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Integrating Manufacturing Geometric Imperfections In The Inelastic Behavior Modeling Of Joints Used In Three-Dimensional Structures

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INTEGRATING MANUFACTURING GEOMETRIC IMPERFECTIONS IN THE INELASTIC BEHAVIOR MODELING OF JOINTS USED IN THREE-DIMENSIONAL STRUCTURES

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DEDICATION

To God for providing me with the strength during this endeavor and for giving me the character and capacity to overcome many challenges.

To the memory of my Grandfather Evaristo/Alberto Garcia Muñetones.

To my beloved family whose love and comprehension helped me reach my educational goals. Especially to my parents, siblings, my grandparents, and sweetheart who have taught me the value of education. Their motivation and support helped me to achieve my doctoral degree.

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Abstract

Three-dimensional structures follow design practices on the common assumption that joints are either rigid, or pinned. However, the non-linear behavior of engagement of the joints is required to be incorporated into the analysis. This research is intended to incorporate manufacturing geometric imperfections into the mechanical analysis of reticulated space structures jointing systems. Imperfect jointing systems deviate from the as-designed models in such a way that the location of the connecting surfaces does not follow the designed interaction path between the component elements. However, current structural analysis methodologies do not consider manufacturing geometric imperfections and often fail to consider the stresses caused as a result of these imperfections. The objective of this dissertation is to develop a procedure to better understand how surface imperfections affect the inelastic behavior jointing systems used in the construction of reticulated structures. Finite element analyses, using the MSC Patran/Nastran software, of a reticulated structure jointing system were conducted to characterize its mechanical behavior. Numerical simulations were conducted to characterize the mechanical behavior of the as-designed jointing system, and the as-built jointing system engagement. An experimental investigation of the jointing system under tensile loading conditions was performed to obtain the real behavior of the jointing system for comparison to the numerical simulation results. Results of the numerical simulations and the experimental investigation provided the basis to assess how the manufacturing geometric imperfections impact the mechanical behavior/capacity of jointing systems. The results of these studies lead to a more realistic modeling of the joints used in reticulated three-dimensional structures. This research is important as it can be used as a base model to develop new approaches considering imperfections of the component elements in the inelastic analysis of the jointing systems used in three-dimensional structures.

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Chapter 1: Introduction

This chapter provides an introduction to reticulated space structures, giving special emphasis to the most common type of three-dimensional structures: domes. In addition, it describes thoroughly the types of jointing systems used in three-dimensional structures, especially the fir-tree jointing system.

1.1 Introduction to Three-Dimensional Structures

Architects and engineers have always been on the search to find a solution to enclose space efficiently. Space grid structures, a special type of structure acting in a three-dimensional manner, are structural systems that enable covering large spans creating a wide diversity of shapes (Chilton 1999). The primary reason why these types of systems are desirable is due to their ability to build large unobstructed areas with minimum interference from internal supports and to provide amazing architectural designs. The progressive development of three-dimensional structures has been a direct consequence of the improving advance of available materials (Makowski 1984). Through history, the materials used to build three-dimensional structures have evolved passing through stone, then stone masonry, and wood during the Middle Ages. Numerous new materials such as fiber reinforced polymer composites have been used to build three-dimensional structures (Bradshaw et al. 2002). The introduction of steel and aluminum materials used in construction opened a new era for three-dimensional structures due to its high strength and comparatively light weight (Castaño and Hardy 2002). **Figure 1.1** and **Figure 1.2** show examples of such structures and their intended use.

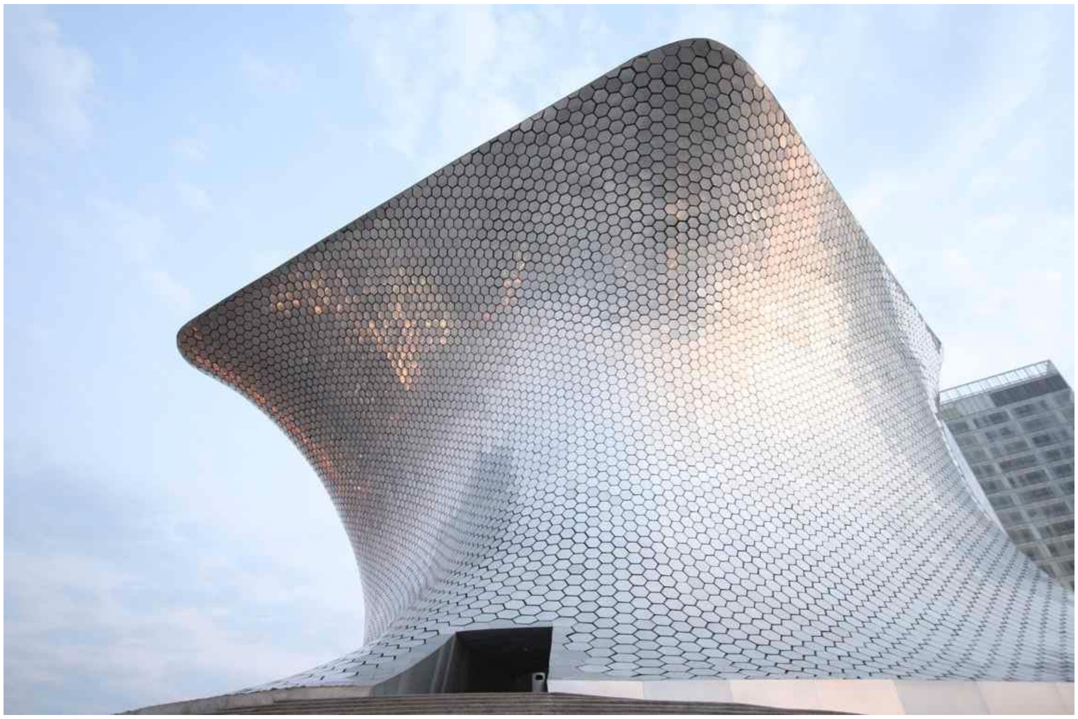


Figure 1.1 Soumaya Museum 151ft Six Story Building Facade in Mexico City, Mexico (Geometrica 2016)

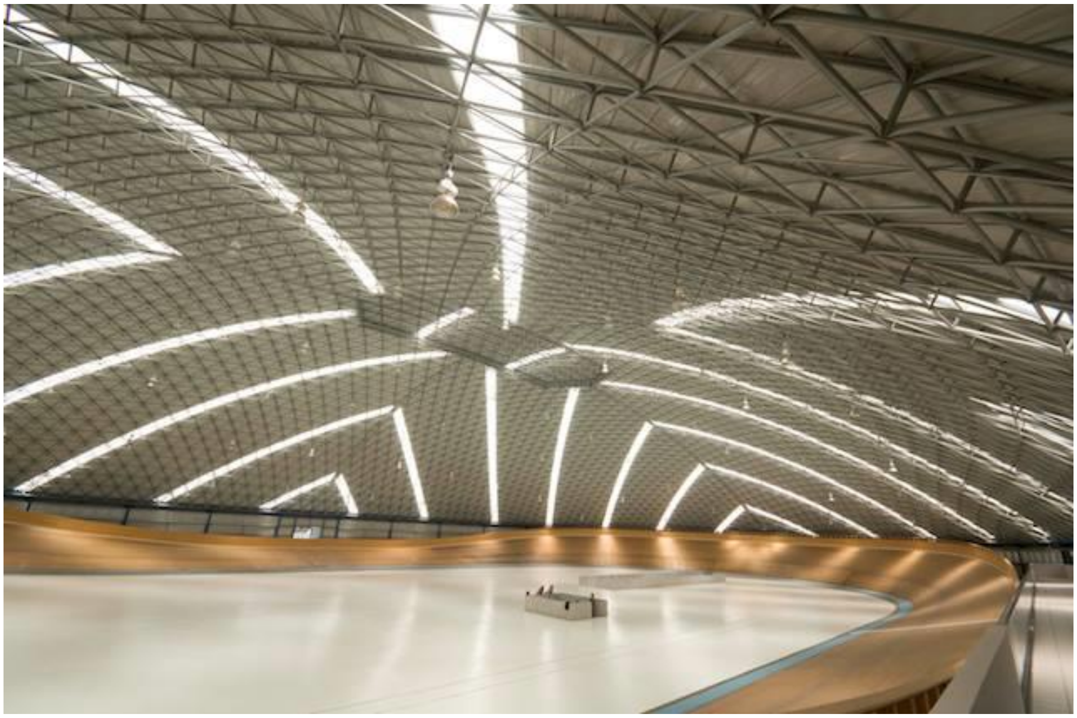
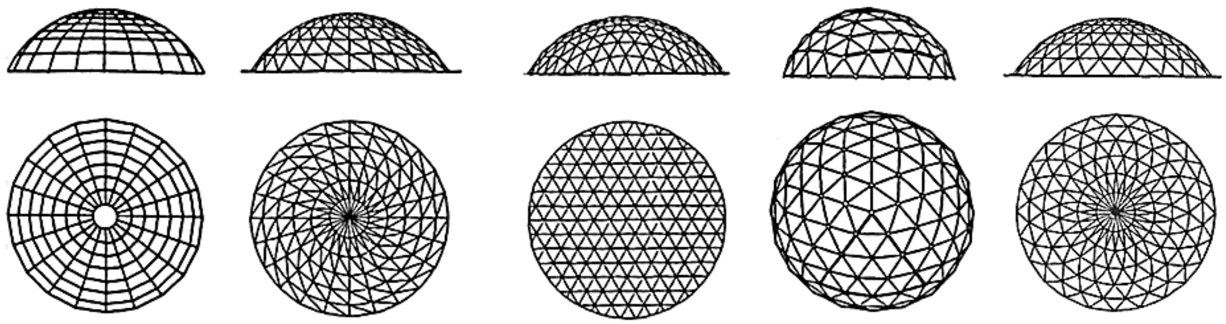


Figure 1.2 Velodrome 80 m x 120 m Sports and Performance Venue in Mexico City, Mexico (Geometrica 2016)

The design of three-dimensional structures has, at all times, been an exceptional achievement requiring a number of unusual obstacles to be overcome such as the highly nonlinear behavior affected by factors including the raise to span ratio, mesh density, and the joint rigidity (Altuna et al. 2012). Modern software and computerized models have enabled the accurate analysis of these structures, a very difficult task to be accomplished before (Lan 2005). Now, designers are able to determine the stress distribution in a very accurate manner. Therefore, three-dimensional structures nowadays can be analyzed and constructed with a high degree of confidence.

1.1.1 Braced Domes

Braced domes are of special interest to engineers as they have proven to be very economical in terms of consumption of construction material. A braced dome is an arrangement of linear intersecting structural members, connected to jointing systems, in single or multiple layers of curved surfaces. Linear structural elements are arranged in such a way that loads are transferred in a three-dimensional manner. Depending on the arrangement of elements, the base of the braced dome can result in a circular, polygonal, or even an oval shape (Narayanan 2007). Therefore, considering the arrangement of the elements, different types of brace domes can be constructed. According to Narayanan (2007), the most frequently used type of domes are: (a) The Ribbed, (b) Schwedler, (c) Three-way grid, (d) Geodesic, and (e) Lamella domes (see **Figure 1.3**).



(a) Ribbed (b) Schwelder (c) Three Way Grid (d) Geodesic (e) Lamella

Figure 1.3 Frequent Shapes of Reticulated Domes (Narayanan 2007)

Domes can also take on irregular shapes to satisfy the need of retrofitting to an existing condition. Such is the example of the Freedome® constructed by Geomtrica® having a whimsically irregular shape structure. This free-style dome is shown in **Figure 1.4**.

Figure 1.4 Freedome® Raw Copper Processing Plant in Cerrillos, Chile (Geometrica 2016)

The methods in which the linear structural elements and connectors are assembled create a unique jointing system. A more in depth explanation of jointing systems used in reticulated dome structures and many other types of three-dimensional structures are described in the following section.

1.1.2 Jointing Systems

The jointing systems are a very important part of the design of three-dimensional structures, including domes. A jointing system's connecting technique can be achieved through bolting, welding, or by special mechanical connectors. The shape of the structural members directly impacts what type of connection will be used. Different connection techniques can be used depending on whether circular, square hollow, or rolled steel sections of structural members are being utilized (Narayanan 2007). Joints used on space frames are extremely important because many members are connected and located into a single joint in a three-dimensional space, and therefore they need to be carefully designed.

A jointing system must meet the following criteria during its design stage: (1) the jointing system must be strong and stiff (not easily bent or changed in shape); (2) the jointing system must be structurally and mechanically simple, and easy to fabricate; and (3) the jointing system must have an effective and easy maintenance procedure.

According to Narayanan (2007), there are approximately 250 different types of jointing system that have been designed and/or used in practice. Most of them have not been commercially successful due to the complexity of the connecting method. There are three types of connecting techniques and can be divided into groups. These groups include the jointing system: (1) that have a connecting node; (2) that do not have a connecting node; and (3) the ones that make use of

prefabricated units for assembling purposes. **Table 1.1** presents the most commonly used proprietary jointing systems around the world.

Table 1.1 Commonly Used Proprietary Jointing Systems

Name	Country	Period of Development	Material	Connecting Method
MERO	Germany	1940-1950	Steel, Aluminum	Bolting
Space Deck	United Kingdom	1950-1960	Steel	Bolting
Triodetic	Canada	1950-1960	Aluminum	Inserting member ends into hub
Unistrut	United States	1950-1960	Steel	Bolting
Oktaplatte	Germany	1950-1960	Steel	Welding
Unibat	France	1960-1970	Steel	Bolting
Nodus	United Kingdom	1960-1970	Steel	Bolting and using pins
NS	Japan	1970-1980	Steel	Bolting
Geometrica®	Mexico	1990-Pres.	Aluminum	Inserting member ends into hub

Source: (Narayanan 2007) & (Castaño 2001)

To understand how different types of jointing systems work, an example of each connecting method shown in **Table 1.1** are presented as follows: bolting, welding, bolting in conjunction with pins, and inserting members ends into a connecting hub. An example of a bolting jointing system is the Mero system (**Figure 1.5**). This system has a connecting method that consists of a spherical node with flat facets and tapped holes that engages to circular hollow members. At the member's ends, hollow sections with steel coned-shapes are welded to accommodate connecting bolts. A hexagonal bolt sleeve is then used for tightening the engaging bolts. Subsequently, dowel pins are inserted to lock the system in place (Lan 2005).

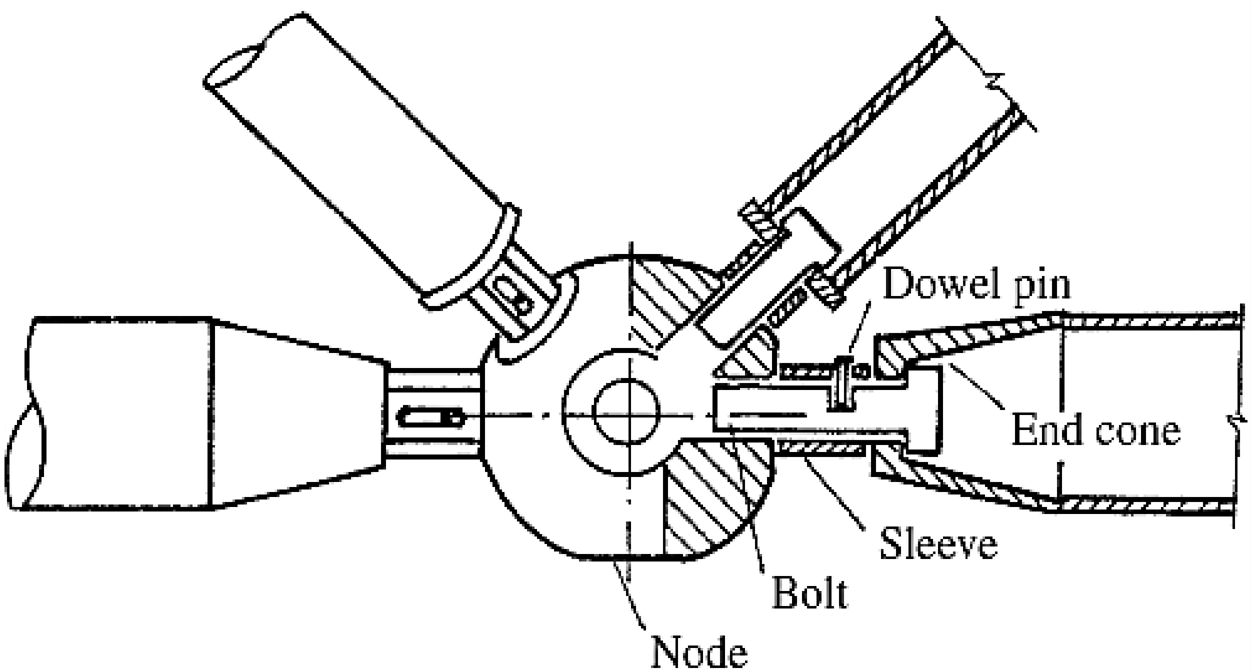


Figure 1.5 Details of the Mero System (Bolting Jointing System) (Lan 2005)

An example of a welding connecting method is the Oktaplatte system (**Figure 1.6**). This method uses two hemispherical hollow steel shells that are welded together and reinforced by a welded disk between them. The jointing system is completed when tubular beam members are fillet welded to the hemispherical shells. These type of jointing system assemblies are transported to the construction site, assembled on the ground, and subsequently erected (Narayanan 2007).

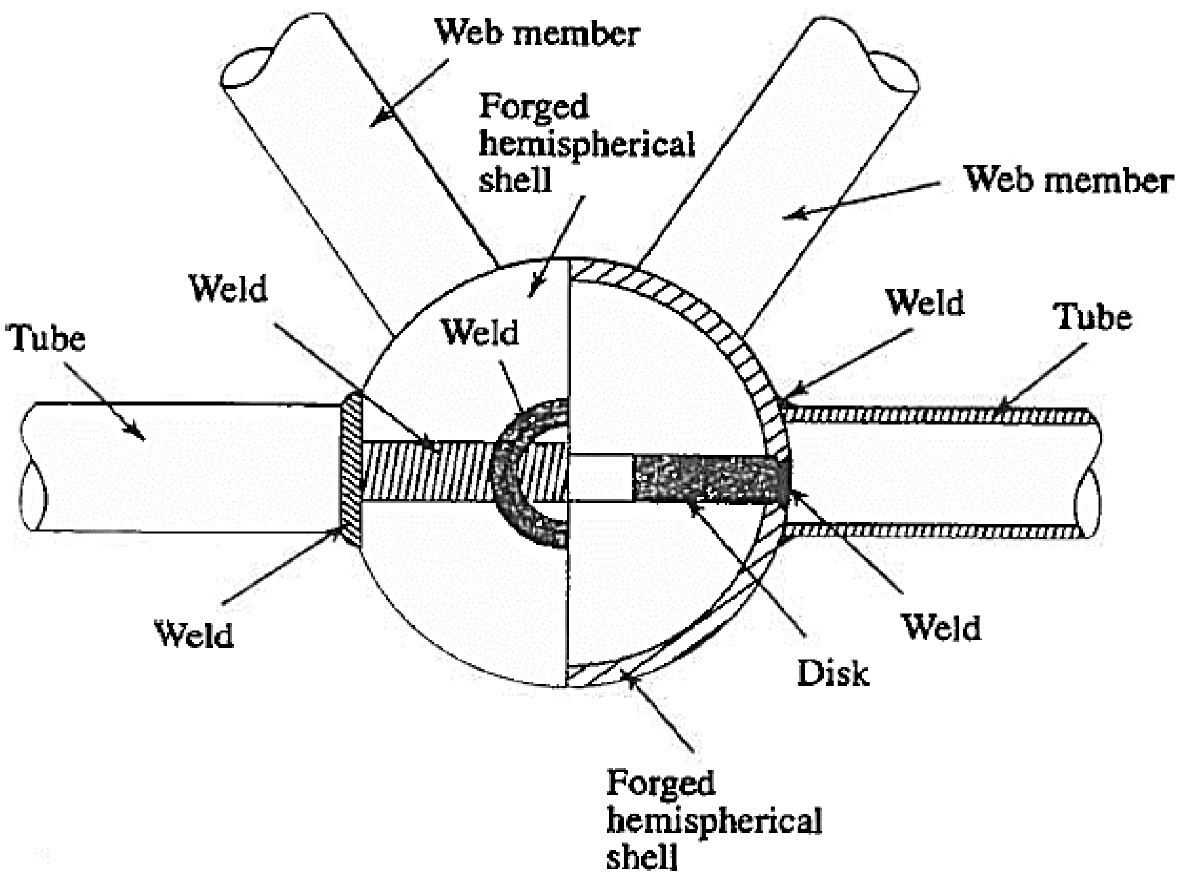


Figure 1.6 Details of the Oktaplatte System (Welding Jointing System) (Narayanan 2007)

The Nodus system is an example of a type of jointing system that engages by bolting and by making use of pins (**Figure 1.7**). This type of jointing system is formed by a pair of hemispherical cast iron casings, locked by a high strength bolt. Chord members are clamped in between the casings by toothed connector head. Bracing members have steel forked connectors to assemble to the node lugs with a headed steel pin that is kept locked in position by a slit cotter pin. (Narayanan 2007).

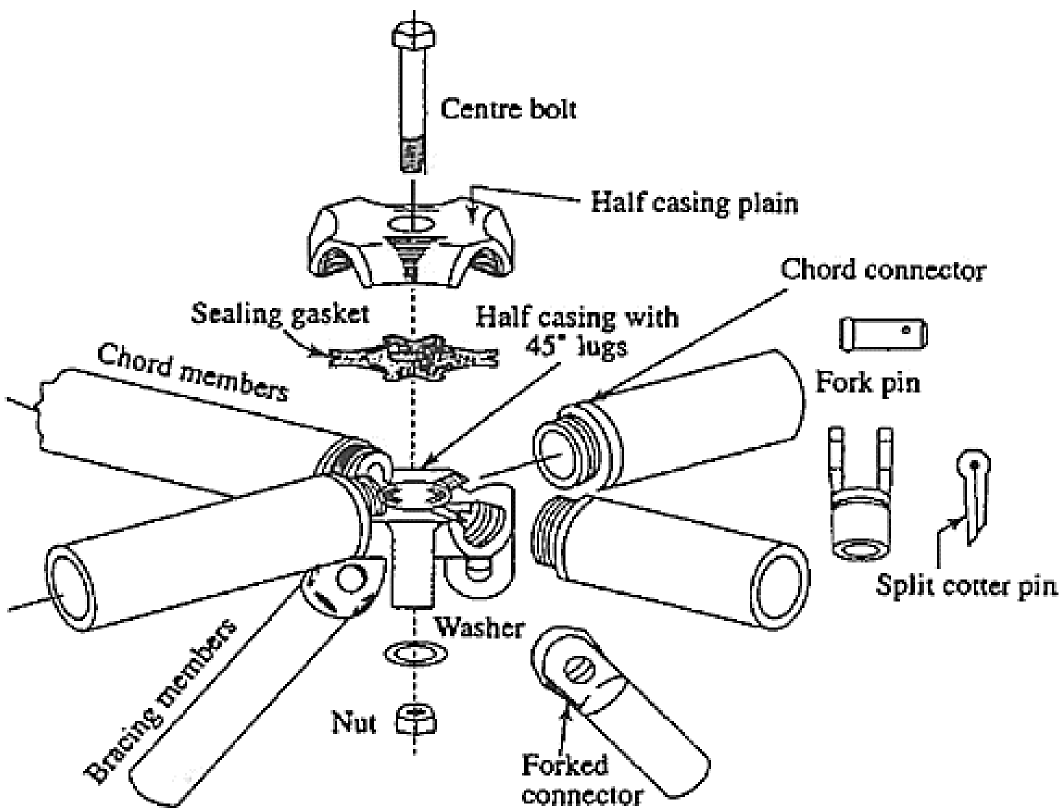


Figure 1.7 Details of the Nodus System (Bolting and using Pins Jointing System) (Narayanan 2007)

The fir-tree jointing system was introduced in 1950's by the Canadian company, S. Fentiman & Sons of Ottawa (Elliott 1984). This particular jointing system has three main components: (1) an extruded aluminum connector that has equally spaced serrated keyways; (2) tubular elements to which the connectors are jointed (these members have the ends pressed to form a coined edge that matches and fits in the connector keyway); and (3) filler shims. Filler shims are thin pieces of extruded material, similar to the pressed coined edges of the tubular members. All the non-loaded slots can be filled with filler shims. The jointing system is completed once the required members are inserted into the connector followed by washers that are placed at each end of the connector, and screwed in place by a hub bolt that passes through the center of the jointing system. The jointing system assembly is seen in **Figure 1.8**.

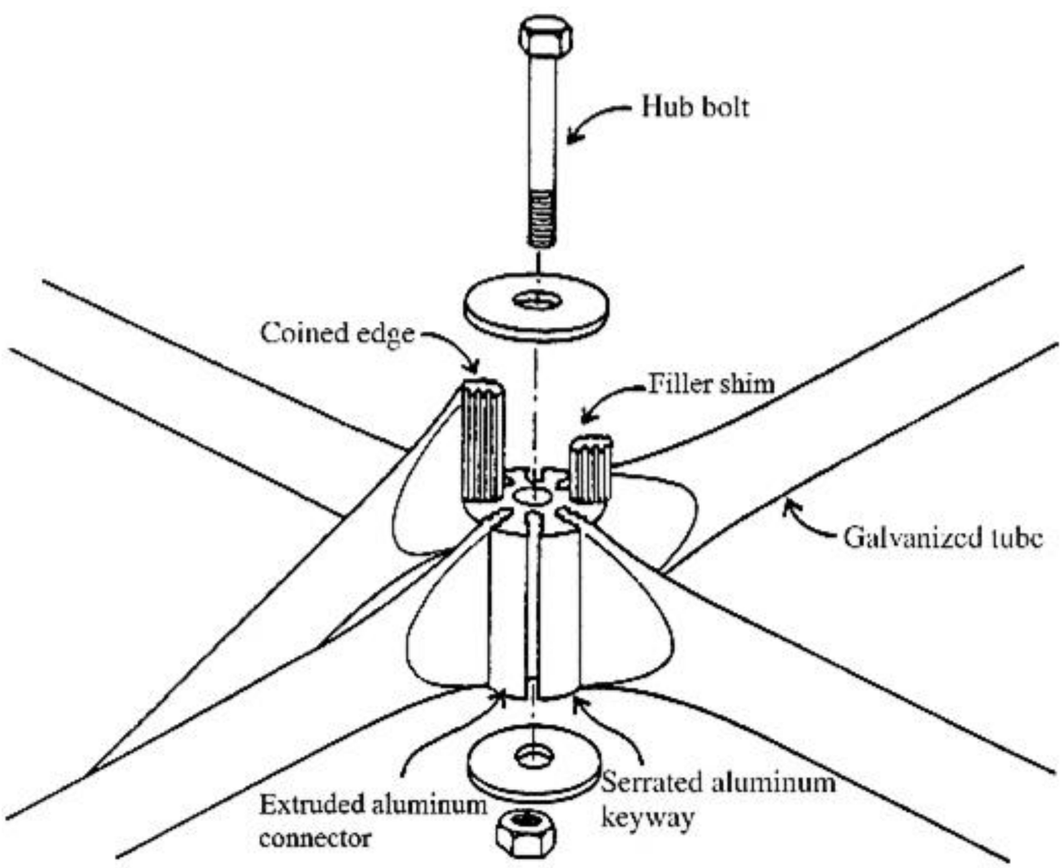


Figure 1.8 Fir-Tree Jointing System (Narayanan 2007)

In space frame's construction, several tubular members can be inserted into a single connector to form a "spider" like form (Castaño 2001). This would result in having a connector with a plurality of tubular members attached with each tube terminating at a free end. The free ends of the tubes can be similarly connected to another connector hubs. This framework of interconnected spiders built with tubes and connector hubs can be jointed to form modular sections of a dome (**Figure 1.9**), i.e., to then be interconnected to eventually complete an entire structure.

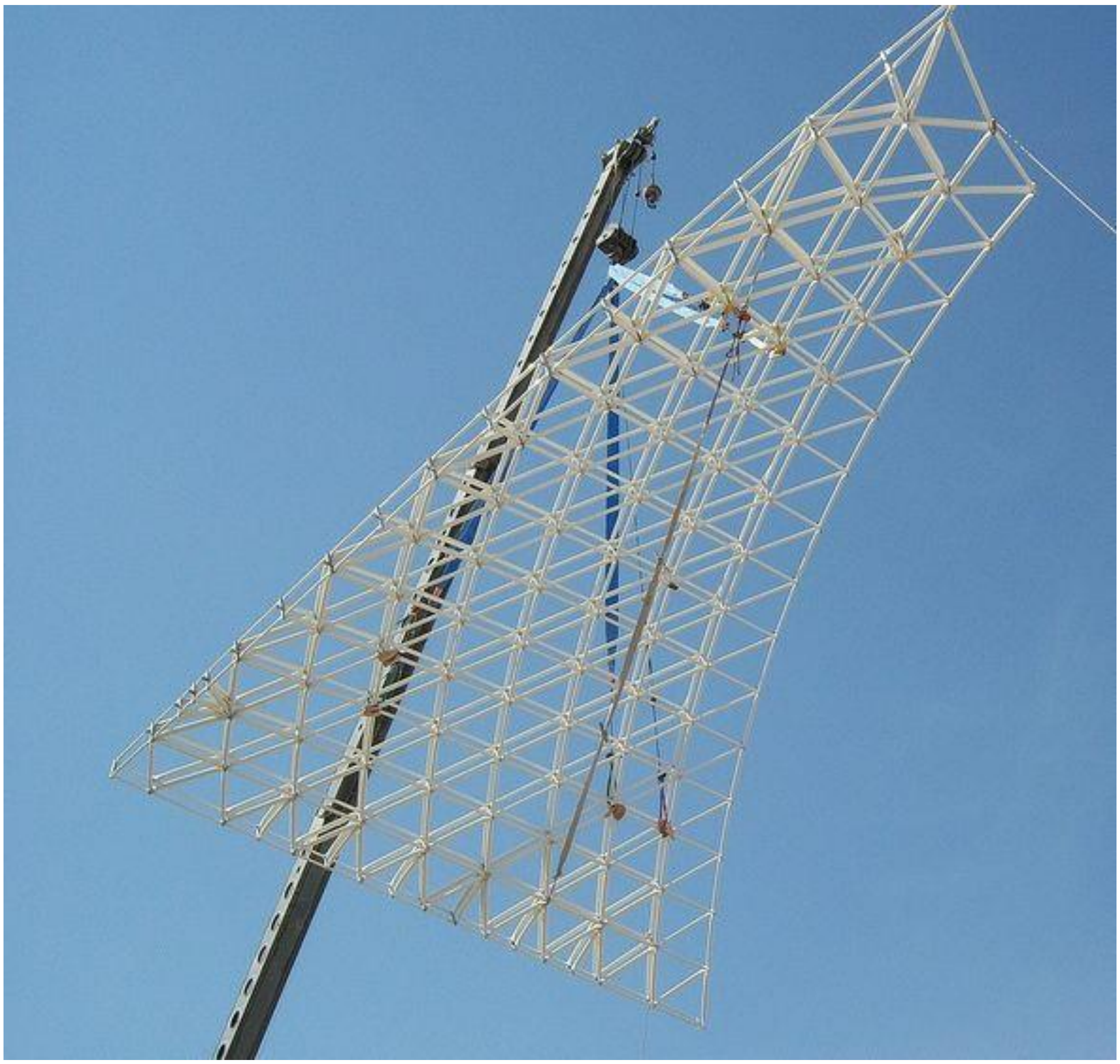


Figure 1.9 Framework of Interconnected Fir-Tree Jointing Systems (Geometrica 2016)

There are important advantages of using the fir-tree jointing system over others. Some of them are:

- The jointing system is achieved by assembling the members into the connector. No additional special member end fittings, welding, bolting or riveting is required.
- The tooth profile enables for a gradual transfer of load from members to the connector.
- The cost of production of the extruded aluminum connectors is low.
- The creation of different types of connectors to suit individual structural requirement or structural configuration is possible due to its low cost. **Figure 1.10** illustrates a sample of the possible variations of connector extrusions.

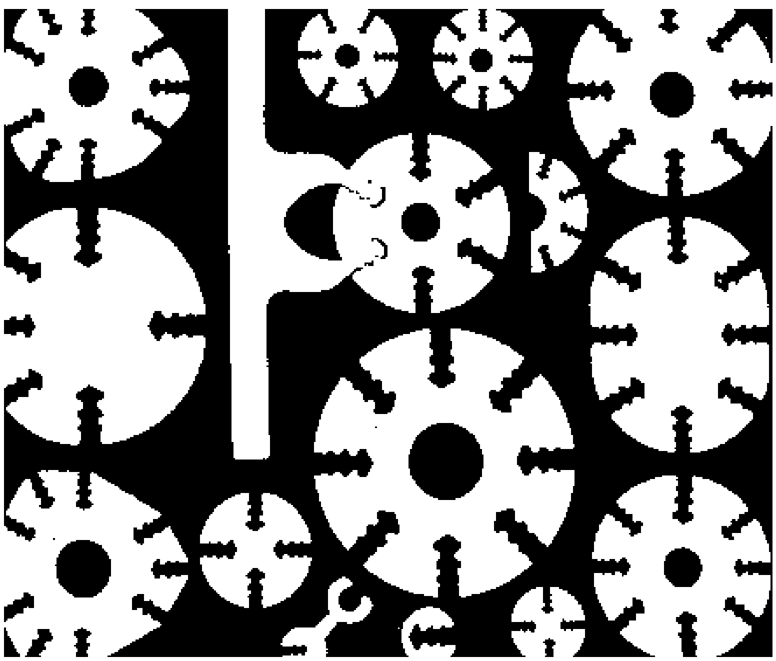


Figure 1.10 Possible Variations of Connector Extrusions (Elliott 1984)

- The production of the tubular structural members is a simple pressing operation: a single stroke cuts and then coins the members to the required length. **Figure 1.11** illustrates a complete typical configuration of a tubular member. The coined section of the members can be formed at various angles to the member axis as well as at angles of twist.

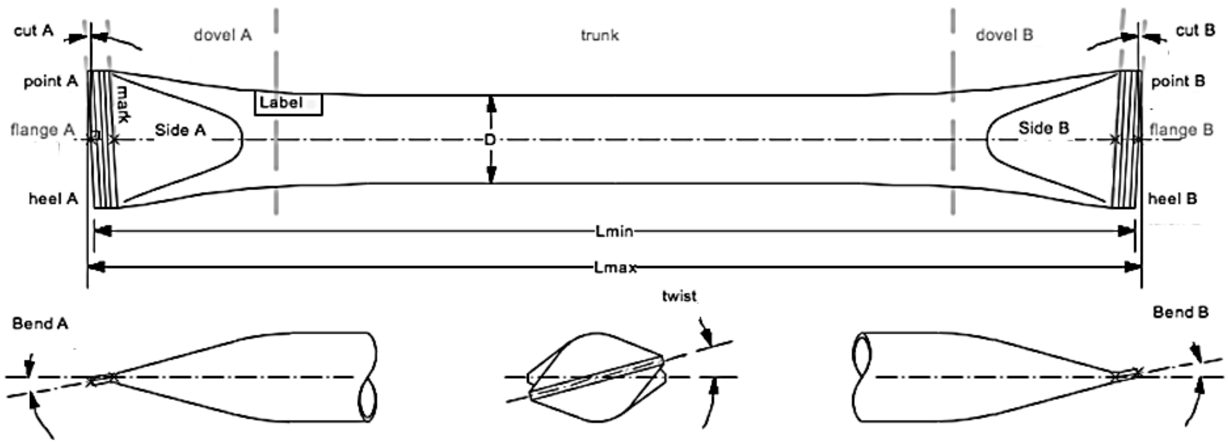


Figure 1.11 Typical Tubular Member Configuration (Geometrica 2016)

Due to previously stated advantages, the fir-tree jointing system has been widely used throughout the world.

1.2 Problem Statement

Based on the review of literature, the performance of three-dimensional structures is influenced by two main factors. These factors are the jointing system mechanical behavior and the geometric imperfections of the three-dimensional structural elements. Common design practices, assuming completely rigid or pinned connections to characterize a jointing system's mechanical behavior are idealizations in the analysis of three-dimensional structures. To achieve more realistic, reliable and economical results, semi-rigid connections have to be considered during the analysis (Kartal et al. 2010). Many studies have been conducted to characterize different jointing system semi-rigidities as well as their impact in the stability behavior of three-dimensional structures (Fan et al. 2010; Hwang et al. 2009; Kato et al. 1998; Ma et al. 2013a; Ma et al. 2013b, Shi et al. 2013). However, it is known that the structural stability of three-dimensional structures is sensitive to small geometric imperfections induced during the fabrication process (Teng 1996). To date, the effect of manufacturing geometric imperfections on the semi-rigid behavior and load

capacity of jointing systems used in three-dimensional structures has never been studied and needs to be addressed.

1.3 Scope of the Research

Due to previously stated advantages presented in **Section 1.1.2**, the Geometrica® 6-Sierra Delta (6Sd-00) fir-tree jointing system was selected as model of study for research purposes. The Geometrica® 6Sd-00 fir-tree jointing system has three main components: (1) an extruded aluminum connector that has equally spaced serrated keyways about a 60 degree angle; (2) tubular elements with coined pressed ends to which connectors are joined; and (3) filler shims. The component elements comprising the studied jointing system of this dissertation are shown in **Figure 1.12**.

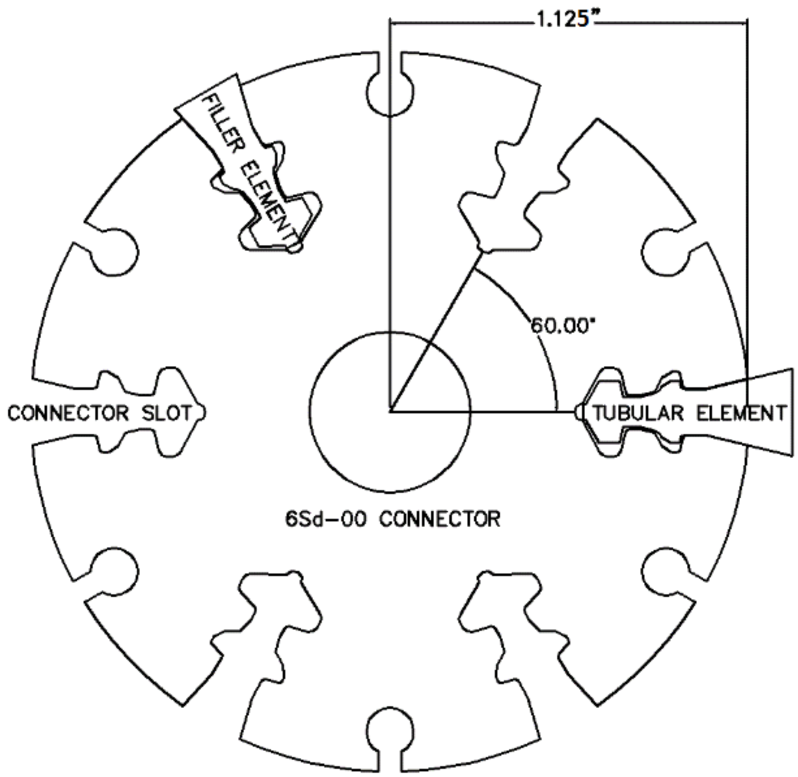


Figure 1.12 Geometrica® 6 Slot Sierra delta (6Sd-00) Jointing System

The scope of this research is to characterize and compare the semi-rigid behaviors of the "as-designed" vs. the "as-built" Geometrica® 6Sd-00 fir-tree jointing system using Finite Element Analysis (FEA). In the present work, the terminology as-designed condition of the jointing system refers to the idealized perfect condition of how the connector is designed, where the contacting surfaces (see **Figure 1.13**) follow the intended paths of interaction. Accordingly, the as-built condition of the jointing system refers to the imperfect manufactured connection where the location of contacting surfaces do not follow the as-designed path between the connector and beam elements due to surface imperfections.

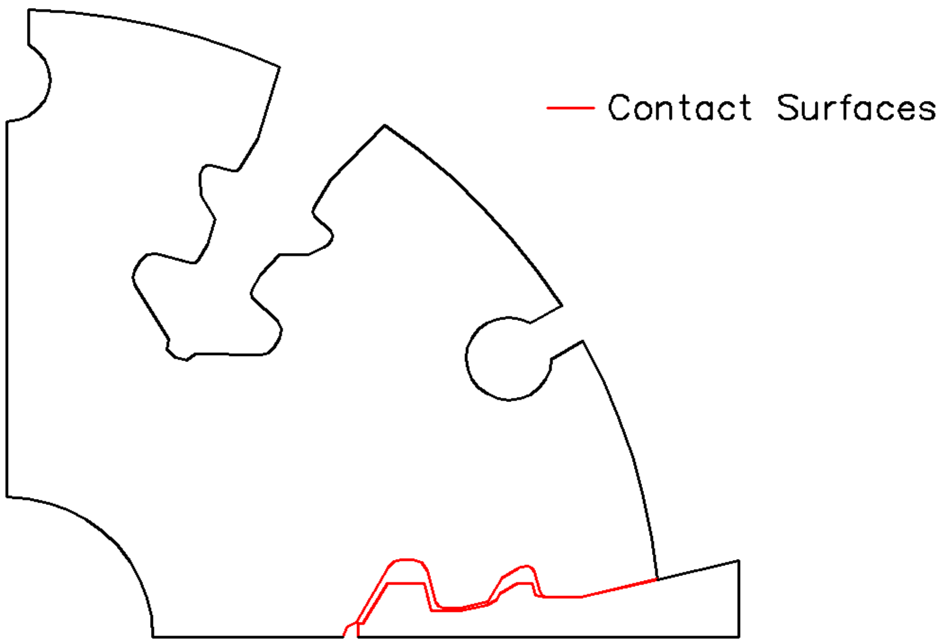


Figure 1.13 Geometrica® 6Sd-00 Jointing System Contact Surfaces

Based on the review of literature, the axial and in-plane bending stiffness define the semi-rigid behavior mechanisms for the fir-tree jointing system (Sugizaki and Kohmura 1994). Therefore, FEA will be conducted to characterize the axial load-displacement and in-plane moment-rotation semi-rigid behaviors of the as-designed and as-built jointing systems using the model configurations shown in **Figure 1.14** to **Figure 1.16**.

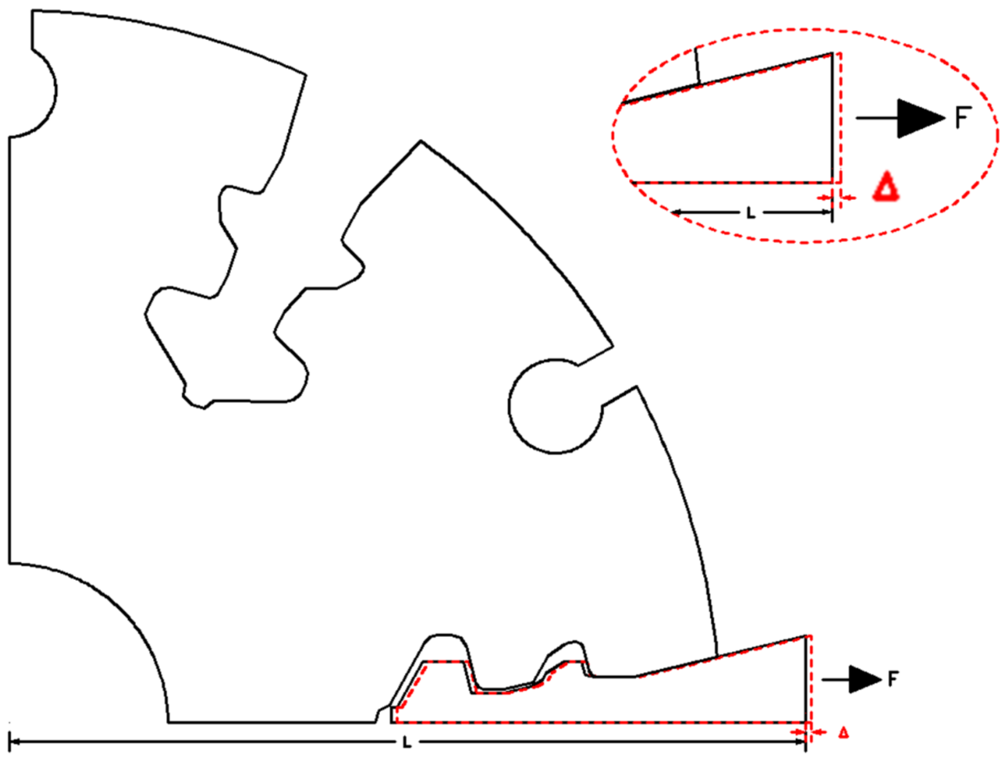


Figure 1.14 Geometrica® 6Sd-00 Jointing System Axial Tensile Semi-Rigid Configuration

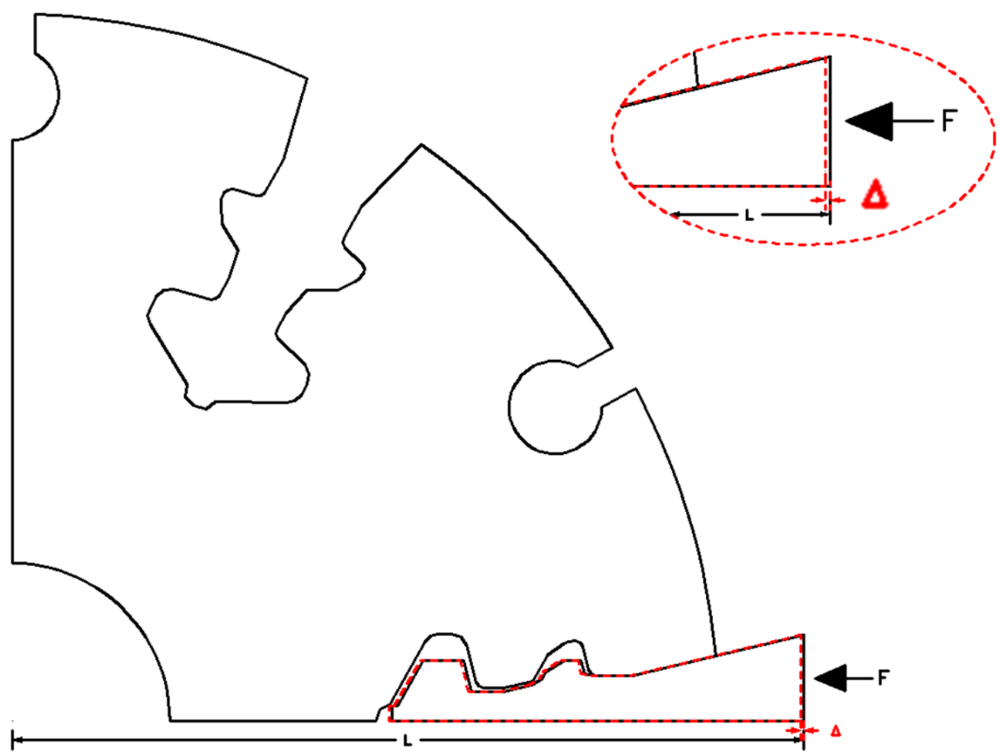


Figure 1.15 Geometrica® 6Sd-00 Jointing System Axial Compressive Semi-Rigid Configuration

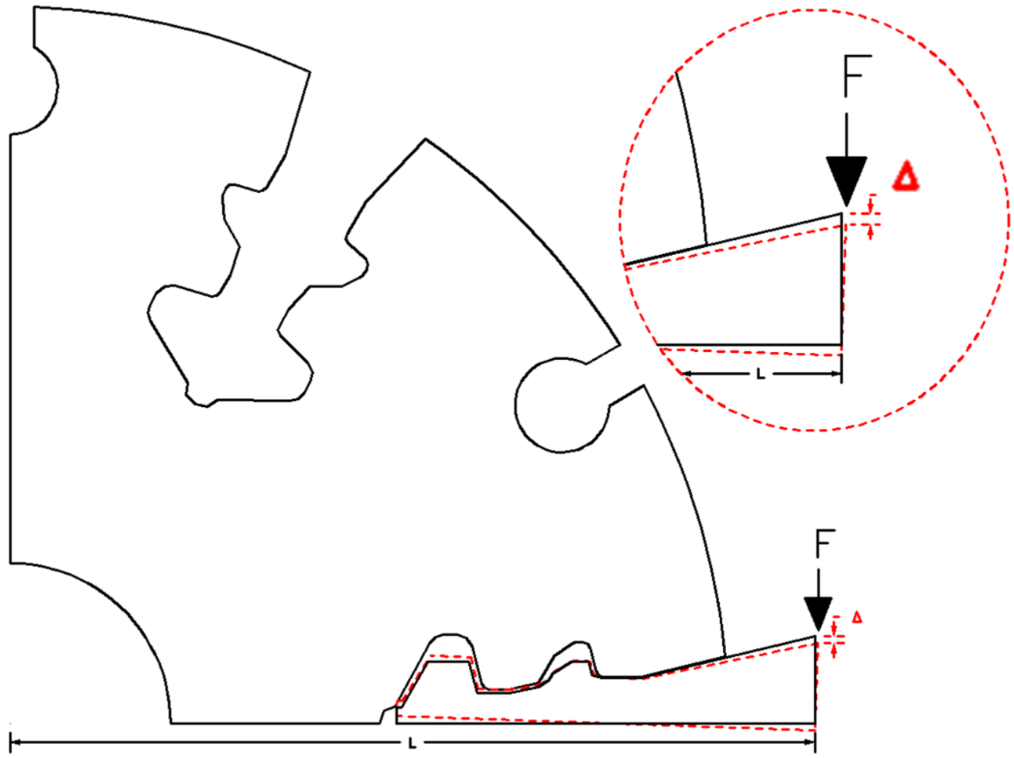


Figure 1.16 Geometrica® 6Sd-00 Jointing System In-Plane Bending Semi-Rigid Configuration

Furthermore, experimental tests will be conducted to identify the tensile inelastic behavior of the jointing system. The experimental testing will enable the comparison of the behavior between the experimental to the analytical results considering manufacturing geometric imperfections.

1.4 Objective

Previous studies have intended to characterize the mechanical behavior of jointing systems (Fan et al. 2010; Hwang et al. 2009; Kato et al. 1998; Ma et al. 2013a; Ma et al. 2013b, Shi et al. 2013), but have not included the incorporation of manufacturing geometric imperfections of the jointing system in the analysis. This research will develop a procedure to be followed to better understand how surface imperfections affect the inelastic behavior of a three-dimensional structure jointing system using the Geometrica® 6Sd-00 fir-tree jointing system as the model of study. The

hypothesis is that surface imperfections will produce a variation in the behavior and load bearing capacity of the jointing system due to the modification of the interaction path between the imperfect contacting surfaces.

The objective of this research will be achieved as follows:

1. Develop finite element simulations with the goal to characterize the inelastic behavior of the as-designed Geometrica® jointing system (as a baseline for future comparison to imperfect jointing systems). The finite element simulations will be conducted using the Patran/Nastran Software (MSC 2014).

2. Develop a database of the as-built dimensions of the jointing system under investigation and perform finite element simulations with the goal to characterize the inelastic behavior of the as-built Geometrica® jointing system.

3. Conduct experimental studies to capture the tensile jointing system's behavior characterization and load capacity. The goal is to compare the real tensile behavior to the predicted finite element behavior of the jointing system.

1.5 Significance of the Study

The results of this research will contribute to the structural engineering profession by leading to a more realistic structural modeling of the fir-tree jointing system used in reticulated three-dimensional structures. The expected results will identify if geometric imperfections produce an important modification in the behavior and capacity of the jointing systems due to the variation of the interaction path between the imperfect contact engagement surfaces as compared to the as-designed jointing system.

Chapter 2: Literature Review

The existence of imperfections is one of the most important factors that affect the behavior of three-dimensional structures (Lan 2005). For this reason, the first part of this literature review will focus on the different types of imperfections that have been considered in their analysis. Additionally, as explained in **Section 1.1.2**, there are many different jointing systems that have unique mechanical behavior properties. Therefore, the second part of this review will describe the analytical and experimental methods that have been utilized to characterize the semi-rigid behavior of jointing systems used in three-dimensional structures. During the last part of the review, the jointing system model used in this research work is introduced along with a description of different studies that have been conducted to characterize its mechanical behavior.

2.1 Geometric Imperfections in Three-Dimensional Structures

The existence of imperfections is an inevitable factor that produces undesirable effects in the behavior of three-dimensional structures. In fact, it is well known that the stability of three-dimensional structures is very sensitive to initial geometric imperfections (Yamada et al. 2001). The structural stability of reticulated structures is generally sensitive to small geometric imperfections induced in the fabrication process. Theoretical loads obtained assuming a perfect geometry often greatly overestimates the actual strength of the structure. In the past, there have been studies with various approaches to consider different types of geometric imperfections in three-dimensional structures including: (1) the member's initial curvature; and (2) nodal coordinate location deviation.

Yadollahi et al. (2011) studied the effect of member initial curvature geometric imperfections on the load bearing capacity of double layer barrel vault space structures. During

the investigation, an initial deviation of the member at midpoint from the chord line, also known as the member's initial curvature (**Figure 2.1**), was considered as the geometric imperfection under study. It was concluded that these types of imperfections can decrease the strength of the structure up to 41%.

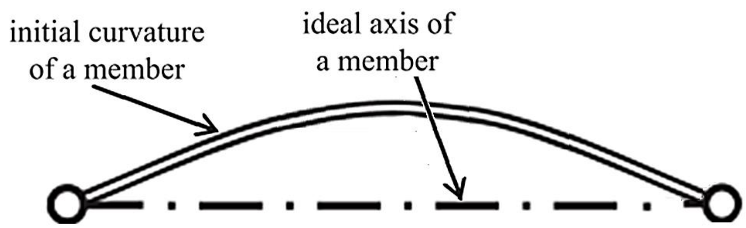


Figure 2.1 Member Initial Curvature

In the case of node deviation, Altuna et al. (2012) investigated how imperfections in the location of the nodes, compared to their designed location, affect the stability of single-layer three-dimensional structures (**Figure 2.2**).

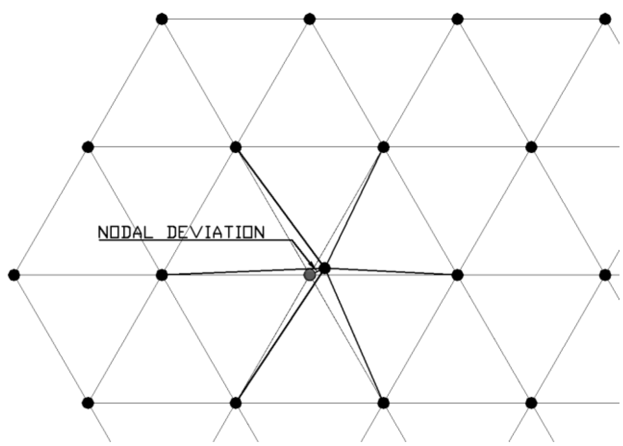


Figure 2.2 Nodal Coordinate Location Deviation

To understand the influence of imperfections, calculations were initially performed on a 15-meter-high single-layer structure without imperfections. Subsequently, analyses were additionally performed following the fundamental mode imperfection method. The fundamental mode imperfection method assumes that the first buckling shape represents the initial state of a structure

with imperfect nodal distribution. During this research, structures were analyzed considering nodal coordinate location deviations of up to 16 cm defined by using the span/300 relation. According to the research results (**Figure 2.3**), the ultimate load factor, that is, the collapse load of the structure given as a factor of applied load, significantly reduced as the size of imperfection increased.

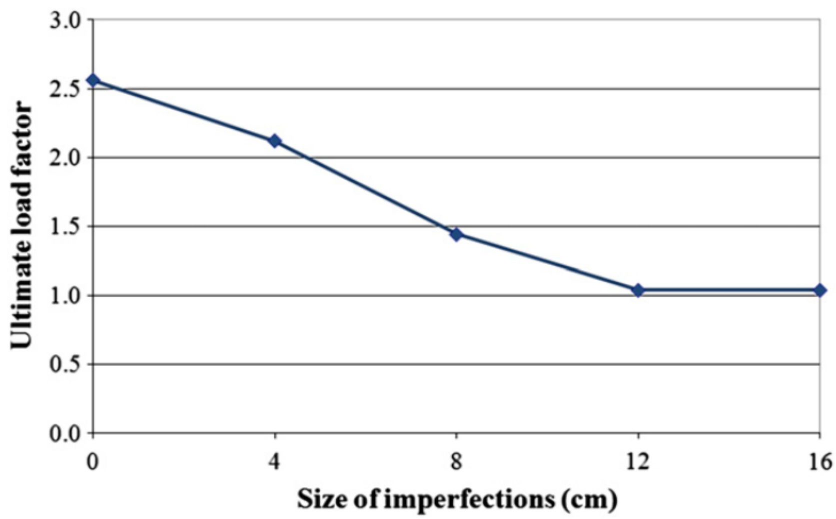


Figure 2.3 Ultimate Load Factor vs. Imperfection Size (Altuna et al. 2012)

Fan et al. (2012) investigated the stability of single-layer Kiewit domes integrating initial curvature of members and node location deviation geometric imperfections under the same analysis. A schematic diagram of the node deviation and initial curvature of members is shown in **Figure 2.4**. The modeling of the reticulated shells was conducted by means of finite element using beam elements rigidly connected at the nodes.

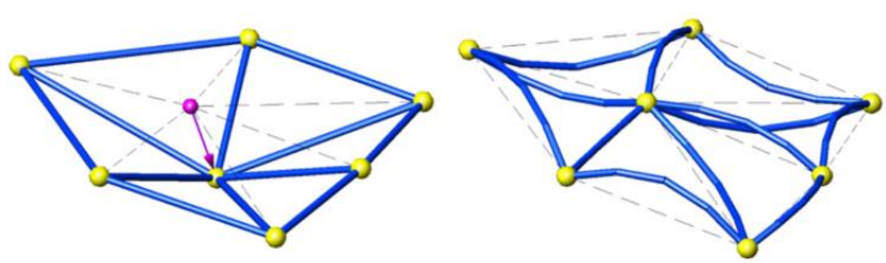


Figure 2.4 Node Deviation and Initial Curvature of Members (Fan et al. 2012)

The "multi-beam method" was used to consider the initial curvature of members and node deviations being random and variable. The authors made an ideal and simplistic assumption where the shape of the initial curvature of the members was represented by a half sine curve member composed of jointed linear bar elements deviated from its ideal axis (**Figure 2.5**).

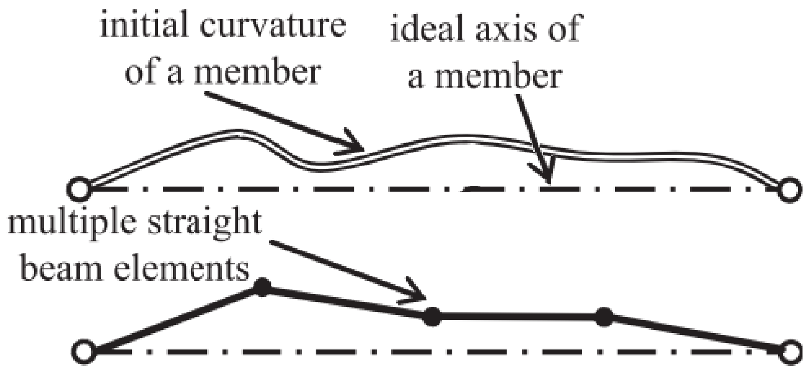


Figure 2.5 Schematic Diagram of the Multi-Beam Method (Fan et al. 2012)

This research used the Kiewitt-6 single layer dome structure as model to investigate how initial curvature of members affect the buckling load of an ideal structure; and of a structure with node deviation. Percentage reductions of the buckling loads were calculated at different amplitudes of the member initial curvature (δ) being δ = 0, l/1000, 2l/1000, 3l/1000, 5l/1000, and 10l/1000, where l is the length of the members; and at different rise (f) to span (L) ratios (f/L = 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, and 1/8). The percentage reductions were calculated to evaluate: (1) the discrepancy between the buckling loads of the ideal structure to the structure with initial member curvature, and (2) the effect of initial curvature of members on the buckling load of the structure with node deviations. For the Kiewitt-6 model, at δ = l/1000, it was concluded that the initial curvature of members decreased the buckling load capacity, as compared to the ideal structure by 12.80%. When node deviations and member curvature were included in the analysis, the capacity of the structure further decreased by 9.44% compared to the structure considering only the member initial curvature imperfection.

Kato et al. (1998) studied how semi-rigidly jointing systems, geometric imperfections of coordinates, and member crookedness reduce the collapse load of reticulated domes. The buckling collapse of steel reticulated domes was analyzed with a second-order elastic analysis with semi-rigid connections modeled with elastic springs at the member ends. The results of the research show that the semi-rigidity of the jointing systems has a more important effect on the capacity of the structures as compared to the geometric imperfections. This research is an example indicating that the semi-rigid behavior of jointing systems in three-dimensional structures is an important factor to consider during the design of such structures. In fact many different studies have been developed to capture the semi-rigid behavior of different jointing systems used in reticulated structures.

2.2 Semi-Rigid Characterization of Jointing Systems used in Three-Dimensional Structures

As Kato et al. (1998) state, the actual stiffness of the jointing system plays a critical role in the behavior of three-dimensional structures. Studies have been conducted to characterize the behavior of different jointing systems used in such structures. For instance, López et al. (2007) analyzed the ORTZ jointing system using finite element modeling simulations to capture its semi-rigid behavior, and validated results through experimental verification (see **Figure 2.6**). During the study, the finite element model was developed using the dimensions and properties of the different component elements of the jointing system considering the possibility of the materials reaching their yielding strength. The proposed finite element model proved to be a good representation of the behavior of the jointing system observed experimentally.

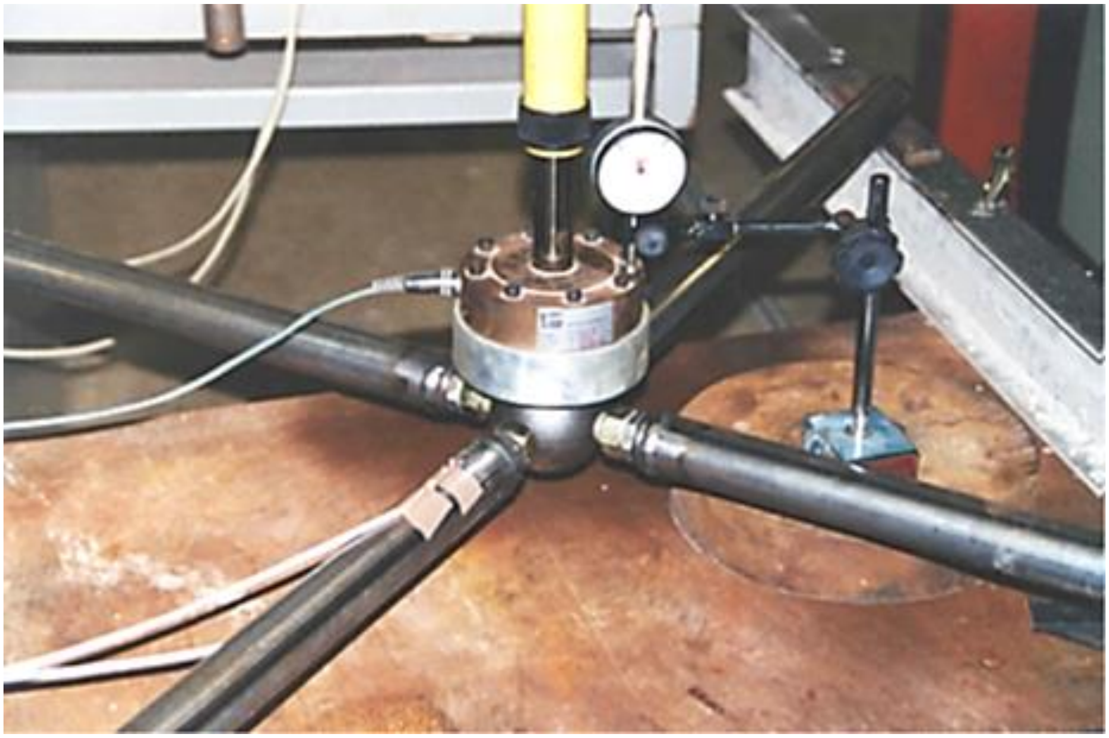


Figure 2.6 Experimental Testing of the ORTZ Jointing System (López et al. 2007)

Hwang et al. (2009) presented the influence of a node connecting system in the buckling capacity of grid shells. Four different types of jointing systems (**Figure 2.7)** were used as models during the study, taking into consideration different bolt clearances to estimate the ultimate loading capacities of the jointing system.

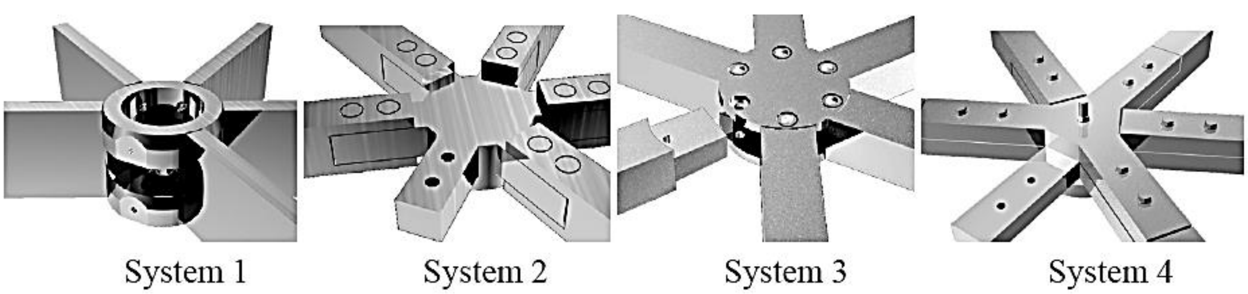


Figure 2.7 Jointing Systems Configurations (Hwang et al. 2009)

A finite element analysis was conducted to characterize the bending moment-rotation and axial load-displacement of the jointing systems. An example of the free body diagram of Jointing System 2 (see Figure above) is shown in **Figure 2.8**.

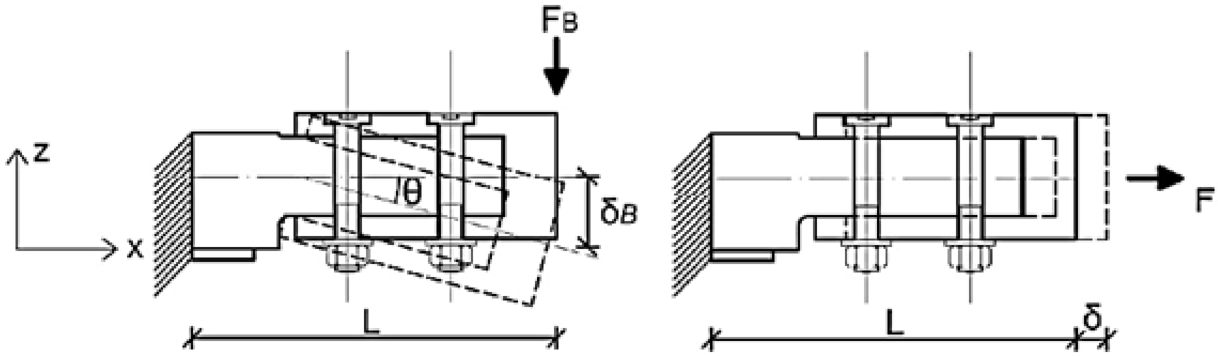


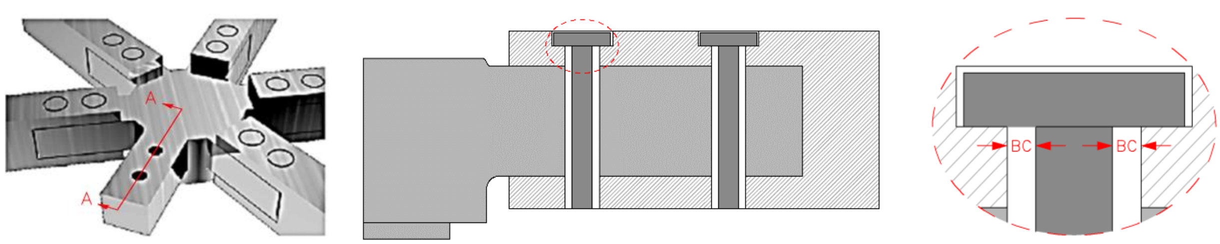
Figure 2.8 Moment-Rotation & Axial Load-Disp. of Jointing System (Hwang et al. 2009)

Using the elements shown in the figure, the researchers calculated the corresponding moment and angle of rotation as follows:

$$Moment = (F_B)(L) \tag{2.1}$$

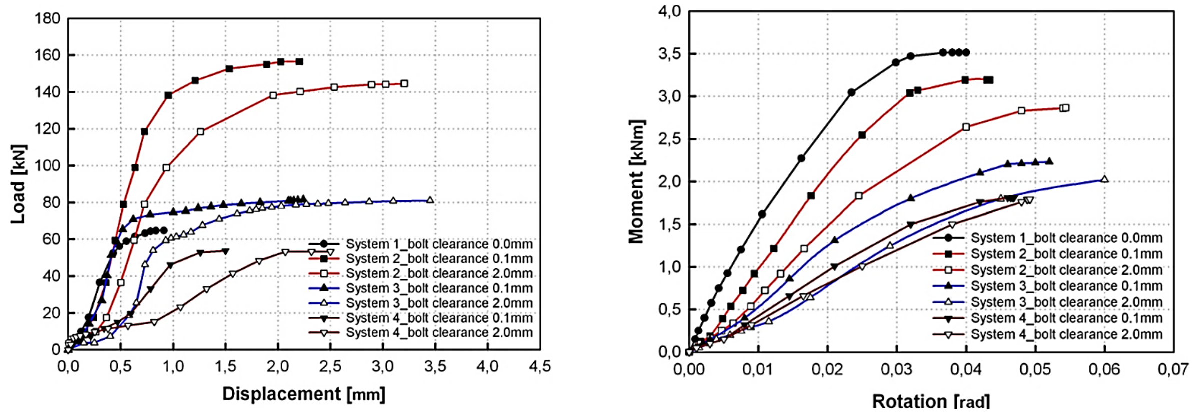
$$Tan\,\theta = \frac{\delta_B}{L} \approx \theta \; for \; |\theta| < 1 \tag{2.2}$$

where F_B is the applied bending force to the beam element, L is the distance from the center of the connector to the location of the applied force, δ_B is the vertical displacement of the beam element in the location of the applied force, and θ is the rotation of the jointing system. To understand the impact of bolt clearances (see **Figure 2.9**) onto the semi-rigid behavior of the different jointing systems, analyses were performed considering two bolt clearances for each connecting system. **Figure 2.10** show the (a) load-displacement and (b) moment-rotation curves for the different types of jointing systems analyzed during this study, displaying how the stiffness of the system was influenced due to the considered bolt clearance.



(a) System 2 (b) Section A-A (c) BC Close-Up

Figure 2.9 Bolt Clearance (BC)



(a) Load-Displacement (b) Moment-Rotation

Figure 2.10 Systems Load-Displacement and Moment-Rotation Curves (Hwang et al. 2009)

The results of the analyses showed that generally the jointing system with a larger bolt clearance experienced higher deformations and a decreased in the load bearing capacity.

Fan et al. (2010) conducted a similar study and developed a finite element model using a bolt-ball jointing system (as seen on **Figure 2.11**) to characterize the non-linear behavior of the connection.

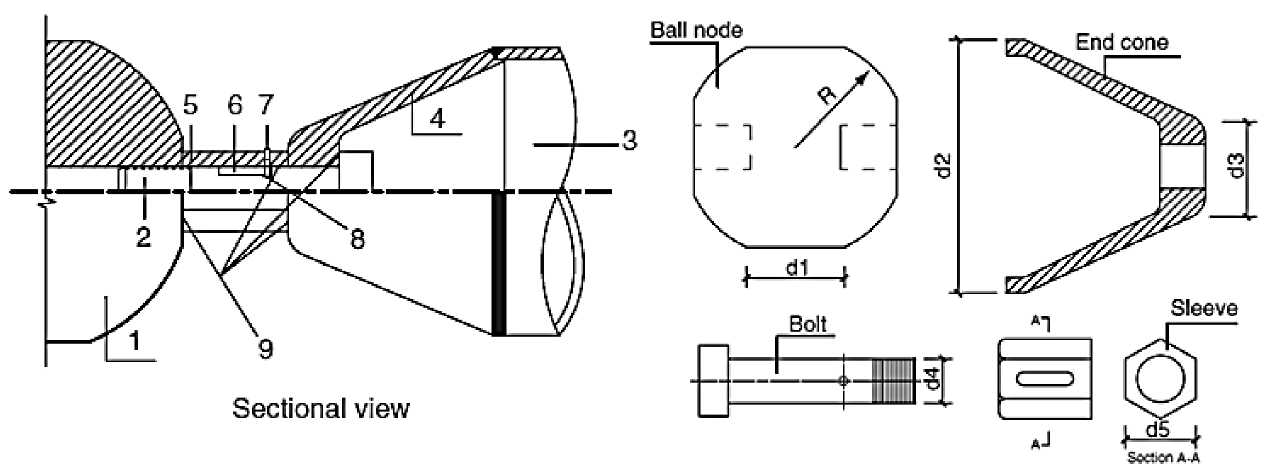


Figure 2.11 Bolt-Ball Jointing System Component Elements (Fan et al. 2010)

Furthermore, the numerical model was verified through laboratory experiments. The model used to develop the finite element analysis of the ball-joint system is shown in **Figure 2.12**.

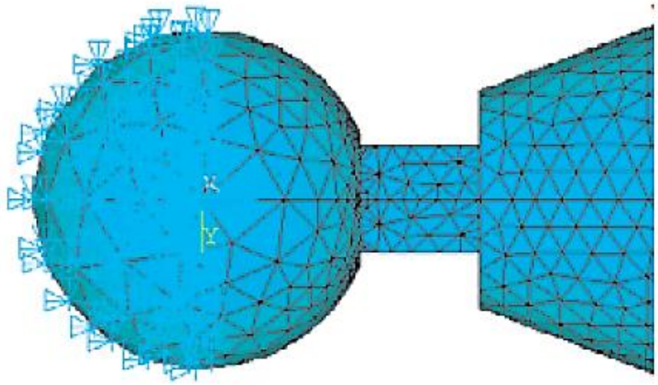


Figure 2.12 Finite Element Model of the Bolt-Ball Jointing System (Fan et al. 2010)

Additionally, the experimental set-up to capture the semi-rigid behavior of the bolt-ball jointing system is shown in **Figure 2.13**. These experiments were conducted to compare analytical to experimental results.

Figure 2.13 Bolt-ball Jointing System Experimental Set-Up Before Test (Fan et al. 2010)

A comparison of the moment-rotation curves generated with the finite element analyses and those obtained with test results of the three different dimension specimens tested during this study are shown in **Figure 2.14**. From the numerical to experimental comparison moment-rotation curves, the specimens proved to have a similar semi-rigid behavior. During the linear stage of the curves before the yield strength, the numerical and experimental values fit closely. Therefore, the authors defined that the actual behavior of the bolt-ball jointing system was well represented; thus proving the validity of the FEM used for simulating the behavior of the jointing system.

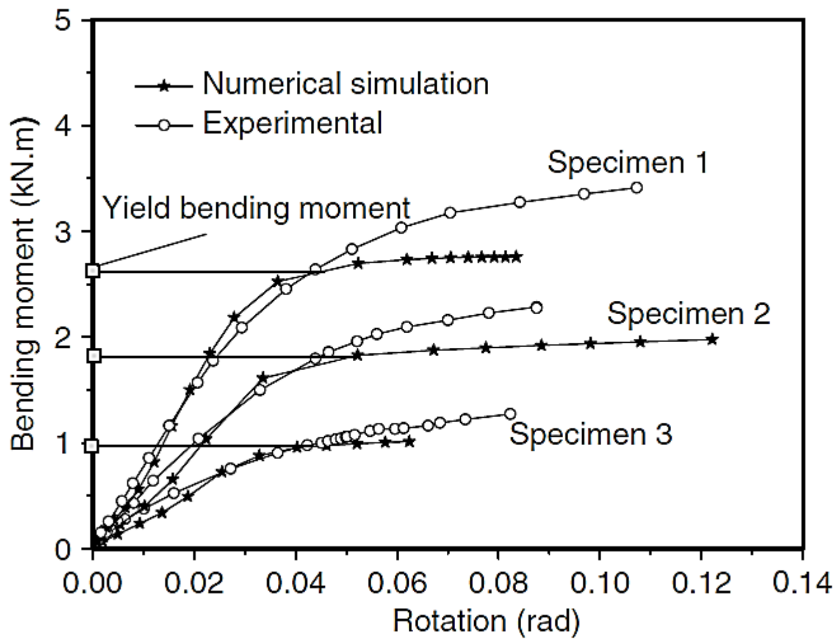


Figure 2.14 Comparison of FEA and Experimental Moment-Rotation Curves (Fan et al. 2010)

Shi et al. (2013) performed finite element analysis and full scale experiments in an aluminum joint configuration (as shown in **Figure 2.15**) used in three-dimensional structures, to capture its mechanical performance and failure mechanism.

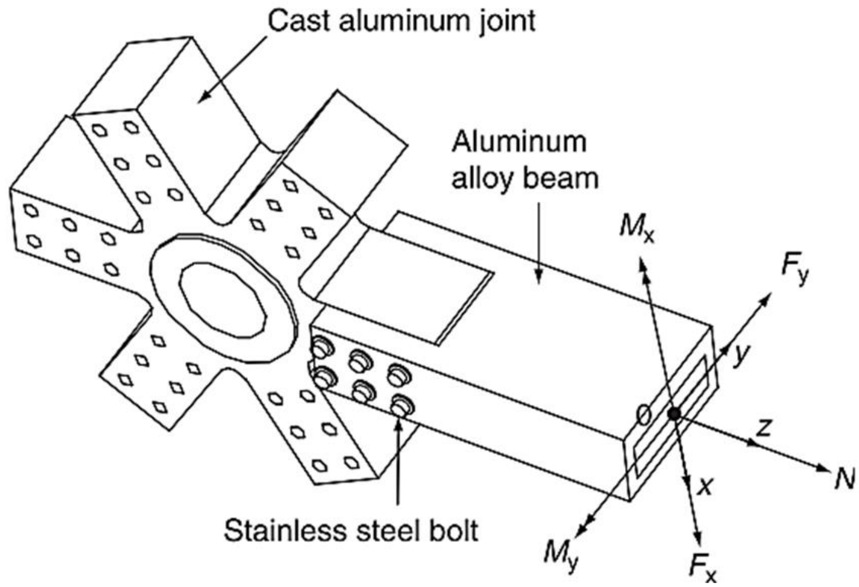
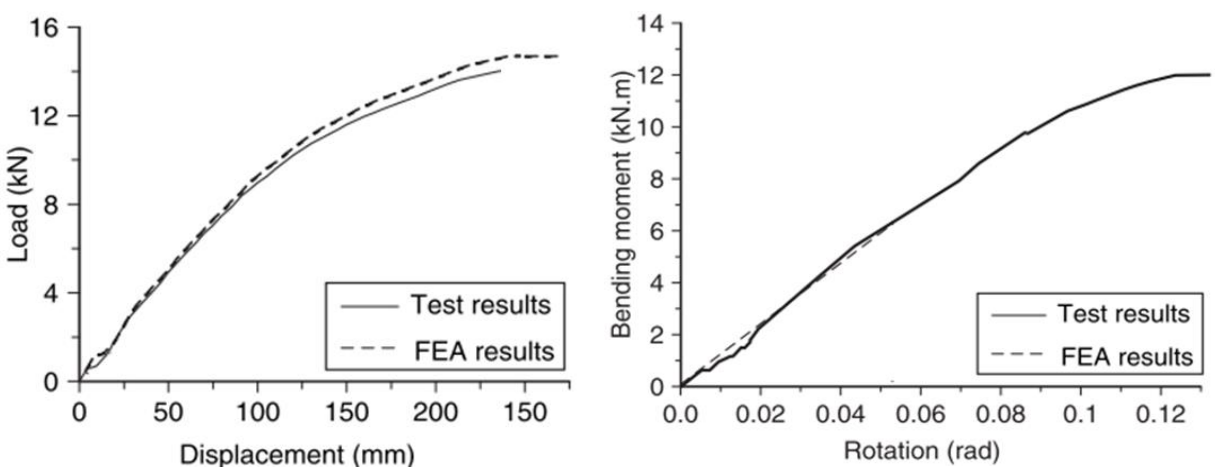


Figure 2.15 Aluminum Jointing System (Shi et al. 2013)

As shown on **Figure 2.16**, the analytical and experimental load-displacement and moment-rotation curves were obtained. From the results, it was concluded that the numerical simulation fit well to the experimental data. The authors established that the elasto-plastic FEA models provided an accurate description of the jointing system stiffness characterization through the modeling of the interaction of contacted surfaces between the jointing system components.



(a)Load-Displacement (b)Moment-Rotation

Figure 2.16 Load-Displacement and Moment-Rotation Curves (Shi et al. 2013)

Ma et al. (2013a) investigated the load-carrying mechanism of socket jointing systems as illustrated in **Figure 2.17**. The models were subjected to pure bending and to proportional axial compression and bending forces. The model used to develop the finite element analysis of the socket jointing system is shown in **Figure 2.18**. The numerical model was verified through laboratory experiments.

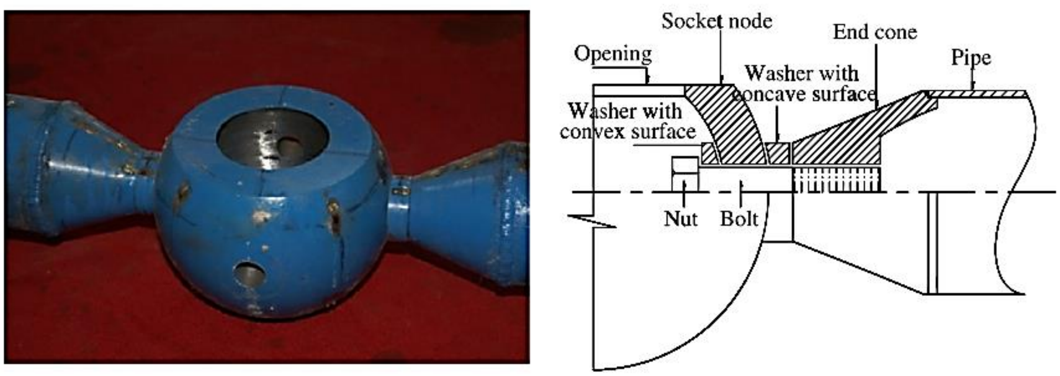


Figure 2.17 Socket Jointing System Component Elements (Ma et al. 2013a)

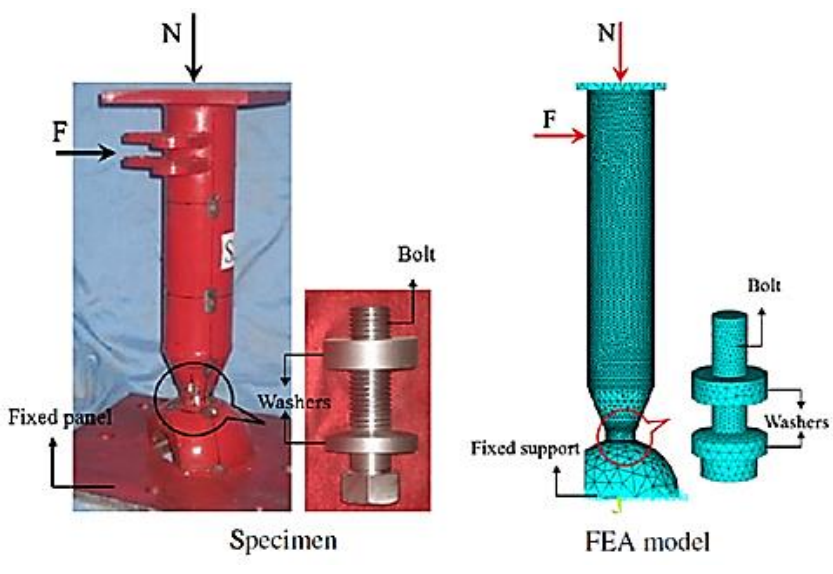


Figure 2.18 Finite Element Model of the Socket Jointing System (Ma et al. 2013a)

The experimental set-up to capture the semi-rigid behavior of the socket jointing system is shown in **Figure 2.19**. These experiments were performed to compare the analytical to experimental results.

Figure 2.19 Socket Jointing System Experimental Set-Up Before Test (Ma et al. 2013a)

The results of the moment-rotation stiffness using finite element analyses and the experimental test of the jointing system showed that the connections exhibit linear behavior in the early loading sequence and non-linear characteristics thereafter. Most importantly, the research results prove that for socket joint connections, the curves of the stiffness obtained numerically and experimentally are extremely similar with some discrepancies as observed in **Figure 2.20**.

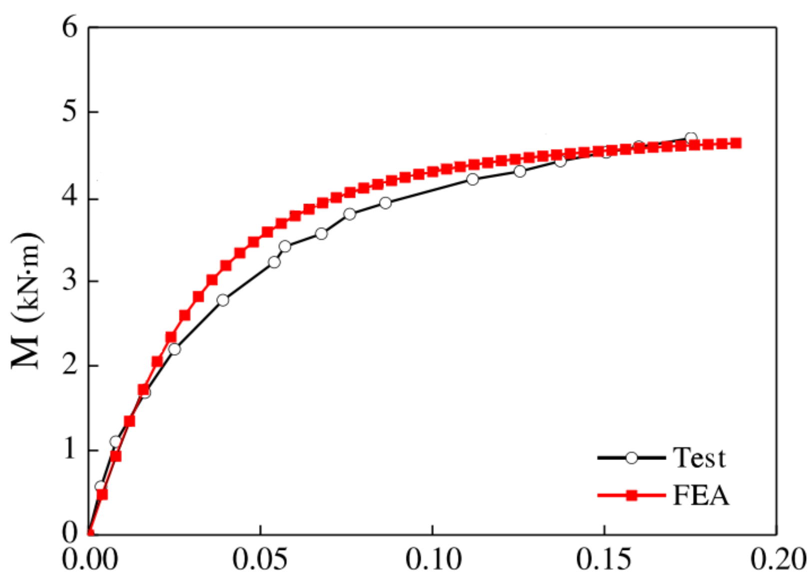


Figure 2.20 Moment-Rotation Comparison Curves of Socket Jointing (Ma et al. 2013a)

The authors concluded that the discrepancies between the numerical and experimental results for the socket jointing system are caused by a couple of simplifications introduced in the developed numerical model. Due to the complexity of the jointing system, it is difficult to model the applied pretension forces to the bolts during the FEA. In addition, it was stated that fabrication errors in the test specimens and imperfections due to bad assembly can lead to a deviation between numerical and physical results.

2.3 Semi-Rigid Characterization of the Fir-Tree Jointing System Mechanical Behavior

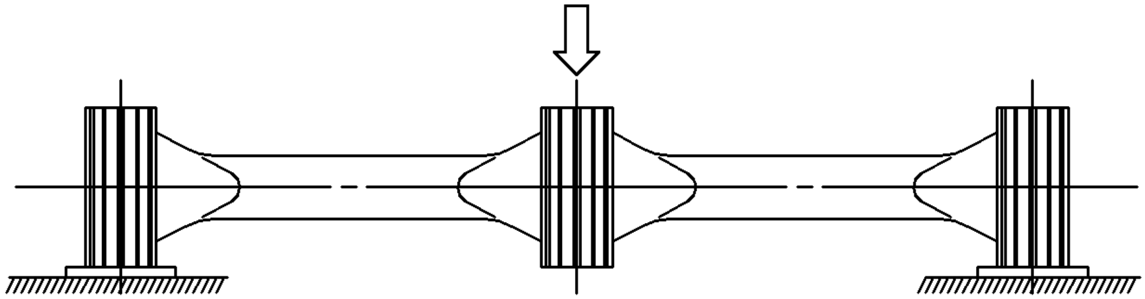
A description of experimental and analytical studies performed to understand the behavior of the fir-tree jointing systems are presented in the forthcoming sections.

2.3.1 Experimental Studies

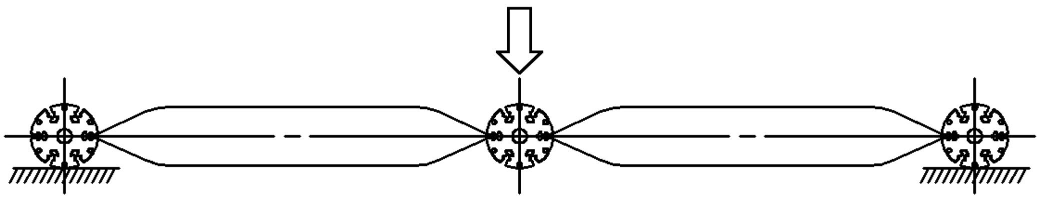
For any structural system to be considered for common practices, there has to be a clear understating of the behavior of its material. This includes the strength and failure mechanisms of any kind of structure (Doran 1997). Structural design standards exist for many materials and forms; no standards have been established for the design of structures making use of the semi-rigid behavior of the fir-tree jointing system. It is vital to characterize the behavior of such jointing systems to establish any design standards.

Sugizaki and Kohmura (1994) conducted an experimental study on an aluminum fir-tree jointing system. In this paper, the authors report the semi-rigid characteristics of the jointing system though basic tensile, compressive, and bending tests. From the tests performed after the specimen configurations shown in **Figure 2.21** and results shown in **Figure 2.22**, the authors gained a better understanding of the structural characteristics of the jointing system under bending

moment-rotation. It was found that the ratio between the out-of-plane and the in-plane bending rigidity is approximately 40:1.



(a) Out-of-Plane Bending



(b) In-Plane Bending

Figure 2.21 Bending Test Specimen Configurations (After Sugizaki and Kohmura 1994)

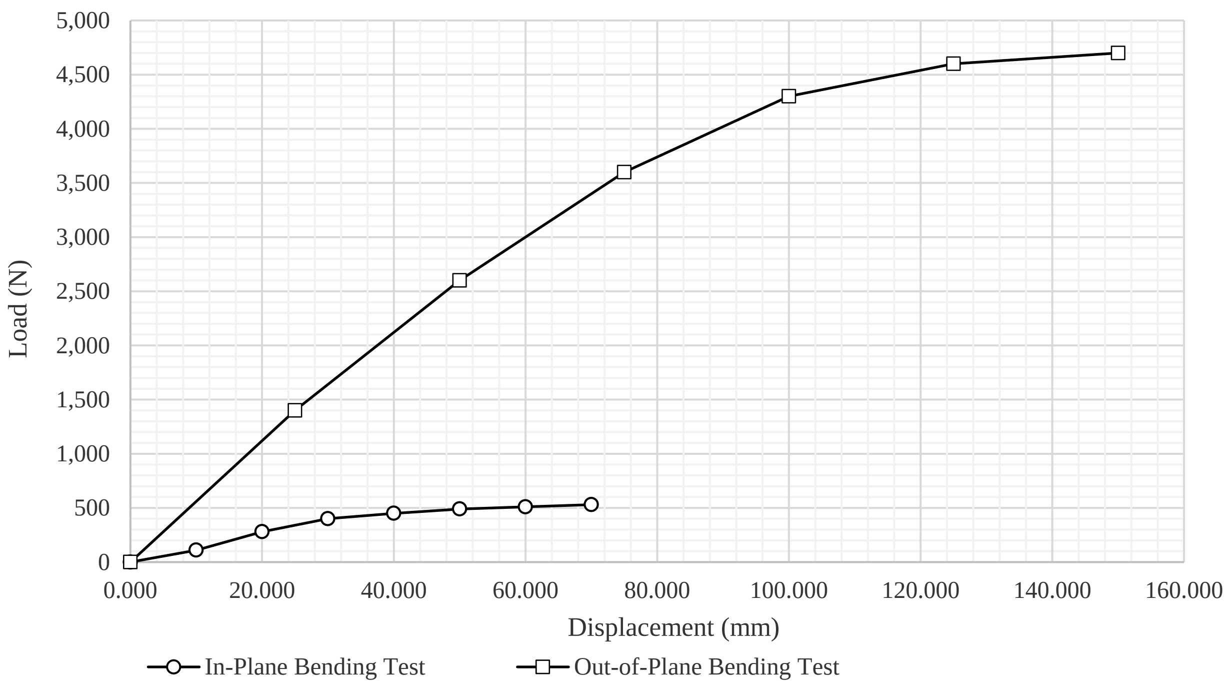


Figure 2.22 Bending Semi-Rigid Test Results (After Sugizaki and Kohmura 1994)

During a study conducted by Doran (1997), tension, compression end buckling, and bending capacities were tested on a sample of Geometrica® 6-6090 extruded aluminum connector portrayed in **Figure 2.23**. The elements comprising the Geometrica® 6-6090 hub jointing system include: (1) a 6005-T5 aluminum fir-tree connector; (2) A500 Class A structural steel tubular elements; and (3) a galvanized threated tie rod.

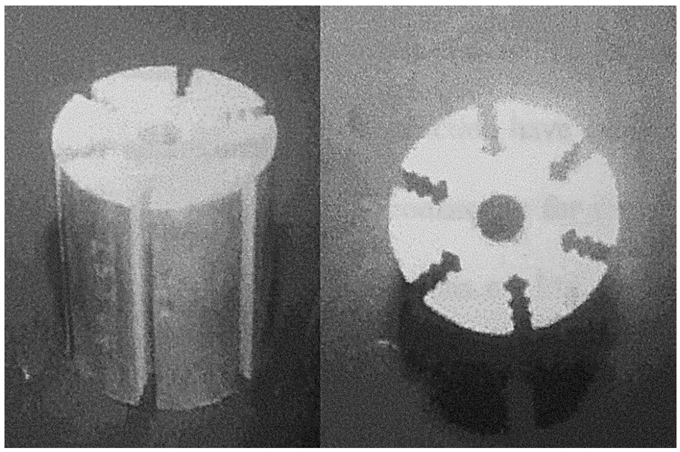


Figure 2.23 Geometrica® 6-6090 Extruded Aluminum Connector (Doran 1997)

The objective of the study was to obtain the strength characterization of the Geometrica® 6-6090 hub jointing system under quasi-static ramped loading conditions. There were two main goals to be accomplished during this study: (1) to characterize the ultimate load capacity and behavior under tensile load cases; and (2) to characterize the ultimate end-crippling load capacity comparing non-reinforced and reinforced structural steel tubular elements.

Nineteen specimens were tested under tensile loading conditions to provide load capacity data of four joint configurations. The jointing configurations of the tensile specimens are shown in **Figure 2.24** and were labeled as follows: (1) the Large Simple Tension (LST) specimens; (2) the Offset Tension (OT) specimens; (3) the Large Diagonal Tension (LDT) specimens; and (4) the Large Offset Diagonal Tension (LODT) specimens. The mentioned jointing system configurations

became subject to study since they are typical configurations encountered during the erection of three-dimensional structures.

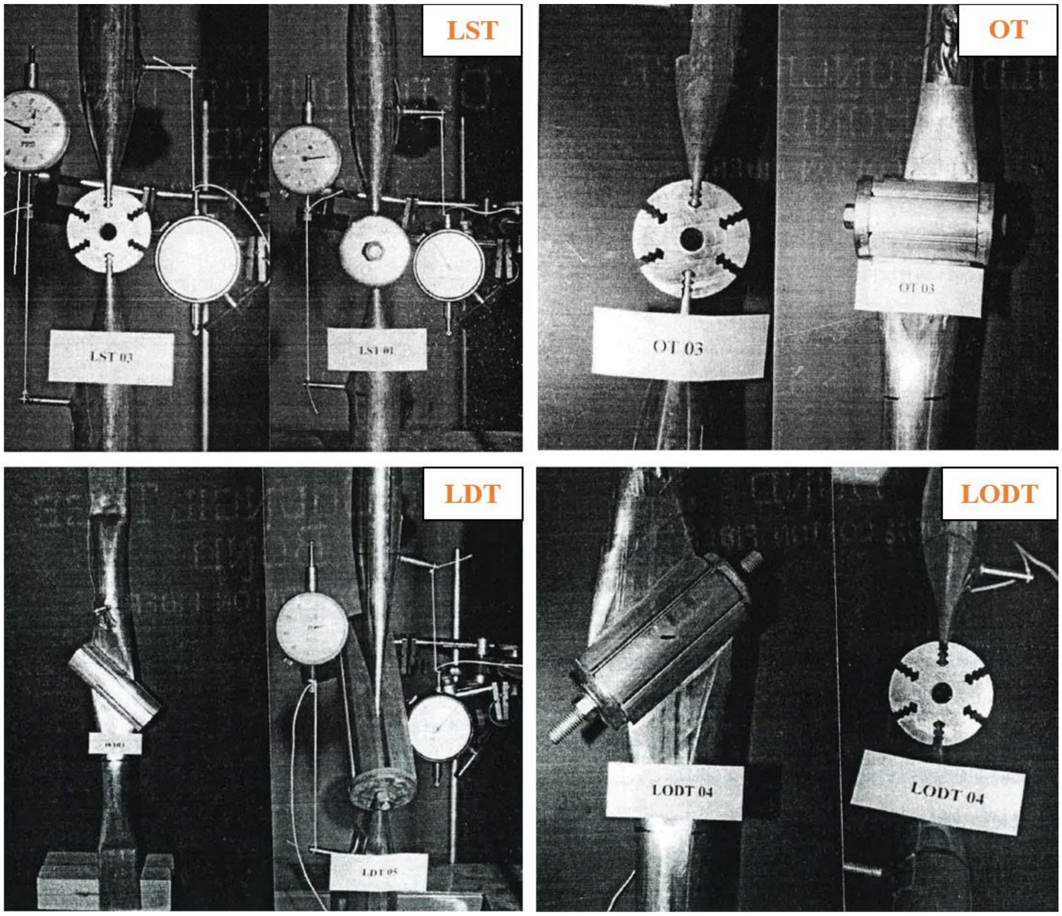


Figure 2.24 Geometrica® 6-6090 Tensile Tested Specimen Joint Configurations (Doran 1997)

The theoretical published ultimate stress value for A500 Class A steel tubing was 45 ksi. This value was compared against the ultimate load values of the connection obtained throughout the tensile testing. The ultimate failure loads for the LST specimens were 12,945-16,800 pounds (**Figure 2.25**) and for the OT specimens 13,170-15,960 pounds. For both the LST and the OT, the failure of the specimens was characterized by shear failure of the aluminum fir-tree teeth. Typical LST and OT specimen failures are shown in **Figure 2.26**.

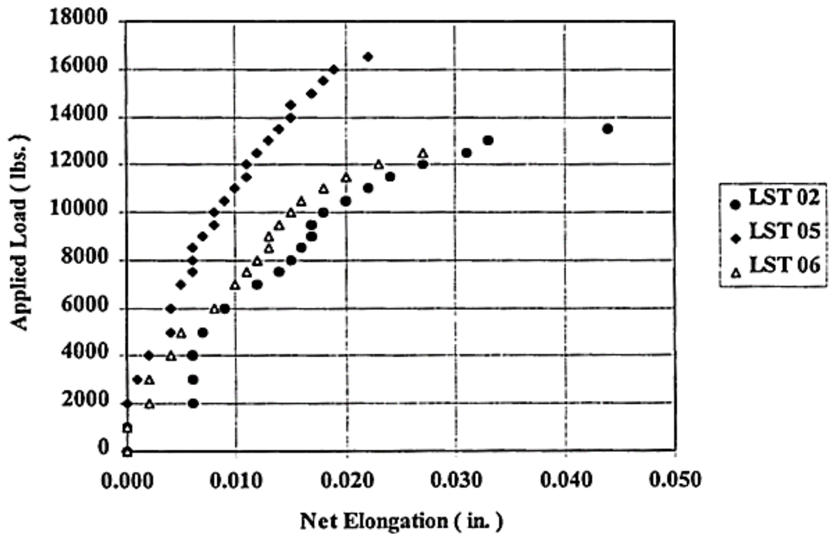


Figure 2.25 "Large Simple Tension" (LST) Specimen Load Vs Elongation (Doran 1997)

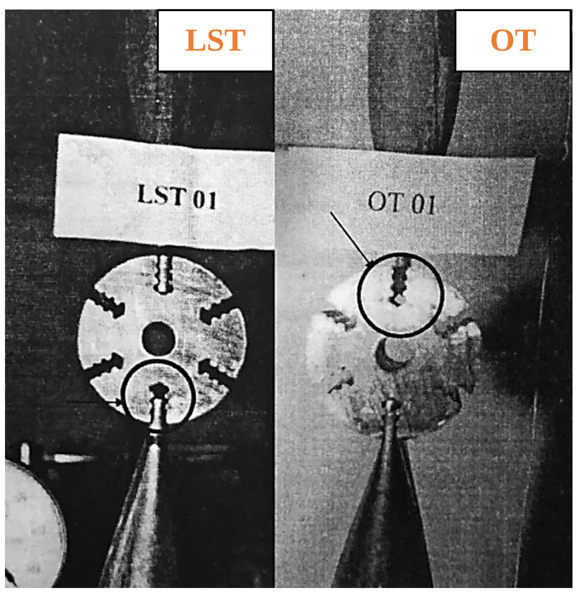


Figure 2.26 Typical LST and OT Specimen Failure (Doran 1997)

The ultimate failure loads for the LDT specimens were 10,800-17,200 pounds and for the LODT specimens 11,200-17,400 pounds. The failure for the LDT and LODT specimens were typically characterized by tie-rod fractures as a consequence of the combined bending and tension over-stress induced by sliding of the tubular elements within the fir-tree slots. The typical failure mechanism of both the LDT and the LODT specimens is shown in **Figure 2.27**.

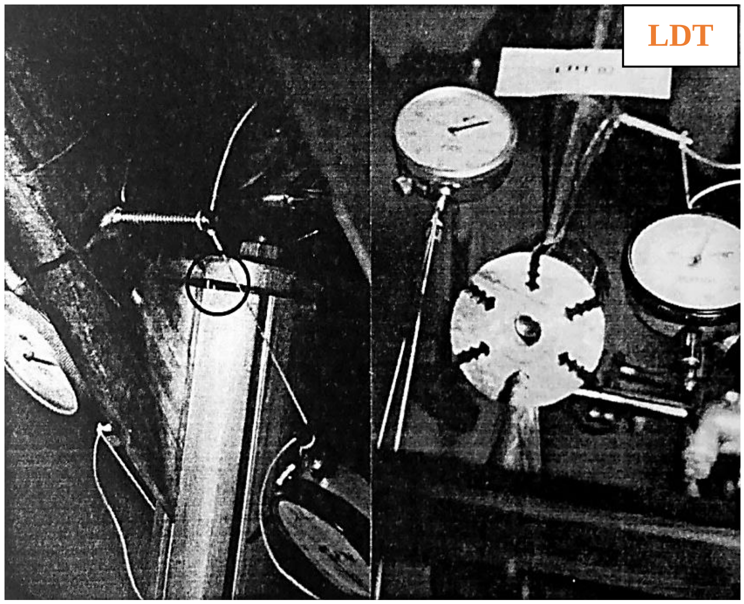


Figure 2.27 Typical LDT and LODT Specimen Failures (Doran 1997)

Forty-two specimens were tested under compression loading conditions to characterize the load carrying capacities and failure modes of the jointing system set in five different configurations. The jointing configurations of the specimens included: (1) the Non-Reinforced Compression (NRC) specimens; (2) the Gusset-Reinforced Compression (GRC) specimens; (3) the Cross-Reinforced Compression (CRC) specimens; (4) the Longitudinally-Reinforced Compression (LRC) specimens; and (5) the Tangentially-Reinforced Compression (TRC) specimens.

The theoretical published yielding stress value for A500 Class A steel tubing was 33 ksi. The theoretical yielding and ultimate stress values were compared against the ultimate load values obtained throughout the compression testing. **Figure 2.28** presents the average failure loads of the different configuration of the jointing system tested under compression loading. It was noted that the material yielding properties exceeded the published stress for A500 structural steel. In addition, a couple of configurations also reached the material ultimate strength.

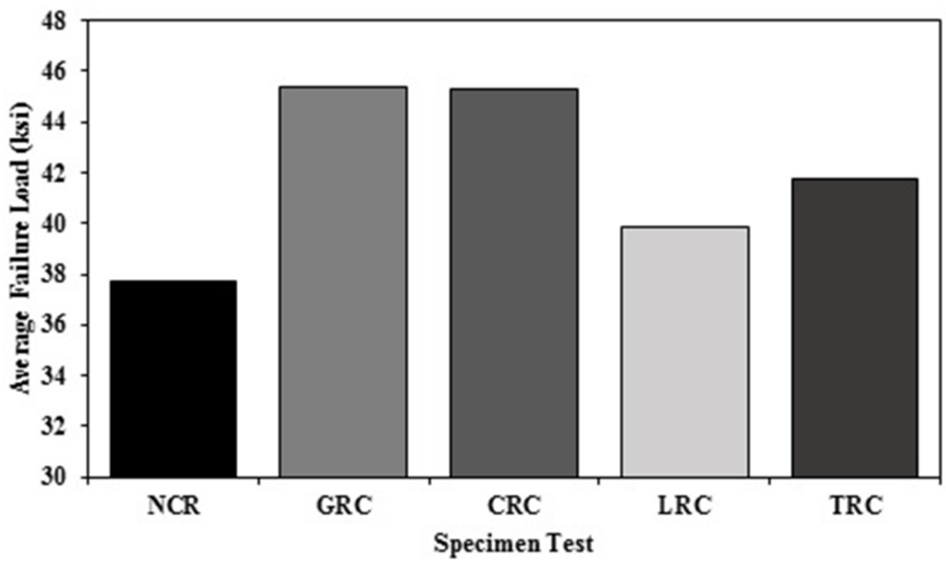


Figure 2.28 Average Failure Loads Compression Specimens (Doran 1997)

Ferregut and Carrasco (1998) conducted a similar study to characterize the structural strength of another Geometrica® connector. Tension and compression tests were conducted on the Geometrica® 6Zd-00 hub jointing system.

Fifteen specimens were tested under tensile loading conditions to provide the jointing system's tensile capacity data under two different configurations. Four of the jointing system specimen configurations included connectors with non-loaded slots, while the other eleven specimens were tested with all non-loaded connector slots filled with filler shims. This was done to study the effect of having connector slots filled by other tubular members. One end of each tubular steel element was die-formed, tapering from the round section to the die formed symmetric serrated end. Flattening a long portion of the tubular elements opposite to the serrated end was done for embracement by the clamping jaws of the universal machine.

The theoretical yielding stress value of 42 ksi for A500 GrB galvanized low-carbon structural steel tubing was compared against the ultimate (failure) load values of the connection obtained throughout the tensile testing. The specimens with no filler shims achieved ultimate

failure loads ranging from 25,800 to 26,125 pounds. The failure mode was characterized by the fracture of the aluminum hub. The specimens with filler shims achieved ultimate failure loads ranging from 27,800 to 28,600 pounds. The failure for this configuration was observed to be characterized by a ductile failure of the steel tube material before the system reached its ultimate capacity. The typical specimen failure with filler shims is shown in **Figure 2.29**.

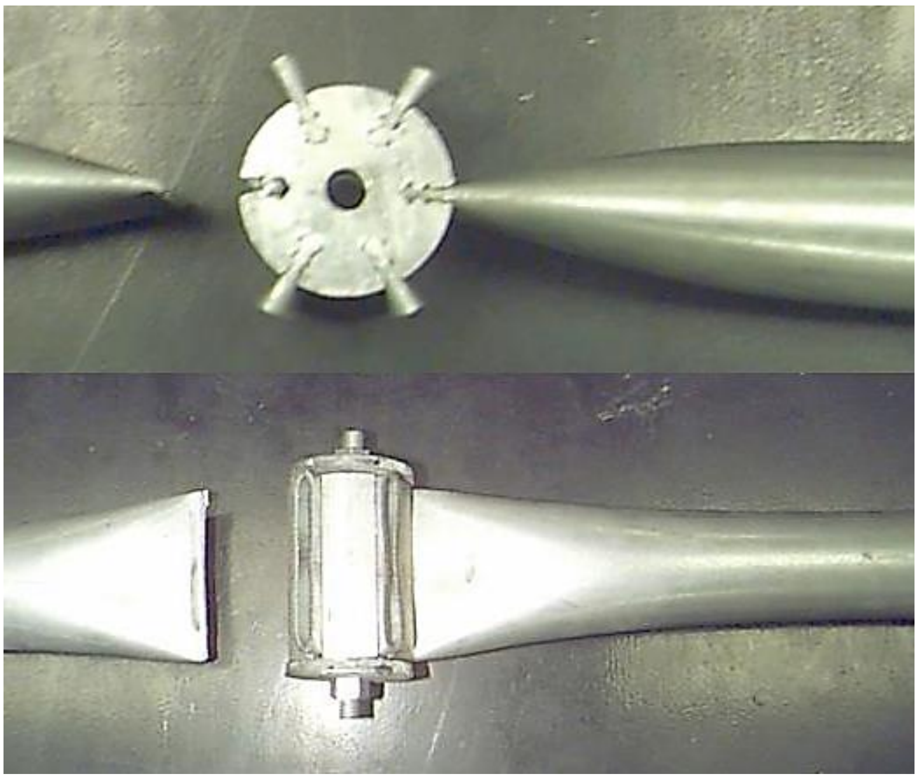


Figure 2.29 Typical Tensile Test on Specimen with Shim Fillers (Ferregut and Carrasco 1998)

Twelve specimens were tested under compression loading conditions to provide joint compressive capacity data. The joint configuration, denoted as Non-Reinforced Tube (NRT), consisted of a connector element, a mild structural steel base plate having attached two welded rolled-formed filler shims, three extra filler shims for non-loaded connector slots, and a tubular member.

The compressive specimens achieved ultimate failure loads ranging from 35.59 to 40.14 ksi. The failure mode was characterized by a local outwards buckling of the tubular member end sections combined with local dimpling at the taper run-out section of the tube parallel to the connector axis as seen in **Figure 2.30**.

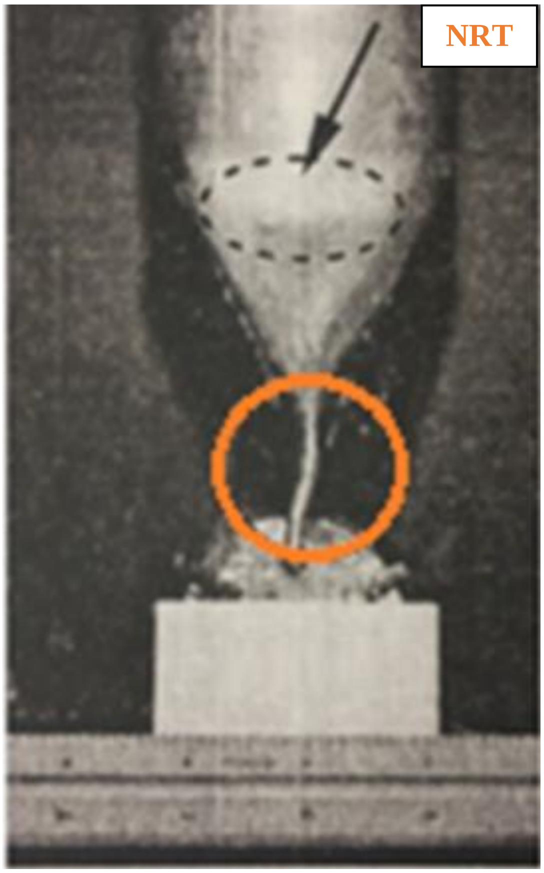


Figure 2.30 Typical Compressive NRT Test Failure Mode (After Doran 1997)

Three other configurations were tested under compression similar to the previously performed by Doran (1997). The tested specimens included the following jointing system configurations: (1) Longitudinal-Reinforced Tube (LRT); (2) Tangential-Reinforced Tube (TRT); and (3) the Cross-Reinforced Tube (CRT). **Figure 2.31** presents the ultimate failure loads for all compressive tests.

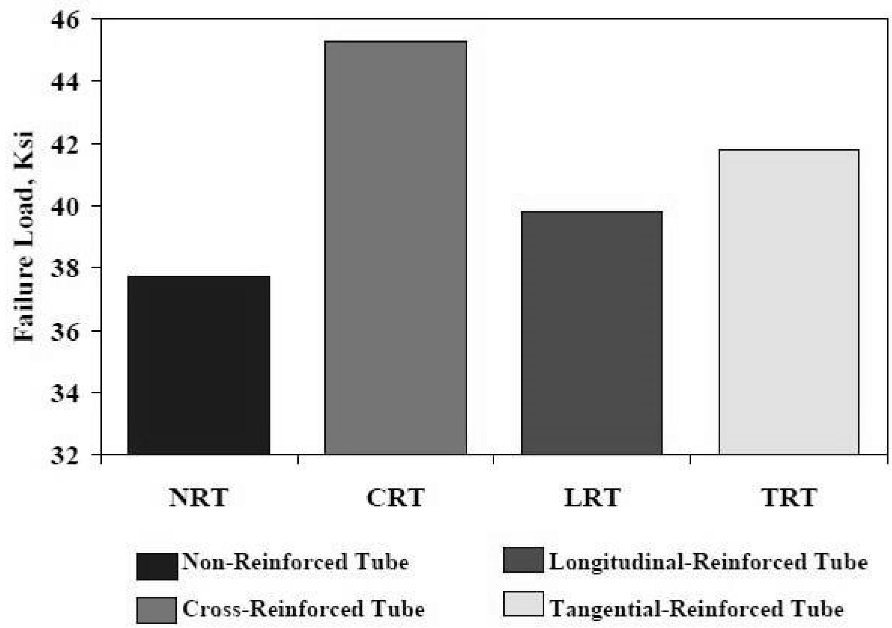


Figure 2.31 Average Failure Loads Compression Specimens (Ferregut and Carrasco 1998)

2.3.2 Analytical Studies

Ferregut and Carrasco (1998) developed a finite element model for the Geometrica® jointing system. The finite element analysis of the 6Zd-00 connector and a pressed-on section of a tube was done using plane strain elements of one inch nominal thickness. Plain strain is the deformation of a body where the displacements of all the points in the body are parallel to a given plane. Also, the values of the displacements do not depend on the distance perpendicular to the plane. Plane strain is commonly used to analyze deformation or fracture of material.

In general, the Geometrica® connectors are symmetrical; these characteristics were taken in advantage to only model one quarter of the connector and half of the pressed-on section of the tube. **Figure 2.32** shows the space discretization and general dimensions to which the jointing system was created and modeled using finite element analysis.

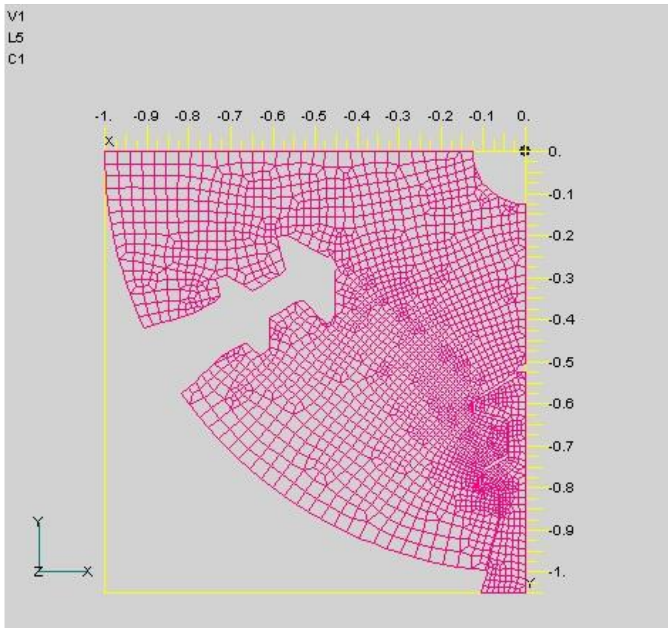


Figure 2.32 6Zd-00 Connector and Tube Space Discretization (Ferregut and Carrasco 1998)

This study was conducted considering that the materials of the jointing system elements behaved in an elastic perfectly-plastic manner. To create an interaction between the connector and the tube, a series of incremental displacements were subjected onto the base of the tube. These displacements were enforced until the static equilibrium was reached. **Figure 2.33** illustrates a plot of the force required to produce the enforced displacement at the base of the tube used in the model.

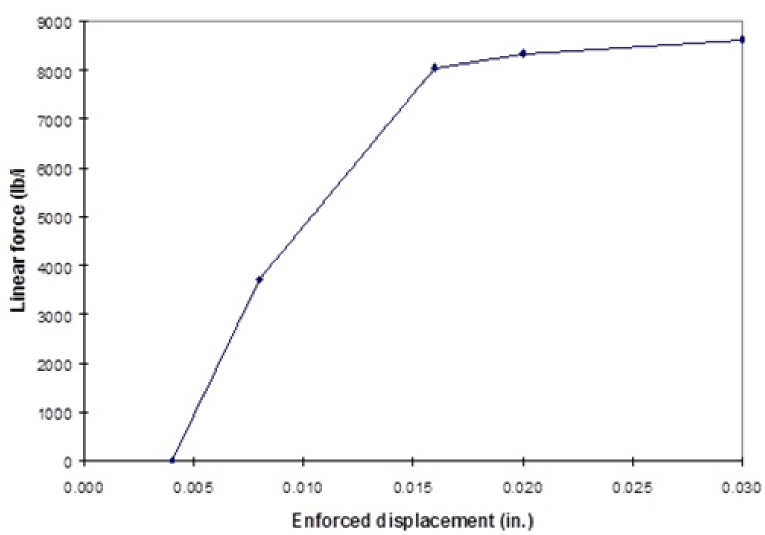


Figure 2.33 6Zd-00 Connector and Tube Load vs. Displacement (Ferregut and Carrasco 1998)

To define the plastic behavior of the material, the VonMises' yield criteria were used. Since the material properties for the jointing system were assumed to be elastic perfectly-plastic, the finite element analysis conducted underestimated the capacity of the system. **Figure 2.34** is a set of graphical representations of the VonMises stress distribution at different enforced displacements.

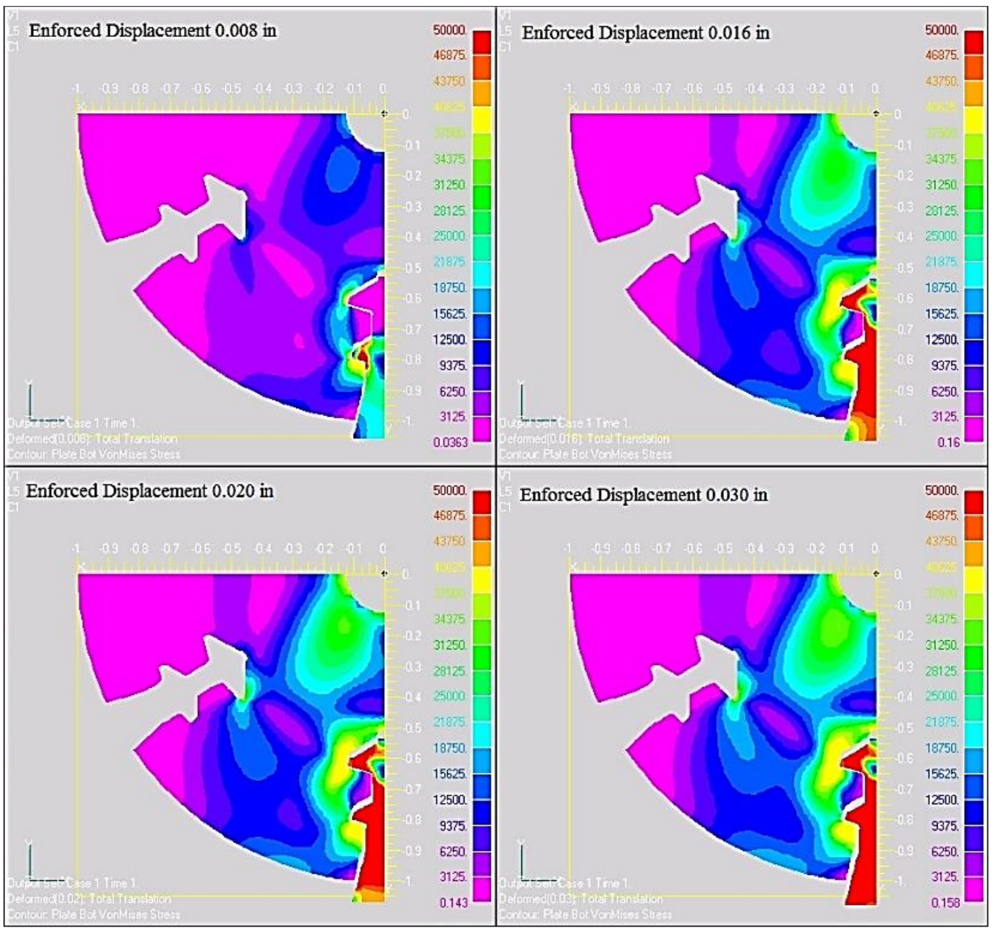


Figure 2.34 6Zd-00 Joint System Von Mises Stress Distributions (Ferregut and Carrasco 1998)

Experimentally, the capacity of the 6Zd-00 jointing system was tested to be at around 28,000 lb. The numerical simulation estimated that the capacity of the system was approximately 25,500 lb. The notable difference in capacities was due to the lack of integrating hardening into the material properties. This research could be further developed to better represent the actual behavior of the jointing system if the hardening of the materials would be included in the analysis.

2.4 Summary of Literature Review

Past research studies to identify three-dimensional structure geometric imperfections and the semi-rigid behaviors of different jointing systems have been reviewed in this chapter. Different types of geometric imperfections considered in three-dimensional structures including member initial curvature and nodal coordinate location deviation have shown to cause a decrease in the load carrying capacity of three-dimensional structures. In addition, studies have been conducted to characterize the semi-rigid behavior of different types of jointing systems. Studies so far have assumed that semi-rigid jointing systems in three-dimensional structures behave as per the finite element analysis (as-designed condition) or experimental tests. Ma et al. (2013a) state that fabrication errors in jointing systems, used in three-dimensional structures, can lead to a variation in the mechanical behavior and load carrying capacity between the “as-built” and “as-designed” jointing system. However, to date, an analysis to understand the effect of manufacturing geometric imperfections on the semi-rigid behavior of jointing systems used in three-dimensional structures does not exist.

This dissertation is the first research work dedicated to study the jointing system mechanical semi-rigid behavior considering manufacturing geometric imperfections. In this study, the as-designed model of the jointing system deviates in such a way that the locations of the contacting surfaces do not follow the intended interaction path due to the component elements’ imperfect engagement geometries. The result of the changes in the interaction path might lead to load transfer discrepancies, affecting the overall behavior of the jointing system and even more important the behavior of the complete structural system. The expected results will help understand how manufacturing geometric imperfections affect mechanical semi-rigid behavior and load capacity of a jointing system used in three-dimensional structures.

Chapter 3: Characterizing Jointing System Dimensions

This chapter describes a procedure to obtain geometric measurements of the as-designed and as-built Geometrica® 6Sd-00 jointing system. The purpose of this chapter is to collect geometric dimensions of the jointing system components and to generate a representative model that would describe the as-designed and as-built conditions of the connections to be used during the finite element modeling and analysis. The main components of the Geometrica® 6Sd-00 jointing system used for this research are as follows: (a) the Geometrica® 6Sd-00 fir-tree connector; and (b) a tube with a pressed end. Three tube thicknesses were considered: (a) 0.090", (b) 0.104", and (c) 0.120".

3.1 As-Designed Dimension of the Jointing System

The as-designed profile of the Geometrica® 6Sd-00 jointing system was obtained from shop drawings of the jointing system's main connecting element components. The procedure to obtain the dimensions of the jointing system is explained in the following:

Step 1: Use the dimensions of the as-designed shop drawings to identify coordinate locations of important inflection points along the contact surface (the engagement surfaces between the connector and tubular element) shown in **Figure 3.1**.

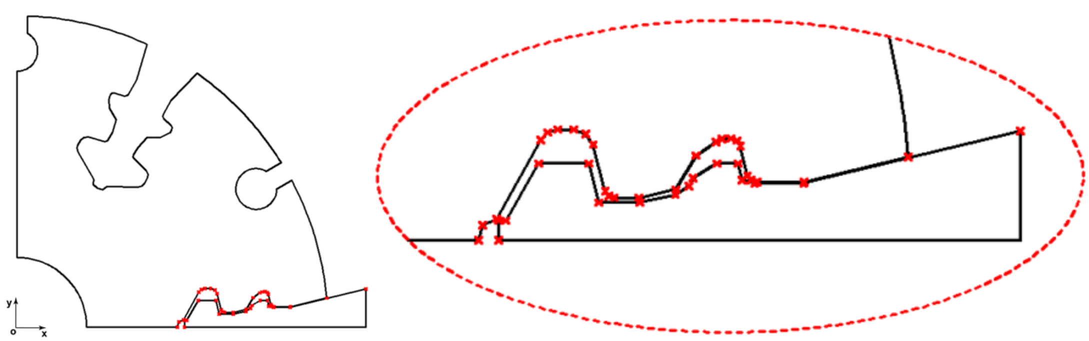


Figure 3.1 Key Inflection Points on Geometrica® 6Sd-00 Jointing System

Step 2: Having obtained the xy-coordinates of important inflection points, the as-designed hub connector slot profile and the as-designed tube coined pressed end profile were generated in a

Computer-Aided Design model (CAD). For example, **Figure 3.2** and **Figure 3.3** present the as-designed 6Sd-00 hub connector slot profile and the as-designed 0.090 in tube coined pressed end profile, respectively.

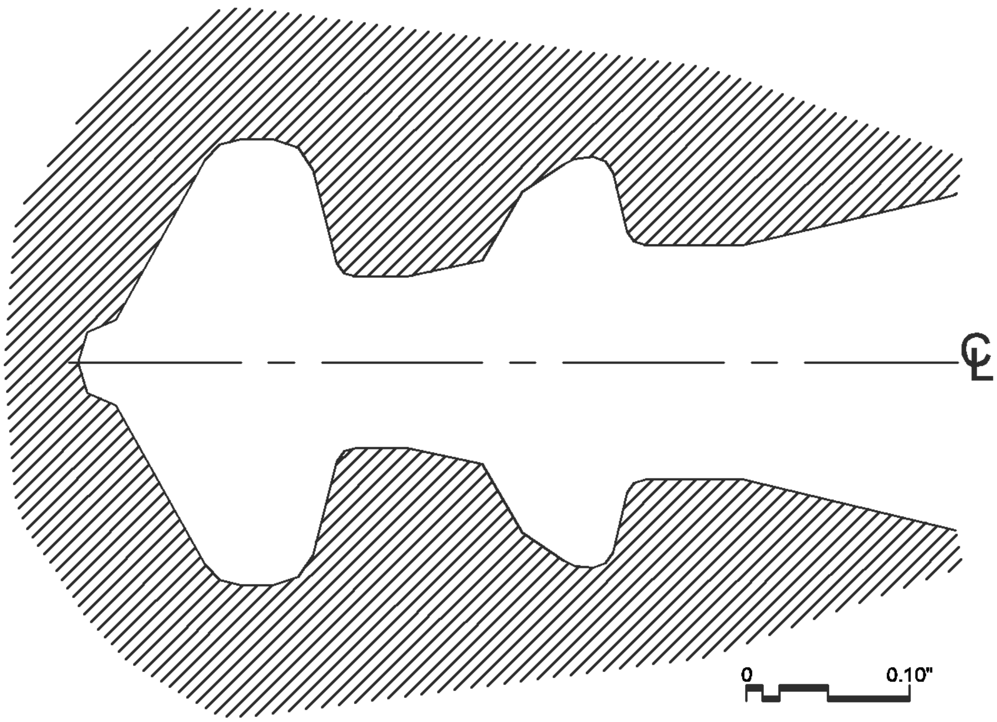


Figure 3.2 As-Designed 6Sd-00 Hub Connector Slot Profile

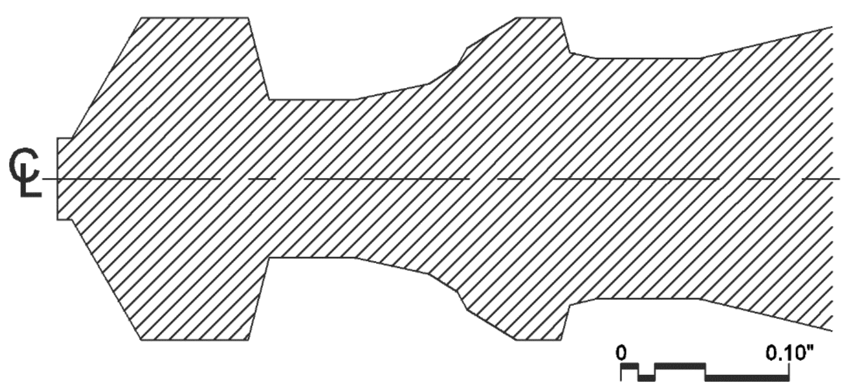


Figure 3.3 As-Designed 0.090 in Tube Coined Pressed End Profile

One as-designed 6Sd-00 hub connector slot profile and three as-designed tube coined pressed end profiles were generated. The complete set of as-designed profiles used in this dissertation can be found in **Appendix A.**

3.2 Database of As-Built Dimensions of the Jointing System

To determine as-built dimensions of the jointing system, three connector and nine tube coined pressed end samples of the Geometrica® 6Sd-00 jointing system components were randomly selected from the production's population to estimate the uncertainty in the geometry from the manufacturing process. The method to obtain the dimensions of the jointing system is explained in the following step-by-step procedure.

Step 1: To capture the manufacturing imperfections along the contacting surfaces of a single jointing system connector, a sample connector was sliced to obtain ten measurable faces using a wire Electrical Discharge Machine (EDM). The wire EDM is a mechanism that uses an electrically charged hair thin wire (0.004 inches) to make highly detailed cuts (Mitsubishi Electric Corporation 2013). This technique is essential to avoid rough cutting of the connector that would leave excessive damaged material along the peripheral edge of the sliced pieces (i.e. cutting with band saw). Using the wire EDM allowed to obtain near perfect cut slices of the connector without inducing damages. Consequently, a near to perfect representation of the as-built geometry of the connector was obtained along its longitudinal axis. Only the cut sliced internal faces of the connector were considered for measurement, excluding the exterior faces due to possible induced damages not caused by manufacturing imperfections (i.e. handling dents). **Figure 3.4** shows the Geometrica® fir-tree hub connector cross-sectional area and longitudinal length of approximately 5.25 inches. This figure also presents the cuts that produced five sliced pieces of connector, each having an approximate length of 1.05 inches.

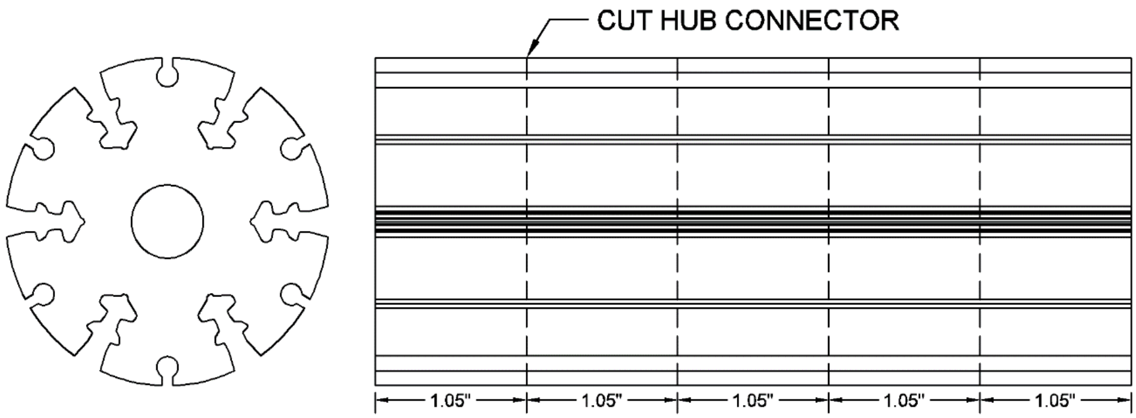


Figure 3.4 Geometrica® 6Sd-00 Hub Connector and Projected Cuts

Step 2: The ends of the tubular element were cut to obtain random samples of the tube coined pressed ends using the same technique as in Step 1. To capture the manufacturing imperfections along the contacting surfaces of a single tube element, the coined pressed ends were sliced three times to obtain four equal length pieces of the coined pressed end as shown in **Figure 3.5**. Only the two internal pieces of each end were used for measurement. The outer two slices of the tubes were not considered as an acceptable specimen due to the concave geometry on one side of the slice preventing it to maintain a stable position in the measuring device.

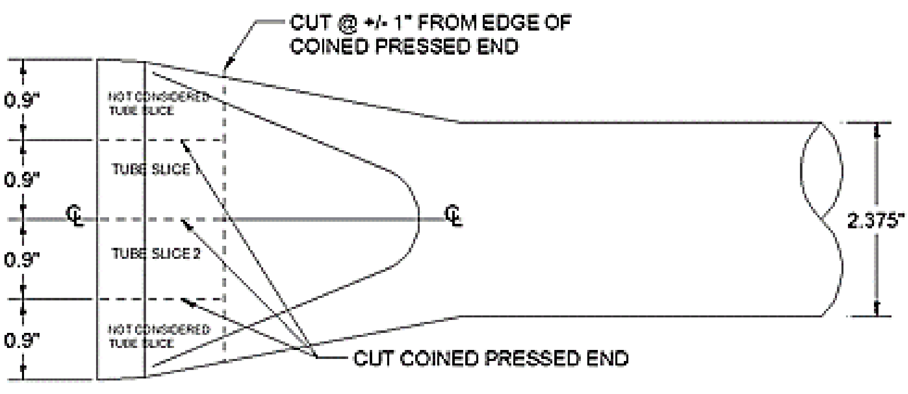
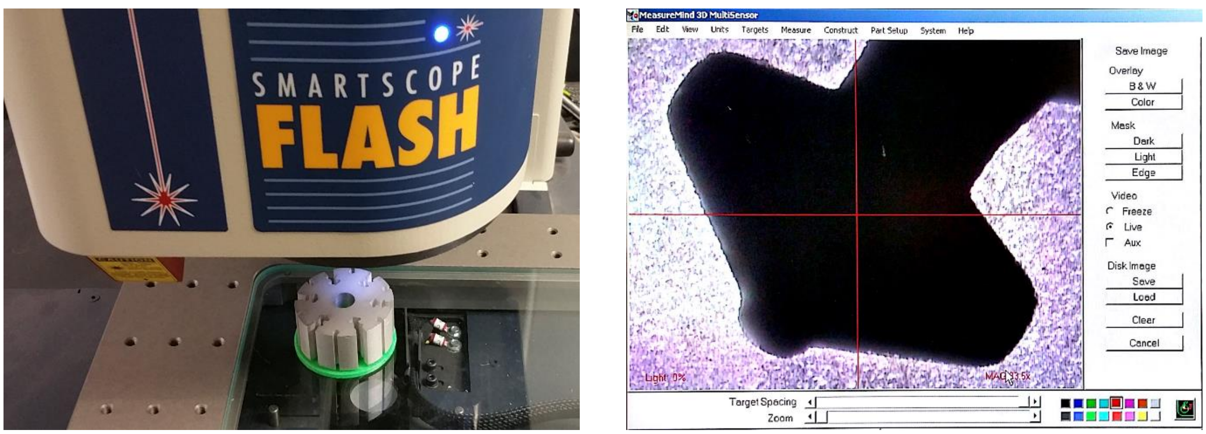


Figure 3.5 Geometrica® Tubular Element and Projected Cuts

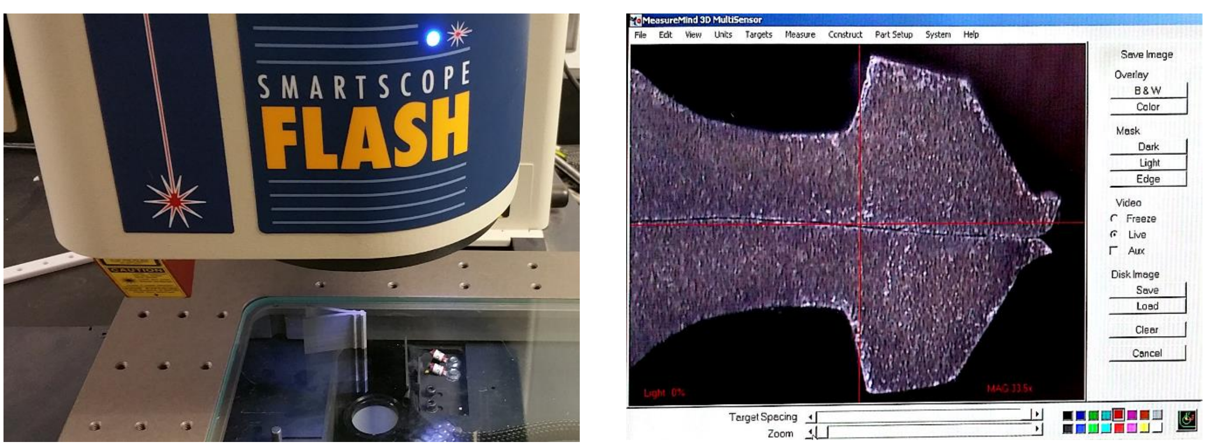
Step 3: Measurements of the specimens were taken using an OGP Smart Scope Measuremind 3D MultiSensor. With the use of the OGP Smart Scope, surfaces were magnified with a 33.5x zoom lens along with a conversion lens (x0.5) enabling precise measurements of the

jointing system components. Defining a predefined origin as the point of reference on the device's measuring stage, measurements were obtained by identifying the coordinate locations of key inflection points along the contact surface of the jointing system as previously presented in **Figure 3.1**. Having the xy-coordinates of key points from the fixed origin, it allowed to replicate the as-built jointing system in a CAD model. **Figure 3.6(a)** illustrates a slice of the Geometrica® 6Sd-00 connector placed under the magnifying scope during inspection. **Figure 3.6(b)** displays a screen shot of the software during the process of magnifying important areas of the connector to determine the position of the magnified features accurately**. Figure 3.7 (a)** and **(b)** follow the same latter description for the inspection of the tube coined pressed end slice.



(a) **(b)**

Figure 3.6 OGP Smart Scope Measuring of Geometrica® 6Sd-00 Connector Slice



(a) **(b)**

Figure 3.7 OGP Smart Scope Measuring of Geometrica® Tube Slice

Step 4: Next, the profiles were generated in CAD software using the coordinate locations of inflection points along the contact surface of the jointing system component elements. An example CAD drawing of the as-built geometry of the 6Sd-00 connector and tube coined pressed end is illustrated in **Figure 3.8** and **Figure 3.9**, respectively. The generated profiles incorporate geometric imperfections created during the manufacturing process of the jointing system.

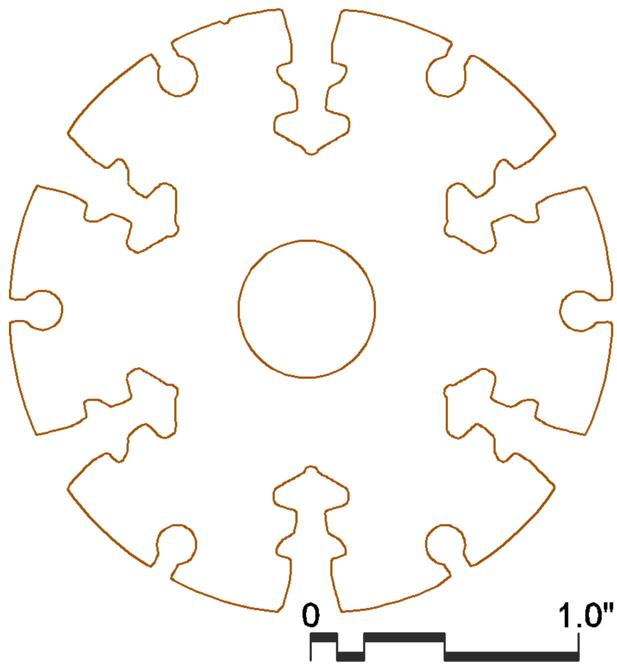


Figure 3.8 As-Built Connector Profile Example

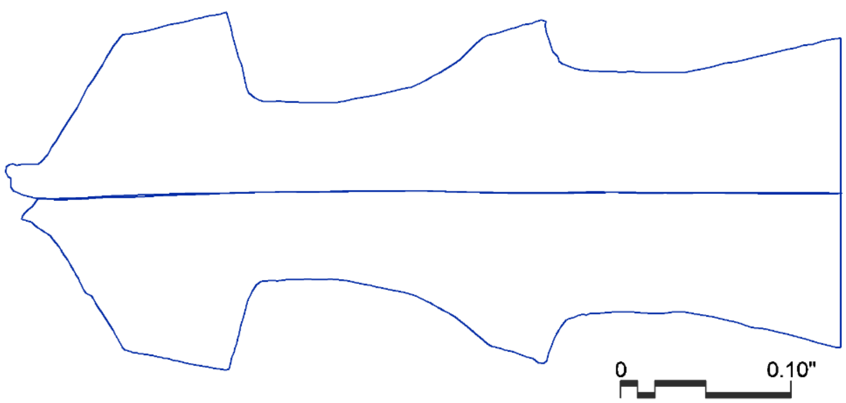


Figure 3.9 As-Built Tube Coined Pressed End Profile Example

Step 5: During this step, the generated hub connector slots and tube coined pressed end profiles were superimposed from the common point of reference. The overlapped profiles allowed the range of dimensional deviations between the profiles to stand out. **Figure 3.10** and **Figure 3.11** show and example of the superimposed slot profiles of one face of the hub connector and the superimposed tube coined pressed end profiles of a specimen measured, respectively.

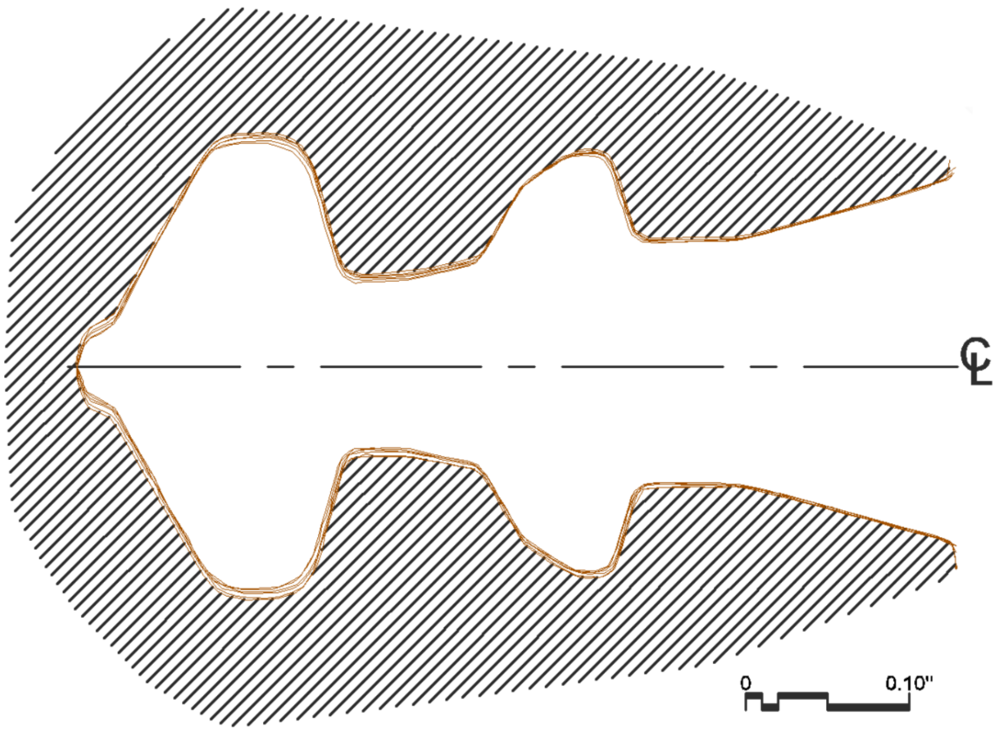


Figure 3.10 As-Built Superimposed 6Sd-00 Hub Connector Slot Profiles

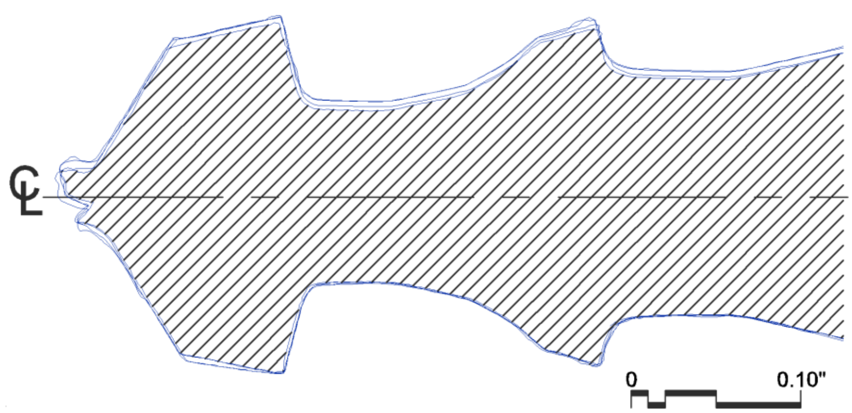


Figure 3.11 As-Built Superimposed Tube Coined Pressed End Profiles

Step 6: A geometric profile that integrates the variability of the manufacturing geometric imperfections was defined to reduce the number of as-built profiles. To define this representative geometry, the as-built profiles were mirrored across its centerline to represent half of the connector slot or tube coined pressed end elements due to symmetrical characteristics. Subsequently, the superimposed profiles were divided at constant horizontal increments of 0.005 inches as shown in **Figure 3.12** and **Figure 3.13**, respectively.

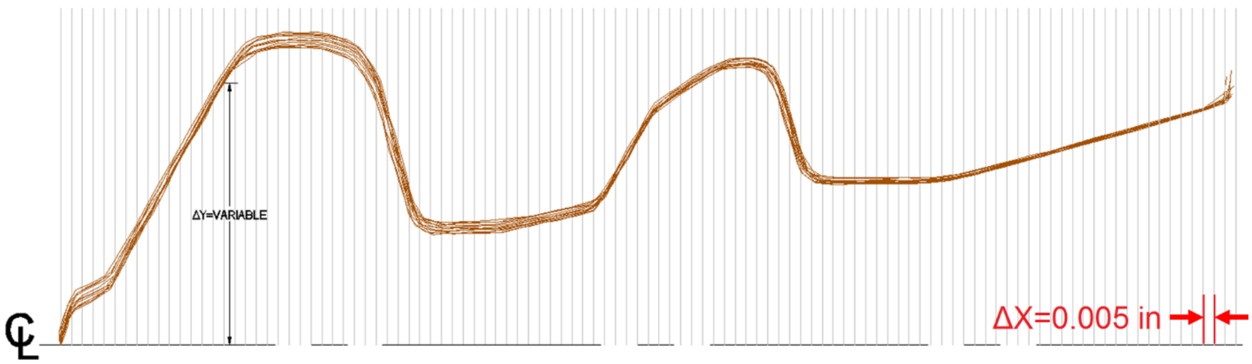


Figure 3.12 Superimposed Profiles of the As-Built 6Sd-00 Hub Connector Slot Profiles Divided at a Constant Horizontal Increment

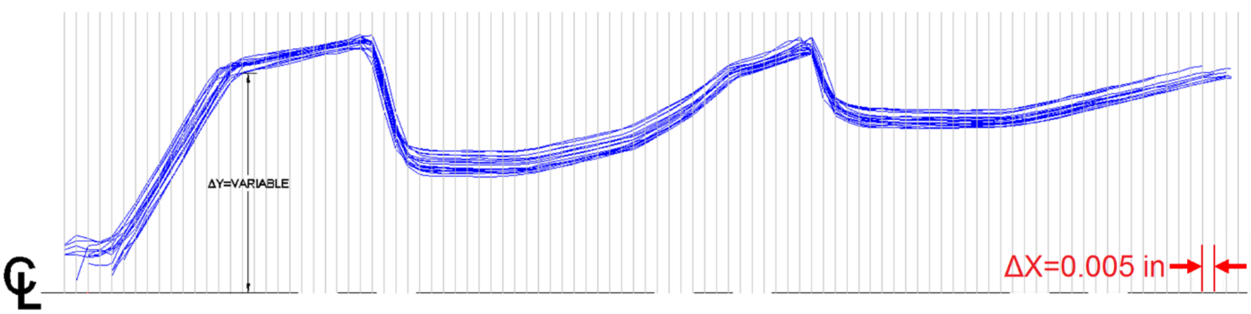


Figure 3.13 Superimposed Profiles of the As-Built Tube Coined Pressed End Profiles Divided at a Constant Horizontal Increment

The partition of the profiles was done to measure the vertical deviations and to identify the mean position of the representative profile at every 0.005 inches horizontally. The mean representative

profile is the average of the experimentally measured profiles at every section. An illustration identifying intersecting points of the profiles at 0.005 inch horizontal increments and the mean representative profile is presented **Figure 3.14**. The increment value was defined through an iterative process until reaching 0.005 inches; result that was capable of capturing the variability of imperfections throughout important inflection points of the geometric profile.

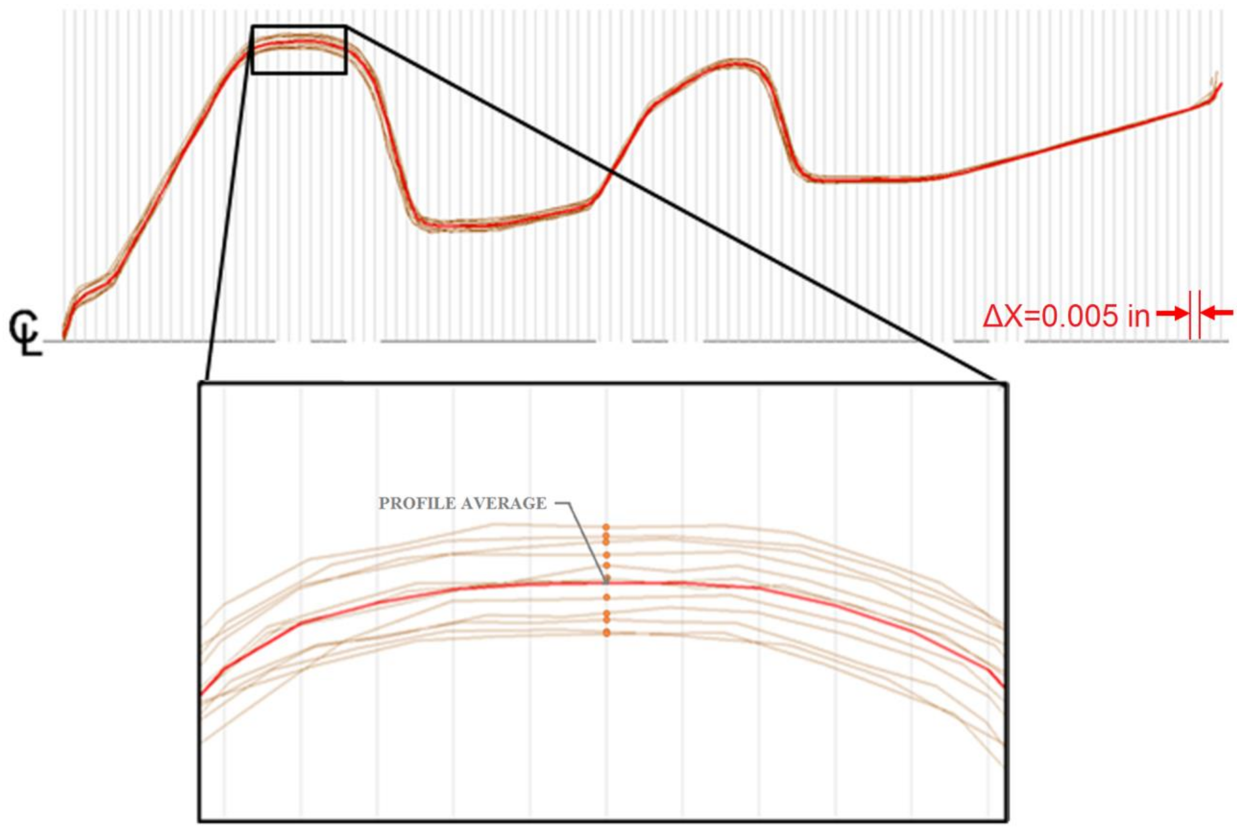


Figure 3.14 Close-Up of Profile Intersections and Profile Average

Step 7: With the profile average coordinate locations at each horizontal increment, the mean as-built representative slot profile and the mean as-built representative tube coined pressed end profiles were CAD generated as shown in **Figure 3.15** and **Figure 3.16**, respectively.

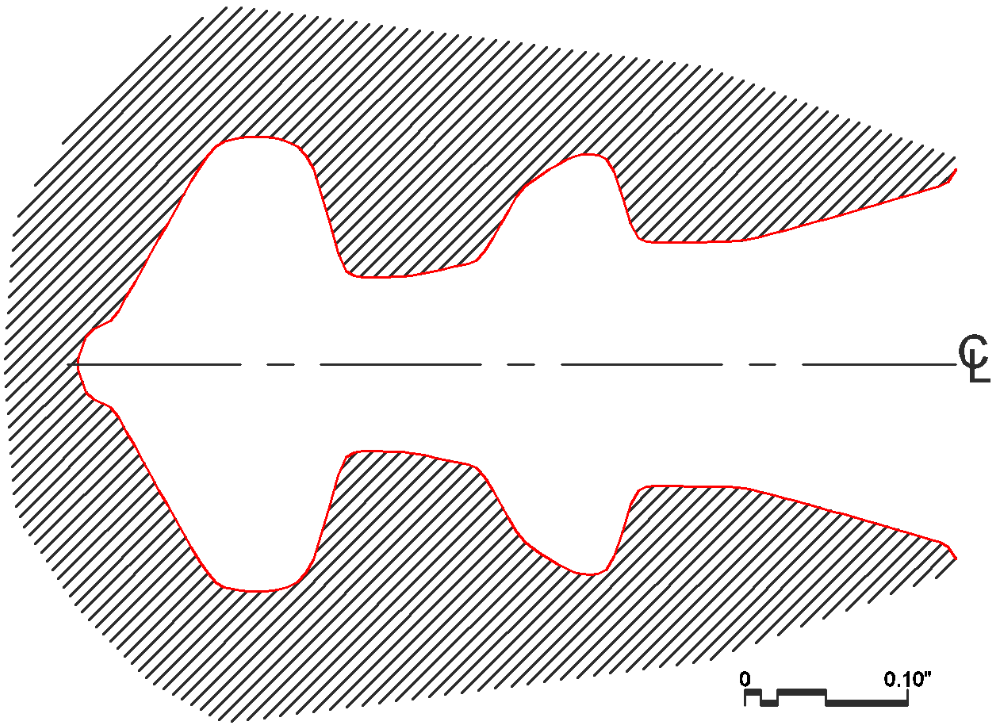


Figure 3.15 Mean As-Built 6Sd-00 Hub Connector Slot Profile

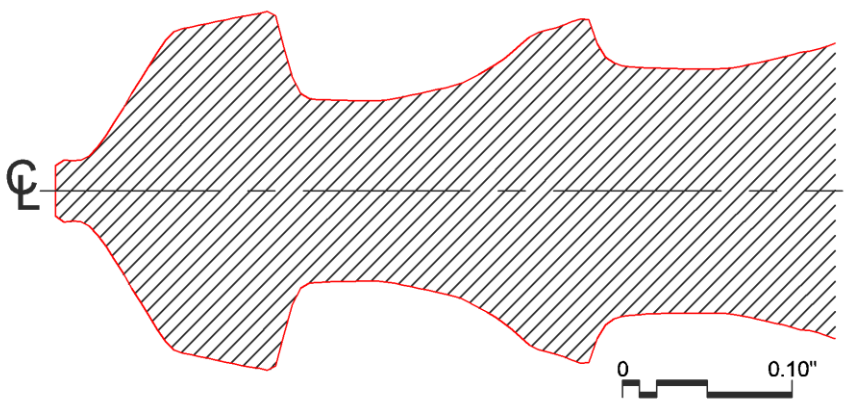


Figure 3.16 Mean As-Built Tube Coined Pressed End Profile

Three 6Sd-00 connector elements were measured and used for this dissertation each identified by letters A through C. Three different tube coined pressed end elements were measured per tubular thickness, each also identified by letters A through C. The step-by-step illustrative procedure to generate all slot connectors and all tube coined pressed end profiles (along with the xy coordinate) considered in the present study can be found in **Appendix B**.

3.3 Comparison of As-Designed and As-Built Geometry

The as-designed profiles were superimposed to all the corresponding mean as-built profiles to define the variations within the connector or tube coined pressed end geometries. The vertical variations between profiles were collected every 0.005 inches horizontally. For the purpose of visualizing how the profiles deviate, **Figure 3.17** and **Figure 3.18** show an example of the superimposed as-designed vs mean as-built hub connector slot and tube coined pressed end profiles, respectively. The red shaded region indicates a negative deviation from the as-designed to the mean as-built profiles of the jointing system, defining a lack of material. The blue shaded region indicates a positive deviation from the as-designed to the mean as-built profiles of the jointing system, defining an excess of material. The previously mentioned figures are used as examples only. The real superimposed as-designed vs mean as-built hub connector slot and tube coined pressed end profiles used during this dissertation can be found in **Appendix C**.

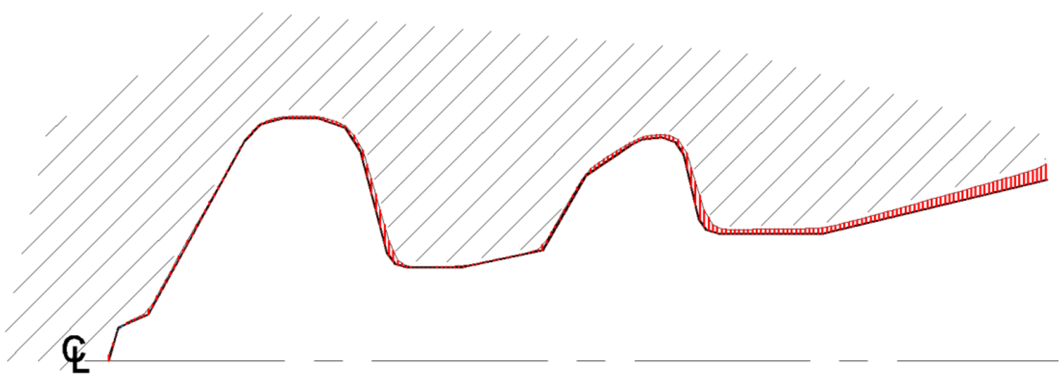


Figure 3.17 As-Designed vs As-Built Connector Slot Geometric Comparison

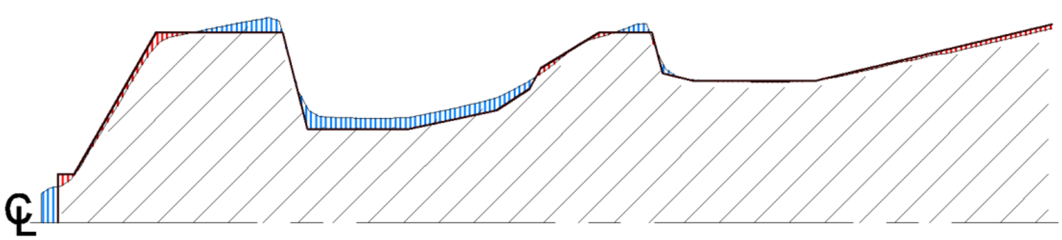


Figure 3.18 As-Designed vs As-Built Tube Geometric Comparison

A comparison analysis of the as-built profiles was performed considering important key points controlled by the manufacturer during the fabrication quality control process of the jointing system (Castaño et al. 2014). These important key points are measured to determine the quality of a manufactured connector and tube coined pressed end component. The Quality Control Points (QCP) used are shown in **Figure 3.19**.

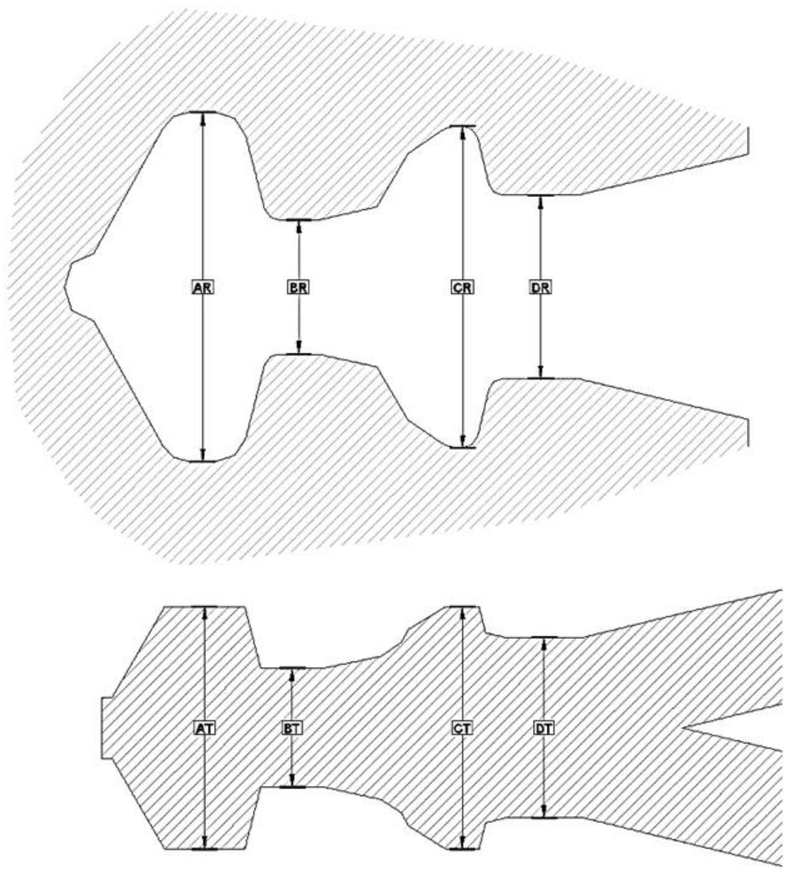


Figure 3.19 Connector Slot and Tube Coined Pressed End Quality Control Measurements

Statistical data of the profile geometric variability (imperfections) was collected; the Coefficient of Variation (COV) was used to define how the superimposed profiles behaved relative to the mean profile. **Figure 3.20** and **Figure 3.21** present a plot of the as-designed vs mean as-built connector slot and tube coined pressed end profiles, respectively. In addition, it displays the coefficient of variation of the measured as-built profiles at every 0.005 inches horizontally and

identifies the quality control points. From the latter mentioned figures, it can be observed that the coefficient of variation at the quality control points is low; with exception for QCP's at "B", which has relatively the highest COV of the connector slot and tube coined presses end profiles. The corresponding plots of all the connector and tube coined pressed end elements considered during this study can be found in **Appendix C**. **Table 3.1** and **Table 3.2** present the coefficient of variation at the QCP's of the manufactured connector slots and tube coined pressed ends, respectively.

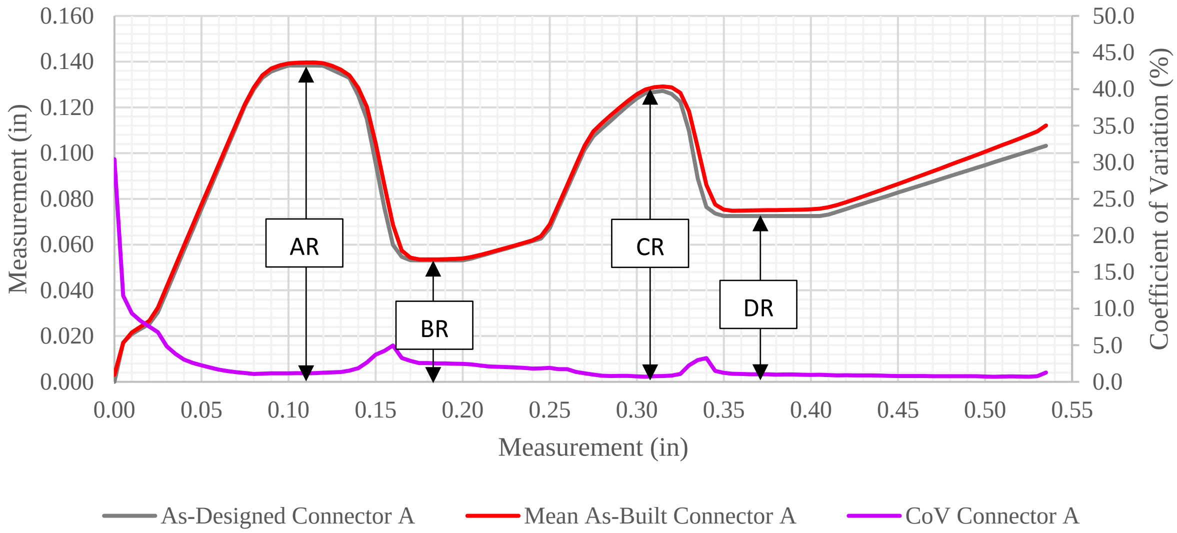


Figure 3.20 Coefficient of Variation - 6Sd-00 Connector A Slot Profiles

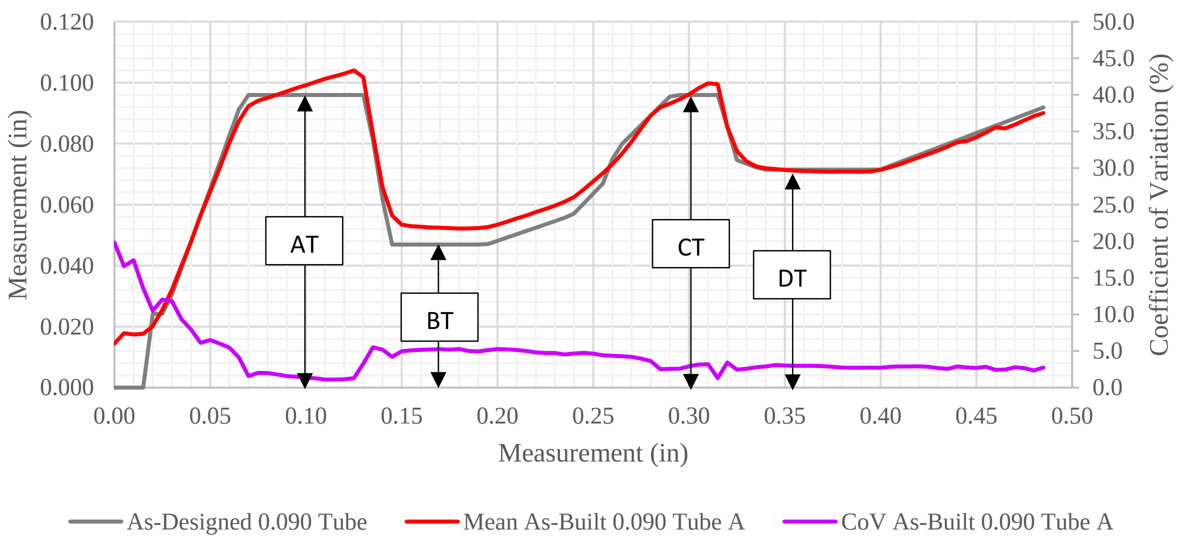


Figure 3.21 Coefficient of Variation - 0.090 in Tube A Coined Pressed End Profiles

Table 3.1 Coefficient of Variation at Quality Control Points of 6Sd-00 Connector

QCP's	Coefficient of Variation (%)		
	Connector A	Connector B	Connector C
AR	1.25	0.43	1.18
BR	2.51	1.31	2.49
CR	0.85	0.64	0.78
DR	1.00	0.94	0.98

Table 3.2 Coefficient of Variation at Quality Control Points of Tube Coined Pressed Ends

QCP's	Coefficient of Variation (%)								
	0.090 Tube A	0.090 Tube B	0.090 Tube C	0.104 Tube A	0.104 Tube B	0.104 Tube C	0.120 Tube A	0.120 Tube B	0.120 Tube C
AT	1.49	1.39	1.44	0.95	1.43	1.43	1.86	1.17	1.57
BT	5.18	7.50	6.35	2.49	4.53	3.71	3.87	4.39	4.05
CT	3.16	1.72	2.19	1.59	0.56	1.30	1.75	2.73	2.44
DT	2.98	4.15	3.53	1.77	2.31	2.06	2.36	2.41	2.32

From **Table 3.1** and **Table 3.2**, the coefficients of variation at the quality control points are relatively low. Indeed, the highest coefficients of variation identified for Connector A-C occur at BR within a range of 1.31 - 2.51%. Likewise, the highest coefficients of variation for the tube coined pressed ends are identified at BT; 7.5% being the highest value. The COV of the measured geometric dimensions was calculated to define how the as-built superimposed profiles behaved relative to the average as-built profile. A low variability of dimensions was observed; therefore, it was determined that the average dimensions of the as-built connector slots and tube coined pressed-ends profiles produced a good representation of the imperfect manufactured jointing system.

Chapter 4: Finite Element Model of the Jointing System

This chapter describes the finite element models of the Geometrica® 6Sd-00 fir-tree jointing system developed using the Patran/Nastran software (MSC 2014).

4.1 General Description of the Jointing System Finite Element Models

The fir-tree jointing system series 6Sd-00 was modeled according to the dimensions provided by Geometrica® (as-designed condition) and by dimensions obtained through the collection of measurements from the manufactured jointing system components (as-built condition). Finite element models were created by importing the CAD models into Patran/Nastran interface; subsequently, assigning the material properties, boundary conditions, mesh and loading conditions.

The aluminum connector, filler shims, and steel tubular elements were assigned elastoplastic material properties. The material stress-strain curves were obtained through experimental testing. Standard coupon tension tests were conducted according to ASTM standards (ASTM 2016) to obtain the aluminum and steel material properties including the elastic modulus (E), yield strength (σ_y), and ultimate tensile strength (σ_u). **Table 4.1** lists the materials properties of the fir-tree jointing system components. **Figure 4.1**, **Figure 4.2**, and **Figure 4.3** present the stress-strain curves obtained, from the coupon tension test, for aluminum A6061-T6, A500 Grade B steel, and A653 SS37 steel, respectively.

Table 4.1 Geometrica® 6Sd-00 Jointing System Material Properties

Component	Material	E(psi)	μ	σ_y (psi)	σ_u (psi)
6Sd-00 Connector	A6061-T6 Aluminum	9.9×10^6	0.34	38,500*	44,628*
2-3/8 inches x 0.090 Tube Coined Pressed End	A500 Grade B Steel	29×10^6	0.29	50,000*	67,700*
2-3/8 inches x 0.104 Tube Coined Pressed End	A653 SS 37 Steel	29×10^6	0.29	62,350*	68,000*
2-3/8 inches x 0.120 Tube Coined Pressed End	A653 SS 37 Steel	29×10^6	0.29	62,350*	68,000*
6Sd-00 Connector Filler Shims	A6061-T6 Aluminum	9.9×10^6	0.34	38,500*	44,628*

* Obtained through experimental test.

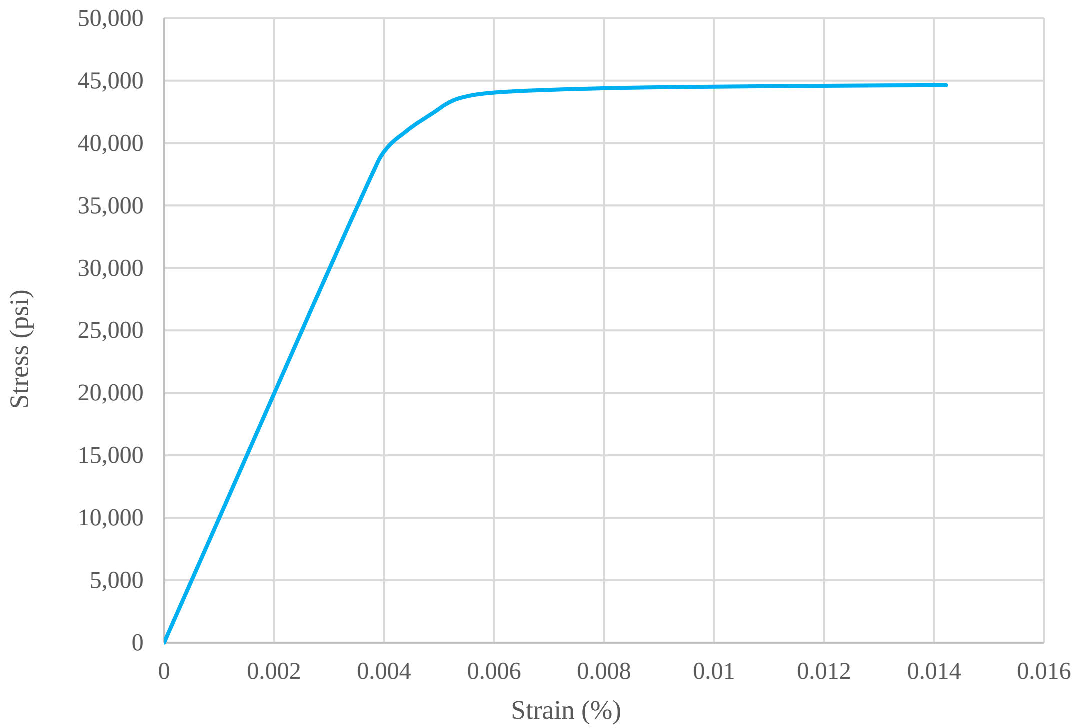


Figure 4.1 Stress-Strain Curve of Aluminum A6061-T6

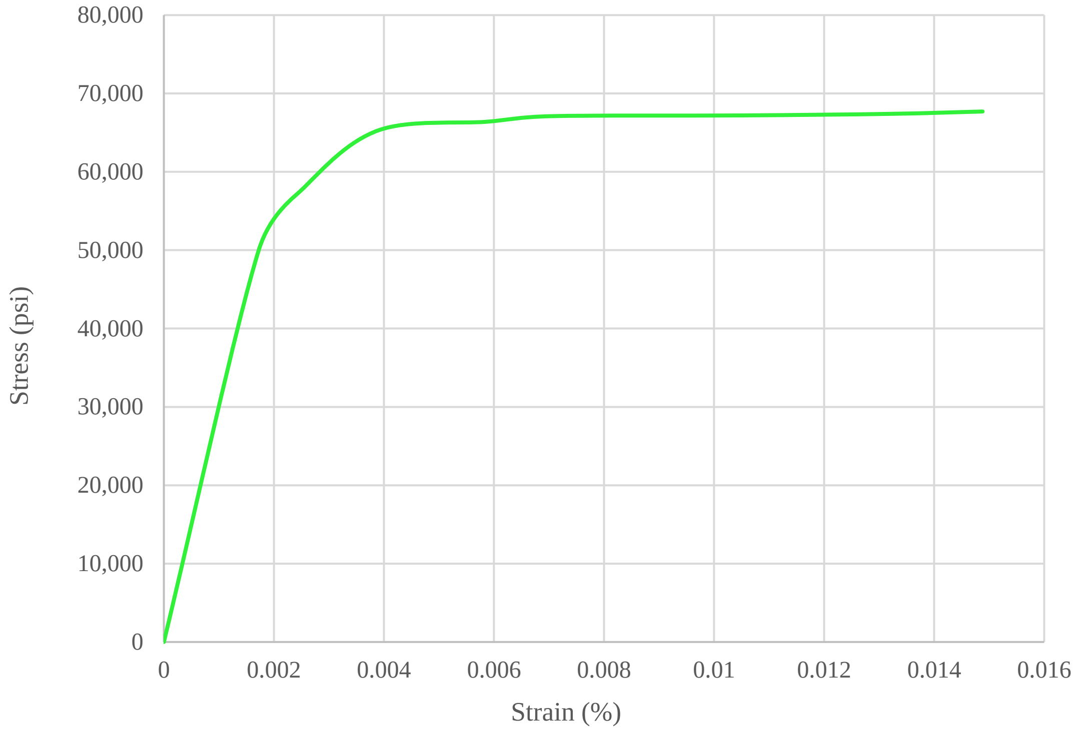


Figure 4.2 Stress-Strain Curve of Steel A500 Grade B

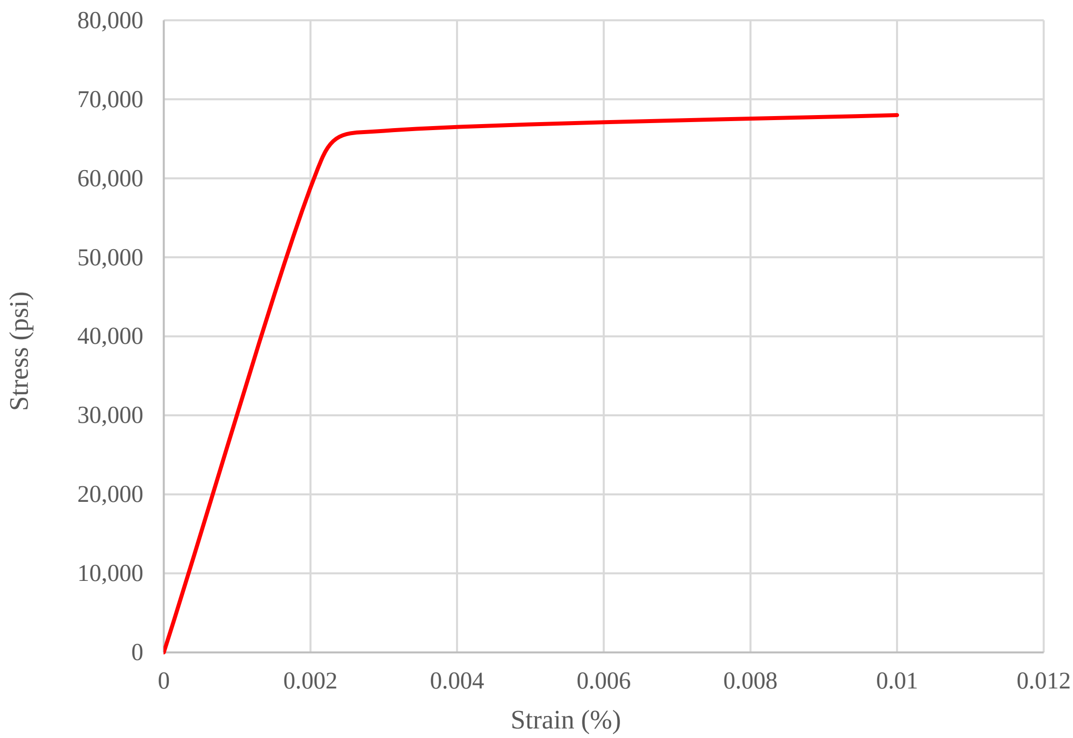


Figure 4.3 Stress-Strain Curve of Steel A653 SS37

Symmetrical characteristics of the jointing system allowed for the simulation of only one quarter of the connector with symmetric boundary conditions for the axial semi-rigid jointing system models and half of the connector with symmetric boundary conditions for the in-plane bending semi-rigid jointing system models. Taking advantage of the symmetrical characteristics of the jointing system allowed a reduction in computer processing time and memory. To trigger the deformation process and the interaction between the jointing system components, a series of incremental displacements were imposed at the base of the tube. Lastly, a tetrahedral finite element mesh was utilized to create elements having four plane triangular faces. These types of elements generate faces to match the irregular surfaces of the jointing system models. **Figure 4.4** displays an example of the axial semi-rigid and in-plane bending finite element models.

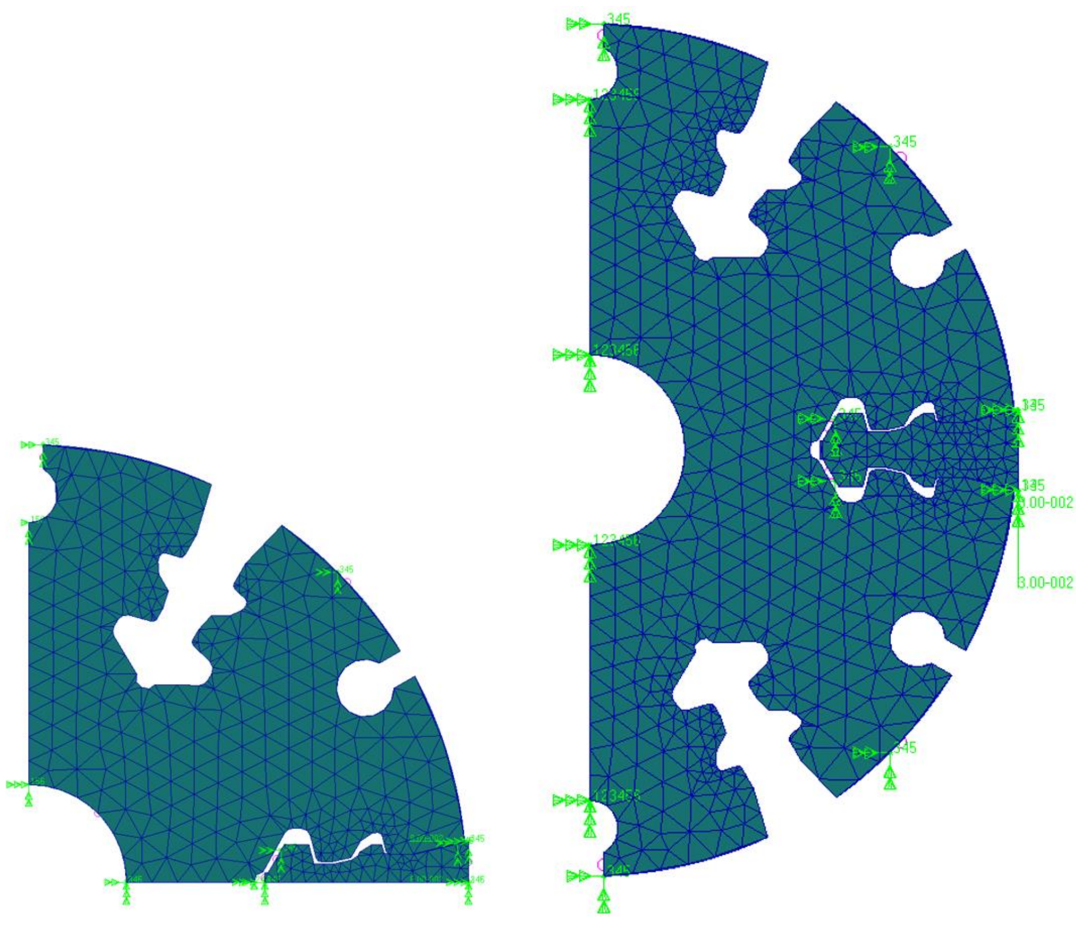


Figure 4.4 Example of the (a) Axial and (b) In-Plane Bending Semi-Rigid Jointing System FEM

4.2 Jointing System Finite Element Models

A common terminology to identify the different as-designed and as-built jointing system configurations will be used throughout the remaining of the document for ease of comprehending the different jointing system model combinations. The callout details for the model combinations are shown in **Figure 4.5**. Using a common nomenclature, an identity can be assigned to a jointing system configuration by the following details: (1) as-designed or as-built; (2) the three different tubular thicknesses; (3) whether or not a filler component was considered in the jointing system model; and (4) the combination of tube-connector components (for as-built only).

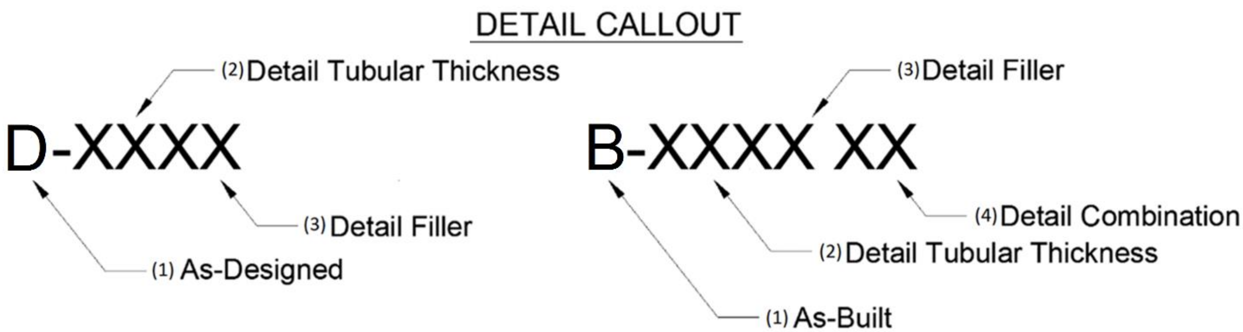


Figure 4.5 FEM Jointing System Detail Callout

The as-designed and as-built jointing system model combinations that were considered for this study are identified in **Table 4.2** and **Table 4.3** respectively. Considering the possible model combinations identified in **Table 4.2** and all the as-designed finite element analyses performed (shown **Figure 4.6**), 18 analyses were performed to characterize the as-designed Geometrica® jointing system. Nine analyses were performed in tension, compression and in-plane bending without the filler component being part of the jointing system model. Similarly, the other nine finite element analyses were performed considering the incorporation of the filler component on the jointing system. This allowed the comparison of the behavior characterization of the jointing system with and without fillers.

Table 4.2 As-Designed Jointing System Model Combinations

Jointing System	Tube Thickness 0.090 in A500 Grade B	Tube Thickness 0.104 in A653 SS 37 steel	Tube Thickness 0.120 in A653 SS 37 steel
Hub Connector A6061-T6 Aluminum	D-090	D-104	D-120

*Note: Each possible combination was also simulated with a filler component.

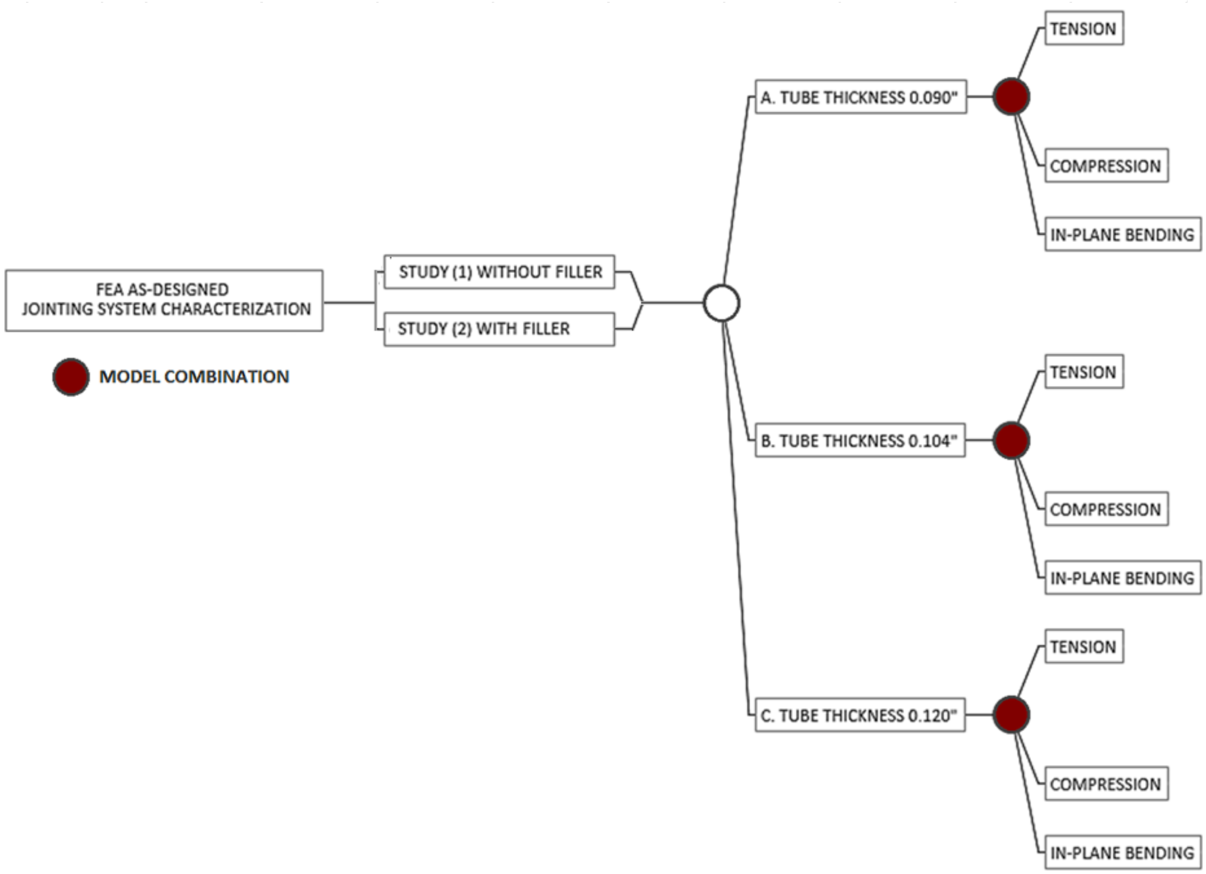


Figure 4.6 As-Designed FEA Performed

Considering the three as-built connector models (A through C), the three as-built tubular coined pressed end models (A through C) per tubular thickness, the possible model combinations identified in **Table 4.3**, and all the as-built finite element analyses performed as per **Figure 4.7**, 162 studies were performed to characterize the as-built Geometrica® jointing system. A total of

81 of the analyses were performed in tension, compression and in-plane bending without the filler component being part of the jointing system model. Similarly, the remainder of the analyses were conducted considering the incorporation of the filler component on the jointing system.

Table 4.3 As-Built Jointing System Model Combinations

Jointing System		**Tube Thickness 0.090 in A500 Grade B**			**Tube Thickness 0.104 in A653 SS 37 steel**			**Tube Thickness 0.120 in A653 SS 37 steel**		
		A	B	C	A	B	C	A	B	C
Hub Connector A6061-T6 Aluminum	A	B-090 AA	B-090 AB	B-090 AC	B-104 AA	B-090 AB	B-090 AC	B-120 AA	B-120 AB	B-120 AC
	B	B-090 BA	B-090 BB	B-090 BC	B-104 BA	B-090 BB	B-090 BC	B-120 BA	B-120 BB	B-120 BC
	C	B-090 CA	B-090 BC	B-090 CC	B-104 CA	B-090 BC	B-090 CC	B-120 CA	B-120 BC	B-120 CC

*Note: Each possible combination was also simulated with a filler component.

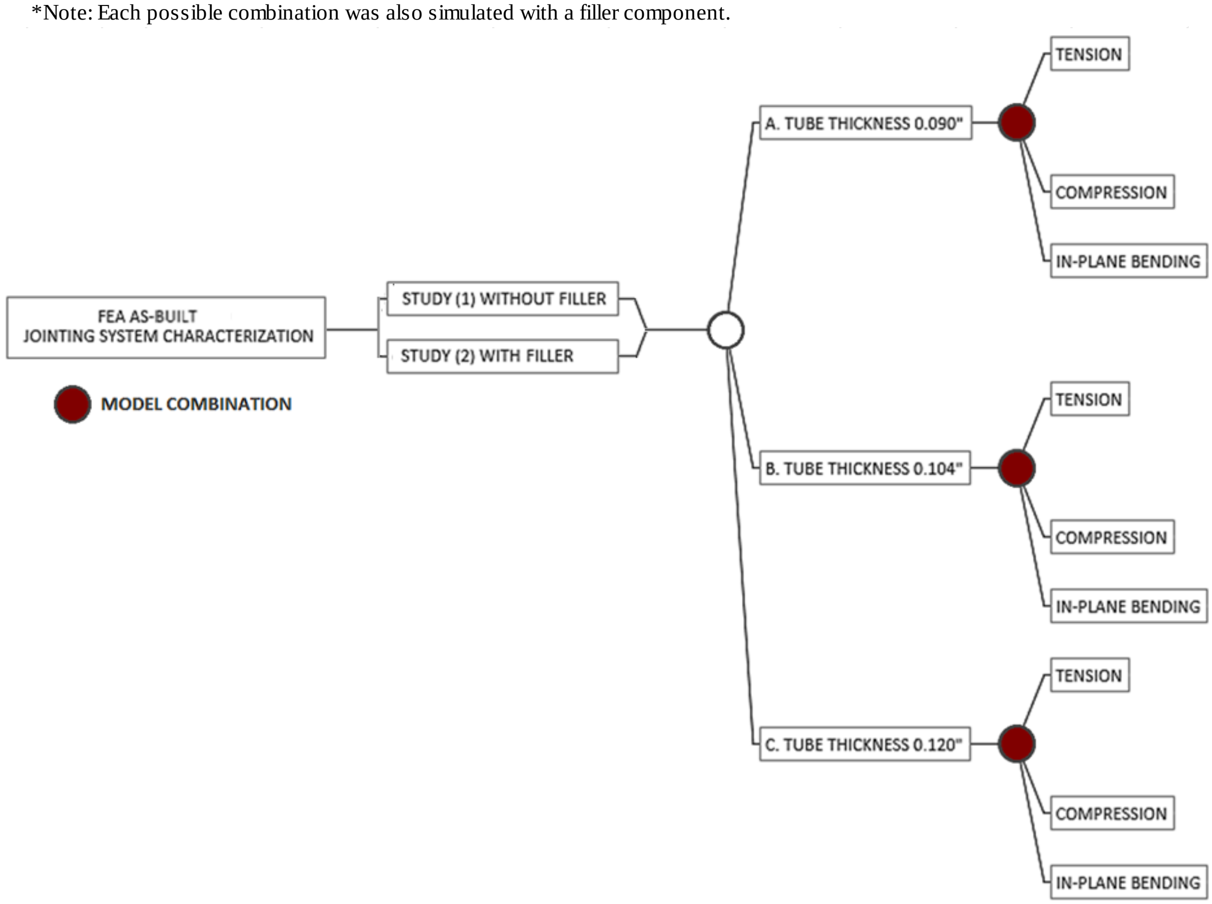


Figure 4.7 As-Built FEA Performed

With the development of the jointing system finite element models and identifying the different models combinations, the finite element analyzes were conducted using Patran/Nastran software (MSC 2014). The results of the analyses are presented in **Chapter 5-6** and are the base to assess how manufacturing geometric imperfections influence the semi-rigid behavior of the jointing system.

Chapter 5: Finite Element Simulation Results: As-Designed Jointing Systems

This chapter presents the finite element simulation results of the 18 as-designed jointing system connections. The set of models includes:

1) 6 models with an as-designed connection and 0.090-inch thickness tubular element: D-090;
2) 6 models with an as-designed connection and 0.104-inch thickness tubular element: D-104;
3) 6 models with an as-designed connection and 0.120-inch thickness tubular element: D-120.

For each system, an analysis was performed in tension, compression and in-plane bending without the filler component being part of the jointing system model. Similarly, identical finite element analyses were performed considering the incorporation of the filler component on the jointing system.

The results for each simulation include: (1) a series of plots to illustrate the deformation process of the jointing system; (2) the axial load-displacement graphs and their corresponding tabulated data; and (3) in-plane moment-rotation graphs and their corresponding tabulated data. The numerical results were used to compare and identify how the incorporation of filler components affect the stiffness characterization and load capacity of the jointing system under axial loading and in-plane bending conditions. The complete sets of graphs for the axial and in-plane semi rigid models simulated during this dissertation are shown in **Appendix D** and **Appendix E,** respectively.

5.1 Axial Semi-Rigid Behavior Characterization

Based on experimental results, Doran (1997) observed that a typical and frequent failure mode of this type of jointing system was shear failure of the aluminum fir-tree teeth during tensile testing. Also, based on experimental results, Ferregut and Carrasco (1998) observed that the jointing system could have ductile failure of the steel tubular material during tensile testing and local outward buckling of the tubular member end sections during compression testing. The models predicted in this chapter displayed similar failure modes.

The axial semi-rigid behavior of each connection is defined by the tensile and compressive load versus displacement behavior of the jointing system. The load-displacement relationship was obtained through the resulting force (F) developed by an applied displacement (Δ) to the beam element (**Figure 5.1**). The stresses at the base of the tube (see **Figure 5.1**) were integrated to calculate the force applied at every displacement. For the axial semi-rigid models, the force was multiplied by two due to the model's symmetrical characteristics. With the model results, graphs were created to define the load required to produce the enforced displacements in tension and compression.

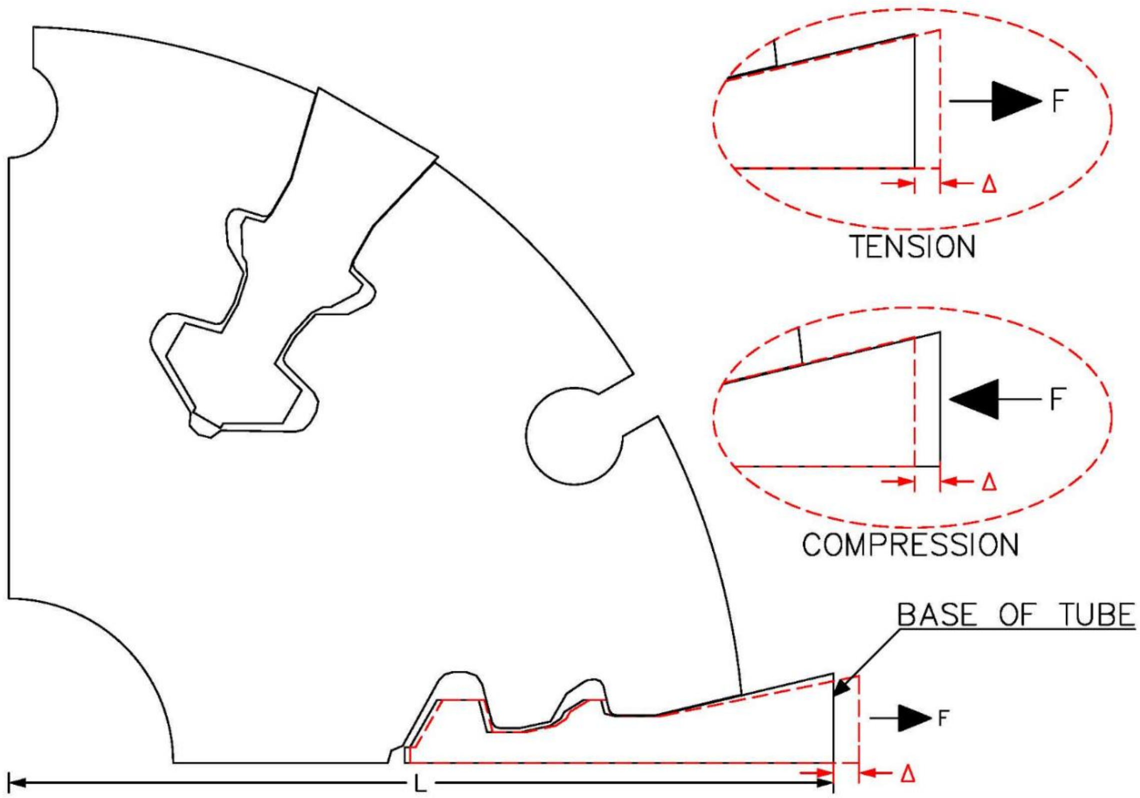
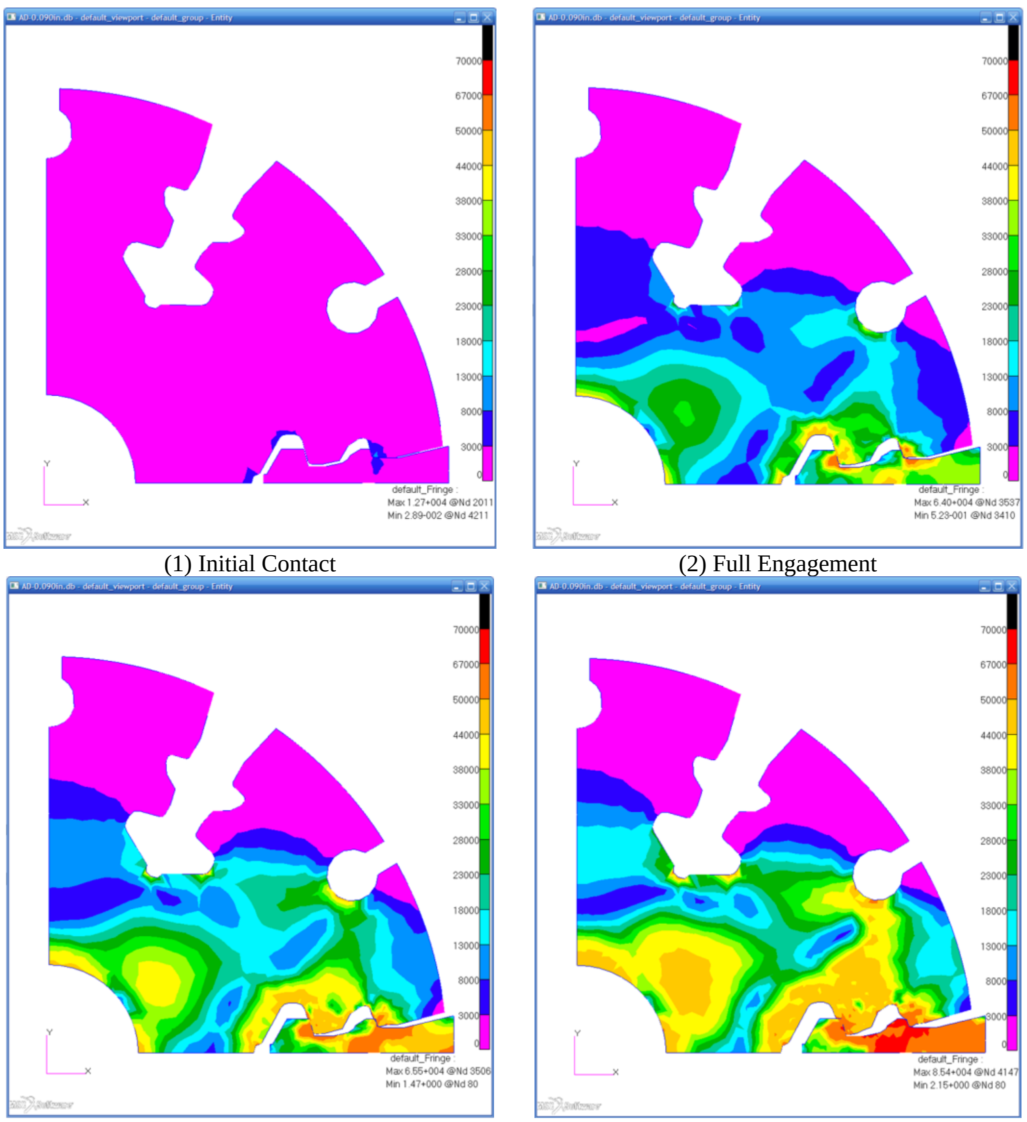


Figure 5.1 Axial Semi-Rigid Jointing System Simulation

Plots of the results of the model analyses show the progress of deformation and the interaction between the jointing system elements. To visualize this interaction, the von Mises stress at key induced displacements during both: tensile and compressive simulations, were calculated and plotted. A series of plots were selected to illustrate the deformation process and stresses developed (described by the colors on the fringe scale) throughout the jointing system going from: (1) initial contact, (2) full engagement, (3) development of yielding stresses, and (4) ultimate capacity (see a typical series of plots in **Figure 5.2**).



(1) Initial Contact (2) Full Engagement

(3) Development of Yielding Stresses (4) Ultimate Capacity

Figure 5.2 Typical Axial Semi-Rigid Deformation Progress and Development of Stresses

A typical axial semi-rigid behavior of the Geometrica® 6Sd-00 jointing system is displayed in **Figure 5.3**. This curve is composed of three main zones; (1) Zone 1 defines the compressive semi-rigid behavior, (2) Zone 2 is the initial flat portion defined by the axial fit tolerances (fit-gap) in the mating parts of the jointing system, (3) Zone 3 defines the tensile semi-rigid behavior of the jointing system. The complete set of graphs and corresponding tabulated data, for all the as-designed axial-semi-rigid models, can be found in **Appendix D**.

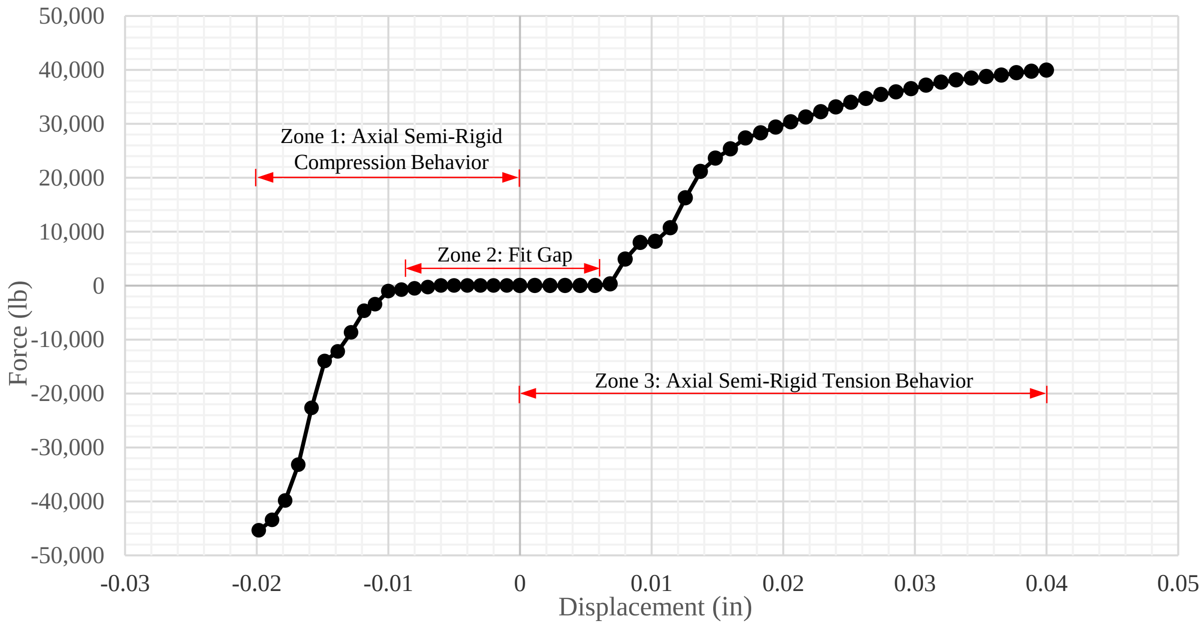


Figure 5.3 Typical Axial Semi-Rigid Behavior of the Jointing System

To assess how incorporating the filler component affects the axial semi-rigid behavior of the jointing systems, **Comparison Type (1)** was conducted. The results of the as-designed axial semi-rigid analysis were compared by computing their ratios, subtracting 1.0, and expressing the change as a percentage per the following equations:

As-Designed vs. As-Designed WF Jointing System Displacement Comparison

$$Displacement\ (\%) = \left(\frac{\Delta_{dF}}{\Delta_d} - 1\right)(100) \qquad \textbf{(5.1)}$$

where Δ_d is the as-designed axial displacement of the jointing system, and Δ_{dF} is the as-designed axial displacement of the jointing system with filler.

As-Designed vs. As-Designed WF Jointing System Ultimate Force Comparison

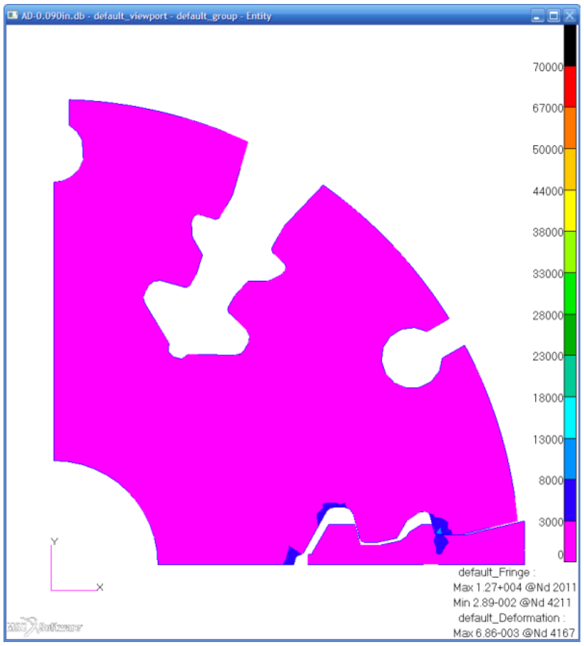
$$Ult.Force\ (\%) = \left(\frac{Fu_{dF}}{Fu_d} - 1\right)(100) \qquad \textbf{(5.2)}$$

where Fu_d is the as-designed axial ultimate force of the jointing system, Fu_{dF} is the as-designed axial ultimate force of the jointing system with filler.

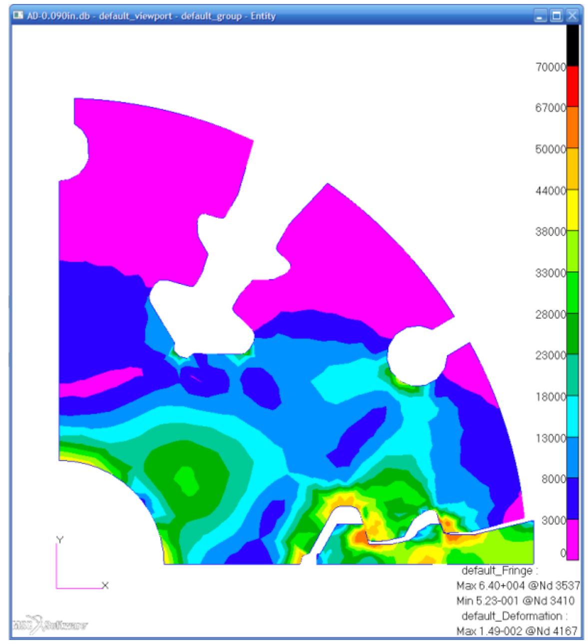
Using the previously presented set of ratios, the percentage change can be calculated. This allows to quantify the impact that the filler component imposes onto the axial semi-rigid behavior of the as-designed jointing system.

5.1.1 D-090 Axial Semi-Rigid Behavior

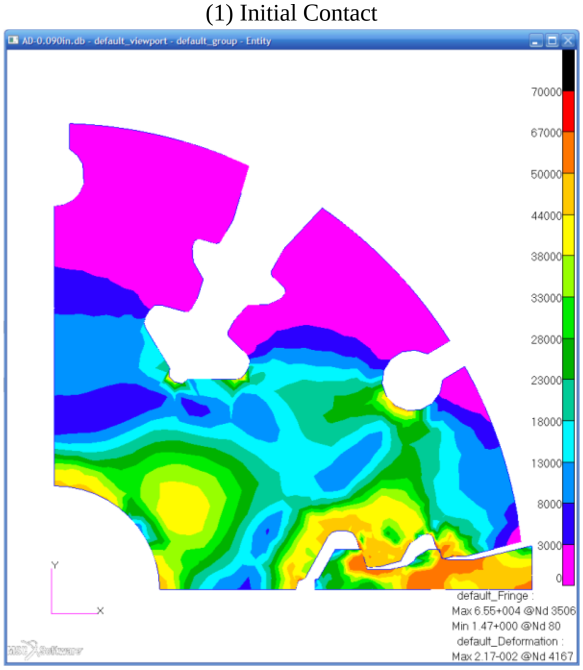
The tensile finite element simulation of the D-090 semi-rigid behavior is illustrated in the series of plots shown in **Figure 5.4**.



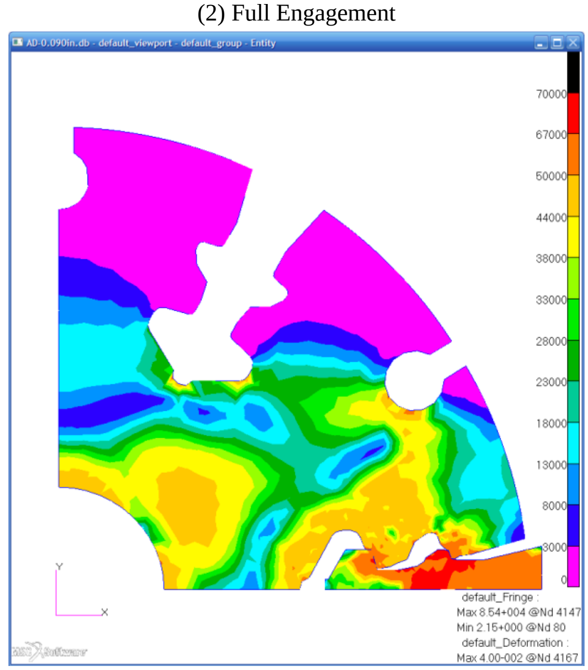
(1) Initial Contact



(2) Full Engagement



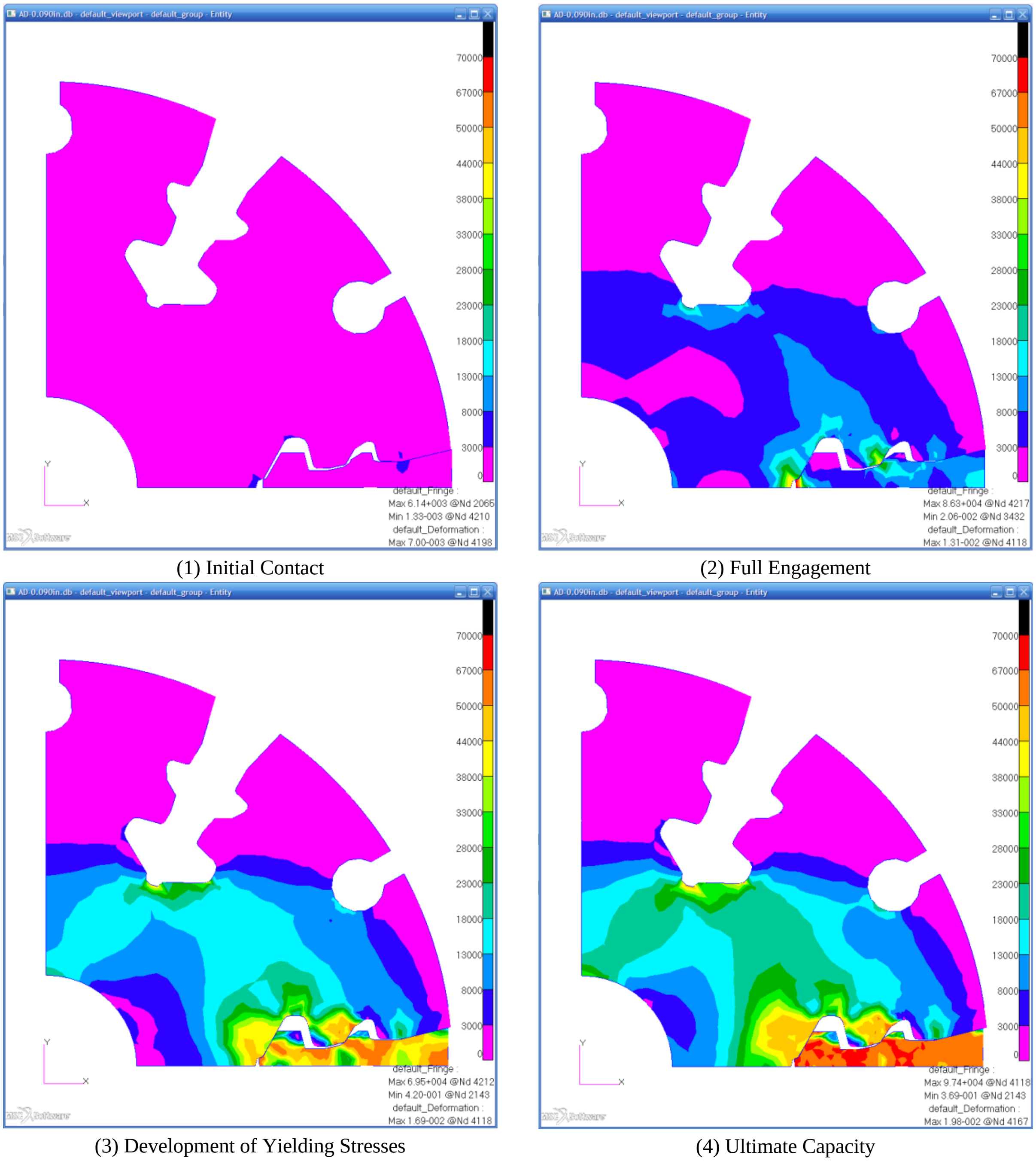
(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure 5.4 Von Mises Stress of D-090 under Tension from Initial Contact to Failure

The compressive finite element simulation of the D-090 semi-rigid behavior is illustrated in the series of plots shown in **Figure 5.5**.



(1) Initial Contact (2) Full Engagement

(3) Development of Yielding Stresses (4) Ultimate Capacity

Figure 5.5 Von Mises Stress of D-090 under Compression from Initial Contact to Failure

Figure 5.6 presents the axial semi-rigid behavior of the D-090 numerical model.

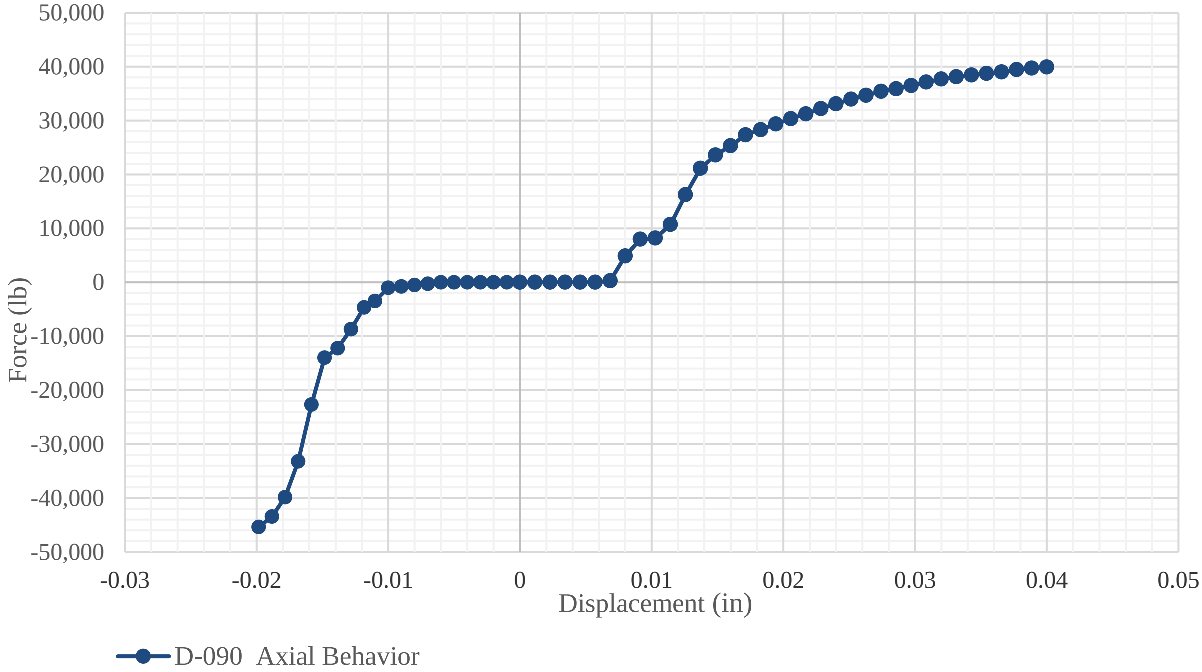
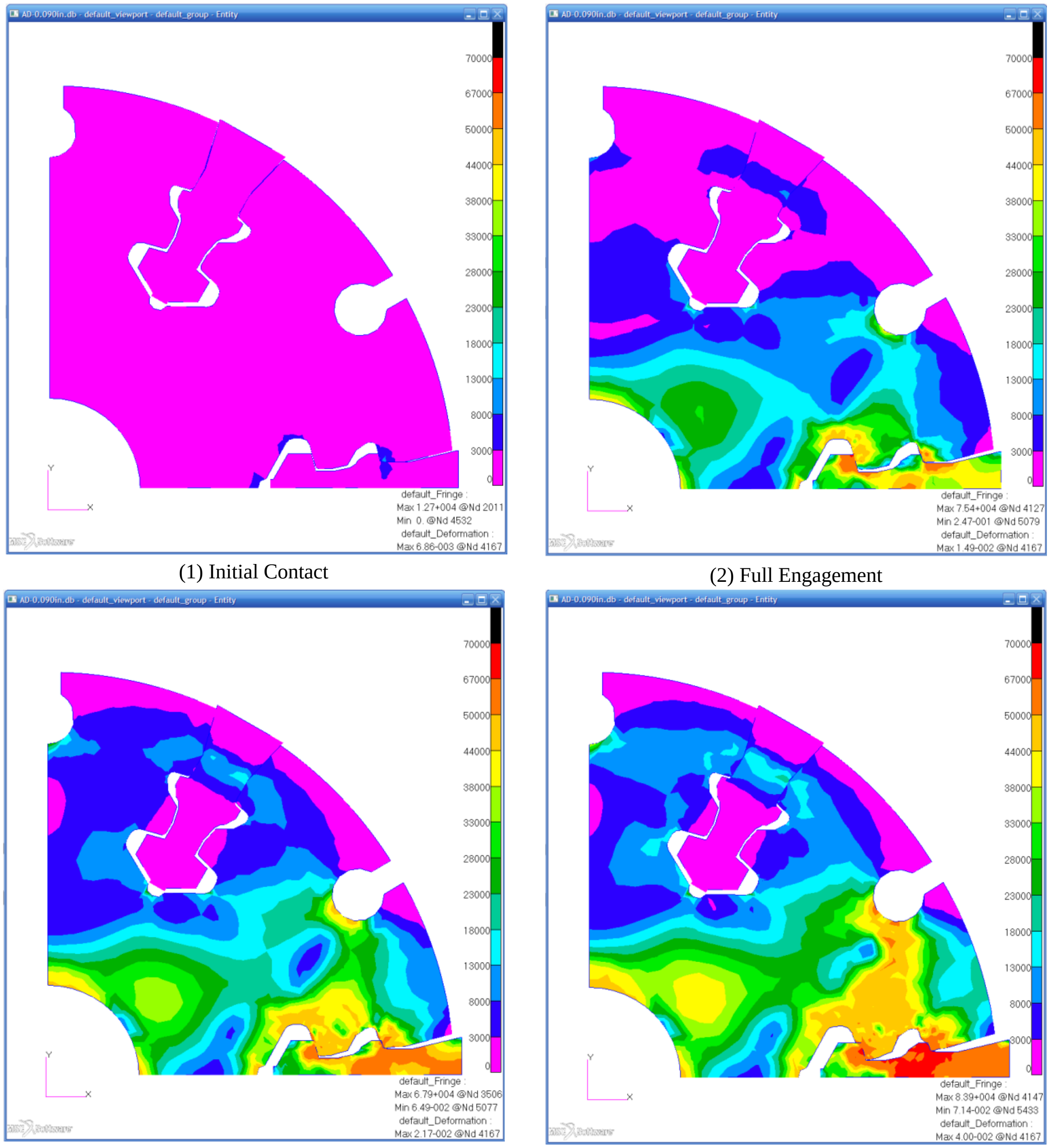


Figure 5.6 Axial Semi-Rigid Behavior of D-090

The tensile finite element simulation of the D-090F semi-rigid behavior is illustrated in the series of plots shown in **Figure 5.7**.



(1) Initial Contact

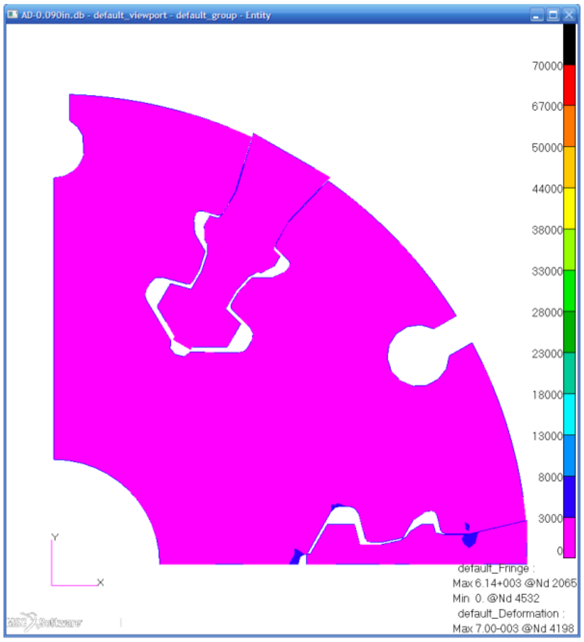
(2) Full Engagement

(3) Development of Yielding Stresses

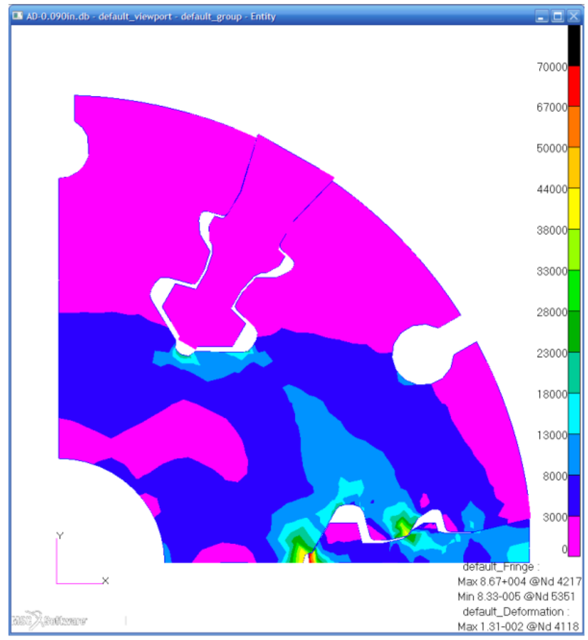
(4) Ultimate Capacity

Figure 5.7 Von Mises Stress of D-090F under Tension from Initial Contact to Failure

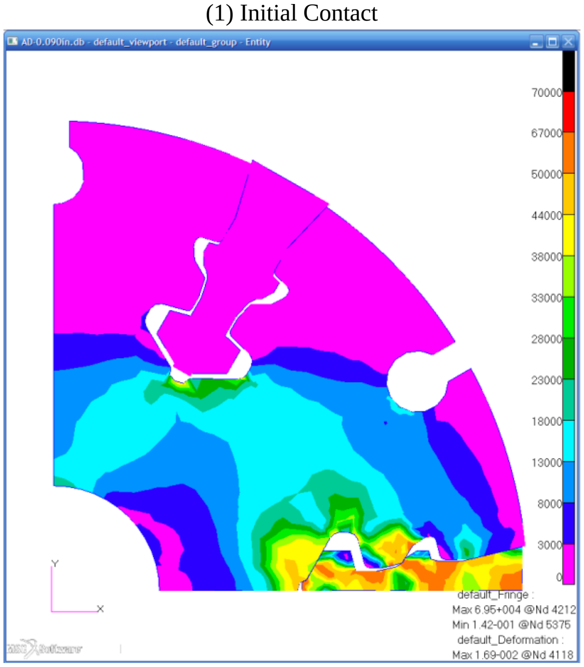
The compressive finite element simulation of the D-090F semi-rigid behavior is illustrated in the series of plots shown in **Figure 5.8**.



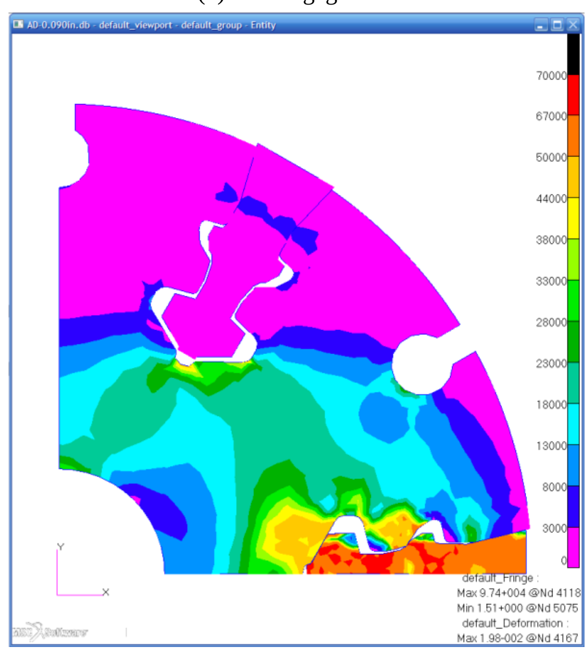
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure 5.8 Von Mises Stress of D-090F under Compression from Initial Contact to Failure

Figure 5.9 presents the axial semi-rigid behavior of the D-090F numerical model.

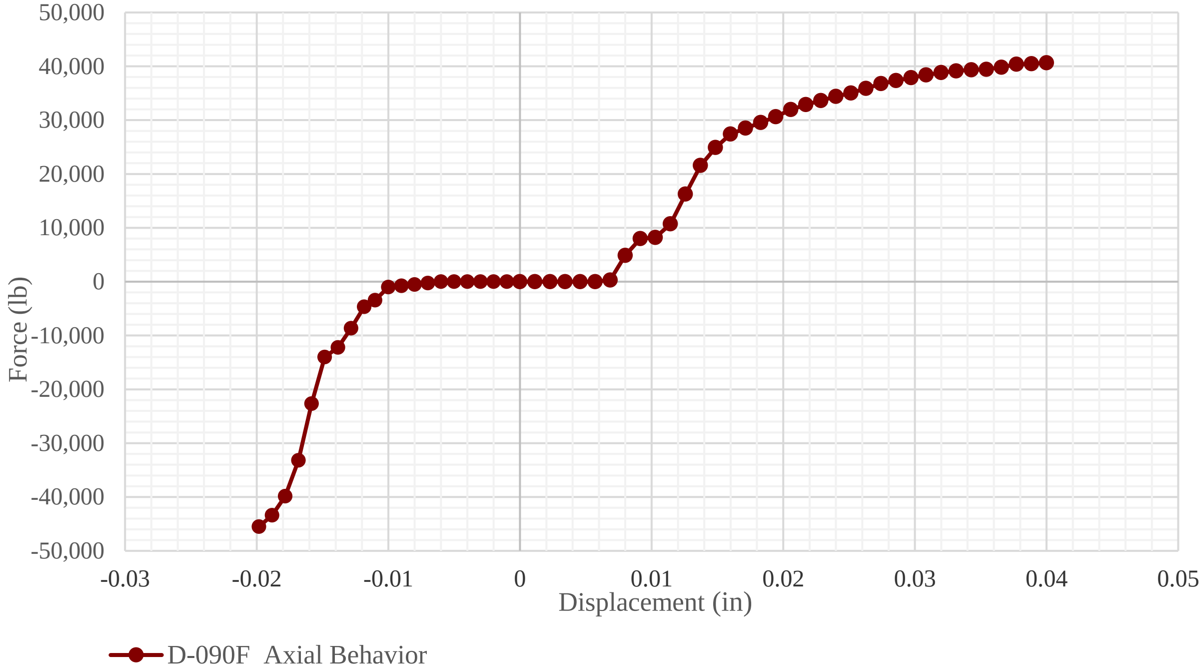


Figure 5.9 Axial Semi-Rigid Behavior of D-090F

From the previous presented series of plots, the numerical models show the progress of deformation and the interaction behavior between the jointing system elements, illustrating the stresses and displacements concentrated around the engagement areas. In a connection that incorporates filler elements (as seen on **Figure 5.7** and **Figure 5.8**), the adjacent connector slots and filler component begin engaging in contact, consequently, restricting further deformations of the jointing system creating an impact to the axial semi-rigid behavior. Additionally, it was observed that during tension, the connector teeth reached failure stresses before the tubular element component. Conversely, during compression, the tubular element reached failure stresses before the connector teeth.

5.1.1.1 Comparison (1): D-090 vs. D-090F Axial Load-Displacement

Figure 5.10 presents a plot of the load-displacement data generated by the axial semi-rigid analysis of the D-090 and D-090F models, up to ultimate capacity at force increments of 5,000 pounds. **Table 5.1** and **Table 5.2** compare the tensile and compressive characterization data at 5,000 pound increments, respectively. The D-090 and D-090F models have ultimate loads recorded at 39,923.19 pounds and 40,648.22 pounds at 0.0400 inches during tension and 45,376.74 pounds and 45,509.90 pounds at 0.0198 inches during compression, respectively. These results represent an increase of 1.82% in tension and 0.30% in compression as a result of the incorporation of the filler into the jointing system.

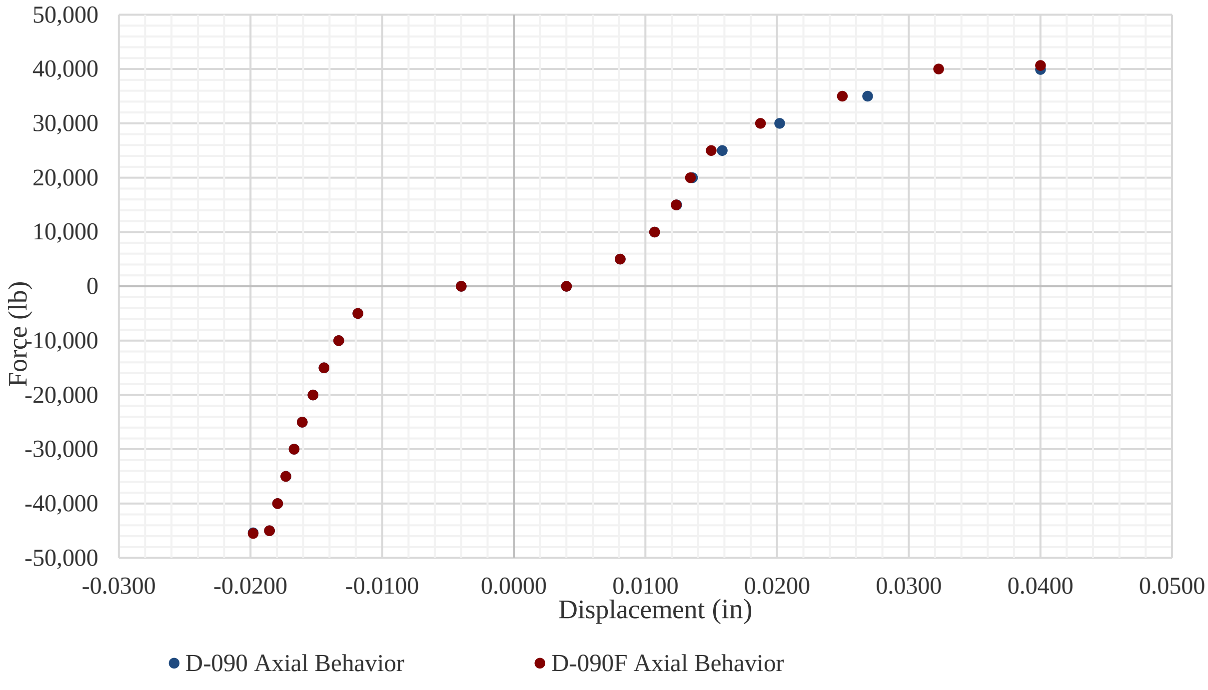


Figure 5.10 Axial Semi-Rigid Behavior of D-090 & D-090F

Table 5.1 Tensile Load-Displacement: 090 Comparison (1)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-090	D-090F	D-090 vs. D-090F
0	0.0040	0.0040	0.00
5,000	0.0081	0.0081	0.00
10,000	0.0107	0.0107	0.00
15,000	0.0124	0.0123	-0.31
20,000	0.0136	0.0134	-1.22
25,000	0.0158	0.0150	-5.27
30,000	0.0202	0.0187	-7.18
35,000	0.0269	0.0249	-7.14
40,000	-	0.0323	-

Table 5.2 Compressive Load-Displacement: 090 Comparison (1)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-090	D-090F	D-090 vs. D-090F
0	-0.0040	-0.0040	0.00
-5,000	-0.0118	-0.0118	0.01
-10,000	-0.0133	-0.0133	0.01
-15,000	-0.0144	-0.0144	0.01
-20,000	-0.0153	-0.0153	0.00
-25,000	-0.0161	-0.0161	0.00
-30,000	-0.0167	-0.0167	0.00
-35,000	-0.0173	-0.0173	0.00
-40,000	-0.0179	-0.0179	0.01
-45,000	-0.0186	-0.0186	0.01

The preceding results show that incorporating the filler into the jointing system did not impact the displacement during the first 10,000 pounds in tension. Furthermore, a slight increase in stiffness of 0.31% is observed at 15,000 pounds reaching up to 7.14% at 35,000 pounds during tension. Also, no significant change of rigidity occurs when incorporating the filler into the jointing system during compression. It can be concluded that, at larger forces, there is a slight increment in rigidity when incorporating the filler into the jointing system.

Similar conclusions are drawn when analyzing the results for the D-104 and D-120 Comparison Type (1) jointing system. The D-104 and D-120 axial semi-rigid behavior characterization results and conclusions can be found in **Appendix F** and **Appendix G**, respectively. Only the axial characterizations results of the jointing system with filler will be used for comparison purposes during **Chapter 6**.

5.2 In-Plane Bending Semi-Rigid Behavior Characterization

Based on experimental results, Doran (1997) observed that a typical and frequent failure mode of this type of jointing system was local yielding of the tubular element adjacent to the connector. The models predicted in this chapter displayed a similar failure mode.

The in-plane bending semi-rigid behavior of the connection is defined by the moment versus rotation characterization of the jointing system. The moment rotation relationship was obtained thought the resulting force (F) due to an applied displacement (Δ) to the beam element; the resulting force was developed at distance (L) from the center of the connector, as per **Figure 5.11** and **Equation (5.3)** and **(5.4)**. The integration of the stresses at the base of the tube (see **Figure 5.11**) was done to calculate the moment about the center of the jointing system at every incremental rotation. Subsequently, graphs were created to define the moment required to produce the rotation during in-plane bending.

In-Plane Moment of the Geometrica® 6Sd-00 Jointing System

$$Moment = (F)(L) \tag{5.3}$$

where F is the resulting force, and L is the perpendicular distance between the line of action of the force and the center of the connector.

In-Plane Rotation of the Geometrica® 6Sd-00 Jointing System

$$Tan\ \theta = \frac{\Delta}{L} \approx \theta\ for\ |\theta| < 1 \tag{5.4}$$

where θ is the angle of rotation expressed in radians, Δ is the vertical displacement, and L is the perpendicular distance between the line of action of the force and the center of the connector.

The analysis was developed with an applied in-plane bending force in a counter-clockwise (CCW) direction; therefore, the characterization results obtained were positive values. The same behavior of the jointing system holds true during in-plane bending in the opposite direction (clockwise (CW) direction), where negative characterization results were obtained. Graphs were created to display the characterization during the positive and negative in-plane bending behaviors.

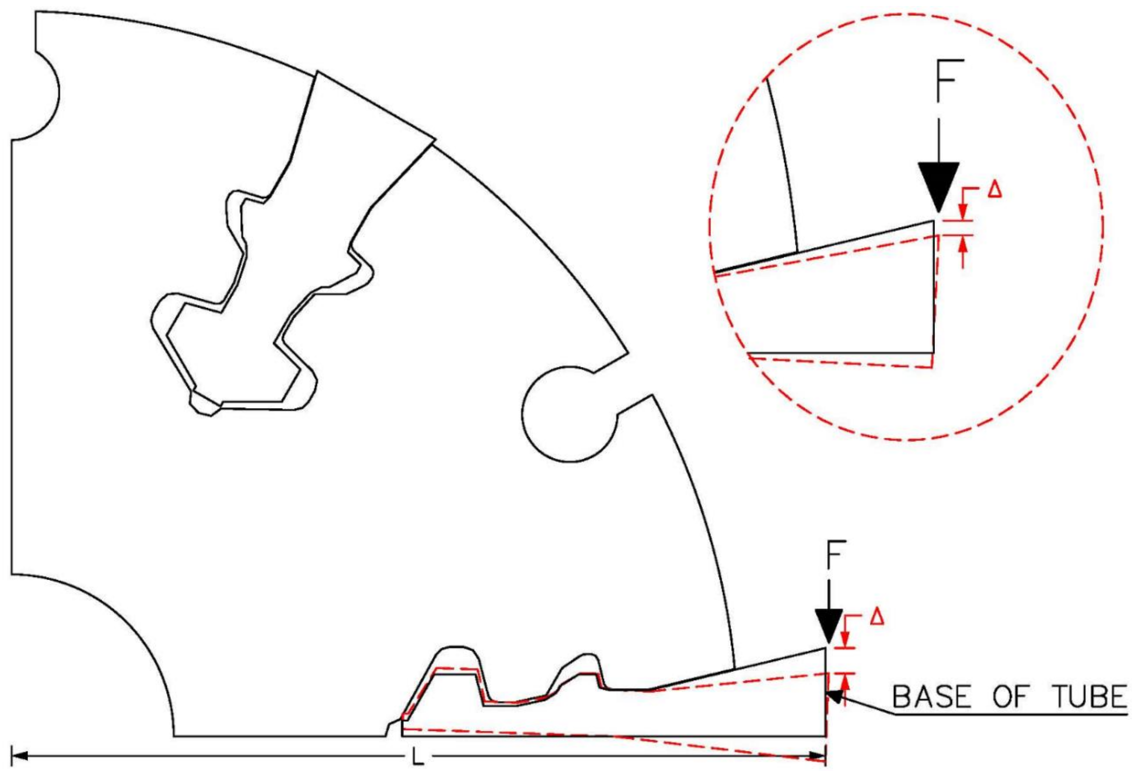
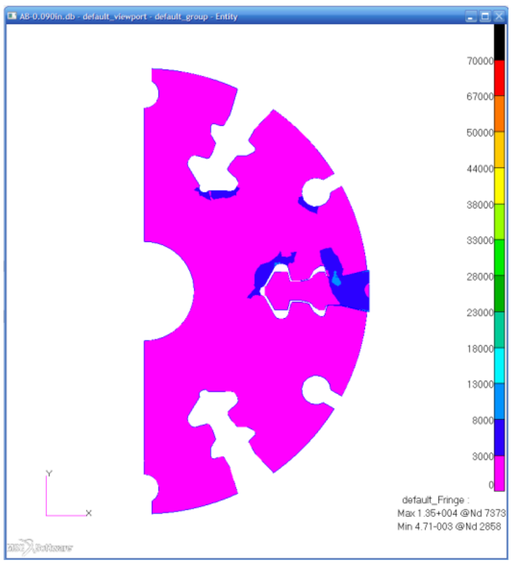
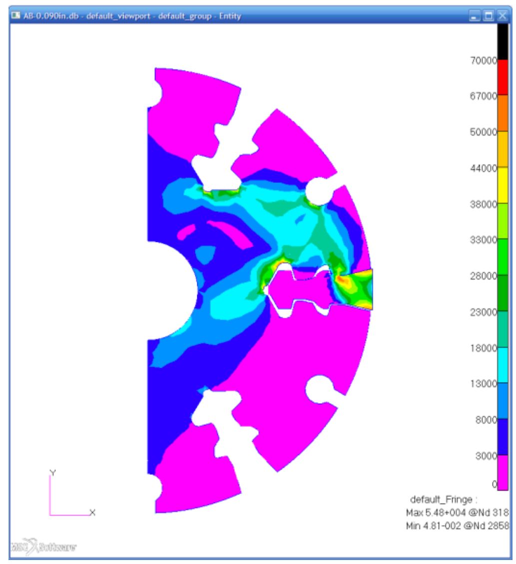


Figure 5.11 In-Plane Bending Semi-Rigid Jointing System Simulation

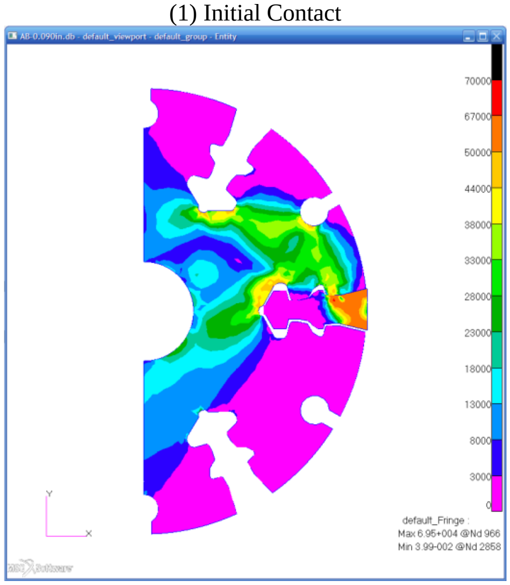
Plots of the results of the analyses show the progress of deformation and the interaction between the jointing system elements. The von Mises stress, at key induces displacements during in-plane bending, were plotted to illustrate the deformation process and stresses developed (described by the colors on the fringe scale) throughout the jointing system. The plots describe the jointing system at: (1) initial contact, (2) full engagement, (3) development of yielding stresses, and (4) ultimate capacity (see a typical series of plots in **Figure 5.12**).



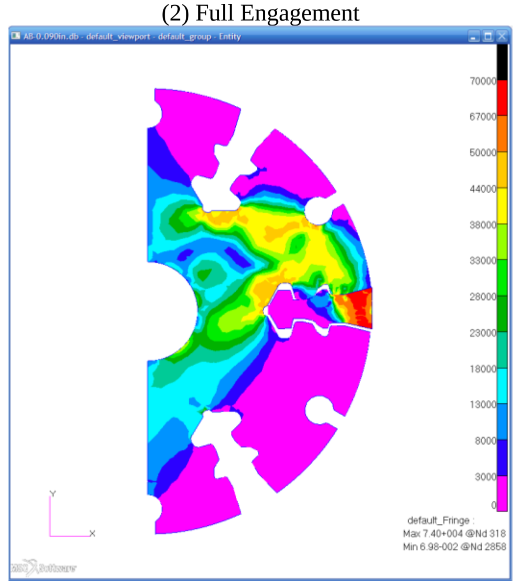
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure 5.12 Typical In-Plane Bending Semi-Rigid Deformation Progress and Development of Stresses

A typical in-plane bending semi-rigid behavior of the Geometrica® 6Sd-00 jointing system is displayed in **Figure 5.13**. This curve is composed of three main zones; (1) Zone 1 defines the negative in-plane bending semi-rigid behavior, (2) Zone 2 is the initial flat portion defined by the in-plane fit tolerances (fit-gap) in the mating parts of the jointing system, (3) Zone 3 defines the positive in-plane bending semi-rigid behavior of the jointing system. The complete set of graphs and corresponding tabulated data, for all the as-designed in-plane semi-rigid models, can be found in **Appendix E**.

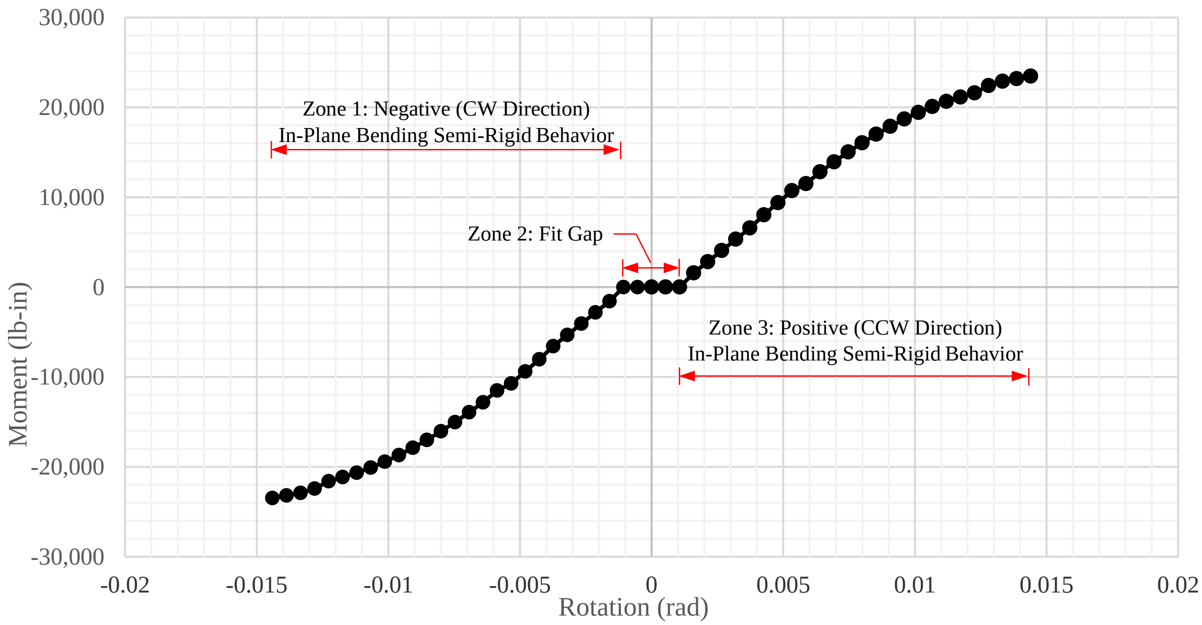


Figure 5.13 Typical In-Plane Bending Semi-Rigid Behavior of the Jointing System

To assess how incorporating the filler component affects the in-plane bending semi-rigid behavior of the jointing systems, **Comparison Type (2)** was conducted. The results of the as-designed in-plane bending semi-rigid analysis were compared using the following equations:

As-Designed vs. As-Designed WF Jointing System Rotation Comparison

$$Rotation\ (\%) = \left(\frac{\theta_{dF}}{\theta_d} - 1\right)(100) \tag{5.5}$$

where θ_d is the as-designed in-plane bending rotation of the jointing system, and θ_{dF} is the as-designed in-plane bending rotation of the jointing system with filler.

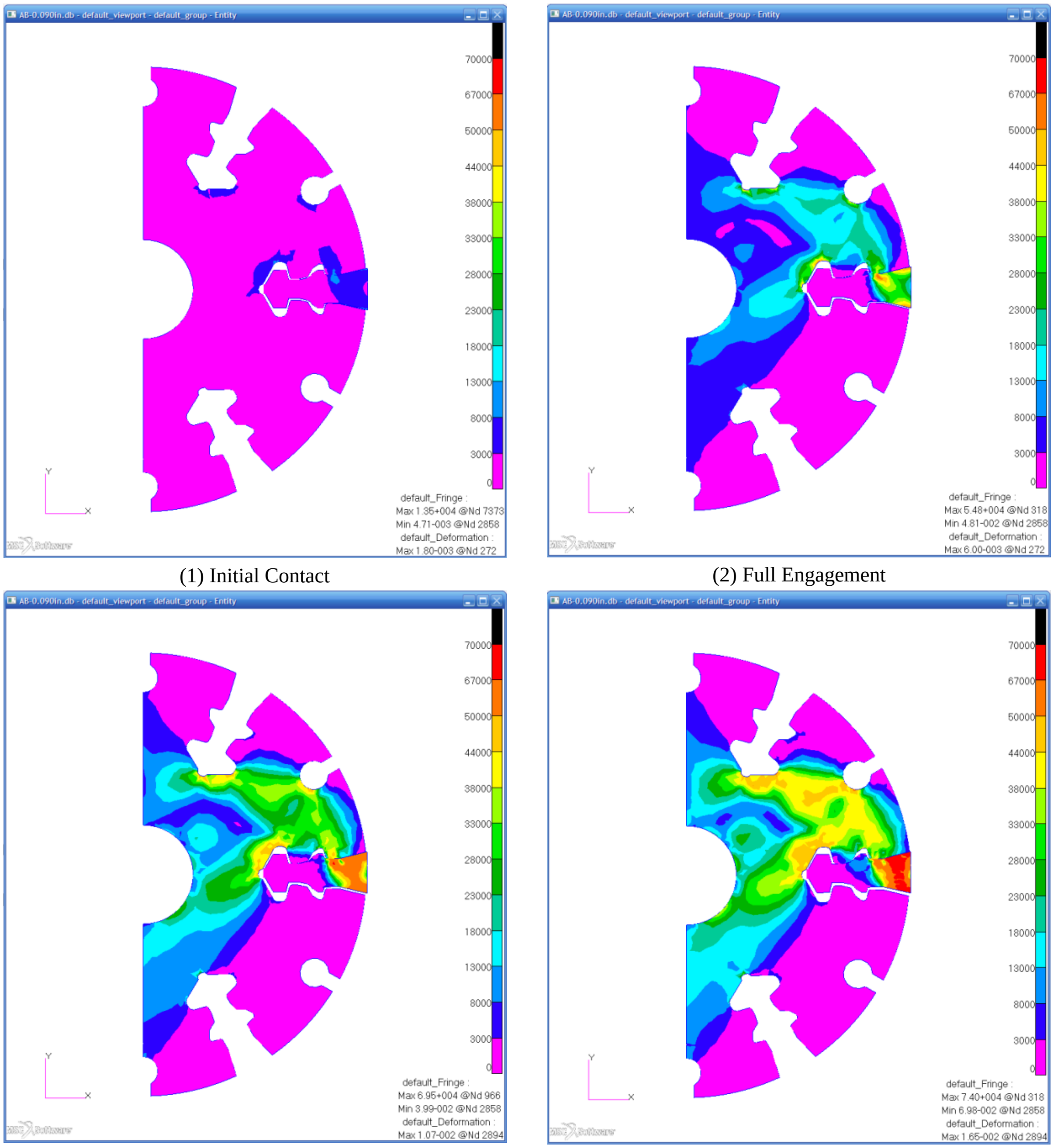
As-Designed vs. As-Designed WF Jointing System Ultimate Moment Comparison

$$Ult. Moment\ (\%) = \left(\frac{Mu_{dF}}{Mu_d} - 1\right)(100) \tag{5.6}$$

where Mu_d is the as-designed in-plane bending ultimate moment of the jointing system, and Mu_{dF} is the as-designed in-plane bending ultimate moment of the jointing system with filler.

5.2.1 D-090 In-Plane Bending Semi-Rigid Behavior

The in-plane bending finite element simulation of the D-090 semi-rigid behavior is illustrated in the series of plots shown in **Figure 5.14**.



(1) Initial Contact

(2) Full Engagement

(3) Development of Yielding Stresses

(4) Ultimate Capacity

Figure 5.14 Von Mises Stress of D-090 under In-Plane Bending from Initial Contact to Failure

Figure 5.15 presents the in-plane bending semi-rigid behavior of the D-090 numerical model.

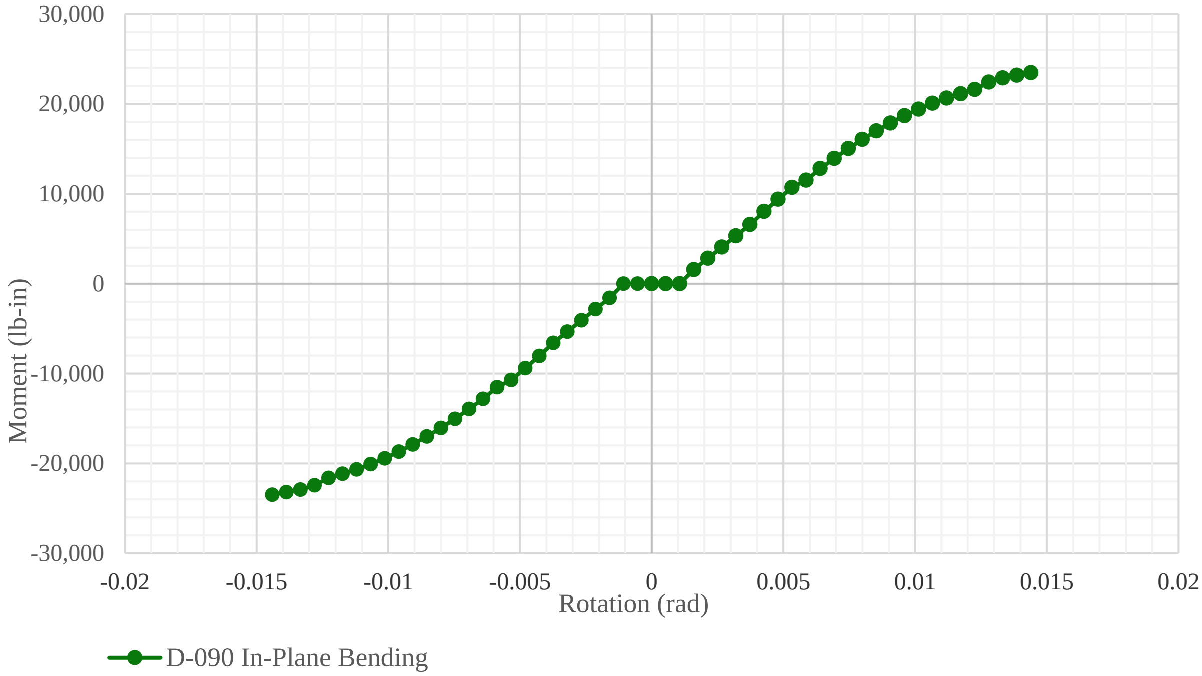
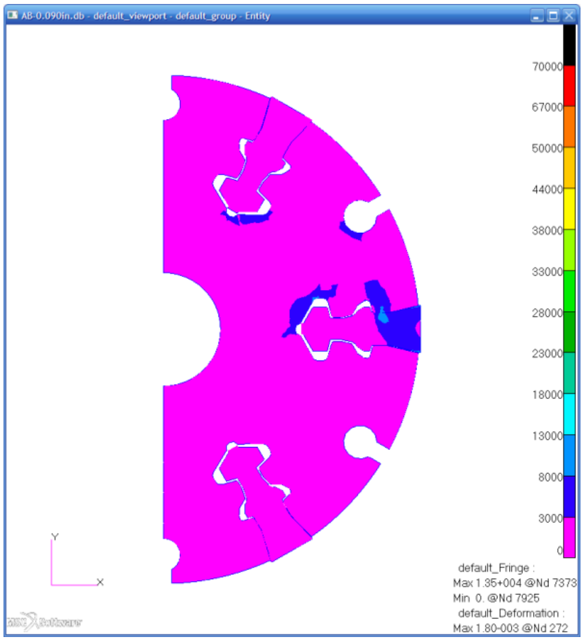
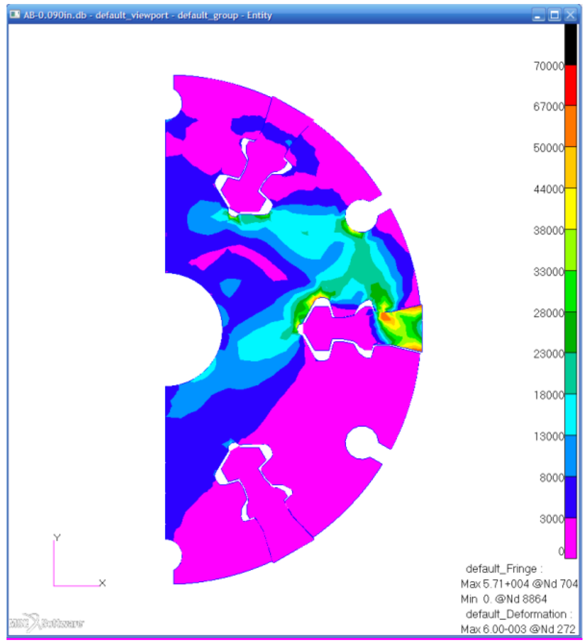


Figure 5.15 In-Plane Bending Semi-Rigid Behavior of D-090

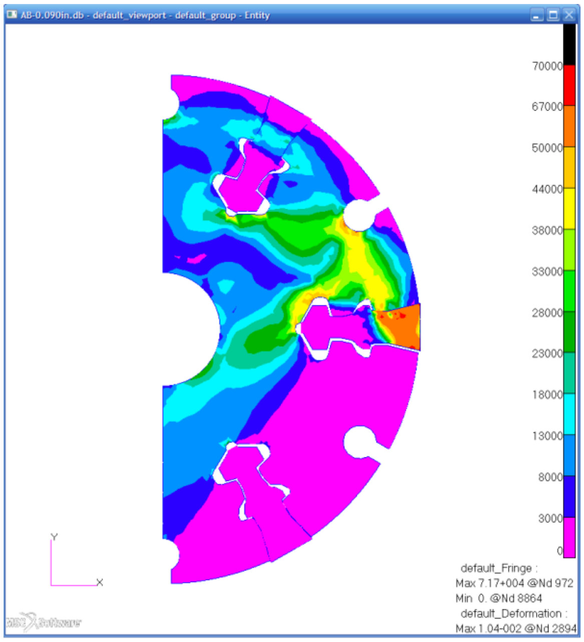
The in-plane bending finite element simulation of the D-090F semi-rigid behavior is illustrated in the series of plots shown in **Figure 5.16**.



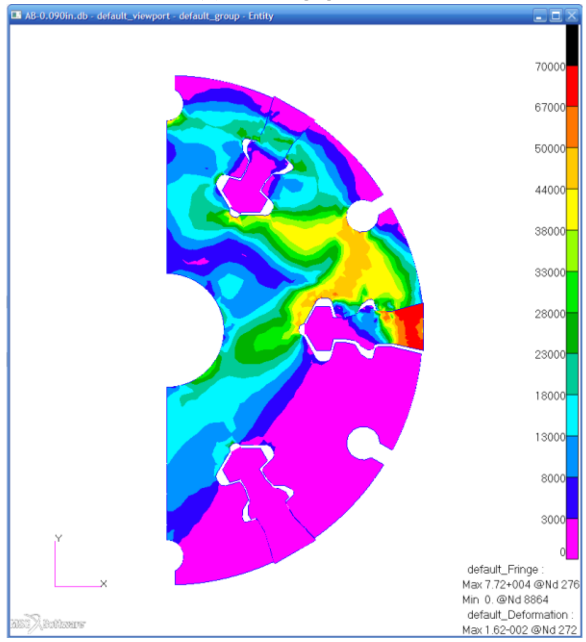
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure 5.16 Von Mises Stress of D-090F under In-Plane Bending from Initial Contact to Failure

Figure 5.17 presents the in-plane bending semi-rigid behavior of the D-090F numerical model.

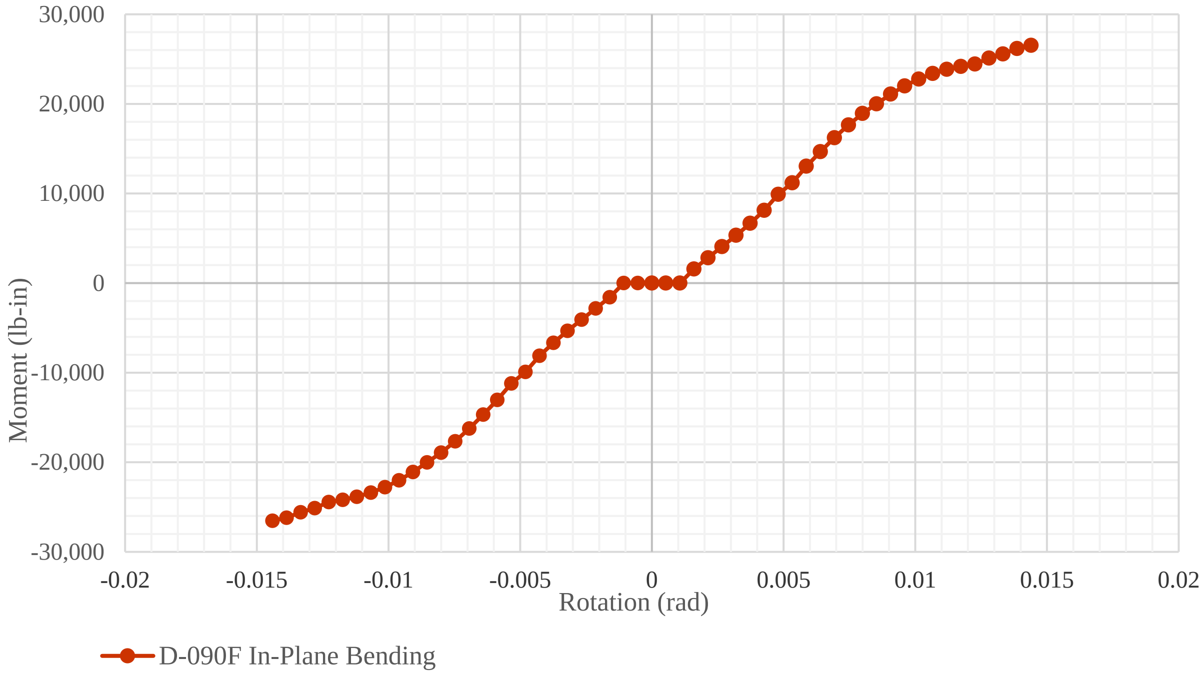


Figure 5.17 In-Plane Bending Semi-Rigid Behavior of D-090F

From the previous presented series of plots, the numerical models show the progress of deformation and the interaction behavior between the jointing system components. In a connection that incorporates filler elements (as seen on **Figure 5.16**), the impact of the fillers is more noticeable during in-plane bending since the deformation of the connection is quickly limited by the filler components.

5.2.1.1 Comparison (2): D-090 vs. D-090F In-Plane Bending Moment-Rotation

Figure 5.18 presents a plot of the moment-rotation results of the in-plane bending semi-rigid analysis of the D-090 and D-090F models, at 2,500 lb.-in increments until ultimate bending capacity was reached. **Table 5.3** compares the in-plane bending characterization data. The D-090 and D-090F models have ultimate in-plane bending moments recorded at 23,472.28 and 26,526.64 lb.-in., respectively; representing an increase of 13.01% due to the incorporation of the filler into the jointing system.

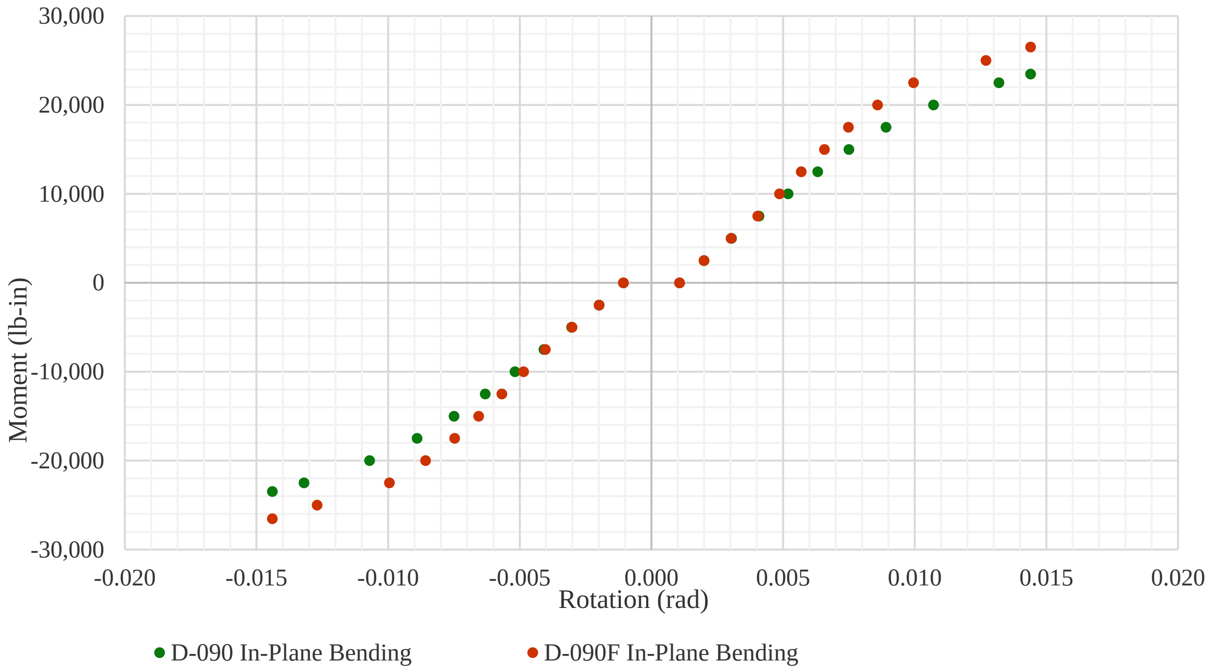


Figure 5.18 In Plane Bending Semi-Rigid Behavior of D-090 & D-090F

Table 5.3 In-Plane Bending Moment-Rotation: 090 Comparison (2)

Moment (lb-in)	Rot. (rad)	Rot. (rad)	Rot. (%)
	D-090	D-090F	D-090 vs. D-090F
0	0.0011	0.0011	0.00
2,500	0.0020	0.0020	0.00
5,000	0.0030	0.0030	-0.61
7,500	0.0041	0.0040	-1.23
10,000	0.0052	0.0049	-6.32
12,500	0.0063	0.0057	-9.93
15,000	0.0075	0.0066	-12.45
17,500	0.0089	0.0075	-16.04
20,000	0.0107	0.0086	-19.85
22,500	0.0132	0.0100	-24.57
25,000	-	0.0127	-

The preceding results show that the incorporation of the filler into the jointing system did not impact the rotation during the initial in-plane bending of 5,000 lb-in. Furthermore, an increase in stiffness of 1.23% was observed at 7,500 lb-in. reaching up to 24.57% at 22,500 lb-in. It can be concluded that at larger bending moments, there is an increment in stiffness when incorporating the filler into the jointing system.

Similar conclusions are drawn when analyzing the results for the D-104 and D-120 jointing systems proving that the thickness of the tube is not a relevant variable. The D-104 and D-120 Comparison Type (2) in-plane bending semi-rigid behavior characterization results and conclusions can be found in **Appendix H** and **Appendix I**, respectively. Only the in-plane characterizations results of the jointing system with filler will be used for comparison purposes. During **Chapter 6**, the as-designed jointing system results are compared to the as-built jointing system results to quantify how manufacturing geometric imperfections influence the semi-rigid behavior and load capacity of the connection.

Chapter 6: Finite Element Simulation Results: As-Built Jointing Systems

This chapter presents the finite element simulation results of the 162 as-built jointing system connections. The set of models includes:

1) 54 models with as-built connections and 0.090-inch thickness tubular element: B-090;
2) 54 models with as-built connections and 0.104-inch thickness tubular element: B-104; and
3) 54 models with as-built connections and 0.120-inch thickness tubular element: B-120.

The differences among the 54 as-built jointing system models in each system is the thickness of the tubular element and the different model component combinations. For each system, an analysis was performed in tension, compression and in-plane bending without the filler component being part of the jointing system model. Similarly, identical finite element analyses were performed considering the incorporation of the filler component on the jointing system.

The results for each simulation include: (1) a series of plots to illustrate the deformation process of the jointing system; (2) typical axial load-displacement graphs and their corresponding tabulated data; and (3) typical in-plane moment-rotation graphs and their corresponding tabulated data. The complete sets of graphs for all the as-built axial and in-plane semi-rigid models simulated are shown in **Appendix J** and **Appendix K**, respectively.

6.1 Axial Semi-Rigid Behavior Characterization

The characterization of the as-built jointing system semi-rigid behavior was obtained following the model conditions explained in **Chapter 5** and illustrated in **Figure 5.1**. Following **Section 5.1**, plots of the results of the model analyses were obtained to show the progress of deformation and the interaction between the jointing system elements. Furthermore, with the model results, graph were created to obtain the load-displacement curves. As explained in **Section 5.3**, only the jointing system that incorporates the filler component was considered to compare to the as-designed jointing system behavior. Statistical parameters (mean, standard deviation and coefficient of variation) were calculated using the as-built jointing system simulation results to estimate the uncertainty in the semi-rigid behavior and load capacity.

To assess how the manufacturing geometric imperfection affects the axial semi-rigid behavior of the jointing systems, **Comparison Type (3)** was conducted. The results of the as-built axial semi-rigid analysis were compared to the theoretical results using the following equation:

As-Designed WF vs. As-Built WF Jointing System Displacement Comparison

$$Displacement\ (\%) = \left(\frac{\overline{\Delta_{bF}}}{\Delta_{dF}} - 1\right)(100) \quad \textbf{(6.1)}$$

where Δ_{dF} is the as-designed displacement of the jointing system, and $\overline{\Delta_{bF}}$ is the mean (μ) value of the as-built displacement of the joining system; both including the filler element contribution.

As-Designed WF vs. As-Built WF Jointing System Ultimate Force Comparison

$$Ult.Force\ (\%) = \left(\frac{\overline{Fu_{bF}}}{Fu_{dF}} - 1\right)(100) \qquad \textbf{(6.2)}$$

where Fu_{dF} is the as-designed ultimate force of the jointing system, and $\overline{Fu_{bF}}$ is the mean (μ) value of the as-built ultimate force of the jointing system; both including the filler element contribution.

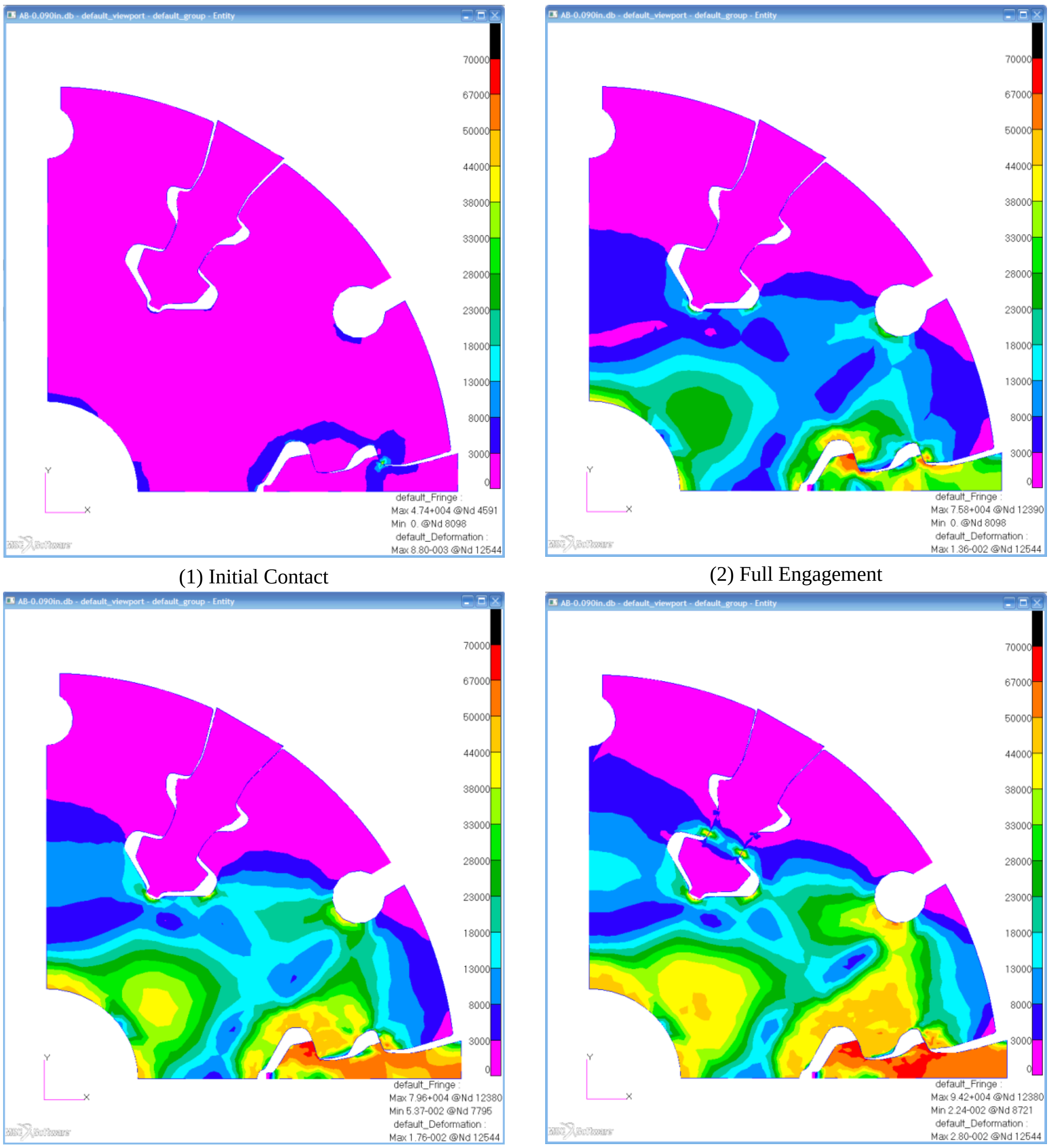
As-Designed WF vs. As-Built WF Jointing System Ultimate Displacement Comparison

$$Ult.Displacement\ (\%) = \left(\frac{\overline{\Delta u_{bF}}}{\Delta u_{dF}} - 1\right)(100) \qquad \textbf{(6.3)}$$

where Δu_{dF} is the as-designed ultimate displacement of the jointing system, and $\overline{\Delta u_{bF}}$ is the mean (μ) value of the as-built ultimate displacement of the jointing system; both including the filler element contribution.

6.1.1 B-090F Axial Semi-Rigid Behavior

The tensile finite element simulation of the B-090F AA semi-rigid behavior is illustrated in the series of plots shown in **Figure 6.1**.



(1) Initial Contact

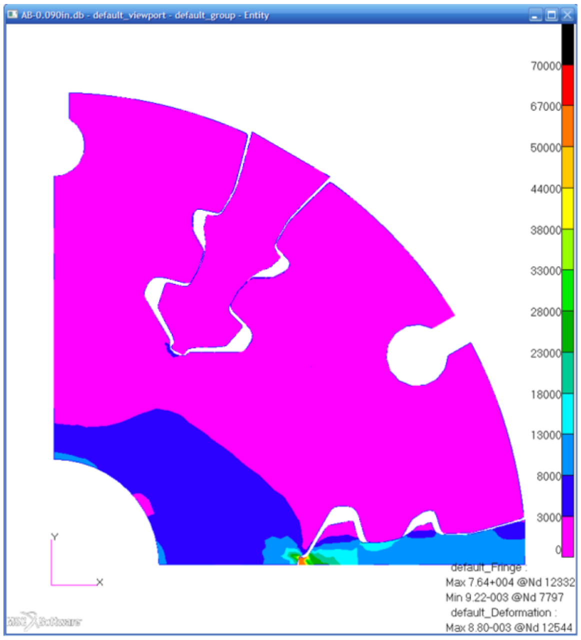
(2) Full Engagement

(3) Development of Yielding Stresses

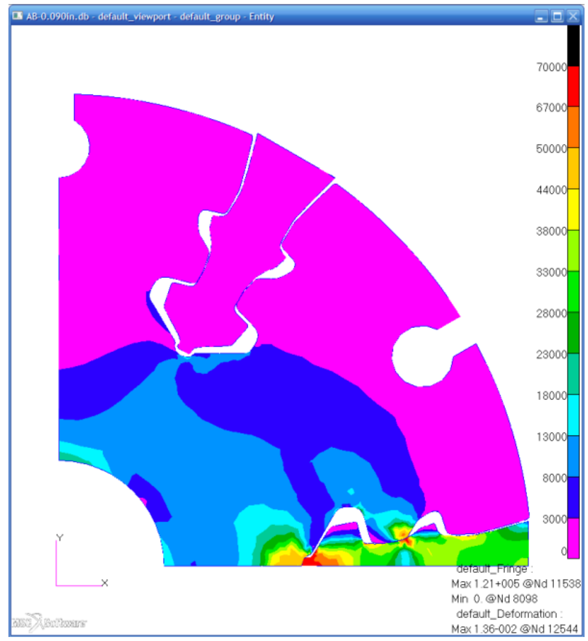
(4) Ultimate Capacity

Figure 6.1 Von Mises Stress of B-090F AA under Tension from Initial Contact to Failure

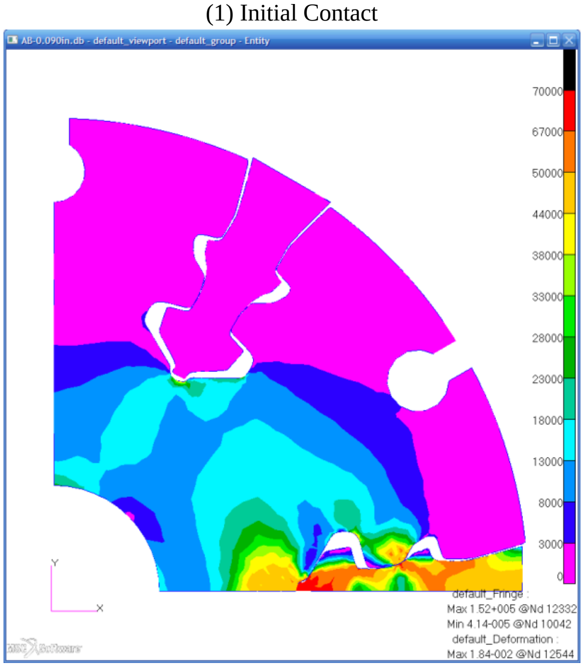
The compressive finite element simulation of the B-090F AA semi-rigid behavior is illustrated in the series of plots shown in **Figure 6.2**.



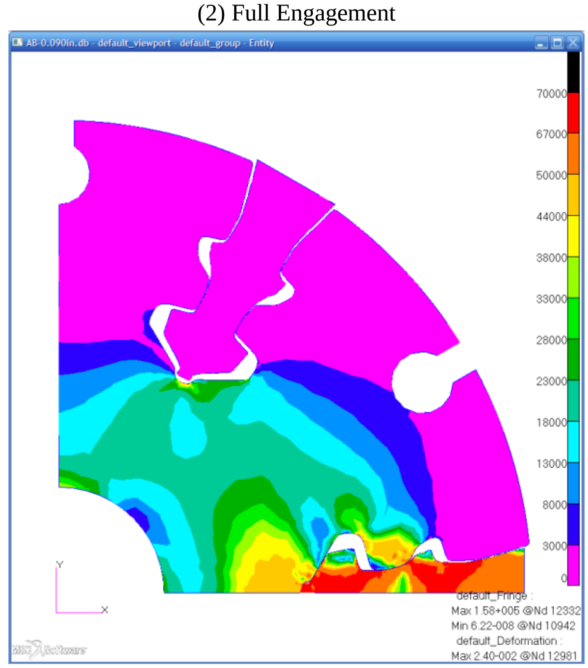
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure 6.2 Von Mises Stress of B-090F AA under Compression from Initial Contact to Failure

Figure 6.3 presents the axial semi-rigid behavior obtained from the B-090F AA simulation model.

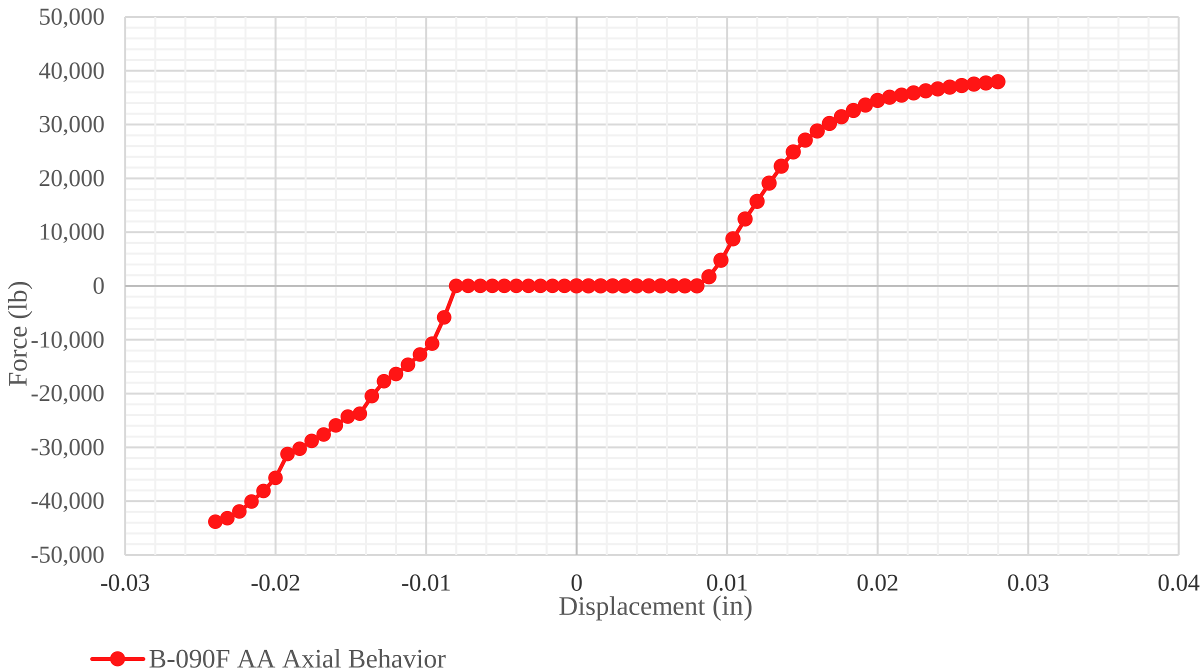


Figure 6.3 Axial Semi-Rigid Behavior of B-090F AA

6.1.1.1 B-090F Representative Axial Semi-Rigid Behavior

Figure 6.4 presents a value plot of the load-displacement recorded during axial semi-rigid analysis of the B-090F model until ultimate capacity was reached. It shows the curve adjusted to the displacement's mean values (μ). **Table 6.1** and **Table 6.2** present statistics for the load-displacement characterization data and ultimate capacities of the B-090F model set for the tensile and compressive behavior, respectively.

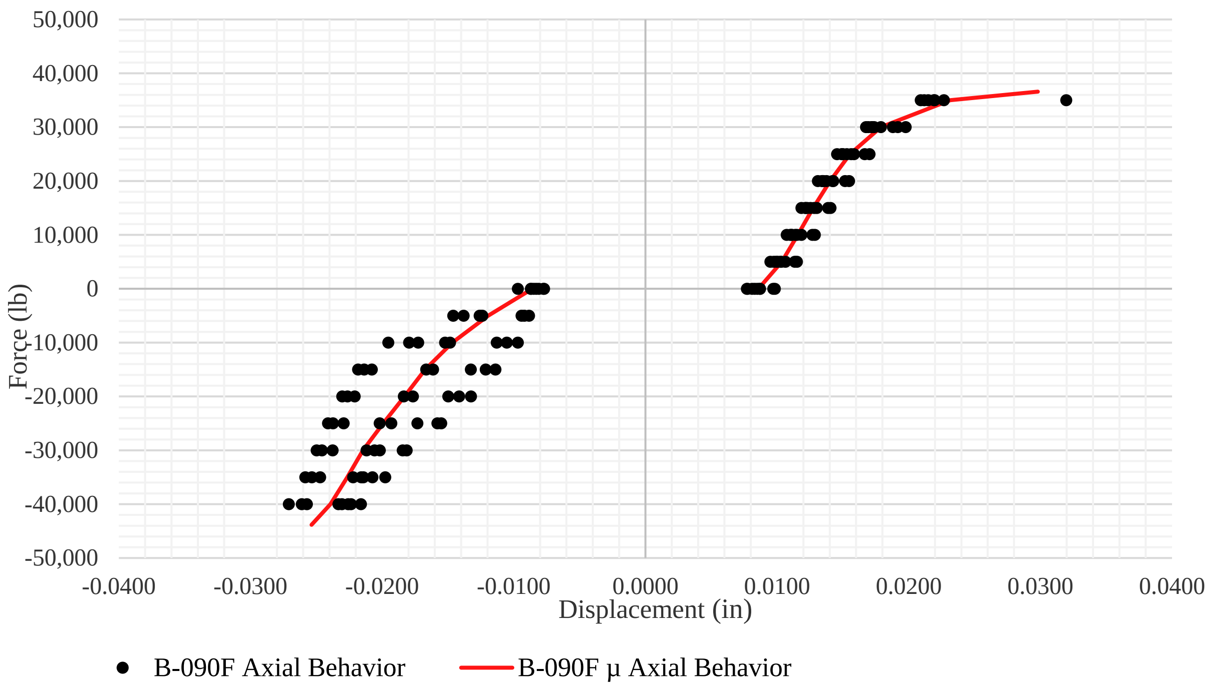


Figure 6.4 Axial Semi-Rigid Behavior of B-090F Model Set

Table 6.1 Tensile Load-Displacement and Capacity Summary of B-090F Model Set and Statistical Properties

		Force (lb)								Ult. Force (lb)	Ult. Disp. (in)
		0	5,000	10,000	15,000	20,000	25,000	30,000	35,000		
Displacement (in)	B-AA	0.0078	0.0095	0.0107	0.0118	0.0131	0.0146	0.0168	0.0209	37,926.91	0.0280
	B-AB	0.0077	0.0098	0.0110	0.0121	0.0134	0.0149	0.0169	0.0212	38,361.25	0.0288
	B-AC	0.0083	0.0102	0.0114	0.0125	0.0137	0.0153	0.0174	0.0215	38,566.76	0.0296
	B-BA	0.0087	0.0103	0.0115	0.0128	0.0143	0.0158	0.0198	-	34,723.73	0.0304
	B-BB	0.0097	0.0113	0.0127	0.0139	0.0152	0.0166	0.0188	-	33,320.20	0.0304
	B-BC	0.0098	0.0115	0.0129	0.0140	0.0155	0.0170	0.0192	0.0320	35,415.61	0.0347
	B-CA	0.0081	0.0099	0.0111	0.0123	0.0135	0.0150	0.0172	0.0219	36,907.93	0.0296
	B-CB	0.0085	0.0100	0.0111	0.0122	0.0134	0.0149	0.0172	0.0220	36,826.06	0.0264
	B-CC	0.0087	0.0106	0.0118	0.0130	0.0142	0.0156	0.0179	0.0227	37,291.68	0.0304
Statistical Data	μ	0.0086	0.0104	0.0116	0.0127	0.0140	0.0155	0.0179	0.0232	36,593.35	0.0298
	σ	0.0008	0.0007	0.0008	0.0008	0.0008	0.0008	0.0011	0.0039	1,769.01	0.0023
	COV	0.088	0.066	0.065	0.061	0.058	0.054	0.060	0.170	0.048	0.076

Table 6.2 Compressive Load-Displacement and Capacity Summary of B-090F Model Set and Statistical Properties

		Force (lb)									Ult. Force (lb)	Ult. Disp. (in)
		0	-5,000	-10,000	-15,000	-20,000	-25,000	-30,000	-35,000	-40,000		
Displacement (in)	B-AA	-0.0078	-0.0089	-0.0097	-0.0114	-0.0133	-0.0155	-0.0181	-0.0198	-0.0216	-43,839.61	-0.0240
	B-AB	-0.0077	-0.0124	-0.0173	-0.0208	-0.0221	-0.0229	-0.0238	-0.0247	-0.0257	-45,169.47	-0.0272
	B-AC	-0.0083	-0.0126	-0.0148	-0.0161	-0.0177	-0.0193	-0.0206	-0.0216	-0.0226	-43,885.83	-0.0239
	B-BA	-0.0087	-0.0094	-0.0113	-0.0133	-0.0150	-0.0173	-0.0202	-0.0214	-0.0231	-43,464.51	-0.0248
	B-BB	-0.0097	-0.0146	-0.0195	-0.0214	-0.0226	-0.0237	-0.0246	-0.0254	-0.0261	-43,702.65	-0.0272
	B-BC	-0.0098	-0.0141	-0.0156	-0.0170	-0.0185	-0.0202	-0.0212	-0.0222	-0.0234	-43,857.30	-0.0245
	B-CA	-0.0081	-0.0092	-0.0105	-0.0121	-0.0142	-0.0158	-0.0184	-0.0207	-0.0224	-42,996.74	-0.0239
	B-CB	-0.0085	-0.0125	-0.0180	-0.0218	-0.0230	-0.0241	-0.0250	-0.0258	-0.0271	-43,342.47	-0.0280
	B-CC	-0.0087	-0.0138	-0.0152	-0.0167	-0.0184	-0.0202	-0.0212	-0.0222	-0.0233	-44,208.53	-0.0248
Statistical Data	μ	-0.0086	-0.0119	-0.0147	-0.0167	-0.0183	-0.0199	-0.0215	-0.0227	-0.0239	-43,829.68	-0.0254
	σ	0.0008	0.0022	0.0035	0.0040	0.0037	0.0033	0.0025	0.0021	0.0019	614.74	0.0016
	COV	0.088	0.186	0.236	0.237	0.202	0.164	0.117	0.095	0.080	0.014	0.064

The preceding results show:

- From **Table 6.1** the model set showed a low coefficient of variation (COV) of displacement values of 5.4 - 8.8% during the first 30,000 pounds in tensile loading. The COV at 35,000 pounds increased to 17.0% due to the early load failure of two specimens for which the last incremental load data was not recorded and to the prolonged displacement recorded at for the B-090F BC failure. The set also showed a low COV of 4.8% for the ultimate tensile load and a low COV of 7.6% for ultimate displacement.
- From **Table 6.2** the model set showed a low COV of displacement values during the beginning and towards the end of the compressive loading. The COV reached higher values between 20.2 - 23.7% during 10,000 - 20,000 pounds of load. The set also displayed a smaller COV of 1.40% for the ultimate compressive load and a low COV of 6.4% for ultimate displacement.
- The results show that the uncertainty in the predictions of tension values is smaller than the uncertainty in the prediction of the compression values. However, the opposite is true when comparing the COVs of the ultimate tensile load to the ultimate compressive load.
- In this dissertation, the as-built mean value curve will be used as the bases for comparing the axial as-built behavior with the as-designed behavior and load capacity.

6.1.1.2 Comparison (3): D-090F vs. B-090F Axial Load-Displacement

Figure 6.5 presents a plot of the load-displacement data recorded during axial semi-rigid analysis of the D-090F and the mean value curve of the B-090F models. **Table 6.3** and **Table 6.4** compare the tensile load-displacement characterization data at 5,000 pound increments and the ultimate tensile capacity, respectively. **Table 6.5** and **Table 6.6** compare the compressive load-displacement characterization data at 5,000 pound increments and the ultimate compressive capacity.

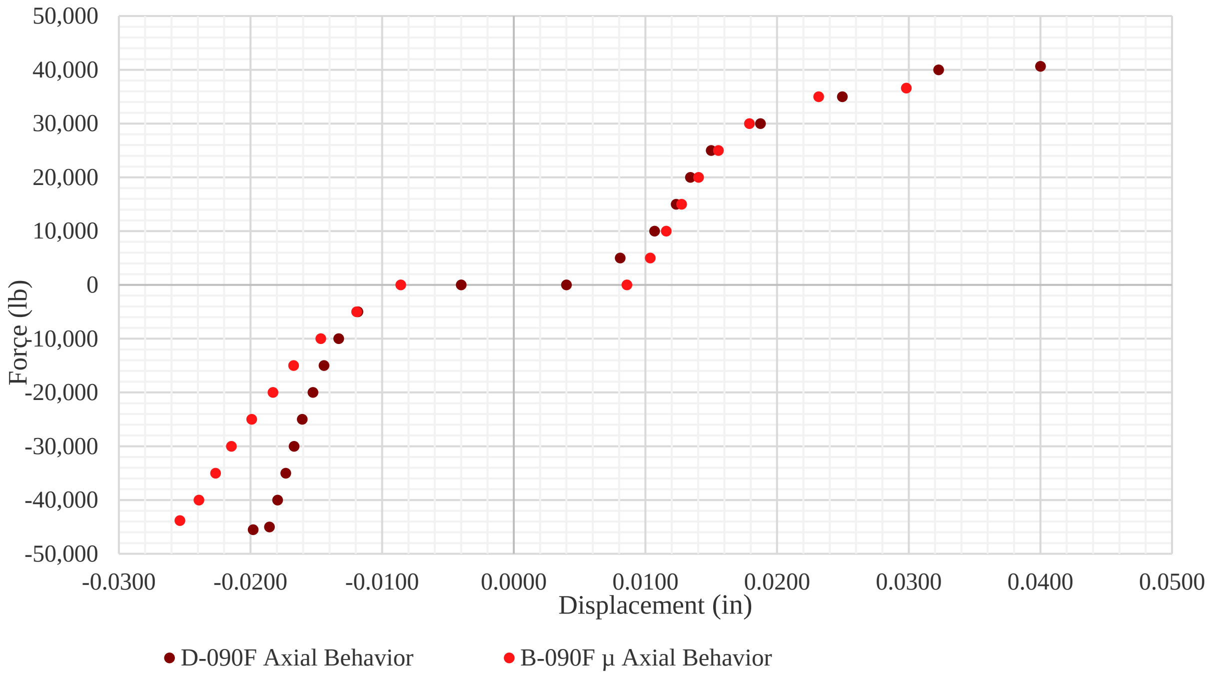


Figure 6.5 Axial Semi-Rigid Behavior of D-090F & B-090F μ

Table 6.3 Tensile Load-Displacement: 090 Comparison (3)

Force (lb)	Disp. (in) D-090F	Disp. (in) B-090F μ	Disp. (%) D-090F vs. B-090F μ
0	0.0040	0.0086	114.65
5,000	0.0081	0.0104	28.29
10,000	0.0107	0.0116	8.22
15,000	0.0123	0.0127	3.40
20,000	0.0134	0.0140	4.66
25,000	0.0150	0.0155	3.65
30,000	0.0187	0.0179	-4.49
35,000	0.0249	0.0232	-7.20
40,000	0.0323	-	-

Table 6.4 Tensile Ultimate Load-Displacement: 090 Comparison (3)

	D-090F	B-090F μ	D-090F vs. B-090F μ (%)
Force (lb)	40,648.22	36,593.35	-9.98
Disp. (in)	0.0400	0.0298	-25.48

Table 6.5 Compressive Load-Displacement: 090 Comparison (3)

Force (lb)	Disp. (in) D-090F	Disp. (in) B-090F μ	Disp. (%) D-090F vs. B-090F μ
0	-0.0040	-0.0086	114.65
-5,000	-0.0118	-0.0119	0.82
-10,000	-0.0133	-0.0147	10.23
-15,000	-0.0144	-0.0167	16.03
-20,000	-0.0153	-0.0183	19.93
-25,000	-0.0161	-0.0199	23.88
-30,000	-0.0167	-0.0215	28.51
-35,000	-0.0173	-0.0227	30.79
-40,000	-0.0179	-0.0239	33.30
-45,000	-0.0186	-	-

Table 6.6 Compressive Ultimate Load-Displacement: 090 Comparison (3)

	D-090F	B-090F μ	D-090F vs. B-090F μ (%)
Force (lb)	-45,509.90	-43,829.68	-3.69
Disp. (in)	-0.0198	-0.0254	28.10

The preceding results show:

- Due to manufacturing geometric imperfections, the fit gap tolerance between the mating parts of the jointing system increased. It is observed that during initial loading there was 114.65% more displacement during the initial gap engagement of the as-built behavior in comparison to the as-designed behavior.
- **Table 6.3** shows that the as-built jointing system experienced a decrease in stiffness until reaching 30,000 pounds load. At this point, the as-built and as designed jointing system behavior curves meet; from this point forward, the as-built behavior became stiffer. From **Table 6.4** there was a reduction of ultimate capacity of 9.98% with 25.48% less displacement as evidenced by the as-built averages.
- **Table 6.5** shows that the as-built jointing system displayed a decrease in stiffness throughout the entire compressive behavior; the stiffness incrementally decayed from 0.82 - 33.30% during 5,000 - 40,000 pounds of load, reaching capacity at a lower applied force. **Table 6.6** shows that there was a reduction of ultimate capacity of 3.69% with 28.10% more displacement as evidenced by the as-built averages.
- For the most part, there was a stiffness reduction during the load-deformation under tensile loading and an overall stiffness reduction on the compressive loading. However, based on the as-built averages, it can be concluded that at larger forces there is a slight increment in stiffness during the tensile load-deformation behavior.

- Results show that geometric imperfections influence more the compression behavior than the tensile behavior. Also, since the uncertainty in compression behavior is larger, wider safety margins should be considered in design.
- Similar conclusions are drawn when analyzing the results for the B-104 and B-120 jointing system. The B-104 and B-120 Comparison Type (3) axial semi-rigid behavior characterization results and conclusions can be found in **Appendix L** and **Appendix M**, respectively.

6.2 In-Plane Bending Semi-Rigid Behavior Characterization

The characterization of the as-built jointing system semi-rigid behavior was obtained following the model conditions explained in **Chapter 5** and illustrated in **Figure 5.11**. Following **Section 5.2**, plots of the results of the model analyses were obtained to show the progress of deformation and the interaction between the jointing system elements. Furthermore, with the model results, graphs were created to obtain the load-displacement curves. As explained in **Section 5.3**, only the jointing system that incorporates the filler component was considered to compare to the as-designed jointing system behavior. Statistical dispersion data (mean, standard deviation and coefficient of variation) were obtained from the as-built jointing system simulation results to estimate the uncertainty in the semi-rigid behavior and load capacity.

To assess how the manufacturing geometric imperfection affects the in-plane bending semi-rigid behavior of the jointing systems, **Comparison Type (4)** was conducted. The results of the in-plane bending semi-rigid analysis were compared to the theoretical results using the following equation:

As-Designed WF vs. As-Built WF Jointing System Rotation Comparison

$$Rotation\ (\%) = \left(\frac{\overline{\theta_{bF}}}{\theta_{dF}} - 1\right)(100) \qquad \textbf{(6.4)}$$

where θ_{dF} is the as-designed rotation of the jointing system, and $\overline{\theta_{bF}}$ is the mean (μ) value of the as-built rotation of the jointing system; both including the filler element contribution.

As-Designed WF vs. As-Built WF Jointing System Ultimate Moment Comparison

$$Ult.Moment\ (\%) = \left(\frac{\overline{Mu_{bF}}}{Mu_{dF}} - 1\right)(100) \qquad \textbf{(6.5)}$$

where Mu_{dF} is the as-designed ultimate moment of the jointing system, and $\overline{Mu_{bF}}$ is the mean (μ) value of the as-built ultimate moment of the jointing system; both including the filler element contribution.

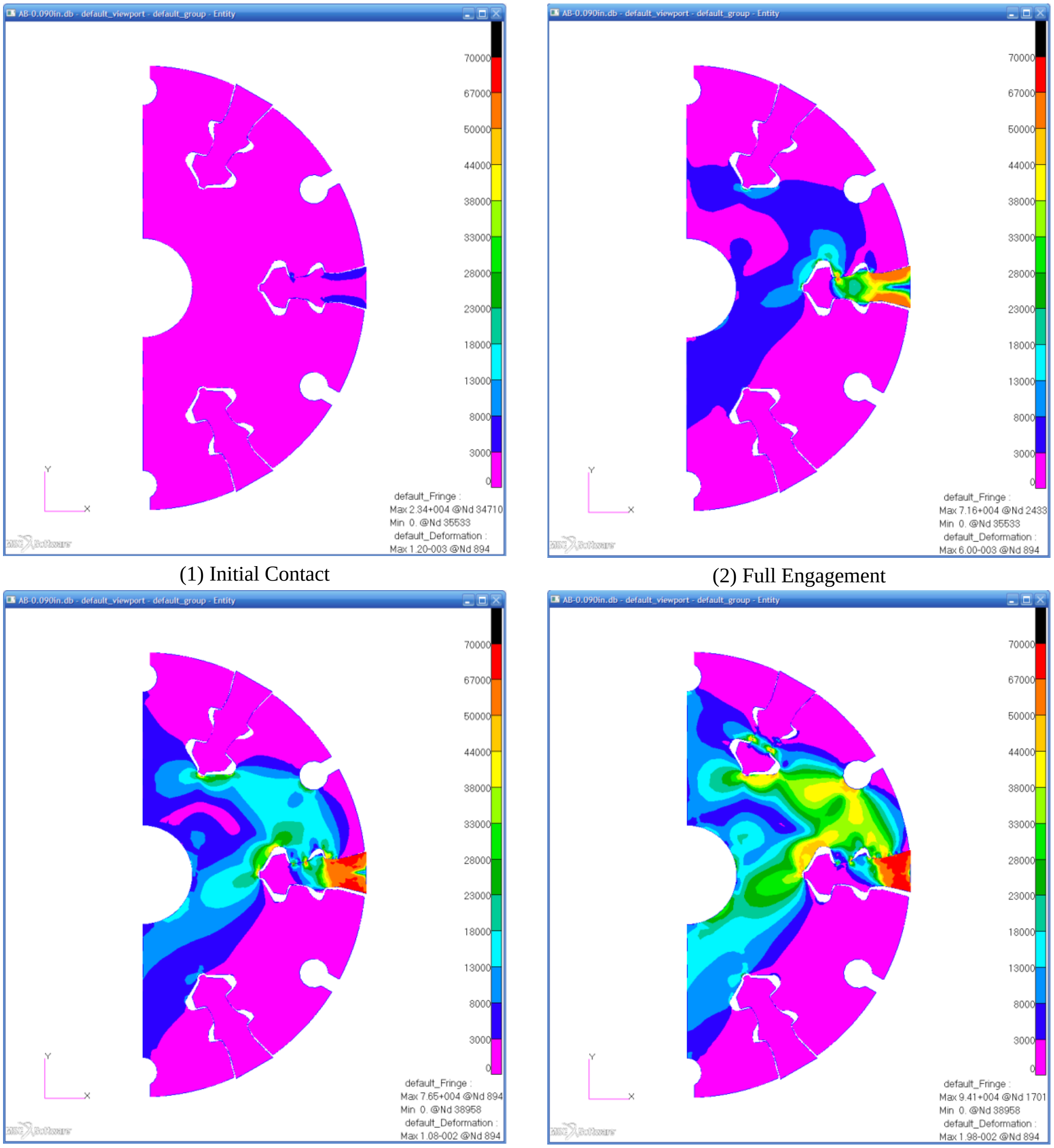
As-Designed WF vs. As-Built WF Jointing System Ultimate Rotation Comparison

$$Ult.Rotation\ (\%) = \left(\frac{\overline{\theta u_{bF}}}{\theta u_{dF}} - 1\right)(100) \qquad \textbf{(6.6)}$$

where θu_{dF} is the as-designed ultimate rotation of the jointing system, and $\overline{\theta u_{bF}}$ is the mean (μ) value of the as-built ultimate rotation of the jointing system; both including the filler element contribution.

6.2.1 B-090F In-Plane Bending Semi-Rigid Behavior

The in-plane bending finite element simulation of the B-090F AA semi-rigid behavior is illustrated in the series of plots shown in **Figure 6.6**.



(1) Initial Contact

(2) Full Engagement

(3) Development of Yielding Stresses

(4) Ultimate Capacity

Figure 6.6 Von Mises Stress of B-090F AA under In-Plane Bending from Initial Contact to Failure

Figure 6.7 presents the in-plane bending semi-rigid behavior obtained from the B-090F AA simulation model.

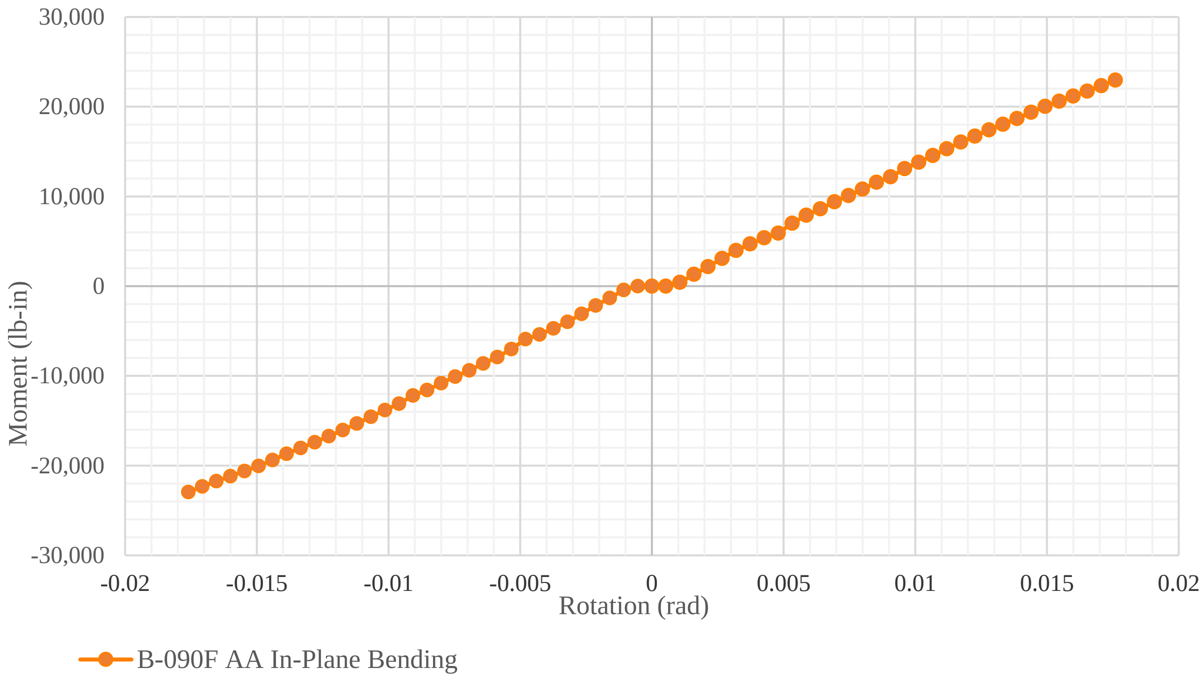


Figure 6.7 In-Plane Bending Semi-Rigid Behavior of B-090F AA

6.2.1.1 B-090F Representative In-Plane Semi-Rigid Behavior

Figure 6.8 presents a value plot of the moment-rotation recorded during in-plane bending semi-rigid analysis of the B-090F model until ultimate capacity was reached. It shows the curve adjusted to the rotation's mean values (μ). **Table 6.7** presents the statistics for the moment-rotation characterization data and ultimate capacities of the B-090F model set for the in-plane bending behavior.

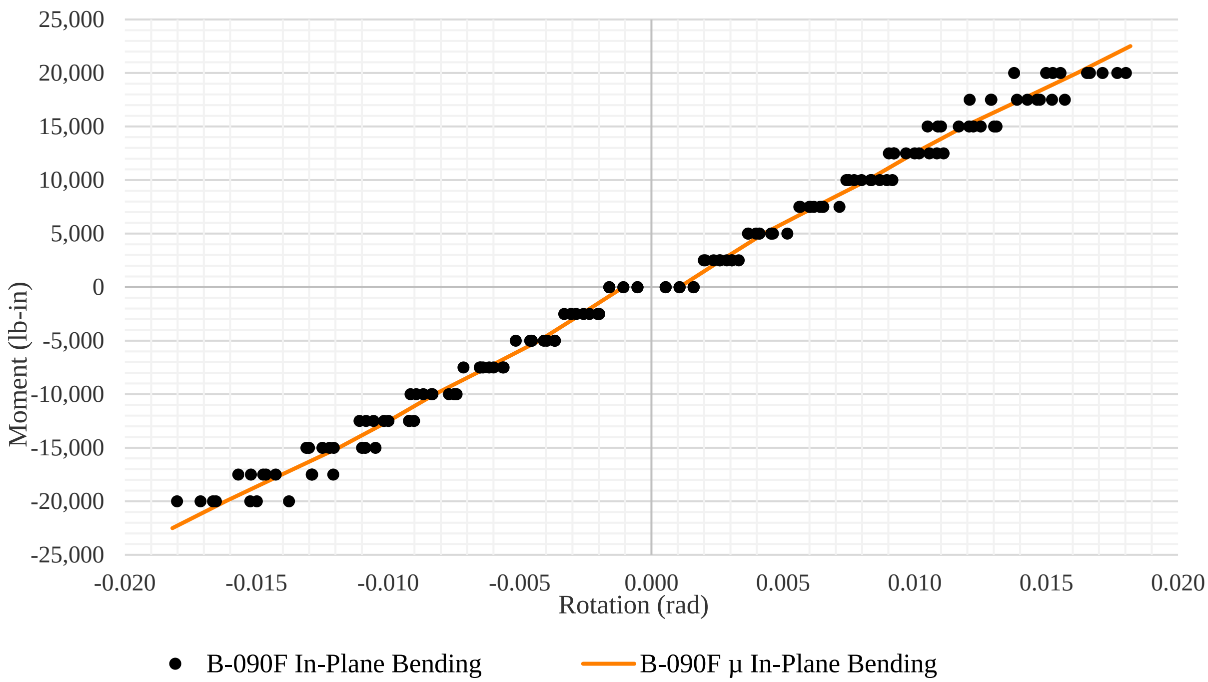


Figure 6.8 In-Plane Bending Semi-Rigid Behavior of B-090F Model Set

Table 6.7 In-Plane Bending Moment-Rotation and Capacity Summary of B-090F Model Set and Statistical Properties

		Moment (lb-in)									Ult. Moment (lb-in)	Ult. Rotation (rad)
		0	2,500	5,000	7,500	10,000	12,500	15,000	17,500	20,000		
Rotation (rad)	B-AA	0.0005	0.0024	0.0040	0.0056	0.0074	0.0092	0.0110	0.0129	0.0150	22,953.27	0.0176
	B-AB	0.0005	0.0020	0.0037	0.0062	0.0077	0.0092	0.0109	0.0129	0.0152	20,509.94	0.0155
	B-AC	0.0005	0.0020	0.0037	0.0056	0.0075	0.0090	0.0105	0.0121	0.0138	25,664.33	0.0181
	B-BA	0.0016	0.0033	0.0052	0.0071	0.0092	0.0111	0.0130	0.0152	0.0177	20,430.45	0.0181
	B-BB	0.0016	0.0031	0.0045	0.0064	0.0089	0.0108	0.0131	0.0157	0.0180	20,101.20	0.0181
	B-BC	0.0016	0.0031	0.0046	0.0065	0.0087	0.0106	0.0125	0.0146	0.0165	23,097.90	0.0187
	B-CA	0.0011	0.0029	0.0045	0.0065	0.0083	0.0102	0.0121	0.0143	0.0167	24,790.00	0.0213
	B-CB	0.0011	0.0026	0.0041	0.0060	0.0084	0.0100	0.0122	0.0147	0.0171	20,145.31	0.0171
	B-CC	0.0011	0.0026	0.0041	0.0060	0.0080	0.0097	0.0117	0.0139	0.0155	24,889.31	0.0192
Statistical Data	μ	0.0011	0.0027	0.0043	0.0062	0.0082	0.0100	0.0119	0.0140	0.0162	22,509.08	0.0182
	σ	0.0005	0.0005	0.0005	0.0005	0.0006	0.0008	0.0009	0.0012	0.0014	2,265.79	0.0016
	COV	0.433	0.174	0.115	0.077	0.076	0.076	0.079	0.085	0.086	0.101	0.087

The preceding results show:

- From **Table 6.7** the model set showed high COV of rotation value of 43.3% during the initial gap engagement. Subsequently, the COV rotation values ranged between 7.6 and 17.4% during the remainder of the in-plane bending behavior. The set also showed a low COV of 10.1% for the ultimate bending moment and a low COV of 8.7% for ultimate rotation.
- In this dissertation, the as-built mean value curve will be used as the bases for comparing the in-plane as-built behavior with the as-designed behavior and moment capacity.

6.2.1.2 Comparison (4): D-090F vs. B-090F In-Plane Bending Moment-Rotation

Figure 6.9 presents a plot of the moment-rotation recorded during in-plane bending semi-rigid analysis of the D-090F and the mean value curve of the B-090F models. **Table 6.8** and **Table 6.9** compare the in-plane bending moment-rotation characterization data at 2,500 lb.-in. increments and the ultimate in-plane bending capacity, respectively.

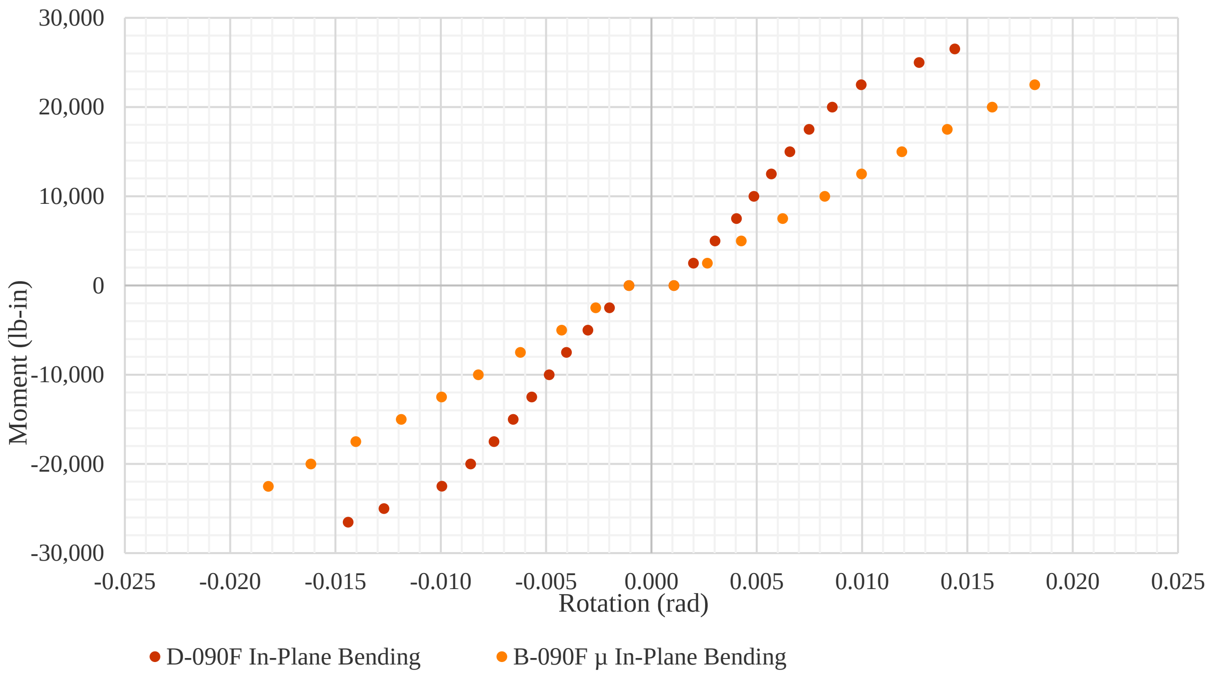


Figure 6.9 In-Plane Bending Semi-Rigid Behavior of D-090F & B-090F μ

Table 6.8 In-Plane Bending Moment-Rotation: 090 Comparison (4)

Moment (lb-in)	Rot. (rad)	Rot. (rad)	Rot. (%)
	D-090F	B-090F µ	D-090F vs. B-090F µ
0	0.0011	0.0011	0.00
2,500	0.0020	0.0027	32.95
5,000	0.0030	0.0043	41.18
7,500	0.0040	0.0062	54.28
10,000	0.0049	0.0082	69.17
12,500	0.0057	0.0100	75.33
15,000	0.0066	0.0119	80.95
17,500	0.0075	0.0140	87.73
20,000	0.0086	0.0162	88.41
22,500	0.0100	-	-
25,000	0.0127	-	-

Table 6.9 In-Plane Ultimate Bending Moment-Rotation: 090 Comparison (4)

	D-090F	B-090F µ	D-090F vs. B-090F µ (%)
Moment (lb-in)	26,526.64	22,509.08	-15.15
Rot. (rad)	0.0144	0.0182	26.34

The preceding results show:

- No percentile change was noted during the initial gap rotation.
- **Table 6.8** shows that beyond the initial gap rotation, the as-built jointing system experienced a decrease in stiffness of 32.95 - 88.41% during bending moments of 2,500 - 20,000 lb-in. From **Table 6.9** there was a reduction of ultimate in-plane bending moment capacity of 15.15% with 26.34% more rotation as evidenced by the as-built averages.
- On its entirety, there was a stiffness reduction during the moment-rotation under in-plane bending. Additionally, based on the as-built averages, it can be concluded that at ultimate

capacity, the as-built jointing system displayed lower bending moment capacities with higher rotations.

- Similar conclusions are drawn when analyzing the results for the B-104 and B-120 jointing system. The B-104 and B-120 Comparison Type (4) in-plane semi-rigid behavior characterization results and conclusions can be found in **Appendix N** and **Appendix O**, respectively.

Chapter 7: Laboratory and Analytical Results: Comparative Analysis

Physical laboratory tests were conducted to capture the actual behavior of the fir-tree jointing system under tensile loading. This chapter presents the description of the experimental tests including the: (1) tensile specimen configuration; (2) equipment, instrumentation, and procedures to conduct laboratory tests; and (3) test results. Six Geometrica® jointing system specimens were tested under tensile loading conditions. The set of specimens included:

1) 2 specimens with 6Sd-00 connectors and 0.090-inch thickness tubular element: E-090;
2) 2 specimens with 6Sd-00 connectors and 0.104-inch thickness tubular element: E-104;
3) 2 specimens with 6Sd-00 connectors and 0.120-inch thickness tubular element: E-120;

Additionally, using the finite element simulations conducted and presented in **Chapter 6**, the load-strain relation of as-built models of the jointing system were obtained. Finally, for the purpose of comparison, the analytical and experimental load-strain curves were plotted to assess if the developed finite element models could predict the actual semi-rigid behavior of the jointing system.

7.1 Description of Tensile Specimen

The primary elements used to build the jointing system specimens include the following components:

- The Geometrica® series 6Sd-00 connector element made of A6061-T6 aluminum;
- Structural tubular element:
    - Made of A500 Grade B steel for the E-090
    - Made of A653 SS 37 steel for the E-104 & E-120
- Filler shim element made of A6061-T6 aluminum; and
- Serrated steel plate.

Figure 7.1 shows a typical tensile specimen configuration. Each of the tensile specimens were constructed using two fir-tree hub connectors elements (approximately 5.20 inches long and 2.25 inches in diameter) and one steel tubular element. The tubular structural elements had an approximate length of 19.75 inches. The tapper die formed fir-tree end consumed approximately 4.00 inches of the tube with its coined pressed end formed perpendicular to the longitudinal axis of the tubular elements. All specimens use four filler shims for the empty slots per connector and two threaded rods along with its complementary washers and nuts for confining the tubular element as an extra safety margin. Both ends of the tubular structural member were engaged to a connector, while the connectors were then engaged to a steel plate located just opposite to the tubular member. The two serrated steel plates were used to provide a flat end to facilitate the engagement with the clamping jaws of the testing machine.

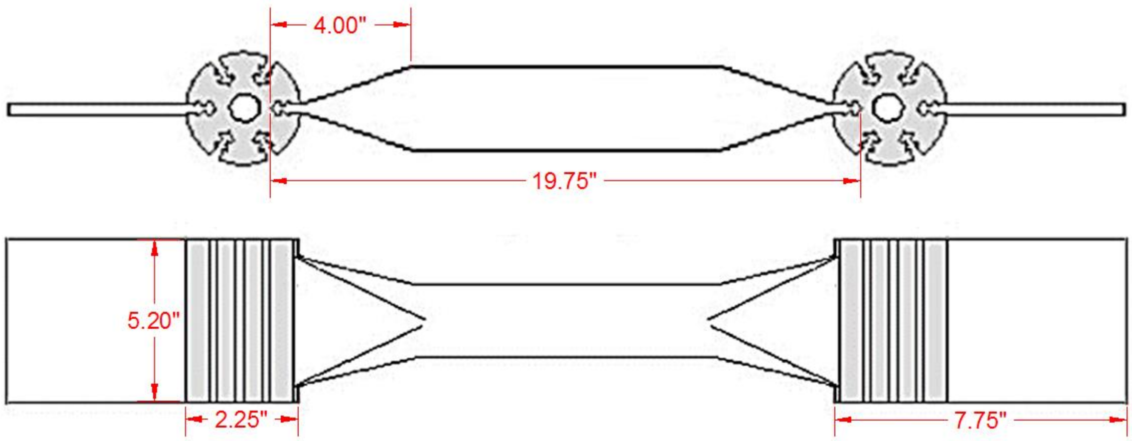


Figure 7.1 Tensile Specimen Configuration

Pre-wired strain gauges (KFH-06-120, Omega®) were bonded to three tensile specimens (one per tubular thickness) to measure the strains developed at the area of interest (exposed taper run-out section of the tube closest to the jointing system engagement). The area of interest is the most adjacent area of the tube, next to the connector, where the strain gauge could possibly be installed to simulate the finite element modeling conditions. **Figure 7.2** shows the installation of the strain gauges on a tensile specimen. Subsequently, **Figure 7.3** shows a complete typical tensile specimen (with strain gauges installed) prior to testing.

(a) Surface Preparation

(b) Installation of Stain Gauge

Figure 7.2 Installation of Strain Gauges on Tensile Specimens

Figure 7.3 Typical Tensile Specimen with Strain Gauges

7.2 Equipment, Instrumentation and Procedure of Test

The experimental tests were conducted using an MTS universal testing machine with a maximum rated load capacity of 220 kips and an adjustable loading rate. **Figure 7.4** shows the configuration of the tensile specimen and MTS universal testing machine.

Figure 7.4 MTS Universal Testing Machine Configuration

Figure 7.5 shows a typical specimen alignment and locked to its final position into the tensile machine. Each specimen was positioned onto the lower clamping jaw of the machine to engage one end of the specimen. Next, the upper clamping jaw was lowered and roughly positioned to engage the opposite end of the specimen. A standard leveling tool was used to align the specimen orientation to the load axis of the machine. After proper alignment was completed, the clamping jaws were fully engaged and locked in final position.

Figure 7.5 Typical Tension Specimen Set-up

Specimens were subjected to a tensile force under load control conditions at a quasi-static rate of 1000 lb./min. The embedded data acquisition system of the MTS machine recorded the applied tensile loading while simultaneously, a separate data acquisition system (LMS Test.Lab)

recorded the developed strains. The data acquisition systems gathered signals generated by the load cell and strain gauges which were simultaneously registered with respect to time. Tensile loading was applied until the specimens reached ultimate capacity. Failure was identified when the load dropped considerably due to shear rupture of the teeth of the connector. **Figure 7.6** shows a typical tensile specimen during experimental testing. For security purposes, a protective shield was placed around testing area to prevent any flying fragments from reaching the operator.

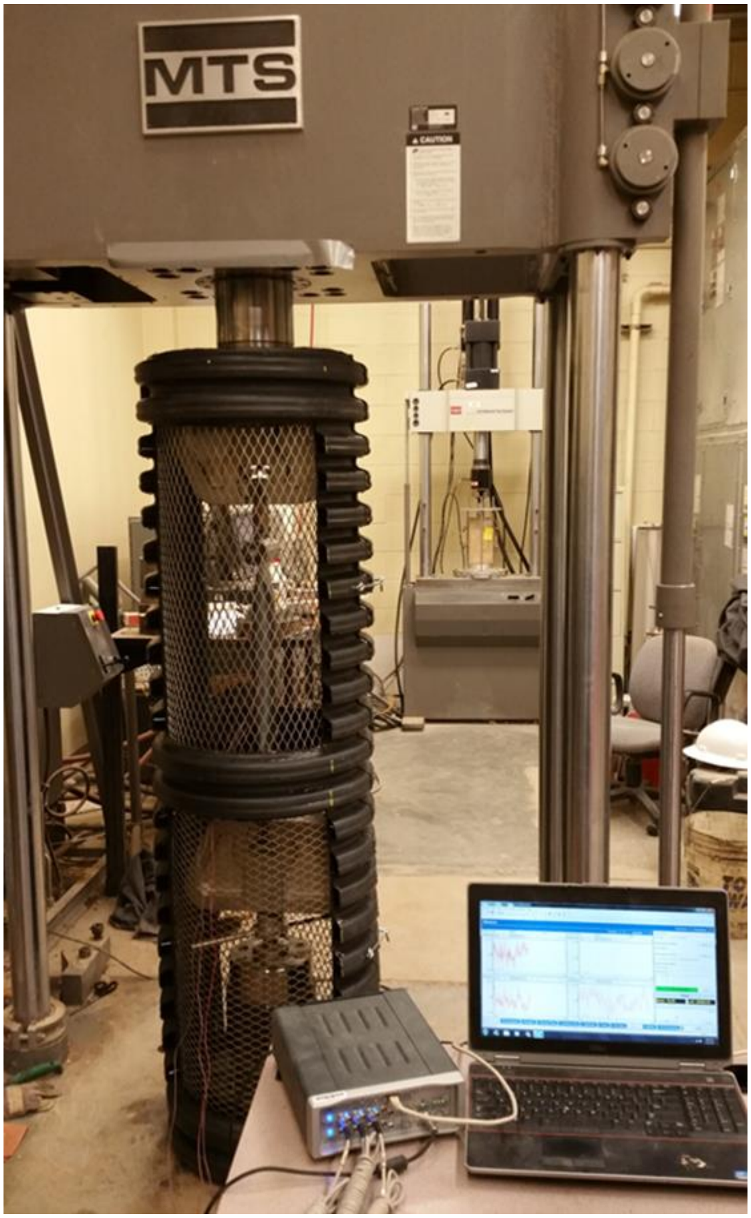


Figure 7.6 Typical Tension Specimen Test in Progress

7.3 Tensile Test Results

A common terminology will be used to callout the six-different experimental specimen jointing system configurations (see **Figure 7.7**). Using a common nomenclature, an identity can be assigned to each jointing system specimen using the following details: (1) the three different tubular thicknesses used within this study; and (2) an identification letter given to the specimen tested.

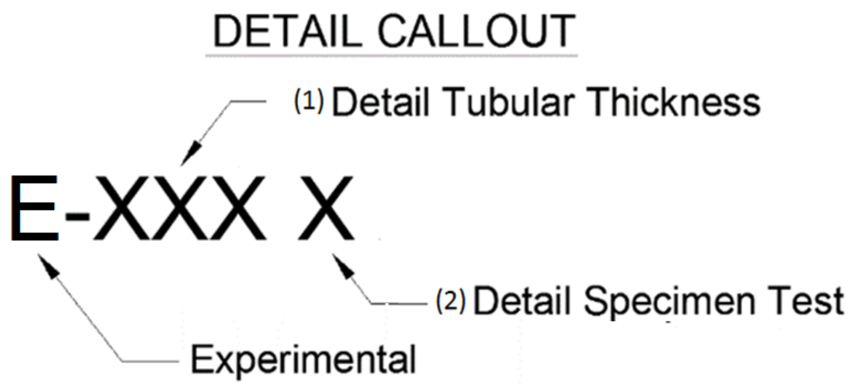


Figure 7.7 Experimental Specimen Jointing System Detail Callout

Two specimens were tested per tubular thickness as follows: (1) one specimen was tested to capture the jointing system ultimate capacity; and (2) one specimen was configured with strain gauges to capture the applied load-strain history of the jointing system. In the six tests conducted, only one failure mode was observed. The failure was determined by the shear failure of the teeth in the connector's slot (**Figure 7.8**). The figure shows the connector teeth splinters that were ultimately released onto the surrounding area of the developed failure.

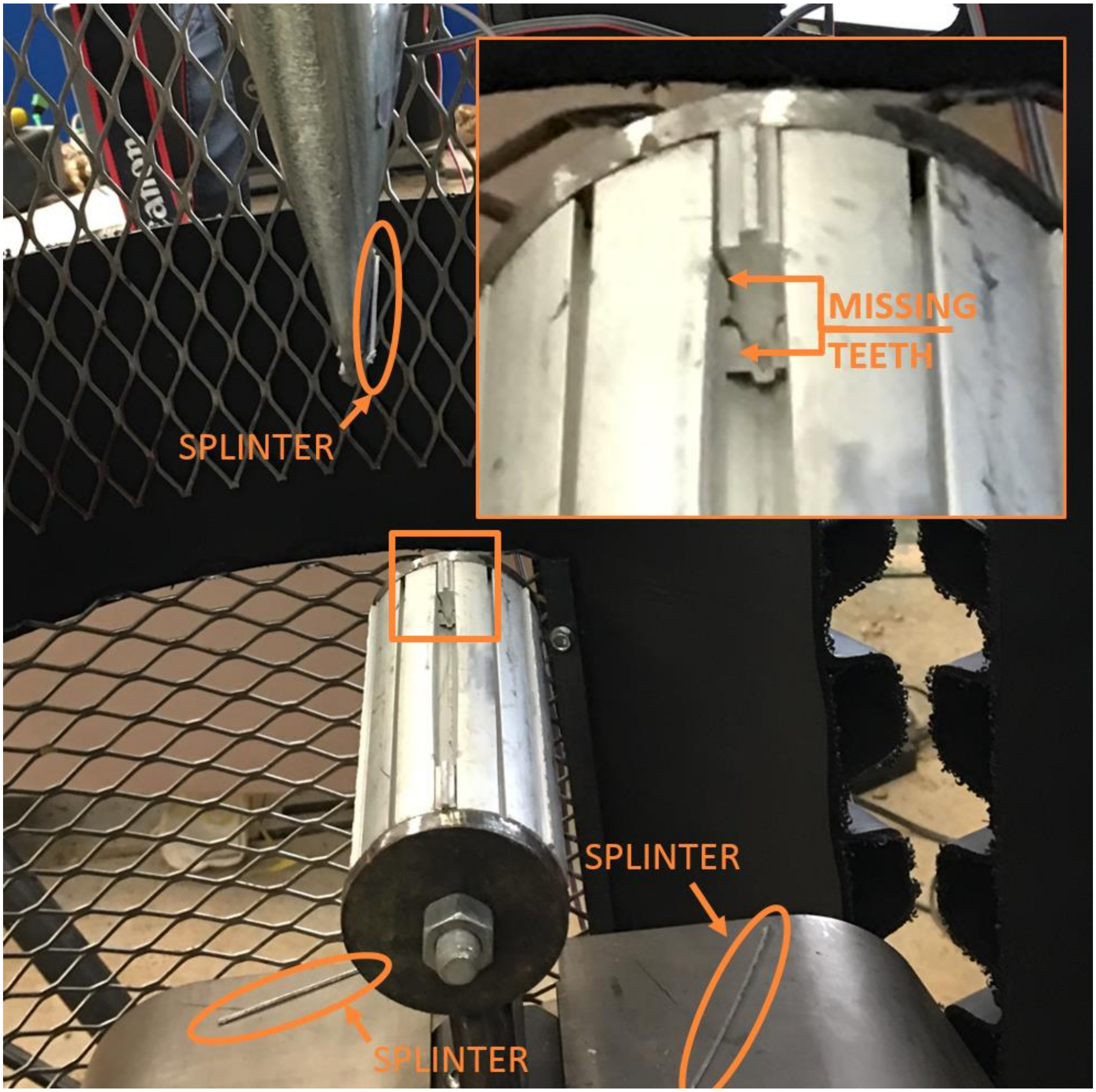


Figure 7.8 Typical Tensile Specimen Failure with Visible Splinters

Table 7.1 shows the ultimate tensile capacity for the entire experimental specimen set. **Table 7.2** presents a summary of the applied load-strain history of the jointing system specimens configured with strain gauges.

Table 7.1 Tensile Ultimate Load-Strain of Test Specimens

	E-090F A	E-090F B	E-104F A	E-104F B	E-120F A	E-120F B
Force (lb)	37,073.57	34,320.03	42,260.32	42,815.62	43,191.18	41,620.90
Strain (in/in)	-	0.00223	-	0.00237	-	0.00214

Table 7.2 Tensile Load-Strain of Test Specimens

Force (lb)	Strain (in/in)		
	E-090F B	E-104F B	E-120F B
0	0.00000	0.00000	0.00000
2,000	0.00011	0.00010	0.00007
4,000	0.00018	0.00021	0.00015
6,000	0.00024	0.00028	0.00023
8,000	0.00031	0.00035	0.00030
10,000	0.00037	0.00042	0.00036
12,000	0.00044	0.00049	0.00041
14,000	0.00050	0.00053	0.00050
16,000	0.00057	0.00059	0.00057
18,000	0.00066	0.00064	0.00066
20,000	0.00074	0.00069	0.00074
22,000	0.00085	0.00074	0.00082
24,000	0.00097	0.00081	0.00091
26,000	0.00111	0.00087	0.00101
28,000	0.00127	0.00093	0.00111
30,000	0.00149	0.00100	0.00122
32,000	0.00177	0.00109	0.00134
34,000	0.00211	0.00119	0.00145
36,000	-	0.00130	0.00159
38,000	-	0.00145	0.00176
40,000	-	0.00167	0.00196
42,000	-	0.00199	-

In **Section 7.4**, the experimental results will be compared to selected finite elements results**.** This comparisons will be the base to assess how well the proposed model accounts for manufacturing geometric imperfection in predicting the jointing system behavior.

7.4 Comparison of Laboratory Test vs. Finite Element Simulation Results

From the finite element simulation results of the as-built Geometrica® 6Sd-00 jointing system presented in **Chapter 6**, the load-strain relation of the following as-built models were obtained:

1) B-090F AB, B-090F BA, and B-090F CB;
2) B-104F AC, B-104 BB, and B-104F CA; and
3) B-120F AC, B-120 BB, and B-120F CA.

The load-strain data of the finite element simulations was plotted along the load-strain curves of the experimental tensile specimens for comparison purposes. **Figure 7.9**, **Figure 7.10** and **Figure 7.11** present a plot of the experimental and numerical tensile load-strain results for the 090, 104 and 120 jointing systems, respectively. The jointing system's experimental load-strain relation is represented by the magenta cross marks while the solid lines represent the finite element simulation results.

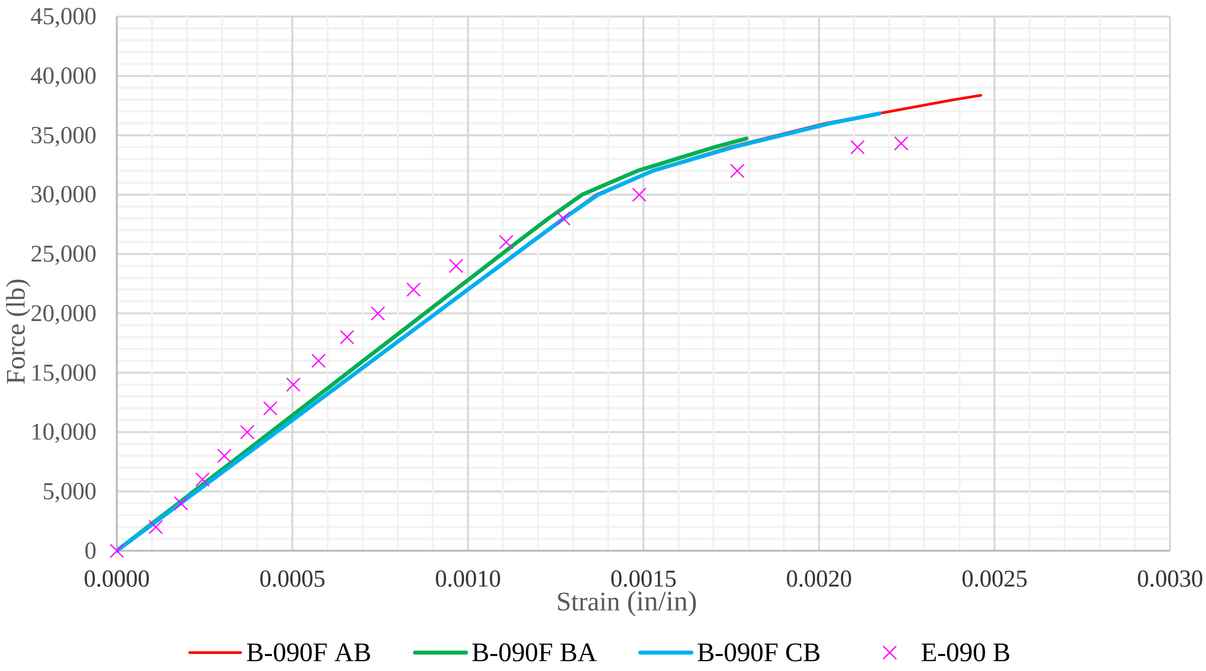


Figure 7.9 Experimental and Numerical Tensile Results of the 090-Jointing System

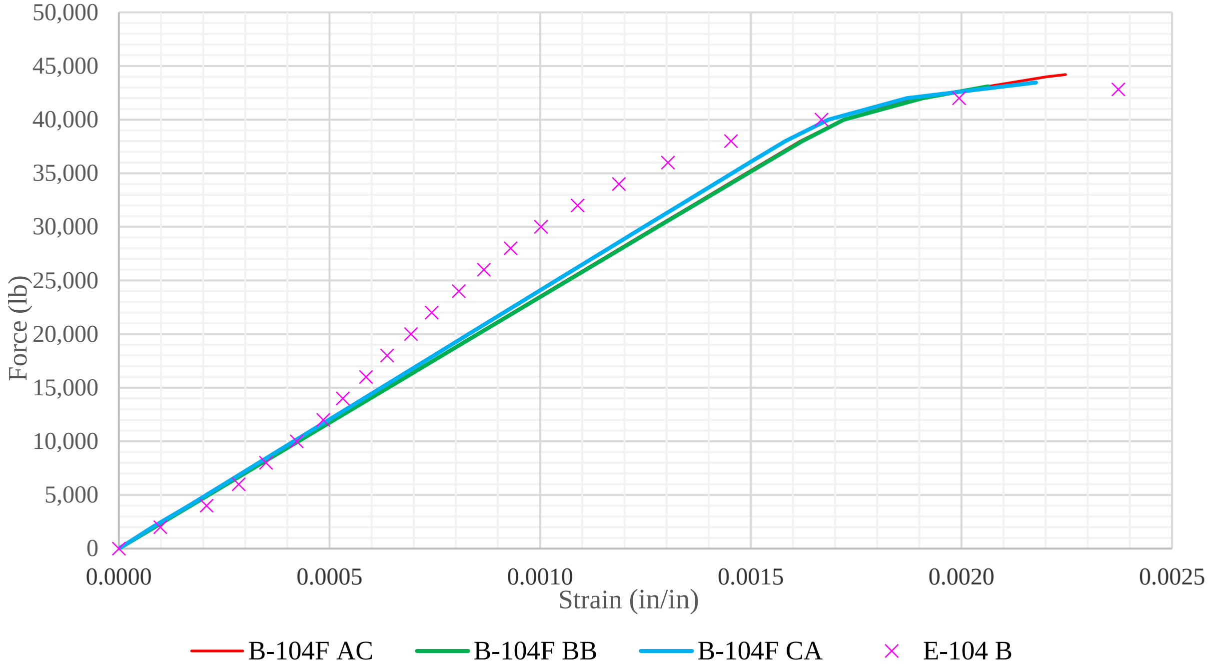


Figure 7.10 Experimental and Numerical Tensile Results of the 104-Jointing System

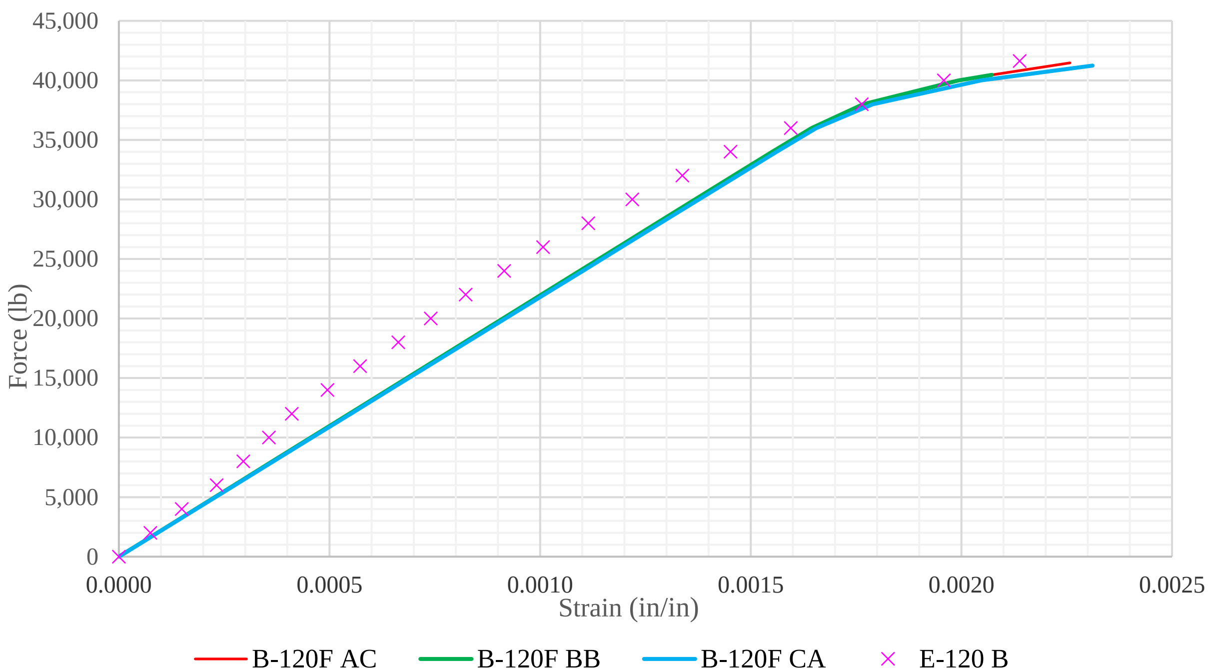


Figure 7.11 Experimental and Numerical Tensile Results of the 120-Jointing System

From the figures the following was concluded:

- The applied load-strain curves of the B-090 finite element model follow a similar path as compared to the E-090 experimentally obtained behavior of the tensile specimen.
- The applied load-strain curves of the B-104 and B-120 finite element models underestimate the stiffness during the non-linear loading of the jointing system. However, the laboratory test results and analytical results follow a similar path during initial and ultimate loading capacity.
- In summary, it can be concluded that the finite element models developed during this dissertation can be used to predict the tensile jointing system semi-rigid behavior.

Chapter 8: Summary, Conclusions, and Recommendations

This chapter summarizes and presents the conclusions of the research reported in this dissertation. This chapter also presents the contributions of the research to the engineering profession and outlines proposals for future studies.

8.1 Summary

A jointing system is an assembly of a connector and structural elements joined together to construct three-dimensional structures. This dissertation was dedicated to study the semi-rigid behavior of the fir-tree jointing system considering manufacturing geometric imperfections. Manufacturing geometric imperfections produce an imperfect jointing system that deviates from the as-designed model in such a way that the location of the connecting surface does not follow the as-designed interaction path between component elements. Hence, unconsidered axial and bending stresses are produced throughout the jointing system because of these manufacturing geometric imperfections. These changes in the interaction path of the jointing system might have a significant impact leading to load transfer discrepancies, affecting the overall behavior and capacity of a complete structural system.

To predict a jointing system's mechanical behavior and capacity, studies have been conducted on many proprietary jointing systems. Nevertheless, studies have failed to include the incorporation of manufacturing imperfections into the analysis; therefore, the stiffness characterization and load capacity of jointing systems may be lacking accuracy. This study developed a step-by-step procedure to enable current numerical models to incorporate manufacturing geometric imperfections in the analysis of the mechanical behavior of jointing systems, using the fir-tree jointing system as the research model of study.

Finite element simulations were conducted to characterize the inelastic behavior of the Geometrica® jointing system models. The models were analyzed, using the as-designed and as-built conditions, to characterize the jointing system's axial and in-plane bending semi rigid behaviors. The results included:

1) Graphs that illustrate the deformation process of the jointing system;
2) Axial load-displacement graphs and their corresponding tabulated data; and
3) In-plane moment-rotation graphs and their corresponding tabulated data.

The numerical results were used: (1) to assess how the incorporation of filler components affect the stiffness characterization and load capacity of the jointing system under axial loading and in-plane bending conditions; and (2) to assess how the manufacturing geometric imperfection affects the axial and in-plane bending semi-rigid behavior of the jointing system.

As part of this research, experimental tests were conducted on representative tensile specimens. The data recorded included: (1) the ultimate tensile capacity of the system; and (2) the load-strain graphs. The experimental data was compared to the finite element simulation results to assess if the developed finite element models could predict the jointing system semi-rigid behavior accurately.

8.2 Conclusions

This research has provided a method to incorporate manufacturing geometric imperfections into the analysis of jointing systems used in three-dimensional structures. Based on the results obtained through: (1) the as-built jointing systems' geometric comparison; (2) the finite element analyses; and (3) the experimental tests conducted, the following is concluded:

1) The COV of the measured geometric dimensions was calculated to define how the as-built superimposed profiles behaved relative to the average as-built profile. A low variability of dimensions was observed; therefore, it was determined that the average value of the measured dimensions of the as-built connector slots and tube coined pressed-ends profiles produced a good representation of the imperfect manufactured jointing system.
2) The finite element analysis of the as-designed jointing system, with and without the filler contribution analytically proved that:
    a. In a connection that incorporates filler elements, the adjacent connector slots and filler components engage in contact as the jointing system is loaded. Consequently, the filler elements restrict further deformations of the jointing system creating an impact to the stiffness behavior;
    b. The incorporation of the filler into the jointing system: (1) slightly increased the stiffness during tension; (2) no significant change of stiffness was observed during compression; and (3) slightly increased the stiffness during in-plane bending;
    c. At larger forces, there is a slight increment in rigidity when incorporating the filler into the jointing system.

3) From the comparative analysis of the as-designed to the as-built jointing system, a total of 54 models were developed for each of the three tubular thickness (referred as model sets). A statistical analysis was performed on the stiffness results obtained from each model set. From the results, it was concluded that:

    a. For the most part, a stiffness reduction was observed under tensile loading and an overall stiffness reduction on the compressive loading of the as-built jointing system. However, based on the average as-built load-deformation curves, at larger forces there is a slight increment in stiffness during tensile loading when compared to the as-designed load-deformation curves; and

    b. An overall stiffness reduction was observed during in-plane bending of the as-built jointing system. Additionally, based on the average as-built moment-rotation curves, the as-built jointing system displays lower ultimate bending moment capacities with higher rotations when compared to the as-designed moment-rotation curves.

4) From the comparison of the laboratory to analytical results of the jointing system, it was observed that: (1) analytical results followed a similar path when compared to the experimental behavior, and (2) analytical results slightly underestimate the stiffness during the non-linear loading of the jointing system; however, the FEA results follow a similar path during initial and ultimate loading capacity.

5) The comparison of FEA results of the as-designed vs. the mean as-built jointing system demonstrated that the inelastic behavior of the fir-tree jointing system, used in three-dimensional structures, is sensitive to manufacturing geometric imperfections.

8.3 Contribution of Study

The major contribution of this research was the development of an enhanced finite element modeling technique that can incorporate the manufacturing geometric imperfections to the inelastic behavior modeling of jointing systems used in three-dimensional structures. The significant highlight contributions in this study are:

1) The development of a more realistic finite element model that accounts for the manufacturing geometric imperfections of the fir-tree jointing system;
2) Better understanding of how manufacturing geometric imperfections impact the stiffness of the fir-tree jointing system, using the base of the tube to characterize the jointing system behavior;
3) A procedure was proposed which can be used to consider manufacturing geometric imperfections in the matting parts of mechanical jointing systems used in three-dimensional structures; and
4) Highlights the need for developing design criteria to allow for manufacturing imperfections to be included in the analysis of the jointing system and three-dimensional structures.

8.4 Recommendations for Future Work

While this research has successfully addressed the influence of manufacturing geometric imperfections in the inelastic behavior modeling of jointing systems used in three-dimensional structures, the following recommendations are proposed:

1) During this research, special attention was given to the axial displacement and in-plane bending semi-rigid behaviors of the fir-tree jointing system with the longitudinal axis of the connector element oriented normal to the tubular member's long axis. A further study can be conducted to identify the impact of imperfections in the axial displacement and in-plane bending semi-rigid behaviors of the fir-tree jointing system with the longitudinal axis of the connector element oriented in a skew with respect to the tubular member's long axis. This configuration is a representative connection condition that arises during the construction of three-dimensional structures;
2) Numerical and experimental results vary as a consequence of the simplifications introduced in the numerical model. Therefore, to better predict the fir-tree jointing system behavior through finite element simulations, the entire jointing system should be modeled including all jointing system components such as the threaded rod, washers and nuts;
3) Experimental testing should employ displacement instrumentation to permit the plotting of conventional load-displacement curves. Additional laboratory specimens should be tested under tensile loading conditions for a more realistic comparison to the finite element simulation results. Further laboratory testing should include specimens to be tested under compressive and in-plane configurations for comparison to the developed as-built finite element load-deformation curves; and

4) Results of this research should be used to further investigate the influence of manufacturing geometric imperfections of the jointing systems in the buckling behavior of a complete three-dimensional structural system.

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Appendix A

As-Designed Geometry

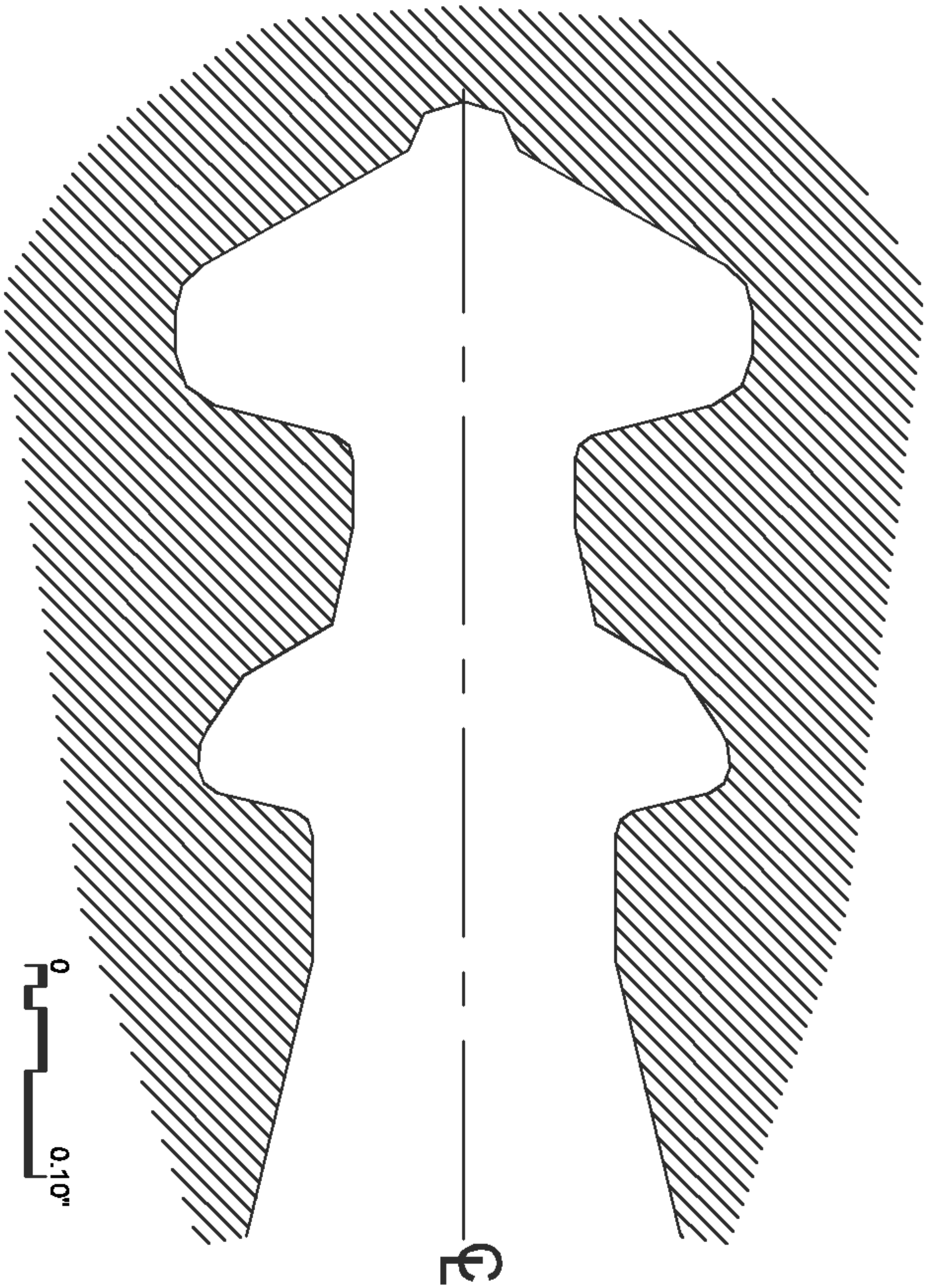


Figure A.1 As-Designed 6Sd-00 Connector Slot Representative Profile

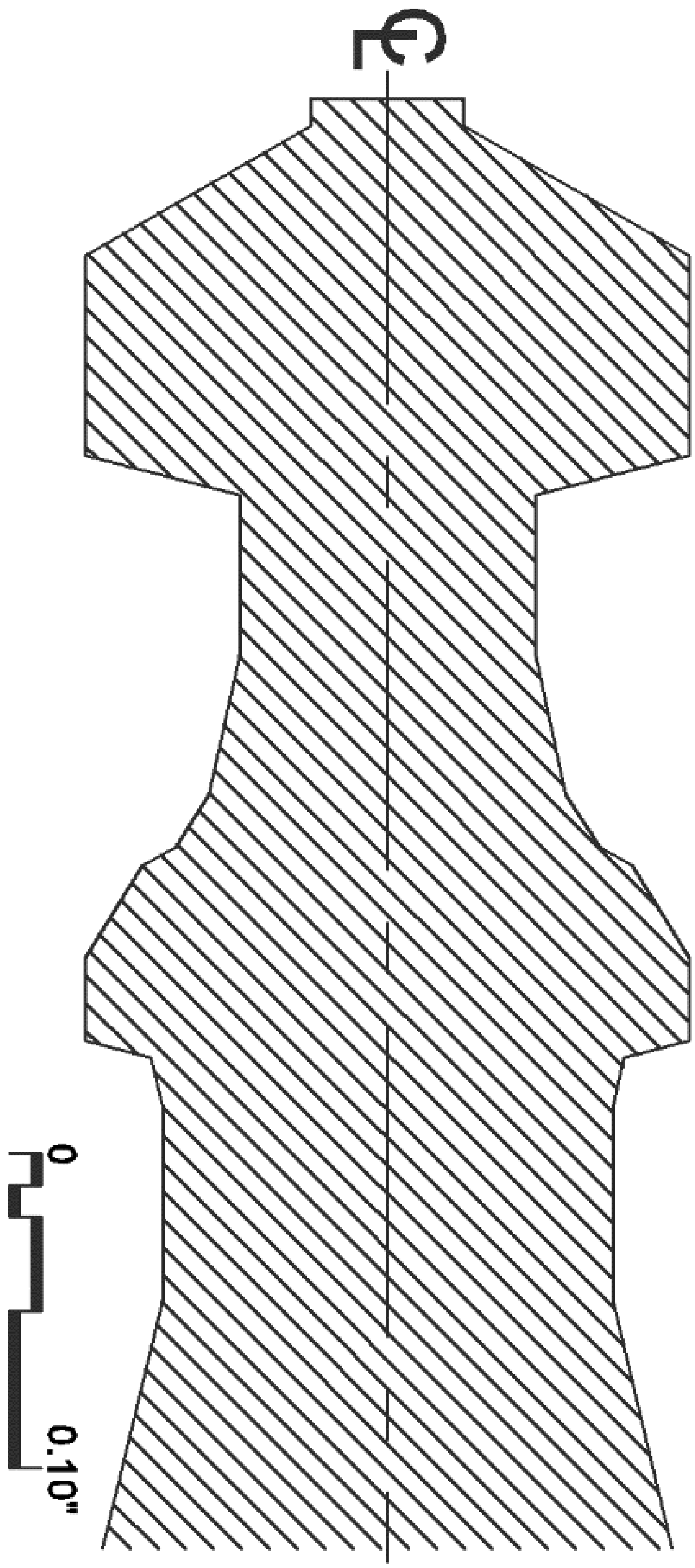


Figure A.2 As-Designed 0.090 in. Tube Coined Pressed-End Representative Profile

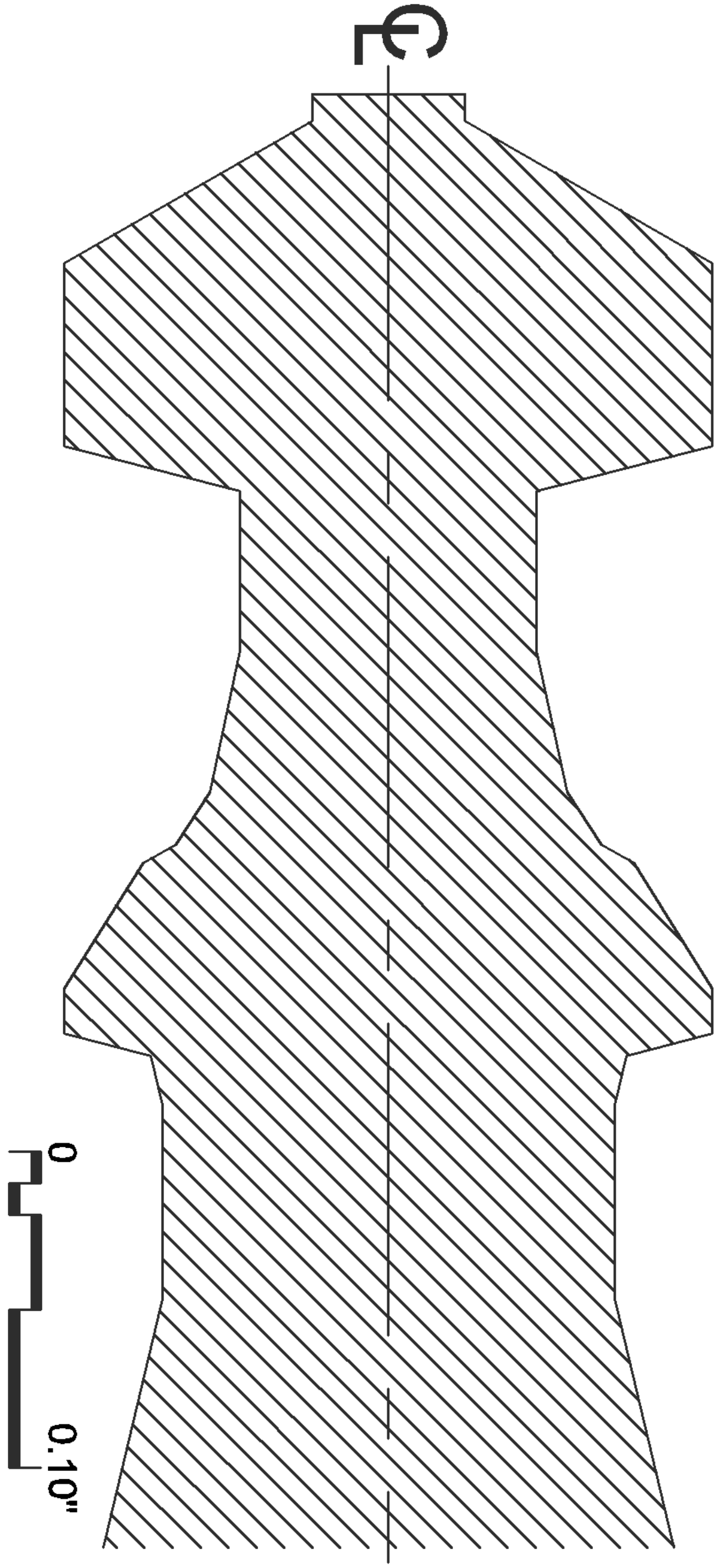


Figure A.3 As-Designed 0.104 in. Tube Coined Pressed-End Representative Profile

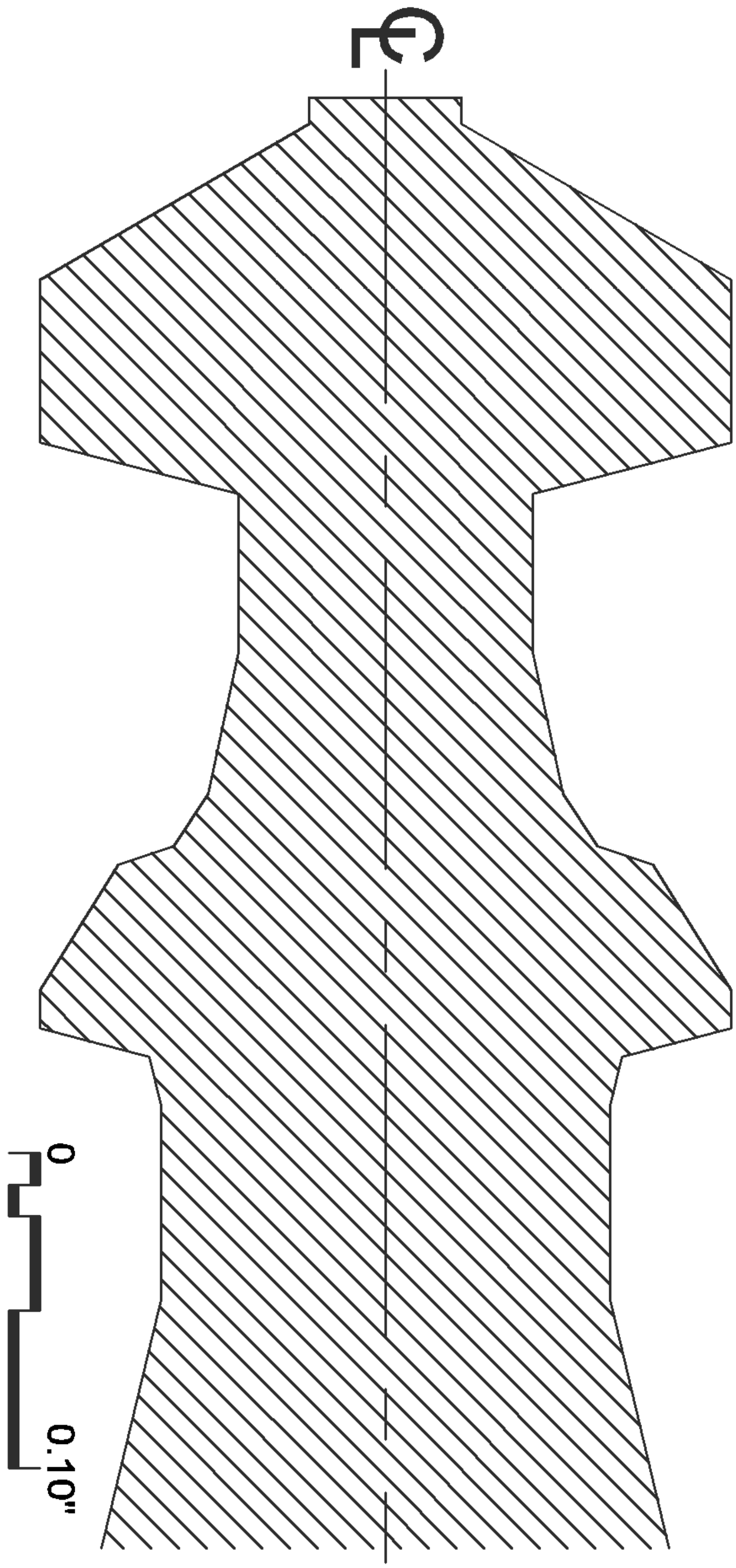


Figure A.4 As-Designed 0.120 in. Tube Coined Pressed-End Representative Profile

Appendix B

As-Built Geometry

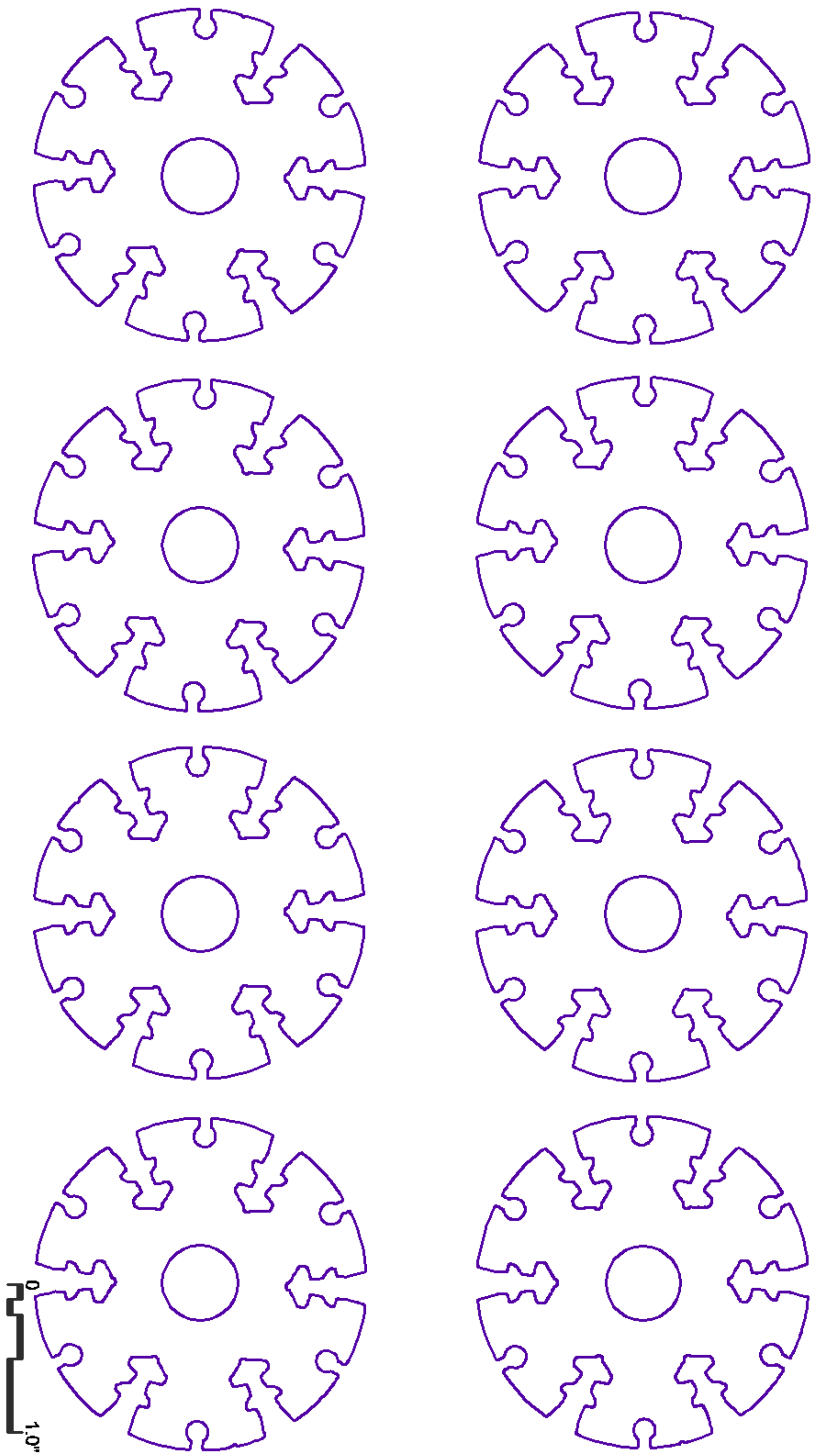


Figure B.1 As-Built 6Sd-00 Connector-A CAD Generation - Step 4

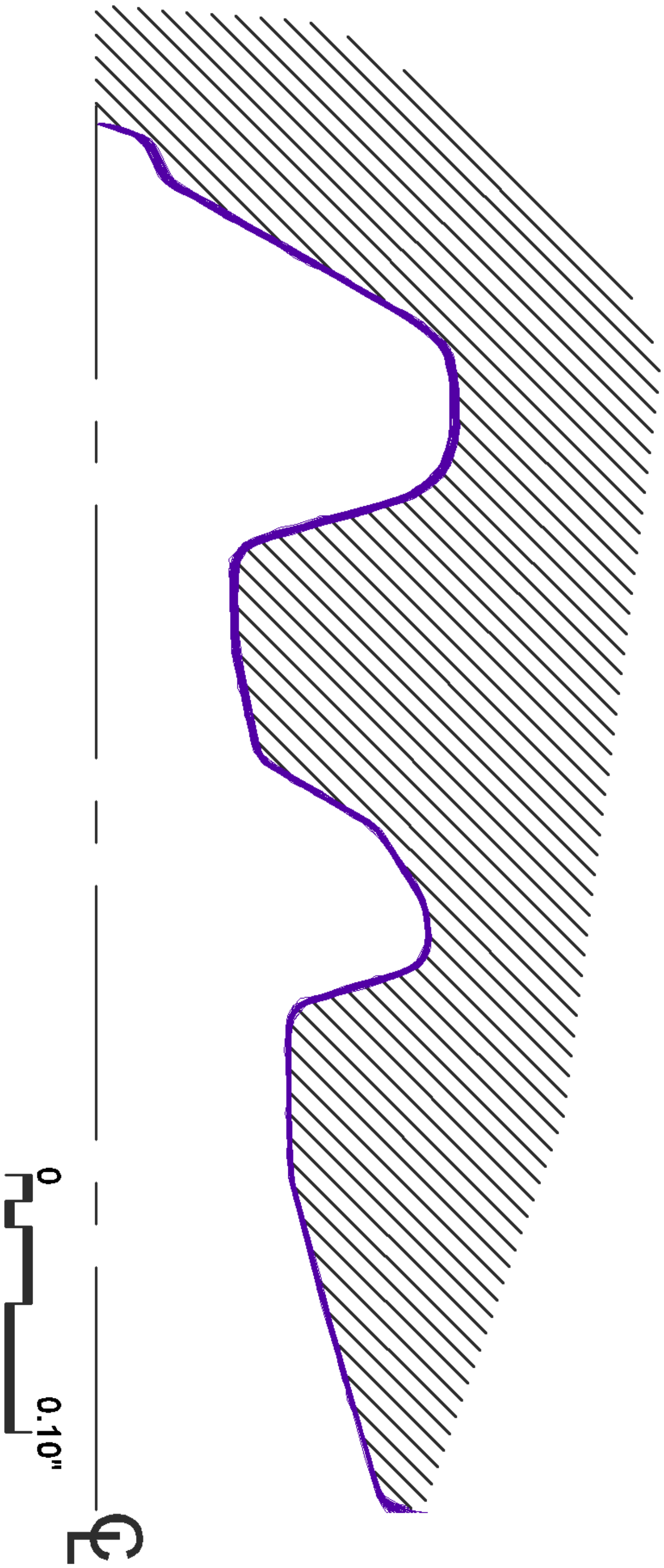


Figure B.2 As-Built 6Sd-00 Superimposed Connector-A Slot Profiles Generation - Step 5

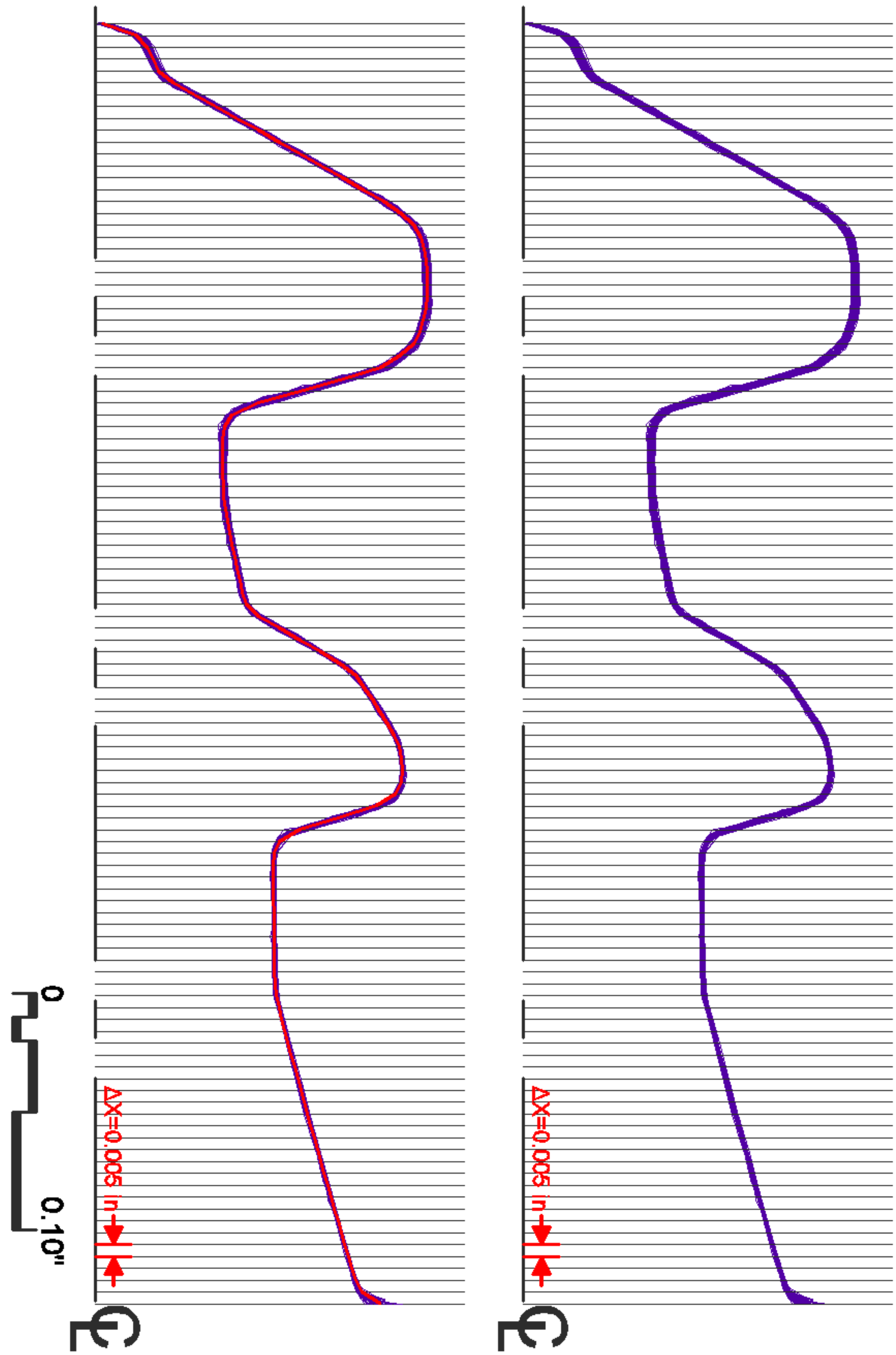


Figure B.3 As-Built 6Sd-00 Superimposed Connector-A Divided Slot Profiles & Mean Profile - Step 6

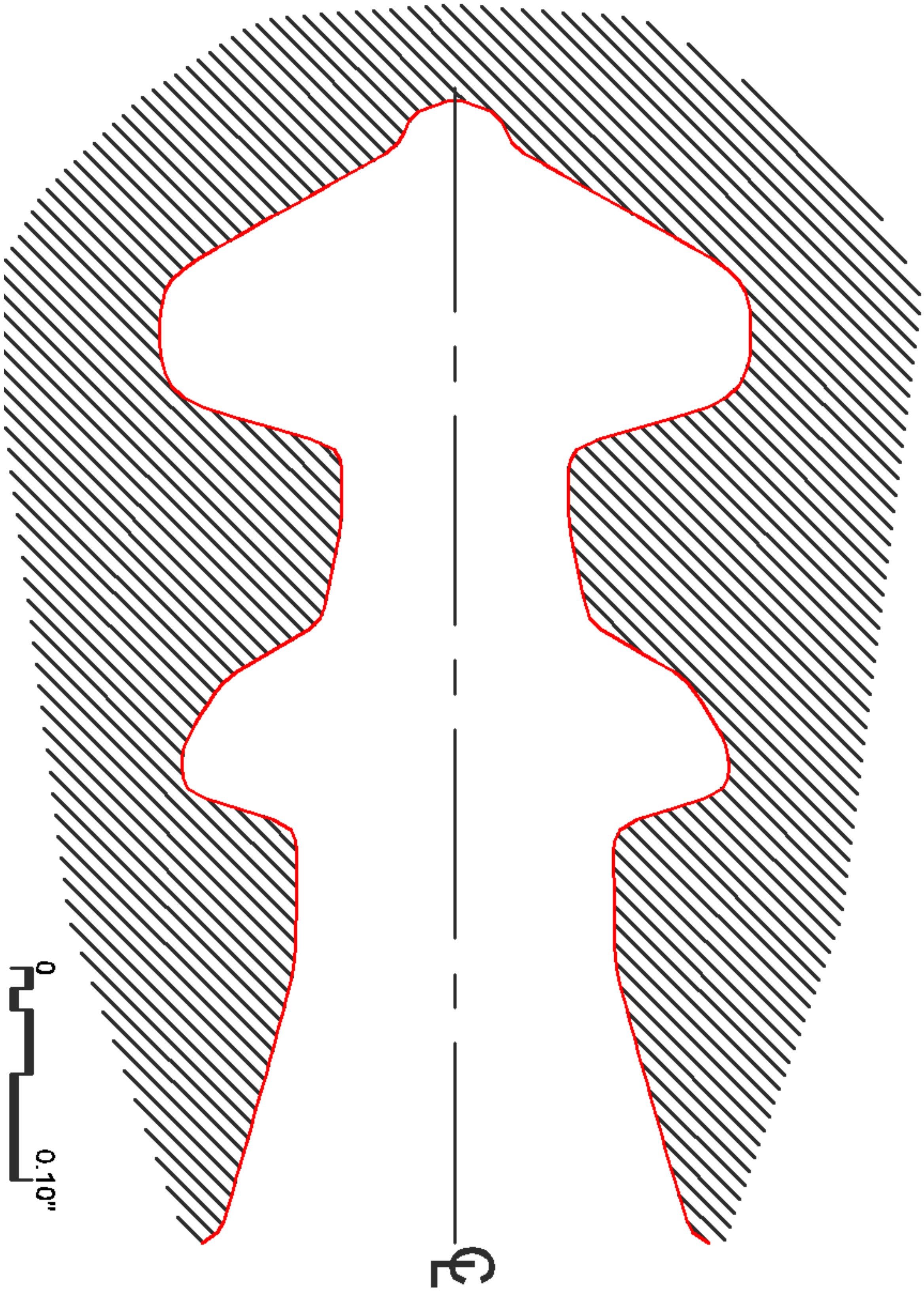


Figure B.4 As-Built 6Sd-00 Connector-A Slot Representative Profile - Step 7

Table B.1 As-Built 6Sd-00 Connector-A XY Coordinates

X-Axis	Y-Axis												
0.000	0.0000	0.0003	0.0004	0.0006	0.0007	0.0010	0.0011	0.0015	0.0017	0.0017	0.0019	0.0026	0.0032
0.005	0.0138	0.0138	0.0144	0.0144	0.0147	0.0149	0.0149	0.0150	0.0151	0.0154	0.0154	0.0156	0.0157
0.010	0.0181	0.0182	0.0183	0.0188	0.0189	0.0192	0.0195	0.0197	0.0198	0.0198	0.0198	0.0199	0.0199
0.015	0.0202	0.0208	0.0213	0.0213	0.0217	0.0217	0.0218	0.0218	0.0219	0.0223	0.0226	0.0226	0.0227
0.020	0.0231	0.0232	0.0239	0.0242	0.0242	0.0244	0.0245	0.0245	0.0246	0.0248	0.0249	0.0250	0.0251
0.025	0.0309	0.0310	0.0311	0.0311	0.0311	0.0312	0.0315	0.0315	0.0316	0.0317	0.0319	0.0319	0.0320
0.030	0.0382	0.0382	0.0390	0.0391	0.0392	0.0393	0.0394	0.0395	0.0396	0.0396	0.0397	0.0398	0.0400
0.035	0.0475	0.0478	0.0480	0.0480	0.0487	0.0488	0.0488	0.0490	0.0490	0.0491	0.0491	0.0492	0.0492
0.040	0.0573	0.0574	0.0575	0.0575	0.0576	0.0576	0.0578	0.0578	0.0578	0.0579	0.0581	0.0582	0.0582
0.045	0.0666	0.0668	0.0669	0.0671	0.0671	0.0671	0.0673	0.0675	0.0675	0.0676	0.0677	0.0677	0.0678
0.050	0.0825	0.0812	0.0812	0.0809	0.0807	0.0798	0.0796	0.0794	0.0792	0.0786	0.0786	0.0783	0.0783
0.055	0.0841	0.0842	0.0842	0.0844	0.0844	0.0844	0.0849	0.0849	0.0850	0.0850	0.0850	0.0851	0.0852
0.060	0.0923	0.0931	0.0932	0.0934	0.0934	0.0935	0.0936	0.0936	0.0937	0.0938	0.0939	0.0939	0.0940
0.065	0.1016	0.1018	0.1020	0.1021	0.1022	0.1022	0.1024	0.1024	0.1026	0.1026	0.1026	0.1027	0.1027
0.070	0.1107	0.1109	0.1110	0.1113	0.1114	0.1114	0.1114	0.1114	0.1114	0.1115	0.1117	0.1117	0.1117
0.075	0.1206	0.1206	0.1206	0.1206	0.1207	0.1207	0.1207	0.1207	0.1207	0.1209	0.1209	0.1210	0.1211
0.080	0.1265	0.1266	0.1267	0.1268	0.1268	0.1269	0.1270	0.1271	0.1272	0.1272	0.1275	0.1276	0.1276
0.085	0.1303	0.1317	0.1318	0.1320	0.1322	0.1322	0.1322	0.1324	0.1327	0.1330	0.1330	0.1332	0.1332
0.090	0.1339	0.1342	0.1343	0.1349	0.1351	0.1352	0.1352	0.1354	0.1354	0.1356	0.1356	0.1356	0.1357
0.095	0.1352	0.1356	0.1361	0.1364	0.1365	0.1365	0.1366	0.1366	0.1367	0.1368	0.1370	0.1370	0.1370
0.100	0.1358	0.1360	0.1361	0.1370	0.1371	0.1372	0.1374	0.1375	0.1376	0.1376	0.1379	0.1380	0.1380
0.105	0.1362	0.1365	0.1370	0.1373	0.1374	0.1376	0.1377	0.1378	0.1378	0.1381	0.1381	0.1382	0.1384
0.110	0.1361	0.1362	0.1366	0.1374	0.1375	0.1376	0.1377	0.1379	0.1380	0.1383	0.1384	0.1384	0.1385
0.115	0.1361	0.1365	0.1370	0.1372	0.1375	0.1378	0.1379	0.1380	0.1381	0.1383	0.1385	0.1385	0.1385
0.120	0.1356	0.1358	0.1359	0.1370	0.1371	0.1371	0.1376	0.1377	0.1377	0.1377	0.1378	0.1378	0.1382
0.125	0.1342	0.1345	0.1349	0.1355	0.1359	0.1363	0.1364	0.1364	0.1366	0.1366	0.1366	0.1368	0.1368
0.130	0.1402	0.1400	0.1394	0.1391	0.1391	0.1391	0.1387	0.1386	0.1383	0.1382	0.1380	0.1377	0.1376
0.135	0.1329	0.1330	0.1330	0.1334	0.1334	0.1336	0.1336	0.1343	0.1343	0.1343	0.1344	0.1345	0.1347
0.140	0.1329	0.1325	0.1322	0.1320	0.1318	0.1316	0.1314	0.1312	0.1312	0.1309	0.1307	0.1306	0.1304
0.145	0.1117	0.1118	0.1136	0.1151	0.1166	0.1167	0.1168	0.1170	0.1172	0.1174	0.1176	0.1181	0.1182
0.150	0.1107	0.1100	0.1099	0.1097	0.1092	0.1091	0.1089	0.1088	0.1081	0.1077	0.1076	0.1073	0.1073
0.155	0.0773	0.0777	0.0804	0.0807	0.0815	0.0815	0.0816	0.0818	0.0818	0.0826	0.0829	0.0835	0.0842
0.160	0.0752	0.0736	0.0734	0.0732	0.0732	0.0732	0.0725	0.0720	0.0719	0.0719	0.0715	0.0714	0.0713
0.165	0.0586	0.0588	0.0588	0.0588	0.0588	0.0589	0.0592	0.0592	0.0597	0.0600	0.0601	0.0603	0.0605
0.170	0.0578	0.0575	0.0569	0.0569	0.0564	0.0562	0.0558	0.0556	0.0555	0.0555	0.0555	0.0554	0.0553
0.175	0.0509	0.0512	0.0516	0.0516	0.0516	0.0517	0.0519	0.0521	0.0521	0.0522	0.0523	0.0524	0.0524
0.180	0.0564	0.0562	0.0560	0.0556	0.0554	0.0554	0.0551	0.0550	0.0549	0.0549	0.0549	0.0548	0.0547
0.185	0.0509	0.0511	0.0514	0.0516	0.0517	0.0519	0.0519	0.0519	0.0521	0.0523	0.0524	0.0524	0.0526
0.190	0.0563	0.0563	0.0559	0.0559	0.0559	0.0554	0.0553	0.0552	0.0550	0.0550	0.0549	0.0549	0.0546
0.195	0.0511	0.0511	0.0519	0.0519	0.0520	0.0520	0.0520	0.0522	0.0524	0.0525	0.0525	0.0525	0.0530
0.200	0.0570	0.0564	0.0563	0.0562	0.0561	0.0560	0.0557	0.0555	0.0553	0.0552	0.0552	0.0551	0.0549
0.205	0.0519	0.0522	0.0527	0.0528	0.0529	0.0530	0.0532	0.0532	0.0532	0.0533	0.0536	0.0536	0.0536
0.210	0.0584	0.0580	0.0578	0.0575	0.0575	0.0573	0.0569	0.0569	0.0568	0.0567	0.0567	0.0567	0.0565
0.215	0.0592	0.0588	0.0583	0.0581	0.0580	0.0579	0.0577	0.0576	0.0575	0.0575	0.0574	0.0574	0.0573
0.220	0.0574	0.0575	0.0576	0.0577	0.0577	0.0577	0.0578	0.0578	0.0580	0.0582	0.0582	0.0583	0.0583
0.225	0.0612	0.0608	0.0605	0.0602	0.0601	0.0599	0.0599	0.0598	0.0597	0.0597	0.0596	0.0595	0.0595
0.230	0.0575	0.0576	0.0576	0.0579	0.0579	0.0581	0.0582	0.0583	0.0583	0.0586	0.0586	0.0586	0.0588
0.235	0.0632	0.0630	0.0627	0.0624	0.0621	0.0621	0.0620	0.0619	0.0619	0.0618	0.0617	0.0617	0.0617
0.240	0.0596	0.0600	0.0600	0.0601	0.0605	0.0606	0.0607	0.0607	0.0609	0.0609	0.0609	0.0609	0.0611
0.245	0.0615	0.0620	0.0620	0.0621	0.0621	0.0622	0.0623	0.0624	0.0624	0.0625	0.0627	0.0628	0.0628
0.250	0.0717	0.0716	0.0716	0.0710	0.0708	0.0706	0.0706	0.0704	0.0703	0.0700	0.0698	0.0696	0.0693
0.255	0.0744	0.0750	0.0757	0.0759	0.0759	0.0759	0.0759	0.0760	0.0762	0.0762	0.0762	0.0762	0.0762
0.260	0.0892	0.0891	0.0890	0.0887	0.0883	0.0878	0.0876	0.0875	0.0873	0.0870	0.0870	0.0868	0.0867
0.265	0.0910	0.0926	0.0929	0.0929	0.0931	0.0933	0.0933	0.0933	0.0933	0.0934	0.0935	0.0935	0.0936

0.270	0.1060	0.1059	0.1058	0.1056	0.1052	0.1050	0.1045	0.1045	0.1044	0.1043	0.1042	0.1040	0.1039
0.275	0.1061	0.1075	0.1081	0.1082	0.1085	0.1085	0.1085	0.1086	0.1086	0.1087	0.1087	0.1088	0.1088
0.280	0.1156	0.1155	0.1148	0.1147	0.1147	0.1146	0.1145	0.1139	0.1139	0.1138	0.1137	0.1137	0.1136
0.285	0.1143	0.1149	0.1153	0.1153	0.1154	0.1154	0.1155	0.1155	0.1155	0.1155	0.1157	0.1157	0.1157
0.290	0.1225	0.1220	0.1216	0.1214	0.1213	0.1213	0.1211	0.1209	0.1207	0.1204	0.1204	0.1204	0.1203
0.295	0.1204	0.1213	0.1215	0.1216	0.1218	0.1218	0.1218	0.1219	0.1220	0.1220	0.1221	0.1221	0.1222
0.300	0.1280	0.1279	0.1273	0.1273	0.1272	0.1272	0.1267	0.1266	0.1265	0.1263	0.1263	0.1262	0.1262
0.305	0.1261	0.1265	0.1265	0.1265	0.1268	0.1269	0.1269	0.1270	0.1270	0.1270	0.1272	0.1272	0.1272
0.310	0.1314	0.1309	0.1307	0.1305	0.1305	0.1304	0.1299	0.1299	0.1297	0.1296	0.1295	0.1295	0.1292
0.315	0.1269	0.1272	0.1276	0.1277	0.1281	0.1281	0.1283	0.1283	0.1283	0.1283	0.1283	0.1284	0.1285
0.320	0.1311	0.1309	0.1307	0.1306	0.1304	0.1300	0.1299	0.1298	0.1297	0.1296	0.1296	0.1294	0.1294
0.325	0.1227	0.1236	0.1240	0.1244	0.1245	0.1251	0.1251	0.1251	0.1251	0.1252	0.1253	0.1254	0.1254
0.330	0.1228	0.1224	0.1218	0.1213	0.1212	0.1211	0.1209	0.1209	0.1207	0.1206	0.1203	0.1203	0.1203
0.335	0.0948	0.0962	0.0975	0.0978	0.0988	0.0992	0.0993	0.0994	0.0994	0.0996	0.0996	0.1000	0.1005
0.340	0.0910	0.0905	0.0901	0.0900	0.0894	0.0894	0.0893	0.0892	0.0890	0.0889	0.0886	0.0885	0.0884
0.345	0.0755	0.0756	0.0756	0.0758	0.0761	0.0762	0.0763	0.0763	0.0763	0.0763	0.0764	0.0764	0.0764
0.350	0.0773	0.0773	0.0772	0.0768	0.0766	0.0762	0.0761	0.0761	0.0761	0.0761	0.0761	0.0760	0.0760
0.355	0.0726	0.0732	0.0733	0.0734	0.0738	0.0739	0.0740	0.0740	0.0740	0.0740	0.0741	0.0741	0.0741
0.360	0.0766	0.0765	0.0764	0.0764	0.0761	0.0758	0.0757	0.0757	0.0756	0.0755	0.0754	0.0754	0.0754
0.365	0.0754	0.0755	0.0756	0.0757	0.0757	0.0758	0.0758	0.0761	0.0761	0.0762	0.0765	0.0765	0.0729
0.370	0.0765	0.0764	0.0762	0.0760	0.0760	0.0759	0.0759	0.0758	0.0758	0.0756	0.0756	0.0755	0.0755
0.375	0.0731	0.0737	0.0737	0.0737	0.0738	0.0741	0.0741	0.0742	0.0742	0.0743	0.0743	0.0743	0.0744
0.380	0.0765	0.0763	0.0761	0.0760	0.0759	0.0759	0.0758	0.0757	0.0757	0.0757	0.0757	0.0756	0.0756
0.385	0.0733	0.0737	0.0738	0.0740	0.0741	0.0741	0.0742	0.0742	0.0743	0.0745	0.0745	0.0745	0.0746
0.390	0.0768	0.0766	0.0766	0.0765	0.0760	0.0760	0.0759	0.0759	0.0758	0.0758	0.0758	0.0757	0.0756
0.395	0.0733	0.0742	0.0743	0.0744	0.0744	0.0744	0.0744	0.0744	0.0745	0.0746	0.0746	0.0746	0.0746
0.400	0.0767	0.0765	0.0765	0.0762	0.0761	0.0761	0.0760	0.0760	0.0760	0.0760	0.0759	0.0758	0.0758
0.405	0.0734	0.0745	0.0747	0.0747	0.0749	0.0749	0.0749	0.0749	0.0749	0.0749	0.0749	0.0751	0.0751
0.410	0.0775	0.0774	0.0773	0.0772	0.0772	0.0772	0.0770	0.0769	0.0769	0.0767	0.0767	0.0767	0.0767
0.415	0.0749	0.0759	0.0761	0.0763	0.0765	0.0765	0.0765	0.0766	0.0767	0.0767	0.0767	0.0768	0.0768
0.420	0.0800	0.0799	0.0796	0.0794	0.0794	0.0793	0.0789	0.0789	0.0789	0.0788	0.0788	0.0787	0.0787
0.425	0.0773	0.0781	0.0788	0.0789	0.0789	0.0790	0.0790	0.0791	0.0791	0.0792	0.0792	0.0792	0.0792
0.430	0.0825	0.0825	0.0823	0.0820	0.0819	0.0818	0.0816	0.0816	0.0815	0.0815	0.0815	0.0814	0.0813
0.435	0.0824	0.0824	0.0824	0.0825	0.0825	0.0826	0.0826	0.0826	0.0826	0.0827	0.0827	0.0828	0.0828
0.440	0.0852	0.0850	0.0848	0.0847	0.0845	0.0844	0.0843	0.0843	0.0842	0.0841	0.0841	0.0840	0.0840
0.445	0.0824	0.0836	0.0839	0.0841	0.0843	0.0845	0.0845	0.0845	0.0846	0.0846	0.0846	0.0846	0.0847
0.450	0.0877	0.0877	0.0874	0.0874	0.0873	0.0871	0.0871	0.0869	0.0869	0.0869	0.0868	0.0868	0.0868
0.455	0.0850	0.0866	0.0867	0.0867	0.0867	0.0871	0.0871	0.0872	0.0872	0.0872	0.0873	0.0873	0.0874
0.460	0.0905	0.0904	0.0902	0.0901	0.0900	0.0899	0.0897	0.0897	0.0897	0.0897	0.0897	0.0896	0.0896
0.465	0.0876	0.0894	0.0894	0.0897	0.0899	0.0899	0.0900	0.0901	0.0901	0.0901	0.0901	0.0902	0.0902
0.470	0.0934	0.0932	0.0930	0.0930	0.0928	0.0926	0.0926	0.0925	0.0925	0.0925	0.0924	0.0924	0.0923
0.475	0.0903	0.0920	0.0925	0.0927	0.0928	0.0928	0.0928	0.0929	0.0929	0.0929	0.0930	0.0930	0.0930
0.480	0.0949	0.0949	0.0948	0.0948	0.0948	0.0948	0.0947	0.0947	0.0947	0.0946	0.0946	0.0945	0.0945
0.485	0.0932	0.0949	0.0951	0.0951	0.0954	0.0955	0.0955	0.0956	0.0956	0.0957	0.0958	0.0958	0.0958
0.490	0.0989	0.0986	0.0986	0.0986	0.0986	0.0985	0.0984	0.0983	0.0982	0.0981	0.0981	0.0980	0.0980
0.495	0.0954	0.0975	0.0984	0.0984	0.0984	0.0985	0.0985	0.0985	0.0985	0.0986	0.0987	0.0987	0.0987
0.500	0.1012	0.1012	0.1009	0.1009	0.1009	0.1009	0.1008	0.1008	0.1008	0.1008	0.1007	0.1007	0.1007
0.505	0.0984	0.1012	0.1015	0.1015	0.1015	0.1016	0.1016	0.1016	0.1017	0.1017	0.1017	0.1017	0.1017
0.510	0.1044	0.1043	0.1042	0.1042	0.1040	0.1040	0.1040	0.1039	0.1039	0.1039	0.1038	0.1038	0.1038
0.515	0.1005	0.1042	0.1042	0.1042	0.1043	0.1045	0.1045	0.1045	0.1045	0.1045	0.1046	0.1046	0.1047
0.520	0.1081	0.1073	0.1073	0.1073	0.1070	0.1070	0.1069	0.1069	0.1068	0.1068	0.1067	0.1067	0.1067
0.525	0.1041	0.1070	0.1071	0.1072	0.1073	0.1073	0.1074	0.1075	0.1075	0.1075	0.1076	0.1077	0.1077
0.530	0.1123	0.1106	0.1105	0.1105	0.1104	0.1101	0.1100	0.1100	0.1100	0.1099	0.1098	0.1098	0.1098
0.535	0.1071	0.1103	0.1104	0.1108	0.1108	0.1108	0.1109	0.1109	0.1109	0.1110	0.1111	0.1112	0.1113
0.540	0.1306	0.1291	0.1288	0.1286	0.1267	0.1241	0.1235	0.1222	0.1220	0.1219	0.1218	0.1217	0.1214

X-Axis							Y-Axis						
0.000	0.0033	0.0041	0.0041	0.0042	0.0043	0.0044	0.0044	0.0049	0.0055	0.0065	0.0070	0.0077	0.0091
0.005	0.0158	0.0161	0.0161	0.0161	0.0161	0.0162	0.0163	0.0164	0.0165	0.0168	0.0168	0.0169	0.0170
0.010	0.0200	0.0203	0.0204	0.0207	0.0209	0.0211	0.0211	0.0211	0.0212	0.0213	0.0214	0.0214	0.0215
0.015	0.0227	0.0230	0.0230	0.0230	0.0231	0.0232	0.0236	0.0236	0.0238	0.0239	0.0240	0.0241	0.0242
0.020	0.0251	0.0255	0.0256	0.0256	0.0256	0.0256	0.0257	0.0259	0.0259	0.0261	0.0261	0.0264	0.0264
0.025	0.0321	0.0322	0.0323	0.0324	0.0325	0.0327	0.0327	0.0332	0.0333	0.0334	0.0334	0.0338	0.0339
0.030	0.0401	0.0401	0.0402	0.0404	0.0405	0.0405	0.0406	0.0408	0.0410	0.0411	0.0411	0.0412	0.0412
0.035	0.0492	0.0493	0.0494	0.0495	0.0496	0.0496	0.0496	0.0496	0.0498	0.0498	0.0499	0.0500	0.0502
0.040	0.0583	0.0584	0.0584	0.0585	0.0586	0.0587	0.0588	0.0590	0.0591	0.0591	0.0592	0.0593	0.0593
0.045	0.0678	0.0678	0.0678	0.0679	0.0679	0.0680	0.0683	0.0683	0.0683	0.0683	0.0684	0.0684	0.0687
0.050	0.0781	0.0780	0.0778	0.0777	0.0776	0.0775	0.0775	0.0773	0.0772	0.0770	0.0769	0.0769	0.0769
0.055	0.0853	0.0853	0.0853	0.0854	0.0854	0.0855	0.0856	0.0856	0.0856	0.0857	0.0857	0.0859	0.0859
0.060	0.0941	0.0942	0.0942	0.0943	0.0944	0.0944	0.0944	0.0945	0.0946	0.0946	0.0947	0.0948	0.0948
0.065	0.1028	0.1029	0.1029	0.1029	0.1030	0.1030	0.1030	0.1032	0.1032	0.1033	0.1035	0.1035	0.1037
0.070	0.1119	0.1121	0.1121	0.1122	0.1123	0.1123	0.1123	0.1123	0.1126	0.1126	0.1127	0.1128	0.1130
0.075	0.1211	0.1212	0.1214	0.1215	0.1216	0.1218	0.1221	0.1221	0.1223	0.1224	0.1225	0.1226	0.1227
0.080	0.1277	0.1279	0.1279	0.1280	0.1280	0.1280	0.1280	0.1281	0.1281	0.1282	0.1283	0.1283	0.1284
0.085	0.1333	0.1333	0.1333	0.1334	0.1334	0.1335	0.1335	0.1336	0.1337	0.1337	0.1338	0.1339	0.1339
0.090	0.1358	0.1361	0.1361	0.1363	0.1365	0.1366	0.1367	0.1367	0.1367	0.1369	0.1370	0.1371	0.1371
0.095	0.1371	0.1374	0.1375	0.1375	0.1376	0.1378	0.1379	0.1380	0.1381	0.1382	0.1383	0.1383	0.1384
0.100	0.1382	0.1383	0.1385	0.1385	0.1385	0.1386	0.1387	0.1387	0.1388	0.1389	0.1390	0.1392	0.1393
0.105	0.1385	0.1385	0.1387	0.1387	0.1389	0.1390	0.1390	0.1393	0.1394	0.1395	0.1396	0.1396	0.1397
0.110	0.1387	0.1389	0.1390	0.1391	0.1391	0.1392	0.1392	0.1393	0.1393	0.1394	0.1395	0.1396	0.1397
0.115	0.1385	0.1386	0.1386	0.1387	0.1387	0.1392	0.1393	0.1394	0.1394	0.1395	0.1396	0.1398	0.1398
0.120	0.1383	0.1384	0.1384	0.1384	0.1387	0.1387	0.1388	0.1390	0.1392	0.1392	0.1392	0.1393	0.1394
0.125	0.1369	0.1372	0.1372	0.1373	0.1375	0.1377	0.1379	0.1381	0.1382	0.1383	0.1384	0.1384	0.1386
0.130	0.1374	0.1374	0.1373	0.1372	0.1372	0.1370	0.1370	0.1369	0.1369	0.1369	0.1368	0.1366	0.1363
0.135	0.1348	0.1349	0.1350	0.1351	0.1352	0.1353	0.1356	0.1356	0.1357	0.1359	0.1360	0.1361	0.1363
0.140	0.1300	0.1299	0.1299	0.1298	0.1298	0.1296	0.1294	0.1294	0.1294	0.1294	0.1292	0.1292	0.1291
0.145	0.1186	0.1186	0.1188	0.1188	0.1191	0.1195	0.1196	0.1198	0.1203	0.1204	0.1204	0.1205	0.1208
0.150	0.1071	0.1069	0.1068	0.1064	0.1064	0.1061	0.1059	0.1059	0.1058	0.1057	0.1049	0.1046	0.1041
0.155	0.0844	0.0846	0.0847	0.0847	0.0852	0.0854	0.0856	0.0858	0.0862	0.0863	0.0864	0.0865	0.0865
0.160	0.0713	0.0708	0.0708	0.0707	0.0707	0.0706	0.0700	0.0700	0.0696	0.0695	0.0691	0.0686	0.0685
0.165	0.0609	0.0620	0.0527	0.0538	0.0540	0.0548	0.0550	0.0551	0.0555	0.0555	0.0556	0.0557	0.0557
0.170	0.0552	0.0550	0.0548	0.0546	0.0546	0.0545	0.0545	0.0544	0.0544	0.0543	0.0543	0.0541	0.0541
0.175	0.0524	0.0526	0.0526	0.0527	0.0529	0.0529	0.0529	0.0530	0.0532	0.0533	0.0535	0.0536	0.0536
0.180	0.0542	0.0540	0.0539	0.0539	0.0538	0.0538	0.0537	0.0537	0.0537	0.0537	0.0536	0.0536	0.0536
0.185	0.0526	0.0528	0.0529	0.0529	0.0529	0.0529	0.0529	0.0530	0.0531	0.0533	0.0534	0.0535	0.0537
0.190	0.0541	0.0541	0.0541	0.0541	0.0540	0.0540	0.0539	0.0538	0.0538	0.0536	0.0534	0.0534	0.0533
0.195	0.0530	0.0530	0.0532	0.0532	0.0532	0.0533	0.0533	0.0533	0.0534	0.0534	0.0536	0.0536	0.0539
0.200	0.0547	0.0546	0.0544	0.0544	0.0543	0.0543	0.0542	0.0542	0.0541	0.0538	0.0538	0.0538	0.0538
0.205	0.0537	0.0539	0.0540	0.0541	0.0541	0.0541	0.0541	0.0542	0.0543	0.0543	0.0543	0.0543	0.0546
0.210	0.0560	0.0558	0.0557	0.0557	0.0557	0.0556	0.0556	0.0555	0.0555	0.0554	0.0554	0.0553	0.0553
0.215	0.0573	0.0572	0.0571	0.0571	0.0570	0.0567	0.0567	0.0567	0.0567	0.0567	0.0566	0.0563	0.0563
0.220	0.0584	0.0584	0.0585	0.0586	0.0587	0.0587	0.0588	0.0588	0.0590	0.0590	0.0594	0.0597	0.0604
0.225	0.0594	0.0593	0.0593	0.0592	0.0590	0.0588	0.0588	0.0588	0.0588	0.0587	0.0587	0.0586	0.0585
0.230	0.0590	0.0590	0.0591	0.0592	0.0592	0.0593	0.0594	0.0594	0.0594	0.0595	0.0596	0.0597	0.0597
0.235	0.0615	0.0615	0.0614	0.0613	0.0613	0.0610	0.0610	0.0609	0.0608	0.0607	0.0607	0.0606	0.0605
0.240	0.0612	0.0612	0.0612	0.0614	0.0614	0.0614	0.0615	0.0615	0.0616	0.0617	0.0617	0.0620	0.0620
0.245	0.0628	0.0628	0.0628	0.0629	0.0629	0.0629	0.0630	0.0632	0.0633	0.0633	0.0634	0.0634	0.0635
0.250	0.0693	0.0693	0.0692	0.0691	0.0691	0.0689	0.0689	0.0688	0.0688	0.0687	0.0686	0.0682	0.0682
0.255	0.0763	0.0763	0.0764	0.0764	0.0764	0.0765	0.0765	0.0766	0.0767	0.0769	0.0769	0.0770	0.0771
0.260	0.0865	0.0865	0.0864	0.0863	0.0863	0.0861	0.0858	0.0858	0.0858	0.0857	0.0857	0.0856	0.0854
0.265	0.0937	0.0937	0.0938	0.0939	0.0939	0.0939	0.0942	0.0942	0.0943	0.0943	0.0944	0.0944	0.0944
0.270	0.1038	0.1035	0.1035	0.1035	0.1035	0.1034	0.1033	0.1033	0.1032	0.1031	0.1031	0.1031	0.1031
0.275	0.1089	0.1089	0.1089	0.1090	0.1091	0.1091	0.1091	0.1092	0.1092	0.1092	0.1094	0.1095	0.1095

0.280	0.1135	0.1135	0.1134	0.1133	0.1132	0.1131	0.1131	0.1131	0.1131	0.1130	0.1129	0.1129	0.1128
0.285	0.1158	0.1158	0.1159	0.1159	0.1161	0.1162	0.1162	0.1163	0.1163	0.1163	0.1164	0.1165	0.1165
0.290	0.1203	0.1203	0.1200	0.1199	0.1198	0.1198	0.1198	0.1197	0.1197	0.1197	0.1197	0.1197	0.1195
0.295	0.1222	0.1222	0.1222	0.1222	0.1224	0.1224	0.1224	0.1224	0.1225	0.1225	0.1227	0.1227	0.1228
0.300	0.1262	0.1261	0.1260	0.1259	0.1259	0.1257	0.1257	0.1257	0.1257	0.1256	0.1255	0.1254	0.1254
0.305	0.1273	0.1273	0.1273	0.1274	0.1274	0.1274	0.1275	0.1275	0.1275	0.1275	0.1275	0.1275	0.1275
0.310	0.1292	0.1292	0.1292	0.1291	0.1289	0.1287	0.1287	0.1287	0.1287	0.1287	0.1287	0.1286	0.1286
0.315	0.1285	0.1286	0.1287	0.1288	0.1288	0.1288	0.1288	0.1289	0.1289	0.1289	0.1289	0.1289	0.1290
0.320	0.1294	0.1293	0.1292	0.1292	0.1291	0.1288	0.1287	0.1287	0.1287	0.1287	0.1286	0.1286	0.1284
0.325	0.1254	0.1254	0.1257	0.1257	0.1257	0.1258	0.1258	0.1258	0.1260	0.1260	0.1262	0.1263	0.1263
0.330	0.1202	0.1201	0.1201	0.1200	0.1200	0.1199	0.1198	0.1197	0.1197	0.1195	0.1195	0.1192	0.1187
0.335	0.1005	0.1009	0.1011	0.1012	0.1015	0.1015	0.1023	0.1026	0.1028	0.1033	0.1034	0.1035	0.1035
0.340	0.0883	0.0883	0.0881	0.0876	0.0875	0.0873	0.0873	0.0872	0.0872	0.0868	0.0866	0.0866	0.0860
0.345	0.0767	0.0768	0.0769	0.0771	0.0771	0.0772	0.0772	0.0772	0.0773	0.0773	0.0773	0.0774	0.0774
0.350	0.0758	0.0757	0.0757	0.0755	0.0755	0.0755	0.0754	0.0753	0.0753	0.0753	0.0752	0.0751	0.0750
0.355	0.0742	0.0742	0.0742	0.0742	0.0742	0.0744	0.0744	0.0745	0.0746	0.0746	0.0746	0.0746	0.0747
0.360	0.0752	0.0752	0.0750	0.0750	0.0750	0.0749	0.0749	0.0749	0.0748	0.0748	0.0748	0.0747	0.0746
0.365	0.0735	0.0736	0.0737	0.0738	0.0739	0.0741	0.0741	0.0742	0.0743	0.0743	0.0743	0.0744	0.0744
0.370	0.0754	0.0753	0.0753	0.0753	0.0753	0.0752	0.0751	0.0750	0.0750	0.0750	0.0749	0.0749	0.0748
0.375	0.0744	0.0745	0.0745	0.0746	0.0747	0.0747	0.0748	0.0749	0.0749	0.0749	0.0750	0.0750	0.0750
0.380	0.0754	0.0753	0.0753	0.0753	0.0752	0.0752	0.0752	0.0752	0.0751	0.0751	0.0750	0.0750	0.0750
0.385	0.0746	0.0747	0.0747	0.0748	0.0748	0.0748	0.0749	0.0749	0.0750	0.0750	0.0750	0.0751	0.0751
0.390	0.0754	0.0754	0.0754	0.0753	0.0753	0.0752	0.0752	0.0752	0.0752	0.0750	0.0750	0.0750	0.0750
0.395	0.0747	0.0747	0.0748	0.0748	0.0749	0.0749	0.0749	0.0749	0.0750	0.0751	0.0751	0.0752	0.0752
0.400	0.0756	0.0755	0.0755	0.0755	0.0755	0.0755	0.0754	0.0754	0.0754	0.0754	0.0753	0.0752	0.0752
0.405	0.0751	0.0752	0.0752	0.0753	0.0753	0.0754	0.0754	0.0754	0.0755	0.0755	0.0757	0.0757	0.0757
0.410	0.0766	0.0766	0.0765	0.0765	0.0765	0.0764	0.0764	0.0763	0.0763	0.0763	0.0762	0.0762	0.0762
0.415	0.0768	0.0768	0.0768	0.0769	0.0769	0.0769	0.0770	0.0771	0.0771	0.0772	0.0772	0.0773	0.0773
0.420	0.0787	0.0787	0.0787	0.0786	0.0786	0.0786	0.0786	0.0786	0.0786	0.0785	0.0785	0.0784	0.0783
0.425	0.0793	0.0793	0.0794	0.0794	0.0795	0.0795	0.0795	0.0796	0.0796	0.0796	0.0797	0.0797	0.0798
0.430	0.0813	0.0813	0.0813	0.0813	0.0813	0.0812	0.0812	0.0811	0.0811	0.0811	0.0810	0.0810	0.0810
0.435	0.0828	0.0828	0.0829	0.0830	0.0830	0.0832	0.0834	0.0836	0.0837	0.0839	0.0798	0.0804	0.0810
0.440	0.0839	0.0839	0.0839	0.0839	0.0839	0.0839	0.0838	0.0838	0.0837	0.0837	0.0837	0.0837	0.0837
0.445	0.0848	0.0848	0.0848	0.0848	0.0849	0.0849	0.0849	0.0849	0.0850	0.0850	0.0850	0.0850	0.0850
0.450	0.0867	0.0867	0.0867	0.0866	0.0866	0.0865	0.0865	0.0864	0.0864	0.0864	0.0863	0.0863	0.0863
0.455	0.0875	0.0875	0.0875	0.0876	0.0876	0.0876	0.0876	0.0876	0.0876	0.0877	0.0877	0.0877	0.0878
0.460	0.0895	0.0895	0.0895	0.0894	0.0894	0.0893	0.0893	0.0892	0.0892	0.0892	0.0892	0.0892	0.0891
0.465	0.0902	0.0902	0.0902	0.0903	0.0903	0.0904	0.0904	0.0905	0.0905	0.0905	0.0906	0.0906	0.0906
0.470	0.0923	0.0922	0.0922	0.0922	0.0922	0.0921	0.0921	0.0921	0.0921	0.0921	0.0921	0.0920	0.0920
0.475	0.0931	0.0931	0.0931	0.0932	0.0932	0.0933	0.0933	0.0933	0.0933	0.0934	0.0934	0.0934	0.0935
0.480	0.0945	0.0945	0.0944	0.0943	0.0943	0.0943	0.0942	0.0942	0.0941	0.0940	0.0940	0.0940	0.0940
0.485	0.0959	0.0960	0.0960	0.0960	0.0960	0.0961	0.0961	0.0961	0.0961	0.0962	0.0962	0.0963	0.0963
0.490	0.0980	0.0979	0.0979	0.0979	0.0978	0.0978	0.0978	0.0977	0.0977	0.0977	0.0977	0.0977	0.0976
0.495	0.0987	0.0988	0.0988	0.0989	0.0989	0.0989	0.0989	0.0990	0.0990	0.0991	0.0991	0.0991	0.0991
0.500	0.1007	0.1006	0.1006	0.1006	0.1005	0.1005	0.1005	0.1005	0.1004	0.1004	0.1004	0.1004	0.1004
0.505	0.1017	0.1017	0.1018	0.1018	0.1018	0.1018	0.1019	0.1019	0.1020	0.1020	0.1020	0.1021	0.1021
0.510	0.1038	0.1038	0.1037	0.1037	0.1037	0.1036	0.1036	0.1035	0.1035	0.1035	0.1035	0.1035	0.1034
0.515	0.1047	0.1047	0.1047	0.1047	0.1048	0.1048	0.1048	0.1048	0.1048	0.1048	0.1048	0.1049	0.1049
0.520	0.1066	0.1066	0.1066	0.1066	0.1065	0.1065	0.1064	0.1064	0.1064	0.1064	0.1064	0.1063	0.1063
0.525	0.1077	0.1077	0.1077	0.1077	0.1077	0.1077	0.1078	0.1078	0.1078	0.1078	0.1078	0.1078	0.1078
0.530	0.1098	0.1098	0.1097	0.1097	0.1096	0.1096	0.1095	0.1094	0.1094	0.1093	0.1093	0.1093	0.1093
0.535	0.1113	0.1113	0.1113	0.1113	0.1114	0.1115	0.1117	0.1117	0.1118	0.1118	0.1118	0.1118	0.1119
0.540	0.1213	0.1212	0.1210	0.1202	0.1202	0.1200	0.1190	0.1190	0.1189	0.1188	0.1185	0.1184	0.1180

X-Axis							Y-Axis						
0.000	0.0086	0.0084	0.0068	0.0052	0.0043	0.0041	0.0040	0.0039	0.0036	0.0035	0.0027	0.0027	0.0027
0.005	0.0171	0.0171	0.0172	0.0172	0.0178	0.0178	0.0180	0.0181	0.0183	0.0184	0.0184	0.0187	0.0189
0.010	0.0216	0.0219	0.0220	0.0225	0.0226	0.0227	0.0227	0.0229	0.0229	0.0230	0.0232	0.0233	0.0235
0.015	0.0243	0.0244	0.0244	0.0244	0.0246	0.0249	0.0250	0.0251	0.0253	0.0253	0.0257	0.0258	0.0258
0.020	0.0265	0.0270	0.0272	0.0272	0.0274	0.0277	0.0278	0.0278	0.0280	0.0281	0.0283	0.0285	0.0287
0.025	0.0341	0.0343	0.0347	0.0353	0.0355	0.0358	0.0370	0.0370	0.0372	0.0390	0.0290	0.0295	0.0296
0.030	0.0413	0.0418	0.0422	0.0422	0.0423	0.0424	0.0425	0.0426	0.0429	0.0429	0.0429	0.0433	0.0434
0.035	0.0503	0.0504	0.0504	0.0507	0.0512	0.0512	0.0512	0.0513	0.0514	0.0515	0.0516	0.0516	0.0516
0.040	0.0595	0.0598	0.0601	0.0603	0.0604	0.0605	0.0606	0.0607	0.0609	0.0609	0.0610	0.0612	0.0612
0.045	0.0688	0.0689	0.0690	0.0691	0.0691	0.0695	0.0695	0.0699	0.0700	0.0705	0.0711	0.0718	0.0720
0.050	0.0769	0.0767	0.0767	0.0767	0.0767	0.0767	0.0766	0.0765	0.0764	0.0764	0.0763	0.0762	0.0762
0.055	0.0860	0.0862	0.0864	0.0865	0.0865	0.0866	0.0867	0.0867	0.0869	0.0871	0.0872	0.0876	0.0876
0.060	0.0951	0.0954	0.0955	0.0955	0.0958	0.0959	0.0959	0.0960	0.0962	0.0963	0.0967	0.0967	0.0971
0.065	0.1037	0.1039	0.1040	0.1040	0.1041	0.1041	0.1042	0.1043	0.1044	0.1046	0.1046	0.1047	0.1048
0.070	0.1130	0.1130	0.1130	0.1130	0.1131	0.1135	0.1137	0.1137	0.1137	0.1137	0.1139	0.1141	0.1143
0.075	0.1228	0.1228	0.1230	0.1234	0.1238	0.1238	0.1243	0.1251	0.1256	0.1190	0.1190	0.1192	0.1198
0.080	0.1285	0.1287	0.1288	0.1288	0.1292	0.1293	0.1294	0.1294	0.1294	0.1296	0.1297	0.1298	0.1299
0.085	0.1339	0.1340	0.1341	0.1342	0.1345	0.1345	0.1346	0.1347	0.1348	0.1350	0.1350	0.1350	0.1351
0.090	0.1371	0.1372	0.1373	0.1374	0.1374	0.1379	0.1379	0.1380	0.1380	0.1383	0.1384	0.1384	0.1385
0.095	0.1385	0.1386	0.1387	0.1387	0.1388	0.1389	0.1390	0.1393	0.1395	0.1395	0.1396	0.1396	0.1398
0.100	0.1395	0.1396	0.1396	0.1397	0.1398	0.1398	0.1398	0.1399	0.1405	0.1405	0.1405	0.1408	0.1409
0.105	0.1398	0.1399	0.1399	0.1399	0.1401	0.1402	0.1403	0.1405	0.1405	0.1406	0.1407	0.1408	0.1412
0.110	0.1399	0.1399	0.1403	0.1404	0.1404	0.1404	0.1406	0.1406	0.1407	0.1408	0.1408	0.1411	0.1412
0.115	0.1398	0.1399	0.1400	0.1400	0.1400	0.1401	0.1403	0.1406	0.1409	0.1409	0.1410	0.1410	0.1410
0.120	0.1394	0.1394	0.1395	0.1402	0.1403	0.1403	0.1404	0.1404	0.1405	0.1407	0.1409	0.1410	0.1410
0.125	0.1386	0.1386	0.1386	0.1387	0.1387	0.1387	0.1388	0.1388	0.1391	0.1391	0.1394	0.1397	0.1399
0.130	0.1363	0.1360	0.1360	0.1359	0.1358	0.1357	0.1356	0.1355	0.1353	0.1352	0.1352	0.1351	0.1351
0.135	0.1366	0.1366	0.1371	0.1373	0.1375	0.1375	0.1290	0.1297	0.1304	0.1304	0.1316	0.1316	0.1319
0.140	0.1289	0.1284	0.1281	0.1278	0.1277	0.1277	0.1271	0.1270	0.1270	0.1268	0.1268	0.1265	0.1264
0.145	0.1209	0.1210	0.1214	0.1215	0.1219	0.1221	0.1222	0.1223	0.1225	0.1228	0.1228	0.1228	0.1233
0.150	0.1041	0.1040	0.1035	0.1034	0.1033	0.1033	0.1030	0.1029	0.1029	0.1022	0.1020	0.1011	0.1005
0.155	0.0866	0.0869	0.0869	0.0880	0.0883	0.0884	0.0885	0.0885	0.0886	0.0890	0.0891	0.0893	0.0896
0.160	0.0684	0.0684	0.0683	0.0683	0.0678	0.0677	0.0677	0.0676	0.0673	0.0673	0.0666	0.0647	0.0647
0.165	0.0559	0.0560	0.0561	0.0563	0.0564	0.0564	0.0567	0.0567	0.0569	0.0570	0.0571	0.0574	0.0578
0.170	0.0538	0.0537	0.0536	0.0536	0.0535	0.0535	0.0535	0.0534	0.0534	0.0534	0.0533	0.0531	0.0527
0.175	0.0536	0.0536	0.0537	0.0537	0.0538	0.0538	0.0539	0.0540	0.0545	0.0545	0.0546	0.0547	0.0548
0.180	0.0531	0.0530	0.0530	0.0529	0.0529	0.0528	0.0528	0.0527	0.0527	0.0525	0.0524	0.0522	0.0521
0.185	0.0537	0.0538	0.0539	0.0539	0.0540	0.0540	0.0541	0.0541	0.0541	0.0548	0.0548	0.0549	0.0550
0.190	0.0532	0.0532	0.0531	0.0531	0.0530	0.0530	0.0529	0.0529	0.0529	0.0527	0.0526	0.0525	0.0524
0.195	0.0539	0.0539	0.0539	0.0539	0.0540	0.0542	0.0543	0.0543	0.0543	0.0545	0.0548	0.0550	0.0551
0.200	0.0538	0.0537	0.0536	0.0536	0.0535	0.0533	0.0533	0.0532	0.0531	0.0530	0.0529	0.0526	0.0526
0.205	0.0546	0.0546	0.0548	0.0548	0.0548	0.0549	0.0550	0.0551	0.0552	0.0556	0.0557	0.0558	0.0559
0.210	0.0552	0.0551	0.0551	0.0551	0.0550	0.0548	0.0548	0.0547	0.0546	0.0545	0.0544	0.0544	0.0543
0.215	0.0563	0.0562	0.0562	0.0562	0.0561	0.0561	0.0560	0.0559	0.0557	0.0556	0.0555	0.0554	0.0552
0.220	0.0554	0.0555	0.0557	0.0557	0.0559	0.0560	0.0561	0.0562	0.0562	0.0563	0.0564	0.0567	0.0567
0.225	0.0585	0.0583	0.0583	0.0582	0.0582	0.0580	0.0579	0.0579	0.0578	0.0577	0.0577	0.0576	0.0575
0.230	0.0598	0.0598	0.0598	0.0598	0.0598	0.0602	0.0604	0.0604	0.0605	0.0605	0.0606	0.0607	0.0607
0.235	0.0605	0.0605	0.0604	0.0604	0.0602	0.0602	0.0602	0.0601	0.0600	0.0600	0.0599	0.0598	0.0597
0.240	0.0620	0.0621	0.0622	0.0622	0.0623	0.0624	0.0625	0.0626	0.0627	0.0627	0.0629	0.0629	0.0629
0.245	0.0635	0.0637	0.0639	0.0639	0.0640	0.0640	0.0640	0.0640	0.0641	0.0642	0.0643	0.0645	0.0646
0.250	0.0682	0.0681	0.0681	0.0681	0.0681	0.0678	0.0678	0.0678	0.0678	0.0677	0.0677	0.0677	0.0676
0.255	0.0775	0.0775	0.0775	0.0775	0.0776	0.0776	0.0777	0.0779	0.0780	0.0780	0.0780	0.0781	0.0786
0.260	0.0854	0.0854	0.0853	0.0852	0.0852	0.0851	0.0850	0.0850	0.0849	0.0849	0.0849	0.0849	0.0849
0.265	0.0944	0.0945	0.0946	0.0949	0.0951	0.0951	0.0951	0.0953	0.0953	0.0955	0.0956	0.0957	0.0958
0.270	0.1030	0.1030	0.1029	0.1029	0.1029	0.1028	0.1028	0.1027	0.1026	0.1026	0.1026	0.1023	0.1023
0.275	0.1095	0.1095	0.1096	0.1096	0.1096	0.1097	0.1097	0.1098	0.1099	0.1099	0.1101	0.1102	0.1103

0.280	0.1127	0.1127	0.1127	0.1127	0.1126	0.1126	0.1125	0.1125	0.1125	0.1124	0.1124	0.1123	0.1123
0.285	0.1165	0.1165	0.1166	0.1166	0.1166	0.1167	0.1168	0.1170	0.1170	0.1170	0.1171	0.1171	0.1171
0.290	0.1194	0.1194	0.1194	0.1194	0.1193	0.1193	0.1193	0.1191	0.1191	0.1190	0.1190	0.1189	0.1189
0.295	0.1228	0.1229	0.1230	0.1230	0.1230	0.1230	0.1230	0.1232	0.1234	0.1234	0.1235	0.1235	0.1236
0.300	0.1253	0.1253	0.1253	0.1252	0.1252	0.1252	0.1251	0.1251	0.1250	0.1249	0.1249	0.1249	0.1249
0.305	0.1276	0.1276	0.1276	0.1277	0.1277	0.1278	0.1281	0.1281	0.1282	0.1282	0.1282	0.1283	0.1286
0.310	0.1286	0.1286	0.1283	0.1283	0.1282	0.1282	0.1282	0.1282	0.1281	0.1281	0.1281	0.1280	0.1279
0.315	0.1290	0.1290	0.1291	0.1291	0.1291	0.1296	0.1296	0.1296	0.1297	0.1297	0.1298	0.1298	0.1299
0.320	0.1284	0.1284	0.1283	0.1282	0.1281	0.1280	0.1280	0.1280	0.1279	0.1278	0.1278	0.1277	0.1277
0.325	0.1264	0.1265	0.1268	0.1269	0.1270	0.1270	0.1270	0.1270	0.1271	0.1271	0.1273	0.1275	0.1277
0.330	0.1185	0.1178	0.1178	0.1175	0.1175	0.1175	0.1170	0.1167	0.1166	0.1165	0.1163	0.1162	0.1159
0.335	0.1037	0.1039	0.1040	0.1041	0.1041	0.1042	0.1043	0.1045	0.1046	0.1046	0.1047	0.1049	0.1050
0.340	0.0858	0.0858	0.0853	0.0849	0.0847	0.0846	0.0845	0.0845	0.0842	0.0836	0.0836	0.0835	0.0831
0.345	0.0776	0.0776	0.0778	0.0778	0.0779	0.0779	0.0780	0.0781	0.0781	0.0782	0.0782	0.0783	0.0783
0.350	0.0750	0.0750	0.0749	0.0748	0.0748	0.0748	0.0747	0.0747	0.0744	0.0744	0.0743	0.0743	0.0743
0.355	0.0747	0.0747	0.0747	0.0749	0.0749	0.0750	0.0751	0.0751	0.0752	0.0752	0.0753	0.0755	0.0755
0.360	0.0746	0.0746	0.0745	0.0745	0.0745	0.0744	0.0744	0.0744	0.0744	0.0743	0.0743	0.0742	0.0741
0.365	0.0744	0.0745	0.0745	0.0745	0.0746	0.0746	0.0746	0.0747	0.0748	0.0748	0.0749	0.0750	0.0750
0.370	0.0748	0.0747	0.0747	0.0747	0.0746	0.0746	0.0745	0.0744	0.0744	0.0743	0.0743	0.0743	0.0742
0.375	0.0750	0.0751	0.0751	0.0752	0.0753	0.0753	0.0753	0.0753	0.0754	0.0754	0.0756	0.0756	0.0757
0.380	0.0749	0.0748	0.0748	0.0747	0.0747	0.0747	0.0747	0.0747	0.0747	0.0745	0.0744	0.0744	0.0744
0.385	0.0751	0.0751	0.0752	0.0752	0.0752	0.0752	0.0753	0.0754	0.0755	0.0756	0.0756	0.0756	0.0756
0.390	0.0750	0.0749	0.0749	0.0749	0.0749	0.0749	0.0748	0.0747	0.0747	0.0746	0.0746	0.0745	0.0745
0.395	0.0753	0.0753	0.0754	0.0754	0.0754	0.0754	0.0755	0.0755	0.0756	0.0756	0.0758	0.0758	0.0759
0.400	0.0752	0.0752	0.0752	0.0751	0.0750	0.0749	0.0749	0.0748	0.0748	0.0748	0.0747	0.0747	0.0747
0.405	0.0757	0.0757	0.0758	0.0759	0.0759	0.0760	0.0760	0.0760	0.0760	0.0760	0.0761	0.0761	0.0761
0.410	0.0761	0.0760	0.0760	0.0760	0.0760	0.0759	0.0759	0.0759	0.0758	0.0757	0.0757	0.0757	0.0757
0.415	0.0773	0.0773	0.0773	0.0773	0.0773	0.0774	0.0774	0.0775	0.0775	0.0775	0.0775	0.0776	0.0777
0.420	0.0783	0.0783	0.0783	0.0782	0.0782	0.0781	0.0780	0.0780	0.0780	0.0780	0.0779	0.0779	0.0779
0.425	0.0799	0.0799	0.0799	0.0799	0.0799	0.0800	0.0800	0.0800	0.0800	0.0800	0.0800	0.0800	0.0801
0.430	0.0809	0.0809	0.0809	0.0808	0.0807	0.0807	0.0807	0.0806	0.0806	0.0805	0.0805	0.0805	0.0805
0.435	0.0815	0.0816	0.0816	0.0817	0.0817	0.0818	0.0819	0.0819	0.0819	0.0820	0.0820	0.0820	0.0820
0.440	0.0836	0.0836	0.0836	0.0835	0.0835	0.0834	0.0834	0.0834	0.0834	0.0834	0.0834	0.0833	0.0832
0.445	0.0850	0.0851	0.0851	0.0852	0.0852	0.0853	0.0853	0.0853	0.0853	0.0854	0.0854	0.0854	0.0854
0.450	0.0863	0.0862	0.0862	0.0862	0.0862	0.0862	0.0862	0.0861	0.0860	0.0860	0.0859	0.0859	0.0859
0.455	0.0878	0.0878	0.0878	0.0879	0.0880	0.0881	0.0881	0.0881	0.0881	0.0881	0.0882	0.0882	0.0882
0.460	0.0891	0.0891	0.0890	0.0890	0.0889	0.0889	0.0889	0.0889	0.0889	0.0888	0.0887	0.0887	0.0886
0.465	0.0906	0.0907	0.0907	0.0907	0.0907	0.0908	0.0909	0.0909	0.0910	0.0910	0.0910	0.0910	0.0911
0.470	0.0919	0.0919	0.0919	0.0918	0.0917	0.0917	0.0917	0.0917	0.0916	0.0916	0.0916	0.0915	0.0915
0.475	0.0935	0.0935	0.0935	0.0935	0.0936	0.0937	0.0937	0.0937	0.0937	0.0938	0.0938	0.0939	0.0939
0.480	0.0934	0.0918	0.0962	0.0959	0.0958	0.0957	0.0956	0.0956	0.0956	0.0955	0.0954	0.0952	0.0952
0.485	0.0963	0.0963	0.0963	0.0964	0.0964	0.0964	0.0964	0.0965	0.0966	0.0966	0.0966	0.0966	0.0967
0.490	0.0976	0.0976	0.0975	0.0975	0.0975	0.0975	0.0974	0.0974	0.0972	0.0972	0.0972	0.0972	0.0971
0.495	0.0991	0.0992	0.0992	0.0992	0.0992	0.0993	0.0993	0.0994	0.0994	0.0994	0.0995	0.0995	0.0995
0.500	0.1003	0.1003	0.1002	0.1002	0.1002	0.1002	0.1002	0.1002	0.1001	0.1001	0.1000	0.1000	0.0999
0.505	0.1021	0.1021	0.1021	0.1022	0.1022	0.1022	0.1023	0.1023	0.1023	0.1023	0.1023	0.1023	0.1023
0.510	0.1034	0.1034	0.1033	0.1033	0.1033	0.1033	0.1033	0.1032	0.1032	0.1032	0.1032	0.1032	0.1032
0.515	0.1049	0.1049	0.1050	0.1051	0.1051	0.1052	0.1052	0.1052	0.1052	0.1053	0.1054	0.1054	0.1054
0.520	0.1063	0.1063	0.1063	0.1063	0.1062	0.1062	0.1062	0.1062	0.1062	0.1062	0.1061	0.1061	0.1060
0.525	0.1079	0.1079	0.1079	0.1079	0.1080	0.1080	0.1081	0.1081	0.1081	0.1081	0.1081	0.1082	0.1082
0.530	0.1093	0.1093	0.1092	0.1092	0.1092	0.1092	0.1092	0.1092	0.1092	0.1091	0.1091	0.1091	0.1091
0.535	0.1119	0.1120	0.1121	0.1121	0.1123	0.1124	0.1125	0.1125	0.1129	0.1129	0.1130	0.1131	0.1131
0.540	0.1179	0.1166	0.1165	0.1163	0.1161	0.1153	0.1151	0.1146	0.1142	0.1135	0.1148	0.1150	0.1159

X-Axis	Y-Axis												
0.000	0.0025	0.0024	0.0018	0.0017	0.0017	0.0012	0.0010	0.0007	0.0007	0.0007	0.0006	0.0002	0.0000
0.005	0.0189	0.0193	0.0195	0.0200	0.0201	0.0206	0.0214	0.0214	0.0218	0.0190	0.0185	0.0185	0.0185
0.010	0.0236	0.0236	0.0238	0.0238	0.0242	0.0243	0.0250	0.0250	0.0267	0.0265	0.0254	0.0254	0.0252
0.015	0.0258	0.0259	0.0267	0.0270	0.0271	0.0275	0.0277	0.0281	0.0287	0.0288	0.0278	0.0275	0.0273
0.020	0.0288	0.0288	0.0289	0.0289	0.0289	0.0299	0.0305	0.0308	0.0318	0.0314	0.0309	0.0305	0.0299
0.025	0.0299	0.0303	0.0304	0.0304	0.0305	0.0308	0.0308	0.0308	0.0309	0.0385	0.0365	0.0363	0.0359
0.030	0.0438	0.0439	0.0440	0.0441	0.0445	0.0446	0.0447	0.0454	0.0471	0.0474	0.0461	0.0461	0.0461
0.035	0.0519	0.0524	0.0526	0.0532	0.0538	0.0545	0.0549	0.0550	0.0557	0.0563	0.0543	0.0539	0.0536
0.040	0.0615	0.0615	0.0617	0.0621	0.0622	0.0623	0.0628	0.0635	0.0643	0.0650	0.0636	0.0636	0.0629
0.045	0.0723	0.0725	0.0738	0.0648	0.0658	0.0664	0.0664	0.0665	0.0666	0.0736	0.0718	0.0714	0.0714
0.050	0.0758	0.0757	0.0755	0.0755	0.0754	0.0754	0.0754	0.0753	0.0751	0.0745	0.0754	0.0754	0.0756
0.055	0.0878	0.0882	0.0883	0.0887	0.0889	0.0892	0.0897	0.0903	0.0913	0.0909	0.0890	0.0889	0.0888
0.060	0.0972	0.0973	0.0973	0.0974	0.0975	0.0976	0.0976	0.0980	0.0998	0.1002	0.0992	0.0984	0.0975
0.065	0.1052	0.1057	0.1057	0.1057	0.1059	0.1064	0.1070	0.1082	0.1086	0.1085	0.1068	0.1065	0.1061
0.070	0.1143	0.1144	0.1146	0.1149	0.1149	0.1150	0.1151	0.1158	0.1173	0.1175	0.1169	0.1156	0.1154
0.075	0.1198	0.1198	0.1198	0.1200	0.1202	0.1204	0.1204	0.1205	0.1206	0.1258	0.1241	0.1240	0.1238
0.080	0.1299	0.1300	0.1302	0.1303	0.1308	0.1308	0.1310	0.1311	0.1325	0.1327	0.1318	0.1317	0.1314
0.085	0.1355	0.1355	0.1360	0.1361	0.1367	0.1371	0.1371	0.1372	0.1382	0.1375	0.1368	0.1364	0.1364
0.090	0.1386	0.1386	0.1387	0.1387	0.1390	0.1391	0.1394	0.1396	0.1407	0.1408	0.1402	0.1402	0.1400
0.095	0.1398	0.1403	0.1403	0.1407	0.1407	0.1414	0.1414	0.1414	0.1418	0.1423	0.1414	0.1407	0.1404
0.100	0.1409	0.1409	0.1409	0.1412	0.1413	0.1414	0.1415	0.1423	0.1429	0.1428	0.1424	0.1422	0.1417
0.105	0.1412	0.1412	0.1415	0.1419	0.1419	0.1421	0.1427	0.1427	0.1433	0.1434	0.1425	0.1420	0.1420
0.110	0.1414	0.1414	0.1414	0.1416	0.1419	0.1419	0.1420	0.1425	0.1432	0.1432	0.1430	0.1427	0.1422
0.115	0.1413	0.1413	0.1415	0.1416	0.1421	0.1423	0.1426	0.1431	0.1432	0.1430	0.1425	0.1420	0.1416
0.120	0.1411	0.1411	0.1412	0.1413	0.1413	0.1415	0.1416	0.1422	0.1430	0.1430	0.1428	0.1423	0.1418
0.125	0.1400	0.1402	0.1404	0.1406	0.1407	0.1408	0.1410	0.1415	0.1419	0.1418	0.1414	0.1404	0.1404
0.130	0.1350	0.1349	0.1347	0.1346	0.1346	0.1338	0.1334	0.1325	0.1325	0.1321	0.1323	0.1328	0.1340
0.135	0.1320	0.1323	0.1324	0.1324	0.1324	0.1325	0.1326	0.1327	0.1329	0.1379	0.1374	0.1367	0.1367
0.140	0.1264	0.1264	0.1257	0.1257	0.1257	0.1249	0.1238	0.1226	0.1225	0.1227	0.1239	0.1239	0.1241
0.145	0.1234	0.1236	0.1241	0.1241	0.1241	0.1244	0.1245	0.1247	0.1251	0.1253	0.1237	0.1235	0.1233
0.150	0.0999	0.0998	0.0996	0.0993	0.0989	0.0976	0.0968	0.0949	0.0947	0.0933	0.0960	0.0967	0.0975
0.155	0.0897	0.0899	0.0900	0.0900	0.0909	0.0909	0.0915	0.0923	0.0924	0.0916	0.0913	0.0913	0.0906
0.160	0.0647	0.0646	0.0643	0.0638	0.0635	0.0631	0.0619	0.0613	0.0612	0.0599	0.0619	0.0628	0.0628
0.165	0.0578	0.0578	0.0579	0.0580	0.0581	0.0581	0.0581	0.0586	0.0586	0.0607	0.0602	0.0599	0.0597
0.170	0.0527	0.0526	0.0525	0.0523	0.0522	0.0518	0.0514	0.0510	0.0509	0.0507	0.0511	0.0518	0.0518
0.175	0.0549	0.0550	0.0552	0.0552	0.0554	0.0556	0.0561	0.0561	0.0567	0.0561	0.0558	0.0557	0.0555
0.180	0.0521	0.0520	0.0519	0.0517	0.0516	0.0515	0.0511	0.0509	0.0508	0.0504	0.0510	0.0510	0.0518
0.185	0.0551	0.0551	0.0551	0.0551	0.0557	0.0559	0.0559	0.0561	0.0563	0.0560	0.0560	0.0558	0.0554
0.190	0.0523	0.0520	0.0520	0.0519	0.0518	0.0516	0.0515	0.0511	0.0509	0.0509	0.0512	0.0513	0.0518
0.195	0.0552	0.0552	0.0555	0.0556	0.0559	0.0560	0.0561	0.0562	0.0566	0.0566	0.0560	0.0557	0.0554
0.200	0.0526	0.0525	0.0525	0.0525	0.0524	0.0521	0.0520	0.0515	0.0513	0.0509	0.0515	0.0518	0.0524
0.205	0.0559	0.0560	0.0561	0.0565	0.0567	0.0569	0.0570	0.0571	0.0577	0.0577	0.0570	0.0561	0.0561
0.210	0.0543	0.0542	0.0541	0.0540	0.0540	0.0538	0.0536	0.0533	0.0532	0.0530	0.0531	0.0534	0.0537
0.215	0.0552	0.0552	0.0552	0.0551	0.0551	0.0548	0.0544	0.0543	0.0543	0.0543	0.0546	0.0546	0.0549
0.220	0.0569	0.0570	0.0570	0.0571	0.0572	0.0572	0.0573	0.0574	0.0574	0.0603	0.0601	0.0597	0.0595
0.225	0.0574	0.0573	0.0571	0.0570	0.0570	0.0569	0.0566	0.0565	0.0565	0.0562	0.0567	0.0570	0.0570
0.230	0.0608	0.0608	0.0609	0.0609	0.0611	0.0613	0.0617	0.0619	0.0620	0.0625	0.0621	0.0620	0.0615
0.235	0.0596	0.0595	0.0595	0.0594	0.0594	0.0589	0.0589	0.0588	0.0586	0.0586	0.0587	0.0590	0.0592
0.240	0.0629	0.0630	0.0630	0.0631	0.0633	0.0635	0.0636	0.0640	0.0646	0.0644	0.0640	0.0638	0.0636
0.245	0.0647	0.0650	0.0650	0.0650	0.0659	0.0660	0.0661	0.0661	0.0669	0.0666	0.0660	0.0656	0.0653
0.250	0.0675	0.0675	0.0675	0.0674	0.0674	0.0671	0.0670	0.0670	0.0663	0.0672	0.0672	0.0673	0.0673
0.255	0.0787	0.0788	0.0791	0.0792	0.0792	0.0792	0.0799	0.0799	0.0801	0.0804	0.0798	0.0796	0.0793
0.260	0.0847	0.0846	0.0845	0.0844	0.0844	0.0843	0.0841	0.0840	0.0821	0.0825	0.0839	0.0840	0.0842
0.265	0.0960	0.0961	0.0961	0.0963	0.0965	0.0968	0.0971	0.0973	0.0976	0.0975	0.0967	0.0967	0.0966
0.270	0.1022	0.1021	0.1019	0.1018	0.1018	0.1016	0.1015	0.1012	0.1000	0.1007	0.1014	0.1014	0.1018
0.275	0.1105	0.1110	0.1110	0.1113	0.1113	0.1114	0.1116	0.1121	0.1122	0.1114	0.1112	0.1111	0.1111

0.280	0.1122	0.1122	0.1122	0.1121	0.1121	0.1120	0.1119	0.1112	0.1111	0.1134	0.1134	0.1135	0.1136
0.285	0.1173	0.1175	0.1179	0.1180	0.1180	0.1180	0.1180	0.1187	0.1189	0.1189	0.1182	0.1181	0.1179
0.290	0.1189	0.1189	0.1187	0.1185	0.1185	0.1185	0.1185	0.1182	0.1175	0.1182	0.1184	0.1185	0.1186
0.295	0.1237	0.1238	0.1242	0.1244	0.1244	0.1244	0.1246	0.1253	0.1255	0.1252	0.1249	0.1248	0.1245
0.300	0.1248	0.1248	0.1247	0.1247	0.1246	0.1245	0.1244	0.1243	0.1238	0.1239	0.1245	0.1246	0.1246
0.305	0.1287	0.1288	0.1288	0.1293	0.1293	0.1293	0.1296	0.1299	0.1301	0.1303	0.1294	0.1293	0.1292
0.310	0.1278	0.1278	0.1278	0.1277	0.1277	0.1275	0.1273	0.1273	0.1269	0.1267	0.1272	0.1272	0.1278
0.315	0.1300	0.1302	0.1304	0.1308	0.1308	0.1310	0.1313	0.1313	0.1315	0.1314	0.1312	0.1309	0.1306
0.320	0.1276	0.1276	0.1275	0.1275	0.1274	0.1272	0.1271	0.1264	0.1261	0.1263	0.1266	0.1267	0.1270
0.325	0.1279	0.1279	0.1279	0.1280	0.1281	0.1281	0.1283	0.1285	0.1291	0.1290	0.1287	0.1284	0.1284
0.330	0.1158	0.1157	0.1149	0.1148	0.1146	0.1144	0.1134	0.1121	0.1113	0.1115	0.1119	0.1125	0.1131
0.335	0.1055	0.1057	0.1059	0.1063	0.1063	0.1063	0.1068	0.1070	0.1074	0.1084	0.1076	0.1062	0.1059
0.340	0.0829	0.0829	0.0829	0.0829	0.0828	0.0815	0.0807	0.0798	0.0796	0.0799	0.0807	0.0808	0.0810
0.345	0.0786	0.0786	0.0787	0.0787	0.0789	0.0795	0.0797	0.0801	0.0809	0.0802	0.0799	0.0790	0.0790
0.350	0.0743	0.0742	0.0742	0.0740	0.0740	0.0740	0.0738	0.0735	0.0734	0.0763	0.0765	0.0766	0.0766
0.355	0.0756	0.0756	0.0757	0.0758	0.0761	0.0764	0.0766	0.0767	0.0768	0.0764	0.0763	0.0762	0.0761
0.360	0.0741	0.0741	0.0740	0.0737	0.0736	0.0734	0.0734	0.0734	0.0728	0.0734	0.0735	0.0736	0.0736
0.365	0.0750	0.0751	0.0751	0.0751	0.0751	0.0752	0.0753	0.0754	0.0754	0.0765	0.0765	0.0764	0.0761
0.370	0.0741	0.0741	0.0740	0.0738	0.0737	0.0737	0.0736	0.0736	0.0730	0.0734	0.0738	0.0739	0.0739
0.375	0.0757	0.0759	0.0759	0.0760	0.0761	0.0762	0.0762	0.0763	0.0763	0.0771	0.0766	0.0765	0.0763
0.380	0.0744	0.0743	0.0742	0.0742	0.0739	0.0738	0.0738	0.0736	0.0731	0.0736	0.0740	0.0741	0.0741
0.385	0.0757	0.0758	0.0759	0.0760	0.0761	0.0762	0.0764	0.0766	0.0767	0.0775	0.0766	0.0765	0.0763
0.390	0.0744	0.0743	0.0743	0.0742	0.0742	0.0742	0.0740	0.0739	0.0733	0.0739	0.0741	0.0741	0.0744
0.395	0.0759	0.0759	0.0759	0.0759	0.0760	0.0762	0.0765	0.0766	0.0767	0.0777	0.0766	0.0766	0.0765
0.400	0.0747	0.0747	0.0747	0.0747	0.0746	0.0746	0.0745	0.0744	0.0734	0.0744	0.0744	0.0744	0.0745
0.405	0.0762	0.0762	0.0764	0.0765	0.0765	0.0766	0.0766	0.0768	0.0769	0.0784	0.0771	0.0770	0.0770
0.410	0.0756	0.0756	0.0755	0.0754	0.0753	0.0753	0.0752	0.0750	0.0741	0.0752	0.0755	0.0756	0.0757
0.415	0.0778	0.0778	0.0778	0.0780	0.0781	0.0781	0.0785	0.0786	0.0787	0.0797	0.0787	0.0785	0.0784
0.420	0.0778	0.0778	0.0778	0.0778	0.0777	0.0776	0.0775	0.0769	0.0760	0.0776	0.0777	0.0778	0.0778
0.425	0.0802	0.0802	0.0802	0.0805	0.0806	0.0807	0.0810	0.0812	0.0812	0.0825	0.0811	0.0811	0.0809
0.430	0.0805	0.0803	0.0803	0.0803	0.0803	0.0802	0.0797	0.0793	0.0787	0.0812	0.0813	0.0813	0.0813
0.435	0.0821	0.0821	0.0822	0.0822	0.0822	0.0822	0.0823	0.0824	0.0824	0.0853	0.0838	0.0838	0.0837
0.440	0.0832	0.0831	0.0831	0.0831	0.0830	0.0828	0.0826	0.0817	0.0810	0.0826	0.0830	0.0831	0.0831
0.445	0.0856	0.0856	0.0857	0.0858	0.0859	0.0860	0.0861	0.0864	0.0866	0.0879	0.0866	0.0865	0.0864
0.450	0.0859	0.0859	0.0857	0.0857	0.0856	0.0855	0.0854	0.0853	0.0837	0.0866	0.0866	0.0867	0.0867
0.455	0.0883	0.0883	0.0884	0.0885	0.0886	0.0887	0.0889	0.0889	0.0890	0.0908	0.0893	0.0891	0.0890
0.460	0.0885	0.0885	0.0885	0.0885	0.0884	0.0881	0.0881	0.0879	0.0863	0.0884	0.0885	0.0886	0.0886
0.465	0.0911	0.0912	0.0912	0.0913	0.0913	0.0915	0.0916	0.0918	0.0920	0.0939	0.0921	0.0918	0.0918
0.470	0.0915	0.0915	0.0915	0.0914	0.0913	0.0913	0.0910	0.0907	0.0889	0.0923	0.0923	0.0923	0.0923
0.475	0.0939	0.0940	0.0941	0.0941	0.0942	0.0943	0.0944	0.0946	0.0948	0.0970	0.0948	0.0947	0.0945
0.480	0.0952	0.0951	0.0951	0.0951	0.0951	0.0951	0.0951	0.0949	0.0949	0.0957	0.0959	0.0959	0.0960
0.485	0.0967	0.0969	0.0969	0.0971	0.0971	0.0971	0.0972	0.0972	0.0975	0.0999	0.0981	0.0974	0.0974
0.490	0.0971	0.0971	0.0970	0.0970	0.0969	0.0968	0.0966	0.0961	0.0943	0.0969	0.0969	0.0971	0.0971
0.495	0.0995	0.0998	0.0998	0.0998	0.0999	0.0999	0.1000	0.1002	0.1003	0.1029	0.1012	0.1001	0.1001
0.500	0.0998	0.0996	0.0970	0.1017	0.1016	0.1014	0.1013	0.1012	0.1012	0.0995	0.0998	0.0998	0.0998
0.505	0.1024	0.1025	0.1026	0.1026	0.1026	0.1027	0.1028	0.1030	0.1030	0.1060	0.1041	0.1028	0.1027
0.510	0.1031	0.1031	0.1031	0.1031	0.1031	0.1029	0.1029	0.1026	0.0993	0.1039	0.1040	0.1040	0.1040
0.515	0.1054	0.1055	0.1055	0.1056	0.1056	0.1057	0.1057	0.1057	0.1059	0.1092	0.1070	0.1058	0.1056
0.520	0.1060	0.1060	0.1059	0.1059	0.1058	0.1058	0.1056	0.1053	0.1024	0.1060	0.1061	0.1061	0.1061
0.525	0.1082	0.1083	0.1084	0.1085	0.1086	0.1087	0.1089	0.1090	0.1102	0.1121	0.1099	0.1088	0.1086
0.530	0.1091	0.1090	0.1090	0.1090	0.1089	0.1088	0.1083	0.1082	0.1055	0.1085	0.1086	0.1087	0.1088
0.535	0.1132	0.1132	0.1136	0.1137	0.1144	0.1148	0.1150	0.1160	0.1161	0.1154	0.1152	0.1147	0.1144
0.540	0.1160	0.1161	0.1162	0.1168	0.1169	0.1171	0.1174	0.1176	0.1180	0.1182	0.1183	0.1188	0.1191

X-Axis	Y-Axis												
0.000													
0.005	0.0182	0.0180	0.0179	0.0179	0.0179	0.0179	0.0176	0.0173	0.0171	0.0169	0.0168	0.0164	0.0162
0.010	0.0249	0.0246	0.0243	0.0239	0.0239	0.0234	0.0231	0.0230	0.0230	0.0230	0.0229	0.0227	0.0225
0.015	0.0264	0.0264	0.0262	0.0260	0.0259	0.0258	0.0257	0.0256	0.0255	0.0255	0.0251	0.0250	0.0250
0.020	0.0299	0.0295	0.0294	0.0290	0.0287	0.0283	0.0282	0.0282	0.0281	0.0278	0.0276	0.0276	0.0274
0.025	0.0355	0.0354	0.0348	0.0348	0.0345	0.0343	0.0342	0.0341	0.0338	0.0337	0.0337	0.0337	0.0336
0.030	0.0447	0.0442	0.0441	0.0439	0.0431	0.0431	0.0430	0.0428	0.0426	0.0425	0.0422	0.0421	0.0420
0.035	0.0535	0.0531	0.0528	0.0527	0.0526	0.0525	0.0522	0.0522	0.0522	0.0521	0.0517	0.0517	0.0515
0.040	0.0628	0.0620	0.0614	0.0614	0.0611	0.0606	0.0604	0.0602	0.0602	0.0602	0.0601	0.0599	0.0596
0.045	0.0713	0.0712	0.0705	0.0704	0.0703	0.0701	0.0700	0.0699	0.0699	0.0697	0.0697	0.0697	0.0696
0.050	0.0757	0.0757	0.0758	0.0758	0.0758	0.0759	0.0760	0.0761	0.0761	0.0762	0.0764	0.0764	0.0766
0.055	0.0887	0.0884	0.0884	0.0884	0.0884	0.0881	0.0880	0.0879	0.0877	0.0874	0.0874	0.0873	0.0872
0.060	0.0974	0.0974	0.0969	0.0963	0.0962	0.0961	0.0960	0.0959	0.0956	0.0955	0.0953	0.0952	0.0952
0.065	0.1061	0.1061	0.1061	0.1056	0.1056	0.1055	0.1055	0.1052	0.1051	0.1051	0.1048	0.1046	0.1045
0.070	0.1148	0.1147	0.1146	0.1144	0.1143	0.1142	0.1138	0.1136	0.1136	0.1135	0.1133	0.1133	0.1132
0.075	0.1235	0.1233	0.1232	0.1231	0.1230	0.1229	0.1227	0.1226	0.1225	0.1225	0.1224	0.1222	0.1222
0.080	0.1308	0.1304	0.1299	0.1299	0.1299	0.1298	0.1297	0.1297	0.1296	0.1295	0.1292	0.1291	0.1288
0.085	0.1364	0.1363	0.1359	0.1357	0.1356	0.1355	0.1353	0.1352	0.1351	0.1350	0.1349	0.1347	0.1346
0.090	0.1394	0.1393	0.1392	0.1388	0.1386	0.1383	0.1383	0.1382	0.1380	0.1379	0.1379	0.1376	0.1376
0.095	0.1404	0.1403	0.1401	0.1401	0.1401	0.1398	0.1398	0.1398	0.1397	0.1395	0.1392	0.1391	0.1390
0.100	0.1417	0.1415	0.1411	0.1410	0.1407	0.1407	0.1405	0.1404	0.1403	0.1402	0.1402	0.1401	0.1398
0.105	0.1415	0.1415	0.1414	0.1413	0.1412	0.1411	0.1409	0.1407	0.1407	0.1405	0.1405	0.1404	0.1403
0.110	0.1420	0.1417	0.1413	0.1413	0.1412	0.1411	0.1410	0.1409	0.1408	0.1406	0.1406	0.1405	0.1402
0.115	0.1416	0.1415	0.1414	0.1413	0.1413	0.1412	0.1412	0.1412	0.1411	0.1410	0.1408	0.1406	0.1405
0.120	0.1416	0.1415	0.1414	0.1412	0.1411	0.1410	0.1407	0.1406	0.1405	0.1404	0.1403	0.1400	0.1400
0.125	0.1403	0.1403	0.1402	0.1400	0.1400	0.1398	0.1398	0.1397	0.1395	0.1395	0.1394	0.1392	0.1392
0.130	0.1341	0.1343	0.1346	0.1349	0.1349	0.1349	0.1353	0.1353	0.1353	0.1353	0.1355	0.1357	0.1358
0.135	0.1365	0.1364	0.1361	0.1361	0.1360	0.1359	0.1357	0.1356	0.1356	0.1355	0.1355	0.1352	0.1349
0.140	0.1243	0.1256	0.1258	0.1261	0.1265	0.1266	0.1268	0.1269	0.1271	0.1271	0.1272	0.1272	0.1278
0.145	0.1231	0.1231	0.1231	0.1230	0.1228	0.1228	0.1228	0.1228	0.1227	0.1226	0.1225	0.1222	0.1222
0.150	0.0977	0.0996	0.1002	0.1008	0.1009	0.1014	0.1015	0.1020	0.1021	0.1022	0.1023	0.1024	0.1026
0.155	0.0905	0.0903	0.0901	0.0900	0.0895	0.0894	0.0893	0.0893	0.0891	0.0881	0.0881	0.0880	0.0880
0.160	0.0633	0.0642	0.0644	0.0650	0.0654	0.0662	0.0663	0.0664	0.0665	0.0667	0.0668	0.0669	0.0675
0.165	0.0597	0.0595	0.0592	0.0591	0.0589	0.0588	0.0587	0.0586	0.0585	0.0584	0.0583	0.0583	0.0582
0.170	0.0523	0.0525	0.0526	0.0526	0.0528	0.0529	0.0532	0.0533	0.0535	0.0536	0.0538	0.0538	0.0538
0.175	0.0552	0.0551	0.0551	0.0550	0.0550	0.0549	0.0549	0.0549	0.0548	0.0547	0.0544	0.0542	0.0541
0.180	0.0518	0.0519	0.0520	0.0520	0.0521	0.0524	0.0525	0.0526	0.0527	0.0527	0.0528	0.0529	0.0529
0.185	0.0552	0.0551	0.0551	0.0550	0.0550	0.0548	0.0548	0.0548	0.0546	0.0545	0.0543	0.0542	0.0542
0.190	0.0520	0.0521	0.0521	0.0521	0.0523	0.0526	0.0526	0.0527	0.0528	0.0528	0.0528	0.0529	0.0529
0.195	0.0554	0.0552	0.0552	0.0552	0.0551	0.0551	0.0551	0.0550	0.0550	0.0549	0.0545	0.0545	0.0544
0.200	0.0524	0.0527	0.0527	0.0528	0.0528	0.0528	0.0528	0.0529	0.0530	0.0531	0.0532	0.0532	0.0533
0.205	0.0560	0.0560	0.0559	0.0559	0.0558	0.0558	0.0558	0.0556	0.0556	0.0555	0.0553	0.0552	0.0551
0.210	0.0538	0.0540	0.0542	0.0542	0.0543	0.0543	0.0543	0.0545	0.0545	0.0547	0.0549	0.0550	0.0550
0.215	0.0550	0.0550	0.0552	0.0552	0.0552	0.0555	0.0555	0.0555	0.0557	0.0557	0.0557	0.0557	0.0558
0.220	0.0593	0.0591	0.0591	0.0588	0.0588	0.0587	0.0586	0.0585	0.0584	0.0580	0.0580	0.0579	0.0577
0.225	0.0571	0.0572	0.0574	0.0574	0.0575	0.0575	0.0576	0.0576	0.0576	0.0577	0.0579	0.0579	0.0580
0.230	0.0615	0.0611	0.0611	0.0611	0.0610	0.0608	0.0607	0.0607	0.0605	0.0601	0.0600	0.0600	0.0599
0.235	0.0593	0.0594	0.0594	0.0595	0.0595	0.0595	0.0596	0.0596	0.0597	0.0598	0.0598	0.0600	0.0601
0.240	0.0635	0.0634	0.0633	0.0632	0.0631	0.0631	0.0626	0.0625	0.0625	0.0623	0.0622	0.0621	0.0620
0.245	0.0651	0.0651	0.0650	0.0649	0.0649	0.0647	0.0646	0.0646	0.0644	0.0643	0.0642	0.0642	0.0641
0.250	0.0674	0.0675	0.0675	0.0678	0.0678	0.0680	0.0680	0.0681	0.0681	0.0682	0.0683	0.0683	0.0685
0.255	0.0792	0.0791	0.0790	0.0790	0.0787	0.0787	0.0786	0.0784	0.0783	0.0782	0.0782	0.0781	0.0780
0.260	0.0844	0.0844	0.0845	0.0845	0.0847	0.0847	0.0847	0.0847	0.0848	0.0850	0.0850	0.0851	0.0851
0.265	0.0965	0.0965	0.0963	0.0960	0.0959	0.0958	0.0958	0.0955	0.0955	0.0954	0.0953	0.0952	0.0952
0.270	0.1020	0.1021	0.1022	0.1022	0.1022	0.1023	0.1023	0.1025	0.1027	0.1027	0.1027	0.1027	0.1027
0.275	0.1110	0.1110	0.1107	0.1105	0.1105	0.1104	0.1104	0.1103	0.1102	0.1101	0.1100	0.1099	0.1098

0.280	0.1136	0.1137	0.1139	0.1140	0.1140	0.1141	0.1141	0.1142	0.1143	0.1145	0.1145	0.1148	0.1149
0.285	0.1177	0.1177	0.1177	0.1174	0.1174	0.1173	0.1173	0.1173	0.1173	0.1172	0.1171	0.1170	0.1170
0.290	0.1187	0.1187	0.1188	0.1189	0.1190	0.1190	0.1191	0.1191	0.1192	0.1192	0.1192	0.1192	0.1192
0.295	0.1244	0.1243	0.1243	0.1241	0.1241	0.1239	0.1238	0.1237	0.1236	0.1236	0.1235	0.1232	0.1231
0.300	0.1246	0.1246	0.1248	0.1249	0.1249	0.1250	0.1250	0.1250	0.1251	0.1251	0.1251	0.1252	0.1253
0.305	0.1291	0.1289	0.1288	0.1287	0.1287	0.1286	0.1286	0.1285	0.1285	0.1284	0.1284	0.1283	0.1282
0.310	0.1278	0.1278	0.1279	0.1279	0.1279	0.1280	0.1281	0.1281	0.1282	0.1283	0.1284	0.1285	0.1285
0.315	0.1305	0.1304	0.1302	0.1302	0.1302	0.1301	0.1301	0.1300	0.1299	0.1299	0.1299	0.1297	0.1297
0.320	0.1271	0.1277	0.1277	0.1278	0.1279	0.1279	0.1280	0.1281	0.1281	0.1281	0.1283	0.1283	0.1283
0.325	0.1278	0.1277	0.1277	0.1276	0.1275	0.1275	0.1275	0.1274	0.1274	0.1271	0.1271	0.1270	0.1268
0.330	0.1139	0.1150	0.1151	0.1151	0.1161	0.1164	0.1164	0.1164	0.1177	0.1177	0.1178	0.1179	0.1181
0.335	0.1055	0.1054	0.1054	0.1054	0.1051	0.1049	0.1049	0.1046	0.1044	0.1042	0.1041	0.1041	0.1039
0.340	0.0822	0.0830	0.0831	0.0831	0.0833	0.0836	0.0836	0.0836	0.0842	0.0845	0.0846	0.0852	0.0854
0.345	0.0789	0.0788	0.0787	0.0787	0.0785	0.0783	0.0783	0.0783	0.0783	0.0781	0.0781	0.0781	0.0780
0.350	0.0767	0.0768	0.0773	0.0734	0.0736	0.0738	0.0741	0.0741	0.0742	0.0743	0.0745	0.0747	0.0747
0.355	0.0760	0.0759	0.0756	0.0756	0.0756	0.0755	0.0755	0.0755	0.0754	0.0754	0.0753	0.0753	0.0753
0.360	0.0740	0.0741	0.0742	0.0742	0.0744	0.0745	0.0745	0.0745	0.0745	0.0745	0.0745	0.0745	0.0747
0.365	0.0761	0.0759	0.0758	0.0758	0.0757	0.0757	0.0757	0.0757	0.0756	0.0755	0.0754	0.0754	0.0753
0.370	0.0740	0.0741	0.0742	0.0743	0.0744	0.0744	0.0745	0.0746	0.0746	0.0746	0.0746	0.0747	0.0748
0.375	0.0762	0.0760	0.0759	0.0759	0.0758	0.0758	0.0757	0.0757	0.0756	0.0755	0.0755	0.0755	0.0755
0.380	0.0743	0.0744	0.0744	0.0744	0.0745	0.0746	0.0746	0.0746	0.0746	0.0746	0.0747	0.0747	0.0748
0.385	0.0762	0.0761	0.0760	0.0759	0.0759	0.0759	0.0758	0.0758	0.0758	0.0758	0.0757	0.0756	0.0755
0.390	0.0744	0.0744	0.0745	0.0745	0.0747	0.0747	0.0747	0.0747	0.0747	0.0748	0.0748	0.0749	0.0749
0.395	0.0764	0.0764	0.0763	0.0761	0.0760	0.0760	0.0760	0.0758	0.0758	0.0758	0.0757	0.0757	0.0757
0.400	0.0745	0.0746	0.0746	0.0747	0.0747	0.0748	0.0748	0.0749	0.0750	0.0750	0.0750	0.0751	0.0751
0.405	0.0770	0.0766	0.0766	0.0766	0.0765	0.0764	0.0764	0.0764	0.0764	0.0763	0.0762	0.0761	0.0761
0.410	0.0757	0.0757	0.0758	0.0758	0.0758	0.0759	0.0759	0.0759	0.0760	0.0761	0.0761	0.0761	0.0761
0.415	0.0783	0.0782	0.0780	0.0780	0.0779	0.0779	0.0779	0.0778	0.0776	0.0776	0.0776	0.0776	0.0776
0.420	0.0778	0.0779	0.0779	0.0780	0.0780	0.0780	0.0780	0.0781	0.0781	0.0781	0.0782	0.0782	0.0782
0.425	0.0808	0.0808	0.0807	0.0805	0.0804	0.0803	0.0803	0.0802	0.0802	0.0802	0.0801	0.0800	0.0800
0.430	0.0813	0.0813	0.0813	0.0814	0.0814	0.0815	0.0815	0.0815	0.0815	0.0817	0.0819	0.0819	0.0820
0.435	0.0835	0.0832	0.0832	0.0832	0.0829	0.0829	0.0828	0.0828	0.0828	0.0828	0.0828	0.0827	0.0827
0.440	0.0832	0.0833	0.0833	0.0833	0.0833	0.0833	0.0834	0.0835	0.0835	0.0835	0.0836	0.0836	0.0836
0.445	0.0862	0.0859	0.0858	0.0858	0.0857	0.0856	0.0856	0.0856	0.0855	0.0855	0.0855	0.0855	0.0854
0.450	0.0867	0.0868	0.0868	0.0868	0.0869	0.0869	0.0869	0.0869	0.0869	0.0869	0.0871	0.0872	0.0872
0.455	0.0888	0.0888	0.0887	0.0885	0.0885	0.0883	0.0883	0.0882	0.0882	0.0882	0.0881	0.0881	0.0881
0.460	0.0887	0.0887	0.0887	0.0888	0.0889	0.0889	0.0889	0.0889	0.0890	0.0890	0.0891	0.0891	0.0891
0.465	0.0916	0.0915	0.0914	0.0913	0.0913	0.0912	0.0912	0.0911	0.0910	0.0910	0.0910	0.0910	0.0909
0.470	0.0924	0.0924	0.0924	0.0926	0.0927	0.0927	0.0927	0.0927	0.0928	0.0929	0.0929	0.0932	0.0932
0.475	0.0944	0.0943	0.0943	0.0941	0.0941	0.0941	0.0940	0.0940	0.0939	0.0938	0.0938	0.0937	0.0937
0.480	0.0963	0.0984	0.0939	0.0942	0.0942	0.0942	0.0943	0.0944	0.0944	0.0944	0.0945	0.0946	0.0946
0.485	0.0973	0.0970	0.0970	0.0970	0.0969	0.0969	0.0969	0.0968	0.0967	0.0967	0.0966	0.0966	0.0966
0.490	0.0971	0.0972	0.0973	0.0973	0.0974	0.0974	0.0974	0.0974	0.0976	0.0976	0.0976	0.0977	0.0977
0.495	0.1000	0.0999	0.0998	0.0998	0.0998	0.0997	0.0997	0.0996	0.0995	0.0995	0.0994	0.0994	0.0994
0.500	0.1000	0.1000	0.1002	0.1002	0.1003	0.1003	0.1003	0.1003	0.1004	0.1004	0.1005	0.1005	0.1005
0.505	0.1027	0.1026	0.1026	0.1025	0.1025	0.1025	0.1024	0.1024	0.1023	0.1023	0.1022	0.1022	0.1022
0.510	0.1041	0.1041	0.1043	0.1056	0.1076	0.1025	0.1026	0.1028	0.1029	0.1030	0.1031	0.1031	0.1032
0.515	0.1056	0.1055	0.1055	0.1054	0.1054	0.1054	0.1053	0.1053	0.1053	0.1052	0.1052	0.1051	0.1051
0.520	0.1061	0.1062	0.1062	0.1062	0.1062	0.1063	0.1063	0.1063	0.1064	0.1064	0.1065	0.1065	0.1065
0.525	0.1084	0.1084	0.1083	0.1083	0.1083	0.1083	0.1082	0.1082	0.1082	0.1082	0.1082	0.1081	0.1081
0.530	0.1089	0.1089	0.1089	0.1089	0.1089	0.1090	0.1090	0.1091	0.1091	0.1092	0.1092	0.1092	0.1092
0.535	0.1138	0.1136	0.1134	0.1133	0.1132	0.1131	0.1130	0.1130	0.1129	0.1129	0.1129	0.1125	0.1125
0.540	0.1192	0.1195	0.1196	0.1198	0.1203	0.1214	0.1215	0.1227	0.1235	0.1247			

X-Axis	Y-Axis												
0.000													
0.005	0.0160	0.0159	0.0159	0.0158	0.0157	0.0155	0.0155	0.0154	0.0154	0.0154	0.0154	0.0152	0.0151
0.010	0.0221	0.0221	0.0220	0.0220	0.0219	0.0217	0.0217	0.0217	0.0215	0.0214	0.0212	0.0212	0.0210
0.015	0.0249	0.0248	0.0246	0.0246	0.0242	0.0242	0.0236	0.0236	0.0235	0.0235	0.0234	0.0234	0.0233
0.020	0.0273	0.0270	0.0269	0.0267	0.0266	0.0264	0.0264	0.0264	0.0264	0.0263	0.0260	0.0260	0.0257
0.025	0.0331	0.0329	0.0326	0.0325	0.0324	0.0323	0.0321	0.0318	0.0317	0.0315	0.0315	0.0313	0.0313
0.030	0.0420	0.0419	0.0417	0.0416	0.0416	0.0415	0.0414	0.0413	0.0412	0.0410	0.0407	0.0406	0.0405
0.035	0.0513	0.0511	0.0508	0.0506	0.0505	0.0504	0.0502	0.0502	0.0501	0.0501	0.0499	0.0499	0.0497
0.040	0.0594	0.0593	0.0592	0.0591	0.0590	0.0590	0.0589	0.0589	0.0589	0.0588	0.0588	0.0588	0.0587
0.045	0.0695	0.0690	0.0689	0.0685	0.0684	0.0684	0.0683	0.0682	0.0682	0.0681	0.0681	0.0679	0.0679
0.050	0.0767	0.0768	0.0769	0.0769	0.0769	0.0770	0.0770	0.0771	0.0771	0.0772	0.0775	0.0777	0.0777
0.055	0.0871	0.0869	0.0866	0.0865	0.0862	0.0862	0.0860	0.0859	0.0859	0.0858	0.0857	0.0857	0.0856
0.060	0.0952	0.0950	0.0949	0.0948	0.0948	0.0947	0.0947	0.0947	0.0945	0.0945	0.0944	0.0944	0.0944
0.065	0.1045	0.1044	0.1042	0.1041	0.1041	0.1041	0.1040	0.1038	0.1037	0.1036	0.1036	0.1034	0.1033
0.070	0.1130	0.1130	0.1128	0.1126	0.1124	0.1123	0.1122	0.1122	0.1121	0.1121	0.1120	0.1120	0.1119
0.075	0.1221	0.1220	0.1220	0.1215	0.1213	0.1212	0.1211	0.1210	0.1209	0.1209	0.1209	0.1209	0.1208
0.080	0.1287	0.1285	0.1284	0.1284	0.1283	0.1283	0.1283	0.1283	0.1282	0.1282	0.1281	0.1281	0.1281
0.085	0.1343	0.1342	0.1341	0.1340	0.1340	0.1339	0.1338	0.1338	0.1337	0.1337	0.1337	0.1337	0.1336
0.090	0.1374	0.1374	0.1373	0.1372	0.1371	0.1370	0.1369	0.1368	0.1368	0.1368	0.1368	0.1367	0.1366
0.095	0.1388	0.1388	0.1388	0.1386	0.1384	0.1384	0.1384	0.1383	0.1382	0.1380	0.1380	0.1378	0.1378
0.100	0.1396	0.1396	0.1395	0.1395	0.1394	0.1392	0.1392	0.1392	0.1390	0.1390	0.1389	0.1388	0.1386
0.105	0.1402	0.1400	0.1398	0.1398	0.1397	0.1396	0.1396	0.1394	0.1391	0.1391	0.1391	0.1390	0.1390
0.110	0.1402	0.1401	0.1400	0.1400	0.1399	0.1399	0.1398	0.1398	0.1396	0.1394	0.1393	0.1392	0.1390
0.115	0.1404	0.1403	0.1399	0.1398	0.1397	0.1397	0.1397	0.1395	0.1395	0.1395	0.1394	0.1392	0.1392
0.120	0.1398	0.1398	0.1397	0.1397	0.1397	0.1396	0.1395	0.1394	0.1393	0.1392	0.1392	0.1390	0.1388
0.125	0.1392	0.1389	0.1384	0.1384	0.1384	0.1384	0.1381	0.1381	0.1381	0.1381	0.1380	0.1380	0.1375
0.130	0.1360	0.1360	0.1362	0.1363	0.1364	0.1365	0.1366	0.1367	0.1368	0.1368	0.1368	0.1368	0.1370
0.135	0.1348	0.1348	0.1347	0.1346	0.1345	0.1344	0.1344	0.1342	0.1341	0.1341	0.1340	0.1337	0.1336
0.140	0.1280	0.1284	0.1287	0.1288	0.1288	0.1291	0.1292	0.1292	0.1292	0.1292	0.1293	0.1293	0.1293
0.145	0.1219	0.1217	0.1217	0.1214	0.1213	0.1211	0.1210	0.1210	0.1210	0.1208	0.1207	0.1206	0.1202
0.150	0.1032	0.1037	0.1038	0.1041	0.1042	0.1042	0.1045	0.1047	0.1052	0.1054	0.1055	0.1055	0.1056
0.155	0.0879	0.0878	0.0877	0.0873	0.0871	0.0871	0.0869	0.0868	0.0867	0.0859	0.0857	0.0856	0.0856
0.160	0.0675	0.0678	0.0683	0.0683	0.0684	0.0686	0.0687	0.0687	0.0690	0.0694	0.0696	0.0701	0.0701
0.165	0.0581	0.0580	0.0577	0.0577	0.0576	0.0575	0.0575	0.0575	0.0575	0.0574	0.0573	0.0572	0.0572
0.170	0.0541	0.0541	0.0542	0.0542	0.0543	0.0543	0.0543	0.0544	0.0544	0.0545	0.0547	0.0549	0.0551
0.175	0.0540	0.0540	0.0540	0.0537	0.0537	0.0536	0.0535	0.0534	0.0534	0.0533	0.0533	0.0533	0.0532
0.180	0.0531	0.0531	0.0532	0.0532	0.0533	0.0533	0.0534	0.0535	0.0535	0.0535	0.0536	0.0538	0.0540
0.185	0.0541	0.0539	0.0538	0.0537	0.0537	0.0536	0.0535	0.0534	0.0532	0.0531	0.0531	0.0531	0.0531
0.190	0.0529	0.0530	0.0531	0.0532	0.0532	0.0533	0.0533	0.0534	0.0535	0.0537	0.0538	0.0538	0.0538
0.195	0.0543	0.0543	0.0541	0.0539	0.0538	0.0538	0.0538	0.0534	0.0534	0.0534	0.0534	0.0532	0.0531
0.200	0.0534	0.0534	0.0535	0.0536	0.0538	0.0539	0.0540	0.0540	0.0541	0.0542	0.0544	0.0544	0.0545
0.205	0.0551	0.0551	0.0549	0.0549	0.0547	0.0547	0.0546	0.0545	0.0545	0.0544	0.0543	0.0542	0.0541
0.210	0.0550	0.0550	0.0551	0.0551	0.0551	0.0553	0.0553	0.0555	0.0555	0.0557	0.0557	0.0558	0.0558
0.215	0.0559	0.0560	0.0561	0.0562	0.0563	0.0563	0.0564	0.0564	0.0565	0.0565	0.0565	0.0566	0.0566
0.220	0.0577	0.0577	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0574	0.0572	0.0572	0.0571	0.0570
0.225	0.0581	0.0581	0.0581	0.0583	0.0583	0.0583	0.0586	0.0586	0.0586	0.0586	0.0587	0.0587	0.0588
0.230	0.0598	0.0598	0.0597	0.0597	0.0597	0.0597	0.0596	0.0595	0.0594	0.0592	0.0592	0.0591	0.0591
0.235	0.0603	0.0603	0.0603	0.0603	0.0604	0.0606	0.0607	0.0607	0.0607	0.0608	0.0608	0.0608	0.0608
0.240	0.0620	0.0620	0.0620	0.0619	0.0618	0.0616	0.0616	0.0616	0.0616	0.0615	0.0615	0.0614	0.0613
0.245	0.0641	0.0641	0.0640	0.0640	0.0639	0.0638	0.0637	0.0636	0.0635	0.0634	0.0634	0.0633	0.0632
0.250	0.0686	0.0686	0.0687	0.0688	0.0689	0.0689	0.0690	0.0691	0.0691	0.0692	0.0693	0.0696	0.0698
0.255	0.0780	0.0776	0.0776	0.0776	0.0774	0.0774	0.0773	0.0773	0.0770	0.0769	0.0769	0.0769	0.0769
0.260	0.0853	0.0853	0.0855	0.0855	0.0856	0.0858	0.0858	0.0859	0.0860	0.0861	0.0862	0.0862	0.0864
0.265	0.0952	0.0952	0.0950	0.0950	0.0949	0.0949	0.0948	0.0947	0.0945	0.0945	0.0943	0.0943	0.0942
0.270	0.1027	0.1029	0.1029	0.1029	0.1029	0.1030	0.1030	0.1031	0.1032	0.1032	0.1035	0.1035	0.1035
0.275	0.1097	0.1097	0.1096	0.1096	0.1096	0.1096	0.1095	0.1094	0.1093	0.1093	0.1092	0.1092	0.1091

0.280	0.1149	0.1155	0.1116	0.1118	0.1119	0.1120	0.1121	0.1122	0.1123	0.1123	0.1124	0.1124	0.1124
0.285	0.1170	0.1170	0.1168	0.1166	0.1166	0.1166	0.1166	0.1165	0.1164	0.1164	0.1164	0.1164	0.1162
0.290	0.1193	0.1194	0.1194	0.1195	0.1195	0.1196	0.1198	0.1198	0.1199	0.1199	0.1200	0.1200	0.1201
0.295	0.1231	0.1231	0.1231	0.1231	0.1230	0.1230	0.1229	0.1229	0.1228	0.1228	0.1228	0.1227	0.1227
0.300	0.1253	0.1254	0.1254	0.1255	0.1255	0.1255	0.1257	0.1257	0.1258	0.1258	0.1258	0.1259	0.1259
0.305	0.1282	0.1282	0.1281	0.1281	0.1281	0.1280	0.1280	0.1279	0.1277	0.1276	0.1275	0.1275	0.1274
0.310	0.1285	0.1285	0.1286	0.1287	0.1287	0.1287	0.1288	0.1288	0.1288	0.1289	0.1291	0.1291	0.1292
0.315	0.1297	0.1296	0.1295	0.1293	0.1292	0.1292	0.1291	0.1291	0.1290	0.1289	0.1289	0.1289	0.1289
0.320	0.1284	0.1285	0.1285	0.1286	0.1286	0.1286	0.1287	0.1288	0.1288	0.1288	0.1291	0.1293	0.1293
0.325	0.1268	0.1267	0.1267	0.1267	0.1266	0.1266	0.1265	0.1264	0.1264	0.1264	0.1264	0.1263	0.1263
0.330	0.1182	0.1183	0.1185	0.1187	0.1188	0.1189	0.1189	0.1190	0.1191	0.1191	0.1193	0.1195	0.1197
0.335	0.1036	0.1036	0.1035	0.1034	0.1033	0.1031	0.1029	0.1028	0.1026	0.1024	0.1022	0.1018	0.1015
0.340	0.0856	0.0856	0.0859	0.0860	0.0860	0.0862	0.0862	0.0862	0.0863	0.0863	0.0863	0.0865	0.0870
0.345	0.0780	0.0780	0.0780	0.0777	0.0777	0.0777	0.0777	0.0775	0.0775	0.0773	0.0772	0.0772	0.0772
0.350	0.0747	0.0747	0.0747	0.0748	0.0749	0.0750	0.0751	0.0751	0.0752	0.0752	0.0752	0.0752	0.0752
0.355	0.0752	0.0752	0.0751	0.0750	0.0750	0.0750	0.0749	0.0749	0.0748	0.0748	0.0748	0.0747	0.0747
0.360	0.0747	0.0747	0.0747	0.0747	0.0747	0.0748	0.0748	0.0749	0.0749	0.0749	0.0749	0.0752	0.0752
0.365	0.0753	0.0752	0.0752	0.0752	0.0751	0.0749	0.0749	0.0749	0.0749	0.0748	0.0748	0.0748	0.0748
0.370	0.0748	0.0748	0.0748	0.0748	0.0749	0.0750	0.0750	0.0751	0.0751	0.0751	0.0753	0.0753	0.0753
0.375	0.0754	0.0754	0.0753	0.0753	0.0752	0.0751	0.0751	0.0751	0.0751	0.0750	0.0749	0.0749	0.0748
0.380	0.0748	0.0748	0.0748	0.0749	0.0751	0.0751	0.0751	0.0751	0.0751	0.0753	0.0754	0.0754	0.0754
0.385	0.0755	0.0755	0.0754	0.0754	0.0753	0.0752	0.0752	0.0752	0.0751	0.0751	0.0749	0.0749	0.0749
0.390	0.0749	0.0750	0.0750	0.0750	0.0751	0.0752	0.0753	0.0753	0.0753	0.0753	0.0755	0.0755	0.0755
0.395	0.0757	0.0756	0.0756	0.0755	0.0755	0.0755	0.0753	0.0753	0.0753	0.0753	0.0752	0.0752	0.0752
0.400	0.0752	0.0752	0.0753	0.0753	0.0754	0.0754	0.0754	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757
0.405	0.0761	0.0761	0.0760	0.0760	0.0759	0.0758	0.0757	0.0756	0.0756	0.0756	0.0755	0.0755	0.0755
0.410	0.0761	0.0762	0.0763	0.0763	0.0763	0.0764	0.0764	0.0764	0.0765	0.0765	0.0765	0.0766	0.0766
0.415	0.0776	0.0776	0.0775	0.0775	0.0774	0.0774	0.0773	0.0773	0.0773	0.0773	0.0772	0.0772	0.0771
0.420	0.0784	0.0784	0.0784	0.0785	0.0785	0.0785	0.0786	0.0786	0.0786	0.0787	0.0787	0.0787	0.0787
0.425	0.0799	0.0799	0.0799	0.0799	0.0799	0.0799	0.0799	0.0798	0.0798	0.0797	0.0797	0.0797	0.0797
0.430	0.0821	0.0823	0.0824	0.0824	0.0840	0.0803	0.0803	0.0804	0.0804	0.0805	0.0805	0.0805	0.0806
0.435	0.0827	0.0826	0.0826	0.0825	0.0825	0.0825	0.0825	0.0825	0.0824	0.0824	0.0824	0.0824	0.0824
0.440	0.0837	0.0837	0.0837	0.0837	0.0838	0.0838	0.0838	0.0838	0.0838	0.0839	0.0839	0.0840	0.0840
0.445	0.0854	0.0854	0.0853	0.0853	0.0853	0.0852	0.0852	0.0852	0.0852	0.0851	0.0851	0.0851	0.0851
0.450	0.0874	0.0875	0.0878	0.0878	0.0880	0.0893	0.0854	0.0857	0.0857	0.0858	0.0859	0.0860	0.0860
0.455	0.0881	0.0881	0.0881	0.0881	0.0880	0.0880	0.0879	0.0879	0.0879	0.0879	0.0879	0.0878	0.0878
0.460	0.0891	0.0892	0.0892	0.0892	0.0892	0.0893	0.0893	0.0893	0.0894	0.0894	0.0895	0.0895	0.0895
0.465	0.0909	0.0909	0.0909	0.0908	0.0908	0.0908	0.0908	0.0907	0.0907	0.0907	0.0906	0.0906	0.0906
0.470	0.0934	0.0955	0.0912	0.0914	0.0914	0.0914	0.0914	0.0916	0.0916	0.0916	0.0916	0.0917	0.0917
0.475	0.0937	0.0937	0.0936	0.0936	0.0936	0.0936	0.0936	0.0936	0.0935	0.0935	0.0934	0.0934	0.0934
0.480	0.0946	0.0946	0.0947	0.0948	0.0948	0.0948	0.0948	0.0948	0.0948	0.0948	0.0949	0.0949	0.0949
0.485	0.0966	0.0965	0.0965	0.0965	0.0965	0.0965	0.0965	0.0964	0.0963	0.0963	0.0963	0.0963	0.0963
0.490	0.0977	0.0977	0.0977	0.0977	0.0978	0.0978	0.0978	0.0978	0.0978	0.0978	0.0979	0.0979	0.0979
0.495	0.0994	0.0994	0.0993	0.0993	0.0993	0.0993	0.0992	0.0992	0.0992	0.0992	0.0992	0.0991	0.0991
0.500	0.1005	0.1005	0.1006	0.1006	0.1006	0.1007	0.1007	0.1007	0.1007	0.1007	0.1007	0.1007	0.1008
0.505	0.1022	0.1022	0.1022	0.1022	0.1021	0.1021	0.1021	0.1020	0.1020	0.1020	0.1020	0.1020	0.1020
0.510	0.1032	0.1032	0.1033	0.1033	0.1033	0.1033	0.1033	0.1033	0.1034	0.1034	0.1034	0.1035	0.1035
0.515	0.1051	0.1051	0.1051	0.1051	0.1050	0.1050	0.1050	0.1050	0.1049	0.1049	0.1049	0.1049	0.1048
0.520	0.1065	0.1065	0.1065	0.1066	0.1066	0.1066	0.1067	0.1067	0.1068	0.1068	0.1068	0.1069	0.1069
0.525	0.1081	0.1080	0.1080	0.1080	0.1080	0.1080	0.1079	0.1079	0.1079	0.1079	0.1079	0.1079	0.1078
0.530	0.1092	0.1093	0.1093	0.1093	0.1093	0.1094	0.1094	0.1094	0.1095	0.1095	0.1095	0.1095	0.1096
0.535	0.1124	0.1124	0.1124	0.1123	0.1122	0.1121	0.1121	0.1121	0.1120	0.1119	0.1118	0.1117	0.1117
0.540													

X-Axis	Y-Axis												
0.000													
0.005	0.0151	0.0149	0.0147	0.0147	0.0141	0.0140	0.0140	0.0135	0.0224	0.0207	0.0198	0.0195	0.0195
0.010	0.0209	0.0207	0.0206	0.0204	0.0203	0.0201	0.0200	0.0200	0.0197	0.0196	0.0195	0.0194	0.0193
0.015	0.0233	0.0231	0.0231	0.0229	0.0225	0.0225	0.0223	0.0221	0.0221	0.0221	0.0220	0.0219	0.0218
0.020	0.0257	0.0256	0.0255	0.0252	0.0251	0.0251	0.0251	0.0250	0.0249	0.0249	0.0249	0.0246	0.0243
0.025	0.0312	0.0311	0.0310	0.0309	0.0309	0.0309	0.0304	0.0303	0.0303	0.0301	0.0301	0.0300	0.0298
0.030	0.0404	0.0404	0.0403	0.0403	0.0402	0.0402	0.0402	0.0402	0.0401	0.0401	0.0401	0.0399	0.0399
0.035	0.0497	0.0496	0.0494	0.0493	0.0492	0.0491	0.0490	0.0489	0.0488	0.0486	0.0486	0.0484	0.0483
0.040	0.0587	0.0586	0.0584	0.0582	0.0582	0.0582	0.0582	0.0582	0.0581	0.0580	0.0580	0.0576	0.0575
0.045	0.0679	0.0677	0.0677	0.0675	0.0674	0.0672	0.0671	0.0670	0.0670	0.0670	0.0669	0.0669	0.0668
0.050	0.0784	0.0785	0.0785	0.0786	0.0787	0.0787	0.0788	0.0790	0.0791	0.0794	0.0796	0.0798	0.0802
0.055	0.0855	0.0855	0.0854	0.0853	0.0853	0.0852	0.0852	0.0851	0.0850	0.0850	0.0849	0.0849	0.0848
0.060	0.0943	0.0942	0.0941	0.0941	0.0940	0.0940	0.0939	0.0939	0.0939	0.0939	0.0938	0.0937	0.0936
0.065	0.1031	0.1031	0.1031	0.1030	0.1030	0.1027	0.1027	0.1026	0.1026	0.1025	0.1025	0.1025	0.1024
0.070	0.1119	0.1119	0.1118	0.1118	0.1117	0.1117	0.1116	0.1116	0.1116	0.1116	0.1115	0.1115	0.1114
0.075	0.1207	0.1206	0.1206	0.1206	0.1206	0.1206	0.1203	0.1203	0.1202	0.1201	0.1200	0.1200	0.1199
0.080	0.1281	0.1280	0.1280	0.1279	0.1279	0.1279	0.1278	0.1278	0.1276	0.1276	0.1275	0.1273	0.1272
0.085	0.1335	0.1335	0.1333	0.1332	0.1330	0.1330	0.1329	0.1329	0.1328	0.1328	0.1326	0.1324	0.1323
0.090	0.1366	0.1364	0.1363	0.1360	0.1360	0.1359	0.1358	0.1356	0.1355	0.1354	0.1352	0.1352	0.1350
0.095	0.1377	0.1377	0.1376	0.1375	0.1374	0.1371	0.1371	0.1369	0.1369	0.1368	0.1367	0.1365	0.1362
0.100	0.1385	0.1384	0.1383	0.1383	0.1382	0.1382	0.1380	0.1378	0.1378	0.1377	0.1376	0.1373	0.1373
0.105	0.1390	0.1389	0.1388	0.1387	0.1385	0.1384	0.1384	0.1382	0.1379	0.1379	0.1378	0.1377	0.1374
0.110	0.1388	0.1388	0.1386	0.1386	0.1384	0.1384	0.1384	0.1383	0.1381	0.1380	0.1379	0.1379	0.1378
0.115	0.1391	0.1391	0.1387	0.1386	0.1385	0.1385	0.1384	0.1384	0.1382	0.1380	0.1380	0.1379	0.1376
0.120	0.1384	0.1383	0.1383	0.1382	0.1381	0.1380	0.1378	0.1378	0.1377	0.1376	0.1376	0.1375	0.1372
0.125	0.1374	0.1372	0.1372	0.1372	0.1371	0.1371	0.1371	0.1367	0.1366	0.1364	0.1364	0.1364	0.1359
0.130	0.1374	0.1376	0.1376	0.1377	0.1377	0.1378	0.1381	0.1381	0.1383	0.1383	0.1384	0.1384	0.1385
0.135	0.1334	0.1334	0.1332	0.1331	0.1327	0.1327	0.1326	0.1326	0.1323	0.1323	0.1322	0.1320	0.1316
0.140	0.1295	0.1296	0.1296	0.1297	0.1299	0.1300	0.1303	0.1303	0.1304	0.1305	0.1307	0.1310	0.1310
0.145	0.1198	0.1195	0.1192	0.1187	0.1186	0.1182	0.1180	0.1180	0.1178	0.1170	0.1170	0.1169	0.1159
0.150	0.1058	0.1061	0.1063	0.1066	0.1066	0.1070	0.1075	0.1076	0.1079	0.1080	0.1080	0.1081	0.1082
0.155	0.0855	0.0854	0.0849	0.0844	0.0842	0.0834	0.0832	0.0828	0.0828	0.0827	0.0822	0.0821	0.0818
0.160	0.0702	0.0706	0.0708	0.0709	0.0709	0.0710	0.0710	0.0714	0.0715	0.0716	0.0717	0.0726	0.0726
0.165	0.0571	0.0569	0.0568	0.0566	0.0564	0.0562	0.0560	0.0559	0.0559	0.0554	0.0553	0.0552	0.0549
0.170	0.0551	0.0553	0.0555	0.0555	0.0555	0.0555	0.0556	0.0557	0.0557	0.0558	0.0559	0.0561	0.0561
0.175	0.0531	0.0531	0.0530	0.0530	0.0529	0.0527	0.0526	0.0525	0.0524	0.0523	0.0521	0.0521	0.0519
0.180	0.0541	0.0541	0.0542	0.0545	0.0546	0.0546	0.0548	0.0548	0.0548	0.0550	0.0551	0.0551	0.0551
0.185	0.0530	0.0530	0.0528	0.0527	0.0526	0.0526	0.0526	0.0526	0.0525	0.0524	0.0522	0.0521	0.0520
0.190	0.0542	0.0544	0.0544	0.0545	0.0547	0.0548	0.0549	0.0549	0.0551	0.0551	0.0552	0.0552	0.0552
0.195	0.0530	0.0529	0.0529	0.0528	0.0528	0.0528	0.0527	0.0527	0.0526	0.0526	0.0524	0.0523	0.0522
0.200	0.0545	0.0545	0.0547	0.0547	0.0550	0.0551	0.0551	0.0553	0.0553	0.0554	0.0555	0.0555	0.0555
0.205	0.0540	0.0540	0.0539	0.0539	0.0537	0.0536	0.0536	0.0535	0.0535	0.0533	0.0533	0.0532	0.0531
0.210	0.0560	0.0560	0.0561	0.0562	0.0562	0.0562	0.0564	0.0565	0.0565	0.0567	0.0567	0.0568	0.0569
0.215	0.0566	0.0567	0.0568	0.0569	0.0569	0.0575	0.0576	0.0577	0.0578	0.0578	0.0579	0.0580	0.0582
0.220	0.0570	0.0570	0.0568	0.0568	0.0568	0.0566	0.0566	0.0565	0.0565	0.0565	0.0563	0.0561	0.0560
0.225	0.0589	0.0589	0.0589	0.0590	0.0591	0.0593	0.0595	0.0597	0.0597	0.0599	0.0600	0.0600	0.0601
0.230	0.0591	0.0590	0.0589	0.0588	0.0588	0.0587	0.0587	0.0587	0.0585	0.0585	0.0584	0.0584	0.0584
0.235	0.0609	0.0611	0.0611	0.0611	0.0611	0.0615	0.0617	0.0617	0.0618	0.0620	0.0620	0.0621	0.0622
0.240	0.0613	0.0613	0.0612	0.0611	0.0609	0.0608	0.0608	0.0608	0.0607	0.0607	0.0605	0.0604	0.0604
0.245	0.0632	0.0631	0.0631	0.0631	0.0630	0.0629	0.0628	0.0628	0.0627	0.0626	0.0626	0.0625	0.0624
0.250	0.0699	0.0699	0.0700	0.0701	0.0701	0.0702	0.0702	0.0703	0.0704	0.0704	0.0705	0.0709	0.0710
0.255	0.0766	0.0766	0.0765	0.0764	0.0764	0.0764	0.0763	0.0762	0.0762	0.0762	0.0761	0.0756	0.0756
0.260	0.0864	0.0866	0.0867	0.0869	0.0871	0.0871	0.0873	0.0875	0.0876	0.0876	0.0877	0.0879	0.0879
0.265	0.0941	0.0941	0.0941	0.0941	0.0941	0.0940	0.0938	0.0938	0.0938	0.0937	0.0936	0.0935	0.0935
0.270	0.1036	0.1039	0.1040	0.1040	0.1041	0.1041	0.1043	0.1044	0.1044	0.1044	0.1045	0.1047	0.1049
0.275	0.1091	0.1090	0.1090	0.1089	0.1089	0.1089	0.1089	0.1088	0.1088	0.1088	0.1087	0.1087	0.1082

0.280	0.1125	0.1125	0.1125	0.1126	0.1126	0.1127	0.1127	0.1128	0.1129	0.1129	0.1130	0.1131	0.1131
0.285	0.1162	0.1160	0.1160	0.1160	0.1159	0.1159	0.1158	0.1158	0.1158	0.1158	0.1157	0.1157	0.1156
0.290	0.1201	0.1202	0.1203	0.1204	0.1205	0.1206	0.1207	0.1207	0.1207	0.1208	0.1208	0.1209	0.1211
0.295	0.1225	0.1224	0.1224	0.1223	0.1223	0.1222	0.1222	0.1221	0.1221	0.1220	0.1219	0.1219	0.1218
0.300	0.1259	0.1260	0.1262	0.1262	0.1264	0.1264	0.1266	0.1266	0.1266	0.1267	0.1267	0.1268	0.1271
0.305	0.1274	0.1273	0.1273	0.1272	0.1272	0.1271	0.1271	0.1271	0.1270	0.1269	0.1269	0.1269	0.1268
0.310	0.1293	0.1293	0.1294	0.1295	0.1295	0.1296	0.1296	0.1296	0.1296	0.1297	0.1297	0.1299	0.1300
0.315	0.1288	0.1288	0.1287	0.1287	0.1286	0.1286	0.1286	0.1285	0.1285	0.1284	0.1283	0.1282	0.1282
0.320	0.1293	0.1293	0.1293	0.1294	0.1295	0.1295	0.1296	0.1296	0.1296	0.1297	0.1297	0.1299	0.1299
0.325	0.1263	0.1262	0.1261	0.1258	0.1258	0.1257	0.1255	0.1255	0.1254	0.1253	0.1251	0.1249	0.1247
0.330	0.1197	0.1198	0.1200	0.1200	0.1201	0.1201	0.1203	0.1204	0.1205	0.1206	0.1206	0.1206	0.1212
0.335	0.1014	0.1012	0.1011	0.1010	0.1007	0.1005	0.1005	0.0992	0.0990	0.0988	0.0985	0.0983	0.0981
0.340	0.0873	0.0874	0.0874	0.0875	0.0879	0.0879	0.0880	0.0883	0.0883	0.0889	0.0891	0.0892	0.0895
0.345	0.0770	0.0769	0.0769	0.0769	0.0768	0.0768	0.0768	0.0767	0.0767	0.0767	0.0765	0.0764	0.0762
0.350	0.0753	0.0753	0.0754	0.0754	0.0755	0.0755	0.0756	0.0756	0.0756	0.0758	0.0759	0.0759	0.0759
0.355	0.0747	0.0746	0.0746	0.0746	0.0745	0.0744	0.0744	0.0744	0.0744	0.0743	0.0743	0.0743	0.0741
0.360	0.0752	0.0752	0.0753	0.0754	0.0755	0.0756	0.0756	0.0756	0.0756	0.0757	0.0757	0.0757	0.0758
0.365	0.0747	0.0747	0.0747	0.0747	0.0746	0.0746	0.0745	0.0745	0.0744	0.0743	0.0741	0.0741	0.0741
0.370	0.0753	0.0753	0.0754	0.0755	0.0755	0.0756	0.0756	0.0757	0.0757	0.0758	0.0759	0.0759	0.0760
0.375	0.0748	0.0747	0.0747	0.0746	0.0746	0.0746	0.0746	0.0746	0.0745	0.0745	0.0744	0.0744	0.0743
0.380	0.0754	0.0755	0.0755	0.0757	0.0757	0.0757	0.0757	0.0758	0.0758	0.0758	0.0759	0.0759	0.0760
0.385	0.0749	0.0749	0.0748	0.0748	0.0747	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0744	0.0744
0.390	0.0755	0.0756	0.0757	0.0758	0.0758	0.0758	0.0758	0.0760	0.0760	0.0760	0.0760	0.0762	0.0763
0.395	0.0751	0.0750	0.0749	0.0749	0.0748	0.0748	0.0748	0.0747	0.0747	0.0747	0.0746	0.0745	0.0745
0.400	0.0758	0.0758	0.0758	0.0759	0.0759	0.0760	0.0760	0.0761	0.0761	0.0762	0.0763	0.0765	0.0765
0.405	0.0755	0.0755	0.0755	0.0754	0.0754	0.0754	0.0754	0.0753	0.0752	0.0751	0.0751	0.0751	0.0750
0.410	0.0766	0.0767	0.0767	0.0767	0.0768	0.0768	0.0768	0.0768	0.0769	0.0769	0.0769	0.0770	0.0772
0.415	0.0771	0.0771	0.0771	0.0770	0.0770	0.0770	0.0770	0.0769	0.0769	0.0768	0.0768	0.0767	0.0766
0.420	0.0788	0.0788	0.0788	0.0788	0.0789	0.0789	0.0790	0.0790	0.0791	0.0791	0.0792	0.0794	0.0795
0.425	0.0796	0.0796	0.0796	0.0795	0.0795	0.0795	0.0794	0.0793	0.0793	0.0793	0.0792	0.0792	0.0792
0.430	0.0806	0.0807	0.0807	0.0807	0.0808	0.0808	0.0808	0.0809	0.0810	0.0810	0.0810	0.0810	0.0811
0.435	0.0823	0.0823	0.0823	0.0822	0.0822	0.0821	0.0821	0.0821	0.0820	0.0819	0.0819	0.0819	0.0818
0.440	0.0840	0.0840	0.0841	0.0842	0.0842	0.0842	0.0842	0.0843	0.0843	0.0843	0.0844	0.0844	0.0845
0.445	0.0850	0.0850	0.0850	0.0850	0.0848	0.0848	0.0848	0.0848	0.0847	0.0847	0.0847	0.0847	0.0846
0.450	0.0860	0.0860	0.0860	0.0861	0.0861	0.0862	0.0863	0.0863	0.0863	0.0864	0.0864	0.0864	0.0865
0.455	0.0878	0.0877	0.0877	0.0877	0.0877	0.0876	0.0875	0.0875	0.0875	0.0874	0.0874	0.0873	0.0873
0.460	0.0895	0.0896	0.0896	0.0896	0.0896	0.0896	0.0897	0.0897	0.0897	0.0899	0.0899	0.0901	0.0901
0.465	0.0905	0.0905	0.0905	0.0905	0.0904	0.0904	0.0904	0.0903	0.0903	0.0902	0.0902	0.0902	0.0901
0.470	0.0918	0.0918	0.0918	0.0918	0.0919	0.0919	0.0919	0.0920	0.0920	0.0920	0.0921	0.0921	0.0922
0.475	0.0934	0.0934	0.0933	0.0933	0.0933	0.0932	0.0932	0.0932	0.0931	0.0930	0.0930	0.0930	0.0930
0.480	0.0950	0.0950	0.0951	0.0951	0.0951	0.0951	0.0951	0.0951	0.0951	0.0952	0.0952	0.0953	0.0954
0.485	0.0963	0.0962	0.0962	0.0962	0.0961	0.0961	0.0960	0.0960	0.0960	0.0960	0.0959	0.0959	0.0959
0.490	0.0980	0.0980	0.0980	0.0980	0.0980	0.0981	0.0982	0.0983	0.0983	0.0984	0.0984	0.0984	0.0984
0.495	0.0991	0.0991	0.0991	0.0990	0.0990	0.0990	0.0988	0.0988	0.0988	0.0988	0.0987	0.0987	0.0985
0.500	0.1008	0.1008	0.1008	0.1008	0.1009	0.1009	0.1009	0.1010	0.1011	0.1011	0.1011	0.1012	0.1013
0.505	0.1019	0.1019	0.1019	0.1019	0.1019	0.1019	0.1019	0.1018	0.1018	0.1017	0.1017	0.1016	0.1016
0.510	0.1035	0.1035	0.1035	0.1035	0.1036	0.1036	0.1036	0.1036	0.1036	0.1036	0.1037	0.1037	0.1038
0.515	0.1048	0.1048	0.1047	0.1047	0.1047	0.1047	0.1047	0.1047	0.1046	0.1046	0.1046	0.1046	0.1045
0.520	0.1069	0.1069	0.1069	0.1069	0.1071	0.1072	0.1084	0.1107	0.1052	0.1058	0.1058	0.1059	0.1059
0.525	0.1078	0.1077	0.1077	0.1077	0.1077	0.1076	0.1075	0.1075	0.1075	0.1075	0.1074	0.1074	0.1074
0.530	0.1096	0.1096	0.1096	0.1096	0.1097	0.1098	0.1098	0.1098	0.1098	0.1098	0.1099	0.1103	0.1103
0.535	0.1114	0.1113	0.1112	0.1111	0.1110	0.1110	0.1108	0.1108	0.1107	0.1107	0.1107	0.1107	0.1106
0.540													

X-Axis	Y-Axis				
0.000					
0.005	0.0194	0.0194	0.0193	0.0192	0.0190
0.010	0.0188	0.0186	0.0185	0.0182	0.0175
0.015	0.0217	0.0210	0.0205	0.0205	0.0205
0.020	0.0242	0.0241	0.0239	0.0236	0.0235
0.025	0.0298	0.0297	0.0295	0.0295	0.0290
0.030	0.0395	0.0391	0.0390	0.0389	0.0386
0.035	0.0482	0.0481	0.0481	0.0480	0.0478
0.040	0.0575	0.0574	0.0572	0.0571	0.0563
0.045	0.0667	0.0666	0.0665	0.0665	0.0664
0.050	0.0802	0.0803	0.0807	0.0808	0.0820
0.055	0.0845	0.0843	0.0842	0.0829	0.0826
0.060	0.0935	0.0934	0.0931	0.0931	0.0929
0.065	0.1024	0.1023	0.1022	0.1022	0.1021
0.070	0.1114	0.1114	0.1110	0.1107	0.1104
0.075	0.1198	0.1197	0.1197	0.1196	0.1193
0.080	0.1271	0.1271	0.1270	0.1267	0.1262
0.085	0.1322	0.1322	0.1322	0.1320	0.1319
0.090	0.1349	0.1349	0.1344	0.1342	0.1338
0.095	0.1362	0.1360	0.1354	0.1353	0.1352
0.100	0.1371	0.1369	0.1369	0.1365	0.1357
0.105	0.1374	0.1372	0.1365	0.1362	0.1361
0.110	0.1377	0.1373	0.1372	0.1365	0.1364
0.115	0.1375	0.1374	0.1363	0.1363	0.1359
0.120	0.1370	0.1367	0.1365	0.1357	0.1356
0.125	0.1359	0.1358	0.1345	0.1342	0.1341
0.130	0.1387	0.1387	0.1390	0.1397	0.1401
0.135	0.1306	0.1301	0.1301	0.1295	0.1287
0.140	0.1314	0.1315	0.1319	0.1320	0.1321
0.145	0.1142	0.1141	0.1139	0.1136	0.1111
0.150	0.1083	0.1087	0.1090	0.1092	0.1098
0.155	0.0812	0.0801	0.0789	0.0787	0.0763
0.160	0.0728	0.0730	0.0731	0.0734	0.0736
0.165	0.0544	0.0543	0.0537	0.0536	0.0534
0.170	0.0562	0.0563	0.0568	0.0570	0.0573
0.175	0.0517	0.0516	0.0511	0.0507	0.0505
0.180	0.0551	0.0555	0.0555	0.0557	0.0561
0.185	0.0519	0.0518	0.0512	0.0511	0.0505
0.190	0.0552	0.0552	0.0558	0.0559	0.0563
0.195	0.0522	0.0520	0.0515	0.0513	0.0510
0.200	0.0555	0.0556	0.0556	0.0561	0.0571
0.205	0.0529	0.0528	0.0523	0.0522	0.0516
0.210	0.0569	0.0571	0.0571	0.0581	0.0582
0.215	0.0583	0.0585	0.0587	0.0589	0.0592
0.220	0.0560	0.0559	0.0558	0.0556	0.0552
0.225	0.0603	0.0605	0.0608	0.0611	0.0614
0.230	0.0583	0.0582	0.0580	0.0576	0.0574
0.235	0.0625	0.0627	0.0630	0.0630	0.0634
0.240	0.0603	0.0602	0.0602	0.0601	0.0598
0.245	0.0624	0.0622	0.0622	0.0620	0.0613
0.250	0.0712	0.0719	0.0668	0.0669	0.0672
0.255	0.0755	0.0755	0.0754	0.0749	0.0748
0.260	0.0880	0.0883	0.0885	0.0886	0.0896
0.265	0.0934	0.0932	0.0931	0.0930	0.0912
0.270	0.1050	0.1052	0.1053	0.1054	0.1055
0.275	0.1080	0.1079	0.1077	0.1071	0.1071

0.280	0.1132	0.1132	0.1133	0.1133	0.1134
0.285	0.1155	0.1154	0.1153	0.1152	0.1152
0.290	0.1212	0.1212	0.1216	0.1216	0.1222
0.295	0.1217	0.1217	0.1217	0.1215	0.1212
0.300	0.1272	0.1273	0.1274	0.1276	0.1280
0.305	0.1268	0.1267	0.1267	0.1266	0.1262
0.310	0.1301	0.1301	0.1305	0.1309	0.1312
0.315	0.1281	0.1278	0.1273	0.1272	0.1272
0.320	0.1300	0.1303	0.1305	0.1306	0.1311
0.325	0.1241	0.1241	0.1238	0.1232	0.1226
0.330	0.1215	0.1218	0.1219	0.1219	0.1226
0.335	0.0980	0.0971	0.0964	0.0953	0.0950
0.340	0.0895	0.0896	0.0897	0.0903	0.0912
0.345	0.0757	0.0755	0.0754	0.0754	0.0752
0.350	0.0760	0.0761	0.0761	0.0762	0.0763
0.355	0.0739	0.0735	0.0735	0.0735	0.0734
0.360	0.0760	0.0762	0.0763	0.0763	0.0764
0.365	0.0741	0.0738	0.0738	0.0737	0.0734
0.370	0.0761	0.0761	0.0765	0.0765	0.0768
0.375	0.0742	0.0740	0.0740	0.0738	0.0735
0.380	0.0762	0.0764	0.0764	0.0765	0.0774
0.385	0.0744	0.0742	0.0741	0.0741	0.0737
0.390	0.0763	0.0764	0.0766	0.0766	0.0776
0.395	0.0745	0.0745	0.0743	0.0740	0.0740
0.400	0.0766	0.0766	0.0766	0.0766	0.0778
0.405	0.0749	0.0749	0.0748	0.0747	0.0746
0.410	0.0774	0.0776	0.0777	0.0778	0.0791
0.415	0.0766	0.0766	0.0766	0.0765	0.0764
0.420	0.0795	0.0797	0.0797	0.0799	0.0811
0.425	0.0791	0.0791	0.0791	0.0791	0.0789
0.430	0.0811	0.0811	0.0811	0.0811	0.0812
0.435	0.0818	0.0817	0.0816	0.0816	0.0815
0.440	0.0848	0.0851	0.0851	0.0852	0.0866
0.445	0.0846	0.0846	0.0844	0.0844	0.0838
0.450	0.0865	0.0865	0.0866	0.0866	0.0866
0.455	0.0873	0.0872	0.0871	0.0870	0.0869
0.460	0.0903	0.0903	0.0904	0.0907	0.0924
0.465	0.0900	0.0900	0.0900	0.0899	0.0899
0.470	0.0922	0.0922	0.0922	0.0922	0.0923
0.475	0.0929	0.0928	0.0928	0.0928	0.0925
0.480	0.0954	0.0955	0.0955	0.0955	0.0957
0.485	0.0958	0.0957	0.0956	0.0956	0.0953
0.490	0.0987	0.0987	0.0987	0.0997	0.1014
0.495	0.0985	0.0985	0.0983	0.0982	0.0977
0.500	0.1013	0.1014	0.1015	0.1026	0.1044
0.505	0.1016	0.1014	0.1013	0.1013	0.1012
0.510	0.1038	0.1038	0.1039	0.1039	0.1039
0.515	0.1044	0.1044	0.1043	0.1042	0.1039
0.520	0.1059	0.1060	0.1060	0.1060	0.1060
0.525	0.1074	0.1074	0.1074	0.1073	0.1069
0.530	0.1103	0.1104	0.1114	0.1117	0.1135
0.535	0.1104	0.1103	0.1103	0.1102	
0.540					

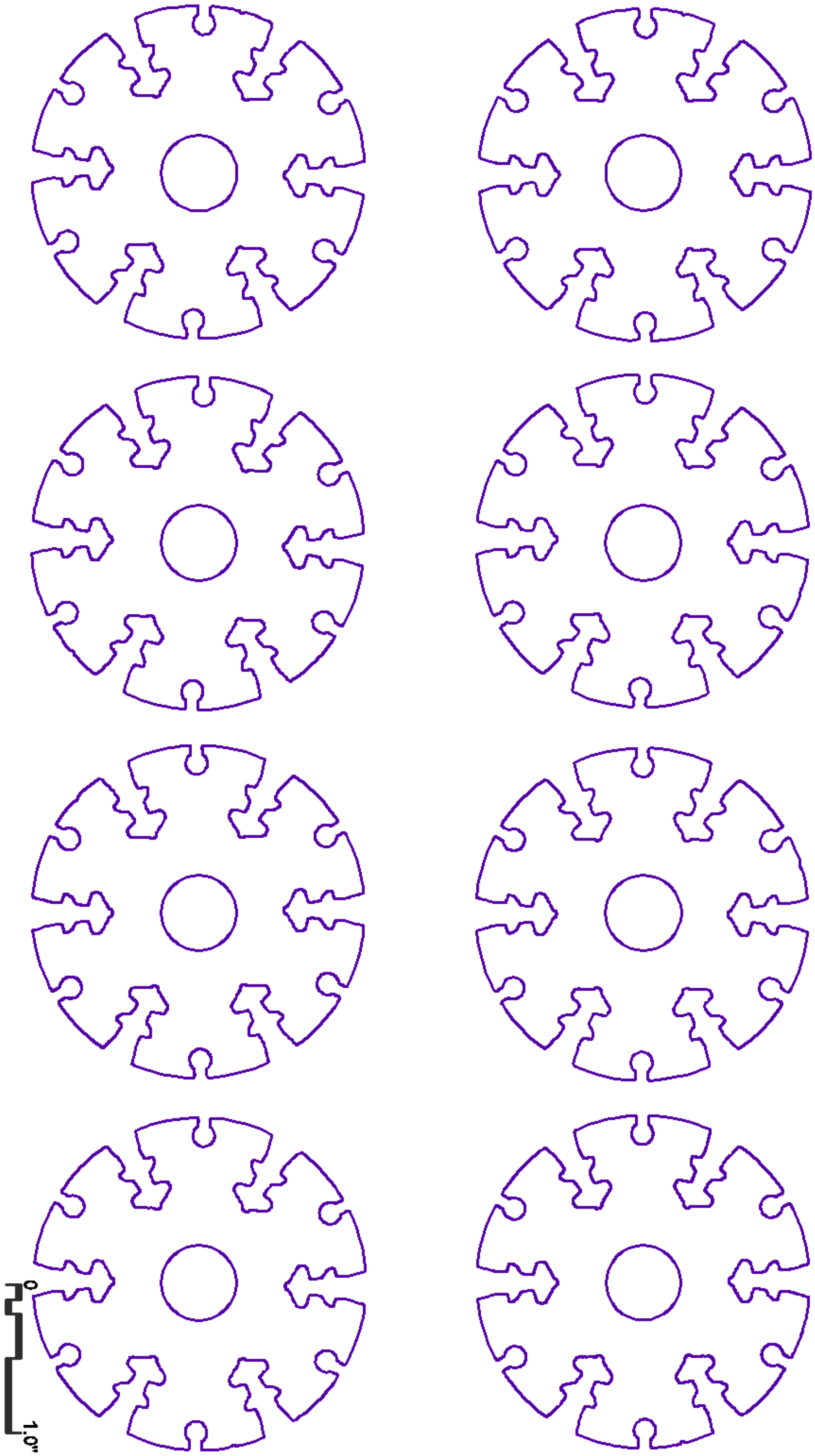


Figure B.5 As-Built 6Sd-00 Connector-B CAD Generation - Step 4

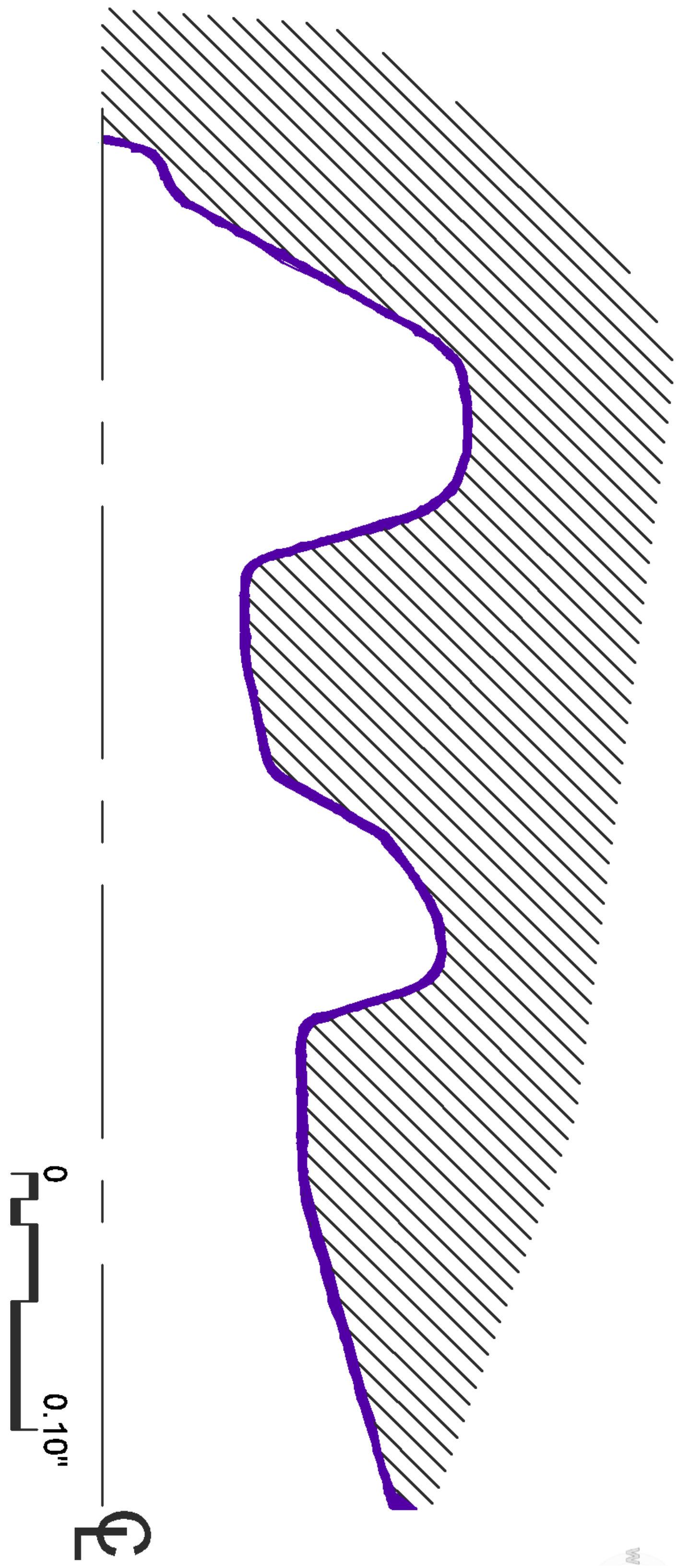


Figure B.6 As-Built 6Sd-00 Superimposed Connector-B Slot Profiles Generation - Step 5

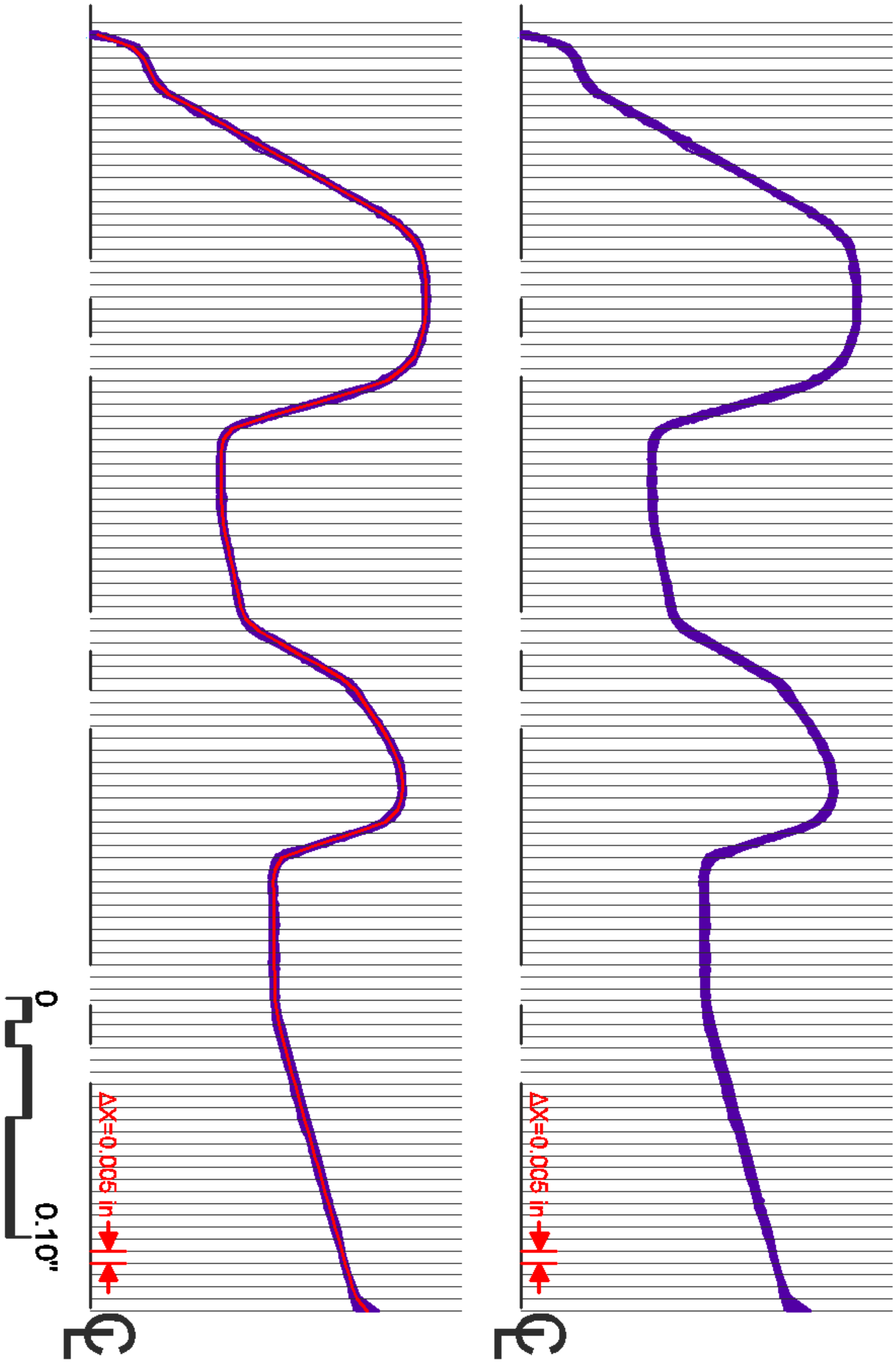


Figure B.7 As-Built 6Sd-00 Superimposed Connector-B Divided Slot Profiles & Mean Profile - Step 6

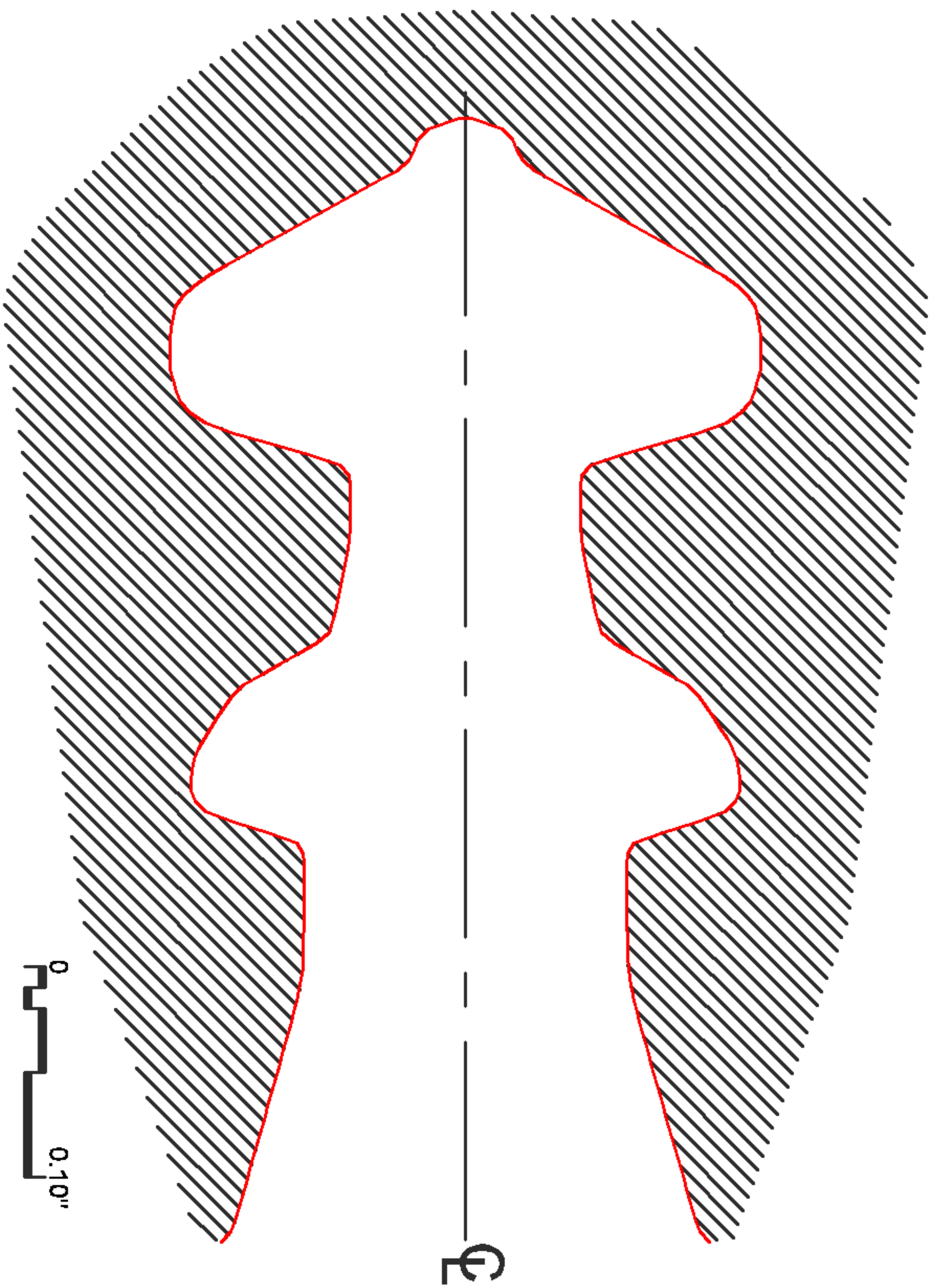


Figure B.8 As-Built 6Sd-00 Connector-B Slot Representative Profile - Step 7

Table B.2 As-Built 6Sd-00 Connector-B XY Coordinates

X-Axis	Y-Axis												
0.000	0.0075	0.0061	0.0060	0.0056	0.0055	0.0050	0.0049	0.0047	0.0045	0.0042	0.0039	0.0038	0.0037
0.005	0.0152	0.0153	0.0159	0.0160	0.0160	0.0163	0.0163	0.0164	0.0166	0.0166	0.0167	0.0167	0.0167
0.010	0.0207	0.0211	0.0212	0.0212	0.0214	0.0215	0.0215	0.0216	0.0216	0.0216	0.0217	0.0217	0.0218
0.015	0.0225	0.0234	0.0234	0.0237	0.0238	0.0238	0.0239	0.0241	0.0241	0.0242	0.0242	0.0242	0.0242
0.020	0.0255	0.0257	0.0259	0.0260	0.0260	0.0262	0.0262	0.0263	0.0264	0.0265	0.0265	0.0266	0.0266
0.025	0.0348	0.0343	0.0343	0.0342	0.0342	0.0341	0.0341	0.0338	0.0338	0.0337	0.0335	0.0335	0.0335
0.030	0.0425	0.0425	0.0427	0.0427	0.0428	0.0429	0.0430	0.0431	0.0431	0.0435	0.0437	0.0437	0.0437
0.035	0.0534	0.0533	0.0532	0.0530	0.0526	0.0525	0.0524	0.0524	0.0524	0.0524	0.0523	0.0521	0.0519
0.040	0.0618	0.0618	0.0582	0.0583	0.0583	0.0583	0.0584	0.0586	0.0587	0.0589	0.0590	0.0590	0.0590
0.045	0.0709	0.0709	0.0708	0.0708	0.0708	0.0708	0.0705	0.0705	0.0702	0.0700	0.0697	0.0696	0.0695
0.050	0.0778	0.0778	0.0778	0.0779	0.0780	0.0780	0.0781	0.0781	0.0782	0.0784	0.0784	0.0785	0.0786
0.055	0.0895	0.0887	0.0885	0.0883	0.0883	0.0882	0.0881	0.0878	0.0878	0.0877	0.0877	0.0877	0.0876
0.060	0.0936	0.0937	0.0940	0.0941	0.0944	0.0944	0.0944	0.0945	0.0946	0.0946	0.0947	0.0948	0.0948
0.065	0.1065	0.1063	0.1061	0.1061	0.1060	0.1059	0.1058	0.1058	0.1056	0.1055	0.1054	0.1054	0.1053
0.070	0.1115	0.1116	0.1120	0.1120	0.1121	0.1124	0.1124	0.1125	0.1126	0.1126	0.1127	0.1127	0.1127
0.075	0.1238	0.1238	0.1237	0.1237	0.1237	0.1235	0.1235	0.1234	0.1231	0.1231	0.1231	0.1230	0.1229
0.080	0.1295	0.1295	0.1296	0.1297	0.1299	0.1300	0.1300	0.1300	0.1300	0.1301	0.1301	0.1302	0.1302
0.085	0.1362	0.1362	0.1360	0.1359	0.1358	0.1357	0.1356	0.1356	0.1356	0.1354	0.1353	0.1353	0.1353
0.090	0.1363	0.1369	0.1370	0.1372	0.1373	0.1373	0.1373	0.1374	0.1374	0.1375	0.1375	0.1375	0.1375
0.095	0.1402	0.1401	0.1401	0.1400	0.1400	0.1398	0.1397	0.1396	0.1396	0.1396	0.1395	0.1395	0.1394
0.100	0.1379	0.1389	0.1389	0.1390	0.1391	0.1392	0.1395	0.1396	0.1396	0.1397	0.1397	0.1397	0.1398
0.105	0.1416	0.1415	0.1415	0.1413	0.1413	0.1412	0.1411	0.1410	0.1410	0.1408	0.1408	0.1408	0.1407
0.110	0.1389	0.1394	0.1396	0.1397	0.1397	0.1398	0.1399	0.1399	0.1401	0.1401	0.1401	0.1401	0.1401
0.115	0.1416	0.1415	0.1415	0.1414	0.1413	0.1413	0.1413	0.1412	0.1411	0.1411	0.1411	0.1410	0.1410
0.120	0.1385	0.1392	0.1393	0.1393	0.1394	0.1394	0.1394	0.1394	0.1395	0.1398	0.1400	0.1400	0.1401
0.125	0.1404	0.1403	0.1402	0.1402	0.1400	0.1399	0.1399	0.1399	0.1398	0.1398	0.1397	0.1396	0.1396
0.130	0.1382	0.1383	0.1383	0.1384	0.1384	0.1385	0.1385	0.1386	0.1387	0.1388	0.1389	0.1392	0.1359
0.135	0.1370	0.1369	0.1369	0.1369	0.1367	0.1367	0.1367	0.1366	0.1365	0.1365	0.1365	0.1364	0.1363
0.140	0.1286	0.1291	0.1293	0.1294	0.1295	0.1295	0.1296	0.1298	0.1299	0.1300	0.1301	0.1301	0.1301
0.145	0.1264	0.1259	0.1259	0.1259	0.1256	0.1255	0.1254	0.1252	0.1249	0.1249	0.1249	0.1248	0.1247
0.150	0.1041	0.1055	0.1062	0.1064	0.1075	0.1080	0.1080	0.1081	0.1082	0.1082	0.1085	0.1085	0.1087
0.155	0.0971	0.0967	0.0964	0.0959	0.0956	0.0955	0.0955	0.0951	0.0948	0.0947	0.0945	0.0944	0.0944
0.160	0.0702	0.0714	0.0714	0.0717	0.0719	0.0719	0.0722	0.0725	0.0726	0.0726	0.0727	0.0727	0.0727
0.165	0.0619	0.0613	0.0612	0.0612	0.0610	0.0609	0.0608	0.0608	0.0607	0.0607	0.0607	0.0605	0.0604
0.170	0.0532	0.0538	0.0545	0.0547	0.0548	0.0548	0.0549	0.0549	0.0549	0.0549	0.0549	0.0549	0.0550
0.175	0.0561	0.0559	0.0557	0.0557	0.0557	0.0554	0.0554	0.0553	0.0553	0.0552	0.0551	0.0551	0.0551
0.180	0.0527	0.0533	0.0538	0.0538	0.0538	0.0539	0.0541	0.0541	0.0542	0.0543	0.0543	0.0543	0.0543
0.185	0.0560	0.0558	0.0558	0.0556	0.0556	0.0555	0.0555	0.0554	0.0554	0.0553	0.0553	0.0553	0.0553
0.190	0.0525	0.0534	0.0537	0.0538	0.0538	0.0538	0.0540	0.0540	0.0541	0.0542	0.0543	0.0543	0.0546
0.195	0.0565	0.0565	0.0563	0.0561	0.0559	0.0559	0.0559	0.0558	0.0557	0.0556	0.0556	0.0556	0.0555
0.200	0.0526	0.0537	0.0538	0.0541	0.0541	0.0543	0.0544	0.0545	0.0545	0.0545	0.0545	0.0545	0.0547
0.205	0.0568	0.0567	0.0567	0.0567	0.0566	0.0564	0.0564	0.0564	0.0563	0.0563	0.0563	0.0562	0.0561
0.210	0.0559	0.0561	0.0562	0.0563	0.0563	0.0563	0.0563	0.0563	0.0564	0.0564	0.0564	0.0565	0.0565
0.215	0.0591	0.0587	0.0587	0.0586	0.0585	0.0585	0.0584	0.0584	0.0584	0.0584	0.0583	0.0581	0.0581
0.220	0.0566	0.0576	0.0576	0.0578	0.0579	0.0580	0.0580	0.0580	0.0581	0.0581	0.0581	0.0582	0.0584
0.225	0.0608	0.0606	0.0606	0.0605	0.0605	0.0604	0.0604	0.0603	0.0603	0.0603	0.0602	0.0602	0.0602
0.230	0.0586	0.0598	0.0598	0.0600	0.0600	0.0601	0.0601	0.0603	0.0603	0.0603	0.0604	0.0605	0.0606
0.235	0.0630	0.0630	0.0629	0.0628	0.0628	0.0627	0.0627	0.0627	0.0626	0.0625	0.0625	0.0625	0.0624
0.240	0.0613	0.0617	0.0618	0.0619	0.0619	0.0622	0.0623	0.0623	0.0623	0.0624	0.0625	0.0626	0.0628
0.245	0.0684	0.0661	0.0660	0.0659	0.0658	0.0658	0.0658	0.0657	0.0657	0.0656	0.0656	0.0655	0.0654
0.250	0.0668	0.0681	0.0682	0.0683	0.0684	0.0685	0.0695	0.0697	0.0697	0.0698	0.0699	0.0700	0.0700
0.255	0.0825	0.0816	0.0815	0.0814	0.0814	0.0812	0.0811	0.0810	0.0810	0.0808	0.0808	0.0807	0.0803
0.260	0.0847	0.0849	0.0853	0.0855	0.0861	0.0863	0.0864	0.0866	0.0867	0.0867	0.0868	0.0868	0.0872
0.265	0.0997	0.0987	0.0985	0.0984	0.0983	0.0982	0.0981	0.0981	0.0980	0.0980	0.0979	0.0978	0.0974

0.270	0.1025	0.1027	0.1030	0.1031	0.1036	0.1041	0.1042	0.1045	0.1045	0.1045	0.1047	0.1048	0.1048
0.275	0.1132	0.1124	0.1123	0.1122	0.1122	0.1121	0.1120	0.1120	0.1119	0.1118	0.1117	0.1117	0.1115
0.280	0.1127	0.1130	0.1131	0.1133	0.1133	0.1134	0.1136	0.1137	0.1139	0.1142	0.1142	0.1143	0.1143
0.285	0.1196	0.1192	0.1191	0.1191	0.1188	0.1187	0.1186	0.1186	0.1186	0.1185	0.1185	0.1184	0.1184
0.290	0.1217	0.1218	0.1219	0.1220	0.1220	0.1221	0.1221	0.1222	0.1222	0.1222	0.1224	0.1227	0.1229
0.295	0.1257	0.1256	0.1255	0.1254	0.1254	0.1253	0.1252	0.1252	0.1252	0.1251	0.1251	0.1250	0.1250
0.300	0.1250	0.1255	0.1256	0.1256	0.1258	0.1260	0.1260	0.1261	0.1263	0.1265	0.1266	0.1266	0.1266
0.305	0.1307	0.1306	0.1305	0.1304	0.1302	0.1301	0.1300	0.1300	0.1299	0.1299	0.1299	0.1297	0.1297
0.310	0.1302	0.1302	0.1303	0.1303	0.1303	0.1303	0.1304	0.1304	0.1304	0.1305	0.1306	0.1306	0.1307
0.315	0.1319	0.1318	0.1316	0.1315	0.1315	0.1314	0.1314	0.1313	0.1313	0.1312	0.1312	0.1312	0.1311
0.320	0.1288	0.1290	0.1292	0.1292	0.1293	0.1293	0.1295	0.1296	0.1297	0.1299	0.1299	0.1300	0.1300
0.325	0.1302	0.1299	0.1298	0.1297	0.1297	0.1297	0.1297	0.1296	0.1295	0.1295	0.1294	0.1294	0.1293
0.330	0.1207	0.1209	0.1210	0.1213	0.1215	0.1216	0.1220	0.1225	0.1225	0.1225	0.1225	0.1228	0.1229
0.335	0.1143	0.1134	0.1133	0.1132	0.1131	0.1130	0.1124	0.1120	0.1119	0.1119	0.1119	0.1118	0.1117
0.340	0.0894	0.0900	0.0901	0.0908	0.0911	0.0913	0.0913	0.0914	0.0916	0.0916	0.0921	0.0924	0.0927
0.345	0.0830	0.0828	0.0821	0.0820	0.0819	0.0819	0.0817	0.0816	0.0816	0.0814	0.0814	0.0813	0.0811
0.350	0.0776	0.0776	0.0776	0.0776	0.0776	0.0776	0.0777	0.0777	0.0777	0.0778	0.0779	0.0780	0.0782
0.355	0.0778	0.0777	0.0776	0.0775	0.0775	0.0774	0.0774	0.0772	0.0772	0.0772	0.0772	0.0772	0.0772
0.360	0.0770	0.0770	0.0771	0.0771	0.0772	0.0772	0.0772	0.0772	0.0772	0.0773	0.0773	0.0774	0.0776
0.365	0.0788	0.0781	0.0778	0.0778	0.0777	0.0776	0.0776	0.0775	0.0775	0.0774	0.0773	0.0772	0.0772
0.370	0.0772	0.0773	0.0773	0.0776	0.0776	0.0777	0.0777	0.0778	0.0778	0.0779	0.0780	0.0782	0.0793
0.375	0.0789	0.0782	0.0780	0.0778	0.0776	0.0776	0.0774	0.0774	0.0774	0.0774	0.0773	0.0773	0.0772
0.380	0.0748	0.0754	0.0756	0.0756	0.0758	0.0758	0.0759	0.0759	0.0761	0.0762	0.0763	0.0764	0.0765
0.385	0.0781	0.0779	0.0779	0.0777	0.0777	0.0777	0.0776	0.0776	0.0774	0.0774	0.0774	0.0774	0.0773
0.390	0.0770	0.0770	0.0770	0.0770	0.0771	0.0771	0.0771	0.0772	0.0772	0.0773	0.0773	0.0774	0.0774
0.395	0.0796	0.0784	0.0782	0.0781	0.0779	0.0779	0.0778	0.0778	0.0778	0.0778	0.0777	0.0776	0.0776
0.400	0.0777	0.0777	0.0777	0.0778	0.0778	0.0779	0.0779	0.0780	0.0781	0.0781	0.0782	0.0783	0.0784
0.405	0.0792	0.0786	0.0785	0.0784	0.0784	0.0783	0.0782	0.0782	0.0782	0.0781	0.0781	0.0781	0.0780
0.410	0.0791	0.0791	0.0793	0.0795	0.0795	0.0759	0.0764	0.0768	0.0770	0.0771	0.0771	0.0772	0.0774
0.415	0.0806	0.0805	0.0804	0.0802	0.0800	0.0800	0.0800	0.0798	0.0798	0.0798	0.0798	0.0797	0.0796
0.420	0.0779	0.0784	0.0788	0.0791	0.0791	0.0791	0.0793	0.0797	0.0797	0.0798	0.0799	0.0799	0.0800
0.425	0.0834	0.0829	0.0829	0.0829	0.0826	0.0826	0.0824	0.0824	0.0823	0.0822	0.0822	0.0822	0.0822
0.430	0.0807	0.0810	0.0810	0.0816	0.0818	0.0822	0.0822	0.0823	0.0824	0.0824	0.0825	0.0826	0.0826
0.435	0.0849	0.0847	0.0846	0.0845	0.0845	0.0845	0.0844	0.0844	0.0842	0.0842	0.0842	0.0842	0.0841
0.440	0.0836	0.0839	0.0840	0.0843	0.0844	0.0848	0.0849	0.0849	0.0849	0.0850	0.0851	0.0851	0.0852
0.445	0.0891	0.0885	0.0883	0.0882	0.0881	0.0881	0.0880	0.0877	0.0876	0.0876	0.0873	0.0873	0.0872
0.450	0.0866	0.0866	0.0867	0.0869	0.0870	0.0873	0.0873	0.0876	0.0877	0.0878	0.0879	0.0879	0.0879
0.455	0.0916	0.0914	0.0912	0.0909	0.0909	0.0908	0.0904	0.0904	0.0904	0.0904	0.0904	0.0904	0.0903
0.460	0.0908	0.0908	0.0909	0.0909	0.0910	0.0910	0.0911	0.0911	0.0911	0.0912	0.0913	0.0913	0.0913
0.465	0.0943	0.0942	0.0940	0.0940	0.0938	0.0938	0.0937	0.0935	0.0933	0.0931	0.0931	0.0931	0.0930
0.470	0.0924	0.0924	0.0925	0.0926	0.0929	0.0929	0.0930	0.0930	0.0931	0.0931	0.0933	0.0933	0.0934
0.475	0.0973	0.0968	0.0967	0.0967	0.0967	0.0965	0.0964	0.0960	0.0959	0.0959	0.0958	0.0958	0.0958
0.480	0.0951	0.0952	0.0954	0.0955	0.0956	0.0956	0.0959	0.0961	0.0961	0.0962	0.0962	0.0963	0.0963
0.485	0.0996	0.0994	0.0994	0.0993	0.0993	0.0993	0.0991	0.0990	0.0988	0.0988	0.0987	0.0987	0.0987
0.490	0.0993	0.0993	0.0994	0.0994	0.0994	0.0994	0.0995	0.0995	0.0996	0.0996	0.0996	0.0996	0.0997
0.495	0.1023	0.1021	0.1020	0.1020	0.1019	0.1018	0.1018	0.1018	0.1017	0.1017	0.1017	0.1017	0.1016
0.500	0.1007	0.1009	0.1012	0.1013	0.1013	0.1016	0.1017	0.1018	0.1019	0.1019	0.1019	0.1020	0.1020
0.505	0.1049	0.1048	0.1047	0.1047	0.1047	0.1047	0.1047	0.1045	0.1045	0.1045	0.1044	0.1043	0.1043
0.510	0.1037	0.1039	0.1040	0.1042	0.1045	0.1046	0.1046	0.1046	0.1047	0.1047	0.1047	0.1047	0.1048
0.515	0.1076	0.1076	0.1075	0.1075	0.1074	0.1073	0.1072	0.1072	0.1071	0.1071	0.1071	0.1071	0.1071
0.520	0.1068	0.1070	0.1071	0.1074	0.1075	0.1075	0.1076	0.1076	0.1077	0.1077	0.1077	0.1077	0.1078
0.525	0.1109	0.1106	0.1105	0.1104	0.1104	0.1103	0.1102	0.1102	0.1101	0.1101	0.1101	0.1100	0.1100
0.530	0.1093	0.1095	0.1097	0.1099	0.1100	0.1100	0.1100	0.1104	0.1104	0.1106	0.1107	0.1107	0.1107
0.535	0.1201	0.1201	0.1201	0.1200	0.1199	0.1197	0.1192	0.1186	0.1172	0.1170	0.1166	0.1162	0.1162

X-Axis	Y-Axis												
0.000	0.0031	0.0029	0.0029	0.0025	0.0024	0.0022	0.0020	0.0019	0.0016	0.0015	0.0012	0.0009	0.0007
0.005	0.0168	0.0168	0.0168	0.0170	0.0171	0.0171	0.0171	0.0171	0.0171	0.0174	0.0175	0.0176	0.0176
0.010	0.0218	0.0219	0.0219	0.0219	0.0219	0.0220	0.0220	0.0221	0.0221	0.0221	0.0222	0.0222	0.0222
0.015	0.0243	0.0243	0.0243	0.0243	0.0244	0.0244	0.0244	0.0244	0.0245	0.0245	0.0245	0.0245	0.0246
0.020	0.0267	0.0267	0.0267	0.0267	0.0268	0.0269	0.0269	0.0269	0.0269	0.0269	0.0270	0.0270	0.0270
0.025	0.0335	0.0333	0.0332	0.0332	0.0331	0.0330	0.0329	0.0328	0.0328	0.0327	0.0327	0.0324	0.0323
0.030	0.0438	0.0402	0.0403	0.0405	0.0406	0.0407	0.0410	0.0410	0.0411	0.0411	0.0412	0.0413	0.0414
0.035	0.0515	0.0512	0.0512	0.0511	0.0511	0.0510	0.0510	0.0510	0.0510	0.0509	0.0509	0.0509	0.0508
0.040	0.0591	0.0591	0.0592	0.0592	0.0593	0.0593	0.0593	0.0595	0.0596	0.0596	0.0596	0.0598	0.0598
0.045	0.0695	0.0692	0.0692	0.0692	0.0691	0.0691	0.0690	0.0690	0.0689	0.0687	0.0687	0.0687	0.0686
0.050	0.0786	0.0787	0.0787	0.0792	0.0792	0.0793	0.0793	0.0795	0.0797	0.0801	0.0758	0.0762	0.0765
0.055	0.0876	0.0875	0.0873	0.0873	0.0873	0.0872	0.0872	0.0871	0.0870	0.0869	0.0869	0.0868	0.0867
0.060	0.0949	0.0951	0.0952	0.0953	0.0954	0.0954	0.0955	0.0955	0.0956	0.0956	0.0957	0.0957	0.0958
0.065	0.1052	0.1052	0.1050	0.1050	0.1048	0.1048	0.1047	0.1047	0.1046	0.1046	0.1045	0.1043	0.1043
0.070	0.1127	0.1127	0.1127	0.1128	0.1128	0.1128	0.1128	0.1131	0.1131	0.1131	0.1135	0.1135	0.1135
0.075	0.1229	0.1228	0.1227	0.1226	0.1226	0.1225	0.1225	0.1225	0.1224	0.1224	0.1224	0.1223	0.1222
0.080	0.1302	0.1304	0.1305	0.1307	0.1309	0.1309	0.1278	0.1278	0.1278	0.1281	0.1282	0.1282	0.1283
0.085	0.1353	0.1352	0.1352	0.1350	0.1350	0.1349	0.1349	0.1348	0.1348	0.1348	0.1348	0.1347	0.1347
0.090	0.1375	0.1376	0.1376	0.1376	0.1376	0.1377	0.1377	0.1377	0.1377	0.1377	0.1378	0.1379	0.1379
0.095	0.1394	0.1394	0.1394	0.1394	0.1394	0.1393	0.1393	0.1393	0.1393	0.1392	0.1392	0.1391	0.1391
0.100	0.1398	0.1398	0.1398	0.1399	0.1399	0.1399	0.1400	0.1400	0.1400	0.1402	0.1402	0.1402	0.1402
0.105	0.1406	0.1406	0.1406	0.1406	0.1406	0.1405	0.1405	0.1405	0.1405	0.1405	0.1405	0.1405	0.1404
0.110	0.1402	0.1402	0.1402	0.1403	0.1403	0.1403	0.1403	0.1404	0.1405	0.1405	0.1406	0.1406	0.1406
0.115	0.1409	0.1409	0.1408	0.1408	0.1407	0.1406	0.1406	0.1406	0.1406	0.1406	0.1405	0.1405	0.1404
0.120	0.1401	0.1401	0.1401	0.1401	0.1402	0.1402	0.1402	0.1403	0.1403	0.1403	0.1404	0.1404	0.1404
0.125	0.1395	0.1395	0.1395	0.1394	0.1394	0.1394	0.1394	0.1393	0.1393	0.1392	0.1392	0.1392	0.1391
0.130	0.1362	0.1365	0.1369	0.1370	0.1370	0.1371	0.1371	0.1371	0.1371	0.1373	0.1373	0.1374	0.1374
0.135	0.1363	0.1363	0.1363	0.1362	0.1362	0.1362	0.1361	0.1361	0.1360	0.1360	0.1359	0.1358	0.1358
0.140	0.1302	0.1302	0.1305	0.1306	0.1306	0.1307	0.1307	0.1308	0.1308	0.1309	0.1310	0.1311	0.1311
0.145	0.1246	0.1245	0.1245	0.1244	0.1244	0.1244	0.1242	0.1242	0.1241	0.1241	0.1241	0.1240	0.1240
0.150	0.1090	0.1092	0.1095	0.1097	0.1098	0.1099	0.1099	0.1099	0.1100	0.1104	0.1104	0.1105	0.1107
0.155	0.0940	0.0939	0.0938	0.0936	0.0935	0.0934	0.0931	0.0930	0.0928	0.0928	0.0927	0.0926	0.0923
0.160	0.0728	0.0733	0.0734	0.0734	0.0738	0.0738	0.0739	0.0744	0.0745	0.0746	0.0747	0.0747	0.0750
0.165	0.0604	0.0604	0.0601	0.0600	0.0600	0.0599	0.0599	0.0599	0.0598	0.0597	0.0597	0.0596	0.0595
0.170	0.0551	0.0551	0.0552	0.0552	0.0554	0.0554	0.0555	0.0555	0.0555	0.0555	0.0556	0.0556	0.0556
0.175	0.0551	0.0551	0.0551	0.0550	0.0550	0.0550	0.0549	0.0549	0.0549	0.0548	0.0548	0.0548	0.0548
0.180	0.0544	0.0546	0.0546	0.0546	0.0546	0.0546	0.0547	0.0548	0.0548	0.0548	0.0548	0.0548	0.0548
0.185	0.0552	0.0552	0.0552	0.0551	0.0551	0.0551	0.0551	0.0551	0.0551	0.0550	0.0550	0.0550	0.0549
0.190	0.0546	0.0546	0.0547	0.0548	0.0548	0.0548	0.0548	0.0549	0.0550	0.0550	0.0550	0.0550	0.0551
0.195	0.0555	0.0554	0.0553	0.0552	0.0551	0.0551	0.0550	0.0550	0.0550	0.0550	0.0550	0.0550	0.0549
0.200	0.0547	0.0547	0.0547	0.0548	0.0550	0.0550	0.0551	0.0551	0.0552	0.0552	0.0552	0.0553	0.0553
0.205	0.0560	0.0560	0.0560	0.0560	0.0559	0.0559	0.0559	0.0559	0.0558	0.0558	0.0558	0.0558	0.0558
0.210	0.0565	0.0566	0.0566	0.0566	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0568	0.0568	0.0568
0.215	0.0581	0.0581	0.0581	0.0580	0.0580	0.0579	0.0579	0.0579	0.0578	0.0578	0.0578	0.0578	0.0578
0.220	0.0584	0.0585	0.0585	0.0585	0.0585	0.0586	0.0588	0.0588	0.0588	0.0588	0.0588	0.0588	0.0589
0.225	0.0602	0.0602	0.0601	0.0601	0.0600	0.0600	0.0600	0.0600	0.0599	0.0599	0.0599	0.0599	0.0599
0.230	0.0606	0.0606	0.0606	0.0607	0.0607	0.0607	0.0608	0.0608	0.0608	0.0609	0.0609	0.0609	0.0610
0.235	0.0624	0.0623	0.0623	0.0623	0.0623	0.0622	0.0622	0.0622	0.0621	0.0621	0.0621	0.0621	0.0620
0.240	0.0628	0.0628	0.0628	0.0629	0.0629	0.0629	0.0629	0.0630	0.0630	0.0630	0.0631	0.0631	0.0632
0.245	0.0654	0.0653	0.0653	0.0652	0.0651	0.0650	0.0650	0.0649	0.0649	0.0649	0.0649	0.0648	0.0646
0.250	0.0701	0.0701	0.0702	0.0703	0.0703	0.0703	0.0704	0.0704	0.0705	0.0706	0.0706	0.0706	0.0707
0.255	0.0803	0.0803	0.0801	0.0799	0.0799	0.0798	0.0798	0.0797	0.0797	0.0797	0.0796	0.0796	0.0795
0.260	0.0872	0.0873	0.0874	0.0875	0.0875	0.0876	0.0876	0.0877	0.0879	0.0880	0.0881	0.0882	0.0882
0.265	0.0974	0.0974	0.0973	0.0972	0.0972	0.0971	0.0970	0.0970	0.0970	0.0969	0.0969	0.0968	0.0968
0.270	0.1049	0.1050	0.1050	0.1052	0.1052	0.1052	0.1053	0.1054	0.1054	0.1054	0.1054	0.1055	0.1056
0.275	0.1114	0.1113	0.1113	0.1113	0.1113	0.1113	0.1113	0.1112	0.1112	0.1112	0.1111	0.1111	0.1111

0.280	0.1143	0.1144	0.1144	0.1144	0.1144	0.1145	0.1145	0.1145	0.1146	0.1146	0.1146	0.1146	0.1146
0.285	0.1184	0.1184	0.1183	0.1182	0.1182	0.1182	0.1182	0.1182	0.1182	0.1180	0.1180	0.1179	0.1179
0.290	0.1185	0.1196	0.1197	0.1198	0.1200	0.1201	0.1201	0.1203	0.1205	0.1206	0.1206	0.1207	0.1207
0.295	0.1250	0.1248	0.1247	0.1246	0.1246	0.1245	0.1245	0.1244	0.1244	0.1244	0.1243	0.1243	0.1242
0.300	0.1267	0.1267	0.1268	0.1268	0.1268	0.1269	0.1270	0.1270	0.1270	0.1271	0.1272	0.1272	0.1272
0.305	0.1297	0.1296	0.1296	0.1296	0.1296	0.1296	0.1295	0.1295	0.1295	0.1294	0.1294	0.1294	0.1293
0.310	0.1307	0.1307	0.1307	0.1307	0.1308	0.1308	0.1308	0.1309	0.1309	0.1309	0.1309	0.1310	0.1310
0.315	0.1311	0.1311	0.1311	0.1311	0.1311	0.1311	0.1310	0.1310	0.1309	0.1309	0.1309	0.1309	0.1308
0.320	0.1301	0.1301	0.1302	0.1303	0.1304	0.1304	0.1305	0.1305	0.1305	0.1306	0.1306	0.1306	0.1306
0.325	0.1292	0.1292	0.1292	0.1292	0.1292	0.1292	0.1292	0.1291	0.1291	0.1290	0.1289	0.1289	0.1289
0.330	0.1229	0.1231	0.1231	0.1231	0.1233	0.1233	0.1235	0.1235	0.1237	0.1240	0.1240	0.1241	0.1241
0.335	0.1115	0.1114	0.1114	0.1114	0.1111	0.1111	0.1109	0.1106	0.1104	0.1104	0.1103	0.1101	0.1101
0.340	0.0928	0.0929	0.0933	0.0934	0.0935	0.0935	0.0936	0.0936	0.0937	0.0939	0.0940	0.0946	0.0947
0.345	0.0811	0.0811	0.0810	0.0810	0.0810	0.0809	0.0809	0.0808	0.0808	0.0807	0.0807	0.0806	0.0806
0.350	0.0782	0.0782	0.0783	0.0783	0.0783	0.0788	0.0789	0.0750	0.0751	0.0755	0.0758	0.0759	0.0760
0.355	0.0771	0.0771	0.0770	0.0770	0.0770	0.0769	0.0769	0.0769	0.0769	0.0769	0.0768	0.0768	0.0767
0.360	0.0776	0.0778	0.0779	0.0779	0.0749	0.0753	0.0754	0.0754	0.0755	0.0755	0.0756	0.0756	0.0758
0.365	0.0772	0.0772	0.0772	0.0772	0.0771	0.0771	0.0771	0.0771	0.0771	0.0771	0.0770	0.0770	0.0770
0.370	0.0750	0.0751	0.0752	0.0755	0.0756	0.0760	0.0762	0.0763	0.0763	0.0763	0.0764	0.0764	0.0764
0.375	0.0772	0.0772	0.0772	0.0771	0.0771	0.0771	0.0771	0.0771	0.0771	0.0771	0.0770	0.0769	0.0769
0.380	0.0765	0.0766	0.0767	0.0767	0.0767	0.0768	0.0769	0.0769	0.0769	0.0770	0.0770	0.0771	0.0771
0.385	0.0773	0.0773	0.0773	0.0772	0.0772	0.0772	0.0772	0.0771	0.0771	0.0771	0.0771	0.0771	0.0771
0.390	0.0774	0.0774	0.0774	0.0775	0.0777	0.0777	0.0777	0.0777	0.0777	0.0778	0.0778	0.0779	0.0781
0.395	0.0775	0.0775	0.0774	0.0774	0.0774	0.0773	0.0773	0.0773	0.0773	0.0772	0.0772	0.0771	0.0771
0.400	0.0795	0.0746	0.0752	0.0759	0.0759	0.0763	0.0764	0.0765	0.0765	0.0766	0.0767	0.0767	0.0768
0.405	0.0779	0.0779	0.0779	0.0779	0.0779	0.0779	0.0778	0.0778	0.0778	0.0777	0.0777	0.0777	0.0776
0.410	0.0774	0.0775	0.0776	0.0776	0.0776	0.0777	0.0777	0.0777	0.0777	0.0777	0.0778	0.0779	0.0779
0.415	0.0795	0.0795	0.0795	0.0794	0.0793	0.0793	0.0792	0.0791	0.0791	0.0790	0.0790	0.0790	0.0790
0.420	0.0801	0.0801	0.0801	0.0801	0.0801	0.0801	0.0802	0.0802	0.0802	0.0802	0.0803	0.0803	0.0803
0.425	0.0822	0.0821	0.0819	0.0819	0.0818	0.0818	0.0818	0.0818	0.0817	0.0816	0.0815	0.0815	0.0815
0.430	0.0826	0.0826	0.0826	0.0827	0.0827	0.0827	0.0827	0.0827	0.0828	0.0829	0.0829	0.0829	0.0829
0.435	0.0841	0.0841	0.0840	0.0840	0.0840	0.0839	0.0839	0.0839	0.0839	0.0839	0.0839	0.0838	0.0838
0.440	0.0852	0.0852	0.0852	0.0853	0.0853	0.0854	0.0855	0.0855	0.0855	0.0855	0.0855	0.0856	0.0856
0.445	0.0872	0.0872	0.0872	0.0871	0.0871	0.0871	0.0871	0.0870	0.0870	0.0870	0.0870	0.0869	0.0868
0.450	0.0879	0.0879	0.0880	0.0880	0.0881	0.0881	0.0882	0.0882	0.0883	0.0883	0.0884	0.0884	0.0884
0.455	0.0902	0.0902	0.0902	0.0901	0.0900	0.0900	0.0899	0.0899	0.0899	0.0898	0.0898	0.0897	0.0896
0.460	0.0913	0.0913	0.0914	0.0915	0.0917	0.0917	0.0917	0.0917	0.0917	0.0919	0.0920	0.0921	0.0923
0.465	0.0930	0.0929	0.0928	0.0927	0.0926	0.0926	0.0925	0.0925	0.0925	0.0925	0.0925	0.0924	0.0924
0.470	0.0934	0.0935	0.0935	0.0936	0.0936	0.0936	0.0937	0.0937	0.0938	0.0938	0.0939	0.0939	0.0939
0.475	0.0956	0.0956	0.0956	0.0955	0.0954	0.0954	0.0953	0.0953	0.0953	0.0953	0.0952	0.0952	0.0952
0.480	0.0964	0.0964	0.0964	0.0965	0.0965	0.0965	0.0966	0.0967	0.0967	0.0967	0.0967	0.0967	0.0967
0.485	0.0987	0.0985	0.0985	0.0984	0.0983	0.0982	0.0982	0.0982	0.0982	0.0981	0.0981	0.0980	0.0980
0.490	0.0997	0.0997	0.0997	0.0998	0.0999	0.1001	0.1002	0.1002	0.1002	0.1002	0.1004	0.1004	0.1005
0.495	0.1015	0.1014	0.1013	0.1012	0.1012	0.1011	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1009
0.500	0.1021	0.1021	0.1021	0.1021	0.1022	0.1023	0.1023	0.1023	0.1023	0.1023	0.1023	0.1023	0.1023
0.505	0.1042	0.1042	0.1042	0.1041	0.1040	0.1040	0.1040	0.1039	0.1039	0.1038	0.1038	0.1038	0.1037
0.510	0.1048	0.1049	0.1049	0.1050	0.1050	0.1050	0.1051	0.1051	0.1051	0.1052	0.1052	0.1052	0.1053
0.515	0.1071	0.1070	0.1070	0.1070	0.1070	0.1069	0.1069	0.1069	0.1068	0.1068	0.1067	0.1067	0.1067
0.520	0.1078	0.1078	0.1078	0.1079	0.1080	0.1080	0.1080	0.1080	0.1081	0.1081	0.1081	0.1082	0.1082
0.525	0.1100	0.1099	0.1099	0.1099	0.1099	0.1098	0.1098	0.1097	0.1097	0.1095	0.1095	0.1095	0.1095
0.530	0.1107	0.1108	0.1109	0.1109	0.1109	0.1110	0.1110	0.1110	0.1111	0.1111	0.1112	0.1112	0.1113
0.535	0.1161	0.1160	0.1159	0.1158	0.1155	0.1153	0.1153	0.1152	0.1147	0.1147	0.1146	0.1145	0.1144

X-Axis						Y-Axis							
0.000	0.0007	0.0006	0.0005	0.0004	0.0003	0.0003	0.0001	0.0002	0.0003	0.0005	0.0007	0.0012	0.0012
0.005	0.0177	0.0177	0.0178	0.0178	0.0179	0.0179	0.0180	0.0180	0.0181	0.0181	0.0182	0.0182	0.0182
0.010	0.0223	0.0223	0.0223	0.0223	0.0223	0.0224	0.0224	0.0224	0.0225	0.0225	0.0227	0.0228	0.0228
0.015	0.0246	0.0246	0.0246	0.0247	0.0247	0.0247	0.0248	0.0248	0.0248	0.0252	0.0253	0.0253	0.0253
0.020	0.0271	0.0271	0.0271	0.0273	0.0274	0.0274	0.0274	0.0275	0.0275	0.0275	0.0277	0.0278	0.0280
0.025	0.0322	0.0322	0.0320	0.0320	0.0319	0.0319	0.0318	0.0318	0.0318	0.0317	0.0317	0.0317	0.0317
0.030	0.0414	0.0415	0.0415	0.0416	0.0416	0.0417	0.0417	0.0417	0.0418	0.0418	0.0418	0.0418	0.0418
0.035	0.0508	0.0508	0.0507	0.0506	0.0506	0.0506	0.0506	0.0505	0.0504	0.0503	0.0502	0.0501	0.0500
0.040	0.0598	0.0599	0.0599	0.0599	0.0599	0.0599	0.0600	0.0600	0.0602	0.0603	0.0605	0.0606	0.0607
0.045	0.0686	0.0685	0.0685	0.0684	0.0684	0.0683	0.0683	0.0682	0.0682	0.0681	0.0681	0.0681	0.0680
0.050	0.0765	0.0766	0.0766	0.0767	0.0768	0.0769	0.0769	0.0771	0.0771	0.0772	0.0773	0.0773	0.0774
0.055	0.0866	0.0866	0.0865	0.0865	0.0863	0.0863	0.0863	0.0862	0.0860	0.0859	0.0859	0.0859	0.0858
0.060	0.0959	0.0959	0.0959	0.0960	0.0960	0.0961	0.0962	0.0963	0.0963	0.0965	0.0966	0.0968	0.0968
0.065	0.1043	0.1042	0.1041	0.1041	0.1040	0.1040	0.1040	0.1039	0.1039	0.1039	0.1037	0.1037	0.1036
0.070	0.1135	0.1137	0.1137	0.1137	0.1138	0.1139	0.1139	0.1139	0.1140	0.1141	0.1141	0.1143	0.1144
0.075	0.1222	0.1222	0.1221	0.1221	0.1220	0.1219	0.1218	0.1218	0.1217	0.1217	0.1217	0.1216	0.1216
0.080	0.1285	0.1286	0.1286	0.1286	0.1286	0.1287	0.1288	0.1288	0.1288	0.1288	0.1289	0.1289	0.1289
0.085	0.1346	0.1346	0.1346	0.1346	0.1345	0.1344	0.1344	0.1343	0.1343	0.1343	0.1342	0.1342	0.1342
0.090	0.1379	0.1379	0.1380	0.1380	0.1380	0.1380	0.1381	0.1381	0.1382	0.1382	0.1382	0.1384	0.1384
0.095	0.1391	0.1390	0.1390	0.1390	0.1390	0.1390	0.1389	0.1389	0.1388	0.1388	0.1388	0.1387	0.1387
0.100	0.1403	0.1403	0.1403	0.1404	0.1404	0.1404	0.1404	0.1404	0.1405	0.1405	0.1405	0.1405	0.1405
0.105	0.1404	0.1404	0.1404	0.1404	0.1403	0.1403	0.1403	0.1403	0.1402	0.1402	0.1401	0.1401	0.1400
0.110	0.1407	0.1407	0.1407	0.1407	0.1407	0.1408	0.1408	0.1408	0.1408	0.1409	0.1409	0.1409	0.1409
0.115	0.1404	0.1404	0.1404	0.1404	0.1403	0.1403	0.1403	0.1403	0.1403	0.1402	0.1401	0.1400	0.1400
0.120	0.1405	0.1405	0.1405	0.1405	0.1406	0.1406	0.1406	0.1406	0.1407	0.1408	0.1409	0.1409	0.1409
0.125	0.1390	0.1390	0.1390	0.1390	0.1389	0.1389	0.1389	0.1389	0.1388	0.1388	0.1388	0.1388	0.1387
0.130	0.1375	0.1375	0.1375	0.1375	0.1376	0.1376	0.1376	0.1377	0.1377	0.1377	0.1378	0.1378	0.1378
0.135	0.1357	0.1357	0.1356	0.1355	0.1355	0.1354	0.1354	0.1354	0.1353	0.1353	0.1353	0.1352	0.1351
0.140	0.1311	0.1312	0.1313	0.1313	0.1313	0.1314	0.1314	0.1315	0.1316	0.1317	0.1318	0.1318	0.1318
0.145	0.1240	0.1239	0.1239	0.1239	0.1238	0.1237	0.1236	0.1236	0.1235	0.1233	0.1233	0.1231	0.1230
0.150	0.1110	0.1111	0.1111	0.1112	0.1112	0.1114	0.1116	0.1117	0.1118	0.1119	0.1119	0.1119	0.1120
0.155	0.0923	0.0918	0.0918	0.0918	0.0917	0.0914	0.0906	0.0902	0.0902	0.0902	0.0901	0.0900	0.0897
0.160	0.0751	0.0751	0.0755	0.0755	0.0755	0.0755	0.0758	0.0758	0.0760	0.0761	0.0762	0.0765	0.0766
0.165	0.0595	0.0595	0.0593	0.0593	0.0593	0.0592	0.0592	0.0591	0.0591	0.0589	0.0588	0.0588	0.0587
0.170	0.0557	0.0557	0.0557	0.0557	0.0558	0.0559	0.0559	0.0559	0.0559	0.0560	0.0561	0.0561	0.0561
0.175	0.0547	0.0546	0.0546	0.0545	0.0545	0.0545	0.0545	0.0544	0.0544	0.0543	0.0543	0.0542	0.0542
0.180	0.0548	0.0549	0.0549	0.0549	0.0549	0.0550	0.0550	0.0550	0.0551	0.0551	0.0551	0.0552	0.0553
0.185	0.0548	0.0547	0.0547	0.0547	0.0547	0.0546	0.0546	0.0546	0.0546	0.0545	0.0544	0.0543	0.0541
0.190	0.0551	0.0551	0.0551	0.0551	0.0551	0.0551	0.0552	0.0553	0.0553	0.0554	0.0555	0.0555	0.0555
0.195	0.0549	0.0549	0.0549	0.0549	0.0549	0.0549	0.0547	0.0547	0.0547	0.0547	0.0546	0.0545	0.0543
0.200	0.0554	0.0554	0.0554	0.0554	0.0554	0.0554	0.0555	0.0555	0.0556	0.0556	0.0557	0.0557	0.0557
0.205	0.0557	0.0556	0.0556	0.0555	0.0555	0.0555	0.0555	0.0554	0.0554	0.0554	0.0553	0.0553	0.0553
0.210	0.0569	0.0569	0.0570	0.0571	0.0572	0.0572	0.0573	0.0574	0.0574	0.0574	0.0574	0.0574	0.0575
0.215	0.0577	0.0577	0.0577	0.0577	0.0576	0.0575	0.0575	0.0574	0.0573	0.0572	0.0571	0.0571	0.0571
0.220	0.0589	0.0590	0.0590	0.0590	0.0591	0.0591	0.0591	0.0592	0.0592	0.0593	0.0594	0.0594	0.0594
0.225	0.0598	0.0598	0.0598	0.0597	0.0597	0.0597	0.0596	0.0595	0.0595	0.0594	0.0594	0.0594	0.0593
0.230	0.0610	0.0611	0.0612	0.0612	0.0612	0.0612	0.0613	0.0613	0.0613	0.0614	0.0614	0.0614	0.0614
0.235	0.0619	0.0619	0.0619	0.0618	0.0618	0.0617	0.0617	0.0617	0.0616	0.0616	0.0616	0.0614	0.0613
0.240	0.0632	0.0632	0.0632	0.0632	0.0632	0.0633	0.0633	0.0634	0.0634	0.0635	0.0635	0.0636	0.0636
0.245	0.0646	0.0645	0.0644	0.0644	0.0644	0.0644	0.0644	0.0644	0.0643	0.0643	0.0643	0.0642	0.0641
0.250	0.0709	0.0710	0.0711	0.0713	0.0713	0.0715	0.0715	0.0716	0.0717	0.0718	0.0720	0.0720	0.0721
0.255	0.0795	0.0794	0.0794	0.0794	0.0793	0.0790	0.0790	0.0790	0.0789	0.0788	0.0787	0.0786	0.0782
0.260	0.0884	0.0884	0.0886	0.0887	0.0888	0.0890	0.0890	0.0890	0.0891	0.0892	0.0893	0.0893	0.0894
0.265	0.0967	0.0967	0.0966	0.0966	0.0964	0.0964	0.0964	0.0964	0.0962	0.0962	0.0962	0.0961	0.0959
0.270	0.1056	0.1056	0.1057	0.1058	0.1058	0.1060	0.1061	0.1061	0.1062	0.1063	0.1065	0.1065	0.1065
0.275	0.1111	0.1111	0.1111	0.1111	0.1110	0.1110	0.1110	0.1109	0.1109	0.1109	0.1108	0.1108	0.1106

0.280	0.1147	0.1147	0.1147	0.1147	0.1150	0.1150	0.1150	0.1151	0.1151	0.1151	0.1152	0.1152	0.1152
0.285	0.1179	0.1178	0.1178	0.1178	0.1178	0.1178	0.1178	0.1177	0.1176	0.1175	0.1175	0.1174	0.1174
0.290	0.1208	0.1208	0.1208	0.1209	0.1210	0.1210	0.1210	0.1211	0.1211	0.1211	0.1211	0.1211	0.1212
0.295	0.1242	0.1242	0.1242	0.1242	0.1242	0.1242	0.1241	0.1240	0.1240	0.1239	0.1239	0.1238	0.1237
0.300	0.1272	0.1272	0.1273	0.1273	0.1274	0.1275	0.1275	0.1276	0.1276	0.1277	0.1278	0.1278	0.1278
0.305	0.1293	0.1293	0.1293	0.1292	0.1292	0.1292	0.1292	0.1291	0.1290	0.1289	0.1288	0.1288	0.1288
0.310	0.1312	0.1312	0.1314	0.1286	0.1287	0.1287	0.1289	0.1291	0.1292	0.1293	0.1294	0.1294	0.1296
0.315	0.1308	0.1307	0.1307	0.1307	0.1306	0.1306	0.1306	0.1305	0.1304	0.1304	0.1303	0.1302	0.1301
0.320	0.1307	0.1307	0.1307	0.1307	0.1308	0.1308	0.1309	0.1309	0.1309	0.1309	0.1310	0.1310	0.1310
0.325	0.1288	0.1288	0.1287	0.1286	0.1286	0.1286	0.1283	0.1281	0.1281	0.1281	0.1281	0.1280	0.1279
0.330	0.1241	0.1241	0.1242	0.1242	0.1242	0.1243	0.1243	0.1244	0.1244	0.1245	0.1245	0.1247	0.1247
0.335	0.1101	0.1100	0.1100	0.1098	0.1098	0.1092	0.1092	0.1092	0.1091	0.1091	0.1091	0.1090	0.1090
0.340	0.0947	0.0949	0.0950	0.0950	0.0951	0.0952	0.0952	0.0952	0.0953	0.0954	0.0960	0.0960	0.0960
0.345	0.0805	0.0805	0.0802	0.0801	0.0801	0.0799	0.0797	0.0796	0.0796	0.0795	0.0795	0.0794	0.0792
0.350	0.0763	0.0763	0.0764	0.0765	0.0765	0.0766	0.0767	0.0768	0.0771	0.0772	0.0772	0.0772	0.0773
0.355	0.0767	0.0767	0.0767	0.0766	0.0766	0.0766	0.0765	0.0765	0.0765	0.0764	0.0763	0.0762	0.0762
0.360	0.0760	0.0761	0.0762	0.0762	0.0764	0.0764	0.0766	0.0766	0.0767	0.0767	0.0767	0.0767	0.0768
0.365	0.0769	0.0769	0.0768	0.0767	0.0766	0.0766	0.0766	0.0765	0.0764	0.0763	0.0763	0.0762	0.0762
0.370	0.0765	0.0766	0.0766	0.0767	0.0768	0.0768	0.0768	0.0768	0.0770	0.0770	0.0770	0.0770	0.0771
0.375	0.0769	0.0768	0.0768	0.0768	0.0768	0.0767	0.0767	0.0766	0.0766	0.0766	0.0764	0.0764	0.0763
0.380	0.0771	0.0771	0.0771	0.0772	0.0772	0.0772	0.0772	0.0772	0.0773	0.0773	0.0773	0.0773	0.0773
0.385	0.0771	0.0770	0.0770	0.0768	0.0768	0.0768	0.0767	0.0767	0.0765	0.0765	0.0764	0.0764	0.0763
0.390	0.0788	0.0748	0.0750	0.0759	0.0759	0.0760	0.0761	0.0762	0.0762	0.0763	0.0763	0.0764	0.0764
0.395	0.0771	0.0771	0.0770	0.0770	0.0770	0.0770	0.0770	0.0768	0.0768	0.0767	0.0765	0.0765	0.0763
0.400	0.0768	0.0770	0.0771	0.0771	0.0771	0.0771	0.0772	0.0772	0.0773	0.0773	0.0773	0.0773	0.0773
0.405	0.0776	0.0776	0.0776	0.0775	0.0775	0.0775	0.0775	0.0774	0.0773	0.0773	0.0772	0.0771	0.0770
0.410	0.0780	0.0780	0.0781	0.0783	0.0783	0.0783	0.0783	0.0783	0.0783	0.0784	0.0784	0.0785	0.0785
0.415	0.0790	0.0789	0.0789	0.0789	0.0789	0.0788	0.0788	0.0788	0.0787	0.0787	0.0787	0.0786	0.0786
0.420	0.0803	0.0804	0.0805	0.0806	0.0806	0.0807	0.0807	0.0808	0.0808	0.0809	0.0809	0.0810	0.0810
0.425	0.0815	0.0814	0.0814	0.0814	0.0814	0.0814	0.0814	0.0814	0.0813	0.0812	0.0811	0.0811	0.0811
0.430	0.0829	0.0830	0.0830	0.0831	0.0831	0.0831	0.0831	0.0833	0.0834	0.0834	0.0835	0.0835	0.0837
0.435	0.0837	0.0837	0.0837	0.0836	0.0836	0.0830	0.0830	0.0827	0.0825	0.0823	0.0864	0.0857	0.0855
0.440	0.0856	0.0856	0.0857	0.0858	0.0858	0.0858	0.0859	0.0860	0.0860	0.0860	0.0861	0.0861	0.0862
0.445	0.0868	0.0867	0.0867	0.0867	0.0867	0.0866	0.0866	0.0866	0.0866	0.0866	0.0865	0.0865	0.0865
0.450	0.0885	0.0885	0.0885	0.0885	0.0886	0.0886	0.0886	0.0886	0.0886	0.0887	0.0888	0.0888	0.0888
0.455	0.0896	0.0896	0.0896	0.0895	0.0894	0.0894	0.0894	0.0894	0.0893	0.0893	0.0893	0.0893	0.0892
0.460	0.0923	0.0924	0.0926	0.0926	0.0930	0.0893	0.0895	0.0897	0.0900	0.0900	0.0902	0.0902	0.0902
0.465	0.0924	0.0923	0.0922	0.0922	0.0922	0.0921	0.0921	0.0921	0.0920	0.0920	0.0919	0.0919	0.0919
0.470	0.0939	0.0939	0.0939	0.0940	0.0940	0.0940	0.0942	0.0943	0.0943	0.0943	0.0944	0.0945	0.0945
0.475	0.0952	0.0952	0.0951	0.0950	0.0950	0.0950	0.0949	0.0949	0.0949	0.0949	0.0949	0.0948	0.0947
0.480	0.0967	0.0967	0.0968	0.0969	0.0969	0.0969	0.0971	0.0971	0.0972	0.0973	0.0973	0.0973	0.0973
0.485	0.0980	0.0980	0.0979	0.0979	0.0979	0.0979	0.0979	0.0977	0.0977	0.0976	0.0976	0.0976	0.0975
0.490	0.1005	0.1006	0.1006	0.1006	0.1007	0.1008	0.0978	0.0979	0.0983	0.0983	0.0984	0.0985	0.0987
0.495	0.1009	0.1008	0.1008	0.1008	0.1007	0.1007	0.1007	0.1007	0.1006	0.1006	0.1006	0.1006	0.1005
0.500	0.1023	0.1024	0.1025	0.1025	0.1025	0.1027	0.1027	0.1028	0.1028	0.1029	0.1029	0.1030	0.1031
0.505	0.1037	0.1037	0.1037	0.1036	0.1036	0.1035	0.1035	0.1035	0.1034	0.1034	0.1034	0.1033	0.1033
0.510	0.1053	0.1053	0.1054	0.1054	0.1054	0.1054	0.1055	0.1055	0.1056	0.1056	0.1057	0.1058	0.1058
0.515	0.1066	0.1066	0.1066	0.1066	0.1065	0.1065	0.1064	0.1064	0.1064	0.1064	0.1063	0.1062	0.1062
0.520	0.1083	0.1083	0.1084	0.1085	0.1085	0.1085	0.1085	0.1085	0.1086	0.1086	0.1086	0.1086	0.1087
0.525	0.1094	0.1093	0.1093	0.1093	0.1092	0.1092	0.1092	0.1092	0.1092	0.1092	0.1091	0.1090	0.1089
0.530	0.1113	0.1113	0.1113	0.1114	0.1114	0.1115	0.1115	0.1115	0.1115	0.1116	0.1117	0.1117	0.1117
0.535	0.1144	0.1144	0.1144	0.1142	0.1138	0.1138	0.1136	0.1136	0.1135	0.1132	0.1130	0.1129	0.1128

X-Axis	Y-Axis												
0.000	0.0014	0.0015	0.0020	0.0023	0.0025	0.0025	0.0026	0.0026	0.0026	0.0027	0.0027	0.0028	0.0034
0.005	0.0183	0.0184	0.0184	0.0188	0.0189	0.0189	0.0196	0.0197	0.0205	0.0203	0.0200	0.0193	0.0191
0.010	0.0229	0.0230	0.0230	0.0231	0.0231	0.0233	0.0235	0.0236	0.0243	0.0244	0.0244	0.0237	0.0234
0.015	0.0253	0.0254	0.0254	0.0255	0.0255	0.0257	0.0259	0.0262	0.0264	0.0264	0.0259	0.0259	0.0257
0.020	0.0280	0.0280	0.0281	0.0281	0.0282	0.0284	0.0284	0.0286	0.0288	0.0294	0.0289	0.0286	0.0285
0.025	0.0316	0.0315	0.0314	0.0313	0.0312	0.0311	0.0311	0.0306	0.0303	0.0307	0.0308	0.0309	0.0310
0.030	0.0418	0.0419	0.0420	0.0422	0.0424	0.0424	0.0425	0.0425	0.0425	0.0445	0.0440	0.0438	0.0436
0.035	0.0500	0.0500	0.0499	0.0498	0.0497	0.0497	0.0496	0.0495	0.0488	0.0490	0.0490	0.0491	0.0492
0.040	0.0608	0.0608	0.0609	0.0611	0.0611	0.0612	0.0612	0.0613	0.0618	0.0619	0.0618	0.0617	0.0617
0.045	0.0680	0.0679	0.0679	0.0678	0.0678	0.0677	0.0676	0.0672	0.0667	0.0692	0.0694	0.0695	0.0697
0.050	0.0774	0.0774	0.0774	0.0776	0.0777	0.0777	0.0777	0.0777	0.0778	0.0802	0.0800	0.0800	0.0796
0.055	0.0856	0.0856	0.0856	0.0856	0.0855	0.0855	0.0855	0.0852	0.0851	0.0842	0.0843	0.0845	0.0850
0.060	0.0968	0.0969	0.0970	0.0970	0.0972	0.0973	0.0976	0.0979	0.0980	0.0975	0.0974	0.0973	0.0972
0.065	0.1035	0.1035	0.1034	0.1031	0.1031	0.1031	0.1031	0.1029	0.1028	0.1024	0.1033	0.1033	0.1034
0.070	0.1145	0.1145	0.1146	0.1147	0.1148	0.1149	0.1149	0.1156	0.1163	0.1158	0.1156	0.1155	0.1150
0.075	0.1215	0.1214	0.1213	0.1213	0.1212	0.1212	0.1207	0.1207	0.1206	0.1231	0.1232	0.1232	0.1233
0.080	0.1290	0.1290	0.1291	0.1291	0.1292	0.1292	0.1293	0.1295	0.1295	0.1316	0.1309	0.1308	0.1307
0.085	0.1341	0.1340	0.1339	0.1338	0.1337	0.1336	0.1335	0.1334	0.1325	0.1328	0.1332	0.1336	0.1336
0.090	0.1385	0.1385	0.1385	0.1385	0.1386	0.1387	0.1388	0.1389	0.1391	0.1394	0.1389	0.1388	0.1386
0.095	0.1387	0.1386	0.1386	0.1385	0.1385	0.1383	0.1381	0.1380	0.1376	0.1379	0.1381	0.1381	0.1384
0.100	0.1406	0.1406	0.1406	0.1409	0.1409	0.1410	0.1411	0.1412	0.1413	0.1413	0.1410	0.1410	0.1408
0.105	0.1399	0.1398	0.1397	0.1397	0.1397	0.1396	0.1395	0.1393	0.1386	0.1403	0.1404	0.1404	0.1404
0.110	0.1410	0.1410	0.1411	0.1412	0.1413	0.1414	0.1415	0.1415	0.1416	0.1420	0.1416	0.1415	0.1414
0.115	0.1399	0.1399	0.1398	0.1398	0.1398	0.1398	0.1393	0.1393	0.1390	0.1405	0.1405	0.1406	0.1408
0.120	0.1409	0.1409	0.1410	0.1410	0.1410	0.1411	0.1412	0.1413	0.1419	0.1417	0.1416	0.1413	0.1412
0.125	0.1387	0.1386	0.1386	0.1386	0.1385	0.1383	0.1382	0.1379	0.1376	0.1381	0.1381	0.1382	0.1383
0.130	0.1378	0.1379	0.1380	0.1380	0.1381	0.1381	0.1381	0.1381	0.1382	0.1391	0.1390	0.1387	0.1384
0.135	0.1351	0.1350	0.1350	0.1347	0.1346	0.1343	0.1342	0.1340	0.1336	0.1336	0.1340	0.1342	0.1343
0.140	0.1318	0.1320	0.1320	0.1323	0.1326	0.1328	0.1328	0.1329	0.1329	0.1327	0.1324	0.1324	0.1324
0.145	0.1228	0.1226	0.1226	0.1225	0.1224	0.1222	0.1219	0.1215	0.1207	0.1209	0.1211	0.1213	0.1219
0.150	0.1120	0.1124	0.1126	0.1128	0.1131	0.1133	0.1136	0.1143	0.1145	0.1139	0.1136	0.1136	0.1131
0.155	0.0897	0.0897	0.0895	0.0893	0.0888	0.0886	0.0883	0.0882	0.0879	0.0887	0.0887	0.0890	0.0892
0.160	0.0768	0.0768	0.0773	0.0775	0.0784	0.0788	0.0793	0.0796	0.0797	0.0793	0.0791	0.0789	0.0786
0.165	0.0586	0.0586	0.0586	0.0584	0.0584	0.0584	0.0583	0.0582	0.0568	0.0570	0.0575	0.0578	0.0578
0.170	0.0561	0.0562	0.0562	0.0564	0.0564	0.0564	0.0565	0.0567	0.0567	0.0568	0.0574	0.0572	0.0568
0.175	0.0541	0.0540	0.0540	0.0539	0.0539	0.0537	0.0537	0.0537	0.0528	0.0552	0.0552	0.0554	0.0555
0.180	0.0553	0.0554	0.0554	0.0555	0.0555	0.0556	0.0558	0.0558	0.0559	0.0560	0.0560	0.0565	0.0559
0.185	0.0540	0.0540	0.0539	0.0539	0.0537	0.0535	0.0532	0.0531	0.0526	0.0532	0.0535	0.0535	0.0536
0.190	0.0555	0.0556	0.0556	0.0557	0.0557	0.0557	0.0559	0.0559	0.0561	0.0561	0.0560	0.0558	0.0558
0.195	0.0542	0.0541	0.0540	0.0540	0.0536	0.0534	0.0533	0.0525	0.0522	0.0535	0.0537	0.0538	0.0539
0.200	0.0560	0.0560	0.0560	0.0561	0.0561	0.0561	0.0561	0.0564	0.0565	0.0566	0.0564	0.0562	0.0561
0.205	0.0552	0.0551	0.0550	0.0549	0.0549	0.0548	0.0548	0.0548	0.0531	0.0560	0.0561	0.0561	0.0562
0.210	0.0575	0.0576	0.0577	0.0544	0.0555	0.0555	0.0556	0.0557	0.0559	0.0577	0.0577	0.0576	0.0575
0.215	0.0571	0.0570	0.0569	0.0569	0.0566	0.0565	0.0565	0.0565	0.0556	0.0563	0.0564	0.0565	0.0566
0.220	0.0594	0.0595	0.0595	0.0596	0.0596	0.0597	0.0597	0.0599	0.0600	0.0601	0.0598	0.0598	0.0595
0.225	0.0593	0.0593	0.0592	0.0591	0.0591	0.0590	0.0589	0.0587	0.0579	0.0584	0.0585	0.0589	0.0590
0.230	0.0616	0.0616	0.0617	0.0617	0.0617	0.0618	0.0618	0.0618	0.0619	0.0623	0.0621	0.0619	0.0616
0.235	0.0613	0.0612	0.0612	0.0612	0.0611	0.0609	0.0609	0.0608	0.0600	0.0602	0.0603	0.0608	0.0612
0.240	0.0636	0.0637	0.0637	0.0638	0.0638	0.0639	0.0640	0.0640	0.0641	0.0644	0.0643	0.0641	0.0639
0.245	0.0640	0.0640	0.0639	0.0638	0.0637	0.0636	0.0634	0.0633	0.0625	0.0651	0.0652	0.0652	0.0653
0.250	0.0722	0.0723	0.0723	0.0724	0.0725	0.0726	0.0727	0.0727	0.0747	0.0744	0.0725	0.0725	0.0723
0.255	0.0778	0.0778	0.0776	0.0773	0.0768	0.0768	0.0763	0.0761	0.0758	0.0752	0.0760	0.0768	0.0770
0.260	0.0895	0.0895	0.0897	0.0897	0.0899	0.0901	0.0906	0.0912	0.0917	0.0916	0.0903	0.0903	0.0901
0.265	0.0959	0.0957	0.0957	0.0957	0.0952	0.0951	0.0950	0.0950	0.0940	0.0939	0.0932	0.0923	0.0934
0.270	0.1066	0.1066	0.1066	0.1067	0.1068	0.1069	0.1073	0.1079	0.1079	0.1081	0.1073	0.1072	0.1071
0.275	0.1106	0.1106	0.1106	0.1098	0.1097	0.1097	0.1097	0.1096	0.1091	0.1076	0.1088	0.1090	0.1097

0.280	0.1154	0.1154	0.1154	0.1156	0.1156	0.1156	0.1157	0.1158	0.1167	0.1170	0.1158	0.1157	0.1156
0.285	0.1174	0.1173	0.1173	0.1171	0.1169	0.1167	0.1166	0.1166	0.1164	0.1163	0.1164	0.1164	0.1167
0.290	0.1212	0.1213	0.1215	0.1216	0.1216	0.1216	0.1216	0.1217	0.1217	0.1240	0.1226	0.1224	0.1224
0.295	0.1234	0.1234	0.1231	0.1231	0.1229	0.1228	0.1227	0.1227	0.1204	0.1225	0.1226	0.1227	0.1231
0.300	0.1279	0.1279	0.1279	0.1279	0.1279	0.1280	0.1280	0.1286	0.1286	0.1298	0.1286	0.1284	0.1284
0.305	0.1286	0.1286	0.1285	0.1284	0.1280	0.1279	0.1278	0.1278	0.1275	0.1250	0.1272	0.1277	0.1279
0.310	0.1298	0.1300	0.1300	0.1301	0.1301	0.1301	0.1301	0.1302	0.1302	0.1319	0.1315	0.1312	0.1312
0.315	0.1301	0.1300	0.1298	0.1298	0.1296	0.1296	0.1295	0.1293	0.1290	0.1275	0.1292	0.1293	0.1295
0.320	0.1310	0.1310	0.1311	0.1312	0.1312	0.1314	0.1316	0.1316	0.1317	0.1318	0.1317	0.1315	0.1315
0.325	0.1278	0.1278	0.1277	0.1276	0.1276	0.1273	0.1272	0.1271	0.1268	0.1287	0.1288	0.1288	0.1288
0.330	0.1247	0.1248	0.1249	0.1249	0.1250	0.1250	0.1252	0.1252	0.1258	0.1253	0.1252	0.1252	0.1251
0.335	0.1086	0.1083	0.1081	0.1078	0.1077	0.1075	0.1071	0.1066	0.1061	0.1054	0.1052	0.1059	0.1063
0.340	0.0961	0.0964	0.0964	0.0965	0.0966	0.0967	0.0978	0.0980	0.0990	0.0976	0.0974	0.0969	0.0967
0.345	0.0792	0.0791	0.0791	0.0789	0.0787	0.0787	0.0785	0.0781	0.0774	0.0774	0.0782	0.0784	0.0784
0.350	0.0773	0.0773	0.0773	0.0774	0.0774	0.0774	0.0775	0.0775	0.0776	0.0786	0.0785	0.0782	0.0780
0.355	0.0761	0.0758	0.0757	0.0756	0.0753	0.0753	0.0752	0.0752	0.0744	0.0747	0.0750	0.0752	0.0752
0.360	0.0768	0.0768	0.0769	0.0769	0.0770	0.0770	0.0770	0.0770	0.0768	0.0767	0.0767	0.0766	0.0766
0.365	0.0761	0.0761	0.0759	0.0757	0.0755	0.0754	0.0754	0.0752	0.0747	0.0750	0.0755	0.0755	0.0757
0.370	0.0771	0.0771	0.0771	0.0771	0.0772	0.0772	0.0772	0.0772	0.0772	0.0788	0.0784	0.0777	0.0776
0.375	0.0762	0.0761	0.0761	0.0757	0.0757	0.0756	0.0751	0.0751	0.0751	0.0765	0.0765	0.0766	0.0766
0.380	0.0774	0.0774	0.0775	0.0776	0.0778	0.0778	0.0778	0.0780	0.0784	0.0765	0.0765	0.0764	0.0763
0.385	0.0763	0.0762	0.0760	0.0758	0.0758	0.0757	0.0754	0.0753	0.0747	0.0769	0.0769	0.0769	0.0769
0.390	0.0765	0.0766	0.0767	0.0768	0.0768	0.0769	0.0769	0.0769	0.0770	0.0787	0.0786	0.0785	0.0785
0.395	0.0762	0.0762	0.0762	0.0762	0.0761	0.0759	0.0758	0.0750	0.0743	0.0754	0.0756	0.0761	0.0761
0.400	0.0774	0.0775	0.0775	0.0775	0.0775	0.0776	0.0776	0.0777	0.0777	0.0793	0.0784	0.0782	0.0781
0.405	0.0769	0.0769	0.0768	0.0768	0.0767	0.0766	0.0765	0.0762	0.0760	0.0755	0.0755	0.0759	0.0759
0.410	0.0785	0.0785	0.0785	0.0785	0.0786	0.0786	0.0788	0.0790	0.0791	0.0799	0.0796	0.0789	0.0788
0.415	0.0786	0.0784	0.0782	0.0782	0.0781	0.0781	0.0780	0.0774	0.0765	0.0769	0.0770	0.0770	0.0775
0.420	0.0811	0.0811	0.0812	0.0814	0.0815	0.0816	0.0816	0.0817	0.0818	0.0822	0.0821	0.0818	0.0814
0.425	0.0811	0.0810	0.0809	0.0807	0.0805	0.0803	0.0800	0.0797	0.0794	0.0797	0.0798	0.0802	0.0808
0.430	0.0837	0.0837	0.0837	0.0838	0.0839	0.0841	0.0842	0.0843	0.0849	0.0849	0.0847	0.0840	0.0840
0.435	0.0855	0.0854	0.0852	0.0851	0.0850	0.0850	0.0849	0.0849	0.0849	0.0825	0.0829	0.0830	0.0835
0.440	0.0863	0.0866	0.0866	0.0866	0.0868	0.0868	0.0869	0.0871	0.0879	0.0875	0.0875	0.0867	0.0866
0.445	0.0862	0.0861	0.0861	0.0858	0.0858	0.0856	0.0852	0.0852	0.0851	0.0869	0.0870	0.0870	0.0870
0.450	0.0889	0.0890	0.0892	0.0894	0.0895	0.0896	0.0898	0.0899	0.0903	0.0903	0.0901	0.0897	0.0893
0.455	0.0892	0.0890	0.0887	0.0885	0.0884	0.0882	0.0880	0.0880	0.0874	0.0880	0.0881	0.0885	0.0890
0.460	0.0905	0.0906	0.0906	0.0906	0.0907	0.0907	0.0908	0.0908	0.0908	0.0912	0.0912	0.0912	0.0912
0.465	0.0918	0.0916	0.0916	0.0915	0.0914	0.0914	0.0911	0.0911	0.0909	0.0925	0.0925	0.0925	0.0926
0.470	0.0947	0.0951	0.0952	0.0952	0.0953	0.0953	0.0954	0.0955	0.0960	0.0960	0.0959	0.0949	0.0948
0.475	0.0947	0.0945	0.0944	0.0943	0.0943	0.0942	0.0939	0.0938	0.0937	0.0936	0.0940	0.0942	0.0946
0.480	0.0974	0.0977	0.0978	0.0979	0.0980	0.0980	0.0981	0.0981	0.0986	0.0989	0.0986	0.0978	0.0978
0.485	0.0975	0.0974	0.0973	0.0970	0.0970	0.0969	0.0968	0.0966	0.0965	0.0967	0.0969	0.0969	0.0974
0.490	0.0989	0.0989	0.0990	0.0990	0.0990	0.0990	0.0991	0.0992	0.0993	0.1011	0.1011	0.1010	0.1006
0.495	0.1005	0.1004	0.1001	0.1001	0.0998	0.0998	0.0997	0.0994	0.0992	0.0994	0.0995	0.0999	0.1003
0.500	0.1031	0.1032	0.1032	0.1033	0.1033	0.1034	0.1034	0.1035	0.1037	0.1044	0.1036	0.1034	0.1034
0.505	0.1033	0.1032	0.1032	0.1031	0.1029	0.1028	0.1028	0.1024	0.1022	0.1039	0.1039	0.1039	0.1040
0.510	0.1058	0.1060	0.1060	0.1060	0.1060	0.1061	0.1061	0.1061	0.1062	0.1064	0.1062	0.1061	0.1061
0.515	0.1062	0.1061	0.1061	0.1061	0.1061	0.1058	0.1055	0.1053	0.1052	0.1055	0.1056	0.1057	0.1061
0.520	0.1087	0.1087	0.1089	0.1089	0.1089	0.1090	0.1090	0.1091	0.1097	0.1091	0.1090	0.1089	0.1089
0.525	0.1089	0.1089	0.1088	0.1087	0.1086	0.1084	0.1082	0.1102	0.1103	0.1103	0.1103	0.1105	0.1107
0.530	0.1117	0.1118	0.1122	0.1122	0.1122	0.1122	0.1129	0.1160	0.1159	0.1157	0.1153	0.1138	0.1133
0.535	0.1128	0.1122	0.1119	0.1116	0.1125	0.1131	0.1131	0.1136	0.1137	0.1138	0.1138	0.1139	0.1142

X-Axis	Y-Axis												
0.000	0.0035	0.0036	0.0046	0.0048	0.0048	0.0052	0.0053	0.0057	0.0058	0.0058	0.0064	0.0073	
0.005	0.0191	0.0186	0.0186	0.0185	0.0185	0.0183	0.0181	0.0180	0.0180	0.0180	0.0180	0.0179	0.0179
0.010	0.0233	0.0232	0.0231	0.0229	0.0228	0.0228	0.0226	0.0226	0.0226	0.0226	0.0225	0.0225	0.0223
0.015	0.0256	0.0256	0.0254	0.0253	0.0253	0.0251	0.0251	0.0251	0.0251	0.0251	0.0250	0.0250	0.0249
0.020	0.0283	0.0282	0.0282	0.0280	0.0279	0.0279	0.0278	0.0278	0.0277	0.0275	0.0275	0.0274	0.0274
0.025	0.0311	0.0314	0.0314	0.0315	0.0315	0.0315	0.0315	0.0316	0.0316	0.0316	0.0317	0.0318	0.0318
0.030	0.0430	0.0429	0.0429	0.0428	0.0427	0.0426	0.0425	0.0424	0.0424	0.0423	0.0423	0.0423	0.0422
0.035	0.0494	0.0494	0.0497	0.0498	0.0499	0.0499	0.0500	0.0500	0.0501	0.0502	0.0503	0.0504	0.0504
0.040	0.0616	0.0614	0.0613	0.0612	0.0611	0.0610	0.0608	0.0606	0.0605	0.0602	0.0601	0.0600	0.0600
0.045	0.0697	0.0699	0.0701	0.0701	0.0703	0.0703	0.0706	0.0708	0.0711	0.0712	0.0715	0.0649	0.0656
0.050	0.0795	0.0794	0.0793	0.0790	0.0789	0.0787	0.0787	0.0786	0.0785	0.0784	0.0783	0.0782	0.0782
0.055	0.0852	0.0852	0.0855	0.0855	0.0856	0.0857	0.0858	0.0858	0.0859	0.0862	0.0863	0.0864	0.0864
0.060	0.0970	0.0969	0.0969	0.0966	0.0966	0.0966	0.0966	0.0965	0.0965	0.0965	0.0965	0.0964	0.0963
0.065	0.1034	0.1035	0.1036	0.1037	0.1037	0.1038	0.1039	0.1039	0.1040	0.1040	0.1041	0.1041	0.1042
0.070	0.1150	0.1148	0.1146	0.1145	0.1145	0.1144	0.1144	0.1144	0.1144	0.1144	0.1142	0.1142	0.1142
0.075	0.1237	0.1237	0.1238	0.1239	0.1241	0.1243	0.1248	0.1198	0.1203	0.1205	0.1206	0.1209	0.1211
0.080	0.1307	0.1305	0.1304	0.1303	0.1302	0.1301	0.1299	0.1299	0.1298	0.1297	0.1297	0.1297	0.1297
0.085	0.1337	0.1339	0.1339	0.1340	0.1340	0.1340	0.1340	0.1341	0.1341	0.1343	0.1343	0.1343	0.1343
0.090	0.1385	0.1385	0.1384	0.1384	0.1382	0.1381	0.1381	0.1381	0.1381	0.1381	0.1381	0.1380	0.1380
0.095	0.1384	0.1384	0.1384	0.1385	0.1385	0.1386	0.1386	0.1386	0.1386	0.1387	0.1387	0.1387	0.1388
0.100	0.1407	0.1406	0.1406	0.1406	0.1405	0.1405	0.1404	0.1404	0.1403	0.1403	0.1402	0.1402	0.1401
0.105	0.1405	0.1405	0.1405	0.1406	0.1406	0.1406	0.1407	0.1407	0.1408	0.1408	0.1409	0.1410	0.1410
0.110	0.1414	0.1414	0.1411	0.1410	0.1409	0.1409	0.1408	0.1408	0.1407	0.1407	0.1406	0.1406	0.1405
0.115	0.1409	0.1409	0.1409	0.1410	0.1411	0.1411	0.1412	0.1412	0.1412	0.1412	0.1413	0.1413	0.1415
0.120	0.1411	0.1410	0.1410	0.1410	0.1410	0.1409	0.1409	0.1408	0.1408	0.1407	0.1407	0.1406	0.1405
0.125	0.1384	0.1384	0.1386	0.1386	0.1387	0.1388	0.1389	0.1389	0.1389	0.1390	0.1390	0.1390	0.1390
0.130	0.1383	0.1383	0.1382	0.1382	0.1382	0.1381	0.1381	0.1380	0.1380	0.1380	0.1379	0.1378	0.1378
0.135	0.1343	0.1344	0.1347	0.1348	0.1348	0.1351	0.1351	0.1352	0.1352	0.1352	0.1353	0.1353	0.1354
0.140	0.1323	0.1319	0.1319	0.1317	0.1317	0.1316	0.1316	0.1316	0.1315	0.1314	0.1314	0.1314	0.1312
0.145	0.1222	0.1225	0.1227	0.1227	0.1228	0.1228	0.1230	0.1230	0.1230	0.1234	0.1235	0.1235	0.1235
0.150	0.1127	0.1124	0.1123	0.1118	0.1116	0.1115	0.1114	0.1113	0.1111	0.1111	0.1111	0.1110	0.1110
0.155	0.0892	0.0894	0.0894	0.0897	0.0899	0.0901	0.0903	0.0903	0.0904	0.0910	0.0911	0.0911	0.0915
0.160	0.0781	0.0780	0.0778	0.0775	0.0767	0.0766	0.0764	0.0763	0.0762	0.0760	0.0759	0.0759	0.0755
0.165	0.0581	0.0581	0.0582	0.0583	0.0585	0.0585	0.0585	0.0586	0.0586	0.0586	0.0586	0.0587	0.0589
0.170	0.0567	0.0567	0.0566	0.0565	0.0565	0.0565	0.0564	0.0563	0.0562	0.0562	0.0561	0.0561	0.0559
0.175	0.0555	0.0555	0.0555	0.0556	0.0556	0.0556	0.0557	0.0536	0.0536	0.0538	0.0538	0.0538	0.0538
0.180	0.0559	0.0558	0.0555	0.0555	0.0554	0.0554	0.0554	0.0554	0.0553	0.0552	0.0552	0.0551	0.0550
0.185	0.0537	0.0538	0.0538	0.0539	0.0541	0.0541	0.0542	0.0542	0.0543	0.0543	0.0543	0.0544	0.0545
0.190	0.0558	0.0557	0.0556	0.0556	0.0555	0.0554	0.0553	0.0553	0.0552	0.0552	0.0552	0.0552	0.0551
0.195	0.0540	0.0541	0.0541	0.0542	0.0542	0.0543	0.0544	0.0544	0.0544	0.0545	0.0545	0.0546	0.0547
0.200	0.0561	0.0560	0.0560	0.0560	0.0558	0.0558	0.0558	0.0557	0.0556	0.0556	0.0555	0.0555	0.0555
0.205	0.0562	0.0562	0.0563	0.0563	0.0564	0.0565	0.0565	0.0566	0.0567	0.0567	0.0568	0.0570	0.0542
0.210	0.0575	0.0573	0.0572	0.0572	0.0572	0.0572	0.0571	0.0571	0.0569	0.0569	0.0568	0.0568	0.0568
0.215	0.0568	0.0571	0.0572	0.0572	0.0572	0.0572	0.0572	0.0574	0.0574	0.0574	0.0575	0.0575	0.0575
0.220	0.0595	0.0594	0.0594	0.0593	0.0593	0.0593	0.0593	0.0592	0.0592	0.0592	0.0592	0.0591	0.0590
0.225	0.0592	0.0592	0.0592	0.0594	0.0594	0.0594	0.0595	0.0596	0.0596	0.0597	0.0597	0.0598	0.0598
0.230	0.0616	0.0616	0.0616	0.0615	0.0615	0.0615	0.0615	0.0615	0.0615	0.0615	0.0614	0.0613	0.0613
0.235	0.0613	0.0614	0.0615	0.0615	0.0615	0.0616	0.0616	0.0616	0.0617	0.0617	0.0617	0.0617	0.0617
0.240	0.0638	0.0638	0.0638	0.0637	0.0636	0.0636	0.0635	0.0635	0.0635	0.0635	0.0635	0.0635	0.0635
0.245	0.0653	0.0654	0.0654	0.0654	0.0655	0.0655	0.0656	0.0656	0.0657	0.0657	0.0657	0.0658	0.0658
0.250	0.0722	0.0722	0.0722	0.0722	0.0719	0.0718	0.0718	0.0717	0.0717	0.0716	0.0716	0.0715	0.0713
0.255	0.0778	0.0782	0.0783	0.0784	0.0786	0.0787	0.0787	0.0787	0.0788	0.0789	0.0789	0.0789	0.0790
0.260	0.0899	0.0895	0.0892	0.0892	0.0891	0.0891	0.0891	0.0890	0.0890	0.0889	0.0889	0.0888	0.0888
0.265	0.0937	0.0938	0.0949	0.0952	0.0953	0.0957	0.0957	0.0958	0.0960	0.0961	0.0961	0.0962	0.0964
0.270	0.1070	0.1070	0.1067	0.1067	0.1065	0.1065	0.1064	0.1063	0.1063	0.1063	0.1063	0.1062	0.1062
0.275	0.1098	0.1102	0.1104	0.1107	0.1107	0.1107	0.1108	0.1108	0.1108	0.1109	0.1109	0.1109	0.1111

0.280	0.1155	0.1155	0.1155	0.1154	0.1153	0.1153	0.1152	0.1152	0.1152	0.1152	0.1151	0.1151	0.1150
0.285	0.1169	0.1170	0.1171	0.1174	0.1174	0.1175	0.1175	0.1176	0.1178	0.1178	0.1178	0.1179	0.1179
0.290	0.1223	0.1223	0.1220	0.1220	0.1220	0.1220	0.1219	0.1218	0.1218	0.1218	0.1218	0.1218	0.1217
0.295	0.1231	0.1234	0.1235	0.1236	0.1240	0.1240	0.1240	0.1240	0.1240	0.1241	0.1242	0.1242	0.1242
0.300	0.1280	0.1279	0.1277	0.1277	0.1277	0.1277	0.1277	0.1277	0.1275	0.1275	0.1275	0.1275	0.1275
0.305	0.1281	0.1282	0.1285	0.1285	0.1288	0.1288	0.1288	0.1290	0.1290	0.1291	0.1291	0.1291	0.1292
0.310	0.1310	0.1310	0.1309	0.1309	0.1308	0.1308	0.1308	0.1308	0.1308	0.1308	0.1307	0.1307	0.1307
0.315	0.1296	0.1297	0.1298	0.1301	0.1302	0.1303	0.1303	0.1303	0.1304	0.1304	0.1304	0.1305	0.1305
0.320	0.1314	0.1312	0.1311	0.1310	0.1308	0.1308	0.1308	0.1308	0.1308	0.1308	0.1307	0.1307	0.1307
0.325	0.1288	0.1289	0.1289	0.1289	0.1289	0.1289	0.1290	0.1290	0.1291	0.1291	0.1291	0.1292	0.1293
0.330	0.1250	0.1250	0.1250	0.1249	0.1249	0.1246	0.1246	0.1245	0.1245	0.1244	0.1243	0.1243	0.1243
0.335	0.1067	0.1067	0.1069	0.1076	0.1081	0.1081	0.1081	0.1083	0.1084	0.1085	0.1085	0.1089	0.1091
0.340	0.0967	0.0966	0.0966	0.0964	0.0962	0.0961	0.0959	0.0957	0.0955	0.0955	0.0955	0.0955	0.0955
0.345	0.0789	0.0790	0.0792	0.0793	0.0794	0.0794	0.0794	0.0795	0.0795	0.0796	0.0796	0.0797	0.0801
0.350	0.0780	0.0779	0.0778	0.0778	0.0778	0.0777	0.0776	0.0775	0.0775	0.0775	0.0775	0.0775	0.0775
0.355	0.0755	0.0758	0.0759	0.0759	0.0759	0.0762	0.0762	0.0762	0.0762	0.0763	0.0763	0.0763	0.0764
0.360	0.0766	0.0766	0.0766	0.0765	0.0765	0.0765	0.0764	0.0764	0.0764	0.0763	0.0762	0.0762	0.0759
0.365	0.0760	0.0761	0.0762	0.0763	0.0763	0.0763	0.0764	0.0764	0.0765	0.0765	0.0766	0.0766	0.0767
0.370	0.0775	0.0775	0.0775	0.0775	0.0773	0.0773	0.0773	0.0772	0.0772	0.0771	0.0771	0.0771	0.0771
0.375	0.0766	0.0766	0.0766	0.0767	0.0768	0.0768	0.0768	0.0769	0.0769	0.0770	0.0770	0.0770	0.0770
0.380	0.0763	0.0763	0.0762	0.0762	0.0756	0.0753	0.0752	0.0788	0.0783	0.0782	0.0778	0.0777	0.0777
0.385	0.0770	0.0770	0.0770	0.0771	0.0771	0.0771	0.0771	0.0771	0.0771	0.0771	0.0772	0.0772	0.0772
0.390	0.0782	0.0778	0.0778	0.0777	0.0776	0.0775	0.0775	0.0774	0.0774	0.0773	0.0773	0.0773	0.0773
0.395	0.0762	0.0764	0.0765	0.0766	0.0766	0.0766	0.0767	0.0768	0.0769	0.0769	0.0770	0.0770	0.0770
0.400	0.0779	0.0778	0.0778	0.0778	0.0778	0.0778	0.0777	0.0777	0.0776	0.0776	0.0775	0.0775	0.0775
0.405	0.0760	0.0766	0.0768	0.0769	0.0769	0.0769	0.0769	0.0769	0.0770	0.0770	0.0771	0.0771	0.0771
0.410	0.0788	0.0787	0.0786	0.0785	0.0785	0.0784	0.0784	0.0784	0.0784	0.0783	0.0783	0.0783	0.0782
0.415	0.0780	0.0784	0.0784	0.0785	0.0785	0.0785	0.0785	0.0785	0.0786	0.0786	0.0786	0.0787	0.0788
0.420	0.0811	0.0811	0.0810	0.0808	0.0808	0.0807	0.0807	0.0807	0.0806	0.0806	0.0806	0.0806	0.0806
0.425	0.0808	0.0810	0.0810	0.0810	0.0811	0.0811	0.0811	0.0812	0.0812	0.0812	0.0812	0.0814	0.0815
0.430	0.0838	0.0838	0.0838	0.0837	0.0836	0.0836	0.0835	0.0835	0.0835	0.0834	0.0834	0.0832	0.0832
0.435	0.0837	0.0837	0.0838	0.0838	0.0838	0.0840	0.0840	0.0840	0.0841	0.0841	0.0841	0.0841	0.0841
0.440	0.0865	0.0865	0.0864	0.0863	0.0863	0.0862	0.0862	0.0862	0.0861	0.0860	0.0860	0.0859	0.0858
0.445	0.0870	0.0870	0.0870	0.0870	0.0870	0.0871	0.0871	0.0872	0.0872	0.0872	0.0872	0.0873	0.0875
0.450	0.0893	0.0891	0.0890	0.0890	0.0890	0.0890	0.0889	0.0888	0.0888	0.0887	0.0887	0.0887	0.0887
0.455	0.0890	0.0891	0.0892	0.0892	0.0892	0.0892	0.0892	0.0893	0.0894	0.0894	0.0895	0.0895	0.0896
0.460	0.0911	0.0911	0.0910	0.0910	0.0909	0.0909	0.0909	0.0907	0.0907	0.0906	0.0905	0.0905	0.0905
0.465	0.0926	0.0926	0.0926	0.0927	0.0927	0.0927	0.0927	0.0928	0.0928	0.0928	0.0929	0.0929	0.0929
0.470	0.0948	0.0948	0.0947	0.0945	0.0945	0.0944	0.0944	0.0944	0.0944	0.0944	0.0944	0.0944	0.0943
0.475	0.0947	0.0948	0.0948	0.0948	0.0948	0.0949	0.0949	0.0949	0.0950	0.0950	0.0951	0.0951	0.0951
0.480	0.0976	0.0975	0.0975	0.0975	0.0974	0.0973	0.0973	0.0973	0.0972	0.0971	0.0970	0.0970	0.0970
0.485	0.0976	0.0977	0.0977	0.0977	0.0977	0.0978	0.0978	0.0979	0.0979	0.0979	0.0979	0.0981	0.0981
0.490	0.1006	0.1003	0.1003	0.1003	0.1002	0.1002	0.1002	0.1001	0.1001	0.1000	0.1000	0.0999	0.0999
0.495	0.1004	0.1004	0.1005	0.1006	0.1006	0.1007	0.1007	0.1008	0.1008	0.1008	0.1009	0.1009	0.1009
0.500	0.1033	0.1032	0.1032	0.1031	0.1030	0.1030	0.1030	0.1030	0.1029	0.1029	0.1028	0.1028	0.1028
0.505	0.1040	0.1040	0.1040	0.1040	0.1041	0.1042	0.1042	0.1042	0.1042	0.1042	0.1043	0.1043	0.1043
0.510	0.1059	0.1059	0.1059	0.1058	0.1058	0.1058	0.1058	0.1057	0.1057	0.1057	0.1057	0.1057	0.1056
0.515	0.1062	0.1063	0.1063	0.1063	0.1063	0.1064	0.1064	0.1065	0.1065	0.1065	0.1066	0.1066	0.1066
0.520	0.1089	0.1088	0.1087	0.1087	0.1086	0.1086	0.1086	0.1086	0.1085	0.1085	0.1085	0.1085	0.1084
0.525	0.1108	0.1110	0.1123	0.1127	0.1097	0.1097	0.1098	0.1098	0.1099	0.1099	0.1099	0.1100	0.1100
0.530	0.1131	0.1130	0.1129	0.1128	0.1127	0.1127	0.1126	0.1124	0.1123	0.1122	0.1121	0.1120	0.1120
0.535	0.1143	0.1145	0.1146	0.1147	0.1149	0.1150	0.1151	0.1151	0.1154	0.1154	0.1158	0.1159	0.1159

X-Axis	Y-Axis												
0.000													
0.005	0.0179	0.0178	0.0177	0.0177	0.0177	0.0177	0.0176	0.0176	0.0175	0.0174	0.0174	0.0172	0.0172
0.010	0.0223	0.0223	0.0223	0.0222	0.0222	0.0222	0.0222	0.0221	0.0221	0.0221	0.0220	0.0220	0.0220
0.015	0.0248	0.0248	0.0248	0.0248	0.0247	0.0247	0.0247	0.0247	0.0247	0.0246	0.0246	0.0245	0.0244
0.020	0.0273	0.0272	0.0272	0.0271	0.0271	0.0271	0.0270	0.0270	0.0270	0.0270	0.0269	0.0269	0.0269
0.025	0.0319	0.0320	0.0321	0.0323	0.0324	0.0325	0.0325	0.0326	0.0327	0.0327	0.0328	0.0328	0.0328
0.030	0.0420	0.0420	0.0420	0.0420	0.0418	0.0418	0.0417	0.0416	0.0416	0.0415	0.0415	0.0414	0.0414
0.035	0.0506	0.0506	0.0506	0.0507	0.0507	0.0507	0.0508	0.0509	0.0509	0.0509	0.0509	0.0510	0.0512
0.040	0.0600	0.0600	0.0599	0.0599	0.0597	0.0597	0.0597	0.0596	0.0595	0.0595	0.0595	0.0594	0.0594
0.045	0.0668	0.0671	0.0672	0.0673	0.0673	0.0676	0.0678	0.0678	0.0680	0.0681	0.0681	0.0682	0.0683
0.050	0.0781	0.0780	0.0780	0.0780	0.0780	0.0779	0.0779	0.0778	0.0778	0.0777	0.0775	0.0774	0.0774
0.055	0.0865	0.0866	0.0866	0.0866	0.0866	0.0867	0.0867	0.0868	0.0868	0.0869	0.0870	0.0870	0.0870
0.060	0.0963	0.0962	0.0962	0.0962	0.0961	0.0958	0.0957	0.0957	0.0956	0.0955	0.0954	0.0954	0.0953
0.065	0.1042	0.1042	0.1043	0.1043	0.1044	0.1045	0.1047	0.1047	0.1047	0.1047	0.1048	0.1050	0.1051
0.070	0.1141	0.1141	0.1137	0.1136	0.1135	0.1135	0.1134	0.1132	0.1132	0.1132	0.1132	0.1132	0.1132
0.075	0.1212	0.1214	0.1216	0.1217	0.1217	0.1218	0.1218	0.1220	0.1220	0.1220	0.1220	0.1220	0.1221
0.080	0.1295	0.1295	0.1295	0.1295	0.1294	0.1294	0.1294	0.1293	0.1293	0.1292	0.1291	0.1290	0.1290
0.085	0.1343	0.1344	0.1344	0.1344	0.1345	0.1346	0.1346	0.1347	0.1347	0.1347	0.1347	0.1348	0.1348
0.090	0.1379	0.1379	0.1378	0.1378	0.1378	0.1377	0.1377	0.1377	0.1377	0.1377	0.1377	0.1376	0.1376
0.095	0.1388	0.1388	0.1388	0.1388	0.1389	0.1389	0.1389	0.1389	0.1389	0.1389	0.1390	0.1390	0.1390
0.100	0.1401	0.1401	0.1401	0.1400	0.1400	0.1399	0.1399	0.1399	0.1399	0.1399	0.1399	0.1399	0.1399
0.105	0.1411	0.1412	0.1412	0.1416	0.1416	0.1390	0.1393	0.1394	0.1395	0.1395	0.1395	0.1396	0.1398
0.110	0.1404	0.1404	0.1404	0.1404	0.1404	0.1404	0.1404	0.1404	0.1404	0.1403	0.1403	0.1403	0.1403
0.115	0.1416	0.1418	0.1394	0.1394	0.1397	0.1397	0.1397	0.1398	0.1399	0.1400	0.1400	0.1400	0.1400
0.120	0.1405	0.1405	0.1404	0.1403	0.1403	0.1403	0.1403	0.1402	0.1402	0.1401	0.1401	0.1401	0.1401
0.125	0.1391	0.1391	0.1391	0.1391	0.1391	0.1392	0.1392	0.1392	0.1392	0.1393	0.1393	0.1394	0.1394
0.130	0.1377	0.1377	0.1377	0.1376	0.1376	0.1376	0.1376	0.1375	0.1375	0.1375	0.1374	0.1374	0.1373
0.135	0.1355	0.1356	0.1356	0.1356	0.1356	0.1356	0.1357	0.1357	0.1357	0.1357	0.1358	0.1358	0.1358
0.140	0.1312	0.1312	0.1312	0.1311	0.1311	0.1311	0.1310	0.1310	0.1310	0.1309	0.1309	0.1309	0.1308
0.145	0.1236	0.1236	0.1236	0.1236	0.1236	0.1236	0.1237	0.1237	0.1237	0.1238	0.1239	0.1239	0.1239
0.150	0.1109	0.1106	0.1105	0.1103	0.1101	0.1101	0.1100	0.1099	0.1099	0.1098	0.1098	0.1097	0.1096
0.155	0.0919	0.0921	0.0922	0.0922	0.0923	0.0923	0.0924	0.0924	0.0926	0.0926	0.0927	0.0927	0.0928
0.160	0.0753	0.0753	0.0753	0.0751	0.0751	0.0750	0.0750	0.0748	0.0745	0.0744	0.0740	0.0739	0.0738
0.165	0.0590	0.0591	0.0591	0.0592	0.0593	0.0593	0.0594	0.0594	0.0595	0.0595	0.0596	0.0596	0.0597
0.170	0.0558	0.0558	0.0556	0.0556	0.0555	0.0555	0.0555	0.0554	0.0553	0.0552	0.0552	0.0552	0.0552
0.175	0.0538	0.0538	0.0540	0.0540	0.0542	0.0542	0.0542	0.0542	0.0543	0.0543	0.0543	0.0543	0.0544
0.180	0.0549	0.0549	0.0549	0.0548	0.0548	0.0547	0.0546	0.0546	0.0546	0.0546	0.0545	0.0545	0.0545
0.185	0.0545	0.0545	0.0545	0.0545	0.0545	0.0546	0.0546	0.0547	0.0548	0.0548	0.0549	0.0549	0.0549
0.190	0.0551	0.0551	0.0550	0.0550	0.0549	0.0549	0.0549	0.0549	0.0547	0.0547	0.0547	0.0547	0.0546
0.195	0.0547	0.0548	0.0548	0.0548	0.0548	0.0549	0.0549	0.0551	0.0551	0.0551	0.0551	0.0551	0.0551
0.200	0.0555	0.0554	0.0553	0.0553	0.0553	0.0553	0.0552	0.0552	0.0550	0.0550	0.0549	0.0549	0.0549
0.205	0.0543	0.0544	0.0545	0.0547	0.0548	0.0549	0.0550	0.0550	0.0551	0.0551	0.0552	0.0552	0.0553
0.210	0.0567	0.0567	0.0567	0.0567	0.0567	0.0567	0.0566	0.0566	0.0566	0.0566	0.0566	0.0566	0.0564
0.215	0.0576	0.0577	0.0577	0.0577	0.0577	0.0578	0.0578	0.0578	0.0578	0.0579	0.0579	0.0579	0.0579
0.220	0.0590	0.0590	0.0590	0.0590	0.0590	0.0589	0.0589	0.0589	0.0588	0.0588	0.0587	0.0587	0.0587
0.225	0.0598	0.0598	0.0598	0.0598	0.0599	0.0599	0.0600	0.0600	0.0600	0.0601	0.0601	0.0601	0.0601
0.230	0.0613	0.0612	0.0612	0.0611	0.0611	0.0611	0.0610	0.0609	0.0609	0.0609	0.0609	0.0609	0.0608
0.235	0.0618	0.0618	0.0618	0.0619	0.0621	0.0621	0.0622	0.0622	0.0622	0.0622	0.0622	0.0623	0.0623
0.240	0.0634	0.0634	0.0634	0.0633	0.0633	0.0632	0.0632	0.0632	0.0632	0.0631	0.0631	0.0630	0.0629
0.245	0.0658	0.0661	0.0661	0.0630	0.0632	0.0633	0.0635	0.0635	0.0638	0.0640	0.0640	0.0641	0.0642
0.250	0.0713	0.0712	0.0712	0.0711	0.0710	0.0710	0.0709	0.0708	0.0707	0.0706	0.0706	0.0706	0.0705
0.255	0.0791	0.0792	0.0792	0.0793	0.0794	0.0794	0.0795	0.0796	0.0796	0.0796	0.0797	0.0797	0.0798
0.260	0.0888	0.0888	0.0887	0.0887	0.0885	0.0885	0.0884	0.0883	0.0881	0.0881	0.0880	0.0879	0.0879
0.265	0.0965	0.0967	0.0967	0.0967	0.0967	0.0967	0.0968	0.0969	0.0969	0.0970	0.0970	0.0970	0.0970
0.270	0.1062	0.1061	0.1061	0.1060	0.1060	0.1057	0.1055	0.1055	0.1055	0.1055	0.1055	0.1054	0.1052
0.275	0.1111	0.1111	0.1112	0.1112	0.1112	0.1112	0.1113	0.1113	0.1114	0.1114	0.1114	0.1114	0.1115

0.280	0.1150	0.1149	0.1148	0.1147	0.1147	0.1147	0.1146	0.1146	0.1146	0.1146	0.1146	0.1146	0.1146
0.285	0.1179	0.1179	0.1179	0.1179	0.1180	0.1180	0.1180	0.1181	0.1181	0.1182	0.1182	0.1182	0.1183
0.290	0.1217	0.1215	0.1215	0.1215	0.1215	0.1214	0.1214	0.1213	0.1212	0.1212	0.1212	0.1211	0.1211
0.295	0.1242	0.1242	0.1243	0.1244	0.1244	0.1244	0.1244	0.1245	0.1245	0.1245	0.1245	0.1246	0.1246
0.300	0.1275	0.1275	0.1274	0.1274	0.1274	0.1273	0.1273	0.1273	0.1273	0.1273	0.1273	0.1273	0.1272
0.305	0.1292	0.1292	0.1292	0.1292	0.1292	0.1292	0.1293	0.1293	0.1293	0.1294	0.1295	0.1295	0.1295
0.310	0.1307	0.1307	0.1306	0.1305	0.1304	0.1304	0.1304	0.1304	0.1303	0.1303	0.1302	0.1302	0.1302
0.315	0.1307	0.1307	0.1307	0.1308	0.1308	0.1308	0.1308	0.1308	0.1309	0.1309	0.1309	0.1309	0.1310
0.320	0.1307	0.1307	0.1306	0.1306	0.1306	0.1306	0.1306	0.1305	0.1305	0.1305	0.1305	0.1304	0.1304
0.325	0.1293	0.1293	0.1293	0.1294	0.1294	0.1295	0.1295	0.1295	0.1297	0.1298	0.1299	0.1261	0.1267
0.330	0.1242	0.1242	0.1242	0.1241	0.1241	0.1240	0.1239	0.1239	0.1237	0.1235	0.1234	0.1232	0.1232
0.335	0.1091	0.1092	0.1092	0.1094	0.1094	0.1095	0.1096	0.1097	0.1098	0.1098	0.1099	0.1099	0.1101
0.340	0.0951	0.0949	0.0949	0.0948	0.0947	0.0946	0.0944	0.0942	0.0941	0.0938	0.0937	0.0937	0.0934
0.345	0.0801	0.0802	0.0803	0.0803	0.0803	0.0804	0.0804	0.0805	0.0806	0.0807	0.0807	0.0808	0.0809
0.350	0.0775	0.0774	0.0773	0.0773	0.0772	0.0772	0.0772	0.0772	0.0772	0.0772	0.0772	0.0772	0.0771
0.355	0.0764	0.0765	0.0766	0.0766	0.0766	0.0766	0.0766	0.0767	0.0767	0.0767	0.0767	0.0767	0.0767
0.360	0.0758	0.0758	0.0756	0.0756	0.0751	0.0749	0.0784	0.0780	0.0777	0.0776	0.0776	0.0775	0.0774
0.365	0.0767	0.0767	0.0768	0.0768	0.0768	0.0768	0.0768	0.0769	0.0769	0.0769	0.0769	0.0769	0.0769
0.370	0.0771	0.0770	0.0770	0.0770	0.0770	0.0770	0.0769	0.0768	0.0768	0.0767	0.0767	0.0767	0.0767
0.375	0.0771	0.0771	0.0772	0.0772	0.0773	0.0774	0.0775	0.0776	0.0776	0.0777	0.0777	0.0777	0.0778
0.380	0.0777	0.0777	0.0777	0.0776	0.0775	0.0775	0.0773	0.0773	0.0772	0.0772	0.0772	0.0771	0.0771
0.385	0.0773	0.0774	0.0774	0.0775	0.0777	0.0777	0.0777	0.0777	0.0777	0.0778	0.0785	0.0786	0.0789
0.390	0.0773	0.0772	0.0772	0.0772	0.0772	0.0771	0.0771	0.0771	0.0771	0.0770	0.0770	0.0770	0.0770
0.395	0.0771	0.0771	0.0771	0.0772	0.0772	0.0772	0.0772	0.0772	0.0773	0.0774	0.0774	0.0774	0.0774
0.400	0.0775	0.0775	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0772	0.0772	0.0772
0.405	0.0772	0.0772	0.0772	0.0773	0.0773	0.0774	0.0774	0.0774	0.0775	0.0775	0.0776	0.0776	0.0776
0.410	0.0782	0.0782	0.0782	0.0781	0.0781	0.0781	0.0781	0.0780	0.0779	0.0779	0.0779	0.0779	0.0779
0.415	0.0788	0.0789	0.0789	0.0790	0.0790	0.0790	0.0791	0.0791	0.0791	0.0791	0.0791	0.0791	0.0791
0.420	0.0805	0.0805	0.0805	0.0805	0.0805	0.0805	0.0804	0.0804	0.0803	0.0803	0.0802	0.0802	0.0801
0.425	0.0815	0.0815	0.0816	0.0816	0.0817	0.0817	0.0817	0.0817	0.0817	0.0818	0.0818	0.0818	0.0818
0.430	0.0831	0.0831	0.0831	0.0831	0.0831	0.0831	0.0830	0.0830	0.0830	0.0829	0.0829	0.0829	0.0828
0.435	0.0842	0.0842	0.0842	0.0842	0.0843	0.0843	0.0843	0.0843	0.0843	0.0844	0.0844	0.0844	0.0845
0.440	0.0858	0.0857	0.0857	0.0857	0.0857	0.0857	0.0856	0.0856	0.0856	0.0856	0.0856	0.0856	0.0856
0.445	0.0875	0.0876	0.0876	0.0876	0.0877	0.0878	0.0878	0.0879	0.0879	0.0879	0.0888	0.0889	0.0848
0.450	0.0886	0.0886	0.0886	0.0885	0.0885	0.0884	0.0884	0.0884	0.0883	0.0883	0.0883	0.0883	0.0883
0.455	0.0896	0.0896	0.0897	0.0897	0.0898	0.0898	0.0898	0.0898	0.0898	0.0898	0.0899	0.0899	0.0900
0.460	0.0904	0.0904	0.0899	0.0898	0.0897	0.0931	0.0929	0.0924	0.0920	0.0919	0.0918	0.0918	0.0917
0.465	0.0929	0.0929	0.0930	0.0930	0.0931	0.0931	0.0931	0.0933	0.0933	0.0935	0.0935	0.0938	0.0942
0.470	0.0942	0.0942	0.0941	0.0941	0.0941	0.0940	0.0940	0.0940	0.0940	0.0940	0.0940	0.0939	0.0939
0.475	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0954	0.0954	0.0954	0.0954	0.0955	0.0955
0.480	0.0970	0.0970	0.0969	0.0969	0.0969	0.0968	0.0968	0.0968	0.0968	0.0968	0.0967	0.0967	0.0967
0.485	0.0981	0.0981	0.0982	0.0982	0.0982	0.0982	0.0982	0.0983	0.0983	0.0983	0.0983	0.0984	0.0984
0.490	0.0999	0.0998	0.0998	0.0997	0.0997	0.0997	0.0997	0.0997	0.0996	0.0996	0.0996	0.0996	0.0996
0.495	0.1010	0.1010	0.1011	0.1011	0.1011	0.1011	0.1011	0.1011	0.1012	0.1012	0.1012	0.1013	0.1014
0.500	0.1028	0.1027	0.1027	0.1026	0.1026	0.1026	0.1026	0.1025	0.1025	0.1025	0.1024	0.1024	0.1024
0.505	0.1044	0.1045	0.1045	0.1045	0.1046	0.1046	0.1047	0.1047	0.1048	0.1048	0.1054	0.1025	0.1026
0.510	0.1056	0.1056	0.1056	0.1055	0.1055	0.1055	0.1054	0.1053	0.1053	0.1053	0.1053	0.1053	0.1053
0.515	0.1066	0.1067	0.1067	0.1067	0.1067	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1069	0.1069
0.520	0.1084	0.1083	0.1083	0.1083	0.1082	0.1082	0.1082	0.1081	0.1081	0.1081	0.1080	0.1080	0.1080
0.525	0.1101	0.1101	0.1102	0.1102	0.1082	0.1084	0.1086	0.1087	0.1087	0.1093	0.1094	0.1094	0.1094
0.530	0.1119	0.1118	0.1117	0.1117	0.1117	0.1116	0.1115	0.1115	0.1114	0.1114	0.1113	0.1113	0.1113
0.535	0.1159	0.1161	0.1163	0.1163	0.1166	0.1172	0.1174	0.1174	0.1176	0.1180	0.1182	0.1183	0.1184

X-Axis	Y-Axis												
0.000													
0.005	0.0171	0.0170	0.0170	0.0170	0.0168	0.0168	0.0168	0.0167	0.0166	0.0166	0.0166	0.0165	0.0165
0.010	0.0219	0.0219	0.0219	0.0219	0.0218	0.0218	0.0218	0.0218	0.0217	0.0217	0.0217	0.0217	0.0216
0.015	0.0244	0.0243	0.0243	0.0243	0.0243	0.0242	0.0241	0.0240	0.0240	0.0239	0.0239	0.0237	0.0237
0.020	0.0269	0.0268	0.0268	0.0268	0.0268	0.0268	0.0268	0.0267	0.0267	0.0266	0.0266	0.0263	0.0262
0.025	0.0329	0.0329	0.0331	0.0334	0.0335	0.0335	0.0340	0.0340	0.0340	0.0341	0.0342	0.0344	0.0344
0.030	0.0414	0.0414	0.0413	0.0413	0.0412	0.0412	0.0412	0.0410	0.0410	0.0408	0.0408	0.0407	0.0404
0.035	0.0513	0.0513	0.0513	0.0513	0.0513	0.0513	0.0519	0.0520	0.0522	0.0524	0.0524	0.0526	0.0527
0.040	0.0593	0.0593	0.0593	0.0593	0.0592	0.0591	0.0590	0.0590	0.0588	0.0588	0.0587	0.0586	0.0585
0.045	0.0683	0.0683	0.0684	0.0685	0.0685	0.0685	0.0686	0.0686	0.0687	0.0687	0.0687	0.0687	0.0688
0.050	0.0774	0.0773	0.0772	0.0772	0.0772	0.0770	0.0770	0.0769	0.0769	0.0769	0.0767	0.0766	0.0766
0.055	0.0870	0.0870	0.0870	0.0873	0.0873	0.0873	0.0875	0.0875	0.0876	0.0876	0.0877	0.0879	0.0880
0.060	0.0953	0.0949	0.0949	0.0949	0.0949	0.0947	0.0946	0.0946	0.0945	0.0945	0.0943	0.0942	0.0942
0.065	0.1052	0.1054	0.1054	0.1056	0.1056	0.1056	0.1057	0.1057	0.1057	0.1057	0.1057	0.1058	0.1059
0.070	0.1131	0.1130	0.1129	0.1129	0.1128	0.1127	0.1126	0.1126	0.1125	0.1124	0.1123	0.1123	0.1123
0.075	0.1221	0.1221	0.1221	0.1222	0.1222	0.1223	0.1223	0.1225	0.1225	0.1225	0.1225	0.1226	0.1228
0.080	0.1290	0.1290	0.1290	0.1289	0.1289	0.1288	0.1287	0.1287	0.1287	0.1287	0.1286	0.1285	0.1284
0.085	0.1348	0.1348	0.1349	0.1350	0.1351	0.1351	0.1351	0.1352	0.1352	0.1355	0.1355	0.1356	0.1357
0.090	0.1376	0.1376	0.1374	0.1374	0.1373	0.1373	0.1373	0.1372	0.1372	0.1372	0.1371	0.1371	0.1371
0.095	0.1391	0.1392	0.1392	0.1393	0.1393	0.1393	0.1393	0.1393	0.1394	0.1394	0.1396	0.1396	0.1397
0.100	0.1398	0.1398	0.1398	0.1398	0.1397	0.1396	0.1395	0.1394	0.1394	0.1394	0.1393	0.1393	0.1392
0.105	0.1399	0.1400	0.1400	0.1400	0.1400	0.1400	0.1401	0.1401	0.1401	0.1402	0.1402	0.1402	0.1402
0.110	0.1403	0.1403	0.1403	0.1402	0.1402	0.1402	0.1400	0.1400	0.1400	0.1400	0.1400	0.1397	0.1397
0.115	0.1400	0.1400	0.1401	0.1401	0.1401	0.1402	0.1402	0.1402	0.1403	0.1403	0.1403	0.1403	0.1404
0.120	0.1401	0.1400	0.1400	0.1400	0.1400	0.1399	0.1399	0.1399	0.1399	0.1399	0.1398	0.1397	0.1396
0.125	0.1394	0.1395	0.1396	0.1396	0.1397	0.1397	0.1398	0.1398	0.1398	0.1398	0.1398	0.1399	0.1399
0.130	0.1373	0.1373	0.1373	0.1373	0.1373	0.1373	0.1372	0.1372	0.1372	0.1371	0.1371	0.1369	0.1367
0.135	0.1359	0.1359	0.1360	0.1360	0.1361	0.1362	0.1362	0.1362	0.1362	0.1363	0.1363	0.1363	0.1364
0.140	0.1308	0.1307	0.1307	0.1306	0.1306	0.1305	0.1303	0.1302	0.1301	0.1301	0.1300	0.1297	0.1295
0.145	0.1239	0.1240	0.1240	0.1240	0.1241	0.1243	0.1244	0.1244	0.1244	0.1245	0.1245	0.1246	0.1247
0.150	0.1094	0.1093	0.1092	0.1091	0.1091	0.1091	0.1090	0.1084	0.1081	0.1080	0.1079	0.1071	0.1070
0.155	0.0929	0.0929	0.0930	0.0932	0.0934	0.0937	0.0941	0.0941	0.0941	0.0943	0.0947	0.0947	0.0948
0.160	0.0736	0.0736	0.0735	0.0734	0.0733	0.0733	0.0732	0.0732	0.0729	0.0723	0.0721	0.0719	0.0717
0.165	0.0597	0.0598	0.0598	0.0599	0.0600	0.0605	0.0605	0.0605	0.0608	0.0611	0.0613	0.0613	0.0615
0.170	0.0551	0.0551	0.0551	0.0551	0.0550	0.0550	0.0550	0.0550	0.0550	0.0549	0.0549	0.0547	0.0546
0.175	0.0544	0.0545	0.0545	0.0545	0.0546	0.0546	0.0546	0.0546	0.0546	0.0547	0.0547	0.0550	0.0550
0.180	0.0544	0.0543	0.0543	0.0542	0.0542	0.0541	0.0541	0.0541	0.0541	0.0540	0.0540	0.0540	0.0539
0.185	0.0550	0.0550	0.0551	0.0551	0.0552	0.0553	0.0553	0.0553	0.0553	0.0554	0.0555	0.0555	0.0556
0.190	0.0546	0.0546	0.0545	0.0544	0.0544	0.0544	0.0543	0.0542	0.0542	0.0542	0.0538	0.0538	0.0538
0.195	0.0552	0.0552	0.0552	0.0552	0.0553	0.0553	0.0554	0.0555	0.0556	0.0558	0.0558	0.0558	0.0559
0.200	0.0549	0.0548	0.0547	0.0547	0.0547	0.0546	0.0546	0.0545	0.0545	0.0545	0.0544	0.0543	0.0543
0.205	0.0553	0.0553	0.0554	0.0554	0.0555	0.0555	0.0555	0.0556	0.0556	0.0556	0.0557	0.0557	0.0558
0.210	0.0564	0.0564	0.0562	0.0562	0.0562	0.0562	0.0561	0.0561	0.0561	0.0560	0.0559	0.0558	0.0556
0.215	0.0579	0.0579	0.0579	0.0580	0.0580	0.0580	0.0580	0.0582	0.0582	0.0583	0.0583	0.0583	0.0584
0.220	0.0587	0.0587	0.0586	0.0586	0.0586	0.0585	0.0584	0.0583	0.0583	0.0582	0.0581	0.0581	0.0580
0.225	0.0601	0.0602	0.0602	0.0602	0.0603	0.0603	0.0603	0.0603	0.0603	0.0604	0.0604	0.0606	0.0606
0.230	0.0608	0.0607	0.0607	0.0606	0.0606	0.0606	0.0606	0.0606	0.0606	0.0606	0.0605	0.0605	0.0604
0.235	0.0623	0.0623	0.0624	0.0624	0.0624	0.0624	0.0625	0.0625	0.0625	0.0625	0.0626	0.0627	0.0627
0.240	0.0629	0.0629	0.0628	0.0628	0.0628	0.0628	0.0628	0.0628	0.0627	0.0627	0.0625	0.0625	0.0624
0.245	0.0643	0.0644	0.0644	0.0644	0.0645	0.0645	0.0646	0.0647	0.0648	0.0648	0.0648	0.0648	0.0649
0.250	0.0704	0.0704	0.0703	0.0703	0.0700	0.0699	0.0698	0.0696	0.0695	0.0695	0.0692	0.0691	0.0688
0.255	0.0799	0.0799	0.0799	0.0800	0.0801	0.0801	0.0801	0.0802	0.0803	0.0803	0.0806	0.0807	0.0809
0.260	0.0878	0.0878	0.0877	0.0876	0.0875	0.0875	0.0874	0.0872	0.0871	0.0870	0.0869	0.0864	0.0859
0.265	0.0970	0.0971	0.0971	0.0972	0.0972	0.0973	0.0974	0.0975	0.0976	0.0976	0.0977	0.0978	0.0978
0.270	0.1052	0.1052	0.1052	0.1051	0.1051	0.1051	0.1050	0.1049	0.1049	0.1048	0.1048	0.1047	0.1040
0.275	0.1115	0.1116	0.1116	0.1116	0.1116	0.1116	0.1116	0.1117	0.1117	0.1118	0.1119	0.1119	0.1120

0.280	0.1146	0.1145	0.1144	0.1144	0.1144	0.1144	0.1144	0.1143	0.1142	0.1142	0.1139	0.1137	0.1137
0.285	0.1183	0.1184	0.1185	0.1185	0.1185	0.1185	0.1185	0.1186	0.1186	0.1187	0.1187	0.1187	0.1187
0.290	0.1211	0.1211	0.1210	0.1209	0.1209	0.1209	0.1209	0.1209	0.1208	0.1207	0.1206	0.1205	0.1205
0.295	0.1246	0.1247	0.1247	0.1247	0.1248	0.1248	0.1248	0.1250	0.1250	0.1251	0.1251	0.1252	0.1252
0.300	0.1272	0.1271	0.1271	0.1270	0.1270	0.1270	0.1269	0.1269	0.1269	0.1266	0.1264	0.1263	0.1263
0.305	0.1295	0.1295	0.1296	0.1296	0.1296	0.1296	0.1297	0.1297	0.1298	0.1298	0.1299	0.1299	0.1300
0.310	0.1301	0.1301	0.1301	0.1301	0.1300	0.1300	0.1299	0.1299	0.1299	0.1298	0.1297	0.1293	0.1293
0.315	0.1310	0.1310	0.1310	0.1310	0.1310	0.1311	0.1311	0.1312	0.1313	0.1313	0.1314	0.1314	0.1315
0.320	0.1302	0.1302	0.1301	0.1301	0.1300	0.1300	0.1299	0.1299	0.1298	0.1297	0.1297	0.1296	0.1296
0.325	0.1271	0.1271	0.1274	0.1276	0.1276	0.1278	0.1278	0.1279	0.1280	0.1281	0.1281	0.1282	0.1284
0.330	0.1231	0.1231	0.1231	0.1229	0.1228	0.1228	0.1226	0.1226	0.1225	0.1225	0.1225	0.1225	0.1223
0.335	0.1105	0.1108	0.1108	0.1109	0.1111	0.1112	0.1114	0.1118	0.1119	0.1120	0.1123	0.1125	0.1127
0.340	0.0933	0.0932	0.0932	0.0928	0.0928	0.0926	0.0925	0.0924	0.0924	0.0923	0.0920	0.0919	0.0917
0.345	0.0809	0.0810	0.0811	0.0811	0.0811	0.0814	0.0815	0.0815	0.0815	0.0815	0.0816	0.0817	0.0817
0.350	0.0770	0.0770	0.0769	0.0769	0.0769	0.0768	0.0768	0.0768	0.0767	0.0766	0.0764	0.0764	0.0763
0.355	0.0768	0.0768	0.0768	0.0768	0.0769	0.0769	0.0770	0.0770	0.0770	0.0771	0.0771	0.0773	0.0774
0.360	0.0773	0.0772	0.0772	0.0771	0.0771	0.0770	0.0770	0.0769	0.0769	0.0769	0.0768	0.0768	0.0768
0.365	0.0770	0.0770	0.0770	0.0770	0.0770	0.0771	0.0771	0.0772	0.0773	0.0773	0.0773	0.0774	0.0774
0.370	0.0767	0.0766	0.0766	0.0766	0.0766	0.0765	0.0765	0.0764	0.0763	0.0763	0.0763	0.0762	0.0762
0.375	0.0778	0.0787	0.0787	0.0765	0.0765	0.0765	0.0765	0.0752	0.0756	0.0756	0.0760	0.0762	0.0762
0.380	0.0770	0.0770	0.0770	0.0770	0.0769	0.0769	0.0769	0.0769	0.0768	0.0767	0.0767	0.0767	0.0767
0.385	0.0753	0.0756	0.0757	0.0762	0.0763	0.0763	0.0764	0.0765	0.0766	0.0766	0.0766	0.0766	0.0767
0.390	0.0770	0.0769	0.0769	0.0769	0.0768	0.0767	0.0767	0.0767	0.0766	0.0765	0.0765	0.0765	0.0764
0.395	0.0774	0.0774	0.0775	0.0775	0.0775	0.0776	0.0776	0.0776	0.0777	0.0777	0.0777	0.0778	0.0779
0.400	0.0772	0.0772	0.0771	0.0770	0.0769	0.0769	0.0769	0.0768	0.0768	0.0767	0.0767	0.0766	0.0766
0.405	0.0776	0.0776	0.0776	0.0777	0.0777	0.0777	0.0778	0.0778	0.0779	0.0779	0.0780	0.0780	0.0780
0.410	0.0779	0.0777	0.0777	0.0777	0.0776	0.0776	0.0776	0.0776	0.0775	0.0775	0.0775	0.0775	0.0774
0.415	0.0792	0.0793	0.0793	0.0793	0.0793	0.0793	0.0793	0.0795	0.0795	0.0795	0.0796	0.0796	0.0797
0.420	0.0801	0.0800	0.0799	0.0798	0.0798	0.0798	0.0798	0.0798	0.0797	0.0797	0.0797	0.0794	0.0794
0.425	0.0819	0.0819	0.0819	0.0819	0.0819	0.0821	0.0822	0.0822	0.0822	0.0822	0.0822	0.0823	0.0824
0.430	0.0827	0.0827	0.0827	0.0826	0.0826	0.0826	0.0826	0.0826	0.0825	0.0825	0.0824	0.0824	0.0822
0.435	0.0845	0.0845	0.0845	0.0845	0.0846	0.0847	0.0848	0.0849	0.0850	0.0850	0.0850	0.0850	0.0851
0.440	0.0855	0.0855	0.0855	0.0855	0.0854	0.0854	0.0854	0.0853	0.0853	0.0853	0.0851	0.0850	0.0848
0.445	0.0857	0.0858	0.0860	0.0863	0.0863	0.0863	0.0864	0.0864	0.0866	0.0866	0.0867	0.0867	0.0867
0.450	0.0883	0.0882	0.0882	0.0881	0.0881	0.0881	0.0880	0.0880	0.0879	0.0878	0.0878	0.0876	0.0876
0.455	0.0900	0.0900	0.0900	0.0901	0.0902	0.0902	0.0902	0.0902	0.0903	0.0903	0.0903	0.0904	0.0904
0.460	0.0917	0.0917	0.0916	0.0916	0.0916	0.0915	0.0915	0.0915	0.0915	0.0914	0.0914	0.0914	0.0913
0.465	0.0946	0.0913	0.0913	0.0915	0.0918	0.0918	0.0919	0.0919	0.0919	0.0920	0.0920	0.0922	0.0923
0.470	0.0939	0.0938	0.0938	0.0936	0.0936	0.0936	0.0936	0.0935	0.0934	0.0934	0.0934	0.0933	0.0932
0.475	0.0955	0.0955	0.0956	0.0957	0.0958	0.0958	0.0958	0.0958	0.0959	0.0959	0.0961	0.0961	0.0962
0.480	0.0967	0.0966	0.0966	0.0966	0.0966	0.0965	0.0964	0.0964	0.0964	0.0963	0.0963	0.0962	0.0962
0.485	0.0985	0.0985	0.0985	0.0985	0.0987	0.0987	0.0987	0.0987	0.0988	0.0988	0.0988	0.0988	0.0989
0.490	0.0995	0.0995	0.0995	0.0995	0.0995	0.0994	0.0994	0.0993	0.0993	0.0992	0.0992	0.0991	0.0990
0.495	0.1014	0.1015	0.1015	0.1015	0.1015	0.1015	0.1016	0.1016	0.1016	0.1016	0.1017	0.1017	0.1019
0.500	0.1022	0.1022	0.1022	0.1022	0.1022	0.1021	0.1021	0.1021	0.1021	0.1021	0.1021	0.1021	0.1019
0.505	0.1031	0.1033	0.1033	0.1033	0.1033	0.1033	0.1035	0.1035	0.1035	0.1036	0.1036	0.1036	0.1036
0.510	0.1052	0.1051	0.1051	0.1051	0.1051	0.1051	0.1050	0.1050	0.1049	0.1049	0.1048	0.1048	0.1047
0.515	0.1070	0.1070	0.1070	0.1070	0.1070	0.1071	0.1072	0.1072	0.1072	0.1072	0.1073	0.1074	0.1074
0.520	0.1079	0.1079	0.1079	0.1079	0.1078	0.1078	0.1078	0.1078	0.1077	0.1076	0.1076	0.1075	0.1075
0.525	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1096	0.1096	0.1096	0.1096	0.1096
0.530	0.1112	0.1111	0.1111	0.1110	0.1110	0.1109	0.1109	0.1109	0.1109	0.1109	0.1107	0.1107	0.1100
0.535	0.1187	0.1189	0.1195	0.1200	0.1200	0.1207	0.1212	0.1223					

X-Axis	Y-Axis			
0.000				
0.005	0.0163	0.0162	0.0161	0.0159
0.010	0.0216	0.0214	0.0212	0.0212
0.015	0.0237	0.0235	0.0233	0.0233
0.020	0.0261	0.0261	0.0261	0.0259
0.025	0.0346	0.0348	0.0349	0.0350
0.030	0.0402	0.0401	0.0399	0.0398
0.035	0.0528	0.0528	0.0529	0.0532
0.040	0.0585	0.0584	0.0583	0.0576
0.045	0.0689	0.0691	0.0691	0.0692
0.050	0.0765	0.0764	0.0756	0.0754
0.055	0.0881	0.0882	0.0882	0.0885
0.060	0.0941	0.0941	0.0938	0.0937
0.065	0.1059	0.1060	0.1062	0.1065
0.070	0.1121	0.1117	0.1116	0.1115
0.075	0.1229	0.1230	0.1230	0.1231
0.080	0.1282	0.1280	0.1280	0.1279
0.085	0.1358	0.1359	0.1360	0.1362
0.090	0.1370	0.1370	0.1369	0.1369
0.095	0.1397	0.1398	0.1400	0.1401
0.100	0.1392	0.1390	0.1389	0.1388
0.105	0.1402	0.1402	0.1403	0.1403
0.110	0.1396	0.1396	0.1395	0.1393
0.115	0.1404	0.1404	0.1404	0.1405
0.120	0.1394	0.1394	0.1394	0.1392
0.125	0.1401	0.1401	0.1402	0.1405
0.130	0.1365	0.1365	0.1365	0.1364
0.135	0.1365	0.1366	0.1369	0.1369
0.140	0.1295	0.1291	0.1290	0.1289
0.145	0.1251	0.1252	0.1252	0.1253
0.150	0.1069	0.1068	0.1060	0.1045
0.155	0.0950	0.0951	0.0952	0.0955
0.160	0.0713	0.0709	0.0708	0.0706
0.165	0.0616	0.0617	0.0620	0.0621
0.170	0.0546	0.0546	0.0545	0.0545
0.175	0.0551	0.0551	0.0551	0.0552
0.180	0.0539	0.0539	0.0539	0.0539
0.185	0.0557	0.0557	0.0558	0.0561
0.190	0.0537	0.0536	0.0535	0.0534
0.195	0.0561	0.0561	0.0561	0.0562
0.200	0.0543	0.0543	0.0541	0.0539
0.205	0.0559	0.0560	0.0560	0.0560
0.210	0.0556	0.0554	0.0554	0.0553
0.215	0.0584	0.0585	0.0587	0.0587
0.220	0.0578	0.0578	0.0577	0.0575
0.225	0.0606	0.0607	0.0609	0.0609
0.230	0.0603	0.0602	0.0601	0.0595
0.235	0.0628	0.0630	0.0632	0.0632
0.240	0.0623	0.0623	0.0620	0.0617
0.245	0.0650	0.0650	0.0650	0.0651
0.250	0.0683	0.0683	0.0682	0.0674
0.255	0.0809	0.0812	0.0816	0.0817
0.260	0.0857	0.0856	0.0856	0.0854
0.265	0.0979	0.0983	0.0983	0.0984
0.270	0.1038	0.1037	0.1033	0.1031
0.275	0.1121	0.1122	0.1123	0.1127

0.280	0.1135	0.1134	0.1130	0.1126
0.285	0.1188	0.1189	0.1189	0.1194
0.290	0.1204	0.1201	0.1199	0.1199
0.295	0.1253	0.1253	0.1254	0.1258
0.300	0.1259	0.1259	0.1256	0.1255
0.305	0.1300	0.1301	0.1302	0.1306
0.310	0.1293	0.1293	0.1287	0.1283
0.315	0.1316	0.1316	0.1317	0.1318
0.320	0.1296	0.1295	0.1295	0.1288
0.325	0.1284	0.1284	0.1286	0.1287
0.330	0.1222	0.1222	0.1221	0.1218
0.335	0.1127	0.1128	0.1130	0.1131
0.340	0.0917	0.0915	0.0904	0.0903
0.345	0.0820	0.0820	0.0821	0.0831
0.350	0.0763	0.0761	0.0759	0.0756
0.355	0.0774	0.0774	0.0776	0.0778
0.360	0.0768	0.0768	0.0768	0.0768
0.365	0.0774	0.0774	0.0774	0.0784
0.370	0.0760	0.0759	0.0758	0.0757
0.375	0.0763	0.0764	0.0764	0.0764
0.380	0.0767	0.0766	0.0765	0.0765
0.385	0.0767	0.0767	0.0767	0.0768
0.390	0.0762	0.0762	0.0759	0.0756
0.395	0.0779	0.0780	0.0780	0.0784
0.400	0.0766	0.0766	0.0757	0.0756
0.405	0.0780	0.0781	0.0781	0.0782
0.410	0.0774	0.0771	0.0769	0.0765
0.415	0.0797	0.0797	0.0799	0.0801
0.420	0.0793	0.0791	0.0786	0.0782
0.425	0.0825	0.0826	0.0829	0.0833
0.430	0.0820	0.0819	0.0816	0.0813
0.435	0.0851	0.0852	0.0853	0.0861
0.440	0.0847	0.0845	0.0844	0.0843
0.445	0.0869	0.0869	0.0869	0.0869
0.450	0.0876	0.0875	0.0871	0.0868
0.455	0.0905	0.0906	0.0908	0.0916
0.460	0.0913	0.0912	0.0912	0.0912
0.465	0.0923	0.0923	0.0924	0.0924
0.470	0.0932	0.0932	0.0930	0.0926
0.475	0.0963	0.0964	0.0965	0.0973
0.480	0.0960	0.0960	0.0957	0.0954
0.485	0.0989	0.0992	0.0993	0.0999
0.490	0.0988	0.0986	0.0981	0.0979
0.495	0.1020	0.1022	0.1022	0.1024
0.500	0.1018	0.1017	0.1015	0.1010
0.505	0.1037	0.1037	0.1038	0.1038
0.510	0.1047	0.1047	0.1046	0.1041
0.515	0.1074	0.1074	0.1075	0.1075
0.520	0.1074	0.1070	0.1069	0.1066
0.525	0.1097	0.1097	0.1097	
0.530	0.1097	0.1097	0.1094	
0.535				

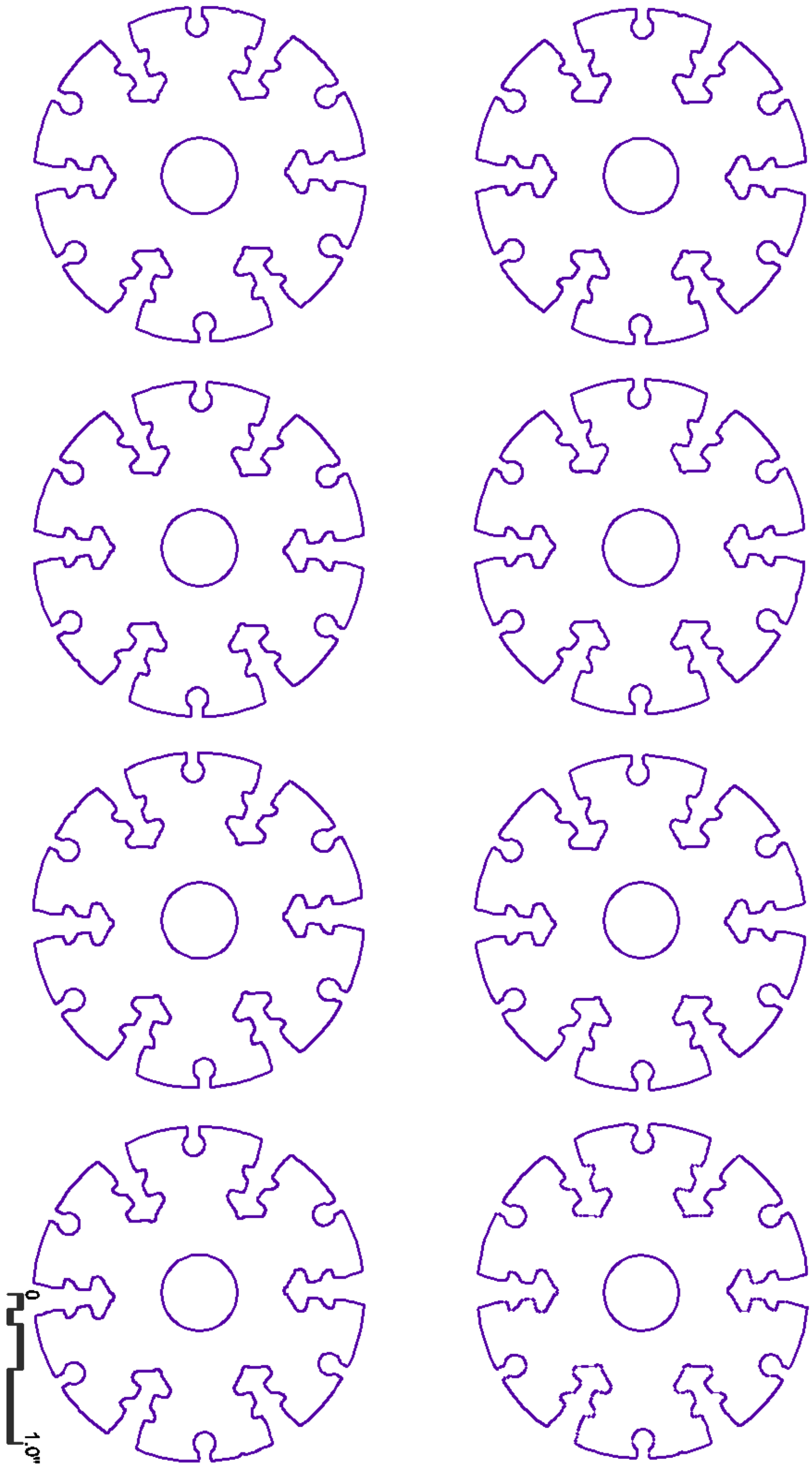


Figure B.9 As-Built 6Sd-00 Connector-C CAD Generation - Step 4

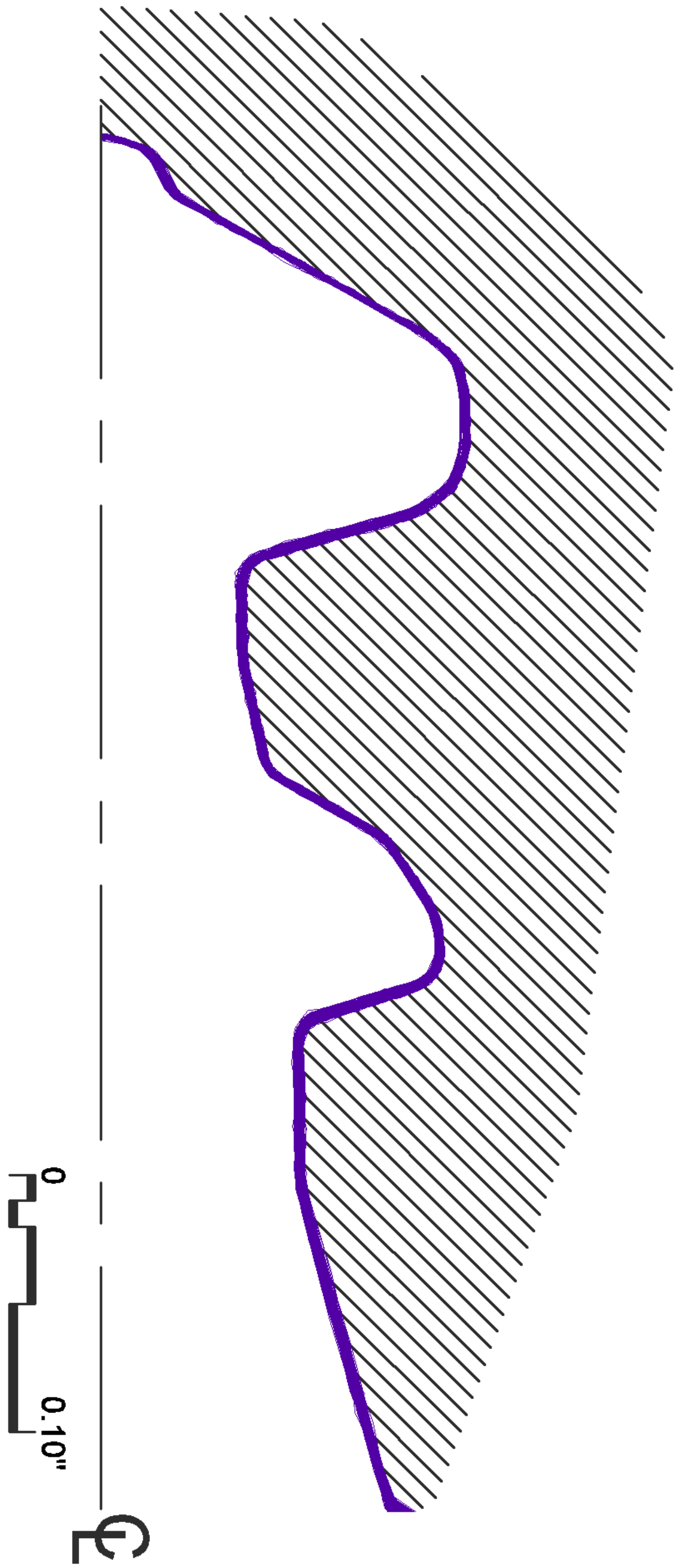


Figure B.10 As-Built 6Sd-00 Superimposed Connector-C Slot Profiles Generation - Step 5

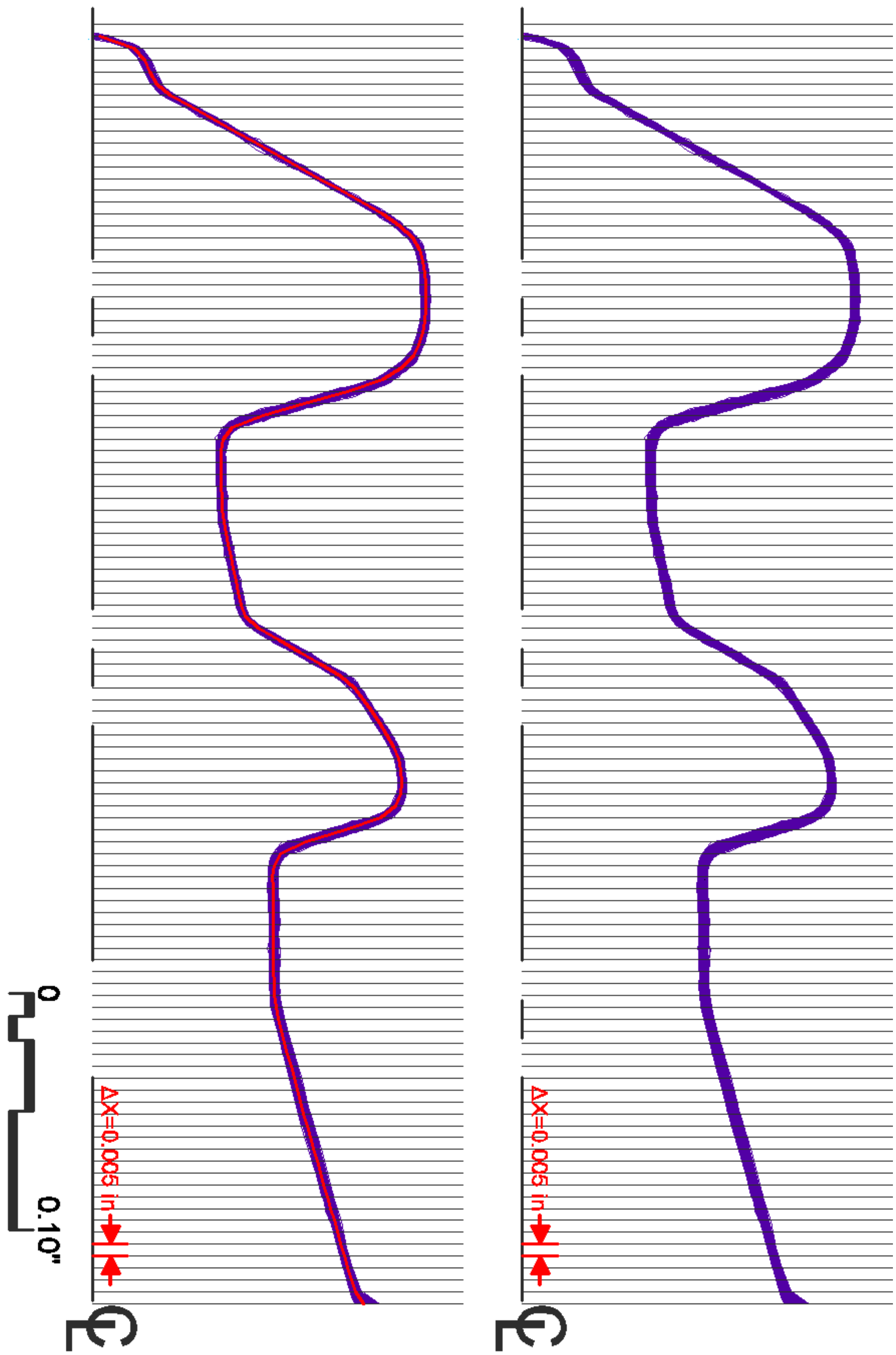


Figure B.11 As-Built 6Sd-00 Superimposed Connector-C Divided Slot Profiles & Mean Profile

- Step 6

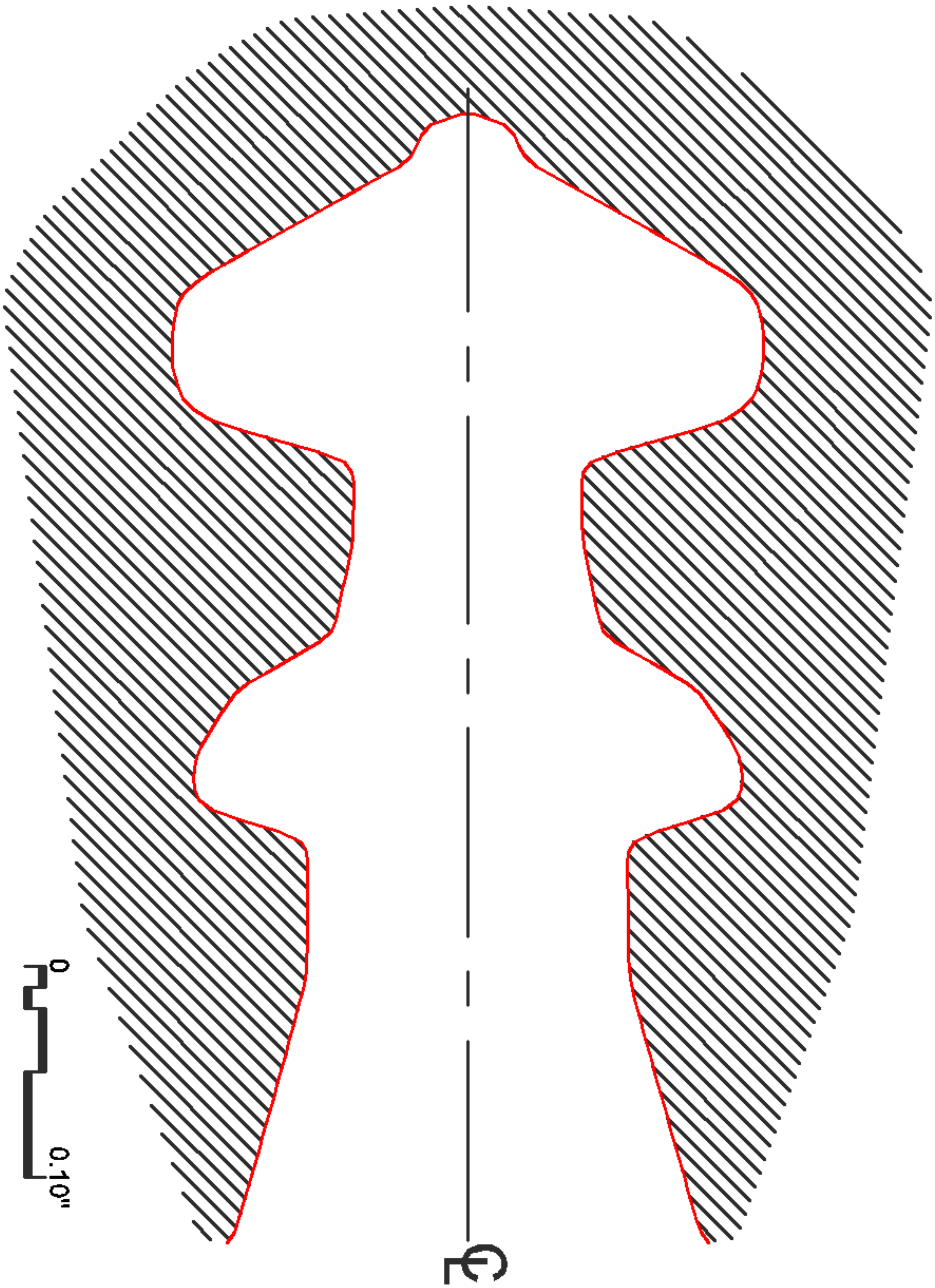


Figure B.12 As-Built 6Sd-00 Connector-C Slot Representative Profile - Step 7

Table B.3 As-Built 6Sd-00 Connector-C XY Coordinates

X-Axis	Y-Axis												
0.000	0.0036	0.0030	0.0056	0.0002	0.0065	0.0090	0.0018	0.0054	0.0014	0.0066	0.0031	0.0008	0.0073
0.005	0.0142	0.0176	0.0205	0.0146	0.0167	0.0207	0.0202	0.0166	0.0149	0.0217	0.0142	0.0137	0.0135
0.010	0.0212	0.0188	0.0256	0.0190	0.0261	0.0228	0.0225	0.0233	0.0245	0.0220	0.0207	0.0219	0.0222
0.015	0.0225	0.0280	0.0245	0.0251	0.0252	0.0282	0.0276	0.0222	0.0286	0.0266	0.0277	0.0253	0.0232
0.020	0.0280	0.0290	0.0242	0.0307	0.0243	0.0287	0.0232	0.0240	0.0237	0.0267	0.0272	0.0286	0.0310
0.025	0.0353	0.0388	0.0390	0.0305	0.0333	0.0319	0.0332	0.0329	0.0320	0.0309	0.0315	0.0364	0.0311
0.030	0.0444	0.0433	0.0395	0.0390	0.0425	0.0383	0.0423	0.0392	0.0404	0.0393	0.0411	0.0390	0.0473
0.035	0.0501	0.0514	0.0532	0.0483	0.0488	0.0559	0.0504	0.0523	0.0509	0.0546	0.0488	0.0549	0.0505
0.040	0.0565	0.0567	0.0649	0.0582	0.0641	0.0608	0.0576	0.0606	0.0586	0.0578	0.0618	0.0625	0.0585
0.045	0.0670	0.0681	0.0736	0.0674	0.0726	0.0721	0.0709	0.0678	0.0685	0.0684	0.0727	0.0737	0.0725
0.050	0.0812	0.0795	0.0789	0.0789	0.0817	0.0801	0.0794	0.0786	0.0820	0.0792	0.0810	0.0801	0.0766
0.055	0.0847	0.0892	0.0848	0.0897	0.0898	0.0878	0.0867	0.0862	0.0880	0.0888	0.0879	0.0832	0.0857
0.060	0.0960	0.0952	0.0979	0.0927	0.0949	0.1000	0.0983	0.0943	0.0975	0.0926	0.0986	0.0955	0.0955
0.065	0.1022	0.1058	0.1050	0.1083	0.1077	0.1081	0.1036	0.1050	0.1081	0.1060	0.1084	0.1073	0.1072
0.070	0.1161	0.1165	0.1169	0.1107	0.1134	0.1111	0.1145	0.1118	0.1106	0.1127	0.1106	0.1129	0.1150
0.075	0.1248	0.1230	0.1203	0.1235	0.1222	0.1236	0.1220	0.1224	0.1255	0.1243	0.1236	0.1245	0.1216
0.080	0.1291	0.1282	0.1278	0.1284	0.1297	0.1297	0.1287	0.1293	0.1323	0.1279	0.1286	0.1327	0.1308
0.085	0.1311	0.1314	0.1314	0.1342	0.1352	0.1332	0.1355	0.1327	0.1346	0.1372	0.1353	0.1309	0.1309
0.090	0.1358	0.1367	0.1406	0.1398	0.1340	0.1392	0.1404	0.1345	0.1377	0.1340	0.1358	0.1371	0.1356
0.095	0.1366	0.1375	0.1380	0.1385	0.1419	0.1377	0.1408	0.1378	0.1394	0.1417	0.1411	0.1394	0.1407
0.100	0.1386	0.1375	0.1362	0.1402	0.1390	0.1367	0.1374	0.1424	0.1383	0.1428	0.1412	0.1407	0.1428
0.105	0.1424	0.1396	0.1406	0.1369	0.1411	0.1368	0.1424	0.1377	0.1368	0.1369	0.1425	0.1393	0.1428
0.110	0.1429	0.1362	0.1403	0.1391	0.1371	0.1414	0.1406	0.1369	0.1361	0.1425	0.1423	0.1363	0.1389
0.115	0.1416	0.1367	0.1373	0.1385	0.1366	0.1378	0.1415	0.1417	0.1367	0.1387	0.1376	0.1371	0.1410
0.120	0.1358	0.1402	0.1383	0.1377	0.1419	0.1389	0.1358	0.1428	0.1389	0.1391	0.1394	0.1386	0.1368
0.125	0.1390	0.1374	0.1386	0.1344	0.1376	0.1354	0.1361	0.1342	0.1370	0.1369	0.1390	0.1374	0.1384
0.130	0.1344	0.1397	0.1329	0.1392	0.1339	0.1374	0.1386	0.1355	0.1345	0.1346	0.1354	0.1373	0.1327
0.135	0.1293	0.1364	0.1341	0.1302	0.1364	0.1361	0.1377	0.1322	0.1379	0.1292	0.1354	0.1324	0.1374
0.140	0.1230	0.1236	0.1235	0.1257	0.1305	0.1298	0.1283	0.1284	0.1247	0.1239	0.1246	0.1257	0.1252
0.145	0.1171	0.1217	0.1238	0.1174	0.1127	0.1118	0.1224	0.1153	0.1195	0.1113	0.1142	0.1205	0.1224
0.150	0.1102	0.1058	0.1132	0.1070	0.1131	0.1059	0.1046	0.0970	0.0966	0.1021	0.0990	0.0947	0.0969
0.155	0.0840	0.0944	0.0966	0.0932	0.0855	0.0797	0.0900	0.0915	0.0805	0.0854	0.0805	0.0945	0.0906
0.160	0.0739	0.0734	0.0673	0.0656	0.0675	0.0783	0.0746	0.0756	0.0732	0.0604	0.0694	0.0627	0.0714
0.165	0.0554	0.0544	0.0602	0.0605	0.0571	0.0615	0.0542	0.0618	0.0586	0.0618	0.0588	0.0619	0.0581
0.170	0.0571	0.0521	0.0552	0.0529	0.0530	0.0545	0.0515	0.0577	0.0575	0.0524	0.0516	0.0560	0.0519
0.175	0.0552	0.0506	0.0532	0.0560	0.0512	0.0541	0.0539	0.0508	0.0535	0.0546	0.0558	0.0545	0.0565
0.180	0.0504	0.0560	0.0522	0.0514	0.0513	0.0522	0.0517	0.0555	0.0508	0.0515	0.0520	0.0544	0.0554
0.185	0.0553	0.0534	0.0522	0.0554	0.0545	0.0528	0.0560	0.0546	0.0531	0.0552	0.0525	0.0538	0.0534
0.190	0.0509	0.0538	0.0517	0.0509	0.0552	0.0555	0.0512	0.0556	0.0526	0.0523	0.0540	0.0562	0.0547
0.195	0.0531	0.0517	0.0546	0.0552	0.0556	0.0515	0.0552	0.0544	0.0543	0.0521	0.0564	0.0519	0.0528
0.200	0.0547	0.0563	0.0531	0.0544	0.0550	0.0535	0.0534	0.0567	0.0535	0.0553	0.0562	0.0541	0.0553
0.205	0.0566	0.0520	0.0551	0.0526	0.0560	0.0557	0.0517	0.0532	0.0542	0.0535	0.0557	0.0528	0.0559
0.210	0.0535	0.0543	0.0534	0.0545	0.0582	0.0574	0.0572	0.0561	0.0540	0.0565	0.0537	0.0572	0.0582
0.215	0.0567	0.0565	0.0562	0.0554	0.0572	0.0577	0.0591	0.0570	0.0575	0.0587	0.0543	0.0574	0.0548
0.220	0.0576	0.0600	0.0559	0.0597	0.0601	0.0556	0.0577	0.0600	0.0586	0.0557	0.0564	0.0579	0.0590
0.225	0.0589	0.0578	0.0587	0.0563	0.0602	0.0605	0.0593	0.0562	0.0568	0.0607	0.0588	0.0570	0.0590
0.230	0.0595	0.0595	0.0620	0.0597	0.0616	0.0608	0.0591	0.0607	0.0585	0.0622	0.0612	0.0613	0.0614
0.235	0.0630	0.0624	0.0631	0.0634	0.0611	0.0607	0.0616	0.0628	0.0628	0.0587	0.0603	0.0595	0.0613
0.240	0.0630	0.0617	0.0639	0.0641	0.0621	0.0619	0.0642	0.0598	0.0603	0.0624	0.0606	0.0623	0.0601
0.245	0.0662	0.0677	0.0677	0.0663	0.0622	0.0655	0.0623	0.0634	0.0645	0.0629	0.0683	0.0676	0.0627
0.250	0.0667	0.0687	0.0731	0.0685	0.0664	0.0710	0.0719	0.0701	0.0709	0.0736	0.0673	0.0736	0.0746
0.255	0.0766	0.0770	0.0753	0.0822	0.0803	0.0767	0.0824	0.0761	0.0793	0.0762	0.0747	0.0768	0.0748
0.260	0.0882	0.0900	0.0912	0.0854	0.0858	0.0833	0.0856	0.0862	0.0850	0.0844	0.0840	0.0865	0.0899
0.265	0.0933	0.0937	0.0912	0.0920	0.0931	0.0980	0.0941	0.0975	0.0926	0.0979	0.0918	0.0959	0.0913

0.270	0.1024	0.1040	0.1040	0.1077	0.1077	0.1055	0.1047	0.1020	0.1076	0.1080	0.1066	0.1013	0.1080
0.275	0.1067	0.1086	0.1085	0.1096	0.1110	0.1073	0.1069	0.1109	0.1120	0.1113	0.1112	0.1070	0.1081
0.280	0.1156	0.1140	0.1141	0.1117	0.1123	0.1140	0.1163	0.1169	0.1154	0.1153	0.1150	0.1113	0.1153
0.285	0.1183	0.1187	0.1197	0.1196	0.1182	0.1146	0.1170	0.1183	0.1164	0.1155	0.1150	0.1167	0.1146
0.290	0.1192	0.1196	0.1186	0.1205	0.1232	0.1214	0.1194	0.1214	0.1203	0.1192	0.1215	0.1203	0.1188
0.295	0.1236	0.1250	0.1250	0.1214	0.1230	0.1258	0.1265	0.1210	0.1215	0.1262	0.1206	0.1231	0.1228
0.300	0.1274	0.1288	0.1297	0.1254	0.1241	0.1258	0.1277	0.1278	0.1298	0.1273	0.1247	0.1242	0.1250
0.305	0.1261	0.1274	0.1311	0.1259	0.1265	0.1290	0.1274	0.1262	0.1257	0.1309	0.1291	0.1281	0.1250
0.310	0.1269	0.1300	0.1288	0.1285	0.1282	0.1267	0.1265	0.1298	0.1313	0.1318	0.1276	0.1310	0.1313
0.315	0.1314	0.1311	0.1301	0.1281	0.1274	0.1297	0.1298	0.1287	0.1298	0.1279	0.1287	0.1280	0.1280
0.320	0.1314	0.1310	0.1282	0.1296	0.1285	0.1291	0.1286	0.1278	0.1272	0.1279	0.1314	0.1309	0.1264
0.325	0.1267	0.1248	0.1277	0.1280	0.1270	0.1257	0.1237	0.1280	0.1237	0.1299	0.1293	0.1282	0.1254
0.330	0.1159	0.1149	0.1237	0.1188	0.1244	0.1169	0.1131	0.1187	0.1121	0.1225	0.1177	0.1227	0.1217
0.335	0.1091	0.0983	0.1038	0.1112	0.1025	0.1032	0.0948	0.1102	0.1011	0.0954	0.0978	0.1030	0.0983
0.340	0.0823	0.0866	0.0935	0.0989	0.0959	0.0829	0.0895	0.0939	0.0940	0.0956	0.0890	0.0965	0.0816
0.345	0.0753	0.0829	0.0802	0.0812	0.0793	0.0765	0.0758	0.0756	0.0822	0.0775	0.0807	0.0832	0.0820
0.350	0.0783	0.0783	0.0746	0.0759	0.0749	0.0782	0.0743	0.0772	0.0784	0.0753	0.0741	0.0776	0.0766
0.355	0.0761	0.0757	0.0773	0.0746	0.0737	0.0741	0.0762	0.0753	0.0768	0.0746	0.0730	0.0736	0.0765
0.360	0.0748	0.0730	0.0745	0.0758	0.0773	0.0755	0.0732	0.0779	0.0769	0.0783	0.0774	0.0770	0.0748
0.365	0.0744	0.0730	0.0765	0.0772	0.0786	0.0757	0.0765	0.0785	0.0742	0.0737	0.0781	0.0785	0.0782
0.370	0.0733	0.0760	0.0785	0.0770	0.0786	0.0747	0.0778	0.0773	0.0751	0.0744	0.0766	0.0740	0.0790
0.375	0.0773	0.0780	0.0739	0.0770	0.0744	0.0733	0.0744	0.0770	0.0761	0.0749	0.0781	0.0760	0.0776
0.380	0.0736	0.0772	0.0787	0.0778	0.0753	0.0751	0.0766	0.0735	0.0756	0.0744	0.0734	0.0784	0.0765
0.385	0.0753	0.0774	0.0763	0.0758	0.0742	0.0778	0.0779	0.0765	0.0767	0.0782	0.0764	0.0755	0.0733
0.390	0.0760	0.0738	0.0766	0.0772	0.0771	0.0744	0.0757	0.0762	0.0754	0.0742	0.0741	0.0753	0.0759
0.395	0.0734	0.0762	0.0778	0.0781	0.0743	0.0741	0.0735	0.0753	0.0795	0.0770	0.0757	0.0763	0.0740
0.400	0.0766	0.0791	0.0737	0.0770	0.0744	0.0770	0.0751	0.0769	0.0783	0.0756	0.0786	0.0776	0.0737
0.405	0.0738	0.0769	0.0758	0.0783	0.0791	0.0772	0.0788	0.0766	0.0743	0.0755	0.0736	0.0742	0.0766
0.410	0.0766	0.0767	0.0788	0.0787	0.0787	0.0774	0.0780	0.0747	0.0784	0.0761	0.0765	0.0784	0.0773
0.415	0.0756	0.0783	0.0778	0.0776	0.0783	0.0789	0.0775	0.0759	0.0804	0.0773	0.0762	0.0787	0.0757
0.420	0.0766	0.0774	0.0764	0.0778	0.0778	0.0799	0.0791	0.0810	0.0794	0.0783	0.0814	0.0797	0.0802
0.425	0.0834	0.0795	0.0825	0.0790	0.0802	0.0826	0.0795	0.0785	0.0819	0.0813	0.0813	0.0823	0.0834
0.430	0.0810	0.0804	0.0795	0.0794	0.0803	0.0848	0.0844	0.0831	0.0811	0.0803	0.0847	0.0808	0.0825
0.435	0.0850	0.0803	0.0818	0.0843	0.0834	0.0808	0.0807	0.0860	0.0802	0.0802	0.0854	0.0815	0.0847
0.440	0.0855	0.0870	0.0830	0.0878	0.0837	0.0846	0.0854	0.0857	0.0828	0.0840	0.0846	0.0847	0.0864
0.445	0.0836	0.0848	0.0860	0.0873	0.0841	0.0833	0.0855	0.0848	0.0873	0.0824	0.0828	0.0865	0.0850
0.450	0.0895	0.0875	0.0887	0.0884	0.0890	0.0891	0.0842	0.0868	0.0857	0.0848	0.0896	0.0894	0.0851
0.455	0.0890	0.0879	0.0892	0.0876	0.0851	0.0865	0.0879	0.0883	0.0890	0.0862	0.0908	0.0891	0.0910
0.460	0.0894	0.0894	0.0921	0.0924	0.0923	0.0877	0.0896	0.0930	0.0889	0.0920	0.0929	0.0915	0.0883
0.465	0.0919	0.0892	0.0901	0.0887	0.0944	0.0910	0.0884	0.0907	0.0917	0.0925	0.0881	0.0926	0.0931
0.470	0.0953	0.0917	0.0920	0.0906	0.0892	0.0899	0.0941	0.0925	0.0940	0.0931	0.0893	0.0893	0.0933
0.475	0.0933	0.0911	0.0945	0.0964	0.0942	0.0926	0.0916	0.0939	0.0907	0.0908	0.0924	0.0907	0.0931
0.480	0.0961	0.0920	0.0941	0.0940	0.0929	0.0950	0.0946	0.0969	0.0986	0.0989	0.0959	0.0948	0.0973
0.485	0.0944	0.0969	0.0977	0.0938	0.0977	0.0949	0.0962	0.0945	0.0936	0.0956	0.0988	0.0984	0.0946
0.490	0.0944	0.1010	0.1000	0.0979	0.1010	0.0987	0.0947	0.0969	0.1002	0.0990	0.0999	0.0991	0.0996
0.495	0.1005	0.0982	0.1024	0.0957	0.1025	0.0999	0.0979	0.0979	0.0963	0.0991	0.0960	0.0987	0.1016
0.500	0.0975	0.0996	0.0981	0.0980	0.1022	0.1030	0.0998	0.1017	0.1012	0.1040	0.1006	0.1037	0.1006
0.505	0.1002	0.1011	0.1001	0.1051	0.1038	0.1038	0.1021	0.1006	0.1023	0.1039	0.1031	0.1007	0.1020
0.510	0.1050	0.1005	0.1070	0.1057	0.1064	0.1015	0.1027	0.1075	0.1057	0.1035	0.1000	0.1055	0.1048
0.515	0.1050	0.1088	0.1056	0.1038	0.1056	0.1032	0.1074	0.1010	0.1036	0.1015	0.1090	0.1031	0.1088
0.520	0.1088	0.1102	0.1107	0.1079	0.1100	0.1084	0.1065	0.1034	0.1061	0.1068	0.1042	0.1080	0.1086
0.525	0.1064	0.1100	0.1093	0.1092	0.1056	0.1122	0.1119	0.1044	0.1102	0.1126	0.1112	0.1051	0.1087
0.530	0.1080	0.1105	0.1148	0.1094	0.1159	0.1072	0.1137	0.1112	0.1083	0.1111	0.1100	0.1129	0.1139
0.535	0.1123	0.1097	0.1182	0.1177	0.1219	0.1113	0.1171	0.1078	0.1139	0.1076	0.1076	0.1108	0.1081
0.540	0.1164	0.1268	0.1215	0.1253	0.1274	0.1168	0.1152	0.1207	0.1250	0.1214	0.1207	0.1248	0.1154

X-Axis	Y-Axis												
0.000	0.0053	0.0032	0.0019	0.0043	0.0086	0.0074	0.0052	0.0012	0.0055	0.0075	0.0029	0.0060	0.0076
0.005	0.0203	0.0223	0.0195	0.0152	0.0220	0.0204	0.0182	0.0182	0.0150	0.0136	0.0156	0.0222	0.0146
0.010	0.0192	0.0187	0.0194	0.0244	0.0236	0.0204	0.0178	0.0236	0.0204	0.0253	0.0190	0.0229	0.0238
0.015	0.0266	0.0215	0.0219	0.0249	0.0249	0.0282	0.0284	0.0223	0.0206	0.0263	0.0219	0.0217	0.0279
0.020	0.0307	0.0309	0.0290	0.0290	0.0289	0.0274	0.0275	0.0265	0.0259	0.0277	0.0276	0.0247	0.0309
0.025	0.0298	0.0374	0.0371	0.0321	0.0302	0.0300	0.0361	0.0296	0.0386	0.0347	0.0340	0.0320	0.0386
0.030	0.0455	0.0428	0.0404	0.0432	0.0439	0.0406	0.0400	0.0456	0.0393	0.0471	0.0414	0.0420	0.0472
0.035	0.0499	0.0477	0.0512	0.0521	0.0510	0.0559	0.0517	0.0559	0.0494	0.0536	0.0523	0.0495	0.0560
0.040	0.0604	0.0602	0.0632	0.0594	0.0569	0.0581	0.0647	0.0640	0.0565	0.0587	0.0603	0.0573	0.0632
0.045	0.0667	0.0666	0.0727	0.0670	0.0719	0.0682	0.0666	0.0718	0.0704	0.0685	0.0687	0.0713	0.0715
0.050	0.0749	0.0778	0.0780	0.0783	0.0818	0.0801	0.0801	0.0735	0.0755	0.0814	0.0800	0.0775	0.0785
0.055	0.0894	0.0874	0.0908	0.0881	0.0900	0.0835	0.0842	0.0847	0.0871	0.0859	0.0882	0.0869	0.0856
0.060	0.0964	0.0958	0.0963	0.0945	0.0970	0.0949	0.0951	0.0989	0.0923	0.0984	0.0965	0.0985	0.0951
0.065	0.1034	0.1025	0.1040	0.1060	0.1039	0.1056	0.1052	0.1054	0.1061	0.1048	0.1020	0.1039	0.1080
0.070	0.1142	0.1128	0.1150	0.1109	0.1116	0.1126	0.1126	0.1113	0.1138	0.1152	0.1149	0.1173	0.1126
0.075	0.1212	0.1236	0.1196	0.1211	0.1202	0.1227	0.1231	0.1237	0.1191	0.1233	0.1192	0.1199	0.1211
0.080	0.1305	0.1301	0.1312	0.1285	0.1302	0.1287	0.1281	0.1291	0.1266	0.1265	0.1285	0.1290	0.1268
0.085	0.1370	0.1377	0.1371	0.1325	0.1330	0.1340	0.1381	0.1316	0.1349	0.1342	0.1356	0.1379	0.1348
0.090	0.1365	0.1369	0.1355	0.1357	0.1340	0.1358	0.1357	0.1397	0.1340	0.1379	0.1365	0.1340	0.1403
0.095	0.1388	0.1369	0.1390	0.1398	0.1356	0.1376	0.1389	0.1419	0.1362	0.1418	0.1404	0.1391	0.1377
0.100	0.1421	0.1387	0.1412	0.1403	0.1393	0.1410	0.1410	0.1376	0.1358	0.1362	0.1371	0.1376	0.1375
0.105	0.1398	0.1369	0.1426	0.1396	0.1373	0.1388	0.1396	0.1414	0.1392	0.1372	0.1398	0.1367	0.1374
0.110	0.1388	0.1407	0.1386	0.1399	0.1393	0.1421	0.1398	0.1424	0.1415	0.1415	0.1374	0.1390	0.1394
0.115	0.1371	0.1400	0.1381	0.1383	0.1394	0.1410	0.1427	0.1382	0.1398	0.1425	0.1408	0.1390	0.1363
0.120	0.1377	0.1395	0.1384	0.1388	0.1421	0.1395	0.1397	0.1371	0.1391	0.1408	0.1427	0.1403	0.1391
0.125	0.1366	0.1390	0.1383	0.1394	0.1361	0.1415	0.1364	0.1355	0.1361	0.1393	0.1384	0.1378	0.1384
0.130	0.1361	0.1356	0.1371	0.1360	0.1388	0.1322	0.1359	0.1384	0.1324	0.1351	0.1323	0.1341	0.1385
0.135	0.1357	0.1354	0.1290	0.1323	0.1297	0.1350	0.1308	0.1302	0.1324	0.1334	0.1300	0.1323	0.1344
0.140	0.1268	0.1286	0.1229	0.1279	0.1279	0.1296	0.1252	0.1269	0.1262	0.1319	0.1320	0.1240	0.1321
0.145	0.1120	0.1123	0.1177	0.1224	0.1164	0.1200	0.1176	0.1225	0.1121	0.1117	0.1252	0.1203	0.1138
0.150	0.1093	0.1034	0.0991	0.1076	0.0948	0.1036	0.1008	0.0948	0.1068	0.0936	0.1130	0.0992	0.0997
0.155	0.0885	0.0860	0.0897	0.0886	0.0914	0.0853	0.0830	0.0949	0.0932	0.0773	0.0897	0.0783	0.0966
0.160	0.0735	0.0731	0.0623	0.0757	0.0615	0.0745	0.0775	0.0690	0.0722	0.0681	0.0718	0.0727	0.0720
0.165	0.0617	0.0616	0.0543	0.0598	0.0547	0.0593	0.0620	0.0561	0.0561	0.0617	0.0616	0.0620	0.0542
0.170	0.0531	0.0547	0.0548	0.0519	0.0555	0.0554	0.0556	0.0555	0.0542	0.0537	0.0543	0.0561	0.0520
0.175	0.0507	0.0513	0.0567	0.0531	0.0550	0.0517	0.0514	0.0555	0.0513	0.0523	0.0514	0.0506	0.0523
0.180	0.0518	0.0559	0.0545	0.0552	0.0555	0.0558	0.0556	0.0563	0.0545	0.0549	0.0508	0.0556	0.0531
0.185	0.0512	0.0534	0.0532	0.0548	0.0558	0.0543	0.0524	0.0543	0.0520	0.0511	0.0506	0.0515	0.0552
0.190	0.0521	0.0560	0.0520	0.0535	0.0528	0.0509	0.0521	0.0553	0.0542	0.0524	0.0519	0.0562	0.0521
0.195	0.0566	0.0557	0.0531	0.0533	0.0546	0.0564	0.0547	0.0522	0.0538	0.0516	0.0555	0.0527	0.0559
0.200	0.0550	0.0525	0.0526	0.0571	0.0563	0.0538	0.0529	0.0510	0.0517	0.0520	0.0513	0.0571	0.0519
0.205	0.0544	0.0547	0.0564	0.0576	0.0533	0.0558	0.0539	0.0549	0.0540	0.0575	0.0533	0.0574	0.0552
0.210	0.0546	0.0563	0.0582	0.0554	0.0540	0.0539	0.0572	0.0537	0.0530	0.0545	0.0575	0.0583	0.0542
0.215	0.0557	0.0575	0.0582	0.0548	0.0590	0.0566	0.0576	0.0583	0.0554	0.0552	0.0574	0.0583	0.0557
0.220	0.0569	0.0576	0.0603	0.0592	0.0583	0.0562	0.0589	0.0584	0.0584	0.0585	0.0567	0.0564	0.0562
0.225	0.0582	0.0576	0.0584	0.0573	0.0574	0.0596	0.0606	0.0603	0.0604	0.0596	0.0608	0.0581	0.0594
0.230	0.0622	0.0610	0.0610	0.0604	0.0584	0.0587	0.0619	0.0613	0.0607	0.0576	0.0584	0.0599	0.0621
0.235	0.0600	0.0604	0.0598	0.0620	0.0612	0.0628	0.0592	0.0604	0.0609	0.0623	0.0633	0.0588	0.0605
0.240	0.0635	0.0639	0.0636	0.0636	0.0632	0.0600	0.0613	0.0636	0.0597	0.0601	0.0636	0.0629	0.0622
0.245	0.0626	0.0683	0.0630	0.0629	0.0675	0.0645	0.0680	0.0644	0.0641	0.0667	0.0678	0.0667	0.0677
0.250	0.0732	0.0728	0.0744	0.0727	0.0678	0.0668	0.0736	0.0731	0.0730	0.0709	0.0690	0.0740	0.0697
0.255	0.0780	0.0792	0.0788	0.0746	0.0808	0.0776	0.0782	0.0806	0.0818	0.0819	0.0792	0.0772	0.0777
0.260	0.0827	0.0899	0.0903	0.0878	0.0908	0.0845	0.0917	0.0825	0.0882	0.0860	0.0874	0.0914	0.0853
0.265	0.0997	0.0975	0.0982	0.0922	0.0930	0.0986	0.0972	0.0993	0.0970	0.0967	0.0912	0.0988	0.0986
0.270	0.1065	0.1009	0.1025	0.1021	0.1012	0.1071	0.1020	0.1052	0.1060	0.1054	0.1072	0.1075	0.1021
0.275	0.1084	0.1126	0.1135	0.1120	0.1097	0.1132	0.1119	0.1113	0.1067	0.1111	0.1132	0.1078	0.1065

0.280	0.1158	0.1121	0.1162	0.1115	0.1114	0.1134	0.1125	0.1132	0.1129	0.1139	0.1120	0.1121	0.1141
0.285	0.1158	0.1193	0.1150	0.1165	0.1191	0.1176	0.1144	0.1155	0.1160	0.1165	0.1200	0.1193	0.1146
0.290	0.1218	0.1187	0.1187	0.1178	0.1234	0.1186	0.1181	0.1178	0.1194	0.1207	0.1232	0.1198	0.1194
0.295	0.1209	0.1224	0.1223	0.1218	0.1220	0.1253	0.1234	0.1222	0.1256	0.1257	0.1255	0.1260	0.1262
0.300	0.1270	0.1248	0.1259	0.1289	0.1244	0.1240	0.1243	0.1287	0.1281	0.1255	0.1240	0.1281	0.1296
0.305	0.1281	0.1250	0.1278	0.1286	0.1284	0.1278	0.1283	0.1259	0.1286	0.1258	0.1268	0.1298	0.1285
0.310	0.1275	0.1264	0.1265	0.1312	0.1267	0.1273	0.1288	0.1269	0.1269	0.1277	0.1287	0.1265	0.1287
0.315	0.1276	0.1290	0.1284	0.1321	0.1321	0.1290	0.1317	0.1297	0.1317	0.1291	0.1280	0.1288	0.1296
0.320	0.1293	0.1291	0.1273	0.1290	0.1273	0.1284	0.1270	0.1263	0.1300	0.1289	0.1301	0.1294	0.1313
0.325	0.1231	0.1278	0.1289	0.1290	0.1250	0.1288	0.1267	0.1265	0.1294	0.1226	0.1261	0.1287	0.1261
0.330	0.1177	0.1205	0.1200	0.1215	0.1253	0.1210	0.1206	0.1177	0.1221	0.1113	0.1221	0.1181	0.1185
0.335	0.0949	0.1013	0.1121	0.0997	0.1115	0.1079	0.1004	0.1112	0.1018	0.0984	0.1055	0.1084	0.1111
0.340	0.0860	0.0918	0.0963	0.0902	0.0870	0.0942	0.0838	0.0900	0.0823	0.0863	0.0820	0.0938	0.0879
0.345	0.0769	0.0803	0.0803	0.0839	0.0759	0.0829	0.0812	0.0783	0.0757	0.0816	0.0803	0.0760	0.0762
0.350	0.0780	0.0776	0.0776	0.0775	0.0772	0.0738	0.0746	0.0747	0.0741	0.0748	0.0777	0.0759	0.0770
0.355	0.0760	0.0731	0.0761	0.0772	0.0747	0.0749	0.0778	0.0751	0.0771	0.0745	0.0769	0.0780	0.0748
0.360	0.0764	0.0732	0.0781	0.0754	0.0758	0.0780	0.0774	0.0752	0.0729	0.0754	0.0780	0.0764	0.0783
0.365	0.0774	0.0787	0.0773	0.0787	0.0779	0.0762	0.0729	0.0741	0.0750	0.0765	0.0784	0.0778	0.0737
0.370	0.0780	0.0760	0.0781	0.0733	0.0735	0.0747	0.0733	0.0738	0.0754	0.0762	0.0751	0.0734	0.0771
0.375	0.0762	0.0778	0.0765	0.0756	0.0773	0.0779	0.0785	0.0752	0.0770	0.0759	0.0757	0.0782	0.0749
0.380	0.0738	0.0747	0.0771	0.0768	0.0782	0.0748	0.0776	0.0753	0.0747	0.0776	0.0784	0.0781	0.0755
0.385	0.0774	0.0772	0.0779	0.0744	0.0755	0.0757	0.0786	0.0750	0.0735	0.0761	0.0783	0.0737	0.0763
0.390	0.0780	0.0764	0.0738	0.0781	0.0750	0.0766	0.0778	0.0772	0.0742	0.0747	0.0756	0.0762	0.0786
0.395	0.0775	0.0744	0.0756	0.0751	0.0767	0.0752	0.0768	0.0772	0.0793	0.0775	0.0787	0.0787	0.0775
0.400	0.0784	0.0767	0.0782	0.0792	0.0759	0.0745	0.0779	0.0773	0.0753	0.0742	0.0787	0.0743	0.0784
0.405	0.0773	0.0782	0.0757	0.0736	0.0751	0.0789	0.0774	0.0743	0.0763	0.0779	0.0753	0.0781	0.0739
0.410	0.0793	0.0762	0.0779	0.0793	0.0797	0.0744	0.0785	0.0743	0.0773	0.0757	0.0770	0.0770	0.0749
0.415	0.0782	0.0785	0.0760	0.0761	0.0773	0.0788	0.0759	0.0755	0.0762	0.0757	0.0763	0.0766	0.0752
0.420	0.0763	0.0764	0.0767	0.0768	0.0769	0.0770	0.0777	0.0820	0.0793	0.0772	0.0791	0.0799	0.0817
0.425	0.0774	0.0827	0.0823	0.0827	0.0807	0.0794	0.0774	0.0778	0.0826	0.0784	0.0807	0.0824	0.0794
0.430	0.0805	0.0823	0.0791	0.0827	0.0834	0.0796	0.0839	0.0788	0.0792	0.0814	0.0810	0.0840	0.0830
0.435	0.0849	0.0810	0.0799	0.0804	0.0817	0.0820	0.0801	0.0828	0.0849	0.0803	0.0842	0.0850	0.0800
0.440	0.0856	0.0866	0.0815	0.0844	0.0853	0.0829	0.0819	0.0817	0.0818	0.0820	0.0877	0.0853	0.0869
0.445	0.0873	0.0838	0.0886	0.0876	0.0880	0.0883	0.0827	0.0836	0.0842	0.0848	0.0880	0.0878	0.0875
0.450	0.0857	0.0838	0.0854	0.0901	0.0865	0.0859	0.0839	0.0890	0.0848	0.0860	0.0864	0.0883	0.0880
0.455	0.0907	0.0851	0.0899	0.0882	0.0888	0.0851	0.0898	0.0892	0.0856	0.0898	0.0855	0.0880	0.0879
0.460	0.0873	0.0920	0.0875	0.0873	0.0864	0.0899	0.0909	0.0879	0.0864	0.0892	0.0905	0.0886	0.0871
0.465	0.0892	0.0933	0.0909	0.0929	0.0944	0.0940	0.0902	0.0886	0.0893	0.0938	0.0879	0.0892	0.0878
0.470	0.0907	0.0950	0.0941	0.0895	0.0910	0.0931	0.0910	0.0957	0.0957	0.0954	0.0902	0.0902	0.0897
0.475	0.0928	0.0933	0.0930	0.0969	0.0911	0.0953	0.0913	0.0913	0.0912	0.0917	0.0932	0.0937	0.0964
0.480	0.0932	0.0974	0.0926	0.0962	0.0981	0.0964	0.0934	0.0951	0.0960	0.0925	0.0978	0.0967	0.0985
0.485	0.0952	0.0944	0.0936	0.0938	0.0971	0.0970	0.0958	0.0998	0.0993	0.0950	0.0977	0.0938	0.0997
0.490	0.0972	0.1010	0.0973	0.1006	0.0992	0.1001	0.0956	0.1010	0.1011	0.0946	0.0963	0.0965	0.0986
0.495	0.0995	0.0969	0.0966	0.0961	0.0983	0.0960	0.0998	0.1014	0.0984	0.0970	0.0963	0.0973	0.0980
0.500	0.1019	0.1004	0.0985	0.1026	0.0985	0.1041	0.1019	0.1004	0.0985	0.0970	0.0971	0.1010	0.1013
0.505	0.0998	0.1023	0.1038	0.0989	0.1052	0.1021	0.1010	0.1032	0.1049	0.1056	0.1038	0.1035	0.1028
0.510	0.1048	0.1059	0.1065	0.0999	0.0999	0.1025	0.1068	0.1074	0.1036	0.1046	0.1034	0.1050	0.1036
0.515	0.1044	0.1043	0.1074	0.1079	0.1070	0.1035	0.1030	0.1030	0.1038	0.1016	0.1006	0.1022	0.1038
0.520	0.1078	0.1049	0.1032	0.1028	0.1063	0.1082	0.1061	0.1090	0.1064	0.1089	0.1047	0.1096	0.1026
0.525	0.1069	0.1055	0.1119	0.1086	0.1104	0.1056	0.1097	0.1081	0.1085	0.1091	0.1114	0.1105	0.1077
0.530	0.1056	0.1059	0.1138	0.1116	0.1118	0.1112	0.1114	0.1120	0.1058	0.1145	0.1132	0.1146	0.1142
0.535	0.1114	0.1163	0.1192	0.1191	0.1213	0.1173	0.1131	0.1206	0.1158	0.1206	0.1117	0.1171	0.1104
0.540	0.1224	0.1263	0.1188	0.1167	0.1166	0.1236	0.1261	0.1193	0.1243	0.1157	0.1285	0.1150	0.1259

X-Axis	Y-Axis												
0.000	0.0003	0.0051	0.0030	0.0043	0.0037	0.0045	0.0085	0.0039	0.0031	0.0056	0.0030	0.0073	0.0059
0.005	0.0207	0.0185	0.0204	0.0222	0.0149	0.0181	0.0204	0.0160	0.0157	0.0202	0.0191	0.0142	0.0207
0.010	0.0233	0.0198	0.0184	0.0232	0.0211	0.0181	0.0264	0.0236	0.0236	0.0235	0.0231	0.0204	0.0249
0.015	0.0225	0.0241	0.0270	0.0260	0.0215	0.0273	0.0267	0.0265	0.0267	0.0245	0.0213	0.0223	0.0271
0.020	0.0236	0.0284	0.0239	0.0243	0.0278	0.0305	0.0308	0.0292	0.0234	0.0299	0.0293	0.0246	0.0233
0.025	0.0359	0.0310	0.0387	0.0327	0.0368	0.0327	0.0313	0.0331	0.0331	0.0336	0.0355	0.0305	0.0340
0.030	0.0424	0.0406	0.0469	0.0383	0.0394	0.0454	0.0456	0.0403	0.0472	0.0387	0.0472	0.0393	0.0451
0.035	0.0556	0.0561	0.0541	0.0554	0.0557	0.0505	0.0492	0.0532	0.0549	0.0485	0.0519	0.0527	0.0478
0.040	0.0623	0.0624	0.0602	0.0585	0.0608	0.0614	0.0618	0.0578	0.0641	0.0614	0.0627	0.0634	0.0600
0.045	0.0738	0.0716	0.0695	0.0658	0.0707	0.0722	0.0702	0.0650	0.0671	0.0686	0.0669	0.0655	0.0709
0.050	0.0807	0.0787	0.0736	0.0763	0.0772	0.0778	0.0807	0.0757	0.0746	0.0792	0.0780	0.0738	0.0791
0.055	0.0835	0.0907	0.0891	0.0893	0.0838	0.0862	0.0905	0.0897	0.0868	0.0902	0.0890	0.0887	0.0897
0.060	0.0957	0.0988	0.0929	0.0950	0.0925	0.0975	0.0932	0.0937	0.0988	0.0954	0.0992	0.0925	0.0979
0.065	0.1071	0.1046	0.1052	0.1060	0.1080	0.1037	0.1064	0.1023	0.1063	0.1026	0.1028	0.1079	0.1056
0.070	0.1134	0.1130	0.1137	0.1157	0.1150	0.1126	0.1169	0.1126	0.1171	0.1155	0.1118	0.1129	0.1150
0.075	0.1228	0.1248	0.1228	0.1225	0.1251	0.1243	0.1226	0.1195	0.1228	0.1210	0.1195	0.1208	0.1233
0.080	0.1286	0.1302	0.1311	0.1270	0.1272	0.1317	0.1284	0.1274	0.1323	0.1292	0.1324	0.1300	0.1315
0.085	0.1334	0.1313	0.1332	0.1362	0.1369	0.1343	0.1305	0.1356	0.1310	0.1314	0.1379	0.1329	0.1324
0.090	0.1344	0.1361	0.1369	0.1357	0.1370	0.1380	0.1372	0.1369	0.1363	0.1406	0.1406	0.1372	0.1345
0.095	0.1360	0.1385	0.1406	0.1396	0.1374	0.1373	0.1354	0.1386	0.1403	0.1388	0.1369	0.1390	0.1356
0.100	0.1383	0.1413	0.1375	0.1379	0.1423	0.1392	0.1425	0.1370	0.1380	0.1421	0.1415	0.1406	0.1380
0.105	0.1395	0.1419	0.1405	0.1411	0.1416	0.1429	0.1413	0.1411	0.1378	0.1411	0.1371	0.1408	0.1385
0.110	0.1422	0.1386	0.1401	0.1383	0.1373	0.1375	0.1391	0.1422	0.1390	0.1370	0.1364	0.1432	0.1416
0.115	0.1375	0.1371	0.1410	0.1380	0.1368	0.1402	0.1407	0.1403	0.1425	0.1405	0.1364	0.1425	0.1370
0.120	0.1424	0.1423	0.1416	0.1368	0.1388	0.1410	0.1410	0.1366	0.1425	0.1424	0.1399	0.1388	0.1376
0.125	0.1401	0.1354	0.1363	0.1382	0.1409	0.1383	0.1390	0.1373	0.1362	0.1413	0.1412	0.1369	0.1399
0.130	0.1377	0.1391	0.1393	0.1326	0.1377	0.1355	0.1401	0.1327	0.1384	0.1356	0.1379	0.1395	0.1356
0.135	0.1294	0.1319	0.1306	0.1362	0.1326	0.1365	0.1341	0.1364	0.1365	0.1316	0.1367	0.1315	0.1356
0.140	0.1317	0.1300	0.1256	0.1248	0.1284	0.1227	0.1257	0.1232	0.1261	0.1285	0.1278	0.1307	0.1228
0.145	0.1250	0.1149	0.1117	0.1181	0.1198	0.1120	0.1242	0.1135	0.1231	0.1152	0.1148	0.1201	0.1202
0.150	0.1009	0.1025	0.0983	0.1111	0.1043	0.0944	0.1113	0.1025	0.0937	0.0990	0.1115	0.1103	0.1001
0.155	0.0898	0.0791	0.0950	0.0764	0.0861	0.0927	0.0958	0.0930	0.0921	0.0878	0.0920	0.0763	0.0885
0.160	0.0714	0.0769	0.0718	0.0725	0.0695	0.0788	0.0721	0.0601	0.0765	0.0639	0.0774	0.0657	0.0644
0.165	0.0548	0.0574	0.0618	0.0554	0.0595	0.0580	0.0598	0.0599	0.0580	0.0597	0.0565	0.0617	0.0591
0.170	0.0521	0.0550	0.0532	0.0552	0.0572	0.0573	0.0545	0.0519	0.0548	0.0553	0.0576	0.0557	0.0512
0.175	0.0545	0.0515	0.0525	0.0521	0.0506	0.0512	0.0527	0.0539	0.0558	0.0556	0.0530	0.0539	0.0515
0.180	0.0520	0.0508	0.0531	0.0550	0.0520	0.0521	0.0523	0.0555	0.0549	0.0517	0.0548	0.0557	0.0507
0.185	0.0531	0.0535	0.0538	0.0548	0.0527	0.0537	0.0563	0.0544	0.0553	0.0506	0.0523	0.0563	0.0525
0.190	0.0548	0.0515	0.0519	0.0559	0.0540	0.0530	0.0515	0.0560	0.0551	0.0551	0.0517	0.0525	0.0524
0.195	0.0540	0.0537	0.0557	0.0553	0.0542	0.0561	0.0542	0.0516	0.0544	0.0555	0.0526	0.0547	0.0557
0.200	0.0543	0.0510	0.0530	0.0565	0.0510	0.0520	0.0557	0.0543	0.0527	0.0560	0.0549	0.0529	0.0519
0.205	0.0555	0.0537	0.0545	0.0521	0.0569	0.0569	0.0542	0.0560	0.0575	0.0561	0.0550	0.0570	0.0548
0.210	0.0558	0.0549	0.0549	0.0550	0.0534	0.0584	0.0575	0.0544	0.0543	0.0576	0.0530	0.0561	0.0559
0.215	0.0575	0.0588	0.0548	0.0592	0.0571	0.0570	0.0548	0.0557	0.0543	0.0547	0.0576	0.0562	0.0554
0.220	0.0600	0.0580	0.0581	0.0561	0.0602	0.0583	0.0602	0.0597	0.0593	0.0555	0.0599	0.0578	0.0595
0.225	0.0573	0.0580	0.0602	0.0576	0.0586	0.0594	0.0566	0.0578	0.0595	0.0573	0.0589	0.0579	0.0607
0.230	0.0608	0.0592	0.0620	0.0597	0.0615	0.0584	0.0617	0.0616	0.0610	0.0598	0.0578	0.0598	0.0607
0.235	0.0602	0.0597	0.0603	0.0590	0.0605	0.0599	0.0622	0.0620	0.0589	0.0611	0.0588	0.0629	0.0625
0.240	0.0639	0.0615	0.0618	0.0606	0.0615	0.0643	0.0611	0.0614	0.0600	0.0618	0.0611	0.0600	0.0643
0.245	0.0679	0.0673	0.0666	0.0632	0.0674	0.0665	0.0647	0.0632	0.0670	0.0682	0.0659	0.0657	0.0625
0.250	0.0680	0.0671	0.0697	0.0667	0.0705	0.0698	0.0730	0.0725	0.0706	0.0741	0.0698	0.0702	0.0715
0.255	0.0798	0.0765	0.0771	0.0748	0.0810	0.0751	0.0782	0.0823	0.0773	0.0796	0.0769	0.0770	0.0802
0.260	0.0861	0.0832	0.0869	0.0822	0.0836	0.0914	0.0893	0.0825	0.0829	0.0909	0.0874	0.0882	0.0903
0.265	0.0947	0.0974	0.0981	0.0942	0.0930	0.0938	0.0927	0.0952	0.0942	0.0958	0.0930	0.0969	0.0917
0.270	0.1041	0.1050	0.1004	0.1022	0.1004	0.1005	0.1071	0.1031	0.1034	0.1054	0.1048	0.1024	0.1056
0.275	0.1087	0.1095	0.1081	0.1118	0.1113	0.1100	0.1105	0.1062	0.1067	0.1120	0.1074	0.1090	0.1132

0.280	0.1132	0.1116	0.1112	0.1128	0.1125	0.1135	0.1114	0.1112	0.1159	0.1113	0.1117	0.1114	0.1139
0.285	0.1171	0.1198	0.1179	0.1167	0.1180	0.1168	0.1166	0.1162	0.1194	0.1195	0.1153	0.1145	0.1166
0.290	0.1204	0.1203	0.1235	0.1213	0.1204	0.1233	0.1189	0.1191	0.1210	0.1237	0.1219	0.1224	0.1229
0.295	0.1239	0.1241	0.1242	0.1257	0.1214	0.1208	0.1267	0.1230	0.1206	0.1213	0.1256	0.1220	0.1254
0.300	0.1250	0.1259	0.1244	0.1297	0.1248	0.1273	0.1266	0.1252	0.1264	0.1291	0.1242	0.1252	0.1242
0.305	0.1307	0.1278	0.1261	0.1310	0.1310	0.1315	0.1269	0.1298	0.1257	0.1295	0.1303	0.1299	0.1297
0.310	0.1268	0.1288	0.1283	0.1298	0.1301	0.1286	0.1315	0.1309	0.1315	0.1305	0.1312	0.1279	0.1269
0.315	0.1320	0.1287	0.1321	0.1270	0.1305	0.1274	0.1279	0.1310	0.1321	0.1311	0.1294	0.1270	0.1296
0.320	0.1275	0.1279	0.1287	0.1317	0.1289	0.1267	0.1314	0.1279	0.1300	0.1311	0.1265	0.1285	0.1312
0.325	0.1242	0.1233	0.1282	0.1252	0.1243	0.1290	0.1284	0.1271	0.1230	0.1234	0.1250	0.1299	0.1283
0.330	0.1147	0.1180	0.1114	0.1163	0.1189	0.1179	0.1138	0.1129	0.1209	0.1119	0.1209	0.1119	0.1190
0.335	0.1036	0.0969	0.0962	0.1031	0.0997	0.1012	0.1007	0.1042	0.1087	0.1073	0.0969	0.1061	0.1049
0.340	0.0957	0.0850	0.0987	0.0804	0.0811	0.0843	0.0980	0.0932	0.0832	0.0812	0.0885	0.0989	0.0820
0.345	0.0791	0.0810	0.0789	0.0836	0.0791	0.0786	0.0837	0.0801	0.0810	0.0823	0.0837	0.0797	0.0775
0.350	0.0741	0.0764	0.0738	0.0743	0.0745	0.0745	0.0738	0.0747	0.0763	0.0770	0.0788	0.0761	0.0755
0.355	0.0767	0.0738	0.0750	0.0762	0.0760	0.0774	0.0779	0.0776	0.0776	0.0748	0.0734	0.0759	0.0781
0.360	0.0756	0.0764	0.0738	0.0757	0.0751	0.0738	0.0732	0.0732	0.0772	0.0731	0.0736	0.0779	0.0744
0.365	0.0744	0.0763	0.0777	0.0738	0.0754	0.0761	0.0761	0.0779	0.0751	0.0745	0.0733	0.0783	0.0771
0.370	0.0749	0.0772	0.0784	0.0736	0.0752	0.0740	0.0763	0.0762	0.0764	0.0756	0.0774	0.0757	0.0730
0.375	0.0783	0.0762	0.0733	0.0737	0.0780	0.0786	0.0752	0.0788	0.0759	0.0746	0.0767	0.0745	0.0782
0.380	0.0735	0.0764	0.0742	0.0763	0.0742	0.0752	0.0741	0.0775	0.0754	0.0754	0.0765	0.0733	0.0735
0.385	0.0776	0.0778	0.0758	0.0781	0.0780	0.0755	0.0744	0.0756	0.0780	0.0739	0.0770	0.0780	0.0753
0.390	0.0769	0.0741	0.0783	0.0767	0.0740	0.0767	0.0746	0.0750	0.0743	0.0773	0.0786	0.0747	0.0741
0.395	0.0748	0.0794	0.0761	0.0791	0.0735	0.0788	0.0791	0.0749	0.0776	0.0783	0.0766	0.0754	0.0769
0.400	0.0744	0.0756	0.0789	0.0738	0.0749	0.0754	0.0783	0.0761	0.0776	0.0760	0.0735	0.0751	0.0787
0.405	0.0771	0.0763	0.0766	0.0781	0.0739	0.0788	0.0764	0.0744	0.0738	0.0771	0.0765	0.0763	0.0789
0.410	0.0795	0.0779	0.0789	0.0751	0.0774	0.0786	0.0758	0.0787	0.0797	0.0794	0.0781	0.0780	0.0773
0.415	0.0772	0.0761	0.0756	0.0784	0.0792	0.0799	0.0763	0.0752	0.0797	0.0785	0.0784	0.0787	0.0751
0.420	0.0768	0.0763	0.0773	0.0787	0.0783	0.0773	0.0761	0.0809	0.0781	0.0767	0.0790	0.0795	0.0763
0.425	0.0821	0.0774	0.0802	0.0813	0.0801	0.0821	0.0824	0.0818	0.0774	0.0824	0.0792	0.0833	0.0782
0.430	0.0841	0.0801	0.0844	0.0807	0.0823	0.0810	0.0820	0.0804	0.0846	0.0793	0.0800	0.0787	0.0819
0.435	0.0855	0.0832	0.0813	0.0830	0.0830	0.0811	0.0824	0.0859	0.0862	0.0835	0.0810	0.0858	0.0805
0.440	0.0823	0.0845	0.0844	0.0866	0.0870	0.0855	0.0826	0.0837	0.0817	0.0812	0.0846	0.0830	0.0876
0.445	0.0854	0.0886	0.0887	0.0844	0.0829	0.0890	0.0852	0.0876	0.0881	0.0841	0.0835	0.0825	0.0872
0.450	0.0854	0.0870	0.0860	0.0842	0.0889	0.0893	0.0871	0.0869	0.0854	0.0872	0.0883	0.0838	0.0868
0.455	0.0890	0.0897	0.0864	0.0858	0.0860	0.0872	0.0880	0.0868	0.0887	0.0899	0.0859	0.0916	0.0915
0.460	0.0924	0.0882	0.0913	0.0870	0.0913	0.0887	0.0924	0.0930	0.0875	0.0871	0.0902	0.0874	0.0885
0.465	0.0912	0.0905	0.0945	0.0900	0.0890	0.0916	0.0898	0.0944	0.0936	0.0902	0.0934	0.0911	0.0878
0.470	0.0891	0.0930	0.0936	0.0906	0.0904	0.0894	0.0941	0.0939	0.0902	0.0890	0.0922	0.0956	0.0960
0.475	0.0929	0.0976	0.0944	0.0922	0.0972	0.0949	0.0921	0.0969	0.0931	0.0922	0.0974	0.0974	0.0937
0.480	0.0944	0.0926	0.0962	0.0956	0.0970	0.0932	0.0988	0.0982	0.0966	0.0934	0.0918	0.0960	0.0951
0.485	0.0979	0.0951	0.0933	0.0936	0.0934	0.0997	0.0987	0.0938	0.0987	0.0992	0.0938	0.0983	0.0976
0.490	0.0983	0.0950	0.1011	0.0985	0.1009	0.0955	0.0987	0.0980	0.1003	0.1002	0.0966	0.1001	0.0955
0.495	0.1015	0.0963	0.0967	0.0970	0.0970	0.1022	0.1024	0.0984	0.0990	0.1020	0.1010	0.1009	0.1023
0.500	0.1017	0.1028	0.1040	0.0989	0.1011	0.1004	0.0988	0.1025	0.0976	0.1011	0.1042	0.0996	0.1037
0.505	0.1032	0.1054	0.0992	0.1015	0.1027	0.1028	0.1013	0.1002	0.0990	0.0987	0.0998	0.1039	0.1024
0.510	0.1002	0.0996	0.1013	0.1024	0.1042	0.1014	0.1044	0.1012	0.1023	0.1027	0.1071	0.1071	0.0997
0.515	0.1054	0.1012	0.1033	0.1053	0.1013	0.1084	0.1008	0.1039	0.1041	0.1089	0.1035	0.1014	0.1036
0.520	0.1058	0.1054	0.1098	0.1044	0.1030	0.1051	0.1033	0.1024	0.1097	0.1063	0.1067	0.1049	0.1052
0.525	0.1096	0.1050	0.1087	0.1062	0.1045	0.1113	0.1107	0.1068	0.1107	0.1052	0.1052	0.1127	0.1108
0.530	0.1088	0.1156	0.1121	0.1131	0.1119	0.1093	0.1082	0.1137	0.1103	0.1131	0.1095	0.1089	0.1144
0.535	0.1160	0.1210	0.1189	0.1116	0.1086	0.1139	0.1217	0.1189	0.1130	0.1162	0.1135	0.1148	0.1215
0.540	0.1214	0.1220	0.1217	0.1173	0.1275	0.1192	0.1303	0.1205	0.1287	0.1250	0.1231	0.1260	0.1261

X-Axis	Y-Axis												
0.000	0.0076	0.0003	0.0007	0.0041	0.0038	0.0061	0.0008	0.0038	0.0032	0.0077	0.0006	0.0053	0.0068
0.005	0.0145	0.0207	0.0193	0.0215	0.0137	0.0173	0.0153	0.0198	0.0213	0.0219	0.0178	0.0190	0.0219
0.010	0.0243	0.0231	0.0258	0.0264	0.0244	0.0266	0.0204	0.0266	0.0199	0.0203	0.0194	0.0235	0.0195
0.015	0.0218	0.0255	0.0258	0.0256	0.0249	0.0256	0.0262	0.0263	0.0219	0.0220	0.0269	0.0259	0.0276
0.020	0.0262	0.0291	0.0291	0.0256	0.0315	0.0284	0.0283	0.0290	0.0274	0.0310	0.0295	0.0257	0.0244
0.025	0.0303	0.0360	0.0296	0.0312	0.0307	0.0386	0.0367	0.0358	0.0304	0.0337	0.0306	0.0303	0.0352
0.030	0.0443	0.0474	0.0463	0.0469	0.0390	0.0394	0.0474	0.0454	0.0392	0.0391	0.0453	0.0389	0.0446
0.035	0.0480	0.0548	0.0512	0.0500	0.0527	0.0494	0.0499	0.0514	0.0497	0.0525	0.0524	0.0476	0.0550
0.040	0.0576	0.0579	0.0632	0.0647	0.0597	0.0616	0.0606	0.0632	0.0583	0.0638	0.0599	0.0595	0.0591
0.045	0.0716	0.0707	0.0649	0.0721	0.0674	0.0719	0.0698	0.0703	0.0684	0.0704	0.0695	0.0717	0.0697
0.050	0.0787	0.0796	0.0809	0.0812	0.0742	0.0753	0.0760	0.0756	0.0775	0.0744	0.0734	0.0734	0.0757
0.055	0.0834	0.0890	0.0901	0.0900	0.0870	0.0881	0.0849	0.0896	0.0885	0.0831	0.0890	0.0899	0.0876
0.060	0.0988	0.0979	0.0936	0.0996	0.0953	0.0977	0.0929	0.0988	0.0956	0.0974	0.0939	0.0933	0.0998
0.065	0.1060	0.1043	0.1050	0.1074	0.1041	0.1034	0.1035	0.1062	0.1037	0.1027	0.1020	0.1063	0.1061
0.070	0.1157	0.1166	0.1175	0.1166	0.1128	0.1121	0.1173	0.1167	0.1144	0.1111	0.1124	0.1132	0.1130
0.075	0.1258	0.1256	0.1258	0.1210	0.1235	0.1202	0.1233	0.1235	0.1237	0.1251	0.1194	0.1254	0.1190
0.080	0.1263	0.1302	0.1316	0.1274	0.1302	0.1294	0.1321	0.1267	0.1295	0.1279	0.1290	0.1323	0.1313
0.085	0.1336	0.1376	0.1364	0.1319	0.1340	0.1346	0.1330	0.1344	0.1311	0.1372	0.1311	0.1307	0.1304
0.090	0.1363	0.1407	0.1400	0.1388	0.1361	0.1405	0.1342	0.1362	0.1402	0.1406	0.1373	0.1395	0.1355
0.095	0.1365	0.1367	0.1403	0.1419	0.1405	0.1383	0.1388	0.1404	0.1395	0.1418	0.1353	0.1419	0.1369
0.100	0.1427	0.1413	0.1384	0.1395	0.1368	0.1382	0.1398	0.1387	0.1396	0.1423	0.1370	0.1385	0.1398
0.105	0.1428	0.1375	0.1412	0.1409	0.1433	0.1388	0.1375	0.1378	0.1371	0.1430	0.1380	0.1402	0.1362
0.110	0.1392	0.1406	0.1407	0.1426	0.1411	0.1394	0.1413	0.1377	0.1390	0.1373	0.1379	0.1429	0.1371
0.115	0.1372	0.1431	0.1418	0.1369	0.1425	0.1384	0.1412	0.1422	0.1397	0.1415	0.1360	0.1382	0.1371
0.120	0.1389	0.1385	0.1409	0.1377	0.1371	0.1361	0.1423	0.1367	0.1413	0.1414	0.1365	0.1428	0.1364
0.125	0.1379	0.1398	0.1371	0.1351	0.1380	0.1362	0.1378	0.1409	0.1350	0.1364	0.1369	0.1361	0.1348
0.130	0.1363	0.1352	0.1371	0.1338	0.1385	0.1356	0.1370	0.1395	0.1362	0.1395	0.1338	0.1323	0.1381
0.135	0.1320	0.1347	0.1350	0.1300	0.1352	0.1305	0.1306	0.1374	0.1341	0.1341	0.1358	0.1314	0.1315
0.140	0.1232	0.1256	0.1249	0.1293	0.1235	0.1303	0.1296	0.1299	0.1230	0.1319	0.1273	0.1269	0.1306
0.145	0.1257	0.1165	0.1203	0.1197	0.1233	0.1183	0.1128	0.1183	0.1155	0.1137	0.1212	0.1221	0.1196
0.150	0.1023	0.1038	0.1001	0.1046	0.1011	0.0945	0.1064	0.0996	0.0974	0.1030	0.1079	0.0977	0.1032
0.155	0.0901	0.0939	0.0824	0.0950	0.0864	0.0877	0.0917	0.0936	0.0770	0.0842	0.0895	0.0786	0.0770
0.160	0.0760	0.0721	0.0762	0.0630	0.0655	0.0699	0.0748	0.0710	0.0710	0.0659	0.0636	0.0767	0.0680
0.165	0.0596	0.0609	0.0549	0.0575	0.0560	0.0536	0.0552	0.0557	0.0602	0.0609	0.0554	0.0564	0.0574
0.170	0.0515	0.0568	0.0526	0.0532	0.0530	0.0542	0.0554	0.0553	0.0512	0.0553	0.0573	0.0537	0.0555
0.175	0.0522	0.0507	0.0526	0.0546	0.0560	0.0558	0.0530	0.0527	0.0506	0.0549	0.0527	0.0509	0.0531
0.180	0.0562	0.0560	0.0511	0.0553	0.0530	0.0518	0.0510	0.0531	0.0559	0.0537	0.0555	0.0505	0.0558
0.185	0.0537	0.0524	0.0560	0.0507	0.0510	0.0545	0.0523	0.0510	0.0522	0.0512	0.0531	0.0535	0.0514
0.190	0.0536	0.0550	0.0516	0.0550	0.0528	0.0510	0.0527	0.0529	0.0555	0.0542	0.0550	0.0530	0.0519
0.195	0.0537	0.0556	0.0529	0.0557	0.0547	0.0528	0.0567	0.0522	0.0538	0.0560	0.0531	0.0532	0.0536
0.200	0.0561	0.0527	0.0557	0.0560	0.0554	0.0522	0.0563	0.0546	0.0551	0.0549	0.0566	0.0540	0.0534
0.205	0.0524	0.0534	0.0526	0.0537	0.0569	0.0523	0.0545	0.0531	0.0540	0.0534	0.0518	0.0556	0.0569
0.210	0.0532	0.0579	0.0532	0.0537	0.0538	0.0535	0.0579	0.0564	0.0546	0.0567	0.0546	0.0582	0.0546
0.215	0.0544	0.0548	0.0583	0.0585	0.0587	0.0585	0.0553	0.0567	0.0575	0.0551	0.0569	0.0548	0.0592
0.220	0.0554	0.0591	0.0594	0.0556	0.0586	0.0570	0.0598	0.0572	0.0565	0.0553	0.0587	0.0571	0.0582
0.225	0.0595	0.0607	0.0582	0.0571	0.0583	0.0583	0.0575	0.0605	0.0582	0.0589	0.0612	0.0603	0.0607
0.230	0.0622	0.0614	0.0613	0.0591	0.0580	0.0584	0.0576	0.0594	0.0622	0.0580	0.0584	0.0579	0.0609
0.235	0.0611	0.0605	0.0616	0.0630	0.0620	0.0621	0.0594	0.0597	0.0616	0.0630	0.0610	0.0626	0.0621
0.240	0.0640	0.0634	0.0637	0.0628	0.0640	0.0608	0.0629	0.0605	0.0606	0.0630	0.0618	0.0625	0.0601
0.245	0.0630	0.0637	0.0622	0.0680	0.0624	0.0633	0.0645	0.0632	0.0626	0.0641	0.0675	0.0634	0.0659
0.250	0.0664	0.0739	0.0672	0.0725	0.0675	0.0679	0.0665	0.0710	0.0696	0.0689	0.0677	0.0704	0.0695
0.255	0.0819	0.0767	0.0771	0.0759	0.0818	0.0795	0.0790	0.0800	0.0805	0.0757	0.0775	0.0816	0.0806
0.260	0.0887	0.0863	0.0852	0.0823	0.0900	0.0912	0.0830	0.0888	0.0850	0.0841	0.0890	0.0899	0.0847
0.265	0.0913	0.0993	0.0954	0.0922	0.0916	0.0971	0.0994	0.0958	0.0912	0.0925	0.0982	0.0948	0.0979
0.270	0.1051	0.1024	0.1012	0.1036	0.1068	0.1042	0.1058	0.1073	0.1021	0.1073	0.1007	0.1034	0.1008
0.275	0.1109	0.1099	0.1063	0.1105	0.1088	0.1117	0.1100	0.1081	0.1087	0.1099	0.1126	0.1114	0.1121

0.280	0.1136	0.1168	0.1159	0.1143	0.1162	0.1132	0.1143	0.1164	0.1125	0.1116	0.1154	0.1139	0.1139
0.285	0.1146	0.1148	0.1152	0.1199	0.1156	0.1199	0.1149	0.1166	0.1190	0.1155	0.1194	0.1151	0.1170
0.290	0.1214	0.1227	0.1224	0.1226	0.1192	0.1227	0.1199	0.1222	0.1228	0.1211	0.1216	0.1214	0.1212
0.295	0.1229	0.1219	0.1249	0.1226	0.1235	0.1267	0.1238	0.1233	0.1208	0.1235	0.1266	0.1257	0.1210
0.300	0.1285	0.1271	0.1242	0.1285	0.1286	0.1278	0.1249	0.1263	0.1250	0.1240	0.1254	0.1296	0.1247
0.305	0.1277	0.1278	0.1306	0.1260	0.1277	0.1282	0.1297	0.1308	0.1265	0.1266	0.1304	0.1272	0.1276
0.310	0.1272	0.1285	0.1297	0.1315	0.1293	0.1288	0.1303	0.1271	0.1319	0.1314	0.1277	0.1283	0.1265
0.315	0.1299	0.1276	0.1303	0.1292	0.1312	0.1314	0.1307	0.1280	0.1294	0.1278	0.1310	0.1274	0.1322
0.320	0.1272	0.1299	0.1292	0.1282	0.1270	0.1290	0.1280	0.1282	0.1268	0.1306	0.1292	0.1295	0.1310
0.325	0.1283	0.1292	0.1259	0.1281	0.1266	0.1261	0.1278	0.1233	0.1257	0.1265	0.1230	0.1242	0.1273
0.330	0.1188	0.1194	0.1173	0.1194	0.1232	0.1157	0.1144	0.1174	0.1138	0.1208	0.1149	0.1160	0.1249
0.335	0.1135	0.1059	0.0986	0.1134	0.1063	0.1111	0.1126	0.1029	0.1119	0.1105	0.1065	0.1046	0.1070
0.340	0.0894	0.0933	0.0899	0.0932	0.0857	0.0868	0.0920	0.0958	0.0897	0.0891	0.0962	0.0850	0.0807
0.345	0.0765	0.0818	0.0826	0.0832	0.0774	0.0788	0.0841	0.0787	0.0799	0.0789	0.0835	0.0795	0.0827
0.350	0.0754	0.0760	0.0767	0.0737	0.0785	0.0748	0.0747	0.0774	0.0767	0.0783	0.0759	0.0743	0.0756
0.355	0.0746	0.0768	0.0769	0.0757	0.0736	0.0743	0.0750	0.0760	0.0745	0.0753	0.0740	0.0769	0.0769
0.360	0.0736	0.0746	0.0772	0.0763	0.0782	0.0762	0.0770	0.0742	0.0737	0.0762	0.0767	0.0773	0.0771
0.365	0.0766	0.0758	0.0737	0.0768	0.0768	0.0734	0.0731	0.0769	0.0735	0.0770	0.0729	0.0740	0.0781
0.370	0.0752	0.0762	0.0737	0.0770	0.0745	0.0786	0.0781	0.0771	0.0741	0.0748	0.0737	0.0765	0.0754
0.375	0.0778	0.0767	0.0777	0.0755	0.0767	0.0789	0.0781	0.0747	0.0782	0.0757	0.0776	0.0754	0.0779
0.380	0.0741	0.0761	0.0768	0.0773	0.0786	0.0784	0.0754	0.0737	0.0786	0.0759	0.0776	0.0787	0.0750
0.385	0.0757	0.0751	0.0738	0.0761	0.0785	0.0775	0.0779	0.0736	0.0787	0.0778	0.0786	0.0742	0.0750
0.390	0.0742	0.0755	0.0762	0.0750	0.0772	0.0777	0.0737	0.0755	0.0763	0.0756	0.0764	0.0780	0.0763
0.395	0.0734	0.0750	0.0794	0.0753	0.0760	0.0739	0.0747	0.0777	0.0743	0.0775	0.0748	0.0768	0.0788
0.400	0.0769	0.0792	0.0767	0.0745	0.0749	0.0761	0.0785	0.0763	0.0781	0.0777	0.0791	0.0736	0.0759
0.405	0.0787	0.0760	0.0773	0.0757	0.0776	0.0738	0.0768	0.0746	0.0757	0.0737	0.0755	0.0755	0.0752
0.410	0.0787	0.0768	0.0760	0.0743	0.0767	0.0784	0.0750	0.0758	0.0742	0.0746	0.0759	0.0743	0.0765
0.415	0.0785	0.0762	0.0773	0.0763	0.0805	0.0760	0.0750	0.0799	0.0781	0.0789	0.0760	0.0779	0.0795
0.420	0.0773	0.0776	0.0816	0.0771	0.0772	0.0766	0.0790	0.0782	0.0762	0.0784	0.0779	0.0773	0.0766
0.425	0.0784	0.0777	0.0808	0.0815	0.0798	0.0787	0.0823	0.0803	0.0805	0.0806	0.0806	0.0792	0.0776
0.430	0.0823	0.0794	0.0787	0.0818	0.0810	0.0818	0.0806	0.0820	0.0832	0.0815	0.0797	0.0832	0.0839
0.435	0.0831	0.0814	0.0812	0.0816	0.0814	0.0834	0.0818	0.0821	0.0822	0.0851	0.0818	0.0811	0.0816
0.440	0.0873	0.0821	0.0839	0.0862	0.0842	0.0814	0.0848	0.0871	0.0825	0.0814	0.0878	0.0870	0.0826
0.445	0.0876	0.0868	0.0878	0.0832	0.0835	0.0883	0.0890	0.0865	0.0846	0.0827	0.0831	0.0883	0.0869
0.450	0.0889	0.0892	0.0859	0.0871	0.0883	0.0850	0.0863	0.0887	0.0896	0.0843	0.0865	0.0861	0.0879
0.455	0.0900	0.0911	0.0855	0.0856	0.0868	0.0867	0.0898	0.0899	0.0896	0.0856	0.0869	0.0914	0.0877
0.460	0.0879	0.0903	0.0916	0.0865	0.0877	0.0875	0.0927	0.0866	0.0925	0.0883	0.0905	0.0908	0.0890
0.465	0.0918	0.0884	0.0940	0.0912	0.0903	0.0935	0.0891	0.0891	0.0909	0.0940	0.0881	0.0912	0.0939
0.470	0.0929	0.0960	0.0958	0.0950	0.0897	0.0949	0.0898	0.0930	0.0902	0.0924	0.0927	0.0891	0.0956
0.475	0.0938	0.0942	0.0953	0.0973	0.0926	0.0935	0.0926	0.0949	0.0913	0.0907	0.0958	0.0956	0.0950
0.480	0.0962	0.0940	0.0970	0.0962	0.0960	0.0988	0.0983	0.0943	0.0969	0.0934	0.0922	0.0986	0.0946
0.485	0.0945	0.0958	0.0935	0.0954	0.0953	0.0970	0.0954	0.0942	0.0936	0.0937	0.0967	0.0982	0.0957
0.490	0.0985	0.1005	0.0999	0.0994	0.0991	0.0958	0.0967	0.0989	0.1009	0.0961	0.0972	0.0956	0.0982
0.495	0.1015	0.1026	0.0971	0.1002	0.0987	0.0980	0.1013	0.1012	0.1009	0.1007	0.0977	0.0999	0.0971
0.500	0.0989	0.0994	0.0975	0.1014	0.1034	0.0990	0.1026	0.0999	0.1026	0.0996	0.0987	0.0976	0.1016
0.505	0.0999	0.1029	0.0990	0.1026	0.0993	0.0995	0.1058	0.1025	0.1020	0.1026	0.0992	0.1011	0.1034
0.510	0.1012	0.1041	0.1046	0.1031	0.1039	0.1025	0.1000	0.1070	0.1008	0.1044	0.1017	0.1005	0.1073
0.515	0.1037	0.1023	0.1019	0.1056	0.1079	0.1082	0.1032	0.1012	0.1056	0.1090	0.1083	0.1015	0.1047
0.520	0.1063	0.1059	0.1037	0.1050	0.1097	0.1085	0.1104	0.1070	0.1085	0.1087	0.1099	0.1031	0.1060
0.525	0.1102	0.1086	0.1108	0.1056	0.1089	0.1065	0.1067	0.1091	0.1120	0.1127	0.1042	0.1043	0.1070
0.530	0.1133	0.1057	0.1135	0.1123	0.1135	0.1134	0.1098	0.1143	0.1112	0.1066	0.1098	0.1115	0.1091
0.535	0.1083	0.1144	0.1216	0.1094	0.1164	0.1116	0.1111	0.1180	0.1113	0.1222	0.1178	0.1140	0.1096
0.540	0.1156	0.1181	0.1223	0.1246	0.1209	0.1299	0.1167	0.1173	0.1213	0.1287	0.1150	0.1235	0.1155

X-Axis	Y-Axis												
0.000	0.0010	0.0021	0.0020	0.0058	0.0087	0.0053	0.0044	0.0034	0.0071	0.0027	0.0056	0.0035	0.0071
0.005	0.0155	0.0145	0.0212	0.0219	0.0164	0.0135	0.0219	0.0199	0.0193	0.0153	0.0148	0.0151	0.0209
0.010	0.0181	0.0248	0.0208	0.0232	0.0201	0.0199	0.0206	0.0210	0.0246	0.0203	0.0224	0.0187	0.0235
0.015	0.0274	0.0241	0.0255	0.0228	0.0281	0.0267	0.0238	0.0250	0.0264	0.0211	0.0281	0.0273	0.0249
0.020	0.0285	0.0256	0.0268	0.0286	0.0282	0.0303	0.0260	0.0253	0.0264	0.0246	0.0297	0.0263	0.0247
0.025	0.0309	0.0294	0.0385	0.0330	0.0353	0.0313	0.0382	0.0356	0.0328	0.0348	0.0318	0.0324	0.0336
0.030	0.0403	0.0459	0.0425	0.0421	0.0423	0.0467	0.0428	0.0467	0.0425	0.0392	0.0428	0.0443	0.0385
0.035	0.0550	0.0504	0.0552	0.0533	0.0554	0.0493	0.0561	0.0475	0.0549	0.0486	0.0542	0.0533	0.0524
0.040	0.0601	0.0567	0.0632	0.0640	0.0592	0.0567	0.0595	0.0622	0.0613	0.0625	0.0582	0.0604	0.0629
0.045	0.0704	0.0717	0.0736	0.0690	0.0688	0.0736	0.0664	0.0699	0.0656	0.0658	0.0709	0.0737	0.0682
0.050	0.0795	0.0820	0.0794	0.0774	0.0774	0.0748	0.0817	0.0799	0.0748	0.0775	0.0787	0.0766	0.0757
0.055	0.0852	0.0893	0.0911	0.0913	0.0837	0.0899	0.0846	0.0874	0.0838	0.0852	0.0860	0.0839	0.0864
0.060	0.0996	0.0991	0.0923	0.0981	0.0928	0.0944	0.1000	0.0983	0.0958	0.0927	0.0955	0.0979	0.0970
0.065	0.1024	0.1080	0.1077	0.1033	0.1045	0.1039	0.1028	0.1030	0.1062	0.1035	0.1029	0.1047	0.1049
0.070	0.1149	0.1123	0.1157	0.1136	0.1114	0.1152	0.1167	0.1155	0.1141	0.1171	0.1152	0.1110	0.1109
0.075	0.1238	0.1193	0.1206	0.1202	0.1246	0.1220	0.1252	0.1197	0.1205	0.1222	0.1232	0.1204	0.1206
0.080	0.1267	0.1271	0.1270	0.1297	0.1279	0.1265	0.1327	0.1308	0.1289	0.1283	0.1303	0.1293	0.1269
0.085	0.1360	0.1304	0.1365	0.1309	0.1350	0.1356	0.1350	0.1344	0.1376	0.1336	0.1335	0.1336	0.1376
0.090	0.1378	0.1346	0.1407	0.1397	0.1390	0.1373	0.1398	0.1407	0.1341	0.1354	0.1381	0.1349	0.1407
0.095	0.1388	0.1392	0.1363	0.1400	0.1391	0.1386	0.1361	0.1376	0.1366	0.1407	0.1398	0.1404	0.1396
0.100	0.1370	0.1379	0.1386	0.1414	0.1374	0.1361	0.1416	0.1384	0.1394	0.1398	0.1395	0.1368	0.1390
0.105	0.1407	0.1423	0.1367	0.1403	0.1404	0.1370	0.1386	0.1415	0.1413	0.1384	0.1374	0.1375	0.1431
0.110	0.1414	0.1408	0.1404	0.1403	0.1361	0.1392	0.1373	0.1369	0.1389	0.1405	0.1430	0.1418	0.1409
0.115	0.1414	0.1403	0.1396	0.1421	0.1394	0.1430	0.1375	0.1389	0.1400	0.1416	0.1418	0.1398	0.1411
0.120	0.1368	0.1392	0.1364	0.1384	0.1400	0.1360	0.1413	0.1364	0.1391	0.1361	0.1370	0.1370	0.1385
0.125	0.1350	0.1385	0.1349	0.1346	0.1375	0.1389	0.1371	0.1355	0.1370	0.1390	0.1397	0.1367	0.1359
0.130	0.1344	0.1355	0.1360	0.1389	0.1369	0.1368	0.1402	0.1397	0.1354	0.1390	0.1380	0.1384	0.1384
0.135	0.1289	0.1357	0.1329	0.1303	0.1364	0.1290	0.1287	0.1373	0.1316	0.1375	0.1346	0.1342	0.1317
0.140	0.1328	0.1275	0.1283	0.1255	0.1269	0.1313	0.1311	0.1286	0.1249	0.1321	0.1307	0.1309	0.1310
0.145	0.1147	0.1193	0.1150	0.1172	0.1199	0.1237	0.1156	0.1130	0.1121	0.1227	0.1160	0.1199	0.1227
0.150	0.1116	0.1004	0.1100	0.1109	0.1073	0.1012	0.1078	0.1066	0.1044	0.0968	0.1088	0.1114	0.1059
0.155	0.0899	0.0825	0.0846	0.0908	0.0879	0.0954	0.0847	0.0911	0.0831	0.0855	0.0907	0.0848	0.0934
0.160	0.0709	0.0667	0.0722	0.0742	0.0701	0.0651	0.0600	0.0701	0.0765	0.0699	0.0695	0.0728	0.0746
0.165	0.0565	0.0529	0.0588	0.0545	0.0567	0.0539	0.0612	0.0589	0.0565	0.0622	0.0600	0.0586	0.0617
0.170	0.0562	0.0560	0.0508	0.0577	0.0510	0.0523	0.0517	0.0541	0.0540	0.0569	0.0571	0.0525	0.0554
0.175	0.0520	0.0560	0.0558	0.0558	0.0551	0.0513	0.0536	0.0547	0.0561	0.0532	0.0550	0.0507	0.0526
0.180	0.0559	0.0539	0.0506	0.0525	0.0527	0.0546	0.0535	0.0529	0.0547	0.0546	0.0542	0.0523	0.0562
0.185	0.0533	0.0556	0.0552	0.0522	0.0506	0.0560	0.0554	0.0520	0.0527	0.0521	0.0534	0.0527	0.0522
0.190	0.0520	0.0528	0.0517	0.0540	0.0551	0.0528	0.0542	0.0522	0.0517	0.0541	0.0560	0.0537	0.0524
0.195	0.0526	0.0517	0.0562	0.0543	0.0514	0.0541	0.0519	0.0513	0.0545	0.0537	0.0526	0.0550	0.0518
0.200	0.0542	0.0513	0.0533	0.0567	0.0536	0.0530	0.0549	0.0556	0.0528	0.0559	0.0534	0.0516	0.0526
0.205	0.0563	0.0562	0.0522	0.0529	0.0525	0.0517	0.0549	0.0551	0.0571	0.0570	0.0561	0.0564	0.0565
0.210	0.0577	0.0534	0.0562	0.0573	0.0546	0.0573	0.0580	0.0531	0.0563	0.0561	0.0540	0.0543	0.0557
0.215	0.0560	0.0551	0.0578	0.0551	0.0559	0.0589	0.0569	0.0550	0.0567	0.0580	0.0568	0.0576	0.0551
0.220	0.0557	0.0575	0.0595	0.0589	0.0555	0.0570	0.0580	0.0580	0.0585	0.0555	0.0600	0.0603	0.0560
0.225	0.0579	0.0577	0.0607	0.0604	0.0562	0.0582	0.0599	0.0578	0.0603	0.0565	0.0599	0.0585	0.0605
0.230	0.0610	0.0611	0.0610	0.0582	0.0584	0.0608	0.0608	0.0617	0.0578	0.0606	0.0582	0.0596	0.0583
0.235	0.0591	0.0588	0.0617	0.0615	0.0618	0.0624	0.0599	0.0619	0.0607	0.0618	0.0618	0.0594	0.0629
0.240	0.0630	0.0607	0.0637	0.0643	0.0603	0.0644	0.0638	0.0646	0.0639	0.0604	0.0636	0.0631	0.0644
0.245	0.0656	0.0655	0.0668	0.0661	0.0613	0.0642	0.0666	0.0625	0.0681	0.0628	0.0650	0.0629	0.0639
0.250	0.0701	0.0678	0.0668	0.0672	0.0707	0.0741	0.0692	0.0681	0.0740	0.0734	0.0697	0.0691	0.0691
0.255	0.0812	0.0814	0.0747	0.0818	0.0795	0.0816	0.0778	0.0776	0.0820	0.0760	0.0768	0.0747	0.0761
0.260	0.0875	0.0842	0.0838	0.0902	0.0868	0.0890	0.0885	0.0899	0.0903	0.0835	0.0903	0.0855	0.0840
0.265	0.0947	0.0969	0.0913	0.0937	0.0995	0.0993	0.0916	0.0944	0.0921	0.0920	0.0950	0.0955	0.0949
0.270	0.1030	0.1012	0.1066	0.1042	0.1020	0.1037	0.1073	0.1011	0.1044	0.1071	0.1046	0.1057	0.1000
0.275	0.1109	0.1064	0.1104	0.1091	0.1107	0.1091	0.1077	0.1102	0.1077	0.1090	0.1062	0.1118	0.1131

0.280	0.1160	0.1116	0.1133	0.1136	0.1136	0.1142	0.1115	0.1161	0.1144	0.1112	0.1139	0.1121	0.1128
0.285	0.1199	0.1197	0.1179	0.1192	0.1160	0.1167	0.1184	0.1158	0.1173	0.1179	0.1162	0.1163	0.1169
0.290	0.1180	0.1231	0.1236	0.1211	0.1180	0.1216	0.1210	0.1201	0.1237	0.1189	0.1202	0.1236	0.1237
0.295	0.1210	0.1219	0.1265	0.1263	0.1209	0.1247	0.1263	0.1253	0.1222	0.1239	0.1227	0.1259	0.1241
0.300	0.1264	0.1284	0.1246	0.1285	0.1243	0.1242	0.1267	0.1239	0.1287	0.1298	0.1252	0.1281	0.1290
0.305	0.1310	0.1313	0.1253	0.1310	0.1270	0.1251	0.1281	0.1261	0.1307	0.1271	0.1299	0.1282	0.1306
0.310	0.1308	0.1290	0.1308	0.1312	0.1264	0.1308	0.1283	0.1308	0.1296	0.1268	0.1280	0.1296	0.1289
0.315	0.1276	0.1289	0.1294	0.1288	0.1303	0.1319	0.1302	0.1316	0.1304	0.1315	0.1302	0.1280	0.1316
0.320	0.1287	0.1297	0.1306	0.1275	0.1311	0.1305	0.1292	0.1264	0.1279	0.1284	0.1303	0.1291	0.1298
0.325	0.1275	0.1298	0.1266	0.1265	0.1283	0.1275	0.1234	0.1230	0.1278	0.1238	0.1266	0.1281	0.1299
0.330	0.1213	0.1154	0.1160	0.1148	0.1209	0.1247	0.1245	0.1241	0.1139	0.1178	0.1239	0.1132	0.1247
0.335	0.1020	0.0974	0.1060	0.1014	0.0989	0.1114	0.0994	0.1124	0.1136	0.1107	0.0963	0.1129	0.1080
0.340	0.0927	0.0945	0.0874	0.0876	0.0853	0.0889	0.0889	0.0945	0.0887	0.0845	0.0982	0.0840	0.0832
0.345	0.0757	0.0837	0.0767	0.0819	0.0794	0.0816	0.0807	0.0754	0.0764	0.0831	0.0840	0.0811	0.0807
0.350	0.0776	0.0741	0.0786	0.0781	0.0756	0.0773	0.0742	0.0786	0.0772	0.0772	0.0784	0.0751	0.0742
0.355	0.0758	0.0756	0.0772	0.0728	0.0774	0.0734	0.0774	0.0743	0.0744	0.0746	0.0754	0.0744	0.0757
0.360	0.0750	0.0781	0.0743	0.0739	0.0781	0.0747	0.0751	0.0751	0.0757	0.0733	0.0735	0.0738	0.0764
0.365	0.0772	0.0787	0.0738	0.0760	0.0763	0.0748	0.0784	0.0767	0.0776	0.0752	0.0751	0.0731	0.0762
0.370	0.0765	0.0742	0.0762	0.0757	0.0787	0.0788	0.0760	0.0769	0.0784	0.0770	0.0749	0.0745	0.0769
0.375	0.0780	0.0768	0.0774	0.0735	0.0773	0.0751	0.0771	0.0775	0.0745	0.0783	0.0763	0.0767	0.0785
0.380	0.0765	0.0782	0.0775	0.0759	0.0746	0.0736	0.0782	0.0771	0.0750	0.0766	0.0756	0.0772	0.0756
0.385	0.0734	0.0753	0.0788	0.0775	0.0744	0.0785	0.0763	0.0741	0.0750	0.0778	0.0733	0.0746	0.0772
0.390	0.0758	0.0750	0.0747	0.0734	0.0774	0.0770	0.0735	0.0762	0.0749	0.0742	0.0753	0.0785	0.0760
0.395	0.0747	0.0793	0.0761	0.0778	0.0749	0.0736	0.0795	0.0785	0.0773	0.0786	0.0748	0.0735	0.0791
0.400	0.0792	0.0769	0.0766	0.0766	0.0786	0.0795	0.0763	0.0783	0.0787	0.0784	0.0754	0.0788	0.0776
0.405	0.0780	0.0778	0.0746	0.0773	0.0764	0.0748	0.0789	0.0767	0.0770	0.0743	0.0750	0.0753	0.0791
0.410	0.0774	0.0741	0.0775	0.0765	0.0789	0.0761	0.0791	0.0787	0.0743	0.0791	0.0764	0.0771	0.0786
0.415	0.0792	0.0771	0.0777	0.0777	0.0804	0.0780	0.0754	0.0757	0.0799	0.0789	0.0756	0.0782	0.0750
0.420	0.0806	0.0793	0.0793	0.0781	0.0781	0.0816	0.0772	0.0765	0.0781	0.0763	0.0770	0.0820	0.0816
0.425	0.0832	0.0834	0.0825	0.0805	0.0807	0.0823	0.0794	0.0812	0.0782	0.0806	0.0781	0.0819	0.0778
0.430	0.0831	0.0828	0.0814	0.0814	0.0807	0.0804	0.0798	0.0830	0.0790	0.0818	0.0830	0.0823	0.0821
0.435	0.0846	0.0856	0.0845	0.0822	0.0838	0.0822	0.0859	0.0813	0.0799	0.0845	0.0815	0.0802	0.0834
0.440	0.0868	0.0831	0.0875	0.0823	0.0814	0.0851	0.0819	0.0817	0.0816	0.0814	0.0823	0.0816	0.0862
0.445	0.0884	0.0826	0.0888	0.0865	0.0826	0.0878	0.0868	0.0874	0.0873	0.0874	0.0878	0.0876	0.0877
0.450	0.0851	0.0851	0.0891	0.0857	0.0859	0.0874	0.0854	0.0869	0.0877	0.0900	0.0851	0.0891	0.0864
0.455	0.0875	0.0872	0.0896	0.0910	0.0859	0.0904	0.0879	0.0869	0.0866	0.0880	0.0913	0.0912	0.0906
0.460	0.0871	0.0886	0.0899	0.0894	0.0906	0.0883	0.0897	0.0915	0.0869	0.0868	0.0902	0.0870	0.0888
0.465	0.0918	0.0912	0.0911	0.0906	0.0903	0.0931	0.0934	0.0915	0.0886	0.0925	0.0919	0.0920	0.0897
0.470	0.0952	0.0913	0.0911	0.0932	0.0901	0.0892	0.0898	0.0939	0.0896	0.0890	0.0947	0.0952	0.0906
0.475	0.0976	0.0961	0.0974	0.0925	0.0973	0.0908	0.0920	0.0904	0.0956	0.0948	0.0975	0.0904	0.0970
0.480	0.0957	0.0970	0.0953	0.0971	0.0944	0.0960	0.0928	0.0981	0.0951	0.0977	0.0958	0.0968	0.0959
0.485	0.0956	0.0943	0.0972	0.0936	0.0965	0.0950	0.0971	0.0987	0.0961	0.0933	0.0932	0.0936	0.0934
0.490	0.0995	0.0980	0.0981	0.1005	0.0955	0.0968	0.0948	0.1000	0.0954	0.0999	0.0974	0.0960	0.0947
0.495	0.0976	0.1020	0.0971	0.0978	0.0988	0.1006	0.0996	0.0982	0.0965	0.1028	0.0992	0.1017	0.0955
0.500	0.1015	0.1013	0.1039	0.1009	0.1033	0.1012	0.1024	0.0998	0.1036	0.1022	0.1009	0.1037	0.0996
0.505	0.0996	0.0997	0.1025	0.1048	0.1008	0.0989	0.1050	0.0991	0.1021	0.1005	0.1057	0.1023	0.1023
0.510	0.1010	0.1012	0.1025	0.1030	0.1063	0.1000	0.1020	0.1039	0.1056	0.0996	0.1015	0.1041	0.1013
0.515	0.1089	0.1083	0.1043	0.1034	0.1088	0.1080	0.1046	0.1037	0.1034	0.1040	0.1038	0.1045	0.1071
0.520	0.1039	0.1096	0.1063	0.1060	0.1052	0.1024	0.1026	0.1087	0.1081	0.1045	0.1060	0.1061	0.1098
0.525	0.1078	0.1118	0.1101	0.1085	0.1069	0.1101	0.1088	0.1062	0.1082	0.1108	0.1101	0.1048	0.1043
0.530	0.1125	0.1150	0.1122	0.1142	0.1130	0.1061	0.1146	0.1099	0.1070	0.1114	0.1084	0.1088	0.1112
0.535	0.1156	0.1210	0.1112	0.1104	0.1113	0.1127	0.1177	0.1075	0.1216	0.1205	0.1151	0.1169	0.1159
0.540	0.1214	0.1257	0.1285	0.1267	0.1151	0.1226	0.1230	0.1259	0.1294	0.1225	0.1210	0.1305	0.1269

X-Axis	Y-Axis												
0.000	0.0035	0.0088	0.0026	0.0055	0.0037	0.0065	0.0040						
0.005	0.0214	0.0216	0.0161	0.0159	0.0177	0.0214	0.0208	0.0221	0.0147	0.0163	0.0145	0.0168	0.0143
0.010	0.0241	0.0235	0.0228	0.0229	0.0236	0.0239	0.0198	0.0184	0.0252	0.0212	0.0200	0.0179	0.0213
0.015	0.0228	0.0279	0.0235	0.0217	0.0228	0.0256	0.0219	0.0272	0.0251	0.0252	0.0203	0.0268	0.0224
0.020	0.0287	0.0246	0.0283	0.0246	0.0256	0.0313	0.0236	0.0249	0.0304	0.0247	0.0241	0.0267	0.0289
0.025	0.0299	0.0351	0.0377	0.0306	0.0331	0.0294	0.0347	0.0295	0.0371	0.0293	0.0355	0.0322	0.0368
0.030	0.0461	0.0426	0.0393	0.0464	0.0433	0.0428	0.0434	0.0463	0.0444	0.0390	0.0450	0.0450	0.0444
0.035	0.0492	0.0559	0.0501	0.0537	0.0492	0.0507	0.0476	0.0514	0.0483	0.0518	0.0485	0.0536	0.0479
0.040	0.0616	0.0619	0.0647	0.0631	0.0573	0.0607	0.0607	0.0607	0.0574	0.0614	0.0631	0.0631	0.0563
0.045	0.0735	0.0681	0.0700	0.0711	0.0655	0.0735	0.0692	0.0676	0.0717	0.0699	0.0717	0.0724	0.0699
0.050	0.0733	0.0736	0.0822	0.0763	0.0777	0.0783	0.0737	0.0742	0.0769	0.0776	0.0817	0.0747	0.0763
0.055	0.0831	0.0890	0.0910	0.0875	0.0869	0.0897	0.0830	0.0904	0.0864	0.0885	0.0911	0.0879	0.0894
0.060	0.0986	0.0978	0.0957	0.0956	0.0938	0.0966	0.0946	0.0953	0.0937	0.0968	0.0949	0.0967	0.0957
0.065	0.1048	0.1061	0.1017	0.1071	0.1073	0.1069	0.1028	0.1054	0.1053	0.1054	0.1045	0.1043	0.1048
0.070	0.1153	0.1164	0.1156	0.1154	0.1162	0.1164	0.1148	0.1123	0.1144	0.1114	0.1150	0.1158	0.1159
0.075	0.1190	0.1205	0.1249	0.1249	0.1235	0.1236	0.1209	0.1255	0.1252	0.1199	0.1255	0.1258	0.1197
0.080	0.1302	0.1281	0.1316	0.1264	0.1322	0.1308	0.1266	0.1285	0.1304	0.1297	0.1265	0.1303	0.1264
0.085	0.1345	0.1329	0.1346	0.1381	0.1322	0.1380	0.1339	0.1313	0.1332	0.1369	0.1362	0.1370	0.1375
0.090	0.1340	0.1393	0.1394	0.1374	0.1345	0.1365	0.1339	0.1396	0.1407	0.1375	0.1363	0.1375	0.1339
0.095	0.1361	0.1389	0.1367	0.1376	0.1417	0.1392	0.1359	0.1354	0.1371	0.1371	0.1381	0.1354	0.1352
0.100	0.1374	0.1395	0.1391	0.1419	0.1425	0.1386	0.1416	0.1429	0.1389	0.1375	0.1411	0.1379	0.1366
0.105	0.1403	0.1427	0.1380	0.1383	0.1376	0.1431	0.1426	0.1412	0.1421	0.1380	0.1388	0.1420	0.1362
0.110	0.1392	0.1391	0.1419	0.1390	0.1420	0.1369	0.1365	0.1367	0.1389	0.1383	0.1362	0.1386	0.1386
0.115	0.1415	0.1392	0.1376	0.1374	0.1389	0.1384	0.1368	0.1425	0.1373	0.1426	0.1389	0.1421	0.1423
0.120	0.1406	0.1379	0.1369	0.1422	0.1417	0.1430	0.1415	0.1397	0.1368	0.1406	0.1370	0.1404	0.1398
0.125	0.1368	0.1362	0.1375	0.1352	0.1393	0.1379	0.1366	0.1346	0.1371	0.1359	0.1372	0.1390	0.1388
0.130	0.1367	0.1398	0.1383	0.1327	0.1393	0.1391	0.1369	0.1353	0.1330	0.1335	0.1380	0.1366	0.1373
0.135	0.1347	0.1376	0.1337	0.1344	0.1316	0.1324	0.1338	0.1314	0.1334	0.1328	0.1376	0.1353	0.1340
0.140	0.1251	0.1287	0.1238	0.1228	0.1319	0.1248	0.1320	0.1280	0.1316	0.1283	0.1254	0.1315	0.1292
0.145	0.1233	0.1238	0.1260	0.1236	0.1261	0.1181	0.1216	0.1202	0.1126	0.1128	0.1250	0.1211	0.1215
0.150	0.0999	0.1093	0.1080	0.1117	0.1109	0.1023	0.1100	0.0935	0.0934	0.0966	0.1050	0.0970	0.1055
0.155	0.0859	0.0919	0.0922	0.0927	0.0953	0.0786	0.0839	0.0935	0.0954	0.0800	0.0804	0.0800	0.0770
0.160	0.0697	0.0615	0.0737	0.0789	0.0785	0.0648	0.0651	0.0664	0.0713	0.0763	0.0614	0.0736	0.0771
0.165	0.0554	0.0613	0.0564	0.0541	0.0605	0.0555	0.0593	0.0562	0.0530	0.0606	0.0622	0.0606	0.0600
0.170	0.0577	0.0525	0.0527	0.0575	0.0531	0.0514	0.0549	0.0549	0.0545	0.0546	0.0542	0.0545	0.0548
0.175	0.0555	0.0557	0.0511	0.0560	0.0511	0.0544	0.0550	0.0555	0.0558	0.0519	0.0537	0.0509	0.0550
0.180	0.0528	0.0545	0.0512	0.0545	0.0504	0.0514	0.0550	0.0516	0.0559	0.0555	0.0547	0.0550	0.0551
0.185	0.0552	0.0541	0.0560	0.0537	0.0541	0.0526	0.0540	0.0553	0.0552	0.0551	0.0517	0.0551	0.0509
0.190	0.0556	0.0558	0.0517	0.0528	0.0509	0.0562	0.0531	0.0535	0.0543	0.0547	0.0514	0.0559	0.0537
0.195	0.0541	0.0519	0.0532	0.0554	0.0532	0.0553	0.0563	0.0519	0.0523	0.0523	0.0551	0.0541	0.0515
0.200	0.0540	0.0563	0.0532	0.0553	0.0528	0.0551	0.0538	0.0542	0.0544	0.0564	0.0570	0.0555	0.0513
0.205	0.0531	0.0551	0.0524	0.0524	0.0541	0.0561	0.0539	0.0537	0.0555	0.0571	0.0519	0.0563	0.0527
0.210	0.0547	0.0545	0.0539	0.0539	0.0540	0.0573	0.0573	0.0553	0.0534	0.0539	0.0583	0.0535	0.0558
0.215	0.0556	0.0574	0.0544	0.0553	0.0565	0.0552	0.0584	0.0572	0.0560	0.0588	0.0591	0.0585	0.0581
0.220	0.0602	0.0585	0.0593	0.0574	0.0592	0.0589	0.0602	0.0603	0.0585	0.0555	0.0560	0.0583	0.0585
0.225	0.0592	0.0604	0.0575	0.0570	0.0577	0.0609	0.0563	0.0577	0.0571	0.0567	0.0582	0.0574	0.0590
0.230	0.0606	0.0624	0.0574	0.0614	0.0612	0.0596	0.0597	0.0605	0.0577	0.0607	0.0616	0.0579	0.0622
0.235	0.0618	0.0606	0.0597	0.0630	0.0614	0.0618	0.0592	0.0592	0.0609	0.0632	0.0611	0.0610	0.0620
0.240	0.0643	0.0639	0.0630	0.0603	0.0617	0.0631	0.0636	0.0617	0.0643	0.0613	0.0604	0.0606	0.0614
0.245	0.0679	0.0674	0.0642	0.0670	0.0617	0.0679	0.0657	0.0633	0.0634	0.0629	0.0659	0.0645	0.0659
0.250	0.0739	0.0717	0.0679	0.0738	0.0715	0.0716	0.0722	0.0744	0.0738	0.0743	0.0727	0.0727	0.0698
0.255	0.0817	0.0786	0.0795	0.0797	0.0746	0.0785	0.0781	0.0748	0.0820	0.0777	0.0790	0.0804	0.0787
0.260	0.0823	0.0897	0.0900	0.0908	0.0837	0.0856	0.0853	0.0842	0.0916	0.0915	0.0855	0.0859	0.0864
0.265	0.0920	0.0953	0.0949	0.0917	0.0952	0.0924	0.0947	0.0933	0.0935	0.0979	0.0921	0.0916	0.0964
0.270	0.1005	0.1030	0.1020	0.1049	0.1046	0.1072	0.1071	0.1072	0.1027	0.1077	0.1038	0.1081	0.1044
0.275	0.1122	0.1073	0.1132	0.1104	0.1083	0.1109	0.1065	0.1096	0.1090	0.1103	0.1136	0.1135	0.1124

0.280	0.1118	0.1159	0.1131	0.1166	0.1154	0.1148	0.1122	0.1115	0.1145	0.1144	0.1162	0.1127	0.1137
0.285	0.1195	0.1167	0.1147	0.1153	0.1156	0.1188	0.1156	0.1167	0.1144	0.1171	0.1171	0.1173	0.1184
0.290	0.1196	0.1193	0.1238	0.1179	0.1199	0.1180	0.1215	0.1190	0.1208	0.1197	0.1229	0.1215	0.1236
0.295	0.1232	0.1259	0.1255	0.1248	0.1235	0.1210	0.1232	0.1261	0.1269	0.1241	0.1247	0.1250	0.1267
0.300	0.1247	0.1281	0.1254	0.1298	0.1286	0.1297	0.1252	0.1279	0.1252	0.1293	0.1265	0.1271	0.1241
0.305	0.1308	0.1305	0.1294	0.1258	0.1309	0.1304	0.1299	0.1302	0.1270	0.1261	0.1252	0.1263	0.1254
0.310	0.1295	0.1276	0.1310	0.1285	0.1281	0.1271	0.1286	0.1298	0.1289	0.1315	0.1264	0.1277	0.1312
0.315	0.1320	0.1307	0.1310	0.1294	0.1270	0.1301	0.1322	0.1322	0.1285	0.1291	0.1313	0.1318	0.1291
0.320	0.1261	0.1298	0.1275	0.1262	0.1264	0.1310	0.1278	0.1287	0.1287	0.1271	0.1280	0.1308	0.1264
0.325	0.1257	0.1243	0.1282	0.1226	0.1263	0.1268	0.1261	0.1233	0.1234	0.1290	0.1265	0.1269	0.1281
0.330	0.1250	0.1219	0.1196	0.1206	0.1159	0.1156	0.1177	0.1194	0.1215	0.1191	0.1220	0.1131	0.1193
0.335	0.0956	0.1043	0.1085	0.0968	0.1023	0.0953	0.1048	0.1136	0.1043	0.1056	0.1097	0.1095	0.1036
0.340	0.0916	0.0877	0.0874	0.0887	0.0833	0.0856	0.0819	0.0944	0.0921	0.0832	0.0876	0.0977	0.0823
0.345	0.0764	0.0800	0.0773	0.0782	0.0833	0.0837	0.0790	0.0792	0.0779	0.0831	0.0780	0.0793	0.0824
0.350	0.0765	0.0774	0.0767	0.0787	0.0774	0.0761	0.0780	0.0749	0.0778	0.0776	0.0772	0.0735	0.0758
0.355	0.0730	0.0776	0.0736	0.0764	0.0763	0.0778	0.0752	0.0753	0.0738	0.0769	0.0728	0.0766	0.0776
0.360	0.0759	0.0770	0.0780	0.0737	0.0761	0.0756	0.0753	0.0730	0.0761	0.0773	0.0761	0.0758	0.0746
0.365	0.0768	0.0737	0.0768	0.0732	0.0740	0.0781	0.0778	0.0762	0.0742	0.0767	0.0780	0.0780	0.0763
0.370	0.0779	0.0782	0.0763	0.0778	0.0772	0.0790	0.0758	0.0792	0.0745	0.0743	0.0749	0.0782	0.0783
0.375	0.0741	0.0764	0.0767	0.0788	0.0744	0.0749	0.0756	0.0754	0.0751	0.0770	0.0741	0.0745	0.0754
0.380	0.0733	0.0788	0.0743	0.0738	0.0741	0.0770	0.0750	0.0766	0.0760	0.0756	0.0765	0.0757	0.0788
0.385	0.0747	0.0746	0.0773	0.0773	0.0770	0.0757	0.0785	0.0777	0.0740	0.0753	0.0768	0.0741	0.0774
0.390	0.0762	0.0781	0.0775	0.0773	0.0771	0.0780	0.0739	0.0786	0.0750	0.0742	0.0751	0.0749	0.0752
0.395	0.0768	0.0795	0.0769	0.0777	0.0736	0.0778	0.0784	0.0757	0.0737	0.0791	0.0785	0.0780	0.0785
0.400	0.0782	0.0789	0.0735	0.0791	0.0739	0.0794	0.0736	0.0743	0.0783	0.0764	0.0757	0.0759	0.0781
0.405	0.0772	0.0754	0.0787	0.0745	0.0789	0.0764	0.0770	0.0752	0.0770	0.0791	0.0751	0.0776	0.0769
0.410	0.0760	0.0789	0.0753	0.0771	0.0775	0.0753	0.0792	0.0758	0.0755	0.0746	0.0785	0.0798	0.0743
0.415	0.0783	0.0756	0.0781	0.0756	0.0761	0.0764	0.0800	0.0749	0.0795	0.0756	0.0776	0.0795	0.0772
0.420	0.0797	0.0791	0.0821	0.0821	0.0773	0.0764	0.0795	0.0775	0.0807	0.0780	0.0799	0.0765	0.0769
0.425	0.0776	0.0797	0.0833	0.0796	0.0788	0.0827	0.0824	0.0817	0.0826	0.0815	0.0811	0.0818	0.0799
0.430	0.0845	0.0796	0.0827	0.0819	0.0806	0.0837	0.0817	0.0797	0.0794	0.0826	0.0792	0.0841	0.0841
0.435	0.0852	0.0850	0.0846	0.0830	0.0798	0.0828	0.0815	0.0857	0.0809	0.0862	0.0808	0.0813	0.0834
0.440	0.0811	0.0811	0.0829	0.0820	0.0830	0.0816	0.0869	0.0847	0.0853	0.0879	0.0833	0.0854	0.0855
0.445	0.0844	0.0838	0.0832	0.0838	0.0834	0.0831	0.0885	0.0849	0.0843	0.0828	0.0846	0.0843	0.0865
0.450	0.0868	0.0854	0.0874	0.0862	0.0849	0.0841	0.0895	0.0864	0.0882	0.0879	0.0897	0.0871	0.0881
0.455	0.0901	0.0890	0.0856	0.0900	0.0868	0.0865	0.0875	0.0912	0.0869	0.0858	0.0853	0.0852	0.0886
0.460	0.0871	0.0869	0.0909	0.0910	0.0874	0.0869	0.0928	0.0874	0.0898	0.0888	0.0907	0.0926	0.0885
0.465	0.0924	0.0930	0.0941	0.0891	0.0893	0.0933	0.0946	0.0896	0.0926	0.0903	0.0939	0.0918	0.0897
0.470	0.0914	0.0900	0.0940	0.0948	0.0945	0.0930	0.0910	0.0915	0.0902	0.0898	0.0893	0.0935	0.0908
0.475	0.0934	0.0919	0.0954	0.0918	0.0923	0.0959	0.0913	0.0955	0.0953	0.0913	0.0948	0.0954	0.0974
0.480	0.0931	0.0953	0.0935	0.0932	0.0927	0.0923	0.0981	0.0954	0.0973	0.0923	0.0985	0.0920	0.0939
0.485	0.0964	0.0958	0.0955	0.0950	0.0990	0.0947	0.0995	0.0964	0.0989	0.0934	0.0985	0.0958	0.0968
0.490	0.0950	0.0989	0.0972	0.0991	0.0999	0.0984	0.0993	0.0949	0.0946	0.0964	0.0988	0.0985	0.0963
0.495	0.0956	0.0997	0.0982	0.1027	0.0965	0.1002	0.1000	0.0997	0.0969	0.1023	0.0979	0.0987	0.1021
0.500	0.1035	0.1026	0.0991	0.1040	0.1002	0.0979	0.1038	0.0971	0.1019	0.1041	0.0981	0.1019	0.0996
0.505	0.1059	0.1046	0.1055	0.1052	0.0992	0.1019	0.0996	0.1050	0.1054	0.1019	0.1009	0.1017	0.1002
0.510	0.1076	0.1052	0.0997	0.1003	0.1009	0.0998	0.1071	0.1032	0.1056	0.1071	0.1034	0.0996	0.1005
0.515	0.1046	0.1039	0.1020	0.1085	0.1043	0.1079	0.1038	0.1008	0.1070	0.1008	0.1060	0.1014	0.1049
0.520	0.1049	0.1046	0.1106	0.1033	0.1034	0.1078	0.1106	0.1038	0.1097	0.1070	0.1083	0.1043	0.1102
0.525	0.1121	0.1058	0.1109	0.1070	0.1058	0.1112	0.1111	0.1086	0.1094	0.1061	0.1076	0.1103	0.1117
0.530	0.1065	0.1110	0.1158	0.1122	0.1111	0.1132	0.1103	0.1128	0.1073	0.1154	0.1141	0.1117	0.1084
0.535	0.1149	0.1100	0.1166	0.1095	0.1146	0.1169	0.1203	0.1106	0.1210	0.1074	0.1124	0.1185	0.1187
0.540	0.1304	0.1256	0.1188	0.1141	0.1195	0.1258	0.1196	0.1243	0.1233	0.1155	0.1176	0.1211	0.1165

X-Axis	Y-Axis												
0.000													
0.005	0.0161	0.0194	0.0197	0.0142	0.0222	0.0171	0.0208	0.0218	0.0201	0.0162	0.0222	0.0145	0.0140
0.010	0.0245	0.0183	0.0266	0.0221	0.0259	0.0211	0.0195	0.0176	0.0217	0.0258	0.0230	0.0246	0.0180
0.015	0.0219	0.0229	0.0228	0.0282	0.0216	0.0252	0.0280	0.0264	0.0202	0.0218	0.0255	0.0227	0.0217
0.020	0.0243	0.0305	0.0303	0.0262	0.0306	0.0246	0.0289	0.0235	0.0276	0.0246	0.0310	0.0292	0.0287
0.025	0.0306	0.0292	0.0302	0.0340	0.0382	0.0344	0.0291	0.0371	0.0334	0.0309	0.0335	0.0350	0.0322
0.030	0.0438	0.0443	0.0409	0.0414	0.0435	0.0426	0.0474	0.0456	0.0388	0.0432	0.0427	0.0467	0.0458
0.035	0.0481	0.0536	0.0503	0.0500	0.0493	0.0513	0.0520	0.0538	0.0475	0.0544	0.0530	0.0491	0.0544
0.040	0.0603	0.0586	0.0571	0.0629	0.0572	0.0588	0.0594	0.0595	0.0614	0.0586	0.0585	0.0604	0.0574
0.045	0.0685	0.0648	0.0673	0.0684	0.0725	0.0667	0.0671	0.0679	0.0665	0.0730	0.0718	0.0714	0.0710
0.050	0.0823	0.0825	0.0761	0.0774	0.0750	0.0757	0.0766	0.0764	0.0733	0.0812	0.0775	0.0808	0.0783
0.055	0.0871	0.0904	0.0903	0.0832	0.0845	0.0877	0.0884	0.0878	0.0903	0.0860	0.0874	0.0909	0.0883
0.060	0.0991	0.0946	0.0953	0.0952	0.0965	0.0926	0.0961	0.0980	0.1000	0.0939	0.1000	0.0940	0.1002
0.065	0.1037	0.1033	0.1033	0.1086	0.1067	0.1040	0.1063	0.1062	0.1062	0.1057	0.1067	0.1080	0.1040
0.070	0.1147	0.1155	0.1146	0.1163	0.1145	0.1116	0.1139	0.1173	0.1122	0.1132	0.1146	0.1107	0.1107
0.075	0.1243	0.1231	0.1257	0.1213	0.1209	0.1239	0.1254	0.1257	0.1209	0.1220	0.1247	0.1221	0.1229
0.080	0.1307	0.1323	0.1292	0.1299	0.1281	0.1304	0.1294	0.1278	0.1320	0.1306	0.1269	0.1300	0.1275
0.085	0.1323	0.1361	0.1311	0.1327	0.1378	0.1363	0.1378	0.1326	0.1361	0.1371	0.1381	0.1357	0.1375
0.090	0.1355	0.1389	0.1364	0.1374	0.1372	0.1391	0.1365	0.1358	0.1400	0.1405	0.1352	0.1393	0.1365
0.095	0.1401	0.1387	0.1356	0.1395	0.1419	0.1398	0.1378	0.1380	0.1371	0.1422	0.1403	0.1361	0.1420
0.100	0.1414	0.1385	0.1377	0.1409	0.1371	0.1424	0.1419	0.1382	0.1376	0.1391	0.1424	0.1416	0.1370
0.105	0.1421	0.1402	0.1387	0.1386	0.1367	0.1418	0.1379	0.1398	0.1399	0.1425	0.1434	0.1368	0.1396
0.110	0.1390	0.1370	0.1377	0.1412	0.1402	0.1422	0.1425	0.1424	0.1401	0.1401	0.1401	0.1406	0.1399
0.115	0.1412	0.1420	0.1372	0.1364	0.1409	0.1394	0.1401	0.1410	0.1397	0.1431	0.1396	0.1397	0.1432
0.120	0.1363	0.1413	0.1393	0.1423	0.1391	0.1422	0.1410	0.1363	0.1405	0.1376	0.1367	0.1375	0.1366
0.125	0.1358	0.1415	0.1403	0.1417	0.1387	0.1341	0.1388	0.1385	0.1416	0.1406	0.1402	0.1369	0.1378
0.130	0.1330	0.1387	0.1390	0.1346	0.1377	0.1324	0.1323	0.1393	0.1349	0.1341	0.1337	0.1397	0.1343
0.135	0.1311	0.1329	0.1306	0.1298	0.1350	0.1357	0.1304	0.1365	0.1369	0.1356	0.1307	0.1362	0.1339
0.140	0.1270	0.1238	0.1328	0.1268	0.1269	0.1226	0.1274	0.1274	0.1245	0.1307	0.1283	0.1328	0.1284
0.145	0.1137	0.1219	0.1179	0.1143	0.1253	0.1221	0.1231	0.1166	0.1262	0.1248	0.1180	0.1259	0.1189
0.150	0.0973	0.0988	0.0962	0.1085	0.1132	0.1049	0.1139	0.1066	0.1113	0.1121	0.1070	0.1087	0.1067
0.155	0.0886	0.0864	0.0765	0.0830	0.0781	0.0947	0.0777	0.0933	0.0795	0.0775	0.0910	0.0912	0.0835
0.160	0.0669	0.0600	0.0681	0.0754	0.0728	0.0772	0.0783	0.0619	0.0724	0.0660	0.0630	0.0699	0.0793
0.165	0.0538	0.0538	0.0549	0.0566	0.0589	0.0617	0.0583	0.0609	0.0533	0.0531	0.0554	0.0551	0.0580
0.170	0.0531	0.0564	0.0546	0.0557	0.0576	0.0523	0.0576	0.0574	0.0518	0.0553	0.0573	0.0526	0.0578
0.175	0.0507	0.0519	0.0524	0.0507	0.0550	0.0560	0.0524	0.0512	0.0561	0.0529	0.0547	0.0528	0.0508
0.180	0.0521	0.0552	0.0537	0.0509	0.0558	0.0521	0.0563	0.0531	0.0506	0.0555	0.0530	0.0513	0.0553
0.185	0.0556	0.0506	0.0527	0.0519	0.0507	0.0549	0.0551	0.0536	0.0540	0.0507	0.0558	0.0551	0.0559
0.190	0.0550	0.0542	0.0561	0.0516	0.0539	0.0556	0.0515	0.0559	0.0510	0.0554	0.0556	0.0521	0.0516
0.195	0.0544	0.0523	0.0566	0.0544	0.0567	0.0550	0.0519	0.0549	0.0511	0.0541	0.0541	0.0552	0.0534
0.200	0.0538	0.0566	0.0520	0.0516	0.0538	0.0524	0.0538	0.0526	0.0515	0.0520	0.0532	0.0541	0.0526
0.205	0.0550	0.0549	0.0567	0.0526	0.0564	0.0529	0.0532	0.0529	0.0526	0.0523	0.0535	0.0520	0.0570
0.210	0.0568	0.0574	0.0569	0.0567	0.0573	0.0536	0.0575	0.0531	0.0564	0.0535	0.0567	0.0583	0.0546
0.215	0.0567	0.0557	0.0589	0.0580	0.0548	0.0586	0.0587	0.0571	0.0572	0.0565	0.0563	0.0549	0.0553
0.220	0.0583	0.0553	0.0561	0.0553	0.0579	0.0599	0.0567	0.0577	0.0559	0.0571	0.0589	0.0574	0.0599
0.225	0.0608	0.0594	0.0601	0.0563	0.0585	0.0567	0.0584	0.0605	0.0580	0.0594	0.0564	0.0562	0.0609
0.230	0.0610	0.0621	0.0588	0.0582	0.0617	0.0580	0.0595	0.0615	0.0579	0.0619	0.0614	0.0596	0.0595
0.235	0.0622	0.0613	0.0615	0.0632	0.0631	0.0600	0.0587	0.0591	0.0603	0.0619	0.0632	0.0612	0.0624
0.240	0.0637	0.0622	0.0627	0.0640	0.0638	0.0617	0.0638	0.0618	0.0630	0.0603	0.0603	0.0609	0.0633
0.245	0.0638	0.0647	0.0655	0.0668	0.0670	0.0667	0.0619	0.0683	0.0656	0.0638	0.0620	0.0624	0.0624
0.250	0.0734	0.0711	0.0667	0.0690	0.0744	0.0682	0.0693	0.0724	0.0738	0.0704	0.0678	0.0729	0.0690
0.255	0.0776	0.0805	0.0755	0.0816	0.0766	0.0757	0.0791	0.0794	0.0776	0.0815	0.0763	0.0765	0.0816
0.260	0.0848	0.0838	0.0830	0.0882	0.0894	0.0839	0.0895	0.0839	0.0831	0.0841	0.0854	0.0902	0.0899
0.265	0.0926	0.0985	0.0927	0.0943	0.0995	0.0937	0.0965	0.0971	0.0929	0.0925	0.0958	0.0986	0.0913
0.270	0.1025	0.1062	0.1037	0.1071	0.1069	0.1008	0.1018	0.1029	0.1027	0.1029	0.1056	0.1048	0.1042
0.275	0.1126	0.1119	0.1082	0.1086	0.1115	0.1105	0.1066	0.1094	0.1066	0.1136	0.1100	0.1127	0.1117

0.280	0.1111	0.1133	0.1122	0.1125	0.1134	0.1143	0.1170	0.1151	0.1166	0.1116	0.1169	0.1121	0.1118
0.285	0.1179	0.1144	0.1190	0.1152	0.1186	0.1158	0.1197	0.1158	0.1164	0.1194	0.1178	0.1149	0.1150
0.290	0.1238	0.1198	0.1182	0.1199	0.1223	0.1214	0.1193	0.1198	0.1187	0.1229	0.1182	0.1196	0.1177
0.295	0.1259	0.1229	0.1206	0.1209	0.1216	0.1231	0.1222	0.1248	0.1258	0.1250	0.1217	0.1205	0.1243
0.300	0.1250	0.1242	0.1249	0.1247	0.1261	0.1297	0.1270	0.1273	0.1274	0.1281	0.1260	0.1295	0.1263
0.305	0.1303	0.1284	0.1255	0.1293	0.1253	0.1310	0.1310	0.1304	0.1252	0.1315	0.1295	0.1264	0.1260
0.310	0.1285	0.1286	0.1288	0.1275	0.1269	0.1315	0.1267	0.1268	0.1313	0.1302	0.1283	0.1279	0.1295
0.315	0.1281	0.1301	0.1289	0.1294	0.1287	0.1273	0.1305	0.1294	0.1270	0.1319	0.1293	0.1278	0.1319
0.320	0.1311	0.1307	0.1313	0.1266	0.1283	0.1264	0.1269	0.1298	0.1299	0.1313	0.1266	0.1294	0.1270
0.325	0.1286	0.1277	0.1246	0.1227	0.1277	0.1264	0.1248	0.1259	0.1242	0.1234	0.1263	0.1238	0.1276
0.330	0.1174	0.1180	0.1151	0.1151	0.1169	0.1169	0.1218	0.1228	0.1208	0.1251	0.1214	0.1137	0.1238
0.335	0.0984	0.1079	0.1099	0.0996	0.1103	0.0975	0.1126	0.1020	0.0967	0.1030	0.0955	0.1020	0.0982
0.340	0.0920	0.0818	0.0873	0.0915	0.0921	0.0837	0.0940	0.0892	0.0844	0.0903	0.0847	0.0944	0.0854
0.345	0.0774	0.0773	0.0832	0.0769	0.0818	0.0756	0.0836	0.0767	0.0769	0.0760	0.0772	0.0810	0.0761
0.350	0.0763	0.0771	0.0748	0.0768	0.0767	0.0782	0.0769	0.0751	0.0739	0.0771	0.0741	0.0765	0.0785
0.355	0.0756	0.0778	0.0771	0.0780	0.0753	0.0745	0.0768	0.0775	0.0757	0.0766	0.0757	0.0769	0.0749
0.360	0.0732	0.0750	0.0772	0.0766	0.0746	0.0744	0.0747	0.0766	0.0731	0.0745	0.0759	0.0728	0.0748
0.365	0.0781	0.0736	0.0782	0.0763	0.0753	0.0737	0.0748	0.0750	0.0763	0.0770	0.0767	0.0737	0.0774
0.370	0.0760	0.0785	0.0745	0.0730	0.0771	0.0769	0.0773	0.0762	0.0737	0.0754	0.0753	0.0756	0.0788
0.375	0.0734	0.0763	0.0754	0.0731	0.0771	0.0732	0.0764	0.0747	0.0748	0.0746	0.0778	0.0762	0.0753
0.380	0.0749	0.0766	0.0770	0.0785	0.0773	0.0762	0.0750	0.0745	0.0753	0.0759	0.0778	0.0753	0.0737
0.385	0.0754	0.0761	0.0746	0.0785	0.0782	0.0748	0.0782	0.0783	0.0775	0.0755	0.0743	0.0733	0.0774
0.390	0.0760	0.0741	0.0770	0.0767	0.0740	0.0773	0.0744	0.0735	0.0769	0.0755	0.0746	0.0783	0.0762
0.395	0.0758	0.0768	0.0758	0.0757	0.0761	0.0752	0.0789	0.0769	0.0763	0.0792	0.0783	0.0735	0.0787
0.400	0.0786	0.0755	0.0782	0.0750	0.0735	0.0772	0.0753	0.0780	0.0760	0.0745	0.0790	0.0755	0.0764
0.405	0.0786	0.0742	0.0776	0.0775	0.0779	0.0752	0.0785	0.0775	0.0740	0.0758	0.0778	0.0791	0.0739
0.410	0.0767	0.0748	0.0787	0.0758	0.0743	0.0797	0.0778	0.0795	0.0773	0.0780	0.0794	0.0765	0.0795
0.415	0.0779	0.0806	0.0800	0.0802	0.0774	0.0767	0.0785	0.0764	0.0788	0.0777	0.0763	0.0758	0.0751
0.420	0.0786	0.0778	0.0781	0.0813	0.0787	0.0765	0.0803	0.0804	0.0768	0.0792	0.0804	0.0787	0.0788
0.425	0.0829	0.0810	0.0819	0.0802	0.0806	0.0779	0.0807	0.0812	0.0805	0.0803	0.0833	0.0825	0.0814
0.430	0.0788	0.0806	0.0808	0.0844	0.0843	0.0818	0.0787	0.0808	0.0828	0.0834	0.0830	0.0811	0.0817
0.435	0.0799	0.0810	0.0802	0.0815	0.0822	0.0854	0.0818	0.0822	0.0860	0.0815	0.0839	0.0849	0.0836
0.440	0.0818	0.0813	0.0859	0.0826	0.0832	0.0830	0.0835	0.0863	0.0839	0.0877	0.0857	0.0849	0.0815
0.445	0.0885	0.0826	0.0865	0.0866	0.0864	0.0862	0.0853	0.0853	0.0836	0.0851	0.0873	0.0836	0.0853
0.450	0.0861	0.0865	0.0896	0.0878	0.0876	0.0896	0.0861	0.0847	0.0853	0.0895	0.0868	0.0872	0.0844
0.455	0.0883	0.0866	0.0898	0.0905	0.0853	0.0910	0.0872	0.0914	0.0876	0.0870	0.0868	0.0912	0.0868
0.460	0.0881	0.0870	0.0908	0.0905	0.0911	0.0922	0.0866	0.0886	0.0894	0.0864	0.0867	0.0867	0.0926
0.465	0.0884	0.0941	0.0898	0.0899	0.0885	0.0931	0.0885	0.0892	0.0931	0.0916	0.0895	0.0886	0.0884
0.470	0.0909	0.0916	0.0957	0.0960	0.0929	0.0931	0.0893	0.0927	0.0941	0.0937	0.0893	0.0954	0.0925
0.475	0.0953	0.0939	0.0941	0.0940	0.0909	0.0959	0.0952	0.0948	0.0926	0.0963	0.0954	0.0921	0.0945
0.480	0.0941	0.0983	0.0927	0.0972	0.0940	0.0966	0.0921	0.0935	0.0973	0.0925	0.0956	0.0936	0.0964
0.485	0.0976	0.0995	0.0972	0.0969	0.0958	0.0961	0.0976	0.0943	0.0951	0.0965	0.0950	0.0959	0.0979
0.490	0.0962	0.0962	0.0977	0.0947	0.0948	0.0985	0.0995	0.0947	0.0987	0.1007	0.1001	0.1007	0.0979
0.495	0.1012	0.0971	0.1003	0.0986	0.0964	0.0960	0.0968	0.1006	0.0958	0.1015	0.0997	0.0997	0.1005
0.500	0.0990	0.1012	0.1031	0.0994	0.0984	0.1036	0.1003	0.0985	0.1038	0.1022	0.1037	0.1019	0.1043
0.505	0.0994	0.1035	0.1018	0.1042	0.1047	0.1045	0.1060	0.1030	0.0986	0.0997	0.1044	0.1022	0.1025
0.510	0.1018	0.1075	0.1062	0.1032	0.1059	0.1029	0.1025	0.1056	0.1058	0.0999	0.1066	0.1039	0.1056
0.515	0.1027	0.1031	0.1021	0.1090	0.1084	0.1029	0.1028	0.1060	0.1022	0.1083	0.1033	0.1043	0.1016
0.520	0.1087	0.1088	0.1076	0.1054	0.1038	0.1045	0.1100	0.1044	0.1034	0.1098	0.1061	0.1053	0.1038
0.525	0.1117	0.1119	0.1075	0.1117	0.1056	0.1089	0.1092	0.1095	0.1077	0.1073	0.1121	0.1051	0.1112
0.530	0.1153	0.1097	0.1117	0.1063	0.1112	0.1114	0.1056	0.1087	0.1144	0.1089	0.1066	0.1085	0.1065
0.535	0.1192	0.1101	0.1076	0.1079	0.1121	0.1078	0.1162	0.1141	0.1146	0.1100	0.1132	0.1173	0.1197
0.540	0.1160	0.1299	0.1294	0.1248	0.1239	0.1229	0.1152						

X-Axis	Y-Axis				
0.000					
0.005	0.0159	0.0143	0.0153	0.0140	0.0188
0.010	0.0199	0.0256	0.0238	0.0237	0.0185
0.015	0.0256	0.0275	0.0244	0.0225	0.0241
0.020	0.0276	0.0257	0.0249	0.0282	0.0279
0.025	0.0361	0.0335	0.0306	0.0307	0.0368
0.030	0.0433	0.0399	0.0393	0.0453	0.0470
0.035	0.0514	0.0543	0.0535	0.0487	0.0491
0.040	0.0598	0.0629	0.0564	0.0630	0.0588
0.045	0.0724	0.0650	0.0685	0.0729	0.0668
0.050	0.0786	0.0756	0.0824	0.0799	0.0780
0.055	0.0876	0.0872	0.0913	0.0875	0.0839
0.060	0.0955	0.0979	0.0990	0.0976	0.0960
0.065	0.1043	0.1070	0.1043	0.1022	0.1077
0.070	0.1149	0.1160	0.1174	0.1146	0.1166
0.075	0.1223	0.1196	0.1196	0.1212	0.1241
0.080	0.1266	0.1321	0.1278	0.1290	0.1290
0.085	0.1317	0.1327	0.1351	0.1308	0.1349
0.090	0.1353	0.1343	0.1378	0.1396	0.1365
0.095	0.1382	0.1373	0.1416	0.1354	0.1398
0.100	0.1388	0.1417	0.1398	0.1385	0.1414
0.105	0.1426	0.1431	0.1396	0.1392	0.1420
0.110	0.1382	0.1411	0.1419	0.1394	0.1427
0.115	0.1397	0.1361	0.1366	0.1366	0.1379
0.120	0.1427	0.1402	0.1396	0.1371	0.1369
0.125	0.1344	0.1358	0.1402	0.1389	0.1351
0.130	0.1370	0.1331	0.1389	0.1369	0.1379
0.135	0.1295	0.1336	0.1293	0.1336	0.1309
0.140	0.1328	0.1327	0.1264	0.1238	0.1236
0.145	0.1198	0.1153	0.1235	0.1217	0.1222
0.150	0.1098	0.0989	0.0943	0.0939	0.1086
0.155	0.0927	0.0898	0.0895	0.0850	0.0911
0.160	0.0765	0.0629	0.0614	0.0787	0.0768
0.165	0.0535	0.0586	0.0571	0.0590	0.0580
0.170	0.0576	0.0574	0.0536	0.0511	0.0528
0.175	0.0520	0.0522	0.0510	0.0516	0.0507
0.180	0.0548	0.0519	0.0516	0.0517	0.0547
0.185	0.0552	0.0522	0.0509	0.0559	0.0511
0.190	0.0562	0.0550	0.0522	0.0514	0.0523
0.195	0.0518	0.0539	0.0546	0.0539	0.0561
0.200	0.0539	0.0537	0.0516	0.0547	0.0550
0.205	0.0573	0.0559	0.0537	0.0544	0.0557
0.210	0.0549	0.0531	0.0573	0.0568	0.0556
0.215	0.0572	0.0559	0.0589	0.0545	0.0569
0.220	0.0582	0.0601	0.0600	0.0563	0.0590
0.225	0.0588	0.0598	0.0612	0.0613	0.0591
0.230	0.0589	0.0587	0.0619	0.0592	0.0616
0.235	0.0632	0.0612	0.0631	0.0594	0.0633
0.240	0.0643	0.0620	0.0644	0.0609	0.0622
0.245	0.0633	0.0638	0.0621	0.0667	0.0626
0.250	0.0694	0.0695	0.0720	0.0738	0.0699
0.255	0.0801	0.0780	0.0806	0.0824	0.0793
0.260	0.0841	0.0910	0.0879	0.0899	0.0870
0.265	0.0964	0.0928	0.0981	0.0917	0.0933
0.270	0.1029	0.1035	0.1070	0.1075	0.1017
0.275	0.1136	0.1067	0.1109	0.1135	0.1101

0.280	0.1133	0.1136	0.1139	0.1137	0.1149
0.285	0.1198	0.1199	0.1158	0.1180	0.1151
0.290	0.1184	0.1218	0.1231	0.1221	0.1197
0.295	0.1255	0.1225	0.1252	0.1245	0.1268
0.300	0.1266	0.1292	0.1242	0.1265	0.1298
0.305	0.1281	0.1250	0.1257	0.1274	0.1292
0.310	0.1306	0.1301	0.1267	0.1315	0.1311
0.315	0.1271	0.1302	0.1294	0.1295	0.1306
0.320	0.1303	0.1269	0.1317	0.1288	0.1313
0.325	0.1281	0.1288	0.1244	0.1272	0.1273
0.330	0.1188	0.1136	0.1146	0.1154	0.1119
0.335	0.0949	0.1073	0.1076	0.1126	0.1132
0.340	0.0914	0.0841	0.0813	0.0808	0.0803
0.345	0.0828	0.0809	0.0833	0.0818	0.0788
0.350	0.0757	0.0772	0.0739	0.0760	0.0785
0.355	0.0775	0.0753	0.0732	0.0751	0.0727
0.360	0.0760	0.0748	0.0750	0.0778	0.0736
0.365	0.0782	0.0735	0.0785	0.0740	0.0772
0.370	0.0747	0.0767	0.0792	0.0774	0.0766
0.375	0.0733	0.0771	0.0734	0.0753	0.0767
0.380	0.0773	0.0749	0.0773	0.0776	0.0769
0.385	0.0760	0.0763	0.0749	0.0761	0.0776
0.390	0.0757	0.0771	0.0779	0.0768	0.0766
0.395	0.0787	0.0776	0.0791	0.0760	0.0773
0.400	0.0794	0.0788	0.0780	0.0737	0.0744
0.405	0.0779	0.0784	0.0759	0.0783	0.0761
0.410	0.0759	0.0787	0.0767	0.0760	0.0744
0.415	0.0782	0.0781	0.0794	0.0755	0.0764
0.420	0.0805	0.0800	0.0818	0.0761	0.0791
0.425	0.0813	0.0821	0.0797	0.0825	0.0809
0.430	0.0846	0.0823	0.0799	0.0845	0.0848
0.435	0.0799	0.0842	0.0798	0.0846	0.0837
0.440	0.0852	0.0875	0.0866	0.0820	0.0855
0.445	0.0867	0.0881	0.0828	0.0870	0.0870
0.450	0.0846	0.0871	0.0888	0.0884	0.0839
0.455	0.0852	0.0894	0.0888	0.0856	0.0851
0.460	0.0900	0.0909	0.0901	0.0894	0.0923
0.465	0.0909	0.0940	0.0885	0.0881	0.0891
0.470	0.0917	0.0899	0.0941	0.0928	0.0945
0.475	0.0971	0.0919	0.0974	0.0930	0.0916
0.480	0.0968	0.0940	0.0988	0.0926	0.0932
0.485	0.0942	0.0944	0.0965	0.0952	0.0993
0.490	0.0982	0.0974	0.0981	0.0953	0.1008
0.495	0.0954	0.1013	0.1017	0.0970	0.0971
0.500	0.1012	0.1031	0.0997	0.0970	0.0983
0.505	0.1043	0.1019	0.1044	0.0997	0.1039
0.510	0.1009	0.1025	0.1043	0.1027	0.1016
0.515	0.1062	0.1036	0.1081	0.1073	0.1026
0.520	0.1097	0.1048	0.1045	0.1068	0.1091
0.525	0.1057	0.1054	0.1121	0.1062	0.1066
0.530	0.1120	0.1150	0.1069	0.1131	0.1093
0.535	0.1178	0.1132	0.1102	0.1083	0.1181
0.540					

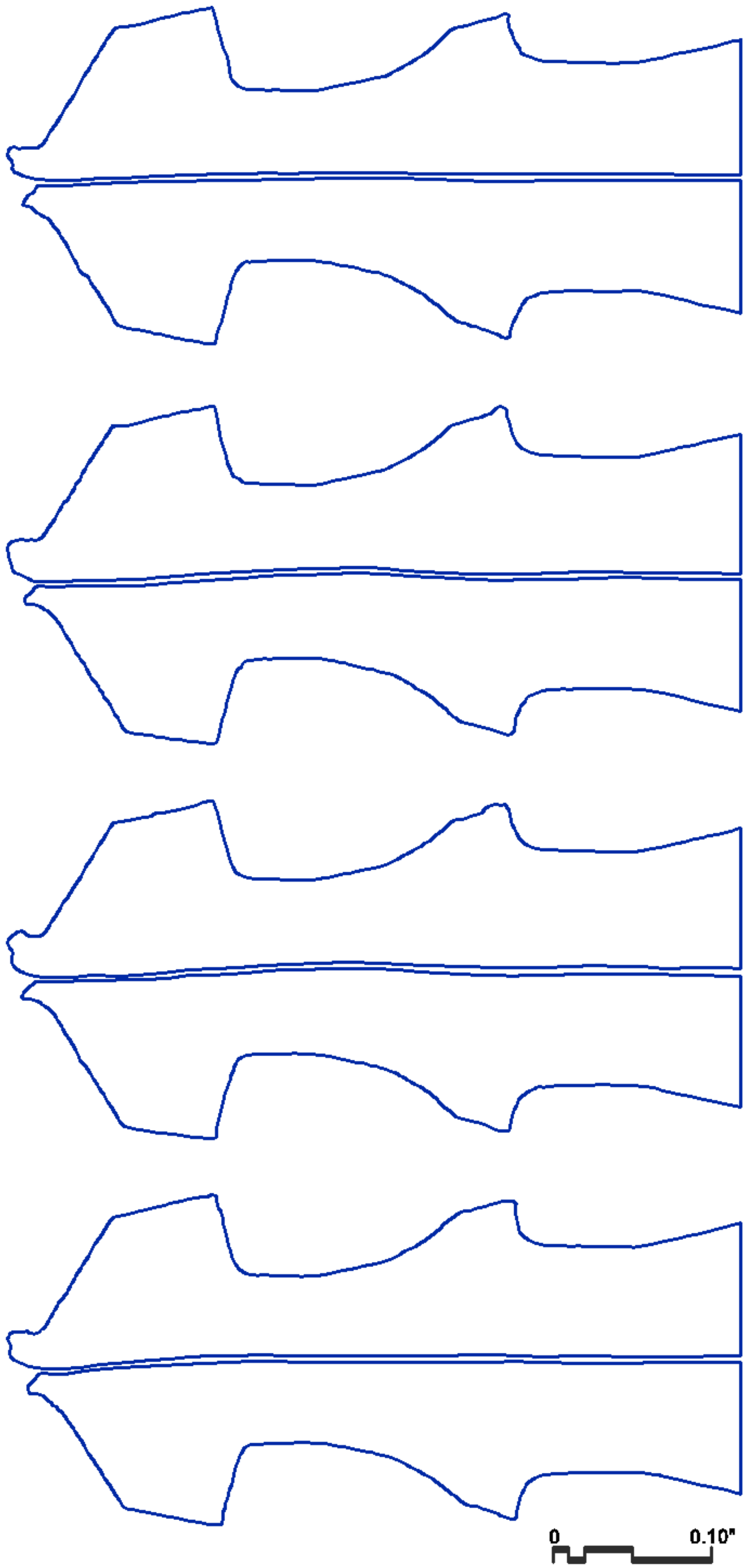


Figure B.13 As-Built 0.090 in. Tube-A Coined Pressed-End CAD Generation - Step 4

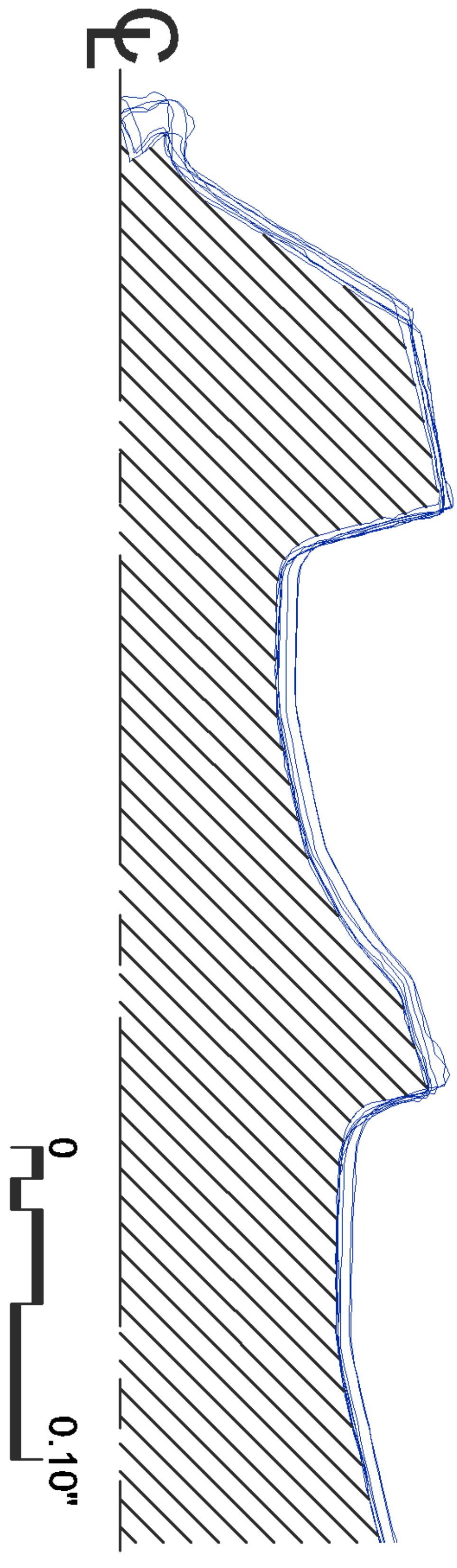


Figure B.14 As-Built 0.090 in. Tube-A Coined Pressed-End Profiles Generation - Step 5

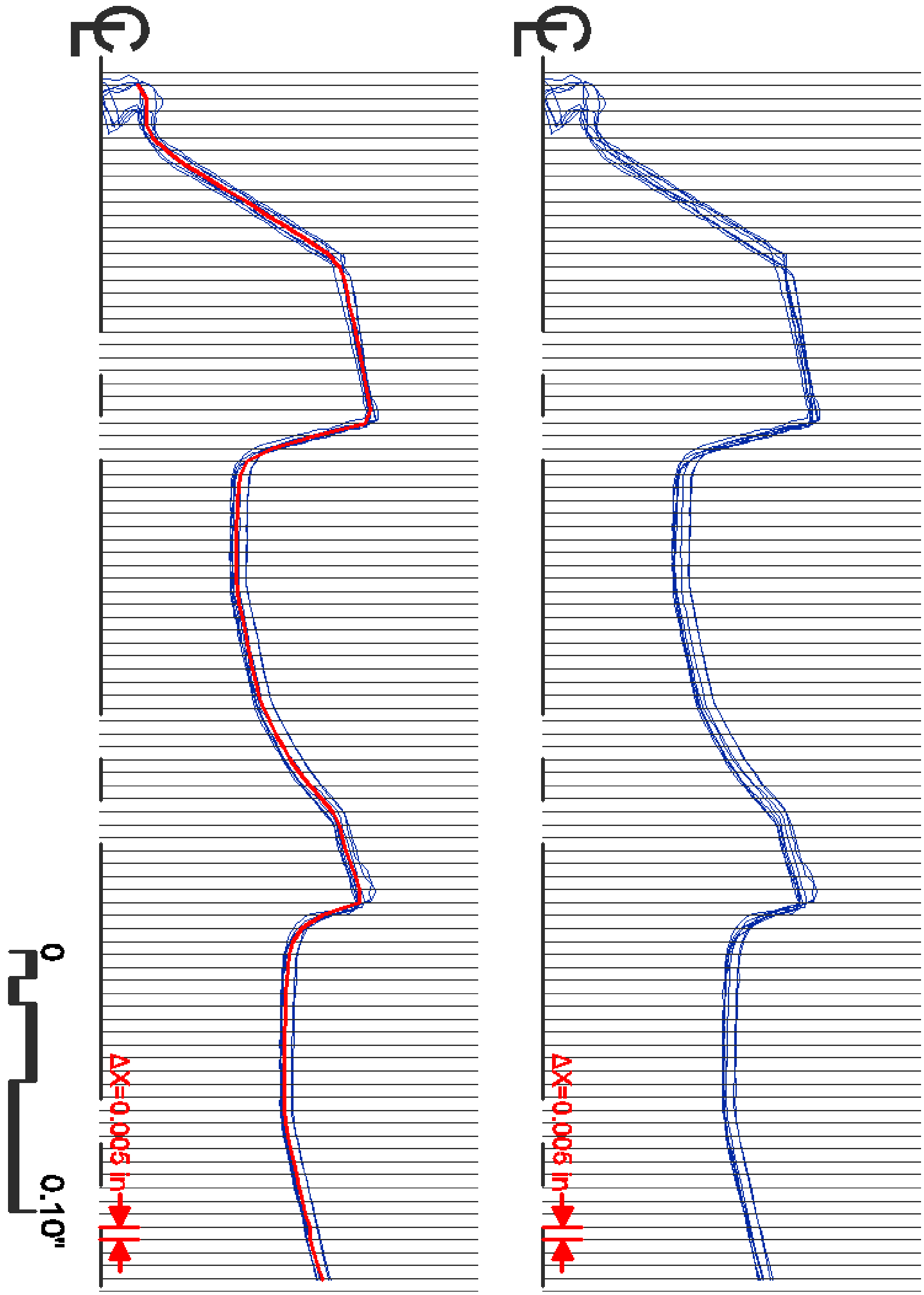


Figure B.15 As-Built 0.090 in Tube-A Coined Pressed-End Divided Profiles & Mean Profile -

Step 6

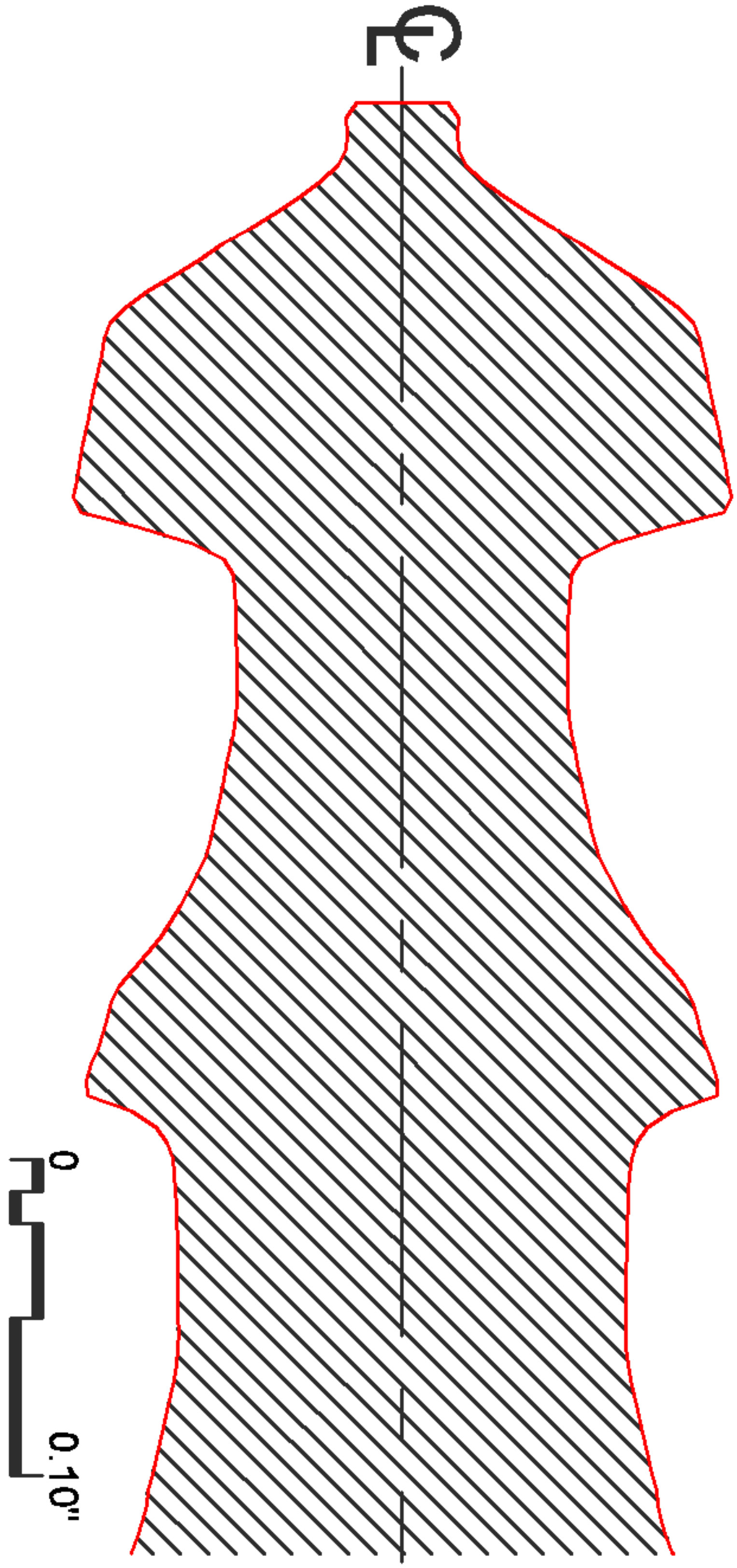


Figure B.16 As-Built 0.090 in. Tube-A Coined Pressed-End Representative Profile - Step 7

Table B.4 As-Built 0.090 in. Tube-A Coined Pressed-End XY Coordinates

X-Axis	Y-Axis							
0.000	0.0195	0.0191	0.0157	0.0155	0.0124	0.0114	0.0074	
0.005	0.0155	0.0168	0.0212					
0.010	0.0222	0.0213	0.0191	0.0168	0.0156	0.0152	0.0148	0.0144
0.015	0.0147	0.0153	0.0159	0.0169	0.0174	0.0197	0.0205	0.0208
0.020	0.0228	0.0227	0.0214	0.0213	0.0193	0.0184	0.0180	0.0175
0.025	0.0211	0.0220	0.0240	0.0246	0.0270	0.0275	0.0275	0.0300
0.030	0.0370	0.0354	0.0353	0.0323	0.0313	0.0304	0.0281	0.0262
0.035	0.0345	0.0367	0.0379	0.0383	0.0403	0.0431	0.0435	0.0453
0.040	0.0529	0.0519	0.0512	0.0478	0.0465	0.0454	0.0448	0.0424
0.045	0.0513	0.0533	0.0545	0.0560	0.0571	0.0589	0.0600	0.0614
0.050	0.0700	0.0684	0.0678	0.0655	0.0614	0.0611	0.0607	0.0590
0.055	0.0665	0.0687	0.0689	0.0690	0.0734	0.0760	0.0763	0.0779
0.060	0.0862	0.0844	0.0840	0.0817	0.0772	0.0770	0.0764	0.0746
0.065	0.0826	0.0846	0.0847	0.0853	0.0882	0.0892	0.0918	0.0925
0.070	0.0936	0.0935	0.0932	0.0931	0.0924	0.0920	0.0912	0.0893
0.075	0.0908	0.0932	0.0937	0.0938	0.0938	0.0941	0.0966	0.0967
0.080	0.0977	0.0976	0.0952	0.0947	0.0947	0.0943	0.0941	0.0919
0.085	0.0934	0.0950	0.0951	0.0958	0.0959	0.0965	0.0984	0.0985
0.090	0.0993	0.0988	0.0976	0.0973	0.0971	0.0961	0.0961	0.0945
0.095	0.0957	0.0971	0.0972	0.0986	0.0986	0.0990	0.0999	0.0999
0.100	0.1007	0.1006	0.0998	0.0996	0.0996	0.0985	0.0979	0.0968
0.105	0.0979	0.0990	0.0996	0.1006	0.1007	0.1012	0.1013	0.1015
0.110	0.1024	0.1021	0.1020	0.1020	0.1018	0.1006	0.1002	0.0993
0.115	0.1001	0.1011	0.1014	0.1026	0.1027	0.1029	0.1031	0.1032
0.120	0.1042	0.1040	0.1040	0.1032	0.1032	0.1022	0.1018	0.1010
0.125	0.1025	0.1029	0.1030	0.1036	0.1038	0.1050	0.1051	0.1064
0.130	0.1036	0.1034	0.1032	0.1031	0.1026	0.1025	0.1022	0.0936
0.135	0.0747	0.0801	0.0811	0.0829	0.0835	0.0868	0.0876	0.0885
0.140	0.0694	0.0687	0.0680	0.0663	0.0661	0.0648	0.0634	0.0589
0.145	0.0532	0.0537	0.0560	0.0562	0.0563	0.0564	0.0595	0.0599
0.150	0.0577	0.0572	0.0542	0.0523	0.0519	0.0517	0.0515	0.0509
0.155	0.0503	0.0508	0.0514	0.0514	0.0519	0.0539	0.0569	0.0571
0.160	0.0568	0.0566	0.0539	0.0516	0.0513	0.0513	0.0502	0.0501
0.165	0.0502	0.0502	0.0507	0.0510	0.0514	0.0535	0.0565	0.0567
0.170	0.0567	0.0564	0.0535	0.0514	0.0509	0.0507	0.0501	0.0498
0.175	0.0498	0.0503	0.0506	0.0509	0.0510	0.0532	0.0564	0.0565
0.180	0.0563	0.0562	0.0532	0.0508	0.0508	0.0505	0.0498	0.0497
0.185	0.0499	0.0500	0.0507	0.0508	0.0508	0.0533	0.0560	0.0562
0.190	0.0562	0.0561	0.0533	0.0511	0.0509	0.0504	0.0503	0.0501
0.195	0.0501	0.0505	0.0508	0.0514	0.0514	0.0535	0.0567	0.0567
0.200	0.0576	0.0575	0.0544	0.0525	0.0519	0.0514	0.0513	0.0507
0.205	0.0516	0.0521	0.0525	0.0529	0.0536	0.0555	0.0586	0.0586
0.210	0.0598	0.0597	0.0564	0.0546	0.0537	0.0536	0.0531	0.0528
0.215	0.0538	0.0543	0.0545	0.0547	0.0555	0.0573	0.0606	0.0607

0.220	0.0617	0.0617	0.0583	0.0567	0.0559	0.0557	0.0554	0.0549
0.225	0.0562	0.0564	0.0566	0.0570	0.0576	0.0594	0.0627	0.0627
0.230	0.0639	0.0638	0.0606	0.0586	0.0579	0.0576	0.0576	0.0571
0.235	0.0582	0.0586	0.0593	0.0594	0.0600	0.0618	0.0651	0.0651
0.240	0.0669	0.0668	0.0631	0.0617	0.0608	0.0605	0.0603	0.0596
0.245	0.0616	0.0626	0.0628	0.0631	0.0648	0.0655	0.0695	0.0695
0.250	0.0723	0.0722	0.0684	0.0675	0.0656	0.0656	0.0651	0.0643
0.255	0.0671	0.0679	0.0682	0.0684	0.0700	0.0710	0.0747	0.0751
0.260	0.0780	0.0777	0.0742	0.0733	0.0712	0.0710	0.0706	0.0699
0.265	0.0731	0.0741	0.0741	0.0744	0.0773	0.0776	0.0810	0.0816
0.270	0.0855	0.0849	0.0820	0.0815	0.0785	0.0778	0.0773	0.0772
0.275	0.0814	0.0815	0.0823	0.0837	0.0855	0.0869	0.0891	0.0899
0.280	0.0935	0.0935	0.0913	0.0895	0.0878	0.0863	0.0862	0.0856
0.285	0.0896	0.0899	0.0899	0.0907	0.0916	0.0931	0.0947	0.0956
0.290	0.0970	0.0960	0.0943	0.0925	0.0920	0.0914	0.0910	0.0907
0.295	0.0921	0.0924	0.0926	0.0932	0.0939	0.0960	0.0972	0.0985
0.300	0.1005	0.0999	0.0974	0.0955	0.0945	0.0940	0.0937	0.0937
0.305	0.0954	0.0955	0.0960	0.0969	0.0973	0.0989	0.1019	0.1037
0.310	0.1054	0.1038	0.1002	0.0985	0.0982	0.0977	0.0976	0.0967
0.315	0.0983	0.0983	0.0988	0.0989	0.0990	0.0998	0.1013	0.1016
0.320	0.0891	0.0881	0.0870	0.0864	0.0852	0.0846	0.0838	0.0797
0.325	0.0741	0.0761	0.0768	0.0769	0.0787	0.0789	0.0790	0.0798
0.330	0.0773	0.0768	0.0743	0.0738	0.0733	0.0731	0.0728	0.0719
0.335	0.0707	0.0711	0.0712	0.0714	0.0720	0.0726	0.0755	0.0759
0.340	0.0753	0.0751	0.0719	0.0713	0.0708	0.0707	0.0703	0.0703
0.345	0.0699	0.0703	0.0704	0.0704	0.0705	0.0717	0.0746	0.0756
0.350	0.0749	0.0744	0.0715	0.0703	0.0703	0.0703	0.0698	0.0693
0.355	0.0695	0.0698	0.0698	0.0700	0.0701	0.0713	0.0742	0.0747
0.360	0.0746	0.0741	0.0712	0.0698	0.0698	0.0697	0.0697	0.0693
0.365	0.0692	0.0695	0.0696	0.0697	0.0698	0.0712	0.0740	0.0744
0.370	0.0744	0.0738	0.0710	0.0700	0.0697	0.0695	0.0694	0.0690
0.375	0.0691	0.0693	0.0695	0.0696	0.0703	0.0708	0.0737	0.0742
0.380	0.0740	0.0737	0.0707	0.0705	0.0697	0.0695	0.0694	0.0692
0.385	0.0693	0.0693	0.0696	0.0698	0.0704	0.0707	0.0736	0.0741
0.390	0.0741	0.0736	0.0707	0.0699	0.0698	0.0697	0.0693	0.0692
0.395	0.0692	0.0694	0.0697	0.0699	0.0701	0.0707	0.0737	0.0741
0.400	0.0746	0.0744	0.0712	0.0706	0.0703	0.0702	0.0701	0.0699
0.405	0.0706	0.0709	0.0709	0.0712	0.0713	0.0722	0.0754	0.0755
0.410	0.0766	0.0765	0.0732	0.0723	0.0723	0.0719	0.0718	0.0714
0.415	0.0725	0.0726	0.0730	0.0734	0.0735	0.0743	0.0775	0.0778
0.420	0.0790	0.0788	0.0757	0.0747	0.0745	0.0740	0.0738	0.0735
0.425	0.0747	0.0749	0.0753	0.0757	0.0757	0.0767	0.0800	0.0801
0.430	0.0812	0.0809	0.0775	0.0769	0.0767	0.0766	0.0762	0.0762
0.435	0.0774	0.0777	0.0778	0.0778	0.0783	0.0787	0.0821	0.0824

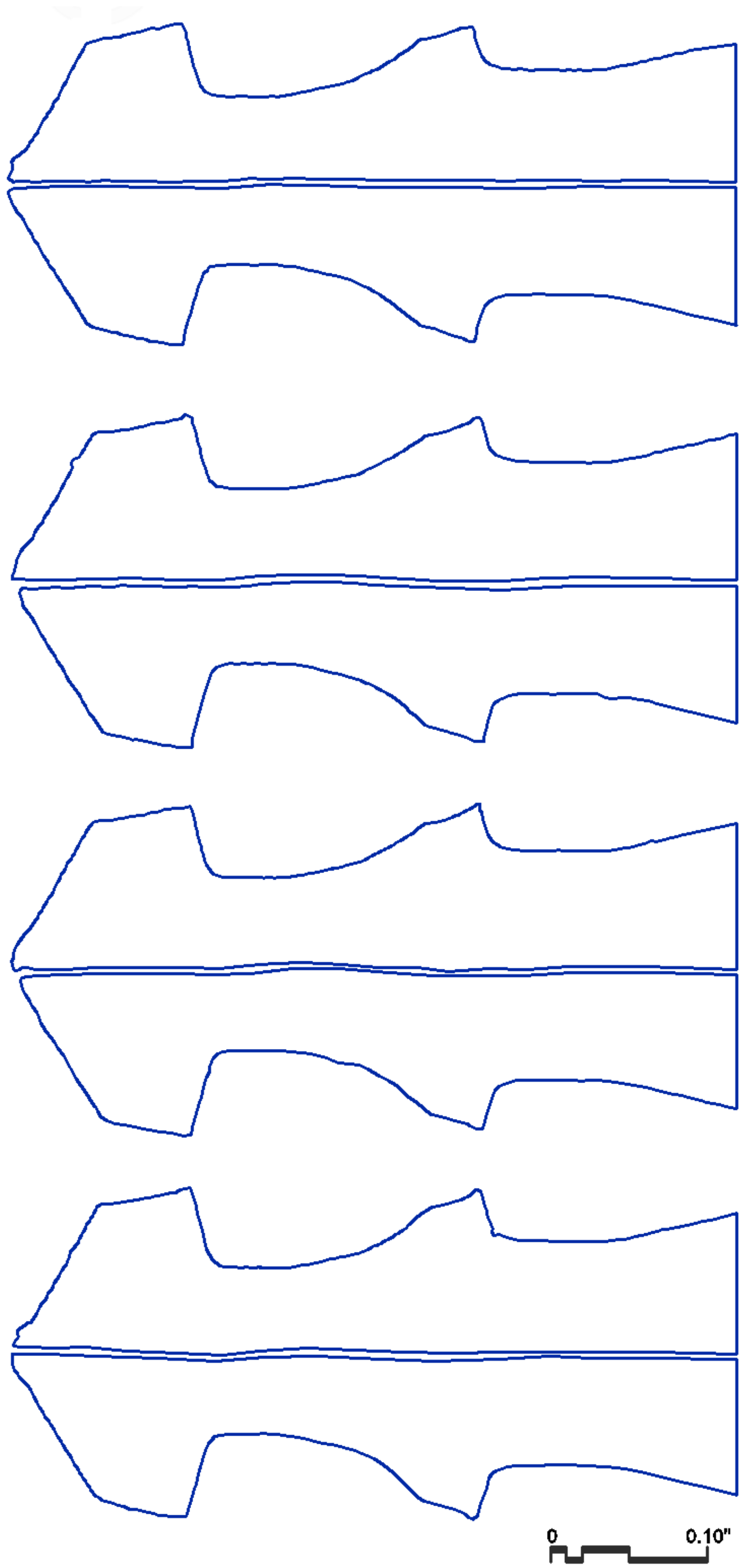


Figure B.17 As-Built 0.090 in. Tube-B Coined Pressed-End CAD Generation - Step 4

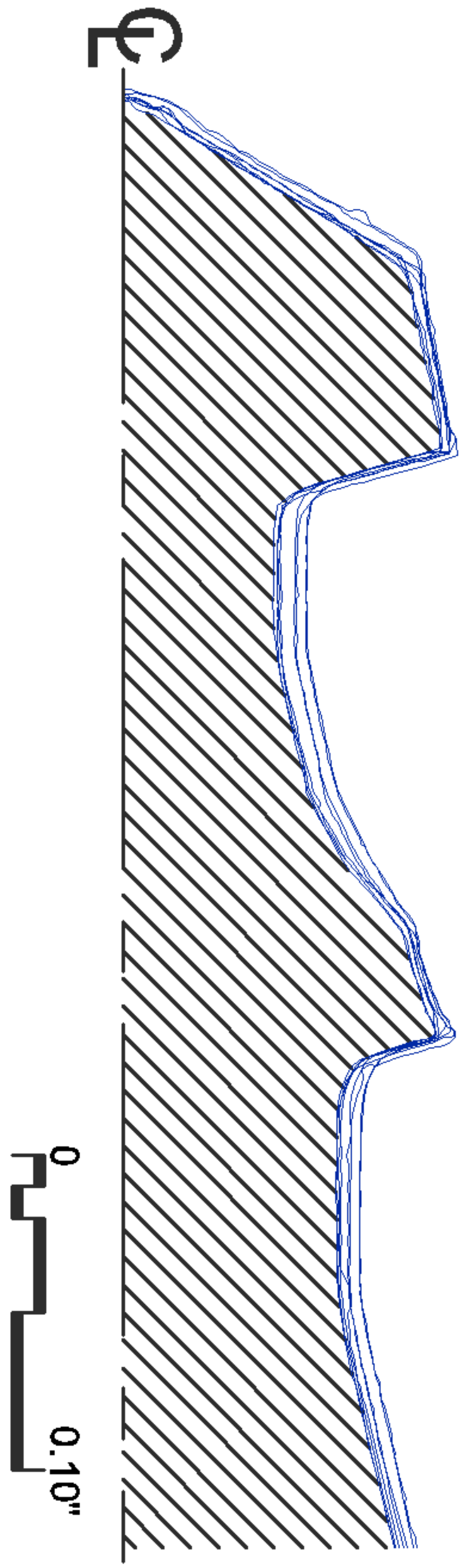


Figure B.18 As-Built 0.090 in. Tube-B Coined Pressed-End Profiles Generation - Step 5

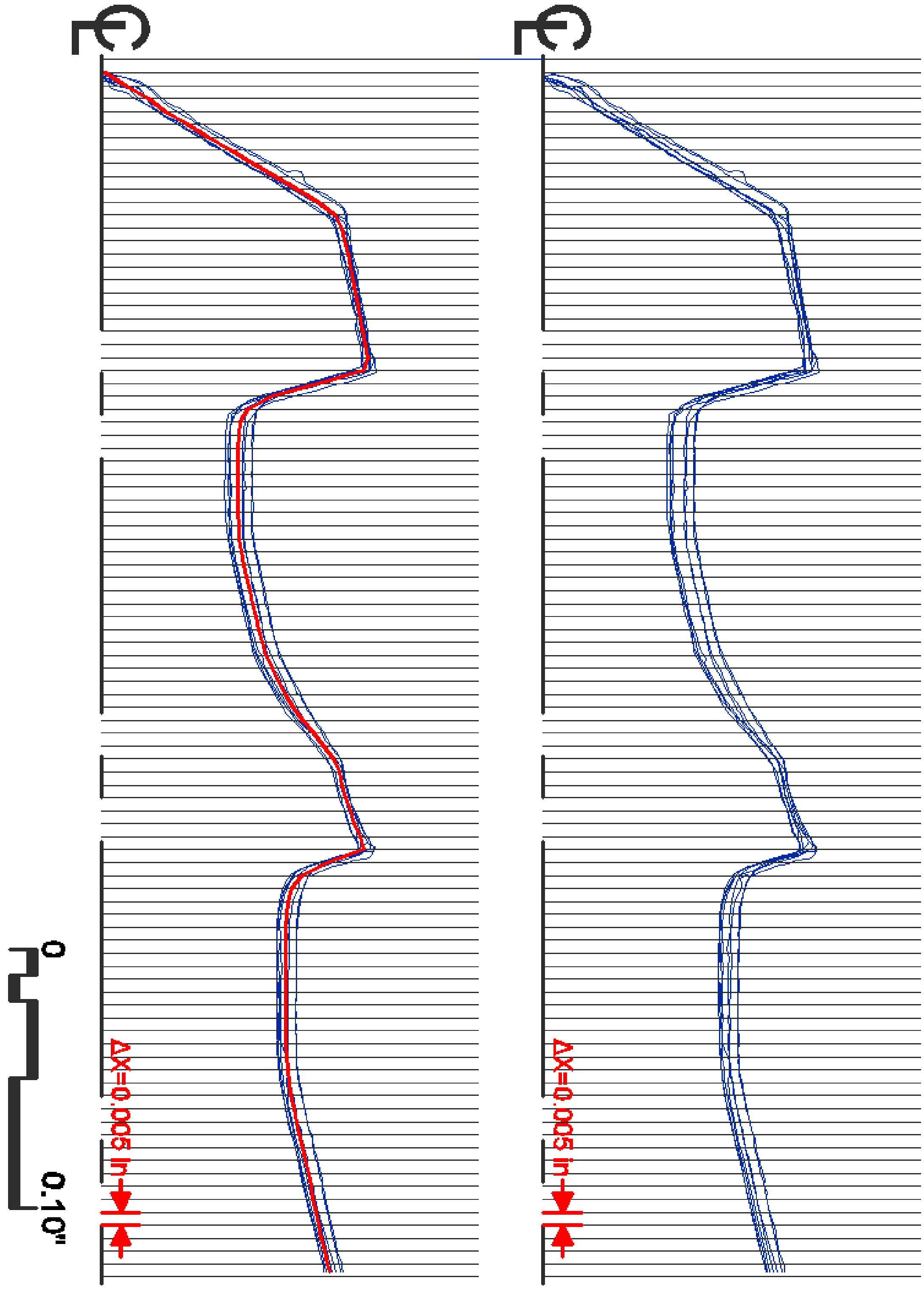


Figure B.19 As-Built 0.090 in. Tube-B Coined Pressed-End Divided Profiles & Mean Profile - Step 6

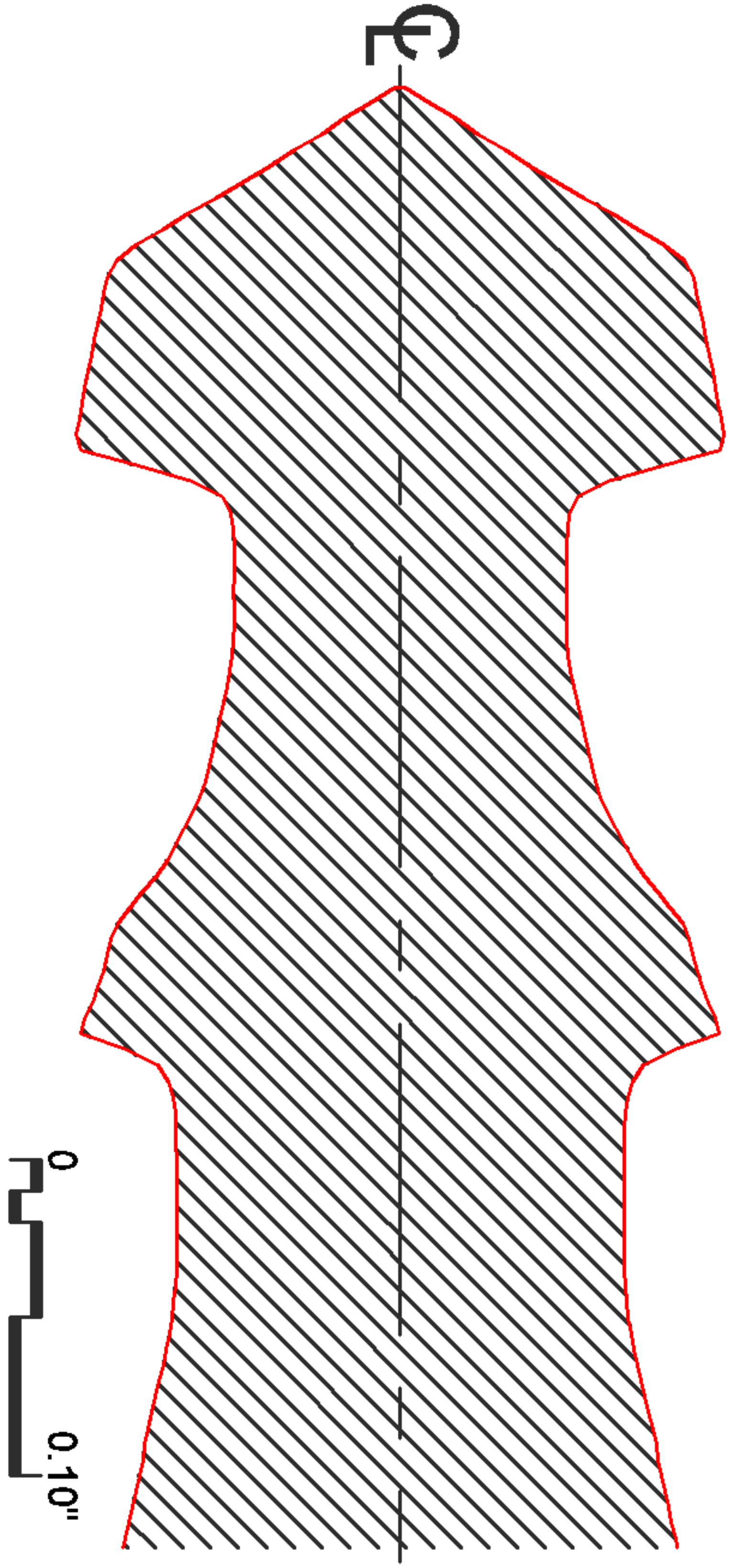


Figure B.20 As-Built 0.090 in. Tube-B Coined Pressed-End Representative Profile - Step 7

Table B.5 As-Built 0.090 in. Tube-B Coined Pressed-End XY Coordinates

X-Axis	Y-Axis							
0.000	0.0005	0.0027						
0.005	0.0174	0.0165	0.0088	0.0087	0.0087	0.0065	0.0064	0.0032
0.010	0.0132	0.0144	0.0172	0.0172	0.0175	0.0179	0.0225	0.0236
0.015	0.0318	0.0294	0.0250	0.0250	0.0224	0.0219	0.0216	0.0214
0.020	0.0296	0.0298	0.0306	0.0327	0.0342	0.0343	0.0374	0.0394
0.025	0.0477	0.0457	0.0422	0.0421	0.0394	0.0390	0.0378	0.0378
0.030	0.0465	0.0467	0.0467	0.0468	0.0502	0.0507	0.0548	0.0563
0.035	0.0658	0.0641	0.0589	0.0579	0.0551	0.0550	0.0550	0.0546
0.040	0.0630	0.0634	0.0645	0.0655	0.0663	0.0666	0.0722	0.0776
0.045	0.0828	0.0812	0.0745	0.0739	0.0738	0.0732	0.0715	0.0712
0.050	0.0787	0.0795	0.0820	0.0826	0.0827	0.0836	0.0899	0.0907
0.055	0.0946	0.0939	0.0909	0.0903	0.0893	0.0882	0.0867	0.0864
0.060	0.0902	0.0904	0.0908	0.0930	0.0945	0.0946	0.0948	0.0959
0.065	0.0962	0.0960	0.0951	0.0948	0.0947	0.0921	0.0916	0.0915
0.070	0.0924	0.0928	0.0932	0.0958	0.0961	0.0961	0.0966	0.0970
0.075	0.0984	0.0974	0.0971	0.0966	0.0966	0.0949	0.0941	0.0933
0.080	0.0944	0.0952	0.0962	0.0975	0.0976	0.0981	0.0983	0.0988
0.085	0.0996	0.0993	0.0993	0.0988	0.0983	0.0971	0.0967	0.0956
0.090	0.0969	0.0974	0.0982	0.0997	0.0998	0.0999	0.1001	0.1008
0.095	0.1017	0.1012	0.1008	0.1005	0.1005	0.0994	0.0986	0.0983
0.100	0.0984	0.0994	0.1001	0.1016	0.1017	0.1017	0.1020	0.1026
0.105	0.1032	0.1030	0.1025	0.1025	0.1024	0.1008	0.1004	0.0996
0.110	0.1005	0.1006	0.1009	0.1027	0.1034	0.1038	0.1052	0.1054
0.115	0.1060	0.1037	0.1033	0.1033	0.1008	0.0996	0.0987	0.0962
0.120	0.0790	0.0791	0.0794	0.0804	0.0837	0.0850	0.0857	0.0935
0.125	0.0740	0.0678	0.0677	0.0665	0.0637	0.0632	0.0628	0.0612
0.130	0.0518	0.0525	0.0534	0.0545	0.0568	0.0604	0.0605	0.0606
0.135	0.0592	0.0588	0.0565	0.0553	0.0505	0.0502	0.0501	0.0485
0.140	0.0479	0.0492	0.0498	0.0499	0.0550	0.0556	0.0583	0.0585
0.145	0.0584	0.0584	0.0553	0.0545	0.0500	0.0490	0.0488	0.0478
0.150	0.0478	0.0489	0.0492	0.0499	0.0546	0.0552	0.0582	0.0584
0.155	0.0585	0.0580	0.0551	0.0546	0.0499	0.0494	0.0491	0.0478
0.160	0.0476	0.0490	0.0496	0.0503	0.0545	0.0556	0.0580	0.0582
0.165	0.0583	0.0582	0.0550	0.0544	0.0500	0.0493	0.0492	0.0476
0.170	0.0478	0.0490	0.0492	0.0499	0.0545	0.0550	0.0580	0.0584
0.175	0.0584	0.0580	0.0552	0.0545	0.0503	0.0497	0.0492	0.0484
0.180	0.0489	0.0495	0.0502	0.0503	0.0549	0.0551	0.0584	0.0589
0.185	0.0597	0.0593	0.0559	0.0557	0.0512	0.0506	0.0500	0.0496
0.190	0.0508	0.0509	0.0517	0.0521	0.0569	0.0569	0.0605	0.0609
0.195	0.0618	0.0614	0.0579	0.0579	0.0535	0.0528	0.0520	0.0520
0.200	0.0530	0.0532	0.0539	0.0546	0.0589	0.0591	0.0624	0.0631
0.205	0.0640	0.0633	0.0602	0.0601	0.0556	0.0550	0.0545	0.0541
0.210	0.0553	0.0562	0.0564	0.0568	0.0611	0.0614	0.0646	0.0651
0.215	0.0661	0.0658	0.0624	0.0622	0.0583	0.0574	0.0572	0.0566
0.220	0.0578	0.0578	0.0586	0.0598	0.0634	0.0636	0.0672	0.0674
0.225	0.0692	0.0687	0.0654	0.0643	0.0619	0.0601	0.0596	0.0590

0.230	0.0613	0.0619	0.0630	0.0633	0.0664	0.0680	0.0710	0.0716
0.235	0.0742	0.0736	0.0703	0.0692	0.0663	0.0654	0.0645	0.0643
0.240	0.0671	0.0676	0.0683	0.0693	0.0716	0.0726	0.0766	0.0768
0.245	0.0792	0.0790	0.0755	0.0743	0.0725	0.0713	0.0712	0.0698
0.250	0.0736	0.0751	0.0760	0.0760	0.0772	0.0782	0.0818	0.0824
0.255	0.0857	0.0852	0.0820	0.0813	0.0813	0.0810	0.0793	0.0785
0.260	0.0825	0.0833	0.0850	0.0854	0.0860	0.0860	0.0885	0.0886
0.265	0.0923	0.0923	0.0901	0.0900	0.0898	0.0895	0.0870	0.0864
0.270	0.0891	0.0901	0.0914	0.0915	0.0918	0.0933	0.0933	0.0936
0.275	0.0943	0.0943	0.0941	0.0933	0.0927	0.0924	0.0912	0.0905
0.280	0.0919	0.0925	0.0937	0.0938	0.0948	0.0955	0.0956	0.0960
0.285	0.0978	0.0978	0.0970	0.0962	0.0955	0.0954	0.0942	0.0939
0.290	0.0951	0.0956	0.0972	0.0972	0.0978	0.0988	0.0998	0.0999
0.295	0.1028	0.1025	0.1014	0.1013	0.0998	0.0985	0.0976	0.0973
0.300	0.0986	0.0990	0.0993	0.1000	0.1003	0.1023	0.1050	0.1054
0.305	0.0953	0.0893	0.0878	0.0861	0.0850	0.0847	0.0842	0.0834
0.310	0.0729	0.0738	0.0744	0.0755	0.0762	0.0773	0.0800	0.0800
0.315	0.0778	0.0776	0.0760	0.0740	0.0717	0.0711	0.0708	0.0702
0.320	0.0687	0.0694	0.0695	0.0701	0.0724	0.0740	0.0763	0.0767
0.325	0.0760	0.0756	0.0731	0.0720	0.0693	0.0685	0.0682	0.0680
0.330	0.0679	0.0680	0.0687	0.0689	0.0722	0.0725	0.0755	0.0758
0.335	0.0755	0.0754	0.0724	0.0717	0.0692	0.0689	0.0679	0.0679
0.340	0.0678	0.0678	0.0684	0.0691	0.0714	0.0725	0.0752	0.0754
0.345	0.0752	0.0752	0.0724	0.0715	0.0694	0.0684	0.0677	0.0677
0.350	0.0676	0.0678	0.0688	0.0691	0.0715	0.0722	0.0752	0.0754
0.355	0.0752	0.0752	0.0721	0.0714	0.0690	0.0686	0.0681	0.0677
0.360	0.0677	0.0680	0.0687	0.0690	0.0715	0.0720	0.0751	0.0751
0.365	0.0751	0.0751	0.0720	0.0714	0.0692	0.0687	0.0683	0.0679
0.370	0.0680	0.0681	0.0688	0.0691	0.0715	0.0720	0.0751	0.0751
0.375	0.0754	0.0752	0.0719	0.0714	0.0694	0.0689	0.0682	0.0680
0.380	0.0682	0.0684	0.0691	0.0716	0.0716	0.0719	0.0753	0.0753
0.385	0.0757	0.0755	0.0724	0.0721	0.0719	0.0697	0.0688	0.0686
0.390	0.0693	0.0694	0.0703	0.0715	0.0728	0.0729	0.0763	0.0766
0.395	0.0775	0.0773	0.0739	0.0736	0.0719	0.0712	0.0702	0.0701
0.400	0.0710	0.0712	0.0721	0.0726	0.0746	0.0749	0.0784	0.0786
0.405	0.0796	0.0795	0.0759	0.0756	0.0737	0.0734	0.0724	0.0721
0.410	0.0733	0.0735	0.0743	0.0746	0.0769	0.0771	0.0809	0.0812
0.415	0.0820	0.0816	0.0783	0.0780	0.0760	0.0754	0.0747	0.0746
0.420	0.0757	0.0761	0.0766	0.0775	0.0791	0.0795	0.0828	0.0834

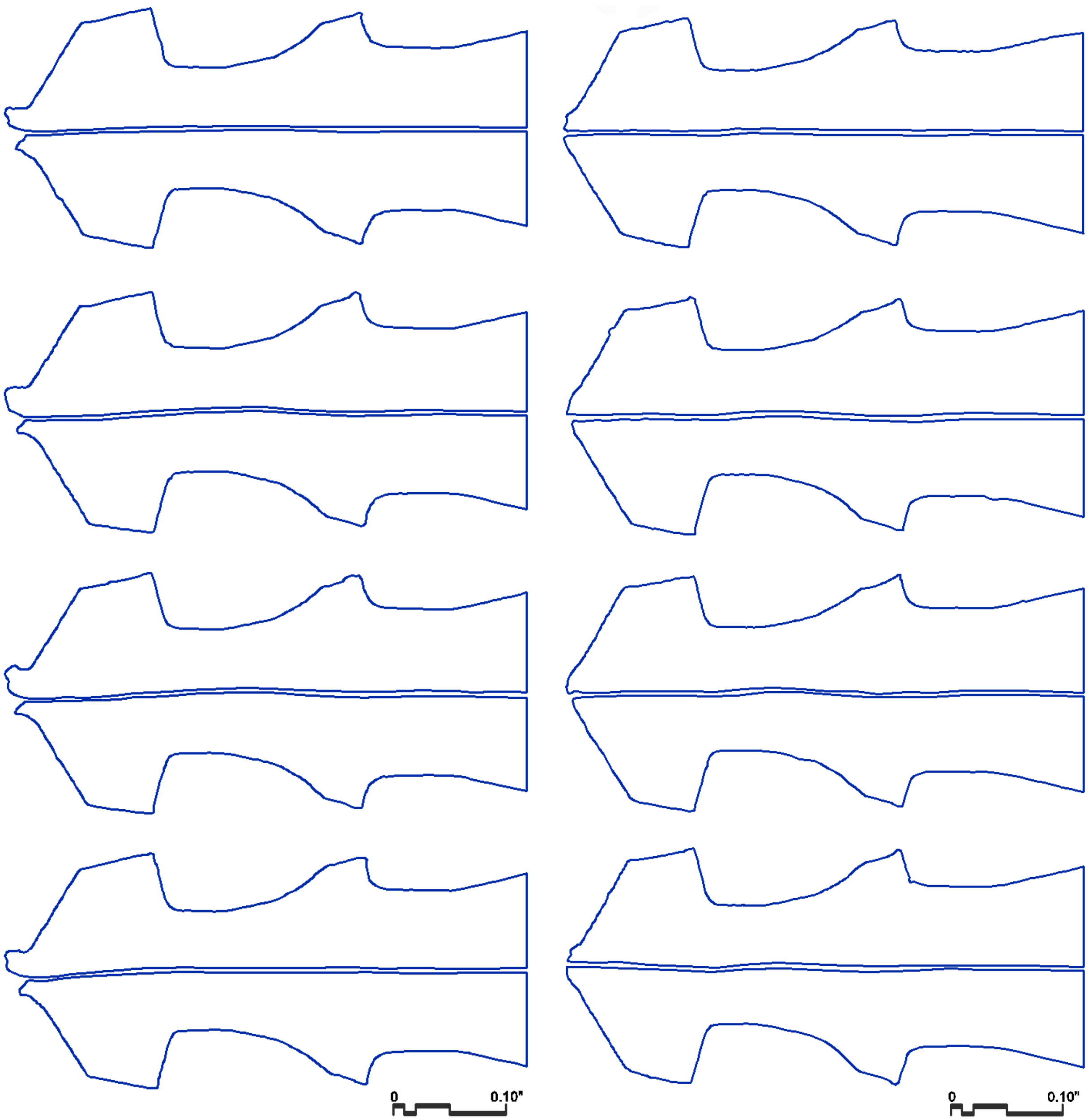


Figure B.21 As-Built 0.090 in. Tube-C Coined Pressed-End CAD Generation - Step 4

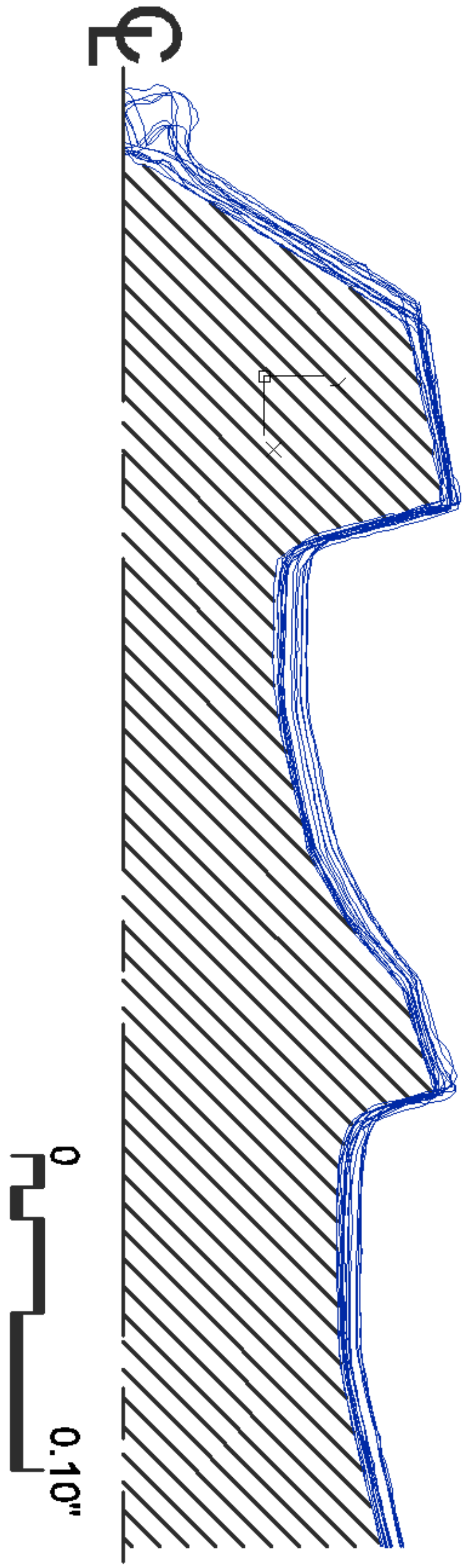


Figure B.22 As-Built 0.090 in. Tube-C Coined Pressed-End Profiles Generation - Step 5

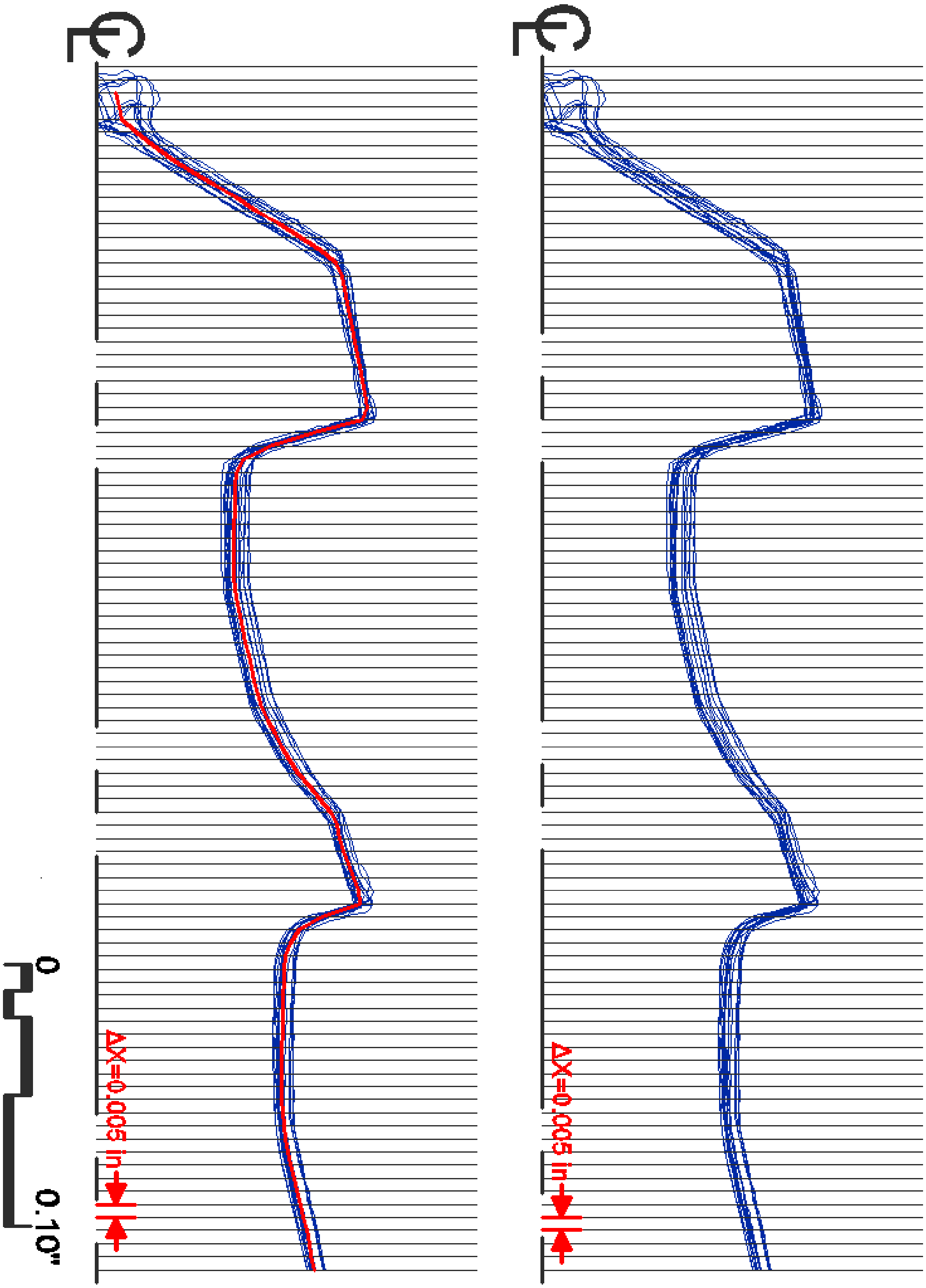


Figure B.23 As-Built 0.090 in. Tube-C Coined Pressed-End Divided Profiles & Mean Profile - Step 6

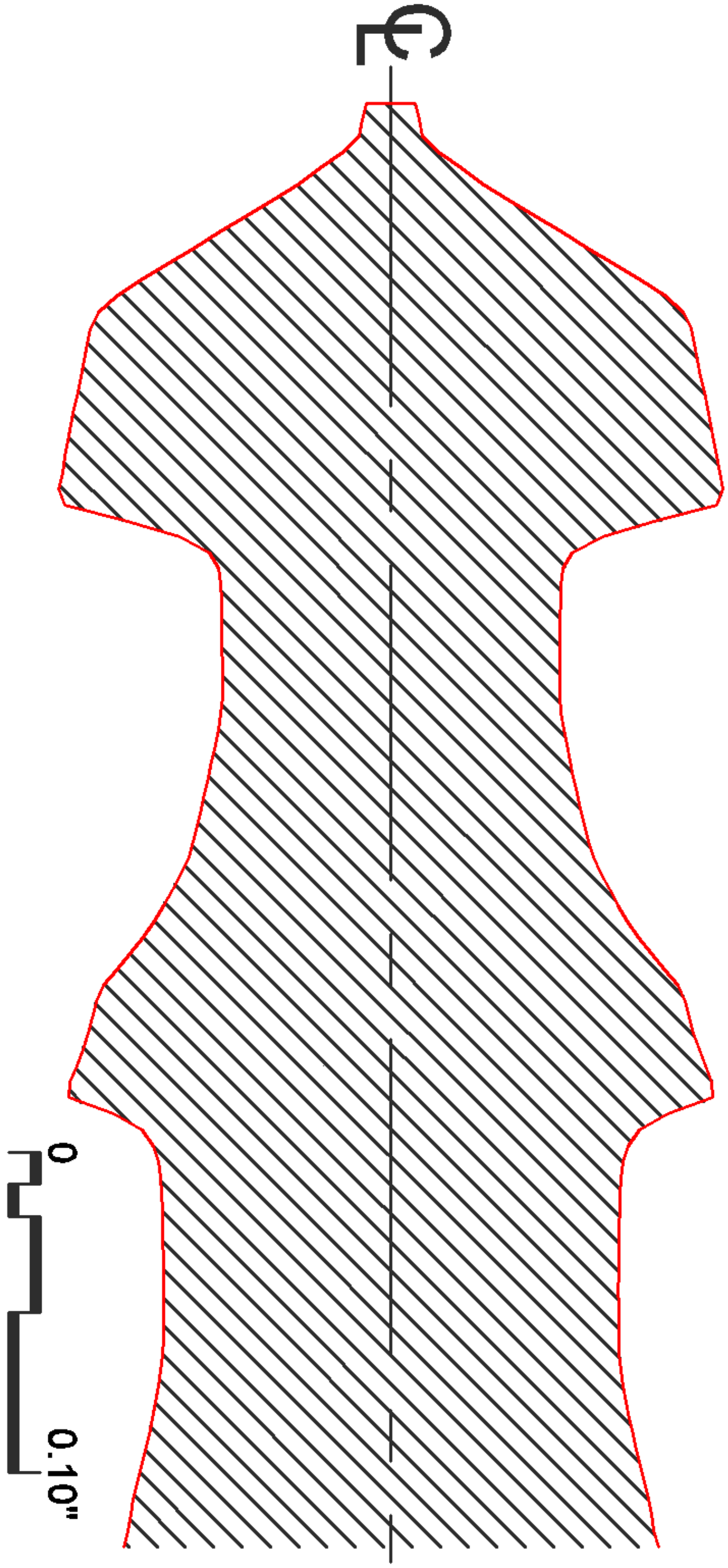


Figure B.24 As-Built 0.090 in. Tube-C Coined Pressed-End Representative Profile - Step 7

Table B.6 As-Built 0.090 in. Tube-C Coined Pressed-End XY Coordinates

X-Axis	Y-Axis							
0.000	0.0005	0.0027	0.0195	0.0191	0.0157	0.0155	0.0168	0.0124
0.005	0.0174	0.0165	0.0088	0.0087	0.0087	0.0212	0.0065	0.0213
0.010	0.0144	0.0132	0.0148	0.0144	0.0152	0.0172	0.0156	0.0172
0.015	0.0208	0.0318	0.0205	0.0294	0.0197	0.0250	0.0174	0.0250
0.020	0.0032	0.0228	0.0064	0.0227	0.0065	0.0214	0.0087	0.0213
0.025	0.0236	0.0211	0.0225	0.0220	0.0179	0.0240	0.0175	0.0246
0.030	0.0214	0.0370	0.0216	0.0354	0.0219	0.0353	0.0224	0.0323
0.035	0.0394	0.0345	0.0374	0.0367	0.0343	0.0379	0.0342	0.0383
0.040	0.0378	0.0529	0.0378	0.0519	0.0390	0.0512	0.0394	0.0478
0.045	0.0563	0.0513	0.0548	0.0533	0.0507	0.0545	0.0502	0.0560
0.050	0.0546	0.0700	0.0550	0.0684	0.0550	0.0678	0.0551	0.0655
0.055	0.0776	0.0665	0.0722	0.0687	0.0666	0.0689	0.0663	0.0690
0.060	0.0712	0.0862	0.0715	0.0844	0.0732	0.0840	0.0738	0.0817
0.065	0.0907	0.0826	0.0899	0.0846	0.0836	0.0847	0.0827	0.0853
0.070	0.0864	0.0936	0.0867	0.0935	0.0882	0.0932	0.0893	0.0931
0.075	0.0959	0.0908	0.0948	0.0932	0.0946	0.0937	0.0945	0.0938
0.080	0.0915	0.0977	0.0916	0.0976	0.0921	0.0952	0.0947	0.0947
0.085	0.0970	0.0934	0.0966	0.0950	0.0961	0.0951	0.0961	0.0958
0.090	0.0933	0.0993	0.0941	0.0988	0.0949	0.0976	0.0966	0.0973
0.095	0.0988	0.0957	0.0983	0.0971	0.0981	0.0972	0.0976	0.0986
0.100	0.0956	0.1007	0.0967	0.1006	0.0971	0.0998	0.0983	0.0996
0.105	0.1008	0.0979	0.1001	0.0990	0.0999	0.0996	0.0998	0.1006
0.110	0.0983	0.1024	0.0986	0.1021	0.0994	0.1020	0.1005	0.1020
0.115	0.1026	0.1001	0.1020	0.1011	0.1017	0.1014	0.1017	0.1026
0.120	0.0996	0.1042	0.1004	0.1040	0.1008	0.1040	0.1024	0.1032
0.125	0.1054	0.1025	0.1052	0.1029	0.1038	0.1030	0.1034	0.1036
0.130	0.0962	0.1036	0.0987	0.1034	0.0996	0.1032	0.1008	0.1031
0.135	0.0935	0.0747	0.0857	0.0801	0.0850	0.0811	0.0837	0.0829
0.140	0.0612	0.0694	0.0628	0.0687	0.0632	0.0680	0.0637	0.0663
0.145	0.0606	0.0532	0.0605	0.0537	0.0604	0.0560	0.0568	0.0562
0.150	0.0485	0.0577	0.0501	0.0572	0.0502	0.0542	0.0505	0.0523
0.155	0.0585	0.0503	0.0583	0.0508	0.0556	0.0514	0.0550	0.0514
0.160	0.0478	0.0568	0.0488	0.0566	0.0490	0.0539	0.0500	0.0516
0.165	0.0584	0.0502	0.0582	0.0502	0.0552	0.0507	0.0546	0.0510
0.170	0.0478	0.0567	0.0491	0.0564	0.0494	0.0535	0.0499	0.0514
0.175	0.0582	0.0498	0.0580	0.0503	0.0556	0.0506	0.0545	0.0509
0.180	0.0476	0.0563	0.0492	0.0562	0.0493	0.0532	0.0500	0.0508
0.185	0.0584	0.0499	0.0580	0.0500	0.0550	0.0507	0.0545	0.0508
0.190	0.0484	0.0562	0.0492	0.0561	0.0497	0.0533	0.0503	0.0511
0.195	0.0589	0.0501	0.0584	0.0505	0.0551	0.0508	0.0549	0.0514
0.200	0.0496	0.0576	0.0500	0.0575	0.0506	0.0544	0.0512	0.0525
0.205	0.0609	0.0516	0.0605	0.0521	0.0569	0.0525	0.0569	0.0529
0.210	0.0520	0.0598	0.0520	0.0597	0.0528	0.0564	0.0535	0.0546
0.215	0.0631	0.0538	0.0624	0.0543	0.0591	0.0545	0.0589	0.0547
0.220	0.0541	0.0617	0.0545	0.0617	0.0550	0.0583	0.0556	0.0567
0.225	0.0651	0.0562	0.0646	0.0564	0.0614	0.0566	0.0611	0.0570

0.230	0.0566	0.0639	0.0572	0.0638	0.0574	0.0606	0.0583	0.0586
0.235	0.0674	0.0582	0.0672	0.0586	0.0636	0.0593	0.0634	0.0594
0.240	0.0590	0.0669	0.0596	0.0668	0.0601	0.0631	0.0619	0.0617
0.245	0.0716	0.0616	0.0710	0.0626	0.0680	0.0628	0.0664	0.0631
0.250	0.0643	0.0723	0.0645	0.0722	0.0654	0.0684	0.0663	0.0675
0.255	0.0768	0.0671	0.0766	0.0679	0.0726	0.0682	0.0716	0.0684
0.260	0.0698	0.0780	0.0712	0.0777	0.0713	0.0742	0.0725	0.0733
0.265	0.0824	0.0731	0.0818	0.0741	0.0782	0.0741	0.0772	0.0744
0.270	0.0785	0.0855	0.0793	0.0849	0.0810	0.0820	0.0813	0.0815
0.275	0.0886	0.0814	0.0885	0.0815	0.0860	0.0823	0.0860	0.0837
0.280	0.0864	0.0935	0.0870	0.0935	0.0895	0.0913	0.0898	0.0895
0.285	0.0936	0.0896	0.0933	0.0899	0.0933	0.0899	0.0918	0.0907
0.290	0.0905	0.0970	0.0912	0.0960	0.0924	0.0943	0.0927	0.0925
0.295	0.0960	0.0921	0.0956	0.0924	0.0955	0.0926	0.0948	0.0932
0.300	0.0939	0.1005	0.0942	0.0999	0.0954	0.0974	0.0955	0.0955
0.305	0.0999	0.0954	0.0998	0.0955	0.0988	0.0960	0.0978	0.0969
0.310	0.0973	0.1054	0.0976	0.1038	0.0985	0.1002	0.0998	0.0985
0.315	0.1054	0.0983	0.1050	0.0983	0.1023	0.0988	0.1003	0.0989
0.320	0.0834	0.0891	0.0842	0.0881	0.0847	0.0870	0.0850	0.0864
0.325	0.0800	0.0741	0.0800	0.0761	0.0773	0.0768	0.0762	0.0769
0.330	0.0702	0.0773	0.0708	0.0768	0.0711	0.0743	0.0717	0.0738
0.335	0.0767	0.0707	0.0763	0.0711	0.0740	0.0712	0.0724	0.0714
0.340	0.0680	0.0753	0.0682	0.0751	0.0685	0.0719	0.0693	0.0713
0.345	0.0758	0.0699	0.0755	0.0703	0.0725	0.0704	0.0722	0.0704
0.350	0.0679	0.0749	0.0679	0.0744	0.0689	0.0715	0.0692	0.0703
0.355	0.0754	0.0695	0.0752	0.0698	0.0725	0.0698	0.0714	0.0700
0.360	0.0677	0.0746	0.0677	0.0741	0.0684	0.0712	0.0694	0.0698
0.365	0.0754	0.0692	0.0752	0.0695	0.0722	0.0696	0.0715	0.0697
0.370	0.0677	0.0744	0.0681	0.0738	0.0686	0.0710	0.0690	0.0700
0.375	0.0751	0.0691	0.0751	0.0693	0.0720	0.0695	0.0715	0.0696
0.380	0.0679	0.0740	0.0683	0.0737	0.0687	0.0707	0.0692	0.0705
0.385	0.0751	0.0693	0.0751	0.0693	0.0720	0.0696	0.0715	0.0698
0.390	0.0680	0.0741	0.0682	0.0736	0.0689	0.0707	0.0694	0.0699
0.395	0.0753	0.0692	0.0753	0.0694	0.0719	0.0697	0.0716	0.0699
0.400	0.0686	0.0746	0.0688	0.0744	0.0697	0.0712	0.0719	0.0706
0.405	0.0766	0.0706	0.0763	0.0709	0.0729	0.0709	0.0728	0.0712
0.410	0.0701	0.0766	0.0702	0.0765	0.0712	0.0732	0.0719	0.0723
0.415	0.0786	0.0725	0.0784	0.0726	0.0749	0.0730	0.0746	0.0734
0.420	0.0721	0.0790	0.0724	0.0788	0.0734	0.0757	0.0737	0.0747

X-Axis	Y-Axis							
0.000	0.0074	0.0114						
0.005	0.0064	0.0155	0.0032					
0.010	0.0168	0.0175	0.0191	0.0179	0.0153	0.0225	0.0222	0.0236
0.015	0.0169	0.0224	0.0159	0.0219	0.0165	0.0216	0.0147	0.0214
0.020	0.0087	0.0193	0.0088	0.0184	0.0144	0.0180	0.0174	0.0175
0.025	0.0172	0.0270	0.0172	0.0275	0.0294	0.0275	0.0132	0.0300
0.030	0.0250	0.0313	0.0250	0.0304	0.0298	0.0281	0.0318	0.0262
0.035	0.0327	0.0403	0.0306	0.0431	0.0457	0.0435	0.0296	0.0453
0.040	0.0421	0.0465	0.0422	0.0454	0.0467	0.0448	0.0477	0.0424
0.045	0.0468	0.0571	0.0467	0.0589	0.0641	0.0600	0.0465	0.0614
0.050	0.0579	0.0614	0.0589	0.0611	0.0634	0.0607	0.0658	0.0590
0.055	0.0655	0.0734	0.0645	0.0760	0.0812	0.0763	0.0630	0.0779
0.060	0.0739	0.0772	0.0745	0.0770	0.0795	0.0764	0.0828	0.0746
0.065	0.0826	0.0882	0.0820	0.0892	0.0939	0.0918	0.0787	0.0925
0.070	0.0903	0.0924	0.0909	0.0920	0.0904	0.0912	0.0946	0.0893
0.075	0.0930	0.0938	0.0908	0.0941	0.0960	0.0966	0.0902	0.0967
0.080	0.0948	0.0947	0.0951	0.0943	0.0928	0.0941	0.0962	0.0919
0.085	0.0958	0.0959	0.0932	0.0965	0.0974	0.0984	0.0924	0.0985
0.090	0.0966	0.0971	0.0971	0.0961	0.0952	0.0961	0.0984	0.0945
0.095	0.0975	0.0986	0.0962	0.0990	0.0993	0.0999	0.0944	0.0999
0.100	0.0988	0.0996	0.0993	0.0985	0.0974	0.0979	0.0996	0.0968
0.105	0.0997	0.1007	0.0982	0.1012	0.1012	0.1013	0.0969	0.1015
0.110	0.1005	0.1018	0.1008	0.1006	0.0994	0.1002	0.1017	0.0993
0.115	0.1016	0.1027	0.1001	0.1029	0.1030	0.1031	0.0984	0.1032
0.120	0.1025	0.1032	0.1025	0.1022	0.1006	0.1018	0.1032	0.1010
0.125	0.1027	0.1038	0.1009	0.1050	0.1037	0.1051	0.1005	0.1064
0.130	0.1033	0.1026	0.1033	0.1025	0.0791	0.1022	0.1060	0.0936
0.135	0.0804	0.0835	0.0794	0.0868	0.0678	0.0876	0.0790	0.0885
0.140	0.0665	0.0661	0.0677	0.0648	0.0525	0.0634	0.0740	0.0589
0.145	0.0545	0.0563	0.0534	0.0564	0.0588	0.0595	0.0518	0.0599
0.150	0.0553	0.0519	0.0565	0.0517	0.0492	0.0515	0.0592	0.0509
0.155	0.0499	0.0519	0.0498	0.0539	0.0584	0.0569	0.0479	0.0571
0.160	0.0545	0.0513	0.0553	0.0513	0.0489	0.0502	0.0584	0.0501
0.165	0.0499	0.0514	0.0492	0.0535	0.0580	0.0565	0.0478	0.0567
0.170	0.0546	0.0509	0.0551	0.0507	0.0490	0.0501	0.0585	0.0498
0.175	0.0503	0.0510	0.0496	0.0532	0.0582	0.0564	0.0476	0.0565
0.180	0.0544	0.0508	0.0550	0.0505	0.0490	0.0498	0.0583	0.0497
0.185	0.0499	0.0508	0.0492	0.0533	0.0580	0.0560	0.0478	0.0562
0.190	0.0545	0.0509	0.0552	0.0504	0.0495	0.0503	0.0584	0.0501
0.195	0.0503	0.0514	0.0502	0.0535	0.0593	0.0567	0.0489	0.0567
0.200	0.0557	0.0519	0.0559	0.0514	0.0509	0.0513	0.0597	0.0507
0.205	0.0521	0.0536	0.0517	0.0555	0.0614	0.0586	0.0508	0.0586
0.210	0.0579	0.0537	0.0579	0.0536	0.0532	0.0531	0.0618	0.0528
0.215	0.0546	0.0555	0.0539	0.0573	0.0633	0.0606	0.0530	0.0607
0.220	0.0601	0.0559	0.0602	0.0557	0.0562	0.0554	0.0640	0.0549
0.225	0.0568	0.0576	0.0564	0.0594	0.0658	0.0627	0.0553	0.0627
0.230	0.0622	0.0579	0.0624	0.0576	0.0578	0.0576	0.0661	0.0571
0.235	0.0598	0.0600	0.0586	0.0618	0.0687	0.0651	0.0578	0.0651
0.240	0.0643	0.0608	0.0654	0.0605	0.0619	0.0603	0.0692	0.0596

0.245	0.0633	0.0648	0.0630	0.0655	0.0736	0.0695	0.0613	0.0695
0.250	0.0692	0.0656	0.0703	0.0656	0.0676	0.0651	0.0742	0.0643
0.255	0.0693	0.0700	0.0683	0.0710	0.0790	0.0747	0.0671	0.0751
0.260	0.0743	0.0712	0.0755	0.0710	0.0751	0.0706	0.0792	0.0699
0.265	0.0760	0.0773	0.0760	0.0776	0.0852	0.0810	0.0736	0.0816
0.270	0.0813	0.0785	0.0820	0.0778	0.0833	0.0773	0.0857	0.0772
0.275	0.0854	0.0855	0.0850	0.0869	0.0923	0.0891	0.0825	0.0899
0.280	0.0900	0.0878	0.0901	0.0863	0.0901	0.0862	0.0923	0.0856
0.285	0.0915	0.0916	0.0914	0.0931	0.0943	0.0947	0.0891	0.0956
0.290	0.0933	0.0920	0.0941	0.0914	0.0925	0.0910	0.0943	0.0907
0.295	0.0938	0.0939	0.0937	0.0960	0.0978	0.0972	0.0919	0.0985
0.300	0.0962	0.0945	0.0970	0.0940	0.0956	0.0937	0.0978	0.0937
0.305	0.0972	0.0973	0.0972	0.0989	0.1025	0.1019	0.0951	0.1037
0.310	0.1013	0.0982	0.1014	0.0977	0.0990	0.0976	0.1028	0.0967
0.315	0.1000	0.0990	0.0993	0.0998	0.0893	0.1013	0.0986	0.1016
0.320	0.0861	0.0852	0.0878	0.0846	0.0738	0.0838	0.0953	0.0797
0.325	0.0755	0.0787	0.0744	0.0789	0.0776	0.0790	0.0729	0.0798
0.330	0.0740	0.0733	0.0760	0.0731	0.0694	0.0728	0.0778	0.0719
0.335	0.0701	0.0720	0.0695	0.0726	0.0756	0.0755	0.0687	0.0759
0.340	0.0720	0.0708	0.0731	0.0707	0.0680	0.0703	0.0760	0.0703
0.345	0.0689	0.0705	0.0687	0.0717	0.0754	0.0746	0.0679	0.0756
0.350	0.0717	0.0703	0.0724	0.0703	0.0678	0.0698	0.0755	0.0693
0.355	0.0691	0.0701	0.0684	0.0713	0.0752	0.0742	0.0678	0.0747
0.360	0.0715	0.0698	0.0724	0.0697	0.0678	0.0697	0.0752	0.0693
0.365	0.0691	0.0698	0.0688	0.0712	0.0752	0.0740	0.0676	0.0744
0.370	0.0714	0.0697	0.0721	0.0695	0.0680	0.0694	0.0752	0.0690
0.375	0.0690	0.0703	0.0687	0.0708	0.0751	0.0737	0.0677	0.0742
0.380	0.0714	0.0697	0.0720	0.0695	0.0681	0.0694	0.0751	0.0692
0.385	0.0691	0.0704	0.0688	0.0707	0.0752	0.0736	0.0680	0.0741
0.390	0.0714	0.0698	0.0719	0.0697	0.0684	0.0693	0.0754	0.0692
0.395	0.0716	0.0701	0.0691	0.0707	0.0755	0.0737	0.0682	0.0741
0.400	0.0721	0.0703	0.0724	0.0702	0.0694	0.0701	0.0757	0.0699
0.405	0.0715	0.0713	0.0703	0.0722	0.0773	0.0754	0.0693	0.0755
0.410	0.0736	0.0723	0.0739	0.0719	0.0712	0.0718	0.0775	0.0714
0.415	0.0726	0.0735	0.0721	0.0743	0.0795	0.0775	0.0710	0.0778
0.420	0.0756	0.0745	0.0759	0.0740	0.0735	0.0738	0.0796	0.0735

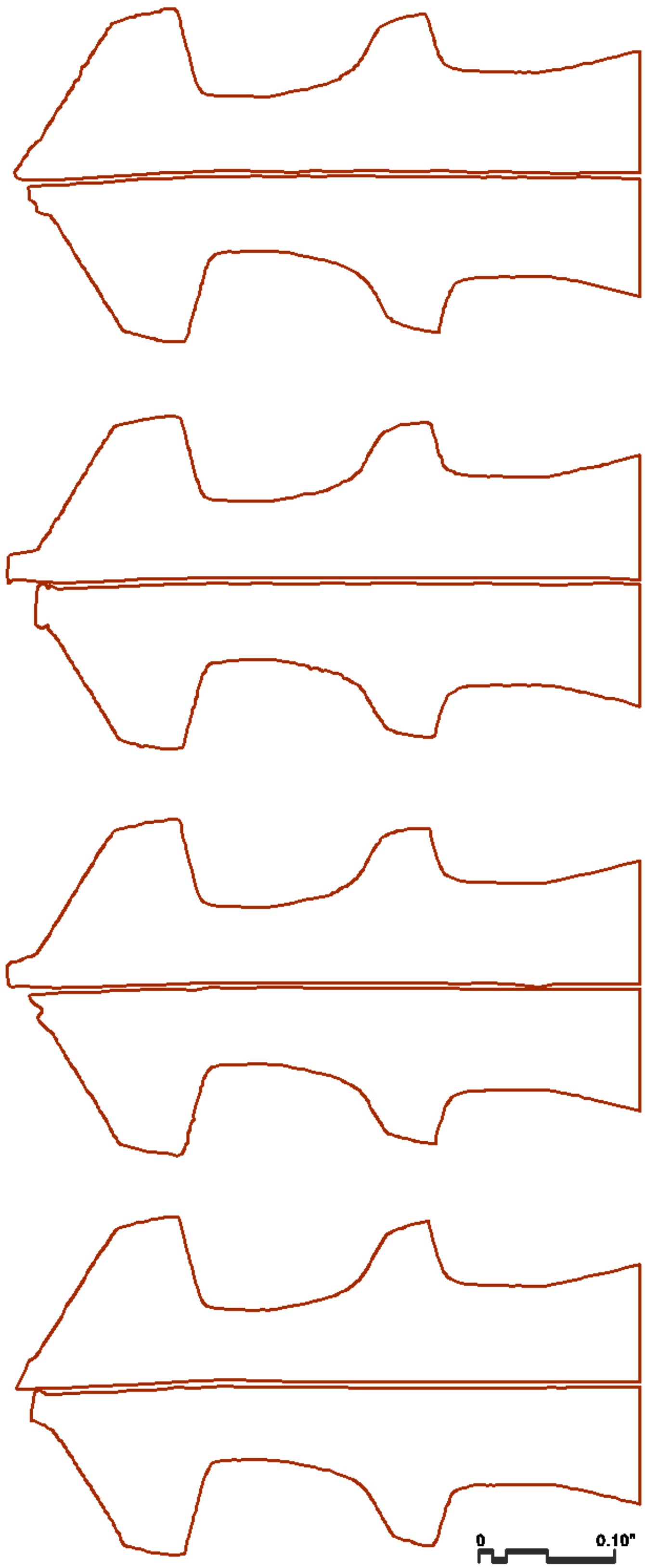


Figure B.25 As-Built 0.104 in. Tube-A Coined Pressed-End CAD Generation - Step 4

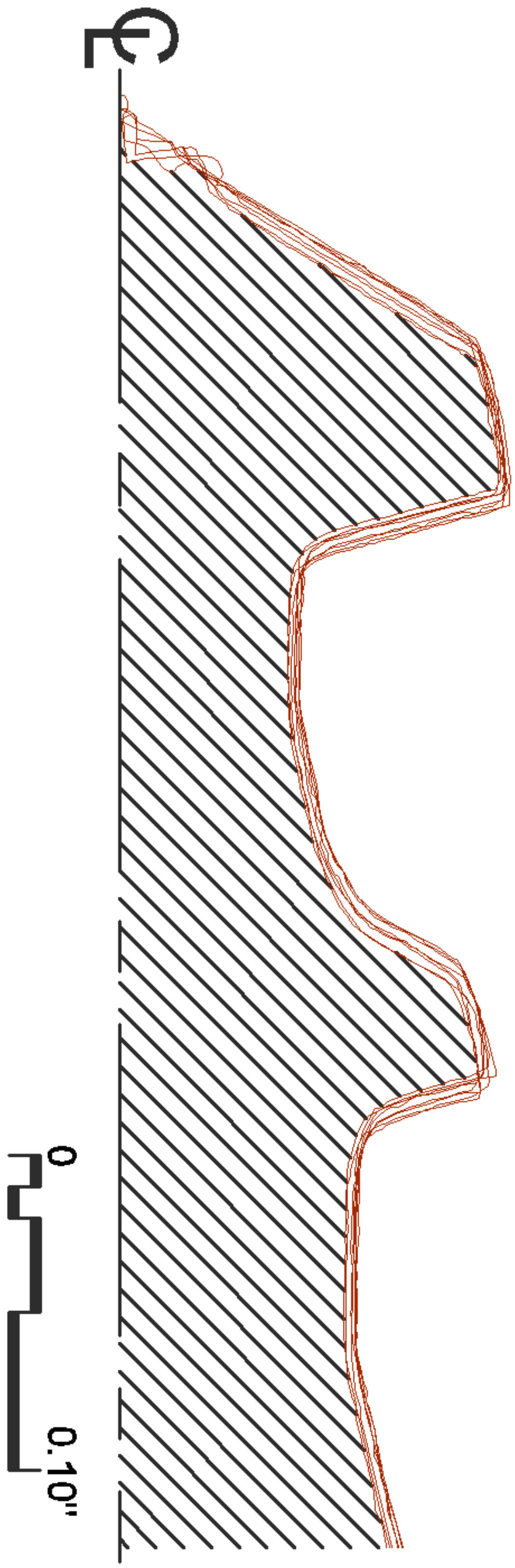


Figure B.26 As-Built 0.104 in. Tube-A Coined Pressed-End Profiles Generation - Step 5

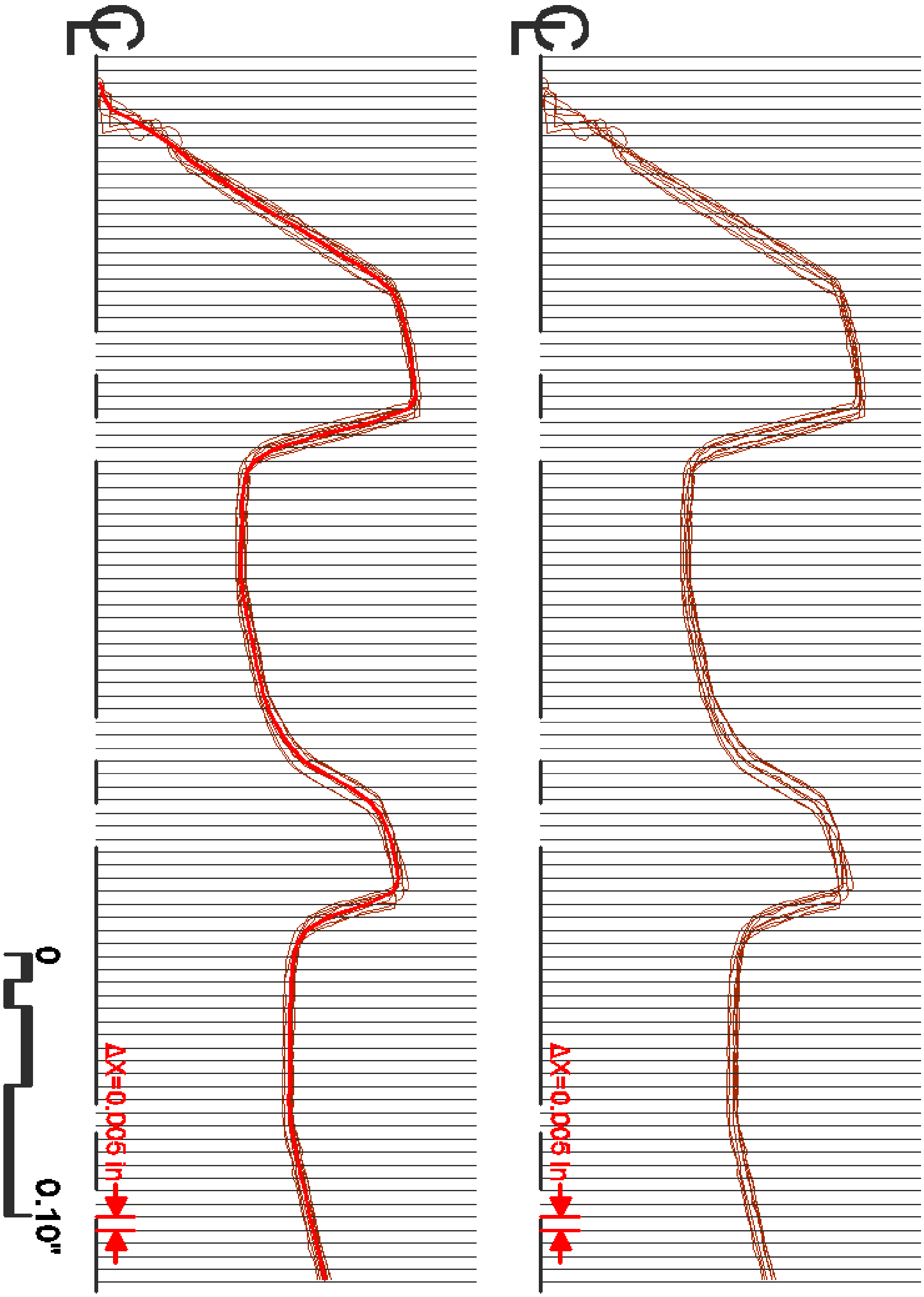


Figure B.27 As-Built 0.104 in. Tube-A Coined Pressed-End Divided Profiles & Mean Profile -

Step 6

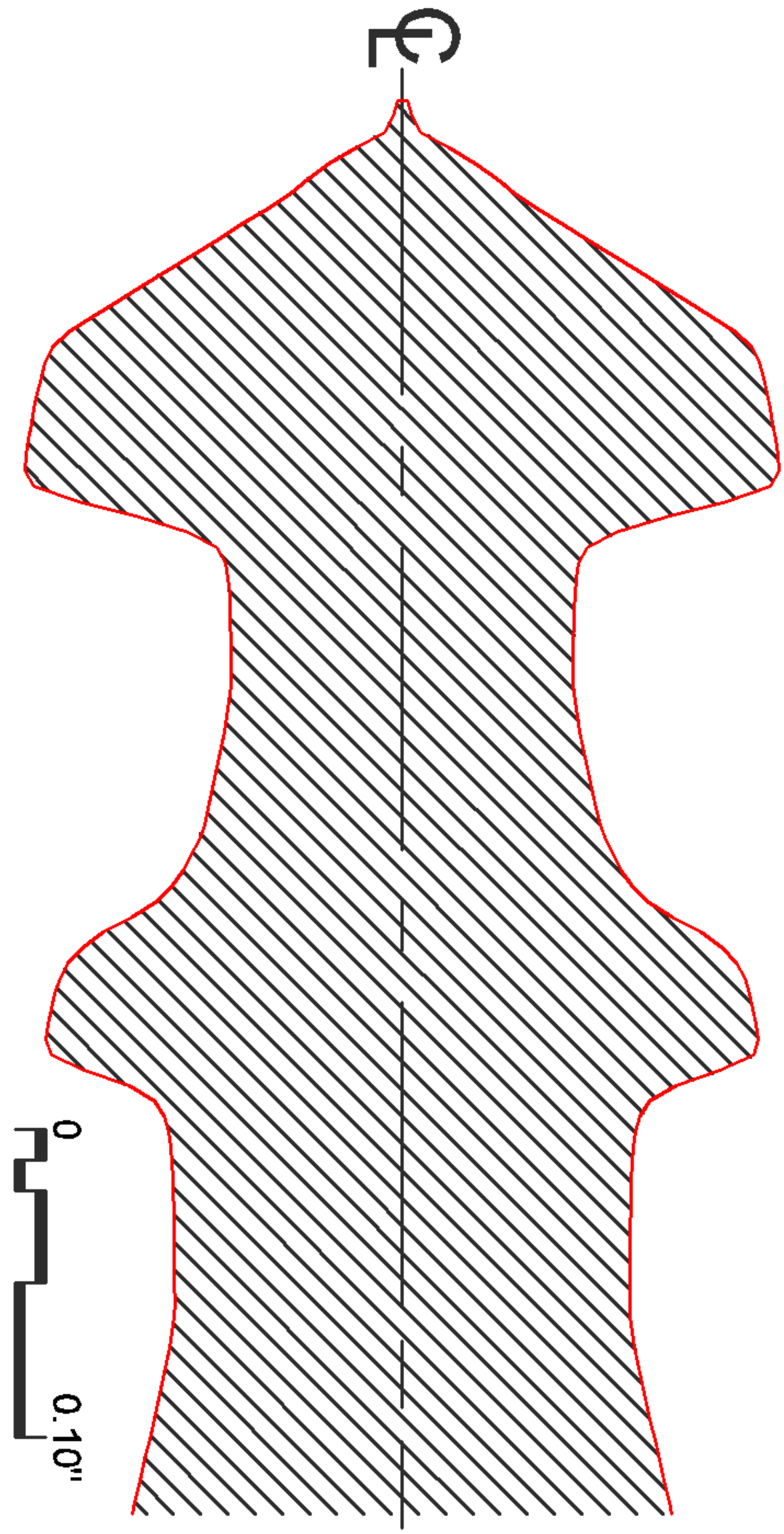


Figure B.28 As-Built 0.104 in. Tube-A Coined Pressed-End Representative Profile - Step 7

Table B.7 As-Built 0.104 in. Tube-A Coined Pressed-End XY Coordinates

X-Axis	Y-Axis							
0.000	0.0006	0.0026						
0.005	0.0055	0.0051	0.0046	0.0013	0.0009	0.0006		
0.010	0.0011	0.0014	0.0054	0.0055	0.0096	0.0125		
0.015	0.0244	0.0209	0.0205	0.0190	0.0179	0.0172	0.0151	0.0093
0.020	0.0132	0.0191	0.0224	0.0231	0.0234	0.0236	0.0257	0.0260
0.025	0.0329	0.0322	0.0314	0.0313	0.0305	0.0289	0.0286	0.0276
0.030	0.0310	0.0323	0.0333	0.0375	0.0381	0.0392	0.0399	0.0410
0.035	0.0493	0.0481	0.0467	0.0460	0.0440	0.0416	0.0388	0.0376
0.040	0.0452	0.0461	0.0501	0.0518	0.0555	0.0557	0.0559	0.0576
0.045	0.0659	0.0640	0.0635	0.0626	0.0600	0.0578	0.0540	0.0526
0.050	0.0606	0.0622	0.0658	0.0684	0.0704	0.0716	0.0717	0.0743
0.055	0.0823	0.0804	0.0800	0.0792	0.0760	0.0744	0.0698	0.0692
0.060	0.0764	0.0783	0.0813	0.0837	0.0880	0.0886	0.0886	0.0900
0.065	0.0984	0.0970	0.0968	0.0951	0.0914	0.0900	0.0860	0.0846
0.070	0.0931	0.0943	0.0976	0.1001	0.1027	0.1039	0.1052	0.1059
0.075	0.1131	0.1116	0.1111	0.1103	0.1085	0.1081	0.1022	0.1013
0.080	0.1092	0.1111	0.1127	0.1145	0.1147	0.1148	0.1150	0.1158
0.085	0.1178	0.1176	0.1164	0.1162	0.1160	0.1156	0.1147	0.1141
0.090	0.1153	0.1162	0.1165	0.1171	0.1173	0.1181	0.1190	0.1190
0.095	0.1206	0.1202	0.1194	0.1187	0.1183	0.1179	0.1174	0.1167
0.100	0.1173	0.1186	0.1188	0.1198	0.1198	0.1204	0.1204	0.1216
0.105	0.1224	0.1213	0.1210	0.1208	0.1201	0.1197	0.1195	0.1185
0.110	0.1198	0.1201	0.1207	0.1210	0.1218	0.1220	0.1221	0.1232
0.115	0.1239	0.1226	0.1224	0.1219	0.1219	0.1217	0.1211	0.1205
0.120	0.1205	0.1212	0.1221	0.1224	0.1226	0.1228	0.1232	0.1243
0.125	0.1240	0.1225	0.1221	0.1221	0.1188	0.1187	0.1181	0.1102
0.130	0.0908	0.0971	0.0983	0.0996	0.1078	0.1143	0.1155	0.1179
0.135	0.0985	0.0963	0.0914	0.0899	0.0807	0.0796	0.0772	0.0711
0.140	0.0609	0.0631	0.0635	0.0651	0.0709	0.0729	0.0782	0.0807
0.145	0.0641	0.0624	0.0612	0.0609	0.0598	0.0594	0.0571	0.0564
0.150	0.0549	0.0556	0.0571	0.0574	0.0578	0.0581	0.0583	0.0586
0.155	0.0583	0.0581	0.0578	0.0566	0.0563	0.0561	0.0545	0.0545
0.160	0.0540	0.0543	0.0554	0.0564	0.0564	0.0567	0.0577	0.0579
0.165	0.0577	0.0575	0.0568	0.0567	0.0561	0.0552	0.0538	0.0538
0.170	0.0537	0.0538	0.0550	0.0560	0.0565	0.0565	0.0572	0.0577
0.175	0.0577	0.0570	0.0564	0.0563	0.0557	0.0550	0.0536	0.0536
0.180	0.0535	0.0537	0.0547	0.0556	0.0560	0.0563	0.0570	0.0574
0.185	0.0576	0.0570	0.0562	0.0561	0.0555	0.0546	0.0538	0.0537
0.190	0.0536	0.0541	0.0548	0.0558	0.0561	0.0562	0.0571	0.0574
0.195	0.0581	0.0578	0.0572	0.0565	0.0562	0.0550	0.0543	0.0540
0.200	0.0546	0.0551	0.0556	0.0566	0.0575	0.0581	0.0587	0.0590
0.205	0.0599	0.0597	0.0593	0.0582	0.0573	0.0561	0.0559	0.0551
0.210	0.0560	0.0570	0.0572	0.0588	0.0591	0.0603	0.0606	0.0609
0.215	0.0622	0.0617	0.0609	0.0603	0.0595	0.0582	0.0580	0.0570
0.220	0.0582	0.0591	0.0591	0.0605	0.0615	0.0622	0.0627	0.0631
0.225	0.0638	0.0638	0.0634	0.0624	0.0618	0.0602	0.0602	0.0592

0.230	0.0605	0.0612	0.0613	0.0628	0.0646	0.0646	0.0650	0.0650
0.235	0.0665	0.0662	0.0661	0.0646	0.0640	0.0628	0.0627	0.0614
0.240	0.0633	0.0638	0.0645	0.0655	0.0664	0.0680	0.0683	0.0687
0.245	0.0717	0.0715	0.0715	0.0685	0.0677	0.0669	0.0658	0.0652
0.250	0.0675	0.0681	0.0699	0.0705	0.0715	0.0736	0.0744	0.0745
0.255	0.0789	0.0782	0.0780	0.0744	0.0739	0.0735	0.0709	0.0698
0.260	0.0736	0.0745	0.0779	0.0790	0.0792	0.0835	0.0844	0.0853
0.265	0.0947	0.0941	0.0928	0.0877	0.0863	0.0856	0.0798	0.0790
0.270	0.0875	0.0876	0.0945	0.0959	0.0960	0.1009	0.1012	0.1014
0.275	0.1089	0.1089	0.1082	0.1046	0.1032	0.1022	0.0970	0.0970
0.280	0.1046	0.1052	0.1075	0.1081	0.1104	0.1105	0.1112	0.1113
0.285	0.1132	0.1132	0.1130	0.1128	0.1107	0.1103	0.1092	0.1078
0.290	0.1096	0.1107	0.1112	0.1134	0.1143	0.1145	0.1145	0.1148
0.295	0.1164	0.1159	0.1154	0.1147	0.1142	0.1121	0.1119	0.1111
0.300	0.1125	0.1131	0.1132	0.1151	0.1156	0.1161	0.1168	0.1179
0.305	0.1191	0.1173	0.1170	0.1158	0.1154	0.1139	0.1138	0.1136
0.310	0.1088	0.1136	0.1140	0.1142	0.1144	0.1146	0.1156	0.1175
0.315	0.1147	0.1138	0.1087	0.1067	0.0991	0.0974	0.0949	0.0915
0.320	0.0809	0.0830	0.0831	0.0846	0.0907	0.0920	0.0979	0.0981
0.325	0.0847	0.0825	0.0816	0.0813	0.0800	0.0792	0.0781	0.0768
0.330	0.0748	0.0764	0.0765	0.0773	0.0780	0.0782	0.0784	0.0786
0.335	0.0771	0.0769	0.0767	0.0762	0.0761	0.0755	0.0747	0.0734
0.340	0.0725	0.0734	0.0750	0.0754	0.0757	0.0758	0.0759	0.0765
0.345	0.0763	0.0759	0.0757	0.0753	0.0751	0.0744	0.0724	0.0723
0.350	0.0720	0.0725	0.0741	0.0748	0.0753	0.0755	0.0755	0.0762
0.355	0.0759	0.0753	0.0753	0.0750	0.0746	0.0740	0.0725	0.0719
0.360	0.0719	0.0726	0.0739	0.0745	0.0749	0.0750	0.0752	0.0761
0.365	0.0756	0.0755	0.0751	0.0745	0.0744	0.0735	0.0723	0.0718
0.370	0.0716	0.0722	0.0740	0.0743	0.0749	0.0751	0.0753	0.0754
0.375	0.0753	0.0753	0.0750	0.0749	0.0743	0.0737	0.0721	0.0717
0.380	0.0714	0.0722	0.0737	0.0741	0.0749	0.0750	0.0753	0.0756
0.385	0.0755	0.0751	0.0749	0.0749	0.0740	0.0736	0.0722	0.0715
0.390	0.0714	0.0719	0.0737	0.0741	0.0748	0.0750	0.0750	0.0753
0.395	0.0754	0.0754	0.0751	0.0750	0.0746	0.0739	0.0721	0.0715
0.400	0.0722	0.0723	0.0740	0.0754	0.0755	0.0759	0.0760	0.0761
0.405	0.0773	0.0770	0.0765	0.0763	0.0762	0.0747	0.0732	0.0727
0.410	0.0737	0.0744	0.0754	0.0772	0.0773	0.0776	0.0781	0.0788
0.415	0.0797	0.0792	0.0784	0.0784	0.0780	0.0766	0.0755	0.0754
0.420	0.0757	0.0765	0.0772	0.0793	0.0794	0.0797	0.0807	0.0807
0.425	0.0817	0.0817	0.0810	0.0808	0.0805	0.0784	0.0777	0.0771
0.430	0.0781	0.0789	0.0796	0.0811	0.0817	0.0820	0.0825	0.0827
0.435	0.0837	0.0836	0.0830	0.0830	0.0829	0.0808	0.0800	0.0792
0.440	0.0805	0.0811	0.0820	0.0842	0.0842	0.0849	0.0850	0.0850
0.445	0.0861	0.0860	0.0854	0.0853	0.0851	0.0832	0.0823	0.0813

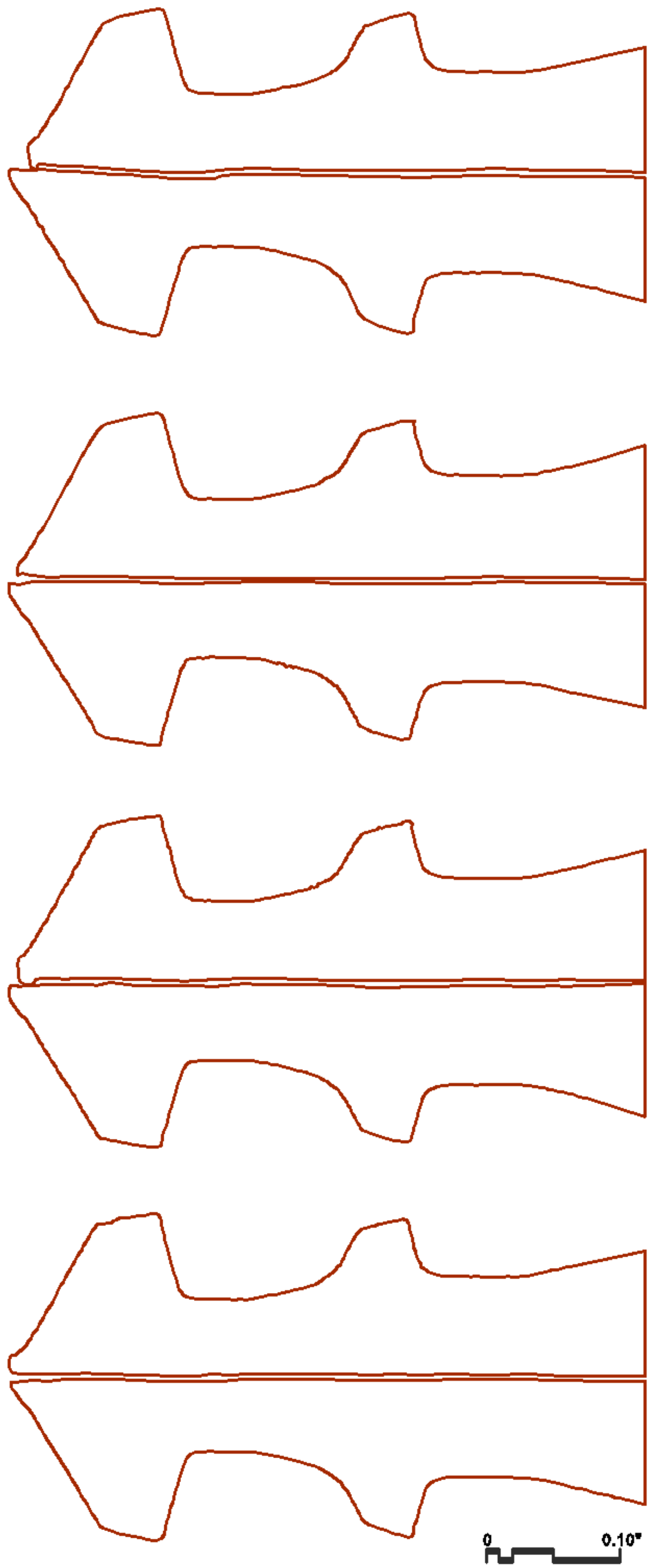


Figure B.29 As-Built 0.104 in. Tube-B Coined Pressed-End CAD Generation - Step 4

Figure B.30 As-Built 0.104 in. Tube-B Coined Pressed-End Profiles Generation - Step 5

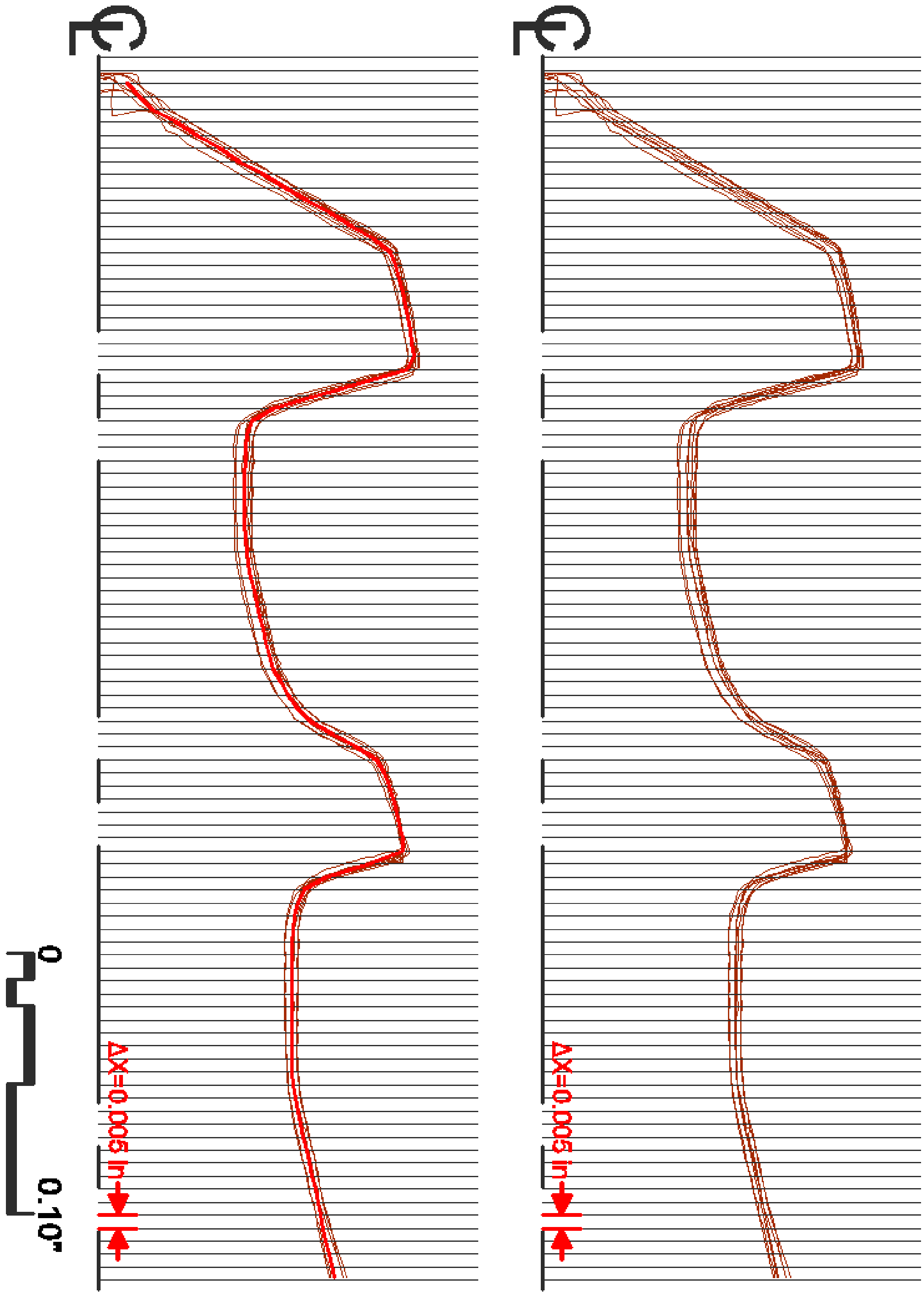


Figure B.31 As-Built 0.104 in. Tube-B Coined Pressed-End Divided Profiles & Mean Profile - Step 6

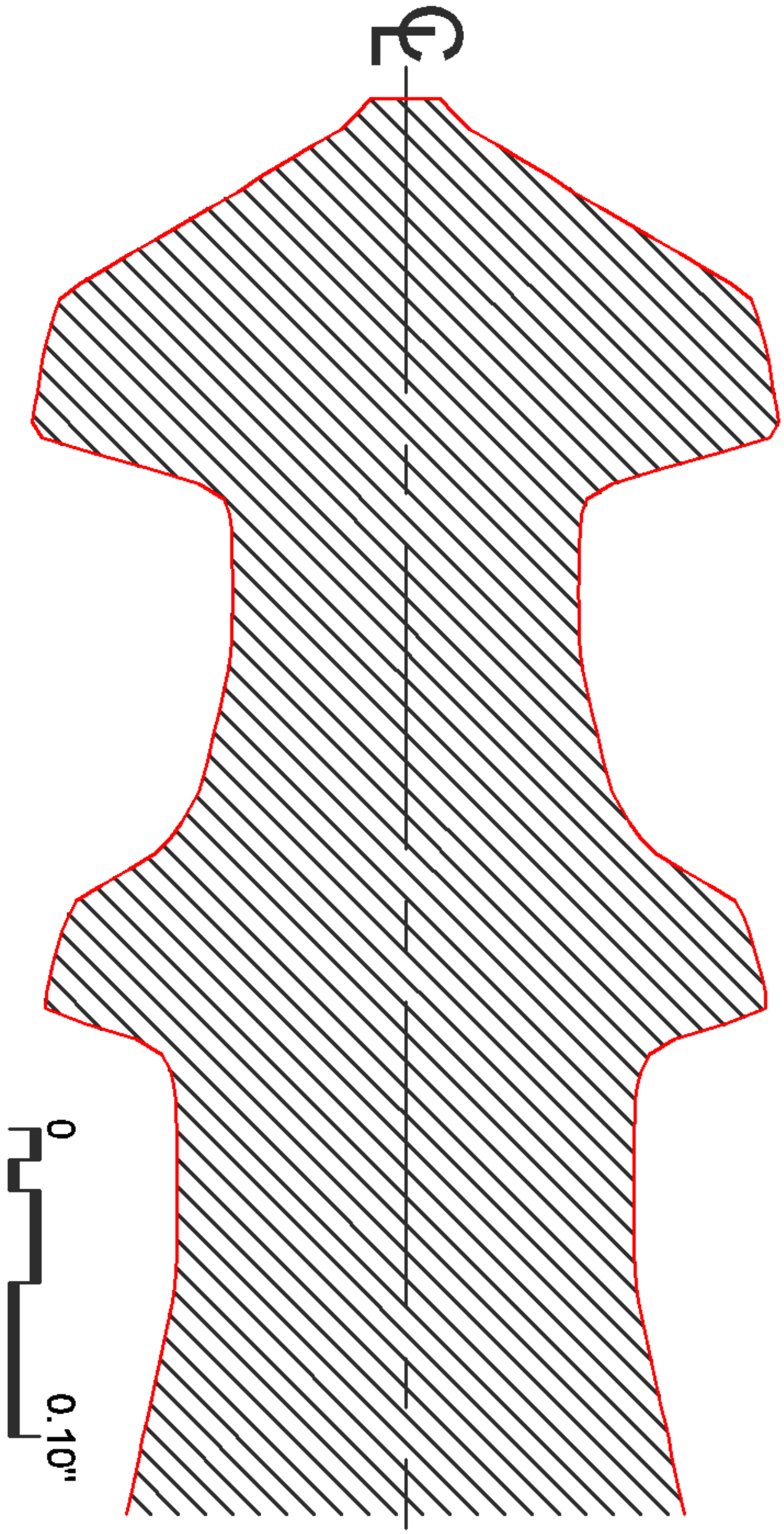


Figure B.32 As-Built 0.104 in. Tube-B Coined Pressed-End Representative Profile - Step 7

Table B.8 As-Built 0.104 in. Tube-B Coined Pressed-End XY Coordinates

X-Axis	Y-Axis							
0.000	0.0157	0.0155	0.0143	0.0078	0.0074	0.0059		
0.005	0.0052	0.0120	0.0143	0.0147	0.0172	0.0196	0.0209	0.0216
0.010	0.0277	0.0266	0.0247	0.0224	0.0205	0.0197	0.0189	0.0051
0.015	0.0243	0.0264	0.0270	0.0285	0.0300	0.0327	0.0349	0.0352
0.020	0.0435	0.0431	0.0406	0.0384	0.0370	0.0352	0.0350	0.0305
0.025	0.0375	0.0434	0.0437	0.0462	0.0465	0.0496	0.0515	0.0520
0.030	0.0596	0.0592	0.0576	0.0552	0.0534	0.0524	0.0519	0.0461
0.035	0.0545	0.0599	0.0618	0.0622	0.0646	0.0673	0.0674	0.0681
0.040	0.0771	0.0757	0.0751	0.0729	0.0707	0.0705	0.0681	0.0638
0.045	0.0732	0.0763	0.0776	0.0801	0.0826	0.0828	0.0837	0.0858
0.050	0.0936	0.0927	0.0916	0.0913	0.0891	0.0872	0.0850	0.0823
0.055	0.0907	0.0929	0.0949	0.0987	0.0995	0.1001	0.1006	0.1028
0.060	0.1105	0.1101	0.1090	0.1076	0.1065	0.1029	0.1015	0.0999
0.065	0.1088	0.1090	0.1093	0.1133	0.1141	0.1141	0.1145	0.1152
0.070	0.1165	0.1160	0.1154	0.1154	0.1146	0.1127	0.1113	0.1111
0.075	0.1125	0.1129	0.1149	0.1161	0.1165	0.1165	0.1169	0.1176
0.080	0.1188	0.1184	0.1184	0.1176	0.1175	0.1163	0.1145	0.1137
0.085	0.1151	0.1155	0.1173	0.1184	0.1186	0.1186	0.1196	0.1200
0.090	0.1208	0.1205	0.1194	0.1193	0.1193	0.1184	0.1165	0.1162
0.095	0.1172	0.1173	0.1194	0.1199	0.1199	0.1200	0.1213	0.1216
0.100	0.1221	0.1221	0.1212	0.1209	0.1206	0.1203	0.1182	0.1181
0.105	0.1188	0.1190	0.1209	0.1213	0.1215	0.1219	0.1227	0.1231
0.110	0.1222	0.1214	0.1206	0.1185	0.1181	0.1172	0.1146	0.1131
0.115	0.0938	0.0972	0.0979	0.1001	0.1011	0.1021	0.1079	0.1121
0.120	0.0920	0.0881	0.0849	0.0834	0.0823	0.0813	0.0799	0.0756
0.125	0.0627	0.0635	0.0646	0.0664	0.0675	0.0682	0.0711	0.0740
0.130	0.0623	0.0621	0.0617	0.0590	0.0584	0.0574	0.0567	0.0549
0.135	0.0527	0.0535	0.0566	0.0569	0.0582	0.0597	0.0597	0.0597
0.140	0.0596	0.0590	0.0590	0.0578	0.0563	0.0562	0.0529	0.0520
0.145	0.0520	0.0527	0.0557	0.0560	0.0577	0.0587	0.0594	0.0596
0.150	0.0591	0.0589	0.0585	0.0576	0.0559	0.0554	0.0526	0.0522
0.155	0.0519	0.0528	0.0556	0.0561	0.0574	0.0583	0.0589	0.0591
0.160	0.0591	0.0588	0.0583	0.0574	0.0560	0.0556	0.0527	0.0518
0.165	0.0521	0.0528	0.0557	0.0559	0.0573	0.0583	0.0589	0.0591
0.170	0.0590	0.0588	0.0581	0.0573	0.0561	0.0559	0.0530	0.0525
0.175	0.0523	0.0532	0.0561	0.0564	0.0572	0.0583	0.0590	0.0591
0.180	0.0594	0.0594	0.0586	0.0582	0.0567	0.0566	0.0534	0.0526
0.185	0.0533	0.0543	0.0573	0.0576	0.0592	0.0593	0.0601	0.0602
0.190	0.0614	0.0613	0.0604	0.0604	0.0584	0.0583	0.0551	0.0544
0.195	0.0553	0.0561	0.0593	0.0597	0.0610	0.0614	0.0622	0.0626
0.200	0.0636	0.0631	0.0625	0.0620	0.0606	0.0604	0.0572	0.0564
0.205	0.0576	0.0584	0.0617	0.0626	0.0632	0.0635	0.0643	0.0646
0.210	0.0659	0.0654	0.0646	0.0644	0.0632	0.0631	0.0596	0.0590
0.215	0.0606	0.0607	0.0640	0.0640	0.0657	0.0657	0.0665	0.0671
0.220	0.0682	0.0680	0.0673	0.0672	0.0655	0.0654	0.0620	0.0619
0.225	0.0630	0.0638	0.0672	0.0673	0.0687	0.0687	0.0695	0.0700

0.230	0.0725	0.0724	0.0718	0.0707	0.0697	0.0697	0.0661	0.0656
0.235	0.0685	0.0690	0.0727	0.0729	0.0732	0.0749	0.0750	0.0752
0.240	0.0794	0.0788	0.0775	0.0769	0.0764	0.0762	0.0723	0.0723
0.245	0.0768	0.0770	0.0802	0.0818	0.0821	0.0825	0.0850	0.0851
0.250	0.0953	0.0942	0.0911	0.0906	0.0895	0.0873	0.0846	0.0838
0.255	0.0933	0.0951	0.0972	0.0991	0.0995	0.1002	0.1026	0.1040
0.260	0.1100	0.1089	0.1080	0.1075	0.1073	0.1056	0.1045	0.1028
0.265	0.1069	0.1081	0.1098	0.1100	0.1102	0.1103	0.1108	0.1112
0.270	0.1126	0.1126	0.1120	0.1119	0.1117	0.1115	0.1105	0.1091
0.275	0.1109	0.1120	0.1127	0.1133	0.1133	0.1135	0.1141	0.1141
0.280	0.1152	0.1152	0.1152	0.1149	0.1148	0.1141	0.1135	0.1126
0.285	0.1143	0.1151	0.1155	0.1160	0.1161	0.1161	0.1162	0.1163
0.290	0.1176	0.1173	0.1173	0.1172	0.1169	0.1166	0.1160	0.1153
0.295	0.1140	0.1166	0.1169	0.1169	0.1170	0.1170	0.1185	0.1191
0.300	0.1123	0.1086	0.1071	0.1036	0.1034	0.1024	0.1020	0.0945
0.305	0.0815	0.0855	0.0862	0.0864	0.0868	0.0899	0.0907	0.0927
0.310	0.0820	0.0819	0.0808	0.0787	0.0786	0.0779	0.0775	0.0759
0.315	0.0737	0.0744	0.0761	0.0762	0.0765	0.0780	0.0785	0.0791
0.320	0.0775	0.0775	0.0765	0.0751	0.0751	0.0749	0.0730	0.0722
0.325	0.0717	0.0719	0.0745	0.0745	0.0748	0.0754	0.0768	0.0770
0.330	0.0772	0.0767	0.0753	0.0746	0.0742	0.0742	0.0716	0.0715
0.335	0.0717	0.0718	0.0742	0.0742	0.0745	0.0751	0.0765	0.0765
0.340	0.0765	0.0765	0.0747	0.0745	0.0744	0.0741	0.0718	0.0716
0.345	0.0716	0.0718	0.0739	0.0745	0.0748	0.0749	0.0765	0.0766
0.350	0.0765	0.0765	0.0750	0.0743	0.0742	0.0740	0.0717	0.0717
0.355	0.0717	0.0718	0.0740	0.0740	0.0743	0.0752	0.0764	0.0767
0.360	0.0765	0.0764	0.0744	0.0743	0.0740	0.0740	0.0719	0.0716
0.365	0.0717	0.0720	0.0740	0.0741	0.0742	0.0744	0.0764	0.0764
0.370	0.0764	0.0764	0.0745	0.0744	0.0742	0.0742	0.0720	0.0719
0.375	0.0721	0.0722	0.0742	0.0744	0.0745	0.0746	0.0764	0.0765
0.380	0.0767	0.0767	0.0748	0.0746	0.0745	0.0745	0.0724	0.0723
0.385	0.0726	0.0728	0.0748	0.0750	0.0750	0.0751	0.0770	0.0774
0.390	0.0778	0.0777	0.0761	0.0761	0.0758	0.0756	0.0734	0.0733
0.395	0.0741	0.0744	0.0764	0.0767	0.0769	0.0773	0.0787	0.0788
0.400	0.0800	0.0797	0.0783	0.0778	0.0777	0.0776	0.0756	0.0750
0.405	0.0762	0.0768	0.0785	0.0789	0.0789	0.0793	0.0807	0.0809
0.410	0.0821	0.0820	0.0808	0.0803	0.0799	0.0796	0.0778	0.0774
0.415	0.0786	0.0787	0.0807	0.0814	0.0816	0.0817	0.0831	0.0834
0.420	0.0844	0.0842	0.0825	0.0822	0.0817	0.0802	0.0799	0.0830

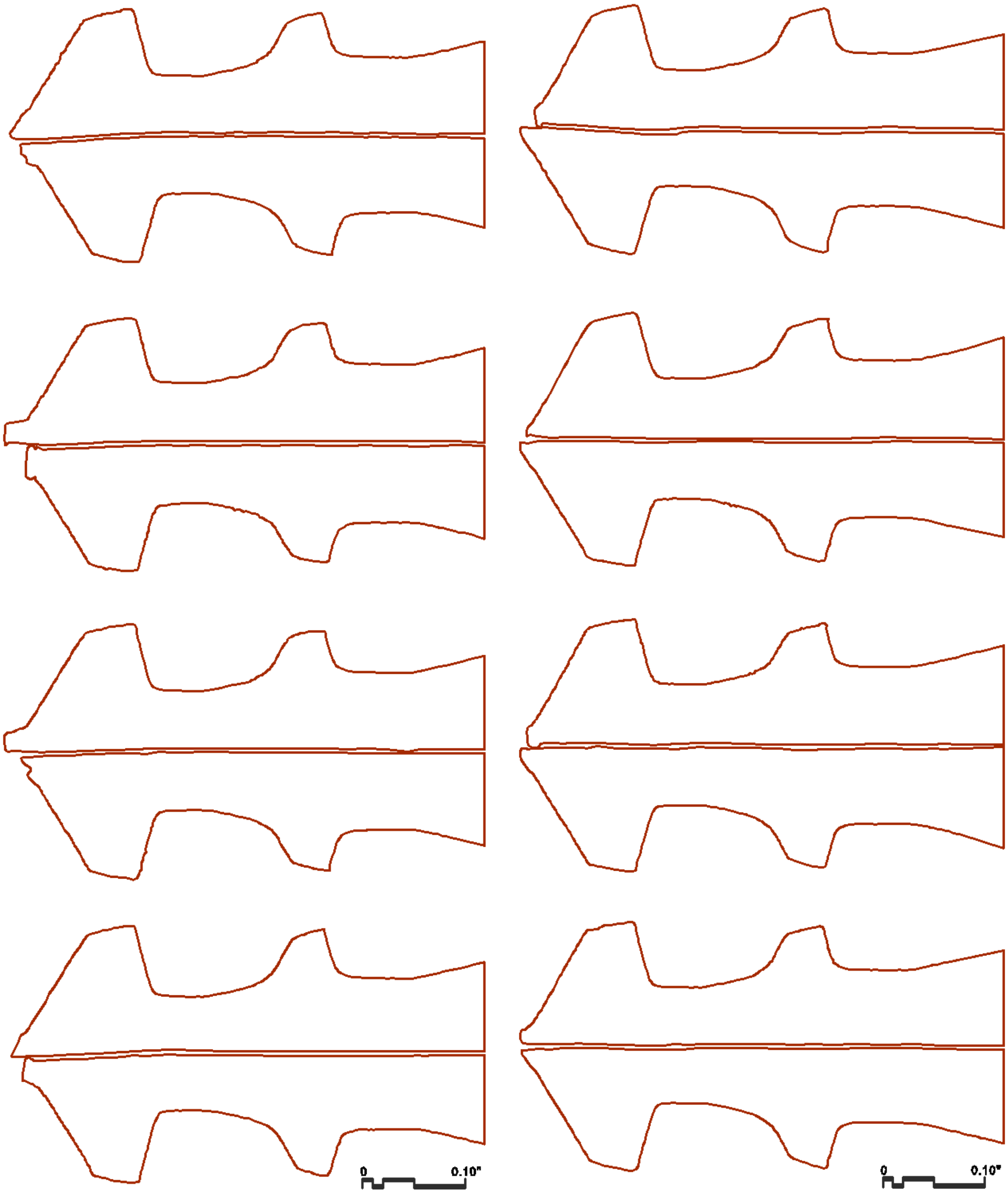


Figure B.33 As-Built 0.104 in. Tube-C Coined Pressed-End CAD Generation - Step 4

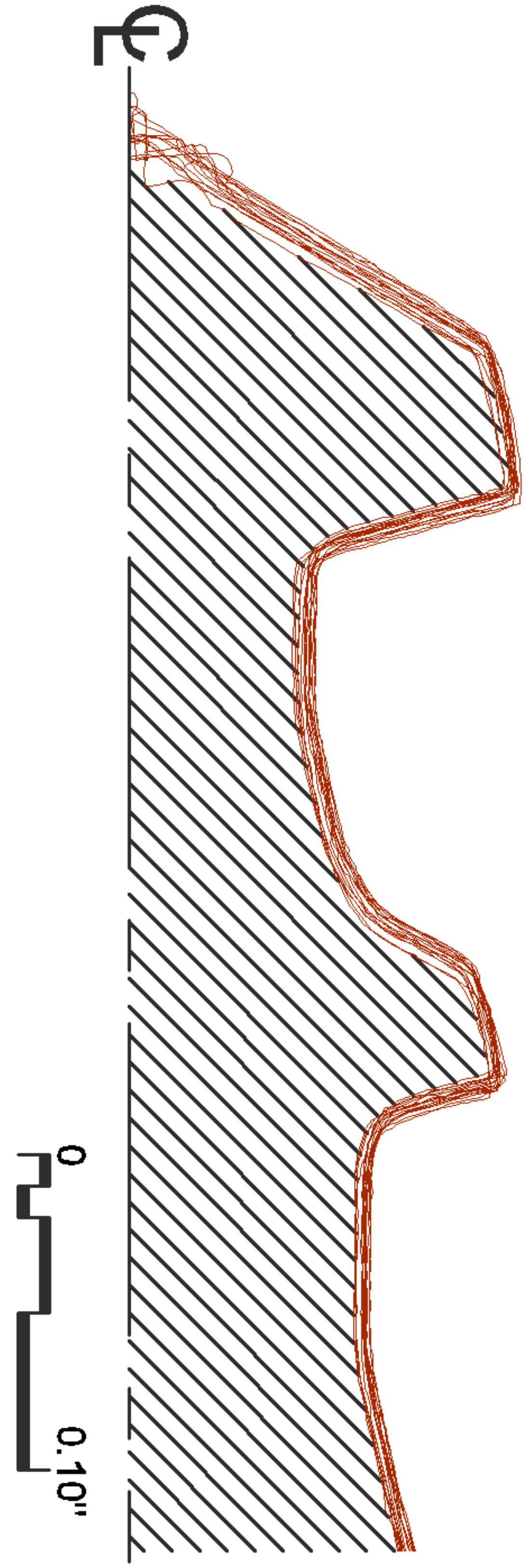


Figure B.34 As-Built 0.104 in. Tube-C Coined Pressed-End Profiles Generation - Step 5

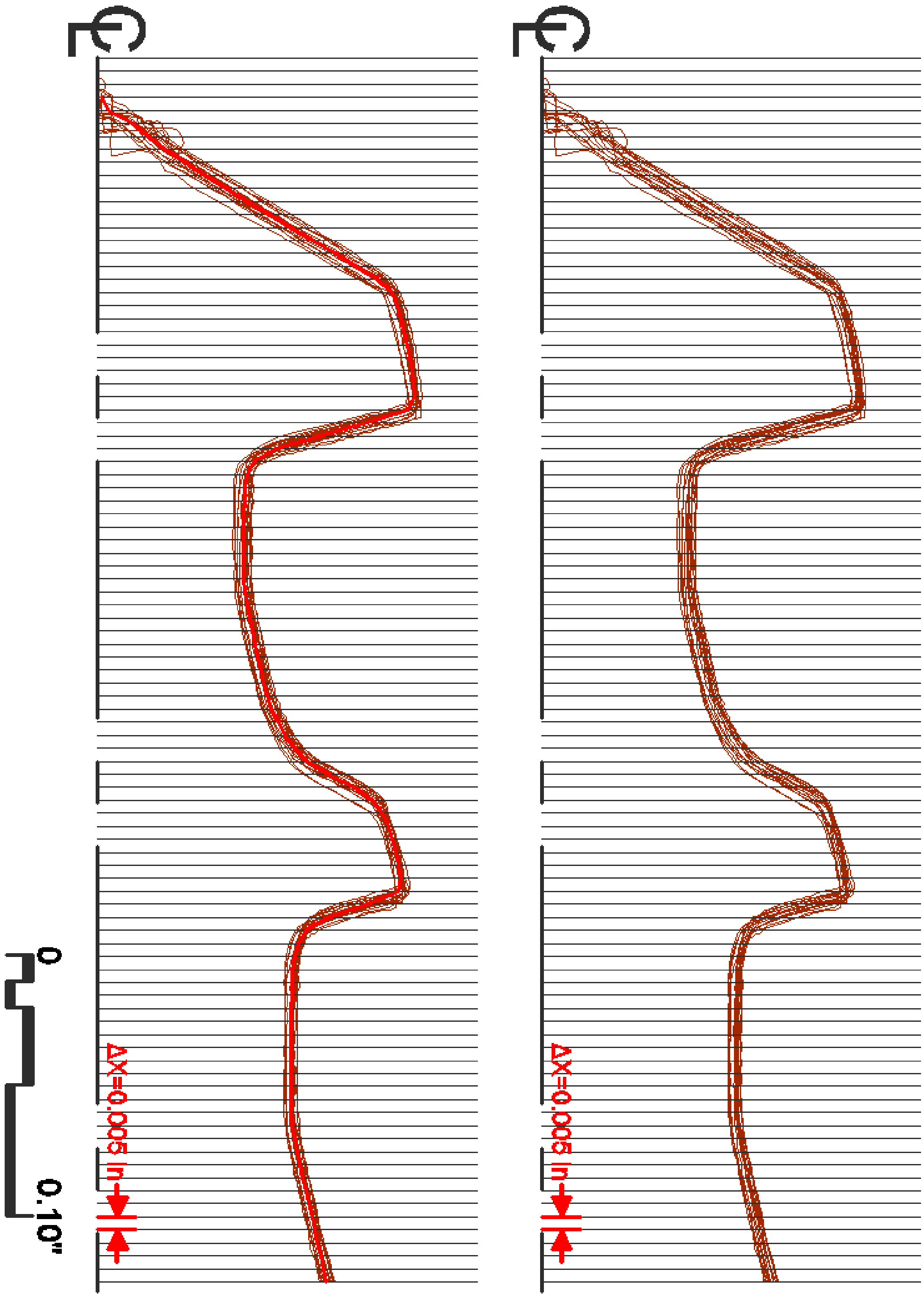


Figure B.35 As-Built 0.104 in. Tube-C Coined Pressed-End Divided Profiles & Mean Profile -

Step 6

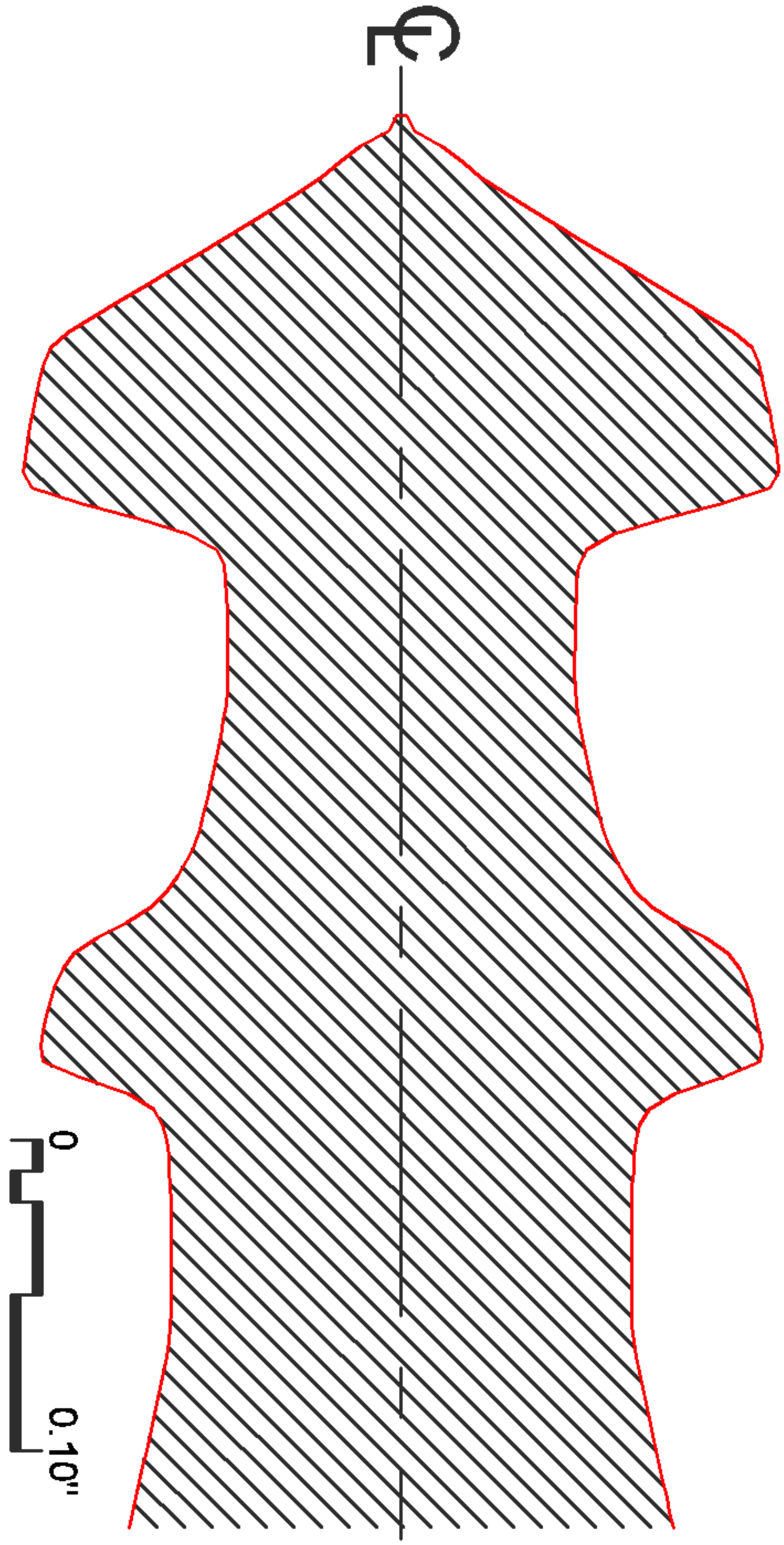


Figure B.36 As-Built 0.104 in. Tube-C Coined Pressed-End Representative Profile - Step 7

Table B.9 As-Built 0.104 in. Tube-C Coined Pressed-End XY Coordinates

X-Axis	Y-Axis							
0.000	0.0216	0.0006	0.0209	0.0026	0.0059	0.0074	0.0078	0.0143
0.005	0.0051	0.0055	0.0189	0.0051	0.0196	0.0046	0.0172	0.0013
0.010	0.0352	0.0011	0.0349	0.0014	0.0197	0.0054	0.0205	0.0055
0.015	0.0305	0.0244	0.0350	0.0209	0.0327	0.0205	0.0300	0.0190
0.020	0.0520	0.0132	0.0515	0.0191	0.0352	0.0224	0.0370	0.0231
0.025	0.0461	0.0329	0.0519	0.0322	0.0496	0.0314	0.0465	0.0313
0.030	0.0681	0.0310	0.0674	0.0323	0.0524	0.0333	0.0534	0.0375
0.035	0.0638	0.0493	0.0681	0.0481	0.0673	0.0467	0.0646	0.0460
0.040	0.0858	0.0452	0.0837	0.0461	0.0705	0.0501	0.0707	0.0518
0.045	0.0823	0.0659	0.0850	0.0640	0.0828	0.0635	0.0826	0.0626
0.050	0.1028	0.0606	0.1006	0.0622	0.0872	0.0658	0.0891	0.0684
0.055	0.0999	0.0823	0.1015	0.0804	0.1001	0.0800	0.0995	0.0792
0.060	0.1152	0.0764	0.1145	0.0783	0.1029	0.0813	0.1065	0.0837
0.065	0.1111	0.0984	0.1113	0.0970	0.1141	0.0968	0.1141	0.0951
0.070	0.1176	0.0931	0.1169	0.0943	0.1127	0.0976	0.1146	0.1001
0.075	0.1137	0.1131	0.1145	0.1116	0.1165	0.1111	0.1165	0.1103
0.080	0.1200	0.1092	0.1196	0.1111	0.1163	0.1127	0.1175	0.1145
0.085	0.1162	0.1178	0.1165	0.1176	0.1186	0.1164	0.1186	0.1162
0.090	0.1216	0.1153	0.1213	0.1162	0.1184	0.1165	0.1193	0.1171
0.095	0.1181	0.1206	0.1182	0.1202	0.1200	0.1194	0.1199	0.1187
0.100	0.1231	0.1173	0.1227	0.1186	0.1203	0.1188	0.1206	0.1198
0.105	0.1131	0.1224	0.1146	0.1213	0.1219	0.1210	0.1215	0.1208
0.110	0.1121	0.1198	0.1079	0.1201	0.1172	0.1207	0.1181	0.1210
0.115	0.0756	0.1239	0.0799	0.1226	0.1021	0.1224	0.1011	0.1219
0.120	0.0740	0.1205	0.0711	0.1212	0.0813	0.1221	0.0823	0.1224
0.125	0.0549	0.1240	0.0567	0.1225	0.0682	0.1221	0.0675	0.1221
0.130	0.0597	0.0908	0.0597	0.0971	0.0574	0.0983	0.0584	0.0996
0.135	0.0520	0.0985	0.0529	0.0963	0.0597	0.0914	0.0582	0.0899
0.140	0.0596	0.0609	0.0594	0.0631	0.0562	0.0635	0.0563	0.0651
0.145	0.0522	0.0641	0.0526	0.0624	0.0587	0.0612	0.0577	0.0609
0.150	0.0591	0.0549	0.0589	0.0556	0.0554	0.0571	0.0559	0.0574
0.155	0.0518	0.0583	0.0527	0.0581	0.0583	0.0578	0.0574	0.0566
0.160	0.0591	0.0540	0.0589	0.0543	0.0556	0.0554	0.0560	0.0564
0.165	0.0525	0.0577	0.0530	0.0575	0.0583	0.0568	0.0573	0.0567
0.170	0.0591	0.0537	0.0590	0.0538	0.0559	0.0550	0.0561	0.0560
0.175	0.0526	0.0577	0.0534	0.0570	0.0583	0.0564	0.0572	0.0563
0.180	0.0602	0.0535	0.0601	0.0537	0.0566	0.0547	0.0567	0.0556
0.185	0.0544	0.0576	0.0551	0.0570	0.0593	0.0562	0.0592	0.0561
0.190	0.0626	0.0536	0.0622	0.0541	0.0583	0.0548	0.0584	0.0558
0.195	0.0564	0.0581	0.0572	0.0578	0.0614	0.0572	0.0610	0.0565
0.200	0.0646	0.0546	0.0643	0.0551	0.0604	0.0556	0.0606	0.0566
0.205	0.0590	0.0599	0.0596	0.0597	0.0635	0.0593	0.0632	0.0582
0.210	0.0671	0.0560	0.0665	0.0570	0.0631	0.0572	0.0632	0.0588
0.215	0.0619	0.0622	0.0620	0.0617	0.0657	0.0609	0.0657	0.0603
0.220	0.0700	0.0582	0.0695	0.0591	0.0654	0.0591	0.0655	0.0605

0.225	0.0656	0.0638	0.0661	0.0638	0.0687	0.0634	0.0687	0.0624
0.230	0.0752	0.0605	0.0750	0.0612	0.0697	0.0613	0.0697	0.0628
0.235	0.0723	0.0665	0.0723	0.0662	0.0749	0.0661	0.0732	0.0646
0.240	0.0851	0.0633	0.0850	0.0638	0.0762	0.0645	0.0764	0.0655
0.245	0.0838	0.0717	0.0846	0.0715	0.0825	0.0715	0.0821	0.0685
0.250	0.1040	0.0675	0.1026	0.0681	0.0873	0.0699	0.0895	0.0705
0.255	0.1028	0.0789	0.1045	0.0782	0.1002	0.0780	0.0995	0.0744
0.260	0.1112	0.0736	0.1108	0.0745	0.1056	0.0779	0.1073	0.0790
0.265	0.1091	0.0947	0.1105	0.0941	0.1103	0.0928	0.1102	0.0877
0.270	0.1141	0.0875	0.1141	0.0876	0.1115	0.0945	0.1117	0.0959
0.275	0.1126	0.1089	0.1135	0.1089	0.1135	0.1082	0.1133	0.1046
0.280	0.1163	0.1046	0.1162	0.1052	0.1141	0.1075	0.1148	0.1081
0.285	0.1153	0.1132	0.1160	0.1132	0.1161	0.1130	0.1161	0.1128
0.290	0.1191	0.1096	0.1185	0.1107	0.1166	0.1112	0.1169	0.1134
0.295	0.0945	0.1164	0.1020	0.1159	0.1170	0.1154	0.1170	0.1147
0.300	0.0927	0.1125	0.0907	0.1131	0.1024	0.1132	0.1034	0.1151
0.305	0.0759	0.1191	0.0775	0.1173	0.0899	0.1170	0.0868	0.1158
0.310	0.0791	0.1088	0.0785	0.1136	0.0779	0.1140	0.0786	0.1142
0.315	0.0722	0.1147	0.0730	0.1138	0.0780	0.1087	0.0765	0.1067
0.320	0.0770	0.0809	0.0768	0.0830	0.0749	0.0831	0.0751	0.0846
0.325	0.0715	0.0847	0.0716	0.0825	0.0754	0.0816	0.0748	0.0813
0.330	0.0765	0.0748	0.0765	0.0764	0.0742	0.0765	0.0742	0.0773
0.335	0.0716	0.0771	0.0718	0.0769	0.0751	0.0767	0.0745	0.0762
0.340	0.0766	0.0725	0.0765	0.0734	0.0741	0.0750	0.0744	0.0754
0.345	0.0717	0.0763	0.0717	0.0759	0.0749	0.0757	0.0748	0.0753
0.350	0.0767	0.0720	0.0764	0.0725	0.0740	0.0741	0.0742	0.0748
0.355	0.0716	0.0759	0.0719	0.0753	0.0752	0.0753	0.0743	0.0750
0.360	0.0764	0.0719	0.0764	0.0726	0.0740	0.0739	0.0740	0.0745
0.365	0.0719	0.0756	0.0720	0.0755	0.0744	0.0751	0.0742	0.0745
0.370	0.0765	0.0716	0.0764	0.0722	0.0742	0.0740	0.0742	0.0743
0.375	0.0723	0.0753	0.0724	0.0753	0.0746	0.0750	0.0745	0.0749
0.380	0.0774	0.0714	0.0770	0.0722	0.0745	0.0737	0.0745	0.0741
0.385	0.0733	0.0755	0.0734	0.0751	0.0751	0.0749	0.0750	0.0749
0.390	0.0788	0.0714	0.0787	0.0719	0.0756	0.0737	0.0758	0.0741
0.395	0.0750	0.0754	0.0756	0.0754	0.0773	0.0751	0.0769	0.0750
0.400	0.0809	0.0722	0.0807	0.0723	0.0776	0.0740	0.0777	0.0754
0.405	0.0774	0.0773	0.0778	0.0770	0.0793	0.0765	0.0789	0.0763
0.410	0.0834	0.0737	0.0831	0.0744	0.0796	0.0754	0.0799	0.0772
0.415	0.0830	0.0797	0.0799	0.0792	0.0817	0.0784	0.0816	0.0784
0.420	0.0757	0.0765	0.0802	0.0772	0.0817	0.0793	0.0822	0.0794

X-Axis	Y-Axis							
0.000	0.0155	0.0157						
0.005	0.0147	0.0009	0.0143	0.0006	0.0120	0.0052		
0.010	0.0224	0.0096	0.0247	0.0125	0.0266	0.0277		
0.015	0.0285	0.0179	0.0270	0.0172	0.0264	0.0151	0.0243	0.0093
0.020	0.0384	0.0234	0.0406	0.0236	0.0431	0.0257	0.0435	0.0260
0.025	0.0462	0.0305	0.0437	0.0289	0.0434	0.0286	0.0375	0.0276
0.030	0.0552	0.0381	0.0576	0.0392	0.0592	0.0399	0.0596	0.0410
0.035	0.0622	0.0440	0.0618	0.0416	0.0599	0.0388	0.0545	0.0376
0.040	0.0729	0.0555	0.0751	0.0557	0.0757	0.0559	0.0771	0.0576
0.045	0.0801	0.0600	0.0776	0.0578	0.0763	0.0540	0.0732	0.0526
0.050	0.0913	0.0704	0.0916	0.0716	0.0927	0.0717	0.0936	0.0743
0.055	0.0987	0.0760	0.0949	0.0744	0.0929	0.0698	0.0907	0.0692
0.060	0.1076	0.0880	0.1090	0.0886	0.1101	0.0886	0.1105	0.0900
0.065	0.1133	0.0914	0.1093	0.0900	0.1090	0.0860	0.1088	0.0846
0.070	0.1154	0.1027	0.1154	0.1039	0.1160	0.1052	0.1165	0.1059
0.075	0.1161	0.1085	0.1149	0.1081	0.1129	0.1022	0.1125	0.1013
0.080	0.1176	0.1147	0.1184	0.1148	0.1184	0.1150	0.1188	0.1158
0.085	0.1184	0.1160	0.1173	0.1156	0.1155	0.1147	0.1151	0.1141
0.090	0.1193	0.1173	0.1194	0.1181	0.1205	0.1190	0.1208	0.1190
0.095	0.1199	0.1183	0.1194	0.1179	0.1173	0.1174	0.1172	0.1167
0.100	0.1209	0.1198	0.1212	0.1204	0.1221	0.1204	0.1221	0.1216
0.105	0.1213	0.1201	0.1209	0.1197	0.1190	0.1195	0.1188	0.1185
0.110	0.1185	0.1218	0.1206	0.1220	0.1214	0.1221	0.1222	0.1232
0.115	0.1001	0.1219	0.0979	0.1217	0.0972	0.1211	0.0938	0.1205
0.120	0.0834	0.1226	0.0849	0.1228	0.0881	0.1232	0.0920	0.1243
0.125	0.0664	0.1188	0.0646	0.1187	0.0635	0.1181	0.0627	0.1102
0.130	0.0590	0.1078	0.0617	0.1143	0.0621	0.1155	0.0623	0.1179
0.135	0.0569	0.0807	0.0566	0.0796	0.0535	0.0772	0.0527	0.0711
0.140	0.0578	0.0709	0.0590	0.0729	0.0590	0.0782	0.0596	0.0807
0.145	0.0560	0.0598	0.0557	0.0594	0.0527	0.0571	0.0520	0.0564
0.150	0.0576	0.0578	0.0585	0.0581	0.0589	0.0583	0.0591	0.0586
0.155	0.0561	0.0563	0.0556	0.0561	0.0528	0.0545	0.0519	0.0545
0.160	0.0574	0.0564	0.0583	0.0567	0.0588	0.0577	0.0591	0.0579
0.165	0.0559	0.0561	0.0557	0.0552	0.0528	0.0538	0.0521	0.0538
0.170	0.0573	0.0565	0.0581	0.0565	0.0588	0.0572	0.0590	0.0577
0.175	0.0564	0.0557	0.0561	0.0550	0.0532	0.0536	0.0523	0.0536
0.180	0.0582	0.0560	0.0586	0.0563	0.0594	0.0570	0.0594	0.0574
0.185	0.0576	0.0555	0.0573	0.0546	0.0543	0.0538	0.0533	0.0537
0.190	0.0604	0.0561	0.0604	0.0562	0.0613	0.0571	0.0614	0.0574
0.195	0.0597	0.0562	0.0593	0.0550	0.0561	0.0543	0.0553	0.0540
0.200	0.0620	0.0575	0.0625	0.0581	0.0631	0.0587	0.0636	0.0590
0.205	0.0626	0.0573	0.0617	0.0561	0.0584	0.0559	0.0576	0.0551
0.210	0.0644	0.0591	0.0646	0.0603	0.0654	0.0606	0.0659	0.0609
0.215	0.0640	0.0595	0.0640	0.0582	0.0607	0.0580	0.0606	0.0570
0.220	0.0672	0.0615	0.0673	0.0622	0.0680	0.0627	0.0682	0.0631
0.225	0.0673	0.0618	0.0672	0.0602	0.0638	0.0602	0.0630	0.0592
0.230	0.0707	0.0646	0.0718	0.0646	0.0724	0.0650	0.0725	0.0650
0.235	0.0729	0.0640	0.0727	0.0628	0.0690	0.0627	0.0685	0.0614
0.240	0.0769	0.0664	0.0775	0.0680	0.0788	0.0683	0.0794	0.0687

0.245	0.0818	0.0677	0.0802	0.0669	0.0770	0.0658	0.0768	0.0652
0.250	0.0906	0.0715	0.0911	0.0736	0.0942	0.0744	0.0953	0.0745
0.255	0.0991	0.0739	0.0972	0.0735	0.0951	0.0709	0.0933	0.0698
0.260	0.1075	0.0792	0.1080	0.0835	0.1089	0.0844	0.1100	0.0853
0.265	0.1100	0.0863	0.1098	0.0856	0.1081	0.0798	0.1069	0.0790
0.270	0.1119	0.0960	0.1120	0.1009	0.1126	0.1012	0.1126	0.1014
0.275	0.1133	0.1032	0.1127	0.1022	0.1120	0.0970	0.1109	0.0970
0.280	0.1149	0.1104	0.1152	0.1105	0.1152	0.1112	0.1152	0.1113
0.285	0.1160	0.1107	0.1155	0.1103	0.1151	0.1092	0.1143	0.1078
0.290	0.1172	0.1143	0.1173	0.1145	0.1173	0.1145	0.1176	0.1148
0.295	0.1169	0.1142	0.1169	0.1121	0.1166	0.1119	0.1140	0.1111
0.300	0.1036	0.1156	0.1071	0.1161	0.1086	0.1168	0.1123	0.1179
0.305	0.0864	0.1154	0.0862	0.1139	0.0855	0.1138	0.0815	0.1136
0.310	0.0787	0.1144	0.0808	0.1146	0.0819	0.1156	0.0820	0.1175
0.315	0.0762	0.0991	0.0761	0.0974	0.0744	0.0949	0.0737	0.0915
0.320	0.0751	0.0907	0.0765	0.0920	0.0775	0.0979	0.0775	0.0981
0.325	0.0745	0.0800	0.0745	0.0792	0.0719	0.0781	0.0717	0.0768
0.330	0.0746	0.0780	0.0753	0.0782	0.0767	0.0784	0.0772	0.0786
0.335	0.0742	0.0761	0.0742	0.0755	0.0718	0.0747	0.0717	0.0734
0.340	0.0745	0.0757	0.0747	0.0758	0.0765	0.0759	0.0765	0.0765
0.345	0.0745	0.0751	0.0739	0.0744	0.0718	0.0724	0.0716	0.0723
0.350	0.0743	0.0753	0.0750	0.0755	0.0765	0.0755	0.0765	0.0762
0.355	0.0740	0.0746	0.0740	0.0740	0.0718	0.0725	0.0717	0.0719
0.360	0.0743	0.0749	0.0744	0.0750	0.0764	0.0752	0.0765	0.0761
0.365	0.0741	0.0744	0.0740	0.0735	0.0720	0.0723	0.0717	0.0718
0.370	0.0744	0.0749	0.0745	0.0751	0.0764	0.0753	0.0764	0.0754
0.375	0.0744	0.0743	0.0742	0.0737	0.0722	0.0721	0.0721	0.0717
0.380	0.0746	0.0749	0.0748	0.0750	0.0767	0.0753	0.0767	0.0756
0.385	0.0750	0.0740	0.0748	0.0736	0.0728	0.0722	0.0726	0.0715
0.390	0.0761	0.0748	0.0761	0.0750	0.0777	0.0750	0.0778	0.0753
0.395	0.0767	0.0746	0.0764	0.0739	0.0744	0.0721	0.0741	0.0715
0.400	0.0778	0.0755	0.0783	0.0759	0.0797	0.0760	0.0800	0.0761
0.405	0.0789	0.0762	0.0785	0.0747	0.0768	0.0732	0.0762	0.0727
0.410	0.0803	0.0773	0.0808	0.0776	0.0820	0.0781	0.0821	0.0788
0.415	0.0814	0.0780	0.0807	0.0766	0.0787	0.0755	0.0786	0.0754
0.420	0.0825	0.0797	0.0842	0.0807	0.0844	0.0807	0.0802	0.0799

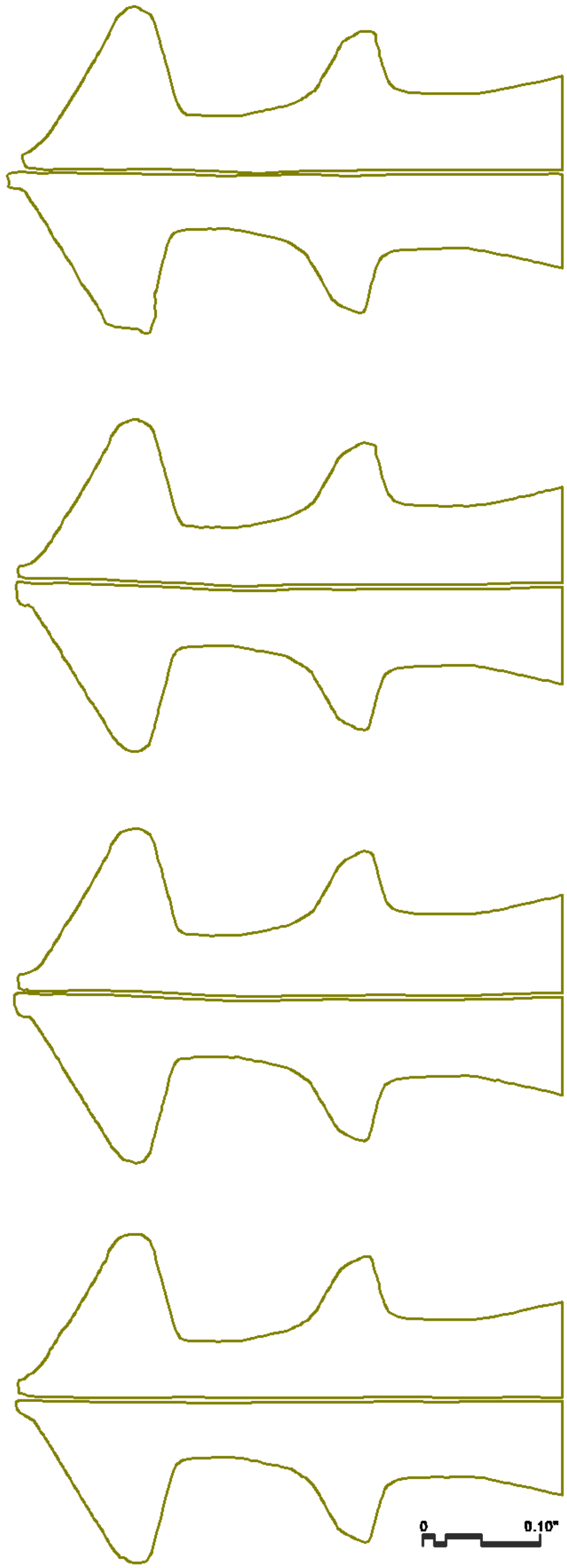


Figure B.37 As-Built 0.120 in. Tube-A Coined Pressed-End CAD Generation - Step 4

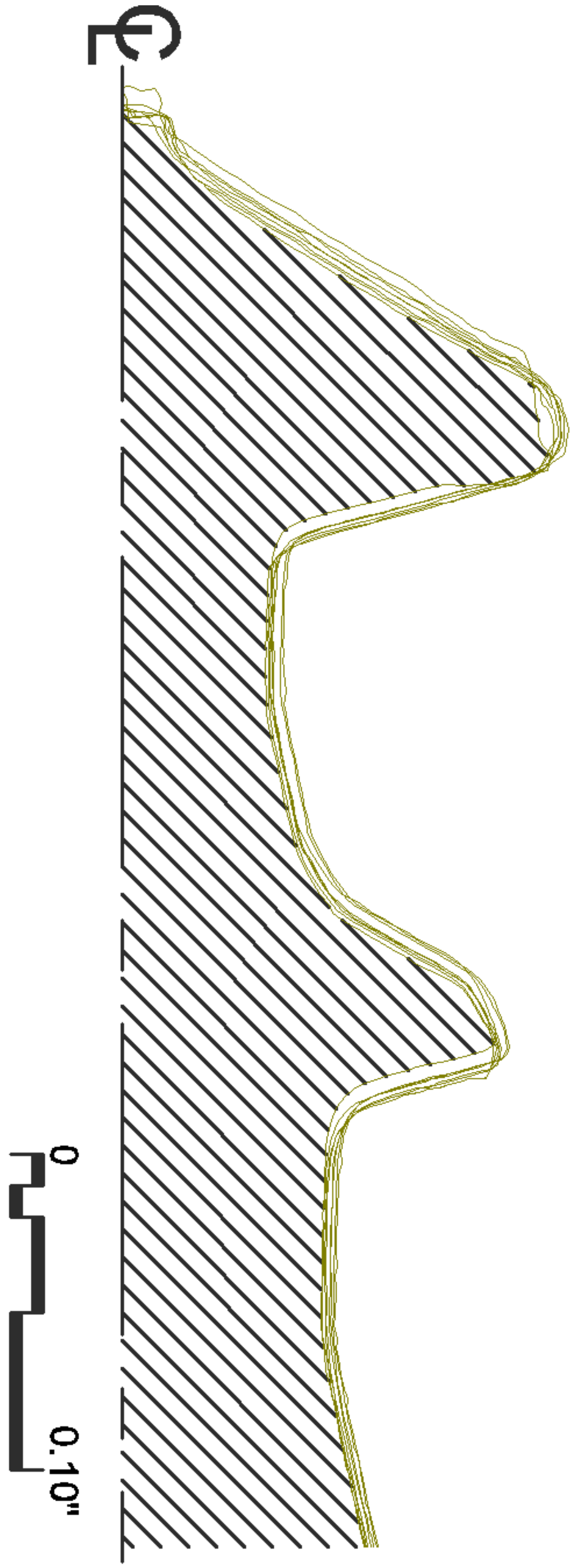


Figure B.38 As-Built 0.120 in. Tube-A Coined Pressed-End Profiles Generation - Step 5

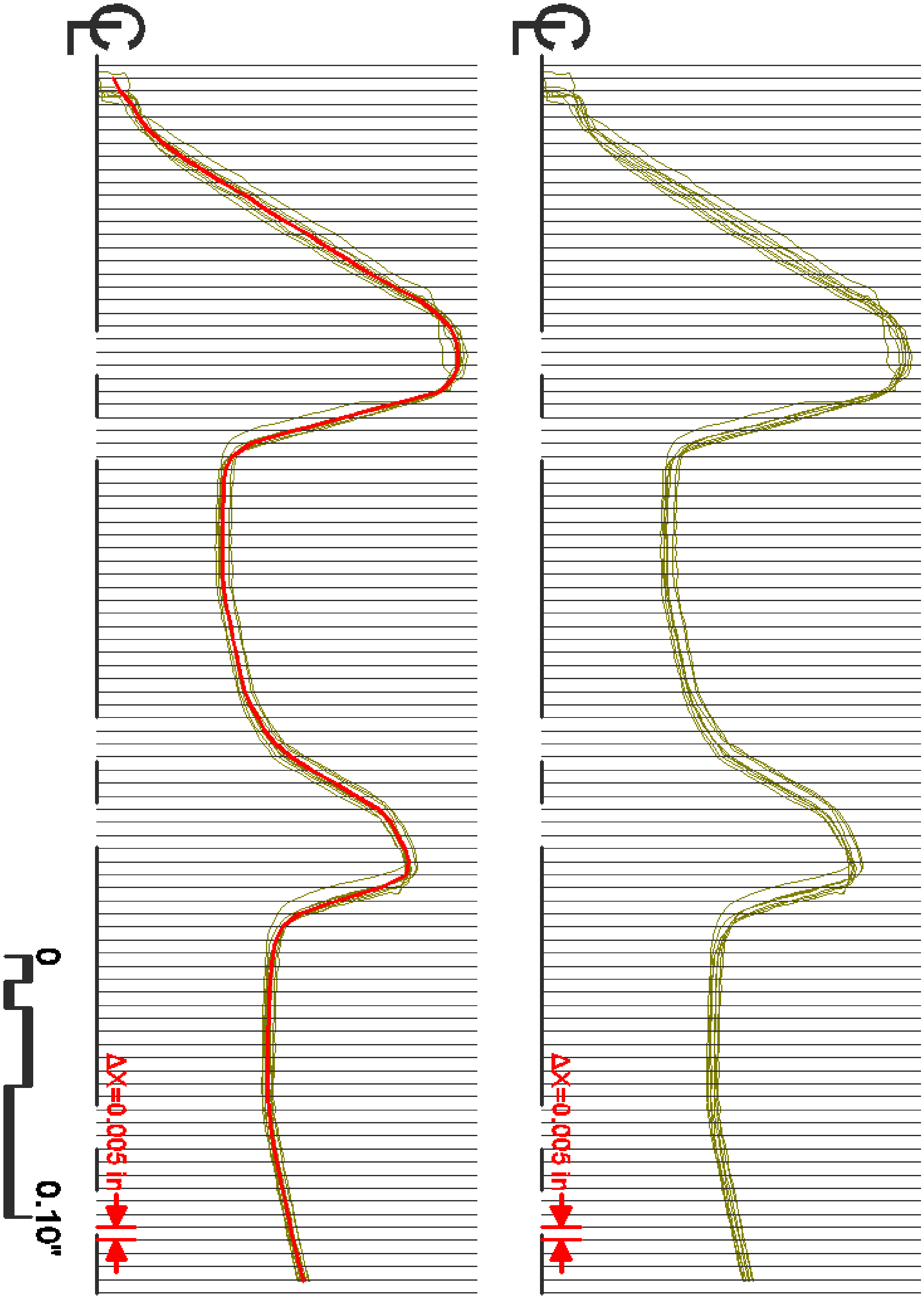


Figure B.39 As-Built 0.120 in. Tube-A Coined Pressed-End Divided Profiles & Mean Profile - Step 6

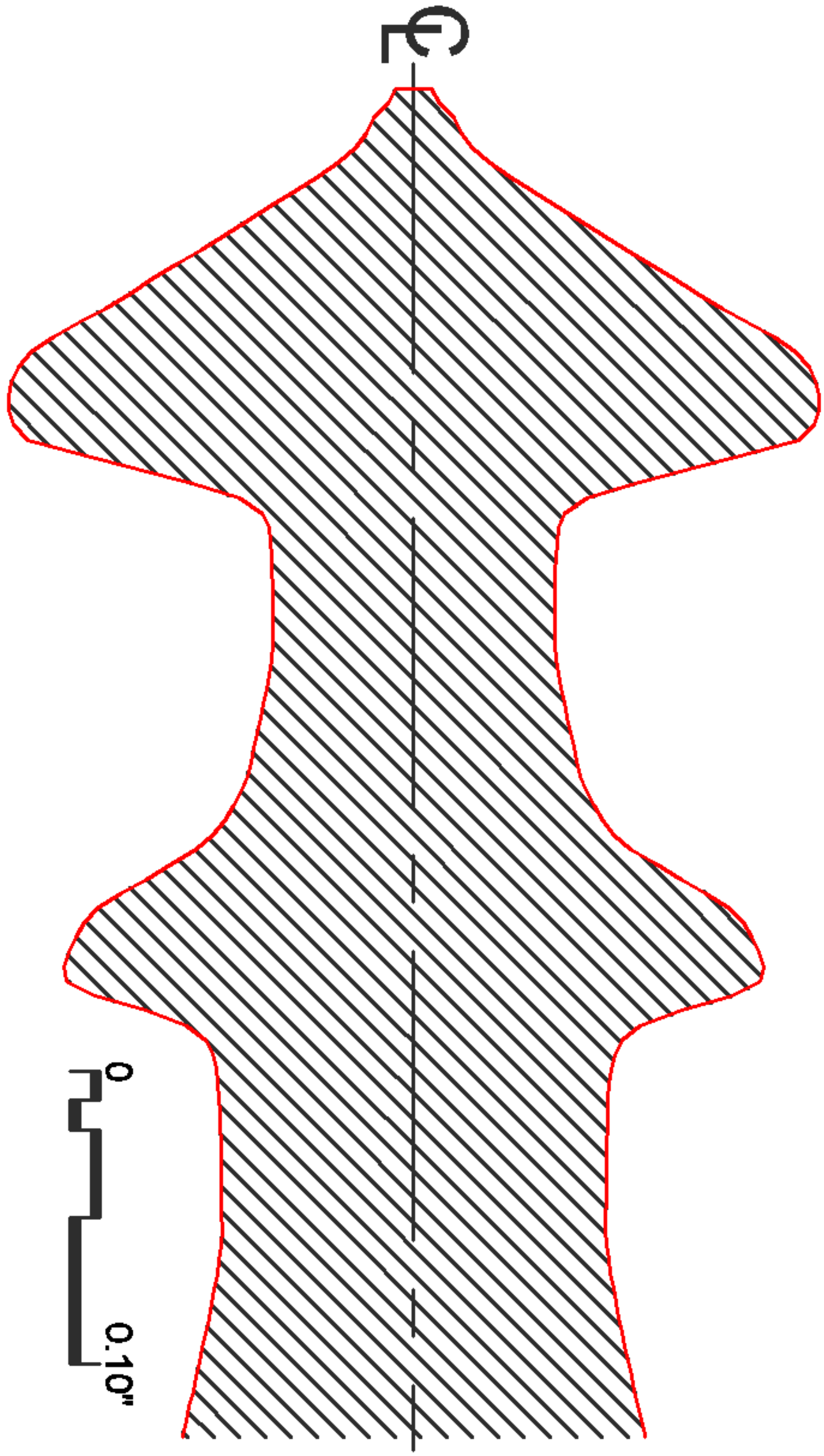


Figure B.40 As-Built 0.120 in. Tube-A Coined Pressed-End Representative Profile - Step 7

Table B.10 As-Built 0.120 in. Tube-A Coined Pressed-End XY Coordinates

X-Axis	Y-Axis							
0.000	0.0008	0.0116						
0.005	0.0122	0.0105	0.0034					
0.010	0.0089	0.0104	0.0136	0.0137	0.0151	0.0155	0.0156	0.0162
0.015	0.0190	0.0185	0.0171	0.0162	0.0160	0.0147	0.0145	0.0130
0.020	0.0164	0.0179	0.0180	0.0185	0.0197	0.0214	0.0215	0.0265
0.025	0.0341	0.0283	0.0272	0.0266	0.0237	0.0220	0.0220	0.0220
0.030	0.0272	0.0276	0.0290	0.0310	0.0329	0.0347	0.0360	0.0418
0.035	0.0503	0.0441	0.0430	0.0417	0.0389	0.0367	0.0352	0.0332
0.040	0.0412	0.0432	0.0447	0.0473	0.0501	0.0504	0.0523	0.0581
0.045	0.0658	0.0609	0.0604	0.0577	0.0559	0.0536	0.0521	0.0487
0.050	0.0567	0.0596	0.0610	0.0639	0.0641	0.0673	0.0695	0.0742
0.055	0.0828	0.0772	0.0751	0.0722	0.0717	0.0689	0.0674	0.0647
0.060	0.0728	0.0754	0.0770	0.0802	0.0804	0.0837	0.0849	0.0918
0.065	0.0986	0.0931	0.0920	0.0885	0.0885	0.0853	0.0838	0.0815
0.070	0.0896	0.0917	0.0932	0.0966	0.0971	0.0999	0.1015	0.1064
0.075	0.1141	0.1089	0.1075	0.1055	0.1045	0.1026	0.1011	0.0982
0.080	0.1079	0.1107	0.1122	0.1125	0.1150	0.1153	0.1168	0.1248
0.085	0.1290	0.1263	0.1253	0.1244	0.1217	0.1212	0.1201	0.1174
0.090	0.1271	0.1282	0.1295	0.1303	0.1310	0.1313	0.1324	0.1332
0.095	0.1375	0.1370	0.1369	0.1357	0.1354	0.1334	0.1330	0.1311
0.100	0.1315	0.1355	0.1373	0.1373	0.1385	0.1387	0.1395	0.1400
0.105	0.1416	0.1405	0.1395	0.1394	0.1385	0.1384	0.1372	0.1325
0.110	0.1329	0.1373	0.1378	0.1378	0.1392	0.1394	0.1404	0.1413
0.115	0.1392	0.1373	0.1371	0.1369	0.1364	0.1361	0.1354	0.1346
0.120	0.1296	0.1307	0.1311	0.1316	0.1317	0.1318	0.1329	0.1330
0.125	0.1198	0.1198	0.1185	0.1153	0.1118	0.1115	0.1112	0.0970
0.130	0.0767	0.0922	0.0928	0.0930	0.0970	0.0998	0.1012	0.1012
0.135	0.0832	0.0832	0.0817	0.0788	0.0739	0.0735	0.0731	0.0583
0.140	0.0503	0.0569	0.0577	0.0579	0.0607	0.0627	0.0646	0.0646
0.145	0.0536	0.0531	0.0523	0.0520	0.0520	0.0512	0.0509	0.0482
0.150	0.0470	0.0477	0.0479	0.0488	0.0490	0.0493	0.0518	0.0527
0.155	0.0521	0.0512	0.0494	0.0483	0.0481	0.0479	0.0474	0.0464
0.160	0.0464	0.0472	0.0472	0.0477	0.0486	0.0487	0.0511	0.0516
0.165	0.0516	0.0509	0.0483	0.0482	0.0477	0.0472	0.0467	0.0460
0.170	0.0459	0.0466	0.0469	0.0475	0.0481	0.0481	0.0508	0.0515
0.175	0.0513	0.0506	0.0482	0.0479	0.0473	0.0469	0.0467	0.0457
0.180	0.0456	0.0468	0.0468	0.0471	0.0478	0.0483	0.0505	0.0513
0.185	0.0517	0.0504	0.0482	0.0479	0.0471	0.0467	0.0467	0.0457
0.190	0.0458	0.0467	0.0471	0.0473	0.0480	0.0482	0.0506	0.0522
0.195	0.0519	0.0512	0.0484	0.0483	0.0482	0.0476	0.0469	0.0461
0.200	0.0465	0.0476	0.0486	0.0491	0.0491	0.0491	0.0523	0.0529
0.205	0.0538	0.0532	0.0502	0.0500	0.0499	0.0497	0.0484	0.0477
0.210	0.0489	0.0494	0.0505	0.0509	0.0511	0.0512	0.0545	0.0551
0.215	0.0558	0.0551	0.0521	0.0520	0.0520	0.0517	0.0505	0.0497
0.220	0.0508	0.0516	0.0528	0.0531	0.0532	0.0532	0.0561	0.0570
0.225	0.0578	0.0573	0.0543	0.0543	0.0542	0.0537	0.0528	0.0519

0.230	0.0532	0.0538	0.0548	0.0553	0.0553	0.0555	0.0583	0.0590
0.235	0.0602	0.0594	0.0573	0.0566	0.0564	0.0560	0.0549	0.0543
0.240	0.0558	0.0567	0.0575	0.0582	0.0583	0.0599	0.0617	0.0626
0.245	0.0655	0.0647	0.0631	0.0612	0.0607	0.0604	0.0588	0.0579
0.250	0.0608	0.0618	0.0633	0.0639	0.0640	0.0665	0.0678	0.0688
0.255	0.0728	0.0724	0.0713	0.0676	0.0672	0.0670	0.0654	0.0640
0.260	0.0673	0.0697	0.0713	0.0727	0.0730	0.0786	0.0800	0.0808
0.265	0.0895	0.0885	0.0867	0.0814	0.0807	0.0796	0.0780	0.0754
0.270	0.0841	0.0868	0.0884	0.0898	0.0900	0.0954	0.0968	0.0982
0.275	0.1067	0.1060	0.1043	0.0991	0.0987	0.0972	0.0956	0.0923
0.280	0.1022	0.1043	0.1059	0.1065	0.1076	0.1113	0.1119	0.1129
0.285	0.1168	0.1157	0.1140	0.1117	0.1117	0.1115	0.1100	0.1094
0.290	0.1126	0.1130	0.1145	0.1146	0.1148	0.1161	0.1183	0.1194
0.295	0.1215	0.1209	0.1182	0.1172	0.1170	0.1168	0.1157	0.1157
0.300	0.1177	0.1181	0.1184	0.1187	0.1192	0.1197	0.1220	0.1227
0.305	0.1215	0.1213	0.1202	0.1200	0.1193	0.1185	0.1178	0.1088
0.310	0.0885	0.1063	0.1065	0.1078	0.1130	0.1152	0.1167	0.1167
0.315	0.1004	0.1004	0.0978	0.0961	0.0887	0.0878	0.0874	0.0741
0.320	0.0693	0.0744	0.0756	0.0759	0.0790	0.0805	0.0824	0.0824
0.325	0.0726	0.0725	0.0724	0.0724	0.0719	0.0716	0.0692	0.0668
0.330	0.0654	0.0670	0.0684	0.0684	0.0694	0.0696	0.0701	0.0704
0.335	0.0696	0.0690	0.0683	0.0678	0.0668	0.0666	0.0657	0.0649
0.340	0.0647	0.0651	0.0657	0.0660	0.0672	0.0676	0.0686	0.0696
0.345	0.0688	0.0682	0.0671	0.0669	0.0656	0.0653	0.0649	0.0644
0.350	0.0642	0.0646	0.0652	0.0654	0.0669	0.0669	0.0682	0.0688
0.355	0.0684	0.0679	0.0668	0.0667	0.0652	0.0650	0.0646	0.0638
0.360	0.0639	0.0643	0.0648	0.0650	0.0664	0.0666	0.0678	0.0683
0.365	0.0682	0.0677	0.0665	0.0663	0.0650	0.0645	0.0641	0.0638
0.370	0.0636	0.0642	0.0646	0.0649	0.0663	0.0664	0.0675	0.0682
0.375	0.0679	0.0674	0.0665	0.0663	0.0649	0.0645	0.0639	0.0636
0.380	0.0635	0.0637	0.0646	0.0652	0.0663	0.0668	0.0674	0.0681
0.385	0.0677	0.0673	0.0668	0.0661	0.0653	0.0647	0.0637	0.0634
0.390	0.0635	0.0637	0.0647	0.0650	0.0661	0.0665	0.0672	0.0675
0.395	0.0684	0.0675	0.0669	0.0663	0.0654	0.0649	0.0641	0.0637
0.400	0.0644	0.0652	0.0652	0.0660	0.0668	0.0676	0.0683	0.0687
0.405	0.0696	0.0690	0.0680	0.0677	0.0665	0.0658	0.0657	0.0650
0.410	0.0662	0.0664	0.0671	0.0672	0.0685	0.0688	0.0701	0.0707
0.415	0.0716	0.0709	0.0698	0.0694	0.0682	0.0679	0.0675	0.0673
0.420	0.0684	0.0684	0.0688	0.0692	0.0704	0.0707	0.0718	0.0724
0.425	0.0736	0.0731	0.0719	0.0713	0.0704	0.0697	0.0694	0.0691
0.430	0.0702	0.0705	0.0708	0.0714	0.0723	0.0730	0.0743	0.0746

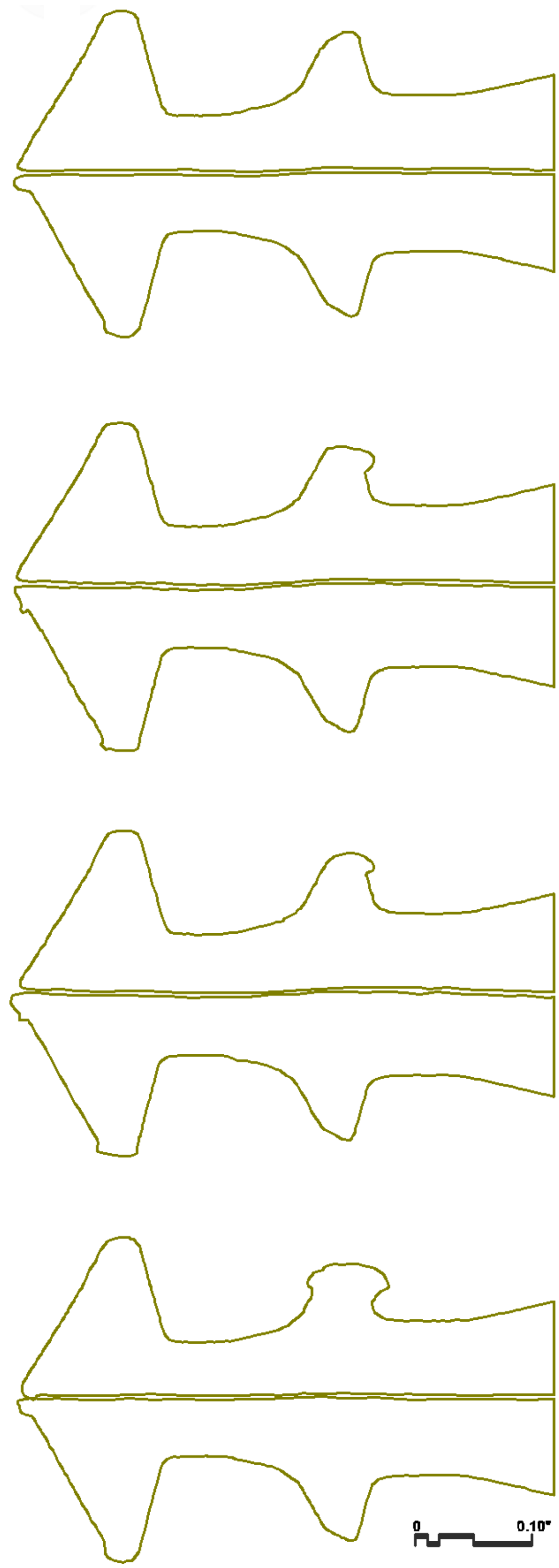


Figure B.41 As-Built 0.120 in. Tube-B Coined Pressed-End CAD Generation - Step 4

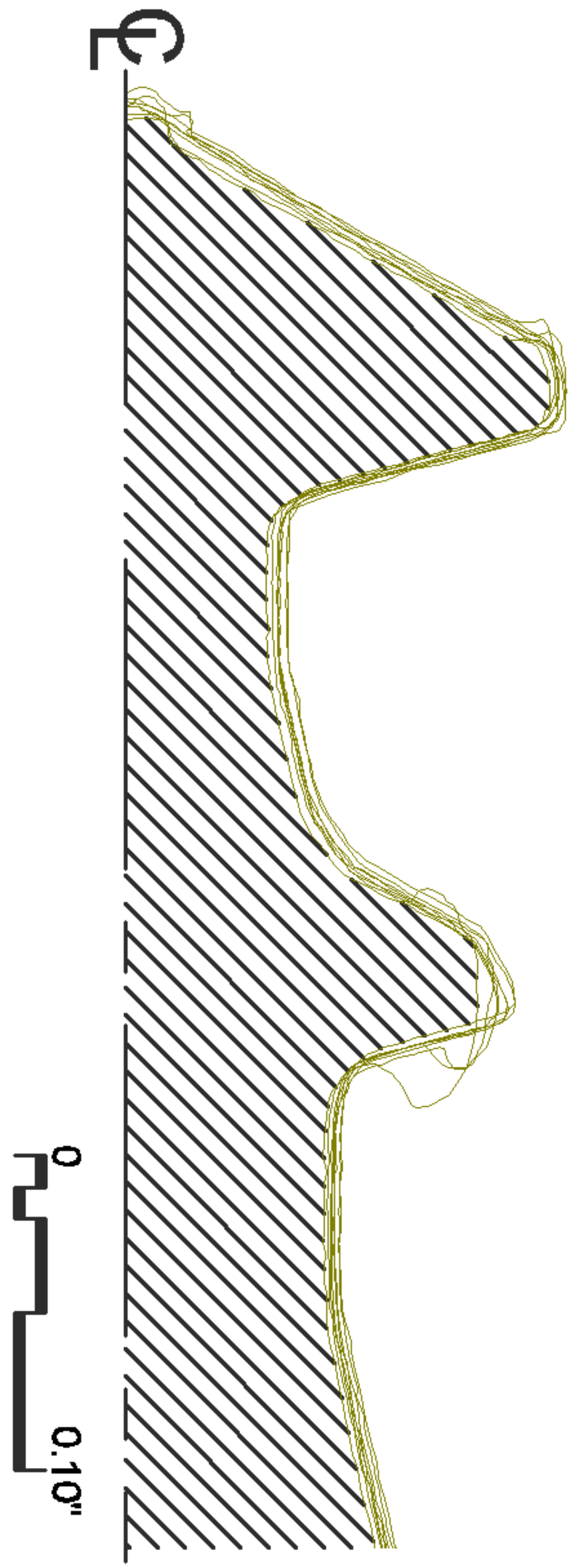


Figure B.42 As-Built 0.120 in. Tube-B Coined Pressed-End Profiles Generation - Step 5

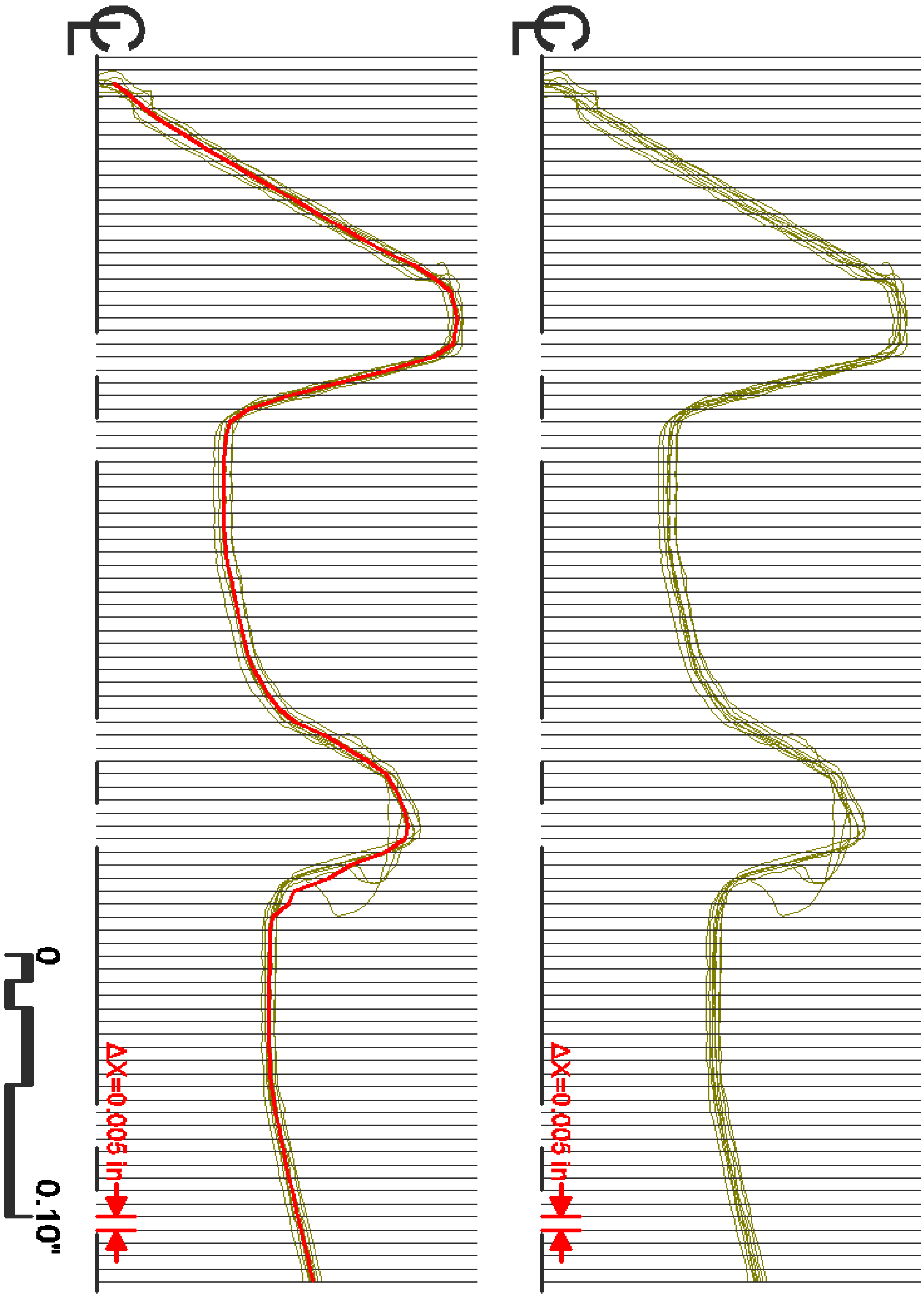


Figure B.43 As-Built 0.120 in. Tube-B Coined Pressed-End Divided Profiles & Mean Profile -

Step 6

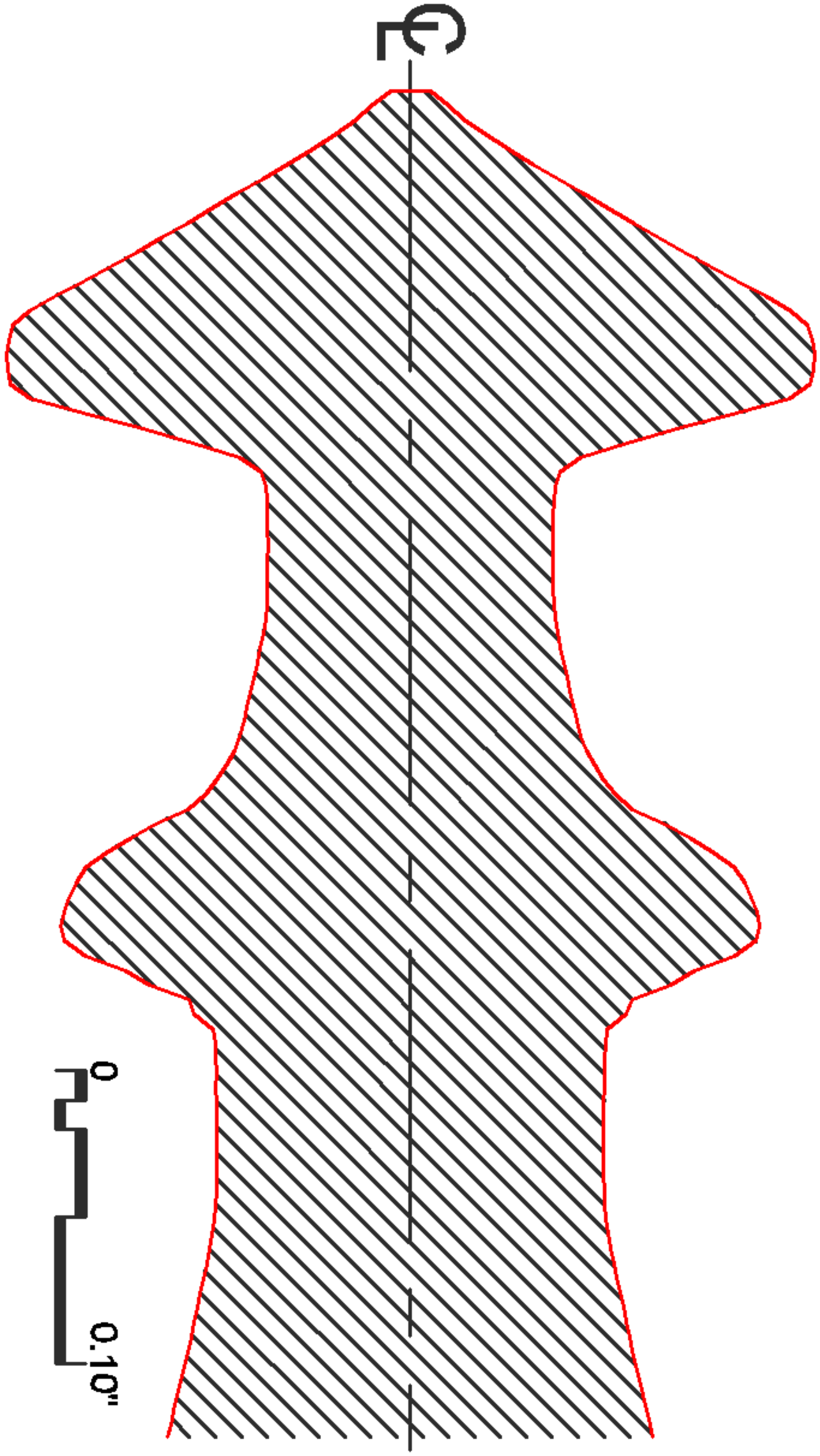


Figure B.44 As-Built 0.120 in. Tube-B Coined Pressed-End Representative Profile - Step 7

Table B.11 As-Built 0.120 in. Tube-B Coined Pressed-End XY Coordinates

X-Axis	Y-Axis							
0.000	0.0133	0.0104	0.0059	0.0028	0.0019			
0.005	0.0061	0.0075	0.0098	0.0114	0.0119	0.0129	0.0159	0.0208
0.010	0.0231	0.0211	0.0200	0.0198	0.0188	0.0167	0.0143	0.0139
0.015	0.0170	0.0190	0.0247	0.0269	0.0270	0.0291	0.0291	0.0323
0.020	0.0395	0.0377	0.0368	0.0352	0.0352	0.0332	0.0275	0.0253
0.025	0.0330	0.0363	0.0408	0.0414	0.0433	0.0453	0.0459	0.0481
0.030	0.0550	0.0546	0.0527	0.0516	0.0508	0.0488	0.0457	0.0423
0.035	0.0515	0.0547	0.0571	0.0588	0.0608	0.0613	0.0642	0.0642
0.040	0.0729	0.0714	0.0692	0.0689	0.0665	0.0648	0.0633	0.0612
0.045	0.0693	0.0730	0.0736	0.0745	0.0768	0.0796	0.0800	0.0820
0.050	0.0915	0.0880	0.0875	0.0858	0.0835	0.0821	0.0817	0.0779
0.055	0.0877	0.0902	0.0909	0.0914	0.0938	0.0958	0.0970	0.0993
0.060	0.1081	0.1061	0.1056	0.1023	0.1002	0.1000	0.0995	0.0964
0.065	0.1049	0.1083	0.1087	0.1101	0.1124	0.1133	0.1153	0.1169
0.070	0.1338	0.1252	0.1230	0.1216	0.1202	0.1192	0.1163	0.1127
0.075	0.1217	0.1251	0.1273	0.1285	0.1321	0.1331	0.1353	0.1373
0.080	0.1385	0.1371	0.1362	0.1360	0.1360	0.1353	0.1343	0.1323
0.085	0.1337	0.1360	0.1368	0.1370	0.1371	0.1379	0.1389	0.1397
0.090	0.1399	0.1398	0.1391	0.1377	0.1376	0.1375	0.1366	0.1349
0.095	0.1349	0.1358	0.1368	0.1372	0.1374	0.1390	0.1392	0.1398
0.100	0.1400	0.1377	0.1374	0.1372	0.1368	0.1347	0.1341	0.1332
0.105	0.1246	0.1254	0.1259	0.1282	0.1312	0.1324	0.1329	0.1352
0.110	0.1180	0.1168	0.1148	0.1122	0.1117	0.1071	0.1070	0.1048
0.115	0.0861	0.0883	0.0889	0.0925	0.0932	0.0952	0.0962	0.0999
0.120	0.0830	0.0780	0.0764	0.0760	0.0733	0.0711	0.0701	0.0661
0.125	0.0551	0.0555	0.0558	0.0570	0.0578	0.0592	0.0610	0.0640
0.130	0.0540	0.0525	0.0524	0.0516	0.0512	0.0500	0.0485	0.0483
0.135	0.0457	0.0471	0.0490	0.0496	0.0497	0.0498	0.0519	0.0520
0.140	0.0521	0.0514	0.0497	0.0495	0.0490	0.0485	0.0467	0.0451
0.145	0.0450	0.0467	0.0484	0.0488	0.0489	0.0492	0.0514	0.0517
0.150	0.0514	0.0513	0.0491	0.0489	0.0487	0.0483	0.0467	0.0448
0.155	0.0449	0.0468	0.0481	0.0484	0.0485	0.0491	0.0514	0.0519
0.160	0.0517	0.0512	0.0494	0.0486	0.0484	0.0484	0.0468	0.0449
0.165	0.0452	0.0469	0.0484	0.0485	0.0486	0.0489	0.0515	0.0517
0.170	0.0489	0.0484	0.0468	0.0450	0.0517	0.0513	0.0489	0.0489
0.175	0.0453	0.0474	0.0485	0.0489	0.0490	0.0492	0.0516	0.0518
0.180	0.0522	0.0522	0.0496	0.0495	0.0494	0.0488	0.0477	0.0458
0.185	0.0462	0.0482	0.0497	0.0500	0.0502	0.0505	0.0534	0.0536
0.190	0.0555	0.0543	0.0516	0.0513	0.0508	0.0508	0.0493	0.0471
0.195	0.0483	0.0508	0.0517	0.0519	0.0525	0.0526	0.0552	0.0557
0.200	0.0567	0.0563	0.0538	0.0535	0.0530	0.0529	0.0522	0.0492
0.205	0.0506	0.0531	0.0542	0.0542	0.0548	0.0549	0.0573	0.0575
0.210	0.0589	0.0586	0.0563	0.0559	0.0554	0.0552	0.0541	0.0517
0.215	0.0527	0.0553	0.0563	0.0566	0.0569	0.0572	0.0594	0.0599
0.220	0.0618	0.0610	0.0587	0.0583	0.0577	0.0575	0.0568	0.0542
0.225	0.0555	0.0582	0.0592	0.0592	0.0602	0.0609	0.0628	0.0639

0.230	0.0673	0.0661	0.0633	0.0633	0.0623	0.0618	0.0612	0.0578
0.235	0.0613	0.0642	0.0646	0.0653	0.0664	0.0666	0.0694	0.0705
0.240	0.0754	0.0729	0.0708	0.0703	0.0689	0.0678	0.0677	0.0647
0.245	0.0694	0.0724	0.0726	0.0743	0.0767	0.0773	0.0800	0.0840
0.250	0.0971	0.0947	0.0926	0.0884	0.0863	0.0847	0.0832	0.0826
0.255	0.0899	0.0914	0.0924	0.0941	0.0949	0.0972	0.1021	0.1039
0.260	0.1093	0.1061	0.1060	0.1041	0.1025	0.1024	0.1004	0.0993
0.265	0.1075	0.1082	0.1083	0.1095	0.1103	0.1127	0.1134	0.1152
0.270	0.1178	0.1164	0.1153	0.1139	0.1129	0.1128	0.1122	0.1113
0.275	0.1118	0.1150	0.1155	0.1156	0.1166	0.1170	0.1192	0.1207
0.280	0.1230	0.1219	0.1189	0.1185	0.1179	0.1169	0.1168	0.1117
0.285	0.1120	0.1160	0.1182	0.1184	0.1209	0.1212	0.1237	0.1238
0.290	0.1224	0.1211	0.1209	0.1184	0.1179	0.1178	0.1151	0.1119
0.295	0.1009	0.1087	0.1092	0.1102	0.1114	0.1133	0.1144	0.1166
0.300	0.1148	0.1127	0.1103	0.0956	0.0946	0.0907	0.0905	0.0902
0.305	0.0740	0.0743	0.0746	0.0747	0.0764	0.0773	0.0830	0.1000
0.310	0.1067	0.0859	0.0723	0.0722	0.0711	0.0707	0.0701	0.0700
0.315	0.0655	0.0663	0.0677	0.0681	0.0689	0.0694	0.0699	0.0701
0.320	0.0692	0.0690	0.0677	0.0675	0.0673	0.0666	0.0654	0.0644
0.325	0.0635	0.0647	0.0661	0.0667	0.0669	0.0671	0.0687	0.0689
0.330	0.0687	0.0683	0.0669	0.0667	0.0662	0.0659	0.0647	0.0634
0.335	0.0630	0.0647	0.0654	0.0662	0.0666	0.0667	0.0684	0.0688
0.340	0.0686	0.0682	0.0668	0.0667	0.0660	0.0656	0.0646	0.0640
0.345	0.0633	0.0645	0.0655	0.0659	0.0665	0.0665	0.0682	0.0682
0.350	0.0685	0.0681	0.0666	0.0665	0.0658	0.0654	0.0643	0.0631
0.355	0.0631	0.0645	0.0654	0.0657	0.0662	0.0665	0.0680	0.0685
0.360	0.0683	0.0680	0.0664	0.0663	0.0658	0.0653	0.0645	0.0632
0.365	0.0635	0.0645	0.0654	0.0656	0.0663	0.0666	0.0681	0.0681
0.370	0.0685	0.0681	0.0667	0.0666	0.0656	0.0652	0.0647	0.0631
0.375	0.0634	0.0647	0.0653	0.0657	0.0668	0.0670	0.0682	0.0688
0.380	0.0688	0.0684	0.0673	0.0670	0.0661	0.0655	0.0649	0.0640
0.385	0.0639	0.0654	0.0660	0.0664	0.0674	0.0677	0.0689	0.0694
0.390	0.0707	0.0697	0.0685	0.0680	0.0671	0.0667	0.0661	0.0642
0.395	0.0650	0.0669	0.0678	0.0679	0.0687	0.0693	0.0705	0.0719
0.400	0.0725	0.0715	0.0702	0.0702	0.0691	0.0687	0.0678	0.0663
0.405	0.0674	0.0689	0.0697	0.0701	0.0708	0.0713	0.0729	0.0736
0.410	0.0749	0.0739	0.0727	0.0717	0.0714	0.0707	0.0701	0.0685
0.415	0.0695	0.0711	0.0719	0.0719	0.0727	0.0738	0.0750	0.0758
0.420	0.0768	0.0759	0.0745	0.0736	0.0735	0.0727	0.0722	0.0703

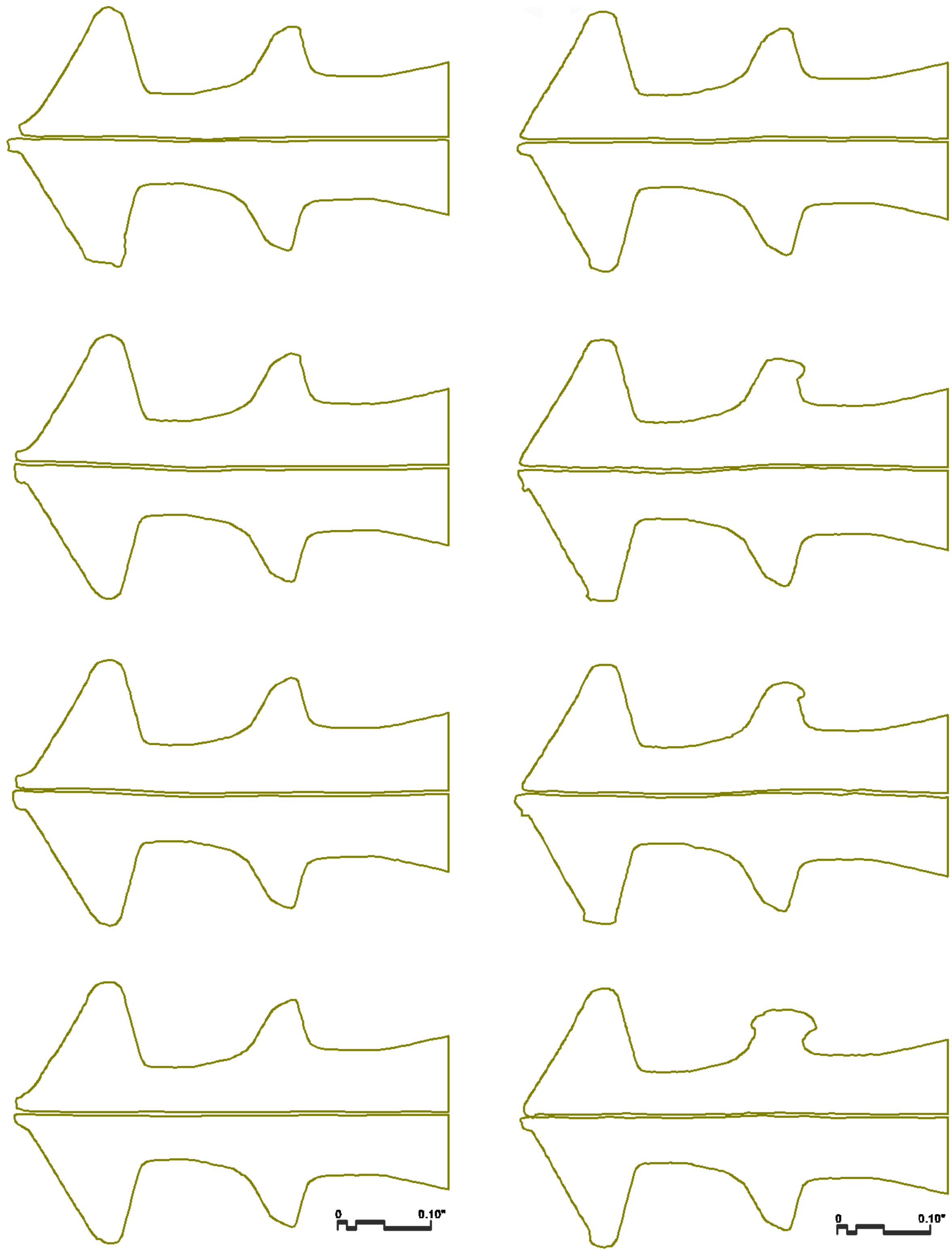


Figure B.45 As-Built 0.120 in. Tube-C Coined Pressed-End CAD Generation - Step 4

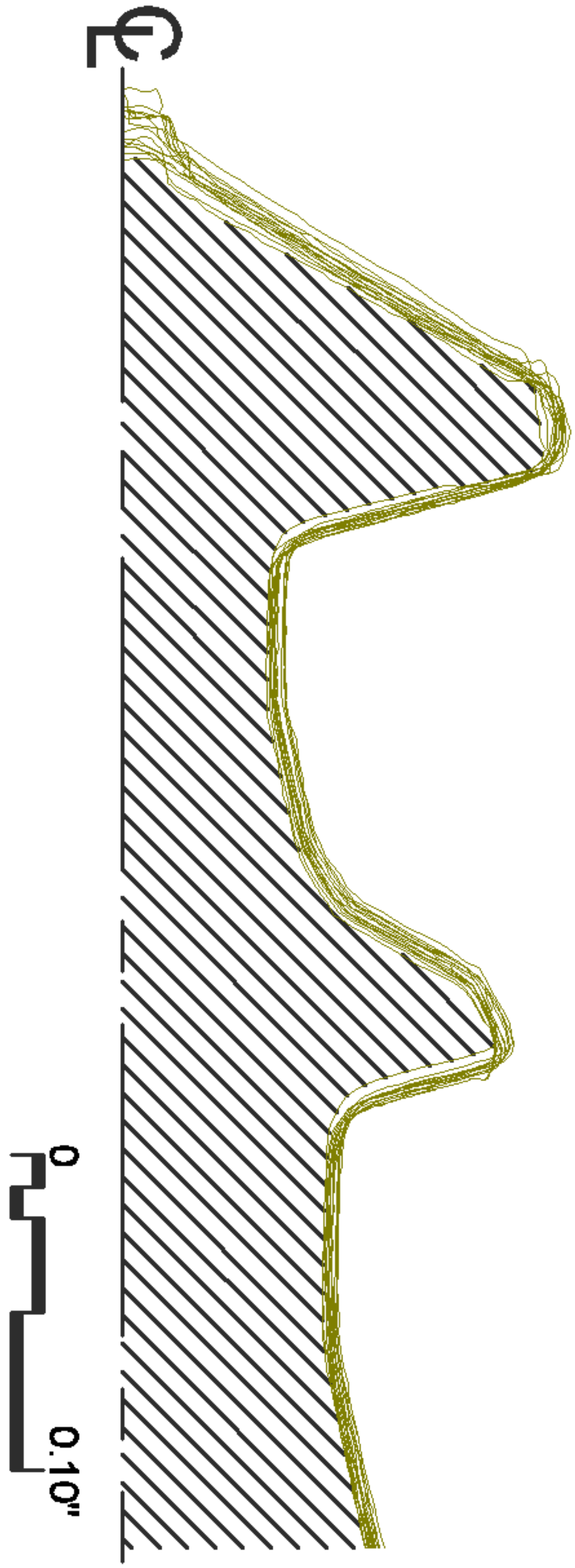


Figure B.46 As-Built 0.120 in. Tube-C Coined Pressed-End Profiles Generation - Step 5

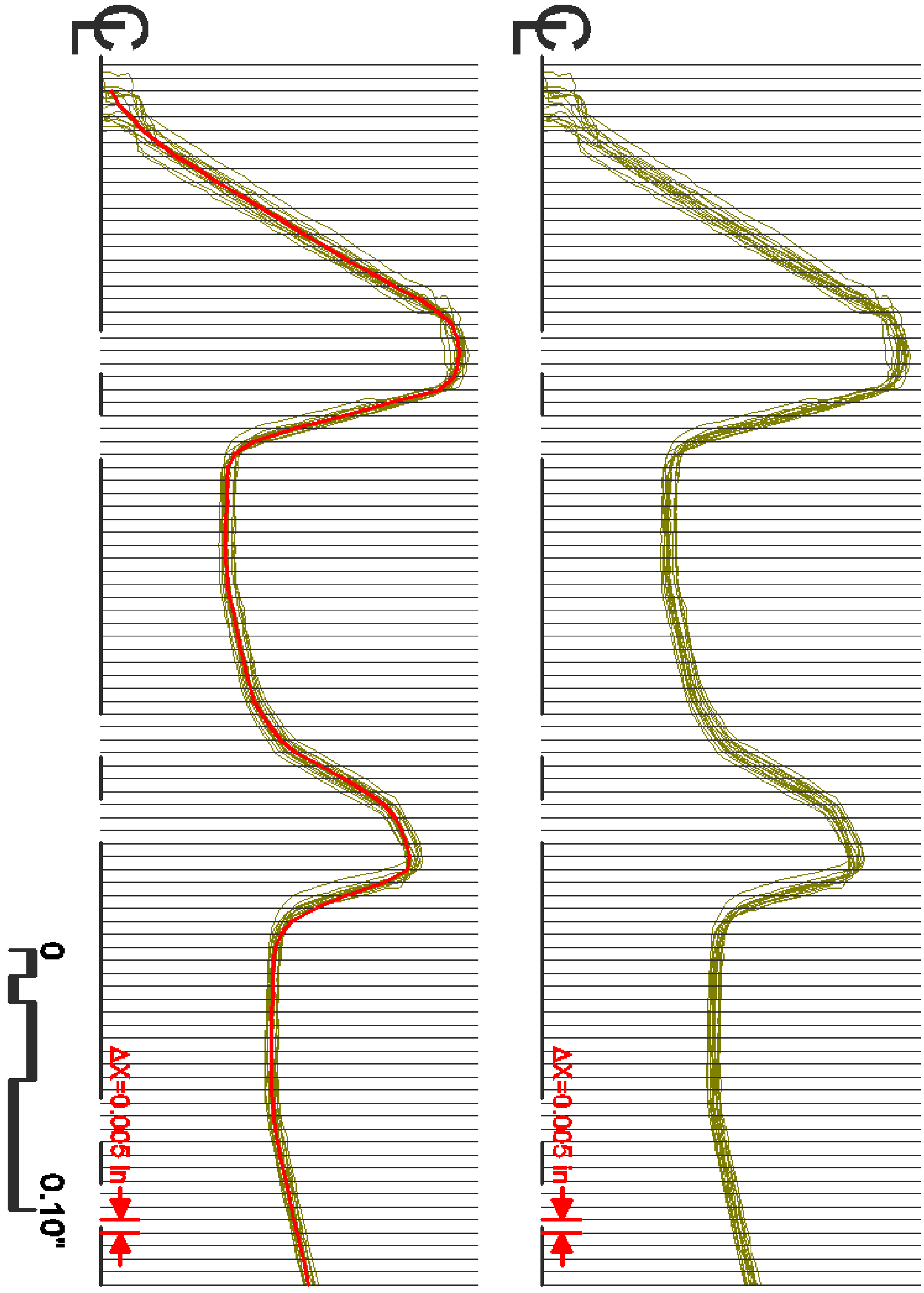


Figure B.47 As-Built 0.120 in. Tube-C Coined Pressed-End Divided Profiles & Mean Profile -

Step 6

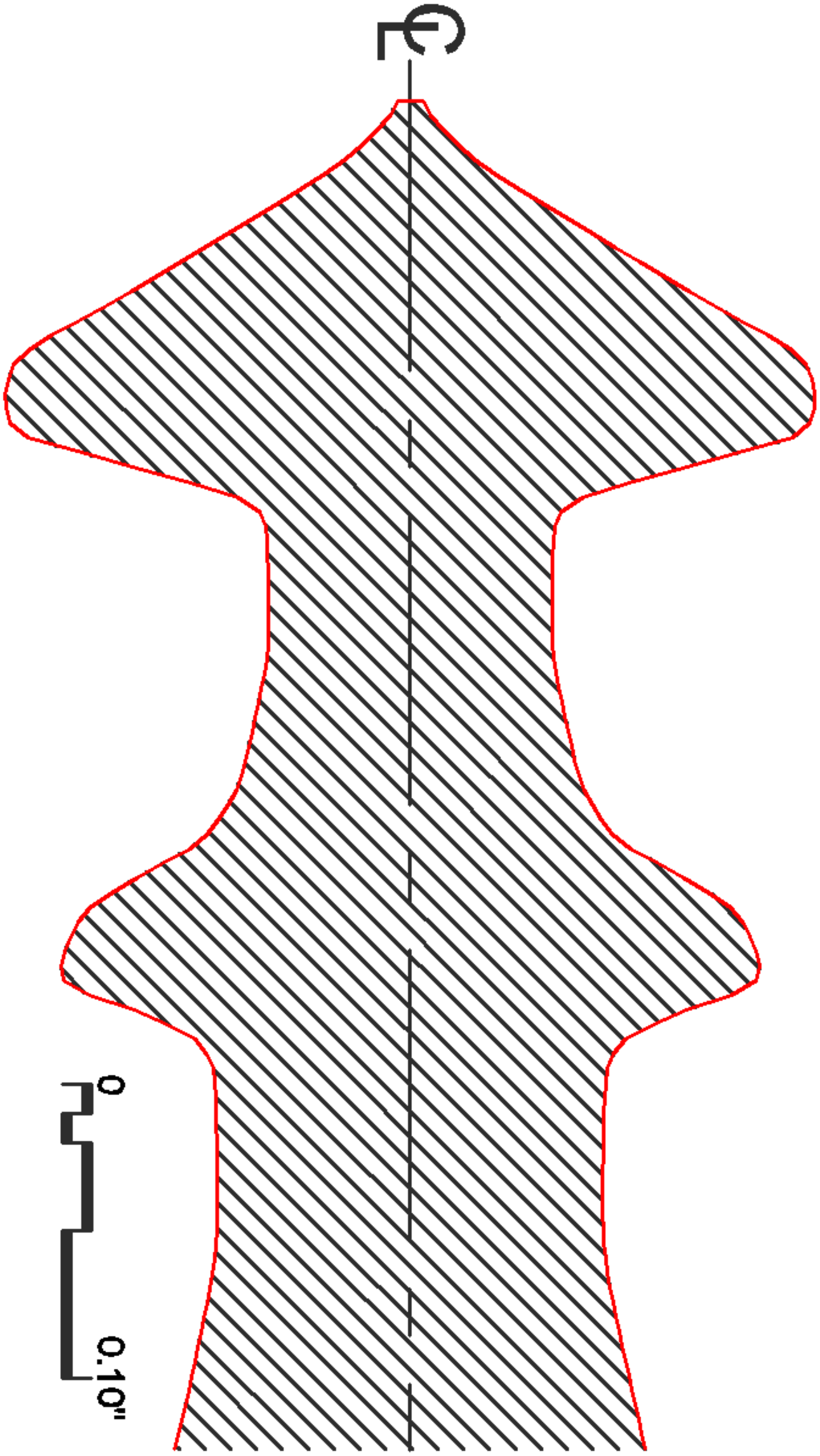


Figure B.48 As-Built 0.120 in. Tube-C Coined Pressed-End Representative Profile - Step 7

Table B.12 As-Built 0.120 in. Tube-C Coined Pressed-End XY Coordinates

X-Axis	Y-Axis							
0.000	0.0133	0.0104	0.0059	0.0028	0.0019	0.0116	0.0008	
0.005	0.0208	0.0075	0.0098	0.0114	0.0119	0.0034	0.0129	0.0105
0.010	0.0136	0.0231	0.0156	0.0211	0.0155	0.0200	0.0151	0.0198
0.015	0.0130	0.0170	0.0145	0.0190	0.0147	0.0247	0.0160	0.0269
0.020	0.0265	0.0395	0.0215	0.0377	0.0214	0.0368	0.0197	0.0352
0.025	0.0220	0.0330	0.0220	0.0363	0.0220	0.0408	0.0237	0.0414
0.030	0.0418	0.0550	0.0360	0.0546	0.0347	0.0527	0.0329	0.0516
0.035	0.0332	0.0515	0.0352	0.0547	0.0367	0.0571	0.0389	0.0588
0.040	0.0581	0.0729	0.0523	0.0714	0.0504	0.0692	0.0501	0.0689
0.045	0.0487	0.0693	0.0521	0.0730	0.0536	0.0736	0.0559	0.0745
0.050	0.0742	0.0915	0.0695	0.0880	0.0673	0.0875	0.0641	0.0858
0.055	0.0647	0.0877	0.0674	0.0902	0.0689	0.0909	0.0717	0.0914
0.060	0.0918	0.1081	0.0849	0.1061	0.0837	0.1056	0.0804	0.1023
0.065	0.0815	0.1049	0.0838	0.1083	0.0853	0.1087	0.0885	0.1101
0.070	0.1064	0.1338	0.1015	0.1252	0.0999	0.1230	0.0971	0.1216
0.075	0.0982	0.1217	0.1011	0.1251	0.1026	0.1273	0.1045	0.1285
0.080	0.1248	0.1385	0.1168	0.1371	0.1153	0.1362	0.1150	0.1360
0.085	0.1174	0.1337	0.1201	0.1360	0.1212	0.1368	0.1217	0.1370
0.090	0.1332	0.1399	0.1324	0.1398	0.1313	0.1391	0.1310	0.1377
0.095	0.1311	0.1349	0.1330	0.1358	0.1334	0.1368	0.1354	0.1372
0.100	0.1400	0.1400	0.1395	0.1377	0.1387	0.1374	0.1385	0.1372
0.105	0.1325	0.1246	0.1372	0.1254	0.1384	0.1259	0.1385	0.1282
0.110	0.1413	0.1180	0.1404	0.1168	0.1394	0.1148	0.1392	0.1122
0.115	0.1346	0.0861	0.1354	0.0883	0.1361	0.0889	0.1364	0.0925
0.120	0.1330	0.0830	0.1329	0.0780	0.1318	0.0764	0.1317	0.0760
0.125	0.0970	0.0551	0.1112	0.0555	0.1115	0.0558	0.1118	0.0570
0.130	0.1012	0.0540	0.1012	0.0525	0.0998	0.0524	0.0970	0.0516
0.135	0.0583	0.0457	0.0731	0.0471	0.0735	0.0490	0.0739	0.0496
0.140	0.0646	0.0521	0.0646	0.0514	0.0627	0.0497	0.0607	0.0495
0.145	0.0482	0.0450	0.0509	0.0467	0.0512	0.0484	0.0520	0.0488
0.150	0.0527	0.0514	0.0518	0.0513	0.0493	0.0491	0.0490	0.0489
0.155	0.0464	0.0449	0.0474	0.0468	0.0479	0.0481	0.0481	0.0484
0.160	0.0516	0.0517	0.0511	0.0512	0.0487	0.0494	0.0486	0.0486
0.165	0.0460	0.0452	0.0467	0.0469	0.0472	0.0484	0.0477	0.0485
0.170	0.0515	0.0489	0.0508	0.0484	0.0481	0.0468	0.0481	0.0450
0.175	0.0457	0.0453	0.0467	0.0474	0.0469	0.0485	0.0473	0.0489
0.180	0.0513	0.0522	0.0505	0.0522	0.0483	0.0496	0.0478	0.0495
0.185	0.0457	0.0462	0.0467	0.0482	0.0467	0.0497	0.0471	0.0500
0.190	0.0522	0.0555	0.0506	0.0543	0.0482	0.0516	0.0480	0.0513
0.195	0.0461	0.0483	0.0469	0.0508	0.0476	0.0517	0.0482	0.0519
0.200	0.0529	0.0567	0.0523	0.0563	0.0491	0.0538	0.0491	0.0535
0.205	0.0477	0.0506	0.0484	0.0531	0.0497	0.0542	0.0499	0.0542
0.210	0.0551	0.0589	0.0545	0.0586	0.0512	0.0563	0.0511	0.0559
0.215	0.0497	0.0527	0.0505	0.0553	0.0517	0.0563	0.0520	0.0566
0.220	0.0570	0.0618	0.0561	0.0610	0.0532	0.0587	0.0532	0.0583
0.225	0.0519	0.0555	0.0528	0.0582	0.0537	0.0592	0.0542	0.0592

0.230	0.0590	0.0673	0.0583	0.0661	0.0555	0.0633	0.0553	0.0633
0.235	0.0543	0.0613	0.0549	0.0642	0.0560	0.0646	0.0564	0.0653
0.240	0.0626	0.0754	0.0617	0.0729	0.0599	0.0708	0.0583	0.0703
0.245	0.0579	0.0694	0.0588	0.0724	0.0604	0.0726	0.0607	0.0743
0.250	0.0688	0.0971	0.0678	0.0947	0.0665	0.0926	0.0640	0.0884
0.255	0.0640	0.0899	0.0654	0.0914	0.0670	0.0924	0.0672	0.0941
0.260	0.0808	0.1093	0.0800	0.1061	0.0786	0.1060	0.0730	0.1041
0.265	0.0754	0.1075	0.0780	0.1082	0.0796	0.1083	0.0807	0.1095
0.270	0.0982	0.1178	0.0968	0.1164	0.0954	0.1153	0.0900	0.1139
0.275	0.0923	0.1118	0.0956	0.1150	0.0972	0.1155	0.0987	0.1156
0.280	0.1129	0.1230	0.1119	0.1219	0.1113	0.1189	0.1076	0.1185
0.285	0.1094	0.1120	0.1100	0.1160	0.1115	0.1182	0.1117	0.1184
0.290	0.1194	0.1224	0.1183	0.1211	0.1161	0.1209	0.1148	0.1184
0.295	0.1157	0.1009	0.1157	0.1087	0.1168	0.1092	0.1170	0.1102
0.300	0.1227	0.1148	0.1220	0.1127	0.1197	0.1103	0.1192	0.0956
0.305	0.1088	0.0740	0.1178	0.0743	0.1185	0.0746	0.1193	0.0747
0.310	0.1167	0.1067	0.1167	0.0859	0.1152	0.0723	0.1130	0.0722
0.315	0.0741	0.0655	0.0874	0.0663	0.0878	0.0677	0.0887	0.0681
0.320	0.0824	0.0692	0.0824	0.0690	0.0805	0.0677	0.0790	0.0675
0.325	0.0668	0.0635	0.0692	0.0647	0.0716	0.0661	0.0719	0.0667
0.330	0.0704	0.0687	0.0701	0.0683	0.0696	0.0669	0.0694	0.0667
0.335	0.0649	0.0630	0.0657	0.0647	0.0666	0.0654	0.0668	0.0662
0.340	0.0696	0.0686	0.0686	0.0682	0.0676	0.0668	0.0672	0.0667
0.345	0.0644	0.0633	0.0649	0.0645	0.0653	0.0655	0.0656	0.0659
0.350	0.0688	0.0685	0.0682	0.0681	0.0669	0.0666	0.0669	0.0665
0.355	0.0638	0.0631	0.0646	0.0645	0.0650	0.0654	0.0652	0.0657
0.360	0.0683	0.0683	0.0678	0.0680	0.0666	0.0664	0.0664	0.0663
0.365	0.0638	0.0635	0.0641	0.0645	0.0645	0.0654	0.0650	0.0656
0.370	0.0682	0.0685	0.0675	0.0681	0.0664	0.0667	0.0663	0.0666
0.375	0.0636	0.0634	0.0639	0.0647	0.0645	0.0653	0.0649	0.0657
0.380	0.0681	0.0688	0.0674	0.0684	0.0668	0.0673	0.0663	0.0670
0.385	0.0634	0.0639	0.0637	0.0654	0.0647	0.0660	0.0653	0.0664
0.390	0.0675	0.0707	0.0672	0.0697	0.0665	0.0685	0.0661	0.0680
0.395	0.0637	0.0650	0.0641	0.0669	0.0649	0.0678	0.0654	0.0679
0.400	0.0687	0.0725	0.0683	0.0715	0.0676	0.0702	0.0668	0.0702
0.405	0.0650	0.0674	0.0657	0.0689	0.0658	0.0697	0.0665	0.0701
0.410	0.0707	0.0749	0.0701	0.0739	0.0688	0.0727	0.0685	0.0717
0.415	0.0673	0.0695	0.0675	0.0711	0.0679	0.0719	0.0682	0.0719
0.420	0.0724	0.0768	0.0718	0.0759	0.0707	0.0745	0.0704	0.0736

X-Axis	Y-Axis							
0.000								
0.005	0.0159	0.0122	0.0061					
0.010	0.0137	0.0162	0.0188	0.0167	0.0104	0.0143	0.0089	0.0139
0.015	0.0162	0.0270	0.0171	0.0291	0.0185	0.0291	0.0190	0.0323
0.020	0.0185	0.0352	0.0180	0.0332	0.0179	0.0275	0.0164	0.0253
0.025	0.0266	0.0433	0.0272	0.0453	0.0283	0.0459	0.0341	0.0481
0.030	0.0310	0.0508	0.0290	0.0488	0.0276	0.0457	0.0272	0.0423
0.035	0.0417	0.0608	0.0430	0.0613	0.0441	0.0642	0.0503	0.0642
0.040	0.0473	0.0665	0.0447	0.0648	0.0432	0.0633	0.0412	0.0612
0.045	0.0577	0.0768	0.0604	0.0796	0.0609	0.0800	0.0658	0.0820
0.050	0.0639	0.0835	0.0610	0.0821	0.0596	0.0817	0.0567	0.0779
0.055	0.0722	0.0938	0.0751	0.0958	0.0772	0.0970	0.0828	0.0993
0.060	0.0802	0.1002	0.0770	0.1000	0.0754	0.0995	0.0728	0.0964
0.065	0.0885	0.1124	0.0920	0.1133	0.0931	0.1153	0.0986	0.1169
0.070	0.0966	0.1202	0.0932	0.1192	0.0917	0.1163	0.0896	0.1127
0.075	0.1055	0.1321	0.1075	0.1331	0.1089	0.1353	0.1141	0.1373
0.080	0.1125	0.1360	0.1122	0.1353	0.1107	0.1343	0.1079	0.1323
0.085	0.1244	0.1371	0.1253	0.1379	0.1263	0.1389	0.1290	0.1397
0.090	0.1303	0.1376	0.1295	0.1375	0.1282	0.1366	0.1271	0.1349
0.095	0.1357	0.1374	0.1369	0.1390	0.1370	0.1392	0.1375	0.1398
0.100	0.1373	0.1368	0.1373	0.1347	0.1355	0.1341	0.1315	0.1332
0.105	0.1394	0.1312	0.1395	0.1324	0.1405	0.1329	0.1416	0.1352
0.110	0.1378	0.1117	0.1378	0.1071	0.1373	0.1070	0.1329	0.1048
0.115	0.1369	0.0932	0.1371	0.0952	0.1373	0.0962	0.1392	0.0999
0.120	0.1316	0.0733	0.1311	0.0711	0.1307	0.0701	0.1296	0.0661
0.125	0.1153	0.0578	0.1185	0.0592	0.1198	0.0610	0.1198	0.0640
0.130	0.0930	0.0512	0.0928	0.0500	0.0922	0.0485	0.0767	0.0483
0.135	0.0788	0.0497	0.0817	0.0498	0.0832	0.0519	0.0832	0.0520
0.140	0.0579	0.0490	0.0577	0.0485	0.0569	0.0467	0.0503	0.0451
0.145	0.0520	0.0489	0.0523	0.0492	0.0531	0.0514	0.0536	0.0517
0.150	0.0488	0.0487	0.0479	0.0483	0.0477	0.0467	0.0470	0.0448
0.155	0.0483	0.0485	0.0494	0.0491	0.0512	0.0514	0.0521	0.0519
0.160	0.0477	0.0484	0.0472	0.0484	0.0472	0.0468	0.0464	0.0449
0.165	0.0482	0.0486	0.0483	0.0489	0.0509	0.0515	0.0516	0.0517
0.170	0.0475	0.0517	0.0469	0.0513	0.0466	0.0489	0.0459	0.0489
0.175	0.0479	0.0490	0.0482	0.0492	0.0506	0.0516	0.0513	0.0518
0.180	0.0471	0.0494	0.0468	0.0488	0.0468	0.0477	0.0456	0.0458
0.185	0.0479	0.0502	0.0482	0.0505	0.0504	0.0534	0.0517	0.0536
0.190	0.0473	0.0508	0.0471	0.0508	0.0467	0.0493	0.0458	0.0471
0.195	0.0483	0.0525	0.0484	0.0526	0.0512	0.0552	0.0519	0.0557
0.200	0.0491	0.0530	0.0486	0.0529	0.0476	0.0522	0.0465	0.0492
0.205	0.0500	0.0548	0.0502	0.0549	0.0532	0.0573	0.0538	0.0575
0.210	0.0509	0.0554	0.0505	0.0552	0.0494	0.0541	0.0489	0.0517
0.215	0.0520	0.0569	0.0521	0.0572	0.0551	0.0594	0.0558	0.0599
0.220	0.0531	0.0577	0.0528	0.0575	0.0516	0.0568	0.0508	0.0542
0.225	0.0543	0.0602	0.0543	0.0609	0.0573	0.0628	0.0578	0.0639
0.230	0.0553	0.0623	0.0548	0.0618	0.0538	0.0612	0.0532	0.0578
0.235	0.0566	0.0664	0.0573	0.0666	0.0594	0.0694	0.0602	0.0705
0.240	0.0582	0.0689	0.0575	0.0678	0.0567	0.0677	0.0558	0.0647

0.245	0.0612	0.0767	0.0631	0.0773	0.0647	0.0800	0.0655	0.0840
0.250	0.0639	0.0863	0.0633	0.0847	0.0618	0.0832	0.0608	0.0826
0.255	0.0676	0.0949	0.0713	0.0972	0.0724	0.1021	0.0728	0.1039
0.260	0.0727	0.1025	0.0713	0.1024	0.0697	0.1004	0.0673	0.0993
0.265	0.0814	0.1103	0.0867	0.1127	0.0885	0.1134	0.0895	0.1152
0.270	0.0898	0.1129	0.0884	0.1128	0.0868	0.1122	0.0841	0.1113
0.275	0.0991	0.1166	0.1043	0.1170	0.1060	0.1192	0.1067	0.1207
0.280	0.1065	0.1179	0.1059	0.1169	0.1043	0.1168	0.1022	0.1117
0.285	0.1117	0.1209	0.1140	0.1212	0.1157	0.1237	0.1168	0.1238
0.290	0.1146	0.1179	0.1145	0.1178	0.1130	0.1151	0.1126	0.1119
0.295	0.1172	0.1114	0.1182	0.1133	0.1209	0.1144	0.1215	0.1166
0.300	0.1187	0.0946	0.1184	0.0907	0.1181	0.0905	0.1177	0.0902
0.305	0.1200	0.0764	0.1202	0.0773	0.1213	0.0830	0.1215	0.1000
0.310	0.1078	0.0711	0.1065	0.0707	0.1063	0.0701	0.0885	0.0700
0.315	0.0961	0.0689	0.0978	0.0694	0.1004	0.0699	0.1004	0.0701
0.320	0.0759	0.0673	0.0756	0.0666	0.0744	0.0654	0.0693	0.0644
0.325	0.0724	0.0669	0.0724	0.0671	0.0725	0.0687	0.0726	0.0689
0.330	0.0684	0.0662	0.0684	0.0659	0.0670	0.0647	0.0654	0.0634
0.335	0.0678	0.0666	0.0683	0.0667	0.0690	0.0684	0.0696	0.0688
0.340	0.0660	0.0660	0.0657	0.0656	0.0651	0.0646	0.0647	0.0640
0.345	0.0669	0.0665	0.0671	0.0665	0.0682	0.0682	0.0688	0.0682
0.350	0.0654	0.0658	0.0652	0.0654	0.0646	0.0643	0.0642	0.0631
0.355	0.0667	0.0662	0.0668	0.0665	0.0679	0.0680	0.0684	0.0685
0.360	0.0650	0.0658	0.0648	0.0653	0.0643	0.0645	0.0639	0.0632
0.365	0.0663	0.0663	0.0665	0.0666	0.0677	0.0681	0.0682	0.0681
0.370	0.0649	0.0656	0.0646	0.0652	0.0642	0.0647	0.0636	0.0631
0.375	0.0663	0.0668	0.0665	0.0670	0.0674	0.0682	0.0679	0.0688
0.380	0.0652	0.0661	0.0646	0.0655	0.0637	0.0649	0.0635	0.0640
0.385	0.0661	0.0674	0.0668	0.0677	0.0673	0.0689	0.0677	0.0694
0.390	0.0650	0.0671	0.0647	0.0667	0.0637	0.0661	0.0635	0.0642
0.395	0.0663	0.0687	0.0669	0.0693	0.0675	0.0705	0.0684	0.0719
0.400	0.0660	0.0691	0.0652	0.0687	0.0652	0.0678	0.0644	0.0663
0.405	0.0677	0.0708	0.0680	0.0713	0.0690	0.0729	0.0696	0.0736
0.410	0.0672	0.0714	0.0671	0.0707	0.0664	0.0701	0.0662	0.0685
0.415	0.0694	0.0727	0.0698	0.0738	0.0709	0.0750	0.0716	0.0758
0.420	0.0692	0.0735	0.0688	0.0727	0.0684	0.0722	0.0684	0.0703

Appendix C

As-Designed vs As-Built Geometric Comparison

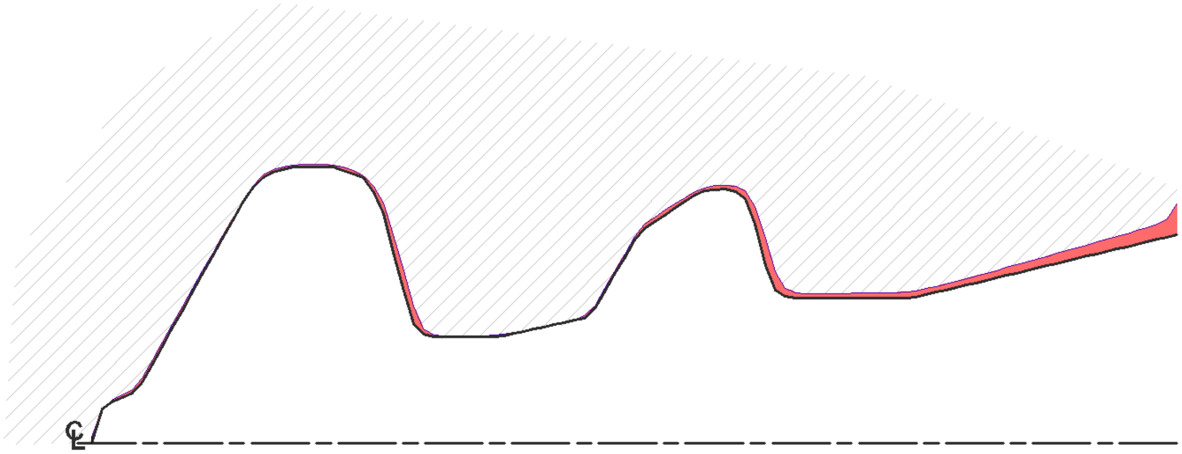


Figure C.1 As-Designed vs Mean As-Built 6Sd-00 Connector-A Slot Geometric Comparison

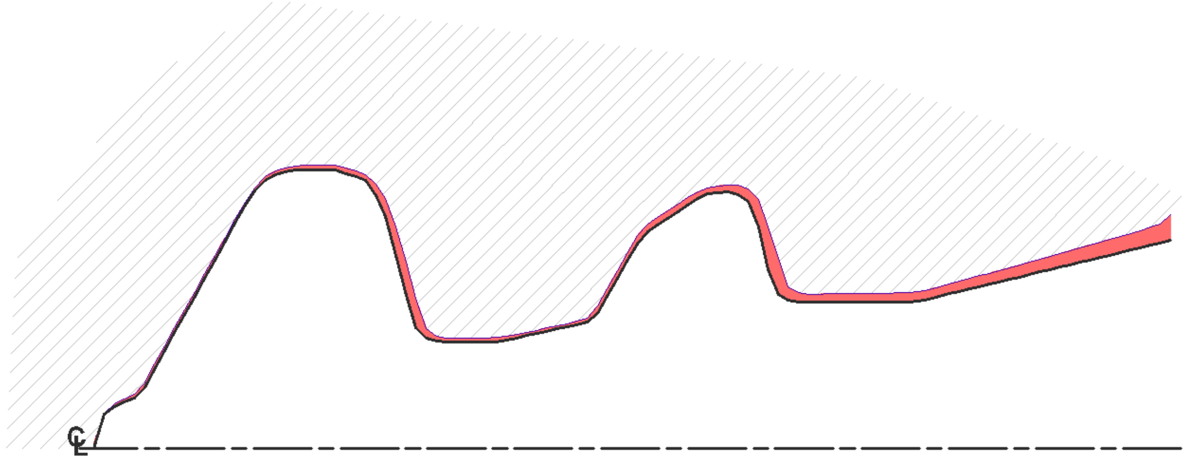


Figure C.2 As-Designed vs Mean As-Built 6Sd-00 Connector-B Slot Geometric Comparison

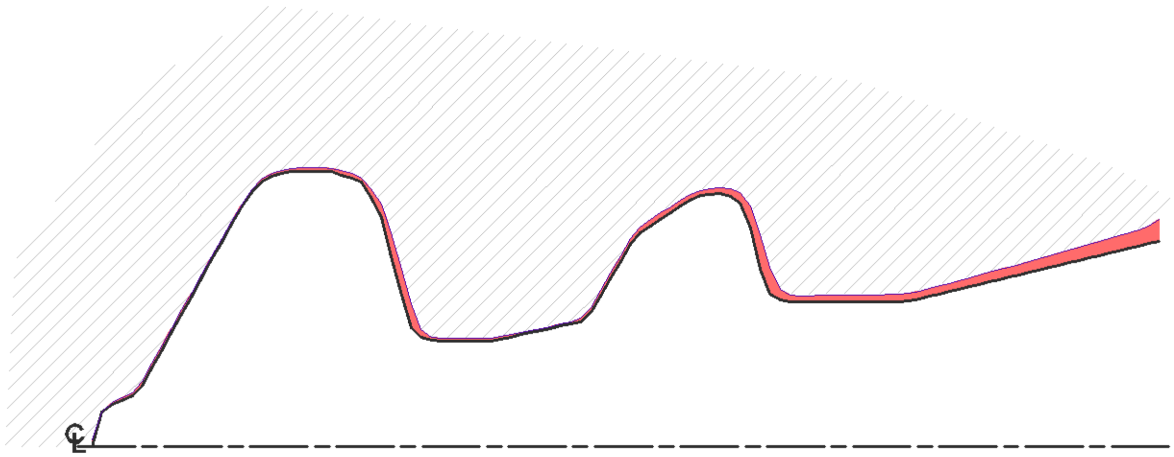


Figure C.3 As-Designed vs Mean As-Built 6Sd-00 Connector-C Slot Geometric Comparison

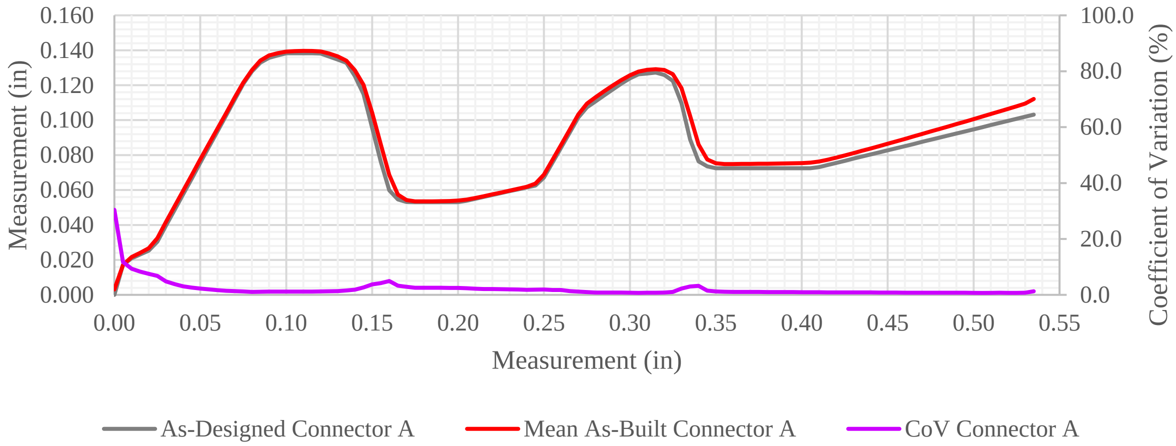


Figure C.4 Coefficient of Variation - 6Sd-00 Connector A Slot Profiles

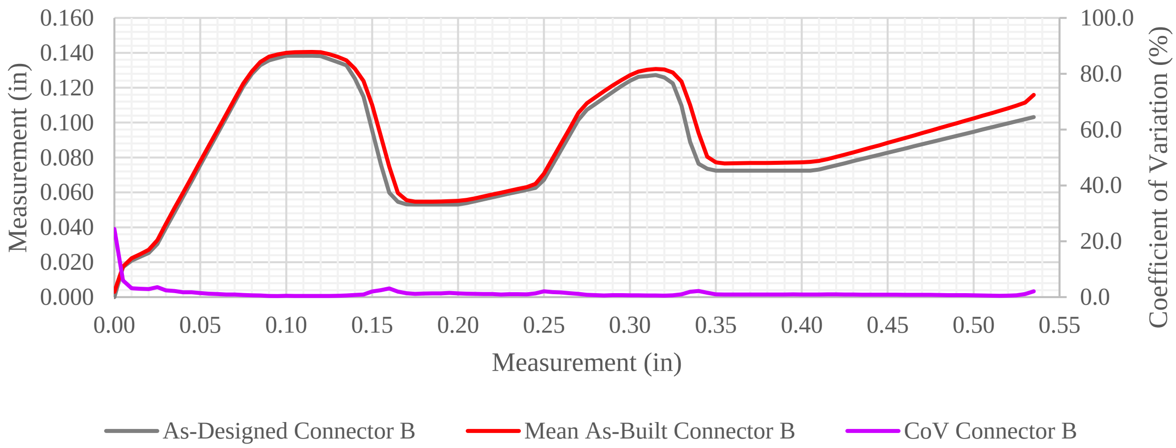


Figure C.5 Coefficient of Variation - 6Sd-00 Connector B Slot Profiles

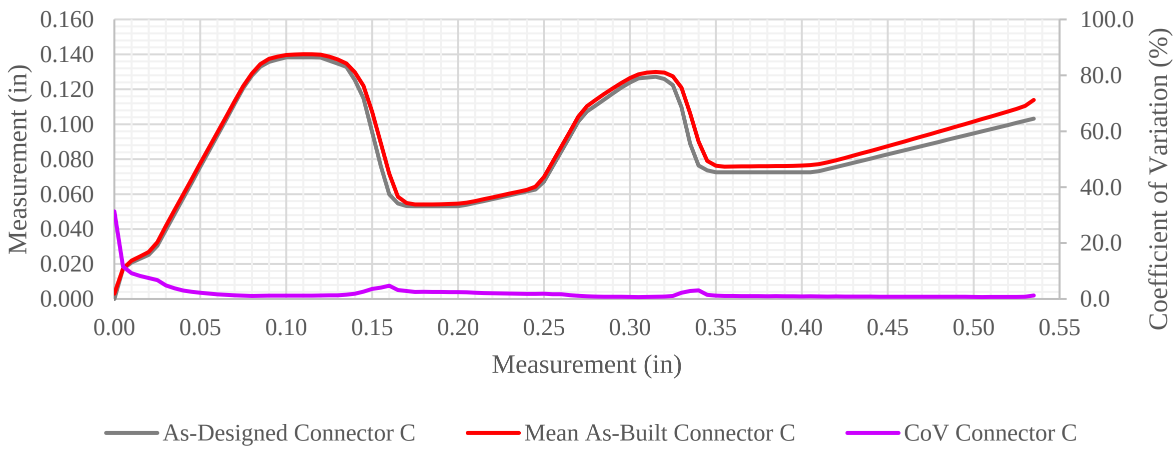


Figure C.6 Coefficient of Variation - 6Sd-00 Connector C Slot Profiles

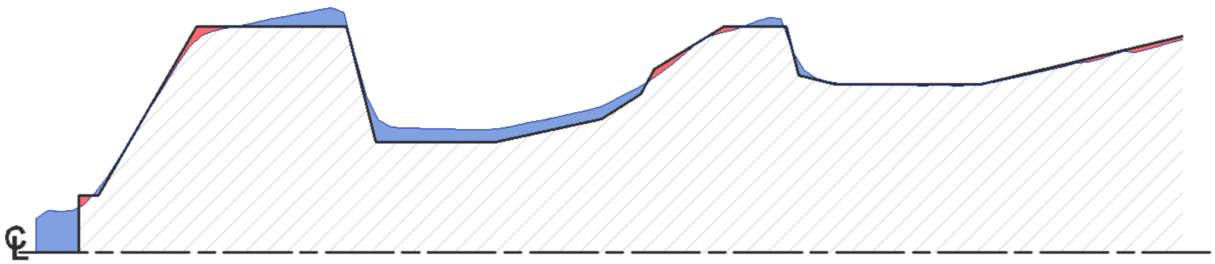


Figure C.7 As-Designed vs Mean As-Built 0.090 in. Tube-A Geometric Comparison

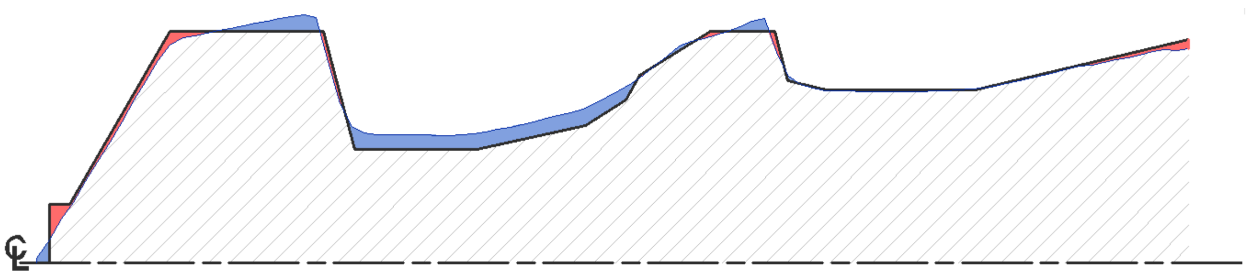


Figure C.8 As-Designed vs Mean As-Built 0.090 in. Tube-B Geometric Comparison

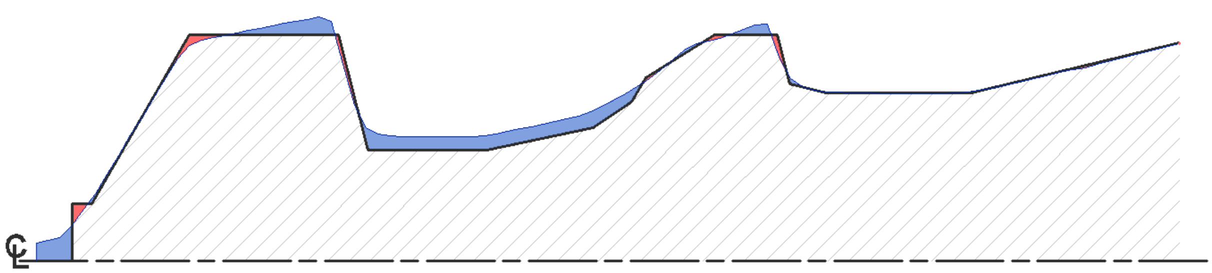


Figure C.9 As-Designed vs Mean As-Built 0.090 in. Tube-C Geometric Comparison

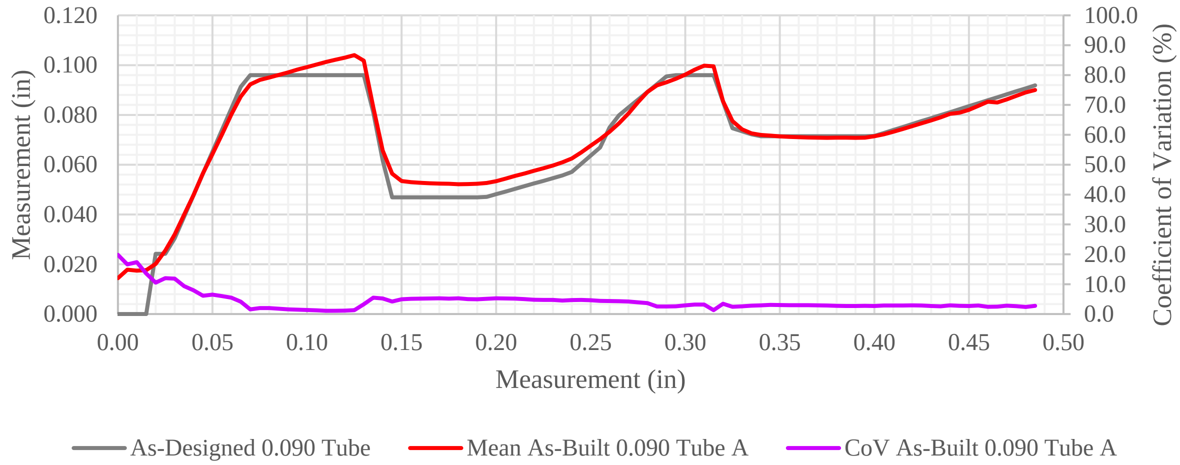


Figure C.10 Coefficient of Variation - 0.090 in Tube A Coined Pressed End Profiles

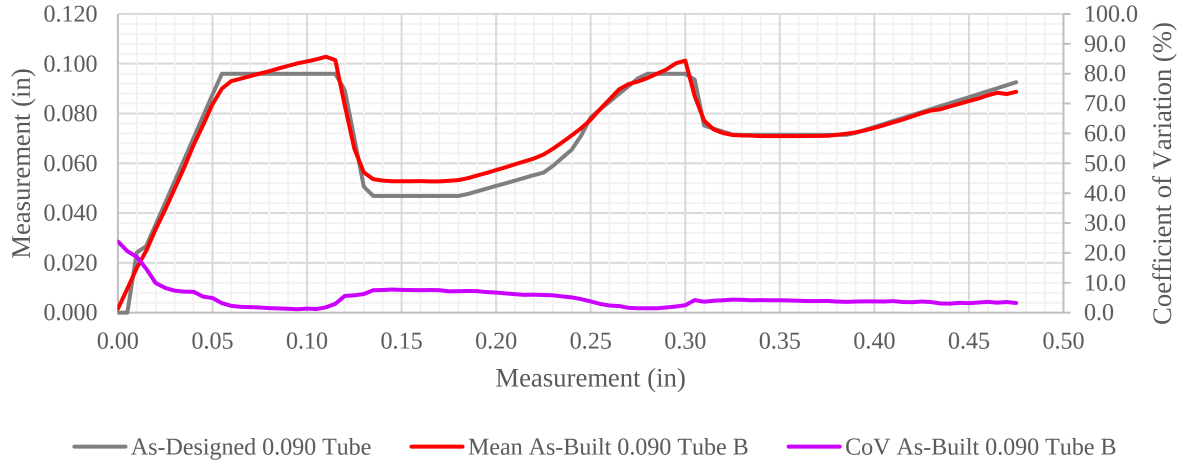


Figure C.11 Coefficient of Variation - 0.090 in Tube B Coined Pressed End Profiles

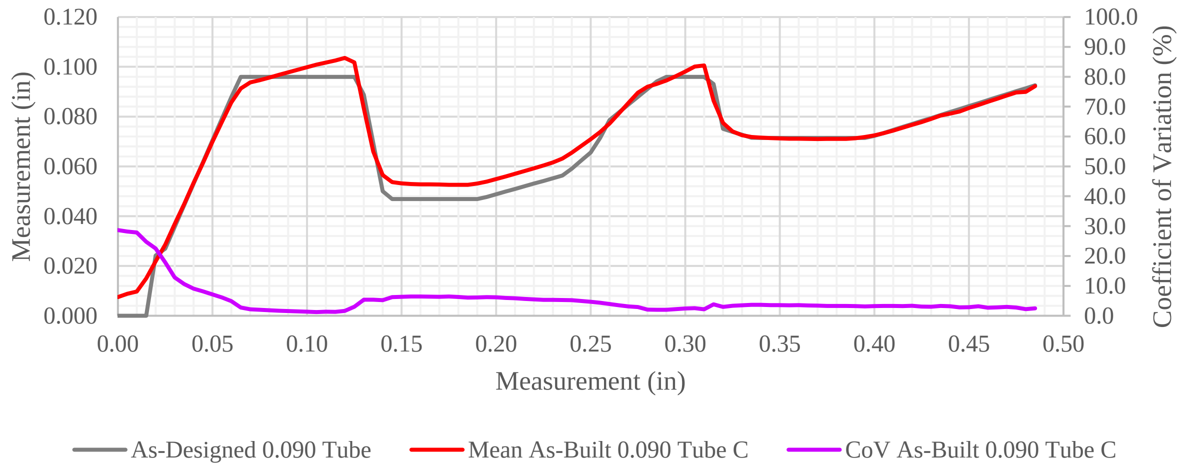


Figure C.12 Coefficient of Variation - 0.090 in Tube C Coined Pressed End Profiles

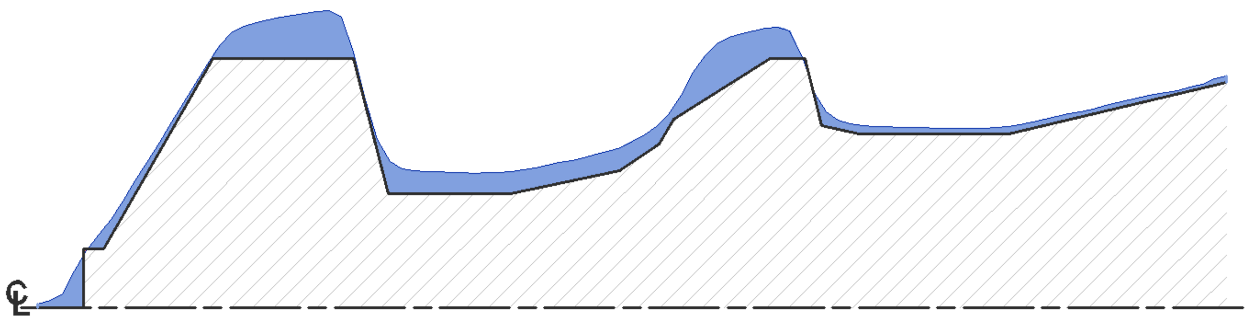


Figure C.13 As-Designed vs Mean As-Built 0.104 in. Tube-A Geometric Comparison

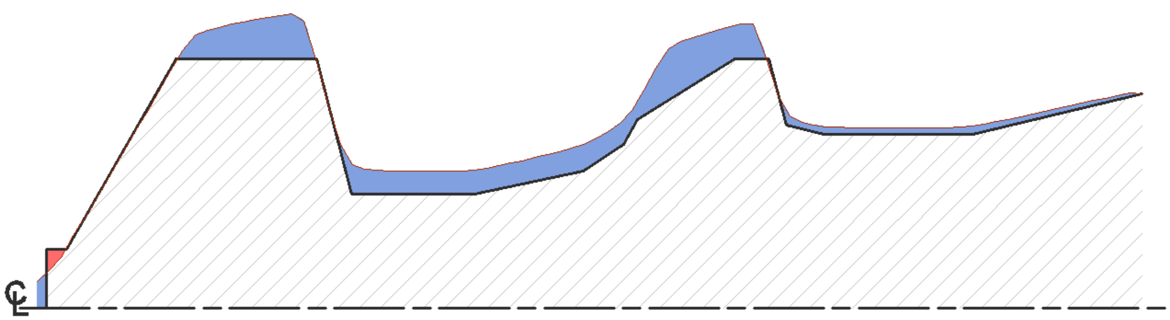


Figure C.14 As-Designed vs Mean As-Built 0.104 in. Tube-B Geometric Comparison

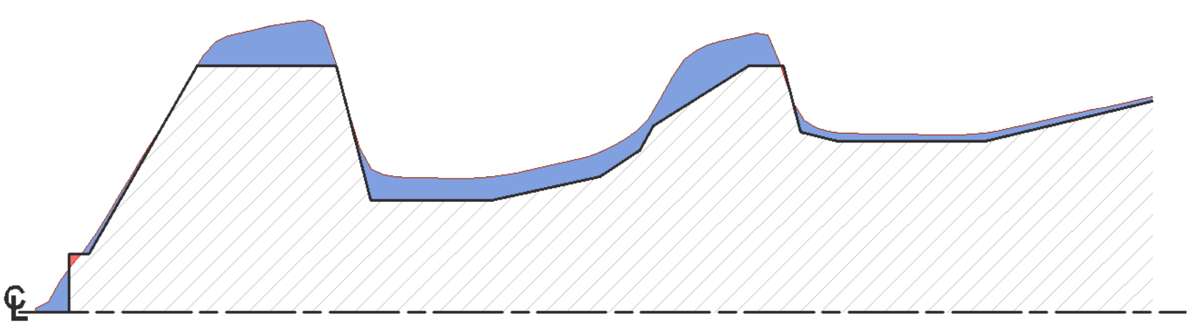


Figure C.15 As-Designed vs Mean As-Built 0.104 in. Tube-C Geometric Comparison

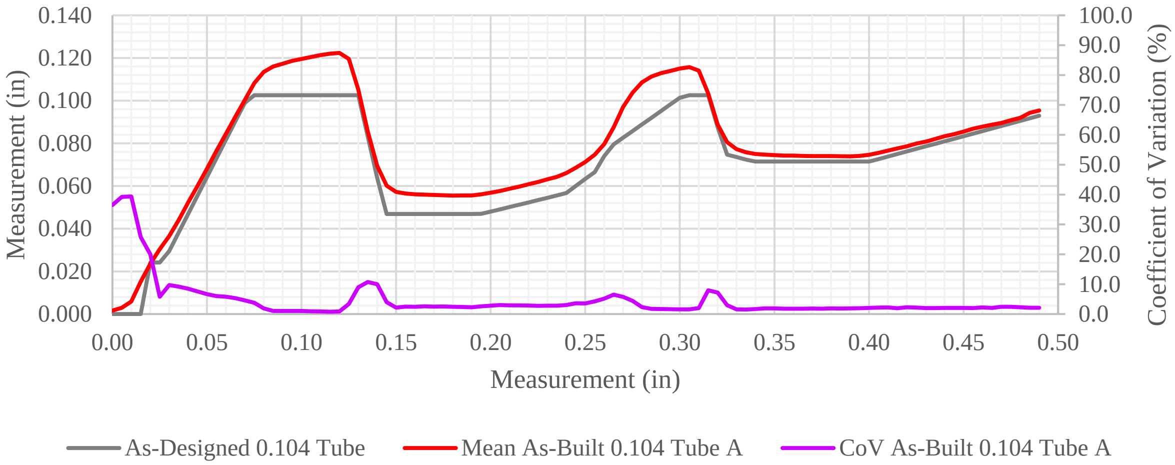


Figure C.16 Coefficient of Variation - 0.104 in Tube A Coined Pressed End Profiles

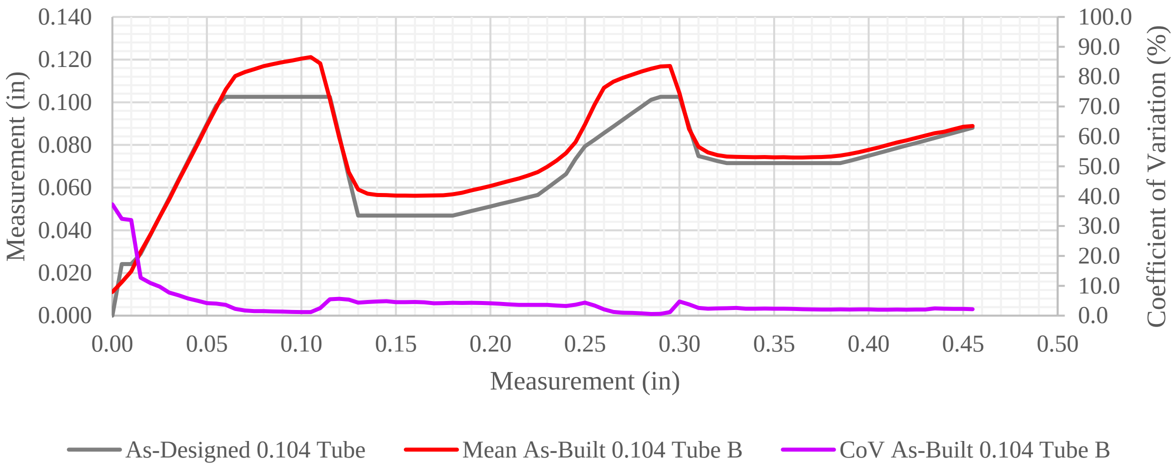


Figure C.17 Coefficient of Variation - 0.104 in Tube B Coined Pressed End Profiles

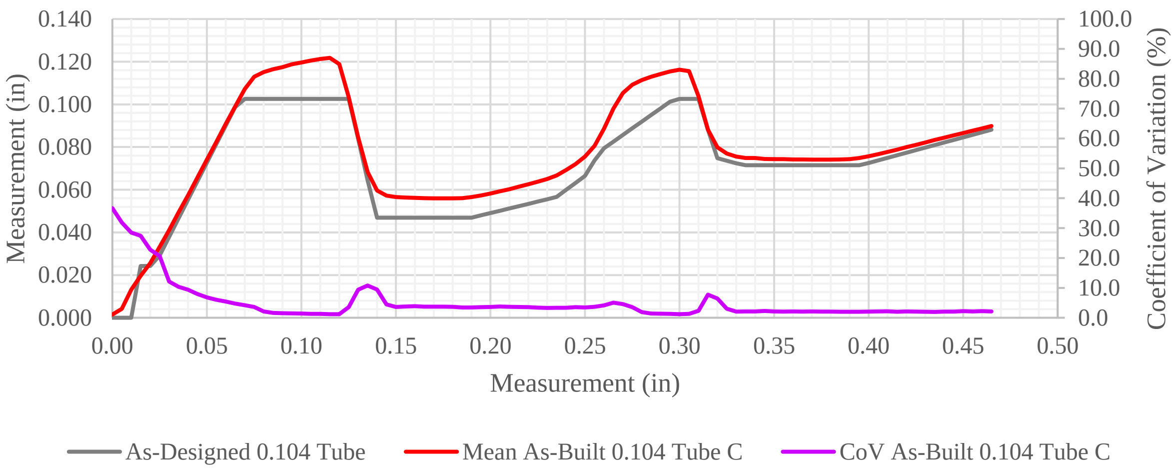


Figure C.18 Coefficient of Variation - 0.104 in Tube C Coined Pressed End Profiles

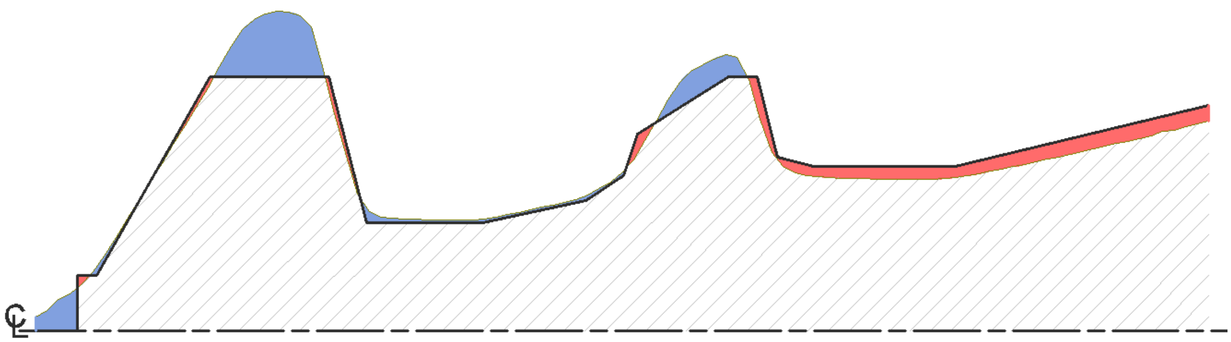


Figure C.19 As-Designed vs Mean As-Built 0.120 in. Tube-A Geometric Comparison

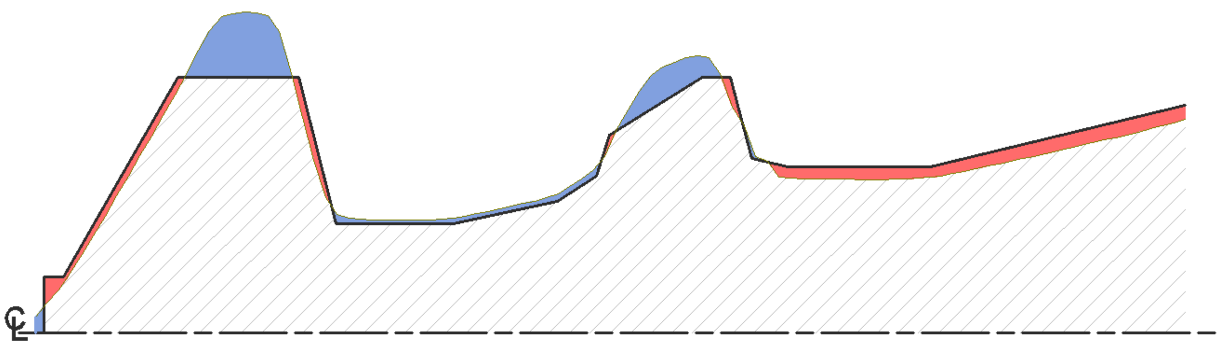


Figure C.20 As-Designed vs Mean As-Built 0.120 in. Tube-B Geometric Comparison

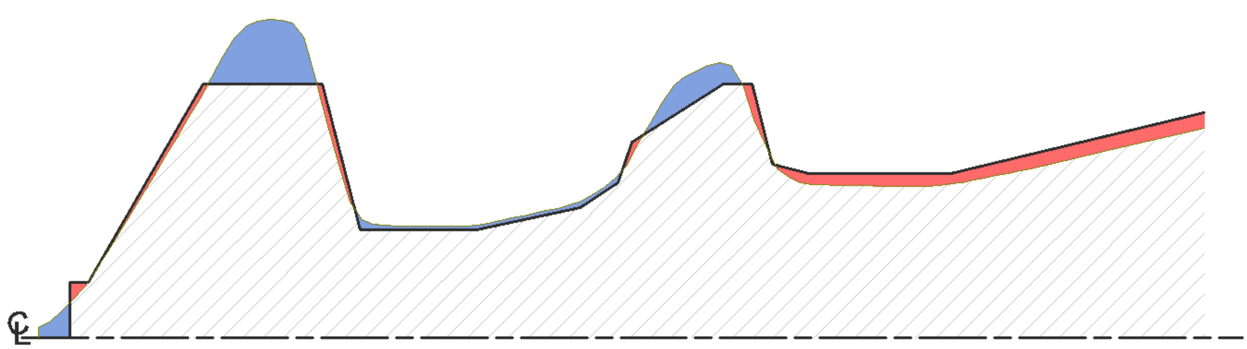


Figure C.21 As-Designed vs Mean As-Built 0.120 in. Tube-C Geometric Comparison

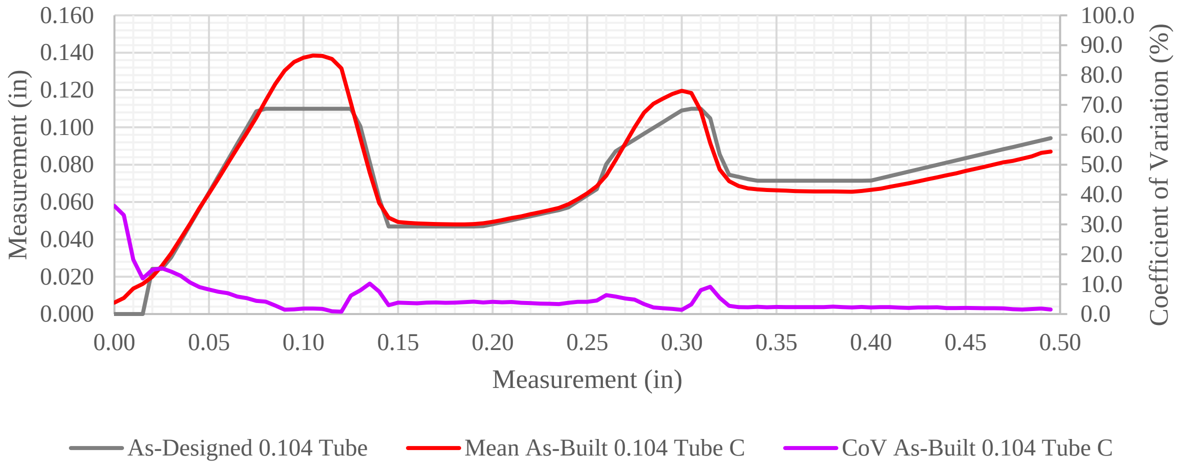


Figure C.22 Coefficient of Variation - 0.104 in Tube A Coined Pressed End Profiles

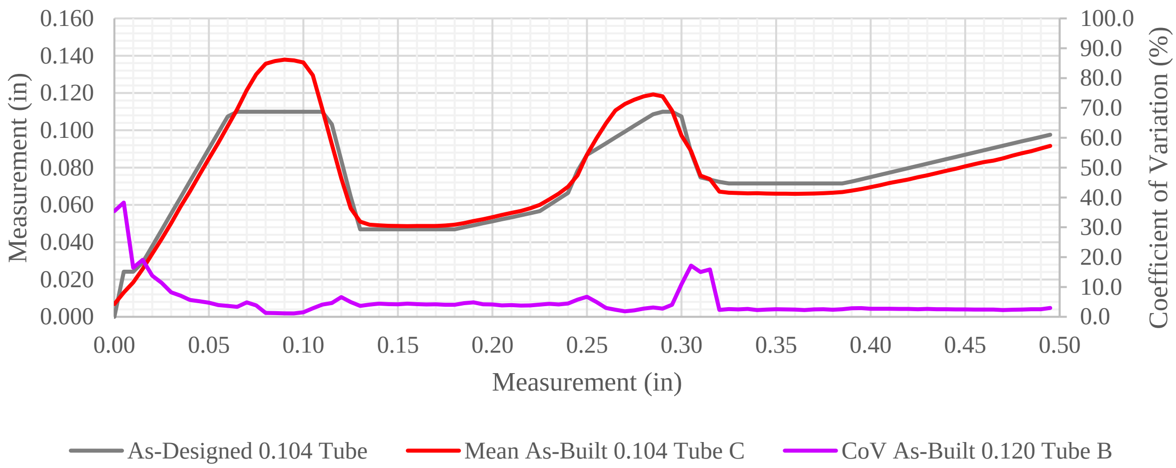


Figure C.23 Coefficient of Variation - 0.104 in Tube B Coined Pressed End Profiles

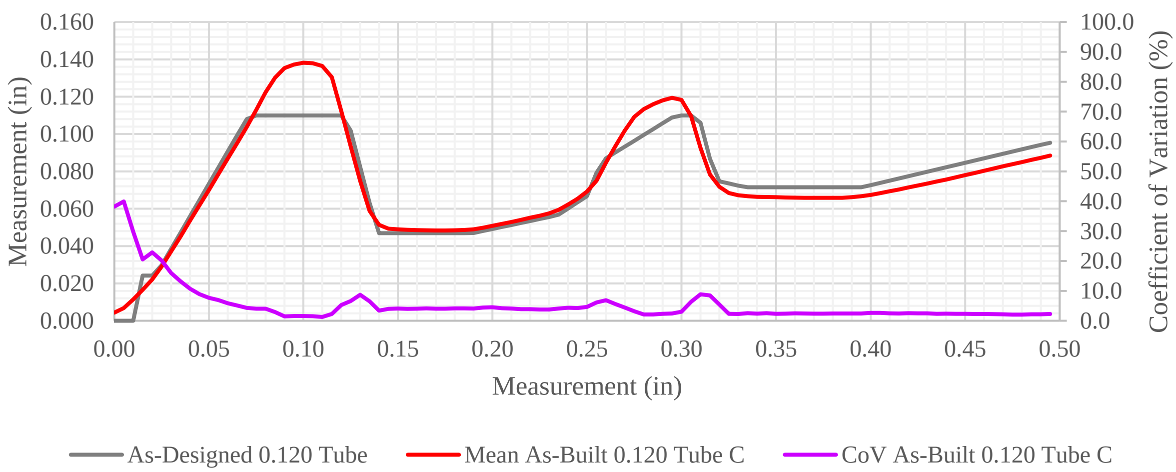


Figure C.24 Coefficient of Variation - 0.104 in Tube C Coined Pressed End Profiles

Appendix D

As-Designed Axial Semi-Rigid Behavior Characterization Graphs and Tabulated Data

D-090 Axial Semi-Rigid Behavior

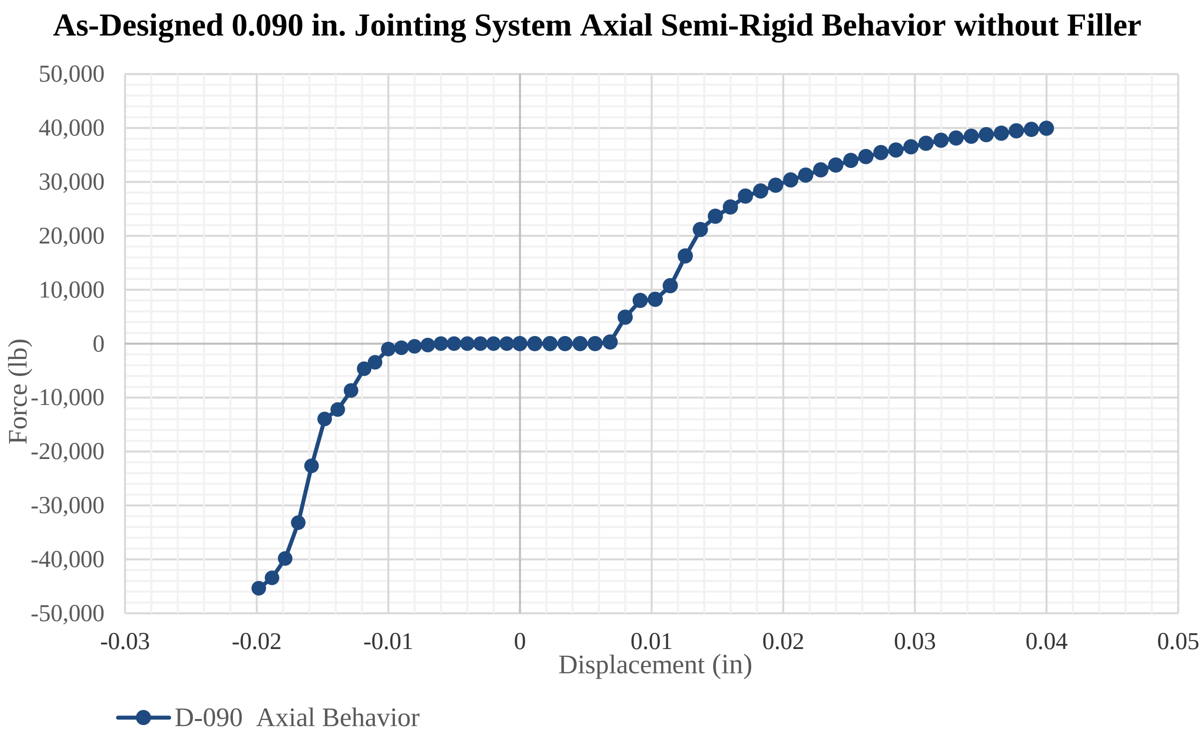


Figure D.1 Axial Semi-Rigid Behavior (D-090)

Table D.1 Tensile Load-Displacement of D-090

Displacement (in)	Force (lb)
	D-090
0.000	0.00
0.002	0.00
0.004	0.00
0.006	71.60
0.008	4,879.09
0.010	8,144.10
0.012	13,485.82
0.014	21,760.79
0.016	25,316.08
0.018	28,066.05
0.020	29,849.39
0.022	31,479.00
0.024	33,104.27
0.026	34,502.74
0.028	35,650.87
0.030	36,636.50
0.032	37,698.20
0.034	38,362.13
0.036	38,867.47
0.038	39,510.47
0.040	39,923.19

Table D.2 Compressive Load-Displacement of D-090

Displacement (in)	Force (lb)
	D-090
0.000	0.00
-0.002	0.00
-0.004	0.00
-0.006	0.00
-0.008	-517.25
-0.010	-1,010.56
-0.012	-5,334.22
-0.014	-12,513.41
-0.016	-24,423.95
-0.018	-40,450.41
-0.0198	-45,375.74

D-090F Axial Semi-Rigid Behavior

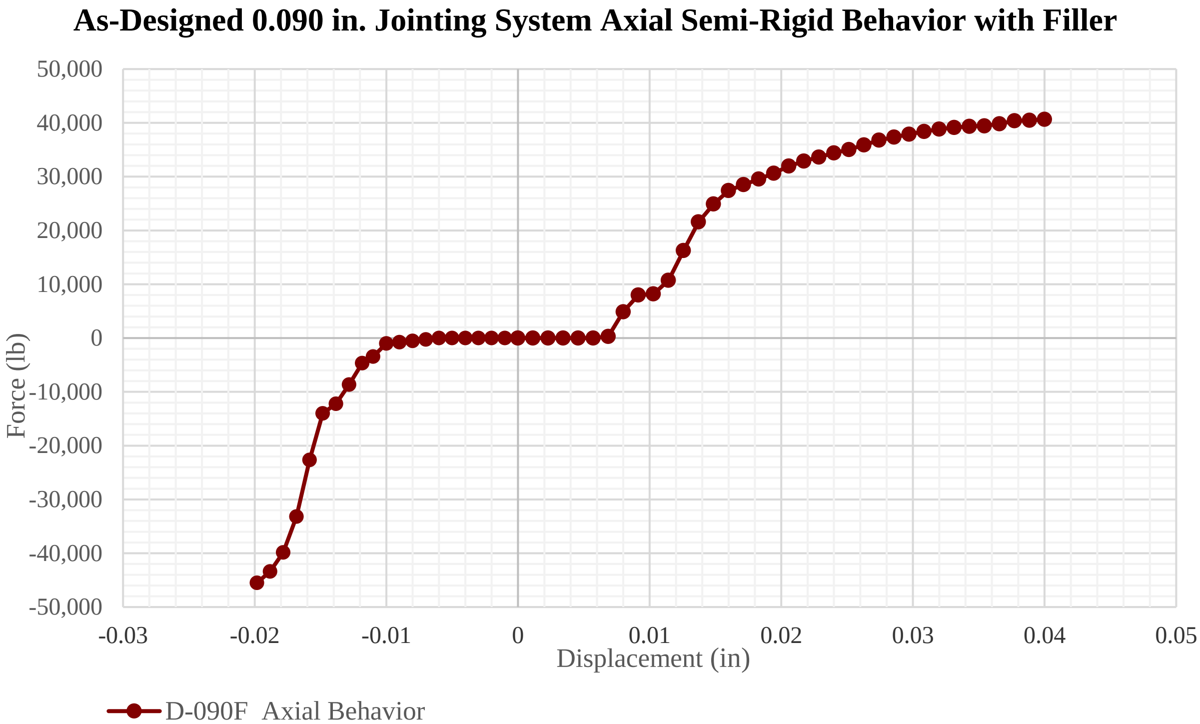


Figure D.2 Axial Semi-Rigid Behavior (D-090F)

Table D.3 Tensile Load-Displacement of D-090F

Displacement (in)	Force (lb)
	D-090F
0.000	0.00
0.002	0.00
0.004	0.00
0.006	71.60
0.008	4,879.09
0.010	8,144.10
0.012	13,485.82
0.014	22,733.71
0.016	27,317.26
0.018	29,249.98
0.020	31,288.61
0.022	33,062.25
0.024	34,393.87
0.026	35,673.58
0.028	37,054.59
0.030	38,010.52
0.032	38,827.11
0.034	39,293.50
0.036	39,625.85
0.038	40,391.87
0.040	40,648.22

Table D.4 Compressive Load-Displacement of D-090F

Displacement (in)	Force (lb)
	D-090F
0.000	0.00
-0.002	0.00
-0.004	0.00
-0.006	0.00
-0.008	-517.25
-0.010	-1,010.56
-0.012	-5,331.29
-0.014	-12,506.86
-0.016	-24,423.67
-0.018	-40,440.63
-0.0198	-45,509.90

D-104 Axial Semi-Rigid Behavior

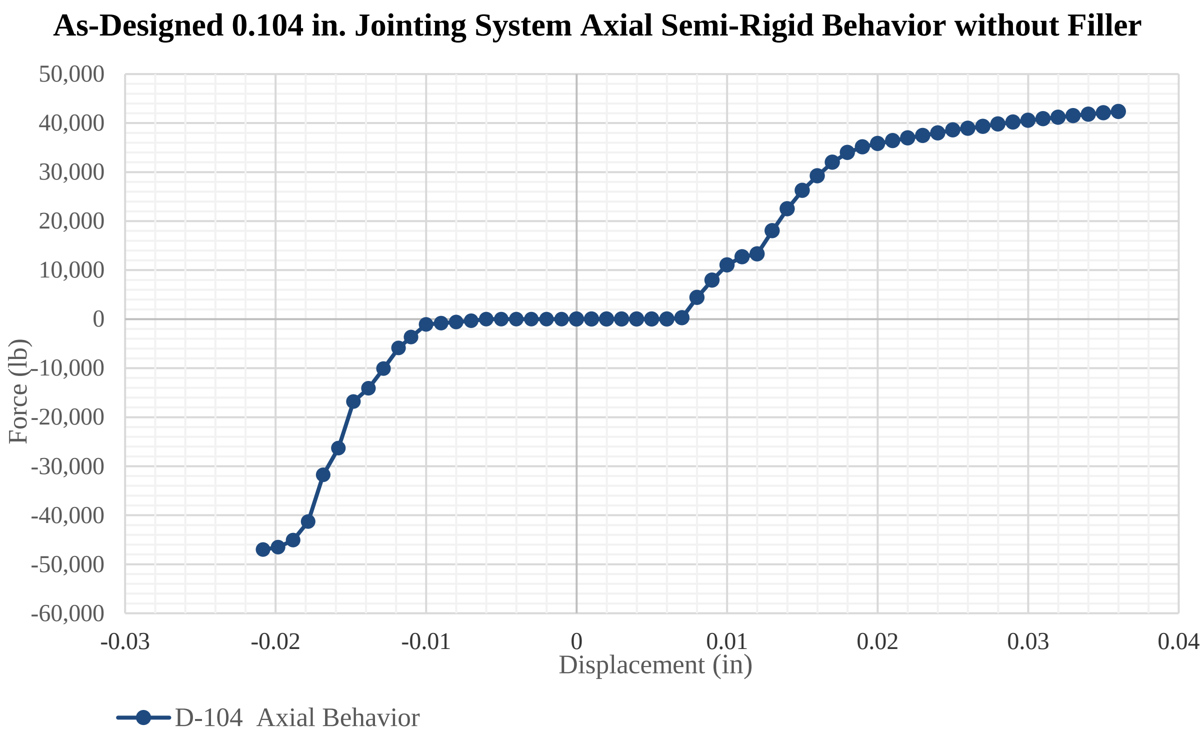


Figure D.3 Axial Semi-Rigid Behavior (D-104)

Table D.5 Tensile Load-Displacement of D-104

Displacement (in)	Force (lb)
	D-104
0.000	0.00
0.002	0.00
0.004	0.00
0.006	0.00
0.008	4,408.28
0.010	11,050.17
0.012	13,281.66
0.014	22,494.79
0.016	29,233.98
0.018	33,986.23
0.020	35,812.83
0.022	36,949.46
0.024	37,956.88
0.026	38,925.66
0.028	39,784.08
0.030	40,548.36
0.032	41,176.44
0.034	41,793.41
0.036	42,337.03

Table D.6 Compressive Load-Displacement of D-104

Displacement (in)	Force (lb)
	D-104
0.000	0.00
-0.002	0.00
-0.004	0.00
-0.006	0.00
-0.008	-578.35
-0.010	-1,070.83
-0.012	-6,594.75
-0.014	-14,553.01
-0.016	-27,230.52
-0.018	-41,918.25
-0.020	-46,594.34
-0.0208	-47,017.89

D-104F Axial Semi-Rigid Behavior

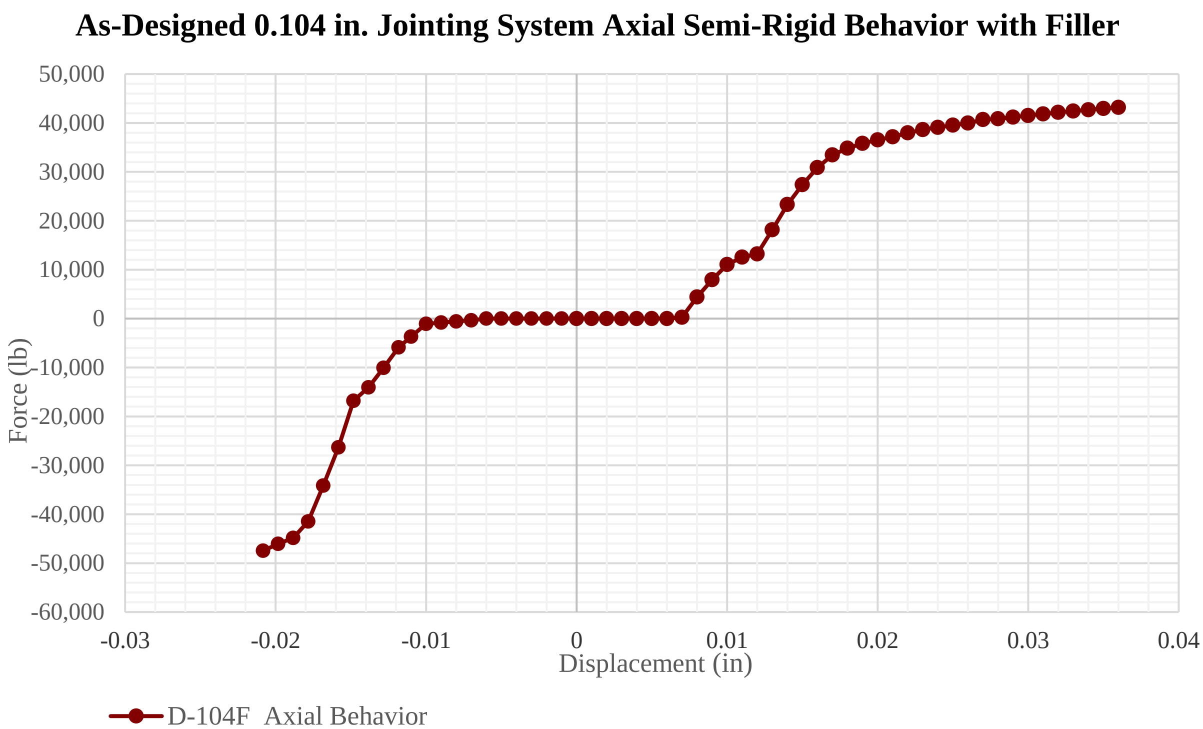


Figure D.4 Axial Semi-Rigid Behavior (D-104F)

Table D.7 Tensile Load-Displacement of D-104F

Displacement (in)	Force (lb)
	D-104F
0.000	0.00
0.002	0.00
0.004	0.00
0.006	0.00
0.008	4,408.28
0.010	11,050.17
0.012	13,221.90
0.014	23,317.89
0.016	30,872.58
0.018	34,833.89
0.020	36,547.98
0.022	37,969.87
0.024	39,098.19
0.026	39,962.72
0.028	40,839.78
0.030	41,521.34
0.032	42,149.41
0.034	42,702.79
0.036	43,178.93

Table D.8 Compressive Load-Displacement of D-104F

Displacement (in)	Force (lb)
	D-104F
0.000	0.00
-0.002	0.00
-0.004	0.00
-0.006	0.00
-0.008	-578.35
-0.010	-1,070.83
-0.012	-6,590.96
-0.014	-14,520.79
-0.016	-27,624.45
-0.018	-42,026.09
-0.020	-46,300.79
-0.0208	-47,472.74

D-120 Axial Semi-Rigid Behavior

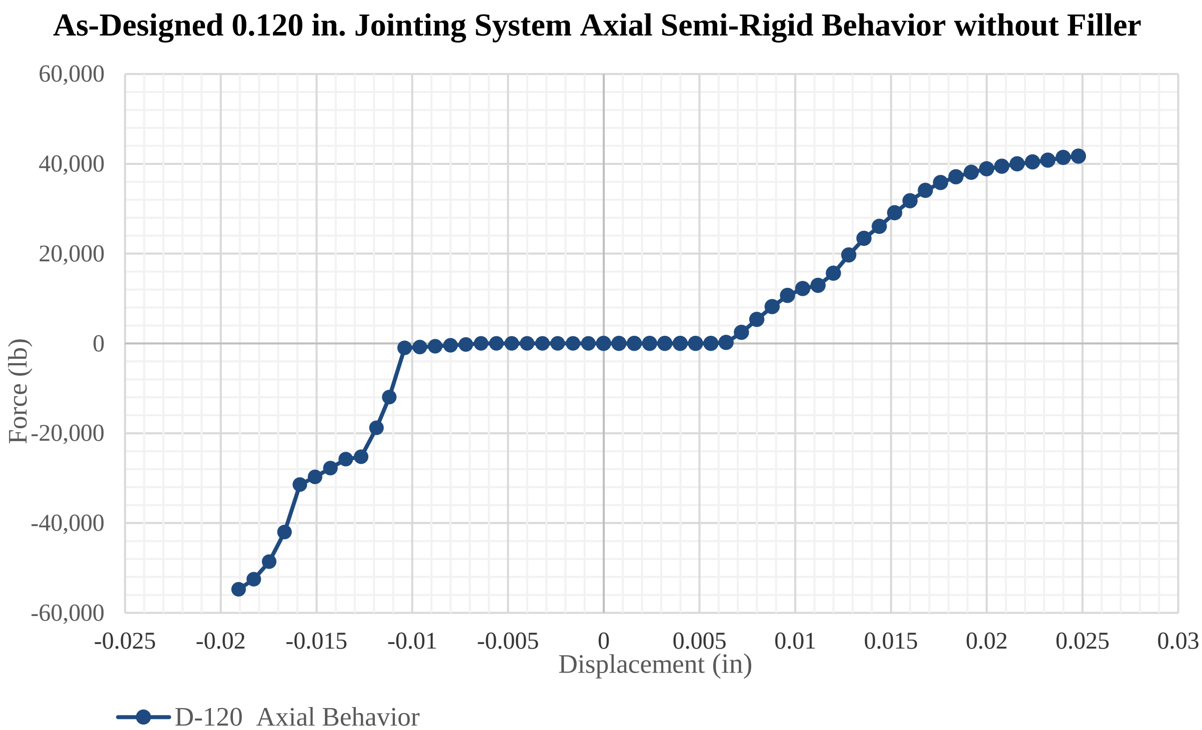


Figure D.5 Axial Semi-Rigid Behavior (D-120)

Table D.9 Tensile Load-Displacement of D-120

Displacement (in)	Force (lb)
	D-120
0.000	0.00
0.002	0.00
0.004	0.00
0.006	101.59
0.008	5,333.01
0.010	11,432.33
0.012	15,599.60
0.014	24,714.68
0.016	31,758.91
0.018	36,440.81
0.020	38,849.73
0.022	40,175.44
0.024	41,380.38
0.0248	41,664.51

Table D.10 Compressive Load-Axial Displacement of D-120

Displacement (in)	Force (lb)
	D-120
0.000	0.00
-0.002	0.00
-0.004	0.00
-0.006	0.00
-0.008	-439.91
-0.010	-903.78
-0.012	-19,878.80
-0.014	-27,096.02
-0.016	-33,201.46
-0.018	-51,221.61
-0.0191	-54,768.46

D-120F Axial Semi-Rigid Behavior

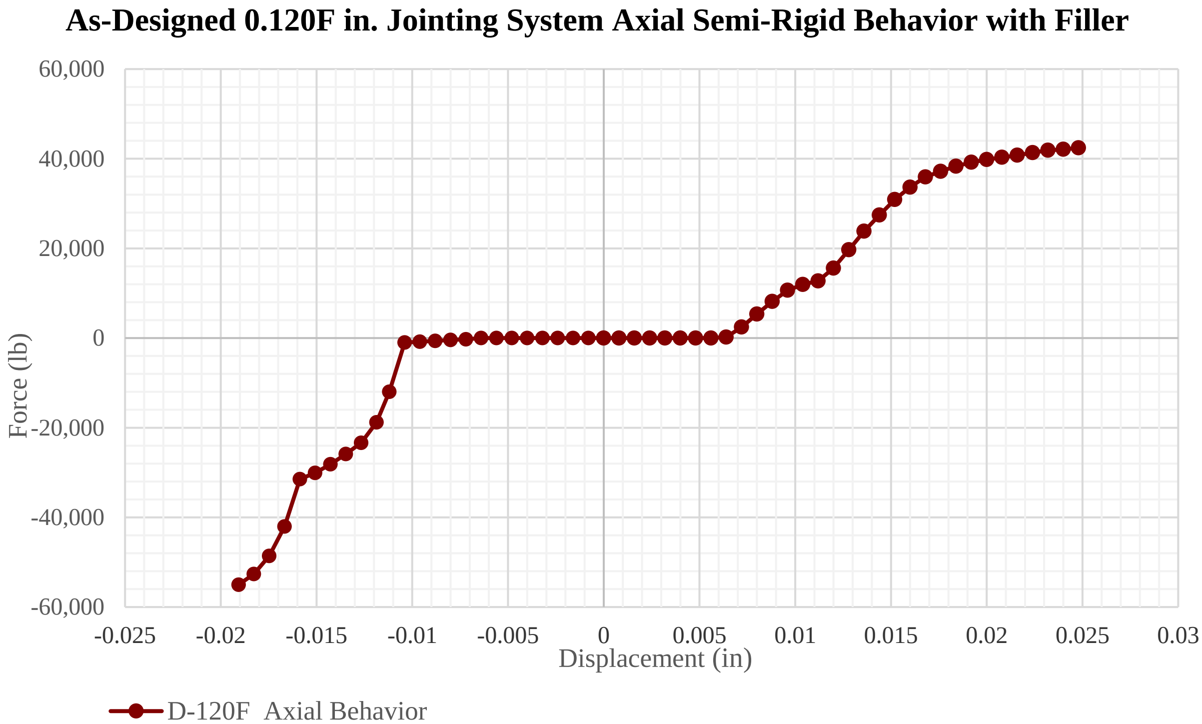


Figure D.6 Axial Semi-Rigid Behavior (D-120F)

Table D.11 Tensile Load-Displacement of D-120F

Displacement (in)	Force (lb)
	D-120F
0.000	0.00
0.002	0.00
0.004	0.00
0.006	101.59
0.008	5,333.01
0.010	11,297.68
0.012	15,600.29
0.014	25,640.22
0.016	33,657.35
0.018	37,751.39
0.020	39,802.76
0.022	41,064.91
0.024	42,094.97
0.0248	42,412.36

Table D.12 Compressive Load-Displacement of D-120F

Displacement (in)	Force (lb)
	D-120F
0.000	0.00
-0.002	0.00
-0.004	0.00
-0.006	0.00
-0.008	-439.91
-0.010	-903.78
-0.012	-19,570.47
-0.014	-27,397.87
-0.016	-33,222.33
-0.018	-51,295.59
-0.0191	-55,015.09

Appendix E

As-Designed In-Plane Semi-Rigid Behavior Characterization Graphs and Tabulated Data

D-090 In-Plane Semi-Rigid Behavior

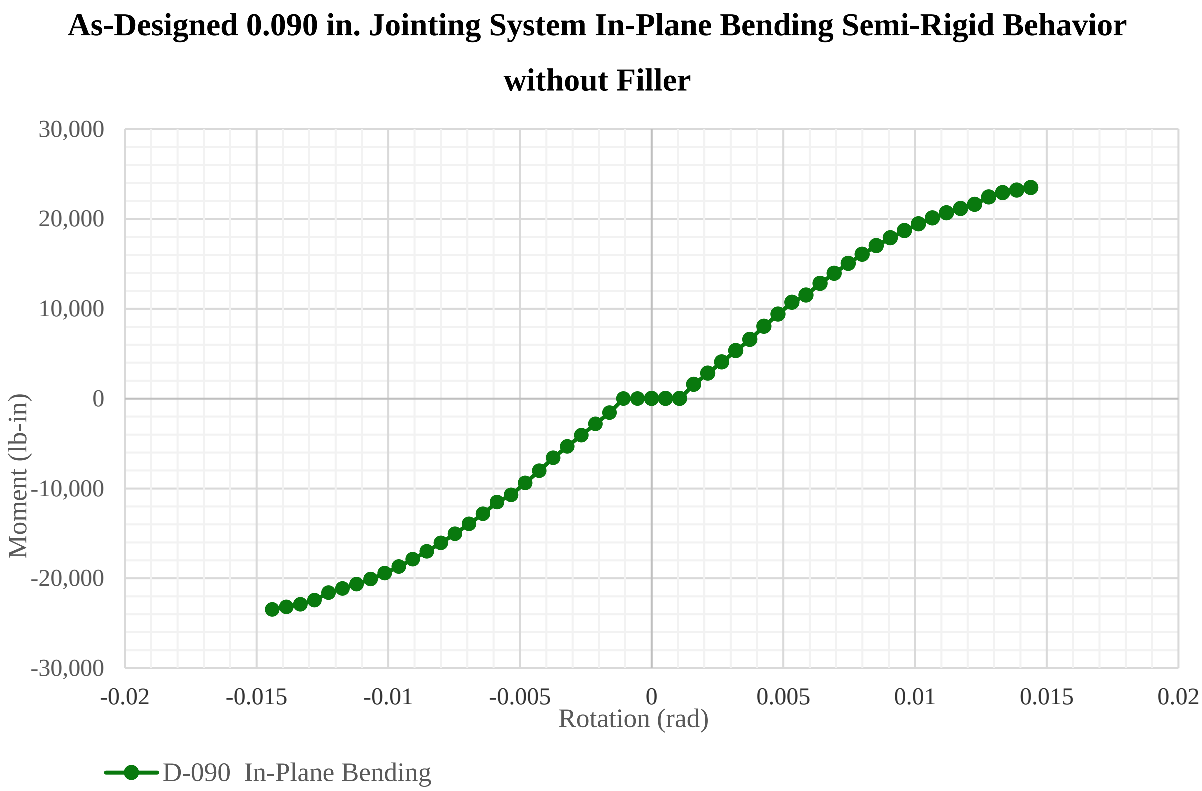


Figure E.1 In-Plane Bending Semi-Rigid Behavior (D-090)

Table E.1 In-Plane Bending Moment-Rotation of D-090

Rotation (rad)	Moment (lb-in)
	D-090
0.000	0.00
0.002	2,508.26
0.004	7,308.33
0.006	11,838.03
0.008	16,053.57
0.010	19,245.24
0.012	21,370.36
0.014	23,260.09
0.0144	23,472.28

D-090F In-Plane Semi-Rigid Behavior

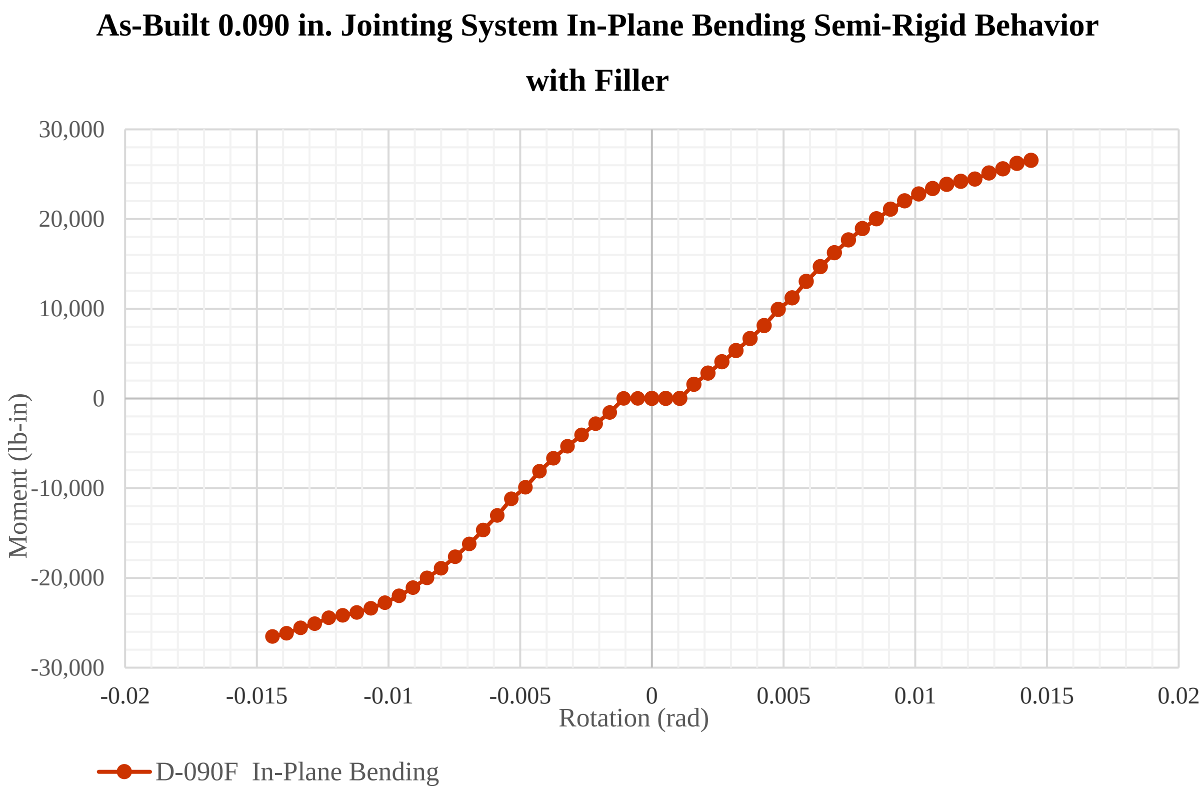


Figure E.2 In-Plane Bending Semi-Rigid Behavior (D-090F)

Table E.2 In-Plane Bending Moment-Rotation of D-090F

Rotation (rad)	Moment (lb-in)
	D-090F
0.000	0.00
0.002	2,508.26
0.004	7,395.90
0.006	13,446.98
0.008	18,931.99
0.010	22,584.68
0.012	24,314.99
0.014	26,268.55
0.0144	26,526.64

D-104 In-Plane Semi-Rigid Behavior

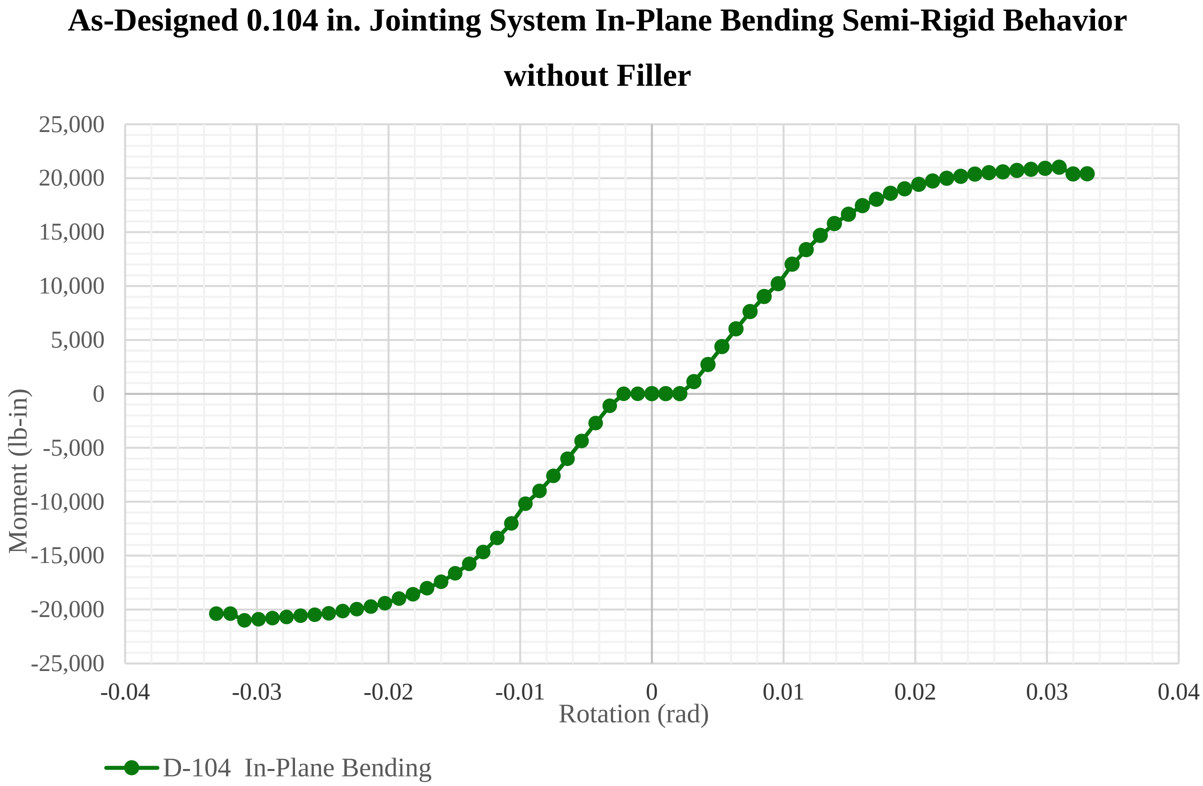


Figure E.3 In-Plane Bending Semi-Rigid Behavior (D-104)

Table E.3 In-Plane Bending Moment-Rotation of D-104

Rotation (rad)	Moment (lb-in)
	D-104
0.000	0.00
0.002	0.87
0.004	2,313.96
0.006	5,402.47
0.008	8,311.22
0.010	10,881.28
0.012	13,692.81
0.014	15,886.84
0.016	17,440.56
0.018	18,516.23
0.020	19,313.83
0.022	19,881.46
0.024	20,251.89
0.026	20,521.52
0.028	20,726.12
0.030	20,914.21
0.032	20,383.06
0.0331	20,385.77

D-104F In-Plane Semi-Rigid Behavior

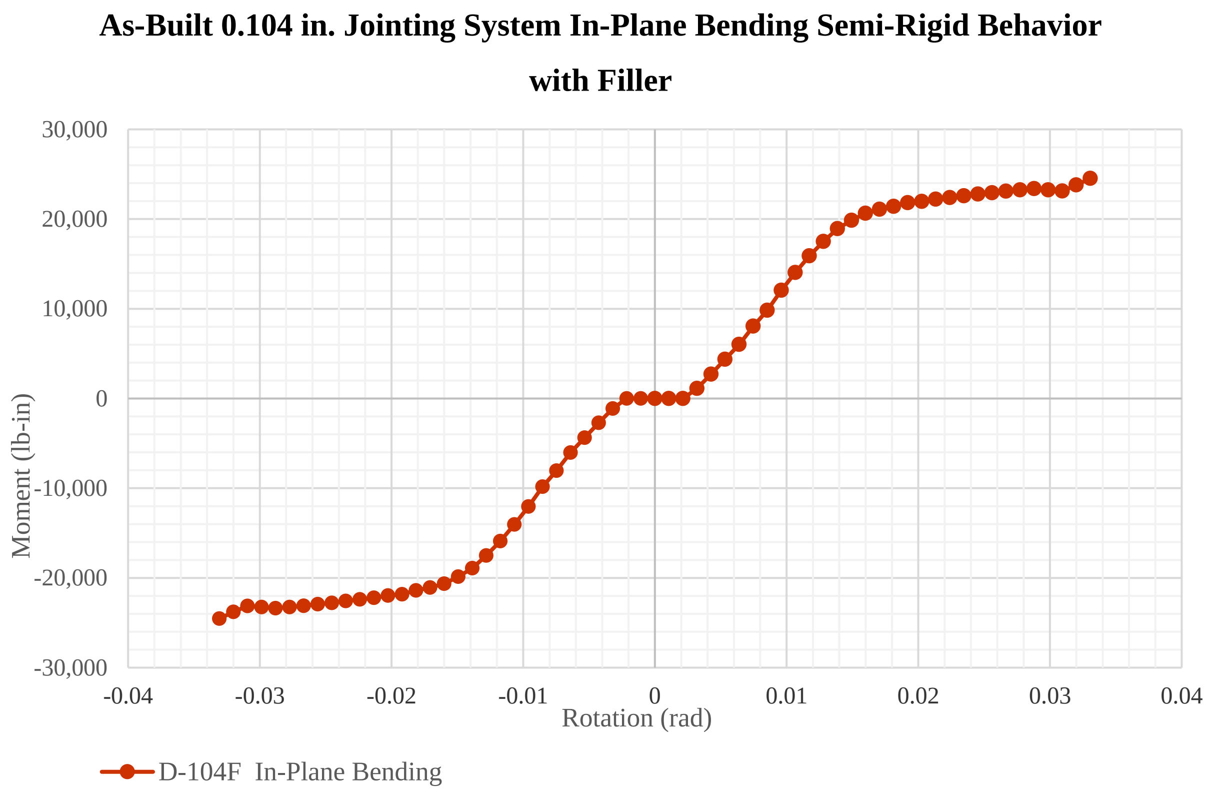


Figure E.4 In-Plane Bending Semi-Rigid Behavior (D-104F)

Table E.4 In-Plane Bending Moment-Rotation of D-104F

Rotation (rad)	Moment (lb-in)
	D-104F
0.000	0.00
0.002	0.87
0.004	2,313.96
0.006	5,403.36
0.008	8,937.75
0.010	12,796.10
0.012	16,297.21
0.014	19,035.86
0.016	20,645.07
0.018	21,359.39
0.020	21,931.54
0.022	22,325.25
0.024	22,681.43
0.026	22,992.38
0.028	23,280.13
0.030	22,232.25
0.032	23,790.53
0.0331	24,533.98

D-120 In-Plane Semi-Rigid Behavior

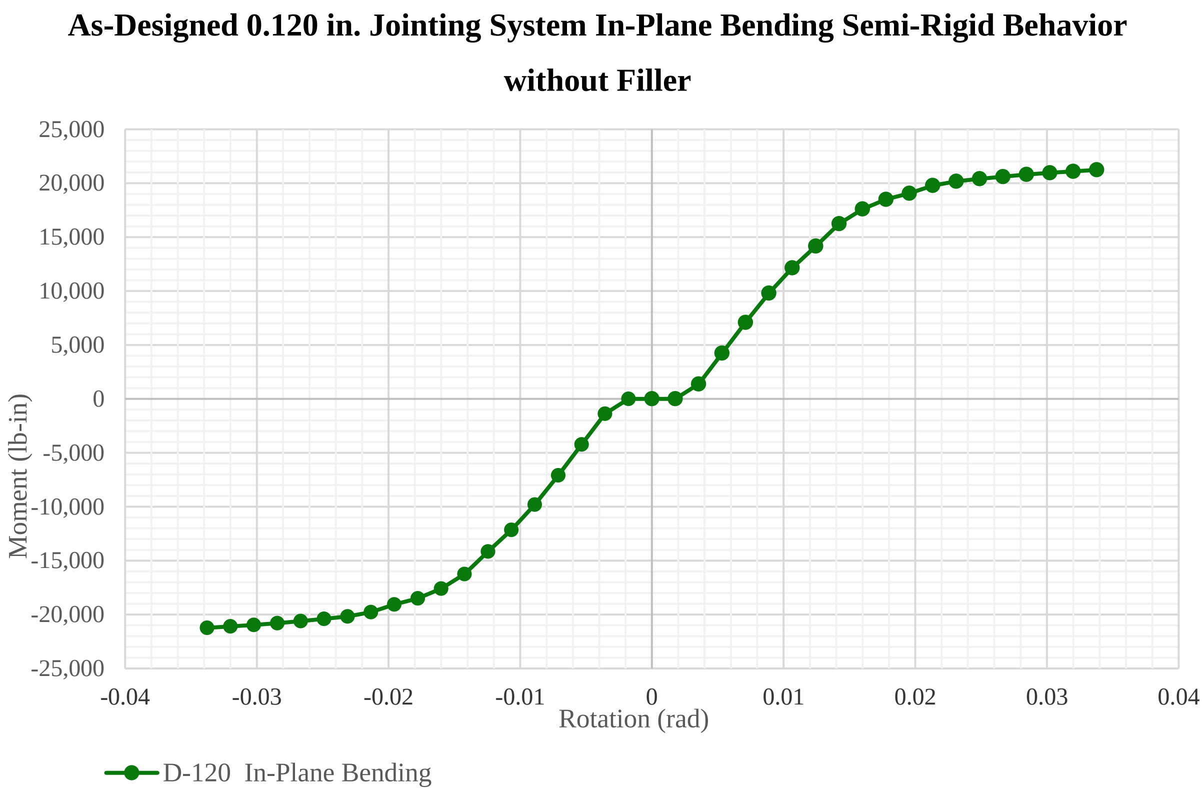


Figure E.5 In-Plane Bending Semi-Rigid Behavior (D-120)

Table E.5 In-Plane Bending Moment-Rotation of D-120

Rotation (rad)	Moment (lb-in)
	D-120
0.000	0.00
0.002	172.39
0.004	2,089.90
0.006	5,303.81
0.008	8,445.36
0.010	11,265.73
0.012	13,652.90
0.014	15,982.03
0.016	17,602.02
0.018	18,568.20
0.020	19,243.36
0.022	19,929.73
0.024	20,290.21
0.026	20,528.13
0.028	20,751.65
0.030	20,938.06
0.032	21,096.64
0.0338	21,235.65

D-120F In-Plane Semi-Rigid Behavior

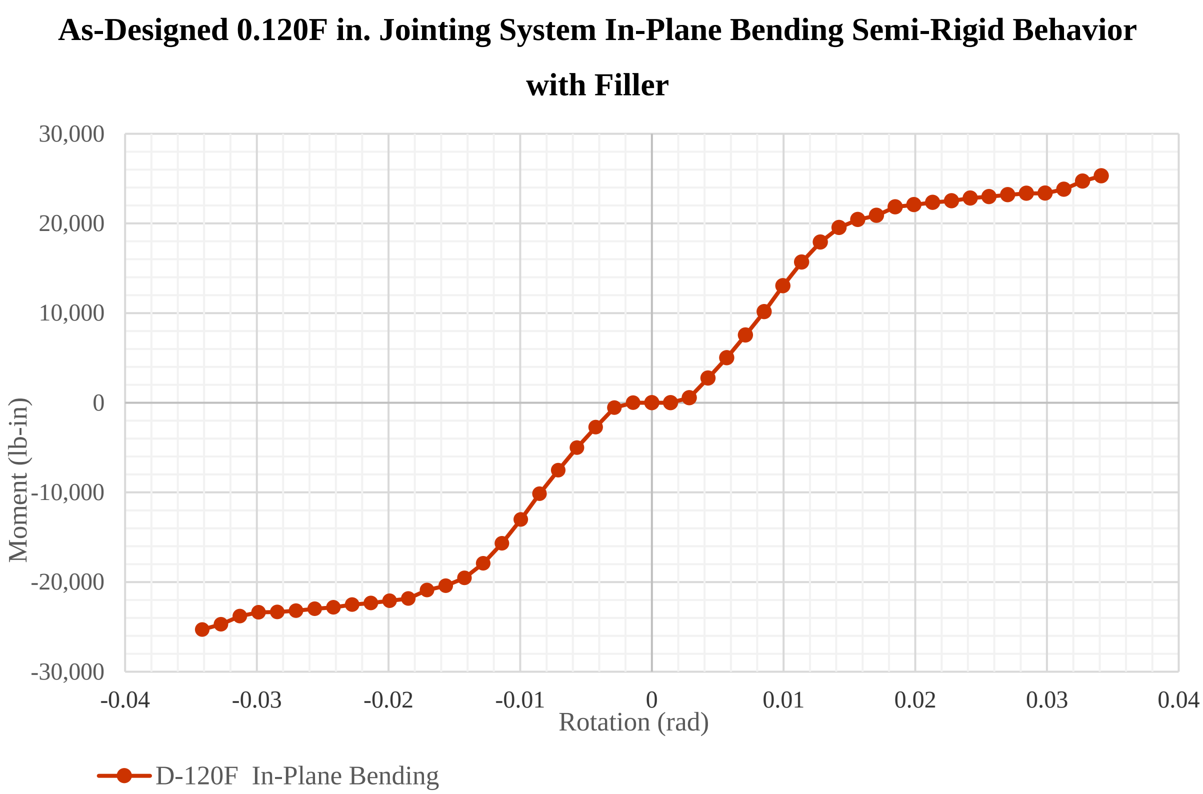


Figure E.6 In-Plane Bending Semi-Rigid Behavior (D-120F)

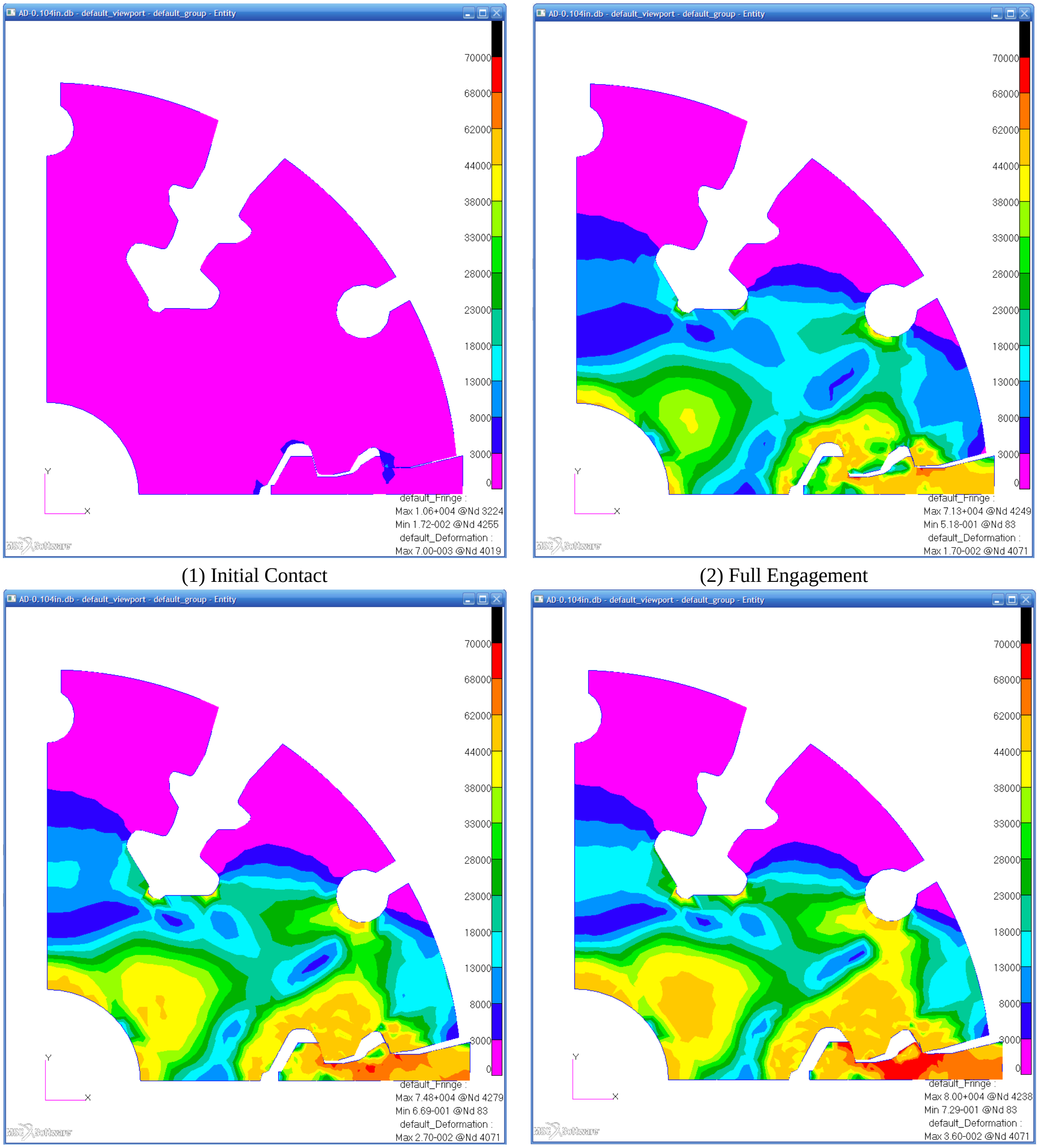
Table E.6 In-Plane Bending Moment-Rotation of D-120F

Rotation (rad)	Moment (lb-in)
	D-120F
0.000	0.00
0.002	224.40
0.004	2,326.09
0.006	5,560.60
0.008	9,166.52
0.010	13,115.92
0.012	16,658.52
0.014	19,286.02
0.016	20,535.16
0.018	21,512.14
0.020	22,100.10
0.022	22,419.58
0.024	22,781.29
0.026	23,041.02
0.028	23,296.61
0.030	22,023.70
0.032	24,255.54
0.034	25,239.19
0.0341	25,293.92

Appendix F

D-104 Axial Semi-Rigid Behavior Results and Conclusions

The tensile finite element simulation of the D-104 semi-rigid behavior is illustrated in the series of plots shown in **Figure F.1**.



(1) Initial Contact

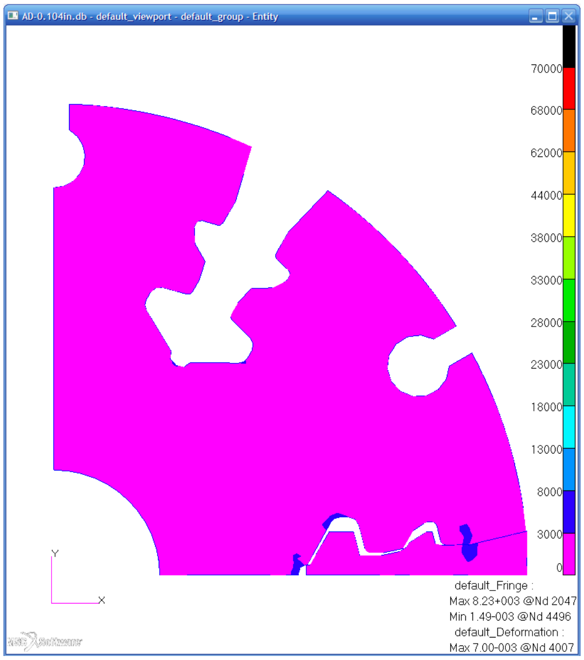
(2) Full Engagement

(3) Development of Yielding Stresses

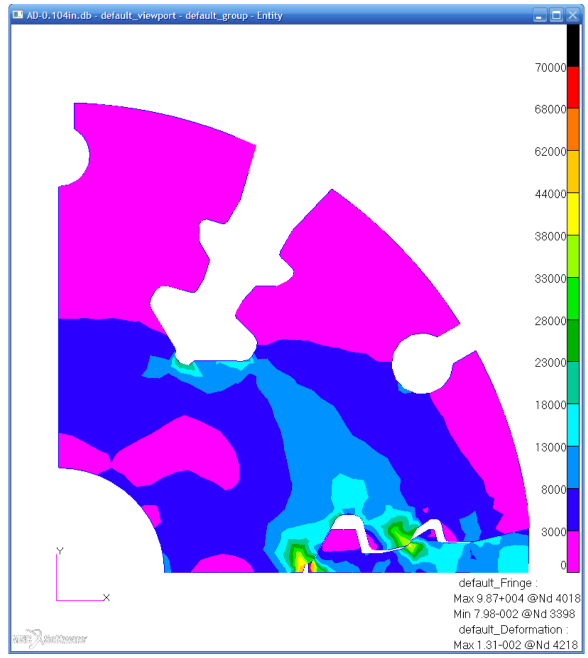
(4) Ultimate Capacity

Figure F.1 Von Mises Stress of D-104 under Tension from Initial Contact to Failure

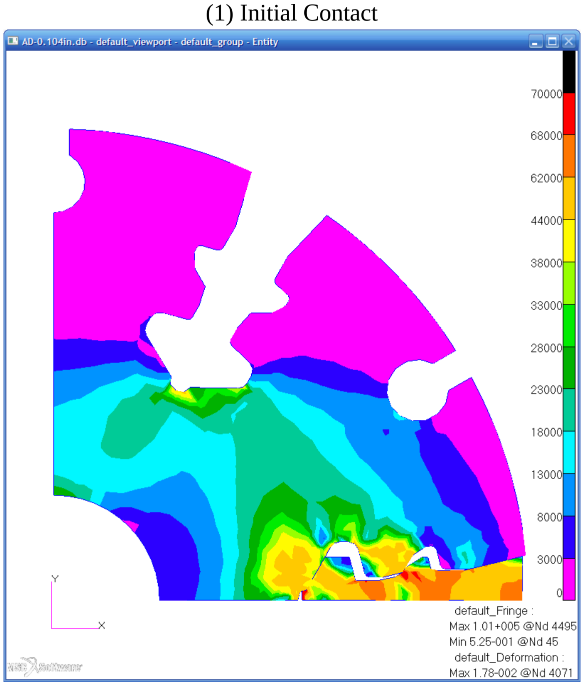
The compressive finite element simulation of the D-104 semi-rigid behavior is illustrated in the series of plots shown in **Figure F.2**.



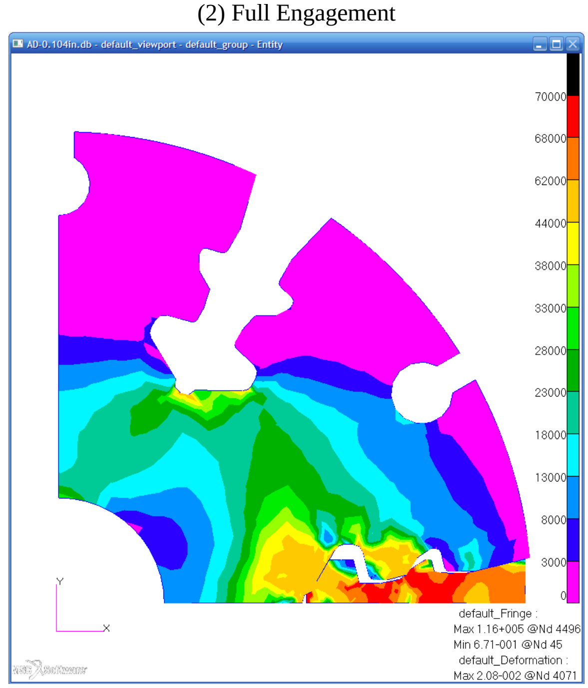
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure F.2 Von Mises Stress of D-104 under Compression from Initial Contact to Failure

Figure F.3 presents the axial semi-rigid behavior of the D-104 simulation model.

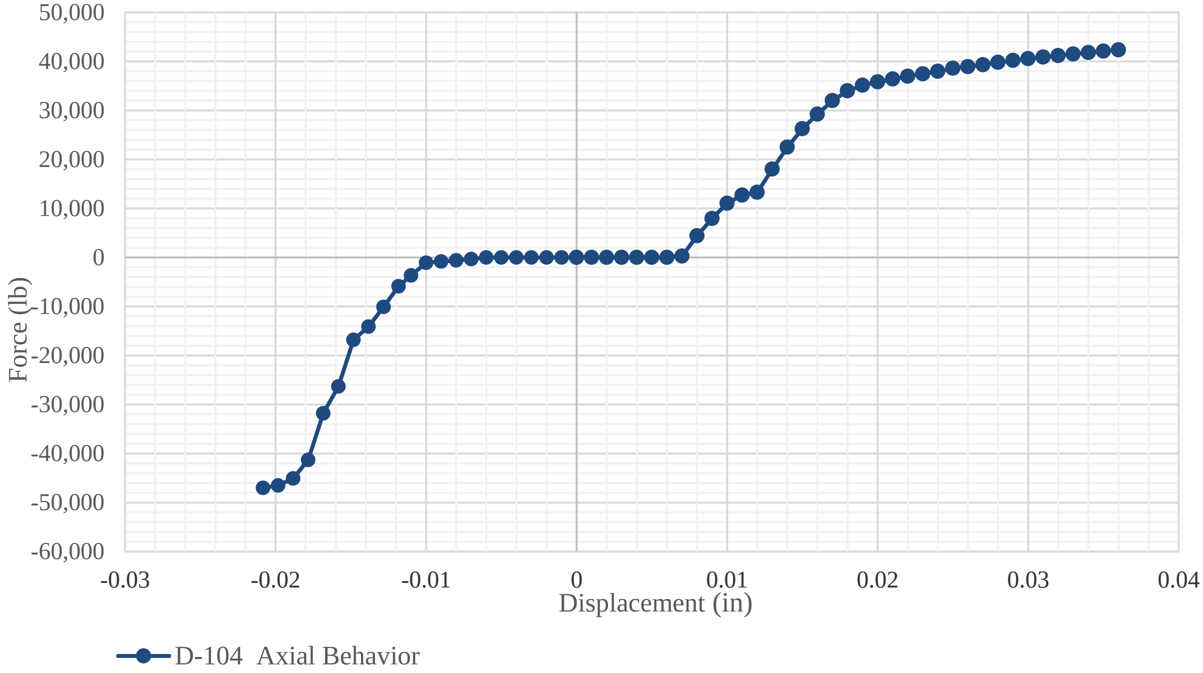
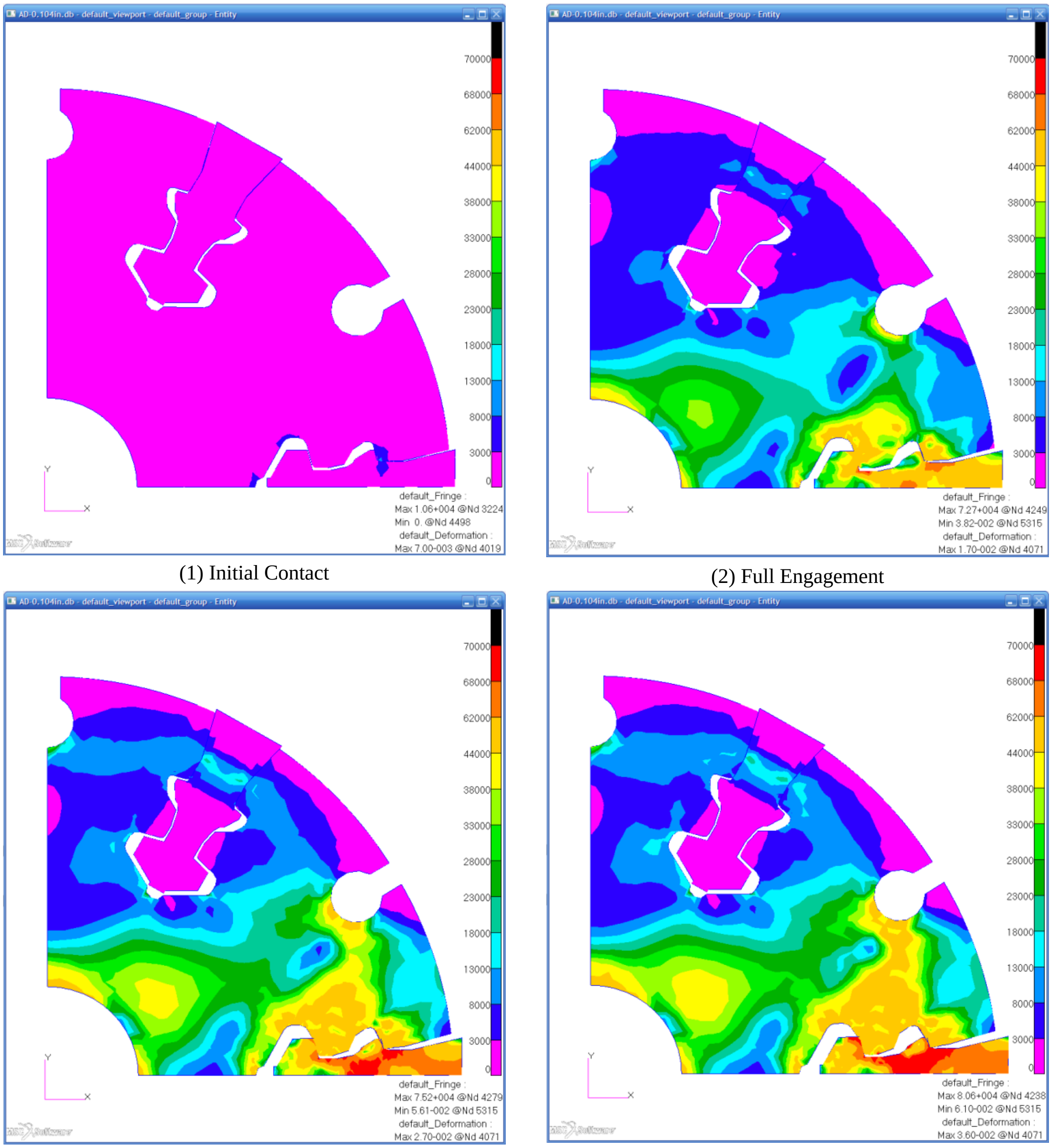


Figure F.3 Axial Semi-Rigid Behavior of D-104

The tensile finite element simulation of the D-104F semi-rigid behavior is illustrated in the series of plots shown in **Figure F.4**.



(1) Initial Contact

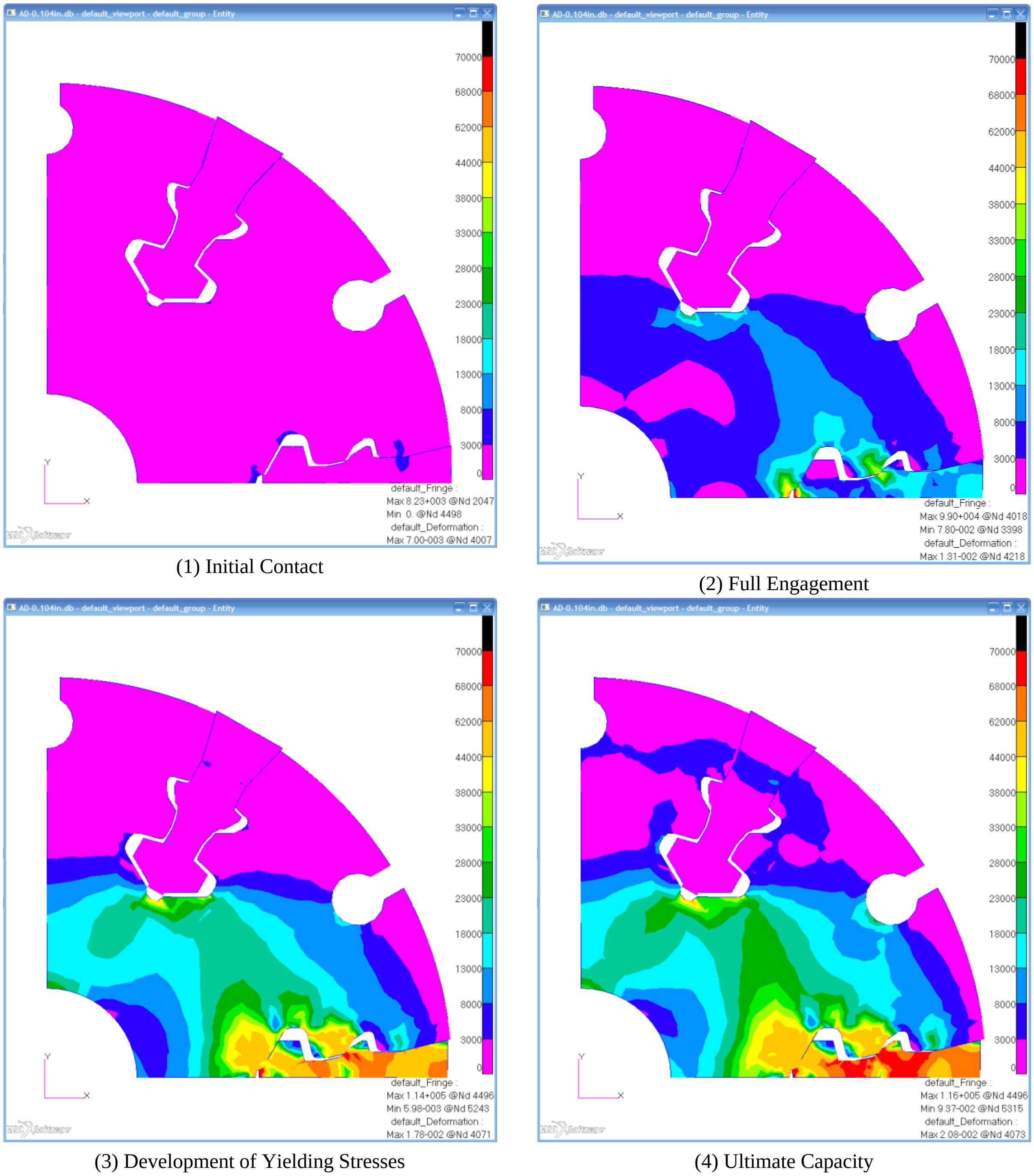
(2) Full Engagement

(3) Development of Yielding Stresses

(4) Ultimate Capacity

Figure F.4 Von Mises Stress of D-104F under Tension from Initial Contact to Failure

The compressive finite element simulation of the D-104F semi-rigid behavior is illustrated in the series of plots shown in **Figure F.5**.



(1) Initial Contact

(2) Full Engagement

(3) Development of Yielding Stresses

(4) Ultimate Capacity

Figure F.5 Von Mises Stress of D-104F under Compression from Initial Contact to Failure

Figure F.6 presents the axial semi-rigid behavior of the D-104F simulation model.

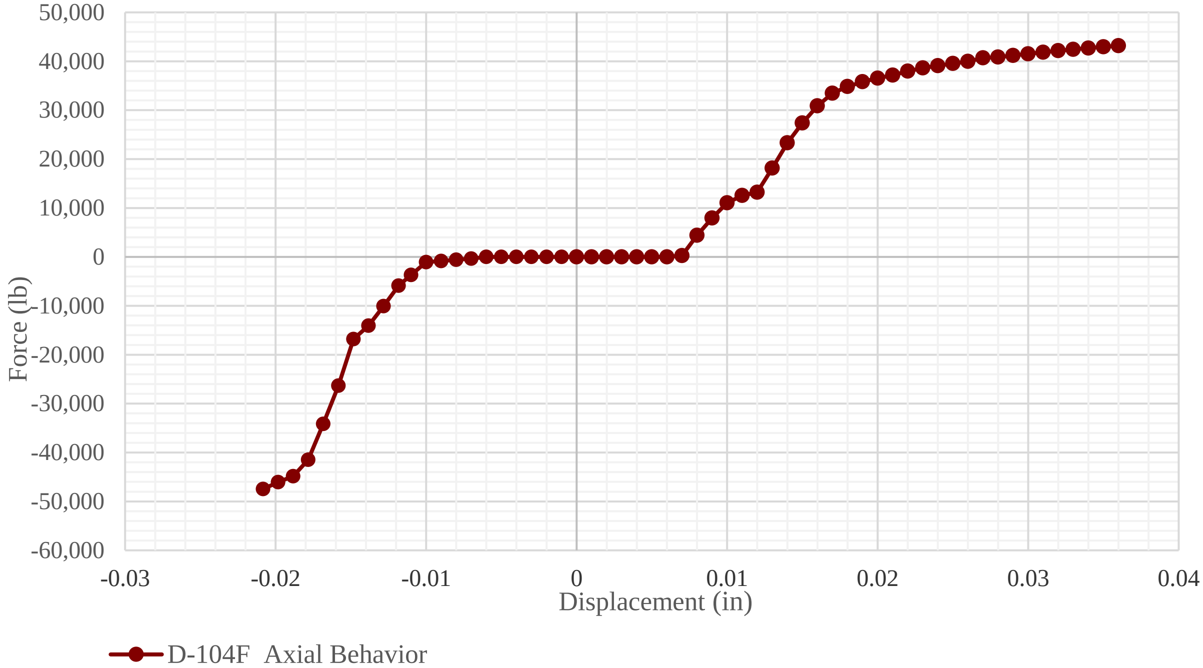


Figure F.6 Axial Semi-Rigid Behavior of D-104F

104 Comparison (1)

Figure F.7 presents a plot of the load-displacement recorded during the axial semi-rigid analysis of the D-104 and D-104F models, up to ultimate capacity at force increments of 5,000 pounds. **Table F.1** and **Table F.2** compare the tensile and compressive characterization data at 5,000 pound increments, respectively. The D-104 and D-104F models have ultimate loads recorded at 42,337.03 pounds and 43,178.93 pounds at 0.0360 inches during tension and 47,017.89 pounds and 47,472.74 pounds at 0.0208 inches during compression, respectively. These results represent an increase of 1.99% in tension and 0.97% in compression as a result of the incorporation of the filler into the jointing system.

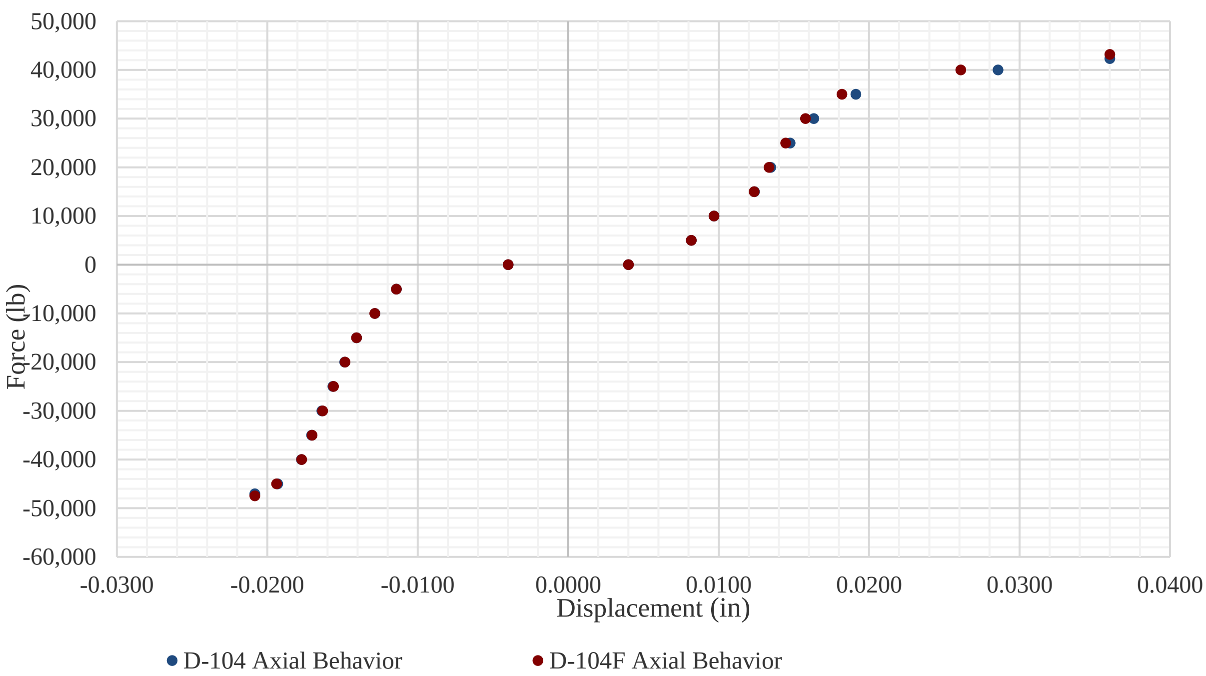


Figure F.7 Axial Semi-Rigid Behavior of D-104 & D-104F

Table F.1 Tensile Load-Displacement: 104 Comparison (1)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-104	D-104F	D-104 vs. D-104F
0	0.0040	0.0040	0.00
5,000	0.0082	0.0082	0.00
10,000	0.0097	0.0097	0.00
15,000	0.0124	0.0124	-0.17
20,000	0.0135	0.0133	-0.86
25,000	0.0147	0.0144	-2.02
30,000	0.0163	0.0158	-3.39
35,000	0.0191	0.0182	-4.79
40,000	0.0286	0.0261	-8.68

Table F.2 Compressive Load-Displacement: 104 Comparison (1)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-104	D-104F	D-104 vs. D-104F
0	-0.0040	-0.0040	0.00
-5,000	-0.0114	-0.0114	0.01
-10,000	-0.0129	-0.0129	0.03
-15,000	-0.0141	-0.0141	0.02
-20,000	-0.0149	-0.0148	-0.15
-25,000	-0.0156	-0.0156	-0.31
-30,000	-0.0164	-0.0163	-0.29
-35,000	-0.0171	-0.0170	-0.20
-40,000	-0.0177	-0.0177	-0.11
-45,000	-0.0193	-0.0194	0.38

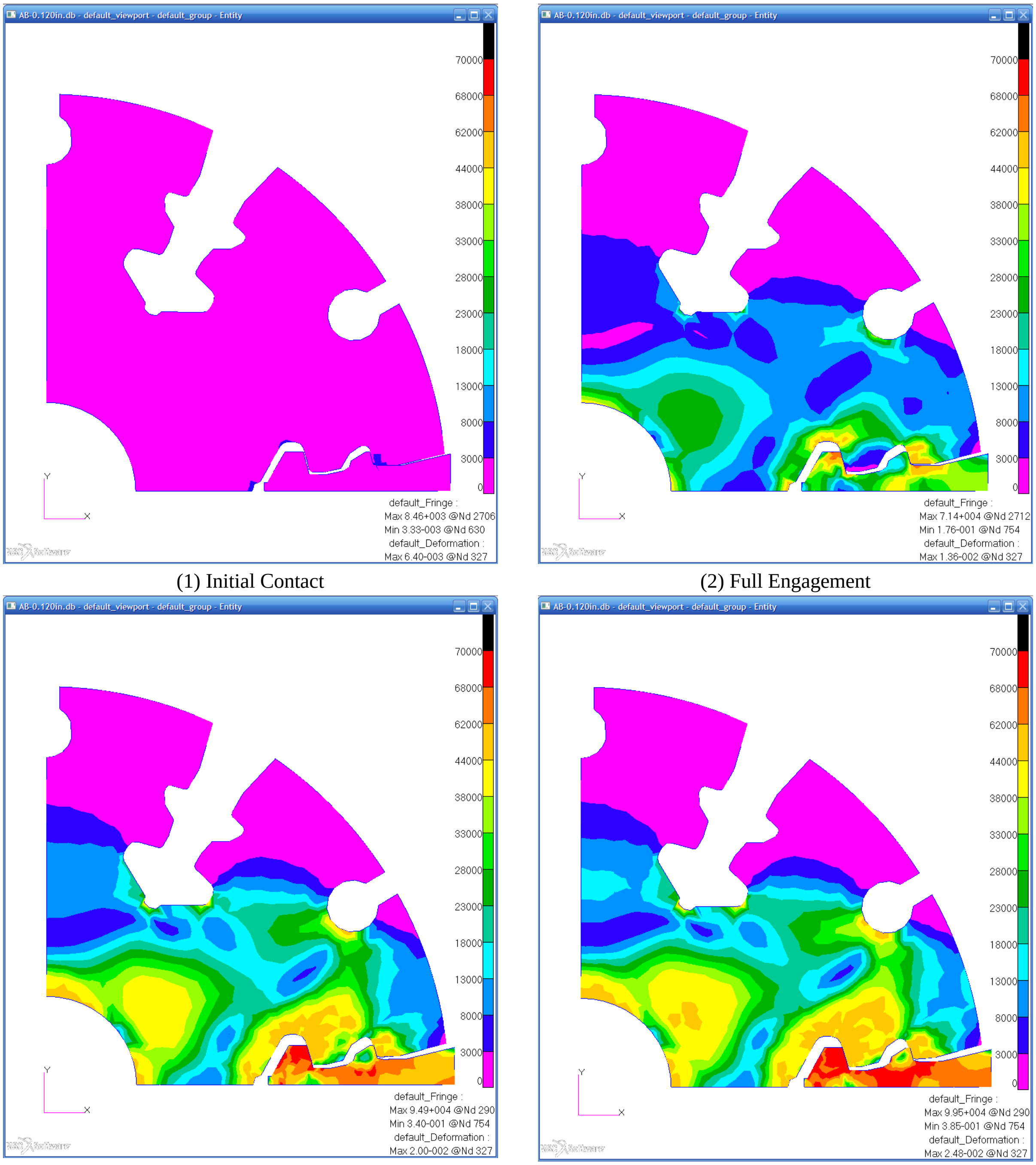
The preceding results show:

- From **Table F.1** it is observed that incorporating the filler into the jointing system did not impact the displacement during the first 10,000 pounds in tension. Furthermore, a slight increase in stiffness of 0.17% is observed at 15,000 pounds reaching up to 8.68% at 40,000 pounds during tension.
- From **Table F.2** no significant change of rigidity was observed due to the incorporation of the filler into the jointing system during compression.
- It can be concluded that at larger forces, there is a slight increment in rigidity when incorporating the filler into the jointing system.

Appendix G

D-120 Axial Semi-Rigid Behavior Results and Conclusions

The tensile finite element simulation of the D-120 semi-rigid behavior is illustrated in the series of plots shown in **Figure G.1**.



(1) Initial Contact

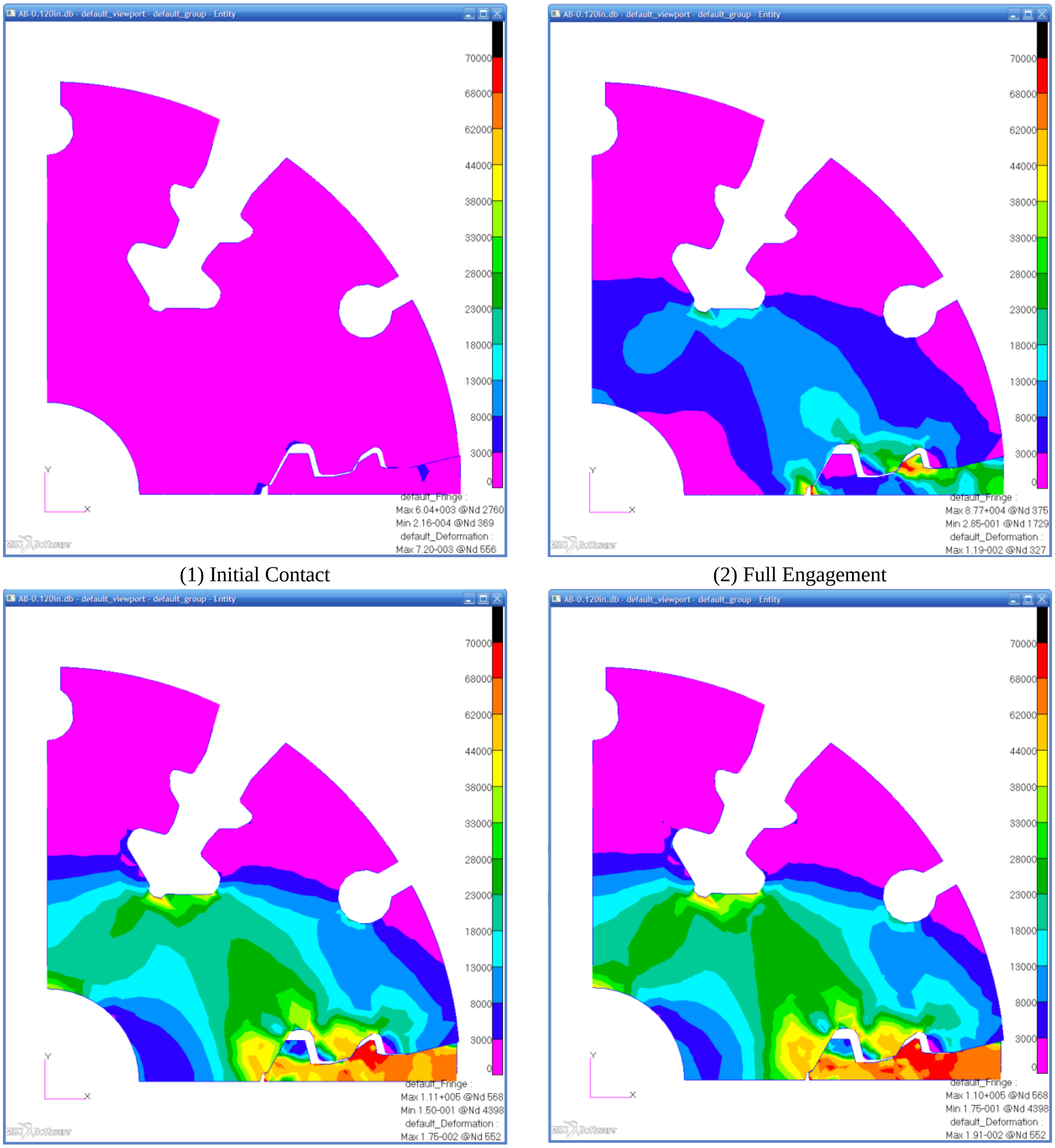
(2) Full Engagement

(3) Development of Yielding Stresses

(4) Ultimate Capacity

Figure G.1 Von Mises Stress of D-120 under Tension from Initial Contact to Failure

The compressive finite element simulation of the D-120 semi-rigid behavior is illustrated in the series of plots shown in **Figure G.2**.



(1) Initial Contact

(2) Full Engagement

(3) Development of Yielding Stresses

(4) Ultimate Capacity

Figure G.2 Von Mises Stress of D-120 under Compression from Initial Contact to Failure

Figure G.3 presents the axial semi-rigid behavior of the D-120 numerical model.

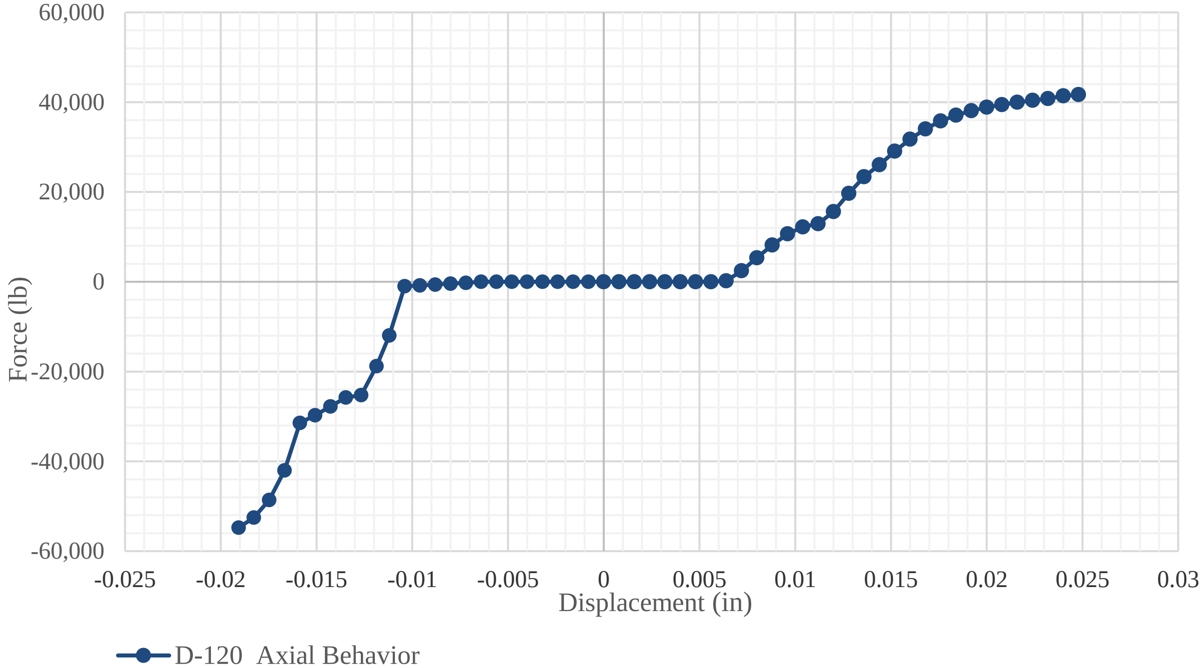
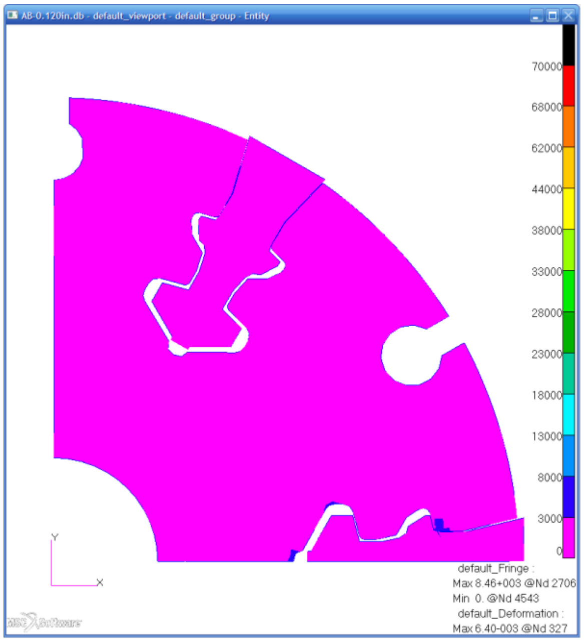
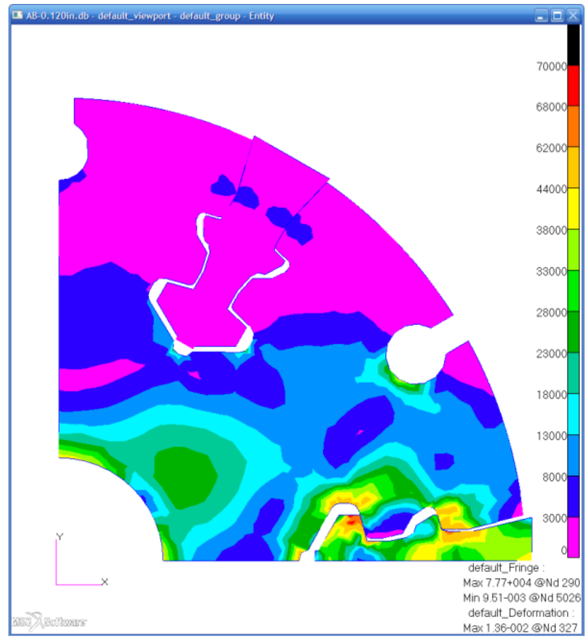


Figure G.3 Axial Semi-Rigid Behavior of D-120

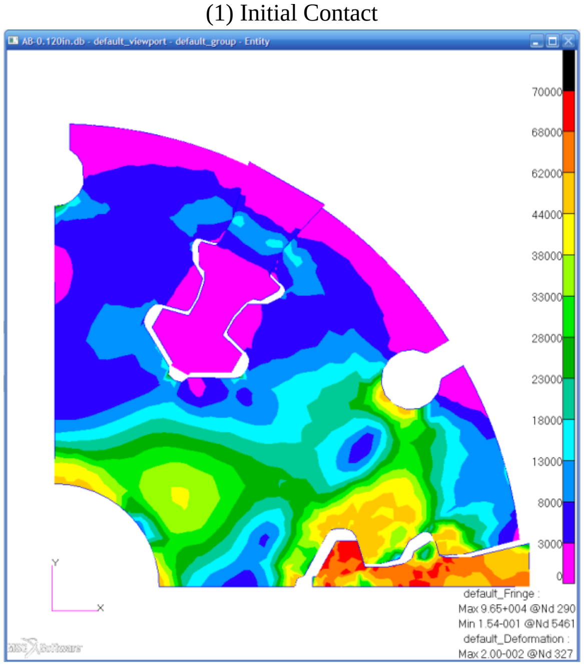
The tensile finite element simulation of the D-120F semi-rigid behavior is illustrated in the series of plots shown in **Figure G.4**.



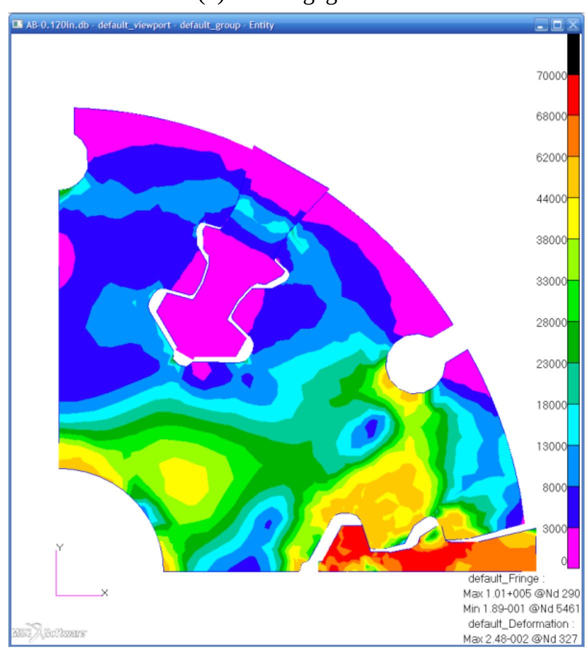
(1) Initial Contact



(2) Full Engagement



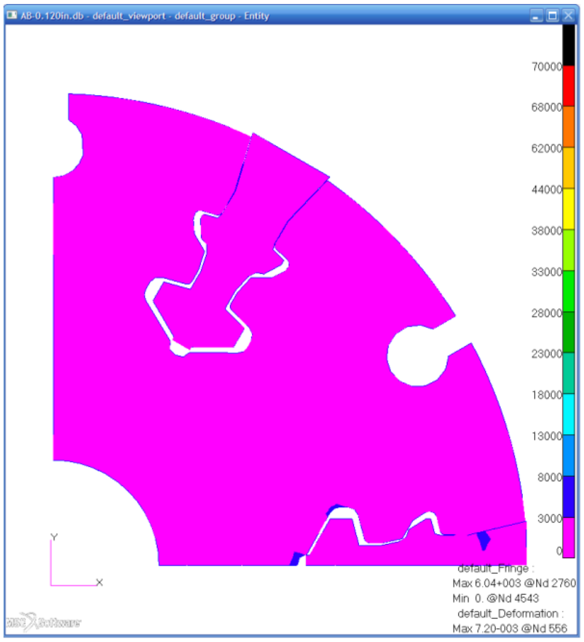
(3) Development of Yielding Stresses



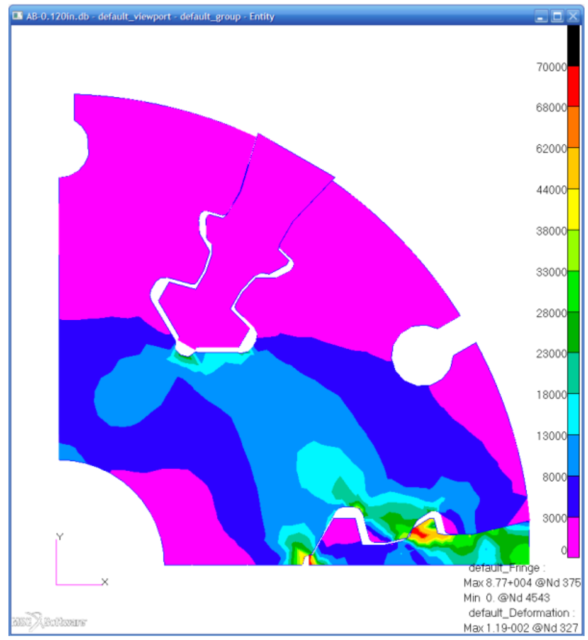
(4) Ultimate Capacity

Figure G.4 Von Mises Stress of D-120F under Tension from Initial Contact to Failure

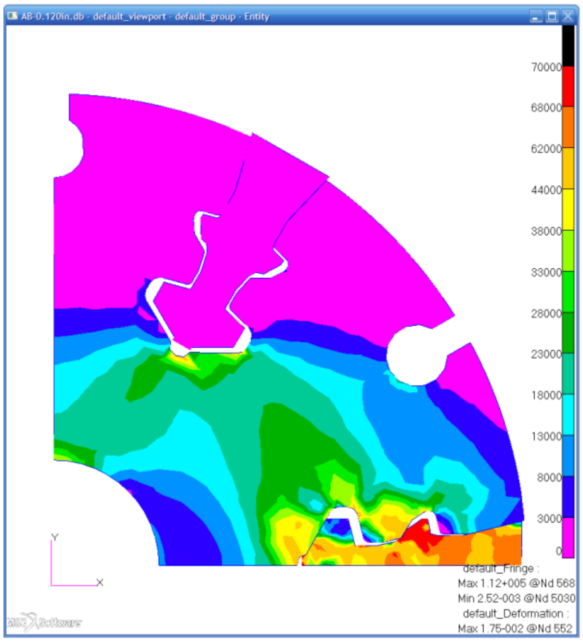
The compressive finite element simulation of the D-120F semi-rigid behavior is illustrated in the series of plots shown in **Figure G.5**



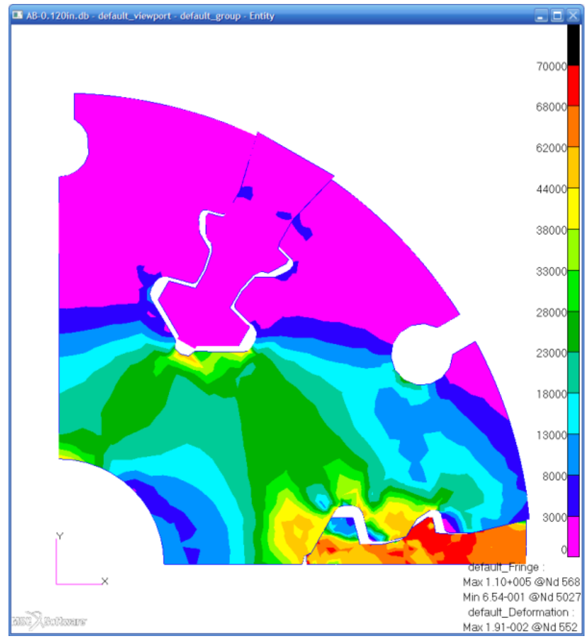
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure G.5 Von Mises Stress of D-120F under Compression from Initial Contact to Failure

Figure G.6 presents the axial semi-rigid behavior of the D-120F numerical model.

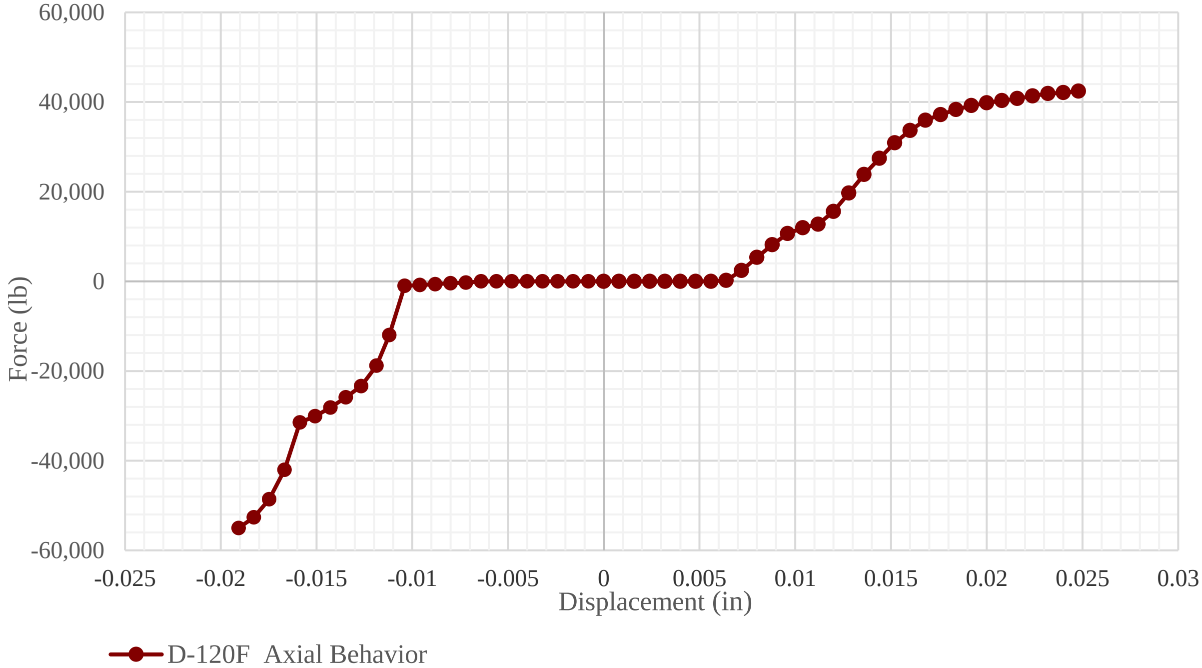


Figure G.6 Axial Semi-Rigid Behavior of D-120F

120 Comparison (1)

Figure G.7 presents a plot of the load-displacement recorded during the axial semi-rigid analysis of the D-120 and D-120F models, up to ultimate capacity at force increments of 5,000 pounds. **Table G.1** and **Table G.2** compare the tensile and compressive characterization data at 5,000 pound increments, respectively. The D-120 and D-120F models have ultimate loads recorded at 41,664.51 pounds and 42,412.36 pounds at 0.0248 inches during tension and 54,768.46 pounds and 55,015.09 pounds at 0.0191 inches during compression, respectively. These results represent an increase of 1.79% in tension and 0.45% in compression as a result of the incorporation of the filler into the jointing system.

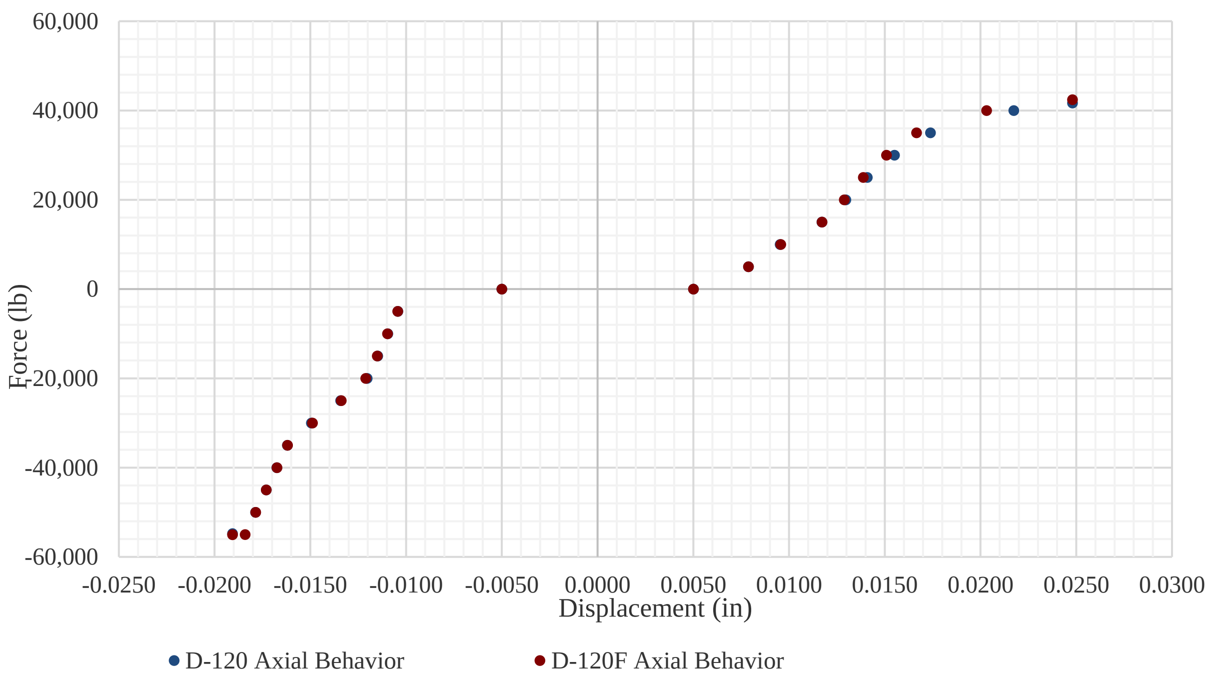


Figure G.7 Axial Semi-Rigid Behavior of D-120 & D-120F

Table G.1 Tensile Load-Displacement: 120 Comparison (1)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-120	D-120F	D-120 vs. D-120F
0	0.0050	0.0050	0.00
5,000	0.0079	0.0079	0.00
10,000	0.0095	0.0096	0.36
15,000	0.0117	0.0117	0.07
20,000	0.0130	0.0129	-0.69
25,000	0.0141	0.0139	-1.48
30,000	0.0155	0.0151	-2.66
35,000	0.0174	0.0167	-4.19
40,000	0.0217	0.0203	-6.55

Table G.2 Compressive Load-Displacement: 120 Comparison (1)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-120	D-120F	D-120 vs. D-120F
0	-0.0050	-0.0050	0.00
-5,000	-0.0104	-0.0104	0.07
-10,000	-0.0110	-0.0110	0.14
-15,000	-0.0115	-0.0115	0.21
-20,000	-0.0120	-0.0121	0.63
-25,000	-0.0134	-0.0134	-0.24
-30,000	-0.0150	-0.0149	-0.39
-35,000	-0.0162	-0.0162	-0.02
-40,000	-0.0168	-0.0168	-0.03
-45,000	-0.0173	-0.0173	-0.04
-50,000	-0.0179	-0.0179	-0.04
-55,000	-	-0.0184	-

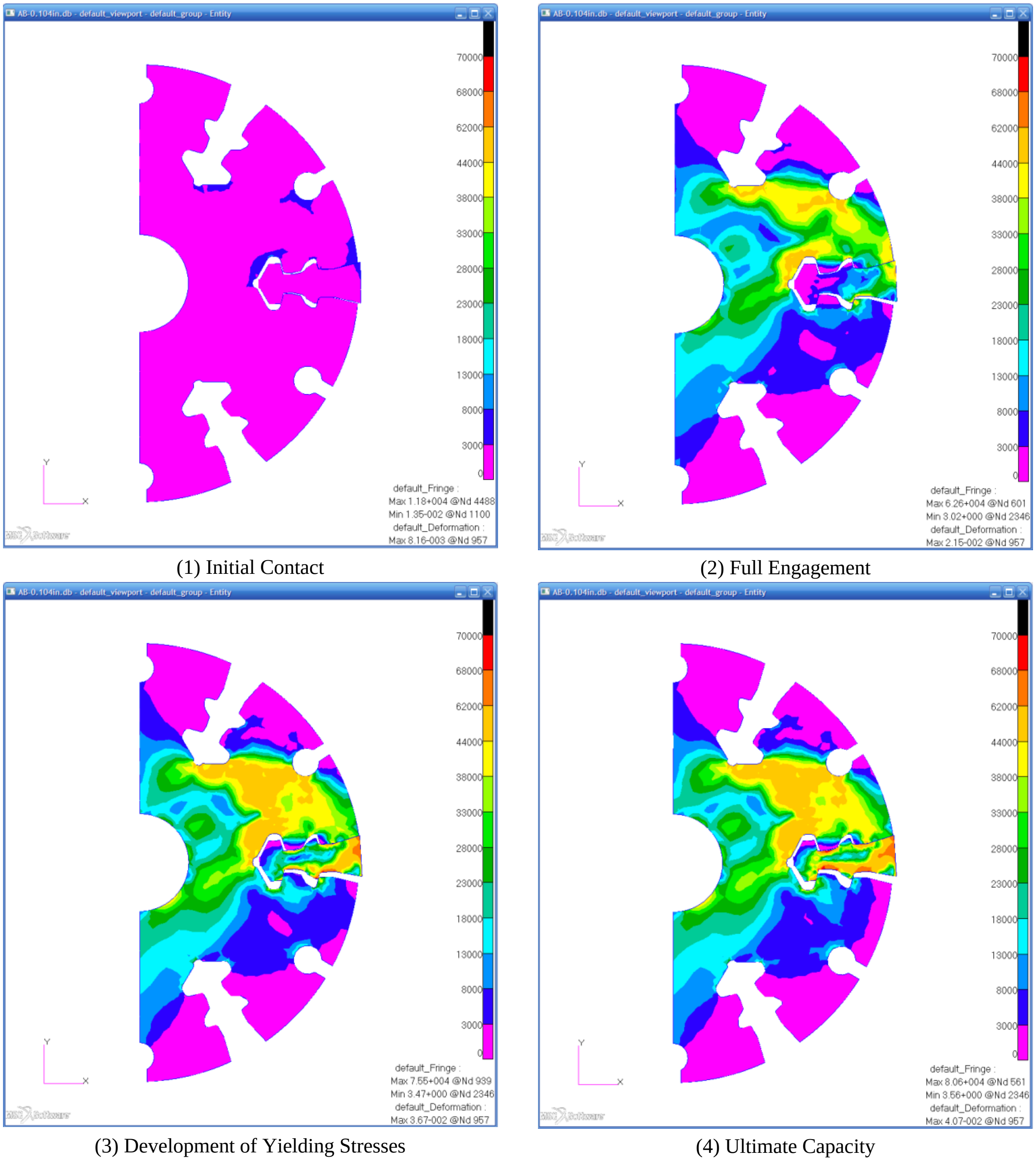
The preceding results show:

- From **Table G.1** it is observed that incorporating the filler into the jointing system did not impact the displacement during the first 15,000 pounds in tension. Furthermore, a slight increase in stiffness of 0.69% is observed at 20,000 pounds reaching up to 6.55% at 40,000 pounds during tension.
- From **Table G.2** no significant change of rigidity was observed due to the incorporation of the filler into the jointing system during compression.
- It can be concluded that at larger forces, there is a slight increment in rigidity when incorporating the filler into the jointing system.

Appendix H

D-104 In-Plane Semi-Rigid Behavior Results and Conclusions

The in-plane bending finite element simulation of the D-104 semi-rigid behavior is illustrated in the series of plots shown in **Figure H.1**.



(1) Initial Contact

(2) Full Engagement

(3) Development of Yielding Stresses

(4) Ultimate Capacity

Figure H.1 Von Mises Stress of D-104 under In-Plane Bending from Initial Contact to Failure

Figure H.2 presents the in-plane bending semi-rigid behavior of the D-104 numerical model.

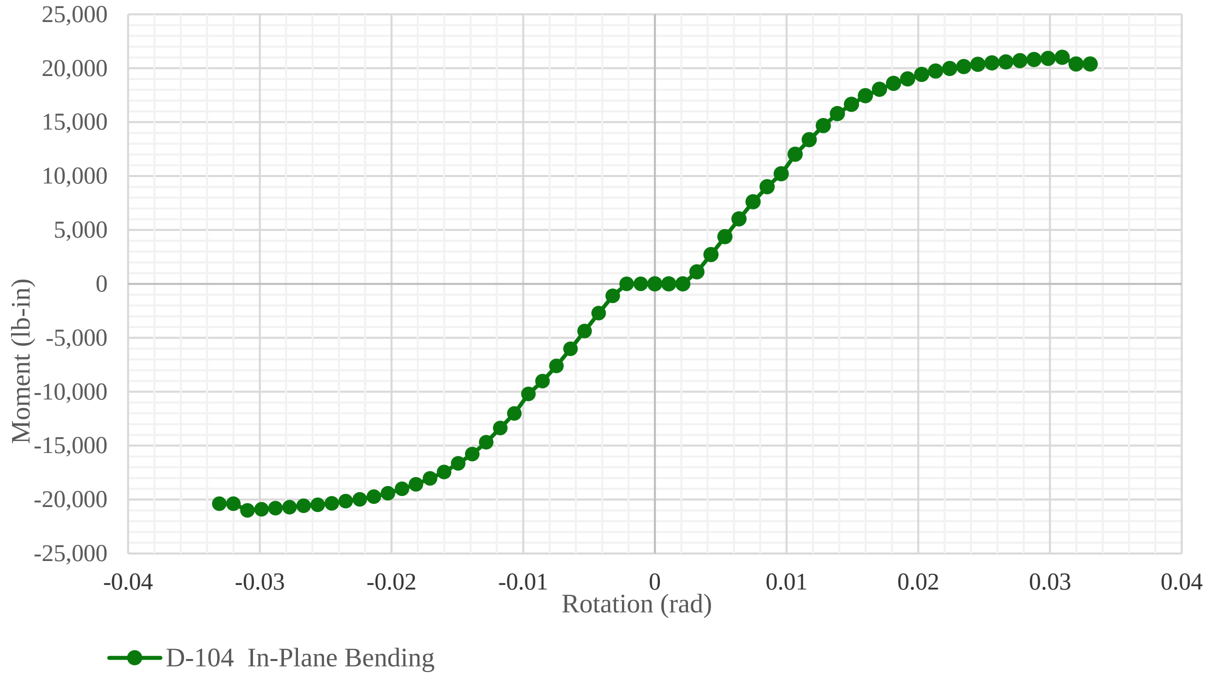
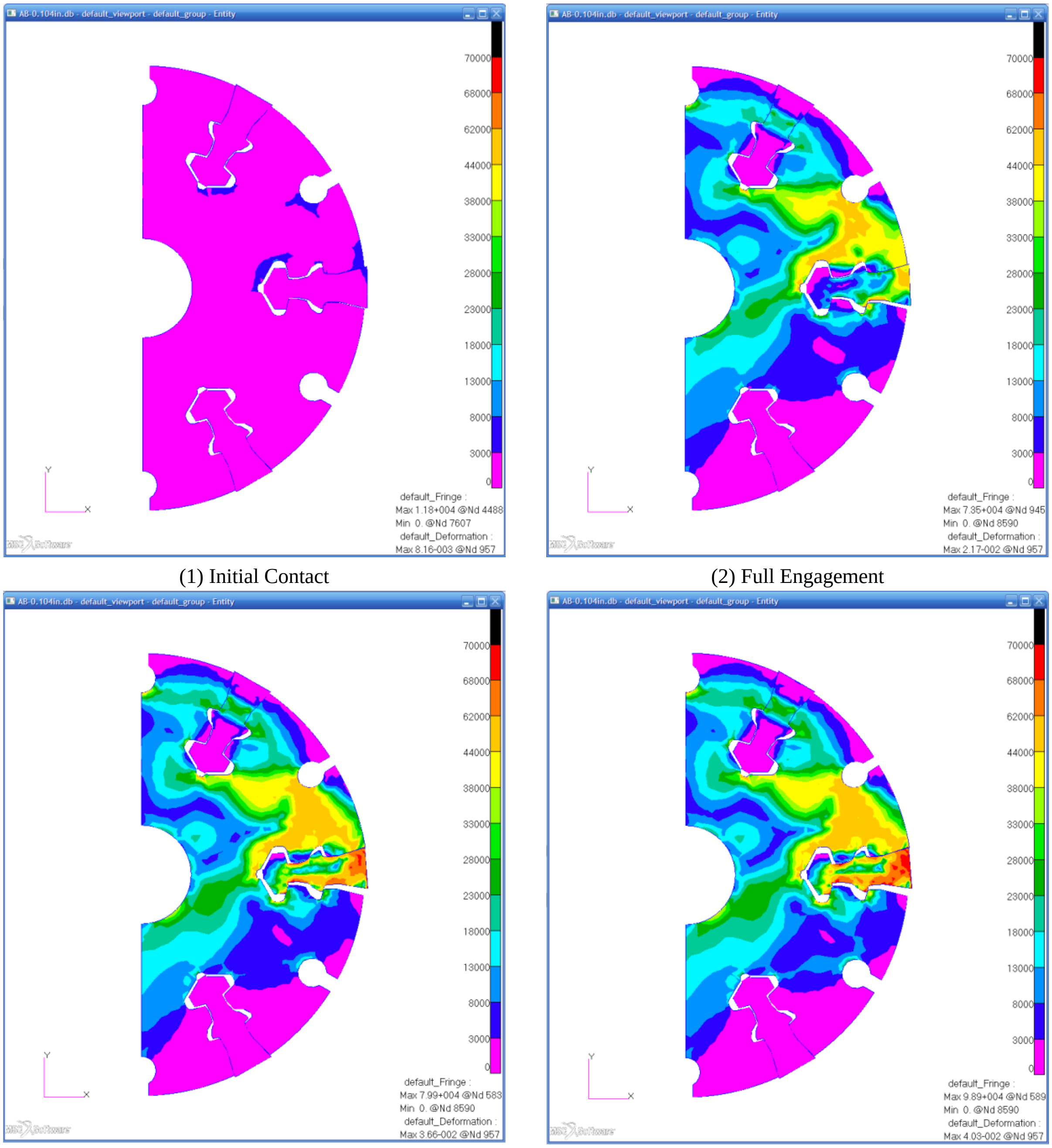


Figure H.2 In-Plane Bending Semi-Rigid Behavior of D-104

The in-plane bending finite element simulation of the D-104F semi-rigid behavior is illustrated in the series of plots shown in **Figure H.3**.



(1) Initial Contact

(2) Full Engagement

(3) Development of Yielding Stresses

(4) Ultimate Capacity

Figure H.3 Von Mises Stress of D-104F under In-Plane Bending from Initial Contact to Failure

Figure H.4 presents the in-plane bending semi-rigid behavior of the D-104F numerical model.

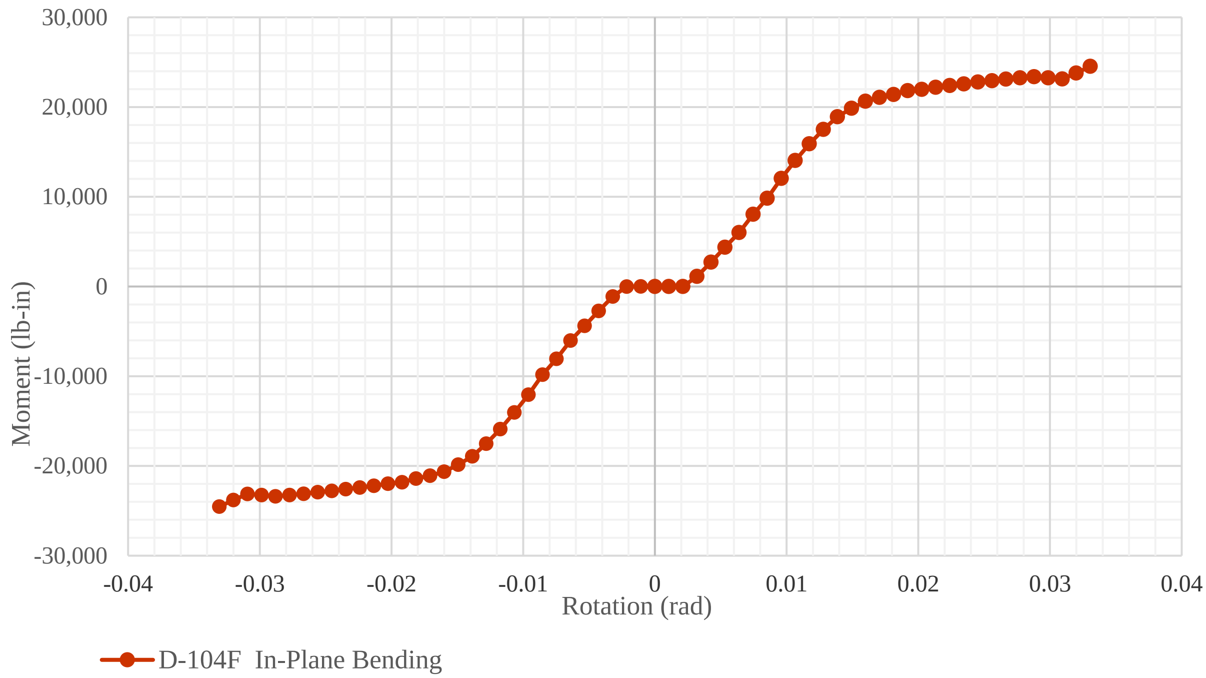


Figure H.4 In-Plane Bending Semi-Rigid Behavior of D-104F

104 Comparison (2)

Figure H.5 presents a plot of the moment-rotation recorded during in-plane bending semi-rigid analysis of the D-104 and D-104F models, up to ultimate bending capacity was reached at moment increments of 2,500 lb.-in. **Table H.1** compares the in-plane bending characterization data at 2,500 lb.-in. The D-104 and D-104F models have ultimate in-plane bending moments recorded at 20,385.77 and 24,533.98 lb.-in. at 0.0331 radians; respectively; representing an increase of 20.35% due to the incorporation of the filler into the jointing system.

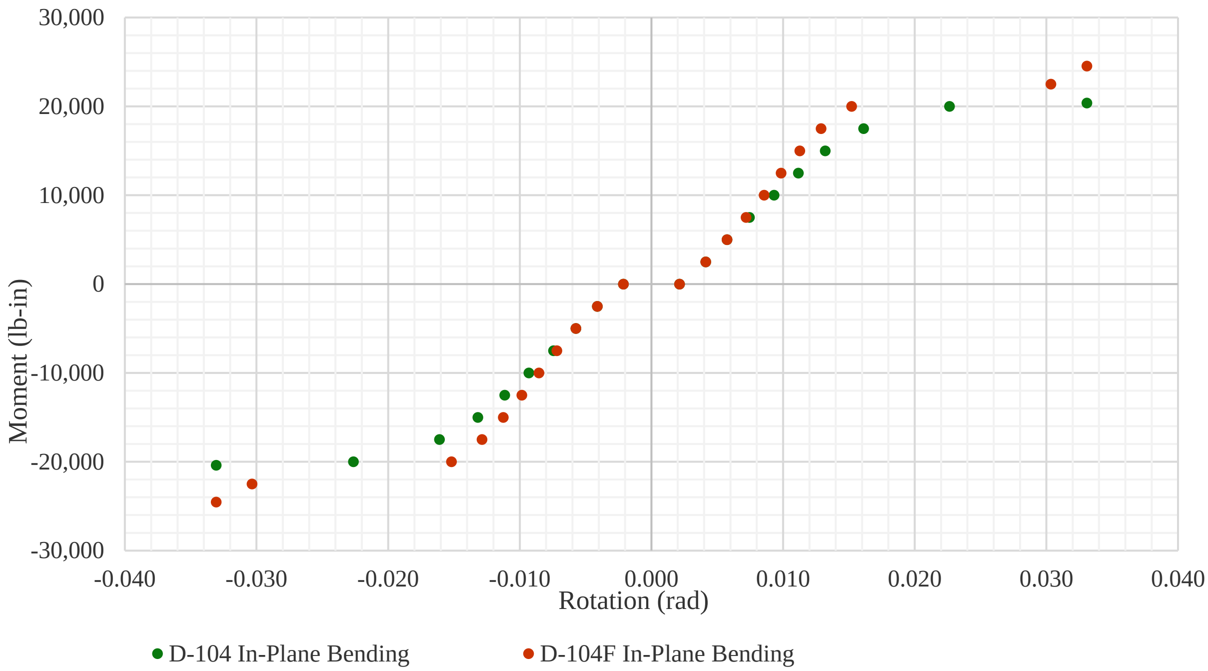


Figure H.5 In Plane Bending Semi-Rigid Behavior of D-104 & D-104F

Table H.1 In-Plane Bending Moment-Rotation: 104 Comparison (2)

Moment (lb-in)	Rot. (rad) D-104	Rot. (rad) D-104F	Rot. (%) D-104 vs. D-104F
0	0.0021	0.0021	0.00
2,500	0.0041	0.0041	0.00
5,000	0.0057	0.0057	-0.01
7,500	0.0074	0.0072	-3.44
10,000	0.0093	0.0086	-8.20
12,500	0.0112	0.0098	-11.70
15,000	0.0132	0.0113	-14.65
17,500	0.0161	0.0129	-20.06
20,000	0.0226	0.0152	-32.87
22,500	-	0.0303	-

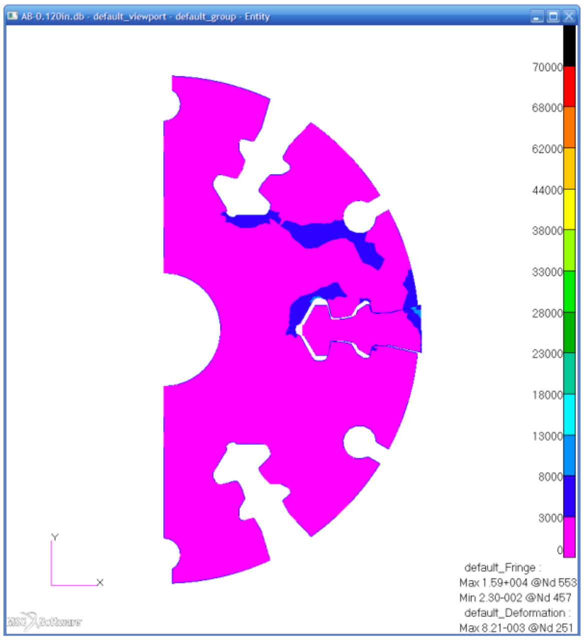
The preceding results show:

- From **Table H.1** it is observed that the incorporation of the filler into the jointing system did not impact the rotation during the initial in-plane bending of 5,000 lb-in. Furthermore, an increase in stiffness of 3.44% was observed at 7,500 lb-in. reaching up to 32.87% at 20,000 lb-in.
- It can be concluded that at larger bending moments, there is an increment in rigidity when incorporating the filler into the jointing system.

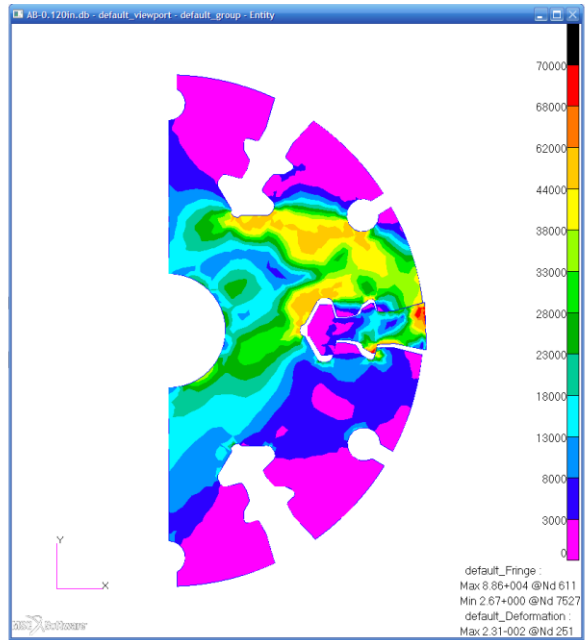
Appendix I

D-120 In-Plane Semi-Rigid Behavior Results and Conclusions

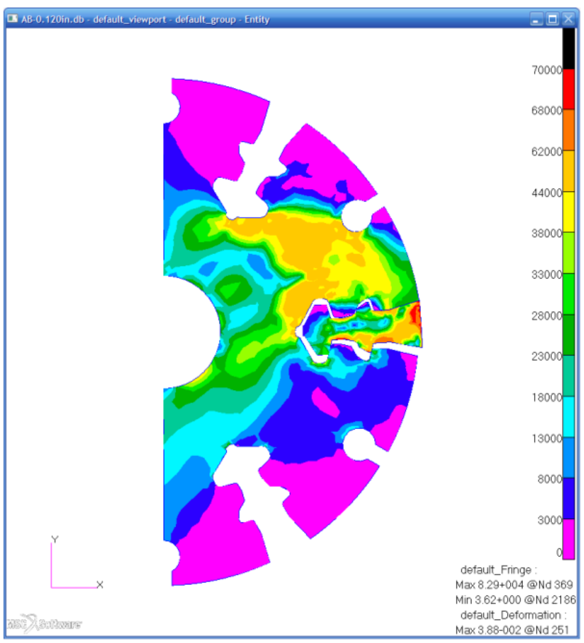
The in-plane bending finite element simulation of the D-120 semi-rigid behavior is illustrated in the series of plots shown in **Figure I.1**.



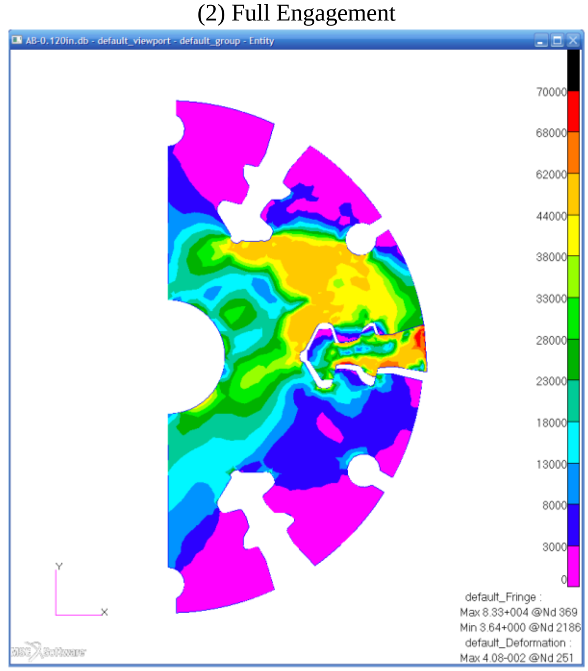
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure I.1 Von Mises Stress of D-120 under In-Plane Bending from Initial Contact to Failure

Figure I.2 presents the in-plane bending semi-rigid behavior of the D-120 numerical model.

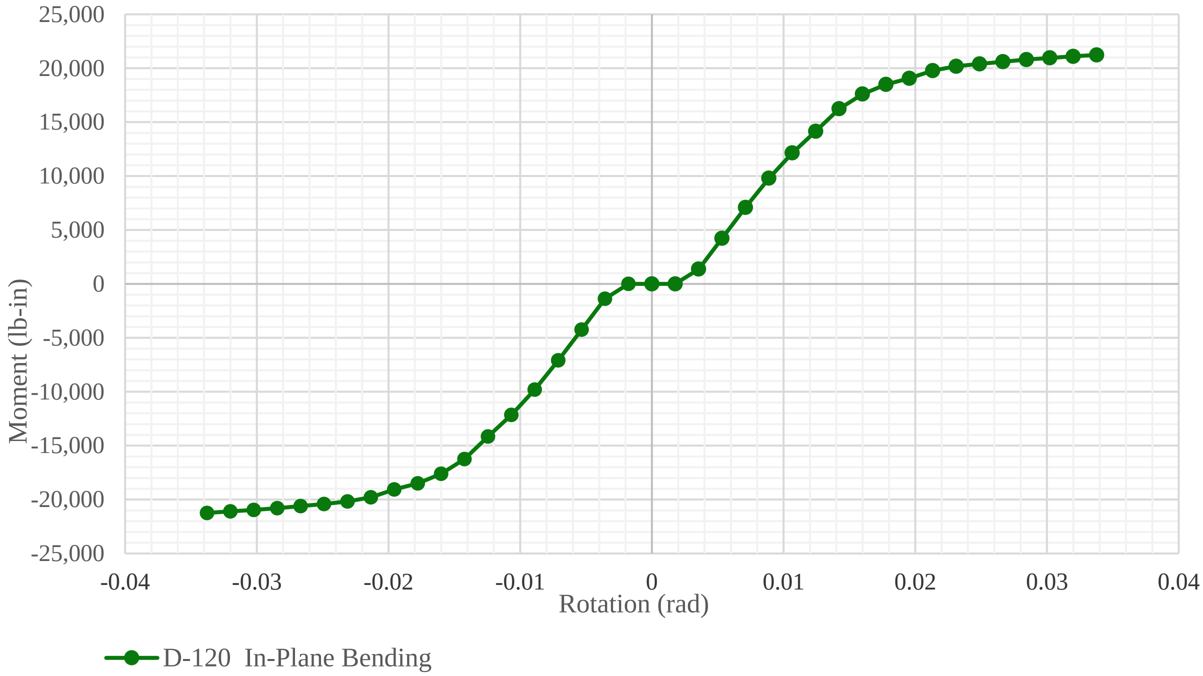
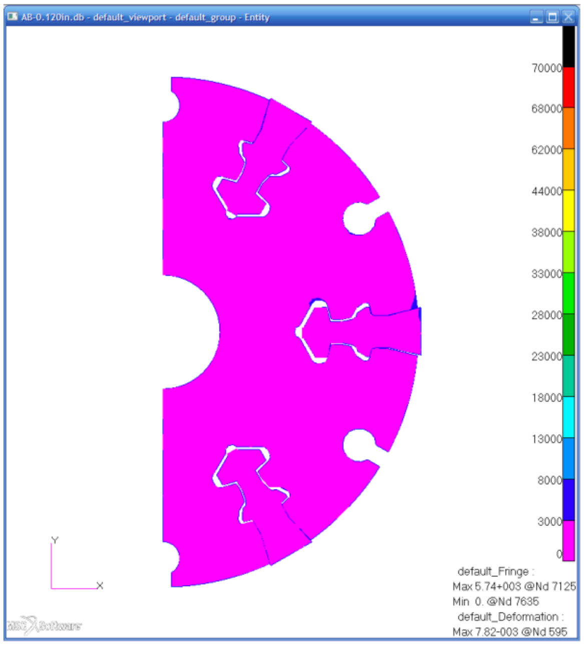
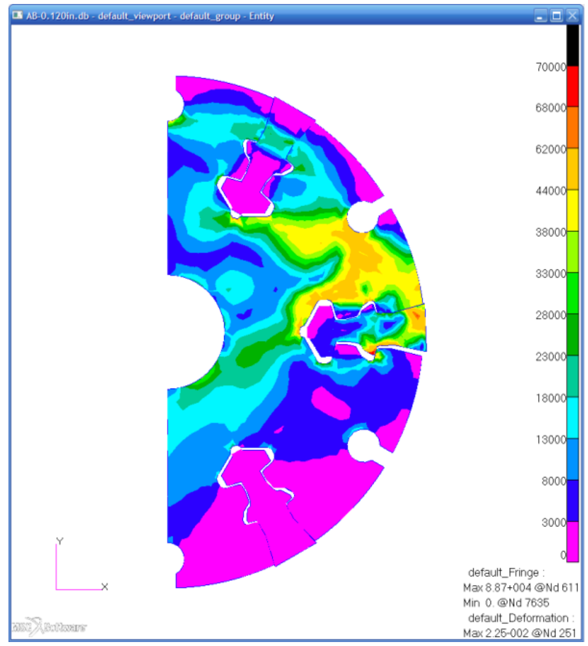


Figure I.2 In-Plane Bending Semi-Rigid Behavior of D-120

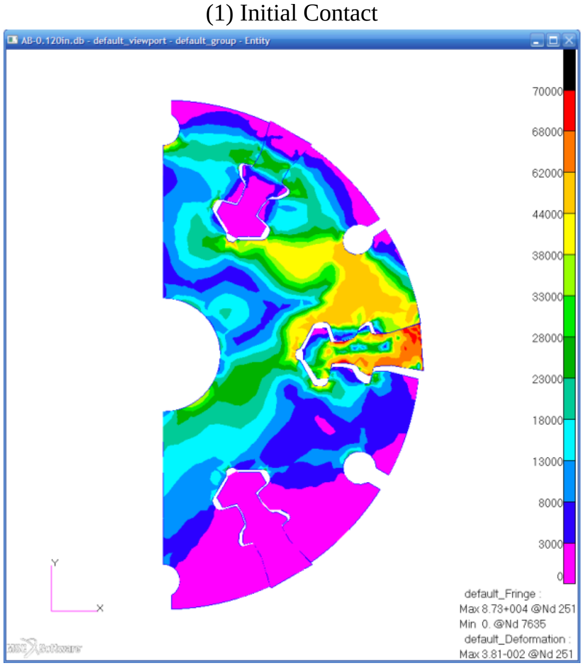
The in-plane bending finite element simulation of the D-120F semi-rigid behavior is illustrated in the series of plots shown in **Figure I.3**.



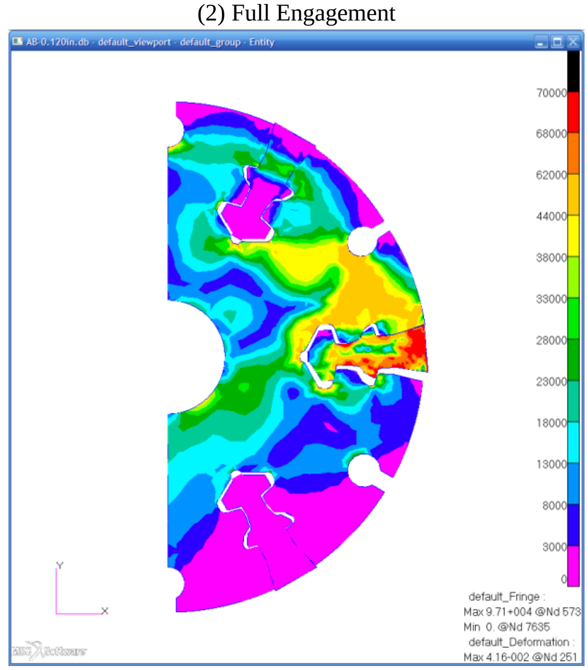
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure I.3 Von Mises Stress of D-120F under In-Plane Bending from Initial Contact to Failure

Figure I.4 presents the in-plane bending semi-rigid behavior of the D-120F numerical model.

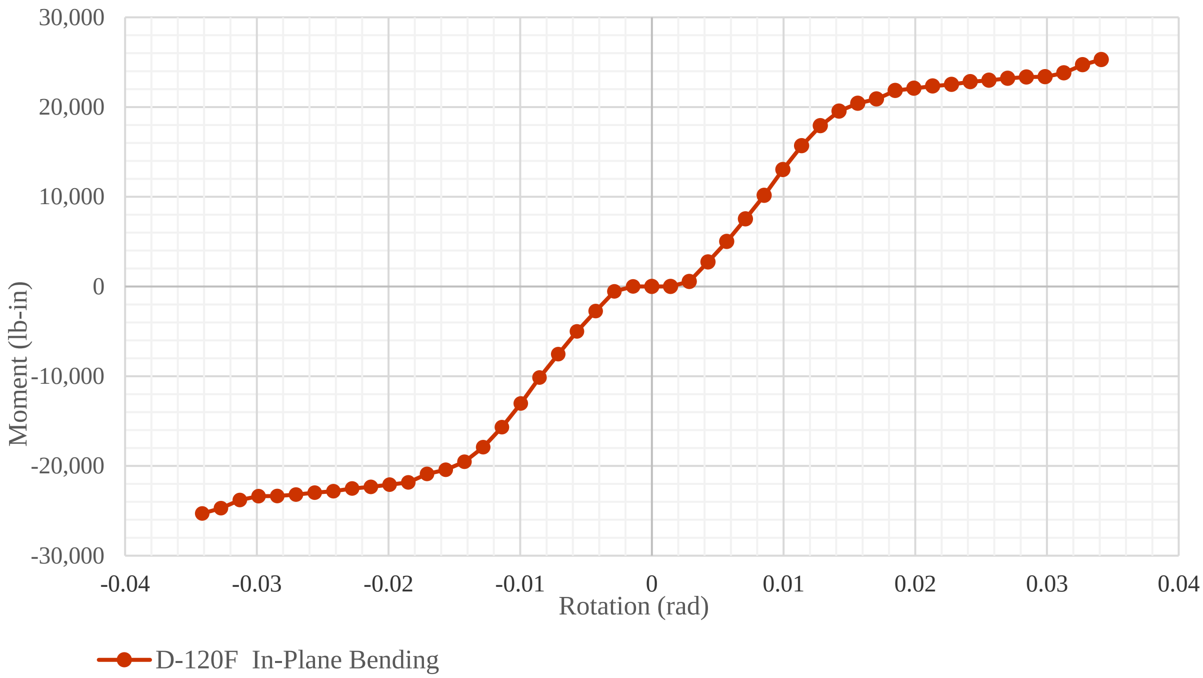


Figure I.4 In-Plane Bending Semi-Rigid Behavior of D-120F

120 Comparison (2)

Figure I.5 presents a plot of the moment-rotation recorded during in-plane bending semi-rigid analysis of the D-104 and D-104F models, up to ultimate bending capacity was reached at moment increments of 2,500 lb.-in. **Table I.1** compares the in-plane bending characterization data at 2,500 lb.-in. The D-104 and D-104F models have ultimate in-plane bending moments recorded at 21,235.65 and 25,293.92 lb.-in. at 0.034 radians; respectively; representing an increase of 19.11% due to the incorporation of the filler into the jointing system.

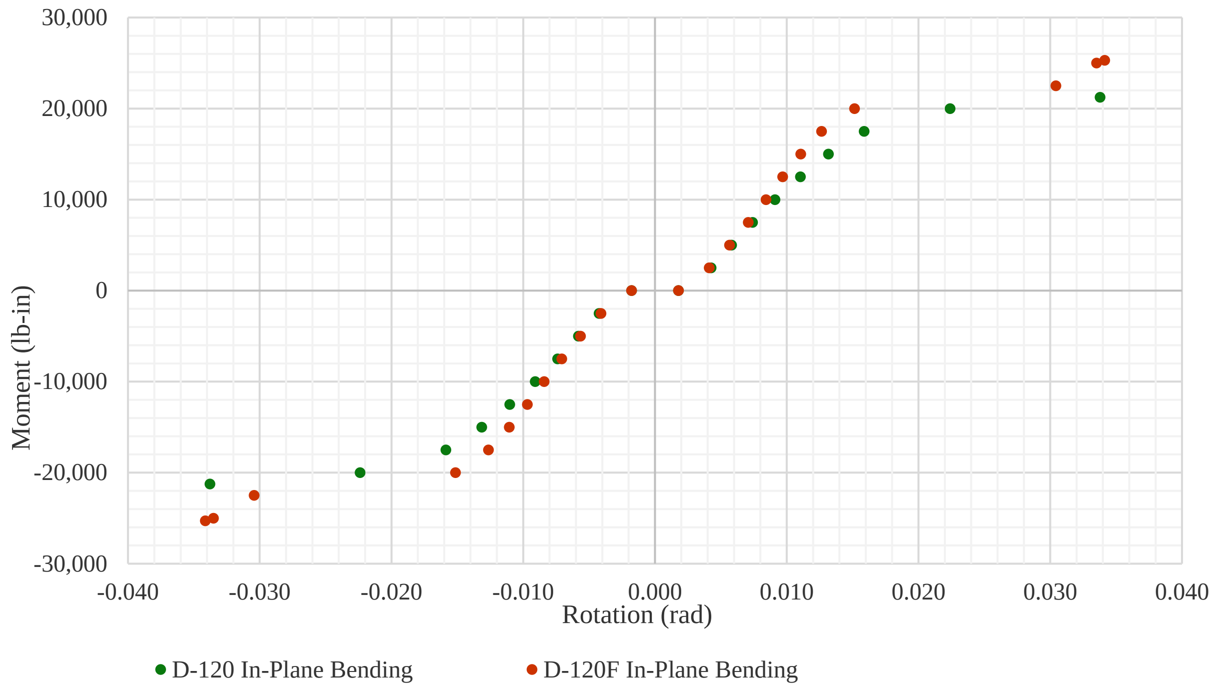


Figure I.5 In Plane Bending Semi-Rigid Behavior of D-120 & D-120F

Table I.1 In-Plane Bending Moment-Rotation: 120 Comparison (2)

Moment (lb-in)	Rot. (rad)	Rot. (rad)	Rot. (%)
	D-120	D-120F	D-120 vs. D-120F
0	0.0018	0.0018	0.00
2,500	0.0043	0.0041	-3.47
5,000	0.0058	0.0057	-2.71
7,500	0.0074	0.0071	-4.36
10,000	0.0091	0.0084	-7.47
12,500	0.0110	0.0097	-12.20
15,000	0.0132	0.0111	-15.91
17,500	0.0159	0.0126	-20.37
20,000	0.0224	0.0151	-32.37
22,500	-	0.0304	-
25,000	-	0.0335	-

The preceding results show:

- From **Table I.1** it is observed that the incorporation of the filler into the jointing system did not impact the rotation during the initial engagement. Furthermore, an increase in stiffness of 3.47% was observed at 2,500 lb-in. reaching up to 32.37% at 20,000 lb-in.
- It can be concluded that at larger bending moments, there is an increment in rigidity when incorporating the filler into the jointing system.

Appendix J

As-Built Axial Semi-Rigid Behavior Characterization Graphs and Tabulated Data

B-090 Axial Semi-Rigid Behavior

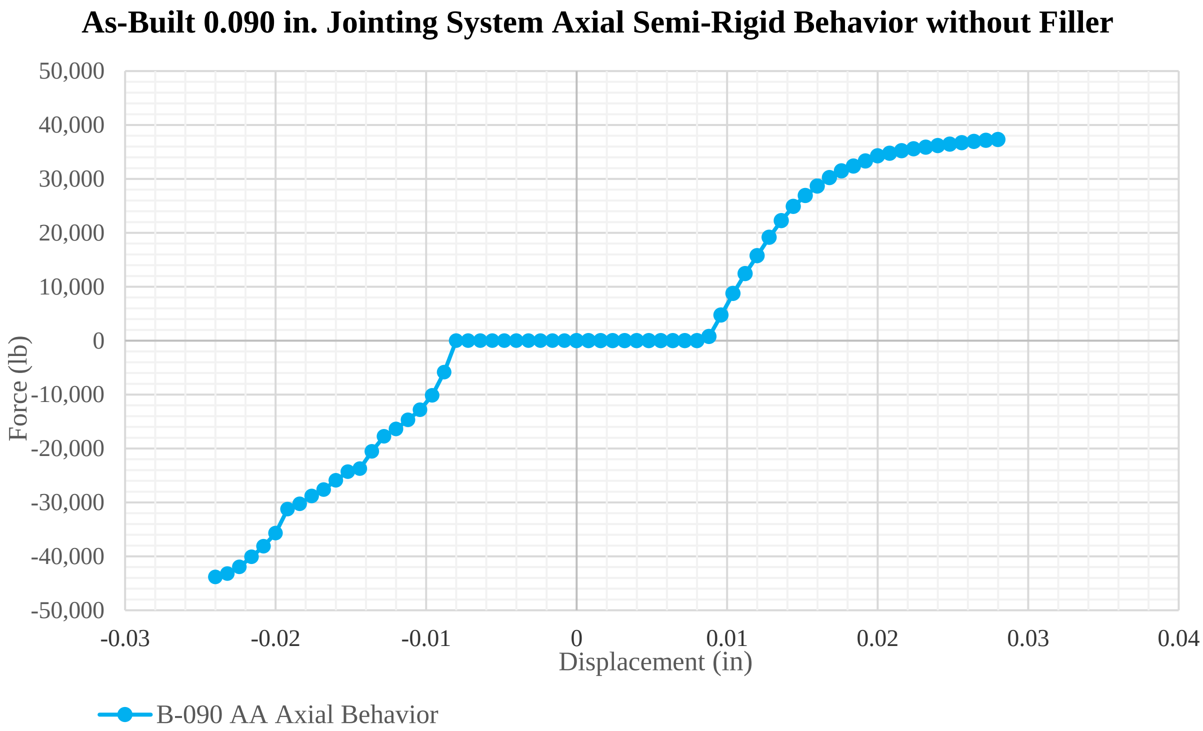


Figure J.1 Axial Semi-Rigid Behavior (B-090 AA)

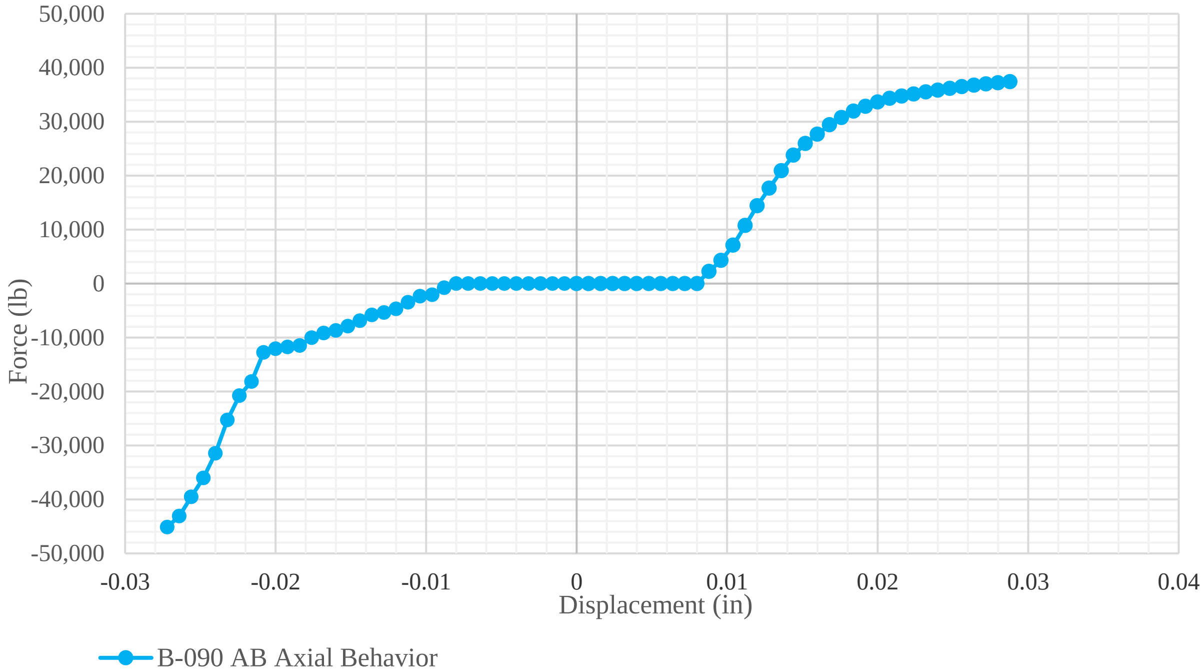


Figure J.2 Axial Semi-Rigid Behavior (B-090 AB)

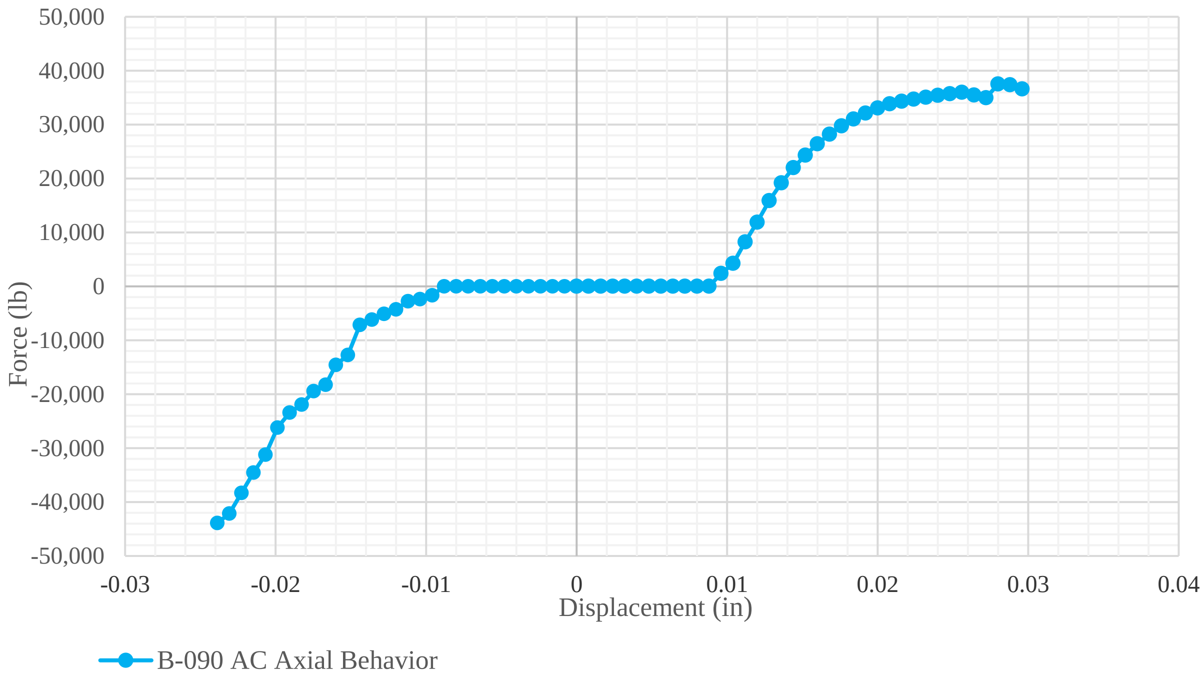


Figure J.3 Axial Semi-Rigid Behavior (B-090 AC)

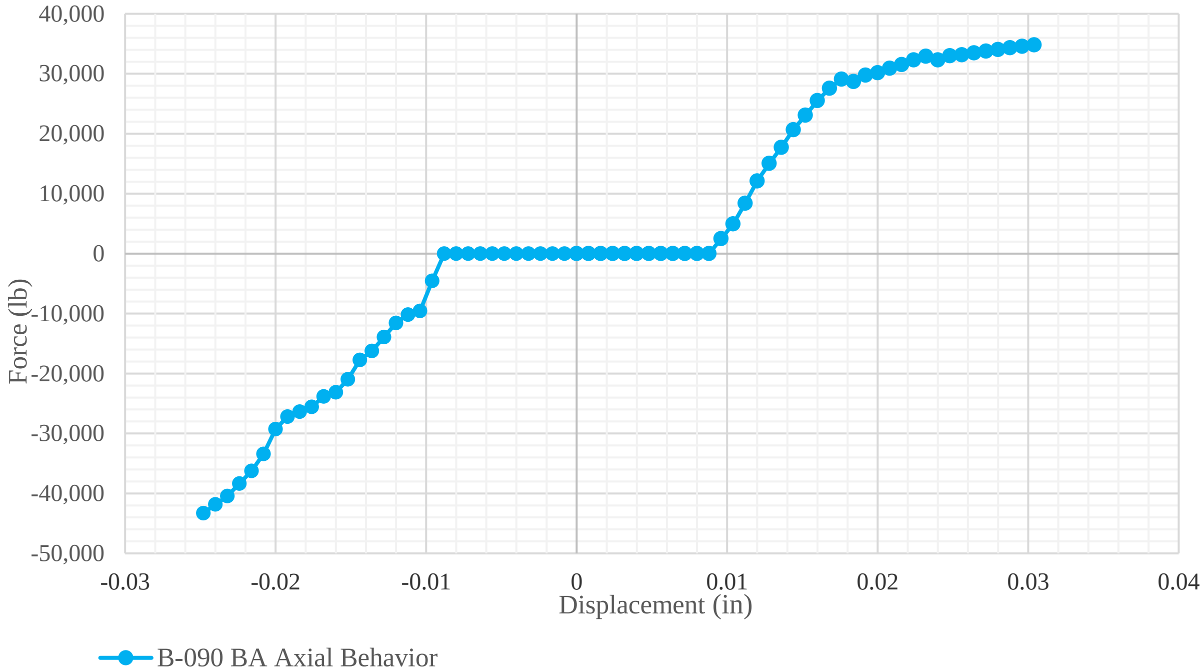


Figure J.4 Axial Semi-Rigid Behavior (B-090 BA)

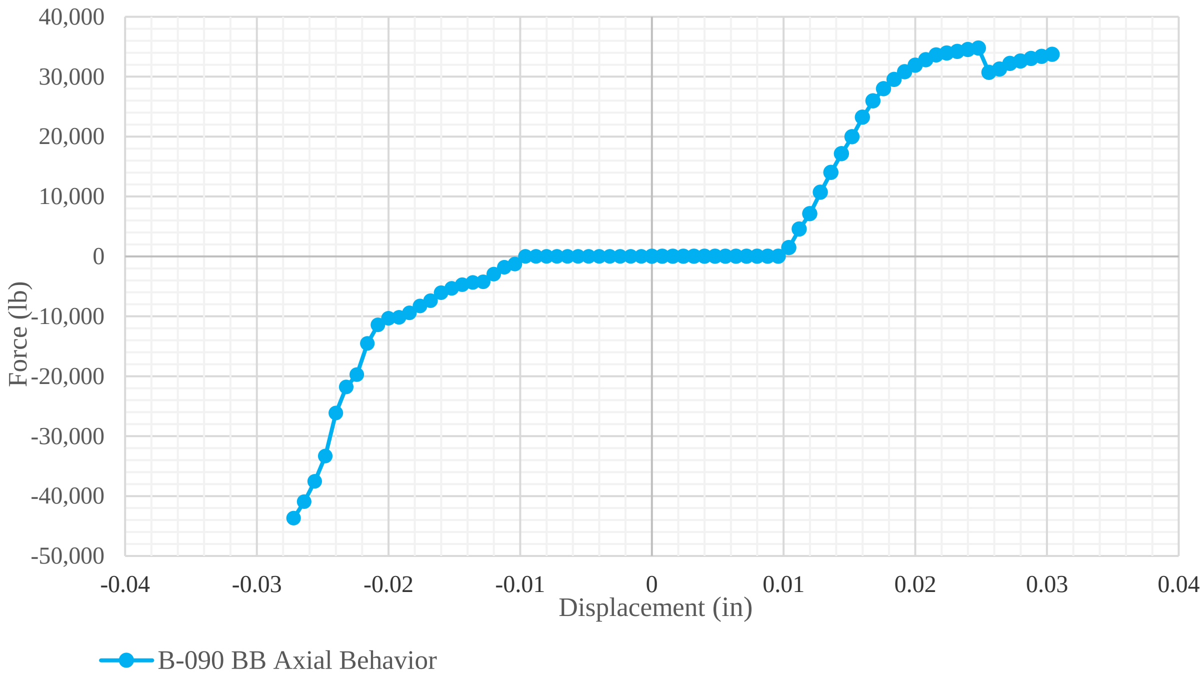


Figure J.5 Axial Semi-Rigid Behavior (B-090 BB)

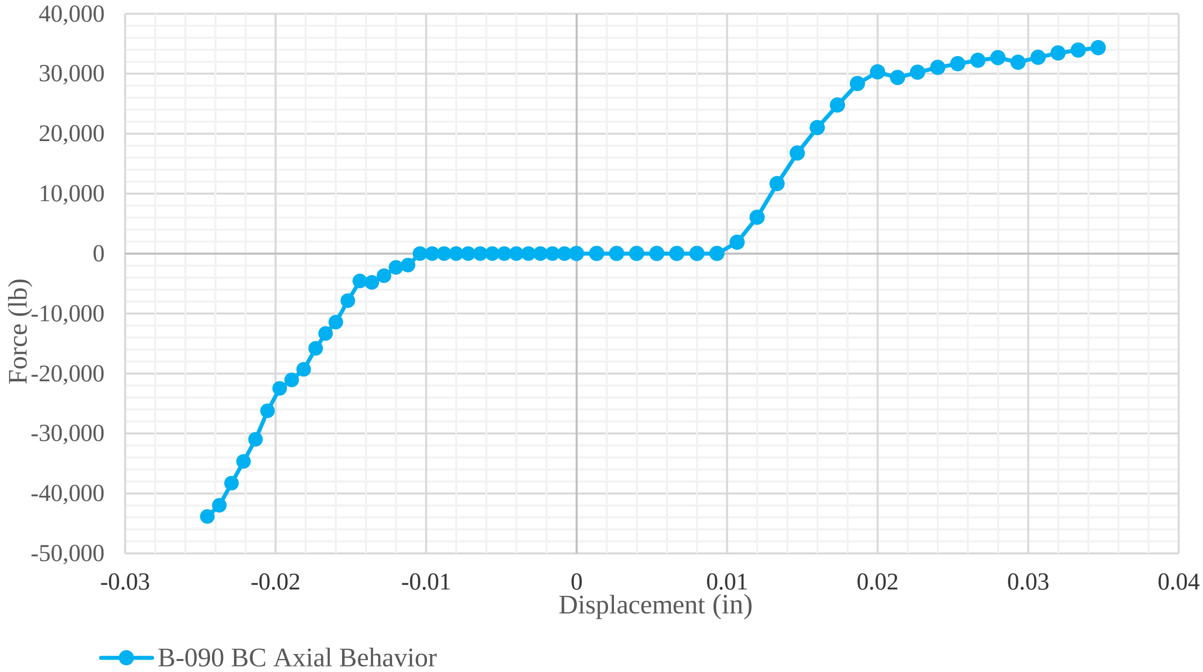


Figure J.6 Axial Semi-Rigid Behavior (B-090 BC)

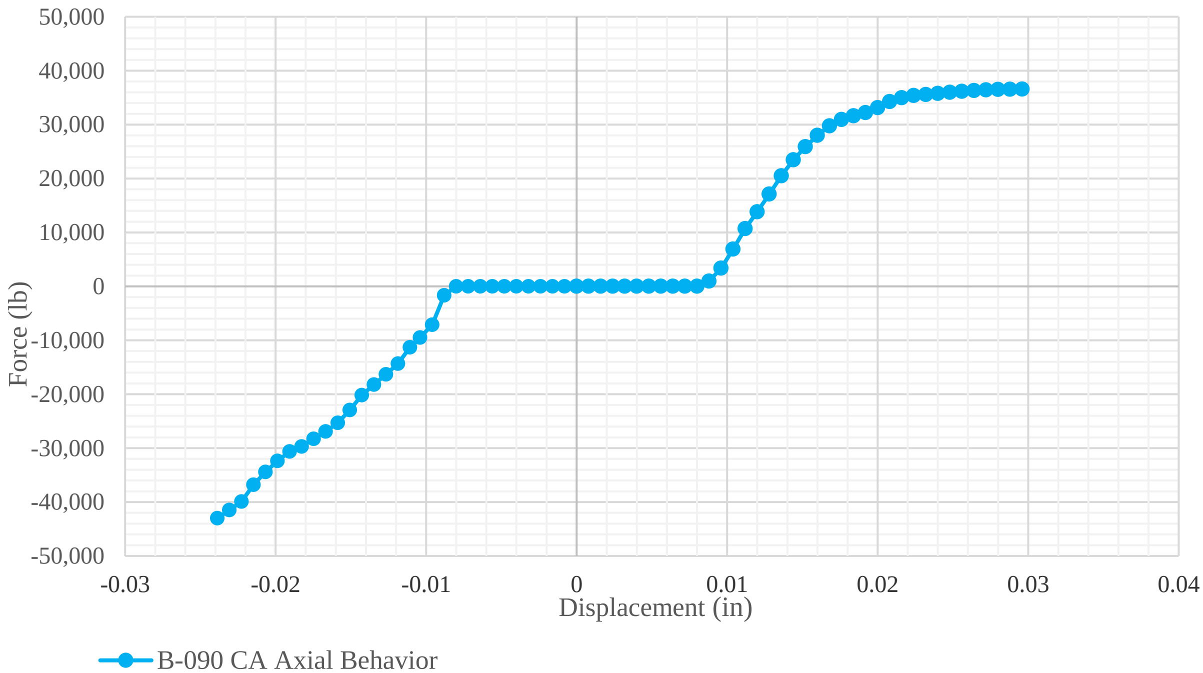


Figure J.7 Axial Semi-Rigid Behavior (B-090 CA)

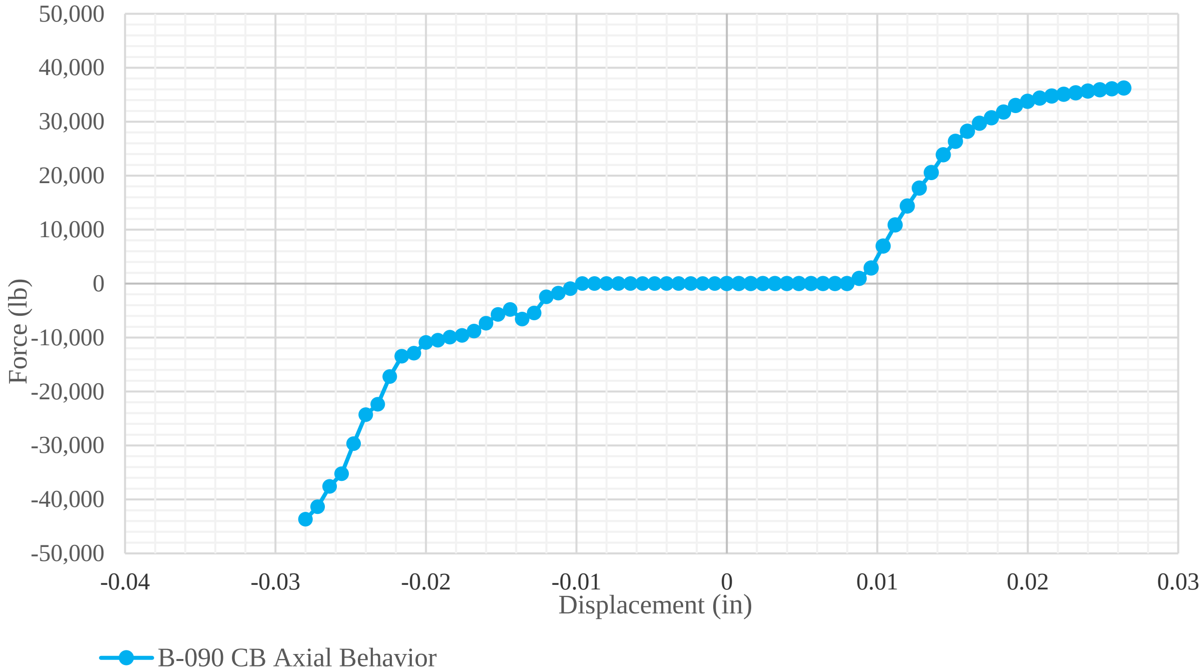


Figure J.8 Axial Semi-Rigid Behavior (B-090 CB)

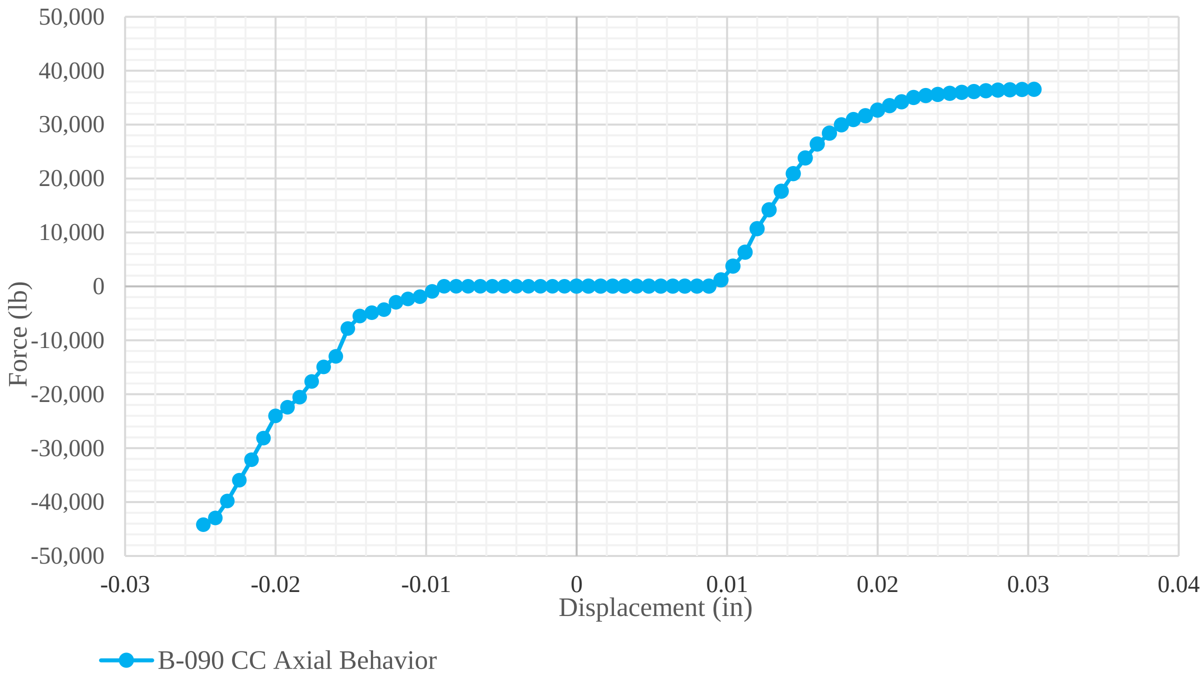


Figure J.9 Axial Semi-Rigid Behavior (B-090 CC)

Table J.1 Tensile Load-Displacement of B-090 Model Set

Displacement (in)	Force (lb)								
	B-090 AA	B-090 AB	B-090 AC	B-090 BA	B-090 BB	B-090 BC	B-090 CA	B-090 CB	B-090 CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.010	6,732.10	5,697.93	3,321.63	3,719.36	726.34	942.77	5,140.28	4,910.72	2,441.61
0.012	15,728.84	14,404.96	11,897.68	12,109.05	7,111.13	6,056.48	13,817.58	14,357.28	10,670.50
0.014	23,565.39	22,338.56	20,581.32	19,186.68	15,556.61	14,210.52	21,975.76	22,189.94	19,246.02
0.016	28,635.22	27,663.48	26,427.74	25,509.93	23,201.15	21,002.31	27,995.83	28,219.67	26,363.15
0.018	31,911.73	31,356.99	30,380.91	28,882.52	28,751.64	26,556.08	31,267.83	31,234.42	30,417.82
0.020	34,251.24	33,626.49	33,081.18	30,154.27	31,905.88	30,287.47	33,123.16	33,750.63	32,640.94
0.022	35,376.98	34,920.81	34,515.02	31,907.95	33,759.58	29,798.59	35,181.23	34,897.89	34,596.61
0.024	36,159.98	35,839.08	35,404.84	32,296.18	34,499.02	31,039.48	35,772.32	35,662.39	35,551.25
0.026	36,806.01	36,619.72	35,726.21	33,301.54	30,977.89	31,939.76	36,224.74	36,143.95	36,025.74
0.028	37,297.44	37,211.73	37,508.42	34,036.01	32,595.08	32,681.43	36,504.16	-	36,350.68
0.030	-	-	-	34,693.32	33,534.87	32,318.95	-	-	36,492.11
0.032	-	-	-	-	-	33,445.87	-	-	-
0.034	-	-	-	-	-	34,132.79	-	-	-

Table J.2 Tensile Ultimate Load-Displacement of B-090 Model Set

	B-090 AA	B-090 AB	B-090 AC	B-090 BA	B-090 BB	B-090 BC	B-090 CA	B-090 CB	B-090 CC
Force (lb)	37,297.44	37,413.52	36,611.69	34,815.34	33,706.75	34,333.43	36,577.02	36,225.66	36,508.67
Displacement (in)	0.0280	0.0288	0.0296	0.0304	0.0304	0.0347	0.0296	0.0264	0.0304

Table J.3 Compressive Load-Displacement of B-090 Model Set

Displacement (in)	Force (lb)								
	B-090 AA	B-090 AB	B-090 AC	B-090 BA	B-090 BB	B-090 BC	B-090 CA	B-090 CB	B-090 CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.010	-11,493.10	-2,196.84	-2,021.50	-7,055.31	-647.71	0.00	-8,299.25	-478.99	-1,434.07
-0.012	-16,386.75	-4,672.90	-4,283.95	-11,558.16	-2,976.48	-2,303.15	-14,658.96	-2,446.32	-2,982.54
-0.014	-22,136.01	-6,349.68	-6,667.02	-16,988.55	-4,535.84	-4,681.20	-19,529.66	-5,701.53	-5,209.16
-0.016	-25,911.85	-8,695.93	-14,567.30	-23,118.66	-6,071.47	-11,441.00	-25,566.05	-7,368.26	-12,995.17
-0.018	-29,545.88	-10,756.87	-21,102.67	-25,963.83	-8,856.25	-18,740.90	-29,230.82	-9,785.07	-19,116.25
-0.020	-35,693.23	-12,074.07	-27,031.81	-29,276.69	-10,346.56	-23,733.50	-32,716.14	-10,908.28	-24,035.74
-0.022	-41,019.94	-19,459.09	-37,042.30	-37,290.47	-17,135.13	-34,064.63	-38,869.42	-15,359.35	-34,052.99
-0.024	-43,839.48	-31,447.66	-	-41,825.45	-26,161.82	-42,604.94	-	-24,306.59	-42,976.91
-0.026	-	-41,308.57	-	-	-39,250.51	-	-	-36,422.56	-
-0.028	-	-	-	-	-	-	-	-43,678.24	-

Table J.4 Compressive Ultimate Load-Displacement of B-090 Model Set

	B-090 AA	B-090 AB	B-090 AC	B-090 BA	B-090 BB	B-090 BC	B-090 CA	B-090 CB	B-090 CC
Force (lb)	-43,839.48	-45,120.77	-43,891.03	-43,306.73	-43,702.65	-43,855.64	-42,996.70	-43,678.24	-44,208.68
Displacement (in)	-0.0240	-0.0272	-0.0239	-0.0248	-0.0272	-0.0245	-0.0239	-0.0280	-0.0248

B-090F Axial Semi-Rigid Behavior

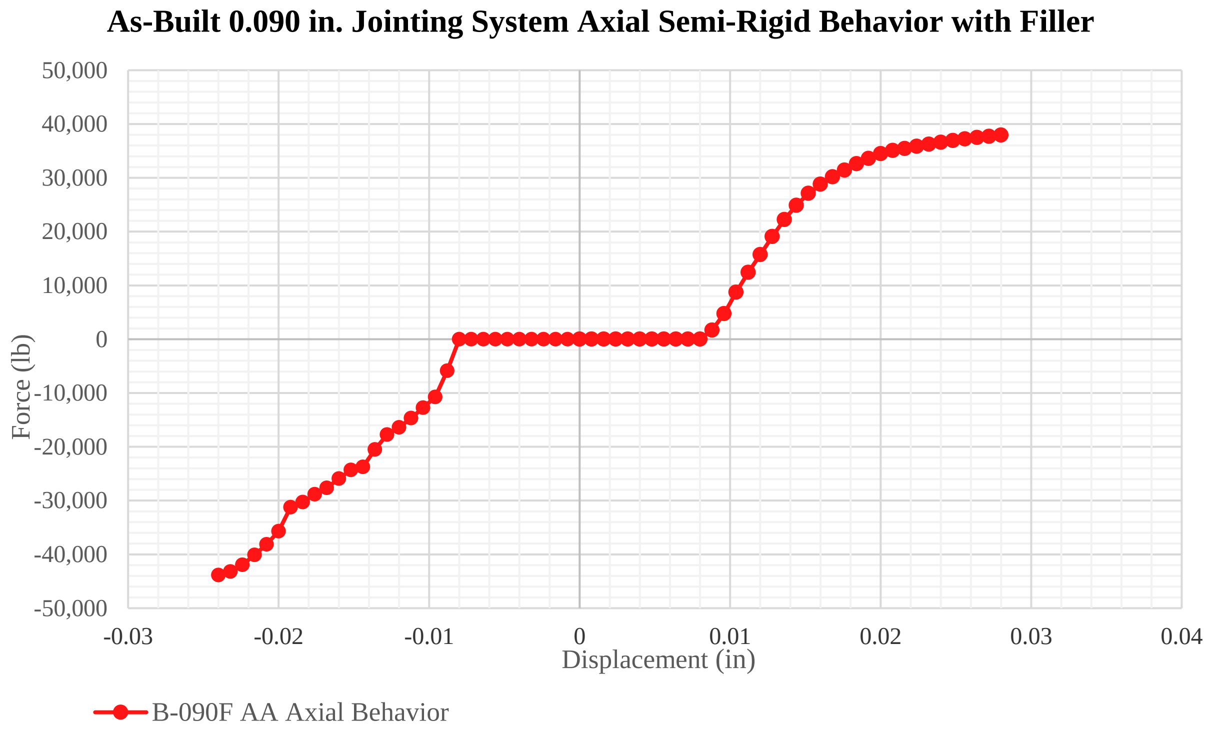


Figure J.10 Axial Semi-Rigid Behavior (B-090F AA)

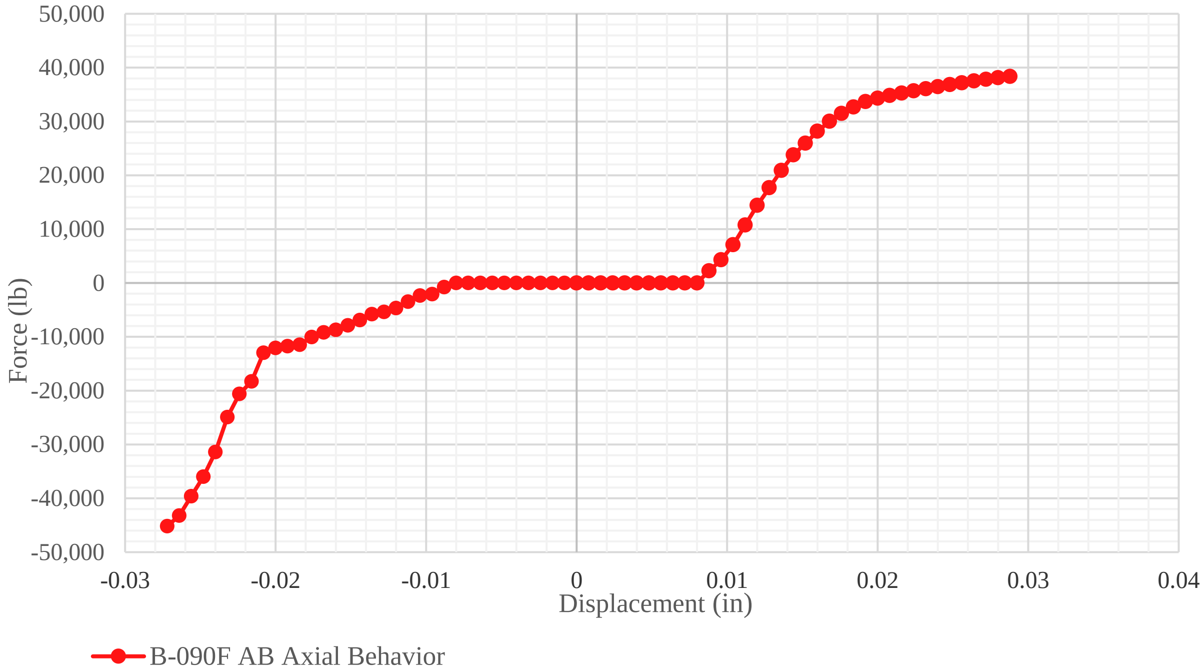


Figure J.11 Axial Semi-Rigid Behavior (B-090F AB)

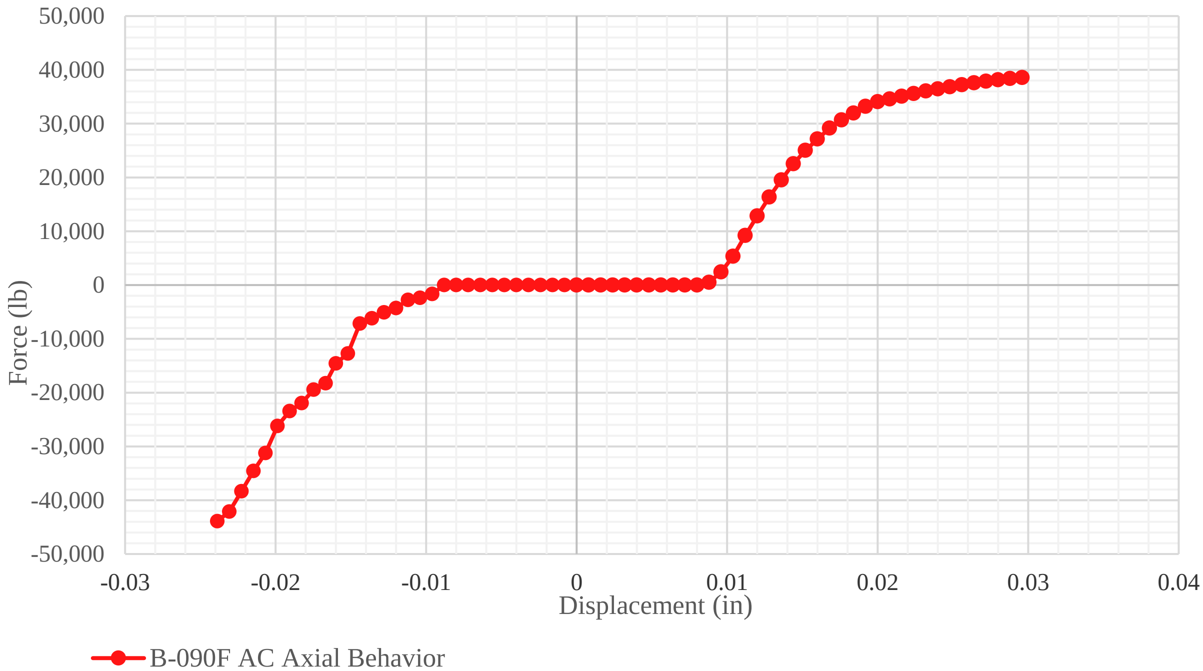


Figure J.12 Axial Semi-Rigid Behavior (B-090F AC)

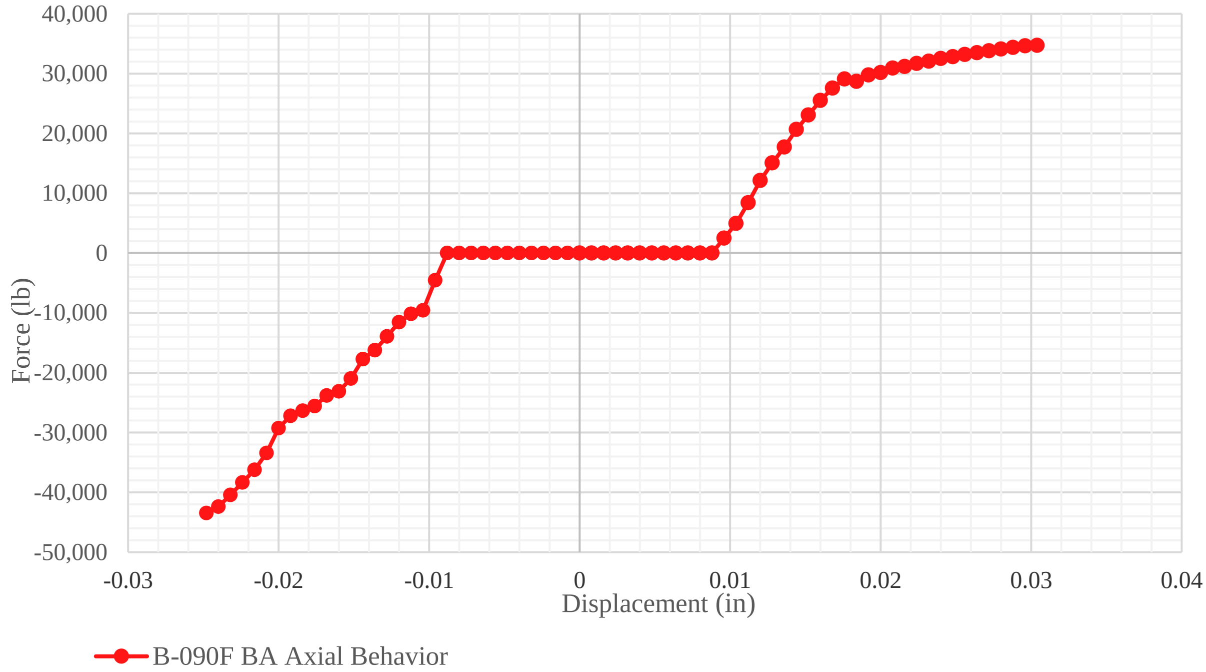


Figure J.13 Axial Semi-Rigid Behavior (B-090F BA)

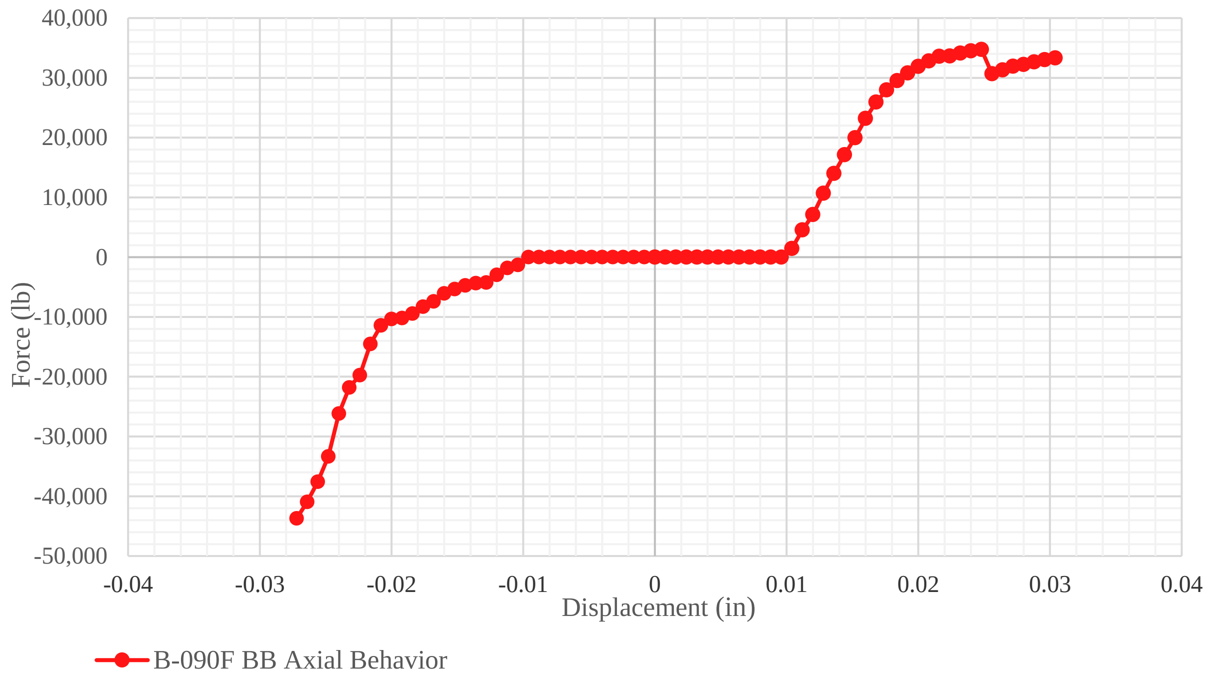


Figure J.14 Axial Semi-Rigid Behavior (B-090F BB)

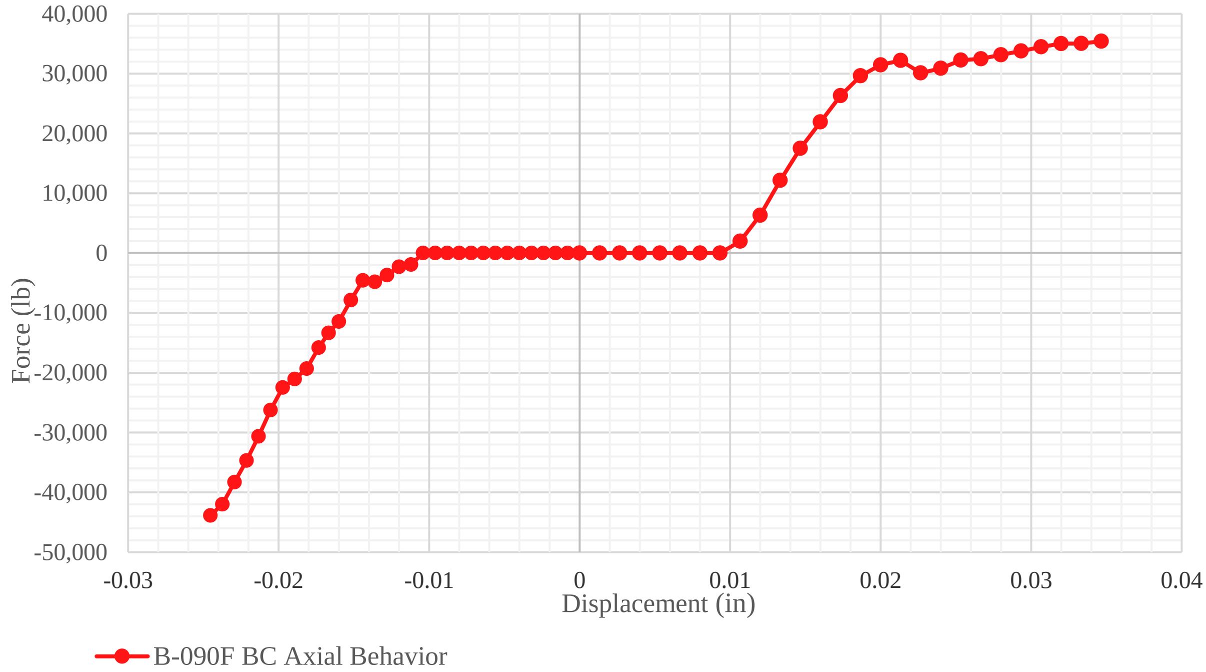


Figure J.15 Axial Semi-Rigid Behavior (B-090F BC)

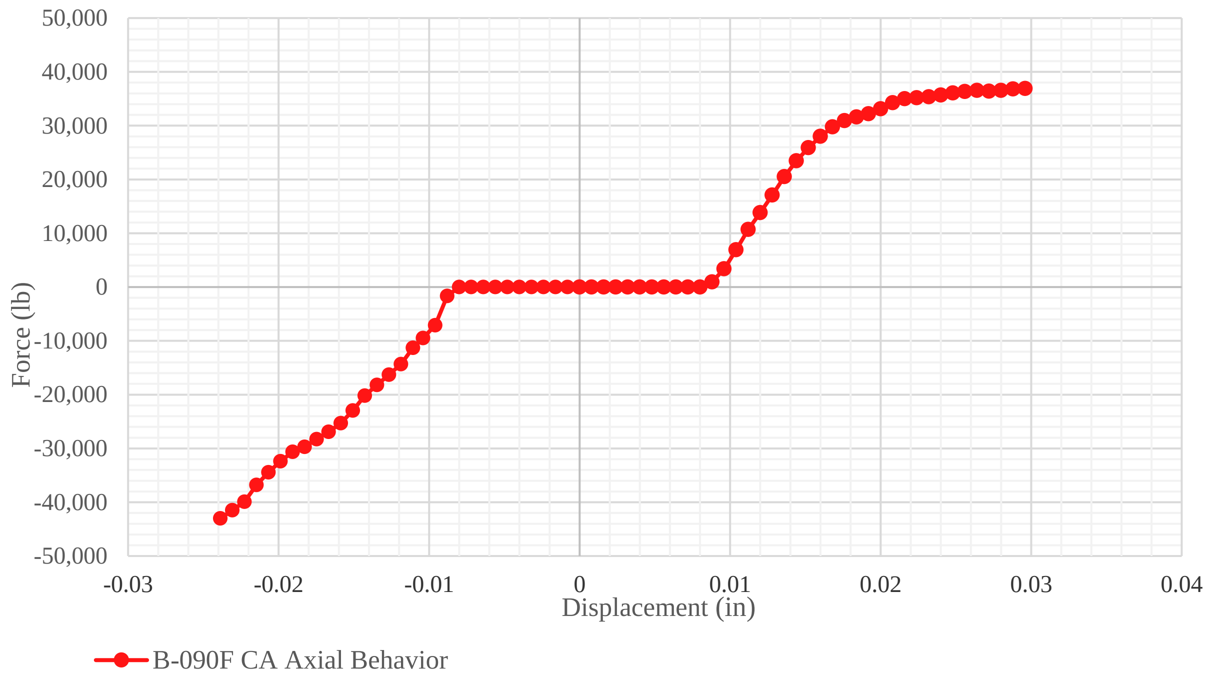


Figure J.16 Axial Semi-Rigid Behavior (B-090F CA)

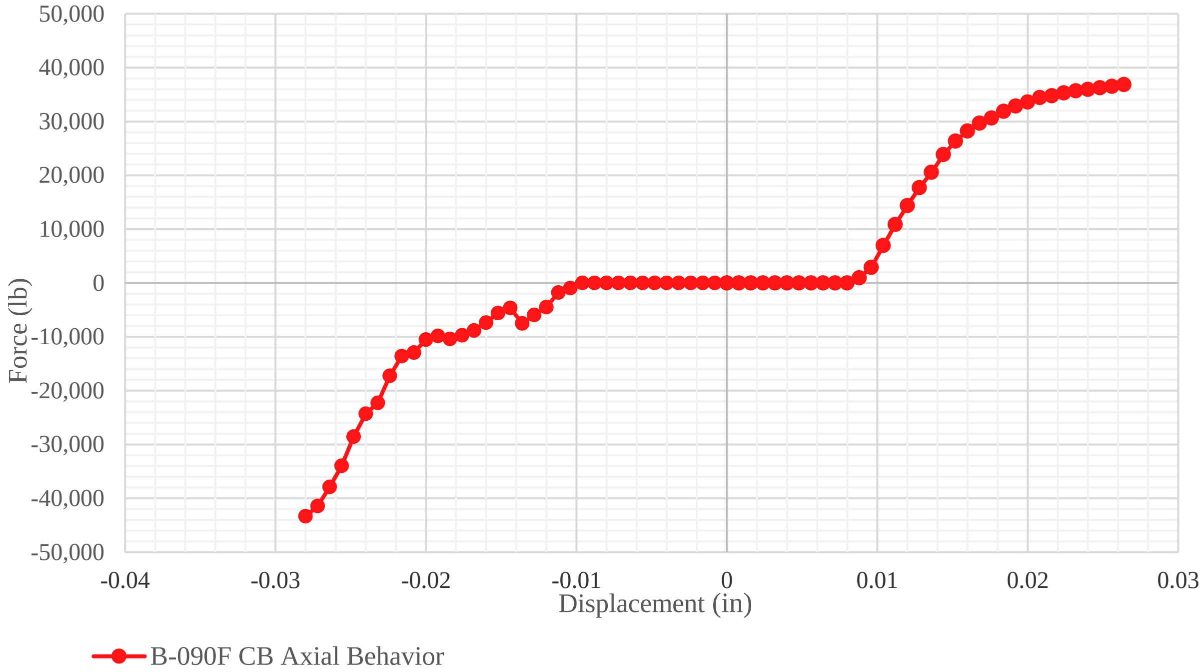


Figure J.17 Axial Semi-Rigid Behavior (B-090F CB)

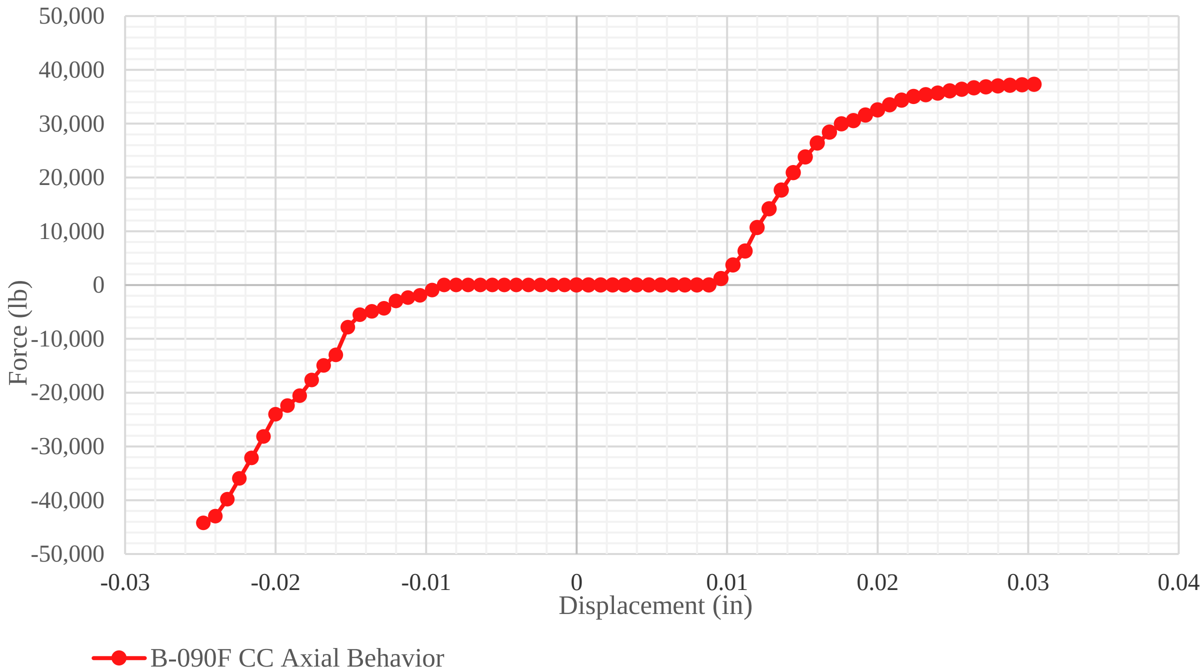


Figure J.18 Axial Semi-Rigid Behavior (B-090F CC)

Table J.5 Tensile Load-Displacement of B-090F Model Set

Displacement (in)	Force (lb)								
	B-090F AA	B-090F AB	B-090F AC	B-090F BA	B-090F BB	B-090F BC	B-090F CA	B-090F CB	B-090F CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.010	6,735.86	5,697.93	3,889.28	3,719.36	726.34	983.93	5,140.28	4,910.72	2,441.61
0.012	15,702.34	14,404.96	12,823.95	12,116.68	7,111.13	6,320.90	13,817.66	14,357.28	10,670.50
0.014	23,556.34	22,344.95	21,038.60	19,185.06	15,556.61	14,830.71	21,975.74	22,189.94	19,246.02
0.016	28,792.70	28,176.79	27,141.87	25,511.76	23,201.15	21,918.51	27,995.86	28,219.67	26,363.15
0.018	32,009.08	32,081.46	31,321.90	28,890.87	28,751.64	27,966.14	31,267.86	31,248.60	30,233.05
0.020	34,466.16	34,320.72	34,057.29	30,152.74	31,905.88	31,453.67	33,125.10	33,608.23	32,513.67
0.022	35,648.77	35,474.82	35,333.75	31,437.65	33,615.08	31,821.93	35,082.62	35,027.27	34,676.39
0.024	36,598.72	36,461.89	36,451.39	32,510.14	34,492.84	30,882.13	35,683.39	35,941.21	35,645.12
0.026	37,351.69	37,345.32	37,393.01	33,335.60	32,167.86	32,360.91	36,445.89	36,676.84	36,493.15
0.028	37,926.91	38,107.41	38,155.16	34,093.77	32,210.94	33,136.96	36,550.82	-	36,976.17
0.030	-	-	-	34,673.85	33,171.34	34,120.56	-	-	37,249.62
0.032	-	-	-	-	-	35,016.90	-	-	-
0.034	-	-	-	-	-	35,224.91	-	-	-

Table J.6 Tensile Ultimate Load-Displacement of B-090F Model Set

	B-090F AA	B-090F AB	B-090F AC	B-090F BA	B-090F BB	B-090F BC	B-090F CA	B-090F CB	B-090F CC
Force (lb)	37,926.91	38,361.25	38,566.76	34,723.73	33,320.20	35,415.61	36,907.93	36,826.06	37,291.68
Displacement (in)	0.0280	0.0288	0.0296	0.0304	0.0304	0.0347	0.0296	0.0264	0.0304

Table J.7 Compressive Load-Displacement of B-090F Model Set

Displacement (in)	Force (lb)								
	B-090F AA	B-090F AB	B-090F AC	B-090F BA	B-090F BB	B-090F BC	B-090F CA	B-090F CB	B-090F CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.010	-11,741.57	-2,196.84	-2,021.50	-7,055.31	-647.71	0.00	-8,299.25	-478.99	-1,434.07
-0.012	-16,391.17	-4,672.90	-4,283.95	-11,558.16	-2,976.48	-2,303.15	-14,658.96	-4,471.36	-2,982.54
-0.014	-22,128.44	-6,349.68	-6,665.19	-16,988.71	-4,535.84	-4,681.20	-19,529.66	-6,503.80	-5,209.16
-0.016	-25,918.04	-8,695.79	-14,567.48	-23,117.53	-6,071.47	-11,441.02	-25,566.05	-7,370.39	-12,995.17
-0.018	-29,548.82	-10,756.86	-21,104.63	-25,963.26	-8,856.25	-18,740.85	-29,230.50	-10,056.06	-19,116.25
-0.020	-35,693.57	-12,078.53	-27,048.58	-29,276.26	-10,346.56	-23,733.50	-32,716.21	-10,510.66	-24,035.74
-0.022	-41,019.82	-19,439.30	-37,068.53	-37,290.49	-17,135.13	-34,000.30	-38,869.47	-15,405.54	-34,052.99
-0.024	-43,839.61	-31,400.59	-	-42,393.79	-26,161.82	-42,607.33	-	-24,283.14	-42,976.53
-0.026	-	-41,405.71	-	-	-39,250.51	-	-	-35,913.70	-
-0.028	-	-	-	-	-	-	-	-43,342.47	-

Table J.8 Compressive Ultimate Load-Displacement of B-090F Model Set

	B-090F AA	B-090F AB	B-090F AC	B-090F BA	B-090F BB	B-090F BC	B-090F CA	B-090F CB	B-090F CC
Force (lb)	-43,839.61	-45,169.47	-43,885.83	-43,464.51	-43,702.65	-43,857.30	-42,996.74	-43,342.47	-44,208.53
Displacement (in)	-0.0240	-0.0272	-0.0239	-0.0248	-0.0272	-0.0245	-0.0239	-0.0280	-0.0248

B-104 Axial Semi-Rigid Behavior

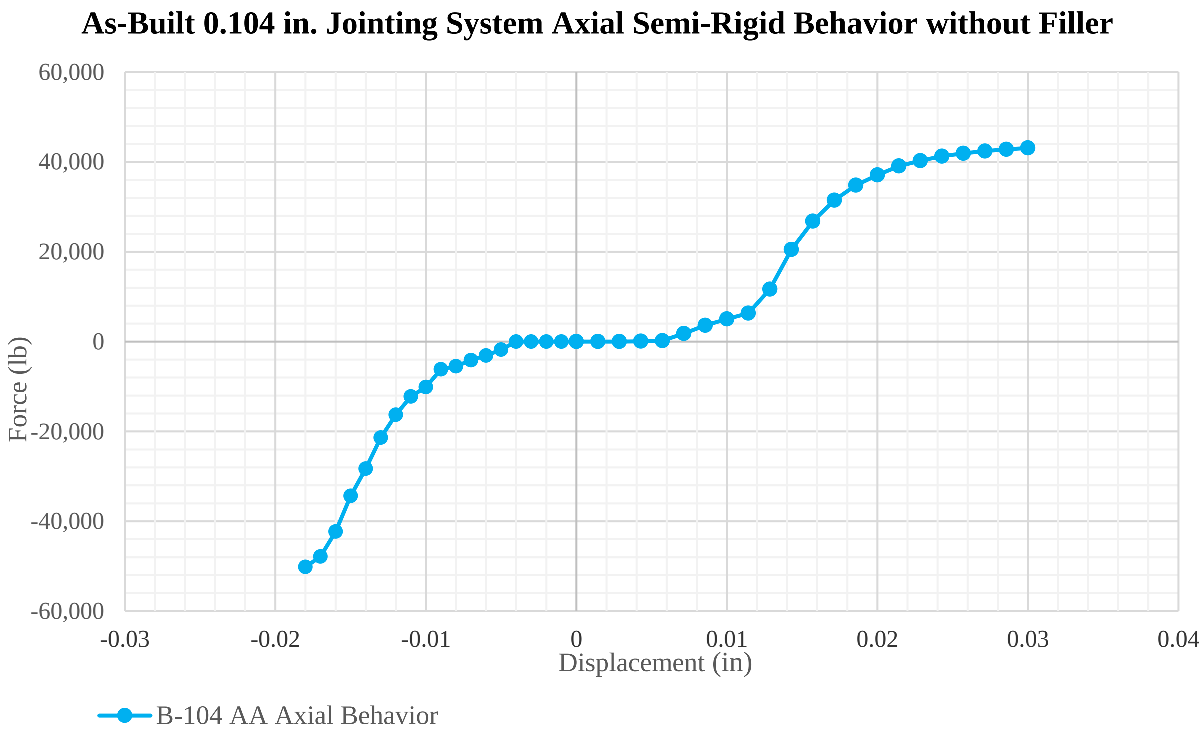


Figure J.19 Axial Semi-Rigid Behavior (B-104 AA)

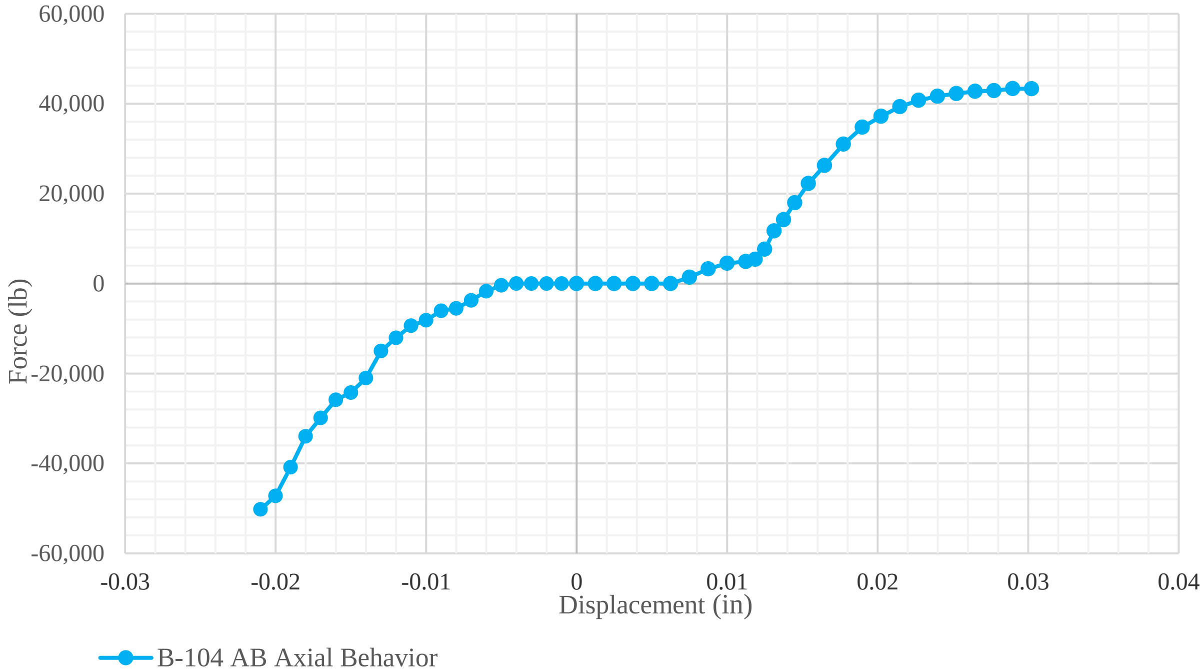


Figure J.20 Axial Semi-Rigid Behavior (B-104 AB)

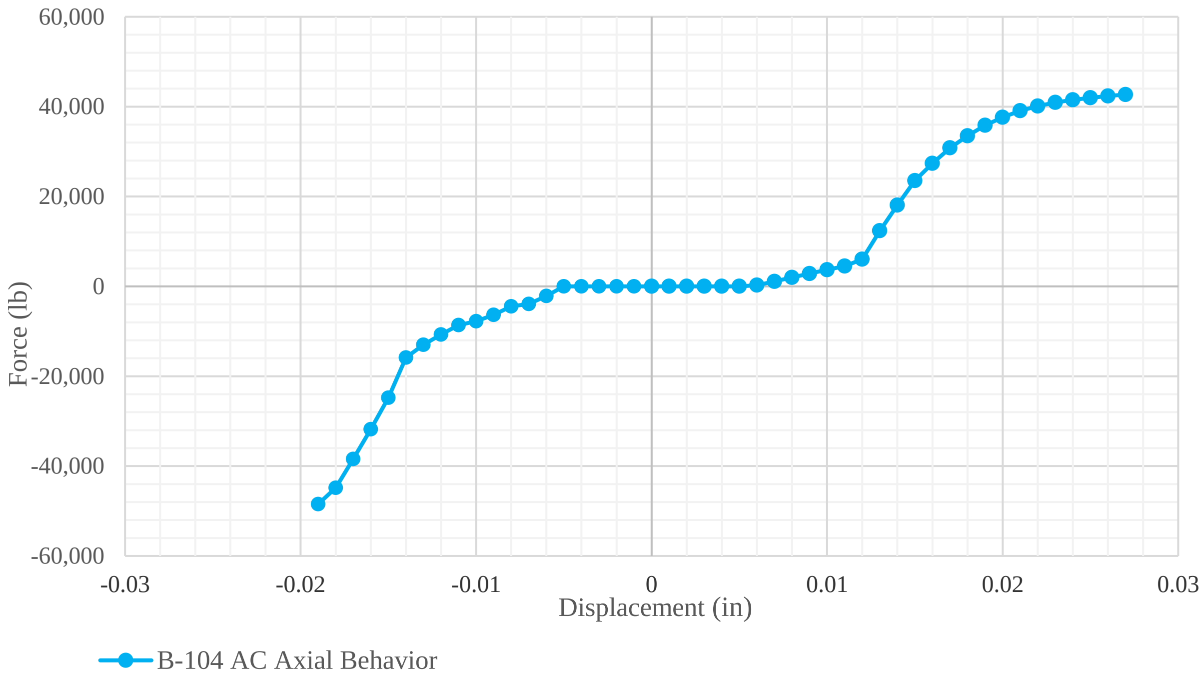


Figure J.21 Axial Semi-Rigid Behavior (B-104 AC)

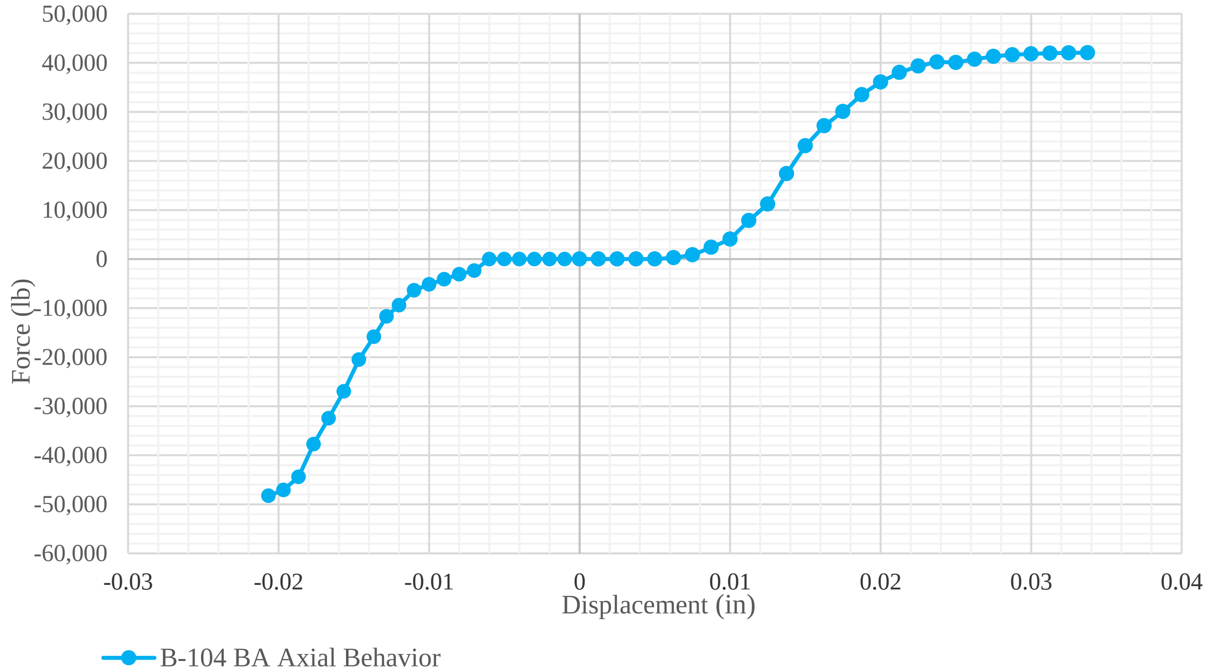


Figure J.22 Axial Semi-Rigid Behavior (B-104 BA)

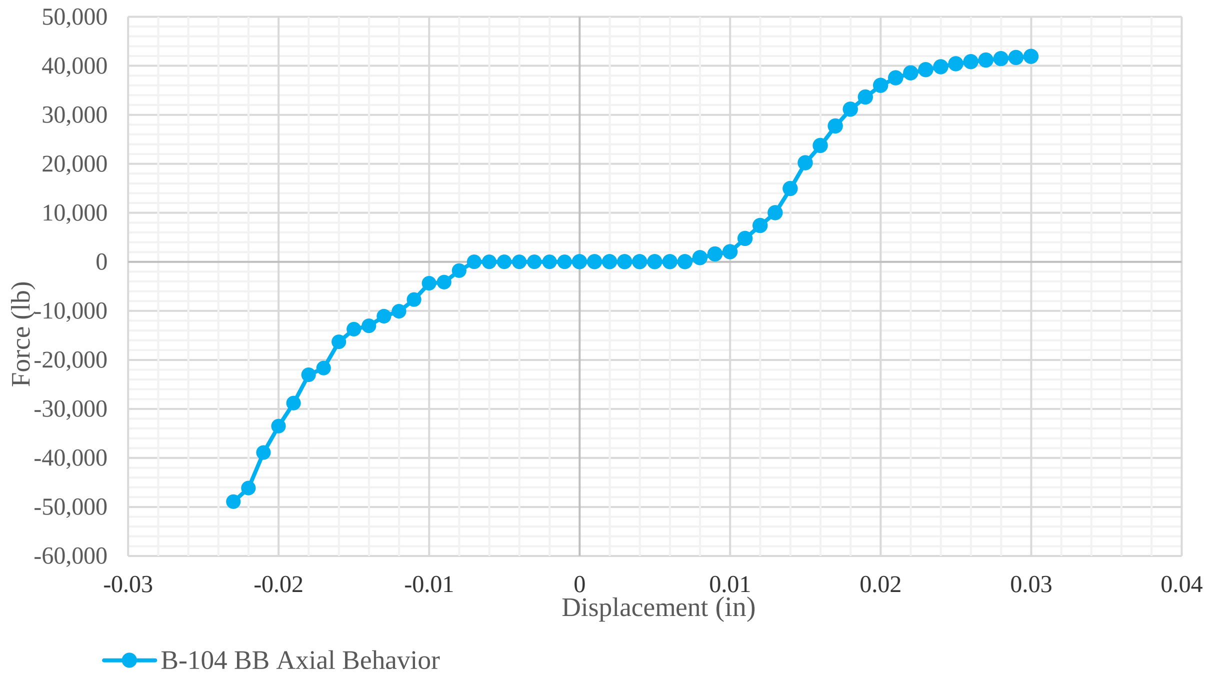


Figure J.23 Axial Semi-Rigid Behavior (B-104 BB)

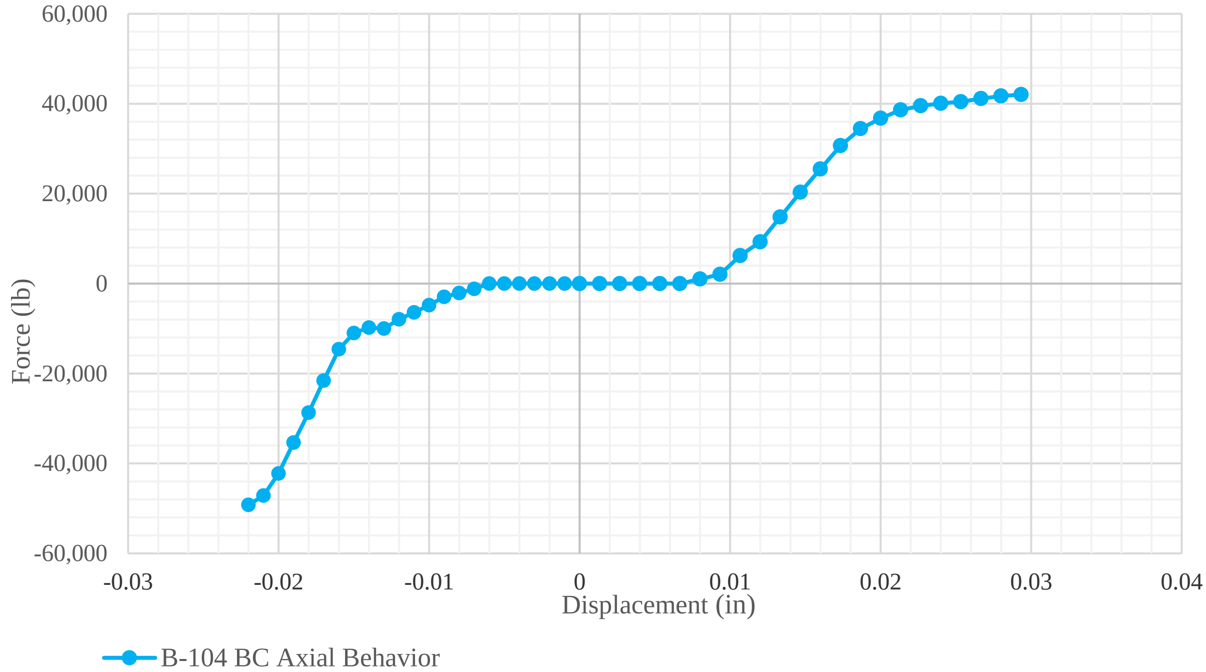


Figure J.24 Axial Semi-Rigid Behavior (B-104 BC)

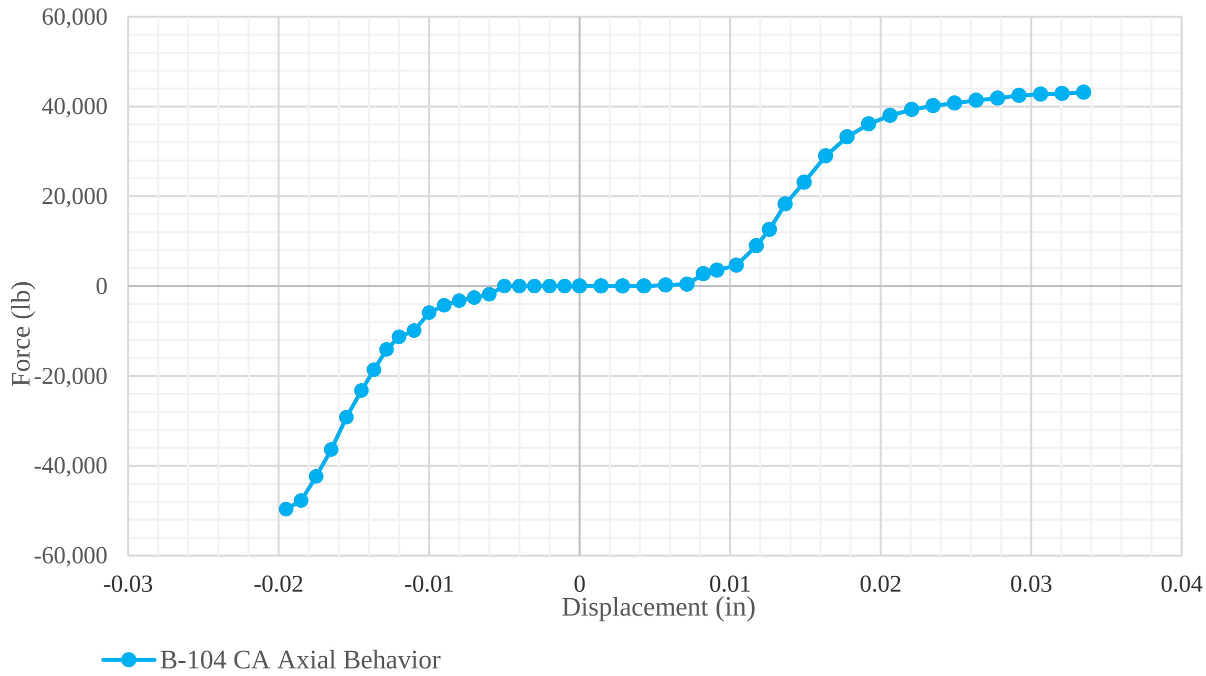


Figure J.25 Axial Semi-Rigid Behavior (B-104 CA)

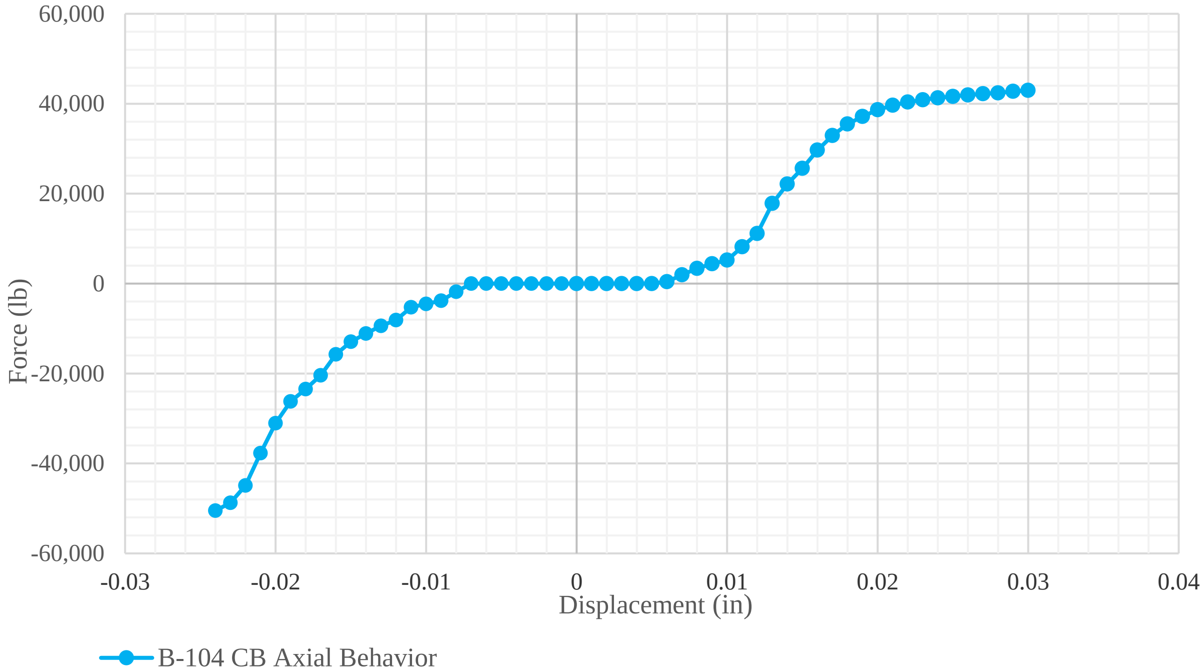


Figure J.26 Axial Semi-Rigid Behavior (B-104 CB)

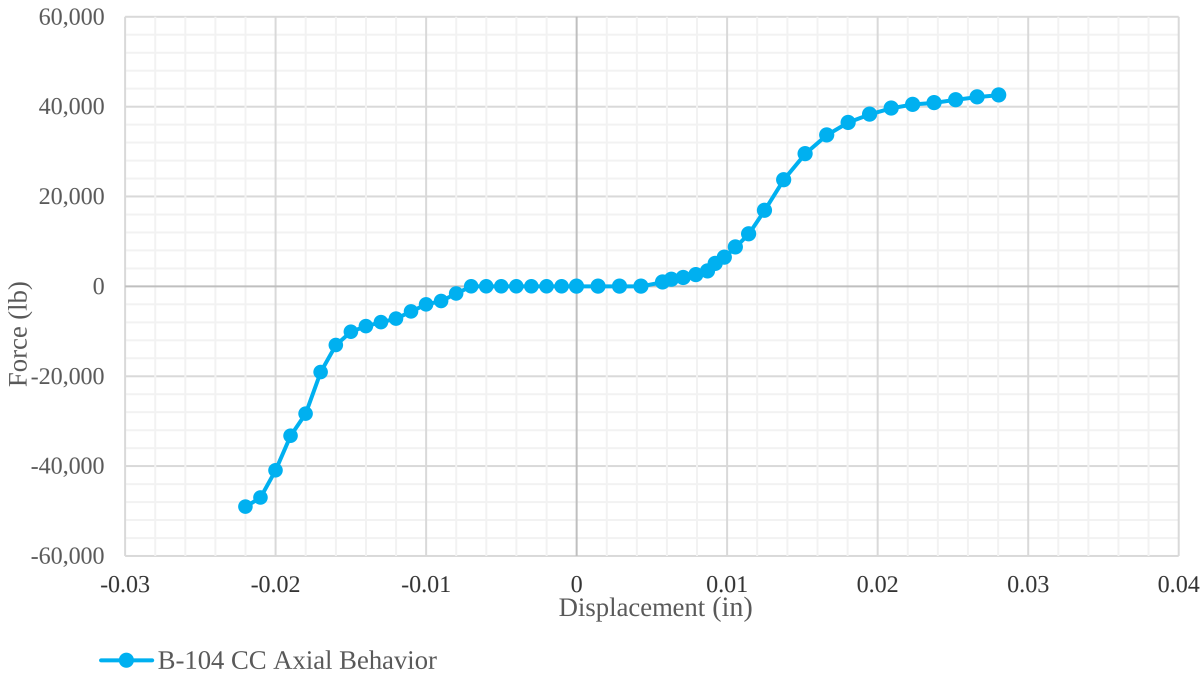


Figure J.27 Axial Semi-Rigid Behavior (B-104 CC)

Table J.9 Tensile Load-Displacement of B-104 Model Set

Displacement (in)	Force (lb)								
	B-104 AA	B-104 AB	B-104 AC	B-104 BA	B-104 BB	B-104 BC	B-104 CA	B-104 CB	B-104 CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.006	514.25	0.00	258.75	216.17	0.00	0.00	269.82	429.57	1,238.47
0.008	2,884.55	2,155.45	1,984.15	1,470.92	822.09	1,010.96	2,781.80	3,369.15	2,624.04
0.010	5,026.86	4,493.86	3,695.51	4,056.69	2,038.59	4,139.53	4,211.82	5,218.32	7,004.11
0.012	8,455.73	5,852.30	6,043.40	9,870.47	7,387.60	9,292.08	10,048.46	11,123.78	14,445.98
0.014	18,721.98	15,454.20	18,068.79	18,536.67	14,922.57	17,562.89	19,582.34	22,133.92	24,667.66
0.016	27,710.91	24,472.71	27,376.00	26,352.30	23,700.97	25,488.05	27,586.60	29,680.02	31,856.43
0.018	33,460.32	31,818.61	33,492.36	31,453.91	31,103.22	32,558.27	33,685.49	35,484.15	36,368.69
0.020	37,072.09	36,746.93	37,636.10	36,085.91	35,965.46	36,758.07	37,165.98	38,653.89	38,784.04
0.022	39,541.27	39,926.34	40,123.89	38,817.78	38,510.47	39,073.05	39,258.83	40,347.29	40,283.86
0.024	41,052.81	41,667.53	41,503.29	40,151.49	39,776.20	40,069.39	40,373.99	41,295.86	40,960.55
0.026	41,990.92	42,547.93	42,359.92	40,587.65	40,806.12	40,794.12	41,229.77	41,941.56	41,859.77
0.028	42,628.46	42,992.83	-	41,434.83	41,432.15	41,701.49	41,948.03	42,410.63	42,538.97
0.030	43,081.44	43,321.47	-	41,824.76	41,879.04	-	42,623.93	42,957.40	-
0.032	-	-	-	42,004.15	-	-	42,866.75	-	-

Table J.10 Tensile Ultimate Load-Displacement of B-104 Model Set

	B-104 AA	B-104 AB	B-104 AC	B-104 BA	B-104 BB	B-104 BC	B-104 CA	B-104 CB	B-104 CC
Force (lb)	43,081.44	43,316.70	42,685.50	42,061.72	41,879.04	42,046.18	43,178.91	42,957.40	42,552.98
Displacement (in)	0.0300	0.0302	0.0270	0.0338	0.0300	0.0293	0.0335	0.0300	0.0280

Table J.11 Compressive Load-Displacement of B-104 Model Set

Displacement (in)	Force (lb)								
	B-104 AA	B-104 AB	B-104 AC	B-104 BA	B-104 BB	B-104 BC	B-104 CA	B-104 CB	B-104 CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.006	-3,102.39	-1,702.15	-2,148.45	0.00	0.00	0.00	-1,804.41	0.00	0.00
-0.008	-5,503.48	-5,500.96	-4,455.03	-3,102.72	-1,797.56	-2,081.38	-3,246.35	-1,814.74	-1,606.99
-0.010	-10,129.71	-8,163.97	-7,772.45	-5,170.15	-3,123.83	-4,802.16	-5,926.34	-4,526.93	-4,013.86
-0.012	-16,274.78	-12,085.53	-10,731.91	-9,417.03	-10,095.05	-7,948.76	-11,285.10	-8,116.02	-7,200.91
-0.014	-28,297.46	-22,122.49	-15,855.40	-17,393.83	-13,069.66	-9,772.66	-20,483.30	-11,118.47	-8,876.51
-0.016	-42,264.78	-25,855.22	-31,810.61	-28,798.08	-14,203.54	-14,599.21	-32,797.81	-15,743.37	-13,072.52
-0.018	-50,150.50	-33,973.11	-44,827.08	-39,954.55	-23,061.70	-28,712.32	-45,063.14	-23,467.23	-28,348.77
-0.020	-	-47,207.96	-	-47,467.22	-33,533.20	-42,218.93	-	-31,055.94	-40,960.07
-0.022	-	-	-	-	-46,168.81	-49,214.89	-	-44,892.18	-49,049.30
-0.024	-	-	-	-	-	-	-	-50,498.72	-

Table J.12 Compressive Ultimate Load-Displacement of B-104 Model Set

	B-104 AA	B-104 AB	B-104 AC	B-104 BA	B-104 BB	B-104 BC	B-104 CA	B-104 CB	B-104 CC
Force (lb)	-50,150.50	-50,219.21	-48,448.87	-48,257.73	-48,933.04	-49,214.89	-49,672.92	-50,498.72	-49,049.30
Displacement (in)	-0.0180	-0.0210	-0.0190	-0.0207	-0.0230	-0.0220	-0.0195	-0.0240	-0.0220

B-104F Axial Semi-Rigid Behavior

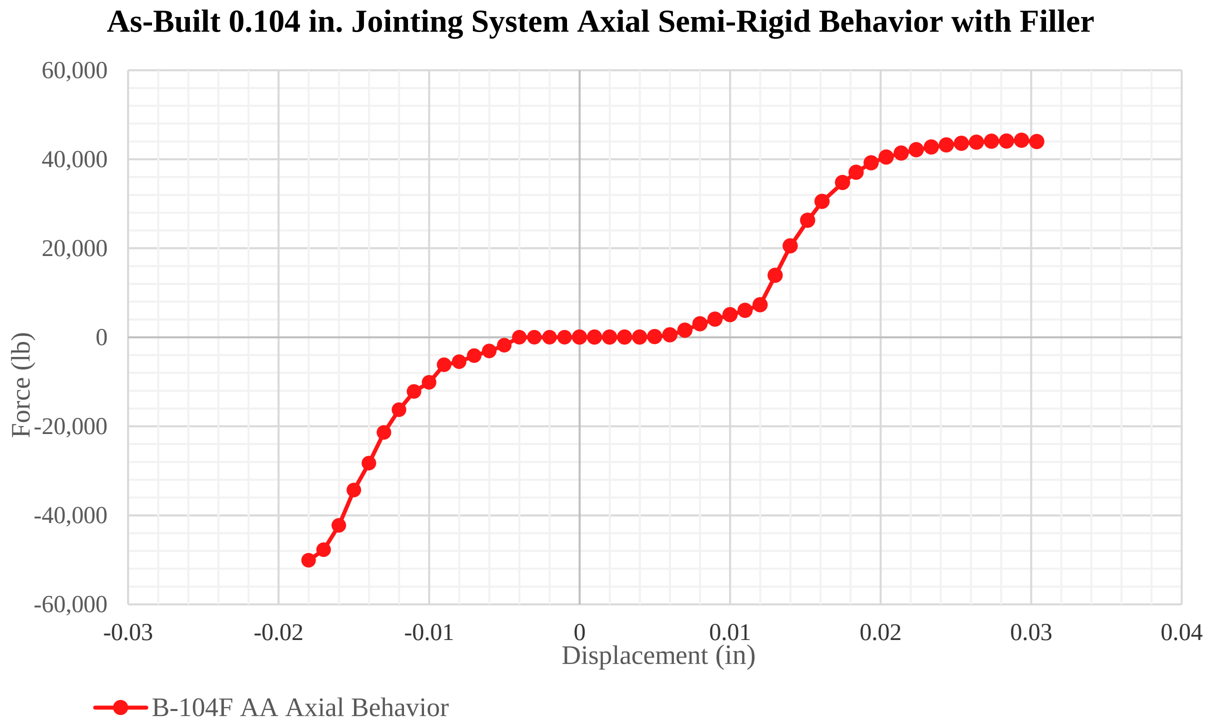


Figure J.28 Axial Semi-Rigid Behavior (B-104F AA)

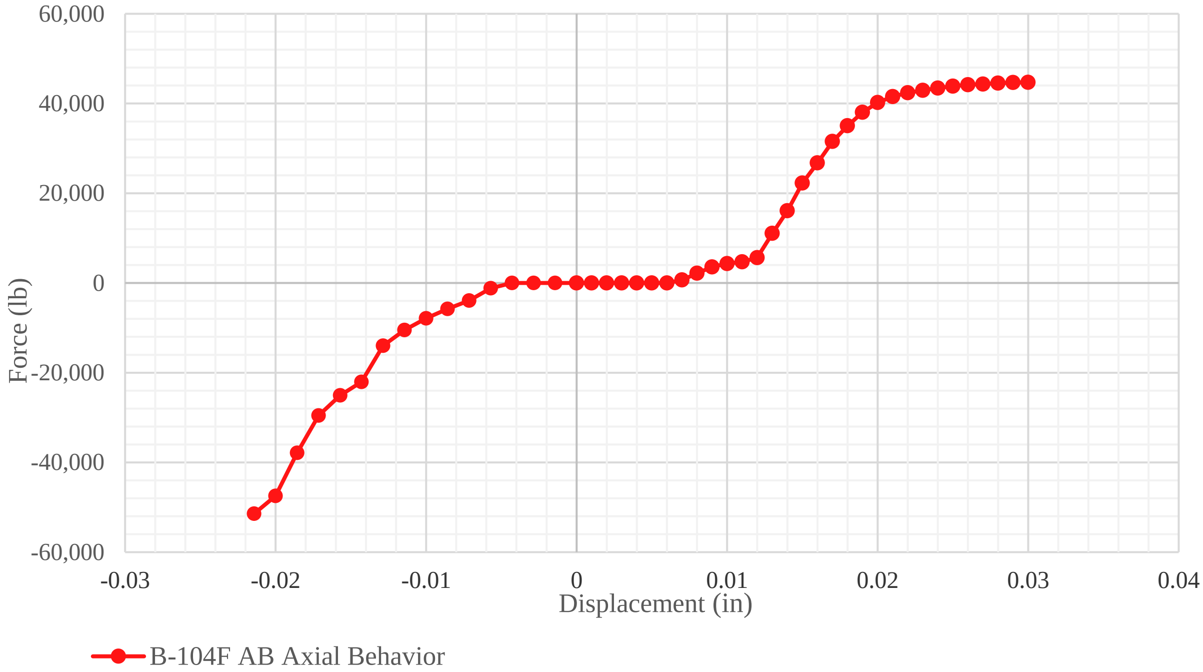


Figure J.29 Axial Semi-Rigid Behavior (B-104F AB)

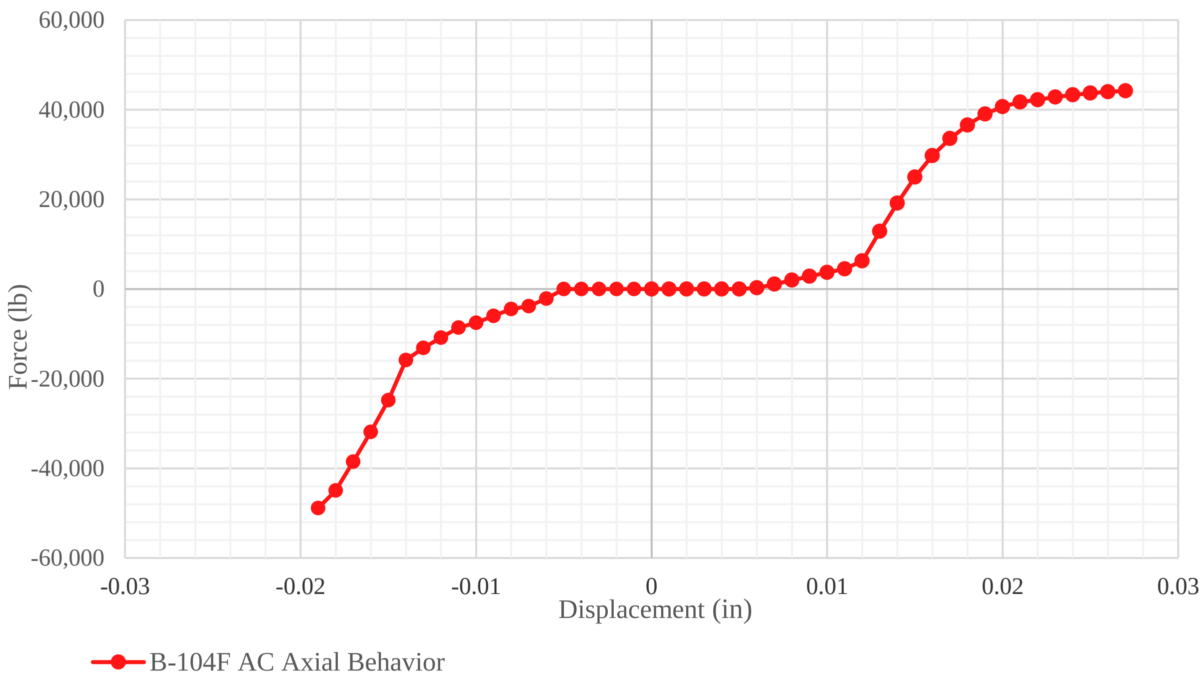


Figure J.30 Axial Semi-Rigid Behavior (B-104F AC)

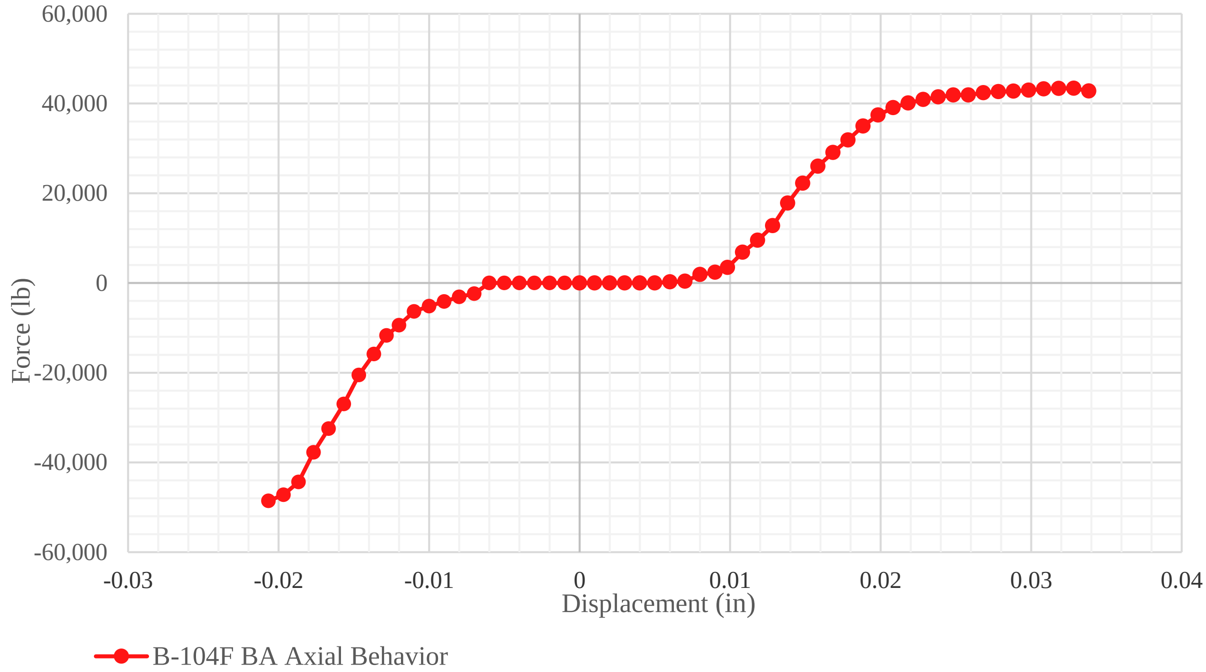


Figure J.31 Axial Semi-Rigid Behavior (B-104F BA)

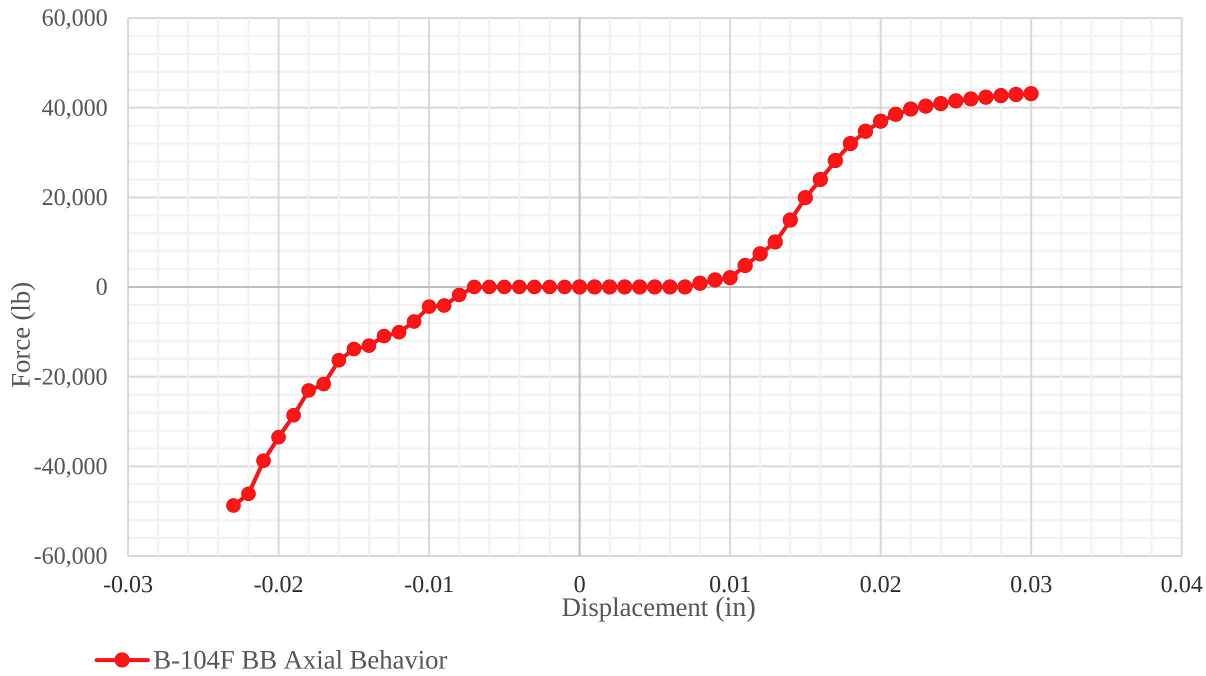


Figure J.32 Axial Semi-Rigid Behavior (B-104F BB)

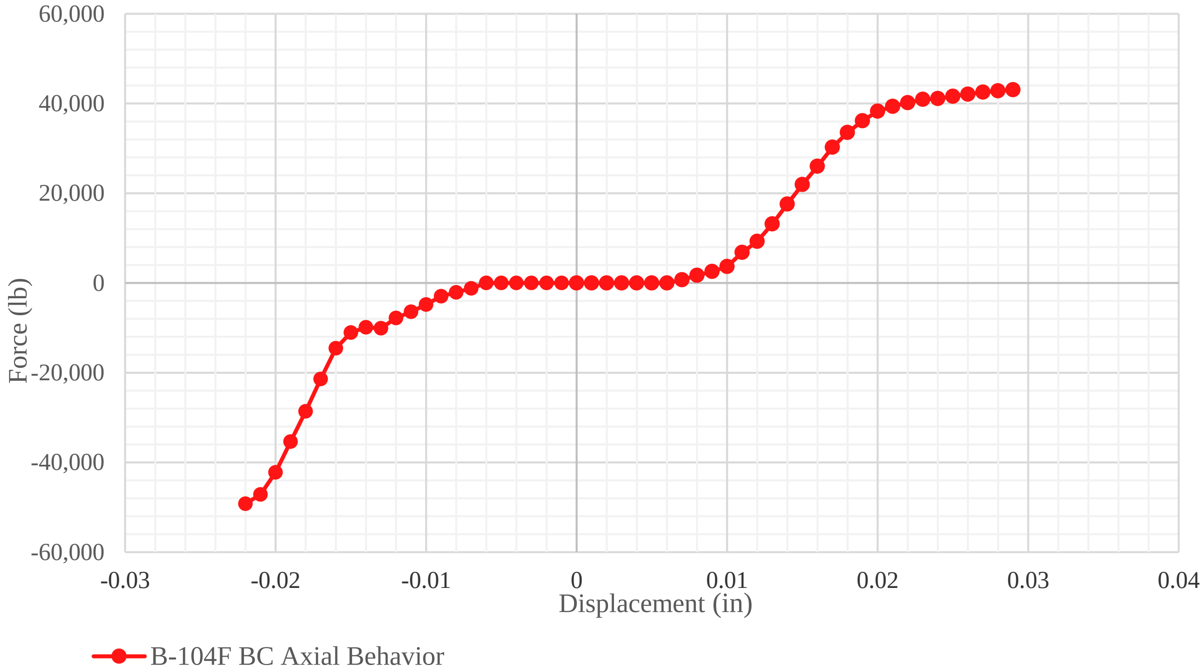


Figure J.33 Axial Semi-Rigid Behavior (B-104F BC)

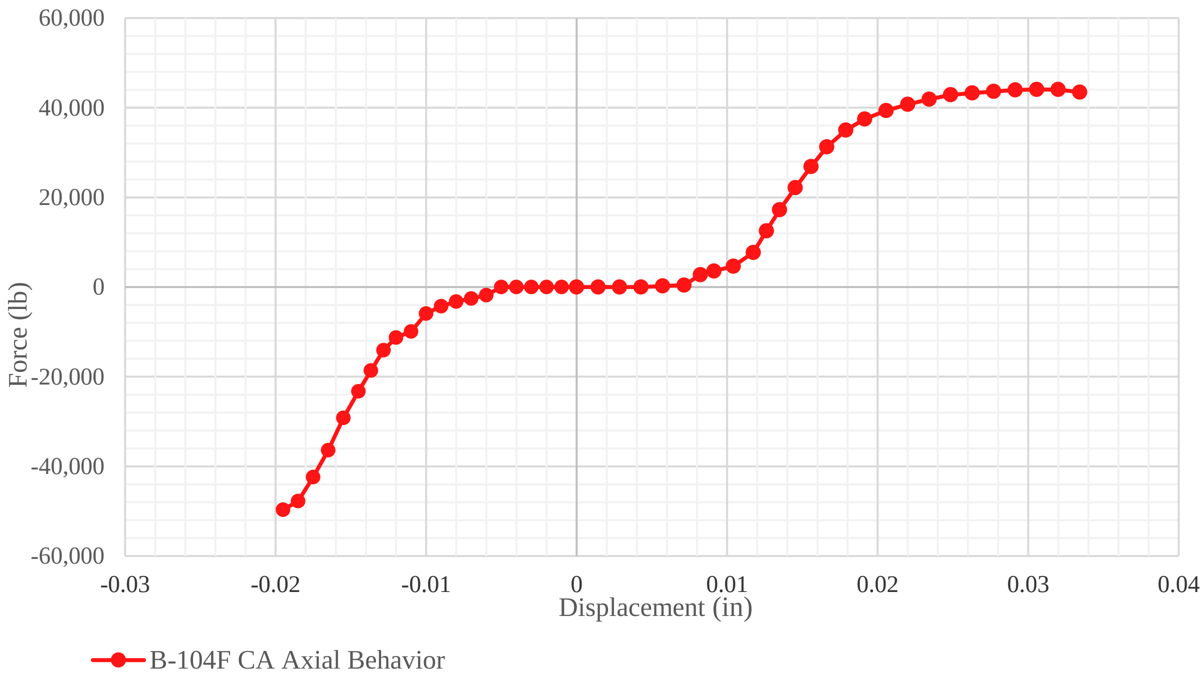


Figure J.34 Axial Semi-Rigid Behavior (B-104F CA)

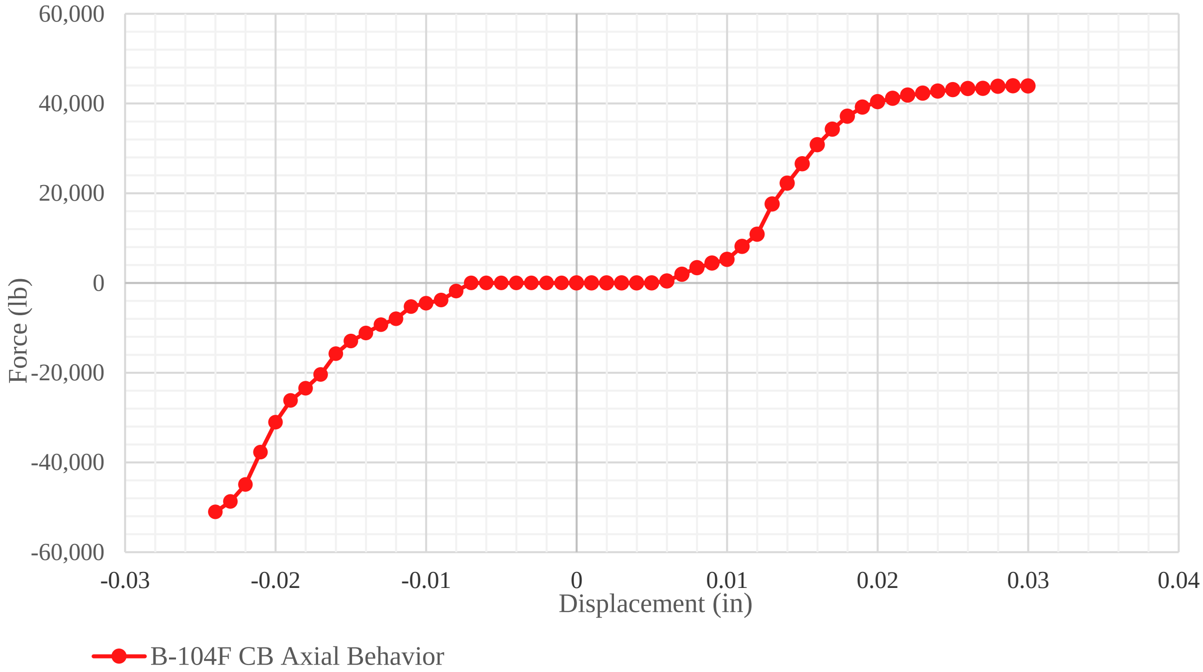


Figure J.35 Axial Semi-Rigid Behavior (B-104F CB)

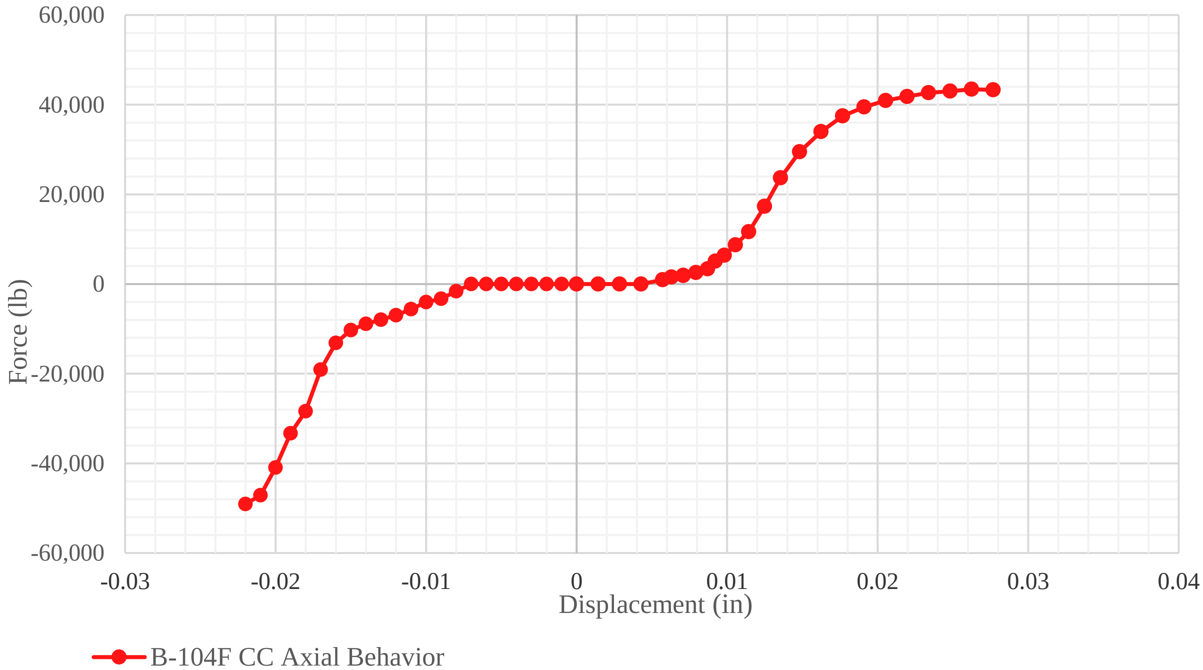


Figure J.36 Axial Semi-Rigid Behavior (B-104F CC)

Table J.13 Tensile Load-Displacement of B-104F Model Set

Displacement (in)	Force (lb)								
	B-104F AA	B-104F AB	B-104F AC	B-104F BA	B-104F BB	B-104F BC	B-104F CA	B-104F CB	B-104F CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.006	502.03	0.00	258.75	237.88	0.00	0.00	269.82	429.57	1,238.47
0.008	2,993.76	2,159.54	1,984.15	1,876.55	822.09	1,701.81	2,781.80	3,369.15	2,624.04
0.010	5,028.14	4,312.17	3,695.23	4,021.17	2,038.59	3,662.66	4,210.53	5,218.32	6,967.25
0.012	7,285.12	5,628.54	6,257.95	10,056.61	7,387.60	9,251.51	9,112.20	10,832.71	14,681.64
0.014	20,493.40	16,070.61	19,138.28	18,546.06	14,902.27	17,596.23	19,632.77	22,212.49	25,744.31
0.016	30,047.05	26,744.68	29,760.99	26,513.85	23,976.59	26,006.15	28,621.62	30,803.23	33,220.48
0.018	36,069.16	35,021.80	36,574.53	32,389.81	31,972.43	33,525.28	35,217.79	37,148.11	37,944.81
0.020	39,972.17	40,195.32	40,676.02	37,699.60	36,970.86	38,278.85	38,600.40	40,375.69	40,386.82
0.022	41,818.44	42,370.92	42,215.06	40,234.26	39,669.52	40,190.95	40,729.10	41,835.41	41,844.52
0.024	42,994.81	43,430.77	43,304.47	41,518.28	40,898.18	41,102.94	42,292.12	42,737.76	42,811.07
0.026	43,708.54	44,175.47	44,007.68	41,976.90	41,928.36	42,071.18	43,187.52	43,310.75	43,376.77
0.028	44,041.63	44,537.81	-	42,641.84	42,663.72	42,820.93	43,693.89	43,801.69	43,404.77
0.030	44,040.72	44,719.07	-	43,000.18	43,102.34	-	44,018.02	43,897.08	-
0.032	-	-	-	43,364.06	-	-	44,047.02	-	-

Table J.14 Tensile Ultimate Load-Displacement of B-104F Model Set

	B-104F AA	B-104F AB	B-104F AC	B-104F BA	B-104F BB	B-104F BC	B-104F CA	B-104F CB	B-104F CC
Force (lb)	43,934.80	44,719.07	44,200.57	42,786.72	43,102.34	43,055.72	43,459.06	43,897.08	43,309.49
Displacement (in)	0.0304	0.0300	0.0270	0.0338	0.0300	0.0290	0.0334	0.0300	0.0277

Table J.15 Compressive Load-Displacement of B-104F Model Set

Displacement (in)	Force (lb)								
	B-104F AA	B-104F AB	B-104F AC	B-104F BA	B-104F BB	B-104F BC	B-104F CA	B-104F CB	B-104F CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.006	-3,102.39	-1,705.37	-2,148.45	0.00	0.00	0.00	-1,804.41	0.00	0.00
-0.008	-5,503.48	-5,027.55	-4,474.17	-3,102.72	-1,797.56	-2,081.38	-3,246.35	-1,814.74	-1,606.99
-0.010	-10,129.71	-7,892.23	-7,530.92	-5,170.15	-3,123.83	-4,802.16	-5,926.34	-4,526.93	-4,013.86
-0.012	-16,274.78	-11,893.20	-10,851.92	-9,416.92	-10,095.05	-7,796.36	-11,285.10	-7,989.47	-6,971.44
-0.014	-28,297.46	-21,365.56	-15,852.61	-17,394.81	-13,081.17	-9,877.59	-20,483.31	-11,155.44	-8,883.91
-0.016	-42,265.93	-25,949.68	-31,851.41	-28,801.40	-14,208.42	-14,562.47	-32,797.82	-15,753.05	-13,132.18
-0.018	-50,129.08	-34,544.84	-44,930.34	-39,942.16	-23,089.43	-28,628.39	-45,063.14	-23,474.37	-28,385.19
-0.020	-	-47,470.05	-	-47,661.26	-33,519.86	-42,224.46	-	-31,059.61	-40,926.96
-0.022	-	-	-	-	-46,157.31	-49,207.67	-	-44,918.60	-49,076.62
-0.024	-	-	-	-	-	-	-	-51,047.35	-

Table J.16 Compressive Ultimate Load-Displacement of B-104F Model Set

	B-104F AA	B-104F AB	B-104F AC	B-104F BA	B-104F BB	B-104F BC	B-104F CA	B-104F CB	B-104F CC
Force (lb)	-50,129.08	-51,431.60	-48,864.94	-48,582.34	-48,746.59	-49,207.67	-49,672.92	-51,047.35	-49,076.62
Displacement (in)	-0.0180	-0.0214	-0.0190	-0.0207	-0.0230	-0.0220	-0.0195	-0.0240	-0.0220

B-120 Axial Semi-Rigid Behavior

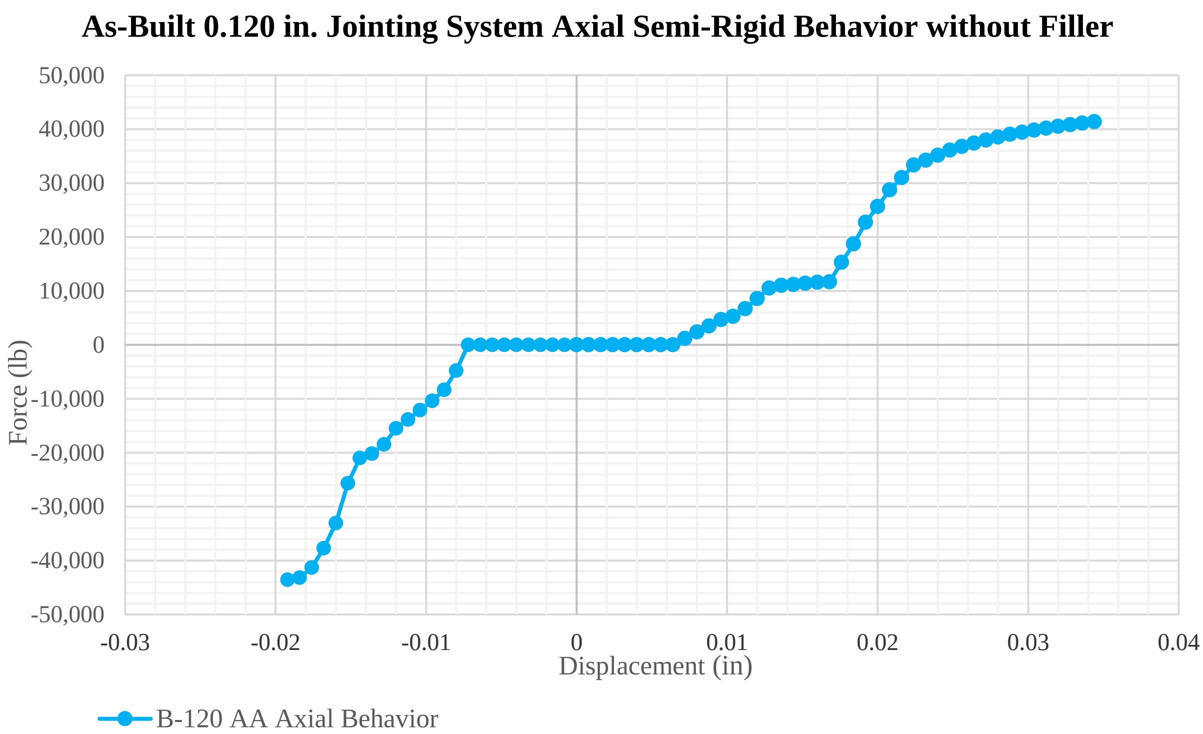


Figure J.37 Axial Semi-Rigid Behavior (B-120 AA)

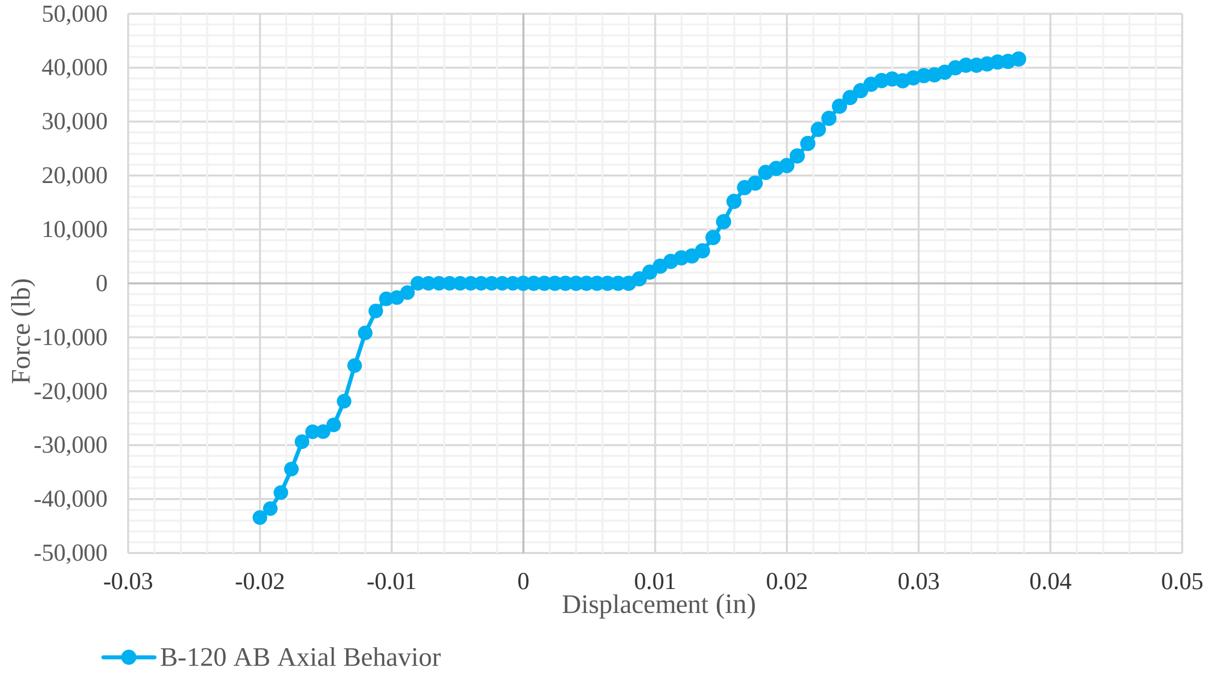


Figure J.38 Axial Semi-Rigid Behavior (B-120 AB)

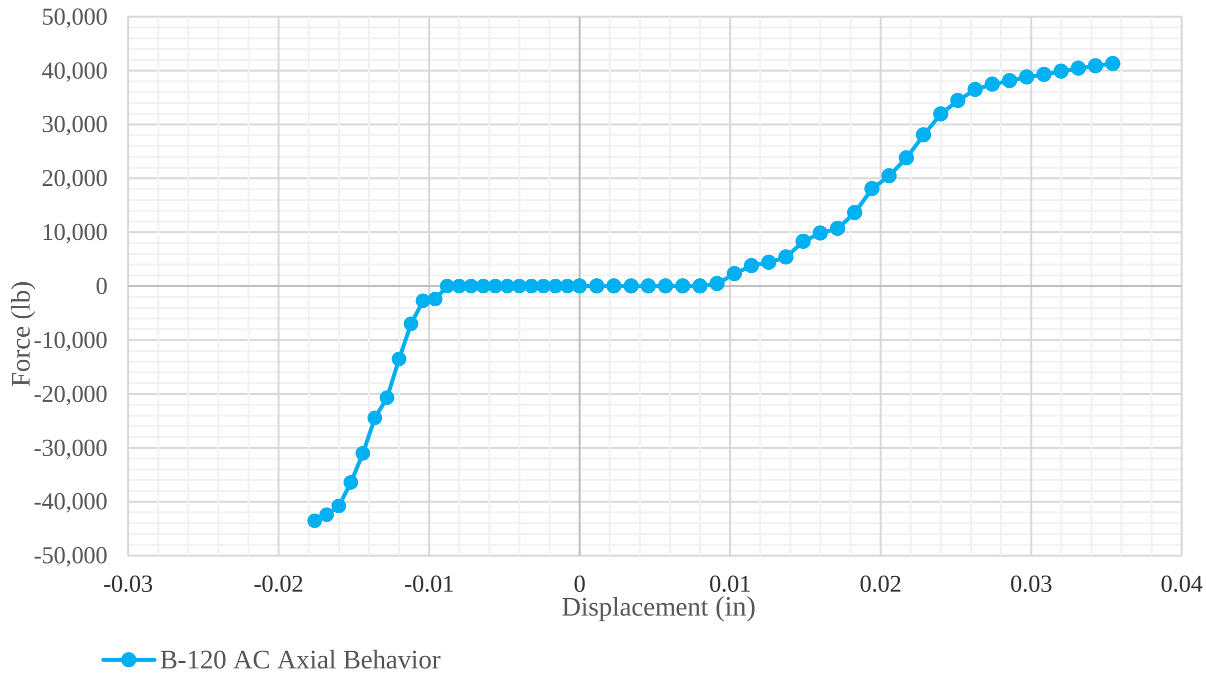


Figure J.39 Axial Semi-Rigid Behavior (B-120 AC)

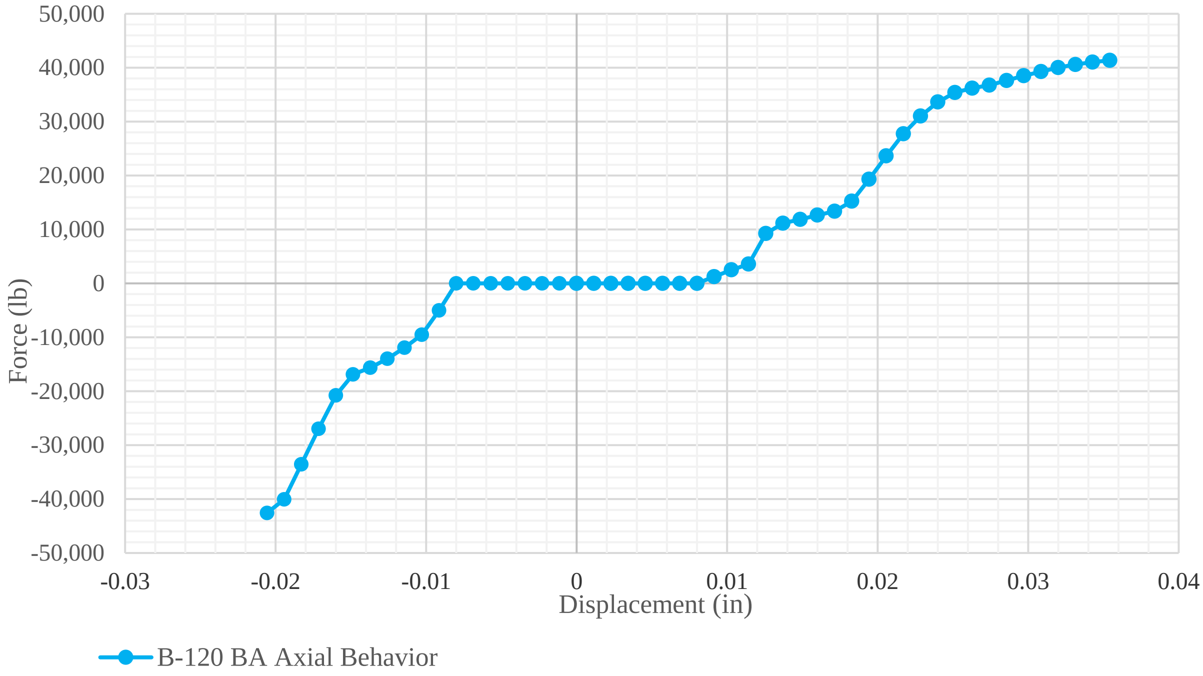


Figure J.40 Axial Semi-Rigid Behavior (B-120 BA)

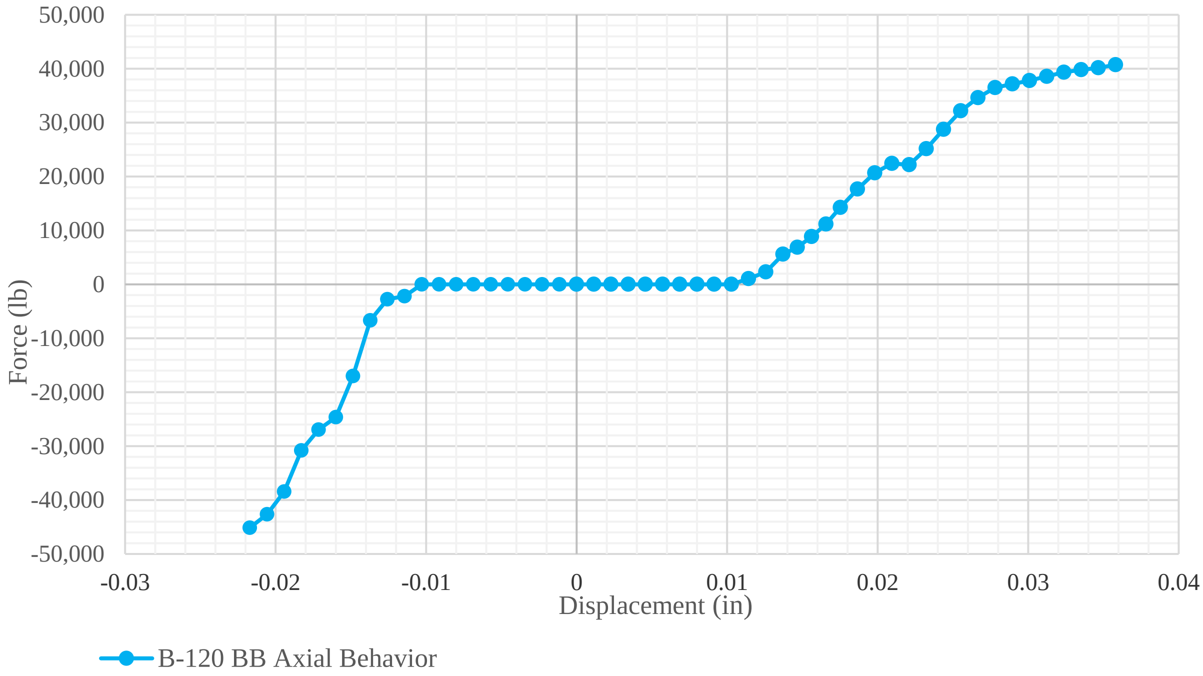


Figure J.41 Axial Semi-Rigid Behavior (B-120 BB)

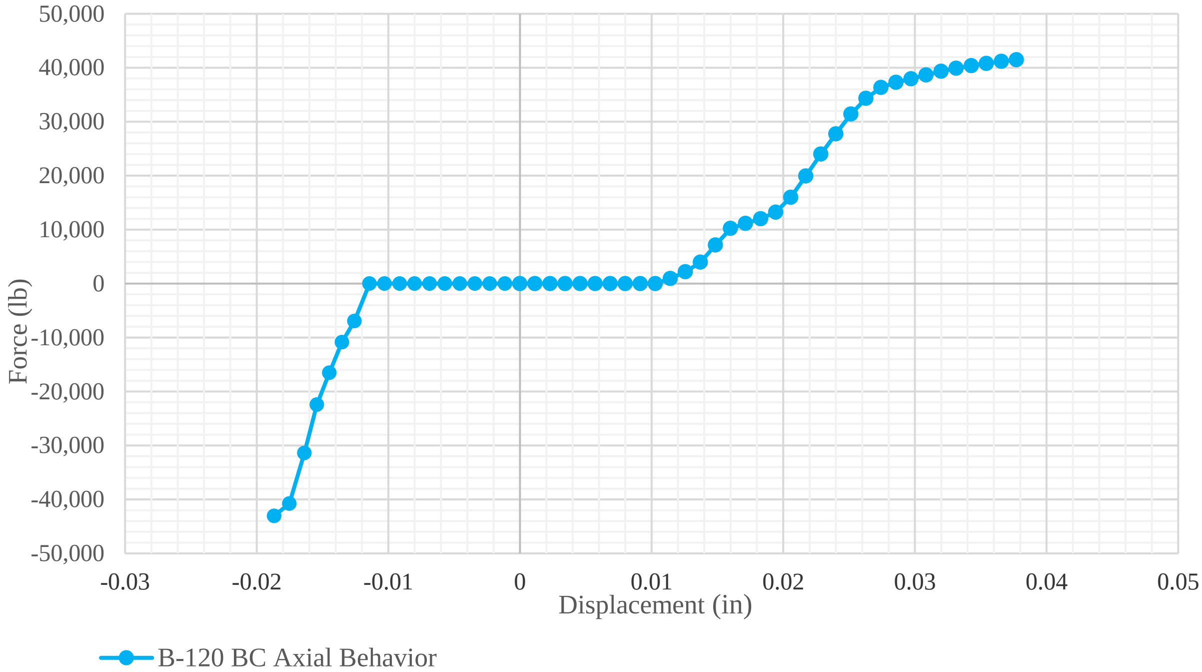


Figure J.42 Axial Semi-Rigid Behavior (B-120 BC)

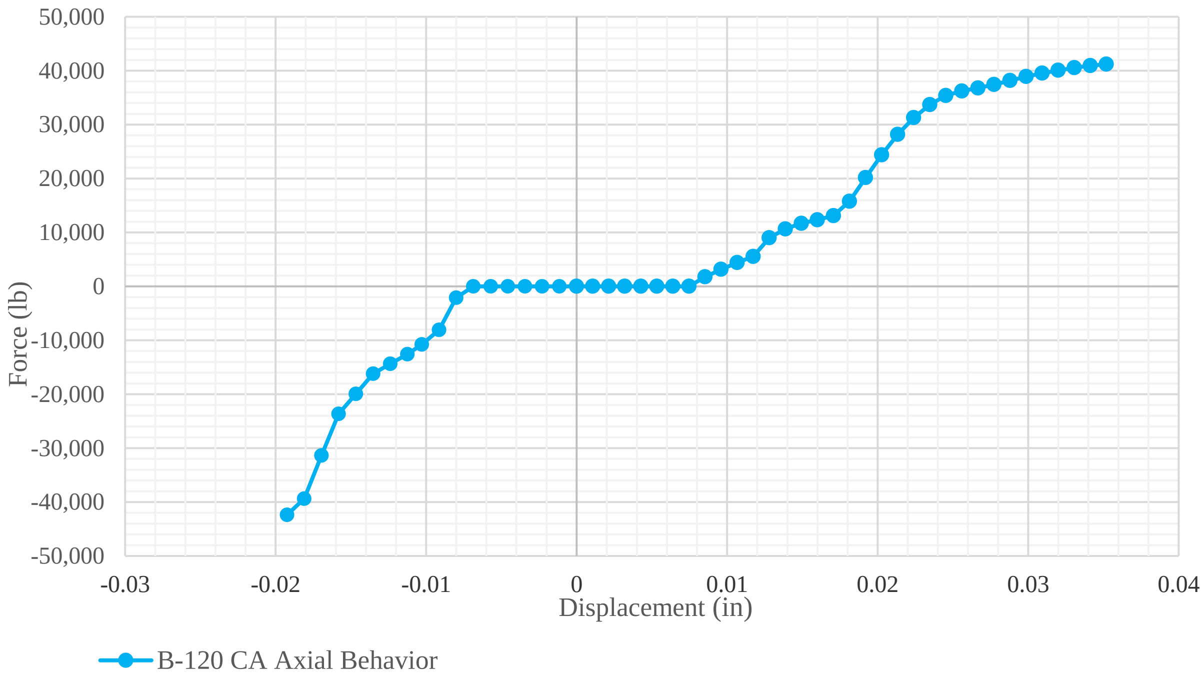


Figure J.43 Axial Semi-Rigid Behavior (B-120 CA)

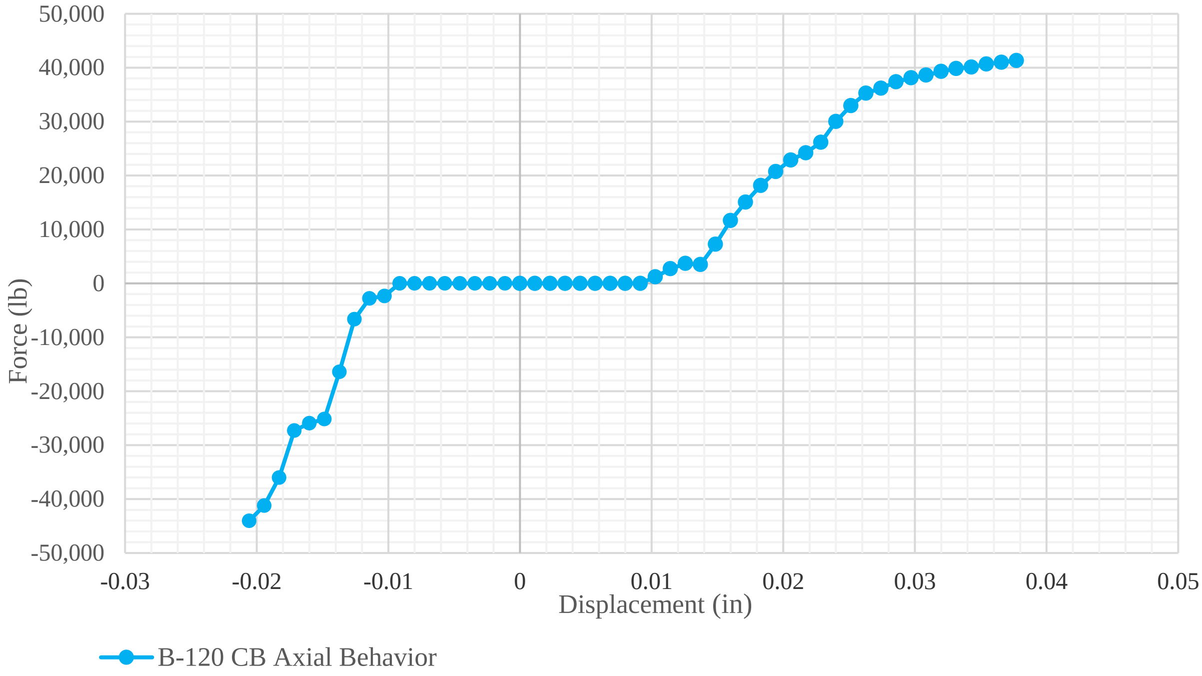


Figure J.44 Axial Semi-Rigid Behavior (B-120 CB)

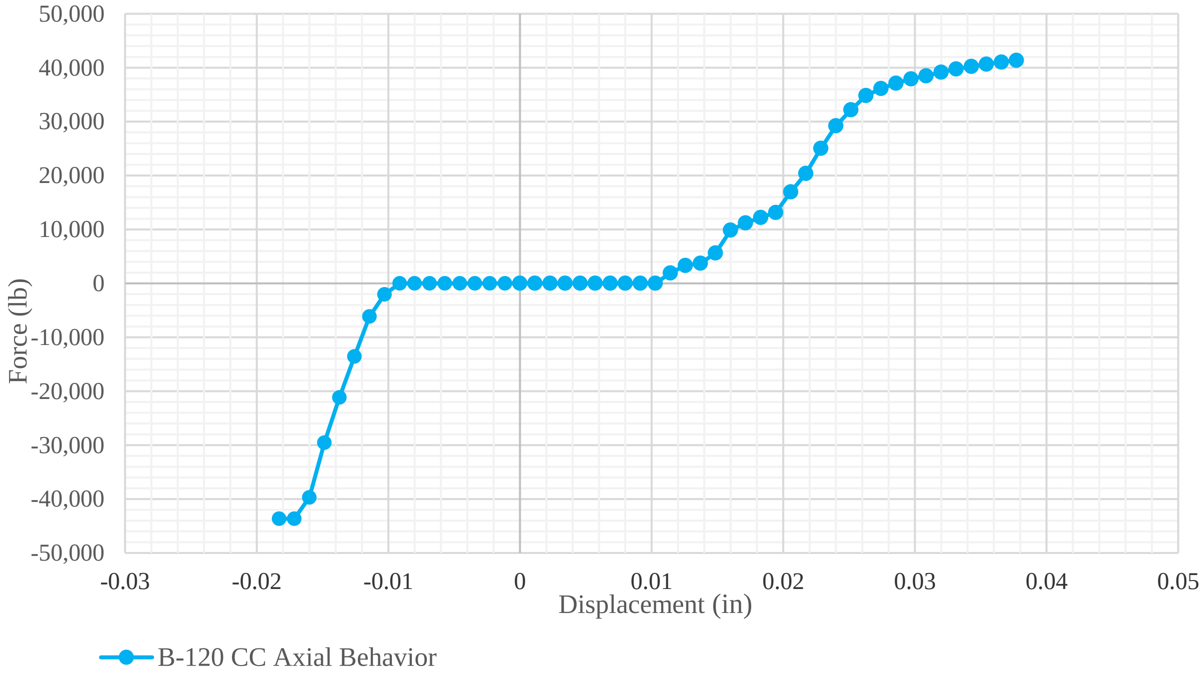


Figure J.45 Axial Semi-Rigid Behavior (B-120 CC)

Table J.17 Tensile Load-Displacement of B-120 Model Set

Displacement (in)	Force (lb)								
	B-120 AA	B-120 AB	B-120 AC	B-120 BA	B-120 BB	B-120 BC	B-120 CA	B-120 CB	B-120 CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.008	2,368.93	0.00	0.00	0.00	0.00	0.00	880.20	0.00	0.00
0.010	4,955.09	2,608.61	1,845.05	2,184.66	0.00	0.00	3,620.72	892.05	0.00
0.012	8,553.89	4,700.94	4,100.83	6,403.44	1,675.09	1,563.67	6,406.65	3,196.90	2,615.37
0.014	11,089.58	7,237.02	6,104.18	11,327.95	5,971.69	4,766.64	10,770.76	4,438.55	4,191.61
0.016	11,570.61	15,166.37	9,825.28	12,650.55	9,781.31	10,212.87	12,341.64	11,649.68	9,854.58
0.018	16,984.98	19,561.90	12,906.14	14,770.83	15,689.63	11,786.38	15,438.83	17,372.05	11,949.21
0.020	25,648.37	21,815.10	19,273.82	21,468.63	20,969.10	14,603.74	23,328.75	21,802.77	15,039.00
0.022	32,149.98	27,222.61	24,861.74	28,568.14	22,193.87	20,955.82	30,112.91	24,699.73	21,527.05
0.024	35,150.08	32,841.17	31,944.83	33,622.48	27,550.68	27,736.71	34,544.76	30,014.01	29,198.78
0.026	37,076.85	36,318.01	35,977.11	35,991.93	33,190.76	33,599.51	36,431.12	34,689.61	34,161.64
0.028	38,510.67	37,876.71	37,784.89	37,188.23	36,602.80	36,808.78	37,607.21	36,786.77	36,614.34
0.030	39,609.57	38,294.46	38,919.48	38,696.91	37,737.45	38,125.42	38,981.71	38,229.75	38,050.72
0.032	40,505.82	39,139.54	39,862.11	40,029.35	39,080.00	39,328.63	40,071.50	39,290.59	39,160.72
0.034	41,224.90	40,443.03	40,761.50	40,919.10	39,943.32	40,264.53	40,889.78	40,043.33	40,105.51
0.036	-	41,014.12	-	-	-	40,979.18	-	40,830.98	40,834.56

Table J.18 Tensile Ultimate Load-Displacement of B-120 Model Set

	B-120 AA	B-120 AB	B-120 AC	B-120 BA	B-120 BB	B-120 BC	B-120 CA	B-120 CB	B-120 CC
Force (lb)	41,355.58	41,586.00	41,295.46	41,361.72	40,732.88	41,455.50	41,188.23	41,314.11	41,357.68
Displacement (in)	0.0344	0.0376	0.0354	0.0354	0.0358	0.0377	0.0352	0.0377	0.0377

Table J.19 Compressive Load-Displacement of B-120 Model Set

Displacement (in)	Force (lb)								
	B-120 AA	B-120 AB	B-120 AC	B-120 BA	B-120 BB	B-120 BC	B-120 CA	B-120 CB	B-120 CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.008	-4,773.55	0.00	0.00	0.00	0.00	0.00	-2,098.19	0.00	0.00
-0.010	-11,262.74	-2,763.83	-2,569.24	-8,385.17	0.00	0.00	-10,094.81	-1,748.31	-1,535.25
-0.012	-15,486.16	-9,189.44	-13,531.37	-12,954.33	-2,488.22	-3,473.68	-13,763.66	-4,706.32	-9,839.60
-0.014	-20,583.22	-24,066.74	-27,744.34	-15,957.66	-9,259.53	-13,684.14	-17,767.39	-18,601.51	-23,253.86
-0.016	-33,065.62	-27,548.78	-40,791.01	-20,760.17	-24,626.44	-27,796.85	-24,940.30	-25,936.45	-39,708.10
-0.018	-42,245.68	-36,631.39	-	-31,916.27	-29,846.30	-41,721.51	-38,721.02	-33,846.38	-43,637.90
-0.020	-	-43,446.13	-	-41,321.05	-40,530.97	-	-	-42,612.60	-

Table J.20 Compressive Ultimate Load-Displacement of B-120 Model Set

	B-120 AA	B-120 AB	B-120 AC	B-120 BA	B-120 BB	B-120 BC	B-120 CA	B-120 CB	B-120 CC
Force (lb)	-43,559.58	-43,446.13	-43,574.80	-42,575.47	-45,124.62	-43,048.64	-42,375.11	-44,025.02	-43,637.19
Displacement (in)	-0.0192	-0.0200	-0.0176	-0.0206	-0.0217	-0.0187	-0.0192	-0.0206	-0.0183

B-120F Axial Semi-Rigid Behavior

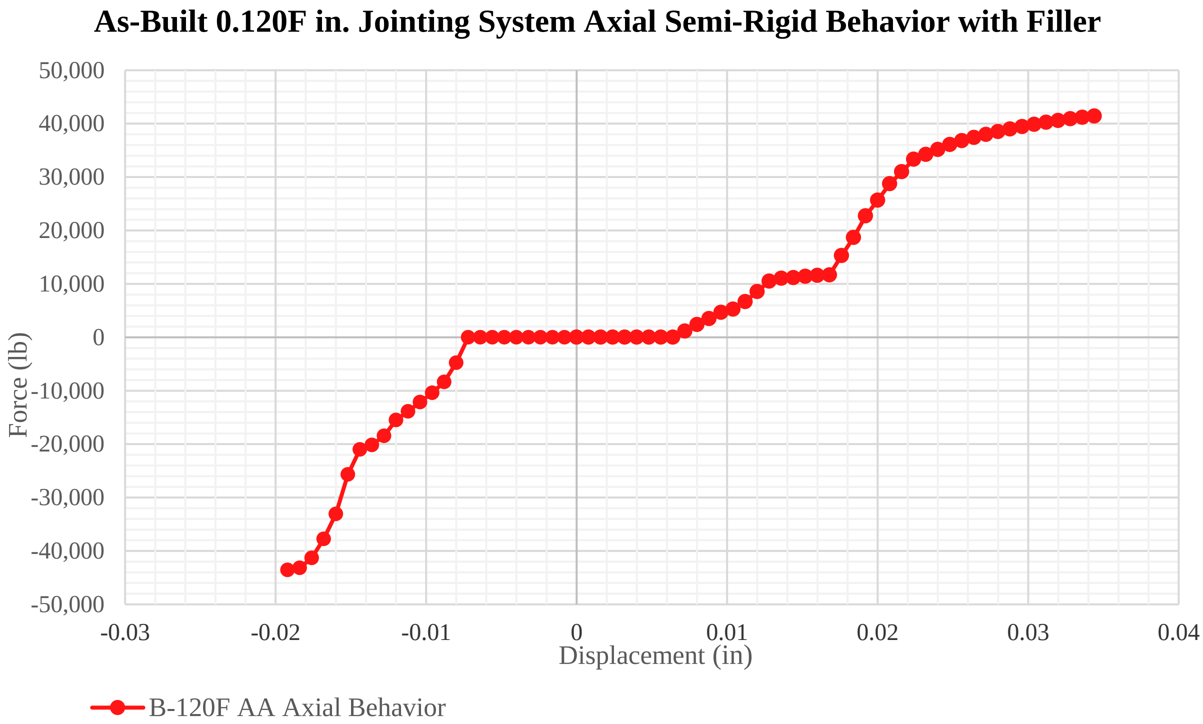


Figure J.46 Axial Semi-Rigid Behavior (B-120F AA)

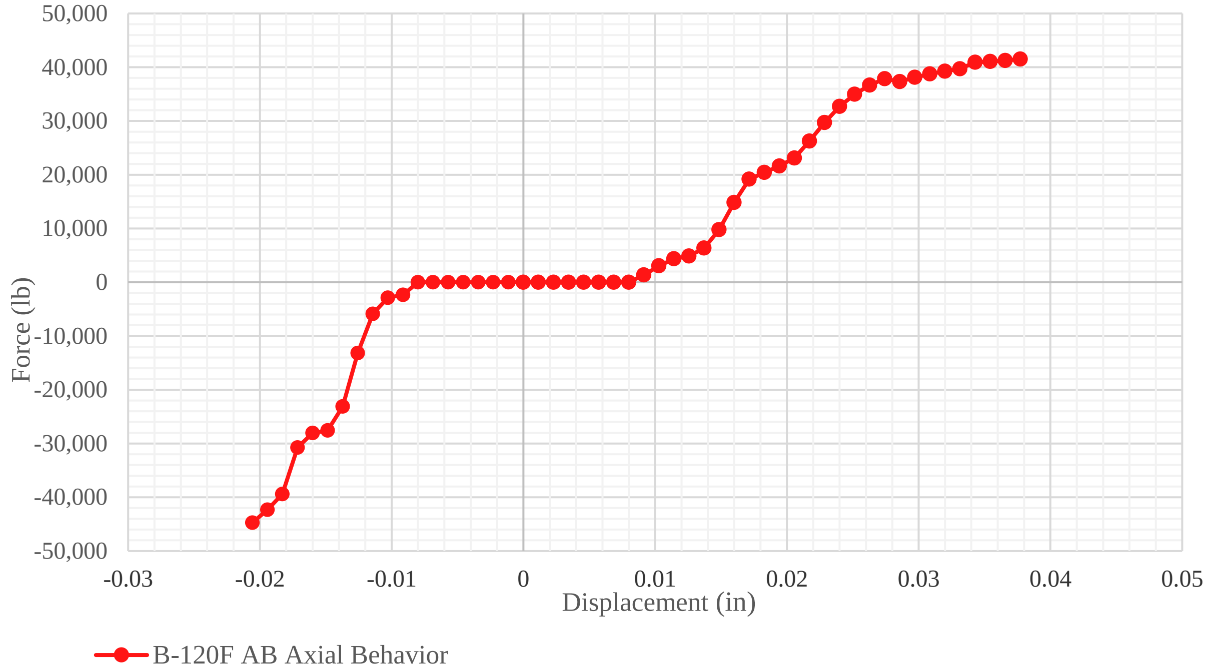


Figure J.47 Axial Semi-Rigid Behavior (B-120F AB)

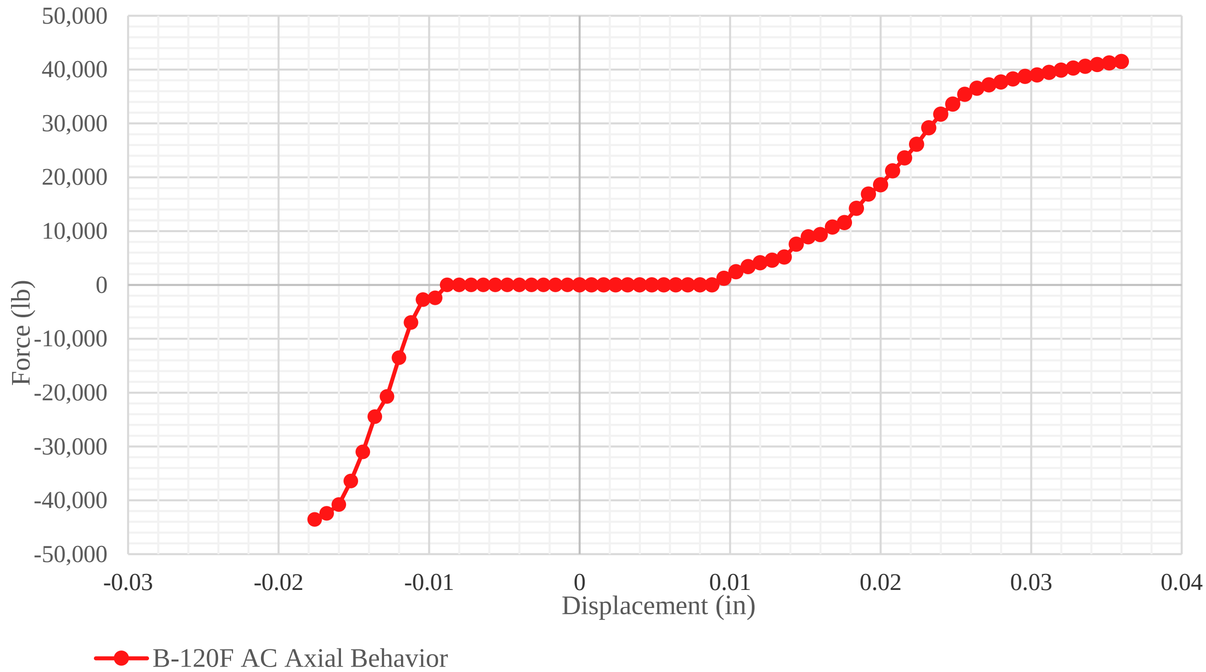


Figure J.48 Axial Semi-Rigid Behavior (B-120F AC)

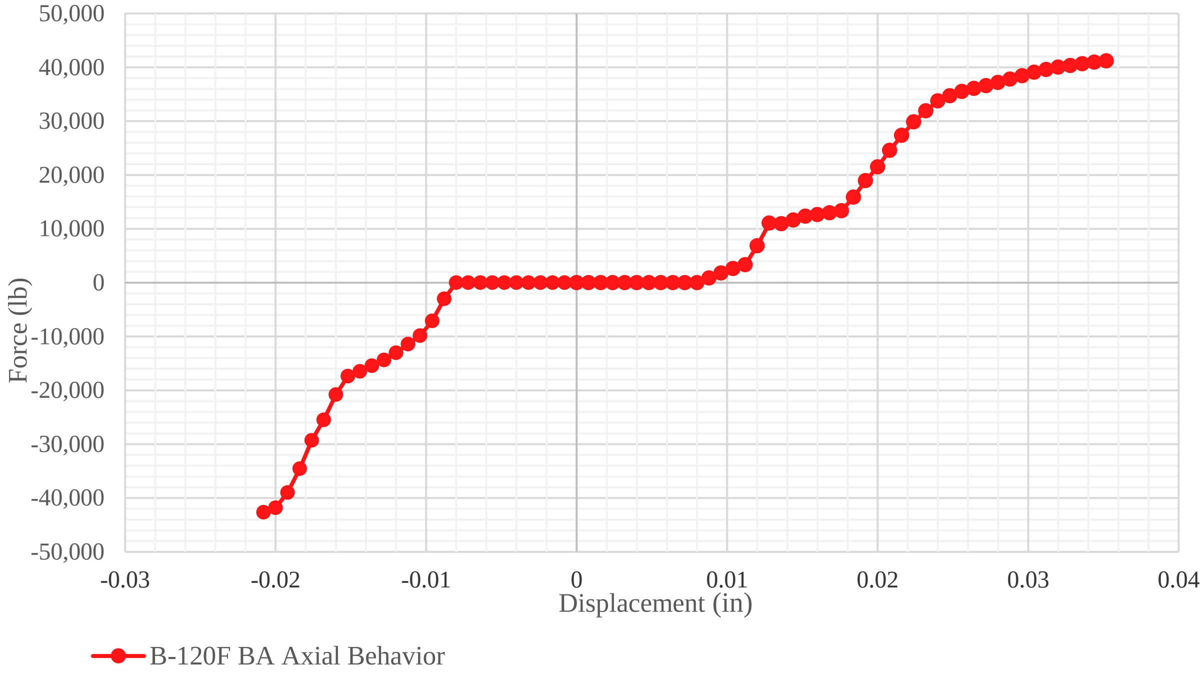


Figure J.49 Axial Semi-Rigid Behavior (B-120F BA)

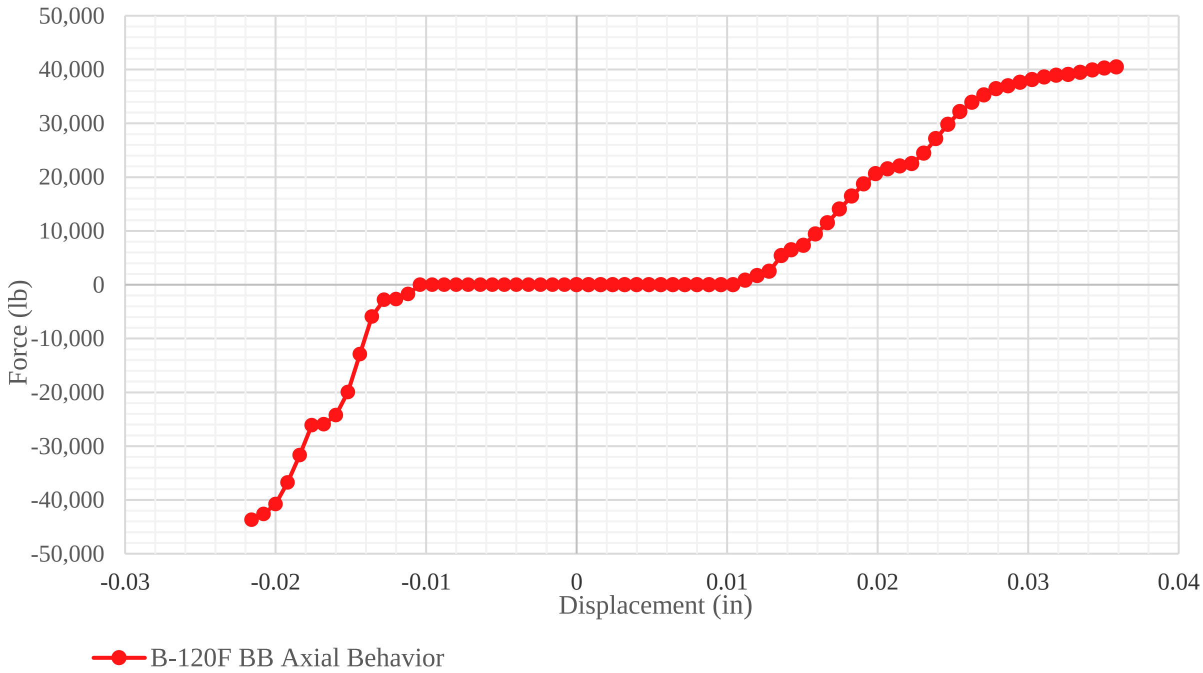


Figure J.50 Axial Semi-Rigid Behavior (B-120F BB)

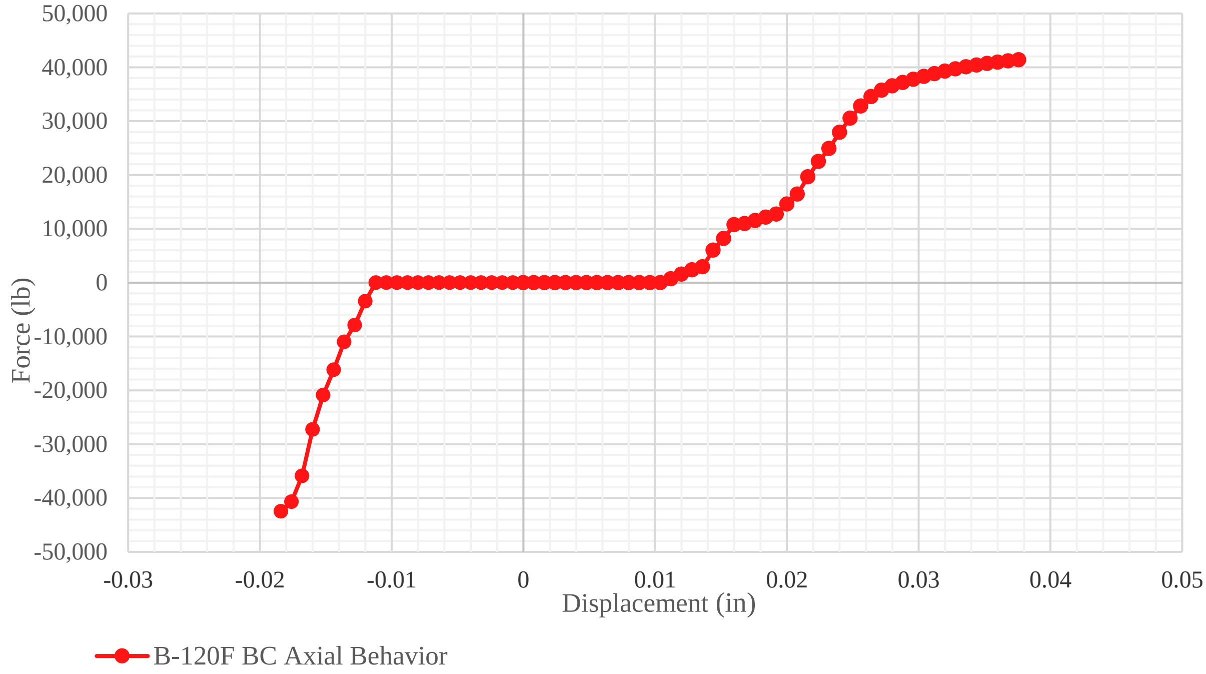


Figure J.51 Axial Semi-Rigid Behavior (B-120F BC)

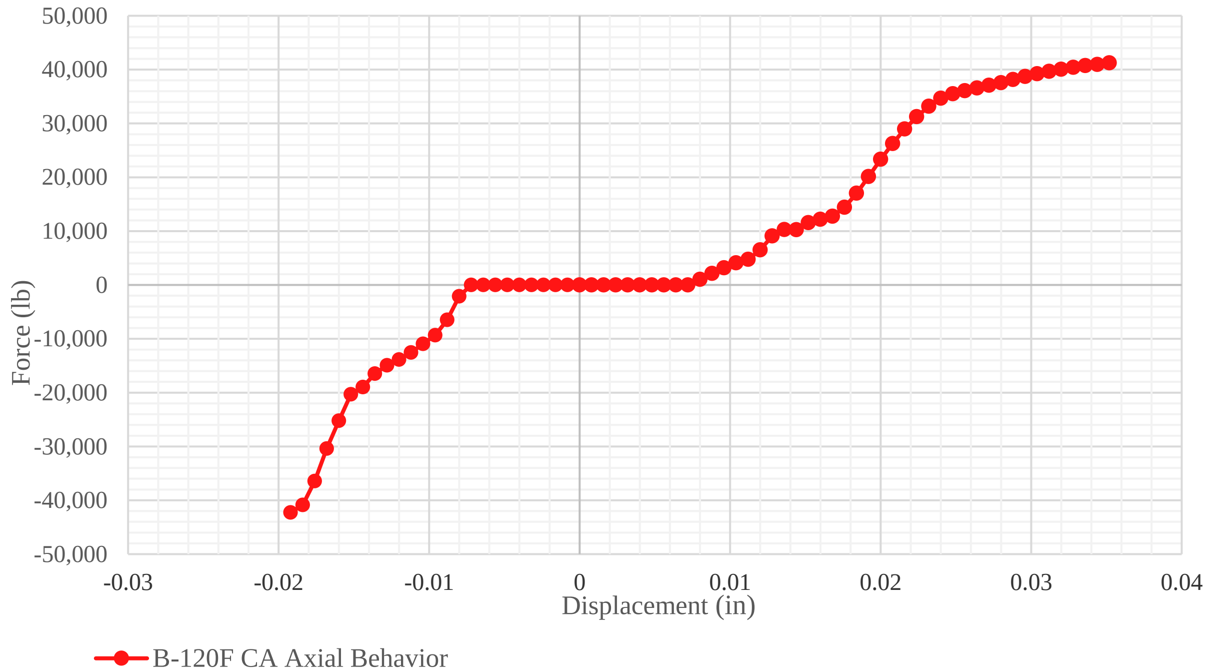


Figure J.52 Axial Semi-Rigid Behavior (B-120F CA)

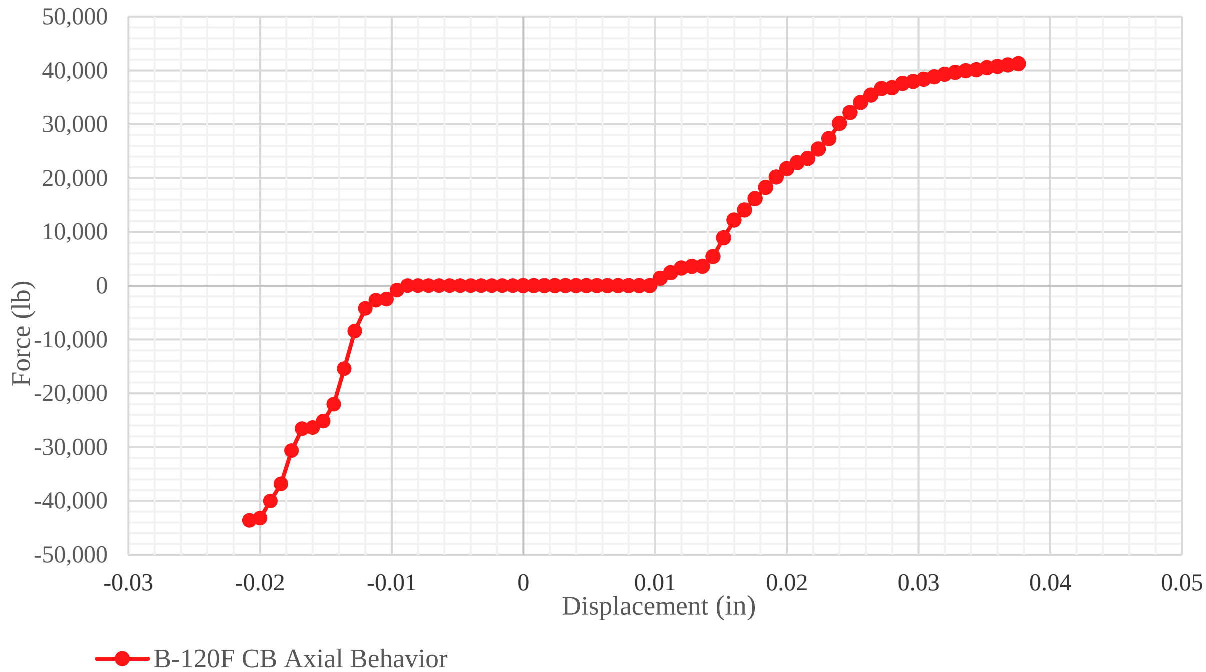


Figure J.53 Axial Semi-Rigid Behavior (B-120F CB)

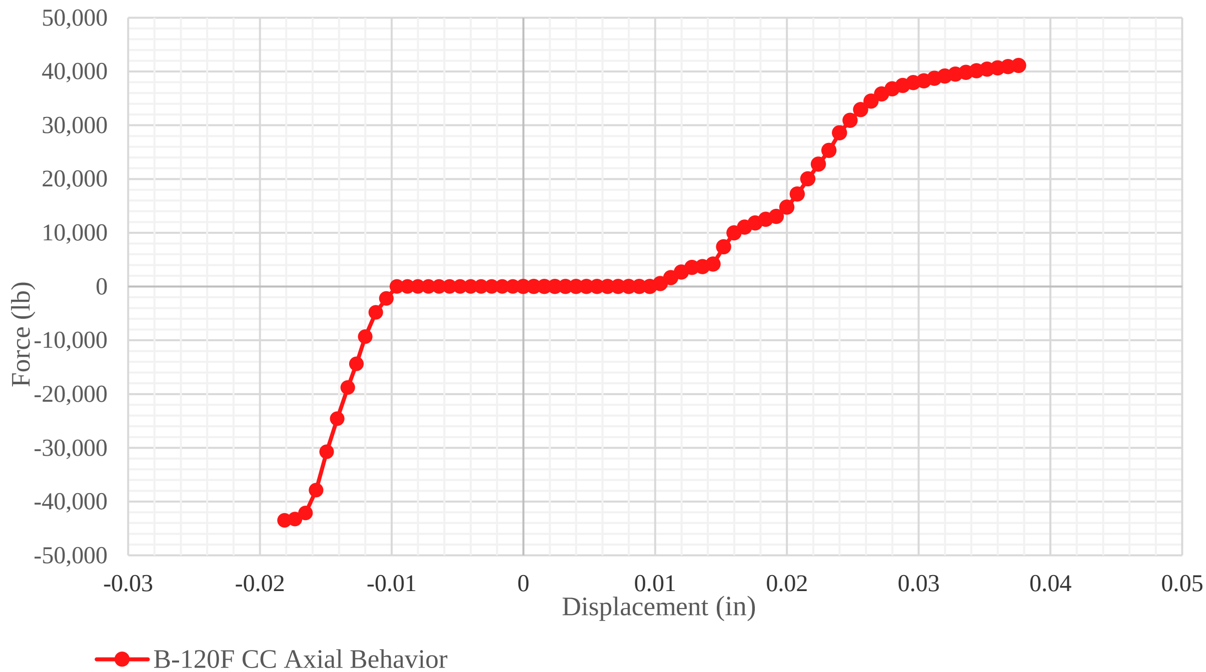


Figure J.54 Axial Semi-Rigid Behavior (B-120F CC)

Table J.21 Tensile Load-Displacement of B-120F Model Set

Displacement (in)	Force (lb)								
	B-120F AA	B-120F AB	B-120F AC	B-120F BA	B-120F BB	B-120F BC	B-120F CA	B-120F CB	B-120F CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.008	2,368.93	0.00	0.00	0.00	0.00	0.00	1,026.19	0.00	0.00
0.010	4,955.09	2,617.83	1,820.92	2,186.47	0.00	0.00	3,639.68	671.84	263.68
0.012	8,553.89	4,618.69	4,093.60	6,840.40	1,694.40	1,570.95	6,501.81	3,274.21	2,662.11
0.014	11,089.58	7,203.88	6,344.77	11,275.34	6,038.70	4,478.06	10,267.00	4,486.96	3,919.40
0.016	11,570.61	14,833.59	9,316.72	12,634.58	9,758.73	10,770.54	12,191.24	12,188.33	9,939.50
0.018	16,984.98	20,098.74	12,869.69	14,615.91	15,651.68	11,849.38	15,718.92	17,218.41	12,139.98
0.020	25,648.37	22,357.53	18,586.73	21,501.46	20,767.56	14,596.84	23,327.48	21,731.56	14,730.21
0.022	32,149.98	27,118.63	24,833.35	28,597.08	22,350.74	21,083.27	30,101.04	24,509.82	21,359.31
0.024	35,150.08	32,692.24	31,690.27	33,749.23	27,576.61	27,909.59	34,669.36	30,152.70	28,563.17
0.026	37,092.93	36,246.29	35,941.28	35,781.81	33,315.64	33,671.91	36,318.87	34,733.50	33,671.88
0.028	38,487.93	37,590.61	37,659.14	37,156.49	36,504.30	36,544.78	37,551.44	36,785.60	36,733.09
0.030	39,638.01	38,266.18	38,854.11	38,745.08	37,942.14	38,023.69	38,964.75	38,156.92	38,075.49
0.032	40,568.09	39,256.29	39,862.25	40,009.44	38,945.43	39,271.39	40,052.01	39,278.29	39,113.14
0.034	41,281.29	40,614.57	40,753.13	40,799.06	39,752.13	40,237.32	40,830.76	40,020.50	39,965.13
0.036	-	41,152.88	-	-	-	40,953.09	-	40,721.30	40,649.99

Table J.22 Tensile Ultimate Load-Displacement of B-120F Model Set

	B-120F AA	B-120F AB	B-120F AC	B-120F BA	B-120F BB	B-120F BC	B-120F CA	B-120F CB	B-120F CC
Force (lb)	41,402.92	41,494.71	41,471.28	41,184.96	40,465.06	41,386.51	41,242.11	41,232.11	41,101.19
Displacement (in)	0.0344	0.0377	0.0360	0.0352	0.0359	0.0376	0.0352	0.0376	0.0376

Table J.23 Compressive Load-Displacement of B-120F Model Set

Displacement (in)	Force (lb)								
	B-120F AA	B-120F AB	B-120F AC	B-120F BA	B-120F BB	B-120F BC	B-120F CA	B-120F CB	B-120F CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-0.008	-4,773.55	0.00	0.00	0.00	0.00	0.00	-2,098.20	0.00	0.00
-0.010	-11,262.74	-2,756.02	-2,569.24	-8,470.77	0.00	0.00	-10,137.94	-1,673.44	-1,107.28
-0.012	-15,486.16	-9,531.98	-13,531.37	-13,030.72	-2,680.90	-3,454.55	-13,856.66	-4,210.85	-9,341.91
-0.014	-20,583.22	-24,215.70	-27,744.34	-15,964.59	-9,397.71	-13,586.88	-17,718.76	-18,724.95	-23,624.32
-0.016	-33,065.62	-28,034.09	-40,791.01	-20,779.38	-24,249.32	-27,265.93	-25,210.71	-26,385.91	-39,304.03
-0.018	-42,245.68	-37,235.64	-	-31,924.05	-28,889.39	-41,573.75	-38,642.22	-33,751.00	-43,468.89
-0.020	-	-43,516.03	-	-41,802.41	-40,769.13	-	-	-43,209.79	-

Table J.24 Compressive Ultimate Load-Displacement of B-120F Model Set

	B-120F AA	B-120F AB	B-120F AC	B-120F BA	B-120F BB	B-120F BC	B-120F CA	B-120F CB	B-120F CC
Force (lb)	-43,559.58	-44,728.23	-43,574.80	-42,645.64	-43,699.01	-42,461.66	-42,249.53	-43,613.55	-43,508.51
Displacement (in)	-0.0192	-0.0206	-0.0176	-0.0208	-0.0216	-0.0184	-0.0192	-0.0208	-0.0181

Appendix K

As-Built In-Plane Semi-Rigid Behavior Characterization Graphs and Tabulated Data

B-090 In-Plane Semi-Rigid Behavior

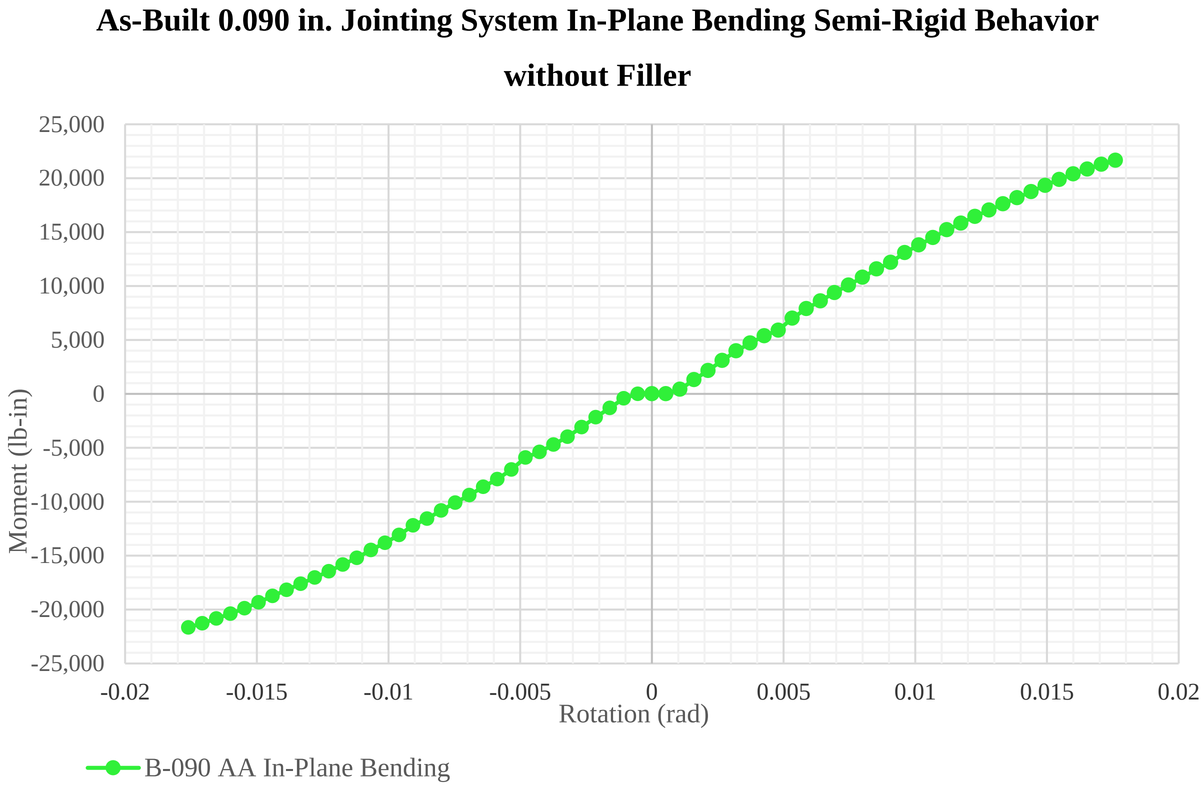


Figure K.1 In-Plane Bending Semi-Rigid Behavior (B-090 AA)

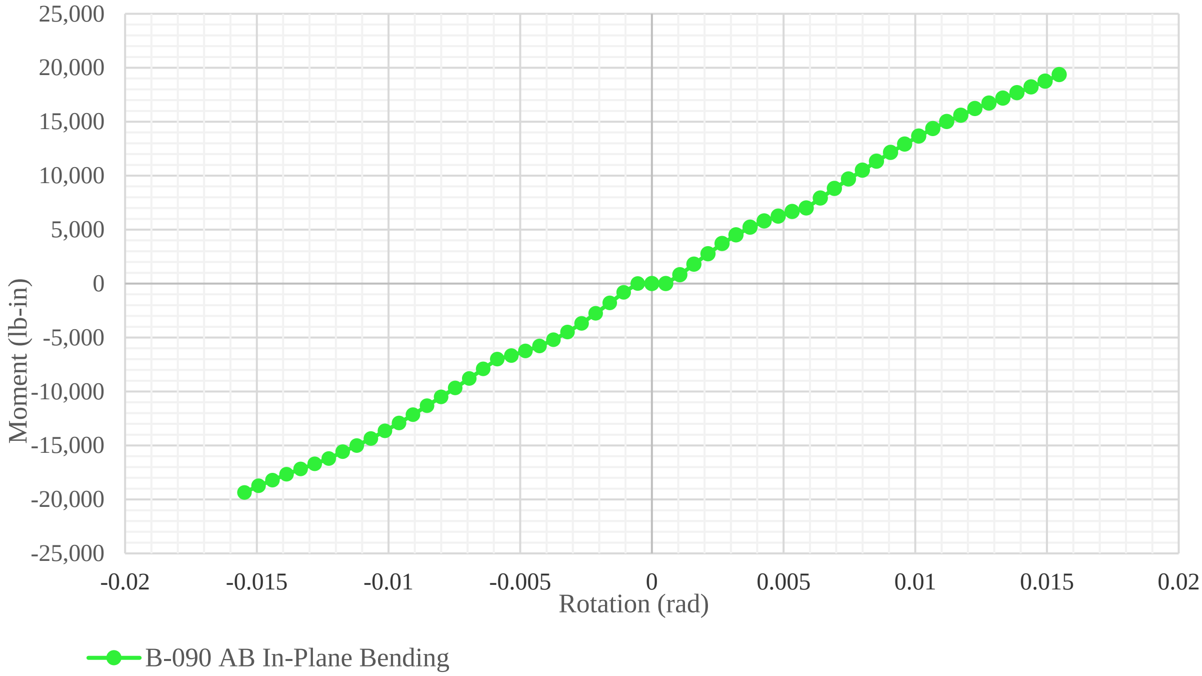


Figure K.2 In-Plane Bending Semi-Rigid Behavior (B-090 AB)

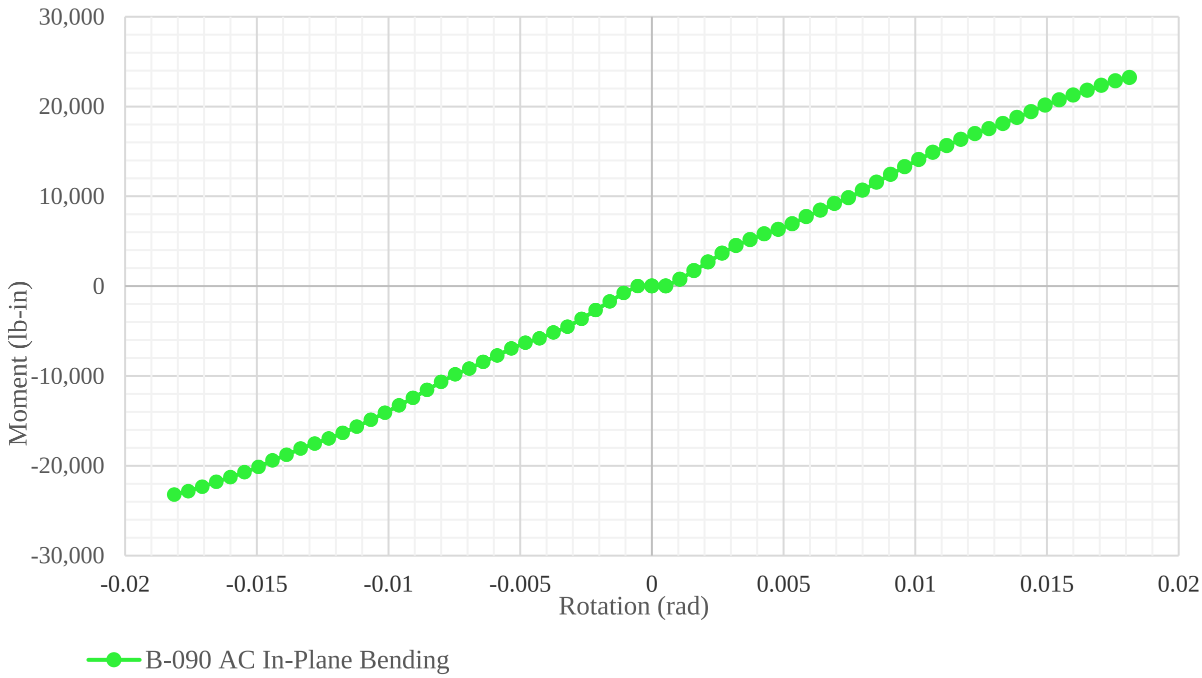


Figure K.3 In-Plane Bending Semi-Rigid Behavior (B-090 AC)

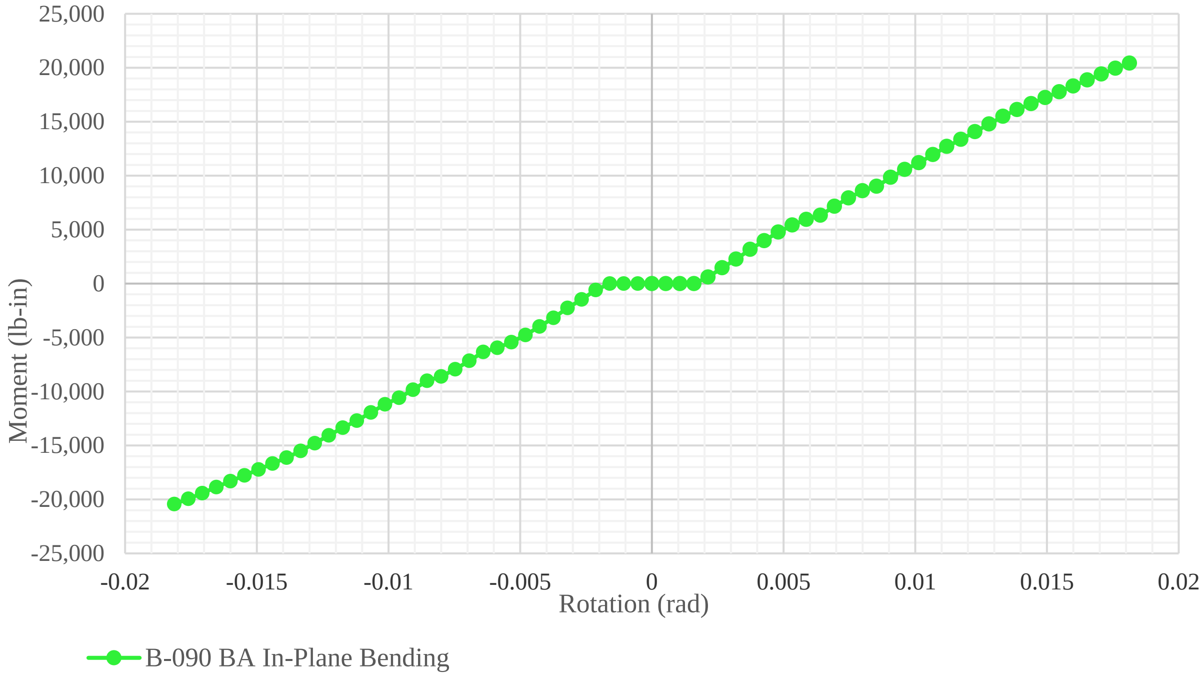


Figure K.4 In-Plane Bending Semi-Rigid Behavior (B-090 BA)

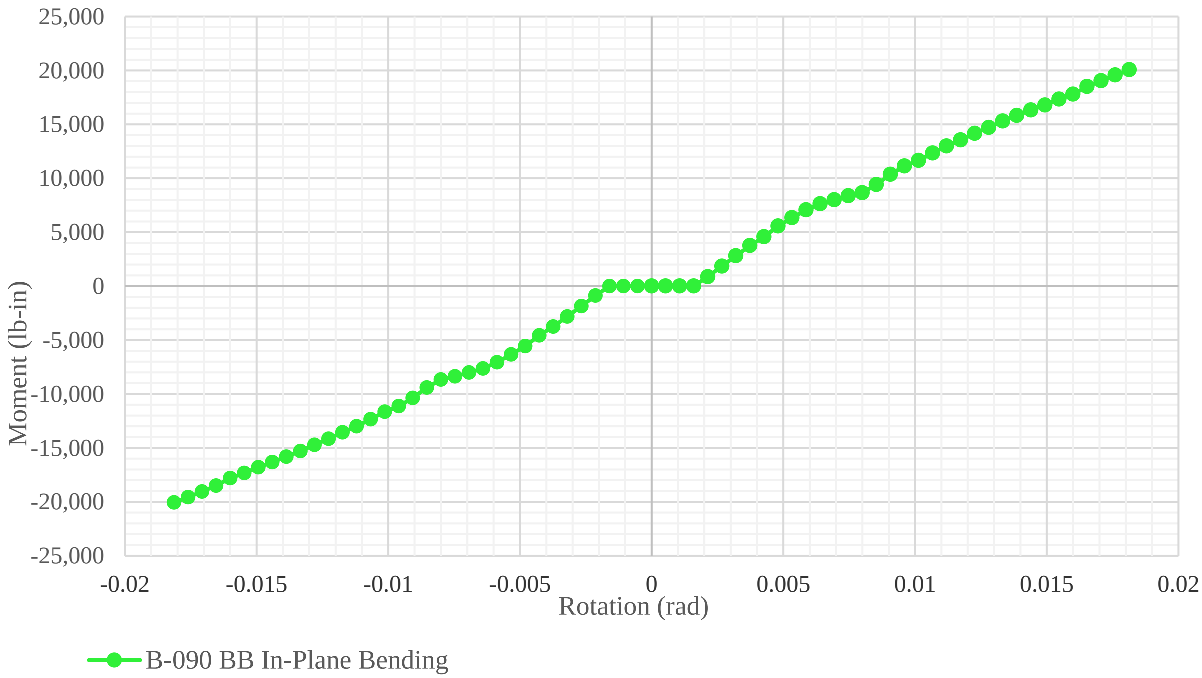


Figure K.5 In-Plane Bending Semi-Rigid Behavior (B-090 BB)

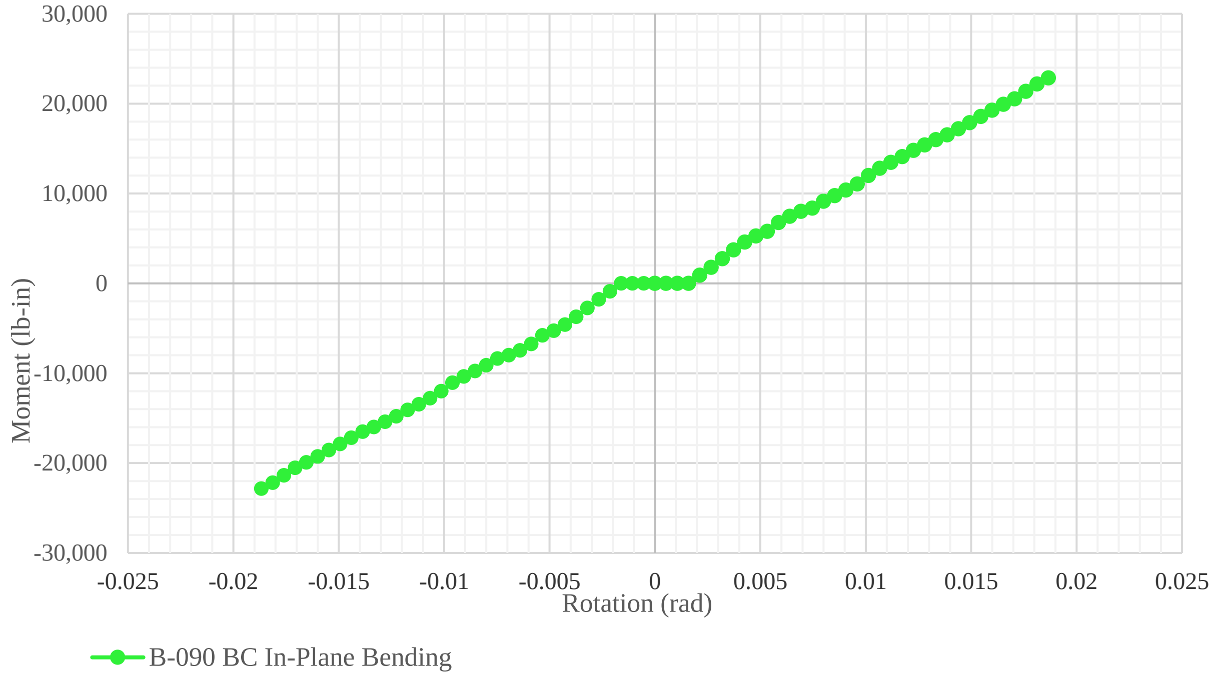


Figure K.6 In-Plane Bending Semi-Rigid Behavior (B-090 BC)

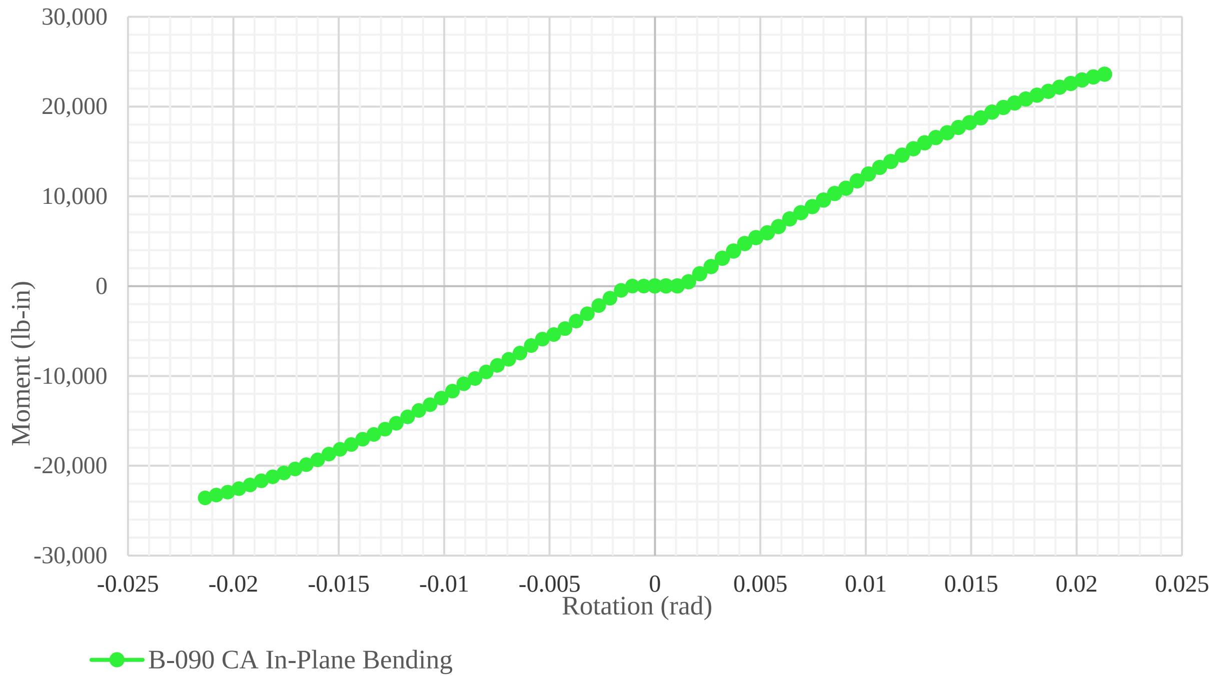


Figure K.7 In-Plane Bending Semi-Rigid Behavior (B-090 CA)

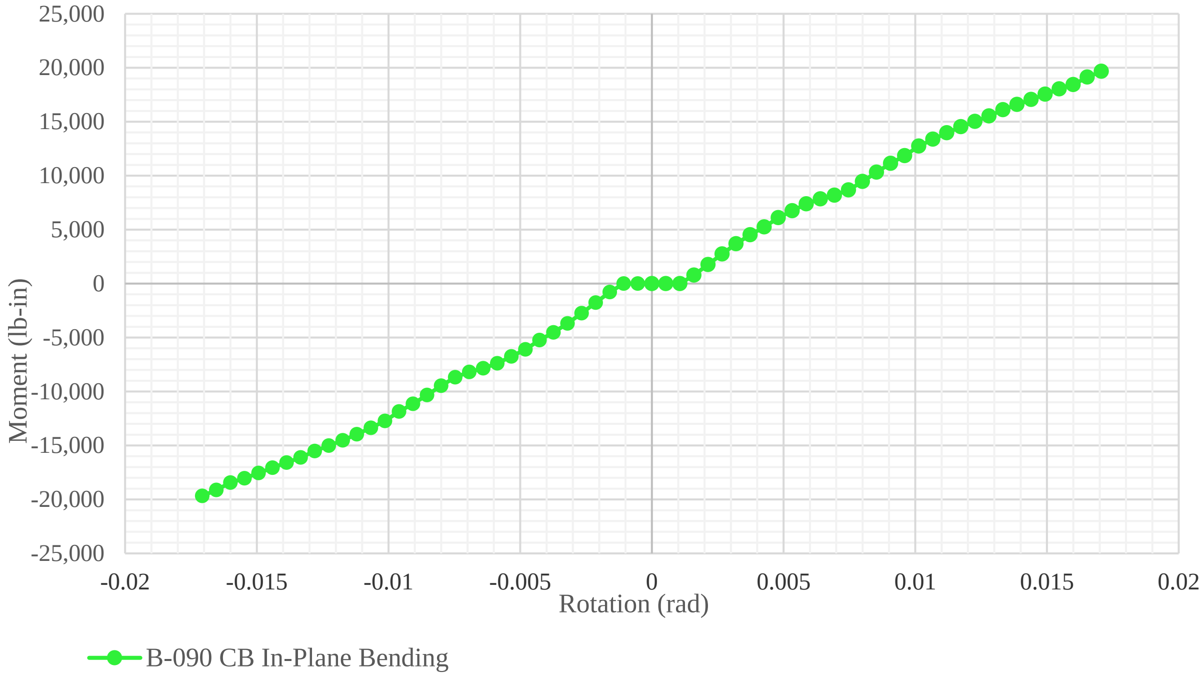


Figure K.8 In-Plane Bending Semi-Rigid Behavior (B-090 CB)

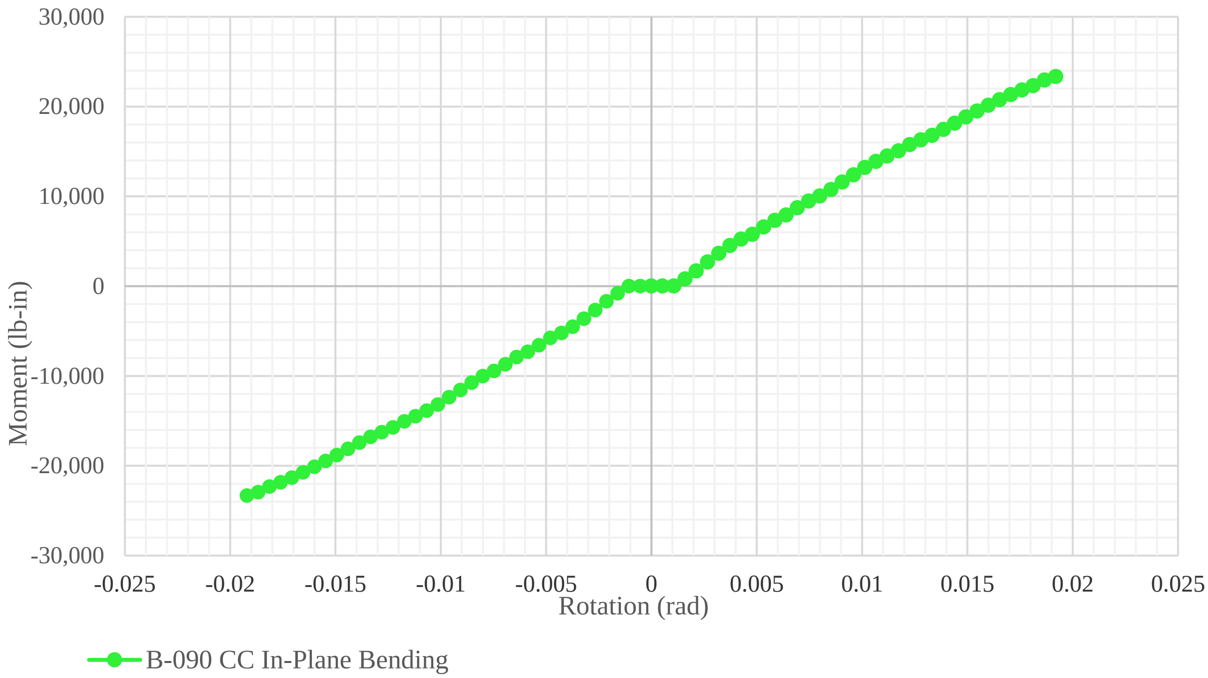


Figure K.9 In-Plane Bending Semi-Rigid Behavior (B-090 CC)

Table K.1 In-Plane Bending Moment-Rotation of B-090 Model Set

Rotation (rad)	Moment (lb-in)								
	B-090 AA	B-090 AB	B-090 AC	B-090 BA	B-090 BB	B-090 BC	B-090 CA	B-090 CB	B-090 CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	1,948.48	2,516.52	2,434.26	447.05	652.98	670.68	1,135.15	1,519.09	1,464.16
0.004	5,044.95	5,499.97	5,494.23	3,574.05	4,165.50	4,150.86	4,312.08	4,884.62	4,866.99
0.006	8,084.46	7,227.94	7,908.74	6,041.65	7,206.05	6,925.40	6,831.43	7,501.35	7,460.99
0.008	10,815.14	10,495.96	10,666.81	8,596.88	8,660.83	9,122.11	9,561.87	9,458.44	10,028.48
0.010	13,629.56	13,468.68	13,895.53	11,035.34	11,519.49	11,757.50	12,282.22	12,513.47	12,995.04
0.012	16,138.39	15,896.88	16,655.13	13,714.23	13,856.71	14,439.89	14,925.90	14,772.94	15,399.51
0.014	18,319.22	17,808.97	18,936.67	16,259.63	15,947.11	16,677.86	17,206.14	16,707.94	17,609.38
0.016	20,386.04	-	21,271.49	18,303.56	17,798.50	19,255.40	19,357.79	18,435.89	20,125.13
0.018	-	-	23,122.88	20,309.07	19,938.46	21,978.40	21,133.78	-	22,203.99
0.020	-	-	-	-	-	-	22,746.96	-	-

Table K.2 In-Plane Bending Ultimate Moment-Rotation of B-090 Model Set

	B-090 AA	B-090 AB	B-090 AC	B-090 BA	B-090 BB	B-090 BC	B-090 CA	B-090 CB	B-090 CC
Moment (lb-in)	21,655.78	19,355.60	23,215.87	20,430.52	20,060.06	22,849.64	23,584.99	19,671.27	23,324.32
Rotation (rad)	0.0176	0.0155	0.0181	0.0181	0.0181	0.0187	0.0213	0.0171	0.0192

B-090F In-Plane Semi-Rigid Behavior

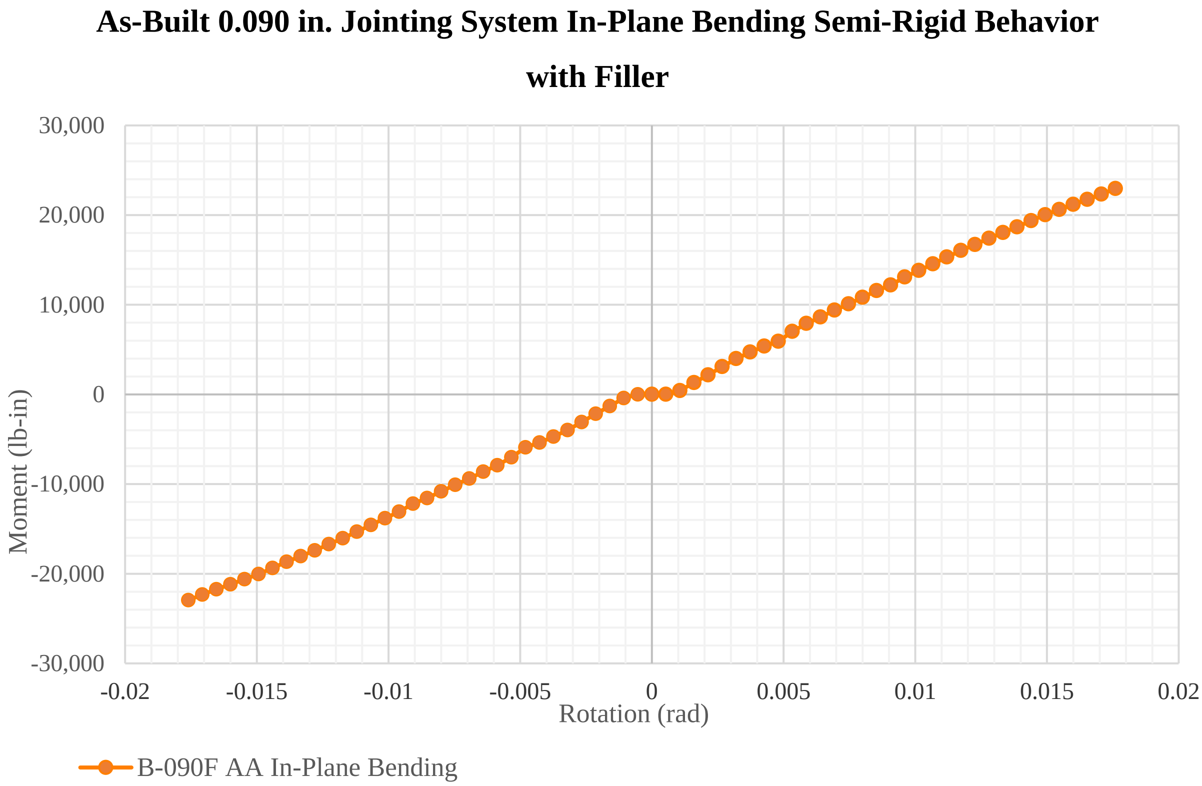


Figure K.10 In-Plane Bending Semi-Rigid Behavior (B-090F AA)

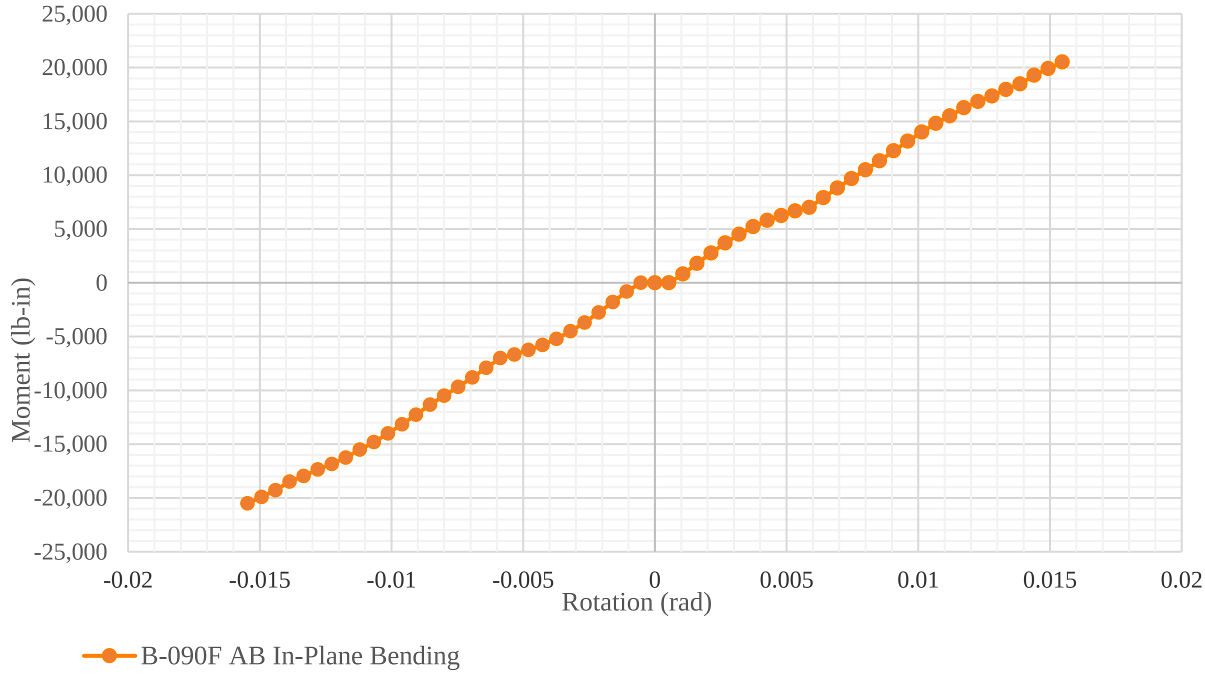


Figure K.11 In-Plane Bending Semi-Rigid Behavior (B-090F AB)

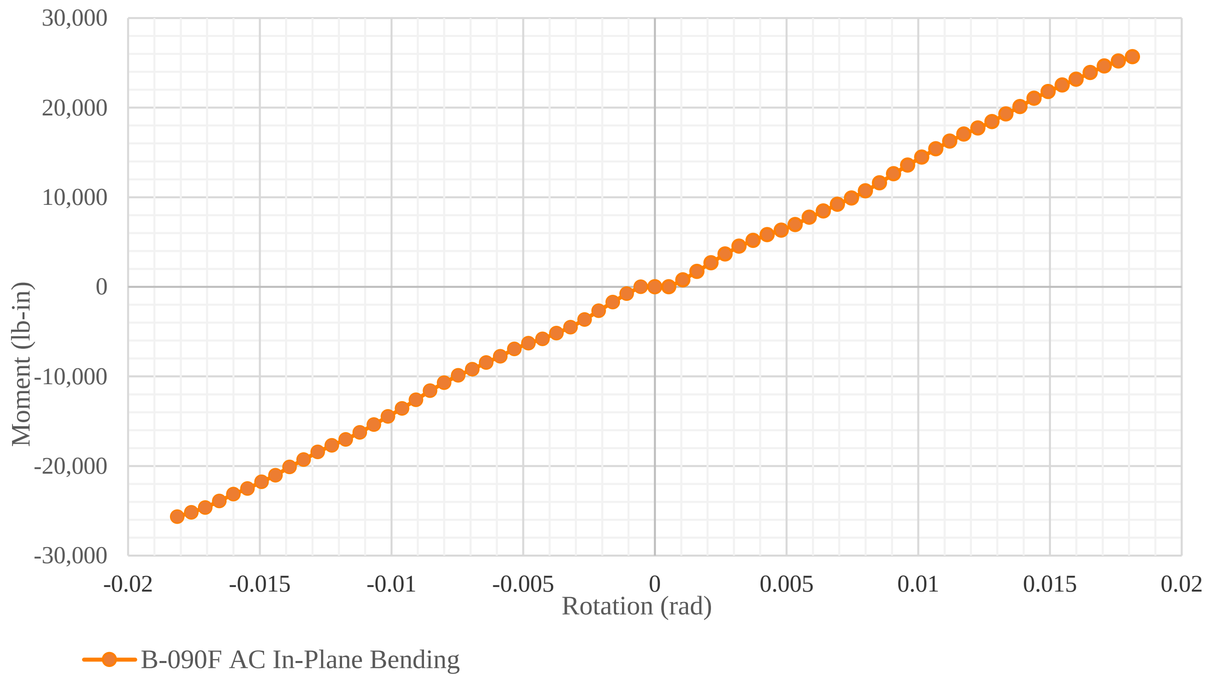


Figure K.12 In-Plane Bending Semi-Rigid Behavior (B-090F AC)

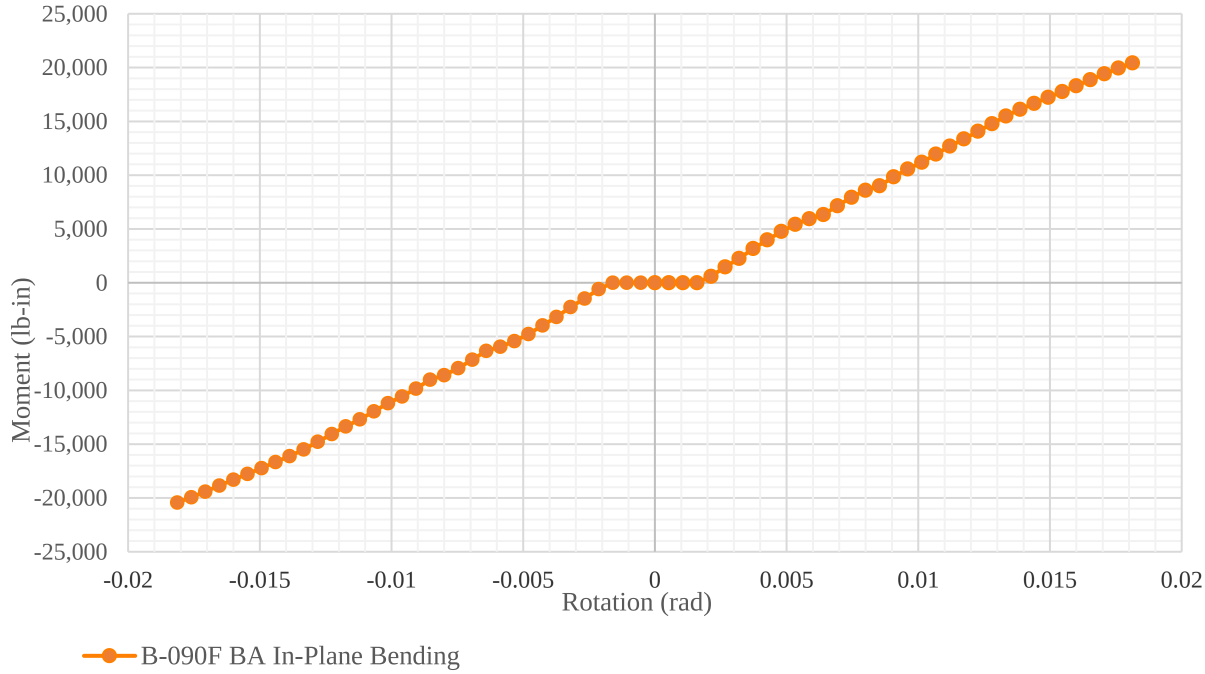


Figure K.13 In-Plane Bending Semi-Rigid Behavior (B-090F BA)

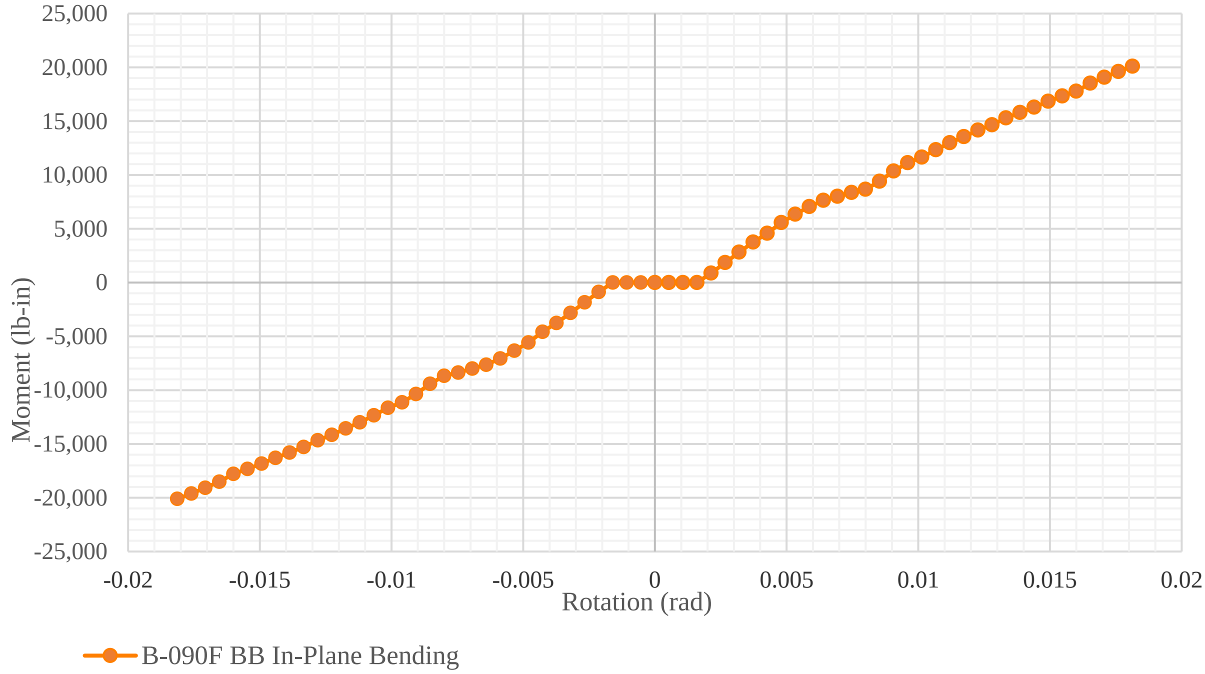


Figure K.14 In-Plane Bending Semi-Rigid Behavior (B-090F BB)

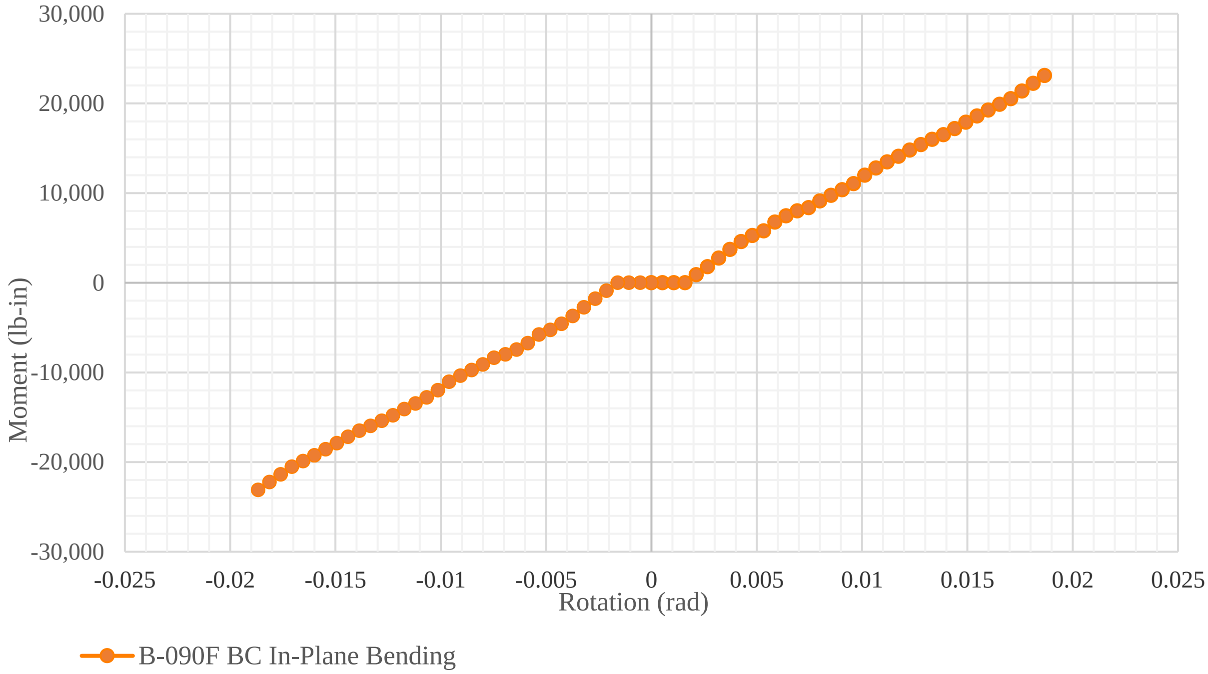


Figure K.15 In-Plane Bending Semi-Rigid Behavior (B-090F BC)

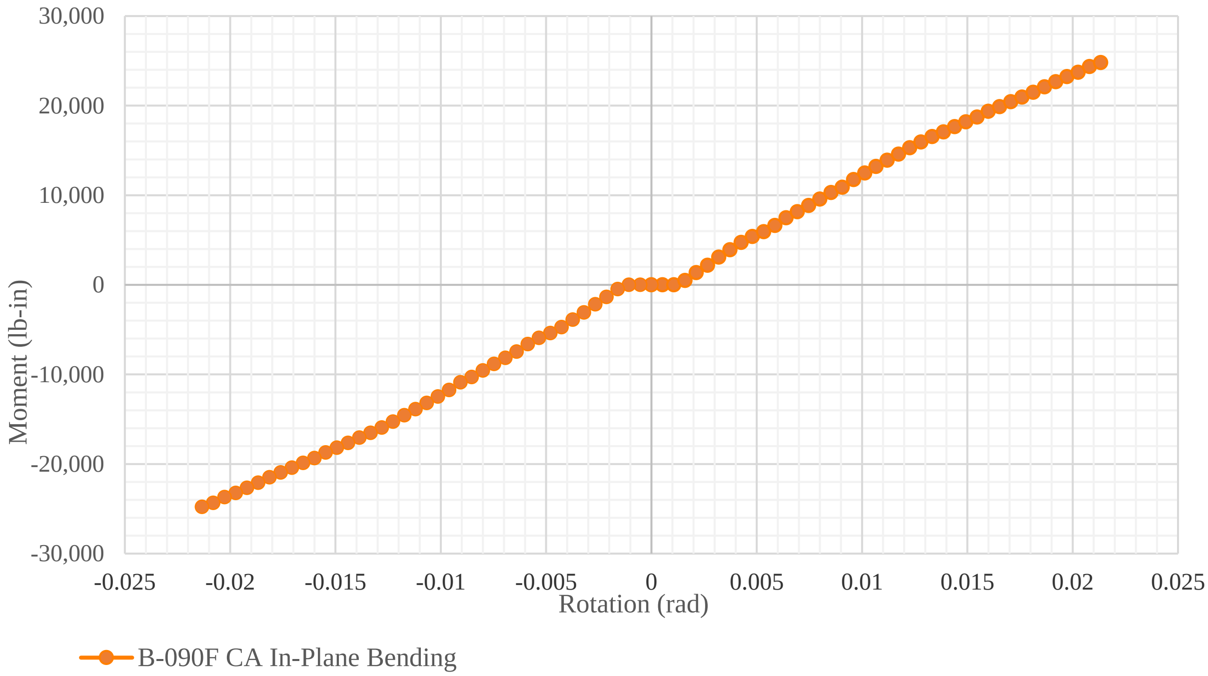


Figure K.16 In-Plane Bending Semi-Rigid Behavior (B-090F CA)

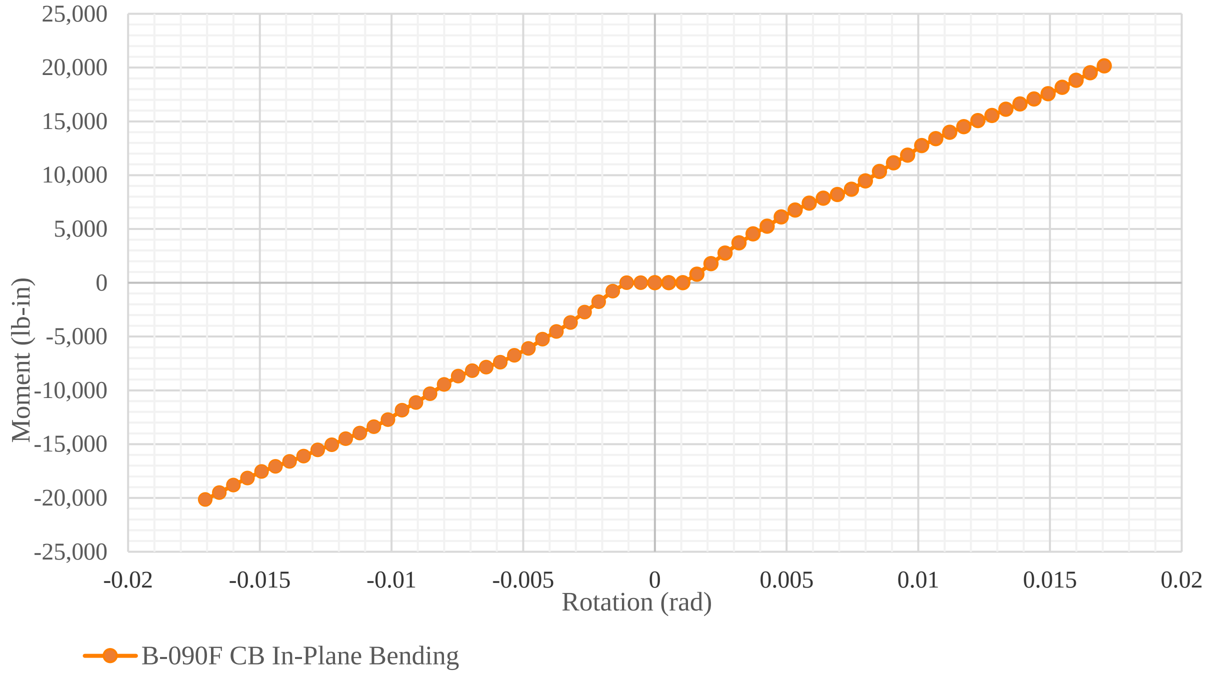


Figure K.17 In-Plane Bending Semi-Rigid Behavior (B-090F CB)

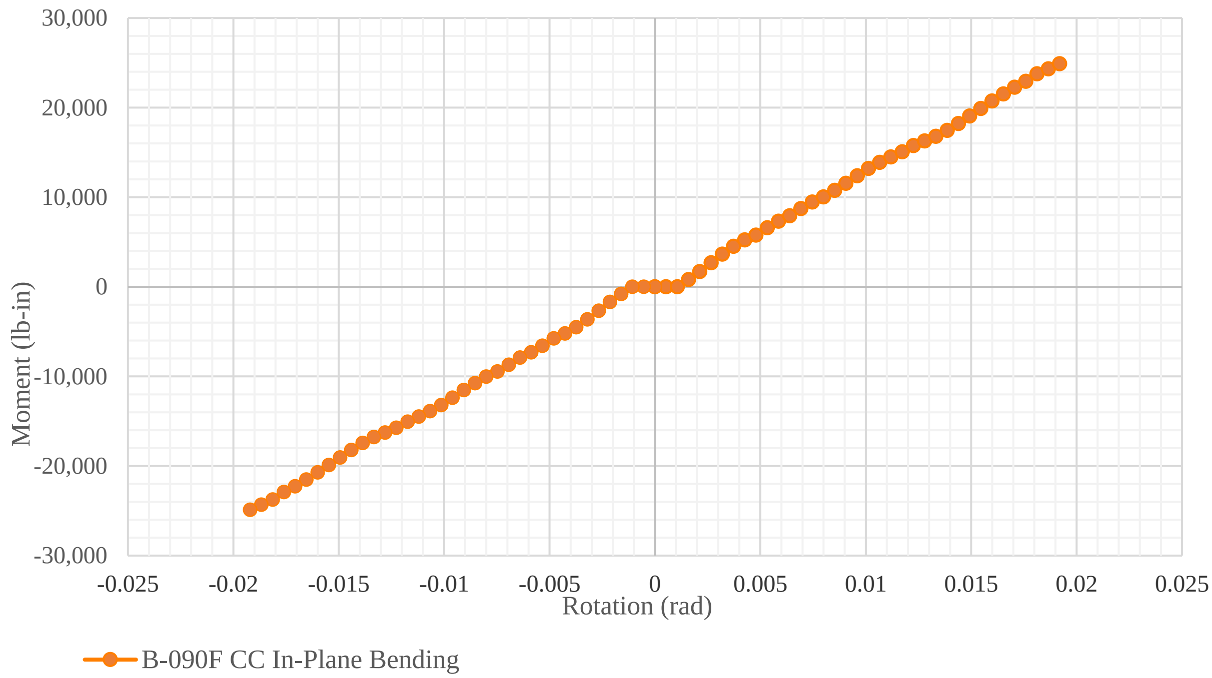


Figure K.18 In-Plane Bending Semi-Rigid Behavior (B-090F CC)

Table K.3 In-Plane Bending Moment-Rotation of B-090F Model Set

Displacement (in)	Moment (lb-in)								
	B-090F AA	B-090F AB	B-090F AC	B-090F BA	B-090F BB	B-090F BC	B-090F CA	B-090F CB	B-090F CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	1,948.48	2,516.52	2,434.26	447.05	652.98	670.68	1,135.15	1,519.09	1,464.17
0.004	5,044.95	5,499.97	5,494.23	3,574.05	4,165.50	4,150.86	4,312.08	4,884.62	4,866.61
0.006	8,084.46	7,227.94	7,928.00	6,041.65	7,206.05	6,925.40	6,831.46	7,501.35	7,459.09
0.008	10,815.14	10,495.96	10,698.01	8,596.88	8,660.83	9,122.11	9,562.30	9,458.44	10,028.18
0.010	13,629.56	13,791.75	14,244.17	11,035.34	11,519.49	11,753.57	12,283.26	12,513.31	12,992.36
0.012	16,380.33	16,553.76	17,374.46	13,714.23	13,856.86	14,440.39	14,923.50	14,781.63	15,398.93
0.014	18,847.12	18,681.48	20,340.36	16,259.47	15,926.62	16,667.85	17,204.92	16,715.91	17,630.39
0.016	21,181.72	-	23,148.29	18,303.32	17,781.29	19,244.36	19,346.39	18,813.70	20,721.41
0.018	-	-	25,544.06	20,308.99	19,978.39	22,019.48	21,347.50	-	23,546.06
0.020	-	-	-	-	-	-	23,467.82	-	-

Table K.4 In-Plane Bending Ultimate Moment-Rotation of B-090F Model Set

	B-090F AA	B-090F AB	B-090F AC	B-090F BA	B-090F BB	B-090F BC	B-090F CA	B-090F CB	B-090F CC
Moment (lb-in)	22,953.27	20,509.94	25,664.33	20,430.45	20,101.20	23,097.90	24,790.00	20,145.31	24,889.31
Rotation (rad)	0.0176	0.0155	0.0181	0.0181	0.0181	0.0187	0.0213	0.0171	0.0192

B-104 In-Plane Semi-Rigid Behavior

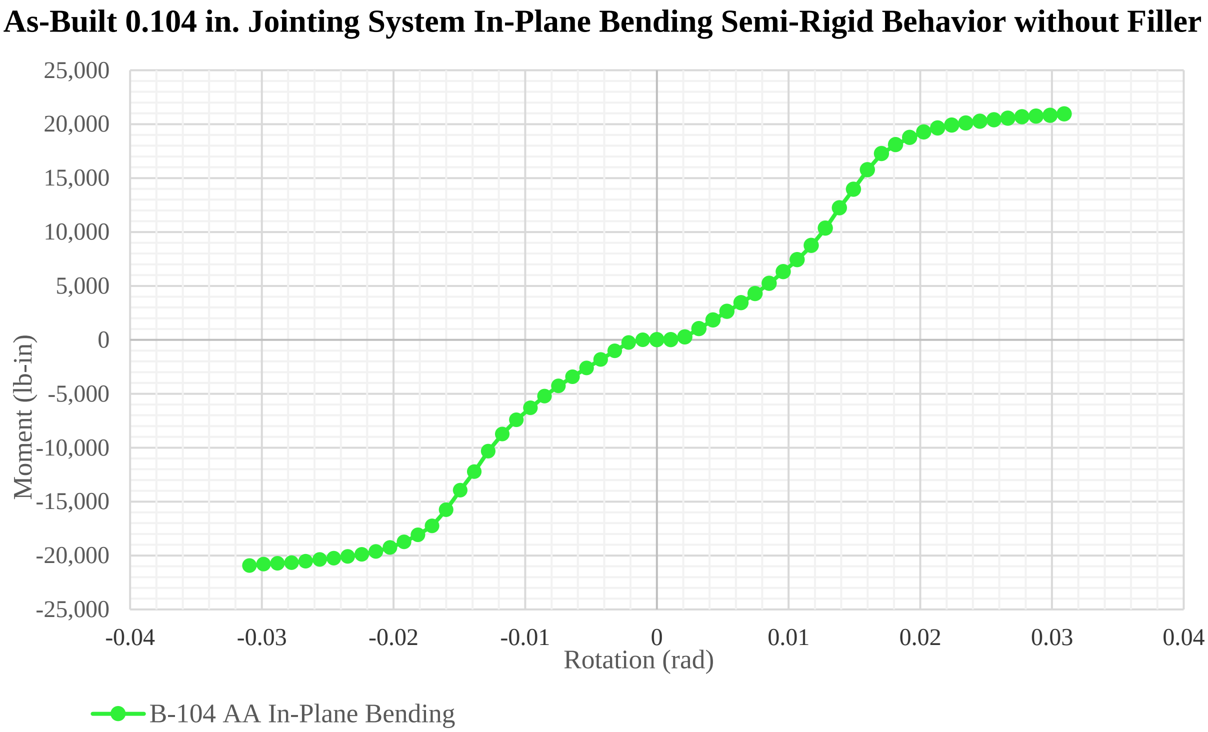


Figure K.19 In-Plane Bending Semi-Rigid Behavior (B-104 AA)

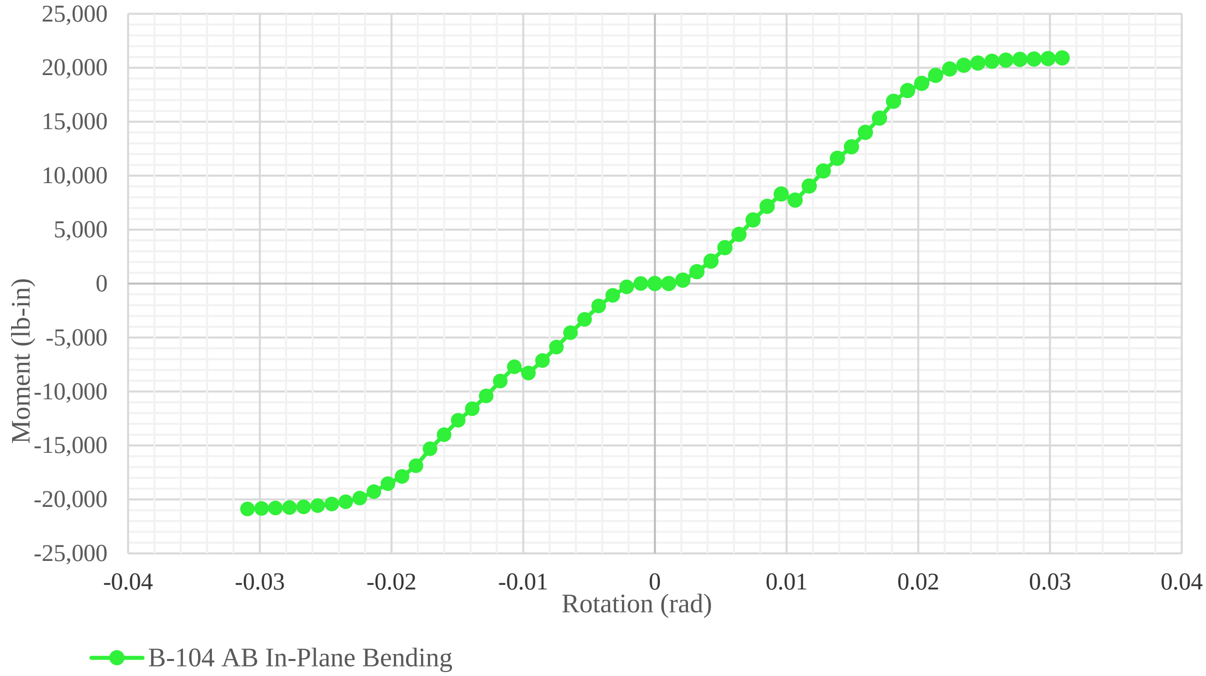


Figure K.20 In-Plane Bending Semi-Rigid Behavior (B-104 AB)

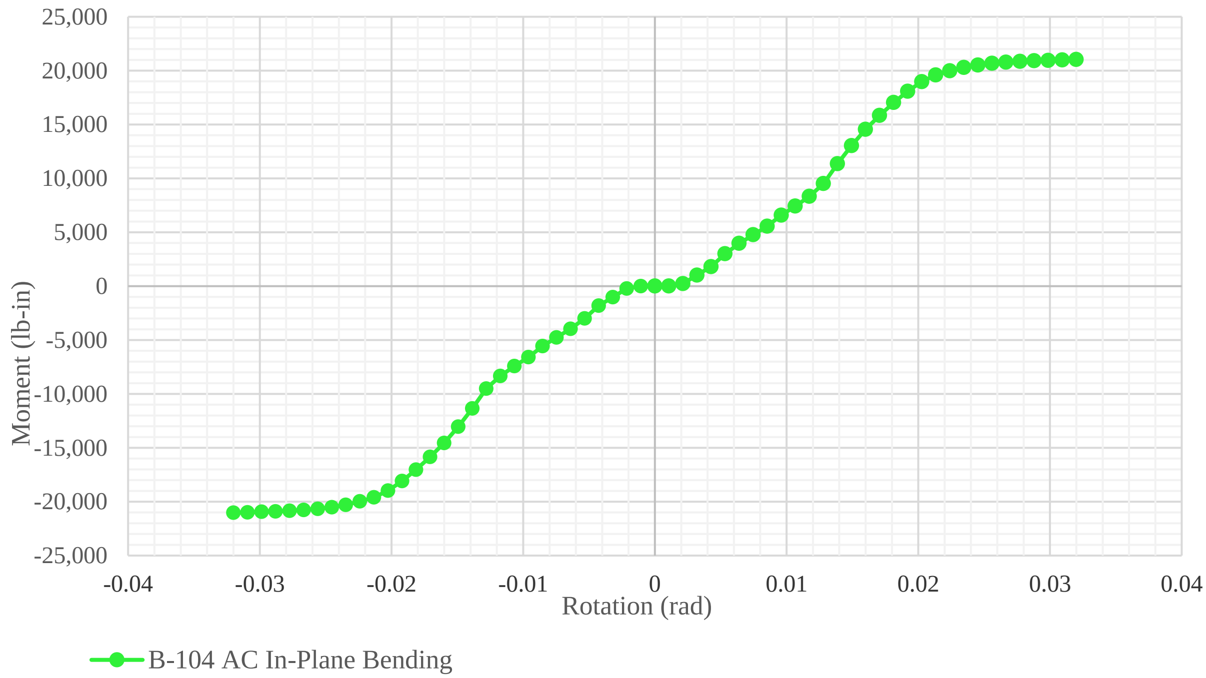


Figure K.21 In-Plane Bending Semi-Rigid Behavior (B-104 AC)

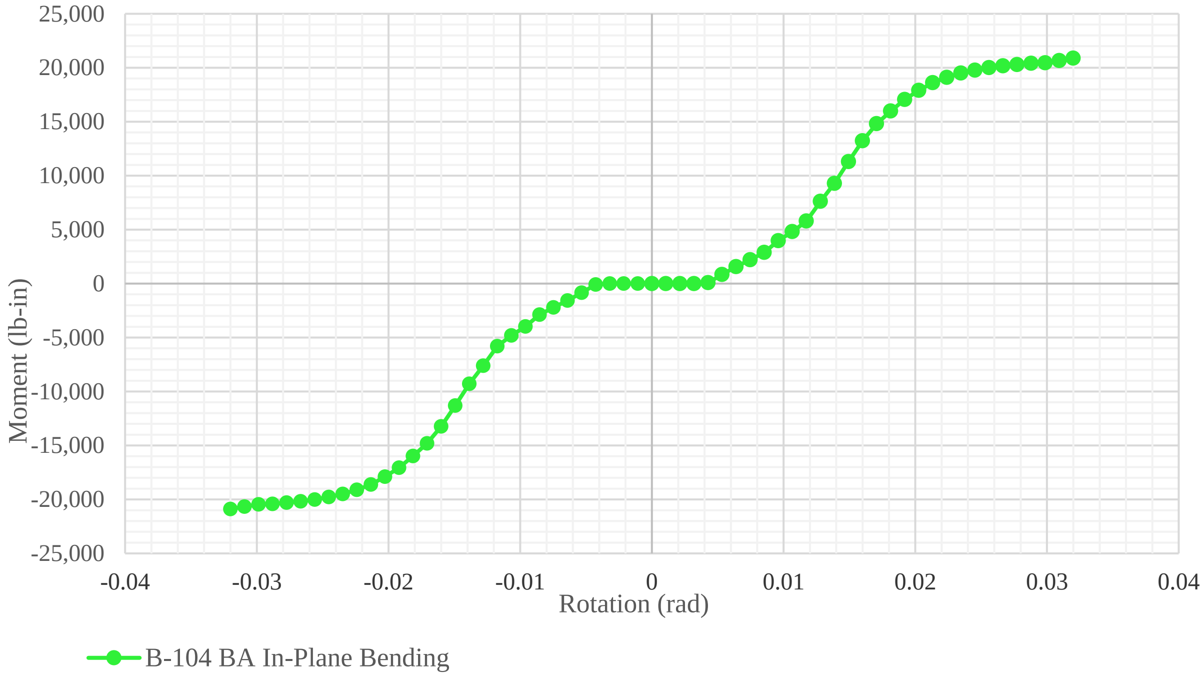


Figure K.22 In-Plane Bending Semi-Rigid Behavior (B-104 BA)

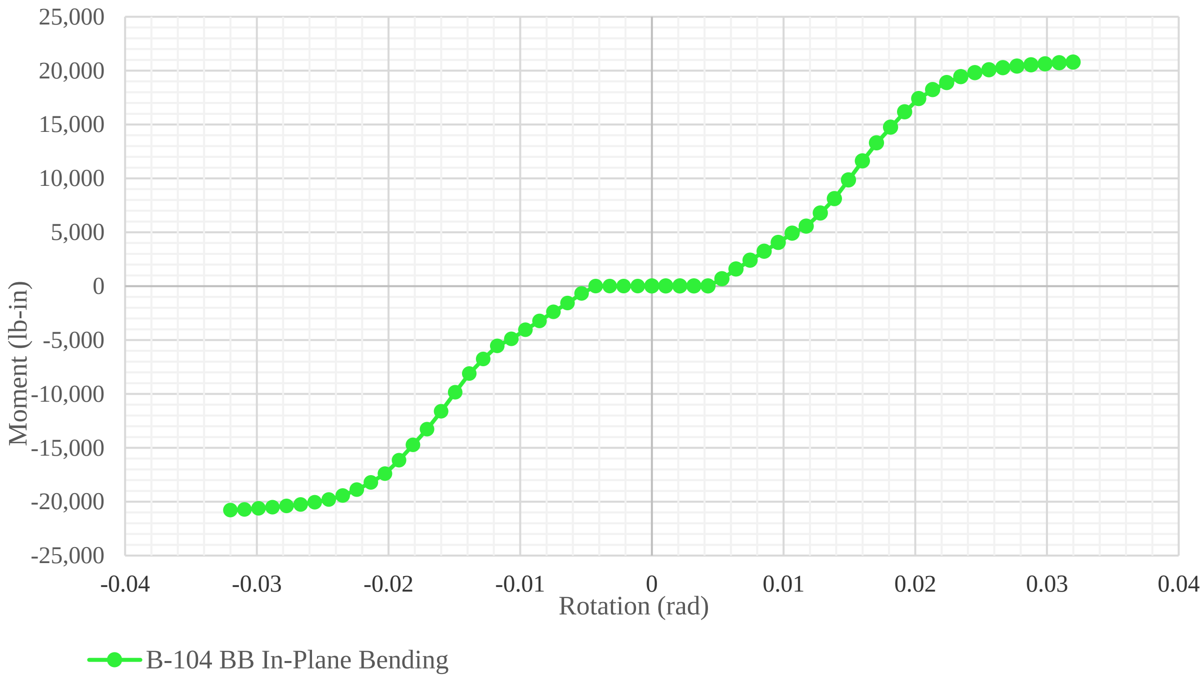


Figure K.23 In-Plane Bending Semi-Rigid Behavior (B-104 BB)

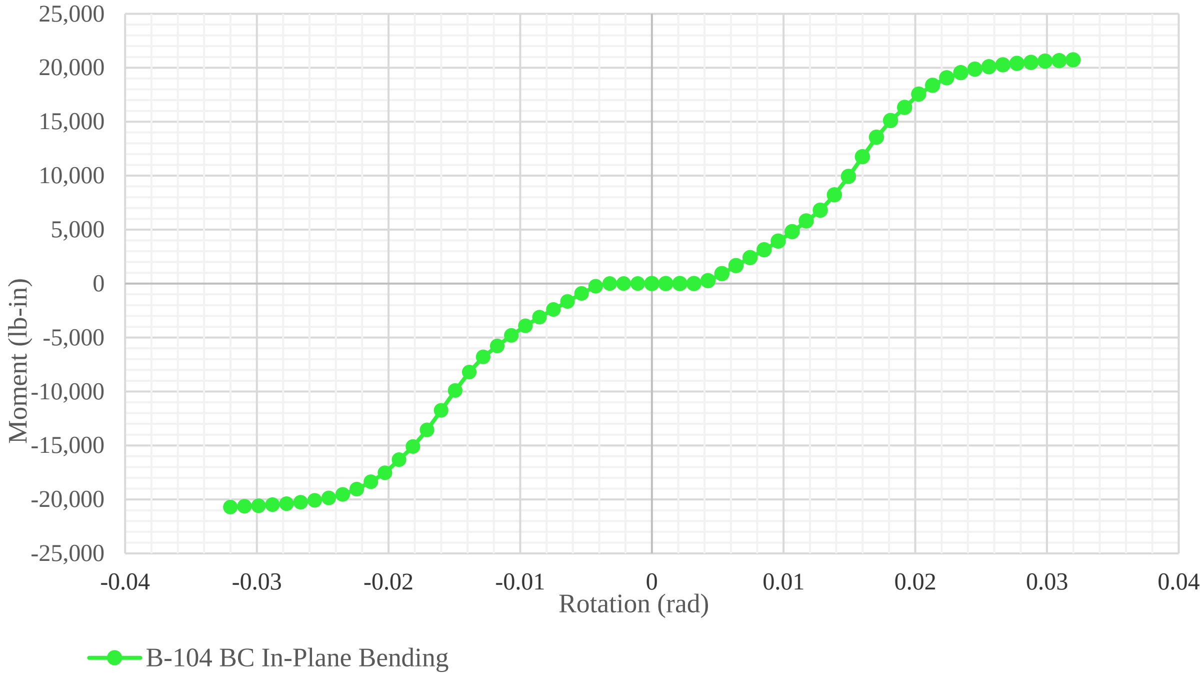


Figure K.24 In-Plane Bending Semi-Rigid Behavior (B-104 BC)

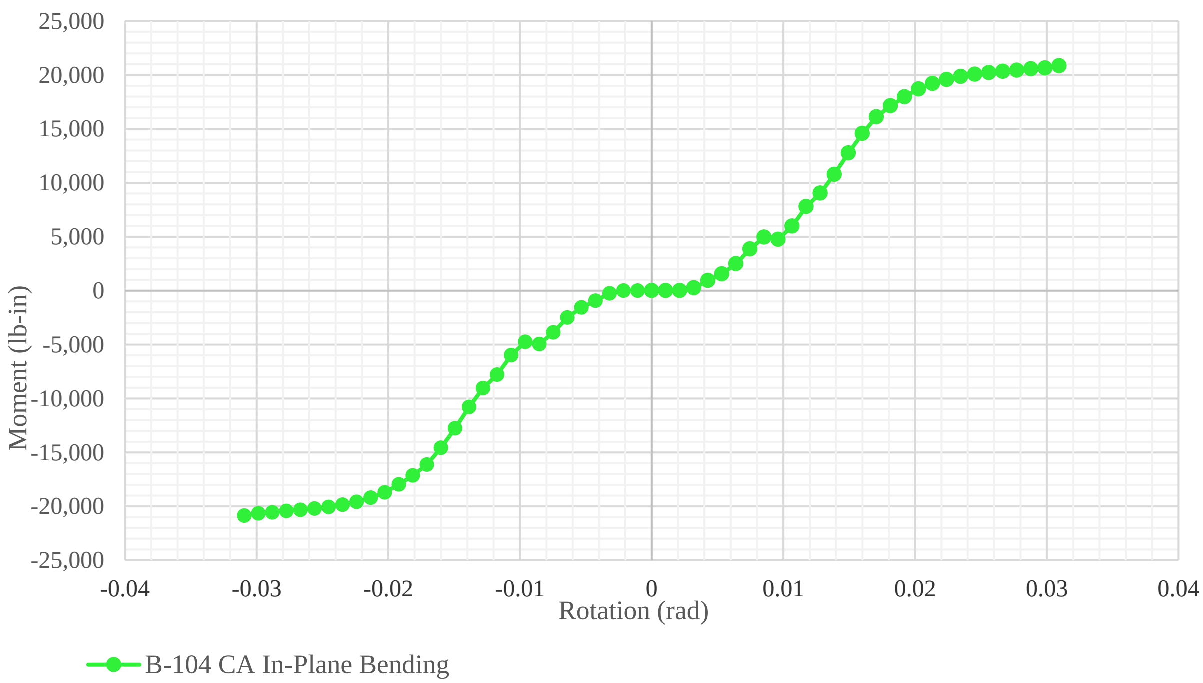


Figure K.25 In-Plane Bending Semi-Rigid Behavior (B-104 CA)

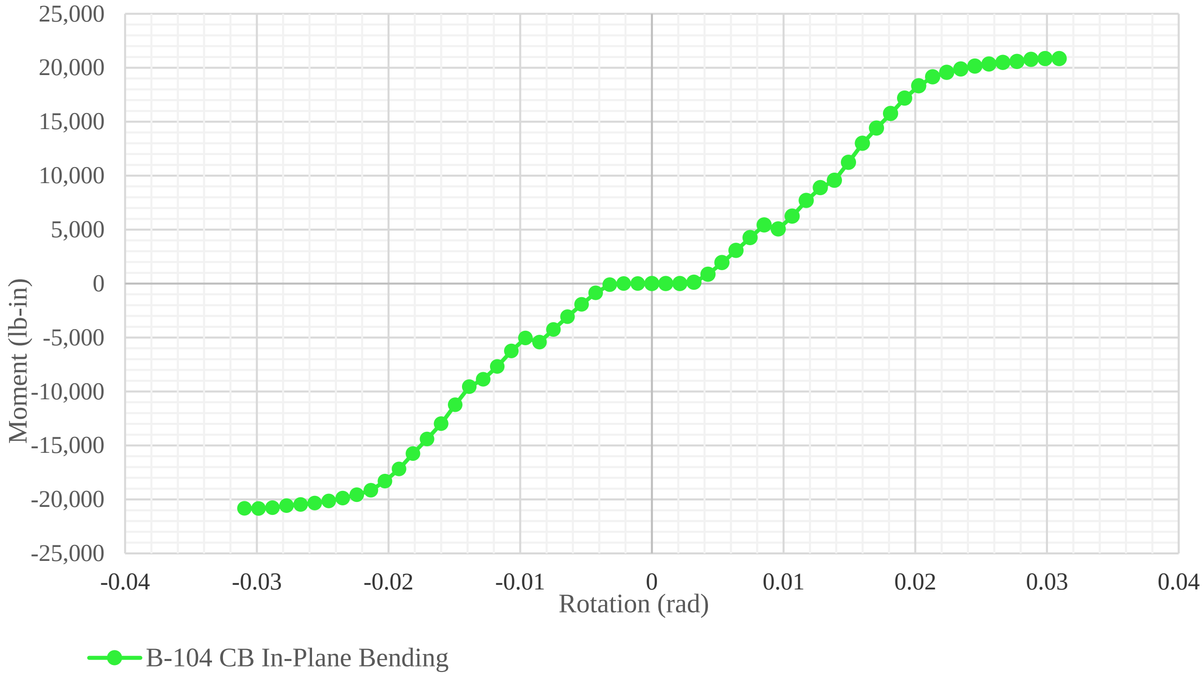


Figure K.26 In-Plane Bending Semi-Rigid Behavior (B-104 CB)

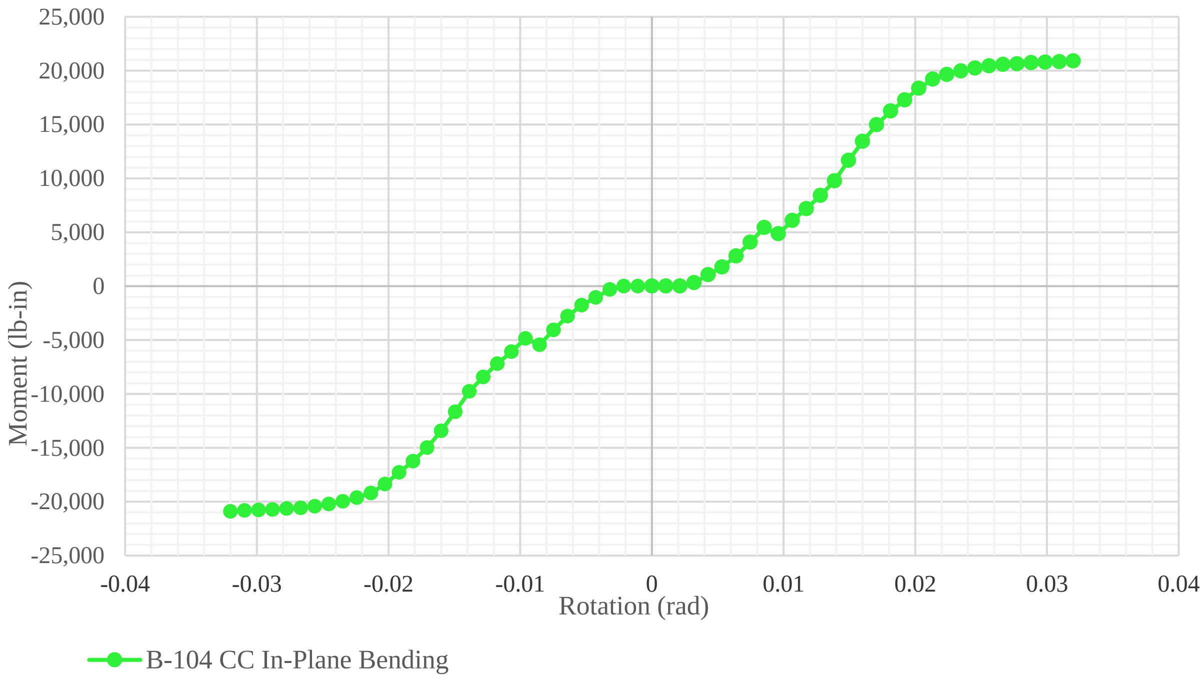


Figure K.27 In-Plane Bending Semi-Rigid Behavior (B-104 CC)

Table K.5 In-Plane Bending Moment-Rotation of B-104 Model Set

Displacement (in)	Moment (lb-in)								
	B-104 AA	B-104 AB	B-104 AC	B-104 BA	B-104 BB	B-104 BC	B-104 CA	B-104 CB	B-104 CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	221.60	269.56	201.01	0.07	0.06	0.07	0.30	0.16	0.64
0.004	1,630.88	1,831.21	1,609.64	61.77	2.69	192.20	764.53	668.00	872.71
0.006	3,126.12	4,089.18	3,603.13	1,296.06	1,242.69	1,381.32	2,140.57	2,640.98	2,411.84
0.008	4,749.28	6,514.32	5,163.87	2,547.29	2,809.09	2,760.79	4,413.49	4,843.25	4,756.02
0.010	6,728.07	8,074.33	6,896.75	4,286.58	4,366.42	4,251.38	5,213.52	5,494.66	5,315.45
0.012	9,137.10	9,381.06	8,628.18	6,248.01	5,857.67	6,040.00	8,102.11	7,986.54	7,501.86
0.014	12,446.15	11,733.59	11,566.70	9,538.07	8,329.67	8,421.34	11,032.73	9,768.97	10,005.46
0.016	15,756.52	14,001.37	14,547.73	13,228.42	11,609.94	11,751.26	14,576.24	12,985.74	13,429.39
0.018	17,984.63	16,681.70	16,889.77	15,834.49	14,553.93	14,905.65	17,010.41	15,580.53	16,092.55
0.020	19,135.21	18,372.29	18,751.51	17,688.10	17,088.21	17,233.75	18,522.39	18,027.67	18,092.18
0.022	19,798.14	19,653.24	19,832.50	18,925.19	18,636.40	18,795.67	19,435.79	19,408.90	19,472.40
0.024	20,169.92	20,324.03	20,404.17	19,637.10	19,617.69	19,696.21	19,957.51	20,012.46	20,095.76
0.026	20,440.78	20,620.94	20,710.31	20,071.07	20,140.70	20,150.49	20,257.72	20,389.54	20,486.00
0.028	20,689.15	20,769.64	20,863.58	20,319.66	20,432.48	20,421.28	20,468.99	20,620.21	20,656.40
0.030	20,816.75	20,851.61	20,941.58	20,485.85	20,629.43	20,600.72	20,677.32	20,839.69	20,778.71
0.032	-	-	21,025.34	20,887.41	20,784.01	20,717.31	-	-	20,899.71

Table K.6 In-Plane Bending Ultimate Moment-Rotation of B-104 Model Set

	B-104 AA	B-104 AB	B-104 AC	B-104 BA	B-104 BB	B-104 BC	B-104 CA	B-104 CB	B-104 CC
Moment (lb-in)	20,941.22	20,895.91	21,025.34	20,887.41	20,784.01	20,717.31	20,859.06	20,834.94	20,899.71
Rotation (rad)	0.0309	0.0309	0.0320	0.0320	0.0320	0.0320	0.0309	0.0309	0.0320

B-104F In-Plane Semi-Rigid Behavior

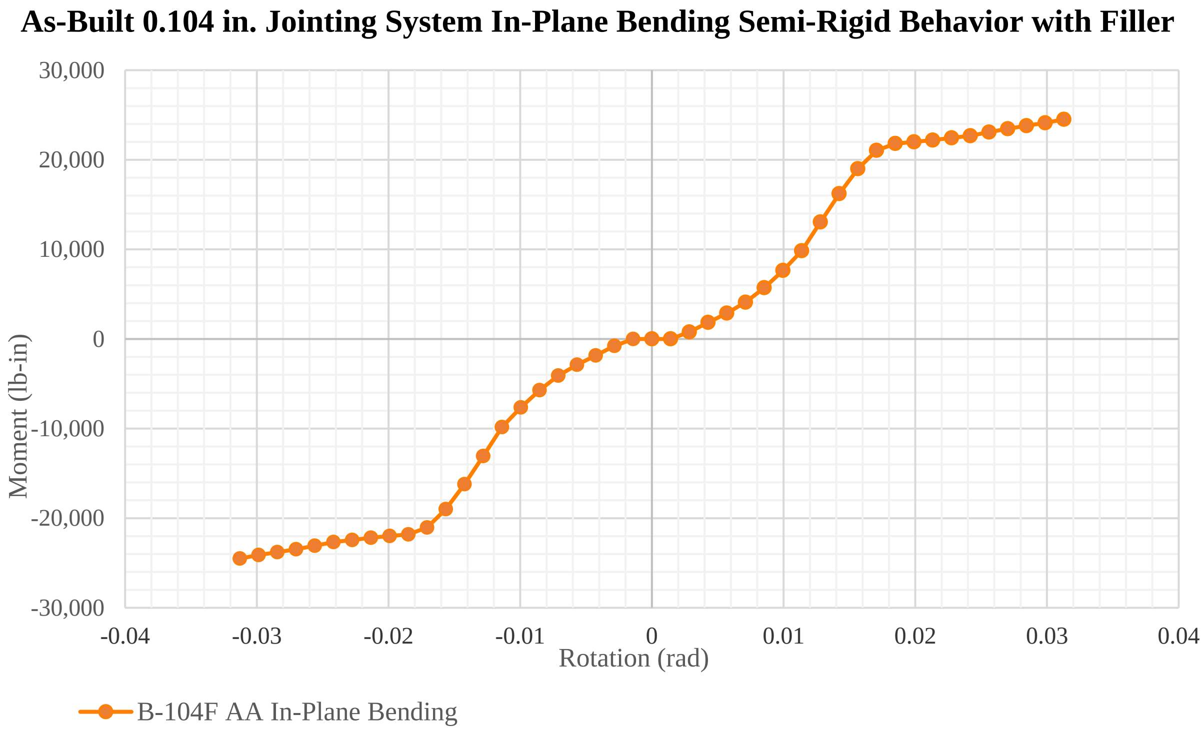


Figure K.28 In-Plane Bending Semi-Rigid Behavior (B-104F AA)

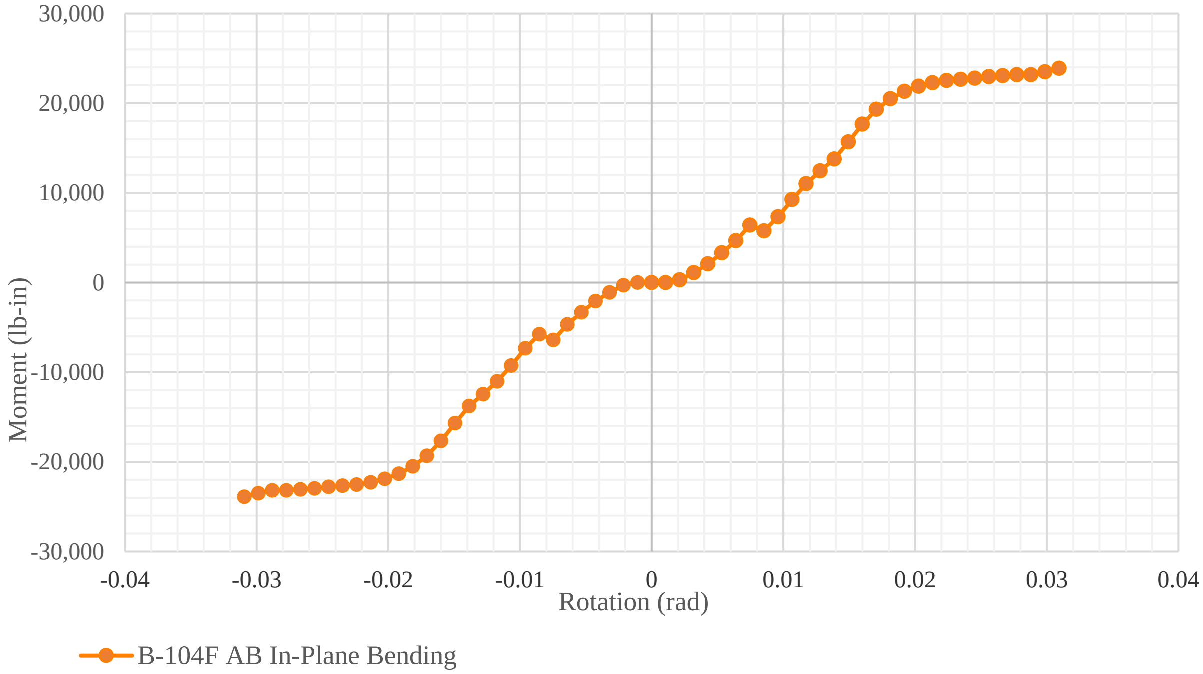


Figure K.29 In-Plane Bending Semi-Rigid Behavior (B-104F AB)

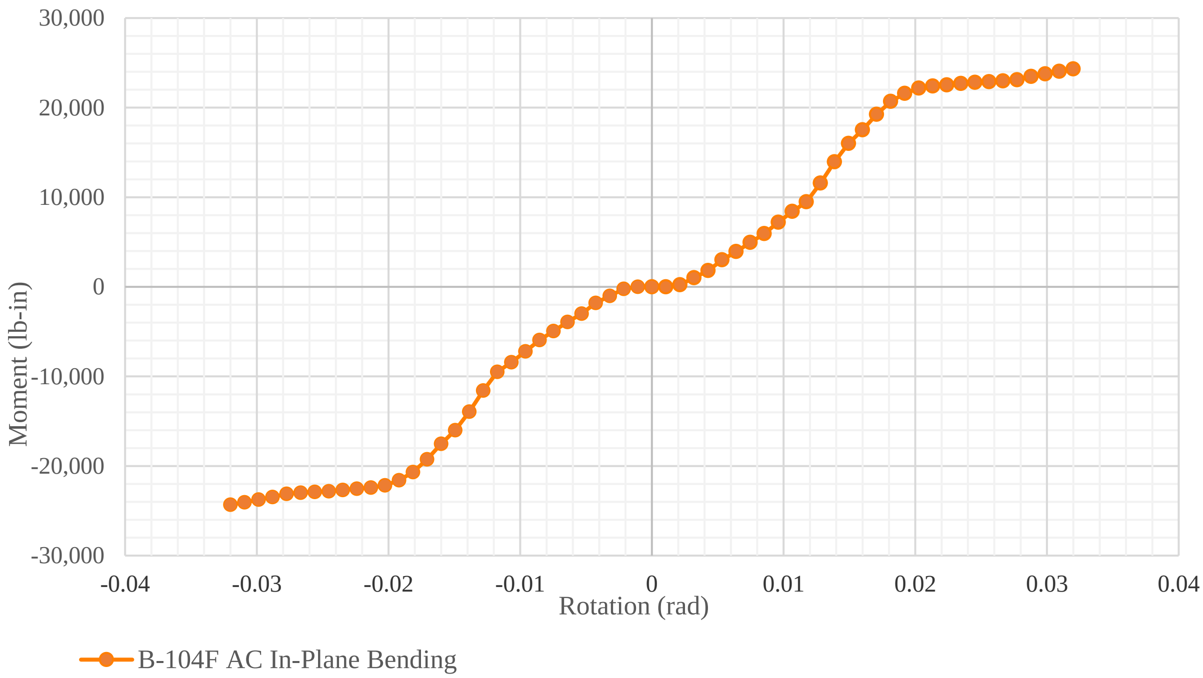


Figure K.30 In-Plane Bending Semi-Rigid Behavior (B-104F AC)

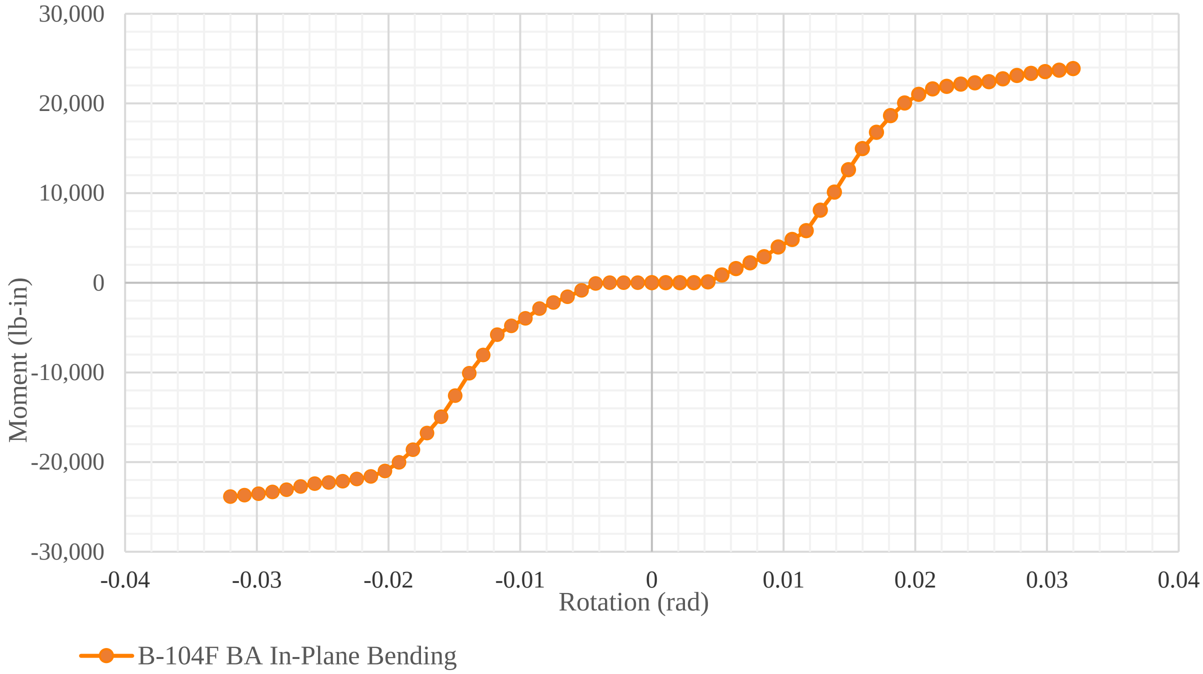


Figure K.31 In-Plane Bending Semi-Rigid Behavior (B-104F BA)

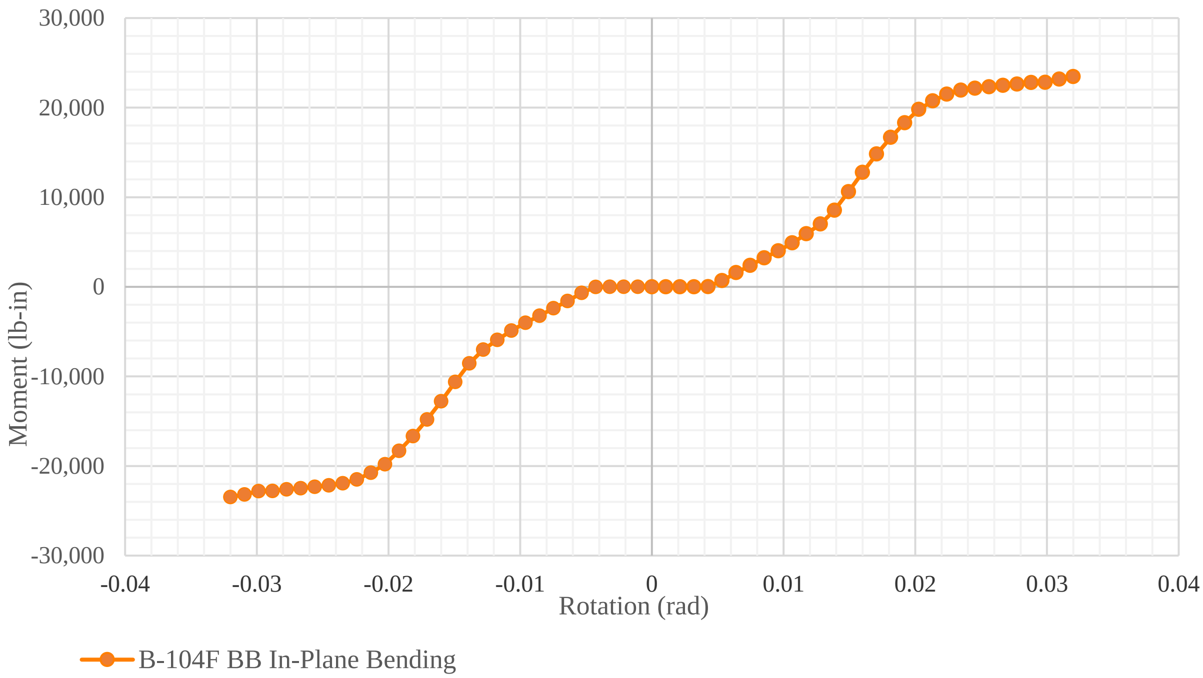


Figure K.32 In-Plane Bending Semi-Rigid Behavior (B-104F BB)

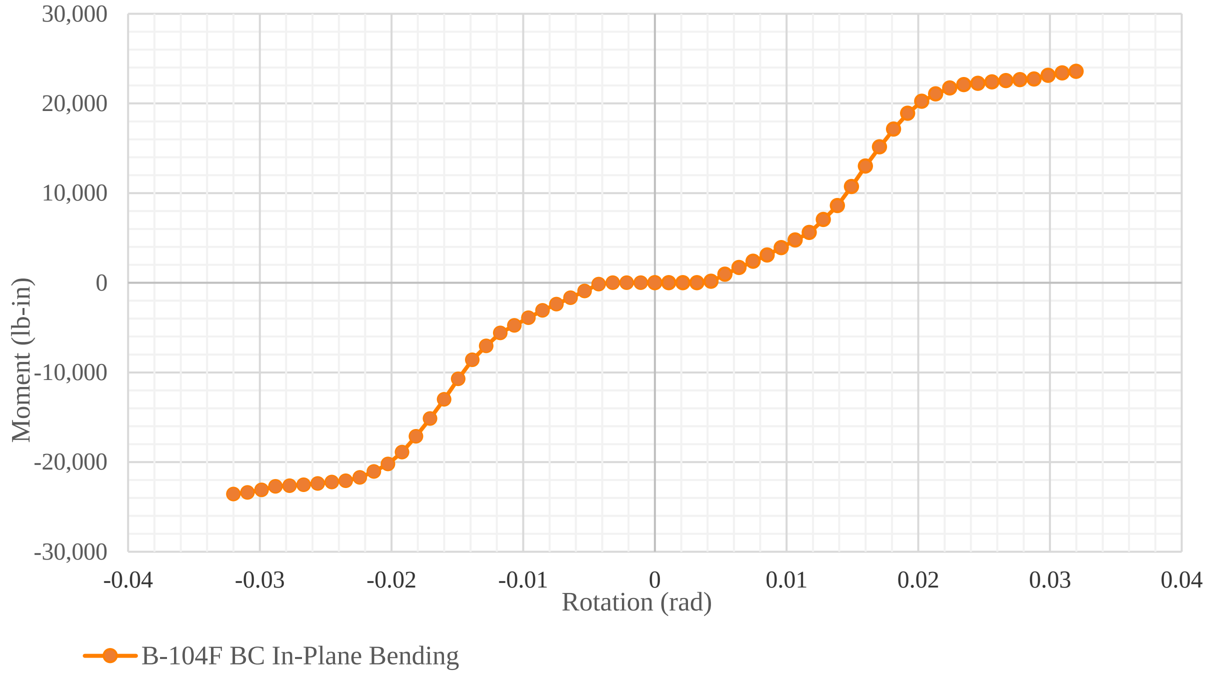


Figure K.33 In-Plane Bending Semi-Rigid Behavior (B-104F BC)

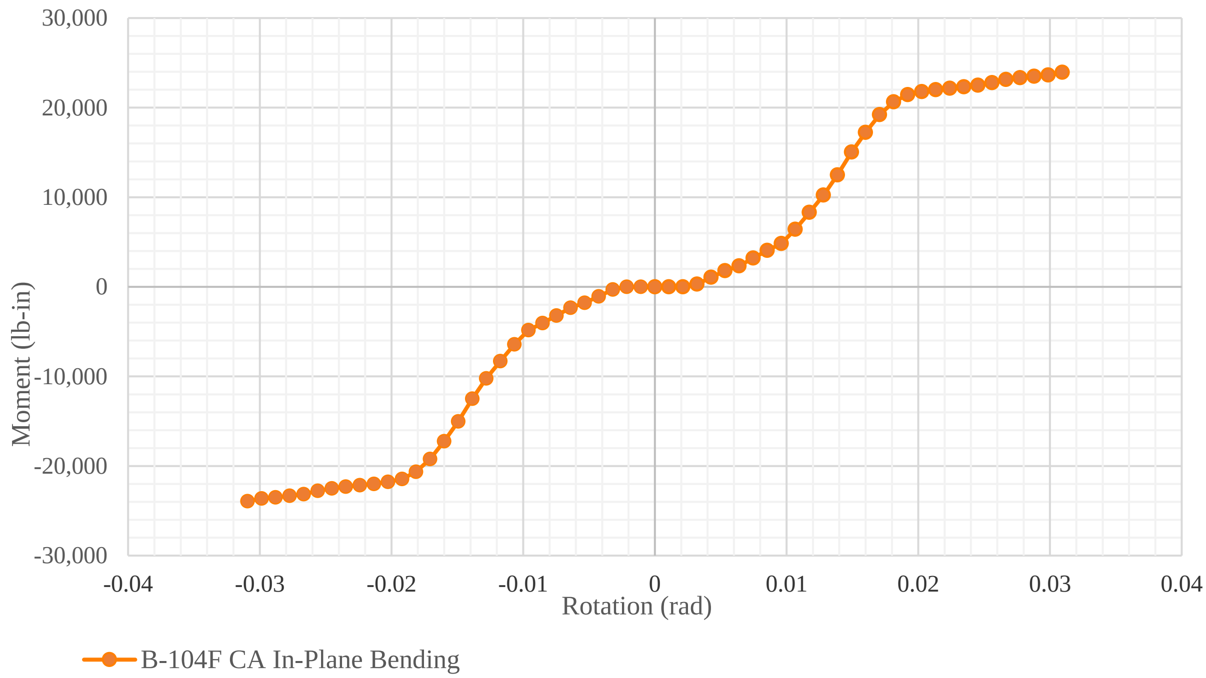


Figure K.34 In-Plane Bending Semi-Rigid Behavior (B-104F CA)

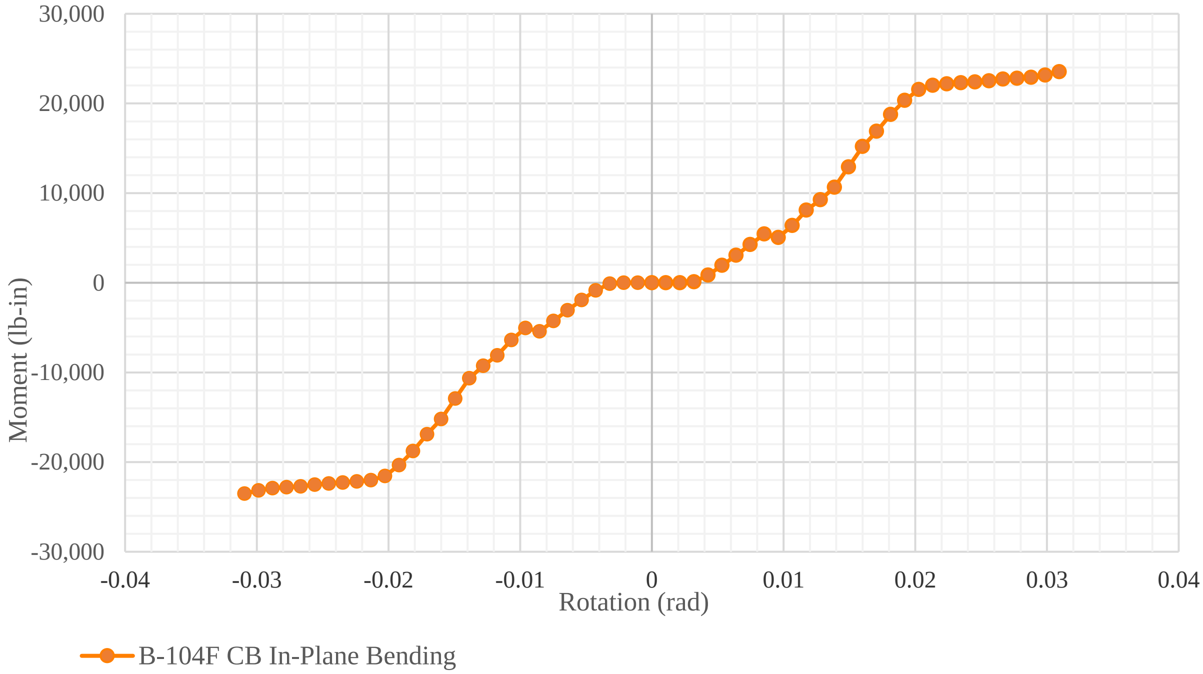


Figure K.35 In-Plane Bending Semi-Rigid Behavior (B-104F CB)

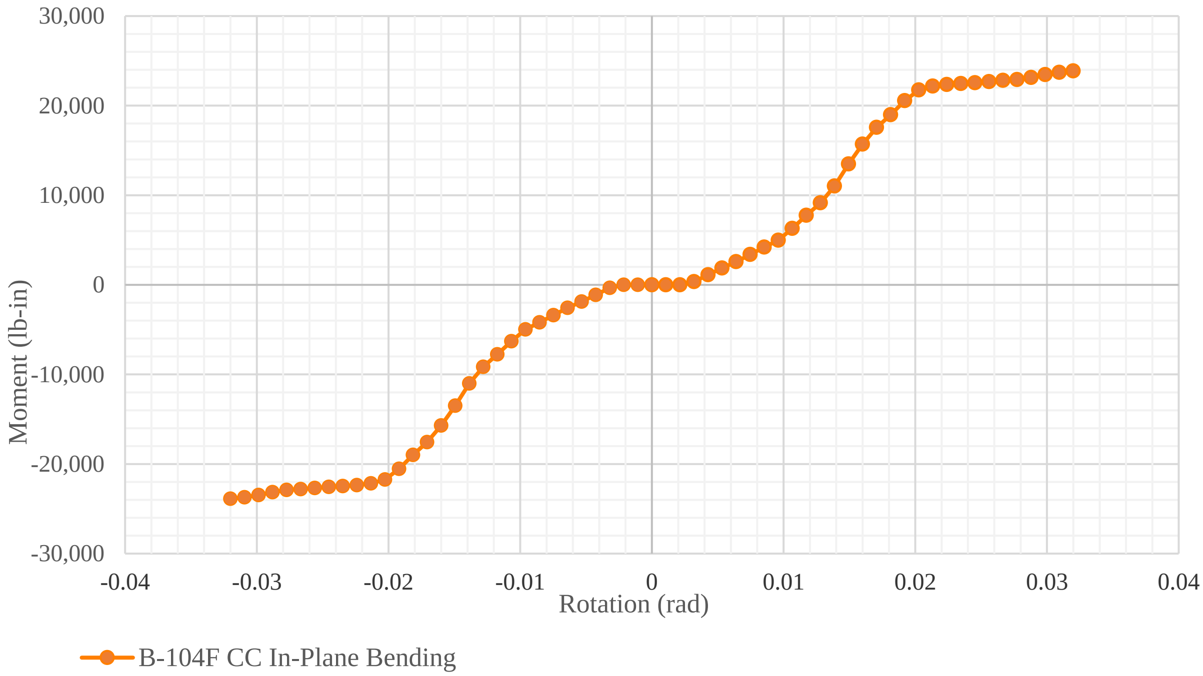


Figure K.36 In-Plane Bending Semi-Rigid Behavior (B-104F CC)

Table K.7 In-Plane Bending Moment-Rotation of B-104F Model Set

Displacement (in)	Moment (lb-in)								
	B-104F AA	B-104F AB	B-104F AC	B-104F BA	B-104F BB	B-104F BC	B-104F CA	B-104F CB	B-104F CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	314.55	261.24	201.02	0.07	0.07	0.07	0.30	0.16	1.15
0.004	1,637.24	1,832.73	1,609.13	61.81	9.72	115.22	869.81	668.00	928.18
0.006	3,138.69	4,163.78	3,580.91	1,296.08	1,242.76	1,400.82	2,130.59	2,641.20	2,309.78
0.008	5,105.59	6,082.98	5,439.50	2,546.67	2,808.57	2,734.78	3,631.30	4,843.32	3,792.04
0.010	7,709.77	8,054.89	7,660.14	4,289.41	4,344.01	4,229.68	5,428.04	5,547.76	5,469.99
0.012	11,247.23	11,379.25	10,007.26	6,358.15	6,188.43	5,956.74	8,782.37	8,389.87	8,108.66
0.014	15,712.47	14,013.50	14,199.24	10,406.96	8,802.87	8,868.82	12,809.76	10,934.38	11,325.33
0.016	19,508.14	17,655.21	17,520.74	14,955.44	12,773.97	13,005.79	17,239.88	15,194.19	15,703.31
0.018	21,547.56	20,350.70	20,505.12	18,388.39	16,442.15	16,880.09	20,465.06	18,533.88	18,802.63
0.020	22,008.72	21,745.84	22,023.29	20,751.54	19,430.68	19,890.21	21,691.40	21,248.40	21,439.75
0.022	22,307.95	22,437.11	22,483.66	21,784.32	21,217.13	21,461.72	22,094.23	22,111.56	22,283.30
0.024	22,641.82	22,721.61	22,751.82	22,209.28	22,045.49	22,160.21	22,407.17	22,342.20	22,508.31
0.026	23,186.72	22,995.58	22,922.79	22,526.98	22,376.33	22,444.07	22,915.02	22,586.77	22,723.87
0.028	23,692.45	23,173.29	23,194.83	23,157.73	22,657.35	22,657.71	23,368.71	22,823.47	22,959.70
0.030	24,155.05	23,550.70	23,793.91	23,559.71	22,857.98	23,147.24	23,669.15	23,199.56	23,497.85
0.032	-	-	24,319.36	23,863.62	23,456.45	23,572.35	-	-	23,871.73

Table K.8 In-Plane Bending Ultimate Moment-Rotation of B-104F Model Set

	B-104F AA	B-104F AB	B-104F AC	B-104F BA	B-104F BB	B-104F BC	B-104F CA	B-104F CB	B-104F CC
Moment (lb-in)	24,511.32	23,890.15	24,319.36	23,863.62	23,456.45	23,572.35	23,934.26	23,524.47	23,871.73
Rotation (rad)	0.0313	0.0309	0.0320	0.0320	0.0320	0.0320	0.0309	0.0309	0.0320

B-120 In-Plane Semi-Rigid Behavior

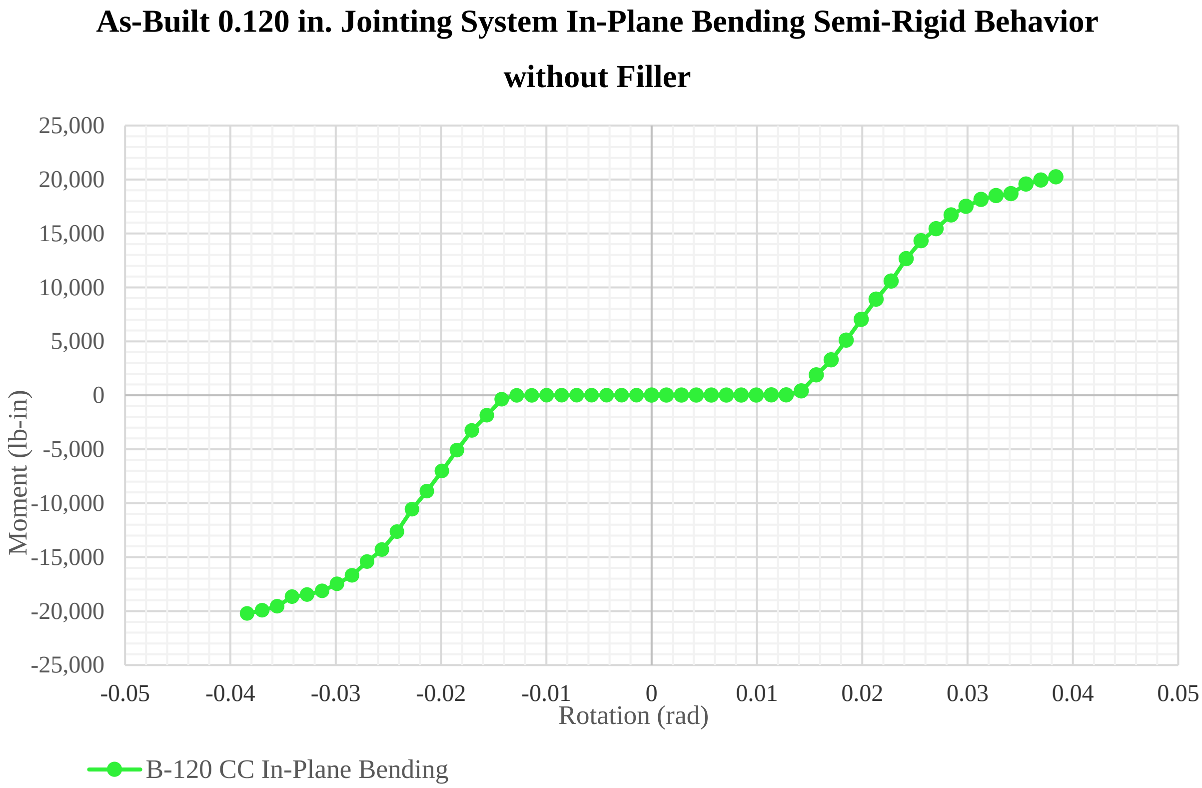


Figure K.37 In-Plane Bending Semi-Rigid Behavior (B-120 AA)

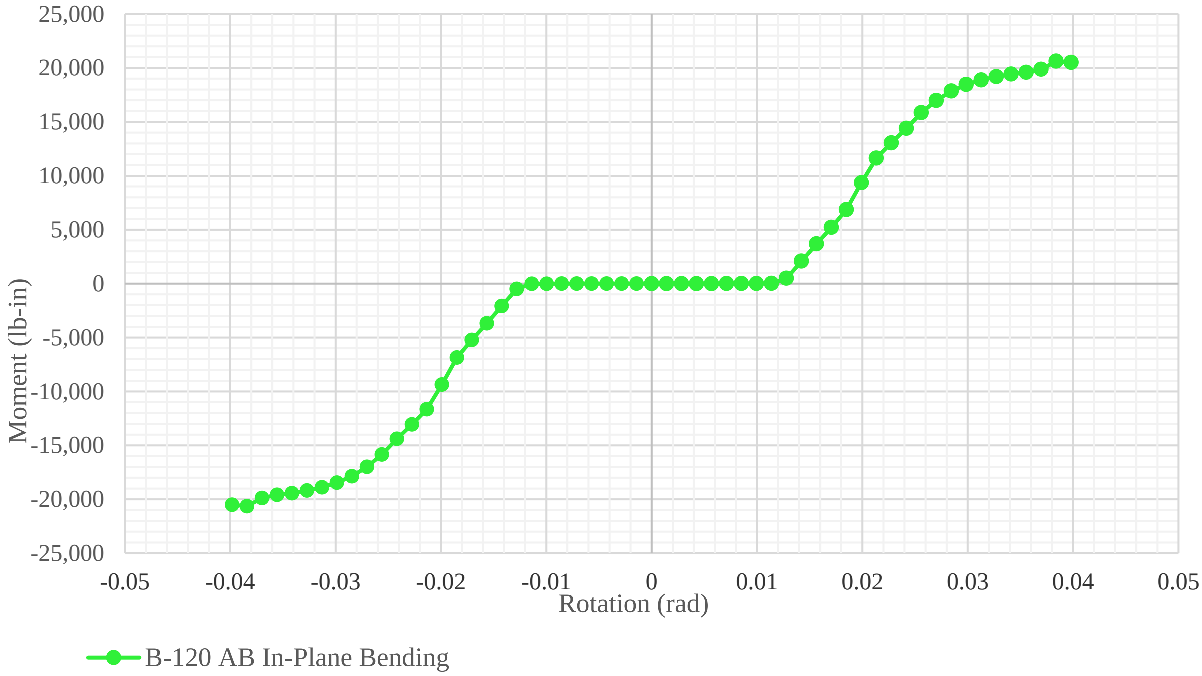


Figure K.38 In-Plane Bending Semi-Rigid Behavior (B-120 AB)

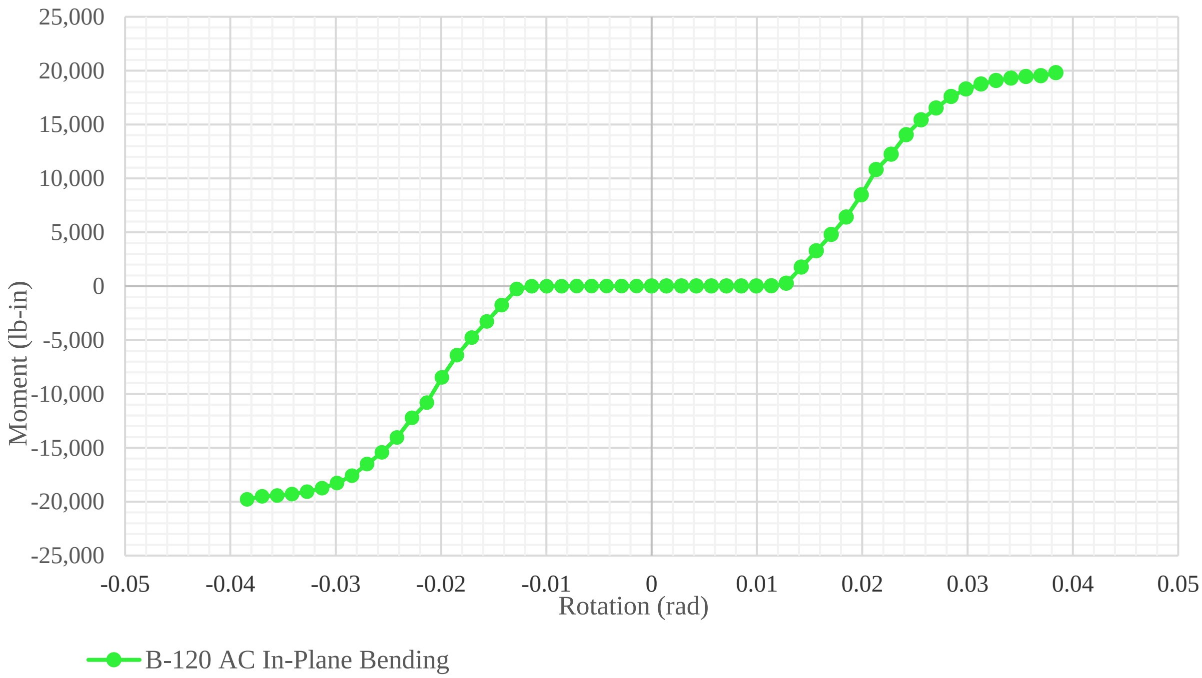


Figure K.39 In-Plane Bending Semi-Rigid Behavior (B-120 AC)

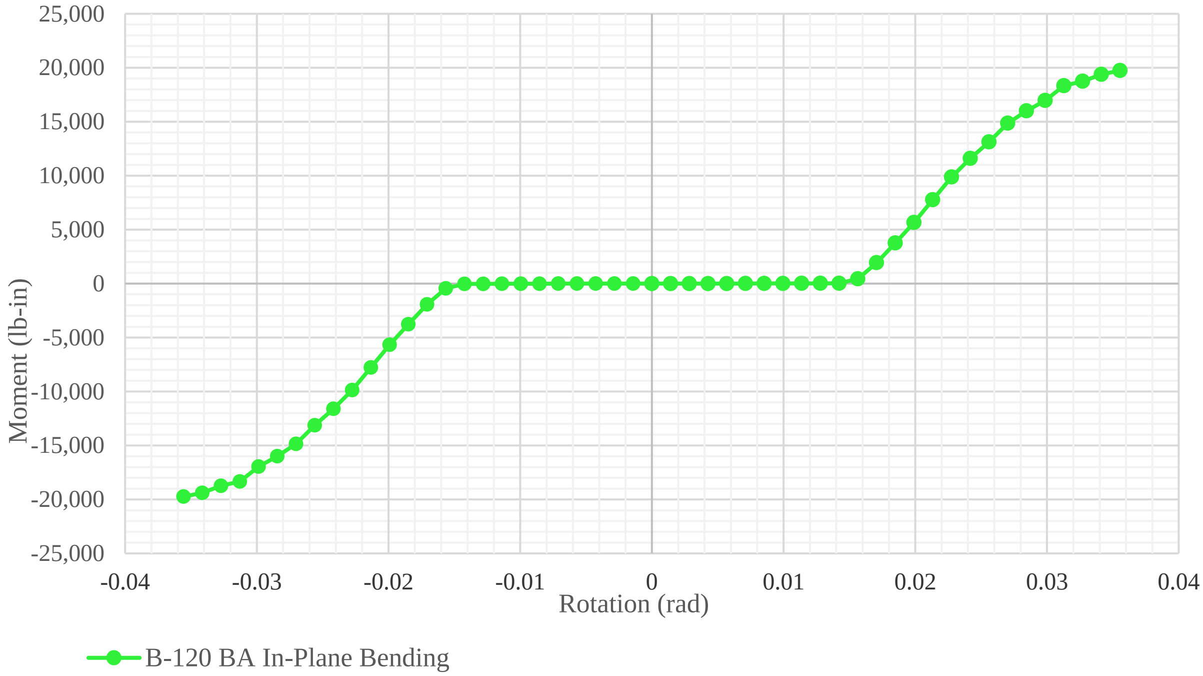


Figure K.40 In-Plane Bending Semi-Rigid Behavior (B-120 BA)

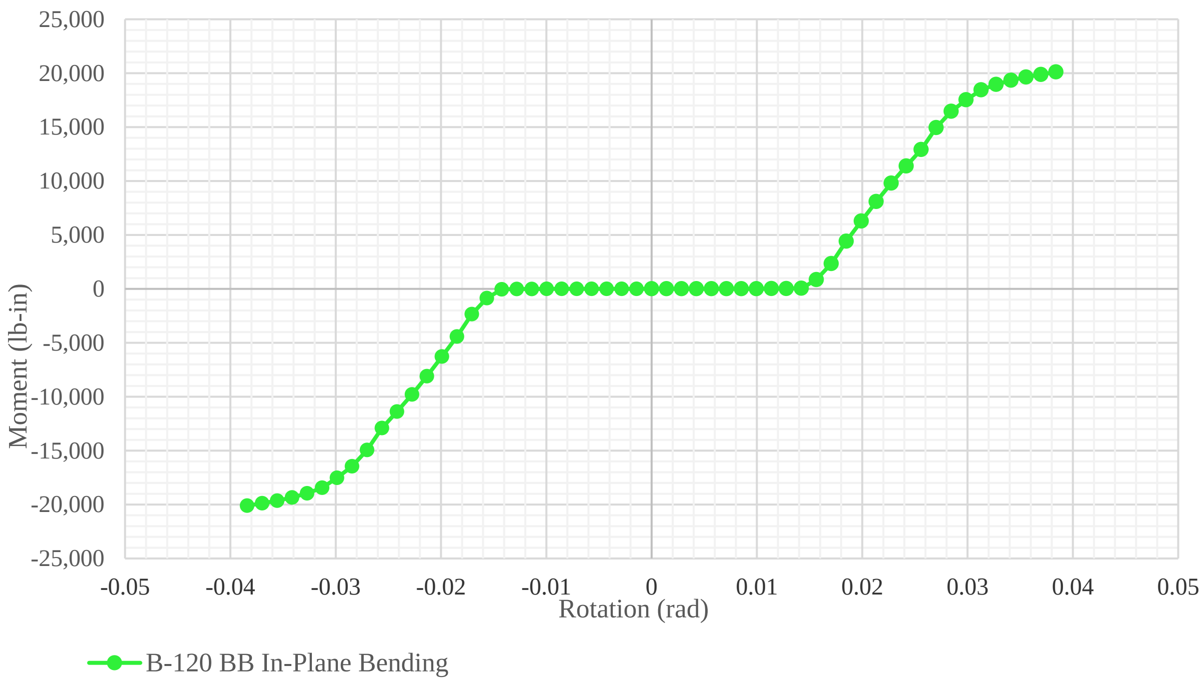


Figure K.41 In-Plane Bending Semi-Rigid Behavior (B-120 BB)

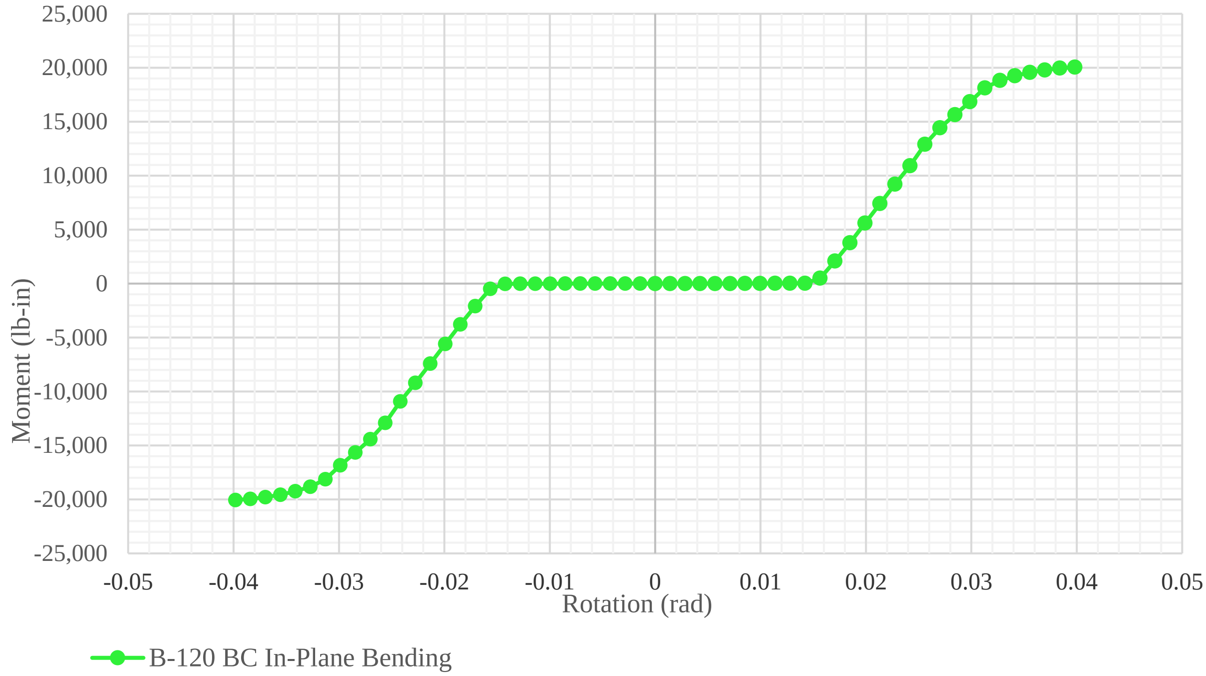


Figure K.42 In-Plane Bending Semi-Rigid Behavior (B-120 BC)

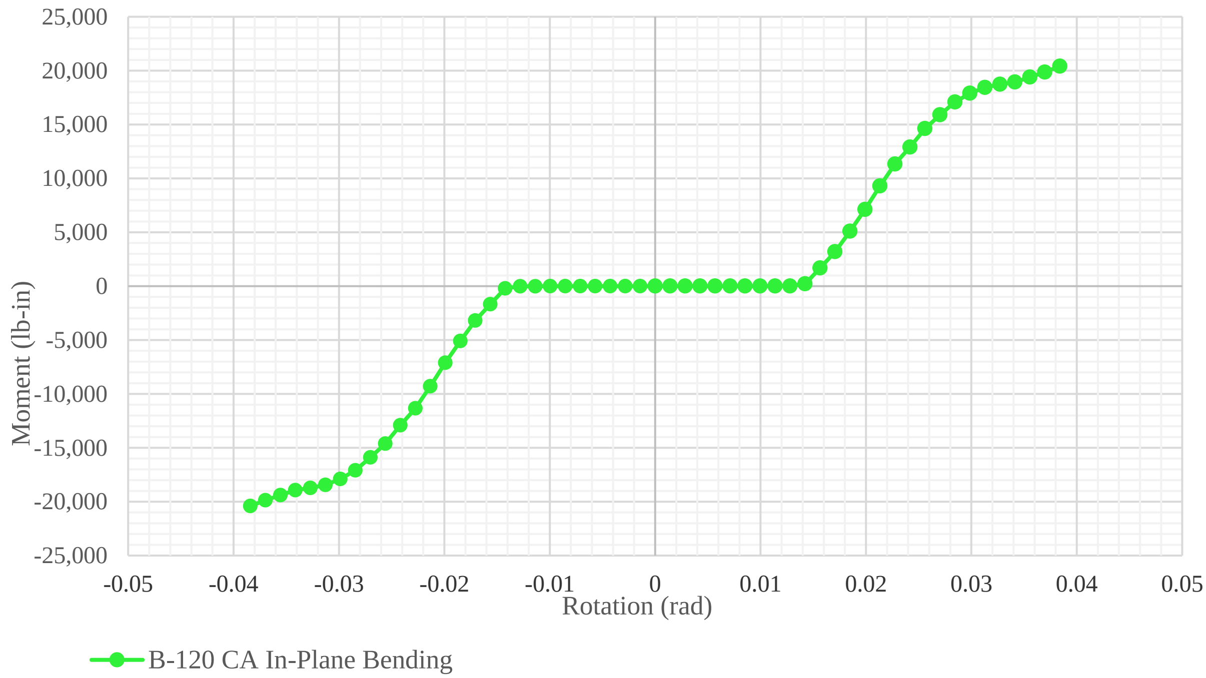


Figure K.43 In-Plane Bending Semi-Rigid Behavior (B-120 CA)

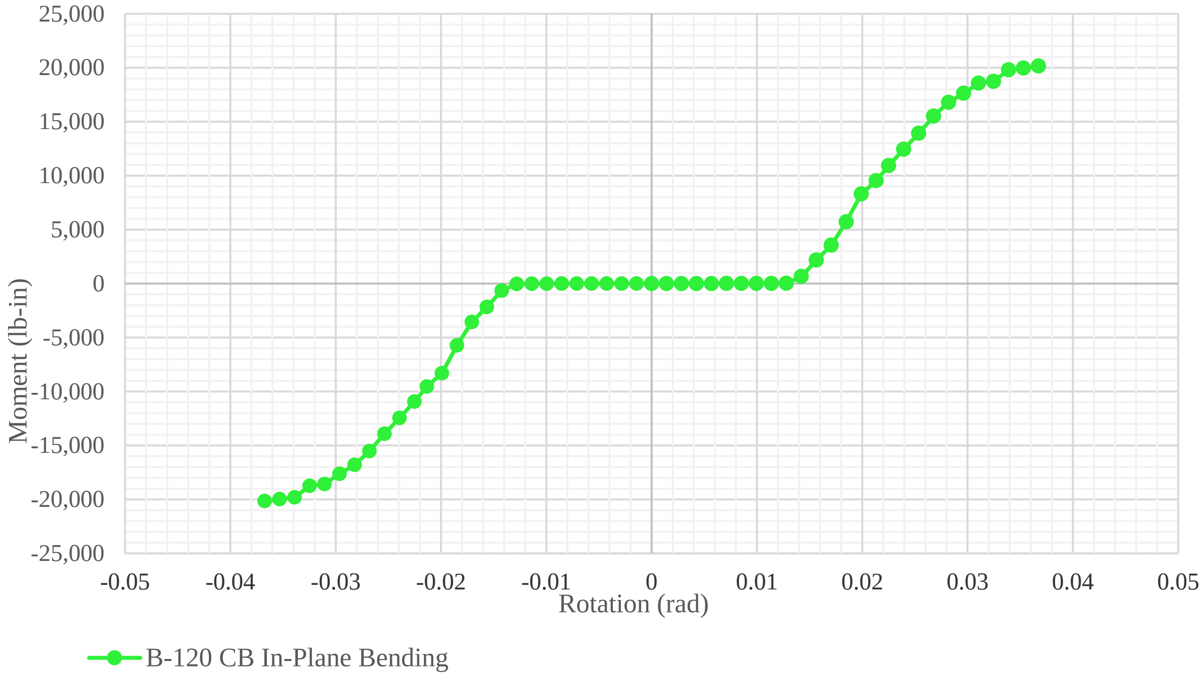


Figure K.44 In-Plane Bending Semi-Rigid Behavior (B-120 CB)

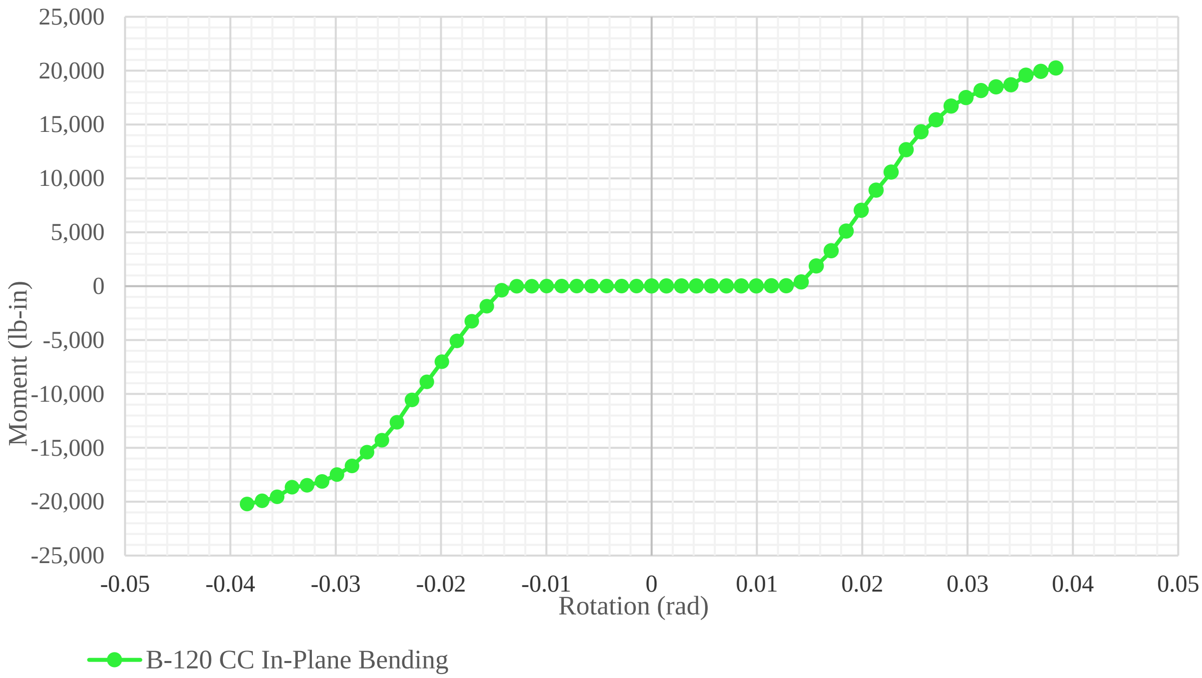


Figure K.45 In-Plane Bending Semi-Rigid Behavior (B-120 CC)

Table K.9 In-Plane Bending Moment-Rotation of B-120 Model Set

Rotation (rad)	Moment (lb-in)								
	B-120 AA	B-120 AB	B-120 AC	B-120 BA	B-120 BB	B-120 BC	B-120 CA	B-120 CB	B-120 CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	0.04	0.02	0.02	0.01	0.00	0.00	0.01	0.00	0.00
0.004	0.23	0.14	0.17	0.05	0.06	0.08	0.09	0.09	0.11
0.006	1.14	0.75	0.86	0.65	0.52	0.54	0.81	0.60	0.68
0.008	2.83	2.24	6.59	6.06	1.69	1.76	2.34	2.13	2.05
0.010	5.76	13.72	14.22	13.57	4.07	11.53	5.02	6.79	4.81
0.012	71.29	225.53	125.65	19.74	18.64	18.42	9.47	13.75	18.95
0.014	1,458.24	1,832.18	1,526.42	24.14	43.03	26.23	180.49	558.41	326.15
0.016	3,615.14	4,067.34	3,649.29	815.31	1,229.07	894.45	2,057.96	2,516.01	2,215.54
0.018	5,886.69	6,293.49	5,845.90	3,138.22	3,703.91	3,196.35	4,439.44	4,978.38	4,463.35
0.020	8,948.22	9,501.91	8,613.50	5,795.63	6,391.45	5,712.17	7,250.24	8,381.05	7,141.69
0.022	11,946.88	12,306.34	11,473.51	8,755.32	8,895.41	8,251.00	10,249.88	10,322.02	9,676.69
0.024	14,390.89	14,229.27	13,821.84	11,382.04	11,186.39	10,703.86	12,706.45	12,508.45	12,383.62
0.026	16,360.63	16,169.00	15,731.22	13,610.14	13,485.38	13,329.91	14,977.94	14,634.54	14,618.64
0.028	17,725.38	17,583.60	17,256.81	15,639.07	15,982.90	15,264.57	16,712.50	16,607.24	16,296.83
0.030	18,723.04	18,499.43	18,322.82	17,090.98	17,611.96	16,964.75	17,945.77	17,876.77	17,550.23
0.032	19,278.58	19,036.57	18,913.31	18,539.20	18,701.07	18,473.65	18,582.93	18,681.83	18,307.46
0.034	19,623.55	19,408.49	19,276.84	19,327.98	19,307.32	19,207.34	18,917.34	19,812.25	18,649.58
0.036	-	19,678.19	19,465.59	-	19,715.36	19,635.76	19,541.16	20,052.66	19,672.52
0.038	-	20,418.85	19,714.44	-	20,042.19	19,911.99	20,252.71	-	20,141.04

Table K.10 In-Plane Bending Ultimate Moment-Rotation of B-120 Model Set

	B-120 AA	B-120 AB	B-120 AC	B-120 BA	B-120 BB	B-120 BC	B-120 CA	B-120 CB	B-120 CC
Moment (lb-in)	19,835.25	20,508.81	19,791.96	19,736.71	20,105.72	20,052.72	20,405.10	20,150.67	20,226.07
Rotation (rad)	0.0356	0.0398	0.0384	0.0356	0.0384	0.0398	0.0384	0.0367	0.0384

B-120f In-Plane Semi-Rigid Behavior

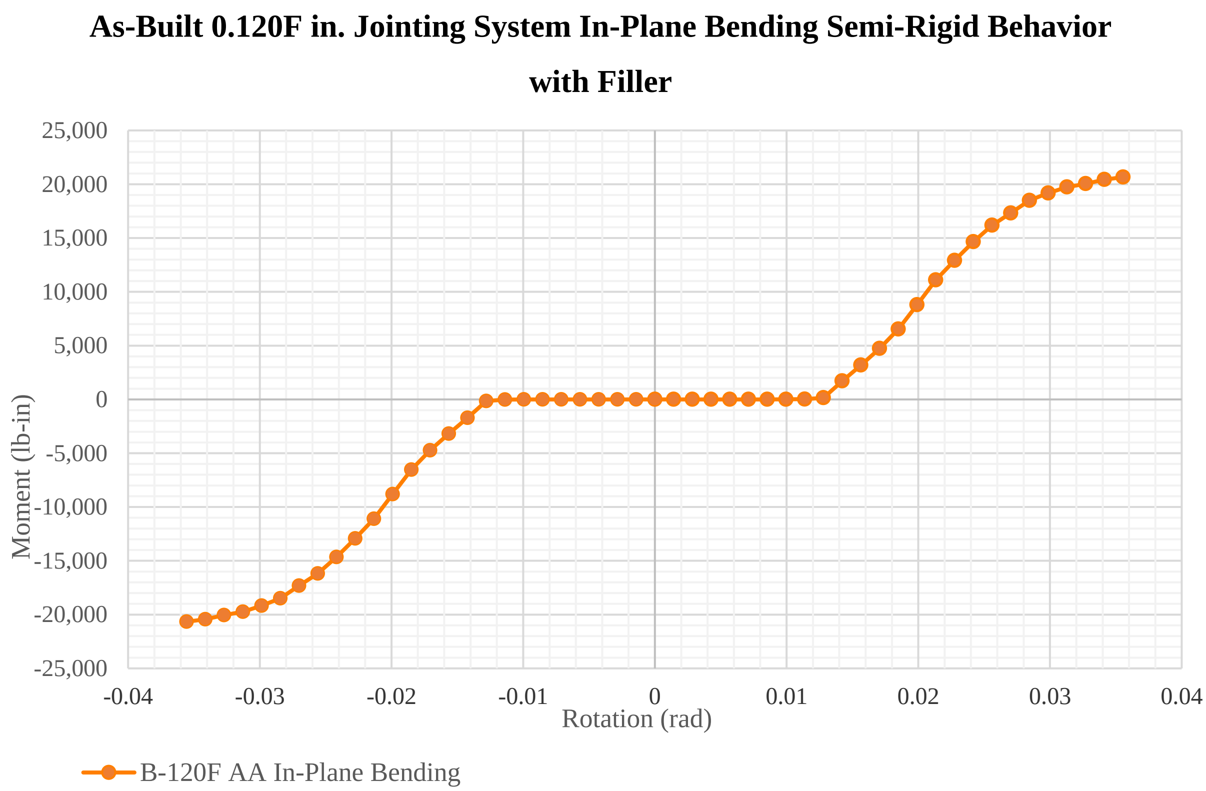


Figure K.46 In-Plane Bending Semi-Rigid Behavior (B-120F AA)

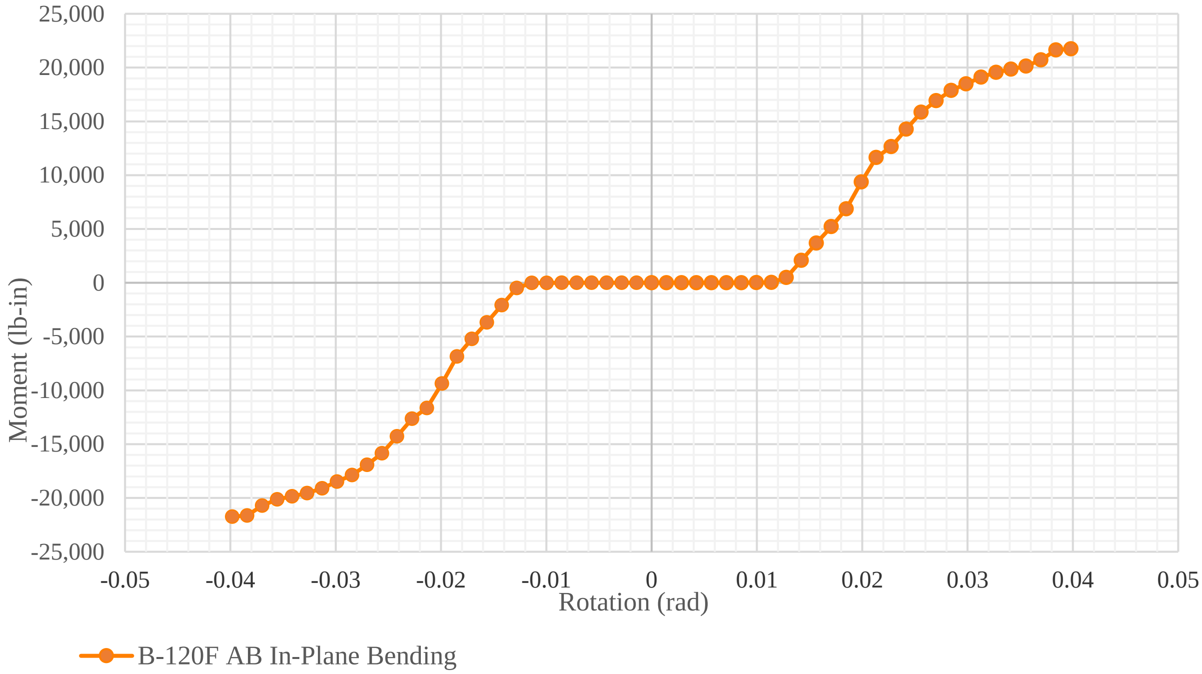


Figure K.47 In-Plane Bending Semi-Rigid Behavior (B-120F AB)

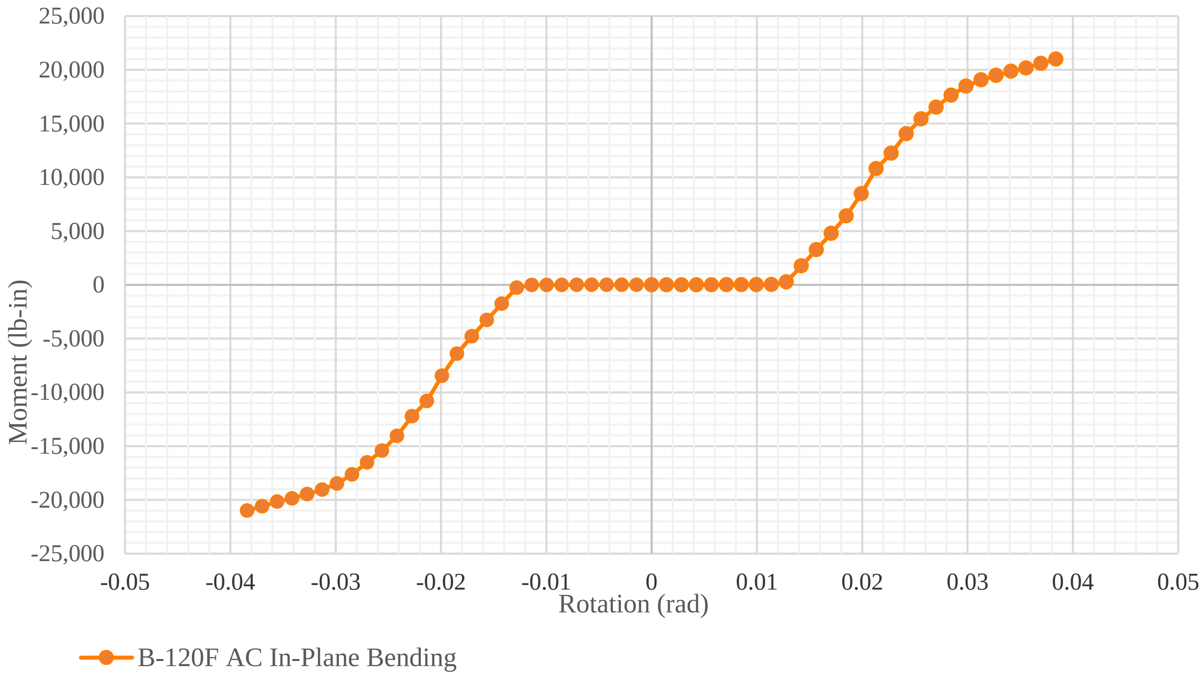


Figure K.48 In-Plane Bending Semi-Rigid Behavior (B-120F AC)

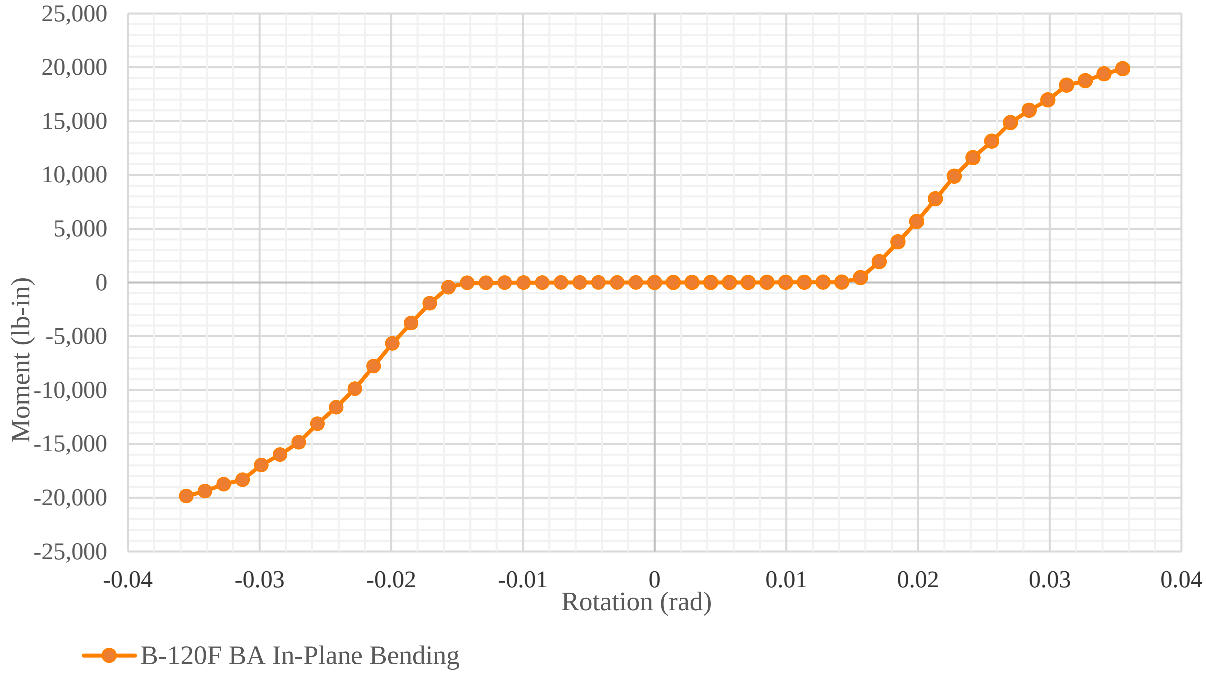


Figure K.49 In-Plane Bending Semi-Rigid Behavior (B-120F BA)

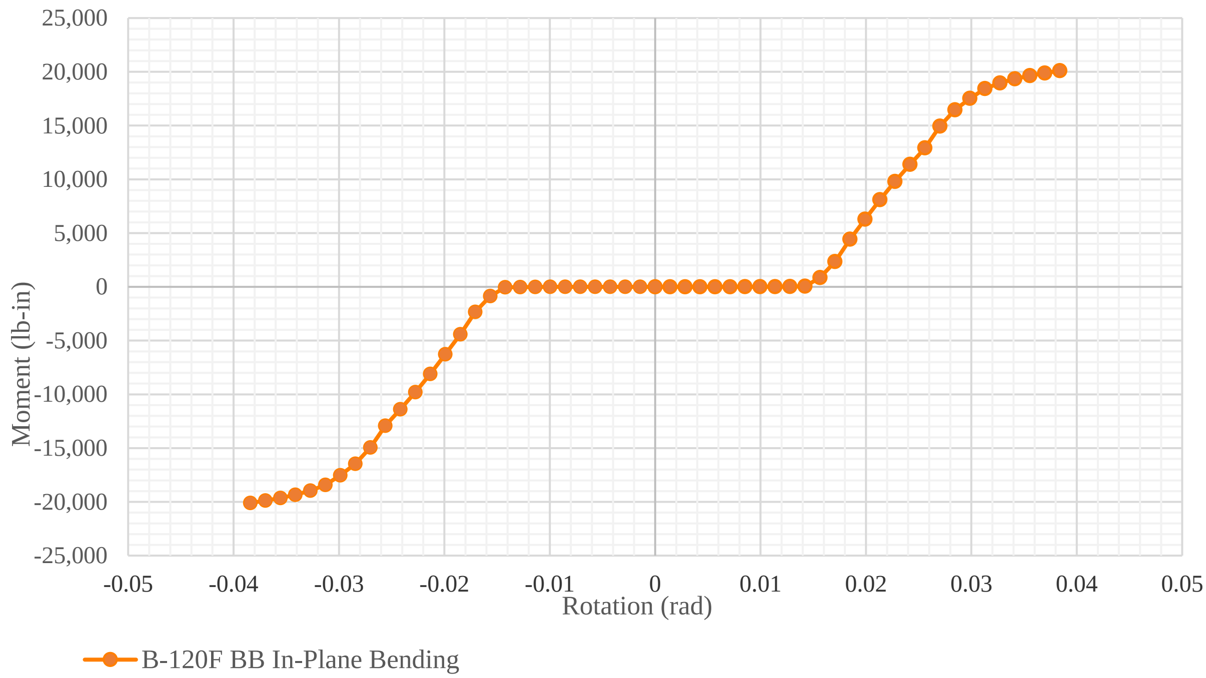


Figure K.50 In-Plane Bending Semi-Rigid Behavior (B-120F BB)

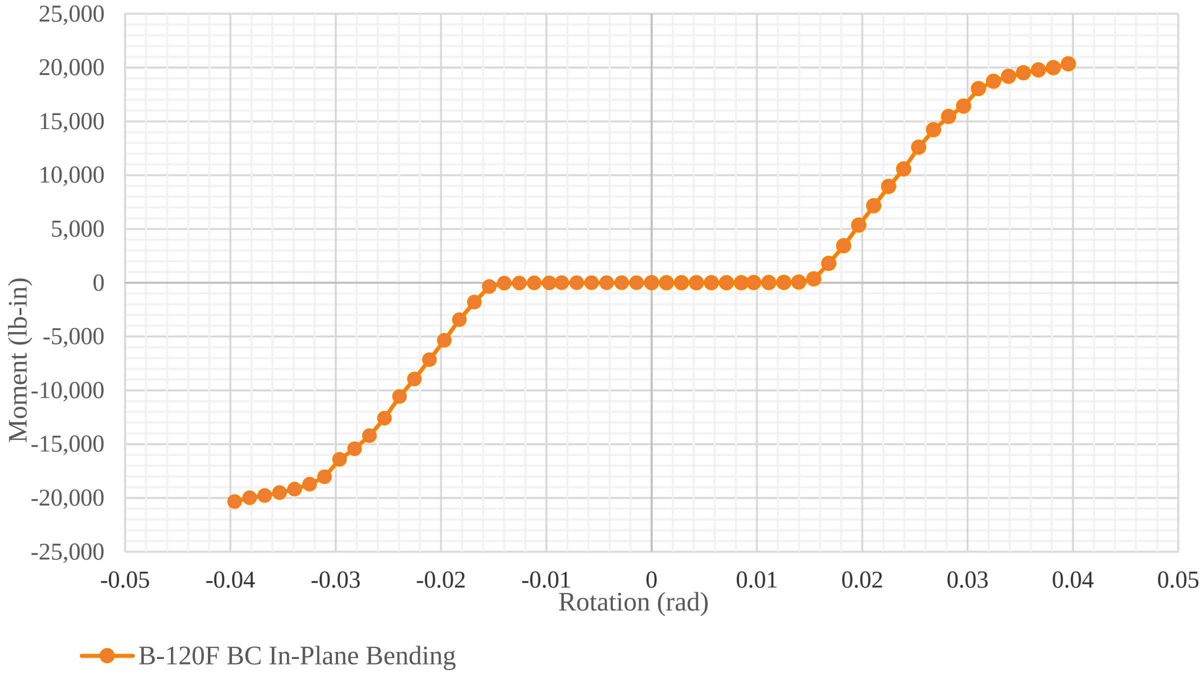


Figure K.51 In-Plane Bending Semi-Rigid Behavior (B-120F BC)

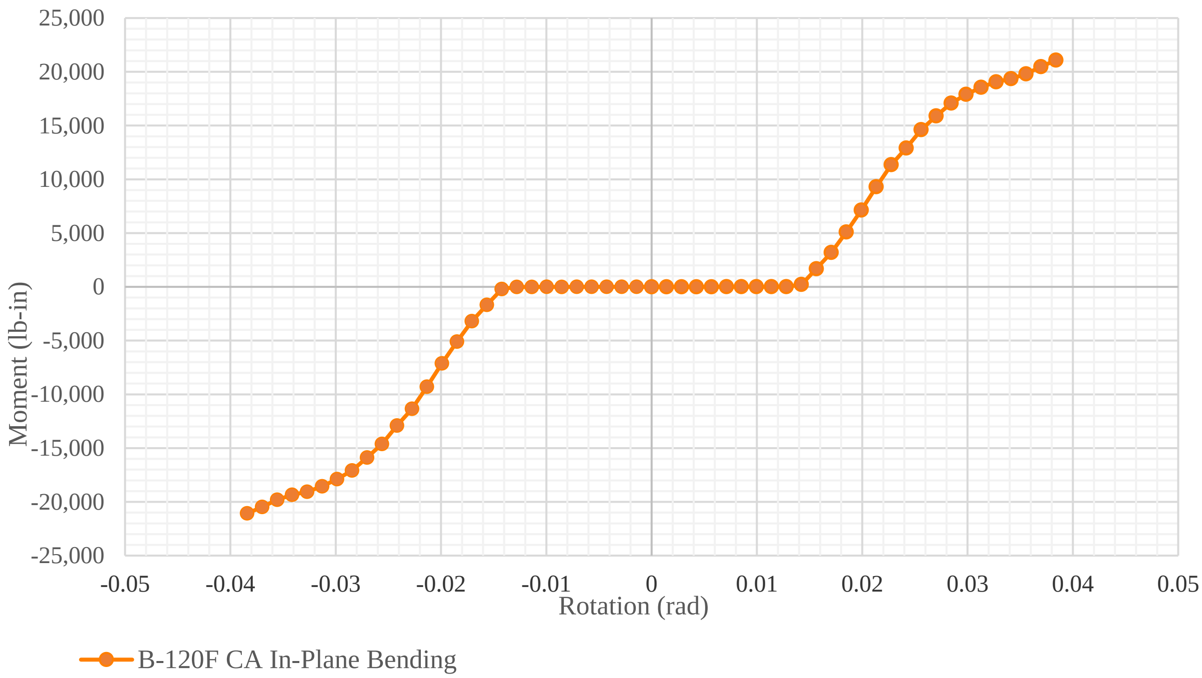


Figure K.52 In-Plane Bending Semi-Rigid Behavior (B-120F CA)

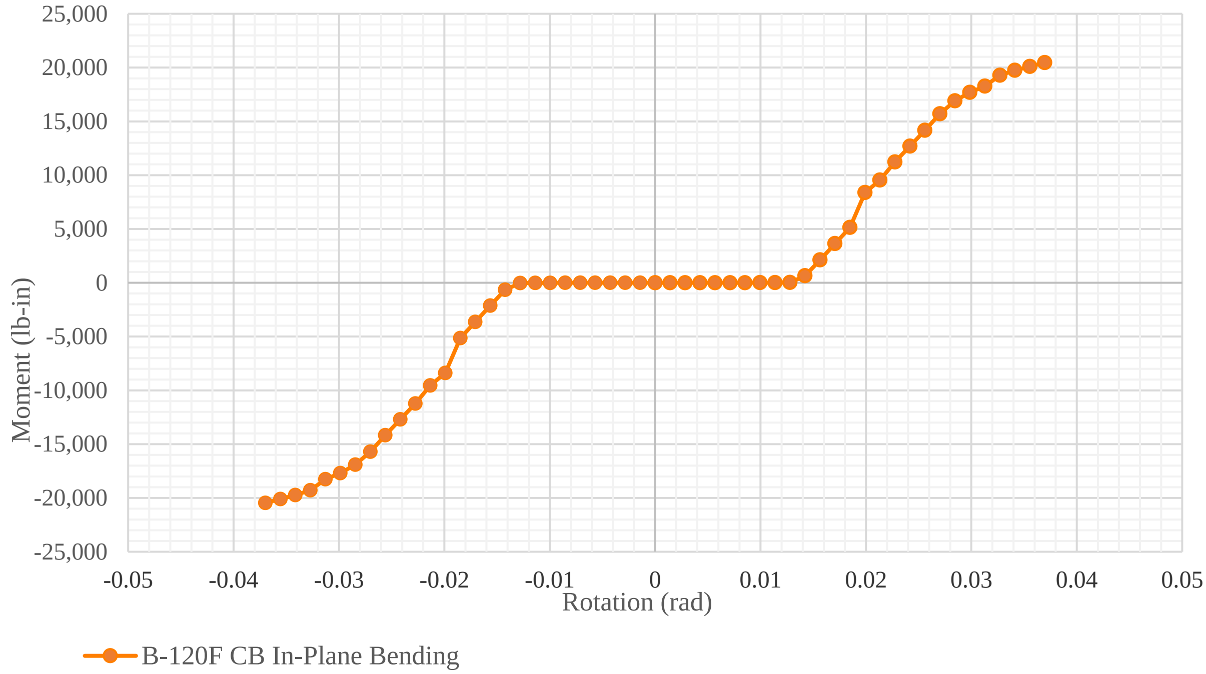


Figure K.53 In-Plane Bending Semi-Rigid Behavior (B-120F CB)

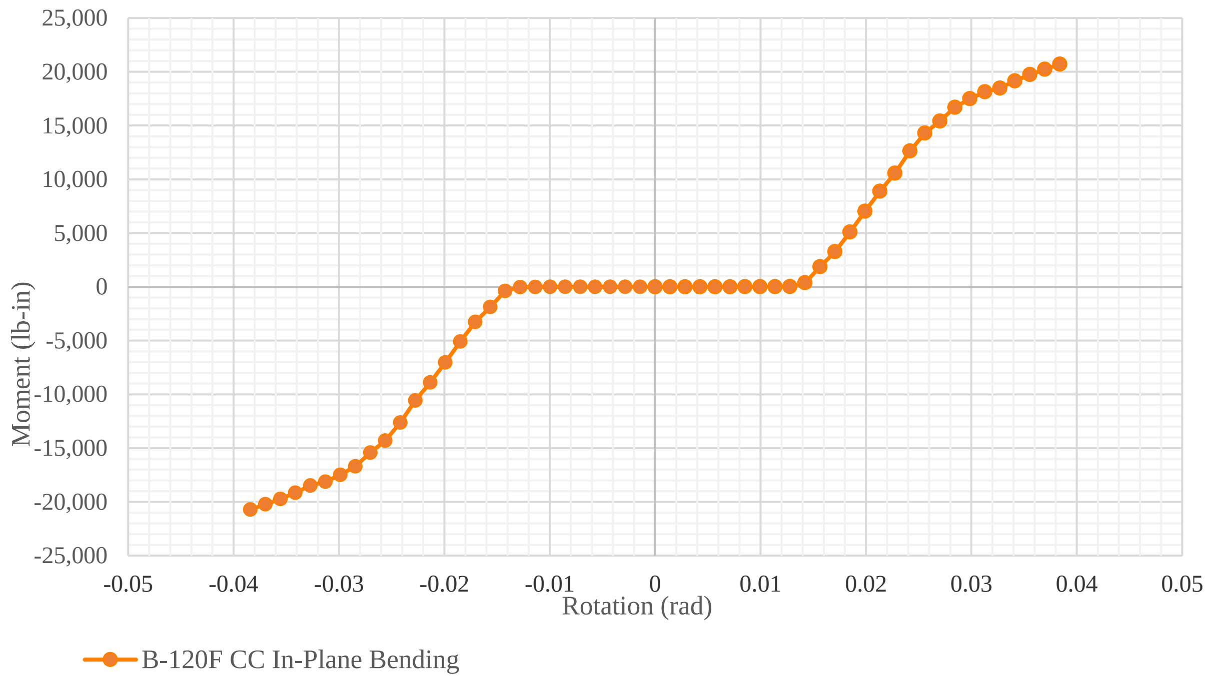


Figure K.54 In-Plane Bending Semi-Rigid Behavior (B-120F CC)

Table K.11 In-Plane Bending Moment-Rotation of B-120F Model Set

Rotation (rad)	Moment (lb-in)								
	B-120F AA	B-120F AB	B-120F AC	B-120F BA	B-120F BB	B-120F BC	B-120F CA	B-120F CB	B-120F CC
0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.002	0.02	0.02	0.02	0.01	0.01	0.00	0.01	0.01	0.00
0.004	0.22	0.14	0.17	0.11	0.06	0.07	0.12	0.09	0.11
0.006	1.01	0.75	0.86	0.65	0.52	0.54	0.81	0.64	0.68
0.008	2.75	2.24	6.59	6.06	1.69	1.83	6.67	1.89	2.05
0.010	6.01	13.72	14.22	13.57	4.07	10.04	5.02	6.74	4.81
0.012	77.30	225.53	125.65	19.74	18.64	18.22	9.47	13.75	18.95
0.014	1,469.29	1,832.18	1,526.42	24.15	43.03	51.79	180.49	554.36	326.15
0.016	3,570.69	4,067.34	3,649.29	815.31	1,229.07	955.43	2,058.06	2,497.98	2,215.54
0.018	5,914.69	6,293.49	5,845.90	3,138.22	3,703.91	3,142.72	4,440.51	4,623.56	4,463.35
0.020	8,943.62	9,501.91	8,613.50	5,795.63	6,391.45	5,765.01	7,260.96	8,450.38	7,141.69
0.022	11,953.82	12,114.01	11,473.51	8,755.32	8,895.41	8,291.52	10,259.63	10,336.24	9,676.69
0.024	14,429.63	14,064.30	13,821.85	11,382.04	11,186.39	10,660.46	12,709.44	12,514.32	12,371.80
0.026	16,497.21	16,148.66	15,731.23	13,610.14	13,485.38	13,317.13	14,974.04	14,599.76	14,617.98
0.028	18,125.29	17,576.39	17,287.55	15,639.07	15,985.70	15,260.48	16,709.58	16,533.28	16,296.75
0.030	19,229.08	18,542.59	18,531.06	17,090.99	17,609.18	16,835.03	17,953.47	17,749.10	17,550.22
0.032	19,889.76	19,326.70	19,261.78	18,539.21	18,691.95	18,486.15	18,806.75	18,775.80	18,307.52
0.034	20,395.51	19,815.66	19,824.20	19,328.02	19,307.06	19,201.00	19,325.25	19,694.44	19,090.84
0.036	-	20,316.21	20,297.77	-	19,715.35	19,634.73	20,016.28	20,216.52	19,891.09
0.038	-	21,375.61	20,878.57	-	20,042.72	19,959.77	20,906.92	-	20,574.95

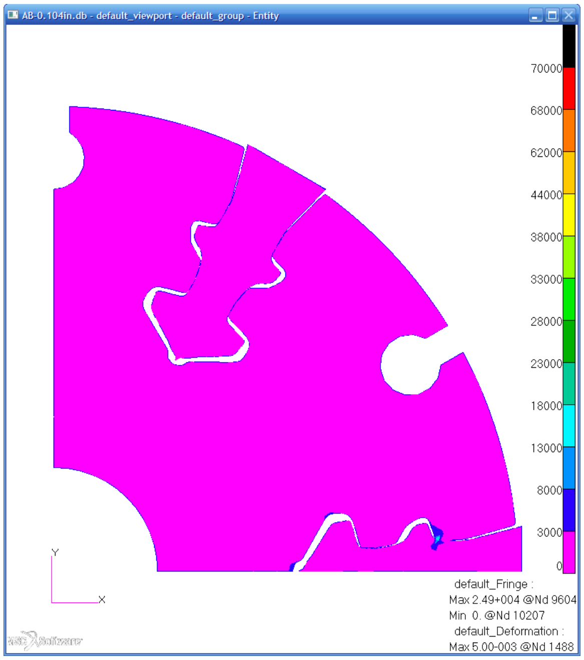
Table K.12 In-Plane Bending Ultimate Moment-Rotation of B-120F Model Set

	B-120F AA	B-120F AB	B-120F AC	B-120F BA	B-120F BB	B-120F BC	B-120F CA	B-120F CB	B-120F CC
Moment (lb-in)	20,661.74	21,738.25	20,989.05	19,855.38	20,106.41	20,336.34	21,074.88	20,459.02	20,710.68
Rotation (rad)	0.0356	0.0398	0.0384	0.0356	0.0384	0.0396	0.0384	0.0370	0.0384

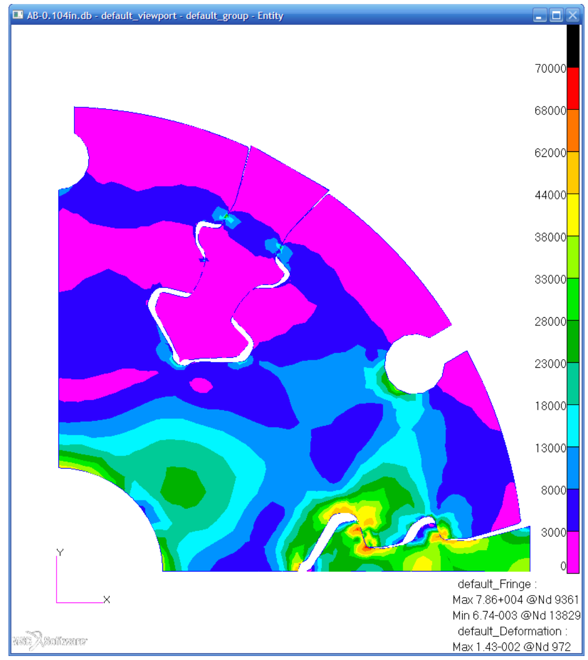
Appendix L

B-104 Axial Semi-Rigid Behavior Results and Conclusions

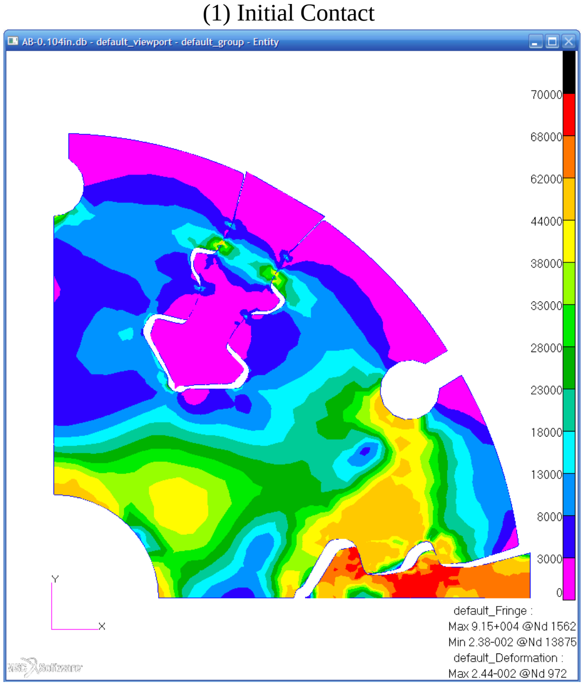
The tensile finite element simulation of the as-designed B-104F AA semi-rigid behavior is illustrated in the series of plots shown in **Figure L.1**.



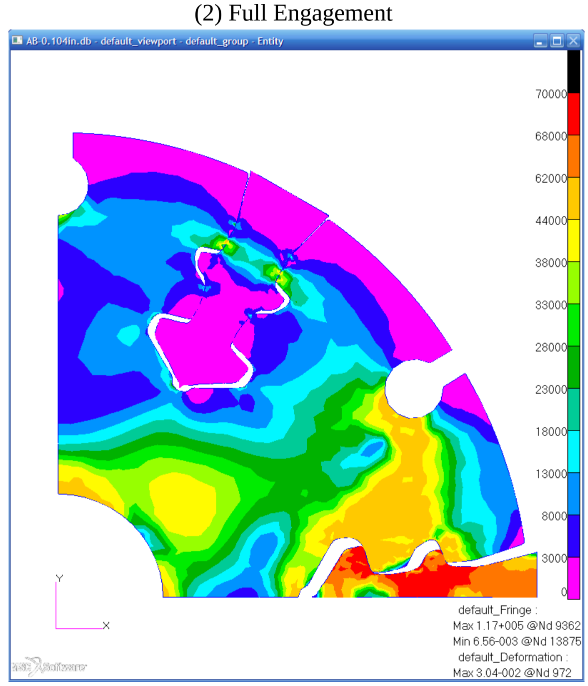
(1) Initial Contact



(2) Full Engagement



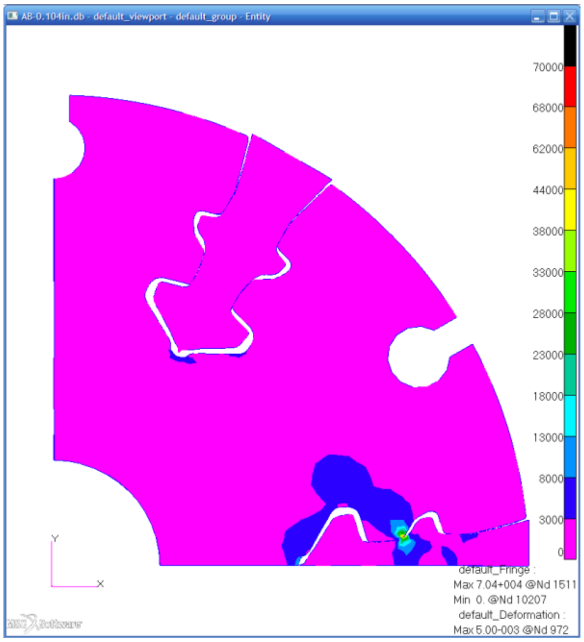
(3) Development of Yielding Stresses



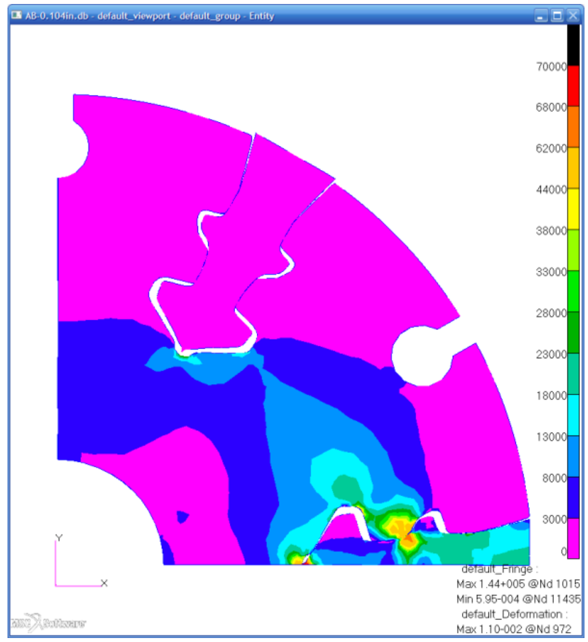
(4) Ultimate Capacity

Figure L.1 Von Mises Stress of B-104F AA under Tension from Initial Contact to Failure

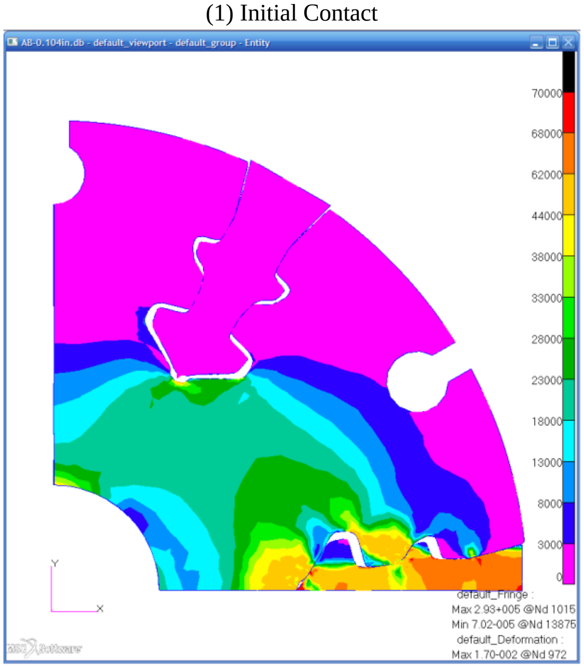
The compressive finite element simulation of the B-104F AA semi-rigid behavior is illustrated in the series of plots shown in **Figure L.2**.



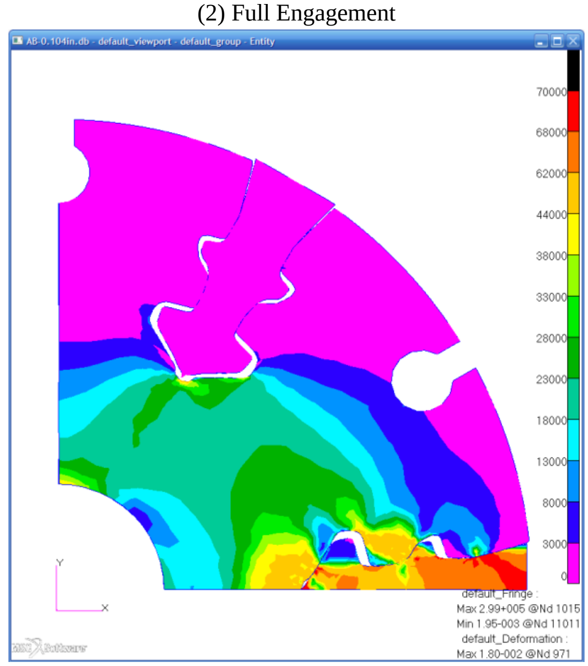
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure L.2 Von Mises Stress of B-104F AA under Compression from Initial Contact to Failure

Figure L.3 presents the axial semi-rigid behavior obtained from the B-104F AA simulation model.

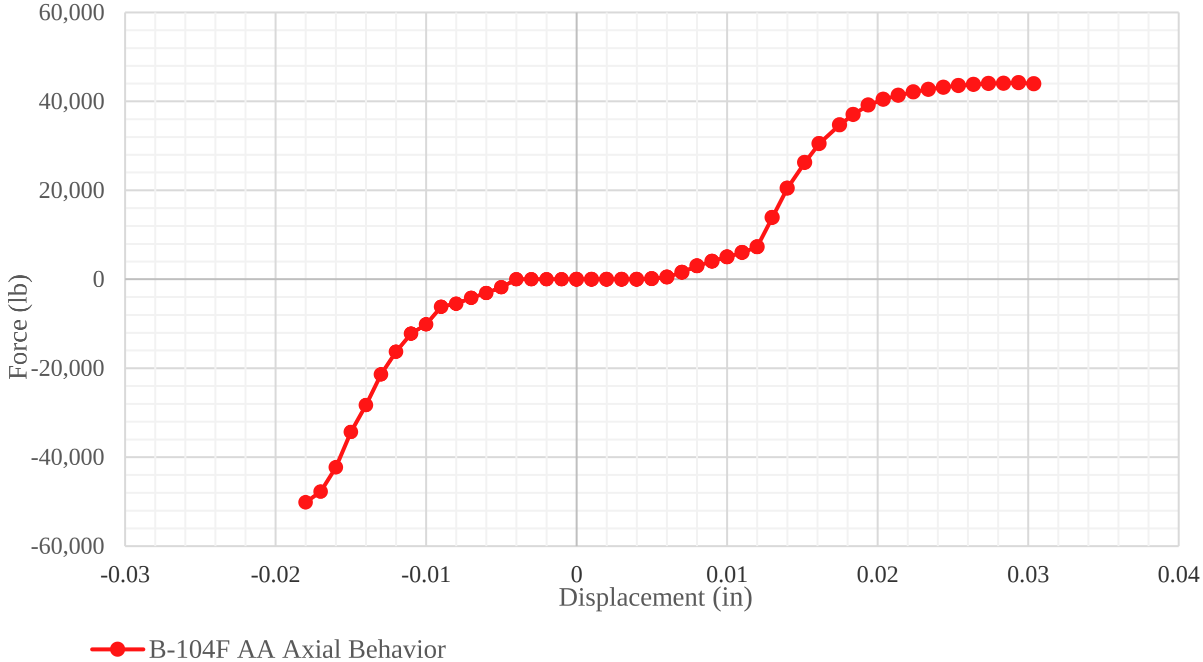


Figure L.3 Axial Semi-Rigid Behavior of B-104F AA

B-104F Representative Axial Semi-Rigid Behavior

Figure L.4 presents a value plot of the load-displacement recorded during axial semi-rigid analysis of the B-104F model until ultimate caoacity was reached. It shows the curve adjusted to the displacement's mean values (μ). **Table L.1** and **Table L.2** present statistics for the load-displacement characterization data and ultimate capacities of the B-104F model set for the tensile and compressive behavior, respectively.

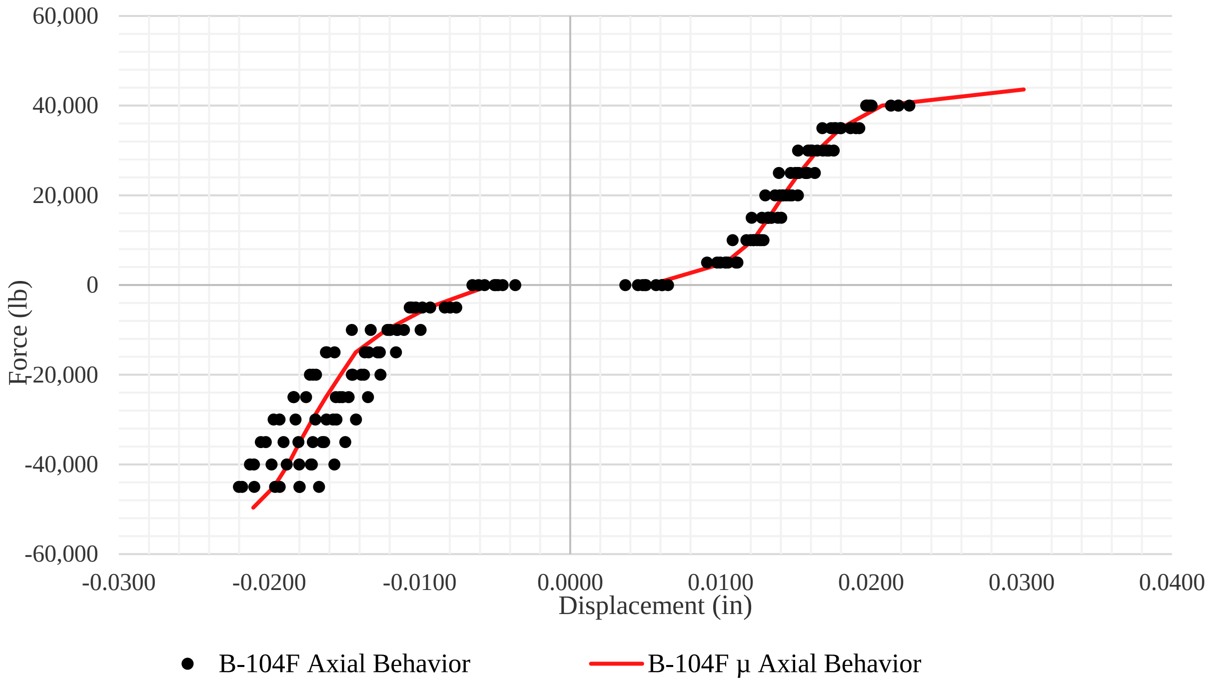


Figure L.4 Axial Semi-Rigid Behavior of B-104F Model Set

Table L.1 Tensile Load-Displacement and Capacity Summary of B-104F Model Set and Statistical Properties

		Force (lb)									Ult. Force (lb)	Ult. Disp. (in)
		0	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000		
Displacement (in)	B-AA	0.0037	0.0100	0.0124	0.0132	0.0139	0.0149	0.0160	0.0176	0.0200	43,934.80	0.0304
	B-AB	0.0050	0.0110	0.0128	0.0138	0.0147	0.0157	0.0168	0.0180	0.0199	44,719.07	0.0300
	B-AC	0.0048	0.0110	0.0126	0.0134	0.0142	0.0151	0.0161	0.0175	0.0197	44,200.57	0.0270
	B-BA	0.0050	0.0103	0.0120	0.0132	0.0144	0.0156	0.0172	0.0190	0.0218	42,786.72	0.0338
	B-BB	0.0065	0.0111	0.0127	0.0140	0.0151	0.0163	0.0175	0.0192	0.0225	43,102.34	0.0300
	B-BC	0.0061	0.0105	0.0122	0.0134	0.0146	0.0158	0.0171	0.0186	0.0218	43,055.72	0.0290
	B-CA	0.0045	0.0103	0.0122	0.0131	0.0141	0.0152	0.0164	0.0179	0.0213	43,459.06	0.0334
	B-CB	0.0061	0.0098	0.0117	0.0127	0.0136	0.0146	0.0158	0.0173	0.0198	43,897.08	0.0300
	B-CC	0.0057	0.0091	0.0108	0.0121	0.0130	0.0139	0.0151	0.0168	0.0197	43,309.49	0.0277
Statistical Data	μ	0.0053	0.0103	0.0121	0.0132	0.0142	0.0152	0.0164	0.0180	0.0207	43,607.20	0.0301
	σ	0.0009	0.0007	0.0006	0.0006	0.0006	0.0007	0.0008	0.0008	0.0011	624.75	0.0023
	COV	0.173	0.065	0.051	0.043	0.045	0.046	0.046	0.045	0.055	0.014	0.076

Table L.2 Compressive Load-Displacement and Capacity Summary of B-104F Model Set and Statistical Properties

		Force (lb)										Ult. Force (lb)	Ult. Disp. (in)
		0	-5,000	-10,000	-15,000	-20,000	-25,000	-30,000	-35,000	-40,000	-45,000		
Displacement (in)	B-AA	-0.0037	-0.0076	-0.0099	-0.0116	-0.0126	-0.0135	-0.0142	-0.0150	-0.0157	-0.0167	-50,129.08	-0.0180
	B-AB	-0.0050	-0.0080	-0.0111	-0.0127	-0.0137	-0.0156	-0.0169	-0.0181	-0.0188	-0.0196	-51,431.60	-0.0214
	B-AC	-0.0048	-0.0083	-0.0115	-0.0137	-0.0145	-0.0151	-0.0158	-0.0165	-0.0172	-0.0180	-48,864.94	-0.0190
	B-BA	-0.0050	-0.0098	-0.0121	-0.0134	-0.0145	-0.0153	-0.0162	-0.0171	-0.0180	-0.0193	-48,582.34	-0.0207
	B-BB	-0.0065	-0.0105	-0.0120	-0.0162	-0.0173	-0.0184	-0.0193	-0.0202	-0.0210	-0.0218	-48,746.59	-0.0230
	B-BC	-0.0061	-0.0101	-0.0141	-0.0161	-0.0168	-0.0175	-0.0182	-0.0189	-0.0197	-0.0208	-49,207.67	-0.0220
	B-CA	-0.0045	-0.0093	-0.0115	-0.0128	-0.0139	-0.0147	-0.0155	-0.0164	-0.0172	-0.0180	-49,672.92	-0.0195
	B-CB	-0.0061	-0.0103	-0.0133	-0.0157	-0.0171	-0.0184	-0.0197	-0.0206	-0.0213	-0.0220	-51,047.35	-0.0240
	B-CC	-0.0057	-0.0107	-0.0145	-0.0162	-0.0169	-0.0176	-0.0183	-0.0191	-0.0199	-0.0210	-49,076.62	-0.0220
Statistical Data	μ	-0.0053	-0.0094	-0.0122	-0.0143	-0.0153	-0.0162	-0.0171	-0.0180	-0.0188	-0.0197	-49,639.90	-0.0211
	σ	0.0009	0.0012	0.0015	0.0018	0.0018	0.0018	0.0019	0.0019	0.0019	0.0019	1,027.90	0.0020
	COV	0.173	0.124	0.121	0.126	0.116	0.109	0.108	0.105	0.101	0.095	0.021	0.093

The preceding results show:

- The fit gap displacement of the model set showed a high COV of 17.3%.
- From **Table L.1** the model set showed a low COV of displacement values of 4.3 - 6.5% during tensile loading. The set also showed a low COV of 1.4% for the ultimate tensile load and a low COV of 7.6% for ultimate displacement.
- From **Table L**.**2** the model set showed a COV of displacement values of 9.5 - 12.6% during compressive loading. The set showed a smaller COV of 2.1% for ultimate compressive load and a low COV of 9.3% for ultimate displacement.
- The results show that the uncertainty in the prediction of tension values is smaller than the uncertainty in the prediction of compression values.
- In this dissertation, the as-built mean value curve will be used as the bases for comparing the as-built with the as-designed behavior and load capacity.

104 Comparison (3)

Figure L.5 presents a plot of the load-displacement recorded during axial semi-rigid analysis of the D-104F and the mean value curve of the B-104F models. **Table L.3** and **Table L.4** compare the tensile load-displacement characterization data at 5,000 pound increments and the ultimate tensile capacity, respectively. **Table L.5** and **Table L.6** compare the compressive load-displacement characterization data at 5,000 pound increments and the ultimate compressive capacity.

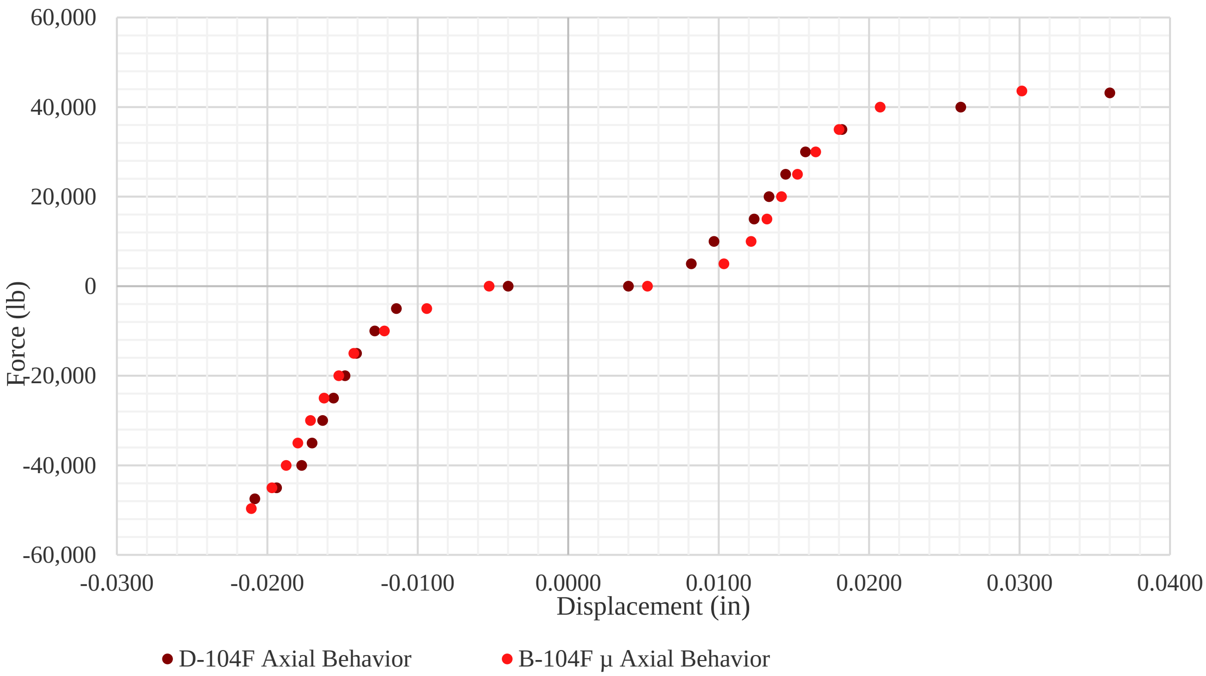


Figure L.5 Axial Semi-Rigid Behavior of D-104F & B-104F μ

Table L.3 Tensile Load-Displacement: 104 Comparison (3)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-104F	B-104F μ	D-104F vs. B-104F μ
0	0.0040	0.0053	31.52
5,000	0.0082	0.0103	26.52
10,000	0.0097	0.0121	25.46
15,000	0.0124	0.0132	6.86
20,000	0.0133	0.0142	6.21
25,000	0.0144	0.0152	5.43
30,000	0.0158	0.0164	4.26
35,000	0.0182	0.0180	-1.06
40,000	0.0261	0.0207	-20.54

Table L.4 Tensile Ultimate Load-Displacement: 104 Comparison (3)

	D-104F	B-104F μ	D-104F vs. B-104F μ (%)
Force (lb)	43,178.93	43,607.20	0.99
Disp. (in)	0.0360	0.0301	-16.26

Table L.5 Compressive Load-Displacement: 104 Comparison (3)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-104F	B-104F μ	D-104F vs. B-104F μ
0	-0.0040	-0.0053	31.52
-5,000	-0.0114	-0.0094	-17.65
-10,000	-0.0129	-0.0122	-4.98
-15,000	-0.0141	-0.0143	1.27
-20,000	-0.0148	-0.0153	2.81
-25,000	-0.0156	-0.0162	4.03
-30,000	-0.0163	-0.0171	4.93
-35,000	-0.0170	-0.0180	5.59
-40,000	-0.0177	-0.0188	5.85
-45,000	-0.0194	-0.0197	1.57

Table L.6 Compressive Ultimate Load-Displacement: 104 Comparison (3)

	D-104F	B-104F μ	D-104F vs. B-104F μ (%)
Force (lb)	-47,472.74	-49,639.90	4.57
Disp. (in)	-0.0208	-0.0211	1.12

The preceding results show:

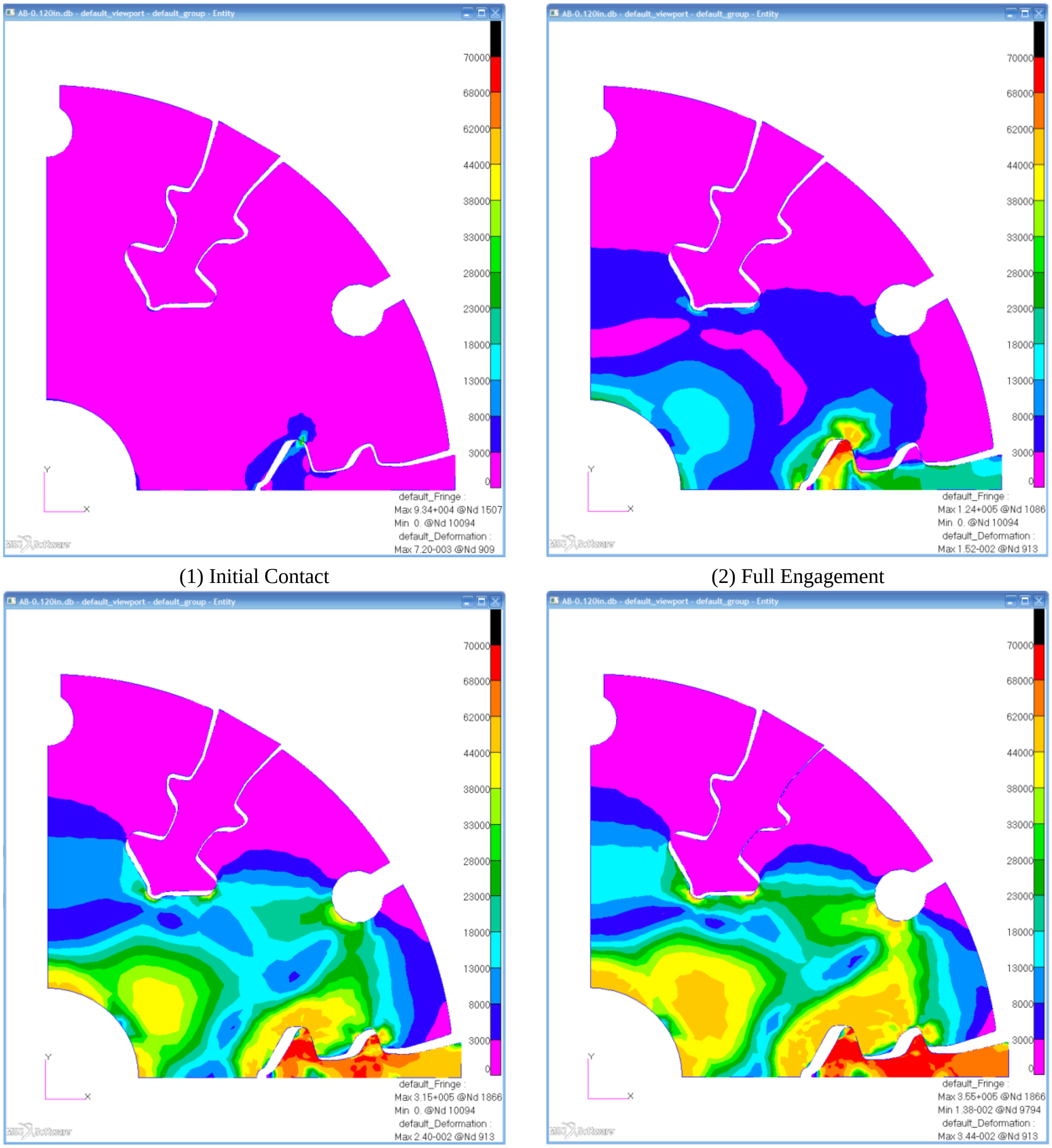
- Due to manufacturing geometric imperfections, the fit gap tolerance between the mating parts of the jointing system increased. It is observed that during initial loading there was 31.52% more displacement during the initial gap engagement of the as-built behavior in comparison to the as-designed behavior.
- **Table L.3** shows that the as-built jointing system experienced a decrease in stiffness until reaching 35,000 pounds load. At this point, the as-built and as designed jointing system behavior curves meet; from this point forward, the as-built behavior became stiffer. From **Table L.4** there was an increase of ultimate capacity of 0.99% with 16.26% less displacement as evidenced by the as-built averages.
- **Table L.5** shows that the as-built jointing system displayed an increase in stiffness of 17.5% and 4.98% during 5,000 and 10,000 pounds of compressive load, respectively. Subsequently, the model set displayed a decrease in stiffness throughout the remainder of the compressive behavior; the stiffness decayed from 1.27 - 5.85% during 15,000 - 45,000 pounds of load. From **Table L.6** there was an increment of ultimate capacity of 4.57% with 1.12% more displacement as evidenced by the as-built averageness.
- For the most part, there was a stiffness reduction during the load-deformation under tensile loading and compressive loading. However, based on the as-built averages, it can be

concluded that at larger forces there is a slight increment in stiffness during the tensile load-deformation behavior.

Appendix M

B-120 Axial Semi-Rigid Behavior Results and Conclusions

The tensile finite element simulation of the as-designed B-120F AA semi-rigid behavior is illustrated in the series of plots shown in **Figure M.1**.



(1) Initial Contact

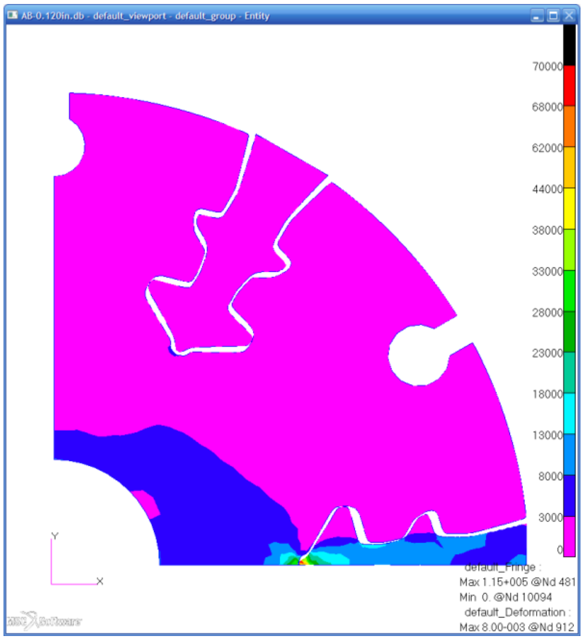
(2) Full Engagement

(3) Development of Yielding Stresses

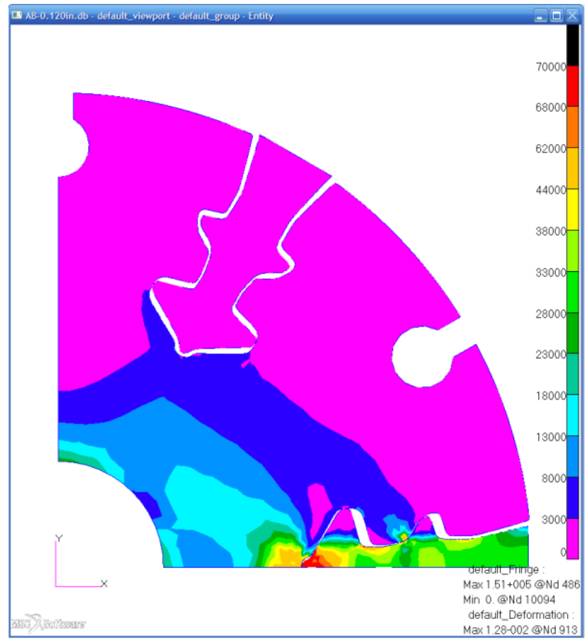
(4) Ultimate Capacity

Figure M.1 Von Mises Stress of B-120F AA under Tension from Initial Contact to Failure

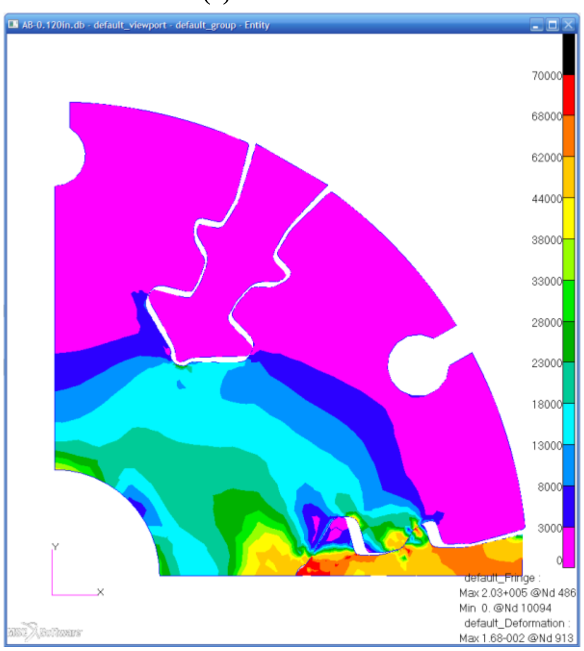
The compressive finite element simulation of the B-120F AA semi-rigid behavior is illustrated in the series of plots shown in **Figure M.2**.



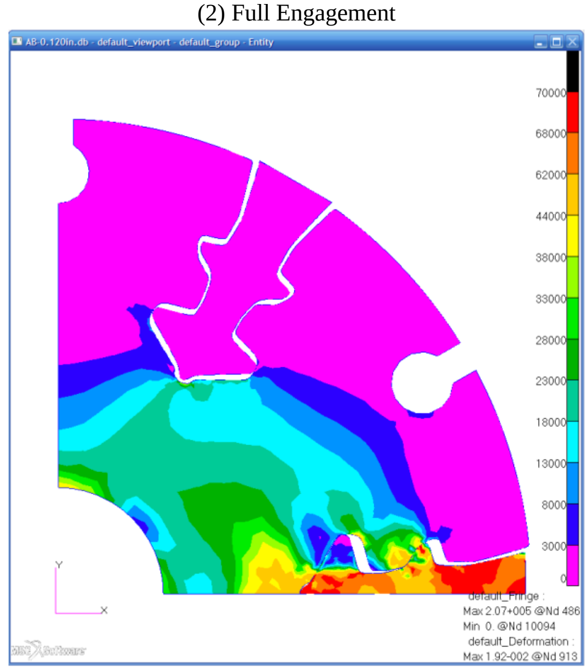
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure M.2 Von Mises Stress of B-120F AA under Compression from Initial Contact to Failure

Figure M.3 presents the axial semi-rigid behavior obtained from the B-120F AA simulation model.

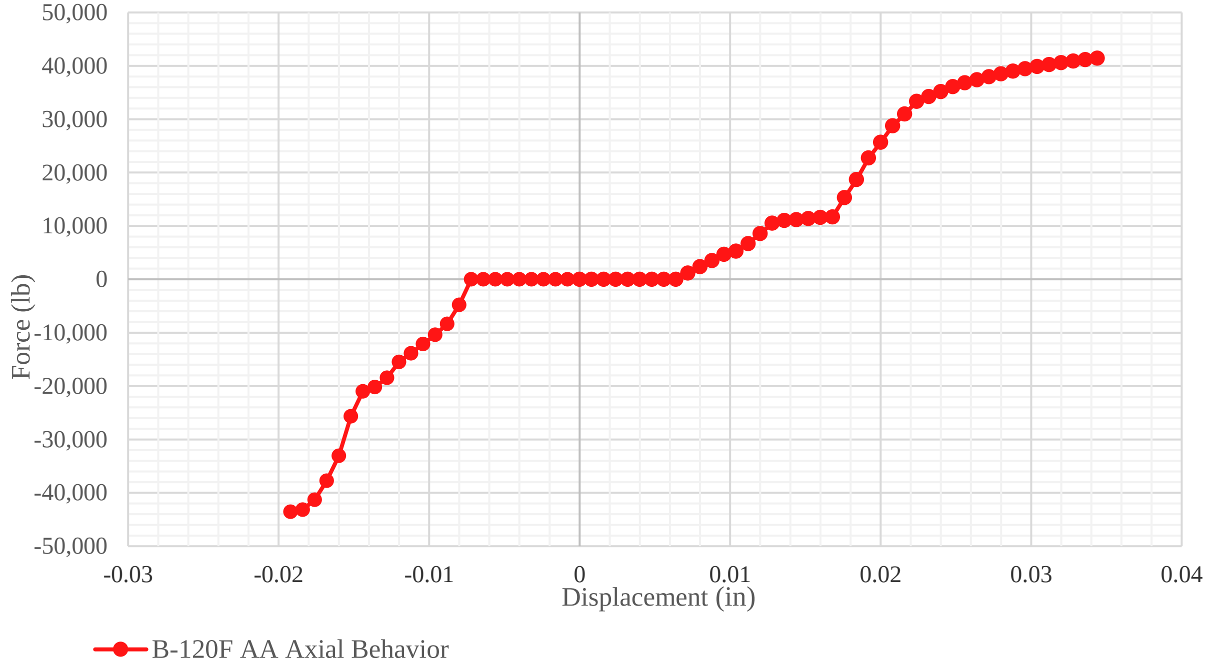


Figure M.3 Axial Semi-Rigid Behavior of B-120F AA

B-120F Representative Axial Semi-Rigid Behavior

Figure M.4 presents a value plot of the load-displacement recorded during axial semi-rigid analysis of the B-120F model until ultimate capacity was reached. It shows the curve adjusted to the displacement's mean (μ). **Table M.1** and **Table M.2** present statistics for the load-displacement characterization data and ultimate capacities of the B-120F model set for the tensile and compressive behavior, respectively.

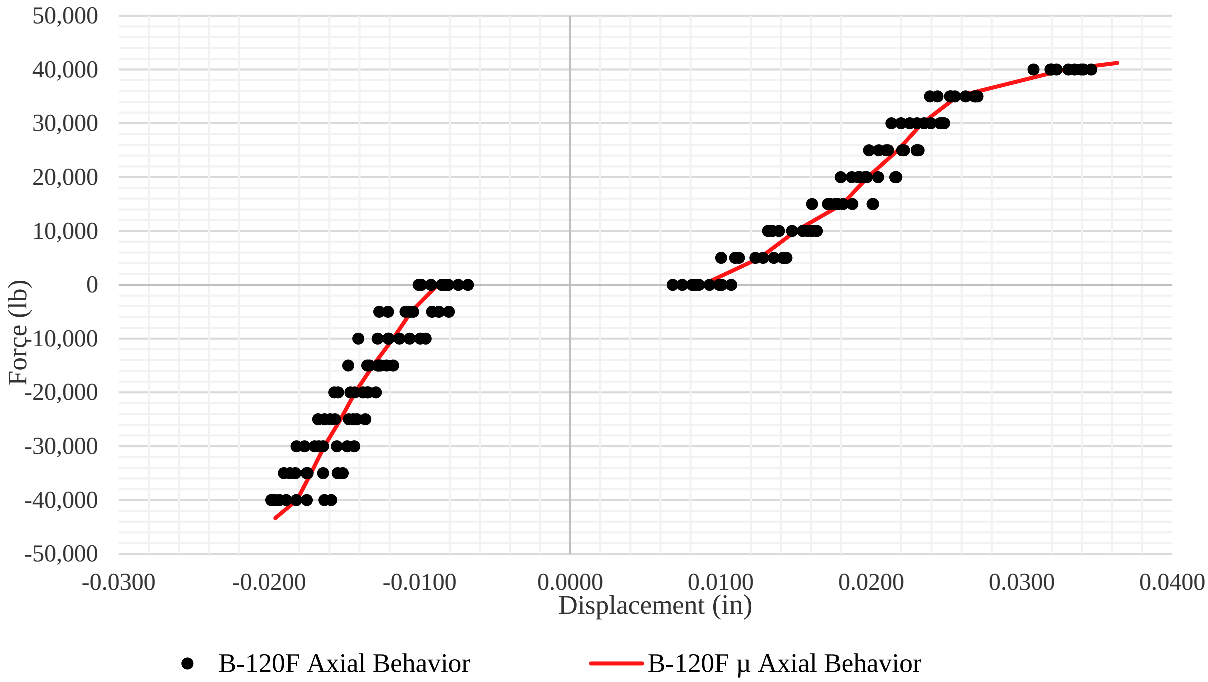


Figure M.4 Axial Semi-Rigid Behavior of B-120F Model Set

Table M.1 Tensile Load-Displacement and Capacity Summary of B-120F Model Set and Statistical Properties

		Force (lb)									Ult. Force (lb)	Ult. Disp. (in)
		0	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000		
Displacement (in)	B-AA	0.0068	0.0100	0.0131	0.0173	0.0187	0.0199	0.0213	0.0239	0.0308	41,402.92	0.0344
	B-AB	0.0083	0.0123	0.0147	0.0161	0.0180	0.0211	0.0230	0.0253	0.0331	41,494.71	0.0377
	B-AC	0.0086	0.0128	0.0164	0.0187	0.0205	0.0220	0.0235	0.0256	0.0323	41,471.28	0.0360
	B-BA	0.0081	0.0112	0.0134	0.0181	0.0196	0.0210	0.0225	0.0252	0.0320	41,184.96	0.0352
	B-BB	0.0101	0.0135	0.0161	0.0178	0.0197	0.0230	0.0248	0.0271	0.0346	40,465.06	0.0359
	B-BC	0.0107	0.0142	0.0158	0.0201	0.0217	0.0231	0.0247	0.0269	0.0335	41,386.51	0.0376
	B-CA	0.0074	0.0110	0.0139	0.0176	0.0191	0.0205	0.0220	0.0244	0.0319	41,242.11	0.0352
	B-CB	0.0093	0.0141	0.0154	0.0171	0.0192	0.0222	0.0239	0.0263	0.0339	41,232.11	0.0376
	B-CC	0.0099	0.0144	0.0161	0.0201	0.0216	0.0230	0.0246	0.0269	0.0341	41,101.19	0.0376
Statistical Data	μ	0.0088	0.0126	0.0150	0.0181	0.0198	0.0218	0.0234	0.0257	0.0329	41,220.09	0.0364
	σ	0.0013	0.0016	0.0012	0.0014	0.0013	0.0012	0.0013	0.0011	0.0013	313.39	0.0013
	COV	0.147	0.126	0.083	0.075	0.063	0.055	0.054	0.044	0.038	0.008	0.036

Table M.2 Compressive Load-Displacement and Capacity Summary of B-120F Model Set and Statistical Properties

		Force (lb)									Ult. Force (lb)	Ult. Disp. (in)
		0	-5,000	-10,000	-15,000	-20,000	-25,000	-30,000	-35,000	-40,000		
Displacement (in)	B-AA	-0.0068	-0.0081	-0.0096	-0.0118	-0.0138	-0.0147	-0.0155	-0.0164	-0.0175	-43,559.58	-0.0192
	B-AB	-0.0083	-0.0107	-0.0121	-0.0127	-0.0134	-0.0144	-0.0164	-0.0175	-0.0189	-44,728.23	-0.0206
	B-AC	-0.0086	-0.0104	-0.0114	-0.0122	-0.0129	-0.0136	-0.0143	-0.0151	-0.0159	-43,574.80	-0.0176
	B-BA	-0.0081	-0.0092	-0.0107	-0.0133	-0.0157	-0.0168	-0.0177	-0.0186	-0.0196	-42,645.64	-0.0208
	B-BB	-0.0101	-0.0127	-0.0141	-0.0148	-0.0154	-0.0163	-0.0182	-0.0190	-0.0199	-43,699.01	-0.0216
	B-BC	-0.0107	-0.0123	-0.0133	-0.0142	-0.0149	-0.0157	-0.0164	-0.0171	-0.0178	-42,461.66	-0.0184
	B-CA	-0.0074	-0.0087	-0.0100	-0.0126	-0.0146	-0.0159	-0.0167	-0.0175	-0.0182	-42,249.53	-0.0192
	B-CB	-0.0093	-0.0121	-0.0128	-0.0135	-0.0143	-0.0156	-0.0170	-0.0183	-0.0193	-43,613.55	-0.0208
	B-CC	-0.0099	-0.0109	-0.0121	-0.0128	-0.0135	-0.0142	-0.0148	-0.0155	-0.0163	-43,508.51	-0.0181
Statistical Data	μ	-0.0088	-0.0106	-0.0118	-0.0131	-0.0143	-0.0152	-0.0163	-0.0172	-0.0182	-43,337.83	-0.0196
	σ	0.0013	0.0016	0.0015	0.0009	0.0010	0.0011	0.0013	0.0014	0.0014	766.92	0.0014
	COV	0.147	0.156	0.128	0.073	0.067	0.070	0.077	0.079	0.078	0.018	0.072

The preceding result show:

- The fit gap displacement of the model set showed a high COV of 14.7%.
- From **Table M.1** the model set showed a COV of displacement value of 12.6% during the first 5,000 pounds in tensile loading. Subsequently, the COV reached lower values between 3.8 - 8.3% during 10,000 - 40,000 pounds of load. The set also showed a low COV of 0.8% for the ultimate tensile load and a low COV of 3.6% for ultimate displacement.
- From **Table M.2** the model set showed a COV of displacement values of 12.8 - 15.6% during 5,000 - 10,000 pounds of load. The COV then reached lower values between 6.7 - 7.9% during the remainder of the compressive loading. The set showed a smaller COV of 1.8% for ultimate compressive load and a low COV of 7.2% for ultimate displacement.
- The results show that the uncertainty in the prediction of tension values is smaller than the uncertainty in the prediction of compression values.
- In this dissertation, the as-built mean value curve will be used as the bases for comparing the as-built with the as-designed behavior and load capacity.

120 Comparison (3)

Figure M.5 presents a plot of the load-displacement recorded during axial semi-rigid analysis of the D-120F and the mean value curve of the B-120F models. **Table M.3** and **Table M.4** compare the tensile load-displacement characterization data at 5,000 pound increments and the ultimate tensile capacity, respectively. **Table M.5** and **Table M.6** compare the compressive load-displacement characterization data at 5,000 pound increments and the ultimate compressive capacity.

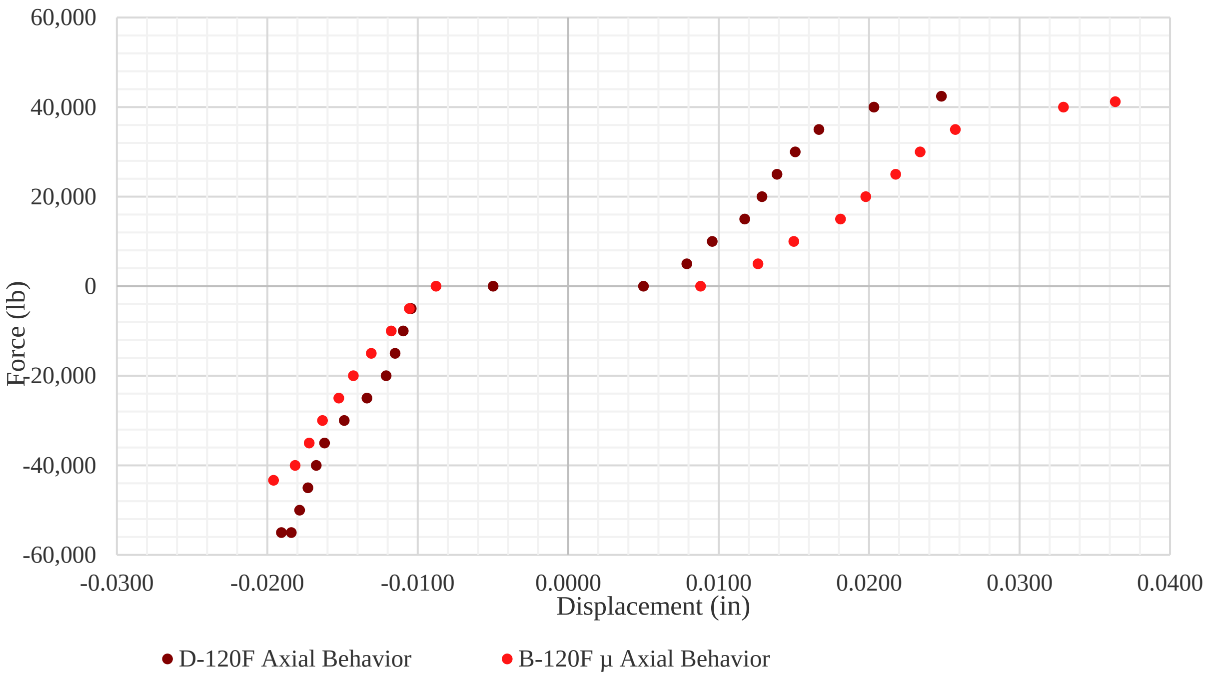


Figure M.5 Axial Semi-Rigid Behavior of D-120F & B-120F μ

Table M.3 Tensile Load-Displacement: 120 Comparison (3)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-120F	B-120F μ	D-120F vs. B-120F μ
0	0.0050	0.0088	75.80
5,000	0.0079	0.0126	60.14
10,000	0.0096	0.0150	56.67
15,000	0.0117	0.0181	54.41
20,000	0.0129	0.0198	53.59
25,000	0.0139	0.0218	56.85
30,000	0.0151	0.0234	55.00
35,000	0.0167	0.0257	54.43
40,000	0.0203	0.0329	62.05

Table M.4 Tensile Ultimate Load-Displacement: 120 Comparison (3)

	D-120F	B-120F μ	D-120F vs. B-120F μ (%)
Force (lb)	42,412.36	41,220.09	-2.81
Disp. (in)	0.0248	0.0364	46.59

Table M.5 Compressive Load-Displacement: 120 Comparison (3)

Force (lb)	Disp. (in)	Disp. (in)	Disp. (%)
	D-120F	B-120F μ	D-120F vs. B-120F μ
0	-0.0050	-0.0088	75.80
-5,000	-0.0104	-0.0106	1.25
-10,000	-0.0110	-0.0118	7.25
-15,000	-0.0115	-0.0131	13.81
-20,000	-0.0121	-0.0143	17.98
-25,000	-0.0134	-0.0152	13.91
-30,000	-0.0149	-0.0163	9.68
-35,000	-0.0162	-0.0172	6.30
-40,000	-0.0168	-0.0182	8.40
-45,000	-0.0173	-	-
-50,000	-0.0179	-	-
-55,000	-0.0184	-	-

Table M.6 Compressive Ultimate Load-Displacement: 120 Comparison (3)

	D-120F	B-120F μ	D-120F vs. B-120F μ (%)
Force (lb)	-55,015.09	-43,337.83	-21.23
Disp. (in)	-0.0191	-0.0196	2.74

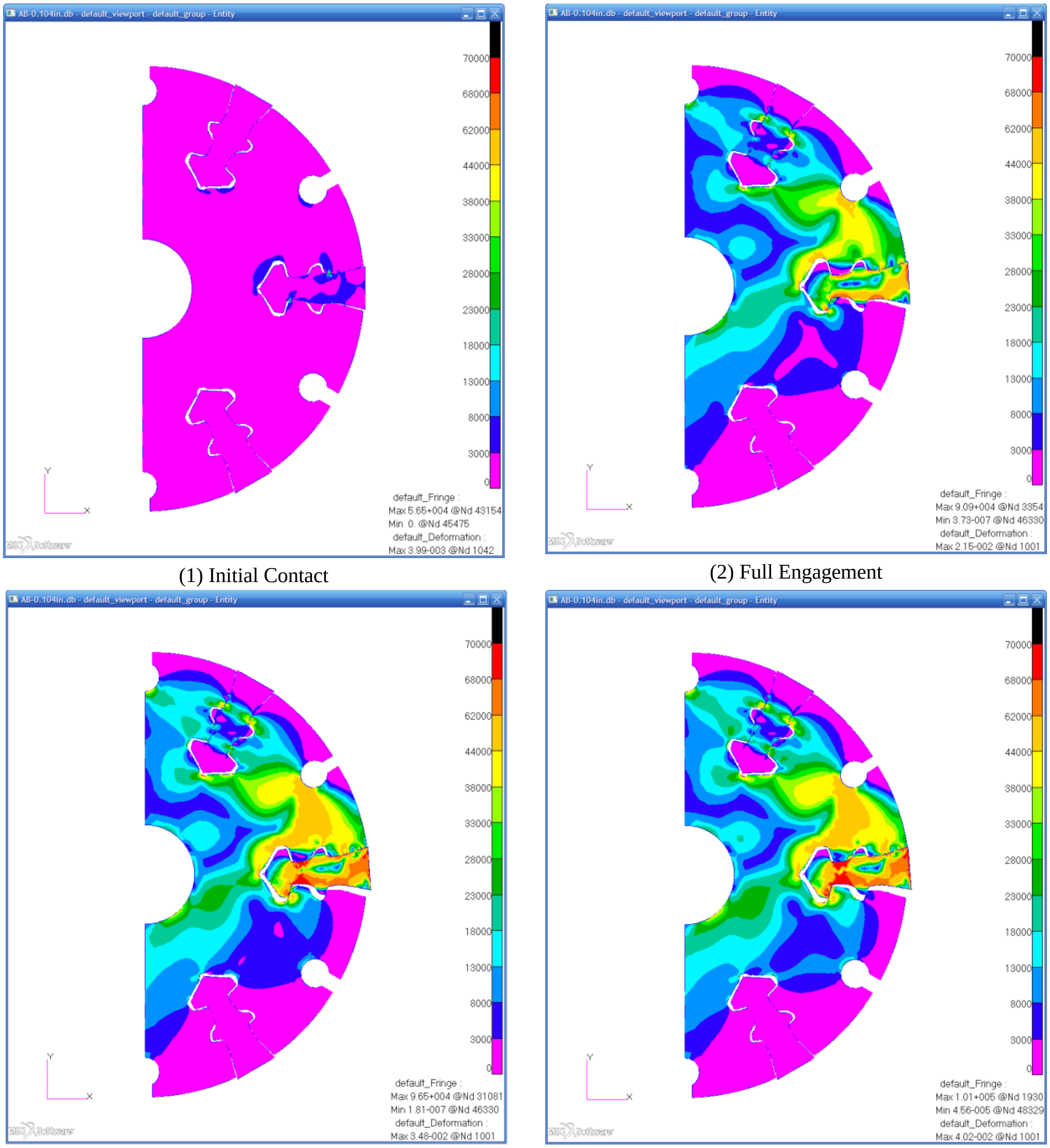
The preceding result show:

- Due to manufacturing geometric imperfections, the fit gap tolerance between the mating parts of the jointing system increased. It is observed that during initial loading there was 75.8% more displacement during the initial gap engagement of the as-built behavior in comparison to the as-designed behavior.
- **Table M.3** shows that the as-built jointing system experienced a decrease in stiffness throughout the entire tensile behavior; the stiffness decayed from 53.59 - 62.05% during 5,000 and 40,000 pounds of load. From **Table M.4** there was a reduction of ultimate capacity of 2.81% with 46.59% more displacement as evidenced by the as-built averages.
- **Table M.5** shows that the as-built jointing system displayed a decrease in stiffness throughout the entire compressive behavior; the stiffness decayed from 1.25 – 17.98% during 5,000 and 40,000 pounds of load. From **Table M.6** there was a reduction of ultimate capacity of 21.23% with 2.74% more displacement as evidenced by the as-built averages.
- On its entirety, there was a stiffness reduction during the load-deformation under tensile loading and compressive loading. Additionally, based on the as-built averages, it can be concluded that at ultimate capacity, the as-built jointing system displayed lower loading capacities with higher displacements.

Appendix N

B-104 In-Plane Semi-Rigid Behavior Results and Conclusions

The in-plane bending finite element simulation of the B-104F AA semi-rigid behavior is illustrated in the series of plots shown in **Figure N.1** .



(1) Initial Contact

(2) Full Engagement

(3) Development of Yielding Stresses

(4) Ultimate Capacity

Figure N.1 Von Mises Stress of B-104F AA under In-Plane Bending from Initial Contact to Failure

Figure N.2 presents the in-plane bending semi-rigid behavior obtained from the B-104F AA simulation model.

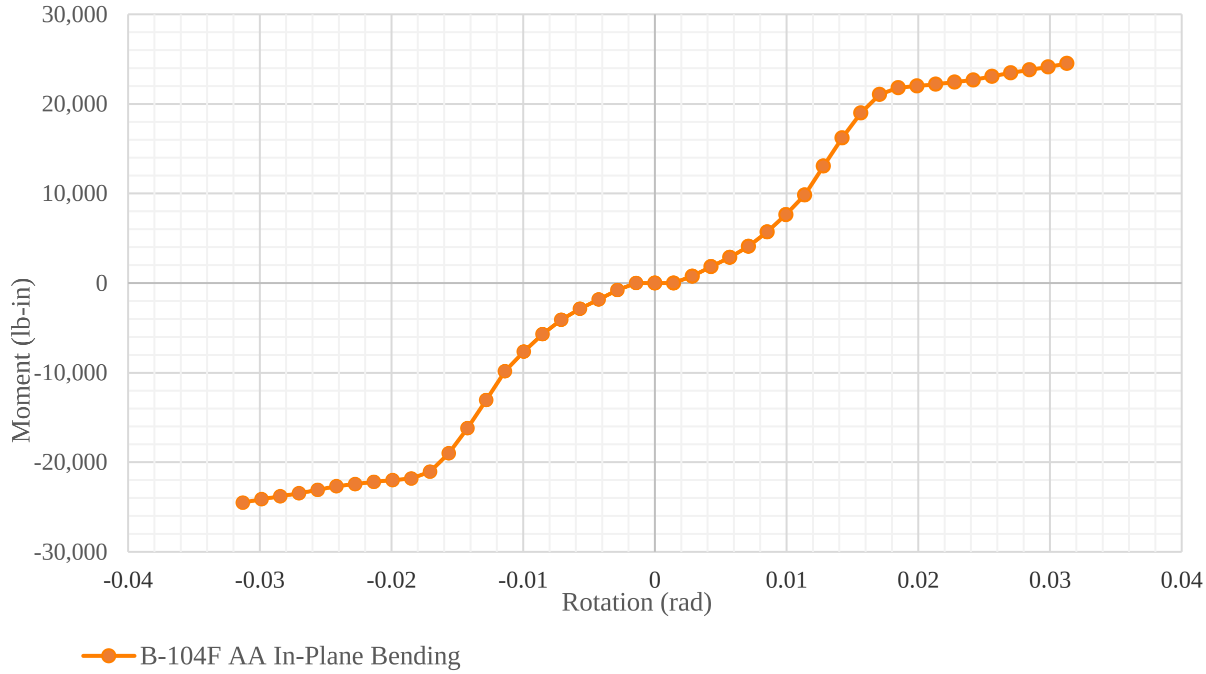


Figure N.2 In-Plane Bending Semi-Rigid Behavior of B-104F AA

B-104F Representative In-Plane Semi-Rigid Behavior

Figure N.3 presents a value plot of the moment-rotation recorded during in-plane bending semi-rigid analysis of the B-104F model until ultimate capacity was reached. It shows the curve adjusted to the rotation's mean values (μ).**Table N.1** presents the statistics for the moment-rotation characterization data and ultimate capacities of the B-104F model set for the in-plane bending behavior.

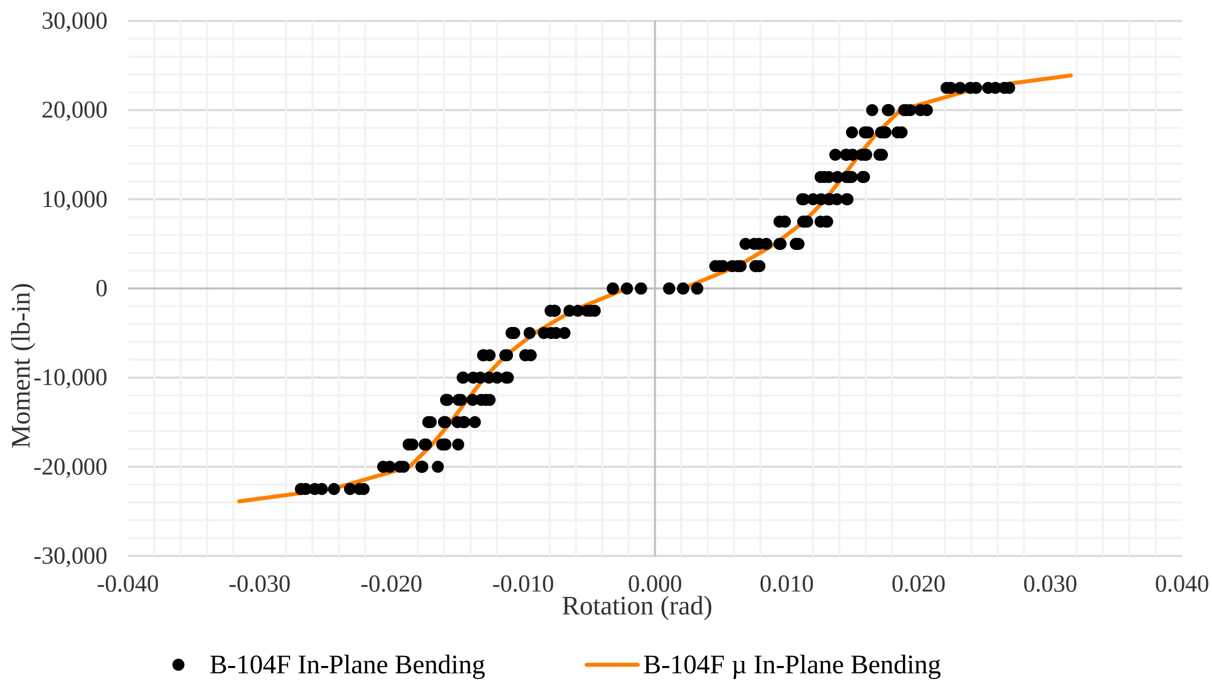


Figure N.3 In-Plane Bending Semi-Rigid Behavior of B-104F Model Set

Table N.1 In-Plane Bending Moment-Rotation and Capacity Summary of B-104F Model Set and Statistical Properties

		Moment (lb-in)										Ult. Moment (lb-in)	Ult. Rotation (rad)
		0	2,500	5,000	7,500	10,000	12,500	15,000	17,500	20,000	22,500		
Rotation (rad)	B-AA	0.0011	0.0051	0.0079	0.0098	0.0113	0.0126	0.0137	0.0149	0.0165	0.0232	24,511.32	0.0313
	B-AB	0.0011	0.0046	0.0069	0.0094	0.0112	0.0129	0.0145	0.0159	0.0177	0.0224	23,890.15	0.0309
	B-AC	0.0011	0.0049	0.0075	0.0099	0.0120	0.0132	0.0145	0.0160	0.0177	0.0221	24,319.36	0.0320
	B-BA	0.0032	0.0079	0.0107	0.0126	0.0138	0.0149	0.0160	0.0175	0.0194	0.0258	23,863.62	0.0320
	B-BB	0.0032	0.0076	0.0107	0.0130	0.0146	0.0159	0.0172	0.0187	0.0206	0.0269	23,456.45	0.0320
	B-BC	0.0032	0.0076	0.0109	0.0131	0.0145	0.0158	0.0170	0.0184	0.0201	0.0265	23,572.35	0.0320
	B-CA	0.0021	0.0065	0.0095	0.0112	0.0126	0.0138	0.0150	0.0162	0.0177	0.0244	23,934.26	0.0309
	B-CB	0.0021	0.0059	0.0084	0.0114	0.0133	0.0147	0.0159	0.0174	0.0191	0.0253	23,524.47	0.0309
	B-CC	0.0021	0.0063	0.0094	0.0115	0.0132	0.0145	0.0157	0.0172	0.0189	0.0239	23,871.73	0.0320
Statistical Data	μ	0.0021	0.0063	0.0091	0.0113	0.0129	0.0143	0.0155	0.0169	0.0186	0.0245	23,882.63	0.0316
	σ	0.0009	0.0013	0.0015	0.0014	0.0013	0.0012	0.0012	0.0012	0.0013	0.0017	352.73	0.0005
	COV	0.433	0.201	0.164	0.122	0.099	0.085	0.077	0.074	0.072	0.071	0.015	0.017

The preceding results show:

- From **Table N.1** the model set showed high COV of rotation value of 43.3% during the initial gap engagement. Subsequently, the COV rotation values decreased between 7.1 - 20.1% during the remainder of the in-plane bending behavior. The set also showed a low COV of 1.5% for the ultimate bending moment and a low COV of 1.7% for ultimate rotation.
- In this dissertation, the as-built mean value curve will be used as the bases for comparing the as-built with the as-designed behavior and moment capacity.

104 Comparison (4)

Figure N.4 presents a plot of the moment-rotation recorded during in-plane bending semi-rigid analysis of the D-104F and the mean value curve of the B-104F models. **Table N.2** and **Table N.3** compare the in-plane bending moment-rotation characterization data at 2,500 lb.-in. increments and the ultimate in-plane bending capacity, respectively.

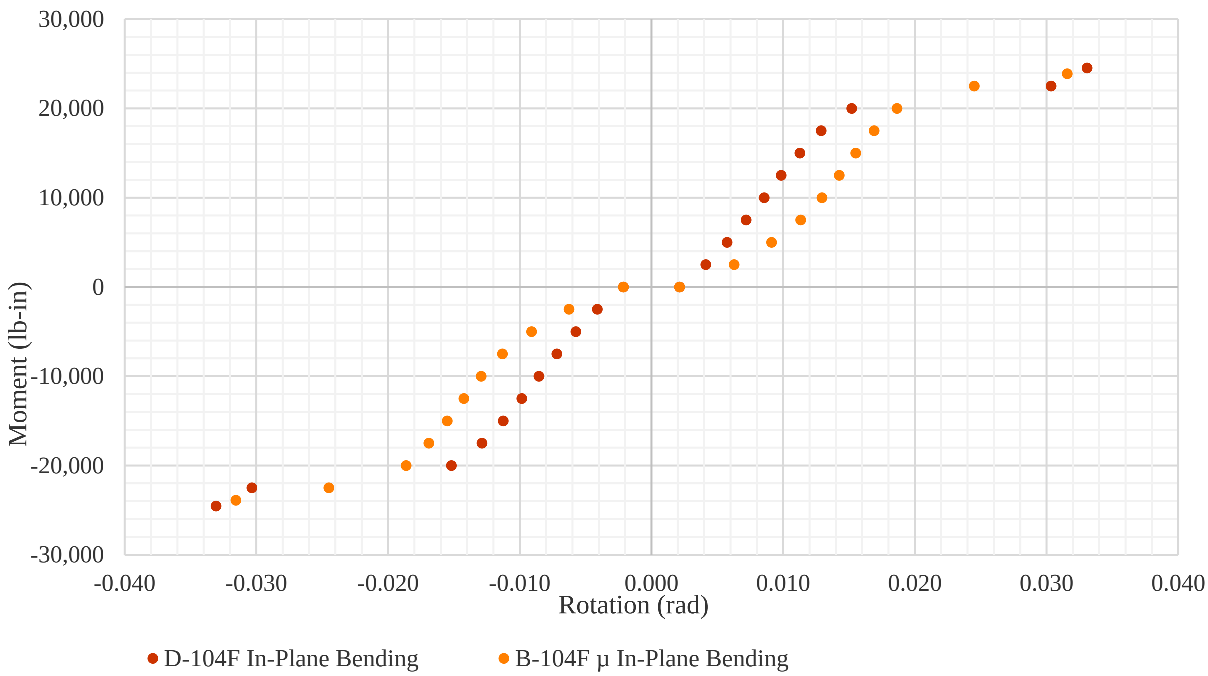


Figure N.4 In-Plane Bending Semi-Rigid Behavior of D-104F & B-104F μ

Table N.2 In-Plane Bending Moment-Rotation: 104 Comparison (4)

Moment (lb-in)	Rot. (rad)	Rot. (rad)	Rot. (%)
	D-104F	B-104F µ	D-104F vs. B-104F µ
0	0.0021	0.0021	0.00
2,500	0.0041	0.0063	52.12
5,000	0.0057	0.0091	58.74
7,500	0.0072	0.0113	57.56
10,000	0.0086	0.0129	51.33
12,500	0.0098	0.0143	44.73
15,000	0.0113	0.0155	37.72
17,500	0.0129	0.0169	31.27
20,000	0.0152	0.0186	22.62
22,500	0.0303	0.0245	-19.25

Table N.3 In-Plane Ultimate Bending Moment-Rotation: 104 Comparison (4)

	D-104F	B-104F µ	D-104F vs. B-104F µ (%)
Moment (lb-in)	24,533.98	23,882.63	-2.65
Rot. (rad)	0.0331	0.0316	-4.54

The preceding results show:

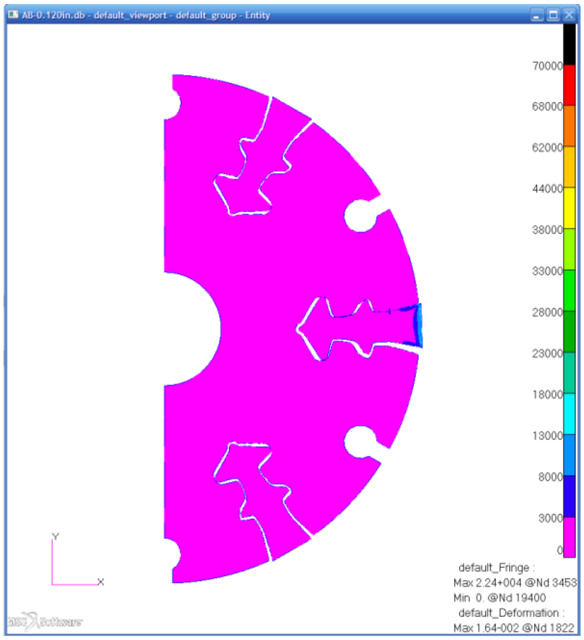
- No percentile change was noted during the initial gap rotation.
- **Table N.2** shows that beyond the initial gap rotation, the as-built jointing system experienced a decrease in stiffness until reaching a bending moment of 22,500 lb-in. At this point, the as-built and as-designed jointing system behavior curves meet: from this point forward, the as-built behavior became stiffer. From **Table N.3** there was a reduction of ultimate in-plane bending moment capacity of 2.65% with 4.54% less rotation as evidenced by the as-built averages.

- For the most part, there was a stiffness reduction during the moment-rotation under in-plane bending. However, based on the as-built averages, it can be concluded that at larger moments there is a slight increment in stiffness.

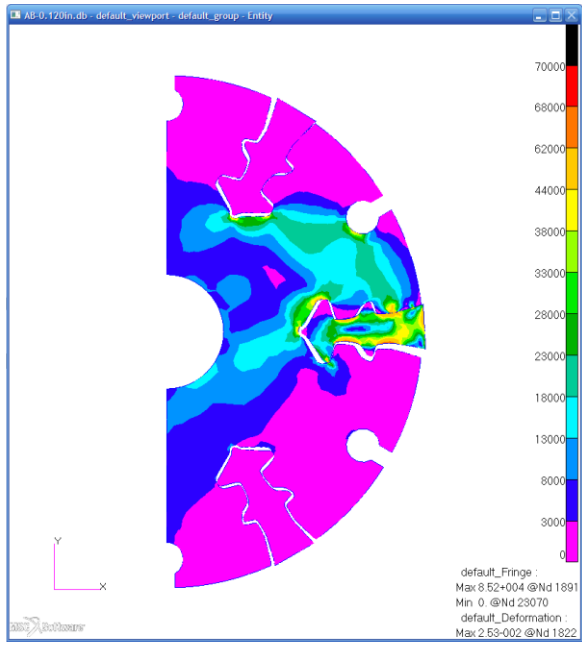
Appendix O

B-120 In-Plane Semi-Rigid Behavior Results and Conclusions

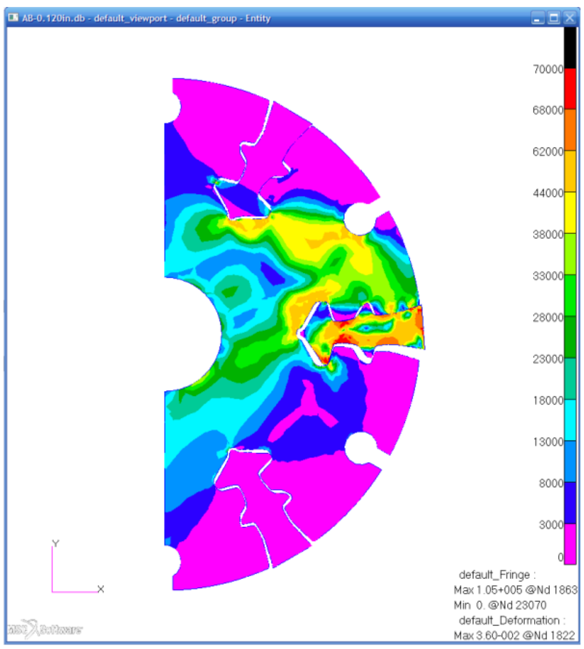
The in-plane bending finite element simulation of the B-120F AA semi-rigid behavior is illustrated in the series of plots shown in **Figure O.1**.



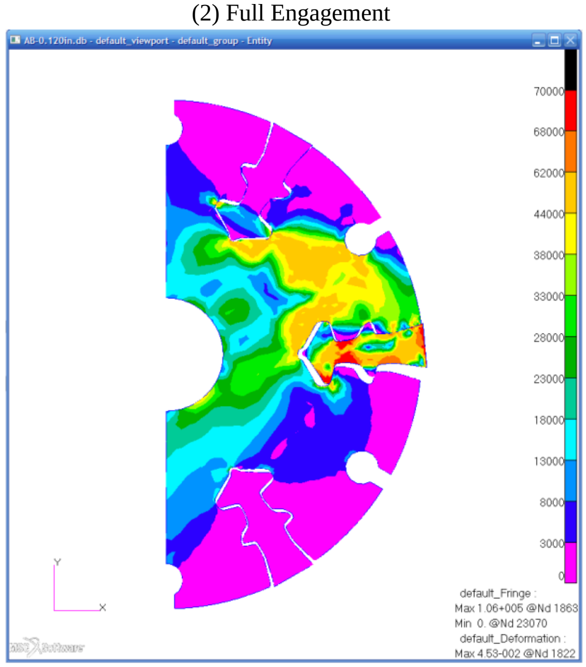
(1) Initial Contact



(2) Full Engagement



(3) Development of Yielding Stresses



(4) Ultimate Capacity

Figure O.1 Von Mises Stress of B-120F AA under In-Plane Bending from Initial Contact to Failure

Figure O.2 presents the in-plane bending semi-rigid behavior obtained from the B-120F AA simulation model.

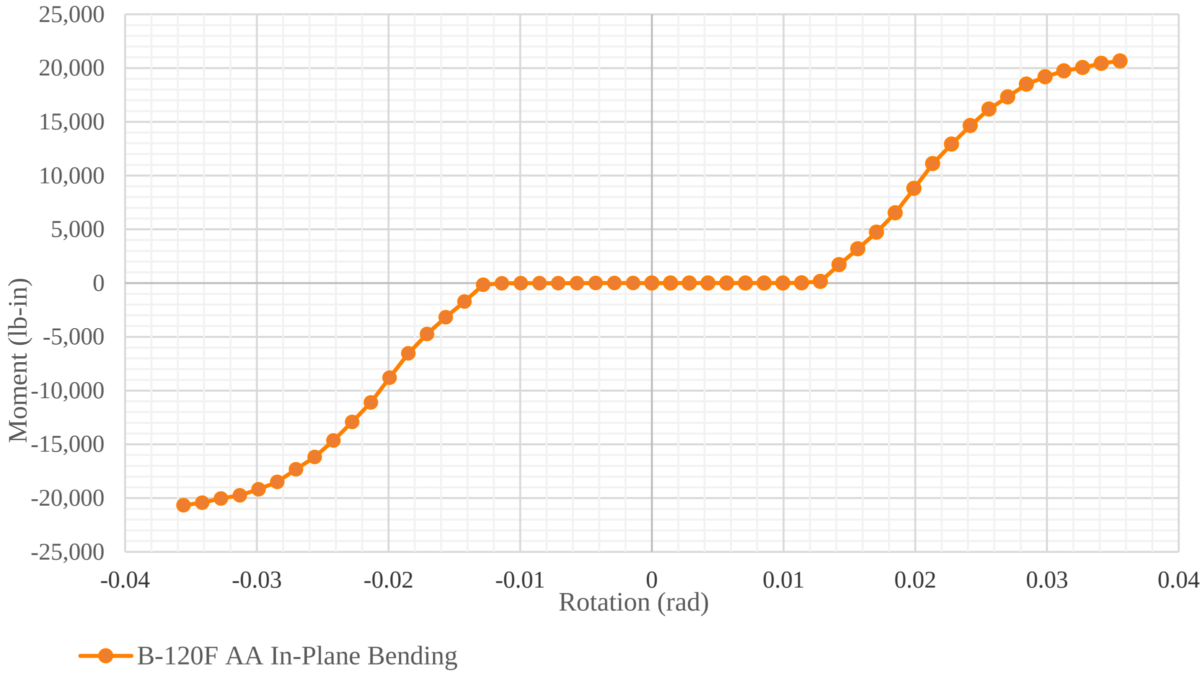


Figure O.2 In-Plane Bending Semi-Rigid Behavior of B-120F AA

B-120F Representative In-Plane Semi-Rigid Behavior

Figure O.3 presents a value plot of the moment-rotation recorded during in-plane bending semi-rigid analysis of the B-120F model until ultimate capacity was reached. It shows the curve adjusted to the rotation's mean values (μ). **Table O.1** presents the statistics for the moment-rotation characterization data and ultimate capacities of the B-120F model set for the in-plane bending behavior.

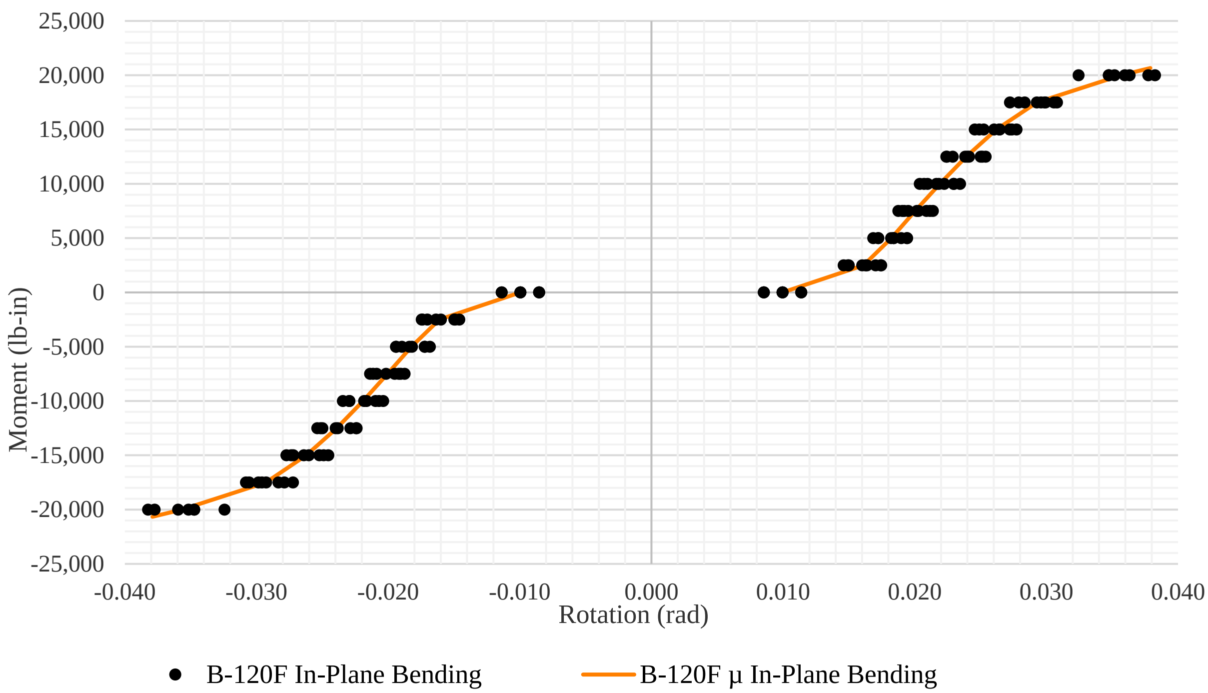


Figure O.3 In-Plane Bending Semi-Rigid Behavior of B-120F Model Set

Table O.1 In-Plane Bending Moment-Rotation and Capacity Summary of B-120F Model Set and Statistical Properties

		Moment (lb-in)									Ult. Moment (lb-in)	Ult. Rotation (rad)
		0	2,500	5,000	7,500	10,000	12,500	15,000	17,500	20,000		
Rotation (rad)	B-AA	0.0085	0.0150	0.0172	0.0190	0.0207	0.0224	0.0246	0.0272	0.0324	20,661.74	0.0356
	B-AB	0.0085	0.0146	0.0168	0.0188	0.0204	0.0224	0.0249	0.0279	0.0347	21,738.25	0.0398
	B-AC	0.0085	0.0149	0.0172	0.0192	0.0210	0.0229	0.0252	0.0283	0.0347	20,989.05	0.0384
	B-BA	0.0100	0.0175	0.0194	0.0212	0.0229	0.0250	0.0274	0.0306	-	19,855.38	0.0356
	B-BB	0.0100	0.0170	0.0190	0.0209	0.0230	0.0251	0.0272	0.0299	0.0377	20,106.41	0.0384
	B-BC	0.0100	0.0174	0.0194	0.0214	0.0234	0.0254	0.0277	0.0308	0.0382	20,336.34	0.0396
	B-CA	0.0114	0.0164	0.0184	0.0202	0.0218	0.0238	0.0260	0.0293	0.0360	21,074.88	0.0384
	B-CB	0.0114	0.0160	0.0182	0.0195	0.0216	0.0240	0.0264	0.0296	0.0352	20,459.02	0.0370
	B-CC	0.0114	0.0163	0.0184	0.0203	0.0222	0.0241	0.0265	0.0299	0.0363	20,710.68	0.0384
Statistical Data	μ	0.0100	0.0161	0.0182	0.0200	0.0219	0.0239	0.0262	0.0293	0.0357	20,659.08	0.0379
	σ	0.0012	0.0011	0.0010	0.0010	0.0011	0.0011	0.0011	0.0012	0.0018	563.98	0.0016
	COV	0.124	0.067	0.053	0.048	0.050	0.048	0.043	0.042	0.052	0.027	0.041

The preceding results show:

- From **Table O.1** the model set showed a low COV of rotation values between 4.2 - 12.4% during in-plane bending. The set also showed a smaller COV of 2.7% for the ultimate bending moment and a low COV of 4.1% for ultimate rotation.
- In this dissertation, the as-built mean value curve will be used as the bases for comparing the as-built with the as-designed behavior and moment capacity.

120 Comparison (4)

Figure O.4 presents a plot of the moment-rotation recorded during in-plane bending semi-rigid analysis of the D-104F and B-104F μ models, up to ultimate bending capacity was reached at moment increments of 2,500 lb.-in. **Table O.2** and **Table O.3** compare the in-plane bending moment-rotation characterization data at 2,500 lb.-in. increments and the ultimate in-plane bending capacity, respectively.

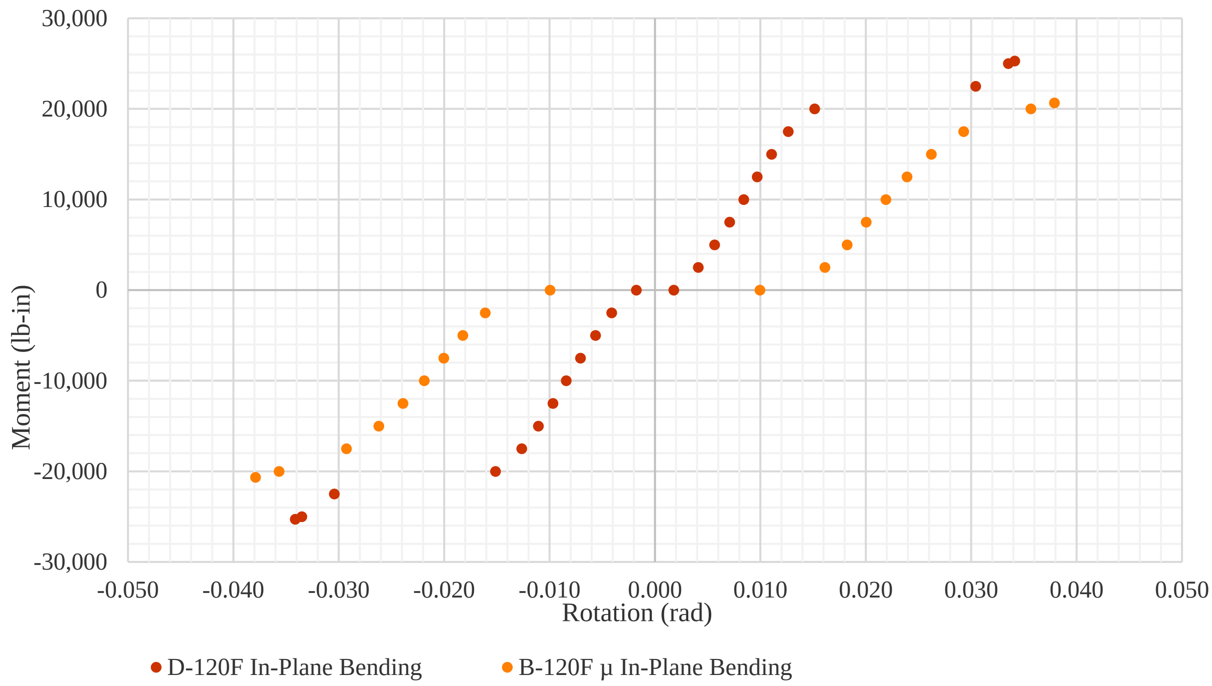


Figure O.4 In-Plane Bending Semi-Rigid Behavior of D-120F & B-120F μ

Table O.2 In-Plane Bending Moment-Rotation: 120 Comparison (4)

Moment (lb-in)	Rot. (rad)	Rot. (rad)	Rot. (%)
	D-120F	B-120F μ	D-120F vs. B-120F μ
0	0.0018	0.0100	460.00
2,500	0.0041	0.0161	292.26
5,000	0.0057	0.0182	222.45
7,500	0.0071	0.0200	183.21
10,000	0.0084	0.0219	160.05
12,500	0.0097	0.0239	146.78
15,000	0.0111	0.0262	136.91
17,500	0.0126	0.0293	131.60
20,000	0.0151	0.0357	135.54
22,500	0.0304	-	-
25,000	0.0335	-	-

Table O.3 In-Plane Ultimate Bending Moment-Rotation: 120 Comparison (4)

	D-120F	B-120F μ	D-120F vs. B-120F μ (%)
Moment (lb-in)	25,293.92	20,659.08	-18.32
Rot. (rad)	0.0341	0.0379	11.03

The preceding results show:

- Due to manufacturing geometric imperfections, the fit gap tolerance between the mating parts of the jointing system increased. From **Table O.2** it is observed that during initial loading there was 460.0% more rotation during the initial gap engagement of the as-built behavior in comparison to the as-designed behavior.
- **Table O.2** shows that the as-built jointing system experienced a decrease in stiffness between 131.60 - 292.26% during bending moments of 2,500 - 20,000 lb-in. From **Table O.3** there was a reduction of ultimate in-plane bending moment capacity of 18.32% with 11.03% more rotation as evidenced by the as-built averages.

- On its entirety, there was a stiffness reduction during the moment-rotation under in-plane bending. Additionally, based on the as-built averages, it can be concluded that the as-built jointing system displayed lower ultimate bending moment capacities with higher rotations.

Curriculum Vitae

Alfonso A. Garcia was born in El Paso, Texas on September 6, 1988. He earned his Bachelor of Science in Civil Engineering from The University of Texas at El Paso in 2012. Upon graduation, he was accepted to the NSF/S-STEM Project: Graduate Bridge to PhD Program at the University of Texas at El Paso where he earned a Master of Engineering in Civil and Environmental Engineering while pursuing his doctoral degree.

He worked as a Teaching and Research Assistant during his first years of graduate studies. In addition to his academia experience, he worked in the professional industry for two and a half years in the private sector, where he has applied his engineering knowledge while managing engineering projects in the southwestern area of the United States.

His excellence in performance allowed him to receive numerous honors and awards including: the Academic Achievement Award; the NCEES Engineering Awards for Connecting Professional Practices and Education; the National Science Foundation/S-STEM Scholarship; the Dwight David Eisenhower Transportation Fellowship: the UTEP Graduate Scholarship; and a study abroad scholarship funded by the 100K Strong in the Americas initiative, among others.

In January 2016, he presented his research studies in the Transportation Research Board Conference during the Eisenhower Innovative Doctoral Research in Washington D.C. His dissertation entitled, "Integrating Manufacturing Geometric Imperfections in the Inelastic Behavior Modeling of Joints Used in Three-Dimensional Structures" was supervised by Dr. Carlos M. Ferregut. Mr. Garcia has a current position with a private engineering company.

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