**RJD INDUSTRIES, LLC.**

# FiberDowel™

## Corrosion Proof Dowel Bar System

U.S. Patent Number 5,791,816

**Engineering Data**

June 2006

**RJD Industries, LLC.**

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U.S. Patent Number 5,791,816

## Corrosion Proof Dowel Bar System

## Engineering Data

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**VER 1.242 8/15**

**FiberDowel being paved over by IL-DOT (9/97)**

# FiberDowel

Corrosion Proof - Transverse Joint Restraint System

## INTRODUCTION

This supplement to the general line catalog, developed for the RJD FiberDowel corrosion proof, transverse joint restraint system, is intended to respond to detailed technical inquiries from various engineering concerns, regarding the performance of the bar portion of the FiberDowel system. For FiberDowel commercial, installation and accessories information, this data should be reviewed in conjunction with the the general line catalog for the system.

All information contained herein, especially as related to technical aspects, such as test data, is considered to be "**Proprietary Information.**" Any type of copying, or use of this information for other than review and/or approval for use of the FiberDowel system, without the express written consent of RJD Industries, will be considered in violation of patent, commercial and manufacturing rights retained by RJD Industries.

In the construction of concrete slabs, either on grade, elevated, or otherwise, joints, known by such terminology as expansion, contraction, etc., are purposely positioned in the slab to control where cracks in, or movement of the slab will occur. These joints may be cut into the slab after the concrete material is placed and hardened, scribed into the concrete during placement, or defined by means of various joint making materials which are placed prior to the concrete placement.

In some cases, transverse joint restraint devices, dowel bars, are cast into the slabs so that the dowel bar longitudinal center is midpoint longitudinally and axially in the joint. These devices function, primarily, to restrain vertical movement between adjacent slabs, while permitting the slab to move horizontally. Current dowel bars, are Grade 60 (ASTM A615) plain uncoated steel or coated steel (zinc galvanized, epoxy or other coating material) of various cross sectional areas to accommodate anticipated loads. The coating for current, steel, dowel bars and dowel baskets is to prevent, or forestall corrosion, rusting, of the steel as a result of environmental or project conditions.

Dowel devices are delivered to the jobsite either as individual bars or assembles in sections known as baskets.

The FiberDowel is the answer to the aforementioned corrosion. In addition the material composition of the device makes it an electrical and thermal insulator.

The data following this introduction presents the case for the use of FiberDowel in applications where corrosion due to environmental or project conditions is a concern, or where other properties of FiberDowel lend themselves to use on a project.

For specific data relative to the characteristics of the FiberDowel resin and reinforcement, please see "SuperTie, Engineering Details."

# FiberDowel

## PRODUCT SPECIFICATION

The following is a synopsis of the FiberDowel bar and its properties, and functional and recommended uses as part of the RJD, FiberDowel System. The FiberDowel System serves the function of being a transverse joint restraint mechanism, used in the construction of concrete decks or slabs on ground.

### THE FiberDowel SYSTEM

The bar is a pultruded product composed of high quality continuous fiberglass filaments and a high quality polyester resin. The filaments are drawn through a resin bath, sized by an appropriate die, to form the product. A UV inhibitor is added to the resin, which makes the product resistant to the effects of direct sunlight indefinitely.

### Applicable Specifications

Specifications which FiberDowel Meets or has been tested to…

| Specification | Description | M/T |
|---|---|---|
| ASTM - A615 | Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. | T |
| ASTM - A663 | Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties. | M |
| ASTM - A775 | Standard Specifications for Epoxy-Coated Reinforcing Steel Bars. | M |
| ASTN - D3916 | “Standard Test Method of Tensile Properties of Pultruded Glass-Fiber-Reinforced Plastic Rod”. | T |
| ASTM - D3963 | Standard Test Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars. | M |
| AASHTO - M31 (ASTM A615) | Deformed and Plain Billet - Steel Bars for Concrete Reinforcement. | T |
| AASHTO - M284 (ASTM D3963) | Epoxy Coated Reinforcing Bars. | M |
| ASTM - T253 | Coated Dowel Bars | M |
| ACI - 325.9R-91 | “Guide For Construction Of Concrete Pavements And Concrete Bases”. | |
| FWHA - DTRS-57-91-C-0018 | Study and Evaluation of Fiber Composite Dowel Bar for use in Highways. | M |

## COMPONENTS OF THE ROD SYSTEM

**The Resin -** A blended unsaturated isophthalic polyester resin as manufactured by the Ashland Chemical Company.

**The Fiberglass Filament -** "E" type continuous fiberglass filaments.

## PROPERTIES OF THE SYSTEM

Concrete is an alkaline product with a Ph of 12/13 during hydration. Reactivity stops below a relative humidity of 80%.

The resin system is recommended for use in basic environments up to a Ph of 13 and acidic environments up to a Ph of 4. The resin resists water and the effects of extreme thermal changes and allows maximum protection from sunlight. The resin is used in the production of products for both the marine and construction industries. In the construction industry, the resin is used in the manufacturing of cultured marble and onyx, and of sanitary ware (acid resistant laboratory fixtures) as well as in the production of polymer concrete.

The "E" type fiberglass is commercially used in corrosive environments, with the exception of some concentrations of hydrofluoric acid. Since the "E" type glass is embedded in the resin, no alkali/silica reaction will occur. Performed tests illustrate this fact.

Having been tested in nuclear environments, the rod system has Tenth Value Layer (TVL) attenuation characteristics equivalent to concrete which has a unit weight of 150 pounds per cubic foot.

The combination of the two components which comprise the bar of the RJD, FiberDowel System, makes a unique product that, besides appropriate strengths for dowel applications, affords resistance to many of the negative aspects encountered when using metal concrete dowel products: rust, effects of freeze/thaw, effects of road salts, etc.

## QUALITY CONTROL

Rigorous Quality Control is maintained throughout our supply effort. During manufacture of the bar strength and hydraulic integrity are tested at random points throughout. Random samples from each run are sent to a certified testing laboratory as a function of further Quality Assurance.

## PRODUCT NUMBERS

FD0500 - Bar, .500” diameter, cut to any length.
FD0750 - Bar, .750” diameter, cut to any length.
FD0875 - Bar, .875” diameter, cut to any length.
FD1000 - Bar, 1.00” diameter, cut to any length.
FD1250 - Bar, 1.250” diameter, cut to any length.
FD1500 - Bar, 1.500” diameter, cut to any length.
FD1750 - Bar, 1.750” diameter, cut to any length.



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**FiberDowel Material Studied after 14 Years in use by O-DOT**

# FiberDowel

Corrosion Proof - Transverse Joint Restraint System

**Summary of Testing Procedure & Results**
**Bond Strength to Concrete**

## General

Since lateral movement of dowel material is desirable, testing was performed to determine the resistance to lateral forces of the FiberDowel system as compared to current dowel bar technology. There is no standard available for testing the bond strength to concrete of dowel bar material. To closely approximate the various dowel systems reaction to lateral stress, testing was performed in accordance with criteria as outlined in ASTM A 775 - 88a, specifically paragraph A.1.2.5., AASHTO M284 and similar to AASHTO T253. Specifically, paragraphs 5.1 through 5.4. One inch, grade 60, plain and epoxy coated steel dowel bar specimens were obtained from two recognized commercial sources. Epoxy coatings were applied by a certified applicator.

One inch (1") nominal FiberDowels (FRP) were as manufactured by RJD Industries.

Dowel material specimens were prepared as follows:

**Test # 1-5** = 5 each (bare) Steel, with no additional surface treatment.
**Test # 6-10** = 5 each Plain (bare) Steel, coated with petroleum grease. (Multipurpose lithium)
**Test # 11-15** = 5 each Epoxy Coated Steel, with no additional surface treatment.
**Test # 16-22** = 7 each FiberDowels (FRP), with no additional surface treatment.

Since loads to effect specimen movement were determined to be in the 0 to 3000 pound range, a 12 ton calibrated hollow core plunger hydraulic cylinder (Enerpac, RCH-121), with a 0 to 3000 psi liquid filled gauge were employed. In order to utilize this hollow core ram set up (maximum cylinder bore .77"), specimen ends were drilled to accommodate a 5/8" all thread rod, which will, fit through the cylinder bore. The specimens were drilled and tapped in the case of steel specimens and drilled, and the all thread rod epoxied into the resultant cavity, in the case of the FRP specimens.

All rod specimens were measured at both ends, and in the center to determine specimen circumferential dimensional, concentricity values, and tolerances.

Please see attached data sheets for specimen dimensional data.

All dowel bar specimens were cast in 3000 psi nominal concrete prisms, so that an imbedded length of 12" was achieved, with enough material not imbedded to enable loading and deflection measurements. Concrete sampling and testing were performed in accordance with applicable ASTM standards.

(Continued on next page)

**Summary Of Testing Procedure & Results - Bond Strength to Concrete** (continued**)**

After the concrete prisms had reached desired strength, each dowel bar/concrete prism specimen was subjected to axial tensile loading utilizing a calibrated hollow core ram. A bridging device was employed to allow free spalling of concrete at the load end. Loads, and corresponding free end deflections, were recorded at crucial points. Loading was continuous until a maximum of .005" deflection, measured at the free end, or free dowel bar movement occurred.

Results were calculated to reflect maximum loading versus material imbed area.

Plain (bare) Steel, with no additional surface treatment = 220 psi. Plain (bare) Steel, coated with petroleum grease = 10 psi.
Epoxy Coated Steel, with no additional surface treatment = 63 psi.
FiberDowels (FRP), with no additional surface treatment = 15 psi.

For dowel applications, it is clear that the lateral resistance afforded by the FiberDowel is significantly less than that of the Plain (bare) Steel or the Epoxy Coated Steel. Where less lateral resistance is a prerequisite, selection of the FiberDowel would eliminate the necessity to coat the dowel material with any material to induce slippage.

Please see attached data sheets which record test results used in the calculations to determine comparison immediately above (maximum load/area of specimen bonding to concrete = bond strength, psi).

**DBBS1196**

## Load Test Data

**1**) Bond Strength to Concrete 12/01/1995
Rod Specimen Dimensional Data: All Bars 24" Long

Measurements taken at three positions, ends and center of specimens.

| Test# | Type Specimen | Average Diameter Inches | Average Eccentricity Inches |
|---|---|---|---|
| 1 | Bare Steel | 1.012 | 0.000 |
| 2 | | 0.999 | 0.004 |
| 3 | | 1.011 | 0.003 |
| 4 | | 1.000 | 0.001 |
| 5 | | 1.000 | 0.005 |
| 6 | Steel/Grease | 0.999 | 0.001 |
| 7 | | 1.000 | 0.005 |
| 8 | | 1.000 | 0.003 |
| 9 | | 0.996 | 0.001 |
| 10 | | 1.103 | 0.000 |
| 11 | Epoxy Coated | 1.024 | 0.000 |
| 12 | | 1.020 | 0.002 |
| 13 | | 1.022 | 0.002 |
| 14 | | 1.020 | 0.000 |
| 15 | | 1.020 | 0.006 |
| 16 | FRP - FiberDowel | 0.973 | 0.000 |
| 17 | | 0.972 | 0.000 |
| 18 | | 0.972 | 0.000 |
| 19 | | 0.972 | 0.000 |
| 20 | | 0.971 | 0.000 |
| 21 | | 0.972 | 0.000 |
| 22 | | 0.974 | 0.000 |

## Load Test Data Continued

**2)** Bond Strength to Concrete Tensile, 1/14/96
Test Equipment - 12t Calibrated Hollow Core Ram Specimen - See

Data Sheet Imbed Length: 12" All Specimens

| Test # | Type Specimen | Load At Max. Defl. | Avg. Load Hi/Lo Out | Imbed Area Sq. Inches | Bond Strength (psi) |
|---|---|---|---|---|---|
| 1 | Bare Steel | 4968 | | 37.7 | |
| 2 | | 7176 | | | |
| 3 | | 8832 | | | |
| 4 | | 8832 | | | |
| 5 | | 8832 | | | |
| | **Summary 1 - 5** | | **8280** | **37.7** | **220** |
| 6 | Steel/Grease | 552 | | 37.7 | |
| 7 | | 276 | | | |
| 8 | | 276 | | | |
| 9 | | 552 | | | |
| 10 | | 276 | | | |
| | **Summary 5 - 10** | | **368** | **37.7** | **10** |
| 11 | Epoxy Coated | 2208 | | 37.7 | |
| 12 | | 2760 | | | |
| 13 | | 2760 | | | |
| 14 | | 2208 | | | |
| 15 | | 2208 | | | |
| | **Summary 11 - 15** | | **2392** | **37.7** | **63** |
| 16 | FRP - FiberDowel | 552 | | 36.6 | |
| 17 | | 552 | | | |
| 18 | | 552 | | | |
| 19 | | 552 | | | |
| 20 | | 552 | | | |
| | | | | | |
| | | | | | |
| 21 | | 552 | | | |
| 22 | | 552 | | | |
| | Summary 16 – 22 | | 552 | 36.6 | 15 |

# FiberDowel

Corrosion Proof - Transverse Joint Restraint System

**Synopsis of Certified Testing -** Details of testing follows.

**Tensile, Shear and Elongation**

Testing Agency - Twining Laboratories, Long Beach, California (*****)
Smith Emery, Los Angeles, CA (*******)
Testing Criteria - ASTM D3916 (Tensile)
- Shear testing was performed using a fixture to accomplish single shear across the longitudinal fiber reinforcement axis.

| Test Results: | Tensile Tests - | | | Single Shear Tests - | |
|---|---|---|---|---|---|
| FiberDowel | Avg. Load | Elongation | Failure Mode | Avg. Load | Failure Mode |
| * .500" | * 20157# | * 0.08% | * Tensile of FiberDowel | ** 6700# | ** Shear. |
| * .750" | * 39086# | * 0.09% | * Tensile of FiberDowel | * 20467# | * Shear. |
| .875" | 53,193# | 0.09% | Tensile of FiberDowel | 25500# | Shear. |
| * 1.000" | * 64413# | * 0.08% | * Tensile of FiberDowel | * 28700# | * Shear. |
| 1.250” | 104300# | 0.24% | Tensile of FiberDowel | 30692# | Shear. |
| 1.500" | 141723# | 0.39% | Tensile of FiberDowel | 32882# | Shear. |
| 1.750" | 192400# | 0.39% | Tensile of FiberDowel | 43300# | Shear. |

**Detailed data for this chart found on page 11**

**DBSTR0799**

**Twining Laboratories** *of Southern California, Inc.*

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Long Beach, CA 90806
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August 21 , 1996

Exam # 96-9-001536
Page 1 of 3

RJD Industries , Inc.
26945 Cabot Rd. Unit 105
Laguna Hills , CA 92653

Attention : Mr. James P. McCallion

Subject : Tensile , Modulus of Elasticity and Shear tests of FRP Rod Specimens and Shear tests of Steel Bar Specimens .

Specifications : Tensile and Modulus Tests per ASTM D 3916 and Shear Tests per Client's instructions .

Test Machine Utilized : 600,000 lb. Capacity Satec U.T.M. S/N 1022 , last calibrated March 22 , 1996 with N.I.S.T. traceable standards .

Test Personnel : G. Lujan and J. McDowell / TLSC

Test results from various dates of tests have been compiled and are presented on tables on the following two pages .

The opportunity to be of service is greatly appreciated . If you have any questions , or if we may be of further service , do not hesitate to call .

Respectfully Submitted ,

Jay McDowell
Director of Testing
Twining Laboratories of Southern California , Inc.

RJD/jmc

**Twining Laboratories of So. Cal., Inc/RJD Industries, Inc.**

8/21/96

Exam # 96-9-001536


## TENSILE TEST RESULTS OF FRP ROD SPECIMENS - ASTM D3916

| Specimen Number | Nominal Dia. In. | Actual Dia. In. | Area Sq. In. | Ultimate Load - Lbs. | Tensile Stress - PSI |
|---|---|---|---|---|---|
| 10 | 0.5000 | 0.5015 | 0.1975 | 21374 | 108220 |
| 11 | 0.5000 | 0.5015 | 0.1975 | 20138 | 101950 |
| 12 | 0.5000 | 0.5012 | 0.1973 | 18959 | 96094 |
| | | | | | |
| 10 | 0.7500 | 0.7350 | 0.4453 | 41669 | 93569 |
| 11 | 0.7500 | 0.7530 | 0.4453 | 38069 | 85484 |
| 12 | 0.7500 | 0.7515 | 0.4436 | 37520 | 84589 |
| | | | | | |
| 10 | 1.0000 | 0.9701 | 0.7391 | 67018 | 90670 |
| 11 | 1.0000 | 0.9713 | 0.7410 | 62979 | 84996 |
| 12 | 1.0000 | 0.9703 | 0.7392 | 63243 | 85528 |
| | | | | | |
| 15 | 1.5000 | 1.4953 | 1.7561 | 144660 | 82378 |
| 16 | 1.5000 | 1.4945 | 1.7542 | 142890 | 81453 |
| 17 | 1.5000 | 1.7495 | 1.7495 | 137620 | 78660 |

## MODULUS OF ELASTICITY TEST RESULTS OF FRP ROD SPECIMENS - ASTM D3916

| Specimem Number | Nominal Dia. In. | Actual Dia. In. | Area Sq. In. | Ultimate Load - Lbs. | Tensile Stress - PSI | Elongation % | MOE MSI |
|---|---|---|---|---|---|---|---|
| 8 | 0.5000 | 0.5015 | 0.1975 | 19658 | 99517 | 0.076 | 6.2 |
| 9 | 0.5000 | 0.5012 | 0.1973 | 20960 | 104870 | 0.090 | 6.2 |
| | | | | | | | |
| 8 | 0.7500 | 0.7510 | 0.4430 | 46293 | 104510 | 0.079 | 5.2 |
| 9 | 0.7500 | 0.7390 | 0.4439 | 45105 | 101610 | 0.109 | 5.3 |
| | | | | | | | |
| 7 | 1.0000 | 0.9713 | 0.7394 | 66539 | 89986 | 0.094 | 6.0 |
| 9 | 1.0000 | 0.9700 | 0.7390 | 65204 | 88235 | 0.091 | 6.0 |
| | | | | | | | |
| 6 | 1.5000 | 1.4932 | 1.7512 | 134440 | 76772 | 0.219 | 5.2 |
| 9 | 1.5000 | 1.4933 | 1.7514 | 137000 | 78226 | o.179 | 5.0 |

**Twining Laboratories of So. Cal , Inc. / RJD Industries, Inc.**

8/21/96

Exam # 96-9-001536


## SHEAR TEST RESULTS OF FRP ROD SPECIMENS - SINGLE SHEAR FIXTURE

| Specimen Number | Nominal Dia. In. | Actual Dia. In. | Area Sq. In. | Ultimate Load - Lbs. | Shear Stress - PSI |
|---|---|---|---|---|---|
| 1 | 0.7500 | 0.7528 | 0.4440 | 21000 | 47300 |
| 2 | 0.7500 | 0.7530 | 0.4450 | 19900 | 44720 |
| 3 | 0 .7500 | 0.7572 | 0.4430 | 20500 | 46280 |
| | | | | | |
| 1 | 1.0000 | 0.9700 | 0.7380 | 30300 | 41060 |
| 2 | 1.0000 | 0.9703 | 0.7390 | 28600 | 38700 |
| 3 | 1.0000 | 0.9702 | 0.7390 | 27200 | 36810 |
| | | | | | |
| 11 | 1.5000 | 1.4923 | 1.7490 | 33982 | 19429 |
| 12 | 1.5000 | 1.4935 | 1.7519 | 31782 | 18142 |

NOTE: Please see previous test results prepared by Smith Emery for shear values for .500" diameter FRP rod.

## SHEAR TEST RESULTS OF STEEL DOWEL BAR SPECIMENS - SINGLE SHEAR FIXTURE

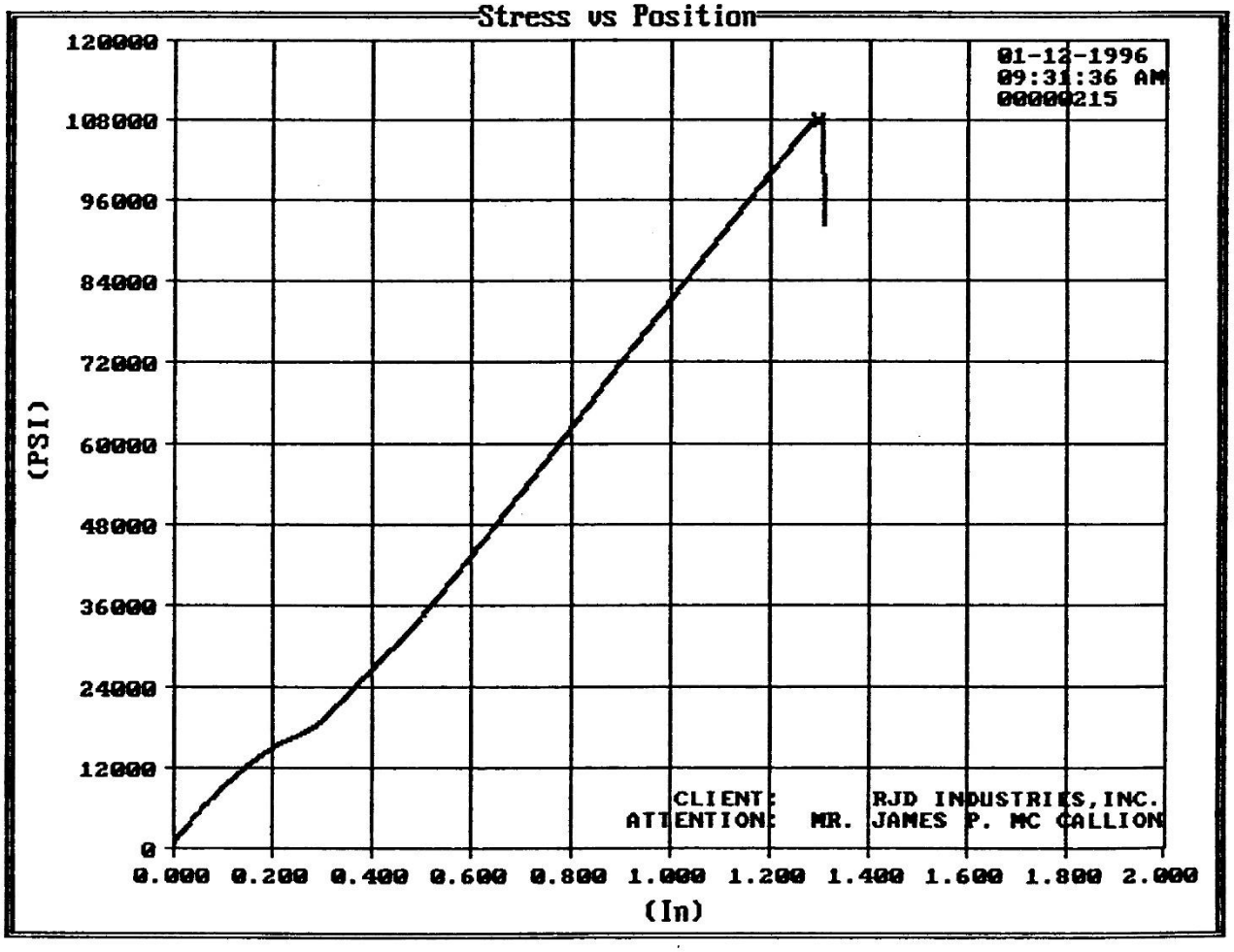
| Specimen Number | Nominal Dia. In. | Actual Dia. In. | Area Sq. In. | Ultimate Load - Lbs. | Shear Stress - PSI |
|---|---|---|---|---|---|
| 1 | 1.0000 | 0.9928 | 0.774 | 64900 | 83900 |
| 2 | 1.0000 | 0.9922 | 0.774 | 63500 | 80900 |

| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 0.500 |
| SPECIMEN NUMBER: | 10 |
| ACTUAL AVG. DIAMETER,IN.: | 0.5015 |

| | |
|---|---|
| Test | Gentest |
| Procedure | FRP DOWEL BAR ASTM D 3916 |

| | | | |
|---|---|---|---|
| Test Date | 01-12-1996 | Tested By | G. LUJAN |
| Test Time | 09:31:36 AM | Test Counter | 00000215 |
| Elapsed Time | 00:06:33 | Datasets | 3932 |
| | | Area | 0.1975 In² |
| ULT. LOAD LBS. | 21378 Lbs | TENSILE STRESS | 108220 PSI |
| POS.@TENSILE | 1.30035 In | ELONG.IN 37.5IN | 3.4667 % |

Event Markers: Stress (PSI) Position (In)

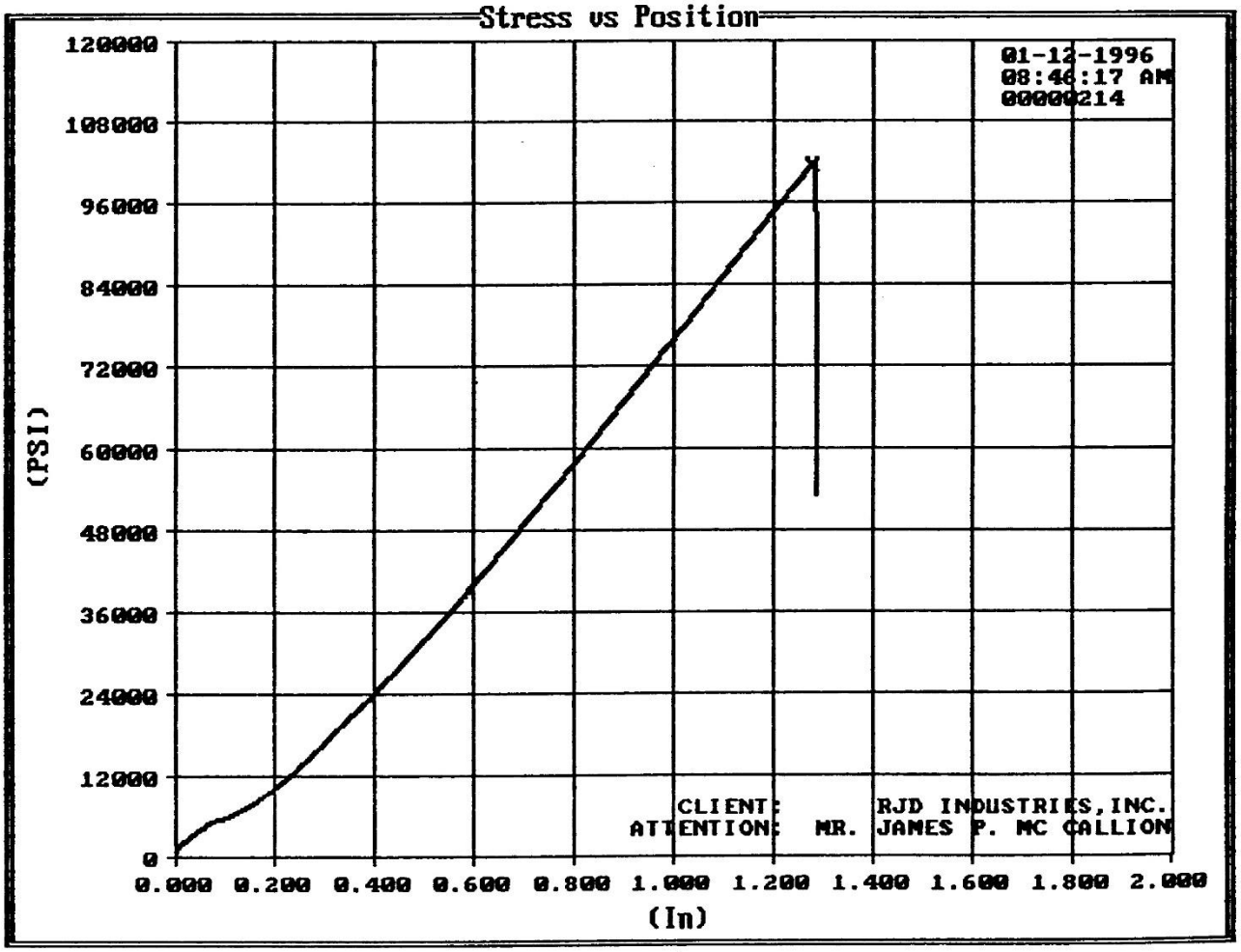


| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 0.500 |
| SPECIMEN NUMBER: | 11 |
| ACTUAL AVG. DIAMETER,IN.: | 0.5015 |

| | |
|---|---|
| Test Procedure | Gentest<br>FRP DOWEL BAR ASTM D 3916 |

| | | | |
|---|---|---|---|
| Test Date | 01-12-1996 | Tested By | G. LUJAN |
| Test Time | 08:46:17 AM | Test Counter | 00000214 |
| Elapsed Time | 00:06:25 | Datasets | 3858 |
| | | Area | 0.1975 In² |
| ULT. LOAD LBS. | 20138 Lbs | TENSILE STRESS | 101950 PSI |
| POS.@TENSILE | 1.28285 In | ELONG.IN 37.5IN | 3.4213 % |

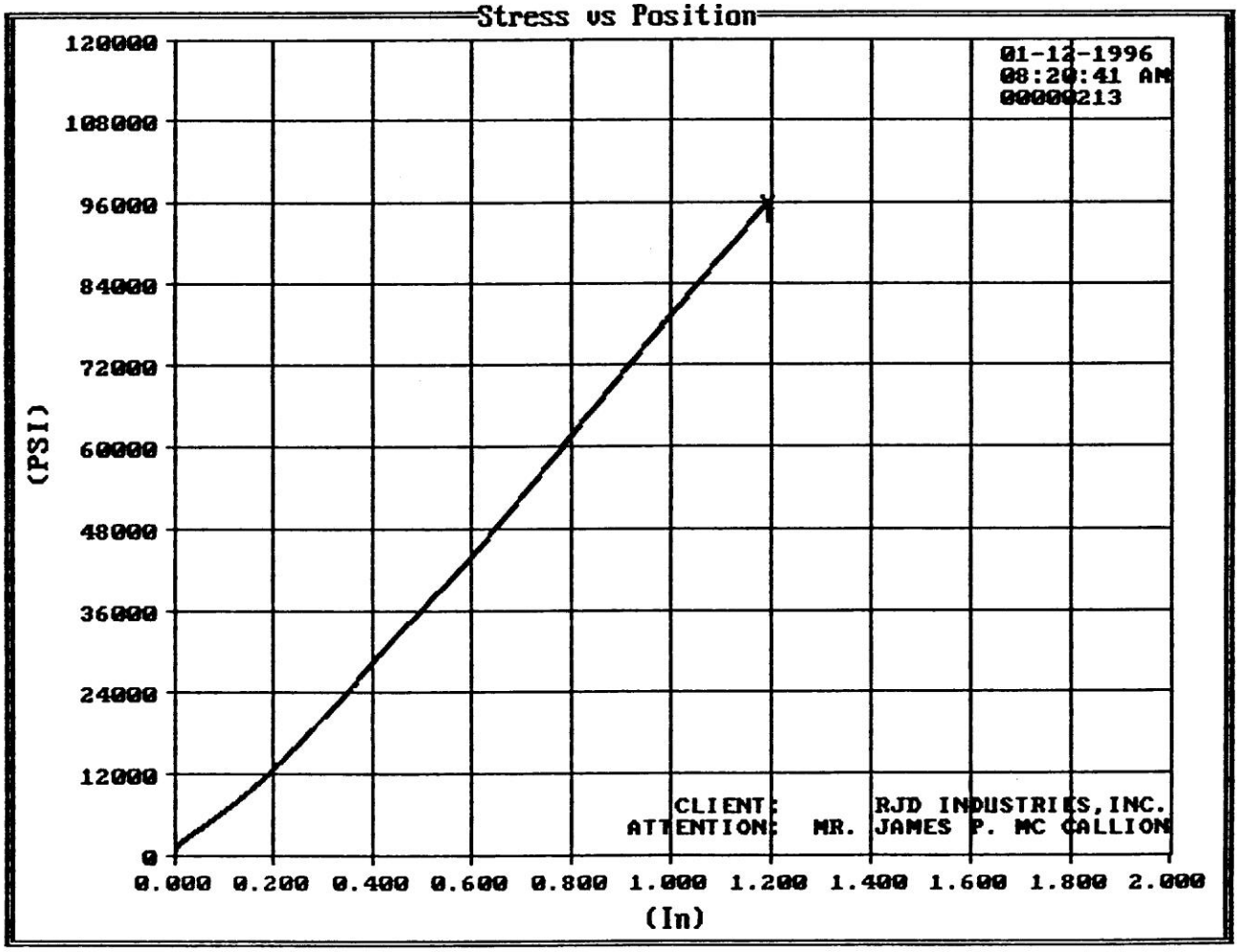
Event Markers: Stress (PSI) Position (In)



| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 0.500 |
| SPECIMEN NUMBER: | 12 |
| ACTUAL AVG. DIAMETER,IN.: | 0.5012 |

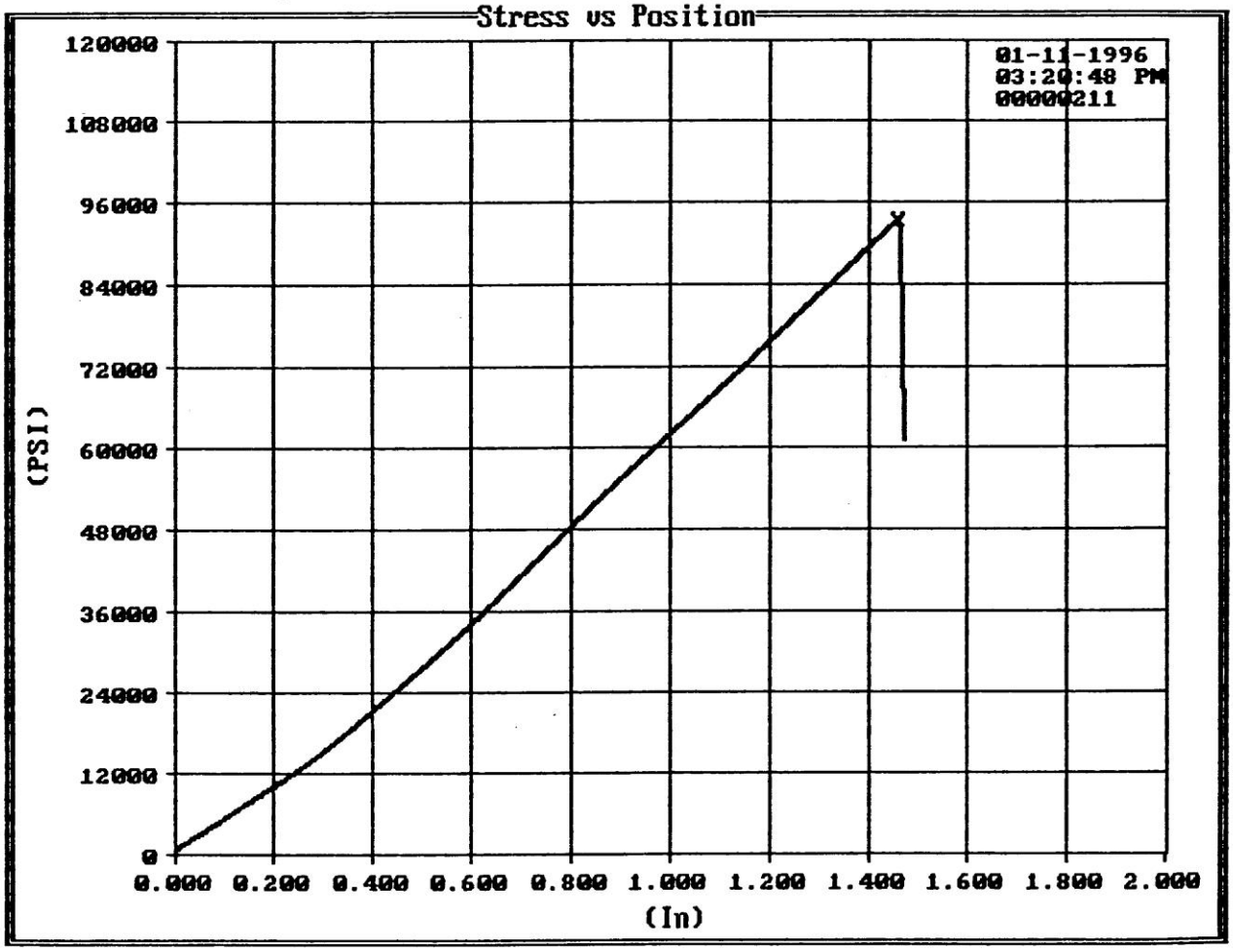
| | |
|---|---|
| Test | Gentest |
| Procedure | FRP DOWEL BAR ASTM D 3916 |

| | | | |
|---|---|---|---|
| Test Date | 01-12-1996 | Tested By | G. LUJAN |
| Test Time | 08:20:41 AM | Test Counter | 00000213 |
| Elapsed Time | 00:05:58 | Datasets | 3587 |
| | | Area | 0.1973 In² |
| ULT. LOAD LBS. | 18959 Lbs | TENSILE STRESS | 96094 PSI |
| POS.@TENSILE | 1.19401 In | ELONG.IN 37.5IN | 3.1840 % |



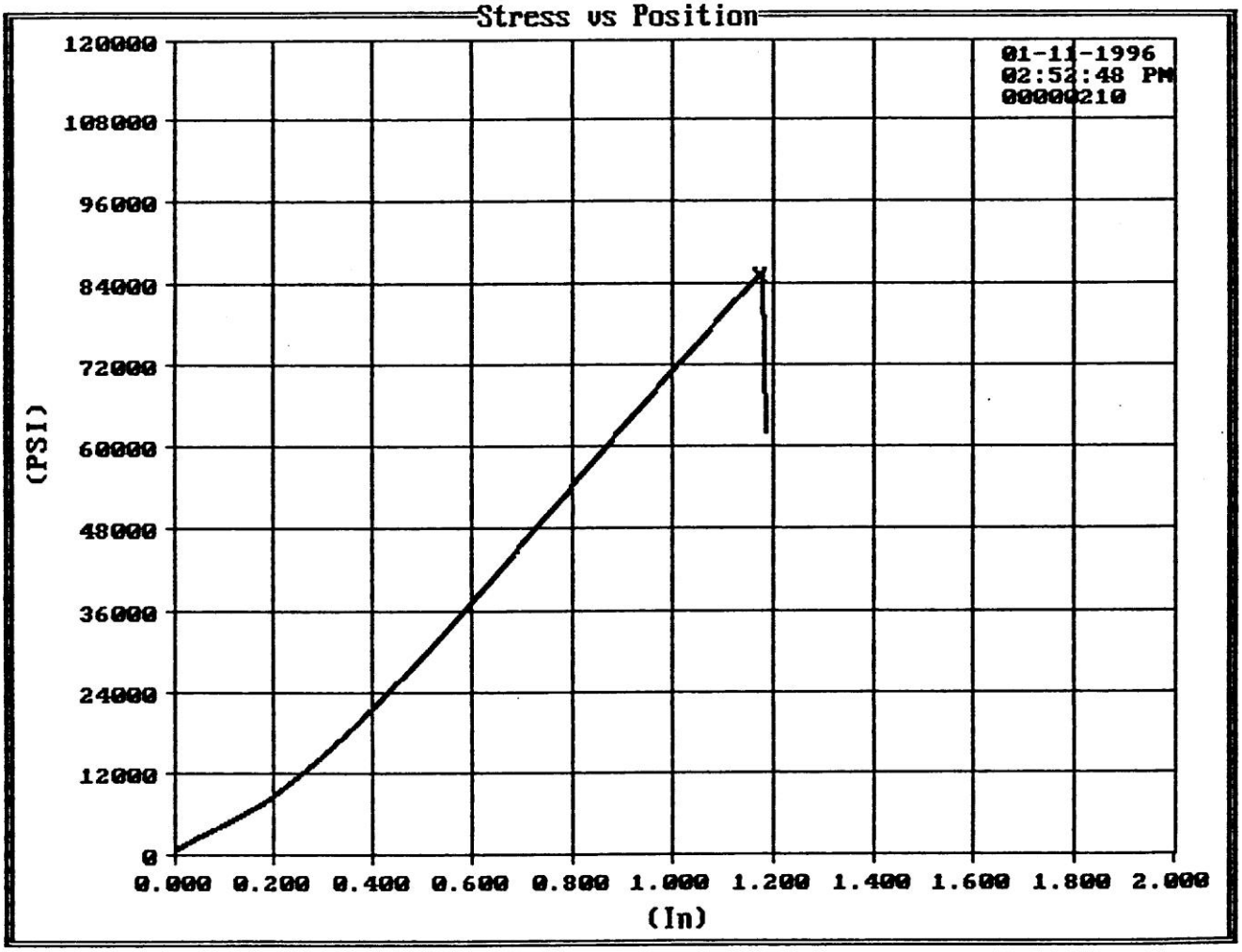
.750" NOMINAL
SPECIMEN #10
AVG. DIA. = 0.7530"

| | | | |
|---|---|---|---|
| Test | Gentest | | |
| Procedure | FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 01-11-1996 | Tested By | G. LUJAN |
| Test Time | 03:20:48 PM | Test Counter | 00000211 |
| Elapsed Time | 00:07:19 | Datasets | 4399 |
| | | Area | 0.4453 In² |
| ULT. LOAD LBS. | 41669 Lbs | TENSILE STRESS | 93569 PSI |
| POS.@TENSILE | 1.46381 In | ELONG.IN 37.5IN | 3.9035 % |



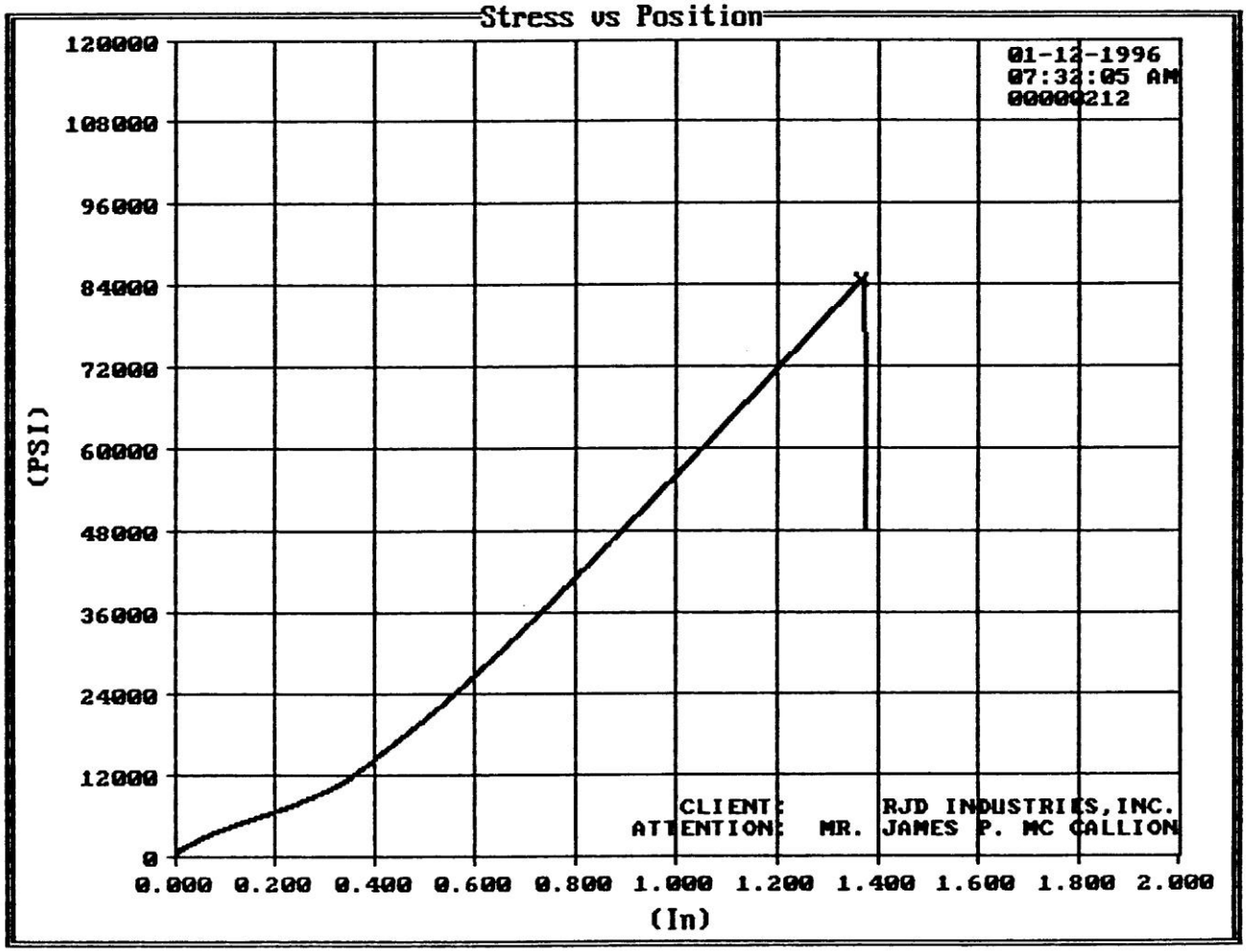
.1750" NOMINAL
SPECIMEN #11
AVG. DIA. = 0.7530"

| | | | |
|---|---|---|---|
| Test | Gentest | | |
| Procedure | FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 01-11-1996 | Tested By | G. LUJAN |
| Test Time | 02:52:48 PM | Test Counter | 00000210 |
| Elapsed Time | 00:05:54 | Datasets | 3541 |
| | | Area | 0.4453 In² |
| ULT. LOAD LBS. | 38069 Lbs | TENSILE STRESS | 85484 PSI |
| POS.@TENSILE | 1.17769 In | ELONG.IN 37.5IN | 3.1405 % |



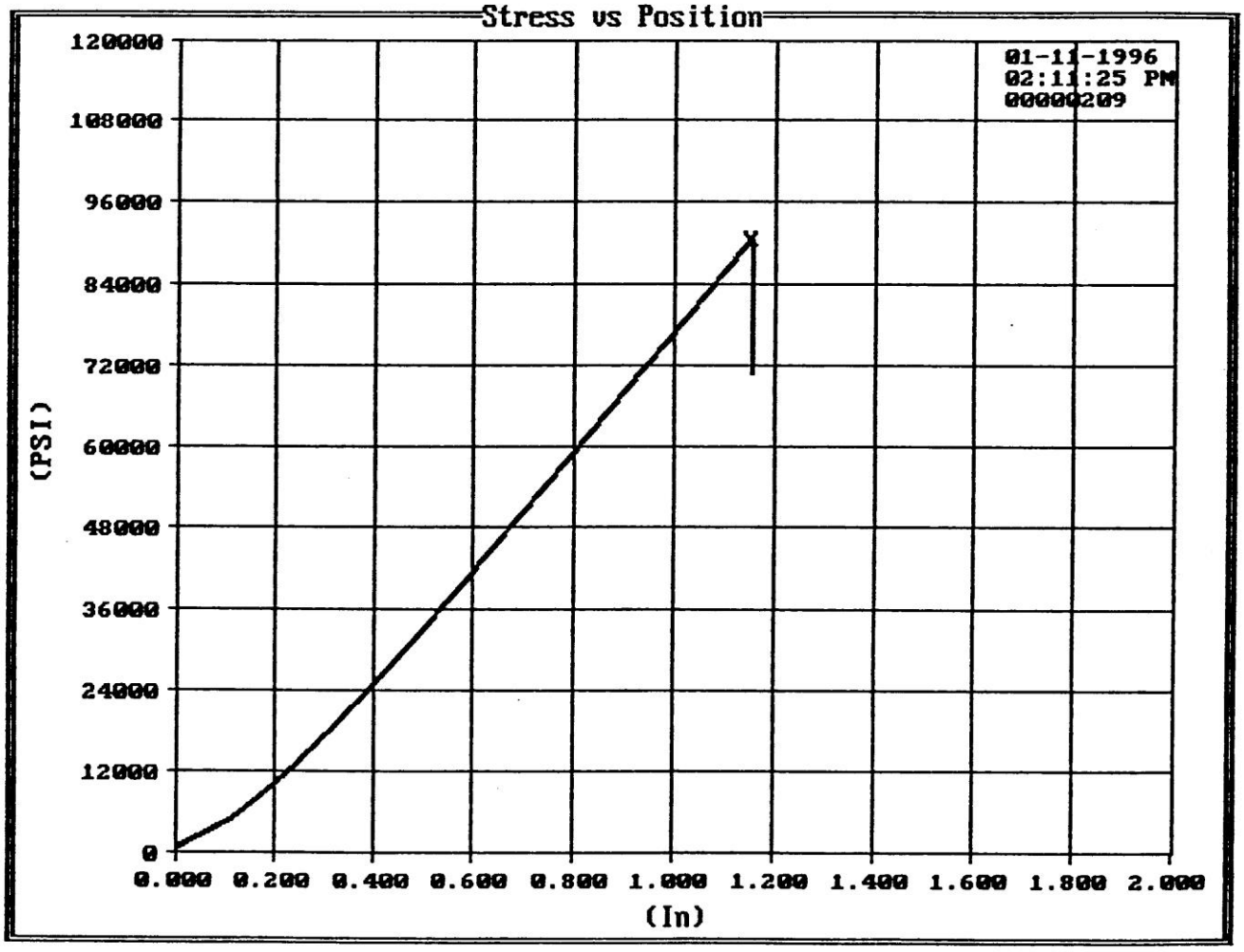
| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 0.750 |
| SPECIMEN NUMBER: | 12 |
| ACTUAL AVG. DIAMETER,IN.: | 0.7515 |

| | | | |
|---|---|---|---|
| Test | Gentest | | |
| Procedure | FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 01-12-1996 | Tested By | G. LUJAN |
| Test Time | 07:32:05 AM | Test Counter | 00000212 |
| Elapsed Time | 00:06:52 | Datasets | 4126 |
| | | Area | 0.4436 In² |
| ULT. LOAD LBS. | 37520 Lbs | TENSILE STRESS | 84589 PSI |
| POS.@TENSILE | 1.37101 In | ELONG.IN 37.5IN | 3.6560 % |



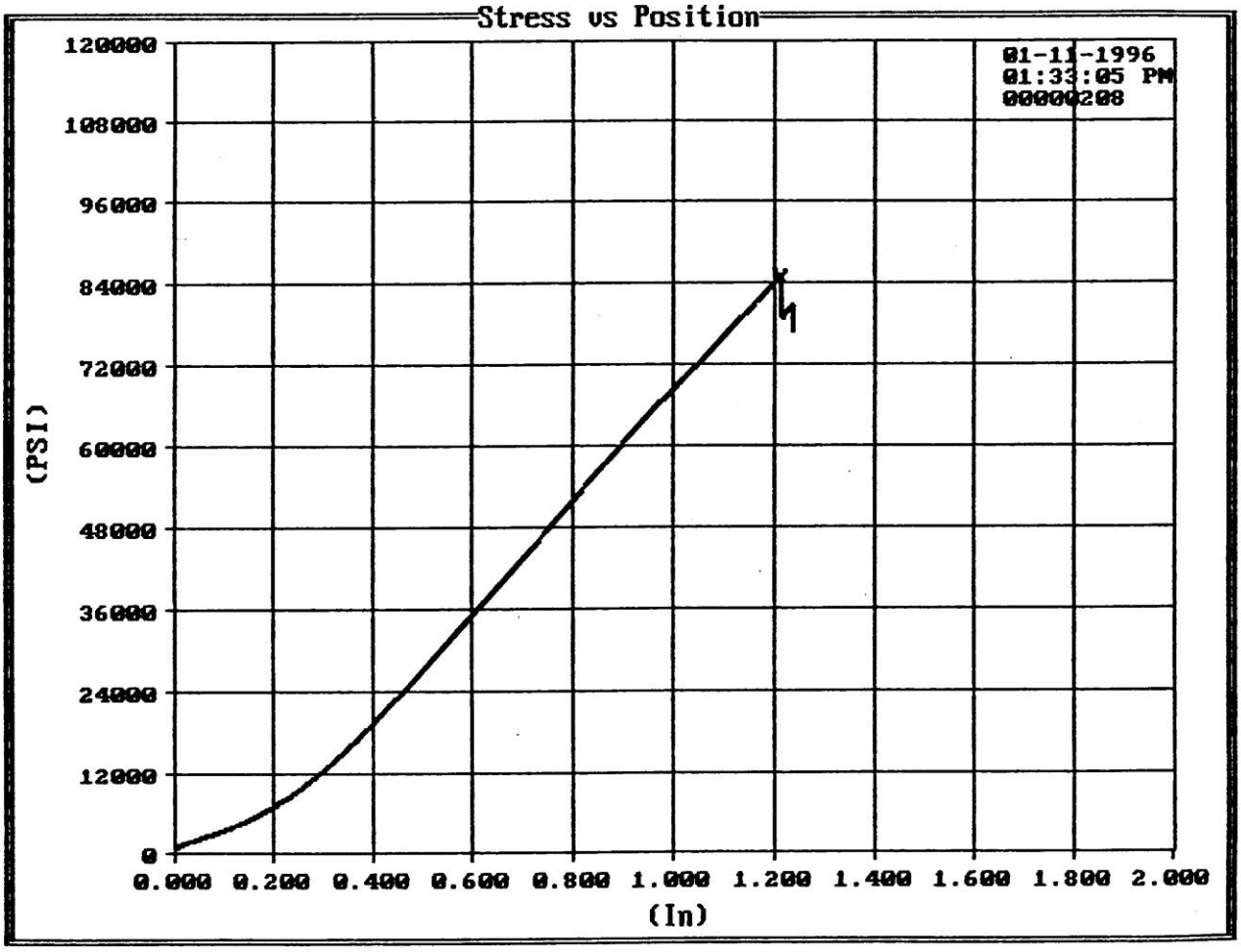
1" ϕ NOMINAL
SPECIMEN # 10
AVG. DIA. = 0.9701"

| | | | |
|---|---|---|---|
| Test | Gentest | | |
| Procedure | FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 01-11-1996 | Tested By | G. LUJAN |
| Test Time | 02:11:25 PM | Test Counter | 00000209 |
| Elapsed Time | 00:05:47 | Datasets | 3474 |
| | | Area | 0.7391 In² |
| ULT. LOAD LBS. | 67018 Lbs | TENSILE STRESS | 90670 PSI |
| POS.@TENSILE | 1.15502 In | ELONG.IN 37.5IN | 3.0800 % |



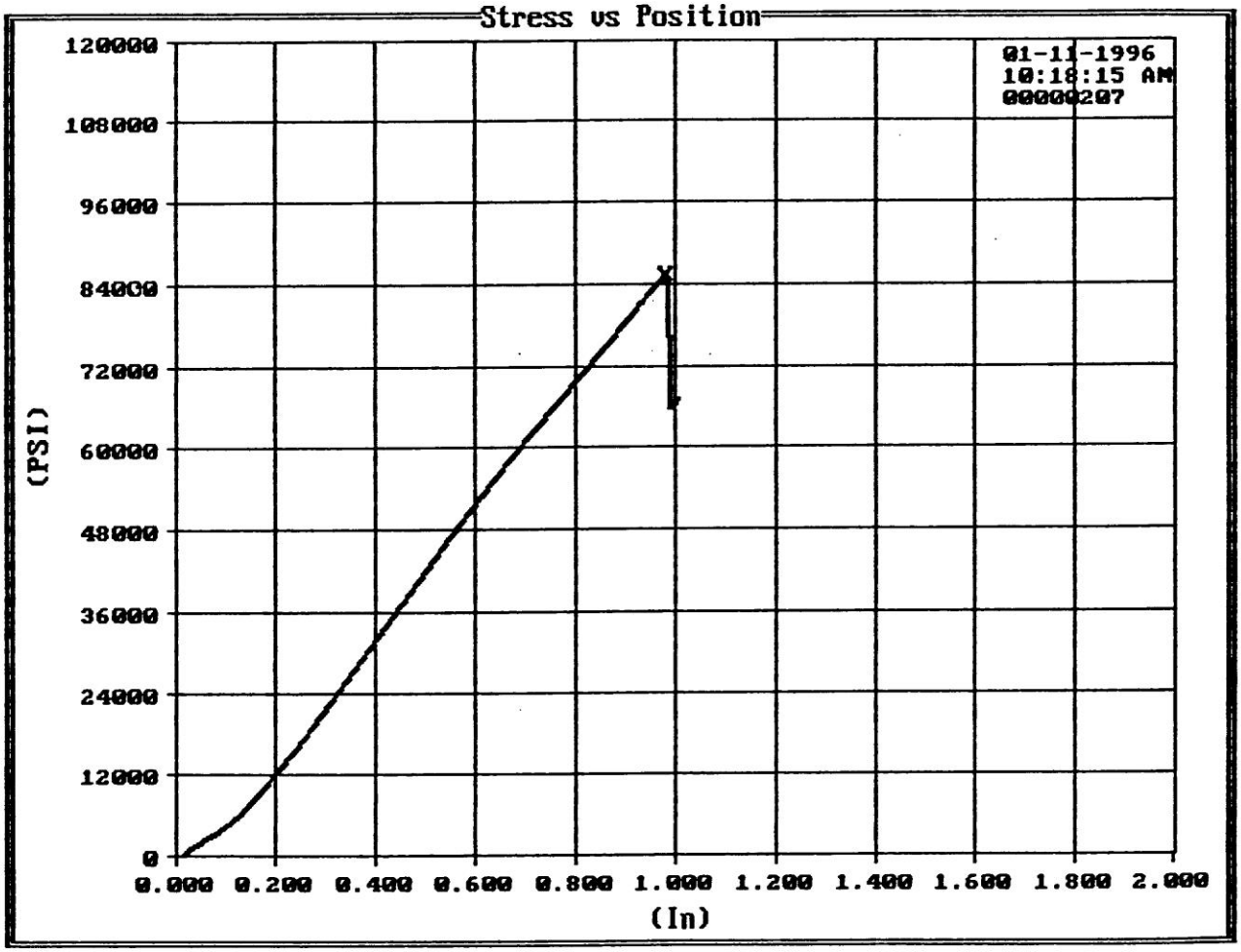
1" NOMINAL
SPECIMEN # 11
AVG. DIA. = 0.9713"

| | | | |
|---|---|---|---|
| Test | Gentest | | |
| Procedure | FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 01-11-1996 | Tested By | G. LUJAN |
| Test Time | 01:33:05 PM | Test Counter | 00000208 |
| Elapsed Time | 00:06:11 | Datasets | 3720 |
| | | Area | 0.7410 In² |
| ULT. LOAD LBS. | 62979 Lbs | TENSILE STRESS | 84996 PSI |
| POS.@TENSILE | 1.21378 In | ELONG.IN 37.5IN | 3.2373 % |



1" NOMINAL
SPECIMEN # 12
AVG DIA, = 0.9703"

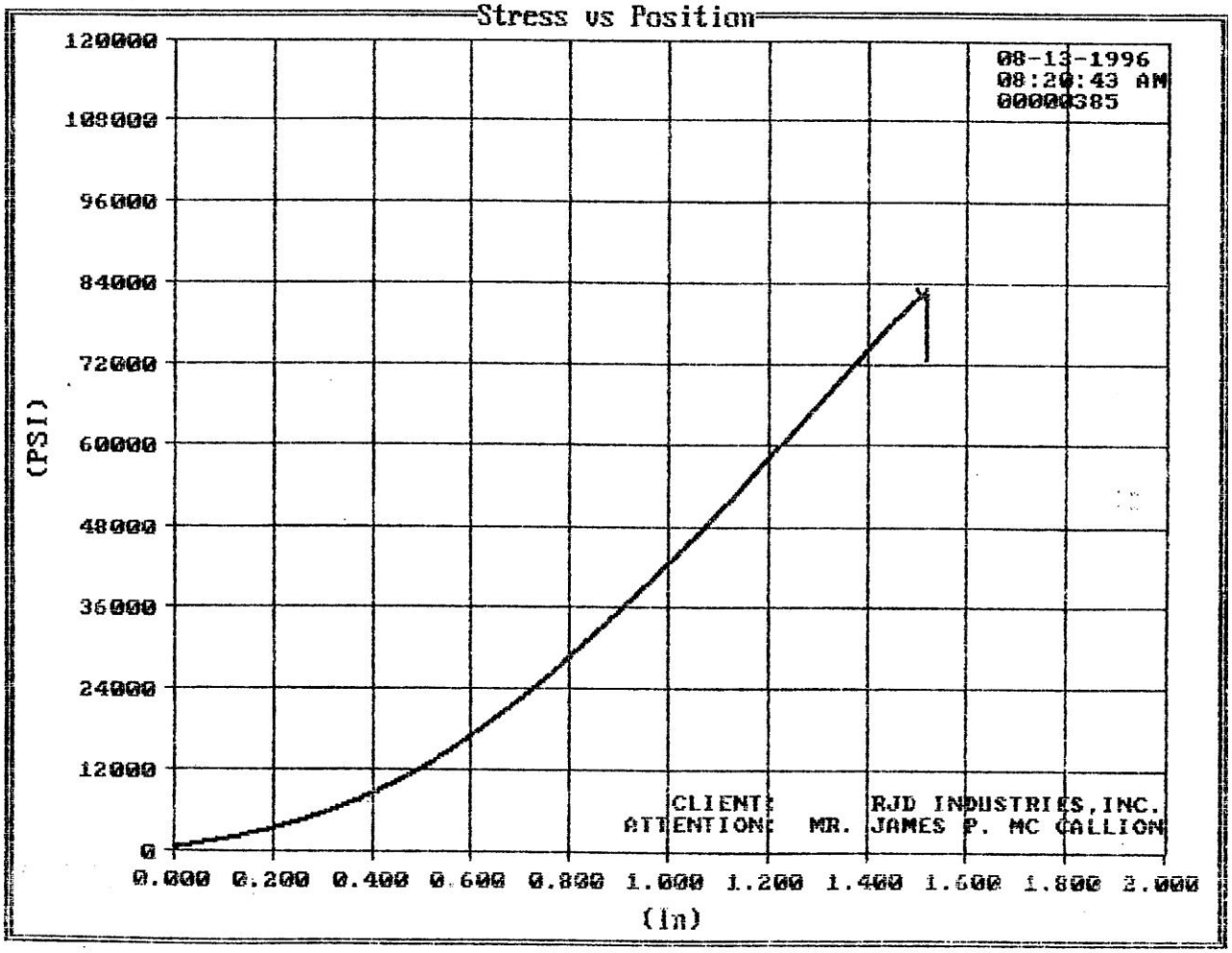
| | | | |
|---|---|---|---|
| Test | Gentest | | |
| Procedure | FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 01-11-1996 | Tested By | G. LUJAN |
| Test Time | 10:18:15 AM | Test Counter | 00000207 |
| Elapsed Time | 00:04:56 | Datasets | 2963 |
| | | Area | 0.7394 In² |
| ULT. LOAD LBS. | 63243 Lbs | TENSILE STRESS | 85528 PSI |
| POS.@TENSILE | 0.98287 In | ELONG.IN 37.5IN | 2.6213 % |



| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 1.5 |
| SPECIMEN NUMBER: | 15 |
| ACTUAL AVG. DIAMETER,IN.: | 1.4953 |

| | |
|---|---|
| Test | Gentest |
| Procedure | FRP DOWEL BAR ASTM D 3916 |

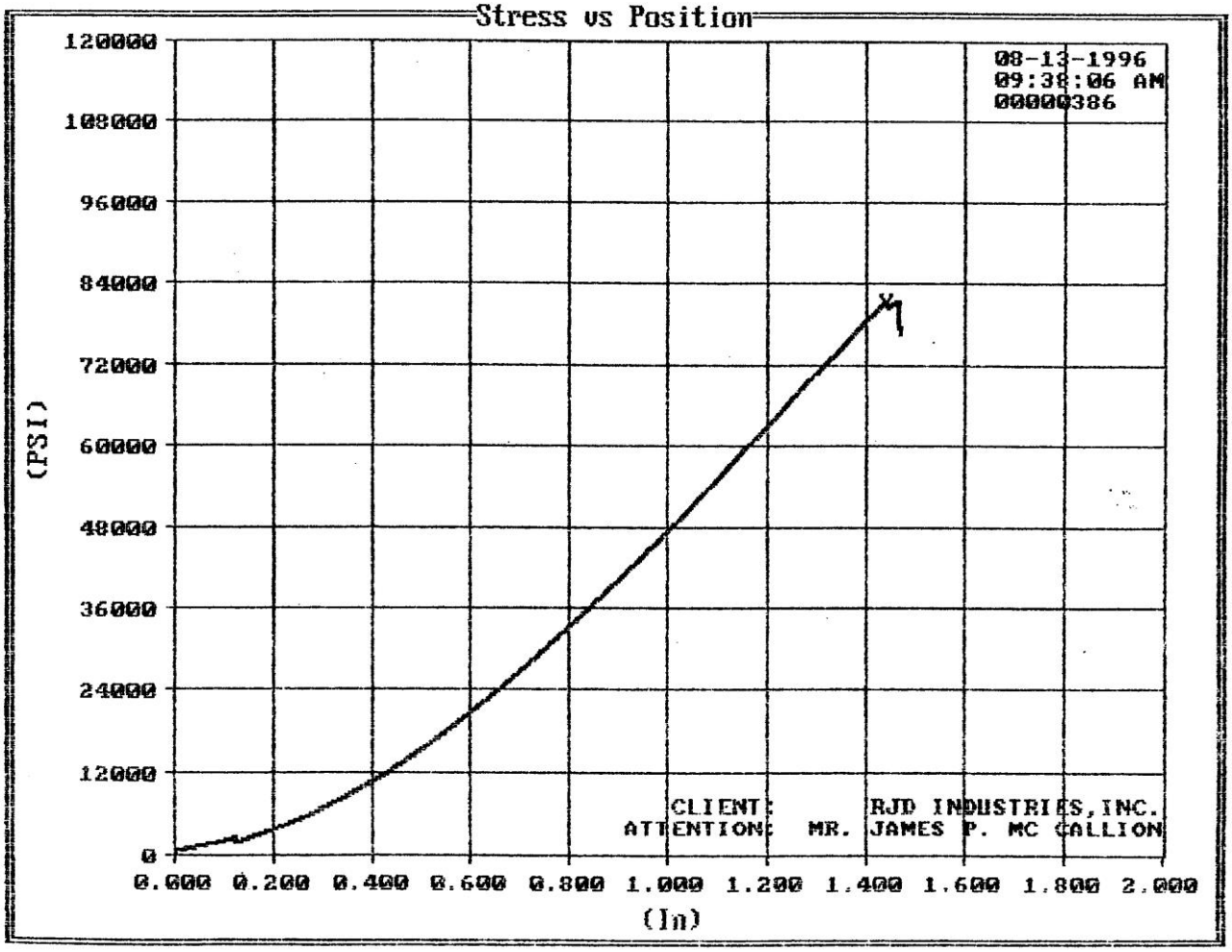
| | | | |
|---|---|---|---|
| Test Date | 08-13-1996 | Tested By | G. LUJAN |
| Test Time | 08:20:43 AM | Test Counter | 00000385 |
| Elapsed Time | 00:07:36 | Datasets | 4566 |
| | | Area | 1.7561 In² |
| ULT. LOAD LBS. | 144660 Lbs | TENSILE STRESS | 82378 PSI |
| POS.@TENSILE | 1.51402 In | ELONG.IN 18.75 | 6.7200 % |
| M.O.E. | 0.0000 | | |



| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 1.5 |
| SPECIMEN NUMBER: | 16 |
| ACTUAL AVG. DIAMETER,IN.: | 1.4945 |

| | |
|---|---|
| Test | Gentest |
| Procedure | FRP DOWEL BAR ASTM D 3916 |

| | | | |
|---|---|---|---|
| Test Date | 08-13-1996 | Tested By | G. LUJAN |
| Test Time | 09:38:06 AM | Test Counter | 00000386 |
| Elapsed Time | 00:07:22 | Datasets | 4422 |
| | | Area | 1.7542 In² |
| ULT. LOAD LBS. | 142890 Lbs | TENSILE STRESS | 81453 PSI |
| POS.@TENSILE | 1.44378 In | ELONG.IN 18.75 | 7.6800 % |
| M.O.E. | 0.0000 | | |



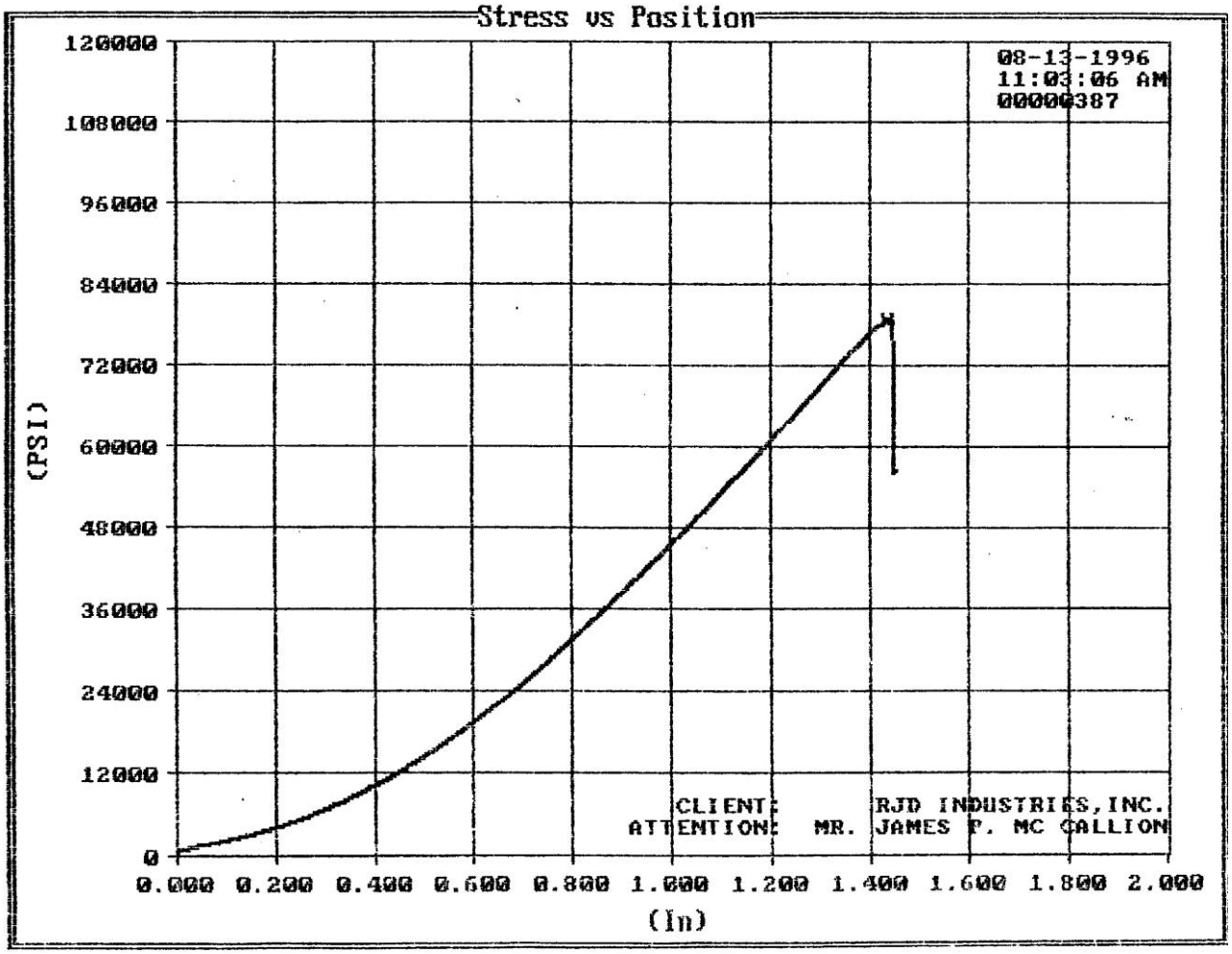
| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES F. MC CALLION |
| NOMINAL DIAMETER,IN.: | 1.5 |
| SPECIMEN NUMBER: | 17 |
| ACTUAL AVG. DIAMETER,IN.: | 1.4925 |

| | |
|---|---|
| Test | Gentest |
| Procedure | FRP DOWEL BAR ASTM D 3916 |

| | | | |
|---|---|---|---|
| Test Date | 08-13-1996 | Tested By | G. LUJAN |
| Test Time | 11:03:06 AM | Test Counter | 00000387 |
| Elapsed Time | 00:07:16 | Datasets | 4364 |
| | | Area | 1.7495 In² |

| | | | |
|---|---|---|---|
| ULT. LOAD LBS. | 137620 Lbs | TENSILE STRESS | 78660 PSI |
| POS.@TENSILE | 1.43935 In | ELONG.IN 18.75 | 7.6800 % |
| M.O.E. | 0.0000 | | |

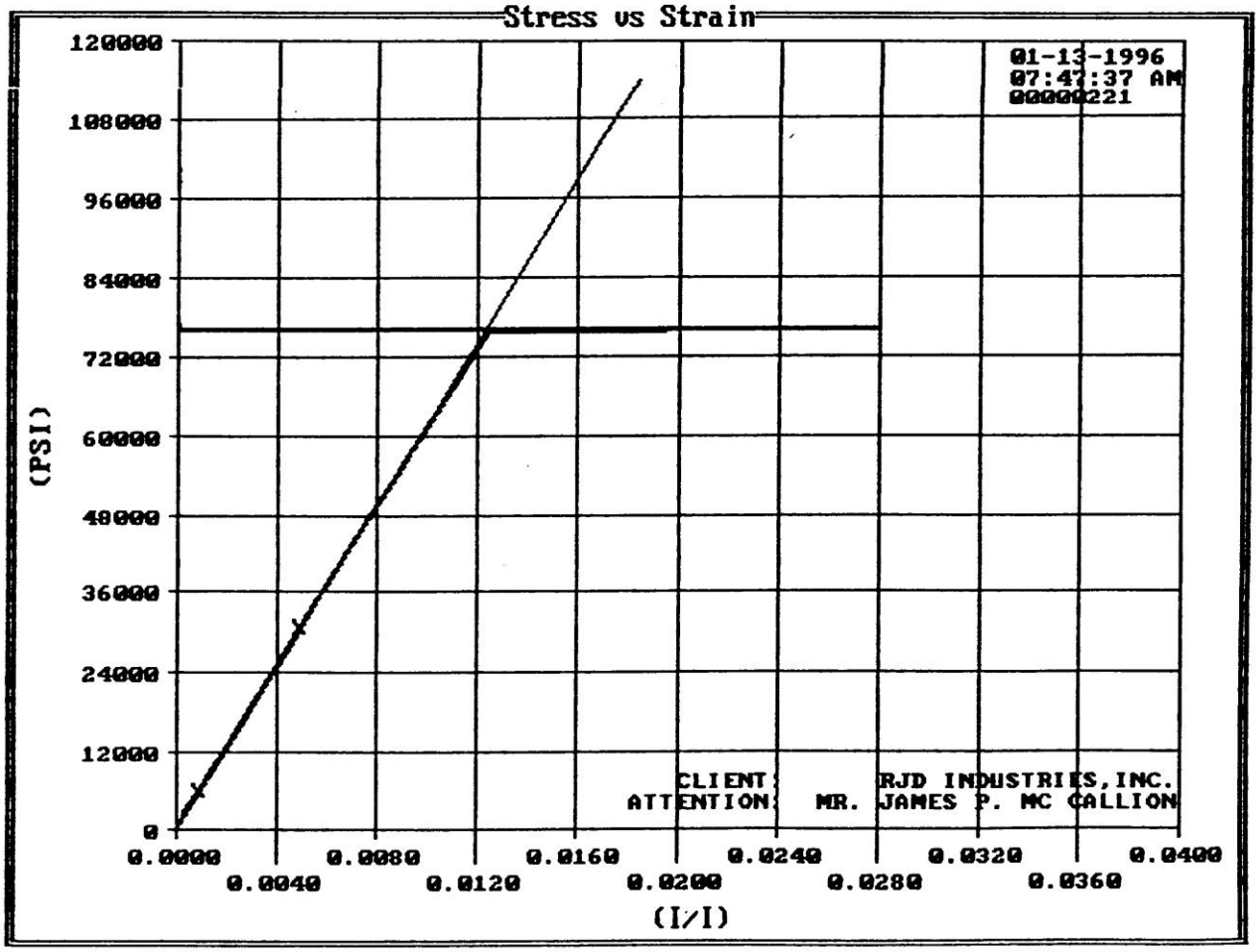
| | | | |
|---|---|---|---|
| Event Markers: | Stress (PSI) | Position | (In) |



| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | .5 |
| SPECIMEN NUMBER: | 8 |
| ACTUAL AVG. DIAMETER,IN.: | 0.5015 |

| | | | |
|---|---|---|---|
| Test | Gentest | | |
| Procedure | FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 01-13-1996 | Tested By | J. McDOWELL |
| Test Time | 07:47:37 AM | Test Counter | 00000221 |
| Elapsed Time | 00:05:28 | Datasets | 3285 |
| | | Area | 0.1975 In² |
| ULT. LOAD LBS. | 19658 Lbs | TENSILE STRESS | 99517 PSI |
| POS.@TENSILE | 1.07641 In | ELONG.IN 37.5IN | 2.8693 % |
| M.O.E. | 6203454 | | |

Event Markers: Stress (PSI) Strain (I/I)

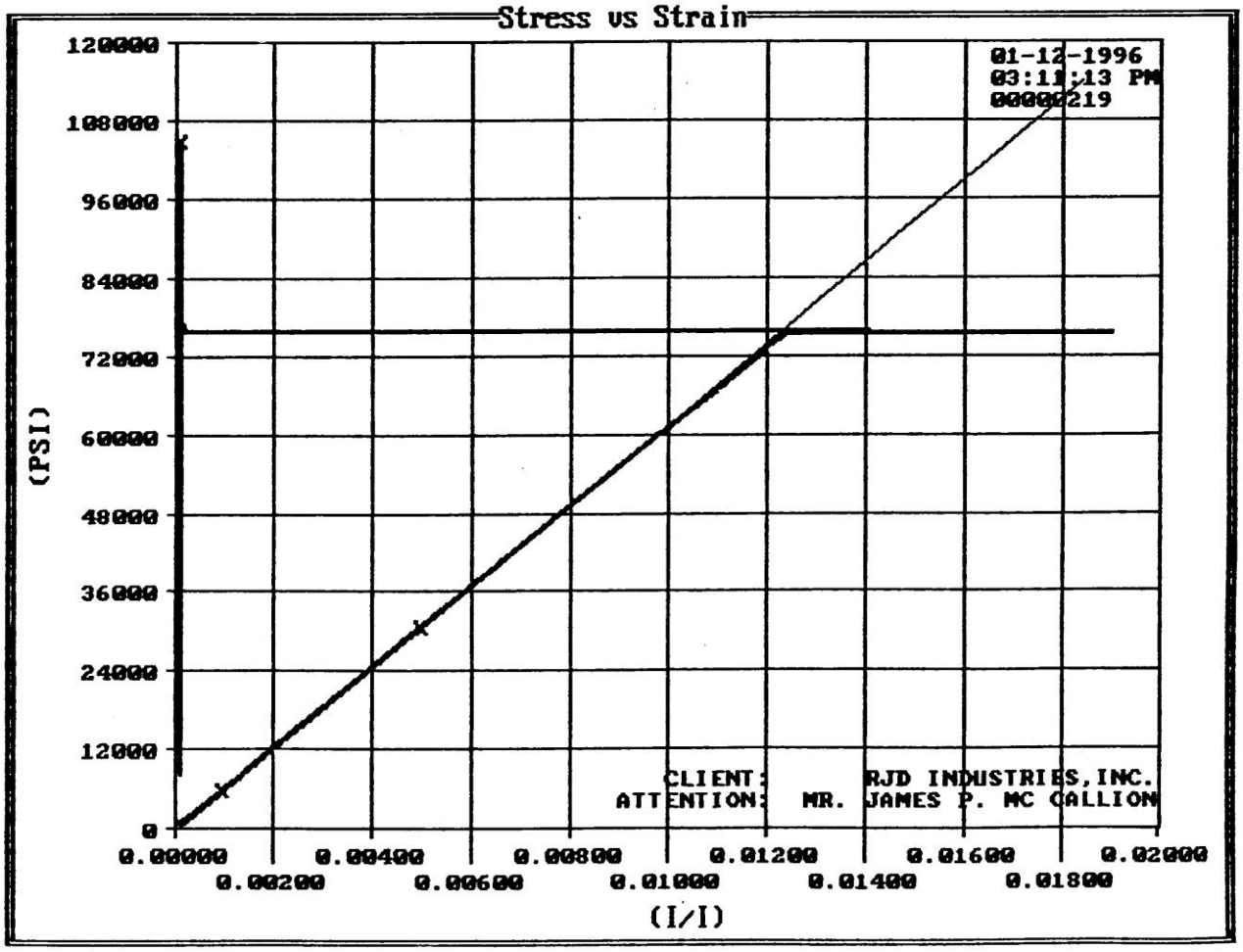


| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | .5" |
| SPECIMEN NUMBER: | 9 |
| ACTUAL AVG. DIAMETER,IN.: | 0.5012 |

| | |
|---|---|
| Test Procedure | Gentest<br>FRP DOWEL BAR ASTM D 3916 |

| | | | |
|---|---|---|---|
| Test Date | 01-12-1996 | Tested By | G. LUJAN |
| Test Time | 03:11:13 PM | Test Counter | 00000219 |
| Elapsed Time | 00:06:24 | Datasets | 3843 |
| | | Area | 0.1973 In² |
| ULT. LOAD LBS. | 20690 Lbs | TENSILE STRESS | 104870 PSI |
| POS.@TENSILE | 1.27776 In | ELONG.IN 37.5IN | 3.4069 % |
| M.O.E. | 6214508 | | |

Event Markers: Stress (PSI) Strain (I/I)

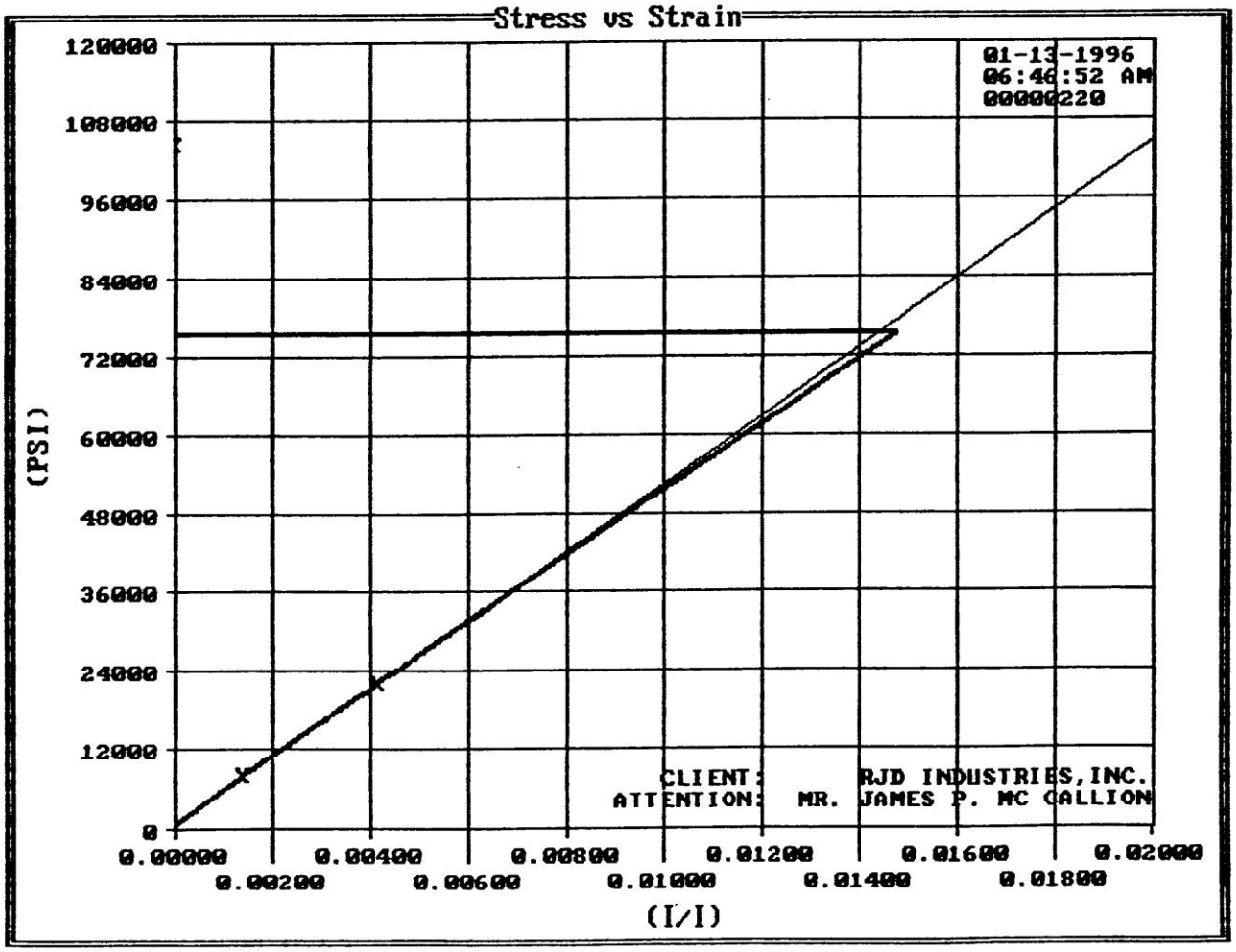


| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | .750 |
| SPECIMEN NUMBER: | 8 |
| ACTUAL AVG. DIAMETER,IN.: | 0.7510 |

| | |
|---|---|
| Test Procedure | Gentest<br>FRP DOWEL BAR ASTM D 3916 |

| | | | |
|---|---|---|---|
| Test Date | 01-13-1996 | Tested By | J. McDOWELL |
| Test Time | 06:46:52 AM | Test Counter | 00000220 |
| Elapsed Time | 00:10:32 | Datasets | 6325 |
| | | Area | 0.4430 In² |
| ULT. LOAD LBS. | 46293 Lbs | TENSILE STRESS | 104510 PSI |
| POS.@TENSILE | 2.21088 In | ELONG.IN 37.5IN | 2.9600 % |
| M.O.E. | 5202456 | | |

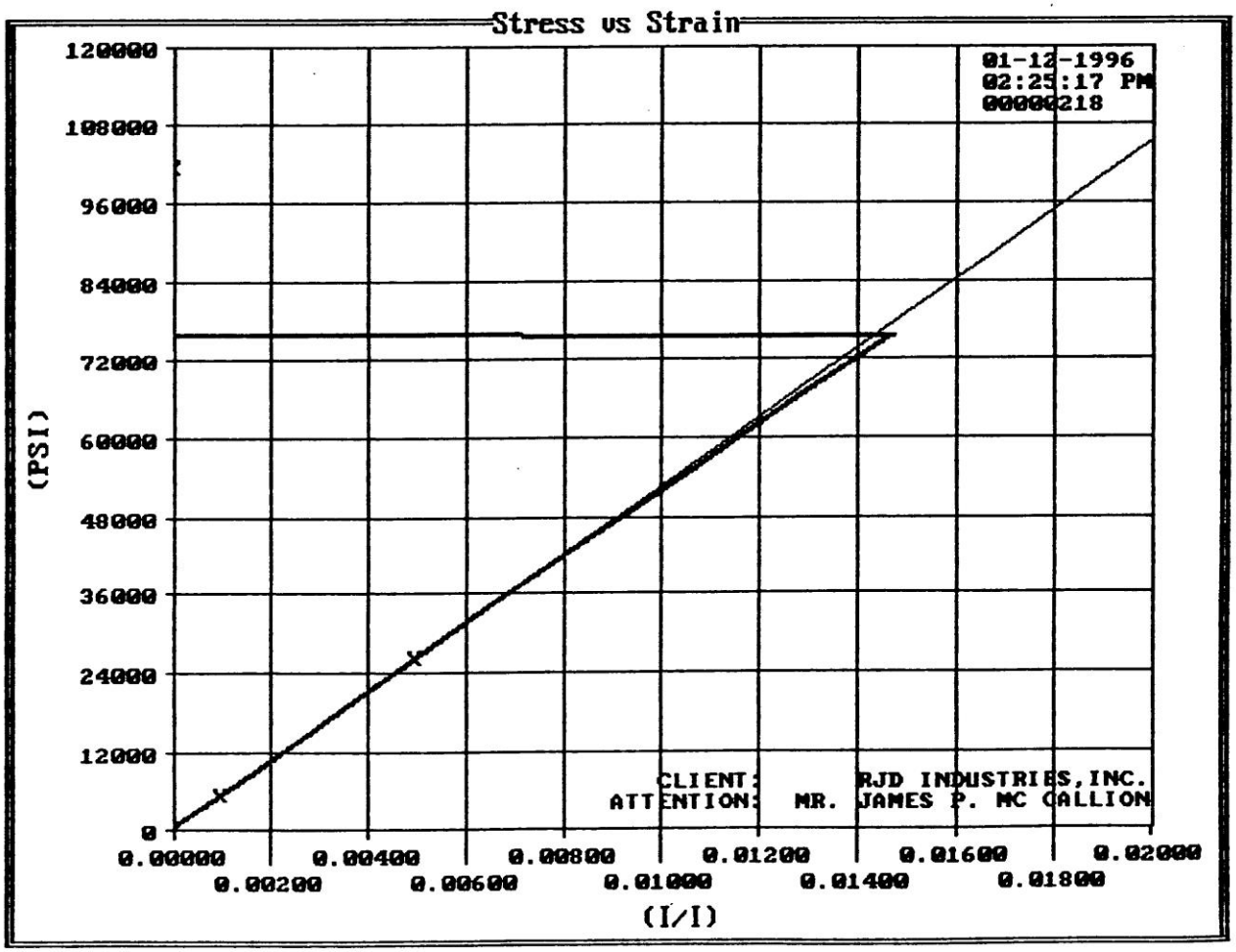
Event Markers: Stress (PSI) Strain (I/I)



| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 1 |
| SPECIMEN NUMBER: | 9 |
| ACTUAL AVG. DIAMETER,IN.: | 0.7518 |

| | | | |
|---|---|---|---|
| Test | Gentest | | |
| Procedure | FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 01-12-1996 | Tested By | G. LUJAN |
| Test Time | 02:25:17 PM | Test Counter | 00000218 |
| Elapsed Time | 00:07:41 | Datasets | 4616 |
| | | Area | 0.4439 In² |
| ULT. LOAD LBS. | 45105 Lbs | TENSILE STRESS | 101610 PSI |
| POS.@TENSILE | 1.53479 In | ELONG.IN 37.5IN | 4.0933 % |
| M.O.E. | 5255509 | | |

Event Markers: Stress (PSI) Strain (I/I)

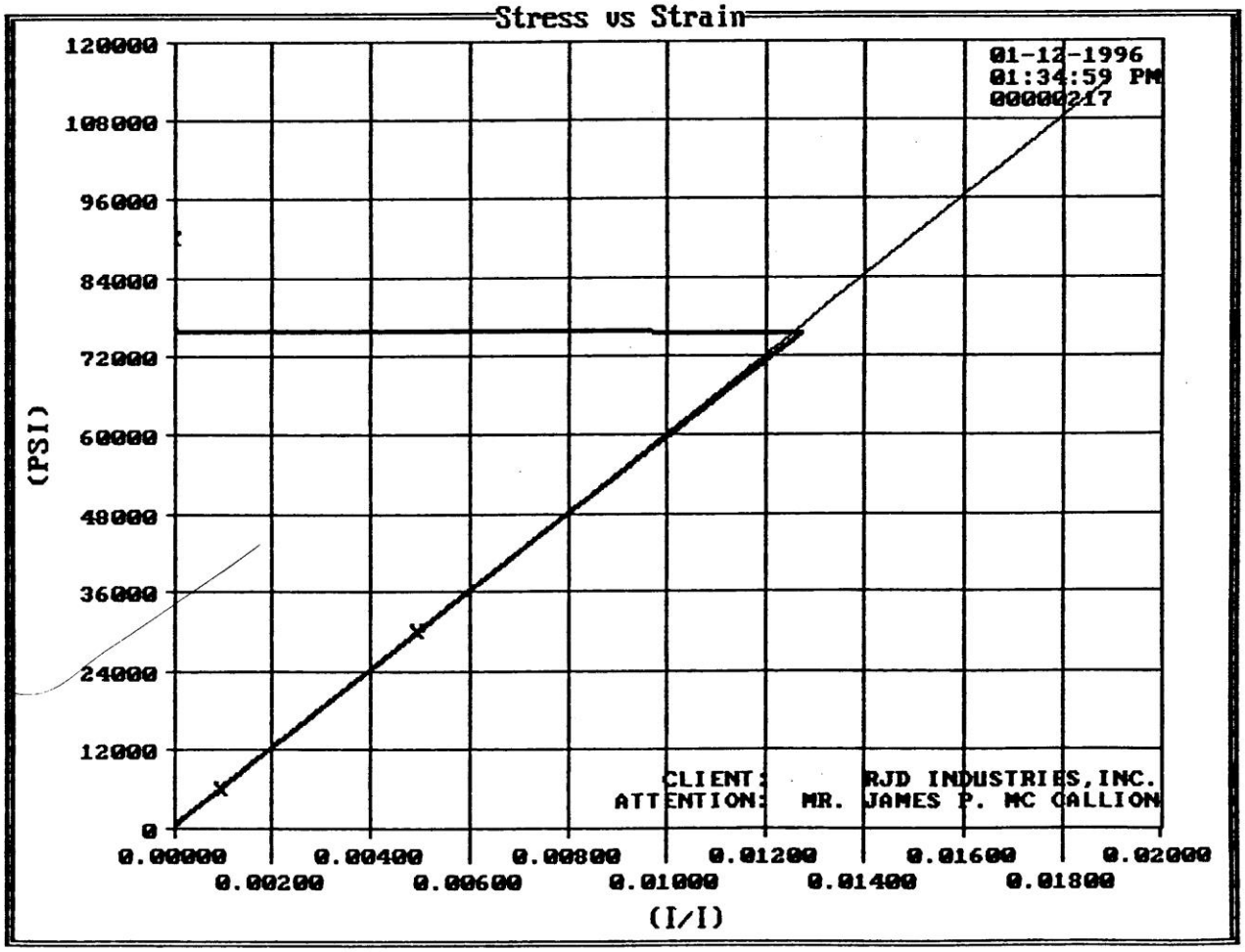


| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 1 |
| SPECIMEN NUMBER: | 7 |
| ACTUAL AVG. DIAMETER,IN.: | 0.9703 |

| | |
|---|---|
| Test | Gentest |
| Procedure | FRP DOWEL BAR ASTM D 3916 |

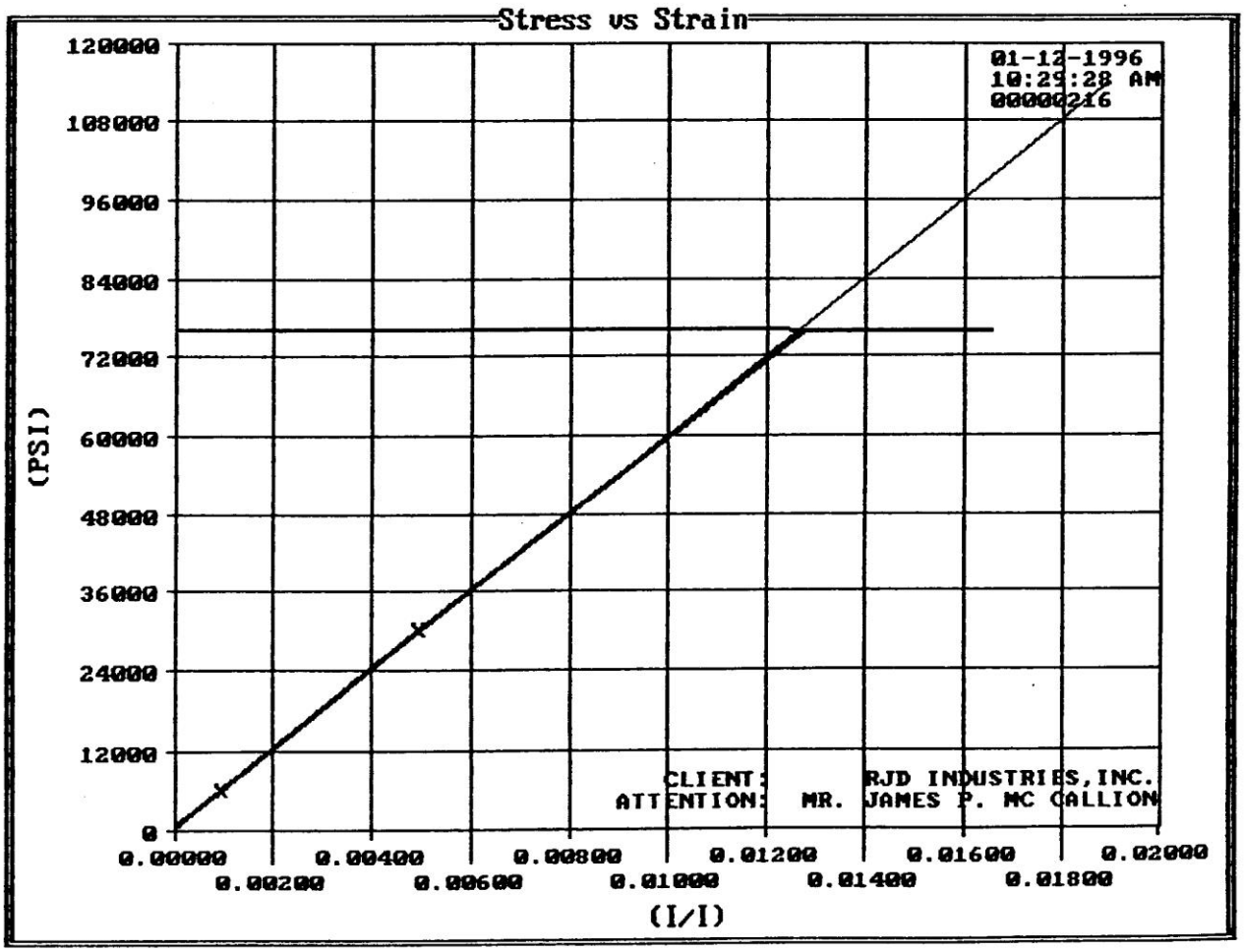
| | | | |
|---|---|---|---|
| Test Date | 01-12-1996 | Tested By | G. LUJAN |
| Test Time | 01:34:59 PM | Test Counter | 00000217 |
| Elapsed Time | 00:06:36 | Datasets | 3965 |
| | | Area | 0.7394 In² |
| ULT. LOAD LBS. | 66539 Lbs | TENSILE STRESS | 89986 PSI |
| POS.@TENSILE | 1.31499 In | ELONG.IN 37.5IN | 3.5067 % |
| M.O.E. | 6021986 | | |

Event Markers: Stress (PSI) Strain (I/I)



| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 1 |
| SPECIMEN NUMBER: | 9 |
| ACTUAL AVG. DIAMETER,IN.: | .9700 |

| | | | |
|---|---|---|---|
| Test | Gentest | | |
| Procedure | FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 01-12-1996 | Tested By | G. LUJAN |
| Test Time | 10:29:28 AM | Test Counter | 00000216 |
| Elapsed Time | 00:06:26 | Datasets | 3864 |
| | | Area | 0.7390 In² |
| ULT. LOAD LBS. | 65204 Lbs | TENSILE STRESS | 88235 PSI |
| POS.@TENSILE | 1.28584 In | ELONG.IN 37.5IN | 3.4293 % |
| | | MOD.OF ELAST. | 6008173 |

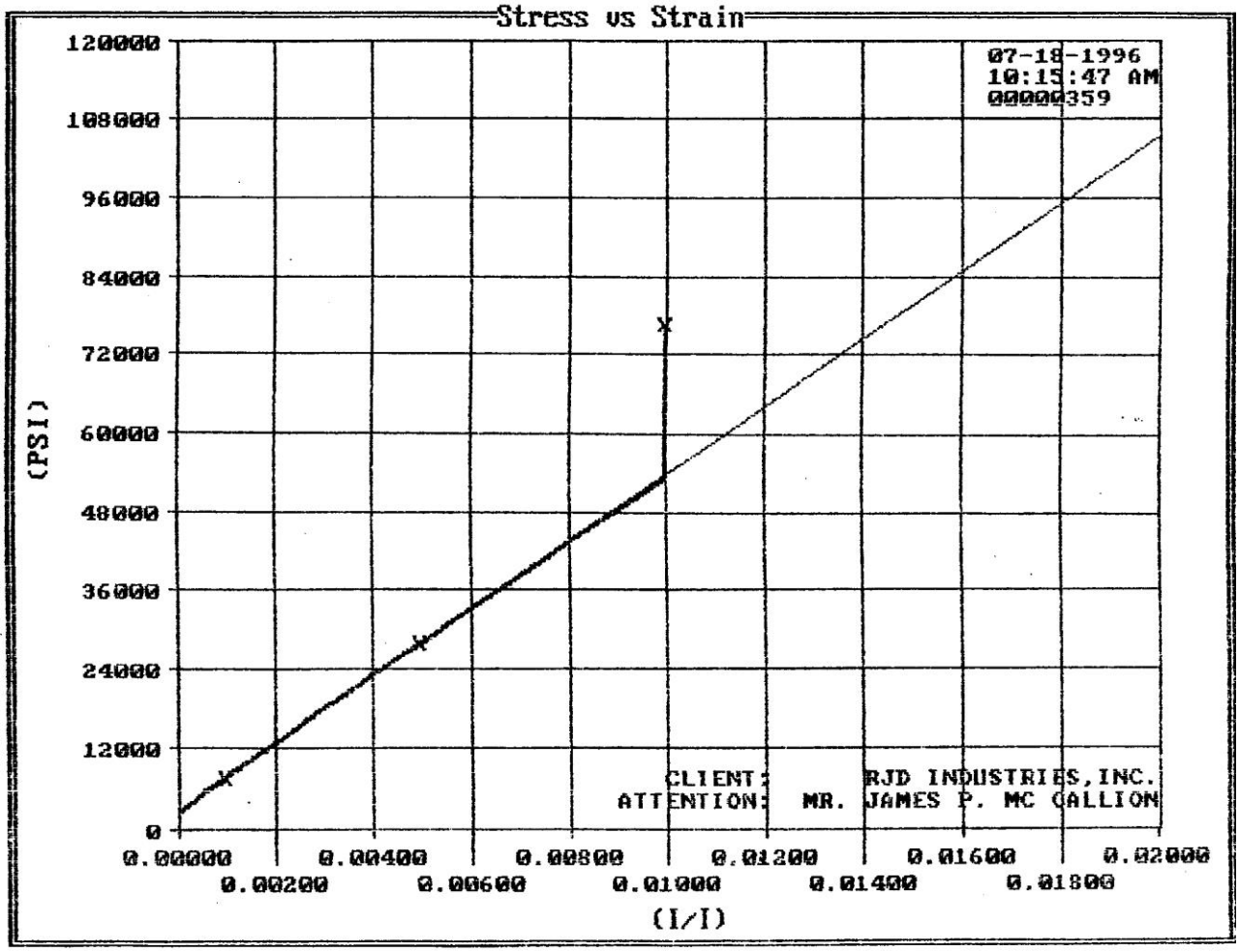


| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 1.5 |
| SPECIMEN NUMBER: | 6 |
| ACTUAL AVG. DIAMETER,IN.: | 1.4932 |

| | |
|---|---|
| Test | Gentest |
| Procedure | FRP DOWEL BAR ASTM D 3916 |

| | | | |
|---|---|---|---|
| Test Date | 07-18-1996 | Tested By | JMC |
| Test Time | 10:15:47 AM | Test Counter | 00000359 |
| Elapsed Time | 00:09:21 | Datasets | 5613 |
| | | Area | 1.7512 In² |
| ULT. LOAD LBS. | 134440 Lbs | TENSILE STRESS | 76772 PSI |
| POS.@TENSILE | 1.65910 In | ELONG.IN 27.5IN | 6.0327 % |
| M.O.E. | 5150668 | | |

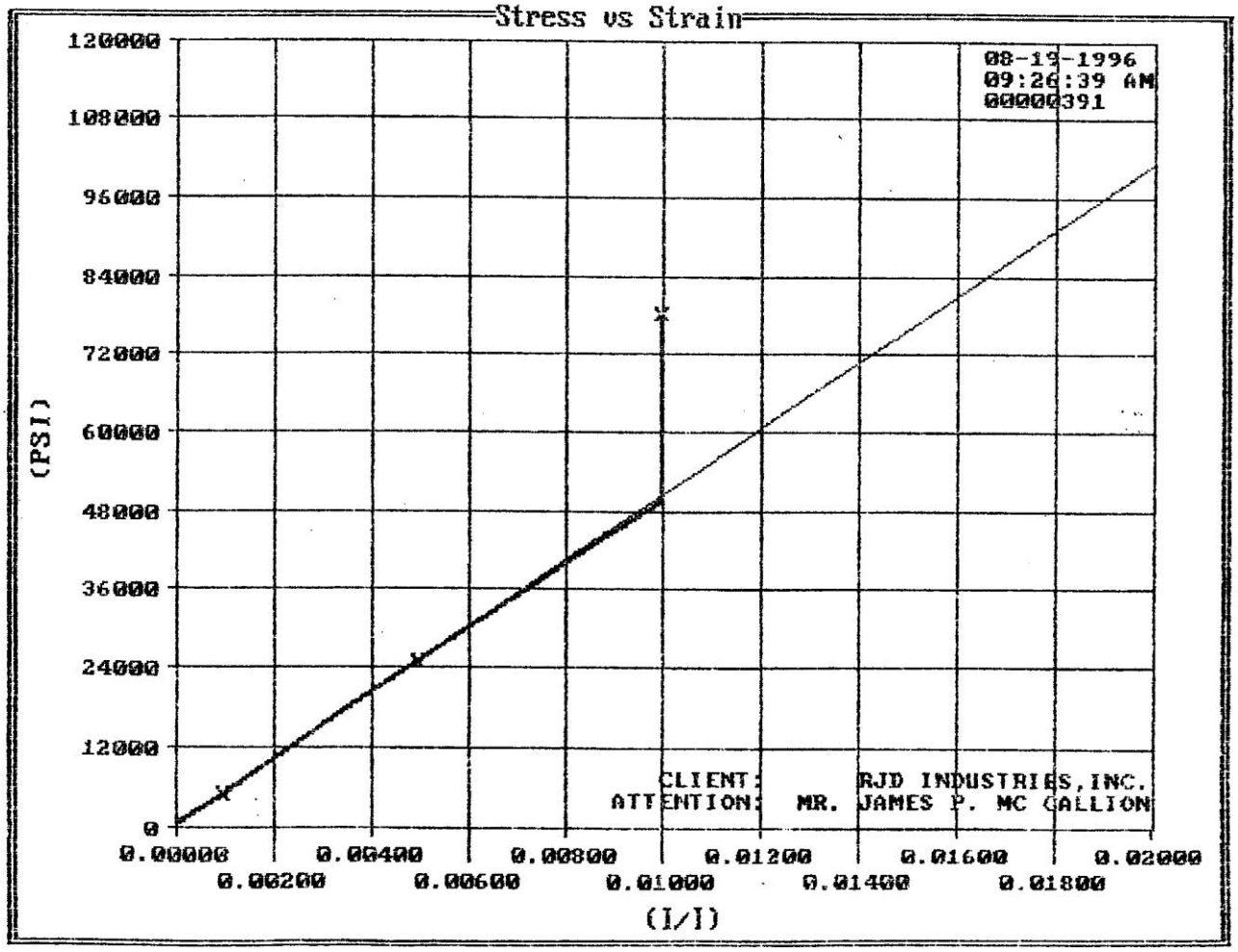
Event Markers: Stress (PSI) Strain (I/I)



| | |
|---|---|
| CLIENT: | RJD INDUSTRIES,INC. |
| ATTENTION: | MR. JAMES P. MC CALLION |
| NOMINAL DIAMETER,IN.: | 1.5 |
| SPECIMEN NUMBER: | 9 |
| ACTUAL AVG. DIAMETER,IN.: | 1.4933 |

| | | | |
|---|---|---|---|
| Test Procedure | Gentest FRP DOWEL BAR ASTM D 3916 | | |
| Test Date | 08-19-1996 | Tested By | G. LUJAN |
| Test Time | 09:26:39 AM | Test Counter | 00000391 |
| Elapsed Time | 00:08:07 | Datasets | 4879 |
| | | Area | 1.7514 In² |
| ULT. LOAD LBS. | 137000 Lbs | TENSILE STRESS | 78226 PSI |
| POS.@TENSILE | 1.61220 In | ELONG.IN 30 In. | 5.3733 % |
| M.O.E. | 5047964 | | |

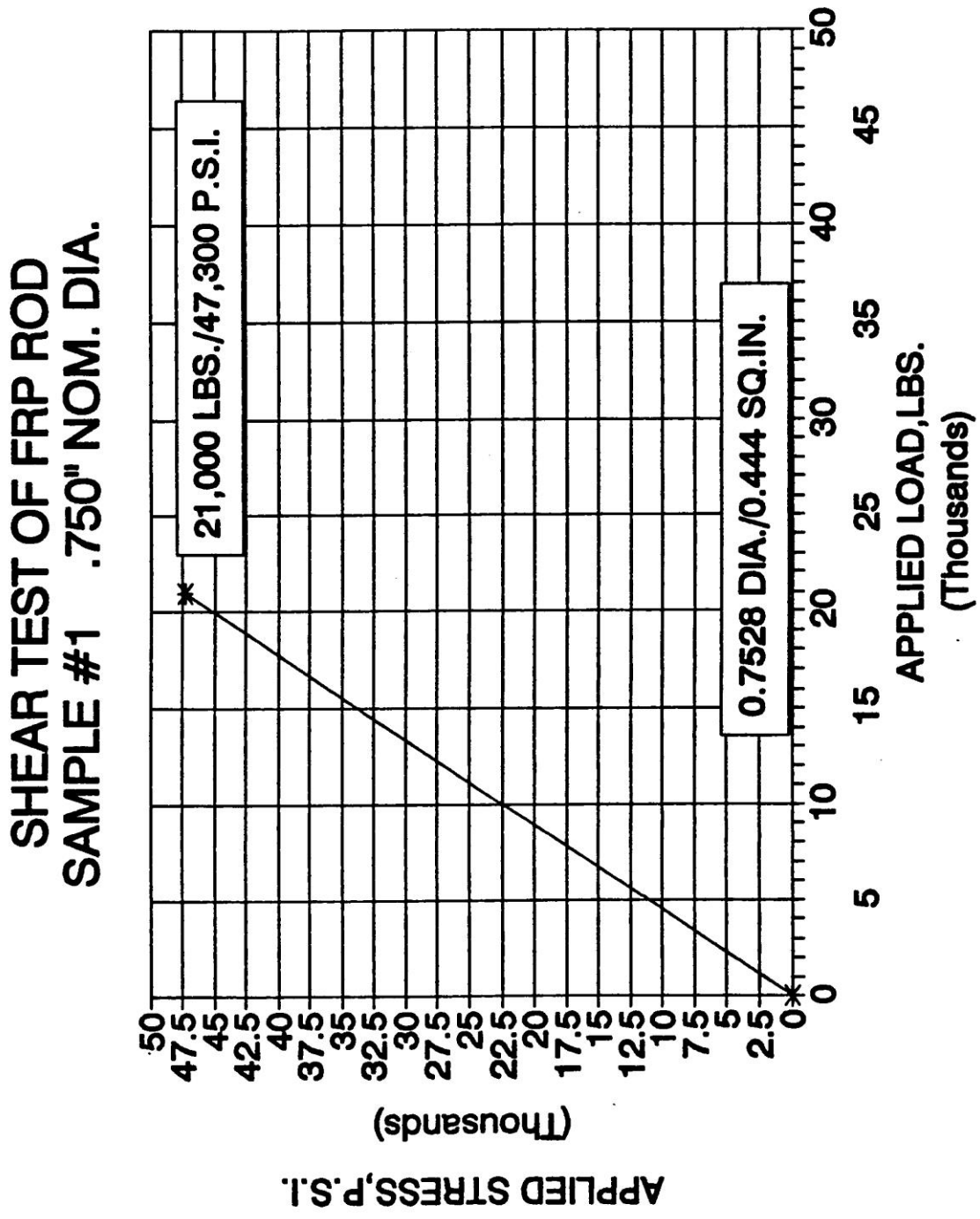
Event Markers: Stress (PSI) Strain (I/I)



**Twining Laboratories** *of Southern California, Inc.*

3310 Airport Way
Long Beach, CA 90806
Mail: P.O. Box 47, 90801

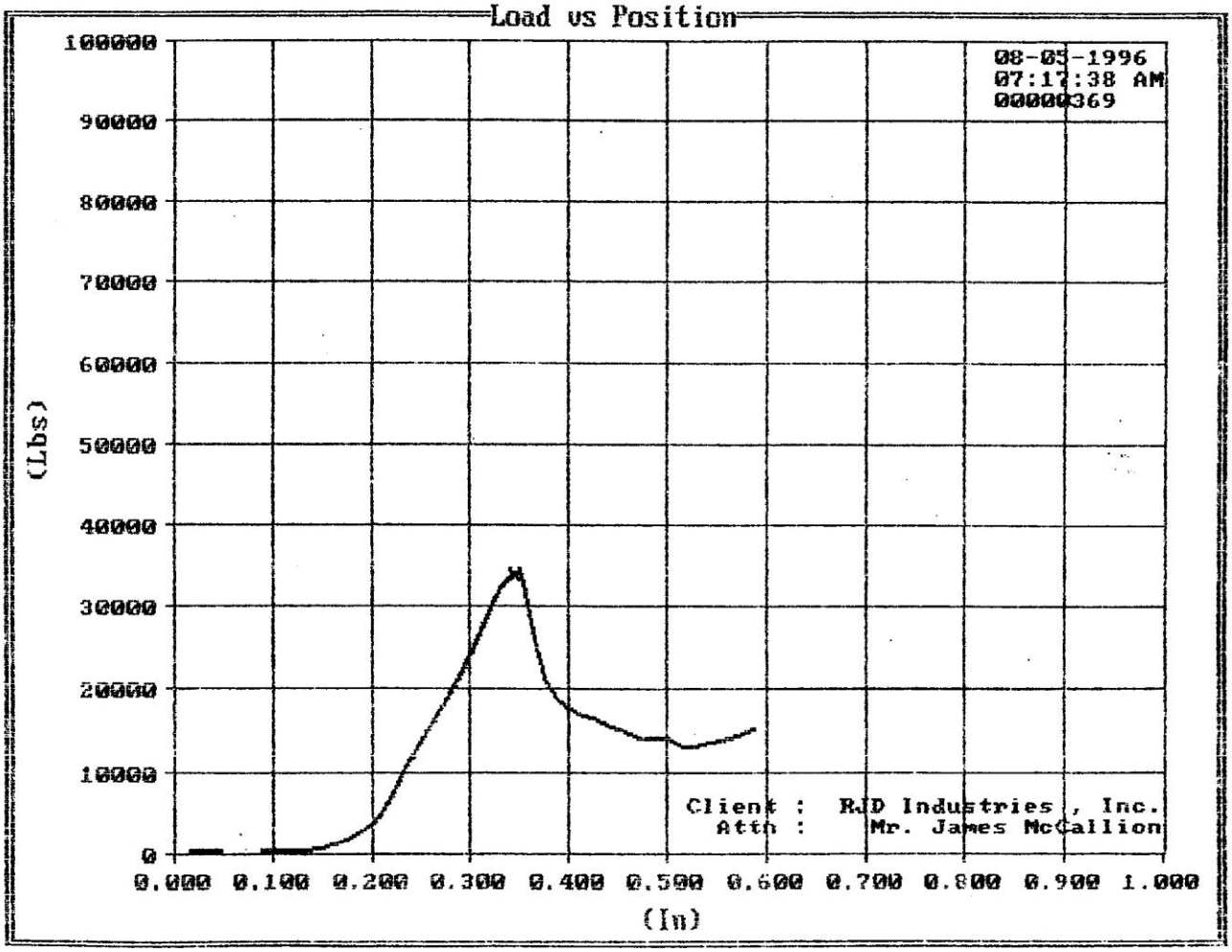
(310) 426-3355
(714) 828-6432
FAX (310) 426-6424



| | |
|---|---|
| Client : | RJD Industries , Inc. |
| Attn : | Mr. James McCallion |
| Address : | 26945 Cabot Rd. Unit 105 |
| City/State/Zip Code : | Laguna Hills, Ca. 92653 |
| Specimen No.: | 11 |

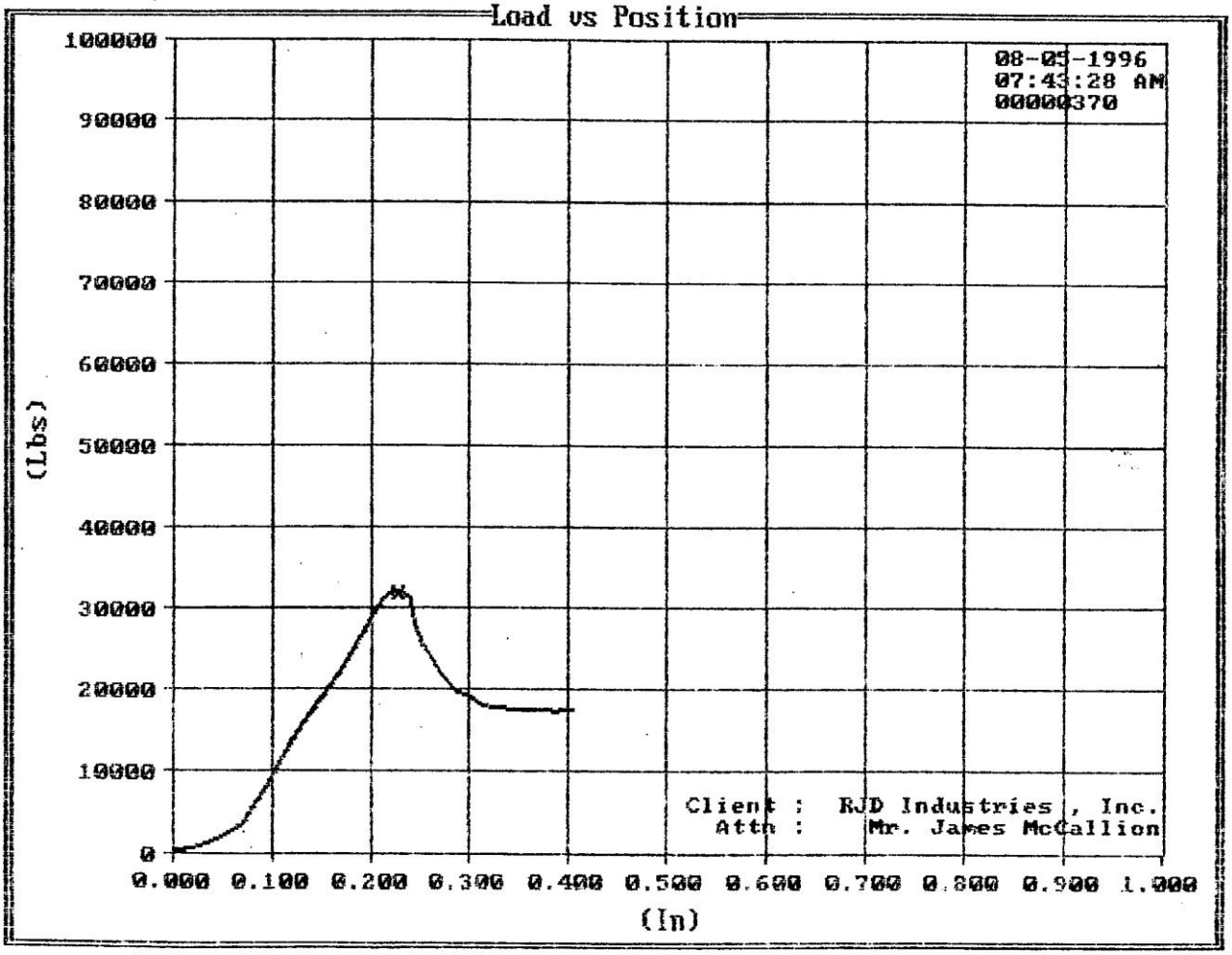
| | |
|---|---|
| Test | Gentest |
| Procedure | RJD Dowel Bar Shear Test |

| | | | |
|---|---|---|---|
| Test Date | 08-05-1996 | Tested By | JMC |
| Test Time | 07:17:38 AM | Test Counter | 00000369 |
| Elapsed Time | 00:01:30 | Datasets | 454 |
| | | Area | 1.7490 In² |
| Ult. Load Lbs. | 33982 Lbs | Ult. Stress PSI | 19429 PSI |
| Def.@ Shear[In] | 0.34826 In | | |



| | |
|---|---|
| Client : | RJD Industries , Inc. |
| Attn : | Mr. James McCallion |
| Address : | 26945 Cabot Rd. Unit 105 |
| City/State/Zip Code : | Laguna Hills, Ca. 92653 |
| Specimen No.: | #12 ## |

| | | | |
|---|---|---|---|
| Test Procedure | Gentest RJD Dowel Bar Shear Test | | |
| Test Date | 08-05-1996 | Tested By | JMC |
| Test Time | 07:43:28 AM | Test Counter | 00000370 |
| Elapsed Time | 00:01:24 | Datasets | 424 |
| | | Area | 1.7519 In² |
| Ult. Load Lbs. | 31782 Lbs | Ult. Stress PSI | 18142 PSI |
| Def.@ Shear[In] | 0.22925 In | | |



**Twining Laboratories** *of Southern California, Inc.*

3310 Airport Way
Long Beach, CA 90806
Mail: P.O. Box 47, 90801

(310) 426-3355
(714) 828-6432
FAX (310) 426-6424

May 8 , 1996

Exam # 96-9-000794
Page 1 of 1

RJD Industries Inc.
26945 Cabot Rd. Unit 105
Laguna Hills , Ca.

Attention : Mr. James P. McCallion

Subject : Single shear tests of ASTM A615 Steel bar samples .

Specification : Per client's instructions

Date of tests : April 26 , 1996

Test Personnel : J. McDowell / TLSC

Testing Machine Utilized : Satec 600,000 b. capacity Universal Testing Machine , S/N 1022 , last calibrated on March , 22 , 1996 using N.I.S.T. traceable standards .

**SHEAR TEST RESULTS OF STEEL BAR SPECIMENS**

| Specimen # | Nominal Dia. , in. | Actual Dia. , in. | Area Sq. in. | Ultimate Load LBS. | Stress P.S.I. |
|---|---|---|---|---|---|
| 1 | 1 | 0.9928 | 0.774 | 64,900 | 83,900 |
| 2 | 1 | 0.9922 | 0.773 | 62,500 | 80,900 |

The opportunity to be of service is greatly appreciated. If you have any questions , or if we may be of further service , do not hesitate to call.

Respectfully Submitted,

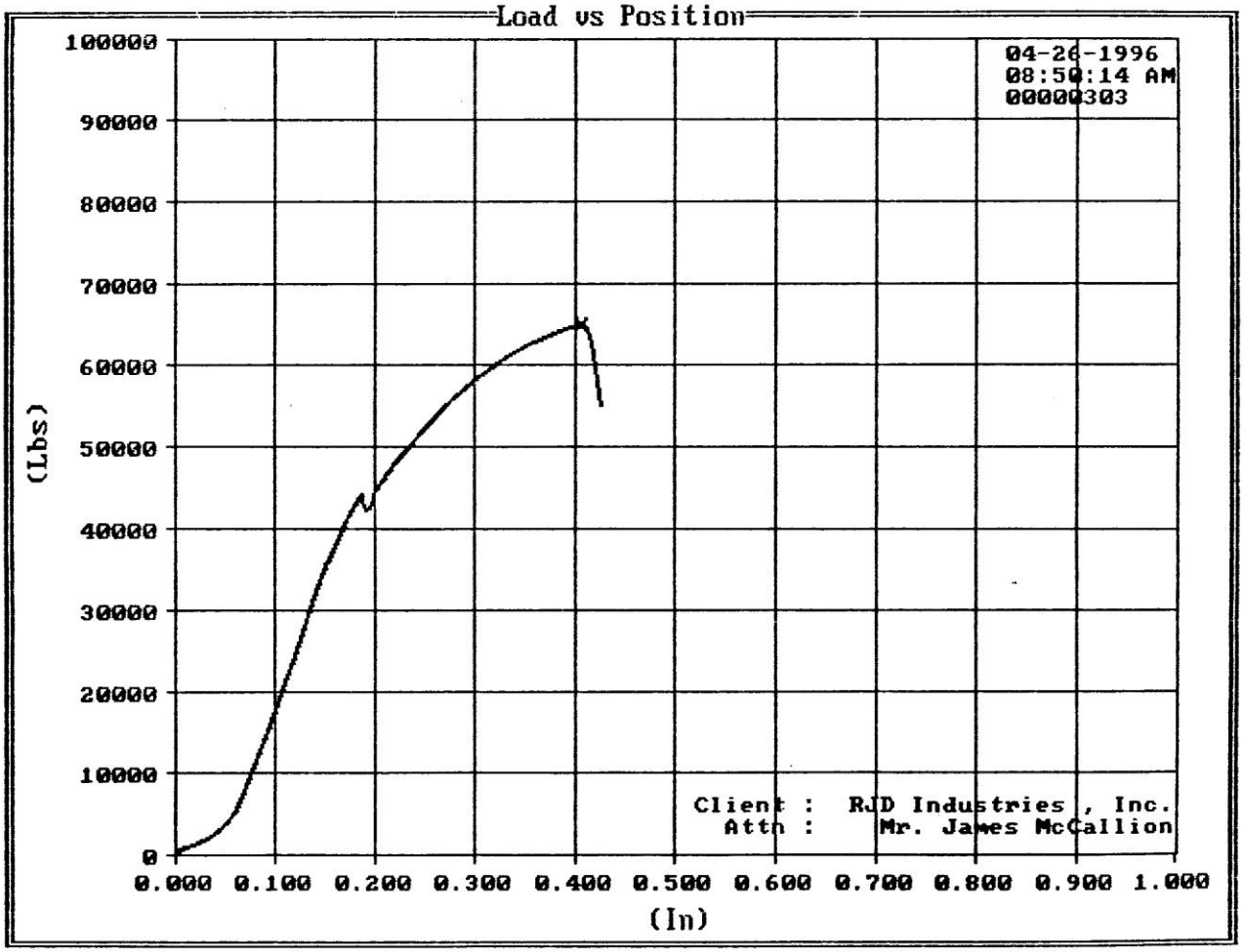
Jay McDowell
Director of Testing
Twining Laboratories of Southern California , Inc.

jmc/rjdshr

| | |
|---|---|
| Client : | RJD Industries , Inc. |
| Attn : | Mr. James McCallion |
| Address : | 26945 Cabot Rd. Unit 105 |
| City/State/Zip Code : | Laguna Hills, Ca. 92653 |
| Specimen No.: | 1 |

| | |
|---|---|
| Test Procedure | Gentest<br>RJD Dowel Bar Shear Test |

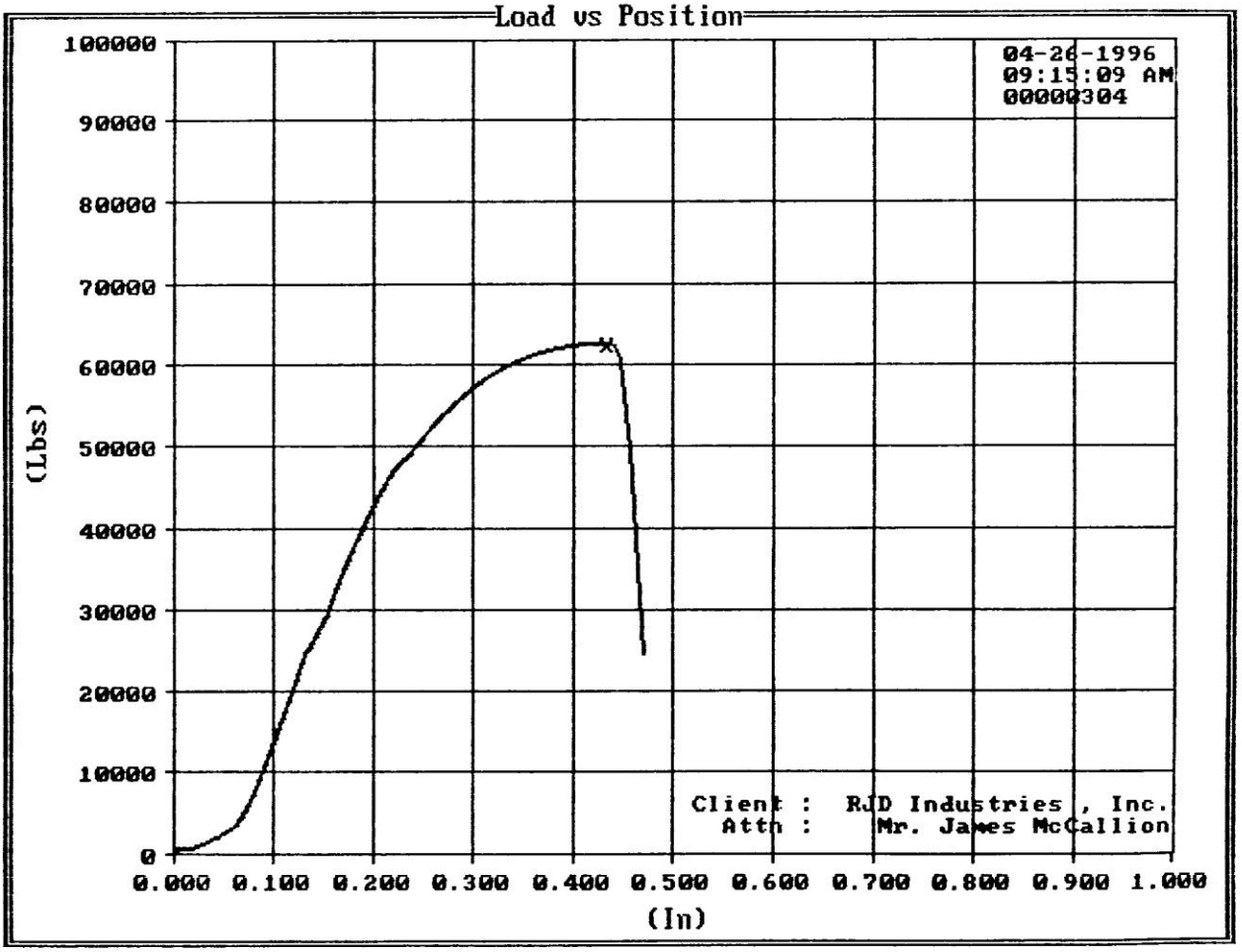
| | | | |
|---|---|---|---|
| Test Date | 04-26-1996 | Tested By | JMC |
| Test Time | 08:50:14 AM | Test Counter | 00000303 |
| Elapsed Time | 00:02:40 | Datasets | 804 |
| | | Area | 0.7741 In² |
| Ult. Load Lbs. | 64943 Lbs | Ult. Stress PSI | 83891 PSI |
| Def.@ Shear[In] | 0.40849 In | | |



| | |
|---|---|
| Client : | RJD Industries , Inc. |
| Attn : | Mr. James McCallion |
| Address : | 26945 Cabot Rd. Unit 105 |
| City/State/Zip Code : | Laguna Hills, Ca. 92653 |
| Specimen No.: | 2 |

| | |
|---|---|
| Test | Gentest |
| Procedure | RJD Dowel Bar Shear Test |

| | | | |
|---|---|---|---|
| Test Date | 04-26-1996 | Tested By | JMC |
| Test Time | 09:15:09 AM | Test Counter | 00000304 |
| Elapsed Time | 00:02:37 | Datasets | 788 |
| | | Area | 0.7732 In² |
| Ult. Load Lbs. | 62522 Lbs | Ult. Stress PSI | 80862 PSI |
| Def.@ Shear[In] | 0.43526 In | | |



# FiberDowel

## Corrosion Proof Dowel Bar System

### Rod Specimen Dimensional Data

**l.00" Nominal FRP Rod** (5' long**)**

**DATE - 1/5/96**

| Specimen/Test# | Marked End | Center | End | Average |
|---|---|---|---|---|
| 1 | 9700 | 9700 | 9700 | 9700 |
| 2 | 9705 | 9700 | 9705 | 9703 |
| 3 | 9700 | 9700 | 9705 | 9702 |
| 4 | 9715 | 9710 | 9715 | 9713 |
| 5 | 9695 | 9705 | 9690 | 9700 |
| 6 | 9700 | 9700 | 9700 | 9700 |
| 7 | 9700 | 9705 | 9705 | 9703 |
| 8 | 9705 | 9705 | 9705 | 9705 |
| 9 | 9695 | 9700 | 9695 | 9700 |
| 10 | 9705 | 9710 | 9705 | 9701 |
| 11 | 9715 | 9715 | 9710 | 9713 |
| 12 | 9705 | 9705 | 9700 | 9703 |
| 13 | 9705 | 9710 | 9705 | 9707 |
| 14 | 9710 | 9710 | 9705 | 9703 |
| 15 | 9710 | 9705 | 9705 | 9706 |
| 16 | 9710 | 9705 | 9705 | 9706 |
| 17 | 9740 | 9735 | 9730 | 9735 |
| 18 | 9705 | 9700 | 9710 | 9705 |
| 19 | 9735 | 9745 | 9740 | 9740 |
| 20 | 9705 | 9705 | 9705 | 9705 |
| | | | | 9708 |

**FiberDowel**
**Corrosion Proof Dowel Bar System**

**Rod Specimen Dimensional Data**
**.750" Nominal FRP Rod** (5' long**)**

**DATE - 1/5/96**

| Specimen/Test# | Marked End | Center | End | Average |
|---|---|---|---|---|
| 1 | 7530 | 7530 | 7525 | 7528 |
| 2 | 7530 | 7530 | 7530 | 7530 |
| 3 | 7520 | 7525 | 7520 | 7522 |
| 4 | 7520 | 7530 | 7520 | 7520 |
| 5 | 7520 | 7530 | 7515 | 7525 |
| 6 | 7530 | 7530 | 7520 | 7527 |
| 7 | 7515 | 7510 | 7510 | 7512 |
| 8 | 7505 | 7515 | 7510 | 7510 |
| 9 | 7520 | 7520 | 7515 | 7518 |
| 10 | 7530 | 7530 | 7530 | 7530 |
| 11 | 7530 | 7530 | 7530 | 7530 |
| 12 | 7515 | 7515 | 7515 | 7515 |
| | | | | |
| | | | | 7522 |

**RJD Industries, LLC**
**FiberDowel**
**Corrosion Proof Dowel Bar System**

**Rod Specimen Dimensional Data**
**.500" Nominal FRP Rod** (5' long**)**

**DATE - 1/5/96**

| Specimen/Test# | Marked End | Center | End | Average |
|---|---|---|---|---|
| 1 | 5015 | 5015 | 5015 | 5015 |
| 2 | 5000 | 5005 | 5005 | 5003 |
| 3 | 5010 | 5005 | 5015 | 5010 |
| 4 | 5005 | 5005 | 5005 | 5005 |
| 5 | 5010 | 5015 | 5015 | 5013 |
| 6 | 5010 | 5010 | 5005 | 5008 |
| 7 | 5015 | 5010 | 5010 | 5013 |
| 8 | 5015 | 5015 | 5015 | 5015 |
| 9 | 5010 | 5010 | 5012 | 5012 |
| 10 | 5015 | 5015 | 5015 | 5015 |
| 11 | 5010 | 5015 | 5015 | 5015 |
| 12 | 5010 | 5010 | 5010 | 5012 |
| | | | | |
| | | | | 5011 |

## FiberDowel
## Corrosion Proof Dowel Bar System

### Rod Specimen Dimensional Data
### 1.00" Nominal Epoxy Coated Steel Dowel Bar

### Control Specimens

**DATE - 1/9/96**

| Specimen/Test# | Marked End | Center | End | Average |
|---|---|---|---|---|
| 1 | 1.023 | 1.020 | 1.039 | 1.027 |
| 2 | 1.040 | 1.023 | 1.027 | 1.030 |
| 3 | 1.035 | 1.035 | 1.036 | 1.038 |
| 4 | 1.037 | 1.035 | 1.029 | 1.033 |
| 5 | 1.037 | 1.043 | 1.011 | 1.030 |
| | | | | |
| | | | | 1.032 |

Corrosion Proof - Transverse Joint Restraint System

## DETERMINE THE REACTION OF THE ROD TO CEMENT SYSTEMS

Please see the attached report titled, "Determine the Reaction of the Rod to Cement Systems". A series of classic corrosion measurement tests were performed. If the specimens weigh less after being exposed to a specific media, for a predetermined period of time, some corrosion has occured:

**1** - Weigh the specimens prior to testing, in this case FRP and steel rods.

**2** - Establish the initial criteria of the medium, in this case the cement alkalinity.

**3** - Maintain the media performance, a constant water bath for the test period.

**4** - Analyze the specimens after the test period.

**5** - Weigh the specimens after the test period.

**6** - Assure test media is still active, measure alkalinity.

Plastic industry authorities advise that corrosion, if any, will occur within the first ninety days of exposure, for the type of resin we use. Further that a 20% reduction, by weight, due to corrosion is accceptable. FRP specimens were tested for a year with no reduction in weight.

Neat cement was used to forestall any buffering action which would be introduced by coarse or fine aggregate. Interestingly, the Ph actually rose, during the test period.

Notice, the **FiberDowe**l fiberglass rod weighed slightly more after the test period. Highly magnified observation of the rod prior to testing shows that although the rod appears smooth, there are many deformations, in the surface of the rod, in the form of smooth ridges and troughs. All surface glass is fully impregnated with resin, and this is proven by no indication of any material corrosion. Highly magnified observation of the rod after the test period showed the presence of cement particles emebedded in the rod deformations, troughs. This indicates adherence to the rod, even over that which would have been nullified by cure shrinkage. This explains why the system is watertight and why the rod remains tightly embedded in the structure.

The steel specimens, after a year, showed, what appeared to be, some passification of the rod surface. This is to be expected with the free alkaline ions present during a constant cure, neutralizing the acidic, oil film, present on the steel.

**FDT1196**

# FiberDowel

Corrosion Proof - Transverse Joint Restraint System

DETERMINE THE REACTION OF THE ROD TO CEMENT SYSTEMS
DOES THE ROD SAPONIFY?

**Summary of Testing Procedure & Results**

**1** - Prepared specimens to be tested at 7, 28, 100 day and 1 year intervals.

**2** - Specimens Comprised of:
- Neat cement, the Ph was measured.
- Rod samples, which were weighed.
- The rod specimens were cast in the cement.

**3** - Measurement Devices Were:
- Corning Ph Meter 10.
- Saturius Analytical Balance, Model 1602.

**4** - All specimens were cured in a water bath for the entire duration of the tests.

**5** - Control specimens of steel ties were prepared, and cast in cement, in the same manner.

**6** - After the prescribed test period had elapsed the fiberglass and steel rods were carefully removed from the cement castings.

**7** - Test Results:

| FRP ROD | | | | | STEEL ROD | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | WEIGHT (GRAMS) | | ph (CONCRETE) | | | WEIGHT (GRAMS) | | ph (CONCRETE) | |
| Test # | IN | OUT | IN | OUT | Test # | IN | OUT | IN | OUT |
| 1 | 111.19 | 111.23 | 11.6 | 11.9 | 1 | 102.97 | 102.97 | 11.6 | 11.9 |
| 2 | 112.38 | 112.44 | 11.6 | 12.0 | 2 | 86.22 | 86.23 | 11.6 | 11.6 |
| 3 | 111.62 | 111.78 | 11.6 | 12.3 | 3 | 98.52 | 98.51 | 11.6 | 12.0 |
| 4 | 112.92 | 113.26 | 11.6 | 12.3 | 4 | 99.12 | 99.11 | 11.6 | 12.3 |

(Tests 1, 2, 3, 4 = 7, 28, 100 days & 1 year durations)

**8** - Observations:

Fiberglass
- No noticable physical deterioration.
- No indication of saponification.
- No cement casting cracking.
- The rod remained firmly anchored in cement.

Steel
- No noticible physical deterioration.
- No cement casting cracking.
- The rod pulled easily from the cement.

**FDT1295**

# Corrosion Proof Dowel Bar System
## MATERIAL SAFETY DATA SHEET

### PLASTICS

**I. PRODUCT IDENTIFICATION**
Product Name: FiberDowel, Corrosion Proof Dowel Bar System
Manufacturer: RJD Industries, Inc.
Address: 26945 Cabot Rd. #105
Laguna Hills, CA 92653
Emergency Telephone: (714)582-0191
Chemical Name and Synonyms: Polyester Fiberglass
Chemical Family: Plastics and Fiberglass
Formula: Mixture

**II. PRODUCT DESCRIPTION AND HAZARDOUS INGREDIENTS/IDENTITY INFORMATION:**
Trade Name: Fiberglass Composite
Generic Name: Polyester Fiberglass Composite
Chemical Name: Polyester Impregnated Fiberglass

**III. PHYSICAL DATA:**
Melting Point F (C): Does Not Melt
Vapor Pressure: Not Applicable
Vapor Density (Air = 1): Not Applicable
Solubility in Water: Negligible
Specific Gravity (Water = 1): 1.6 - 2.0
% Volatile by Volume (%): Not Applicable
Evaporation Rate: Not Applicable
Appearance and Odor: Various colors, in Rods of varying diameters. No odor.

**IV. FIRE AND EXPLOSION HAZARD DATA:**
Flash Point F (C): 650
Extinguishing Media: Use methods applicable and and appropriate for surrounding area.
Flammable Limits: Not Applicable
Unusual Fire and Explosion Hazards: None
Special Fire Fighting Apparatus: Use self-contained breathing apparatus for protection against degradation products from surrounding materials.

**V. HEALTH HAZARD DATA:**
Over exposure to nuisance dust can lead to difficulty in breathing. Asthmatic or bronchial conditions could be aggravated.
Inhalation: Irritation or soreness in throat and nose. In extreme exposures some congestion may occur.
Skin Contact: Temporary irritation, itiching, rash or dermatitis may result.
Skin Absorbtion: Not Applicable
Ingestion: Not Known
Eyes: Temporary irritation or inflammation
Emergency and First Aid Procedures:
In the event of acute exposure, remove to fresh air, administer oxygen and seek a physician's assistance.
Inhalation: Remove to fresh air. Drink water to clear throat, and blow nose to evacuate fibers.
Skin Contact: Wash affected areas gently with soap and warm water.
Skin Absorbtion: Not Applicable.

Eyes: Flush with copius quantities of water a minimum of 15 minutes. If irritation persists consult a physician.

**VI. REACTIVITY DATA:**
Stability: Considered Stable.
Incompatability: Not incompatible with materials.
Hazardous Polymerization: Not Applicable.
Hazardous Decomposition Products: Carbon monoxide.
Conditions to Avoid: When heated to decomposition or combustion temperatures, products of decomposition include carbon dioxide, carbon monoxide and other volatiles as indicated.

**VII. SPILL OR LEAK PROCEDURES:**
Procedures for spill/leak: Vacuum clean dust. If sweeping is necessary, use a dust surpressant.

Waste Management: Wastes are not hazardous as defined by RCRA (40CFR Part 261). Comply with Federal, State and Local regulations. Method of disposal - Landfill, RQ - N/A.

**(continued on next page)**

**Material Safety Data Sheet (con't):**

**VIII. SPECIAL PROTECTION INFORMATION:**
When machining thermoplastics dry, a dusty condition will result. A suitable dust collection system should be employed along with a dust mask for respiratory protection. A protective cream or clothing should be used to protect skin for worker comfort. When machining any plastics, safety glasses or a face shield and gloves should be used.

VIII Special Protection Information (con't):
Goggles: Safety glasses are recommended.
Gloves: Hand protection recommended.
Respirator: Use a respirator such as 3M Model 9900 or equivalent for protection against nuisance dust when handling or working with this product.
Ventilation: Use sufficient natural or mechanical ventilation to maintain airborn concentrations below PEI/TLV.
Other: Wear loose fitting, long sleeved clothing.

**XIV SPECIAL PRECAUTIONS:**

Precautions to be taken in handling and storing: standard safety precautions apply.
Other Precuations: When fighting fires where plastics are burning, a self-contained breathing apparatus (SCBA) must be used.

Information contained in this Material Safety Data Sheet is offered without charge for use by technically qualified personnel at their discretion and risk. All statements, technical information and recommendations contained herein, are based on tests and data which we believe to be reliable, but the accuracy or completeness thereof is not guaranteed and no warranty of any kind is made with respect thereto. This information is not intended as a license to operate under or a recommendation to practice or infringe any patent of this Company or others covering any process, composition or matter or use.

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**DBMSDS1196**