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Evaluation of the Motor-Operated Valve Analysis and Test System (MOVATS) to Detect Degradation, Incorrect Adjustments, and Other Abnormalities in Motor-Operated Valves

J. L. Crowley
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Prepared for the U.S. Nuclear Regulatory Commission
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EVALUATION OF THE MOTOR-OPERATED VALVE ANALYSIS AND TEST SYSTEM (MOVATS) TO DETECT DEGRADATION, INCORRECT ADJUSTMENTS, AND OTHER ABNORMALITIES IN MOTOR-OPERATED VALVES

J. L. Crowley D. M. Eissenberg

ABSTRACT

As a part of the Nuclear Regulatory Commission Nuclear Plant Aging Research Program, a field test program was carried out to evaluate a technique of valve signature analysis to detect and differentiate abnormalities, including time-dependent degradation (aging) and incorrect adjustments in motor-operated valves. The technique described in this report is the Motor-Operated Valve Analysis and Test System (MOVATS), which is commercially available from MOVATS, Inc. In-situ signature traces were obtained on 36 motor-operated valves at 4 nuclear plant sites. Described are the test equipment package, method of obtaining the signatures, and determinations made as a result of analyzing these signatures. Based on evaluations of the signature-analysis technique and on the results obtained from the field test program, the capabilities and limitations of MOVATS are discussed.

1. INTRODUCTION

The Office of Nuclear Regulatory Research (RES) of the Nuclear Regulatory Commission (NRC) has instituted a Nuclear Plant Aging Research (NPAR) Program[1] to carry out research aimed at increasing the understanding of the causes, consequences, and methods for mitigating the effects of time-dependent degradation (aging) of nuclear plant components that are considered important to ensure safety. An important aspect of the NPAR Program strategy is to demonstrate the utility of condition-monitoring, signature-analysis, and other surveillance methods for detecting, differentiating, and trending various types of abnormalities in the components so that corrective measures can be implemented prior to loss of safety function. Oak Ridge National Laboratory (ORNL) is a contractor to NRC, carrying out specific tasks in support of the NPAR Program, including investigation of the sources of aging effects, abnormality characterization and identification, and evaluation of inspection and surveillance monitoring methods for selected components.

This report documents the results of a field test program carried out as part of ORNL's activities in support of the NPAR Program. The field test program involves the evaluation of a signature-analysis method for monitoring the health of motor-operated valves (MOVs), one of the components under study at ORNL.

The technique tested, the Motor-Operated Valve Analysis and Test System (MOVATS), was recently developed and is currently marketed by MOVATS, Inc., of Marietta, Georgia. The tests were carried out by MOVATS, Inc., under subcontract to Martin Marietta Energy Systems, Inc. The results obtained are presented, essentially as received from the subcontractor, in Sect. 5 and Appendix B of this report.

2. BACKGROUND

ORNL has been investigating the aging of MOVs in nuclear power plants as part of the NRC/RES NPAR Program. A Phase I study[2] has been completed recently that characterized time-dependent degradation and failure modes and causes expected in MOVs in nuclear plant service based on analyses of designs, maintenance practices, and operating experiences. The study also identified potential parameters for detecting, differentiating, and trending the degradation expected to occur over the operating life of the MOVs. It was learned during the course of this work that some of these parameters could be monitored by the signature-analysis method MOVATS.

A specific request was initiated by NRC Office of Nuclear Reactor Regulation[3] that a limited field test program of the MOVATS signature-analysis technique be carried out to "learn exactly what [it] can provide about safety related MOV operational readiness above and beyond the currently used ASME Section XI methods." It was in this context and with a limited scope of work that a statement of work was prepared (Appendix A), and a contract was awarded to MOVATS, Inc. This report describes the results of that field test program.

It is not the intent of this limited investigation to answer all pertinent questions concerning the operational readiness of MOVs in nuclear power plants. It is expected that upon completion of the Phase II study of MOVs as an element of the NRC/RES NPAR (Fig. B.7 in Ref. 1), a comprehensive report will be issued on the operational readiness of MOVs.

2.1 Objective

The objectives of this test program were to

1. evaluate the capability of MOVATS to provide useful diagnostic information for determining the operational readiness of MOVs beyond that currently provided by the *ASME Code* Sect. XI methods and
2. identify and characterize the types of abnormalities found in some selected MOVs installed in nuclear plants utilizing the MOVATS technique.

Note that the MOVATS technique has been applied only to MOVs that utilize Limitorque operators manufactured by the Limitorque Corporation. Limitorque operators are currently used in over 90% of the MOVs installed in U.S. nuclear power plants.

2.2 *ASME Code* Sect. XI Division 1 Requirements

Technical Specifications for both pressurized-water reactors (PWR) and boiling-water reactors (BWR) require that surveillance testing of safety-related MOVs be carried out in accordance with the provisions of Article IWV-3000 of Sect. XI, Division 1, of the *ASME Boiler and Pressure Vessel Code*.[4]

Under Article IWV-3000, category A and B valves* in nuclear plant service are required to be tested after installation but prior to service; after replacement, repair, or maintenance that could affect performance; and periodically in service as specified. Three types of tests are required: (1) valve position indicator verification, (2) valve exercising, and (3) valve leak rate. However, because MOVATS does not address either position indication or valve leakage, only the valve exercising test will be discussed in this report.

The exercising test is expected to be performed every 3 months except where other provisions are made. The tests that apply to MOVs (both categories A and B) involve two procedures that are carried out when the valve is at its design conditions if possible:

1. exercising full stroke or part stroke to verify valve disk movement; when movement is not verified, corrective action is initiated immediately and
2. exercising full stroke to measure stroke time; where stroke times are measured to be >25% above the previous test, the test frequency is increased to once per month until corrective action is taken. When the stroke time exceeds the limiting stroke time specified by the owner, corrective action is initiated immediately.

Other details of the test, exceptions to the procedures, and corrective actions are described in Article IWV-3000 of Ref. 4.

2.3 Valve Operability vs Operational Readiness

A component that is operable at a given point in time can be defined as one that has been demonstrated by testing at that time to have met a set of functional performance requirements under specified test conditions. Article IWV-3000 thus provides the basis for determining MOV operability. Periodic repetition of the operability test demonstrates continuing operability.

Operational readiness can be defined as the ability of a component, as installed and maintained, to operate properly under all anticipated operating conditions when called upon at any time in the future. Thus operational readiness is an extrapolation of operability in two dimensions — time and operating conditions.

Operational readiness can be inferred to some extent from operability tests. A MOV that periodically passes the IWV-3000 tests has a reasonable probability of being operable in the future under conditions similar to the test conditions. However, components can degrade with time and eventually fail under some operating conditions if not maintained properly. Operability tests as delineated in *ASME Code* Sect. XI cannot predict future failures.

Operational readiness can be more directly predicted if the degradations or other abnormalities that lead to failures can be periodically

*These include all valves that are neither self-actuating (i.e., check valves) nor limited to only one actuation (i.e., rupture disks).

or continuously monitored and trended so that incipient defects can be identified and interpreted and corrective action can be taken prior to failure. Signature-analysis methods, such as MOVATS, could provide the basis for determining operational readiness, provided they cover the range of degradations expected, and can provide sufficient quantitative data so that the results can be trended and extrapolated.

3. APPLICATION OF THE MOVATS SYSTEM TO THE LIMITORQUE MOV

MOVATS is a portable signature-analysis device designed for use in the field. The system acquires, stores, and performs calculations on instantaneous readings of the following motor-operator characteristic parameters obtained during a valve cycle at ambient conditions:

1. axial motion of the worm,
2. actuations of torque and limit switches, and
3. motor current.

To understand the relationship between these characteristics and MOV abnormalities, a brief description is included of the Limitorque motor operator and of the instrumentation package adopted by MOVATS for obtaining the three characteristic parameters.

3.1 The Limitorque Motor Operator

This brief summary of the workings of a Limitorque operator is keyed to Fig. 3.1, a picture of Limitorque SMB-0 to SMB-4 operators.

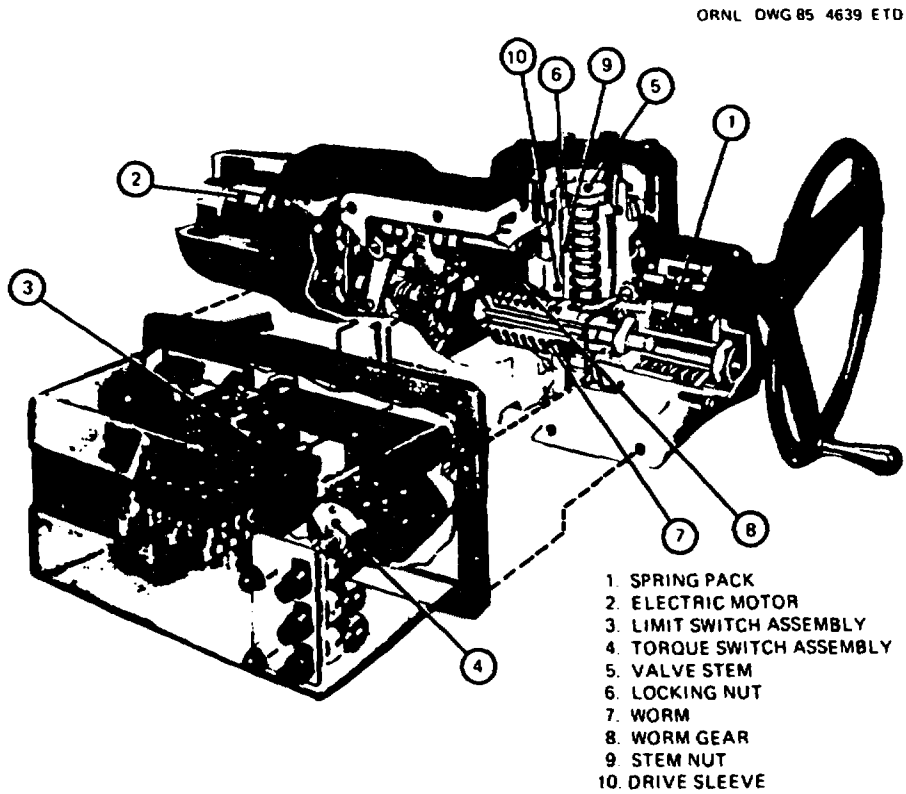

Fig. 3.1. Limitorque operator sizes SMB-0 to SMB-4 with some parts identified.

An electric motor (2)* rotates the worm (7) through a pinion and gear. The worm is engaged with and drives a worm gear (8). The worm gear is equipped with two lugs that can contact two similar lugs on the drive sleeve (10). These are spaced about a half-turn apart so that when the direction of the motor is reversed, there is approximately one-half revolution of lost motion before the lugs reengage. The reengagement causes a "hammerblow" that provides added impulse to lift the valve obturator out of its seat. Once the worm gear lugs are engaged, the drive sleeve rotates the stem nut (9), which causes the stem to raise or lower the obturator. In some gate valves the stem is fitted to the obturator with a clearance so that it must move a fixed distance before the obturator itself will move. This configuration can give rise to a second hammerblow, the magnitude of which may be greater than the first.

The torque transferred by the worm, which causes the worm gear to rotate, also causes the worm itself to translate axially along the spline of its shaft. This axially directed motion is limited by the counteracting thrust generated by compression of the spring pack (1) such that the distance travelled by the worm is proportional to the torque being delivered to the worm gear.

The torque switch (4) is rotated mechanically, that is, through a rack and pinion gear, by the axial movements of the worm. When a preset amount of rotation occurs either in the opening or closing direction, the torque switch will open, removing electric power from the motor.

The limit switch (3), usually consisting of two rotary switches, is geared directly to the motor shaft so that it tracks valve stem position and actuates one rotor at each of the preset valve positions of near full-open and near full-closed. Generally, the torque switch is wired to stop the motor in the closed position (i.e., torque seated valve), while the limit switch is wired to stop the motor in the open position (i.e., limit open valve). The limit switch also provides an interval of bypass around the torque switch during the hammerblow to prevent an interruption of motor power if there is enough spring-pack deflection during hammerblow to open the torque switch. Other contacts on the limit switch are used to actuate valve position lights in the control room or other remote locations.

3.2 Stem-Thrust Signature

The basis for the MOVATS system is the proportionality between the thrust being delivered to the valve stem and the axial movement of the worm to compress the spring pack. Thus, if the instantaneous axial motion of the worm throughout a valve cycle was accurately monitored, a stem-thrust signature would result. Abnormalities that affect stem thrust, such as valve and/or operator binding, poor lubrication, gear wear, and stem damage, potentially could be recognized by examination of the worm motion signature. To obtain a reading of worm axial motion, a linear variable differential transformer is used in a device developed by MOVATS called the thrust measuring device (TMD). To install the TMD on

aging

*The numbers in parentheses refer to the key in Fig. 3.1.

the motor operator, the spring-pack dust cover is removed and the TMD mounted so that its plunger maintains contact with the spring-pack preload nut. With the TMD installed and its output conditioned and connected to a recording system, axial movement of the worm is converted into a voltage output of the TMD. The spring pack, when originally installed in the motor operator, is preloaded to some value specified by the vendor. As a result, the amount of deflection of the spring pack (and the accompanying TMD reading) will reflect only that thrust caused by torque exerted by the worm on the worm gear that exceeds the spring-pack preload. Thus, a zero worm deflection or TMD reading during cycling of the valve can represent any thrust less than the spring-pack preload.

Although knowledge of the worm axial motion throughout the valve cycle provides information regarding the valve and operator mechanical condition, calibration of movement of the worm with the actual stem thrust is needed to properly establish spring-pack preload and torque-switch setpoints. To calibrate the spring-pack, a stem thrust calibration fixture (Fig. 3.2) developed by MOVATS, Inc., is installed in place

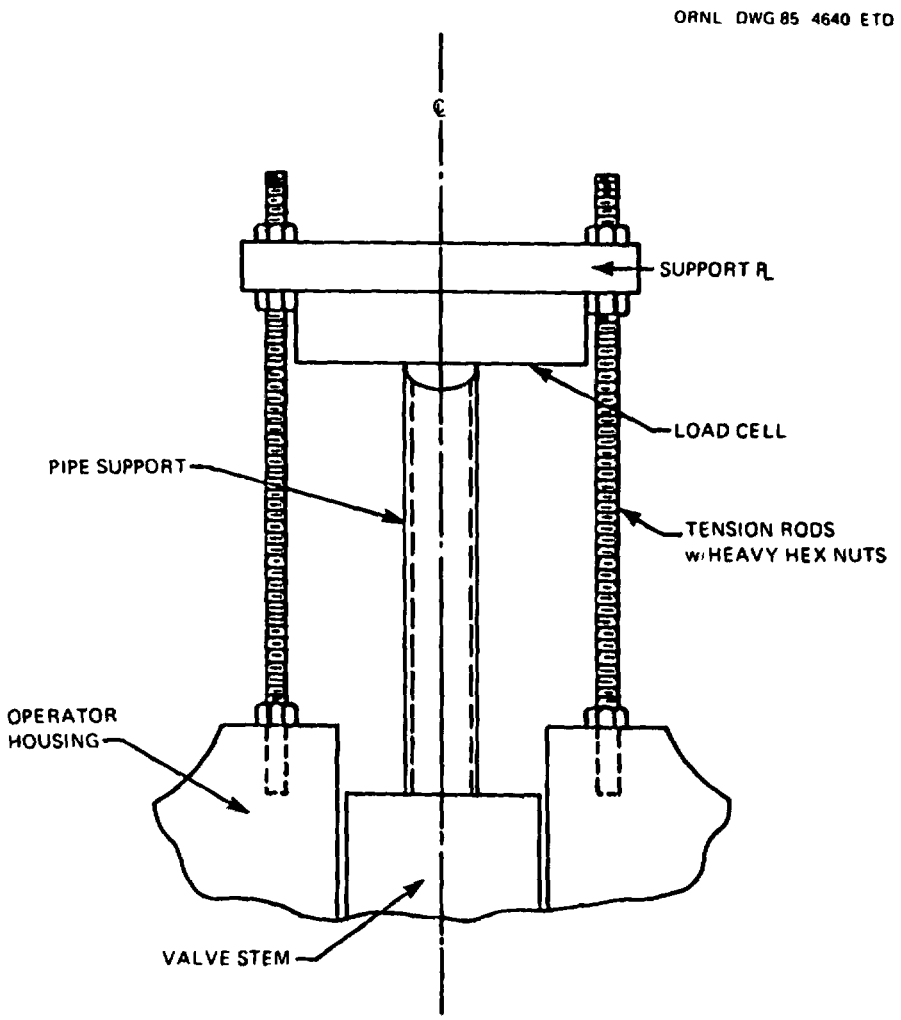

Fig. 3.2. Stem-thrust calibration fixture.

of the upper-bearing thrust cover. A load cell is mounted in the path of the rising valve stem. With the TMD also installed, the valve is opened electrically. As the rising valve stem contacts the load cell, the stem load rises sharply, producing a corresponding worm motion. When the values of worm motion are plotted against the load cell readings, the slope of the resultant curve represents the spring-pack constant, given either as pounds of stem thrust per inch of worm deflection or pounds of stem thrust per volt of TMD output.

3.3 Switch Signatures

By means of a specially designed multicoil transformer device, a single signature is generated that gives the exact times during the valve cycle that the torque and limit switches actuate. By superimposing this signature on the thrust signature, the exact points and loading conditions at which the various switches actuate are determined within the valve cycle.

To install the switch-sensing circuit, MOVATS signal leads are attached in series with the control circuit. An alternate technique is available for monitoring the control-switch positions without lifting any control circuit leads. However, this technique precludes observation of the torque-switch actuation during part of the cycle.

3.4 Motor-Current Signature

In measuring this parameter, a clamp-on ammeter with analog output is attached to the motor power lead either at the valve or the motor-control center. Changes in motor current provide a signature of degrading mechanical or electrical conditions similar to that provided by spring-pack deflection.

3.5 Signature Analysis

Figures 3.3 and 3.4 are schematic representations of hypothetical spring-pack deflections, switch actuations, and motor currents for close-to-open and open-to-close cycles of a normal MOV. Table 3.1 provides a key to the signatures in Figs. 3.3 and 3.4.

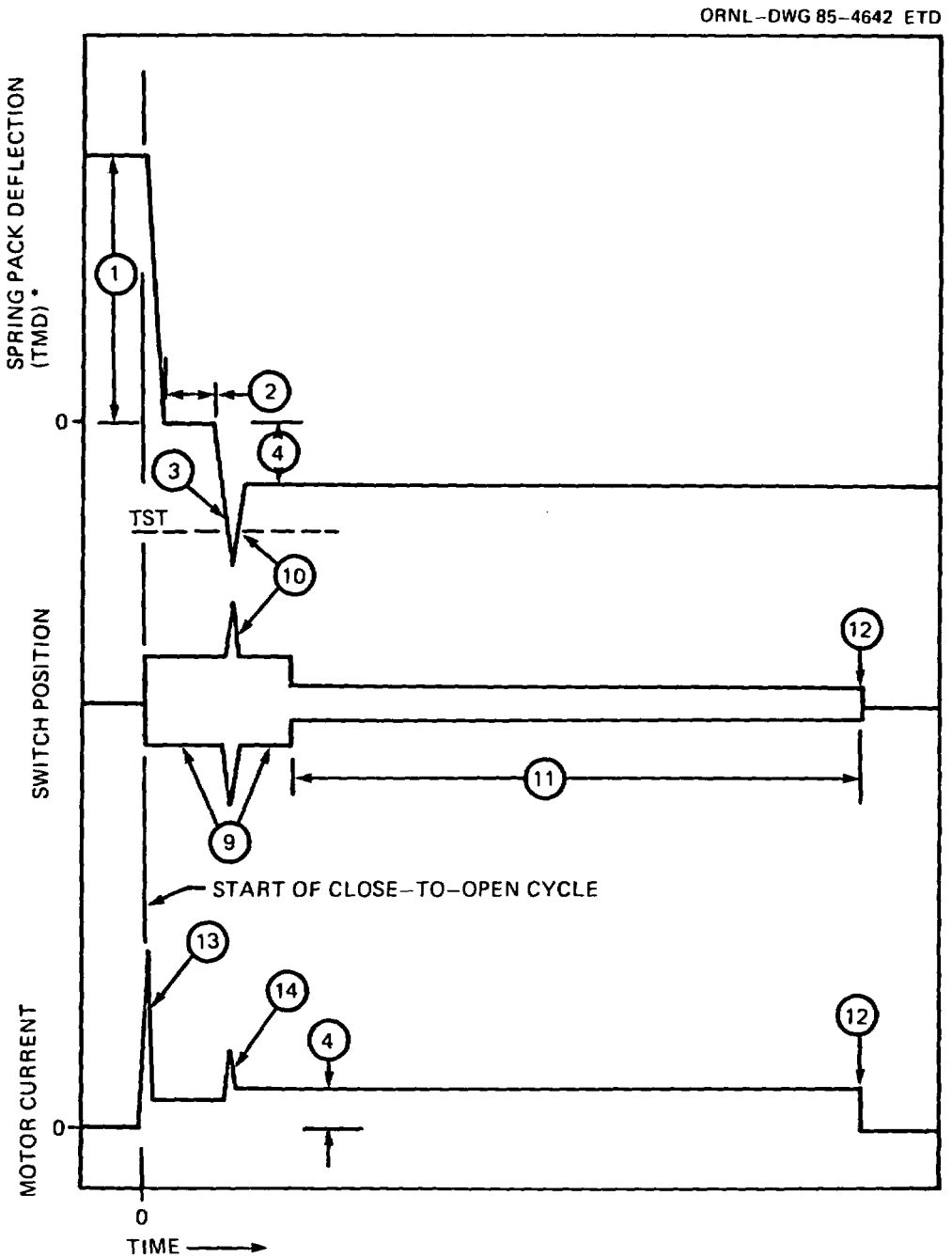

Fig. 3.3. Hypothetical close-to-open valve cycle as indicated by the TMD, the switch-position-indicating device, and the motor current. See Table 3.1 for explanation.

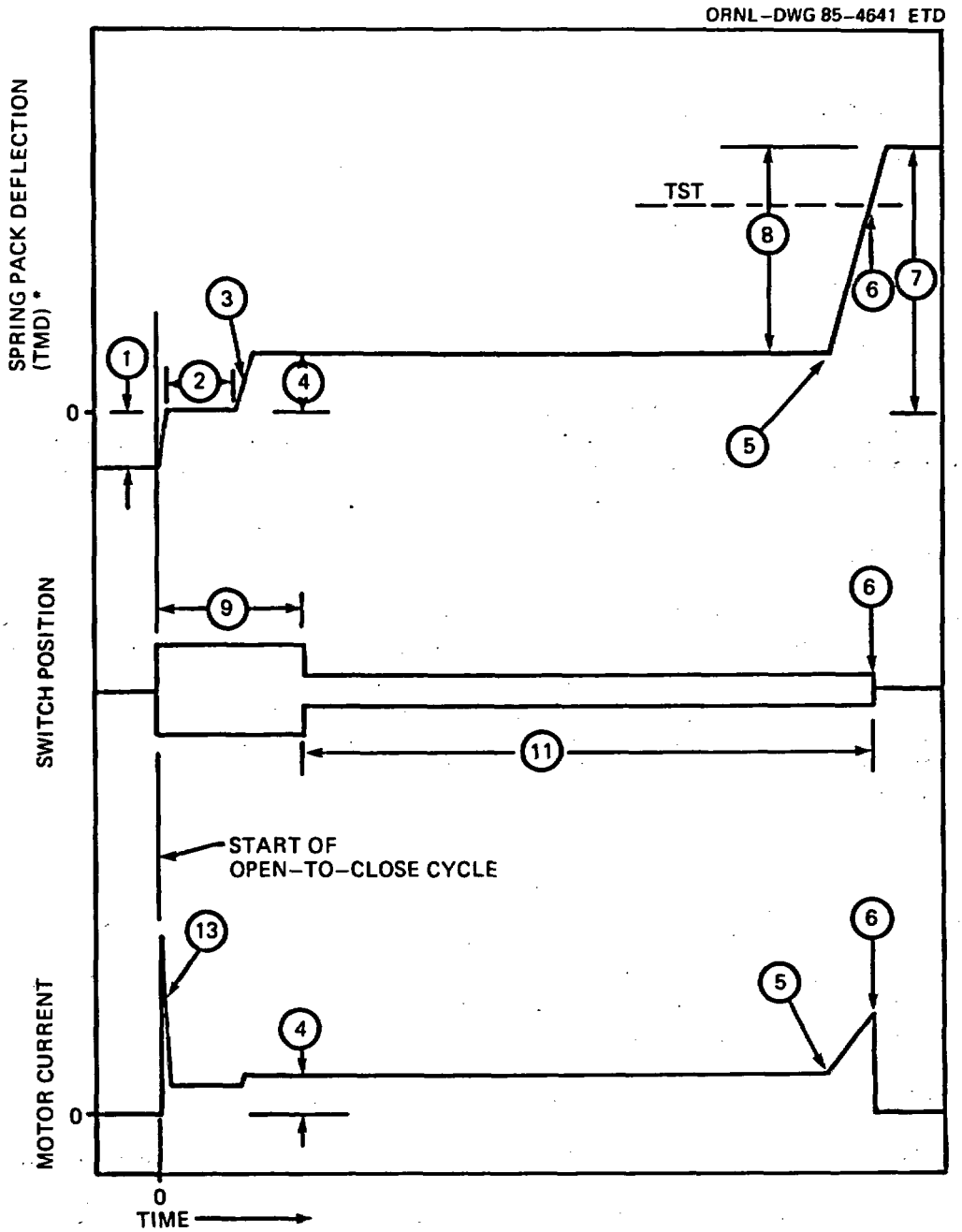

Fig. 3.4. Hypothetical open-to-close valve cycle as indicated by the TMD, the switch-position-indicating device, and the motor current. See Table 3.1 for explanation.

Table 3.1. Interpretation of valve signatures in Figs. 3.3 and 3.4[a]

Thrust signature (measured as spring-pack deflection)

1. Spring-pack relaxation

   The beginning worm position results from the stem thrust remaining from the previous valve operation. As soon as the motor starts, the spring pack relaxes, and the worm returns to its zero deflection condition. Because the spring pack is assisting the motor at this time, this period is short.

2. Zero worm deflection

   During this time interval the spring pack is in its zero deflection position. The worm gear must make one-half of a revolution before contacting the drive sleeve lugs. Meanwhile, the motor is accelerating to operating speed.

3. Hammerblow

   This thrust transient can occur when the valve stem starts moving and also when the valve stem initiates movement of the obturator (in the case of some gate valves). Because the load on the stem may be much greater in the closed position, the thrusts at hammerblow are usually greater in the close-to-open cycle. In this example, the hammerblow is large enough to trip the torque switch momentarily (see No. 10).

4. Running load

   This is the thrust required to overcome packing and gear friction. In this example, running load is greater than zero because spring-pack preload was less than running load. In many cases the reverse is true, and the TMD output does not reflect running load; in other words, it shows decreasing thrust.

5. Valve seating [open-to-close cycle only (Fig. 3.4)]

   At this time in the open-to-close cycle, the valve obturator contacts the valve seat. Motion of the worm changes from all rotational to partly rotational and partly axial, resulting in the slowing down of the stem as the spring pack is compressed.

6. Torque-switch-trip (TST)

   The torque switch opens at its setpoint, shutting off power to the motor [open-to-close cycle (Fig. 3.4)].

Table 3.1 (continued)

7. Total thrust

   The total thrust is the maximum thrust produced by the valve operator at a given setting of the torque switch. This may include inertia overshoot of the thrust above the torque-switch setpoint.

8. Available thrust

   The available thrust is that portion of the total thrust useful for seating the valve. It consists of the difference between the total thrust of No. 7 and the running load of No. 4.

Switch signatures

The various switch positions as recorded by MOVATS are represented by the width of the bar. In these examples, it is assumed that valve operation is stopped by the torque switch on closing (Fig. 3.4) and by the limit switch on opening (Fig. 3.3).

9. Both the bypass switch and the torque switch are closed. The bypass around the torque switch negates the momentary torque-switch trip to accommodate the thrust from a hammerblow without tripping the motor.

10. The torque switch opens momentarily as a result of the hammerblow. The motor continues to run because the bypass (limit) switch is closed.

11. The bypass switch opens just after the hammerblow, while the torque switch remains closed. Any subsequent loads in excess of the torque-switch setting will open the torque switch and shut down the motor.

12. The limit switch opens and shuts down the motor.

Motor-current signature

13. The starting current for an induction motor is typically six to ten times running current.

14. The hammerblow, if sufficiently large as it is in the close-to-open example, may cause a momentary but measurable current increase, as shown in Fig. 3.3.

[a]Adapted from MOVATS, Inc., information brochure.

4. DEGRADATION, INCORRECT ADJUSTMENTS, AND OTHER ABNORMALITIES IDENTIFIABLE BY MOVATS

Abnormalities in motor-operated valves identified and differentiated by the MOVATS method are classified into two types: (1) degradation of valve parts that, if allowed to progress, can lead to MOV failure and (2) incorrect adjustments or other abnormalities that either cause degradation of valve parts and, thus, ultimately MOV failure or that can directly cause MOV failure under some anticipated operating conditions. In identifying and characterizing abnormalities based on the MOVATS method, no distinction was made between the two types of abnormalities, although from the standpoint of the NPAR Program, the former are of greater interest.

4.1 Bent Stem

A bent stem is a degradation that can be recognized by a gradual increase and/or decrease in the running load in both the close and open directions that may also be reflected in the motor-current signature.

This degradation, if it becomes progressively worse, can result in failure of the valve to complete its stroke because of premature torque-switch trip.

4.2 Gear Wear

Gear wear is a degradation that can be identified in both the thrust and motor-current signatures in the form of cyclic loading. When this degradation is noted, the frequency of the cycling can identify the worn gear.

Gear wear, if it progresses, can ultimately lead to failure of the valve to operate if gear teeth break or wear to the point where torque cannot be transferred between gears.

4.3 Motor Pinion Binding

Binding of the motor-pinion gear can be recognized by an erratic motor-current signature that does not have a comparable thrust signature, indicating that the degradation is occurring upstream of the worm. Binding, if it gets worse, can result in failure of the MOV to operate because of motor burnout or actuation of the thermal overload switch.

4.4 Stem Wear

Stem wear can be recognized by a nonuniform thrust signature. Typically, stem wear has not been noted in the motor-current signature.

Conclusive verification that stem wear is present either in the form of worn threads or burrs is obtained by comparing a signature with that taken in the opposite direction of valve operation. The degraded area should be reflected in the opposite side of the signature when comparing open and close cycles.

Stem wear, if it progresses, can lead to failure to operate because of gear breakage or premature torque-switch trip.

4.5 Grease Hardening

Grease hardening can result from extended exposure of the grease to elevated temperature or radiation environments. The effect of grease hardening depends on where it occurs in the operator. Hardened grease in the region between the motor and the worm gear can be detected by an increased motor current with no comparable change in stem thrust. On the other hand, hardened grease in the spring pack can be detected as an abnormally high spring-pack constant.

The consequence of progressive grease hardening in the gears can be motor burnout. Grease hardening in the spring pack can lead to a broken obturator or seat or a bent stem, resulting from the excess torque permitted by the abnormally high spring constant.

4.6 Motor Degradation

Motor bearing wear and changes in the electrical resistance characteristics of either the conductors or insulation can be detected as increased motor current without a comparable increase in stem thrust indication. It may be difficult to differentiate this degradation from the motor pinion gear wear. Motor degradation, if it worsens with time, can lead to failure of the valve to operate because of motor failure or actuation of the motor thermal overload switch.

4.7 Excessive Inertia

Excessive inertia can occur when the total thrust exceeds vendor specifications for maximum thrust, even though the torque-switch setting is correct. Excessive inertia arises because of the continuing inertial movement of the obturator into the seat after torque-switch trip and is more commonly seen when the valve is being tested at ambient conditions. The excessive inertia is measured as the inertia overshoot, which is the percentage by which the total thrust exceeds the thrust at torque-switch trip.

Excessive inertia, if allowed to continue, can lead to progressive degradation of valve parts, which in turn can cause valve failures. Degradations that can result from excessive inertia include bent stem and deformed or broken valve seat.

4.8 Inadequate Stem Lubrication

Inadequate stem lubrication is reflected in the running load, showing up as a choppy and rough thrust signature. Because of the small magnitude of the peaks, this may not show up in the motor-current signature.

Inadequate stem lubrication can lead to degradation of the stem and stem nut or, alternately, to premature torque-switch trip as a result of increased running load.

4.9 Improper Seating

Improper seating involves either misalignment of the disk and seat or discontinuities in the mating surfaces. A normal valve, upon seating, will have a rapid linear thrust increase. Discontinuities in the measured thrust during seating is indicative of binding either in the seating area or the stem disk assembly.

Improper seating can lead to permanent deformation of the obturator or seat and leakage through the valve.

4.10 Valve Backseating

Valves that are limit-opened and are incorrectly adjusted may contact the backseat either before or after the motor has been deenergized. The thrust signature in the close-to-open cycle for this condition will indicate an increase in thrust when there is backseat contact. Comparison with the limit-switch signature can determine whether improper limit-switch setting or inertia overshoot caused the backseating.

The effect of frequent backseating during normal valve operation can be mechanical damage to the obturator or stem, leading to failure of the valve to operate. Another potential degradation resulting from frequent backseating during normal operation is damage to the obturator or seat such that stem leakage cannot be temporarily reduced during plant operation by use of occasional backseating.

4.11 Incorrect Torque-Switch Calibration

The thrust delivered to the valve stem at a given torque-switch setting may not correspond to that given in the manufacturer's specifications. This can be determined by direct comparison of stem thrust (as calibrated using a load cell) and torque-switch setpoint.

Premature torque-switch actuation resulting from an incorrect calibration can result in failure of the valve to complete its stroke. An abnormally high stem thrust caused by an incorrect calibration can lead to valve obturator or seat damage, mechanical degradation of other operator or valve parts, thermal overload actuation, or motor burnout, resulting ultimately in failure of the valve to operate.

Abnormality Nonagin

4.12 Unbalanced Torque Switch

Torque switches can be installed unbalanced so that at equal torque-switch trip settings, the actual thrust setpoints in open and close directions are not equal. This abnormality is detected by determining from the stem thrust and control switch signatures the actual amount of thrust that trips the torque switch in each direction. Comparison of the movements in the open and close directions provides an indication as to the magnitude of torque-switch unbalance.

The effect of an unbalanced torque switch is to permit the motor operator to deliver more thrust in one direction than in the other. This could lead to the same types of degradation or failures listed in Sect. 4.11.

4.13 Excessive Spring-Pack Gap

The preload on the spring pack is such that, when assembled in the motor operator, no gap should exist between the spring pack and the shoulder that holds it in place. The presence of a gap can be observed in the thrust signature as an extension of the zero load condition.

Spring-pack gap can lead to premature torque-switch actuation (i.e., actuation at too low a value of stem thrust over that expected from the torque-switch setting, which can result in a valve that fails to close completely).

4.14 Excessive Packing Tightness

Excessive valve packing tightness appears as a cyclic variation in the running load and also may appear in the motor-current signature. It may be difficult to differentiate this abnormality from mechanical gear wear without diagnostic testing, such as loosening or replacing packing.

Excessive packing tightness can, under some anticipated operating conditions, lead to premature torque-switch actuation, resulting in failure of the valve to open or close completely.

4.15 Improperly Set Bypass Switch

The close-to-open limit switch is intended to provide bypass protection of the torque switch during hammerblow. An improperly set bypass switch, which terminates the bypass too early in the stroke, can be detected by comparing the measured bypass actuation time with the hammerblow time as measured from either the motor-current or stem-thrust signatures. Note that the hammerblow magnitude may be much smaller during (ambient) tests than under anticipated operating conditions. However, the hammerblow time will be independent of operating conditions.

An improperly set bypass time can lead to failure of the valve to open under some operating conditions.

4.16 Loose Stem-Nut Locknut

This abnormality can be identified from the thrust signature as a period of time following the first hammerblow during which the running load is very low or zero. Normally, following the first hammerblow, the running load should reflect the force needed to raise or lower the stem; however, if the stem-nut locknut is loose and the stem nut is free to move axially, the movement will require minimal thrust.

If undetected, a loose stem-nut locknut can gradually rotate away from its normal position adjacent to the stem nut, allowing the stem nut (rather than the stem) to displace during valve actuation. At some point, if the locknut rotates off the stem, the stem can become unconstrained, rendering the valve inoperative.

5. SUMMARY OF RESULTS

5.1 Analysis Summary

This section describes the history and significant abnormalities identified for each valve tested essentially as provided by MOVATS, Inc. In some instances the abnormality was identified wholly or in part by visual inspection concurrent with the MOVATS testing. A more complete description of the abnormalities found for each valve is included in Appendix B.

Valve No. 1

Valve Type: 12-in. gate

Operator Type: SMB-1

Safety Related: No

Plant Type: PWR

History. No significant prior mechanical or electrical problems existed with this valve other than adjustments to the limit switch, which were made in October 1984 because of valve leakage. When the leakage was noted, it was found that an additional 9.5 turns of the handwheel were required to completely close the valve following motor operation.

Signature-analysis findings. Analysis of the time between the initial hammerblow loading condition and the actual unseating of the valve suggested that the stem-nut locknut had loosened. This condition was confirmed by removal of the stem guard pipe and performance of a visual inspection of the locknut. The locknut was found to have loosened ~0.8 in. This condition could explain the incomplete closure condition noted on this valve in October 1984. The result of a loosened locknut would be a delay in actual movement of the stem during initial motor operation. The limit switch gear train, however, would still operate as the motor turned.

The torque switch was out of balance by a factor of 3 to 1. This condition immediately negates any correlation of torque-switch settings to actual delivered thrust or operator output torque.

Valve No. 2

Valve Type: 12-in. gate

Operator Type: SMB-1

Safety Related: No

Plant Type: PWR

History. No significant prior mechanical or electrical problems.

Signature-analysis findings. This valve is a duplicate of Valve No. 1. Analysis of the thrust and switch signatures showed that the close-to-open bypass switch was opening prior to the valve unseating.

This situation can lead to an inability to unseat the valve under some conditions.

Valve No. 3

Valve Type: 12-in. gate

Operator Type: SMB-1

Safety Related: No

Plant Type: PWR

History. As with Valve No. 1, this valve required adjustment of the close limit switch in October 1984 because the valve was leaking when closed electrically from the control room.

Signature-analysis findings. This valve is a duplicate of Valve Nos. 1 and 2. The thrust and control switch signatures showed that a large gap existed between the stem nut and locknut, a circumstance indicative of a loose locknut. Inspection of the locknut revealed that it had backed off 3/4 in. and was significantly loading the stem guard pipe to the point where a 5-ft pipe wrench was required to remove the guard pipe.

Analysis of the thrust and switch signatures showed that the close-to-open bypass switch was opening prior to the valve unseating. This situation can lead to an inability to unseat the valve under some conditions.

Valve No. 4

Valve Type: 4-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. Valve has not exhibited any unusual mechanical or electrical problems in the past.

Signature-analysis findings. A significant cyclic loading condition that is indicative of abnormality either in the worm gear or drive sleeve alignment or of an excessive packing load was found.

Valve No. 5

Valve Type: 6-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. This is a steam bleed throttling valve. The only problem noted in the past with this valve has been failure to provide leak-tight shutoff. Historically, steam cutting of the seat has been noted.

Signature-analysis findings. Thrust signatures showed that if the control switch was released at the control panel immediately upon receipt of the closed light indication, the valve would not hit the seat. Thus, complete closure of the valve was dependent upon the technique the operator used at the control switch. If the switch was held in the closed position beyond the time that the closed indication was received, then the valve would close. Therefore, there could be occasions when the valve was thought to be shut by the operators in the control room when, in fact, it was not. Because the disk was almost in contact with the seat in these cases, steam cutting of the valve seat area could occur.

Valve No. 6

Valve Type: 6-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. Same as Valve No. 5.

Signature-analysis findings. Same as for Valve No. 5 regarding the incomplete closure condition.

Examination of the thrust signatures showed that this valve clearly had a significant loosening of the locknut. Inspection of the operator by plant maintenance personnel showed that the locknut had, in fact, completely loosened and was exerting a significant force on the valve stem guard pipe.

Valve No. 7

Valve Type: 18-in. gate

Operator Type: SMB-2

Safety Related: No

Plant Type: PWR

History. The maintenance history of this MOV is not available.

Signature analysis findings. The as-found torque-switch settings caused the operator to develop thrust in excess of the Limitorque-designated maximum in both directions. This condition poses the possibility of damage to the valve and/or operator, rendering the MOV inoperable.

The torque switch was out of balance by a factor to 2.5 to 1. This condition negates the assumption that the same torque-switch settings for both directions will cause the operator to deliver equal thrusts during a torque switch trip condition.

The close-to-open bypass switch was opening before the valve had unseated, which can lead to the inability of the operator to unseat the valve under some flow conditions.

Valve No. 8

Valve Type: 6-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. No maintenance history is available.

Signature-analysis findings. The as-found torque-switch settings caused the operator to develop thrust in excess of the Limitorque-designated maximum. This condition presents the possibility of damage to the valve and/or operator.

The close-to-open bypass switch was opening before the unseating of the valve, which can lead to the inability of the operator to unseat the valve under a flow condition.

Valve No. 9

Valve Type: 6-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. This operator had the tripper fingers replaced in October 1983; the valve stem packing was replaced in January 1984.

Signature-analysis findings. The as-found torque-switch settings caused the operator to develop thrusts in excess of the Limitorque-designated maximum in both directions. This condition presents the possibility of damage to the operator and/or valve. The settings were adjusted to achieve calculated thrusts at torque-switch trip.

The close-to-open bypass switch was opening before the unseating of the valve, which can lead to the inability of the operator to unseat the valve under a flow condition.

Valve No. 10

Valve Type: 20-in. gate

Operator Type: SB-3

Safety Related: Yes

Plant Type: PWR

History. This operator was installed in 1979, the torque switch was replaced in August 1981, and packing was replaced in October 1984.

Signature-analysis findings. The torque-switch settings were changed to achieve the thrust at torque-switch trip values calculated by the technical functions department of this facility.

The torque switch was out of balance by a factor of 2 to 1. This condition negates the assumption that the same torque-switch settings for

both directions will cause the operator to deliver equal thrusts during a torque-switch trip condition.

There was a localized binding of the valve stem noted at the beginning of the open-to-close cycle.

Valve No. 11

Valve Type: 20-in. gate

Operator Type: SB-3

Safety Related: Yes

Plant Type: PWR

History. This operator was replaced in 1979. No significant electrical or mechanical problems were documented.

Signature-analysis findings. The torque switch was out of balance by a factor of 2.2 to 1. This condition negates the assumption that the same torque-switch settings for both directions will cause the operator to deliver equal thrusts during a torque-switch trip condition.

The close-to-open bypass switch was opening before the unseating of the gate. This can lead to the inability of the operator to unseat the valve under a flow condition if the hammerblow thrust exceeds the torque-switch setting.

The open torque-switch setting was changed to achieve the specified thrust value at torque-switch trip.

Valve No. 12

Valve Type: 12-in. gate

Operator Type: SMB-3

Safety Related: No

Plant Type: PWR

History. No maintenance history is available.

Signature-analysis findings. The torque-switch settings were changed to achieve calculated thrust at torque-switch trip.

The torque switch was significantly out of balance, negating the assumption that the same torque-switch settings in both directions will cause the operator to deliver equal thrusts during a torque-switch trip condition.

Valve No. 13

Valve Type: 6-in. gate

Operator Type: SMB-0

Safety Related: Yes

Plant Type: PWR

History. The starter button closing contacts were replaced in November 1983.

Signature-analysis findings. The close-to-open bypass switch was opening before valve unseating. This can lead to the inability of the operator to unseat the valve under a flow condition.

The torque-switch settings were changed to allow the operator to deliver calculated thrusts under a torque-switch trip condition.

The torque switch was out of balance, negating the assumption that the same torque-switch settings will cause the operator to deliver equal thrusts in both directions at torque-switch trip.

Valve No. 14

Valve Type: 6-in. gate

Operator Type: SMB-0

Safety Related: Yes

Plant Type: PWR

History. The motor was replaced in December 1983 and May 1976. In November 1983 the operator was unable to unseat the valve. This was attributed to the gate being in the seat during cooldown and becoming pinched through contraction of the valve body. (Note: this is a dc throttle valve with no "seal-in" in the control circuit.)

Signature-analysis findings. The close-to-open bypass switch was opening well before unseating of the valve. This can lead to the inability of the operator to unseat the valve under some flow conditions.

The torque-switch settings were changed to allow the operator to deliver calculated thrust values under a torque-switch trip condition.

Valve No. 15

Valve Type: 4-in. gate

Operator Type: SMB-00

Safety Related: No

Plant Type: PWR

History. The valve stem packing was replaced in October 1983. The torque switch was replaced in August 1981.

Signature-analysis findings. The torque-switch settings were changed to allow the operator to deliver calculated thrusts under a torque-switch trip condition.

Valve No. 16

Valve Type: 12-in. gate

Operator Type: SMB-0

Safety Related: Yes

Plant Type: PWR

History. No history is available.

Signature-analysis findings. This valve was found to be moderately backseating, which can cause damage to the upper part of the gate and the valve bonnet and wear on the stem-to-gate connection.

The torque-switch setting was changed to allow the operator to develop calculated thrusts under a torque-switch trip condition.

The close-to-open bypass switch was opening before valve unseating. This could lead to the inability of the operator to unseat the valve under some flow conditions.

Valve No. 17

Valve Type: 18-in. gate

Operator Type: SMB-1

Safety Related: No

Plant Type: PWR

History. Operator was removed and disassembled. Inspection revealed a loose wormshaft-bearing locknut. The bearing was replaced, and the operator was reassembled and greased in October 1984.

Signature-analysis findings. The close-to-open bypass switch was opening before valve unseating. This can lead to the inability of the operator to unseat the valve under some flow conditions.

The torque switch was found to be out of balance, negating the assumption that the same torque-switch settings will cause the operator to deliver equal thrusts under a torque-switch trip condition.

It was observed that the torque-switch limiter plate was not installed on this operator. Normally installed by Limitorque, this limiter plate prevents setting the torque switch at a valve sufficiently high to cause valve or operator damage.

The torque-switch settings were changed to allow the operator to develop calculated thrust values under a torque-switch trip condition.

Valve No. 18

Valve Type: 18-in. gate

Operator Type: SMB-1

Safety Related: No

Plant Type: PWR

History. No major electrical or mechanical maintenance has been documented.

Signature-analysis findings. The close-to-open bypass switch was opening before valve unseating. This can lead to the inability of the operator to unseat the valve under some flow conditions.

The torque switch was out of balance, negating the assumption that equal thrusts at torque-switch trip would be delivered with equal torque-switch settings.

Torque-switch settings were changed to allow the operator to deliver calculated torque-switch trip thrust values.

Valve No. 19

Valve Type: 12-in. gate

Operator Type: SMB-0

Safety Related: Yes

Plant Type: PWR

History. No major mechanical or electrical maintenance has been documented.

Signature-analysis findings. The torque switch was out of balance by a factor of 2.3 to 1, negating the assumption that equal thrusts at torque-switch trip will be delivered with equal torque-switch settings.

The torque-switch settings were changed to allow the operator to develop calculated thrusts under a torque-switch trip condition.

Valve No. 20

Valve Type: 12-in. gate

Operator Type: SMB-0

Safety Related: Yes

Plant Type: PWR

History. No major mechanical or electrical maintenance has been documented.

Signature-analysis findings. This valve was generating excessive thrust during backseating, causing damage to the stem-to-valve connection, the upper portion of the gate, and the valve bonnet.

This valve exhibits an abnormality in the thrust signature that is apparently traceable to the valve guide.

Valve No. 21

Valve Type: 12-in. gate

Operator Type: SMB-3

Safety Related: Yes

Plant Type: PWR

History. Maintenance history of this MOV is not available.

Signature-analysis findings. The close-to-open bypass switch was opening before the valve had unseated. This can lead to the inability of the operator to unseat the valve under some flow conditions.

The torque switch was out of balance by a factor of 1.2 to 1. This condition negates the assumption that the same torque-switch settings for both directions will cause the operator to deliver equal thrusts upon a torque-switch trip condition.

Valve No. 22

Valve Type: 1.5-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. Maintenance history for this MOV is not available.

Signature-analysis findings. The motor-current signatures indicate an excessive or unbalanced force exerted on the operator by stem packing.

Valve No. 23

Valve Type: 12-in. gate

Operator Type: SMB-3

Safety Related: Yes

Plant Type: PWR

History. This MOV had the motor bearings replaced in 1976. The valve itself was overhauled because of leaking past the seal in November 1983.

Signature-analysis findings. The torque switch was out of balance by a factor of 2.1 to 1. This condition negates the assumption that the same torque-switch settings for both directions will cause the operator to deliver equal thrusts during a torque-switch trip condition.

Torque-switch settings were changed to allow the operator to deliver calculated torque-switch trip thrust values.

Valve No. 24

Valve Type: 1-in. globe

Operator Type: SMB-000

Safety Related: Yes

Plant Type: PWR

History. No significant mechanical or electrical maintenance has been documented.

Signature-analysis findings. The torque-switch settings were changed to allow the operator to deliver calculated torque-switch trip thrust values.

Valve No. 25

Valve Type: 14-in. gate

Operator Type: SMB-2

Safety Related: Yes

Plant Type: PWR

History. This is a high-speed valve with a motor brake installed to reduce the effects of inertia and the tendency of some high-speed valves to rebound out of the seat.

The valve stem was repacked in 1979; the packing was tightened in 1981 and 1983 because of leaks.

Signature-analysis findings. The torque-switch settings were changed to allow the calculated torque-switch trip thrust values to be achieved.

The close-to-open bypass switch was opening before the valve had unseated. This can lead to the inability of the operator to unseat the valve under some flow conditions.

The torque switch was out of balance by a factor of 1.73 to 1. This condition negates the assumption that the same torque-switch settings for both directions will cause the operator to deliver equal thrusts during a torque-switch trip condition.

The excessively tightened packing causes a high running load that subtracts from the thrust available to close the valve.

Valve No. 26

Valve Type: 2.5-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. This is a block valve designed to use a limit switch to stop valve travel in both directions, with torque-switch protection also in the control circuit.

The valve stem packing was replaced in December 1983.

Signature-analysis findings. The close limit switch was opening before the gate contacted the seat. There was no stem thrust into the seat — clearly an undesirable condition.

The close-to-open bypass switch was opening before the valve had unseated. This can lead to the inability of the operator to unseat the valve under some flow conditions.

Valve No. 27

Valve Type: 2.5-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. This is a block valve. The disk was reworked in February 1983, and the torque switch and limit switch assembly/wiring were replaced in April 1984 and February 1982, respectively.

Signature-analysis findings. This valve exhibits a loading condition that may correspond to operator gear wear.

Valve No. 28

Valve Type: 2.5-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. This MOV had the torque switch and the limit switch assembly replaced in December 1983. The valve stem packing was replaced in September 1981.

Signature-analysis findings. The close-to-open bypass switch was set to open too long after gate unseating. This removed the protective torque switch from the circuit for an undesirably long fraction of the operating cycle. Should an obstruction have occurred, the motor could have gone to a locked rotor condition.

Valve No. 29

Valve Type: 16-in. gate

Operator Type: SMB-0

Safety Related: No

Plant Type: PWR

History. No significant prior mechanical or electrical problems.

Signature-analysis findings. The close-to-open bypass switch was actuating prior to the unseating of the disk. This can lead to the inability of the operator to unseat the valve under some flow conditions.

There appears to be a slight galling condition in the close-to-open direction toward the end of the valve guides.

Valve No. 30

Valve Type: 8-in. gate

Operator Type: SMB-0

Safety Related: Yes

Plant Type: PWR

History. Bonnet gasket replaced; limits reset because of a steam leak in April 1981. Valve repacked because of packing leak in May 1983 and July 1983.

Signature-analysis findings. The close-to-open bypass switch was actuating prior to the unseating of the disk. This can lead to the inability of the operator to unseat the valve under some flow conditions.

Valve No. 31

Valve Type: 4-in. gate

Operator Type: SMB-00

Safety Related: Yes

Plant Type: PWR

History. The valve was disassembled and the packing reworked because of a steam leak at either the packing or the bonnet in April 1981. Valve operability was checked in July 1981, because it "torqued out" before going closed. A lantern ring was installed upside down, then reinstalled, and the valve repacked in June 1981 and again in July 1983. The valve was repacked in July 1983. The valve was stroked, and the housing was inspected for cracks in July 1981.

Signature-analysis findings. The close-to-open bypass switch was actuating prior to the unseating of the disk. This can lead to the inability of the operator to unseat the valve under some flow conditions.

The valve was coasting into the backseat after the open limit switch had actuated. Most valve backseats are not designed for this type of loading condition.

Valve No. 32

Valve Type: 12-in. gate

Operator Type: SMB-1

Safety Related: No

Plant Type: PWR

History. No significant prior mechanical or electrical problems.

Signature-analysis findings. The close-to-open bypass switch was actuating prior to the unseating of the disk. This can lead to the inability of the operator to unseat the valve under some flow conditions.

Valve No. 33

Valve Type: 12-in. gate

Operator Type: SMB-1

Safety Related: No

Plant Type: PWR

History. No significant prior mechanical or electrical problems.

Signature-analysis findings. The close-to-open bypass switch was actuating prior to the unseating of the disk. This can lead to the inability of the operator to unseat the valve under a flow condition.

Unusual seating and unseating thrust signatures that may have been caused by grease packed in the spring cartridge cap were noted.

Valve No. 34

Valve Type: 24-in. gate

Operator Type: SMB-4

Safety Related: No

Plant Type: PWR

History. Motor was removed to allow a new pinion key to be installed in July 1981. Bonnet bolts were retorqued to 45,000 psi bolt stress in April 1982. The valve was Furmanited and the rings were repaired in June 1982.

Signature-analysis findings. Water was present in the spring-pack cavity when the MOVATS spring cartridge cap was installed.

Valve No. 35

Valve Type: 16-in. gate

Operator Type: SMB-0

Safety Related: No

Plant Type: PWR

History. No significant prior mechanical or electrical problems.

Signature-analysis findings. In the absence of bypass protection, the torque switch actuated, causing the valve to trip during the initial close-to-open stroke. The close-to-open bypass switch was adjusted to properly cover the unseating of the disk.

Valve No. 36

Valve Type: 10-in. gate

Operator Type: SMB-0

Safety Related: Yes

Plant Type: BWR

History. The maintenance history of this MOV is not available.

Signature-analysis findings. This MOV exhibits severe loading conditions in the operator. Signatures indicate the following possibilities: (1) the worm gear is not moving freely on the drive assembly and (2) the worm shaft bearing locknut is loose.

The thrust signatures indicate the existence of a spring-pack gap, which has the effect of reducing the load at torque-switch trip for any particular torque-switch setting.

5.2 Statistical Summary

Table 5.1 is a summary of the significant abnormalities detected and the percentage of the valves displaying that particular abnormality

Table 5.1. Summary of significant MOV abnormalities identified by MOVATS

Abnormality	Percent[a]
Improperly set bypass switch	75
Incorrect torque-switch calibration	50
Unbalanced torque switch	33
Excessive spring-pack gap	17
Excessive packing tightness	8
Excessive inertia	8
Loose stem-nut locknut	8
Valve backseating	8
Steam wear	8
Grease hardening	8
Gear wear	6
Motor degradation	3
Miscellaneous abnormalities	35

[a]The percentages shown in this table are based on a limited sampling of valves available for use in this test program. As a result, the values should be considered as indicators of frequency of occurrence of the listed abnormalities rather than absolute measures applicable generally to all MOVs.

arranged in order of decreasing frequency. Note that some of the observed abnormalities involving stem thrust load conditions could only be determined if a calibration of the spring pack is performed. Because calibrations were obtained only on selected valves, the percentage of occurrences for those particular abnormalities was based on those valves that were calibrated.

6. ANALYSIS AND CONCLUSIONS

In this section the results of the 36 valve tests are analyzed to conclude what the MOVATS signature-analysis method provides regarding MOV operational readiness. Note that all of the valves included in this study were considered operational by the utility at the time of the MOVATS test.

6.1 Analyses of Abnormalities Found During Testing

The MOVATS test method utilized three signatures (stem thrust measured as axial worm movement, motor current, and switch actuation times) taken during an MOV cycle to detect and differentiate among abnormalities present in the MOVs. A characterization of each of the abnormalities detectable by the MOVATS method, including six that could be identified as time-dependent degradations (aging related) and ten that could be characterized as incorrect adjustments or other abnormalities, is given in Sect. 4. Of the latter, six could also be considered as the type of abnormalities that could cause valve failure under some anticipated operating conditions. These results are given in Table 6.1.

An examination of the statistics of the MOVATS test results (Table 5.1) shows that nearly all of the abnormalities detectable by the MOVATS method were, in fact, observed during the tests in one or more of the

Table 6.1. Summary of abnormalities detectable by MOVATS classified by type

Time-dependent degradations	Incorrect adjustments and other abnormalities
Bent stem ?	Excessive inertia
Gear wear 6	Inadequate stem lubrication
Motor pinion binding ?	Improper seating
Stem wear 8	Valve backseating
Grease hardening 8	Incorrect torque-switch calibration[a]
Motor degradation 3	Unbalanced torque switch[a]
	Excessive spring-pack gap[a]
	Excessive packing tightness[a]
	Improperly set bypass switch[a]
	Loose stem-nut locknut[a]

[a]Abnormalities that can cause valve failure under some anticipated operating conditions.

valves. The abnormalities included both time-dependent degradations and incorrect adjustments. In no case was the magnitude of the abnormality sufficiently large enough to have been noted during previous routine surveillance testing, however.

Note that the three most common abnormalities involved incorrect adjustments of the torque and limit switches. The most frequently observed abnormality was an improperly set bypass (limit) switch, occurring in 75% of the valves tested. All three of these commonly occurring abnormalities could, under some conditions, cause failure of the valve to operate.

6.2 MOVATS Capabilities in Providing Diagnostic Information Regarding Operational Readiness

As defined in Sect. 2.3, operational readiness is the ability of a component as installed and maintained to operate properly when called upon at any time in the future under all anticipated operating conditions. The MOVATS method, which detected the incorrect adjustments that can cause valve failures under some anticipated operating conditions, thus provided diagnostic information that indicated specific valves that, although operable, may not have been in a state of operational readiness.

The MOVATS method also detected, and to some extent determined the magnitude of, various time-dependent degradations present in MOVs. Although it is not possible to determine operational readiness based on a single measurement of the extent of degradation, the MOVATS method, if utilized periodically during successive outages, could provide diagnostic information useful for determining operational readiness with regard to those degradations detectable by the MOVATS method.

6.3 MOVATS Limitations in Providing Diagnostic Information Regarding Operational Readiness

Although the MOVATS method was found to be capable of detecting many abnormalities in MOVs, it cannot be assumed capable of detecting all abnormalities that can cause MOV failures. The limitations in that regard are of two types:

1. Degradation that cannot be detected or differentiated using the three signatures obtained by MOVATS, including, for example, valve leakage, motor overheating, loose fasteners, and cracked or corroded gears, shafts, or other mechanical parts where the part is still geometrically intact.
2. Degradation that cannot be detected or trended by tests carried out at shutdown (ambient) conditions, including, for example, degradations of the obturator, seat, or stem that show up as increased running load only when there is a pressure differential across the obturator or an elevated pressure or temperature in the valve body.

A second limitation of the MOVATS method is the requirement that it be installed and removed manually for each valve tested. This can result in excessive radiation exposures to the technicians carrying out the tests in some instances. It also limits the number of valves that can be practically monitored during a given outage.

6.4 Conclusions

Based on the field tests carried out as part of this program and on an analysis of the capabilities and limitations of the MOVATS method, the following conclusions appear justified:

1. The MOVATS method can provide valuable diagnostic information regarding the operational readiness of MOVs well beyond that obtainable from *ASME Code* Sect. XI type surveillance tests.
2. The field tests carried out as part of this task demonstrated that incorrectly adjusted bypass and torque switches are extremely common. Both of these abnormalities, but particularly the incorrectly adjusted bypass switch, can directly affect MOV operational readiness.
3. The MOVATS method can provide useful diagnostic information regarding time-dependent degradation (aging) of MOV parts. However, to use that information in determining operational readiness, the method must be applied periodically, and trending data must be obtained from which operability into the future can be extrapolated.
4. The MOVATS method has limitations with regard to its ability to detect all abnormalities and to its convenience. Neither limitation, however, affects its ability to provide diagnostic information regarding MOV operational readiness beyond that obtained using the *ASME Code* Sect. XI tests.

REFERENCES

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2. W. L. Greenstreet, G. A. Murphy, and D. M. Eissenberg, *Aging and Service Wear of Electric Motor-Operated Valves Used in Engineered Safety-Feature Systems of Nuclear Power Plants*, NUREG/CR-4234, Vol. 1 (ORNL-6170/V1), Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., June 1985.

3. H. R. Denton, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C., memorandum to R. B. Minogue, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, May 14, 1984.

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Appendix A

STATEMENT OF WORK

FIELD INVESTIGATION TO IDENTIFY DEFECTS AND SERVICE WEAR IN OPERATIONAL MOTOR-OPERATED VALVES IN NUCLEAR POWER PLANTS

Objective

Using valve signature-analysis techniques, determine the general condition of a representative sample of operational MOVs at nuclear power plants. Characterize the defects and/or service wear diagnosed by signature analysis and suggest maintenance actions, if any.

Method of Accomplishment

1. Obtain the cooperation of one or more utilities in making available for signature analysis operational MOVs in operational (preferably older) nuclear power plants. The valves should include as many MOVs as possible from safety-related systems, and their prior operating and maintenance histories should be available.
2. Develop and submit for approval a test procedure based on MOVATS technology for both obtaining valve-operator signatures and diagnosing valve and/or operator defects and service wear during both opening and closing cycles based on the signatures obtained. The test procedure dealing with diagnosis should include acceptance and/or rejection criteria for each defect and/or service wear identified.
3. Using the test procedure, obtain valve signatures using MOVATS equipment for a total of ~40 valves. Analyze data for each valve to obtain a diagnosis of defects and service wear. Based on the acceptance/rejection criteria, identify remedial actions, if any, for each valve where defects and/or service wear are identified. Whenever possible, an independent verification of actual defect, degradation, or service wear will be obtained and documented. In those cases where remedial action is accomplished during the period of testing, a second set of diagnostic data should be taken and analyzed following completion of remedial action.
4. Prepare monthly status reports plus a final report giving the results of the task in terms of the statistics of defects and service wear identified and of the recommended remedial action.

Appendix B

DETAILED SIGNATURE ANALYSIS REPORTS

Comment

The following motor-operated valve analyses are presented essentially as received from MOVATS, Inc. Codes 1 through 4 are used by MOVATS to designate the level of importance of their findings; Code 1 is of the highest importance and Code 4 the lowest. These assignments of code level were subjective on the part of MOVATS, Inc., and have no relationship to any other system.

If the valve test reports are examined closely, it will be apparent that sometimes the plot information does not substantiate the comments. The reason for this is that the conclusions were reached by viewing the data on a storage oscilloscope while the plots included here were formed on an x-y plotter. Although both methods used the same basic data, the x-y plotter cannot match the oscilloscope for revealing the fine structure.

Test I.D. Valve #1

Code	Comments
1	The thrust signatures show that the potential for a loosened stem nut locknut exists. (See Recommendation #1).
4	The torque switch was found to be out of balance by a factor of 2.94 to 1.0. (See Recommendation #2).

Recommendations

1. We recommend that the following actions be taken to visually determine if the locknut is in fact loosened:

   a. Operate the valve to a mid-position by opening the valve.

   b. Remove the stem guard pipe if one exists.

   c. Once the guard pipe is removed, visually inspect the locknut to determine if it has backed itself out.

   d. Please note also that if the locknut is found to be loose, readjustment to the correct position will result in the limit, bypass, and light indication switches being improperly positioned.

2. An open torque switch setting of 1.0 resulted in the actuator developing approximately 4300 pounds of thrust, while a close torque switch setting of 1.0 resulted in approximately 12,700 pounds of thrust. This data should be considered should it become necessary to change torque switch settings in the future without the use of the MOVATS Series 2000 System.

TEST ID: VALVE #1

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 1
TEMP	: AMBIENT	SERIAL NO.	: 100817
PRESS	: ATMOSPHERIC	ORDER NO.	: 336591A
SFTY REL'D	: N/A	ORIENTATION	: HORIZONTAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: IFDN-74
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 3.0/3.0	VOLTS	: 575 AC
CLOSE T.S. SETTING	: 1.75/1.75	RATED AMPS	: 6.35
LIMITER PLATE	: NONE	SPEED	: 1720
TS BALANCEABLE	: YES	HORSEPOWER	: 12 FT #

TEST EQUIPMENT

LOAD CELL # : 50 K--N/A

AMP PROBE # : SIMPSON(20) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #1 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-01		TS-CO-01-02	
STROKE TIME	: 57.78 SECONDS	STROKE TIME	: 57.4 SECONDS
BYPASS TIME	: 0.48 SECONDS	BYPASS TIME	: 3.54 SECONDS
THRUST AT CST	: 16376 #	PROTECTION MARGIN	: 1.76 SECONDS
SEAT THRUST AT CST	: 12744 #	UNSEATING TIME	: 1.78 SECONDS
AVE RUN THRUST	: 2931 #	AVE RUN THRUST	: 2293 #
MAX RUN THRUST	: 3632 #	MAX RUN THRUST	: 2994 #
INERTIAL THRUST	: 36 %	UNSEATING THRUST	: 5161 #
TOTAL THRUST	: 22429 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.75/1.75	TORQUE SW. SETTING	: 3.0/3.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-N/A-N/A K-FACTOR: 12744 #/V PRELOAD: < RUNNING

MOTOR CURRENT SIGNATURE ANALYSIS

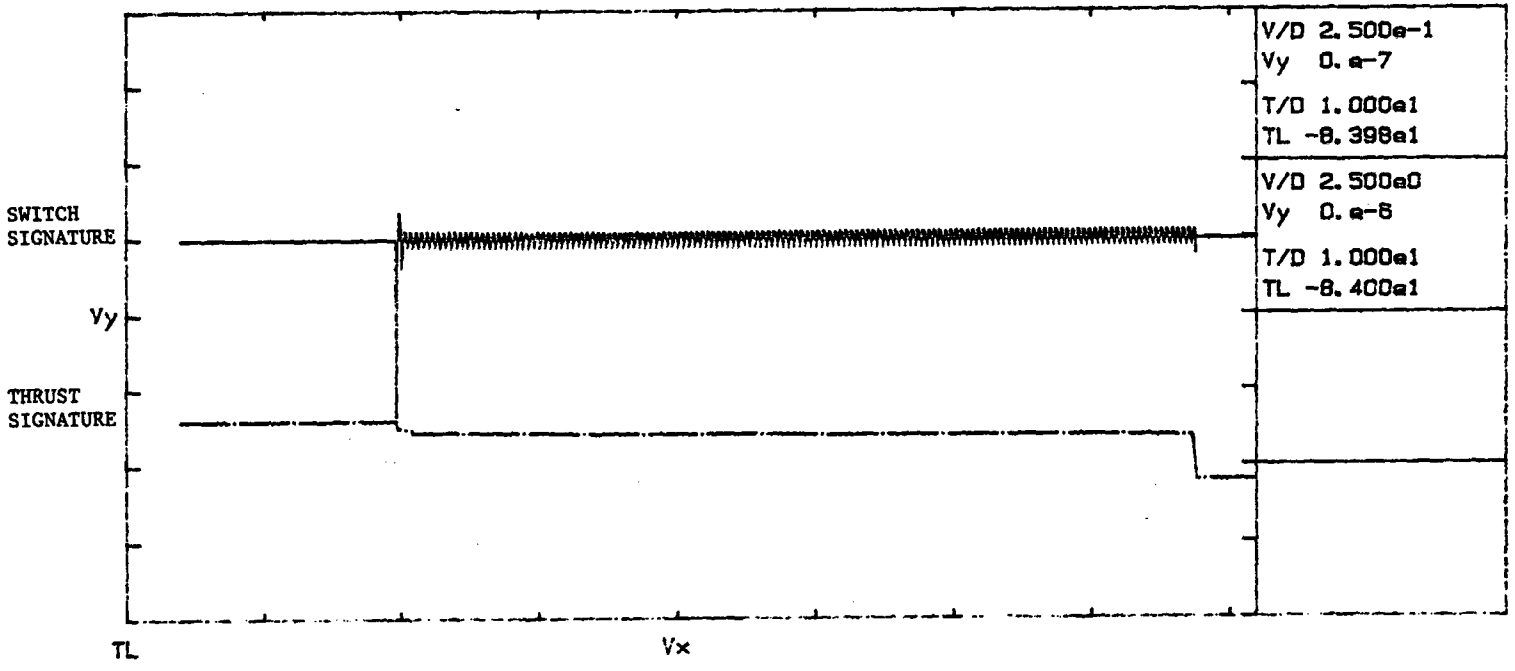
CS-OC-01-03		CS-CO-01-04	
STROKE TIME	: 57.94 SECONDS	STROKE TIME	: 57.4 SECONDS
PEAK INRUSH	: 20.72 AMPERES	PEAK INRUSH	: 20.05 AMPERES
AVE. RUN CURRENT	: 5.41 AMPERES	AVE. RUN CURRENT	: 5.35 AMPERES
MAX. RUN CURRENT	: 5.41 AMPERES	MAX. RUN CURRENT	: 5.35 AMPERES
SEATING CURRENT	: 6.21 AMPERES	END CURRENT	: 5.31 AMPERES

TEST IDENTIFICATION: VALVE #1
STORAGE LOCATION : 01-01

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 57.78 SECONDS	AVE RUN THRUST	: 2931 #
		MAX RUN THRUST	: 3632 #
BYPASS TIME	: 0.48 SECONDS	THRUST AT CST	: 16376 #
		SEAT THRUST AT CST	: 12744 #
		INERTIAL THRUST	: 36 %
TORQUE SW. SETTING	: 1.75/1.75	TOTAL THRUST	: 22429 #

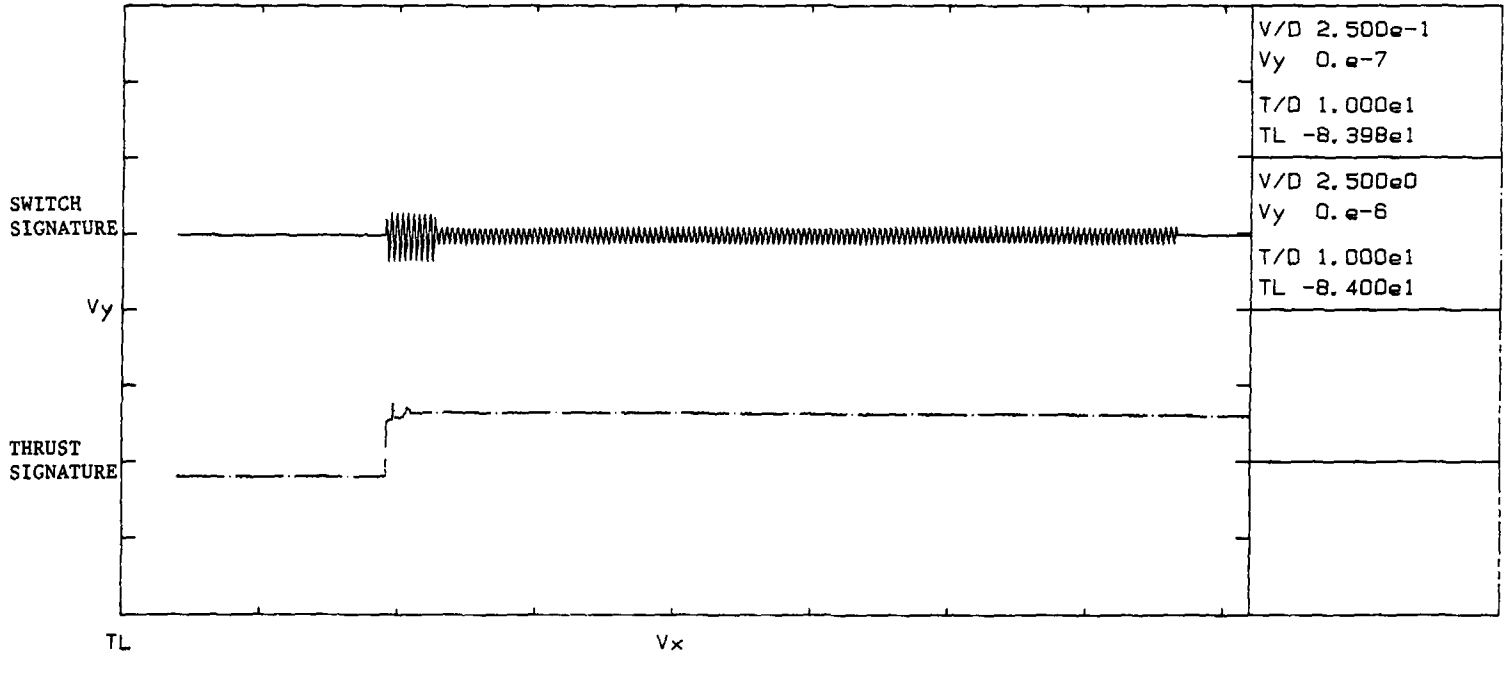


TEST IDENTIFICATION: VALVE #1
STORAGE LOCATION : 01-02

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 57.4	SECONDS	AVE RUN THRUST	: 2293	#
			MAX RUN THRUST	: 2994	#
BYPASS TIME	: 3.54	SECONDS	UNSEATING THRUST	: 5161	#
UNSEATING TIME	: 1.78	SECONDS	THRUST AT CST	: N/A	
PROTECTION MARGIN	: 1.76	SECONDS	TORQUE SW. SETTING	: 3.0/3.0	



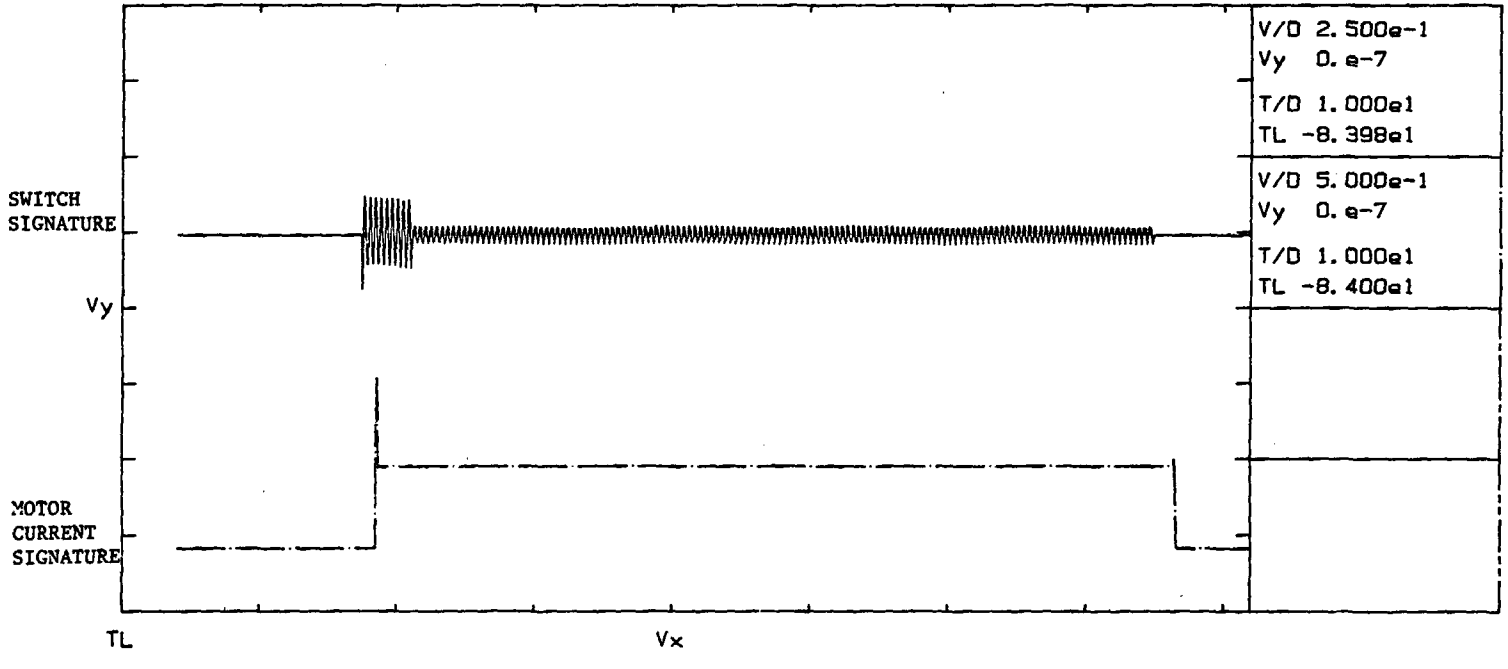
TEST IDENTIFICATION: VALVE #1
STORAGE LOCATION : 01-03

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 57.94 SECONDS

PEAK INRUSH : 20.72 AMPERES
AVE. RUN CURRENT : 5.41 AMPERES
MAX. RUN CURRENT : 5.41 AMPERES
SEATING CURRENT : 6.21 AMPERES



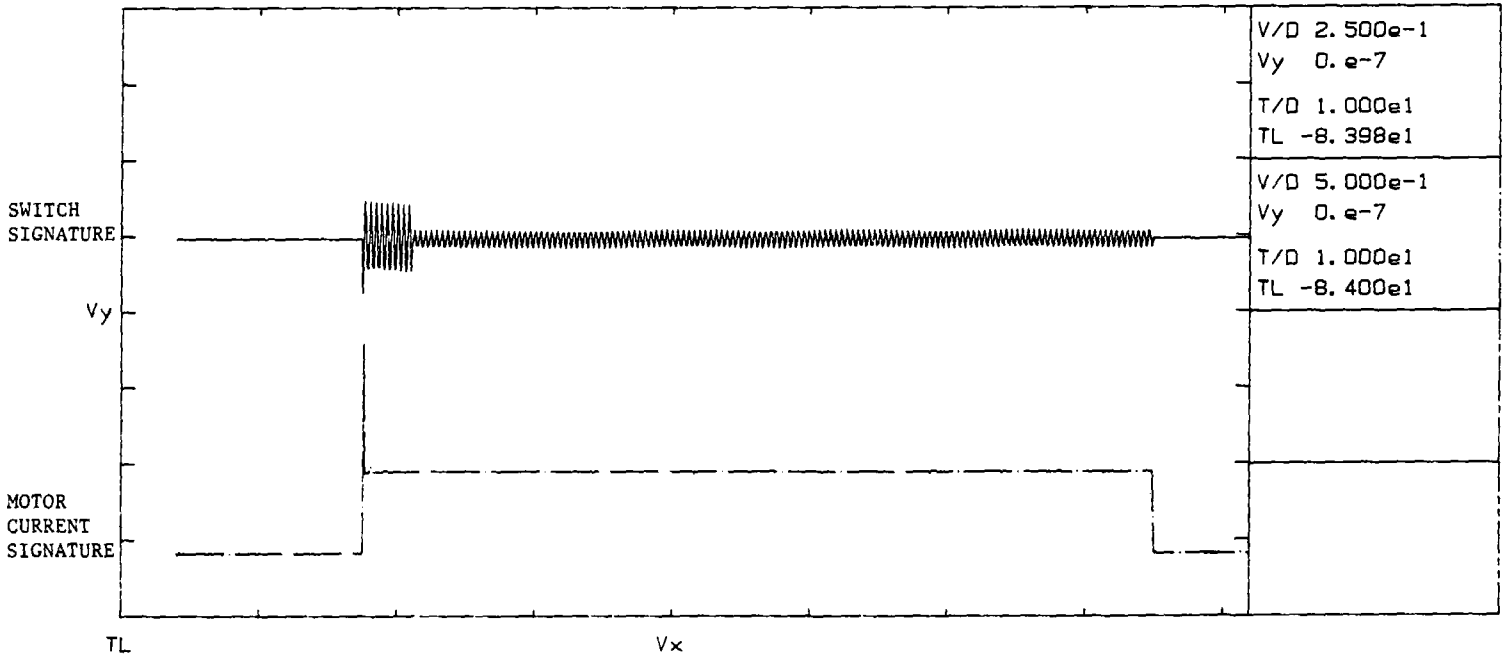
TEST IDENTIFICATION: VALVE #1
STORAGE LOCATION : 01-04

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 57.4 SECONDS

PEAK INRUSH : 20.05 AMPERES
AVE. RUN CURRENT : 5.35 AMPERES
MAX. RUN CURRENT : 5.35 AMPERES
END CURRENT : 5.31 AMPERES



Test I.D. Valve #2

Code	Comments
1	The close-to-open bypass switch requires adjustment to properly cover the unseating of the valve.

Recommendation

1. The bypass switch should be set to actuate after the valve has unseated.

TEST ID: VALVE #2

SYSTEM

SYSTEM : N/A
FLOW : 0
TEMP : AMBIENT
PRESS : ATMOSPHERIC
SFTY REL'D: N/A

OPERATOR

TYPE : SMB
SIZE : 1
SERIAL NO. : 103130
ORDER NO. : 338610A
ORIENTATION: VERTICAL

ELECTRICAL

CONTROL CIR VOLTS: 120
AC/DC : AC
OPEN CONTROL : LIMIT
CLOSE CONTROL : TORQUE
MCC : N/A
SW. SENSING CIR. : CURRENT

VALVE

ID. NO. : IDFW-76
TYPE : GATE
SIZE : 12
BODY ORIENTATION: HORIZONTAL
INITIAL POSITION: N/A
FINAL POSITION : N/A

TORQUE SWITCH

OPEN T.S. SETTING : 3.5/3.5
CLOSE T.S. SETTING: 3.0/3.0
LIMITER PLATE : 4.0
TS BALANCEABLE : YES

MOTOR

VOLTS : 575 AC
RATED AMPS: 6.35
SPEED : 1720
HORSEPOWER: 12.0

TEST EQUIPMENT

LOAD CELL # : N/A--N/A
AMP PROBE # : SIMPSON(20) N/A
MAINFRAME # : N/A
TMD # : N/A

TEST ID: VALVE #2 BY: RLB DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-09		TS-CO-01-10	
STROKE TIME	: 61.68 SECONDS	STROKE TIME	: 61.72 SECONDS
BYPASS TIME	: 0 SECONDS	BYPASS TIME	: 0.82 SECONDS
THRUST AT CST	: 3.18 V	PROTECTION MARGIN	:-1.42 SECONDS
SEAT THRUST AT CST	: 3.18 V	UNSEATING TIME	: 2.24 SECONDS
AVE RUN THRUST	: <PRELOAD	AVE RUN THRUST	: <PRELOAD
MAX RUN THRUST	: <PRELOAD	MAX RUN THRUST	: <PRELOAD
INERTIAL THRUST	: 6 %	UNSEATING THRUST	: 0.935 V
TOTAL THRUST	: 3.39 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 3.0/3.0	TORQUE SW. SETTING	: 3.5/3.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-01-11		CS-CO-01-12	
STROKE TIME	: 62.06 SECONDS	STROKE TIME	: 61.66 SECONDS
PEAK INRUSH	: 18.84 AMPERES	PEAK INRUSH	: 18.99 AMPERES
AVE. RUN CURRENT	: 6 AMPERES	AVE. RUN CURRENT	: 5.7 AMPERES
MAX. RUN CURRENT	: 6 AMPERES	MAX. RUN CURRENT	: 5.75 AMPERES
SEATING CURRENT	: 15.06 AMPERES	END CURRENT	: 5.63 AMPERES

TEST IDENTIFICATION: VALVE #3
STORAGE LOCATION : 01-09

PLOT NO. 1

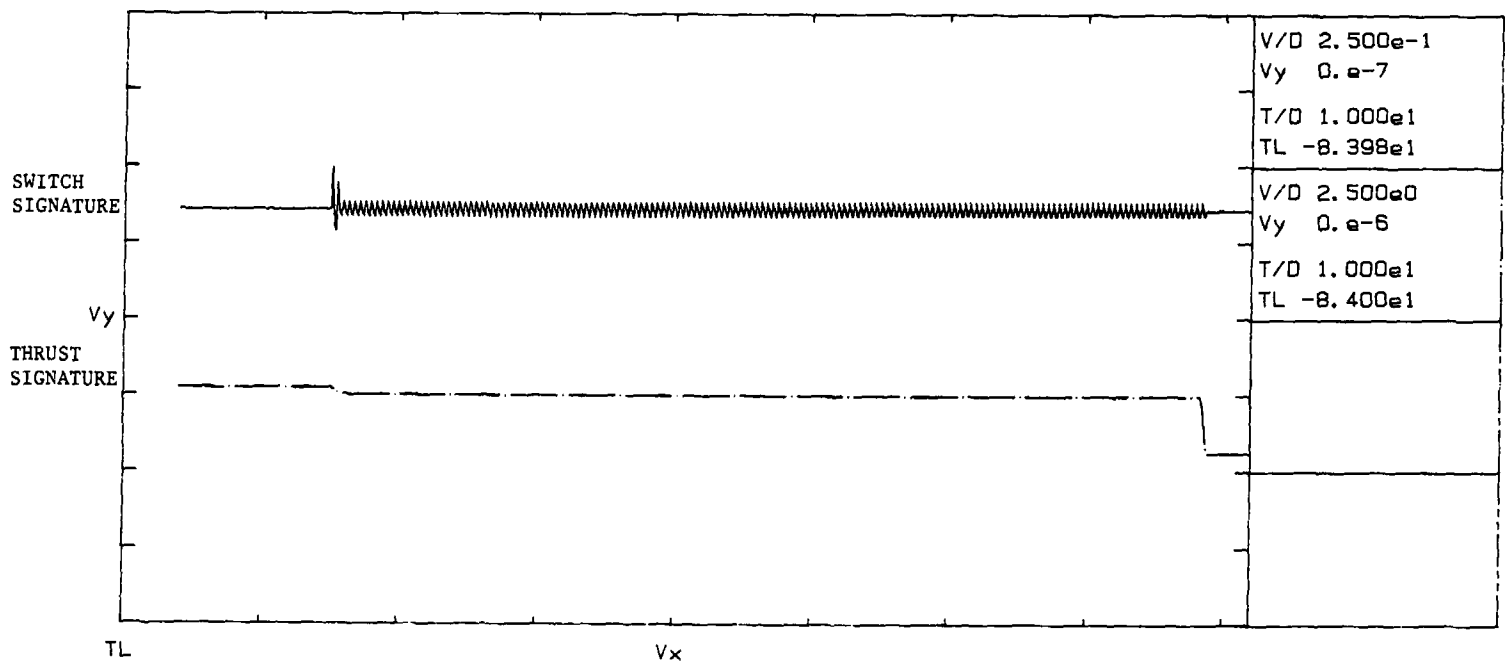
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 61.68 SECONDS

BYPASS TIME : 0 SECONDS

TORQUE SW. SETTING: 3.0/3.0

AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD
THRUST AT CST	: 3.18 V
SEAT THRUST AT CST	: 3.18 V
INERTIAL THRUST	: 6 %
TOTAL THRUST	: 3.39 V

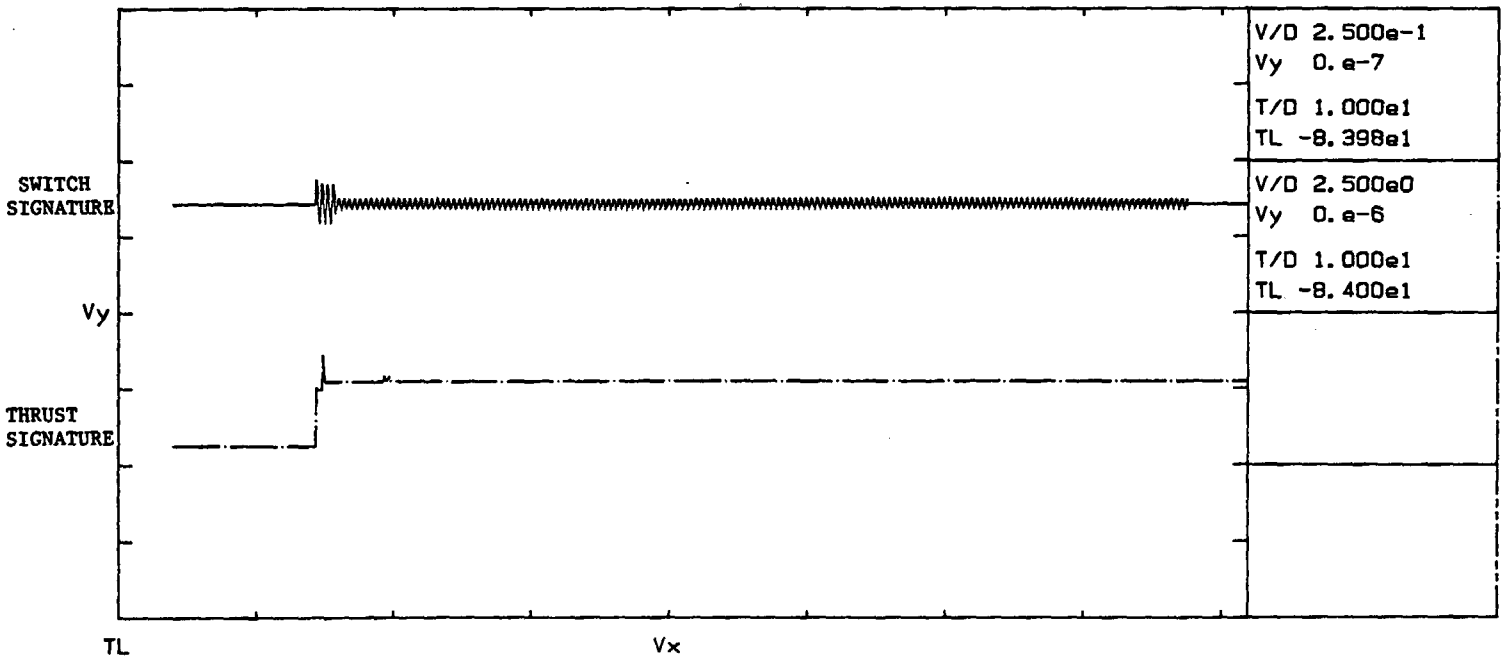


TEST IDENTIFICATION: VALVE #2
STORAGE LOCATION : 01-10

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 61.72 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 0.82	UNSEATING THRUST	: 0.935 V
UNSEATING TIME	: 2.24 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	:-1.42 SECONDS	TORQUE SW. SETTING	: 3.5/3.5



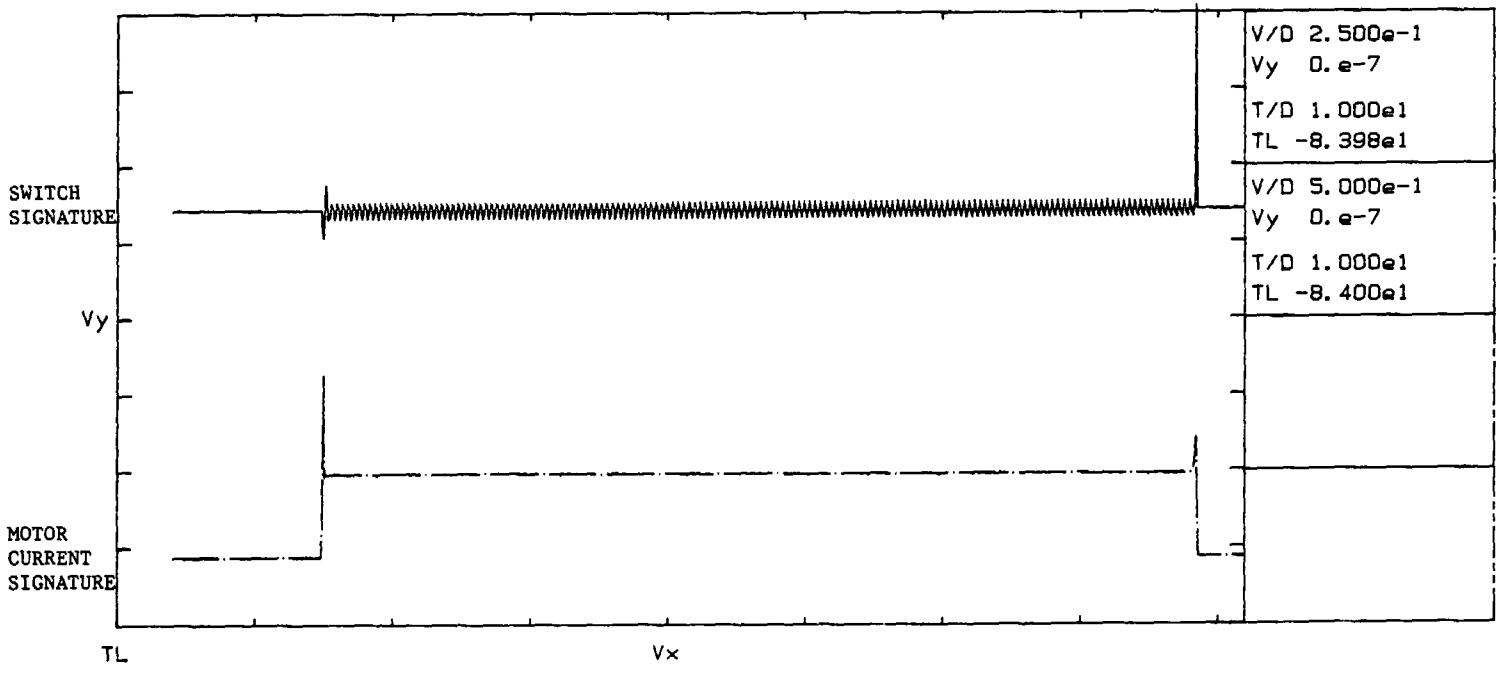
TEST IDENTIFICATION: VALVE #2
STORAGE LOCATION : 01-11

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 62.06 SECONDS

PEAK INRUSH : 18.84 AMPERES
AVE. RUN CURRENT : 6 AMPERES
MAX. RUN CURRENT : 6 AMPERES
SEATING CURRENT : 15.06 AMPERES



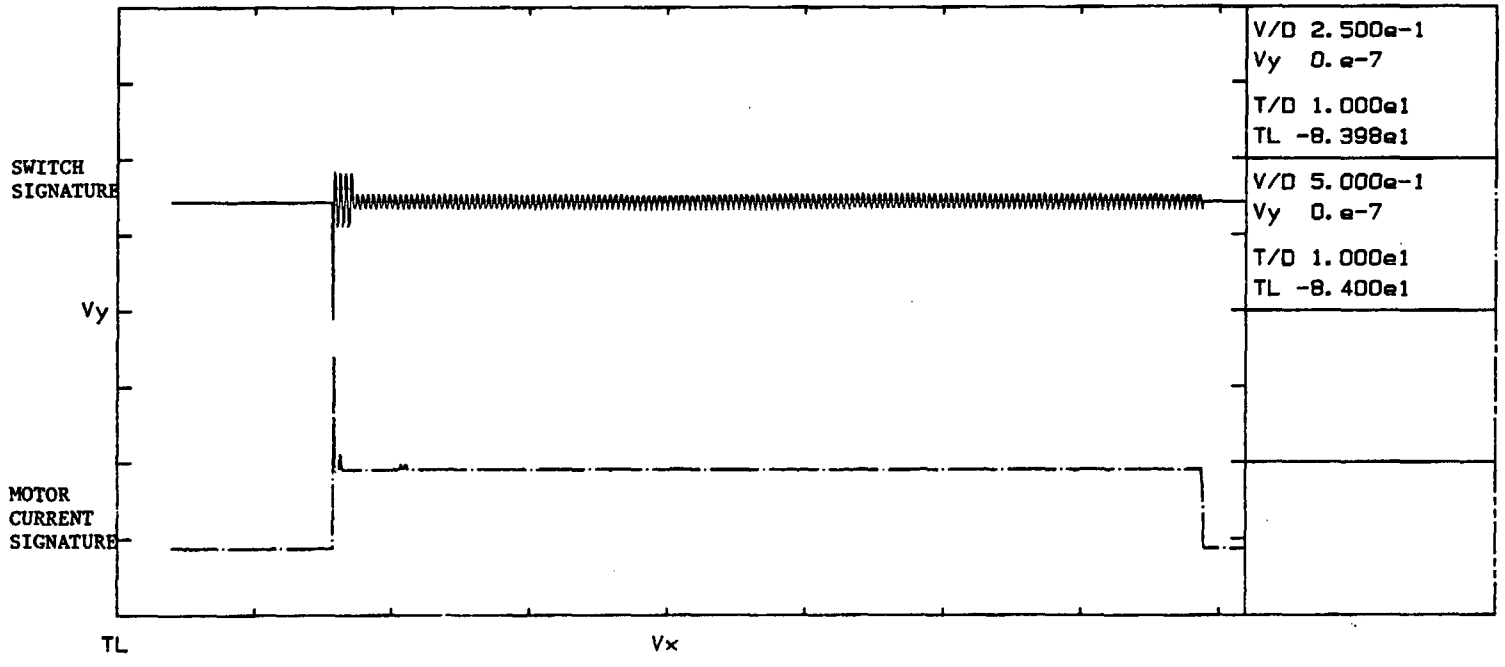
TEST IDENTIFICATION: VALVE #2
STORAGE LOCATION : 01-12

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 61.66 SECONDS

PEAK INRUSH : 18.99 AMPERES
AVE. RUN CURRENT : 5.7 AMPERES
MAX. RUN CURRENT : 5.75 AMPERES
END CURRENT : 5.63 AMPERES



Test I.D. Valve #3

Code	Comments
1	Thrust signatures show that the potential for a loosened stem nut locknut exists. (See Recommendation #1).
3	The close-to-open bypass switch requires adjustment to properly cover the unseating of the disc. (See Recommendation #2).
4	Thrust signatures indicate an apparent gap of .025" in the spring pack assembly.

Recommendations

1. We recommend that the following actions be taken to visually determine if the locknut is in fact loosened:

   a. Operate the valve to a mid-position by opening the valve.

   b. Remove the stem thread guard pipe if one exists.

   c. Once the guard pipe is removed, visually inspect the locknut to determine if it has backed itself out.

   d. Please note also that if the locknut is found to be loose, readjustment to the correct position will result in the limit, bypass, and light indication switches being improperly positioned.

2. The close-to-open bypass switch should be reset to actuate after valve unseating has occurred.

TEST ID: VALVE #3

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 1
TEMP	: AMBIENT	SERIAL NO.	: 100816
PRESS	: ATMOSPHERIC	ORDER NO.	: 336591A
SFTY REL'D	: N/A	ORIENTATION	: HORIZONTAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: VALVE #3
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 3.0/3.0	VOLTS	: 575 AC
CLOSE T.S. SETTING	: 2.0/2.0	RATED AMPS	: 6.35
LIMITER PLATE	: 4.0	SPEED	: 1720
TS BALANCEABLE	: YES	HORSEPOWER	: 12

TEST EQUIPMENT

LOAD CELL # : N/A--N/A

AMP PROBE # : SIMPSON(20) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #3 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-05		TS-CO-01-06	
STROKE TIME	: 63.54 SECONDS	STROKE TIME	: 63.1 SECONDS
BYPASS TIME	: 0.4 SECONDS	BYPASS TIME	: 1.38 SECONDS
THRUST AT CST	: 1.685 V	PROTECTION MARGIN	:-4.06 SECONDS
SEAT THRUST AT CST	: 1.505 V	UNSEATING TIME	: 5.44 SECONDS
AVE RUN THRUST	: 0.18 V	AVE RUN THRUST	: 0.25 V
MAX RUN THRUST	: 0.185 V	MAX RUN THRUST	: 0.25 V
INERTIAL THRUST	: 22 %	UNSEATING THRUST	: 0.525 V
TOTAL THRUST	: 2.07 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.0/2.0	TORQUE SW. SETTING	: 3.0/3.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

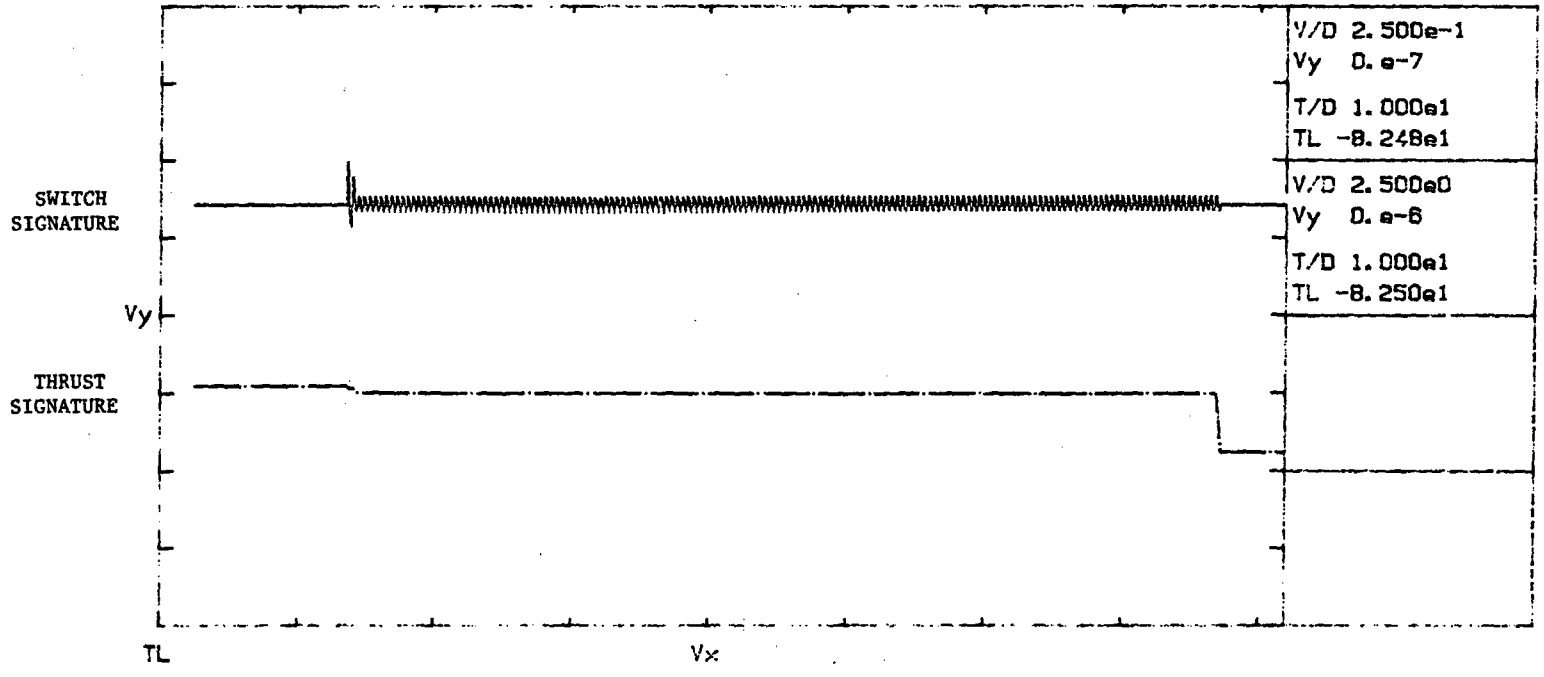
CS-OC-01-08		CS-CO-01-07	
STROKE TIME	: 63.56 SECONDS	STROKE TIME	: 63.08 SECONDS
PEAK INRUSH	: 21.12 AMPERES	PEAK INRUSH	: 18.23 AMPERES
AVE. RUN CURRENT	: 5.41 AMPERES	AVE. RUN CURRENT	: 5.15 AMPERES
MAX. RUN CURRENT	: 5.41 AMPERES	MAX. RUN CURRENT	: 5.17 AMPERES
SEATING CURRENT	: 7.95 AMPERES	END CURRENT	: 5.14 AMPERES

TEST IDENTIFICATION: VALVE #3
STORAGE LOCATION : 01-05

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 63.54 SECONDS	AVE RUN THRUST	: 0.18 V
		MAX RUN THRUST	: 0.185 V
BYPASS TIME	: 0.4 SECONDS	THRUST AT CST	: 1.685 V
		SEAT THRUST AT CST	: 1.505 V
		INERTIAL THRUST	: 22 %
TORQUE SW. SETTING: 2.0/2.0		TOTAL THRUST	: 2.07 V

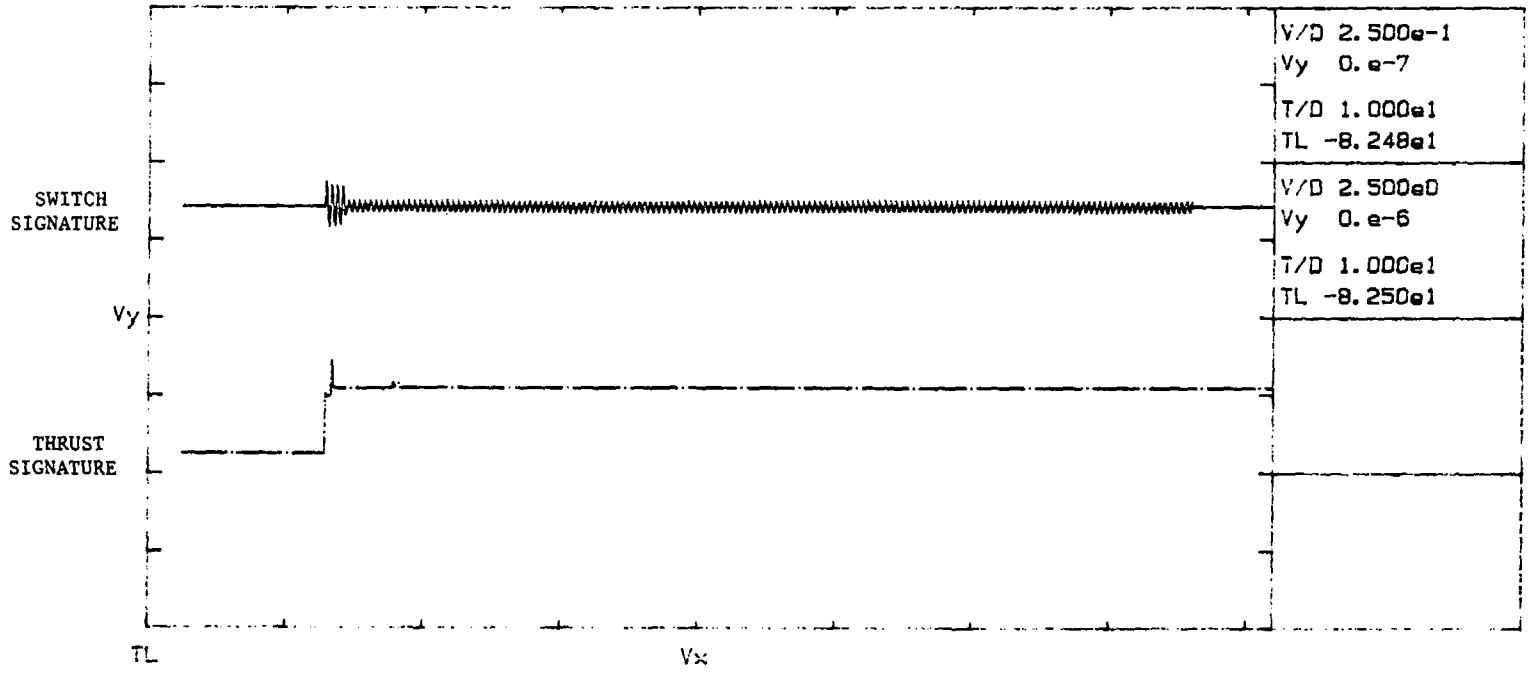


TEST IDENTIFICATION: VALVE #3.
STORAGE LOCATION : 01-06

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 63.1	SECONDS	AVE RUN THRUST	: 0.25	V
			MAX RUN THRUST	: 0.25	V
BYPASS TIME	: 1.38		UNSEATING THRUST	: 0.525	V
UNSEATING TIME	: 5.44	SECONDS	THRUST AT CST	: N/A	
PROTECTION MARGIN	:-4.06	SECONDS	TORQUE SW. SETTING:	3.0/3.0	



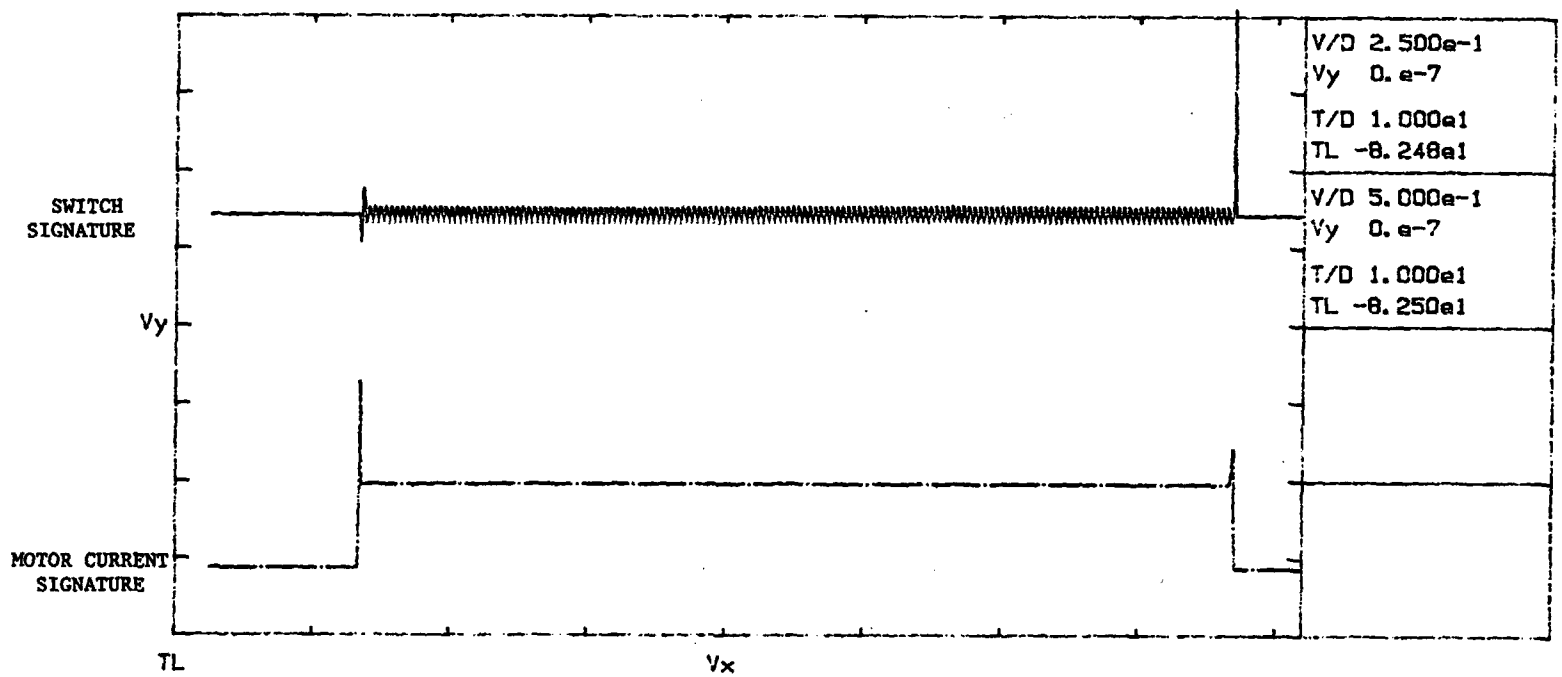
TEST IDENTIFICATION: VALVE #3
STORAGE LOCATION : 01-08

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 63.56 SECONDS

PEAK INRUSH : 21.12 AMPERES
AVE. RUN CURRENT : 5.41 AMPERES
MAX. RUN CURRENT : 5.41 AMPERES
SEATING CURRENT : 7.95 AMPERES



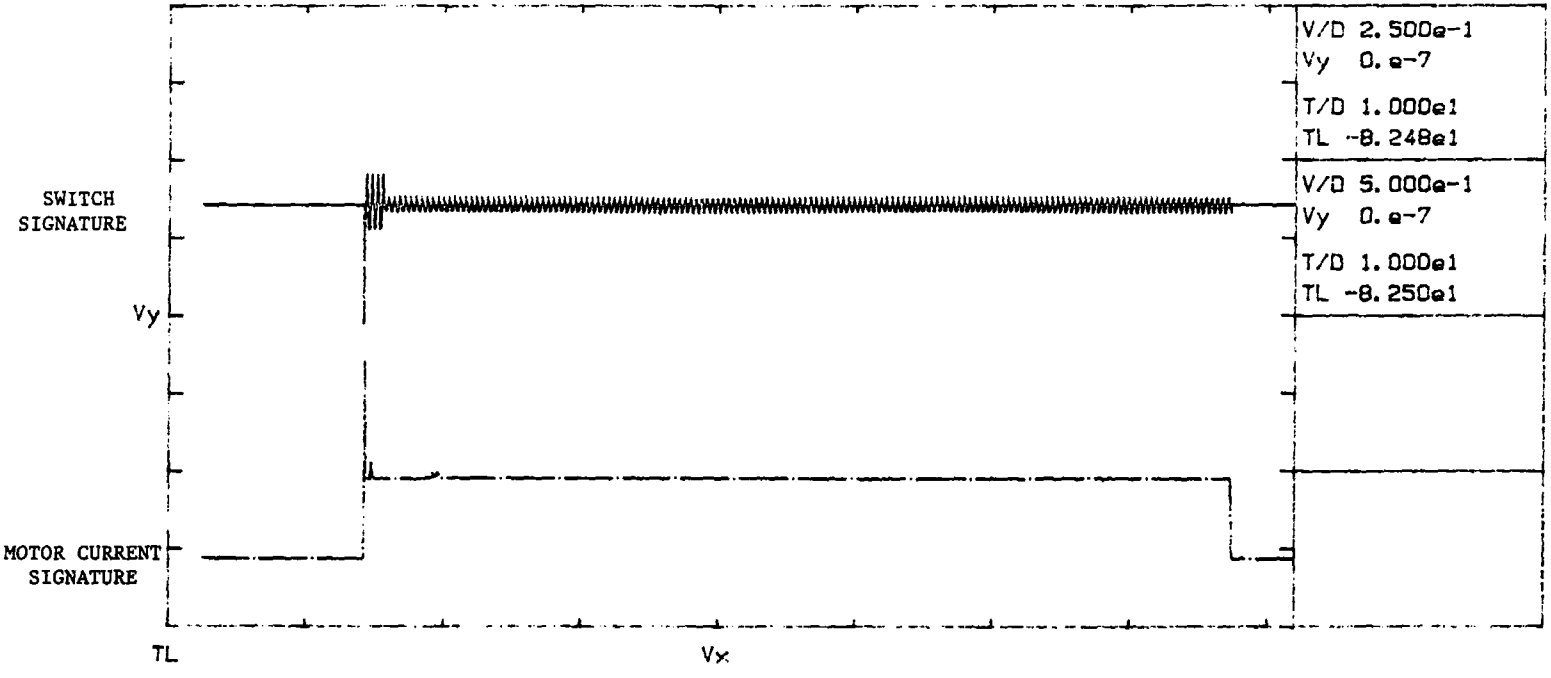
TEST IDENTIFICATION: VALVE #3
STORAGE LOCATION : 01-07

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 63.08 SECONDS

PEAK INRUSH : 18.23 AMPERES
AVE. RUN CURRENT : 5.15 AMPERES
MAX. RUN CURRENT : 5.17 AMPERES
END CURRENT : 5.14 AMPERES



Test I.D. Valve #4

Code	Comments
2	Drawing OEE-145-17 Rev 1 shows the power supply for this valve as 600 volts. Motor name plate rating is 208/416v, 5.1/2.55 Amps. Based on this information, we would expect that the normal running current should be somewhat less than 2.55. Since the average running current is 3.5 Amps, it appears that this machine is operating with excessive mechanical degradation. (See Recommendation #1).
3	Thrust signatures indicate a distinct cyclic loading condition occurring at a frequency of 37.5 RPM. (See Recommendation #2).

Recommendations

1. Actual line voltage and rated running currents should be verified immediately.

2. This degradation may be caused by a slight vertical misalignment of the drive sleeve (perhaps incorrect upper bearing housing gaskets), or significant wear on approximately 50% of the worm gear's circumference, or possibly excessive packing load. The condition does not, in our opinion, jeopardize the operability of the valve at this time.

TEST ID: VALVE #4

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 00
TEMP	: AMBIENT	SERIAL NO.	: 101681
PRESS	: ATMOSPHERIC	ORDER NO.	: 340064
SFTY REL'D	: N/A	ORIENTATION	: HORIZONTAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 110	ID. NO.	: FDW-103
AC/DC	: AC	TYPE	: N/A
OPEN CONTROL	: LIMIT	SIZE	: 4"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.0/2.0	VOLTS	: 208/416 N/A
CLOSE T.S. SETTING	: 3.0/3.0	RATED AMPS	: 5.1
LIMITER PLATE	: N/A	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER	: N/A

TEST EQUIPMENT

LOAD CELL # : N/A--

AMP PROBE # : N/A N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #4 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-19		TS-CO-01-18	
STROKE TIME	: 22.98 SECONDS	STROKE TIME	: 22.45 SECONDS
BYPASS TIME	: 0.98 SECONDS	BYPASS TIME	: 1.72 SECONDS
THRUST AT CST	: 2.57 V	PROTECTION MARGIN	: 0.91 SECONDS
SEAT THRUST AT CST	: 2.415 V	UNSEATING TIME	: 0.81 SECONDS
AVE RUN THRUST	: 0.105 V	AVE RUN THRUST	: 0.284 V
MAX RUN THRUST	: 0.165 V	MAX RUN THRUST	: 0.334 V
INERTIAL THRUST	: 4 %	UNSEATING THRUST	: 1.204 V
TOTAL THRUST	: 2.695 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 3.0/3.0	TORQUE SW. SETTING	: 2.0/2.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-02-01		CS-CO-01-20	
STROKE TIME	: 23 SECONDS	STROKE TIME	: 22.47 SECONDS
PEAK INRUSH	: 12.08 AMPERES	PEAK INRUSH	: 12.7 AMPERES
AVE. RUN CURRENT	: 3.66 AMPERES	AVE. RUN CURRENT	: 3.66 AMPERES
MAX. RUN CURRENT	: 3.67 AMPERES	MAX. RUN CURRENT	: 3.66 AMPERES
SEATING CURRENT	: 4.76 AMPERES	END CURRENT	: 3.66 AMPERES

TEST IDENTIFICATION: VALVE #4
STORAGE LOCATION : 01-19

PLOT NO. 1

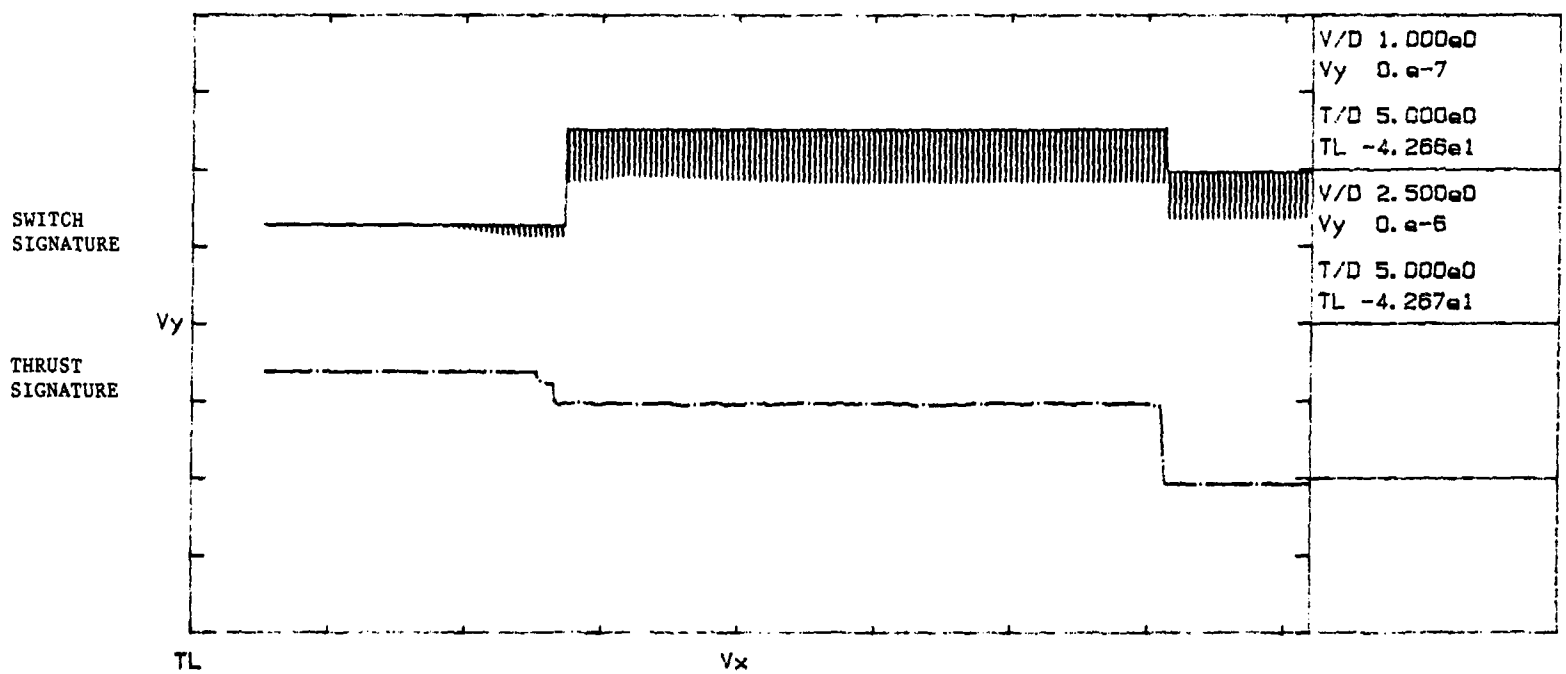
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 22.98 SECONDS

BYPASS TIME : 0.98 SECONDS

TORQUE SW. SETTING: 3.0/3.0

AVE RUN THRUST : 0.105 V
MAX RUN THRUST : 0.165 V
THRUST AT CST : 2.57 V
SEAT THRUST AT CST: 2.415 V
INERTIAL THRUST : 4 %
TOTAL THRUST : 2.695 V

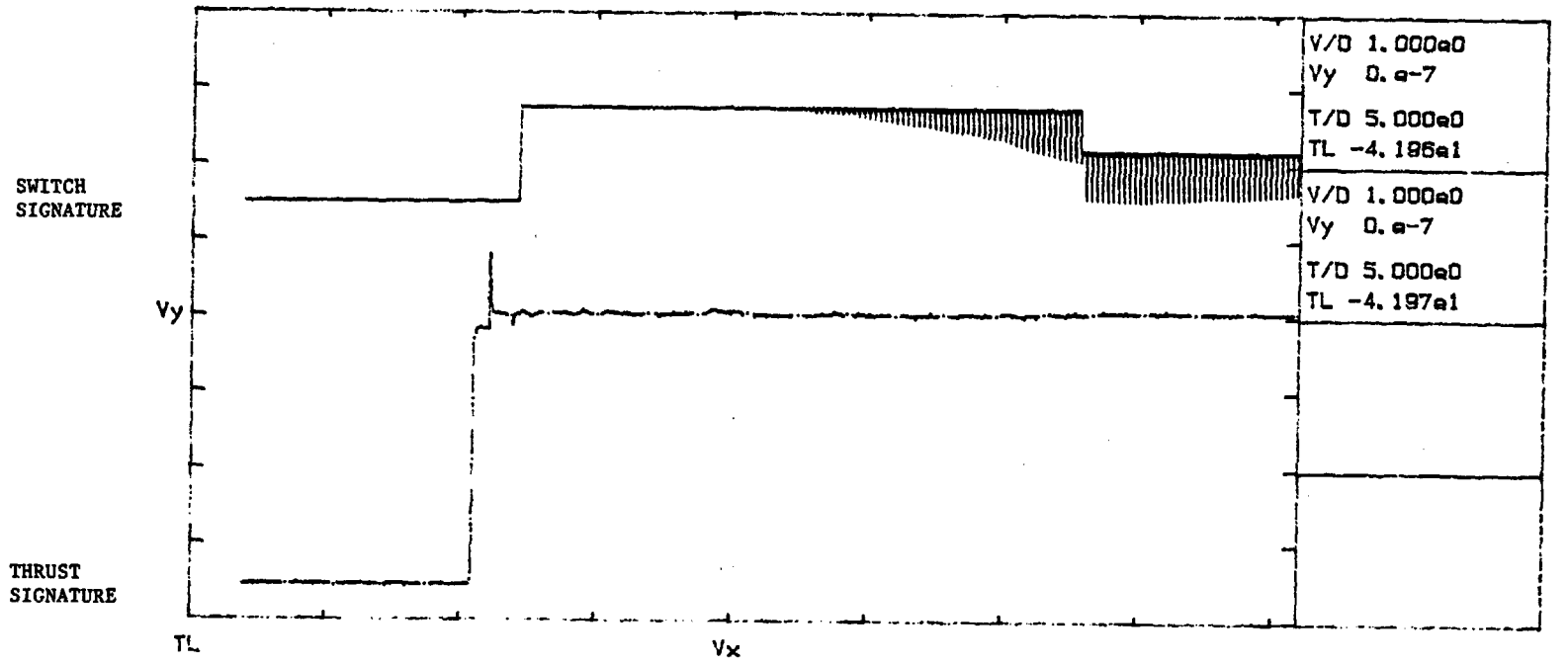


TEST IDENTIFICATION: VALVE #4
STORAGE LOCATION : 01-18

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 22.45 SECONDS	AVE RUN THRUST	: 0.284 V
		MAX RUN THRUST	: 0.334 V
BYPASS TIME	: 1.72	UNSEATING THRUST	: 1.204 V
UNSEATING TIME	: 0.81 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 0.91 SECONDS	TORQUE SW. SETTING	: 2.0/2.0



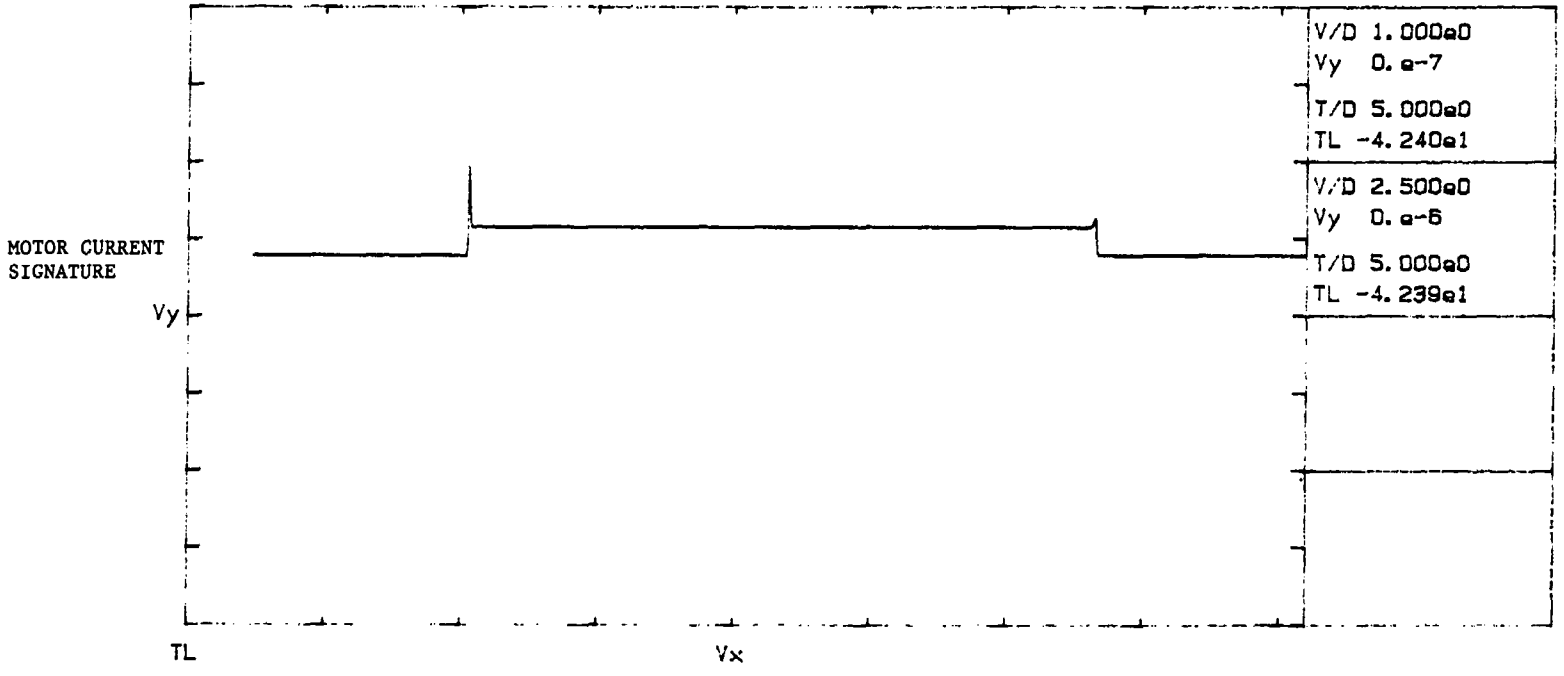
TEST IDENTIFICATION: VALVE #4
STORAGE LOCATION : 02-01

PLOT NO. 3

MOTOR CURRENT : OPEN TO CLOSE

STROKE TIME : 23 SECONDS

PEAK INRUSH : 12.08 AMPERES
AVE. RUN CURRENT : 3.66 AMPERES
MAX. RUN CURRENT : 3.67 AMPERES
SEATING CURRENT : 4.76 AMPERES



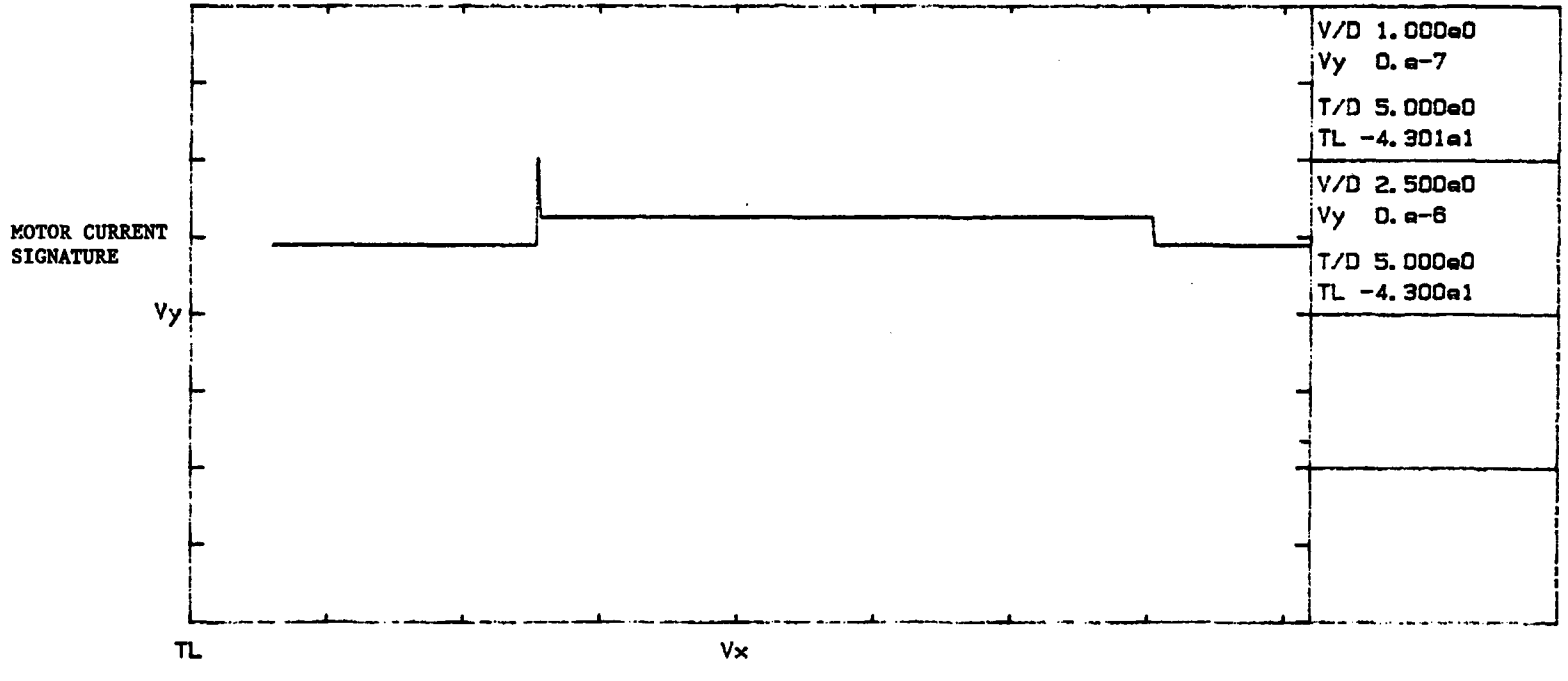
TEST IDENTIFICATION: VALVE #4
STORAGE LOCATION : 01-20

PLOT NO. 4

MOTOR CURRENT : CLOSE TO OPEN

STROKE TIME : 22.47 SECONDS

PEAK INRUSH : 12.7 AMPERES
AVE. RUN CURRENT : 3.66 AMPERES
MAX. RUN CURRENT : 3.66 AMPERES
END CURRENT : 3.66 AMPERES



Test I.D. Valve #5

Code	Comments
1/4	This valve exhibited the same condition as described for Valve #6 in that release of the hand switch in the control room upon receipt of closed indication would not guarantee valve closure. The switches were reset to ensure disc contact with the seat.
2	During equipment installation, a "pool" of oil was noted in the electrical compartment cover. The limit switch rotors as well were coated with oil. (See Recommendation #1).
4	The thrust signatures revealed a minor gap of approximately .010" in the spring pack assembly.

Recommendations

1. The limit switches should be cleaned immediately and the cause for the oil leakage determined.

TEST ID: VALVE #5

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 00
TEMP	: AMBIENT	SERIAL NO.	: 120565
PRESS	: ATMOSPHERIC	ORDER NO.	: 346299A
SFTY REL'D:	N/A	ORIENTATION:	HORIZONTAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS:	110	ID. NO.	: VALVE #5
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 6"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION:	HORIZONTAL
MCC	: N/A	INITIAL POSITION:	N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.25/2.25	VOLTS	: 208 AC
CLOSE T.S. SETTING:	2.25/2.25	RATED AMPS:	8.8
LIMITER PLATE	: 3.75	SPEED	: 1750
TS BALANCEABLE	: YES	HORSEPOWER:	1.6

TEST EQUIPMENT

LOAD CELL # : N/A--N/A

AMP PROBE # : SIMPSON(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #5 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-12		TS-CO-01-11	
STROKE TIME	: 29.16 SECONDS	STROKE TIME	: 29.04 SECONDS
BYPASS TIME	: 0 SECONDS	BYPASS TIME	: 1.3 SECONDS
THRUST AT CST	: 0.056 V	PROTECTION MARGIN	: 0.76 SECONDS
SEAT THRUST AT CST	:-2E-03 V	UNSEATING TIME	: 0.54 SECONDS
AVE RUN THRUST	: 0.058 V	AVE RUN THRUST	: 0.026 V
MAX RUN THRUST	: 0.058 V	MAX RUN THRUST	: 0.026 V
INERTIAL THRUST	: 0 %	UNSEATING THRUST	:<PRELOAD
TOTAL THRUST	: 0.056 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.25/2.25	TORQUE SW. SETTING	: 2.25/2.25

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

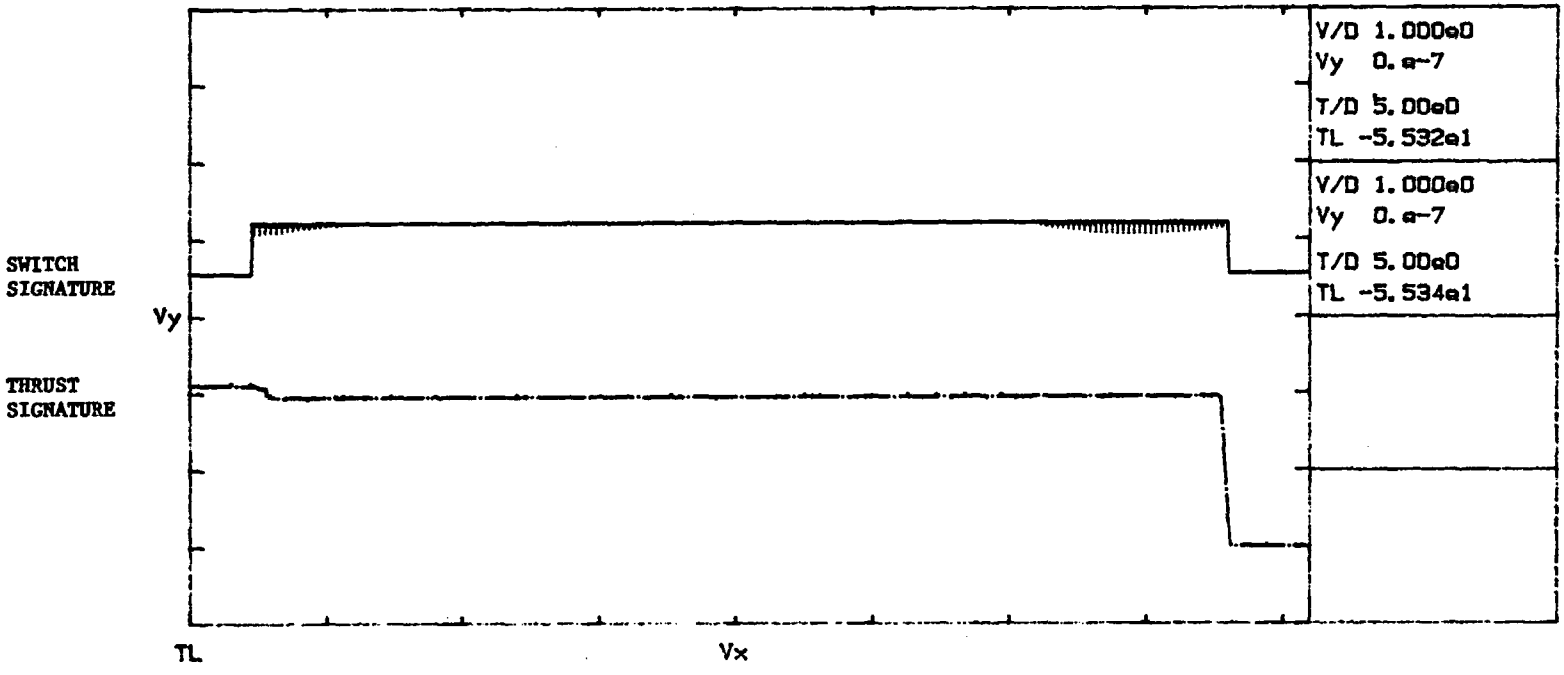
CS-OC-01-15		CS-CO-01-14	
STROKE TIME	: 29.64 SECONDS	STROKE TIME	: 35.2 SECONDS
PEAK INRUSH	: 23.7 AMPERES	PEAK INRUSH	: 24.5 AMPERES
AVE. RUN CURRENT	: 5.96 AMPERES	AVE. RUN CURRENT	: 5.98 AMPERES
MAX. RUN CURRENT	: 5.96 AMPERES	MAX. RUN CURRENT	: 5.98 AMPERES
SEATING CURRENT	: 5.88 AMPERES	END CURRENT	: 5.96 AMPERES

TEST IDENTIFICATION: VALVE #5
STORAGE LOCATION : 01-12

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 29.16 SECONDS	AVE RUN THRUST	: 0.058 V
		MAX RUN THRUST	: 0.058 V
BYPASS TIME	: 0 SECONDS	THRUST AT CST	: 0.056 V
		SEAT THRUST AT CST	:-2E-03 V
		INERTIAL THRUST	: 0 %
TORQUE SW. SETTING: 2.25/2.25		TOTAL THRUST	: 0.056 V

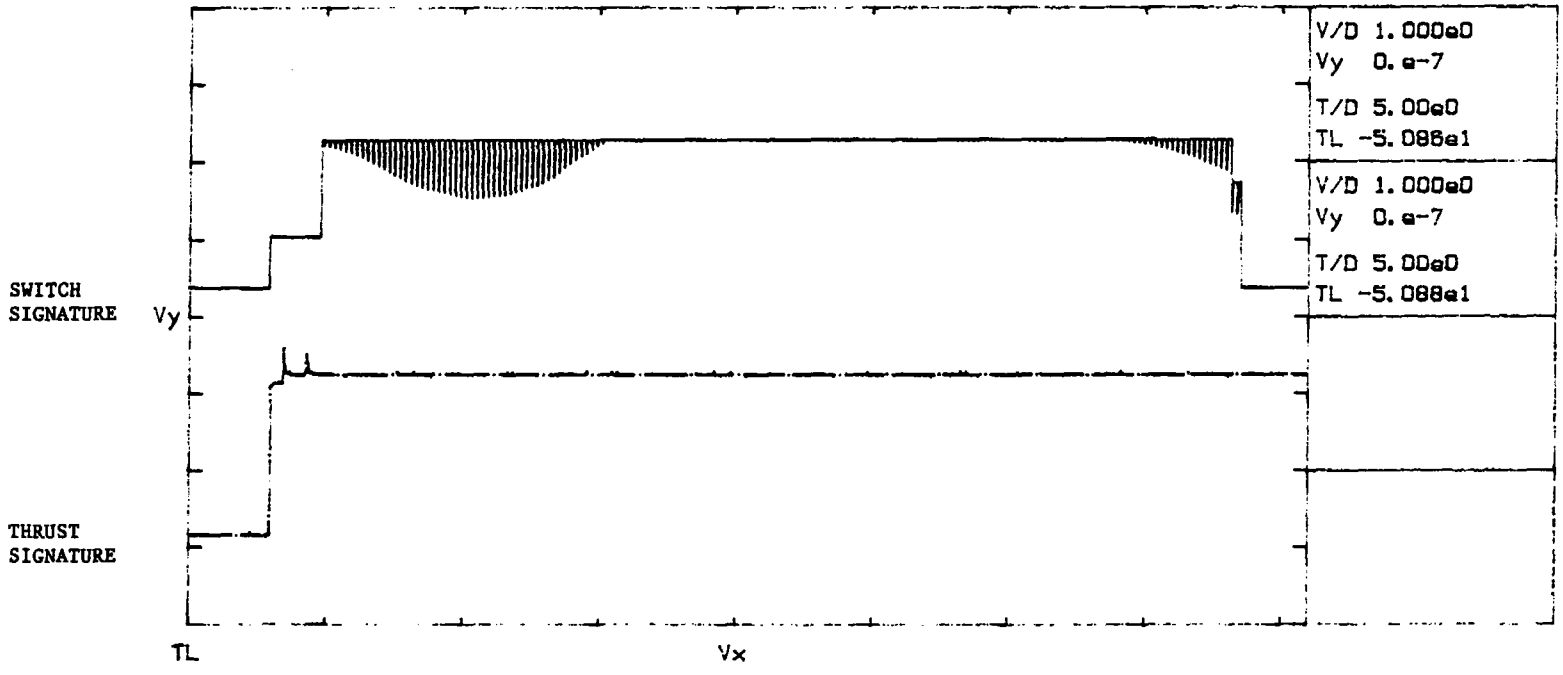


TEST IDENTIFICATION: VALVE #5
STORAGE LOCATION : 01-11

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 29.04 SECONDS	AVE RUN THRUST	: 0.026 V
		MAX RUN THRUST	: 0.026 V
BYPASS TIME	: 1.3 SECONDS	UNSEATING THRUST	:<PRELOAD
UNSEATING TIME	: 0.54 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 0.76 SECONDS	TORQUE SW. SETTING	: 2.25/2.25



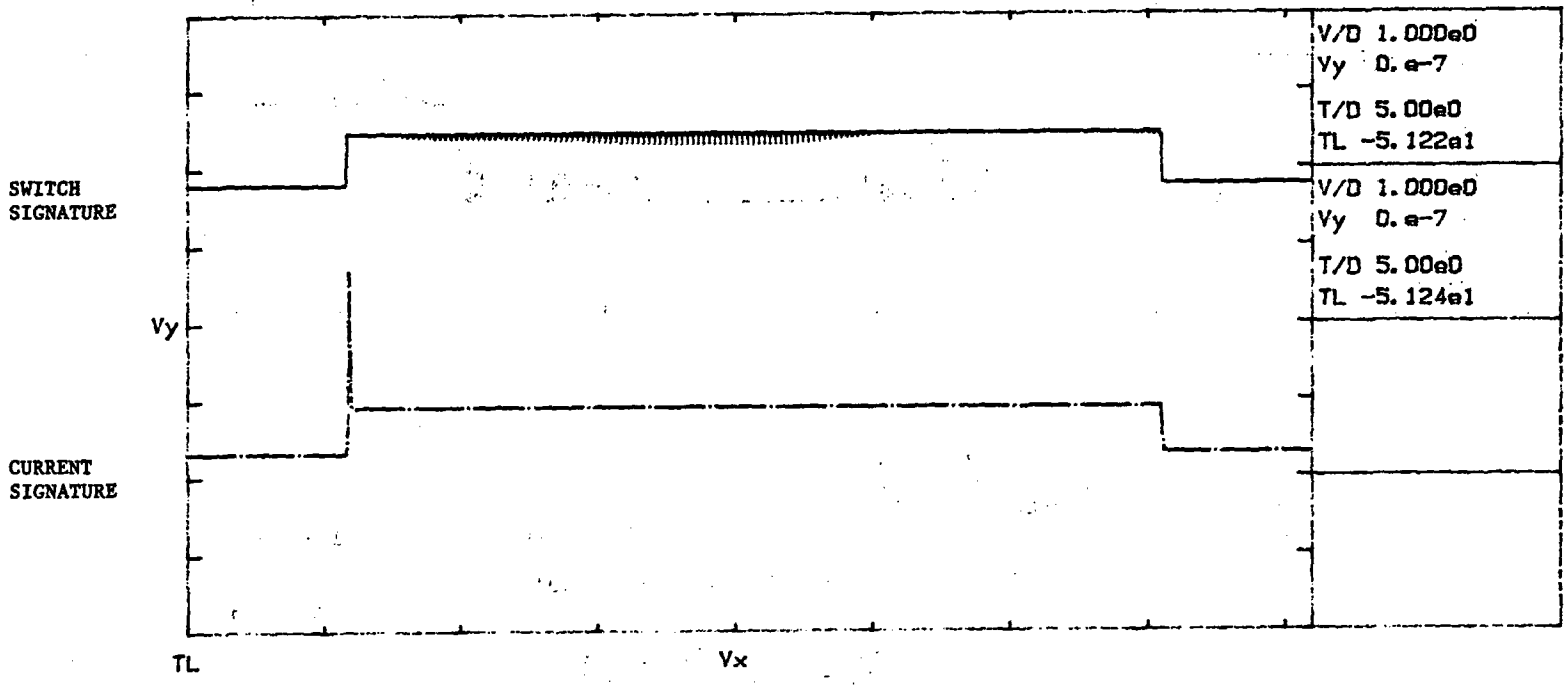
TEST IDENTIFICATION: VALVE #5
STORAGE LOCATION : 01-15

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 29.64 SECONDS

PEAK INRUSH	: 23.7	AMPERES
AVE. RUN CURRENT	: 5.96	AMPERES
MAX. RUN CURRENT	: 5.96	AMPERES
SEATING CURRENT	: 5.88	AMPERES



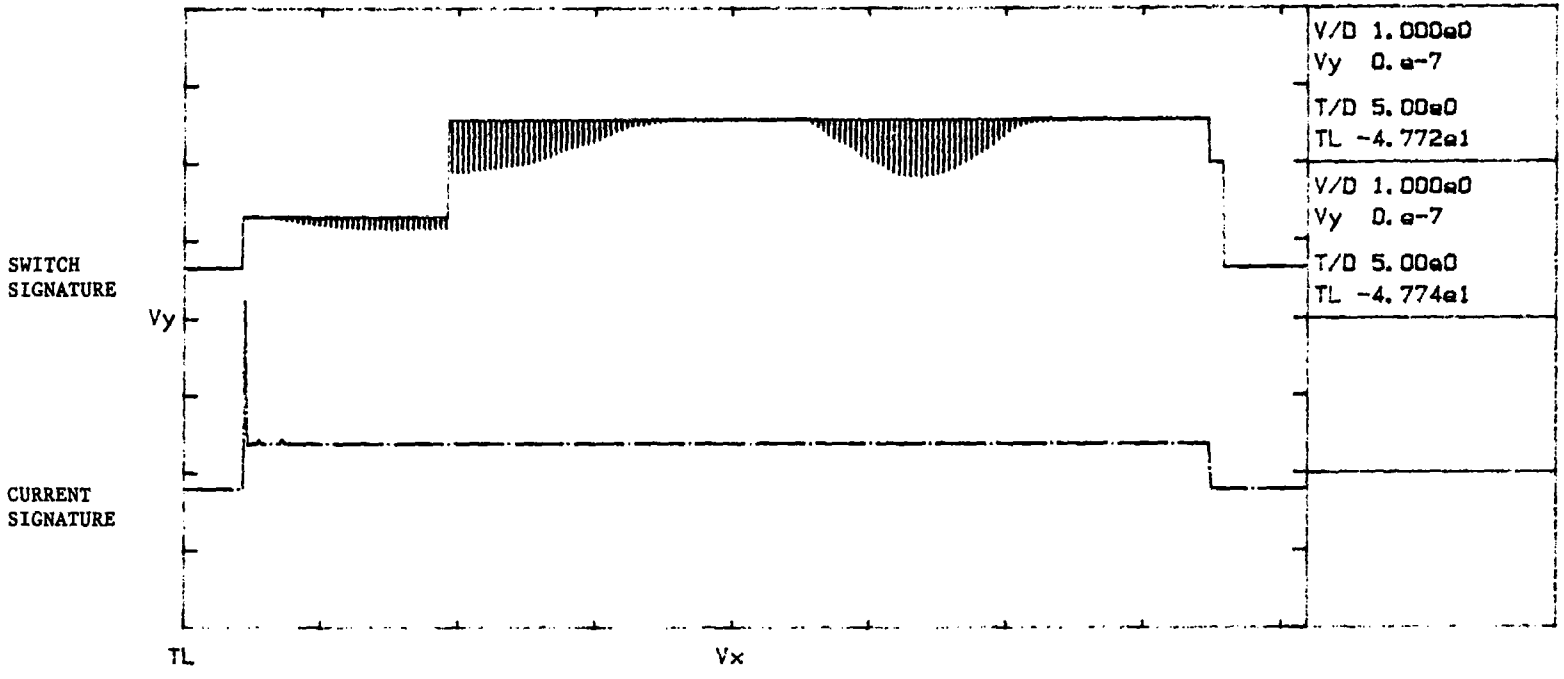
TEST IDENTIFICATION: VALVE #5
STORAGE LOCATION : 01-14

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 35.2 SECONDS

PEAK INRUSH	: 24.5	AMPERES
AVE. RUN CURRENT	: 5.98	AMPERES
MAX. RUN CURRENT	: 5.98	AMPERES
END CURRENT	: 5.96	AMPERES



Test I.D. Valve #6

Code	Comments
1	Initial motor current signatures indicated a high running current (50% over rated). Since the stem was not lubricatd, it was originally thought that this might be the cause of the high current. The stem was lubricated and the valve cycled. Thrust signatures taken at this time showed in one case that the valve did not hit the seat. In a re-test it barely hit the seat. This was quite perplexing since the original signature showed clearly that the valve was being seated and the torque switch terminating travel. It is important to note that initial signatures showed that the close to open torque switch bypass, LS-5, was set to trip three seconds after hammerblow. During the original analysis of this switch signature, it was concluded that the setting was excessive, however, it was not of major concern since the overall valve cycle was 36-37 seconds. Final signatures showed, however, that the setting of LS-5 must be shortened and reset to open just after hammerblow. This is critical since, as was learned later, this valve does not have a seal-in contactor. Operationally, what this means is that the control room terminates valve operation as soon as the light indications show the valve to be open/closed. The closed light indication (LS-7) is on the same limit switch rotor as LS-5. Therefore, with LS-5 set to trip after a significant amount of stem travel, this conversely established that the closed light would be activated before the valve was actually closed. The amount of time that the operator holds the control switch after receipt of closed indication, dictates whether or not the valve actually closes and/or the magnitude of the seating load. To

Test I.D. Valve #6

	preclude valve leakage and possible seat damage to this steam valve, it is recommended that LS-5 be set to trip just after hammerblow and retested to verify that the valve will seat if the control switch is released at the time the closed indication is received and that the torque switch is, in fact, terminating the travel. LS-7 (closed indication) was satisfactorily reset to close later in the open to close cycle.
1	The thrust signatures reveal that the potential exists for a loose stem nut locknut. (See Recommendation No. 1.)
2	During equipment installation oil was noted to be dripping from the limit switch rotors. This condition could throw the entire control functions into turmoil. (See Recommendation No. 2.)
2	It should be noted that although the valve is not set up to reliably hit the seat, the actual seating force will probably vary from operator to operator (control room). Consistent seating force will only be attained if the torque switch is allowed to terminate travel. (See Recommendation No. 3.)

Recommendations

1. We recommend that the following actions be taken to visually determine if the locknut is in fact loosened:

   A. Operate the valve to a mid-position by opening the valve.

   B. Remove the stem thread guard pipe if one exists.

   C. Once the guard pipe is removed, visually inspect the locknut to determine if it has backed itself out.

   D. Please note also that if the locknut is found to be loose, readjustment to the correct position will result in the limit, bypass, and light indication switches being improperly positioned.

Test I.D. Valve #6

2. Not only should the switches be cleaned but, likewise, the condition of the gearbox grease and sealing gaskets inspected. Oil leakage may be an early indication of incompatible lubricating greases.

3. If the present setup is not deemed to be optimum by plant engineering and operations personnel, then consideration should be given to using a seal-in contactor in the close direction.

TEST ID: VALVE #6

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 00
TEMP	: AMBIENT	SERIAL NO.	: 120564
PRESS	: ATMOSHERIC	ORDER NO.	: 346299A
SFTY REL'D	: N/A	ORIENTATION	: HORIZONTAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 110	ID. NO.	: VALVE #6
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 6"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.0/2.0	VOLTS	: 208 AC
CLOSE T.S. SETTING	: 2.0/2.0	RATED AMPS	: 8.8
LIMITER PLATE	: 4.0	SPEED	: 1750
TS BALANCEABLE	: YES	HORSEPOWER	: 1.6

TEST EQUIPMENT

LOAD CELL # : N/A--N/A

AMP PROBE # : SIMPSON(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #6 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-01		TS-CO-01-02	
STROKE TIME	: 35.56 SECONDS	STROKE TIME	: 36.18 SECONDS
BYPASS TIME	: 0.9 SECONDS	BYPASS TIME	: 3.86 SECONDS
THRUST AT CST	: 1.546 V	PROTECTION MARGIN	:-0.46 SECONDS
SEAT THRUST AT CST	: 1.524 V	UNSEATING TIME	: 4.32 SECONDS
AVE RUN THRUST	: 0.022 V	AVE RUN THRUST	: 0.038 V
MAX RUN THRUST	: 0.022 V	MAX RUN THRUST	: 0.038 V
INERTIAL THRUST	: 21 %	UNSEATING THRUST	: 0.24 V
TOTAL THRUST	: 1.886 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.0/2.0	TORQUE SW. SETTING	: 2.0/2.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-01-03		CS-CO-01-04	
STROKE TIME	: 36.62 SECONDS	STROKE TIME	: 36.26 SECONDS
PEAK INRUSH	: 24.38 AMPERES	PEAK INRUSH	: 24.92 AMPERES
AVE. RUN CURRENT	: 5.74 AMPERES	AVE. RUN CURRENT	: 6.02 AMPERES
MAX. RUN CURRENT	: 5.74 AMPERES	MAX. RUN CURRENT	: 6.02 AMPERES
SEATING CURRENT	: 8.86 AMPERES	END CURRENT	: 5.98 AMPERES

TEST IDENTIFICATION: VALVE #6
STORAGE LOCATION : 01-01

PLOT NO. 1

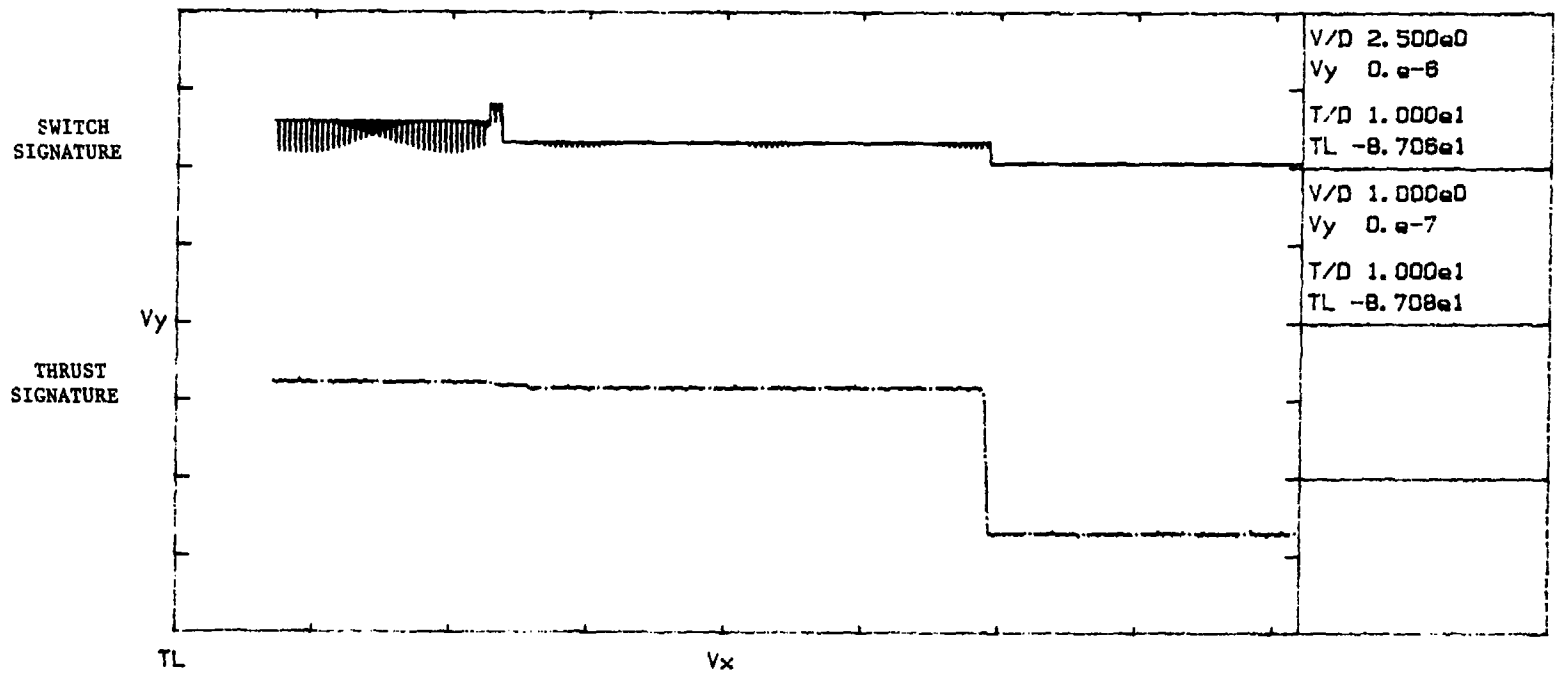
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 35.56 SECONDS

BYPASS TIME : 0.9 SECONDS

TORQUE SW. SETTING: 2.0/2.0

AVE RUN THRUST	: 0.022	V
MAX RUN THRUST	: 0.022	V
THRUST AT CST	: 1.546	V
SEAT THRUST AT CST	: 1.524	V
INERTIAL THRUST	: 21	%
TOTAL THRUST	: 1.886	V

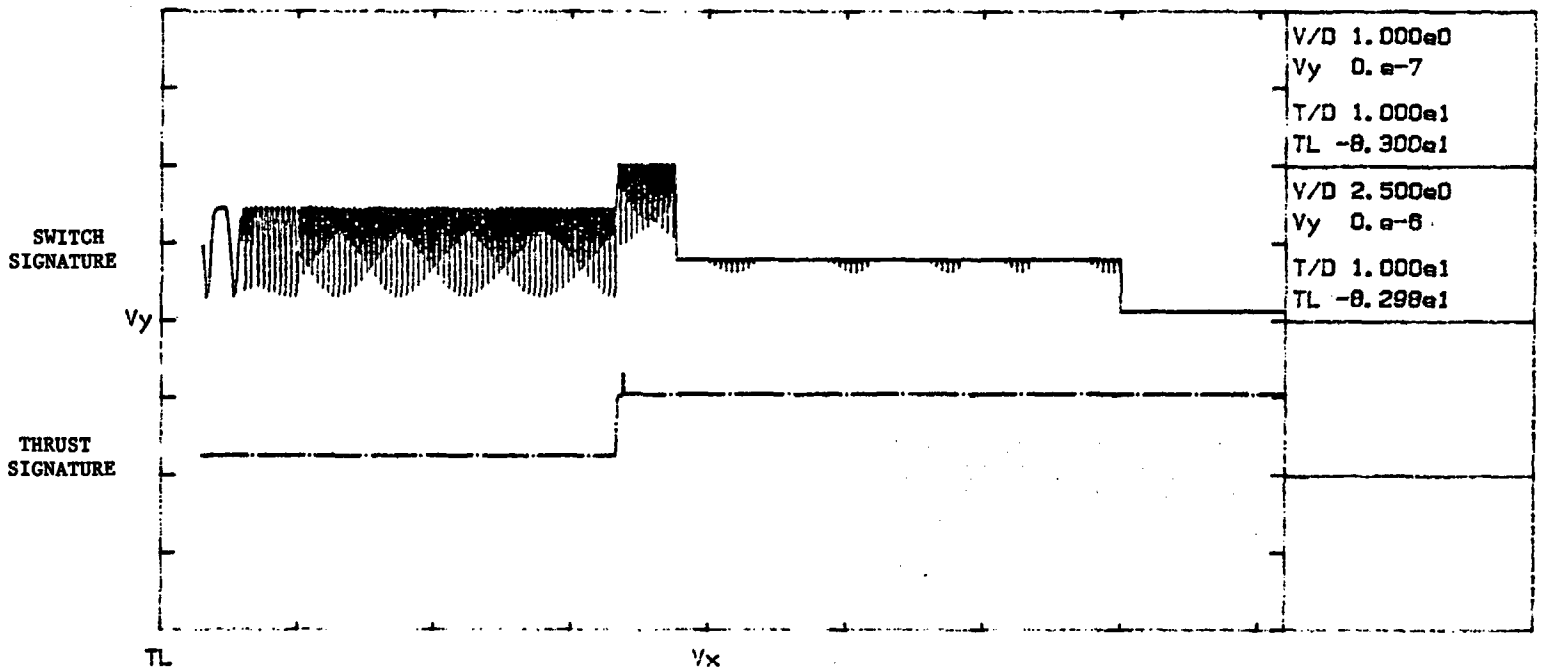


TEST IDENTIFICATION: VALVE #6
STORAGE LOCATION : 01-02

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 36.18 SECONDS	AVE RUN THRUST	: 0.038 V
		MAX RUN THRUST	: 0.038 V
BYPASS TIME	: 3.86	UNSEATING THRUST	: 0.24 V
UNSEATING TIME	: 4.32 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	:-0.46 SECONDS	TORQUE SW. SETTING	: 2.0/2.0



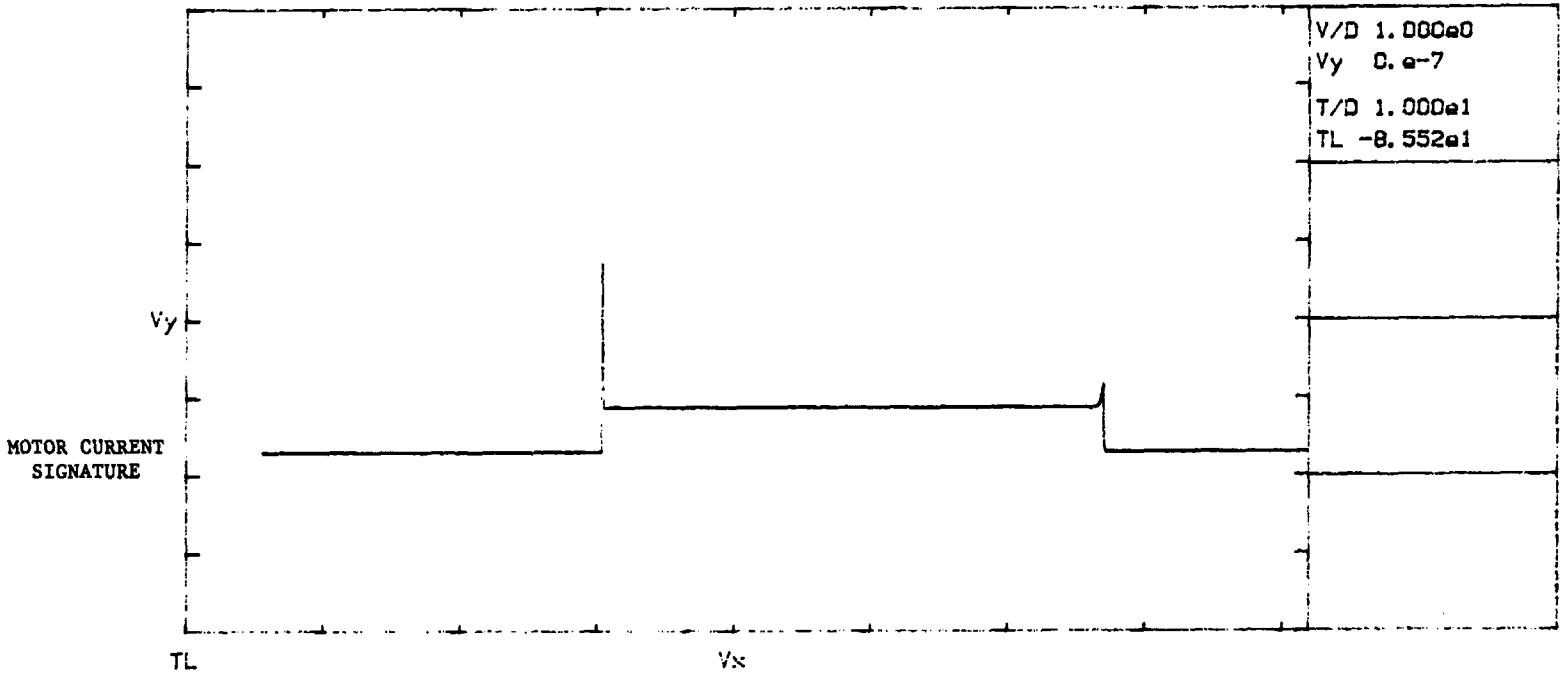
TEST IDENTIFICATION: VALVE #6
STORAGE LOCATION : 01-03

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 36.62 SECONDS

PEAK INRUSH : 24.38 AMPERES
AVE. RUN CURRENT : 5.74 AMPERES
MAX. RUN CURRENT : 5.74 AMPERES
SEATING CURRENT : 8.86 AMPERES



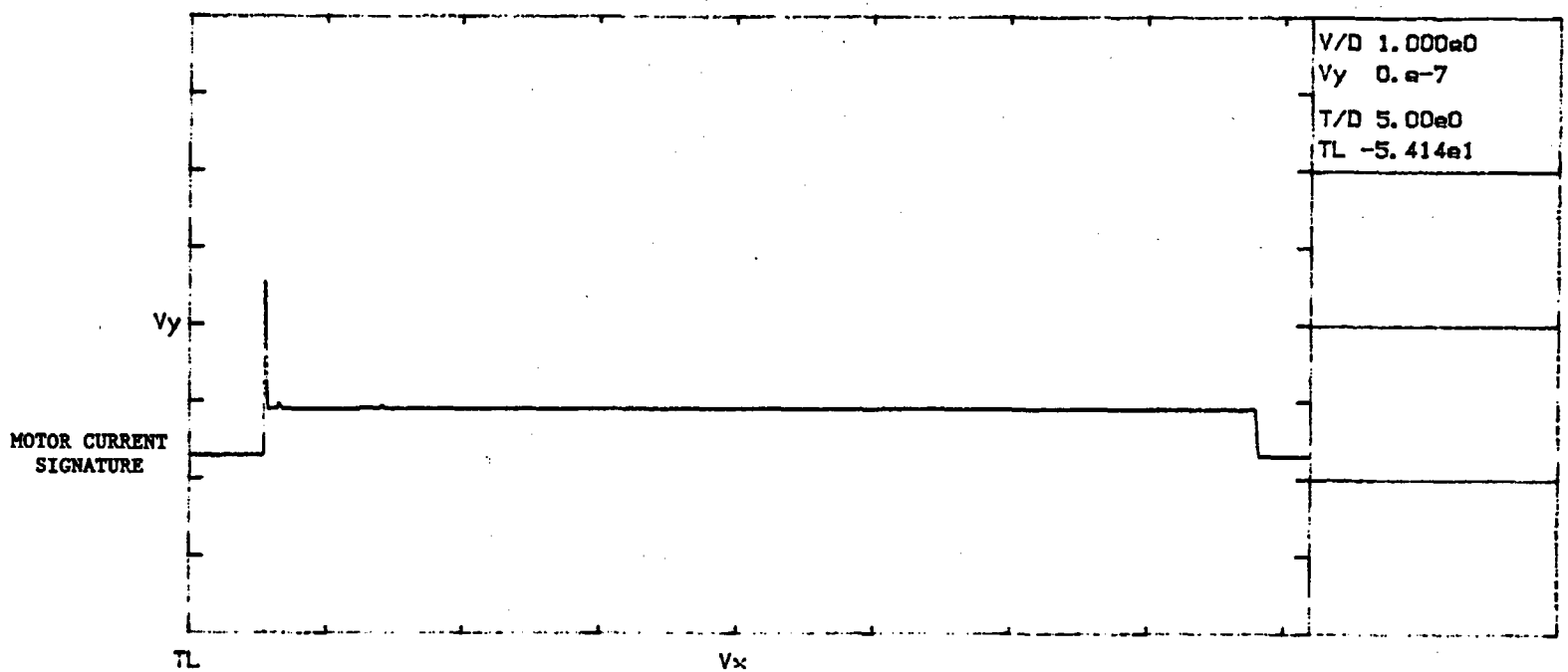
TEST IDENTIFICATION: VALVE #6
STORAGE LOCATION : 01-04

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 36.26 SECONDS

PEAK INRUSH : 24.92 AMPERES
AVE. RUN CURRENT : 6.02 AMPERES
MAX. RUN CURRENT : 6.02 AMPERES
END CURRENT : 5.98 AMPERES



Test I.D. Valve #7

Code	Comments
1,4	Testing the valve at the as found settings revealed that the operator was developing thrusts in both directions that exceeded the operator's designed maximum. The torque switch settings were changed from 4.0 in the open direction and 4.5 in the closed direction to 3.0 in the open direction and 3.0 in the closed direction. This was done to attain the target thrust values which are lower than the operator's design maximum.
1,4	The close-to-open bypass required adjustment to properly cover the unseating of the valve.
3,4	The torque switch was found to be out of balance by a factor of 2.5 to 1.0. This condition was corrected at the time of the test.
4	At the present torque switch setting this valve is generating approximately 75,000 pounds of total thrust which is within 10% of the operator's maximum designed thrust. (See Recommendation #1).
4	The operator exhibits a slight spring pack relaxation after the valve has been driven into the seat. (See Recommendation #2).

Recommendations

1. A torque switch limiter plate needs to be installed at a torque switch setting of 3.0 to prevent a torque switch setting that would not protect the operator from developing excessive thrusts.

Test I.D. Valve #7

2. This relaxation is caused by a spring pack force on the worm. Since the spring pack compression forces the torque switch contact open, relaxation of the spring pack could allow the torque switch contacts to reclose. A review of the control circuit should be conducted to determine whether reclosure of the torque switch contacts would allow the motor to re-energize, causing a hammering effect within the operator.

TEST ID: VALVE #7

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 2
TEMP	: AMBIENT	SERIAL NO.	: 103887
PRESS	: ATMOSPHERIC	ORDER NO.	: 339961A
SFTY REL'D:	N/A	ORIENTATION:	VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS:	125	ID. NO.	: COV-9B
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 18
CLOSE CONTROL	: TORQUE	BODY ORIENTATION:	HORIZONTAL
MCC	: N/A	INITIAL POSITION:	N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 4.0/3.0	VOLTS	: 460 AC
CLOSE T.S. SETTING:	4.5/3.0	RATED AMPS:	9.5
LIMITER PLATE	: N/A	SPEED	: 1705
TS BALANCEABLE	: YES	HORSEPOWER:	N/A

TEST EQUIPMENT

LOAD CELL # : 200K--N/A

AMP PROBE # : FLUKE(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #7 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-01		TS-CO-01-02	
STROKE TIME	: 36.04 SECONDS	STROKE TIME	: 36.22 SECONDS
BYPASS TIME	: 0 SECONDS	BYPASS TIME	: 3.6 SECONDS
THRUST AT CST	: 64607 #	PROTECTION MARGIN	: 2.52 SECONDS
SEAT THRUST AT CST	: 64520 #	UNSEATING TIME	: 1.08 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 21 %	UNSEATING THRUST	: 17912 #
TOTAL THRUST	: 75303 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 4.5/3.0	TORQUE SW. SETTING	: 4.0/3.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-01-05 K-FACTOR: 17391 #/V PRELOAD: 14000 #

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-01-03		CS-CO-01-04	
STROKE TIME	: 36.38 SECONDS	STROKE TIME	: 36.24 SECONDS
PEAK INRUSH	: 15.8 AMPERES	PEAK INRUSH	: 18.8 AMPERES
AVE. RUN CURRENT	: 6.35 AMPERES	AVE. RUN CURRENT	: 6.9 AMPERES
MAX. RUN CURRENT	: 6.35 AMPERES	MAX. RUN CURRENT	: 6.9 AMPERES
SEATING CURRENT	: 9.45 AMPERES	END CURRENT	: 6.5 AMPERES

TEST IDENTIFICATION: VALVE #7
STORAGE LOCATION : 01-01

PLOT NO. 1

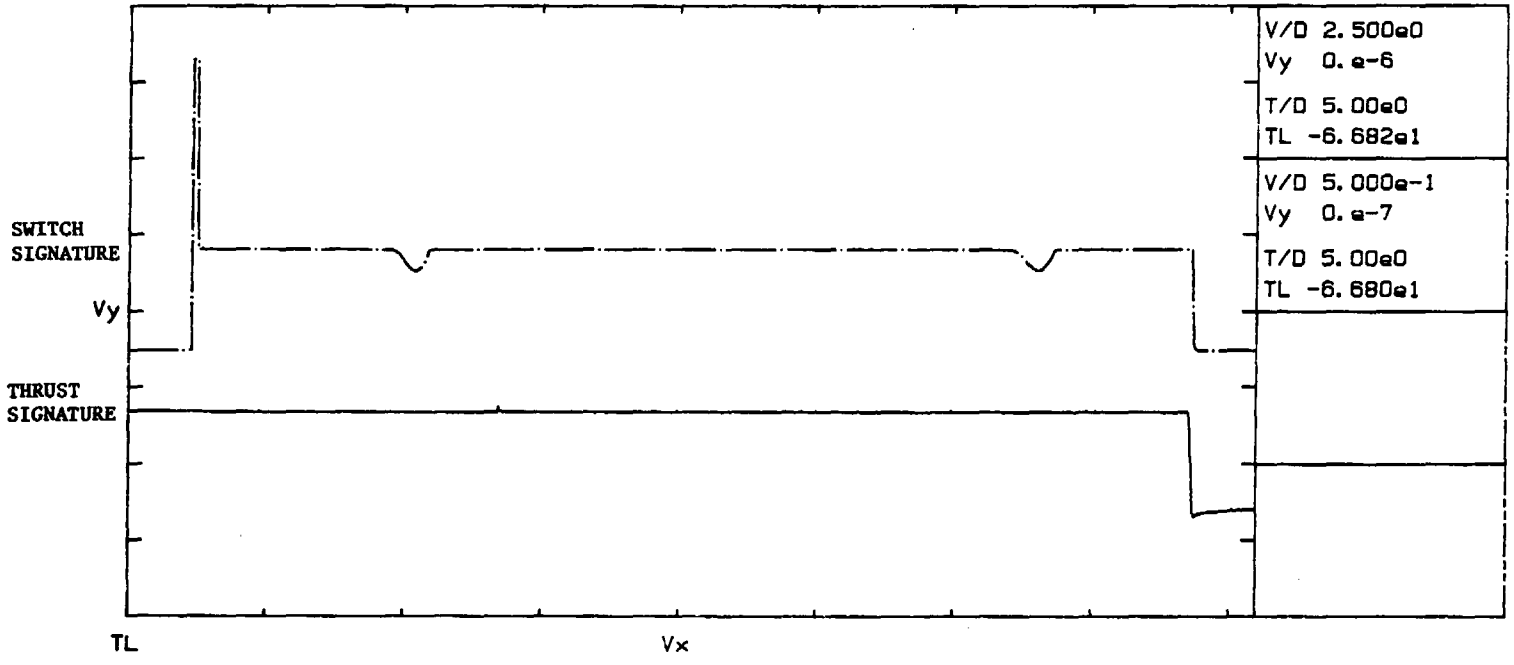
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 36.04 SECONDS

BYPASS TIME : 0 SECONDS

TORQUE SW. SETTING:4.5/3.0

AVE RUN THRUST :<PRELOAD
MAX RUN THRUST :<PRELOAD
THRUST AT CST : 64607 #
SEAT THRUST AT CST: 64520 #
INERTIAL THRUST : 21 %
TOTAL THRUST : 75303 #

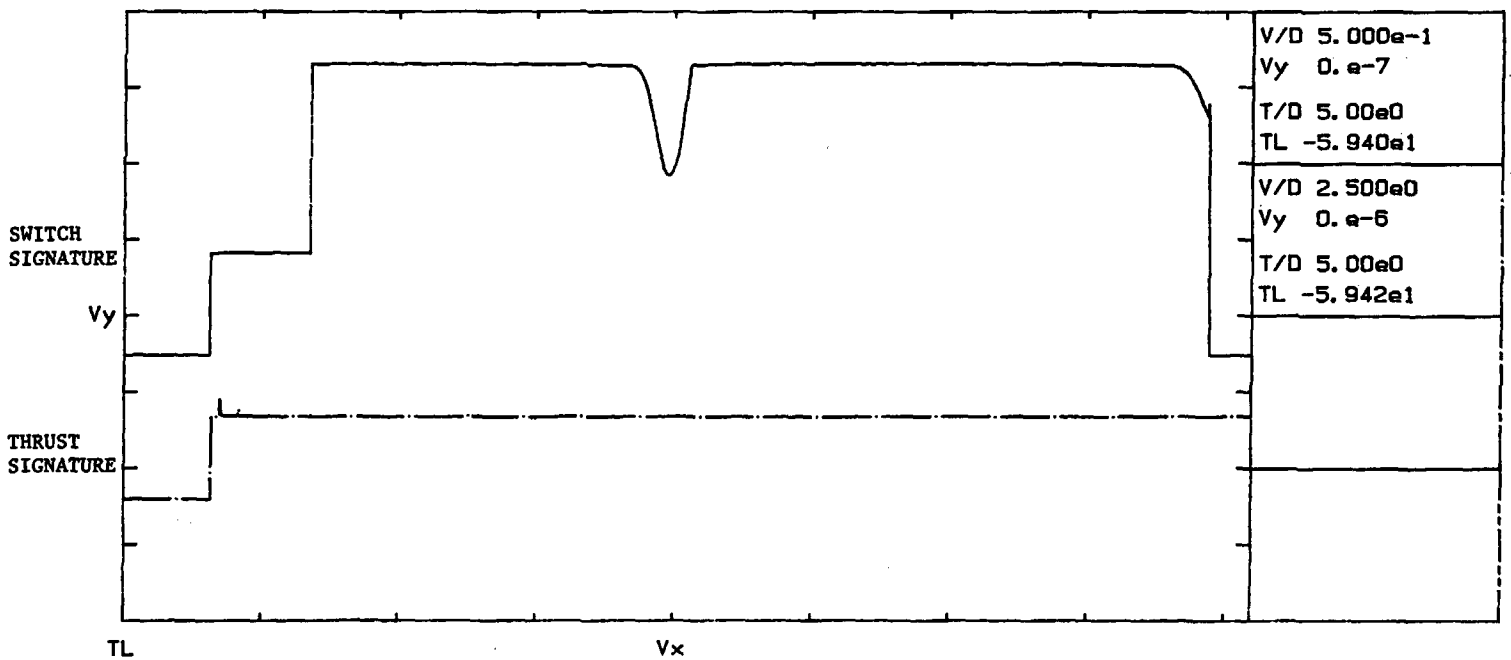


TEST IDENTIFICATION: VALVE #7
STORAGE LOCATION : 01-02

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 36.22 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 3.6 SECONDS	UNSEATING THRUST	: 17912 #
UNSEATING TIME	: 1.08 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 2.52 SECONDS	TORQUE SW. SETTING	: 4.0/3.0



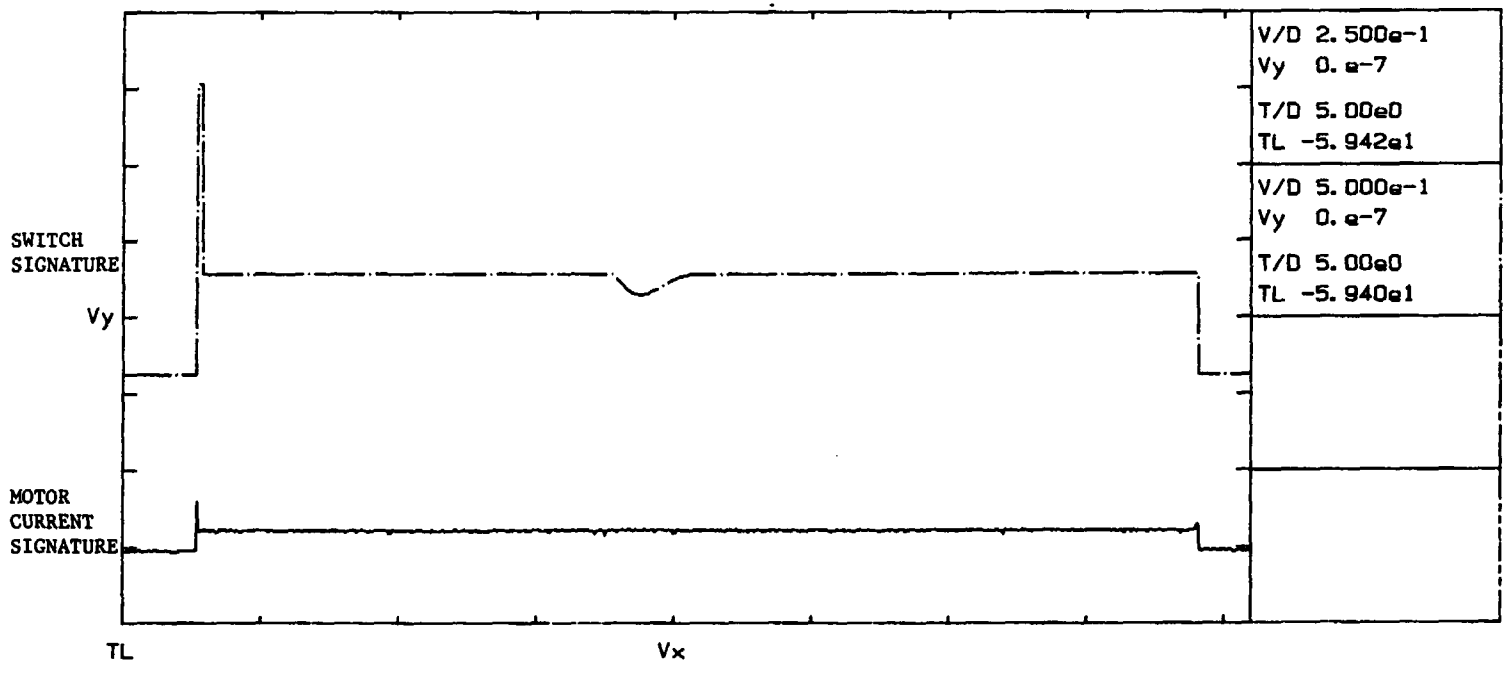
TEST IDENTIFICATION: VALVE #7
STORAGE LOCATION : 01-03

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 36.38 SECONDS

PEAK INRUSH	: 15.8	AMPERES
AVE. RUN CURRENT	: 6.35	AMPERES
MAX. RUN CURRENT	: 6.35	AMPERES
SEATING CURRENT	: 9.45	AMPERES



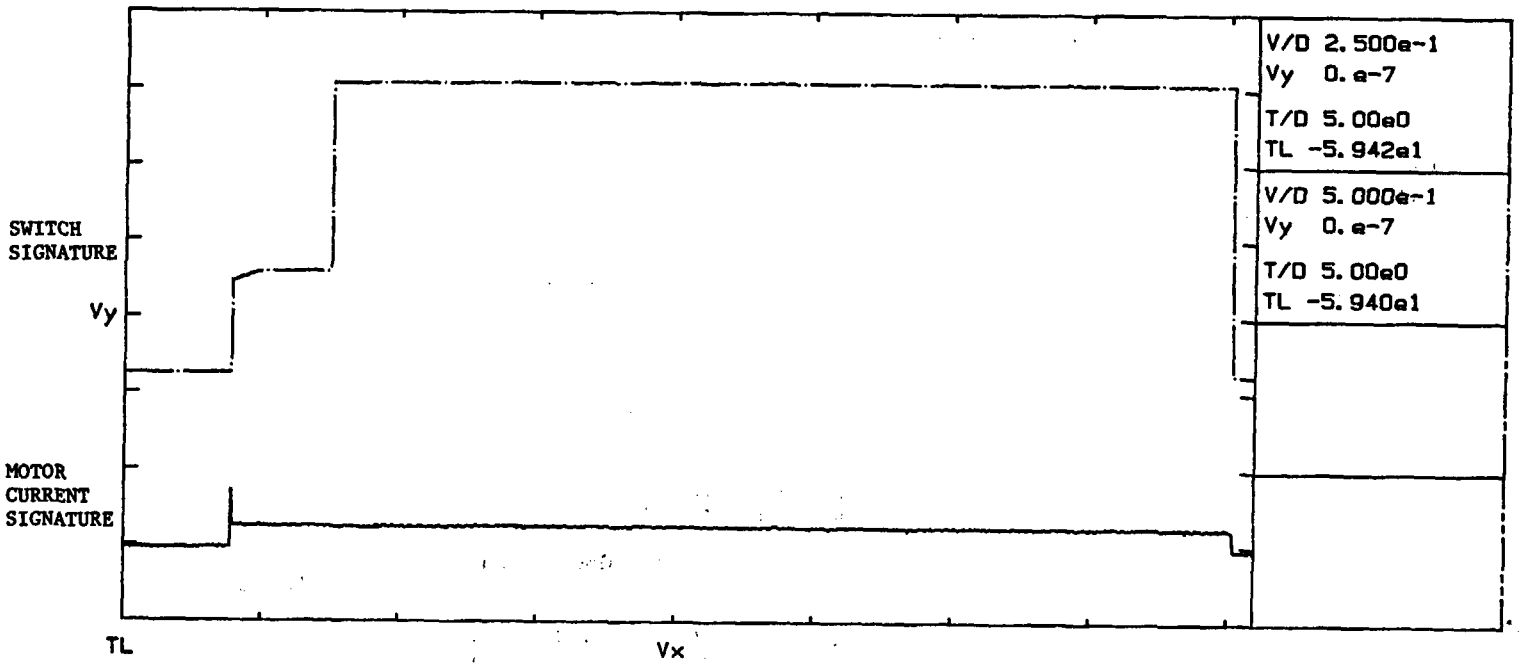
TEST IDENTIFICATION: VALVE #7
STORAGE LOCATION : 01-04

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 36.24 SECONDS

PEAK INRUSH : 18.8 AMPERES
AVE. RUN CURRENT : 6.9 AMPERES
MAX. RUN CURRENT : 6.9 AMPERES
END CURRENT : 6.5 AMPERES

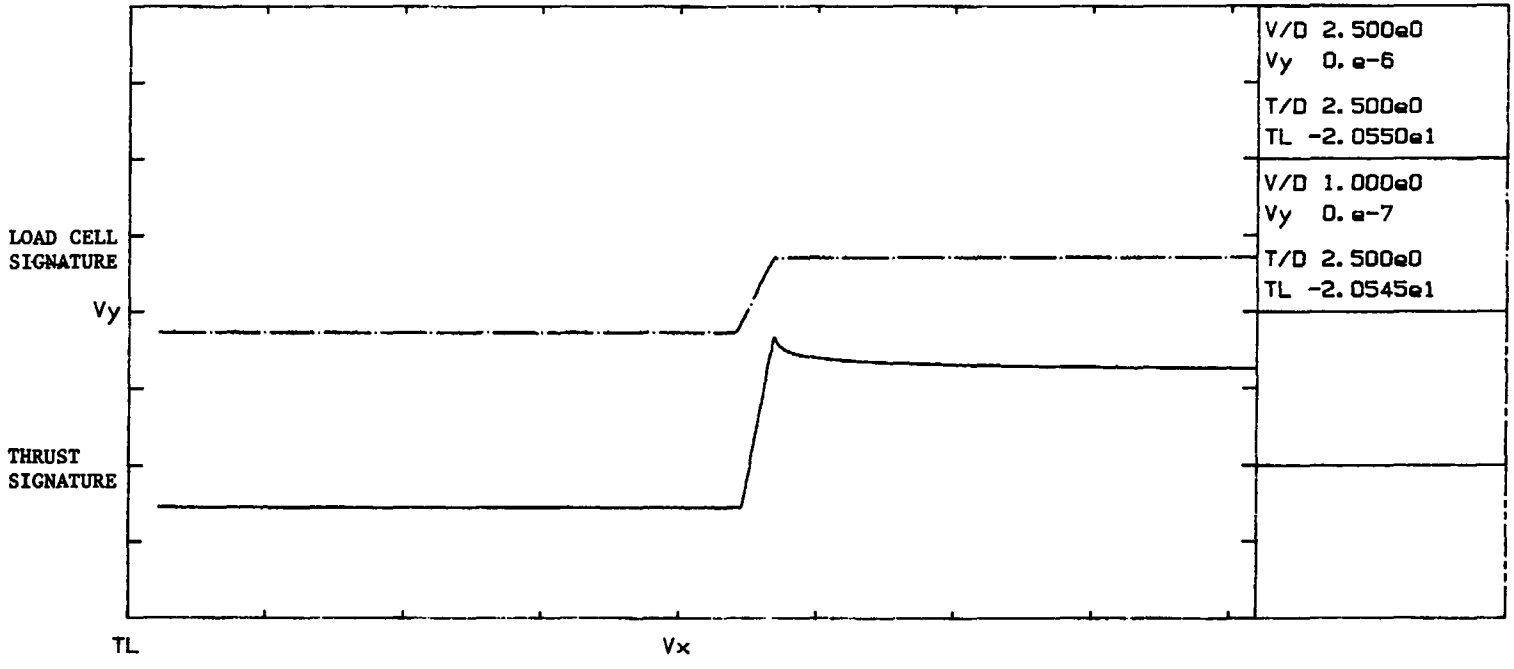


TEST IDENTIFICATION: VALVE #7
STORAGE LOCATION : 01-05

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 14000 #
K-FACTOR: 17391 #/V



Test I.D. Valve #8

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
2,3	Initial testing showed the operator was delivering approximately 14,700 pounds of total thrust in the open-to-close direction, and approximately 13,500 pounds of total thrust in the close-to-open direction. These conditions are over and near, respectively, the designed maximum output of an SMB-00 which is 14,000 pounds. (See Recommendation #1).
4	Both the current and thrust signatures reveal a degradation from the beginning of the open-to-close stroke that lasts for 11.5 seconds. (See Recommendation #2).
4	The as found open and close torque switch settings were changed from 2.0 to <2.0 to attain proper target thrust values and stay under the designed maximum thrust of the operator.
4	During equipment installation, it was noted that the spring cartridge cap appeared to be packed with grease. (See Recommendation #3).
4	This operator exhibits a slight relaxation of the spring pack after the valve has fully seated. (See Recommendation #4).

Recommendations

1. When convenient, re-evaluate your target thrust values due to the fact that they are very near the maximum design output of the operator. The thrust values that the operator is delivering at torque switch trip are just over the minimum target thrust, however, the total

Test I.D. Valve #8

thrust being developed is within 10% of the design maximum of the operator. Based on this data, a blocking device should be installed on the torque switch with a setting of 2.0.

2. This condition does not, in our opinion, jeopardize the operability of the valve at this time.

3. It should be noted that the Belleville springs do not require lubrication to function properly.

4. This relaxation is caused by a spring pack force being exerted on the worm. Since spring pack compression forces the torque switch contacts open, relaxation of the spring pack could allow the torque switch contacts to reclose. A review of the control circuit should be conducted to determine whether reclosure of the torque switch contacts would allow the motor to re-energize, causing a hammering effect within the operator.

TEST ID: VALVE #8

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 00
TEMP	: AMBIENT	SERIAL NO.	: 139892
PRESS	: ATMOSPHERIC	ORDER NO.	: 355695B
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: FWV-92A
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 6
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.0/1.8	VOLTS	: 480 AC
CLOSE T.S. SETTING	: 2.0/1.8	RATED AMPS	: 3.8
LIMITER PLATE	: N/A	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER	: N/A

TEST EQUIPMENT

LOAD CELL # : 50K--N/A

AMP PROBE # : FLUKEN/A N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #8 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

	TS-OC-01-17		TS-CO-01-18
STROKE TIME	: 27.25 SECONDS	STROKE TIME	: 27.13 SECONDS
BYPASS TIME	: 0.53 SECONDS	BYPASS TIME	: 4.27 SECONDS
THRUST AT CST	: 13205 #	PROTECTION MARGIN	: 2.84 SECONDS
SEAT THRUST AT CST	: 12788 #	UNSEATING TIME	: 1.43 SECONDS
AVE RUN THRUST	: 695 #	AVE RUN THRUST	: 173 #
MAX RUN THRUST	: 2363 #	MAX RUN THRUST	: 0 #
INERTIAL THRUST	: 11 %	UNSEATING THRUST	: 2467 #
TOTAL THRUST	: 14734 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.0/1.8	TORQUE SW. SETTING	: 2.0/1.8

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-01-16 K-FACTOR: 6950 #/V PRELOAD: < RUNNING LOAD

MOTOR CURRENT SIGNATURE ANALYSIS

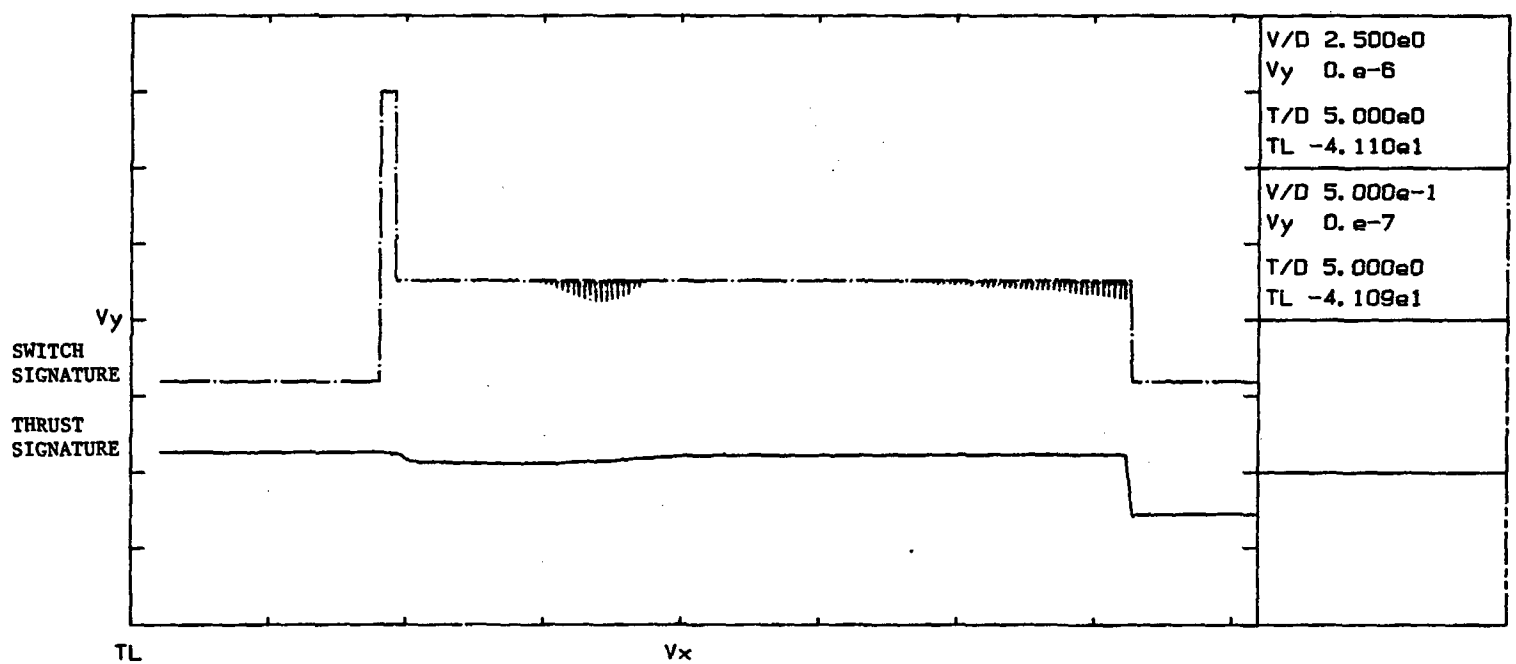
	CS-OC-01-19		CS-CO-01-20
STROKE TIME	: 27.26 SECONDS	STROKE TIME	: 27.13 SECONDS
PEAK INRUSH	: 9.1 AMPERES	PEAK INRUSH	: 9.83 AMPERES
AVE. RUN CURRENT	: 2.08 AMPERES	AVE. RUN CURRENT	: 2.15 AMPERES
MAX. RUN CURRENT	: 2.32 AMPERES	MAX. RUN CURRENT	: 2.27 AMPERES
SEATING CURRENT	: 3.53 AMPERES	END CURRENT	: 2.27 AMPERES

TEST IDENTIFICATION: VALVE #8
STORAGE LOCATION : 01-17

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 27.25 SECONDS	AVE RUN THRUST	: 695 #
		MAX RUN THRUST	: 2363 #
BYPASS TIME	: 0.53 SECONDS	THRUST AT CST	: 13205 #
		SEAT THRUST AT CST	: 12788 #
		INERTIAL THRUST	: 11 %
TORQUE SW. SETTING: 2.0/1.8		TOTAL THRUST	: 14734 #

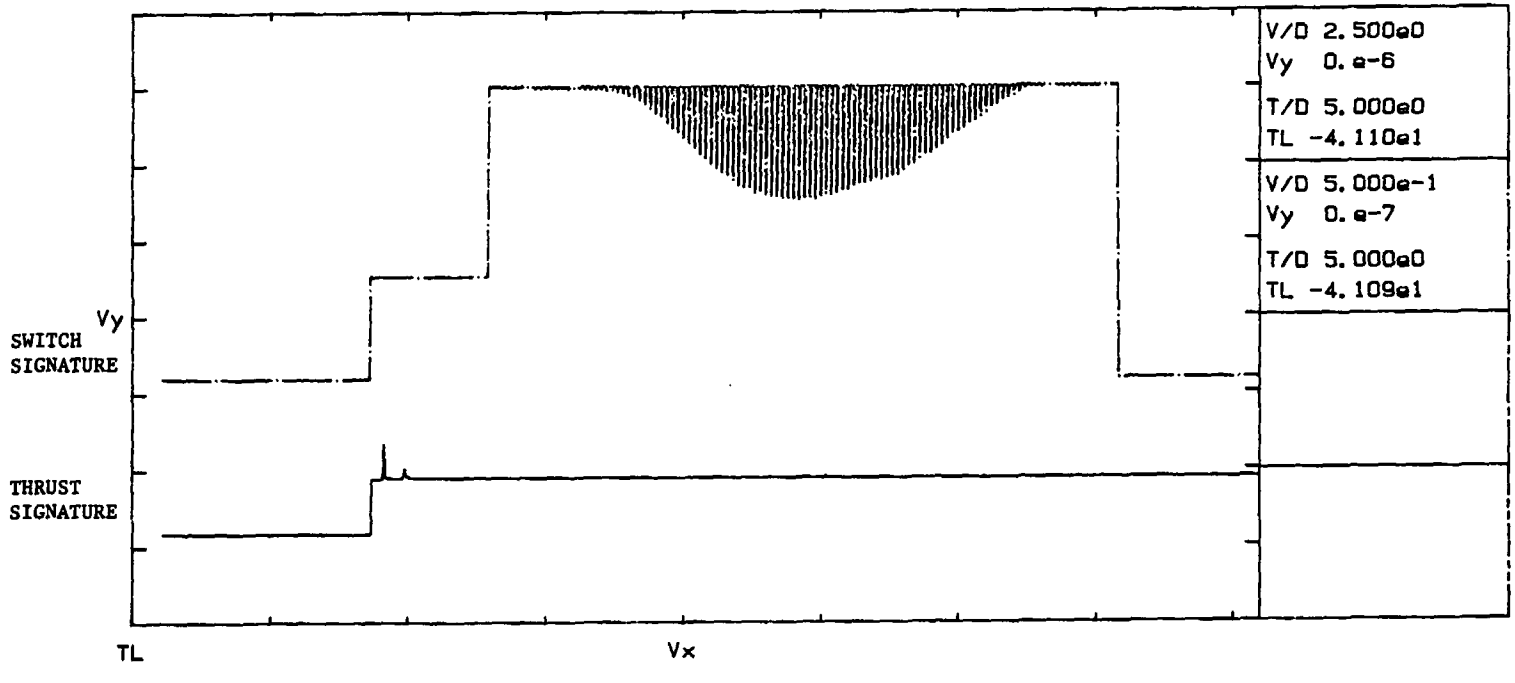


TEST IDENTIFICATION: VALVE #8
STORAGE LOCATION : 01-18

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 27.13 SECONDS	AVE RUN THRUST	: 173 #
		MAX RUN THRUST	: 0 #
BYPASS TIME	: 4.27 SECONDS	UNSEATING THRUST	: 2467 #
UNSEATING TIME	: 1.43 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 2.84 SECONDS	TORQUE SW. SETTING	: 2.0/1.8



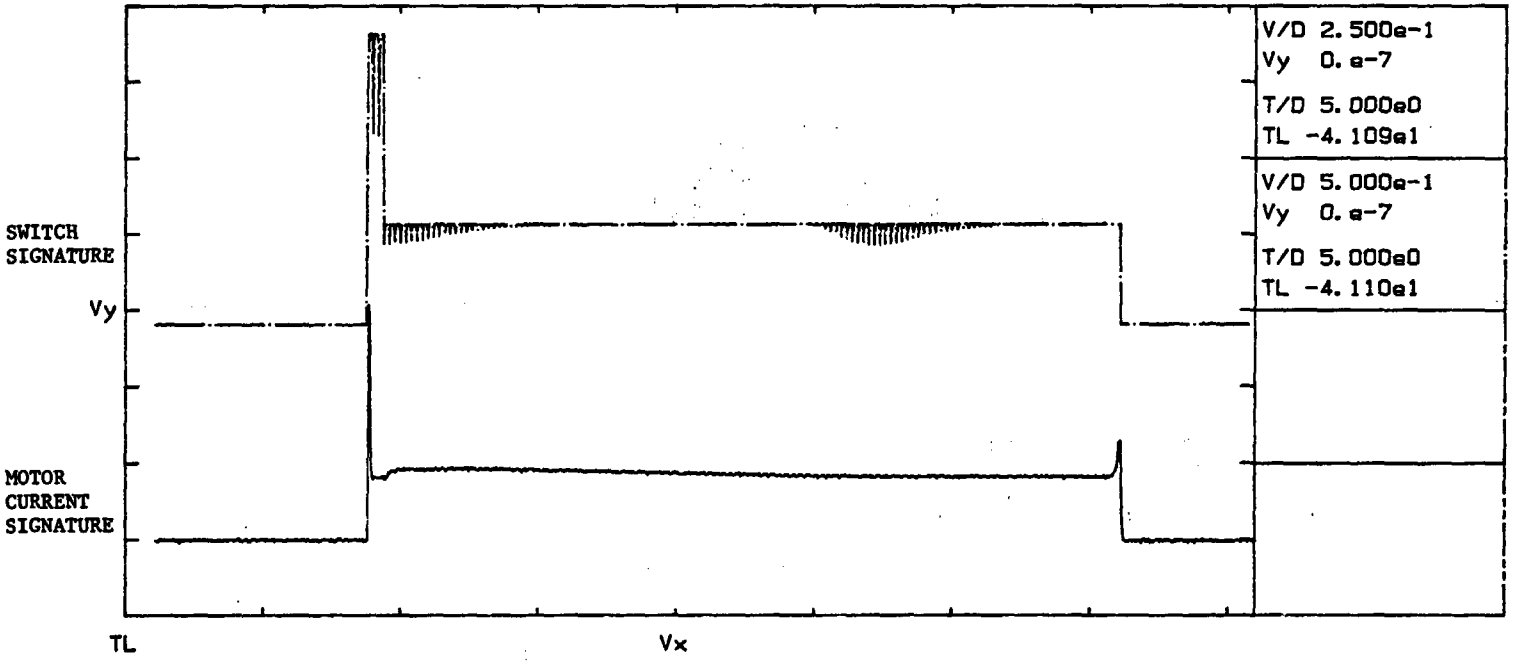
TEST IDENTIFICATION: VALVE #8
STORAGE LOCATION : 01-19

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 27.26 SECONDS

PEAK INRUSH : 9.1 AMPERES
AVE. RUN CURRENT : 2.08 AMPERES
MAX. RUN CURRENT : 2.32 AMPERES
SEATING CURRENT : 3.53 AMPERES



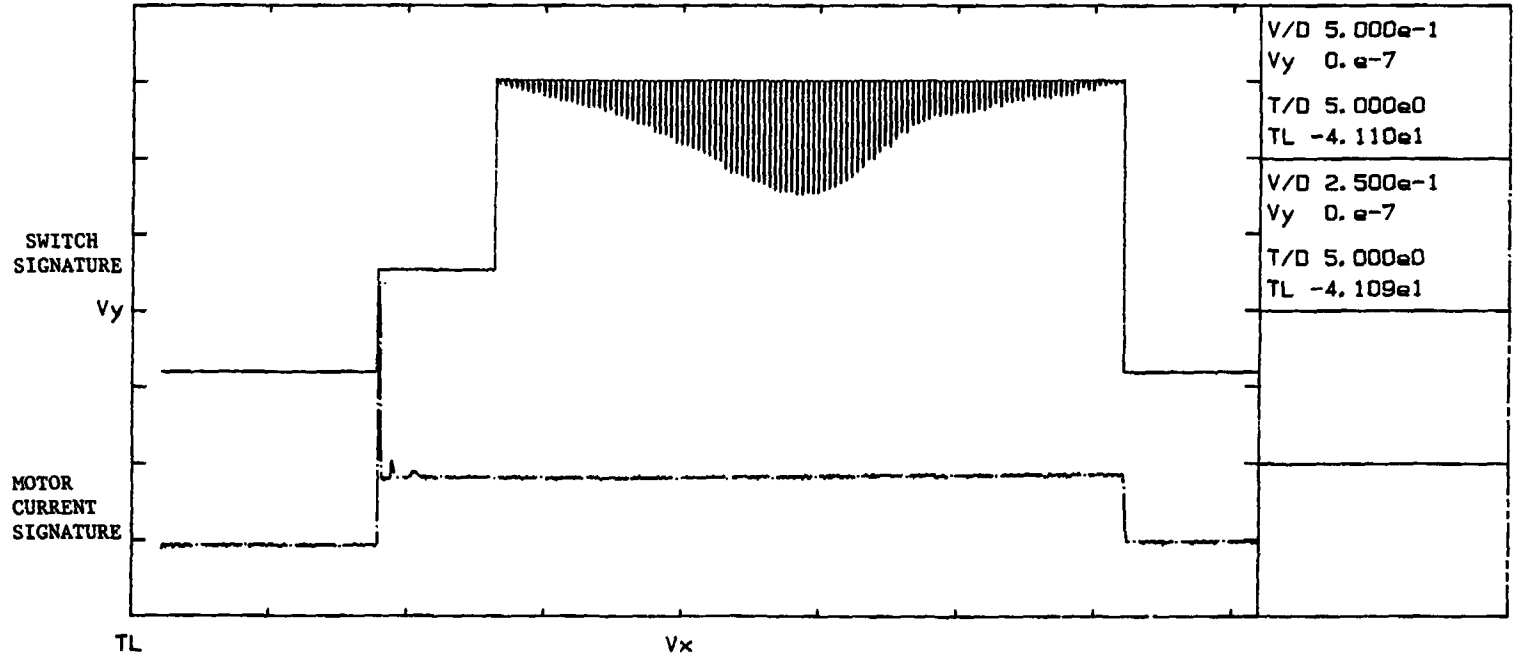
TEST IDENTIFICATION: VALVE #8
STORAGE LOCATION : 01-20

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 27.13 SECONDS

PEAK INRUSH : 9.83 AMPERES
AVE. RUN CURRENT : 2.15 AMPERES
MAX. RUN CURRENT : 2.27 AMPERES
END CURRENT : 2.27 AMPERES

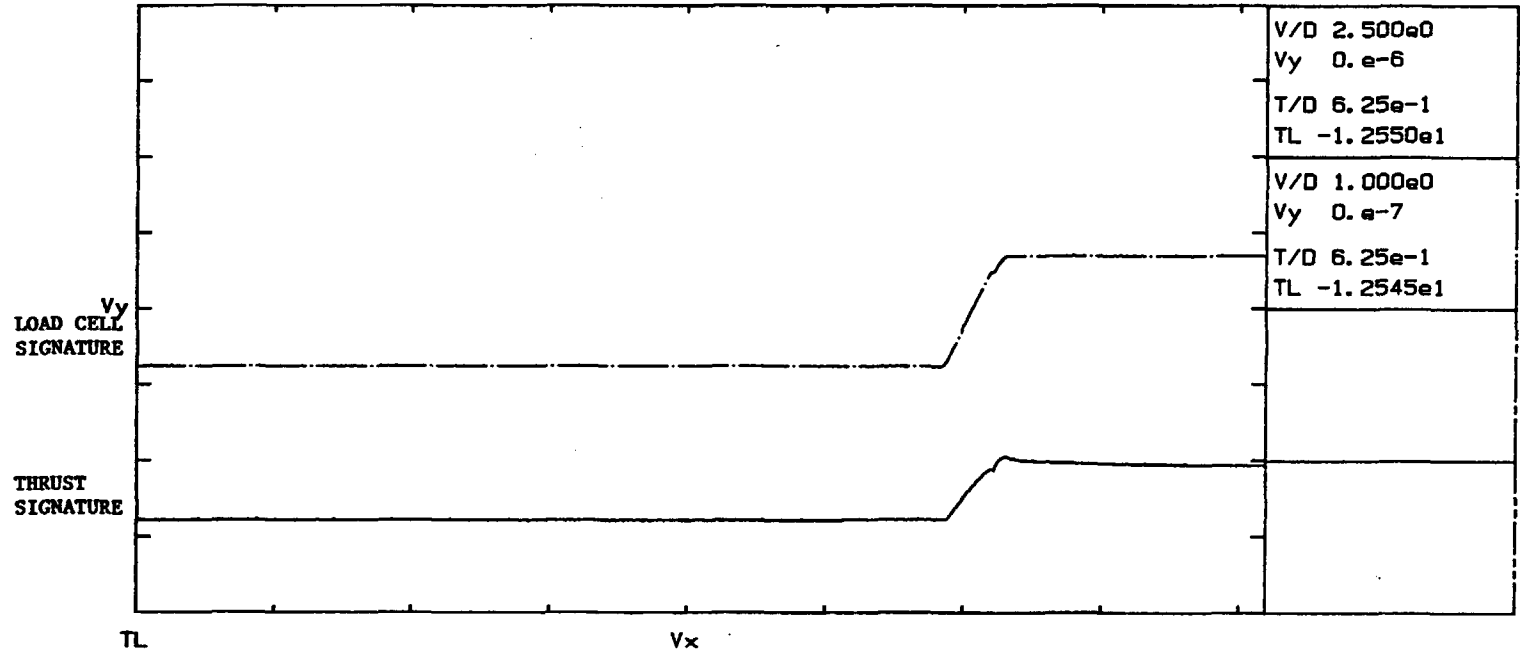


TEST IDENTIFICATION: VALVE #8
STORAGE LOCATION : 01-16

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: < RUNNING LOAD
K-FACTOR: 6950 #/V



Test I.D. Valve #9

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
1,3	This valve, when tested at the as found setting, developed a total thrust in the open direction of 14,560 pounds exceeding the maximum designed thrust of this operator which is 14,000 pounds. At the final torque switch setting, the valve is delivering approximately 13,000 pounds of total thrust in both directions. (See Recommendation #1).
4	During equipment installation, it was noted that the spring cartridge cap cavity was full of grease. (See Recommendation #2).
4	The initial torque switch settings were changed from 2.5 to 2.25 in the open direction and 2.25 to 2.5 in the closed direction to attain the desired target thrust values.
4	This operator exhibits a slight spring pack relaxation after the valve has fully seated. (See Recommendation #3).

Recommendations

1. This data should be considered if it becomes necessary to change torque switch settings in the future without the use of the MOVATS Series 2000 System. Consideration should be given to installing a blocking device on the torque switch at an open setting of 2.5.

2. It should be noted that the Belleville springs do not require lubrication to function properly.

Test I.D. Valve #9

3. This relaxation is caused by a spring pack force being exerted on the worm. Since spring pack compression forces the torque switch contacts to reclose. A review of the control circuit should be conducted to determine whether reclosure of the torque switch contacts would allow the motor to re-energize, causing a hammering effect within the operator.

TEST ID: VALVE #9

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 00
TEMP	: AMBIENT	SERIAL NO.	: 139893
PRESS	: ATMOSPHERIC	ORDER NO.	: 355695B
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: FWV-92B
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 6"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.25/2.25	VOLTS	: 480 AC
CLOSE T.S. SETTING	: 2.5/2.5	RATED AMPS	: 3.8
LIMITER PLATE	: N/A	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER	: .8

TEST EQUIPMENT

LOAD CELL # : 50K--N/A

AMP PROBE # : FLUKE(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #9 BY: RLB JR DATE: 6/14/85

THRUST SIGNATURE ANALYSIS

TS-OC-2-2		TS-CO-2-2	
STROKE TIME	: 28.46 SECONDS	STROKE TIME	: 28.12 SECONDS
BYPASS TIME	: 0.56 SECONDS	BYPASS TIME	: 5.32 SECONDS
THRUST AT CST	: 12233 #	PROTECTION MARGIN	: 1.86 SECONDS
SEAT THRUST AT CST	: 12206 #	UNSEATING TIME	: 3.46 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 2 %	UNSEATING THRUST	: 6330 #
TOTAL THRUST	: 12501 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.5/2.5	TORQUE SW. SETTING	: 2.25/2.25

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-2-1 K-FACTOR: 5366 #/V PRELOAD: 1260 #

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-2-3		CS-CO-2-3	
STROKE TIME	: 28.1 SECONDS	STROKE TIME	: 28.28 SECONDS
PEAK INRUSH	: 10.96 AMPERES	PEAK INRUSH	: 9.56 AMPERES
AVE. RUN CURRENT	: 2.14 AMPERES	AVE. RUN CURRENT	: 2.2 AMPERES
MAX. RUN CURRENT	: 2.48 AMPERES	MAX. RUN CURRENT	: 4.4 AMPERES
SEATING CURRENT	: 2.42 AMPERES	END CURRENT	: 5.1 AMPERES

TEST IDENTIFICATION: VALVE #9
STORAGE LOCATION : 2-2

PLOT NO. 1

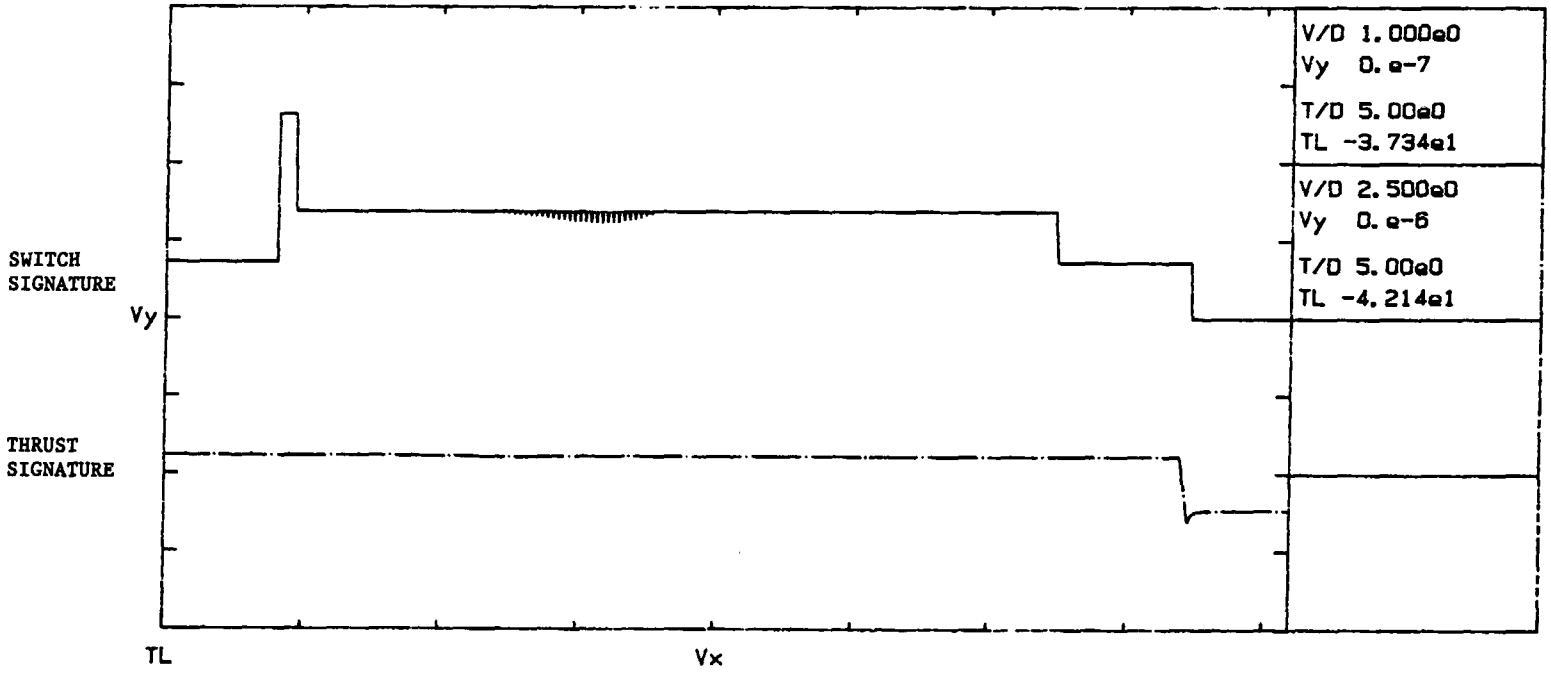
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 28.46 SECONDS

BYPASS TIME : 0.56 SECONDS

TORQUE SW. SETTING:2.5/2.5

AVE RUN THRUST :<PRELOAD
MAX RUN THRUST :<PRELOAD
THRUST AT CST : 12233 #
SEAT THRUST AT CST: 12206 #
INERTIAL THRUST : 2 %
TOTAL THRUST : 12501 #

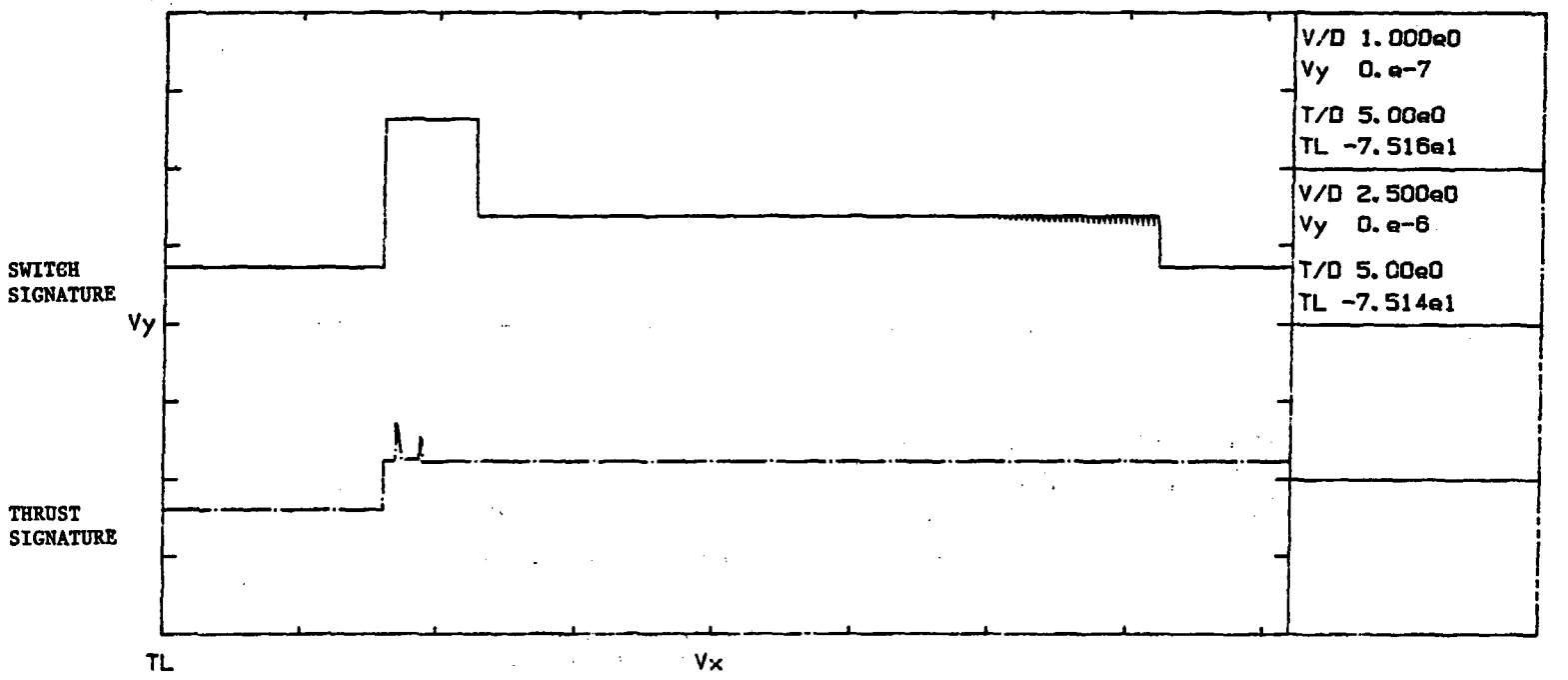


TEST IDENTIFICATION: VALVE #9
STORAGE LOCATION : 2-2

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 28.12 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 5.32 SECONDS	UNSEATING THRUST	: 6330 #
UNSEATING TIME	: 3.46 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 1.86 SECONDS	TORQUE SW. SETTING	: 2.25/2.5



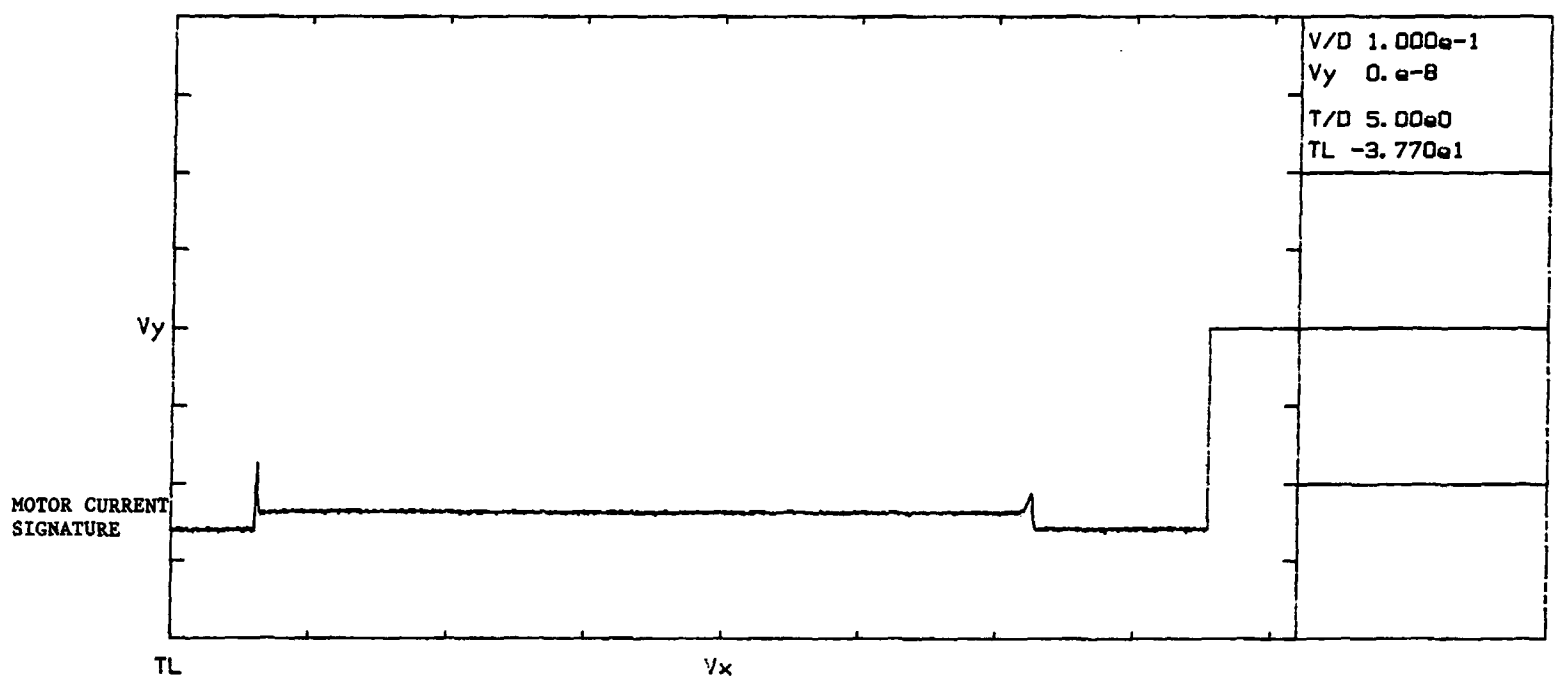
TEST IDENTIFICATION: VALVE #9
STORAGE LOCATION : 2-3

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 28.1 SECONDS

PEAK INRUSH : 10.96 AMPERES
AVE. RUN CURRENT : 2.14 AMPERES
MAX. RUN CURRENT : 2.48 AMPERES
SEATING CURRENT : 2.42 AMPERES



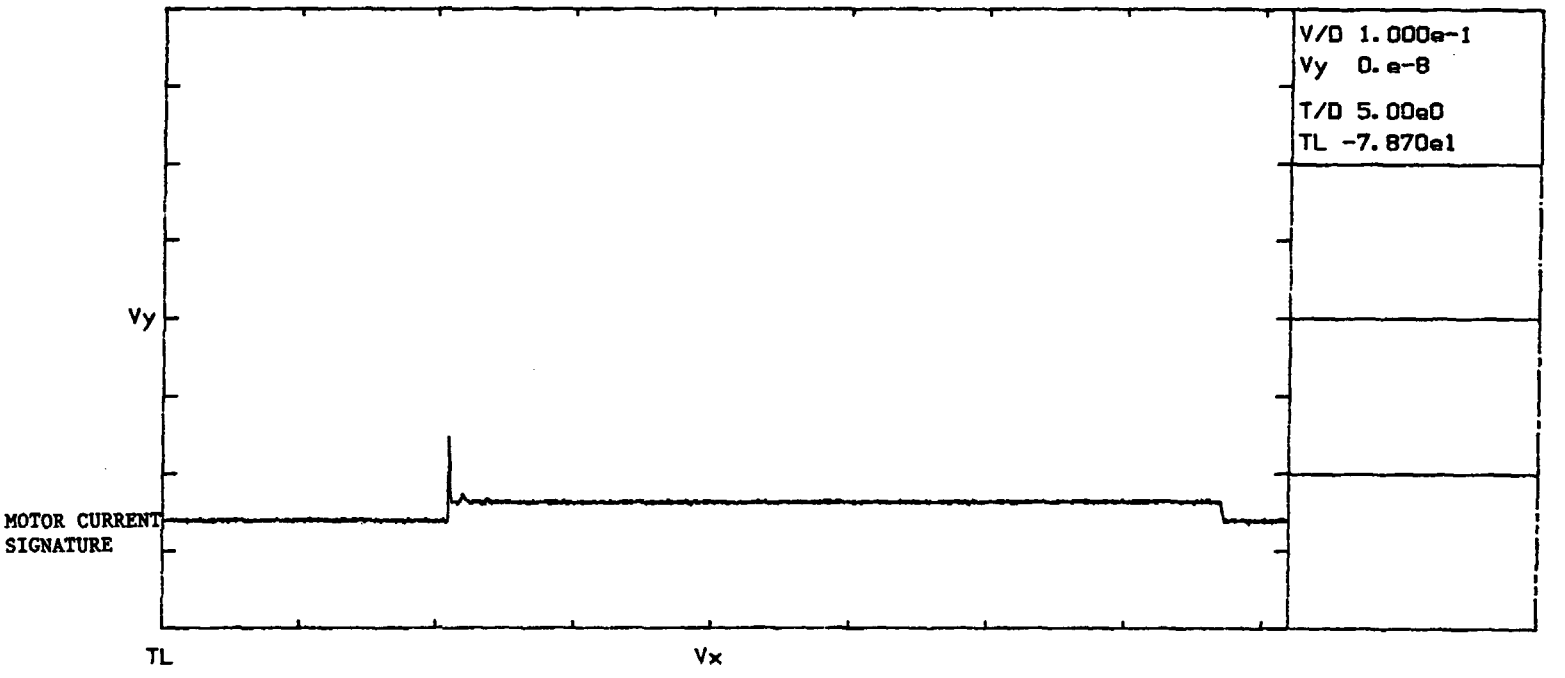
TEST IDENTIFICATION: VALVE #9
STORAGE LOCATION : 2-3

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 28.28 SECONDS

PEAK INRUSH : 9.56 AMPERES
AVE. RUN CURRENT : 2.2 AMPERES
MAX. RUN CURRENT : 4.4 AMPERES
END CURRENT : 5.1 AMPERES

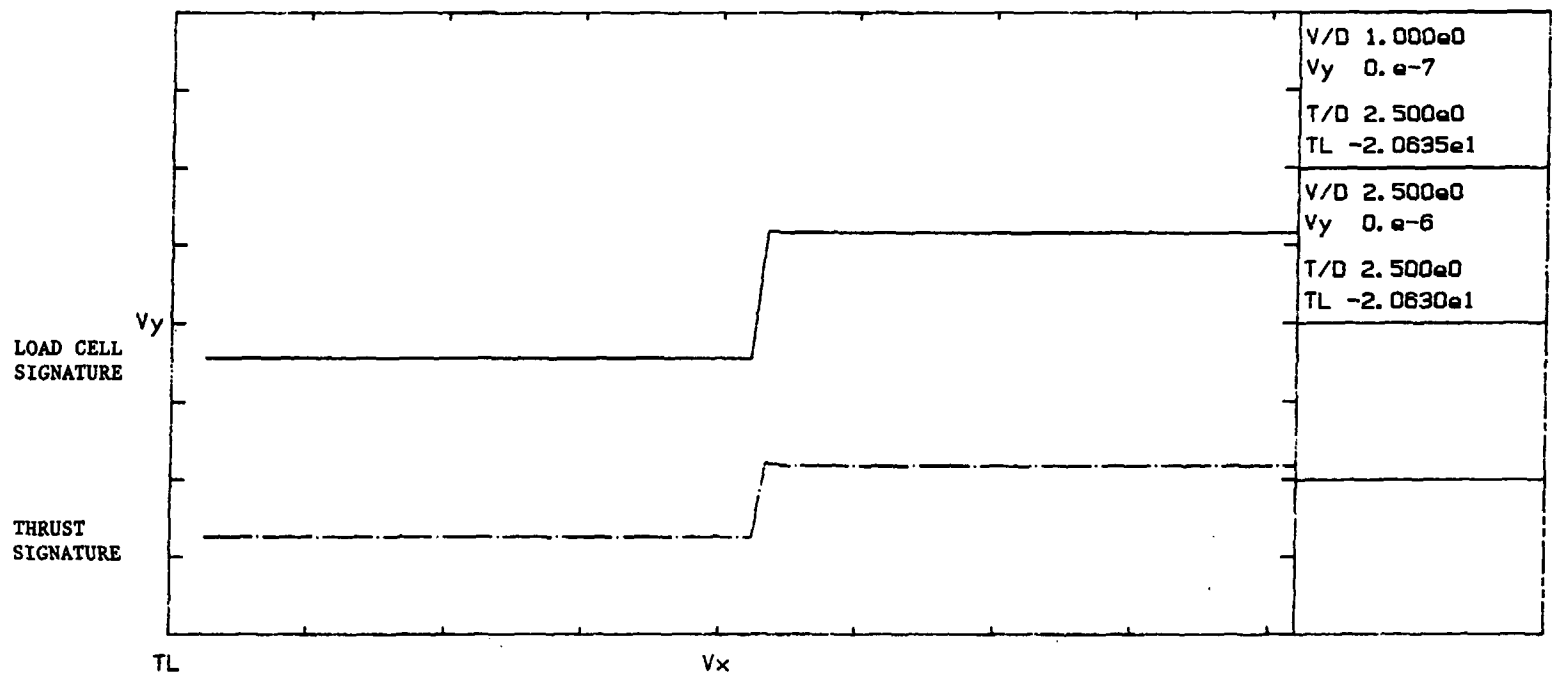


TEST IDENTIFICATION: VALVE #9
STORAGE LOCATION : 2-1

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 1260 #
K-FACTOR: 5366 #/V



Test I.D. Valve #10

Code	Comments
1,4	During equipment installation, it was noted that the torque switch was improperly installed. The torque switch was correctly reinstalled and the test was continued.
3,4	The torque switch was found to be out of balance by a factor of 2.0 to 1.0. This condition was corrected at the time of the test.
4	During equipment installation, it was noted that the spring cartridge cavity had oil in it. (See Recommendation #1).
4	During testing on this valve, the torque switch settings were changed from 2.5 to 3.5 in the open direction, and 3.0 to 3.5 in the closed direction. This was done to attain the target thrust values.

Recommendations

1. Consideration should be given to sampling the grease in this operator and performing a chemical analysis to determine if it has degraded to a point where the lubricating quality has been reduced.

TEST ID: VALVE #10

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SB
FLOW	: 0	SIZE	: 3
TEMP	: AMBIENT	SERIAL NO.	: 289880
PRESS	: ATMOSPHERIC	ORDER NO.	: 3DZ555A
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: FWV-5A
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 20
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.5/3.5	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 3.0/3.5	RATED AMPS	: 26
LIMITER PLATE	: 4.25	SPEED	: 3480
TS BALANCEABLE	: YES	HORSEPOWER	: N/A

TEST EQUIPMENT

LOAD CELL #	: 200K--N/A
AMP PROBE #	: FLUKE(200) N/A
MAINFRAME #	: N/A
TMD #	: N/A

TEST ID: VALVE #10 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-07		TS-CO-01-08	
STROKE TIME	: 28.08 SECONDS	STROKE TIME	: 26.5 SECONDS
BYPASS TIME	: 1.68 SECONDS	BYPASS TIME	: 3.49 SECONDS
THRUST AT CST	: 68962 #	PROTECTION MARGIN	: 2.14 SECONDS
SEAT THRUST AT CST	: 68962 #	UNSEATING TIME	: 1.35 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 8 %	UNSEATING THRUST	: 50275 #
TOTAL THRUST	: 75212 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 3.0/3.5	TORQUE SW. SETTING	: 2.5/3.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-01-06 K-FACTOR: 12500 #/V PRELOAD: 6400 #

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-01-09		CS-CO-01-10	
STROKE TIME	: 28.37 SECONDS	STROKE TIME	: 26.55 SECONDS
PEAK INRUSH	: 183 AMPERES	PEAK INRUSH	: 183 AMPERES
AVE. RUN CURRENT	: 15.3 AMPERES	AVE. RUN CURRENT	: 13.9 AMPERES
MAX. RUN CURRENT	: 15.3 AMPERES	MAX. RUN CURRENT	: 14.1 AMPERES
SEATING CURRENT	: 70.2 AMPERES	END CURRENT	: 14.2 AMPERES

TEST IDENTIFICATION: VALVE #10
STORAGE LOCATION : 01-07

PLOT NO. 1

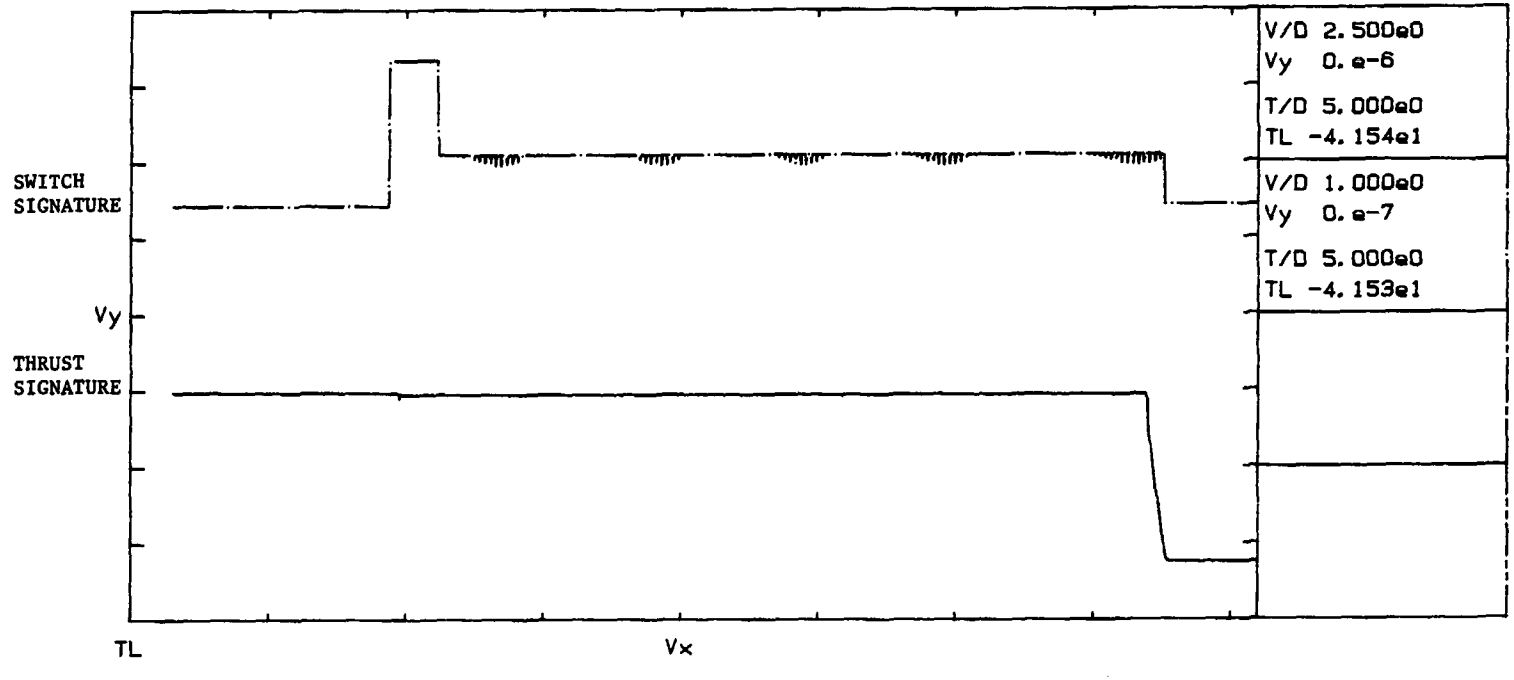
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 28.08 SECONDS

BYPASS TIME : 1.68 SECONDS

TORQUE SW. SETTING:3.0/3.5

AVE RUN THRUST :<PRELOAD
MAX RUN THRUST :<PRELOAD
THRUST AT CST : 68962 #
SEAT THRUST AT CST: 68962 #
INERTIAL THRUST : 8 %
TOTAL THRUST : 75212 #

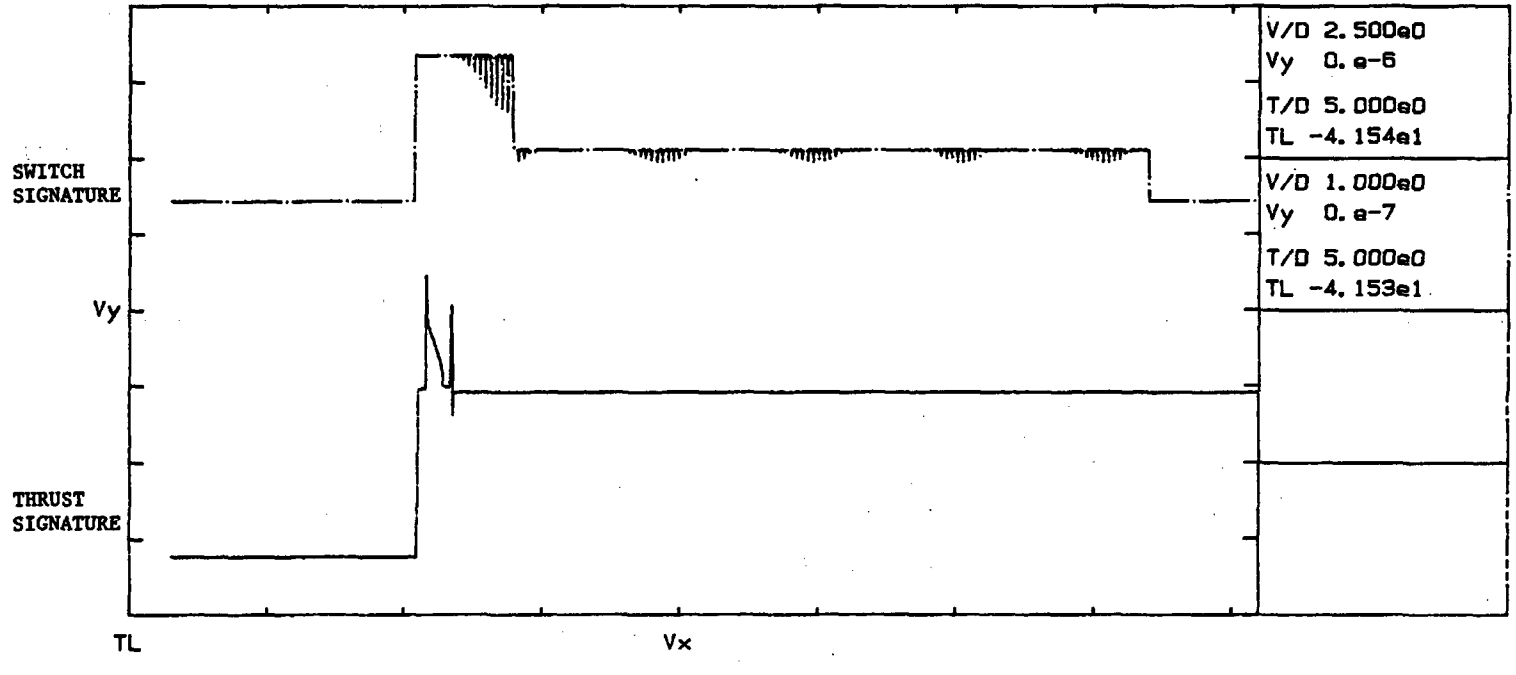


TEST IDENTIFICATION: VALVE #10
STORAGE LOCATION : 01-08

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 26.5 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 3.49 SECONDS	UNSEATING THRUST	: 50275 #
UNSEATING TIME	: 1.35 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 2.14 SECONDS	TORQUE SW. SETTING	: 2.5/3.5



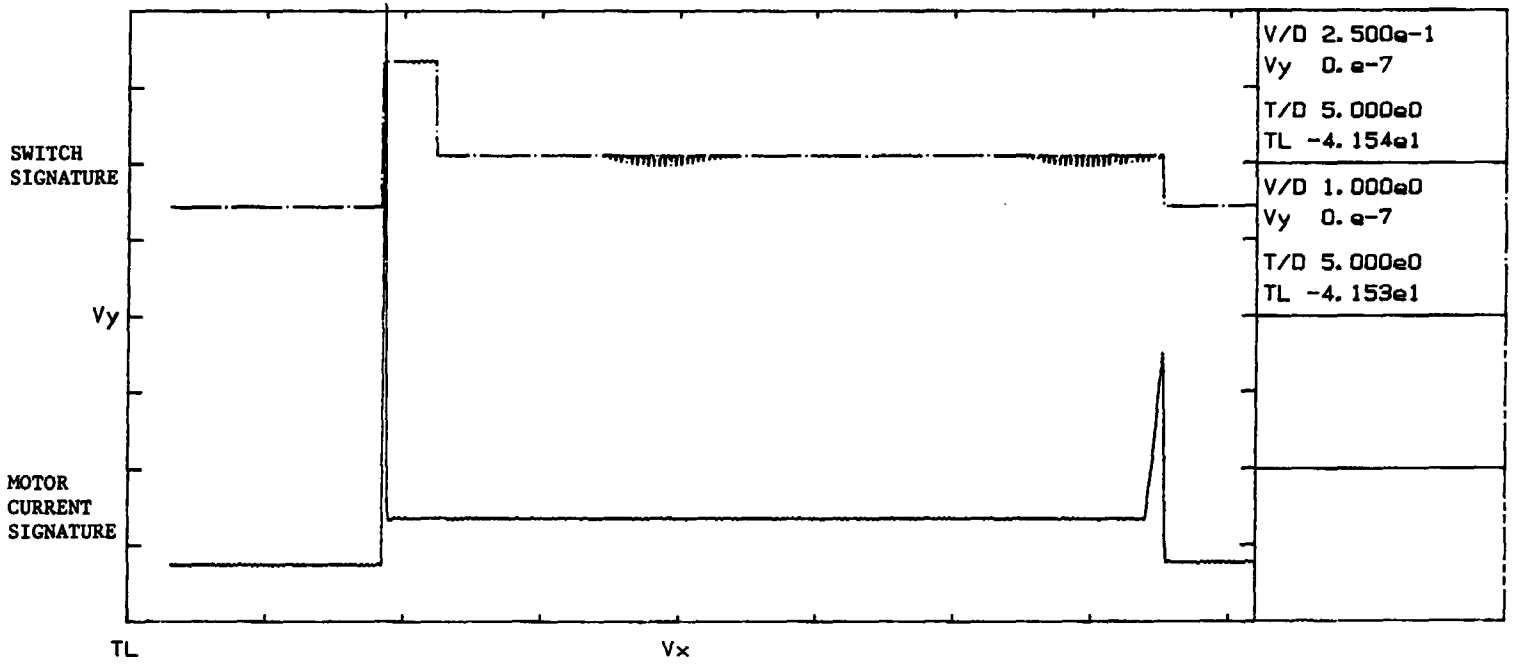
TEST IDENTIFICATION: VALVE #10
STORAGE LOCATION : 01-09

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 28.37 SECONDS

PEAK INRUSH : 18.3 AMPERES
AVE. RUN CURRENT : 1.53 AMPERES
MAX. RUN CURRENT : 1.53 AMPERES
SEATING CURRENT : 7.02 AMPERES



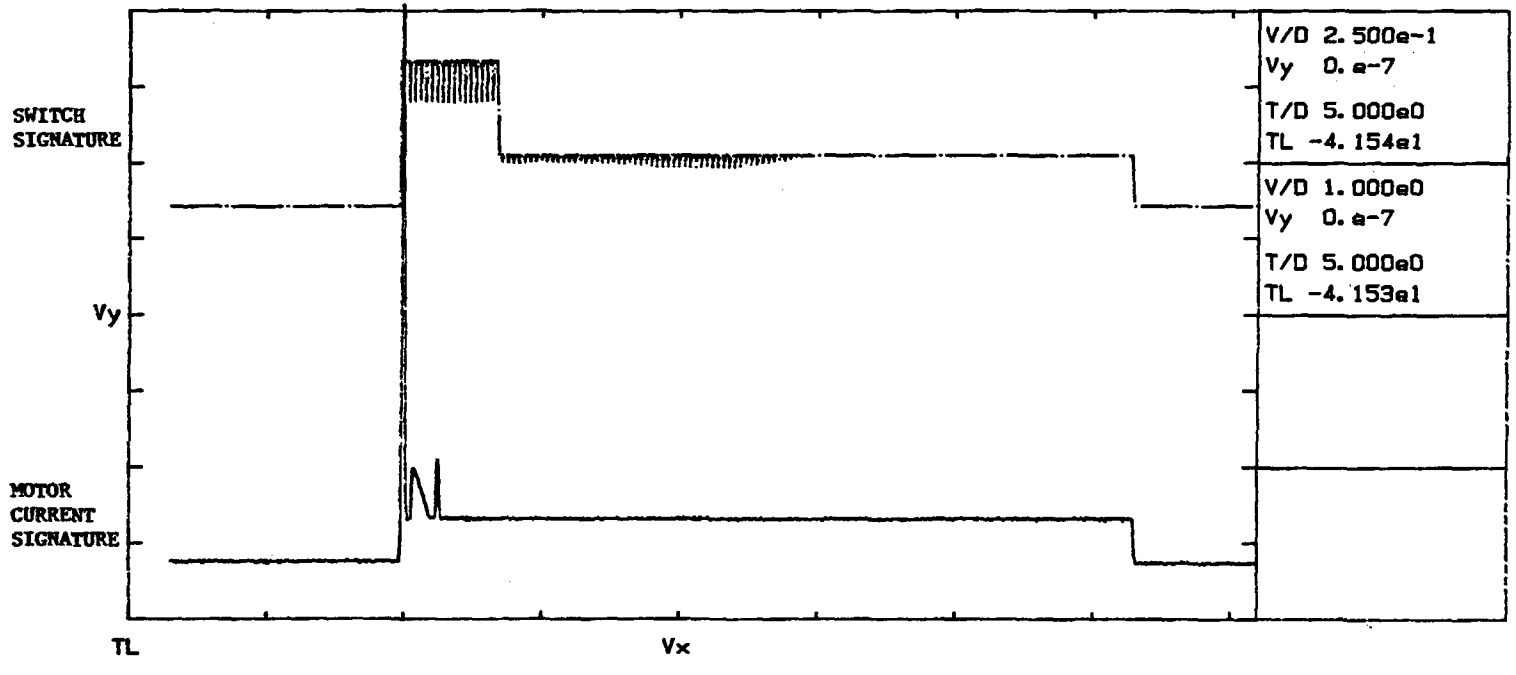
TEST IDENTIFICATION: VALVE #10
STORAGE LOCATION : 01-10

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 26.55 SECONDS

PEAK INRUSH : 18.3 AMPERES
AVE. RUN CURRENT : 1.39 AMPERES
MAX. RUN CURRENT : 1.41 AMPERES
END CURRENT : 1.42 AMPERES

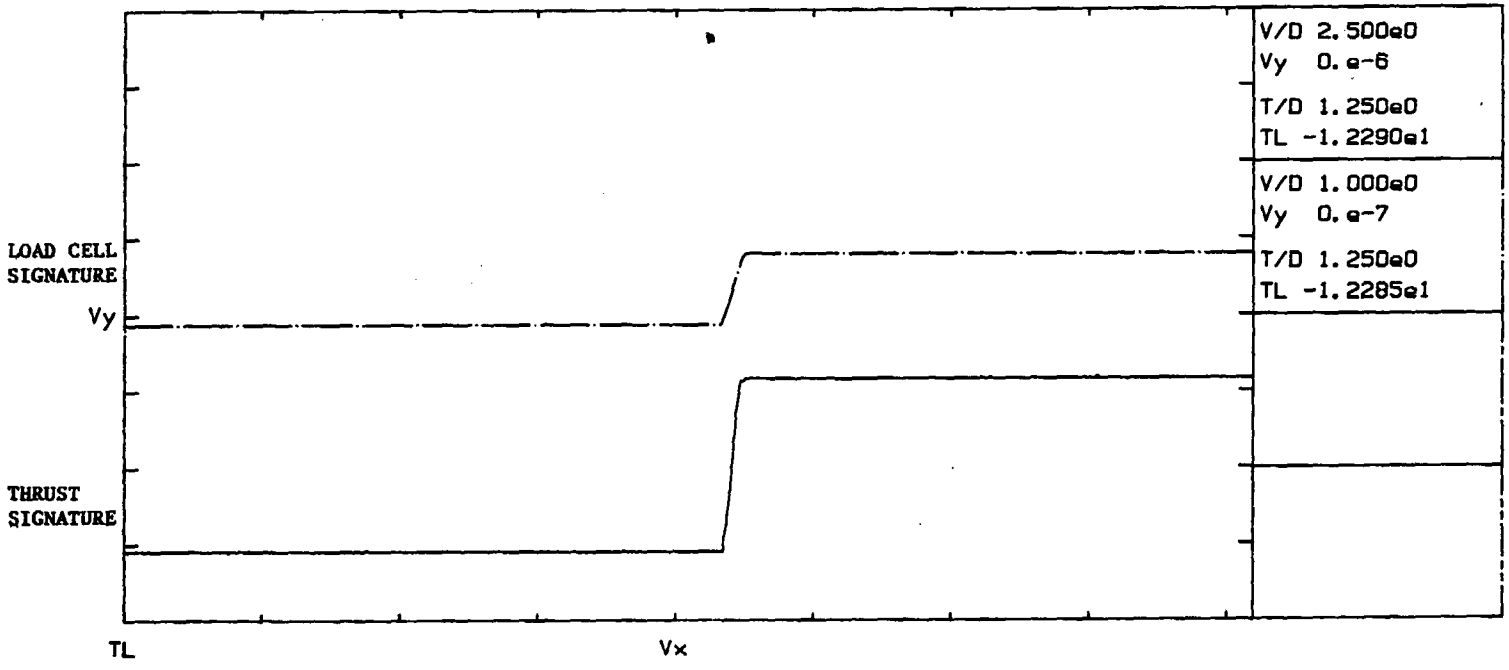


TEST IDENTIFICATION: VALVE #10
*STORAGE LOCATION : 01-06

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 6400 #
K-FACTOR: 12500 #/V



Test I.D. Valve #11

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
3,4	Initial testing showed the torque switch to be out of balance by a factor of 2.2 to 1.0. This condition was corrected at the time of testing.
4	During testing to achieve the correct thrust value the open torque switch setting was changed from 3.0 to 2.5.
4	During equipment installation it was noted that the spring cartridge cap was full of grease. (See Recommendation No. 1.)
4	On the analysis sheet it is obvious there is a difference in stroke times of approximately 1.4 seconds. This condition was found to be inherent in the SB operators due to the compensating spring pack.
4	In the last two seconds of the close-to-open stroke the running load and running current both drop slightly signaling a "freeing-up" of the stem/valve or compensating spring pack.

Recommendations

1. It should be noted that the Belleville springs do not require lubrication to function properly.

TEST ID: VALVE #11

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SB
FLOW	: 0	SIZE	: 3
TEMP	: AMBIENT	SERIAL NO.	: 289881
PRESS	: ATMOSPHERIC	ORDER NO.	: 302555A
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: FWV-5B
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 20
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 3.0/2.5	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 2.5/2.5	RATED AMPS	: 26
LIMITER PLATE	: 4.5	SPEED	: 3480
TS BALANCEABLE	: YES	HORSEPOWER	: N/A

TEST EQUIPMENT

LOAD CELL # : 200K--N/A

AMP PROBE # : FLUKE(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #11 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

	TS-OC-01-12		TS-CO-01-13
STROKE TIME	: 29.13 SECONDS	STROKE TIME	: 27.67 SECONDS
BYPASS TIME	: 1.6 SECONDS	BYPASS TIME	: 3.36 SECONDS
THRUST AT CST	: 72042 #	PROTECTION MARGIN	: 2.06 SECONDS
SEAT THRUST AT CST	: 72042 #	UNSEATING TIME	: 1.3 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 18 %	UNSEATING THRUST	: 39763 #
TOTAL THRUST	: 83980 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.5/2.5	TORQUE SW. SETTING	: 3.0/2.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-01-11 K-FACTOR: 19100 #/V PRELOAD: 11400

MOTOR CURRENT SIGNATURE ANALYSIS

	CS-OC-01-14		CS-CO-01-15
STROKE TIME	: 29.19 SECONDS	STROKE TIME	: 27.71 SECONDS
PEAK INRUSH	: 188.4 AMPERES	PEAK INRUSH	: 190.3 AMPERES
AVE. RUN CURRENT	: 14.7 AMPERES	AVE. RUN CURRENT	: 14.3 AMPERES
MAX. RUN CURRENT	: 14.7 AMPERES	MAX. RUN CURRENT	: 14.3 AMPERES
SEATING CURRENT	: 45.1 AMPERES	END CURRENT	: 13.8 AMPERES

TEST IDENTIFICATION: VALVE #11
STORAGE LOCATION : 01-12

PLOT NO. 1

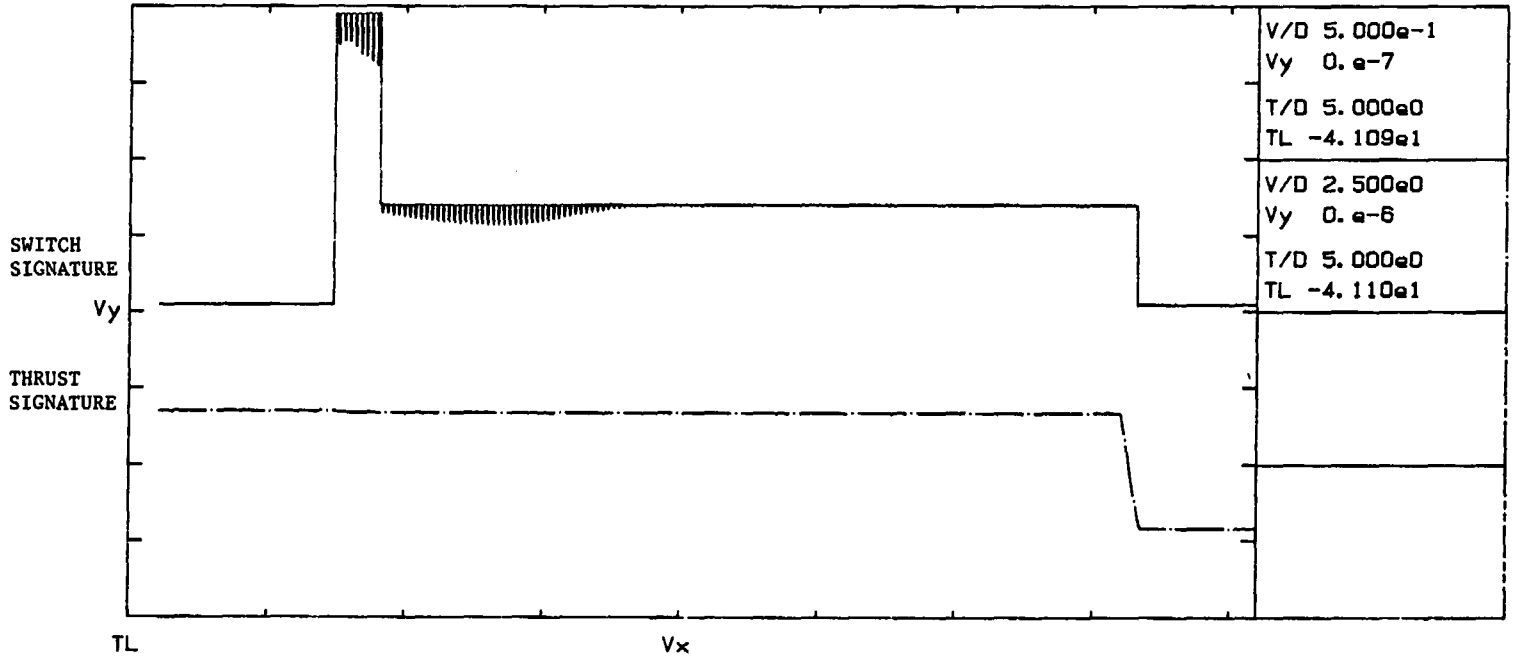
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 29.13 SECONDS

BYPASS TIME : 1.6 SECONDS

TORQUE SW. SETTING:2.5/2.5

AVE RUN THRUST :<PRELOAD
MAX RUN THRUST :<PRELOAD
THRUST AT CST : 72042 #
SEAT THRUST AT CST: 72042 #
INERTIAL THRUST : 18 %
TOTAL THRUST : 83980 #

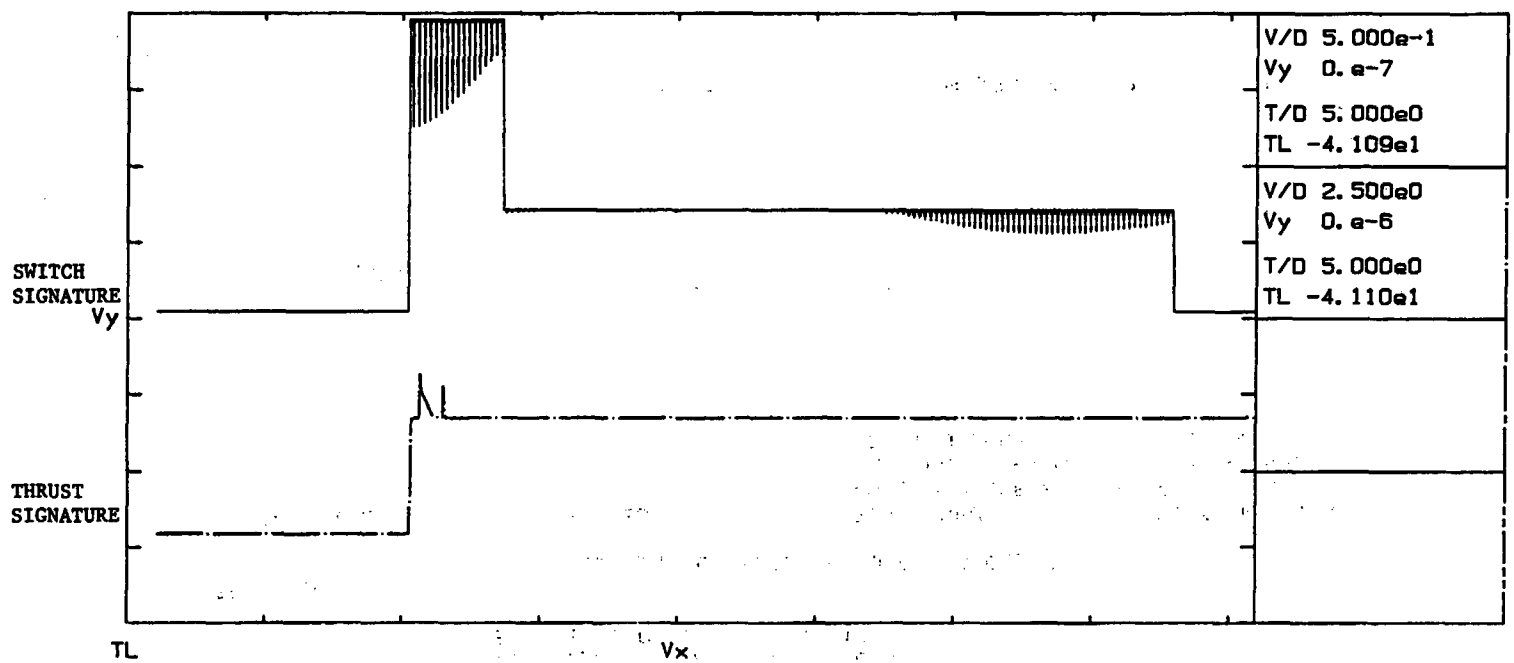


TEST IDENTIFICATION: VALVE #11
STORAGE LOCATION : 01-13

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 27.67 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 3.36 SECONDS	UNSEATING THRUST	: 39763 #
UNSEATING TIME	: 1.3 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 2.06 SECONDS	TORQUE SW. SETTING	: 3.0/2.5



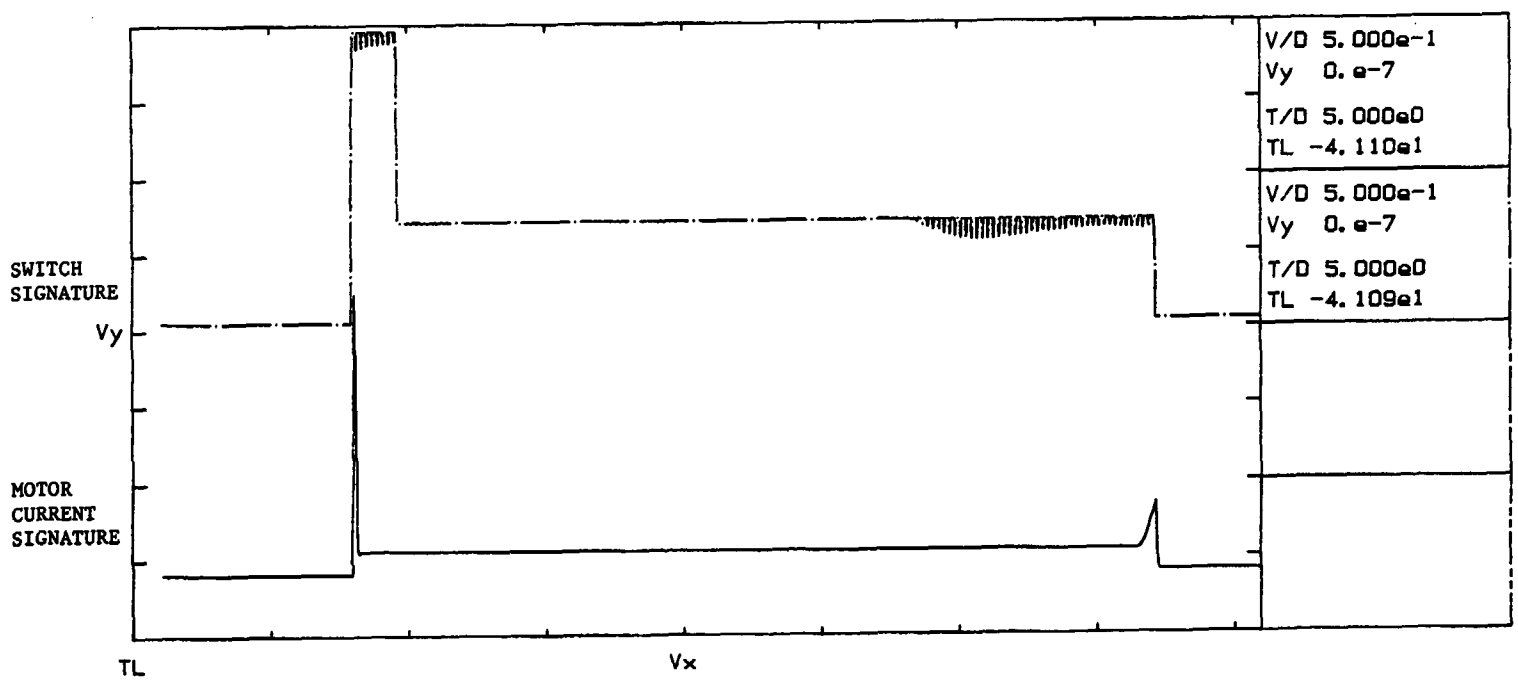
TEST IDENTIFICATION: VALVE #11
STORAGE LOCATION : 01-14

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 29.19 SECONDS

PEAK INRUSH : 188.4 AMPERES
AVE. RUN CURRENT : 14.7 AMPERES
MAX. RUN CURRENT : 14.7 AMPERES
SEATING CURRENT : 45.1 AMPERES



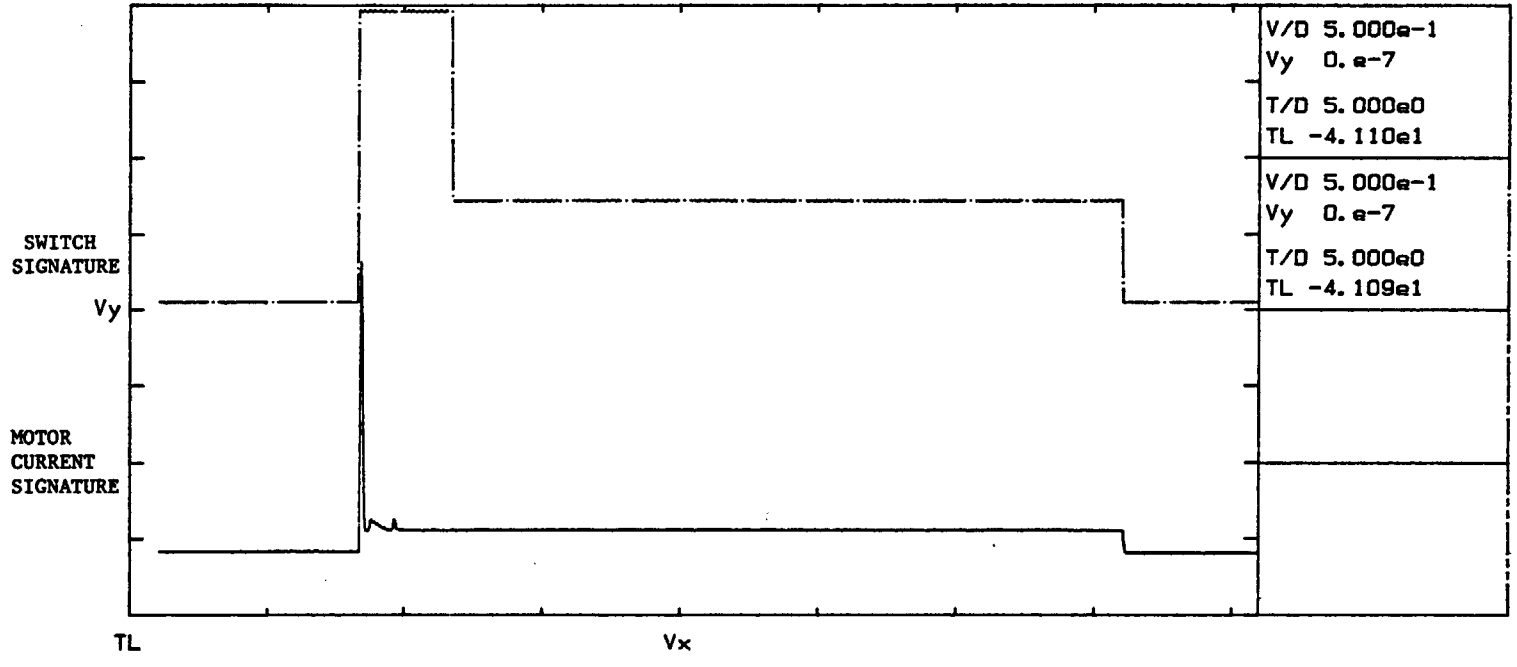
TEST IDENTIFICATION: VALVE #11
STORAGE LOCATION : 01-15

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 27.71 SECONDS

PEAK INRUSH	: 190.3	AMPERES
AVE. RUN CURRENT	: 14.3	AMPERES
MAX. RUN CURRENT	: 14.3	AMPERES
END CURRENT	: 13.8	AMPERES

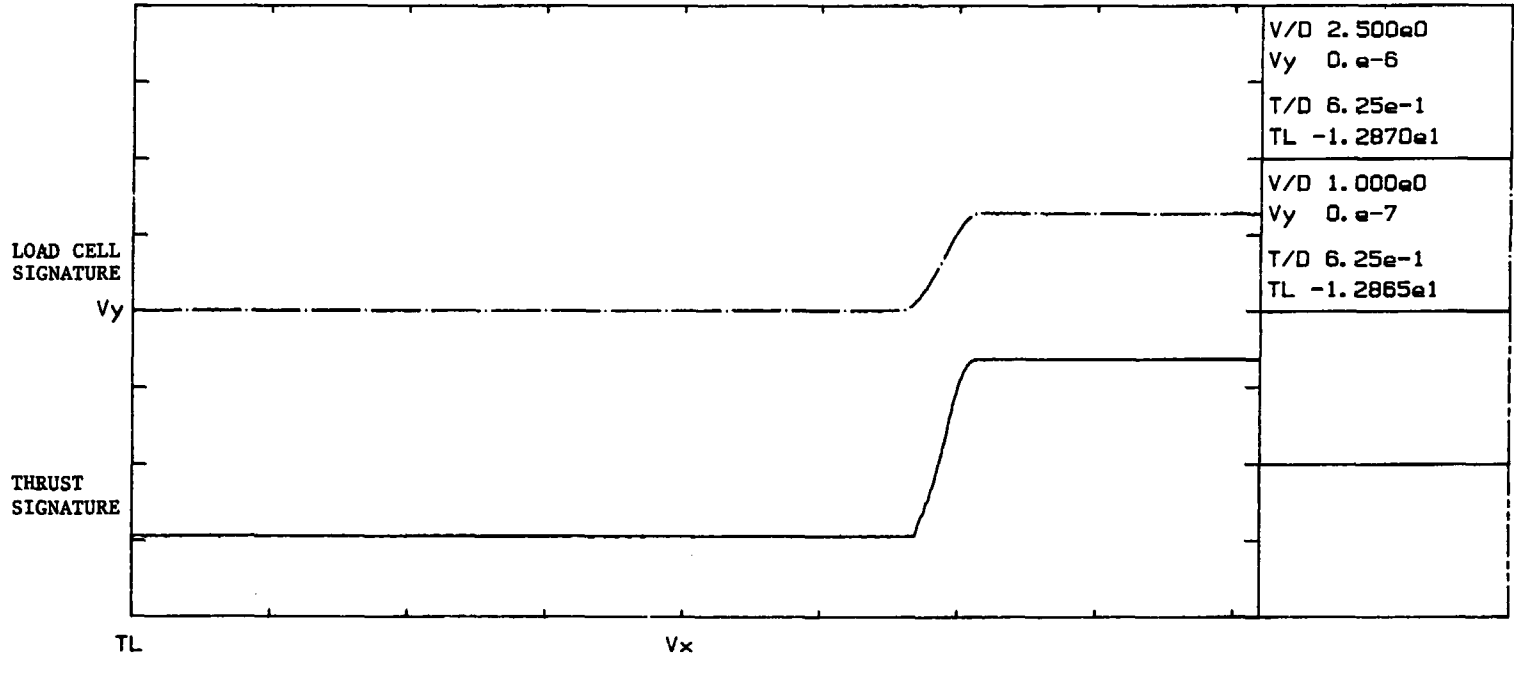


TEST IDENTIFICATION: VALVE #11
STORAGE LOCATION : 01-11

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 11400 #
K-FACTOR: 19100 #/V



Test I.D. Valve #12

Code	Comments
4	The operator exhibits a slight spring pack relaxation after the valve has been driven into the seat. (See Recommendation No. 1.)
4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
4	The torque switch was found to be out of balance by a factor of 1.7 to 1.0. This condition was corrected at the time of testing.
4	The torque switch settings were changed from 3.25 to >3.0 in the open direction and 3.0 to >3.0 in the closed direction to achieve the correct thrusts.

Recommendations

1. This relaxation is caused by a spring pack force extended on the worm. Since spring pack compression forces the torque switch contacts open, relaxation of the spring pack could allow the torque switch contact to reclose. A review of the control circuit should be conducted to determine whether reclosure of the torque switch would allow the motor to re-energize, causing a hammering effect within the operator.

TEST ID: VALVE #12

SYSTEM

SYSTEM : N/A
FLOW : 0
TEMP : AMBIENT
PRESS : ATMOSPHERIC
SFTY REL'D: N/A

OPERATOR

TYPE : SMB
SIZE : 3
SERIAL NO. : 103282
ORDER NO. : 337070A
ORIENTATION: VERTICAL

ELECTRICAL

CONTROL CIR VOLTS: 120
AC/DC : AC
OPEN CONTROL : LIMIT
CLOSE CONTROL : TORQUE
MCC : N/A
SW. SENSING CIR. : CURRENT

VALVE

ID. NO. : COV-1
TYPE : N/A
SIZE : 12
BODY ORIENTATION: HORIZONTAL
INITIAL POSITION: N/A
FINAL POSITION : N/A

TORQUE SWITCH

OPEN T.S. SETTING 3.25/>3.0
CLOSE T.S. SETTING: 3.0/>3.0
LIMITER PLATE : NONE
TS BALANCEABLE : YES

MOTOR

VOLTS : 460 AC
RATED AMPS: 11.4
SPEED : 1740
HORSEPOWER: 6.6

TEST EQUIPMENT

LOAD CELL # : 200K--N/A
AMP PROBE # : FLUKE200 N/A
MAINFRAME # : N/A
TMD # : N/A

TEST ID: VALVE #12 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-02-18		TS-CO-02-19	
STROKE TIME	: 130.2 SECONDS	STROKE TIME	: 129.35 SECONDS
BYPASS TIME	: 0.95 SECONDS	BYPASS TIME	: 17.05 SECONDS
THRUST AT CST	: 127982 #	PROTECTION MARGIN	: 13.65 SECONDS
SEAT THRUST AT CST	: 127982 #	UNSEATING TIME	: 3.4 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 3 %	UNSEATING THRUST	: 70264 #
TOTAL THRUST	: 131807 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 3.2/3.2	TORQUE SW. SETTING	: 3.2/3.2

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-02-17 K-FACTOR: 23180 #/V PRELOAD: 24600 #

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-02-20		CS-CO-03-01	
STROKE TIME	: 130.35 SECONDS	STROKE TIME	: 129.4 SECONDS
PEAK INRUSH	: 53.1 AMPERES	PEAK INRUSH	: 62.9 AMPERES
AVE. RUN CURRENT	: 10.3 AMPERES	AVE. RUN CURRENT	: 9.46 AMPERES
MAX. RUN CURRENT	: 10.3 AMPERES	MAX. RUN CURRENT	: 9.46 AMPERES
SEATING CURRENT	: 24.6 AMPERES	END CURRENT	: 9.46 AMPERES

TEST IDENTIFICATION: VALVE #12
STORAGE LOCATION : 02-18

PLOT NO. 1

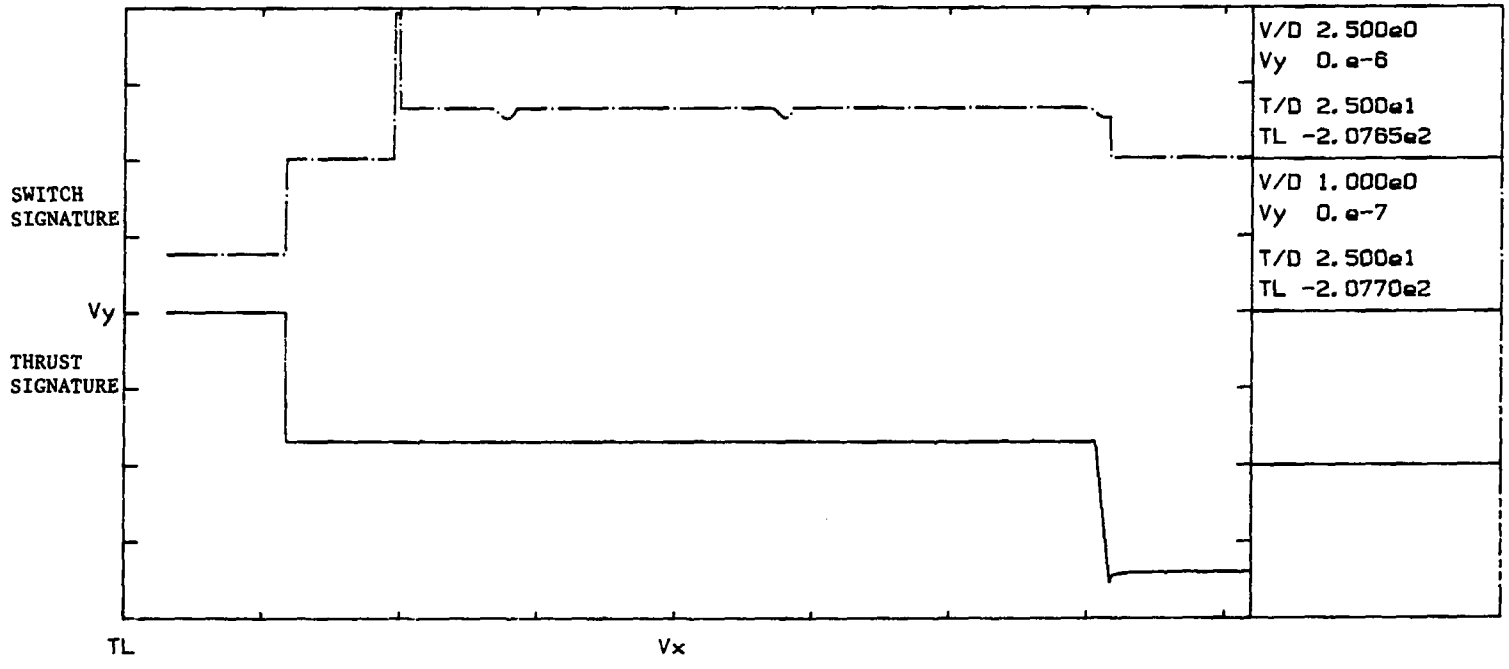
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 130.2 SECONDS

BYPASS TIME : 0.95 SECONDS

TORQUE SW. SETTING:3.2/3.2

AVE RUN THRUST :<PRELOAD
MAX RUN THRUST :<PRELOAD
THRUST AT CST : 127982 #
SEAT THRUST AT CST: 127982 #
INERTIAL THRUST : 3± %
TOTAL THRUST : 131807 #

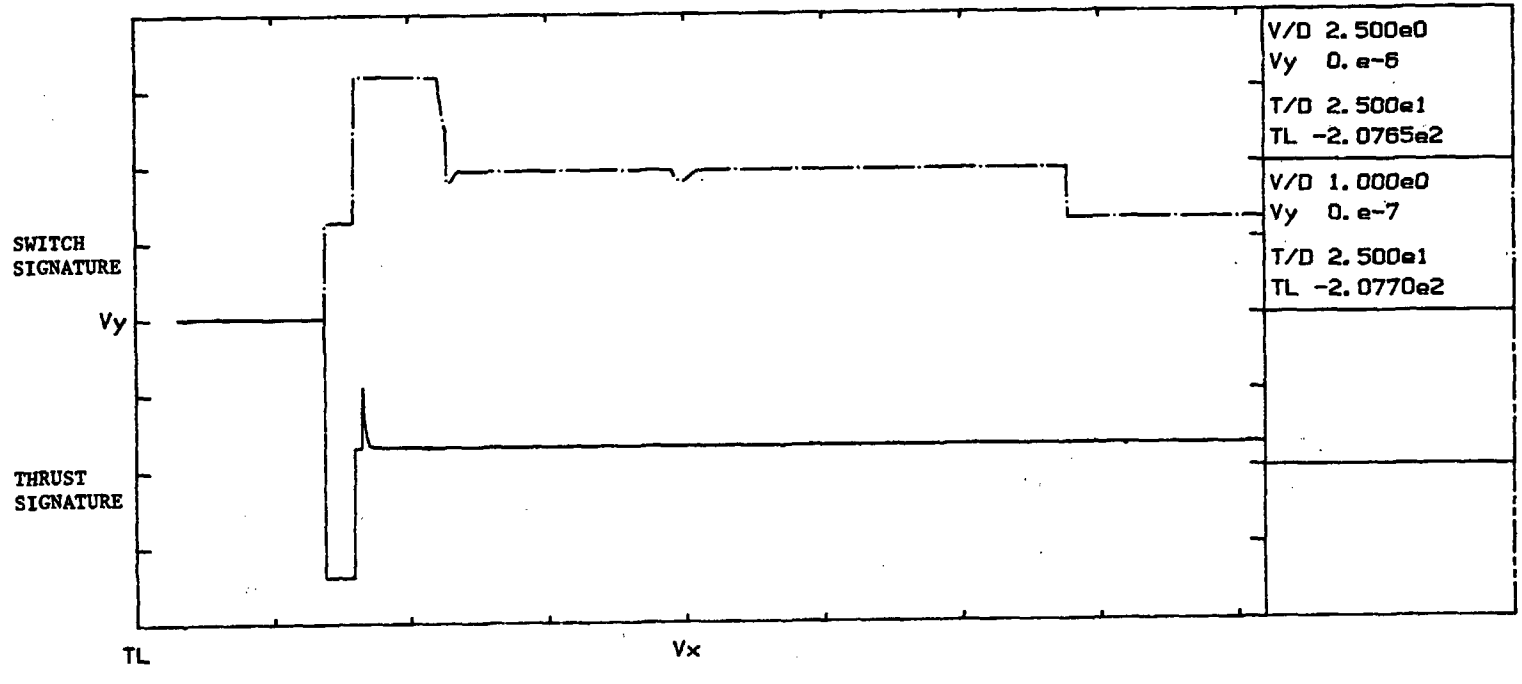


TEST IDENTIFICATION: VALVE #12
STORAGE LOCATION : 02-19

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 129.35 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 17.05 SECONDS	UNSEATING THRUST	: 70264 #
UNSEATING TIME	: 3.4 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 13.65 SECONDS	TORQUE SW. SETTING	: 3.2/3.2



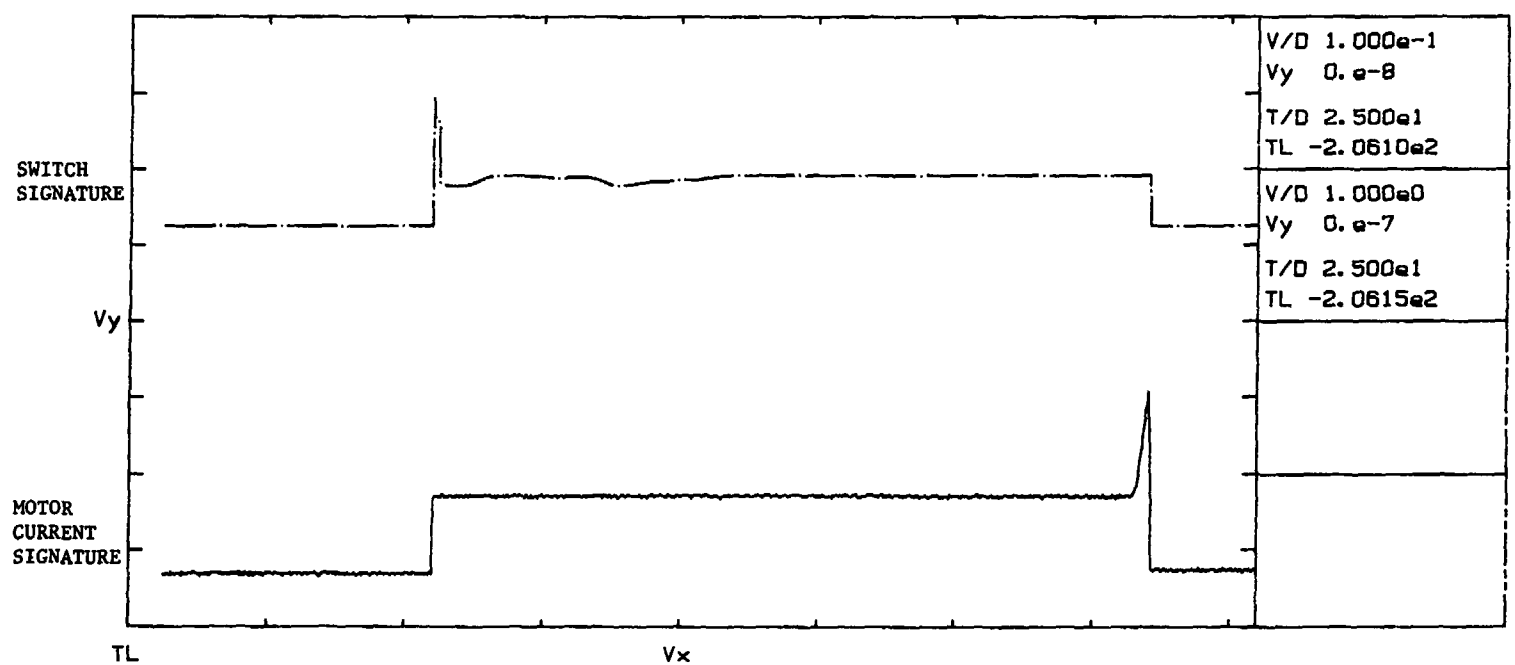
TEST IDENTIFICATION: VALVE #12
STORAGE LOCATION : 02-20

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 130.35 SECONDS

PEAK INRUSH	: 53.1	AMPERES
AVE. RUN CURRENT	: 10.3	AMPERES
MAX. RUN CURRENT	: 10.3	AMPERES
SEATING CURRENT	: 24.6	AMPERES



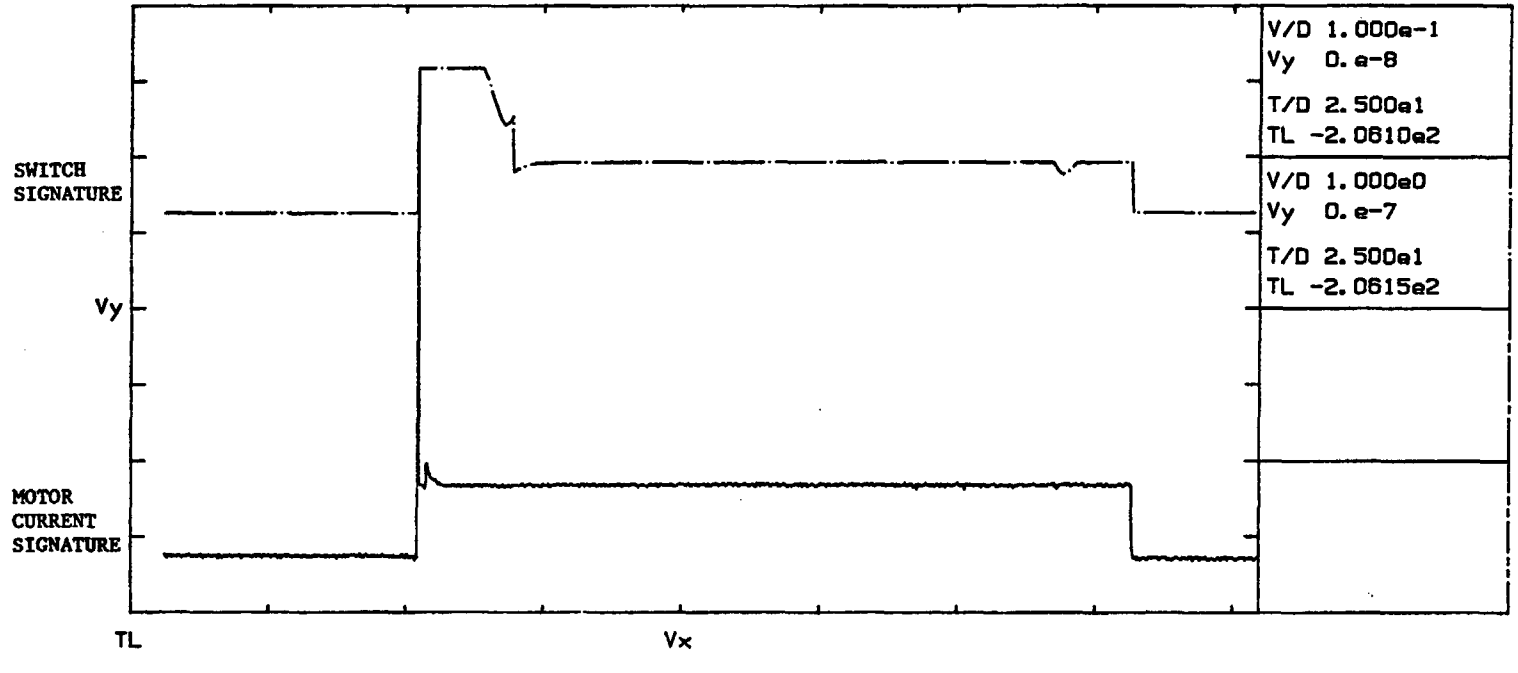
TEST IDENTIFICATION: VALVE #12
STORAGE LOCATION : 03-01

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 129.4 SECONDS

PEAK INRUSH	: 62.9	AMPERES
AVE. RUN CURRENT	: 9.46	AMPERES
MAX. RUN CURRENT	: 9.46	AMPERES
END CURRENT	: 9.46	AMPERES

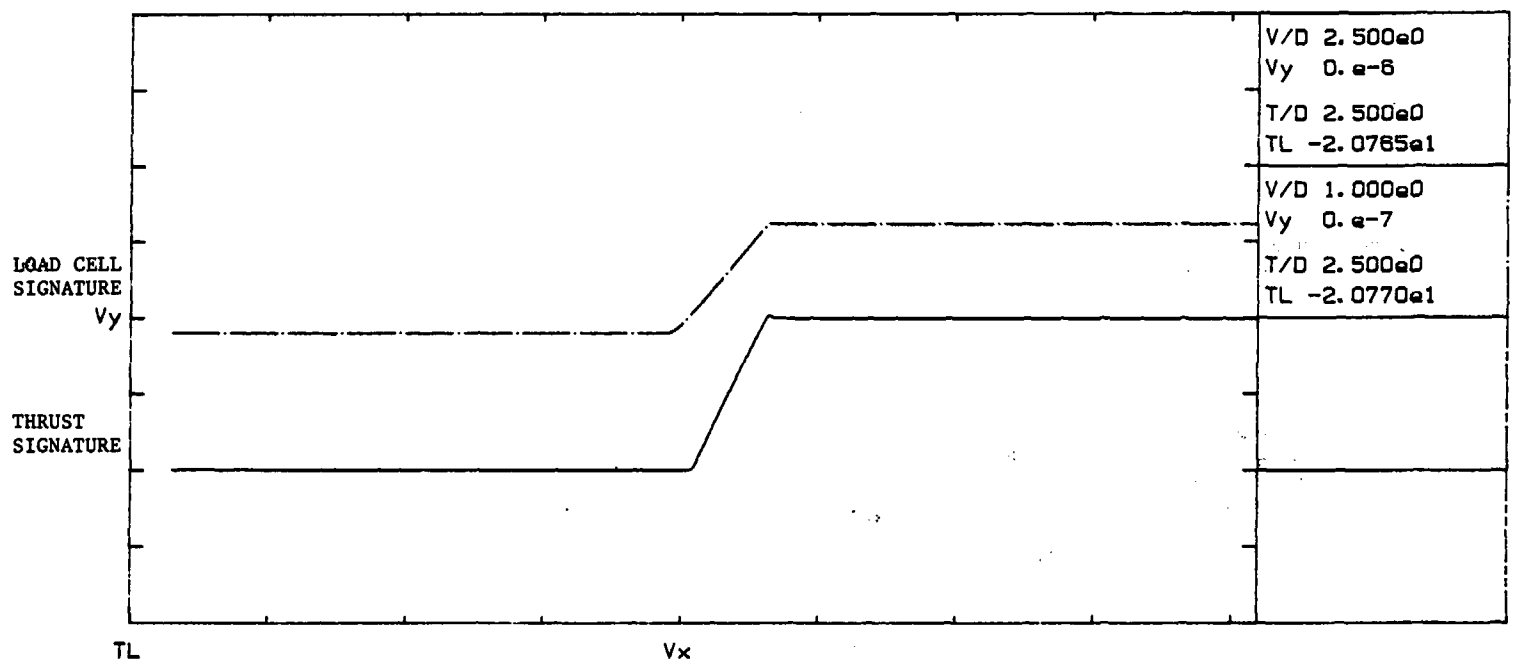


TEST IDENTIFICATION: VALVE #12
STORAGE LOCATION : 02-17

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 24600 #
K-FACTOR: 23180 #/V



Test I.D. Valve #13

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
4	The torque switch was found to be out of balance by a factor of 1.2 to 1.0. This condition was corrected at the time of testing.
4	During testing, the open torque switch setting was changed from 2.25 to >1.5 and the closed torque switch setting changed from >2.0 to >1.5 to obtain target thrust loads.

Recommendations

1. No corrective action necessary at this time.

TEST ID: VALVE #13

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 0
TEMP	: AMBIENT	SERIAL NO.	: 94927A
PRESS	: ATMOSPHERIC	ORDER NO.	: 336542K
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: MSV-10B
AC/DC	: N/A	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 6
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.25/1.5	VOLTS	: 240 DC
CLOSE T.S. SETTING	: 2.25/1.5	RATED AMPS	: 4.7
LIMITER PLATE	: 4.0	SPEED	: 1900
TS BALANCEABLE	: YES	HORSEPOWER	: 1.08

TEST EQUIPMENT

LOAD CELL # : 50K--N/A

AMP PROBE # : FLUKE(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #13 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-02-14		TS-CO-02-13	
STROKE TIME	: 26.51 SECONDS	STROKE TIME	: 26.03 SECONDS
BYPASS TIME	: 0.3 SECONDS	BYPASS TIME	: 3.66 SECONDS
THRUST AT CST	: 10281.#	PROTECTION MARGIN	: 2.15 SECONDS
SEAT THRUST AT CST	: 9872 #	UNSEATING TIME	: 1.51 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 11 %	UNSEATING THRUST	: 2653 #
TOTAL THRUST	: 11677 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.25/>1.5	TORQUE SW. SETTING	: 2.25/>1.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-02-12 K-FACTOR: 6811 #/V PRELOAD: 780 #

MOTOR CURRENT SIGNATURE ANALYSIS

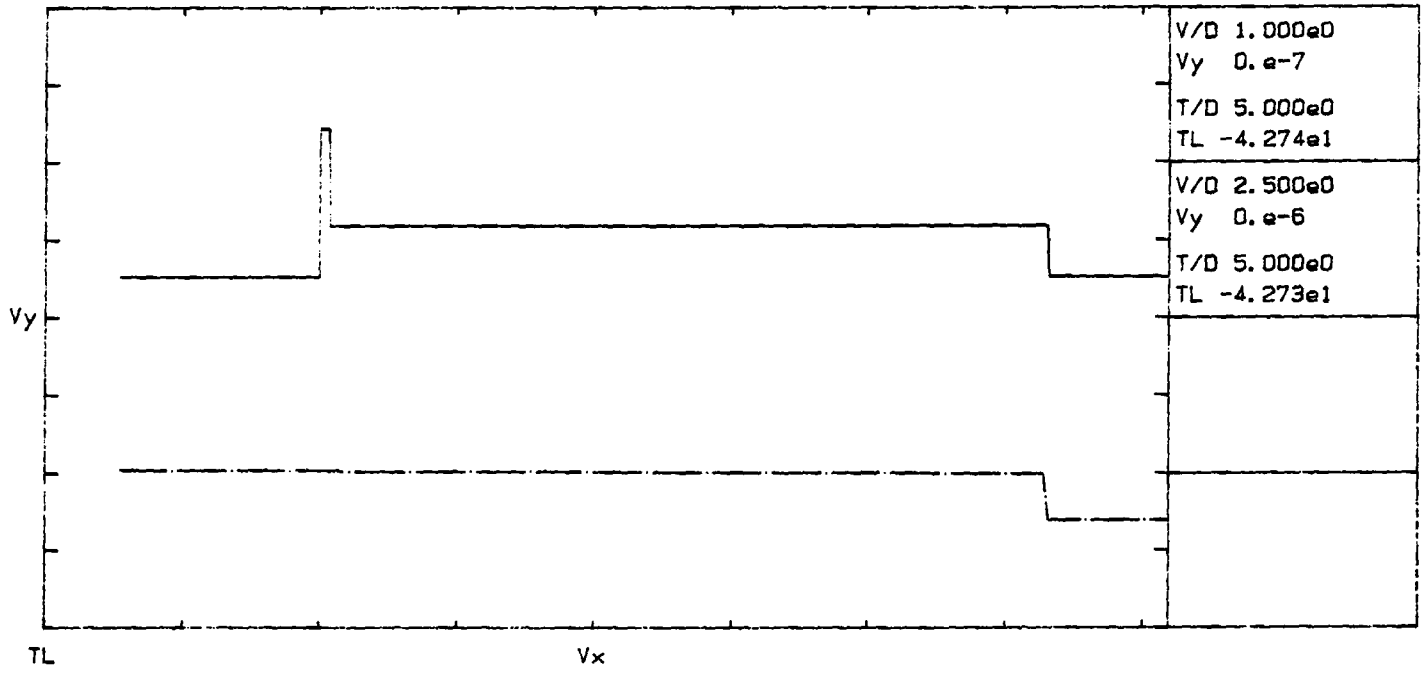
CS-OC-02-15		CS-CO-02-16	
STROKE TIME	: 26.56 SECONDS	STROKE TIME	: 25.48 SECONDS
PEAK INRUSH	: 14.7 AMPERES	PEAK INRUSH	: 21.6 AMPERES
AVE. RUN CURRENT	: 2.28 AMPERES	AVE. RUN CURRENT	: 2.37 AMPERES
MAX. RUN CURRENT	: 2.28 AMPERES	MAX. RUN CURRENT	: 2.37 AMPERES
SEATING CURRENT	: 11.4 AMPERES	END CURRENT	: 2.37 AMPERES

TEST IDENTIFICATION: VALVE #13
STORAGE LOCATION : 02-14

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 26.51 SECONDS	AVE RUN THRUST	:<PRELOAD
		MAX RUN THRUST	:<PRELOAD
BYPASS TIME	: 0.3 SECONDS	THRUST AT CST	: 10281 #
		SEAT THRUST AT CST	: 9872 #
		INERTIAL THRUST	: 11 %
TORQUE SW. SETTING:	2.25/>1.5	TOTAL THRUST	: 11677 #

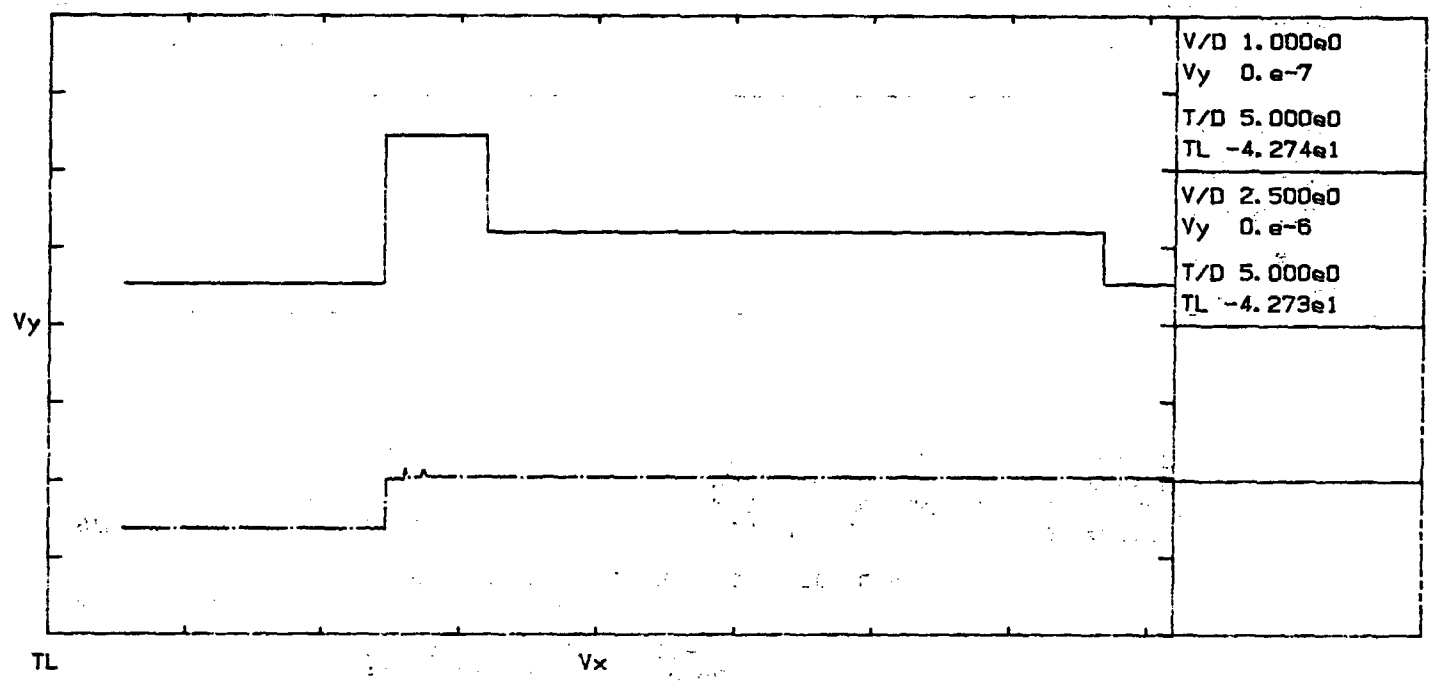


TEST IDENTIFICATION: VALVE #13
STORAGE LOCATION : 02-13

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 26.03 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 3.66 SECONDS	UNSEATING THRUST	: 2653 #
UNSEATING TIME	: 1.51 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 2.15 SECONDS	TORQUE SW. SETTING	: 2.25/>1.5



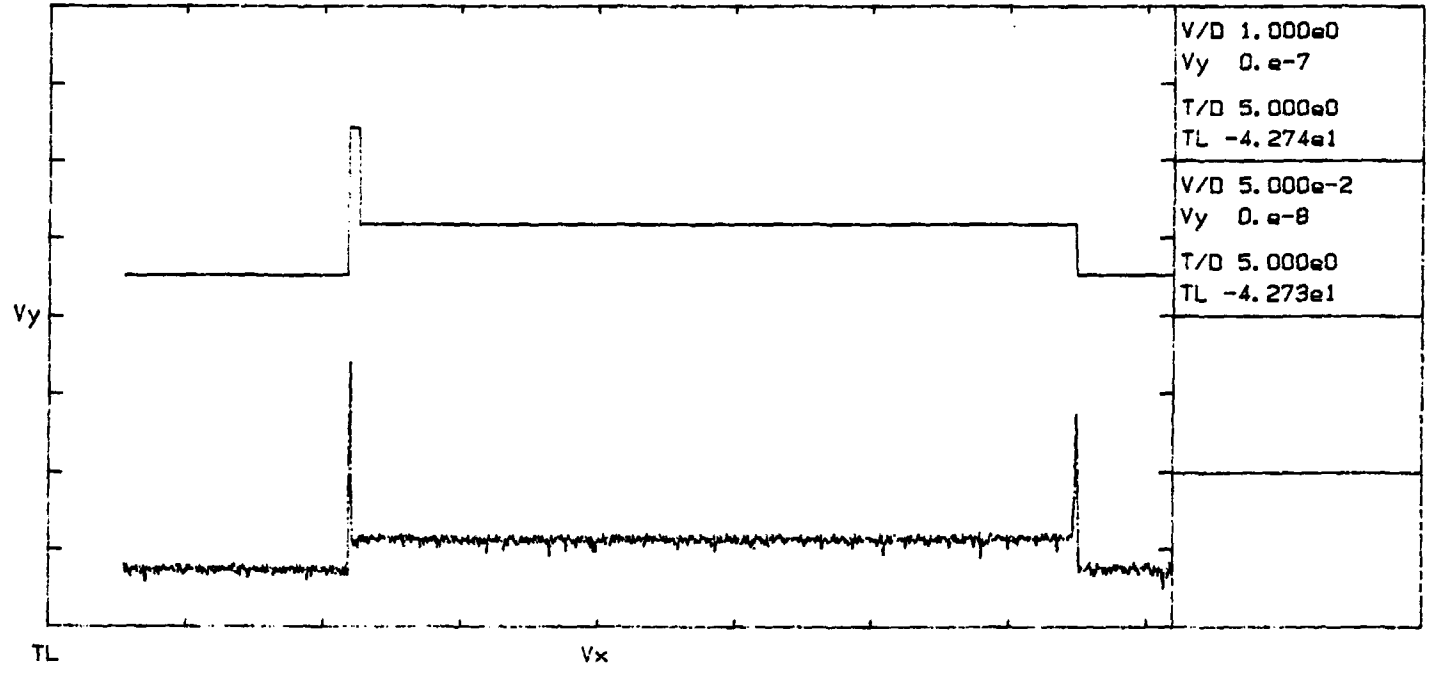
TEST IDENTIFICATION: VALVE #13
STORAGE LOCATION : 02-15

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 26.56 SECONDS

PEAK INRUSH : 14.7 AMPERES
AVE. RUN CURRENT : 2.28 AMPERES
MAX. RUN CURRENT : 2.28 AMPERES
SEATING CURRENT : 11.4 AMPERES



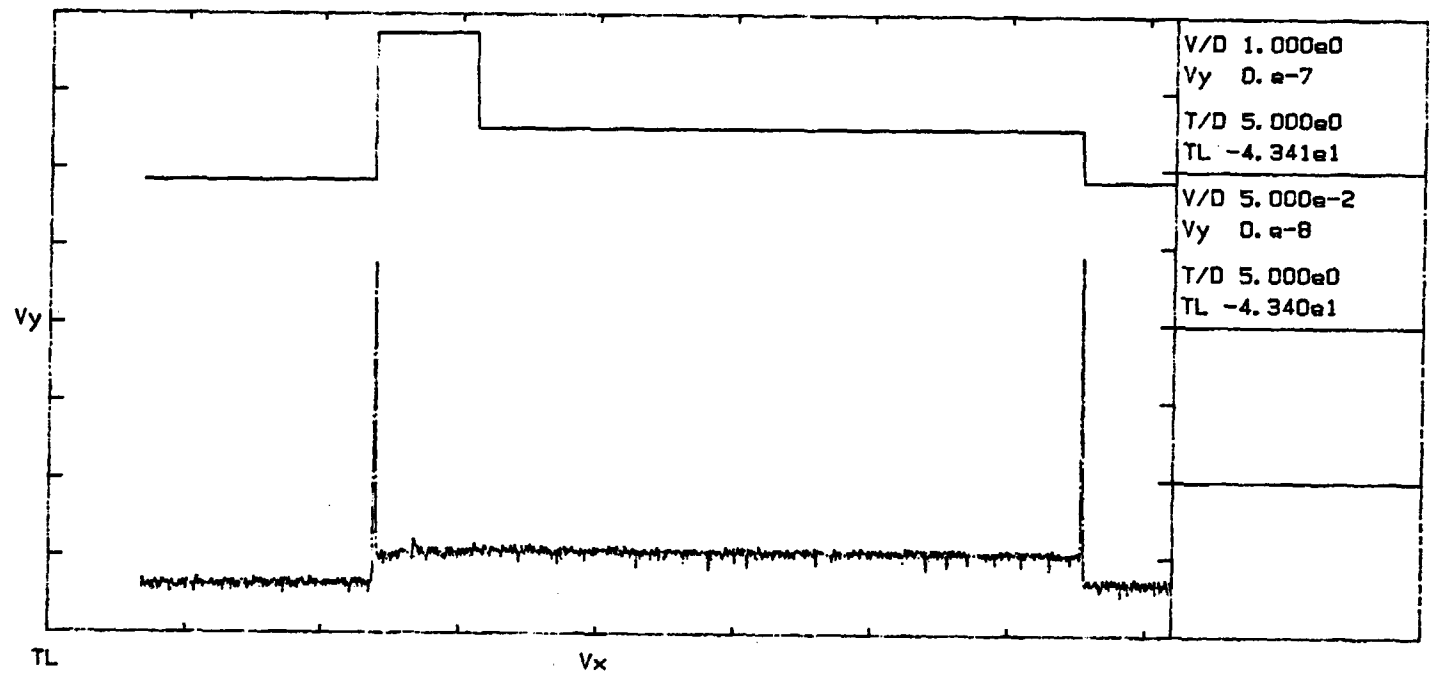
TEST IDENTIFICATION: VALVE #13
STORAGE LOCATION : 02-16

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 25.48 SECONDS

PEAK INRUSH : 21.6 AMPERES
AVE. RUN CURRENT : 2.37 AMPERES
MAX. RUN CURRENT : 2.37 AMPERES
END CURRENT : 2.37 AMPERES

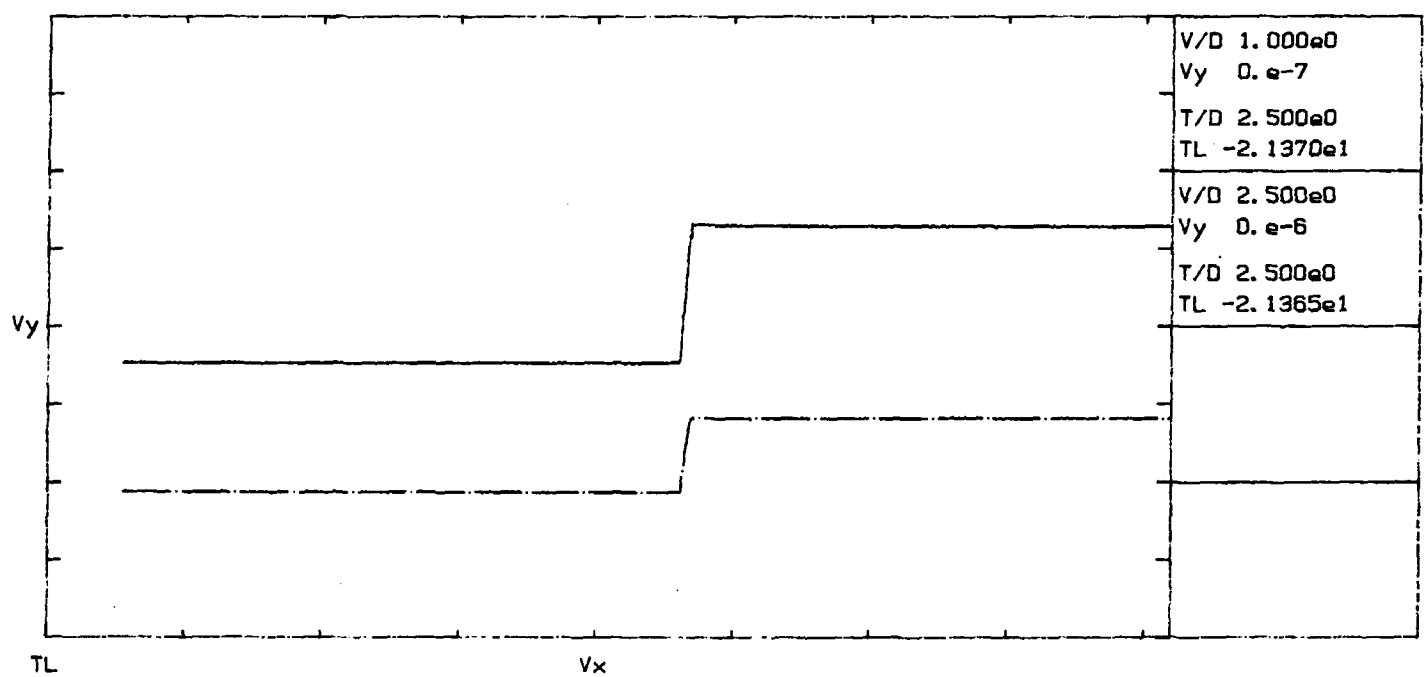


TEST IDENTIFICATION: VALVE #13
STORAGE LOCATION : 02-12

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 780 #
K-FACTOR: 6811 #/V



Test I.D. Valve #14

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
2,4	The as found open torque switch setting resulted in the operator developing thrusts in excess of its design maximum. The open torque switch setting was lowered from 2.5 to 2.0 to attain the target thrust value.
4	During equipment installation, it was noted that the spring cartridge cap was full of grease. (See Recommendation #1).

Recommendations

1. It should be noted that the Belleville springs do not require lubrication to function properly.

TEST ID: VALVE 14

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 0
TEMP	: AMBIENT	SERIAL NO.	: 94926A
PRESS	: ATMOSPHERIC	ORDER NO.	: 336542K
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: MSV-10A
AC/DC	: DC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 6"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.5/1.5	VOLTS	: 250 DC
CLOSE T.S. SETTING	: 2.0/1.5	RATED AMPS	: 4.8
LIMITER PLATE	: 4.0	SPEED	: 1900
TS BALANCEABLE	: YES	HORSEPOWER	: 1.0

TEST EQUIPMENT

LOAD CELL # : 50K--N/A

AMP PROBE # : FLUKE(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #14 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-02-05		TS-CO-02-05	
STROKE TIME	: 26.5 SECONDS	STROKE TIME	: 26.44 SECONDS
BYPASS TIME	: 0 SECONDS	BYPASS TIME	: 3.06 SECONDS
THRUST AT CST	: 7358 #	PROTECTION MARGIN	: 1.56 SECONDS
SEAT THRUST AT CST	: 5727 #	UNSEATING TIME	: 1.5 SECONDS
AVE RUN THRUST	: 948 #	AVE RUN THRUST	: 531 #
MAX RUN THRUST	: 1630 #	MAX RUN THRUST	: 1365 #
INERTIAL THRUST	: 29 %	UNSEATING THRUST	: 5272 #
TOTAL THRUST	: 9558 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.5/1.5	TORQUE SW. SETTING	: 1.5/1.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-02-04 K-FACTOR: 7586 #/V PRELOAD: < RUNNING LOA

MOTOR CURRENT SIGNATURE ANALYSIS

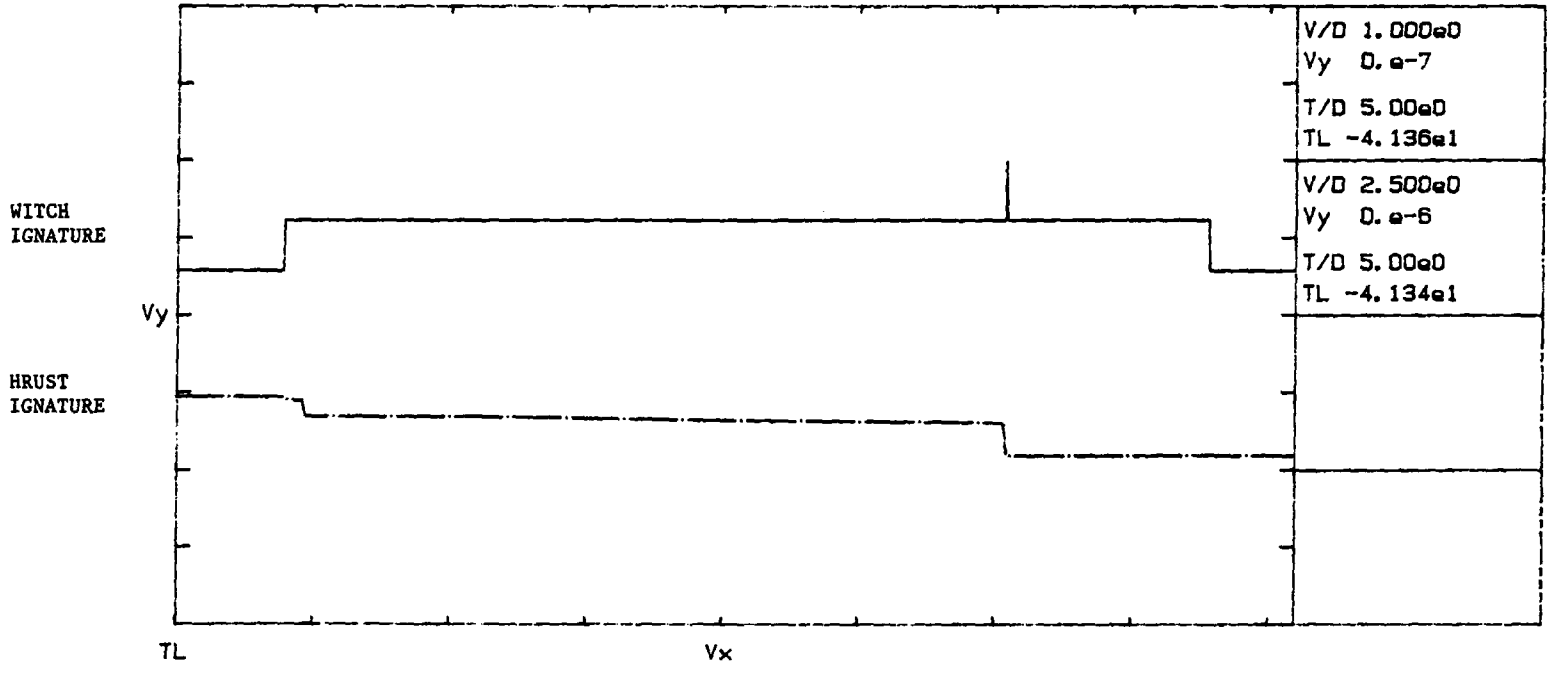
CS-OC-02-06		CS-CO-02-06	
STROKE TIME	: 26.06 SECONDS	STROKE TIME	: 26.06 SECONDS
PEAK INRUSH	: N/A	PEAK INRUSH	: N/A
AVE. RUN CURRENT	: N/A	AVE. RUN CURRENT	: N/A
MAX. RUN CURRENT	: N/A	MAX. RUN CURRENT	: N/A
SEATING CURRENT	: N/A	END CURRENT	: N/A

TEST IDENTIFICATION: VALVE #14
STORAGE LOCATION : 02-05

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 26.5 SECONDS	AVE RUN THRUST	: 948 #
		MAX RUN THRUST	: 1630 #
BYPASS TIME	: 0 SECONDS	THRUST AT CST	: 7358 #
		SEAT THRUST AT CST	: 5727 #
		INERTIAL THRUST	: 29 %
TORQUE SW. SETTING: 1.5/1.5		TOTAL THRUST	: 9558 #

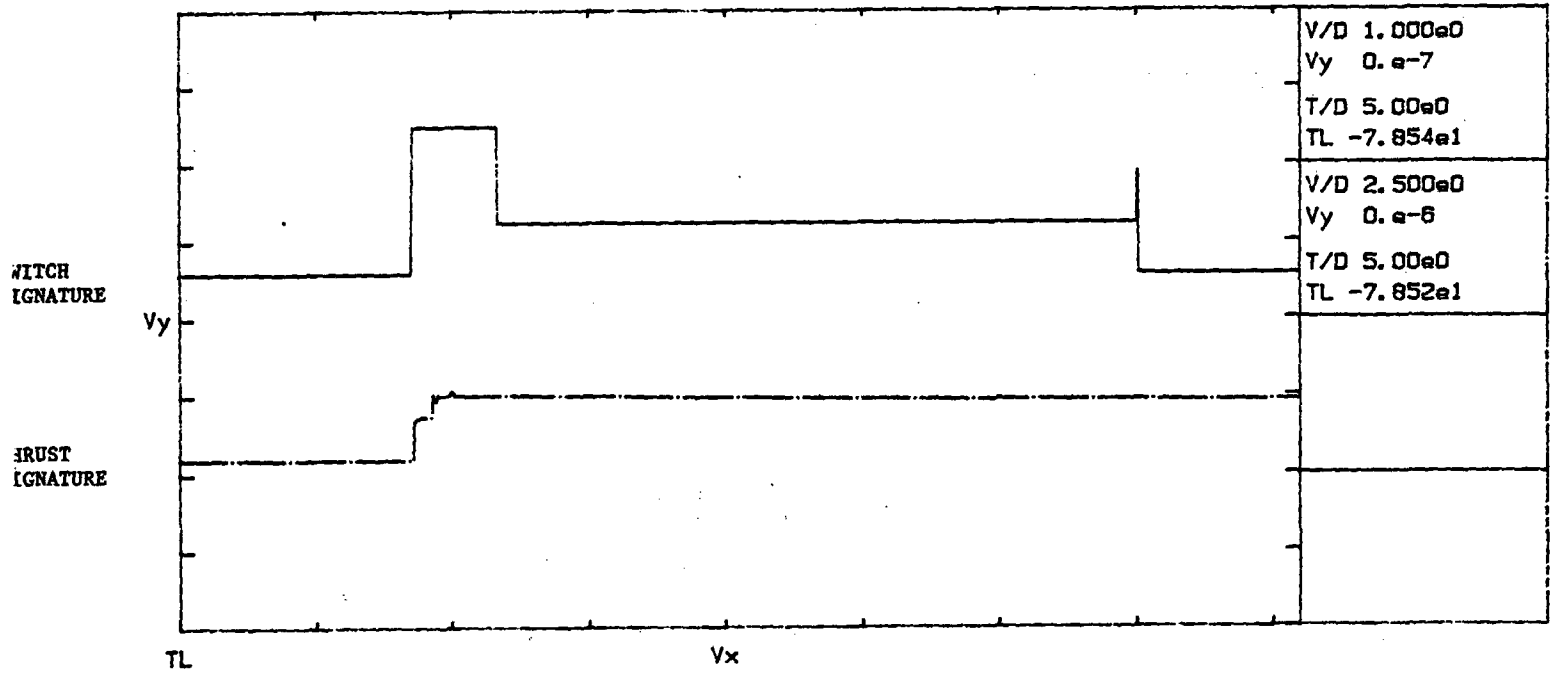


TEST IDENTIFICATION: VALVE #14
STORAGE LOCATION : 02-05

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 26.44 SECONDS	AVE RUN THRUST	: 531 #
		MAX RUN THRUST	: 1365 #
BYPASS TIME	: 3.06 SECONDS	UNSEATING THRUST	: 5272 #
UNSEATING TIME	: 1.5 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 1.56 SECONDS	TORQUE SW. SETTING	: 1.5/1.5

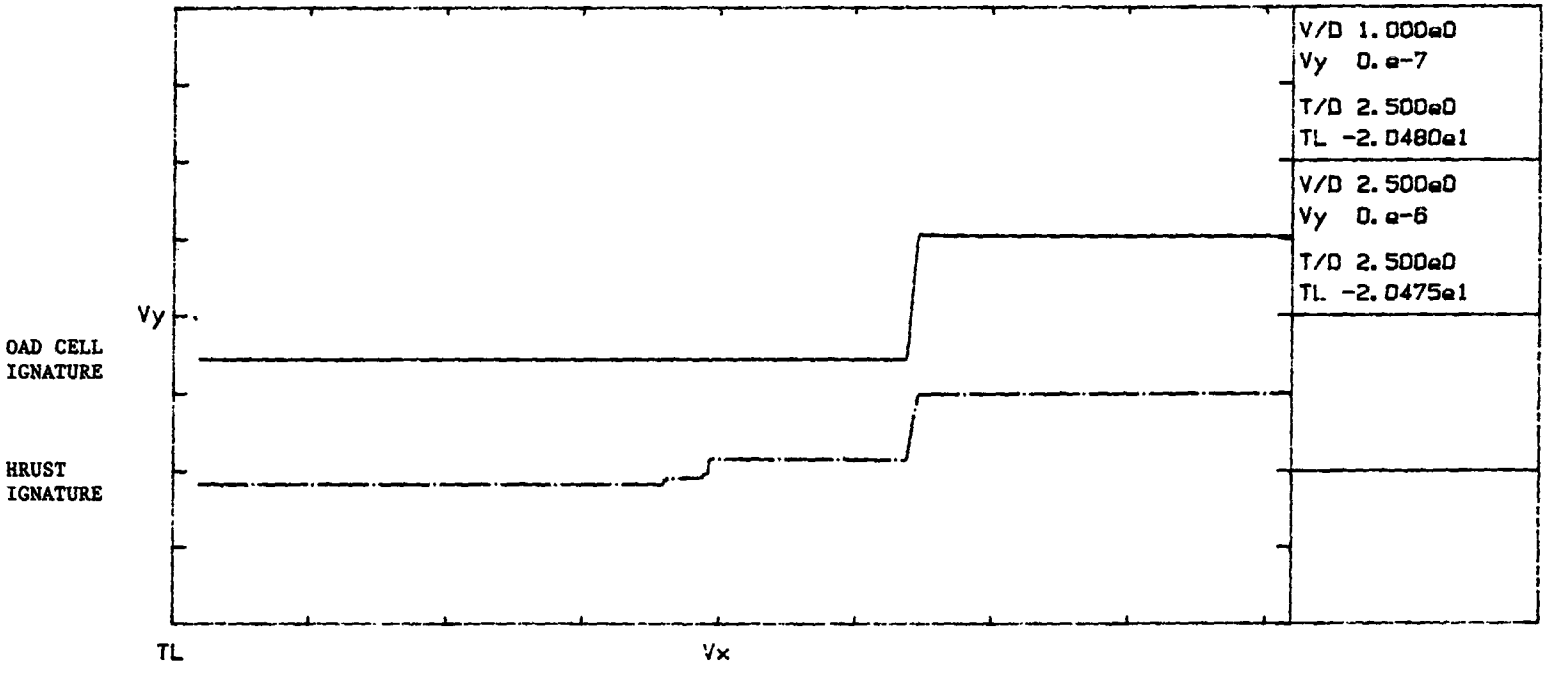


TEST IDENTIFICATION: VALVE #14
STORAGE LOCATION : 02-04

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: < RUNNING LOAD
K-FACTOR: 7586 #/V



Test I.D. Valve #15

Code	Comments
3	During equipment installation, brass filings were noted in the grease present in the spring pack cavity. (See Recommendation #1).
4	The initial torque switch settings were changed from 2.0 to 1.75 in the open direction and 1.0 to >1.0 in the closed direction to achieve the desired thrust values.

Recommendations

1. This appears to be caused by worm gear wear, therefore, we recommend monitoring this condition at normal maintenance intervals.

TEST ID: VALVE #15

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 00
TEMP	: AMBIENT	SERIAL NO.	: 9445H2A
PRESS	: ATMOSPHERIC	ORDER NO.	: 336542R
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: ASV-4
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 4
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.0/1.75	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 1.0/1.1	RATED AMPS	: 2.3
LIMITER PLATE	: NONE	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER	: N/A

TEST EQUIPMENT

LOAD CELL # : 50K--N/A

AMP PROBE # : FLUKE(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #15 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-02-09		TS-CO-02-08	
STROKE TIME	: 39.24 SECONDS	STROKE TIME	: 38.94 SECONDS
BYPASS TIME	: 0.46 SECONDS	BYPASS TIME	: 2.64 SECONDS
THRUST AT CST	: 7048 #	PROTECTION MARGIN	: 2.34 SECONDS
SEAT THRUST AT CST	: 7048 #	UNSEATING TIME	: 0.3 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 23 %	UNSEATING THRUST	: 4172 #
TOTAL THRUST	: 7874 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.0/>1.0	TORQUE SW. SETTING	: 2.0/1.75

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-02-07 K-FACTOR: 3060 #/V PRELOAD: 3560 #

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-02-10		CS-CO-02-11	
STROKE TIME	: 39.3 SECONDS	STROKE TIME	: 38.96 SECONDS
PEAK INRUSH	: 6.2 AMPERES	PEAK INRUSH	: 6.3 AMPERES
AVE. RUN CURRENT	: 1.7 AMPERES	AVE. RUN CURRENT	: 1.7 AMPERES
MAX. RUN CURRENT	: 1.7 AMPERES	MAX. RUN CURRENT	: 1.7 AMPERES
SEATING CURRENT	: 2.2 AMPERES	END CURRENT	: 1.7 AMPERES

TEST IDENTIFICATION: VALVE #15
STORAGE LOCATION : 02-09

PLOT NO. 1

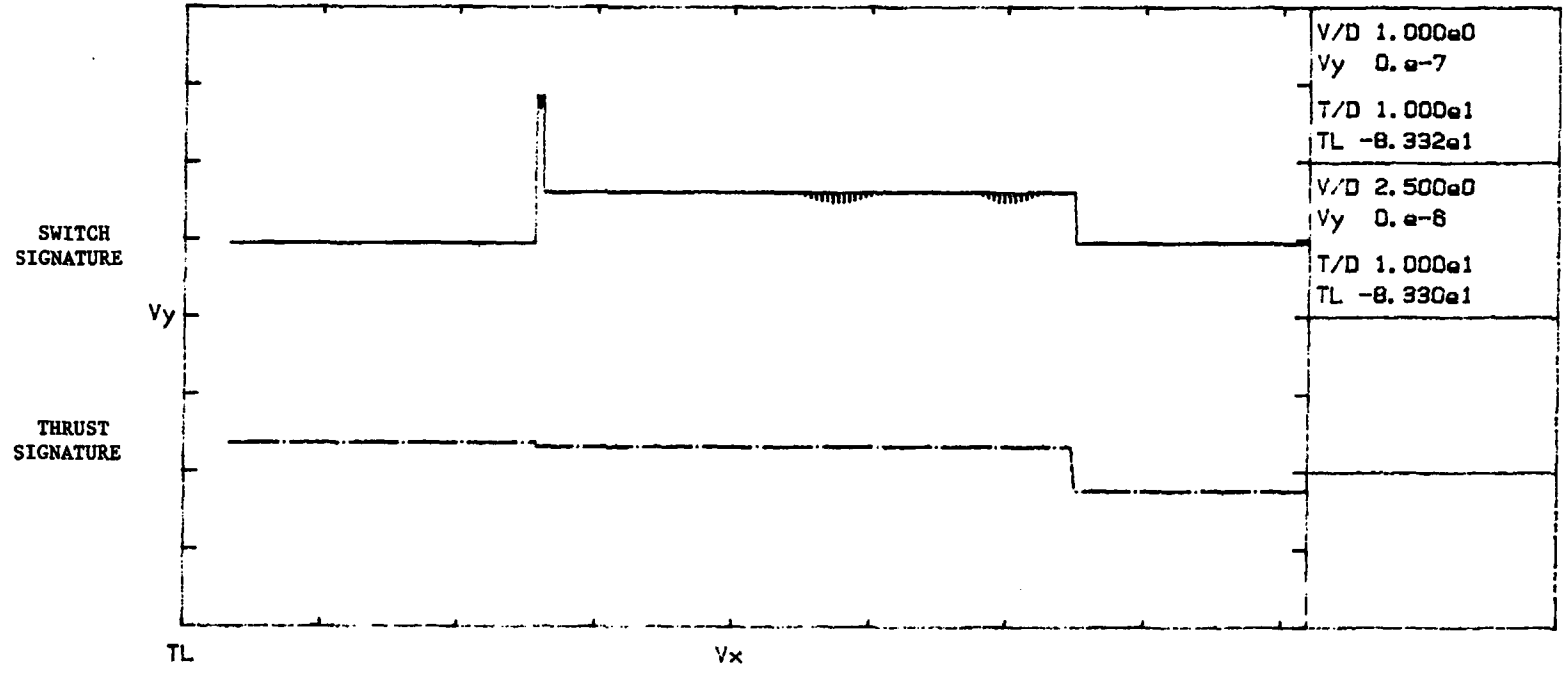
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 39.24 SECONDS

BYPASS TIME : 0.46 SECONDS

TORQUE SW. SETTING:1.0/>1.0

AVE RUN THRUST :<PRELOAD
MAX RUN THRUST :<PRELOAD
THRUST AT CST : 7048 #
SEAT THRUST AT CST: 7048 #
INERTIAL THRUST : 23 %
TOTAL THRUST : 7874 #

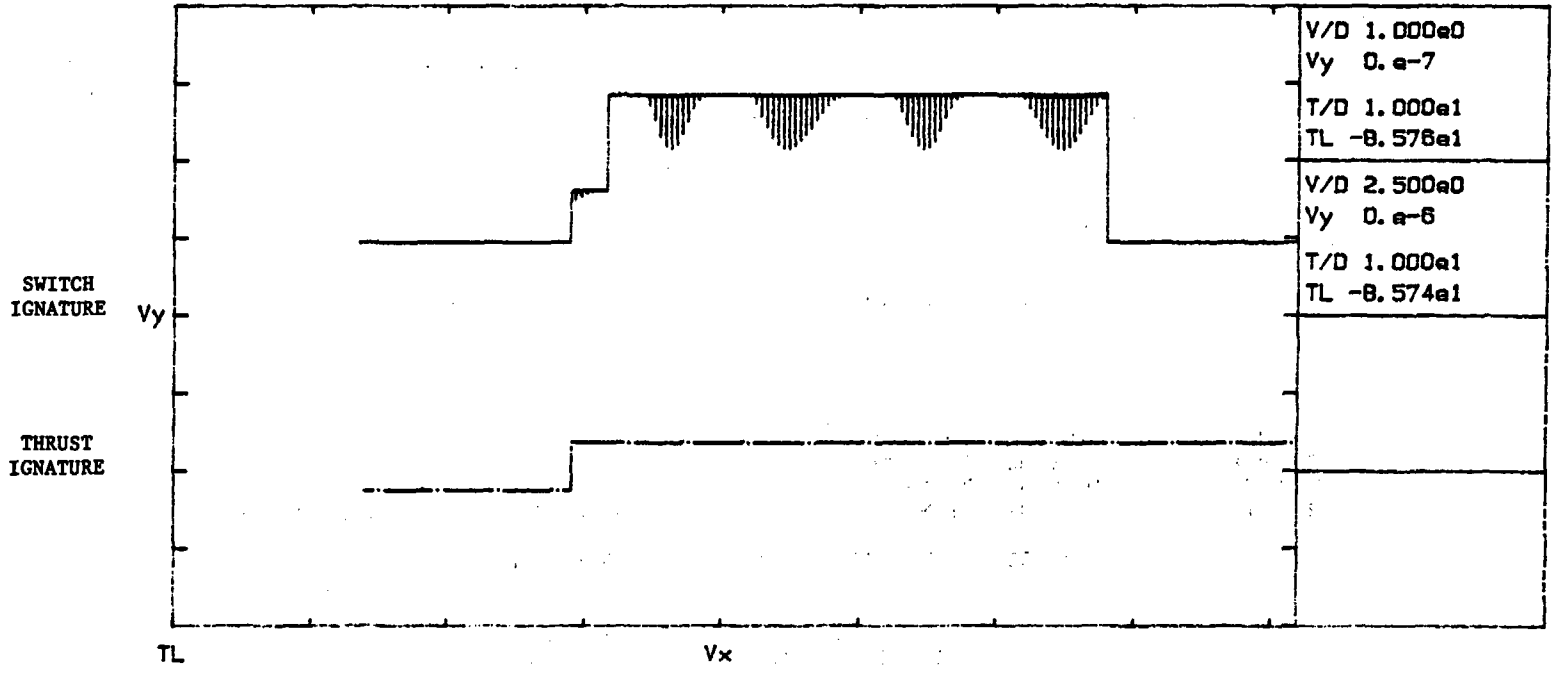


TEST IDENTIFICATION: VALVE #15
STORAGE LOCATION : 02-08

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 38.94 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 2.64 SECONDS	UNSEATING THRUST	: 4172 #
UNSEATING TIME	: 0.3 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 2.34 SECONDS	TORQUE SW. SETTING	: 2.0/1.75



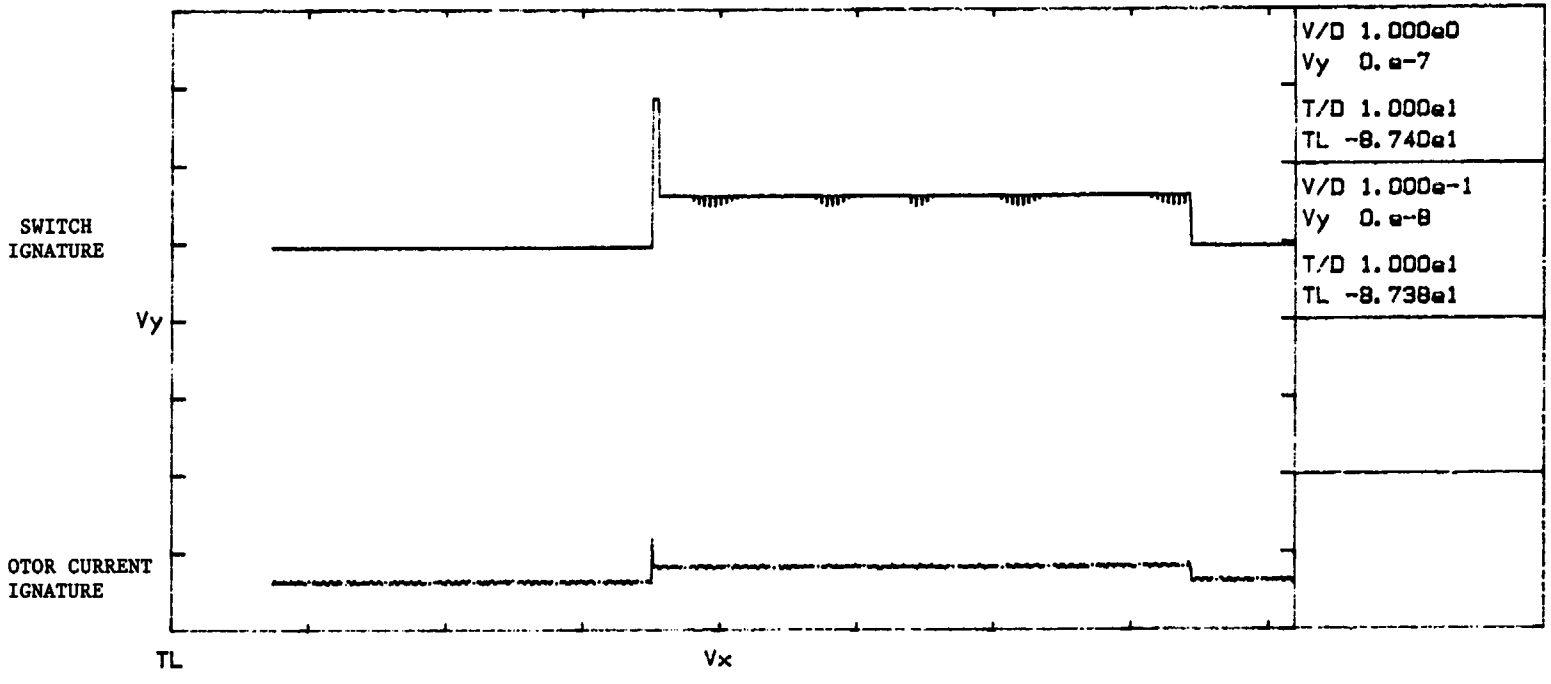
TEST IDENTIFICATION: VALVE #15
STORAGE LOCATION : 02-10

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 39.3 SECONDS

PEAK INRUSH	: 6.2	AMPERES
AVE. RUN CURRENT	: 1.7	AMPERES
MAX. RUN CURRENT	: 1.7	AMPERES
SEATING CURRENT	: 2.2	AMPERES



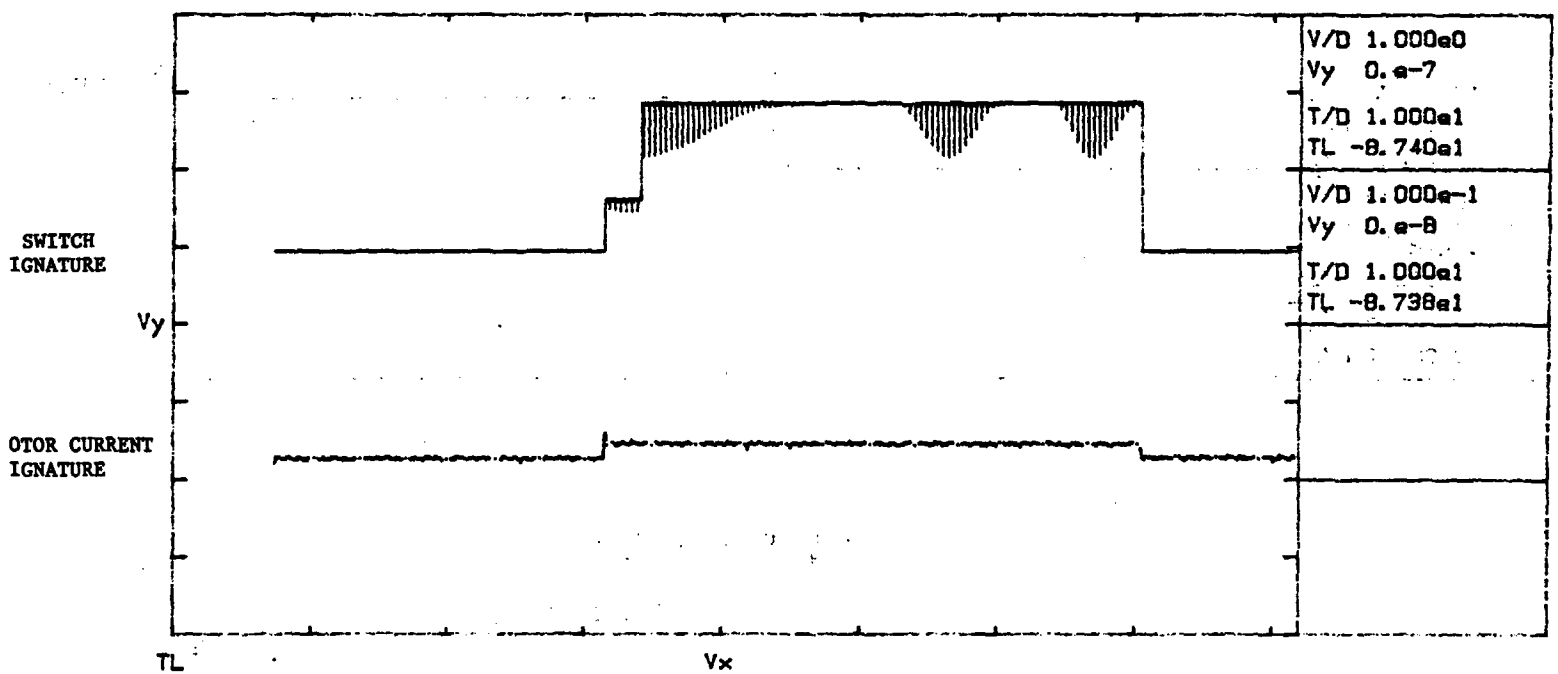
TEST IDENTIFICATION: VALVE #15
STORAGE LOCATION : 02-11

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 38.96 SECONDS

PEAK INRUSH	: 6.3	AMPERES
AVE. RUN CURRENT	: 1.7	AMPERES
MAX. RUN CURRENT	: 1.7	AMPERES
END CURRENT	: 1.7	AMPERES

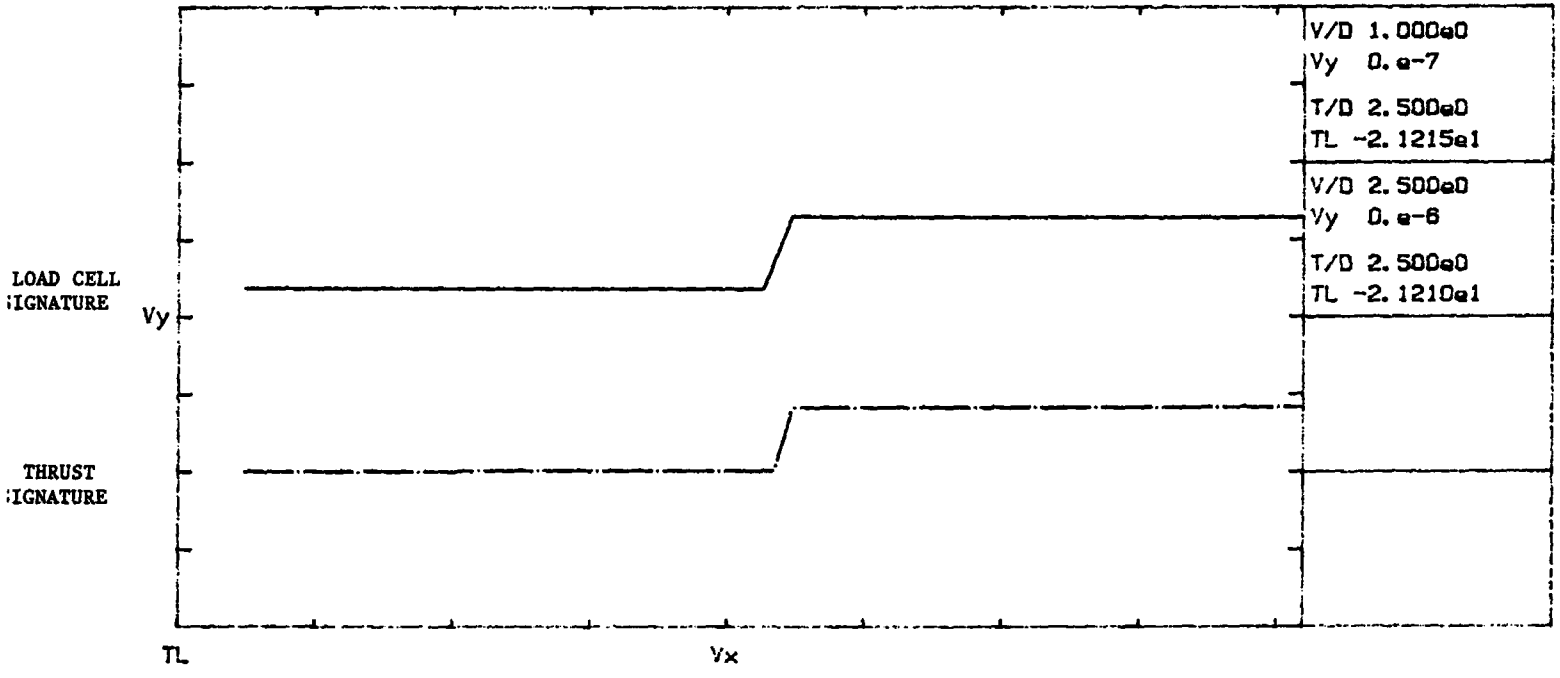


TEST IDENTIFICATION: VALVE #15
STORAGE LOCATION : 02-07

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 3560 #
K-FACTOR: 3060 #/V



Test I.D. Valve #16

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover unseating of the valve.
1,4	Thrust signatures indicated that this valve is backseating. This condition was corrected at the time of the test.
4	After detailed analysis it was found that the thrust developed was less than the target thrust values. This condition was corrected during recent re-testing.
4	To acquire the target thrust loads, the torque switch settings were changed from 2.5 to >1.0 in the open direction and 2.0 to >1.0 in the closed direction.
4	Thrust signatures indicate that this particular valve develops initial thrusts of approximately 151%. (See Recommendation No. 1.)

Recommendations

1. Due to the fact that the total thrust value is well within the design limitation of the actuator, this condition, in our opinion, does not jeopardize valve operability at this time. No further corrective action is necessary at this time.

TEST ID: VALVE #16

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 0
TEMP	: AMBIENT	SERIAL NO.	: 95088A
PRESS	: ATMOSPHERIC	ORDER NO.	: 336542L
SFTY REL'D:	N/A	ORIENTATION:	VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS:	120	ID. NO.	: C0V-10A
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12
CLOSE CONTROL	: TORQUE	BODY ORIENTATION:	HORIZONTAL
MCC	: N/A	INITIAL POSITION:	N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.5/>1.0	VOLTS	: 460 AC
CLOSE T.S. SETTING:	2.0/>1.0	RATED AMPS:	4.6
LIMITER PLATE	: 2.5	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER:	7.5

TEST EQUIPMENT

LOAD CELL # : N/A--N/A

AMP PROBE # : FLUKE(20) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #16 BY: RLB DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-03-03		TS-CO-03-04	
STROKE TIME	: 62.8 SECONDS	STROKE TIME	: 62.66 SECONDS
BYPASS TIME	: 0.24 SECONDS	BYPASS TIME	: 4.9 SECONDS
THRUST AT CST	: 2236 #	PROTECTION MARGIN	: 3.64 SECONDS
SEAT THRUST AT CST	: 1224 #	UNSEATING TIME	: 1.26 SECONDS
AVE RUN THRUST	: 1011 #	AVE RUN THRUST	: 1970 #
MAX RUN THRUST	: 1224 #	MAX RUN THRUST	: 2023 #
INERTIAL THRUST	: 340 %	UNSEATING THRUST	: 2715 #
TOTAL THRUST	: 9851 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.0/>1.0	TORQUE SW. SETTING	: 2.5/>1.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-03-02 K-FACTOR: 10650 #/V PRELOAD: < RUNNING LO

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-03-05		CS-CO-03-06	
STROKE TIME	: 62.86 SECONDS	STROKE TIME	: 62.74 SECONDS
PEAK INRUSH	: 6.77 AMPERES	PEAK INRUSH	: 6.32 AMPERES
AVE. RUN CURRENT	: 2.37 AMPERES	AVE. RUN CURRENT	: 2.08 AMPERES
MAX. RUN CURRENT	: 2.37 AMPERES	MAX. RUN CURRENT	: 2.08 AMPERES
SEATING CURRENT	: 2.37 AMPERES	END CURRENT	: 2.08 AMPERES

TEST IDENTIFICATION: VALVE #16
STORAGE LOCATION : 03-03

PLOT NO. 1

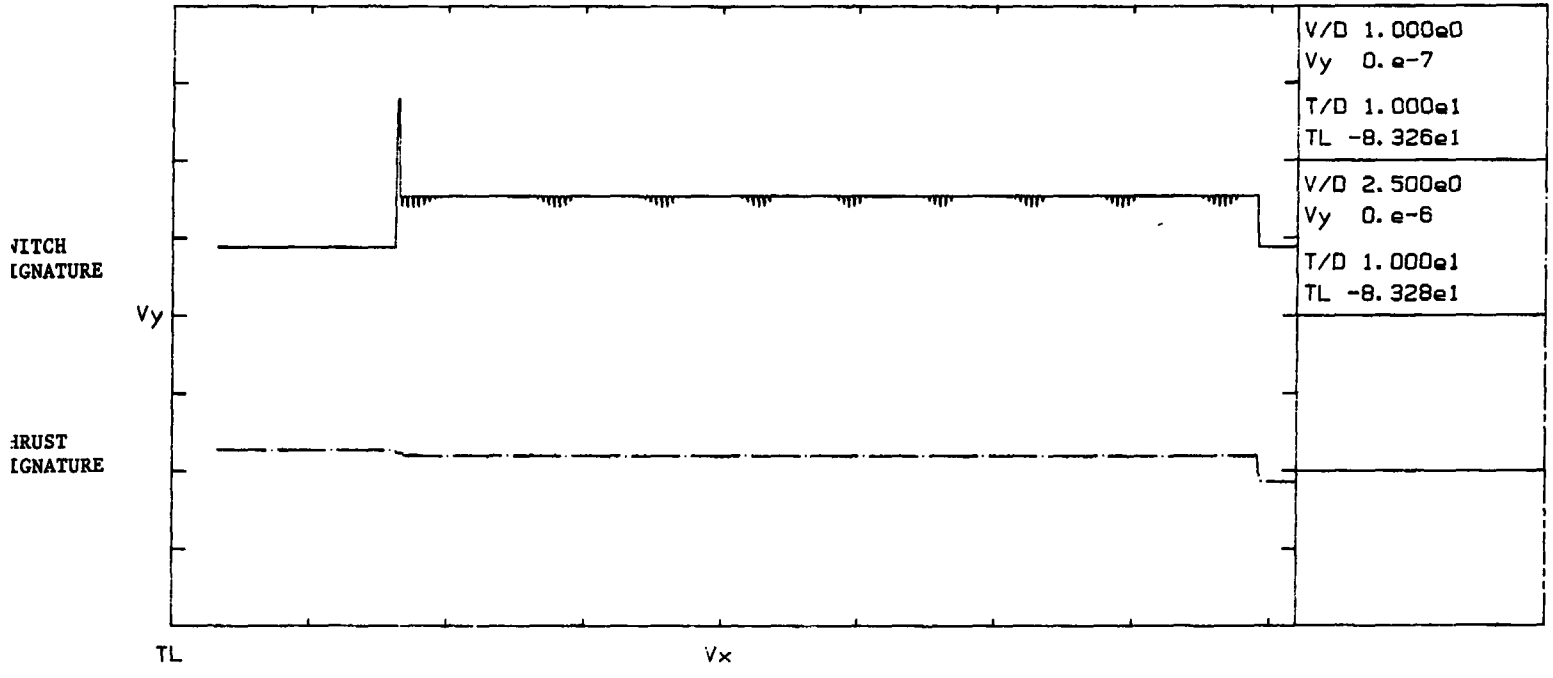
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 62.8 SECONDS

BYPASS TIME : 0.24 SECONDS

TORQUE SW. SETTING:2.0/>1.0

AVE RUN THRUST	: 1011	#
MAX RUN THRUST	: 1224	#
THRUST AT CST	: 2236	#
SEAT THRUST AT CST	: 1224	#
INERTIAL THRUST	: 340	%
TOTAL THRUST	: 9851	#

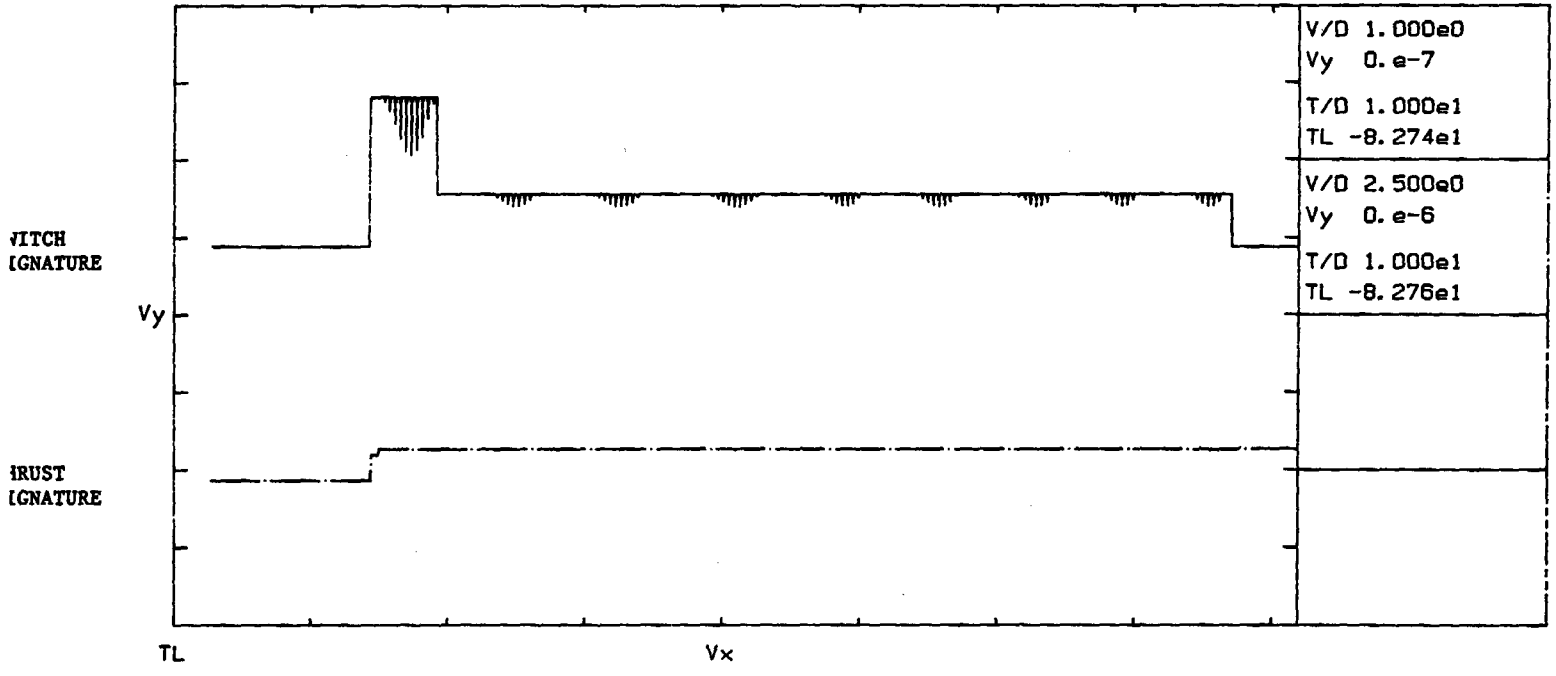


TEST IDENTIFICATION: VALVE #16
STORAGE LOCATION : 03-04

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 62.66 SECONDS	AVE RUN THRUST	: 1970 #
		MAX RUN THRUST	: 2023 #
BYPASS TIME	: 4.9 SECONDS	UNSEATING THRUST	: 2715 #
UNSEATING TIME	: 1.26 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 3.64 SECONDS	TORQUE SW. SETTING	: 2.5/>1.0



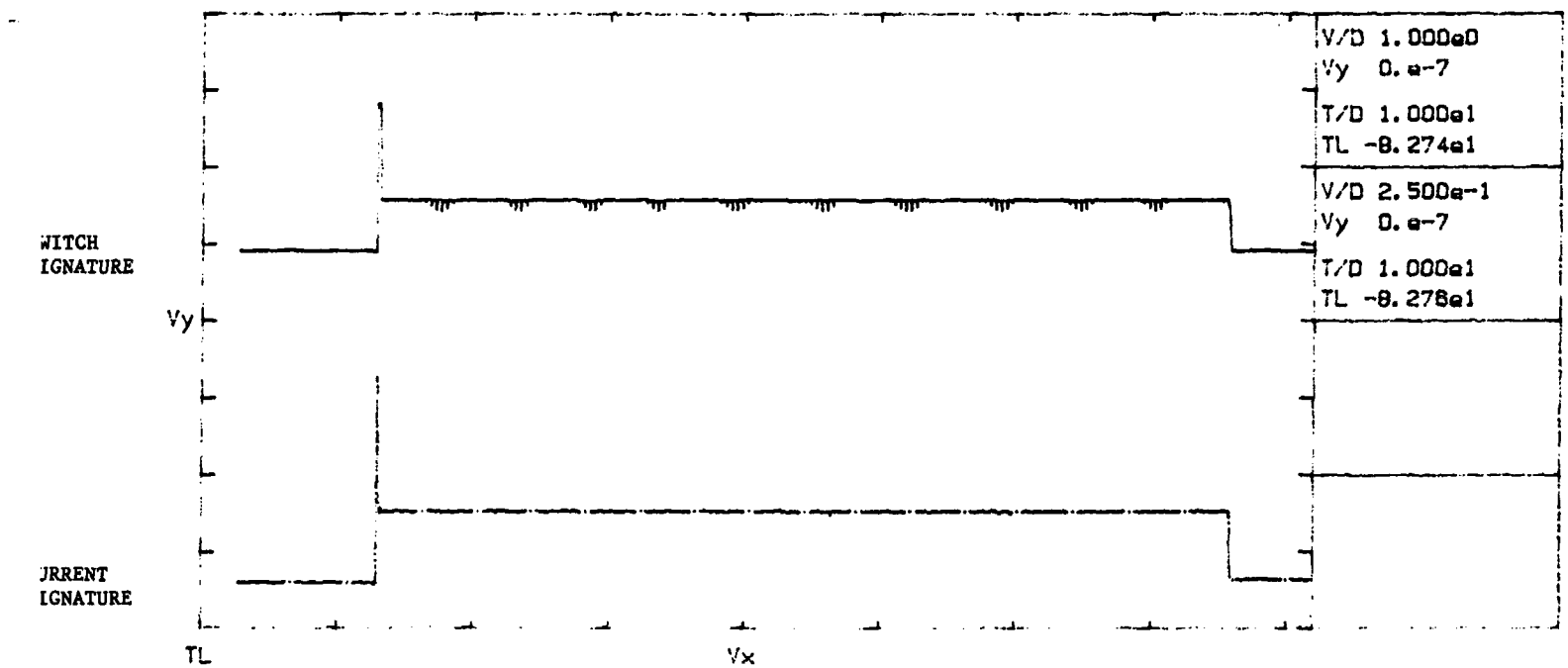
TEST IDENTIFICATION: VALVE #16
STORAGE LOCATION : 03-05

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 62.86 SECONDS

PEAK INRUSH	: 6.77	AMPERES
AVE. RUN CURRENT	: 2.37	AMPERES
MAX. RUN CURRENT	: 2.37	AMPERES
SEATING CURRENT	: 2.37	AMPERES



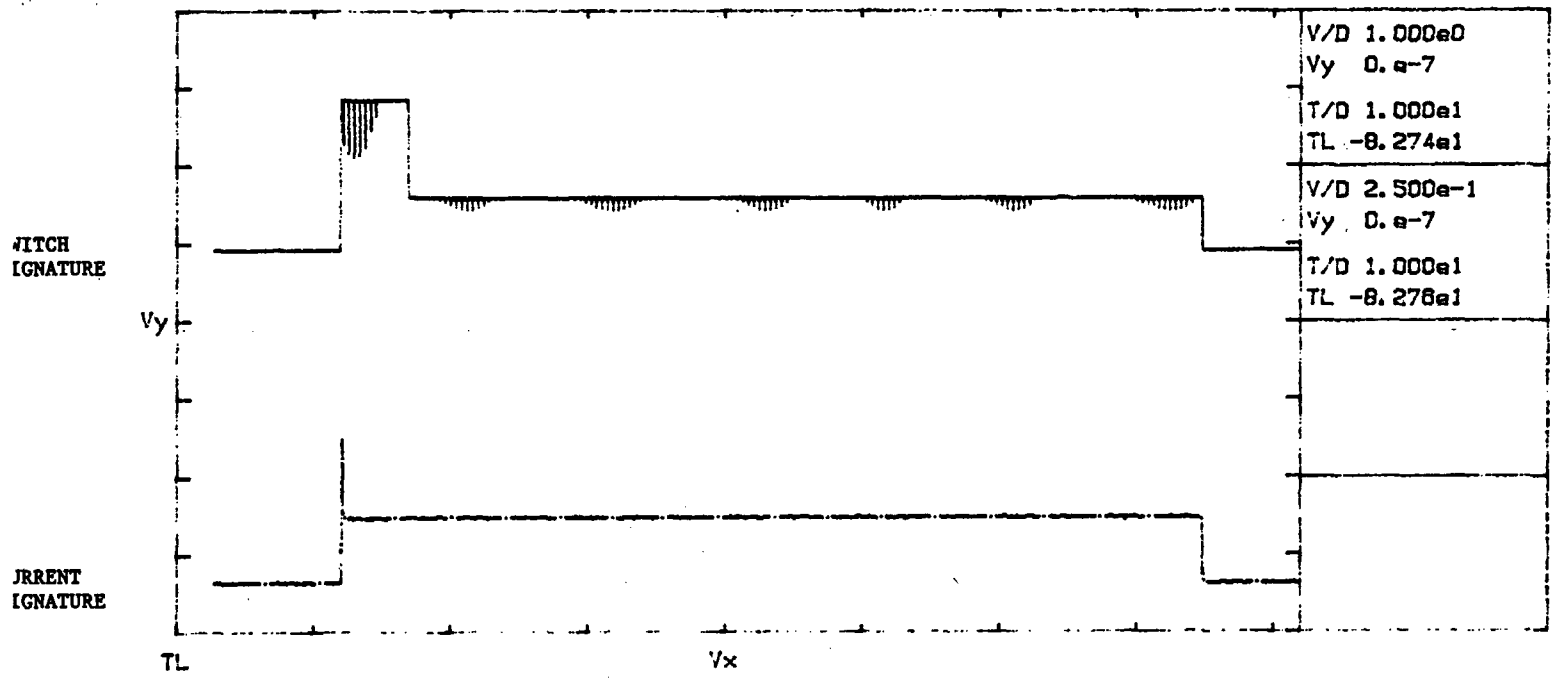
TEST IDENTIFICATION: VALVE #16
STORAGE LOCATION : 03-06

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 62.74 SECONDS

PEAK INRUSH : 6.32 AMPERES
AVE. RUN CURRENT : 2.08 AMPERES
MAX. RUN CURRENT : 2.08 AMPERES
END CURRENT : 2.08 AMPERES

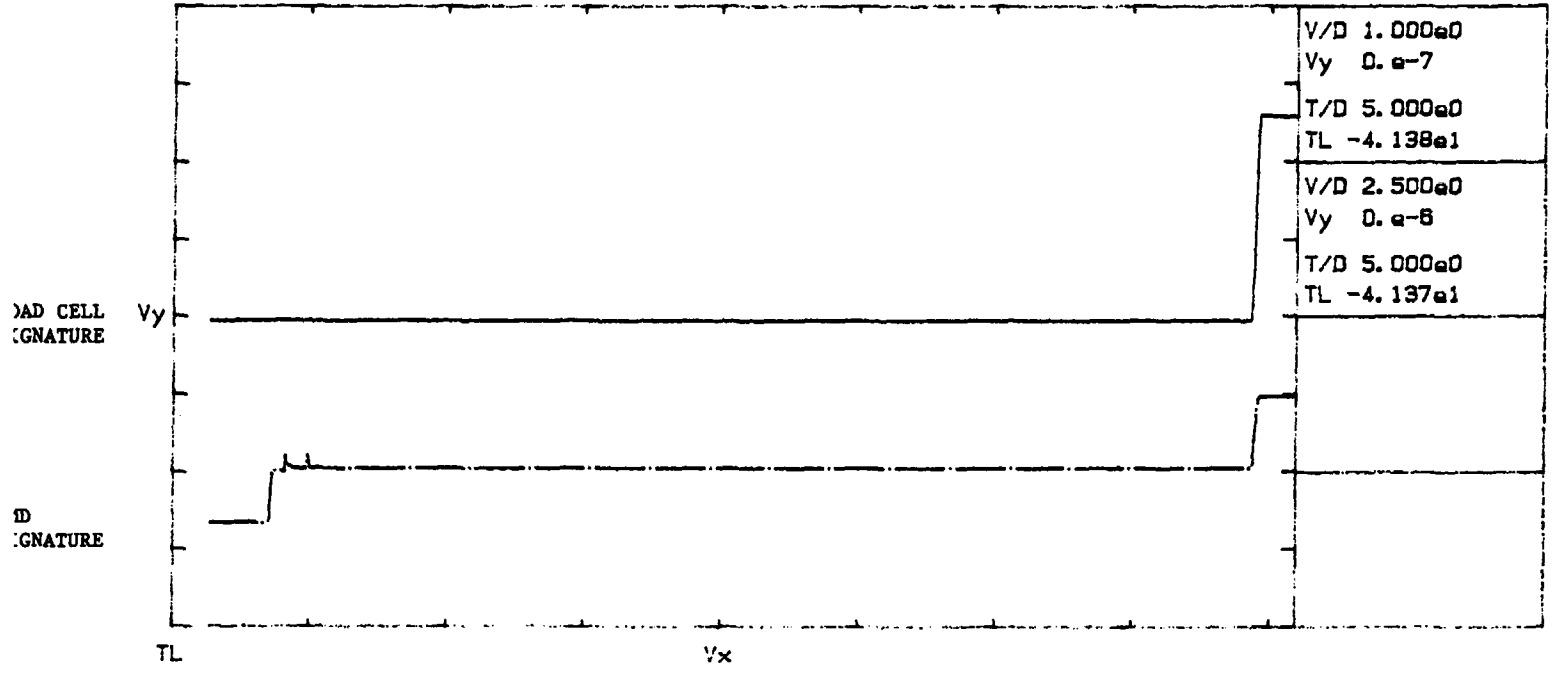


TEST IDENTIFICATION: VALVE #16
STORAGE LOCATION : 03-02

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: < RUNNING LOAD
K-FACTOR: 10650 #/V



Test I.D. Valve #17

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
3	During testing the motor went "locked rotor" going open against the load cell at the as found torque switch setting of >3.0. This valve was tested three times at this setting and the locked rotor condition occurred only on the third run. Since the valve only needs approximately 6000 pounds to close, consideration should be given to installing a blocking device at a torque switch setting of 2.5 to prevent the motor from going "locked rotor" during normal operation.
4	The torque switch was found to be out of balance by a factor of 1.29 to 1.0. This condition was corrected at the time of testing.
4	During equipment installation, it was noted that the spring cartridge cap was full of grease (See Recommendation No. 1.)
4	The open torque switch setting was changed from >3.0 to 1.5 and the closed torque switch setting was changed from 2.5 to 1.5 to attain the target thrust loads.
4	This valve exhibits relatively high running loads in both directions, most likely due to high packing drag.

Recommendations

1. It should be noted that the Belleville springs do not require lubrication to function properly.

TEST ID: VALVE #17

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 1
TEMP	: AMBIENT	SERIAL NO.	: 95294A
PRESS	: ATMOSPHERIC	ORDER NO.	: 336542D
SFTY REL'D	: NO	ORIENTATION	: HORIZONTAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: EX-V-5B
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 18"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: >3.0/1.5	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 2.5/1.5	RATED AMPS	: 2.8
LIMITER PLATE	: 4.0	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER	: N/A

TEST EQUIPMENT

LOAD CELL # : 50 K--N/A

AMP PROBE # : FLUKE(20) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #17 BY: RLB DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

	TS-OC-03-18		TS-CO-03-19	
STROKE TIME	: 88.5	SECONDS	STROKE TIME	: 88.2 SECONDS
BYPASS TIME	: 0.25	SECONDS	BYPASS TIME	: 9.55 SECONDS
THRUST AT CST	: 8991	#	PROTECTION MARGIN	: 7.65 SECONDS
SEAT THRUST AT CST	: 4909	#	UNSEATING TIME	: 1.9 SECONDS
AVE RUN THRUST	: 4081	#	AVE RUN THRUST	: 3226 #
MAX RUN THRUST	: 4164	#	MAX RUN THRUST	: 3419 #
INERTIAL THRUST	: 51	%	UNSEATING THRUST	: 7170 #
TOTAL THRUST	: 13652	#	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.5/1.5		TORQUE SW. SETTING	: >3.0/1.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-03-17 K-FACTOR: 5516 #/V PRELOAD: < RUNNING LOA

MOTOR CURRENT SIGNATURE ANALYSIS

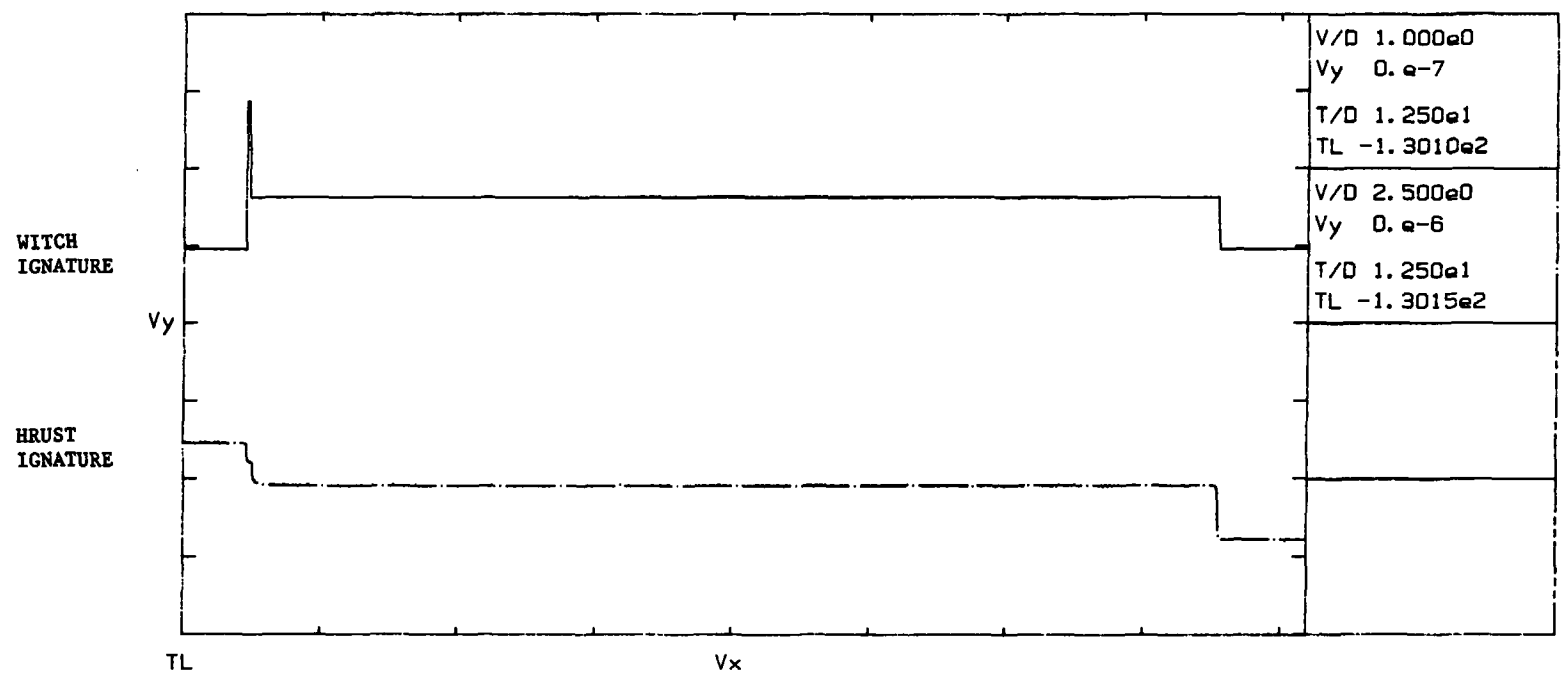
	CS-OC-03-20		CS-CO-04-01	
STROKE TIME	: 88.55	SECONDS	STROKE TIME	: 88.25 SECONDS
PEAK INRUSH	: 7.76	AMPERES	PEAK INRUSH	: 8.18 AMPERES
AVE. RUN CURRENT	: 2.66	AMPERES	AVE. RUN CURRENT	: 2.38 AMPERES
MAX. RUN CURRENT	: 2.68	AMPERES	MAX. RUN CURRENT	: 2.41 AMPERES
SEATING CURRENT	: 2.82	AMPERES	END CURRENT	: 2.41 AMPERES

TEST IDENTIFICATION: VALVE #17
STORAGE LOCATION : 03-18

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 88.5 SECONDS	AVE RUN THRUST	: 4081 #
		MAX RUN THRUST	: 4164 #
BYPASS TIME	: 0.25 SECONDS	THRUST AT CST	: 8991 #
		SEAT THRUST AT CST	: 4909 #
		INERTIAL THRUST	: 51 %
TORQUE SW. SETTING: 2.5/1.5		TOTAL THRUST	: 13652 #

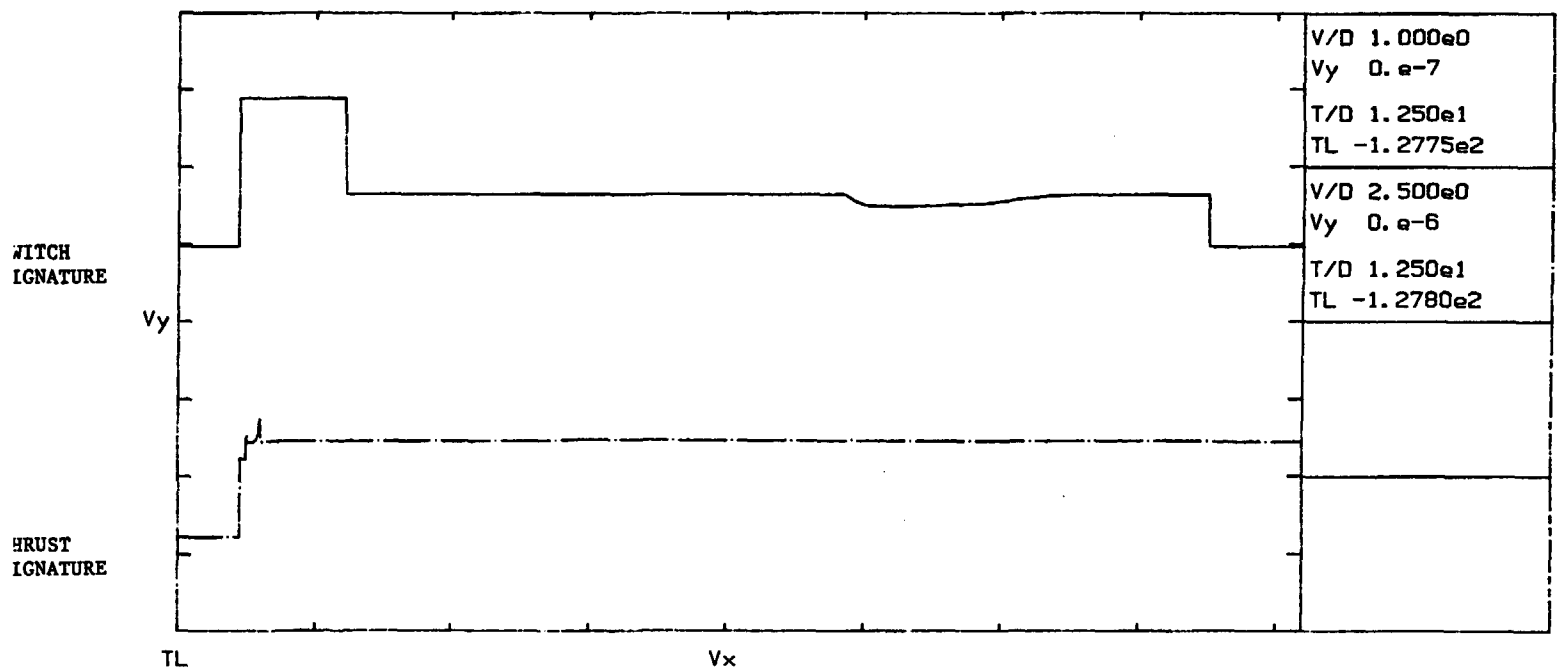


TEST IDENTIFICATION: VALVE #17
STORAGE LOCATION : 03-19

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 88.2 SECONDS	AVE RUN THRUST	: 3226 #
		MAX RUN THRUST	: 3419 #
BYPASS TIME	: 9.55 SECONDS	UNSEATING THRUST	: 7170 #
UNSEATING TIME	: 1.9 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 7.65 SECONDS	TORQUE SW. SETTING	: >3.0/1.5



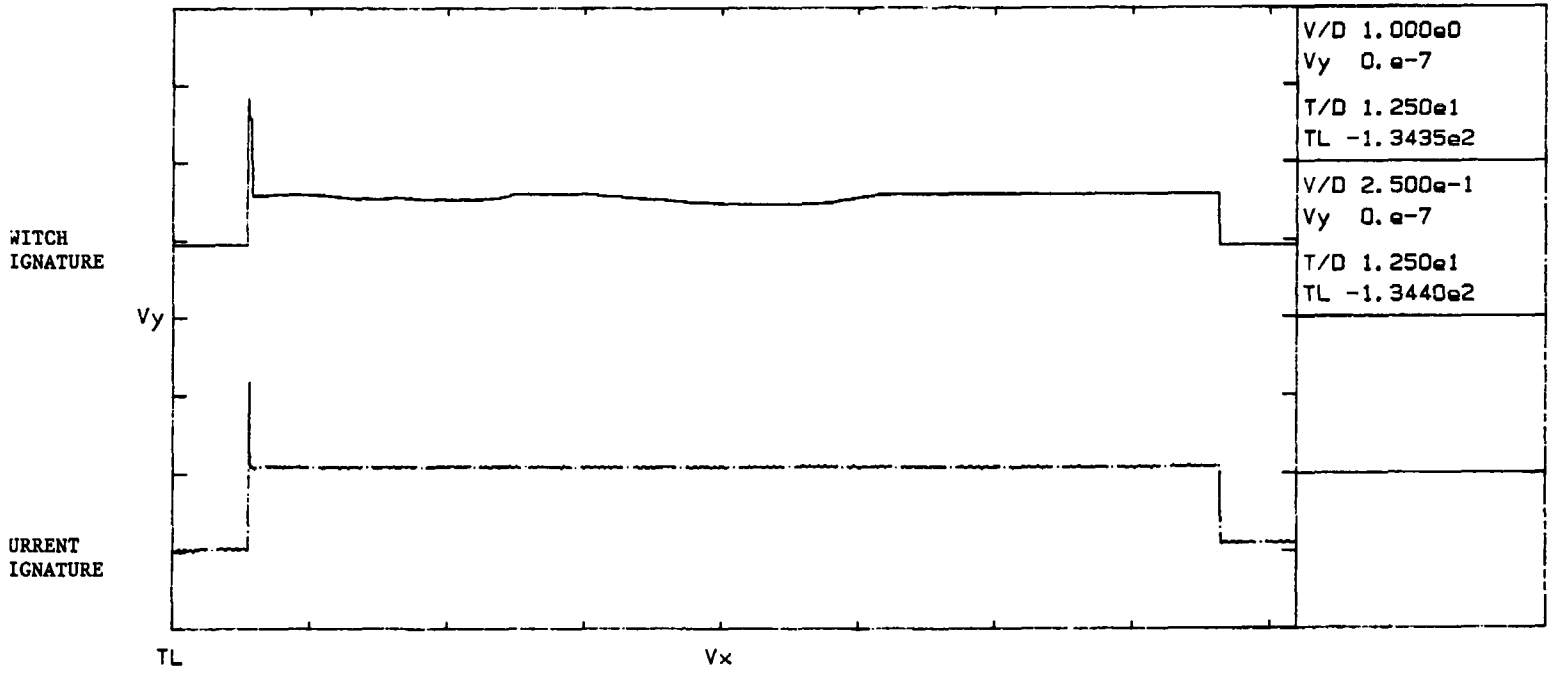
TEST IDENTIFICATION: VALVE #17
STORAGE LOCATION : 03-20

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 88.55 SECONDS

PEAK INRUSH	: 7.76	AMPERES
AVE. RUN CURRENT	: 2.66	AMPERES
MAX. RUN CURRENT	: 2.68	AMPERES
SEATING CURRENT	: 2.82	AMPERES



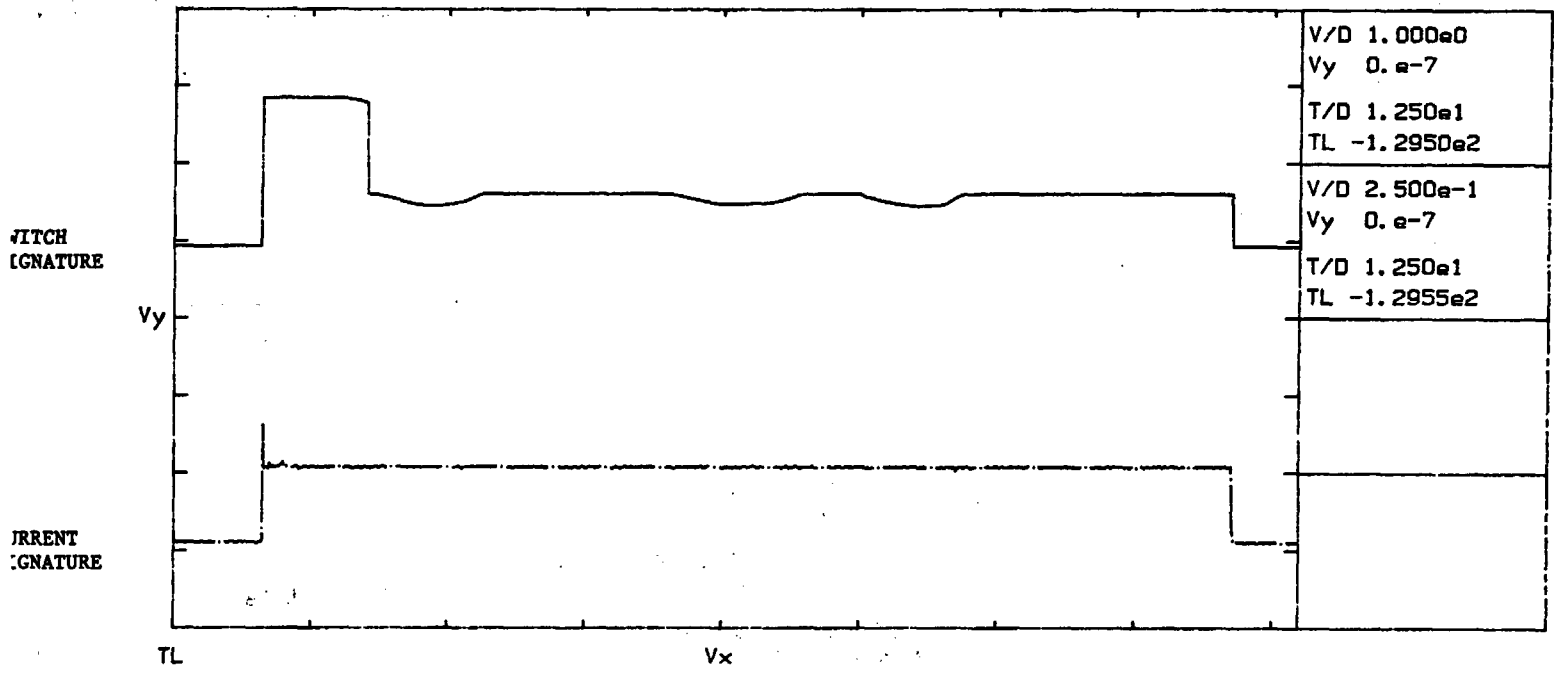
TEST IDENTIFICATION: VALVE #17
STORAGE LOCATION : 04-01

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 88.25 SECONDS

PEAK INRUSH : 8.18 AMPERES
AVE. RUN CURRENT : 2.38 AMPERES
MAX. RUN CURRENT : 2.41 AMPERES
END CURRENT : 2.41 AMPERES

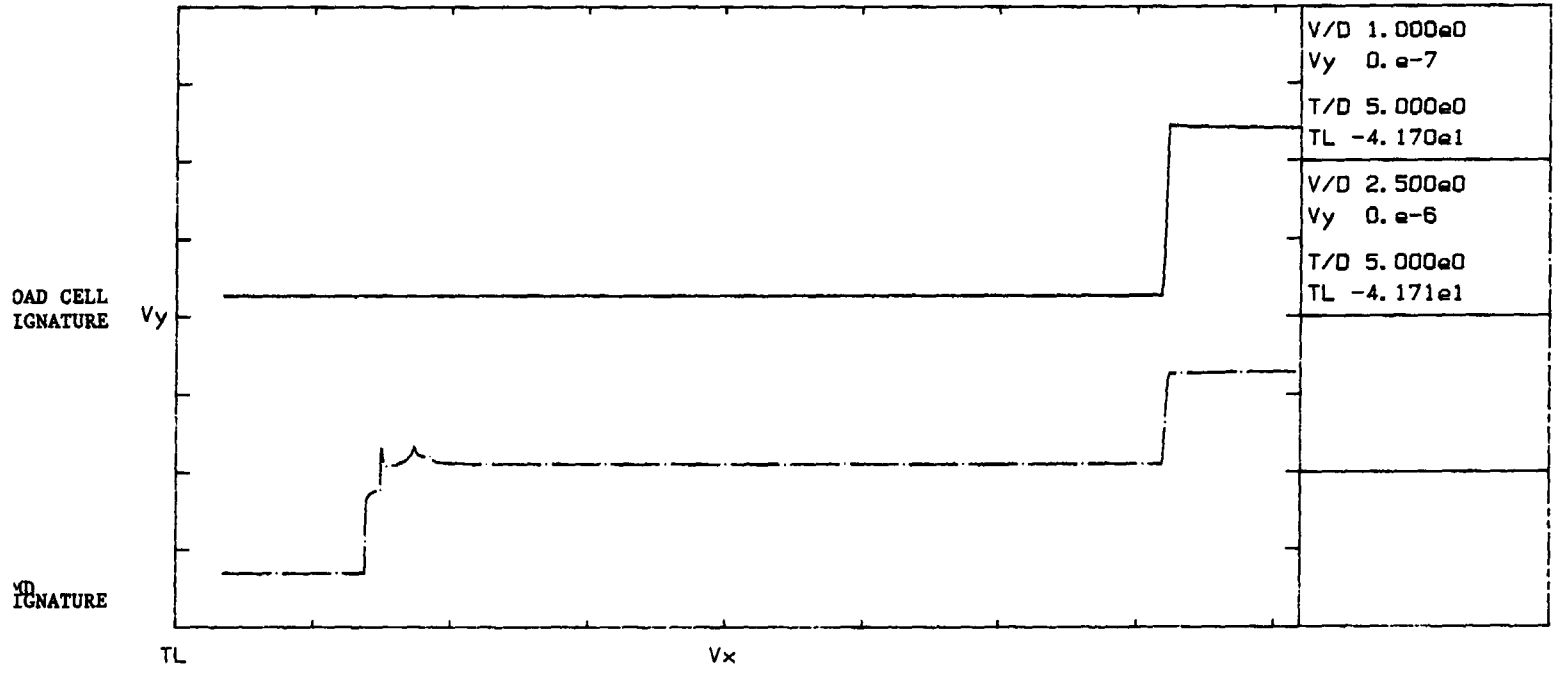


TEST IDENTIFICATION: VALVE #17
STORAGE LOCATION : 03-17

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: < RUNNING LOAD
K-FACTOR: 5516 #/V



Test I.D. Valve #18

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
4	The torque switch was found to be out of balance by a factor of 1.35 to 1.0. This condition was corrected at the time of testing.
4	During equipment installation, it was noted that the spring pack cartridge cap was full of grease. (See Recommendation No. 1.)
4	This particular valve exhibits approximately 149% inertia. (See Recommendation No. 2.)
4	The torque switch settings were changed from 2.5 to 1.75 in the open direction and 2.0 to 1.75 in the close direction to attain target thrust loads.

Recommendations

1. It should be noted that the Belleville springs do not require lubrication to function properly.

2. Due to the fact that the total thrust value is well within the design limitation of the actuator, this condition does not in our opinion jeopardize the operability of the valve at this time.

TEST ID: VALVE #18

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 1
TEMP	: AMBIENT	SERIAL NO.	: 95293A
PRESS	: ATMOSPHERIC	ORDER NO.	: 336542D
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: EXV-5A
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 18"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.5/1.75	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 2.0/1.75	RATED AMPS	: 2.8
LIMITER PLATE	: 4.5	SPEED	: 120
TS BALANCEABLE	: YES	HORSEPOWER	: N/A

TEST EQUIPMENT

LOAD CELL #	: 200K--N/A
AMP PROBE #	: FLUKE(20) N/A
MAINFRAME #	: N/A
TMD #	: N/A

TEST ID: VALVE #18 BY: RLB DATE: 06-16-84

THRUST SIGNATURE ANALYSIS

TS-OC-1-14		TS-CO-1-15	
STROKE TIME	: 88.35 SECONDS	STROKE TIME	: 88 SECONDS
BYPASS TIME	: 0.4 SECONDS	BYPASS TIME	: 6.15 SECONDS
THRUST AT CST	: 3969 #	PROTECTION MARGIN	: 3.7 SECONDS
SEAT THRUST AT CST	: 3687 #	UNSEATING TIME	: 2.45 SECONDS
AVE RUN THRUST	: 225 #	AVE RUN THRUST	: 140 #
MAX RUN THRUST	: 281 #	MAX RUN THRUST	: 1365 #
INERTIAL THRUST	: 176 %	UNSEATING THRUST	: 2026 #
TOTAL THRUST	: 10978 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.0/1.75	TORQUE SW. SETTING	: 2.5/1.75

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-1-13 K-FACTOR: 5630 #/V PRELOAD: < RUNNING LOAD

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-1-16		CS-CO-1-17	
STROKE TIME	: 88.45 SECONDS	STROKE TIME	: 88.05 SECONDS
PEAK INRUSH	: 8.07 AMPERES	PEAK INRUSH	: 7.18 AMPERES
AVE. RUN CURRENT	: 2.46 AMPERES	AVE. RUN CURRENT	: 2.29 AMPERES
MAX. RUN CURRENT	: 2.51 AMPERES	MAX. RUN CURRENT	: 2.32 AMPERES
SEATING CURRENT	: 2.63 AMPERES	END CURRENT	: 2.3 AMPERES

TEST IDENTIFICATION: VALVE #18
STORAGE LOCATION : 1-14

PLOT NO. 1

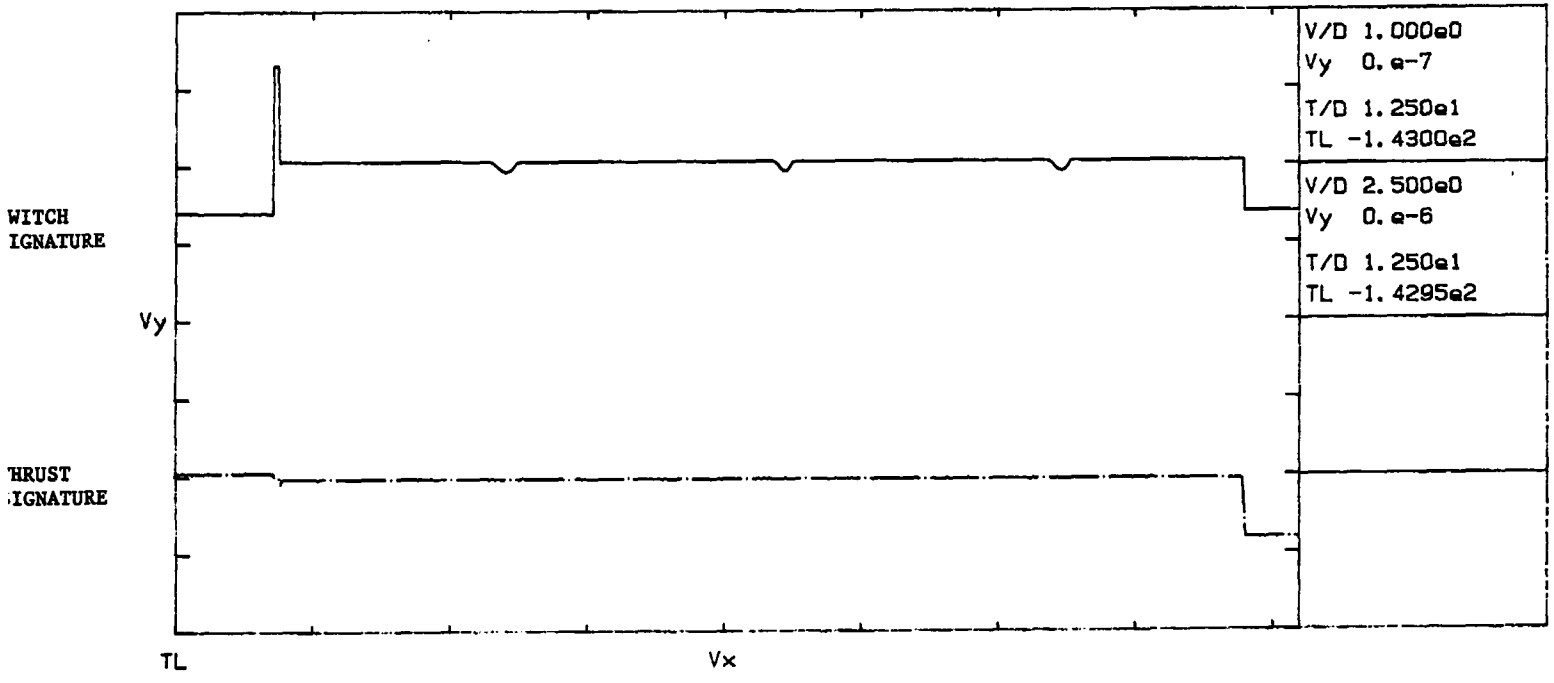
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 88.35 SECONDS

BYPASS TIME : 0.4 SECONDS

TORQUE SW. SETTING:2.0/1.75

AVE RUN THRUST : 225 #
MAX RUN THRUST : 281 #
THRUST AT CST : 3969 #
SEAT THRUST AT CST: 3687 #
INERTIAL THRUST : 176 %
TOTAL THRUST : 10978 #

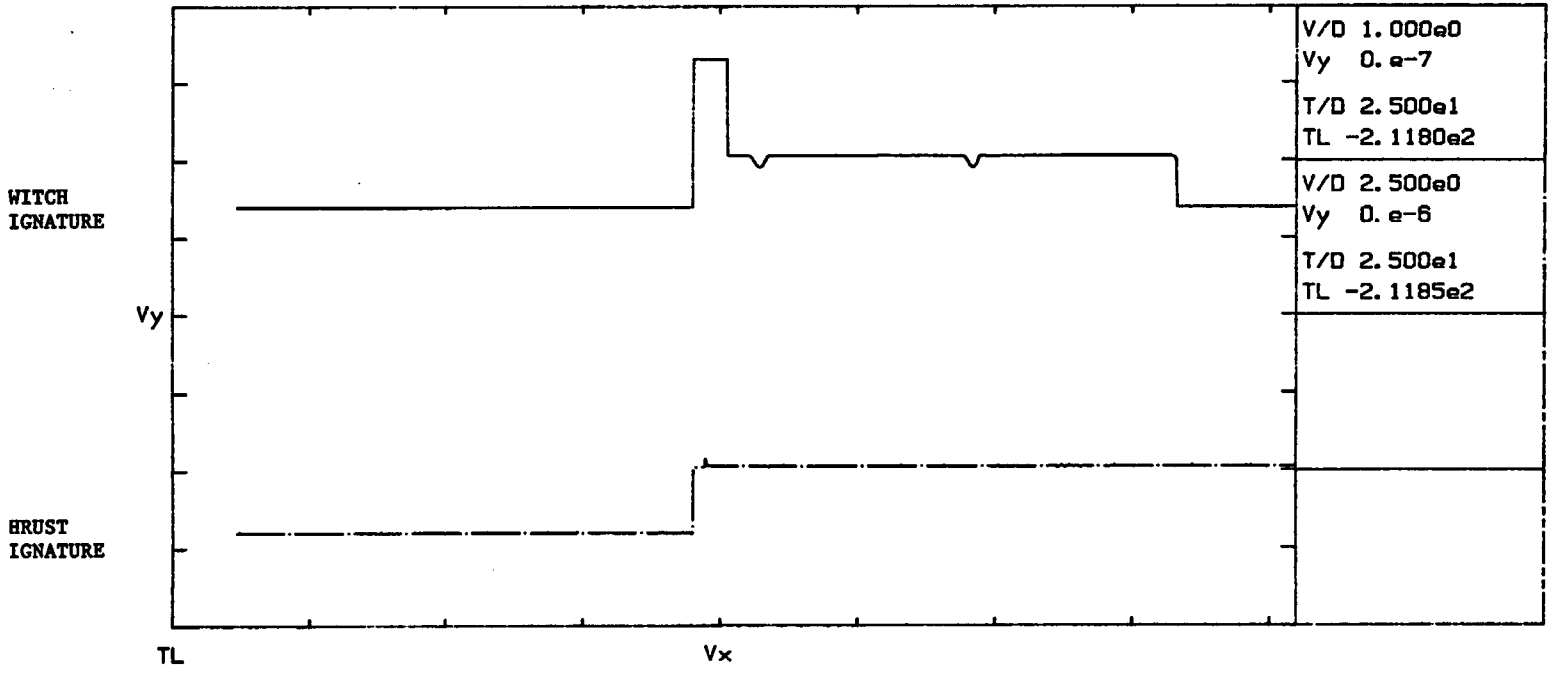


TEST IDENTIFICATION: VALVE #18
STORAGE LOCATION : 1-15

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 88 SECONDS	AVE RUN THRUST	: 140 #
		MAX RUN THRUST	: 1365 #
BYPASS TIME	: 6.15 SECONDS	UNSEATING THRUST	: 2026 #
UNSEATING TIME	: 2.45 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 3.7 SECONDS	TORQUE SW. SETTING	: 2.5/1.75



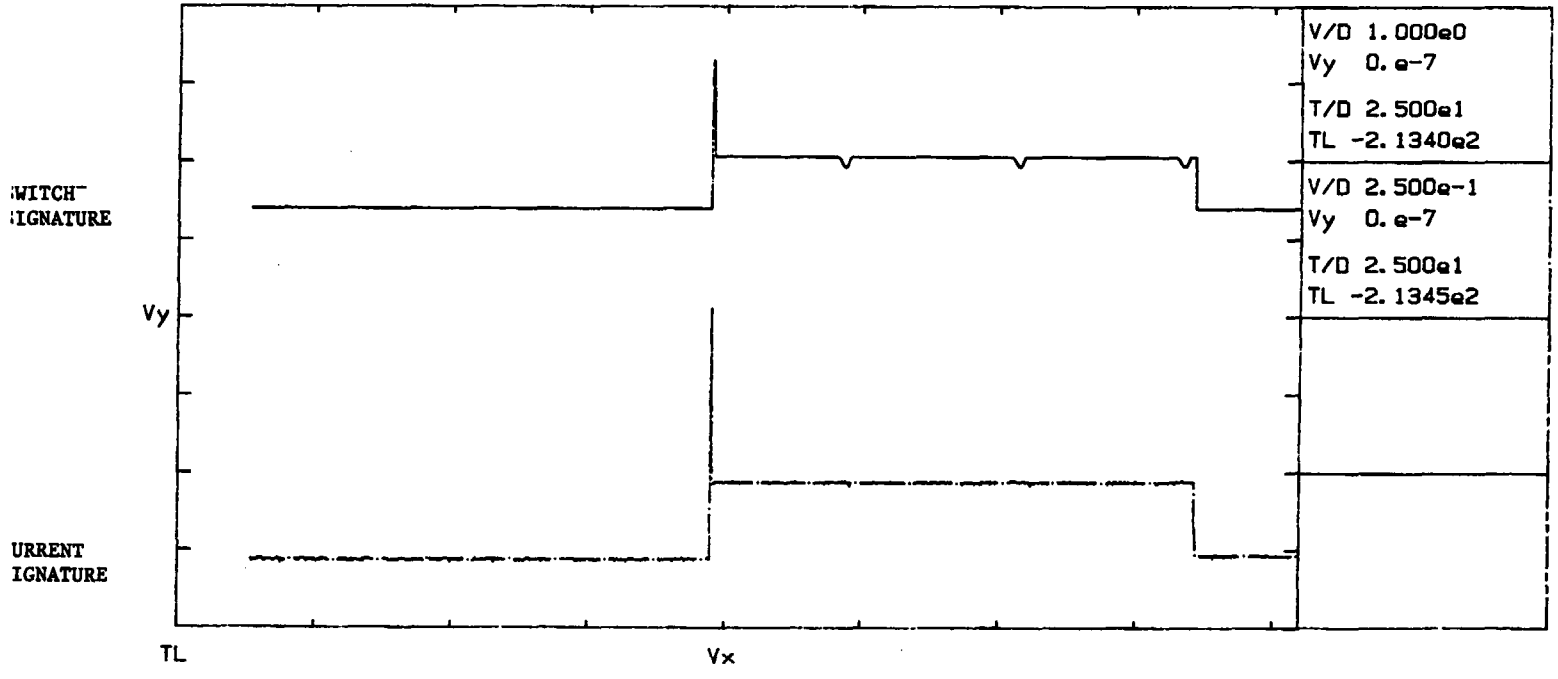
TEST IDENTIFICATION: VALVE #18
STORAGE LOCATION : 1-16

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 88.45 SECONDS

PEAK INRUSH	: 8.07	AMPERES
AVE. RUN CURRENT	: 2.46	AMPERES
MAX. RUN CURRENT	: 2.51	AMPERES
SEATING CURRENT	: 2.63	AMPERES



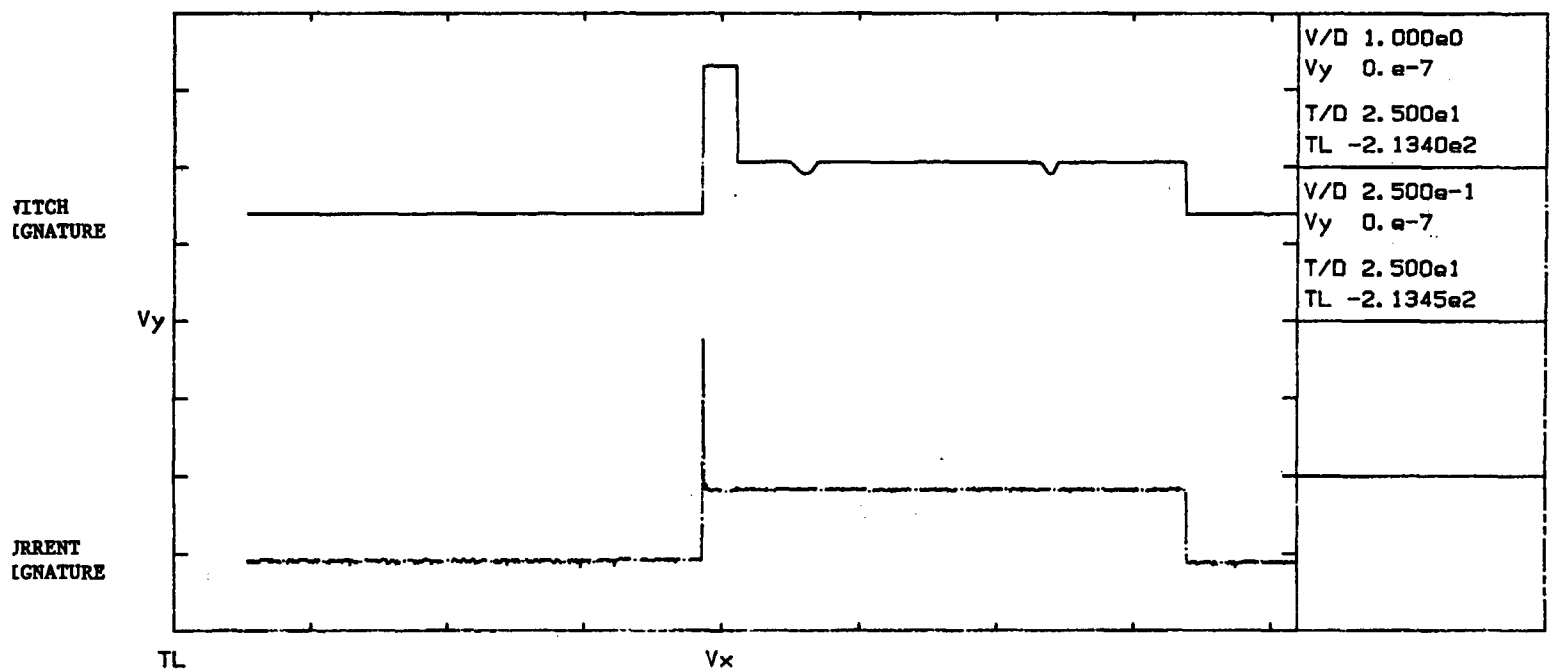
TEST IDENTIFICATION: VALVE #18
STORAGE LOCATION : 1-17

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 88.05 SECONDS

PEAK INRUSH : 7.18 AMPERES
AVE. RUN CURRENT : 2.29 AMPERES
MAX. RUN CURRENT : 2.32 AMPERES
END CURRENT : 2.3 AMPERES



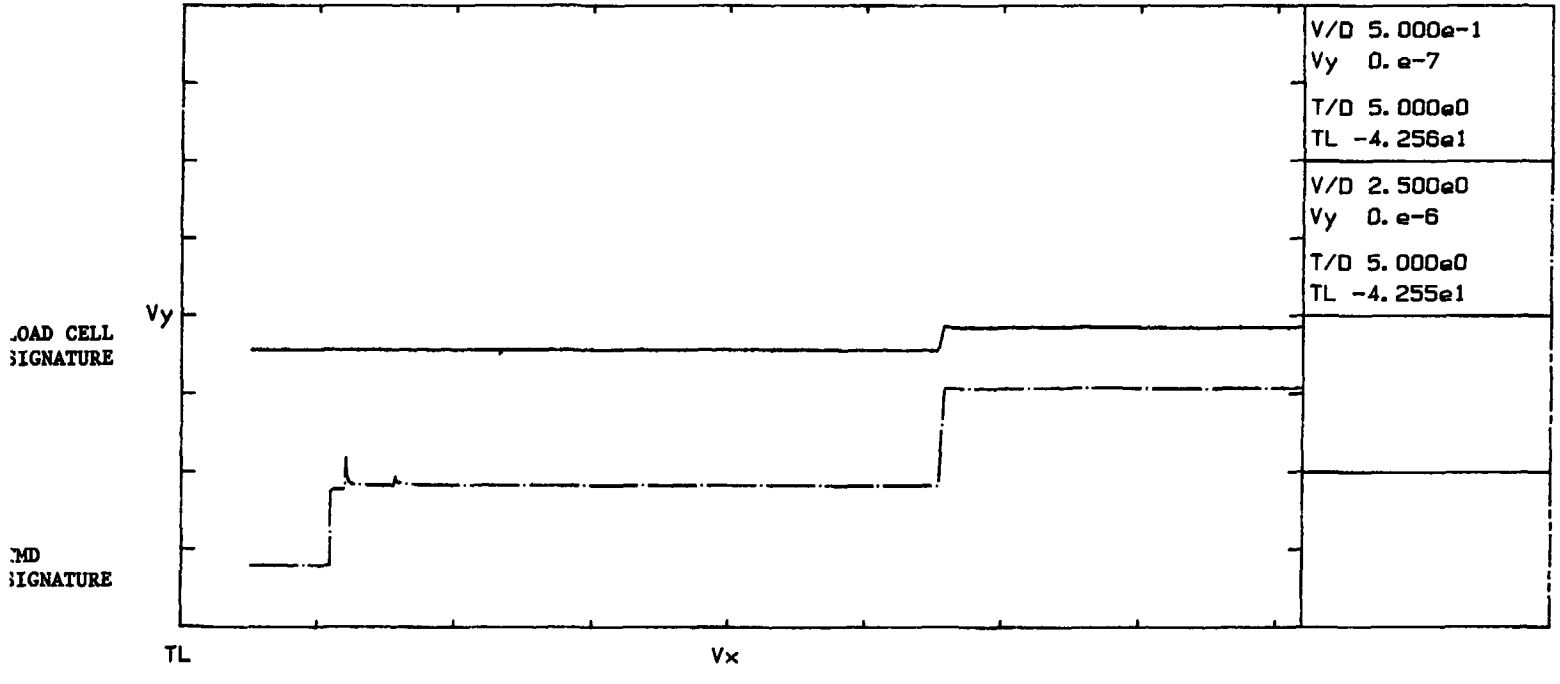
179

TEST IDENTIFICATION: VALVE #18
STORAGE LOCATION : 1-13

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: < RUNNING LOAD
K-FACTOR: 5630 #/V



Test I.D. Valve #19

Code	Comments
4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
4	The torque switch was found to be out of balance by a factor of 2.3 to 1.0. (See Recommendation #1).
4	This valve exhibits approximately 230% inertia. (See Recommendation #2).
4	The open torque switch setting was changed from 2.5 to 1.5 and the closed torque switch setting was changed from 2.0 to 1.0 to attain the correct target thrust loads.
4	During equipment installation, it was noted that the spring cartridge cap was full of grease. (See Recommendation #3).

Recommendations

1. The torque switch was adjusted to attain as close to a balanced condition as possible (1.6 to 1.0). This data should be considered if it becomes necessary to change torque switch settings in the future without the use of the MOVATS Series 2000 System.

2. Due to the fact that the total thrust value is well within the design limitations of the actuator, this condition does not, in our opinion, jeopardize the operability of the valve at this time.

3. It should be noted that the Belleville springs do not require lubrication to function properly.

TEST ID: VALVE #19

SYSTEM		OPERATOR	
SYSTEM	:	TYPE	: SMB
FLOW	: 0	SIZE	: 0
TEMP	: AMBIENT	SERIAL NO.	: 95086A
PRESS	: ATMOSPHERIC	ORDER NO.	: 336542C
SFTY REL'D:		ORIENTATION:	VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS:	120	ID. NO.	: C0V-10B
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION:	HORIZONTAL
MCC	:	INITIAL POSITION:	
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	:

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 1.0/1.0	VOLTS	: 460 AC
CLOSE T.S. SETTING:	1.5/1.5	RATED AMPS:	4.6
LIMITER PLATE	: 2.5	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER:	7.5

TEST EQUIPMENT

LOAD CELL # : 50 K--

AMP PROBE # : FLUKE(20)

MAINFRAME # :

TMD # :

TEST ID: VALVE #19 BY: RLB DATE: 06-16-85

THRUST SIGNATURE ANALYSIS

TS-OC-03-08		TS-CO-03-09	
STROKE TIME	: 63.9 SECONDS	STROKE TIME	: 63.78 SECONDS
BYPASS TIME	: 0.28 SECONDS	BYPASS TIME	: 3.96 SECONDS
THRUST AT CST	: 3610 #	PROTECTION MARGIN	: 3.2 SECONDS
SEAT THRUST AT CST	: 3554 #	UNSEATING TIME	: 0.78 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 224 %	UNSEATING THRUST	: 6570 #
TOTAL THRUST	: 9671 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.5/1.5	TORQUE SW. SETTING	: 1.0/1.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-03-07 K-FACTOR: 5638 #/V PRELOAD: 1440 #

MOTOR CURRENT SIGNATURE ANALYSIS

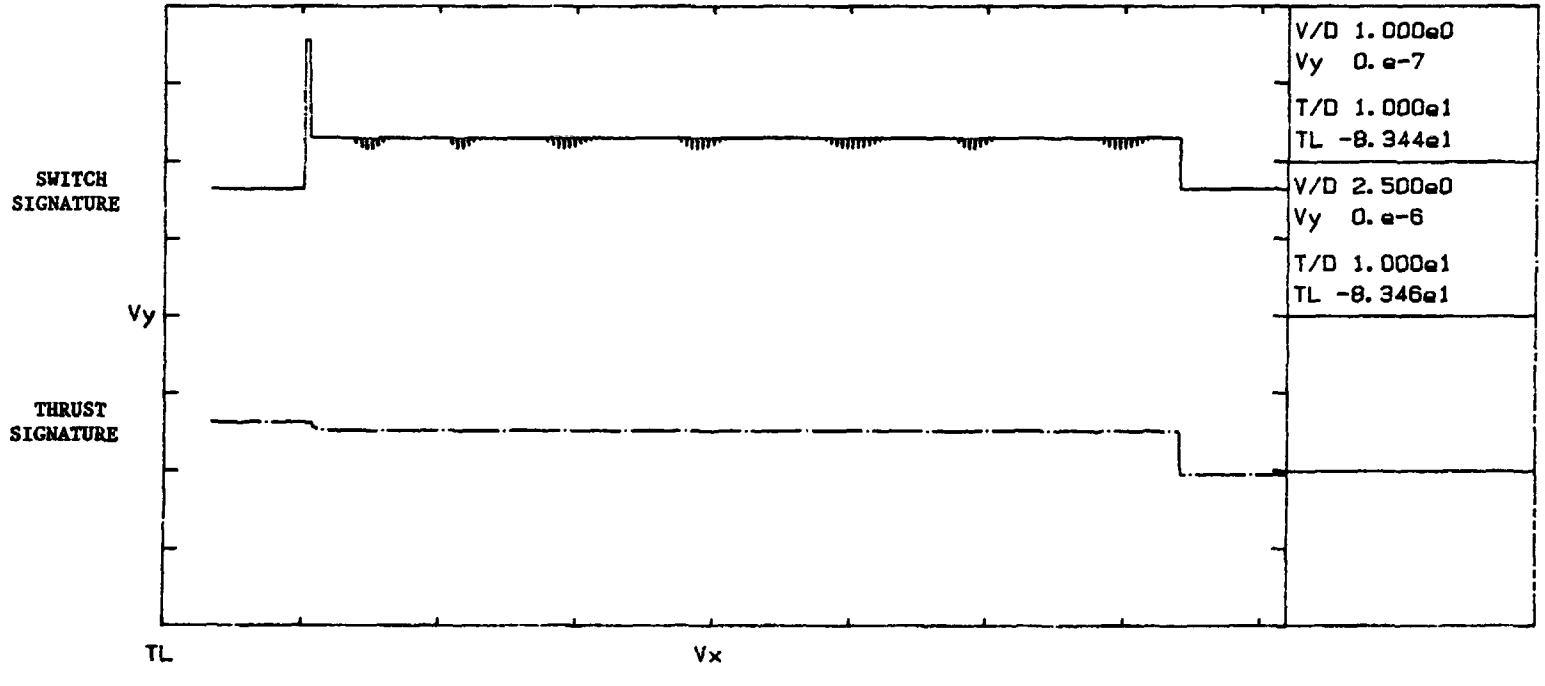
CS-OC-03-10		CS-CO-03-11	
STROKE TIME	: 63.84 SECONDS	STROKE TIME	: 63.8 SECONDS
PEAK INRUSH	: 7.15 AMPERES	PEAK INRUSH	: 6.29 AMPERES
AVE. RUN CURRENT	: 2.28 AMPERES	AVE. RUN CURRENT	: 2.19 AMPERES
MAX. RUN CURRENT	: 2.28 AMPERES	MAX. RUN CURRENT	: 2.19 AMPERES
SEATING CURRENT	: 2.35 AMPERES	END CURRENT	: 2.19 AMPERES

TEST IDENTIFICATION: VALVE #19
STORAGE LOCATION : 03-08

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 63.9 SECONDS	AVE RUN THRUST	:<PRELOAD
		MAX RUN THRUST	:<PRELOAD
BYPASS TIME	: 0.28 SECONDS	THRUST AT CST	: 3610 #
		SEAT THRUST AT CST	: 3554 #
		INERTIAL THRUST	: 224 %
TORQUE SW. SETTING: 1.5/1.5		TOTAL THRUST	: 9671 #

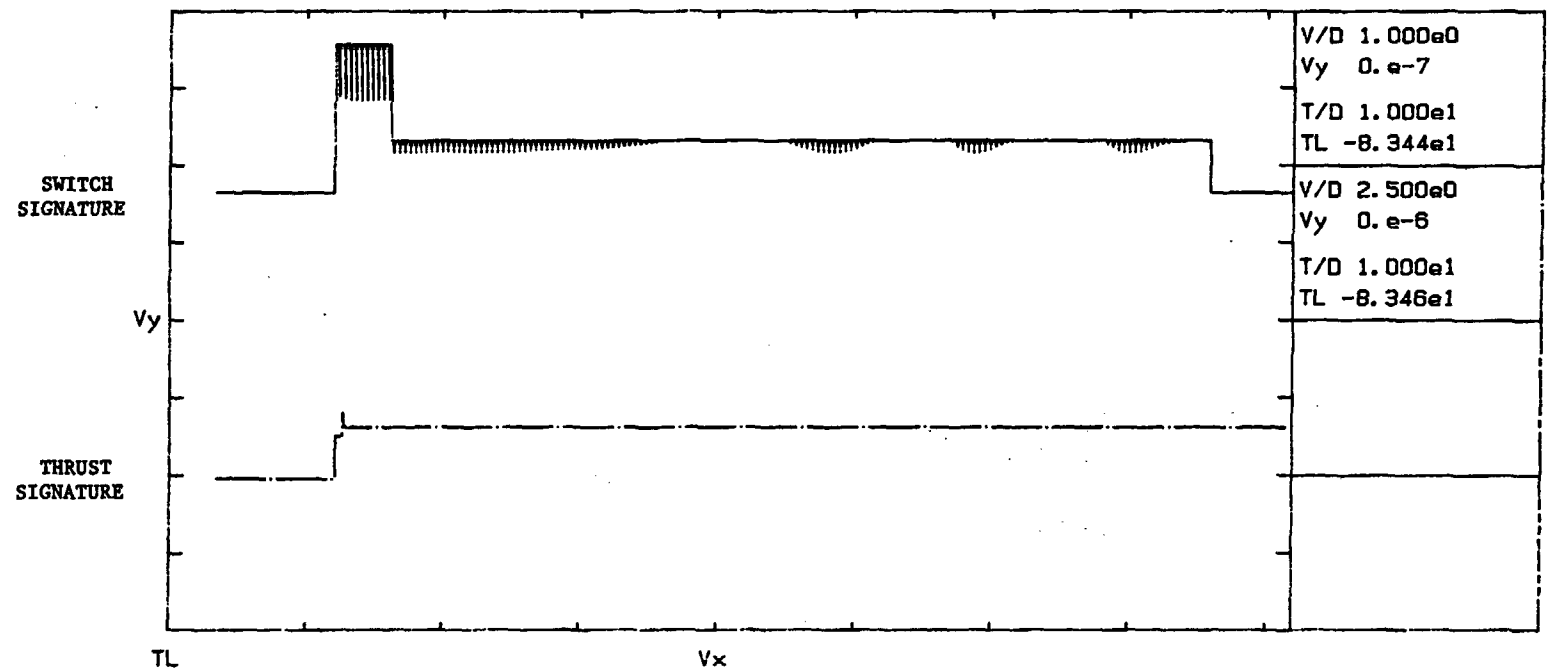


TEST IDENTIFICATION: VALVE #19
STORAGE LOCATION : 03-09

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 63.78 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 3.98 SECONDS	UNSEATING THRUST	: 6570 #
UNSEATING TIME	: 0.78 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 3.2 SECONDS	TORQUE SW. SETTING	: 1.0/1.0



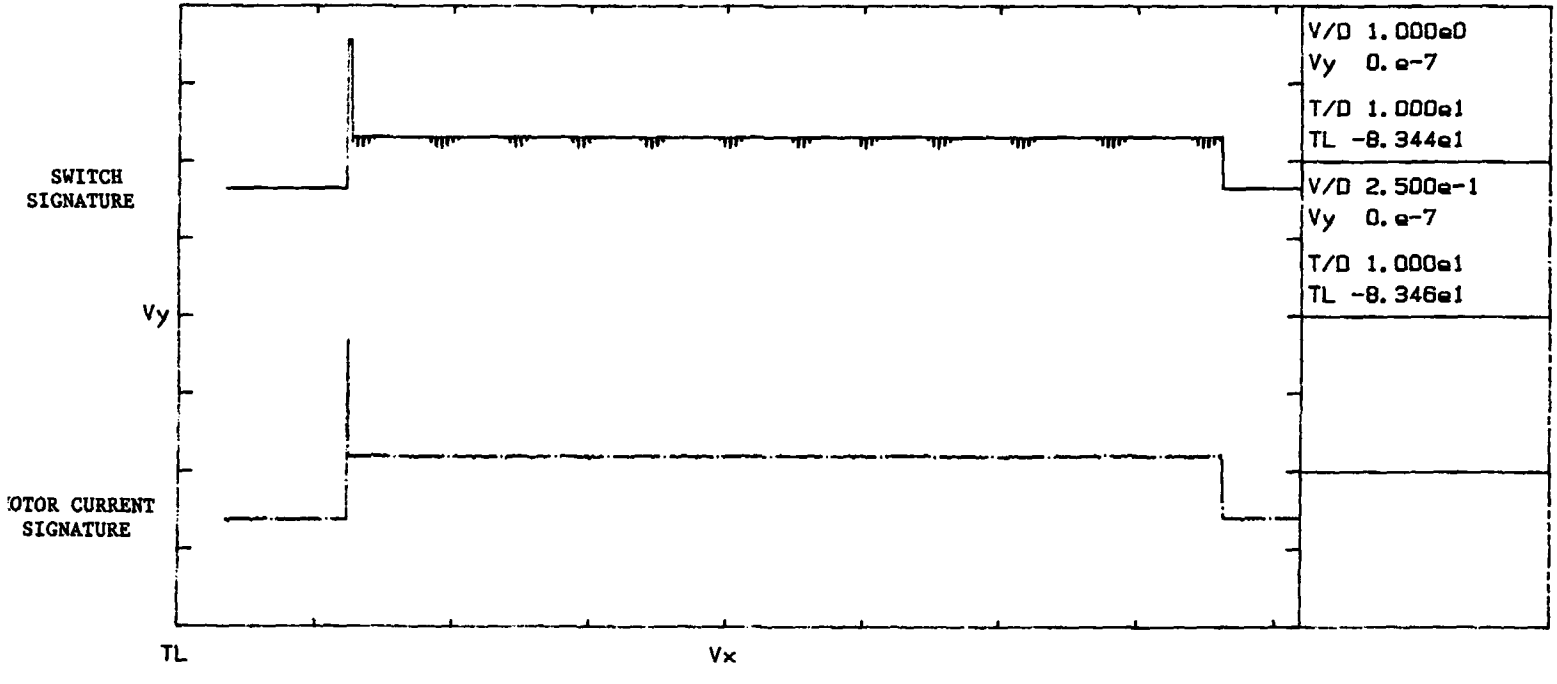
TEST IDENTIFICATION: VALVE #19
STORAGE LOCATION : 03-10

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 63.84 SECONDS

PEAK INRUSH : 7.15 AMPERES
AVE. RUN CURRENT : 2.28 AMPERES
MAX. RUN CURRENT : 2.28 AMPERES
SEATING CURRENT : 2.35 AMPERES



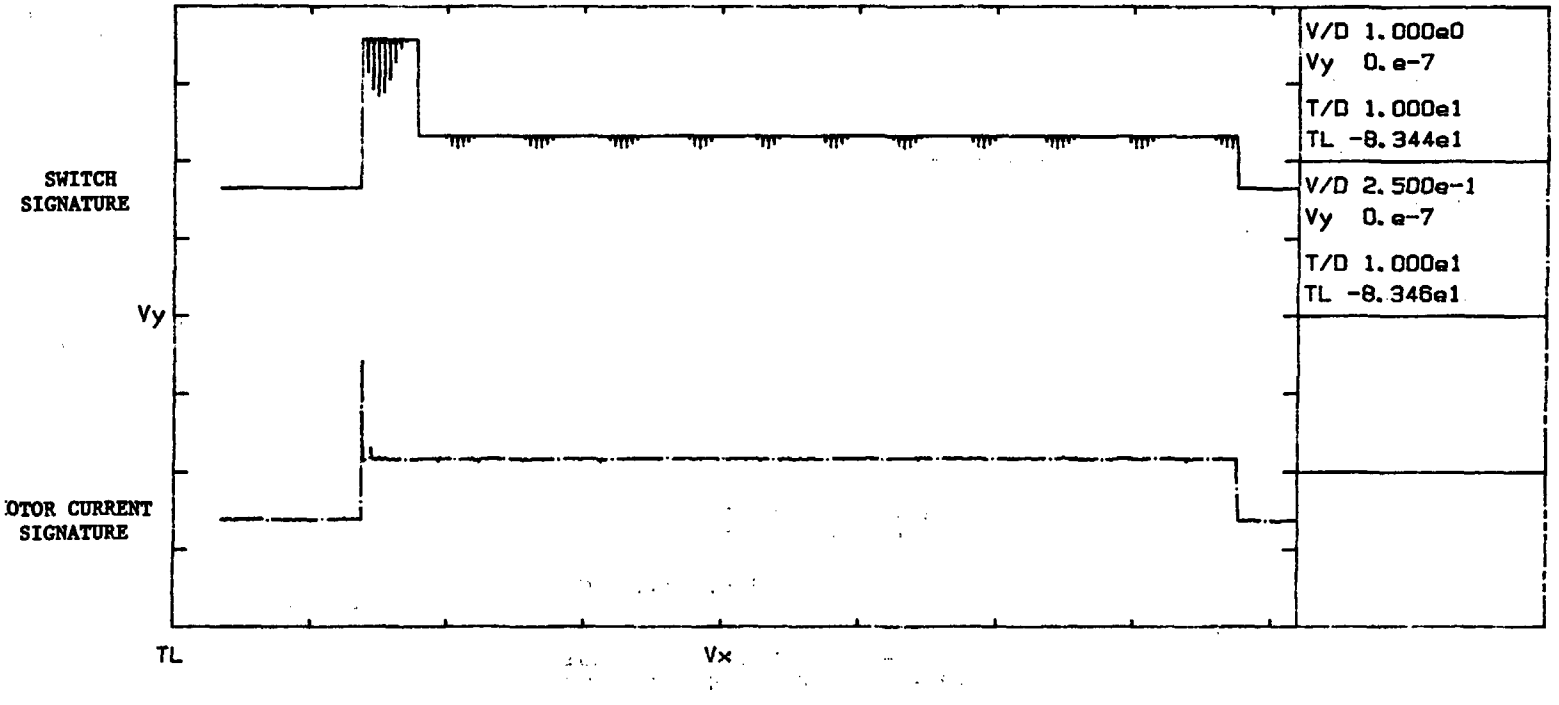
TEST IDENTIFICATION: VALVE #19
STORAGE LOCATION : 03-11

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 63.8 SECONDS

PEAK INRUSH	: 6.29	AMPERES
AVE. RUN CURRENT	: 2.19	AMPERES
MAX. RUN CURRENT	: 2.19	AMPERES
END CURRENT	: 2.19	AMPERES

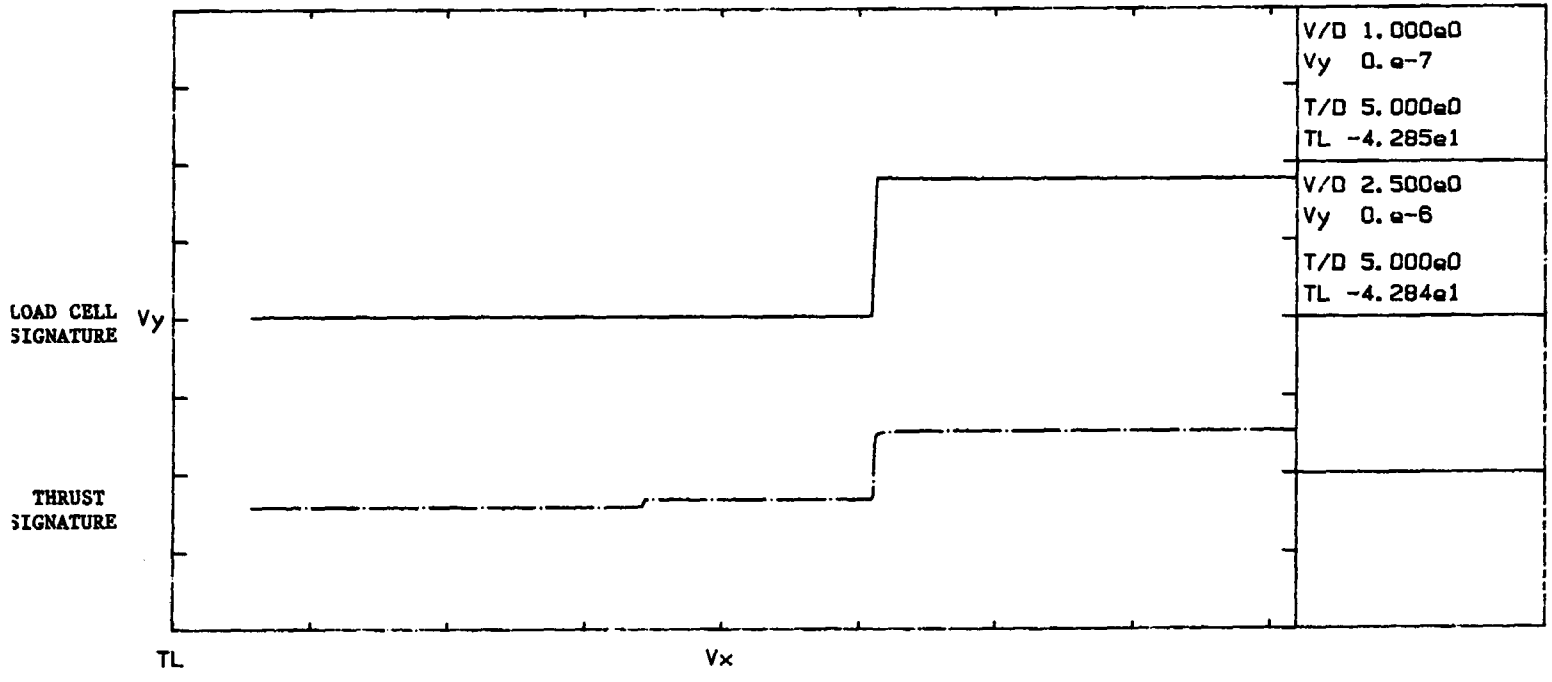


TEST IDENTIFICATION: VALVE #19
STORAGE LOCATION : 03-07

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 1440 #
K-FACTOR: 5638 #/V



TEST ID: VALVE #20 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

TS-OC-05-02		TS-CO-05-03	
STROKE TIME	: 53.14 SECONDS	STROKE TIME	: 52.86 SECONDS
BYPASS TIME	: 0 SECONDS	BYPASS TIME	: 3.08 SECONDS
THRUST AT CST	: 16020 #	PROTECTION MARGIN	: 1.88 SECONDS
SEAT THRUST AT CST	: 15960 #	UNSEATING TIME	: 1.2 SECONDS
AVE RUN THRUST	: 60 #	AVE RUN THRUST	: 480 #
MAX RUN THRUST	: 120 #	MAX RUN THRUST	: 960 #
INERTIAL THRUST	: 7 %	UNSEATING THRUST	: 2640 #
TOTAL THRUST	: 17160 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.0/<2.0	TORQUE SW. SETTING	: 2.0/<2.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-05-01 K-FACTOR: 12000 #/V PRELOAD: < RUNNING LOAD

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-05-04		CS-CO-05-05	
STROKE TIME	: 53.16 SECONDS	STROKE TIME	: 52.88 SECONDS
PEAK INRUSH	: 11.08 AMPERES	PEAK INRUSH	: 11.31 AMPERES
AVE. RUN CURRENT	: 1.56 AMPERES	AVE. RUN CURRENT	: 1.41 AMPERES
MAX. RUN CURRENT	: 1.5 AMPERES	MAX. RUN CURRENT	: 1.41 AMPERES
SEATING CURRENT	: 3.19 AMPERES	END CURRENT	: 1.41 AMPERES

Test I. D. Valve #20

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve. This condition was corrected at the time of testing.
1,4	The thrust signatures revealed that the valve was backseating. This condition was corrected at the time of testing.
3	The close-to-open thrust signature revealed the possibility for slight guide wear. (See Recommendation #1).
4	The open torque switch setting was changed from 2.0 to <2.0 and the closed torque switch setting was changed from 2.0 to >1.5 to attain the target thrust values.

Recommendations

1. This condition does not, in our opinion, jeopardize the operability of the valve at this time, but should be monitored during the next testing period.

TEST ID: VALVE #20

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 0
TEMP	: AMBIENT	SERIAL NO.	: 144289
PRESS	: ATMOSPHERIC	ORDER NO.	: 359329A
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: DHV-3
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: NA/

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.0/<2.0	VOLTS	: 0 AC
CLOSE T.S. SETTING	: 2.0/<2.0	RATED AMPS	: 460
LIMITER PLATE	: 3.0	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER	: N/A

TEST EQUIPMENT

LOAD CELL # : 50K--N/A

AMP PROBE # : FLUKE(20) N/A

MAINFRAME # : N/A

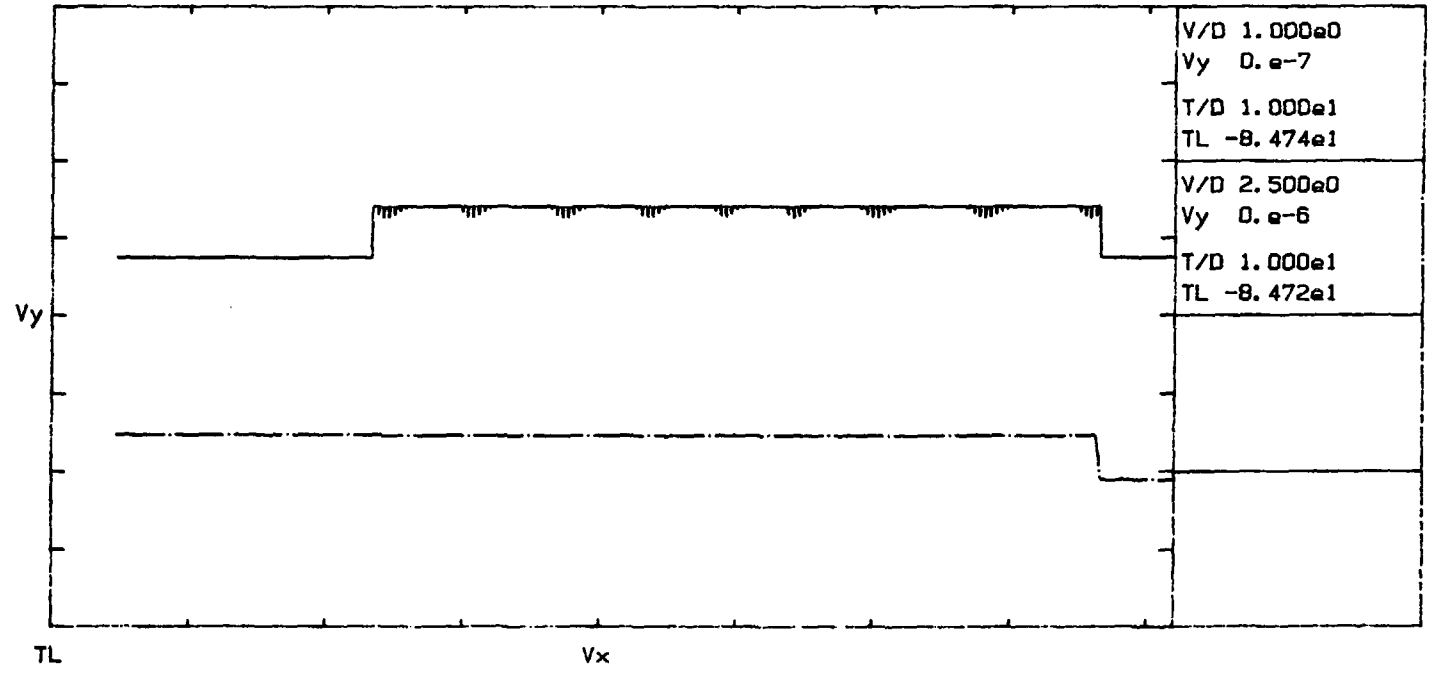
TMD # : N/A

TEST IDENTIFICATION: VALVE #20
STORAGE LOCATION : 05-02

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 53.14 SECONDS	AVE RUN THRUST	: 60 #
		MAX RUN THRUST	: 120 #
BYPASS TIME	: 0 SECONDS	THRUST AT CST	: 16020 #
		SEAT THRUST AT CST	: 15960 #
		INERTIAL THRUST	: 7 %
TORQUE SW. SETTING:	2.0/<2.0	TOTAL THRUST	: 17160 #

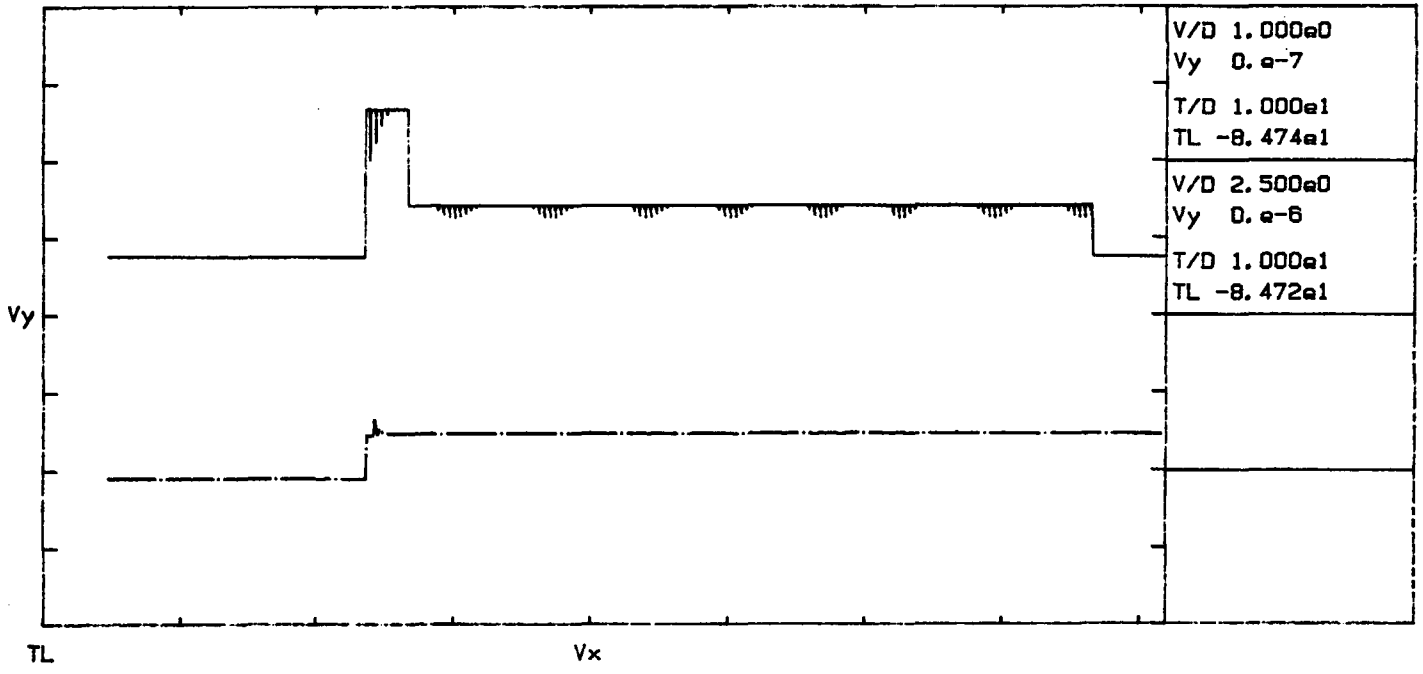


TEST IDENTIFICATION: VALVE #20
STORAGE LOCATION : 05-03

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 52.86 SECONDS	AVE RUN THRUST	: 480 #
		MAX RUN THRUST	: 960 #
BYPASS TIME	: 3.08 SECONDS	UNSEATING THRUST	: 2640 #
UNSEATING TIME	: 1.2 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 1.88 SECONDS	TORQUE SW. SETTING	: 2.0/<2.0



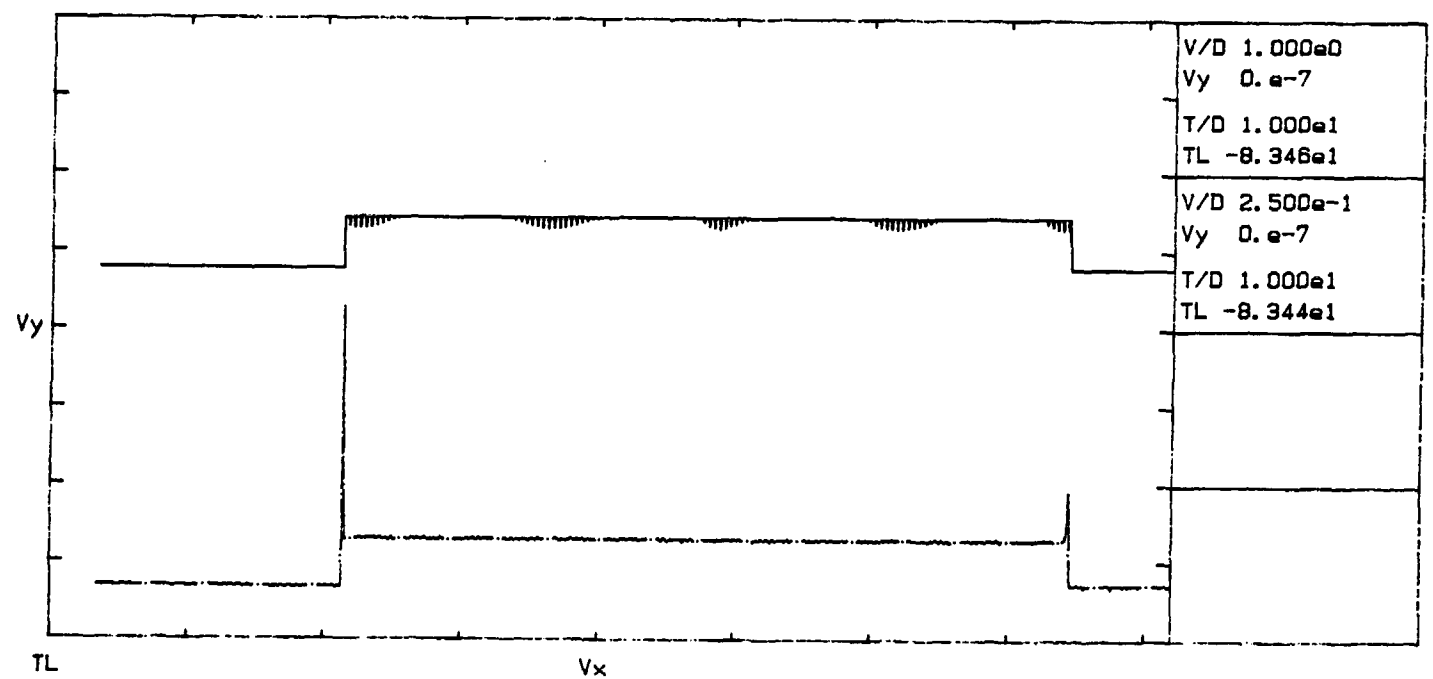
TEST IDENTIFICATION: VALVE #20
STORAGE LOCATION : 05-04

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 53.16 SECONDS

PEAK INRUSH : 11.08 AMPERES
AVE. RUN CURRENT : 1.56 AMPERES
MAX. RUN CURRENT : 1.5 AMPERES
SEATING CURRENT : 3.19 AMPERES



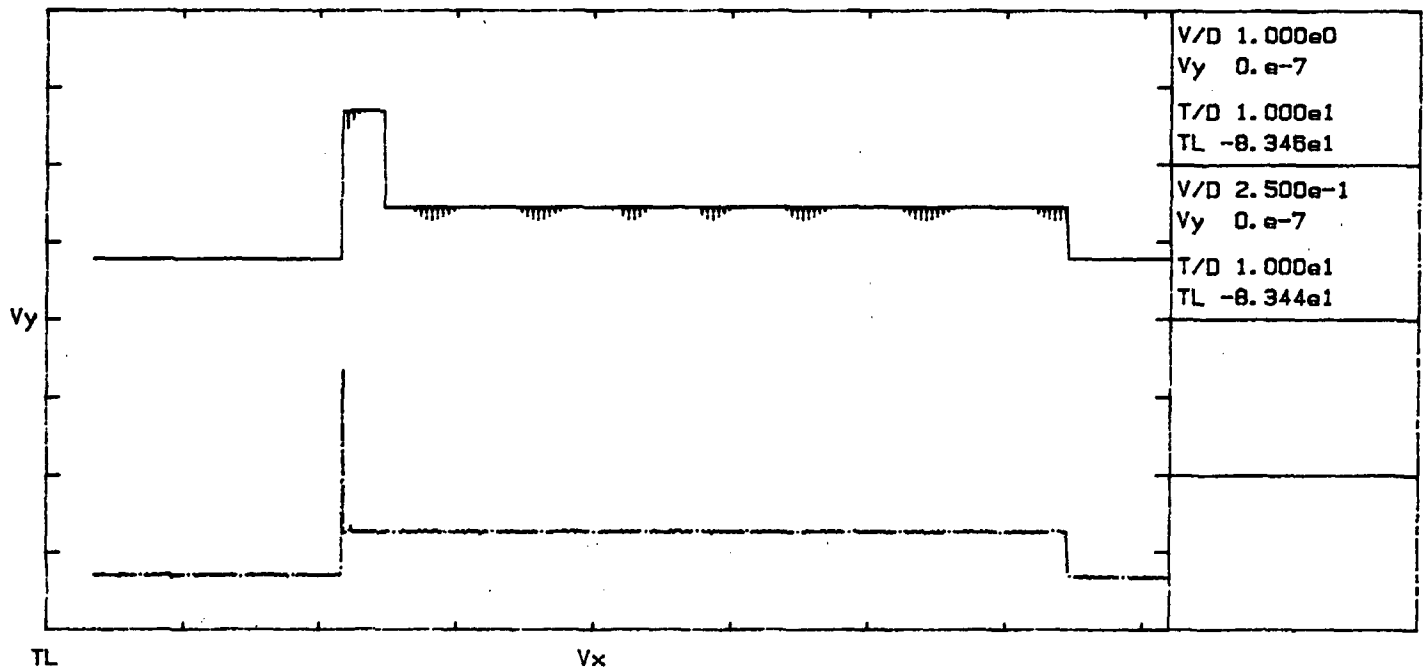
TEST IDENTIFICATION: VALVE #20
STORAGE LOCATION : 05-05

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 52.88 SECONDS

PEAK INRUSH : 11.31 AMPERES
AVE. RUN CURRENT : 1.41 AMPERES
MAX. RUN CURRENT : 1.41 AMPERES
END CURRENT : 1.41 AMPERES

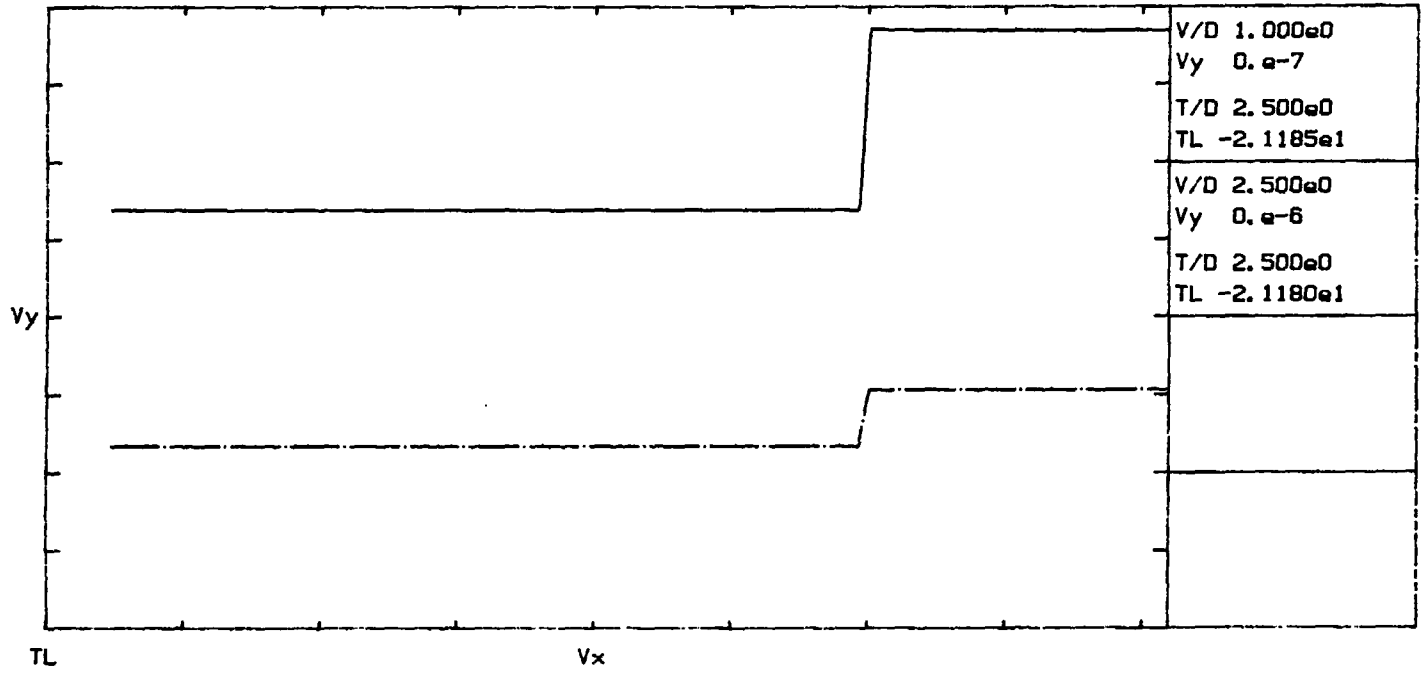


TEST IDENTIFICATION: VALVE #20
STORAGE LOCATION : 05-01

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: < RUNNING LOAD
K-FACTOR: 12000 #/V



TEST ID: VALVE #21

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 3
TEMP	: AMBIENT	SERIAL NO.	: 101465
PRESS	: ATMOSPHERIC	ORDER NO.	: 336584F
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: DHV-2
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.0/1.0	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 1.0/1.0	RATED AMPS	: 9.8
LIMITER PLATE	: NONE	SPEED	: 1725
TS BALANCEABLE	: YES	HORSEPOWER	: 6.56

TEST EQUIPMENT

LOAD CELL #	: 200K--N/A
AMP PROBE #	: FLUKE(200) N/A
MAINFRAME #	: N/A
TMD #	: N/A

Test I. D. Valve #21

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the valve unseating.
4	There is an apparent gap of approximately .011" in the spring pack assembly.
4	The torque switch was found to be out of balance by a factor of 1.2 to 1.0. This condition was corrected at the time of the test.
4	The open torque switch setting was changed from 2.0 to 1.0 to obtain the target thrust load. The closed torque switch setting remained at 1.0.

Recommendations

1. No further corrective action necessary at this time.

TEST ID: VALVE #21 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

TS-OC-05-12		TS-CO-05-13	
STROKE TIME	: 50.46 SECONDS	STROKE TIME	: 49.6 SECONDS
BYPASS TIME	: 0 SECONDS	BYPASS TIME	: 6.16 SECONDS
THRUST AT CST	: 32456 #	PROTECTION MARGIN	: 3.72 SECONDS
SEAT THRUST AT CST	: 32345 #	UNSEATING TIME	: 2.44 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 309 %	UNSEATING THRUST	: 39754 #
TOTAL THRUST	: 54573 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.0/1.0	TORQUE SW. SETTING	: 2.0/1.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-05-11 K-FACTOR: 22117 #/V PRELOAD: 25600 #

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-05-14		CS-CO-05-15	
STROKE TIME	: 50.56 SECONDS	STROKE TIME	: 49.68 SECONDS
PEAK INRUSH	: 51.7 AMPERES	PEAK INRUSH	: 52.72 AMPERES
AVE. RUN CURRENT	: 5.46 AMPERES	AVE. RUN CURRENT	: 5.8 AMPERES
MAX. RUN CURRENT	: 5.46 AMPERES	MAX. RUN CURRENT	: 5.8 AMPERES
SEATING CURRENT	: 7.44 AMPERES	END CURRENT	: 5.54 AMPERES

TEST IDENTIFICATION: VALVE #21
STORAGE LOCATION : 05-12

PLOT NO. 1

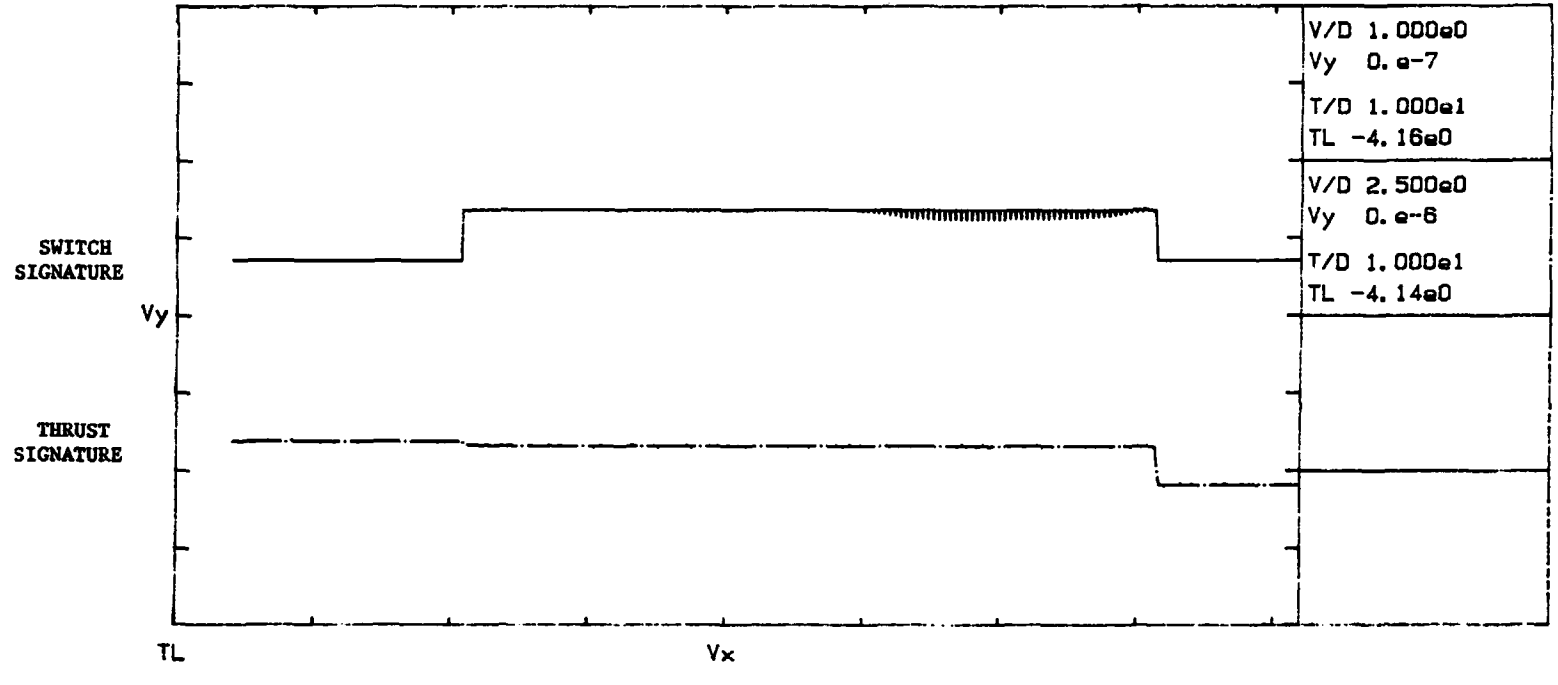
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 50.46 SECONDS

BYPASS TIME : 0 SECONDS

TORQUE SW. SETTING: 1.0/1.0

AVE RUN THRUST :<PRELOAD
MAX RUN THRUST :<PRELOAD
THRUST AT CST : 32456 #
SEAT THRUST AT CST: 32345 #
INERTIAL THRUST : 309 %
TOTAL THRUST : 54573 #

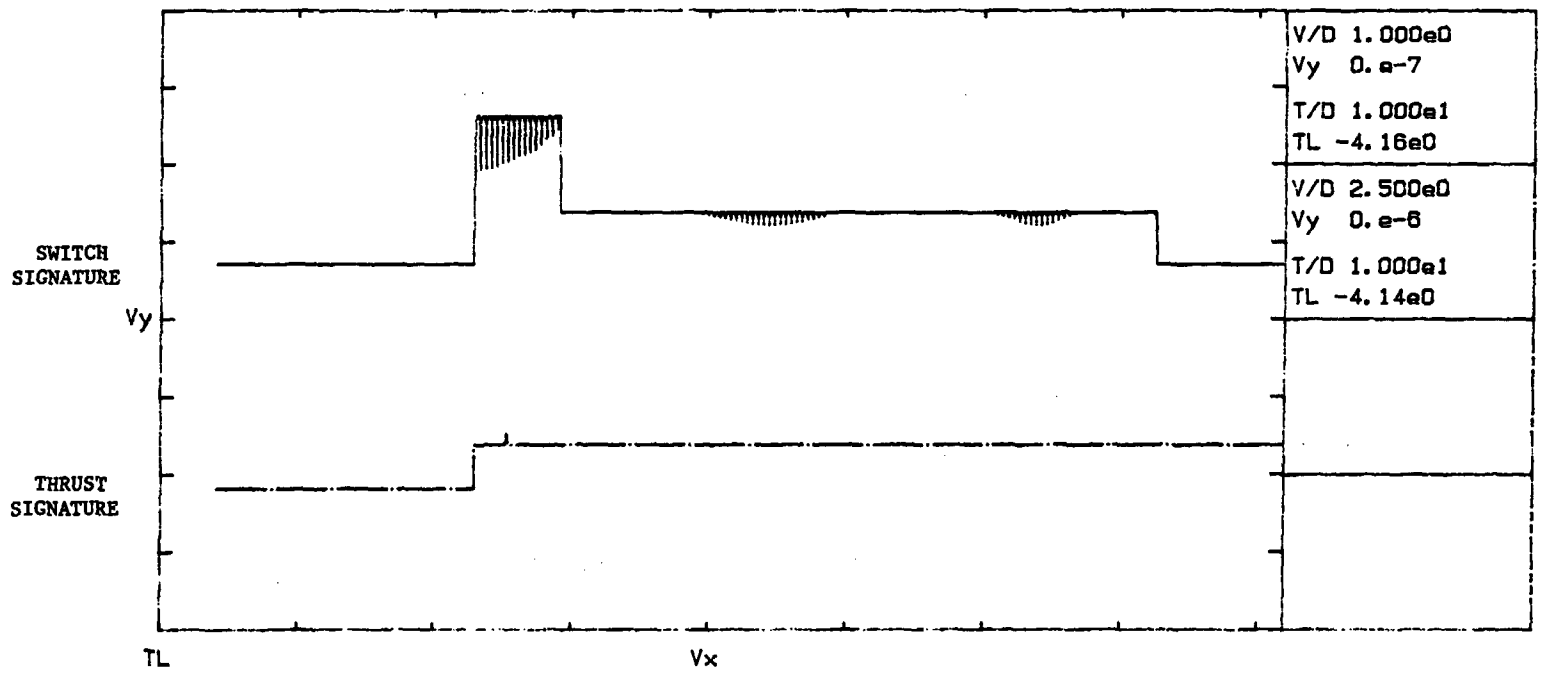


TEST IDENTIFICATION: VALVE #21
STORAGE LOCATION : 05-13

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 49.6 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 6.16 SECONDS	UNSEATING THRUST	: 39754 #
UNSEATING TIME	: 2.44 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 3.72 SECONDS	TORQUE SW. SETTING	: 2.0/1.0



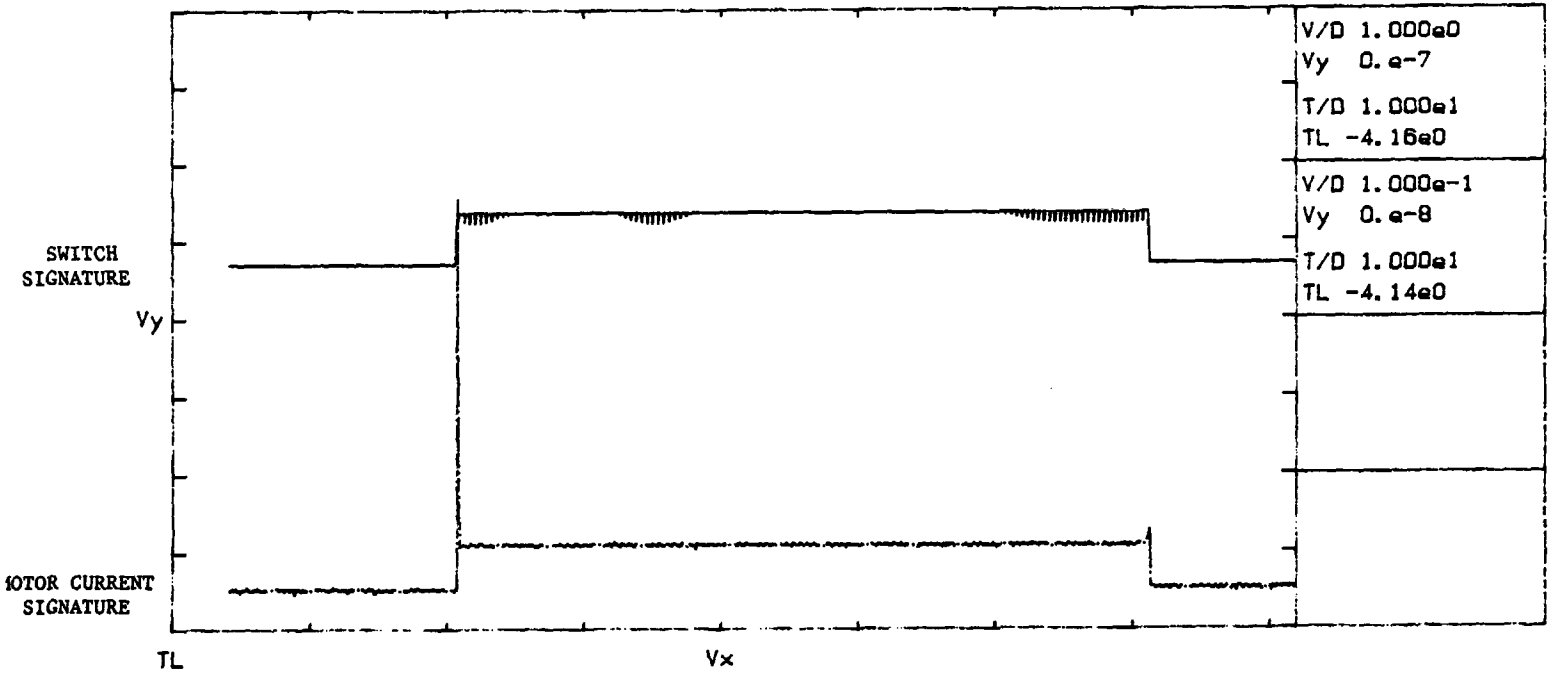
TEST IDENTIFICATION: VALVE #21
STORAGE LOCATION : 05-14

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 50.56 SECONDS

PEAK INRUSH : 51.7 AMPERES
AVE. RUN CURRENT : 5.46 AMPERES
MAX. RUN CURRENT : 5.46 AMPERES
SEATING CURRENT : 7.44 AMPERES



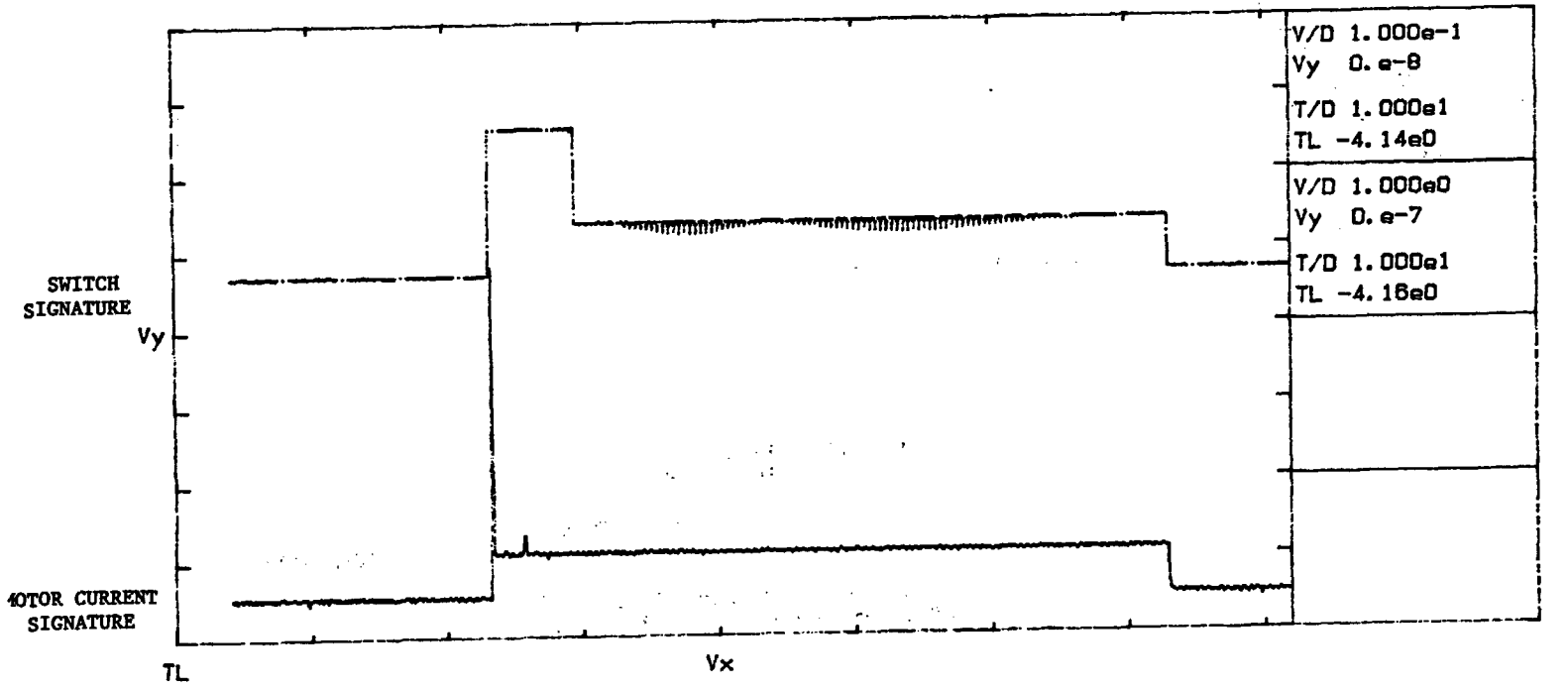
TEST IDENTIFICATION: VALVE #21
STORAGE LOCATION : 05-15

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 49.68 SECONDS

PEAK INRUSH : 52.72 AMPERES
AVE. RUN CURRENT : 5.8 AMPERES
MAX. RUN CURRENT : 5.8 AMPERES
END CURRENT : 5.54 AMPERES

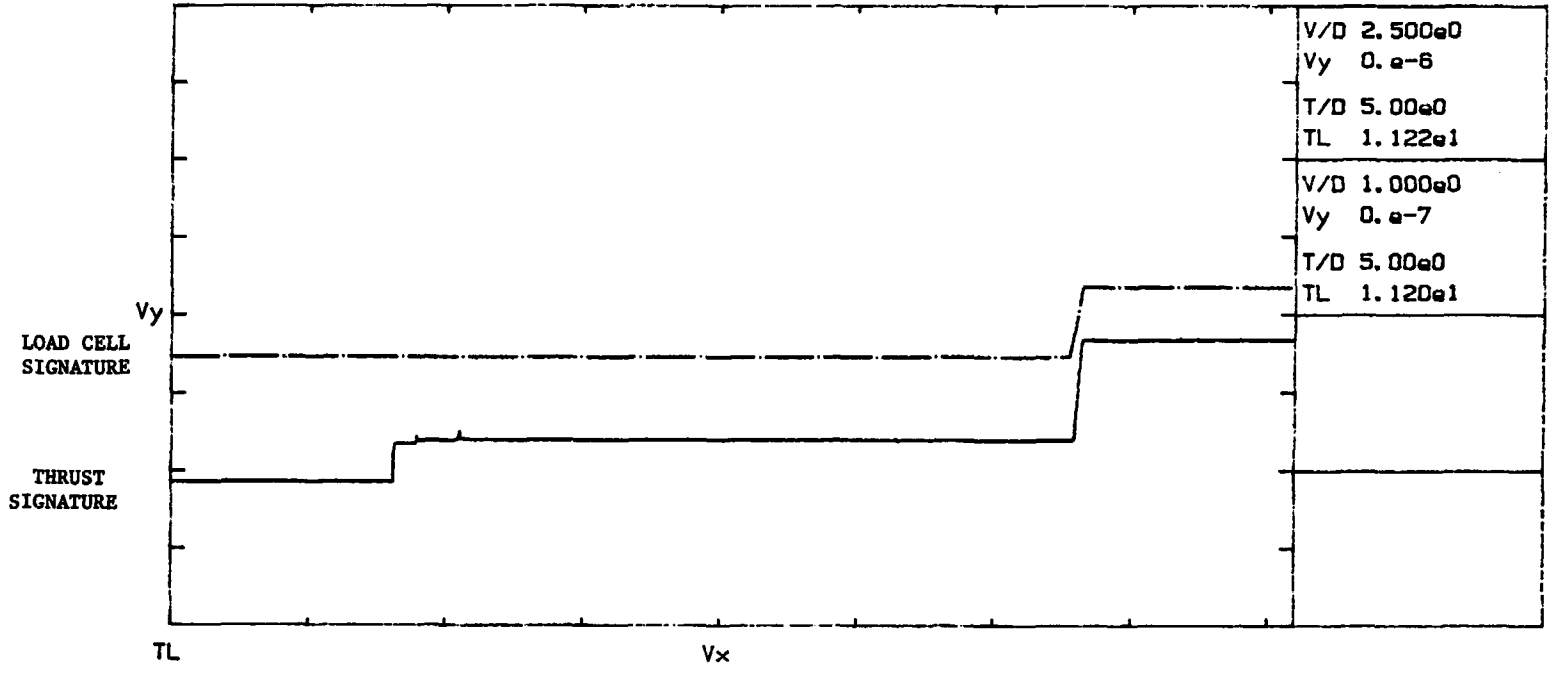


TEST IDENTIFICATION: VALVE #21
STORAGE LOCATION : 05-11

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 25600 #
K-FACTOR: 22117 #/V



TEST ID: VALVE #22

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 00
TEMP	: AMBIENT	SERIAL NO.	: 101234
PRESS	: ATMOSPHERIC	ORDER NO.	: 337110
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: RCV-4
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 1.5
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 1.5/1.5	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 1.5/1.5	RATED AMPS	: 2.3
LIMITER PLATE	: 3.0	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER	: 0.7

TEST EQUIPMENT

LOAD CELL # : 50K--N/A

AMP PROBE # : FLUKE(20) N/A

MAINFRAME # : N/A

TMD # : N/A

Test I.D. Valve #22

Code	Comments
4	At the time of testing, no closing or opening thrust values were available. In our effort to document alternative torque switch settings, should the thrust figures become available, the torque switches were reset to 2.5. Both thrust values increased and were over the design maximum of this operator. However, in this case, this valve has a rotating stem and because of the mechanical design, exerted no excessive force on the operator. The final close torque switch setting allowed the operator to develop slightly more than the 14,000 pound maximum. This was brought to the attention of management and provisions were made to lower the setting slightly, even though this condition posed no danger to the operator. (See Recommendation #1).
4	The close-to-open bypass switch required adjustment to properly cover the valve unseating.
4	The thrust signatures reveal an apparent gap of approximately .050" in the spring pack assembly.
4	In the current signatures there is an apparent cyclic loading condition at a frequency of approximately 2.0 seconds. (See Recommendation #2).

Recommendations

1. Consideration should be given to installing a torque switch limiter plate at a setting of 1.5 to prevent a torque switch setting that would not protect the MOV assembly from a mechanical overload condition.

2. This characteristic is typical of rotating stem type operators and does not, in our opinion, jeopardize the operability of the valve at this time. No further corrective action is necessary at this time.

TEST ID: VALVE #22 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

TS-OC-06-02		TS-CO-06-03	
STROKE TIME	: 25.22 SECONDS	STROKE TIME	: 24.86 SECONDS
BYPASS TIME	: 1.61 SECONDS	BYPASS TIME	: 3.13 SECONDS
THRUST AT CST	: 13079 #	PROTECTION MARGIN	: 1.42 SECONDS
SEAT THRUST AT CST	: 13079 #	UNSEATING TIME	: 1.71 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 14 %	UNSEATING THRUST	: 7238 #
TOTAL THRUST	: 14797 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.5/1.5	TORQUE SW. SETTING	: 1.5/1.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-06-01 K-FACTOR: 9818 #/V PRELOAD: 3360 #

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-06-04		CS-CO-06-05	
STROKE TIME	: 25.12 SECONDS	STROKE TIME	: 24.84 SECONDS
PEAK INRUSH	: 5.91 AMPERES	PEAK INRUSH	: 6 AMPERES
AVE. RUN CURRENT	: 1.72 AMPERES	AVE. RUN CURRENT	: 1.77 AMPERES
MAX. RUN CURRENT	: 1.77 AMPERES	MAX. RUN CURRENT	: 1.79 AMPERES
SEATING CURRENT	: 1.85 AMPERES	END CURRENT	: 1.8 AMPERES

TEST IDENTIFICATION: VALVE #22
STORAGE LOCATION : 06-02

PLOT NO. 1

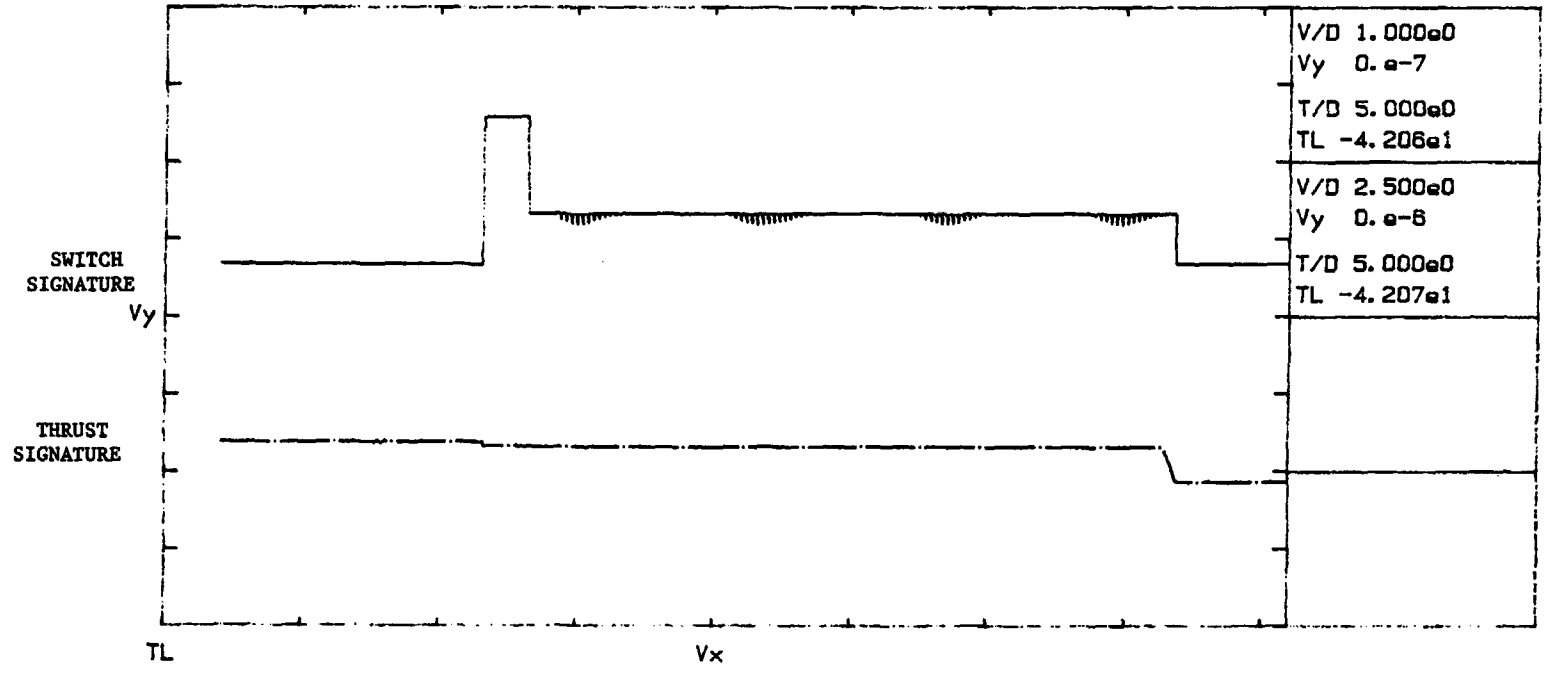
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 25.22 SECONDS

BYPASS TIME : 1.61 SECONDS

TORQUE SW. SETTING: 1.5/1.5

AVE RUN THRUST :<PRELOAD
MAX RUN THRUST :<PRELOAD
THRUST AT CST : 13079 #
SEAT THRUST AT CST: 13079 #
INERTIAL THRUST : 14 %
TOTAL THRUST : 14797 #

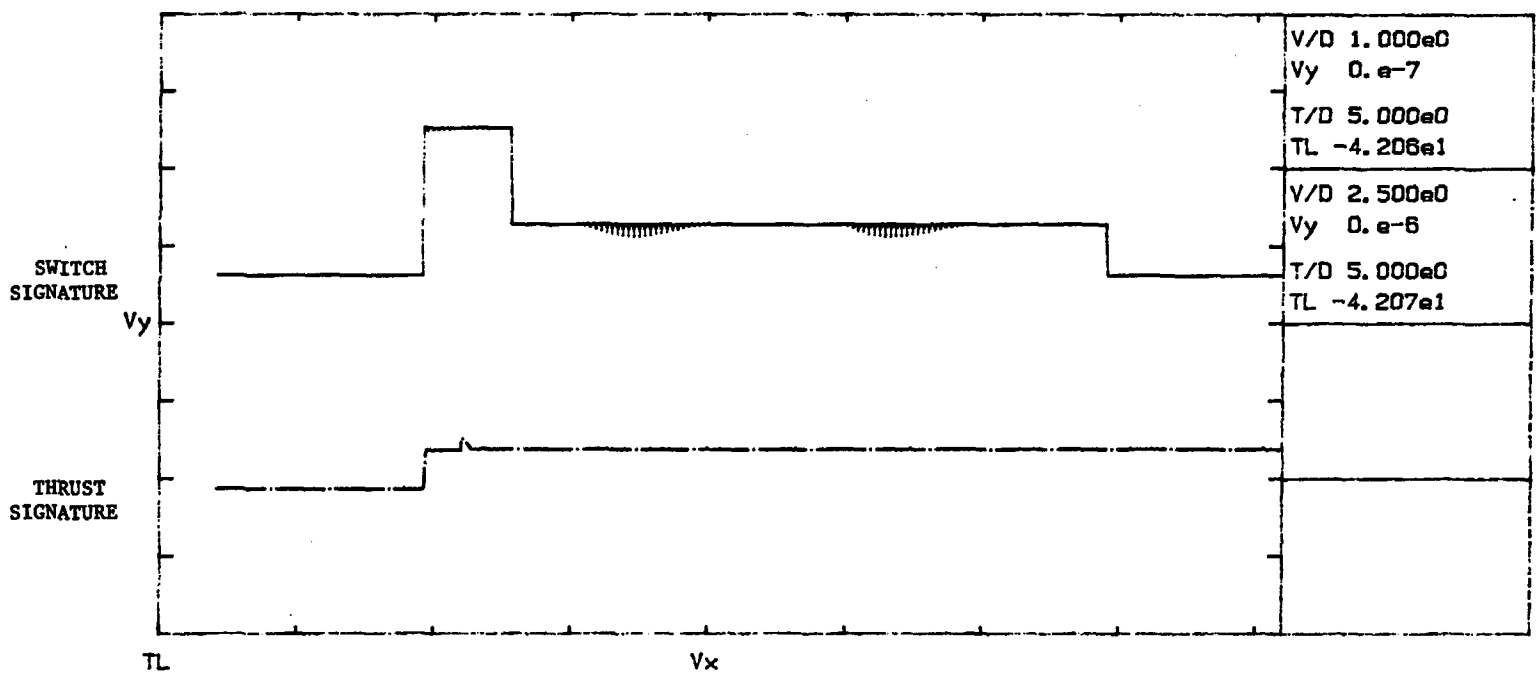


TEST IDENTIFICATION: VALVE #22
STORAGE LOCATION : 06-03

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 24.86 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 3.13 SECONDS	UNSEATING THRUST	: 7238 #
UNSEATING TIME	: 1.71 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 1.42 SECONDS	TORQUE SW. SETTING	: 1.5/1.5



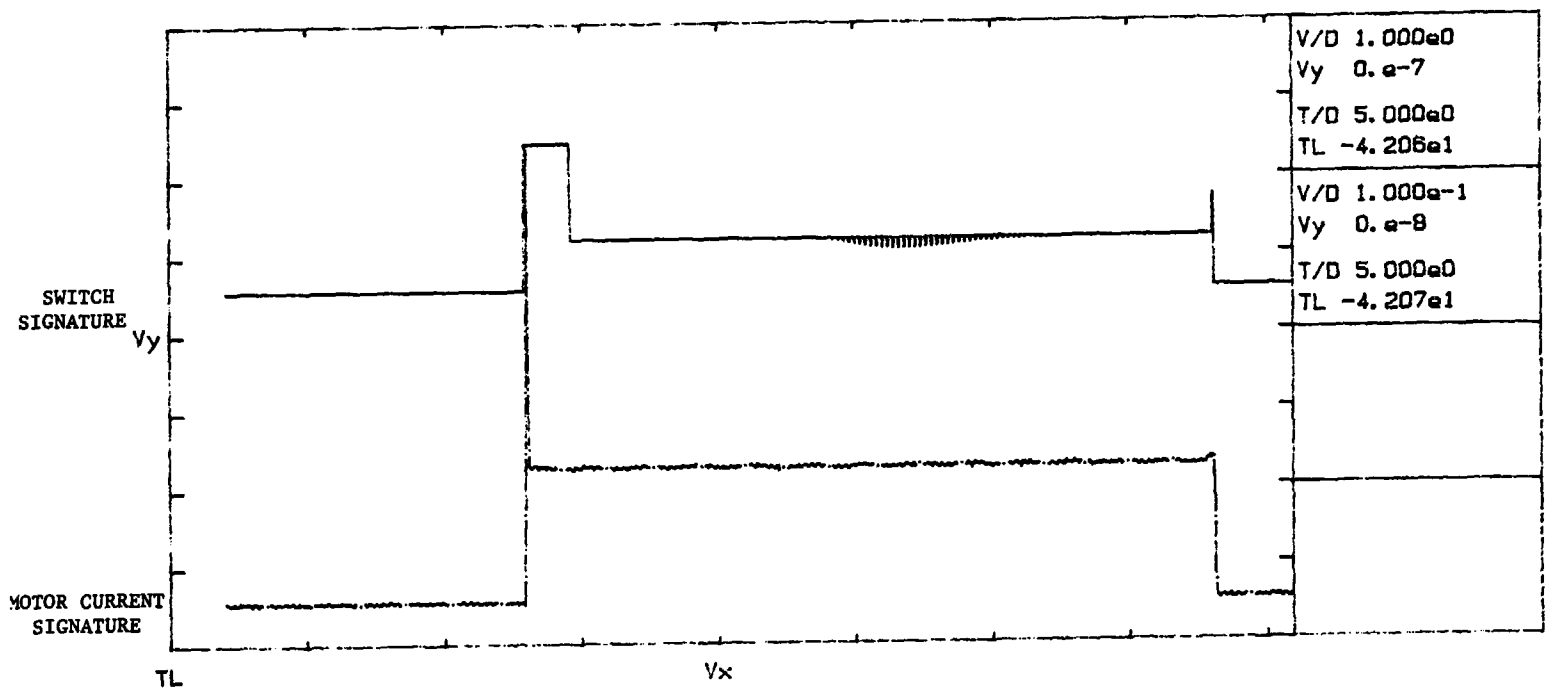
TEST IDENTIFICATION: VALVE #22
STORAGE LOCATION : 06-04

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 25.12 SECONDS

PEAK INRUSH : 5.91 AMPERES
AVE. RUN CURRENT : 1.72 AMPERES
MAX. RUN CURRENT : 1.77 AMPERES
SEATING CURRENT : 1.85 AMPERES



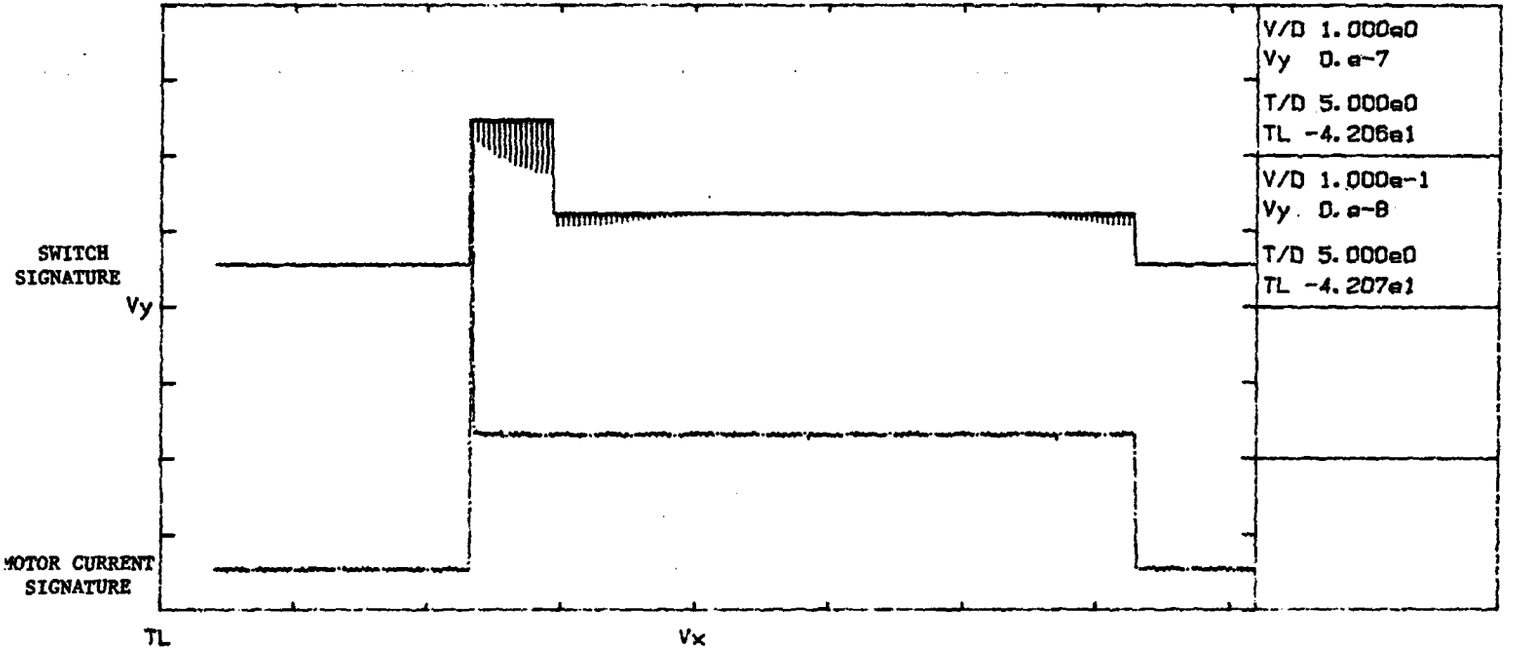
TEST IDENTIFICATION: VALVE #22
STORAGE LOCATION : 06-05

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 24.84 SECONDS

PEAK INRUSH	: 6 AMPERES
AVE. RUN CURRENT	: 1.77 AMPERES
MAX. RUN CURRENT	: 1.79 AMPERES
END CURRENT	: 1.8 AMPERES

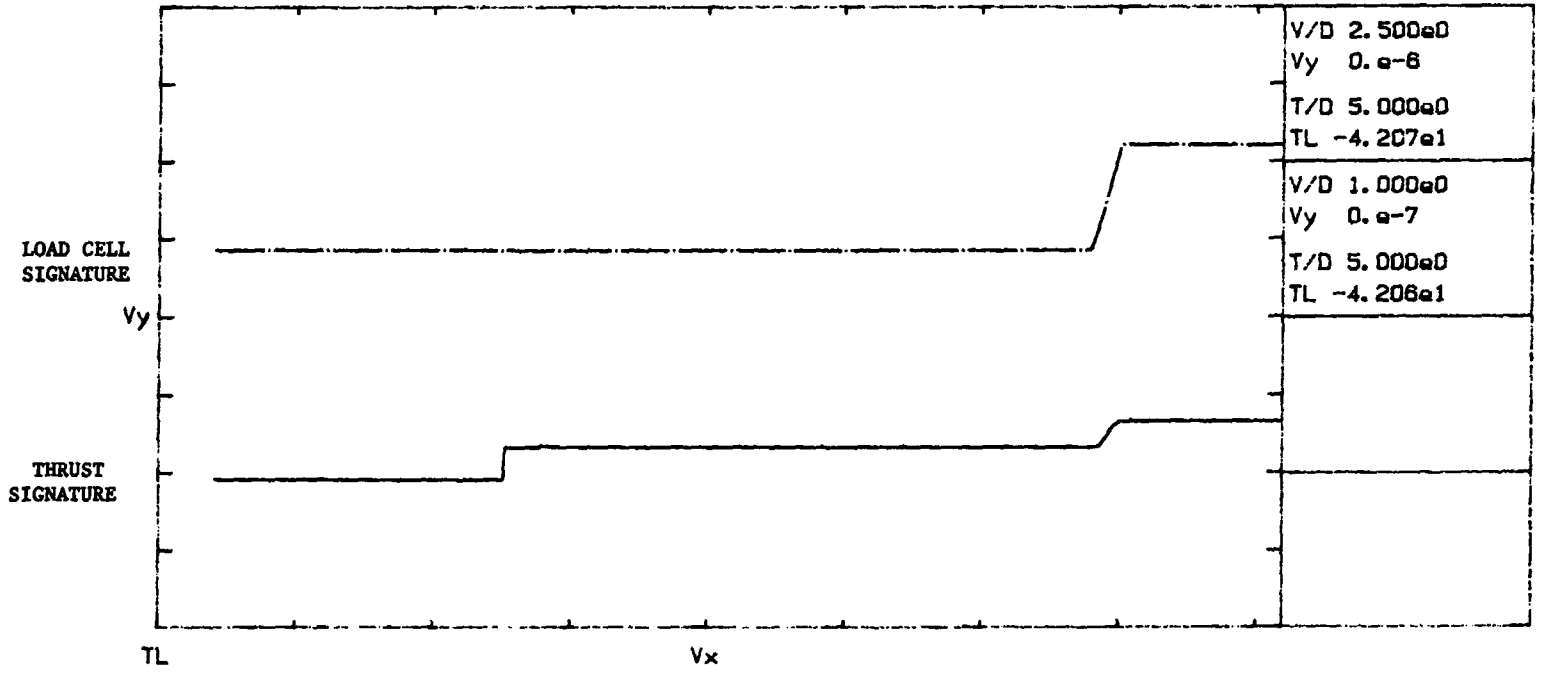


TEST IDENTIFICATION: VALVE #22
STORAGE LOCATION : 06-01

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 3360 #
K-FACTOR: 9818 #/V



TEST ID: VALVE #23

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 3
TEMP	: AMBIENT	SERIAL NO.	: 101464
PRESS	: ATMOSPHERIC	ORDER NO.	: 336584D
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: DH-V-1
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.0/1.0	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 1.5/1.0	RATED AMPS	: 9.8
LIMITER PLATE	: 2.0	SPEED	: 1725
TS BALANCEABLE	: YES	HORSEPOWER	: 6.56

TEST EQUIPMENT

LOAD CELL # : 200K--N/A

AMP PROBE # : FLUKE(200) N/A

MAINFRAME # : N/A

TMD # : N/A

Test I.D. Valve #23

Code	Comments
4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
3	The torque switch was found to be out of balance by a factor of 2.1 to 1.0. (See Recommendation #1).
4	The open torque switch setting was changed from 2.0 to 1.0 and the close torque switch setting was changed from 1.5 to 1.0 to attain target thrust values.

Recommendations

1. Due to rust on the torque switch, it could not be adjusted. This data should be considered if it becomes necessary to change the torque switch settings in the future without the use of the MOVATS 2000 Series System.

TEST ID: VALVE #23 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

	TS-OC-05-07		TS-CO-05-08
STROKE TIME	: 52.98 SECONDS	STROKE TIME	: 51.96 SECONDS
BYPASS TIME	: 0 SECONDS	BYPASS TIME	: 4.44 SECONDS
THRUST AT CST	: 38146 #	PROTECTION MARGIN	: 2.44 SECONDS
SEAT THRUST AT CST	: 38237 #	UNSEATING TIME	: 2 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 129 %	UNSEATING THRUST	: 33957 #
TOTAL THRUST	: 53352 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.5/1.0	TORQUE SW. SETTING	: 2.0/1.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-05-06 K-FACTOR: 18211 #/V PRELOAD: 26400 #

MOTOR CURRENT SIGNATURE ANALYSIS

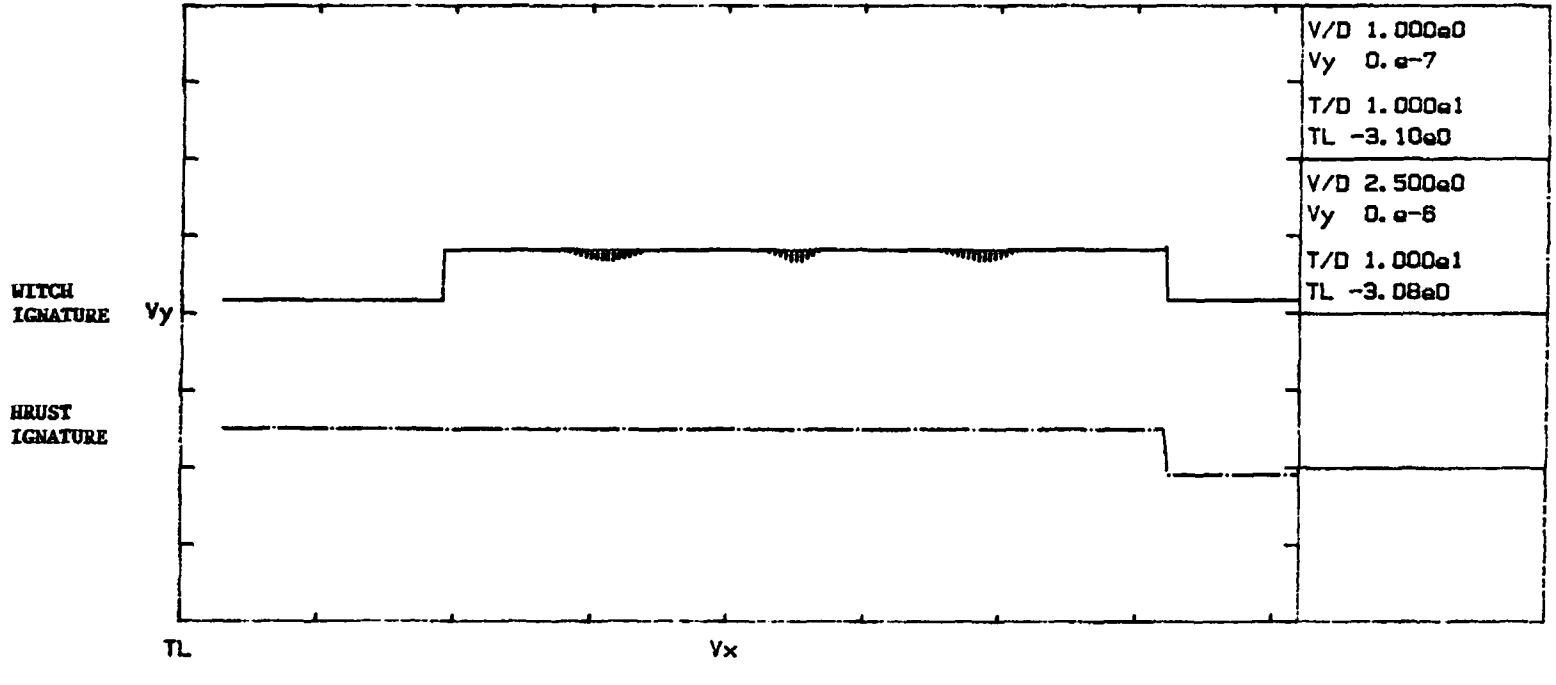
	CS-OC-05-09		CS-CO-05-10
STROKE TIME	: 53.02 SECONDS	STROKE TIME	: 52 SECONDS
PEAK INRUSH	: 58.3 AMPERES	PEAK INRUSH	: 56.7 AMPERES
AVE. RUN CURRENT	: 6.2 AMPERES	AVE. RUN CURRENT	: 6.1 AMPERES
MAX. RUN CURRENT	: 6.2 AMPERES	MAX. RUN CURRENT	: 6.1 AMPERES
SEATING CURRENT	: 8.9 AMPERES	END CURRENT	: 6 AMPERES

TEST IDENTIFICATION: VALVE #23
STORAGE LOCATION : 05-07

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 52.98 SECONDS	AVE RUN THRUST	:<PRELOAD
		MAX RUN THRUST	:<PRELOAD
BYPASS TIME	: 0 SECONDS	THRUST AT CST	: 38146 #
		SEAT THRUST AT CST	: 38237 #
		INERTIAL THRUST	: 129 %
TORQUE SW. SETTING:	1.5/1.0	TOTAL THRUST	: 53352 #

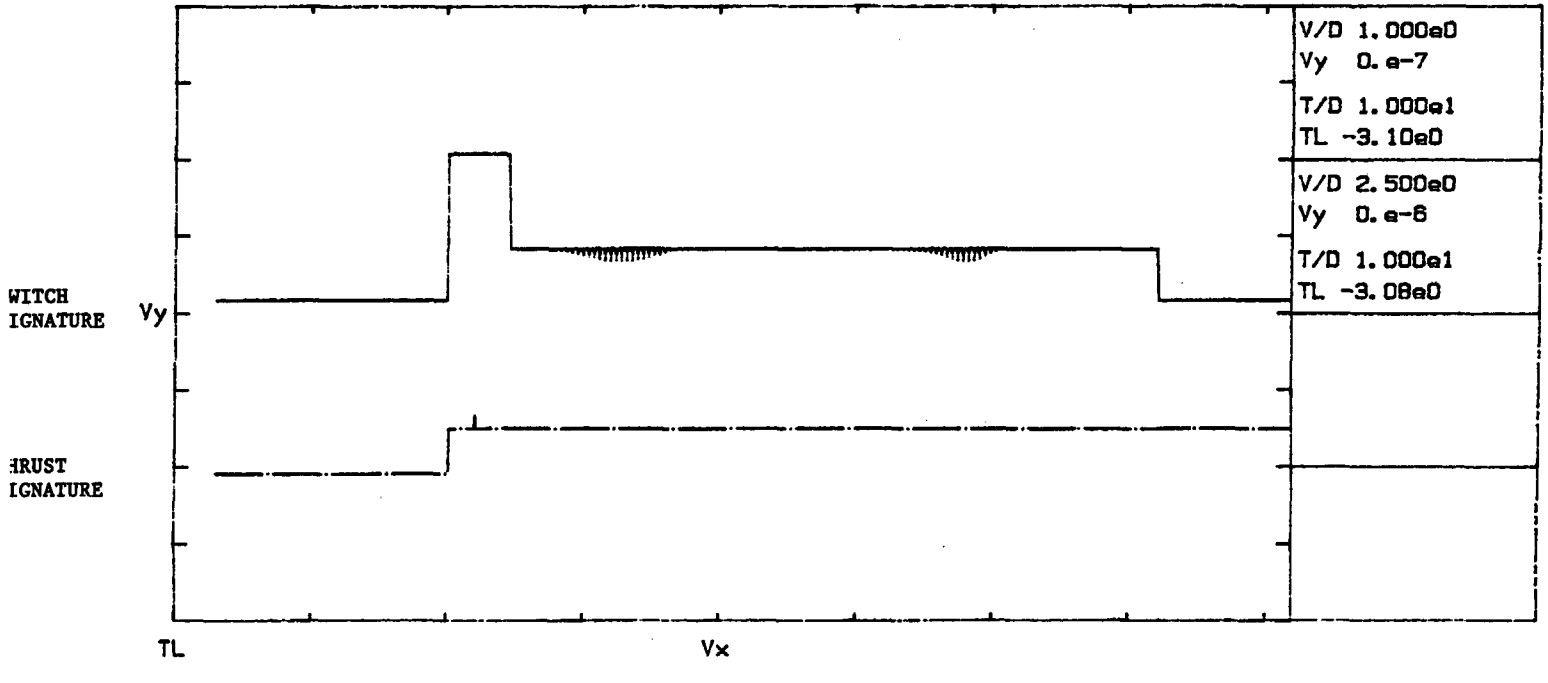


TEST IDENTIFICATION: VALVE #23
STORAGE LOCATION : 05-08

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 51.96 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 4.44 SECONDS	UNSEATING THRUST	: 33957 #
UNSEATING TIME	: 2 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 2.44 SECONDS	TORQUE SW. SETTING	: 2.0/1.0



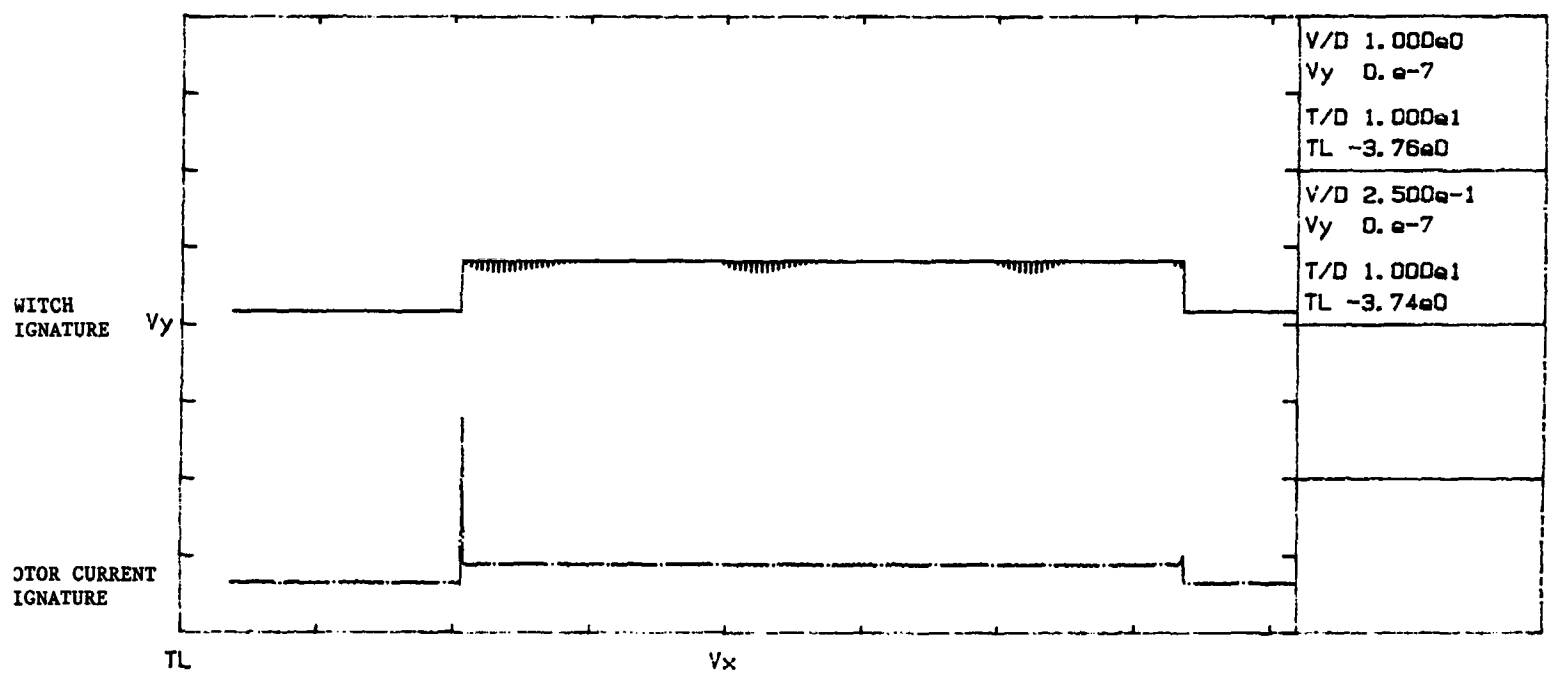
TEST IDENTIFICATION: VALVE #23
STORAGE LOCATION : 05-09

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 53.02 SECONDS

PEAK INRUSH : 5.83 AMPERES
AVE. RUN CURRENT : 0.62 AMPERES
MAX. RUN CURRENT : 0.62 AMPERES
SEATING CURRENT : 0.89 AMPERES



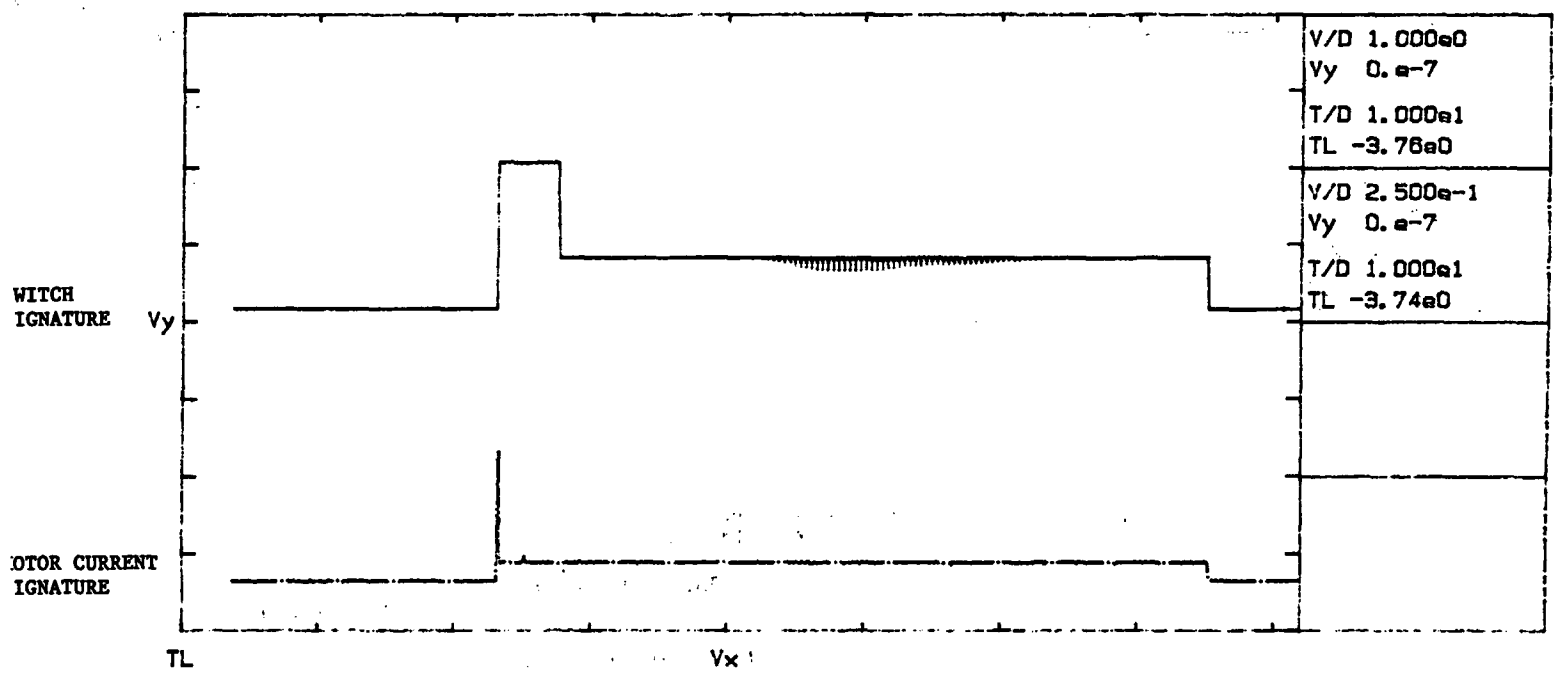
TEST IDENTIFICATION: VALVE #23
STORAGE LOCATION : 05-10

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 52 SECONDS

PEAK INRUSH : 5.67 AMPERES
AVE. RUN CURRENT : 0.61 AMPERES
MAX. RUN CURRENT : 0.61 AMPERES
END CURRENT : 0.6 AMPERES

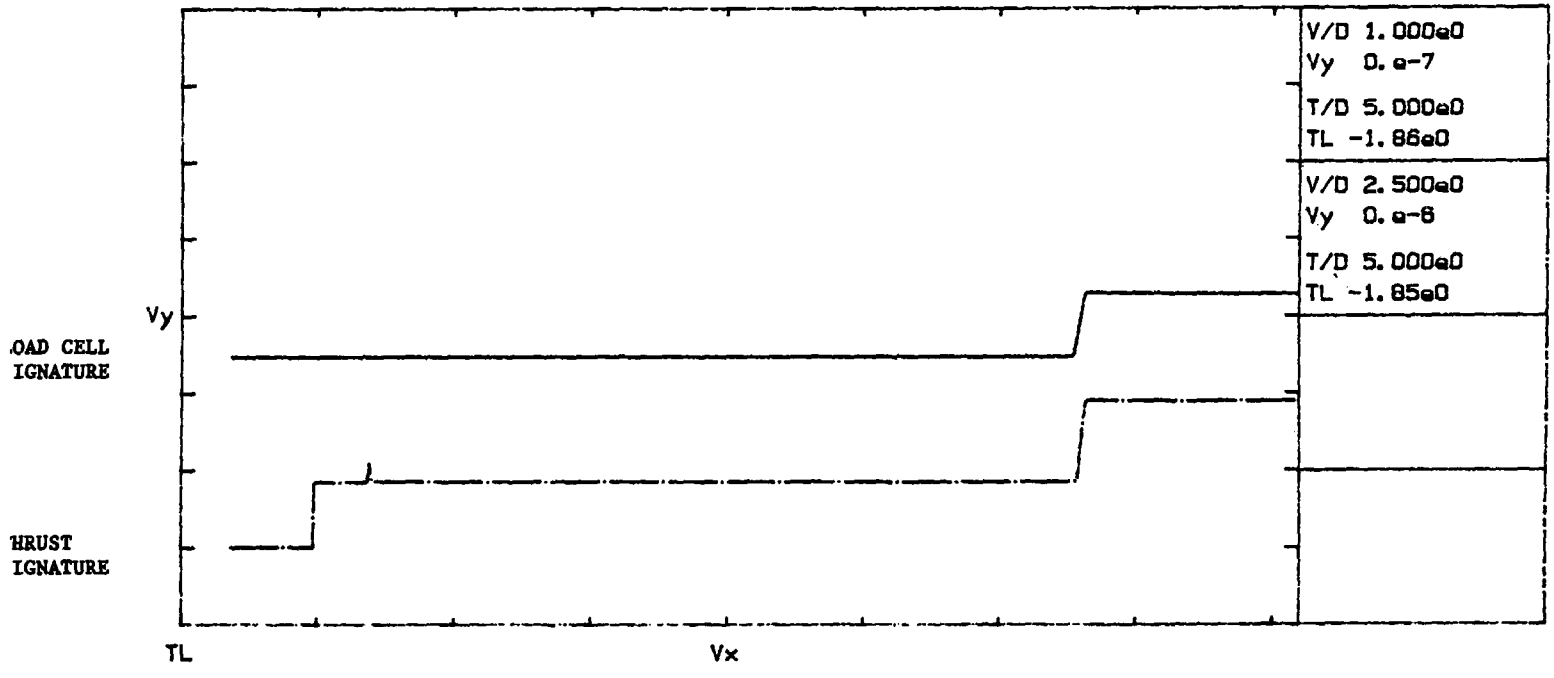


TEST IDENTIFICATION: VALVE #23
STORAGE LOCATION : 05-06

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 26400 #
K-FACTOR: 18211 #/V



Test I.D. Valve #24

Code	Comments
4	The open torque switch setting was raised from 2.0 to 3.0 and the closed torque switch setting was raised from 1.5 to 3.0 to achieve the target thrust load values. (The torque switch blockplate required removal.)
4	The thrust signatures indicate minor loading conditions throughout both opening and closing strokes. (See Recommendation #1).
4	The open-to-close thrust signature reveals a minor degradation as the valve approaches the seat. (See Recommendation #2).

Recommendations

1. This characteristic is typical of rotating stem type operators and does not, in our opinion, jeopardize valve operability at this time.

2. The loading condition is not significant enough to warrant inspection and does not, in our opinion, jeopardize valve operability at this time. However, it should be monitored during future MOVATS testing.

TEST ID: VALVE #24 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

TS-OC-06-07		TS-CO-06-08	
STROKE TIME	: 7.09 SECONDS	STROKE TIME	: 6.882 SECONDS
BYPASS TIME	: 1.142 SECONDS	BYPASS TIME	: 1.506 SECONDS
THRUST AT CST	: 2008 #	PROTECTION MARGIN	: 0.348 SECONDS
SEAT THRUST AT CST	: 1591 #	UNSEATING TIME	: 1.158 SECONDS
AVE RUN THRUST	: 239 #	AVE RUN THRUST	: 467 #
MAX RUN THRUST	: 0 #	MAX RUN THRUST	: 732 #
INERTIAL THRUST	: 22 %	UNSEATING THRUST	: 2414 #
TOTAL THRUST	: 2450 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.5/3.0	TORQUE SW. SETTING	: 2.0/3.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-06-06 K-FACTOR: 725 #/V PRELOAD: < RUNNING LOAD

MOTOR CURRENT SIGNATURE ANALYSIS

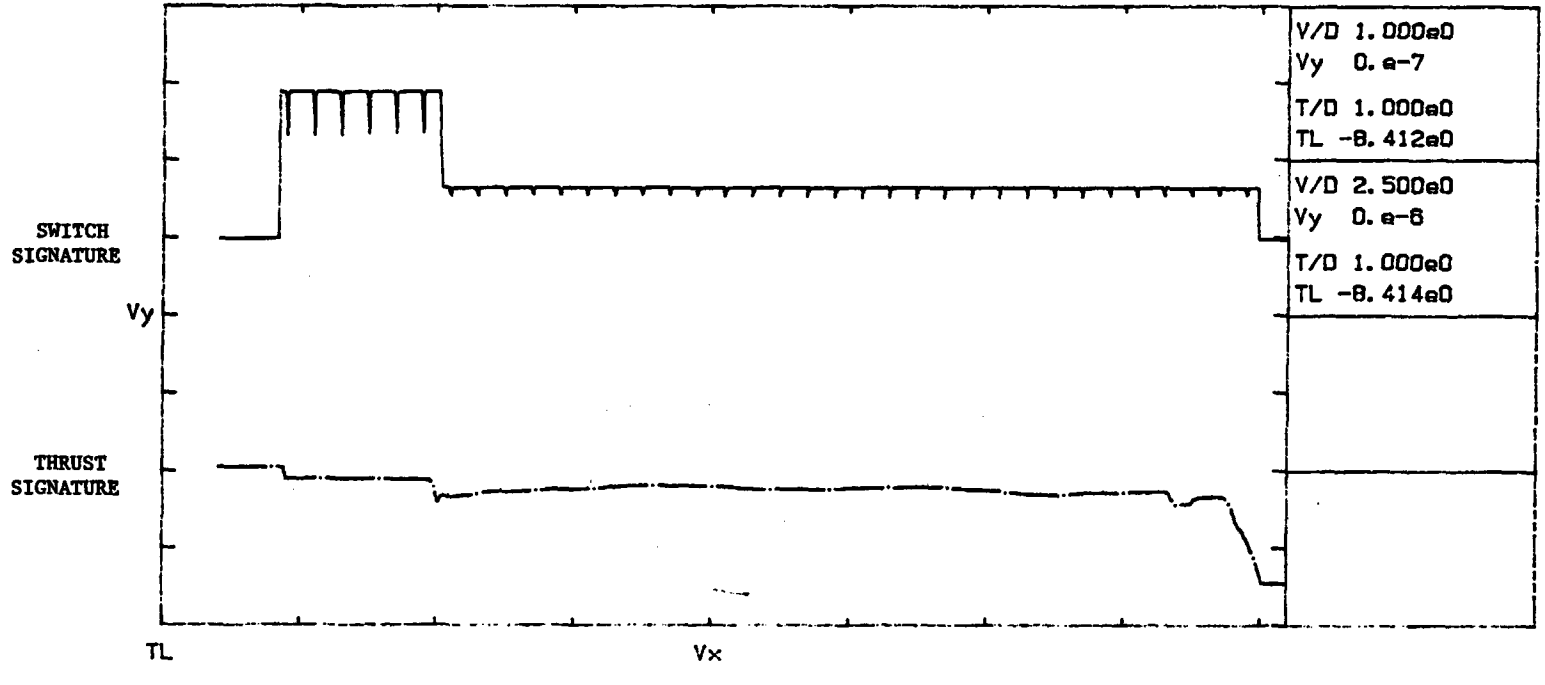
CS-OC-06-09		CS-CO-06-10	
STROKE TIME	: 7.12 SECONDS	STROKE TIME	: 6.904 SECONDS
PEAK INRUSH	: 1.91 AMPERES	PEAK INRUSH	: 1.94 AMPERES
AVE. RUN CURRENT	: 0.84 AMPERES	AVE. RUN CURRENT	: 0.78 AMPERES
MAX. RUN CURRENT	: 0.84 AMPERES	MAX. RUN CURRENT	: 0.79 AMPERES
SEATING CURRENT	: 0.81 AMPERES	END CURRENT	: 0.79 AMPERES

TEST IDENTIFICATION: VALVE #24
STORAGE LOCATION : 06-07

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 7.09 SECONDS	AVE RUN THRUST	: 239 #
		MAX RUN THRUST	: 0 #
BYPASS TIME	: 1.142 SECONDS	THRUST AT CST	: 2008 #
		SEAT THRUST AT CST	: 1591 #
		INERTIAL THRUST	: 22 %
TORQUE SW. SETTING: 1.5/3.0		TOTAL THRUST	: 2450 #

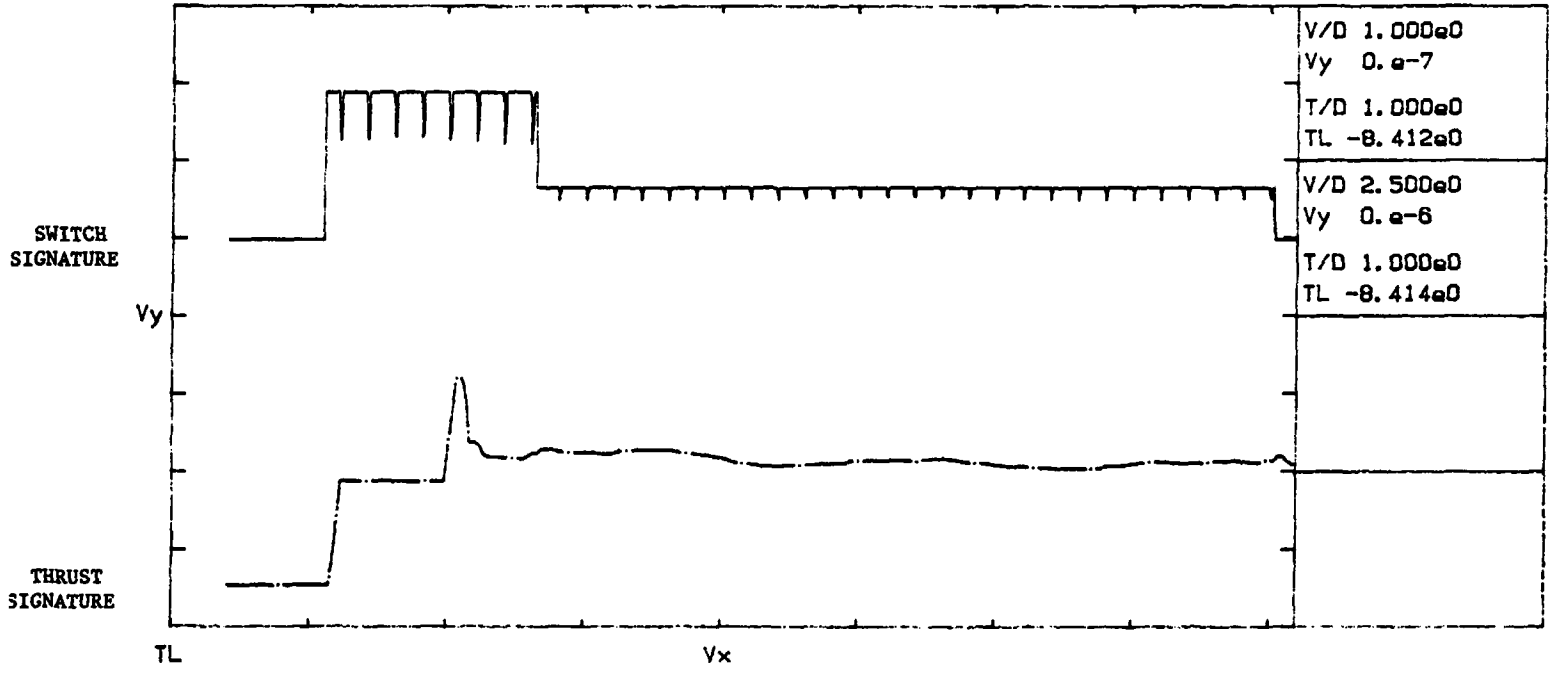


TEST IDENTIFICATION: VALVE #24
STORAGE LOCATION : 06-08

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 6.882	SECONDS	AVE RUN THRUST	: 467	#
			MAX RUN THRUST	: 732	#
BYPASS TIME	: 1.506	SECONDS	UNSEATING THRUST	: 2414	#
UNSEATING TIME	: 1.158	SECONDS	THRUST AT CST	: N/A	
PROTECTION MARGIN	: 0.348	SECONDS	TORQUE SW. SETTING	: 2.0/3.0	



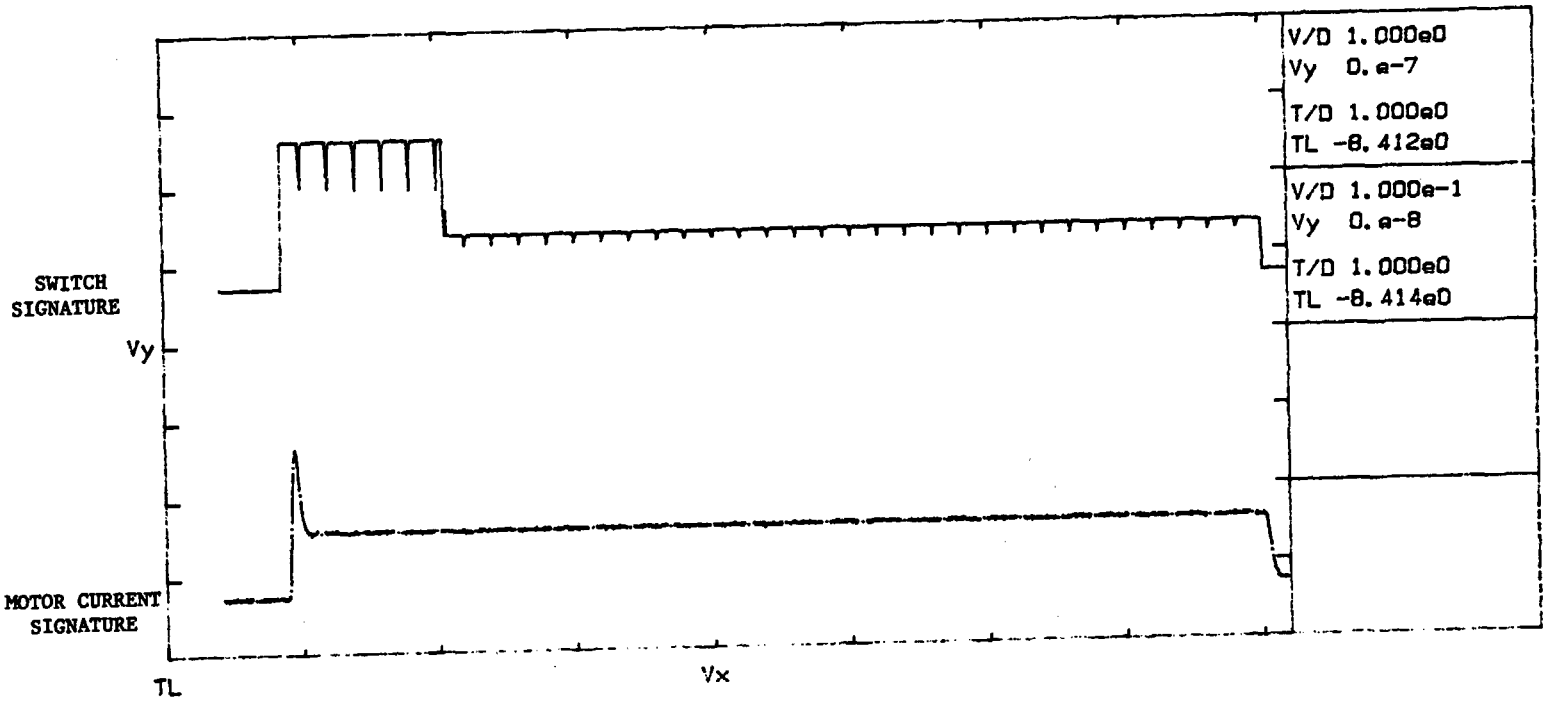
TEST IDENTIFICATION: VALVE #24
STORAGE LOCATION : 06-09

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 7.12 SECONDS

PEAK INRUSH	: 1.91	AMPERES
AVE. RUN CURRENT	: 0.84	AMPERES
MAX. RUN CURRENT	: 0.84	AMPERES
SEATING CURRENT	: 0.81	AMPERES



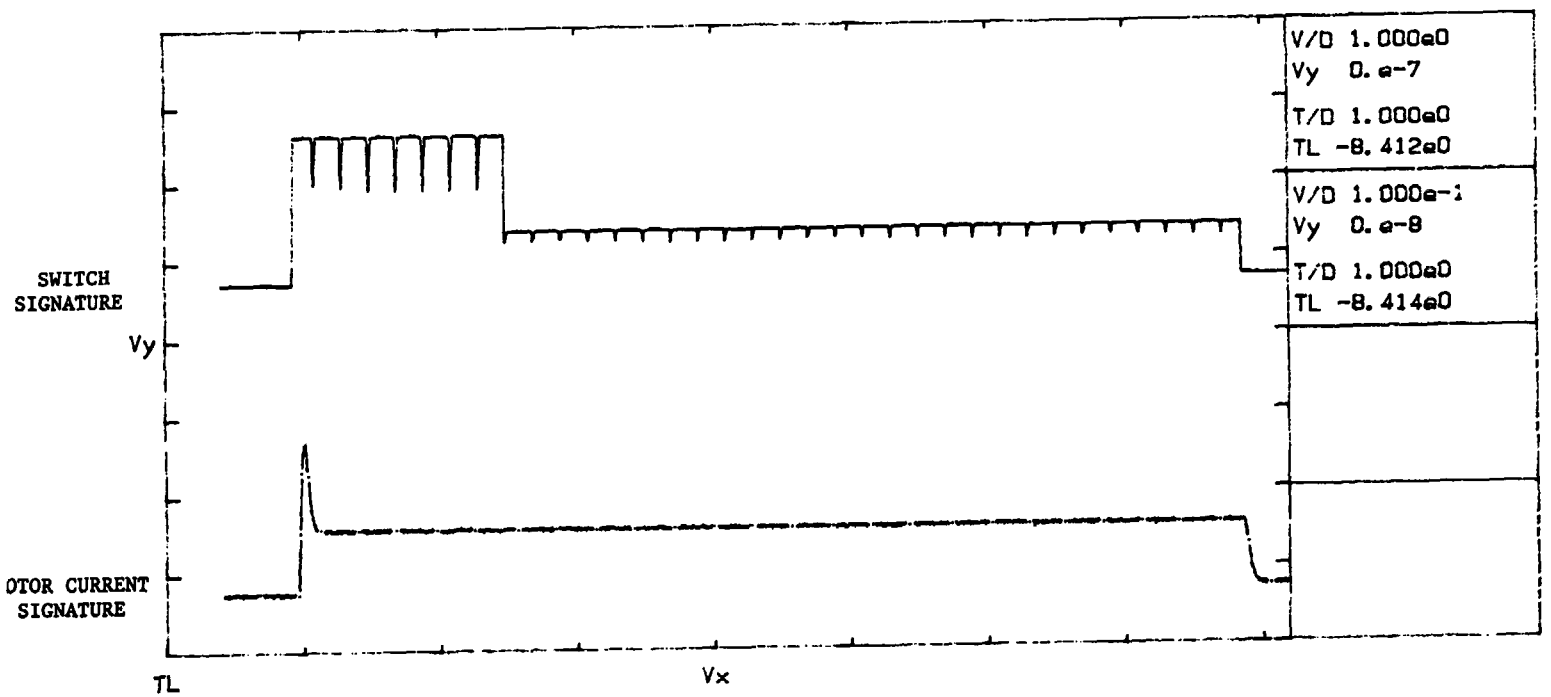
TEST IDENTIFICATION: VALVE #24
STORAGE LOCATION : 06-10

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 6.904 SECONDS

PEAK INRUSH	: 1.94	AMPERES
AVE. RUN CURRENT	: 0.78	AMPERES
MAX. RUN CURRENT	: 0.79	AMPERES
END CURRENT	: 0.79	AMPERES

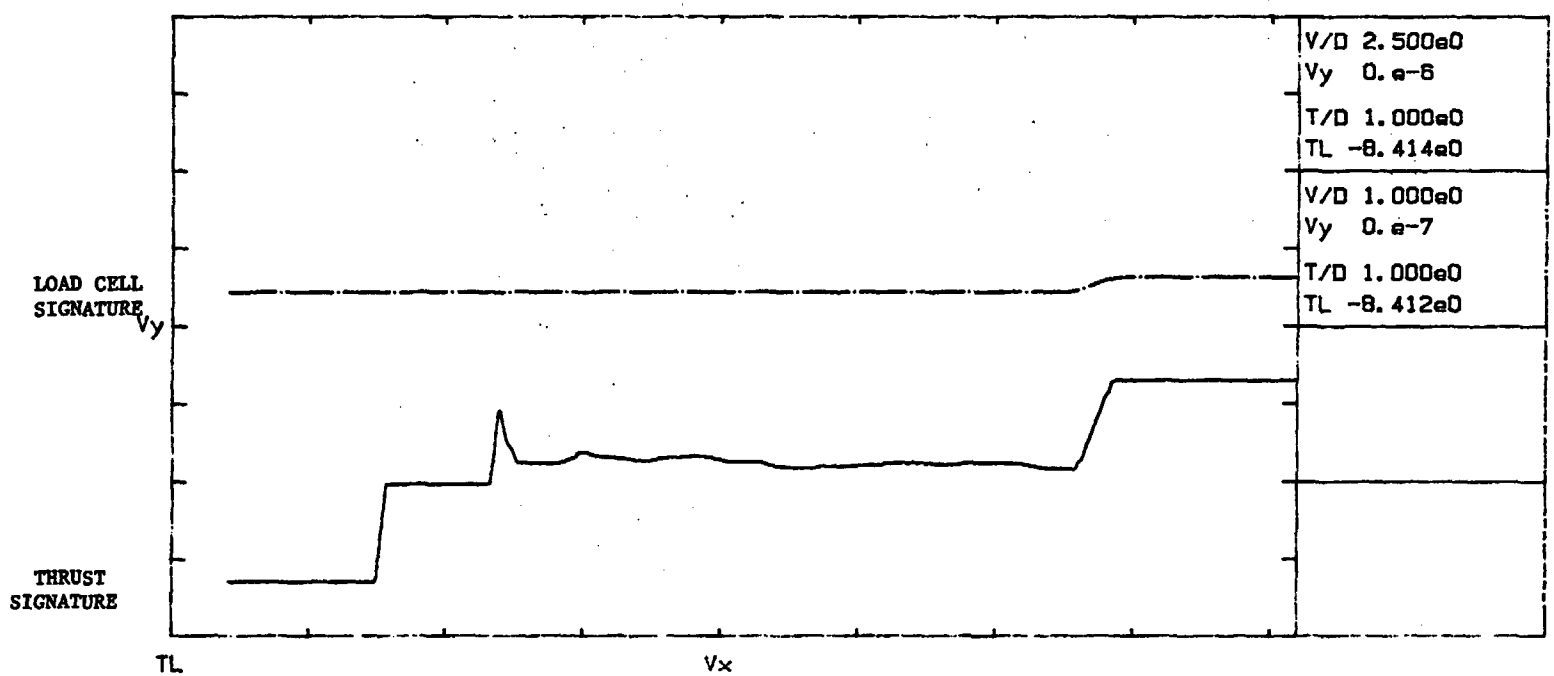


TEST IDENTIFICATION: VALVE #24
STORAGE LOCATION : 06-06

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: < RUNNING LOAD
K-FACTOR: 725 #/V



Test I.D. Valve #25

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
4	The open torque switch setting was reduced from 2.0 to <1.5 and the closed torque switch setting was reduced from 1.75 to >1.5 to attain the target thrust loads.
4	The torque switch was found to be out of balance by a factor of 1.73 to 1.0. This condition was corrected at the time of the test.
4	The open-to-close thrust signature reveals that this MOV is developing excessive inertial forces (approximately 300%) which should be limited by the operator's motor brake. (See Recommendation #1).
4	The close-to-open thrust signature reveals a slightly extended loading condition during valve unseating. (See Recommendation #2).

Recommendations

1. The inertial forces are caused mainly by the high stem travel rate (1.4 in./sec.). These forces are excessive, however, due to the fact that total thrust is well within design limitations, it is our opinion that this condition does not jeopardize valve operability. Since inertial thrust and post-stroke spring pack relaxation are occurring (apparently) uninhibited, it seems clear that the motor brake is not functioning as intended. Consideration may be given to performing a diagnostic test to verify this likelihood. Alternatives to motor brakes are available and this information could be supplied by the operator manufacturer.

2. The condition does not, in our opinion, appear to be a serious degradation, however, it should be monitored during future MOVATS testing.

TEST ID: VALVE #25

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 2
TEMP	: AMBIENT	SERIAL NO.	: 105902
PRESS	: ATMOSPHERIC	ORDER NO.	: 3411740
SFTY REL'D:	N/A	ORIENTATION:	VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS:	N/A	ID. NO.	: DHV-5A
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 14
CLOSE CONTROL	: TORQUE	BODY ORIENTATION:	HORIZONTAL
MCC	: N/A	INITIAL POSITION:	N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.0/1.4	VOLTS	: 460 AC
CLOSE T.S. SETTING:	1.75/1.6	RATED AMPS:	7.55
LIMITER PLATE	: 2	SPEED	: 3450
TS BALANCEABLE	: YES	HORSEPOWER:	5.3

TEST EQUIPMENT

LOAD CELL # : 200K--N/A

AMP PROBE # : FLUKE(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE 25# BY: RLB DATE: 06-16-85

THRUST SIGNATURE ANALYSIS

TS-OC-04-15		TS-CO-04-16	
STROKE TIME	: 9.845 SECONDS	STROKE TIME	: 9.74 SECONDS
BYPASS TIME	: 0 SECONDS	BYPASS TIME	: 1.425 SECONDS
THRUST AT CST	: 7943 #	PROTECTION MARGIN	: 0.815 SECONDS
SEAT THRUST AT CST	: 6486 #	UNSEATING TIME	: 0.61 SECONDS
AVE RUN THRUST	: 1457 #	AVE RUN THRUST	: 1457 #
MAX RUN THRUST	: 2397 #	MAX RUN THRUST	: 1927 #
INERTIAL THRUST	: 297 %	UNSEATING THRUST	: 6063 #
TOTAL THRUST	: 31584 #	THRUST AT CST	: 7567 #
TORQUE SW. SETTING	: 2.0/>1.5	TORQUE SW. SETTING	: 2.0/<1.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-04-14 K-FACTOR: 9400 #/V PRELOAD: < RUNNING LOAD

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-04-17		CS-CO-04-18	
STROKE TIME	: 9.88 SECONDS	STROKE TIME	: 9.77 SECONDS
PEAK INRUSH	: 39.7 AMPERES	PEAK INRUSH	: 37.4 AMPERES
AVE. RUN CURRENT	: 4.2 AMPERES	AVE. RUN CURRENT	: 3.9 AMPERES
MAX. RUN CURRENT	: 4.2 AMPERES	MAX. RUN CURRENT	: 3.9 AMPERES
SEATING CURRENT	: 4.8 AMPERES	END CURRENT	: 3.9 AMPERES

TEST IDENTIFICATION: VALVE 25#
STORAGE LOCATION : 04-15

PLOT NO. 1

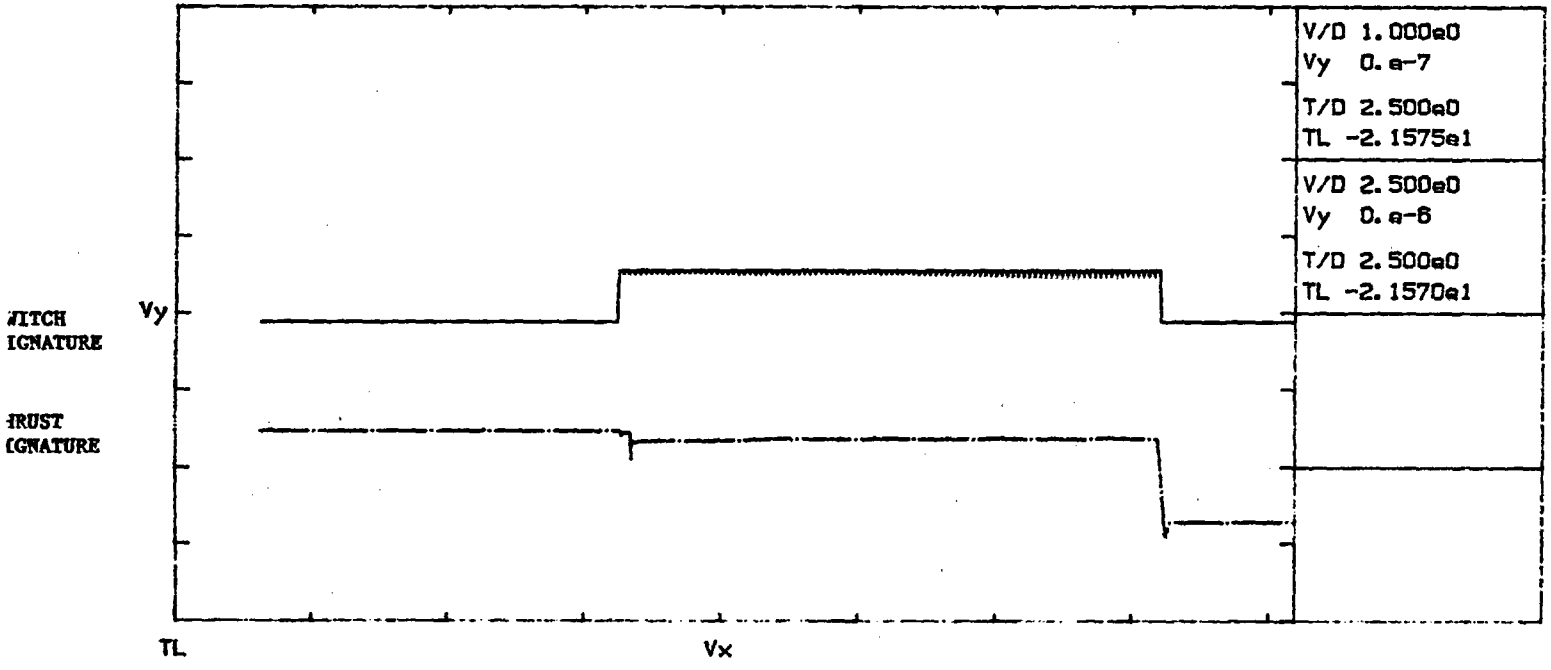
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 9.845 SECONDS

BYPASS TIME : 0 SECONDS

TORQUE SW. SETTING:2.0/>1.5

AVE RUN THRUST : 1457 #
MAX RUN THRUST : 2397 #
THRUST AT CST : 7943 #
SEAT THRUST AT CST: 6486 #
INERTIAL THRUST : 297 %
TOTAL THRUST : 31584 #

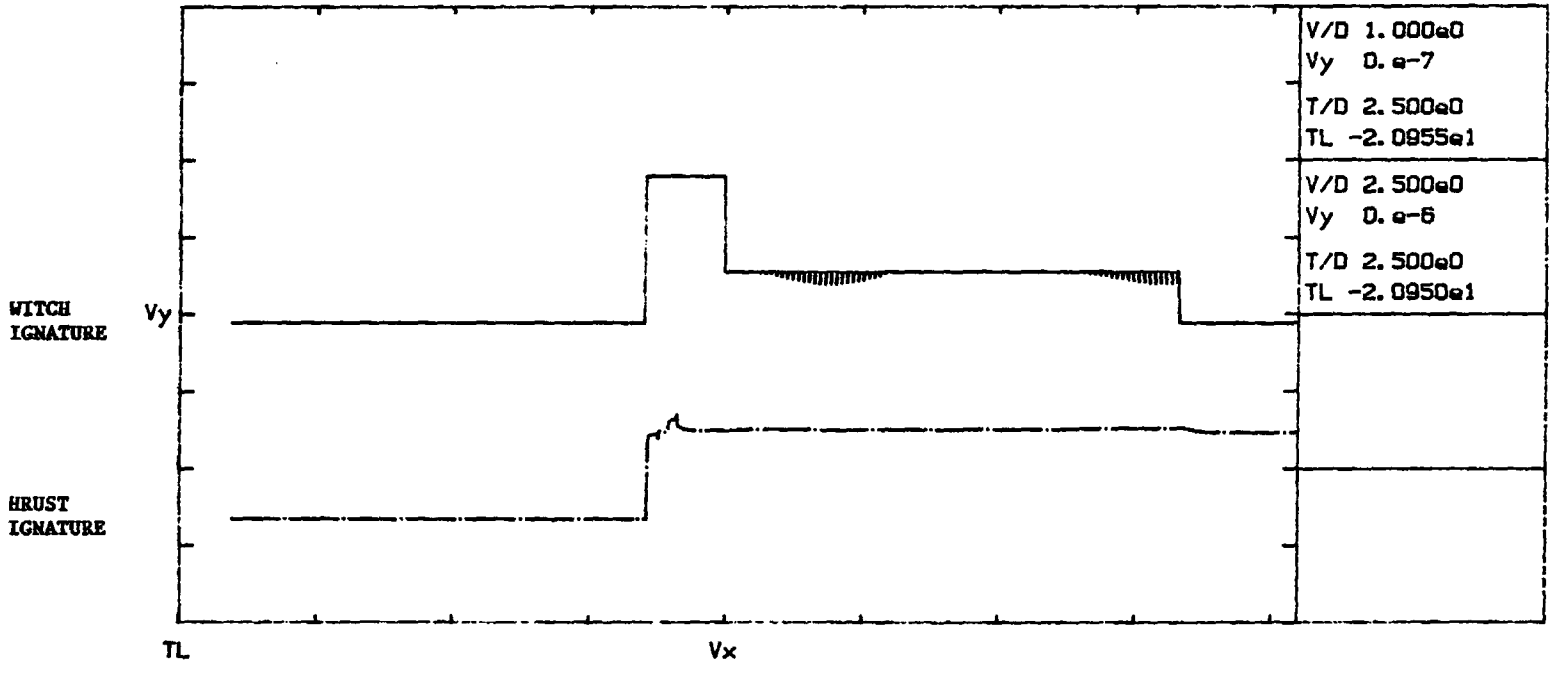


TEST IDENTIFICATION: VALVE 25#
STORAGE LOCATION : 04-16

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 9.74 SECONDS	AVE RUN THRUST	: 1457 #
		MAX RUN THRUST	: 1927 #
BYPASS TIME	: 1.425 SECONDS	UNSEATING THRUST	: 6063 #
UNSEATING TIME	: 0.61 SECONDS	THRUST AT CST	: 7567 #
PROTECTION MARGIN	: 0.815 SECONDS	TORQUE SW. SETTING	: 2.0/<1.5



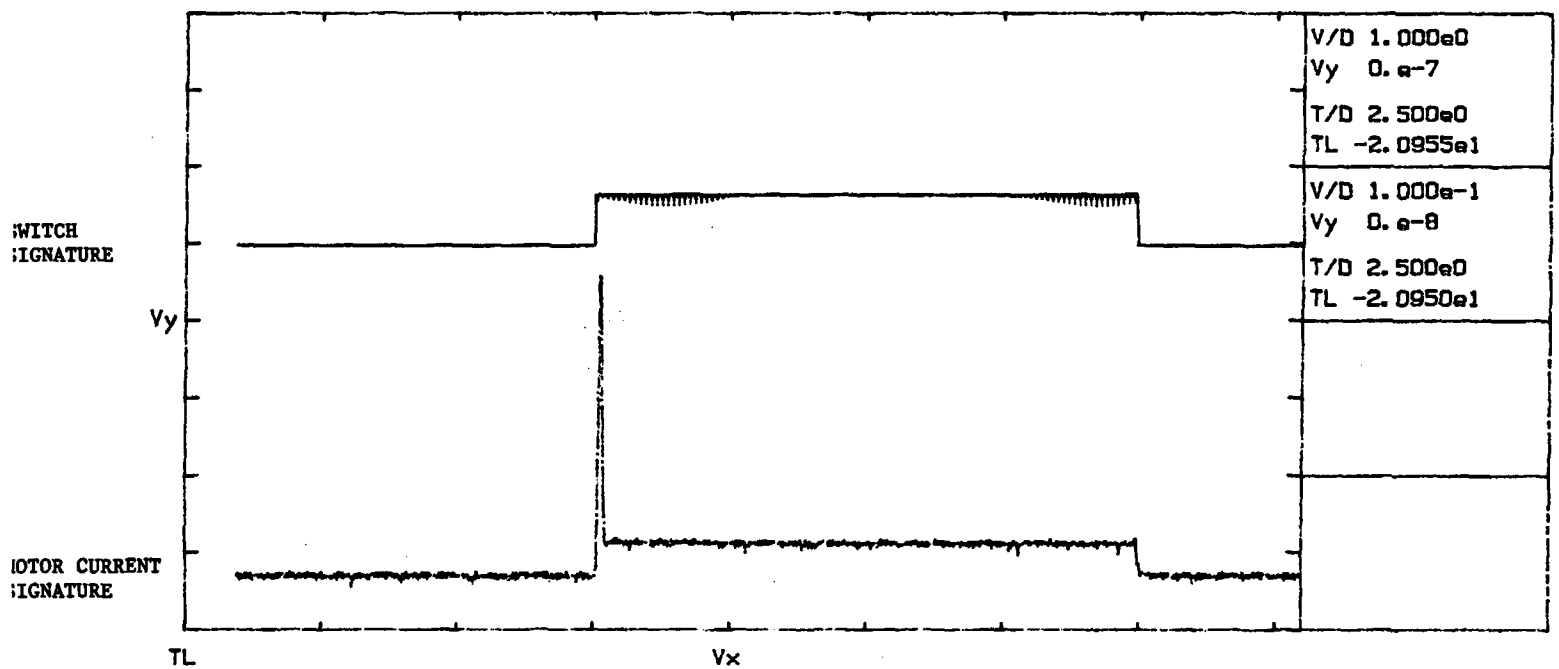
TEST IDENTIFICATION: VALVE 25#
STORAGE LOCATION : 04-17

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 9.88 SECONDS

PEAK INRUSH : 39.7 AMPERES
AVE. RUN CURRENT : 4.2 AMPERES
MAX. RUN CURRENT : 4.2 AMPERES
SEATING CURRENT : 4.8 AMPERES



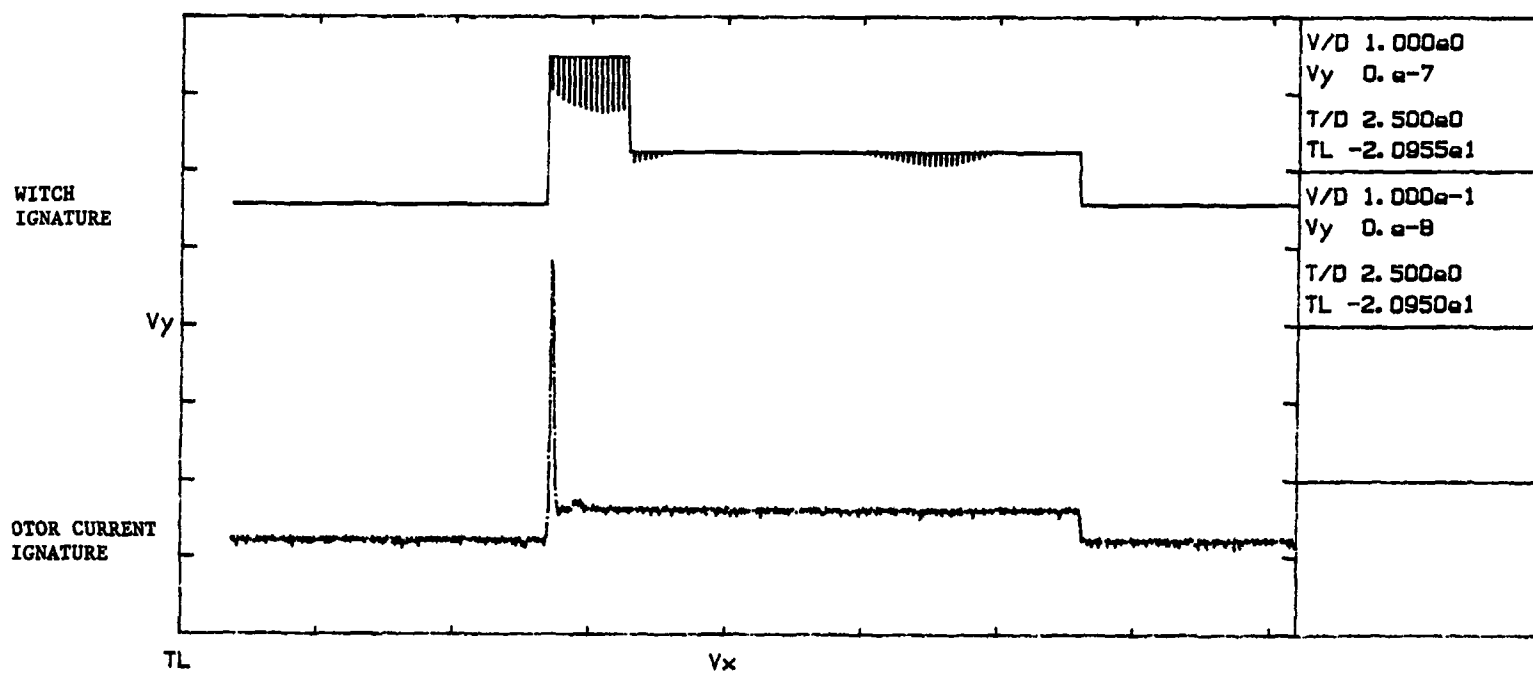
TEST IDENTIFICATION: VALVE 25#
STORAGE LOCATION : 04-18

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 9.77 SECONDS

PEAK INRUSH : 37.4 AMPERES
AVE. RUN CURRENT : 3.9 AMPERES
MAX. RUN CURRENT : 3.9 AMPERES
END CURRENT : 3.9 AMPERES

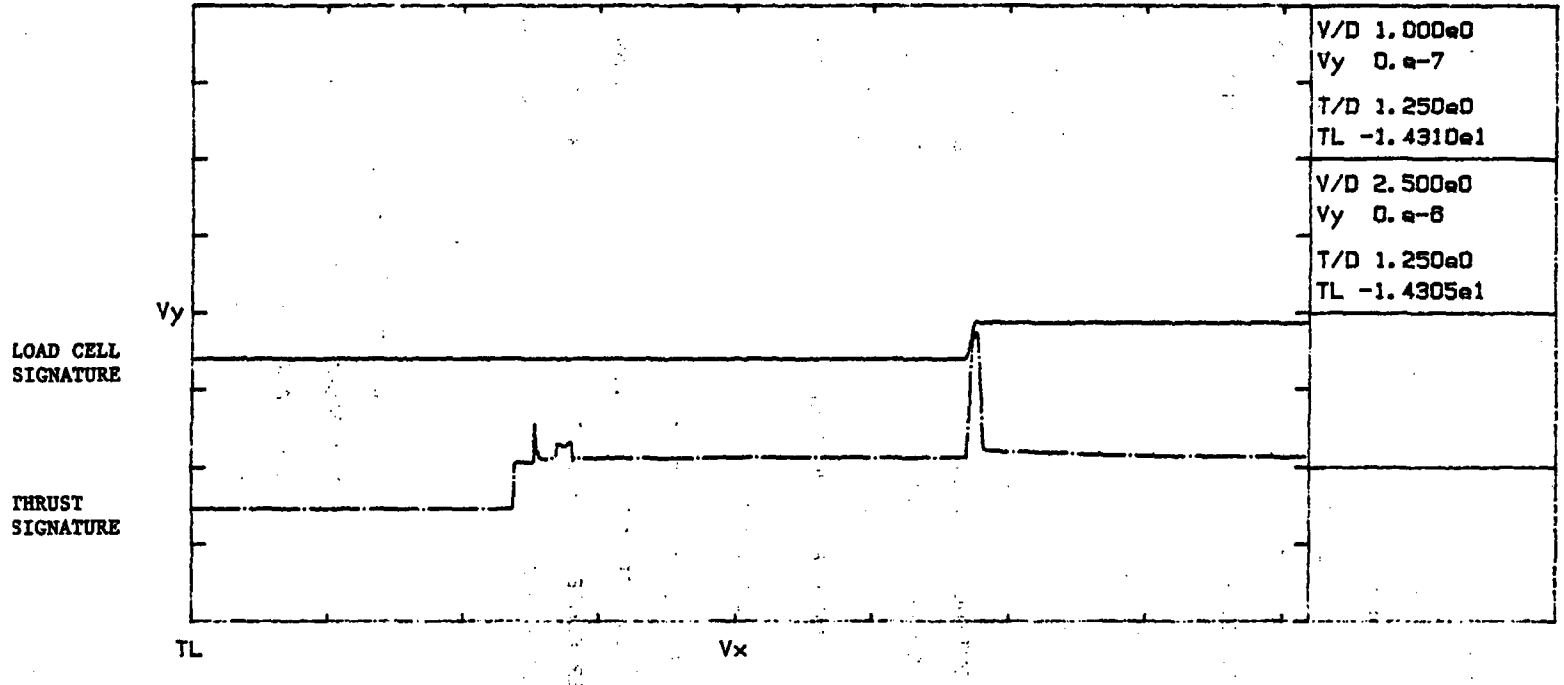


TEST IDENTIFICATION: VALVE 25#
STORAGE LOCATION : 04-14

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: < RUNNING LOAD
K-FACTOR: 9400 #/V



TEST ID: VALVE 26

SYSTEM

SYSTEM : N/A
FLOW : 0
TEMP : AMBIENT
PRESS : ATMOSPHERIC
SFTY REL'D: N/A

OPERATOR

TYPE : GATE
SIZE : 00
SERIAL NO. : 133079A
ORDER NO. : 533079A
ORIENTATION: VERTICAL

ELECTRICAL

CONTROL CIR VOLTS: 120
AC/DC : AC
OPEN CONTROL : LIMIT
CLOSE CONTROL : LIMIT
MCC : N/A
SW. SENSING CIR. : VOLTAGE

VALVE

ID. NO. : RCV-1
TYPE : GATE
SIZE : 2.5
BODY ORIENTATION: HORIZONTAL
INITIAL POSITION: N/A
FINAL POSITION : N/A

TORQUE SWITCH

OPEN T.S. SETTING : 2.25/2.25
CLOSE T.S. SETTING: 1.0/1.0
LIMITER PLATE : 2.75
TS BALANCEABLE : NO

MOTOR

VOLTS : 460 AC
RATED AMPS: 4
SPEED : 1700
HORSEPOWER: 1.6

TEST EQUIPMENT

LOAD CELL # : 50K--N/A
AMP PROBE # : FLUKE(20) N/A
MAINFRAME # : N/A
TMD # : N/A

Test I.D. Valve #26

Code	Comments
1,4	The close-to-open bypass switch required adjustment to preclude an inadvertent torque switch trip during operator hammerblow.
1	The open-to-close thrust and motor current signatures indicate that the disc does not contact the seat. (See Recommendation #1).

Recommendations

1. An assessment of this condition should be made by plant personnel to determine if an adjustment to the close limit switch should be made to allow the operator to develop a seating force.

TEST ID: VALVE #26 BY: RLB DATE: 06-16-85

THRUST SIGNATURE ANALYSIS

TS-OC-06-12		TS-CO-06-13	
STROKE TIME	: 4.272 SECONDS	STROKE TIME	: 4.206 SECONDS
BYPASS TIME	: 0.59 SECONDS	BYPASS TIME	: 0.59 SECONDS
THRUST AT CST	: <PRELOAD	PROTECTION MARGIN	: 0.164 SECONDS
SEAT THRUST AT CST	: <PRELOAD	UNSEATING TIME	: 0.426 SECONDS
AVE RUN THRUST	: <PRELOAD	AVE RUN THRUST	: <PRELOAD
MAX RUN THRUST	: <PRELOAD	MAX RUN THRUST	: <PRELOAD
INERTIAL THRUST	: 0 %	UNSEATING THRUST	: <PRELOAD
TOTAL THRUST	: <PRELOAD	THRUST AT CST	: 9234
TORQUE SW. SETTING	: 1.0/1.0	TORQUE SW. SETTING	: 2.25/2.25

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-06-11 K-FACTOR: 8265 #/V PRELOAD: 4640 #

MOTOR CURRENT SIGNATURE ANALYSIS

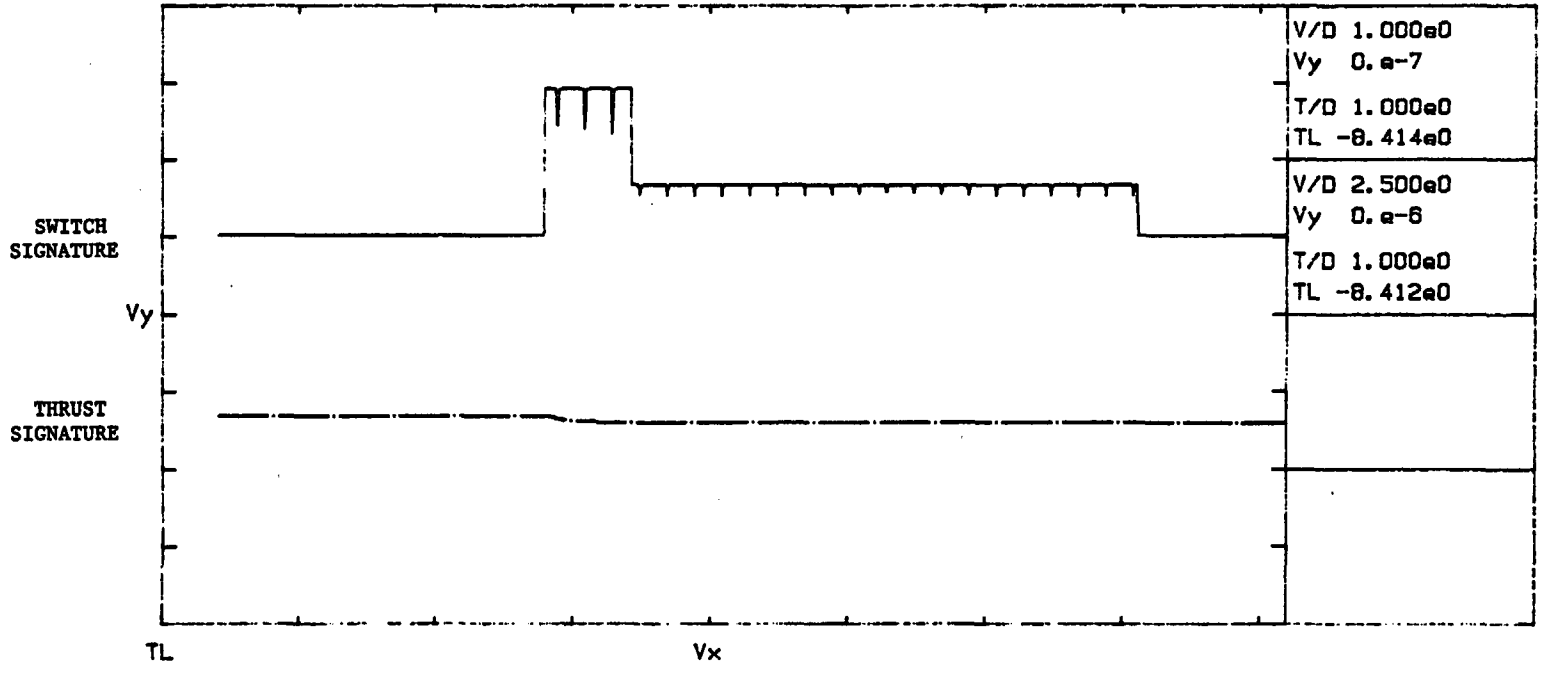
CS-OC-06-14		CS-CO-06-15	
STROKE TIME	: 4.292 SECONDS	STROKE TIME	: 4.24 SECONDS
PEAK INRUSH	: 10.64 AMPERES	PEAK INRUSH	: 10.35 AMPERES
AVE. RUN CURRENT	: 2.65 AMPERES	AVE. RUN CURRENT	: 2.76 AMPERES
MAX. RUN CURRENT	: 2.65 AMPERES	MAX. RUN CURRENT	: 2.76 AMPERES
SEATING CURRENT	: 2.65 AMPERES	END CURRENT	: 2.76 AMPERES

TEST IDENTIFICATION: VALVE #26
STORAGE LOCATION : 06-12

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 4.272 SECONDS	AVE RUN THRUST	:<PRELOAD
		MAX RUN THRUST	:<PRELOAD
BYPASS TIME	: 0.59 SECONDS	THRUST AT CST	:<PRELOAD
		SEAT THRUST AT CST	:<PRELOAD
		INERTIAL THRUST	: 0 %
TORQUE SW. SETTING: 1.0/1.0		TOTAL THRUST	:<PRELOAD

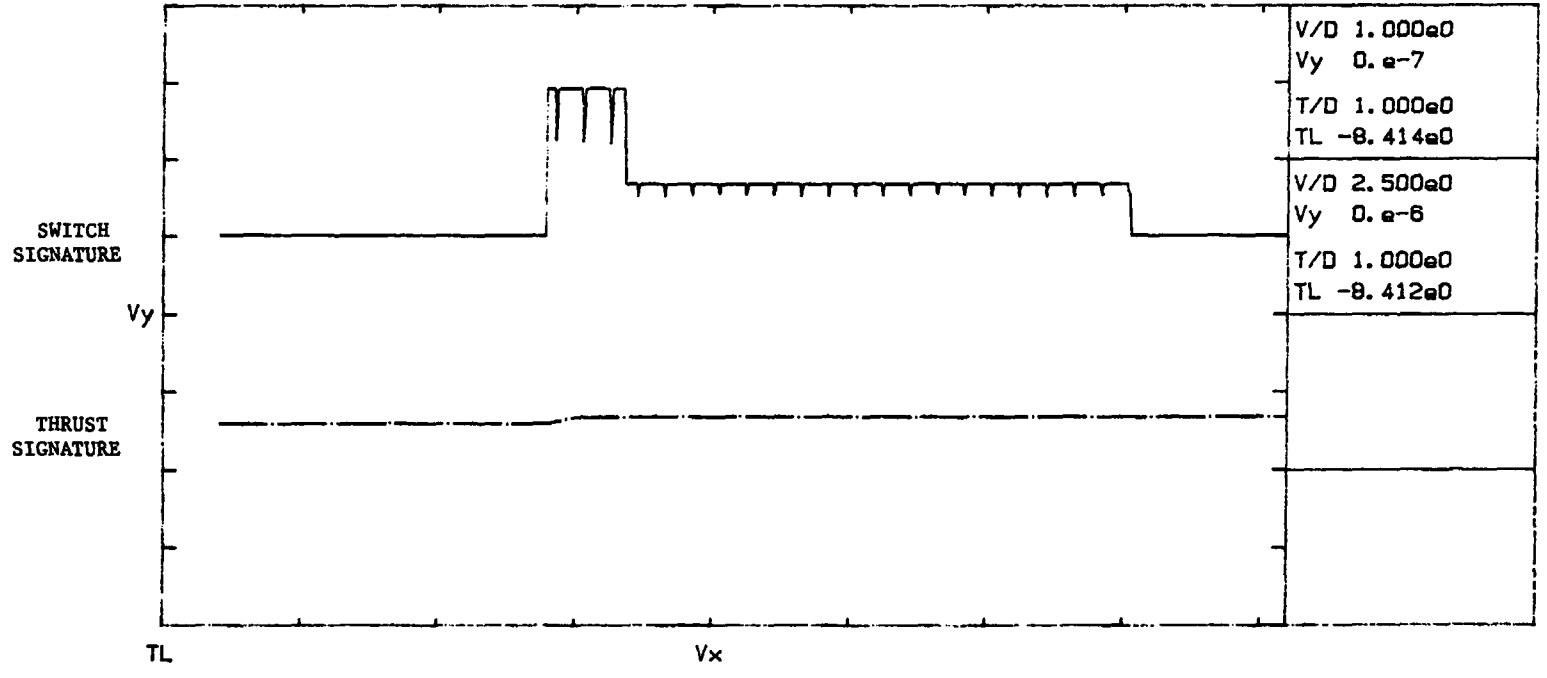


TEST IDENTIFICATION: VALVE #26
STORAGE LOCATION : 06-13

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 4.206 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 0.59 SECONDS	UNSEATING THRUST	: <PRELOAD
UNSEATING TIME	: 0.426 SECONDS	THRUST AT CST	: 9234
PROTECTION MARGIN	: 0.164 SECONDS	TORQUE SW. SETTING	: 2.25/2.25



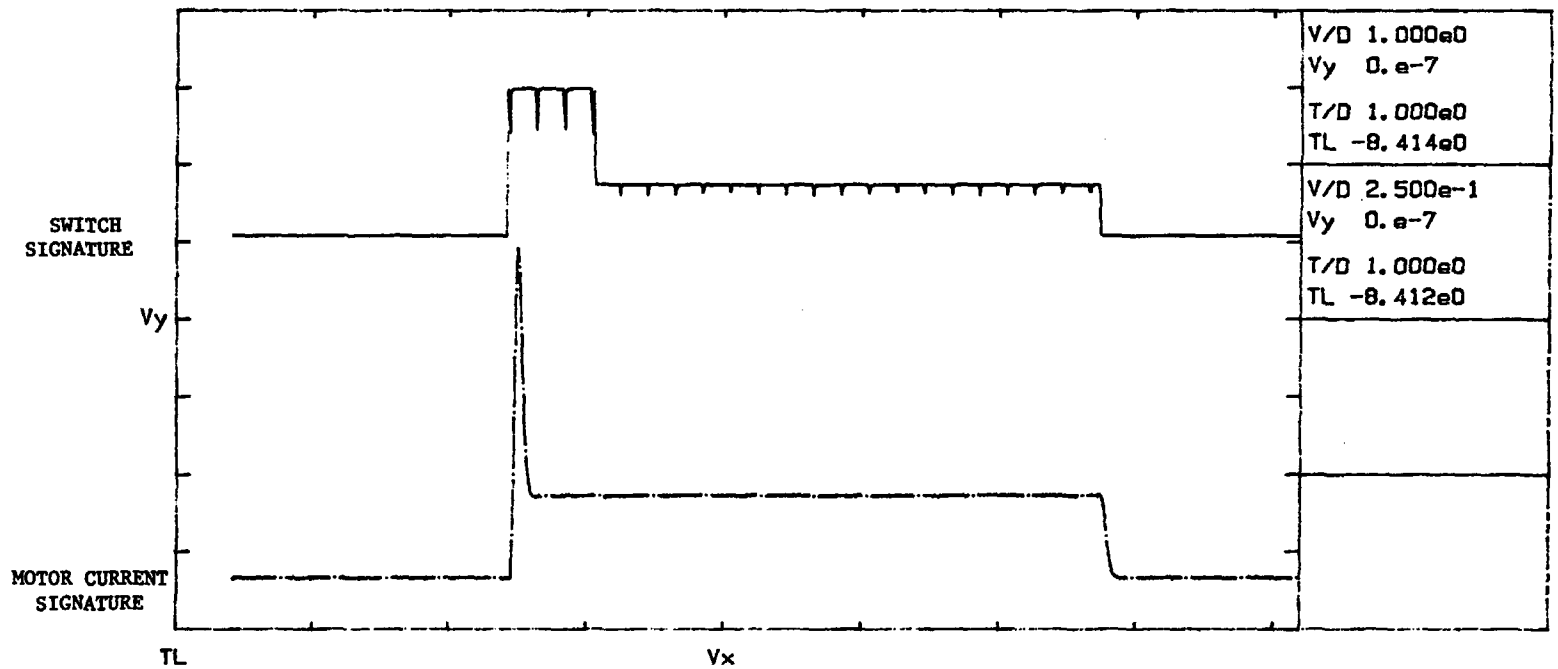
TEST IDENTIFICATION: VALVE #26
STORAGE LOCATION : 06-14

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 4.292 SECONDS

PEAK INRUSH : 10.64 AMPERES
AVE. RUN CURRENT : 2.65 AMPERES
MAX. RUN CURRENT : 2.65 AMPERES
SEATING CURRENT : 2.65 AMPERES



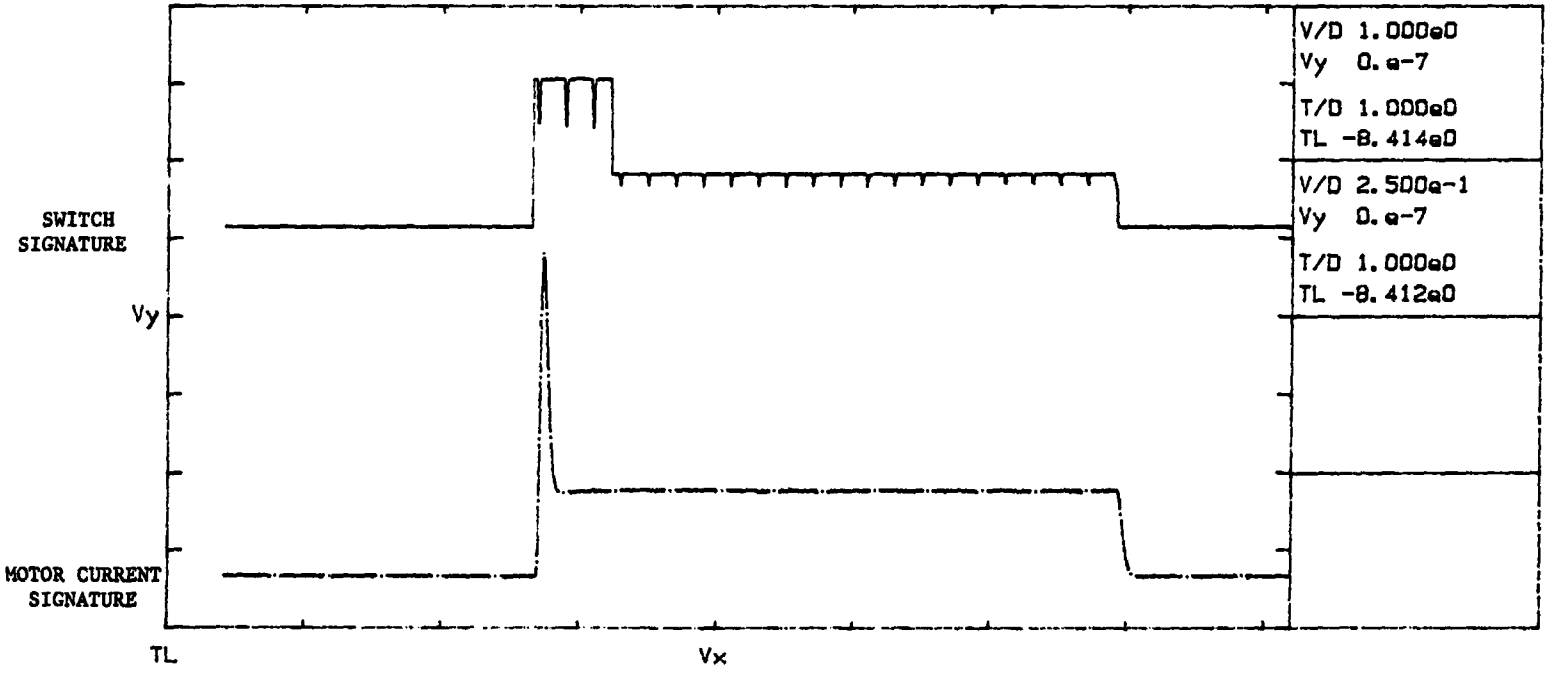
TEST IDENTIFICATION: VALVE #26
STORAGE LOCATION : 06-15

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 4.24 SECONDS

PEAK INRUSH : 10.35 AMPERES
AVE. RUN CURRENT : 2.76 AMPERES
MAX. RUN CURRENT : 2.76 AMPERES
END CURRENT : 2.76 AMPERES

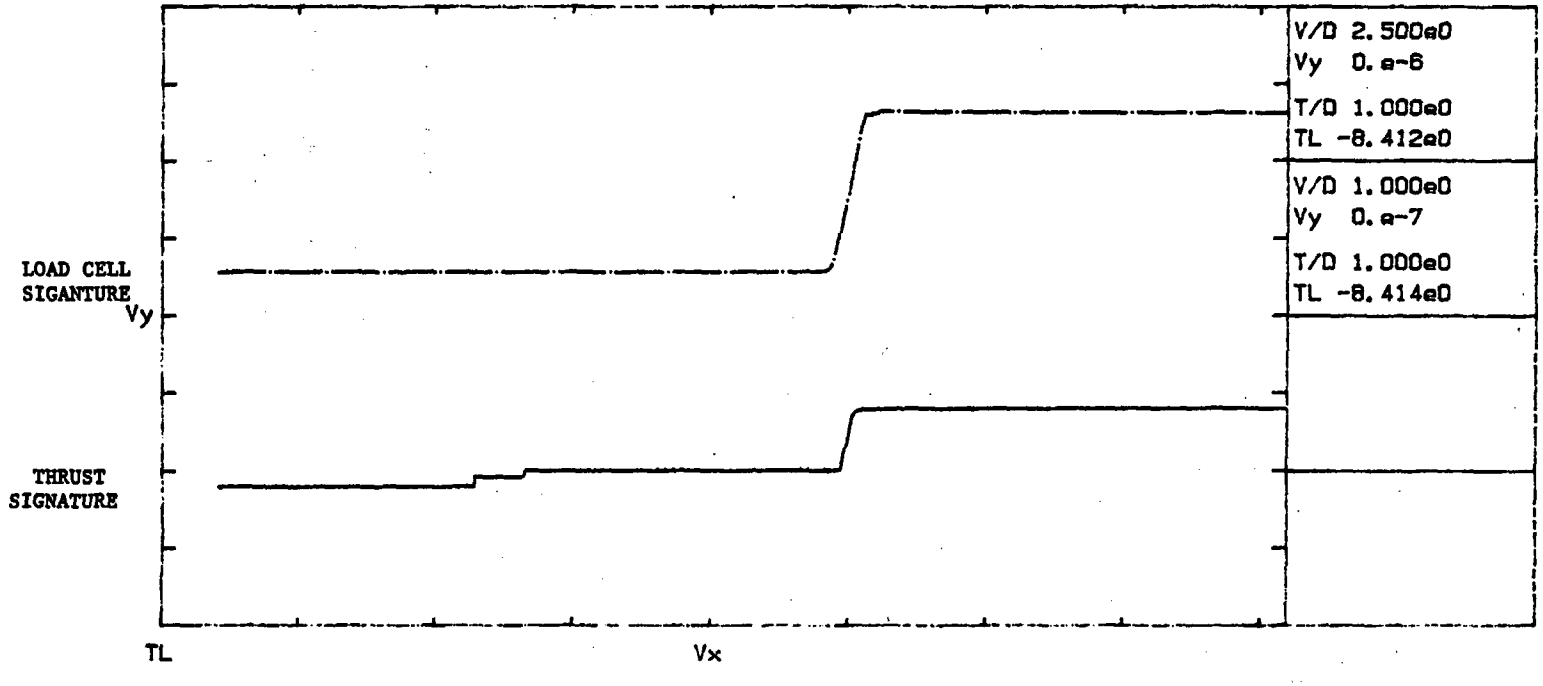


TEST IDENTIFICATION: VALVE #26
STORAGE LOCATION : 06-11

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 4640 #
K-FACTOR: 8265 #/V



TEST ID: VALVE #27

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 00
TEMP	: AMBIENT	SERIAL NO.	: 104595
PRESS	: ATMOSPHERIC	ORDER NO.	: 3381639
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: RC-V-2
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 2.5
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.75/2.75	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 2.5/2.5	RATED AMPS	: 4
LIMITER PLATE	: 2.75	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER	: 1.6

TEST EQUIPMENT

LOAD CELL # : 50K--N/A

AMP PROBE # : FLUKE(20) N/A

MAINFRAME # : N/A

TMD # : N/A

Test I.D. Valve #27

Code	Comments
3	This particular valve exibits a cyclic loading condition that may correspond to operator gear wear. It shows up in both directions of the thrust signatures. (See Recommendation #1).
4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
4	During equipment installation, it was noted that the spring cartridge cap was full of grease. (See Recommendation #2).

Recommendations

1. This condition does not, in our opinion, jeopardize the operability of the valve at this time.

2. It should be noted that the Belleville springs do not require lubrication to function properly.

TEST ID: VALVE #27 BY: RLB DATE: 06-14-85

THRUST SIGNATURE ANALYSIS

TS-OC-06-17		TS-CO-06-18	
STROKE TIME	: 9.925 SECONDS	STROKE TIME	: 9.515 SECONDS
BYPASS TIME	: 0.98 SECONDS	BYPASS TIME	: 1.515 SECONDS
THRUST AT CST	: 6383 #	PROTECTION MARGIN	: 0.4 SECONDS
SEAT THRUST AT CST	: 5844 #	UNSEATING TIME	: 1.115 SECONDS
AVE RUN THRUST	: 492 #	AVE RUN THRUST	: 305 #
MAX RUN THRUST	: 739 #	MAX RUN THRUST	: 410 #
INERTIAL THRUST	: 10 %	UNSEATING THRUST	: 4330 #
TOTAL THRUST	: 7041 #	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.5/2.5	TORQUE SW. SETTING	: 2.75/2.75

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-06-16 K-FACTOR: 2347 #/V PRELOAD: < RUNNING LOAD

MOTOR CURRENT SIGNATURE ANALYSIS

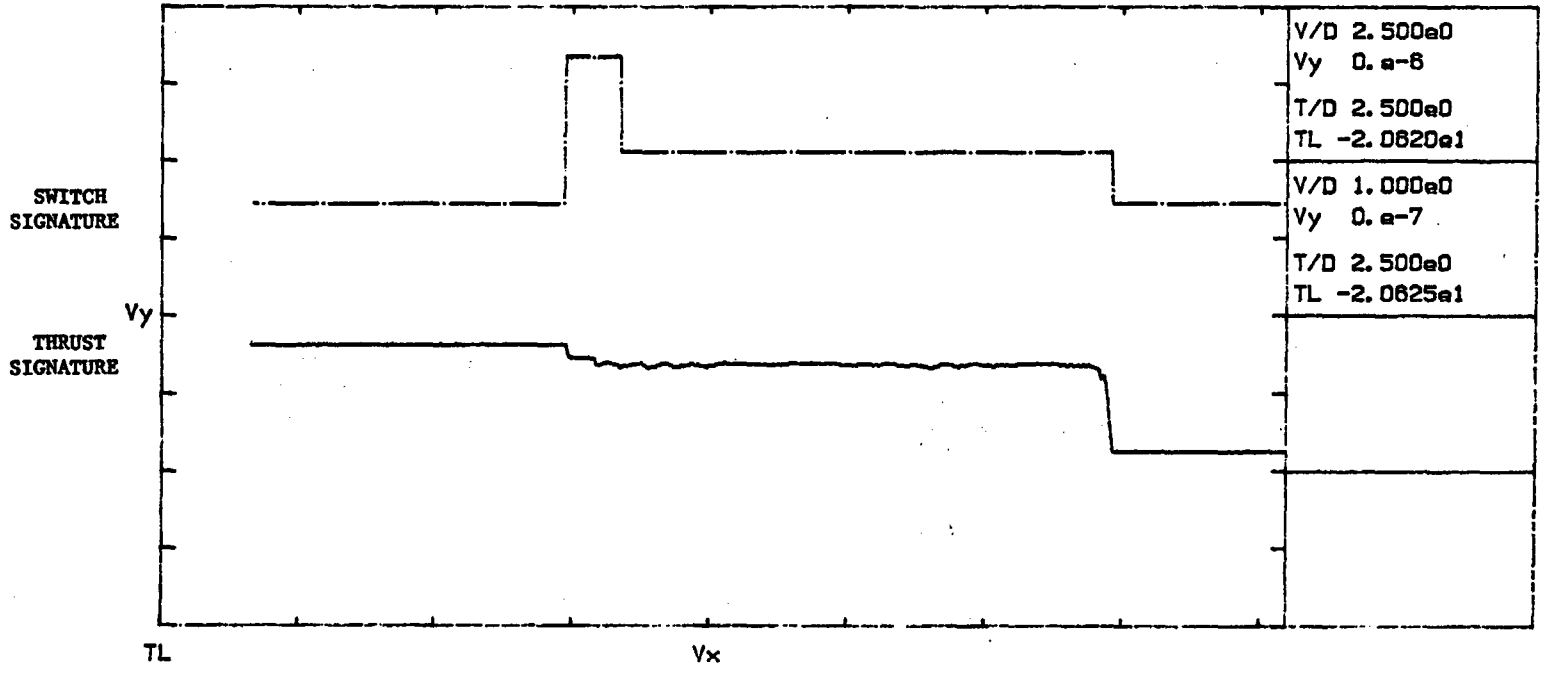
CS-OC-06-19		CS-CO-06-20	
STROKE TIME	: 9.99 SECONDS	STROKE TIME	: 9.55 SECONDS
PEAK INRUSH	: 5.92 AMPERES	PEAK INRUSH	: 5.86 AMPERES
AVE. RUN CURRENT	: 1.82 AMPERES	AVE. RUN CURRENT	: 1.77 AMPERES
MAX. RUN CURRENT	: 1.82 AMPERES	MAX. RUN CURRENT	: 1.77 AMPERES
SEATING CURRENT	: 2.4 AMPERES	END CURRENT	: 1.75 AMPERES

TEST IDENTIFICATION: VALVE #27
STORAGE LOCATION : 06-17

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 9.925 SECONDS	AVE RUN THRUST	: 492 #
		MAX RUN THRUST	: 739 #
BYPASS TIME	: 0.98 SECONDS	THRUST AT CST	: 6383 #
		SEAT THRUST AT CST	: 5844 #
		INERTIAL THRUST	: 10 %
TORQUE SW. SETTING: 2.5/2.5		TOTAL THRUST	: 7041 #

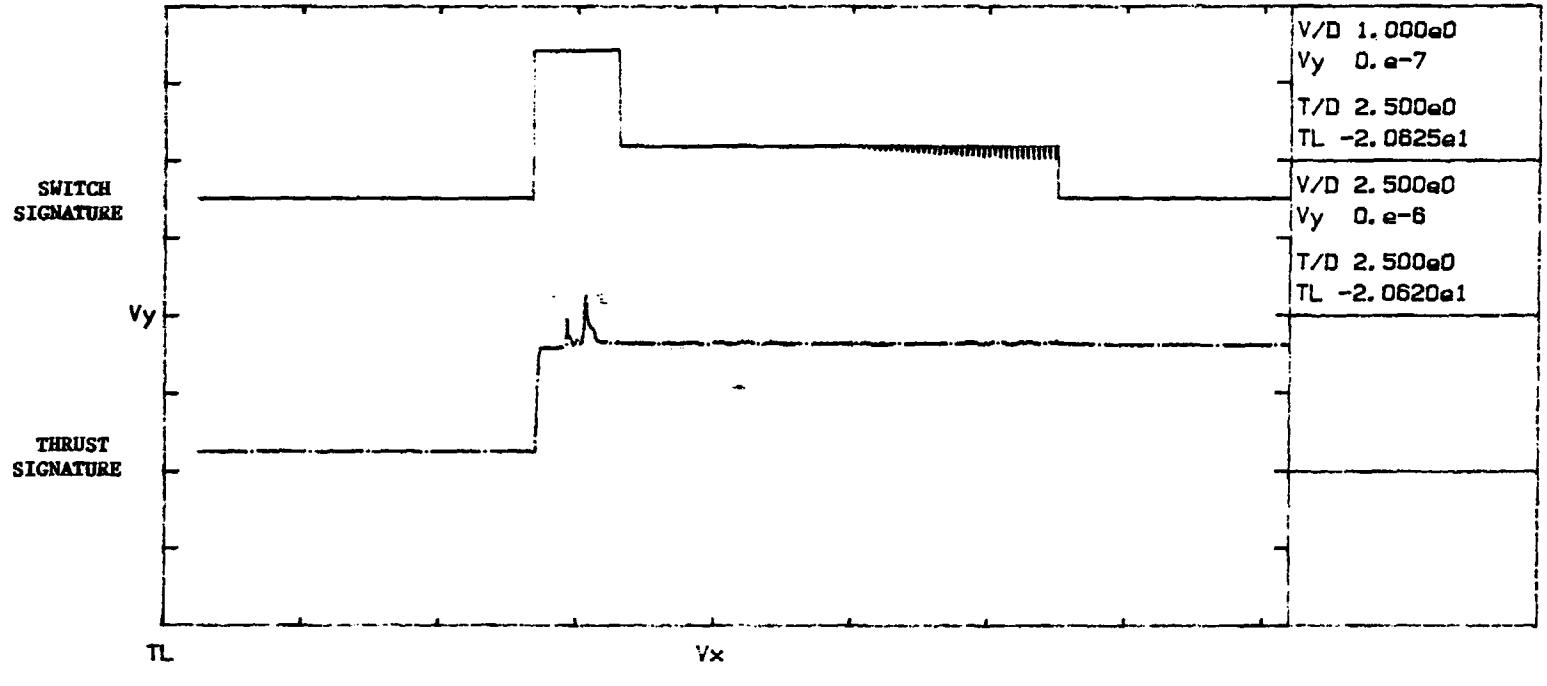


TEST IDENTIFICATION: VALVE #27
STORAGE LOCATION : 06-18

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 9.515 SECONDS	AVE RUN THRUST	: 305 #
		MAX RUN THRUST	: 410 #
BYPASS TIME	: 1.515 SECONDS	UNSEATING THRUST	: 4330 #
UNSEATING TIME	: 1.115 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 0.4 SECONDS	TORQUE SW. SETTING	: 2.75/2.75



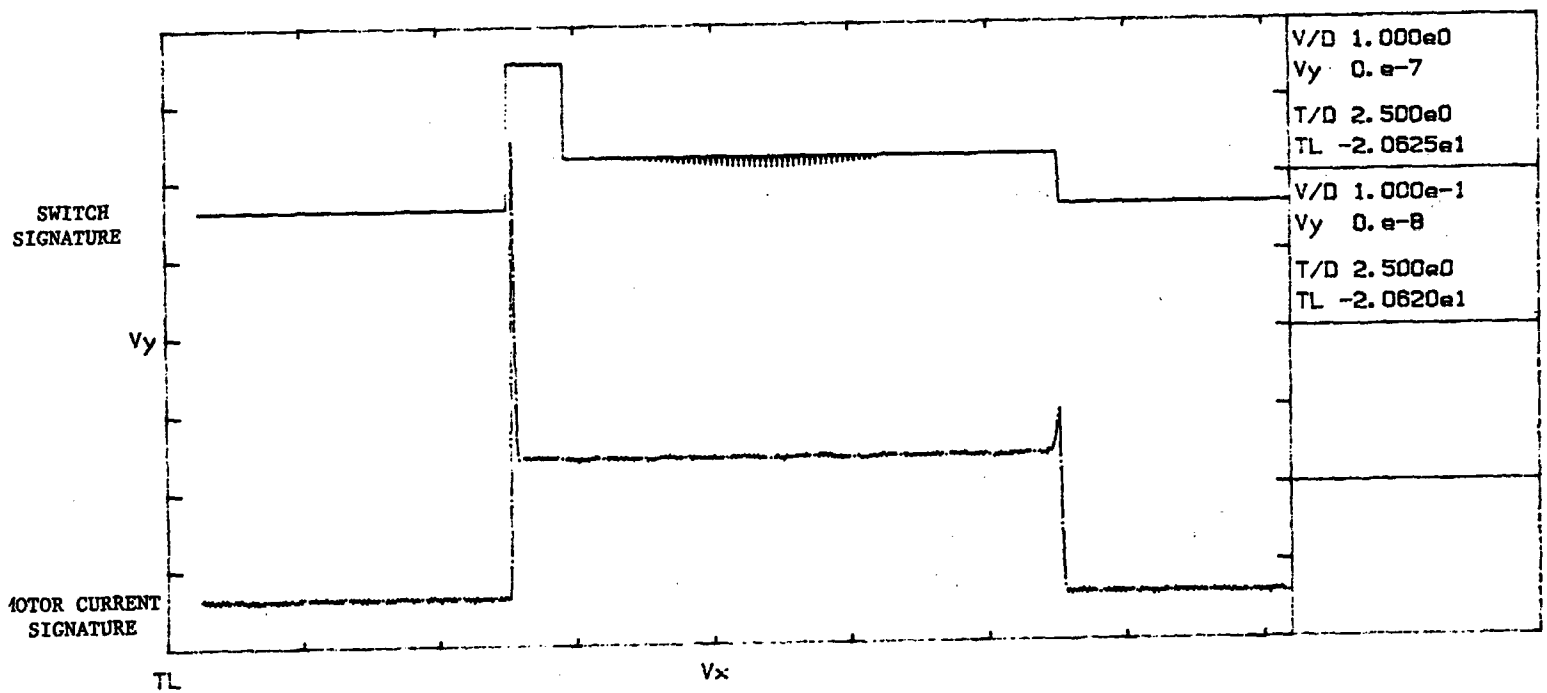
TEST IDENTIFICATION: VALVE #27
STORAGE LOCATION : 06-19

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 9.99 SECONDS

PEAK INRUSH : 5.92 AMPERES
AVE. RUN CURRENT : 1.82 AMPERES
MAX. RUN CURRENT : 1.82 AMPERES
SEATING CURRENT : 2.4 AMPERES



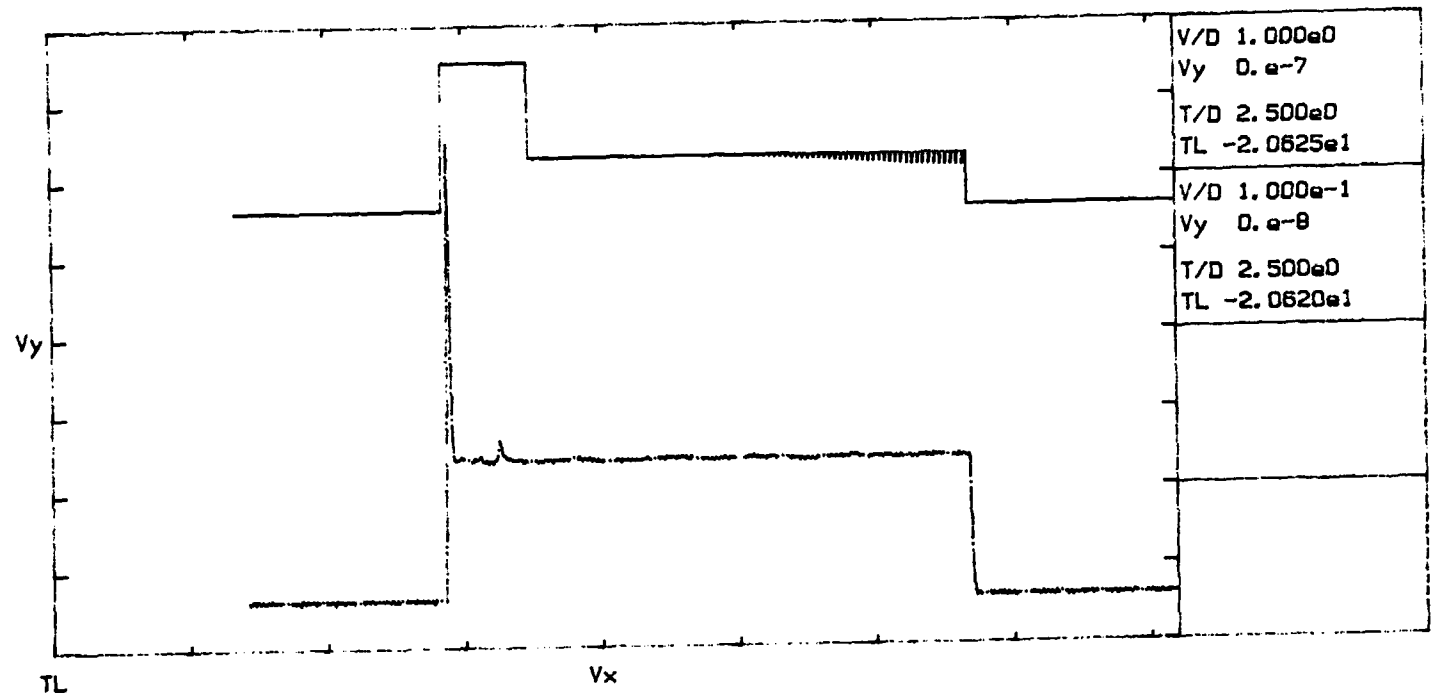
TEST IDENTIFICATION: VALVE #27
STORAGE LOCATION : 06-20

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 9.55 SECONDS

PEAK INRUSH	: 5.86	AMPERES
AVE. RUN CURRENT	: 1.77	AMPERES
MAX. RUN CURRENT	: 1.77	AMPERES
END CURRENT	: 1.75	AMPERES

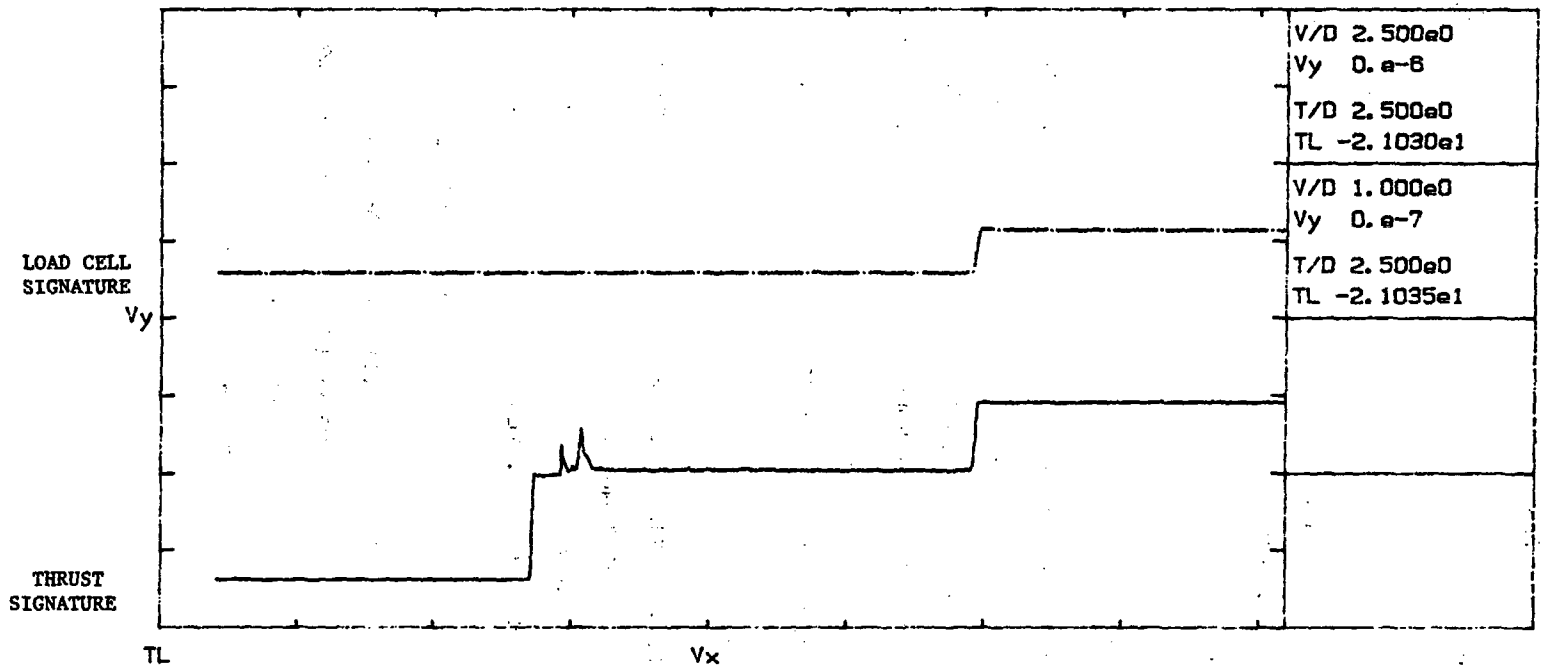


TEST IDENTIFICATION: VALVE #27
STORAGE LOCATION : 06-16

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: < RUNNING LOAD
K-FACTOR: 2347 #/V



TEST ID: VALVE #28

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 00
TEMP	: AMBIENT	SERIAL NO.	: 97218A
PRESS	: ATMOSPHERIC	ORDER NO.	: 337610
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: N/A	ID. NO.	: RCV-3
AC/DC	: AC	TYPE	: N/A
OPEN CONTROL	: LIMIT	SIZE	: 2.5
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.5/2.5	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 1.5/1.5	RATED AMPS	: 2
LIMITER PLATE	: NONE	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER	: 1.0

TEST EQUIPMENT

LOAD CELL # : N/A--N/A

AMP PROBE # : SIMPSONN/A N/A

MAINFRAME # : N/A

TMD # : N/A

Test I.D. Valve #28

Code	Comments
4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve. (See Recommendation #1).

Recommendations

1. No further corrective action necessary at this time.

TEST ID: VALVE #28 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-07-01		TS-CO-07-02	
STROKE TIME	: 29.91 SECONDS	STROKE TIME	: 29.41 SECONDS
BYPASS TIME	: 1.44 SECONDS	BYPASS TIME	: 4.13 SECONDS
THRUST AT CST	: 1.945 V	PROTECTION MARGIN	: 2.81 SECONDS
SEAT THRUST AT CST	: 1.925 V	UNSEATING TIME	: 1.32 SECONDS
AVE RUN THRUST	: 0.02 V	AVE RUN THRUST	: 0.06 V
MAX RUN THRUST	: 0 V	MAX RUN THRUST	: 0.06 V
INERTIAL THRUST	: 12 %	UNSEATING THRUST	: 0.11 V
TOTAL THRUST	: 2.185 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.5/1.5	TORQUE SW. SETTING	: 2.5/2.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

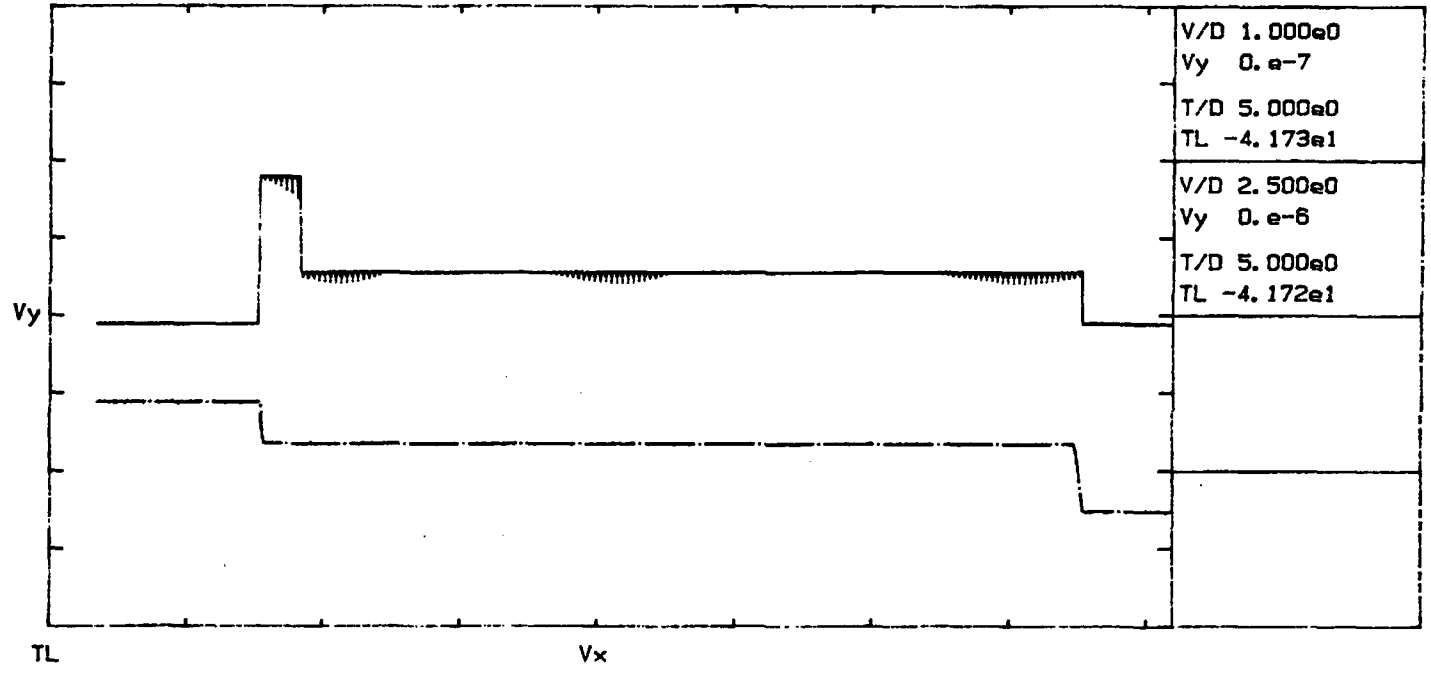
CS-OC-07-03		CS-CO-07-04	
STROKE TIME	: 29.94 SECONDS	STROKE TIME	: 29.41 SECONDS
PEAK INRUSH	: 7.66 AMPERES	PEAK INRUSH	: 7.26 AMPERES
AVE. RUN CURRENT	: 1.82 AMPERES	AVE. RUN CURRENT	: 1.94 AMPERES
MAX. RUN CURRENT	: 1.82 AMPERES	MAX. RUN CURRENT	: 1.94 AMPERES
SEATING CURRENT	: 2.38 AMPERES	END CURRENT	: 1.94 AMPERES

TEST IDENTIFICATION: VALVE #28
STORAGE LOCATION : 07-01

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 29.91 SECONDS	AVE RUN THRUST	: 0.02 V
		MAX RUN THRUST	: 0 V
BYPASS TIME	: 1.44 SECONDS	THRUST AT CST	: 1.945 V
		SEAT THRUST AT CST	: 1.925 V
		INERTIAL THRUST	: 12 %
TORQUE SW. SETTING: 1.5/1.5		TOTAL THRUST	: 2.185 V

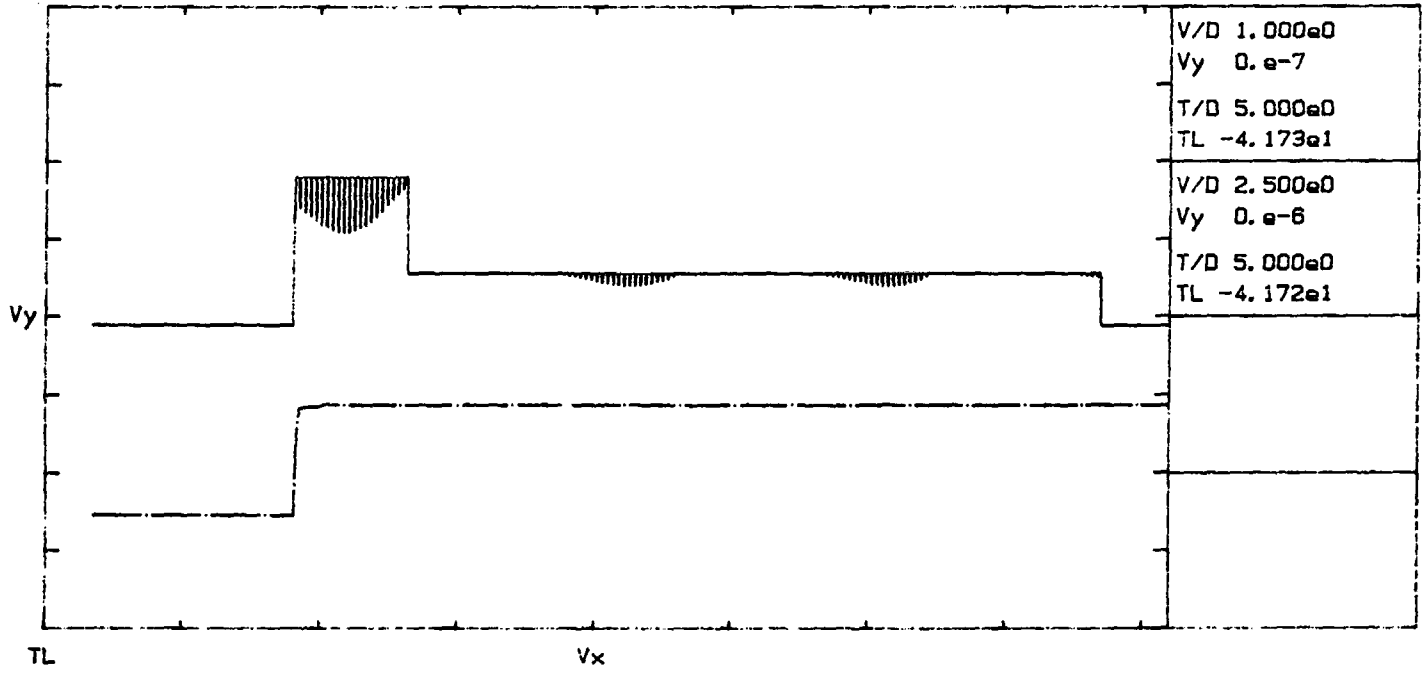


TEST IDENTIFICATION: VALVE #28
STORAGE LOCATION : 07-02

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 29.41	SECONDS	AVE RUN THRUST	: 0.06	V
			MAX RUN THRUST	: 0.06	V
BYPASS TIME	: 4.13		UNSEATING THRUST	: 0.11	V
UNSEATING TIME	: 1.32	SECONDS	THRUST AT CST	: N/A	
PROTECTION MARGIN	: 2.81	SECONDS	TORQUE SW. SETTING	: 2.5/2.5	



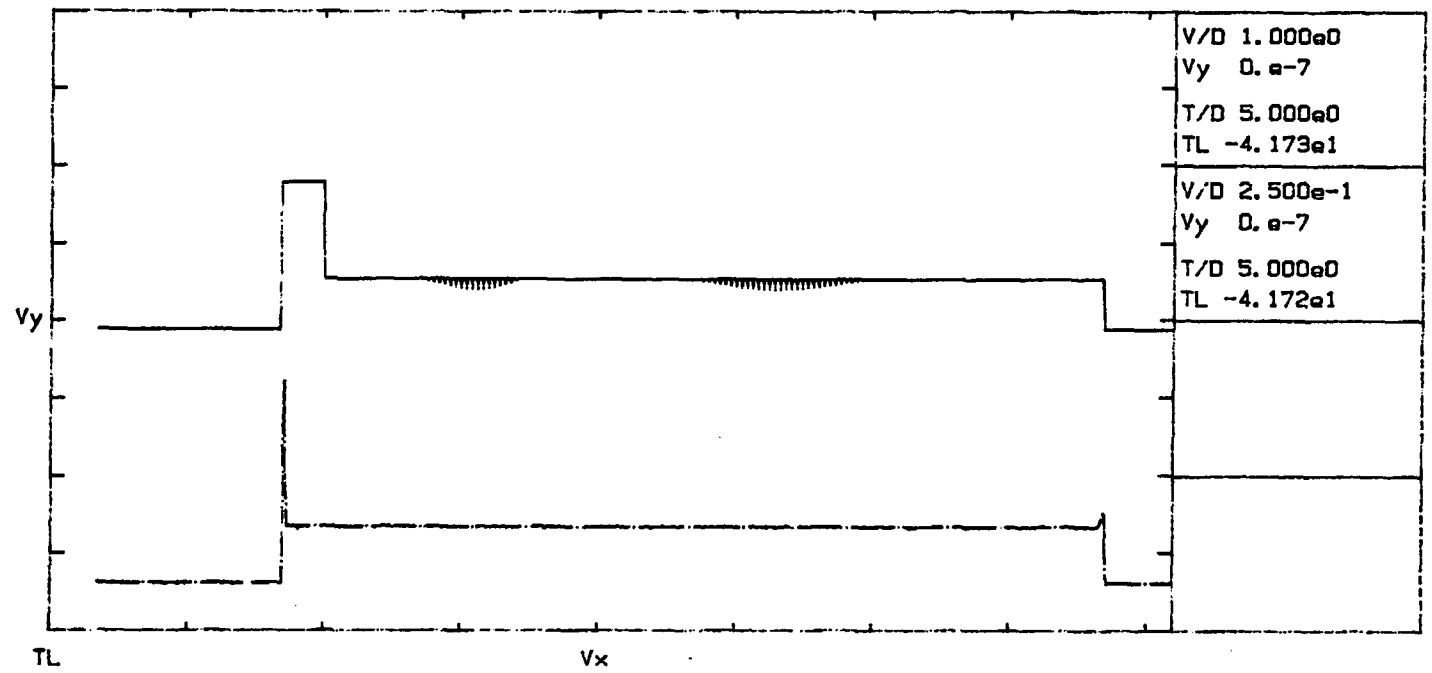
TEST IDENTIFICATION: VALVE #28
STORAGE LOCATION : 07-03

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 29.94 SECONDS

PEAK INRUSH : 7.66 AMPERES
AVE. RUN CURRENT : 1.82 AMPERES
MAX. RUN CURRENT : 1.82 AMPERES
SEATING CURRENT : 2.38 AMPERES



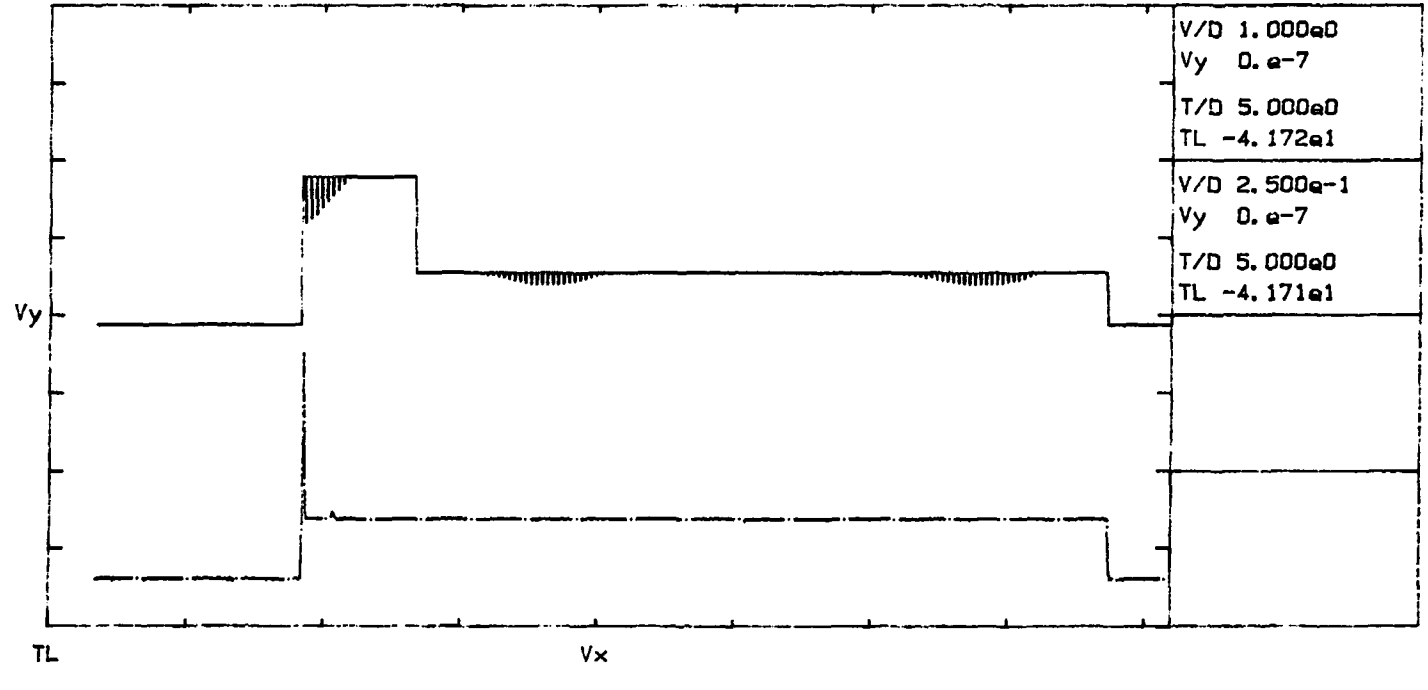
TEST IDENTIFICATION: VALVE #28
STORAGE LOCATION : 07-04

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 29.41 SECONDS

PEAK INRUSH : 7.26 AMPERES
AVE. RUN CURRENT : 1.94 AMPERES
MAX. RUN CURRENT : 1.94 AMPERES
END CURRENT : 1.94 AMPERES



Test I.D. Valve #29

Code	Comments
1,4	The close-to-open bypass switch was reset to properly cover the unseating of the valve and the possible valve guide wear.
4	The close-to-open thrust signature revealed a slight galling condition occurring towards the end of the valve guides.
4	The open-to-close thrust signature indicates an unusual loading condition occurring approximately six seconds into the open-to-close stroke. (See Recommendation #1).

Recommendations

1. This condition does not, in our opinion, jeopardize the operability of the valve at this time.

TEST ID: VALVE #29

SYSTEM

SYSTEM : N/A
FLOW : 0
TEMP : AMBIENT
PRESS : ATMOSPHERIC
SFTY REL'D: N/A

OPERATOR

TYPE : SMB
SIZE : 0
SERIAL NO. : 144044
ORDER NO. : 358972K
ORIENTATION: VERTICAL

ELECTRICAL

CONTROL CIR VOLTS: 120
AC/DC : AC
OPEN CONTROL : LIMIT
CLOSE CONTROL : TORQUE
MCC : N/A
SW. SENSING CIR. : CURRENT

VALVE

ID. NO. : 2-FCV-5-42
TYPE : GATE
SIZE : 16
BODY ORIENTATION: HORIZONTAL
INITIAL POSITION: N/A
FINAL POSITION : N/A

TORQUE SWITCH

OPEN T.S. SETTING : 2.0/2.0
CLOSE T.S. SETTING: 2.25/2.25
LIMITER PLATE : 5
TS BALANCEABLE : YES

MOTOR

VOLTS : 230/460 AC
RATED AMPS: 14
SPEED : 1750
HORSEPOWER: 2.6

TEST EQUIPMENT

LOAD CELL # : N/A--N/A
AMP PROBE # : SIMPSON(20) N/A
MAINFRAME # : N/A
TMD # : N/A

TEST ID: VALVE #29 BY: RLBJ DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

	TS-OC-02-08		TS-CO-02-07
STROKE TIME	: 76.72 SECONDS	STROKE TIME	: 75.94 SECONDS
BYPASS TIME	: 0.96 SECONDS	BYPASS TIME	: 7.84 SECONDS
THRUST AT CST	: 2.01 V	PROTECTION MARGIN	: 5.24 SECONDS
SEAT THRUST AT CST	: 1.885 V	UNSEATING TIME	: 2.6 SECONDS
AVE RUN THRUST	: 0.105 V	AVE RUN THRUST	: 0.16 V
MAX RUN THRUST	: 0.28 V	MAX RUN THRUST	: 0.19 V
INERTIAL THRUST	: 24 %	UNSEATING THRUST	: 1.04 V
TOTAL THRUST	: 2.5 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.25/2.25	TORQUE SW. SETTING	: 2.0/2.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

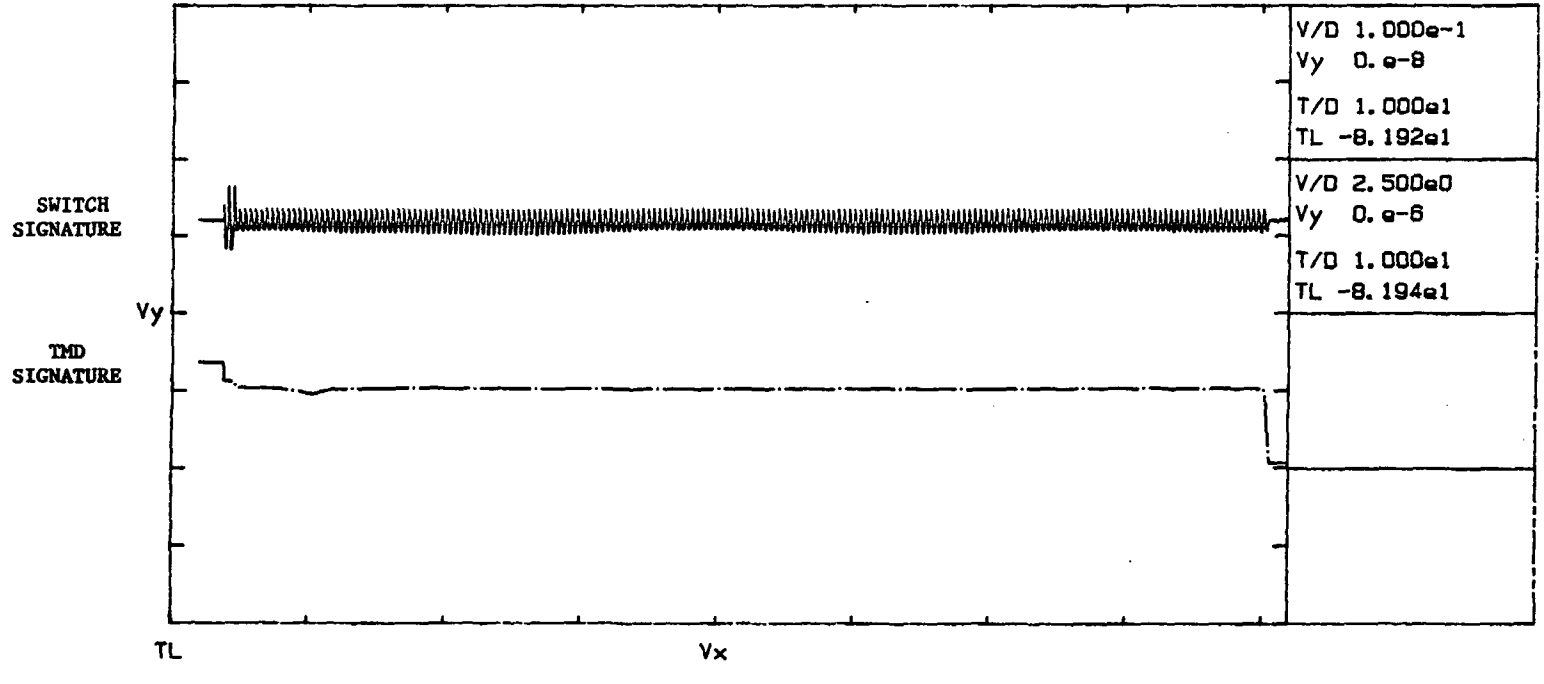
	CS-OC-02-10		CS-CO-02-09
STROKE TIME	: 76.72 SECONDS	STROKE TIME	: 76 SECONDS
PEAK INRUSH	: 12.56 AMPERES	PEAK INRUSH	: 13.04 AMPERES
AVE. RUN CURRENT	: 5.16 AMPERES	AVE. RUN CURRENT	: 5.1 AMPERES
MAX. RUN CURRENT	: 5.16 AMPERES	MAX. RUN CURRENT	: 5.1 AMPERES
SEATING CURRENT	: 5.54 AMPERES	END CURRENT	: 5.1 AMPERES

TEST IDENTIFICATION: VALVE #29
STORAGE LOCATION : 02-08

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 76.72 SECONDS	AVE RUN THRUST	: 0.105 V
		MAX RUN THRUST	: 0.28 V
BYPASS TIME	: 0.96 SECONDS	THRUST AT CST	: 2.01 V
		SEAT THRUST AT CST	: 1.885 V
		INERTIAL THRUST	: 24 %
TORQUE SW. SETTING: 2.25/2.25		TOTAL THRUST	: 2.5 V

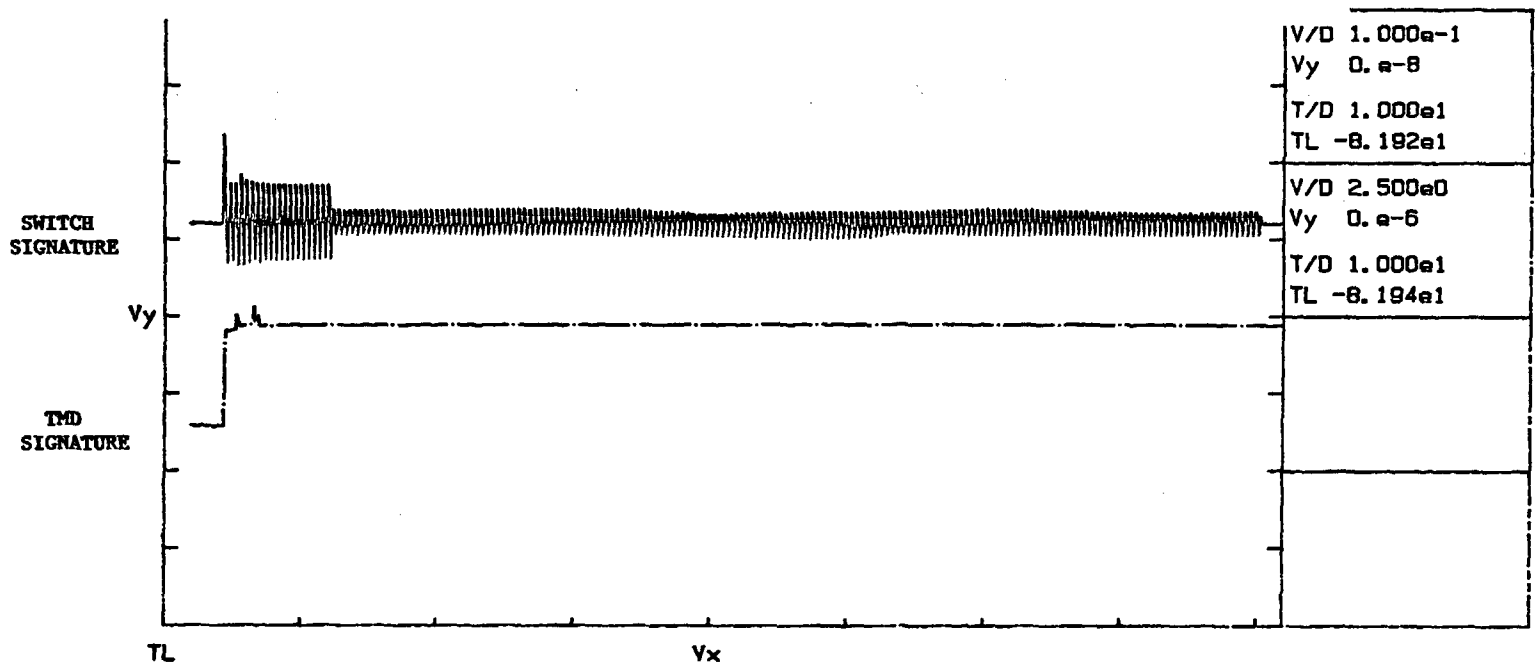


TEST IDENTIFICATION: VALVE #29
STORAGE LOCATION : 02-07

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 75.94 SECONDS	AVE RUN THRUST	: 0.16 V
		MAX RUN THRUST	: 0.19 V
BYPASS TIME	: 7.84	UNSEATING THRUST	: 1.04 V
UNSEATING TIME	: 2.6 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 5.24 SECONDS	TORQUE SW. SETTING	: 2.0/2.0



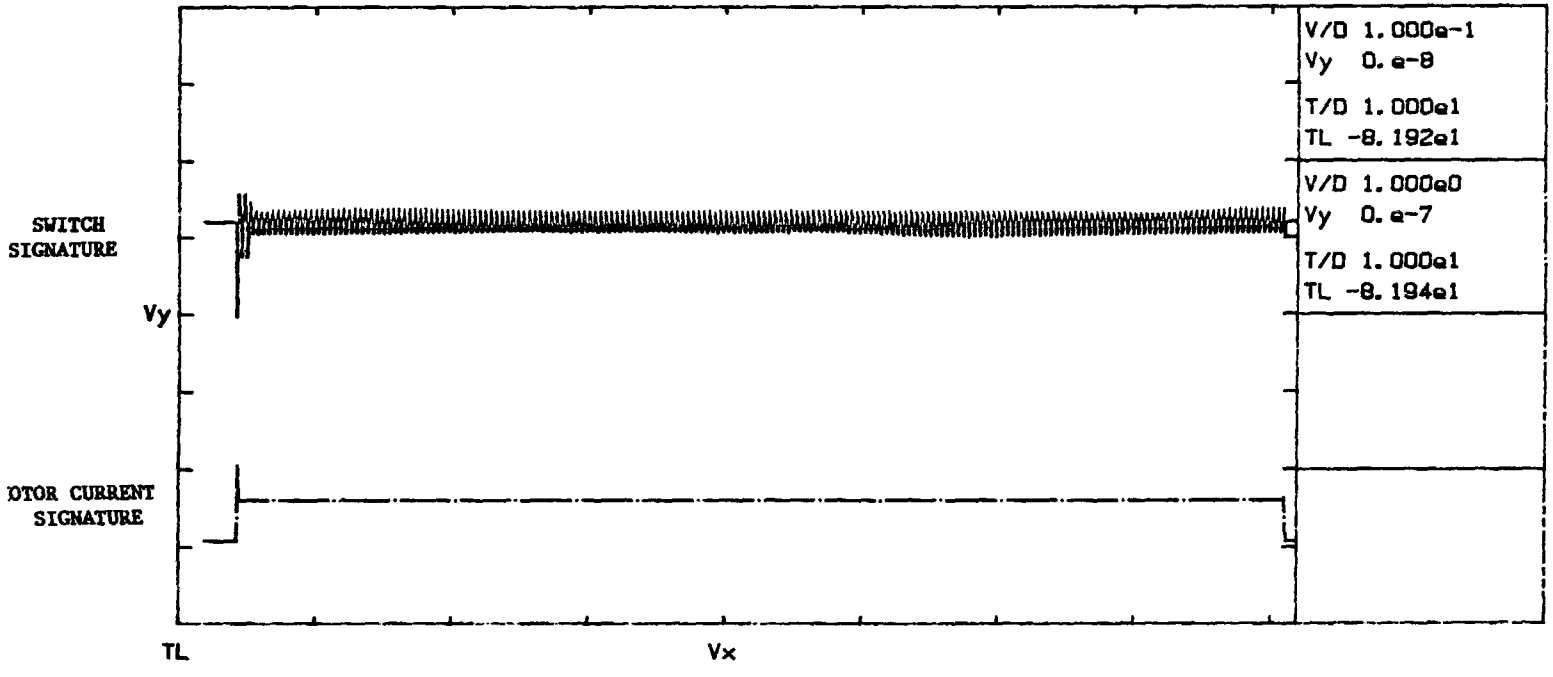
TEST IDENTIFICATION: VALVE #29
STORAGE LOCATION : 02-10

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 76.72 SECONDS

PEAK INRUSH : 12.56 AMPERES
AVE. RUN CURRENT : 5.16 AMPERES
MAX. RUN CURRENT : 5.16 AMPERES
SEATING CURRENT : 5.54 AMPERES



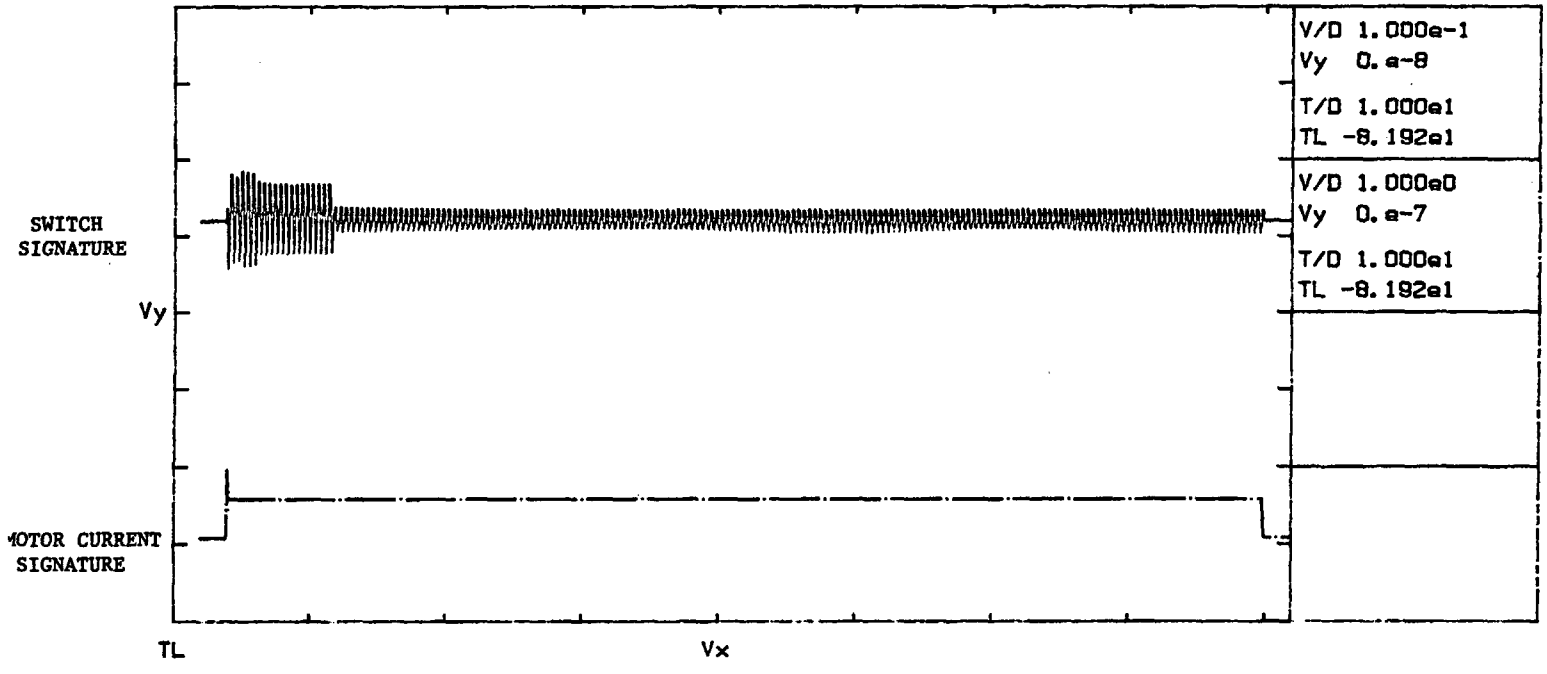
TEST IDENTIFICATION: VALVE #29
STORAGE LOCATION : 02-09

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 76 SECONDS

PEAK INRUSH : 13.04 AMPERES
AVE. RUN CURRENT : 5.1 AMPERES
MAX. RUN CURRENT : 5.1 AMPERES
END CURRENT : 5.1 AMPERES



Test I.D. Valve #30

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
3	During equipment installation, the spring cartridge cap was found to be full of grease.
4	The thrust signatures revealed a gap of .170" in the spring pack assembly.

Recommendations

1. It should be noted that the Belleville springs do not require lubrication to function properly.

TEST ID: VALVE #30

SYSTEM

SYSTEM :
FLOW : 0
TEMP : AMBIENT
PRESS : ATMOSPHERIC
SFTY REL'D:

OPERATOR

TYPE : SMB
SIZE : 0
SERIAL NO. : 144035
ORDER NO. : 358972F
ORIENTATION: VERTICAL

ELECTRICAL

CONTROL CIR VOLTS: 120
AC/DC : AC
OPEN CONTROL : LIMIT
CLOSE CONTROL : TORQUE
MCC :
SW. SENSING CIR. : CURRENT

VALVE

ID. NO. : 2-FCV-1-137B
TYPE : GATE
SIZE : 8"
BODY ORIENTATION: HORIZONTAL
INITIAL POSITION:
FINAL POSITION :

TORQUE SWITCH

OPEN T.S. SETTING : 3.0/3.0
CLOSE T.S. SETTING: 1.5/1.5
LIMITER PLATE : 5.0
TS BALANCEABLE : YES

MOTOR

VOLTS : 460 AC
RATED AMPS: 5.75
SPEED : 1700
HORSEPOWER: 2.6

TEST EQUIPMENT

LOAD CELL # : N/A--
AMP PROBE # : SIMPSON(20)
MAINFRAME # :
TMD # :

TEST ID: VALVE #30 BY: RLB DATE: 06-16-85

THRUST SIGNATURE ANALYSIS

	TS-OC-02-03		TS-CO-02-02	
STROKE TIME	: 43.06	SECONDS	STROKE TIME	: 42.8 SECONDS
BYPASS TIME	: 0.38	SECONDS	BYPASS TIME	: 4.04 SECONDS
THRUST AT CST	: 0.755	V	PROTECTION MARGIN	: 2.4 SECONDS
SEAT THRUST AT CST	: 0.615	V	UNSEATING TIME	: 1.64 SECONDS
AVE RUN THRUST	: 0.1	V	AVE RUN THRUST	: 0.09 V
MAX RUN THRUST	: 0.125	V	MAX RUN THRUST	: 0.1 V
INERTIAL THRUST	: 76	%	UNSEATING THRUST	: 0.355 V
TOTAL THRUST	: 1.33	V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.5/1.5		TORQUE SW. SETTING	: 3.0/3.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

	CS-OC-02-05		CS-CO-02-04	
STROKE TIME	: 43.14	SECONDS	STROKE TIME	: 42.82 SECONDS
PEAK INRUSH	: 16.89	AMPERES	PEAK INRUSH	: 16.08 AMPERES
AVE. RUN CURRENT	: 5.51	AMPERES	AVE. RUN CURRENT	: 5.15 AMPERES
MAX. RUN CURRENT	: 5.51	AMPERES	MAX. RUN CURRENT	: 5.15 AMPERES
SEATING CURRENT	: 5.54	AMPERES	END CURRENT	: 5.15 AMPERES

TEST IDENTIFICATION: VALVE #30
STORAGE LOCATION : 02-03

PLOT NO. 1

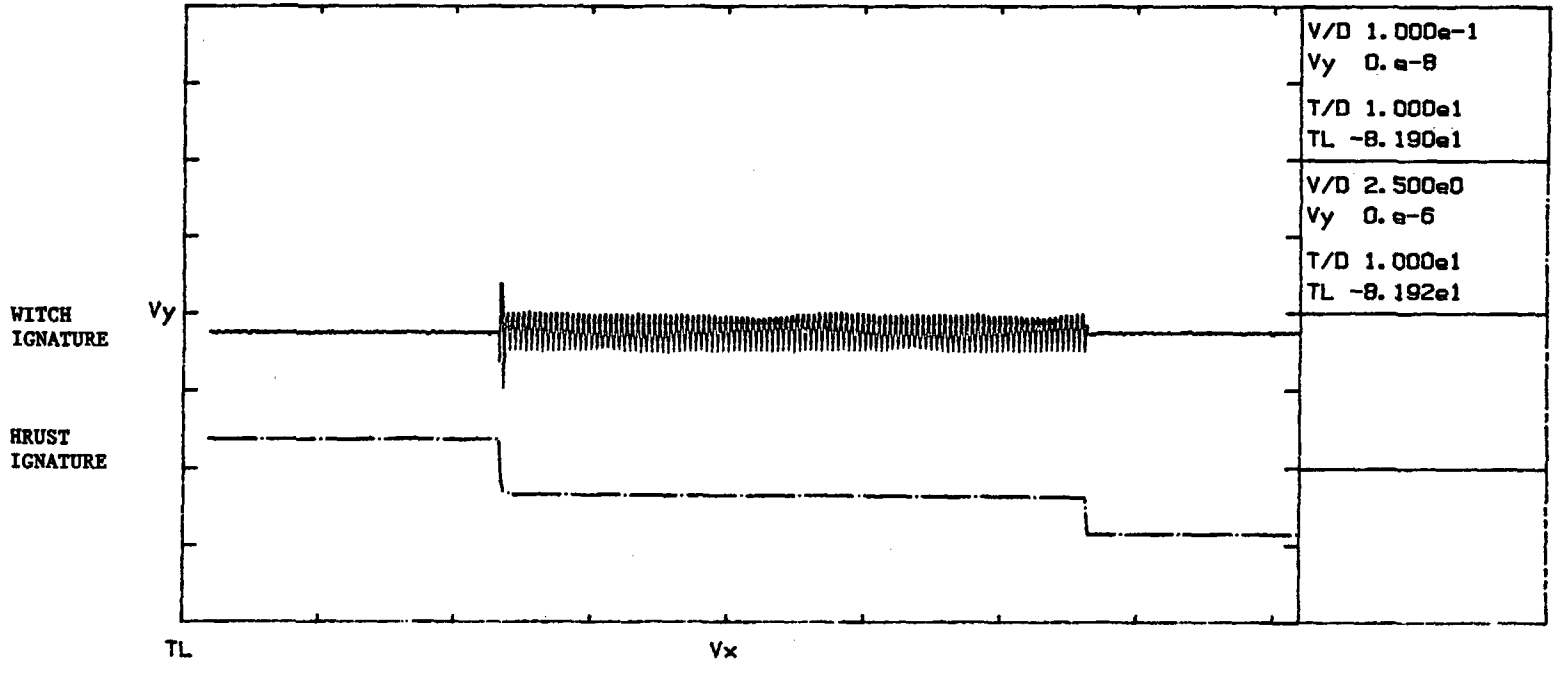
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 43.06 SECONDS

BYPASS TIME : 0.38 SECONDS

TORQUE SW. SETTING: 1.5/1.5

AVE RUN THRUST : 0.1 V
MAX RUN THRUST : 0.125 V
THRUST AT CST : 0.755 V
SEAT THRUST AT CST: 0.615 V
INERTIAL THRUST : 76 %
TOTAL THRUST : 1.33 V

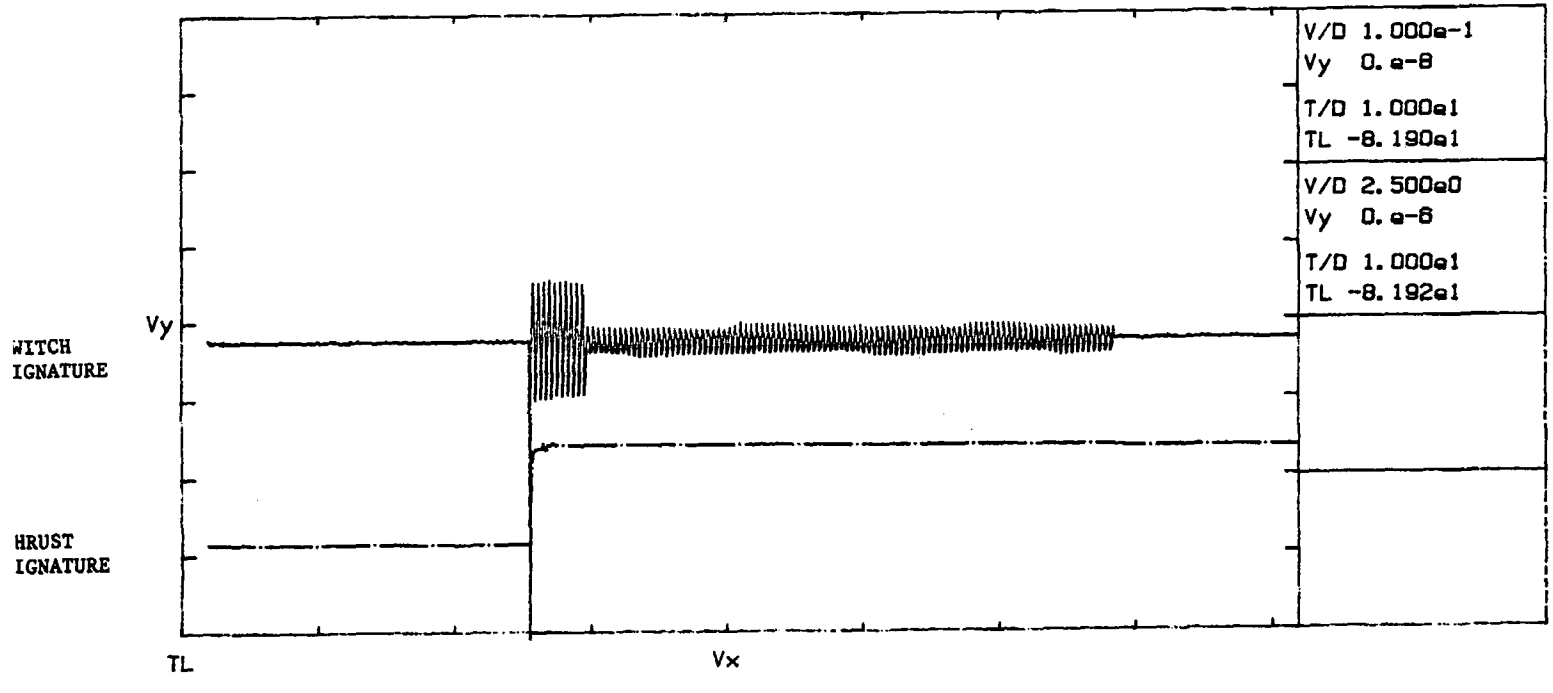


TEST IDENTIFICATION: VALVE #30
STORAGE LOCATION : 02-02

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 42.8 SECONDS	AVE RUN THRUST	: 0.09 V
		MAX RUN THRUST	: 0.1 V
BYPASS TIME	: 4.04	UNSEATING THRUST	: 0.355 V
UNSEATING TIME	: 1.64 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 2.4 SECONDS	TORQUE SW. SETTING	: 3.0/3.0



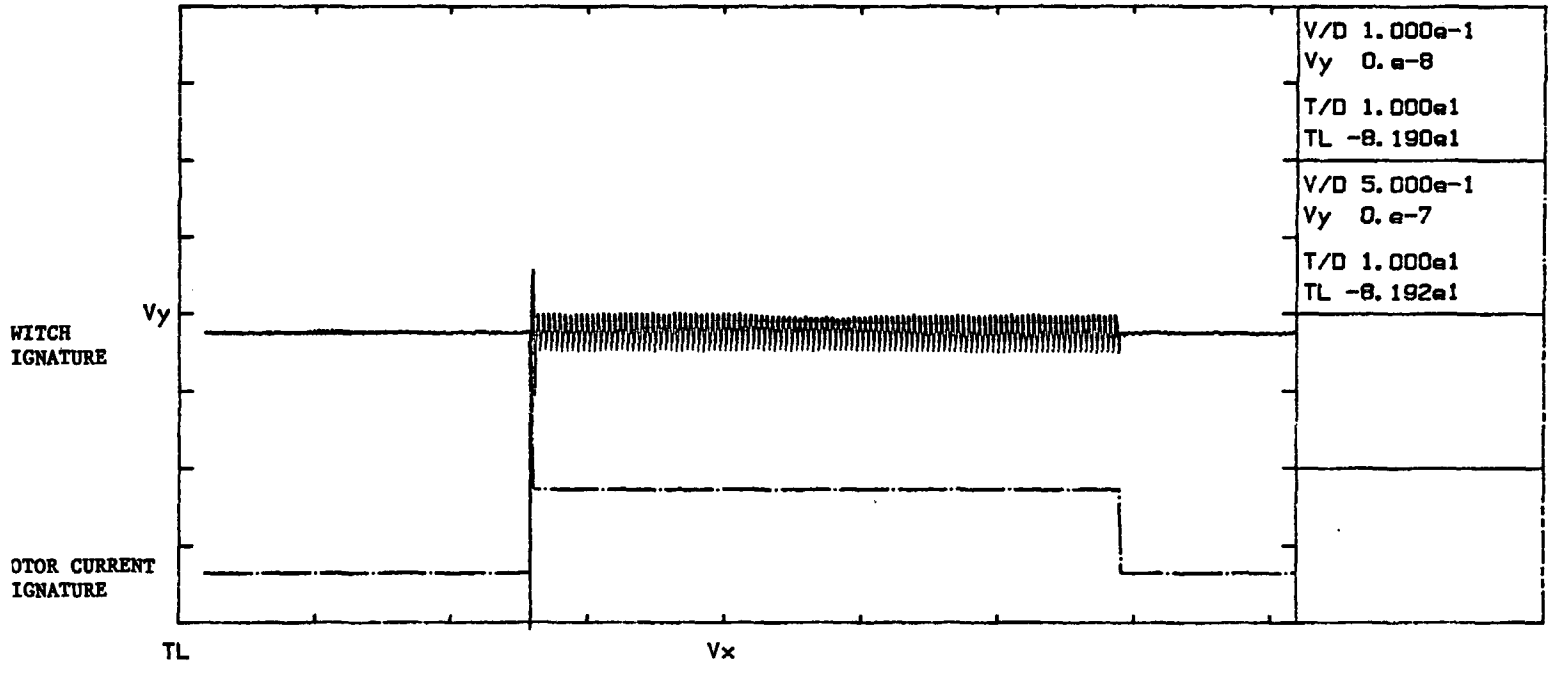
TEST IDENTIFICATION: VALVE #30
STORAGE LOCATION : 02-05

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 43.14 SECONDS

PEAK INRUSH : 16.89 AMPERES
AVE. RUN CURRENT : 5.51 AMPERES
MAX. RUN CURRENT : 5.51 AMPERES
SEATING CURRENT : 5.54 AMPERES



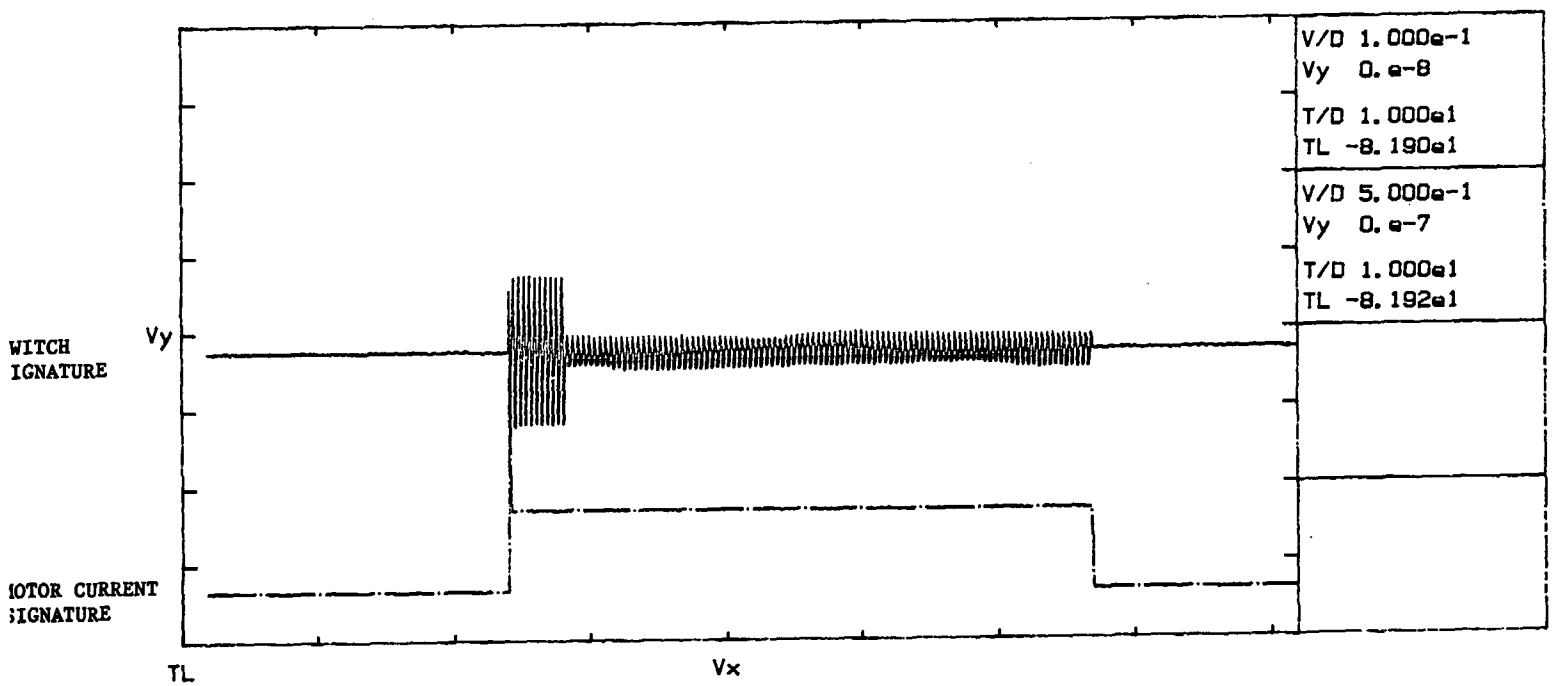
TEST IDENTIFICATION: VALVE #30
STORAGE LOCATION : 02-04

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 42.82 SECONDS

PEAK INRUSH : 16.08 AMPERES
AVE. RUN CURRENT : 5.15 AMPERES
MAX. RUN CURRENT : 5.15 AMPERES
END CURRENT : 5.15 AMPERES



TEST ID: VALVE #31

SYSTEM

SYSTEM :
FLOW : 0
TEMP : AMBIENT
PRESS : ATMOSPHERIC
SFTY REL'D:

OPERATOR

TYPE : SMB
SIZE : 00
SERIAL NO. : 175499
ORDER NO. : 36820C
ORIENTATION: VERTICAL

ELECTRICAL

CONTROL CIR VOLTS: 120
AC/DC : AC
OPEN CONTROL : LIMIT
CLOSE CONTROL : TORQUE
MCC :
SW. SENSING CIR. : CURRENT

VALVE

ID. NO. : 2-FCV-1-17
TYPE : GATE
SIZE : 4"
BODY ORIENTATION: HORIZONTAL
INITIAL POSITION:
FINAL POSITION :

TORQUE SWITCH

OPEN T.S. SETTING : 2.0/2.0
CLOSE T.S. SETTING: 1.5/1.5
LIMITER PLATE : NONE
TS BALANCEABLE : NO

MOTOR

VOLTS : 460 AC
RATED AMPS: 2.6
SPEED : 1750
HORSEPOWER: 1.0

TEST EQUIPMENT

LOAD CELL # : --
AMP PROBE # : SIMPSON(20)

Test I.D. Valve #31

Code	Comments
1	The close-to-open bypass switch requires adjustment to properly cover the unseating of the valve. (See Recommendation #1).
1	The thrust and switch signatures indicate that the valve is backseating. (See Recommendation #2).
4	During equipment installation, oil was noted in the spring pack cavity. (See Recommendation #3).

Recommendations

1. The close-to-open bypass switch should be reset to actuate after valve unseating to preclude an inadvertent torque switch trip.

2. The inertia developed within the actuator is causing the valve to coast into the backseat after the open control circuit has been broken. The open limit switch should be set to actuate earlier in the close-to-open stroke to compensate for the inertia factor.

3. Consideration should be given to sampling the grease in this operator and performing a chemical analysis to determine if it has degraded to a point where the lubricating quality has been reduced.

TEST ID: VALVE #31 BY: RLB DATE: 06-16-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-11		TS-CO-01-12	
STROKE TIME	: 13.63 SECONDS	STROKE TIME	: 13.53 SECONDS
BYPASS TIME	: 0.85 SECONDS	BYPASS TIME	: 1.14 SECONDS
THRUST AT CST	: 0.785 V	PROTECTION MARGIN	:-0.22 SECONDS
SEAT THRUST AT CST	: 0.785 V	UNSEATING TIME	: 1.36 SECONDS
AVE RUN THRUST	:<PRELOAD	AVE RUN THRUST	:<PRELOAD
MAX RUN THRUST	:<PRELOAD	MAX RUN THRUST	:<PRELOAD
INERTIAL THRUST	: 29 %	UNSEATING THRUST	:<PRELOAD
TOTAL THRUST	: 1.02 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.5/1.5	TORQUE SW. SETTING	: 2.0/2.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-01-13		CS-CO-01-14	
STROKE TIME	: 13.64 SECONDS	STROKE TIME	: 13.53 SECONDS
PEAK INRUSH	: 5.72 AMPERES	PEAK INRUSH	: 5.61 AMPERES
AVE. RUN CURRENT	: 2.41 AMPERES	AVE. RUN CURRENT	: 2.31 AMPERES
MAX. RUN CURRENT	: 2.41 AMPERES	MAX. RUN CURRENT	: 2.31 AMPERES
SEATING CURRENT	: 2.63 AMPERES	END CURRENT	: 2.31 AMPERES

TEST IDENTIFICATION: VALVE #31
STORAGE LOCATION : 01-11

PLOT NO. 1

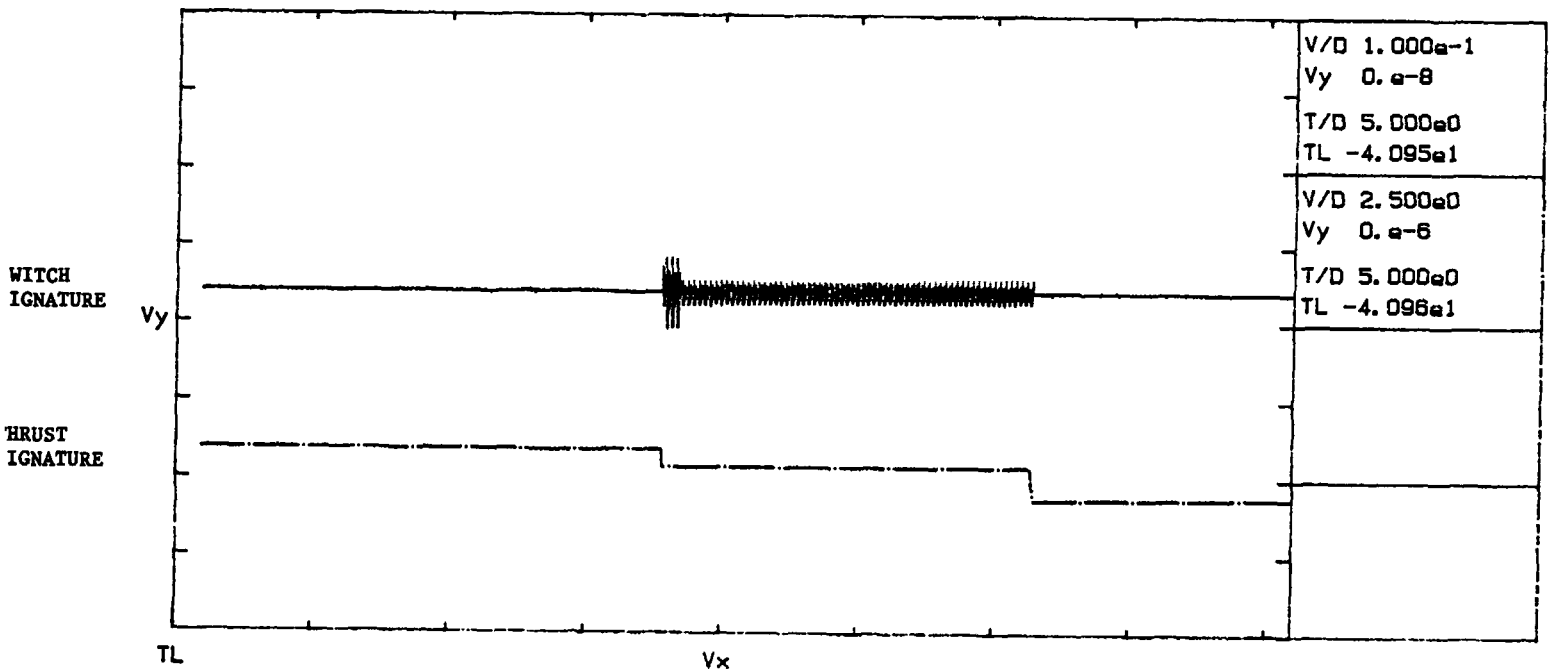
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 13.63 SECONDS

BYPASS TIME : 0.85 SECONDS

TORQUE SW. SETTING: 1.5/1.5

AVE RUN THRUST : <PRELOAD
MAX RUN THRUST : <PRELOAD
THRUST AT CST : 0.785 V
SEAT THRUST AT CST: 0.785 V
INERTIAL THRUST : 29 %
TOTAL THRUST : 1.02 V

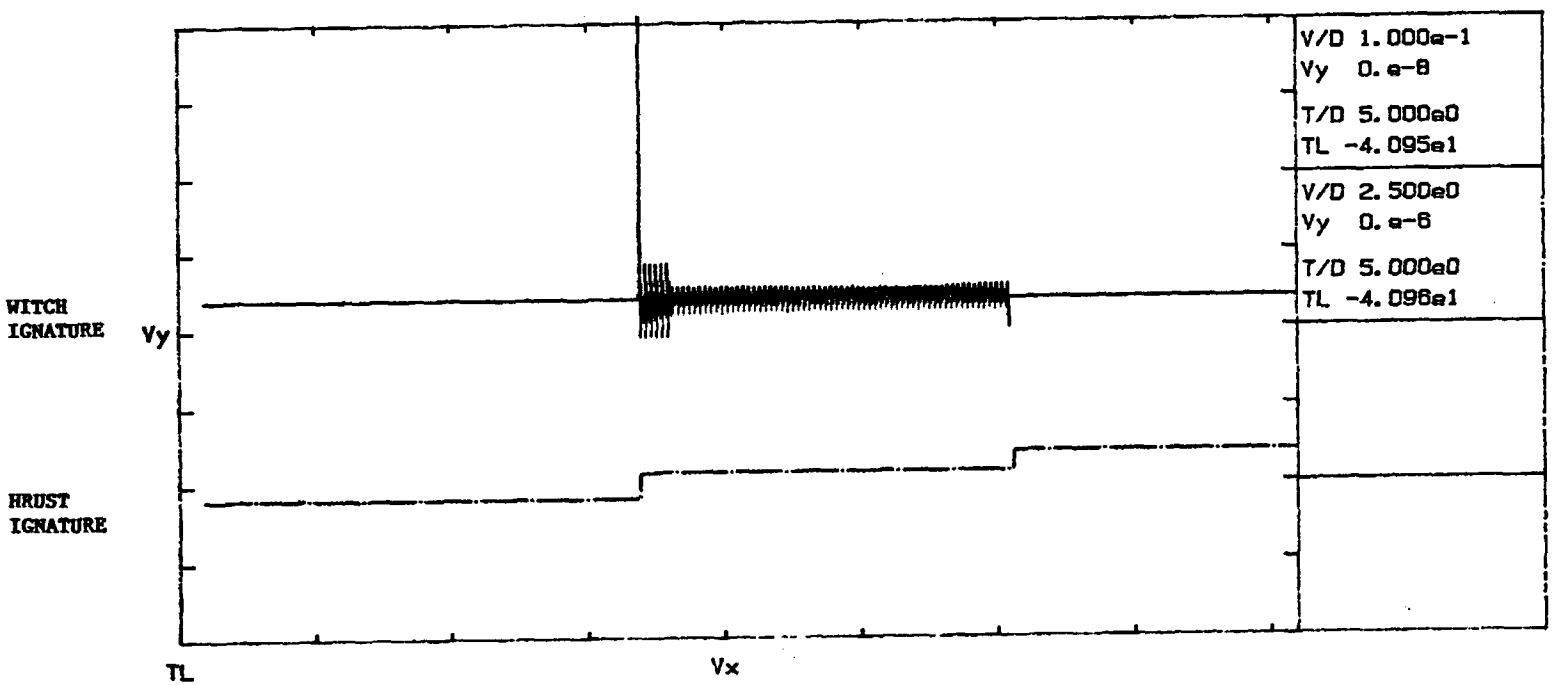


TEST IDENTIFICATION: VALVE #31
STORAGE LOCATION : 01-12

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 13.53 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 1.14	UNSEATING THRUST	:<PRELOAD
UNSEATING TIME	: 1.36 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	:-0.22 SECONDS	TORQUE SW. SETTING	: 2.0/2.0



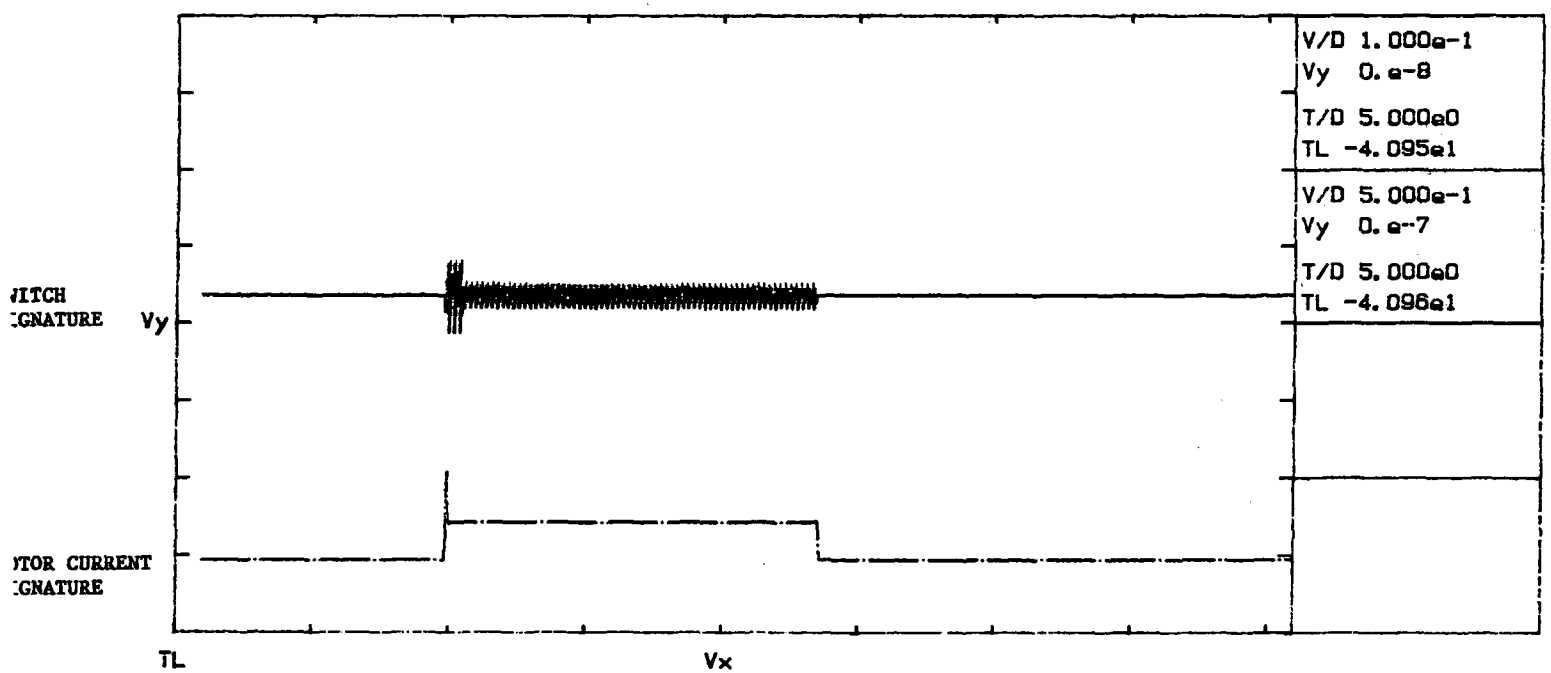
TEST IDENTIFICATION: VALVE #31
STORAGE LOCATION : 01-13

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 13.64 SECONDS

PEAK INRUSH : 5.72 AMPERES
AVE. RUN CURRENT : 2.41 AMPERES
MAX. RUN CURRENT : 2.41 AMPERES
SEATING CURRENT : 2.63 AMPERES



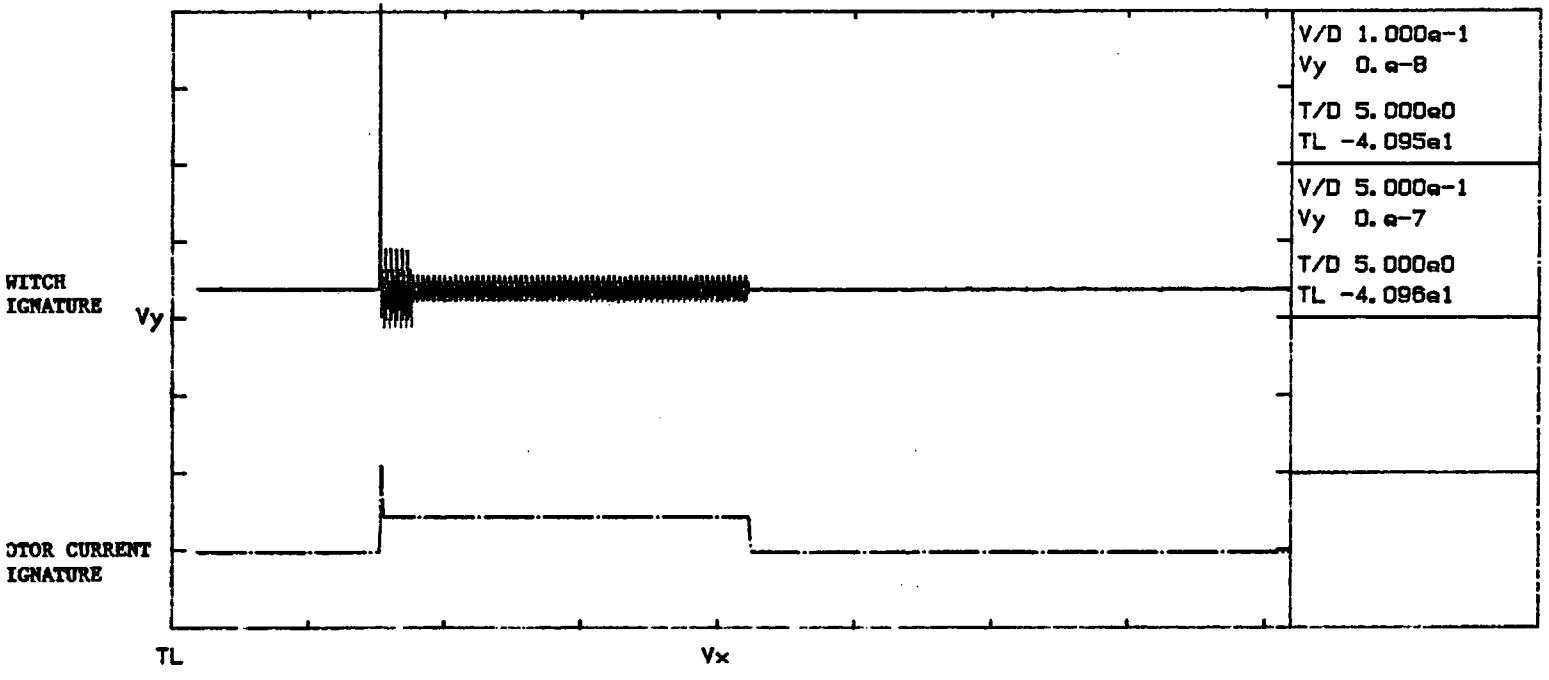
TEST IDENTIFICATION: VALVE #31
STORAGE LOCATION : 01-14

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 13.53 SECONDS

PEAK INRUSH : 5.61 AMPERES
AVE. RUN CURRENT : 2.31 AMPERES
MAX. RUN CURRENT : 2.31 AMPERES
END CURRENT : 2.31 AMPERES



TEST ID: VALVE #32

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 1
TEMP	: AMBIENT	SERIAL NO.	: 216593
PRESS	: ATMOSPHERIC	ORDER NO.	: 382435A
SFTY REL'D:	N/A	ORIENTATION:	VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS:	120	ID. NO.	: 2-FCV-6-108
AC, DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12
CLOSE CONTROL	: TORQUE	BODY ORIENTATION:	HORIZONTAL
MOC	: N/A	INITIAL POSITION:	N/A
SW. SENSING CIR.	: CURRENT	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 1.5/1.5	VOLTS	: 230/460 AC
CLOSE T.S. SETTING:	1.75/1.75	RATED AMPS:	9.46
LIMITER PLATE	: 4.5	SPEED	: 1735
TS BALANCEABLE	: YES	HORSEPOWER:	65

TEST EQUIPMENT

LOAD CELL # : N/A--N/A

AMP PROBE # : SIMPSON(20) N/A

MAINFRAME # : N/A

TMD # : N/A

Test I. D. Valve #32

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
4	During equipment installation, it was noted that there was separated grease in the spring cartridge cap. (See Recommendation #1).
4	During equipment installation, standing water was noted inside the limit switch compartment. (See Recommendation #2).
4	The motor current signatures indicate a 50 RPM cyclic loading condition. (See Recommendation #3).

Recommendations

1. Consideration should be given to sampling the grease in this operator and performing a chemical analysis to determine if it has degraded to a point where the lubricating quality has been reduced.

2. The cause of this condition should be investigated and, if possible, alleviated.

3. The magnitude of this condition does not, in our opinion, jeopardize the operability of the valve at this time.

TEST ID: VALVE #19

SYSTEM		OPERATOR	
SYSTEM	:	TYPE	: SMB
FLOW	: 0	SIZE	: 0
TEMP	: AMBIENT	SERIAL NO.	: 95086A
PRESS	: ATMOSPHERIC	ORDER NO.	: 336542C
SFTY REL'D:		ORIENTATION:	VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS:	120	ID. NO.	: COV-10B
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION:	HORIZONTAL
MCC	:	INITIAL POSITION:	
SW. SENSING CIR.	: VOLTAGE	FINAL POSITION	:

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 1.0/1.0	VOLTS	: 460 AC
CLOSE T.S. SETTING:	1.5/1.5	RATED AMPS:	4.6
LIMITER PLATE	: 2.5	SPEED	: 1700
TS BALANCEABLE	: YES	HORSEPOWER:	7.5

TEST EQUIPMENT

LOAD CELL # : 50 K--

AMP PROBE # : FLUKE(20)

MAINFRAME # :

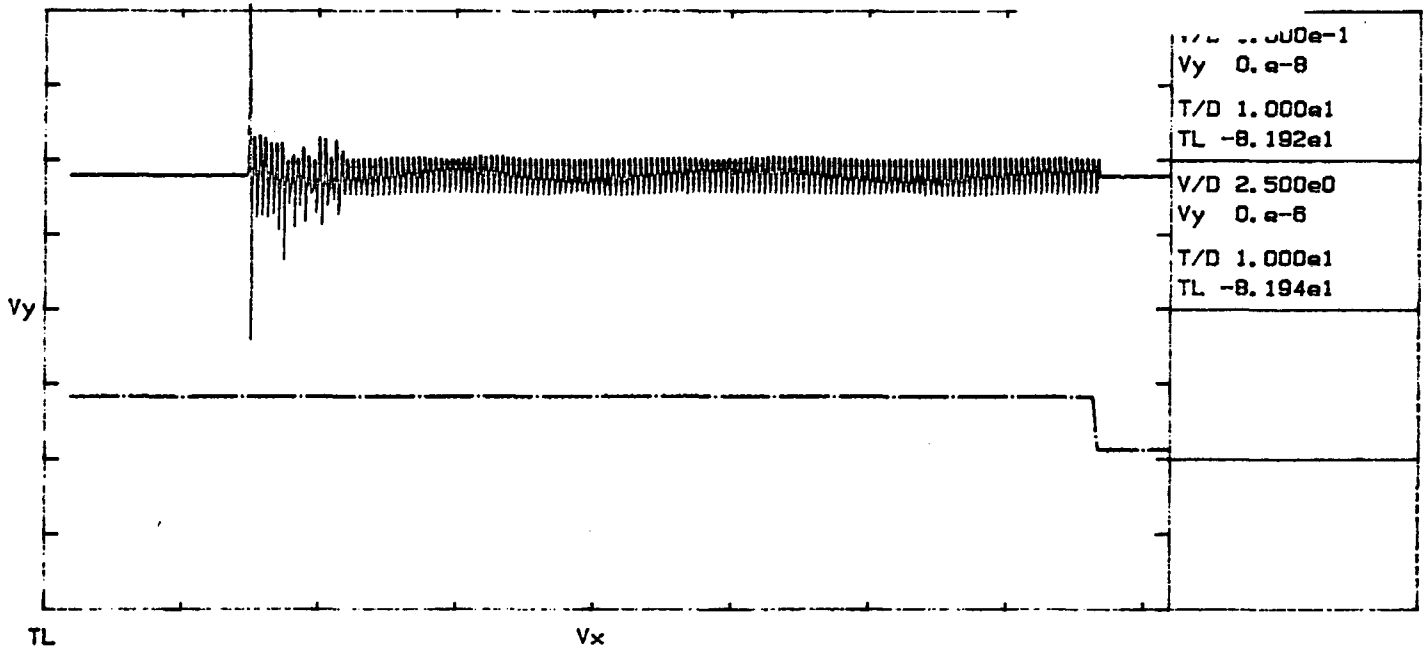
TMD # :

TEST IDENTIFICATION: VALVE #32
STORAGE LOCATION : 01-16

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 62.42 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 0.68 SECONDS	THRUST AT CST	: 1.48 V
		SEAT THRUST AT CST	: 1.48 V
		INERTIAL THRUST	: 17 %
TORQUE SW. SETTING: 1.75/1.75		TOTAL THRUST	: 1.74 V

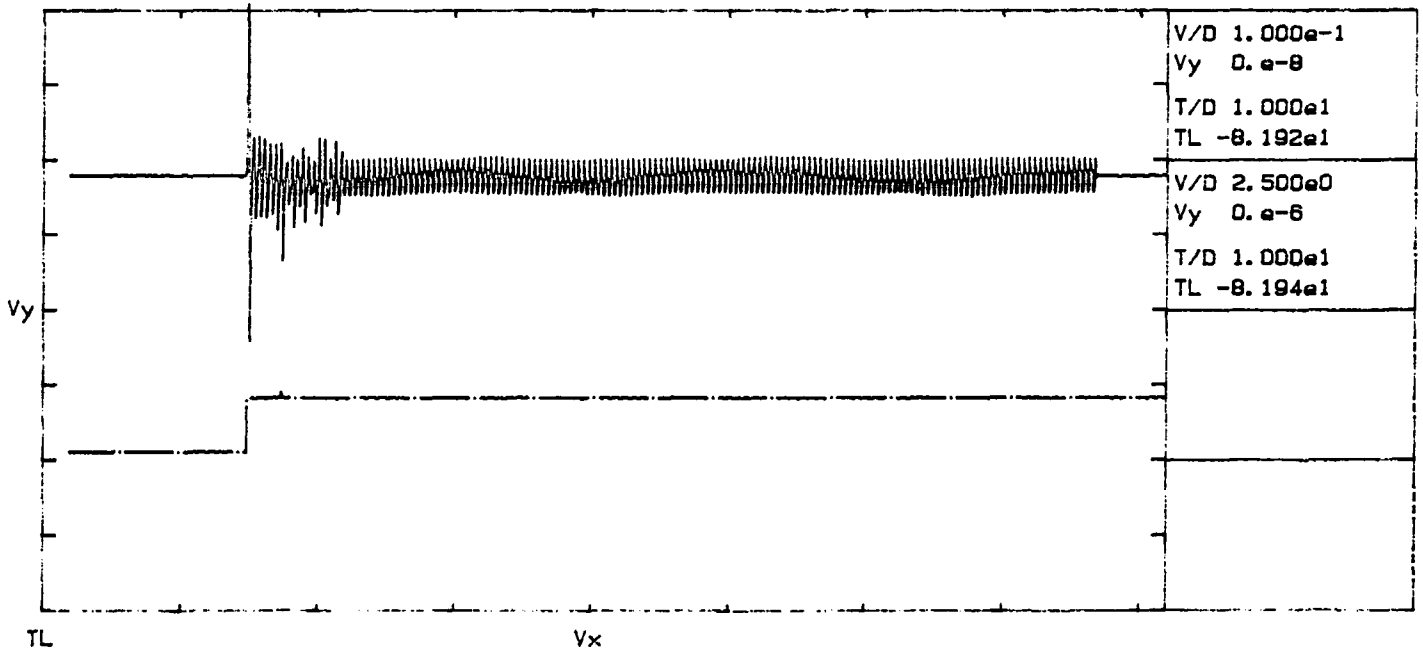


TEST IDENTIFICATION: VALVE #32
STORAGE LOCATION : 01-15

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 61.9	SECONDS	AVE RUN THRUST	: <PRELOAD
			MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 7.02		UNSEATING THRUST	: 0.52 V
UNSEATING TIME	: 2.68	SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 4.34	SECONDS	TORQUE SW. SETTING	: 1.5/1.5



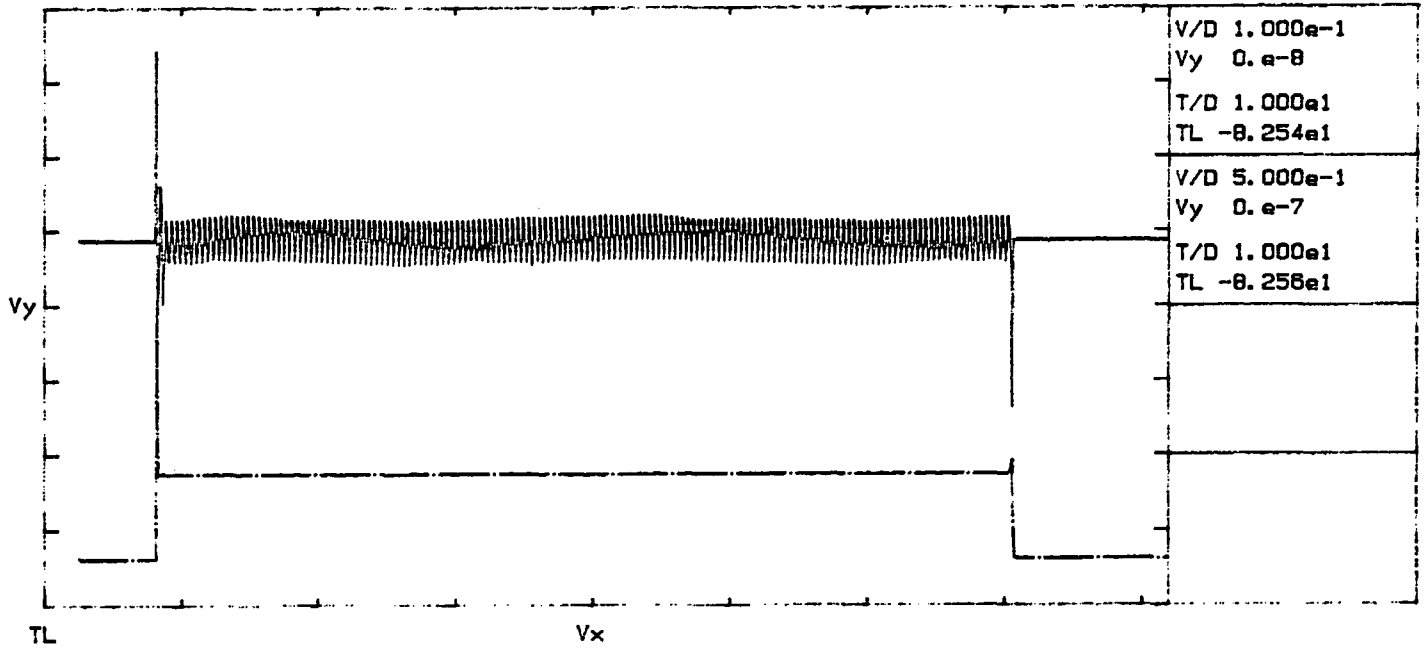
TEST IDENTIFICATION: VALVE #32
STORAGE LOCATION : 01-18

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 62.44 SECONDS

PEAK INRUSH : 21.8 AMPERES
AVE. RUN CURRENT : 5.61 AMPERES
MAX. RUN CURRENT : 5.66 AMPERES
SEATING CURRENT : 6.9 AMPERES



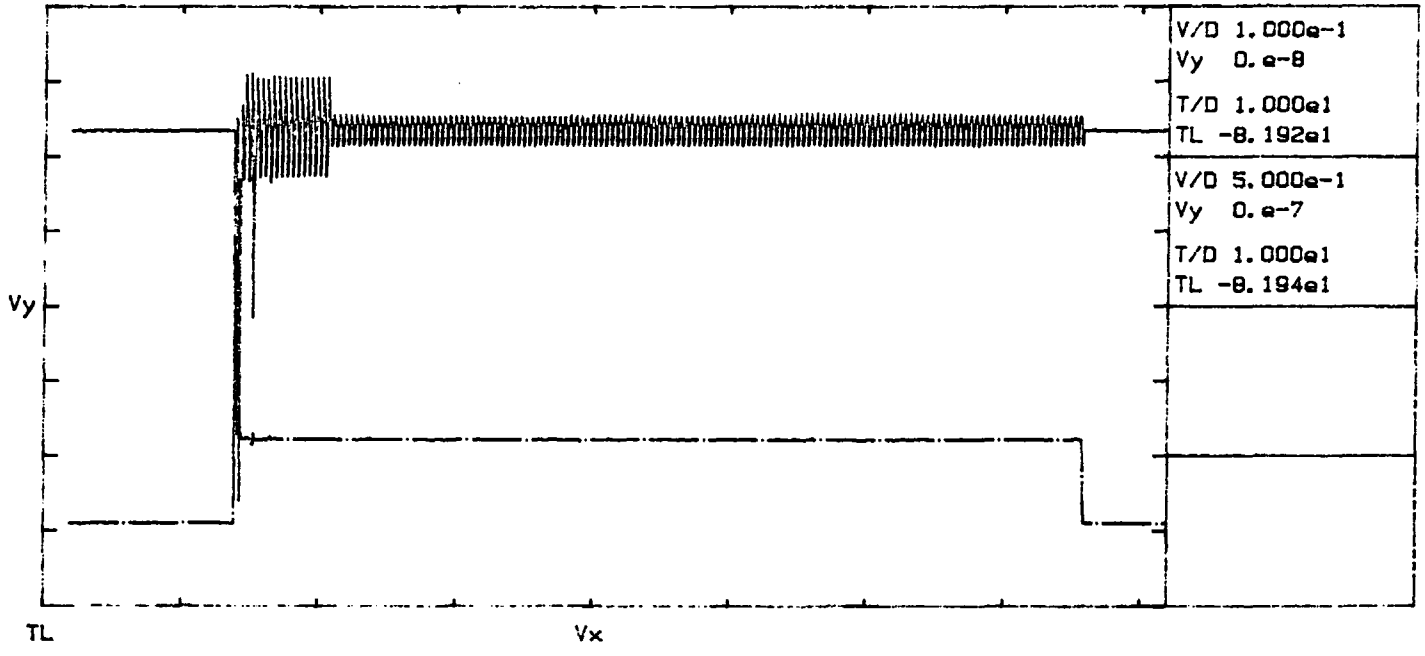
TEST IDENTIFICATION: VALVE #32
STORAGE LOCATION : 01-17

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 61.88 SECONDS

PEAK INRUSH	: 23.19	AMPERES
AVE. RUN CURRENT	: 5.56	AMPERES
MAX. RUN CURRENT	: 5.56	AMPERES
END CURRENT	: 5.56	AMPERES



TEST ID: VALVE #33

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 1
TEMP	: AMBIENT	SERIAL NO.	: 149029
PRESS	: ATMOSPHERIC	ORDER NO.	: 359503E
SFTY REL'D	: N/A	ORIENTATION	:

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: 2-FCV-2-94
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 12"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: CURRENT	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 2.0/2.0	VOLTS	: 460 AC
CLOSE T.S. SETTING	: 2.0/2.0	RATED AMPS	: 6
LIMITER PLATE	: 4.5	SPEED	: 1720
TS BALANCEABLE	: YES	HORSEPOWER	: 1.0

TEST EQUIPMENT

LOAD CELL # : N/A--

AMP PROBE # : SIMPSON(20) N/A

MAINFRAME # : N/A

TMD # : N/A

Test I.D. Valve #33

Code	Comments
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
3	The thrust signatures reveal unusual seating and unseating conditions. (See Recommendation #1).
3	During equipment installation, it was noted that the spring cartridge cap had apparently been packed with grease. (See Recommendation #2).
4	The motor is running approximately 16% above its rated amperage in the closed direction. (See Recommendation #1).
4	The valve was noted to be leaking from the packing gland.

Recommendations

1. This condition does not, in our opinion, jeopardize the operability of the valve at this time, however, the condition should be monitored during the next testing period.

2. It should be noted that the Belleville springs do not require lubrication to function properly.

TEST ID: VALVE #33 BY: RLB DATE: 06-16-85

THRUST SIGNATURE ANALYSIS

	TS-OC-01-06		TS-CO-01-07	
STROKE TIME	: 70.82	SECONDS	STROKE TIME	: 70.32 SECONDS
BYPASS TIME	: 0.48	SECONDS	BYPASS TIME	: 10.36 SECONDS
THRUST AT CST	: 1.555	V	PROTECTION MARGIN	: 4.98 SECONDS
SEAT THRUST AT CST	: 1.555	V	UNSEATING TIME	: 5.38 SECONDS
AVE RUN THRUST	: <PRELOAD		AVE RUN THRUST	: <PRELOAD
MAX RUN THRUST	: <PRELOAD		MAX RUN THRUST	: <PRELOAD
INERTIAL THRUST	: 19	%	UNSEATING THRUST	: 0.805 V
TOTAL THRUST	: 1.86	V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.0/2.0		TORQUE SW. SETTING	: 2.0/2.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

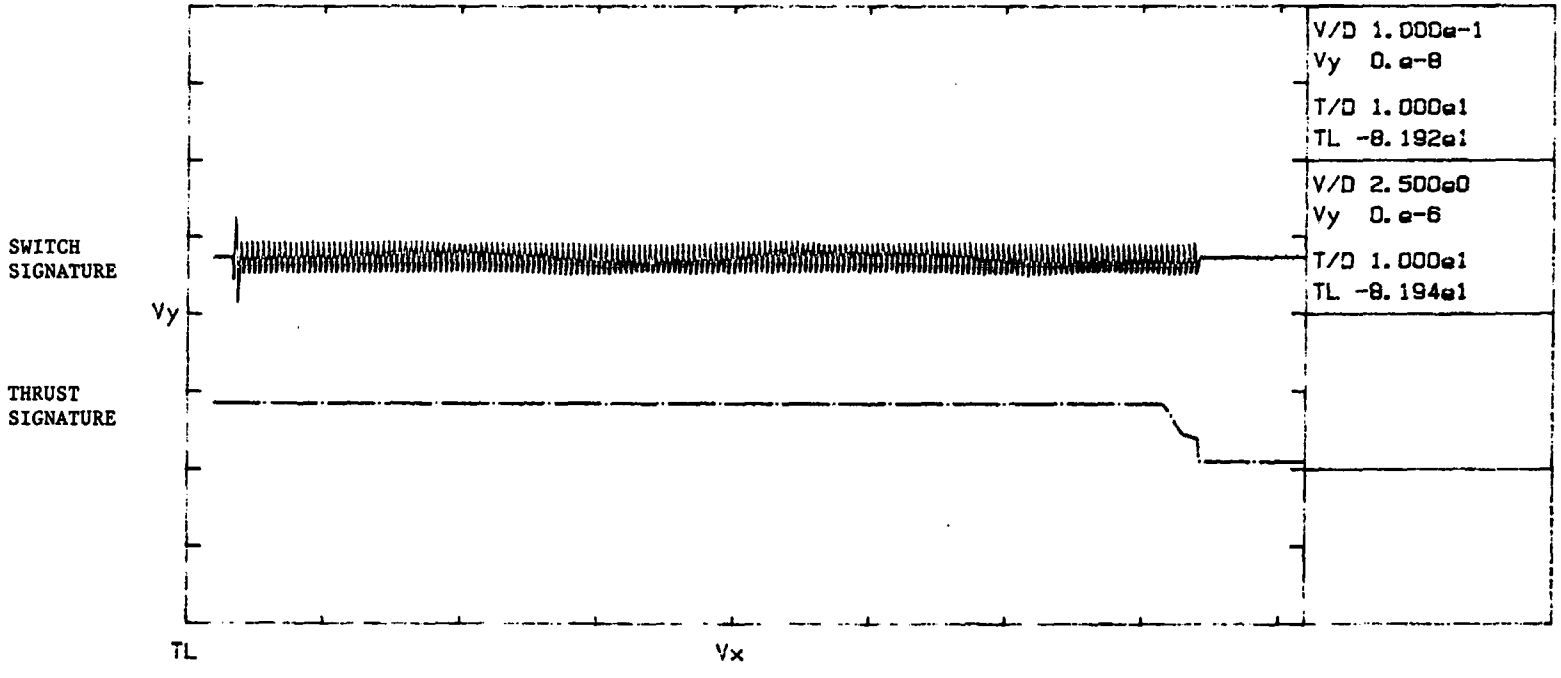
	CS-OC-01-09		CS-CO-01-08	
STROKE TIME	: 70.86	SECONDS	STROKE TIME	: 70.38 SECONDS
PEAK INRUSH	: 12.92	AMPERES	PEAK INRUSH	: 11.76 AMPERES
AVE. RUN CURRENT	: 7.12	AMPERES	AVE. RUN CURRENT	: 6.36 AMPERES
MAX. RUN CURRENT	: 7.12	AMPERES	MAX. RUN CURRENT	: 6.36 AMPERES
SEATING CURRENT	: 8.22	AMPERES	END CURRENT	: 6.22 AMPERES

TEST IDENTIFICATION: VALVE #33
STORAGE LOCATION : 01-06

PLOT NO. 1

TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME	: 70.82 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 0.48 SECONDS	THRUST AT CST	: 1.555 V
		SEAT THRUST AT CST	: 1.555 V
		INERTIAL THRUST	: 19 %
TORQUE SW. SETTING: 2.0/2.0		TOTAL THRUST	: 1.86 V

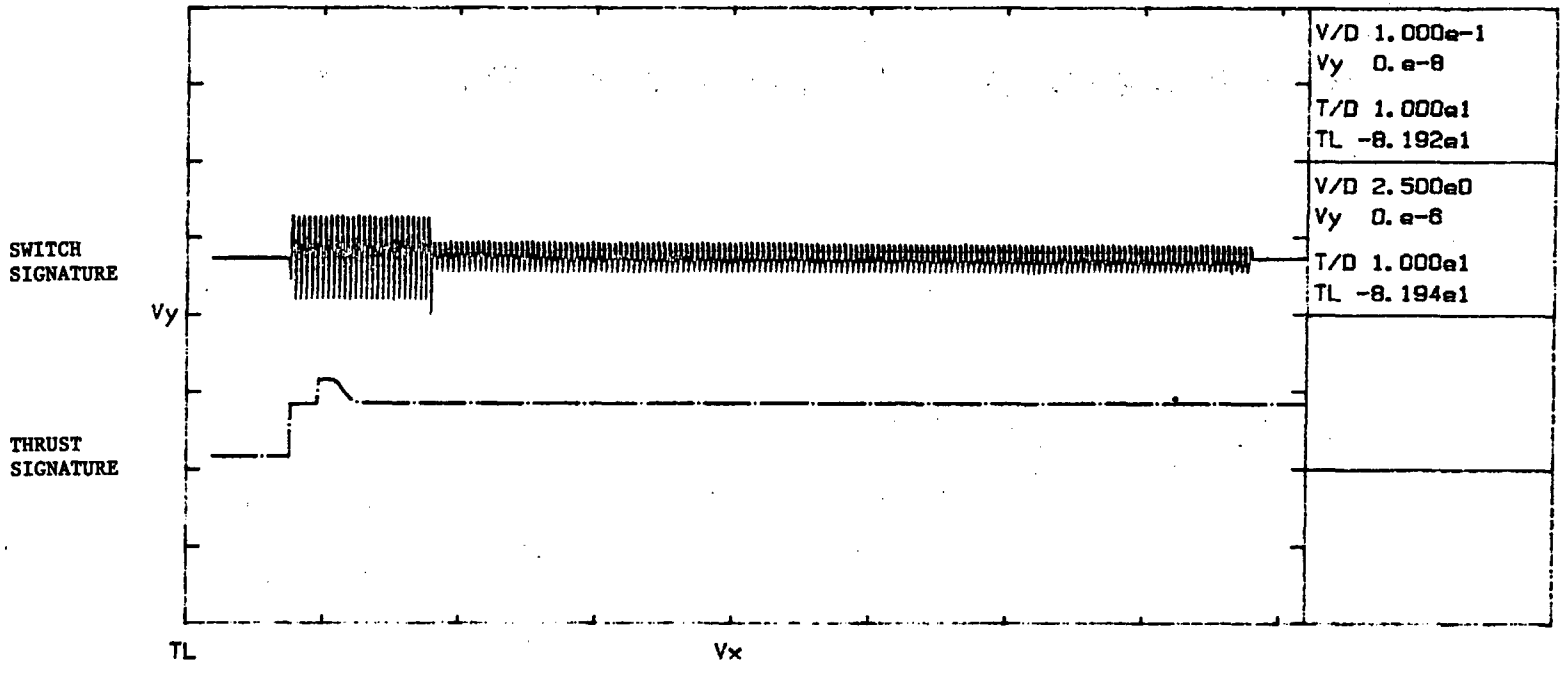


TEST IDENTIFICATION: VALVE #33
STORAGE LOCATION : 01-07

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 70.32 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 10.36	UNSEATING THRUST	: 0.805 V
UNSEATING TIME	: 5.38 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 4.98 SECONDS	TORQUE SW. SETTING	: 2.0/2.0



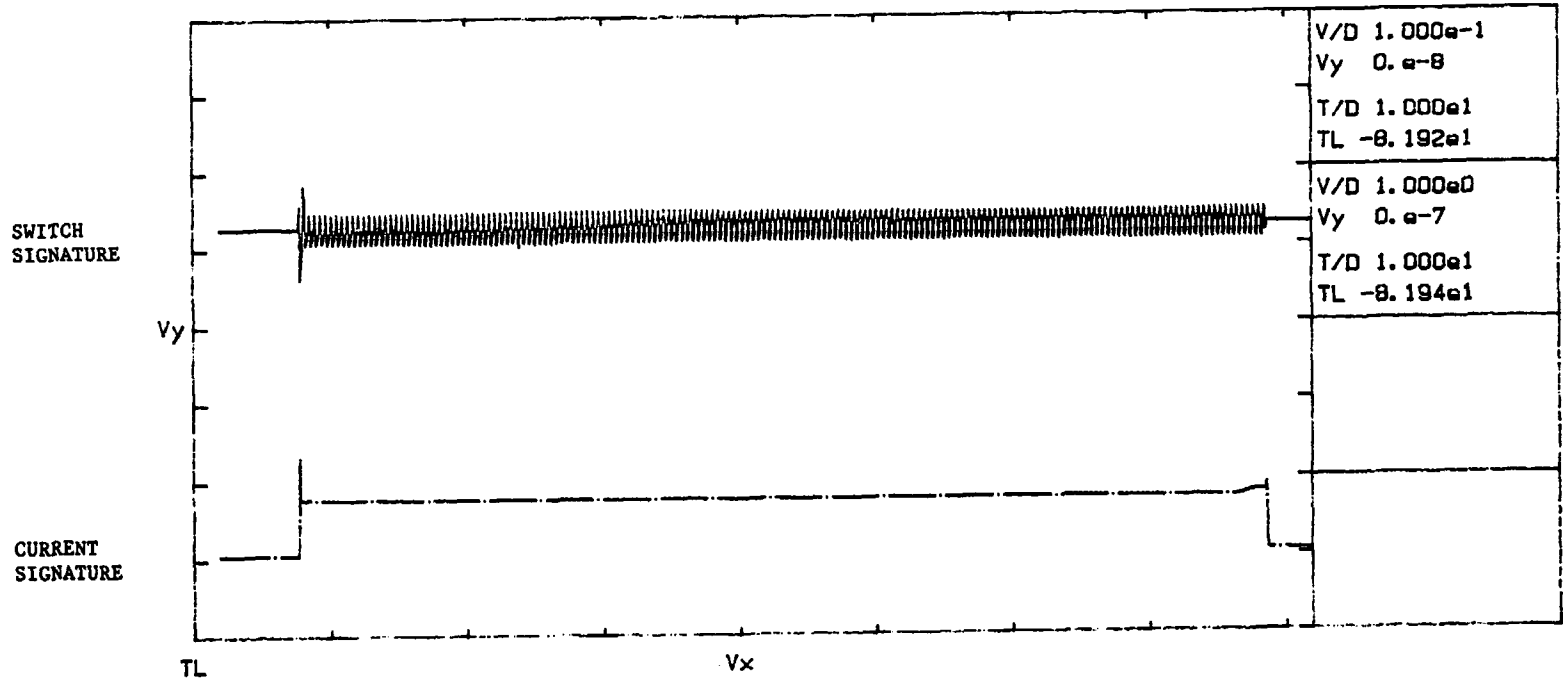
TEST IDENTIFICATION: VALVE #33
STORAGE LOCATION : 01-09

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 70.86 SECONDS

PEAK INRUSH : 12.92 AMPERES
AVE. RUN CURRENT : 7.12 AMPERES
MAX. RUN CURRENT : 7.12 AMPERES
SEATING CURRENT : 8.22 AMPERES



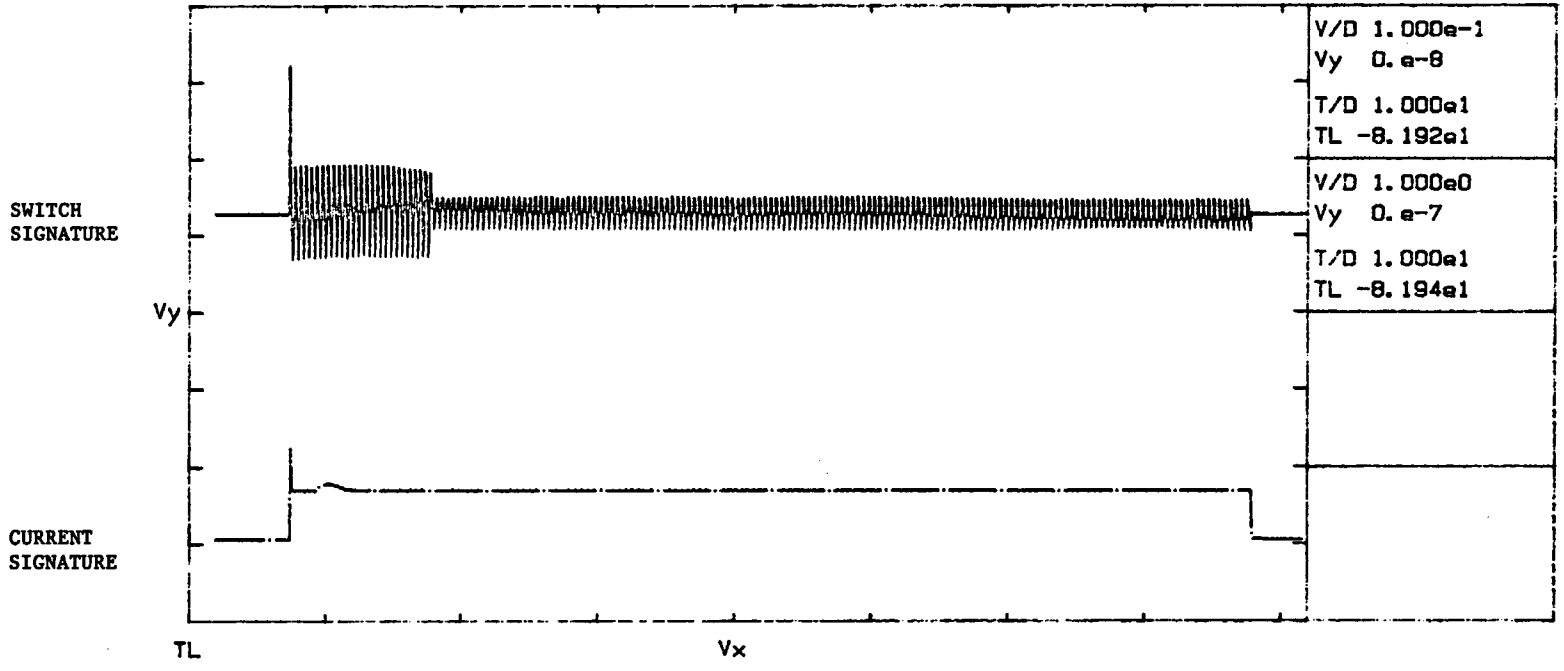
TEST IDENTIFICATION: VALVE #33
STORAGE LOCATION : 01-08

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 70.38 SECONDS

PEAK INRUSH : 11.76 AMPERES
AVE. RUN CURRENT : 6.36 AMPERES
MAX. RUN CURRENT : 6.36 AMPERES
END CURRENT : 6.22 AMPERES



Test I.D. Valve #34

Code	Comments
3	During equipment installation, it was noted that the declutch pin on the original unit's spring cartridge cap was found to be sheared completely off. (See Recommendation #1).
4	During equipment installation, it was noted that four (4) upper bearing housing bolts were loose.
4	During equipment installation, it was noted that there was water in the spring cartridge cap. (See Recommendation #2).
4	The thrust signatures revealed an approximate gap of .032" in the spring pack assembly.

Recommendations

1. The declutch pin should be replaced and the spring on the declutch shaft restored at the next opportunity.

2. The cause for this condition should be determined and if possible, alleviated.

TEST ID: VALVE 34

SYSTEM		OPERATOR	
SYSTEM	: N/A	TYPE	: SMB
FLOW	: 0	SIZE	: 4
TEMP	: AMBIENT	SERIAL NO.	: 147582
PRESS	: ATMOSPHERIC	ORDER NO.	: 358972G
SFTY REL'D	: N/A	ORIENTATION	: VERTICAL

ELECTRICAL		VALVE	
CONTROL CIR VOLTS	: 120	ID. NO.	: 003-67
AC/DC	: AC	TYPE	: GATE
OPEN CONTROL	: LIMIT	SIZE	: 24"
CLOSE CONTROL	: TORQUE	BODY ORIENTATION	: HORIZONTAL
MCC	: N/A	INITIAL POSITION	: N/A
SW. SENSING CIR.	: CURRENT	FINAL POSITION	: N/A

TORQUE SWITCH		MOTOR	
OPEN T.S. SETTING	: 1.25/1.25	VOLTS	: 230/460 AC
CLOSE T.S. SETTING	: 1.25/1.25	RATED AMPS	: 52
LIMITER PLATE	: 4.0	SPEED	: 1730
TS BALANCEABLE	: YES	HORSEPOWER	: 250ft/lb-50ft/lb

TEST EQUIPMENT

LOAD CELL # : 200K--N/A

AMP PROBE # : SIMP(200) N/A

MAINFRAME # : N/A

TMD # : N/A

TEST ID: VALVE #34 BY: RLB DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

	TS-OC-02-12		TS-CO-02-13	
STROKE TIME	: 106.5	SECONDS	STROKE TIME	: 103.6 SECONDS
BYPASS TIME	: 2	SECONDS	BYPASS TIME	: 4 SECONDS
THRUST AT CST	: 36122 #		PROTECTION MARGIN	: 1.6 SECONDS
SEAT THRUST AT CST	: 36122 #		UNSEATING TIME	: 2.4 SECONDS
AVE RUN THRUST	: <PRELOAD		AVE RUN THRUST	: <PRELOAD
MAX RUN THRUST	: <PRELOAD		MAX RUN THRUST	: <PRELOAD
INERTIAL THRUST	: 69 %		UNSEATING THRUST	: 25785 #
TOTAL THRUST	: 52164 #		THRUST AT CST	: N/A
TORQUE SW. SETTING	: 1.25/1.25		TORQUE SW. SETTING	: 1.25/1.25

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

TL-CAL-02-11 K-FACTOR: 35650#/V PRELOAD: 10200 #

MOTOR CURRENT SIGNATURE ANALYSIS

	CS-OC-02-14		CS-CO-02-15	
STROKE TIME	: 106.45	SECONDS	STROKE TIME	: 103.7 SECONDS
PEAK INRUSH	: 72.42	AMPERES	PEAK INRUSH	: 72.44 AMPERES
AVE. RUN CURRENT	: 18.68	AMPERES	AVE. RUN CURRENT	: 18.92 AMPERES
MAX. RUN CURRENT	: 18.74	AMPERES	MAX. RUN CURRENT	: 18.92 AMPERES
SEATING CURRENT	: 20.04	AMPERES	END CURRENT	: 18.92 AMPERES

TEST IDENTIFICATION: VALVE #34
STORAGE LOCATION : 02-12

PLOT NO. 1

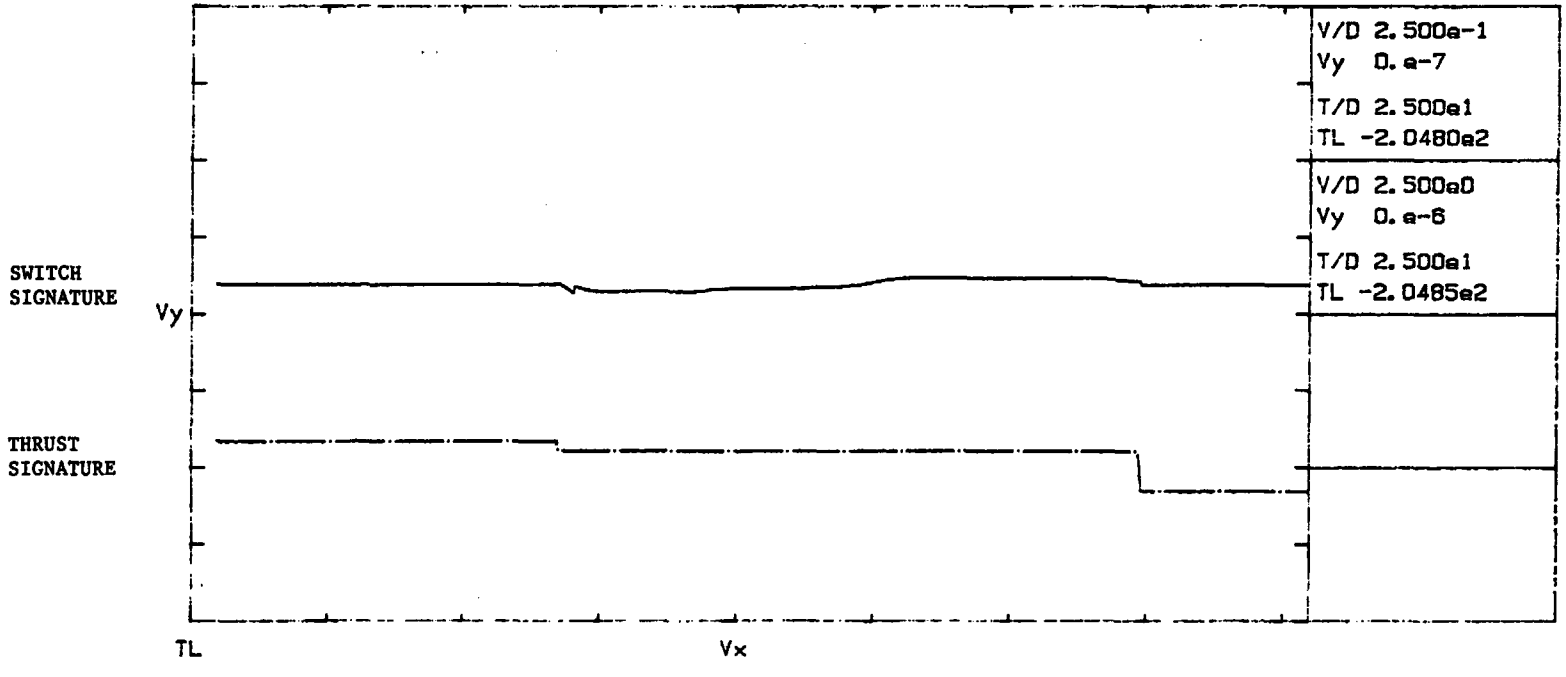
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 106.5 SECONDS

BYPASS TIME : 3 SECONDS

TORQUE SW. SETTING: 1.25/1.25

AVE RUN THRUST : 3000 #
MAX RUN THRUST : 3380 #
THRUST AT CST : 7303 #
SEAT THRUST AT CST: 2695 #
INERTIAL THRUST : 9 %
TOTAL THRUST : 7974 #

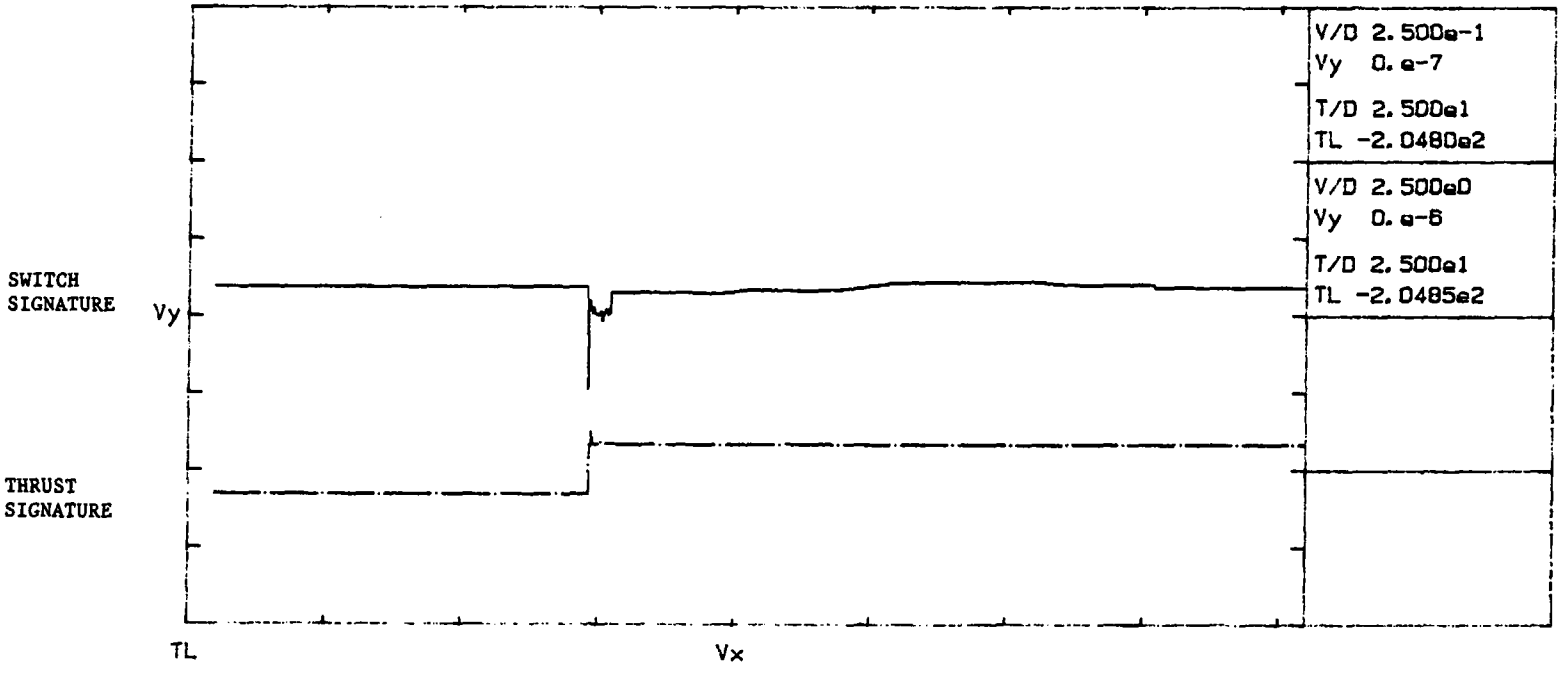


TEST IDENTIFICATION: VALVE #34
STORAGE LOCATION : 02-13

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 103.6 SECONDS	AVE RUN THRUST	: <PRELOAD
		MAX RUN THRUST	: <PRELOAD
BYPASS TIME	: 4 SECONDS	UNSEATING THRUST	: 25785 #
UNSEATING TIME	: 2.4 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: 1.6 SECONDS	TORQUE SW. SETTING	: 1.25/1.25



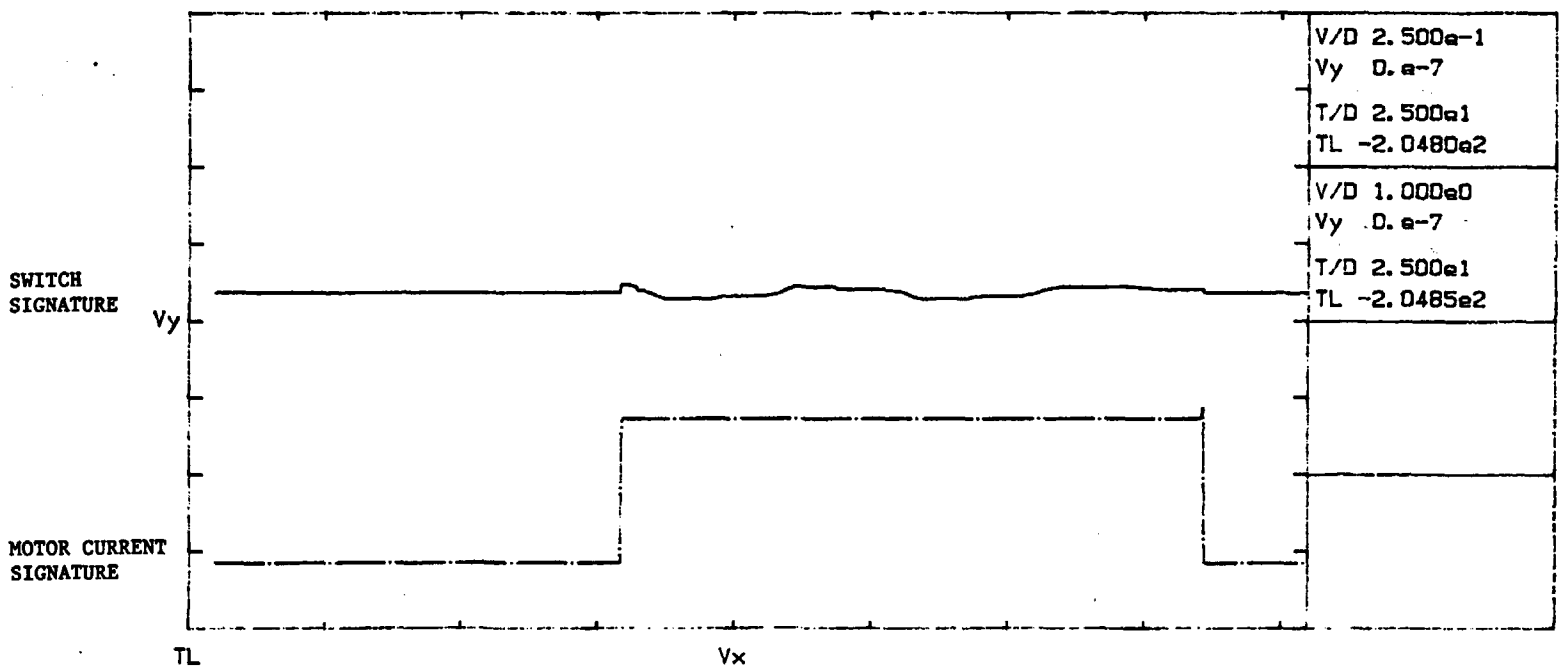
TEST IDENTIFICATION: VALVE #34
STORAGE LOCATION : 02-14

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 106.45 SECONDS

PEAK INRUSH	: 72.42	AMPERES
AVE. RUN CURRENT	: 18.68	AMPERES
MAX. RUN CURRENT	: 18.74	AMPERES
SEATING CURRENT	: 20.04	AMPERES



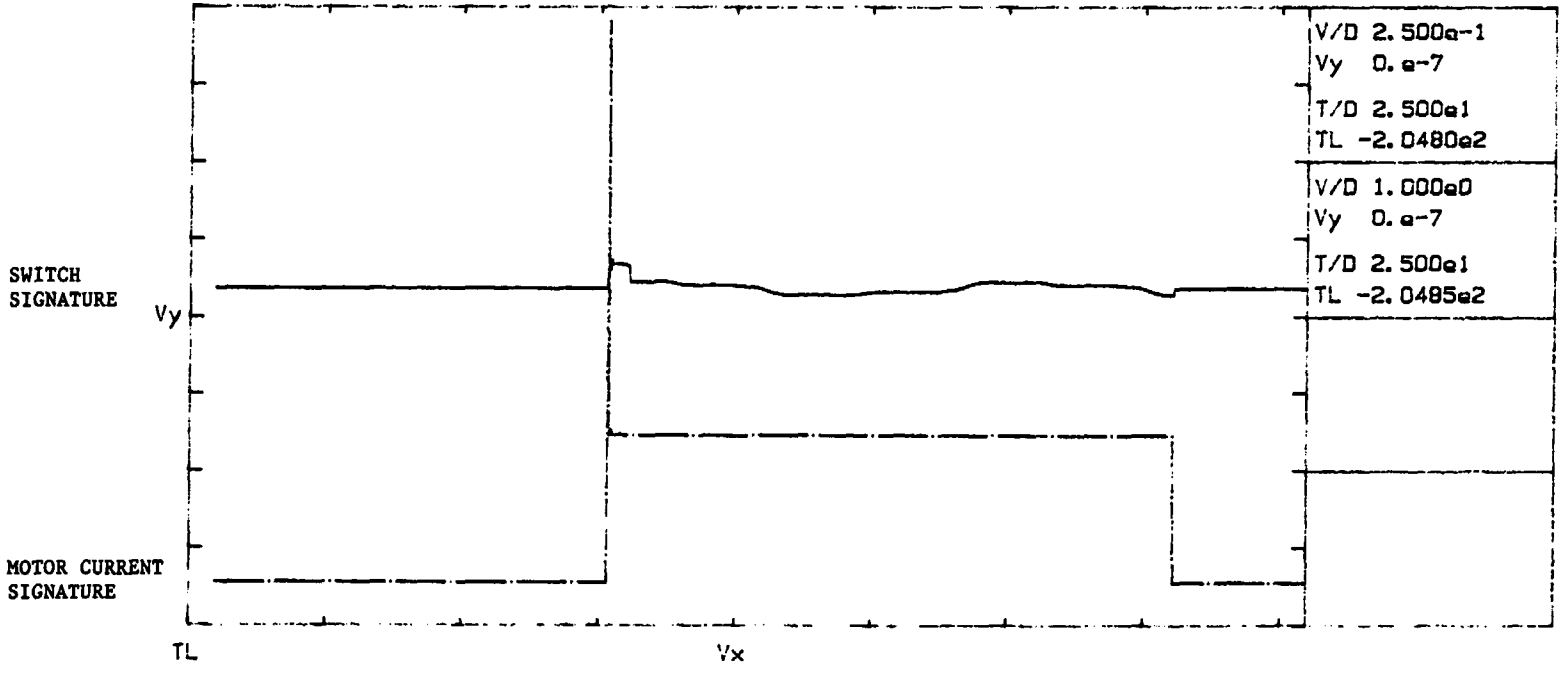
TEST IDENTIFICATION: VALVE #34
STORAGE LOCATION : 02-15

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 103.7 SECONDS

PEAK INRUSH	: 72.44	AMPERES
AVE. RUN CURRENT	: 18.92	AMPERES
MAX. RUN CURRENT	: 18.92	AMPERES
END CURRENT	: 18.92	AMPERES

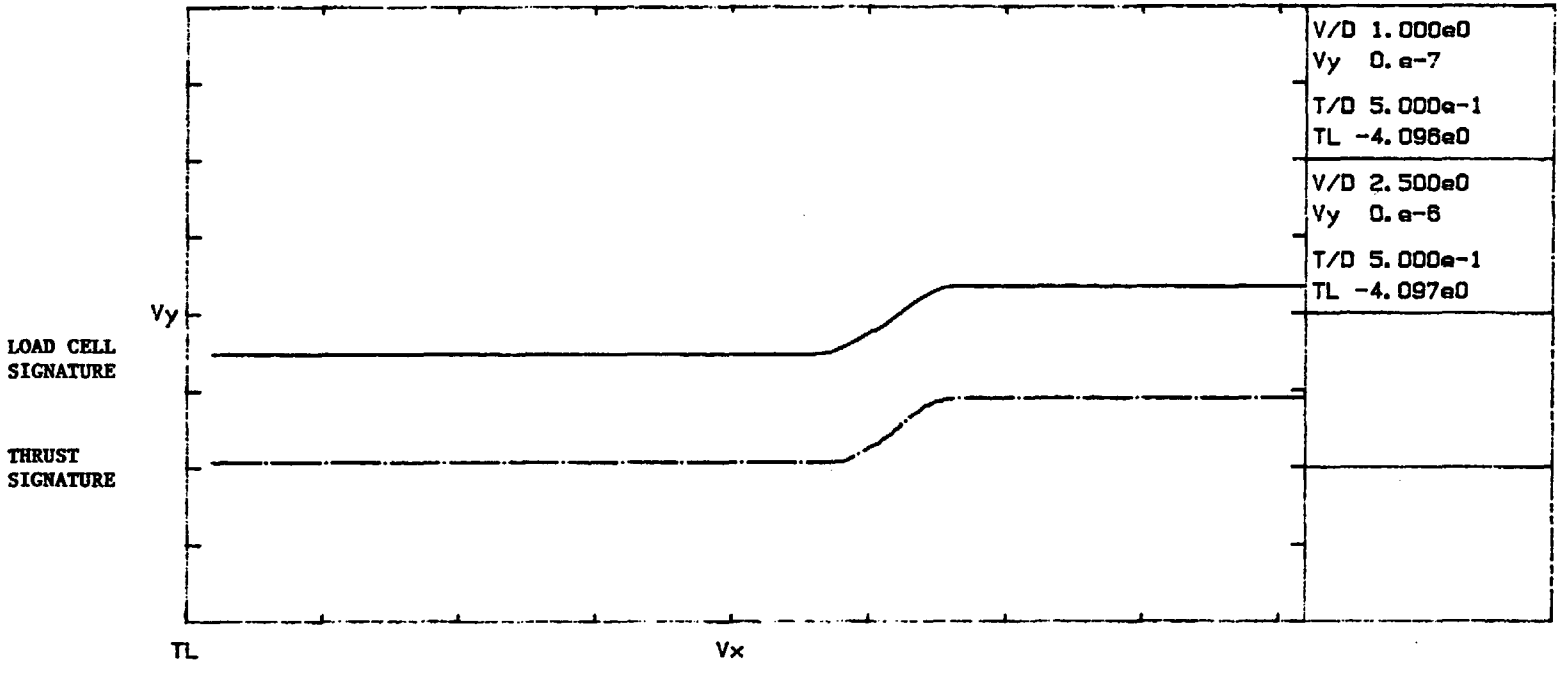


TEST IDENTIFICATION: VALVE #34
STORAGE LOCATION : 02-11

PLOT NO. 5

TMD & LOAD CELL

PRELOAD: 10200 #
K-FACTOR: 3565 0 #/V



Test I.D. Valve #35

Code	Comments
1	The valve tripped during the initial close-to-open stroke because the torque switch actuated without bypass protection when the disc was being lifted from the seat.
1,4	The close-to-open bypass switch required adjustment to properly cover the unseating of the valve.
4	The close-to-open thrust signature indicates a minor loading condition occurring just after valve unseating. (See Recommendation #1).
4	The thrust signatures reveal an apparent gap of approximately .050" in the spring pack assembly.

Recommendations

1. Since this characteristic does not occur in the open-to-close thrust signature, this condition does not, in our opinion, jeopardize the operability of the valve at this time. The condition should be monitored, however, during future MOVATS testing.

TEST ID: VALVE #35

SYSTEM

SYSTEM : N/A
FLOW : 0
TEMP : AMBIENT
PRESS : ATMOSPHERIC
SFTY REL'D: N/A

OPERATOR

TYPE : SMB
SIZE : 0
SERIAL NO. : 144043
ORDER NO. : 358972K
ORIENTATION:

ELECTRICAL

CONTROL CIR VOLTS: 120
AC/DC : AC
OPEN CONTROL : LIMIT
CLOSE CONTROL : TORQUE
MCC :
SW. SENSING CIR. : CURRENT

VALVE

ID. NO. : 2-FCV-5-40
TYPE : GATE
SIZE : 16"
BODY ORIENTATION: HORIZONTAL
INITIAL POSITION: N/A
FINAL POSITION : N/A

TORQUE SWITCH

OPEN T.S. SETTING : 2.0/2.0
CLOSE T.S. SETTING: 2.75/2.75
LIMITER PLATE : 5.0
TS BALANCEABLE : YES

MOTOR

VOLTS : 460 AC
RATED AMPS: 7
SPEED : 1750
HORSEPOWER: 2.6

TEST EQUIPMENT

LOAD CELL # : N/A--
AMP PROBE # : SIMPSON(20) N/A
MAINFRAME # :
TMD # :

TEST ID: VALVE #35 BY: RLB DATE: 06-16-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-02		TS-CO-01-03	
STROKE TIME	: 76.52 SECONDS	STROKE TIME	: 75.8 SECONDS
BYPASS TIME	: 0.92 SECONDS	BYPASS TIME	: 5.6 SECONDS
THRUST AT CST	: 2.905 V	PROTECTION MARGIN	: 2.54 SECONDS
SEAT THRUST AT CST	: 2.33 V	UNSEATING TIME	: 3.06 SECONDS
AVE RUN THRUST	: 0.545 V	AVE RUN THRUST	: 0.215 V
MAX RUN THRUST	: 0.595 V	MAX RUN THRUST	: 0.265 V
INERTIAL THRUST	: 9 %	UNSEATING THRUST	: 0.66 V
TOTAL THRUST	: 3.185 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 2.75/2.75	TORQUE SW. SETTING	: 2.0/2.0

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-01-04		CS-CO-01-05	
STROKE TIME	: 76.6 SECONDS	STROKE TIME	: 75.76 SECONDS
PEAK INRUSH	: 1.37 AMPERES	PEAK INRUSH	: 1.36 AMPERES
AVE. RUN CURRENT	: 0.58 AMPERES	AVE. RUN CURRENT	: 0.59 AMPERES
MAX. RUN CURRENT	: 0.58 AMPERES	MAX. RUN CURRENT	: 0.59 AMPERES
SEATING CURRENT	: 0.63 AMPERES	END CURRENT	: 0.59 AMPERES

TEST IDENTIFICATION: VALVE #35
STORAGE LOCATION : 01-02

PLOT NO. 1

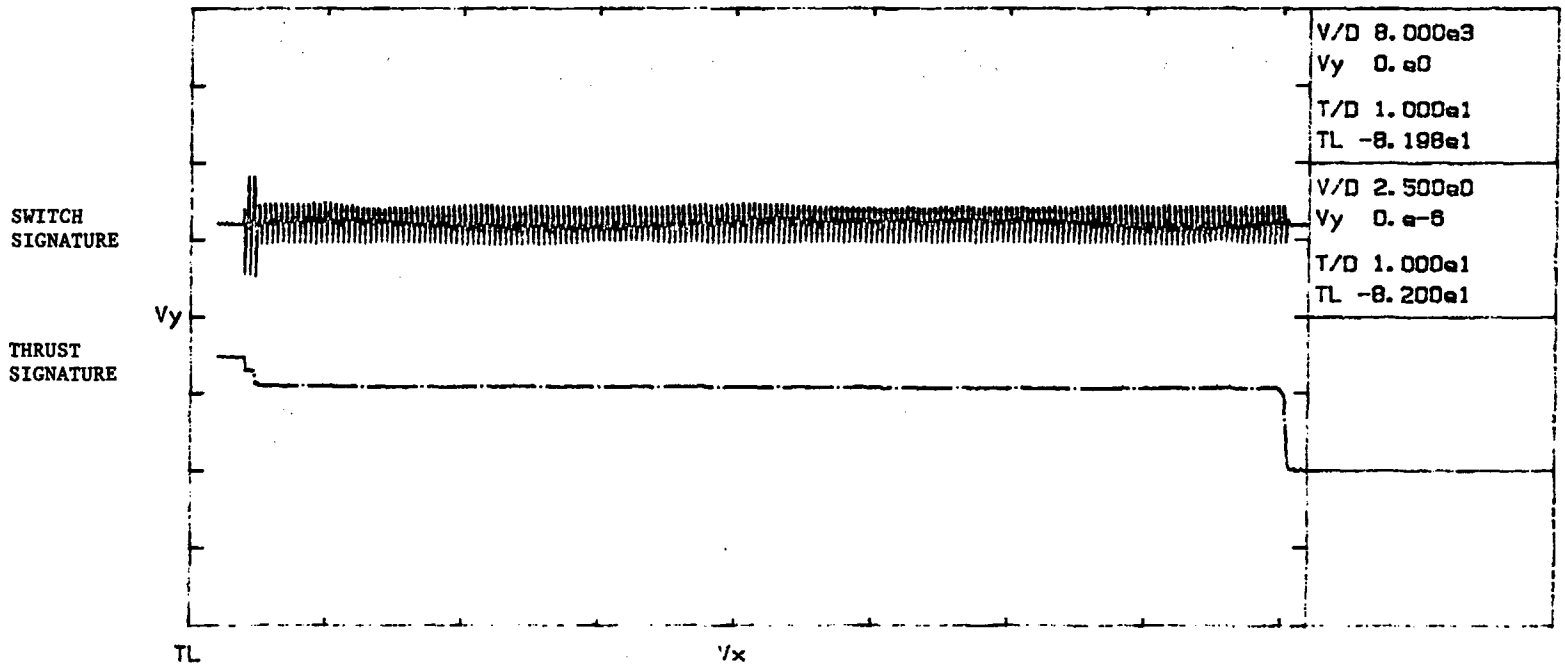
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 76.52 SECONDS

BYPASS TIME : 0.92 SECONDS

TORQUE SW. SETTING: 2.75/2.75

AVE RUN THRUST : 0.545 V
MAX RUN THRUST : 0.595 V
THRUST AT CST : 2.905 V
SEAT THRUST AT CST: 2.33 V
INERTIAL THRUST : 9 %
TOTAL THRUST : 3.185 V

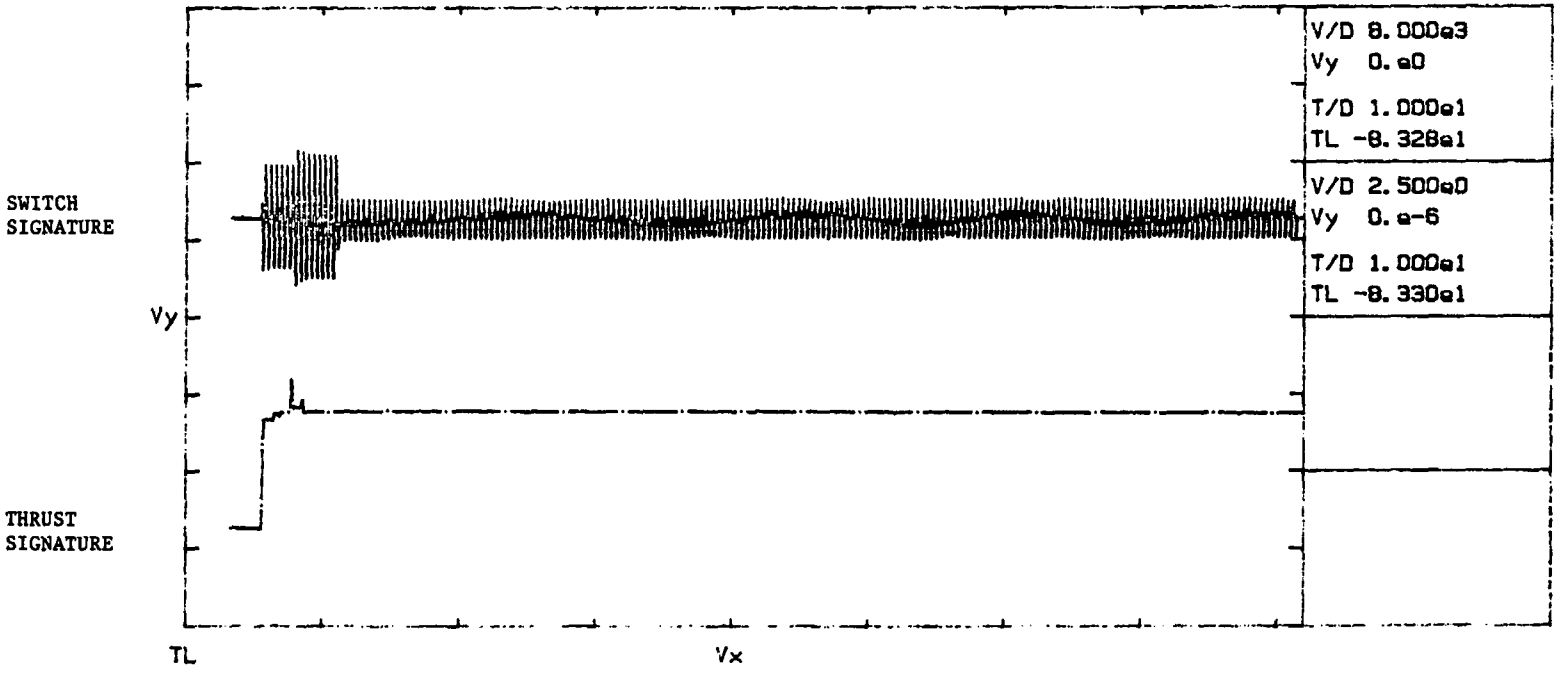


TEST IDENTIFICATION: VALVE #35
STORAGE LOCATION : 01-03

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 75.8	SECONDS	AVE RUN THRUST	: 0.215	V
			MAX RUN THRUST	: 0.265	V
BYPASS TIME	: 5.6		UNSEATING THRUST	: 0.66	V
UNSEATING TIME	: 3.06	SECONDS	THRUST AT CST	: N/A	
PROTECTION MARGIN	: 2.54	SECONDS	TORQUE SW. SETTING	: 2.0/2.0	



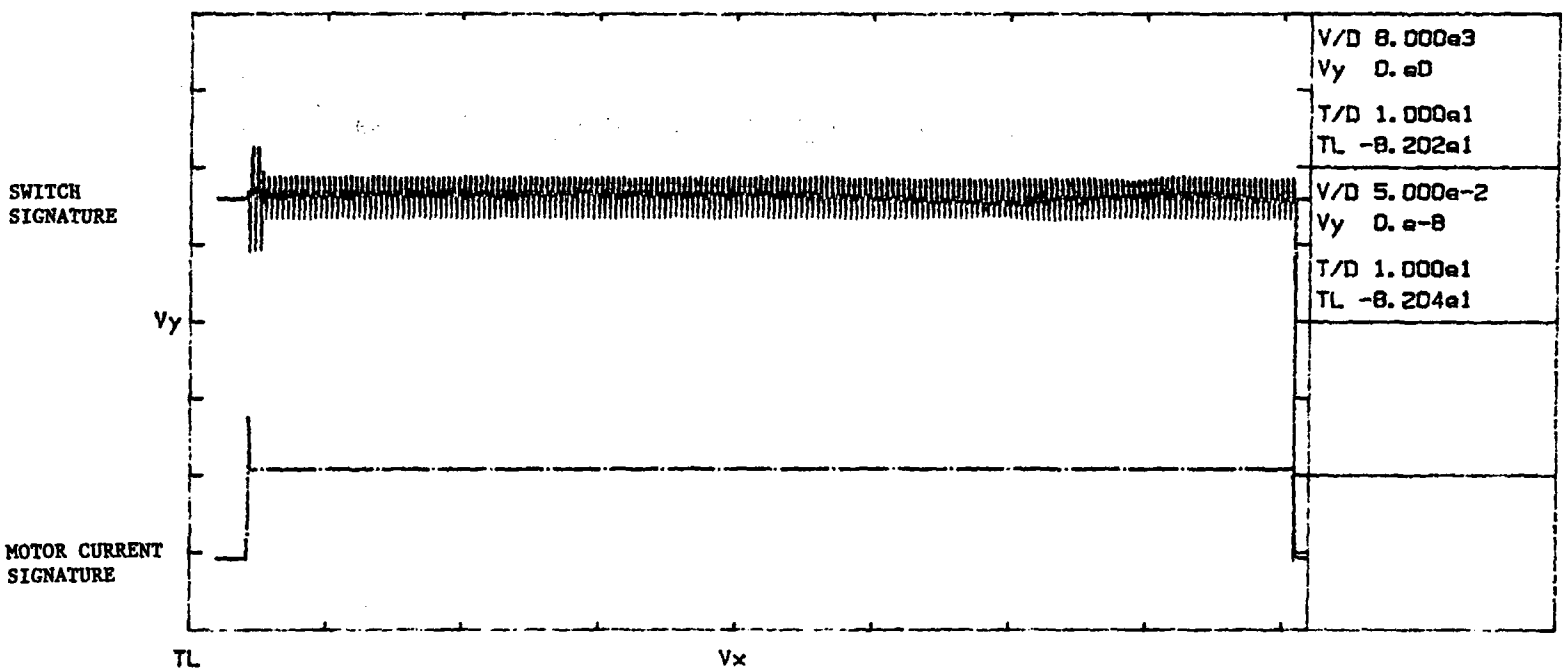
TEST IDENTIFICATION: VALVE #35
STORAGE LOCATION : 01-04

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 76.6 SECONDS

PEAK INRUSH : 1.37 AMPERES
AVE. RUN CURRENT : 0.58 AMPERES
MAX. RUN CURRENT : 0.58 AMPERES
SEATING CURRENT : 0.63 AMPERES



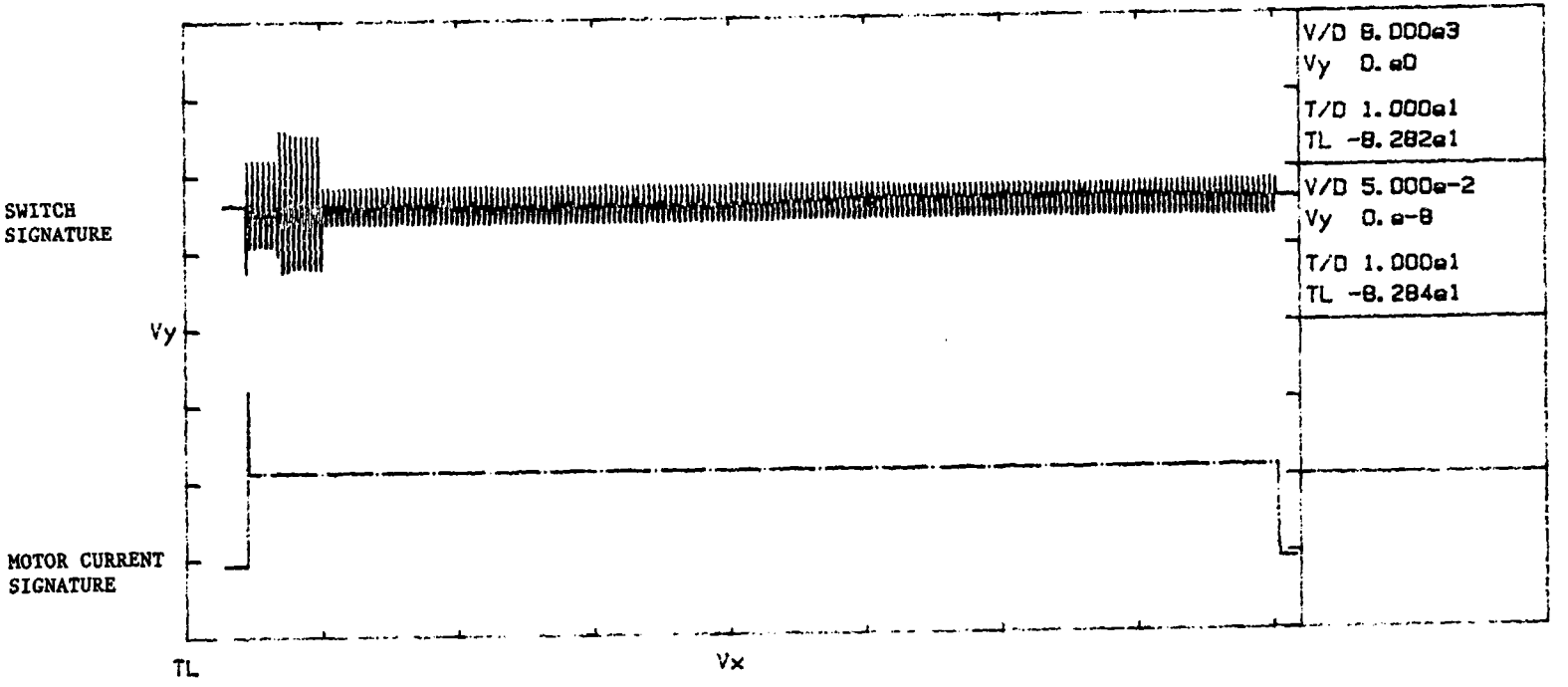
TEST IDENTIFICATION: VALVE #35
STORAGE LOCATION : 01-05

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 75.76 SECONDS

PEAK INRUSH	: 1.36	AMPERES
AVE. RUN CURRENT	: 0.59	AMPERES
MAX. RUN CURRENT	: 0.59	AMPERES
END CURRENT	: 0.59	AMPERES



Test I.D. Valve #36

Code	Comments
2	After review of the thrust signatures, it was determined that there is a mechanical problem in the operator. At this time we are unable to pinpoint the specific problem or the magnitude of the problem without disassembling the motor operator. Signatures indicate the following possibilities: 1) The worm gear is not moving freely on the drive sleeve assembly. 2) The worm shaft bearing locknut may be loose.
4	The thrust signatures revealed a definite gap in the spring pack assembly, the severity of which is indeterminable at this time due to the fact that a spring pack calibration was not performed during this test.

Recommendations

1. During the next outage, we suggest that the operator be disassembled to find the cause of the mechanical degradation.

TEST ID: VAVLE #36

SYSTEM

SYSTEM : N/A
FLOW : 0
TEMP : AMBIENT
PRESS : ATMOSPHERIC
SFTY REL'D: N/A

OPERATOR

TYPE : SMB
SIZE : 0
SERIAL NO. : N/A
ORDER NO. : N/A
ORIENTATION: VERTICAL

ELECTRICAL

CONTROL CIR VOLTS: 125
AC/DC : N/A
OPEN CONTROL : LIMIT
CLOSE CONTROL : LIMIT
MCC : N/A
SN. SENSING CIR. : VOLTAGE

VALVE

ID. NO. : 2E41-F011
TYPE : GATE
SIZE : 10
BODY ORIENTATION: HORIZONTAL
INITIAL POSITION: N/A
FINAL POSITION : N/A

TORQUE SWITCH

OPEN T.S. SETTING : 3.5/3.5
CLOSE T.S. SETTING: 3.5/3.5
LIMITER PLATE : 5
TS BALANCEABLE : YES

MOTOR

VOLTS : 240 DC
RATED AMPS: 12
SPEED : 1900
HORSEPOWER: 2.9

TEST EQUIPMENT

LOAD CELL # : 50K--N/A
AMP PROBE # : FLUKE(N/A) N/A
MAINFRAME # : N/A
TMD # : N/A

TEST ID: VALVE #36 BY: RLB DATE: 06-17-85

THRUST SIGNATURE ANALYSIS

TS-OC-01-02		TS-CO-01-01	
STROKE TIME	: 29.9 SECONDS	STROKE TIME	: 29.91 SECONDS
BYPASS TIME	: 0 SECONDS	BYPASS TIME	: N/A
THRUST AT CST	: 3.945 V	PROTECTION MARGIN	: N/A
SEAT THRUST AT CST	: 2.56 V	UNSEATING TIME	: 1.96 SECONDS
AVE RUN THRUST	: 1.37 V	AVE RUN THRUST	: 0.17 V
MAX RUN THRUST	: 1.385 V	MAX RUN THRUST	: 0.175 V
INERTIAL THRUST	: 2 %	UNSEATING THRUST	: 2.36 V
TOTAL THRUST	: 4.05 V	THRUST AT CST	: N/A
TORQUE SW. SETTING	: 3.5/3.5	TORQUE SW. SETTING	: 3.5/3.5

SPRING PACK CALIBRATION SIGNATURE ANALYSIS

NO SPRING PACK CALIBRATION SIGNATURE ACQUIRED

MOTOR CURRENT SIGNATURE ANALYSIS

CS-OC-01-04		CS-CO-01-03	
STROKE TIME	: 30.06 SECONDS	STROKE TIME	: 29.91 SECONDS
PEAK INRUSH	: 14.5 AMPERES	PEAK INRUSH	: 14.94 AMPERES
AVE. RUN CURRENT	: 3.54 AMPERES	AVE. RUN CURRENT	: 3.64 AMPERES
MAX. RUN CURRENT	: 3.64 AMPERES	MAX. RUN CURRENT	: 3.72 AMPERES
SEATING CURRENT	: 15.5 AMPERES	END CURRENT	: 3.52 AMPERES

TEST IDENTIFICATION: VALVE #36
STORAGE LOCATION : 01-02

PLOT NO. 1

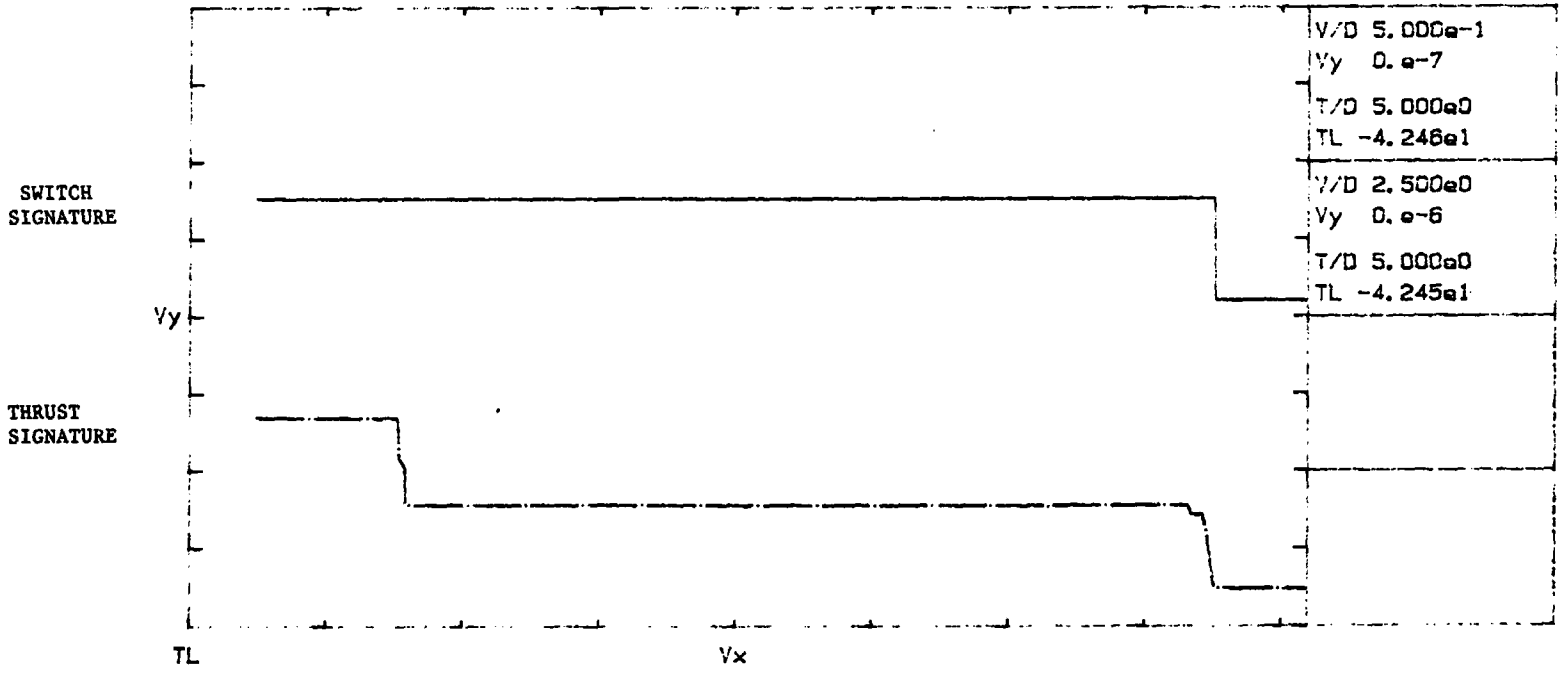
TMD & SWITCHES: OPEN TO CLOSE

STROKE TIME : 29.9 SECONDS

BYPASS TIME : 0 SECONDS

TORQUE SW. SETTING: 3.5/3.5

AVE RUN THRUST : 1.37 V
MAX RUN THRUST : 1.385 V
THRUST AT CST : 3.945 V
SEAT THRUST AT CST: 2.56 V
INERTIAL THRUST : 2 %
TOTAL THRUST : 4.05 V

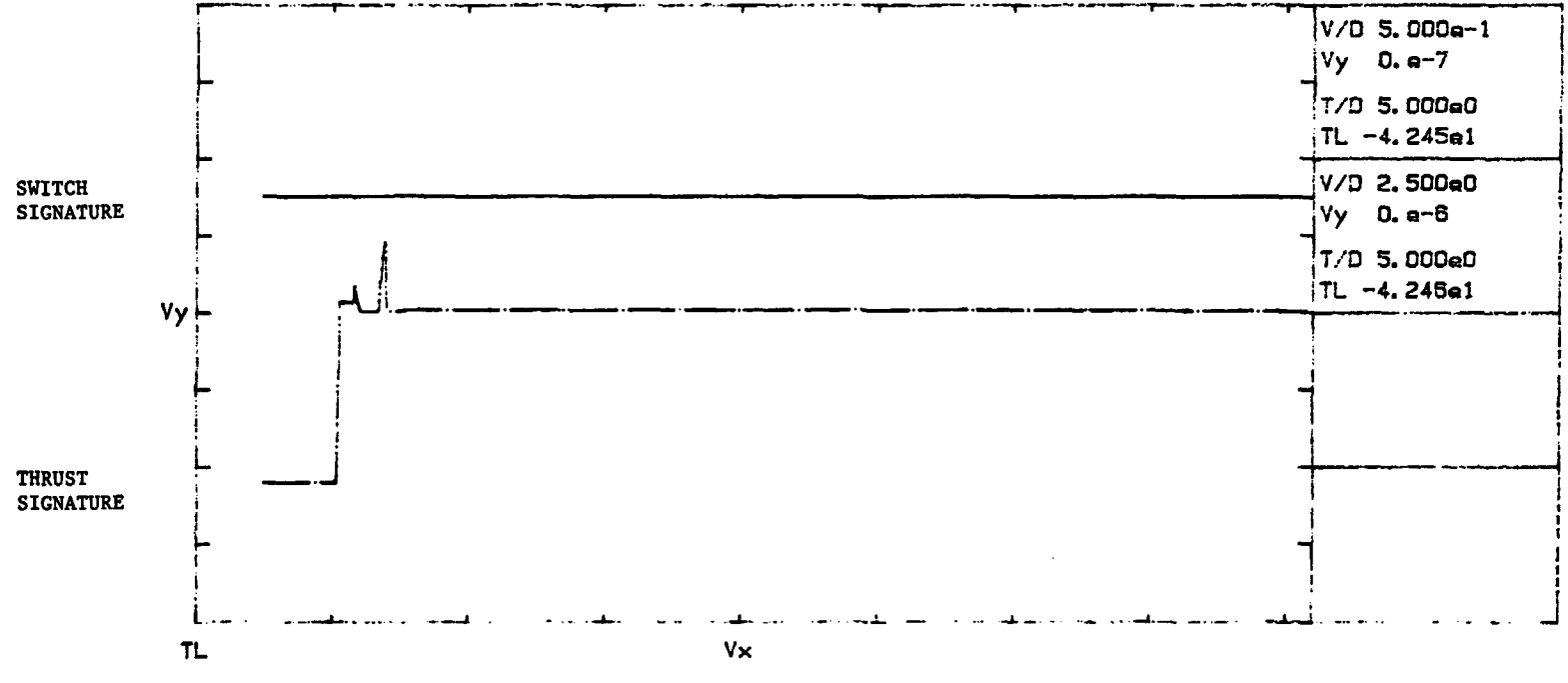


TEST IDENTIFICATION: VALVE #36
STORAGE LOCATION : 01-01

PLOT NO. 2

TMD & SWITCHES: CLOSE TO OPEN

STROKE TIME	: 29.91 SECONDS	AVE RUN THRUST	: 0.17 V
		MAX RUN THRUST	: 0.175 V
BYPASS TIME	: N/A	UNSEATING THRUST	: 2.36 V
UNSEATING TIME	: 1.96 SECONDS	THRUST AT CST	: N/A
PROTECTION MARGIN	: N/A	TORQUE SW. SETTING	: 3.5/3.5



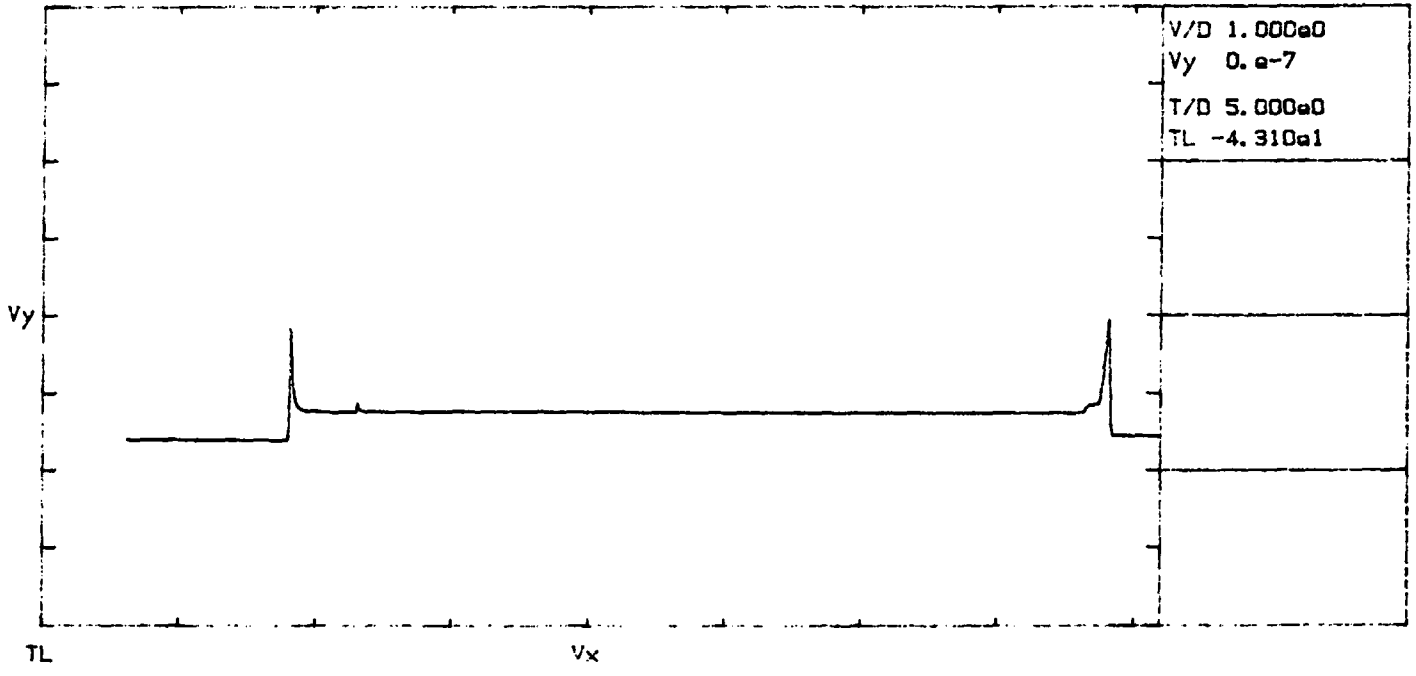
TEST IDENTIFICATION: VALVE #36
STORAGE LOCATION : 01-04

PLOT NO. 3

MOTOR CURRENT & SWITCHES: OPEN TO CLOSE

STROKE TIME : 30.06 SECONDS

PEAK INRUSH : 14.5 AMPERES
AVE. RUN CURRENT : 3.54 AMPERES
MAX. RUN CURRENT : 3.64 AMPERES
SEATING CURRENT : 15.5 AMPERES



CURRENT SIGNATURE

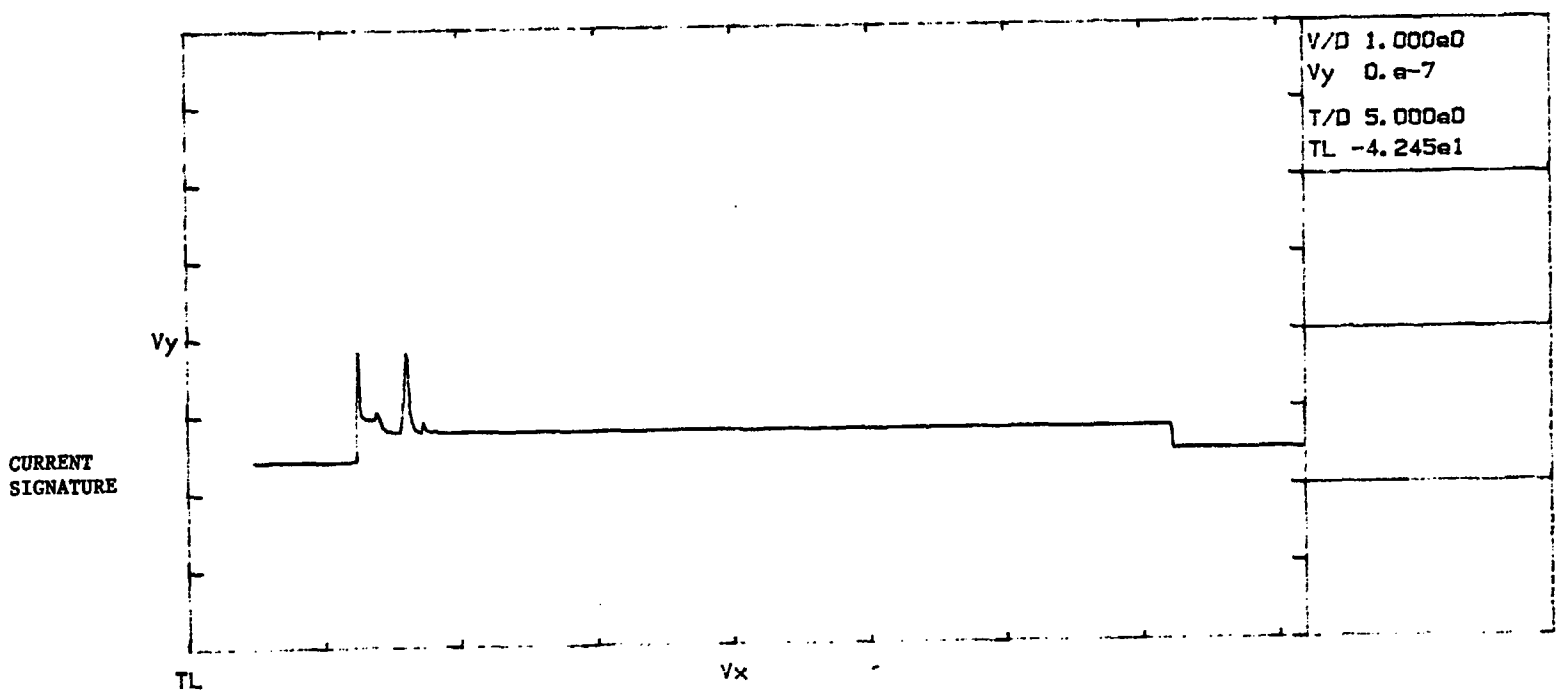
TEST IDENTIFICATION: VALVE #36
STORAGE LOCATION : 01-03

PLOT NO. 4

MOTOR CURRENT & SWITCHES: CLOSE TO OPEN

STROKE TIME : 29.91 SECONDS

PEAK INRUSH	:	14.94 AMPERES
AVE. RUN CURRENT	:	3.64 AMPERES
MAX. RUN CURRENT	:	3.72 AMPERES
END CURRENT	:	3.52 AMPERES



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13 ABSTRACT (200 words or less)

As a part of the NRC Nuclear Plant Aging Research (NPAR) program, a field test program was carried out to evaluate a technique of valve signature analysis to detect and differentiate abnormalities, including time-dependent degradation (aging) and incorrect adjustments in motor-operated valves. The technique described in this report is the Motor-Operated Valve Analysis and Test System (MOVATS) which is commercially available from MOVATS, Inc. In-situ signature traces were obtained on 36 motor-operated valves at 4 nuclear plant sites. Described in this letter report are the test equipment package, the method of obtaining the signatures, and the determinations made as a result of analyzing these signatures. Based on evaluations of the signature analysis technique, and on the results obtained from the field test program, the capabilities and limitations of MOVATS are discussed.

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