-62.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	-2	0	1
0046 1 4								
-62.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	-2	0	1
-49.5000000	-30.0000000	-1	0.0000000	-1	0.0000000	0		
-37.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	0		
0047 1 1								
-37.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	0		
-36.8720530	-29.4161390	-1	0.0000000	-1	0.0000000	0		
-36.7266910	-28.8363660	-1	0.0000000	-1	0.0000000	0		
0048 1 1								
-36.7266910	-28.8363660	-1	0.0000000	-1	0.0000000	0		
-36.5639950	-28.2612320	-1	0.0000000	-1	0.0000000	0		
-36.3840200	-27.6912950	-1	0.0000000	-1	0.0000000	0		
0049 1 1								
-36.3840200	-27.6912950	-1	0.0000000	-1	0.0000000	0		
-36.1868470	-27.1271100	-1	0.0000000	-1	0.0000000	0		
-35.9725840	-26.5692330	-1	0.0000000	-1	0.0000000	0		
0050 1 1								
-35.9725840	-26.5692330	-1	0.0000000	-1	0.0000000	0		
-35.7413540	-26.0182160	-1	0.0000000	-1	0.0000000	0		
-35.4933050	-25.4746060	-1	0.0000000	-1	0.0000000	0		
0051 1 1								
-35.4933050	-25.4746060	-1	0.0000000	-1	0.0000000	0		
-35.2286050	-24.9389450	-1	0.0000000	-1	0.0000000	0		
-34.9474520	-24.4117710	-1	0.0000000	-1	0.0000000	0		
0052 1 1								
-34.9474520	-24.4117710	-1	0.0000000	-1	0.0000000	0		
-34.6500560	-23.8936100	-1	0.0000000	-1	0.0000000	0		
-34.3366610	-23.3849790	-1	0.0000000	-1	0.0000000	0		
0053 1 1								
-34.3366610	-23.3849790	-1	0.0000000	-1	0.0000000	0		
-34.0075320	-22.8863920	-1	0.0000000	-1	0.0000000	0		
-33.6629540	-22.3983410	-1	0.0000000	-1	0.0000000	0		
0054 1 1								
-33.6629540	-22.3983410	-1	0.0000000	-1	0.0000000	0		
-33.3032360	-21.9213120	-1	0.0000000	-1	0.0000000	0		

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-32.9287130	-21.4557740	-1	0.0000000	-1	0.0000000	0
0055 1 1						
-32.9287130	-21.4557740	-1	0.0000000	-1	0.0000000	0
-32.5397330	-21.0021790	-1	0.0000000	-1	0.0000000	0
-32.1366780	-20.5609680	-1	0.0000000	-1	0.0000000	0
0056 1 1						
-32.1366780	-20.5609680	-1	0.0000000	-1	0.0000000	0
-31.7199390	-20.1325620	-1	0.0000000	-1	0.0000000	0
-31.2899290	-19.7173620	-1	0.0000000	-1	0.0000000	0
0057 1 1						
-31.2899290	-19.7173620	-1	0.0000000	-1	0.0000000	0
-30.8470810	-19.3157570	-1	0.0000000	-1	0.0000000	0
-30.3918430	-18.9281140	-1	0.0000000	-1	0.0000000	0
0058 1 1						
-30.3918430	-18.9281140	-1	0.0000000	-1	0.0000000	0
-29.9246720	-18.5547780	-1	0.0000000	-1	0.0000000	0
-29.4460510	-18.1960790	-1	0.0000000	-1	0.0000000	0
0059 1 1						
-29.4460510	-18.1960790	-1	0.0000000	-1	0.0000000	0
-28.9564640	-17.8523280	-1	0.0000000	-1	0.0000000	0
-28.4564090	-17.5238130	-1	0.0000000	-1	0.0000000	0
0060 1 1						
-28.4564090	-17.5238130	-1	0.0000000	-1	0.0000000	0
-27.9463980	-17.2108080	-1	0.0000000	-1	0.0000000	0
-27.4269430	-16.9135610	-1	0.0000000	-1	0.0000000	0
0061 1 1						
-27.4269430	-16.9135610	-1	0.0000000	-1	0.0000000	0
-26.8985910	-16.6322690	-1	0.0000000	-1	0.0000000	0
-26.3618170	-16.3672470	-1	0.0000000	-1	0.0000000	0
0062 1 1						
-26.3618170	-16.3672470	-1	0.0000000	-1	0.0000000	0
-25.8168760	-16.1193410	-1	0.0000000	-1	0.0000000	0
-25.2644210	-15.8886490	-1	0.0000000	-1	0.0000000	0
0063 1 1						
-25.2644210	-15.8886490	-1	0.0000000	-1	0.0000000	0
-24.7067210	-15.6738580	-1	0.0000000	-1	0.0000000	0
-24.1937660	-15.4889750	-1	0.0000000	-1	0.0000000	0
0064 1 1						
-24.1937660	-15.4889750	-1	0.0000000	-1	0.0000000	0
-23.6814600	-15.3152570	-1	0.0000000	-1	0.0000000	0
-23.1680960	-15.1513480	-1	0.0000000	-1	0.0000000	0
0065 1 1						
-23.1680960	-15.1513480	-1	0.0000000	-1	0.0000000	0
-22.6541940	-14.9961780	-1	0.0000000	-1	0.0000000	0
-22.1392270	-14.8486600	-1	0.0000000	-1	0.0000000	0
0066 1 1						
-22.1392270	-14.8486600	-1	0.0000000	-1	0.0000000	0
-21.6237560	-14.7084000	-1	0.0000000	-1	0.0000000	0
-21.1072320	-14.5748160	-1	0.0000000	-1	0.0000000	0

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0067	1	1				
	-21.1072320	-14.5748160	-1	0.0000000	-1	0.0000000
	-20.5900300	-14.4476180	-1	0.0000000	-1	0.0000000
	-20.0719290	-14.3264120	-1	0.0000000	-1	0.0000000
0068	1	1				
	-20.0719290	-14.3264120	-1	0.0000000	-1	0.0000000
	-19.5530890	-14.2109080	-1	0.0000000	-1	0.0000000
	-19.0334590	-14.1008050	-1	0.0000000	-1	0.0000000
0069	1	1				
	-19.0334590	-14.1008050	-1	0.0000000	-1	0.0000000
	-18.5130540	-13.9958890	-1	0.0000000	-1	0.0000000
	-17.9918290	-13.8959670	-1	0.0000000	-1	0.0000000
0070	1	1				
	-17.9918290	-13.8959670	-1	0.0000000	-1	0.0000000
	-17.4698810	-13.8008030	-1	0.0000000	-1	0.0000000
	-16.9472920	-13.7101910	-1	0.0000000	-1	0.0000000
0071	1	1				
	-16.9472920	-13.7101910	-1	0.0000000	-1	0.0000000
	-16.4240060	-13.6239530	-1	0.0000000	-1	0.0000000
	-15.9001150	-13.5419440	-1	0.0000000	-1	0.0000000
0072	1	1				
	-15.9001150	-13.5419440	-1	0.0000000	-1	0.0000000
	-15.3755720	-13.4640060	-1	0.0000000	-1	0.0000000
	-14.8504690	-13.3900040	-1	0.0000000	-1	0.0000000
0073	1	1				
	-14.8504690	-13.3900040	-1	0.0000000	-1	0.0000000
	-14.3248320	-13.3197950	-1	0.0000000	-1	0.0000000
	-13.7986800	-13.2532360	-1	0.0000000	-1	0.0000000
0074	1	1				
	-13.7986800	-13.2532360	-1	0.0000000	-1	0.0000000
	-13.2720240	-13.1902110	-1	0.0000000	-1	0.0000000
	-12.7449000	-13.1306100	-1	0.0000000	-1	0.0000000
0075	1	1				
	-12.7449000	-13.1306100	-1	0.0000000	-1	0.0000000
	-12.2173350	-13.0743260	-1	0.0000000	-1	0.0000000
	-11.6893620	-13.0212660	-1	0.0000000	-1	0.0000000
0076	1	1				
	-11.6893620	-13.0212660	-1	0.0000000	-1	0.0000000
	-11.1609440	-12.9712940	-1	0.0000000	-1	0.0000000
	-10.6321650	-12.9243020	-1	0.0000000	-1	0.0000000
0077	1	1				
	-10.6321650	-12.9243020	-1	0.0000000	-1	0.0000000
	-10.1029990	-12.8802070	-1	0.0000000	-1	0.0000000
	-9.5734790	-12.8389350	-1	0.0000000	-1	0.0000000
0078	1	1				
	-9.5734790	-12.8389350	-1	0.0000000	-1	0.0000000
	-9.0435910	-12.8003850	-1	0.0000000	-1	0.0000000
	-8.5133160	-12.7644570	-1	0.0000000	-1	0.0000000
0079	1	1				
	-8.5133160	-12.7644570	-1	0.0000000	-1	0.0000000

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-7.9827010	-12.7310960	-1	0.0000000	-1	0.0000000	0
-7.4515850	-12.7002270	-1	0.0000000	-1	0.0000000	0
0080 1 1						
-7.4515850	-12.7002270	-1	0.0000000	-1	0.0000000	0
-6.9200650	-12.6717650	-1	0.0000000	-1	0.0000000	0
-6.3876870	-12.6455960	-1	0.0000000	-1	0.0000000	0
0081 1 1						
-6.3876870	-12.6455960	-1	0.0000000	-1	0.0000000	0
-5.8545820	-12.6217180	-1	0.0000000	-1	0.0000000	0
-5.3146670	-12.5998890	-1	0.0000000	-1	0.0000000	0
0082 1 1						
-5.3146670	-12.5998890	-1	0.0000000	-1	0.0000000	0
-4.7759650	-12.5803830	-1	0.0000000	-1	0.0000000	0
-4.2397240	-12.5631460	-1	0.0000000	-1	0.0000000	0
0083 1 1						
-4.2397240	-12.5631460	-1	0.0000000	-1	0.0000000	0
-3.7053990	-12.5481030	-1	0.0000000	-1	0.0000000	0
-3.1729650	-12.5352090	-1	0.0000000	-1	0.0000000	0
0084 1 1						
-3.1729650	-12.5352090	-1	0.0000000	-1	0.0000000	0
-2.6419170	-12.5243890	-1	0.0000000	-1	0.0000000	0
-2.1121110	-12.5155840	-1	0.0000000	-1	0.0000000	0
0085 1 1						
-2.1121110	-12.5155840	-1	0.0000000	-1	0.0000000	0
-1.5831520	-12.5087610	-1	0.0000000	-1	0.0000000	0
-1.0548970	-12.5038980	-1	0.0000000	-1	0.0000000	0
0086 1 1						
-1.0548970	-12.5038980	-1	0.0000000	-1	0.0000000	0
-0.5269560	-12.5009750	-1	0.0000000	-1	0.0000000	0
0.0000000	-12.5000000	-1	0.0000000	-1	0.0000000	0
0087 1 1						
0.0000000	-12.5000000	-1	0.0000000	-1	0.0000000	0
0.5269560	-12.5009750	-1	0.0000000	-1	0.0000000	0
1.0548970	-12.5038980	-1	0.0000000	-1	0.0000000	0
0088 1 1						
1.0548970	-12.5038980	-1	0.0000000	-1	0.0000000	0
1.5831520	-12.5087610	-1	0.0000000	-1	0.0000000	0
2.1121110	-12.5155840	-1	0.0000000	-1	0.0000000	0
0089 1 1						
2.1121110	-12.5155840	-1	0.0000000	-1	0.0000000	0
2.6419170	-12.5243890	-1	0.0000000	-1	0.0000000	0
3.1729650	-12.5352090	-1	0.0000000	-1	0.0000000	0
0090 1 1						
3.1729650	-12.5352090	-1	0.0000000	-1	0.0000000	0
3.7053990	-12.5481030	-1	0.0000000	-1	0.0000000	0
4.2397240	-12.5631460	-1	0.0000000	-1	0.0000000	0
0091 1 1						
4.2397240	-12.5631460	-1	0.0000000	-1	0.0000000	0
4.7759650	-12.5803830	-1	0.0000000	-1	0.0000000	0
5.3146670	-12.5998890	-1	0.0000000	-1	0.0000000	0

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0092	1	1					
	5.3146670	-12.5998890	-1	0.0000000	-1	0.0000000	0
	5.8545820	-12.6217180	-1	0.0000000	-1	0.0000000	0
	6.3876870	-12.6455960	-1	0.0000000	-1	0.0000000	0
0093	1	1					
	6.3876870	-12.6455960	-1	0.0000000	-1	0.0000000	0
	6.9200650	-12.6717650	-1	0.0000000	-1	0.0000000	0
	7.4515850	-12.7002270	-1	0.0000000	-1	0.0000000	0
0094	1	1					
	7.4515850	-12.7002270	-1	0.0000000	-1	0.0000000	0
	7.9827010	-12.7310960	-1	0.0000000	-1	0.0000000	0
	8.5133160	-12.7644570	-1	0.0000000	-1	0.0000000	0
0095	1	1					
	8.5133160	-12.7644570	-1	0.0000000	-1	0.0000000	0
	9.0435910	-12.8003850	-1	0.0000000	-1	0.0000000	0
	9.5734790	-12.8389350	-1	0.0000000	-1	0.0000000	0
0096	1	1					
	9.5734790	-12.8389350	-1	0.0000000	-1	0.0000000	0
	10.1029990	-12.8802070	-1	0.0000000	-1	0.0000000	0
	10.6321650	-12.9243020	-1	0.0000000	-1	0.0000000	0
0097	1	1					
	10.6321650	-12.9243020	-1	0.0000000	-1	0.0000000	0
	11.1609440	-12.9712940	-1	0.0000000	-1	0.0000000	0
	11.6893620	-13.0212660	-1	0.0000000	-1	0.0000000	0
0098	1	1					
	11.6893620	-13.0212660	-1	0.0000000	-1	0.0000000	0
	12.2173350	-13.0743260	-1	0.0000000	-1	0.0000000	0
	12.7449000	-13.1306100	-1	0.0000000	-1	0.0000000	0
0099	1	1					
	12.7449000	-13.1306100	-1	0.0000000	-1	0.0000000	0
	13.2720240	-13.1902110	-1	0.0000000	-1	0.0000000	0
	13.7986800	-13.2532360	-1	0.0000000	-1	0.0000000	0
0100	1	1					
	13.7986800	-13.2532360	-1	0.0000000	-1	0.0000000	0
	14.3248320	-13.3197950	-1	0.0000000	-1	0.0000000	0
	14.8504690	-13.3900040	-1	0.0000000	-1	0.0000000	0
0101	1	1					
	14.8504690	-13.3900040	-1	0.0000000	-1	0.0000000	0
	15.3755720	-13.4640060	-1	0.0000000	-1	0.0000000	0
	15.9001150	-13.5419440	-1	0.0000000	-1	0.0000000	0
0102	1	1					
	15.9001150	-13.5419440	-1	0.0000000	-1	0.0000000	0
	16.4240060	-13.6239530	-1	0.0000000	-1	0.0000000	0
	16.9472920	-13.7101910	-1	0.0000000	-1	0.0000000	0
0103	1	1					
	16.9472920	-13.7101910	-1	0.0000000	-1	0.0000000	0
	17.4698810	-13.8008030	-1	0.0000000	-1	0.0000000	0
	17.9918290	-13.8959670	-1	0.0000000	-1	0.0000000	0
0104	1	1					

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17.9918290	-13.8959670	-1	0.0000000	-1	0.0000000	0
18.5130540	-13.9958890	-1	0.0000000	-1	0.0000000	0
19.0334590	-14.1008050	-1	0.0000000	-1	0.0000000	0
0105 1 1						
19.0334590	-14.1008050	-1	0.0000000	-1	0.0000000	0
19.5530890	-14.2109080	-1	0.0000000	-1	0.0000000	0
20.0719290	-14.3264120	-1	0.0000000	-1	0.0000000	0
0106 1 1						
20.0719290	-14.3264120	-1	0.0000000	-1	0.0000000	0
20.5900300	-14.4476180	-1	0.0000000	-1	0.0000000	0
21.1072320	-14.5748160	-1	0.0000000	-1	0.0000000	0
0107 1 1						
21.1072320	-14.5748160	-1	0.0000000	-1	0.0000000	0
21.6237560	-14.7084000	-1	0.0000000	-1	0.0000000	0
22.1392270	-14.8486600	-1	0.0000000	-1	0.0000000	0
0108 1 1						
22.1392270	-14.8486600	-1	0.0000000	-1	0.0000000	0
22.6541940	-14.9961780	-1	0.0000000	-1	0.0000000	0
23.1680960	-15.1513480	-1	0.0000000	-1	0.0000000	0
0109 1 1						
23.1680960	-15.1513480	-1	0.0000000	-1	0.0000000	0
23.6814600	-15.3152570	-1	0.0000000	-1	0.0000000	0
24.1937660	-15.4889750	-1	0.0000000	-1	0.0000000	0
0110 1 1						
24.1937660	-15.4889750	-1	0.0000000	-1	0.0000000	0
24.7067210	-15.6738580	-1	0.0000000	-1	0.0000000	0
25.2644210	-15.8886490	-1	0.0000000	-1	0.0000000	0
0111 1 1						
25.2644210	-15.8886490	-1	0.0000000	-1	0.0000000	0
25.8168760	-16.1193410	-1	0.0000000	-1	0.0000000	0
26.3618170	-16.3672470	-1	0.0000000	-1	0.0000000	0
0112 1 1						
26.3618170	-16.3672470	-1	0.0000000	-1	0.0000000	0
26.8985910	-16.6322690	-1	0.0000000	-1	0.0000000	0
27.4269430	-16.9135610	-1	0.0000000	-1	0.0000000	0
0113 1 1						
27.4269430	-16.9135610	-1	0.0000000	-1	0.0000000	0
27.9463980	-17.2108080	-1	0.0000000	-1	0.0000000	0
28.4564090	-17.5238130	-1	0.0000000	-1	0.0000000	0
0114 1 1						
28.4564090	-17.5238130	-1	0.0000000	-1	0.0000000	0
28.9564640	-17.8523280	-1	0.0000000	-1	0.0000000	0
29.4460510	-18.1960790	-1	0.0000000	-1	0.0000000	0
0115 1 1						
29.4460510	-18.1960790	-1	0.0000000	-1	0.0000000	0
29.9246720	-18.5547780	-1	0.0000000	-1	0.0000000	0
30.3918430	-18.9281140	-1	0.0000000	-1	0.0000000	0
0116 1 1						
30.3918430	-18.9281140	-1	0.0000000	-1	0.0000000	0
30.8470810	-19.3157570	-1	0.0000000	-1	0.0000000	0

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	31.2899290	-19.7173620	-1	0.0000000	-1	0.0000000	0
0117	1 1						
	31.2899290	-19.7173620	-1	0.0000000	-1	0.0000000	0
	31.7199390	-20.1325620	-1	0.0000000	-1	0.0000000	0
	32.1366780	-20.5609680	-1	0.0000000	-1	0.0000000	0
0118	1 1						
	32.1366780	-20.5609680	-1	0.0000000	-1	0.0000000	0
	32.5397330	-21.0021790	-1	0.0000000	-1	0.0000000	0
	32.9287130	-21.4557740	-1	0.0000000	-1	0.0000000	0
0119	1 1						
	32.9287130	-21.4557740	-1	0.0000000	-1	0.0000000	0
	33.3032360	-21.9213120	-1	0.0000000	-1	0.0000000	0
	33.6629540	-22.3983410	-1	0.0000000	-1	0.0000000	0
0120	1 1						
	33.6629540	-22.3983410	-1	0.0000000	-1	0.0000000	0
	34.0075320	-22.8863920	-1	0.0000000	-1	0.0000000	0
	34.3366610	-23.3849790	-1	0.0000000	-1	0.0000000	0
0121	1 1						
	34.3366610	-23.3849790	-1	0.0000000	-1	0.0000000	0
	34.6500560	-23.8936100	-1	0.0000000	-1	0.0000000	0
	34.9474520	-24.4117710	-1	0.0000000	-1	0.0000000	0
0122	1 1						
	34.9474520	-24.4117710	-1	0.0000000	-1	0.0000000	0
	35.2286050	-24.9389450	-1	0.0000000	-1	0.0000000	0
	35.4933050	-25.4746060	-1	0.0000000	-1	0.0000000	0
0123	1 1						
	35.4933050	-25.4746060	-1	0.0000000	-1	0.0000000	0
	35.7413540	-26.0182160	-1	0.0000000	-1	0.0000000	0
	35.9725840	-26.5692330	-1	0.0000000	-1	0.0000000	0
0124	1 1						
	35.9725840	-26.5692330	-1	0.0000000	-1	0.0000000	0
	36.1868470	-27.1271100	-1	0.0000000	-1	0.0000000	0
	36.3840200	-27.6912950	-1	0.0000000	-1	0.0000000	0
0125	1 1						
	36.3840200	-27.6912950	-1	0.0000000	-1	0.0000000	0
	36.5639950	-28.2612320	-1	0.0000000	-1	0.0000000	0
	36.7266910	-28.8363660	-1	0.0000000	-1	0.0000000	0
0126	1 1						
	36.7266910	-28.8363660	-1	0.0000000	-1	0.0000000	0
	36.8720530	-29.4161390	-1	0.0000000	-1	0.0000000	0
	37.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	0
0127	1 4						
	37.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	0
	49.5000000	-30.0000000	-1	0.0000000	-1	0.0000000	0
	62.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	-2 0 1
0128	1 4						
	62.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	-2 0 1
	92.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	0
	122.0000000	-30.0000000	-1	0.0000000	-1	0.0000000	0

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0129	1	4						
	122.0000000	-30.0000000	-1	100.0000000	-1	0.0000000	0	
	122.0000000	-15.0000000	-1	100.0000000	-1	0.0000000	0	
	122.0000000	0.0000000	-1	100.0000000	-1	0.0000000	-2	0 1
0130	1	4						
	122.0000000	0.0000000	-1	100.0000000	-1	0.0000000	-2	0 1
	122.0000000	15.0000000	-1	100.0000000	-1	0.0000000	0	
	122.0000000	30.0000000	-1	100.0000000	-1	0.0000000	0	
0131	1	4						
	122.0000000	30.0000000	-1	0.0000000	-1	0.0000000	0	
	92.0000000	30.0000000	-1	0.0000000	-1	0.0000000	0	
	62.0000000	30.0000000	-1	0.0000000	-1	0.0000000	-2	0 1
0132	1	4						
	62.0000000	30.0000000	-1	0.0000000	-1	0.0000000	-2	0 1
	49.5000000	30.0000000	-1	0.0000000	-1	0.0000000	0	
	37.0000000	30.0000000	-1	0.0000000	-1	0.0000000	0	
0133	1	2						
	37.0000000	30.0000000	-1	0.0000000	-1	0.0000000	0	
	36.8720530	29.4161390	-1	0.0000000	-1	0.0000000	0	
	36.7266910	28.8363660	-1	0.0000000	-1	0.0000000	0	
0134	1	2						
	36.7266910	28.8363660	-1	0.0000000	-1	0.0000000	0	
	36.5639950	28.2612320	-1	0.0000000	-1	0.0000000	0	
	36.3840200	27.6912950	-1	0.0000000	-1	0.0000000	0	
0135	1	2						
	36.3840200	27.6912950	-1	0.0000000	-1	0.0000000	0	
	36.1868470	27.1271100	-1	0.0000000	-1	0.0000000	0	
	35.9725840	26.5692330	-1	0.0000000	-1	0.0000000	0	
0136	1	2						
	35.9725840	26.5692330	-1	0.0000000	-1	0.0000000	0	
	35.7413540	26.0182160	-1	0.0000000	-1	0.0000000	0	
	35.4933050	25.4746060	-1	0.0000000	-1	0.0000000	0	
0137	1	2						
	35.4933050	25.4746060	-1	0.0000000	-1	0.0000000	0	
	35.2286050	24.9389450	-1	0.0000000	-1	0.0000000	0	
	34.9474520	24.4117710	-1	0.0000000	-1	0.0000000	0	
0138	1	2						
	34.9474520	24.4117710	-1	0.0000000	-1	0.0000000	0	
	34.6500560	23.8936100	-1	0.0000000	-1	0.0000000	0	
	34.3366610	23.3849790	-1	0.0000000	-1	0.0000000	0	
0139	1	2						
	34.3366610	23.3849790	-1	0.0000000	-1	0.0000000	0	
	34.0075320	22.8863920	-1	0.0000000	-1	0.0000000	0	
	33.6629540	22.3983410	-1	0.0000000	-1	0.0000000	0	
0140	1	2						
	33.6629540	22.3983410	-1	0.0000000	-1	0.0000000	0	
	33.3032360	21.9213120	-1	0.0000000	-1	0.0000000	0	
	32.9287130	21.4557740	-1	0.0000000	-1	0.0000000	0	
0141	1	2						
	32.9287130	21.4557740	-1	0.0000000	-1	0.0000000	0	

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32.5397330	21.0021790	-1	0.0000000	-1	0.0000000	0
32.1366780	20.5609680	-1	0.0000000	-1	0.0000000	0
0142 1 2						
32.1366780	20.5609680	-1	0.0000000	-1	0.0000000	0
31.7199390	20.1325620	-1	0.0000000	-1	0.0000000	0
31.2899290	19.7173620	-1	0.0000000	-1	0.0000000	0
0143 1 2						
31.2899290	19.7173620	-1	0.0000000	-1	0.0000000	0
30.8470810	19.3157570	-1	0.0000000	-1	0.0000000	0
30.3918430	18.9281140	-1	0.0000000	-1	0.0000000	0
0144 1 2						
30.3918430	18.9281140	-1	0.0000000	-1	0.0000000	0
29.9246720	18.5547780	-1	0.0000000	-1	0.0000000	0
29.4460510	18.1960790	-1	0.0000000	-1	0.0000000	0
0145 1 2						
29.4460510	18.1960790	-1	0.0000000	-1	0.0000000	0
28.9564640	17.8523280	-1	0.0000000	-1	0.0000000	0
28.4564090	17.5238130	-1	0.0000000	-1	0.0000000	0
0146 1 2						
28.4564090	17.5238130	-1	0.0000000	-1	0.0000000	0
27.9463980	17.2108080	-1	0.0000000	-1	0.0000000	0
27.4269430	16.9135610	-1	0.0000000	-1	0.0000000	0
0147 1 2						
27.4269430	16.9135610	-1	0.0000000	-1	0.0000000	0
26.8985910	16.6322690	-1	0.0000000	-1	0.0000000	0
26.3618170	16.3672470	-1	0.0000000	-1	0.0000000	0
0148 1 2						
26.3618170	16.3672470	-1	0.0000000	-1	0.0000000	0
25.8168760	16.1193410	-1	0.0000000	-1	0.0000000	0
25.2644210	15.8886490	-1	0.0000000	-1	0.0000000	0
0149 1 2						
25.2644210	15.8886490	-1	0.0000000	-1	0.0000000	0
24.7067210	15.6738580	-1	0.0000000	-1	0.0000000	0
24.1937660	15.4889750	-1	0.0000000	-1	0.0000000	0
0150 1 2						
24.1937660	15.4889750	-1	0.0000000	-1	0.0000000	0
23.6814600	15.3152570	-1	0.0000000	-1	0.0000000	0
23.1680960	15.1513480	-1	0.0000000	-1	0.0000000	0
0151 1 2						
23.1680960	15.1513480	-1	0.0000000	-1	0.0000000	0
22.6541940	14.9961780	-1	0.0000000	-1	0.0000000	0
22.1392270	14.8486600	-1	0.0000000	-1	0.0000000	0
0152 1 2						
22.1392270	14.8486600	-1	0.0000000	-1	0.0000000	0
21.6237560	14.7084000	-1	0.0000000	-1	0.0000000	0
21.1072320	14.5748160	-1	0.0000000	-1	0.0000000	0
0153 1 2						
21.1072320	14.5748160	-1	0.0000000	-1	0.0000000	0
20.5900300	14.4476180	-1	0.0000000	-1	0.0000000	0
20.0719290	14.3264120	-1	0.0000000	-1	0.0000000	0

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0154	1	2				
	20.0719290	14.3264120	-1	0.0000000	-1	0.0000000
	19.5530890	14.2109080	-1	0.0000000	-1	0.0000000
	19.0334590	14.1008050	-1	0.0000000	-1	0.0000000
0155	1	2				
	19.0334590	14.1008050	-1	0.0000000	-1	0.0000000
	18.5130540	13.9958890	-1	0.0000000	-1	0.0000000
	17.9918290	13.8959670	-1	0.0000000	-1	0.0000000
0156	1	2				
	17.9918290	13.8959670	-1	0.0000000	-1	0.0000000
	17.4698810	13.8008030	-1	0.0000000	-1	0.0000000
	16.9472920	13.7101910	-1	0.0000000	-1	0.0000000
0157	1	2				
	16.9472920	13.7101910	-1	0.0000000	-1	0.0000000
	16.4240060	13.6239530	-1	0.0000000	-1	0.0000000
	15.9001150	13.5419440	-1	0.0000000	-1	0.0000000
0158	1	2				
	15.9001150	13.5419440	-1	0.0000000	-1	0.0000000
	15.3755720	13.4640060	-1	0.0000000	-1	0.0000000
	14.8504690	13.3900040	-1	0.0000000	-1	0.0000000
0159	1	2				
	14.8504690	13.3900040	-1	0.0000000	-1	0.0000000
	14.3248320	13.3197950	-1	0.0000000	-1	0.0000000
	13.7986800	13.2532360	-1	0.0000000	-1	0.0000000
0160	1	2				
	13.7986800	13.2532360	-1	0.0000000	-1	0.0000000
	13.2720240	13.1902110	-1	0.0000000	-1	0.0000000
	12.7449000	13.1306100	-1	0.0000000	-1	0.0000000
0161	1	2				
	12.7449000	13.1306100	-1	0.0000000	-1	0.0000000
	12.2173350	13.0743260	-1	0.0000000	-1	0.0000000
	11.6893620	13.0212660	-1	0.0000000	-1	0.0000000
0162	1	2				
	11.6893620	13.0212660	-1	0.0000000	-1	0.0000000
	11.1609440	12.9712940	-1	0.0000000	-1	0.0000000
	10.6321650	12.9243020	-1	0.0000000	-1	0.0000000
0163	1	2				
	10.6321650	12.9243020	-1	0.0000000	-1	0.0000000
	10.1029990	12.8802070	-1	0.0000000	-1	0.0000000
	9.5734790	12.8389350	-1	0.0000000	-1	0.0000000
0164	1	2				
	9.5734790	12.8389350	-1	0.0000000	-1	0.0000000
	9.0435910	12.8003850	-1	0.0000000	-1	0.0000000
	8.5133160	12.7644570	-1	0.0000000	-1	0.0000000
0165	1	2				
	8.5133160	12.7644570	-1	0.0000000	-1	0.0000000
	7.9827010	12.7310960	-1	0.0000000	-1	0.0000000
	7.4515850	12.7002270	-1	0.0000000	-1	0.0000000
0166	1	2				

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	7.4515850	12.7002270	-1	0.0000000	-1	0.0000000	0
	6.9200650	12.6717650	-1	0.0000000	-1	0.0000000	0
	6.3876870	12.6455960	-1	0.0000000	-1	0.0000000	0
0167	1 2						
	6.3876870	12.6455960	-1	0.0000000	-1	0.0000000	0
	5.8545820	12.6217180	-1	0.0000000	-1	0.0000000	0
	5.3146670	12.5998890	-1	0.0000000	-1	0.0000000	0
0168	1 2						
	5.3146670	12.5998890	-1	0.0000000	-1	0.0000000	0
	4.7759650	12.5803830	-1	0.0000000	-1	0.0000000	0
	4.2397240	12.5631460	-1	0.0000000	-1	0.0000000	0
0169	1 2						
	4.2397240	12.5631460	-1	0.0000000	-1	0.0000000	0
	3.7053990	12.5481030	-1	0.0000000	-1	0.0000000	0
	3.1729650	12.5352090	-1	0.0000000	-1	0.0000000	0
0170	1 2						
	3.1729650	12.5352090	-1	0.0000000	-1	0.0000000	0
	2.6419170	12.5243890	-1	0.0000000	-1	0.0000000	0
	2.1121110	12.5155840	-1	0.0000000	-1	0.0000000	0
0171	1 2						
	2.1121110	12.5155840	-1	0.0000000	-1	0.0000000	0
	1.5831520	12.5087610	-1	0.0000000	-1	0.0000000	0
	1.0548970	12.5038980	-1	0.0000000	-1	0.0000000	0
0172	1 16						
	1.0548970	12.5038980	-1	0.0000000	-1	0.0000000	0
	0.5269560	12.5009750	-1	0.0000000	-1	0.0000000	0
	0.0000000	12.5000000	-1	0.0000000	-1	0.0000000	1

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Appendix G:

IGES file of coordinates for Modified Constant-Stress Coupon

The following input file can also be found stored in Objective folder fAV1044714. The name of the file is A1_mod_optimal_3D_msmth_smoothed_002.igs.

```

MSC.Patran generated IGES File from database      S0000001
/home/username/abaqus/abopt/fillet3dmod/A1_mod_optimal_3D_msmth_iges_002S0000002
.d                                              S0000003
,,22HMSC.Patran IGES Access,80H/home/username/abaqus/abopt/fillet3dmod/AG0000001
1_mod_optimal_3D_msmth_smoothed_002.igs,35HMSC.Patran 19.0.132332 MSC.SoG0000002
ftware,11H19.0.132332,                           G0000003
32,38,6,,,22HMSC.Patran IGES Export,            G0000004
1.0, 2,2HMM,1,0,13H140501.142551,0.200000E-04,37., G0000005
8Husername,23HMSC.Patran User's Group,          G0000006
11,0,13H140501.142551,;                         G0000007
    116     1     2     2     0     0     0 000000000D0000001
    116     0     0     1     0     0     0 OPOINT 1D0000002
    116     2     2     2     0     0     0 OPOINT 000000000D0000003
    116     0     0     1     0     0     0 OPOINT 2D0000004
    116     3     2     2     0     0     0 OPOINT 000000000D0000005
    116     0     0     1     0     0     0 OPOINT 3D0000006
    116     4     2     2     0     0     0 OPOINT 000000000D0000007
    116     0     0     1     0     0     0 OPOINT 4D0000008
    116     5     2     2     0     0     0 OPOINT 000000000D0000009
    116     0     0     1     0     0     0 OPOINT 5D0000010
    116     6     2     2     0     0     0 OPOINT 000000000D0000011
    116     0     0     1     0     0     0 OPOINT 6D0000012
    116     7     2     2     0     0     0 OPOINT 000000000D0000013
    116     0     0     1     0     0     0 OPOINT 7D0000014
    116     8     2     2     0     0     0 OPOINT 000000000D0000015
    116     0     0     1     0     0     0 OPOINT 8D0000016
    116     9     2     2     0     0     0 OPOINT 000000000D0000017
    116     0     0     1     0     0     0 OPOINT 9D0000018
    116    10     2     2     0     0     0 OPOINT 000000000D0000019
    116     0     0     1     0     0     0 OPOINT 10D0000020
    116    11     2     2     0     0     0 OPOINT 000000000D0000021
    116     0     0     1     0     0     0 OPOINT 11D0000022
    116    12     2     2     0     0     0 OPOINT 000000000D0000023
    116     0     0     1     0     0     0 OPOINT 12D0000024
    116    13     2     2     0     0     0 OPOINT 000000000D0000025
    116     0     0     1     0     0     0 OPOINT 13D0000026
    116    14     2     2     0     0     0 OPOINT 000000000D0000027
    116     0     0     1     0     0     0 OPOINT 14D0000028
    116    15     2     2     0     0     0 OPOINT 000000000D0000029
    116     0     0     1     0     0     0 OPOINT 15D0000030
    116    16     2     2     0     0     0 OPOINT 000000000D0000031
    116     0     0     1     0     0     0 OPOINT 16D0000032
    116    17     2     2     0     0     0 OPOINT 000000000D0000033
    116     0     0     1     0     0     0 OPOINT 17D0000034
    116    18     2     2     0     0     0 OPOINT 000000000D0000035
    116     0     0     1     0     0     0 OPOINT 18D0000036
    116    19     2     2     0     0     0 OPOINT 000000000D0000037

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116	0	0	1	0	0	OPOINT	19D0000038
116	20	2	2	0	0	OPOINT	00000000D0000039
116	0	0	1	0	0	OPOINT	20D0000040
116	21	2	2	0	0	OPOINT	00000000D0000041
116	0	0	1	0	0	OPOINT	21D0000042
116	22	2	2	0	0	OPOINT	00000000D0000043
116	0	0	1	0	0	OPOINT	22D0000044
116	23	2	2	0	0	OPOINT	00000000D0000045
116	0	0	1	0	0	OPOINT	23D0000046
116	24	2	2	0	0	OPOINT	00000000D0000047
116	0	0	1	0	0	OPOINT	24D0000048
116	25	2	2	0	0	OPOINT	00000000D0000049
116	0	0	1	0	0	OPOINT	25D0000050
116	26	2	2	0	0	OPOINT	00000000D0000051
116	0	0	1	0	0	OPOINT	26D0000052
116	27	2	2	0	0	OPOINT	00000000D0000053
116	0	0	1	0	0	OPOINT	27D0000054
116	28	2	2	0	0	OPOINT	00000000D0000055
116	0	0	1	0	0	OPOINT	28D0000056
116	29	2	2	0	0	OPOINT	00000000D0000057
116	0	0	1	0	0	OPOINT	29D0000058
116	30	2	2	0	0	OPOINT	00000000D0000059
116	0	0	1	0	0	OPOINT	30D0000060
116	31	2	2	0	0	OPOINT	00000000D0000061
116	0	0	1	0	0	OPOINT	31D0000062
116	32	2	2	0	0	OPOINT	00000000D0000063
116	0	0	1	0	0	OPOINT	32D0000064
116	33	2	2	0	0	OPOINT	00000000D0000065
116	0	0	1	0	0	OPOINT	33D0000066
116	34	2	2	0	0	OPOINT	00000000D0000067
116	0	0	1	0	0	OPOINT	34D0000068
116	35	2	2	0	0	OPOINT	00000000D0000069
116	0	0	1	0	0	OPOINT	35D0000070
116	36	2	2	0	0	OPOINT	00000000D0000071
116	0	0	1	0	0	OPOINT	36D0000072
116	37	2	2	0	0	OPOINT	00000000D0000073
116	0	0	1	0	0	OPOINT	37D0000074
116	38	2	2	0	0	OPOINT	00000000D0000075
116	0	0	1	0	0	OPOINT	38D0000076
116	39	2	2	0	0	OPOINT	00000000D0000077
116	0	0	1	0	0	OPOINT	39D0000078
116	40	2	2	0	0	OPOINT	00000000D0000079
116	0	0	1	0	0	OPOINT	40D0000080
116	41	2	2	0	0	OPOINT	00000000D0000081
116	0	0	1	0	0	OPOINT	41D0000082
116	42	2	2	0	0	OPOINT	00000000D0000083
116	0	0	1	0	0	OPOINT	42D0000084
116	43	2	2	0	0	OPOINT	00000000D0000085
116	0	0	1	0	0	OPOINT	43D0000086
116	44	2	2	0	0	OPOINT	00000000D0000087
116	0	0	1	0	0	OPOINT	44D0000088
116	45	2	2	0	0	OPOINT	00000000D0000089
116	0	0	1	0	0	OPOINT	45D0000090
116	46	2	2	0	0	OPOINT	00000000D0000091
116	0	0	1	0	0	OPOINT	46D0000092
116	47	2	2	0	0	OPOINT	00000000D0000093
116	0	0	1	0	0	OPOINT	47D0000094
116	48	2	2	0	0	OPOINT	00000000D0000095
116	0	0	1	0	0	OPOINT	48D0000096
116	49	2	2	0	0	OPOINT	00000000D0000097

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116	0	0	1	0	0	OPOINT	49D0000098
116	50	2	2	0	0	OPOINT	00000000D0000099
116	0	0	1	0	0	OPOINT	50D0000100
116	51	2	2	0	0	OPOINT	00000000D0000101
116	0	0	1	0	0	OPOINT	51D0000102
116	52	2	2	0	0	OPOINT	00000000D0000103
116	0	0	1	0	0	OPOINT	52D0000104
116	53	2	2	0	0	OPOINT	00000000D0000105
116	0	0	1	0	0	OPOINT	53D0000106
116	54	2	2	0	0	OPOINT	00000000D0000107
116	0	0	1	0	0	OPOINT	54D0000108
116	55	2	2	0	0	OPOINT	00000000D0000109
116	0	0	1	0	0	OPOINT	55D0000110
116	56	2	2	0	0	OPOINT	00000000D0000111
116	0	0	1	0	0	OPOINT	56D0000112
116	57	2	2	0	0	OPOINT	00000000D0000113
116	0	0	1	0	0	OPOINT	57D0000114
116	58	2	2	0	0	OPOINT	00000000D0000115
116	0	0	1	0	0	OPOINT	58D0000116
116	59	2	2	0	0	OPOINT	00000000D0000117
116	0	0	1	0	0	OPOINT	59D0000118
116	60	2	2	0	0	OPOINT	00000000D0000119
116	0	0	1	0	0	OPOINT	60D0000120
116	61	2	2	0	0	OPOINT	00000000D0000121
116	0	0	1	0	0	OPOINT	61D0000122
116	62	2	2	0	0	OPOINT	00000000D0000123
116	0	0	1	0	0	OPOINT	62D0000124
116	63	2	2	0	0	OPOINT	00000000D0000125
116	0	0	1	0	0	OPOINT	63D0000126
116	64	2	2	0	0	OPOINT	00000000D0000127
116	0	0	1	0	0	OPOINT	64D0000128
116	65	2	2	0	0	OPOINT	00000000D0000129
116	0	0	1	0	0	OPOINT	65D0000130
116	66	2	2	0	0	OPOINT	00000000D0000131
116	0	0	1	0	0	OPOINT	66D0000132
116	67	2	2	0	0	OPOINT	00000000D0000133
116	0	0	1	0	0	OPOINT	67D0000134
116	68	2	2	0	0	OPOINT	00000000D0000135
116	0	0	1	0	0	OPOINT	68D0000136
116	69	2	2	0	0	OPOINT	00000000D0000137
116	0	0	1	0	0	OPOINT	69D0000138
116	70	2	2	0	0	OPOINT	00000000D0000139
116	0	0	1	0	0	OPOINT	70D0000140
116	71	2	2	0	0	OPOINT	00000000D0000141
116	0	0	1	0	0	OPOINT	71D0000142
116	72	2	2	0	0	OPOINT	00000000D0000143
116	0	0	1	0	0	OPOINT	72D0000144
116	73	2	2	0	0	OPOINT	00000000D0000145
116	0	0	1	0	0	OPOINT	73D0000146
116	74	2	2	0	0	OPOINT	00000000D0000147
116	0	0	1	0	0	OPOINT	74D0000148
116	75	2	2	0	0	OPOINT	00000000D0000149
116	0	0	1	0	0	OPOINT	75D0000150
116	76	2	2	0	0	OPOINT	00000000D0000151
116	0	0	1	0	0	OPOINT	76D0000152
116	77	2	2	0	0	OPOINT	00000000D0000153
116	0	0	1	0	0	OPOINT	77D0000154
116	78	2	2	0	0	OPOINT	00000000D0000155
116	0	0	1	0	0	OPOINT	78D0000156
116	79	2	2	0	0	OPOINT	00000000D0000157

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116	0	0	1	0	0	OPOINT	79D0000158
116	80	2	2	0	0	OPOINT	00000000D0000159
116	0	0	1	0	0	OPOINT	80D0000160
116	81	2	2	0	0	OPOINT	00000000D0000161
116	0	0	1	0	0	OPOINT	81D0000162
116	82	2	2	0	0	OPOINT	00000000D0000163
116	0	0	1	0	0	OPOINT	82D0000164
116	83	2	2	0	0	OPOINT	00000000D0000165
116	0	0	1	0	0	OPOINT	83D0000166
116	84	2	2	0	0	OPOINT	00000000D0000167
116	0	0	1	0	0	OPOINT	84D0000168
116	85	2	2	0	0	OPOINT	00000000D0000169
116	0	0	1	0	0	OPOINT	85D0000170
116	86	2	2	0	0	OPOINT	00000000D0000171
116	0	0	1	0	0	OPOINT	86D0000172
116	87	2	2	0	0	OPOINT	00000000D0000173
116	0	0	1	0	0	OPOINT	87D0000174
116	88	2	2	0	0	OPOINT	00000000D0000175
116	0	0	1	0	0	OPOINT	88D0000176
116	89	2	2	0	0	OPOINT	00000000D0000177
116	0	0	1	0	0	OPOINT	89D0000178
116	90	2	2	0	0	OPOINT	00000000D0000179
116	0	0	1	0	0	OPOINT	90D0000180
116	91	2	2	0	0	OPOINT	00000000D0000181
116	0	0	1	0	0	OPOINT	91D0000182
116	92	2	2	0	0	OPOINT	00000000D0000183
116	0	0	1	0	0	OPOINT	92D0000184
116	93	2	2	0	0	OPOINT	00000000D0000185
116	0	0	1	0	0	OPOINT	93D0000186
116	94	2	2	0	0	OPOINT	00000000D0000187
116	0	0	1	0	0	OPOINT	94D0000188
116	95	2	2	0	0	OPOINT	00000000D0000189
116	0	0	1	0	0	OPOINT	95D0000190
116	96	2	2	0	0	OPOINT	00000000D0000191
116	0	0	1	0	0	OPOINT	96D0000192
116	97	2	2	0	0	OPOINT	00000000D0000193
116	0	0	1	0	0	OPOINT	97D0000194
116	98	2	2	0	0	OPOINT	00000000D0000195
116	0	0	1	0	0	OPOINT	98D0000196
116	99	2	2	0	0	OPOINT	00000000D0000197
116	0	0	1	0	0	OPOINT	99D0000198
116	100	2	2	0	0	OPOINT	00000000D0000199
116	0	0	1	0	0	OPOINT	100D0000200
116	101	2	2	0	0	OPOINT	00000000D0000201
116	0	0	1	0	0	OPOINT	101D0000202
116	102	2	2	0	0	OPOINT	00000000D0000203
116	0	0	1	0	0	OPOINT	102D0000204
116	103	2	2	0	0	OPOINT	00000000D0000205
116	0	0	1	0	0	OPOINT	103D0000206
116	104	2	2	0	0	OPOINT	00000000D0000207
116	0	0	1	0	0	OPOINT	104D0000208
116	105	2	2	0	0	OPOINT	00000000D0000209
116	0	0	1	0	0	OPOINT	105D0000210
116	106	2	2	0	0	OPOINT	00000000D0000211
116	0	0	1	0	0	OPOINT	106D0000212
116	107	2	2	0	0	OPOINT	00000000D0000213
116	0	0	1	0	0	OPOINT	107D0000214
116	108	2	2	0	0	OPOINT	00000000D0000215
116	0	0	1	0	0	OPOINT	108D0000216
116	109	2	2	0	0	OPOINT	00000000D0000217

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116	0	0	1	0	0	OPOINT	109D0000218
116	110	2	2	0	0	OPOINT	00000000D0000219
116	0	0	1	0	0	OPOINT	110D0000220
116	111	2	2	0	0	OPOINT	00000000D0000221
116	0	0	1	0	0	OPOINT	111D0000222
116	112	2	2	0	0	OPOINT	00000000D0000223
116	0	0	1	0	0	OPOINT	112D0000224
116	113	2	2	0	0	OPOINT	00000000D0000225
116	0	0	1	0	0	OPOINT	113D0000226
116	114	2	2	0	0	OPOINT	00000000D0000227
116	0	0	1	0	0	OPOINT	114D0000228
116	115	2	2	0	0	OPOINT	00000000D0000229
116	0	0	1	0	0	OPOINT	115D0000230
116	116	2	2	0	0	OPOINT	00000000D0000231
116	0	0	1	0	0	OPOINT	116D0000232
116	117	2	2	0	0	OPOINT	00000000D0000233
116	0	0	1	0	0	OPOINT	117D0000234
116	118	2	2	0	0	OPOINT	00000000D0000235
116	0	0	1	0	0	OPOINT	118D0000236
116	119	2	2	0	0	OPOINT	00000000D0000237
116	0	0	1	0	0	OPOINT	119D0000238
116	120	2	2	0	0	OPOINT	00000000D0000239
116	0	0	1	0	0	OPOINT	120D0000240
116	121	2	2	0	0	OPOINT	00000000D0000241
116	0	0	1	0	0	OPOINT	121D0000242
116	122	2	2	0	0	OPOINT	00000000D0000243
116	0	0	1	0	0	OPOINT	122D0000244
116	123	2	2	0	0	OPOINT	00000000D0000245
116	0	0	1	0	0	OPOINT	123D0000246
116	124	2	2	0	0	OPOINT	00000000D0000247
116	0	0	1	0	0	OPOINT	124D0000248
116	125	2	2	0	0	OPOINT	00000000D0000249
116	0	0	1	0	0	OPOINT	125D0000250
116	126	2	2	0	0	OPOINT	00000000D0000251
116	0	0	1	0	0	OPOINT	126D0000252
116	127	2	2	0	0	OPOINT	00000000D0000253
116	0	0	1	0	0	OPOINT	127D0000254
116	128	2	2	0	0	OPOINT	00000000D0000255
116	0	0	1	0	0	OPOINT	128D0000256
116	129	2	2	0	0	OPOINT	00000000D0000257
116	0	0	1	0	0	OPOINT	129D0000258
116	130	2	2	0	0	OPOINT	00000000D0000259
116	0	0	1	0	0	OPOINT	130D0000260
116	131	2	2	0	0	OPOINT	00000000D0000261
116	0	0	1	0	0	OPOINT	131D0000262
116	132	2	2	0	0	OPOINT	00000000D0000263
116	0	0	1	0	0	OPOINT	132D0000264
116	133	2	2	0	0	OPOINT	00000000D0000265
116	0	0	1	0	0	OPOINT	133D0000266
116	134	2	2	0	0	OPOINT	00000000D0000267
116	0	0	1	0	0	OPOINT	134D0000268
116	135	2	2	0	0	OPOINT	00000000D0000269
116	0	0	1	0	0	OPOINT	135D0000270
116	136	2	2	0	0	OPOINT	00000000D0000271
116	0	0	1	0	0	OPOINT	136D0000272
116	137	2	2	0	0	OPOINT	00000000D0000273
116	0	0	1	0	0	OPOINT	137D0000274
116	138	2	2	0	0	OPOINT	00000000D0000275
116	0	0	1	0	0	OPOINT	138D0000276
116	139	2	2	0	0	OPOINT	00000000D0000277

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116	0	0	1	0	0	0POINT	139D0000278
116	140	2	2	0	0	0	00000000D0000279
116	0	0	1	0	0	0POINT	140D0000280
116	141	2	2	0	0	0	00000000D0000281
116	0	0	1	0	0	0POINT	141D0000282
116	142	2	2	0	0	0	00000000D0000283
116	0	0	1	0	0	0POINT	142D0000284
116	143	2	2	0	0	0	00000000D0000285
116	0	0	1	0	0	0POINT	143D0000286
116	144	2	2	0	0	0	00000000D0000287
116	0	0	1	0	0	0POINT	144D0000288
116	145	2	2	0	0	0	00000000D0000289
116	0	0	1	0	0	0POINT	145D0000290
116	146	2	2	0	0	0	00000000D0000291
116	0	0	1	0	0	0POINT	146D0000292
116	147	2	2	0	0	0	00000000D0000293
116	0	0	1	0	0	0POINT	147D0000294
116	148	2	2	0	0	0	00000000D0000295
116	0	0	1	0	0	0POINT	148D0000296
116	149	2	2	0	0	0	00000000D0000297
116	0	0	1	0	0	0POINT	149D0000298
116	150	2	2	0	0	0	00000000D0000299
116	0	0	1	0	0	0POINT	150D0000300
116	151	2	2	0	0	0	00000000D0000301
116	0	0	1	0	0	0POINT	151D0000302
116	152	2	2	0	0	0	00000000D0000303
116	0	0	1	0	0	0POINT	152D0000304
116	153	2	2	0	0	0	00000000D0000305
116	0	0	1	0	0	0POINT	153D0000306
116	154	2	2	0	0	0	00000000D0000307
116	0	0	1	0	0	0POINT	154D0000308
116	155	2	2	0	0	0	00000000D0000309
116	0	0	1	0	0	0POINT	155D0000310
116	156	2	2	0	0	0	00000000D0000311
116	0	0	1	0	0	0POINT	156D0000312
116	157	2	2	0	0	0	00000000D0000313
116	0	0	1	0	0	0POINT	157D0000314
116	158	2	2	0	0	0	00000000D0000315
116	0	0	1	0	0	0POINT	158D0000316
116	159	2	2	0	0	0	00000000D0000317
116	0	0	1	0	0	0POINT	159D0000318
116	160	2	2	0	0	0	00000000D0000319
116	0	0	1	0	0	0POINT	160D0000320
116	161	2	2	0	0	0	00000000D0000321
116	0	0	1	0	0	0POINT	161D0000322
124	162	2	1	0	0	0	00010000D0000323
124	0	0	4	0	0	0MATRIX	1D0000324
100	166	2	1	0	0	323	00000000D0000325
100	0	0	3	0	0	0CIRC ARC	1D0000326
124	169	2	1	0	0	0	00010000D0000327
124	0	0	4	0	0	0MATRIX	2D0000328
100	173	2	1	0	0	327	00000000D0000329
100	0	0	3	0	0	0CIRC ARC	2D0000330
124	176	2	1	0	0	0	00010000D0000331
124	0	0	4	0	0	0MATRIX	3D0000332
100	180	2	1	0	0	331	00000000D0000333
100	0	0	3	0	0	0CIRC ARC	3D0000334
124	183	2	1	0	0	0	00010000D0000335
124	0	0	4	0	0	0MATRIX	4D0000336
100	187	2	1	0	0	335	00000000D0000337

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100	0	0	3	0	0	0CIRC ARC	4D0000338
124	190	2	1	0	0	0	000010000D0000339
124	0	0	4	0	0	0MATRIX	5D0000340
100	194	2	1	0	0	339	000000000D0000341
100	0	0	3	0	0	0CIRC ARC	5D0000342
124	197	2	1	0	0	0	000010000D0000343
124	0	0	4	0	0	0MATRIX	6D0000344
100	201	2	1	0	0	343	000000000D0000345
100	0	0	3	0	0	0CIRC ARC	6D0000346
124	204	2	1	0	0	0	000010000D0000347
124	0	0	4	0	0	0MATRIX	7D0000348
100	208	2	1	0	0	347	000000000D0000349
100	0	0	3	0	0	0CIRC ARC	7D0000350
124	211	2	1	0	0	0	000010000D0000351
124	0	0	4	0	0	0MATRIX	8D0000352
100	215	2	1	0	0	351	000000000D0000353
100	0	0	3	0	0	0CIRC ARC	8D0000354
124	218	2	1	0	0	0	000010000D0000355
124	0	0	4	0	0	0MATRIX	9D0000356
100	222	2	1	0	0	355	000000000D0000357
100	0	0	3	0	0	0CIRC ARC	9D0000358
124	225	2	1	0	0	0	000010000D0000359
124	0	0	4	0	0	0MATRIX	10D0000360
100	229	2	1	0	0	359	000000000D0000361
100	0	0	3	0	0	0CIRC ARC	10D0000362
124	232	2	1	0	0	0	000010000D0000363
124	0	0	4	0	0	0MATRIX	11D0000364
100	236	2	1	0	0	363	000000000D0000365
100	0	0	3	0	0	0CIRC ARC	11D0000366
124	239	2	1	0	0	0	000010000D0000367
124	0	0	4	0	0	0MATRIX	12D0000368
100	243	2	1	0	0	367	000000000D0000369
100	0	0	3	0	0	0CIRC ARC	12D0000370
124	246	2	1	0	0	0	000010000D0000371
124	0	0	4	0	0	0MATRIX	13D0000372
100	250	2	1	0	0	371	000000000D0000373
100	0	0	3	0	0	0CIRC ARC	13D0000374
124	253	2	1	0	0	0	000010000D0000375
124	0	0	4	0	0	0MATRIX	14D0000376
100	257	2	1	0	0	375	000000000D0000377
100	0	0	3	0	0	0CIRC ARC	14D0000378
124	260	2	1	0	0	0	000010000D0000379
124	0	0	4	0	0	0MATRIX	15D0000380
100	264	2	1	0	0	379	000000000D0000381
100	0	0	3	0	0	0CIRC ARC	15D0000382
124	267	2	1	0	0	0	000010000D0000383
124	0	0	4	0	0	0MATRIX	16D0000384
100	271	2	1	0	0	383	000000000D0000385
100	0	0	3	0	0	0CIRC ARC	16D0000386
124	274	2	1	0	0	0	000010000D0000387
124	0	0	4	0	0	0MATRIX	17D0000388
100	278	2	1	0	0	387	000000000D0000389
100	0	0	3	0	0	0CIRC ARC	17D0000390
124	281	2	1	0	0	0	000010000D0000391
124	0	0	4	0	0	0MATRIX	18D0000392
100	285	2	1	0	0	391	000000000D0000393
100	0	0	3	0	0	0CIRC ARC	18D0000394
124	288	2	1	0	0	0	000010000D0000395
124	0	0	4	0	0	0MATRIX	19D0000396
100	292	2	1	0	0	395	000000000D0000397

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100	0	0	3	0	0	0CIRC ARC	19D0000398
124	295	2	1	0	0	0	000010000D0000399
124	0	0	4	0	0	0MATRIX	20D0000400
100	299	2	1	0	0	399	000000000D0000401
100	0	0	3	0	0	0CIRC ARC	20D0000402
124	302	2	1	0	0	0	000010000D0000403
124	0	0	4	0	0	0MATRIX	21D0000404
100	306	2	1	0	0	403	000000000D0000405
100	0	0	3	0	0	0CIRC ARC	21D0000406
124	309	2	1	0	0	0	000010000D0000407
124	0	0	4	0	0	0MATRIX	22D0000408
100	313	2	1	0	0	407	000000000D0000409
100	0	0	3	0	0	0CIRC ARC	22D0000410
124	316	2	1	0	0	0	000010000D0000411
124	0	0	4	0	0	0MATRIX	23D0000412
100	320	2	1	0	0	411	000000000D0000413
100	0	0	3	0	0	0CIRC ARC	23D0000414
124	323	2	1	0	0	0	000010000D0000415
124	0	0	4	0	0	0MATRIX	24D0000416
100	327	2	1	0	0	415	000000000D0000417
100	0	0	3	0	0	0CIRC ARC	24D0000418
124	330	2	1	0	0	0	000010000D0000419
124	0	0	4	0	0	0MATRIX	25D0000420
100	334	2	1	0	0	419	000000000D0000421
100	0	0	3	0	0	0CIRC ARC	25D0000422
124	337	2	1	0	0	0	000010000D0000423
124	0	0	4	0	0	0MATRIX	26D0000424
100	341	2	1	0	0	423	000000000D0000425
100	0	0	3	0	0	0CIRC ARC	26D0000426
124	344	2	1	0	0	0	000010000D0000427
124	0	0	4	0	0	0MATRIX	27D0000428
100	348	2	1	0	0	427	000000000D0000429
100	0	0	3	0	0	0CIRC ARC	27D0000430
124	351	2	1	0	0	0	000010000D0000431
124	0	0	4	0	0	0MATRIX	28D0000432
100	355	2	1	0	0	431	000000000D0000433
100	0	0	3	0	0	0CIRC ARC	28D0000434
124	358	2	1	0	0	0	000010000D0000435
124	0	0	4	0	0	0MATRIX	29D0000436
100	362	2	1	0	0	435	000000000D0000437
100	0	0	3	0	0	0CIRC ARC	29D0000438
124	365	2	1	0	0	0	000010000D0000439
124	0	0	4	0	0	0MATRIX	30D0000440
100	369	2	1	0	0	439	000000000D0000441
100	0	0	3	0	0	0CIRC ARC	30D0000442
124	372	2	1	0	0	0	000010000D0000443
124	0	0	4	0	0	0MATRIX	31D0000444
100	376	2	1	0	0	443	000000000D0000445
100	0	0	3	0	0	0CIRC ARC	31D0000446
124	379	2	1	0	0	0	000010000D0000447
124	0	0	4	0	0	0MATRIX	32D0000448
100	383	2	1	0	0	447	000000000D0000449
100	0	0	3	0	0	0CIRC ARC	32D0000450
124	386	2	1	0	0	0	000010000D0000451
124	0	0	4	0	0	0MATRIX	33D0000452
100	390	2	1	0	0	451	000000000D0000453
100	0	0	3	0	0	0CIRC ARC	33D0000454
124	393	2	1	0	0	0	000010000D0000455
124	0	0	4	0	0	0MATRIX	34D0000456
100	397	2	1	0	0	455	000000000D0000457

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100	0	0	3	0	0	0CIRC ARC	34D0000458
124	400	2	1	0	0	0	000010000D0000459
124	0	0	4	0	0	0MATRIX	35D0000460
100	404	2	1	0	0	459	000000000D0000461
100	0	0	3	0	0	0CIRC ARC	35D0000462
124	407	2	1	0	0	0	000010000D0000463
124	0	0	4	0	0	0MATRIX	36D0000464
100	411	2	1	0	0	463	000000000D0000465
100	0	0	3	0	0	0CIRC ARC	36D0000466
124	414	2	1	0	0	0	000010000D0000467
124	0	0	4	0	0	0MATRIX	37D0000468
100	418	2	1	0	0	467	000000000D0000469
100	0	0	3	0	0	0CIRC ARC	37D0000470
124	421	2	1	0	0	0	000010000D0000471
124	0	0	4	0	0	0MATRIX	38D0000472
100	425	2	1	0	0	471	000000000D0000473
100	0	0	3	0	0	0CIRC ARC	38D0000474
124	428	2	1	0	0	0	000010000D0000475
124	0	0	4	0	0	0MATRIX	39D0000476
100	432	2	1	0	0	475	000000000D0000477
100	0	0	3	0	0	0CIRC ARC	39D0000478
124	435	2	1	0	0	0	000010000D0000479
124	0	0	4	0	0	0MATRIX	40D0000480
100	439	2	1	0	0	479	000000000D0000481
100	0	0	3	0	0	0CIRC ARC	40D0000482
124	442	2	1	0	0	0	000010000D0000483
124	0	0	4	0	0	0MATRIX	41D0000484
100	446	2	1	0	0	483	000000000D0000485
100	0	0	3	0	0	0CIRC ARC	41D0000486
124	449	2	1	0	0	0	000010000D0000487
124	0	0	4	0	0	0MATRIX	42D0000488
100	453	2	1	0	0	487	000000000D0000489
100	0	0	3	0	0	0CIRC ARC	42D0000490
124	456	2	1	0	0	0	000010000D0000491
124	0	0	4	0	0	0MATRIX	43D0000492
100	460	2	1	0	0	491	000000000D0000493
100	0	0	3	0	0	0CIRC ARC	43D0000494
124	463	2	1	0	0	0	000010000D0000495
124	0	0	4	0	0	0MATRIX	44D0000496
100	467	2	1	0	0	495	000000000D0000497
100	0	0	3	0	0	0CIRC ARC	44D0000498
124	470	2	1	0	0	0	000010000D0000499
124	0	0	4	0	0	0MATRIX	45D0000500
100	474	2	1	0	0	499	000000000D0000501
100	0	0	3	0	0	0CIRC ARC	45D0000502
124	477	2	1	0	0	0	000010000D0000503
124	0	0	4	0	0	0MATRIX	46D0000504
100	481	2	1	0	0	503	000000000D0000505
100	0	0	3	0	0	0CIRC ARC	46D0000506
124	484	2	1	0	0	0	000010000D0000507
124	0	0	4	0	0	0MATRIX	47D0000508
100	488	2	1	0	0	507	000000000D0000509
100	0	0	3	0	0	0CIRC ARC	47D0000510
124	491	2	1	0	0	0	000010000D0000511
124	0	0	4	0	0	0MATRIX	48D0000512
100	495	2	1	0	0	511	000000000D0000513
100	0	0	3	0	0	0CIRC ARC	48D0000514
124	498	2	1	0	0	0	000010000D0000515
124	0	0	4	0	0	0MATRIX	49D0000516
100	502	2	1	0	0	515	000000000D0000517

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100	0	0	3	0	0	0CIRC ARC	49D0000518
124	505	2	1	0	0	0	000010000D0000519
124	0	0	4	0	0	0MATRIX	50D0000520
100	509	2	1	0	0	519	00000000D0000521
100	0	0	3	0	0	0CIRC ARC	50D0000522
124	512	2	1	0	0	0	000010000D0000523
124	0	0	4	0	0	0MATRIX	51D0000524
100	516	2	1	0	0	523	00000000D0000525
100	0	0	3	0	0	0CIRC ARC	51D0000526
124	519	2	1	0	0	0	000010000D0000527
124	0	0	4	0	0	0MATRIX	52D0000528
100	523	2	1	0	0	527	00000000D0000529
100	0	0	3	0	0	0CIRC ARC	52D0000530
124	526	2	1	0	0	0	000010000D0000531
124	0	0	4	0	0	0MATRIX	53D0000532
100	530	2	1	0	0	531	00000000D0000533
100	0	0	3	0	0	0CIRC ARC	53D0000534
124	533	2	1	0	0	0	000010000D0000535
124	0	0	4	0	0	0MATRIX	54D0000536
100	537	2	1	0	0	535	00000000D0000537
100	0	0	3	0	0	0CIRC ARC	54D0000538
124	540	2	1	0	0	0	000010000D0000539
124	0	0	4	0	0	0MATRIX	55D0000540
100	544	2	1	0	0	539	00000000D0000541
100	0	0	3	0	0	0CIRC ARC	55D0000542
124	547	2	1	0	0	0	000010000D0000543
124	0	0	4	0	0	0MATRIX	56D0000544
100	551	2	1	0	0	543	00000000D0000545
100	0	0	3	0	0	0CIRC ARC	56D0000546
124	554	2	1	0	0	0	000010000D0000547
124	0	0	4	0	0	0MATRIX	57D0000548
100	558	2	1	0	0	547	00000000D0000549
100	0	0	3	0	0	0CIRC ARC	57D0000550
124	561	2	1	0	0	0	000010000D0000551
124	0	0	4	0	0	0MATRIX	58D0000552
100	565	2	1	0	0	551	00000000D0000553
100	0	0	3	0	0	0CIRC ARC	58D0000554
124	568	2	1	0	0	0	000010000D0000555
124	0	0	4	0	0	0MATRIX	59D0000556
100	572	2	1	0	0	555	00000000D0000557
100	0	0	3	0	0	0CIRC ARC	59D0000558
124	575	2	1	0	0	0	000010000D0000559
124	0	0	4	0	0	0MATRIX	60D0000560
100	579	2	1	0	0	559	00000000D0000561
100	0	0	3	0	0	0CIRC ARC	60D0000562
124	582	2	1	0	0	0	000010000D0000563
124	0	0	4	0	0	0MATRIX	61D0000564
100	586	2	1	0	0	563	00000000D0000565
100	0	0	3	0	0	0CIRC ARC	61D0000566
124	589	2	1	0	0	0	000010000D0000567
124	0	0	4	0	0	0MATRIX	62D0000568
100	593	2	1	0	0	567	00000000D0000569
100	0	0	3	0	0	0CIRC ARC	62D0000570
124	596	2	1	0	0	0	000010000D0000571
124	0	0	4	0	0	0MATRIX	63D0000572
100	600	2	1	0	0	571	00000000D0000573
100	0	0	3	0	0	0CIRC ARC	63D0000574
124	603	2	1	0	0	0	000010000D0000575
124	0	0	4	0	0	0MATRIX	64D0000576
100	607	2	1	0	0	575	00000000D0000577

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100	0	0	3	0	0	0CIRC ARC	64D0000578
124	610	2	1	0	0	0	000010000D0000579
124	0	0	4	0	0	0MATRIX	65D0000580
100	614	2	1	0	0	579	000000000D0000581
100	0	0	3	0	0	0CIRC ARC	65D0000582
124	617	2	1	0	0	0	000010000D0000583
124	0	0	4	0	0	0MATRIX	66D0000584
100	621	2	1	0	0	583	000000000D0000585
100	0	0	3	0	0	0CIRC ARC	66D0000586
124	624	2	1	0	0	0	000010000D0000587
124	0	0	4	0	0	0MATRIX	67D0000588
100	628	2	1	0	0	587	000000000D0000589
100	0	0	3	0	0	0CIRC ARC	67D0000590
124	631	2	1	0	0	0	000010000D0000591
124	0	0	4	0	0	0MATRIX	68D0000592
100	635	2	1	0	0	591	000000000D0000593
100	0	0	3	0	0	0CIRC ARC	68D0000594
124	638	2	1	0	0	0	000010000D0000595
124	0	0	4	0	0	0MATRIX	69D0000596
100	642	2	1	0	0	595	000000000D0000597
100	0	0	3	0	0	0CIRC ARC	69D0000598
124	645	2	1	0	0	0	000010000D0000599
124	0	0	4	0	0	0MATRIX	70D0000600
100	649	2	1	0	0	599	000000000D0000601
100	0	0	3	0	0	0CIRC ARC	70D0000602
124	652	2	1	0	0	0	000010000D0000603
124	0	0	4	0	0	0MATRIX	71D0000604
100	656	2	1	0	0	603	000000000D0000605
100	0	0	3	0	0	0CIRC ARC	71D0000606
124	659	2	1	0	0	0	000010000D0000607
124	0	0	4	0	0	0MATRIX	72D0000608
100	663	2	1	0	0	607	000000000D0000609
100	0	0	3	0	0	0CIRC ARC	72D0000610
124	666	2	1	0	0	0	000010000D0000611
124	0	0	4	0	0	0MATRIX	73D0000612
100	670	2	1	0	0	611	000000000D0000613
100	0	0	3	0	0	0CIRC ARC	73D0000614
124	673	2	1	0	0	0	000010000D0000615
124	0	0	4	0	0	0MATRIX	74D0000616
100	677	2	1	0	0	615	000000000D0000617
100	0	0	3	0	0	0CIRC ARC	74D0000618
124	680	2	1	0	0	0	000010000D0000619
124	0	0	4	0	0	0MATRIX	75D0000620
100	684	2	1	0	0	619	000000000D0000621
100	0	0	3	0	0	0CIRC ARC	75D0000622
124	687	2	1	0	0	0	000010000D0000623
124	0	0	4	0	0	0MATRIX	76D0000624
100	691	2	1	0	0	623	000000000D0000625
100	0	0	3	0	0	0CIRC ARC	76D0000626
124	694	2	1	0	0	0	000010000D0000627
124	0	0	4	0	0	0MATRIX	77D0000628
100	698	2	1	0	0	627	000000000D0000629
100	0	0	3	0	0	0CIRC ARC	77D0000630
124	701	2	1	0	0	0	000010000D0000631
124	0	0	4	0	0	0MATRIX	78D0000632
100	705	2	1	0	0	631	000000000D0000633
100	0	0	3	0	0	0CIRC ARC	78D0000634
124	708	2	1	0	0	0	000010000D0000635
124	0	0	4	0	0	0MATRIX	79D0000636
100	712	2	1	0	0	635	000000000D0000637

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100	0	0	3	0	0	0CIRC ARC	79D0000638
124	715	2	1	0	0	0	000010000D0000639
124	0	0	4	0	0	0MATRIX	80D0000640
100	719	2	1	0	0	639	000000000D0000641
100	0	0	3	0	0	0CIRC ARC	80D0000642
124	722	2	1	0	0	0	000010000D0000643
124	0	0	4	0	0	0MATRIX	81D0000644
100	726	2	1	0	0	643	000000000D0000645
100	0	0	3	0	0	0CIRC ARC	81D0000646
124	729	2	1	0	0	0	000010000D0000647
124	0	0	4	0	0	0MATRIX	82D0000648
100	733	2	1	0	0	647	000000000D0000649
100	0	0	3	0	0	0CIRC ARC	82D0000650
124	736	2	1	0	0	0	000010000D0000651
124	0	0	4	0	0	0MATRIX	83D0000652
100	740	2	1	0	0	651	000000000D0000653
100	0	0	3	0	0	0CIRC ARC	83D0000654
124	743	2	1	0	0	0	000010000D0000655
124	0	0	4	0	0	0MATRIX	84D0000656
100	747	2	1	0	0	655	000000000D0000657
100	0	0	3	0	0	0CIRC ARC	84D0000658
124	750	2	1	0	0	0	000010000D0000659
124	0	0	4	0	0	0MATRIX	85D0000660
100	754	2	1	0	0	659	000000000D0000661
100	0	0	3	0	0	0CIRC ARC	85D0000662
124	757	2	1	0	0	0	000010000D0000663
124	0	0	4	0	0	0MATRIX	86D0000664
100	761	2	1	0	0	663	000000000D0000665
100	0	0	3	0	0	0CIRC ARC	86D0000666
124	764	2	1	0	0	0	000010000D0000667
124	0	0	4	0	0	0MATRIX	87D0000668
100	768	2	1	0	0	667	000000000D0000669
100	0	0	3	0	0	0CIRC ARC	87D0000670
124	771	2	1	0	0	0	000010000D0000671
124	0	0	4	0	0	0MATRIX	88D0000672
100	775	2	1	0	0	671	000000000D0000673
100	0	0	3	0	0	0CIRC ARC	88D0000674
124	778	2	1	0	0	0	000010000D0000675
124	0	0	4	0	0	0MATRIX	89D0000676
100	782	2	1	0	0	675	000000000D0000677
100	0	0	3	0	0	0CIRC ARC	89D0000678
124	785	2	1	0	0	0	000010000D0000679
124	0	0	4	0	0	0MATRIX	90D0000680
100	789	2	1	0	0	679	000000000D0000681
100	0	0	3	0	0	0CIRC ARC	90D0000682
124	792	2	1	0	0	0	000010000D0000683
124	0	0	4	0	0	0MATRIX	91D0000684
100	796	2	1	0	0	683	000000000D0000685
100	0	0	3	0	0	0CIRC ARC	91D0000686
124	799	2	1	0	0	0	000010000D0000687
124	0	0	4	0	0	0MATRIX	92D0000688
100	803	2	1	0	0	687	000000000D0000689
100	0	0	3	0	0	0CIRC ARC	92D0000690
124	806	2	1	0	0	0	000010000D0000691
124	0	0	4	0	0	0MATRIX	93D0000692
100	810	2	1	0	0	691	000000000D0000693
100	0	0	3	0	0	0CIRC ARC	93D0000694
124	813	2	1	0	0	0	000010000D0000695
124	0	0	4	0	0	0MATRIX	94D0000696
100	817	2	1	0	0	695	000000000D0000697

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100	0	0	3	0	0	0CIRC ARC	94D0000698
124	820	2	1	0	0	0	000010000D0000699
124	0	0	4	0	0	0MATRIX	95D0000700
100	824	2	1	0	0	699	000000000D0000701
100	0	0	3	0	0	0CIRC ARC	95D0000702
124	827	2	1	0	0	0	000010000D0000703
124	0	0	4	0	0	0MATRIX	96D0000704
100	831	2	1	0	0	703	000000000D0000705
100	0	0	3	0	0	0CIRC ARC	96D0000706
124	834	2	1	0	0	0	000010000D0000707
124	0	0	4	0	0	0MATRIX	97D0000708
100	838	2	1	0	0	707	000000000D0000709
100	0	0	3	0	0	0CIRC ARC	97D0000710
124	841	2	1	0	0	0	000010000D0000711
124	0	0	4	0	0	0MATRIX	98D0000712
100	845	2	1	0	0	711	000000000D0000713
100	0	0	3	0	0	0CIRC ARC	98D0000714
124	848	2	1	0	0	0	000010000D0000715
124	0	0	4	0	0	0MATRIX	99D0000716
100	852	2	1	0	0	715	000000000D0000717
100	0	0	3	0	0	0CIRC ARC	99D0000718
124	855	2	1	0	0	0	000010000D0000719
124	0	0	4	0	0	0MATRIX	100D0000720
100	859	2	1	0	0	719	000000000D0000721
100	0	0	3	0	0	0CIRC ARC	100D0000722
124	862	2	1	0	0	0	000010000D0000723
124	0	0	4	0	0	0MATRIX	101D0000724
100	866	2	1	0	0	723	000000000D0000725
100	0	0	3	0	0	0CIRC ARC	101D0000726
124	869	2	1	0	0	0	000010000D0000727
124	0	0	4	0	0	0MATRIX	102D0000728
100	873	2	1	0	0	727	000000000D0000729
100	0	0	3	0	0	0CIRC ARC	102D0000730
124	876	2	1	0	0	0	000010000D0000731
124	0	0	4	0	0	0MATRIX	103D0000732
100	880	2	1	0	0	731	000000000D0000733
100	0	0	3	0	0	0CIRC ARC	103D0000734
124	883	2	1	0	0	0	000010000D0000735
124	0	0	4	0	0	0MATRIX	104D0000736
100	887	2	1	0	0	735	000000000D0000737
100	0	0	3	0	0	0CIRC ARC	104D0000738
124	890	2	1	0	0	0	000010000D0000739
124	0	0	4	0	0	0MATRIX	105D0000740
100	894	2	1	0	0	739	000000000D0000741
100	0	0	3	0	0	0CIRC ARC	105D0000742
124	897	2	1	0	0	0	000010000D0000743
124	0	0	4	0	0	0MATRIX	106D0000744
100	901	2	1	0	0	743	000000000D0000745
100	0	0	3	0	0	0CIRC ARC	106D0000746
124	904	2	1	0	0	0	000010000D0000747
124	0	0	4	0	0	0MATRIX	107D0000748
100	908	2	1	0	0	747	000000000D0000749
100	0	0	3	0	0	0CIRC ARC	107D0000750
124	911	2	1	0	0	0	000010000D0000751
124	0	0	4	0	0	0MATRIX	108D0000752
100	915	2	1	0	0	751	000000000D0000753
100	0	0	3	0	0	0CIRC ARC	108D0000754
124	918	2	1	0	0	0	000010000D0000755
124	0	0	4	0	0	0MATRIX	109D0000756
100	922	2	1	0	0	755	000000000D0000757

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100	0	0	3	0	0	0CIRC ARC	109D0000758
124	925	2	1	0	0	0	00001000D0000759
124	0	0	4	0	0	0MATRIX	110D0000760
100	929	2	1	0	0	759	00000000D0000761
100	0	0	3	0	0	0CIRC ARC	110D0000762
124	932	2	1	0	0	0	00001000D0000763
124	0	0	4	0	0	0MATRIX	111D0000764
100	936	2	1	0	0	763	00000000D0000765
100	0	0	3	0	0	0CIRC ARC	111D0000766
124	939	2	1	0	0	0	00001000D0000767
124	0	0	4	0	0	0MATRIX	112D0000768
100	943	2	1	0	0	767	00000000D0000769
100	0	0	3	0	0	0CIRC ARC	112D0000770
124	946	2	1	0	0	0	00001000D0000771
124	0	0	4	0	0	0MATRIX	113D0000772
100	950	2	1	0	0	771	00000000D0000773
100	0	0	3	0	0	0CIRC ARC	113D0000774
124	953	2	1	0	0	0	00001000D0000775
124	0	0	4	0	0	0MATRIX	114D0000776
100	957	2	1	0	0	775	00000000D0000777
100	0	0	3	0	0	0CIRC ARC	114D0000778
124	960	2	1	0	0	0	00001000D0000779
124	0	0	4	0	0	0MATRIX	115D0000780
100	964	2	1	0	0	779	00000000D0000781
100	0	0	3	0	0	0CIRC ARC	115D0000782
124	967	2	1	0	0	0	00001000D0000783
124	0	0	4	0	0	0MATRIX	116D0000784
100	971	2	1	0	0	783	00000000D0000785
100	0	0	3	0	0	0CIRC ARC	116D0000786
124	974	2	1	0	0	0	00001000D0000787
124	0	0	4	0	0	0MATRIX	117D0000788
100	978	2	1	0	0	787	00000000D0000789
100	0	0	3	0	0	0CIRC ARC	117D0000790
124	981	2	1	0	0	0	00001000D0000791
124	0	0	4	0	0	0MATRIX	118D0000792
100	985	2	1	0	0	791	00000000D0000793
100	0	0	3	0	0	0CIRC ARC	118D0000794
124	988	2	1	0	0	0	00001000D0000795
124	0	0	4	0	0	0MATRIX	119D0000796
100	992	2	1	0	0	795	00000000D0000797
100	0	0	3	0	0	0CIRC ARC	119D0000798
124	995	2	1	0	0	0	00001000D0000799
124	0	0	4	0	0	0MATRIX	120D0000800
100	999	2	1	0	0	799	00000000D0000801
100	0	0	3	0	0	0CIRC ARC	120D0000802
124	1002	2	1	0	0	0	00001000D0000803
124	0	0	4	0	0	0MATRIX	121D0000804
100	1006	2	1	0	0	803	00000000D0000805
100	0	0	3	0	0	0CIRC ARC	121D0000806
124	1009	2	1	0	0	0	00001000D0000807
124	0	0	4	0	0	0MATRIX	122D0000808
100	1013	2	1	0	0	807	00000000D0000809
100	0	0	3	0	0	0CIRC ARC	122D0000810
124	1016	2	1	0	0	0	00001000D0000811
124	0	0	4	0	0	0MATRIX	123D0000812
100	1020	2	1	0	0	811	00000000D0000813
100	0	0	3	0	0	0CIRC ARC	123D0000814
124	1023	2	1	0	0	0	00001000D0000815
124	0	0	4	0	0	0MATRIX	124D0000816
100	1027	2	1	0	0	815	00000000D0000817

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100	0	0	3	0	0	0CIRC ARC	124D0000818
124	1030	2	1	0	0	0	000010000D0000819
124	0	0	4	0	0	0MATRIX	125D0000820
100	1034	2	1	0	0	819	00000000D0000821
100	0	0	3	0	0	0CIRC ARC	125D0000822
124	1037	2	1	0	0	0	000010000D0000823
124	0	0	4	0	0	0MATRIX	126D0000824
100	1041	2	1	0	0	823	00000000D0000825
100	0	0	3	0	0	0CIRC ARC	126D0000826
124	1044	2	1	0	0	0	000010000D0000827
124	0	0	4	0	0	0MATRIX	127D0000828
100	1048	2	1	0	0	827	00000000D0000829
100	0	0	3	0	0	0CIRC ARC	127D0000830
124	1051	2	1	0	0	0	000010000D0000831
124	0	0	4	0	0	0MATRIX	128D0000832
100	1055	2	1	0	0	831	00000000D0000833
100	0	0	3	0	0	0CIRC ARC	128D0000834
124	1058	2	1	0	0	0	000010000D0000835
124	0	0	4	0	0	0MATRIX	129D0000836
100	1062	2	1	0	0	835	00000000D0000837
100	0	0	3	0	0	0CIRC ARC	129D0000838
124	1065	2	1	0	0	0	000010000D0000839
124	0	0	4	0	0	0MATRIX	130D0000840
100	1069	2	1	0	0	839	00000000D0000841
100	0	0	3	0	0	0CIRC ARC	130D0000842
124	1072	2	1	0	0	0	000010000D0000843
124	0	0	4	0	0	0MATRIX	131D0000844
100	1076	2	1	0	0	843	00000000D0000845
100	0	0	3	0	0	0CIRC ARC	131D0000846
124	1079	2	1	0	0	0	000010000D0000847
124	0	0	4	0	0	0MATRIX	132D0000848
100	1083	2	1	0	0	847	00000000D0000849
100	0	0	3	0	0	0CIRC ARC	132D0000850
124	1086	2	1	0	0	0	000010000D0000851
124	0	0	4	0	0	0MATRIX	133D0000852
100	1090	2	1	0	0	851	00000000D0000853
100	0	0	3	0	0	0CIRC ARC	133D0000854
124	1093	2	1	0	0	0	000010000D0000855
124	0	0	4	0	0	0MATRIX	134D0000856
100	1097	2	1	0	0	855	00000000D0000857
100	0	0	3	0	0	0CIRC ARC	134D0000858
124	1100	2	1	0	0	0	000010000D0000859
124	0	0	4	0	0	0MATRIX	135D0000860
100	1104	2	1	0	0	859	00000000D0000861
100	0	0	3	0	0	0CIRC ARC	135D0000862
124	1107	2	1	0	0	0	000010000D0000863
124	0	0	4	0	0	0MATRIX	136D0000864
100	1111	2	1	0	0	863	00000000D0000865
100	0	0	3	0	0	0CIRC ARC	136D0000866
124	1114	2	1	0	0	0	000010000D0000867
124	0	0	4	0	0	0MATRIX	137D0000868
100	1118	2	1	0	0	867	00000000D0000869
100	0	0	3	0	0	0CIRC ARC	137D0000870
124	1121	2	1	0	0	0	000010000D0000871
124	0	0	4	0	0	0MATRIX	138D0000872
100	1125	2	1	0	0	871	00000000D0000873
100	0	0	3	0	0	0CIRC ARC	138D0000874
124	1128	2	1	0	0	0	000010000D0000875
124	0	0	4	0	0	0MATRIX	139D0000876
100	1132	2	1	0	0	875	00000000D0000877

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100	0	0	3	0	0	0CIRC ARC	139D0000878
124	1135	2	1	0	0	0	000010000D0000879
124	0	0	4	0	0	0MATRIX	140D0000880
100	1139	2	1	0	0	879	00000000D0000881
100	0	0	3	0	0	0CIRC ARC	140D0000882
124	1142	2	1	0	0	0	000010000D0000883
124	0	0	4	0	0	0MATRIX	141D0000884
100	1146	2	1	0	0	883	00000000D0000885
100	0	0	3	0	0	0CIRC ARC	141D0000886
124	1149	2	1	0	0	0	000010000D0000887
124	0	0	4	0	0	0MATRIX	142D0000888
100	1153	2	1	0	0	887	00000000D0000889
100	0	0	3	0	0	0CIRC ARC	142D0000890
124	1156	2	1	0	0	0	000010000D0000891
124	0	0	4	0	0	0MATRIX	143D0000892
100	1160	2	1	0	0	891	00000000D0000893
100	0	0	3	0	0	0CIRC ARC	143D0000894
124	1163	2	1	0	0	0	000010000D0000895
124	0	0	4	0	0	0MATRIX	144D0000896
100	1167	2	1	0	0	895	00000000D0000897
100	0	0	3	0	0	0CIRC ARC	144D0000898
124	1170	2	1	0	0	0	000010000D0000899
124	0	0	4	0	0	0MATRIX	145D0000900
100	1174	2	1	0	0	899	00000000D0000901
100	0	0	3	0	0	0CIRC ARC	145D0000902
124	1177	2	1	0	0	0	000010000D0000903
124	0	0	4	0	0	0MATRIX	146D0000904
100	1181	2	1	0	0	903	00000000D0000905
100	0	0	3	0	0	0CIRC ARC	146D0000906
124	1184	2	1	0	0	0	000010000D0000907
124	0	0	4	0	0	0MATRIX	147D0000908
100	1188	2	1	0	0	907	00000000D0000909
100	0	0	3	0	0	0CIRC ARC	147D0000910
124	1191	2	1	0	0	0	000010000D0000911
124	0	0	4	0	0	0MATRIX	148D0000912
100	1195	2	1	0	0	911	00000000D0000913
100	0	0	3	0	0	0CIRC ARC	148D0000914
124	1198	2	1	0	0	0	000010000D0000915
124	0	0	4	0	0	0MATRIX	149D0000916
100	1202	2	1	0	0	915	00000000D0000917
100	0	0	3	0	0	0CIRC ARC	149D0000918
124	1205	2	1	0	0	0	000010000D0000919
124	0	0	4	0	0	0MATRIX	150D0000920
100	1209	2	1	0	0	919	00000000D0000921
100	0	0	3	0	0	0CIRC ARC	150D0000922
124	1212	2	1	0	0	0	000010000D0000923
124	0	0	4	0	0	0MATRIX	151D0000924
100	1216	2	1	0	0	923	00000000D0000925
100	0	0	3	0	0	0CIRC ARC	151D0000926
124	1219	2	1	0	0	0	000010000D0000927
124	0	0	4	0	0	0MATRIX	152D0000928
100	1223	2	1	0	0	927	00000000D0000929
100	0	0	3	0	0	0CIRC ARC	152D0000930
124	1226	2	1	0	0	0	000010000D0000931
124	0	0	4	0	0	0MATRIX	153D0000932
100	1230	2	1	0	0	931	00000000D0000933
100	0	0	3	0	0	0CIRC ARC	153D0000934
124	1233	2	1	0	0	0	000010000D0000935
124	0	0	4	0	0	0MATRIX	154D0000936
100	1237	2	1	0	0	935	00000000D0000937

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100	0	0	3	0	0	0CIRC ARC	154D0000938
124	1240	2	1	0	0	0	000010000D0000939
124	0	0	4	0	0	0MATRIX	155D0000940
100	1244	2	1	0	0	939	000000000D0000941
100	0	0	3	0	0	0CIRC ARC	155D0000942
124	1247	2	1	0	0	0	000010000D0000943
124	0	0	4	0	0	0MATRIX	156D0000944
100	1251	2	1	0	0	943	000000000D0000945
100	0	0	3	0	0	0CIRC ARC	156D0000946
124	1254	2	1	0	0	0	000010000D0000947
124	0	0	4	0	0	0MATRIX	157D0000948
100	1258	2	1	0	0	947	000000000D0000949
100	0	0	3	0	0	0CIRC ARC	157D0000950
124	1261	2	1	0	0	0	000010000D0000951
124	0	0	4	0	0	0MATRIX	158D0000952
100	1265	2	1	0	0	951	000000000D0000953
100	0	0	3	0	0	0CIRC ARC	158D0000954
124	1268	2	1	0	0	0	000010000D0000955
124	0	0	4	0	0	0MATRIX	159D0000956
100	1272	2	1	0	0	955	000000000D0000957
100	0	0	3	0	0	0CIRC ARC	159D0000958
124	1275	2	1	0	0	0	000010000D0000959
124	0	0	4	0	0	0MATRIX	160D0000960
100	1279	2	1	0	0	959	000000000D0000961
100	0	0	3	0	0	0CIRC ARC	160D0000962
116,	-0.370000000E+02,	0.300000000E+02,	0.000000000E+00;				1P0000001
116,	-0.368720512E+02,	0.294161396E+02,	0.000000000E+00;				3P0000002
116,	-0.367266922E+02,	0.288363667E+02,	0.000000000E+00;				5P0000003
116,	-0.365639954E+02,	0.282612324E+02,	0.000000000E+00;				7P0000004
116,	-0.363840218E+02,	0.276912956E+02,	0.000000000E+00;				9P0000005
116,	-0.361868477E+02,	0.271271095E+02,	0.000000000E+00;				11P0000006
116,	-0.359725838E+02,	0.265692329E+02,	0.000000000E+00;				13P0000007
116,	-0.357413559E+02,	0.260182152E+02,	0.000000000E+00;				15P0000008
116,	-0.354933052E+02,	0.254746056E+02,	0.000000000E+00;				17P0000009
116,	-0.352286034E+02,	0.249389458E+02,	0.000000000E+00;				19P0000010
116,	-0.349474525E+02,	0.244117718E+02,	0.000000000E+00;				21P0000011
116,	-0.346500549E+02,	0.238936100E+02,	0.000000000E+00;				23P0000012
116,	-0.343366623E+02,	0.233849792E+02,	0.000000000E+00;				25P0000013
116,	-0.340075302E+02,	0.228863926E+02,	0.000000000E+00;				27P0000014
116,	-0.336629524E+02,	0.223983402E+02,	0.000000000E+00;				29P0000015
116,	-0.333032341E+02,	0.219213123E+02,	0.000000000E+00;				31P0000016
116,	-0.329287148E+02,	0.214557743E+02,	0.000000000E+00;				33P0000017
116,	-0.325397339E+02,	0.210021782E+02,	0.000000000E+00;				35P0000018
116,	-0.321366768E+02,	0.205609684E+02,	0.000000000E+00;				37P0000019
116,	-0.317199383E+02,	0.201325626E+02,	0.000000000E+00;				39P0000020
116,	-0.312899284E+02,	0.197173615E+02,	0.000000000E+00;				41P0000021
116,	-0.308470802E+02,	0.193157578E+02,	0.000000000E+00;				43P0000022
116,	-0.303918438E+02,	0.189281139E+02,	0.000000000E+00;				45P0000023
116,	-0.299246712E+02,	0.185547771E+02,	0.000000000E+00;				47P0000024
116,	-0.294460506E+02,	0.181960793E+02,	0.000000000E+00;				49P0000025
116,	-0.289564648E+02,	0.178523273E+02,	0.000000000E+00;				51P0000026
116,	-0.284564095E+02,	0.175238132E+02,	0.000000000E+00;				53P0000027
116,	-0.279463978E+02,	0.172108078E+02,	0.000000000E+00;				55P0000028
116,	-0.274269428E+02,	0.169135609E+02,	0.000000000E+00;				57P0000029
116,	-0.268985901E+02,	0.166322689E+02,	0.000000000E+00;				59P0000030
116,	-0.263618164E+02,	0.163672466E+02,	0.000000000E+00;				61P0000031
116,	-0.258168755E+02,	0.161193409E+02,	0.000000000E+00;				63P0000032
116,	-0.252644215E+02,	0.158886490E+02,	0.000000000E+00;				65P0000033
116,	-0.247067204E+02,	0.156738577E+02,	0.000000000E+00;				67P0000034
116,	-0.241937656E+02,	0.154889746E+02,	0.000000000E+00;				69P0000035

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116, -0.236814594E+02, 0.153152571E+02, 0.000000000E+00;	71P00000036
116, -0.231680965E+02, 0.151513481E+02, 0.000000000E+00;	73P00000037
116, -0.226541939E+02, 0.149961777E+02, 0.000000000E+00;	75P00000038
116, -0.221392269E+02, 0.148486605E+02, 0.000000000E+00;	77P00000039
116, -0.216237564E+02, 0.147083998E+02, 0.000000000E+00;	79P00000040
116, -0.211072311E+02, 0.145748158E+02, 0.000000000E+00;	81P00000041
116, -0.205900307E+02, 0.144476175E+02, 0.000000000E+00;	83P00000042
116, -0.200719299E+02, 0.143264122E+02, 0.000000000E+00;	85P00000043
116, -0.195530891E+02, 0.142109079E+02, 0.000000000E+00;	87P00000044
116, -0.190334587E+02, 0.141008053E+02, 0.000000000E+00;	89P00000045
116, -0.185130539E+02, 0.139958887E+02, 0.000000000E+00;	91P00000046
116, -0.179918289E+02, 0.138959665E+02, 0.000000000E+00;	93P00000047
116, -0.174698811E+02, 0.138008032E+02, 0.000000000E+00;	95P00000048
116, -0.169472923E+02, 0.137101908E+02, 0.000000000E+00;	97P00000049
116, -0.164240055E+02, 0.136239529E+02, 0.000000000E+00;	99P00000050
116, -0.159001150E+02, 0.135419436E+02, 0.000000000E+00;	101P00000051
116, -0.153755722E+02, 0.134640064E+02, 0.000000000E+00;	103P00000052
116, -0.148504686E+02, 0.133900042E+02, 0.000000000E+00;	105P00000053
116, -0.143248320E+02, 0.133197947E+02, 0.000000000E+00;	107P00000054
116, -0.137986803E+02, 0.132532358E+02, 0.000000000E+00;	109P00000055
116, -0.132720242E+02, 0.131902113E+02, 0.000000000E+00;	111P00000056
116, -0.127448997E+02, 0.131306105E+02, 0.000000000E+00;	113P00000057
116, -0.122173347E+02, 0.130743256E+02, 0.000000000E+00;	115P00000058
116, -0.116893616E+02, 0.130212660E+02, 0.000000000E+00;	117P00000059
116, -0.111609440E+02, 0.129712944E+02, 0.000000000E+00;	119P00000060
116, -0.106321650E+02, 0.129243021E+02, 0.000000000E+00;	121P00000061
116, -0.101029987E+02, 0.128802071E+02, 0.000000000E+00;	123P00000062
116, -0.957347870E+01, 0.128389349E+02, 0.000000000E+00;	125P00000063
116, -0.904359055E+01, 0.128003855E+02, 0.000000000E+00;	127P00000064
116, -0.851331615E+01, 0.127644567E+02, 0.000000000E+00;	129P00000065
116, -0.798270082E+01, 0.127310963E+02, 0.000000000E+00;	131P00000066
116, -0.745158482E+01, 0.127002268E+02, 0.000000000E+00;	133P00000067
116, -0.692006493E+01, 0.126717653E+02, 0.000000000E+00;	135P00000068
116, -0.638768721E+01, 0.126455956E+02, 0.000000000E+00;	137P00000069
116, -0.585458183E+01, 0.126217184E+02, 0.000000000E+00;	139P00000070
116, -0.531466722E+01, 0.125998888E+02, 0.000000000E+00;	141P00000071
116, -0.477596521E+01, 0.125803833E+02, 0.000000000E+00;	143P00000072
116, -0.423972416E+01, 0.125631456E+02, 0.000000000E+00;	145P00000073
116, -0.370539904E+01, 0.125481033E+02, 0.000000000E+00;	147P00000074
116, -0.317296505E+01, 0.125352087E+02, 0.000000000E+00;	149P00000075
116, -0.264191699E+01, 0.125243893E+02, 0.000000000E+00;	151P00000076
116, -0.211211109E+01, 0.125155840E+02, 0.000000000E+00;	153P00000077
116, -0.158315206E+01, 0.125087614E+02, 0.000000000E+00;	155P00000078
116, -0.105489695E+01, 0.125038977E+02, 0.000000000E+00;	157P00000079
116, -0.526956022E+00, 0.125009747E+02, 0.000000000E+00;	159P00000080
116, 0.000000000E+00, 0.125000000E+02, 0.000000000E+00;	161P00000081
116, 0.526956022E+00, 0.125009747E+02, 0.000000000E+00;	163P00000082
116, 0.105489695E+01, 0.125038977E+02, 0.000000000E+00;	165P00000083
116, 0.158315206E+01, 0.125087614E+02, 0.000000000E+00;	167P00000084
116, 0.211211109E+01, 0.125155840E+02, 0.000000000E+00;	169P00000085
116, 0.264191699E+01, 0.125243893E+02, 0.000000000E+00;	171P00000086
116, 0.317296505E+01, 0.125352087E+02, 0.000000000E+00;	173P00000087
116, 0.370539904E+01, 0.125481033E+02, 0.000000000E+00;	175P00000088
116, 0.423972416E+01, 0.125631456E+02, 0.000000000E+00;	177P00000089
116, 0.477596521E+01, 0.125803833E+02, 0.000000000E+00;	179P00000090
116, 0.531466722E+01, 0.125998888E+02, 0.000000000E+00;	181P00000091
116, 0.585458183E+01, 0.126217184E+02, 0.000000000E+00;	183P00000092
116, 0.638768721E+01, 0.126455956E+02, 0.000000000E+00;	185P00000093
116, 0.692006493E+01, 0.126717653E+02, 0.000000000E+00;	187P00000094
116, 0.745158482E+01, 0.127002268E+02, 0.000000000E+00;	189P00000095

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116, 0.798270082E+01, 0.127310963E+02, 0.000000000E+00;	191P00000096
116, 0.851331615E+01, 0.127644567E+02, 0.000000000E+00;	193P00000097
116, 0.904359055E+01, 0.128003855E+02, 0.000000000E+00;	195P00000098
116, 0.957347870E+01, 0.128389349E+02, 0.000000000E+00;	197P00000099
116, 0.101029987E+02, 0.128802071E+02, 0.000000000E+00;	199P0000100
116, 0.106321650E+02, 0.129243021E+02, 0.000000000E+00;	201P0000101
116, 0.111609440E+02, 0.129712944E+02, 0.000000000E+00;	203P0000102
116, 0.116893616E+02, 0.130212660E+02, 0.000000000E+00;	205P0000103
116, 0.122173347E+02, 0.130743256E+02, 0.000000000E+00;	207P0000104
116, 0.127448997E+02, 0.131306105E+02, 0.000000000E+00;	209P0000105
116, 0.132720242E+02, 0.131902113E+02, 0.000000000E+00;	211P0000106
116, 0.137986803E+02, 0.132532358E+02, 0.000000000E+00;	213P0000107
116, 0.143248320E+02, 0.133197947E+02, 0.000000000E+00;	215P0000108
116, 0.148504686E+02, 0.133900042E+02, 0.000000000E+00;	217P0000109
116, 0.153755722E+02, 0.134640064E+02, 0.000000000E+00;	219P0000110
116, 0.159001150E+02, 0.135419436E+02, 0.000000000E+00;	221P0000111
116, 0.164240055E+02, 0.136239529E+02, 0.000000000E+00;	223P0000112
116, 0.169472923E+02, 0.137101908E+02, 0.000000000E+00;	225P0000113
116, 0.174698811E+02, 0.138008032E+02, 0.000000000E+00;	227P0000114
116, 0.179918289E+02, 0.138959665E+02, 0.000000000E+00;	229P0000115
116, 0.185130539E+02, 0.139958887E+02, 0.000000000E+00;	231P0000116
116, 0.190334587E+02, 0.141008053E+02, 0.000000000E+00;	233P0000117
116, 0.195530891E+02, 0.142109079E+02, 0.000000000E+00;	235P0000118
116, 0.200719299E+02, 0.143264122E+02, 0.000000000E+00;	237P0000119
116, 0.205900307E+02, 0.144476175E+02, 0.000000000E+00;	239P0000120
116, 0.211072311E+02, 0.145748158E+02, 0.000000000E+00;	241P0000121
116, 0.216237564E+02, 0.147083998E+02, 0.000000000E+00;	243P0000122
116, 0.221392269E+02, 0.148486605E+02, 0.000000000E+00;	245P0000123
116, 0.226541939E+02, 0.149961777E+02, 0.000000000E+00;	247P0000124
116, 0.231680965E+02, 0.151513481E+02, 0.000000000E+00;	249P0000125
116, 0.236814594E+02, 0.153152571E+02, 0.000000000E+00;	251P0000126
116, 0.241937656E+02, 0.154889746E+02, 0.000000000E+00;	253P0000127
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116, 0.252644215E+02, 0.158886490E+02, 0.000000000E+00;	257P0000129
116, 0.258168755E+02, 0.161193409E+02, 0.000000000E+00;	259P0000130
116, 0.263618164E+02, 0.163672466E+02, 0.000000000E+00;	261P0000131
116, 0.268985901E+02, 0.166322689E+02, 0.000000000E+00;	263P0000132
116, 0.274269428E+02, 0.169135609E+02, 0.000000000E+00;	265P0000133
116, 0.279463978E+02, 0.172108078E+02, 0.000000000E+00;	267P0000134
116, 0.284564095E+02, 0.175238132E+02, 0.000000000E+00;	269P0000135
116, 0.289564648E+02, 0.178523273E+02, 0.000000000E+00;	271P0000136
116, 0.294460506E+02, 0.181960793E+02, 0.000000000E+00;	273P0000137
116, 0.299246712E+02, 0.185547771E+02, 0.000000000E+00;	275P0000138
116, 0.303918438E+02, 0.189281139E+02, 0.000000000E+00;	277P0000139
116, 0.308470802E+02, 0.193157578E+02, 0.000000000E+00;	279P0000140
116, 0.312899284E+02, 0.197173615E+02, 0.000000000E+00;	281P0000141
116, 0.317199383E+02, 0.201325626E+02, 0.000000000E+00;	283P0000142
116, 0.321366768E+02, 0.205609684E+02, 0.000000000E+00;	285P0000143
116, 0.325397339E+02, 0.210021782E+02, 0.000000000E+00;	287P0000144
116, 0.329287148E+02, 0.214557743E+02, 0.000000000E+00;	289P0000145
116, 0.3303032341E+02, 0.219213123E+02, 0.000000000E+00;	291P0000146
116, 0.336629524E+02, 0.223983402E+02, 0.000000000E+00;	293P0000147
116, 0.340075302E+02, 0.228863926E+02, 0.000000000E+00;	295P0000148
116, 0.343366623E+02, 0.233849792E+02, 0.000000000E+00;	297P0000149
116, 0.346500549E+02, 0.238936100E+02, 0.000000000E+00;	299P0000150
116, 0.349474525E+02, 0.244117718E+02, 0.000000000E+00;	301P0000151
116, 0.352286034E+02, 0.249389458E+02, 0.000000000E+00;	303P0000152
116, 0.354933052E+02, 0.254746056E+02, 0.000000000E+00;	305P0000153
116, 0.357413559E+02, 0.260182152E+02, 0.000000000E+00;	307P0000154
116, 0.359725838E+02, 0.265692329E+02, 0.000000000E+00;	309P0000155

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116, 0.361868477E+02, 0.271271095E+02, 0.000000000E+00;	311P0000156
116, 0.363840218E+02, 0.276912956E+02, 0.000000000E+00;	313P0000157
116, 0.365639954E+02, 0.282612324E+02, 0.000000000E+00;	315P0000158
116, 0.367266922E+02, 0.288363667E+02, 0.000000000E+00;	317P0000159
116, 0.368720512E+02, 0.294161396E+02, 0.000000000E+00;	319P0000160
116, 0.370000000E+02, 0.300000000E+02, 0.000000000E+00;	321P0000161
124, -0.979913771E+00, 0.199421763E+00, 0.000000000E+00,	323P0000162
-0.174294739E+02, -0.199421763E+00, -0.979913771E+00,	323P0000163
0.000000000E+00, 0.339827881E+02, 0.000000000E+00,	323P0000164
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	323P0000165
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	325P0000166
0.199716816E+02, 0.000000000E+00, 0.199627361E+02,	325P0000167
0.597648680E+00;	325P0000168
124, -0.973509073E+00, 0.228648141E+00, 0.000000000E+00,	327P0000169
-0.174294357E+02, -0.228648141E+00, -0.973509073E+00,	327P0000170
0.000000000E+00, 0.339826279E+02, 0.000000000E+00,	327P0000171
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	327P0000172
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	329P0000173
0.199716835E+02, 0.000000000E+00, 0.199627380E+02,	329P0000174
0.597650230E+00;	329P0000175
124, -0.966217399E+00, 0.257728457E+00, 0.000000000E+00,	331P0000176
-0.174903107E+02, -0.257728457E+00, -0.966217399E+00,	331P0000177
0.000000000E+00, 0.339674721E+02, 0.000000000E+00,	331P0000178
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	331P0000179
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	333P0000180
0.199089584E+02, 0.000000000E+00, 0.198999863E+02,	333P0000181
0.597636819E+00;	333P0000182
124, -0.958022058E+00, 0.286694616E+00, 0.000000000E+00,	335P0000183
-0.175956039E+02, -0.286694616E+00, -0.958022058E+00,	335P0000184
0.000000000E+00, 0.339376526E+02, 0.000000000E+00,	335P0000185
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	335P0000186
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	337P0000187
0.197995358E+02, 0.000000000E+00, 0.197905140E+02,	337P0000188
0.597609520E+00;	337P0000189
124, -0.948906660E+00, 0.315557033E+00, 0.000000000E+00,	339P0000190
-0.176932240E+02, -0.315557033E+00, -0.948906660E+00,	339P0000191
0.000000000E+00, 0.339068832E+02, 0.000000000E+00,	339P0000192
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	339P0000193
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	341P0000194
0.196971931E+02, 0.000000000E+00, 0.196881256E+02,	341P0000195
0.597579360E+00;	341P0000196
124, -0.938872039E+00, 0.344266176E+00, 0.000000000E+00,	343P0000197
-0.177804337E+02, -0.344266176E+00, -0.938872039E+00,	343P0000198
0.000000000E+00, 0.338763847E+02, 0.000000000E+00,	343P0000199
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	343P0000200
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	345P0000201
0.196048164E+02, 0.000000000E+00, 0.195957069E+02,	345P0000202
0.597538531E+00;	345P0000203
124, -0.927917957E+00, 0.372784317E+00, 0.000000000E+00,	347P0000204
-0.178656101E+02, -0.372784317E+00, -0.927917957E+00,	347P0000205
0.000000000E+00, 0.338435783E+02, 0.000000000E+00,	347P0000206
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	347P0000207
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	349P0000208
0.195135498E+02, 0.000000000E+00, 0.195044003E+02,	349P0000209
0.597497404E+00;	349P0000210
124, -0.916038990E+00, 0.401089132E+00, 0.000000000E+00,	351P0000211
-0.179434204E+02, -0.401089132E+00, -0.916038990E+00,	351P0000212
0.000000000E+00, 0.338110695E+02, 0.000000000E+00,	351P0000213
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	351P0000214
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	353P0000215

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0.194292336E+02, 0.000000000E+00, 0.194200459E+02,	353P0000216
0.597458005E+00;	353P0000217
124, -0.903244376E+00, 0.429126471E+00, 0.000000000E+00,	355P0000218
-0.180154076E+02, -0.429126471E+00, -0.903244376E+00,	355P0000219
0.000000000E+00, 0.337782593E+02, 0.000000000E+00,	355P0000220
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	355P0000221
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	357P0000222
0.193501320E+02, 0.000000000E+00, 0.193409081E+02,	357P0000223
0.597422302E+00;	357P0000224
124, -0.889543653E+00, 0.456850141E+00, 0.000000000E+00,	359P0000225
-0.180766335E+02, -0.456850141E+00, -0.889543653E+00,	359P0000226
0.000000000E+00, 0.337478218E+02, 0.000000000E+00,	359P0000227
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	359P0000228
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	361P0000229
0.192817631E+02, 0.000000000E+00, 0.192725067E+02,	361P0000230
0.597387969E+00;	361P0000231
124, -0.874933779E+00, 0.484242529E+00, 0.000000000E+00,	363P0000232
-0.181342697E+02, -0.484242529E+00, -0.874933779E+00,	363P0000233
0.000000000E+00, 0.337172279E+02, 0.000000000E+00,	363P0000234
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	363P0000235
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	365P0000236
0.192165203E+02, 0.000000000E+00, 0.192072334E+02,	365P0000237
0.597369611E+00;	365P0000238
124, -0.859439969E+00, 0.511236668E+00, 0.000000000E+00,	367P0000239
-0.181783447E+02, -0.511236668E+00, -0.859439969E+00,	367P0000240
0.000000000E+00, 0.336917839E+02, 0.000000000E+00,	367P0000241
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	367P0000242
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	369P0000243
0.191656322E+02, 0.000000000E+00, 0.191563206E+02,	369P0000244
0.597355425E+00;	369P0000245
124, -0.843064427E+00, 0.537812591E+00, 0.000000000E+00,	371P0000246
-0.182168083E+02, -0.537812591E+00, -0.843064427E+00,	371P0000247
0.000000000E+00, 0.336682510E+02, 0.000000000E+00,	371P0000248
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	371P0000249
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	373P0000250
0.191205482E+02, 0.000000000E+00, 0.191112156E+02,	373P0000251
0.597352207E+00;	373P0000252
124, -0.825838447E+00, 0.563906848E+00, 0.000000000E+00,	375P0000253
-0.182439041E+02, -0.563906848E+00, -0.825838447E+00,	375P0000254
0.000000000E+00, 0.336502609E+02, 0.000000000E+00,	375P0000255
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	375P0000256
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	377P0000257
0.190880260E+02, 0.000000000E+00, 0.190786762E+02,	377P0000258
0.597361743E+00;	377P0000259
124, -0.807771146E+00, 0.589496136E+00, 0.000000000E+00,	379P0000260
-0.182669544E+02, -0.589496136E+00, -0.807771146E+00,	379P0000261
0.000000000E+00, 0.336340485E+02, 0.000000000E+00,	379P0000262
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	379P0000263
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	381P0000264
0.190598507E+02, 0.000000000E+00, 0.190504856E+02,	381P0000265
0.597381592E+00;	381P0000266
124, -0.788896024E+00, 0.614526689E+00, 0.000000000E+00,	383P0000267
-0.182771568E+02, -0.614526689E+00, -0.788896024E+00,	383P0000268
0.000000000E+00, 0.336261826E+02, 0.000000000E+00,	383P0000269
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	383P0000270
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	385P0000271
0.190469685E+02, 0.000000000E+00, 0.190375957E+02,	385P0000272
0.597413361E+00;	385P0000273
124, -0.769225717E+00, 0.638977230E+00, 0.000000000E+00,	387P0000274
-0.182827244E+02, -0.638977230E+00, -0.769225717E+00,	387P0000275

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0.000000000E+00, 0.336218452E+02, 0.000000000E+00,	387P0000276
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	387P0000277
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	389P0000278
0.190399132E+02, 0.000000000E+00, 0.190305367E+02,	389P0000279
0.597467959E+00;	389P0000280
124, -0.748797357E+00, 0.662799001E+00, 0.000000000E+00,	391P0000281
-0.182773380E+02, -0.662799001E+00, -0.748797357E+00,	391P0000282
0.000000000E+00, 0.336265564E+02, 0.000000000E+00,	391P0000283
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	391P0000284
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	393P0000285
0.190470695E+02, 0.000000000E+00, 0.190376949E+02,	393P0000286
0.597521901E+00;	393P0000287
124, -0.727645516E+00, 0.685953319E+00, 0.000000000E+00,	395P0000288
-0.182694244E+02, -0.685953319E+00, -0.727645516E+00,	395P0000289
0.000000000E+00, 0.336336632E+02, 0.000000000E+00,	395P0000290
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	395P0000291
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	397P0000292
0.190577030E+02, 0.000000000E+00, 0.190483322E+02,	397P0000293
0.597590744E+00;	397P0000294
124, -0.705793202E+00, 0.708417952E+00, 0.000000000E+00,	399P0000295
-0.182517509E+02, -0.708417952E+00, -0.705793202E+00,	399P0000296
0.000000000E+00, 0.336508369E+02, 0.000000000E+00,	399P0000297
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	399P0000298
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	401P0000299
0.190823421E+02, 0.000000000E+00, 0.190729809E+02,	401P0000300
0.597673297E+00;	401P0000301
124, -0.683273613E+00, 0.730162323E+00, 0.000000000E+00,	403P0000302
-0.182318077E+02, -0.730162323E+00, -0.683273613E+00,	403P0000303
0.000000000E+00, 0.336715775E+02, 0.000000000E+00,	403P0000304
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	403P0000305
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	405P0000306
0.191111145E+02, 0.000000000E+00, 0.191017628E+02,	405P0000307
0.597756207E+00;	405P0000308
124, -0.660127938E+00, 0.751153171E+00, 0.000000000E+00,	407P0000309
-0.182056084E+02, -0.751153171E+00, -0.660127938E+00,	407P0000310
0.000000000E+00, 0.337003670E+02, 0.000000000E+00,	407P0000311
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	407P0000312
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	409P0000313
0.191500340E+02, 0.000000000E+00, 0.191406994E+02,	409P0000314
0.597847521E+00;	409P0000315
124, -0.636380374E+00, 0.771375477E+00, 0.000000000E+00,	411P0000316
-0.181777573E+02, -0.771375477E+00, -0.636380374E+00,	411P0000317
0.000000000E+00, 0.337331696E+02, 0.000000000E+00,	411P0000318
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	411P0000319
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	413P0000320
0.191930599E+02, 0.000000000E+00, 0.191837425E+02,	413P0000321
0.597949684E+00;	413P0000322
124, -0.612075329E+00, 0.790799439E+00, 0.000000000E+00,	415P0000323
-0.181443787E+02, -0.790799439E+00, -0.612075329E+00,	415P0000324
0.000000000E+00, 0.337748795E+02, 0.000000000E+00,	415P0000325
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	415P0000326
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	417P0000327
0.192464752E+02, 0.000000000E+00, 0.192371826E+02,	417P0000328
0.598043382E+00;	417P0000329
124, -0.587244272E+00, 0.809409797E+00, 0.000000000E+00,	419P0000330
-0.181114426E+02, -0.809409797E+00, -0.587244272E+00,	419P0000331
0.000000000E+00, 0.338187828E+02, 0.000000000E+00,	419P0000332
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	419P0000333
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	421P0000334
0.193013515E+02, 0.000000000E+00, 0.192920818E+02,	421P0000335

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0.598142266E+00;	421P0000336
124, -0.561916232E+00, 0.827194095E+00, 0.000000000E+00,	423P0000337
-0.180766201E+02, -0.827194095E+00, -0.561916232E+00,	423P0000338
0.000000000E+00, 0.338684921E+02, 0.000000000E+00,	423P0000339
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	423P0000340
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	425P0000341
0.193620396E+02, 0.000000000E+00, 0.193527946E+02,	425P0000342
0.598239958E+00;	425P0000343
124, -0.536134243E+00, 0.844132781E+00, 0.000000000E+00,	427P0000344
-0.180413818E+02, -0.844132781E+00, -0.536134243E+00,	427P0000345
0.000000000E+00, 0.339220695E+02, 0.000000000E+00,	427P0000346
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	427P0000347
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	429P0000348
0.194261570E+02, 0.000000000E+00, 0.194169407E+02,	429P0000349
0.598330975E+00;	429P0000350
124, -0.509926081E+00, 0.860218167E+00, 0.000000000E+00,	431P0000351
-0.180050697E+02, -0.860218167E+00, -0.509926081E+00,	431P0000352
0.000000000E+00, 0.339813004E+02, 0.000000000E+00,	431P0000353
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	431P0000354
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	433P0000355
0.194956264E+02, 0.000000000E+00, 0.194864407E+02,	433P0000356
0.598419130E+00;	433P0000357
124, -0.483360291E+00, 0.875421464E+00, 0.000000000E+00,	435P0000358
-0.179487839E+02, -0.875421464E+00, -0.483360291E+00,	435P0000359
0.000000000E+00, 0.340796051E+02, 0.000000000E+00,	435P0000360
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	435P0000361
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	437P0000362
0.196088905E+02, 0.000000000E+00, 0.195997562E+02,	437P0000363
0.598497033E+00;	437P0000364
124, -0.456381410E+00, 0.889784276E+00, 0.000000000E+00,	439P0000365
-0.179720745E+02, -0.889784276E+00, -0.456381410E+00,	439P0000366
0.000000000E+00, 0.340358543E+02, 0.000000000E+00,	439P0000367
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	439P0000368
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	441P0000369
0.195593319E+02, 0.000000000E+00, 0.195501709E+02,	441P0000370
0.598563671E+00;	441P0000371
124, -0.428454041E+00, 0.903563619E+00, 0.000000000E+00,	443P0000372
-0.182654037E+02, -0.903563619E+00, -0.428454041E+00,	443P0000373
0.000000000E+00, 0.334417114E+02, 0.000000000E+00,	443P0000374
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	443P0000375
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	445P0000376
0.188968048E+02, 0.000000000E+00, 0.188873215E+02,	445P0000377
0.598604500E+00;	445P0000378
124, -0.399757802E+00, 0.916620851E+00, 0.000000000E+00,	447P0000379
-0.181879711E+02, -0.916620851E+00, -0.399757802E+00,	447P0000380
0.000000000E+00, 0.336119652E+02, 0.000000000E+00,	447P0000381
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	447P0000382
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	449P0000383
0.190838165E+02, 0.000000000E+00, 0.190744247E+02,	449P0000384
0.598612010E+00;	449P0000385
124, -0.372391552E+00, 0.928075731E+00, 0.000000000E+00,	451P0000386
-0.172910404E+02, -0.928075731E+00, -0.372391552E+00,	451P0000387
0.000000000E+00, 0.357599411E+02, 0.000000000E+00,	451P0000388
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	451P0000389
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	453P0000390
0.214112835E+02, 0.000000000E+00, 0.214029427E+02,	453P0000391
0.597575188E+00;	453P0000392
124, -0.348794401E+00, 0.937199295E+00, 0.000000000E+00,	455P0000393
-0.155191765E+02, -0.937199295E+00, -0.348794401E+00,	455P0000394
0.000000000E+00, 0.403604927E+02, 0.000000000E+00,	455P0000395

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0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	455P0000396
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	457P0000397
0.263408585E+02, 0.000000000E+00, 0.263352165E+02,	457P0000398
0.545227349E+00;	457P0000399
124, -0.330081433E+00, 0.943952441E+00, 0.000000000E+00,	459P0000400
-0.147639360E+02, -0.943952441E+00, -0.330081433E+00,	459P0000401
0.000000000E+00, 0.424559898E+02, 0.000000000E+00,	459P0000402
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	459P0000403
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	461P0000404
0.285681915E+02, 0.000000000E+00, 0.285630703E+02,	461P0000405
0.540933967E+00;	461P0000406
124, -0.312640846E+00, 0.949871421E+00, 0.000000000E+00,	463P0000407
-0.142351799E+02, -0.949871421E+00, -0.312640846E+00,	463P0000408
0.000000000E+00, 0.440151253E+02, 0.000000000E+00,	463P0000409
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	463P0000410
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	465P0000411
0.302144756E+02, 0.000000000E+00, 0.302096691E+02,	465P0000412
0.538873434E+00;	465P0000413
124, -0.296600670E+00, 0.955001593E+00, 0.000000000E+00,	467P0000414
-0.130788708E+02, -0.955001593E+00, -0.296600670E+00,	467P0000415
0.000000000E+00, 0.476368675E+02, 0.000000000E+00,	467P0000416
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	467P0000417
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	469P0000418
0.340161934E+02, 0.000000000E+00, 0.340119591E+02,	469P0000419
0.536801577E+00;	469P0000420
124, -0.282218993E+00, 0.959350049E+00, 0.000000000E+00,	471P0000421
-0.120343409E+02, -0.959350049E+00, -0.282218993E+00,	471P0000422
0.000000000E+00, 0.510963554E+02, 0.000000000E+00,	471P0000423
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	471P0000424
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	473P0000425
0.376298294E+02, 0.000000000E+00, 0.376260147E+02,	473P0000426
0.535665035E+00;	473P0000427
124, -0.268968552E+00, 0.963148952E+00, 0.000000000E+00,	475P0000428
-0.113384686E+02, -0.963148952E+00, -0.268968552E+00,	475P0000429
0.000000000E+00, 0.535250740E+02, 0.000000000E+00,	475P0000430
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	475P0000431
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	477P0000432
0.401562119E+02, 0.000000000E+00, 0.401526566E+02,	477P0000433
0.534200490E+00;	477P0000434
124, -0.256469101E+00, 0.966552377E+00, 0.000000000E+00,	479P0000435
-0.107500238E+02, -0.966552377E+00, -0.256469101E+00,	479P0000436
0.000000000E+00, 0.556881218E+02, 0.000000000E+00,	479P0000437
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	479P0000438
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	481P0000439
0.423978271E+02, 0.000000000E+00, 0.423944702E+02,	481P0000440
0.533509314E+00;	481P0000441
124, -0.244601488E+00, 0.969623744E+00, 0.000000000E+00,	483P0000442
-0.101752138E+02, -0.969623744E+00, -0.244601488E+00,	483P0000443
0.000000000E+00, 0.579103775E+02, 0.000000000E+00,	483P0000444
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	483P0000445
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	485P0000446
0.446931763E+02, 0.000000000E+00, 0.446900024E+02,	485P0000447
0.532602072E+00;	485P0000448
124, -0.233305708E+00, 0.972403407E+00, 0.000000000E+00,	487P0000449
-0.963730145E+01, -0.972403407E+00, -0.233305708E+00,	487P0000450
0.000000000E+00, 0.600979004E+02, 0.000000000E+00,	487P0000451
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	487P0000452
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	489P0000453
0.469458275E+02, 0.000000000E+00, 0.469428101E+02,	489P0000454
0.532081127E+00;	489P0000455

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124, -0.222546503E+00, 0.974922061E+00, 0.000000000E+00,	491P0000456
-0.907370281E+01, -0.974922061E+00, -0.222546503E+00,	491P0000457
0.000000000E+00, 0.625069695E+02, 0.000000000E+00,	491P0000458
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	491P0000459
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	493P0000460
0.494199066E+02, 0.000000000E+00, 0.494170494E+02,	493P0000461
0.531534672E+00;	493P0000462
124, -0.212293595E+00, 0.977205932E+00, 0.000000000E+00,	495P0000463
-0.854782581E+01, -0.977205932E+00, -0.212293595E+00,	495P0000464
0.000000000E+00, 0.648690948E+02, 0.000000000E+00,	495P0000465
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	495P0000466
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	497P0000467
0.518398285E+02, 0.000000000E+00, 0.518371048E+02,	497P0000468
0.531160057E+00;	497P0000469
124, -0.202458948E+00, 0.979290724E+00, 0.000000000E+00,	499P0000470
-0.813101196E+01, -0.979290724E+00, -0.202458948E+00,	499P0000471
0.000000000E+00, 0.668357697E+02, 0.000000000E+00,	499P0000472
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	499P0000473
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	501P0000474
0.538501587E+02, 0.000000000E+00, 0.538475418E+02,	501P0000475
0.530869424E+00;	501P0000476
124, -0.192953706E+00, 0.981207848E+00, 0.000000000E+00,	503P0000477
-0.776343250E+01, -0.981207848E+00, -0.192953706E+00,	503P0000478
0.000000000E+00, 0.686598434E+02, 0.000000000E+00,	503P0000479
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	503P0000480
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	505P0000481
0.557108841E+02, 0.000000000E+00, 0.557083588E+02,	505P0000482
0.530710220E+00;	505P0000483
124, -0.183823273E+00, 0.982959330E+00, 0.000000000E+00,	507P0000484
-0.723191309E+01, -0.982959330E+00, -0.183823273E+00,	507P0000485
0.000000000E+00, 0.714325333E+02, 0.000000000E+00,	507P0000486
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	507P0000487
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	509P0000488
0.585340271E+02, 0.000000000E+00, 0.585316238E+02,	509P0000489
0.530547082E+00;	509P0000490
124, -0.175106868E+00, 0.984549463E+00, 0.000000000E+00,	511P0000491
-0.674493647E+01, -0.984549463E+00, -0.175106868E+00,	511P0000492
0.000000000E+00, 0.741024857E+02, 0.000000000E+00,	511P0000493
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	511P0000494
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	513P0000495
0.612479973E+02, 0.000000000E+00, 0.612457008E+02,	513P0000496
0.530381560E+00;	513P0000497
124, -0.166724965E+00, 0.986003399E+00, 0.000000000E+00,	515P0000498
-0.635743904E+01, -0.986003399E+00, -0.166724965E+00,	515P0000499
0.000000000E+00, 0.763380737E+02, 0.000000000E+00,	515P0000500
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	515P0000501
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	517P0000502
0.635169029E+02, 0.000000000E+00, 0.635146866E+02,	517P0000503
0.530340910E+00;	517P0000504
124, -0.158633173E+00, 0.987337589E+00, 0.000000000E+00,	519P0000505
-0.598036671E+01, -0.987337589E+00, -0.158633173E+00,	519P0000506
0.000000000E+00, 0.786254730E+02, 0.000000000E+00,	519P0000507
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	519P0000508
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	521P0000509
0.658351517E+02, 0.000000000E+00, 0.658330154E+02,	521P0000510
0.530266404E+00;	521P0000511
124, -0.150810868E+00, 0.988562703E+00, 0.000000000E+00,	523P0000512
-0.561133671E+01, -0.988562703E+00, -0.150810868E+00,	523P0000513
0.000000000E+00, 0.809847107E+02, 0.000000000E+00,	523P0000514
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	523P0000515

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100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00, 0.682230530E+02, 0.000000000E+00, 0.682209930E+02, 0.530296922E+00;	525P00000516
124, -0.143262208E+00, 0.989684820E+00, 0.000000000E+00, -0.524605465E+01, -0.989684820E+00, -0.143262208E+00, 0.000000000E+00, 0.834407959E+02, 0.000000000E+00, 0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	525P00000517
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00, 0.707061386E+02, 0.000000000E+00, 0.707041473E+02, 0.530288279E+00;	525P00000518
124, -0.135972485E+00, 0.990712643E+00, 0.000000000E+00, -0.486481571E+01, -0.990712643E+00, -0.135972485E+00, 0.000000000E+00, 0.861467285E+02, 0.000000000E+00, 0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	527P00000519
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00, 0.734387741E+02, 0.000000000E+00, 0.734368591E+02, 0.530301392E+00;	527P00000520
124, -0.128948435E+00, 0.991651297E+00, 0.000000000E+00, -0.448669863E+01, -0.991651297E+00, -0.128948435E+00, 0.000000000E+00, 0.889779282E+02, 0.000000000E+00, 0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	527P00000521
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00, 0.762950974E+02, 0.000000000E+00, 0.762932587E+02, 0.530341923E+00;	527P00000522
124, -0.122161500E+00, 0.992510200E+00, 0.000000000E+00, -0.416952467E+01, -0.992510200E+00, -0.122161500E+00, 0.000000000E+00, 0.914860306E+02, 0.000000000E+00, 0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	529P00000523
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124, -0.115587756E+00, 0.993297279E+00, 0.000000000E+00, -0.385886765E+01, -0.993297279E+00, -0.115587756E+00, 0.000000000E+00, 0.940816727E+02, 0.000000000E+00, 0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	529P00000525
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124, -0.109221675E+00, 0.994017422E+00, 0.000000000E+00, -0.355825663E+01, -0.994017422E+00, -0.109221675E+00, 0.000000000E+00, 0.967374878E+02, 0.000000000E+00, 0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	531P00000527
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00, 0.841100769E+02, 0.000000000E+00, 0.841084061E+02, 0.530556202E+00;	531P00000528
124, -0.103037842E+00, 0.994677424E+00, 0.000000000E+00, -0.328518891E+01, -0.994677424E+00, -0.103037842E+00, 0.000000000E+00, 0.993009415E+02, 0.000000000E+00, 0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	531P00000529
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00, 0.866880188E+02, 0.000000000E+00, 0.866863937E+02, 0.530630708E+00;	533P00000530
124, -0.970726684E-01, 0.995277345E+00, 0.000000000E+00, -0.292032695E+01, -0.995277345E+00, -0.970726684E-01, 0.000000000E+00, 0.102929382E+03, 0.000000000E+00, 0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	533P00000531
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124, -0.913348272E-01, 0.995820284E+00, 0.000000000E+00,	535P00000533
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 0.530860126E+00; 561P0000581
 124, -0.857818872E-01, 0.996313930E+00, 0.000000000E+00, 563P0000582
 -0.235100842E+01, -0.996313930E+00, -0.857818872E-01, 563P0000583
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 124, -0.803748369E-01, 0.996764719E+00, 0.000000000E+00, 567P0000589
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 124, -0.700825006E-01, 0.997541189E+00, 0.000000000E+00, 575P0000603
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 124, -0.603878759E-01, 0.998174965E+00, 0.000000000E+00, 583P0000617
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 0.116762016E+03, 0.000000000E+00, 0.116760803E+03, 589P0000629
 0.532280326E+00; 589P0000630
 124, -0.512870625E-01, 0.998683929E+00, 0.000000000E+00, 591P0000631
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 0.000000000E+00, 0.134056427E+03, 0.000000000E+00, 591P0000633
 0.000000000E+00, 0.100000000E+01, 0.000000000E+00; 591P0000634
 100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00, 593P0000635

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0.121544617E+03, 0.000000000E+00, 0.121543449E+03,	593P0000636
0.533019722E+00;	593P0000637
124, -0.469208211E-01, 0.998898566E+00, 0.000000000E+00,	595P0000638
-0.642672896E+00, -0.998898566E+00, -0.469208211E-01,	595P0000639
0.000000000E+00, 0.134951355E+03, 0.000000000E+00,	595P0000640
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	595P0000641
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	597P0000642
0.122440613E+03, 0.000000000E+00, 0.122439453E+03,	597P0000643
0.533638656E+00;	597P0000644
124, -0.425853617E-01, 0.999092817E+00, 0.000000000E+00,	599P0000645
-0.597664952E+00, -0.999092817E+00, -0.425853617E-01,	599P0000646
0.000000000E+00, 0.135953964E+03, 0.000000000E+00,	599P0000647
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	599P0000648
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0.123444229E+03, 0.000000000E+00, 0.123443047E+03,	601P0000650
0.540354848E+00;	601P0000651
124, -0.382892787E-01, 0.999266684E+00, 0.000000000E+00,	603P0000652
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0.000000000E+00, 0.140479523E+03, 0.000000000E+00,	603P0000654
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0.539053917E+00;	605P0000658
124, -0.341517664E-01, 0.999416590E+00, 0.000000000E+00,	607P0000659
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0.536516726E+00;	609P0000665
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0.534535766E+00;	613P0000672
124, -0.261738934E-01, 0.999657452E+00, 0.000000000E+00,	615P0000673
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0.000000000E+00, 0.148135086E+03, 0.000000000E+00,	615P0000675
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0.135633438E+03, 0.000000000E+00, 0.135632401E+03,	617P0000678
0.532589018E+00;	617P0000679
124, -0.222854689E-01, 0.999751627E+00, 0.000000000E+00,	619P0000680
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0.531157017E+00;	621P0000686
124, -0.184925944E-01, 0.999828994E+00, 0.000000000E+00,	623P0000687
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0.529878199E+00;	625P0000693
124, -0.147552537E-01, 0.999891162E+00, 0.000000000E+00,	627P0000694
-0.119952122E-01, -0.999891162E+00, -0.147552537E-01,	627P0000695

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0.000000000E+00, 0.154830124E+03, 0.000000000E+00,	627P0000696
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0.14233032E+03, 0.000000000E+00, 0.142329056E+03,	629P0000699
0.529001892E+00;	629P0000700
124, -0.110523878E-01, 0.999938905E+00, 0.000000000E+00,	631P0000701
-0.143608858E-02, -0.999938905E+00, -0.110523878E-01,	631P0000702
0.000000000E+00, 0.155610809E+03, 0.000000000E+00,	631P0000703
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	631P0000704
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0.143110794E+03, 0.000000000E+00, 0.143109818E+03,	633P0000706
0.528276563E+00;	633P0000707
124, -0.736975716E-02, 0.999972880E+00, 0.000000000E+00,	635P0000708
0.629189005E-02, -0.999972880E+00, -0.736975716E-02,	635P0000709
0.000000000E+00, 0.156492355E+03, 0.000000000E+00,	635P0000710
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	635P0000711
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0.143992371E+03, 0.000000000E+00, 0.143991394E+03,	637P0000713
0.527948081E+00;	637P0000714
124, -0.369096897E-02, 0.999993145E+00, 0.000000000E+00,	639P0000715
0.117449241E-02, -0.999993145E+00, -0.369096897E-02,	639P0000716
0.000000000E+00, 0.155587234E+03, 0.000000000E+00,	639P0000717
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0.143087234E+03, 0.000000000E+00, 0.143086258E+03,	641P0000720
0.526956081E+00;	641P0000721
124, -0.869870917E-06, 0.100000000E+01, 0.000000000E+00,	643P0000722
0.123856807E-03, -0.100000000E+01, -0.869870917E-06,	643P0000723
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0.526956022E+00;	645P0000728
124, 0.369170983E-02, 0.999993145E+00, 0.000000000E+00,	647P0000729
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0.527948141E+00;	649P0000735
124, 0.737245614E-02, 0.999972880E+00, 0.000000000E+00,	651P0000736
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0.528276682E+00;	653P0000742
124, 0.110489652E-01, 0.999938905E+00, 0.000000000E+00,	655P0000743
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0.529002190E+00;	657P0000749
124, 0.147563014E-01, 0.999891102E+00, 0.000000000E+00,	659P0000750
0.118459957E-01, -0.999891102E+00, 0.147563014E-01,	659P0000751
0.000000000E+00, 0.154830124E+03, 0.000000000E+00,	659P0000752
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	659P0000753
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0.142330048E+03, 0.000000000E+00, 0.142329071E+03,	661P0000755

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0.529878318E+00;	661P0000756
124, 0.184899773E-01, 0.999828994E+00, 0.000000000E+00,	663P0000757
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0.000000000E+00, 0.153774002E+03, 0.000000000E+00,	663P0000759
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0.531157374E+00;	665P0000763
124, 0.222901292E-01, 0.999751508E+00, 0.000000000E+00,	667P0000764
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0.532589138E+00;	669P0000770
124, 0.261710249E-01, 0.999657452E+00, 0.000000000E+00,	671P0000771
0.155732855E+00,-0.999657452E+00, 0.261710249E-01,	671P0000772
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0.534536183E+00;	673P0000777
124, 0.301313903E-01, 0.999545872E+00, 0.000000000E+00,	675P0000778
0.194859490E+00,-0.999545872E+00, 0.301313903E-01,	675P0000779
0.000000000E+00, 0.146743073E+03, 0.000000000E+00,	675P0000780
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0.536517084E+00;	677P0000784
124, 0.341521837E-01, 0.999416590E+00, 0.000000000E+00,	679P0000785
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0.000000000E+00, 0.140479523E+03, 0.000000000E+00,	683P0000794
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0.540354252E+00;	685P0000798
124, 0.425845347E-01, 0.999092877E+00, 0.000000000E+00,	687P0000799
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0.533638239E+00;	689P0000805
124, 0.469229892E-01, 0.998898506E+00, 0.000000000E+00,	691P0000806
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124, 0.512840487E-01, 0.998684108E+00, 0.000000000E+00,	695P0000813
0.686764121E+00,-0.998684108E+00, 0.512840487E-01,	695P0000814
0.000000000E+00, 0.134056458E+03, 0.000000000E+00,	695P0000815

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0.532280087E+00;	697P00000819
124, 0.557494946E-01, 0.998444796E+00, 0.000000000E+00,	699P00000820
0.942161322E+00,-0.998444796E+00, 0.557494946E-01,	699P00000821
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0.532011032E+00;	701P00000826
124, 0.603854246E-01, 0.998175085E+00, 0.000000000E+00,	703P00000827
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0.531661630E+00;	705P00000833
124, 0.651763901E-01, 0.997873724E+00, 0.000000000E+00,	707P00000834
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0.531124175E+00;	717P00000854
124, 0.803747326E-01, 0.996764719E+00, 0.000000000E+00,	719P00000855
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124, 0.857815146E-01, 0.996313930E+00, 0.000000000E+00,	723P00000862
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0.530861437E+00;	725P00000868
124, 0.913352370E-01, 0.995820165E+00, 0.000000000E+00,	727P00000869
0.258137846E+01,-0.995820165E+00, 0.913352370E-01,	727P00000870
0.000000000E+00, 0.106513550E+03, 0.000000000E+00,	727P00000871
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0.939348831E+02, 0.000000000E+00, 0.939333801E+02,	729P00000874
0.530773342E+00;	729P00000875

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124, 0.970703065E-01, 0.995277524E+00, 0.000000000E+00,	731P00000876
0.292054009E+01, -0.995277524E+00, 0.970703065E-01,	731P00000877
0.000000000E+00, 0.102929405E+03, 0.000000000E+00,	731P00000878
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	731P00000879
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	733P00000880
0.903347473E+02, 0.000000000E+00, 0.903331909E+02,	733P00000881
0.530630648E+00;	733P00000882
124, 0.103042655E+00, 0.994676888E+00, 0.000000000E+00,	735P00000883
0.328477216E+01, -0.994676888E+00, 0.103042655E+00,	735P00000884
0.000000000E+00, 0.993008881E+02, 0.000000000E+00,	735P00000885
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	735P00000886
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	737P00000887
0.866880112E+02, 0.000000000E+00, 0.866863861E+02,	737P00000888
0.530556202E+00;	737P00000889
124, 0.109217875E+00, 0.994017839E+00, 0.000000000E+00,	739P00000890
0.355857587E+01, -0.994017839E+00, 0.109217875E+00,	739P00000891
0.000000000E+00, 0.967375259E+02, 0.000000000E+00,	739P00000892
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	739P00000893
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	741P00000894
0.841100769E+02, 0.000000000E+00, 0.841084061E+02,	741P00000895
0.530480742E+00;	741P00000896
124, 0.115587287E+00, 0.993297338E+00, 0.000000000E+00,	743P00000897
0.385890603E+01, -0.993297338E+00, 0.115587287E+00,	743P00000898
0.000000000E+00, 0.940816803E+02, 0.000000000E+00,	743P00000899
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	743P00000900
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	745P00000901
0.814373169E+02, 0.000000000E+00, 0.814355927E+02,	745P00000902
0.530410707E+00;	745P00000903
124, 0.122162804E+00, 0.992510080E+00, 0.000000000E+00,	747P00000904
0.416942215E+01, -0.992510080E+00, 0.122162804E+00,	747P00000905
0.000000000E+00, 0.914860153E+02, 0.000000000E+00,	747P00000906
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	747P00000907
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	749P00000908
0.788231583E+02, 0.000000000E+00, 0.788213730E+02,	749P00000909
0.530341923E+00;	749P00000910
124, 0.128949046E+00, 0.991651237E+00, 0.000000000E+00,	751P00000911
0.448665237E+01, -0.991651237E+00, 0.128949046E+00,	751P00000912
0.000000000E+00, 0.889779205E+02, 0.000000000E+00,	751P00000913
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	751P00000914
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	753P00000915
0.762950974E+02, 0.000000000E+00, 0.762932587E+02,	753P00000916
0.530301511E+00;	753P00000917
124, 0.135973886E+00, 0.990712404E+00, 0.000000000E+00,	755P00000918
0.486471176E+01, -0.990712404E+00, 0.135973886E+00,	755P00000919
0.000000000E+00, 0.861467209E+02, 0.000000000E+00,	755P00000920
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	755P00000921
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	757P00000922
0.734387817E+02, 0.000000000E+00, 0.734368668E+02,	757P00000923
0.530288696E+00;	757P00000924
124, 0.143257305E+00, 0.989685476E+00, 0.000000000E+00,	759P00000925
0.524640179E+01, -0.989685476E+00, 0.143257305E+00,	759P00000926
0.000000000E+00, 0.834408417E+02, 0.000000000E+00,	759P00000927
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	759P00000928
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	761P00000929
0.707061386E+02, 0.000000000E+00, 0.707041473E+02,	761P00000930
0.530297458E+00;	761P00000931
124, 0.150814921E+00, 0.988561988E+00, 0.000000000E+00,	763P00000932
0.561105919E+01, -0.988561988E+00, 0.150814921E+00,	763P00000933
0.000000000E+00, 0.809846725E+02, 0.000000000E+00,	763P00000934
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	763P00000935

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100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	765P0000936
0.682230606E+02, 0.000000000E+00, 0.682210007E+02,	765P0000937
0.530266106E+00;	765P0000938
124, 0.158631563E+00, 0.987337768E+00, 0.000000000E+00,	767P0000939
0.598047256E+01,-0.987337768E+00, 0.158631563E+00,	767P0000940
0.000000000E+00, 0.786254883E+02, 0.000000000E+00,	767P0000941
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	767P0000942
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	769P0000943
0.658351517E+02, 0.000000000E+00, 0.658330154E+02,	769P0000944
0.530340254E+00;	769P0000945
124, 0.166727036E+00, 0.986003041E+00, 0.000000000E+00,	771P0000946
0.635730791E+01,-0.986003041E+00, 0.166727036E+00,	771P0000947
0.000000000E+00, 0.763380508E+02, 0.000000000E+00,	771P0000948
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	771P0000949
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	773P0000950
0.635169029E+02, 0.000000000E+00, 0.635146866E+02,	773P0000951
0.530381024E+00;	773P0000952
124, 0.175103992E+00, 0.984549940E+00, 0.000000000E+00,	775P0000953
0.674511337E+01,-0.984549940E+00, 0.175103992E+00,	775P0000954
0.000000000E+00, 0.741025085E+02, 0.000000000E+00,	775P0000955
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	775P0000956
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	777P0000957
0.612479897E+02, 0.000000000E+00, 0.612456932E+02,	777P0000958
0.530547261E+00;	777P0000959
124, 0.183823645E+00, 0.982959270E+00, 0.000000000E+00,	779P0000960
0.723188972E+01,-0.982959270E+00, 0.183823645E+00,	779P0000961
0.000000000E+00, 0.714325333E+02, 0.000000000E+00,	779P0000962
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	779P0000963
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	781P0000964
0.585340309E+02, 0.000000000E+00, 0.585316238E+02,	781P0000965
0.530711532E+00;	781P0000966
124, 0.192956552E+00, 0.981207252E+00, 0.000000000E+00,	783P0000967
0.776327515E+01,-0.981207252E+00, 0.192956552E+00,	783P0000968
0.000000000E+00, 0.686598053E+02, 0.000000000E+00,	783P0000969
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	783P0000970
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	785P0000971
0.557108765E+02, 0.000000000E+00, 0.557083473E+02,	785P0000972
0.530869305E+00;	785P0000973
124, 0.202457145E+00, 0.979291081E+00, 0.000000000E+00,	787P0000974
0.813110828E+01,-0.979291081E+00, 0.202457145E+00,	787P0000975
0.000000000E+00, 0.668357925E+02, 0.000000000E+00,	787P0000976
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	787P0000977
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	789P0000978
0.538501625E+02, 0.000000000E+00, 0.538475418E+02,	789P0000979
0.531160116E+00;	789P0000980
124, 0.212293178E+00, 0.977205992E+00, 0.000000000E+00,	791P0000981
0.854784775E+01,-0.977205992E+00, 0.212293178E+00,	791P0000982
0.000000000E+00, 0.648690948E+02, 0.000000000E+00,	791P0000983
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	791P0000984
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	793P0000985
0.518398247E+02, 0.000000000E+00, 0.518371010E+02,	793P0000986
0.531535447E+00;	793P0000987
124, 0.222546145E+00, 0.974922121E+00, 0.000000000E+00,	795P0000988
0.907371902E+01,-0.974922121E+00, 0.222546145E+00,	795P0000989
0.000000000E+00, 0.625069771E+02, 0.000000000E+00,	795P0000990
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	795P0000991
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	797P0000992
0.494199104E+02, 0.000000000E+00, 0.494170456E+02,	797P0000993
0.532081842E+00;	797P0000994
124, 0.233307242E+00, 0.972403049E+00, 0.000000000E+00,	799P0000995

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0.963722801E+01, -0.972403049E+00, 0.233307242E+00,	799P0000996
0.000000000E+00, 0.600978851E+02, 0.000000000E+00,	799P0000997
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	799P0000998
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	801P0000999
0.469458313E+02, 0.000000000E+00, 0.469428101E+02,	801P0001000
0.532604277E+00;	801P0001001
124, 0.244599625E+00, 0.969624162E+00, 0.000000000E+00,	803P0001002
0.101752977E+02, -0.969624162E+00, 0.244599625E+00,	803P0001003
0.000000000E+00, 0.579103966E+02, 0.000000000E+00,	803P0001004
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	803P0001005
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0.446931725E+02, 0.000000000E+00, 0.446899872E+02,	805P0001007
0.533509910E+00;	805P0001008
124, 0.256471872E+00, 0.966551661E+00, 0.000000000E+00,	807P0001009
0.107499065E+02, -0.966551661E+00, 0.256471872E+00,	807P0001010
0.000000000E+00, 0.556880913E+02, 0.000000000E+00,	807P0001011
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	807P0001012
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	809P0001013
0.423978271E+02, 0.000000000E+00, 0.423944626E+02,	809P0001014
0.534201264E+00;	809P0001015
124, 0.268965244E+00, 0.963149846E+00, 0.000000000E+00,	811P0001016
0.113386002E+02, -0.963149846E+00, 0.268965244E+00,	811P0001017
0.000000000E+00, 0.535251122E+02, 0.000000000E+00,	811P0001018
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	811P0001019
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0.535668135E+00;	813P0001022
124, 0.282220095E+00, 0.959349692E+00, 0.000000000E+00,	815P0001023
0.120343008E+02, -0.959349692E+00, 0.282220095E+00,	815P0001024
0.000000000E+00, 0.510963402E+02, 0.000000000E+00,	815P0001025
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0.376298256E+02, 0.000000000E+00, 0.376259956E+02,	817P0001028
0.536804378E+00;	817P0001029
124, 0.296602249E+00, 0.955001175E+00, 0.000000000E+00,	819P0001030
0.130788164E+02, -0.955001175E+00, 0.296602249E+00,	819P0001031
0.000000000E+00, 0.476368561E+02, 0.000000000E+00,	819P0001032
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0.538877487E+00;	821P0001036
124, 0.312638760E+00, 0.949872136E+00, 0.000000000E+00,	823P0001037
0.142352438E+02, -0.949872136E+00, 0.312638760E+00,	823P0001038
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0.540935993E+00;	825P0001043
124, 0.330082536E+00, 0.943952024E+00, 0.000000000E+00,	827P0001044
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0.000000000E+00, 0.424559784E+02, 0.000000000E+00,	827P0001046
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	827P0001047
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0.285681915E+02, 0.000000000E+00, 0.285629883E+02,	829P0001049
0.545230806E+00;	829P0001050
124, 0.348793656E+00, 0.937199533E+00, 0.000000000E+00,	831P0001051
0.155191956E+02, -0.937199533E+00, 0.348793656E+00,	831P0001052
0.000000000E+00, 0.403605003E+02, 0.000000000E+00,	831P0001053
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	831P0001054
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	833P0001055

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0.263408604E+02, 0.000000000E+00, 0.263340816E+02,	833P0001056
0.597594678E+00;	833P0001057
124, 0.372392148E+00, 0.928075433E+00, 0.000000000E+00,	835P0001058
0.172910271E+02,-0.928075433E+00, 0.372392148E+00,	835P0001059
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0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	835P0001061
100, 0.000000000E+00, 0.000000000E+00, 0.000000000E+00,	837P0001062
0.214112854E+02, 0.000000000E+00, 0.214029160E+02,	837P0001063
0.598626614E+00;	837P0001064
124, 0.399758697E+00, 0.916620433E+00, 0.000000000E+00,	839P0001065
0.181879539E+02,-0.916620433E+00, 0.399758697E+00,	839P0001066
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0.598606229E+00;	841P0001071
124, 0.428453296E+00, 0.903563917E+00, 0.000000000E+00,	843P0001072
0.182654171E+02,-0.903563917E+00, 0.428453296E+00,	843P0001073
0.000000000E+00, 0.334417191E+02, 0.000000000E+00,	843P0001074
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	843P0001075
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0.188968067E+02, 0.000000000E+00, 0.188873234E+02,	845P0001077
0.598559320E+00;	845P0001078
124, 0.456381321E+00, 0.889784276E+00, 0.000000000E+00,	847P0001079
0.179720764E+02,-0.889784276E+00, 0.456381321E+00,	847P0001080
0.000000000E+00, 0.340358543E+02, 0.000000000E+00,	847P0001081
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0.598496556E+00;	849P0001085
124, 0.483358979E+00, 0.875422180E+00, 0.000000000E+00,	851P0001086
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0.598419368E+00;	853P0001092
124, 0.509927571E+00, 0.860217273E+00, 0.000000000E+00,	855P0001093
0.180050411E+02,-0.860217273E+00, 0.509927571E+00,	855P0001094
0.000000000E+00, 0.339812813E+02, 0.000000000E+00,	855P0001095
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	855P0001096
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0.598330915E+00;	857P0001099
124, 0.536132812E+00, 0.844133675E+00, 0.000000000E+00,	859P0001100
0.180414104E+02,-0.844133675E+00, 0.536132812E+00,	859P0001101
0.000000000E+00, 0.339220848E+02, 0.000000000E+00,	859P0001102
0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	859P0001103
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0.194261551E+02, 0.000000000E+00, 0.194169426E+02,	861P0001105
0.598240674E+00;	861P0001106
124, 0.561918974E+00, 0.827192247E+00, 0.000000000E+00,	863P0001107
0.180765667E+02,-0.827192247E+00, 0.561918974E+00,	863P0001108
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0.000000000E+00, 0.100000000E+01, 0.000000000E+00;	863P0001110
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0.193620415E+02, 0.000000000E+00, 0.193528004E+02,	865P0001112
0.598142147E+00;	865P0001113
124, 0.587243080E+00, 0.809410632E+00, 0.000000000E+00,	867P0001114
0.181114655E+02,-0.809410632E+00, 0.587243080E+00,	867P0001115

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0.000000000E+00, 0.338187981E+02, 0.000000000E+00,	867P0001116
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0.193013515E+02, 0.000000000E+00, 0.192920837E+02,	869P0001119
0.598043621E+00;	869P0001120
124, 0.612073839E+00, 0.790800631E+00, 0.000000000E+00,	871P0001121
0.181444073E+02,-0.790800631E+00, 0.612073839E+00,	871P0001122
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S 3G 7D 962P 1281	T0000001

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DEFENCE SCIENCE AND TECHNOLOGY GROUP DOCUMENT CONTROL DATA		1. DLM/CAVEAT (OF DOCUMENT)		
<p>2. TITLE</p> <p>A Modified Constant-Stress Coupon for Enhanced Natural Crack Start during Fatigue Testing</p>		<p>3. SECURITY CLASSIFICATION (FOR UNCLASSIFIED REPORTS THAT ARE LIMITED RELEASE USE (L) NEXT TO DOCUMENT CLASSIFICATION)</p> <p>Document (U) Title (U) Abstract (U)</p>		
<p>4. AUTHOR(S)</p> <p>Witold Waldman, Robert Kaye and Xiaobo Yu</p>		<p>5. CORPORATE AUTHOR</p> <p>Defence Science and Technology Group 506 Lorimer St Fishermans Bend Victoria 3207 Australia</p>		
6a. DST GROUP NUMBER	6b. AR NUMBER	6c. TYPE OF REPORT	7. DOCUMENT DATE	
DST-Group-TR-3252	AR-016-590	Technical Report	May 2016	
8. OBJECTIVE FOLDER ID	9. TASK NUMBER	10. TASK SPONSOR	11. NO. OF PAGES	12. NO. OF REFERENCES
fAV1044714	AIR 07/283	OIC-ASI-DGTA	95	33
<p>13. DST GROUP PUBLICATIONS REPOSITORY</p> <p>http://dspace.dsto.defence.gov.au/dspace/</p>		<p>14. RELEASE AUTHORITY</p> <p>Chief, Aerospace Division</p>		
<p>15. SECONDARY RELEASE STATEMENT OF THIS DOCUMENT</p> <p><i>Approved for public release</i></p> <p>OVERSEAS ENQUIRIES OUTSIDE STATED LIMITATIONS SHOULD BE REFERRED THROUGH DOCUMENT EXCHANGE, PO BOX 1500, EDINBURGH, SA 5111</p>				
<p>16. DELIBERATE ANNOUNCEMENT</p> <p>No Limitations</p>				
<p>17. CITATION IN OTHER DOCUMENTS</p> <p>Yes</p>				
<p>18. RESEARCH LIBRARY THESAURUS</p> <p>Shape optimisation, Stress concentration, Fatigue testing, Constant-stress coupon, Fatigue coupon, Stress intensity factor, Fillet, Notch analysis, Finite element analysis, Boundary element analysis, Natural crack start, Beta factors</p>				
<p>19. ABSTRACT</p> <p>This report details the development of a modified constant-stress coupon for use in fatigue testing. This novel coupon design has a significantly greater surface area along the notch boundary that is subjected to the peak stress, and it is useful in studies of the probabilistic growth of in-service fatigue cracks where fatigue life is governed by the most severe defect. The extended region of uniform stress is achieved by shape optimisation of the notch boundary, resulting in the elimination of the highly-localised stress concentration that is a characteristic feature of a traditional dog-bone coupon. The presence of an extensive region of uniform stress increases the incidence of fatigue cracking from small naturally-occurring surface imperfections or discontinuities, as well as more uniformly distributing the fatigue cracking over the region of constant stress. Stress intensity factors have also been computed for simulated crack growth trajectories for edge cracks starting at various locations distributed along the notch boundary. Use of the constant-stress coupon reduces the number of coupons that need to be tested in order to attain desired statistical confidence levels, leading to significant time savings and greatly reduced costs in conducting fatigue testing programs studying the initiation and growth behaviour of small cracks.</p>				