MASTERARBEIT | MASTER'S THESIS

Titel | Title

Pop-Ins and Force Overshoots in CuZr-based Metallic Glass under Nanoindentation Experiments with Cyclic Loading

verfasst von | submitted by

Georg Staska BSc

angestrebter akademischer Grad | in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien | Vienna, 2025

Studienkennzahl lt. Studienblatt | Degree programme code as it appears on the student record sheet:	UA 066 876
Studienrichtung lt. Studienblatt | Degree programme as it appears on the student record sheet:	Masterstudium Physics
Betreut von | Supervisor:	ao. Univ.-Prof. Mag. Dr. Christian Rentenberger

Abstract

Metallische Gläser (**MG**) sind eine vielversprechende Klasse struktureller Materialien, die einige interessante Eigenschaften besitzen, darunter ein hoher E-Modul, eine hohe Elastizitätsgrenze und hoher Korrosionswiderstand. Ein Nachteil ist ihre begrenzte Duktilität bei Raumtemperatur wegen lokaler Verformung und Erweichung in den Scherbändern. Trotzdem zeigen einige Studien dass Härtung in MG vorkommen kann.

Diese Masterarbeit untersucht das Verformungsverhalten, inklusive Härtung, eines $Cu_{45}Zr_{45}Al_5Ag_5$ massiven MG unter zyklischen Nanoindentierungsversuchen. Die Probe wurde durch Hochdruck-Torsion mechanisch deformiert und dadurch strukturell modifiziert (8 GPa, 20 Umdrehungen, Raumtemperatur). Härte und E-Modul der Probe wurden auf einem Querschnitt der Scheibe mit einem standard Nanoindentierungs-Protokoll (ISO 14577) gemessen um einen Überblick ihrer lokalen mechanischen Eigenschaften zu bekommen. Nanoindentierungsversuche mit zyklischer Belastung, Entlastung und Wiederbelastung um bestimmte Referenzkräfte, wurden durchgeführt um zwei Phänomene die während solchen Experimenten auftreten besser zu verstehen: Pop-Ins und Force Overshoots. Die Referenzkräfte für diese Arbeit waren Vielfache von 5 mN bis zu einer maximalen Belastung von 50 mN, die Größen der Entlastung 1 mN, 2 mN, 5 mN and 10 mN, während als Belastungs- und Entlastungsraten 1 mN/s und 0.1 mN/s verwendet wurden. Messungen mit den selben Parametern wurden in einer "weichen" und "harten" Region der Probe durchgeführt. Die Daten die durch diese Experimente gewonnen wurden, wurden mithilfe verschiedener Python Skripte verarbeitet und visualisiert. Diese Skripte waren zum Teil selbst programmiert und zum Teil vom Betreuer zur Verfügung gestellt.

Es konnte gezeigt werden, dass die Resultate bezüglich Pop-Ins und Force Overshoots unabhängig von der Temperaturdrift-Korrektur, welche den Verlauf der Kurve maßgeblich ändern kann, sind. Die Ergebnisse zu Pop-Ins und Force Overshoots können wie folgt zusammengefasst werden: Die Belastungsrate beeinflusst die Last beim ersten Pop-In entsprechend der kumulativen Häufigkeitsverteilungen. Eine erhöhte Belastungsrate verschiebt die Verteilung zu höheren Kraftwerten, ein Indiz dass die Initiation der plastischen Verformung durch Scherbänder schwieriger wird. Hohe Belastungsraten erzeugen weniger, größere Pop-ins als niedrige Belastungsraten. Die Entlastungsrate hat den umgekehrten Einfluss, mit wenigeren, größeren Pop-Ins für kleine Entlastungsraten. Für verschiedene Kombinationen aus Entlastungsrate und Entlastungsgröße, die zu derselben Entlastungsdauer führen (z.B. $1mN$ @ $0.1mN/s = 10s = 10mN$ @ $1mN/s$), verursacht die größere Entlastung mehr und größere Pop-Ins. Vergleicht man verschiedene Belastungssegmente, hängt eine höhere maximale Belastung mit einer größeren Zahl an Pop-Ins zusammen, während sich die durchschnittliche Größe der Pop-Ins verringert, aber die maximale Pop-In Größe ansteigt. Die lokale Beschaffenheit der Probe beeinflusst die Größe und Anzahl der Pop-Ins auf eine komplexe Art. Die Kräfte bei denen erste Pop-Ins und Force Overshoots auftreten scheinen nicht miteinander zusammenzuhängen. Größere Force Overshoots werden durch größere Entlastung, höhere Maximalbelastung, schnelle Belastung und langsame Entlastung bedingt, während der Einfluss der lokalen Härte vernachlässigbar erscheint. Die relative Härtung, welche durch Entlasten verursacht wird, kann aus dem Force Overshoot berechnet werden und scheint einer Potenzfunktion der Referenzkraft zu folgen. Der Grad der Härtung steigt mit der Entlastungsdauer und der berechneten Verformungsrate beim Wiederbelasten.

Abstract

Metallic glasses (**MG**) are a promising class of structural materials, exhibiting a range of interesting properties, including high Young's modulus, high elastic limit and resistance to corrosion. One drawback is their limited ductility at room temperature due to strain localization and softening in shear bands. Nevertheless, a few studies show that hardening can also occur in MGs.

This master's thesis investigates the deformation behavior, including hardening, of a $Cu_{45}Zr_{45}Al_5Ag_5$ bulk MG under cyclic nanoindentation conditions. The sample was structurally modified by mechanical deformation using high pressure torsion (8 GPa, 20 turns at room temperature). Hardness and Young's modulus of the sample were measured on the cross-section of the disc with a standard nanoindentation protocol (ISO 14577) to map its local mechanical properties. Nanoindentation experiments with cyclic loading, meaning unloading and reloading with reference to certain forces, were performed to gain insight into two phenomena occurring in such experiments: pop-ins and force overshoots. For this study the reference forces for unloading were multiples of 5 mN up to a final load of 50 mN, the unloading sizes were 1 mN, 2 mN, 5 mN and 10 mN, while the loading and unloading rates were either 1 mN/s or 0.1 mN/s. Measurements with the same parameters were also conducted both in a "softer" and "harder" region of the sample. The data recorded during all these experiments was then processed and visualized using a variety of Python scripts, partially self-coded and partially provided by the supervisor.

It could be demonstrated that the results concerning pop-ins and force overshoots are independent of thermal drift corrections, which can alter the nanoindentation curve considerably. The outcomes regarding pop-ins and force overshoots can be summarized as follows: Loading rate influences the load at first pop-in as indicated by cumulative frequency distributions. An increase in the loading rate leads to a shift of the distribution to higher loads, indicating that the initiation of plastic deformation by shear banding becomes more difficult. High loading rates produce fewer, larger pop-ins than low loading rates. The unloading rate shows the reverse effect with fewer, larger pop-ins for the low unloading rate. For different unloading rate and unloading amount combinations resulting in the same duration of unloading (e.g. $1mN$ @ $0.1mN/s = 10s = 10mN$ @ $1mN/s$), the larger unloading amount produces both more and larger pop-ins. Comparing different loading segments, a higher maximum load is related to a higher number of pop-ins, while the average pop-in size decreases and the maximum size increases. Local sample hardness influences both pop-in count and size in a complex manner. The forces at which first pop-ins and force overshoots occur do not seem to be correlated. Larger force overshoots are related to larger unloading size, larger maximum load, fast loading and slow unloading, while the influence of local hardness is mostly negligible. The relative hardening due to unloading, which can be computed from the force overshoot, seems to follow a power function of the reference force. The degree of hardening increases with the duration of unloading and the calculated strain-rate for reloading.

Contents

List of Figures

List of Tables

Acknowledgement

This section serves to acknowledge all the people in my environment who, in one way or another, helped me to complete this thesis.

In my professional circle, the person I want to thank most is my thesis supervisor, Professor Christian Rentenberger. Always helpful and ever patient, he gave me feedback, instruction and new ideas all the way from experimentation over data analysis to writing.
For their expert support in preparing the sample, be it cutting, grinding, mounting or polishing, I want to thank PhD candidate Stefan Noisternig and technical assistant Andreas Berger.
For doing work on cyclic indentation experiments that is as of yet unpublished, but foundational to my thesis and sharing algorithms and experimentally determined parameters for data analysis with me, I want to thank PhD candidate Ahmad Oweisi.

In my private circle, the person I want to thank most is my life partner Viola, who always lent an ear for me to talk about my progress, problems or next steps.
My family and both our cats were of course another source of resilience and motivation.
I also want to thank all my friends who were subjected to impromptu lectures on my thesis topic so I could see whether I could clearly and concisely explain everything.

I also want to thank everybody working on developing and maintaining the python libraries and tools used in the making of this thesis.

Last but not least I want to thank the University of Vienna, for fostering an incredible environment for learning and academic growth in its faculty of physics, and the faculty of physics for letting me use the facilities, equipment and precious time of their personnel to write my thesis.

To all those mentioned, by name or more vaguely, I want to extend my deepest gratitude.

1. Introduction

1.1. Metallic Glasses

Metallic glasses are a rather novel class of metallic materials, which differs from crystalline metals and alloys by lacking long-range[1] order and a regular lattice. However, order is still present at short and medium range. Short-range[2] or local order is the arrangement of neighboring atoms in clusters, with the exact geometry being governed by the composition of the material. Medium-range[3] order is the arrangement of these clusters in relation to each other, with disorder arising from the fact that the clusters don't perfectly tile 3D-space. [1]
This structure is referred to as amorphous and can be produced in a variety of ways, but the terms metallic glass (**MG**) or bulk[4] metallic glass (**BMG**) are commonly reserved for amorphous metallic alloys created by rapid quenching from a melt.[2] Amorphous metallic compounds produced by other means, like sputter deposition, severe plastic deformation or high energy ion irradiation, are most commonly called amorphous metals.

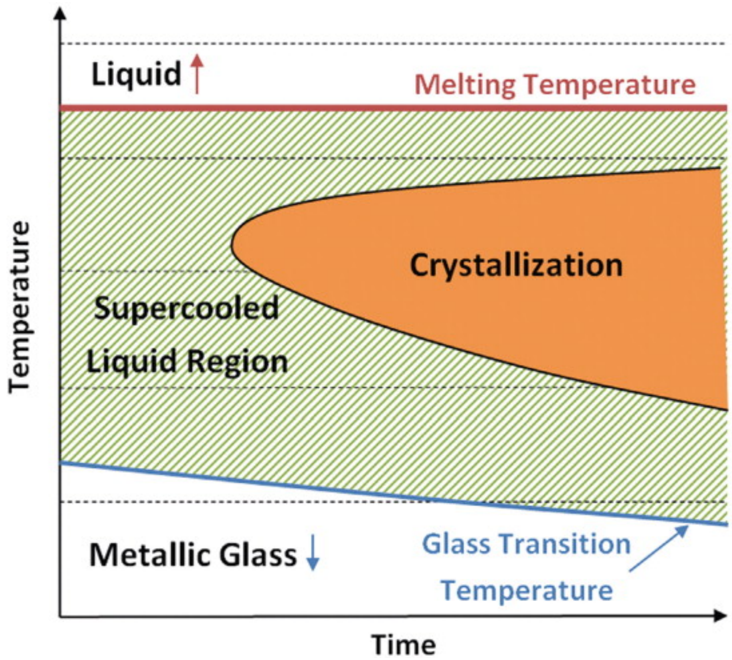


Figure 1: Example of a time temperature transformation (**TTT**) diagram.
[3, Fig. 1]

The schematic time temperature transformation (**TTT**) diagram, shown in Fig. 1, depicts how the structure after solidifying depends on the rate of cooling. To form a metallic glass the cooling rate and crystallization rate are in direct competition. The rate of crystal nucleation depends on a thermodynamic term and a kinetic term. The free energy difference between the melt and the crystal is the thermodynamic driving force of crystallization, while reduced atomic transport given by a big viscosity η inhibits it. The temperature dependence of η above the glass transition temperature is described by the Vogel-Fulcher-Tammann equation (1).[4]

$$\eta = \eta_0 * e^{\frac{B}{T-T_{VF}}} \tag{1}$$

[1] $> 100\,nm$
[2] ~ 5 Å
[3] $\sim 10 - 15$ Å
[4] Larger than $1mm$ in every direction.

In this equation η_0 is the high temperature limit of the viscosity, B is a material-specific parameter and T_{VF} is the Vogel-temperature, $\sim 50\,C^{\circ}$ below the materials' glass transition temperature.

When cooling down the melt, the free energy and the viscosity increase, with the viscosity increasing faster as T approaches the glass-transition temperature. With a sufficiently high cooling rate, the atomic arrangement in the supercooled melt gets frozen in place and crystallization is suppressed. The lowest cooling rate that can accomplish this is called the critical cooling rate (**CCR**).
The lower a compound's CCR is, the higher its glass forming ability (**GFA**). Quantifying and predicting GFA is very much an ongoing field of research, as a reliable and universal way of doing so would simplify the development of new MGs drastically. One popular and simple criterion for GFA is the reduced glass transition temperature $T_{rg} = T_g/T_l$ [5]. In the case of high T_{rg} the interval between T_l and T_g is small and the probability of being able to cool through this interval without crystallization is high.[5]
Other proposed measures are the γ-parameter proposed by Lu et al. in 2002 [6], the σ-parameter proposed by Park et al. in 2005 [7], the ϵ-parameter also proposed by Park et al. in 2015 [8] and more.

A few properties agreed to contribute to high GFA (and therefore low CCR) are [9]:

- **Multiple Components**
  More components lead to a more complex unit cell of the crystal phase. This makes crystallization less energetically favorable, reducing crystallization rate.

- **Negative Mixing Enthalpy**
  Impedes crystallization by reducing crystal nucleation rate.

- **Large Mismatch of Atomic Radii**
  A mismatch of the atomic radii of constituent atoms $> 12\%$, can reduce free volume in the melt, thereby increasing viscosity.

Using these insights, CCRs could be reduced from the order of $10^6 K/s$, for the first metallic glasses discovered in the 1960s, to $10^{-1} K/s$, for select compositions in the 2000s onwards.

A consequence of metallic glasses lacking a regular structure, is the difference in their mechanisms of deformation from their crystalline counterparts. In crystalline metals plastic deformation is controlled by defects like vacancies, dislocations and grain boundaries. The absence of these defects in metallic glasses leads to two modes of plastic deformation, depending on the temperature and strain rate.[10]

- Near the glass transition temperature, at low strain rates, MGs display uniform deformation in a viscous flow, which makes them easily moldable, even into complex shapes.

- At lower temperatures and higher strain rates, MGs deform by the formation and activation of shear bands (**SB**). SB formation occurs due to the coalescence of shear transformation zones (**STZ**), which are localized areas susceptible to atomic rearrangement under external stress. At the yield stress, multiple STZs in the direction of the maximal resolved shear stress are activated, leading to the nucleation and growth of one or multiple SBs. While the SBs themselves are only 10-200 nm wide, the volume dilation and heat generated by their friction also affect their surroundings, leading to work softening.[11][12]

[5] Where T_g is the glass transition temperature and T_l is the liquidus temperature of the alloy.

Because of these differences in structure and mechanisms of deformation, MGs have very different properties from "classical" metals[3][13], among which are:

- High Hardness
- High Strength
- High Elastic Modulus
- Resistance to Corrosion
- High Magnetic Susceptibility[6]
- High Electrical Resistance
- Good Biocompatibility
- Brittle at Room Temperature
- Highly Moldable near the Glass Transition Temperature

These properties are the reason why metallic glasses are desirable for a wide range of applications, be it in sporting goods and as aerospace or medical coatings for their high hardness and elastic modulus, transformer cores and electronic article surveillance for their high magnetic susceptibility, medical implants for their good biocompatibility or μm-scale components for their low casting shrinkage and high shape fidelity. However, for applications at room temperature the limited ductility of BMGs, due to strain localization in shear bands, is a huge drawback. One strategy to enhance ductility of BMGs is by rejuvenation processes, such as thermal cycling or mechanical deformation, which alter their atomic structure. [14] [15] Highly rejuvenated BMG can even show a tendency for strain hardening. [16]

[6] When containing ferromagnetic elements.

1.2. Research Questions

The focus of this master's thesis is to study the behavior of a metallic glass in nanoindentation experiments under cyclic loading, especially examining and analyzing the pop-ins, force overshoots and hardening of a rejuvenated CuZr-based BMG.
To do this the following research questions will be addressed:

- How suitable is the method used by Ebner et al.[14] to detect and measure pop-ins in loading segments after a load reduction?
- How are pop-in counts and sizes affected by
  - loading/unloading rate?
  - amount of load reduction?
  - reference force?
  - local hardness of the sample?
- How are the force overshoots affected by
  - loading/unloading rate?
  - amount of load reduction?
  - reference force?
  - local hardness of the sample?
- Are the size and load at which a pop-in occurs correlated?
- Is there a correlation between the occurrence of the first pop-in and force overshoot in a loading segment?
- Do unloading rate and amount of load reduction have discernibly different effects on the pop-ins and force overshoots?
- How is the hardening after reloading affected by the indentation parameters?

2. Theoretical Background

2.1. Nano-Indentation

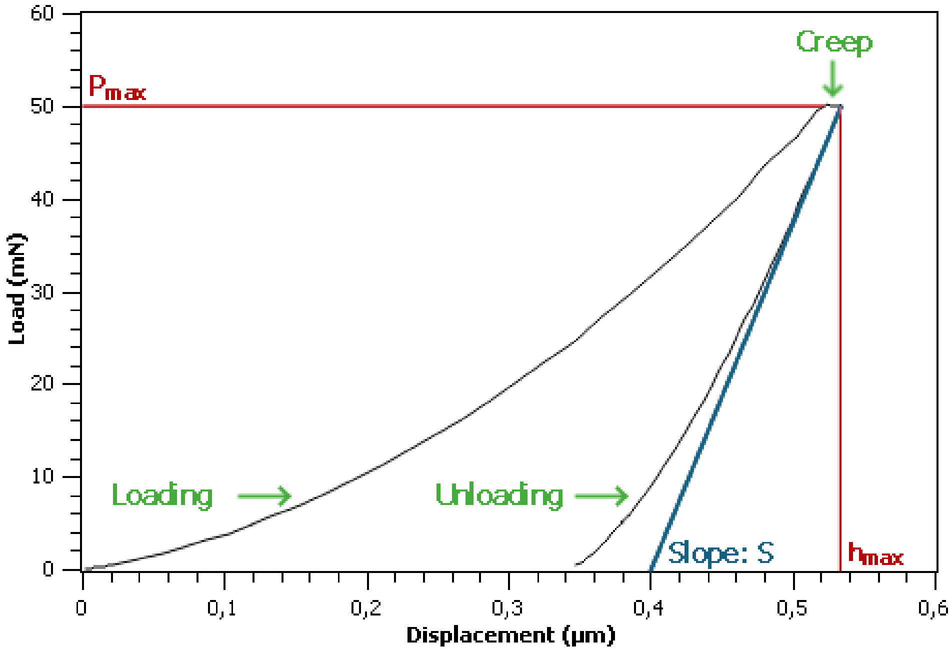


Figure 2: Annotated Example Load/Displacement curve [17, Fig. 2].

Nano-Indentation is a technique to characterize material properties while only leaving minimal markings on the samples surface. The measurement is taken by continually recording the load[7] and displacement[8] of an indenter head pressed into the material.
This data is most often presented as a Load/Displacement curve, as shown in Fig. 2.

Regular indentation experiments consist of five distinct stages:

Approach - Loading - Creep - Unloading - Hold

Approach
This first stage serves to find the sample's surface height at the location of the indent. The tip is lowered towards the expected surface height[9] with minimal speed and at high measurement frequency until the piezoelectric pressure sensor signals contact between tip and surface.

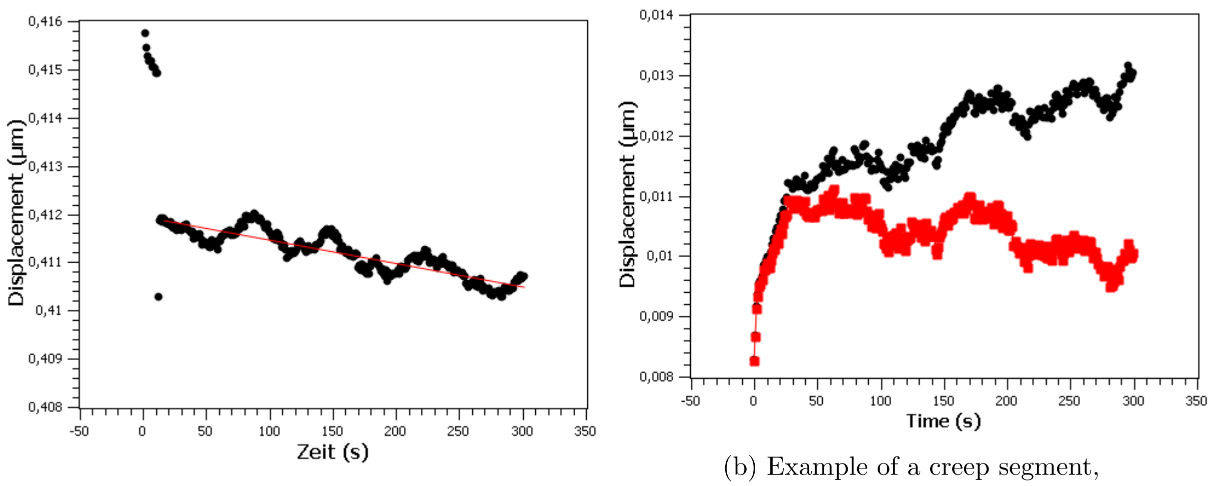
Loading
In this stage the load is increased to the maximum load P_{max} (Fig. 2). Depending on the requirements of the specific experiment the loading rate can be linear or quadratic and can vary from 0.1 mN/s to 50 mN/s.

[7] Applied force, P
[8] Penetration depth, h
[9] Either set manually or determined by an approach-only point.

Creep
The load is held constant, during which the tip sinks further into the sample (= creeps). In a Load/Displacement curve, this segment is visible as a plateau. If the creep segment is of particular interest, it can also be visualized as a Displacement/Time curve (Fig. 3b).

Unloading
During this segment the load is reduced, most often linearly and at a rate of $5mN/s$ or less.

Hold
This segment happens during unloading. The load is held constant at a low enough level so no additional creep occurs. The small variations in displacement (Fig. 3a) recorded during this segment are mostly temperature drift and sensor noise and therefore this part of the data is used to characterize them and calculate appropriate corrections. Due to the small size of these fluctuations they generally aren't visible in the Load/Displacement curve.



(a) Example Displacement/Time diagram of a hold segment, with linear fit function.

(b) Example of a creep segment, with and without temperature drift correction applied. (Black and red curve respectively.)

Figure 3: Calculating and applying temperature drift correction [17]

This raw data is then most often corrected in two ways:

Zero Point Correction
To ensure that the surface detected by the approach segment is not a false positive, data from the end of the approach segment and the beginning of the loading segment is fitted against a reference function according to Hertzian contact theory (2), where h_0 is varied to minimize the squared errrors. [18, Pages 51, 52]

$$F = C * \sqrt{(h - h_0)^3} \tag{2}$$

Temperature Drift Correction
To correct a whole range of error sources, like temperature drift and drift effects in the piezo sensors, the Displacement/Time curve of the hold phase is fitted with a linear function. The slope of this fit function (c_{drift})is then used to correct the data as shown in equation (3).

$$h_{corr} = h_{raw} - (t * c_{drift}) \tag{3}$$

This correction is most important for parts of the data where the load is kept constant for a period of time, like creep segments.

This corrected data can now be used to calculate material parameters.

Elastic Stiffness - S = dP/dh
Calculated by fitting the beginning of the unloading segment with the function[10] $P = \alpha(h-h_f)^m$ and numerically calculating the average slope in the approximately linear portion. (cf. Fig. 2) The elastic stiffness is then used to calculate the contact depth h_c and the corresponding contact area A_c of the indenter. The functional relationship between h_c and A_c is determined by calibration. [18]

Hardness - H
Calculating the hardness then becomes trivial, as seen in (4).

$$H = \frac{P_{max}}{A_c} \tag{4}$$

Young's Modulus - E
To calculate the elastic modulus, one must first calculate the effective elastic modulus E_{eff} as seen in (5)[11]

$$E_{eff} = \frac{S\sqrt{\pi}}{2\beta\sqrt{A_c}} \tag{5}$$

With E_{eff}, the Poisson's ratio of both the sample (ν) and the indenter (ν_i) and Young's modulus of the indenter (E_i), the sample's Young's modulus can be calculated.

$$E = \frac{1-\nu^2}{\frac{1}{E_{eff}} - \frac{1-\nu_i^2}{E_i}} \tag{6}$$

(Main sources for this section: [3], [18], [19])

[10] In this equation, α and m are fit parameters, while h_f is the minimum displacement.
[11] β quantifies the change in apparent stiffness caused by the indenter's geometry.

2.1.1. Cyclic Loading

In cyclic loading experiments, cycles of unloading and reloading are inserted into the indentation protocol. An unloading/reloading cycle can be characterized by its **reference force**, the force value at which unloading begins, and its **size**, the amount of unloading or force decrement.
In literature cyclic loading is frequently used with these cycles happening at the maximum indentation force to investigate a materials fatigue behaviour.
For experiments in this thesis the cycles are inserted at regular force intervals into the loading segment, which gives multiple opportunities per indent to observe pop-ins and overshoots.
Fig. 4 shows an example Load/Displacement curve of these experiments.

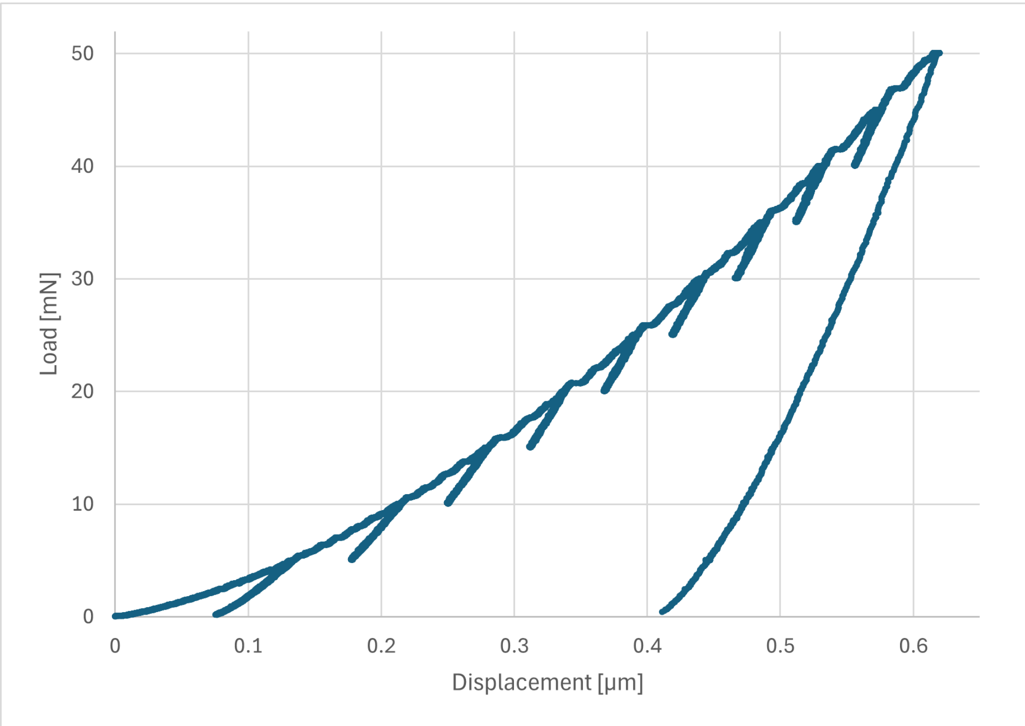


Figure 4: Example Load/Displacement curve of an indent with cyclic loading, with an unloading size of 5 mN.

2.1.2. Pop-Ins

Defined as sudden bursts of high displacement in a loading segment, pop-ins occur when the sample material suddenly gives way under the indenter.[21]
In crystalline metals pop-ins are caused by simultaneous activation of multiple dislocations.
In metallic glasses the most widely accepted mechanism is the local deformation of the sample by the formation of shear bands.
Pop-ins can be characterized by the force at which they occur and their amount of displacement.
In a Load/Displacement curve pop-ins are visible as small plateaus, with a typical displacement amount of up to 20 nm, as can be seen in Fig. 5 at 22 mN.

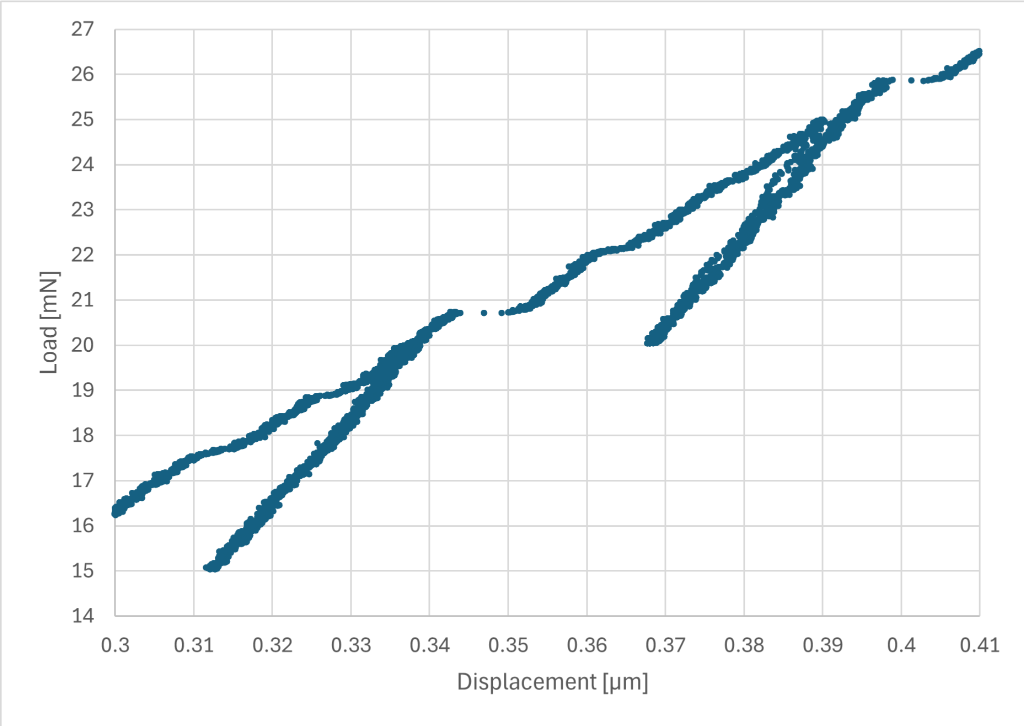


Figure 5: Detail view of the curve in Fig. 4.

2.1.3. Force Overshoots

When the load is further increased after an unloading/reloading cycle, it often keeps conforming to the reloading segment's slope well above the reference force, indicating that the deformation continues in an elastic manner. This elastic deformation above the reference force is referred to as a force overshoot. In most cases these force overshoots end with an abrupt change in the slope of the displacement curve. A good example of a force overshoot can be seen in Fig. 5 from 20 mN upwards, terminating a bit short of 21 mN in a pop-in.

2.2. Hardening in Metallic Glasses under Cyclic Loading

While metallic glasses normally display work softening, several authors showed that hardening of the material can occur after full unloading. [22]
A. Oweisi and C. Rentenberger showed an elegant way to calculate this relative hardening without knowledge of the total hardness H. [23]

$$\frac{P}{S^2} \propto \frac{H}{E_{eff}^2} \implies \frac{\Delta P}{P} = \frac{\Delta H}{H} \tag{7}$$

The proportionality of load P and hardness H [24] with the assumption of S and E_{eff} being constant for a given value of P, leads to the relative hardening $\frac{\Delta H}{H}$ being calculable as $\frac{\Delta P}{P}$ [12], as seen in (7).

[12] Where ΔP is the force overshoot and P is the reference force.

2.3. Detection of Pop-Ins

Pop-ins can be identified and quantified in multiple ways. It can be done manually, algorithmically or by utilizing deep learning.[25] Since the dataset of this master's thesis is too big for manual analysis and both deep learning and manual analysis don't have identifiable and reproducible parameters, this thesis uses the algorithm laid out by Ebner et al. in [14].
The steps of the algorithm are as follows:

- A load-displacement curve is aquired (Fig. 6a) and the square root of the load data is taken to linearize it.
- A Savitzky-Golay filter[13] is applied to both the displacement and square root of load data to smooth out the noise.
- The displacement is considered as a function of the square root of the load (Fig. 6b) and its derivative with respect to the square root of the load is taken (Fig. 6c).
  The local maxima of this derivative are potential pop-ins if their value exceeds a defined threshold. ($50\ nm/\sqrt{mN}$ for experiments in this thesis.)
- To check whether the local maxima are pop-ins, the derivatives at their n-th predecessor and successor data points are taken. This n is called the **window size**. These derivatives are then used as the slopes of linear fits through both of these points, with the difference between the fit curves at the potential pop-in (Δh) being the pop-in size (Fig. 6d). If this calculated pop-in size exceeds the **threshold value** ($0.5\ nm$ in this case.), the event is recorded as a pop-in.

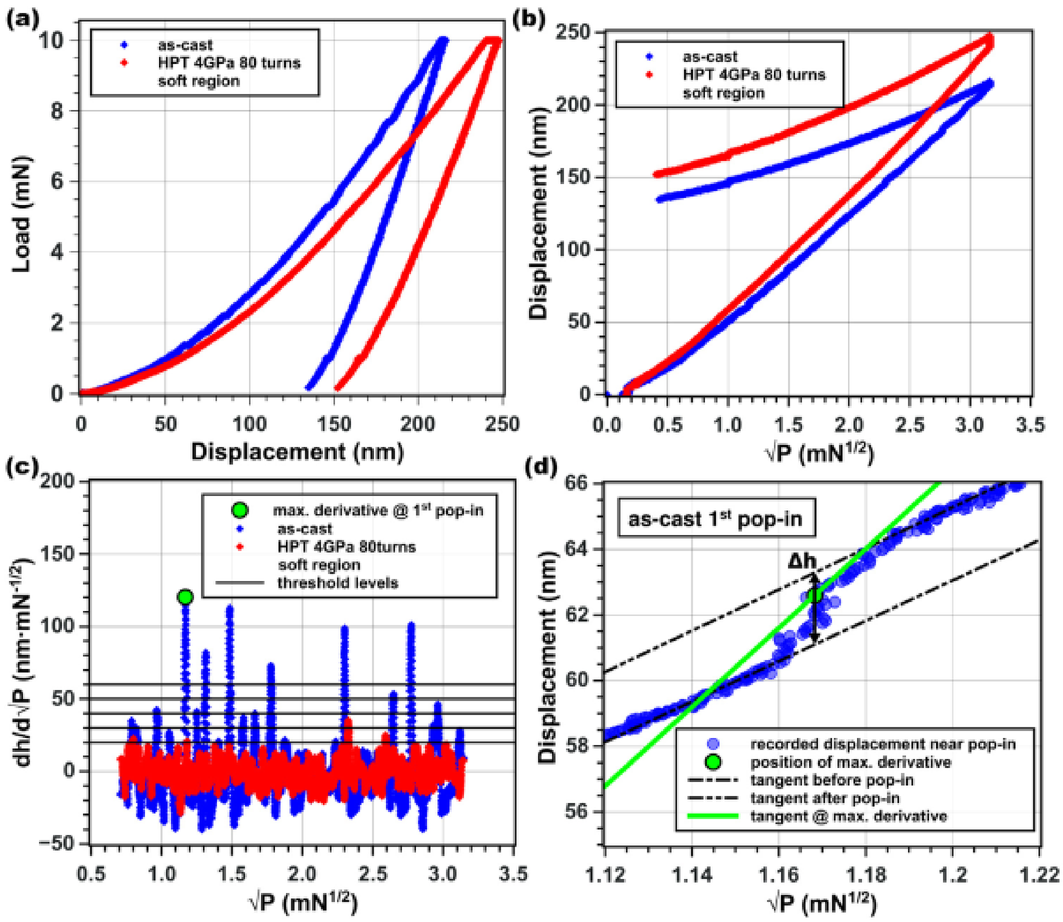


Figure 6: Visualization of Ebner et al.'s Algorithm.
[14, Reproduction of Fig. 1]

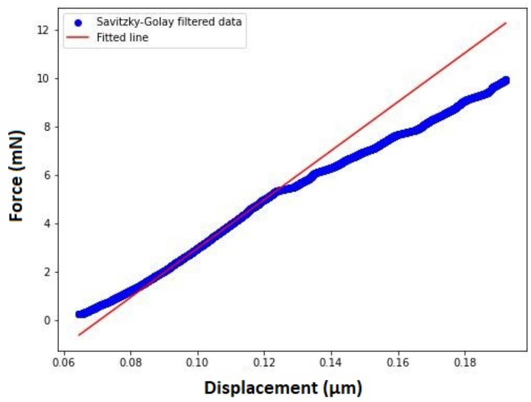
[13] See section 2.5.

Advantages of this algorithm include its ability to detect pop-ins with magnitudes similar to the noise level [14] and only relying on four parameters, the filter's window size, the derivative threshold, the window size for the pop-in detection and the threshold value for pop-ins.

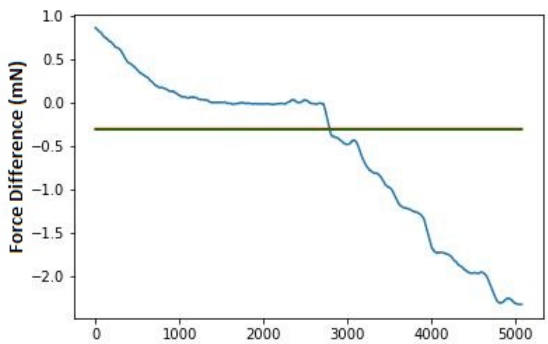
2.4. Detection of Force Overshoots

For the detection of force overshoots an algorithm created by PhD candidate Ahmad Oweisi Fordoei is used. Appropriate values for the window size for the Savitzky-Golay filter, the start index, how many data points are to be considered for the linear fit and both upper and lower limit were determined experimentally and graciously provided by him.
This algorithm acts on the Load/Displacement data as follows:

- A Savitzky-Golay filter[14] is applied to both the displacement and load.
- The first portion of a loading segment following an unloading can be non-linear, therefore all data points with an index lower than the **start index** are not considered.
- A linear fit is performed on a part of the elastic reloading segment, considering the load as a function of the displacement. (Fig. 7a)
- The projected load from this fit is then subtracted from the measured load. When this difference falls into a critical region, defined by **upper limit** and **lower limit**, the data point is considered the end of elastic deformation. (Fig. 7b)
- Finally the overshoot amount is calculated by subtracting the reference force from the measured force.



(a) Example Force/Displacement diagram of a loading segment with linear fit function.



(b) Example of curve of difference between projected and measured force for every measurement of a loading segment.

Figure 7: Visualization of force overshoot detection.

2.5. Savitzky-Golay-Filter

Savitzky-Golay filters are a type of digital filter that can be used to smooth a set of data or find its derivatives. This is done by convoluting sub-sets of the data with a low-degree polynomial by the method of linear least squares. With equal spacing of the data points, an analytical solution to the least-squares equations can be found and expressed as a set of "convolution coefficients", which can be applied to any sub-set of the data. The number of points in the sub-set is often called the **window size**.

[14]See section 2.5.

This method, developed with the motivation of easily finding extrema in experimental data curves, was published by Abraham Savitzky and Marcel J.E. Golay in *Analytical Chemistry*, along with convolution coefficients for various polynomials and window sizes, in 1964.[26]
Using this method, the convolution becomes a linear equation.

$$Y_j = \sum_{i=\frac{1-m}{2}}^{\frac{m-1}{2}} C_i y_{j+i} \quad , \quad \frac{m+1}{2} \leq j \leq n - \frac{m-1}{2} \tag{8}$$

Where:

- Y = filtered data point
- y = recorded data point
- C = convolution coefficient
- m = window size
- n = size of data set
- j= index of data point being filtered
- i = index iterating over the filtering window

As one can see from the values j can assume in (8), the first and last $\frac{m-1}{2}$ points of the data series can not be filtered without taking additional steps. This is mostly necessary when the window size is large compared to the length of the data set.
The method has been extended for 2- and 3-dimensional data and can be further adapted by changing the weighting of data points in the implicit objective function.
While the filter performs noise reduction, it also inevitably distorts the signal. Both S/N[15] improvement and signal distortion decrease with the degree of the polynomial used and increase with the window size. Therefore the choice of both these parameters is always a compromise between noise reduction and distortion. When end-effects are of little concern, multiple passes of the same filter with a small width can be a way to get large S/N increases with less distortion.
For a linear polynomial with window size m, the standard deviation of the noise σ will be decreased by a factor of $\sqrt{m}$.
Applying the convolution also affects the correlation between the data points, increasing it with each pass.

2.6. Cumulative Frequency Distribution (CFD)

To describe the distribution of a sample's first pop-ins an empirical cumulative frequency distribution is used. For this, the list of forces at which these pop-ins occur is put into ascending order and every entry is assigned a value $i * \frac{1}{n}$, where i is the entry's index[16] and n is the total number of entries. For a variable following a normal distribution (like the occurence of first pop-ins) plotting this data results in a sigmoid curve, examples for which can be seen in Fig. 8.
While the mean μ and variance σ^2 are the characteristic values for such a distribution, only μ is used to describe pop-ins and force overshoots in this thesis. This is because obtaining σ^2 requires an additional fitting process of the empirical data.

[15] Signal-to-noise ratio.
[16] Starting from 1.

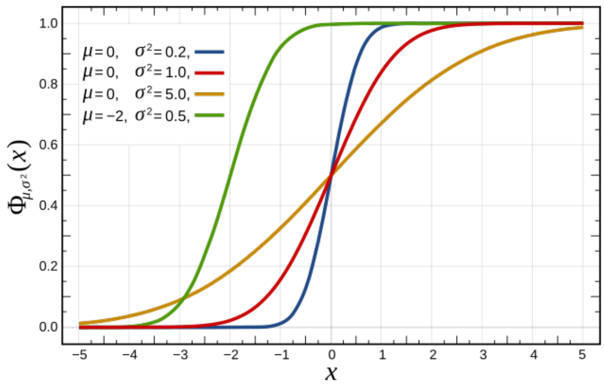


Figure 8: Examples of sigmoid cumulative distribution functions.
(Picture from the public domain.)

3. Research Methods

3.1. Sample

The sample was a cross section of a HPT treated disc of $Cu_{45}Zr_{45}Al_5Ag_5$ glass, with 8 mm diameter and 0.5 mm thickness. (Fig. 9) The disc was HPT treated with 20 turns at a pressure of 8 GPa. Then the cross section of 1 mm thickness was cut out of the disc via spark erosion. After an acetone washing to remove oxidation and residue of the dielectric fluid used in the spark erosion process, one of the cut faces was ground flat and the sample was affixed to a cylindrical sample holder, using a thermally activated mounting medium[17]. On the sample holder, the exposed cut face was ground flat and polished to ensure an even surface for the indentation experiments, with the final polishing step being a 0.1 μm particle size alumina polishing paste.

$$Sample's\ Poisson's\ ratio: \quad \nu_{sample} \ = \ 0.3722 \tag{9}$$

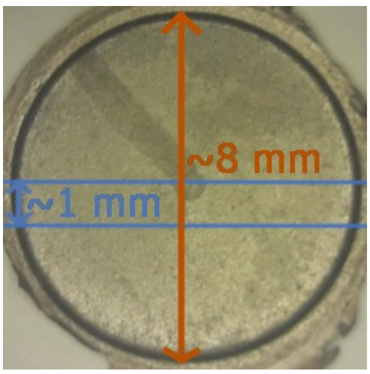
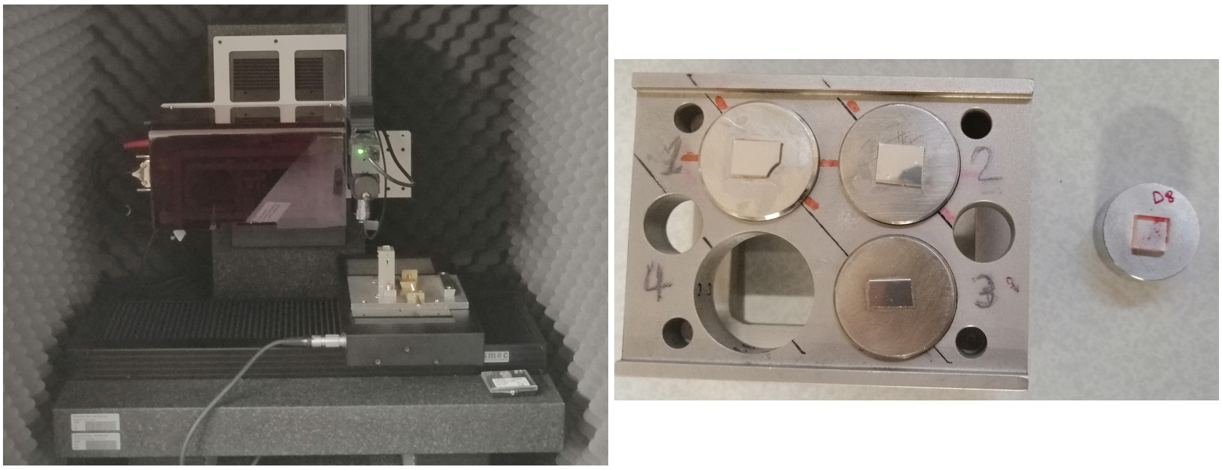


Figure 9: Photograph of the sample.
The material around the disc is
flashing from the HPT processing.

[17]Crystalbond 509

3.2. Nanoindentation



(a) Nanoindenter in its protective enclosure, with the sample sled removed.

(b) Sample sled holding up to four sample holders.

Figure 10: Photographs of the nanoindenter.

The experiments for this thesis were all done using the nanoindenter depicted in Fig. 10, a UNAT series model produced by ASMEC. It consists of a platform to fixate the sample sled, that is movable in the x and y direction, and a Z-stage housing both the indenter tip and a digital microscope, moving in the z direction. This setup, calibrated correctly for the indenter's and microscope's relative position, allows for very precise control over the position of indents and the viewing of the sample before and after the indentation process. This can be helpful in various ways, like positioning indents away from surface defects or being able to visually check up on anomalous indents. The whole instrument is situated in an airtight, noise dampening, temperature isolating housing, which rests on active vibration dampeners. The software used to control the indenter and record the data, InspectorX, is also developed and supplied by ASMEC. All measurements were conducted with two Berkovich indenter tips[18], identified as B2 and B3. While these tips were manufactured the same, with their parameters being $E_i = 1140\ GPa$ and $\nu_i = 0.070$, B2 was used for survey measurements and B3 was used for all experiments involving cyclic indentation. Their area functions, determined by calibration measurements on sapphire and fused silica, can be seen in (10) and (11).

$$A(h)_{B2} = (0.06736318 + h^{\frac{1}{4}} * (-0.5086008) + h^{\frac{1}{2}} * 3.811138 + h * (-0.7002309) + h^{\frac{3}{2}} * 3.150398)^2 \quad (10)$$

$$A(h)_{B3} = ((-0.04598705) + h^{\frac{1}{4}} * 0.5795208 + h^{\frac{1}{2}} * 1.351439 + h * 2.496455 + h^{\frac{3}{2}} * 1.312238)^2 \quad (11)$$

[18]Indenter shaped like a flat, three-sided pyramid with a half angle of 65.27°.

3.2.1. Calibration Measurements

Before and after any measurement series, a set of five indents was done on a reference surface to make sure the instrument was calibrated accurately. These measurements were conducted on a sample of fused silica (amorphous SiO_2) with the ISO 14577 [27] measurement protocol going up to 50 mN, described in Table 1.
The hardness and Young's modulus data of these small measurement series then have their average and standard deviation calculated. These results were compared to their according literature values to determine the quality of the instrument's calibration.

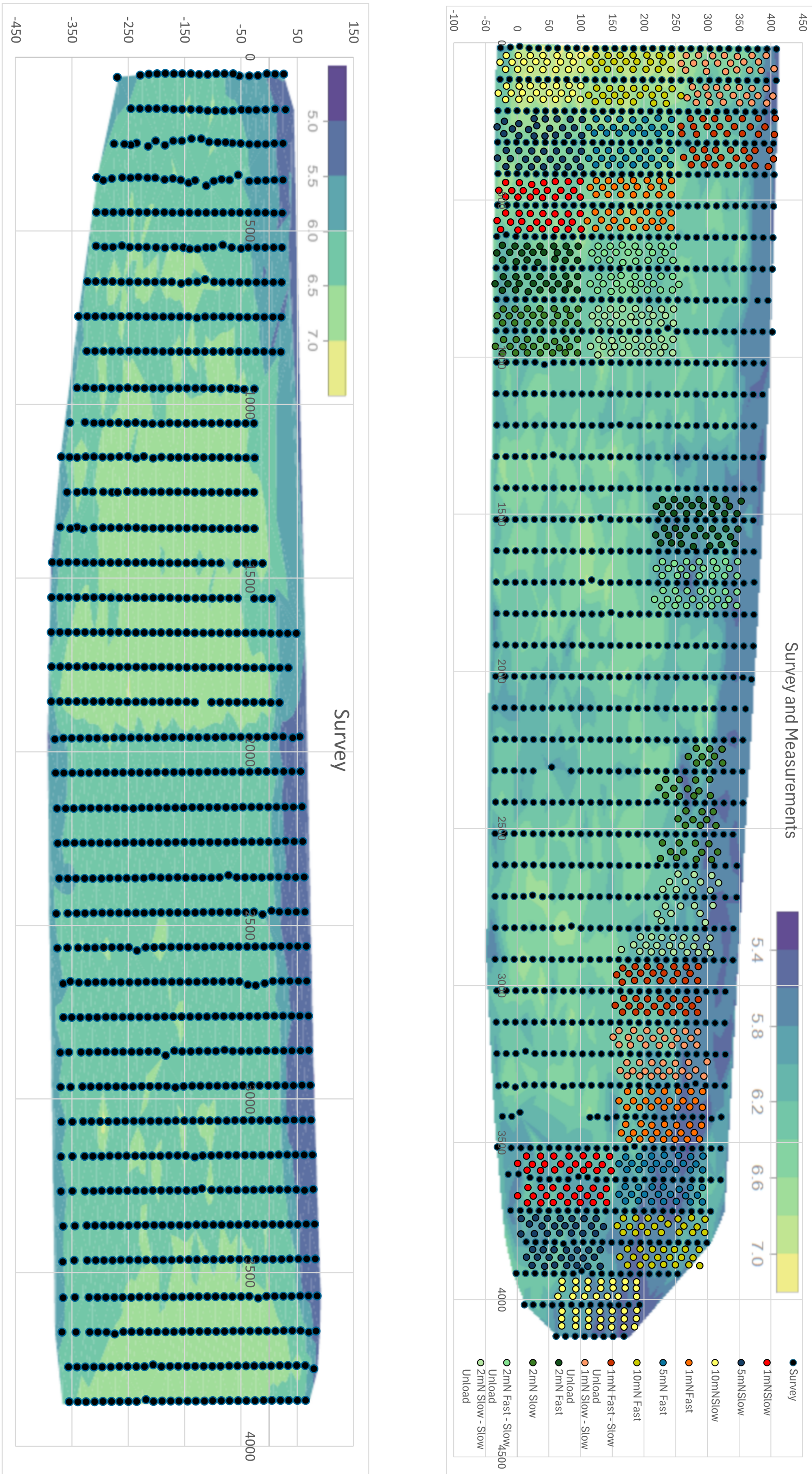
$$SiO_2\ Poisson's\ ratio: \quad \nu_{SiO_2} = 0.17 \tag{12}$$

Segment	Target Force [mN]	Time [s]	Acquisition Rate [s^{-1}]	(Un)Loading-Mode
Loading	50.0	17.0	2.765	Squared
Creep	50.0	30.0	1	-
Unloading	5.0	10.0	2.5	Linear
Hold	5.0	60.0	0.83	-
Total Unloading	0.0	3	2.5	Linear

Table 1: ISO 14577 measurement protocol

3.2.2. Survey Measurements

The first nanoindentation experiments done on the sample were survey measurements to characterize the samples surface and identify hard and soft areas. For this, the 50mN measurement protocol outlined in ISO 14577 [27], described in table 1, was used.
Indents for the survey were positioned in vertical columns roughly 100 μm radially spaced, with at least 15 μm of vertical spacing between points and every column having a dedicated approach point at its start. These columns were placed over one half of the sample, with every indent position being checked, and if necessary corrected, manually through use of the indenter's microscope. The hardness of this part of the sample is rather uniform, staying mostly in a range of 6.0 GPa − 7.0 GPa, with the exception of some thin bands towards the top and bottom edge (Fig. 11a). As this variation in hardness was too small, both in magnitude and area, to investigate the influence of hardness on pop-ins and overshoots, the other half of the sample was surveyed too. There, larger areas with a hardness below 6.0 GPa, concentrated towards the top edge and tip, were found (Fig. 11b). This led to the decision to conduct the cyclic loading indentations on the right half of the sample.



(a) Left half of the sample.

(b) Right half of the sample.

Figure 11: Composites of indent positions and contour maps of H. (Spacial measurements are given in μm.)

3.2.3. Cyclic loading measurements

Segment	Target Force [mN]	Time [s]	(Un)Loading-Mode
Cyclic Loading	50.0	Variable	Linear
Creep	50.0	30.0	-
Unloading	5.0	20.0	Linear
Hold	5.0	60.0	-
Total Unloading	0.0	3.0	Linear

Table 2: General structure of the cyclic loading measurement protocols.

Unloading Size	Loading Size	First Unloading
1 mN	6 mN	5 mN
2 mN	7 mN	5 mN
5 mN	10 mN	5 mN
10 mN	15 mN	10 mN

Table 3: Loading cycles of various unloading sizes and their first unloading.

Designation	Loading Rate	Unloading Rate	Unloading Size	Duration	Acquisition Rate
1mN/FF	1 mNs^{-1}	1 mNs^{-1}	1 mN	181 s	512 s^{-1}
1mN/FS	1 mNs^{-1}	0.1 mNs^{-1}	1 mN	262 s	512 s^{-1}
1mN/SF	0.1 mNs^{-1}	1 mNs^{-1}	1 mN	707 s	64 s^{-1}
1mN/SS	0.1 mNs^{-1}	0.1 mNs^{-1}	1 mN	788 s	64 s^{-1}
2mN/FF	1 mNs^{-1}	1 mNs^{-1}	2 mN	199 s	512 s^{-1}
2mN/FS	1 mNs^{-1}	0.1 mNs^{-1}	2 mN	361 s	512 s^{-1}
2mN/SF	0.1 mNs^{-1}	1 mNs^{-1}	2 mN	811 s	64 s^{-1}
2mN/SS	0.1 mNs^{-1}	0.1 mNs^{-1}	2 mN	973 s	64 s^{-1}
5mN/FF	1 mNs^{-1}	1 mNs^{-1}	5 mN	253 s	512 s^{-1}
5mN/SF	0.1 mNs^{-1}	1 mNs^{-1}	5 mN	1107 s	64 s^{-1}
10mN/FF	1 mNs^{-1}	1 mNs^{-1}	10 mN	323 s	512 s^{-1}
10mN/SF	0.1 mNs^{-1}	1 mNs^{-1}	10 mN	1492 s	64 s^{-1}

Table 4: Characteristic values of the measurement protocols used.

Twelve different measurement protocols were used to collect data for this thesis, while their general structure is the same (Table 2), they have varying unloading sizes (Table 3), loading and unloading rates and durations (Table 4). The designation for each measurement protocol consists of its associated **unloading size**, a slash as a separator and two letters denoting **loading rate and unloading rate**, either being F (fast, 1 mNs^{-1}), or S (slow, 0.1 mNs^{-1}).
The acquisition rate for each protocol was chosen depending on the loading rate, with 1 mNs^{-1} corresponding to 512 s^{-1} and 0.1 mNs^{-1} corresponding to 64 s^{-1}.
For each protocol, 42 indentations were performed in **a hard and a soft** area of the sample each (Fig. 11b), adding /H for hard and /S for soft to its designation.
So for instance the measurement series 2mN/FS/H is to be understood as 2 mN unloading size, 1 mNs^{-1} loading rate, 0.1 mNs^{-1} unloading rate, in a hard area of the sample.

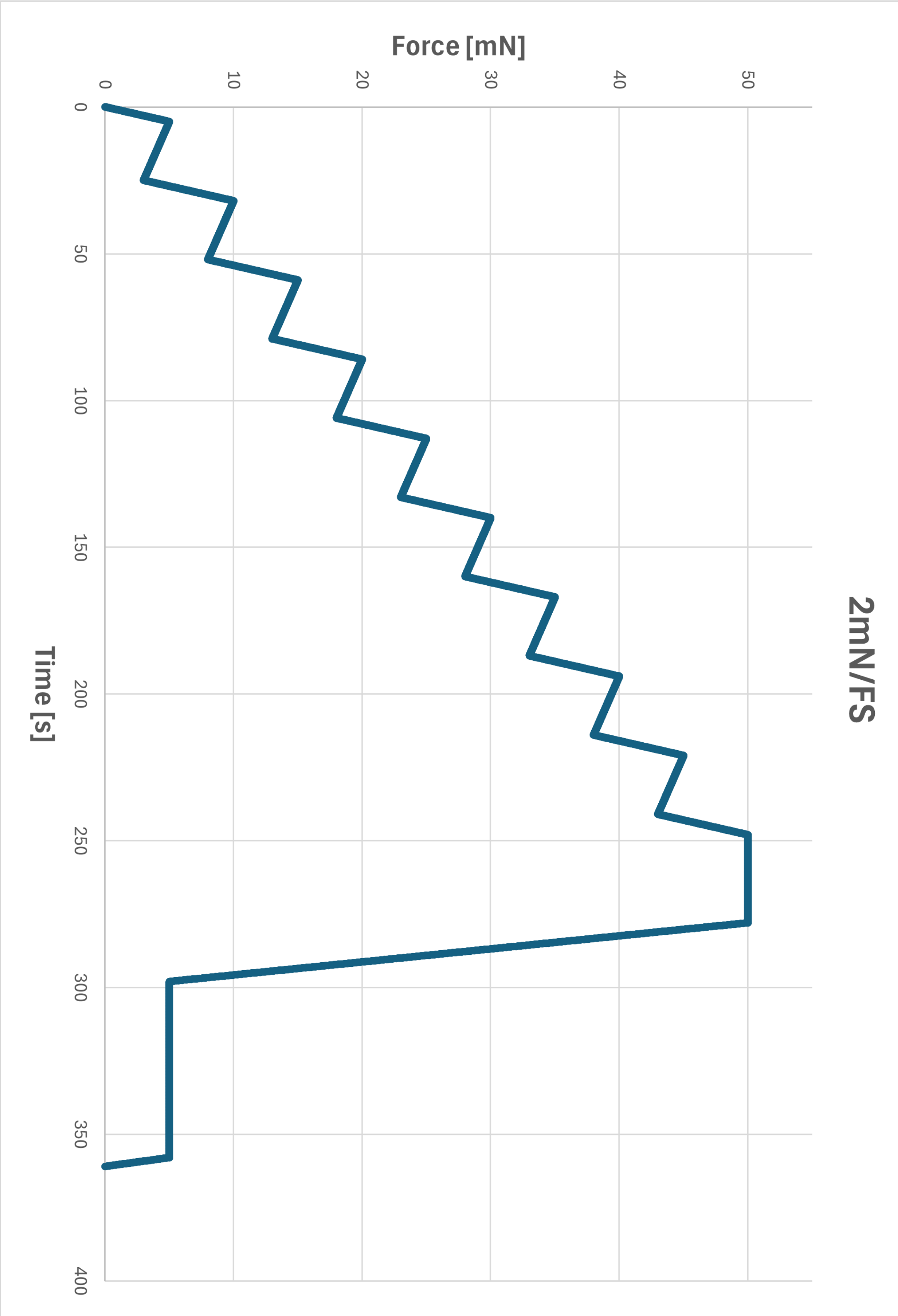


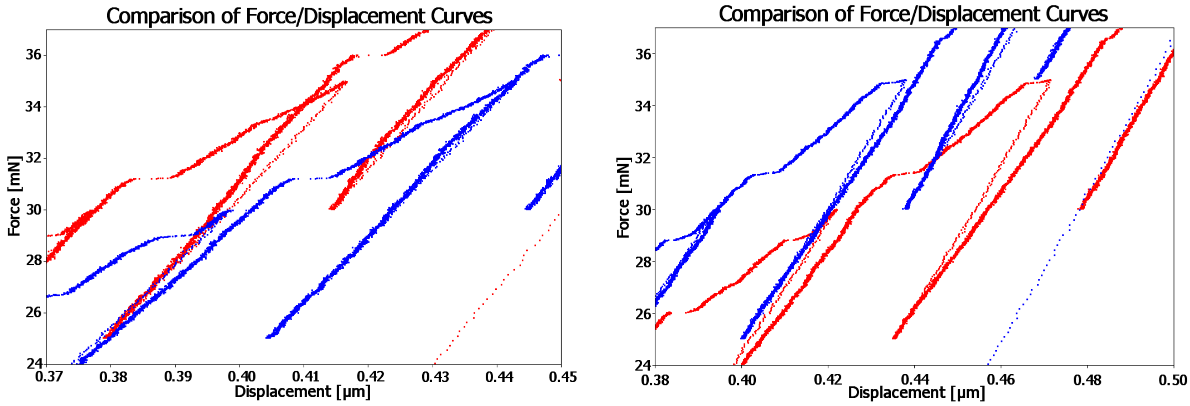
Figure 12: Example Force/Time diagram of a cyclic loading experiment.
The example experiment has an unloading size of 2 mN,
a loading rate of 1 mNs^{-1} and an unloading rate of 0.1 mNs^{-1}

Fig. 12 shows the applied force as a function of time during the 2mN/FS measurement protocol.

3.3. Data Preprocessing

3.3.1. Temperature Drift Correction

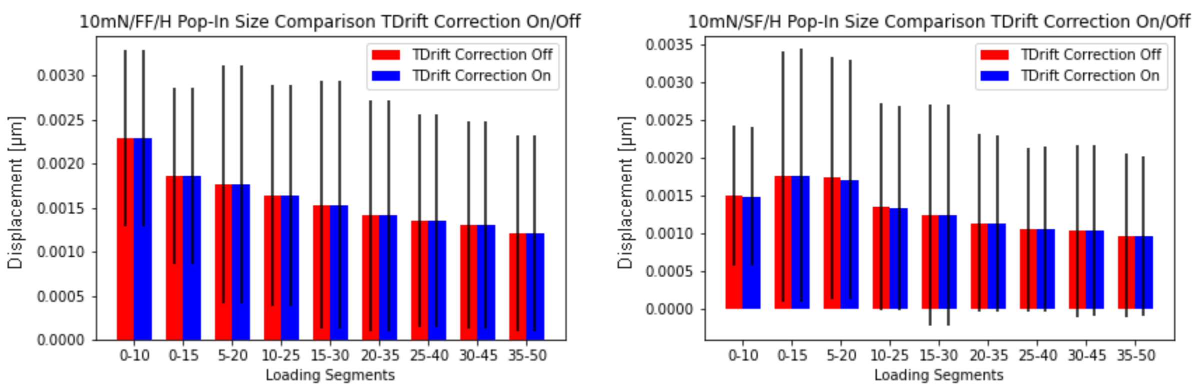
In the early stages of processing data from the measurement series taking the longest per indent, some of the Force/Displacement curves were found to exhibit artifacts, like the curve intersecting with itself (Fig. 13a) or the unloading and loading portion of a cycle displaying a large discrepancy at the reference force (Fig. 13b).



(a) Curve self-intersecting. (b) Loading cycle cleaving apart.

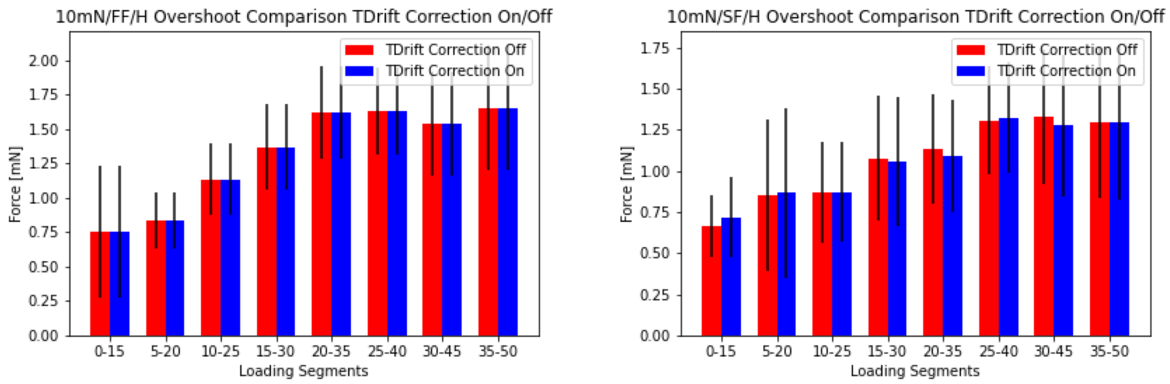
Figure 13: Examples of artifacts caused by temperature drift correction, with direct comparison between corrected (red) and raw (blue) data.

Possible causes for these artifacts are the total measurement time per indent being so much larger than the hold period that is used to calculate the temperature drift, or the cyclic loadings themselves by some, as of yet, not understood mechanism.
Due to its linear dependence on time (3), temperature drift correction is most important in portions of indentation data, where the force is either varied extremely slowly or kept constant, leading to small, gradual changes in displacement. In the case of pop-ins and force overshoots, because both occur near instantaneously and are detected by relative changes in the slope, the results based on corrected and noncorrected data should be very similar. To investigate this, a part of the analysis of the measurement series 10mN/FF and 10mN/SF was conducted on both the corrected and raw data.



(a) Comparison for 10/FF/H. (b) Comparison for 10/SF/H.

Figure 14: Comparisons between average detected pop-in sizes per loading segment, with and without temperature drift correction. The vertical bars represent the standard deviation.



(a) Comparison for 10/FF/H.

(b) Comparison for 10/SF/H.

Figure 15: Comparisons between average detected relative overshoot sizes per loading segment, with and without temperature drift correction. The vertical bars represent the standard deviation.

Selected results of this are visualized in Fig. 14 and Fig. 15, with the comparisons with fast loading showing virtually no difference and the comparisons with slow loading showing differences $< 5\%$. All other categories of comparison[19] showed the same result.
Therefore, and to keep the data comparable between measurement protocols, it was decided to analyze all data without temperature drift correction.

3.3.2. Pop-In Size Threshold

The noise level was examined to find a minimum size threshold for the pop-ins. Considering the curves in Fig. 16 representative, resulted in a conservatively estimated noise magnitude of $\pm 2.5\ nm$ for a time resolution of $512\ s^{-1}$ and $\pm 1.2\ nm$ for a time resolution of $64\ s^{-1}$. As the Savitzky-Golay filter reduces noise by a factor of $\sim \sqrt{m}$ and the window sizes used at those data rates were $m = 91$ and $m = 61$ respectively, reducing noise by factors ~ 9.5 and ~ 7.8, a size threshold of $0.5\ nm$ was chosen. Although this is significantly larger than our estimated effective noise, it is not really reasonable to consider displacement shifts smaller than this threshold.

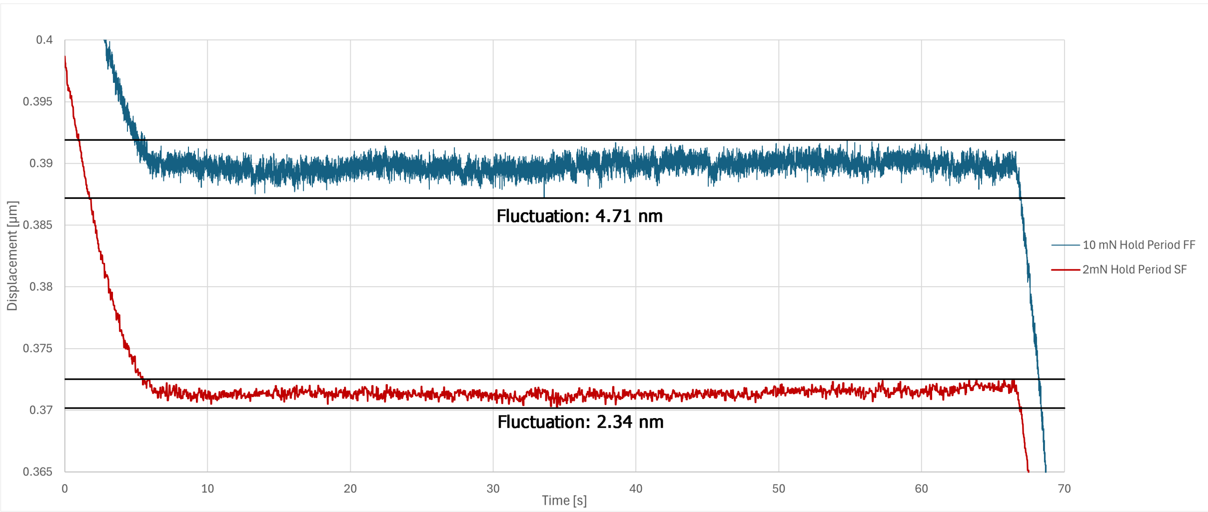


Figure 16: Example hold periods with different time resolutions. $64\ s^{-1}$ for 2mN/SF and $512\ s^{-1}$ for 10mN/FF.

[19]First pop-in size and occurrence, pop-in occurrence, overshoot occurrence and hardening.

3.4. Data Processing

Processing the data was done in multiple steps, which are outlined in Fig. 17 and further described in the list following it. All scripts used were written in Python 3. Except stated otherwise, reading and writing data was done using the libraries openpyxl for .xlsx files, xlrd and xlwt for .xls files and csv for .csv files, calculations were done with the scipy and numpy libraries and data visualisations were created utilizing matplotlib.

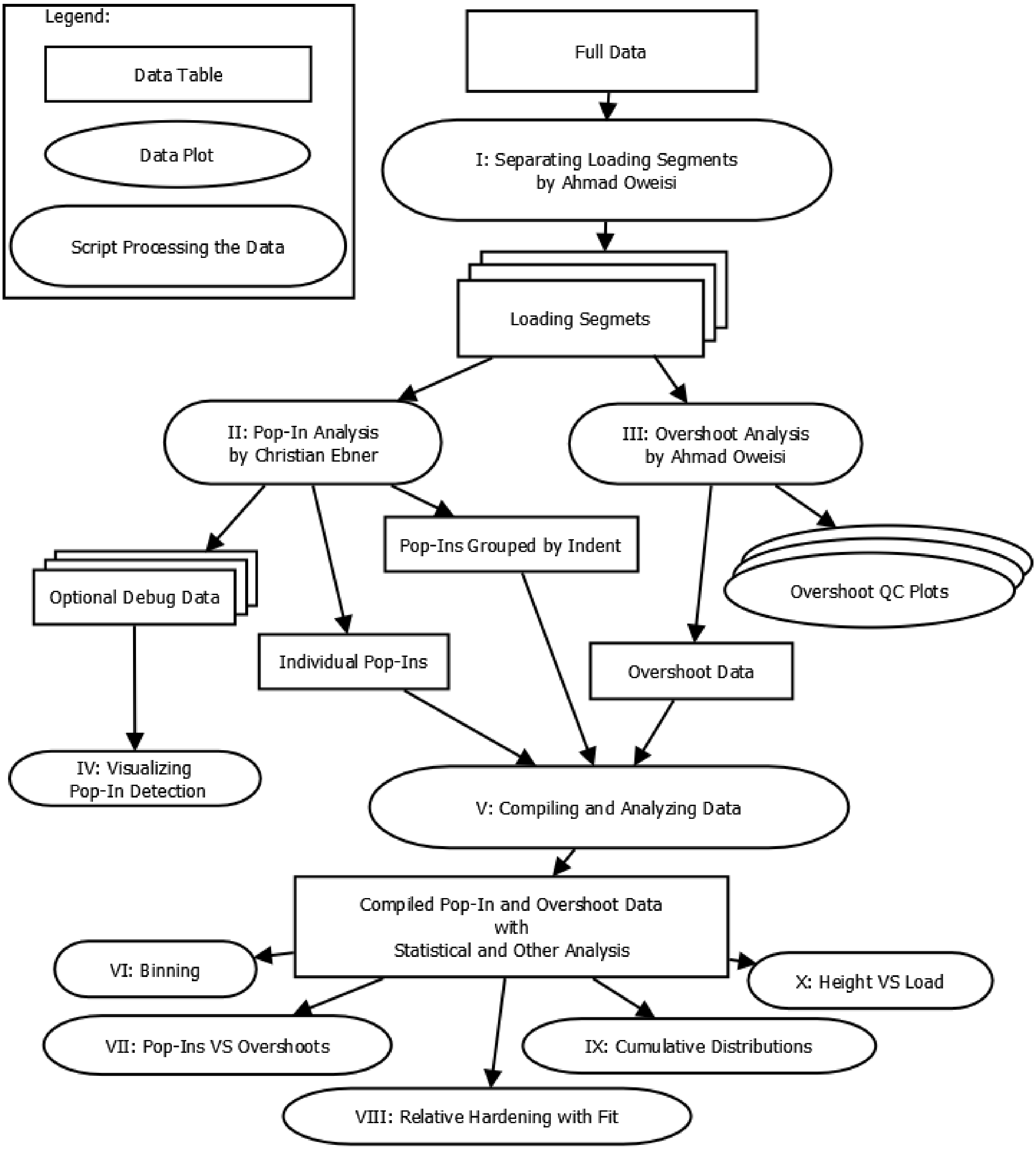


Figure 17: Flowchart showing the steps of data processing

I: Separating Loading Segments

This script dissects the .xlsx files containing the complete indentation data of a measurement series into separate loading segments. This is done by calculating the slope between each pair of values and assigning a status based on that slope, "Loading" for all slope values $> -10^{-5}$, "Unloading" for all others. Coherent sections with a status of "Loading" are then compiled into new .xlsx files, based on their minimum and maximum load.

II: Pop-In Analysis

This script utilizes the pop-in detection algorithm described in Section 2.3. The minimum threshold for a pop-in's derivative was 50 $nm/\sqrt{mN}$ for all sets of data. The values "low_threshold" and "up_threshold" represent the lowest and highest force values that are to be analyzed in a file. Values for other variable parameters can be found in Table 5.

Time Resolution [s^{-1}]	Filter Window Size	Pop-In Detection Window Size
64	61	121
512	91	181

Table 5: Parameters for pop-in detection.

III: Overshoot Analysis

This script utilizes the force overshoot detection algorithm described in Section 2.4.
The window size for the Savitzky-Golay filter can be found in Table 5.
The amount of ignored data points at the start of each curve and amount of data points used for the linear fit for any measurement protocol is displayed in Table 6

Measurement Protocol(s)	# Data Points Ignored	# Data Points Used in Linear Fit
1mN/FF & 1mN/FS	100	380
1mN/SF & 1mN/SS	100	500
2mN/FF & 2mN/FS	512	512
2mN/SF & 2mN/SS	640	640
5mN/FF	1300	1200
5mN/SF	1300	1800
10mN/FF	2000	3050
10mN/SF	2000	4300

Table 6: Parameters for force overshoot detection.

The script also creates visualizations of the linear fit and the difference between projected and measured displacement for each indentation.

IV: Visualizing Pop-In Detection

This script uses the optional debug data produced by **II**, separate .xlsx-files for each indentation containing relevant values, to create visualizations of the pop-in detection process similar to Fig. 6. The pop-in visualized is the one corresponding to the largest local maximum in the derivative.

V: Compiling and Analyzing Data

This script compiles and analyzes the data that **II** and **III** put out.
For analysis data is grouped by unloading size, loading segment, loading and unloading speed, and hardness. These groups get a designation that consists of these attributes concatenated by a slash, for example: 1mN/9-15/FF/H.

Each of these groups is saved as a column with the following structure:

- Designation
- Mean
- Empirical Standard Deviation
- Empirical Variance
- Maximum
- Minimum
- List of the Values

Multiple categories of data are grouped and analyzed, before each is saved in a separate sheet in the output .xlsx-file, to ease further use of the data:

- Number of Pop-Ins
- Height of Pop-Ins
- Load at Pop-Ins
- Derivative at Pop-Ins
- First Pop-Ins Height
- First Pop-Ins Load
- Overshoot Amount
- Overshoot Occurence
- Relative Hardening

The first column of each sheet also contains a legend for the rows.

VI: Binning

This script uses the output data of **V** to create binned histograms of pop-in size, overshoot amount and relative hardening. To make comparisons between measurement series possible, finding a single binning for each of these categories was necessary. To ensure that bins are narrower were most of the data is concentrated and wider towards the maximum where it is sparse, essentially increasing resolution where it is needed, a bin size distribution following a geometric progression was used.

$$x_{i+1} \; = \; x_i * a \tag{13}$$

The relation between the upper bound of one bin and the next is described in (13), where a is the geometric constant. Choosing to have ten bins, with x_0 representing the minimum value and x_{10} representing the maximum value of the data, the geometric constant can be computed as shown in (14).

$$\sqrt[10]{\frac{x_{10}}{x_0}} = a \tag{14}$$

The histogram data for each of theses quantities is added to the output file of **V** as its own sheet, with the first column containing the bin boundaries and the geometric constant. Every column after that is made up of the designation of the associated measurement series and the counts for each bin. Each data series was also plotted as a separate histogram.

VII: Pop-Ins VS Overshoots

This script uses the averages and standard deviations for load at first pop-ins and overshoot occurrence put out by **V**. If the standard deviations from the means overlap, this can be seen as an indicator for them being correlated. To confirm or deny this connection more definitively, a two-sample t-test [28] was performed on a selection of this data.

This data is appended as its own sheet to the output of **V**, with the first column containing the legend and every column after containing one data series each.

VIII: Relative Hardening with Fit

This script uses the relative hardening data put out by **V**. It considers the average relative hardening as a function of the corresponding reference force and fit it with a function of the form $f(x) = a * x^b$. The fit parameters a and b can then be used to characterize and compare the relation of the average amount of hardening and the reference force at which it occurs between different data series. The script also creates a plot of the data and the fit curve.

IX: Cumulative Distributions

This script uses the load at first pop-in and overshoot data put out by **V**. It creates cumulative distribution plots, with the data series being grouped by different criteria and also displays the calculated median value of these distributions.

X: Height VS Load

This script uses the load at pop-in and pop-in height data for general and first pop-ins in **V**'s output file. It creates scatter plots of the pop-in height over the pop-in force, with an optional linear fit and/or Pearson correlation coefficient with the data series being grouped by various criteria.

4. Results

4.1. Fused Silica Calibration Measurements

Since the measurements on fused silica are just to check the calibration of the instrument, before and after a measurement series, their results shown here will also include some discussion. Literature values for fused Silica are $H_{SiO_2} = 9 - 10\ GPa$ and $E_{SiO_2} = \sim 75\ GPa$. [29]

Measurement Series	Indenter	H Average [GPa]	E Average [GPa]
Before Survey of Left Half	B2	9.57 ± 0.08	71.30 ± 0.26
After Survey of Left Half	B2	9.49 ± 0.15	71.23 ± 0.06
Before Survey of Right Half	B3	9.68 ± 0.12	71.26 ± 0.18
After Survey of Right Half	B3	9.72 ± 0.17	71.12 ± 0.15
Before 10mN Slow	B3	9.47 ± 0.12	71.74 ± 0.18
After 10mN Slow	B3	9.44 ± 0.17	71.66 ± 0.29
Before 5mN + 1mN Slow	B3	9.48 ± 0.13	71.58 ± 0.47
After 5mN + 1mN Slow	B3	9.50 ± 0.15	71.78 ± 0.13
Before 10mN + 5mN + 1mN Fast	B3	9.37 ± 0.18	71.58 ± 0.23
After 10mN + 5mN + 1mN Fast	B3	10.36 ± 0.12	75.52 ± 0.13
Before 1mN Slow Unload	B3	11.44 ± 0.04	79.04 ± 0.15
After 1mN Slow Unload	B3	11.48 ± 0.12	79.34 ± 0.24
Before 2mN All	B3	11.42 ± 0.08	78.86 ± 0.27
After 2mN All	B3	11.44 ± 0.12	78.98 ± 0.16

Table 7: Averaged results of calibration measurements.

The results shown in Table 7 are to be understood as averages with standard deviations and are listed in chronological order. An example of calibration test indents is shown in Fig. 18. Calculations of H and E were performed with the same area function.

The measurement series where accuracy mattered the most were the surveys conducted with the B2 tip. As the data was used to calculate hardness values and identify regions for further experiments. With deviations of $< 0.5\%$ in H and E for series of over 1000 indentations, the tip and its calibration proved to be very stable. The calibration tests between the surveys of the left and right half show a slightly larger variation of $\sim 2\%$ in H, but the averages still lie within each others standard deviations.

Over all the measurement series of cyclic loading experiments, conducted with the B3 tip, there is also remarkably little shift in the calibration during and between most measurements. From before the slow 10 mN unload measurements to before the 10, 5 and 1 mN unload fast measurement series all the shifts in H are $< 2\%$ and shifts in E are even $< 0.3\%$. During this combined measurement series there is one big shift of $\sim 10.6\%$ in H and $\sim 6\%$ in E. Causes for this could be that the tip changed its shape due to wear that lead to tip rounding or the indenters' stiffness changed.
Before adding the measurements with 1mN slow unloading to the scope of the thesis, roughly a month passed, with the calibration measurements before conducting them showing another shift of roughly the same magnitude in H and E. As before, the cause for this is unclear, with another possible explanation here being other experiments performed with this tip. But during these slow unloading measurements and even through the 2 mN unloading experiments, performed several months later, tip and calibration proved to be remarkably stable once again, with $\sim 0.5\%$ variation in H and $\sim 0.6\%$ in E.

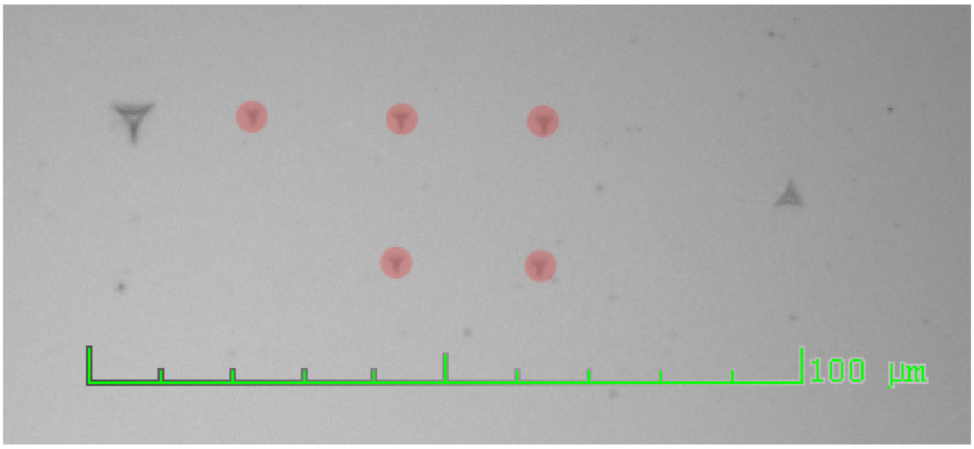


Figure 18: Microscope image of calibration test indents, overlaid in red for better visibility. The edges of the indents have lengths of $\sim 4\ \mu m$.

4.2. Survey Measurements

The results of these measurement series are visualized in Fig. 11.

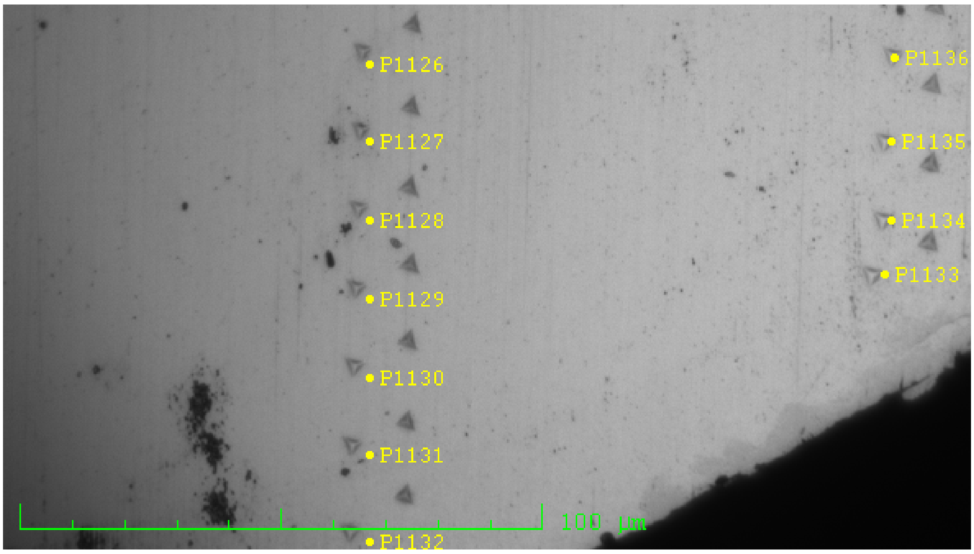


Figure 19: Microscope image of survey indents.
The edges of the indents have lengths of $\sim 5\ \mu m$.
The distance between indents in a column was at least $15\ \mu m$.

A microscopic example image of the indents made when surveying the right side of the sample is shown in Fig. 19. The marks next to the indents display the internal numbering the indenter used when programming the measurement series.[20] The unmarked row of indents is a remnant of the survey measurement using the B3 indenter tip first, but this measurement series was discarded and repeated with the B2 tip, for better comparability of the data between the samples halves.

[20] Deviation between markers and actual indents is due to this image being a cropped detail view of the lower left quadrant of the microscope's field of view.

4.3. Cyclic Loading Experiments

The tables and figures presented here are a selection of results.
For the full statistical data on pop-ins, overshoots and hardening, please see **Appendix A**.

4.3.1. Visualizing Pop-In Detection

Fig. 20, Fig. 21 and Fig. 22 visualize examples of pop-in detection on different loading segments of the same indentation.
In the case of well defined pop-ins the position and height can be determined well and correctly.
Even larger pop-ins with sizes $> 5\ nm$ are analyzed correctly (Fig. 21).
In the case of more gradual changes the size is usually underestimated (Fig. 22).
It should be noted that at higher forces, strong variations in the slope during reloading are frequently detected below the reference force.

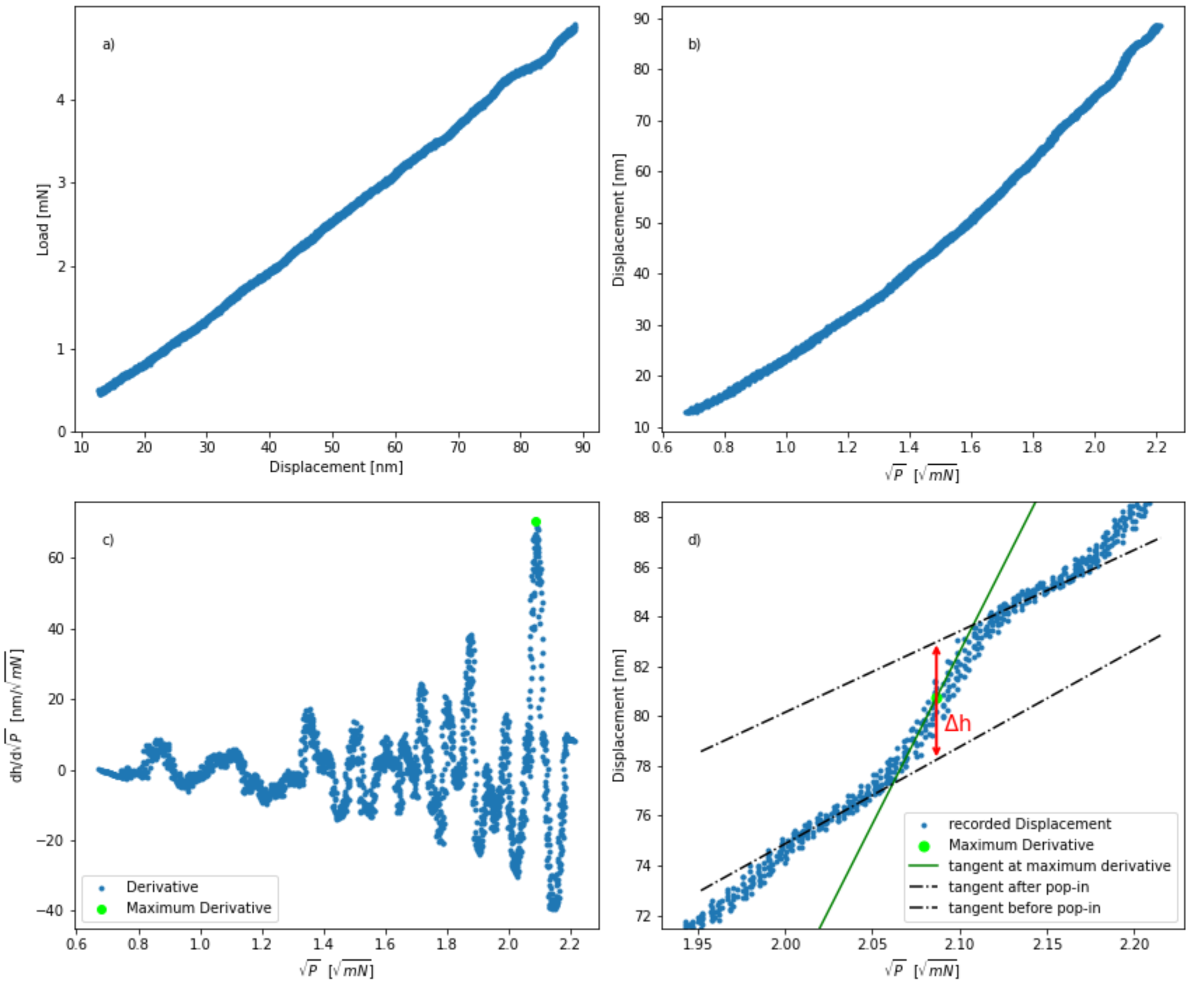


Figure 20: Example visualization of pop-in detection
using the procedure described by Ebner et al. in [14].
Automatic evaluation yields a pop-in at $P = 4.355\ mN$
with a size of about $4\ nm$.
(Indent 8 2mN/FF/0-5/H)

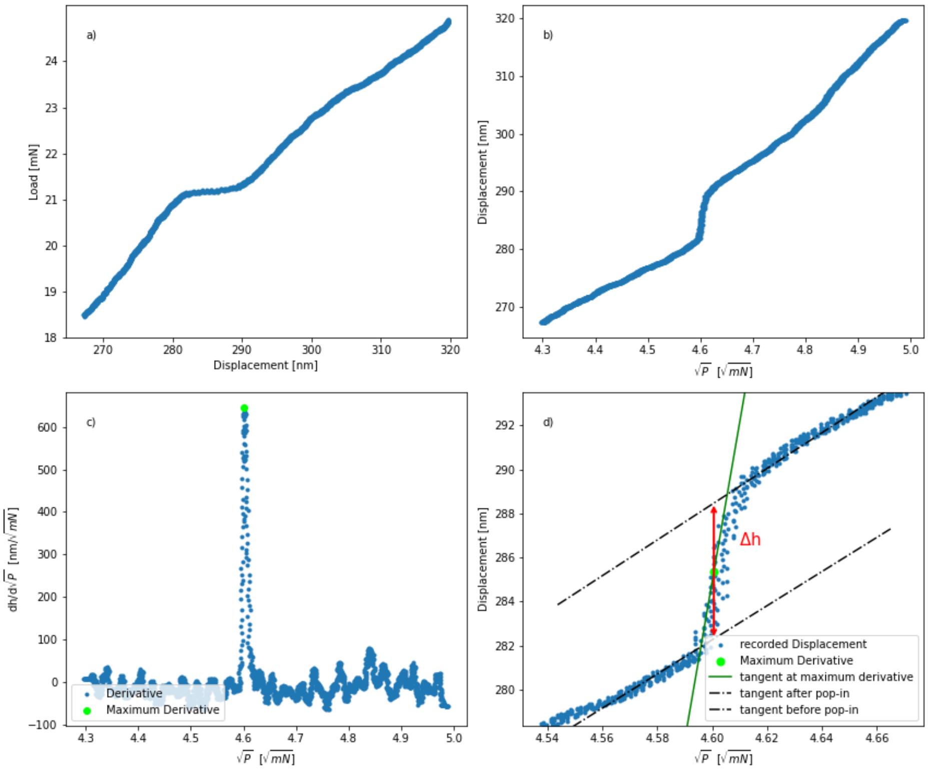


Figure 21: Example visualization of pop-in detection (Indent 8 2mN/FF/18-25/H, reference force 20 mN)

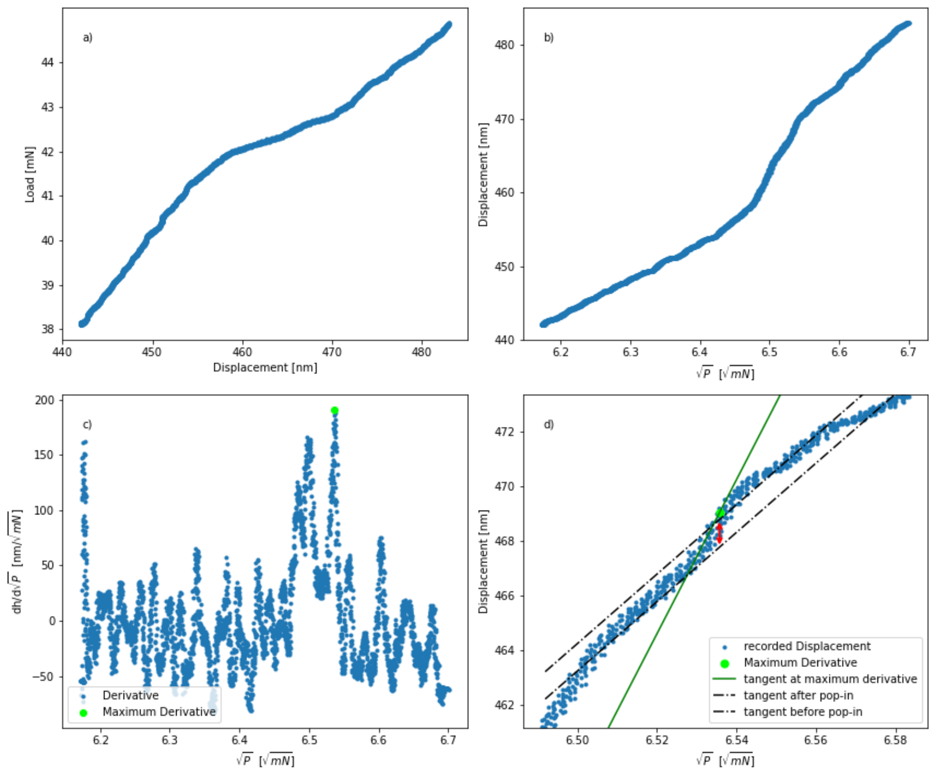


Figure 22: Example visualization of pop-in detection (Indent 8 2mN/FF/38-45/H, reference force 40 mN)

4.3.2. Histograms

For the full binning and count data for pop-ins, overshoots and hardening, please see **Appendix A**.

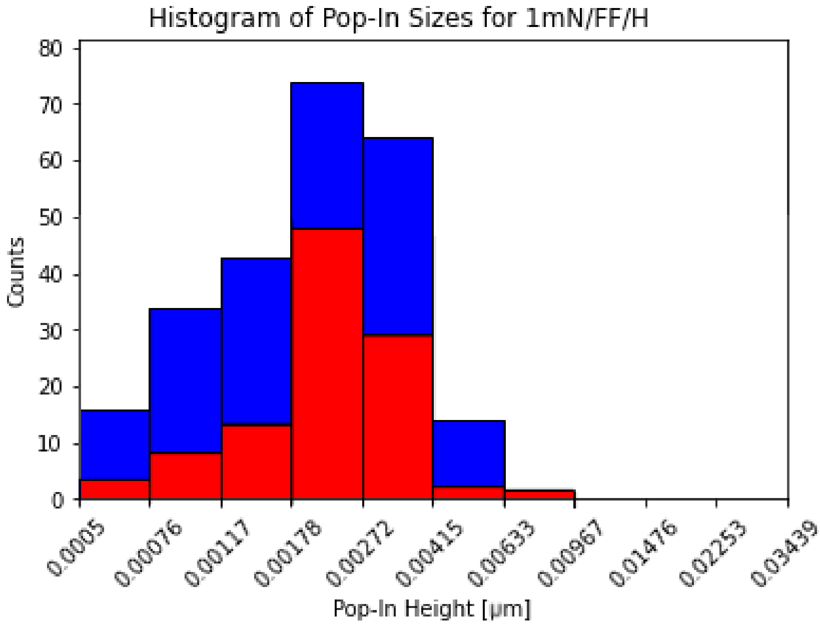


Figure 23: Composite pop-in size histogram for loading segments 0-5 mN (red) and 4-10 mN (blue) of the 1mN/FF/H indentation series

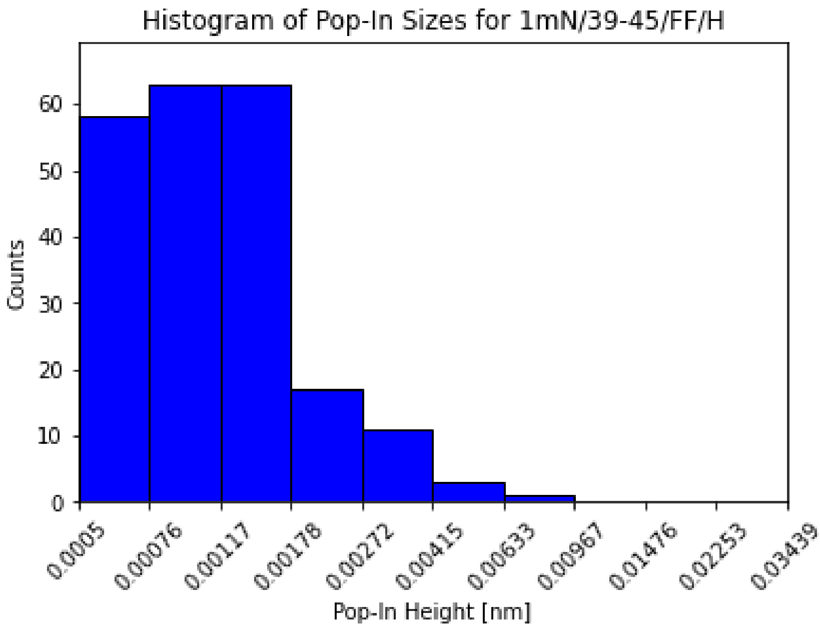


Figure 24: Pop-in size histogram for 1mN/39-45/FF/H

One interesting trend visible through the histograms (Fig. 23), is that for 1 mN and 2 mN measurement series the loading segment after the first unloading often has the highest number of counts over all bins. (E.g.: 1mN/FF/H has its maximum count in the $4 - 10$ mN loading segment.) For loading segments with higher maximum load (Fig. 24), the relative amount of smaller pop-ins increases while the total number stays similar.

4.3.3. Correlation between Pop-In Height and Load

Fig. 25 and Fig. 26 show scatter plots of mean pop-in height against the mean of the load at which pop-ins occur, per loading segment, comparing the 2mN/FF and 2mN/FS data.

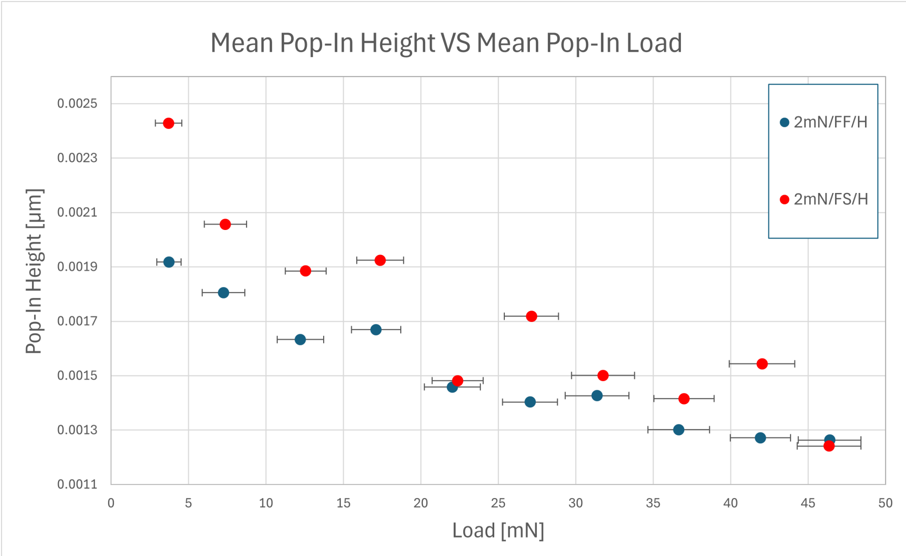


Figure 25: Scatter plot of mean pop-in height over mean pop-in load, per loading segment, comparing 2mN/FF/H and 2mN/FS/H. (Error bars represent the standard deviations.)

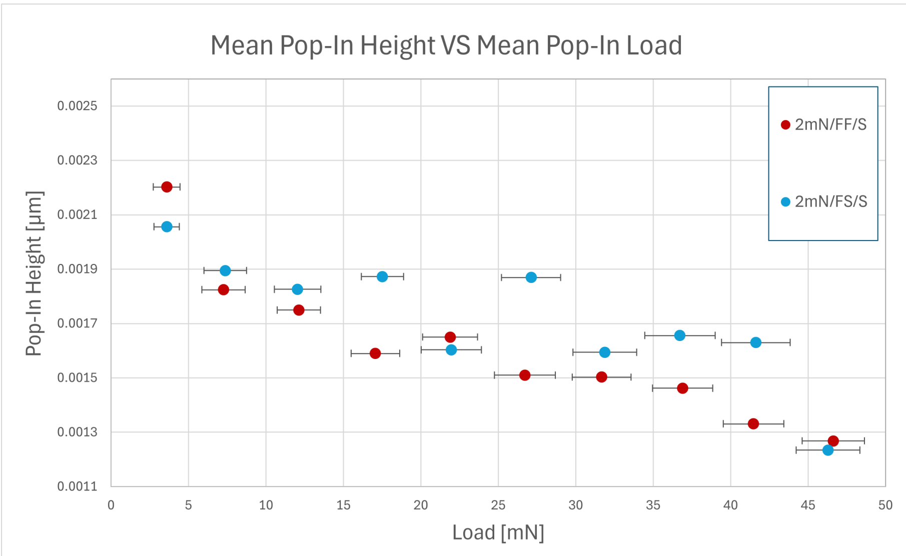


Figure 26: Scatter plot of mean pop-in height over mean pop-in load, per loading segment, comparing 2mN/FF/S and 2mN/FS/S. (Error bars represent the standard deviations.)

These plots both show that, even though the unloading amount is equal for all depicted measurement series, the measurements with slow unloading rate produce higher mean pop-in heights for most loading segments. This effect seems more pronounced for measurements on hard areas of the sample, but only for the first few loading segments.
As a general trend the mean pop-in height decreases as the reference force of the loading segment increases.

The following scatter plots show the relation between pop-in height and load at which they occur. Data obtained from all curves is separated according to loading and unloading rate. With Fig. 27 depicting all pop-ins, except for the first per loading and indentation, and Fig. 28 depicting the first pop-ins per loading and indentation. Filtering out all the pop-ins smaller than 2 nm yields Fig. 29 and Fig. 30 respectively.

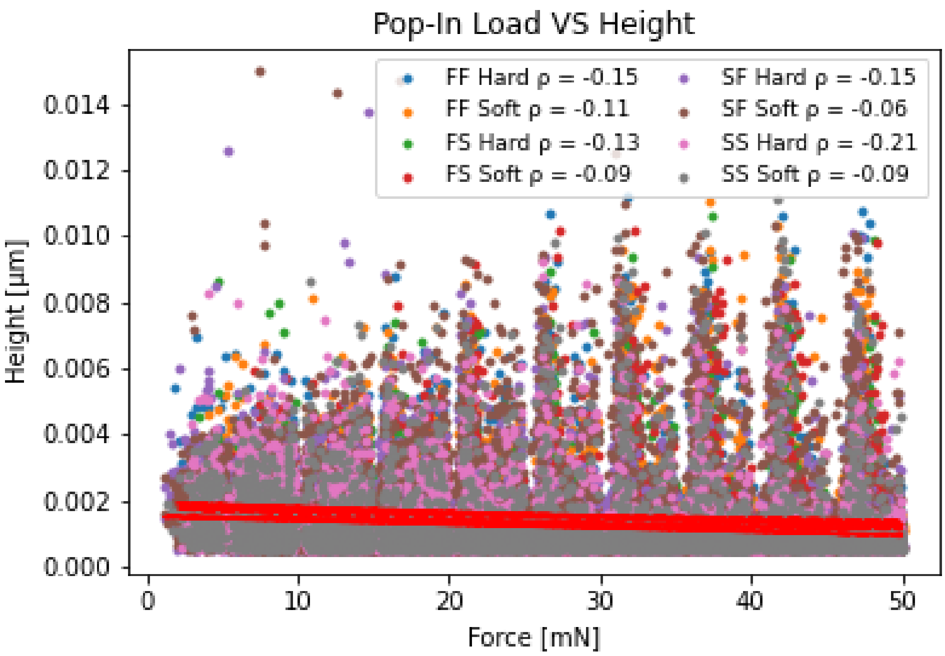


Figure 27: Height over load scatter plot of pop-ins excluding the first per loading segment, with linear fit and Pearson correlation coefficient.

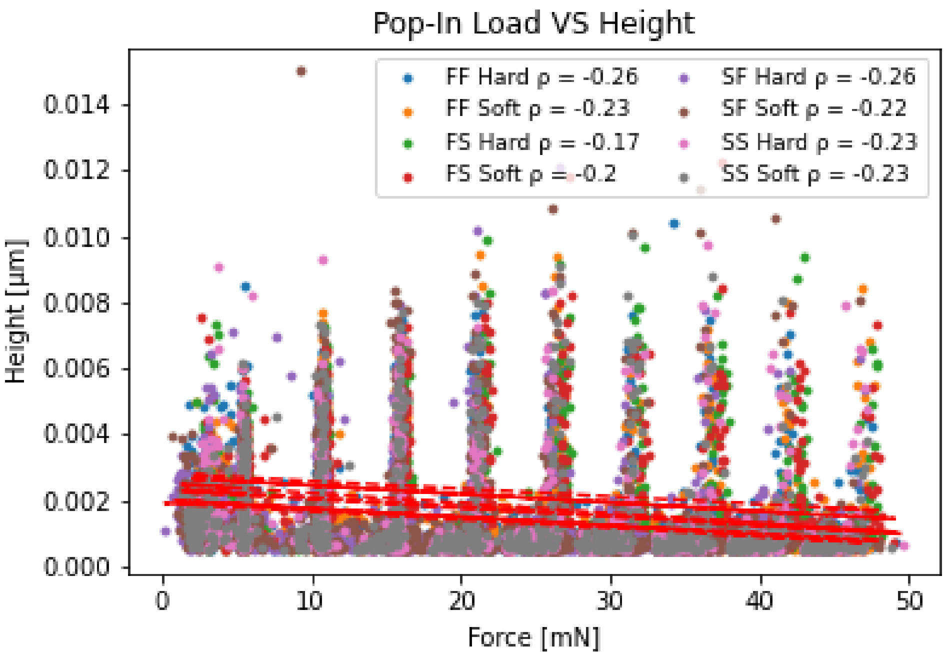


Figure 28: Height over load scatter plot of first pop-ins per loading segment, with linear fit and Pearson correlation coefficient.

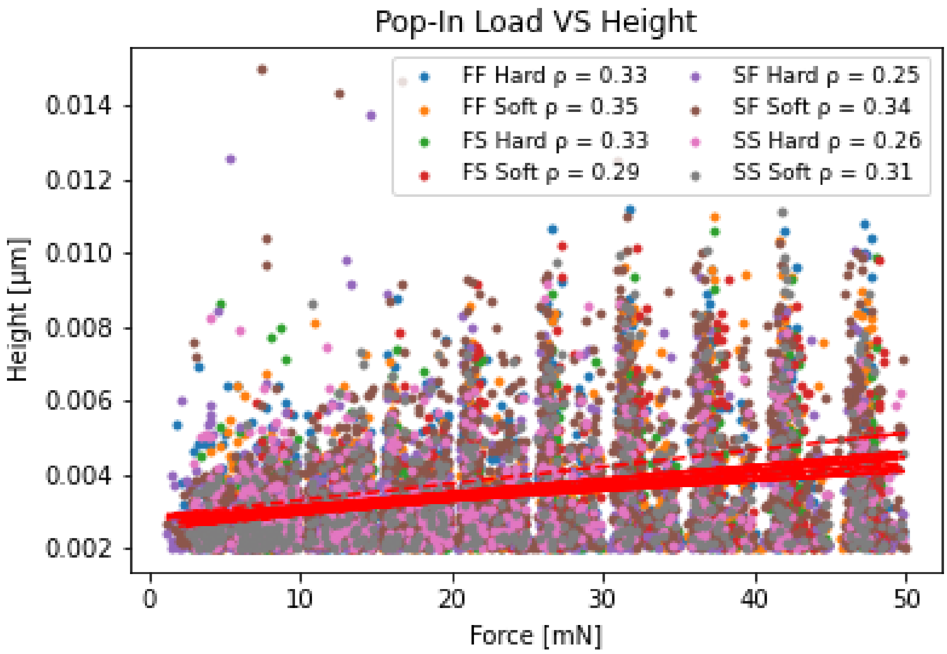


Figure 29: Height over load scatter plot of pop-ins excluding the first per loading segment, with linear fit and Pearson correlation coefficient. With pop-ins $< 2\ nm$ filtered out.

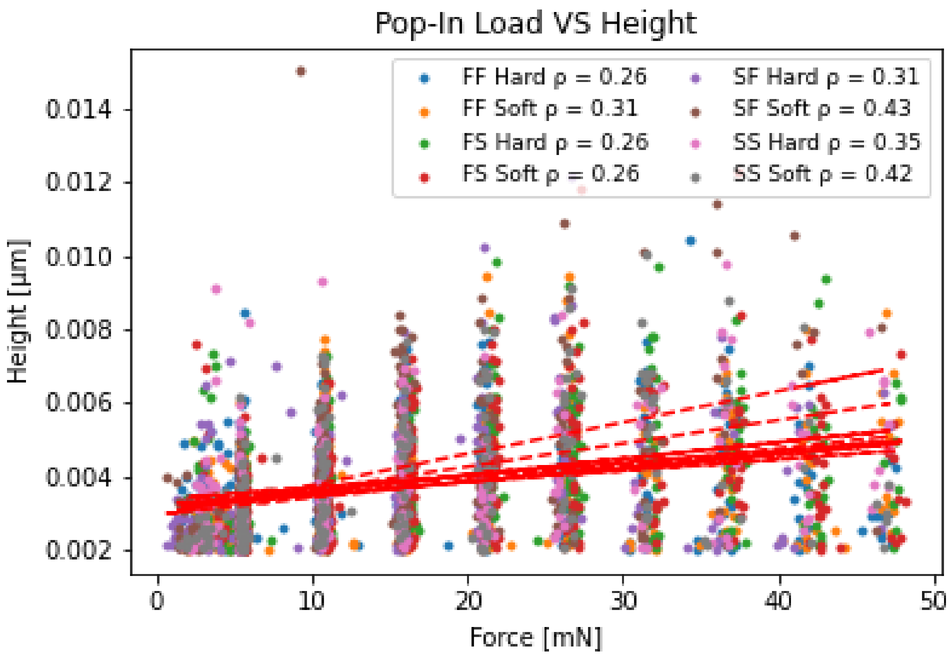


Figure 30: Height over load scatter plot of first pop-ins per loading segment, with linear fit and Pearson correlation coefficient. With pop-ins $< 2\ nm$ filtered out.

The plots using unfiltered data (Fig. 27 and Fig. 28) show an inverse proportionality between pop-in load and height. For the filtered data, only showing pop-ins with size $> 2\ nm$ (Fig. 29 and Fig. 30), this trend reverses and a higher load correlates with a larger pop-in size. This is the result of pop-ins smaller than 2 nm becoming more prevalent in loading segments with higher forces.

4.3.4. First Pop-In Load VS Force Overshoot

The comparison between load at first pop-in relative to the reference force and the force overshoot is shown in Fig. 31, Fig. 32a, Fig. 32b, Fig. 32c and Fig. 32d. Values shown are averages for per loading segment, while the error bars represent their standard deviations.
The first pop-ins generally occur at lower forces than the force overshoots. This difference grows larger for greater unloading amounts and loading segments with higher maximum force.

Two-sample t-tests were performed on the mean values depicted in the diagrams in this section. The test statistic t can be calculated as shown in (15), with $\overline{x}$ and $\overline{y}$ being the means of the quantities being compared, $m = n = 42$ being their respective sample sizes s_x^2 and s_y^2 their empiric sample variances, and s^2 being the pooled sample variance.

$$t = \sqrt{\frac{nm}{n+m}}\,\frac{\overline{x}-\overline{y}}{s}\ ,\ s^2 = \frac{(n-1)s_x^2+(m-1)s_y^2}{n+m-2} \qquad (15)$$

If the computed test statistic is larger than the 97.5% quantile of a t distribution with $m + n - 2 = 82$ degrees of freedom, $t(0.975; 82) = 1.989$, the two quantities can be considered distinct with a confidence interval of 95%. The collected test statistics can be seen in Table 8. With the exception of a few loading segments with low reference force the test statistics exceed 1.989, therefore the first pop-in and force overshoot should be considered distinct events.

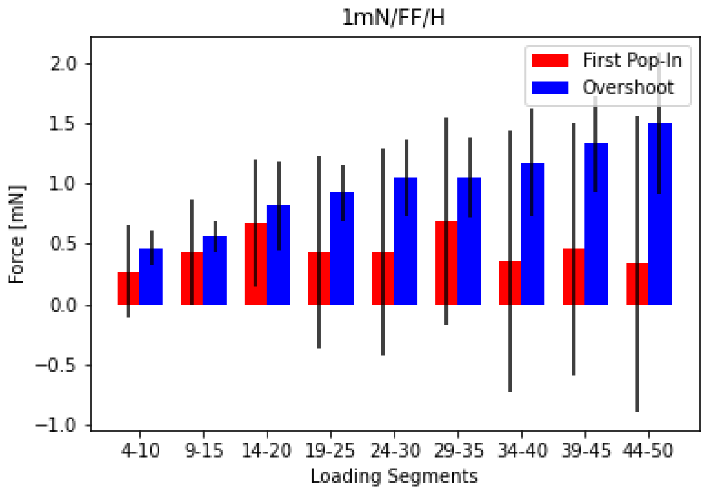
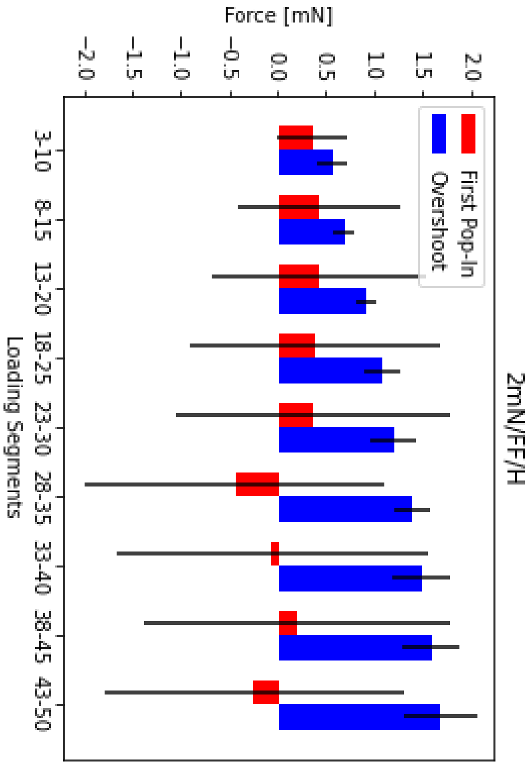


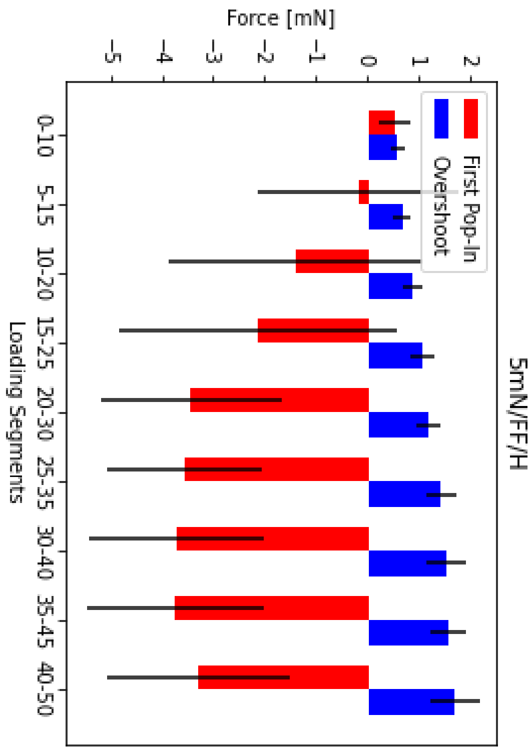
Figure 31: Comparing occurrence of first pop-ins and force overshoots, with respect to the reference force, for 1mN/FF/H

Reference Force	1mN/FF/H	2mN/FF/H	5mN/FF/H	10mN/FF/H	10mN/SF/H
5 mN	3.069426	3.406033	0.93301	-	-
10 mN	1.874344	1.94829	2.840725	2.238111	2.029883
15 mN	1.406427	2.883618	5.986477	5.072244	2.397502
20 mN	3.831615	3.457869	7.692171	12.24323	7.40413
25 mN	4.365338	3.78287	16.8535	21.36016	13.23739
30 mN	2.509246	7.581702	21.0556	33.43889	20.60333
35 mN	4.495185	6.136098	19.56221	55.54493	26.81766
40 mN	5.082772	5.617239	19.76072	57.77756	28.33825
45 mN	5.545837	7.84761	17.66452	35.26465	29.80916

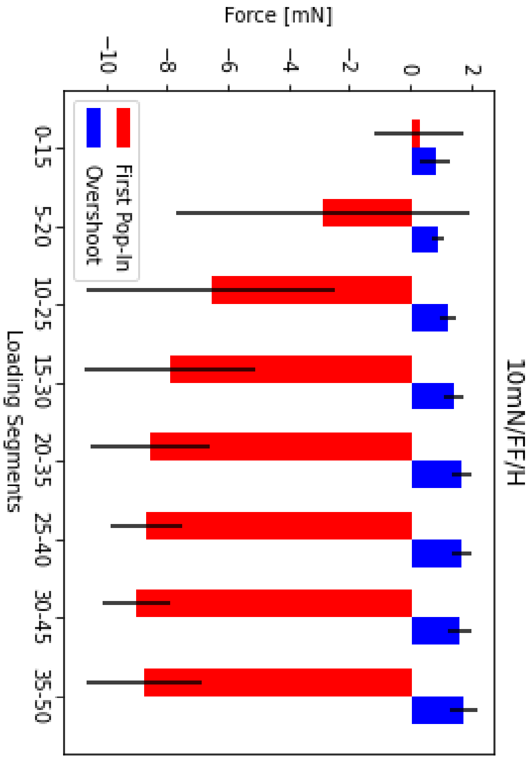
Table 8: Collected test statistics of two-sample t-tests on the mean values of the first pop-in load and force overshoot.



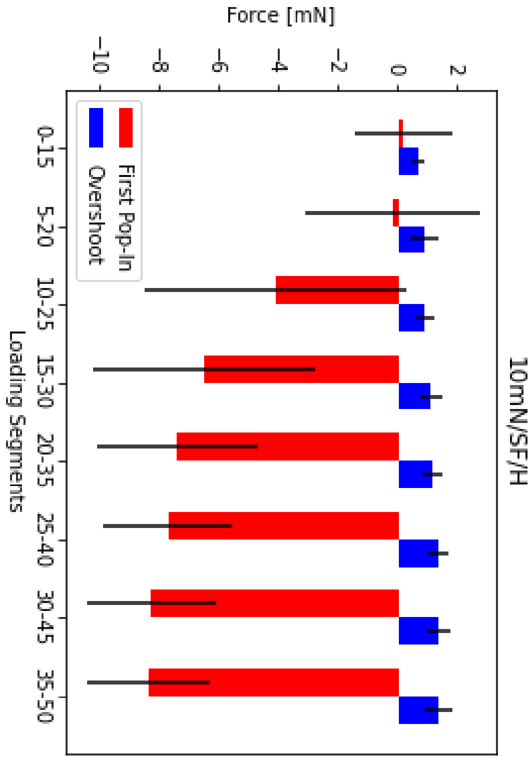
(a) 2mN/FF/H



(b) 5mN/FF/H



(c) 10mN/FF/H



(d) 10mN/SF/H

Figure 32: Comparing occurence of first pop-ins and force overshoots, with respect to the reference force.

4.3.5. Cumulative Frequency Distributions of Pop-Ins

The first pop-ins of the first loading segments grouped only by their associated loading rate are displayed in Fig. 33. The CFDs with fast loading rate in hard and soft areas of the sample differ from each other more than their slow loading rate counterparts, implying that fast loading rates are more sensitive to differences in the structural state. The first pop-ins in general and their median specifically are also occurring at higher loads for the experiments with fast loading rate.

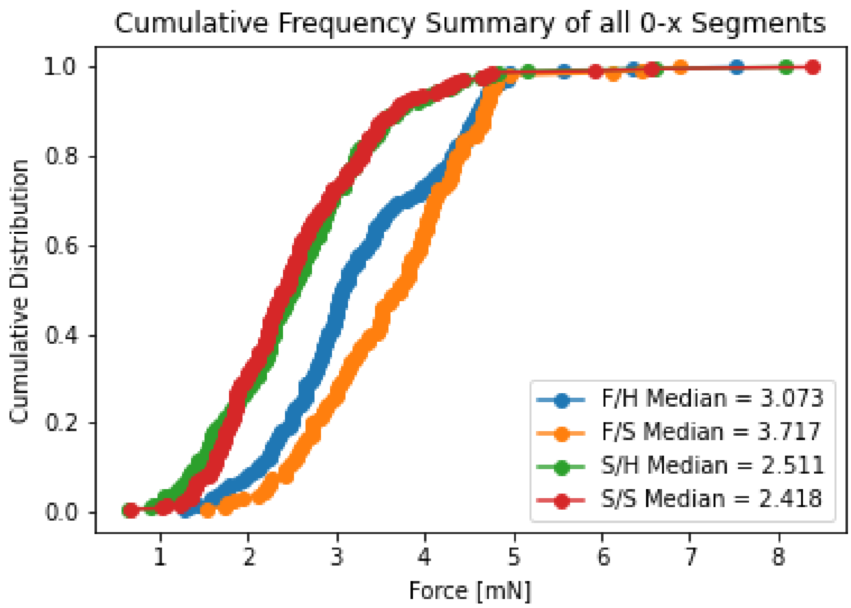


Figure 33: Cumulative frequency distributions of first pop-ins in first loading segments, taken from all measurement series and grouped by load speed (F, S) and sample area (H, S).

Measurement Series	0-5 [mN]	4-10 [mN]	9-15 [mN]	14-20 [mN]	19-25 [mN]
1mN/FF/H	3.010	5.327	10.567	15.784	20.779
1mN/FF/S	3.826	5.387	10.633	15.864	20.961
1mN/FS/H	3.401	5.572	10.834	16.077	21.465
1mN/FS/S	3.769	5.567	10.944	16.225	21.502
1mN/SF/H	1.623	5.278	10.288	15.386	20.509
1mN/SF/S	2.238	5.293	10.485	15.386	20.011
1mN/SS /H	2.908	5.393	10.552	15.610	20.694
1mN/SS /S	2.843	5.421	10.473	15.489	20.250

Table 9: Median values of selected cumulative frequency distributions for 1mN unload measurements

Selected median values of the cumulative frequency distributions for 1 mN unloading size can be seen in Table 9. Plotted examples of these CFDs are pictured in Fig. 34, Fig. 35 and Fig. 36. For the $0-5$ mN loading segment (Fig. 34) the CFDs are varied, with the pop-ins occurring at lower loads for slow loading rates. For the $4-10$ mN loading segment (Fig. 35) most of the pop-ins occur in a narrow range of load values for all measurement protocols. For the $34-40$ mN loading segment (Fig. 36) the portion of first pop-ins below the reference force is more pronounced for slow loading rates, which is reflected in the median also being ≤ 35 mN. These CFDs' shapes are not sigmoid, implying the first pop-ins not being normally distributed at high loads.

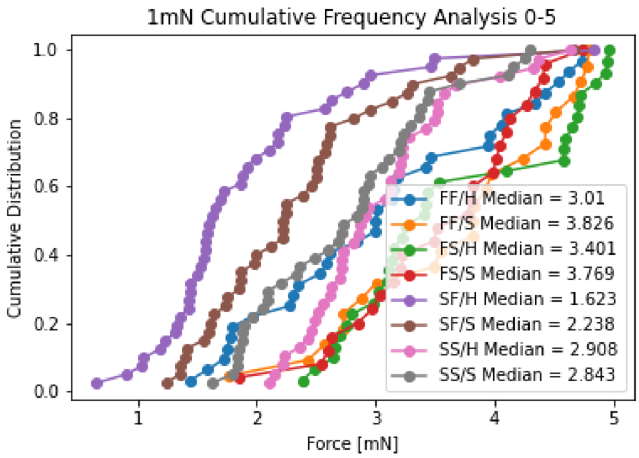


Figure 34: Cumulative frequency distributions of first pop-ins of 1mN/0-5.

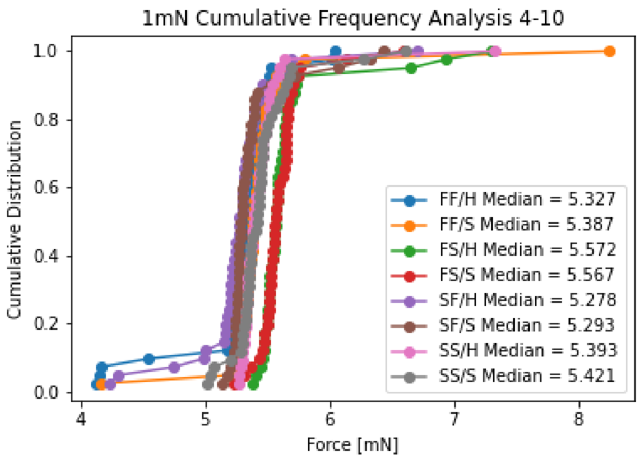


Figure 35: Cumulative frequency distributions of first pop-ins of 1mN/4-10. (Reference force 5 mN.)

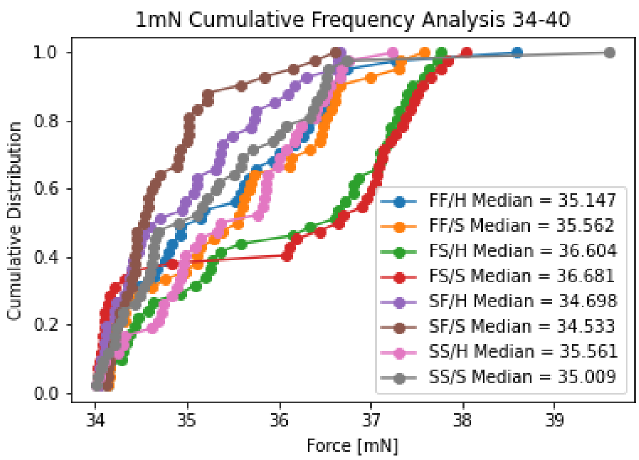


Figure 36: Cumulative frequency distributions of first pop-ins of 1mN/34-40. (Reference force 35 mN.)

4.3.6. Force Overshoot Amounts

The average overshoot amounts for $1mN$ and $2mN$ unloading sizes, recorded on a hard area of the sample, are displayed in Fig. 37 and Fig. 38. These figures show a general correlation between larger reference force and larger average overshoot amounts. The overshoot amounts are also on average greater for larger unloading amounts. The overshoot amount seems to be proportional to the loading rate, with faster loading producing larger overshoots, with this effect being more pronounced in experiments with slow unloading. The unloading rate however, seems to be inversely related to the overshoot amount, with slower unloading producing larger overshoots, with this effect being more pronounced in experiments with fast loading.

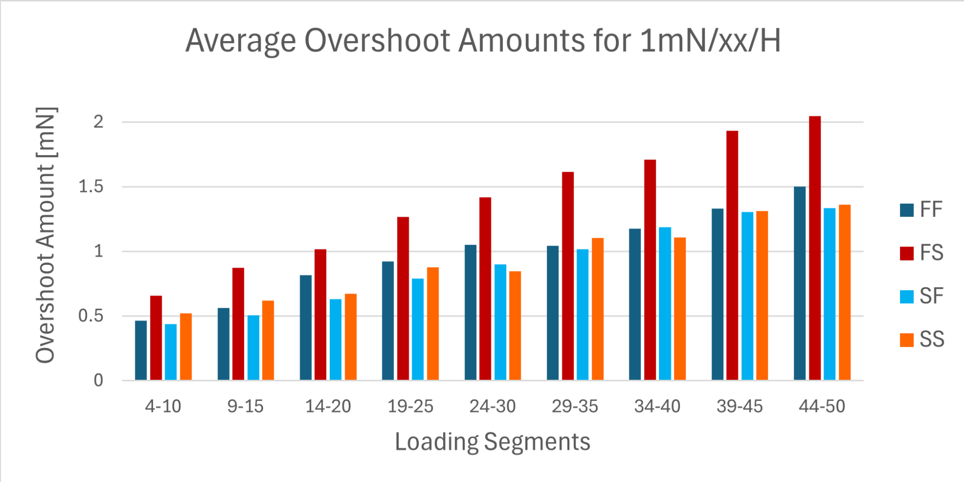


Figure 37: Average overshoot amounts for different loading and unloading rates with 1mN unloading size.

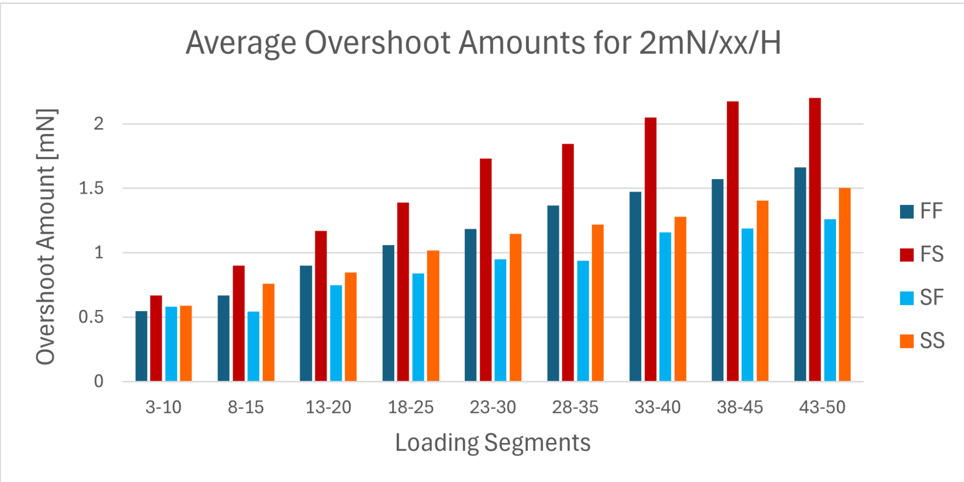
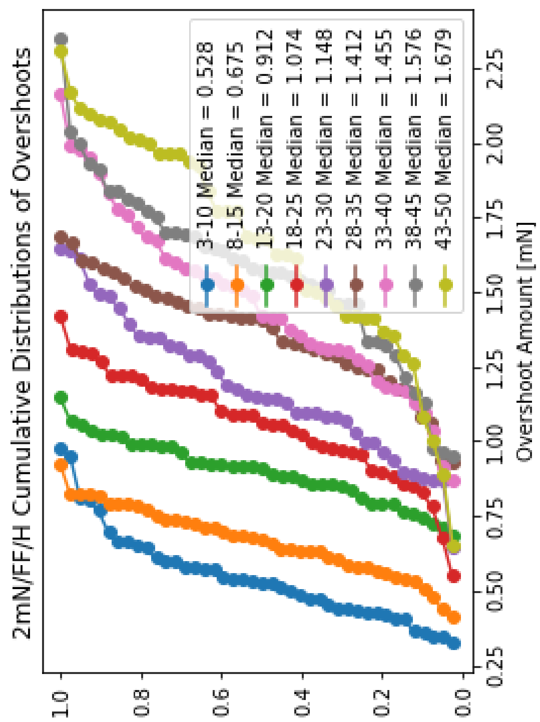


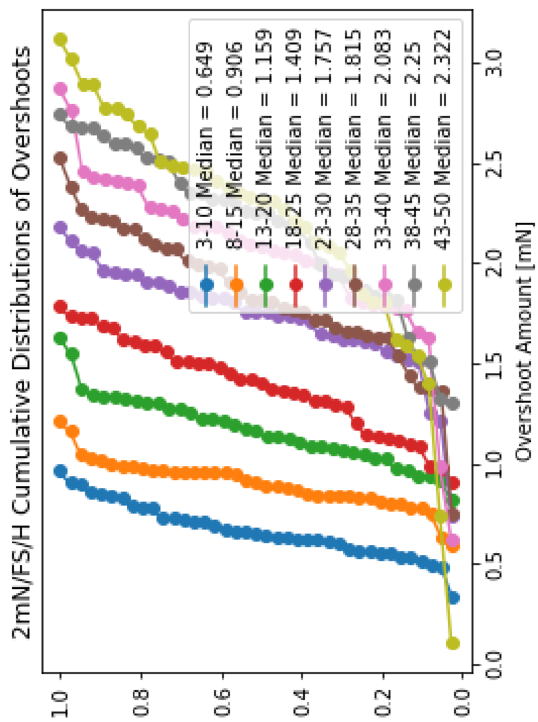
Figure 38: Average overshoot amounts for different loading and unloading rates with 2mN unloading size.

4.3.7. Cumulative Frequency Distributions of Force Overshoots

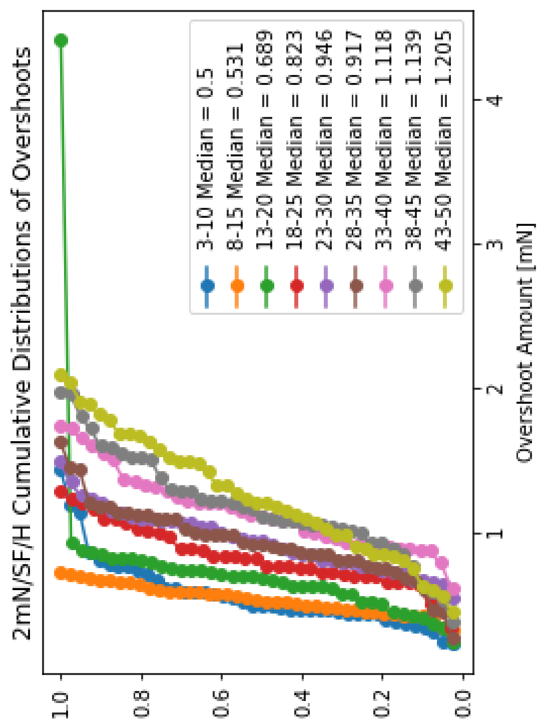
In Fig. 39 and Fig. 40 CFDs for force overshoot amounts in all loading segments for selected measurement protocols are shown. Generally the distributions are broader and the medians higher for load segments with higher maximum force. The median of a given segment increases with increased loading rate and reduced unloading rate (cf. Fig. 39). In Fig. 40 data from hard and soft areas is compared, showing a change of the distributions and lower medians for the soft areas.



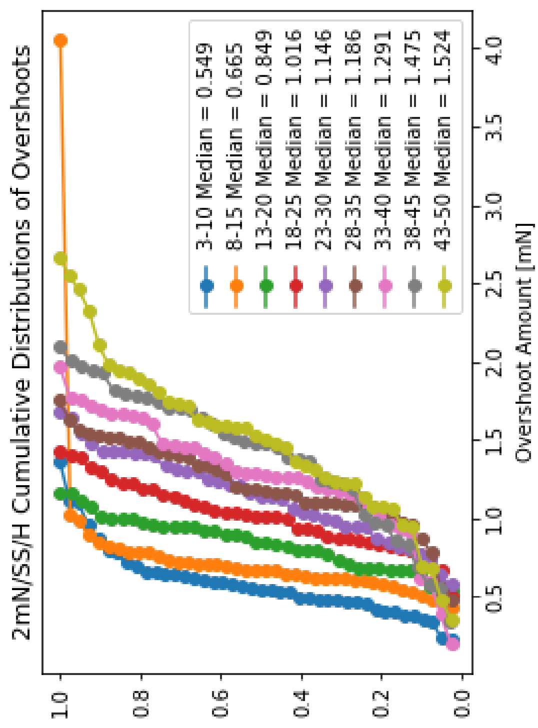
(a) 2mN/FF/H



(b) 2mN/FS/H

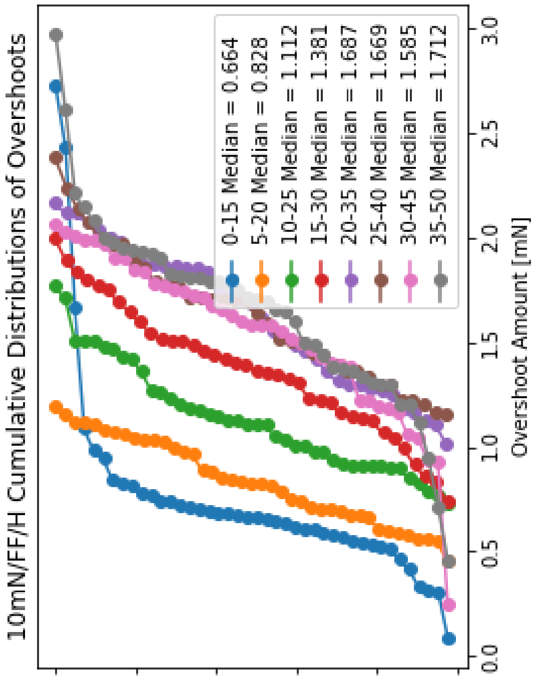


(c) 2mN/SF/H

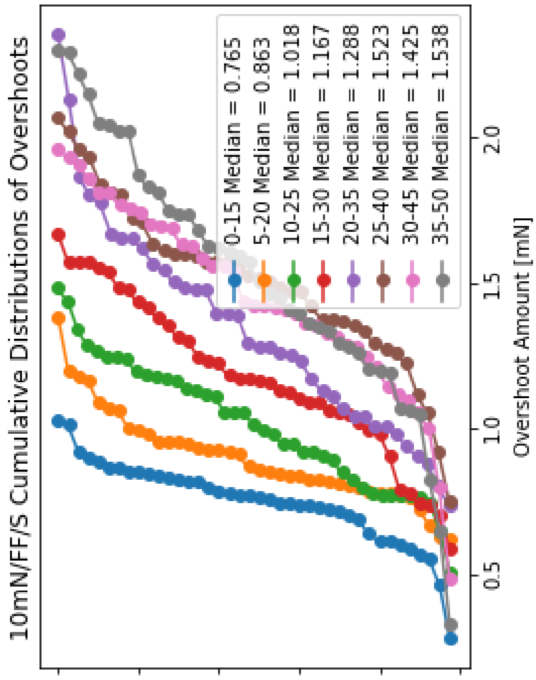


(d) 2mN/SS/H

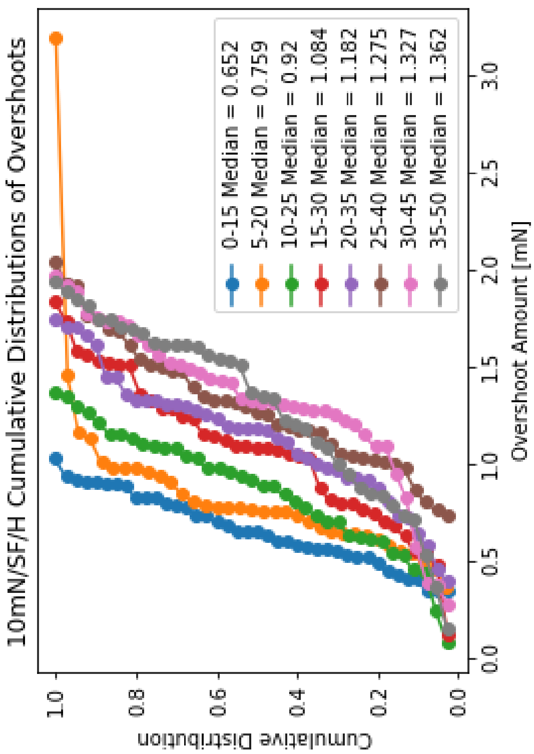
Figure 39: Cumulative frequency distributions of force overshoot amounts at 2mN unloading size.



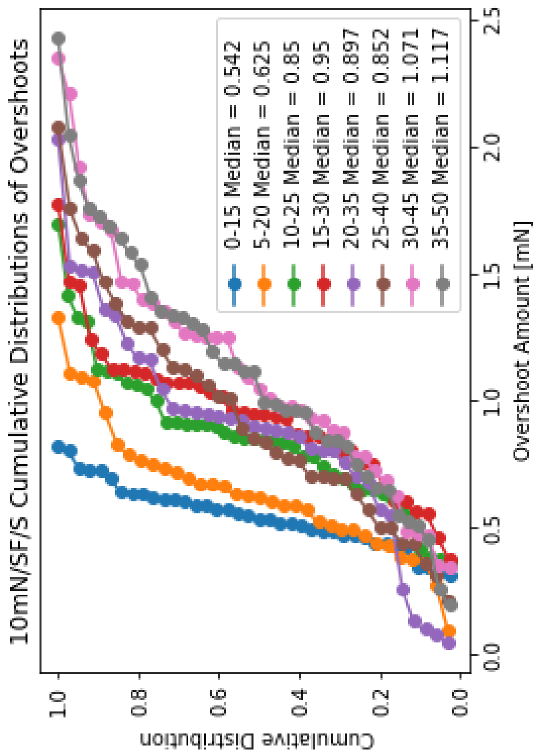
(a) 10mN/FF/H



(b) 10mN/FF/S



(c) 10mN/SF/H



(d) 10mN/SF/S

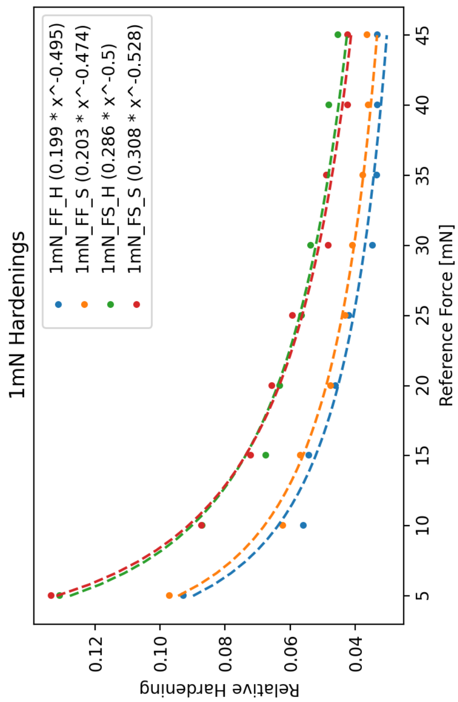
Figure 40: Cumulative frequency distributions of force overshoot amounts at 10mN unloading size.

4.3.8. Relative Hardening

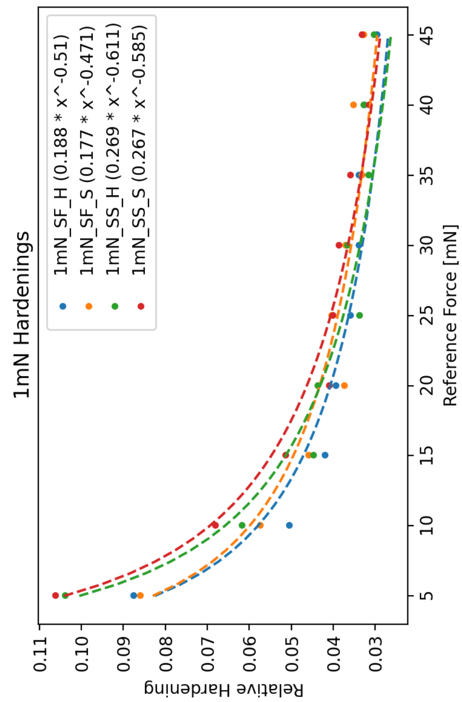
The averages of relative hardening, calculated according to (7) and fitted with power functions ($f(x) = a * x^b$), are displayed in Fig. 41, Fig. 42 and Fig. 43.
Because relative hardening is calculated by dividing the force overshoot amount by the reference force, all trends regarding loading rate, unloading rate and unloading size identified in section **4.3.6** are still present and recognizable; only the dependency with respect to the reference force is reversed. The plots also show that the relationship between hardening (and therefore force overshoot amount,) and the unloading amount does not appear to be strictly linear, as 10 mN of unloading cause less hardening than 5 mN of unloading. Nevertheless, a general trend of hardening based on the unloading duration and unloading size is occurring. This is described in more detail in the discussion.
The decrease of hardening with increasing load can be understood based on the strain rate during reloading. The constant loading rate (0.1 mN/s, 1 mN/s) used for the experiments leads to decreasing elastic strain rates $\dot{\epsilon}$ with increasing load. $\dot{\epsilon}$ was calculated from the experimental data using equation (16) and the corresponding values are listed in the appendix.

$$\dot{\epsilon} = \frac{\dot{h}}{h} \tag{16}$$

Plotting these average hardening values over the respective average elastic strain rate yields Fig. 44. The axes are logarithmically scaled and the data series are displayed with power function fit. Fig. 44 shows clearly that hardening increases with increasing elastic strain rate. The exponent in the fit function related to the slope in Fig. 44 lies between 0.37 and 0.51.
The data points with low strain rates are associated with the loading segments with high maximum force. In Fig. 44a experiments with 1 mN of unloading in a hard area of the sample are compared, showing the generally higher strain rates for experiments with fast loading and that the relative hardening for experiments with fast loading is influenced by the unloading rate to a greater extent. In Fig. 44b experiments with fast loading performed on a hard sample area are compiled, again showing greater hardening values for slow unloading.

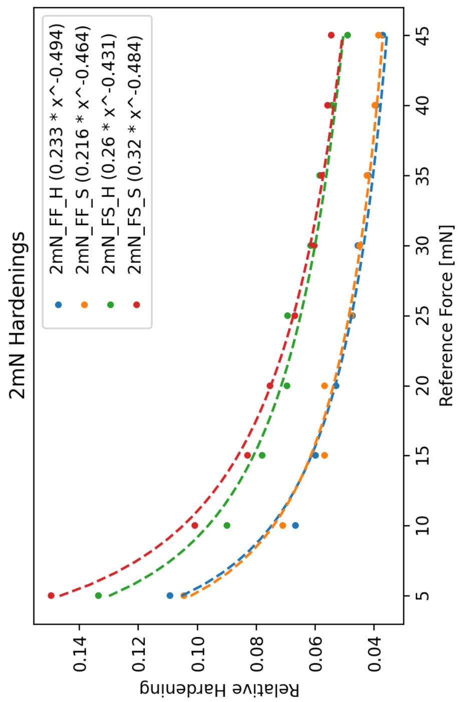


(a) Protocols with fast loading.

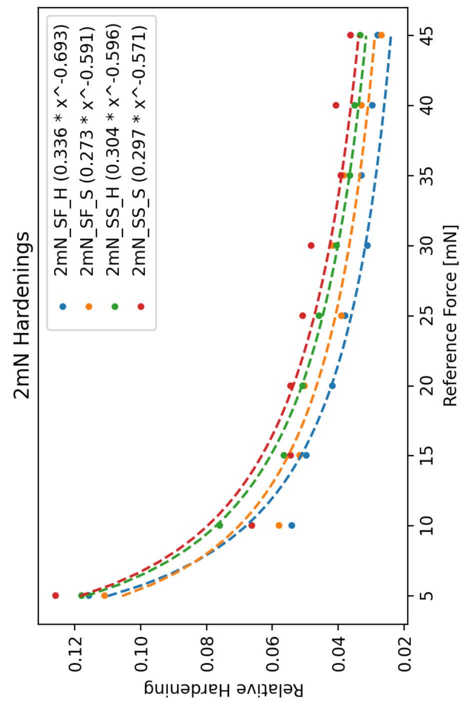


(b) Protocols with slow loading.

Figure 41: Average relative hardening for 1mN unloading, with power fit.

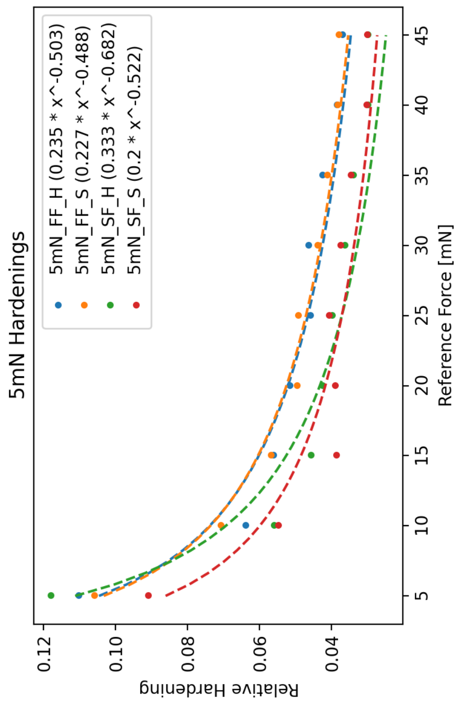


(a) Protocols with fast loading.

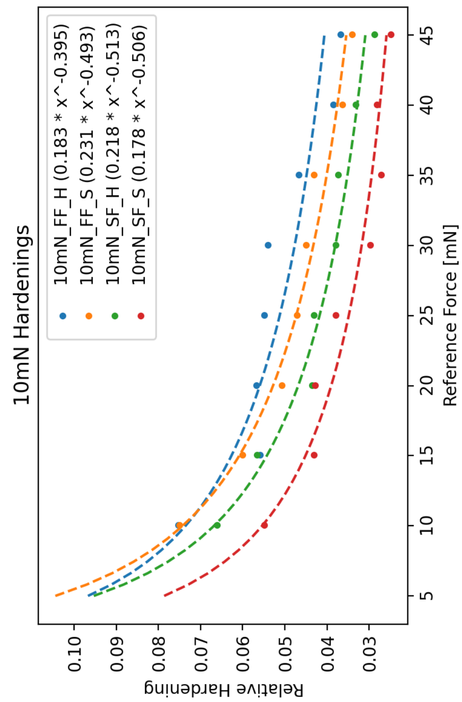


(b) Protocols with slow loading.

Figure 42: Average relative hardening for 2mN unloading, with power fit.

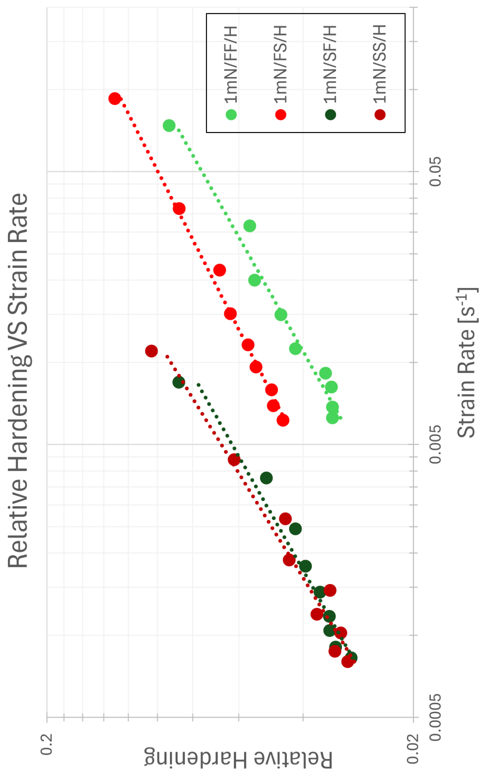


(a) 5mN unloading.

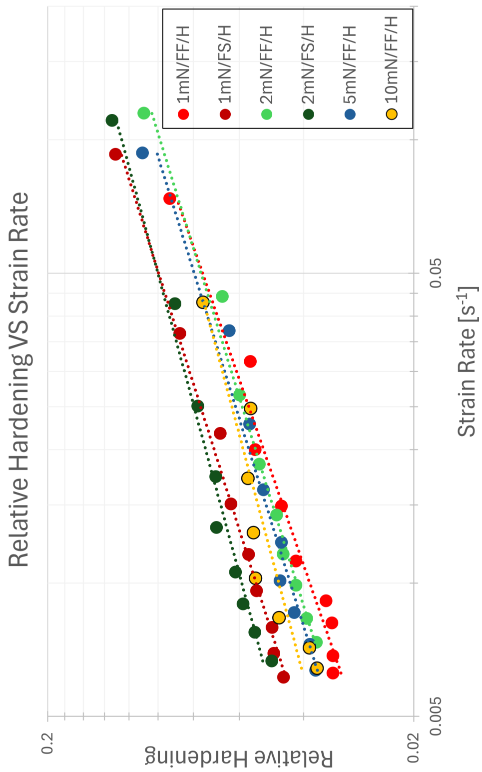


(b) 10mN unloading.

Figure 43: Average relative hardening, with power fit.



(a) 1mN/H



(b) Fx/H

Figure 44: Average relative hardening over average elastic strain for different selections of experiment series.

5. Discussion and Conclusions

One question this thesis set out to answer was whether the method for pop-in detection described by Ebner et al. was suitable for the detection of pop-ins after unloading. Judging by the results visualized in Fig. 20, Fig. 21, Fig. 22 and other pop-ins analyzed with it, the method seems well-suited.

The count and size of pop-ins and size of force overshoots all vary with the parameters of the specific experiment. While these relationships are complex, certain trends stood out in analysing the data. (See **Appendix A**)

For **pop-in counts**:

- Slow **loading rate** ($0.1\ mN/s$) seems to produce more pop-ins compared to the high **loading rate** ($1\ mN/s$).
- Fast **unloading rate** seems to produce more pop-ins. An exception to this being the $43 - 50\ mN$ loading segment with 2 mN unloading, which stands out significantly.
- For the same **unloading time** achieved by different unloading rate and size combinations, like 1mN/FS and 10mN/FF, the larger **unloading amount** seems associated with higher pop-in counts. This effect seems to be more pronounced with a fast loading rate and independent of local hardness.
- **Local hardness** makes the largest difference at low forces, whereas hard and soft areas display roughly equalized pop-in counts at high force segments.
- Comparing pop-in counts by **loading segments**, higher forces seem to correspond to higher counts. This is especially pronounced for larger unloading amounts (5mN, 10mN).

For **pop-in sizes**:

- Fast **loading rate** seems to correspond to larger pop-ins.
- **Unloading rate** shows an impact on the pop-in size (cf. Fig. 25 and Fig. 26) with a trend to larger pop-in size after slow unloading.
- Comparing equal **unloading times**, the larger **unloading amount** seems to produce larger pop-ins. The amount alone has no obvious effect on the average pop-in size.
- The effect of **local hardness** on the pop-in size seems to vary with the loading and unloading rate. (cf. Fig. 25 and Fig. 26).
- Comparing **loading segments**, the average pop-in size seems to decrease with the maximum force (cf. Fig. 25 and Fig. 26). This is confirmed for the first pop-ins in a segment (cf. Fig. 28) as well as for the rest (cf. Fig. 27). Nevertheless, larger pop-ins ($> 2\ nm$) increase their size with load or indentation depth (cf. Fig. 29 and Fig. 30), which is in agreement with literature. [30]

For **pop-in load**:

- **Loading rate** affects the load at which the first pop-in of a nanoindentation curve occurs, as shown by the CFD of the first loading segment (cf. Fig. 33). A higher loading rate leads to higher mean loads for the initiation of the first pop-in and therefore for the onset of yielding by propagation of a shear band. A discussion of the effect of alloying on the first pop-in distribution can be found in [31].

Some observed effects on the **force overshoots** are:

- Fast **loading rate** seems related to larger overshoots. (cf. Fig. 37 and Fig. 38)
- Slow **unloading rate** seems related to larger overshoots, as a longer time for unloading allows for more relaxation to take place and thereby reducing the number of potential STZs for the following reloading, resulting in a higher force overshoot. This is especially pronounced for the higher loading rate (cf. Fig. 37 and Fig. 38), and is reflected in an increased hardening (cf. Fig. 41, Fig. 42 and Fig. 43).
- Equal **unloading time** leads to a higher force overshoot if the **unloading amount** is smaller, due to a longer time at higher stress. With equal loading rates, the larger unloading amount shows larger overshoots for measurements in hard areas, while this effect seems to be absent in soft regions (cf. Fig. 37 and Fig. 38).
- For **local hardness**, the effect on the overshoot size seems mostly negligible. The exception being measurements with 5 mN and 10 mN unloading size, where higher hardness corresponds to slightly larger overshoots (cf. Fig. 40a and Fig. 40b).
- Comparing overshoot sizes by **loading segments**, the average overshoot size increases with the reference force (cf. Fig. 37 and Fig. 38).

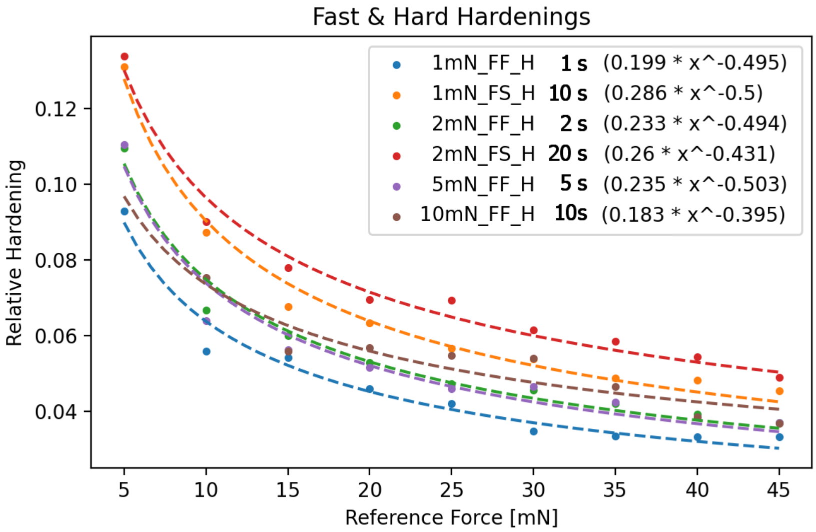
The correlation between the unfiltered size and load at which pop-ins occur is depicted in Fig. 27 and Fig. 28.The amount of small pop-ins, just above the detection threshold, increases with the load, leading to negative correlation coefficients. The two diagrams with filtered data, only containing "large" pop-ins ($> 2nm$), is depicted in Fig. 29 and Fig. 30. The conclusion drawn from this data is that the amount of small pop-ins increases, while the large pop-ins become bigger and less abundant with increasing load.

The comparison of average load at first pop-ins and force overshoots is depicted in Fig. 31,Fig. 32 and Table 8, showing that the two do not seem to be strongly related. This indicates that pop-ins with sizes $> 0.5\ nm$ can occur at lower loads than the respective force overshoot. Consequently single pop-in events related to the initiation or reactivation of existing shear bands seem likely even at lower loads before large plastic deformation is detected at the overshoot force.

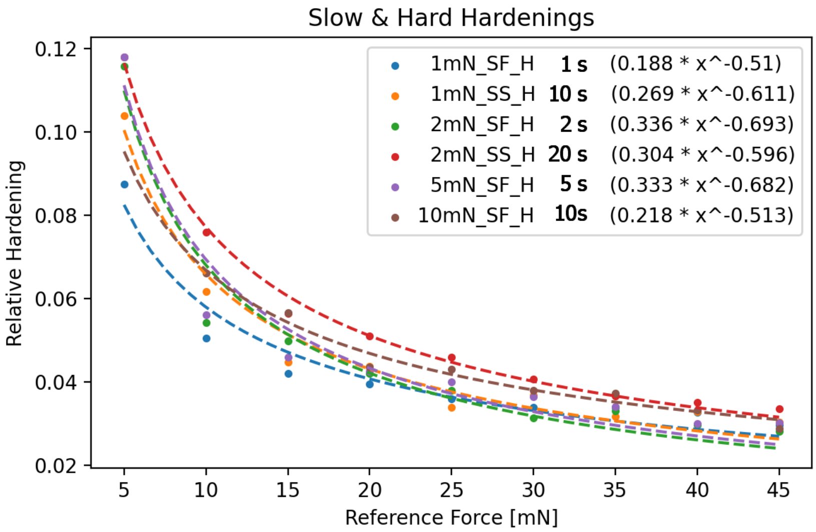
The average relative hardening values depicted in Fig. 41, Fig. 42 and Fig. 43 show that slow unloading and fast loading correspond to higher hardening. The effect of unloading duration on sample hardening can be seen in Fig. 45, with longer unloading time resulting in more hardening. With equal unloading time, the smaller unloading amount produces larger hardening as discussed for the force overshoot above. The small ranges of variation in the fit parameters also look promising. The effect of unloading duration on hardening is also evident when relative hardening is plotted as a function of strain-rate (cf. Fig. 44). Therefore, it can be concluded that the degree of relative hardening increases with the duration of unloading and the strain-rate for reloading.

The seemingly small influence of local hardness on many results could very well be a consequence of the low degree of structural modification of the sample and lack of accurate hardness data per indent.

A summary of the impact of loading and unloading rate on various parameters important for plastic deformation of BMGs is listed in Table 10.



(a) Fast loading rate.



(b) Slow loading rate.

Figure 45: Average relative hardening for different measurement protocols on hard areas of the sample. Unloading times are listed in the legend.

	Pop-In		**Force Overshoot**	**Hardening**
	Count	Mean Size		
Loading Rate				
Low	High	Small	Small	Reduced
High	Reduced	Large	Large	Increased
Unloading Rate				
Low	Small	Large	Large	Increased
High	High	Reduced	Small	Reduced
Load				
Low	Low	High	Small	Large
High	High	Low	Large	Smaller

Table 10: Summarized influence of loading and unloading rate on plastic deformation behaviour of BMGs.

6. Future Research

As this thesis offered a rather broad look at indentation experiments with cyclic loading on a sample of metallic glass, there is ample opportunity for future work.

Investigating and understanding the effect of cyclic loading measurements on the indenter tip would allow for accounting for them better in future experiments.

Conducting experiments with the same measurement protocols on an as-cast sample and a sample that was put through more turns of HPT treatment and therefore experienced more structural modification could help understand the influence of sample hardness better.

Additional measurement protocols that could provide insightful data include 5 mN and 10 mN unloading sizes with a slow unloading speed, different unloading sizes like 3 mN and 4 mN and different loading/unloading rates like 0.5 mN/s and 2 mN/s.

Doing more in-depth analysis on the data recorded for this thesis could also provide new insights, e.g. by analyzing the data with a deep learning tool and then comparing these results to those presented in this thesis.

Simulating force overshoots with respect to different loading and unloading parameters by using the shear transformation model could also help understand how the evolution of the population of STZs during unloading and reloading influences the force overshoots.

Appendizes

A. Compiled Statistical and Histogram Data

Statistical Data on Pop-In Counts

-	Avg.	St.D.	Var.	Max.	Min.
1mN/0-5/FF/H	2.54	1.8	3.25	7	0
1mN/4-10/FF/H	6	1.92	3.7	11	1
1mN/9-15/FF/H	6.15	1.97	3.88	11	2
1mN/14-20/FF/H	4.8	1.89	3.56	11	2
1mN/19-25/FF/H	5.12	2.75	7.56	15	2
1mN/24-30/FF/H	4.68	1.74	3.02	9	2
1mN/29-35/FF/H	4.98	3.19	10.17	17	1
1mN/34-40/FF/H	5.63	2.9	8.39	11	1
1mN/39-45/FF/H	5.27	3.04	9.25	16	1
1mN/44-50/FF/H	5	2.17	4.7	9	1
1mN/0-5/FF/S	1.05	1.23	1.51	5	0
1mN/4-10/FF/S	4.52	2.11	4.45	9	0
1mN/9-15/FF/S	4.57	2.48	6.15	12	1
1mN/14-20/FF/S	3.74	1.8	3.22	8	1
1mN/19-25/FF/S	4.05	1.83	3.36	8	1
1mN/24-30/FF/S	3.83	1.94	3.75	9	1
1mN/29-35/FF/S	5.55	3.13	9.81	13	1
1mN/34-40/FF/S	4.81	2.36	5.57	11	1
1mN/39-45/FF/S	4.86	2.8	7.83	12	1
1mN/44-50/FF/S	5.86	2.62	6.86	14	1
1mN/0-5/FS/H	1.63	1.46	2.14	6	0
1mN/4-10/FS/H	5.8	2.68	7.16	13	1
1mN/9-15/FS/H	5.44	2.59	6.7	17	2
1mN/14-20/FS/H	4.29	2.03	4.11	11	1
1mN/19-25/FS/H	4.05	1.67	2.8	8	1
1mN/24-30/FS/H	3.63	2.05	4.19	13	1
1mN/29-35/FS/H	3.76	1.87	3.49	8	1
1mN/34-40/FS/H	3.68	1.66	2.77	7	1
1mN/39-45/FS/H	4.56	2.4	5.75	9	1
1mN/44-50/FS/H	3.9	2.34	5.49	11	1
1mN/0-5/FS/S	1.31	1.33	1.78	5	0
1mN/4-10/FS/S	4.74	2.57	6.59	11	0
1mN/9-15/FS/S	5	2.65	7.02	13	1
1mN/14-20/FS/S	4.48	2.14	4.6	9	1
1mN/19-25/FS/S	3.36	1.83	3.36	9	1
1mN/24-30/FS/S	3.6	2.23	4.98	10	1
1mN/29-35/FS/S	3.9	1.91	3.65	8	1
1mN/34-40/FS/S	3.9	1.79	3.21	8	1
1mN/39-45/FS/S	4.19	2.43	5.91	13	1
1mN/44-50/FS/S	3.88	2.01	4.06	8	1
1mN/0-5/SF/H	6.05	2.33	5.45	10	1
1mN/4-10/SF/H	7.46	1.82	3.3	12	3
1mN/9-15/SF/H	6.98	2.26	5.12	11	2
1mN/14-20/SF/H	7.22	2.29	5.23	12	2
1mN/19-25/SF/H	6.39	2.1	4.39	13	3
1mN/24-30/SF/H	6.17	2.56	6.55	14	2
1mN/29-35/SF/H	8.49	2.79	7.81	16	4
1mN/34-40/SF/H	7.71	2.38	5.66	12	3
1mN/39-45/SF/H	8.85	2.77	7.68	14	1
1mN/44-50/SF/H	8.44	3.19	10.15	18	4

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
1mN/0-5/SF/S	4.07	2.37	5.63	10	0
1mN/4-10/SF/S	6.93	2.68	7.19	13	2
1mN/9-15/SF/S	6.52	1.97	3.87	11	3
1mN/14-20/SF/S	6.33	2.46	6.03	13	2
1mN/19-25/SF/S	6.45	2.96	8.74	15	2
1mN/24-30/SF/S	7.5	2.85	8.11	14	2
1mN/29-35/SF/S	6.86	2.46	6.03	14	1
1mN/34-40/SF/S	7.62	2.61	6.83	15	2
1mN/39-45/SF/S	7.55	3	8.99	13	2
1mN/44-50/SF/S	7.5	3.08	9.48	13	2
1mN/0-5/SS/H	3.19	1.76	3.08	8	0
1mN/4-10/SS/H	6.83	1.61	2.58	10	3
1mN/9-15/SS/H	6.31	1.83	3.34	12	3
1mN/14-20/SS/H	5.81	2.06	4.26	10	2
1mN/19-25/SS/H	6.43	2.57	6.59	16	2
1mN/24-30/SS/H	6.14	2.17	4.71	12	2
1mN/29-35/SS/H	6.29	2.49	6.21	14	2
1mN/34-40/SS/H	6.81	3.13	9.82	14	2
1mN/39-45/SS/H	7.5	2.77	7.67	15	3
1mN/44-50/SS/H	7.21	2.42	5.88	13	2
1mN/0-5/SS/S	3.26	1.59	2.54	7	0
1mN/4-10/SS/S	6.43	2.03	4.1	11	3
1mN/9-15/SS/S	6.98	2.71	7.34	14	2
1mN/14-20/SS/S	6.57	2.55	6.49	15	3
1mN/19-25/SS/S	6.43	2.45	6.01	13	1
1mN/24-30/SS/S	6.4	2.59	6.69	11	1
1mN/29-35/SS/S	7.52	3.21	10.3	15	3
1mN/34-40/SS/S	7.29	2.97	8.84	16	1
1mN/39-45/SS/S	7.69	3.59	12.9	19	2
1mN/44-50/SS/S	7.36	3.35	11.21	20	1
2mN/0-5/FF/H	1.76	1.85	3.41	7	0
2mN/3-10/FF/H	6.52	2.99	8.94	14	0
2mN/8-15/FF/H	5.45	2.99	8.94	14	1
2mN/13-20/FF/H	4.48	1.95	3.82	9	1
2mN/18-25/FF/H	4.93	2.16	4.65	11	2
2mN/23-30/FF/H	5.36	3.24	10.53	12	1
2mN/28-35/FF/H	4.64	2.9	8.38	14	1
2mN/33-40/FF/H	5.12	2.55	6.5	12	1
2mN/38-45/FF/H	4.79	3.01	9.05	13	1
2mN/43-50/FF/H	4.38	2.14	4.58	9	1
2mN/0-5/FF/S	1.26	1.34	1.81	5	0
2mN/3-10/FF/S	5.69	3.2	10.22	13	1
2mN/8-15/FF/S	5.55	2.14	4.6	11	1
2mN/13-20/FF/S	5	2.59	6.68	14	1
2mN/18-25/FF/S	4.57	2.68	7.18	12	1
2mN/23-30/FF/S	5.02	2.49	6.22	12	1
2mN/28-35/FF/S	4.67	3.06	9.35	15	1
2mN/33-40/FF/S	4.81	3.1	9.62	15	1
2mN/38-45/FF/S	5.86	2.91	8.47	12	1
2mN/43-50/FF/S	4.83	2.42	5.85	14	2
2mN/0-5/FS/H	2.28	1.81	3.26	8	0
2mN/3-10/FS/H	5.54	2.39	5.73	10	1
2mN/8-15/FS/H	5.77	2.32	5.39	14	2
2mN/13-20/FS/H	4.15	2.36	5.55	13	1

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/18-25/FS/H	6.31	3.17	10.06	13	1
2mN/23-30/FS/H	3.92	1.9	3.6	9	1
2mN/28-35/FS/H	5.41	2.67	7.14	11	1
2mN/33-40/FS/H	5.36	2.75	7.55	12	1
2mN/38-45/FS/H	4.38	2.31	5.35	13	1
2mN/43-50/FS/H	10.62	3.74	13.98	18	4
2mN/0-5/FS/S	1.24	1.21	1.45	4	0
2mN/3-10/FS/S	4.71	2.62	6.84	11	0
2mN/8-15/FS/S	4.79	3.18	10.12	15	0
2mN/13-20/FS/S	4.76	2.92	8.53	12	1
2mN/18-25/FS/S	6.24	2.65	7.02	12	1
2mN/23-30/FS/S	4.05	1.99	3.95	9	1
2mN/28-35/FS/S	5.79	2.28	5.2	10	1
2mN/33-40/FS/S	5.55	2.62	6.89	11	1
2mN/38-45/FS/S	4.62	2.29	5.27	11	1
2mN/43-50/FS/S	11.74	3.55	12.64	20	5
2mN/0-5/SF/H	3.21	1.72	2.95	7	0
2mN/3-10/SF/H	6.12	2.4	5.77	13	2
2mN/8-15/SF/H	5.07	1.64	2.7	8	1
2mN/13-20/SF/H	5.05	1.81	3.27	9	2
2mN/18-25/SF/H	4.57	1.55	2.4	9	1
2mN/23-30/SF/H	4.36	1.87	3.5	9	1
2mN/28-35/SF/H	5.86	2.47	6.08	15	2
2mN/33-40/SF/H	5.07	2.25	5.04	12	1
2mN/38-45/SF/H	5.52	2.74	7.52	13	1
2mN/43-50/SF/H	6.05	2.7	7.31	12	2
2mN/0-5/SF/S	3.21	1.87	3.49	7	0
2mN/3-10/SF/S	4.74	1.47	2.15	9	1
2mN/8-15/SF/S	4.83	1.85	3.41	10	2
2mN/13-20/SF/S	4.24	1.57	2.48	8	0
2mN/18-25/SF/S	4.95	2.12	4.49	10	2
2mN/23-30/SF/S	4.74	1.82	3.32	9	2
2mN/28-35/SF/S	5.19	2.13	4.55	11	1
2mN/33-40/SF/S	5.74	2.57	6.59	14	2
2mN/38-45/SF/S	6.55	3.13	9.81	15	1
2mN/43-50/SF/S	6.29	2.29	5.23	11	1
2mN/0-5/SS/H	3.26	1.77	3.12	7	0
2mN/3-10/SS/H	5.98	2.08	4.32	10	1
2mN/8-15/SS/H	4.86	1.51	2.27	8	3
2mN/13-20/SS/H	5.24	2.1	4.43	14	2
2mN/18-25/SS/H	5.36	2.55	6.53	12	1
2mN/23-30/SS/H	6.21	3.08	9.49	17	2
2mN/28-35/SS/H	6.24	2.17	4.72	12	2
2mN/33-40/SS/H	6.67	2.31	5.35	11	2
2mN/38-45/SS/H	5.98	2.24	5	13	3
2mN/43-50/SS/H	6.69	3.19	10.17	14	2
2mN/0-5/SS/S	3.6	1.67	2.78	7	0
2mN/3-10/SS/S	5.33	1.87	3.5	10	2
2mN/8-15/SS/S	4.21	1.44	2.07	8	1
2mN/13-20/SS/S	4.55	1.92	3.67	9	1
2mN/18-25/SS/S	4.62	2.34	5.46	11	1
2mN/23-30/SS/S	4.81	1.98	3.91	10	2
2mN/28-35/SS/S	5.1	2.6	6.77	11	2
2mN/33-40/SS/S	5.57	2.86	8.2	14	1

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/38-45/SS/S	5.62	2.09	4.39	9	1
2mN/43-50/SS/S	5.71	2.82	7.97	12	2
5mN/0-5/FF/H	2.44	1.55	2.4	6	0
5mN/0-10/FF/H	6.59	2.17	4.7	12	3
5mN/5-15/FF/H	6.02	2.53	6.42	14	1
5mN/10-20/FF/H	5.85	2.2	4.83	11	2
5mN/15-25/FF/H	5.95	3.07	9.45	17	2
5mN/20-30/FF/H	7.17	3.07	9.4	14	2
5mN/25-35/FF/H	7.95	3.44	11.85	18	2
5mN/30-40/FF/H	7.85	3.6	12.98	19	1
5mN/35-45/FF/H	8.41	3.58	12.8	18	3
5mN/40-50/FF/H	8.29	3.41	11.61	17	1
5mN/0-5/FF/S	1.12	1.23	1.52	5	0
5mN/0-10/FF/S	5	2.02	4.1	11	2
5mN/5-15/FF/S	5.36	2.05	4.19	11	2
5mN/10-20/FF/S	6.02	2.71	7.34	13	2
5mN/15-25/FF/S	6.83	2.7	7.26	13	1
5mN/20-30/FF/S	7.26	2.36	5.56	13	3
5mN/25-35/FF/S	7.29	3.15	9.92	15	3
5mN/30-40/FF/S	7.38	3.11	9.66	13	2
5mN/35-45/FF/S	7.81	3.31	10.94	14	1
5mN/40-50/FF/S	8.48	3.93	15.48	18	2
5mN/0-5/SF/H	5.33	2.26	5.11	10	1
5mN/0-10/SF/H	8.07	2.69	7.24	15	3
5mN/5-15/SF/H	11.26	5.55	30.83	26	3
5mN/10-20/SF/H	13.71	7.23	52.26	31	4
5mN/15-25/SF/H	13.95	7.71	59.51	28	3
5mN/20-30/SF/H	15.57	7.3	53.23	29	5
5mN/25-35/SF/H	14.88	7.65	58.45	34	5
5mN/30-40/SF/H	15.74	6.14	37.66	31	5
5mN/35-45/SF/H	16.57	5.22	27.28	32	9
5mN/40-50/SF/H	16.02	6.87	47.24	31	6
5mN/0-5/SF/S	5.05	2.4	5.75	11	1
5mN/0-10/SF/S	7.31	1.58	2.51	10	3
5mN/5-15/SF/S	8.14	2.74	7.49	15	3
5mN/10-20/SF/S	8	2.69	7.22	14	3
5mN/15-25/SF/S	9.02	2.8	7.83	18	3
5mN/20-30/SF/S	10.52	3.87	14.94	28	4
5mN/25-35/SF/S	11.14	3.23	10.42	16	5
5mN/30-40/SF/S	11.67	3.17	10.03	18	6
5mN/35-45/SF/S	11.93	3.93	15.48	21	7
5mN/40-50/SF/S	11.21	3.42	11.68	21	5
10mN/0-10/FF/H	8.69	2.61	6.8	15	3
10mN/0-15/FF/H	6.69	2.47	6.12	15	3
10mN/5-20/FF/H	6.9	3.25	10.58	16	1
10mN/10-25/FF/H	8.14	3.36	11.3	15	3
10mN/15-30/FF/H	9.17	3.9	15.22	19	3
10mN/20-35/FF/H	10.45	4.02	16.16	21	3
10mN/25-40/FF/H	11.05	3.99	15.95	19	4
10mN/30-45/FF/H	11.64	4.16	17.31	26	5
10mN/35-50/FF/H	13.86	4.9	24.03	28	3
10mN/0-10/FF/S	7.29	2.62	6.86	13	2
10mN/0-15/FF/S	6.34	1.92	3.68	11	3
10mN/5-20/FF/S	6.22	2.29	5.23	12	3

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
10mN/10-25/FF/S	8.29	3.23	10.41	18	3
10mN/15-30/FF/S	8.24	3.12	9.74	17	3
10mN/20-35/FF/S	9.76	3.3	10.89	17	4
10mN/25-40/FF/S	10.56	3.02	9.1	17	5
10mN/30-45/FF/S	12.07	3.65	13.32	19	6
10mN/35-50/FF/S	12.98	4.56	20.77	27	7
10mN/0-10/SF/H	8.66	3.06	9.38	14	2
10mN/0-15/SF/H	5.34	1.87	3.48	10	1
10mN/5-20/SF/H	4.44	1.53	2.35	8	1
10mN/10-25/SF/H	5.73	2.01	4.05	10	2
10mN/15-30/SF/H	7.34	2.84	8.08	15	2
10mN/20-35/SF/H	7.54	2.97	8.8	15	3
10mN/25-40/SF/H	9.29	2.97	8.81	17	4
10mN/30-45/SF/H	9.2	3.54	12.56	19	3
10mN/35-50/SF/H	10.1	3.58	12.84	19	2
10mN/0-10/SF/S	8.63	3.48	12.14	17	1
10mN/0-15/SF/S	6.15	1.51	2.28	9	4
10mN/5-20/SF/S	5.27	1.63	2.65	11	3
10mN/10-25/SF/S	5.83	2	4	12	3
10mN/15-30/SF/S	6.41	2.56	6.55	12	2
10mN/20-35/SF/S	7.98	2.4	5.77	12	2
10mN/25-40/SF/S	8.68	3.1	9.62	15	3
10mN/30-45/SF/S	9.2	3.11	9.66	16	3
10mN/35-50/SF/S	10.12	3.36	11.26	17	5

Statistical Data on Pop-In Sizes

-	Avg.	St.D.	Var.	Max.	Min.
1mN/0-5/FF/H	0.002352	0.00094	8.83E-07	0.006938	0.000619
1mN/4-10/FF/H	0.002257	0.001126	1.27E-06	0.006406	0.00052
1mN/9-15/FF/H	0.00185	0.00105	1.1E-06	0.005699	0.000508
1mN/14-20/FF/H	0.002007	0.00139	1.93E-06	0.006325	0.000501
1mN/19-25/FF/H	0.001929	0.001568	2.46E-06	0.007635	0.000503
1mN/24-30/FF/H	0.001831	0.001392	1.94E-06	0.006584	0.000511
1mN/29-35/FF/H	0.0016	0.001305	1.7E-06	0.007511	0.000505
1mN/34-40/FF/H	0.001517	0.001398	1.95E-06	0.010431	0.0005
1mN/39-45/FF/H	0.001316	0.000938	8.8E-07	0.006536	0.000504
1mN/44-50/FF/H	0.001339	0.001072	1.15E-06	0.007412	0.000502
1mN/0-5/FF/S	0.002037	0.000836	6.99E-07	0.003933	0.000522
1mN/4-10/FF/S	0.001836	0.000811	6.58E-07	0.004497	0.000504
1mN/9-15/FF/S	0.001438	0.000816	6.66E-07	0.005256	0.000501
1mN/14-20/FF/S	0.001559	0.001166	1.36E-06	0.006904	0.000501
1mN/19-25/FF/S	0.001462	0.001144	1.31E-06	0.006137	0.000501
1mN/24-30/FF/S	0.001452	0.001136	1.29E-06	0.006712	0.000506
1mN/29-35/FF/S	0.001323	0.000928	8.61E-07	0.006641	0.000504
1mN/34-40/FF/S	0.00131	0.001124	1.26E-06	0.008129	0.000504
1mN/39-45/FF/S	0.001297	0.001111	1.24E-06	0.007641	0.000509
1mN/44-50/FF/S	0.001259	0.001077	1.16E-06	0.007948	0.000505
1mN/0-5/FS/H	0.001995	0.000962	9.25E-07	0.006166	0.00051
1mN/4-10/FS/H	0.001917	0.000924	8.54E-07	0.007996	0.000513
1mN/9-15/FS/H	0.001819	0.0011	1.21E-06	0.00535	0.000513
1mN/14-20/FS/H	0.001871	0.001318	1.74E-06	0.006609	0.000509
1mN/19-25/FS/H	0.001879	0.001624	2.64E-06	0.009872	0.000501
1mN/24-30/FS/H	0.001861	0.001521	2.31E-06	0.007072	0.000501
1mN/29-35/FS/H	0.001792	0.001629	2.65E-06	0.009369	0.000502

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
1mN/34-40/FS/H	0.001693	0.001679	2.82E-06	0.009037	0.000507
1mN/39-45/FS/H	0.001545	0.001504	2.26E-06	0.009398	0.000504
1mN/44-50/FS/H	0.001515	0.001433	2.05E-06	0.009885	0.000502
1mN/0-5/FS/S	0.002194	0.0011	1.21E-06	0.006923	0.000587
1mN/4-10/FS/S	0.001907	0.000858	7.36E-07	0.004969	0.000511
1mN/9-15/FS/S	0.001856	0.001099	1.21E-06	0.005019	0.000505
1mN/14-20/FS/S	0.001721	0.001314	1.73E-06	0.006406	0.000508
1mN/19-25/FS/S	0.001913	0.001636	2.68E-06	0.008026	0.000504
1mN/24-30/FS/S	0.00167	0.001438	2.07E-06	0.00742	0.000504
1mN/29-35/FS/S	0.001654	0.001432	2.05E-06	0.006857	0.000513
1mN/34-40/FS/S	0.00154	0.001506	2.27E-06	0.008103	0.000505
1mN/39-45/FS/S	0.001516	0.001342	1.8E-06	0.008276	0.00051
1mN/44-50/FS/S	0.001384	0.00123	1.51E-06	0.007348	0.000503
1mN/0-5/SF/H	0.001786	0.000832	6.92E-07	0.005388	0.000513
1mN/4-10/SF/H	0.001578	0.00091	8.27E-07	0.007127	0.000501
1mN/9-15/SF/H	0.001472	0.000953	9.07E-07	0.005916	0.000502
1mN/14-20/SF/H	0.001333	0.00103	1.06E-06	0.008875	0.000507
1mN/19-25/SF/H	0.001268	0.000982	9.64E-07	0.007007	0.0005
1mN/24-30/SF/H	0.001269	0.001297	1.68E-06	0.008328	0.000503
1mN/29-35/SF/H	0.001053	0.000748	5.59E-07	0.006259	0.0005
1mN/34-40/SF/H	0.001117	0.001008	1.02E-06	0.007314	0.000502
1mN/39-45/SF/H	0.001012	0.000772	5.97E-07	0.007767	0.000501
1mN/44-50/SF/H	0.00096	0.000587	3.45E-07	0.005511	0.000501
1mN/0-5/SF/S	0.001806	0.001726	2.98E-06	0.021491	0.000504
1mN/4-10/SF/S	0.001293	0.000759	5.76E-07	0.004482	0.000503
1mN/9-15/SF/S	0.001378	0.001212	1.47E-06	0.015014	0.000503
1mN/14-20/SF/S	0.001371	0.001355	1.84E-06	0.014668	0.000502
1mN/19-25/SF/S	0.001112	0.00083	6.88E-07	0.00516	0.000501
1mN/24-30/SF/S	0.001102	0.000939	8.82E-07	0.006937	0.000503
1mN/29-35/SF/S	0.001184	0.001142	1.3E-06	0.008699	0.000508
1mN/34-40/SF/S	0.001103	0.000977	9.54E-07	0.00668	0.0005
1mN/39-45/SF/S	0.001094	0.001089	1.19E-06	0.008093	0.000504
1mN/44-50/SF/S	0.000993	0.000884	7.82E-07	0.006378	0.000503
1mN/0-5/SS/H	0.001678	0.000862	7.42E-07	0.005028	0.000508
1mN/4-10/SS/H	0.001808	0.001006	1.01E-06	0.00599	0.000513
1mN/9-15/SS/H	0.001625	0.001266	1.6E-06	0.0093	0.000502
1mN/14-20/SS/H	0.001529	0.00124	1.54E-06	0.006853	0.000502
1mN/19-25/SS/H	0.00139	0.001085	1.18E-06	0.006171	0.000502
1mN/24-30/SS/H	0.001435	0.001425	2.03E-06	0.008534	0.000505
1mN/29-35/SS/H	0.001241	0.001209	1.46E-06	0.008073	0.000502
1mN/34-40/SS/H	0.001166	0.001198	1.43E-06	0.009783	0.000501
1mN/39-45/SS/H	0.00109	0.001087	1.18E-06	0.007851	0.0005
1mN/44-50/SS/H	0.001093	0.001065	1.13E-06	0.007905	0.0005
1mN/0-5/SS/S	0.00145	0.000655	4.3E-07	0.00392	0.000511
1mN/4-10/SS/S	0.00148	0.000878	7.7E-07	0.006158	0.000503
1mN/9-15/SS/S	0.001313	0.00101	1.02E-06	0.007332	0.000501
1mN/14-20/SS/S	0.001261	0.001	9.99E-07	0.005491	0.000502
1mN/19-25/SS/S	0.001228	0.000945	8.93E-07	0.006741	0.000501
1mN/24-30/SS/S	0.001192	0.001027	1.05E-06	0.007265	0.000502
1mN/29-35/SS/S	0.001241	0.001143	1.31E-06	0.00844	0.000502
1mN/34-40/SS/S	0.001045	0.000813	6.61E-07	0.00735	0.000502
1mN/39-45/SS/S	0.001082	0.001137	1.29E-06	0.011151	0.0005
1mN/44-50/SS/S	0.001018	0.000741	5.49E-07	0.007523	0.000501
2mN/0-5/FF/H	0.001918	0.000859	7.37E-07	0.005227	0.000545

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/3-10/FF/H	0.001805	0.00093	8.65E-07	0.005932	0.000514
2mN/8-15/FF/H	0.001633	0.001153	1.33E-06	0.006487	0.000503
2mN/13-20/FF/H	0.001669	0.001325	1.75E-06	0.007153	0.000521
2mN/18-25/FF/H	0.001458	0.00121	1.46E-06	0.006917	0.000503
2mN/23-30/FF/H	0.001403	0.001209	1.46E-06	0.006742	0.0005
2mN/28-35/FF/H	0.001427	0.001452	2.11E-06	0.008747	0.000501
2mN/33-40/FF/H	0.001301	0.00112	1.25E-06	0.006108	0.000501
2mN/38-45/FF/H	0.001272	0.001075	1.16E-06	0.007008	0.000505
2mN/43-50/FF/H	0.001264	0.001171	1.37E-06	0.00768	0.000501
2mN/0-5/FF/S	0.002202	0.000762	5.81E-07	0.00499	0.000816
2mN/3-10/FF/S	0.001824	0.000962	9.25E-07	0.006708	0.000525
2mN/8-15/FF/S	0.001749	0.001175	1.38E-06	0.007251	0.000504
2mN/13-20/FF/S	0.00159	0.001291	1.67E-06	0.006577	0.000501
2mN/18-25/FF/S	0.00165	0.001591	2.53E-06	0.009438	0.000501
2mN/23-30/FF/S	0.00151	0.001595	2.54E-06	0.009426	0.000503
2mN/28-35/FF/S	0.001503	0.001457	2.12E-06	0.0085	0.0005
2mN/33-40/FF/S	0.001462	0.001392	1.94E-06	0.009441	0.000501
2mN/38-45/FF/S	0.001331	0.001331	1.77E-06	0.008875	0.0005
2mN/43-50/FF/S	0.001268	0.001256	1.58E-06	0.008441	0.000502
2mN/0-5/FS/H	0.002428	0.001455	2.12E-06	0.008613	0.000532
2mN/3-10/FS/H	0.002057	0.001223	1.5E-06	0.0077	0.0005
2mN/8-15/FS/H	0.001885	0.001226	1.5E-06	0.007264	0.000518
2mN/13-20/FS/H	0.001924	0.00158	2.49E-06	0.007384	0.000503
2mN/18-25/FS/H	0.001482	0.001331	1.77E-06	0.007107	0.000501
2mN/23-30/FS/H	0.001719	0.001687	2.85E-06	0.009199	0.000503
2mN/28-35/FS/H	0.001501	0.001511	2.28E-06	0.009712	0.000501
2mN/33-40/FS/H	0.001416	0.001488	2.21E-06	0.010574	0.000501
2mN/38-45/FS/H	0.001544	0.001468	2.16E-06	0.008727	0.000503
2mN/43-50/FS/H	0.001241	0.000945	8.94E-07	0.007475	0.000501
2mN/0-5/FS/S	0.002056	0.001058	1.12E-06	0.007594	0.000538
2mN/3-10/FS/S	0.001895	0.000979	9.58E-07	0.005916	0.000504
2mN/8-15/FS/S	0.001826	0.001254	1.57E-06	0.006584	0.000501
2mN/13-20/FS/S	0.001873	0.001524	2.32E-06	0.007863	0.000502
2mN/18-25/FS/S	0.001603	0.001541	2.37E-06	0.009165	0.000502
2mN/23-30/FS/S	0.001869	0.002033	4.13E-06	0.011808	0.000503
2mN/28-35/FS/S	0.001594	0.001649	2.72E-06	0.01015	0.0005
2mN/33-40/FS/S	0.001656	0.001824	3.33E-06	0.012276	0.000506
2mN/38-45/FS/S	0.00163	0.001702	2.9E-06	0.008562	0.000513
2mN/43-50/FS/S	0.001234	0.001001	1E-06	0.009792	0.000501
2mN/0-5/SF/H	0.001842	0.001259	1.58E-06	0.008454	0.000576
2mN/3-10/SF/H	0.001562	0.000902	8.14E-07	0.004917	0.000505
2mN/8-15/SF/H	0.001595	0.001087	1.18E-06	0.00504	0.000502
2mN/13-20/SF/H	0.001476	0.001184	1.4E-06	0.006193	0.000506
2mN/18-25/SF/H	0.001294	0.001178	1.39E-06	0.006695	0.000501
2mN/23-30/SF/H	0.001382	0.001328	1.76E-06	0.007796	0.000501
2mN/28-35/SF/H	0.001069	0.000885	7.83E-07	0.005459	0.000501
2mN/33-40/SF/H	0.001172	0.00115	1.32E-06	0.007801	0.000505
2mN/38-45/SF/H	0.001024	0.000866	7.49E-07	0.005903	0.000501
2mN/43-50/SF/H	0.000981	0.000933	8.7E-07	0.007926	0.0005
2mN/0-5/SF/S	0.001591	0.000663	4.4E-07	0.003941	0.000556
2mN/3-10/SF/S	0.001703	0.001065	1.13E-06	0.005858	0.000519
2mN/8-15/SF/S	0.001888	0.001612	2.6E-06	0.007067	0.000502
2mN/13-20/SF/S	0.002076	0.00185	3.42E-06	0.007987	0.000504
2mN/18-25/SF/S	0.001731	0.001783	3.18E-06	0.009206	0.000501

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/23-30/SF/S	0.001809	0.001885	3.55E-06	0.008835	0.000505
2mN/28-35/SF/S	0.001488	0.001701	2.89E-06	0.009043	0.000501
2mN/33-40/SF/S	0.001532	0.00187	3.5E-06	0.011447	0.0005
2mN/38-45/SF/S	0.00128	0.001554	2.41E-06	0.010588	0.000501
2mN/43-50/SF/S	0.001209	0.001274	1.62E-06	0.009553	0.000501
2mN/0-5/SS/H	0.001993	0.001343	1.8E-06	0.0091	0.00052
2mN/3-10/SS/H	0.001875	0.00125	1.56E-06	0.008208	0.000502
2mN/8-15/SS/H	0.001714	0.001269	1.61E-06	0.007473	0.000507
2mN/13-20/SS/H	0.001596	0.001456	2.12E-06	0.006936	0.000501
2mN/18-25/SS/H	0.001354	0.001179	1.39E-06	0.00727	0.000503
2mN/23-30/SS/H	0.001241	0.001272	1.62E-06	0.009184	0.000501
2mN/28-35/SS/H	0.00112	0.001063	1.13E-06	0.008612	0.000501
2mN/33-40/SS/H	0.00113	0.001119	1.25E-06	0.007704	0.000502
2mN/38-45/SS/H	0.001061	0.000952	9.06E-07	0.006729	0.000502
2mN/43-50/SS/H	0.001011	0.00094	8.83E-07	0.00703	0.000502
2mN/0-5/SS/S	0.001759	0.000728	5.3E-07	0.003719	0.000617
2mN/3-10/SS/S	0.001764	0.001065	1.13E-06	0.004901	0.000504
2mN/8-15/SS/S	0.002051	0.001685	2.84E-06	0.008647	0.000502
2mN/13-20/SS/S	0.001799	0.001656	2.74E-06	0.007673	0.000502
2mN/18-25/SS/S	0.001671	0.001743	3.04E-06	0.00798	0.000502
2mN/23-30/SS/S	0.001669	0.001849	3.42E-06	0.009764	0.000501
2mN/28-35/SS/S	0.001619	0.002028	4.11E-06	0.010039	0.000503
2mN/33-40/SS/S	0.001334	0.001556	2.42E-06	0.010071	0.000501
2mN/38-45/SS/S	0.001367	0.001682	2.83E-06	0.009844	0.0005
2mN/43-50/SS/S	0.001206	0.001343	1.8E-06	0.008921	0.000501
5mN/0-5/FF/H	0.002357	0.000992	9.84E-07	0.005377	0.000647
5mN/0-10/FF/H	0.00211	0.001053	1.11E-06	0.006061	0.000507
5mN/5-15/FF/H	0.001806	0.001107	1.23E-06	0.006551	0.000501
5mN/10-20/FF/H	0.001849	0.001281	1.64E-06	0.008791	0.000512
5mN/15-25/FF/H	0.001762	0.00145	2.1E-06	0.007696	0.000507
5mN/20-30/FF/H	0.001661	0.001573	2.48E-06	0.010693	0.0005
5mN/25-35/FF/H	0.001564	0.001497	2.24E-06	0.011168	0.000505
5mN/30-40/FF/H	0.001529	0.001504	2.26E-06	0.009543	0.000503
5mN/35-45/FF/H	0.001324	0.001175	1.38E-06	0.008529	0.000502
5mN/40-50/FF/H	0.001191	0.001047	1.1E-06	0.009952	0.000504
5mN/0-5/FF/S	0.002116	0.000976	9.53E-07	0.004736	0.000684
5mN/0-10/FF/S	0.002089	0.000997	9.93E-07	0.006043	0.00055
5mN/5-15/FF/S	0.001802	0.001127	1.27E-06	0.006269	0.000506
5mN/10-20/FF/S	0.001547	0.000994	9.88E-07	0.006137	0.000503
5mN/15-25/FF/S	0.001437	0.000998	9.96E-07	0.007139	0.000502
5mN/20-30/FF/S	0.001466	0.001148	1.32E-06	0.007453	0.000502
5mN/25-35/FF/S	0.001433	0.001307	1.71E-06	0.009602	0.000512
5mN/30-40/FF/S	0.001399	0.001245	1.55E-06	0.008248	0.000504
5mN/35-45/FF/S	0.001264	0.001062	1.13E-06	0.007918	0.000502
5mN/40-50/FF/S	0.001213	0.001062	1.13E-06	0.00867	0.0005
5mN/0-5/SF/H	0.001786	0.000855	7.32E-07	0.006026	0.000506
5mN/0-10/SF/H	0.00157	0.000965	9.3E-07	0.006479	0.000507
5mN/5-15/SF/H	0.001195	0.000739	5.47E-07	0.005775	0.000502
5mN/10-20/SF/H	0.001183	0.000811	6.58E-07	0.006313	0.0005
5mN/15-25/SF/H	0.001185	0.000911	8.29E-07	0.008297	0.0005
5mN/20-30/SF/H	0.001107	0.000785	6.16E-07	0.007339	0.000502
5mN/25-35/SF/H	0.001106	0.000841	7.08E-07	0.007865	0.0005
5mN/30-40/SF/H	0.001075	0.00087	7.58E-07	0.009334	0.0005
5mN/35-45/SF/H	0.001017	0.000741	5.49E-07	0.007178	0.0005

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
5mN/40-50/SF/H	0.001061	0.000804	6.47E-07	0.008024	0.000501
5mN/0-5/SF/S	0.001674	0.000823	6.77E-07	0.007581	0.000518
5mN/0-10/SF/S	0.00164	0.002219	4.93E-06	0.034394	0.000501
5mN/5-15/SF/S	0.001329	0.000859	7.38E-07	0.005257	0.000501
5mN/10-20/SF/S	0.001333	0.001013	1.03E-06	0.005438	0.0005
5mN/15-25/SF/S	0.001306	0.001298	1.69E-06	0.008721	0.000502
5mN/20-30/SF/S	0.001235	0.001234	1.52E-06	0.008403	0.000502
5mN/25-35/SF/S	0.001239	0.001476	2.18E-06	0.010974	0.000503
5mN/30-40/SF/S	0.001158	0.001235	1.52E-06	0.009518	0.000501
5mN/35-45/SF/S	0.00115	0.001218	1.48E-06	0.00969	0.0005
5mN/40-50/SF/S	0.001049	0.00113	1.28E-06	0.010027	0.000501
10mN/0-10/FF/H	0.002292	0.000999	9.97E-07	0.008485	0.000514
10mN/0-15/FF/H	0.001855	0.000999	9.97E-07	0.005207	0.000506
10mN/5-20/FF/H	0.001766	0.001355	1.84E-06	0.007663	0.00051
10mN/10-25/FF/H	0.001631	0.001255	1.58E-06	0.007194	0.000501
10mN/15-30/FF/H	0.001533	0.0014	1.96E-06	0.009249	0.000501
10mN/20-35/FF/H	0.001408	0.001309	1.71E-06	0.008422	0.000502
10mN/25-40/FF/H	0.001348	0.001208	1.46E-06	0.008396	0.0005
10mN/30-45/FF/H	0.001299	0.001174	1.38E-06	0.010579	0.000502
10mN/35-50/FF/H	0.001205	0.001111	1.23E-06	0.010775	0.0005
10mN/0-10/FF/S	0.002244	0.001009	1.02E-06	0.006389	0.000559
10mN/0-15/FF/S	0.002111	0.001447	2.09E-06	0.00809	0.000502
10mN/5-20/FF/S	0.00198	0.001426	2.03E-06	0.007229	0.000501
10mN/10-25/FF/S	0.001581	0.001189	1.41E-06	0.007573	0.000511
10mN/15-30/FF/S	0.001445	0.00131	1.72E-06	0.008797	0.000504
10mN/20-35/FF/S	0.001551	0.001471	2.17E-06	0.008508	0.000501
10mN/25-40/FF/S	0.001427	0.001442	2.08E-06	0.011017	0.000501
10mN/30-45/FF/S	0.001337	0.001297	1.68E-06	0.010347	0.0005
10mN/35-50/FF/S	0.001239	0.001221	1.49E-06	0.008953	0.000501
10mN/0-10/SF/H	0.001496	0.000923	8.52E-07	0.012595	0.000515
10mN/0-15/SF/H	0.001751	0.001657	2.75E-06	0.013727	0.000514
10mN/5-20/SF/H	0.001733	0.001604	2.57E-06	0.007947	0.000508
10mN/10-25/SF/H	0.001341	0.001373	1.89E-06	0.010226	0.000501
10mN/15-30/SF/H	0.001236	0.001463	2.14E-06	0.012124	0.000501
10mN/20-35/SF/H	0.001135	0.001174	1.38E-06	0.007196	0.000503
10mN/25-40/SF/H	0.001044	0.001092	1.19E-06	0.007501	0.0005
10mN/30-45/SF/H	0.001029	0.001138	1.29E-06	0.008459	0.0005
10mN/35-50/SF/H	0.000968	0.001077	1.16E-06	0.010106	0.0005
10mN/0-10/SF/S	0.001601	0.001105	1.22E-06	0.01039	0.000504
10mN/0-15/SF/S	0.001926	0.001605	2.58E-06	0.01433	0.000511
10mN/5-20/SF/S	0.002009	0.001921	3.69E-06	0.008715	0.000505
10mN/10-25/SF/S	0.001739	0.001839	3.38E-06	0.009319	0.0005
10mN/15-30/SF/S	0.00167	0.001899	3.61E-06	0.010884	0.000501
10mN/20-35/SF/S	0.001465	0.00181	3.28E-06	0.012527	0.000501
10mN/25-40/SF/S	0.001359	0.00167	2.79E-06	0.010005	0.000501
10mN/30-45/SF/S	0.001222	0.00145	2.1E-06	0.010299	0.000501
10mN/35-50/SF/S	0.001212	0.001504	2.26E-06	0.009848	0.0005

Statistical Data on Load at Pop-Ins

-	Avg.	St.D.	Var.	Max.	Min.
1mN/0-5/FF/H	3.786955	0.909029	0.826334	4.91339	1.44286
1mN/4-10/FF/H	7.12278	1.385823	1.920505	9.83735	4.12675
1mN/9-15/FF/H	12.29424	1.364738	1.86251	14.87286	9.13593
1mN/14-20/FF/H	17.21687	1.346177	1.812192	19.86292	14.13486
1mN/19-25/FF/H	22.06694	1.544436	2.385283	24.80536	19.14374
1mN/24-30/FF/H	26.9509	1.558788	2.429819	29.74658	24.13587
1mN/29-35/FF/H	32.09022	1.502084	2.256258	34.8546	29.11864
1mN/34-40/FF/H	37.08984	1.644021	2.702805	39.88963	34.12888
1mN/39-45/FF/H	42.06286	1.519754	2.309653	44.82632	39.13912
1mN/44-50/FF/H	47.09183	1.730112	2.993289	49.93803	44.14085
1mN/0-5/FF/S	3.889349	0.778364	0.605851	4.89345	1.76945
1mN/4-10/FF/S	6.999634	1.399406	1.958338	9.88654	4.15808
1mN/9-15/FF/S	12.07152	1.348952	1.819671	14.83768	9.15196
1mN/14-20/FF/S	17.28796	1.462118	2.137789	19.8422	14.15448
1mN/19-25/FF/S	22.03591	1.575999	2.483772	24.86642	19.13444
1mN/24-30/FF/S	26.99879	1.551452	2.407003	29.85046	24.13797
1mN/29-35/FF/S	32.19913	1.645926	2.709072	34.80143	29.14157
1mN/34-40/FF/S	36.9912	1.62917	2.654194	39.83064	34.13845
1mN/39-45/FF/S	42.05159	1.5295	2.339372	44.8732	39.13058
1mN/44-50/FF/S	46.8586	1.685197	2.839891	49.95348	44.1371
1mN/0-5/FS/H	3.935794	0.785204	0.616546	4.95453	2.38317
1mN/4-10/FS/H	7.276694	1.347181	1.814896	9.94396	5.3799
1mN/9-15/FS/H	12.46539	1.364037	1.860597	14.93375	9.03504
1mN/14-20/FS/H	17.39799	1.372722	1.884366	19.9744	14.04127
1mN/19-25/FS/H	22.59113	1.490568	2.221792	24.97352	19.0128
1mN/24-30/FS/H	27.19185	1.561886	2.439489	29.91279	24.03788
1mN/29-35/FS/H	32.0551	1.553294	2.412724	34.94182	29.00944
1mN/34-40/FS/H	37.31164	1.497338	2.24202	39.93048	34.02658
1mN/39-45/FS/H	41.93388	1.701658	2.895641	44.81342	39.02303
1mN/44-50/FS/H	47.25016	1.629966	2.656788	49.91176	44.03995
1mN/0-5/FS/S	3.941651	0.709744	0.503736	4.94987	1.84707
1mN/4-10/FS/S	7.280115	1.381388	1.908232	9.94786	5.23139
1mN/9-15/FS/S	12.30738	1.233428	1.521344	14.94644	9.03753
1mN/14-20/FS/S	17.48057	1.385534	1.919704	19.96677	14.03217
1mN/19-25/FS/S	22.15035	1.453108	2.111523	24.93464	19.04326
1mN/24-30/FS/S	27.46423	1.328428	1.764722	29.8901	24.01728
1mN/29-35/FS/S	32.31777	1.502746	2.258245	34.92557	29.03877
1mN/34-40/FS/S	37.32309	1.720588	2.960425	39.96581	34.02761
1mN/39-45/FS/S	42.47776	1.615301	2.609198	44.94762	39.02491
1mN/44-50/FS/S	47.30253	1.779726	3.167426	49.89445	44.03919
1mN/0-5/SF/H	3.009403	0.953089	0.908378	4.89087	0.65603
1mN/4-10/SF/H	7.222984	1.438081	2.068077	9.88983	4.23058
1mN/9-15/SF/H	12.15514	1.496376	2.239141	14.87183	9.1174
1mN/14-20/SF/H	17.15495	1.479894	2.190086	19.85637	14.09019
1mN/19-25/SF/H	22.08331	1.448858	2.09919	24.84561	19.0467
1mN/24-30/SF/H	27.09127	1.525491	2.327123	29.7447	24.09528
1mN/29-35/SF/H	32.0759	1.583816	2.508473	34.86626	29.08069
1mN/34-40/SF/H	37.12178	1.670581	2.790841	39.8797	34.04496
1mN/39-45/SF/H	42.22994	1.537777	2.364759	44.86733	39.04625
1mN/44-50/SF/H	46.86907	1.655485	2.740631	49.88129	44.04348
1mN/0-5/SF/S	3.197033	0.969868	0.940643	4.87134	1.24595
1mN/4-10/SF/S	7.194547	1.398109	1.95471	9.83431	5.13363
1mN/9-15/SF/S	12.34366	1.481825	2.195804	14.83263	9.17327

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
1mN/14-20/SF/S	17.01112	1.497938	2.243818	19.74728	14.06898
1mN/19-25/SF/S	22.18325	1.60682	2.581869	24.89239	19.05567
1mN/24-30/SF/S	27.11168	1.530866	2.343551	29.88567	24.04294
1mN/29-35/SF/S	31.97701	1.529095	2.338132	34.84535	29.04102
1mN/34-40/SF/S	36.93289	1.722247	2.966135	39.84878	34.11978
1mN/39-45/SF/S	41.97164	1.598414	2.554928	44.88091	39.0438
1mN/44-50/SF/S	47.0235	1.63513	2.673651	49.93069	44.04312
1mN/0-5/SS/H	3.723698	0.790416	0.624757	4.91455	2.11037
1mN/4-10/SS/H	7.308161	1.407168	1.980121	9.90979	5.26829
1mN/9-15/SS/H	12.31998	1.410061	1.988272	14.91258	9.00799
1mN/14-20/SS/H	17.25243	1.468521	2.156553	19.89008	14.01297
1mN/19-25/SS/H	22.19524	1.466177	2.149676	24.87654	19.04914
1mN/24-30/SS/H	27.23137	1.482456	2.197675	29.84157	24.01625
1mN/29-35/SS/H	32.07123	1.564366	2.447241	34.88213	29.01297
1mN/34-40/SS/H	37.26124	1.563068	2.443181	39.91028	34.01368
1mN/39-45/SS/H	42.10191	1.663203	2.766244	44.89173	39.01453
1mN/44-50/SS/H	47.05853	1.631443	2.661607	49.91585	44.0146
1mN/0-5/SS/S	3.535367	0.872476	0.761215	4.91754	1.63023
1mN/4-10/SS/S	7.320575	1.323203	1.750865	9.91268	5.0151
1mN/9-15/SS/S	12.19147	1.518658	2.306323	14.90269	9.01521
1mN/14-20/SS/S	17.25076	1.499226	2.24768	19.8951	14.01175
1mN/19-25/SS/S	22.2693	1.555934	2.420931	24.91721	19.00642
1mN/24-30/SS/S	26.50606	1.37143	1.880819	28.94608	24.01539
1mN/29-35/SS/S	32.2576	1.636117	2.676877	34.92088	29.00982
1mN/34-40/SS/S	37.21348	1.610449	2.593547	39.90847	34.01575
1mN/39-45/SS/S	42.15349	1.614356	2.606145	44.90943	39.00013
1mN/44-50/SS/S	47.13874	1.560816	2.436147	49.93601	44.0733
2mN/0-5/FF/H	3.739696	0.783441	0.61378	4.87177	2.19857
2mN/3-10/FF/H	7.265039	1.372262	1.883103	9.87713	3.16698
2mN/8-15/FF/H	12.22407	1.49396	2.231916	14.8807	8.15324
2mN/13-20/FF/H	17.1127	1.583712	2.508145	19.8064	13.11335
2mN/18-25/FF/H	22.03278	1.801526	3.245497	24.87103	18.1277
2mN/23-30/FF/H	27.04971	1.770441	3.13446	29.87023	23.12191
2mN/28-35/FF/H	31.38291	2.058865	4.238925	34.83771	28.13015
2mN/33-40/FF/H	36.64761	1.996019	3.98409	39.87389	33.14628
2mN/38-45/FF/H	41.93112	1.944773	3.78214	44.85252	38.13168
2mN/43-50/FF/H	46.3878	2.026078	4.104992	49.87614	43.14253
2mN/0-5/FF/S	3.595873	0.86872	0.754674	4.86689	1.54438
2mN/3-10/FF/S	7.261693	1.3974	1.952726	9.88188	3.14467
2mN/8-15/FF/S	12.12869	1.392145	1.938069	14.7001	8.11933
2mN/13-20/FF/S	17.06693	1.564938	2.44903	19.87602	13.14294
2mN/18-25/FF/S	21.89021	1.765693	3.117672	24.87865	18.12832
2mN/23-30/FF/S	26.70917	1.965041	3.861385	29.83175	23.12147
2mN/28-35/FF/S	31.66898	1.893945	3.587029	34.864	28.1069
2mN/33-40/FF/S	36.90369	1.941351	3.768844	39.71488	33.12597
2mN/38-45/FF/S	41.47671	1.957121	3.830324	44.76427	38.14517
2mN/43-50/FF/S	46.62328	2.012546	4.05034	49.93884	43.11631
2mN/0-5/FS/H	3.715974	0.849741	0.722059	4.95249	1.94544
2mN/3-10/FS/H	7.385762	1.368521	1.87285	9.94386	5.34061
2mN/8-15/FS/H	12.56746	1.316279	1.732591	14.92751	10.53311
2mN/13-20/FS/H	17.37053	1.50815	2.274517	19.84951	13.00519
2mN/18-25/FS/H	22.37353	1.655036	2.739145	24.95563	18.02527
2mN/23-30/FS/H	27.13738	1.750679	3.064878	29.94818	23.03051
2mN/28-35/FS/H	31.75888	2.04189	4.169317	34.93181	28.02664

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/33-40/FS/H	36.98796	1.939081	3.760037	39.95057	33.03386
2mN/38-45/FS/H	42.02442	2.106898	4.439018	44.91442	38.01257
2mN/43-50/FS/H	46.35995	2.059995	4.243578	49.89763	43.00504
2mN/0-5/FS/S	3.594049	0.815414	0.6649	4.80051	2.21275
2mN/3-10/FS/S	7.369408	1.372874	1.884782	9.93956	5.42779
2mN/8-15/FS/S	12.04272	1.494945	2.23486	14.90303	8.05192
2mN/13-20/FS/S	17.52314	1.354066	1.833494	19.96357	13.03166
2mN/18-25/FS/S	21.96549	1.933646	3.738985	24.94857	18.03298
2mN/23-30/FS/S	27.11551	1.899061	3.606432	29.95203	23.02666
2mN/28-35/FS/S	31.88329	2.056281	4.22829	34.83028	28.01019
2mN/33-40/FS/S	36.72548	2.274953	5.175413	39.92072	33.02289
2mN/38-45/FS/S	41.6255	2.221326	4.93429	44.92972	38.0082
2mN/43-50/FS/S	46.28171	2.049072	4.198697	49.83143	43.02109
2mN/0-5/SF/H	3.601568	0.875306	0.766161	4.86408	1.81427
2mN/3-10/SF/H	7.312344	1.430964	2.047659	9.88985	4.87688
2mN/8-15/SF/H	12.30514	1.457709	2.124916	14.88373	8.60922
2mN/13-20/SF/H	17.32454	1.486386	2.209343	19.85032	13.13128
2mN/18-25/SF/H	22.24658	1.442433	2.080614	24.84965	18.13481
2mN/23-30/SF/H	27.0383	1.702518	2.898568	29.89032	23.11944
2mN/28-35/SF/H	31.87843	1.788679	3.199372	34.8369	28.07936
2mN/33-40/SF/H	36.93428	1.748759	3.058158	39.85486	33.10405
2mN/38-45/SF/H	41.62398	1.889781	3.571272	44.842	38.09033
2mN/43-50/SF/H	46.71008	1.792065	3.211498	49.94111	43.04677
2mN/0-5/SF/S	3.347238	0.857304	0.73497	4.89352	1.41448
2mN/3-10/SF/S	7.137103	1.427221	2.03696	9.87163	3.04775
2mN/8-15/SF/S	12.24608	1.443083	2.08249	14.86744	8.04388
2mN/13-20/SF/S	17.23098	1.464465	2.144657	19.79873	13.12085
2mN/18-25/SF/S	21.97595	1.764464	3.113332	24.85784	18.04682
2mN/23-30/SF/S	26.72959	1.779255	3.165747	29.88693	23.04316
2mN/28-35/SF/S	31.86818	1.88327	3.546705	34.88472	28.08819
2mN/33-40/SF/S	36.78768	1.921212	3.691056	39.88552	33.11586
2mN/38-45/SF/S	41.48023	1.889146	3.568871	44.88316	38.044
2mN/43-50/SF/S	46.46527	1.879768	3.533529	49.93553	43.11368
2mN/0-5/SS/H	3.609726	0.824046	0.679051	4.89218	1.56341
2mN/3-10/SS/H	7.271064	1.422342	2.023058	9.88963	3.0071
2mN/8-15/SS/H	12.21088	1.336225	1.785497	14.86646	9.6667
2mN/13-20/SS/H	17.28004	1.580456	2.497842	19.91142	13.11481
2mN/18-25/SS/H	21.98464	1.684065	2.836074	24.91825	18.04484
2mN/23-30/SS/H	26.61675	1.899609	3.608516	29.91209	23.0194
2mN/28-35/SS/H	31.98739	1.818185	3.305798	34.9157	28.06035
2mN/33-40/SS/H	36.62297	1.981019	3.924437	39.90709	33.01708
2mN/38-45/SS/H	41.76266	1.854953	3.440849	44.91649	38.08442
2mN/43-50/SS/H	46.62136	1.953833	3.817464	49.9023	43.01424
2mN/0-5/SS/S	3.401915	0.952743	0.90772	4.87428	1.36
2mN/3-10/SS/S	7.260243	1.357135	1.841814	9.91153	5.24746
2mN/8-15/SS/S	12.2204	1.436409	2.06327	14.83623	8.05066
2mN/13-20/SS/S	17.025	1.570405	2.466173	19.91214	13.01521
2mN/18-25/SS/S	21.87057	1.722731	2.967801	24.90537	18.02155
2mN/23-30/SS/S	26.97073	1.801793	3.246456	29.91286	23.07585
2mN/28-35/SS/S	31.58375	2.026547	4.106892	34.83969	28.01086
2mN/33-40/SS/S	36.79505	1.911097	3.652291	39.90935	33.02702
2mN/38-45/SS/S	41.5135	1.970185	3.881631	44.86345	38.01789
2mN/43-50/SS/S	46.71068	2.013949	4.055989	49.94694	43.0562
5mN/0-5/FF/H	3.6678	0.915715	0.838534	4.89602	1.28915

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
5mN/0-10/FF/H	7.373915	1.347254	1.815092	9.87197	5.17525
5mN/5-15/FF/H	12.21502	1.782684	3.177961	14.86324	5.10664
5mN/10-20/FF/H	16.31098	2.567553	6.592328	19.84261	10.14408
5mN/15-25/FF/H	21.17367	2.875777	8.270095	24.88817	15.11876
5mN/20-30/FF/H	25.14095	3.090128	9.548891	29.87587	20.11009
5mN/25-35/FF/H	30.30589	3.03034	9.182961	34.86844	25.11134
5mN/30-40/FF/H	34.99852	3.159638	9.983314	39.81017	30.11683
5mN/35-45/FF/H	40.19865	3.091097	9.554883	44.83113	35.13328
5mN/40-50/FF/H	45.09412	3.138847	9.852359	49.89877	40.11696
5mN/0-5/FF/S	4.102149	0.538341	0.289811	4.89658	1.75023
5mN/0-10/FF/S	7.114999	1.376377	1.894414	9.87247	5.28827
5mN/5-15/FF/S	11.99569	2.104191	4.427618	14.81319	5.13255
5mN/10-20/FF/S	15.92874	2.663476	7.094107	19.85429	10.14418
5mN/15-25/FF/S	20.51992	2.999087	8.994524	24.70437	15.12573
5mN/20-30/FF/S	25.25603	3.168104	10.03688	29.82632	20.11728
5mN/25-35/FF/S	29.88829	3.065154	9.395169	34.85463	25.12079
5mN/30-40/FF/S	35.08803	3.289107	10.81822	39.83703	30.12263
5mN/35-45/FF/S	40.19267	2.928696	8.577261	44.85527	35.12107
5mN/40-50/FF/S	45.09604	3.16288	10.00381	49.93812	40.12194
5mN/0-5/SF/H	3.118169	1.040163	1.081939	4.89249	0.92603
5mN/0-10/SF/H	7.101182	1.675194	2.806275	9.87089	0.18757
5mN/5-15/SF/H	10.85263	2.678213	7.172822	14.85463	5.04948
5mN/10-20/SF/H	15.37869	2.748009	7.551556	19.88812	10.07195
5mN/15-25/SF/H	20.05151	2.868895	8.230557	24.88878	15.04142
5mN/20-30/SF/H	25.00278	2.899028	8.404362	29.88024	20.04376
5mN/25-35/SF/H	30.14272	2.919327	8.52247	34.88804	25.0411
5mN/30-40/SF/H	34.85211	2.933804	8.607208	39.84717	30.04103
5mN/35-45/SF/H	40.11014	2.892131	8.364421	44.89086	35.04367
5mN/40-50/SF/H	45.13583	2.871826	8.247385	49.93841	40.03853
5mN/0-5/SF/S	3.245366	0.969877	0.940661	4.88445	0.66762
5mN/0-10/SF/S	7.097012	1.475672	2.177607	9.88092	0.36983
5mN/5-15/SF/S	11.33	2.576145	6.636524	14.89003	5.04326
5mN/10-20/SF/S	15.8366	2.75246	7.576036	19.8875	10.04358
5mN/15-25/SF/S	20.24827	2.914651	8.495191	24.86152	15.0918
5mN/20-30/SF/S	25.26384	2.837404	8.05086	29.86024	20.08224
5mN/25-35/SF/S	29.93996	2.947331	8.68676	34.88017	25.07958
5mN/30-40/SF/S	35.01413	2.932752	8.601031	39.88138	30.04302
5mN/35-45/SF/S	40.20865	2.825756	7.984898	44.88242	35.06572
5mN/40-50/SF/S	44.92669	2.986363	8.918362	49.94389	40.04067
10mN/0-10/FF/H	6.06408	2.161315	4.671283	9.86825	1.69085
10mN/0-15/FF/H	12.26706	1.57538	2.481821	14.87094	1.93499
10mN/5-20/FF/H	16.49331	3.363471	11.31294	19.83981	5.1197
10mN/10-25/FF/H	18.96543	4.966133	24.66248	24.83409	10.11027
10mN/15-30/FF/H	23.09026	5.03154	25.3164	29.84153	15.10653
10mN/20-35/FF/H	27.68805	4.912956	24.13714	34.84506	20.11649
10mN/25-40/FF/H	32.32672	4.798369	23.02434	39.81697	25.09747
10mN/30-45/FF/H	37.73761	4.783227	22.87926	44.85007	30.11645
10mN/35-50/FF/H	42.75726	4.705397	22.14076	49.93805	35.11575
10mN/0-10/FF/S	6.410794	2.022629	4.091029	9.8794	1.95328
10mN/0-15/FF/S	12.42322	1.402588	1.967254	14.86428	5.7442
10mN/5-20/FF/S	15.93098	3.830035	14.66917	19.83396	5.11959
10mN/10-25/FF/S	19.39781	4.704404	22.13142	24.84311	10.09857
10mN/15-30/FF/S	23.53522	5.088801	25.8959	29.79917	15.10395
10mN/20-35/FF/S	27.89207	4.890731	23.91925	34.77657	20.12435

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
10mN/25-40/FF/S	32.39594	5.030318	25.3041	39.83618	25.1016
10mN/30-45/FF/S	37.40481	4.956504	24.56693	44.78576	30.12059
10mN/35-50/FF/S	42.31741	4.984308	24.84333	49.95221	35.12002
10mN/0-10/SF/H	5.816115	2.305429	5.315004	9.86731	1.04948
10mN/0-15/SF/H	12.12418	1.696779	2.879058	14.88885	1.05029
10mN/5-20/SF/H	17.07576	2.161418	4.671727	19.88712	5.32705
10mN/10-25/SF/H	20.42768	3.979703	15.83804	24.84125	10.11657
10mN/15-30/SF/H	24.36773	4.734789	22.41823	29.87055	15.04101
10mN/20-35/SF/H	28.8414	4.717664	22.25635	34.88617	20.11688
10mN/25-40/SF/H	33.28509	4.684423	21.94382	39.77429	25.12179
10mN/30-45/SF/H	38.16264	4.771334	22.76563	44.86629	30.08289
10mN/35-50/SF/H	42.9292	4.788269	22.92752	49.95329	35.07413
10mN/0-10/SF/S	5.941386	2.216987	4.915033	9.88417	1.37798
10mN/0-15/SF/S	12.21697	1.436136	2.062487	14.88331	6.21228
10mN/5-20/SF/S	17.26898	2.282909	5.211673	19.88782	5.52507
10mN/10-25/SF/S	20.73323	3.67522	13.50724	24.88909	10.05385
10mN/15-30/SF/S	24.61053	4.62981	21.43514	29.88967	15.06761
10mN/20-35/SF/S	28.7163	4.879806	23.81251	34.88629	20.05587
10mN/25-40/SF/S	33.27074	4.935344	24.35762	39.85996	25.1203
10mN/30-45/SF/S	38.52648	4.845162	23.47559	44.88398	30.10144
10mN/35-50/SF/S	43.33094	4.60856	21.23883	49.92085	35.10284

Statistical Data on First Pop-In Size

-	Avg.	St.D.	Var.	Max.	Min.
1mN/0-5/FF/H	0.024928	0.07783	0.006058	0.34176	0.000774
1mN/4-10/FF/H	0.002598	0.001421	2.02E-06	0.005531	0.000527
1mN/9-15/FF/H	0.002721	0.001411	1.99E-06	0.005699	0.000552
1mN/14-20/FF/H	0.002856	0.0018	3.24E-06	0.006325	0.000501
1mN/19-25/FF/H	0.002716	0.002231	4.98E-06	0.007635	0.000515
1mN/24-30/FF/H	0.002337	0.001816	3.3E-06	0.006109	0.000523
1mN/29-35/FF/H	0.001988	0.001876	3.52E-06	0.006632	0.000526
1mN/34-40/FF/H	0.002164	0.002239	5.01E-06	0.010431	0.000515
1mN/39-45/FF/H	0.001352	0.000985	9.71E-07	0.005406	0.000512
1mN/44-50/FF/H	0.001121	0.000619	3.83E-07	0.002961	0.000502
1mN/0-5/FF/S	0.037883	0.065714	0.004318	0.17876	0.000522
1mN/4-10/FF/S	0.002331	0.001003	1.01E-06	0.004497	0.000678
1mN/9-15/FF/S	0.001798	0.001021	1.04E-06	0.005011	0.000536
1mN/14-20/FF/S	0.002197	0.00168	2.82E-06	0.006904	0.00053
1mN/19-25/FF/S	0.001807	0.001384	1.92E-06	0.005651	0.000537
1mN/24-30/FF/S	0.001984	0.001712	2.93E-06	0.006712	0.000567
1mN/29-35/FF/S	0.001287	0.001003	1.01E-06	0.00496	0.000504
1mN/34-40/FF/S	0.00132	0.001243	1.54E-06	0.00661	0.000542
1mN/39-45/FF/S	0.001503	0.00152	2.31E-06	0.006813	0.000515
1mN/44-50/FF/S	0.001372	0.001254	1.57E-06	0.006804	0.000509
1mN/0-5/FS/H	0.00905	0.039822	0.001586	0.227196	0.00051
1mN/4-10/FS/H	0.002197	0.000914	8.35E-07	0.004045	0.00092
1mN/9-15/FS/H	0.002275	0.001471	2.16E-06	0.00535	0.000516
1mN/14-20/FS/H	0.002503	0.001893	3.58E-06	0.006609	0.000509
1mN/19-25/FS/H	0.003104	0.00238	5.66E-06	0.009872	0.00051
1mN/24-30/FS/H	0.002586	0.001883	3.55E-06	0.006768	0.000526
1mN/29-35/FS/H	0.002055	0.001949	3.8E-06	0.007468	0.000515
1mN/34-40/FS/H	0.001987	0.00198	3.92E-06	0.008234	0.000507
1mN/39-45/FS/H	0.001901	0.001881	3.54E-06	0.009398	0.000508
1mN/44-50/FS/H	0.001643	0.001681	2.83E-06	0.00658	0.000502

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
1mN/0-5/FS/S	0.002474	0.001385	1.92E-06	0.006923	0.00095
1mN/4-10/FS/S	0.002244	0.00102	1.04E-06	0.004969	0.000592
1mN/9-15/FS/S	0.002583	0.001273	1.62E-06	0.005019	0.000574
1mN/14-20/FS/S	0.002157	0.001441	2.08E-06	0.005501	0.000509
1mN/19-25/FS/S	0.002921	0.002119	4.49E-06	0.008026	0.000518
1mN/24-30/FS/S	0.002376	0.002004	4.02E-06	0.00742	0.00052
1mN/29-35/FS/S	0.001988	0.001735	3.01E-06	0.006777	0.000579
1mN/34-40/FS/S	0.001612	0.001557	2.42E-06	0.005836	0.000505
1mN/39-45/FS/S	0.001814	0.001506	2.27E-06	0.006135	0.00051
1mN/44-50/FS/S	0.001562	0.001501	2.25E-06	0.007348	0.000508
1mN/0-5/SF/H	0.00189	0.000739	5.46E-07	0.003994	0.000632
1mN/4-10/SF/H	0.002021	0.001199	1.44E-06	0.007127	0.000568
1mN/9-15/SF/H	0.001498	0.000922	8.51E-07	0.004604	0.00055
1mN/14-20/SF/H	0.001292	0.001005	1.01E-06	0.00573	0.000511
1mN/19-25/SF/H	0.001445	0.001164	1.36E-06	0.004976	0.000505
1mN/24-30/SF/H	0.001563	0.001858	3.45E-06	0.008328	0.000509
1mN/29-35/SF/H	0.001058	0.000715	5.12E-07	0.003845	0.000516
1mN/34-40/SF/H	0.001031	0.000734	5.38E-07	0.004425	0.000502
1mN/39-45/SF/H	0.00094	0.000669	4.48E-07	0.004202	0.000502
1mN/44-50/SF/H	0.000923	0.000756	5.72E-07	0.005376	0.000518
1mN/0-5/SF/S	0.001659	0.000674	4.54E-07	0.003288	0.000813
1mN/4-10/SF/S	0.001747	0.000925	8.56E-07	0.004204	0.000553
1mN/9-15/SF/S	0.001908	0.002351	5.53E-06	0.015014	0.00054
1mN/14-20/SF/S	0.001504	0.001109	1.23E-06	0.00433	0.000557
1mN/19-25/SF/S	0.001137	0.000699	4.89E-07	0.003838	0.000512
1mN/24-30/SF/S	0.001276	0.00127	1.61E-06	0.005746	0.00053
1mN/29-35/SF/S	0.001119	0.000984	9.69E-07	0.006342	0.000508
1mN/34-40/SF/S	0.000924	0.000855	7.31E-07	0.005791	0.000512
1mN/39-45/SF/S	0.000982	0.001084	1.18E-06	0.007595	0.000526
1mN/44-50/SF/S	0.000774	0.000242	5.85E-08	0.001412	0.000503
1mN/0-5/SS/H	0.001809	0.000833	6.94E-07	0.00444	0.000604
1mN/4-10/SS/H	0.002245	0.001218	1.48E-06	0.00599	0.000592
1mN/9-15/SS/H	0.002169	0.001817	3.3E-06	0.0093	0.000541
1mN/14-20/SS/H	0.002212	0.00179	3.21E-06	0.006853	0.000504
1mN/19-25/SS/H	0.001495	0.001148	1.32E-06	0.004994	0.000511
1mN/24-30/SS/H	0.001524	0.001687	2.85E-06	0.0084	0.000514
1mN/29-35/SS/H	0.001338	0.001493	2.23E-06	0.006452	0.000505
1mN/34-40/SS/H	0.001775	0.002229	4.97E-06	0.009783	0.000506
1mN/39-45/SS/H	0.001339	0.001492	2.22E-06	0.006457	0.000501
1mN/44-50/SS/H	0.001327	0.001675	2.8E-06	0.007905	0.000501
1mN/0-5/SS/S	0.001526	0.000658	4.33E-07	0.00291	0.000511
1mN/4-10/SS/S	0.002043	0.00116	1.35E-06	0.006158	0.000548
1mN/9-15/SS/S	0.001626	0.001094	1.2E-06	0.004734	0.000501
1mN/14-20/SS/S	0.00155	0.001298	1.68E-06	0.005144	0.000506
1mN/19-25/SS/S	0.001291	0.000932	8.68E-07	0.004683	0.000519
1mN/24-30/SS/S	0.001058	0.000709	5.03E-07	0.004042	0.000503
1mN/29-35/SS/S	0.001399	0.001549	2.4E-06	0.006799	0.000515
1mN/34-40/SS/S	0.001013	0.000574	3.29E-07	0.003754	0.000515
1mN/39-45/SS/S	0.00097	0.001146	1.31E-06	0.008094	0.000508
1mN/44-50/SS/S	0.001042	0.000697	4.86E-07	0.003815	0.000508
2mN/0-5/FF/H	0.001967	0.000961	9.24E-07	0.005227	0.000664
2mN/3-10/FF/H	0.002559	0.00115	1.32E-06	0.005932	0.000514
2mN/8-15/FF/H	0.002787	0.001585	2.51E-06	0.006487	0.000545
2mN/13-20/FF/H	0.0028	0.001888	3.56E-06	0.007153	0.000612

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/18-25/FF/H	0.002626	0.001893	3.58E-06	0.006917	0.00051
2mN/23-30/FF/H	0.002486	0.00185	3.42E-06	0.006045	0.000506
2mN/28-35/FF/H	0.001934	0.002155	4.64E-06	0.007651	0.000508
2mN/33-40/FF/H	0.001572	0.001463	2.14E-06	0.005623	0.000501
2mN/38-45/FF/H	0.001491	0.001447	2.09E-06	0.007008	0.000548
2mN/43-50/FF/H	0.00111	0.000806	6.49E-07	0.004267	0.000521
2mN/0-5/FF/S	0.002272	0.000878	7.71E-07	0.00499	0.000816
2mN/3-10/FF/S	0.002239	0.001197	1.43E-06	0.004878	0.000551
2mN/8-15/FF/S	0.002563	0.001447	2.09E-06	0.005856	0.000532
2mN/13-20/FF/S	0.002493	0.001779	3.16E-06	0.006577	0.000514
2mN/18-25/FF/S	0.002667	0.002294	5.26E-06	0.009438	0.000521
2mN/23-30/FF/S	0.00209	0.002278	5.19E-06	0.009426	0.000506
2mN/28-35/FF/S	0.001664	0.001492	2.23E-06	0.005889	0.0005
2mN/33-40/FF/S	0.002153	0.002007	4.03E-06	0.007169	0.000514
2mN/38-45/FF/S	0.001251	0.001441	2.08E-06	0.007993	0.0005
2mN/43-50/FF/S	0.001443	0.001774	3.15E-06	0.008441	0.000502
2mN/0-5/FS/H	0.002738	0.001723	2.97E-06	0.007333	0.000532
2mN/3-10/FS/H	0.003026	0.00114	1.3E-06	0.005257	0.001219
2mN/8-15/FS/H	0.003065	0.00168	2.82E-06	0.007264	0.000657
2mN/13-20/FS/H	0.003224	0.00196	3.84E-06	0.006762	0.000513
2mN/18-25/FS/H	0.002316	0.002061	4.25E-06	0.007107	0.000501
2mN/23-30/FS/H	0.002462	0.002249	5.06E-06	0.009199	0.00053
2mN/28-35/FS/H	0.001845	0.002323	5.4E-06	0.009712	0.000501
2mN/33-40/FS/H	0.0017	0.00178	3.17E-06	0.006784	0.000509
2mN/38-45/FS/H	0.001816	0.001865	3.48E-06	0.008727	0.000509
2mN/43-50/FS/H	0.000907	0.000342	1.17E-07	0.001992	0.000502
2mN/0-5/FS/S	0.002257	0.001349	1.82E-06	0.007594	0.000545
2mN/3-10/FS/S	0.002527	0.001061	1.13E-06	0.005627	0.000643
2mN/8-15/FS/S	0.002673	0.001759	3.09E-06	0.006584	0.000548
2mN/13-20/FS/S	0.003375	0.002	4E-06	0.007234	0.000517
2mN/18-25/FS/S	0.001686	0.001897	3.6E-06	0.007123	0.000546
2mN/23-30/FS/S	0.002305	0.002593	6.72E-06	0.011808	0.00051
2mN/28-35/FS/S	0.001419	0.001494	2.23E-06	0.006461	0.000509
2mN/33-40/FS/S	0.001718	0.002321	5.39E-06	0.012276	0.000511
2mN/38-45/FS/S	0.00143	0.001588	2.52E-06	0.00774	0.00054
2mN/43-50/FS/S	0.000874	0.000334	1.12E-07	0.0021	0.000509
2mN/0-5/SF/H	0.00227	0.00142	2.02E-06	0.006464	0.000818
2mN/3-10/SF/H	0.001769	0.000826	6.82E-07	0.004168	0.00052
2mN/8-15/SF/H	0.002088	0.001243	1.55E-06	0.00504	0.000504
2mN/13-20/SF/H	0.002304	0.001446	2.09E-06	0.005709	0.000571
2mN/18-25/SF/H	0.002111	0.001785	3.19E-06	0.006695	0.00051
2mN/23-30/SF/H	0.001767	0.001809	3.27E-06	0.006675	0.000509
2mN/28-35/SF/H	0.001113	0.001042	1.08E-06	0.005459	0.000506
2mN/33-40/SF/H	0.001444	0.001674	2.8E-06	0.007801	0.000517
2mN/38-45/SF/H	0.001036	0.00108	1.17E-06	0.005903	0.000508
2mN/43-50/SF/H	0.000833	0.000891	7.94E-07	0.006308	0.000508
2mN/0-5/SF/S	0.001422	0.000592	3.5E-07	0.003056	0.000634
2mN/3-10/SF/S	0.002201	0.001205	1.45E-06	0.005005	0.000529
2mN/8-15/SF/S	0.003148	0.002002	4.01E-06	0.007067	0.000536
2mN/13-20/SF/S	0.002978	0.002101	4.41E-06	0.007987	0.000557
2mN/18-25/SF/S	0.00232	0.002092	4.37E-06	0.00888	0.000512
2mN/23-30/SF/S	0.001719	0.002114	4.47E-06	0.008835	0.000507
2mN/28-35/SF/S	0.001294	0.001289	1.66E-06	0.004982	0.000503
2mN/33-40/SF/S	0.001625	0.002565	6.58E-06	0.011447	0.0005

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/38-45/SF/S	0.00119	0.001954	3.82E-06	0.010588	0.000505
2mN/43-50/SF/S	0.000967	0.00119	1.42E-06	0.008078	0.000501
2mN/0-5/SS/H	0.002351	0.001682	2.83E-06	0.0091	0.0006
2mN/3-10/SS/H	0.002074	0.0015	2.25E-06	0.008208	0.000513
2mN/8-15/SS/H	0.00229	0.001351	1.83E-06	0.00614	0.000552
2mN/13-20/SS/H	0.002655	0.002101	4.42E-06	0.006936	0.000506
2mN/18-25/SS/H	0.001651	0.001614	2.61E-06	0.00727	0.000507
2mN/23-30/SS/H	0.001343	0.001461	2.13E-06	0.006633	0.000507
2mN/28-35/SS/H	0.001107	0.001132	1.28E-06	0.005869	0.000507
2mN/33-40/SS/H	0.001154	0.001501	2.25E-06	0.007704	0.000508
2mN/38-45/SS/H	0.000919	0.000846	7.16E-07	0.005167	0.000503
2mN/43-50/SS/H	0.001028	0.001252	1.57E-06	0.00663	0.000503
2mN/0-5/SS/S	0.001779	0.000668	4.46E-07	0.003583	0.000741
2mN/3-10/SS/S	0.002635	0.001124	1.26E-06	0.004901	0.000569
2mN/8-15/SS/S	0.003238	0.001993	3.97E-06	0.007308	0.000506
2mN/13-20/SS/S	0.002543	0.002147	4.61E-06	0.007673	0.000507
2mN/18-25/SS/S	0.002705	0.002485	6.18E-06	0.00798	0.000503
2mN/23-30/SS/S	0.002552	0.002608	6.8E-06	0.009117	0.000529
2mN/28-35/SS/S	0.002226	0.00256	6.55E-06	0.010039	0.000503
2mN/33-40/SS/S	0.0014	0.001894	3.59E-06	0.008821	0.000504
2mN/38-45/SS/S	0.000962	0.000961	9.23E-07	0.0055	0.000518
2mN/43-50/SS/S	0.00074	0.00043	1.85E-07	0.002972	0.000501
5mN/0-5/FF/H	0.007607	0.032871	0.001081	0.207537	0.000687
5mN/0-10/FF/H	0.002927	0.001239	1.54E-06	0.006061	0.000941
5mN/5-15/FF/H	0.002339	0.001488	2.21E-06	0.006551	0.00053
5mN/10-20/FF/H	0.001751	0.001294	1.67E-06	0.005632	0.000556
5mN/15-25/FF/H	0.001786	0.001999	4E-06	0.007696	0.00051
5mN/20-30/FF/H	0.001055	0.000722	5.21E-07	0.00502	0.000508
5mN/25-35/FF/H	0.001107	0.000896	8.04E-07	0.006116	0.000505
5mN/30-40/FF/H	0.001133	0.000997	9.94E-07	0.005441	0.000507
5mN/35-45/FF/H	0.000925	0.000583	3.4E-07	0.004039	0.000523
5mN/40-50/FF/H	0.00099	0.000636	4.04E-07	0.004473	0.000507
5mN/0-5/FF/S	0.01715	0.053433	0.002855	0.203542	0.000693
5mN/0-10/FF/S	0.002994	0.001181	1.4E-06	0.006043	0.000749
5mN/5-15/FF/S	0.002462	0.001602	2.56E-06	0.006269	0.000508
5mN/10-20/FF/S	0.001682	0.001184	1.4E-06	0.005118	0.000505
5mN/15-25/FF/S	0.001363	0.001209	1.46E-06	0.005809	0.000521
5mN/20-30/FF/S	0.001252	0.001103	1.22E-06	0.00584	0.000502
5mN/25-35/FF/S	0.000943	0.00094	8.83E-07	0.006641	0.000512
5mN/30-40/FF/S	0.001203	0.000943	8.88E-07	0.005118	0.000507
5mN/35-45/FF/S	0.000879	0.000406	1.65E-07	0.002096	0.00051
5mN/40-50/FF/S	0.000901	0.000402	1.62E-07	0.00226	0.000509
5mN/0-5/SF/H	0.001711	0.000698	4.87E-07	0.003378	0.000535
5mN/0-10/SF/H	0.002336	0.001263	1.6E-06	0.005374	0.000507
5mN/5-15/SF/H	0.001157	0.000888	7.88E-07	0.005775	0.000504
5mN/10-20/SF/H	0.000909	0.000415	1.72E-07	0.002786	0.000505
5mN/15-25/SF/H	0.001065	0.001177	1.39E-06	0.008193	0.000502
5mN/20-30/SF/H	0.000895	0.000322	1.03E-07	0.001909	0.000523
5mN/25-35/SF/H	0.000809	0.000262	6.88E-08	0.001384	0.000503
5mN/30-40/SF/H	0.000849	0.000369	1.36E-07	0.002084	0.000503
5mN/35-45/SF/H	0.00079	0.000205	4.2E-08	0.001373	0.000509
5mN/40-50/SF/H	0.000863	0.000379	1.44E-07	0.002181	0.000502
5mN/0-5/SF/S	0.001727	0.000789	6.22E-07	0.003966	0.000524
5mN/0-10/SF/S	0.003201	0.005056	2.56E-05	0.034394	0.000507

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
5mN/5-15/SF/S	0.001307	0.000828	6.85E-07	0.003552	0.000502
5mN/10-20/SF/S	0.000926	0.000571	3.27E-07	0.003801	0.000502
5mN/15-25/SF/S	0.001016	0.001227	1.51E-06	0.00822	0.000504
5mN/20-30/SF/S	0.000816	0.00026	6.76E-08	0.001687	0.000538
5mN/25-35/SF/S	0.000785	0.000257	6.61E-08	0.001897	0.000503
5mN/30-40/SF/S	0.000694	0.00022	4.84E-08	0.00149	0.000502
5mN/35-45/SF/S	0.000806	0.000298	8.9E-08	0.00179	0.000514
5mN/40-50/SF/S	0.000781	0.000236	5.56E-08	0.001582	0.000501
10mN/0-10/FF/H	0.008292	0.037921	0.001438	0.248037	0.000514
10mN/0-15/FF/H	0.002577	0.001307	1.71E-06	0.005207	0.000543
10mN/5-20/FF/H	0.00192	0.001446	2.09E-06	0.007478	0.000527
10mN/10-25/FF/H	0.001419	0.000973	9.47E-07	0.004969	0.000501
10mN/15-30/FF/H	0.001012	0.000637	4.06E-07	0.004483	0.000514
10mN/20-35/FF/H	0.000972	0.000364	1.33E-07	0.001995	0.000514
10mN/25-40/FF/H	0.000794	0.000256	6.55E-08	0.001499	0.000501
10mN/30-45/FF/H	0.000911	0.000351	1.24E-07	0.001888	0.000528
10mN/35-50/FF/H	0.000956	0.00033	1.09E-07	0.001743	0.000542
10mN/0-10/FF/S	0.013952	0.042801	0.001832	0.193837	0.000569
10mN/0-15/FF/S	0.003662	0.002072	4.29E-06	0.007718	0.000521
10mN/5-20/FF/S	0.002332	0.001858	3.45E-06	0.006821	0.000565
10mN/10-25/FF/S	0.001455	0.001312	1.72E-06	0.005721	0.000526
10mN/15-30/FF/S	0.001152	0.001506	2.27E-06	0.008797	0.000532
10mN/20-35/FF/S	0.000971	0.000397	1.58E-07	0.002487	0.000509
10mN/25-40/FF/S	0.000907	0.000359	1.29E-07	0.00185	0.000501
10mN/30-45/FF/S	0.001007	0.000415	1.73E-07	0.002095	0.000511
10mN/35-50/FF/S	0.000919	0.000397	1.58E-07	0.002553	0.000526
10mN/0-10/SF/H	0.001383	0.000678	4.6E-07	0.004287	0.00059
10mN/0-15/SF/H	0.002514	0.001791	3.21E-06	0.006986	0.000524
10mN/5-20/SF/H	0.002849	0.002198	4.83E-06	0.007947	0.000566
10mN/10-25/SF/H	0.001378	0.00187	3.5E-06	0.010226	0.000509
10mN/15-30/SF/H	0.001213	0.002168	4.7E-06	0.012124	0.000507
10mN/20-35/SF/H	0.000686	0.000153	2.33E-08	0.001125	0.000516
10mN/25-40/SF/H	0.000696	0.000192	3.69E-08	0.001226	0.0005
10mN/30-45/SF/H	0.000807	0.000839	7.04E-07	0.005972	0.000515
10mN/35-50/SF/H	0.00069	0.000345	1.19E-07	0.002597	0.000503
10mN/0-10/SF/S	0.001362	0.000659	4.34E-07	0.004068	0.000568
10mN/0-15/SF/S	0.002539	0.001761	3.1E-06	0.006791	0.000608
10mN/5-20/SF/S	0.003612	0.002658	7.07E-06	0.008399	0.000531
10mN/10-25/SF/S	0.001462	0.001907	3.64E-06	0.007139	0.000506
10mN/15-30/SF/S	0.001509	0.002108	4.44E-06	0.010884	0.000504
10mN/20-35/SF/S	0.001017	0.001638	2.68E-06	0.010125	0.000504
10mN/25-40/SF/S	0.000794	0.000716	5.13E-07	0.005141	0.000501
10mN/30-45/SF/S	0.000828	0.000963	9.27E-07	0.006798	0.000504
10mN/35-50/SF/S	0.000664	0.000148	2.19E-08	0.001165	0.000501

Statistical Data on Load at First Pop-Ins

-	Avg.	St.D.	Var.	Max.	Min.
1mN/0-5/FF/H	2.824047	1.286489	1.655055	4.74353	0.13927
1mN/4-10/FF/H	5.268602	0.386643	0.149493	6.04465	4.12675
1mN/9-15/FF/H	10.42767	0.437317	0.191246	10.91946	9.13593
1mN/14-20/FF/H	15.67451	0.524519	0.27512	16.96708	14.13486
1mN/19-25/FF/H	20.43118	0.794556	0.631319	21.36158	19.14374
1mN/24-30/FF/H	25.43274	0.862099	0.743215	26.57993	24.13587
1mN/29-35/FF/H	30.68571	0.860618	0.740664	31.60632	29.11864
1mN/34-40/FF/H	35.36087	1.083885	1.174807	38.59549	34.12888
1mN/39-45/FF/H	40.45422	1.043853	1.08963	42.39124	39.13912
1mN/44-50/FF/H	45.33314	1.231199	1.51585	49.1193	44.14085
1mN/0-5/FF/S	2.824511	1.729685	2.991812	4.78883	0.03288
1mN/4-10/FF/S	5.445927	0.500431	0.250431	8.24112	4.15808
1mN/9-15/FF/S	10.63969	0.590272	0.34842	13.00621	9.15196
1mN/14-20/FF/S	15.72182	0.587522	0.345183	16.64468	14.15448
1mN/19-25/FF/S	20.58606	0.936756	0.877512	23.19413	19.13444
1mN/24-30/FF/S	25.72257	0.955554	0.913084	27.02214	24.13797
1mN/29-35/FF/S	30.57701	1.324566	1.754476	34.52268	29.14157
1mN/34-40/FF/S	35.49556	1.051218	1.105059	37.57991	34.13845
1mN/39-45/FF/S	40.49205	1.177182	1.385758	42.40611	39.13058
1mN/44-50/FF/S	45.13939	1.014766	1.02975	47.41175	44.1371
1mN/0-5/FS/H	3.553633	1.062291	1.128462	4.95453	0.20601
1mN/4-10/FS/H	5.665804	0.384857	0.148115	7.30264	5.3799
1mN/9-15/FS/H	10.81499	0.483214	0.233495	12.25685	9.03504
1mN/14-20/FS/H	15.95794	0.520499	0.270919	16.66007	14.04127
1mN/19-25/FS/H	21.12256	0.9306	0.866016	22.30915	19.0128
1mN/24-30/FS/H	26.01451	1.033035	1.067161	27.29222	24.03788
1mN/29-35/FS/H	30.74262	1.320424	1.743518	32.24571	29.00944
1mN/34-40/FS/H	36.04317	1.297673	1.683955	37.76467	34.02658
1mN/39-45/FS/H	40.71595	1.591538	2.532993	43.19713	39.02303
1mN/44-50/FS/H	45.94182	1.424414	2.028956	47.88368	44.03995
1mN/0-5/FS/S	3.556556	0.724599	0.525044	4.7364	1.84707
1mN/4-10/FS/S	5.602695	0.212779	0.045275	6.60333	5.23139
1mN/9-15/FS/S	10.85028	0.452819	0.205045	11.69076	9.03753
1mN/14-20/FS/S	16.06346	0.641149	0.411073	17.51505	14.03217
1mN/19-25/FS/S	21.11878	0.907181	0.822977	21.99465	19.04326
1mN/24-30/FS/S	26.46943	0.968996	0.938953	29.17458	24.01728
1mN/29-35/FS/S	30.94894	1.298991	1.687379	34.88493	29.03877
1mN/34-40/FS/S	35.99379	1.507997	2.274054	38.04997	34.02761
1mN/39-45/FS/S	41.41212	1.414492	2.000787	43.14951	39.02491
1mN/44-50/FS/S	46.0359	1.651173	2.726373	49.04797	44.03919
1mN/0-5/SF/H	1.894267	0.801009	0.641616	4.83031	0.65603
1mN/4-10/SF/H	5.27317	0.362593	0.131474	6.71117	4.23058
1mN/9-15/SF/H	10.163	0.603719	0.364477	11.74152	9.1174
1mN/14-20/SF/H	15.26193	0.649381	0.421696	16.76641	14.09019
1mN/19-25/SF/H	20.21423	0.621336	0.386058	21.04318	19.0467
1mN/24-30/SF/H	25.40495	0.889284	0.790825	28.14159	24.09528
1mN/29-35/SF/H	30.03665	0.799504	0.639206	32.16105	29.08069
1mN/34-40/SF/H	34.9686	0.825886	0.682087	36.675	34.04496
1mN/39-45/SF/H	40.03783	0.835238	0.697623	43.10334	39.04625
1mN/44-50/SF/H	44.87127	0.79417	0.630706	47.05736	44.04348
1mN/0-5/SF/S	2.340367	0.771931	0.595877	4.65826	1.24595
1mN/4-10/SF/S	5.377214	0.272917	0.074484	6.43378	5.13363
1mN/9-15/SF/S	10.47117	0.663431	0.440141	12.86792	9.17327

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
1mN/14-20/SF/S	15.1718	0.586638	0.344144	16.32399	14.06898
1mN/19-25/SF/S	20.09442	0.705505	0.497738	21.4212	19.05567
1mN/24-30/SF/S	25.23217	0.673588	0.453721	26.62038	24.04294
1mN/29-35/SF/S	30.12679	0.79196	0.627201	31.36235	29.04102
1mN/34-40/SF/S	34.74064	0.61302	0.375794	36.607	34.11978
1mN/39-45/SF/S	40.08753	0.893546	0.798424	42.14647	39.0438
1mN/44-50/SF/S	45.13454	1.038977	1.079474	48.04345	44.04312
1mN/0-5/SS/H	3.028127	0.618911	0.383051	4.64104	2.11037
1mN/4-10/SS/H	5.455296	0.309938	0.096062	7.32589	5.26829
1mN/9-15/SS/H	10.52486	0.447746	0.200477	12.164	9.00799
1mN/14-20/SS/H	15.48368	0.541791	0.293537	16.45369	14.01297
1mN/19-25/SS/H	20.45327	0.65159	0.424569	21.35284	19.04914
1mN/24-30/SS/H	25.38787	0.569331	0.324137	26.28343	24.01625
1mN/29-35/SS/H	30.22679	0.854336	0.729889	32.35323	29.01297
1mN/34-40/SS/H	35.47218	0.89518	0.801348	37.24199	34.01368
1mN/39-45/SS/H	40.06574	0.877692	0.770344	41.94419	39.01453
1mN/44-50/SS/H	45.14558	0.91168	0.83116	47.13157	44.0146
1mN/0-5/SS/S	2.771558	0.741552	0.549899	4.29181	1.63023
1mN/4-10/SS/S	5.45113	0.271713	0.073828	6.61304	5.0151
1mN/9-15/SS/S	10.19211	0.65987	0.435428	11.03695	9.01521
1mN/14-20/SS/S	15.27887	0.601576	0.361893	16.06865	14.01175
1mN/19-25/SS/S	20.27187	0.724399	0.524754	21.76794	19.00642
1mN/24-30/SS/S	25.05228	0.951517	0.905385	27.80192	24.01539
1mN/29-35/SS/S	30.10835	0.896794	0.804239	31.90824	29.00982
1mN/34-40/SS/S	35.24857	1.106138	1.223541	39.59231	34.01575
1mN/39-45/SS/S	40.22591	0.989638	0.979384	44.03411	39.00013
1mN/44-50/SS/S	45.2658	1.137946	1.294922	48.87355	44.0733
2mN/0-5/FF/H	3.349793	0.825507	0.681462	4.70275	2.19857
2mN/3-10/FF/H	5.342206	0.358744	0.128697	5.54973	3.16698
2mN/8-15/FF/H	10.41193	0.842882	0.710451	11.88401	8.15324
2mN/13-20/FF/H	15.40653	1.102097	1.214618	16.19291	13.11335
2mN/18-25/FF/H	20.36606	1.2854	1.652254	21.57313	18.1456
2mN/23-30/FF/H	25.346	1.418758	2.012875	26.78021	23.12191
2mN/28-35/FF/H	29.5384	1.552286	2.409591	32.05397	28.13015
2mN/33-40/FF/H	34.92436	1.606302	2.580206	37.2441	33.14628
2mN/38-45/FF/H	40.17952	1.577343	2.488011	42.51709	38.13168
2mN/43-50/FF/H	44.73521	1.548529	2.397943	47.56044	43.14253
2mN/0-5/FF/S	3.403679	0.914284	0.835916	4.72645	1.54438
2mN/3-10/FF/S	5.486167	0.515951	0.266206	7.1944	3.14467
2mN/8-15/FF/S	10.41955	0.852517	0.726785	11.16272	8.11933
2mN/13-20/FF/S	15.33497	1.133993	1.28594	16.29766	13.14294
2mN/18-25/FF/S	20.29421	1.356719	1.840687	21.66799	18.12832
2mN/23-30/FF/S	24.8838	1.469014	2.158003	26.72268	23.12147
2mN/28-35/FF/S	30.06473	1.738138	3.021125	34.79709	28.1069
2mN/33-40/FF/S	35.06003	1.609013	2.588924	37.12415	33.12597
2mN/38-45/FF/S	39.48843	1.363572	1.859328	42.4283	38.14517
2mN/43-50/FF/S	44.95769	1.620925	2.627398	47.61452	43.11656
2mN/0-5/FS/H	3.242701	0.783267	0.613507	4.93713	1.94544
2mN/3-10/FS/H	5.605113	0.134623	0.018123	6.0476	5.34061
2mN/8-15/FS/H	10.91506	0.137947	0.019029	11.21292	10.53311
2mN/13-20/FS/H	15.88028	1.009103	1.018289	16.76044	13.00519
2mN/18-25/FS/H	20.39073	1.510062	2.280287	22.06486	18.02527
2mN/23-30/FS/H	25.67149	1.640722	2.691969	27.71816	23.03051
2mN/28-35/FS/H	30.16788	1.7765	3.155952	32.69251	28.02664

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/33-40/FS/H	35.1448	1.883993	3.549429	37.93499	33.03386
2mN/38-45/FS/H	40.50613	1.961042	3.845687	42.85836	38.01257
2mN/43-50/FS/H	43.79285	1.17309	1.37614	48.10864	43.00504
2mN/0-5/FS/S	3.38183	0.788753	0.622131	4.70215	2.21275
2mN/3-10/FS/S	6.01386	0.791877	0.627069	8.4066	5.42779
2mN/8-15/FS/S	10.61611	1.106892	1.22521	12.98047	8.05614
2mN/13-20/FS/S	16.0521	0.944139	0.891399	17.86083	13.03166
2mN/18-25/FS/S	19.75986	1.574424	2.478812	22.05206	18.03298
2mN/23-30/FS/S	25.61914	1.694061	2.869842	28.85852	23.02666
2mN/28-35/FS/S	29.66996	1.612212	2.599229	32.64452	28.01019
2mN/33-40/FS/S	34.4957	1.76988	3.132475	37.68886	33.02289
2mN/38-45/FS/S	39.33142	1.79027	3.205066	43.03187	38.0082
2mN/43-50/FS/S	43.46898	0.622664	0.387711	46.33322	43.02109
2mN/0-5/SF/H	2.866785	0.751568	0.564855	4.75303	1.81427
2mN/3-10/SF/H	5.471395	0.523501	0.274054	7.80805	4.87688
2mN/8-15/SF/H	10.53892	0.487013	0.237181	12.84396	8.60922
2mN/13-20/SF/H	15.54214	0.820406	0.673066	18.35948	13.13128
2mN/18-25/SF/H	20.60861	0.6898	0.475824	21.44076	18.13481
2mN/23-30/SF/H	25.20407	1.020445	1.041308	26.35115	23.11944
2mN/28-35/SF/H	29.9196	1.221049	1.490961	32.34101	28.07936
2mN/33-40/SF/H	35.07854	1.309352	1.714403	37.04738	33.10405
2mN/38-45/SF/H	39.38846	1.223262	1.49637	41.92337	38.09033
2mN/43-50/SF/H	44.44887	1.148686	1.319478	46.81362	43.04677
2mN/0-5/SF/S	2.521351	0.73948	0.546831	4.35096	1.41448
2mN/3-10/SF/S	5.558042	0.834133	0.695777	9.25503	3.04775
2mN/8-15/SF/S	10.46629	0.590645	0.348862	11.61481	8.04388
2mN/13-20/SF/S	15.57885	0.754729	0.569615	16.50008	13.12085
2mN/18-25/SF/S	20.12174	1.411525	1.992404	23.98384	18.04682
2mN/23-30/SF/S	24.93482	1.329375	1.767237	28.22234	23.04316
2mN/28-35/SF/S	29.8211	1.315573	1.730732	32.40181	28.08819
2mN/33-40/SF/S	34.62184	1.270864	1.615095	37.1216	33.11586
2mN/38-45/SF/S	39.31028	1.350888	1.824899	42.66959	38.044
2mN/43-50/SF/S	44.37232	1.29464	1.676093	47.54046	43.11368
2mN/0-5/SS/H	2.86475	0.688292	0.473747	4.35975	1.56341
2mN/3-10/SS/H	5.462724	0.681177	0.464002	8.72091	3.0071
2mN/8-15/SS/H	10.69926	0.296778	0.088077	11.67433	9.6667
2mN/13-20/SS/H	15.48164	0.821004	0.674048	16.24333	13.11481
2mN/18-25/SS/H	20.09015	1.221847	1.492911	21.94115	18.04484
2mN/23-30/SS/H	24.70195	1.320843	1.744626	26.56253	23.0194
2mN/28-35/SS/H	29.61723	1.252668	1.569177	31.80281	28.06035
2mN/33-40/SS/H	34.31083	1.175191	1.381073	36.97877	33.01708
2mN/38-45/SS/H	39.45019	1.282984	1.646047	41.92015	38.08442
2mN/43-50/SS/H	44.31404	1.583499	2.507468	49.56775	43.01424
2mN/0-5/SS/S	2.513394	0.821927	0.675564	4.64651	1.36
2mN/3-10/SS/S	5.564501	0.37721	0.142287	7.69586	5.24746
2mN/8-15/SS/S	10.59628	0.53731	0.288702	12.41033	8.05066
2mN/13-20/SS/S	15.28696	0.982123	0.964565	16.40186	13.01521
2mN/18-25/SS/S	20.33612	1.242356	1.543449	22.3751	18.02155
2mN/23-30/SS/S	25.18048	1.40198	1.965549	27.20463	23.07585
2mN/28-35/SS/S	29.82383	1.491058	2.223254	32.11965	28.01086
2mN/33-40/SS/S	34.75652	1.381366	1.908171	38.63071	33.02702
2mN/38-45/SS/S	39.40656	1.282453	1.644685	42.06802	38.01789
2mN/43-50/SS/S	44.55149	1.246883	1.554717	47.2157	43.0562
5mN/0-5/FF/H	3.055188	1.106844	1.225104	4.80027	0.17916

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
5mN/0-10/FF/H	5.503245	0.309015	0.09549	7.31446	5.17525
5mN/5-15/FF/H	9.781199	1.948708	3.797463	11.82645	5.10664
5mN/10-20/FF/H	13.55121	2.47443	6.122804	16.39026	10.14408
5mN/15-25/FF/H	17.81535	2.7006	7.293241	21.58276	15.11876
5mN/20-30/FF/H	21.53644	1.759833	3.097014	26.31363	20.11068
5mN/25-35/FF/H	26.41703	1.506289	2.268908	31.84131	25.11134
5mN/30-40/FF/H	31.25283	1.690097	2.856429	36.77347	30.11683
5mN/35-45/FF/H	36.21824	1.713236	2.935176	42.13527	35.13328
5mN/40-50/FF/H	41.67879	1.769616	3.131542	47.26865	40.11696
5mN/0-5/FF/S	3.615083	1.162616	1.351676	4.6751	0.12739
5mN/0-10/FF/S	5.51566	0.357826	0.128039	7.70124	5.28827
5mN/5-15/FF/S	9.657706	2.130108	4.537359	11.08104	5.13255
5mN/10-20/FF/S	13.18414	2.557431	6.540451	16.5443	10.14418
5mN/15-25/FF/S	17.31702	2.501756	6.258782	21.54957	15.12573
5mN/20-30/FF/S	21.73346	2.069273	4.281893	26.60757	20.11728
5mN/25-35/FF/S	26.14415	1.544186	2.384512	31.55016	25.12079
5mN/30-40/FF/S	31.30257	1.809371	3.273823	36.959	30.12263
5mN/35-45/FF/S	36.49645	1.877553	3.525204	42.4189	35.12107
5mN/40-50/FF/S	41.19011	1.440892	2.076168	46.12819	40.12194
5mN/0-5/SF/H	2.021765	0.768193	0.590121	4.15781	0.92603
5mN/0-10/SF/H	4.677212	1.35766	1.84324	6.07326	0.18757
5mN/5-15/SF/H	6.90885	1.843998	3.400327	11.0518	5.04948
5mN/10-20/SF/H	11.76968	1.753955	3.076359	15.80205	10.07195
5mN/15-25/SF/H	16.17088	1.395061	1.946194	20.90216	15.04142
5mN/20-30/SF/H	20.64756	0.942765	0.888807	24.9969	20.04376
5mN/25-35/SF/H	25.60248	0.700108	0.490151	27.6941	25.0411
5mN/30-40/SF/H	30.48388	0.397069	0.157663	31.88322	30.04103
5mN/35-45/SF/H	35.72	0.734855	0.540012	38.03175	35.04367
5mN/40-50/SF/H	40.80959	0.960081	0.921755	44.25324	40.03853
5mN/0-5/SF/S	2.110351	0.685165	0.469451	3.76436	0.66762
5mN/0-10/SF/S	5.160139	0.832797	0.693552	6.23587	0.36983
5mN/5-15/SF/S	7.634017	2.31998	5.382309	10.67332	5.04326
5mN/10-20/SF/S	11.8909	1.85444	3.438947	16.48871	10.04358
5mN/15-25/SF/S	16.46591	1.524424	2.323869	20.85999	15.0918
5mN/20-30/SF/S	21.0543	0.992669	0.985391	24.05821	20.08224
5mN/25-35/SF/S	25.86831	0.810388	0.656729	28.23301	25.07958
5mN/30-40/SF/S	30.8189	1.074339	1.154205	35.34496	30.04302
5mN/35-45/SF/S	36.09238	0.826467	0.683048	38.81423	35.06572
5mN/40-50/SF/S	40.80496	0.716617	0.51354	43.06326	40.04067
10mN/0-10/FF/H	3.230707	1.291469	1.667893	7.51207	0.17169
10mN/0-15/FF/H	10.21824	1.473485	2.171159	12.11319	1.93499
10mN/5-20/FF/H	12.07434	4.8044	23.08226	16.29214	5.1197
10mN/10-25/FF/H	13.38476	4.094933	16.76848	21.46762	10.11027
10mN/15-30/FF/H	17.0455	2.812595	7.910692	26.37907	15.10653
10mN/20-35/FF/H	21.38382	1.955638	3.82452	31.27768	20.11649
10mN/25-40/FF/H	26.25324	1.168501	1.365393	29.15977	25.09747
10mN/30-45/FF/H	30.9256	1.129798	1.276443	34.39486	30.11645
10mN/35-50/FF/H	36.1826	1.869839	3.496297	46.66304	35.11575
10mN/0-10/FF/S	3.541806	1.465362	2.147286	6.88803	0.15289
10mN/0-15/FF/S	10.58263	0.875464	0.766437	11.78627	5.7442
10mN/5-20/FF/S	11.26872	4.824466	23.27547	16.29952	5.11959
10mN/10-25/FF/S	13.23426	3.885477	15.09694	21.62236	10.09857
10mN/15-30/FF/S	17.88114	3.654036	13.35198	26.57192	15.10395
10mN/20-35/FF/S	21.44307	1.800198	3.240712	28.08077	20.12435

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
10mN/25-40/FF/S	25.88249	1.009739	1.019573	30.67653	25.1016
10mN/30-45/FF/S	30.90097	1.057476	1.118256	35.29806	30.12059
10mN/35-50/FF/S	36.34832	1.804309	3.255532	43.68216	35.12002
10mN/0-10/SF/H	2.827266	1.362267	1.855772	8.08683	1.04948
10mN/0-15/SF/H	10.14581	1.63617	2.677054	12.08047	1.05029
10mN/5-20/SF/H	14.75708	2.917173	8.5099	17.31673	5.32705
10mN/10-25/SF/H	15.8534	4.379888	19.18341	21.36142	10.11657
10mN/15-30/SF/H	18.46176	3.708781	13.75505	26.6395	15.04101
10mN/20-35/SF/H	22.57202	2.673305	7.146561	30.84328	20.11688
10mN/25-40/SF/H	27.24785	2.163914	4.682523	33.13686	25.12179
10mN/30-45/SF/H	31.71044	2.160302	4.666906	41.95055	30.08289
10mN/35-50/SF/H	36.61957	2.053173	4.215521	46.60503	35.07413
10mN/0-10/SF/S	3.144485	1.391784	1.937062	8.37145	1.37798
10mN/0-15/SF/S	10.35772	0.688389	0.473879	10.82911	6.21228
10mN/5-20/SF/S	14.66281	3.042722	9.258157	16.98587	5.52507
10mN/10-25/SF/S	15.34777	4.459036	19.883	21.39448	10.05385
10mN/15-30/SF/S	19.6011	4.225013	17.85074	26.84788	15.06761
10mN/20-35/SF/S	22.50019	3.088682	9.539959	31.39299	20.05587
10mN/25-40/SF/S	27.23524	3.067042	9.406745	36.49478	25.1203
10mN/30-45/SF/S	31.90885	2.218884	4.923445	41.49284	30.10144
10mN/35-50/SF/S	36.77662	1.735488	3.01192	41.86379	35.10284

Statistical Data on Overshoot Amounts

-	Avg.	St.D.	Var.	Max.	Min.
1mN/4-10/FF/H	0.464351	0.14603	0.021325	0.91346	0.19188
1mN/9-15/FF/H	0.559755	0.131579	0.017313	0.89275	0.17305
1mN/14-20/FF/H	0.814503	0.375531	0.141024	2.9222	0.44165
1mN/19-25/FF/H	0.921707	0.238831	0.05704	1.32181	0.12719
1mN/24-30/FF/H	1.050957	0.314849	0.09913	1.57158	0.11406
1mN/29-35/FF/H	1.04252	0.329496	0.108567	1.50938	0.21778
1mN/34-40/FF/H	1.174159	0.447226	0.200011	2.20685	0.30276
1mN/39-45/FF/H	1.33114	0.40068	0.160545	2.01625	0.14412
1mN/44-50/FF/H	1.498555	0.582111	0.338854	2.44274	0.16651
1mN/4-10/FF/S	0.485921	0.128878	0.01661	0.83628	0.27198
1mN/9-15/FF/S	0.624551	0.147299	0.021697	0.99444	0.24912
1mN/14-20/FF/S	0.853371	0.189623	0.035957	1.25259	0.49521
1mN/19-25/FF/S	0.953319	0.310591	0.096467	1.62194	0.13051
1mN/24-30/FF/S	1.077586	0.368682	0.135926	1.83186	0.0362
1mN/29-35/FF/S	1.230914	0.397991	0.158396	1.97382	0.30382
1mN/34-40/FF/S	1.322446	0.399539	0.159631	2.1505	0.24045
1mN/39-45/FF/S	1.443259	0.582157	0.338907	2.5493	0.11494
1mN/44-50/FF/S	1.641067	0.63593	0.404407	2.89056	0.08925
1mN/4-10/FS/H	0.654429	0.126743	0.016064	1.01476	0.46901
1mN/9-15/FS/H	0.872411	0.14408	0.020759	1.27324	0.51858
1mN/14-20/FS/H	1.014261	0.196341	0.03855	1.4733	0.56838
1mN/19-25/FS/H	1.265887	0.244081	0.059576	1.69234	0.59574
1mN/24-30/FS/H	1.416116	0.359042	0.128911	2.17054	0.36782
1mN/29-35/FS/H	1.615041	0.351347	0.123445	2.15769	0.86727
1mN/34-40/FS/H	1.709452	0.462184	0.213614	2.33166	0.28565
1mN/39-45/FS/H	1.931346	0.579116	0.335375	3.08856	0.37652
1mN/44-50/FS/H	2.044392	0.636593	0.405251	3.28931	0.42573
1mN/4-10/FS/S	0.66757	0.134119	0.017988	1.04201	0.43663
1mN/9-15/FS/S	0.873711	0.236761	0.056056	1.81783	0.23244
1mN/14-20/FS/S	1.084357	0.244907	0.059979	1.92807	0.58733

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
1mN/19-25/FS/S	1.314735	0.261703	0.068489	1.71172	0.48977
1mN/24-30/FS/S	1.483495	0.343408	0.117929	2.10762	0.56954
1mN/29-35/FS/S	1.451822	0.490925	0.241007	2.3609	0.01899
1mN/34-40/FS/S	1.71387	0.47696	0.227491	2.58369	0.44729
1mN/39-45/FS/S	1.699429	0.593164	0.351844	2.73533	0.32658
1mN/44-50/FS/S	1.913239	0.673795	0.454	3.1292	0.04764
1mN/4-10/SF/H	0.437652	0.130348	0.016991	0.76444	0.22823
1mN/9-15/SF/H	0.50489	0.146393	0.021431	0.85528	0.22432
1mN/14-20/SF/H	0.630566	0.158703	0.025187	1.14395	0.20671
1mN/19-25/SF/H	0.788983	0.277443	0.076975	1.69208	0.46023
1mN/24-30/SF/H	0.899166	0.283203	0.080204	1.56559	0.38791
1mN/29-35/SF/H	1.017707	0.662551	0.438973	4.44326	0.19615
1mN/34-40/SF/H	1.186929	0.445379	0.198363	2.5105	0.27092
1mN/39-45/SF/H	1.305197	0.420138	0.176516	2.12894	0.46705
1mN/44-50/SF/H	1.33327	0.4908	0.240884	2.33176	0.27931
1mN/4-10/SF/S	0.430001	0.186976	0.03496	1.43378	0.17475
1mN/9-15/SF/S	0.57475	0.148452	0.022038	0.90358	0.32433
1mN/14-20/SF/S	0.689367	0.178502	0.031863	1.20003	0.38192
1mN/19-25/SF/S	0.746324	0.210982	0.044514	1.38547	0.38772
1mN/24-30/SF/S	1.010581	0.26202	0.068654	1.6283	0.6287
1mN/29-35/SF/S	1.11399	0.340625	0.116025	2.53812	0.56488
1mN/34-40/SF/S	1.159907	0.40483	0.163888	2.06153	0.28256
1mN/39-45/SF/S	1.408073	0.434258	0.18858	2.34724	0.36015
1mN/44-50/SF/S	1.471635	0.497758	0.247763	2.53664	0.50765
1mN/4-10/SS/H	0.519806	0.135858	0.018457	0.90875	0.29348
1mN/9-15/SS/H	0.617432	0.131539	0.017302	1.01749	0.27026
1mN/14-20/SS/H	0.670922	0.187023	0.034978	1.1131	0.34322
1mN/19-25/SS/H	0.87397	0.239872	0.057538	1.66884	0.3734
1mN/24-30/SS/H	0.845333	0.281443	0.07921	1.52114	0.37779
1mN/29-35/SS/H	1.101411	0.388907	0.151248	2.2767	0.49542
1mN/34-40/SS/H	1.105841	0.379069	0.143694	1.69642	0.42016
1mN/39-45/SS/H	1.312362	0.416088	0.173129	2.26691	0.46879
1mN/44-50/SS/H	1.361554	0.444543	0.197619	2.69558	0.4152
1mN/4-10/SS/S	0.530946	0.168897	0.028526	0.99671	0.29165
1mN/9-15/SS/S	0.681506	0.177937	0.031662	1.25468	0.34268
1mN/14-20/SS/S	0.771046	0.28376	0.08052	1.75709	0.27151
1mN/19-25/SS/S	0.819169	0.257469	0.06629	1.42514	0.26534
1mN/24-30/SS/S	1.004509	0.339404	0.115195	1.89151	0.31858
1mN/29-35/SS/S	1.159009	0.336781	0.113422	1.78783	0.26599
1mN/34-40/SS/S	1.259666	0.610458	0.372659	3.54799	0.26539
1mN/39-45/SS/S	1.258103	0.361555	0.130722	1.98294	0.47144
1mN/44-50/SS/S	1.492518	0.565991	0.320345	2.72607	0.39565
2mN/3-10/FF/H	0.547277	0.153472	0.023554	0.97933	0.32786
2mN/8-15/FF/H	0.667695	0.115649	0.013375	0.92328	0.41119
2mN/13-20/FF/H	0.899263	0.108073	0.01168	1.14742	0.68171
2mN/18-25/FF/H	1.058715	0.181664	0.033002	1.42096	0.55126
2mN/23-30/FF/H	1.185365	0.234315	0.054904	1.64822	0.64176
2mN/28-35/FF/H	1.367136	0.184225	0.033939	1.68922	0.93296
2mN/33-40/FF/H	1.471251	0.298381	0.089031	2.16231	0.86926
2mN/38-45/FF/H	1.570304	0.294362	0.086649	2.34697	0.95093
2mN/43-50/FF/H	1.664645	0.375341	0.140881	2.30808	0.65212
2mN/3-10/FF/S	0.523055	0.164308	0.026997	1.34716	0.27384
2mN/8-15/FF/S	0.711008	0.179012	0.032045	1.56137	0.41431
2mN/13-20/FF/S	0.853298	0.189295	0.035833	1.14881	0.33697

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/18-25/FF/S	1.137006	0.1909	0.036443	1.57678	0.80238
2mN/23-30/FF/S	1.196982	0.25076	0.062881	1.60542	0.61198
2mN/28-35/FF/S	1.344306	0.203459	0.041396	1.81319	0.93032
2mN/33-40/FF/S	1.481585	0.267252	0.071424	2.02152	0.95379
2mN/38-45/FF/S	1.591076	0.378014	0.142894	2.66326	0.86298
2mN/43-50/FF/S	1.735596	0.495074	0.245098	2.81549	0.69274
2mN/3-10/FS/H	0.668479	0.133698	0.017875	0.96105	0.33885
2mN/8-15/FS/H	0.900099	0.120401	0.014496	1.21292	0.59265
2mN/13-20/FS/H	1.169895	0.172656	0.02981	1.62949	0.8182
2mN/18-25/FS/H	1.390741	0.234403	0.054945	1.78012	0.90911
2mN/23-30/FS/H	1.732916	0.268825	0.072267	2.17752	0.74194
2mN/28-35/FS/H	1.845115	0.341606	0.116694	2.52459	0.7471
2mN/33-40/FS/H	2.049226	0.419289	0.175804	2.86778	0.62232
2mN/38-45/FS/H	2.176806	0.396481	0.157197	2.73819	1.30076
2mN/43-50/FS/H	2.202688	0.613999	0.376994	3.11287	0.10963
2mN/3-10/FS/S	0.748711	0.344979	0.11901	2.72192	0.48649
2mN/8-15/FS/S	1.009022	0.268941	0.072329	2.44725	0.59728
2mN/13-20/FS/S	1.24505	0.189074	0.035749	1.53563	0.46511
2mN/18-25/FS/S	1.507465	0.264017	0.069705	1.91527	0.84927
2mN/23-30/FS/S	1.673673	0.385391	0.148526	2.28728	0.40782
2mN/28-35/FS/S	1.809393	0.467009	0.218097	2.78823	0.95701
2mN/33-40/FS/S	2.028821	0.466679	0.217789	3.01909	0.58399
2mN/38-45/FS/S	2.229558	0.715903	0.512517	3.27274	0.16652
2mN/43-50/FS/S	2.459823	0.724233	0.524513	3.45841	0.41234
2mN/3-10/SF/H	0.579265	0.244667	0.059862	1.44339	0.23827
2mN/8-15/SF/H	0.542721	0.101761	0.010355	0.72574	0.33511
2mN/13-20/SF/H	0.747819	0.615273	0.378561	4.40857	0.25021
2mN/18-25/SF/H	0.838897	0.214981	0.046217	1.28517	0.33933
2mN/23-30/SF/H	0.947929	0.211202	0.044606	1.49096	0.5554
2mN/28-35/SF/H	0.938175	0.261753	0.068514	1.62855	0.27896
2mN/33-40/SF/H	1.156268	0.269871	0.07283	1.7375	0.61449
2mN/38-45/SF/H	1.18699	0.364445	0.13282	1.97109	0.38998
2mN/43-50/SF/H	1.260276	0.426132	0.181589	2.09929	0.45441
2mN/3-10/SF/S	0.555226	0.275566	0.075937	2.06919	0.2774
2mN/8-15/SF/S	0.581498	0.140816	0.019829	0.85632	0.27712
2mN/13-20/SF/S	0.777689	0.256044	0.065559	1.42823	0.09006
2mN/18-25/SF/S	1.00514	0.332743	0.110718	1.69549	0.34505
2mN/23-30/SF/S	0.979674	0.29906	0.089437	1.50646	0.34997
2mN/28-35/SF/S	1.248399	0.376523	0.141769	2.1533	0.5059
2mN/33-40/SF/S	1.342684	0.482498	0.232804	2.60923	0.66218
2mN/38-45/SF/S	1.322638	0.476012	0.226587	2.45626	0.32626
2mN/43-50/SF/S	1.210167	0.450682	0.203114	1.99179	0.33451
2mN/3-10/SS/H	0.590073	0.229403	0.052626	1.36163	0.22307
2mN/8-15/SS/H	0.760356	0.541989	0.293752	4.05123	0.43133
2mN/13-20/SS/H	0.847492	0.163749	0.026814	1.16757	0.53735
2mN/18-25/SS/H	1.018339	0.211236	0.044621	1.42205	0.51032
2mN/23-30/SS/H	1.146606	0.277826	0.077187	1.67804	0.57809
2mN/28-35/SS/H	1.217884	0.274794	0.075512	1.75271	0.48339
2mN/33-40/SS/H	1.278447	0.382265	0.146127	1.97424	0.20381
2mN/38-45/SS/H	1.405109	0.446589	0.199441	2.09511	0.34435
2mN/43-50/SS/H	1.504941	0.523912	0.274483	2.66826	0.35341
2mN/3-10/SS/S	0.629757	0.355649	0.126486	2.72257	0.37906
2mN/8-15/SS/S	0.664021	0.154601	0.023901	1.07486	0.26903
2mN/13-20/SS/S	0.819853	0.166685	0.027784	1.15763	0.52118

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/18-25/SS/S	1.091123	0.231335	0.053516	1.71396	0.66795
2mN/23-30/SS/S	1.273472	0.399551	0.159641	2.19201	0.40786
2mN/28-35/SS/S	1.447559	0.350534	0.122874	2.39911	0.88474
2mN/33-40/SS/S	1.376943	0.427651	0.182885	2.59874	0.37845
2mN/38-45/SS/S	1.628689	0.364383	0.132775	3.02594	0.86117
2mN/43-50/SS/S	1.635404	0.536527	0.287862	2.71706	0.03605
5mN/0-10/FF/H	0.551521	0.130212	0.016955	1.06192	0.37354
5mN/5-15/FF/H	0.638684	0.171491	0.029409	1.25256	0.42784
5mN/10-20/FF/H	0.84373	0.191056	0.036502	1.17644	0.43609
5mN/15-25/FF/H	1.031361	0.219759	0.048294	1.56088	0.41919
5mN/20-30/FF/H	1.150257	0.225092	0.050667	1.61588	0.71482
5mN/25-35/FF/H	1.394566	0.27974	0.078255	2.23983	0.61218
5mN/30-40/FF/H	1.488013	0.389315	0.151566	2.2039	0.29115
5mN/35-45/FF/H	1.53955	0.332387	0.110481	2.24595	0.44326
5mN/40-50/FF/H	1.668934	0.469263	0.220208	2.75504	0.85893
5mN/0-10/FF/S	0.52935	0.085505	0.007311	0.75882	0.26235
5mN/5-15/FF/S	0.708627	0.11362	0.012909	1.01053	0.53279
5mN/10-20/FF/S	0.853125	0.165727	0.027465	1.18344	0.52454
5mN/15-25/FF/S	0.993678	0.209397	0.043847	1.35552	0.56744
5mN/20-30/FF/S	1.233744	0.257725	0.066422	1.7236	0.45527
5mN/25-35/FF/S	1.31737	0.318795	0.10163	1.92506	0.58364
5mN/30-40/FF/S	1.440217	0.382159	0.146046	2.29071	0.5752
5mN/35-45/FF/S	1.532214	0.410417	0.168442	2.33068	0.34161
5mN/40-50/FF/S	1.709553	0.449254	0.201829	2.3702	0.34073
5mN/0-10/SF/H	0.590112	0.419686	0.176136	2.98386	0.23445
5mN/5-15/SF/H	0.560836	0.139491	0.019458	0.97221	0.20842
5mN/10-20/SF/H	0.687676	0.151382	0.022916	0.93716	0.2548
5mN/15-25/SF/H	0.850576	0.235999	0.055696	1.40878	0.45037
5mN/20-30/SF/H	0.997467	0.229678	0.052752	1.53371	0.60249
5mN/25-35/SF/H	1.091444	0.305702	0.093454	1.82378	0.48154
5mN/30-40/SF/H	1.188014	0.404586	0.16369	1.95143	0.2647
5mN/35-45/SF/H	1.196207	0.409493	0.167684	1.80656	0.3495
5mN/40-50/SF/H	1.352018	0.390929	0.152825	1.97278	0.52848
5mN/0-10/SF/S	0.454737	0.127065	0.016145	0.74253	0.1407
5mN/5-15/SF/S	0.548936	0.111805	0.0125	0.80531	0.25418
5mN/10-20/SF/S	0.579972	0.235031	0.05524	1.05941	0.05364
5mN/15-25/SF/S	0.779322	0.236441	0.055904	1.30501	0.25565
5mN/20-30/SF/S	1.017819	0.320773	0.102895	1.58493	0.42314
5mN/25-35/SF/S	1.125355	0.329749	0.108734	1.91621	0.53764
5mN/30-40/SF/S	1.213496	0.300045	0.090027	1.75674	0.77106
5mN/35-45/SF/S	1.212759	0.412651	0.170281	2.26702	0.36959
5mN/40-50/SF/S	1.353949	0.440167	0.193747	2.46623	0.55761
10mN/0-15/FF/H	0.75344	0.480108	0.230503	2.72464	0.08868
10mN/5-20/FF/H	0.837918	0.202723	0.041097	1.19253	0.4563
10mN/10-25/FF/H	1.136305	0.259492	0.067336	1.77347	0.72924
10mN/15-30/FF/H	1.370848	0.307361	0.094471	1.99541	0.74122
10mN/20-35/FF/H	1.623018	0.336888	0.113494	2.16557	1.01292
10mN/25-40/FF/H	1.633118	0.318308	0.10132	2.38311	1.15441
10mN/30-45/FF/H	1.541836	0.376223	0.141544	2.06733	0.24551
10mN/35-50/FF/H	1.655332	0.455922	0.207865	2.97036	0.45581
10mN/0-15/FF/S	0.750389	0.142481	0.020301	1.03025	0.28153
10mN/5-20/FF/S	0.900899	0.158644	0.025168	1.38561	0.62035
10mN/10-25/FF/S	1.015549	0.222885	0.049678	1.48235	0.50679
10mN/15-30/FF/S	1.178961	0.273435	0.074766	1.67171	0.58651

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
10mN/20-35/FF/S	1.34823	0.363293	0.131982	2.35339	0.73362
10mN/25-40/FF/S	1.507823	0.286743	0.082221	2.07208	0.75149
10mN/30-45/FF/S	1.455162	0.323425	0.104604	1.96114	0.48282
10mN/35-50/FF/S	1.530746	0.441559	0.194974	2.30193	0.32497
10mN/0-15/SF/H	0.661631	0.187255	0.035065	1.02425	0.3411
10mN/5-20/SF/H	0.849657	0.461038	0.212556	3.1861	0.3642
10mN/10-25/SF/H	0.869548	0.306147	0.093726	1.36271	0.08253
10mN/15-30/SF/H	1.077038	0.3808	0.145008	1.83456	0.12463
10mN/20-35/SF/H	1.136253	0.332194	0.110353	1.7401	0.39678
10mN/25-40/SF/H	1.306757	0.331573	0.109941	2.04201	0.73388
10mN/30-45/SF/H	1.324616	0.409059	0.167329	1.96661	0.27611
10mN/35-50/SF/H	1.293579	0.456014	0.207949	1.94023	0.15183
10mN/0-15/SF/S	0.548271	0.125013	0.015628	0.81909	0.31018
10mN/5-20/SF/S	0.646253	0.254689	0.064867	1.33137	0.09503
10mN/10-25/SF/S	0.856909	0.282149	0.079608	1.69976	0.36265
10mN/15-30/SF/S	0.947672	0.283809	0.080547	1.7743	0.37831
10mN/20-35/SF/S	0.893086	0.437631	0.191521	2.03091	0.05002
10mN/25-40/SF/S	0.948685	0.442118	0.195468	2.0773	0.21415
10mN/30-45/SF/S	1.126267	0.478099	0.228579	2.3534	0.34331
10mN/35-50/SF/S	1.116485	0.49892	0.248921	2.42756	0.19611

Statistical Data on Hardening

-	Avg.	St.D.	Var.	Max.	Min.
1mN/4-10/FF/H	0.09287	0.029206	0.000853	0.182692	0.038376
1mN/9-15/FF/H	0.055975	0.013158	0.000173	0.089275	0.017305
1mN/14-20/FF/H	0.0543	0.025035	0.000627	0.194813	0.029443
1mN/19-25/FF/H	0.046085	0.011942	0.000143	0.066091	0.006359
1mN/24-30/FF/H	0.042038	0.012594	0.000159	0.062863	0.004562
1mN/29-35/FF/H	0.034751	0.010983	0.000121	0.050313	0.007259
1mN/34-40/FF/H	0.033547	0.012778	0.000163	0.063053	0.00865
1mN/39-45/FF/H	0.033279	0.010017	0.0001	0.050406	0.003603
1mN/44-50/FF/H	0.033301	0.012936	0.000167	0.054283	0.0037
1mN/4-10/FF/S	0.097184	0.025776	0.000664	0.167256	0.054396
1mN/9-15/FF/S	0.062455	0.01473	0.000217	0.099444	0.024912
1mN/14-20/FF/S	0.056891	0.012642	0.00016	0.083506	0.033014
1mN/19-25/FF/S	0.047666	0.01553	0.000241	0.081097	0.006526
1mN/24-30/FF/S	0.043103	0.014747	0.000217	0.073274	0.001448
1mN/29-35/FF/S	0.04103	0.013266	0.000176	0.065794	0.010127
1mN/34-40/FF/S	0.037784	0.011415	0.00013	0.061443	0.00687
1mN/39-45/FF/S	0.036081	0.014554	0.000212	0.063733	0.002873
1mN/44-50/FF/S	0.036468	0.014132	0.0002	0.064235	0.001983
1mN/4-10/FS/H	0.130886	0.025349	0.000643	0.202952	0.093802
1mN/9-15/FS/H	0.087241	0.014408	0.000208	0.127324	0.051858
1mN/14-20/FS/H	0.067617	0.013089	0.000171	0.09822	0.037892
1mN/19-25/FS/H	0.063294	0.012204	0.000149	0.084617	0.029787
1mN/24-30/FS/H	0.056645	0.014362	0.000206	0.086822	0.014713
1mN/29-35/FS/H	0.053835	0.011712	0.000137	0.071923	0.028909
1mN/34-40/FS/H	0.048841	0.013205	0.000174	0.066619	0.008161
1mN/39-45/FS/H	0.048284	0.014478	0.00021	0.077214	0.009413
1mN/44-50/FS/H	0.045431	0.014147	0.0002	0.073096	0.009461
1mN/4-10/FS/S	0.133514	0.026824	0.00072	0.208402	0.087326
1mN/9-15/FS/S	0.087371	0.023676	0.000561	0.181783	0.023244
1mN/14-20/FS/S	0.07229	0.016327	0.000267	0.128538	0.039155
1mN/19-25/FS/S	0.065737	0.013085	0.000171	0.085586	0.024489

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
1mN/24-30/FS/S	0.05934	0.013736	0.000189	0.084305	0.022782
1mN/29-35/FS/S	0.048394	0.016364	0.000268	0.078697	0.000633
1mN/34-40/FS/S	0.048968	0.013627	0.000186	0.07382	0.01278
1mN/39-45/FS/S	0.042486	0.014829	0.00022	0.068383	0.008165
1mN/44-50/FS/S	0.042516	0.014973	0.000224	0.069538	0.001059
1mN/4-10/SF/H	0.08753	0.02607	0.00068	0.152888	0.045646
1mN/9-15/SF/H	0.050489	0.014639	0.000214	0.085528	0.022432
1mN/14-20/SF/H	0.042038	0.01058	0.000112	0.076263	0.013781
1mN/19-25/SF/H	0.039449	0.013872	0.000192	0.084604	0.023012
1mN/24-30/SF/H	0.035967	0.011328	0.000128	0.062624	0.015516
1mN/29-35/SF/H	0.033924	0.022085	0.000488	0.148109	0.006538
1mN/34-40/SF/H	0.033912	0.012725	0.000162	0.071729	0.007741
1mN/39-45/SF/H	0.03263	0.010503	0.00011	0.053224	0.011676
1mN/44-50/SF/H	0.029628	0.010907	0.000119	0.051817	0.006207
1mN/4-10/SF/S	0.086	0.037395	0.001398	0.286756	0.03495
1mN/9-15/SF/S	0.057475	0.014845	0.00022	0.090358	0.032433
1mN/14-20/SF/S	0.045958	0.0119	0.000142	0.080002	0.025461
1mN/19-25/SF/S	0.037316	0.010549	0.000111	0.069274	0.019386
1mN/24-30/SF/S	0.040423	0.010481	0.00011	0.065132	0.025148
1mN/29-35/SF/S	0.037133	0.011354	0.000129	0.084604	0.018829
1mN/34-40/SF/S	0.03314	0.011567	0.000134	0.058901	0.008073
1mN/39-45/SF/S	0.035202	0.010856	0.000118	0.058681	0.009004
1mN/44-50/SF/S	0.032703	0.011061	0.000122	0.05637	0.011281
1mN/4-10/SS/H	0.103961	0.027172	0.000738	0.18175	0.058696
1mN/9-15/SS/H	0.061743	0.013154	0.000173	0.101749	0.027026
1mN/14-20/SS/H	0.044728	0.012468	0.000155	0.074207	0.022881
1mN/19-25/SS/H	0.043699	0.011994	0.000144	0.083442	0.01867
1mN/24-30/SS/H	0.033813	0.011258	0.000127	0.060846	0.015112
1mN/29-35/SS/H	0.036714	0.012964	0.000168	0.07589	0.016514
1mN/34-40/SS/H	0.031595	0.010831	0.000117	0.048469	0.012005
1mN/39-45/SS/H	0.032809	0.010402	0.000108	0.056673	0.01172
1mN/44-50/SS/H	0.030257	0.009879	9.76E-05	0.059902	0.009227
1mN/4-10/SS/S	0.106189	0.033779	0.001141	0.199342	0.05833
1mN/9-15/SS/S	0.068151	0.017794	0.000317	0.125468	0.034268
1mN/14-20/SS/S	0.051403	0.018917	0.000358	0.117139	0.018101
1mN/19-25/SS/S	0.040958	0.012873	0.000166	0.071257	0.013267
1mN/24-30/SS/S	0.04018	0.013576	0.000184	0.07566	0.012743
1mN/29-35/SS/S	0.038634	0.011226	0.000126	0.059594	0.008866
1mN/34-40/SS/S	0.03599	0.017442	0.000304	0.101371	0.007583
1mN/39-45/SS/S	0.031453	0.009039	8.17E-05	0.049574	0.011786
1mN/44-50/SS/S	0.033167	0.012578	0.000158	0.060579	0.008792
2mN/3-10/FF/H	0.109455	0.030694	0.000942	0.195866	0.065572
2mN/8-15/FF/H	0.06677	0.011565	0.000134	0.092328	0.041119
2mN/13-20/FF/H	0.059951	0.007205	5.19E-05	0.076495	0.045447
2mN/18-25/FF/H	0.052936	0.009083	8.25E-05	0.071048	0.027563
2mN/23-30/FF/H	0.047415	0.009373	8.78E-05	0.065929	0.02567
2mN/28-35/FF/H	0.045571	0.006141	3.77E-05	0.056307	0.031099
2mN/33-40/FF/H	0.042036	0.008525	7.27E-05	0.06178	0.024836
2mN/38-45/FF/H	0.039258	0.007359	5.42E-05	0.058674	0.023773
2mN/43-50/FF/H	0.036992	0.008341	6.96E-05	0.051291	0.014492
2mN/3-10/FF/S	0.104611	0.032862	0.00108	0.269432	0.054768
2mN/8-15/FF/S	0.071101	0.017901	0.00032	0.156137	0.041431
2mN/13-20/FF/S	0.056887	0.01262	0.000159	0.076587	0.022465
2mN/18-25/FF/S	0.05685	0.009545	9.11E-05	0.078839	0.040119

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/23-30/FF/S	0.047879	0.01003	0.000101	0.064217	0.024479
2mN/28-35/FF/S	0.04481	0.006782	4.6E-05	0.06044	0.031011
2mN/33-40/FF/S	0.042331	0.007636	5.83E-05	0.057758	0.027251
2mN/38-45/FF/S	0.039777	0.00945	8.93E-05	0.066582	0.021575
2mN/43-50/FF/S	0.038569	0.011002	0.000121	0.062566	0.015394
2mN/3-10/FS/H	0.133696	0.02674	0.000715	0.19221	0.06777
2mN/8-15/FS/H	0.09001	0.01204	0.000145	0.121292	0.059265
2mN/13-20/FS/H	0.077993	0.01151	0.000132	0.108633	0.054547
2mN/18-25/FS/H	0.069537	0.01172	0.000137	0.089006	0.045455
2mN/23-30/FS/H	0.069317	0.010753	0.000116	0.087101	0.029678
2mN/28-35/FS/H	0.061504	0.011387	0.00013	0.084153	0.024903
2mN/33-40/FS/H	0.058549	0.01198	0.000144	0.081937	0.017781
2mN/38-45/FS/H	0.05442	0.009912	9.82E-05	0.068455	0.032519
2mN/43-50/FS/H	0.048949	0.013644	0.000186	0.069175	0.002436
2mN/3-10/FS/S	0.149742	0.068996	0.00476	0.544384	0.097298
2mN/8-15/FS/S	0.100902	0.026894	0.000723	0.244725	0.059728
2mN/13-20/FS/S	0.083003	0.012605	0.000159	0.102375	0.031007
2mN/18-25/FS/S	0.075373	0.013201	0.000174	0.095764	0.042464
2mN/23-30/FS/S	0.066947	0.015416	0.000238	0.091491	0.016313
2mN/28-35/FS/S	0.060313	0.015567	0.000242	0.092941	0.0319
2mN/33-40/FS/S	0.057966	0.013334	0.000178	0.08626	0.016685
2mN/38-45/FS/S	0.055739	0.017898	0.00032	0.081819	0.004163
2mN/43-50/FS/S	0.054663	0.016094	0.000259	0.076854	0.009163
2mN/3-10/SF/H	0.115853	0.048933	0.002394	0.288678	0.047654
2mN/8-15/SF/H	0.054272	0.010176	0.000104	0.072574	0.033511
2mN/13-20/SF/H	0.049855	0.041018	0.001682	0.293905	0.016681
2mN/18-25/SF/H	0.041945	0.010749	0.000116	0.064259	0.016967
2mN/23-30/SF/H	0.037917	0.008448	7.14E-05	0.059638	0.022216
2mN/28-35/SF/H	0.031272	0.008725	7.61E-05	0.054285	0.009299
2mN/33-40/SF/H	0.033036	0.007711	5.95E-05	0.049643	0.017557
2mN/38-45/SF/H	0.029675	0.009111	8.3E-05	0.049277	0.00975
2mN/43-50/SF/H	0.028006	0.00947	8.97E-05	0.046651	0.010098
2mN/3-10/SF/S	0.111045	0.055113	0.003037	0.413838	0.05548
2mN/8-15/SF/S	0.05815	0.014082	0.000198	0.085632	0.027712
2mN/13-20/SF/S	0.051846	0.01707	0.000291	0.095215	0.006004
2mN/18-25/SF/S	0.050257	0.016637	0.000277	0.084774	0.017253
2mN/23-30/SF/S	0.039187	0.011962	0.000143	0.060258	0.013999
2mN/28-35/SF/S	0.041613	0.012551	0.000158	0.071777	0.016863
2mN/33-40/SF/S	0.038362	0.013786	0.00019	0.074549	0.018919
2mN/38-45/SF/S	0.033066	0.0119	0.000142	0.061407	0.008156
2mN/43-50/SF/S	0.026893	0.010015	0.0001	0.044262	0.007434
2mN/3-10/SS/H	0.118015	0.045881	0.002105	0.272326	0.044614
2mN/8-15/SS/H	0.076036	0.054199	0.002938	0.405123	0.043133
2mN/13-20/SS/H	0.056499	0.010917	0.000119	0.077838	0.035823
2mN/18-25/SS/H	0.050917	0.010562	0.000112	0.071102	0.025516
2mN/23-30/SS/H	0.045864	0.011113	0.000123	0.067122	0.023124
2mN/28-35/SS/H	0.040596	0.00916	8.39E-05	0.058424	0.016113
2mN/33-40/SS/H	0.036527	0.010922	0.000119	0.056407	0.005823
2mN/38-45/SS/H	0.035128	0.011165	0.000125	0.052378	0.008609
2mN/43-50/SS/H	0.033443	0.011642	0.000136	0.059295	0.007854
2mN/3-10/SS/S	0.125951	0.07113	0.005059	0.544514	0.075812
2mN/8-15/SS/S	0.066402	0.01546	0.000239	0.107486	0.026903
2mN/13-20/SS/S	0.054657	0.011112	0.000123	0.077175	0.034745
2mN/18-25/SS/S	0.054556	0.011567	0.000134	0.085698	0.033398

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
2mN/23-30/SS/S	0.050939	0.015982	0.000255	0.08768	0.016314
2mN/28-35/SS/S	0.048252	0.011684	0.000137	0.07997	0.029491
2mN/33-40/SS/S	0.039341	0.012219	0.000149	0.07425	0.010813
2mN/38-45/SS/S	0.040717	0.00911	8.3E-05	0.075649	0.021529
2mN/43-50/SS/S	0.036342	0.011923	0.000142	0.060379	0.000801
5mN/0-10/FF/H	0.110304	0.026042	0.000678	0.212384	0.074708
5mN/5-15/FF/H	0.063868	0.017149	0.000294	0.125256	0.042784
5mN/10-20/FF/H	0.056249	0.012737	0.000162	0.078429	0.029073
5mN/15-25/FF/H	0.051568	0.010988	0.000121	0.078044	0.02096
5mN/20-30/FF/H	0.04601	0.009004	8.11E-05	0.064635	0.028593
5mN/25-35/FF/H	0.046486	0.009325	8.69E-05	0.074661	0.020406
5mN/30-40/FF/H	0.042515	0.011123	0.000124	0.062969	0.008319
5mN/35-45/FF/H	0.038489	0.00831	6.91E-05	0.056149	0.011082
5mN/40-50/FF/H	0.037087	0.010428	0.000109	0.061223	0.019087
5mN/0-10/FF/S	0.10587	0.017101	0.000292	0.151764	0.05247
5mN/5-15/FF/S	0.070863	0.011362	0.000129	0.101053	0.053279
5mN/10-20/FF/S	0.056875	0.011048	0.000122	0.078896	0.034969
5mN/15-25/FF/S	0.049684	0.01047	0.00011	0.067776	0.028372
5mN/20-30/FF/S	0.04935	0.010309	0.000106	0.068944	0.018211
5mN/25-35/FF/S	0.043912	0.010626	0.000113	0.064169	0.019455
5mN/30-40/FF/S	0.041149	0.010919	0.000119	0.065449	0.016434
5mN/35-45/FF/S	0.038305	0.01026	0.000105	0.058267	0.00854
5mN/40-50/FF/S	0.03799	0.009983	9.97E-05	0.052671	0.007572
5mN/0-10/SF/H	0.118022	0.083937	0.007045	0.596772	0.04689
5mN/5-15/SF/H	0.056084	0.013949	0.000195	0.097221	0.020842
5mN/10-20/SF/H	0.045845	0.010092	0.000102	0.062477	0.016987
5mN/15-25/SF/H	0.042529	0.0118	0.000139	0.070439	0.022519
5mN/20-30/SF/H	0.039899	0.009187	8.44E-05	0.061348	0.0241
5mN/25-35/SF/H	0.036381	0.01019	0.000104	0.060793	0.016051
5mN/30-40/SF/H	0.033943	0.01156	0.000134	0.055755	0.007563
5mN/35-45/SF/H	0.029905	0.010237	0.000105	0.045164	0.008737
5mN/40-50/SF/H	0.030045	0.008687	7.55E-05	0.04384	0.011744
5mN/0-10/SF/S	0.090947	0.025413	0.000646	0.148506	0.02814
5mN/5-15/SF/S	0.054894	0.01118	0.000125	0.080531	0.025418
5mN/10-20/SF/S	0.038665	0.015669	0.000246	0.070627	0.003576
5mN/15-25/SF/S	0.038966	0.011822	0.00014	0.06525	0.012783
5mN/20-30/SF/S	0.040713	0.012831	0.000165	0.063397	0.016926
5mN/25-35/SF/S	0.037512	0.010992	0.000121	0.063874	0.017921
5mN/30-40/SF/S	0.034671	0.008573	7.35E-05	0.050193	0.02203
5mN/35-45/SF/S	0.030319	0.010316	0.000106	0.056676	0.00924
5mN/40-50/SF/S	0.030088	0.009781	9.57E-05	0.054805	0.012391
10mN/0-15/FF/H	0.075344	0.048011	0.002305	0.272464	0.008868
10mN/5-20/FF/H	0.055861	0.013515	0.000183	0.079502	0.03042
10mN/10-25/FF/H	0.056815	0.012975	0.000168	0.088674	0.036462
10mN/15-30/FF/H	0.054834	0.012294	0.000151	0.079816	0.029649
10mN/20-35/FF/H	0.054101	0.01123	0.000126	0.072186	0.033764
10mN/25-40/FF/H	0.046661	0.009095	8.27E-05	0.068089	0.032983
10mN/30-45/FF/H	0.038546	0.009406	8.85E-05	0.051683	0.006138
10mN/35-50/FF/H	0.036785	0.010132	0.000103	0.066008	0.010129
10mN/0-15/FF/S	0.075039	0.014248	0.000203	0.103025	0.028153
10mN/5-20/FF/S	0.06006	0.010576	0.000112	0.092374	0.041357
10mN/10-25/FF/S	0.050777	0.011144	0.000124	0.074118	0.025339
10mN/15-30/FF/S	0.047158	0.010937	0.00012	0.066868	0.02346
10mN/20-35/FF/S	0.044941	0.01211	0.000147	0.078446	0.024454

Table continued from previous page

-	Avg.	St.D.	Var.	Max.	Min.
10mN/25-40/FF/S	0.043081	0.008193	6.71E-05	0.059202	0.021471
10mN/30-45/FF/S	0.036379	0.008086	6.54E-05	0.049029	0.01207
10mN/35-50/FF/S	0.034017	0.009812	9.63E-05	0.051154	0.007222
10mN/0-15/SF/H	0.066163	0.018726	0.000351	0.102425	0.03411
10mN/5-20/SF/H	0.056644	0.030736	0.000945	0.212407	0.02428
10mN/10-25/SF/H	0.043477	0.015307	0.000234	0.068136	0.004126
10mN/15-30/SF/H	0.043082	0.015232	0.000232	0.073382	0.004985
10mN/20-35/SF/H	0.037875	0.011073	0.000123	0.058003	0.013226
10mN/25-40/SF/H	0.037336	0.009474	8.97E-05	0.058343	0.020968
10mN/30-45/SF/H	0.033115	0.010226	0.000105	0.049165	0.006903
10mN/35-50/SF/H	0.028746	0.010134	0.000103	0.043116	0.003374
10mN/0-15/SF/S	0.054827	0.012501	0.000156	0.081909	0.031018
10mN/5-20/SF/S	0.043084	0.016979	0.000288	0.088758	0.006335
10mN/10-25/SF/S	0.042845	0.014107	0.000199	0.084988	0.018132
10mN/15-30/SF/S	0.037907	0.011352	0.000129	0.070972	0.015132
10mN/20-35/SF/S	0.02977	0.014588	0.000213	0.067697	0.001667
10mN/25-40/SF/S	0.027105	0.012632	0.00016	0.059351	0.006119
10mN/30-45/SF/S	0.028157	0.011952	0.000143	0.058835	0.008583
10mN/35-50/SF/S	0.024811	0.011087	0.000123	0.053946	0.004358

Binned Histogram Data of Pop-In Size - a = 1.526688

-	0.0005	0.0008	0.0012	0.0018	0.0027	0.0041	0.0063	0.0097	0.0148	0.0225	0.0344
1mN/0-5/FF/H		3	8	13	48	29	2	1	0	0	0
1mN/4-10/FF/H		16	34	43	74	64	14	1	0	0	0
1mN/9-15/FF/H		27	52	65	59	38	11	0	0	0	0
1mN/14-20/FF/H		26	45	48	23	36	19	0	0	0	0
1mN/19-25/FF/H		39	51	49	26	18	22	5	0	0	0
1mN/24-30/FF/H		40	46	38	30	20	17	1	0	0	0
1mN/29-35/FF/H		46	55	54	24	12	10	3	0	0	0
1mN/34-40/FF/H		56	68	60	21	12	10	3	1	0	0
1mN/39-45/FF/H		58	63	63	17	11	3	1	0	0	0
1mN/44-50/FF/H		59	63	50	16	8	7	2	0	0	0
1mN/0-5/FF/S		2	5	10	17	10	0	0	0	0	0
1mN/4-10/FF/S		15	27	61	63	20	4	0	0	0	0
1mN/9-15/FF/S		33	58	51	39	9	2	0	0	0	0
1mN/14-20/FF/S		34	44	36	23	12	6	2	0	0	0
1mN/19-25/FF/S		41	53	41	14	14	7	0	0	0	0
1mN/24-30/FF/S		41	54	32	17	8	8	1	0	0	0
1mN/29-35/FF/S		58	79	56	24	9	6	1	0	0	0
1mN/34-40/FF/S		62	67	43	16	5	7	2	0	0	0
1mN/39-45/FF/S		60	74	47	10	2	9	2	0	0	0
1mN/44-50/FF/S		68	92	55	15	9	3	4	0	0	0
1mN/0-5/FS/H		3	8	20	24	10	2	0	0	0	0
1mN/4-10/FS/H		12	36	77	79	30	3	1	0	0	0
1mN/9-15/FS/H		31	44	59	47	31	11	0	0	0	0
1mN/14-20/FS/H		26	43	38	31	24	11	3	0	0	0
1mN/19-25/FS/H		31	42	39	17	24	7	5	1	0	0
1mN/24-30/FS/H		38	32	31	13	20	11	4	0	0	0
1mN/29-35/FS/H		39	38	32	18	11	11	5	0	0	0
1mN/34-40/FS/H		46	42	26	15	4	15	3	0	0	0
1mN/39-45/FS/H		64	51	28	18	15	7	4	0	0	0
1mN/44-50/FS/H		41	55	33	10	10	8	2	1	0	0
1mN/0-5/FS/S		3	4	15	22	8	2	1	0	0	0
1mN/4-10/FS/S		8	24	73	57	32	5	0	0	0	0
1mN/9-15/FS/S		22	43	63	36	35	11	0	0	0	0
1mN/14-20/FS/S		41	50	34	31	18	12	2	0	0	0
1mN/19-25/FS/S		26	40	26	20	11	14	4	0	0	0
1mN/24-30/FS/S		37	50	19	20	14	6	5	0	0	0
1mN/29-35/FS/S		42	45	34	16	15	8	4	0	0	0
1mN/34-40/FS/S		59	42	28	11	11	10	3	0	0	0
1mN/39-45/FS/S		54	49	32	17	13	9	2	0	0	0
1mN/44-50/FS/S		55	49	27	14	9	8	1	0	0	0
1mN/0-5/SF/H		18	39	82	80	26	3	0	0	0	0
1mN/4-10/SF/H		42	78	88	66	29	2	1	0	0	0
1mN/9-15/SF/H		63	88	57	45	27	6	0	0	0	0
1mN/14-20/SF/H		98	81	63	24	21	8	1	0	0	0
1mN/19-25/SF/H		93	73	54	20	18	3	1	0	0	0
1mN/24-30/SF/H		115	60	44	11	11	8	4	0	0	0
1mN/29-35/SF/H		140	131	44	17	11	5	0	0	0	0
1mN/34-40/SF/H		139	101	43	18	4	8	3	0	0	0
1mN/39-45/SF/H		171	117	47	15	8	4	1	0	0	0
1mN/44-50/SF/H		148	128	52	11	5	2	0	0	0	0
1mN/0-5/SF/S		10	42	55	48	14	0	1	0	1	0
1mN/4-10/SF/S		79	78	74	43	14	3	0	0	0	0
1mN/9-15/SF/S		65	86	73	27	16	6	0	0	1	0
1mN/14-20/SF/S		80	90	50	21	15	7	2	1	0	0

Table continued from previous page

-	0.0005	0.0008	0.0012	0.0018	0.0027	0.0041	0.0063	0.0097	0.0148	0.0225	0.0344
1mN/19-25/SF/S		108	95	39	12	11	6	0	0	0	0
1mN/24-30/SF/S		131	116	40	10	10	5	3	0	0	0
1mN/29-35/SF/S		122	99	32	15	8	9	3	0	0	0
1mN/34-40/SF/S		158	87	41	14	10	9	1	0	0	0
1mN/39-45/SF/S		162	92	37	7	6	10	3	0	0	0
1mN/44-50/SF/S		163	101	31	8	4	7	1	0	0	0
1mN/0-5/SS/H		15	23	52	29	11	4	0	0	0	0
1mN/4-10/SS/H		38	58	63	68	54	6	0	0	0	0
1mN/9-15/SS/H		69	73	42	35	32	13	1	0	0	0
1mN/14-20/SS/H		67	73	40	27	24	10	3	0	0	0
1mN/19-25/SS/H		84	88	36	32	19	11	0	0	0	0
1mN/24-30/SS/H		105	66	37	17	14	16	3	0	0	0
1mN/29-35/SS/H		113	80	39	9	10	10	3	0	0	0
1mN/34-40/SS/H		136	83	35	13	7	7	4	1	0	0
1mN/39-45/SS/H		158	92	38	10	5	8	4	0	0	0
1mN/44-50/SS/H		153	96	26	7	8	11	2	0	0	0
1mN/0-5/SS/S		18	35	48	31	5	0	0	0	0	0
1mN/4-10/SS/S		56	64	75	51	21	3	0	0	0	0
1mN/9-15/SS/S		91	97	49	29	18	7	2	0	0	0
1mN/14-20/SS/S		103	81	46	20	15	11	0	0	0	0
1mN/19-25/SS/S		98	85	48	19	11	8	1	0	0	0
1mN/24-30/SS/S		92	102	41	19	8	4	3	0	0	0
1mN/29-35/SS/S		120	105	51	15	14	7	4	0	0	0
1mN/34-40/SS/S		140	102	38	12	7	6	1	0	0	0
1mN/39-45/SS/S		149	111	40	9	5	4	4	1	0	0
1mN/44-50/SS/S		140	107	35	15	9	2	1	0	0	0
2mN/0-5/FF/H		3	13	19	29	8	2	0	0	0	0
2mN/3-10/FF/H		17	52	90	85	21	9	0	0	0	0
2mN/8-15/FF/H		53	55	50	36	21	13	1	0	0	0
2mN/13-20/FF/H		47	48	37	22	20	13	1	0	0	0
2mN/18-25/FF/H		60	68	33	20	13	12	1	0	0	0
2mN/23-30/FF/H		64	75	47	15	8	15	1	0	0	0
2mN/28-35/FF/H		77	60	24	11	8	10	5	0	0	0
2mN/33-40/FF/H		73	75	36	12	8	11	0	0	0	0
2mN/38-45/FF/H		76	57	37	16	8	5	2	0	0	0
2mN/43-50/FF/H		80	49	30	7	12	3	3	0	0	0
2mN/0-5/FF/S		0	5	9	29	9	1	0	0	0	0
2mN/3-10/FF/S		23	41	67	78	22	7	1	0	0	0
2mN/8-15/FF/S		45	42	62	44	29	9	2	0	0	0
2mN/13-20/FF/S		57	53	43	24	19	13	1	0	0	0
2mN/18-25/FF/S		64	53	23	20	16	11	5	0	0	0
2mN/23-30/FF/S		74	65	31	15	10	8	8	0	0	0
2mN/28-35/FF/S		61	60	41	9	9	12	4	0	0	0
2mN/33-40/FF/S		62	67	34	13	12	10	4	0	0	0
2mN/38-45/FF/S		83	90	37	13	11	7	5	0	0	0
2mN/43-50/FF/S		80	66	29	12	7	5	4	0	0	0
2mN/0-5/FS/H		1	8	22	36	12	6	4	0	0	0
2mN/3-10/FS/H		25	27	57	57	34	14	2	0	0	0
2mN/8-15/FS/H		25	47	58	54	27	12	2	0	0	0
2mN/13-20/FS/H		32	43	26	26	19	10	6	0	0	0
2mN/18-25/FS/H		72	81	44	18	17	10	4	0	0	0
2mN/23-30/FS/H		43	41	28	16	11	10	4	0	0	0
2mN/28-35/FS/H		79	55	34	16	10	12	4	1	0	0
2mN/33-40/FS/H		74	73	28	7	13	8	5	1	0	0
2mN/38-45/FS/H		52	54	29	14	7	13	2	0	0	0
2mN/43-50/FS/H		118	145	102	27	11	9	2	0	0	0
2mN/0-5/FS/S		2	4	18	20	7	0	1	0	0	0
2mN/3-10/FS/S		9	37	67	51	28	6	0	0	0	0
2mN/8-15/FS/S		36	35	55	38	22	13	2	0	0	0
2mN/13-20/FS/S		37	55	40	25	19	20	4	0	0	0
2mN/18-25/FS/S		77	81	41	29	12	15	7	0	0	0
2mN/23-30/FS/S		53	43	29	12	12	14	5	2	0	0
2mN/28-35/FS/S		83	67	40	18	12	18	4	1	0	0
2mN/33-40/FS/S		69	76	42	14	11	10	10	1	0	0
2mN/38-45/FS/S		55	65	37	12	7	10	8	0	0	0
2mN/43-50/FS/S		137	171	133	29	11	7	4	1	0	0
2mN/0-5/SF/H		9	32	44	29	13	6	2	0	0	0
2mN/3-10/SF/H		50	54	69	57	22	5	0	0	0	0
2mN/8-15/SF/H		49	60	35	29	33	7	0	0	0	0
2mN/13-20/SF/H		78	51	30	23	20	10	0	0	0	0
2mN/18-25/SF/H		82	57	16	13	14	9	1	0	0	0
2mN/23-30/SF/H		77	48	22	15	10	9	2	0	0	0
2mN/28-35/SF/H		130	62	25	11	13	5	0	0	0	0
2mN/33-40/SF/H		102	59	24	12	9	5	2	0	0	0
2mN/38-45/SF/H		128	61	19	12	5	7	0	0	0	0
2mN/43-50/SF/H		154	58	23	7	6	5	1	0	0	0
2mN/0-5/SF/S		5	33	59	25	13	0	0	0	0	0
2mN/3-10/SF/S		32	50	40	44	24	9	0	0	0	0
2mN/8-15/SF/S		62	42	32	15	21	30	1	0	0	0
2mN/13-20/SF/S		45	46	20	16	25	18	8	0	0	0
2mN/18-25/SF/S		84	45	24	16	15	18	6	0	0	0
2mN/23-30/SF/S		71	48	21	21	12	15	11	0	0	0
2mN/28-35/SF/S		99	61	15	11	13	10	9	0	0	0
2mN/33-40/SF/S		112	60	19	20	8	10	9	3	0	0
2mN/38-45/SF/S		148	71	22	5	9	12	7	1	0	0
2mN/43-50/SF/S		145	58	25	11	13	9	3	0	0	0
2mN/0-5/SS/H		13	24	42	33	18	4	3	0	0	0
2mN/3-10/SS/H		28	57	63	54	33	14	2	0	0	0
2mN/8-15/SS/H		38	55	47	29	24	9	2	0	0	0
2mN/13-20/SS/H		77	58	28	17	21	16	3	0	0	0
2mN/18-25/SS/H		90	57	31	20	20	5	2	0	0	0
2mN/23-30/SS/H		128	69	25	12	15	9	3	0	0	0

Table continued from previous page

-	0.0005	0.0008	0.0012	0.0018	0.0027	0.0041	0.0063	0.0097	0.0148	0.0225	0.0344
2mN/28-35/SS/H		121	83	29	15	4	8	2	0	0	0
2mN/33-40/SS/H		137	97	13	11	11	9	2	0	0	0
2mN/38-45/SS/H		133	64	30	11	7	5	1	0	0	0
2mN/43-50/SS/H		162	74	20	9	9	5	2	0	0	0
2mN/0-5/SS/S		7	31	48	51	14	0	0	0	0	0
2mN/3-10/SS/S		45	41	48	44	39	7	0	0	0	0
2mN/8-15/SS/S		38	39	31	23	22	19	5	0	0	0
2mN/13-20/SS/S		58	53	19	20	19	18	4	0	0	0
2mN/18-25/SS/S		77	47	23	13	9	16	9	0	0	0
2mN/23-30/SS/S		87	43	26	10	12	15	8	1	0	0
2mN/28-35/SS/S		111	48	15	5	9	14	10	2	0	0
2mN/33-40/SS/S		126	46	24	14	9	7	7	1	0	0
2mN/38-45/SS/S		124	52	25	10	6	11	7	1	0	0
2mN/43-50/SS/S		143	50	14	8	12	8	5	0	0	0
5mN/0-5/FF/H		5	5	19	37	30	4	0	0	0	0
5mN/0-10/FF/H		15	27	84	80	52	12	0	0	0	0
5mN/5-15/FF/H		34	48	66	54	33	11	1	0	0	0
5mN/10-20/FF/H		27	57	71	40	26	18	1	0	0	0
5mN/15-25/FF/H		45	61	68	32	16	16	6	0	0	0
5mN/20-30/FF/H		62	105	54	33	16	15	8	1	0	0
5mN/25-35/FF/H		96	92	69	31	14	15	8	1	0	0
5mN/30-40/FF/H		91	98	76	19	12	18	8	0	0	0
5mN/35-45/FF/H		103	118	71	26	13	8	6	0	0	0
5mN/40-50/FF/H		114	119	72	18	7	6	3	1	0	0
5mN/0-5/FF/S		4	4	8	23	5	3	0	0	0	0
5mN/0-10/FF/S		11	28	54	73	35	9	0	0	0	0
5mN/5-15/FF/S		33	45	58	46	30	13	0	0	0	0
5mN/10-20/FF/S		53	59	67	48	18	8	0	0	0	0
5mN/15-25/FF/S		57	84	91	33	11	10	1	0	0	0
5mN/20-30/FF/S		63	94	94	24	12	17	1	0	0	0
5mN/25-35/FF/S		98	89	66	13	24	12	4	0	0	0
5mN/30-40/FF/S		97	91	67	27	15	9	4	0	0	0
5mN/35-45/FF/S		109	112	56	32	7	9	3	0	0	0
5mN/40-50/FF/S		128	125	53	31	7	7	5	0	0	0
5mN/0-5/SF/H		17	37	74	70	24	2	0	0	0	0
5mN/0-10/SF/H		52	102	81	63	33	7	1	0	0	0
5mN/5-15/SF/H		133	171	107	41	15	6	0	0	0	0
5mN/10-20/SF/H		189	184	137	39	16	11	0	0	0	0
5mN/15-25/SF/H		187	208	130	30	16	12	3	0	0	0
5mN/20-30/SF/H		263	191	137	39	15	7	2	0	0	0
5mN/25-35/SF/H		237	204	129	29	16	6	4	0	0	0
5mN/30-40/SF/H		280	207	124	27	8	12	3	0	0	0
5mN/35-45/SF/H		293	247	118	20	7	8	3	0	0	0
5mN/40-50/SF/H		261	231	133	31	7	6	4	0	0	0
5mN/0-5/SF/S		16	43	75	62	15	0	1	0	0	0
5mN/0-10/SF/S		70	72	76	53	29	5	0	0	1	1
5mN/5-15/SF/S		95	108	65	43	26	5	0	0	0	0
5mN/10-20/SF/S		120	91	58	27	28	12	0	0	0	0
5mN/15-25/SF/S		164	108	52	12	23	13	7	0	0	0
5mN/20-30/SF/S		188	140	59	16	19	14	6	0	0	0
5mN/25-35/SF/S		222	148	48	13	12	13	10	2	0	0
5mN/30-40/SF/S		232	148	65	11	15	8	11	0	0	0
5mN/35-45/SF/S		251	144	56	14	16	13	6	1	0	0
5mN/40-50/SF/S		247	143	46	17	4	6	7	1	0	0
10mN/0-10/FF/H		7	25	96	136	86	12	3	0	0	0
10mN/0-15/FF/H		28	49	78	79	37	10	0	0	0	0
10mN/5-20/FF/H		53	70	73	43	31	14	6	0	0	0
10mN/10-25/FF/H		62	95	96	46	21	16	6	0	0	0
10mN/15-30/FF/H		88	117	108	32	12	17	11	0	0	0
10mN/20-35/FF/H		116	157	92	38	12	14	10	0	0	0
10mN/25-40/FF/H		150	140	104	33	16	14	7	0	0	0
10mN/30-45/FF/H		147	156	119	40	8	12	6	1	0	0
10mN/35-50/FF/H		189	206	124	39	10	6	5	3	0	0
10mN/0-10/FF/S		12	31	66	104	73	12	1	0	0	0
10mN/0-15/FF/S		33	35	70	62	39	15	6	0	0	0
10mN/5-20/FF/S		44	47	61	46	31	21	5	0	0	0
10mN/10-25/FF/S		66	100	86	46	28	9	5	0	0	0
10mN/15-30/FF/S		94	110	64	34	18	12	6	0	0	0
10mN/20-35/FF/S		98	125	103	30	13	18	13	0	0	0
10mN/25-40/FF/S		140	116	111	26	15	15	9	1	0	0
10mN/30-45/FF/S		151	163	113	35	11	13	8	1	0	0
10mN/35-50/FF/S		201	166	112	23	7	12	11	0	0	0
10mN/0-10/SF/H		44	98	127	63	19	3	0	1	0	0
10mN/0-15/SF/H		54	53	43	32	21	12	2	2	0	0
10mN/5-20/SF/H		63	38	25	21	18	12	5	0	0	0
10mN/10-25/SF/H		106	67	20	17	11	11	2	1	0	0
10mN/15-30/SF/H		168	69	21	17	9	11	5	1	0	0
10mN/20-35/SF/H		174	82	13	13	12	13	2	0	0	0
10mN/25-40/SF/H		230	92	19	15	11	10	4	0	0	0
10mN/30-45/SF/H		229	88	29	11	7	6	7	0	0	0
10mN/35-50/SF/H		265	98	20	9	13	4	3	2	0	0
10mN/0-10/SF/S		51	89	108	61	36	7	0	2	0	0
10mN/0-15/SF/S		54	49	58	36	27	25	2	1	0	0
10mN/5-20/SF/S		54	58	32	22	18	19	13	0	0	0
10mN/10-25/SF/S		97	52	28	15	18	19	10	0	0	0
10mN/15-30/SF/S		116	60	23	18	15	19	11	1	0	0
10mN/20-35/SF/S		174	71	25	13	12	19	11	2	0	0
10mN/25-40/SF/S		201	75	28	9	10	18	14	1	0	0
10mN/30-45/SF/S		209	98	25	10	9	15	10	1	0	0
10mN/35-50/SF/S		243	98	27	8	9	18	11	1	0	0

Binned Histogram Data of Overshoot Amount - a = 1.725511

-	0.019	0.033	0.057	0.098	0.168	0.290	0.501	0.865	1.492	2.575	4.443
1mN/4-10/FF/H		0	0	0	0	3	22	14	1	0	0
1mN/9-15/FF/H		0	0	0	0	1	10	29	1	0	0
1mN/14-20/FF/H		0	0	0	0	0	1	30	9	0	1
1mN/19-25/FF/H		0	0	0	1	0	0	13	25	0	0
1mN/24-30/FF/H		0	0	0	1	1	1	7	28	1	0
1mN/29-35/FF/H		0	0	0	0	1	3	7	28	1	0
1mN/34-40/FF/H		0	0	0	0	0	4	6	19	11	0
1mN/39-45/FF/H		0	0	0	1	0	1	3	18	16	0
1mN/44-50/FF/H		0	0	0	1	1	0	4	12	23	0
1mN/4-10/FF/S		0	0	0	0	1	26	15	0	0	0
1mN/9-15/FF/S		0	0	0	0	1	5	35	1	0	0
1mN/14-20/FF/S		0	0	0	0	0	1	23	18	0	0
1mN/19-25/FF/S		0	0	0	1	1	1	11	26	1	0
1mN/24-30/FF/S		0	1	0	0	0	1	8	25	6	0
1mN/29-35/FF/S		0	0	0	0	0	3	4	25	10	0
1mN/34-40/FF/S		0	0	0	0	1	1	4	21	15	0
1mN/39-45/FF/S		0	0	0	1	0	2	4	11	23	0
1mN/44-50/FF/S		0	0	1	0	0	1	4	10	23	3
1mN/4-10/FS/H		0	0	0	0	0	4	35	2	0	0
1mN/9-15/FS/H		0	0	0	0	0	0	23	18	0	0
1mN/14-20/FS/H		0	0	0	0	0	0	7	34	0	0
1mN/19-25/FS/H		0	0	0	0	0	0	2	30	8	0
1mN/24-30/FS/H		0	0	0	0	0	1	1	19	18	0
1mN/29-35/FS/H		0	0	0	0	0	0	0	12	27	0
1mN/34-40/FS/H		0	0	0	0	1	0	2	4	32	0
1mN/39-45/FS/H		0	0	0	0	0	1	1	6	27	4
1mN/44-50/FS/H		0	0	0	0	0	2	0	4	25	9
1mN/4-10/FS/S		0	0	0	0	0	3	35	4	0	0
1mN/9-15/FS/S		0	0	0	0	1	1	17	21	1	0
1mN/14-20/FS/S		0	0	0	0	0	0	6	35	1	0
1mN/19-25/FS/S		0	0	0	0	0	1	1	27	12	0
1mN/24-30/FS/S		0	0	0	0	0	0	1	19	22	0
1mN/29-35/FS/S		1	0	0	0	1	0	1	20	18	0
1mN/34-40/FS/S		0	0	0	0	0	1	2	8	29	1
1mN/39-45/FS/S		0	0	0	0	0	1	2	10	25	2
1mN/44-50/FS/S		0	1	0	0	0	1	1	7	25	5
1mN/4-10/SF/H		0	0	0	0	4	25	11	0	0	0
1mN/9-15/SF/H		0	0	0	0	3	13	25	0	0	0
1mN/14-20/SF/H		0	0	0	0	1	5	33	1	0	0
1mN/19-25/SF/H		0	0	0	0	0	4	23	11	1	0
1mN/24-30/SF/H		0	0	0	0	0	5	12	23	1	0
1mN/29-35/SF/H		0	0	0	0	1	2	15	18	2	1
1mN/34-40/SF/H		0	0	0	0	1	0	7	20	10	0
1mN/39-45/SF/H		0	0	0	0	0	1	5	22	12	0
1mN/44-50/SF/H		0	0	0	0	1	1	5	15	17	0
1mN/4-10/SF/S		0	0	0	0	2	34	5	1	0	0
1mN/9-15/SF/S		0	0	0	0	0	14	26	1	0	0
1mN/14-20/SF/S		0	0	0	0	0	6	29	5	0	0
1mN/19-25/SF/S		0	0	0	0	0	7	25	10	0	0
1mN/24-30/SF/S		0	0	0	0	0	0	13	27	1	0
1mN/29-35/SF/S		0	0	0	0	0	0	6	31	2	0
1mN/34-40/SF/S		0	0	0	0	1	2	2	30	7	0
1mN/39-45/SF/S		0	0	0	0	0	2	2	16	20	0
1mN/44-50/SF/S		0	0	0	0	0	0	3	21	17	0
1mN/4-10/SS/H		0	0	0	0	0	21	20	1	0	0
1mN/9-15/SS/H		0	0	0	0	1	6	32	1	0	0
1mN/14-20/SS/H		0	0	0	0	0	8	29	4	0	0
1mN/19-25/SS/H		0	0	0	0	0	1	22	18	1	0
1mN/24-30/SS/H		0	0	0	0	0	3	20	16	1	0
1mN/29-35/SS/H		0	0	0	0	0	1	11	24	5	0
1mN/34-40/SS/H		0	0	0	0	0	2	8	20	8	0
1mN/39-45/SS/H		0	0	0	0	0	1	5	18	14	0
1mN/44-50/SS/H		0	0	0	0	0	1	4	21	12	1
1mN/4-10/SS/S		0	0	0	0	0	25	14	3	0	0
1mN/9-15/SS/S		0	0	0	0	0	4	33	5	0	0
1mN/14-20/SS/S		0	0	0	0	1	4	27	9	1	0
1mN/19-25/SS/S		0	0	0	0	1	3	22	14	0	0
1mN/24-30/SS/S		0	0	0	0	0	2	13	20	4	0
1mN/29-35/SS/S		0	0	0	0	1	1	5	28	5	0
1mN/34-40/SS/S		0	0	0	0	1	2	6	22	9	1
1mN/39-45/SS/S		0	0	0	0	0	1	8	18	12	0
1mN/44-50/SS/S		0	0	0	0	0	3	3	14	19	1
2mN/3-10/FF/H		0	0	0	0	0	18	22	2	0	0
2mN/8-15/FF/H		0	0	0	0	0	3	38	1	0	0
2mN/13-20/FF/H		0	0	0	0	0	0	15	25	0	0
2mN/18-25/FF/H		0	0	0	0	0	0	6	34	0	0
2mN/23-30/FF/H		0	0	0	0	0	0	1	36	4	0
2mN/28-35/FF/H		0	0	0	0	0	0	0	29	9	0
2mN/33-40/FF/H		0	0	0	0	0	0	0	22	20	0
2mN/38-45/FF/H		0	0	0	0	0	0	0	13	29	0
2mN/43-50/FF/H		0	0	0	0	0	0	1	13	27	0
2mN/3-10/FF/S		0	0	0	0	1	17	23	1	0	0
2mN/8-15/FF/S		0	0	0	0	0	2	37	2	1	0
2mN/13-20/FF/S		0	0	0	0	0	3	16	22	0	0
2mN/18-25/FF/S		0	0	0	0	0	0	2	35	2	0
2mN/23-30/FF/S		0	0	0	0	0	0	5	31	5	0
2mN/28-35/FF/S		0	0	0	0	0	0	0	32	8	0
2mN/33-40/FF/S		0	0	0	0	0	0	0	21	20	0
2mN/38-45/FF/S		0	0	0	0	0	0	1	17	23	1
2mN/43-50/FF/S		0	0	0	0	0	0	2	10	28	1
2mN/3-10/FS/H		0	0	0	0	0	3	33	3	0	0

Table continued from previous page

-	0.019	0.033	0.057	0.098	0.168	0.290	0.501	0.865	1.492	2.575	4.443
2mN/8-15/FS/H		0	0	0	0	0	0	15	24	0	0
2mN/13-20/FS/H		0	0	0	0	0	0	1	34	2	0
2mN/18-25/FS/H		0	0	0	0	0	0	0	23	15	0
2mN/23-30/FS/H		0	0	0	0	0	0	1	2	34	0
2mN/28-35/FS/H		0	0	0	0	0	0	1	4	33	0
2mN/33-40/FS/H		0	0	0	0	0	0	1	1	32	2
2mN/38-45/FS/H		0	0	0	0	0	0	0	2	28	7
2mN/43-50/FS/H		0	0	0	1	0	0	1	1	24	9
2mN/3-10/FS/S		0	0	0	0	0	1	36	4	0	1
2mN/8-15/FS/S		0	0	0	0	0	0	10	31	1	0
2mN/13-20/FS/S		0	0	0	0	0	1	1	37	2	0
2mN/18-25/FS/S		0	0	0	0	0	0	1	17	19	0
2mN/23-30/FS/S		0	0	0	0	0	1	2	8	31	0
2mN/28-35/FS/S		0	0	0	0	0	0	0	10	25	1
2mN/33-40/FS/S		0	0	0	0	0	0	1	5	31	4
2mN/38-45/FS/S		0	0	0	1	0	0	2	1	20	14
2mN/43-50/FS/S		0	0	0	0	0	1	1	4	12	23
2mN/3-10/SF/H		0	0	0	0	2	20	17	3	0	0
2mN/8-15/SF/H		0	0	0	0	0	16	25	0	0	0
2mN/13-20/SF/H		0	0	0	0	1	6	30	2	0	1
2mN/18-25/SF/H		0	0	0	0	0	2	21	14	0	0
2mN/23-30/SF/H		0	0	0	0	0	0	16	24	0	0
2mN/28-35/SF/H		0	0	0	0	1	2	13	25	1	0
2mN/33-40/SF/H		0	0	0	0	0	0	2	30	6	0
2mN/38-45/SF/H		0	0	0	0	0	1	5	24	10	0
2mN/43-50/SF/H		0	0	0	0	0	1	8	18	14	0
2mN/3-10/SF/S		0	0	0	0	1	19	21	0	1	0
2mN/8-15/SF/S		0	0	0	0	1	9	29	0	0	0
2mN/13-20/SF/S		0	0	1	0	0	2	23	12	0	0
2mN/18-25/SF/S		0	0	0	0	0	2	11	22	4	0
2mN/23-30/SF/S		0	0	0	0	0	2	10	20	1	0
2mN/28-35/SF/S		0	0	0	0	0	0	5	24	8	0
2mN/33-40/SF/S		0	0	0	0	0	0	4	23	11	1
2mN/38-45/SF/S		0	0	0	0	0	2	2	18	13	0
2mN/43-50/SF/S		0	0	0	0	0	5	5	19	11	0
2mN/3-10/SS/H		0	0	0	0	2	15	20	5	0	0
2mN/8-15/SS/H		0	0	0	0	0	3	34	3	0	1
2mN/13-20/SS/H		0	0	0	0	0	0	20	19	0	0
2mN/18-25/SS/H		0	0	0	0	0	0	10	29	0	0
2mN/23-30/SS/H		0	0	0	0	0	0	7	28	3	0
2mN/28-35/SS/H		0	0	0	0	0	1	2	30	8	0
2mN/33-40/SS/H		0	0	0	0	1	1	2	25	10	0
2mN/38-45/SS/H		0	0	0	0	0	1	5	14	17	0
2mN/43-50/SS/H		0	0	0	0	0	2	2	15	21	1
2mN/3-10/SS/S		0	0	0	0	0	11	28	2	0	1
2mN/8-15/SS/S		0	0	0	0	1	3	31	3	0	0
2mN/13-20/SS/S		0	0	0	0	0	0	18	17	0	0
2mN/18-25/SS/S		0	0	0	0	0	0	5	29	4	0
2mN/23-30/SS/S		0	0	0	0	0	2	2	24	10	0
2mN/28-35/SS/S		0	0	0	0	0	0	0	22	14	0
2mN/33-40/SS/S		0	0	0	0	0	1	4	18	14	1
2mN/38-45/SS/S		0	0	0	0	0	0	1	10	25	1
2mN/43-50/SS/S		0	1	0	0	0	0	1	13	20	3
5mN/0-10/FF/H		0	0	0	0	0	15	25	1	0	0
5mN/5-15/FF/H		0	0	0	0	0	10	28	3	0	0
5mN/10-20/FF/H		0	0	0	0	0	2	20	18	0	0
5mN/15-25/FF/H		0	0	0	0	0	1	7	31	1	0
5mN/20-30/FF/H		0	0	0	0	0	0	4	28	4	0
5mN/25-35/FF/H		0	0	0	0	0	0	1	26	12	0
5mN/30-40/FF/H		0	0	0	0	0	1	2	13	23	0
5mN/35-45/FF/H		0	0	0	0	0	1	1	12	25	0
5mN/40-50/FF/H		0	0	0	0	0	0	1	11	27	1
5mN/0-10/FF/S		0	0	0	0	1	15	26	0	0	0
5mN/5-15/FF/S		0	0	0	0	0	0	39	3	0	0
5mN/10-20/FF/S		0	0	0	0	0	0	23	19	0	0
5mN/15-25/FF/S		0	0	0	0	0	0	12	29	0	0
5mN/20-30/FF/S		0	0	0	0	0	1	1	33	7	0
5mN/25-35/FF/S		0	0	0	0	0	0	3	25	11	0
5mN/30-40/FF/S		0	0	0	0	0	0	2	20	18	0
5mN/35-45/FF/S		0	0	0	0	0	1	1	14	25	0
5mN/40-50/FF/S		0	0	0	0	0	1	2	8	30	0
5mN/0-10/SF/H		0	0	0	0	3	17	18	3	0	1
5mN/5-15/SF/H		0	0	0	0	1	12	27	1	0	0
5mN/10-20/SF/H		0	0	0	0	1	4	29	4	0	0
5mN/15-25/SF/H		0	0	0	0	0	2	17	18	0	0
5mN/20-30/SF/H		0	0	0	0	0	0	13	24	1	0
5mN/25-35/SF/H		0	0	0	0	0	1	8	27	5	0
5mN/30-40/SF/H		0	0	0	0	1	1	8	20	9	0
5mN/35-45/SF/H		0	0	0	0	0	3	6	20	13	0
5mN/40-50/SF/H		0	0	0	0	0	0	6	16	19	0
5mN/0-10/SF/S		0	0	0	1	0	31	10	0	0	0
5mN/5-15/SF/S		0	0	0	0	1	15	26	0	0	0
5mN/10-20/SF/S		0	1	0	0	4	8	23	6	0	0
5mN/15-25/SF/S		0	0	0	0	1	3	21	12	0	0
5mN/20-30/SF/S		0	0	0	0	0	2	13	24	3	0
5mN/25-35/SF/S		0	0	0	0	0	0	6	27	5	0
5mN/30-40/SF/S		0	0	0	0	0	0	6	25	9	0
5mN/35-45/SF/S		0	0	0	0	0	1	7	21	10	0
5mN/40-50/SF/S		0	0	0	0	0	0	5	19	15	0
10mN/0-15/FF/H		0	0	1	0	0	5	30	3	2	1
10mN/5-20/FF/H		0	0	0	0	0	1	23	17	0	0
10mN/10-25/FF/H		0	0	0	0	0	0	5	32	5	0

Table continued from previous page

-	0.019	0.033	0.057	0.098	0.168	0.290	0.501	0.865	1.492	2.575	4.443
10mN/15-30/FF/H		0	0	0	0	0	0	3	22	13	0
10mN/20-35/FF/H		0	0	0	0	0	0	0	15	22	0
10mN/25-40/FF/H		0	0	0	0	0	0	0	13	23	0
10mN/30-45/FF/H		0	0	0	0	1	0	0	14	26	0
10mN/35-50/FF/H		0	0	0	0	0	1	1	13	25	2
10mN/0-15/FF/S		0	0	0	0	1	1	31	7	0	0
10mN/5-20/FF/S		0	0	0	0	0	0	20	20	0	0
10mN/10-25/FF/S		0	0	0	0	0	0	12	29	0	0
10mN/15-30/FF/S		0	0	0	0	0	0	6	28	6	0
10mN/20-35/FF/S		0	0	0	0	0	0	2	24	12	0
10mN/25-40/FF/S		0	0	0	0	0	0	1	16	21	0
10mN/30-45/FF/S		0	0	0	0	0	1	1	19	18	0
10mN/35-50/FF/S		0	0	0	0	0	1	2	16	21	0
10mN/0-15/SF/H		0	0	0	0	0	8	24	8	0	0
10mN/5-20/SF/H		0	0	0	0	0	2	22	10	0	1
10mN/10-25/SF/H		0	0	1	0	1	2	12	21	0	0
10mN/15-30/SF/H		0	0	0	1	0	1	10	18	8	0
10mN/20-35/SF/H		0	0	0	0	0	2	5	28	5	0
10mN/25-40/SF/H		0	0	0	0	0	0	3	24	11	0
10mN/30-45/SF/H		0	0	0	0	1	2	2	21	13	0
10mN/35-50/SF/H		0	0	0	1	0	1	6	11	18	0
10mN/0-15/SF/S		0	0	0	0	0	14	24	0	0	0
10mN/5-20/SF/S		0	0	1	0	1	8	19	5	0	0
10mN/10-25/SF/S		0	0	0	0	0	4	19	17	1	0
10mN/15-30/SF/S		0	0	0	0	0	2	12	22	1	0
10mN/20-35/SF/S		0	1	1	2	1	0	9	17	4	0
10mN/25-40/SF/S		0	0	0	0	1	5	12	13	4	0
10mN/30-45/SF/S		0	0	0	0	0	5	5	22	6	0
10mN/35-50/SF/S		0	0	0	0	2	1	10	17	9	0
10mN/10-25/FF/S		66	100	86	46	28	9	5	0	0	0
10mN/15-30/FF/S		94	110	64	34	18	12	6	0	0	0
10mN/20-35/FF/S		98	125	103	30	13	18	13	0	0	0
10mN/25-40/FF/S		140	116	111	26	15	15	9	1	0	0
10mN/30-45/FF/S		151	163	113	35	11	13	8	1	0	0
10mN/35-50/FF/S		201	166	112	23	7	12	11	0	0	0
10mN/0-10/SF/H		44	98	127	63	19	3	0	1	0	0
10mN/0-15/SF/H		54	53	43	32	21	12	2	2	0	0
10mN/5-20/SF/H		63	38	25	21	18	12	5	0	0	0
10mN/10-25/SF/H		106	67	20	17	11	11	2	1	0	0
10mN/15-30/SF/H		168	69	21	17	9	11	5	1	0	0
10mN/20-35/SF/H		174	82	13	13	12	13	2	0	0	0
10mN/25-40/SF/H		230	92	19	15	11	10	4	0	0	0
10mN/30-45/SF/H		229	88	29	11	7	6	7	0	0	0
10mN/35-50/SF/H		265	98	20	9	13	4	3	2	0	0
10mN/0-10/SF/S		51	89	108	61	36	7	0	2	0	0
10mN/0-15/SF/S		54	49	58	36	27	25	2	1	0	0
10mN/5-20/SF/S		54	58	32	22	18	19	13	0	0	0
10mN/10-25/SF/S		97	52	28	15	18	19	10	0	0	0
10mN/15-30/SF/S		116	60	23	18	15	19	11	1	0	0
10mN/20-35/SF/S		174	71	25	13	12	19	11	2	0	0
10mN/25-40/SF/S		201	75	28	9	10	18	14	1	0	0
10mN/30-45/SF/S		209	98	25	10	9	15	10	1	0	0
10mN/35-50/SF/S		243	98	27	8	9	18	11	1	0	0

Binned Histogram Data of Hardening - a = 1.983538

-	0.00063	0.00126	0.00249	0.00494	0.00980	0.01944	0.03855	0.07647	0.15168	0.30086	0.59677
1mN/4-10/FF/H		0	0	0	0	0	1	11	27	1	0
1mN/9-15/FF/H		0	0	0	0	1	3	36	1	0	0
1mN/14-20/FF/H		0	0	0	0	0	6	33	1	1	0
1mN/19-25/FF/H		0	0	0	1	0	10	28	0	0	0
1mN/24-30/FF/H		0	0	1	1	1	9	27	0	0	0
1mN/29-35/FF/H		0	0	0	1	3	16	20	0	0	0
1mN/34-40/FF/H		0	0	0	2	3	21	14	0	0	0
1mN/39-45/FF/H		0	0	1	0	2	26	10	0	0	0
1mN/44-50/FF/H		0	0	1	1	4	17	18	0	0	0
1mN/4-10/FF/S		0	0	0	0	0	0	10	30	2	0
1mN/9-15/FF/S		0	0	0	0	0	4	34	4	0	0
1mN/14-20/FF/S		0	0	0	0	0	3	35	4	0	0
1mN/19-25/FF/S		0	0	0	2	0	5	33	1	0	0
1mN/24-30/FF/S		0	1	0	0	1	11	28	0	0	0
1mN/29-35/FF/S		0	0	0	0	3	15	24	0	0	0
1mN/34-40/FF/S		0	0	0	1	2	15	24	0	0	0
1mN/39-45/FF/S		0	0	1	1	5	11	23	0	0	0
1mN/44-50/FF/S		0	1	0	1	4	17	19	0	0	0
1mN/4-10/FS/H		0	0	0	0	0	0	0	31	10	0
1mN/9-15/FS/H		0	0	0	0	0	0	8	33	0	0
1mN/14-20/FS/H		0	0	0	0	0	1	32	8	0	0
1mN/19-25/FS/H		0	0	0	0	0	1	35	4	0	0
1mN/24-30/FS/H		0	0	0	0	1	2	35	1	0	0
1mN/29-35/FS/H		0	0	0	0	0	5	34	0	0	0
1mN/34-40/FS/H		0	0	0	1	0	5	33	0	0	0
1mN/39-45/FS/H		0	0	0	1	1	8	28	1	0	0
1mN/44-50/FS/H		0	0	0	1	2	11	26	0	0	0
1mN/4-10/FS/S		0	0	0	0	0	0	0	32	10	0
1mN/9-15/FS/S		0	0	0	0	0	2	8	30	1	0
1mN/14-20/FS/S		0	0	0	0	0	0	24	18	0	0
1mN/19-25/FS/S		0	0	0	0	0	2	27	12	0	0
1mN/24-30/FS/S		0	0	0	0	0	3	33	6	0	0
1mN/29-35/FS/S		1	0	0	1	0	9	29	1	0	0
1mN/34-40/FS/S		0	0	0	0	1	9	31	0	0	0
1mN/39-45/FS/S		0	0	0	1	1	12	26	0	0	0

Table continued from previous page

-	0.00063	0.00126	0.00249	0.00494	0.00980	0.01944	0.03855	0.07647	0.15168	0.30086	0.59677
1mN/44-50/FS/S		1	0	0	1	1	9	28	0	0	0
1mN/4-10/SF/H		0	0	0	0	0	0	14	25	1	0
1mN/9-15/SF/H		0	0	0	0	0	10	30	1	0	0
1mN/14-20/SF/H		0	0	0	0	1	14	25	0	0	0
1mN/19-25/SF/H		0	0	0	0	0	22	16	1	0	0
1mN/24-30/SF/H		0	0	0	0	5	18	18	0	0	0
1mN/29-35/SF/H		0	0	0	1	6	22	9	1	0	0
1mN/34-40/SF/H		0	0	0	1	2	24	11	0	0	0
1mN/39-45/SF/H		0	0	0	0	5	23	12	0	0	0
1mN/44-50/SF/H		0	0	0	1	6	25	7	0	0	0
1mN/4-10/SF/S		0	0	0	0	0	1	18	21	2	0
1mN/9-15/SF/S		0	0	0	0	0	3	33	5	0	0
1mN/14-20/SF/S		0	0	0	0	0	12	27	1	0	0
1mN/19-25/SF/S		0	0	0	0	1	23	18	0	0	0
1mN/24-30/SF/S		0	0	0	0	0	24	17	0	0	0
1mN/29-35/SF/S		0	0	0	0	1	25	12	1	0	0
1mN/34-40/SF/S		0	0	0	2	1	29	10	0	0	0
1mN/39-45/SF/S		0	0	0	1	3	20	16	0	0	0
1mN/44-50/SF/S		0	0	0	0	3	29	9	0	0	0
1mN/4-10/SS/H		0	0	0	0	0	0	6	35	1	0
1mN/9-15/SS/H		0	0	0	0	0	2	35	3	0	0
1mN/14-20/SS/H		0	0	0	0	0	12	29	0	0	0
1mN/19-25/SS/H		0	0	0	0	1	16	24	1	0	0
1mN/24-30/SS/H		0	0	0	0	3	26	11	0	0	0
1mN/29-35/SS/H		0	0	0	0	1	23	17	0	0	0
1mN/34-40/SS/H		0	0	0	0	7	19	12	0	0	0
1mN/39-45/SS/H		0	0	0	0	4	22	12	0	0	0
1mN/44-50/SS/H		0	0	0	1	4	26	8	0	0	0
1mN/4-10/SS/S		0	0	0	0	0	0	8	30	4	0
1mN/9-15/SS/S		0	0	0	0	0	1	30	11	0	0
1mN/14-20/SS/S		0	0	0	0	1	7	31	3	0	0
1mN/19-25/SS/S		0	0	0	0	1	17	22	0	0	0
1mN/24-30/SS/S		0	0	0	0	2	15	22	0	0	0
1mN/29-35/SS/S		0	0	0	1	1	17	21	0	0	0
1mN/34-40/SS/S		0	0	0	2	5	17	16	1	0	0
1mN/39-45/SS/S		0	0	0	0	3	28	8	0	0	0
1mN/44-50/SS/S		0	0	0	2	4	19	15	0	0	0
2mN/3-10/FF/H		0	0	0	0	0	0	5	32	5	0
2mN/8-15/FF/H		0	0	0	0	0	0	32	10	0	0
2mN/13-20/FF/H		0	0	0	0	0	0	39	1	0	0
2mN/18-25/FF/H		0	0	0	0	0	2	38	0	0	0
2mN/23-30/FF/H		0	0	0	0	0	7	34	0	0	0
2mN/28-35/FF/H		0	0	0	0	0	4	34	0	0	0
2mN/33-40/FF/H		0	0	0	0	0	16	26	0	0	0
2mN/38-45/FF/H		0	0	0	0	0	17	25	0	0	0
2mN/43-50/FF/H		0	0	0	0	1	21	19	0	0	0
2mN/3-10/FF/S		0	0	0	0	0	0	5	36	1	0
2mN/8-15/FF/S		0	0	0	0	0	0	33	8	1	0
2mN/13-20/FF/S		0	0	0	0	0	5	35	1	0	0
2mN/18-25/FF/S		0	0	0	0	0	0	37	2	0	0
2mN/23-30/FF/S		0	0	0	0	0	6	35	0	0	0
2mN/28-35/FF/S		0	0	0	0	0	7	33	0	0	0
2mN/33-40/FF/S		0	0	0	0	0	13	28	0	0	0
2mN/38-45/FF/S		0	0	0	0	0	18	24	0	0	0
2mN/43-50/FF/S		0	0	0	0	2	16	23	0	0	0
2mN/3-10/FS/H		0	0	0	0	0	0	1	28	10	0
2mN/8-15/FS/H		0	0	0	0	0	0	3	36	0	0
2mN/13-20/FS/H		0	0	0	0	0	0	18	19	0	0
2mN/18-25/FS/H		0	0	0	0	0	0	27	11	0	0
2mN/23-30/FS/H		0	0	0	0	0	1	28	8	0	0
2mN/28-35/FS/H		0	0	0	0	0	1	35	2	0	0
2mN/33-40/FS/H		0	0	0	0	1	1	32	2	0	0
2mN/38-45/FS/H		0	0	0	0	0	4	33	0	0	0
2mN/43-50/FS/H		0	1	0	0	1	4	30	0	0	0
2mN/3-10/FS/S		0	0	0	0	0	0	0	28	13	1
2mN/8-15/FS/S		0	0	0	0	0	0	2	39	1	0
2mN/13-20/FS/S		0	0	0	0	0	1	7	33	0	0
2mN/18-25/FS/S		0	0	0	0	0	0	19	18	0	0
2mN/23-30/FS/S		0	0	0	0	1	2	30	9	0	0
2mN/28-35/FS/S		0	0	0	0	0	4	26	6	0	0
2mN/33-40/FS/S		0	0	0	0	1	2	35	3	0	0
2mN/38-45/FS/S		0	0	1	0	1	2	31	3	0	0
2mN/43-50/FS/S		0	0	0	1	1	4	34	1	0	0
2mN/3-10/SF/H		0	0	0	0	0	0	6	28	8	0
2mN/8-15/SF/H		0	0	0	0	0	2	39	0	0	0
2mN/13-20/SF/H		0	0	0	0	1	9	29	0	1	0
2mN/18-25/SF/H		0	0	0	0	1	15	21	0	0	0
2mN/23-30/SF/H		0	0	0	0	0	22	18	0	0	0
2mN/28-35/SF/H		0	0	0	1	2	33	6	0	0	0
2mN/33-40/SF/H		0	0	0	0	1	29	8	0	0	0
2mN/38-45/SF/H		0	0	0	1	4	28	7	0	0	0
2mN/43-50/SF/H		0	0	0	0	9	26	6	0	0	0
2mN/3-10/SF/S		0	0	0	0	0	0	6	31	4	1
2mN/8-15/SF/S		0	0	0	0	0	5	30	4	0	0
2mN/13-20/SF/S		0	0	0	1	0	7	28	2	0	0
2mN/18-25/SF/S		0	0	0	0	1	10	24	4	0	0
2mN/23-30/SF/S		0	0	0	0	2	13	18	0	0	0
2mN/28-35/SF/S		0	0	0	0	1	15	21	0	0	0
2mN/33-40/SF/S		0	0	0	0	1	21	17	0	0	0
2mN/38-45/SF/S		0	0	0	2	1	21	11	0	0	0
2mN/43-50/SF/S		0	0	0	3	8	25	4	0	0	0
2mN/3-10/SS/H		0	0	0	0	0	0	5	30	7	0

Table continued from previous page

-	0.00063	0.00126	0.00249	0.00494	0.00980	0.01944	0.03855	0.07647	0.15168	0.30086	0.59677
2mN/8-15/SS/H		0	0	0	0	0	0	31	9	0	1
2mN/13-20/SS/H		0	0	0	0	0	3	34	2	0	0
2mN/18-25/SS/H		0	0	0	0	0	4	35	0	0	0
2mN/23-30/SS/H		0	0	0	0	0	11	27	0	0	0
2mN/28-35/SS/H		0	0	0	0	2	17	22	0	0	0
2mN/33-40/SS/H		0	0	0	1	3	18	17	0	0	0
2mN/38-45/SS/H		0	0	0	1	3	18	15	0	0	0
2mN/43-50/SS/H		0	0	0	1	3	25	12	0	0	0
2mN/3-10/SS/S		0	0	0	0	0	0	1	35	5	1
2mN/8-15/SS/S		0	0	0	0	0	2	27	9	0	0
2mN/13-20/SS/S		0	0	0	0	0	3	31	1	0	0
2mN/18-25/SS/S		0	0	0	0	0	1	34	3	0	0
2mN/23-30/SS/S		0	0	0	0	1	6	28	3	0	0
2mN/28-35/SS/S		0	0	0	0	0	5	30	1	0	0
2mN/33-40/SS/S		0	0	0	0	2	15	21	0	0	0
2mN/38-45/SS/S		0	0	0	0	0	15	22	0	0	0
2mN/43-50/SS/S		1	0	0	0	1	20	16	0	0	0
5mN/0-10/FF/H		0	0	0	0	0	0	2	37	2	0
5mN/5-15/FF/H		0	0	0	0	0	0	30	11	0	0
5mN/10-20/FF/H		0	0	0	0	0	3	36	1	0	0
5mN/15-25/FF/H		0	0	0	0	0	2	37	1	0	0
5mN/20-30/FF/H		0	0	0	0	0	8	28	0	0	0
5mN/25-35/FF/H		0	0	0	0	0	5	34	0	0	0
5mN/30-40/FF/H		0	0	0	1	2	9	27	0	0	0
5mN/35-45/FF/H		0	0	0	0	2	16	21	0	0	0
5mN/40-50/FF/H		0	0	0	0	1	21	18	0	0	0
5mN/0-10/FF/S		0	0	0	0	0	0	1	40	1	0
5mN/5-15/FF/S		0	0	0	0	0	0	30	12	0	0
5mN/10-20/FF/S		0	0	0	0	0	2	39	1	0	0
5mN/15-25/FF/S		0	0	0	0	0	8	33	0	0	0
5mN/20-30/FF/S		0	0	0	0	1	4	37	0	0	0
5mN/25-35/FF/S		0	0	0	0	0	10	29	0	0	0
5mN/30-40/FF/S		0	0	0	0	2	13	25	0	0	0
5mN/35-45/FF/S		0	0	0	1	1	15	24	0	0	0
5mN/40-50/FF/S		0	0	0	1	2	13	25	0	0	0
5mN/0-10/SF/H		0	0	0	0	0	0	5	33	3	1
5mN/5-15/SF/H		0	0	0	0	0	3	36	2	0	0
5mN/10-20/SF/H		0	0	0	0	1	6	31	0	0	0
5mN/15-25/SF/H		0	0	0	0	0	14	23	0	0	0
5mN/20-30/SF/H		0	0	0	0	0	18	20	0	0	0
5mN/25-35/SF/H		0	0	0	0	3	20	18	0	0	0
5mN/30-40/SF/H		0	0	0	1	2	22	14	0	0	0
5mN/35-45/SF/H		0	0	0	2	6	25	9	0	0	0
5mN/40-50/SF/H		0	0	0	0	6	27	8	0	0	0
5mN/0-10/SF/S		0	0	0	0	0	1	12	29	0	0
5mN/5-15/SF/S		0	0	0	0	0	2	38	2	0	0
5mN/10-20/SF/S		0	0	1	0	4	15	22	0	0	0
5mN/15-25/SF/S		0	0	0	0	1	20	16	0	0	0
5mN/20-30/SF/S		0	0	0	0	1	16	25	0	0	0
5mN/25-35/SF/S		0	0	0	0	3	19	16	0	0	0
5mN/30-40/SF/S		0	0	0	0	0	26	14	0	0	0
5mN/35-45/SF/S		0	0	0	1	7	24	7	0	0	0
5mN/40-50/SF/S		0	0	0	0	5	29	5	0	0	0
10mN/0-15/FF/H		0	0	0	1	0	3	27	8	3	0
10mN/5-20/FF/H		0	0	0	0	0	4	35	2	0	0
10mN/10-25/FF/H		0	0	0	0	0	2	38	2	0	0
10mN/15-30/FF/H		0	0	0	0	0	4	33	1	0	0
10mN/20-35/FF/H		0	0	0	0	0	3	34	0	0	0
10mN/25-40/FF/H		0	0	0	0	0	8	28	0	0	0
10mN/30-45/FF/H		0	0	0	1	0	16	24	0	0	0
10mN/35-50/FF/H		0	0	0	0	2	20	20	0	0	0
10mN/0-15/FF/S		0	0	0	0	0	1	19	20	0	0
10mN/5-20/FF/S		0	0	0	0	0	0	36	4	0	0
10mN/10-25/FF/S		0	0	0	0	0	7	34	0	0	0
10mN/15-30/FF/S		0	0	0	0	0	7	33	0	0	0
10mN/20-35/FF/S		0	0	0	0	0	13	24	1	0	0
10mN/25-40/FF/S		0	0	0	0	0	9	29	0	0	0
10mN/30-45/FF/S		0	0	0	0	1	21	17	0	0	0
10mN/35-50/FF/S		0	0	0	1	2	23	14	0	0	0
10mN/0-15/SF/H		0	0	0	0	0	3	23	14	0	0
10mN/5-20/SF/H		0	0	0	0	0	6	26	2	1	0
10mN/10-25/SF/H		0	0	1	0	1	11	24	0	0	0
10mN/15-30/SF/H		0	0	0	1	1	11	25	0	0	0
10mN/20-35/SF/H		0	0	0	0	3	15	22	0	0	0
10mN/25-40/SF/H		0	0	0	0	0	24	14	0	0	0
10mN/30-45/SF/H		0	0	0	3	1	24	11	0	0	0
10mN/35-50/SF/H		0	0	1	1	6	23	6	0	0	0
10mN/0-15/SF/S		0	0	0	0	0	4	32	2	0	0
10mN/5-20/SF/S		0	0	0	1	1	11	20	1	0	0
10mN/10-25/SF/S		0	0	0	0	3	11	26	1	0	0
10mN/15-30/SF/S		0	0	0	0	2	19	16	0	0	0
10mN/20-35/SF/S		0	1	3	1	2	19	9	0	0	0
10mN/25-40/SF/S		0	0	0	2	7	20	6	0	0	0
10mN/30-45/SF/S		0	0	0	2	6	24	6	0	0	0
10mN/35-50/SF/S		0	0	1	1	12	21	4	0	0	0

Average Elastic Strain Rate Data for Experiments with 1mN Unloading Size, by Loading Segment

	4-10	9-15	14-20	19-25	24-30	29-35	34-40	39-45	44-50
1mN/FF/H	0.073569	0.03157	0.019987	0.01491	0.011195	0.009103	0.008119	0.006843	0.00626
1mN/FF/S	0.062604	0.02788	0.017833	0.013038	0.010428	0.008544	0.007403	0.006405	0.005677
1mN/FS/H	0.092545	0.036505	0.021725	0.015059	0.011584	0.009601	0.007927	0.006928	0.006122
1mN/FS/S	0.09388	0.036841	0.022113	0.015273	0.011979	0.009704	0.008036	0.006779	0.006012
1mN/SF/H	0.008454	0.003768	0.002454	0.00179	0.001436	0.001171	0.001041	0.000904	0.000827
1mN/SF/S	0.008033	0.003966	0.002487	0.001862	0.001516	0.001262	0.001084	0.000943	0.000894
1mN/SS/H	0.010998	0.004393	0.002671	0.001884	0.00146	0.001194	0.00102	0.000873	0.000801
1mN/SS/S	0.010523	0.004323	0.002618	0.001857	0.00146	0.001202	0.001048	0.000867	0.000779

Average Elastic Strain Rate Data for Experiments with 2mN Unloading Size, by Loading Segment

	3-10	9-15	13-20	18-25	23-30	28-35	33-40	38-45	43-50
2mN/FF/H	0.114764	0.044228	0.026533	0.01852	0.014208	0.011609	0.009884	0.008304	0.007345
2mN/FF/S	0.106221	0.042044	0.025005	0.017556	0.013651	0.011166	0.009528	0.008159	0.007115
2mN/FS/H	0.110461	0.042587	0.025063	0.01737	0.013327	0.010578	0.008963	0.007732	0.006666
2mN/FS/S	0.103421	0.040985	0.024279	0.016939	0.013067	0.01055	0.008761	0.007655	0.006509
2mN/SF/H	0.011457	0.004549	0.002712	0.001996	0.001508	0.001245	0.001051	0.000917	0.000853
2mN/SF/S	0.010647	0.00437	0.002679	0.001852	0.001518	0.00121	0.001057	0.000891	0.000786
2mN/SS/H	0.011203	0.004458	0.002632	0.00185	0.00143	0.001155	0.000971	0.000861	0.000729
2mN/SS/S	0.010654	0.004305	0.002603	0.001831	0.001429	0.001158	0.000985	0.000842	0.000751

Average Elastic Strain Rate Data for Experiments with 5mN Unloading Size, by Loading Segment

	0-10	5-10	10-20	15-25	20-30	25-35	30-40	35-45	40-50
5mN/FF/H	0.093359	0.037079	0.022792	0.01621	0.012347	0.010114	0.008572	0.007269	0.006351
5mN/FF/S	0.08818	0.035196	0.02151	0.015348	0.011882	0.009909	0.008149	0.007025	0.006212
5mN/SF/H	0.009628	0.003926	0.00237	0.001699	0.001301	0.00108	0.000917	0.000793	0.000697
5mN/SF/S	0.009381	0.003864	0.002369	0.001725	0.001344	0.001135	0.000966	0.000848	0.000753

Average Elastic Strain Rate Data for Experiments with 10mN Unloading Size, by Loading Segment

	0-15	5-20	10-25	15-30	20-35	25-40	30-45	35-50
10mN/FF/H	0.042989	0.024732	0.017216	0.012988	0.010246	0.008348	0.007135	0.006417
10mN/FF/S	0.04105	0.02341	0.01627	0.012341	0.00968	0.007928	0.006717	0.006091
10mN/SF/H	0.004584	0.002582	0.001805	0.001372	0.001114	0.000949	0.000821	0.000723
10mN/SF/S	0.004231	0.002477	0.001766	0.001372	0.00114	0.000974	0.000842	0.000744

References

[1] H.W. Sheng, W.K. Luo, F.M. Alamgir, J.M. Bai, E. Ma
Atomic Packing and Short-to-Medium-Range order in Metallic Glasses
Nature 439, 419-425 (2006)

[2] A.L.Greer, E. Ma
Bulk Metallic Glasses: At the Cutting Edge of Metals Research
Technical Feature Volume 32, 611-619 (2007)

[3] Tim Burgess, M. Ferry
Nanoindentation of Metallic Glasses
Materials Today 2009 Volume 12, Issues 1-2

[4] H.Vogel
Das Temperaturabhängigkeitsgesetz der Viskosität von Flüssigkeiten
Physikalische Zeitschrift, Volume 22, 645 (1921)

[5] Z.P. Lu, Y. Li, S.C. Ng
Reduced Glass Transition Temperature and Glass Forming Ability of Bulk Glass Forming Alloys
Journal of Non-Crystalline Solids 270 (2000) 103-114

[6] Z.P. Lu, C.T. Liu
A New Glass-Forming Ability Criterion for Bulk Metallic Glasses
Acta Materialia 50, 3501-3512 (2002)

[7] E.S. Park, D.H. Kim, W.T. Kim
Parameter for Glass Forming Ability of Ternary Alloy Systems
Applied Physics Letters Volume 86, Issue 5 (2005)

[8] E.S. Park, C.W. Ryu, W.T. Kim, D.H. Kim
A Novel Parameter to Describe the Glass-Forming Ability of Alloys
Journal of Applied Physics Volume 118, Issue 6 (2015)

[9] Chengying Tang and Huaiying Zhou
Thermodynamics and the Glass Forming Ability of Alloys
Thermodynamics - Physical Chemistry of Aqueous Systems 2011 ISBN: 978-953-307-979-0

[10] C.A. Schuh, T.C. Hufnagel, U. Ramamurty
Mechanical Behaviour of Amorphous Alloys
Acta Materialia 55 (2007) 4067-4109

[11] A.L.Greer, Y.Q. Cheng, E. Ma
Shear Bands in Metallic Glasses
Materials Science & Engineering R74 (2013) Pages 71-132

[12] Christian Ebner, Benjamin Escher, Christoph Gammer, Jürgen Eckert, Christian Rentenberger
Structural and Mechanical Characterization of Heterogeneities in a CuZr-Based Bulk Metallic Glass Processed by High Pressure Torsion
Acta Materialia 160 (2018) 147-157

[13] Takeshi Egami, Takuya Iwashita, Wojciech Dmowski
Mechanical Properties of Metallic Glasses
MDPI Metals 2013 Volume 3 Issue 1

[14] Christian Ebner, Simon Pauly, Jürgen Eckert, Christian Rentenberger
Effect of Mechanically Induced Structural Rejuvenation on the Deformation Behaviour of CuZr Based Bulk Metallic Glass
Materials Science & Engineering A773 (2020) 138848

[15] J. Pan, Y.P. Ivanov, W.H. Zhou, Y. Li, A.L. Greer
Strain-Hardening and Suppression of Shear-Banding in Rejuvenated Bulk Metallic Glass
Nature 578, 559-562 (2020)

[16] S.V. Ketov, Y.H. Sun, S. Nachum, Z. Lu, A. Checchi, A.R. Beraldin, H.Y. Bai, W.H. Wang, D.V. Louzguine-Luzgin, M.A. Carpenter, A.L. Greer
Rejuvenation of Metallic Glasses by Non-Affine Thermal Strain
Nature 524, 200-203 (2015)

[17] Georg Staska
Bachelor's Thesis: Charakterisierung Mechanischer Eigenschaften Metallischer Gläser durch Nanoindentations-Kriechversuche
2019

[18] *asmec Indent Analyser Version 3 User Manual*
Revision: August 12th 2014

[19] W.C. Oliver, G.M. Pharr
Measurement of hardness and elastic modulus by instrumented indentation
Journal of Materials Research and Technology, Vol. 19, No. 1, Jan 2004

[20] Bing Yang, Laura Riester, T.G. Nieh
Strain hardening and Recovery in a Bulk Metallic Glass Under Nanoindentation
Scripta Materialia 54 (2006) 1277-1280

[21] D.F. Bahr, D.E. Kramer, W.W. Gerberich
Non-Linear Deformation Mechanisms During Nanoindentation
Acta Materialia Volume 46, Issue 10, 12 June (1998) 3605 - 3617

[22] B.C. Wei, L.C. Zhang, T.H. Zhang, D.M. Xing, J. Das, J. Eckert
Strain Rate Dependence of Plastic Flow in Ce-Based Bulk Metallic Glass during Nanoindentation
Journal of Materials Research Volume 22, 258-263 (2007)

[23] A. Oweisi, C. Rentenberger
Evaluation of Hardening and Deformation Discontinuity in As-Cast and Structural Modified CuZr Based Bulk Metallic Glass
Poster Session, 2024

[24] W.C. Oliver, G.M. Pharr
Measurements of Hardness and Elastic Modulus by Instrumented Indentation: Advances in Understanding and Refinements to Methodology
Journal of Materials Research 19 (2004), 3

[25] Stephania Kossman, Maxence Bigerelle
Pop-In Identification in Nanoindentation Curves with Deep Learning Algorithms
Materials 2021, 14, 7027

[26] A. Savitzky, M.J.E. Golay
Smoothing and Differentiation of Data by Simplified Least Squares Procedures
Analytical Chemistry, Volume 36, Issue 8, 1964, 1627-1639

[27] *Metallic Materials - Instrumented Indentation Test for Hardness and Material Parameters - Part 1: Test Method*
ISO 14577 - 1, 2015

[28] Student
The Probable Error of a Mean
Biometrika, Volume 6, Issue 1 (March 1908)

[29] Chenghui Gao, Ming Liu
Instrumented Indentation of Fused Silica by Berkovich Indenter
Journal of Non-Crystalline Solids, Volume 475, November 2017, 151-160

[30] B.Yang, T.G. Nieh
Effect of the Nanoindentation Rate on the Shear Band Formation in an Au-Based Bulk Metallic Glass
Acta Materialia Volume 55, Issue 1 295-300 (2007)

[31] R. Limbach, K. Kosiba, S. Pauly, U. Kühn, L. Wondraczek
Serrated Flow of CuZr-Based Bulk Metallic Glasses Probed by Nanoindentation:
Role of the Activation Barrier, Size and Distribution of Shear Transformation Zones
Journal of Non-Crystalline Solids 459, 130-141 (2017)