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BY OVERNIGHT MAIL

January 5, 2000

U.S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

Subject: USNRC Docket Nos. 72-1008 and 72-1014
High-Seismic Topical Report Review, TAC No. L22966

- References:
1. Holtec Project Nos. 71178 and 5014
 2. Phone Conversations Among NRC, CNWRA and Holtec International Held December 14, 1999 and December 28, 1999.

Dear Sir:

In our December 14, 1999 telephone conference with the Spent Fuel Project Office and the Center for Nuclear Waste Regulatory Analysis, Holtec International had offered to perform additional sensitivity studies to quantify the effect of variation in certain key structural parameters in the HI-STAR 100 and HI-STORM 100 dynamic models. We had also undertaken to provide time history plots of key system response parameters to aid in the visualization of the behavior of the anchored casks under the postulated seismic inputs. Our response was scheduled for submittal to the NRC on January 15, 2000. Fortunately, we have been able to complete our work ahead of the committed schedule and are able to provide the required information in a manner, which we believe, would help the reviewers glean additional insight into the seismic characteristic of anchored casks and instill additional confidence in the veracity of the analyses contained in the topical report. This information will have served a valuable purpose if it helps in winnowing and sharpening any remaining questions that need to be asked in the next round of RAIs.

Table 1 summarizes the parametric evaluations performed for the anchored HI-STAR 100 System. In addition to the 20% range (10% lower and 10% higher than base case, as promised in the December 14, 1999 teleconference) assigned to spring constants representing the effective tension/shear connections, we have added two additional simulations where the range is extended to 50% (i.e., 25% above and below the nominal values provided in Appendix B of the topical report). Table 2 summarizes the maximum values obtained for the key HI-STAR 100 structural response parameters and for all degrees of freedom (these were the items originally agreed upon to report to the staff by 1/15/00) for each evaluation including the "base case." The nomenclature used in Table 2 and the physical meaning of the degrees-of-freedom are defined in Appendix A of the topical report. Table 3

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provides the corresponding results for the HI-STORM configuration. Enclosed Figures N-1 to N-79 provide the graphical result for the key system responses over the entire time duration of the seismic event. These figures are indexed on the first three pages of the enclosure.

In the tables, the "maximum horizontal displacement" is obtained from calculating the square root of the sum of the squares of the instantaneous values for each of the two horizontal displacements (x, y directions) at each instant of time and recording the maximum value. Similarly, the "net shear" is the maximum value for the resultant shear force in the clevis bolt. The reported maximum values for the clevis compression force and overpack-to-MPC horizontal impact force are the actual instantaneous maximum values (rather than the bounding values reported in the topical report). Finally, the "net overpack-to-MPC impact force" represents the value of the instantaneous sum of impacts at both the top and bottom of the MPC in either horizontal direction.

A review of the information provided on the HI-STAR 100 System in Table 2 provides the following valuable insights with respect to the behavior of this system:

(i) A 20% variation on the overpack-to-MPC interface impact stiffness results in:

- 0.57% range on the clevis bolt tension
- 2.67% range on the clevis bolt net shear
- 0.14% range on the maximum compression force on any clevis
- 10.6% range on the maximum net impact force between the overpack and the MPC

A 20% variation in input results in a maximum of 2.67% variation on shear. In other words, the maximum variation in the force in the cask-to-pad connection members is less than 14% of the postulated variation in the input parameter.

(ii) A 20% variation on the effective tension and shear springs connecting the cask to ground results in:

- 3.69% range on the clevis bolt tension
- 1.58% range on the clevis bolt net shear
- 2.05% range on maximum compression force on any clevis
- 11.3% range on maximum net impact force between overpack and MPC



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A 20% variation in input results in a maximum 3.69% variation on clevis bolt tension; i.e., the variation in the cask-to-pad connection member loading is less than 20% of the percentage change in the input parameters.

- (iii) 50% range on the effective tension and shear springs connecting the cask to ground results in:
- 5.11% range on the clevis bolt tension
 - 2.16% range on clevis bolt net shear
 - 7.52% range on maximum compression force on any clevis
 - 6.6% range on maximum net impact force between overpack and MPC

To summarize, the variation in any of the cask-to-pad connection member loadings is approximately 15% of the percentage change in the input parameters.

SUMMARY

The above results indicate that the key forces in the cask-to-ISFSI pad connection members are relatively insensitive to the large postulated variations in the input data. Furthermore, the behavior of a response parameter with respect to a change in a set of input data is monotonic. For example, the tension in the clevis bolt decreases as the stiffness of the cask-to-pad connection "springs" is increased (Run #250, 452 and 552 in Table 2). The maximum shear in the bolts also exhibits a monotonic behavior, although the change in the shear force is quite miniscule.

The above observation, along with others which can be gleaned from the information provided in the attached tables, make it possible to define a bounding set of input parameter values which will result in bounding results for the key system responses (viz. tension and shear in the connection members). Such an approach may remove any technical concerns associated with the structural idealization of the member stiffnesses inherent in the dynamic model.

An evaluation of the corresponding data in Table 3 leads to similar conclusions for the HI-STORM support structure. In general, the results convincingly demonstrate the stability of the response to expected ranges of input parameters.



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If you have any questions or require additional information, please contact us.

We trust that the Center and NRC reviewers will find the information provided herewith to be valuable in resolving the issues pertaining to simplifications attendant to the structural simulation of the anchored casks in our topical report.

Sincerely,

Approval:

Brian Gutherman, P.E.
Licensing Manager

K.P. Singh, Ph.D., PE
President and CEO

cc: Ms. Marissa Bailey, USNRC (w/encl.)

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Enclosure: Time-History Plots (83 Pages)

Technical Concurrence:

Dr. Alan Soler (Structural Evaluation)



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TABLE 1
SIMULATION CASES FOR SENSITIVITY STUDY

ITEM	OVERPACK-TO GROUND EFFECTIVE TENSION/SHEAR SPRING RATES	OVERPACK-TO-MPC COMPRESSION- ONLY CONTACT SPRING RATES
HI-STAR 100		
Base Case-Run ID 250	Nominal value	Nominal value
Run ID 451	10% decrease	Nominal value
Run ID 452	10% increase	Nominal value
Run ID 551	25% decrease	Nominal Value
Run ID 552	25% increase	Nominal Value
Run ID 453	Nominal value	10% decrease
Run ID 454	Nominal value	10% increase
HI-STORM 100		
Base Case-Run ID 113	Nominal value	Nominal value
Run ID 351	10% decrease	Nominal value
Run ID 352	10% increase	Nominal value
Run ID 353	Nominal value	10% decrease
Run ID 354	Nominal value	10% increase



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TABLE 2
SUMMARY OF RESULTS FROM HI-STAR HIGH SEISMIC SUPPORT
SENSITIVITY STUDY

Item	Run 250	Run 451	Run 452	Run 551	Run 552	Run 453	Run 454
Maximum Horizontal Displacement of Overpack Centroid (inch)	0.155	0.171	0.142	0.196	0.130	0.155	0.155
Maximum Vertical Displacement of Overpack Centroid (inch)	0.033	0.037	0.029	0.046	0.025	0.033	0.033
Maximum Tension in Clevis Bolt (kips)	352	354	341	359	336	353	351
Maximum Net Shear in Clevis Bolt (kips)	100.01	99.24	100.82	98.89	101.05	98.33	101.00
Maximum Compression Force at any Location (kips)	294	306	284	324	265	294	295
Maximum Compression Force on any Clevis (kips)	449.04	456.00	446.80	469.00	435.20	449.01	449.62
Maximum Net Overpack-to MPC Horizontal Impact Force (kips)	831	873	967	814	869	799	887
Max. Value of q ₁ (inch)	0.14950	0.16340	0.13740	0.18350	0.12480	0.14960	0.14940
Max. Value of q ₂ (inch)	0.14760	0.15730	0.13910	0.18410	0.12790	0.14760	0.14750
Max. Value of q ₃ (inch)	0.03263	0.03673	0.02903	0.04574	0.02509	0.03265	0.03260
Max. Value of q ₄ (radians)	0.00135	0.00144	0.00128	0.00168	0.00118	0.00135	0.00135
Max. Value of q ₅ (radians)	0.00138	0.00150	0.00127	0.00168	0.00115	0.00138	0.00138
Max. Value of q ₆ (radians)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Max. Value of q ₇ (inch)	0.36420	0.37750	0.35320	0.39710	0.34340	0.36730	0.36180
Max. Value of q ₈ (inch)	0.37380	0.38780	0.36510	0.41300	0.35590	0.37890	0.36950
Max. Value of q ₉ (inch)	0.04047	0.04457	0.03689	0.05354	0.03300	0.04049	0.04044
Max. Value of q ₁₀ (radians)	0.00192	0.00197	0.00197	0.00203	0.00200	0.00192	0.00193
Max. Value of q ₁₁ (radians)	0.00198	0.00202	0.00209	0.00197	0.00192	0.00200	0.00202
Max. Value of q ₁₂ (inch)	0.70190	0.72630	0.68190	0.76100	0.66250	0.70580	0.69890
Max. Value of q ₁₃ (inch)	0.69830	0.71510	0.68410	0.76400	0.66560	0.70250	0.69490
Max. Value of q ₁₄ (inch)	0.63630	0.65340	0.62340	0.68200	0.60540	0.63960	0.63370
Max. Value of q ₁₅ (inch)	0.63820	0.65620	0.62800	0.69230	0.61470	0.64280	0.63450
Max. Value of q ₁₆ (inch)	0.56910	0.58270	0.56040	0.60190	0.55440	0.57220	0.56660
Max. Value of q ₁₇ (inch)	0.58750	0.60080	0.57640	0.62470	0.56800	0.59220	0.58360
Max. Value of q ₁₈ (inch)	0.51570	0.52110	0.51370	0.53410	0.51120	0.52050	0.51210
Max. Value of q ₁₉ (inch)	0.53930	0.54750	0.53220	0.56150	0.52630	0.54430	0.53510
Max. Value of q ₂₀ (inch)	0.47520	0.47640	0.47430	0.47920	0.47330	0.47930	0.47140
Max. Value of q ₂₁ (inch)	0.48540	0.48820	0.48320	0.49260	0.48120	0.49060	0.48100
Max. Value of q ₂₂ (inch)	0.66650	0.67060	0.66290	0.67950	0.65900	0.66650	0.66640
Max. Value of q ₂₃ (inch)	0.05847	0.05874	0.05826	0.05916	0.05801	0.05851	0.05857



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TABLE 3
SUMMARY OF RESULTS FROM HI-STORM HIGH SEISMIC SUPPORT
SENSITIVITY STUDY

Item	Run 113	Run 351	Run 352	Run 353	Run 354
Maximum Horizontal Displacement of Overpack Centroid (inch)	0.249	0.275	0.228	0.250	0.248
Maximum Vertical Displacement of Overpack Centroid (inch)	0.032	0.037	0.029	0.032	0.032
Maximum Tension in Sector Lug Spring (kips)	354	350	357	356	353
Maximum Net Shear in Sector Lug Spring (kips)	95.60	96.13	95.07	95.27	95.92
Maximum Compression Force at any Single Location (kips)	111	116	107	111	110
Maximum Net Overpack-to MPC Horizontal Impact Force (kips)	964	957	1025	919	1074
Max. Value of q_1 (inch)	0.21520	0.23940	0.19530	0.21590	0.21440
Max. Value of q_2 (inch)	0.23140	0.25520	0.21180	0.23230	0.23060
Max. Value of q_3 (inch)	0.03238	0.03665	0.02900	0.03251	0.03227
Max. Value of q_4 (radians)	0.00080	0.00087	0.00074	0.00081	0.00080
Max. Value of q_5 (radians)	0.00077	0.00084	0.00071	0.00077	0.00076
Max. Value of q_6 (radians)	0.00040	0.00045	0.00035	0.00040	0.00040
Max. Value of q_7 (inch)	0.44770	0.47150	0.42790	0.45540	0.44110
Max. Value of q_8 (inch)	0.44760	0.47110	0.42860	0.45260	0.44380
Max. Value of q_9 (inch)	1.19400	1.19400	1.19400	1.19400	1.19400
Max. Value of q_{10} (radians)	0.00160	0.00150	0.00140	0.00163	0.00161
Max. Value of q_{11} (radians)	0.00162	0.00162	0.00180	0.00160	0.00168



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Enclosure

TIME-HISTORY PLOTS (83 TOTAL PAGES)

NRC HIGH SEISMIC SENSITIVITY STUDIES - LIST OF FIGURES AND FIGURE CAPTIONS

Figure Title RUN 250

Figure N-1 - Run 250 -HI-STAR 100-Overpack Horizontal Displacement vs. Time
Figure N-2 – Run 250 – HI-STAR 100-Overpack Vertical Displacement vs. Time
Figure N-3 – Run 250 - HI-STAR 100-Maximum Clevis Bolt Tension vs. Time
Figure N-4 – Run 250 - HI-STAR 100-Maximum Clevis Bolt Net Shear vs. Time
Figure N-5 –Run 250 – HI-STAR 100-Maximum Compression Force at Any Location vs. Time
Figure N-6 – Run 250 – HI-STAR 100-Maximum Compression Force on Clevis vs. Time
Figure N-7 – Run 250 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

Figure Title RUN 351

Figure N-8 - Run 351 -HI-STAR 100-Overpack Horizontal Displacement vs. Time
Figure N-9 – Run 351 – HI-STAR 100-Overpack Vertical Displacement vs. Time
Figure N-10 – Run 351 - HI-STAR 100-Maximum Clevis Bolt Tension vs. Time
Figure N-11– Run 351 - HI-STAR 100-Maximum Clevis Bolt Net Shear vs. Time
Figure N-12 –Run 351 – HI-STAR 100-Maximum Compression Force at Any Location vs. Time
Figure N-13 – Run 351 – HI-STAR 100-Maximum Compression Force on Clevis vs. Time
Figure N-14 – Run 351 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

Figure Title RUN 352

Figure N-15 - Run 352 -HI-STAR 100-Overpack Horizontal Displacement vs. Time
Figure N-16 – Run 352 – HI-STAR 100-Overpack Vertical Displacement vs. Time
Figure N-17 – Run 352 - HI-STAR 100-Maximum Clevis Bolt Tension vs. Time
Figure N-18– Run 352 - HI-STAR 100-Maximum Clevis Bolt Net Shear vs. Time
Figure N-19 –Run 352 – HI-STAR 100-Maximum Compression Force at Any Location vs. Time
Figure N-20 – Run 352 – HI-STAR 100-Maximum Compression Force on Clevis vs. Time
Figure N-21 – Run 352 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

Figure Title RUN 551

Figure N-22 - Run 551 -HI-STAR 100-Overpack Horizontal Displacement vs. Time
Figure N-23 – Run 551 – HI-STAR 100-Overpack Vertical Displacement vs. Time
Figure N-24 – Run 551 - HI-STAR 100-Maximum Clevis Bolt Tension vs. Time
Figure N-25– Run 551 - HI-STAR 100-Maximum Clevis Bolt Net Shear vs. Time
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Figure N-27 – Run 551 – HI-STAR 100-Maximum Compression Force on Clevis vs. Time
Figure N-28 – Run 551 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

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Figure N-29 - Run 552 -HI-STAR 100-Overpack Horizontal Displacement vs. Time
Figure N-30 – Run 552 – HI-STAR 100-Overpack Vertical Displacement vs. Time
Figure N-31 – Run 552 - HI-STAR 100-Maximum Clevis Bolt Tension vs. Time
Figure N-32– Run 552 - HI-STAR 100-Maximum Clevis Bolt Net Shear vs. Time
Figure N-33 –Run 552 – HI-STAR 100-Maximum Compression Force at Any Location vs. Time
Figure N-34 – Run 552 – HI-STAR 100-Maximum Compression Force on Clevis vs. Time
Figure N-35 – Run 552 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

Figure Title RUN 353

Figure N-36 - Run 353 -HI-STAR 100-Overpack Horizontal Displacement vs. Time
Figure N-37 – Run 353 – HI-STAR 100-Overpack Vertical Displacement vs. Time
Figure N-38 – Run 353 - HI-STAR 100-Maximum Clevis Bolt Tension vs. Time
Figure N-39– Run 353 - HI-STAR 100-Maximum Clevis Bolt Net Shear vs. Time
Figure N-40 –Run 353 – HI-STAR 100-Maximum Compression Force at Any Location vs. Time
Figure N-41 – Run 353 – HI-STAR 100-Maximum Compression Force on Clevis vs. Time
Figure N-42 – Run 353 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

Figure Title RUN 354

Figure N-43 - Run 354 -HI-STAR 100-Overpack Horizontal Displacement vs. Time
Figure N-44 – Run 354 – HI-STAR 100-Overpack Vertical Displacement vs. Time
Figure N-45 – Run 354 - HI-STAR 100-Maximum Clevis Bolt Tension vs. Time
Figure N-46– Run 354 - HI-STAR 100-Maximum Clevis Bolt Net Shear vs. Time
Figure N-47 –Run 354 – HI-STAR 100-Maximum Compression Force at Any Location vs. Time
Figure N-48 – Run 354 – HI-STAR 100-Maximum Compression Force on Clevis vs. Time
Figure N-49 – Run 354 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

Figure Title RUN 113

Figure N-50 - Run 113 -HI-STORM 100-Overpack Horizontal Displacement vs. Time
Figure N-51 – Run 113 – HI-STORM100-Overpack Vertical Displacement vs. Time
Figure N-52 – Run 113 - HI-STORM 100-Maximum Sector Lug Spring Tension vs. Time
Figure N-53– Run 113 - HI-STORM 100-Maximum Sector Lug Spring Net Shear vs. Time
Figure N-54 –Run 113 – HI-STORM 100-Maximum Compression Force at Any Location vs. Time
Figure N-55 – Run 113 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

Figure Title RUN 451

Figure N-56 - Run 451 -HI-STORM 100-Overpack Horizontal Displacement vs. Time
Figure N-57 – Run 451 – HI-STORM100-Overpack Vertical Displacement vs. Time
Figure N-58 – Run 451 - HI-STORM 100-Maximum Sector Lug Spring Tension vs. Time
Figure N-59– Run 451 - HI-STORM 100-Maximum Sector Lug Spring Net Shear vs. Time
Figure N-60 –Run 451 – HI-STORM 100-Maximum Compression Force at Any Location vs. Time
Figure N-61 – Run 451 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

Figure Title RUN 452

Figure N-62 - Run 452 -HI-STORM 100-Overpack Horizontal Displacement vs. Time
Figure N-63 – Run 452 – HI-STORM100-Overpack Vertical Displacement vs. Time
Figure N-64 – Run 452 - HI-STORM 100-Maximum Sector Lug Spring Tension vs. Time
Figure N-65– Run 452 - HI-STORM 100-Maximum Sector Lug Spring Net Shear vs. Time
Figure N-66 –Run 452 – HI-STORM 100-Maximum Compression Force at Any Location vs. Time
Figure N-67 – Run 452 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

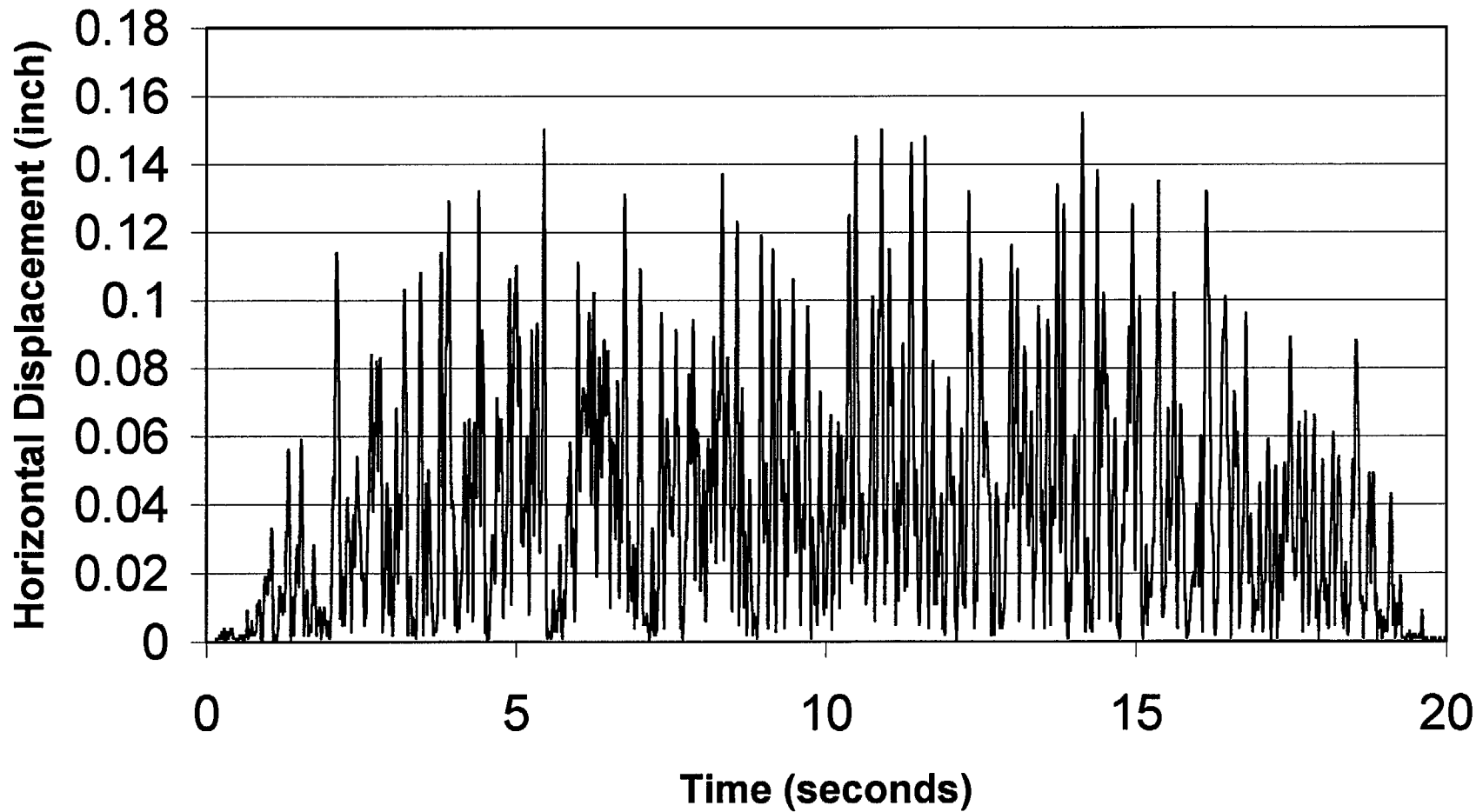
Figure Title RUN 453

Figure N-68 - Run 453 -HI-STORM 100-Overpack Horizontal Displacement vs. Time
Figure N-69 – Run 453 – HI-STORM100-Overpack Vertical Displacement vs. Time
Figure N-70 – Run 453 - HI-STORM 100-Maximum Sector Lug Spring Tension vs. Time
Figure N-71– Run 453 - HI-STORM 100-Maximum Sector Lug Spring Net Shear vs. Time
Figure N-72 –Run 453 – HI-STORM 100-Maximum Compression Force at Any Location vs. Time
Figure N-73 – Run 453 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

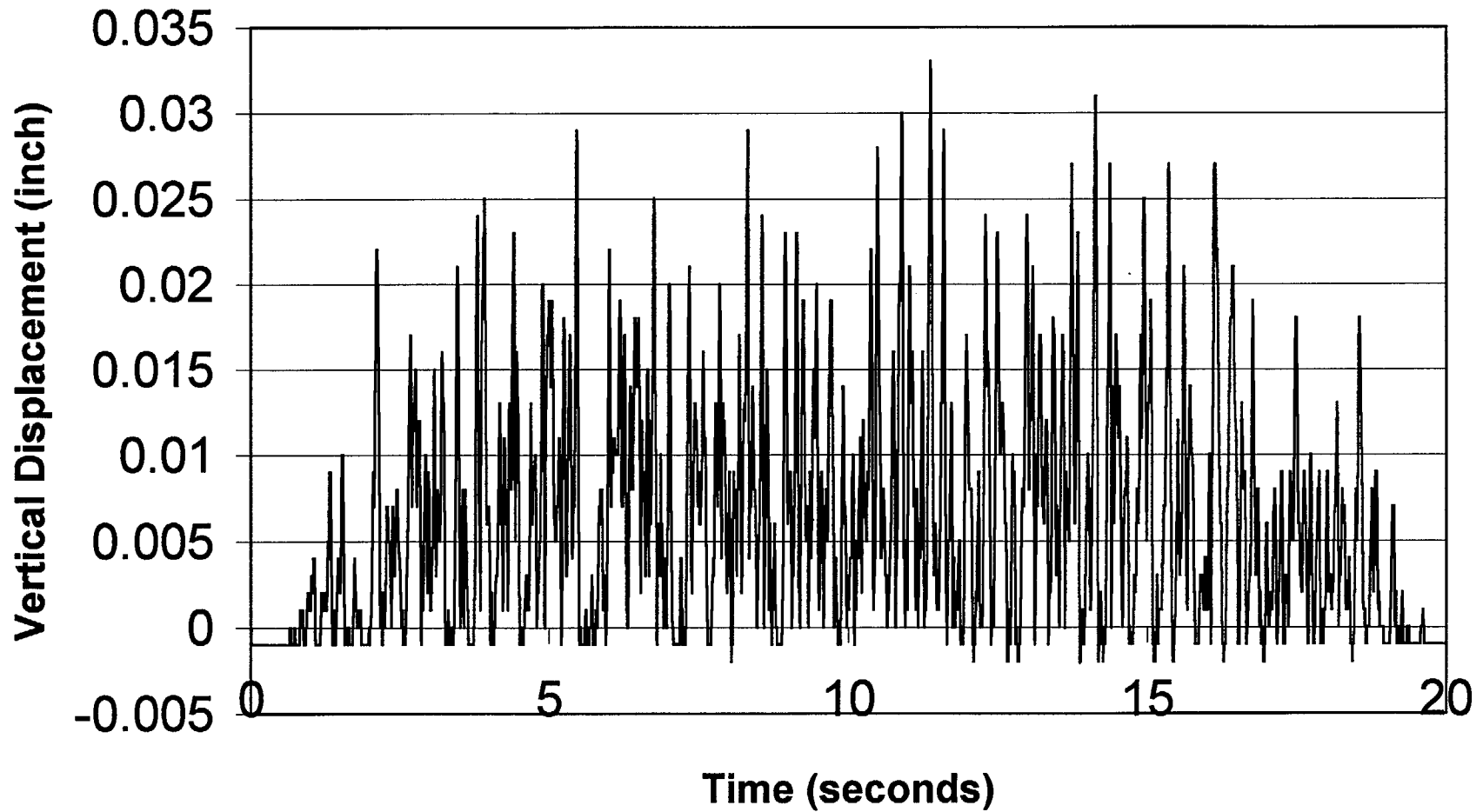
Figure Title RUN 454

Figure N-74 - Run 454 -HI-STORM 100-Overpack Horizontal Displacement vs. Time
Figure N-75 – Run 454 – HI-STORM100-Overpack Vertical Displacement vs. Time
Figure N-76 – Run 454 - HI-STORM 100-Maximum Sector Lug Spring Tension vs. Time
Figure N-77– Run 454 - HI-STORM 100-Maximum Sector Lug Spring Net Shear vs. Time
Figure N-78 –Run 454 – HI-STORM 100-Maximum Compression Force at Any Location vs. Time
Figure N-79 – Run 454 – HI-STAR 100-Net Overpack-to-MPC Impact Force vs. Time

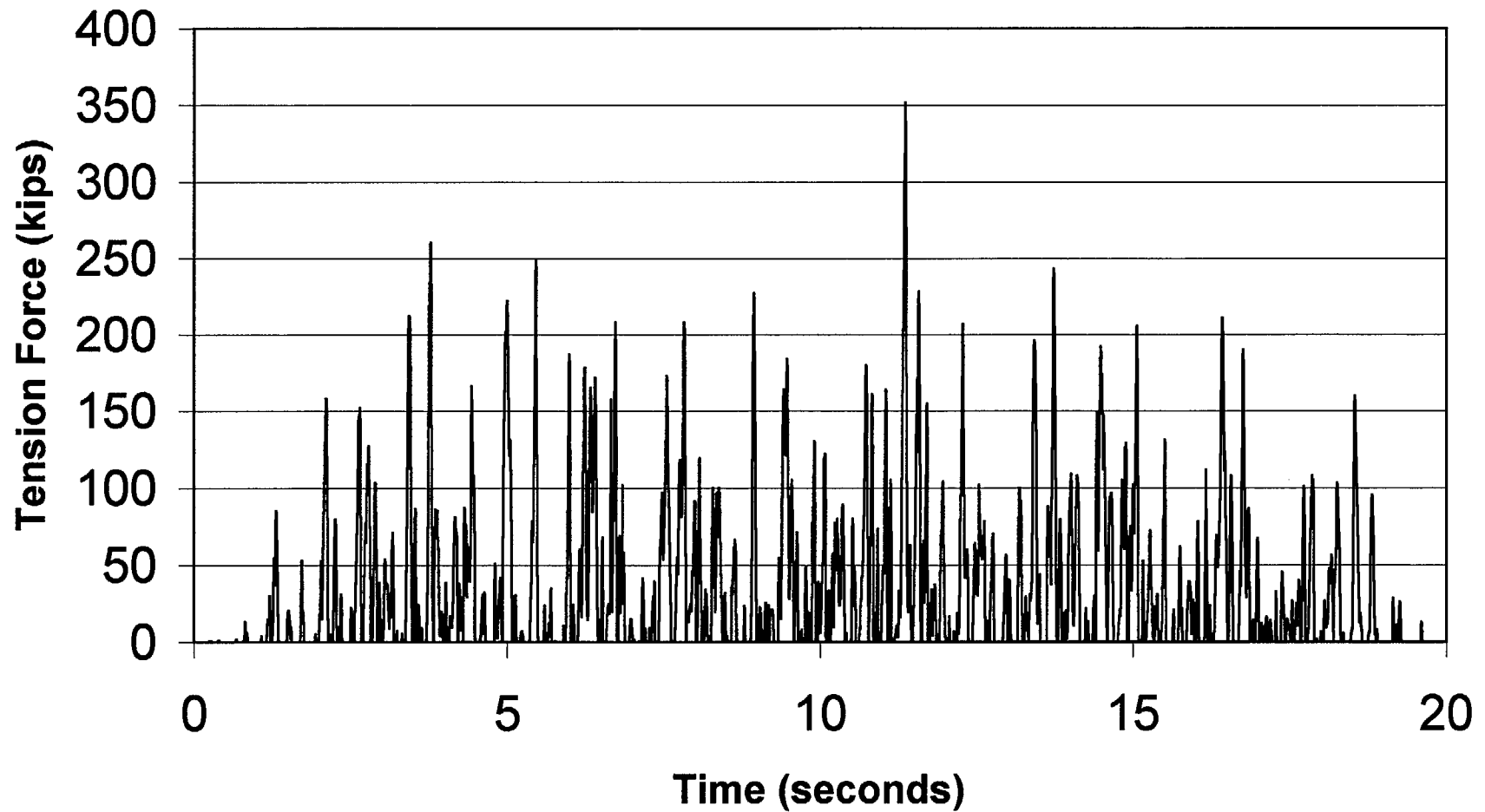
**Figure N-1 - Run 250 - HI-STAR 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-2 - Run 250 - HI-STAR 100 Overpack
Vertical Displacement vs. Time**



**Figure N-3 - Run 250 - HI-STAR 100 - Maximum
Clevis Bolt Tension vs. Time**



**Figure N-4 - Run 250 - HI-STAR 100 - Maximum
Clevis Bolt Net Shear vs. Time**

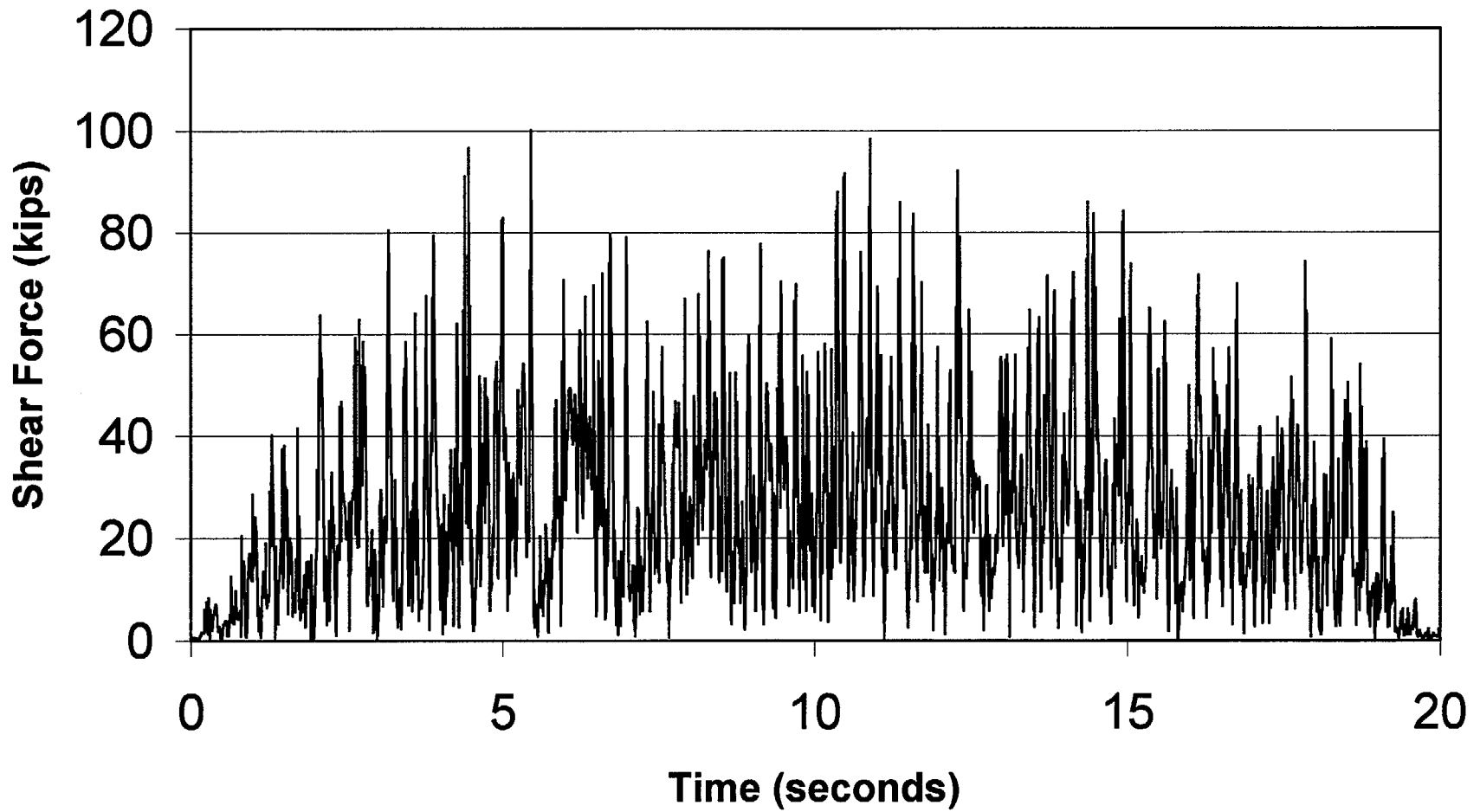
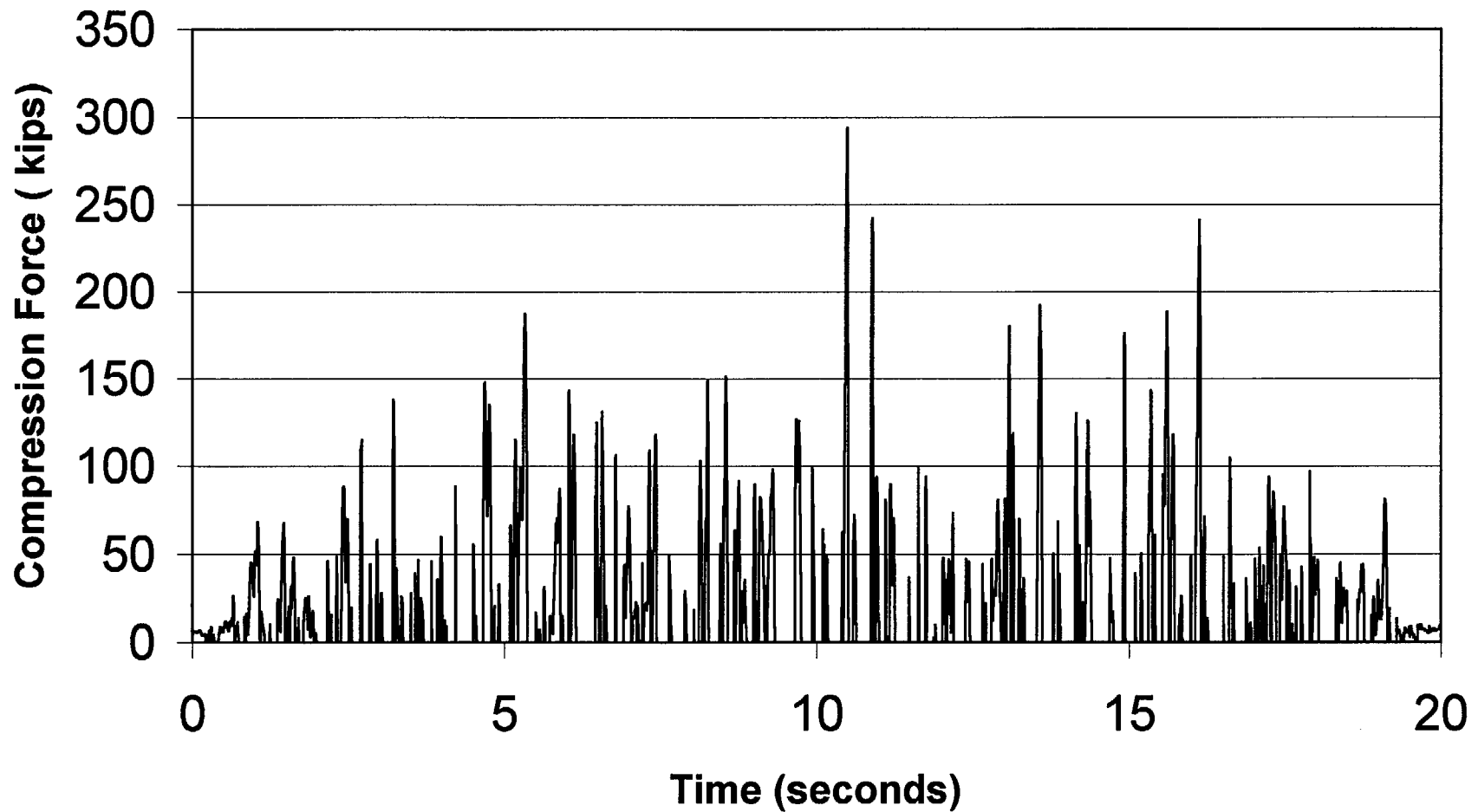
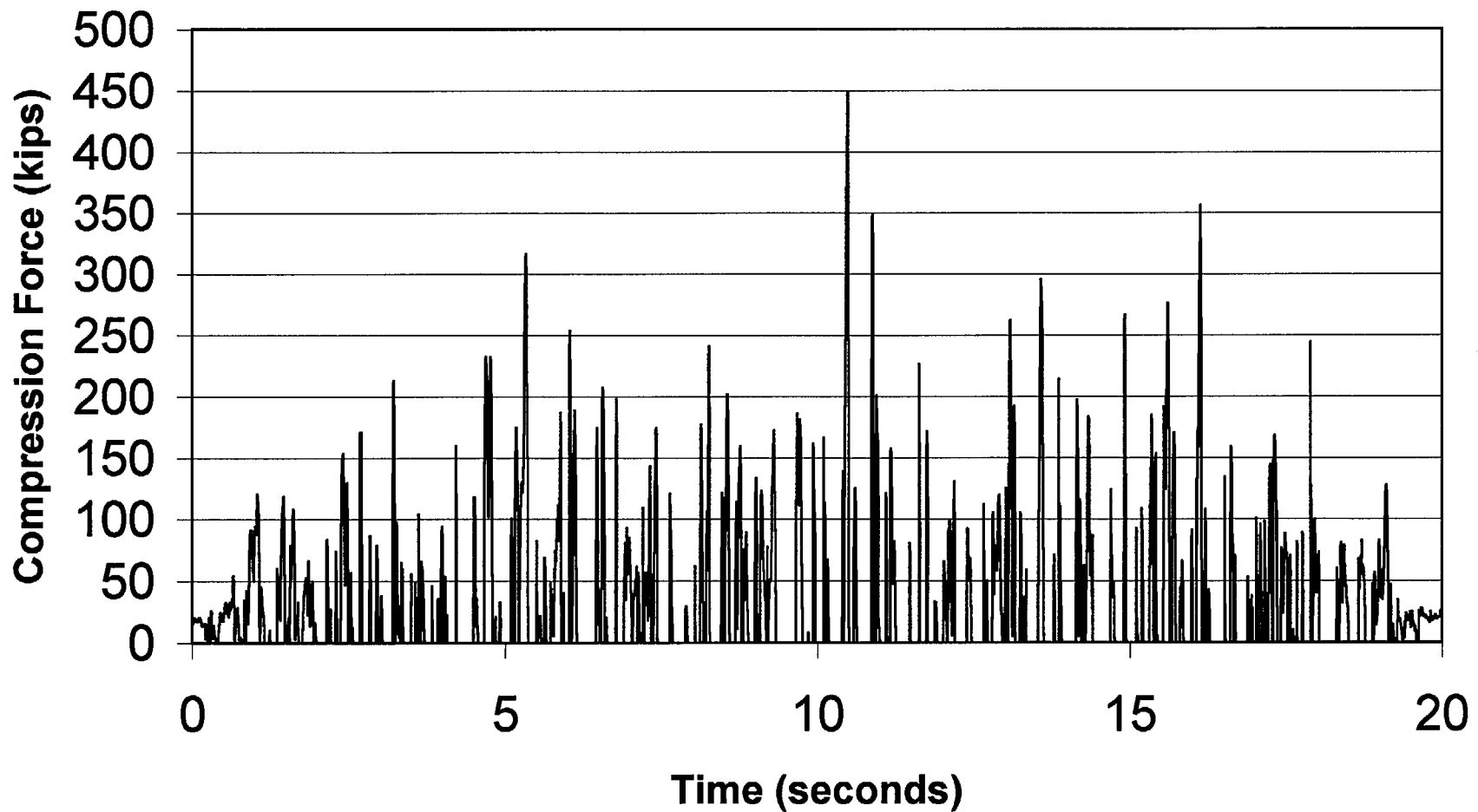


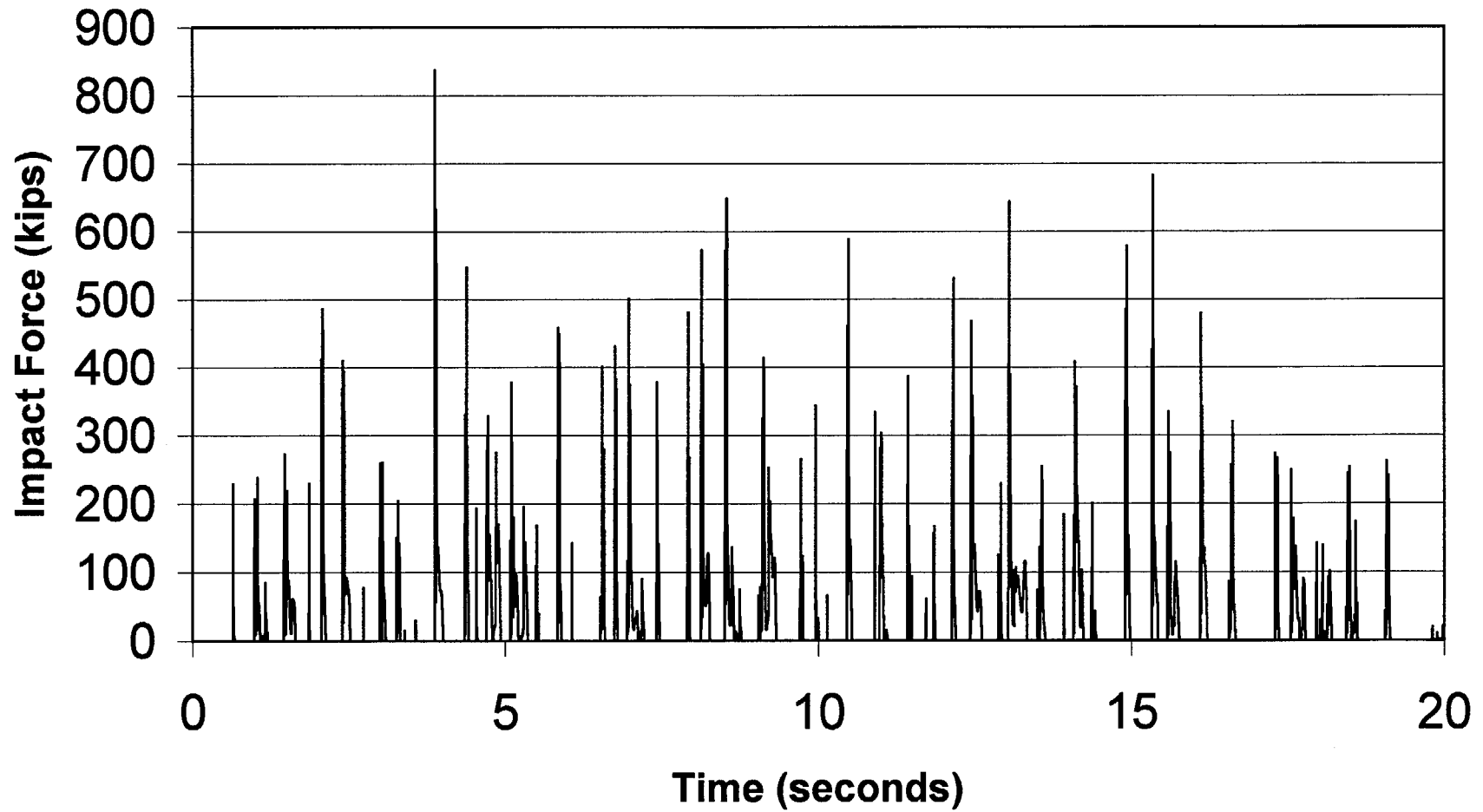
Figure N-5 - Run 250 - HI-STAR 100 - Maximum Compression Force at Any Location vs. Time



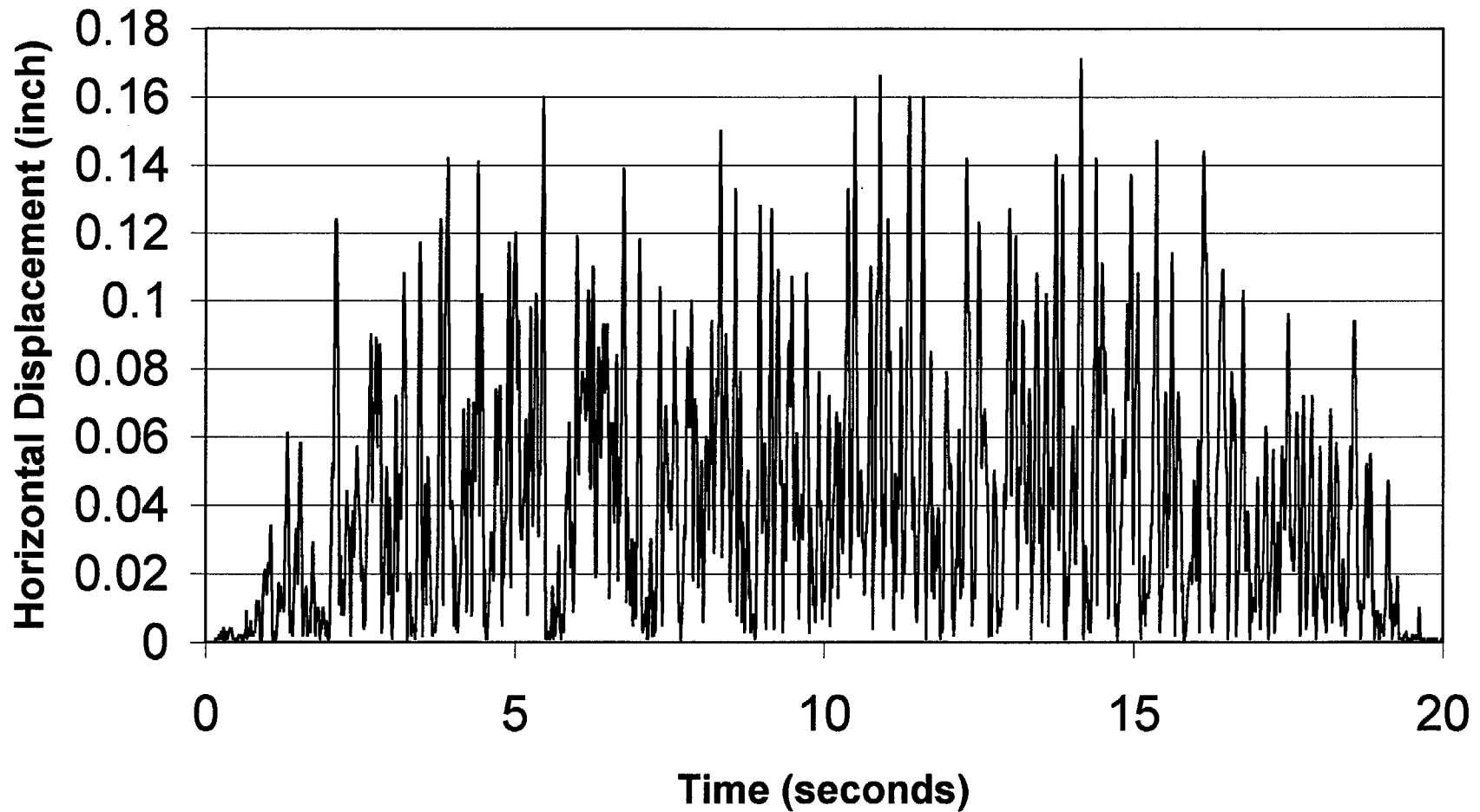
**Figure N-6 - Run 250 - HI-STAR 100 - Maximum
Compression Force on Clevis vs. Time**



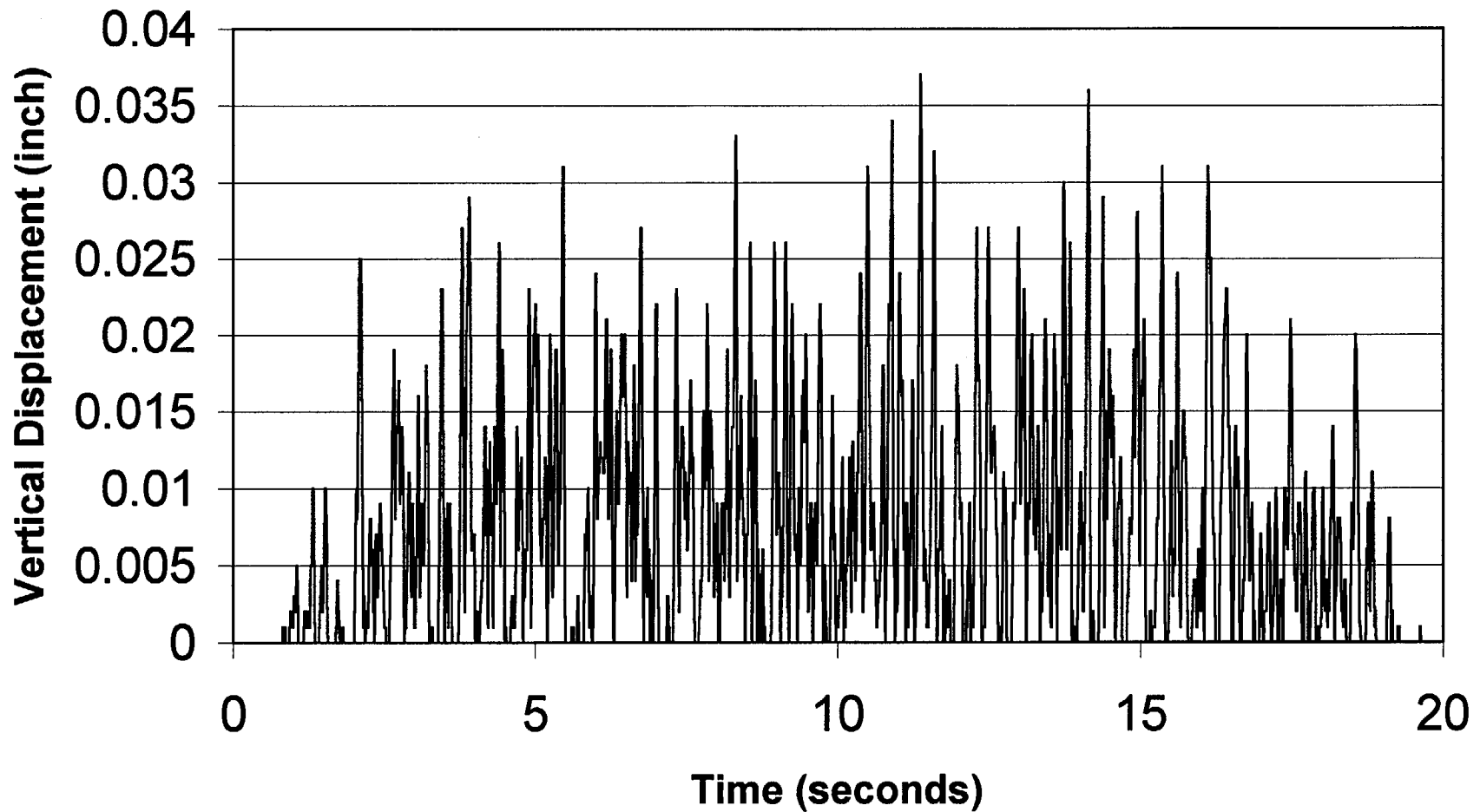
**Figure N-7 - Run 250 - HI-STAR 100 - Net
Overpack-to-MPC Impact Force vs. Time**



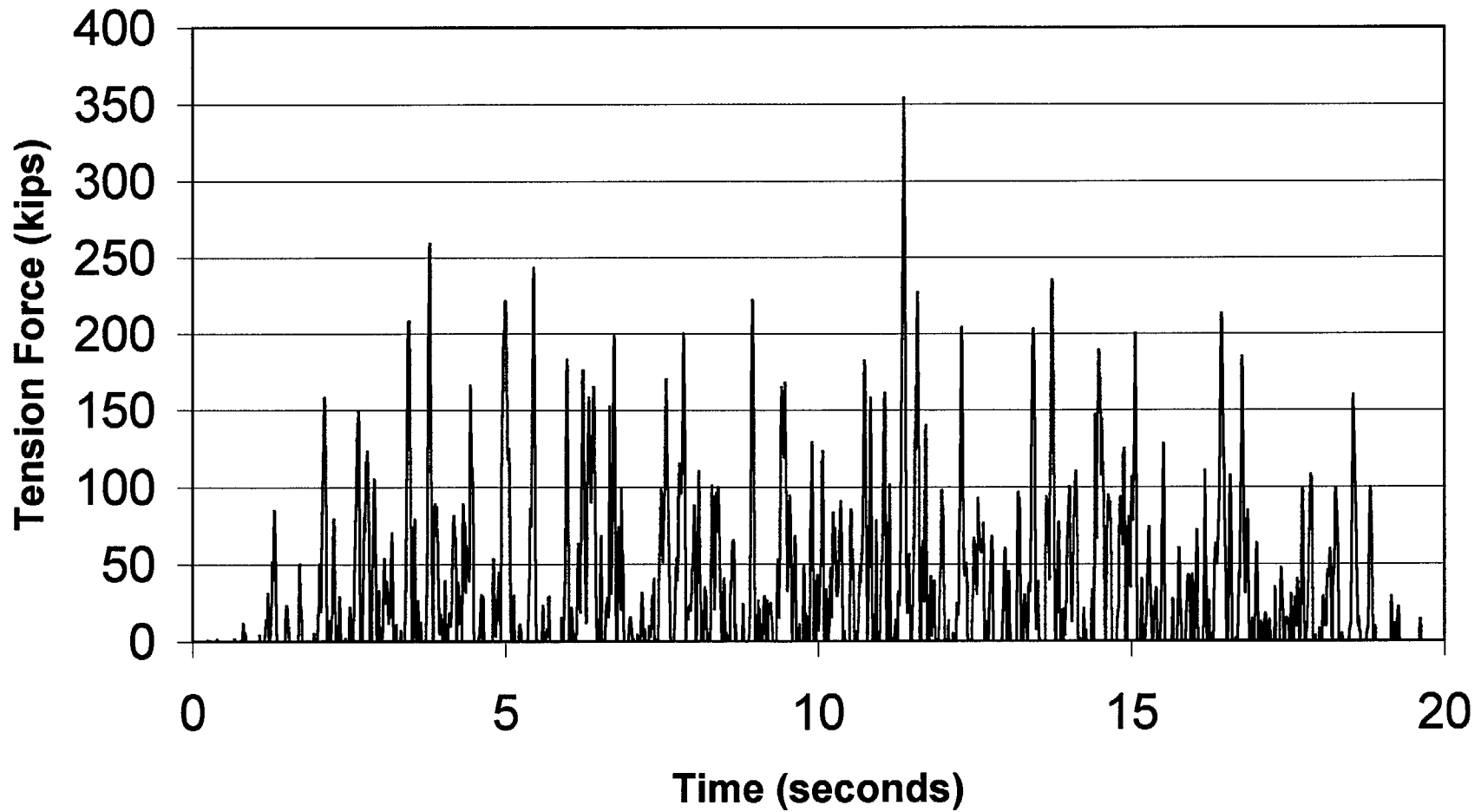
**Figure N-8 - Run 451 - HI-STAR 100 Overpack
Horizontal Displacement vs. Time**



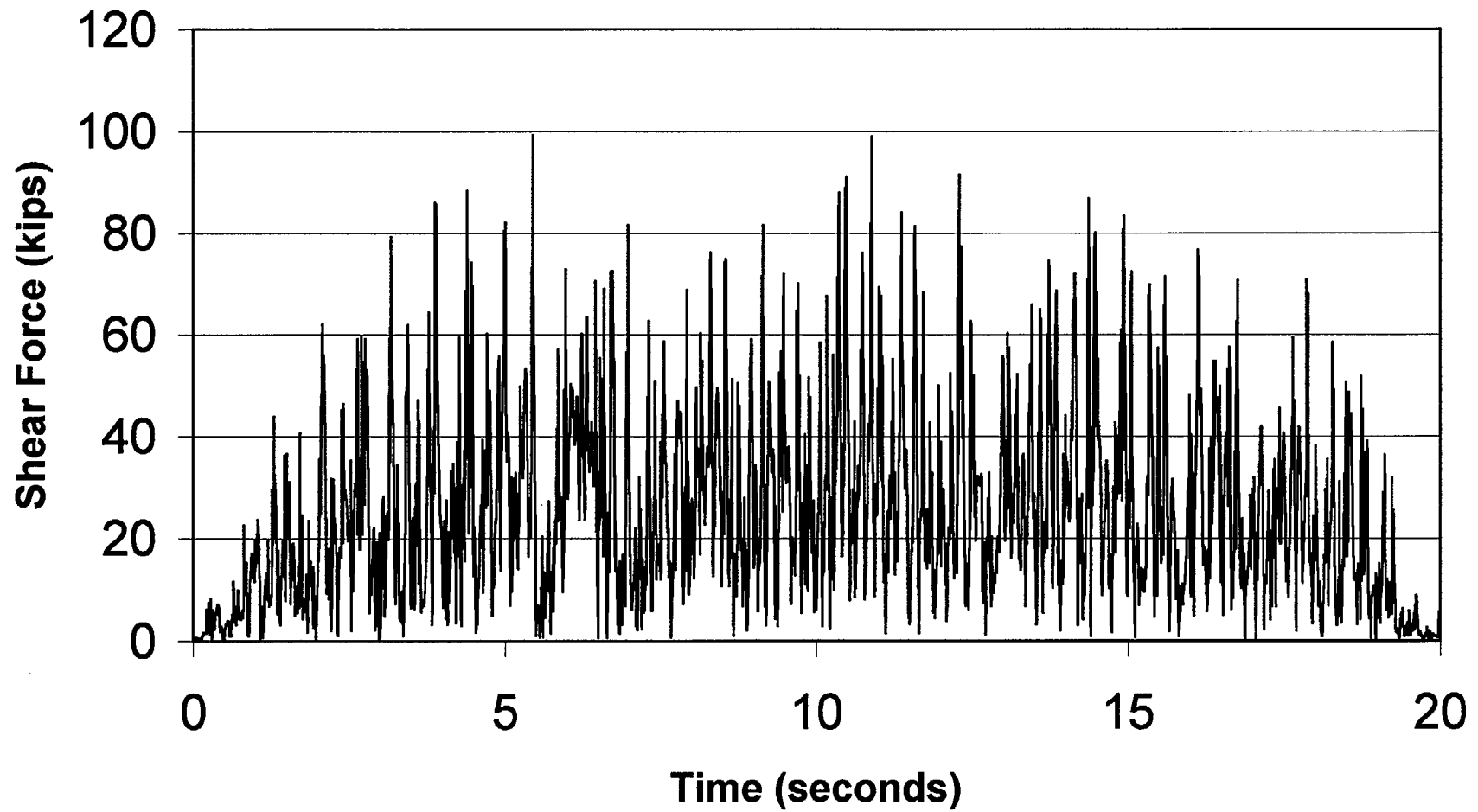
**Figure N-9 - Run 451 - HI-STAR 100 Overpack
Vertical Displacement vs. Time**



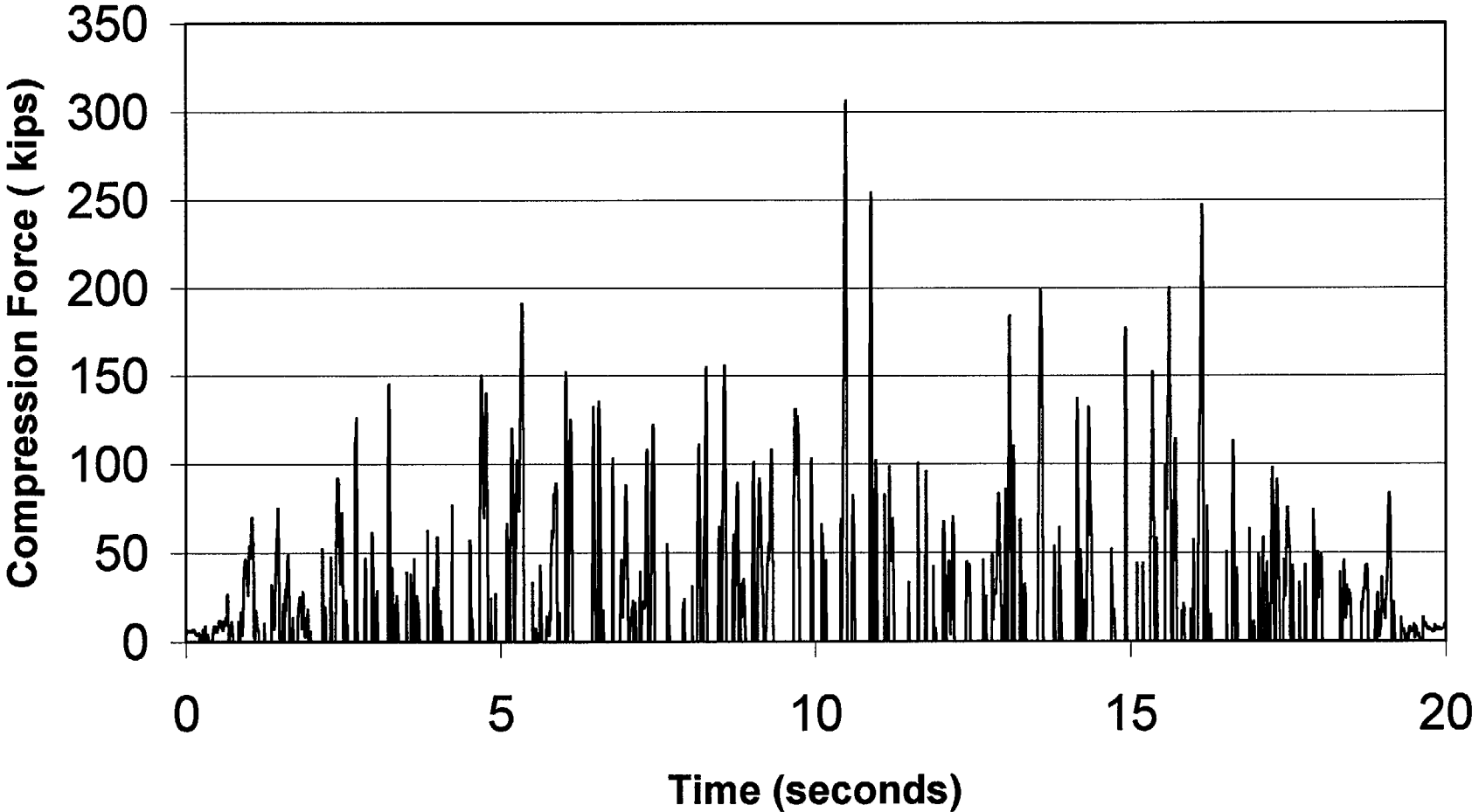
**Figure N-10 - Run 451 - HI-STAR 100 - Maximum
Clevis Bolt Tension vs. Time**



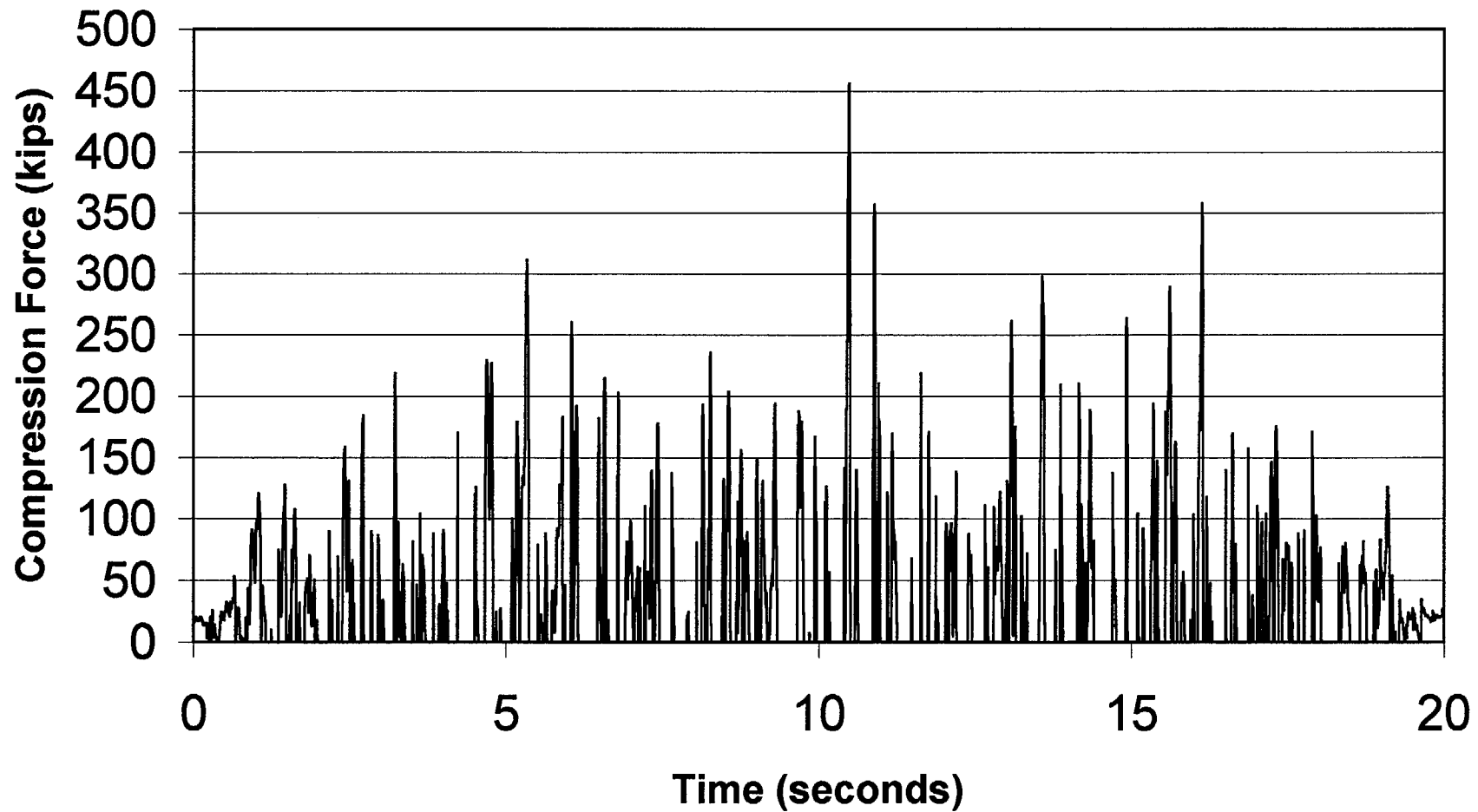
**Figure N-11 - Run 451 - HI-STAR 100 - Maximum
Clevis Bolt Net Shear vs. Time**



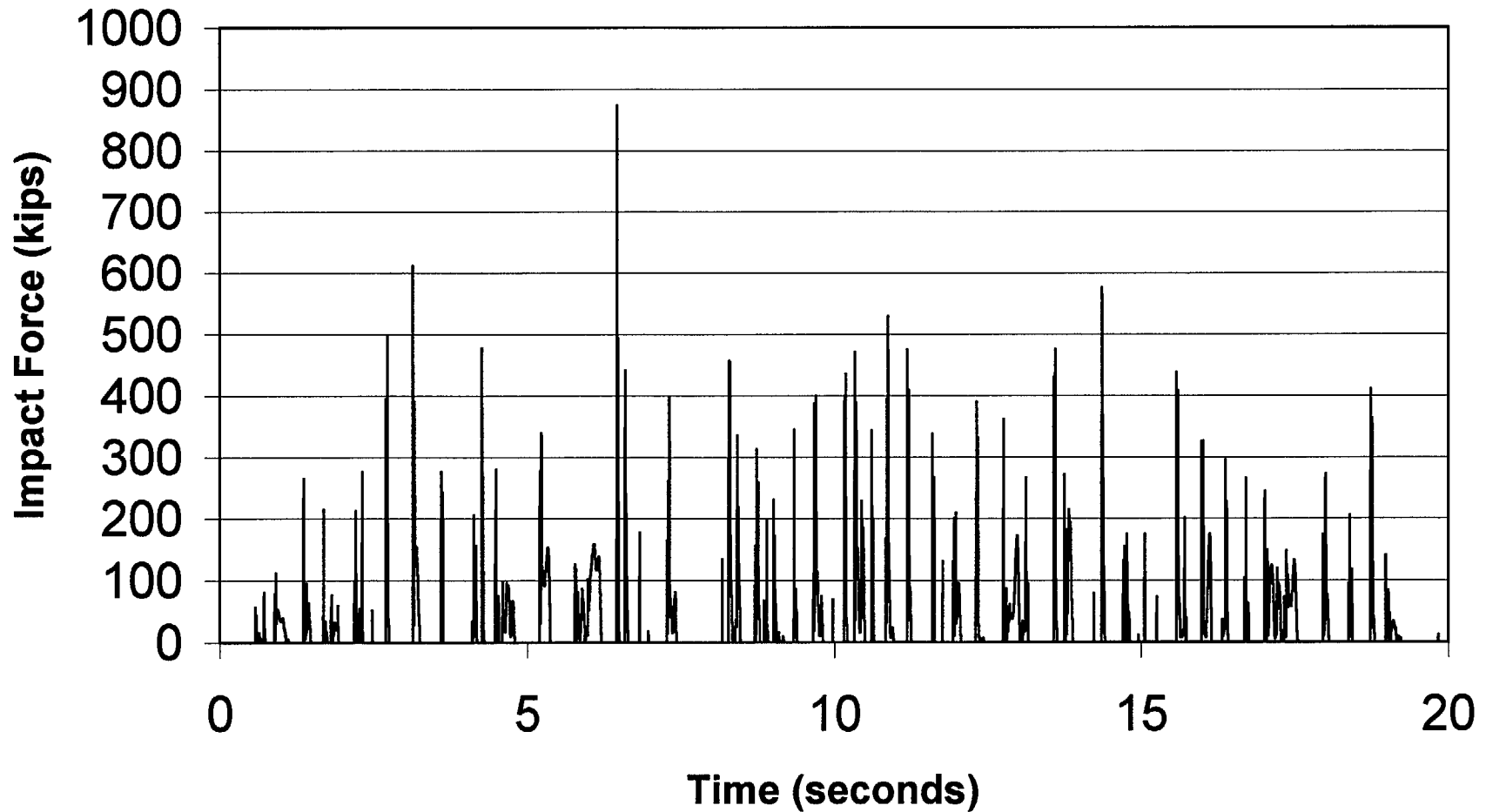
**Figure N-12 - Run 451 - HI-STAR 100 - Maximum
Compression Force at Any Location vs. Time**



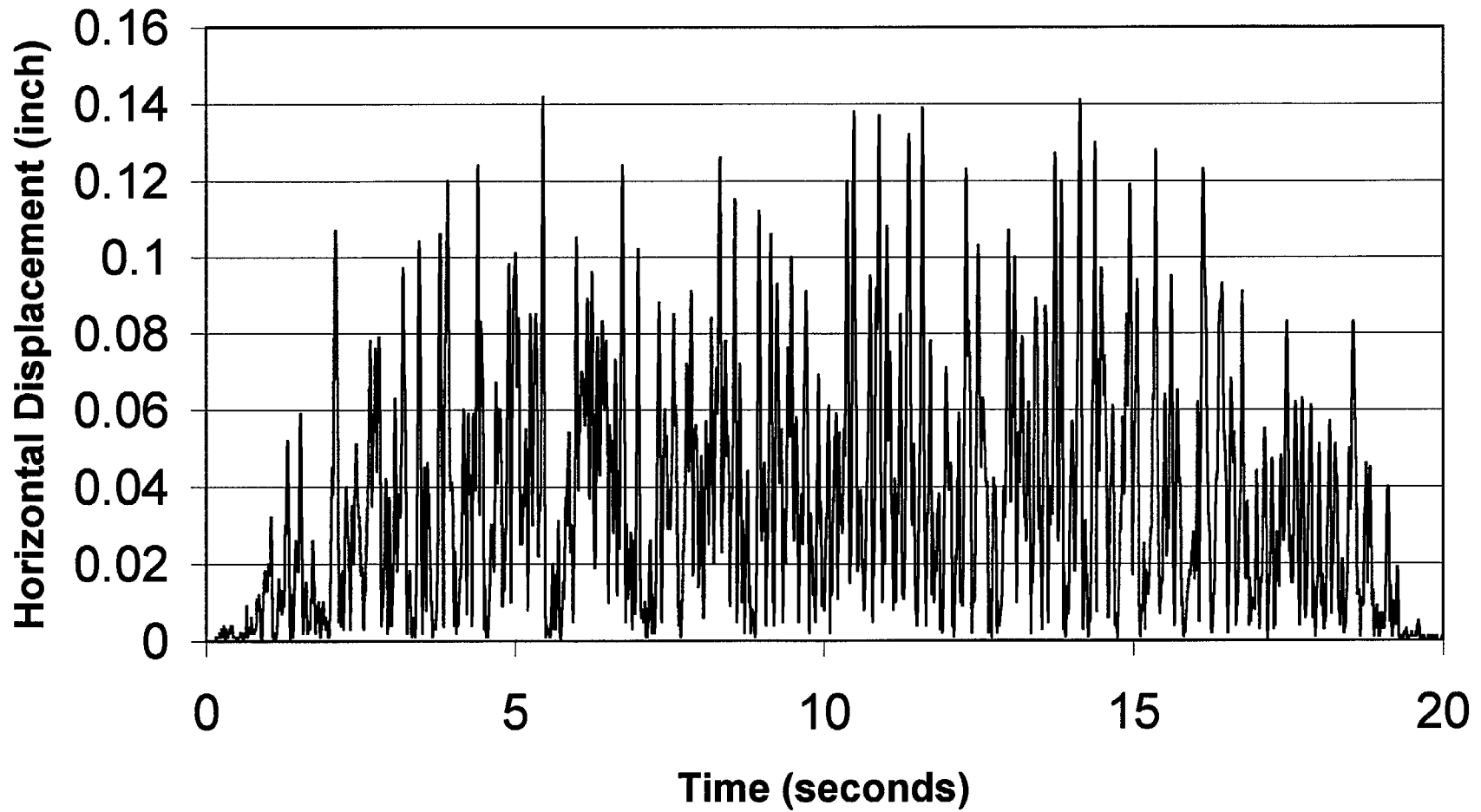
**Figure N-13 - Run 451 - HI-STAR 100 - Maximum
Compression Force on Clevis vs. Time**



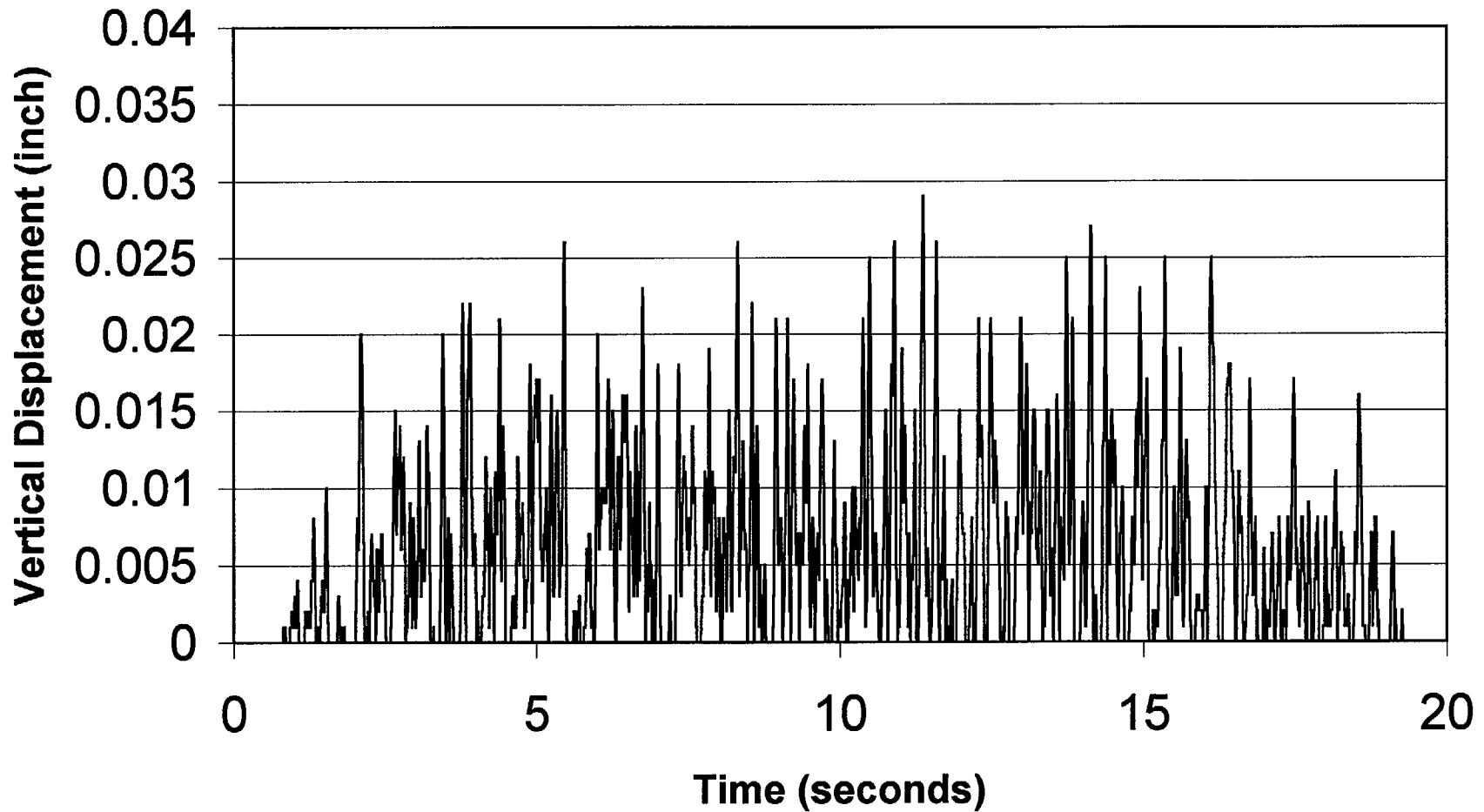
**Figure N-14 - Run 451 - HI-STAR 100 - Net
Overpack-to-MPC Impact Force vs. Time**



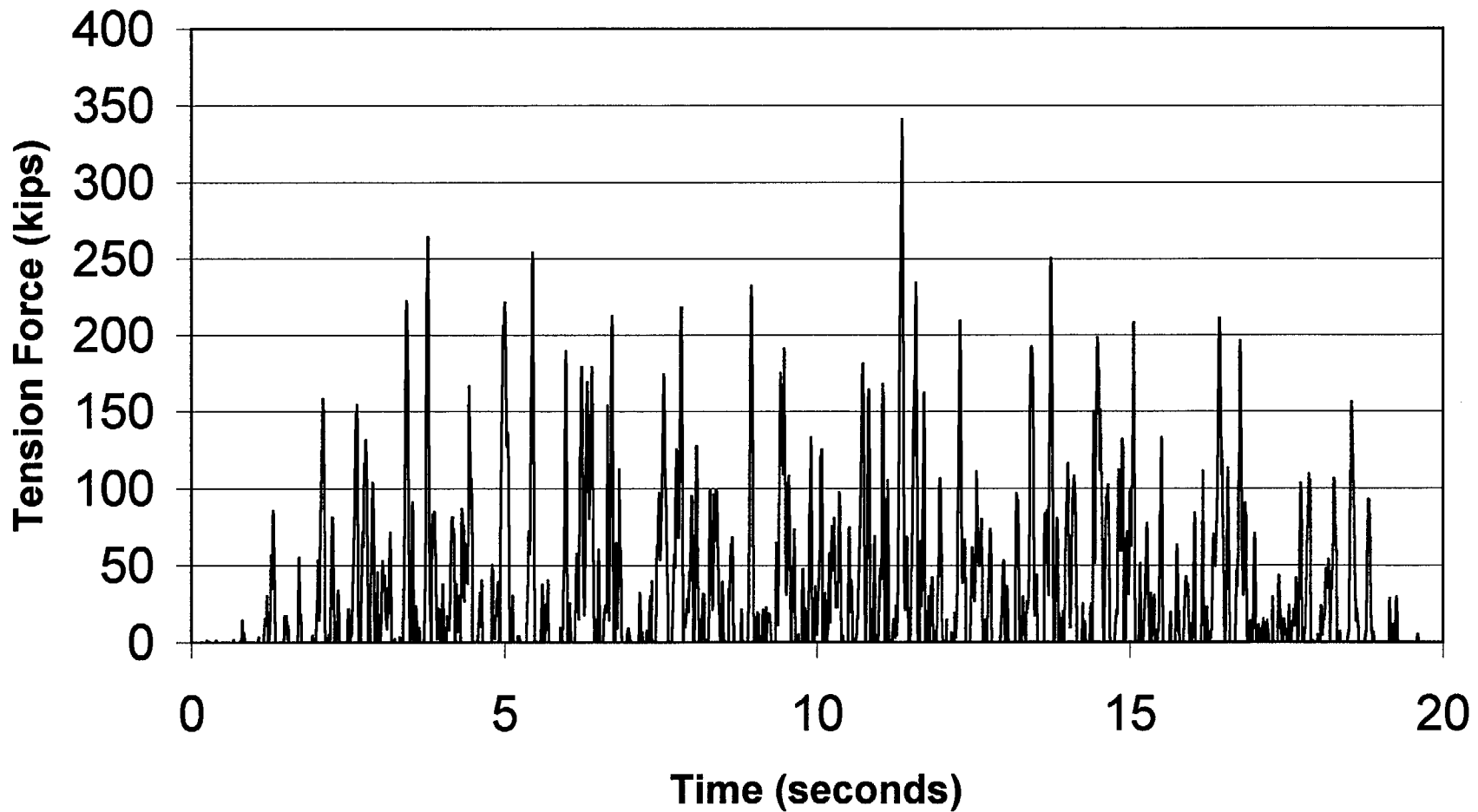
**Figure N-15 - Run 452 - HI-STAR 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-16 - Run 452 - HI-STAR 100 Overpack
Vertical Displacement vs. Time**



**Figure N-17 - Run 452 - HI-STAR 100 - Maximum
Clevis Bolt Tension vs. Time**



**Figure N-18 - Run 452 - HI-STAR 100 - Maximum
Clevis Bolt Net Shear vs. Time**

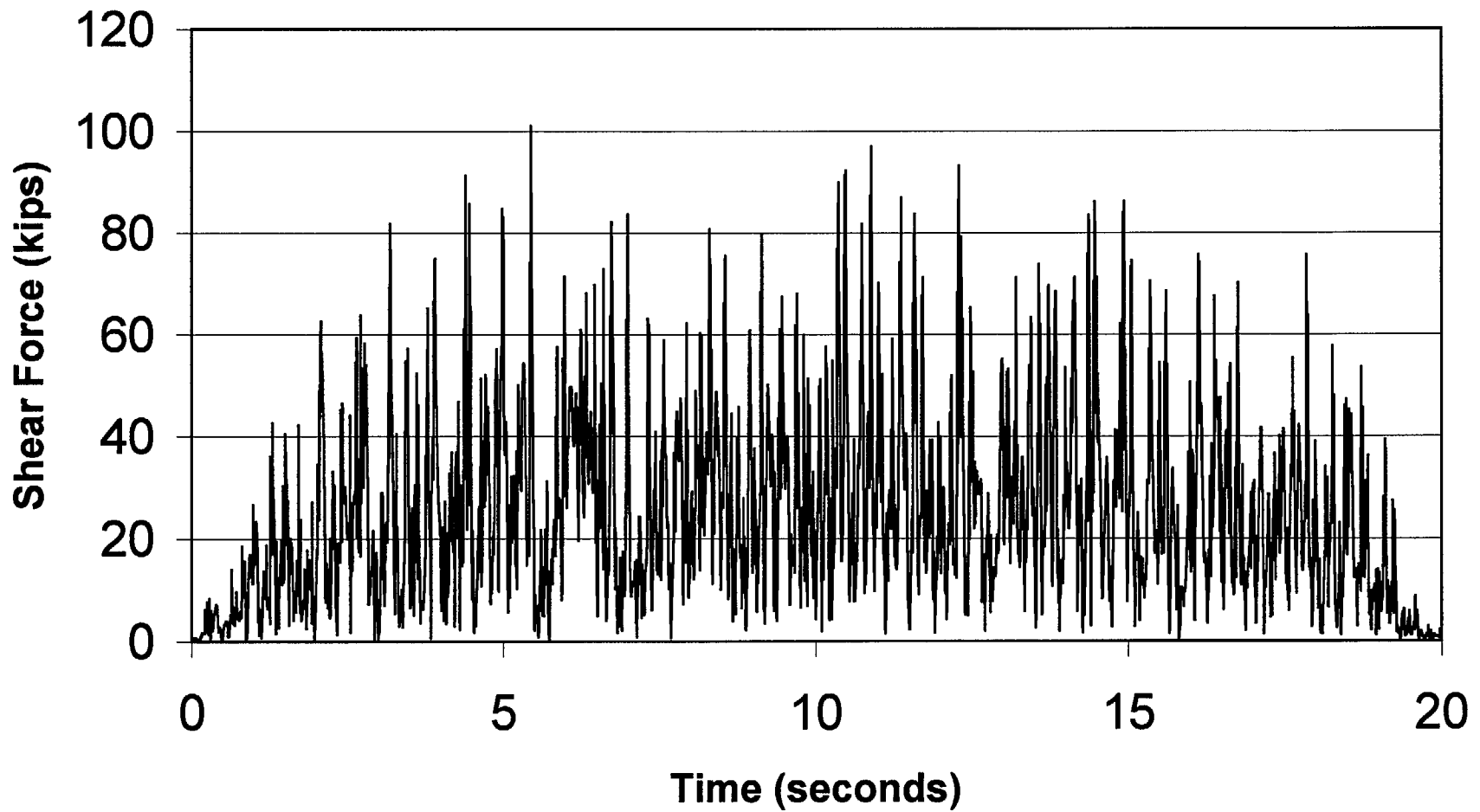
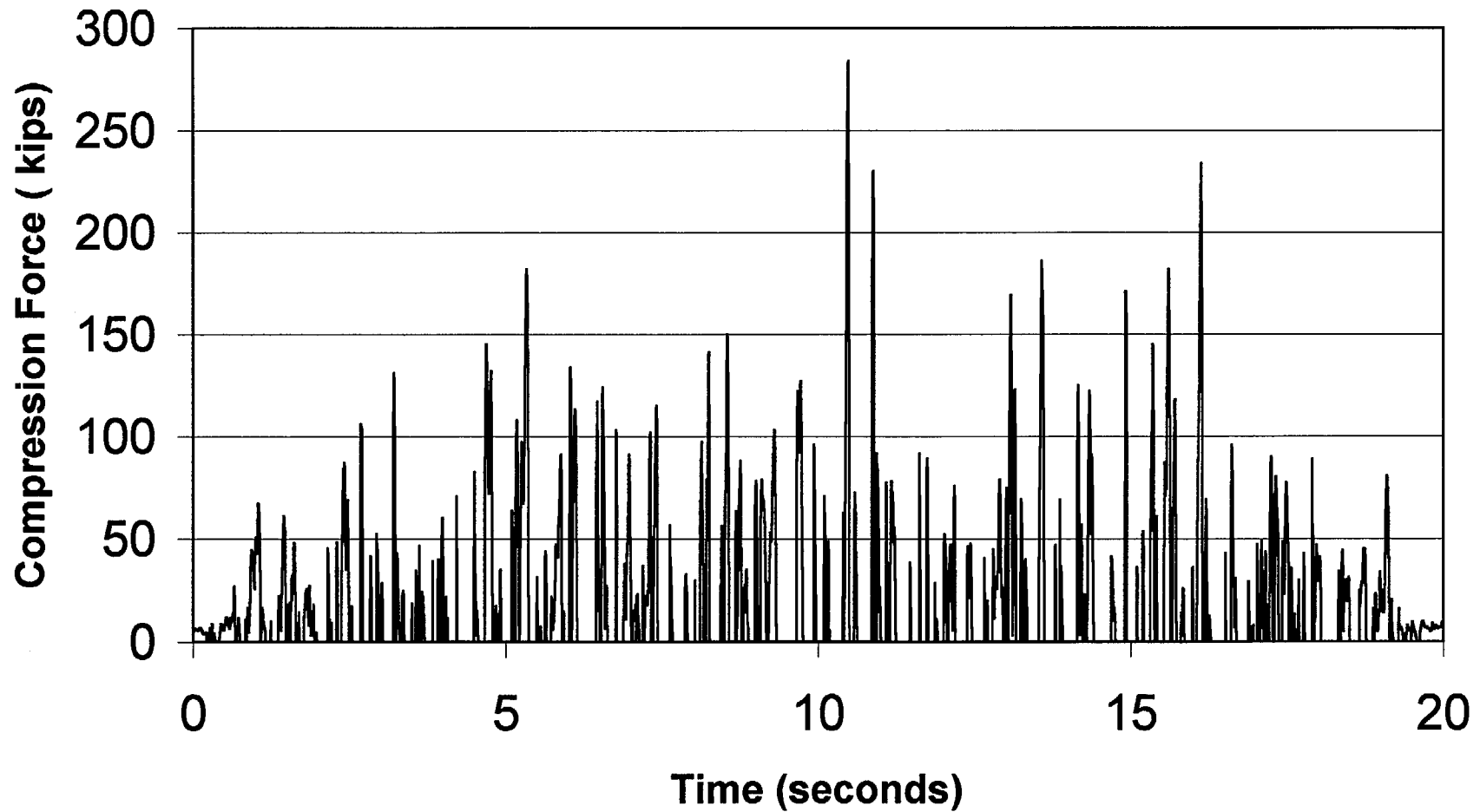
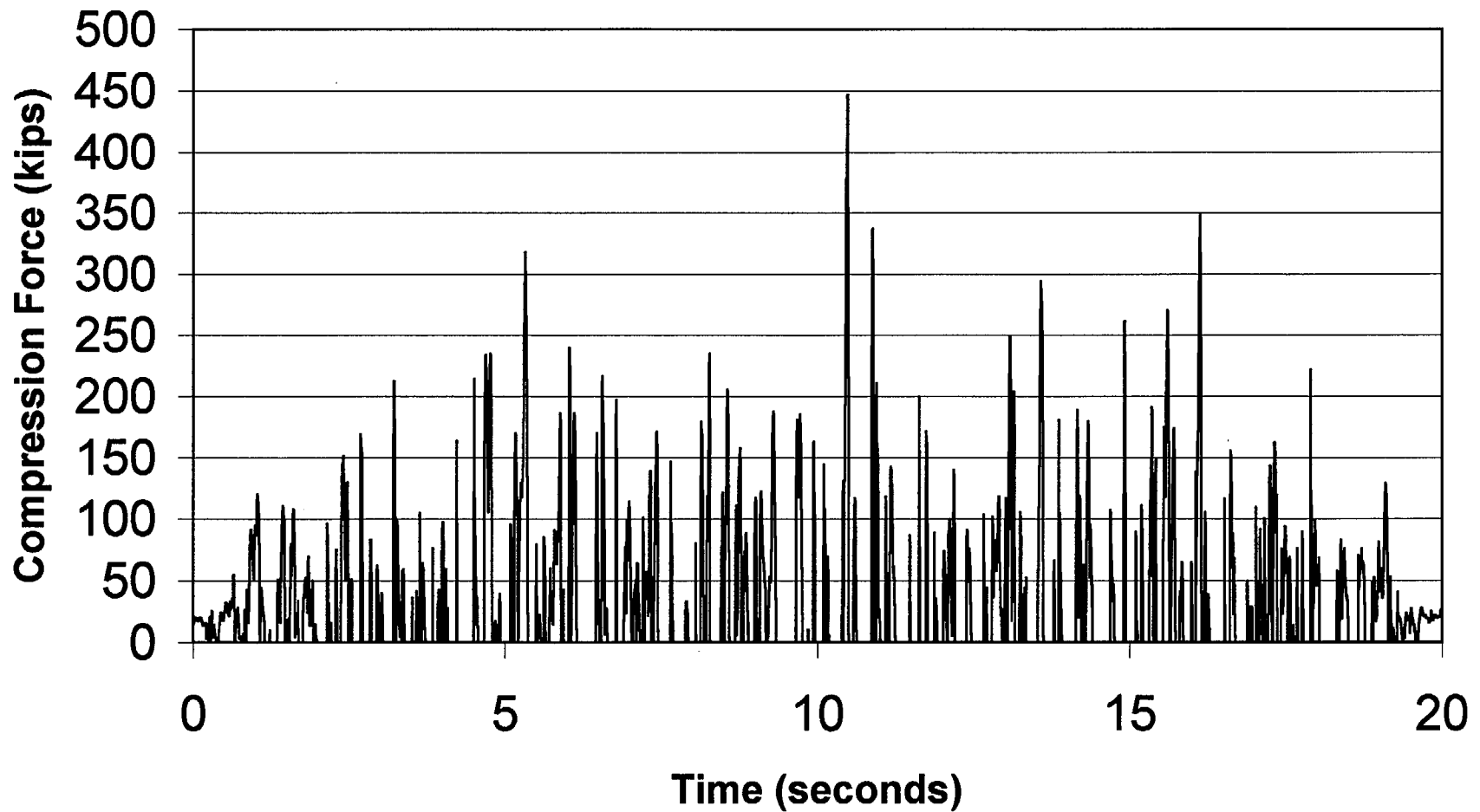


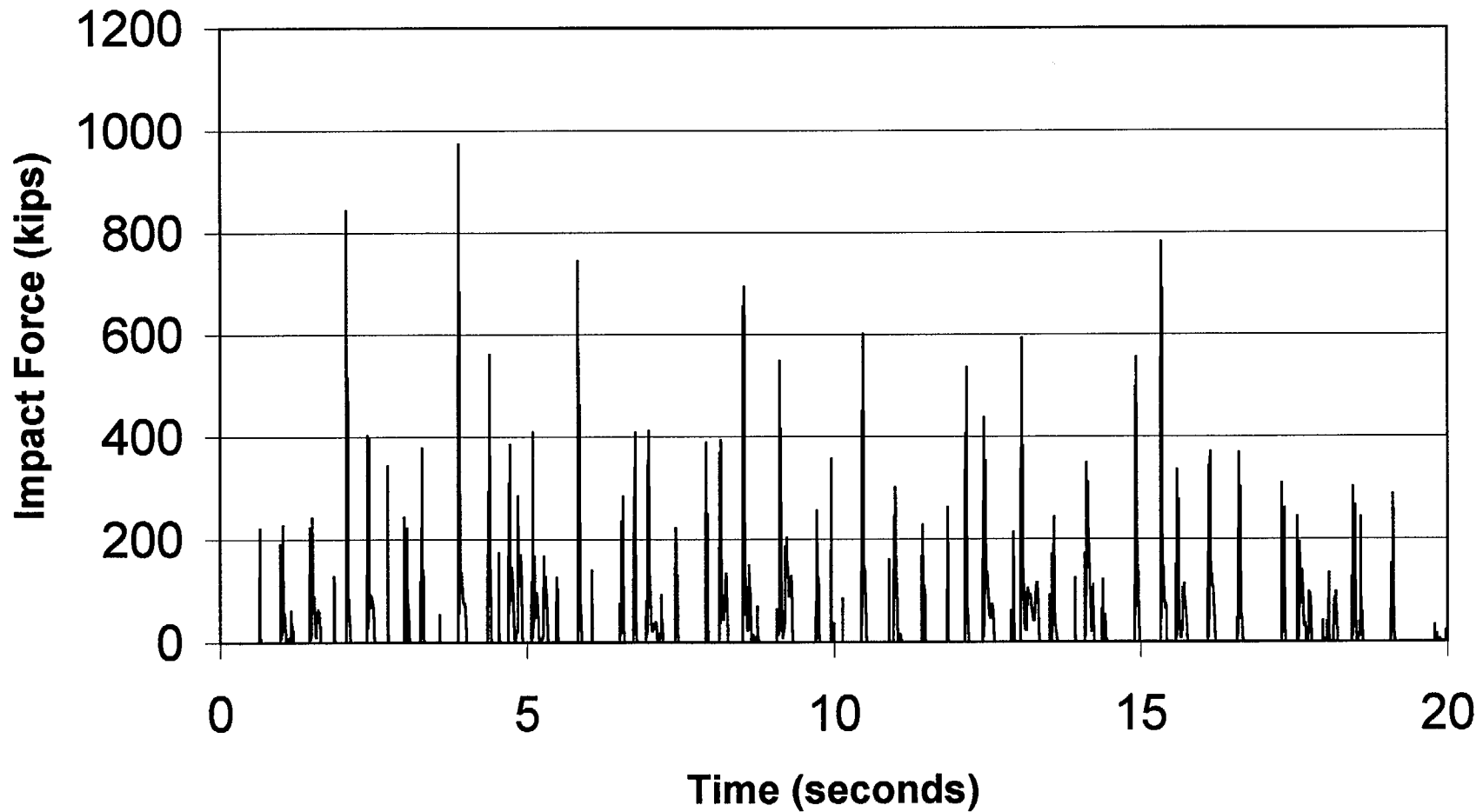
Figure N-19 - Run 452 - HI-STAR 100 - Maximum Compression Force at Any Location vs. Time



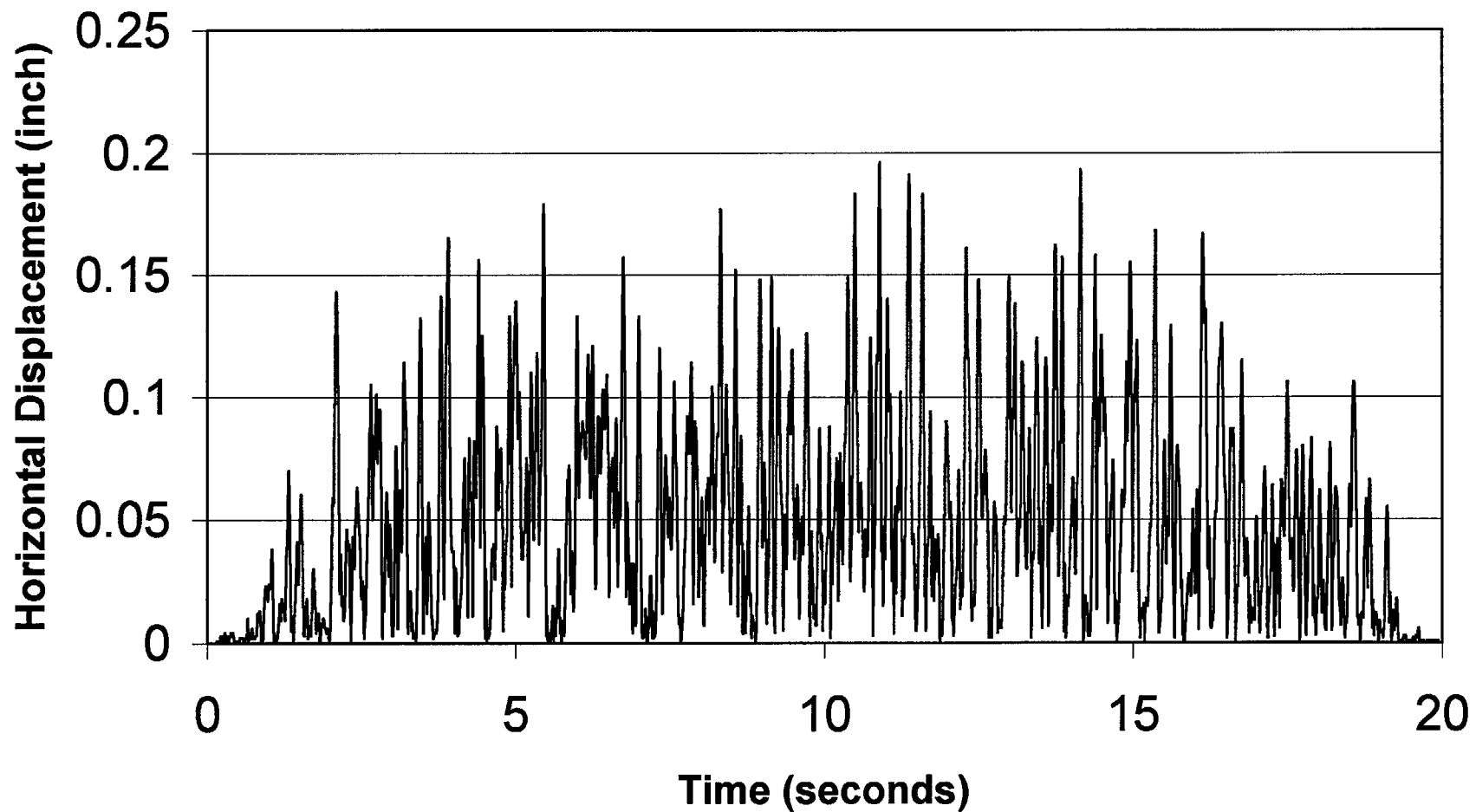
**Figure N-20 - Run 452 - HI-STAR 100 - Maximum
Compression Force on Clevis vs. Time**



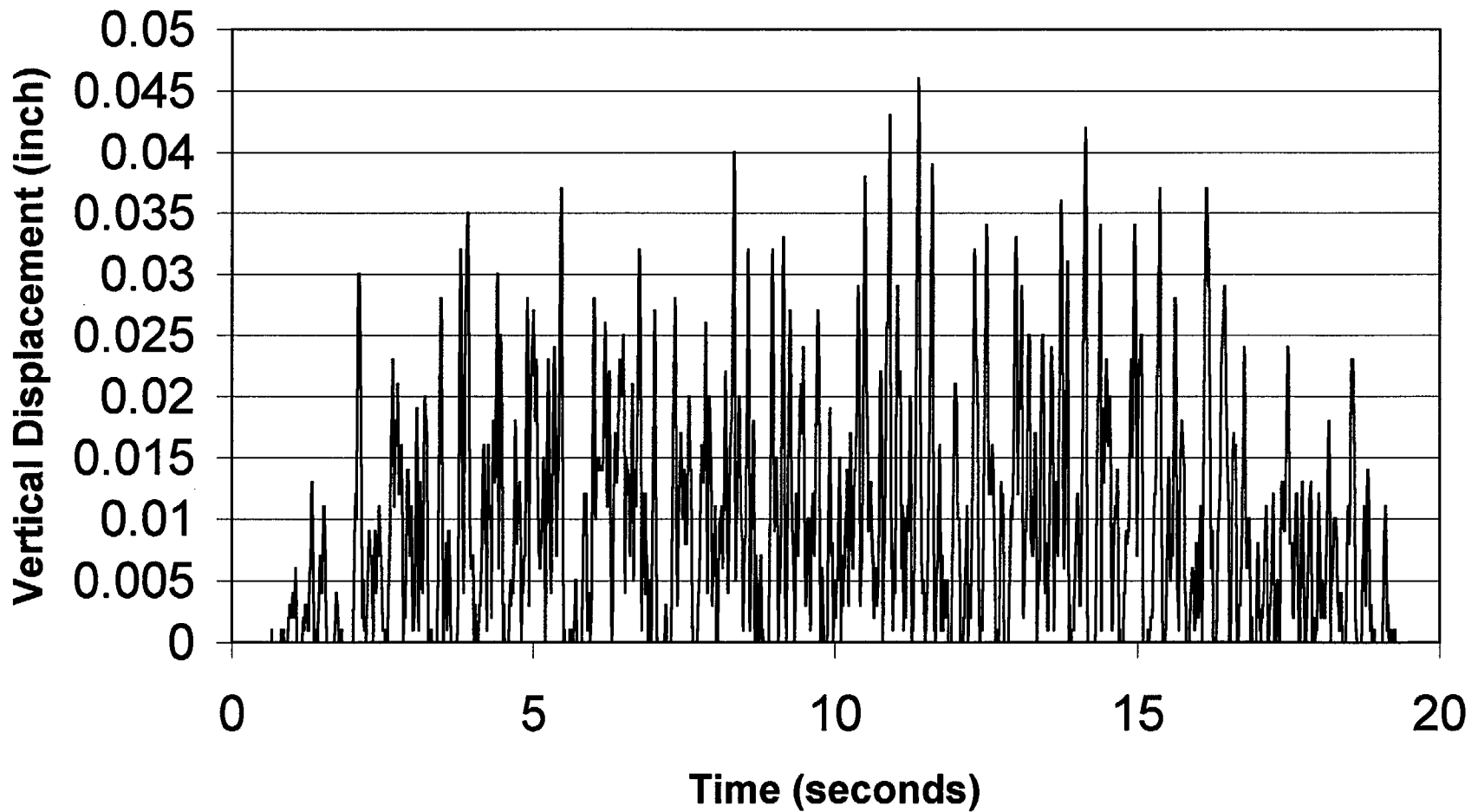
**Figure N-21 - Run 452 - HI-STAR 100 - Net
Overpack-to-MPC Impact Force vs. Time**



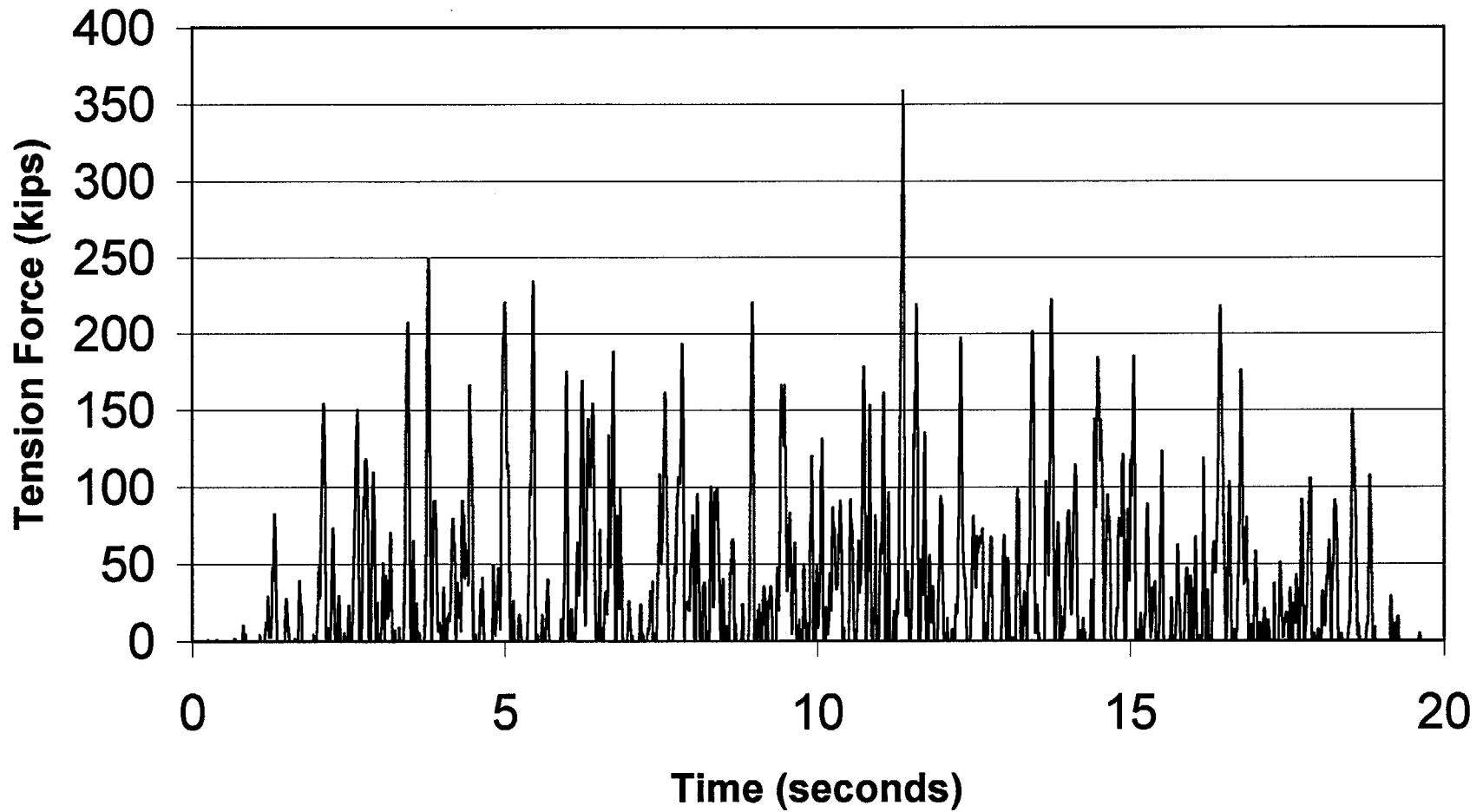
**Figure N-22 - Run 551 - HI-STAR 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-23 - Run 551 - HI-STAR 100 Overpack
Vertical Displacement vs. Time**



**Figure N-24 - Run 551 - HI-STAR 100 - Maximum
Clevis Bolt Tension vs. Time**



**Figure N-25 - Run 551 - HI-STAR 100 - Maximum
Clevis Bolt Net Shear vs. Time**

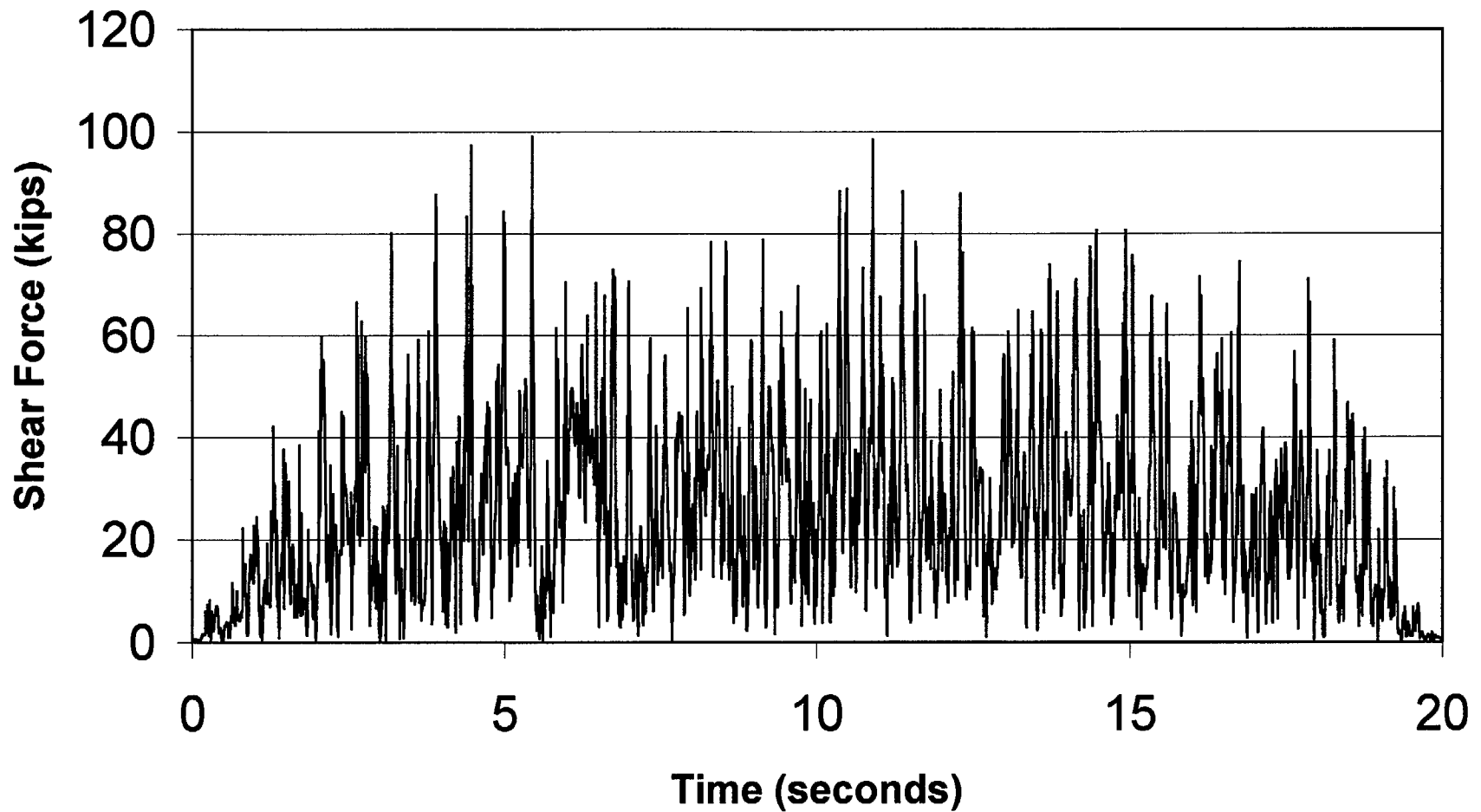
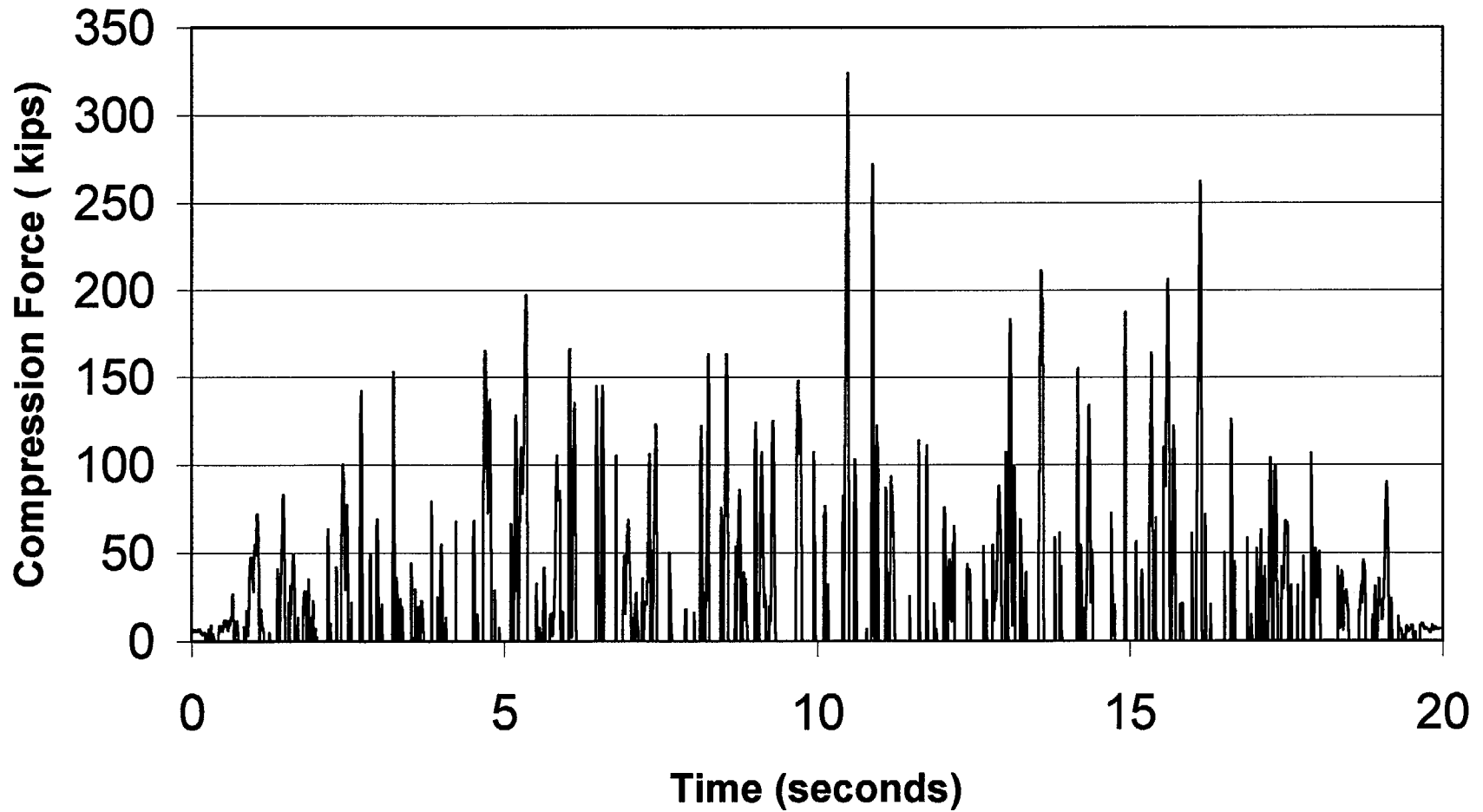
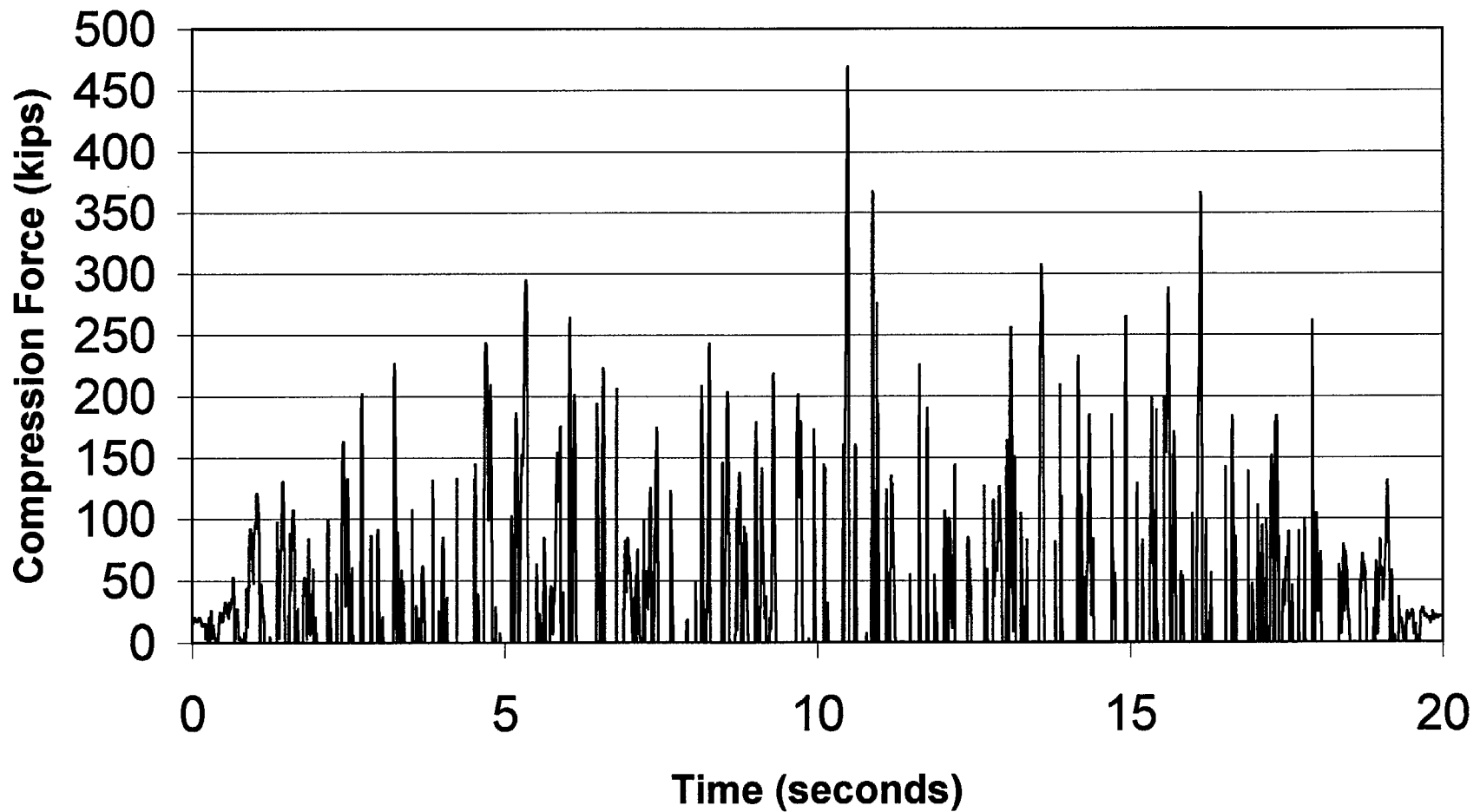


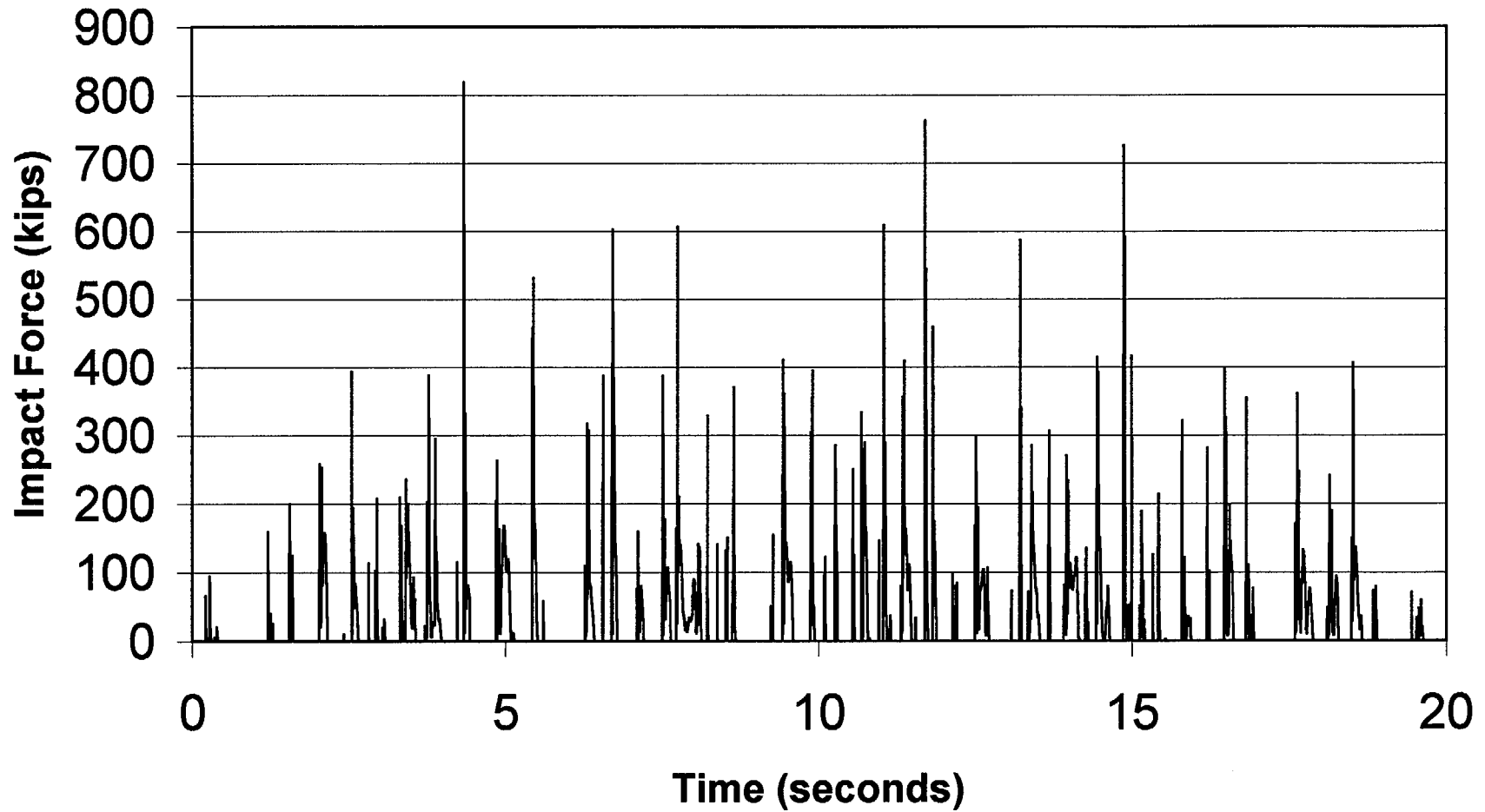
Figure N-26 - Run 551 - HI-STAR 100 - Maximum Compression Force at Any Location vs. Time



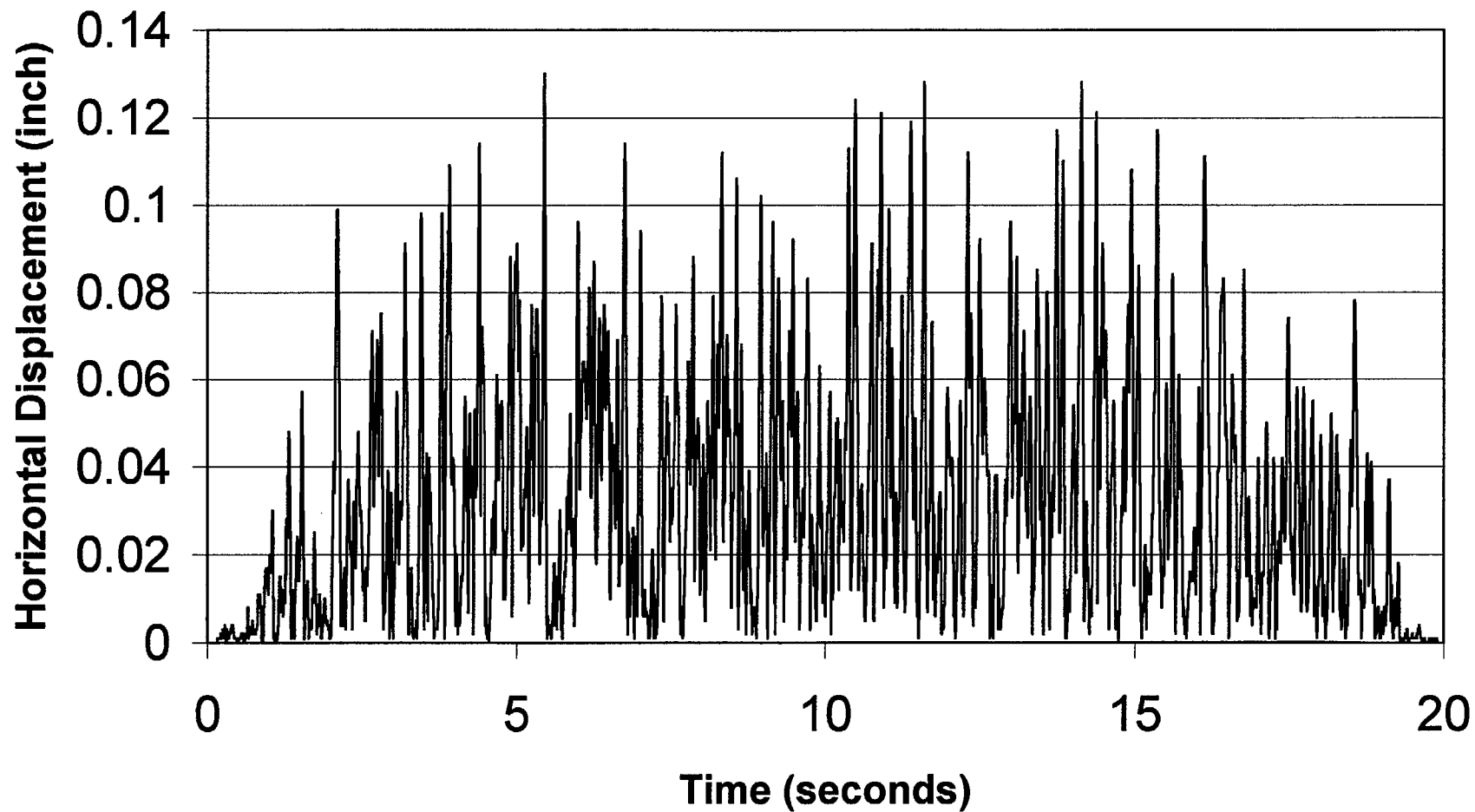
**Figure N-27 - Run 551 - HI-STAR 100 - Maximum
Compression Force on Clevis vs. Time**



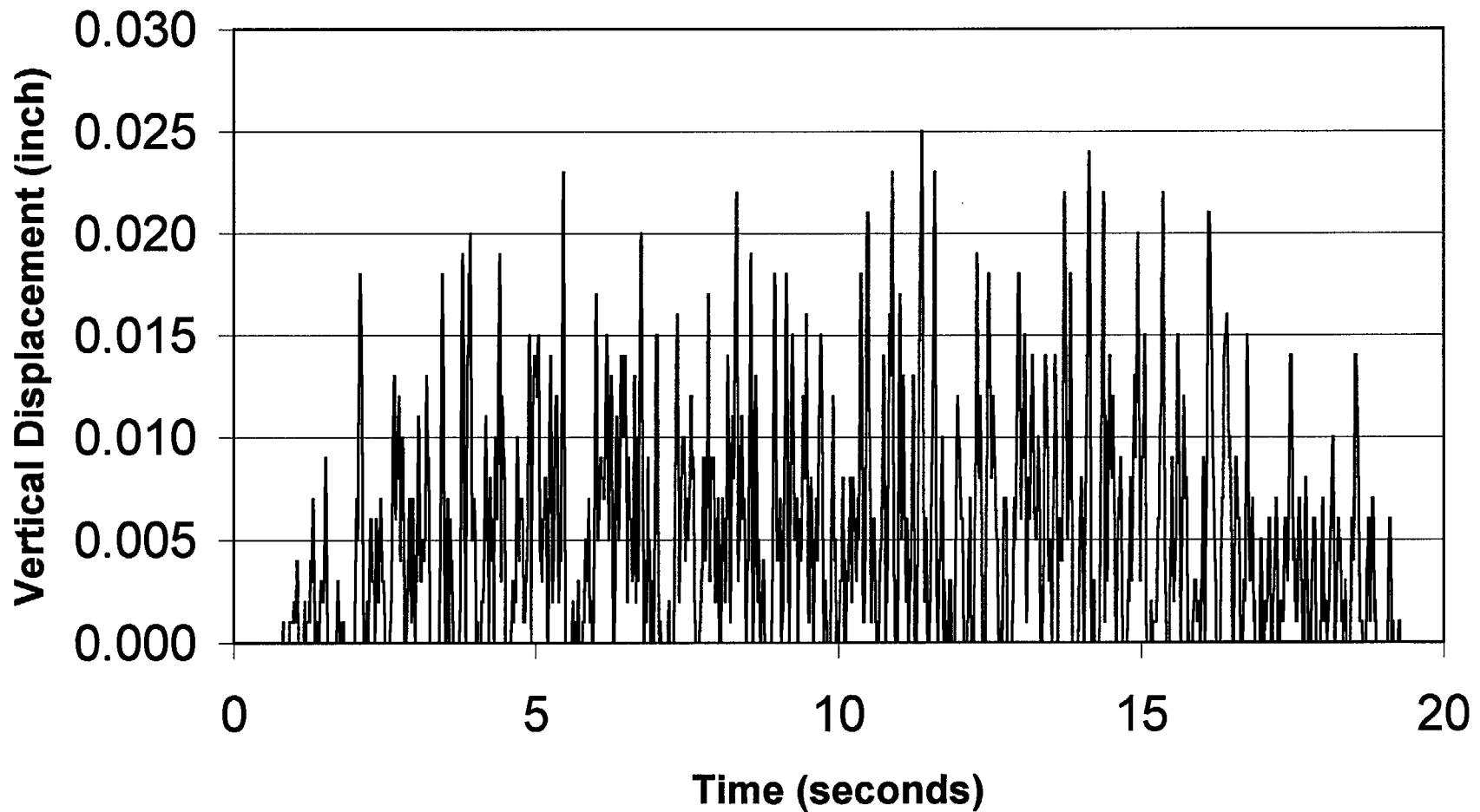
**Figure N-28 - Run 551 - HI-STAR 100 - Net
Overpack-to-MPC Impact Force vs. Time**



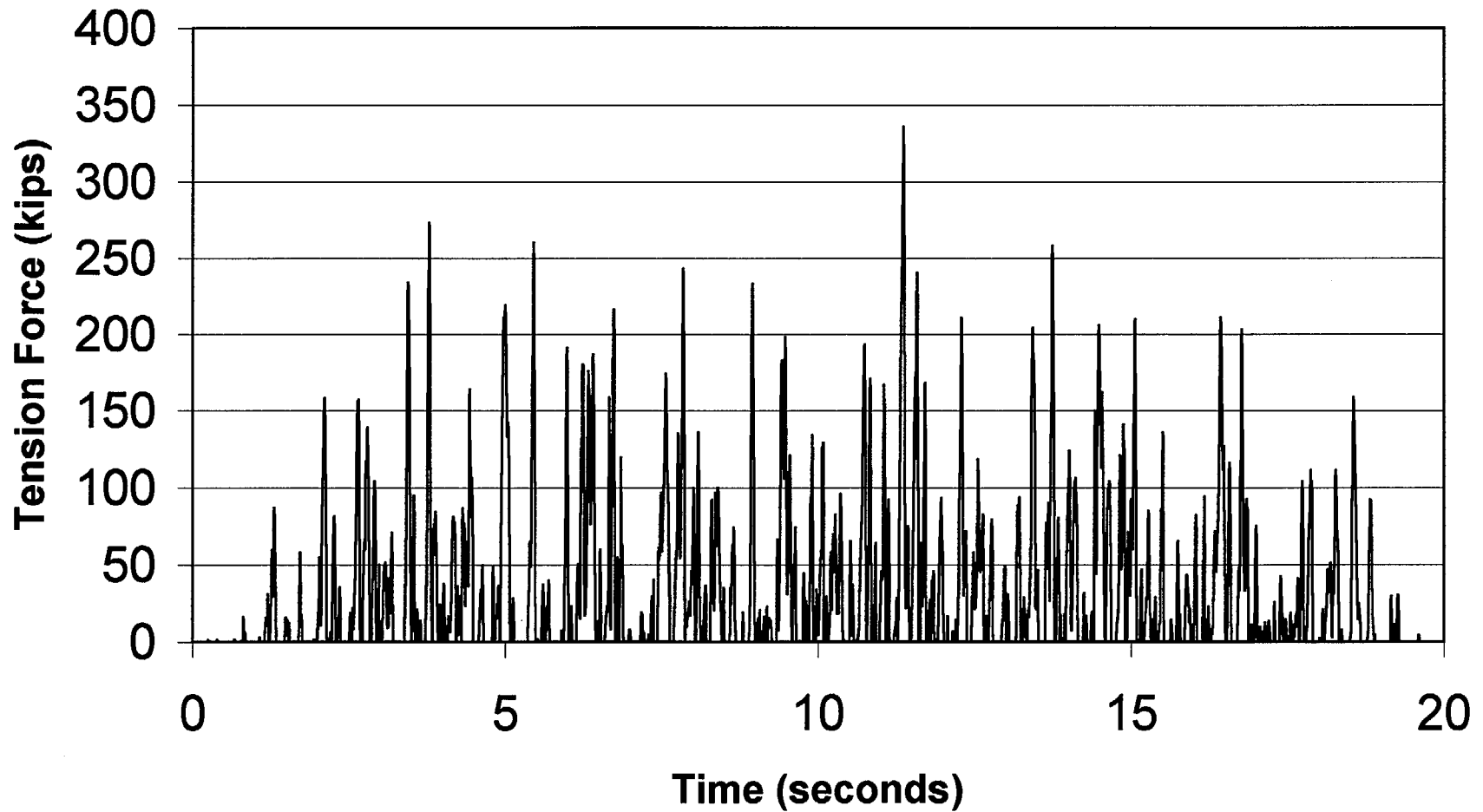
**Figure N-29 - Run 552 - HI-STAR 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-30 - Run 552 - HI-STAR 100 Overpack
Vertical Displacement vs. Time**



**Figure N-31 - Run 552 - HI-STAR 100 - Maximum
Clevis Bolt Tension vs. Time**



**Figure N-32 - Run 552 - HI-STAR 100 - Maximum
Clevis Bolt Net Shear vs. Time**

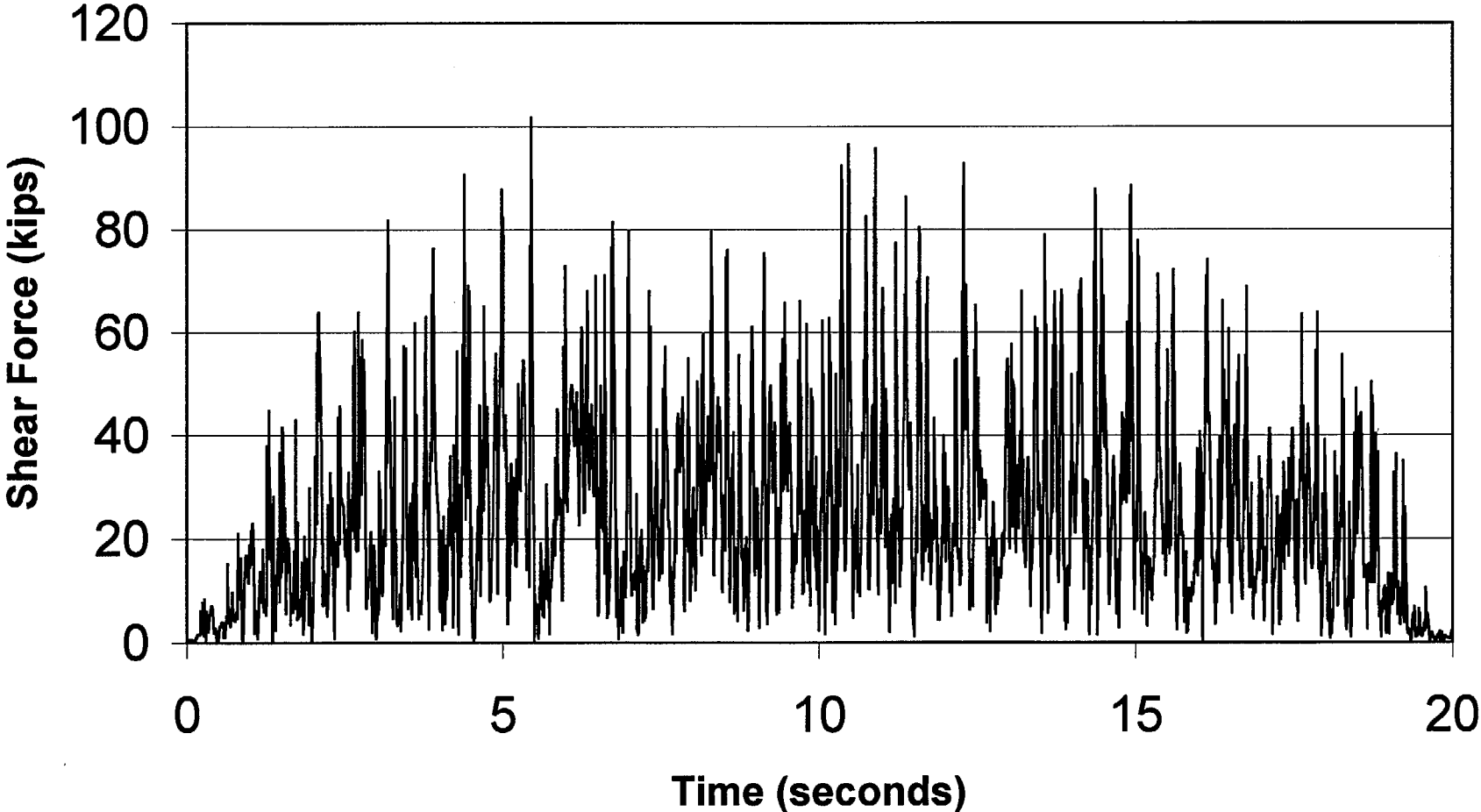
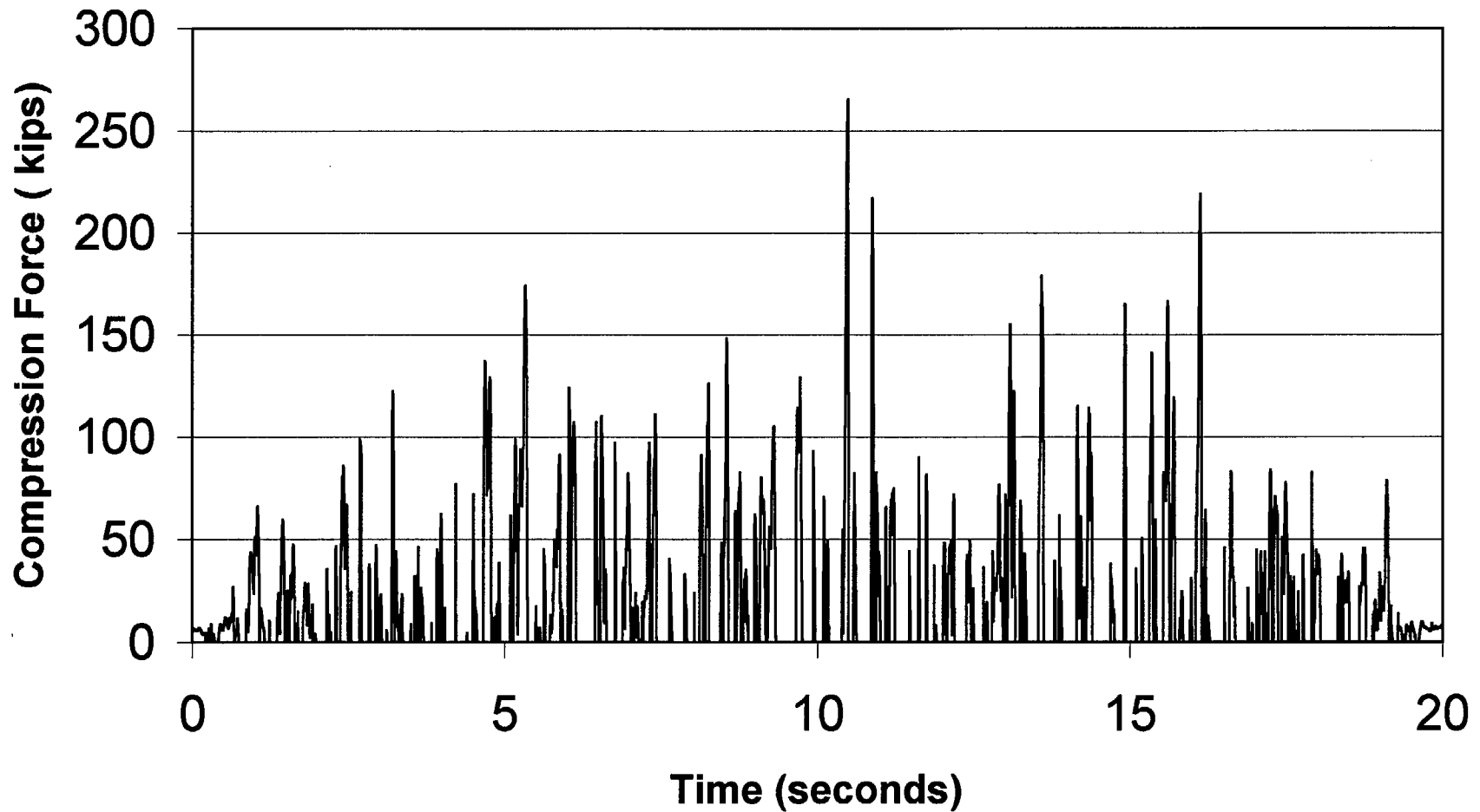
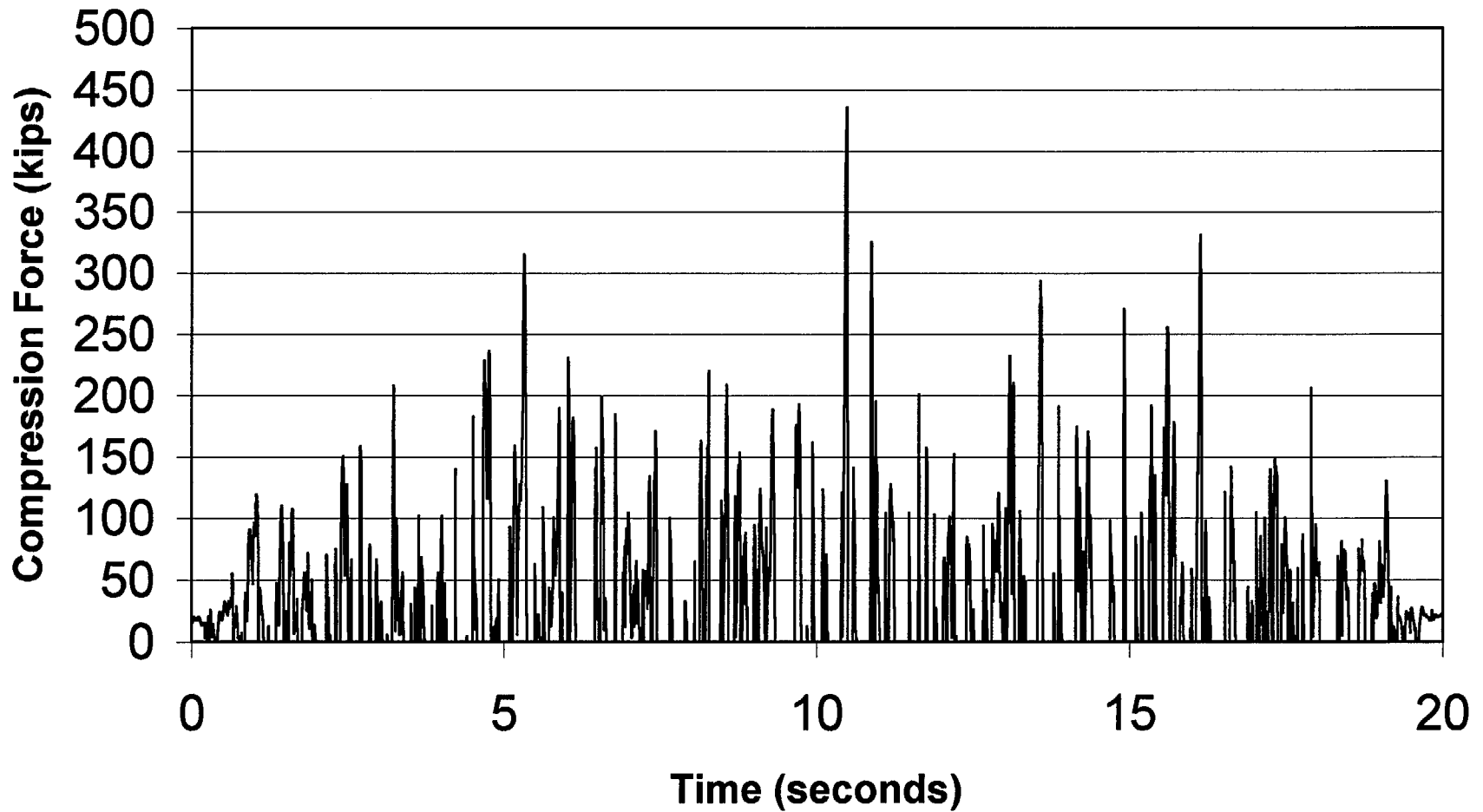


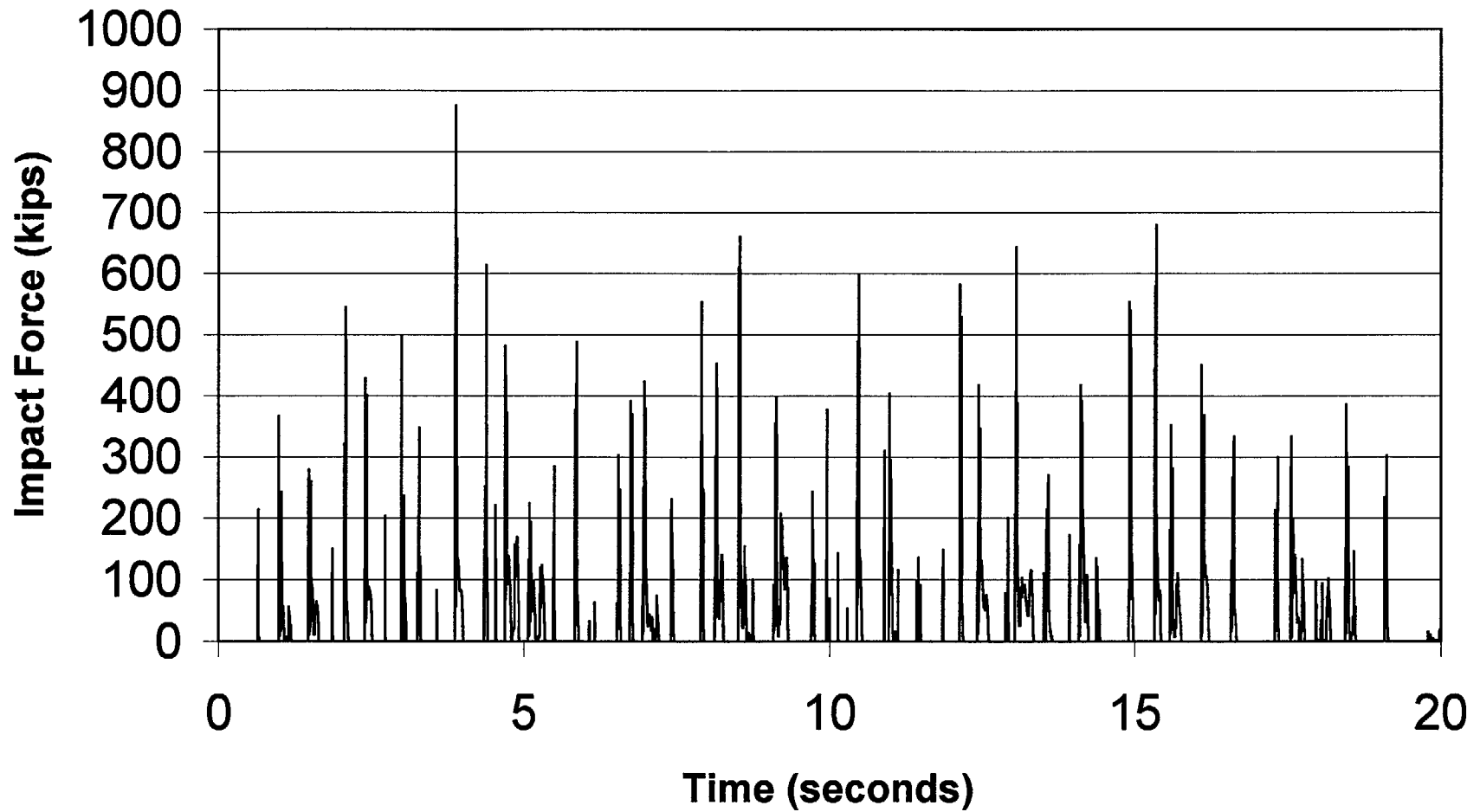
Figure N-33 - Run 552 - HI-STAR 100 - Maximum Compression Force at Any Location vs. Time



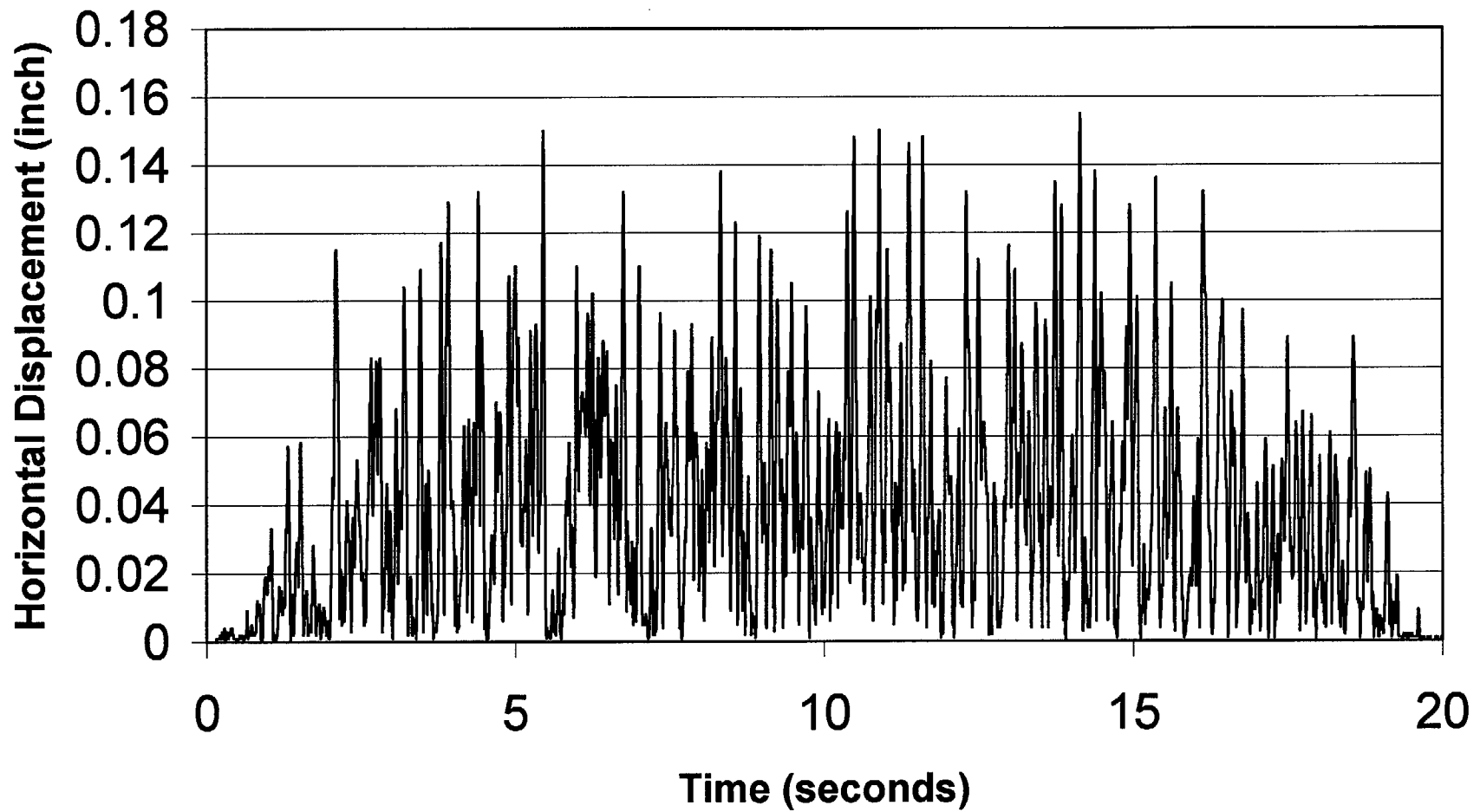
**Figure N-34 - Run 552 - HI-STAR 100 - Maximum
Compression Force on Clevis vs. Time**



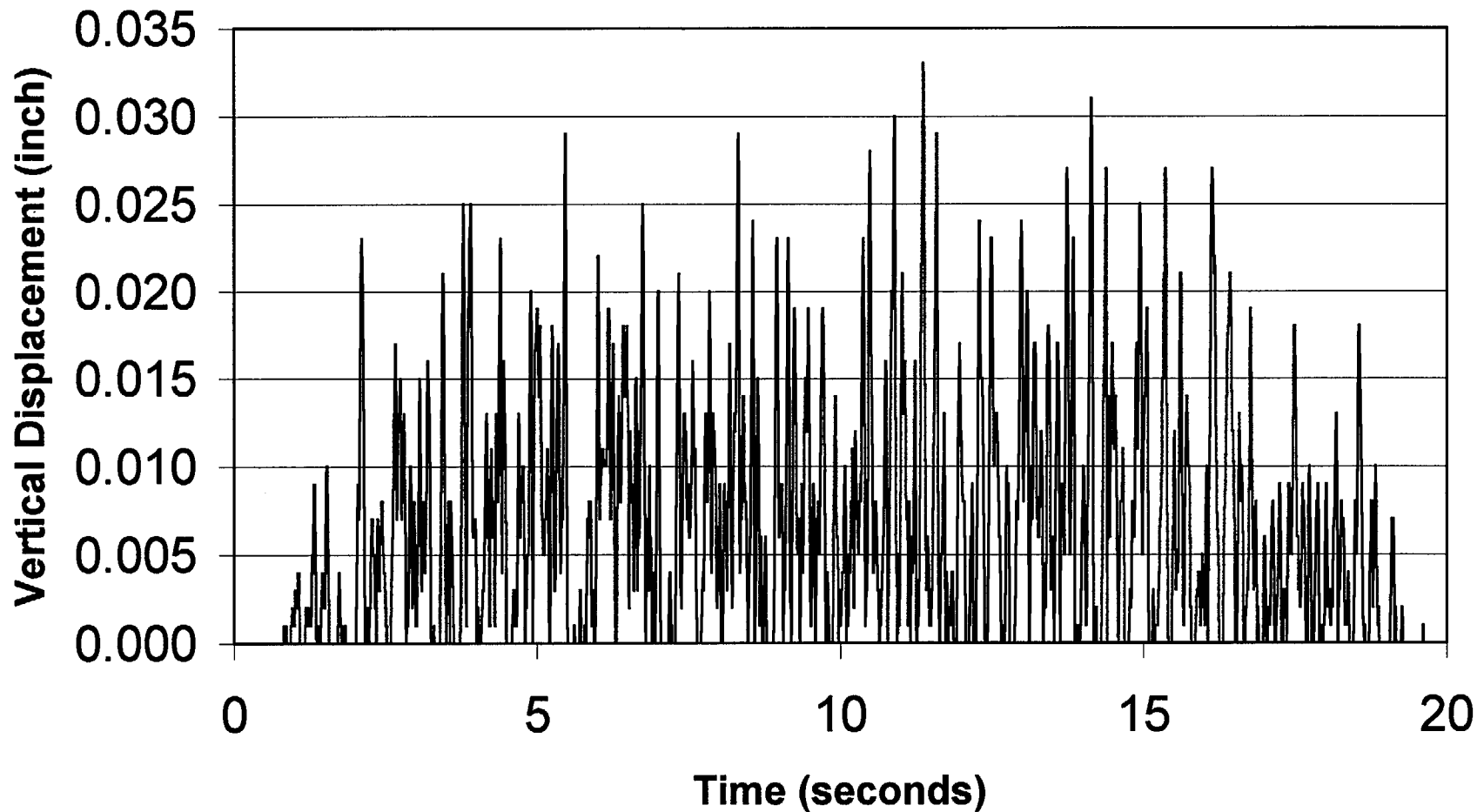
**Figure N-35 - Run 552 - HI-STAR 100 - Net
Overpack-to-MPC Impact Force vs. Time**



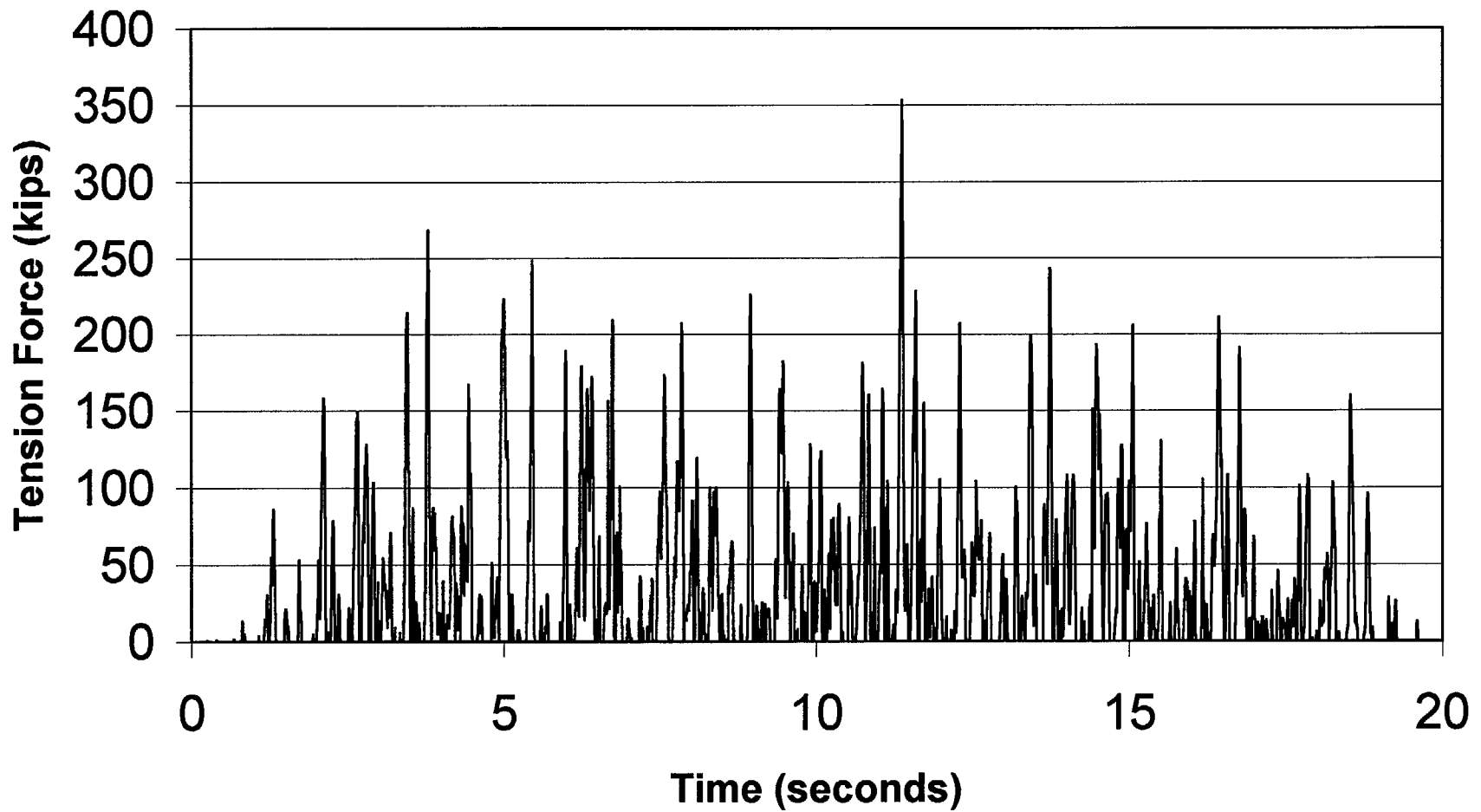
**Figure N-36 - Run 453 - HI-STAR 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-37 - Run 453 - HI-STAR 100 Overpack
Vertical Displacement vs. Time**



**Figure N-38 - Run 453 - HI-STAR 100 - Maximum
Clevis Bolt Tension vs. Time**



**Figure N-39 - Run 453 - HI-STAR 100 - Maximum
Clevis Bolt Net Shear vs. Time**

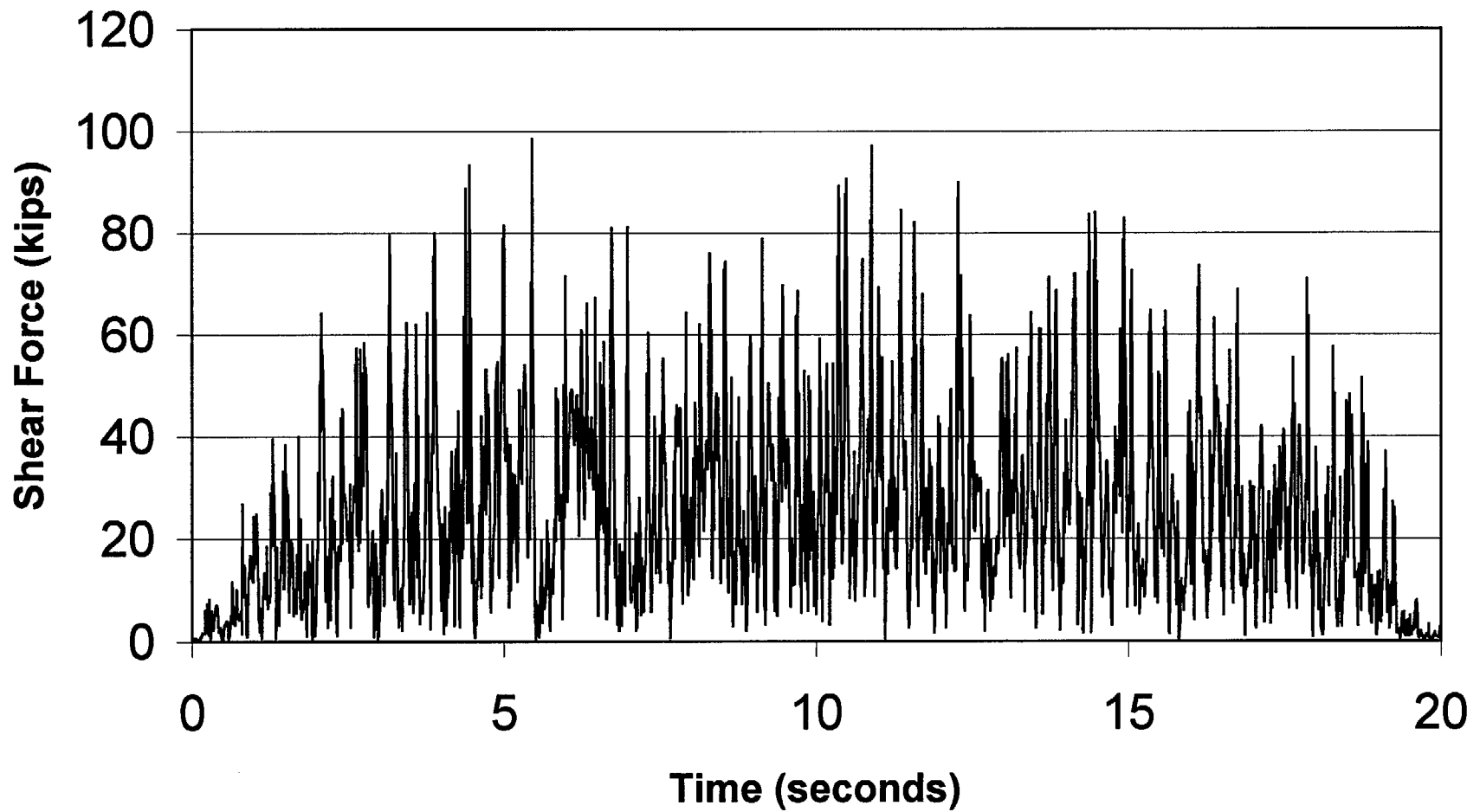
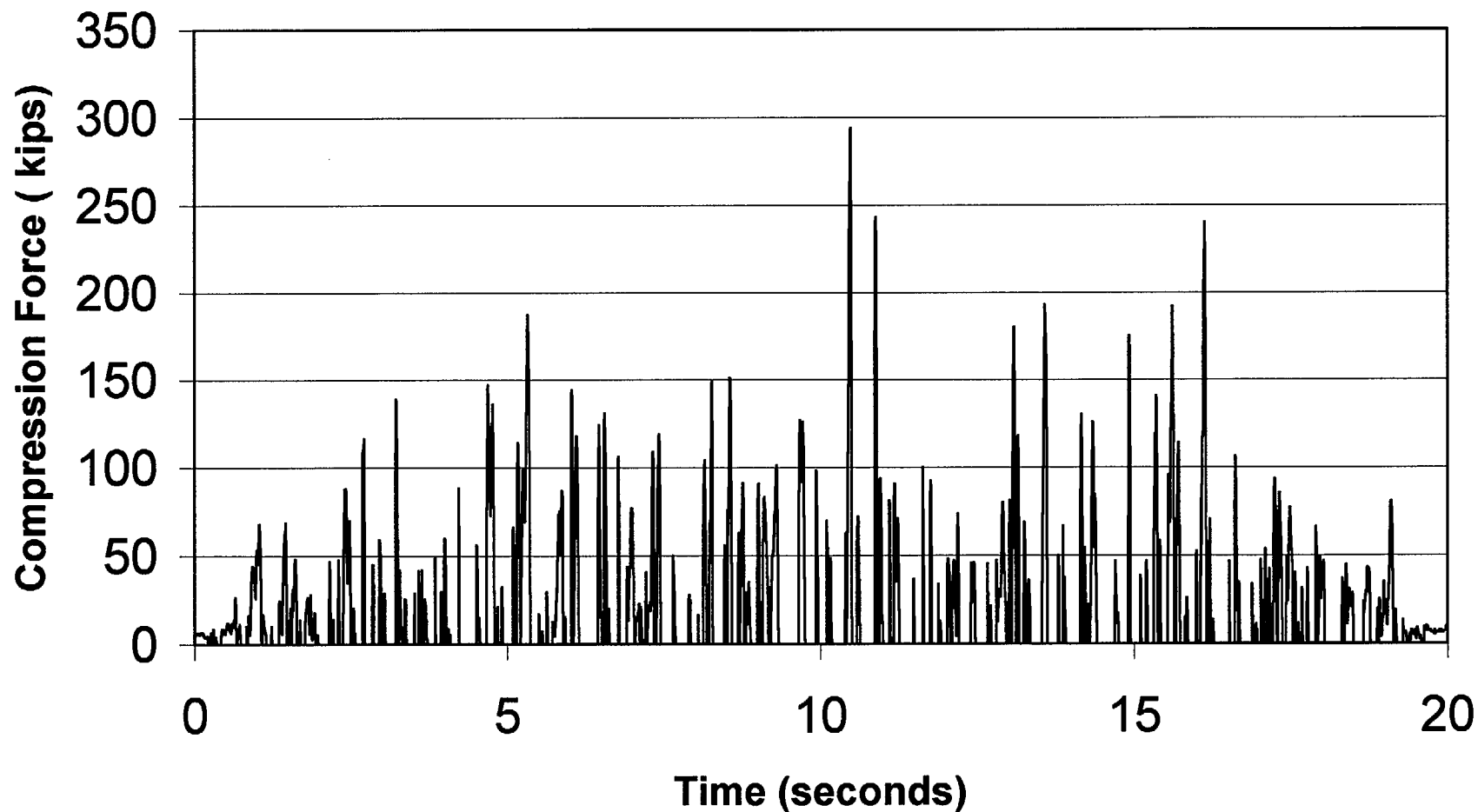
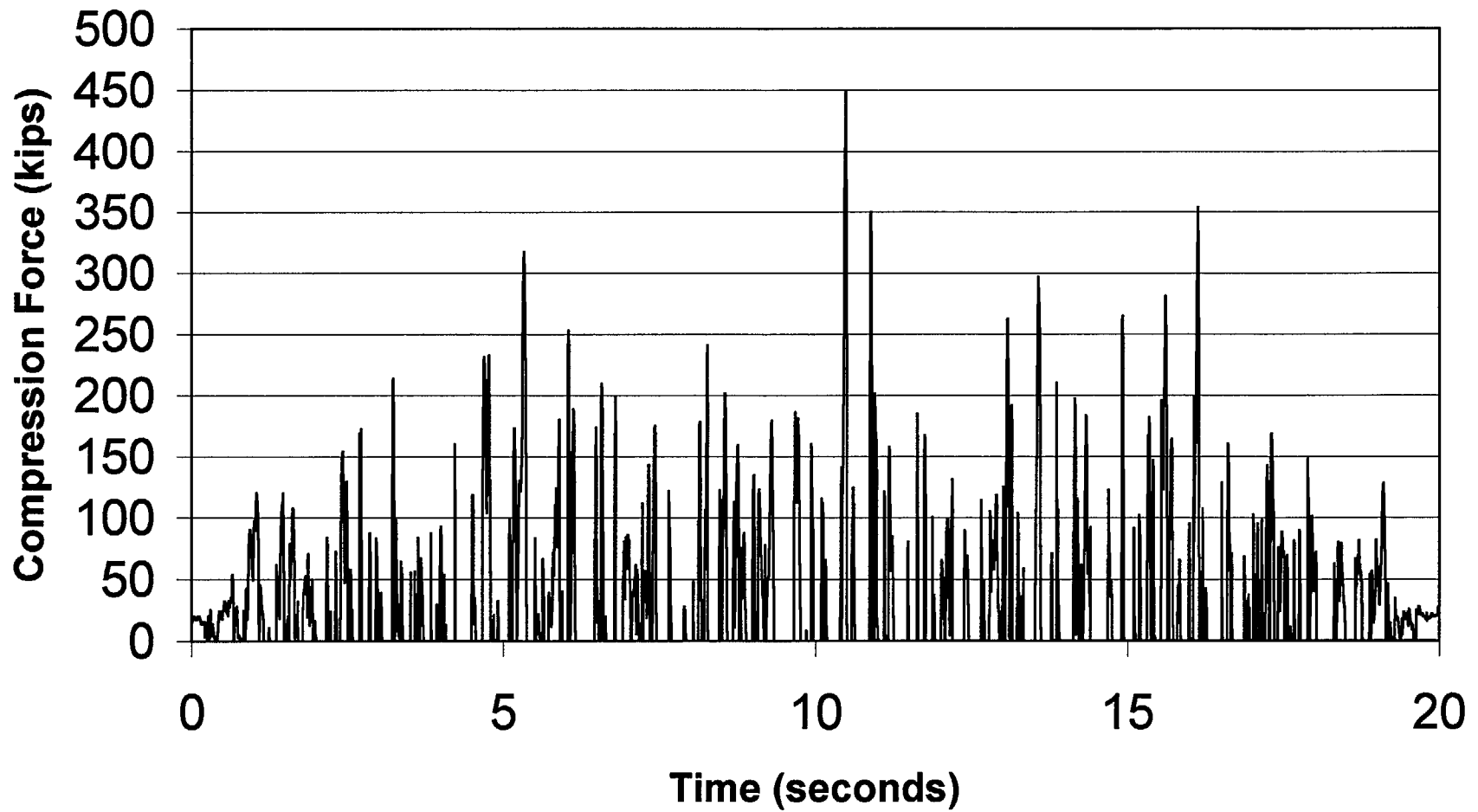


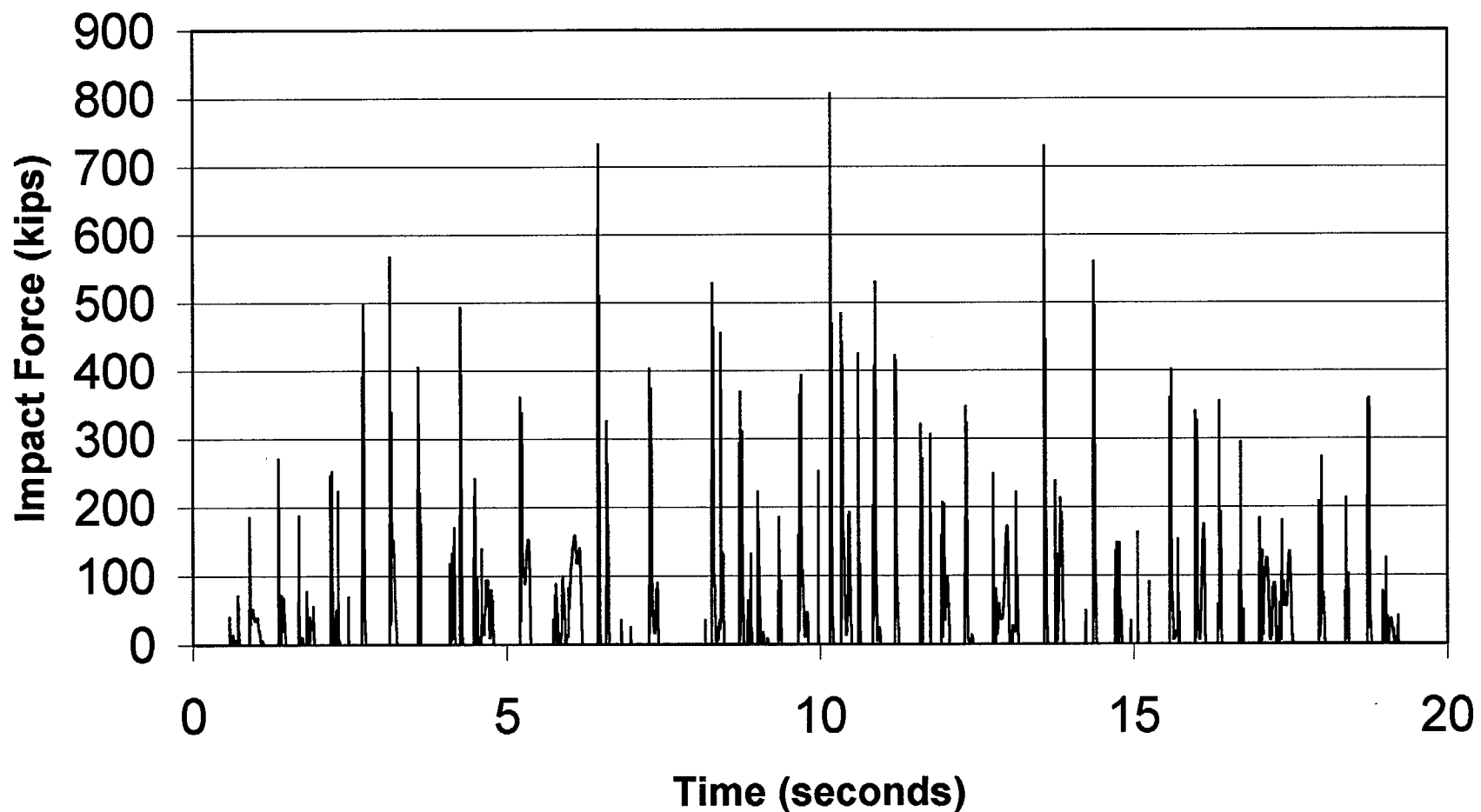
Figure N-40 - Run 453 - HI-STAR 100 - Maximum Compression Force at Any Location vs. Time



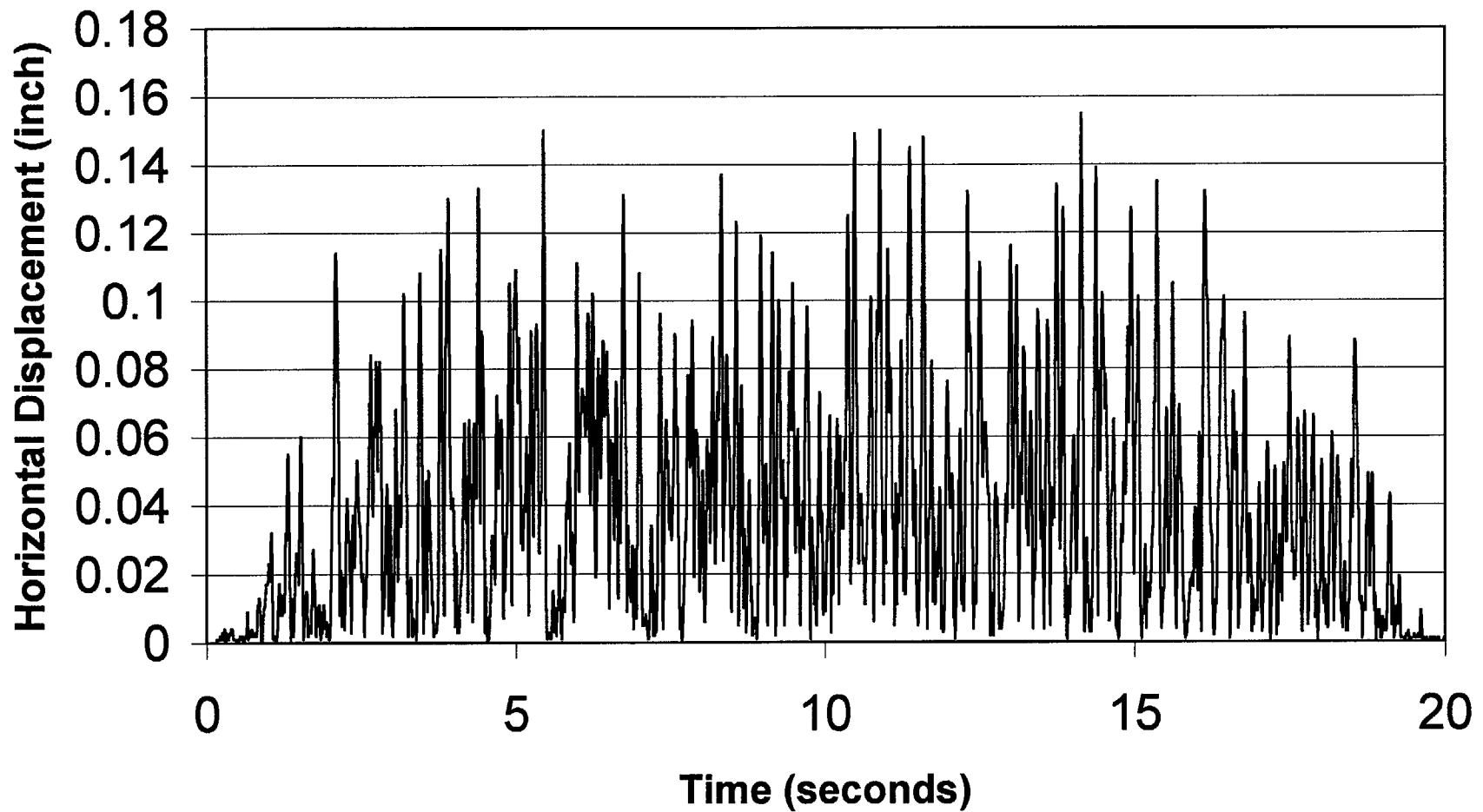
**Figure N-41 - Run 453 - HI-STAR 100 - Maximum
Compression Force on Clevis vs. Time**



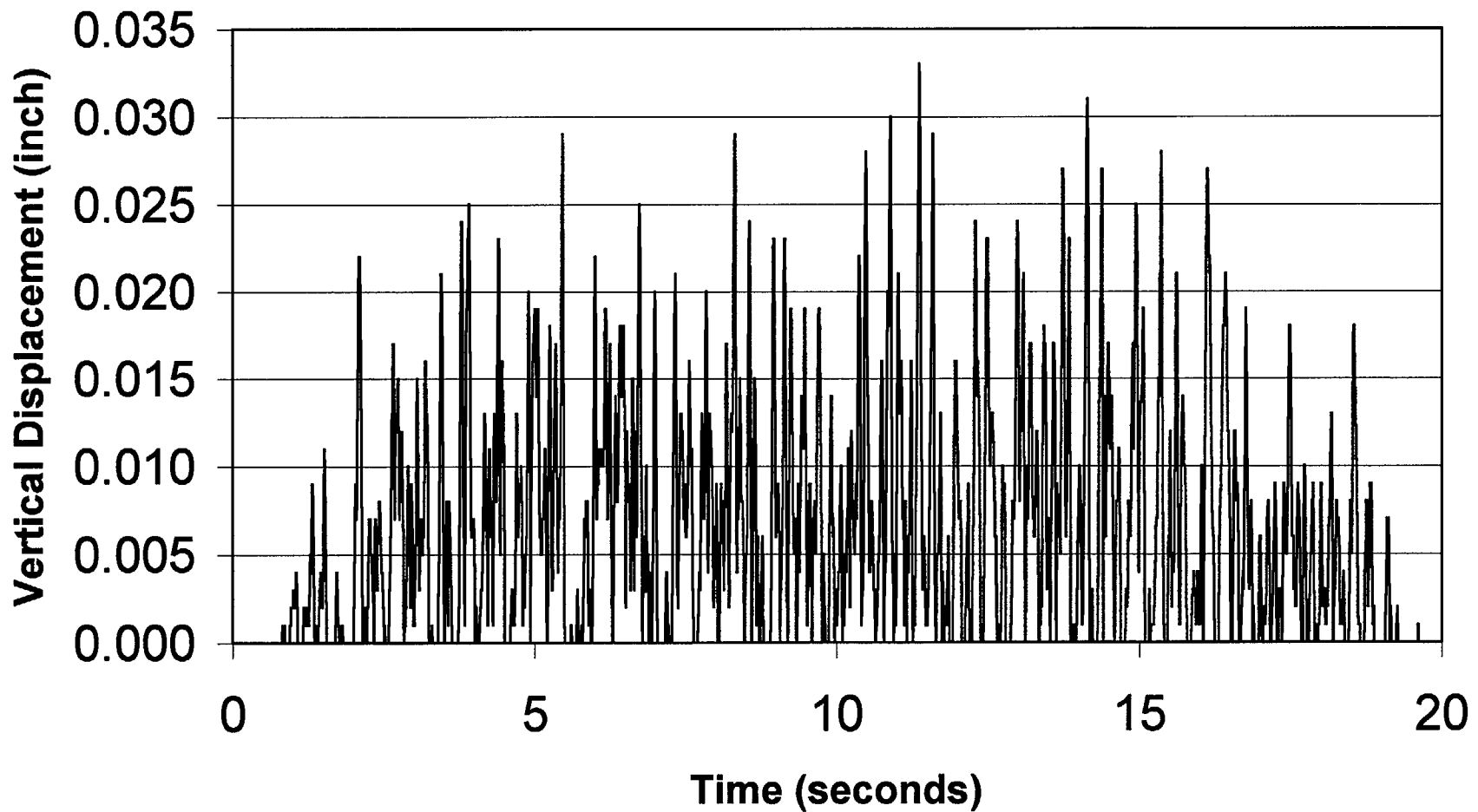
**Figure N-42 - Run 453 - HI-STAR 100 - Net
Overpack-to-MPC Impact Force vs. Time**



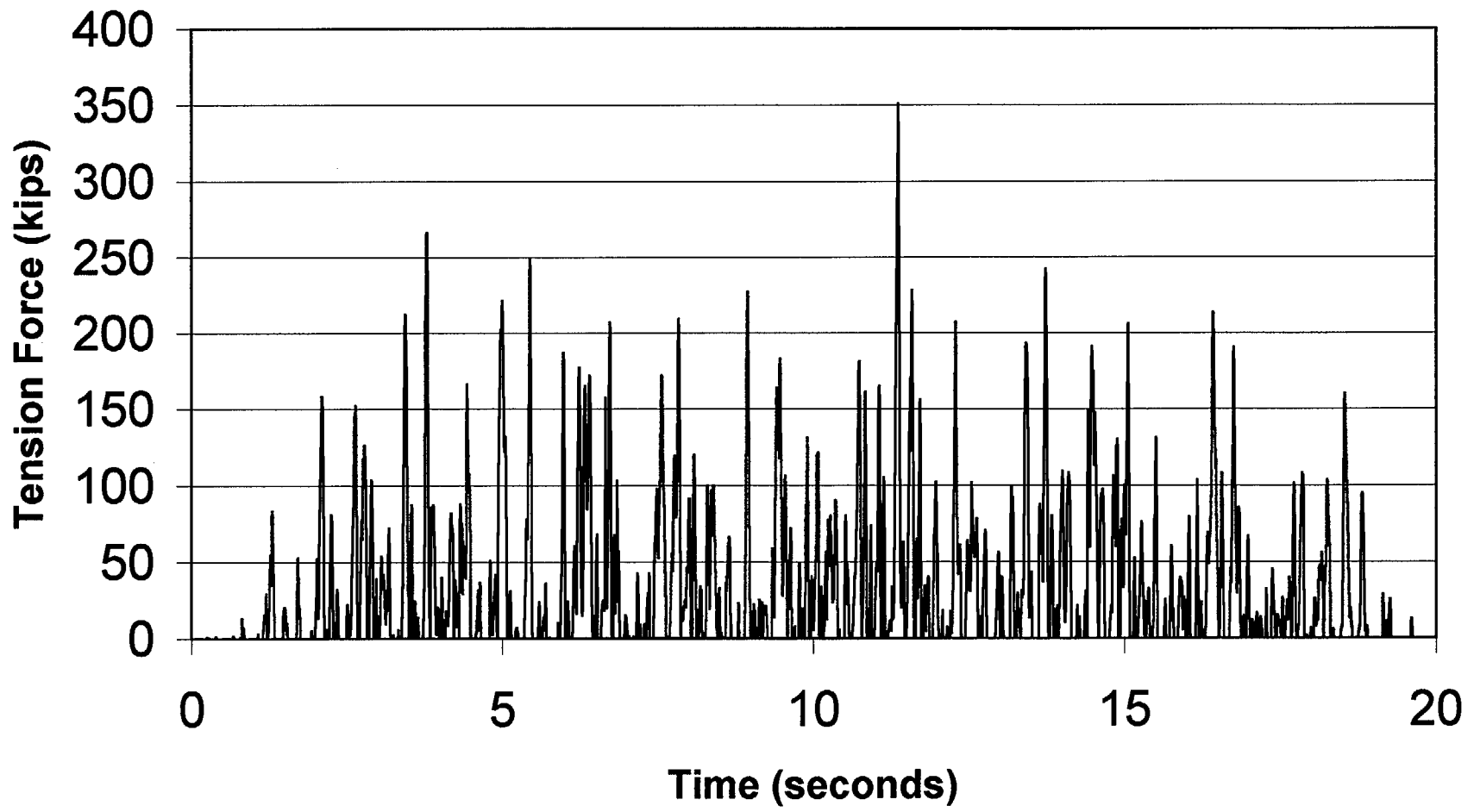
**Figure N-43 - Run 454 - HI-STAR 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-44 - Run 454 - HI-STAR 100 Overpack
Vertical Displacement vs. Time**



**Figure N-45 - Run 454 - HI-STAR 100 - Maximum
Clevis Bolt Tension vs. Time**



**Figure N-46 - Run 454 - HI-STAR 100 - Maximum
Clevis Bolt Net Shear vs. Time**

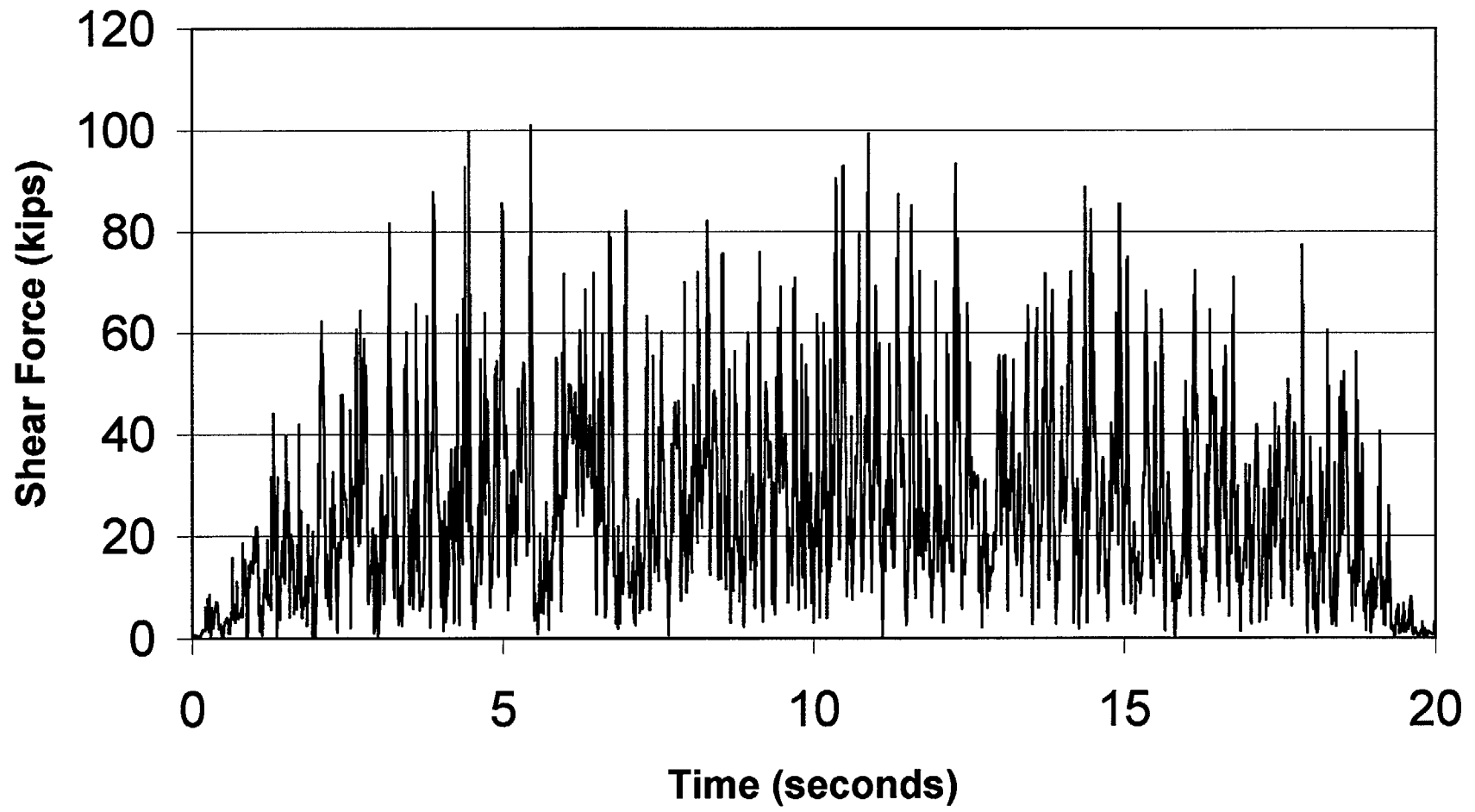
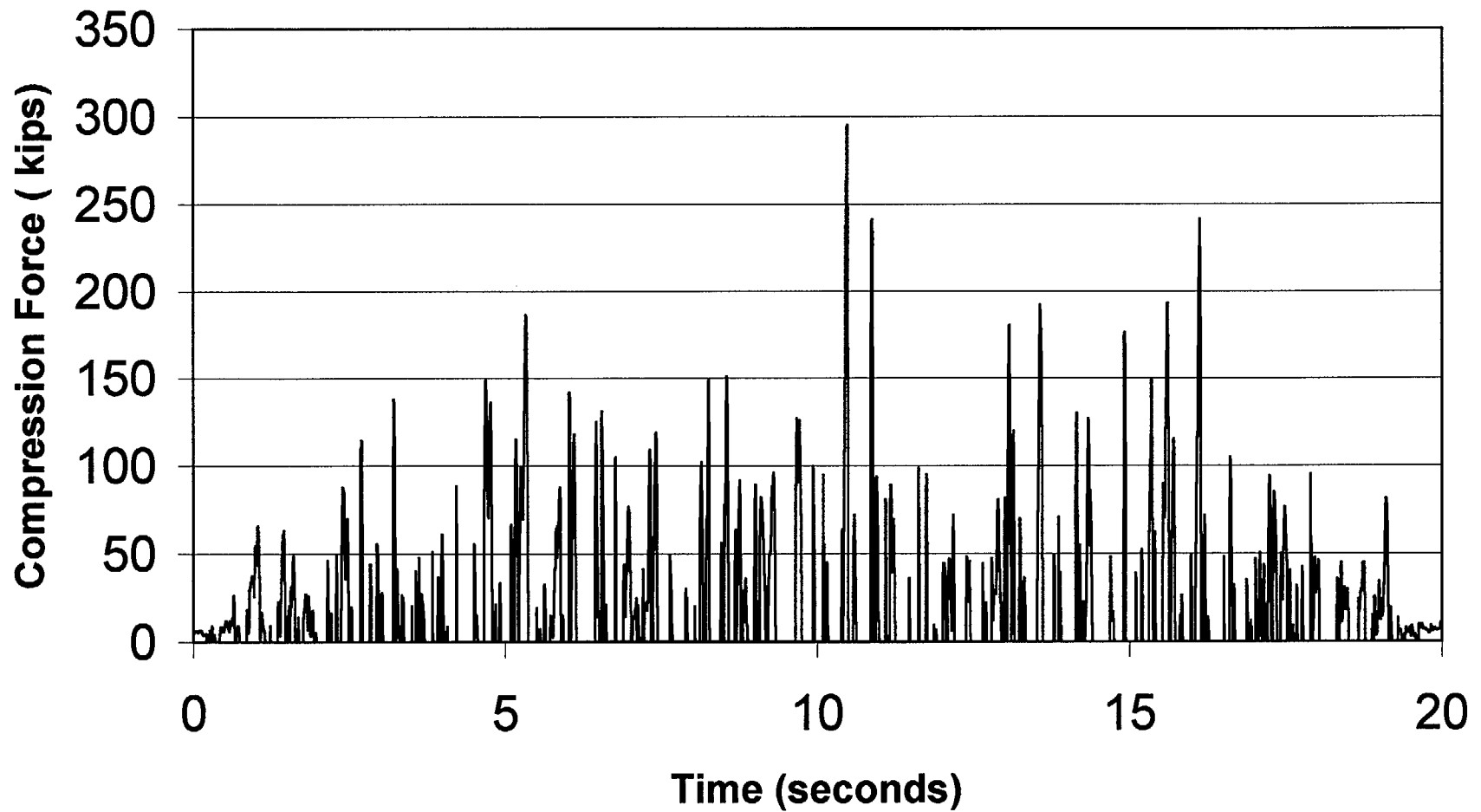
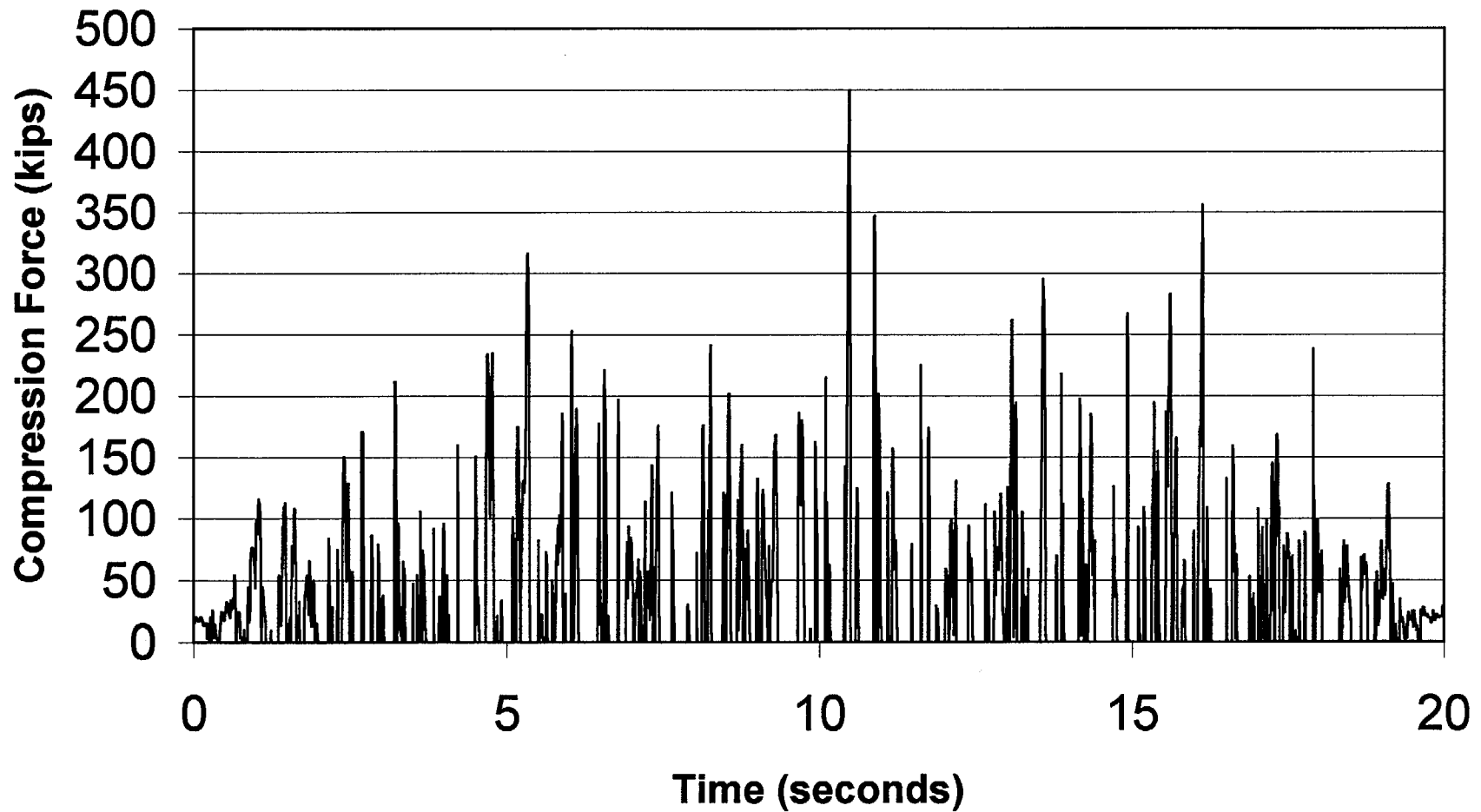


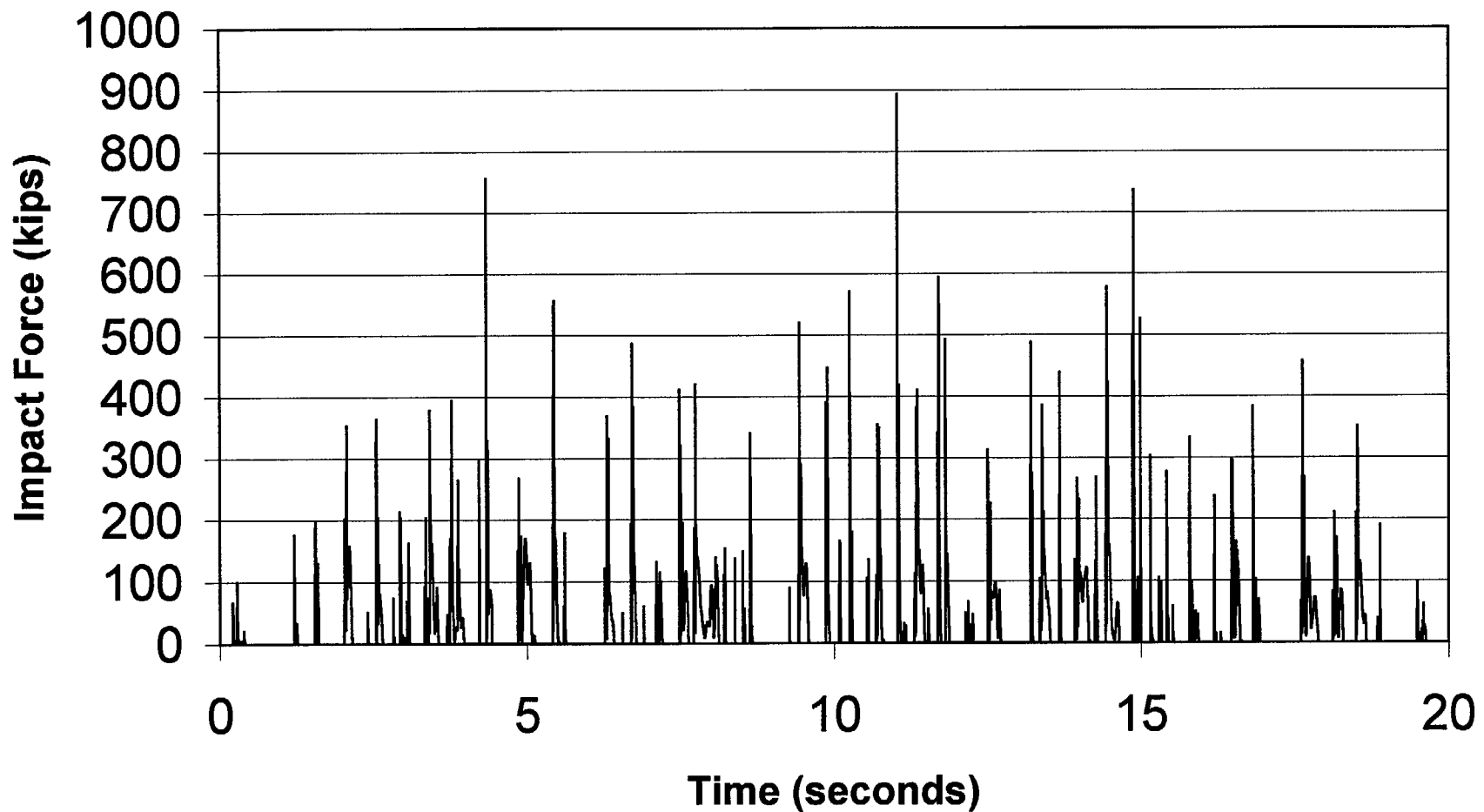
Figure N-47 - Run 454 - HI-STAR 100 - Maximum Compression Force at Any Location vs. Time



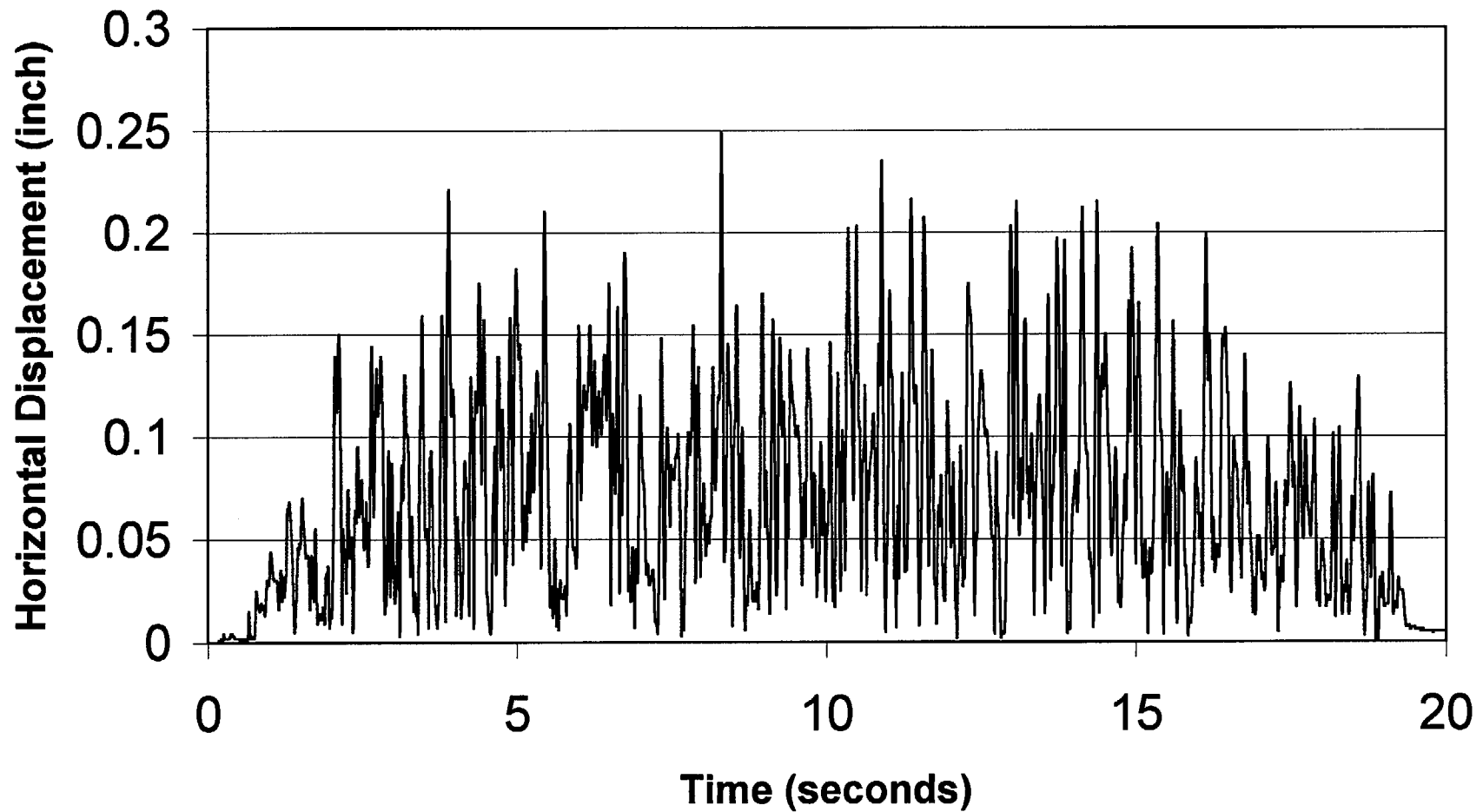
**Figure N-48 - Run 454 - HI-STAR 100 - Maximum
Compression Force on Clevis vs. Time**



**Figure N-49 - Run 454 - HI-STAR 100 - Net
Overpack-to-MPC Impact Force vs. Time**



**Figure N-50 - Run 113 - HI-STORM 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-51 - Run 113 - HI-STORM 100 Overpack
Vertical Displacement vs. Time**

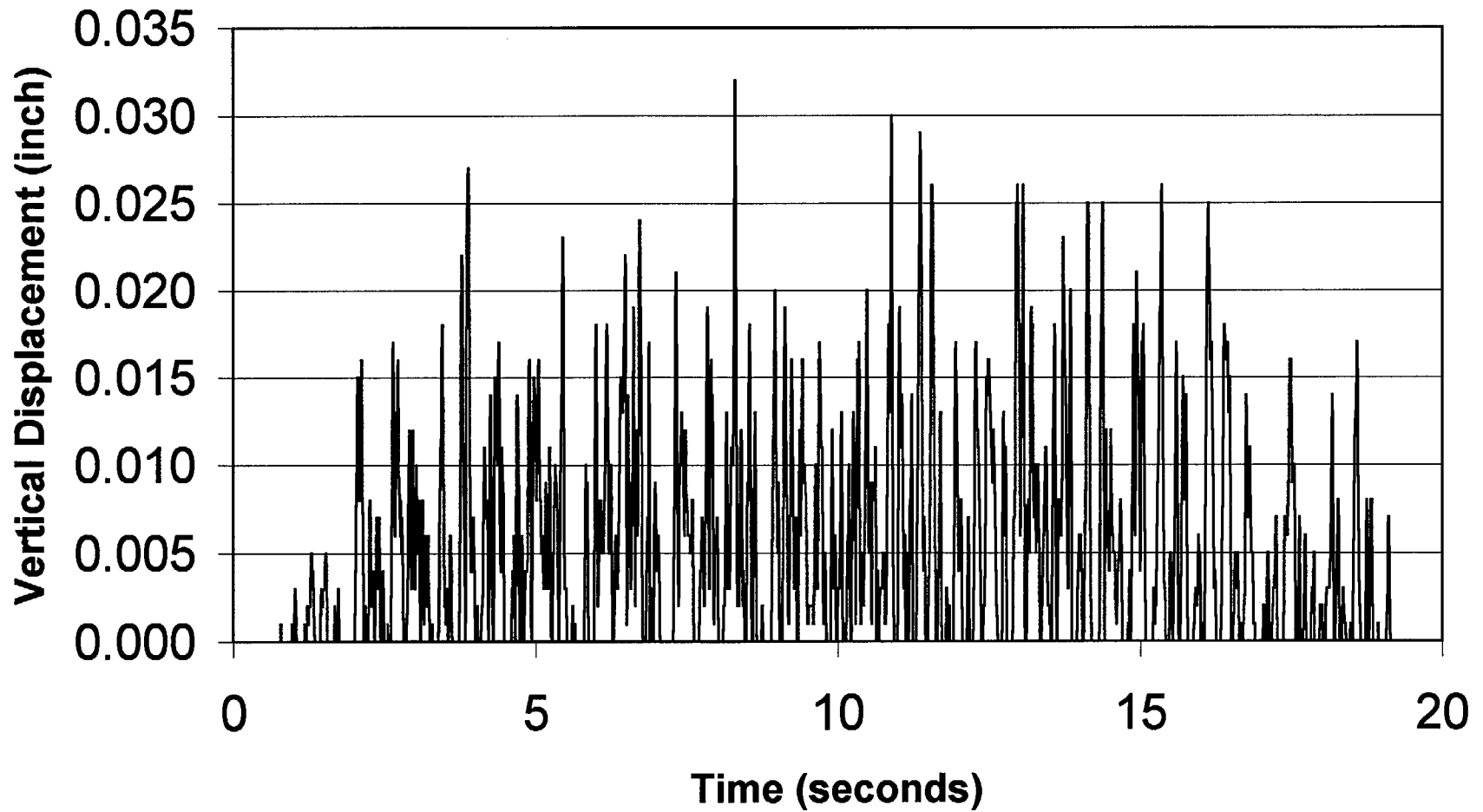


Figure N-52 - Run 113 - HI-STORM 100
Maximum Sector Lug Spring Tension vs. Time

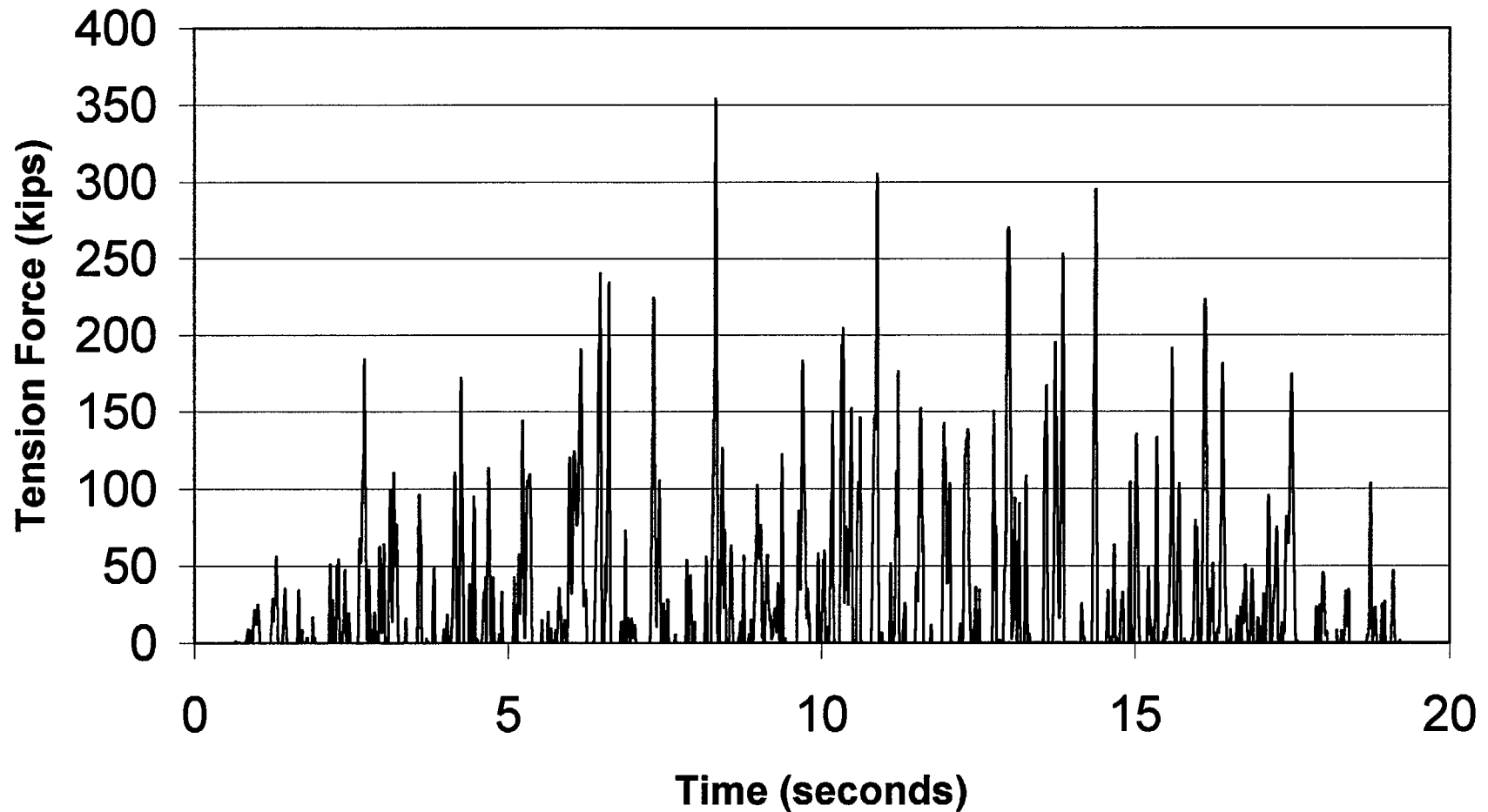
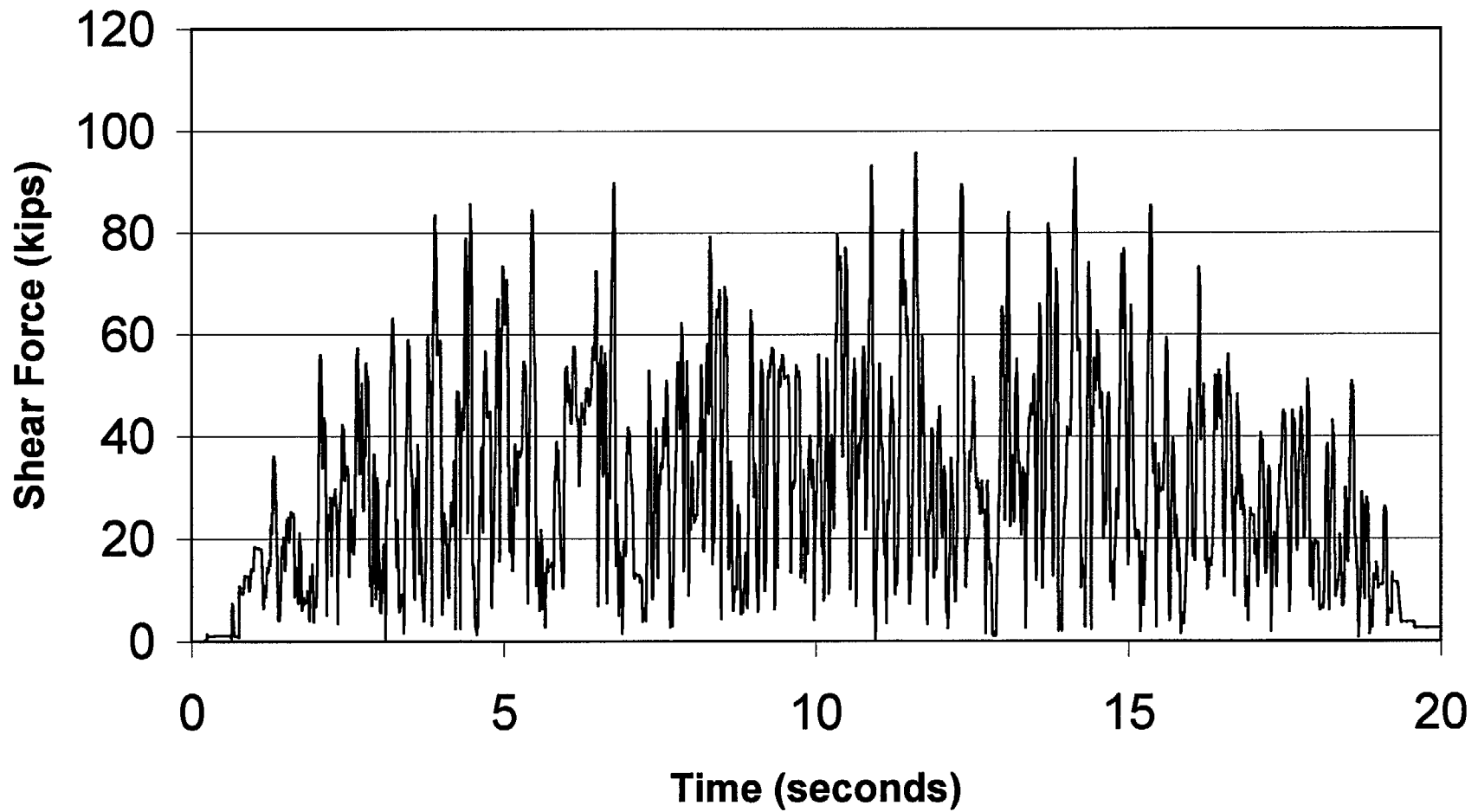


Figure N-53 - Run 113 - HI-STORM 100
Maximum Sector Lug Spring Net Shear vs. Time



**Figure N-54 - Run 113 - HI-STORM 100 Maximum
Compression Force at Any Location vs. Time**

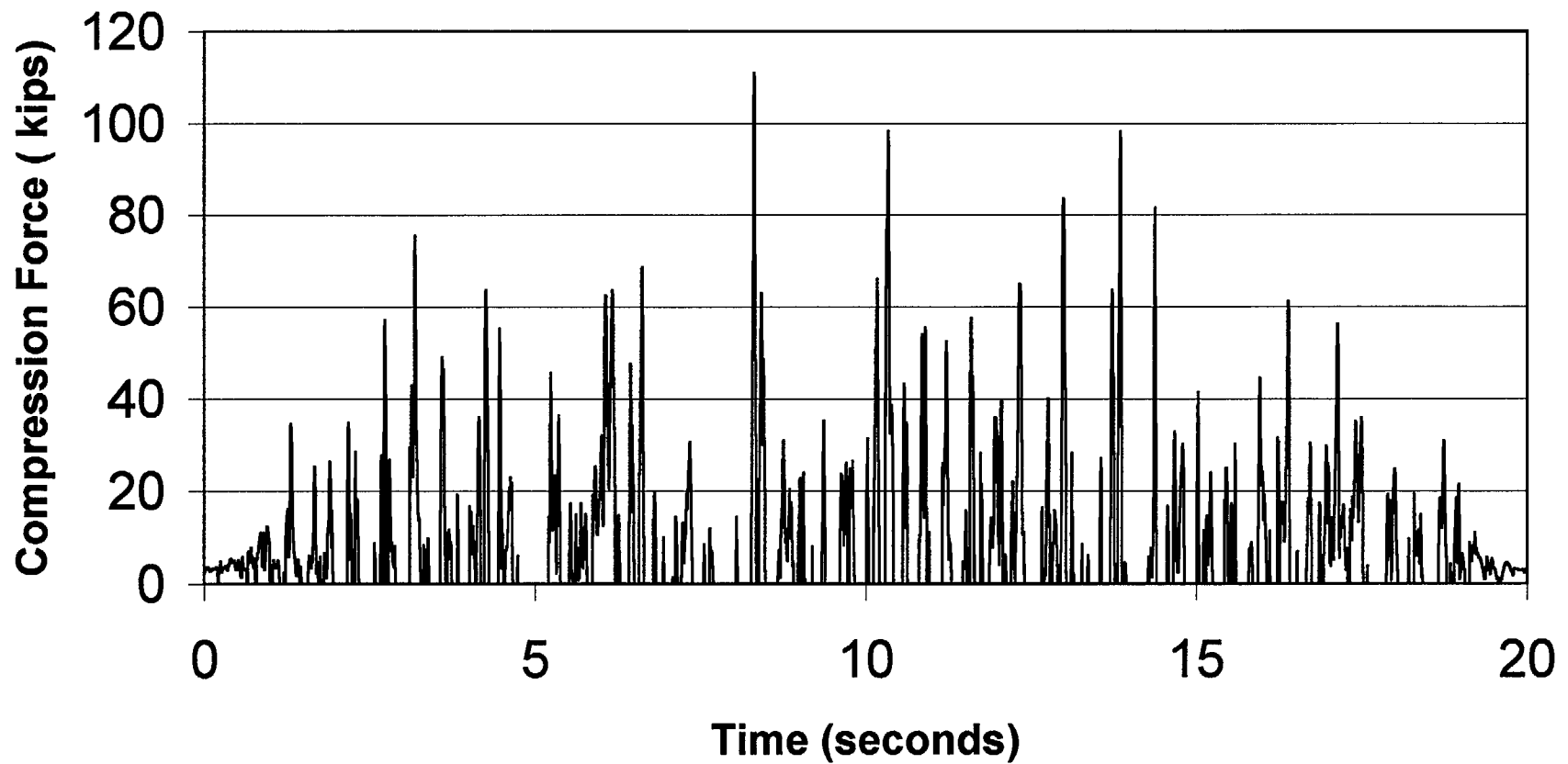
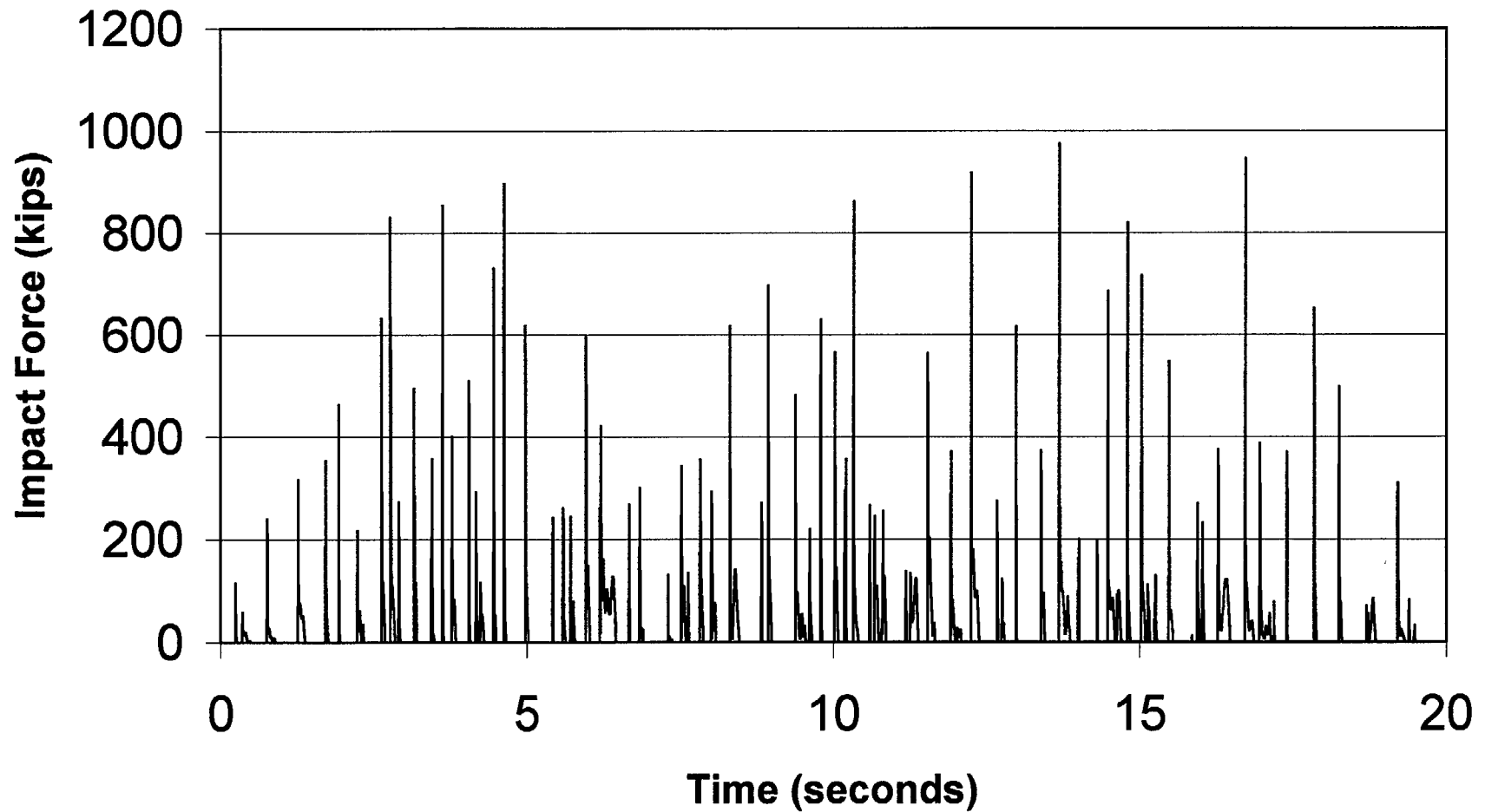
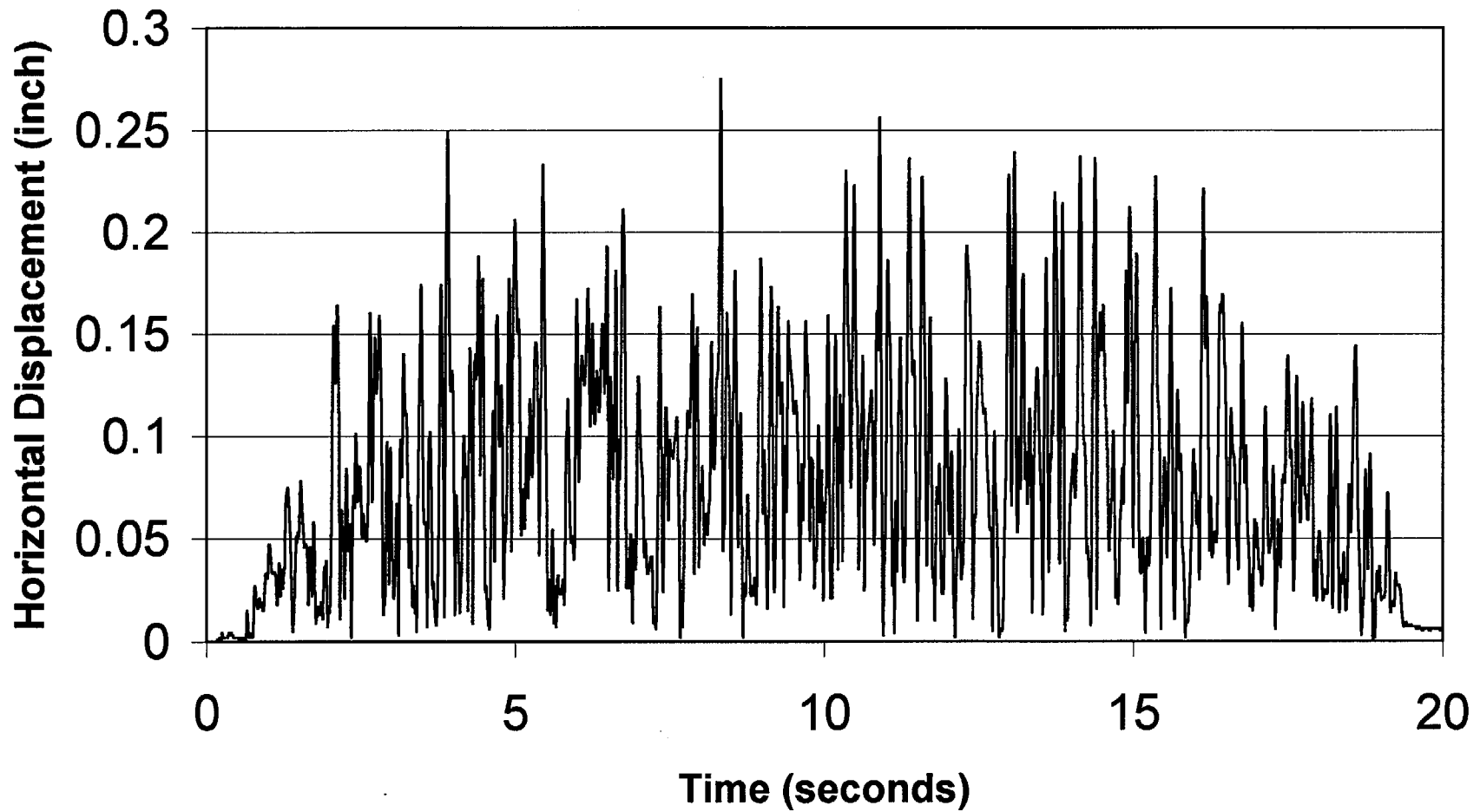


Figure N-55 - Run 113 - HI-STORM 100
Net Overpack-to-MPC Impact Force vs. Time



**Figure N-56 - Run 351 - HI-STORM 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-57 - Run 351 - HI-STORM 100 Overpack
Vertical Displacement vs. Time**

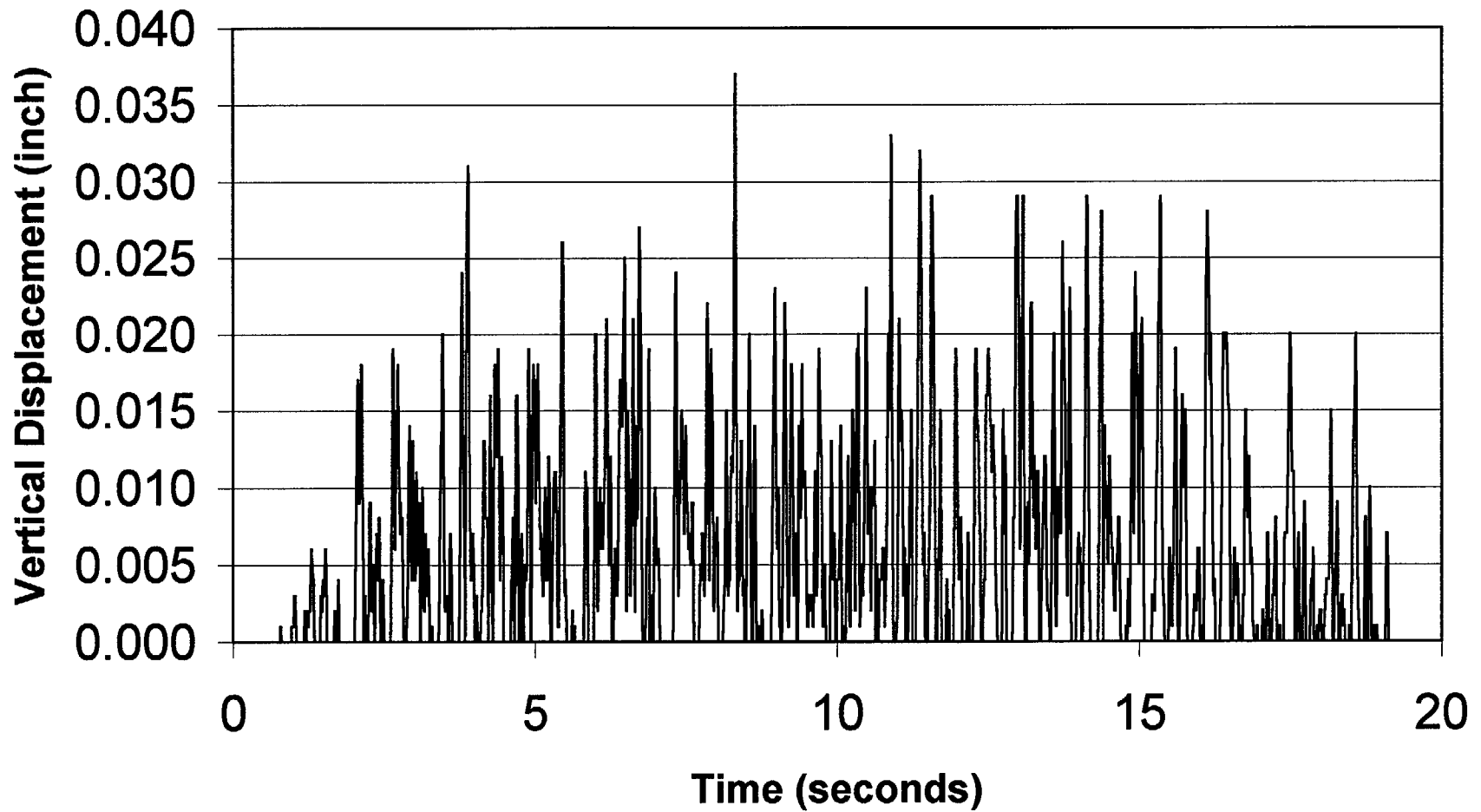


Figure N-58 - Run 351 - HI-STORM 100
Maximum Sector Lug Spring Tension vs. Time

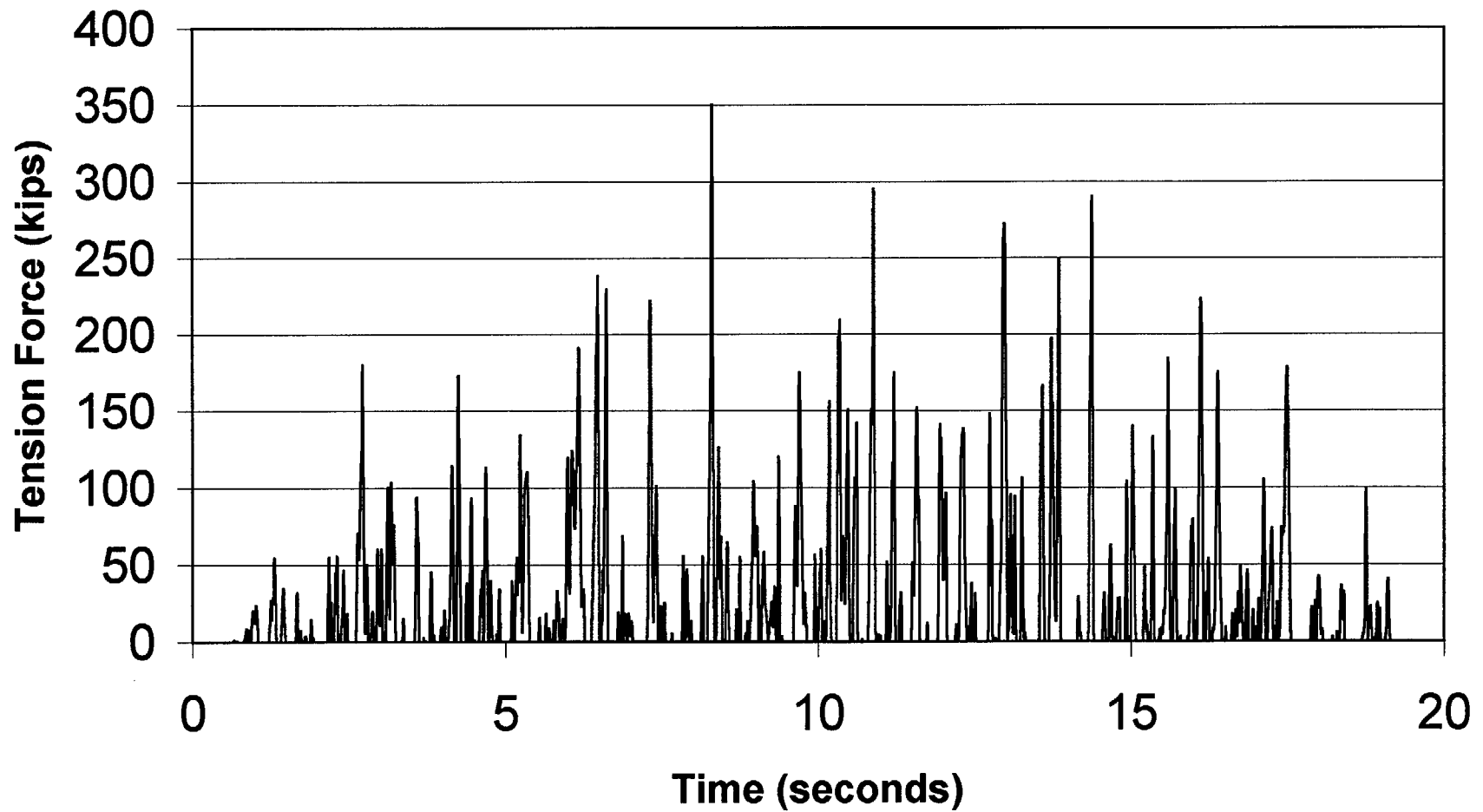
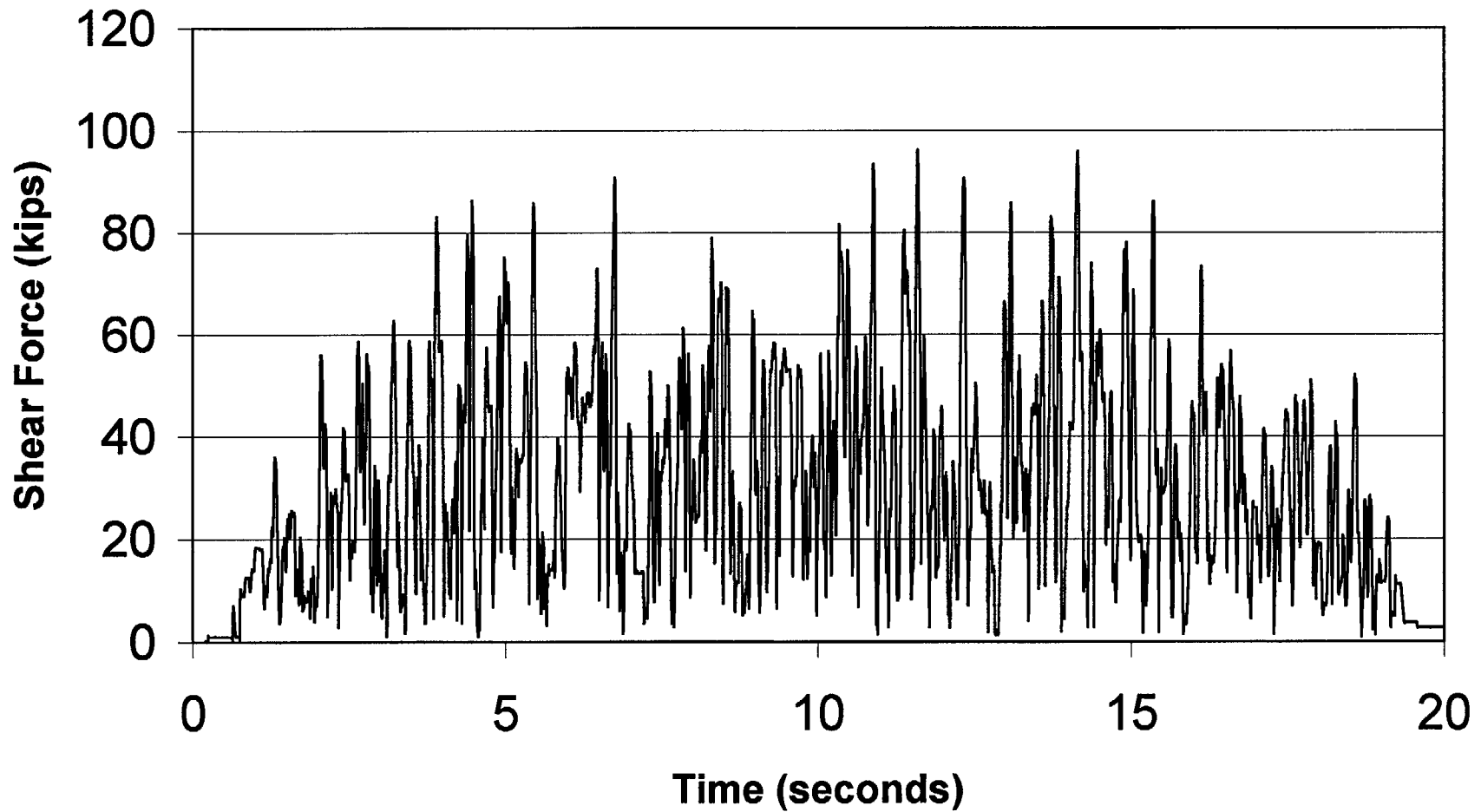


Figure N-59 - Run 351 - HI-STORM 100
Maximum Sector Lug Spring Net Shear vs. Time



**Figure N-60 - Run 351 - HI-STORM 100 Maximum
Compression Force at Any Location vs. Time**

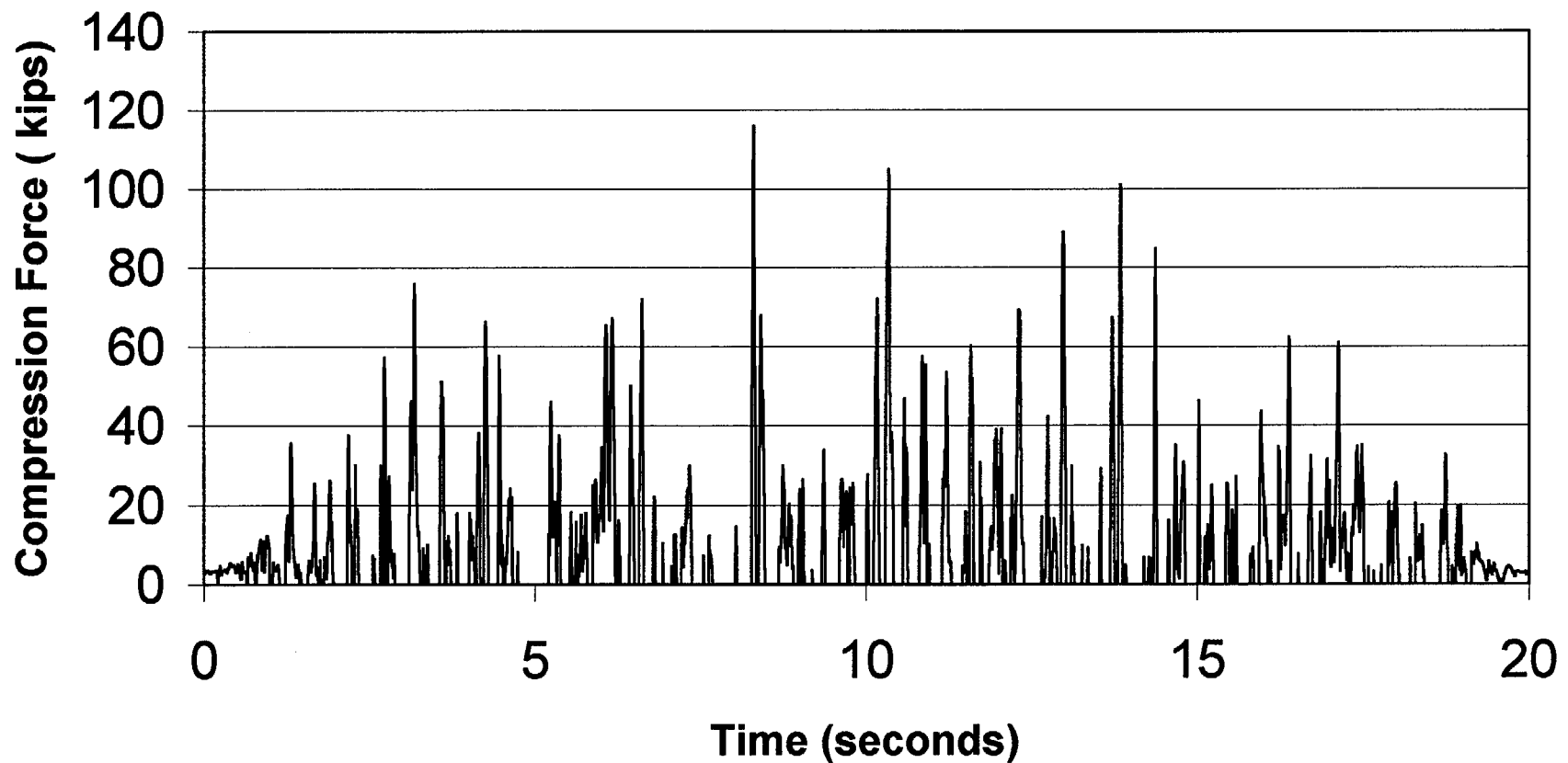
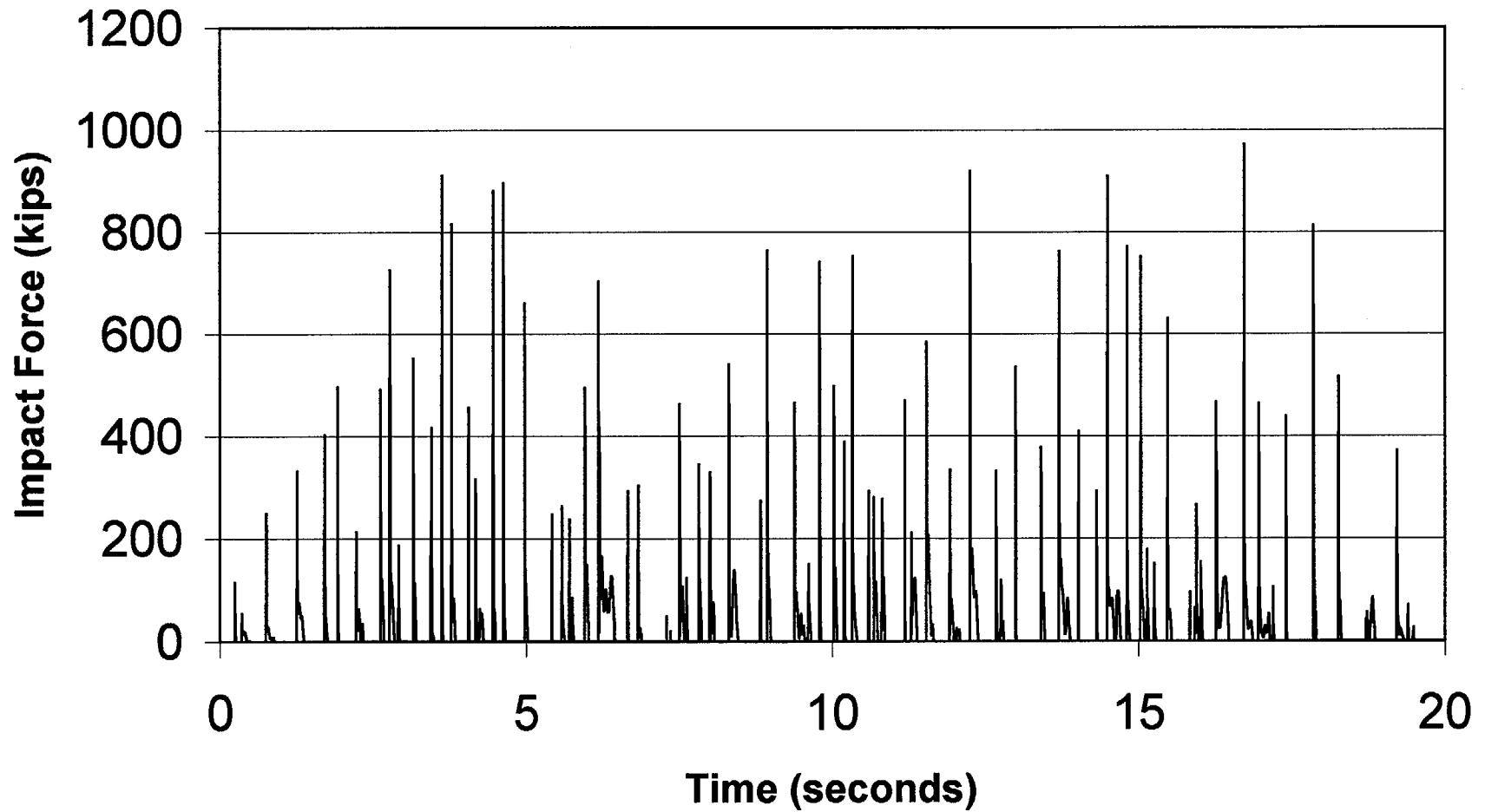
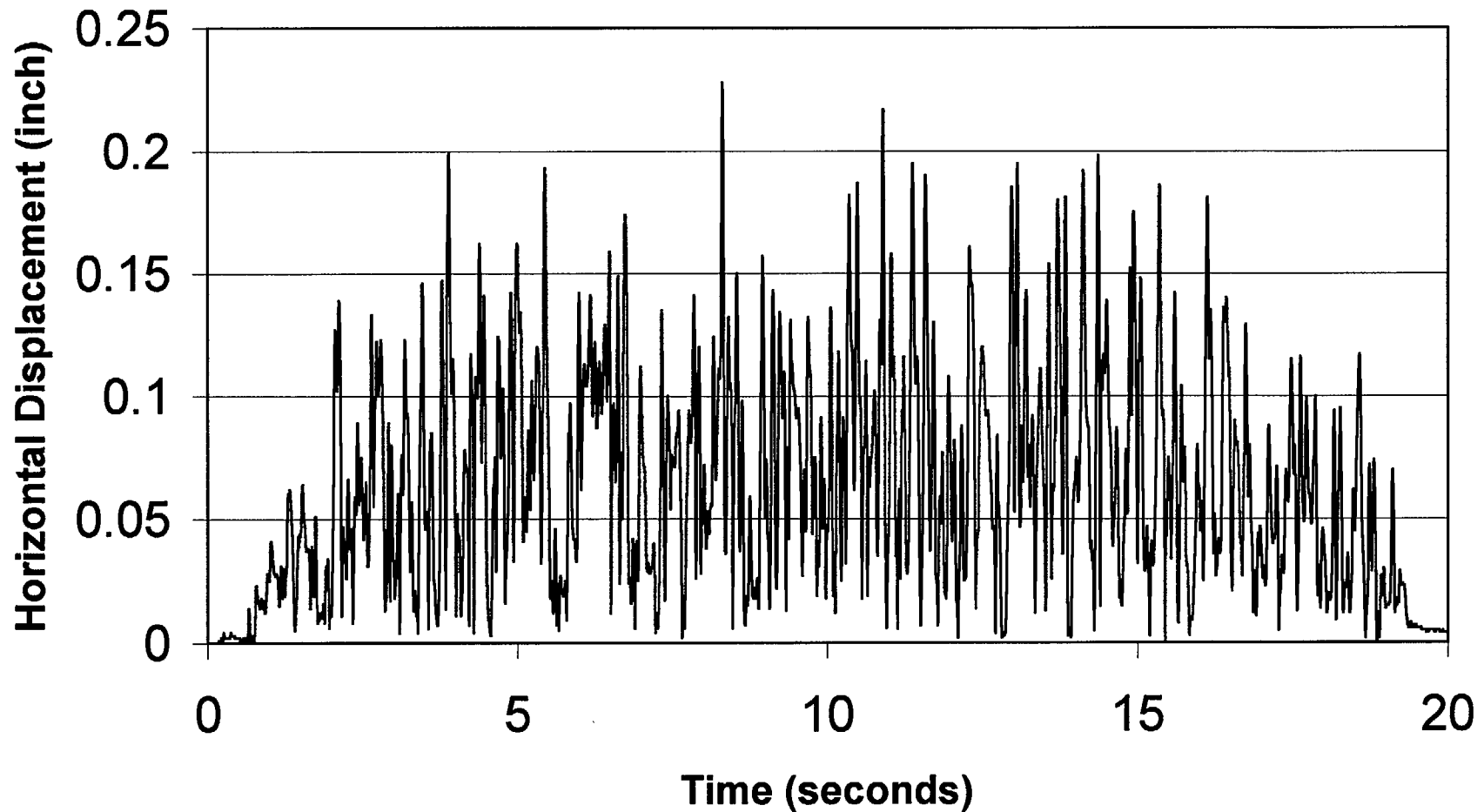


Figure N-61 - Run 351 - HI-STORM 100
Net Overpack-to-MPC Impact Force vs. Time



**Figure N-62 - Run 352 - HI-STORM 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-63 - Run 352 - HI-STORM 100 Overpack
Vertical Displacement vs. Time**

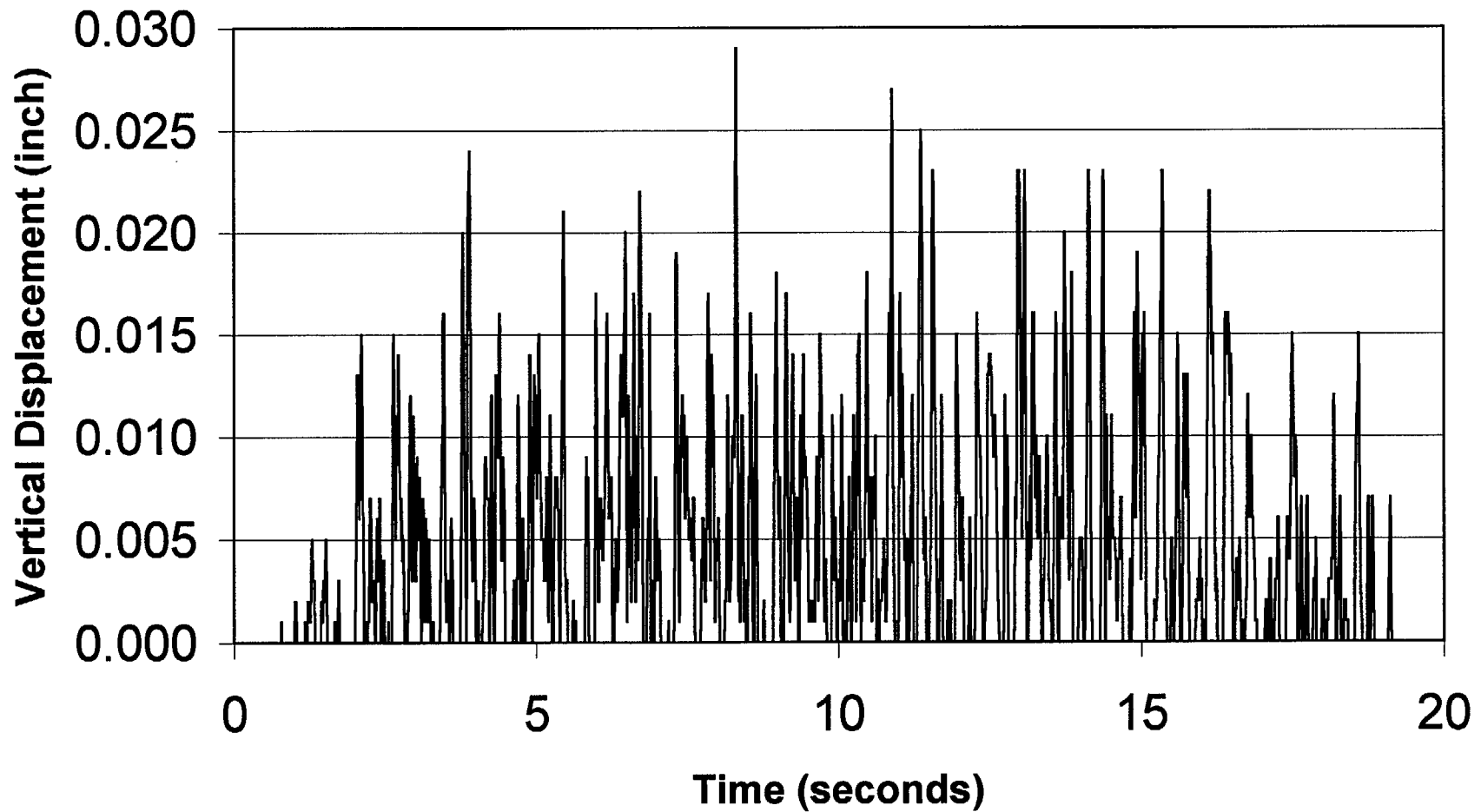


Figure N-64 - Run 352 - HI-STORM 100
Maximum Sector Lug Spring Tension vs. Time

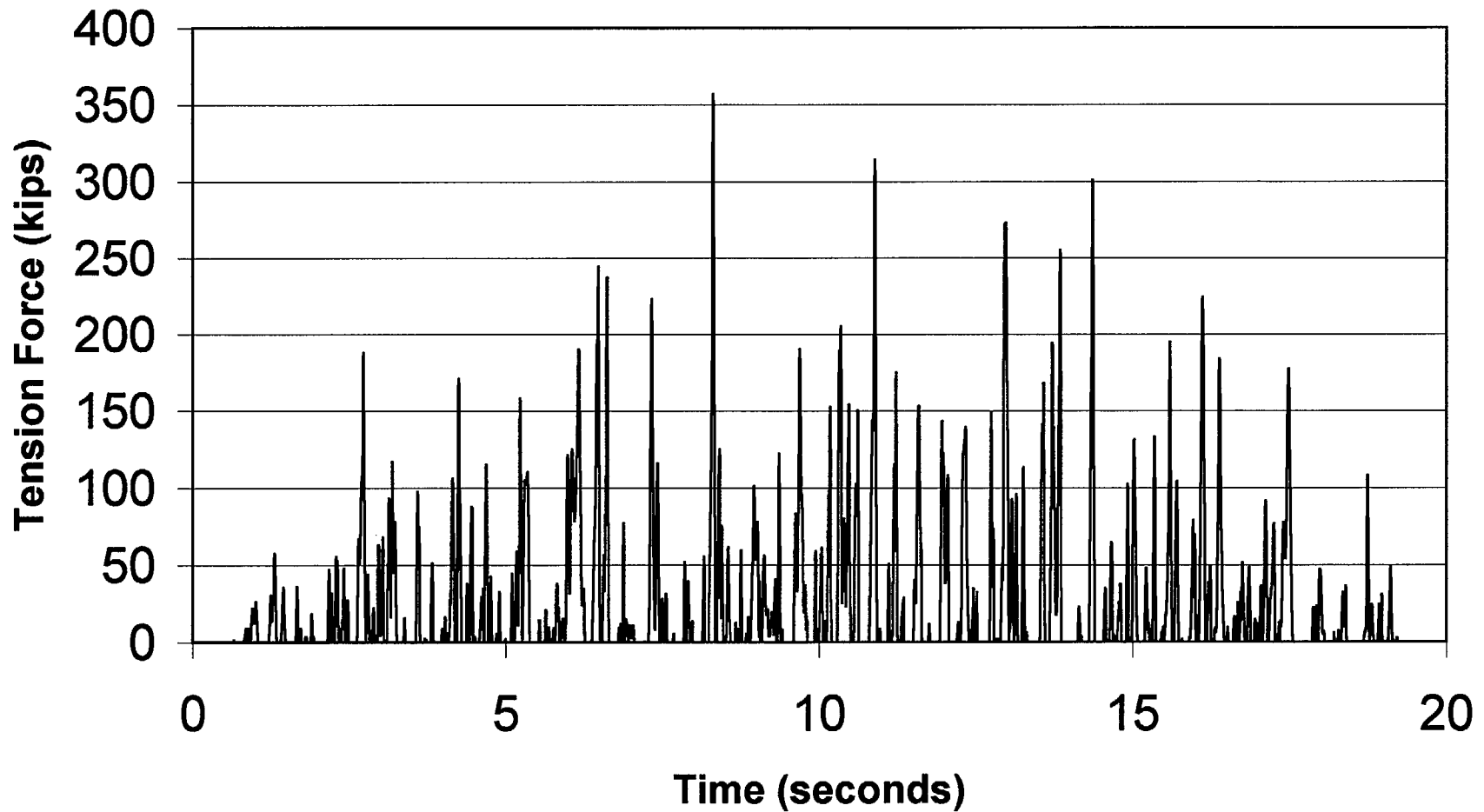
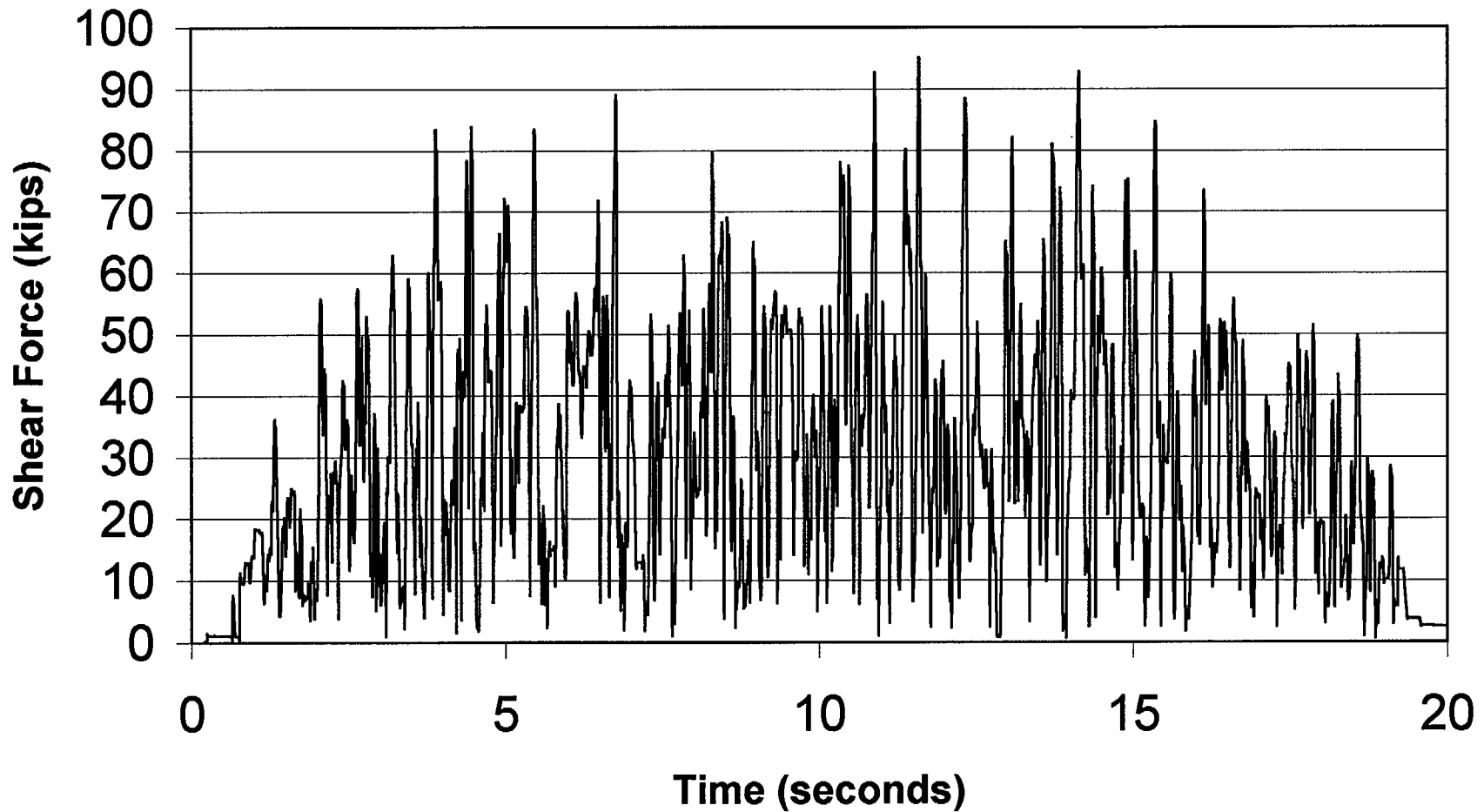


Figure N-65 - Run 352 - HI-STORM 100
Maximum Sector Lug Spring Net Shear vs. Time



**Figure N-66 - Run 352 - HI-STORM 100 Maximum
Compression Force at Any Location vs. Time**

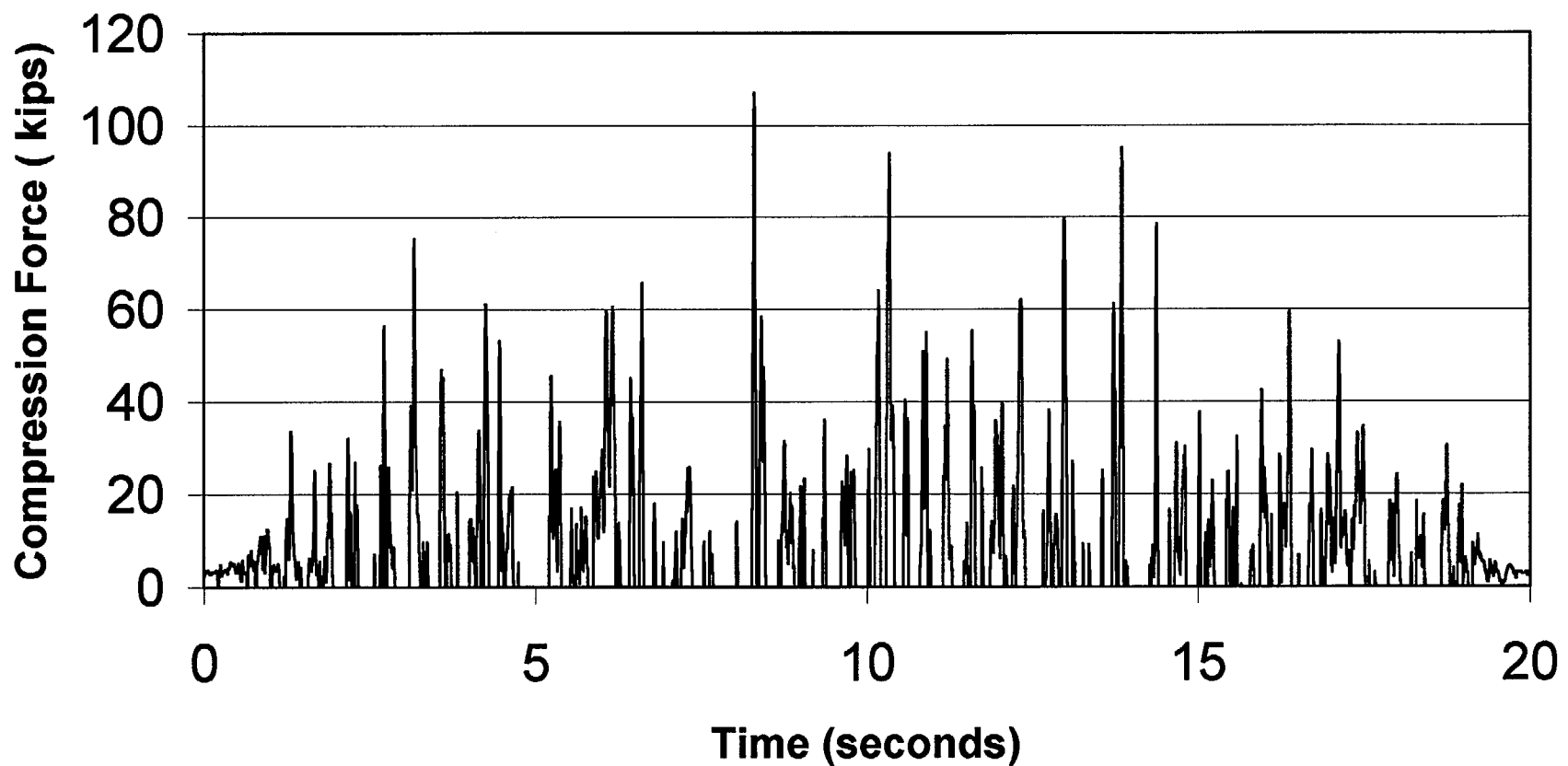
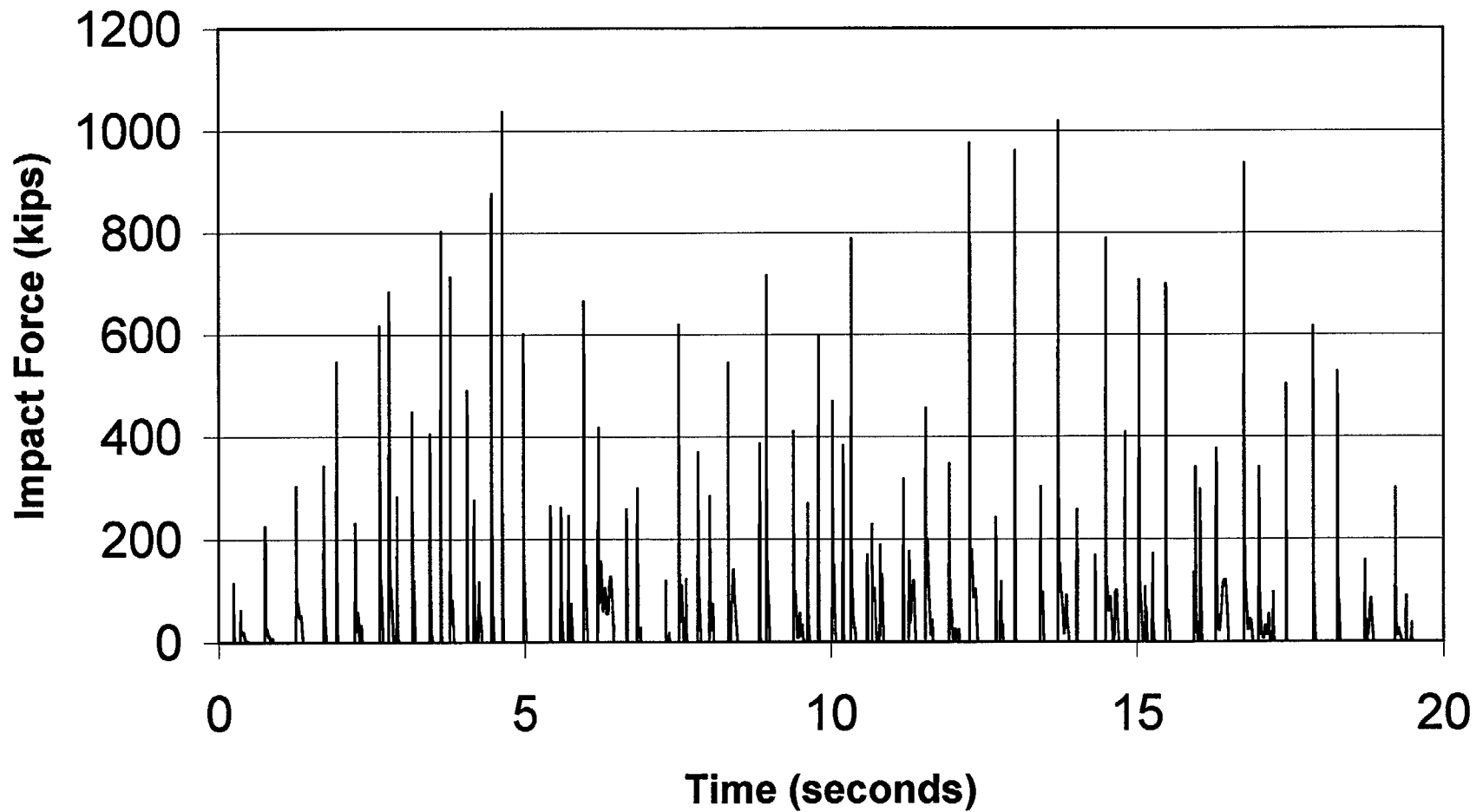
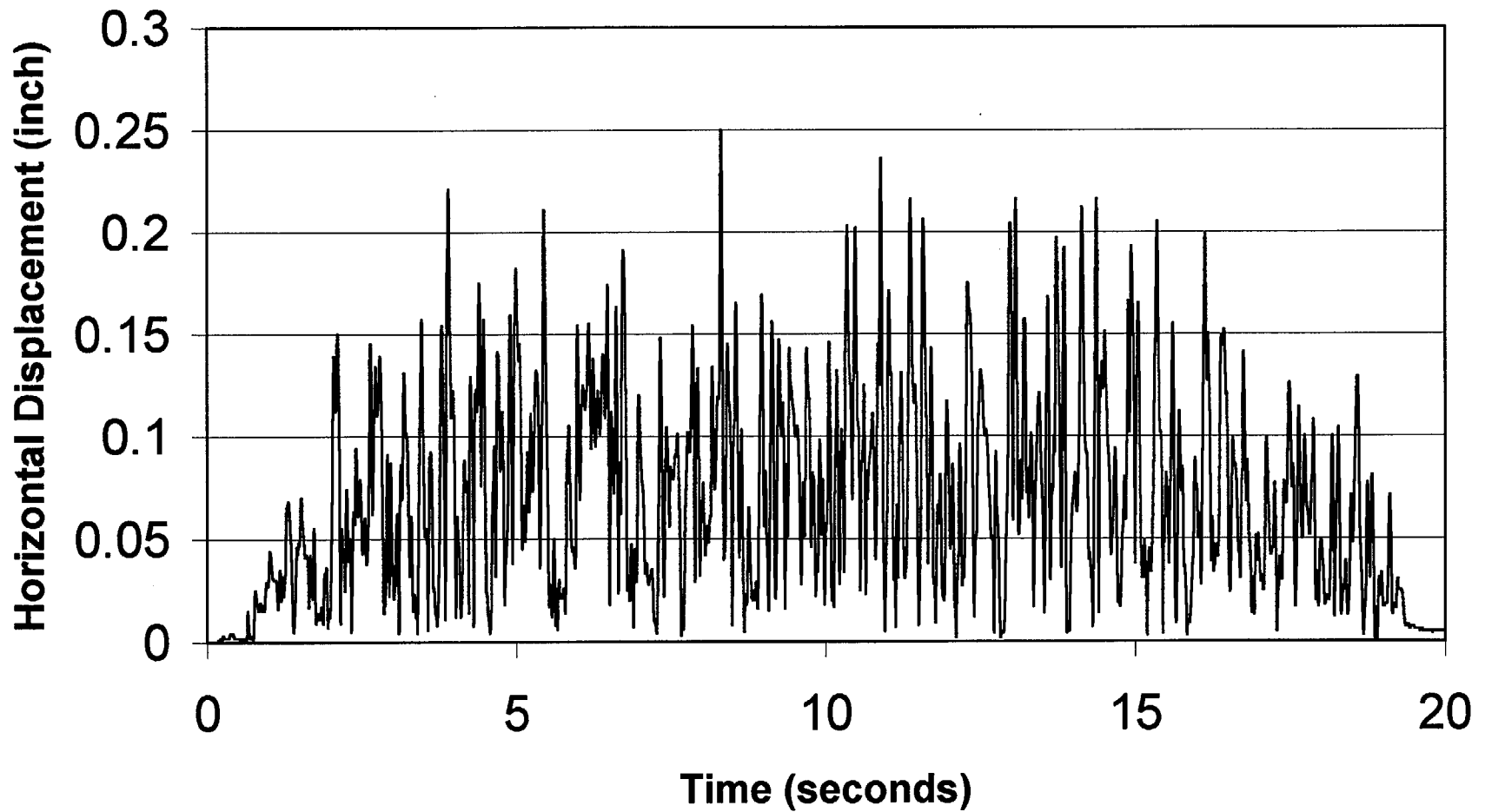


Figure N-67 - Run 352 - HI-STORM 100
Net Overpack-to-MPC Impact Force vs. Time



**Figure N-68 - Run 353 - HI-STORM 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-69 - Run 353 - HI-STORM 100 Overpack
Vertical Displacement vs. Time**

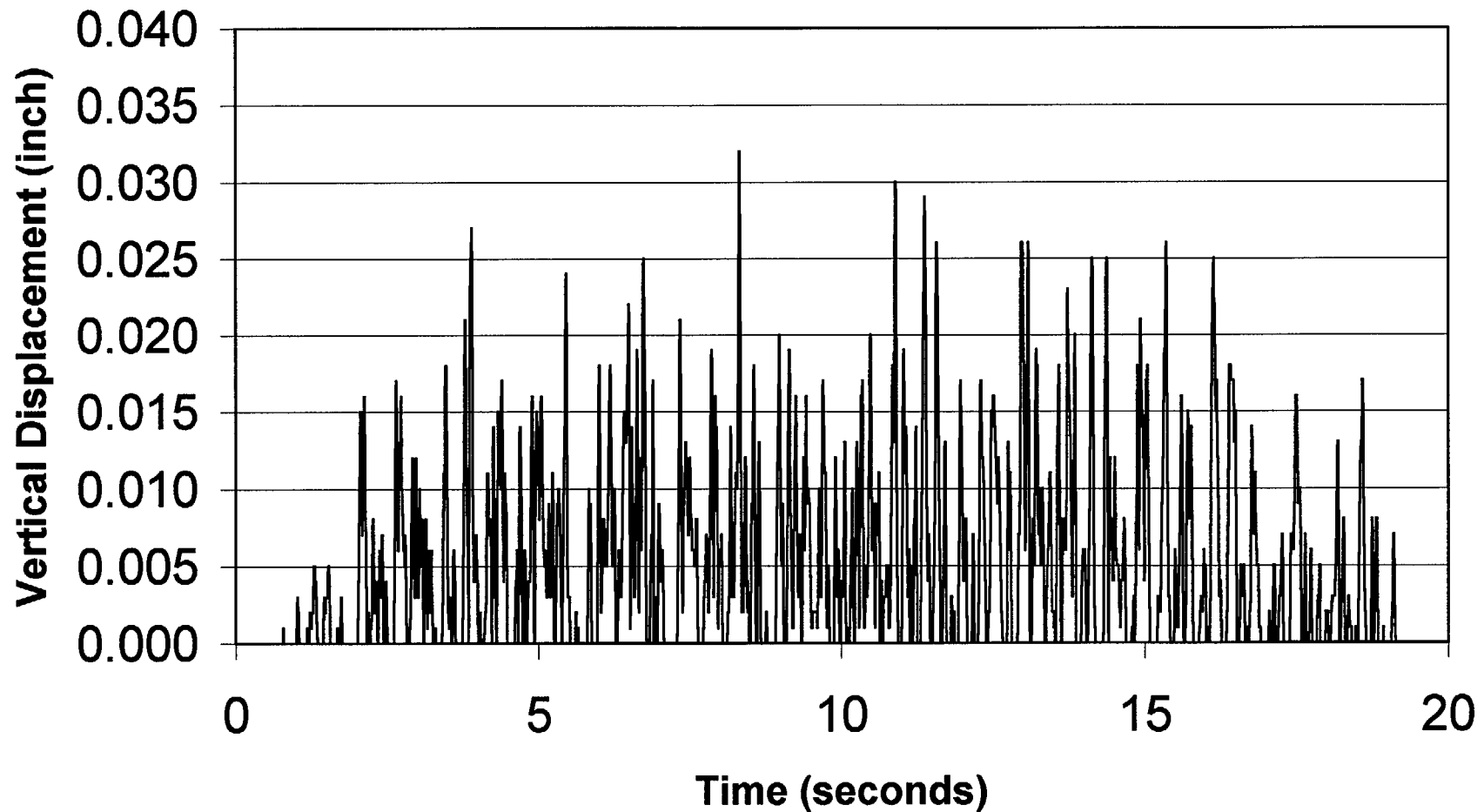


Figure N-70 - Run 353 - HI-STORM 100
Maximum Sector Lug Spring Tension vs. Time

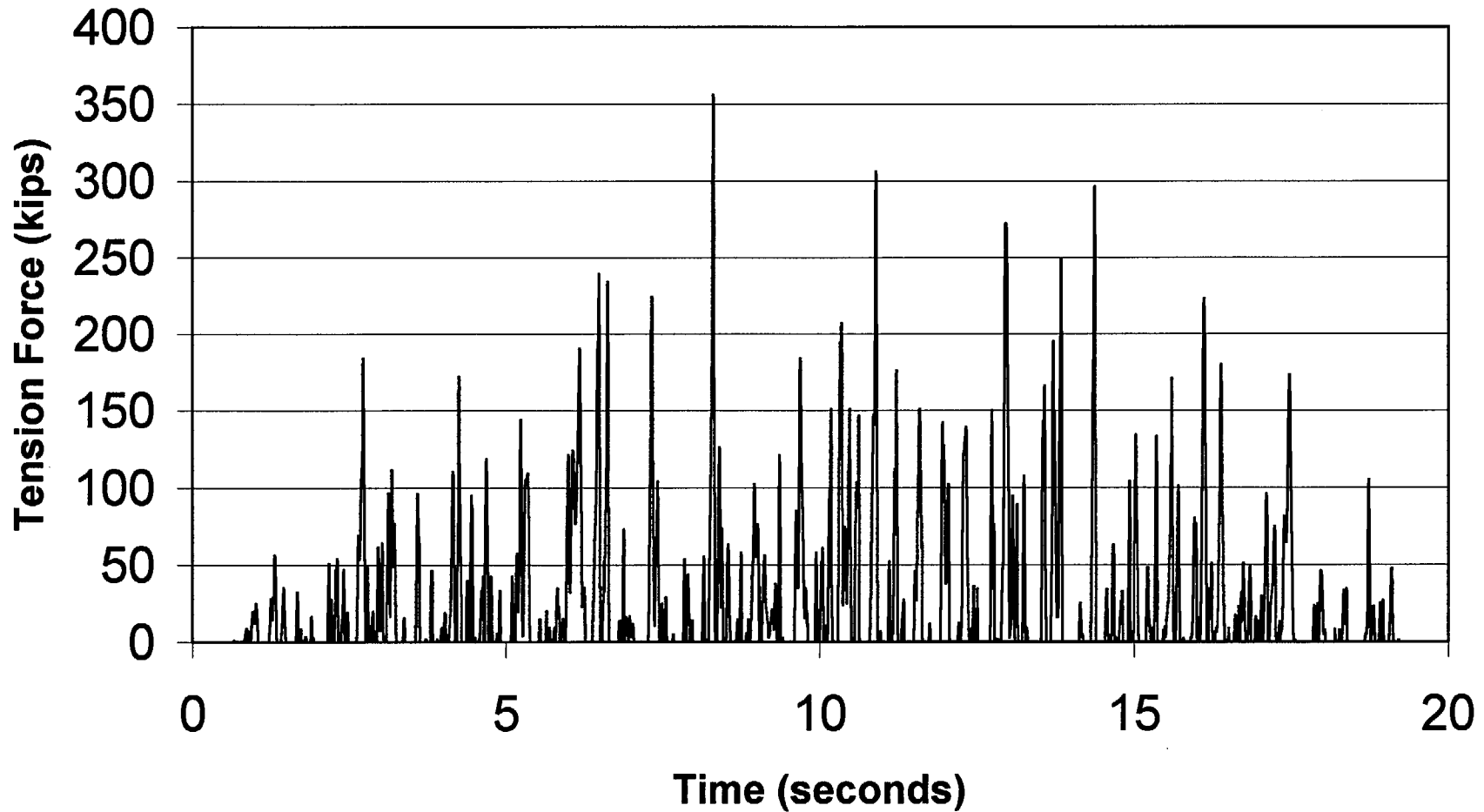
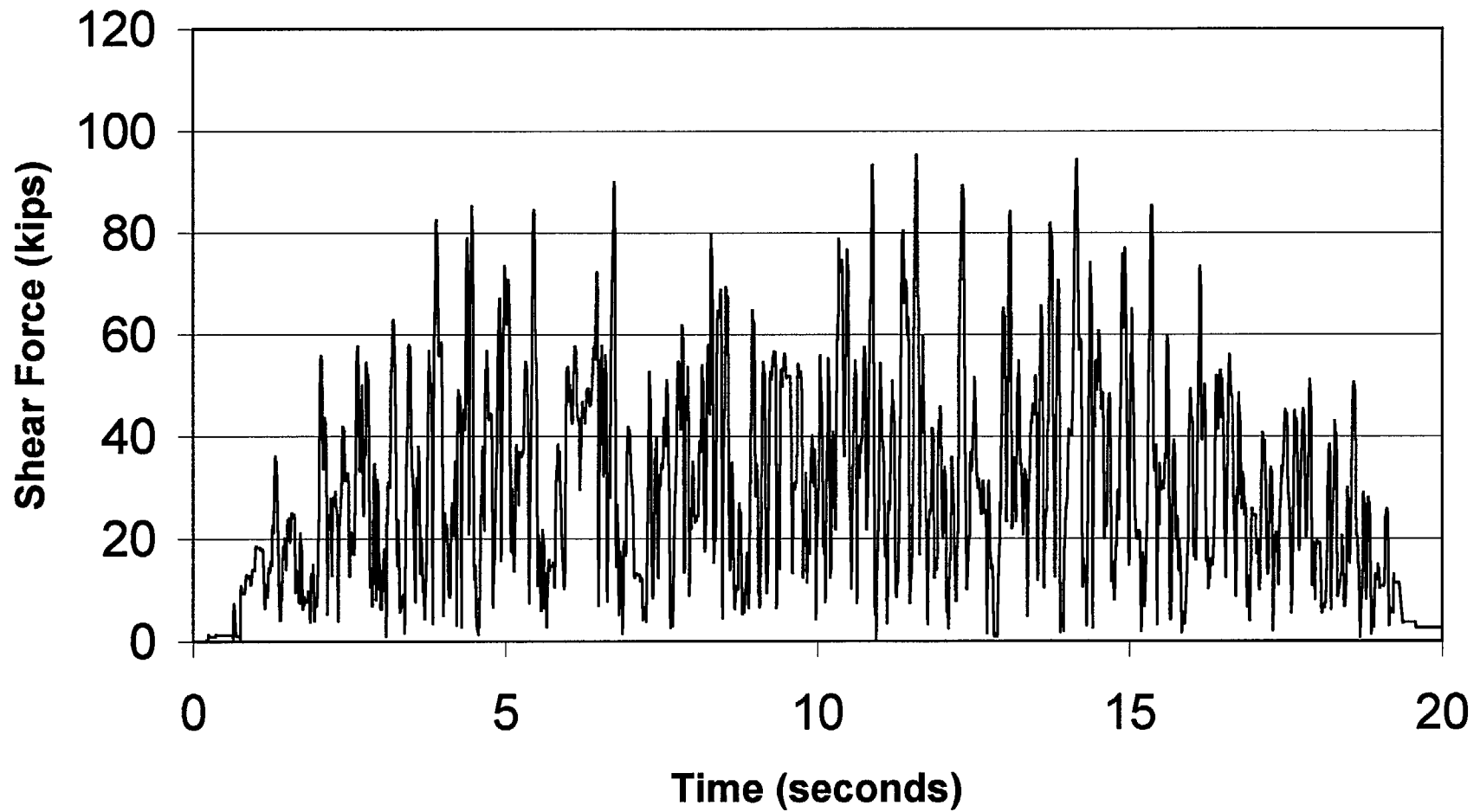


Figure N-71 - Run 353 - HI-STORM 100
Maximum Sector Lug Spring Net Shear vs. Time



**Figure N-72 - Run 353 - HI-STORM 100 Maximum
Compression Force at Any Location vs. Time**

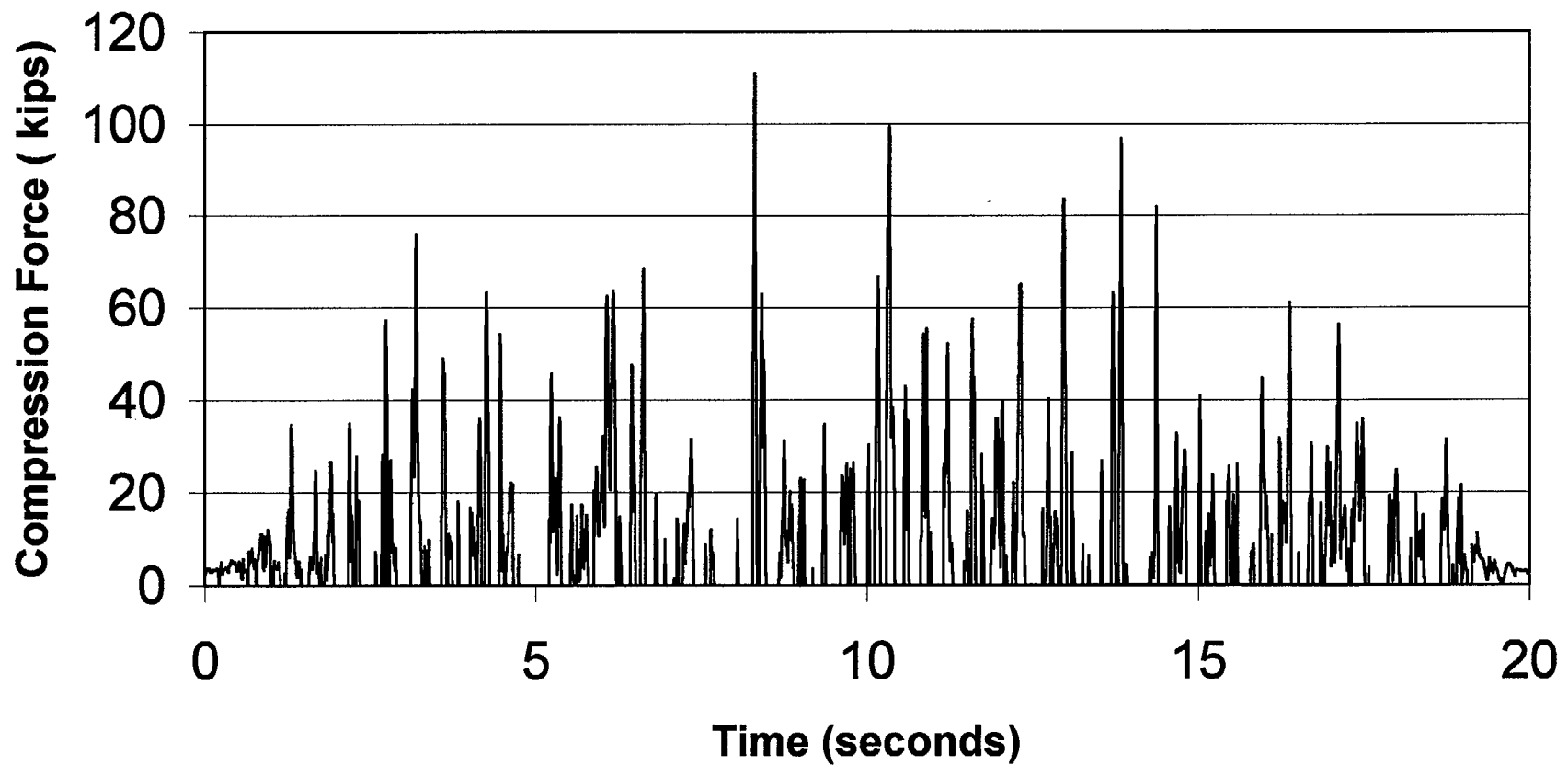
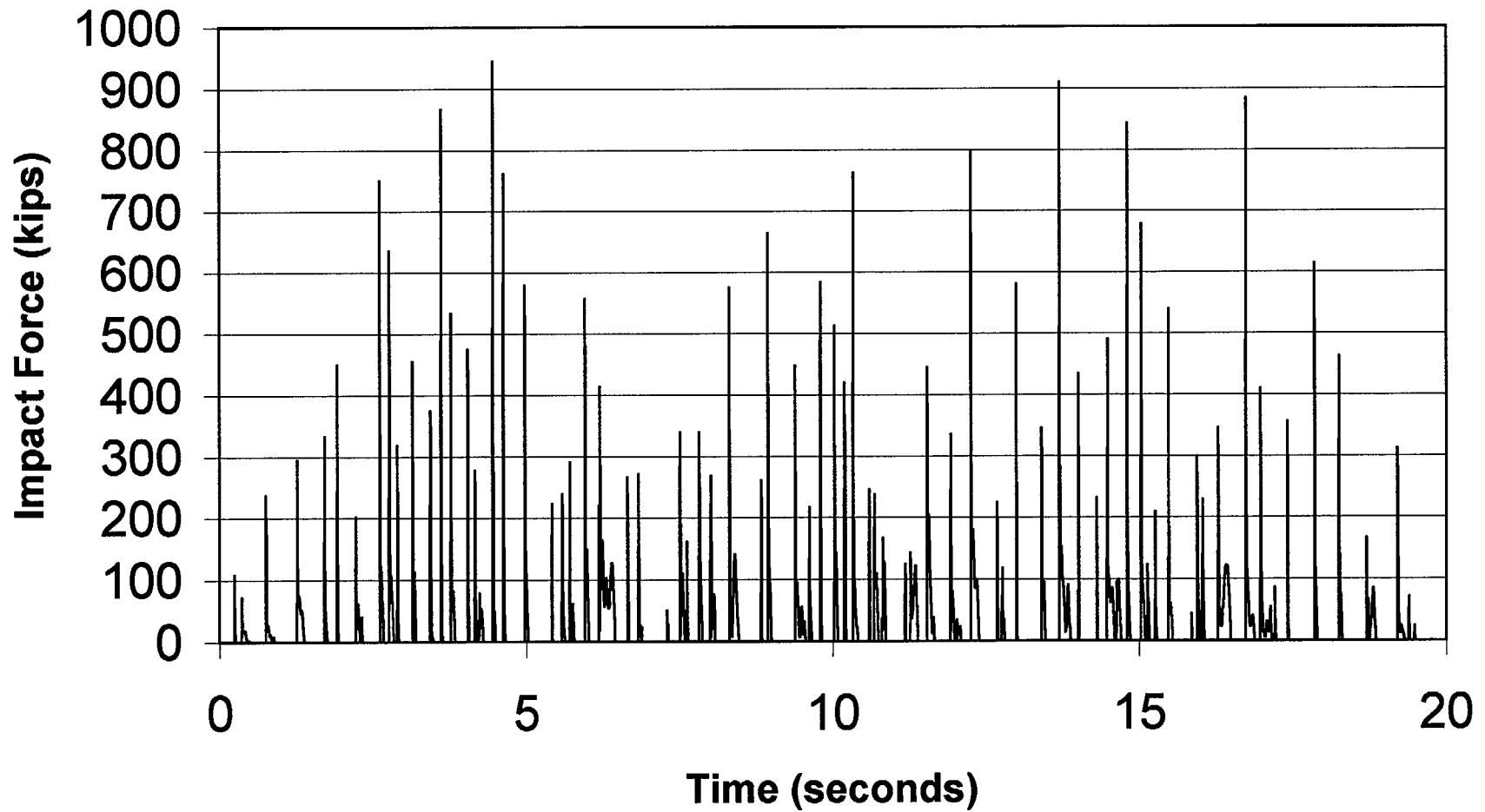
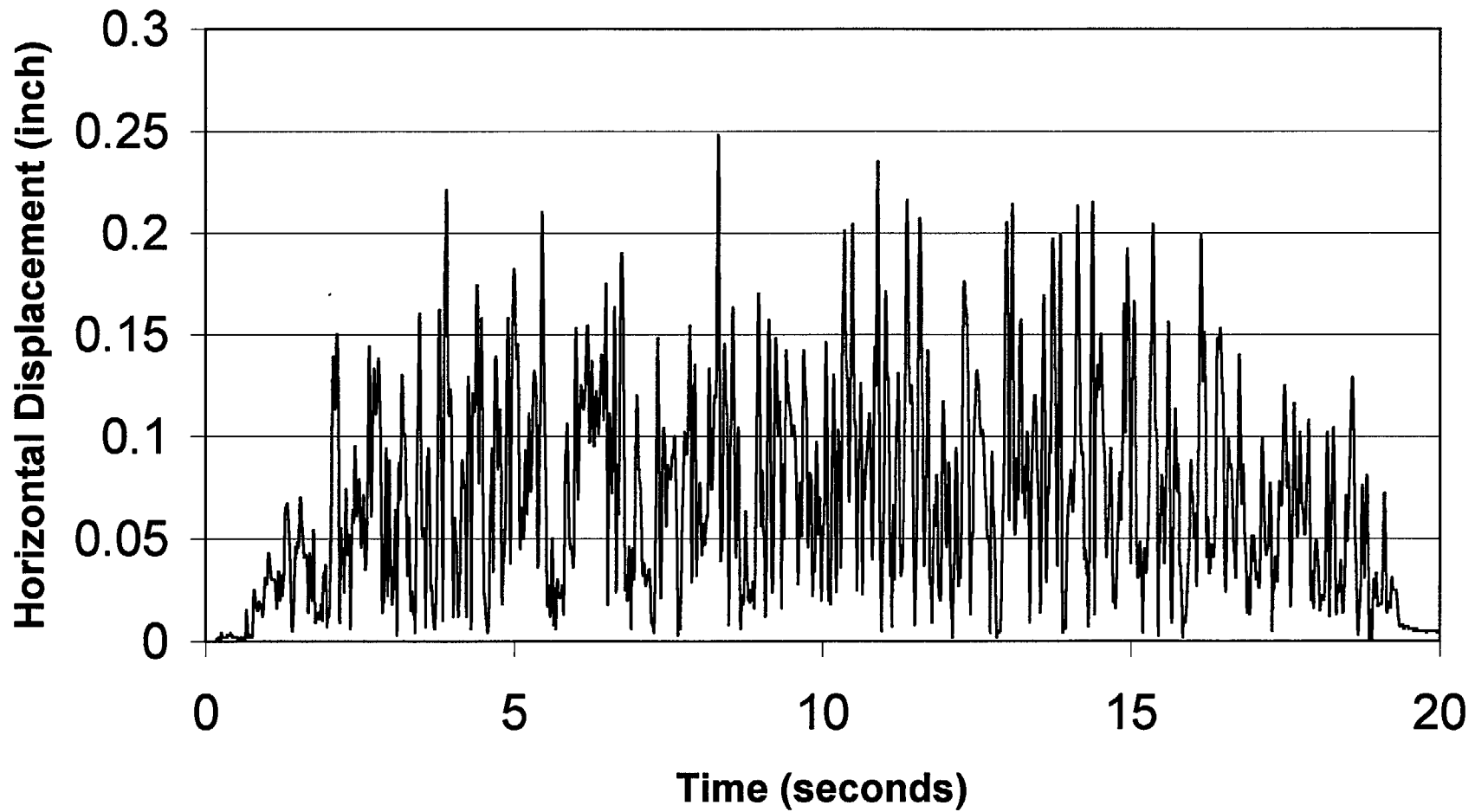


Figure N-73 - Run 353 - HI-STORM 100
Net Overpack-to-MPC Impact Force vs. Time



**Figure N-74 - Run 354 - HI-STORM 100 Overpack
Horizontal Displacement vs. Time**



**Figure N-75 - Run 354 - HI-STORM 100 Overpack
Vertical Displacement vs. Time**

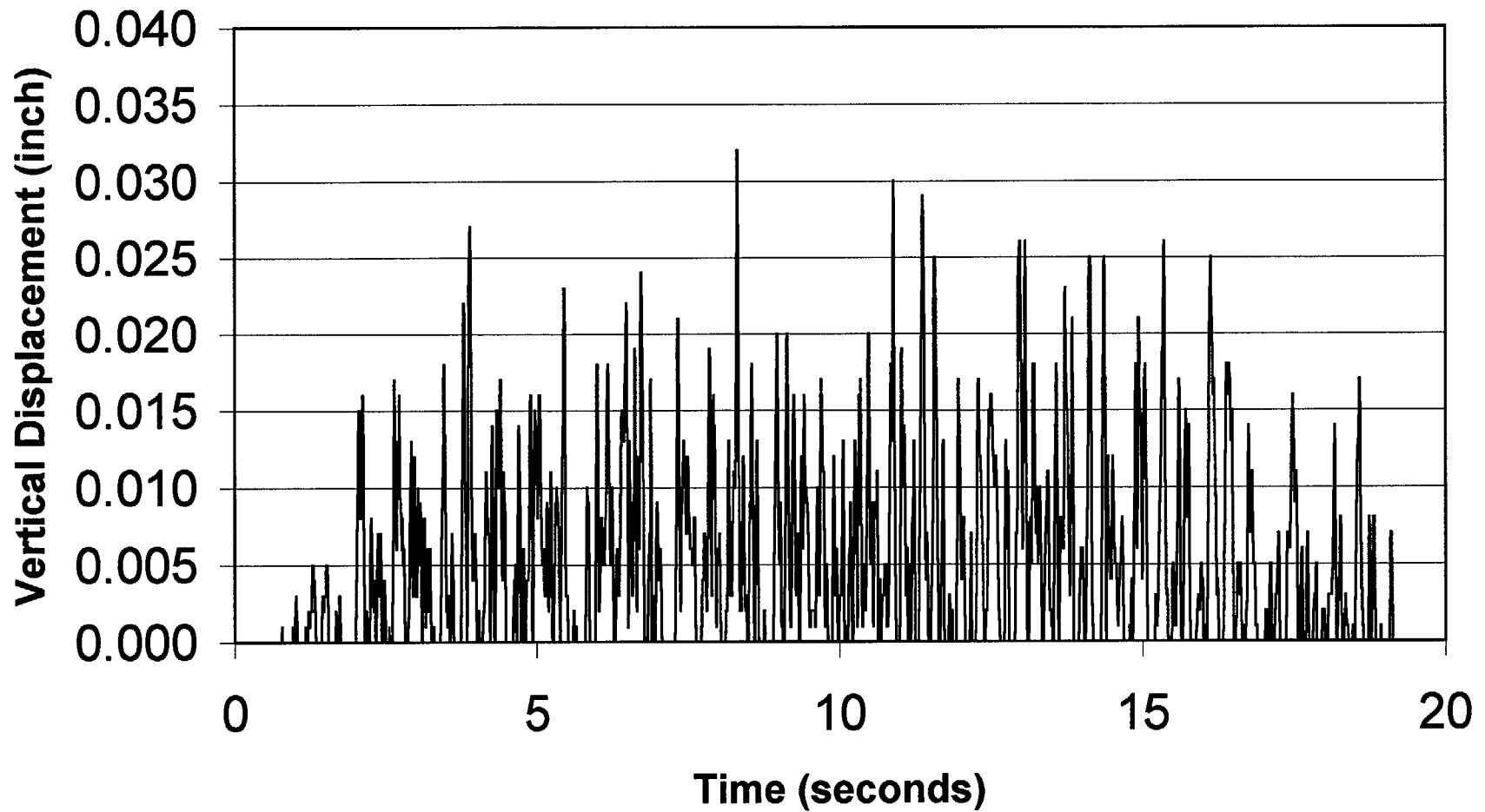


Figure N-76 - Run 354 - HI-STORM 100
Maximum Sector Lug Spring Tension vs. Time

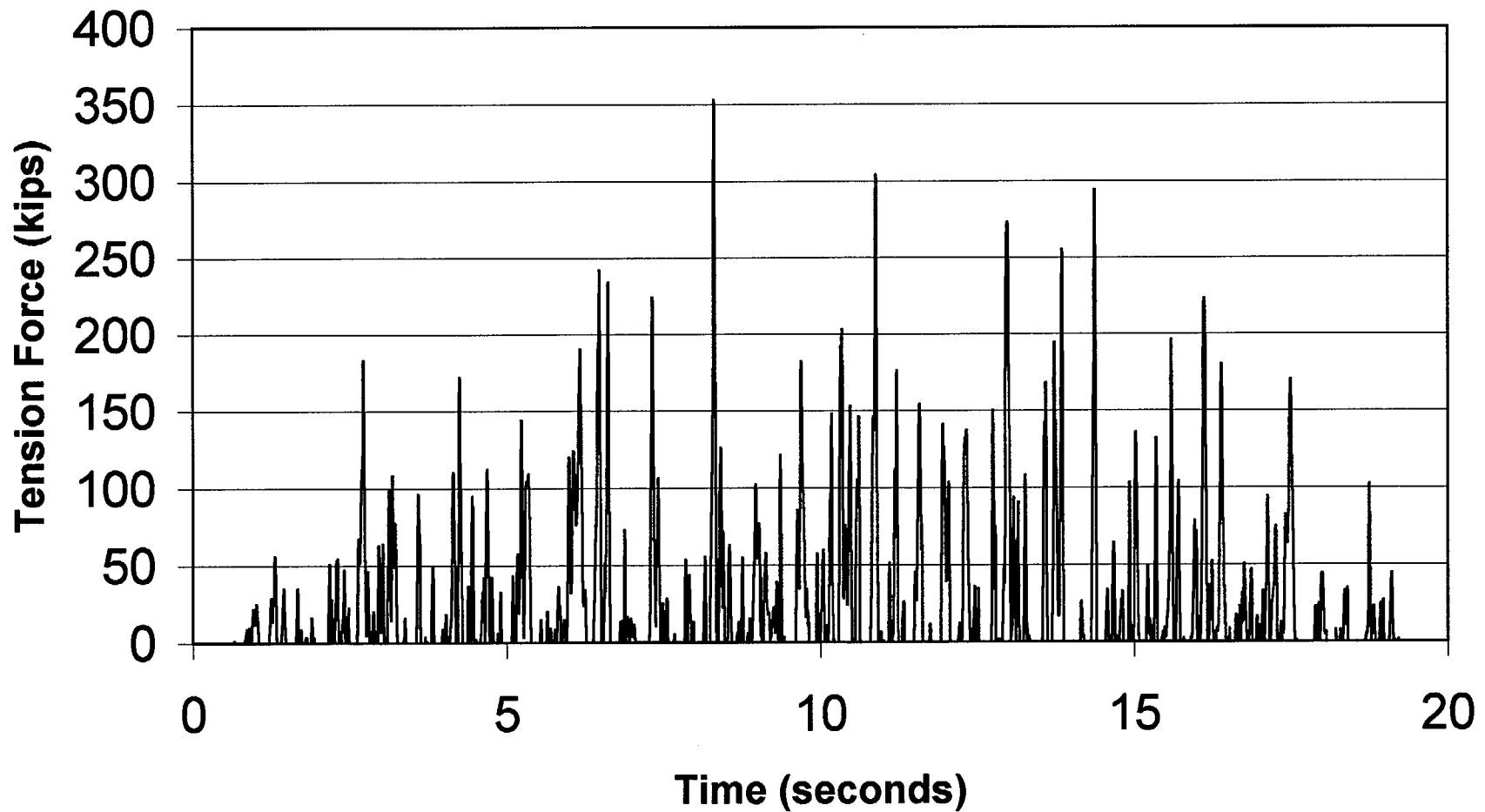
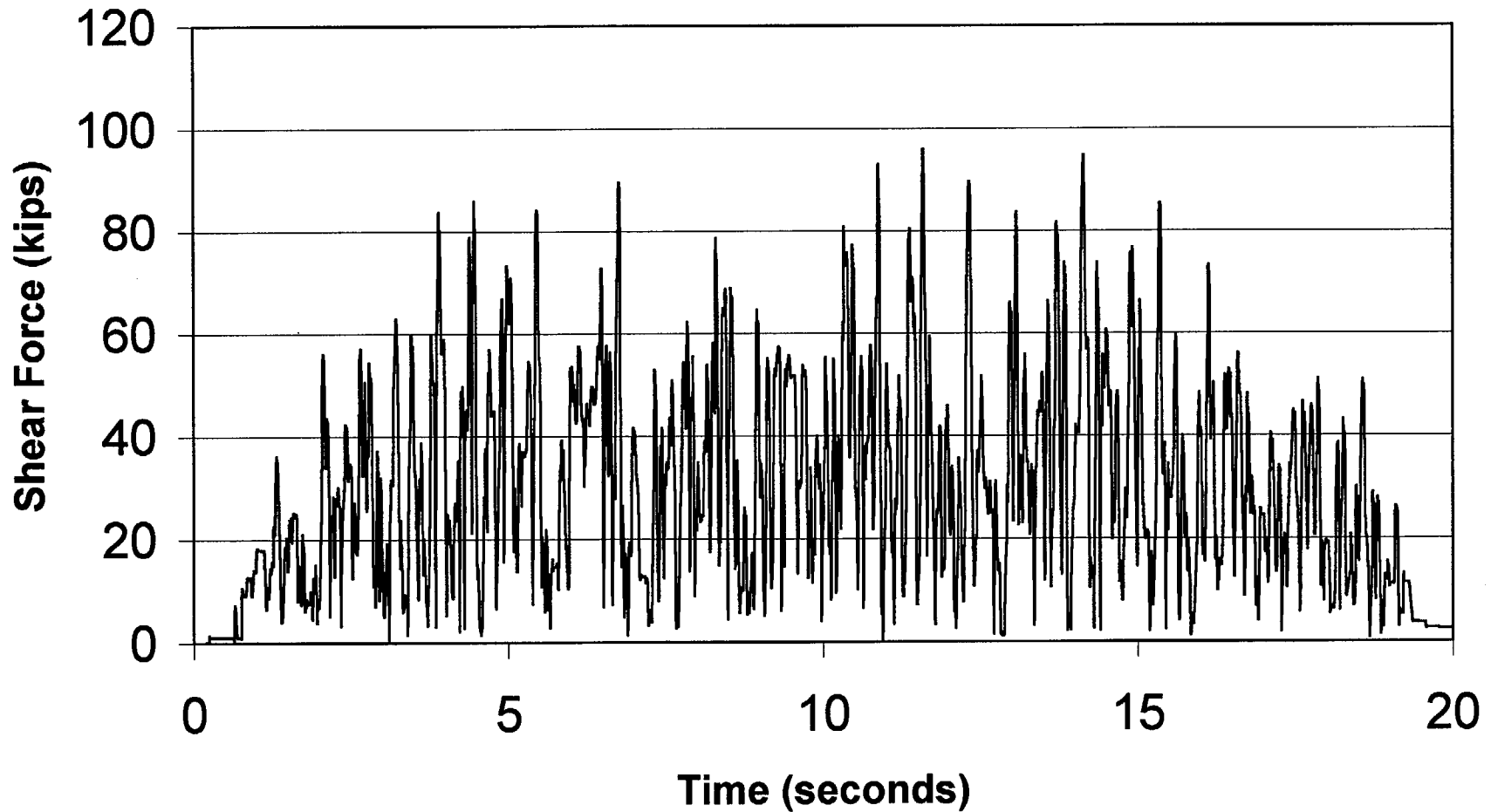


Figure N-77 - Run 354 - HI-STORM 100
Maximum Sector Lug Spring Net Shear vs. Time



**Figure N-78 - Run 354 - HI-STORM 100 Maximum
Compression Force at Any Location vs. Time**

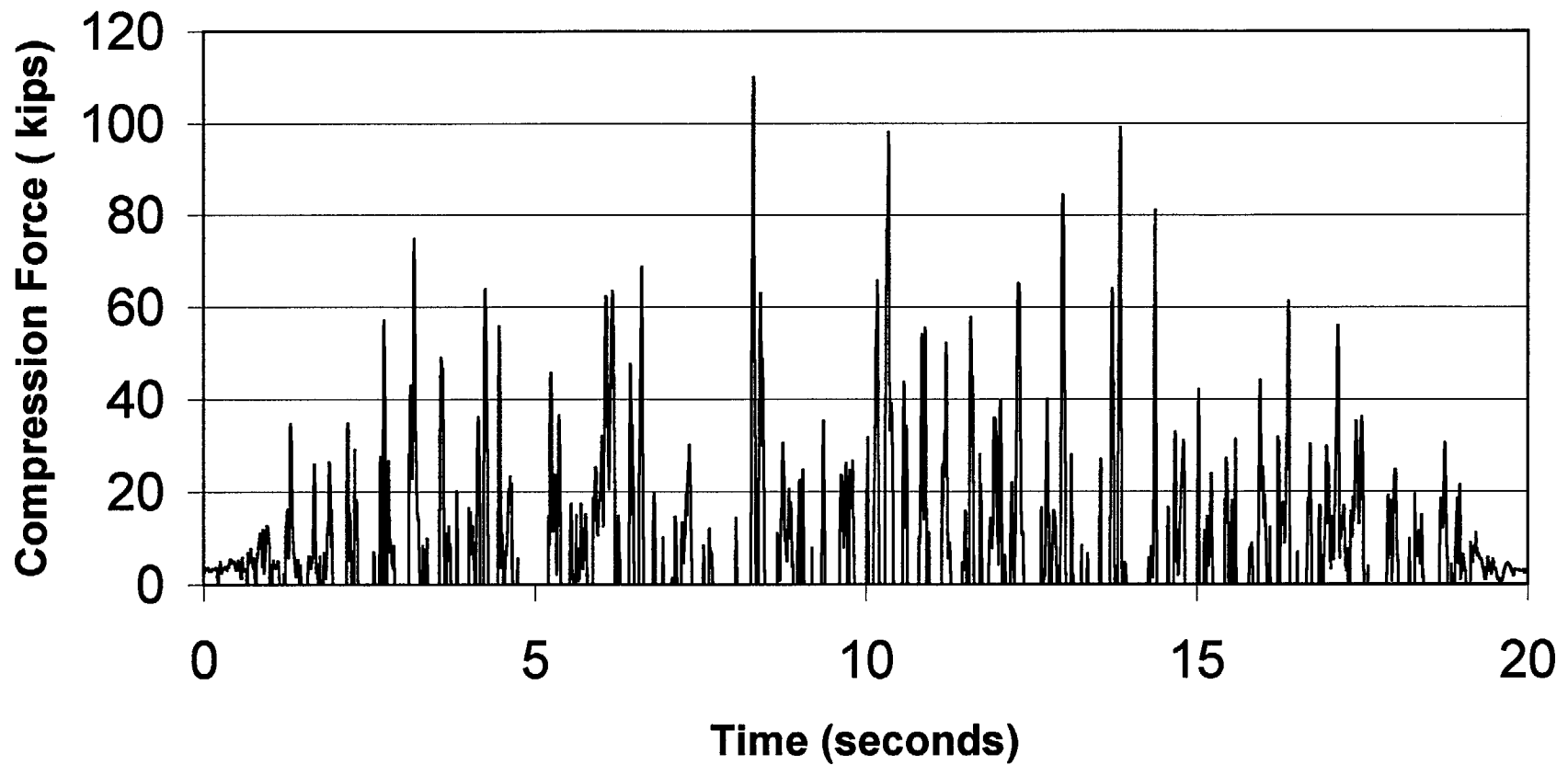


Figure N-79 - Run 354 - HI-STORM 100
Net Overpack-to-MPC Impact Force vs. Time

