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MODELING THE HUMAN OPERATOR WITH FINITE-STATE MACHINES

by L. J. Fogel and Roger A. Moore

Prepared by
DECISION SCIENCE, INC.
San Diego, Calif.
for Langley Research Center

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • JULY 1968

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By L. J. Fogel and Roger A. Moore

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Prepared under Contract No. NAS 1-6739 by
DECISION SCIENCE, INC.
San Diego, Calif.

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PREFACE

The work reported on herein was authorized under Contract NAS1-6739, this study being conducted under the direction of P. Gainer, Control and Guidance Branch, Langley Research Center, NASA. A. Vogeley, Head of that Branch, and Dr. R. Saucer of Langley Research Center offered technical consultation and guidance throughout this study.

This study was performed at Decision Science, Inc. under the direction of Dr. L. J. Fogel, with R. A. Moore acting as principal investigator. W. D. Dietrichson and J. Presley cooperated in various aspects of this work. Drs. A. J. Owens and M. J. Walsh served as technical advisors throughout this program of investigation.

Under this contract, Decision Science, Inc. was to evaluate the use of finite-state machines and the evolutionary programming technique for representing and analyzing the performance of the human operator in control of dynamic systems. This work included,

An expansion of the existing evolutionary program to permit the use of 64-symbol input and output alphabets;

Use of the evolutionary programming technique for deriving logical representations of given linear and nonlinear transducers based upon their input-output histories, this with respect to various criteria (expressions of the loss function);

Investigation of the worth of greater specificity in the language and representation of the given transducer;

Analysis of the performance of the human operator in a single axis tracking task with respect to various performance criteria; this under various levels of specificity and complexity of representation, the intent being to identify the "strategy" of the human operator and the extent to which this strategy is actually followed; and, lastly,

Comparison of the above-mentioned technique with the technique previously used for the analysis of input-output history taken in-flight at Edwards Flight Research Center, NASA.

This report contains background information pertinent to finite-state machines and evolutionary programming, a detailed

examination of the findings of the above-referenced task, and an interpretation of these results.

CONTENTS

Preface iii
Summary 1
Introduction 3
Analytical Techniques 5
Experimental Results 19
Conclusion 33
References 35
Tables 36
Figures 150

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LIST OF TABLES

No.	Title	Page
1	Initial 15-State Finite Machine of Exp. 1	36
2	Final 15-State Finite Machine of Exp. 1	40
3	Summary of Experiments to Determine Optimum Time Interval Between Data Samples	45
4	Initial Equivalent 63-State Finite Machine of Exp. 5	46
5	Comparison of Scoring Methods for Setting the Output Symbols of the Finite-State Machine Models	55
6	Final Equivalent 63-State Finite Machine of Exp. 9.	56
7	Final Equivalent 63-State Finite Machine of Exp. 11.	64
8	Final Equivalent 63-State Finite Machine of Exp. 12.	72
9	Relationship of Number of States of Finite Machines and Average Error	80
10	Summary of Investigation of Time Interval of Sampling Data	81
11	Summary of Investigation of Time Delay Introduced in Output to Correspond to Human Operator's Reaction Time	82
12	Results of Display Error Input with Delay	83
13	Final Equivalent 63-State Finite Machine of Exp. 36.	84
14	Final Equivalent 63-State Finite Machine of Exp. 38.	92
15	Final Equivalent 63-State Finite Machine of Exp. 39.	100
16	Summary of Effect of Machine Size upon Modeling Capability with Respect to Human Operator	108
17	Results of Different Cost Matrices in Modeling the Human Operator in his Performance of Single Axis Tracking	109
18	Final Equivalent 63-State Finite Machine of Exp. 45.	110
19	Final Equivalent 63-State Finite Machine of Exp. 47.	118
20	Final Equivalent 63-State Finite Machine of Exp. 60.	126
21	Final Equivalent 63-State Finite Machine of Exp. 61.	134
22	Effect of Various Cost Matrices on Error Distribution	142
23	Matrix Representation of 31-State and 31-Symbol Alphabet Machine of Exp. 63	143
24	Matrix Representation of 15-State and 15-Symbol Alphabet Machine of Exp. 64	144
25	Matrix Representation of 7-State and 7-Symbol Alphabet Machine of Exp. 65	145

No.	Title	Page
26	Time Variant Analysis of Human Pilot (Exp. 65A)....	146
27	Summary of Flight Data Experiments	147
28	State-Change Response of a 16-State Machine	148

LIST OF FIGURES

No.	Title	Page
1	Logical flow chart of a 64 symbol evolutionary program.	150
2	Comparison of Linear Dynamic System with Final 15-State Machine of Exp. 1	154
3	Comparison of Linear Dynamic System with Final Equivalent 63-State Machine of Exp. 9	155
4	Comparison of Linear Dynamic System with Final Equivalent 63-State Machine of Exp. 11	156
5	Comparison of Linear Dynamic System with Final Equivalent 63-State Machine of Exp. 12	157
6	State size vs. accuracy for input alphabet of 64 symbols and time step of .12 sec	158
7	Accuracy as a function of alphabet size	159
8	Comparison of Non-Linear Dynamic System with Initial 31 State Machine using error display as input (Exp. 20)	160
9	Comparison of Non-Linear Dynamic System with Initial 31 State Machine using error rate as input (Exp. 21)	161
10	Comparison of Non-Linear Dynamic System with Final Equivalent 63 State Machine using "Average Scoring Method (Exp. 36)	162
11	Comparison of Non-Linear Dynamic System with Final Equivalent 63 State Machine using "Magnitude of the Difference" Scoring (Exp. 38)	163
12	Comparison of Non-Linear Dynamic System with Final Equivalent 63 State Machine using "All or Nothing" Scoring (Exp. 39)	164
13	Error distribution using "Average" Scoring Method (Exp. 36)	165
14	Error distribution using "Magnitude of the Difference" Scoring Method (Exp. 38)	166
15	Error distribution using "All or Nothing" Scoring Method (Exp. 39)	167
16	Adjusted error as a function of machine size	168
17	Comparison of Human Operator with Final 15 State Machine (Exp. 40)	169
18	Comparison of Human Operator with Final 31 State Machine (Exp. 43)	170
19	Comparison of Human Operator with Final 31 State Machine (Exp. 44)	171
20	Comparison of Human Operator with Final Equivalent 63 State Machine (Exp. 45)	172
21	Comparison of Human Operator with Final Equivalent 63 State Machine (Exp.47)	173
22	Error distribution using "Magnitude of Difference" Scoring Method (Exp. 40)	174

No.	Title	Page
23	Error distribution using "Average" Method of Scoring (Exp. 43).....	175
24	Error distribution using "Magnitude of Difference Scoring Method (Exp. 44).....	176
25	Error distribution using "Magnitude of Difference" Scoring Method (Exp. 45).....	177
26	Error distribution using "Average" Scoring Method (Exp. 47).....	178
27	Adjusted average error as a function of time delay.....	179
28	Comparison of Human Operator with Final Equivalent 63 State Machine (Exp. 60).....	180
29	Comparison of Human Operator with Final Equivalent 63 State Machine (Exp. 61).....	181
30	Error distribution using "All or Nothing" Scoring Method (Exp. 60).....	182
31	Error distribution using "Zero Band Magnitude of Error" Scoring Method (Exp. 61).....	183
32	Comparison of Human Operator with Final Equivalent 63 State Machine of Exp. 36.....	184
33	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of Level for constant rate of zero...	185
34	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of +1.....	186
35	Comparison of models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -1.....	187
36	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 2.....	188
37	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -2.....	189
38	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 3.....	190
39	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function level for constant rate of -3.....	191
40	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 4.....	192
41	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -4.....	193
42	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 5.....	194

No.	Title	Page
43	Comparison of models of Human Behavior and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -5.....	195
44	Comparison of MOdels of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 6.....	196
45	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -6.....	197
46	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 7.....	198
47	Comparison of Models of Human Oeprator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -7.....	199
48	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 10.....	200
49	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 15.....	201
50	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 20.....	202
51	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 24.....	203
52	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 26.....	204
53	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 31.....	205
54	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 32.....	206
55	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 34.....	207
56	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 36.....	208
57	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 40.....	209

No.	Title	Page
58	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 45.....	210
59	Comparison of Models of Human OPerator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 50.....	211
60	Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 55.....	212
61	Comparison of Human Operator with 15 state machine of reduced alphabet size (Exp. 62).....	213
62	Comparison of Human Operator with 31 state 31 symbol alphabet machine (Exp. 63).....	214
63	Comparison of Human Operator with 15 state 15 symbol alphabet machine (Exp. 64).....	215
64	Comparison of Human Operator with 7 state 7 symbol alphabet machine (Exp. 65).....	216
65	Comparison of Human Operator with 31 state machine. (Exp. 66).....	217
66	Comparison of Human Operator with 15 state machine. (Exp. 67).....	218
67	Comparison of Human Operator with 64 state 64 symbol alphabet machine (Exp. 68).....	219
68	Comparison of Human Operator with 16 state 16 symbol alphabet machine (Exp. 69).....	220
69	Comparison of Human Operator with 8 state 8 symbol alphabet machine.....	221
70	Comparison of Human Operator with Current Recall (Exp. 71).....	222
71	Comparison of Human Operator with Complete Recall (Exp. 72).....	223
72	Comparison of Human Operator with Increased Sampling Interval (Exp. 73).....	224

MODELING THE HUMAN OPERATOR WITH FINITE-STATE MACHINES

By Dr. L. J. Fogel and Roger A. Moore
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SUMMARY

The prospect of using finite-state machines to represent arbitrary analog transducers and the human operator in his performance of flight control is considered in this experimental investigation, together with the use of evolutionary programming as a means for finding such representations. A series of tasks of increasing difficulty which demonstrate this capability are presented, ranging from the characterization of relatively simple linear analog "pilots", through more complex nonlinear analog "pilots", and on to the human pilot acting both in a simulator and in flight. Consideration is given to the trade-off of worth in terms of the adequacy of representation against the resulting complexity of the input and output functions in terms of the size of the alphabet and the complexity of characterization of the logic of the given transducer. The findings of the investigation demonstrate that finite-state machines do offer a suitable means for representing the human operator in terms of his stimulus-response behavior with respect to non-convergent tracking tasks.

In addition, alternative hypotheses concerning the logic of pilot behavior were examined in order to reveal their relative worth on the basis of the available empirical evidence. Additional tasks are outlined which may well be addressed through the use of the technique described in this report. These include the design of control systems, the development of training sequences suitable to the needs of the individual student, the assessment of displays and controls in terms of their modification of the goal exhibited by human behavior, and the comparative evaluation of the worth of including additional reality in training devices and simulators.

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INTRODUCTION

An extensive history testifies to the long-standing interest in developing suitable models of human behavior. In recent years, these efforts have included attempts to develop explicit mathematical representations in the hope that these might facilitate the design of systems which include the human operator. From an engineering viewpoint, it is of interest to enquire as to the worth of modifying the plant dynamics in order to make it more compatible with the dynamics of human control; "Will the expected errors of human control seriously degrade system performance?"; "Might these errors introduce undesirable vibrations, improper modes of response, and so forth?"

At the same time, there is the concern for gaining a deeper understanding of the human operator. Such knowledge should help to introduce him into vehicle systems in a most meaningful way. It is important to resolve such questions as "How does the human operator organize his perception of the dynamic plant under his cognizance?"; "How well does he know the criteria against which he optimizes his performance?"; "To what extent are these criteria affected by the immediate displays and controls, to say nothing of the instructions he receives?"; "What kind of displayed information would be most suitable in terms of the desired performance of the system?"; and so forth.

Traditionally, the search for adequate models of the human operator has begun with linear dynamic representations generally expressed in the form of differential equations; this in spite of the fact that it is universally recognized that the human operator is nonlinear in his transduction. Hopefully the best linear representation would account for a major portion of the observed behavior, thus leaving only a small residue in the form of unaccountable deviations of the actual output from that of the model when both are driven by the same sequence of input symbols. Although such linear transfer representations of the human operator have proven suitable for certain gross engineering purposes, more specific application would require considerable reduction in the amount of residual error which usually remains. Unfortunately this remnant generally depends upon the dynamics of the plant and upon the particular human operator under consideration. There will remain doubt as to the legitimacy of interpreting the model in any psychological sense until it becomes possible to distinguish that component of the remnant which is strictly random from the remainder which

is due to the nonlinearity of the human operator.

In view of this difficulty, the thesis was advanced that possibly a sequence of linear transfer functions might form an adequate model for the human operator, this model being consistent with the psychology of C. E. Hull, which predicts random variations of response as well as variations of response due to reactive inhibition and its spontaneous decay. A detailed analysis based upon the assumption of a time-varying linear operator did, in fact, produce a reduction in the remnant; however, this approach would only appear reasonable if some realistic restrictions were placed upon the changeability of the model (in time and in structure). Unfortunately no such natural constraints have yet been demonstrated. Thus, the psychological significance of this model also remains in doubt.

A key to this problem may be in the use of a different class of mathematical functions for modeling human behavior. Finite-state machines constitute a very general class of functions. Any transduction which can be represented by a finite number of input symbols being mapped into a finite number of output symbols in a finite number of mutually exclusive ways is a finite-state machine. That is to say, the response of a finite-state machine to any particular input symbol depends not only upon that symbol but upon the internal state of that machine at the time it receives the input symbol. While in principle it is possible to represent any exhibited behavior of the human operator by a finite-state machine, and this to an arbitrary level of precision, it is far more important to find a suitable representation of the same behavior at a lesser level of specificity and this with respect to the minimization of some given cost function. Although no analytic method exists for performing this operation, the desired finite-state machine representation can be found through a trial and error search technique which benefits from the implicit recall of each past attempt; that is, a simulation of evolution. A more explicit description of the nature of finite-state machines and evolutionary programming is contained in the following section of this report.

The body of this report is devoted to a summary of some background material pertinent to the current investigation, to a brief description of the findings of this investigation, and to an interpretation of these results as they pertain to answering the need for an adequate mathematical model of the human operator.

ANALYTICAL TECHNIQUES

Early attempts to find a useful mathematical representation of the human transfer characteristics proceeded under the assumption that the operator's behavior was time-invariant and linear with respect to a single input-signal stimulus. Variable gain and response delay, probably the most obvious of human control characteristics, were included in one of the first mathematical models which expressed the human operator's transduction in the Laplace domain. The gain was recognized to be dependent upon many factors including the transfer function of the controlled vehicle, the absolute range of the display and controlled displacements, the amount and the nature of the noise imposed upon the system, the physical and emotional status of the man in control, and the nature of the task at hand as seen in terms of the performance criterion.

In actual practice, human reaction time is also a function of the immediate situation, being particularly dependent upon the nature of the displayed signal. In general, the presentation of a time-patterned and therefore more predictable signal is readily recognized by the observer. Upon realization of its regularity (in almost any regard), he may be expected to institute a new tracking procedure wherein that portion of the signal which is predictable will be self-generated in synchronism with the displayed signal. In the case of a perfectly predictable signal, the human becomes a precognitive signal generator and thus eliminates the response delay. He modifies his behavior from active tracking to what is usually termed "monitoring" and thus reduces his workload while accomplishing superior system control, continuing in this mode of operations at least until the signal becomes again unpredictable. Completely unpredictable displayed signals are generally accompanied by reaction times in excess of one-half second, this reaction time being a measure of the difficulty of interpreting the display.

In 1947, Tustin suggested that the human operator also considers the derivative and integral of the presented time-dependent data. This concept received a series of careful examinations in the succeeding years. As a result, it became possible to separately identify individual terms of the transfer function which correspond to physical limitations of the human operator. Specifically, a neuromuscular time lag ranging from about 0.1 to 0.16 seconds, a lead-time constant (usually falling in the range of 0.25 to 2.5 seconds) and a lag-time constant (of from 5 to 20 seconds) were introduced. The lead-lag factor repre-

sented the equalization performed by the human operator in order to adjust for the observed characteristics of the input stimulus signal and the controlled vehicle. Effectively, the operator thus placed greater importance upon higher frequency components in order to extract anticipatory information and, at the same time, performed an integrative smoothing so as to constrain the displayed signal to better fit the frequency response capabilities of the controlled vehicle. In essence, the more this lag term approaches pure integration, the greater the relative importance the pilot is attributing to the "drift components" of the displayed signal.

But the human operator does not always attempt to completely eliminate the perceived tracking error. At times, he may feel that the amount of effort required on his part is at a greater cost than the value which would be gained through the expected improvement of system performance. On the other hand, he may observe that the present error is most probably the direct result of a cyclic disturbance in the system which, if allowed to complete its activity, would leave the primary trajectory of the vehicle essentially undisturbed. If the displayed signal is characterized by high frequency components, these may be interpreted as sensed noise which are best discarded from transduction in view of the low frequency bandpass characteristic of the controlled system and vehicle response.

In addition to these reasons for the acceptance of some error, there remains other equally valid possibilities. For many reasons the human operator may not hold a level of aspiration toward superior system performance greater than that already being achieved. The nature of the training and/or specific instruction prior to the tracking task may have a significant bearing upon this factor. He may be fatigued, bored, or under the influence of drugs. In any case, the man at the controls just may not care.

Whenever these conditions exist, an indifference threshold appears; that is, there is some range around the signal which is considered to be "zero error" in the sense that it fails to elicit any associated control response. This indifference threshold always exists even in the limit of an "all-out" effort when it is reduced to the limit of visual acuity. Clearly, this form of nonlinearity must be exhibited in any adequate mathematical model of the human operator.

For a particular class of input signals (both the input and output being assumed stationary processes), such nonlinear transduction can be described in terms of a linearized component, called the "describing function" and some usually less significant "remnant" term. Even though the signal may appear random

to the tracker, it may still be describable in terms of some of its statistical parameters. These, together with the fixed transduction characteristic, furnish the required information to determine the equivalent pure gain which is a function of both the indifference threshold and the variance (or standard deviation) of the input signal.

Here is a natural outgrowth of the frequency response analysis technique due to Nyquist. If a linear system is stimulated with a sinusoidal forcing function, the output will also be sinusoidal having some amplitude ratio and phase relation to the input, both being a function of the sinusoidal frequency. Neither of these parameters, the amplitude ratio nor the phase shift, are dependent upon the input amplitude or its time of origin, thus it becomes possible to utilize these parameters to fully describe the linear system in terms of its transfer function. If, however, the same sinusoidal input were applied to a nonlinear system, the output would not, in general, be sinusoidal. The output can be expanded in a Fourier Series to evidence the various spectral components. It then becomes possible to use the ratio of the output to the input to define a function which is dependent upon the input amplitude and frequency. This ratio defines the describing function, where conventionally only the first harmonic component of the output is considered for a sinusoidal input. Note that this technique represents a system only for a particular class of inputs (these being conventionally presumed to be simple sinusoids).

A considerable amount of empirical evidence has been gathered in various efforts to determine the describing function for the human operator in the control of various types of vehicles. According to McRuer, Krendel and Senders,

"There are many factors which limit the generality of the describing functions obtained experimentally and listed in the tables. Among these are the following:

(1) The magnitude of the remnant term is large in almost all cases except for the simplest controlled elements and inputs. It may indeed be larger than the linear portion of the describing function. The remnant must be treated as a noise generated by the man as an input to the controlled system. It must, however, be remembered that this 'noise' is a result of the method of analysis rather than of the observation of behavior. The attempt to linearize behavior gives rise to a large noise component. With more sophisticated techniques of analysis, the noise or uncorrelated part of the behavior would be reduced in magnitude.

(2) Most of the data on which the conclusions

tabulated are based are themselves the result of experimentation on a very few subjects (and for short periods of time). No population data are available, or data about fatigue and learning.

(3) Most of the data apply only to specific aircraft dynamics, rather than to a sample of controlled elements selected for the purpose of exploring the nature of the man's adaptation to different controlled elements.

(4) Most of the data were obtained in experiments in which the subject operated only one channel at a time, or in some cases, two. In most operational situations, the human operator is confronted with many indicators and many controls. He must distribute his attention among all of these rather than concentrate on one. It might be expected that the describing function appropriate to such a sampling system would be different from those found even if the major inputs and controlled elements were the same in the two cases.

(5) In addition to such deficiencies with regard to sampling, there exists also the likelihood of interference and "coupling" among the many channels which a man might be called upon to operate.

In spite of these deficiencies, the describing functions for human operators have considerable utility, both in establishing boundaries for the controlled elements which men are to use, and in estimating the effects of different inputs on behaviour and performance."

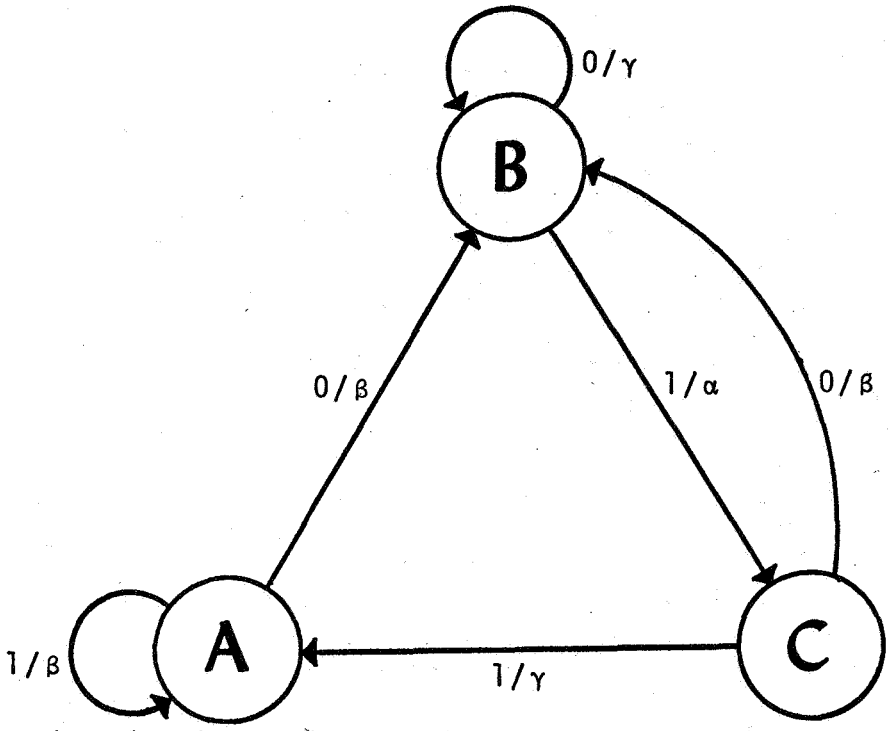
Other techniques have been considered in efforts to overcome the difficulty introduced by the nonlinearity of human performance. One of these is based on the phase-space method of analysis introduced by Poincare in 1881. For the simple tracking situation, the phase-space is reduced to a phase-plane showing the position error on the abscissa and the first derivative of this error on the ordnate. The origin describes the system when it is in steady-state zero error. Sudden shift of the reference signal provides a displacement error and a "proper" corrective action should null the error through a single ballistic action. Unfortunately, in real world situations this rarely occurs. There is either an undershoot or an overshoot with the trajectory in the phase-plane continuing in a counterclockwise movement until the error is eliminated. Within such a view, it is possible to separate modes of behavior, thus offering a simplified model of the human operator for each

individual mode and some relatively simple set of rules for the transition between modes. In one study performed by Senders and Fogel, six modes were separately identified... reaction, acquisition, tracking, synchronism, steady-state tremor, and reassurance.

Another technique is based on a stochastic model which traces the probability distribution of the transformed variable through a logical flow replicating the heuristic properties of human decision behavior (ref. 1). Still another offers a characterization of the time-varying human operator through continually varying linear and nonlinear models (ref. 2). Unfortunately, according to Gagne and Wierwille. "There appears to be no deterministic mechanism for explaining the linear time-variability of the human operator". Further, "There appears to be no simple relationship between the time-varying transfer characteristics and the signals of the corresponding manual control system". Nonlinear constant-coefficient models were then used to replicate the logic of human transduction. "The nonlinear filter which was synthesized in order to obtain this (satisfactory) result had 68 linear and nonlinear component filter outputs, and therefore, is too complicated to yield intuitive information about the logic-strategy of the human operator." Clearly, what is needed is a mathematical model of a different kind, one which extracts a considerable amount of redundancy from the empirical data in such a way as to offer a relatively simple and consistent view of individual features of the transduction, hopefully in a manner suitable for direct interpretation within a psychological frame of reference.

A convenient form of mathematical function for this purpose appears to be the finite-state machine ... a "machine" being defined in terms of the finite alphabet of possible input symbols, the finite alphabet of possible output symbols, and some finite number of possible different internal states. To specify such a machine, each of these states must be described in terms of the symbols which would emerge from the machine and the next state of the machine when the machine is in that state and receives each of the possible input symbols. For example, a three-state machine is shown in the following sketch.

The alphabet of input symbols is comprised of 0 and 1, whereas the alphabet of output symbols is comprised of α, β, and γ (input symbols are shown to the left of the virgule, output symbols are shown to the right). As shown in the "state diagram," an input of 1 to the machine while it is in state B will cause the machine to output an α and change its internal state from B to C.



On the other hand, an input of the symbol 0 when the machine is in state B causes an output symbol γ and the machine remains in state B. Thus a sequence of input symbols is transformed into a sequence of output symbols,

Present State	C	B	C	A	A	B
Input Symbol	0	1	1	1	0	1
Next State	B	C	A	A	B	C
Output Symbol	β	α	γ	β	β	α

assuming that the machine is in state C when the first input is received. In general, the output sequence would have been different had the machine been in another "initial state." A finite-state machine, therefore, is completely specified by the state diagram and an identification of its initial state. It is assumed that the machine acts only when an input symbol is received and that the operation is always completed before the next input symbol is received.

In essence, a finite-state machine representation of the human operator portrays his behavior as being dependent upon his internal (psychological) state. For each such state, he is presumed to behave in a consistent manner with respect to stimulus-response and with respect to the result of each stimulus in terms of his next internal state. For example, if the pilot is in the "indifferent state" for some class of

stimuli his response is nil and he remains in that state. For some other class of stimuli, his response may also be nil, but any one of these will transfer him into a new state ... a "responsive state". Still another class of stimuli will place him in a responsive state and, at the same time, will elicit a particular output symbol (his overt reaction).

Clearly, any finite organism operating upon a finite set of discriminably different stimuli and responding within a finite set of discriminably different output symbols can be exactly represented by a finite-state machine. The hope is that actual human performance can be represented in terms of a relatively simple finite-state machine, thus depicting the essential ingredients of his behavior, and this in an intuitively satisfying manner. That is to say, given any finite sequence of input-output data, it is always possible to find a finite-state machine which will exactly represent the given transduction. The problem is to find a meaningful approximation to such a machine in the sense that this replication reflects not only the measured input-output behavior of the human operator but also his goal-seeking intent. Such a model might be expected to reveal the important consistencies of human behavior, not only as these are evidenced in terms of overt transduction, but also in terms of state properties having psychological significance.

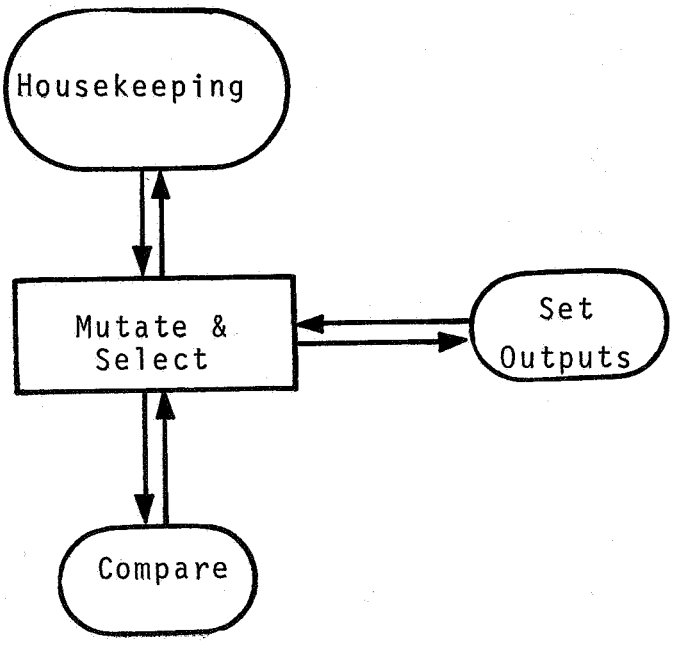
One means for finding such a finite-state machine representation for the human operator is to perform a simulated evolution of finite-state machine-organisms with iterative mutation and selection conducted in fast-time, scoring each organism in terms of its ability with respect to the given goal (performance criterion) in the light of the available experience. That is to say, if the task is to predict each next input symbol, then an arbitrary initial machine-organism is driven by the recall (the sequence of input symbols on record up to the present moment) and the output symbol corresponding to each of these input symbols is scored in terms of its worth as a prediction of the next input symbol. The cumulative score in this regard represents the worth of the organism with respect to this goal-seeking task. This organism is randomly mutated to form an "offspring" which is then similarly evaluated in terms of its response behavior when driven by the same sequence of input symbols. A comparison is made between the offspring and its parent, the better of these two being retained to serve as the new parent of another offspring ... and so the process goes, finding logics more and more appropriate to the given goal in view of the available evidence until an externally imposed criterion has been met. This criterion concerns the cost of computation and is essentially different from the presumed goal of the behavior to be represented in terms of the evolved finite-state machines. For

example, there might be some maximum cost constraint imposed upon the computation or some minimum level of confidence might be required (this being measured in terms of the scored worth of each machine-organism) or the computation might be carried on within real-time constraints so that the best approximation to the desired finite-state machine representation might be forced through external conditions.

Note that this nonregressive evolution yields a logic which might well form the initial organism for a next model of the human operator ... a model depicting his goal-seeking response behavior over the original recall, plus his next stimulus-response transduction. If the human operator is strongly consistent over time, the modeling may be expected to converge rapidly as each transduction is accompanied by an updated model. On the other hand, this process also permits the presumption that the human behavior is responding to a sequence of goals. Naturally, the more variable this goal direction, the less the likelihood of convergence upon a singular representation in the form of a finite-state machine. At this point it is appropriate to mention that the evolutionary program may well include a cost-for-complexity which reduces the worth of each evaluated machine organism (thus incorporating an embodiment of the Maxim of Parsimony). The result of the simulated evolution can be of any desired complexity, ranging from a one-state machine (after each transduction, the human operator is presumed to return to the original state, much as a typewriter does), or an extremely complex machine of many states. In general, the greater the number of states, the lower the statistical confidence accompanying each of the transitions within the machine, and thus the lower the credibility of the overall model. A more extensive discussion of evolutionary programming may be found in the book entitled "Artificial Intelligence Through Simulated Evolution" (ref. 3).

In order to examine evolutionary programming in greater detail, it is best to begin with the preliminary concept of a Moore-machine, a triplet (I, Σ, f), consisting of an input alphabet I, a set of states Σ, and a transfer function f, from $I \times \Sigma$ to the set of states. When an element of the input alphabet is received by a Moore-machine, it will transfer from one state to another in accordance with the rule laid down by the transfer function. The present program is capable of representing Moore-machines of up to 32 states that will accept an alphabet of up to 64 symbols. Once the input alphabet and the number of states are specified, the function f is given in tabular form specifying for each input, and each state the next-state reference.

A finite-state machine consists of a quintuplet (I, Σ, f, O, g); where I is an input alphabet, Σ is a set of states, f a next state transition function, O an output alphabet which may or may not be identical with I, and g an output function. For a given Moore-machine and a given output alphabet O the specification of g will uniquely determine a finite-state machine. This is exactly the purpose of the output determination algorithm. Referring to the following sketch, it can be seen that evolutionary programming incorporates an environmental comparison procedure, a selection procedure, and an output determination algorithm.



For a given Moore-machine, the output determination algorithm selects an output function g so as to minimize losses with respect to a given loss function and a given sensed output environment. Suppose that two finite-state machines g_1 and g_2 be derived in this fashion from two given Moore-machines f_1 and f_2. If the comparison module indicates that g_1 is preferable to g_2 then f_1 will be said to be more successful than f_2.

Given an initial Moore-machine f, successive Moore-machines or mutants are obtained by means of the selection and mutation module. This module operates upon the stored state-transition table and is stochastic in nature. A description of the operation of this module follows.

Consider the next-state transition table for a given Moore-machine. One of the four possible modes of mutation is to select an entry in this table at random and to replace it with a

random digit. (The present program also provides for replacing two or more such entries in a single functional operation.)

The second mode of mutation is to permute the starting state. The output of a finite-state machine depends upon the present state of the machine. Therefore, a given finite-state machine will react in varying fashion to identical sequences of input symbols depending upon the state of that machine when the first input symbol was received.

The starting machine might have three states, but for a given environment it may be more appropriate to have two states, or four states. Additional modes of mutation provide for the addition or deletion of a state. Deletion of a state is accomplished by deleting a row at random from the next-state transition table and altering all references to the deleted state. The process by which a state is added is somewhat more complex.

Summarizing, the mutation procedure consists in a preliminary choice among the four possible modes of mutation, followed by the execution of one of the modes. Given an initial machine f, and a second Moore-machine f' developed by the mutation procedure, the comparison routine is applied to f and f'. The more successful is preserved and used as the progenitor of future mutants.

Suppose the goal of an evolutionary program is to match the output of a black box. The evolutionary program and the black box are fed the same stream of input symbols. A stream of output symbols is produced by the black box. Simultaneously, a stream of output symbols is produced by the evolutionary program. If the output of the black box and the evolutionary program coincide a zero loss might be recorded; while if the outputs differ, a unit loss would be incurred. Alternatively, the loss might be set equal to the magnitude of the difference between the output of the plant and the program or to the square of this difference. A predetermined input to the evolutionary program is a loss matrix specifying for each possible pair of output symbols an associated loss.

A comparison is made each time an output symbol is produced. It would be possible, therefore, to use a different loss matrix at each stage of the process. The present version of the program, however, uses only a single pre-determined loss matrix read into the program prior to the exercise of the prediction routine.

This algorithm determines an output for each input-state pair of a given Moore-machine; when this machine is exercised over an input environment of fixed-length, the outputs of the

machine are set so as to minimize the losses or fit score recorded by the comparison routine. For a given recall, not all input-state transition pairs of the machine will have been exercised. Accordingly, the algorithm distinguishes between exercised pairs and unexercised pairs.

During the course of the selection process the same storage area is used over and over again for storing the output table. The present version of the evolutionary program sets the output of unexercised state-input pairs by omitting to rezero them; thus, information regarding possible past exercise of these transitions is preserved.

Suppose that for a given exercised state-input pair a unique output symbol was to be found in the corresponding comparison environment -- the symbol 2, for example. If the program's goal is to match its environment the output for that particular state-input pair will also be set to 2. In a 'noisy' environment several different symbols would be observed; it would be necessary to try each possible output symbol and see which resulted in a minimum total loss.

The philosophy underlying this algorithm is that the distribution of symbols in the sample or recall reflects the distribution that would be experienced in the future; the longer the recall the more accurately will the sample reflect the distribution. If the environment were changing rapidly, it would be better to focus attention on recently received outputs; by the use of a shorter recall, for example. Such considerations have dictated several modifications to the basic evolutionary program. These are discussed later in the text.

It was noted that a long recall is desirable for most problems involving a 'noisy' environment. If too short a recall is used, even a periodic environment may appear noisy. Recall length should be at least as long as the period of the environment, (if such exists). On the other hand, the longer the recall the more time-consuming the fitting process, and the more expensive the execution of the program. There would appear to be some optimal recall length for any given environment, but if the nature of the environment is unknown in advance then the optimum cannot be derived analytically. Accordingly, an adaptive feature was built into the program. At any given stage, two evolutionary processes operate in parallel. One uses a recall of length n_1, the other a recall of length n_2. These two processes are compared periodically by means of the action score.

Action score is obtained by comparing the output of the

evolutionary processes with that of the comparison environment with respect to a given loss function. This loss function may differ from the loss function previously discussed. The action scores are periodically rezeroed.

At intervals, the action scores of the two processes are compared. Suppose that the action score is greater for the process using n_1; n_2 would then be reset to some new value.

Note that action score is a measure of the predictive ability of a process or series of models whereas fit score is a measure of the matching ability of an individual model and is the criteria used in the selection of a 'best' model.

The system contains the capacity for altering the number of states during the mutation process. It is easy to see that for any environment, the larger the machine, the better the fit score. Consequently, there is a tendency for the succession of machines to grow to a maximum permissible size. The present version of the program contains sufficient storage area to accommodate up to a 32-state 64-input symbol machine, but also contains provision for restricting the maximum size of the machines for any given computer run, as the larger the machine the greater the time consumed. If the comparison environment is being generated by a five-state machine, say, then it is inefficient to attempt to match this environment by any machine larger than five-states, (although, it would be entirely possible to find a 15- or 20-state machine that would provide a perfect fit to the comparison environment). There are certain problems for which a larger machine is completely undesirable; for example, a sequence of independent identically distributed random variables could be matched equally well by a one-state or a 10-state machine, but for a given recall the one-state machine will always make better use of the environment. The full recall is used for the determination of the outputs of a one-state machine, but the recall will be partitioned into a large number of subsamples in fitting the output of a 10-state machine. If the environment were known in advance, it would be possible to use an optimal machine size initially, and suppress the addition or deletion of states. Since such information concerning the environment is usually not specified in advance, it was necessary to build an adaptive feature into the program. Essentially, two processes are constructed; one uses machines confined to M_1 states, the other machines with M_2 states. Each process permits only two possible modes of mutation; altering the state transition table or permuting the starting state. Periodically a comparison is made between the two processes on the basis of action score. The process with the inferior action score is suppressed and is replaced by a process with a different number of states.

The present version of the program considers four processes or players simultaneously. Suppose these players be denoted as A, B, C, and D. A and B might be restricted to one number of states, C and D to some other number of states. A and C would have the same recall length, while B and D would use a different recall length. In this fashion, simultaneous adaptation of state size and recall length is accomplished. Fig. 1 shows a logical flow chart for the 64 symbol evolutionary program.

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EXPERIMENTAL RESULTS

The previously described techniques of finite-state machine representation were used in this investigation to model a linear dynamic system, a nonlinear dynamic system, and a human operator in single axis tracking tasks. Additionally, actual in flight pilot response data was examined. The results of this experimentation are described below.

Modeling a Linear Dynamic System

A linear dynamic system of the form

$$\frac{K_1 A + K_1 K_2 s}{(A + s)^2}$$

is commonly used to model the human operator in tracking control, the constants being chosen to typify the human operator in control of a second order plant having the transfer characteristic K/s^2 through the use of compensatory tracking. With this dynamic system being driven by a random disturbance, the input and output were recorded, the data being quantized into 64 equal class intervals of amplitude, there being some 350 environmental points transcribed to punched cards at five points per second. These data were then used for a trial run using the evolutionary program under the goal to minimize the magnitude-of-the-difference; that is to say, the error for each data point is taken to be the number of symbols between the actual output and the output of the finite-state machine. The evolutionary program was initiated with two machines, these being similar in structure but different in size (5 and 15 states, respectively). Table 1 indicates the initial 15-state machine. This table is read as follows: Assume the machine is presently in state 2 with an input of symbol 29. By looking at the major column labeled "State 2" opposite an input symbol of 29, it can be seen that the next state will be 7 and the present output symbol will be 0. The structure of this machine is such that an ordering can be given to the states in the following manner: For any state, if under the input x the transition is to state A, and under input y the transition is to state B, then A is greater than or equal to B so long as x is greater than y.

In the trial experiment, the evolutionary program was permitted to operate for only 10 moves after fitting the initial recall of 300 data points. The results indicated that the 15-state machine was superior to the 5-state machine and that the chosen structure for the initial machine was indeed appropriate. The best machine evolved at the end of this experiment fitted the recall of 300 data points with an average "fit score" of 0.85;

that is, an average error per data point of 0.85 symbol. Over the 10 moves, the average "action score" was 1.7. Table 2 indicates the final machine evolved by the program in this first experiment. The output symbols for the unused state-input pairs over the initial recall were set to the most frequently used output symbols (in this case, the symbol 33). The relatively large difference between the fit and action scores indicates that the initial recall of 300 data points was inadequate and that the machine was encountering new situations in the 10 moves; that is, situations which were not in the original 300 data points.

To gain a better understanding of the nature of the errors which were encountered and their effect on the overall problem, a program was written which would take the final finite-state machine evolved by the evolutionary program and drive it over the 350 data points, comparing the true symbols with these generated output symbols. The finite-state machine was started in an arbitrary state such that the starting position would not correspond to the conditions used in the initial recall. After a few moves, the machine became synchronized and predicted 55.4% of the symbols correctly. Twenty-nine and seven-tenths percent of the errors were within two symbols of the correct symbol. The average error per prediction over the 350 data points was 0.965 symbols. Figure 2 indicates these results. Clearly, the finite-state machine provides a surprisingly good fit to the actual output sequence. The noticeable errors were of two kinds. The deviations flagged with a 1 were due to a previously unexercised state-input pair occurring such that the output was a 33; that is, near to the 0 level. This difficulty is correctable by increasing the length of recall. The more common error occurred at the peaks of the output variable. The source of these errors was the time interval of 5 data points per second which was evidently too large to depict the difference in the rates of change occurring at the peaks. This error was reduced by increasing the number of samples per second in order to establish a more suitable time interval for the quantized data.

Modeling of the above-described analog "pilot" through the use of finite-state machines operating upon discrete inputs can be compared to numerical integration wherein each sensed amplitude is taken to correspond with a rectangular segment of that height. If the time interval between samples is too large, there will be an error due to the poor approximation of the step function assumed at each point in time. On the other hand, if the time interval becomes too small, the round-off error becomes predominant. In this case, the range over which the time interval between data points can be varied was rather severely curtailed in view of the restriction to the 64-symbol alphabet. That is to say, amplitude quantization places an important constraint upon the limit of highest meaningful time interval sampling. Table 3

summarizes the results of the experiments performed in order to determine the proper time interval of sampling. Evidently the recall length used in Experiment 1 was too short for a true indication of the average error but it was observed that appreciable error was present, this being due to the coarseness of the time interval sampling. The round-off errors were evidently not excessive.

In Experiment 2 the opposite situation prevailed. The round-off error became predominant which caused a large average error. In Experiments 3 and 4, a larger machine (of 31 states) having the same basic structure as the original 15-state machine was used. The recall was longer than that used in Experiment 1 but was still found to be too short to yield a true picture in terms of the average error. These experiments did show, however, that the greater number of states did indeed reduce the larger errors. In the first four experiments, it was observed that only a small portion of the finite-state machine used was being exercised. This is understandable in that since the sensed variable was continuous, it is highly improbable for the input to change from symbol 0 to symbol 63 in a single time interval. In fact, the largest such change appears to be in the order of 10 symbols.

In Experiment 5, an initial machine of different structure was used, this being a folded-over equivalent to a 63-state machine. This folding is accomplished by overlaying the useful transitions on to the nonused portions of the machine. This machine, shown in Table 4, permits a fuller utilization of the state input combinations within the size constraint. The 800 data points which formed the recall used in this experiment were still not enough. However, a significant improvement in the average error over that obtained in Experiment 4 was achieved.

In the subsequent experiments, a larger recall of 4,000 data points was used with the above-referenced 31-state initial machine. A sampling time interval of 0.12 seconds was found to provide the best results. The quantizing interval used to establish the 64-symbol expression of the data base was changed in Experiment 10. In the experiments which preceded this one, the quantizing interval was established by placing equal class intervals between the referenced levels provided on the tape. Thus the actual input symbols ranged from 9 to 52. In Experiment 10 and in the succeeding experiments, the amplitude quantization was based on the actual maximum and minimum experienced input signal. This improved the results significantly, as expected, since it effectively provided a larger input alphabet and therefore greater resolution.

Table 5 offers a comparison of three different methods of scoring used for setting the output symbols of the finite-state

machine model. For each state-input pair exercised over the recall of 4,000 data points, the evolutionary program chooses that output symbol which minimizes the error score. Table 6 indicates the final machine evolved by the evolutionary program. In this case, the output symbols of the unused state-input pairs were arbitrarily set by the program to be symbol 33. Figure 3 describes the relationship between the input symbol sequence, the actual output sequence, and the finite-state machine output sequence found in Experiment 9. An "all-or-nothing" scoring was used in Experiment 11, that is to say, the error for each data point is taken to be one if the actual output and the output of the finite-state machine differ, and zero otherwise. As shown in Table 5, the number of correct predictions rises from 33.1% to 36.26%. On the other hand, the larger errors occur more frequently. Table 7 indicates the machine last evolved in Experiment 11 and Figure 4 offers the results of this experiment in graphic form. In this experiment, the output symbols for the unused state-input pairs were automatically set to symbol 43. In Experiment 12, these output symbols were set by means of averaging. This method can be shown to be equivalent to accepting the least square's criterion; that is

$$\text{Error} = E(x) = \sum_{i=1}^{N} (x_i - x)^2$$

where x is the output setting, x_i is the actual output symbol, and N is the number of data points. x is to be chosen so as to minimize the above-defined error. Taking the derivative, and setting that derivative equal to 0 permits finding the minimum value of x; that is,

$$\frac{dE}{dx} = 2 \sum_{i=1}^{N} (x_i - x) = 0$$

$$Nx = \sum_{i=1}^{N} x_i$$

$$x = \frac{1}{N} \sum_{i=1}^{N} x_i$$

thus x is chosen to be the arithmetic mean. This method for setting the output symbols reduced the number of correct predictions to 24.7% and, at the same time, significantly reduced the percentage of large errors. Table 8 indicates the machine which finally evolved in Experiment 12. Figure 5 indicates the results of this experiment in graphic form.

It was of interest to examine the relationship between the size of the finite-state machines and the average error resulting from their use, reference Table 9. An equivalent 63-state machine was used in Experiment 9. Experiment 14 used a 31-state machine which could also be replaced by a folded-over 15-state machine. As expected, the reduction in machine size increased the average error. A 15-state machine was used in Experiment 13. This reduction in the number of states also increased the average error.

It was also of interest to examine the effect of alphabet size upon the modeling capability with respect to the linear dynamic analog "pilot". This modeling is measured in terms of the adjusted accuracy which is defined as the alphabet resolution multiplied by the average error measured in number of symbols. For a 64-symbol alphabet, the symbol resolution error is 1.56%. This figure multiplied by the average error associated with a given machine yields the accuracy. Figure 6 indicates the effect of machine size upon accuracy for an input alphabet of 64 symbols and a time interval of sampling of 0.12 seconds. As can be seen, the curve flattens with increasing number of states so that little improvement can be expected by increasing the size of the machine beyond 31 states. Figure 7 indicates the accuracy as a function of alphabet size. The number of states for each machine was chosen to fall upon the flat region of the curve shown in Figure 6. A program was written to use the same structure as the previous experiments and to fit output symbols to a machine of the same structure for a 100-symbol alphabet. Figure 7 indicates that this curve also flattens so little improvement can be expected by increasing the alphabet size further. It should be noted, however, that with a still larger number of symbols, it would be possible to reduce the time interval of sampling which would then generate a new curve having lower values than that shown in Figure 7.

Modeling a Nonlinear Dynamic System

In a more difficult problem, an attempt was made to model a nonlinear dynamic system, this being comprised of linear segments, its logic being: When the motion of the plant is away from the reference, the analog "pilot" responds in proportion to the rate of this motion. If the plant is not moving or is moving toward

the reference, there is no response unless the rate is such that a simple prediction indicates that the plant would cross the reference in less than T seconds, this causing the "pilot" to respond in proportion to the rate of motion. The prediction is of the form $X(t+T) = X(T) + T\,\dot{X}(T)$ where $X(T)$ is the present displacement of the plant from the reference and $\dot{X}(T)$ is the present rate of the plant. All outputs of the system were transformed by a second order approximation to a transport delay and by a lag filter to represent the inertia of the "pilot's" musculature. The input and output of the nonlinear system were recorded while it controlled a second order plant in order to track a random variable.

Here the sampling rate was increased from 25 to 100 data points per second in digitizing the analog tape produced by driving the nonlinear dynamic system with an analog variable. In addition to the displayed error, the tape also included tracks of error rate information. The programs were modified to accommodate the change in tape format due to the increase in sampling rate and the inclusion of error rate information.

Before establishing a suitable time interval, two preliminary experiments were performed in order to establish which of the two input environments appeared most promising (the displayed error or displayed error rate). The error display was used for the input in Experiment 20 with the same initial 31-state machine used as in the previous experiments attempting to model the linear dynamic system. The time interval of sampling was 0.15 seconds. In Experiment 21, the error rate was used as the input sequence with the same initial machine and sampling rate. In these experiments, the average error was 2.6 symbols and 1.72 symbols, respectively, over a recall of 4,000 data points. Figures 8 and 9 indicate the results of these experiments. The time interval of sampling of 0.15 seconds was chosen on the basis of those experiments which used the error rate for input in that they consistently produced the lowest error score. The results of these experiments are summarized in Table 10. The column labeled "Adjusted Error in Percent" is the error in number of symbols corrected for the alphabet size. The error was further reduced by increasing the alphabet size to 100 symbols. While the average error in these experiments is quite low, there were still several errors of large magnitude. For example, in Experiment 29, 10% of the points were in error by four or more symbols.

From Figure 9, it can be observed that the finite-state machine led the actual output by a noticeable amount and that the peaks of the actual output were lagging the peaks of the error rate input. It was, therefore, found worthwhile to introduce a delay in the output to correspond to the reaction time of

the human operator. This delay was introduced by fitting the (n+d)th output symbol with the input symbol n where d is the delay in an integral number of sampling intervals. Table 11 summarizes the results of these experiments. While the scores for the 31-state machine did not show a very dramatic change with the introduction of delay, the score for the one-state machine changed drastically. In that the scores for the best one-state machine and the 31-state machine were similar, experiments were performed using the displayed error as the input signal with a delay of 0.3 seconds. Table 12 summarizes the results of these experiments.

Figures 10, 11, and 12 indicate the results of Experiments 36, 38, and 39, respectively. The initial machine in each of these experiments was the same as that used in Experiment 5. The final machines for Experiments 36, 38, and 39 are shown in Tables 13, 14, and 15, respectively. To better illustrate the effects of these three different scoring matrices, appropriate error histograms are shown in Figures 13, 14, and 15, respectively. As can be seen, "average" scoring predicts 37% of the symbols correctly (reference Fig. 13), this being compared to 47.8% for the "magnitude-of-the-difference" (reference Fig. 14) and 50.6% for the "all-or-nothing" scoring (reference Fig. 15). However, 90% of the data points are in error by less than 2.5 symbols in using the "average" scoring, while for the "magnitude-of-the-difference", 90% of the data points fall within 2.9 symbols and for the "all-or-nothing" scoring, 90% fall within 3.5 symbols. Note that the symmetry in these figures is artificial in that the error distributions were calculated only in terms of magnitude. It was reasonably assumed that there would be an equal number of positive and negative errors of each amplitude. It was of interest to determine the effect of machine size upon the modeling capability with respect to the nonlinear dynamic analog "pilot". The result is shown in Figure 16.

Modeling the Human Operator

While the recording of the nonlinear analog "pilot" was being made, the input and output of a human operator were recorded while he was in control of a second order plant. In this performance, the human operator attempted to execute the strategy exhibited by the nonlinear system. The results of preliminary experiments on modeling the human operator are summarized in Table 16. A delay of 0.15 seconds significantly reduced the error score in comparison to no delay and the delay of 0.3 seconds. Clearly further experimentation was required to establish the proper delay. The results of Experiments 40, 43, 44, 45, and 47 are shown in Figures 17 through 21, respectively. Figures 22 through 26 indicate the error distribution for these

experiments. Here the same assumption of symmetry is made. As expected, the success of predicting the actual pilot was considerably less than that obtained as a result of modeling and predicting the analog "pilot" of nonlinear dynamic form. In general, however, the human operator was seen to behave quite consistently as evidenced by the degree of fit obtained in Experiments 45 and 47. The histograms shown in Figures 25 and 26 exhibit the same characteristics with regard to the scoring methods as that obtained from exercising the program to model the nonlinear analog "pilot". The "magnitude-of-the-difference" (reference Figure 25) correctly predicts 28.3% of the time while the "average" method (reference Figure 26) achieves a comparable score of only 17%. As expected, however, the larger errors are significantly reduced through the use of the "average" scoring method.

Figure 27 indicates the results of continued experimentation intended to determine the proper time interval of sampling and delay in order to optimize the representation of the human operator. For time delays of 0 and 0.3 seconds, a sampling time interval of 0.15 seconds was used. In all other cases, a time interval equal to the delay was chosen as most appropriate. As shown in Figure 27, a delay of about 0.15 seconds yields lowest average error.

With respect to modeling of the human operator in his performance of single axis tracking, four distinct possible matrix expressions of goal were used: The "magnitude-of-the-error", "all-or-none", "average", and "zero band magnitude-of-the-error". The first three of these cost matrices have been previously described. The "zero band magnitude-of-the-error" is similar to the "magnitude-of-the-error" goal expression except that no penalty is associated with errors of plus or minus one symbol from the correct value; that is, a band of zeros exists around the correct symbol. Table 17 indicates the results of using these four matrices in separate experiments. In all of these experiments, the structure of the initial finite-state machine was the same as that used in the previous experiments concerned with modeling the analog "pilot". The final machines in Experiments 45, 47, 60, and 61 are indicated in Tables 18, 19, 20, and 21, respectively. The results of these experiments are graphically indicated in Figures 20, 21, 28, and 29, respectively. Note that Table 17 fails to indicate a true picture of the results in that it only pertains to average error. To more fully evaluate the effect of using different error cost matrices (expressions of goal), the frequency distributions of the resulting error must be examined in detail. Figures 25, 26, 30, and 31 offer the histograms of error found in Experiments 45, 47, 60, and 61, respec-

tively. In all of these experiments, a recall of 4,000 data points was used. The assumption of symmetric error distribution was made as previously indicated. The effect of these distinct expressions of goal on the distribution of error is summarized in Table 22. Each cost matrix represents a different strategy according to which the program algorithmically determines the output symbols for each state-input pair. The goal in Experiment 45 was to minimize the average error and, as can be seen, this experiment demonstrated the smallest average error. The goal in Experiment 47 was to minimize large errors. This is clearly evident from the demonstrated result. The intent in Experiment 60 was to achieve the maximum number of correct predictions under the philosophy that "a miss is as good as a mile". In Experiment 61, all errors which were not in excess of one symbol were accepted as being correct, the attempt being to minimize the average error with respect to all other deviations.

After the experiments directed toward modeling the human operator were complete, a study was undertaken to gain a better insight into his behavior. From the experimental results, it was evident that the nonlinear analog "pilot" was a "rate machine". Comparison of these results with comparable results taken on the human pilot indicated that the human operator had a similar strategy. In these experiments, there was the concern that the recall used for fitting the machine might be so small that the resulting small remnant may be due to the uniqueness of exercising the state-input pairs. Experiment 36H was conducted in order to clarify these points. This experiment consisted of taking the final machine from Experiment 36 (which had attempted to model the nonlinear analog "pilot"), driving this machine by the input used by the human pilot, and comparing the machine output with the pilot's output. The result of this experiment was surprisingly good, the average error being 3.65 symbols. While this was not as low as that obtained from modeling the human operator directly, it did indeed confirm that the length of recall was adequate and that the primary strategy of the human pilot was rate control. Figure 32 indicates the results of this experiment in graphic form. The difference in average error and the corresponding larger remnant found for the human operator indicated, however, that the man was not using a pure rate control strategy.

Further studies were conducted in order to establish the difference between the finite-state machines obtained by modeling the human operator and those obtained by modeling the nonlinear analog "pilot". The first of these experiments is described in Figures 33 through 47. These data were obtained from the final machines of Experiments 36 and 45 by holding rate constant and plotting the output symbol as a function of the

input symbol. For example, the curve for zero rate is a plot of the output symbols for an input of 1 into state 1, an input of 2 into state 2, and so forth. The family of curves described in these figures show that the human operator was not using a pure rate mode of control. This is most clearly shown in Figure 33. The nonlinear analog "pilot" maintained an almost constant output of symbol 32 regardless of the level of input symbol while the human operator maintained a tendency to correct for positional errors. This may be seen in that for all levels less than the midpoint (symbol 32), the human operator's output symbols were above the line derived from the nonlinear "pilot" model and for all levels greater than the symbol 32, the human operator's output symbols were below that of the nonlinear analog "pilot". In general, all of the remaining curves in this family demonstrate this same characteristic. With larger excursions from the center position, the discrepancy between the model of the human operator and that of the nonlinear analog "pilot" becomes greater. It is also evident from these data that with larger rates, the human operator's output becomes more erratic. In summary, the results of these experiments indicate that the human subject was trying to fly by rate but that he was also influenced by position. As expected, he demonstrated greater deviation at higher rates. These same results are shown in Figures 48 through 60, here being plotted as a function of a set of constant levels rather than constant rates.

An attempt was made to reduce the machine and alphabet size used to represent the human operator. A 64-symbol 15-state machine provided an adequate representation of the human operator's transduction, yielding an average score of 3.5 symbols (reference Experiment 40). The result of using a reduced alphabet size is shown in Figure 61. Clearly these results are degraded beyond the point of usefulness, the loss of accuracy resulting from an inability to distinguish rate at the lower alphabet size when using a time interval of sampling of 0.15 seconds (rate being established as the first difference taken on successive input data points). As previously noted, the human operator's primary mode of behavior was rate-directed and therefore a considerable loss of information is to be expected through curtailment of the alphabet size. Two means for overcoming this difficulty were apparent. First, it would be possible to increase the time interval of sampling. This would once again establish a significant measure for rate. However, it would also contribute error due to any large changes in rate over the selected time interval of sampling. An alternative approach would be to establish another method for determining rate (a method which does not depend solely upon the first difference of successive quantized input data points). This could be achieved by either determining rate by taking first differences of the raw digitized positional data before quantization

or by using the rate input that was given on the tape as a secondary input. The latter method appeared to be more readily implemented and was therefore followed.

Several methods are possible for handling the double input of simultaneous position and rate. Probably the simplest approach is to map the two alphabets of position and rate into a single unique input alphabet. Thus a 4-symbol position and 4-symbol rate description of the input requires a 16-symbol input alphabet. The availability of 64 symbols in the program limited the position and rate to 8 symbols each (assuming, of course, that equal resolution is desired). If, however, certain assumptions can be made with respect to the structure of the machine, the process of double input coding can be simplified. In this case, the structure of the machine was fixed and a matrix was established so that all occurrences were represented. Columns were taken to represent the (n-1) rate symbols while rows were taken to represent the (n-1) position symbols. The output for the n-th move was then added to the previous value in the location corresponding to the row-column designation for position and rate information for the input at (n-1) and a counter was indexed for the frequency of occurrence of this combination. After the initial recall was exercised, the output symbol was determined for each of the position-rate combinations by dividing every point in the matrix (the sum of the output symbols) by the corresponding frequency of occurrence. This method yields a pseudo-finite-state machine for an rms cost matrix.

Three experiments were performed with the program written on the latter basis starting with a 31-symbol alphabet machine. Subsequently, the number of states and the alphabet size were reduced until the results were significantly degraded. Tables 23, 24, and 25 indicate the machines used in Experiments 63, 64, and 65, respectively. The machine used in Experiment 63 consisted of 31 states and a 31-symbol alphabet; that used in Experiment 64 consisted of 15 states and a 15-symbol alphabet; and that used in Experiment 65 was of 7 states with a 7-symbol alphabet. Figures 62, 63, and 64 indicate the results of these experiments.

As may be seen from Figure 62, the machine used in Experiment 63 yielded an average score of 2.8 symbols and thus provided a good approximation to the human operator's response behavior. With the number of states and alphabet size reduced to 15, the average score increased to 3.2 symbols (reference Figure 63), thus offering a less accurate although still adequate representation of the human operator. Further reduction in the number of states and alphabet size to 7 yielded an average score of 3.76 (reference Figure 64). It appeared that further reduction in the number of states and alphabet size would produce only inadequate representations of the pilot's

response.

Experiment 65A was performed in order to determine whether or not there existed any significant variation in the human operator's performance with respect to time. Table 26 indicates the results of using the 7-state 7-symbol machine of Experiment 65 with the output computed over each successive quarter of the total recall of 4,000 data points. Evidently no significant trend or variation in human performance was evidenced during the time over which the history was recorded.

In a further test of the technique described above, a time history of the human operator's in-flight response was examined in detail. A time interval sampling of 0.2 seconds was chosen to yield suitable resolution and significant rate of change discrimination on both the input and output data. Accordingly, every fifth data pair of the original record was quantized into a 63-symbol "environment". These data are shown as a function of time in the top two curves of Figure 65.

As previously described, a machine was constructed which used position as input data and yielded output symbols on the basis of this input and the difference from the last input symbol ... this being essentially a position-rate input machine. This machine was then driven over the same environment in order to compare its output with that of the human operator. The result of doing this for a 31-state machine is shown in Figure 65 and for a 15-state machine, in Figure 66. The mean error for these experiments is shown in Table 27. As can be seen, most of the error is due to the averaging process in the generation of the matrix elements. The times of greatest error and the periods of zero error are both associated with the most radical pilot response. At such times, the environment appears to pass through atypical situations, thus contributing to the uniqueness of representation. When the machine size is reduced, the mean error is increased by about one symbol, but the number of extreme errors is reduced.

But the presence of a number of radical adjustments by the pilot implies that he is not consistently following a rate-position strategy. Visual inspection of the data indicates that the pilot's response to position information might well be affected by his present "stick position" in relation to the input symbol, or his last response. Thus a position-last output machine was devised in an analogy to the rate-position machines described above. In effect, the machine's state at any given time is the pilot's previous output, and the machine's input is the position. In order to minimize the mean-squared error, the mean of the observed pilot responses was used for any state-position combination which occurred more than

once.

A 64-state 64-symbol machine generated in this manner was driven by the actual data base with a resulting good fit (reference Figure 67), this being largely due to the fact that most of the transitions in this machine were exercised only a single time, thus making the machine a rather unique description of the record. This uniqueness is most noticeable when the pilot makes extreme moves. Reducing the machine to 16-state 16-symbol and then to 8-state 8-symbol in effect performs an averaging on the observed responses. This greatly reduces the number of correct responses yet remains a good representation of the track (reference Figures 68 and 69, respectively). Here greatest errors are seen to occur during violent maneuvers, that is, when the pilot's behavior is least typical. The influence of stick position is shown in Table 28 wherein the 16-state machine's output is expressed as the change of state, that is, the control stick adjustment. Except for a few elements, this output "map" shows the strong dependency of each next output on the previous output.

In order to test the machine in the prediction of new situations, the program was modified to make it predict each next pilot response on the basis of the current recall. In this case, newly experienced situations are arbitrarily predicted as being without change from the previous situation. With respect to the 64-state 64-symbol machine, this amounted to predicting the last state, thus the prediction was almost identical to the actual response with a one-interval length delay. Under this condition, the error plot becomes virtually the negative of the stick velocity (reference Figure 70).

As might be expected, the 16-state 16-symbol and 8-state 8-symbol machines yielded previous-point prediction during the early portion of the run but as the machine becomes more completely specified, the lag disappears and soon most of the errors result from the averaging of prior "experience" (reference Figure 71). Doubling of the time interval of sampling for the 16-state 16-symbol machine greatly increases the magnitude-of-the-error because previous position prediction becomes less reliable as the representation of the velocity measured in symbols per interval increases and as more and more details of the environment are lost (reference Figure 72).

It is of interest to compare the results obtained through the use of the finite-state machine representation (Experiment 69) with the more conventional technique for modeling the human operator. The technique used for comparison purposes was a time-varying representation consisting of a seven pole filter having a 20 second interpolation window with the filter poles being located at one-quarter, one-half, one, two, four, eight,

and 16 per second, this model and the empirical results under investigation being furnished by personnel of the Flight Research Center, NASA. The rms error of this technique was 18.39% while Experiment 69 produced an rms error of only 5.9% against these same data. That is to say, the same data points were used for the fitting and the error measurement in both instances. Temporal variability was found to be insignificant in the two different approaches to the problem of representing the human operator.

It is important to note, however, that the two techniques differ in objective. The finite-state machine model was devised in order to yield a deeper understanding of the behavioral properties and strategies of the human pilot. Consequently, fitting is performed in the time domain. In contradistinction, the filter model grows out of conventional control system theory which is formulated in the frequency domain. With this transformed back into the time domain, it is reasonable to expect greater error. If the finite-state machine model is placed within a closed-loop configuration, the results would differ considerably from those obtained through the above-described attempt to represent the human pilot because, as previously indicated, the large excursions present in the pilot's output are apparently caused by periods of inattention to the parameter under consideration as a result of the exigencies of flight control. This condition may be expected to exist so long as the spans of inattention are not recorded as part of the relevant data base.

Clearly, representation of the human operator's in-flight control requires recognition of the fact that he performs within a hierarchy of subgoals. Thus modeling of his tracking performance on single variables offers only a first step toward understanding his overall behavior. Clearly, attention must also be given to the problem of modeling the human operator's switching function over the various parameters, this as a function of these parameters and the values observed on each of them during his recent experience. The finite-state machine representation technique also appears appropriate in this regard.

CONCLUSION

The experimental findings of this investigation demonstrate that finite-state machines do indeed offer a suitable means for representing the human operator in terms of his stimulus-response behavior with respect to nonconvergent tracking tasks. In point of fact, the logical representation expressed in this form serves to produce a smaller residual error (remnant) than is achieved through more conventional techniques operating on a similar data base. Further, the finite-state machine models are derived through a goal-seeking technique which replicates the heuristic behavior of the human operator in the sense that he attempts to minimize some loss function. Additional experiments performed on the same data base but with respect to alternative expressions of goal can be used to derive approximate representations for the exhibited goal of the human operator. In point of fact, the strategy of the human operator was clearly discernible on the basis of the finite-state machine analysis of his input-output time history in the above-described experiments.

This investigation marks the initiation of a point of view in representing the human operator through finite-state machines. Clearly, additional work is in order. First, it would be desirable to improve the representation in situations wherein the human operator is simultaneously monitoring a number of variables offered to him by separate displays. There is need for representing his switching function among displays, this in addition to his tracking function on each individual display. Then, too, it is important to examine the dependency of the finite-state machine behavior of the human operator as he reflects different transfer properties of the equipment system under his control. There is also the question of the degree of universality of this representation; that is to say, presumably given a sufficient time history of human performance, it should be possible to achieve a sufficiently precise representation of the individual to characterize this person and no other. On the other hand, it should be possible to find finite-state machines which are of lesser complexity, and thus become more appropriate for modeling of a class of operators rather than a single individual. Further research in this direction is in order.

Motivation for further studies may also be found in the possibility of objectively determining the human operator's goal on the basis of his exhibited behavior, this goal being distinct from the goal he is instructed to follow and possibly even the goal he believes he is following This technique may

then be used for evaluating alternative displays, for assessing the degree of capability of trainees, for designing optimal training sequences and instruction, and for the design of control systems for complex man-machine mechanisms.

Decision Science, Inc.

San Diego, California, October 23, 1967

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TABLE 1

INITIAL 15-STATE FINITE MACHINE OF EXP. 1

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0
1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
2	1	0	2	1	0	2	1	0	2	1	0	2	1	0	2	1	0	2	1	0	2	1	0
3	1	0	3	1	0	3	1	0	3	1	0	3	1	0	3	1	0	3	1	0	3	1	0
4	1	0	4	1	0	4	1	0	4	1	0	4	1	0	4	1	0	4	1	0	4	1	0
5	2	0	5	2	0	5	2	0	5	2	0	5	2	0	5	2	0	5	2	0	5	2	0
6	2	0	6	2	0	6	2	0	6	2	0	6	2	0	6	2	0	6	2	0	6	2	0
7	2	0	7	2	0	7	2	0	7	2	0	7	2	0	7	2	0	7	2	0	7	2	0
8	2	0	8	2	0	8	2	0	8	2	0	8	2	0	8	2	0	8	2	0	8	2	0
9	2	0	9	2	0	9	2	0	9	2	0	9	2	0	9	2	0	9	2	0	9	2	0
10	3	0	10	3	0	10	3	0	10	3	0	10	3	0	10	3	0	10	3	0	10	3	0
11	3	0	11	3	0	11	3	0	11	3	0	11	3	0	11	3	0	11	3	0	11	3	0
12	3	0	12	3	0	12	3	0	12	3	0	12	3	0	12	3	0	12	3	0	12	3	0
13	3	0	13	3	0	13	3	0	13	3	0	13	3	0	13	3	0	13	3	0	13	3	0
14	4	0	14	4	0	14	4	0	14	4	0	14	4	0	14	4	0	14	4	0	14	4	0
15	4	0	15	4	0	15	4	0	15	4	0	15	4	0	15	4	0	15	4	0	15	4	0
16	4	0	16	4	0	16	4	0	16	4	0	16	4	0	16	4	0	16	4	0	16	4	0
17	4	0	17	4	0	17	4	0	17	4	0	17	4	0	17	4	0	17	4	0	17	4	0
18	5	0	18	5	0	18	5	0	18	5	0	18	5	0	18	5	0	18	5	0	18	5	0
19	5	0	19	5	0	19	5	0	19	5	0	19	5	0	19	5	0	19	5	0	19	5	0
20	5	0	20	5	0	20	5	0	20	5	0	20	5	0	20	5	0	20	5	0	20	5	0
21	5	0	21	5	0	21	5	0	21	5	0	21	5	0	21	5	0	21	5	0	21	5	0
22	6	0	22	6	0	22	6	0	22	6	0	22	6	0	22	6	0	22	6	0	22	6	0
23	6	0	23	6	0	23	6	0	23	6	0	23	6	0	23	6	0	23	6	0	23	6	0
24	6	0	24	6	0	24	6	0	24	6	0	24	6	0	24	6	0	24	6	0	24	6	0
25	6	0	25	6	0	25	6	0	25	6	0	25	6	0	25	6	0	25	6	0	25	6	0
26	7	0	26	7	0	26	7	0	26	7	0	26	7	0	26	7	0	26	7	0	26	7	0
27	7	0	27	7	0	27	7	0	27	7	0	27	7	0	27	7	0	27	7	0	27	7	0
28	7	0	28	7	0	28	7	0	28	7	0	28	7	0	28	7	0	28	7	0	28	7	0
29	7	0	29	7	0	29	7	0	29	7	0	29	7	0	29	7	0	29	7	0	29	7	0
30	8	0	30	8	0	30	8	0	30	8	0	30	8	0	30	8	0	30	8	0	30	8	0
31	8	0	31	8	0	31	8	0	31	8	0	31	8	0	31	8	0	31	8	0	31	8	0

TABLE 1 - CONTINUED

INITIAL 15-STATE FINITE MACHINE OF EXP. 1

32	8	0	32	8	0	32	8	0	32	8	0	32	8	0	32	8	0	32	8	0	32	8	0
33	8	0	33	8	0	33	8	0	33	8	0	33	8	0	33	8	0	33	8	0	33	8	0
34	9	0	34	9	0	34	9	0	34	9	0	34	9	0	34	9	0	34	9	0	34	9	0
35	9	0	35	9	0	35	9	0	35	9	0	35	9	0	35	9	0	35	9	0	35	9	0
36	9	0	36	9	0	36	9	0	36	9	0	36	9	0	36	9	0	36	9	0	36	9	0
37	9	0	37	9	0	37	9	0	37	9	0	37	9	0	37	9	0	37	9	0	37	9	0
38	10	0	38	10	0	38	10	0	38	10	0	38	10	0	38	10	0	38	10	0	38	10	0
39	10	0	39	10	0	39	10	0	39	10	0	39	10	0	39	10	0	39	10	0	39	10	0
40	10	0	40	10	0	40	10	0	40	10	0	40	10	0	40	10	0	40	10	0	40	10	0
41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0
42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0
43	11	0	43	11	0	43	11	0	43	11	0	43	11	0	43	11	0	43	11	0	43	11	0
44	11	0	44	11	0	44	11	0	44	11	0	44	11	0	44	11	0	44	11	0	44	11	0
45	11	0	45	11	0	45	11	0	45	11	0	45	11	0	45	11	0	45	11	0	45	11	0
46	12	0	46	12	0	46	12	0	46	12	0	46	12	0	46	12	0	46	12	0	46	12	0
47	12	0	47	12	0	47	12	0	47	12	0	47	12	0	47	12	0	47	12	0	47	12	0
48	12	0	48	12	0	48	12	0	48	12	0	48	12	0	48	12	0	48	12	0	48	12	0
49	12	0	49	12	0	49	12	0	49	12	0	49	12	0	49	12	0	49	12	0	49	12	0
50	13	0	50	13	0	50	13	0	50	13	0	50	13	0	50	13	0	50	13	0	50	13	0
51	13	0	51	13	0	51	13	0	51	13	0	51	13	0	51	13	0	51	13	0	51	13	0
52	13	0	52	13	0	52	13	0	52	13	0	52	13	0	52	13	0	52	13	0	52	13	0
53	13	0	53	13	0	53	13	0	53	13	0	53	13	0	53	13	0	53	13	0	53	13	0
54	14	0	54	14	0	54	14	0	54	14	0	54	14	0	54	14	0	54	14	0	54	14	0
55	14	0	55	14	0	55	14	0	55	14	0	55	14	0	55	14	0	55	14	0	55	14	0
56	14	0	56	14	0	56	14	0	56	14	0	56	14	0	56	14	0	56	14	0	56	14	0
57	14	0	57	14	0	57	14	0	57	14	0	57	14	0	57	14	0	57	14	0	57	14	0
58	14	0	58	14	0	58	14	0	58	14	0	58	14	0	58	14	0	58	14	0	58	14	0
59	15	0	59	15	0	59	15	0	59	15	0	59	15	0	59	15	0	59	15	0	59	15	0
60	15	0	60	15	0	60	15	0	60	15	0	60	15	0	60	15	0	60	15	0	60	15	0
61	15	0	61	15	0	61	15	0	61	15	0	61	15	0	61	15	0	61	15	0	61	15	0
62	15	0	62	15	0	62	15	0	62	15	0	62	15	0	62	15	0	62	15	0	62	15	0
63	15	0	63	15	0	63	15	0	63	15	0	63	15	0	63	15	0	63	15	0	63	15	0

TABLE 1 - CONTINUED

INITIAL 15-STATE FINITE MACHINE OF EXP. 1

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0
1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
2	1	0	2	1	0	2	1	0	2	1	0	2	1	0	2	1	0	2	1	0
3	1	0	3	1	0	3	1	0	3	1	0	3	1	0	3	1	0	3	1	0
4	1	0	4	1	0	4	1	0	4	1	0	4	1	0	4	1	0	4	1	0
5	2	0	5	2	0	5	2	0	5	2	0	5	2	0	5	2	0	5	2	0
6	2	0	6	2	0	6	2	0	6	2	0	6	2	0	6	2	0	6	2	0
7	2	0	7	2	0	7	2	0	7	2	0	7	2	0	7	2	0	7	2	0
8	2	0	8	2	0	8	2	0	8	2	0	8	2	0	8	2	0	8	2	0
9	2	0	9	2	0	9	2	0	9	2	0	9	2	0	9	2	0	9	2	0
10	3	0	10	3	0	10	3	0	10	3	0	10	3	0	10	3	0	10	3	0
11	3	0	11	3	0	11	3	0	11	3	0	11	3	0	11	3	0	11	3	0
12	3	0	12	3	0	12	3	0	12	3	0	12	3	0	12	3	0	12	3	0
13	3	0	13	3	0	13	3	0	13	3	0	13	3	0	13	3	0	13	3	0
14	4	0	14	4	0	14	4	0	14	4	0	14	4	0	14	4	0	14	4	0
15	4	0	15	4	0	15	4	0	15	4	0	15	4	0	15	4	0	15	4	0
16	4	0	16	4	0	16	4	0	16	4	0	16	4	0	16	4	0	16	4	0
17	4	0	17	4	0	17	4	0	17	4	0	17	4	0	17	4	0	17	4	0
18	5	0	18	5	0	18	5	0	18	5	0	18	5	0	18	5	0	18	5	0
19	5	0	19	5	0	19	5	0	19	5	0	19	5	0	19	5	0	19	5	0
20	5	0	20	5	0	20	5	0	20	5	0	20	5	0	20	5	0	20	5	0
21	5	0	21	5	0	21	5	0	21	5	0	21	5	0	21	5	0	21	5	0
22	6	0	22	6	0	22	6	0	22	6	0	22	6	0	22	6	0	22	6	0
23	6	0	23	6	0	23	6	0	23	6	0	23	6	0	23	6	0	23	6	0
24	6	0	24	6	0	24	6	0	24	6	0	24	6	0	24	6	0	24	6	0
25	6	0	25	6	0	25	6	0	25	6	0	25	6	0	25	6	0	25	6	0
26	7	0	26	7	0	26	7	0	26	7	0	26	7	0	26	7	0	26	7	0
27	7	0	27	7	0	27	7	0	27	7	0	27	7	0	27	7	0	27	7	0
28	7	0	28	7	0	28	7	0	28	7	0	28	7	0	28	7	0	28	7	0
29	7	0	29	7	0	29	7	0	29	7	0	29	7	0	29	7	0	29	7	0
30	8	0	30	8	0	30	8	0	30	8	0	30	8	0	30	8	0	30	8	0
31	8	0	31	8	0	31	8	0	31	8	0	31	8	0	31	8	0	31	8	0

TABLE 1 - CONCLUDED

INITIAL 15-STATE FINITE MACHINE OF EXP. 1

32	8	0	32	8	0	32	8	0	32	8	0	32	8	0	32	8	0	32	8	0	32	8	0
33	8	0	33	8	0	33	8	0	33	8	0	33	8	0	33	8	0	33	8	0	33	8	0
34	9	0	34	9	0	34	9	0	34	9	0	34	9	0	34	9	0	34	9	0	34	9	0
35	9	0	35	9	0	35	9	0	35	9	0	35	9	0	35	9	0	35	9	0	35	9	0
36	9	0	36	9	0	36	9	0	36	9	0	36	9	0	36	9	0	36	9	0	36	9	0
37	9	0	37	9	0	37	9	0	37	9	0	37	9	0	37	9	0	37	9	0	37	9	0
38	10	0	38	10	0	38	10	0	38	10	0	38	10	0	38	10	0	38	10	0	38	10	0
39	10	0	39	10	0	39	10	0	39	10	0	39	10	0	39	10	0	39	10	0	39	10	0
40	10	0	40	10	0	40	10	0	40	10	0	40	10	0	40	10	0	40	10	0	40	10	0
41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0
42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0
43	11	0	43	11	0	43	11	0	43	11	0	43	11	0	43	11	0	43	11	0	43	11	0
44	11	0	44	11	0	44	11	0	44	11	0	44	11	0	44	11	0	44	11	0	44	11	0
45	11	0	45	11	0	45	11	0	45	11	0	45	11	0	45	11	0	45	11	0	45	11	0
46	12	0	46	12	0	46	12	0	46	12	0	46	12	0	46	12	0	46	12	0	46	12	0
47	12	0	47	12	0	47	12	0	47	12	0	47	12	0	47	12	0	47	12	0	47	12	0
48	12	0	48	12	0	48	12	0	48	12	0	48	12	0	48	12	0	48	12	0	48	12	0
49	12	0	49	12	0	49	12	0	49	12	0	49	12	0	49	12	0	49	12	0	49	12	0
50	13	0	50	13	0	50	13	0	50	13	0	50	13	0	50	13	0	50	13	0	50	13	0
51	13	0	51	13	0	51	13	0	51	13	0	51	13	0	51	13	0	51	13	0	51	13	0
52	13	0	52	13	0	52	13	0	52	13	0	52	13	0	52	13	0	52	13	0	52	13	0
53	13	0	53	13	0	53	13	0	53	13	0	53	13	0	53	13	0	53	13	0	53	13	0
54	14	0	54	14	0	54	14	0	54	14	0	54	14	0	54	14	0	54	14	0	54	14	0
55	14	0	55	14	0	55	14	0	55	14	0	55	14	0	55	14	0	55	14	0	55	14	0
56	14	0	56	14	0	56	14	0	56	14	0	56	14	0	56	14	0	56	14	0	56	14	0
57	14	0	57	14	0	57	14	0	57	14	0	57	14	0	57	14	0	57	14	0	57	14	0
58	14	0	58	14	0	58	14	0	58	14	0	58	14	0	58	14	0	58	14	0	58	14	0
59	15	0	59	15	0	59	15	0	59	15	0	59	15	0	59	15	0	59	15	0	59	15	0
60	15	0	60	15	0	60	15	0	60	15	0	60	15	0	60	15	0	60	15	0	60	15	0
61	15	0	61	15	0	61	15	0	61	15	0	61	15	0	61	15	0	61	15	0	61	15	0
62	15	0	62	15	0	62	15	0	62	15	0	62	15	0	62	15	0	62	15	0	62	15	0
63	15	0	63	15	0	63	15	0	63	15	0	63	15	0	63	15	0	63	15	0	63	15	0

TABLE 2

FINAL 15-STATE FINITE MACHINE OF EXP. 1

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	0	0	1	0	0	1	33	0	1	0	0	1	0	0	1	33	0	1	33	0	1	33
1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33
2	1	33	2	1	33	2	1	33	2	1	33	2	1	33	2	1	33	2	1	33	2	1	33
3	1	33	3	1	33	3	1	33	3	1	33	3	1	33	3	1	33	3	1	33	3	1	33
4	1	33	4	1	33	4	1	33	4	1	33	4	1	33	4	1	33	4	1	33	4	1	33
5	2	33	5	2	33	5	2	33	5	2	33	5	2	33	5	2	33	5	2	33	5	2	33
6	2	33	6	2	33	6	2	33	6	2	33	6	2	33	6	2	33	6	2	33	6	2	33
7	2	33	7	2	33	7	2	33	7	2	33	7	2	33	7	2	33	7	2	33	7	2	33
8	2	33	8	2	33	8	2	33	8	2	33	8	2	33	8	2	33	8	2	33	8	2	33
9	2	33	9	2	60	9	3	60	9	2	33	9	2	33	9	2	33	9	2	33	9	2	33
10	3	33	10	3	33	10	3	33	10	3	33	10	3	33	10	3	33	10	3	33	10	3	33
11	3	33	11	3	33	11	3	33	11	3	33	11	3	33	11	3	33	11	3	33	11	3	33
12	3	33	12	3	33	12	3	33	12	3	33	12	3	33	12	3	33	12	3	33	12	3	33
13	3	49	13	3	60	13	3	49	13	3	33	13	3	60	13	3	33	13	3	33	13	3	33
14	4	33	14	4	56	14	4	56	14	4	56	14	4	56	14	4	33	14	4	33	14	4	33
15	4	33	15	4	53	15	4	51	15	4	51	15	4	51	15	4	33	15	4	33	15	4	33
16	4	33	16	4	48	16	4	51	16	4	48	16	4	51	16	4	33	16	4	33	16	4	33
17	4	33	17	4	52	17	4	33	17	4	46	17	4	52	17	4	57	17	4	33	17	4	33
18	5	50	18	5	50	18	5	55	18	5	33	18	5	50	18	5	54	18	5	33	18	5	33
19	5	59	19	5	49	19	5	55	19	3	38	19	5	49	19	5	51	19	5	54	19	5	59
20	5	52	20	5	48	20	15	33	20	5	38	20	5	41	20	5	49	20	5	52	20	5	43
21	5	42	21	5	49	21	5	49	21	5	38	21	5	42	21	12	44	21	5	49	21	5	33
22	6	52	22	6	47	22	6	47	22	6	33	22	6	39	22	6	41	22	6	45	22	6	52
23	6	44	23	6	37	23	6	33	23	6	33	23	6	35	23	6	38	23	6	44	23	6	33
24	6	44	24	6	33	24	6	44	24	6	33	24	6	44	24	6	33	24	6	44	24	6	47
25	6	34	25	6	34	25	6	40	25	6	33	25	6	34	25	4	34	25	6	40	25	6	33
26	7	37	26	7	33	26	7	41	26	7	44	26	7	31	26	5	33	26	7	39	26	2	40
27	7	34	27	7	45	27	7	36	27	7	32	27	7	33	27	7	32	27	7	36	27	13	42
28	7	32	28	7	25	28	7	32	28	7	29	28	14	25	28	7	29	28	7	32	28	7	39
29	7	32	29	7	26	29	7	35	29	7	29	29	7	29	29	7	26	29	7	31	29	7	36
30	8	27	30	8	21	30	8	27	30	8	41	30	8	26	30	8	21	30	8	24	30	8	27
31	8	28	31	8	18	31	8	33	31	8	33	31	8	26	31	8	18	31	11	26	31	8	33

TABLE 2 - CONTINUED

FINAL 15-STATE FINITE MACHINE OF EXP. 1

32	8	29	32	8	33	32	8	26	32	8	33	32	8	24	32	8	33	32	8	25	32	8	25
33	8	27	33	8	19	33	8	26	33	8	27	33	8	19	33	8	33	33	8	19	33	8	24
34	9	25	34	9	19	34	9	25	34	9	34	34	9	19	34	9	33	34	9	19	34	9	25
35	9	23	35	9	33	35	9	25	35	9	30	35	9	14	35	9	33	35	9	14	35	9	21
36	9	12	36	9	24	36	9	19	36	9	26	36	9	20	36	9	33	36	9	12	36	9	20
37	9	21	37	9	33	37	9	20	37	9	26	37	9	33	37	9	33	37	9	19	37	9	19
38	10	21	38	10	29	38	10	19	38	10	25	38	10	19	38	10	33	38	10	33	38	10	10
39	10	15	39	10	15	39	10	14	39	10	21	39	10	15	39	10	33	39	10	33	39	10	12
40	10	22	40	10	24	40	10	15	40	10	20	40	10	17	40	10	33	40	10	33	40	10	17
41	10	33	41	10	26	41	10	10	41	10	21	41	10	33	41	10	33	41	10	33	41	10	33
42	11	16	42	11	33	42	11	8	42	11	15	42	11	13	42	11	33	42	11	33	42	11	33
43	11	14	43	11	33	43	11	14	43	11	14	43	11	33	43	11	33	43	11	33	43	11	33
44	11	33	44	11	33	44	11	11	44	11	6	44	11	6	44	11	33	44	11	33	44	11	33
45	11	14	45	11	33	45	11	17	45	11	7	45	11	33	45	11	33	45	11	33	45	11	33
46	12	9	46	12	12	46	12	12	46	12	7	46	12	3	46	12	33	46	12	33	46	12	33
47	12	33	47	12	33	47	12	33	47	12	33	47	12	33	47	12	33	47	12	33	47	12	33
48	12	33	48	12	14	48	12	14	48	12	14	48	12	14	48	12	33	48	12	33	48	12	33
49	12	33	49	12	6	49	12	9	49	12	9	49	12	33	49	12	33	49	12	33	49	12	6
50	13	33	50	13	33	50	13	33	50	13	33	50	13	33	50	13	33	50	13	33	50	13	33
51	13	1	51	13	5	51	13	33	51	13	1	51	13	5	51	13	33	51	13	33	51	13	33
52	13	33	52	13	33	52	13	33	52	13	33	52	13	33	52	13	33	52	13	33	52	13	33
53	13	33	53	13	33	53	13	33	53	13	33	53	13	33	53	13	33	53	13	33	53	13	33
54	14	33	54	14	33	54	14	33	54	14	33	54	14	33	54	14	33	54	14	33	54	14	33
55	14	33	55	14	33	55	14	33	55	14	33	55	14	33	55	14	33	55	14	33	55	14	33
56	14	33	56	14	33	56	14	33	56	14	33	56	14	33	56	14	33	56	14	33	56	14	33
57	14	33	57	14	33	57	14	33	57	14	33	57	14	33	57	14	33	57	14	33	57	14	33
58	14	33	58	14	33	58	14	33	58	14	33	58	14	33	58	14	33	58	14	33	58	14	33
59	15	33	59	15	33	59	15	33	59	15	33	59	15	33	59	15	33	59	15	33	59	15	33
60	15	33	60	15	33	60	15	33	60	15	33	60	15	33	60	15	33	60	15	33	60	15	33
61	15	33	61	15	33	61	15	33	61	15	33	61	15	33	61	15	33	61	15	33	61	15	33
62	15	24	62	15	33	62	15	33	62	15	24	62	15	24	62	15	33	62	15	33	62	15	33
63	15	33	63	15	63	63	15	63	63	15	24	63	15	24	63	15	33	63	15	33	63	15	63

TABLE 2 - CONTINUED

FINAL 15-STATE FINITE MACHINE OF EXP. 1

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	33	0	1	33	0	1	0	0	1	0	0	1	33	0	1	33	0	1	0
1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33
2	1	33	2	1	33	2	1	33	2	1	33	2	1	33	2	1	33	2	1	33
3	1	33	3	1	33	3	1	33	3	1	33	3	1	33	3	1	33	3	1	33
4	1	33	4	1	33	4	1	33	4	1	33	4	1	33	4	1	33	4	1	33
5	2	33	5	2	33	5	2	33	5	2	33	5	2	33	5	2	33	5	2	33
6	2	33	6	2	33	6	2	33	6	2	33	6	2	33	6	2	33	6	2	33
7	2	33	7	2	33	7	2	33	7	2	33	7	2	33	7	2	33	7	2	33
8	2	33	8	2	33	8	2	33	8	2	33	8	2	33	8	2	33	8	2	33
9	2	33	9	2	33	9	2	33	9	2	33	9	2	33	9	2	33	9	2	33
10	3	33	10	3	33	10	3	33	10	3	33	10	3	33	10	3	33	10	3	33
11	3	33	11	3	33	11	3	33	11	3	33	11	3	33	11	3	33	11	3	33
12	3	33	12	3	33	12	3	33	12	3	33	12	3	33	12	3	33	12	3	33
13	3	33	13	3	33	13	3	33	13	3	49	13	3	49	13	3	33	13	3	33
14	4	33	14	4	33	14	4	33	14	4	33	14	4	33	14	4	33	14	4	33
15	4	33	15	4	53	15	4	33	15	4	33	15	4	33	15	4	33	15	4	33
16	4	33	16	4	33	16	4	33	16	4	33	16	4	33	16	4	33	16	4	33
17	4	33	17	4	33	17	4	33	17	4	33	17	4	33	17	4	33	17	4	57
18	5	33	18	5	50	18	5	33	18	5	33	18	5	33	18	5	33	18	5	54
19	5	33	19	5	33	19	5	33	19	5	33	19	5	33	19	5	33	19	5	33
20	5	33	20	5	33	20	5	43	20	5	45	20	5	33	20	5	48	20	5	33
21	5	33	21	5	33	21	5	33	21	5	42	21	5	33	21	5	49	21	5	33
22	6	33	22	6	33	22	6	39	22	6	33	22	6	33	22	6	47	22	6	33
23	6	33	23	6	33	23	6	33	23	6	33	23	6	45	23	6	33	23	6	33
24	6	33	24	6	33	24	6	33	24	6	33	24	6	48	24	6	33	24	6	33
25	6	48	25	6	33	25	6	33	25	6	33	25	6	33	25	6	33	25	6	33
26	7	50	26	7	33	26	7	33	26	7	33	26	7	42	26	7	33	26	7	33
27	7	43	27	7	33	27	7	33	27	7	33	27	7	33	27	7	33	27	7	33
28	7	39	28	7	33	28	7	33	28	7	33	28	7	33	28	7	33	28	7	23
29	7	33	29	7	33	29	7	33	29	7	33	29	7	35	29	7	33	29	7	33
30	8	36	30	8	44	30	8	33	30	8	33	30	8	34	30	8	33	30	8	33
31	8	33	31	8	33	31	8	33	31	8	33	31	8	33	31	8	33	31	8	33

TABLE 2 - CONCLUDED

FINAL 15-STATE FINITE MACHINE OF EXP. 1

32	13	33	32	8	33	32	1	26	32	8	33	32	8	32	32	3	21	32	8	33
33	8	30	33	8	21	33	8	33	33	8	33	33	8	33	33	8	33	33	8	33
34	9	29	34	9	34	34	9	23	34	9	33	34	9	29	34	9	33	34	9	33
35	9	27	35	9	30	35	9	33	35	9	33	35	9	27	35	9	14	35	9	18
36	9	23	36	9	25	36	9	34	36	9	33	36	9	24	36	9	12	36	9	33
37	9	21	37	9	26	37	9	33	37	9	33	37	9	21	37	9	33	37	9	33
38	10	19	38	10	23	38	4	26	38	10	33	38	10	21	38	10	33	38	10	33
39	10	15	39	10	20	39	10	21	39	10	33	39	10	33	39	10	15	39	10	33
40	10	15	40	10	17	40	10	22	40	10	33	40	10	33	40	10	33	40	10	33
41	10	10	41	10	18	41	10	21	41	10	26	41	10	33	41	10	26	41	10	33
42	11	8	42	11	14	42	11	16	42	11	33	42	11	33	42	11	33	42	11	33
43	11	33	43	11	14	43	11	14	43	11	19	43	11	33	43	11	33	43	11	33
44	11	33	44	12	6	44	11	14	44	11	14	44	11	33	44	11	33	44	11	33
45	11	33	45	11	8	45	11	7	45	11	14	45	11	17	45	11	33	45	11	33
46	12	33	46	12	3	46	12	12	46	12	7	46	12	33	46	12	33	46	12	33
47	12	33	47	12	33	47	12	33	47	12	33	47	12	33	47	12	33	47	12	33
48	12	33	48	12	33	48	12	33	48	12	33	48	12	14	48	12	33	48	12	33
49	12	33	49	12	33	49	12	6	49	13	9	49	12	33	49	12	33	49	12	33
50	13	33	50	13	33	50	13	33	50	13	33	50	13	33	50	13	33	50	13	33
51	13	33	51	13	33	51	13	33	51	13	1	51	13	5	51	13	5	51	13	33
52	13	33	52	13	33	52	13	33	52	13	33	52	13	33	52	13	33	52	13	33
53	13	33	53	13	33	53	13	33	53	13	33	53	13	33	53	13	33	53	13	33
54	14	33	54	14	33	54	14	33	54	14	33	54	14	33	54	14	33	54	14	33
55	14	33	55	14	33	55	14	33	55	14	33	55	14	33	55	14	33	55	14	33
56	14	33	56	14	33	56	14	33	56	14	33	56	14	33	56	14	33	56	14	33
57	14	33	57	14	33	57	14	33	57	14	33	57	14	33	57	14	33	57	14	33
58	14	33	58	14	33	58	14	33	58	14	33	58	14	33	58	14	33	58	14	33
59	15	33	59	15	33	59	15	33	59	15	33	59	15	33	59	15	33	59	15	33
60	15	33	60	15	33	60	15	33	60	15	33	60	15	33	60	15	33	60	15	33
61	15	33	61	15	33	61	15	33	61	15	33	61	15	33	61	15	33	61	15	33
62	15	33	62	15	33	62	15	24	62	15	24	62	15	33	62	15	33	62	15	33
63	15	33	63	15	33	63	15	33	63	15	33	63	15	33	63	15	33	63	15	24

TABLE 3

SUMMARY OF EXPERIMENTS TO DETERMINE OPTIMUM TIME INTERVAL BETWEEN DATA SAMPLES

Exp. No.	Machine Size	Time Interval	Recall Length	Aver. Error	Remarks
1	15	.2 sec	300	1.02	Recall was not long enough to give a true picture of average score for the 5 state machine.
	5	.2 sec	300	2.36	
2	15	.04 sec	800	2.84	Round off errors become excessive.
	5	.04 sec	800	3.31	
3	31	.12 sec	800	1.49	Too short recall for 31 state.
	5	.12 sec	800	3.06	
4	31	.2 sec	800	.955	Too short recall for 31 state.
	5	.2 sec	800	2.54	
5	31*	.2 sec	800	.745	31 state machine folded over so it is equivalent to 63 state machine. Too short recall for 31 state.
	5	.2 sec	800	2.53	
6	31*	.2 sec	4000	1.75	
	5	.2 sec	4000	3.275	
8	31*	.12 sec	4000	1.52	
	5	.12 sec	4000	3.14	
10	31*	.08 sec	4000	1.535	Adjusted quantizing scale on input.
	5	.08 sec	4000	3.07	

* Denotes equivalent 63 state machine

PRECEDING PAGE BLANK NOT FILMED.

TABLE 4
INITIAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 5

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0
1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0
3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0
4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0
5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0
6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0
7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0
8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0
9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0
10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0
11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0
12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0
13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0
14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0
15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0
16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0
17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0
18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0
19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0
20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0
21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0
22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0
23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0
24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0
25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0
26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0
27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0
28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0
29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0
30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0
31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0

TABLE 4 - CONTINUED

INITIAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 5

32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0
33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0
34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0
35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0
36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0
37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0
38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0
39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0
40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0
41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0
42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0
43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0
44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0
45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0
46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0
47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0
48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0
49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0
50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0
51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0
52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0
53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0
54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0
55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0
56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0
57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0
58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0
59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0
60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0
61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0
62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0
63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0

TABLE 4 - CONTINUED
INITIAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 5

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0
1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0
3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0
4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0
5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0
6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0
7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0
8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0
9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0
10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0
11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0
12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0
13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0
14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0
15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0
16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0
17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0
18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0
19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0
20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0
21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0
22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0
23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0
24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0
25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0
26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0
27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0
28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0
29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0
30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0
31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0

TABLE 4 - CONTINUED
INITIAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 5

32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0
33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0
34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0
35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0
36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0
37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0
38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0
39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0
40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0
41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0
42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0
43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0
44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0
45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0
46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0
47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0
48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0
49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0
50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0
51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0
52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0
53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0
54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0
55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0
56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0
57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0
58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0
59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0
60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0
61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0
62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0
63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0

TABLE 4 - CONTINUED
INITIAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 5

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0
1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0
3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0
4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0
5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0
6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0
7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0
8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0
9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0
10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0
11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0
12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0
13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0
14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0
15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0
16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0
17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0
18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0
19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0
20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0
21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0
22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0
23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0
24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0
25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0
26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0
27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0
28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0
29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0
30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0
31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0

TABLE 4 - CONTINUED
INITIAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 5

32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0
33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0
34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0
35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0
36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0
37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0
38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0
39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0
40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0
41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0
42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0
43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0
44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0
45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0
46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0
47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0
48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0
49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0
50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0
51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0
52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0
53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0
54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0
55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0
56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0
57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0
58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0
59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0
60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0
61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0
62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0
63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0

TABLE 4 - CONTINUED
INITIAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 5

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0
1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0
3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0
4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0
5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0	5	5	0
6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0
7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0
8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0	8	8	0
9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0	9	9	0
10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0
11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0
12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12	12	0
13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	13	0
14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0	14	14	0
15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0
16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0	16	16	0
17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0	17	17	0
18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18	18	0
19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0	19	19	0
20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0
21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0	21	21	0
22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0	22	22	0
23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0	23	23	0
24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0	24	24	0
25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0
26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0	26	26	0
27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0
28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0	28	28	0
29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0	29	29	0
30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0
31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0	31	31	0

TABLE 4 - CONCLUDED
INITIAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 5

32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0	32	1	0
33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0	33	2	0
34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0	34	3	0
35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0	35	4	0
36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0	36	5	0
37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0	37	6	0
38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0	38	7	0
39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0	39	8	0
40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0	40	9	0
41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0	41	10	0
42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0	42	11	0
43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0	43	12	0
44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0	44	13	0
45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0	45	14	0
46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0	46	15	0
47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0	47	16	0
48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0	48	17	0
49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0	49	18	0
50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0	50	19	0
51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0	51	20	0
52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0	52	21	0
53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0	53	22	0
54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0	54	23	0
55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0	55	24	0
56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0	56	25	0
57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0	57	26	0
58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0	58	27	0
59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0	59	28	0
60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0	60	29	0
61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0	61	30	0
62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0	62	31	0
63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0	63	1	0

TABLE 5

COMPARISON OF SCORING METHODS
FOR SETTING THE OUTPUT SYMBOLS OF THE
FINITE STATE MACHINE MODELS

Exp. No.	Scoring Method	Recall Length	Time Interval	Average Error Per Point	Cumulative Error Distribution					
					0	<1	<2	<3	<4	<5
9	Magni-tude of Error	4000	.12 sec	1.3534	33.1	61.12	81.0	92.58	97.9	99.52
11	All or None	4000	.12 sec	1,5312	36.26	57.4	75.06	86.76	94.36	98.14
12	Average of Outputs	4000	.12 sec	1.3822	24.74	60.16	83.76	94.96	98.9	99.82

PRECEDING PAGE BLANK NOT FILMED.

TABLE 6
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 9

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	33	0	1	33	0	1	60	0	1	33	0	1	33	0	1	33	0	1	33	0	1	33
1	1	33	1	1	59	1	1	59	1	1	62	1	1	33	1	1	33	1	1	33	1	1	33
2	2	33	2	2	33	2	2	58	2	2	60	2	2	33	2	2	61	2	2	63	2	2	33
3	3	55	3	3	33	3	3	57	3	3	58	3	3	33	3	3	59	3	3	61	3	3	33
4	4	55	4	4	33	4	4	52	4	4	56	4	4	33	4	4	58	4	4	57	4	4	61
5	5	52	5	5	33	5	5	51	5	5	53	5	5	33	5	5	58	5	5	55	5	5	59
6	6	33	6	6	33	6	6	50	6	6	52	6	6	55	6	6	55	6	6	53	6	6	57
7	7	33	7	7	33	7	7	49	7	7	51	7	7	48	7	7	53	7	7	52	7	7	55
8	8	33	8	8	33	8	8	48	8	8	48	8	8	46	8	8	51	8	8	53	8	8	55
9	9	33	9	9	33	9	9	45	9	9	46	9	9	44	9	9	49	9	9	48	9	9	51
10	10	33	10	10	33	10	10	45	10	10	44	10	10	43	10	10	47	10	10	47	10	10	49
11	11	33	11	11	33	11	11	33	11	11	33	11	11	42	11	11	33	11	11	42	11	11	48
12	12	33	12	12	33	12	12	33	12	12	33	12	12	33	12	12	33	12	12	41	12	12	47
13	13	33	13	13	33	13	13	33	13	13	33	13	13	33	13	13	33	13	13	41	13	13	44
14	14	33	14	14	33	14	14	33	14	14	33	14	14	33	14	14	33	14	14	33	14	14	39
15	15	33	15	15	33	15	15	33	15	15	33	15	15	33	15	15	33	15	15	33	15	15	33
16	16	33	16	16	33	16	16	33	16	16	33	16	16	33	16	16	33	16	16	33	16	16	33
17	17	33	17	17	33	17	17	33	17	17	33	17	17	33	17	17	33	17	17	33	17	17	33
18	18	33	18	18	33	18	18	33	18	18	33	18	18	33	18	18	33	18	18	33	18	18	33
19	19	33	19	19	33	19	19	33	19	19	33	19	19	33	19	19	33	19	19	33	19	19	33
20	20	33	20	20	33	20	20	33	20	20	33	20	20	33	20	20	33	20	20	33	20	20	33
21	21	33	21	21	33	21	21	33	21	21	33	21	21	33	21	21	33	21	21	33	21	21	33
22	22	33	22	22	33	22	22	33	22	22	33	22	22	33	22	22	33	22	22	33	22	22	33
23	23	50	23	23	52	23	23	33	23	23	33	23	23	33	23	23	33	23	23	33	23	23	33
24	24	47	24	24	48	24	24	53	24	24	33	24	24	33	24	24	33	24	24	33	24	24	33
25	25	44	25	25	45	25	25	49	25	25	50	25	25	33	25	25	33	25	25	33	25	25	33
26	26	42	26	26	45	26	26	44	26	26	47	26	26	33	26	26	33	26	26	33	26	26	33
27	27	41	27	27	43	27	27	43	27	27	45	27	27	45	27	27	33	27	27	33	27	27	33
28	28	41	28	28	42	28	28	42	28	28	42	28	28	43	28	28	46	28	28	45	28	28	33
29	29	38	29	29	38	29	29	40	29	29	41	29	29	40	29	29	44	29	29	42	29	29	47
30	30	34	30	30	37	30	30	36	30	30	39	30	30	40	30	30	41	30	30	40	30	30	45
31	31	33	31	31	36	31	31	36	31	31	37	31	31	38	31	31	37	31	31	42	31	31	41

TABLE 6 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 9

32	1	32	32	1	31	32	1	34	32	1	35	32	1	35	32	1	36	32	1	38	32	1	39
33	2	31	33	2	31	33	2	32	33	2	33	33	2	34	33	2	36	33	2	39	33	2	38
34	3	27	34	3	29	34	3	30	34	3	31	34	3	32	34	3	32	34	3	37	34	3	36
35	4	26	35	4	26	35	4	28	35	4	30	35	4	30	35	4	32	35	4	33	35	4	32
36	5	23	36	5	23	36	5	27	36	5	27	36	5	27	36	5	30	36	5	31	36	5	31
37	6	21	37	6	22	37	6	24	37	6	25	37	6	27	37	6	27	37	6	29	37	6	30
38	7	16	38	7	21	38	7	21	38	7	23	38	7	24	38	7	25	38	7	24	38	7	27
39	8	17	39	8	20	39	8	20	39	8	22	39	8	23	39	8	24	39	8	24	39	8	27
40	9	14	40	9	17	40	9	17	40	9	19	40	9	20	40	9	21	40	9	22	40	9	24
41	10	33	41	10	16	41	10	14	41	10	16	41	10	18	41	10	18	41	10	19	41	10	21
42	11	33	42	11	33	42	11	33	42	11	11	42	11	17	42	11	17	42	11	18	42	11	20
43	12	33	43	12	33	43	12	33	43	12	11	43	12	11	43	12	16	43	12	16	43	12	18
44	13	33	44	13	33	44	13	33	44	13	33	44	13	33	44	13	16	44	13	13	44	13	14
45	14	33	45	14	33	45	14	33	45	14	33	45	14	33	45	14	11	45	14	12	45	14	12
46	15	33	46	15	33	46	15	33	46	15	33	46	15	33	46	15	7	46	15	9	46	15	12
47	16	33	47	16	33	47	16	33	47	16	33	47	16	33	47	16	33	47	16	6	47	16	9
48	17	33	48	17	33	48	17	33	48	17	33	48	17	33	48	17	33	48	17	33	48	17	7
49	18	33	49	18	33	49	18	33	49	18	33	49	18	33	49	18	33	49	18	33	49	18	33
50	19	33	50	19	33	50	19	33	50	19	33	50	19	33	50	19	33	50	19	33	50	19	33
51	20	33	51	20	33	51	20	33	51	20	33	51	20	33	51	20	33	51	20	33	51	20	33
52	21	33	52	21	33	52	21	33	52	21	33	52	21	33	52	21	33	52	21	33	52	21	33
53	22	33	53	22	33	53	22	33	53	22	33	53	22	33	53	22	33	53	22	33	53	22	33
54	23	33	54	23	33	54	23	33	54	23	33	54	23	33	54	23	33	54	23	33	54	23	33
55	24	33	55	24	33	55	24	33	55	24	33	55	24	33	55	24	33	55	24	33	55	24	33
56	25	33	56	25	33	56	25	33	56	25	33	56	25	33	56	25	33	56	25	33	56	25	33
57	26	33	57	26	33	57	26	33	57	26	33	57	26	33	57	26	33	57	26	33	57	26	33
58	27	33	58	27	33	58	27	33	58	27	33	58	27	33	58	27	33	58	27	33	58	27	33
59	28	15	59	28	33	59	28	33	59	28	33	59	28	33	59	28	33	59	28	33	59	28	33
60	29	13	60	29	33	60	29	33	60	29	33	60	29	33	60	29	33	60	29	33	60	29	33
61	30	12	61	30	33	61	30	33	61	30	33	61	30	33	61	30	33	61	30	33	61	30	33
62	31	8	62	31	33	62	31	33	62	31	33	62	31	33	62	31	33	62	31	33	62	31	33
63	1	3	63	1	33	63	1	33	63	1	33	63	1	33	63	1	33	63	1	33	63	1	33

TABLE 6 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 9

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	33	0	1	33	0	1	33	0	1	33	0	1	33	0	1	33	0	1	33	0	1	33
1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33
2	2	33	2	2	33	2	2	33	2	2	33	2	2	33	2	2	33	2	2	33	2	2	33
3	3	33	3	3	33	3	3	33	3	3	33	3	3	33	3	3	33	3	3	33	3	3	33
4	4	63	4	4	63	4	4	33	4	4	33	4	4	33	4	4	33	4	4	33	4	4	33
5	5	59	5	5	61	5	5	33	5	5	33	5	5	33	5	5	33	5	5	33	5	5	33
6	6	60	6	6	60	6	6	61	6	6	60	6	6	63	6	6	33	6	6	33	6	6	33
7	7	58	7	7	57	7	7	60	7	7	57	7	7	60	7	7	33	7	7	62	7	7	33
8	8	53	8	8	53	8	8	61	8	8	56	8	8	59	8	8	33	8	8	59	8	8	33
9	9	52	9	9	55	9	9	55	9	9	55	9	9	57	9	9	57	9	9	59	9	9	59
10	10	51	10	10	51	10	10	51	10	10	33	10	10	55	10	10	55	10	10	33	10	10	58
11	11	50	11	11	43	11	11	50	11	11	51	11	11	50	11	11	53	11	11	57	11	11	33
12	12	47	12	12	45	12	12	46	12	12	47	12	12	48	12	12	51	12	12	52	12	12	54
13	13	45	13	13	46	13	13	45	13	13	49	13	13	46	13	13	47	13	13	48	13	13	50
14	14	42	14	14	39	14	14	46	14	14	42	14	14	46	14	14	47	14	14	45	14	14	48
15	15	39	15	15	38	15	15	39	15	15	43	15	15	44	15	15	45	15	15	48	15	15	47
16	16	36	16	16	40	16	16	36	16	16	44	16	16	42	16	16	43	16	16	44	16	16	46
17	17	33	17	17	37	17	17	33	17	17	40	17	17	41	17	17	41	17	17	43	17	17	41
18	18	33	18	18	34	18	18	33	18	18	33	18	18	38	18	18	41	18	18	38	18	18	41
19	19	33	19	19	33	19	19	33	19	19	33	19	19	33	19	19	37	19	19	36	19	19	39
20	20	33	20	20	33	20	20	33	20	20	33	20	20	34	20	20	33	20	20	32	20	20	37
21	21	33	21	21	33	21	21	33	21	21	33	21	21	30	21	21	33	21	21	35	21	21	37
22	22	33	22	22	33	22	22	33	22	22	33	22	22	33	22	22	33	22	22	31	22	22	31
23	23	33	23	23	33	23	23	33	23	23	33	23	23	33	23	23	33	23	23	33	23	23	31
24	24	33	24	24	33	24	24	33	24	24	33	24	24	33	24	24	33	24	24	33	24	24	33
25	25	33	25	25	33	25	25	33	25	25	33	25	25	33	25	25	33	25	25	33	25	25	27
26	26	33	26	26	33	26	26	33	26	26	33	26	26	33	26	26	33	26	26	33	26	26	33
27	27	33	27	27	33	27	27	33	27	27	33	27	27	33	27	27	33	27	27	33	27	27	33
28	28	33	28	28	33	28	28	33	28	28	33	28	28	33	28	28	33	28	28	33	28	28	33
29	29	48	29	29	33	29	29	33	29	29	33	29	29	33	29	29	33	29	29	33	29	29	33
30	30	45	30	30	33	30	30	33	30	30	33	30	30	33	30	30	33	30	30	33	30	30	33
31	31	43	31	31	33	31	31	33	31	31	33	31	31	33	31	31	33	31	31	33	31	31	33

TABLE 6 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 9

32	1	40	32	1	41	32	1	33	32	1	33	32	1	33	32	1	33	32	1	33	32	1	33
33	2	38	33	2	39	33	2	43	33	2	33	33	2	33	33	2	33	33	2	33	33	2	33
34	3	37	34	3	38	34	3	39	34	3	33	34	3	33	34	3	43	34	3	33	34	3	33
35	4	34	35	4	36	35	4	38	35	4	38	35	4	40	35	4	41	35	4	33	35	4	33
36	5	32	36	5	35	36	5	35	36	5	34	36	5	38	36	5	39	36	5	33	36	5	33
37	6	32	37	6	31	37	6	34	37	6	35	37	6	36	37	6	37	37	6	33	37	6	33
38	7	29	38	7	29	38	7	32	38	7	32	38	7	35	38	7	33	38	7	33	38	7	33
39	8	27	39	8	27	39	8	29	39	8	31	39	8	31	39	8	32	39	8	33	39	8	36
40	9	26	40	9	26	40	9	27	40	9	28	40	9	30	40	9	31	40	9	32	40	9	33
41	10	22	41	10	24	41	10	25	41	10	26	41	10	27	41	10	29	41	10	29	41	10	31
42	11	21	42	11	22	42	11	24	42	11	24	42	11	25	42	11	28	42	11	28	42	11	29
43	12	18	43	12	20	43	12	22	43	12	21	43	12	23	43	12	25	43	12	26	43	12	28
44	13	17	44	13	19	44	13	19	44	13	21	44	13	21	44	13	22	44	13	26	44	13	25
45	14	12	45	14	15	45	14	17	45	14	18	45	14	19	45	14	20	45	14	22	45	14	24
46	15	13	46	15	14	46	15	14	46	15	15	46	15	18	46	15	19	46	15	20	46	15	20
47	16	10	47	16	9	47	16	13	47	16	14	47	16	16	47	16	16	47	16	18	47	16	18
48	17	33	48	17	9	48	17	12	48	17	12	48	17	11	48	17	16	48	17	16	48	17	16
49	18	33	49	18	8	49	18	33	49	18	10	49	18	12	49	18	11	49	18	14	49	18	14
50	19	33	50	19	33	50	19	33	50	19	7	50	19	11	50	19	10	50	19	12	50	19	14
51	20	33	51	20	33	51	20	33	51	20	33	51	20	11	51	20	8	51	20	9	51	20	11
52	21	33	52	21	33	52	21	33	52	21	33	52	21	33	52	21	6	52	21	8	52	21	8
53	22	33	53	22	33	53	22	33	53	22	33	53	22	33	53	22	33	53	22	3	53	22	7
54	23	33	54	23	33	54	23	33	54	23	33	54	23	33	54	23	33	54	23	33	54	23	33
55	24	33	55	24	33	55	24	33	55	24	33	55	24	33	55	24	33	55	24	33	55	24	1
56	25	33	56	25	33	56	25	33	56	25	33	56	25	33	56	25	33	56	25	33	56	25	33
57	26	33	57	26	33	57	26	33	57	26	33	57	26	33	57	26	33	57	26	33	57	26	33
58	27	33	58	27	33	58	27	33	58	27	33	58	27	33	58	27	33	58	27	33	58	27	33
59	28	33	59	28	33	59	28	33	59	28	33	59	28	33	59	28	33	59	28	33	59	28	33
60	29	33	60	29	33	60	29	33	60	29	33	60	29	33	60	29	33	60	29	33	60	29	33
61	30	33	61	30	33	61	30	33	61	30	33	61	30	33	61	30	33	61	30	33	61	30	33
62	31	33	62	31	33	62	31	33	62	31	33	62	31	33	62	31	33	62	31	33	62	31	33
63	1	33	63	1	33	63	1	33	63	1	33	63	1	33	63	1	33	63	1	33	63	1	33

TABLE 6 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 9

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	33	0	1	33	0	1	33	0	1	33	0	1	33	0	1	33	0	1	33	0	1	33
1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33
2	2	33	2	2	33	2	2	33	2	2	33	2	2	33	2	2	33	2	2	33	2	2	33
3	3	33	3	3	33	3	3	33	3	3	33	3	3	33	3	3	33	3	3	33	3	3	33
4	4	33	4	4	33	4	4	33	4	4	33	4	4	33	4	4	33	4	4	33	4	4	33
5	5	33	5	5	33	5	5	33	5	5	33	5	5	33	5	5	33	5	5	33	5	5	33
6	6	33	6	6	33	6	6	33	6	6	33	6	6	33	6	6	33	6	6	33	6	6	33
7	7	33	7	7	33	7	7	33	7	7	33	7	7	33	7	7	33	7	7	33	7	7	33
8	8	33	8	8	33	8	8	33	8	8	33	8	8	33	8	8	33	8	8	33	8	8	33
9	9	33	9	9	33	9	9	33	9	9	33	9	9	33	9	9	33	9	9	33	9	9	33
10	10	33	10	10	61	10	10	33	10	10	33	10	10	33	10	10	33	10	10	33	10	10	33
11	11	33	11	11	57	11	11	60	11	11	33	11	11	33	11	11	33	11	11	33	11	11	33
12	12	55	12	12	57	12	12	57	12	12	59	12	12	33	12	12	33	12	12	33	12	12	33
13	13	51	13	13	55	13	13	55	13	13	56	13	13	33	13	13	33	13	13	60	13	13	33
14	14	50	14	14	52	14	14	51	14	14	56	14	14	56	14	14	57	14	14	59	14	14	33
15	15	48	15	15	48	15	15	52	15	15	51	15	15	33	15	15	54	15	15	58	15	15	60
16	16	46	16	16	48	16	16	47	16	16	53	16	16	51	16	16	52	16	16	55	16	16	53
17	17	45	17	17	45	17	17	48	17	17	48	17	17	49	17	17	51	17	17	50	17	17	52
18	18	45	18	18	43	18	18	44	18	18	47	18	18	48	18	18	47	18	18	49	18	18	51
19	19	41	19	19	43	19	19	44	19	19	45	19	19	47	19	19	46	19	19	48	19	19	49
20	20	38	20	20	38	20	20	40	20	20	43	20	20	44	20	20	45	20	20	44	20	20	45
21	21	40	21	21	37	21	21	40	21	21	40	21	21	41	21	21	43	21	21	43	21	21	44
22	22	36	22	22	35	22	22	37	22	22	38	22	22	38	22	22	40	22	22	40	22	22	42
23	23	33	23	23	34	23	23	36	23	23	35	23	23	37	23	23	37	23	23	38	23	23	40
24	24	33	24	24	32	24	24	33	24	24	34	24	24	35	24	24	36	24	24	36	24	24	37
25	25	33	25	25	29	25	25	33	25	25	32	25	25	33	25	25	34	25	25	36	25	25	37
26	26	33	26	26	24	26	26	29	26	26	31	26	26	32	26	26	30	26	26	36	26	26	34
27	27	33	27	27	23	27	27	28	27	27	28	27	27	27	27	27	32	27	27	31	27	27	31
28	28	33	28	28	22	28	28	33	28	28	24	28	28	23	28	28	25	28	28	29	28	28	32
29	29	33	29	29	33	29	29	33	29	29	33	29	29	33	29	29	24	29	29	29	29	29	26
30	30	33	30	30	33	30	30	33	30	30	33	30	30	33	30	30	24	30	30	25	30	30	26
31	31	33	31	31	33	31	31	33	31	31	33	31	31	33	31	31	24	31	31	22	31	31	24

TABLE 6 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 9

32	1	33	32	1	33	32	1	33	32	1	33	32	1	33	32	1	33	32	1	21	32	1	22
33	2	33	33	2	33	33	2	33	33	2	33	33	2	33	33	2	33	33	2	33	33	2	33
34	3	33	34	3	33	34	3	33	34	3	33	34	3	33	34	3	33	34	3	33	34	3	33
35	4	33	35	4	33	35	4	33	35	4	33	35	4	33	35	4	33	35	4	33	35	4	33
36	5	33	36	5	33	36	5	33	36	5	33	36	5	33	36	5	33	36	5	33	36	5	33
37	6	33	37	6	33	37	6	33	37	6	33	37	6	33	37	6	33	37	6	33	37	6	33
38	7	33	38	7	33	38	7	33	38	7	33	38	7	33	38	7	33	38	7	33	38	7	33
39	8	33	39	8	36	39	8	33	39	8	33	39	8	33	39	8	33	39	8	33	39	8	33
40	9	34	40	9	37	40	9	33	40	9	33	40	9	33	40	9	33	40	9	33	40	9	33
41	10	30	41	10	33	41	10	33	41	10	33	41	10	33	41	10	33	41	10	33	41	10	33
42	11	29	42	11	32	42	11	33	42	11	34	42	11	33	42	11	33	42	11	33	42	11	33
43	12	29	43	12	29	43	12	29	43	12	33	43	12	33	43	12	33	43	12	33	43	12	33
44	13	28	44	13	29	44	13	29	44	13	30	44	13	33	44	13	31	44	13	33	44	13	33
45	14	24	45	14	24	45	14	26	45	14	30	45	14	27	45	14	30	45	14	33	45	14	33
46	15	23	46	15	24	46	15	24	46	15	23	46	15	26	46	15	27	46	15	33	46	15	33
47	16	20	47	16	22	47	16	23	47	16	22	47	16	25	47	16	24	47	16	25	47	16	28
48	17	18	48	17	20	48	17	20	48	17	23	48	17	21	48	17	23	48	17	24	48	17	26
49	18	17	49	18	16	49	18	19	49	18	19	49	18	21	49	18	19	49	18	22	49	18	23
50	19	14	50	19	14	50	19	16	50	19	18	50	19	19	50	19	18	50	19	20	50	19	21
51	20	10	51	20	15	51	20	13	51	20	15	51	20	16	51	20	16	51	20	18	51	20	21
52	21	10	52	21	10	52	21	12	52	21	12	52	21	16	52	21	16	52	21	17	52	21	20
53	22	7	53	22	5	53	22	10	53	22	12	53	22	13	53	22	14	53	22	16	53	22	15
54	23	5	54	23	7	54	23	9	54	23	9	54	23	9	54	23	12	54	23	13	54	23	13
55	24	3	55	24	4	55	24	7	55	24	7	55	24	8	55	24	11	55	24	10	55	24	13
56	25	2	56	25	33	56	25	4	56	25	7	56	25	6	56	25	8	56	25	10	56	25	12
57	26	33	57	26	33	57	26	33	57	26	33	57	26	3	57	26	6	57	26	7	57	26	10
58	27	33	58	27	33	58	27	33	58	27	33	58	27	3	58	27	4	58	27	4	58	27	8
59	28	33	59	28	33	59	28	33	59	28	33	59	28	33	59	28	33	59	28	33	59	28	5
60	29	33	60	29	33	60	29	33	60	29	33	60	29	33	60	29	33	60	29	33	60	29	2
61	30	33	61	30	33	61	30	33	61	30	33	61	30	33	61	30	33	61	30	33	61	30	0
62	31	33	62	31	33	62	31	33	62	31	33	62	31	33	62	31	33	62	31	33	62	31	33
63	1	33	63	1	33	63	1	33	63	1	33	63	1	33	63	1	33	63	1	33	63	1	33

TABLE 6 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 9

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	33	0	1	33	0	1	33	0	1	33	0	1	33	0	1	33	0	1	33
1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33	1	1	33
2	2	33	2	2	33	2	2	33	2	2	33	2	2	33	2	2	33	2	2	33
3	3	33	3	3	33	3	3	33	3	3	33	3	3	33	3	3	33	3	3	33
4	4	33	4	4	33	4	4	33	4	4	33	4	4	33	4	4	33	4	4	33
5	5	33	5	5	33	5	5	33	5	5	33	5	5	33	5	5	33	5	5	33
6	6	33	6	6	33	6	6	33	6	6	33	6	6	33	6	6	33	6	6	33
7	7	33	7	7	33	7	7	33	7	7	33	7	7	33	7	7	33	7	7	33
8	8	33	8	8	33	8	8	33	8	8	33	8	8	33	8	8	33	8	8	33
9	9	33	9	9	33	9	9	33	9	9	33	9	9	33	9	9	33	9	9	33
10	10	33	10	10	33	10	10	33	10	10	33	10	10	33	10	10	33	10	10	33
11	11	33	11	11	33	11	11	33	11	11	33	11	11	33	11	11	33	11	11	33
12	12	33	12	12	33	12	12	33	12	12	33	12	12	33	12	12	33	12	12	33
13	13	33	13	13	33	13	13	33	13	13	33	13	13	33	13	13	33	13	13	33
14	14	33	14	14	33	14	14	33	14	14	33	14	14	33	14	14	33	14	14	33
15	15	33	15	15	33	15	15	33	15	15	33	15	15	33	15	15	33	15	15	33
16	16	57	16	16	33	16	16	33	16	16	33	16	16	33	16	16	33	16	16	33
17	17	33	17	17	33	17	17	33	17	17	33	17	17	33	17	17	33	17	17	33
18	18	52	18	18	55	18	18	33	18	18	33	18	18	33	18	18	33	18	18	33
19	19	49	19	19	51	19	19	53	19	19	54	19	19	56	19	19	33	19	19	33
20	20	46	20	20	51	20	20	52	20	20	53	20	20	55	20	20	33	20	20	33
21	21	47	21	21	47	21	21	48	21	21	50	21	21	54	21	21	53	21	21	33
22	22	43	22	22	45	22	22	45	22	22	47	22	22	47	22	22	48	22	22	52
23	23	42	23	23	41	23	23	44	23	23	46	23	23	45	23	23	50	23	23	49
24	24	40	24	24	40	24	24	41	24	24	42	24	24	45	24	24	47	24	24	46
25	25	38	25	25	40	25	25	39	25	25	41	25	25	43	25	25	45	25	25	43
26	26	35	26	26	37	26	26	38	26	26	39	26	26	41	26	26	42	26	26	43
27	27	34	27	27	35	27	27	37	27	27	37	27	27	38	27	27	39	27	27	42
28	28	32	28	28	33	28	28	33	28	28	36	28	28	36	28	28	37	28	28	39
29	29	28	29	29	32	29	29	32	29	29	32	29	29	33	29	29	35	29	29	37
30	30	26	30	30	29	30	30	30	30	30	30	30	30	32	30	30	33	30	30	35
31	31	23	31	31	26	31	31	27	31	31	29	31	31	30	31	31	32	31	31	34

TABLE 6 - CONCLUDED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 9

32	1	25	32	1	23	32	1	27	32	1	28	32	1	27	32	1	28	32	1	32
33	2	19	33	2	22	33	2	22	33	2	26	33	2	25	33	2	27	33	2	28
34	3	33	34	3	17	34	3	21	34	3	23	34	3	23	34	3	25	34	3	28
35	4	33	35	4	17	35	4	19	35	4	21	35	4	24	35	4	22	35	4	25
36	5	33	36	5	33	36	5	33	36	5	16	36	5	20	36	5	21	36	5	22
37	6	33	37	6	33	37	6	33	37	6	13	37	6	18	37	6	21	37	6	20
38	7	33	38	7	33	38	7	33	38	7	13	38	7	16	38	7	16	38	7	20
39	8	33	39	8	33	39	8	33	39	8	33	39	8	33	39	8	33	39	8	14
40	9	33	40	9	33	40	9	33	40	9	33	40	9	33	40	9	33	40	9	14
41	10	33	41	10	33	41	10	33	41	10	33	41	10	33	41	10	33	41	10	33
42	11	33	42	11	33	42	11	33	42	11	33	42	11	33	42	11	33	42	11	33
43	12	33	43	12	33	43	12	33	43	12	33	43	12	33	43	12	33	43	12	33
44	13	33	44	13	33	44	13	33	44	13	33	44	13	33	44	13	33	44	13	33
45	14	33	45	14	33	45	14	33	45	14	33	45	14	33	45	14	33	45	14	33
46	15	33	46	15	33	46	15	33	46	15	33	46	15	33	46	15	33	46	15	33
47	16	33	47	16	33	47	16	33	47	16	33	47	16	33	47	16	33	47	16	33
48	17	33	48	17	33	48	17	33	48	17	33	48	17	33	48	17	33	48	17	33
49	18	26	49	18	26	49	18	33	49	18	33	49	18	33	49	18	33	49	18	33
50	19	24	50	19	33	50	19	33	50	19	33	50	19	33	50	19	33	50	19	33
51	20	21	51	20	21	51	20	33	51	20	33	51	20	33	51	20	33	51	20	33
52	21	21	52	21	21	52	21	33	52	21	33	52	21	33	52	21	33	52	21	33
53	22	16	53	22	20	53	22	33	53	22	20	53	22	33	53	22	33	53	22	33
54	23	16	54	23	16	54	23	16	54	23	19	54	23	33	54	23	33	54	23	33
55	24	15	55	24	15	55	24	15	55	24	18	55	24	18	55	24	33	55	24	33
56	25	12	56	25	14	56	25	16	56	25	16	56	25	17	56	25	19	56	25	33
57	26	13	57	26	11	57	26	14	57	26	11	57	26	13	57	26	18	57	26	33
58	27	6	58	27	7	58	27	10	58	27	11	58	27	13	58	27	15	58	27	33
59	28	4	59	28	7	59	28	8	59	28	8	59	28	11	59	28	13	59	28	33
60	29	3	60	29	6	60	29	7	60	29	6	60	29	9	60	29	11	60	29	10
61	30	2	61	30	2	61	30	3	61	30	6	61	30	6	61	30	6	61	30	8
62	31	0	62	31	33	62	31	2	62	31	33	62	31	3	62	31	4	62	31	5
63	1	33	63	1	33	63	1	33	63	1	33	63	1	1	63	1	0	63	1	0

TABLE 7
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 11

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43
1	1	43	1	1	59	1	1	60	1	1	62	1	1	43	1	1	43	1	1	43	1	1	43
2	2	43	2	2	43	2	2	58	2	2	59	2	2	43	2	2	61	2	2	63	2	2	43
3	3	55	3	3	43	3	3	57	3	3	58	3	3	43	3	3	59	3	3	61	3	3	43
4	4	55	4	4	43	4	4	52	4	4	54	4	4	43	4	4	58	4	4	57	4	4	61
5	5	52	5	5	43	5	5	50	5	5	53	5	5	43	5	5	58	5	5	56	5	5	59
6	6	43	6	6	43	6	6	48	6	6	52	6	6	55	6	6	55	6	6	55	6	6	57
7	7	43	7	7	43	7	7	47	7	7	51	7	7	48	7	7	51	7	7	52	7	7	55
8	8	43	8	8	43	8	8	46	8	8	48	8	8	48	8	8	49	8	8	53	8	8	55
9	9	43	9	9	43	9	9	45	9	9	46	9	9	46	9	9	47	9	9	48	9	9	51
10	10	43	10	10	43	10	10	43	10	10	44	10	10	43	10	10	47	10	10	44	10	10	49
11	11	43	11	11	43	11	11	43	11	11	43	11	11	42	11	11	43	11	11	42	11	11	48
12	12	43	12	12	43	12	12	43	12	12	43	12	12	43	12	12	43	12	12	43	12	12	47
13	13	43	13	13	43	13	13	43	13	13	43	13	13	43	13	13	43	13	13	41	13	13	44
14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	39
15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43
16	16	43	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43
17	17	43	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43
18	18	43	18	18	43	18	18	43	18	18	43	18	18	43	18	18	43	18	18	43	18	18	43
19	19	43	19	19	43	19	19	43	19	19	43	19	19	43	19	19	43	19	19	43	19	19	43
20	20	43	20	20	43	20	20	43	20	20	43	20	20	43	20	20	43	20	20	43	20	20	43
21	21	43	21	21	43	21	21	43	21	21	43	21	21	43	21	21	43	21	21	43	21	21	43
22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	43
23	23	50	23	23	52	23	23	43	23	23	43	23	23	43	23	23	43	23	23	43	23	23	43
24	24	48	24	24	50	24	24	53	24	24	43	24	24	43	24	24	43	24	24	43	24	24	43
25	25	46	25	25	45	25	25	48	25	25	50	25	25	43	25	25	43	25	25	43	25	25	43
26	26	41	26	26	44	26	26	44	26	26	47	26	26	43	26	26	43	26	26	43	26	26	43
27	27	41	27	27	43	27	27	43	27	27	45	27	27	45	27	27	43	27	27	43	27	27	43
28	28	42	28	28	42	28	28	40	28	28	41	28	28	43	28	28	46	28	28	43	28	28	43
29	29	37	29	29	38	29	29	40	29	29	41	29	29	40	29	29	44	29	29	43	29	29	47
30	30	34	30	30	37	30	30	36	30	30	41	30	30	40	30	30	41	30	30	40	30	30	45
31	31	33	31	31	33	31	31	35	31	31	33	31	31	37	31	31	37	31	31	42	31	31	41

TABLE 7 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 11

32	1	33	32	1	30	32	1	33	32	1	35	32	1	34	32	1	36	32	1	38	32	1	39
33	2	31	33	2	31	33	2	31	33	2	32	33	2	34	33	2	35	33	2	39	33	2	37
34	3	25	34	3	28	34	3	32	34	3	29	34	3	32	34	3	32	34	3	33	34	3	34
35	4	23	35	4	25	35	4	27	35	4	30	35	4	29	35	4	34	35	4	33	35	4	32
36	5	25	36	5	22	36	5	25	36	5	27	36	5	27	36	5	29	36	5	31	36	5	31
37	6	21	37	6	22	37	6	23	37	6	24	37	6	27	37	6	27	37	6	31	37	6	30
38	7	16	38	7	21	38	7	21	38	7	23	38	7	21	38	7	23	38	7	23	38	7	29
39	8	17	39	8	20	39	8	20	39	8	20	39	8	21	39	8	25	39	8	24	39	8	26
40	9	14	40	9	17	40	9	14	40	9	17	40	9	20	40	9	22	40	9	22	40	9	24
41	10	43	41	10	16	41	10	13	41	10	16	41	10	19	41	10	18	41	10	19	41	10	21
42	11	43	42	11	43	42	11	43	42	11	11	42	11	18	42	11	17	42	11	16	42	11	20
43	12	43	43	12	43	43	12	43	43	12	11	43	12	11	43	12	16	43	12	15	43	12	16
44	13	43	44	13	43	44	13	43	44	13	43	44	13	43	44	13	16	44	13	13	44	13	14
45	14	43	45	14	43	45	14	43	45	14	43	45	14	43	45	14	11	45	14	12	45	14	12
46	15	43	46	15	43	46	15	43	46	15	43	46	15	43	46	15	7	46	15	9	46	15	12
47	16	43	47	16	43	47	16	43	47	16	43	47	16	43	47	16	43	47	16	6	47	16	10
48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	7
49	18	43	49	18	43	49	18	43	49	18	43	49	18	43	49	18	43	49	18	43	49	18	43
50	19	43	50	19	43	50	19	43	50	19	43	50	19	43	50	19	43	50	19	43	50	19	43
51	20	43	51	20	43	51	20	43	51	20	43	51	20	43	51	20	43	51	20	43	51	20	43
52	21	43	52	21	43	52	21	43	52	21	43	52	21	43	52	21	43	52	21	43	52	21	43
53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	43
54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43
55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43
56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43
57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43
58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43
59	28	15	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43
60	29	13	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43
61	30	12	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43
62	31	7	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43
63	1	7	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43

TABLE 7 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 11

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43
1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43
2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43
3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43
4	4	63	4	4	63	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43
5	5	59	5	5	61	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43
6	6	60	6	6	60	6	6	61	6	6	60	6	6	63	6	6	43	6	6	43	6	6	43
7	7	58	7	7	58	7	7	60	7	7	57	7	7	60	7	7	43	7	7	62	7	7	43
8	8	53	8	8	53	8	8	61	8	8	56	8	8	58	8	8	43	8	8	59	8	8	43
9	9	53	9	9	55	9	9	55	9	9	55	9	9	57	9	9	57	9	9	59	9	9	59
10	10	51	10	10	48	10	10	51	10	10	53	10	10	55	10	10	53	10	10	58	10	10	58
11	11	50	11	11	47	11	11	49	11	11	50	11	11	50	11	11	52	11	11	57	11	11	56
12	12	47	12	12	45	12	12	46	12	12	47	12	12	48	12	12	49	12	12	52	12	12	54
13	13	45	13	13	46	13	13	45	13	13	46	13	13	46	13	13	46	13	13	48	13	13	49
14	14	43	14	14	39	14	14	46	14	14	42	14	14	48	14	14	47	14	14	45	14	14	48
15	15	40	15	15	38	15	15	39	15	15	43	15	15	44	15	15	45	15	15	46	15	15	47
16	16	36	16	16	40	16	16	36	16	16	43	16	16	42	16	16	43	16	16	44	16	16	46
17	17	34	17	17	36	17	17	35	17	17	38	17	17	41	17	17	41	17	17	45	17	17	41
18	18	33	18	18	34	18	18	33	18	18	35	18	18	38	18	18	41	18	18	36	18	18	44
19	19	32	19	19	43	19	19	43	19	19	43	19	19	36	19	19	37	19	19	38	19	19	38
20	20	43	20	20	43	20	20	43	20	20	43	20	20	34	20	20	33	20	20	32	20	20	37
21	21	43	21	21	43	21	21	43	21	21	43	21	21	30	21	21	43	21	21	35	21	21	37
22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	31	22	22	30
23	23	43	23	23	43	23	23	43	23	23	43	23	23	43	23	23	43	23	23	43	23	23	31
24	24	43	24	24	43	24	24	43	24	24	43	24	24	43	24	24	43	24	24	43	24	24	29
25	25	43	25	25	43	25	25	43	25	25	43	25	25	43	25	25	43	25	25	43	25	25	27
26	26	43	26	26	43	26	26	43	26	26	43	26	26	43	26	26	43	26	26	43	26	26	43
27	27	43	27	27	43	27	27	43	27	27	43	27	27	43	27	27	43	27	27	43	27	27	43
28	28	43	28	28	43	28	28	43	28	28	43	28	28	43	28	28	43	28	28	43	28	28	43
29	29	48	29	29	43	29	29	43	29	29	43	29	29	43	29	29	43	29	29	43	29	29	43
30	30	43	30	30	43	30	30	43	30	30	43	30	30	43	30	30	43	30	30	43	30	30	43
31	31	43	31	31	43	31	31	43	31	31	43	31	31	43	31	31	43	31	31	43	31	31	43

TABLE 7 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 11

32	1	40	32	1	41	32	1	43	32	1	43	32	1	43	32	1	43	32	1	43	32	1	43
33	2	38	33	2	40	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43
34	3	37	34	3	38	34	3	38	34	3	43	34	3	43	34	3	43	34	3	43	34	3	43
35	4	34	35	4	38	35	4	38	35	4	38	35	4	40	35	4	41	35	4	43	35	4	43
36	5	32	36	5	35	36	5	35	36	5	34	36	5	38	36	5	39	36	5	43	36	5	43
37	6	33	37	6	30	37	6	33	37	6	35	37	6	38	37	6	37	37	6	43	37	6	43
38	7	28	38	7	28	38	7	32	38	7	31	38	7	35	38	7	33	38	7	36	38	7	43
39	8	27	39	8	26	39	8	29	39	8	31	39	8	31	39	8	31	39	8	33	39	8	36
40	9	26	40	9	26	40	9	26	40	9	27	40	9	30	40	9	30	40	9	31	40	9	33
41	10	21	41	10	22	41	10	23	41	10	26	41	10	26	41	10	29	41	10	27	41	10	31
42	11	21	42	11	19	42	11	24	42	11	24	42	11	24	42	11	27	42	11	28	42	11	31
43	12	18	43	12	22	43	12	22	43	12	21	43	12	22	43	12	25	43	12	25	43	12	27
44	13	19	44	13	19	44	13	18	44	13	22	44	13	20	44	13	21	44	13	23	44	13	23
45	14	12	45	14	15	45	14	14	45	14	16	45	14	19	45	14	20	45	14	22	45	14	25
46	15	13	46	15	14	46	15	14	46	15	17	46	15	18	46	15	18	46	15	20	46	15	21
47	16	10	47	16	9	47	16	13	47	16	15	47	16	16	47	16	16	47	16	16	47	16	18
48	17	43	48	17	9	48	17	13	48	17	12	48	17	11	48	17	18	48	17	18	48	17	16
49	18	43	49	18	8	49	18	43	49	18	10	49	18	12	49	18	13	49	18	14	49	18	13
50	19	43	50	19	43	50	19	43	50	19	7	50	19	11	50	19	10	50	19	12	50	19	14
51	20	43	51	20	43	51	20	43	51	20	43	51	20	11	51	20	8	51	20	9	51	20	12
52	21	43	52	21	43	52	21	43	52	21	43	52	21	43	52	21	6	52	21	5	52	21	7
53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	3	53	22	7
54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	5
55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	1
56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43
57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43
58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43
59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43
60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43
61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43
62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43
63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43

TABLE 7 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 11

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43
1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43
2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43
3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43
4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43
5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43
6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43
7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43
8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43
9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43
10	10	43	10	10	61	10	10	43	10	10	43	10	10	43	10	10	43	10	10	43	10	10	43
11	11	43	11	11	57	11	11	59	11	11	43	11	11	43	11	11	43	11	11	43	11	11	43
12	12	55	12	12	57	12	12	57	12	12	59	12	12	43	12	12	43	12	12	43	12	12	43
13	13	51	13	13	53	13	13	55	13	13	56	13	13	43	13	13	43	13	13	60	13	13	43
14	14	50	14	14	52	14	14	51	14	14	56	14	14	55	14	14	57	14	14	59	14	14	43
15	15	48	15	15	48	15	15	52	15	15	51	15	15	54	15	15	54	15	15	58	15	15	60
16	16	46	16	16	48	16	16	47	16	16	53	16	16	51	16	16	52	16	16	55	16	16	53
17	17	43	17	17	44	17	17	48	17	17	49	17	17	48	17	17	51	17	17	50	17	17	52
18	18	40	18	18	43	18	18	44	18	18	47	18	18	45	18	18	47	18	18	49	18	18	51
19	19	41	19	19	42	19	19	43	19	19	45	19	19	47	19	19	47	19	19	47	19	19	49
20	20	37	20	20	37	20	20	40	20	20	44	20	20	42	20	20	42	20	20	44	20	20	45
21	21	33	21	21	33	21	21	41	21	21	38	21	21	40	21	21	43	21	21	43	21	21	43
22	22	34	22	22	35	22	22	37	22	22	38	22	22	38	22	22	40	22	22	40	22	22	42
23	23	33	23	23	34	23	23	36	23	23	33	23	23	37	23	23	41	23	23	41	23	23	40
24	24	33	24	24	33	24	24	30	24	24	34	24	24	35	24	24	36	24	24	36	24	24	36
25	25	29	25	25	29	25	25	33	25	25	28	25	25	31	25	25	32	25	25	39	25	25	36
26	26	43	26	26	24	26	26	29	26	26	31	26	26	29	26	26	33	26	26	36	26	26	32
27	27	43	27	27	43	27	27	28	27	27	28	27	27	27	27	27	32	27	27	31	27	27	31
28	28	43	28	28	22	28	28	43	28	28	24	28	28	23	28	28	25	28	28	29	28	28	32
29	29	43	29	29	43	29	29	43	29	29	43	29	29	43	29	29	24	29	29	26	29	29	25
30	30	43	30	30	43	30	30	43	30	30	43	30	30	43	30	30	24	30	30	25	30	30	26
31	31	43	31	31	43	31	31	43	31	31	43	31	31	43	31	31	24	31	31	23	31	31	21

TABLE 7 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 11

32	1	43	32	1	43	32	1	43	32	1	43	32	1	43	32	1	43	32	1	21	32	1	22
33	2	43	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43
34	3	43	34	3	43	34	3	43	34	3	43	34	3	43	34	3	43	34	3	43	34	3	43
35	4	43	35	4	43	35	4	43	35	4	43	35	4	43	35	4	43	35	4	43	35	4	43
36	5	43	36	5	43	36	5	43	36	5	43	36	5	43	36	5	43	36	5	43	36	5	43
37	6	43	37	6	43	37	6	43	37	6	43	37	6	43	37	6	43	37	6	43	37	6	43
38	7	43	38	7	43	38	7	43	38	7	43	38	7	43	38	7	43	38	7	43	38	7	43
39	8	43	39	8	36	39	8	43	39	8	43	39	8	43	39	8	43	39	8	43	39	8	43
40	9	34	40	9	37	40	9	43	40	9	43	40	9	43	40	9	43	40	9	43	40	9	43
41	10	30	41	10	33	41	10	43	41	10	43	41	10	43	41	10	43	41	10	43	41	10	43
42	11	29	42	11	32	42	11	43	42	11	34	42	11	43	42	11	43	42	11	43	42	11	43
43	12	27	43	12	27	43	12	29	43	12	32	43	12	43	43	12	43	43	12	43	43	12	43
44	13	28	44	13	29	44	13	29	44	13	30	44	13	43	44	13	31	44	13	43	44	13	43
45	14	23	45	14	24	45	14	26	45	14	30	45	14	27	45	14	30	45	14	43	45	14	43
46	15	24	46	15	24	46	15	21	46	15	23	46	15	26	46	15	28	46	15	43	46	15	43
47	16	21	47	16	20	47	16	23	47	16	22	47	16	25	47	16	24	47	16	25	47	16	28
48	17	18	48	17	19	48	17	20	48	17	23	48	17	21	48	17	22	48	17	24	48	17	26
49	18	17	49	18	15	49	18	18	49	18	19	49	18	20	49	18	19	49	18	22	49	18	23
50	19	15	50	19	14	50	19	17	50	19	18	50	19	19	50	19	18	50	19	19	50	19	21
51	20	9	51	20	15	51	20	13	51	20	16	51	20	16	51	20	16	51	20	18	51	20	21
52	21	9	52	21	10	52	21	12	52	21	12	52	21	14	52	21	16	52	21	17	52	21	20
53	22	7	53	22	5	53	22	10	53	22	11	53	22	14	53	22	13	53	22	16	53	22	15
54	23	5	54	23	7	54	23	9	54	23	8	54	23	9	54	23	12	54	23	12	54	23	11
55	24	3	55	24	4	55	24	7	55	24	7	55	24	10	55	24	8	55	24	10	55	24	13
56	25	2	56	25	43	56	25	4	56	25	7	56	25	6	56	25	7	56	25	10	56	25	12
57	26	43	57	26	43	57	26	43	57	26	43	57	26	3	57	26	6	57	26	7	57	26	10
58	27	43	58	27	43	58	27	43	58	27	43	58	27	3	58	27	2	58	27	4	58	27	8
59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	5
60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	2
61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	0
62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43
63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43

TABLE 7 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 11

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43
1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43
2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43
3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43
4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43
5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43
6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43
7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43
8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43
9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43
10	10	43	10	10	43	10	10	43	10	10	43	10	10	43	10	10	43	10	10	43
11	11	43	11	11	43	11	11	43	11	11	43	11	11	43	11	11	43	11	11	43
12	12	43	12	12	43	12	12	43	12	12	43	12	12	43	12	12	43	12	12	43
13	13	43	13	13	43	13	13	43	13	13	43	13	13	43	13	13	43	13	13	43
14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	43
15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43
16	16	57	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43
17	17	55	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43
18	18	52	18	18	55	18	18	43	18	18	43	18	18	43	18	18	43	18	18	43
19	19	49	19	19	51	19	19	53	19	19	54	19	19	56	19	19	43	19	19	43
20	20	46	20	20	50	20	20	52	20	20	53	20	20	55	20	20	43	20	20	43
21	21	47	21	21	49	21	21	46	21	21	50	21	21	54	21	21	53	21	21	43
22	22	42	22	22	45	22	22	45	22	22	46	22	22	46	22	22	48	22	22	52
23	23	44	23	23	41	23	23	44	23	23	46	23	23	45	23	23	50	23	23	49
24	24	40	24	24	42	24	24	39	24	24	42	24	24	45	24	24	47	24	24	46
25	25	38	25	25	37	25	25	39	25	25	43	25	25	43	25	25	45	25	25	42
26	26	35	26	26	37	26	26	39	26	26	38	26	26	41	26	26	43	26	26	43
27	27	34	27	27	32	27	27	38	27	27	35	27	27	38	27	27	37	27	27	41
28	28	30	28	28	33	28	28	32	28	28	32	28	28	36	28	28	37	28	28	39
29	29	28	29	29	28	29	29	29	29	29	32	29	29	32	29	29	35	29	29	37
30	30	26	30	30	29	30	30	30	30	30	30	30	30	30	30	30	34	30	30	34
31	31	23	31	31	26	31	31	26	31	31	29	31	31	30	31	31	32	31	31	34

TABLE 7 - CONCLUDED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 11

32	1	25	32	1	23	32	1	27	32	1	28	32	1	29	32	1	28	32	1	33
33	2	19	33	2	21	33	2	21	33	2	26	33	2	25	33	2	29	33	2	28
34	3	43	34	3	17	34	3	21	34	3	20	34	3	25	34	3	25	34	3	28
35	4	43	35	4	17	35	4	19	35	4	21	35	4	22	35	4	22	35	4	24
36	5	43	36	5	43	36	5	43	36	5	16	36	5	20	36	5	20	36	5	22
37	6	43	37	6	43	37	6	43	37	6	13	37	6	18	37	6	18	37	6	18
38	7	43	38	7	43	38	7	43	38	7	13	38	7	16	38	7	16	38	7	20
39	8	43	39	8	43	39	8	43	39	8	43	39	8	43	39	8	43	39	8	14
40	9	43	40	9	43	40	9	43	40	9	43	40	9	43	40	9	43	40	9	14
41	10	43	41	10	43	41	10	43	41	10	43	41	10	43	41	10	43	41	10	43
42	11	43	42	11	43	42	11	43	42	11	43	42	11	43	42	11	43	42	11	43
43	12	43	43	12	43	43	12	43	43	12	43	43	12	43	43	12	43	43	12	43
44	13	43	44	13	43	44	13	43	44	13	43	44	13	43	44	13	43	44	13	43
45	14	43	45	14	43	45	14	43	45	14	43	45	14	43	45	14	43	45	14	43
46	15	43	46	15	43	46	15	43	46	15	43	46	15	43	46	15	43	46	15	43
47	16	43	47	16	43	47	16	43	47	16	43	47	16	43	47	16	43	47	16	43
48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	43
49	18	26	49	18	26	49	18	43	49	18	43	49	18	43	49	18	43	49	18	43
50	19	25	50	19	24	50	19	43	50	19	43	50	19	43	50	19	43	50	19	43
51	20	21	51	20	21	51	20	43	51	20	43	51	20	43	51	20	43	51	20	43
52	21	21	52	21	21	52	21	43	52	21	43	52	21	43	52	21	43	52	21	43
53	22	15	53	22	20	53	22	43	53	22	20	53	22	43	53	22	43	53	22	43
54	23	16	54	23	16	54	23	16	54	23	19	54	23	43	54	23	43	54	23	43
55	24	15	55	24	15	55	24	14	55	24	17	55	24	18	55	24	43	55	24	43
56	25	10	56	25	14	56	25	16	56	25	16	56	25	17	56	25	19	56	25	43
57	26	13	57	26	10	57	26	12	57	26	11	57	26	12	57	26	18	57	26	43
58	27	6	58	27	7	58	27	11	58	27	11	58	27	13	58	27	14	58	27	43
59	28	4	59	28	4	59	28	6	59	28	9	59	28	11	59	28	13	59	28	43
60	29	3	60	29	6	60	29	7	60	29	6	60	29	9	60	29	11	60	29	10
61	30	1	61	30	2	61	30	3	61	30	6	61	30	6	61	30	6	61	30	8
62	31	0	62	31	43	62	31	2	62	31	43	62	31	5	62	31	4	62	31	5
63	1	43	63	1	43	63	1	43	63	1	43	63	1	1	63	1	0	63	1	2

TABLE 8
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 12

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43
1	1	43	1	1	61	1	1	60	1	1	62	1	1	43	1	1	43	1	1	43	1	1	43
2	2	43	2	2	43	2	2	58	2	2	59	2	2	43	2	2	61	2	2	63	2	2	43
3	3	55	3	3	43	3	3	57	3	3	58	3	3	43	3	3	61	3	3	61	3	3	43
4	4	55	4	4	43	4	4	55	4	4	57	4	4	43	4	4	58	4	4	57	4	4	61
5	5	52	5	5	43	5	5	50	5	5	53	5	5	43	5	5	58	5	5	56	5	5	59
6	6	43	6	6	43	6	6	48	6	6	52	6	6	55	6	6	55	6	6	55	6	6	57
7	7	43	7	7	43	7	5	47	7	7	51	7	7	50	7	7	51	7	7	54	7	7	55
8	8	43	8	8	43	8	6	46	8	8	48	8	8	48	8	8	49	8	8	53	8	8	55
9	9	43	9	9	43	9	7	45	9	9	46	9	9	46	9	9	47	9	9	48	9	9	51
10	10	43	10	10	43	10	10	43	10	10	45	10	10	43	10	10	47	10	10	47	10	10	50
11	11	43	11	11	43	11	11	43	11	11	43	11	11	42	11	11	43	11	11	42	11	11	48
12	12	43	12	12	43	12	12	43	12	12	43	12	12	43	12	12	43	12	12	42	12	12	47
13	13	43	13	13	43	13	13	43	13	13	43	13	13	43	13	13	43	13	13	41	13	13	44
14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	39
15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43
16	16	43	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43
17	17	43	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43
18	18	43	18	18	43	18	18	43	18	18	43	18	18	43	18	18	43	18	18	43	18	18	43
19	19	43	19	19	43	19	19	43	19	19	43	19	19	43	19	19	43	19	19	43	19	19	43
20	20	43	20	20	43	20	20	43	20	20	43	20	20	43	20	20	43	20	20	43	20	20	43
21	21	43	21	21	43	21	21	43	21	21	43	21	21	43	21	21	43	21	21	43	21	21	43
22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	43
23	23	50	23	23	52	23	23	43	23	23	43	23	23	43	23	23	43	23	23	43	23	23	43
24	24	48	24	24	50	24	24	53	24	24	43	24	24	43	24	24	43	24	24	43	24	24	43
25	25	46	25	25	47	25	25	48	25	25	50	25	25	43	25	25	43	25	25	43	25	25	43
26	26	44	26	26	45	26	26	46	26	26	48	26	26	43	26	26	43	26	26	43	26	26	43
27	27	42	27	27	43	27	27	44	27	27	46	27	27	46	27	27	43	27	27	43	27	27	43
28	28	41	28	28	42	28	28	42	28	28	43	28	28	43	28	28	46	28	28	43	28	28	43
29	29	38	29	29	39	29	29	40	29	29	41	29	29	42	29	29	44	29	29	43	29	29	47
30	30	35	30	30	37	30	30	39	30	30	39	30	30	41	30	30	42	30	30	40	30	30	45
31	31	34	31	31	35	31	31	36	31	31	37	31	31	38	31	31	38	31	31	41	31	31	41

TABLE 8 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 12

32	1	32	32	1	32	32	1	34	32	1	35	32	1	35	32	1	37	32	1	39	32	1	39
33	2	30	33	2	31	33	2	32	33	2	33	33	2	34	33	2	36	33	2	38	33	2	39
34	3	27	34	3	29	34	3	30	34	3	31	34	3	32	34	3	33	34	3	34	34	3	36
35	4	26	35	4	27	35	4	28	35	4	30	35	4	30	35	4	32	35	4	33	35	4	34
36	5	24	36	5	24	36	5	27	36	5	27	36	5	27	36	5	30	36	5	31	36	5	32
37	6	22	37	6	22	37	6	24	37	6	25	37	6	27	37	6	27	37	6	29	37	6	31
38	7	17	38	7	20	38	7	21	38	7	23	38	7	24	38	7	25	38	7	25	38	7	27
39	8	17	39	8	20	39	8	20	39	8	22	39	8	23	39	8	24	39	8	25	39	8	26
40	9	14	40	9	16	40	9	16	40	9	18	40	9	20	40	9	21	40	9	22	40	9	23
41	10	43	41	10	16	41	10	15	41	10	17	41	10	18	41	10	19	41	10	20	41	10	21
42	11	43	42	11	43	42	11	43	42	11	11	42	11	17	42	11	16	42	11	19	42	11	20
43	12	43	43	12	43	43	12	43	43	12	11	43	12	12	43	12	16	43	12	16	43	12	18
44	13	43	44	13	43	44	13	43	44	13	43	44	13	43	44	13	16	44	13	13	44	13	15
45	14	43	45	14	43	45	14	43	45	14	43	45	14	43	45	14	11	45	14	12	45	14	12
46	15	43	46	15	43	46	15	43	46	15	43	46	15	43	46	15	7	46	15	9	46	15	12
47	16	43	47	16	43	47	16	43	47	16	43	47	16	43	47	16	43	47	16	6	47	16	10
48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	7
49	18	43	49	18	43	49	18	43	49	18	43	49	18	43	49	18	43	49	18	43	49	18	43
50	19	43	50	19	43	50	19	43	50	19	43	50	19	43	50	19	43	50	19	43	50	19	43
51	20	43	51	20	43	51	20	43	51	20	43	51	20	43	51	20	43	51	20	43	51	20	43
52	21	43	52	21	43	52	21	43	52	21	43	52	21	43	52	21	43	52	21	43	52	21	43
53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	43
54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43
55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43
56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43
57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43
58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43
59	28	15	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43
60	29	13	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43
61	30	12	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43
62	31	7	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43
63	1	5	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43

TABLE 8 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 12

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43
1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43
2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43
3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43
4	4	63	4	4	63	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43
5	5	59	5	5	61	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43
6	6	60	6	6	60	6	6	61	6	6	60	6	6	63	6	6	43	6	6	43	6	6	43
7	7	58	7	7	58	7	7	60	7	7	57	7	7	60	7	7	43	7	7	62	7	7	43
8	8	55	8	8	53	8	8	61	8	8	56	8	8	58	8	8	43	8	8	59	8	8	43
9	9	53	9	9	55	9	9	55	9	9	55	9	9	57	9	9	58	9	9	59	9	9	61
10	10	51	10	10	51	10	10	53	10	10	53	10	10	55	10	10	56	10	10	58	10	10	58
11	11	50	11	11	47	11	11	51	11	11	51	11	11	50	11	11	54	11	11	57	11	11	56
12	12	47	12	12	48	12	12	48	12	12	48	12	12	48	12	12	52	12	12	52	12	12	54
13	13	45	13	13	47	13	13	46	13	13	49	13	13	46	13	13	47	13	13	50	13	13	50
14	14	43	14	14	39	14	14	46	14	14	47	14	14	47	14	14	47	14	14	45	14	14	49
15	15	40	15	15	40	15	15	40	15	15	44	15	15	45	15	15	46	15	15	49	15	15	48
16	16	36	16	16	41	16	16	36	16	16	43	16	16	42	16	16	43	16	16	43	16	16	47
17	17	34	17	17	36	17	17	35	17	17	38	17	17	40	17	17	41	17	17	43	17	17	44
18	18	33	18	18	35	18	18	33	18	18	35	18	18	38	18	18	40	18	18	39	18	18	42
19	19	32	19	19	43	19	19	43	19	19	43	19	19	36	19	19	36	19	19	38	19	19	39
20	20	43	20	20	43	20	20	43	20	20	43	20	20	34	20	20	35	20	20	36	20	20	37
21	21	43	21	21	43	21	21	43	21	21	43	21	21	30	21	21	43	21	21	35	21	21	37
22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	43	22	22	33	22	22	32
23	23	43	23	23	43	23	23	43	23	23	43	23	23	43	23	23	43	23	23	43	23	23	31
24	24	43	24	24	43	24	24	43	24	24	43	24	24	43	24	24	43	24	24	43	24	24	29
25	25	43	25	25	43	25	25	43	25	25	43	25	25	43	25	25	43	25	25	43	25	25	27
26	26	43	26	26	43	26	26	43	26	26	43	26	26	43	26	26	43	26	26	43	26	26	43
27	27	43	27	27	43	27	27	43	27	27	43	27	27	43	27	27	43	27	27	43	27	26	43
28	28	43	28	28	43	28	28	43	28	28	43	28	28	43	28	28	43	28	28	43	28	27	43
29	29	48	29	29	43	29	29	43	29	29	43	29	29	43	29	29	43	29	29	43	29	28	43
30	30	45	30	30	43	30	30	43	30	30	43	30	30	43	30	30	43	30	30	43	30	30	43
31	31	44	31	31	43	31	31	43	31	31	43	31	31	43	31	31	43	31	31	43	31	31	43

TABLE 8 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 12

32	1	40	32	1	41	32	1	43	32	1	43	32	1	43	32	1	43	32	1	43	32	1	43
33	2	40	33	2	40	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43
34	3	38	34	3	38	34	3	39	34	3	43	34	3	43	34	3	43	34	3	43	34	3	43
35	4	34	35	4	37	35	4	38	35	4	38	35	4	40	35	4	41	35	4	43	35	4	43
36	5	33	36	5	35	36	5	35	36	5	34	36	5	40	36	5	39	36	5	43	36	5	43
37	6	32	37	6	32	37	6	35	37	6	35	37	6	38	37	6	37	37	6	43	37	6	43
38	7	29	38	7	29	38	7	32	38	7	32	38	7	36	38	7	35	38	7	36	38	7	43
39	8	27	39	8	27	39	8	29	39	8	31	39	8	33	39	8	32	39	8	33	39	8	36
40	9	25	40	9	26	40	9	27	40	9	29	40	9	30	40	9	31	40	9	32	40	9	34
41	10	23	41	10	24	41	10	25	41	10	26	41	10	27	41	10	28	41	10	30	41	10	31
42	11	20	42	11	22	42	11	24	42	11	24	42	11	25	42	11	28	42	11	27	42	11	29
43	12	19	43	12	20	43	12	22	43	12	22	43	12	23	43	12	25	43	12	26	43	12	29
44	13	17	44	13	18	44	13	19	44	13	21	44	13	21	44	13	23	44	13	25	44	13	25
45	14	12	45	14	16	45	14	17	45	14	18	45	14	19	45	14	20	45	14	22	45	14	23
46	15	13	46	15	15	46	15	15	46	15	16	46	15	18	46	15	19	46	15	20	46	15	20
47	16	10	47	16	9	47	16	13	47	16	14	47	16	16	47	16	16	47	16	18	47	16	18
48	17	43	48	17	10	48	17	11	48	17	13	48	17	12	48	17	16	48	17	17	48	17	16
49	18	43	49	18	9	49	18	43	49	18	10	49	18	12	49	18	12	49	18	13	49	18	14
50	19	43	50	19	43	50	19	43	50	19	7	50	19	11	50	19	10	50	19	12	50	19	13
51	20	43	51	20	43	51	20	43	51	20	43	51	20	11	51	20	8	51	20	9	51	20	11
52	21	43	52	21	43	52	21	43	52	21	43	52	21	43	52	21	6	52	21	8	52	21	8
53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	43	53	22	3	53	22	7
54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	43	54	23	5
55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	43	55	24	1
56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43	56	25	43
57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43	57	26	43
58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43	58	27	43
59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43
60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43
61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43
62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43
63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43

TABLE 8 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 12

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43
1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43
2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43
3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43
4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43
5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43
6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43
7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43
8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43
9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43
10	10	43	10	10	61	10	10	43	10	10	43	10	10	43	10	10	43	10	10	43	10	10	43
11	11	43	11	11	57	11	11	60	11	11	43	11	11	43	11	11	43	11	11	43	11	11	43
12	12	55	12	12	57	12	12	57	12	12	59	12	12	43	12	12	43	12	12	43	12	12	43
13	13	51	13	13	53	13	13	55	13	13	56	13	13	43	13	13	43	13	13	60	13	13	43
14	14	51	14	14	52	14	14	52	14	14	56	14	14	56	14	14	57	14	14	59	14	14	43
15	15	48	15	15	50	15	15	53	15	15	51	15	15	54	15	15	55	15	15	58	15	15	60
16	16	47	16	16	48	16	16	48	16	16	52	16	16	52	16	16	53	16	16	55	16	16	53
17	17	46	17	17	46	17	17	49	17	17	48	17	17	50	17	17	51	17	17	50	17	17	52
18	18	44	18	18	45	18	18	45	18	18	46	18	18	48	18	18	47	18	18	49	18	18	51
19	19	42	19	19	43	19	19	43	19	19	44	19	19	46	19	19	46	19	19	49	19	19	50
20	20	39	20	20	39	20	20	41	20	20	43	20	20	44	20	20	45	20	20	45	20	20	46
21	21	35	21	21	36	21	21	39	21	21	39	21	21	41	21	21	42	21	21	43	21	21	45
22	22	36	22	22	35	22	22	37	22	22	38	22	22	38	22	22	40	22	22	41	22	22	42
23	23	33	23	23	34	23	23	36	23	23	35	23	23	37	23	23	39	23	23	39	23	23	41
24	24	33	24	24	31	24	24	33	24	24	34	24	24	36	24	24	36	24	24	37	24	24	37
25	25	29	25	25	29	25	25	33	25	25	31	25	25	33	25	25	34	25	25	36	25	25	37
26	26	43	26	26	26	26	26	29	26	26	31	26	26	32	26	26	31	26	26	35	26	26	34
27	27	43	27	27	43	27	27	28	27	27	29	27	27	27	27	27	31	27	27	31	27	27	32
28	28	43	28	28	23	28	28	43	28	28	25	28	28	26	28	28	28	28	28	30	28	28	32
29	29	43	29	29	43	29	29	43	29	29	43	29	29	43	29	29	25	29	29	28	29	29	26
30	30	43	30	30	43	30	30	43	30	30	43	30	30	43	30	30	24	30	30	25	30	30	26
31	31	43	31	31	43	31	31	43	31	31	43	31	31	43	31	31	24	31	31	23	31	31	23

TABLE 8 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 12

32	1	43	32	1	43	32	1	43	32	1	43	32	1	43	32	1	43	32	1	21	32	1	22
33	2	43	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43	33	2	43
34	3	43	34	3	43	34	3	43	34	3	43	34	3	43	34	3	43	34	3	43	34	3	43
35	4	43	35	4	43	35	4	43	35	4	43	35	4	43	35	4	43	35	4	43	35	4	43
36	5	43	36	5	43	36	5	43	36	5	43	36	5	43	36	5	43	36	5	43	36	5	43
37	6	43	37	6	43	37	6	43	37	6	43	37	6	43	37	6	43	37	6	43	37	6	43
38	7	43	38	7	43	38	7	43	38	7	43	38	7	43	38	7	43	38	7	43	38	7	43
39	8	43	39	8	36	39	8	43	39	8	43	39	8	43	39	8	43	39	8	43	39	8	43
40	9	34	40	9	37	40	9	43	40	9	43	40	9	43	40	9	43	40	9	43	40	9	43
41	10	32	41	10	33	41	10	43	41	10	43	41	10	43	41	10	43	41	10	43	41	10	43
42	11	30	42	11	32	42	11	43	42	11	34	42	11	43	42	11	43	42	11	43	42	11	43
43	12	29	43	12	30	43	12	29	43	12	32	43	12	43	43	12	43	43	12	43	43	12	43
44	13	28	44	13	28	44	13	28	44	13	30	44	13	43	44	13	31	44	13	43	44	13	43
45	14	24	45	14	24	45	14	27	45	14	30	45	14	27	45	14	30	45	14	43	45	14	43
46	15	22	46	15	24	46	15	24	46	15	23	46	15	27	46	15	28	46	15	43	46	15	43
47	16	20	47	16	23	47	16	22	47	16	24	47	16	26	47	16	26	47	16	25	47	16	28
48	17	18	48	17	20	48	17	20	48	17	23	48	17	22	48	17	24	48	17	24	48	17	26
49	18	16	49	18	17	49	18	19	49	18	20	49	18	21	49	18	21	49	18	22	49	18	25
50	19	14	50	19	15	50	19	16	50	19	19	50	19	19	50	19	20	50	19	21	50	19	22
51	20	11	51	20	14	51	20	14	51	20	14	51	20	18	51	20	17	51	20	21	51	20	21
52	21	11	52	21	11	52	21	13	52	21	14	52	21	15	52	21	16	52	21	17	52	21	20
53	22	8	53	22	5	53	22	11	53	22	12	53	22	13	53	22	14	53	22	16	53	22	16
54	23	5	54	23	7	54	23	9	54	23	9	54	23	9	54	23	13	54	23	13	54	23	13
55	24	3	55	24	4	55	24	7	55	24	7	55	24	9	55	24	10	55	24	10	55	24	13
56	25	1	56	25	43	56	25	5	56	25	7	56	25	7	56	25	8	56	25	10	56	25	12
57	26	43	57	26	43	57	26	43	57	26	43	57	26	3	57	26	7	57	26	7	57	26	9
58	27	43	58	27	43	58	27	43	58	27	43	58	27	3	58	27	4	58	27	4	58	27	8
59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	43	59	28	5
60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	43	60	29	2
61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	43	61	30	0
62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43	62	31	43
63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43	63	1	43

TABLE 8 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 12

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43	0	1	43
1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43	1	1	43
2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43	2	2	43
3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43	3	3	43
4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43	4	4	43
5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43	5	5	43
6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43	6	6	43
7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43	7	7	43
8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43	8	8	43
9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43	9	9	43
10	10	43	10	10	43	10	10	43	10	10	43	10	10	43	10	10	43	10	10	43
11	11	43	11	11	43	11	11	43	11	11	43	11	11	43	11	11	43	11	11	43
12	12	43	12	12	43	12	12	43	12	12	43	12	12	43	12	12	43	12	12	43
13	13	43	13	13	43	13	13	43	13	13	43	13	13	43	13	13	43	13	13	43
14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	43	14	14	43
15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43	15	15	43
16	16	57	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43	16	16	43
17	17	55	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43	17	17	43
18	18	52	18	18	55	18	18	43	18	18	43	18	18	43	18	18	43	18	18	43
19	19	50	19	19	53	19	19	53	19	19	54	19	19	56	19	19	43	19	19	43
20	20	47	20	20	51	20	20	52	20	20	53	20	20	55	20	20	43	20	20	43
21	21	47	21	21	48	21	21	49	21	21	51	21	21	54	21	21	53	21	21	43
22	22	43	22	22	45	22	22	45	22	22	48	22	22	47	22	22	48	22	22	51
23	23	42	23	23	43	23	23	45	23	23	45	23	23	46	23	23	50	23	23	49
24	24	40	24	24	41	24	24	42	24	24	43	24	24	45	24	24	47	24	24	46
25	25	38	25	25	40	25	25	39	25	25	42	25	25	43	25	25	45	25	25	43
26	26	35	26	26	37	26	26	38	26	26	39	26	26	41	26	26	42	26	26	43
27	27	34	27	27	34	27	27	37	27	27	37	27	27	39	27	27	40	27	27	42
28	28	32	28	28	33	28	28	33	28	28	35	28	28	36	28	28	38	28	28	39
29	29	29	29	29	31	29	29	32	29	29	32	29	29	34	29	29	35	29	29	38
30	30	27	30	30	29	30	30	31	30	30	31	30	30	31	30	30	33	30	30	35
31	31	25	31	31	27	31	31	28	31	31	29	31	31	30	31	31	32	31	31	34

TABLE 8 - CONCLUDED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 12

32	1	25	32	1	23	32	1	26	32	1	28	32	1	27	32	1	29	32	1	32
33	2	22	33	2	23	33	2	23	33	2	26	33	2	25	33	2	27	33	2	28
34	3	43	34	3	19	34	3	22	34	3	23	34	3	23	34	3	26	34	3	27
35	4	43	35	4	17	35	4	19	35	4	21	35	4	24	35	4	22	35	4	26
36	5	43	36	5	43	36	5	43	36	5	18	36	5	21	36	5	21	36	5	22
37	6	43	37	6	43	37	6	43	37	6	13	37	6	18	37	6	20	37	6	20
38	7	43	38	7	43	38	7	43	38	7	13	38	7	16	38	7	16	38	7	18
39	8	43	39	8	43	39	8	43	39	8	43	39	8	43	39	8	43	39	8	14
40	9	43	40	9	43	40	9	43	40	9	43	40	9	43	40	9	43	40	9	14
41	10	43	41	10	43	41	10	43	41	10	43	41	10	43	41	10	43	41	10	43
42	11	43	42	11	43	42	11	43	42	11	43	42	11	43	42	11	43	42	11	43
43	12	43	43	12	43	43	12	43	43	12	43	43	12	43	43	12	43	43	12	43
44	13	43	44	13	43	44	13	43	44	13	43	44	13	43	44	13	43	44	13	43
45	14	43	45	14	43	45	14	43	45	14	43	45	14	43	45	14	43	45	14	43
46	15	43	46	15	43	46	15	43	46	15	43	46	15	43	46	15	43	46	15	43
47	16	43	47	16	43	47	16	43	47	16	43	47	16	43	47	16	43	47	16	43
48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	43	48	17	43
49	18	26	49	18	26	49	18	43	49	18	43	49	18	43	49	18	43	49	18	43
50	19	25	50	19	24	50	19	43	50	19	43	50	19	43	50	19	43	50	19	43
51	20	24	51	20	21	51	20	43	51	20	43	51	20	43	51	20	43	51	20	43
52	21	22	52	21	21	52	21	43	52	21	43	52	21	43	52	21	43	52	21	43
53	22	17	53	22	20	53	22	43	53	22	21	53	22	43	53	22	43	53	22	43
54	23	18	54	23	17	54	23	16	54	23	19	54	23	43	54	23	43	54	23	43
55	24	15	55	24	15	55	24	16	55	24	17	55	24	19	55	24	43	55	24	43
56	25	11	56	25	15	56	25	16	56	25	16	56	25	17	56	25	19	56	25	43
57	26	13	57	26	11	57	26	12	57	26	12	57	26	13	57	26	18	57	26	43
58	27	7	58	27	8	58	27	10	58	27	12	58	27	13	58	27	14	58	27	43
59	28	4	59	28	7	59	28	8	59	28	9	59	28	11	59	28	12	59	28	43
60	29	3	60	29	6	60	29	7	60	29	6	60	29	10	60	29	11	60	29	10
61	30	1	61	30	2	61	30	4	61	30	6	61	30	6	61	30	8	61	30	8
62	31	0	62	31	43	62	31	2	62	31	43	62	31	5	62	31	5	62	31	5
63	1	43	63	1	43	63	31	43	63	1	43	63	1	1	63	1	0	63	1	0

TABLE 9

RELATIONSHIP OF NUMBER OF STATES OF FINITE MACHINES AND AVERAGE ERROR

Exp. No.	No. of States	Equivalent State Size	Used State Input Pairs	Recall	Average Error in Symbols
9	31	63	909	4000	1.35
13	15	15	258	4000	1.762
14	31	31	473	4000	1.465

TABLE 10

SUMMARY OF INVESTIGATION OF TIME INTERVAL OF SAMPLING DATA

Exp. No.	Description			Input Type	Time Interval Sec.	Aver. Error in Symbols	Aver. Error in Percent
21	31 State	64 Symbols	Magnitude of Difference	Rate	.15	1.72	2.68
22	31 State	64 Symbols	Magnitude of Difference	Rate	.07	2.09	3.26
23	31 State	64 Symbols	Magnitude of Difference	Rate	.10	1.77	2.76
24	49 State	100 Symbols	Average Setting	Rate	.10	2.49	2.49
25	49 State	100 Symbols	Average Setting	Display	.10	4.18	4.18
29	31 State	64 Symbols	Average Setting	Rate	.15	1.85	2.89
30	31 State	64 Symbols	All or Nothing	Rate	.15	2.10	3.28
37	49 State	100 Symbols	Average Setting	Rate	.15	2.09	2.09

TABLE 11

SUMMARY OF INVESTIGATION OF TIME DELAY INTRODUCED IN OUTPUT TO CORRESPOND TO HUMAN OPERATOR'S REACTION TIME

Exp. No.	Time Interval In Sec.	Aver. Error Delay In Sec.	Aver. Error 31 State	Aver. Error 1 State	Type of Input
21	.15	.0	1.72	6.34	Rate
26	.15	.15	1.73	4.48	Rate
27	.15	.30	1.69	2.31	Rate
28	.15	.45	2.13	3.84	Rate

TABLE 12

RESULTS OF DISPLAY ERROR INPUT WITH DELAY

Exp. No.	Scoring Method for Setting Output	Machine Size	Delay in Seconds	Aver. Error in Symbols	Adjusted Error in Percent
36	Average	31	.30	1.06	1.65
38	Magnitude of Difference	31	.30	1.01	1.57
39	All or Nothing	31	.30	1.12	1.75
41	Average	15	.30	1.35	2.11
42	Average	7	.30	2.01	3.12

TABLE 13

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 36

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	39	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	31	1	1	35	1	1	62	1	1	38	1	1	32	1	1	32	1	1	32	1	1	32
2	2	31	2	2	32	2	2	33	2	2	32	2	2	37	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	34	3	3	35	3	3	38	3	3	32	3	3	43
4	4	31	4	4	32	4	4	32	4	4	32	4	4	34	4	4	34	4	4	36	4	4	40
5	5	32	5	5	32	5	5	31	5	5	32	5	5	32	5	5	33	5	5	34	5	5	35
6	6	30	6	6	31	6	6	31	6	6	32	6	6	31	6	6	34	6	6	35	6	6	35
7	7	32	7	7	32	7	7	32	7	7	32	7	7	31	7	7	32	7	7	32	7	7	34
8	8	32	8	8	32	8	8	32	8	8	32	8	8	31	8	8	32	8	8	32	8	8	33
9	9	32	9	9	32	9	9	31	9	9	31	9	9	31	9	9	31	9	9	31	9	9	32
10	10	32	10	10	32	10	10	32	10	10	31	10	10	31	10	10	31	10	10	31	10	10	31
11	11	32	11	11	32	11	11	32	11	11	31	11	11	30	11	11	30	11	11	31	11	11	31
12	12	32	12	12	32	12	12	32	12	12	32	12	12	32	12	12	31	12	12	32	12	12	31
13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	28	13	13	31
14	14	32	14	14	32	14	14	32	14	14	32	14	14	32	14	14	32	14	14	32	14	14	31
15	15	32	15	15	32	15	15	32	15	15	32	15	15	32	15	15	32	15	15	32	15	15	32
16	16	32	16	16	32	16	16	32	16	16	32	16	16	32	16	16	21	16	16	32	16	16	32
17	17	32	17	17	32	17	17	32	17	17	32	17	17	32	17	17	32	17	17	32	17	17	32
18	18	32	18	18	32	18	18	32	18	18	32	18	18	32	18	18	32	18	18	32	18	18	32
19	19	31	19	19	32	19	19	32	19	19	32	19	19	32	19	19	32	19	19	32	19	19	32
20	20	32	20	20	32	20	20	32	20	20	32	20	20	32	20	20	32	20	20	32	20	20	32
21	21	32	21	21	32	21	21	32	21	21	32	21	21	32	21	21	32	21	21	32	21	21	32
22	22	58	22	22	61	22	22	63	22	22	63	22	22	32	22	22	32	22	22	32	22	22	32
23	23	55	23	23	58	23	23	63	23	23	32	23	23	32	23	23	32	23	23	32	23	23	32
24	24	51	24	24	32	24	24	58	24	24	63	24	24	32	24	24	32	24	24	32	24	24	32
25	25	50	25	25	53	25	25	56	25	25	58	25	25	32	25	25	32	25	25	32	25	25	32
26	26	46	26	26	49	26	26	54	26	26	55	26	26	53	26	26	32	26	26	63	26	26	32
27	27	44	27	27	47	27	27	51	27	27	53	27	27	56	27	27	57	27	27	32	27	27	63
28	28	42	28	28	46	28	28	48	28	28	48	28	28	53	28	28	58	28	28	59	28	28	32
29	29	41	29	29	42	29	29	45	29	29	48	29	29	51	29	29	52	29	29	53	29	29	55
30	30	38	30	30	39	30	30	42	30	30	46	30	30	47	30	30	50	30	30	53	30	30	53
31	31	35	31	31	36	31	31	39	31	31	44	31	31	46	31	31	47	31	31	48	31	31	51

TABLE 13 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 36

32	1	31	32	1	34	32	1	37	32	1	39	32	1	40	32	1	45	32	1	47	32	1	51
33	2	28	33	2	31	33	2	33	33	2	34	33	2	37	33	2	39	33	2	42	33	2	44
34	3	25	34	3	29	34	3	31	34	3	32	34	3	34	34	3	36	34	3	39	34	3	42
35	4	24	35	4	27	35	4	28	35	4	31	35	4	32	35	4	34	35	4	36	35	4	41
36	5	21	36	5	24	36	5	26	36	5	29	36	5	30	36	5	32	36	5	32	36	5	33
37	6	19	37	6	21	37	6	23	37	6	27	37	6	29	37	6	31	37	6	31	37	6	32
38	7	15	38	7	18	38	7	20	38	7	24	38	7	26	38	7	29	38	7	30	38	7	32
39	8	14	39	8	17	39	8	19	39	8	21	39	8	24	39	8	27	39	8	27	39	8	31
40	9	12	40	9	14	40	9	15	40	9	20	40	9	22	40	9	24	40	9	27	40	9	29
41	10	6	41	10	9	41	10	12	41	10	16	41	10	19	41	10	23	41	10	24	41	10	26
42	11	7	42	11	8	42	11	11	42	11	15	42	11	15	42	11	20	42	11	22	42	11	25
43	12	32	43	12	32	43	12	7	43	12	9	43	12	14	43	12	18	43	12	20	43	12	23
44	13	32	44	13	3	44	13	32	44	13	32	44	13	13	44	13	15	44	13	19	44	13	19
45	14	32	45	14	5	45	14	32	45	14	32	45	14	10	45	14	10	45	14	14	45	14	15
46	15	32	46	15	32	46	15	32	46	15	32	46	15	6	46	15	8	46	15	13	46	15	32
47	16	32	47	16	32	47	16	32	47	16	32	47	16	32	47	16	8	47	16	9	47	16	16
48	17	32	48	17	32	48	17	32	48	17	32	48	17	1	48	17	4	48	17	32	48	17	9
49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32
50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	8
51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32
52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32
53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32
54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32
55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32
56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32
57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32
58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32
59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32
60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32
61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32
63	1	31	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32

TABLE 13 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 36

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32
2	2	32	2	2	32	2	2	47	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32
4	4	41	4	4	32	4	4	45	4	4	45	4	4	32	4	4	32	4	4	32	4	4	32
5	5	32	5	5	41	5	5	32	5	5	45	5	5	32	5	5	48	5	5	32	5	5	32
6	6	37	6	6	41	6	6	39	6	6	44	6	6	44	6	6	32	6	6	50	6	6	32
7	7	36	7	7	37	7	7	38	7	7	41	7	7	45	7	7	45	7	7	32	7	7	32
8	8	33	8	8	36	8	8	37	8	8	40	8	8	42	8	8	47	8	8	43	8	8	50
9	9	32	9	9	32	9	9	36	9	9	37	9	9	42	9	9	41	9	9	45	9	9	45
10	10	32	10	10	33	10	10	34	10	10	36	10	10	36	10	10	41	10	10	43	10	10	46
11	11	31	11	11	31	11	11	32	11	11	34	11	11	36	11	11	38	11	11	39	11	11	41
12	12	31	12	12	32	12	12	31	12	12	32	12	12	32	12	12	34	12	12	36	12	12	44
13	13	31	13	13	31	13	13	31	13	13	31	13	13	32	13	13	33	13	13	35	13	13	38
14	14	31	14	14	31	14	14	31	14	14	32	14	14	31	14	14	33	14	14	34	14	14	35
15	15	31	15	15	32	15	15	31	15	15	31	15	15	32	15	15	31	15	15	33	15	15	34
16	16	28	16	16	31	16	16	31	16	16	31	16	16	31	16	16	31	16	16	31	16	16	32
17	17	32	17	17	29	17	17	30	17	17	31	17	17	31	17	17	31	17	17	31	17	17	32
18	18	20	18	18	25	18	18	32	18	18	30	18	18	31	18	18	30	18	18	32	18	18	31
19	19	32	19	19	17	19	19	25	19	19	23	19	19	25	19	19	31	19	19	31	19	19	31
20	20	32	20	20	32	20	20	32	20	20	32	20	20	22	20	20	28	20	20	30	20	20	31
21	21	32	21	21	32	21	21	15	21	21	32	21	21	32	21	21	21	21	21	26	21	21	28
22	22	32	22	22	32	22	22	32	22	22	32	22	22	32	22	22	32	22	22	21	22	22	25
23	23	32	23	23	32	23	23	32	23	23	32	23	23	13	23	23	17	23	23	23	23	23	21
24	24	32	24	24	32	24	24	32	24	24	32	24	24	32	24	24	32	24	24	32	24	24	17
25	25	32	25	25	32	25	25	32	25	25	32	25	25	32	25	25	32	25	25	32	25	25	12
26	26	32	26	26	32	26	26	32	26	26	32	26	26	32	26	26	32	26	26	32	26	26	32
27	27	32	27	27	32	27	27	32	27	27	32	27	27	32	27	27	32	27	27	32	27	27	6
28	28	32	28	28	32	28	28	32	28	28	32	28	28	32	28	28	32	28	28	32	28	28	32
29	29	32	29	29	32	29	29	32	29	29	32	29	29	32	29	29	32	29	29	32	29	29	32
30	30	32	30	30	32	30	30	32	30	30	32	30	30	32	30	30	32	30	30	32	30	30	32
31	31	32	31	31	32	31	31	32	31	31	32	31	31	32	31	31	32	31	31	32	31	31	32

TABLE 13 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 36

32	1	52	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32
33	2	50	33	2	52	33	2	50	33	2	55	33	2	32	33	2	32	33	2	32	33	2	32
34	3	46	34	3	48	34	3	32	34	3	52	34	3	53	34	3	56	34	3	32	34	3	32
35	4	42	35	4	44	35	4	46	35	4	48	35	4	32	35	4	55	35	4	56	35	4	32
36	5	36	36	5	44	36	5	43	36	5	46	36	5	47	36	5	32	36	5	32	36	5	32
37	6	34	37	6	40	37	6	39	37	6	43	37	6	44	37	6	45	37	6	50	37	6	51
38	7	33	38	7	32	38	7	35	38	7	38	38	7	43	38	7	43	38	7	32	38	7	32
39	8	31	39	8	32	39	8	33	39	8	34	39	8	37	39	8	41	39	8	42	39	8	45
40	9	30	40	9	32	40	9	32	40	9	34	40	9	34	40	9	36	40	9	34	40	9	32
41	10	28	41	10	30	41	10	32	41	10	32	41	10	34	41	10	33	41	10	37	41	10	37
42	11	26	42	11	29	42	11	31	42	11	32	42	11	32	42	11	32	42	11	33	42	11	33
43	12	25	43	12	27	43	12	28	43	12	31	43	12	32	43	12	32	43	12	32	43	12	33
44	13	23	44	13	24	44	13	27	44	13	29	44	13	31	44	13	31	44	13	32	44	13	32
45	14	23	45	14	24	45	14	25	45	14	28	45	14	29	45	14	30	45	14	31	45	14	32
46	15	18	46	15	32	46	15	23	46	15	24	46	15	27	46	15	30	46	15	31	46	15	31
47	16	16	47	16	16	47	16	18	47	16	24	47	16	25	47	16	28	47	16	30	47	16	31
48	17	10	48	17	14	48	17	18	48	17	21	48	17	22	48	17	24	48	17	27	48	17	30
49	18	9	49	18	12	49	18	16	49	18	16	49	18	20	49	18	32	49	18	26	49	18	27
50	19	32	50	19	11	50	19	14	50	19	17	50	19	32	50	19	19	50	19	23	50	19	25
51	20	9	51	20	32	51	20	32	51	20	13	51	20	32	51	20	17	51	20	32	51	20	21
52	21	32	52	21	32	52	21	32	52	21	12	52	21	17	52	21	17	52	21	16	52	21	18
53	22	32	53	22	32	53	22	7	53	22	32	53	22	32	53	22	32	53	22	15	53	22	18
54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	16
55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32
56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32
57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32
58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32
59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32
60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32
61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32
63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32

TABLE 13 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 36

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32
2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32
4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32
5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32
6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32
7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32
8	8	52	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32
9	9	50	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32
10	10	48	10	10	51	10	10	53	10	10	32	10	10	32	10	10	32	10	10	32	10	10	32
11	11	44	11	11	48	11	11	51	11	11	32	11	11	32	11	11	59	11	11	61	11	11	32
12	12	42	12	12	45	12	12	49	12	12	52	12	12	55	12	12	55	12	12	32	12	12	58
13	13	44	13	13	42	13	13	43	13	13	46	13	13	51	13	13	53	13	13	32	13	13	57
14	14	39	14	14	40	14	14	42	14	14	45	14	14	50	14	14	51	14	14	57	14	14	32
15	15	36	15	15	42	15	15	41	15	15	41	15	15	32	15	15	47	15	15	51	15	15	32
16	16	34	16	16	35	16	16	38	16	16	40	16	16	41	16	16	45	16	16	50	16	16	51
17	17	32	17	17	33	17	17	38	17	17	38	17	17	40	17	17	41	17	17	44	17	17	49
18	18	31	18	18	33	18	18	34	18	18	35	18	18	38	18	18	41	18	18	42	18	18	47
19	19	31	19	19	32	19	19	34	19	19	34	19	19	38	19	19	37	19	19	41	19	19	42
20	20	31	20	20	31	20	20	32	20	20	32	20	20	34	20	20	36	20	20	38	20	20	41
21	21	31	21	21	31	21	21	31	21	21	32	21	21	32	21	21	34	21	21	37	21	21	38
22	22	26	22	22	29	22	22	30	22	22	31	22	22	32	22	22	33	22	22	35	22	22	36
23	23	24	23	23	27	23	23	28	23	23	30	23	23	31	23	23	31	23	23	33	23	23	35
24	24	19	24	24	22	24	24	28	24	24	27	24	24	30	24	24	31	24	24	30	24	24	33
25	25	18	25	25	18	25	25	23	25	25	23	25	25	27	25	25	28	25	25	31	25	25	31
26	26	16	26	26	16	26	26	19	26	26	20	26	26	23	26	26	25	26	26	30	26	26	30
27	27	32	27	27	11	27	27	12	27	27	20	27	27	16	27	27	22	27	27	25	27	27	29
28	28	32	28	28	32	28	28	11	28	28	17	28	28	15	28	28	19	28	28	20	28	28	23
29	29	32	29	29	6	29	29	32	29	29	32	29	29	11	29	29	15	29	29	17	29	29	19
30	30	32	30	30	32	30	30	32	30	30	32	30	30	11	30	30	12	30	30	14	30	30	18
31	31	32	31	31	32	31	31	4	31	31	7	31	31	8	31	31	32	31	31	11	31	31	14

TABLE 13 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 36

32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	8	32	1	11
33	2	32	33	2	32	33	2	32	33	2	32	33	2	3	33	2	32	33	2	3	33	2	8
34	3	32	34	3	32	34	3	32	34	3	32	34	3	32	34	3	32	34	3	32	34	3	7
35	4	32	35	4	32	35	4	32	35	4	32	35	4	32	35	4	32	35	4	32	35	4	32
36	5	32	36	5	32	36	5	32	36	5	32	36	5	32	36	5	32	36	5	32	36	5	32
37	6	32	37	6	32	37	6	32	37	6	32	37	6	32	37	6	32	37	6	32	37	6	32
38	7	53	38	7	32	38	7	32	38	7	32	38	7	32	38	7	32	38	7	32	38	7	32
39	8	52	39	8	32	39	8	32	39	8	32	39	8	32	39	8	32	39	8	32	39	8	32
40	9	32	40	9	32	40	9	32	40	9	32	40	9	32	40	9	32	40	9	32	40	9	32
41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	32
42	11	37	42	11	36	42	11	32	42	11	32	42	11	32	42	11	32	42	11	32	42	11	32
43	12	34	43	12	36	43	12	37	43	12	40	43	12	41	43	12	32	43	12	32	43	12	32
44	13	32	44	13	34	44	13	33	44	13	37	44	13	32	44	13	32	44	13	32	44	13	32
45	14	32	45	14	33	45	14	32	45	14	33	45	14	35	45	14	40	45	14	32	45	14	32
46	15	32	46	15	32	46	15	32	46	15	32	46	15	36	46	15	39	46	15	32	46	15	32
47	16	32	47	16	32	47	16	32	47	16	33	47	16	31	47	16	33	47	16	38	47	16	32
48	17	31	48	17	31	48	17	32	48	17	32	48	17	32	48	17	34	48	17	32	48	17	32
49	18	28	49	18	30	49	18	31	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32
50	19	28	50	19	29	50	19	31	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32
51	20	25	51	20	28	51	20	30	51	20	31	51	20	31	51	20	32	51	20	32	51	20	32
52	21	23	52	21	26	52	21	28	52	21	29	52	21	31	52	21	32	52	21	32	52	21	32
53	22	21	53	22	23	53	22	25	53	22	28	53	22	29	53	22	31	53	22	31	53	22	32
54	23	17	54	23	21	54	23	20	54	23	25	54	23	32	54	23	29	54	23	30	54	23	32
55	24	18	55	24	18	55	24	22	55	24	23	55	24	25	55	24	27	55	24	29	55	24	31
56	25	14	56	25	32	56	25	32	56	25	22	56	25	23	56	25	25	56	25	28	56	25	29
57	26	10	57	26	32	57	26	17	57	26	32	57	26	28	57	26	25	57	26	27	57	26	28
58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	21	58	27	24	58	27	25
59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32
60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32
61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32
63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32

TABLE 13 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 36

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32
2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32
4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32
5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32
6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32
7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32
8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32
9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32
10	10	32	10	10	32	10	10	32	10	10	32	10	10	32	10	10	32	10	10	32
11	11	32	11	11	32	11	11	32	11	11	32	11	11	32	11	11	32	11	11	32
12	12	32	12	12	32	12	12	32	12	12	32	12	12	32	12	12	32	12	12	32
13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	32
14	14	32	14	14	61	14	14	32	14	14	32	14	14	32	14	14	32	14	14	32
15	15	55	15	15	32	15	15	62	15	15	32	15	15	32	15	15	32	15	15	32
16	16	56	16	16	32	16	16	32	16	16	32	16	16	32	16	16	32	16	16	32
17	17	52	17	17	56	17	17	58	17	17	58	17	17	32	17	17	32	17	17	32
18	18	50	18	18	52	18	18	53	18	18	57	18	18	32	18	18	32	18	18	32
19	19	47	19	19	51	19	19	52	19	19	32	19	19	57	19	19	32	19	19	32
20	20	32	20	20	45	20	20	48	20	20	32	20	20	54	20	20	56	20	20	32
21	21	39	21	21	41	21	21	48	21	21	48	21	21	51	21	21	56	21	21	32
22	22	38	22	22	40	22	22	44	22	22	46	22	22	50	22	22	54	22	22	57
23	23	37	23	23	39	23	23	42	23	23	44	23	23	45	23	23	50	23	23	53
24	24	34	24	24	36	24	24	39	24	24	43	24	24	43	24	24	48	24	24	50
25	25	32	25	25	35	25	25	37	25	25	39	25	25	41	25	25	44	25	25	47
26	26	31	26	26	32	26	26	34	26	26	36	26	26	39	26	26	41	26	26	45
27	27	28	27	27	31	27	27	33	27	27	34	27	27	37	27	27	41	27	27	43
28	28	26	28	28	30	28	28	30	28	28	32	28	28	34	28	28	38	28	28	38
29	29	21	29	29	26	29	29	30	29	29	30	29	29	32	29	29	36	29	29	38
30	30	18	30	30	22	30	30	26	30	30	28	30	30	29	30	30	31	30	30	34
31	31	16	31	31	19	31	31	21	31	31	23	31	31	26	31	31	29	31	31	32

TABLE 13 - CONCLUDED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 36

32	1	13	32	1	15	32	1	17	32	1	21	32	1	24	32	1	27	32	1	31
33	2	10	33	2	13	33	2	14	33	2	18	33	2	19	33	2	24	33	2	27
34	3	9	34	3	12	34	3	14	34	3	16	34	3	17	34	3	21	34	3	24
35	4	32	35	4	9	35	4	9	35	4	14	35	4	14	35	4	17	35	4	23
36	5	1	36	5	6	36	5	10	36	5	11	36	5	12	36	5	16	36	5	18
37	6	32	37	6	32	37	6	4	37	6	8	37	6	11	37	6	13	37	6	14
38	7	32	38	7	32	38	7	32	38	7	32	38	7	9	38	7	12	38	7	12
39	8	32	39	8	32	39	8	0	39	8	3	39	8	5	39	8	7	39	8	6
40	9	32	40	9	32	40	9	32	40	9	32	40	9	1	40	9	32	40	9	6
41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	3	41	10	5
42	11	32	42	11	32	42	11	32	42	11	32	42	11	32	42	11	32	42	11	0
43	12	32	43	12	32	43	12	32	43	12	32	43	12	32	43	12	32	43	12	32
44	13	32	44	13	32	44	13	32	44	13	32	44	13	32	44	13	32	44	13	32
45	14	32	45	14	32	45	14	32	45	14	32	45	14	32	45	14	32	45	14	32
46	15	32	46	15	32	46	15	32	46	15	32	46	15	32	46	15	32	46	15	32
47	16	32	47	16	32	47	16	32	47	16	32	47	16	32	47	16	32	47	16	32
48	17	32	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32
49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32
50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32
51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32
52	21	32	52	21	33	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32
53	22	32	53	22	33	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32
54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32
55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32
56	25	30	56	25	31	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32
57	26	31	57	26	31	57	26	31	57	26	32	57	26	32	57	26	32	57	26	32
58	27	28	58	27	30	58	27	31	58	27	32	58	27	32	58	27	31	58	27	32
59	28	26	59	28	27	59	28	29	59	28	31	59	28	31	59	28	32	59	28	32
60	29	32	60	29	32	60	29	28	60	29	30	60	29	32	60	29	31	60	29	32
61	30	32	61	30	24	61	30	24	61	30	27	61	30	30	61	30	31	61	30	31
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	29	62	31	31
63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	28	63	1	28

TABLE 14

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 38

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	37	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	31	1	1	35	1	1	32	1	1	36	1	1	32	1	1	32	1	1	32	1	1	32
2	2	31	2	2	32	2	2	33	2	2	32	2	2	37	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	34	3	3	34	3	3	38	3	3	32	3	3	41
4	4	31	4	4	31	4	4	32	4	4	32	4	4	33	4	4	34	4	4	36	4	4	39
5	5	31	5	5	32	5	5	31	5	5	32	5	5	31	5	5	33	5	5	35	5	5	35
6	6	30	6	6	31	6	6	31	6	6	31	6	6	31	6	6	34	6	6	35	6	6	35
7	7	32	7	7	32	7	7	32	7	7	32	7	7	31	7	7	32	7	7	32	7	7	34
8	8	32	8	8	32	8	8	32	8	8	32	8	8	31	8	8	31	8	8	32	8	8	33
9	9	32	9	9	32	9	9	31	9	9	31	9	9	31	9	9	31	9	9	31	9	9	32
10	10	32	10	10	32	10	10	32	10	10	31	10	10	31	10	10	31	10	10	31	10	10	31
11	11	32	11	11	32	11	11	32	11	11	31	11	11	30	11	11	29	11	11	31	11	11	31
12	12	32	12	12	32	12	12	32	12	12	32	12	12	32	12	12	31	12	12	32	12	12	31
13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	28	13	13	31
14	14	32	14	14	32	14	14	32	14	14	32	14	14	32	14	14	32	14	14	32	14	14	31
15	15	32	15	15	32	15	15	32	15	15	32	15	15	32	15	15	32	15	15	32	15	15	32
16	16	32	16	16	32	16	16	32	16	16	32	16	16	32	16	16	21	16	16	32	16	16	32
17	17	32	17	17	32	17	17	32	17	17	32	17	17	32	17	17	32	17	17	32	17	17	32
18	18	32	18	18	32	18	18	32	18	18	32	18	18	32	18	18	32	18	18	32	18	18	32
19	19	31	19	19	32	19	19	32	19	19	32	19	19	32	19	19	32	19	19	32	19	19	32
20	20	32	20	20	32	20	20	32	20	20	32	20	20	32	20	20	32	20	20	32	20	20	32
21	21	32	21	21	32	21	21	32	21	21	32	21	21	32	21	21	32	21	21	32	21	21	32
22	22	58	22	22	61	22	22	63	22	22	63	22	22	32	22	22	32	22	22	32	22	22	32
23	23	55	23	23	56	23	23	63	23	23	32	23	23	32	23	23	32	23	23	32	23	23	32
24	24	51	24	24	32	24	24	56	24	24	63	24	24	32	24	24	32	24	24	32	24	24	32
25	25	50	25	25	51	25	25	55	25	25	58	25	25	32	25	25	32	25	25	32	25	25	32
26	26	46	26	26	50	26	26	54	26	26	54	26	26	53	26	26	32	26	26	63	26	26	32
27	27	43	27	27	47	27	27	50	27	27	53	27	27	56	27	27	57	27	27	32	27	27	63
28	28	42	28	28	44	28	28	48	28	28	48	28	28	55	28	28	58	28	28	59	28	28	32
29	29	40	29	29	42	29	29	42	29	29	47	29	29	50	29	29	52	29	29	53	29	29	54
30	30	37	30	30	38	30	30	43	30	30	45	30	30	47	30	30	51	30	30	52	30	30	53
31	31	34	31	31	36	31	31	38	31	31	43	31	31	46	31	31	46	31	31	47	31	31	50

TABLE 14 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 38

32	1	31	32	1	34	32	1	38	32	1	39	32	1	40	32	1	45	32	1	47	32	1	51
33	2	28	33	2	31	33	2	32	33	2	33	33	2	35	33	2	39	33	2	42	33	2	40
34	3	25	34	3	29	34	3	31	34	3	33	34	3	32	34	3	35	34	3	38	34	3	43
35	4	23	35	4	25	35	4	29	35	4	31	35	4	31	35	4	34	35	4	35	35	4	41
36	5	20	36	5	24	36	5	26	36	5	29	36	5	30	36	5	32	36	5	32	36	5	33
37	6	17	37	6	23	37	6	23	37	6	27	37	6	29	37	6	31	37	6	31	37	6	31
38	7	13	38	7	18	38	7	20	38	7	23	38	7	25	38	7	29	38	7	31	38	7	32
39	8	14	39	8	17	39	8	20	39	8	21	39	8	24	39	8	28	39	8	27	39	8	31
40	9	11	40	9	14	40	9	14	40	9	19	40	9	21	40	9	24	40	9	26	40	9	29
41	10	6	41	10	9	41	10	9	41	10	17	41	10	18	41	10	22	41	10	24	41	10	26
42	11	7	42	11	7	42	11	11	42	11	14	42	11	14	42	11	18	42	11	21	42	11	25
43	12	32	43	12	32	43	12	7	43	12	9	43	12	14	43	12	18	43	12	20	43	12	22
44	13	32	44	13	3	44	13	32	44	13	32	44	13	12	44	13	14	44	13	19	44	13	20
45	14	32	45	14	5	45	14	32	45	14	32	45	14	10	45	14	10	45	14	12	45	14	13
46	15	32	46	15	32	46	15	32	46	15	32	46	15	6	46	15	7	46	15	13	46	15	32
47	16	32	47	16	32	47	16	32	47	16	32	47	16	32	47	16	7	47	16	9	47	16	16
48	17	32	48	17	32	48	17	32	48	17	32	48	17	1	48	17	4	48	17	32	48	17	9
49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32
50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	8
51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32
52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32
53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32
54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32
55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32
56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32
57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32
58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32
59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32
60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32
61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32
63	1	31	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32

TABLE 14 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 38

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32
2	2	32	2	2	32	2	2	47	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32
4	4	39	4	4	32	4	4	44	4	4	45	4	4	32	4	4	32	4	4	32	4	4	32
5	5	32	5	5	42	5	5	32	5	5	45	5	5	32	5	5	48	5	5	32	5	5	32
6	6	36	6	6	40	6	6	39	6	6	45	6	6	44	6	6	32	6	6	50	6	6	32
7	7	35	7	7	36	7	7	38	7	7	39	7	7	45	7	7	45	7	7	32	7	7	32
8	8	32	8	8	36	8	8	37	8	8	40	8	8	42	8	8	46	8	8	43	8	8	50
9	9	32	9	9	32	9	9	35	9	9	37	9	9	42	9	9	40	9	9	45	9	9	44
10	10	32	10	10	32	10	10	34	10	10	36	10	10	35	10	10	39	10	10	39	10	10	46
11	11	31	11	11	31	11	11	32	11	11	34	11	11	36	11	11	36	11	11	39	11	11	41
12	12	31	12	12	32	12	12	31	12	12	32	12	12	32	12	12	34	12	12	36	12	12	44
13	13	31	13	13	31	13	13	31	13	13	31	13	13	32	13	13	33	13	13	35	13	13	38
14	14	31	14	14	30	14	14	31	14	14	31	14	14	31	14	14	32	14	14	34	14	14	35
15	15	31	15	15	32	15	15	31	15	15	31	15	15	31	15	15	31	15	15	32	15	15	33
16	16	28	16	16	31	16	16	31	16	16	31	16	16	31	16	16	31	16	16	31	16	16	32
17	17	32	17	17	27	17	17	30	17	17	32	17	17	31	17	17	31	17	17	31	17	17	32
18	18	19	18	18	25	18	18	32	18	18	28	18	18	30	18	18	31	18	18	31	18	18	31
19	19	32	19	19	17	19	19	23	19	19	23	19	19	25	19	19	30	19	19	31	19	19	31
20	20	32	20	20	32	20	20	32	20	20	32	20	20	19	20	20	26	20	20	30	20	20	31
21	21	32	21	21	32	21	21	15	21	21	32	21	21	32	21	21	20	21	21	26	21	21	28
22	22	32	22	22	32	22	22	32	22	22	32	22	22	32	22	22	32	22	22	21	22	22	25
23	23	32	23	23	32	23	23	32	23	23	32	23	23	13	23	23	17	23	23	23	23	23	21
24	24	32	24	24	32	24	24	32	24	24	32	24	24	32	24	24	32	24	24	32	24	24	16
25	25	32	25	25	32	25	25	32	25	25	32	25	25	32	25	25	32	25	25	32	25	25	12
26	26	32	26	26	32	26	26	32	26	26	32	26	26	32	26	26	32	26	26	32	26	26	32
27	27	32	27	27	32	27	27	32	27	27	32	27	27	32	27	27	32	27	27	32	27	27	6
28	28	32	28	28	32	28	28	32	28	28	32	28	28	32	28	28	32	28	28	32	28	28	32
29	29	32	29	29	32	29	29	32	29	29	32	29	29	32	29	29	32	29	29	32	29	29	32
30	30	32	30	30	32	30	30	32	30	30	32	30	30	32	30	30	32	30	30	32	30	30	32
31	31	32	31	31	32	31	31	32	31	31	32	31	31	32	31	31	32	31	31	32	31	31	32

TABLE 14 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 38

32	1	50	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32
33	2	50	33	2	52	33	2	50	33	2	55	33	2	32	33	2	32	33	2	32	33	2	32
34	3	46	34	3	48	34	3	32	34	3	52	34	3	53	34	3	56	34	3	32	34	3	32
35	4	42	35	4	41	35	4	46	35	4	47	35	4	32	35	4	55	35	4	54	35	4	32
36	5	36	36	5	44	36	5	42	36	5	46	36	5	47	36	5	32	36	5	32	36	5	32
37	6	33	37	6	37	37	6	39	37	6	42	37	6	44	37	6	45	37	6	49	37	6	51
38	7	32	38	7	32	38	7	34	38	7	38	38	7	43	38	7	42	38	7	32	38	7	32
39	8	31	39	8	32	39	8	32	39	8	32	39	8	34	39	8	39	39	8	42	39	8	45
40	9	30	40	9	31	40	9	32	40	9	33	40	9	34	40	9	35	40	9	34	40	9	32
41	10	29	41	10	31	41	10	32	41	10	32	41	10	33	41	10	32	41	10	37	41	10	37
42	11	25	42	11	29	42	11	31	42	11	32	42	11	32	42	11	32	42	11	33	42	11	32
43	12	24	43	12	27	43	12	28	43	12	31	43	12	32	43	12	32	43	12	32	43	12	32
44	13	23	44	13	24	44	13	26	44	13	27	44	13	30	44	13	31	44	13	32	44	13	32
45	14	22	45	14	25	45	14	25	45	14	28	45	14	29	45	14	30	45	14	31	45	14	32
46	15	18	46	15	32	46	15	23	46	15	24	46	15	27	46	15	30	46	15	31	46	15	31
47	16	13	47	16	16	47	16	17	47	16	24	47	16	26	47	16	28	47	16	30	47	16	31
48	17	10	48	17	13	48	17	18	48	17	18	48	17	20	48	17	25	48	17	26	48	17	29
49	18	9	49	18	11	49	18	16	49	18	18	49	18	20	49	18	32	49	18	26	49	18	26
50	19	32	50	19	12	50	19	14	50	19	17	50	19	32	50	19	16	50	19	23	50	19	24
51	20	9	51	20	32	51	20	32	51	20	12	51	20	32	51	20	15	51	20	32	51	20	19
52	21	32	52	21	32	52	21	32	52	21	12	52	21	17	52	21	17	52	21	16	52	21	18
53	22	32	53	22	32	53	22	7	53	22	32	53	22	32	53	22	32	53	22	14	53	22	18
54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	15
55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32
56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32
57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32
58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32
59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32
60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32
61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32
63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32

TABLE 14 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 38

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32
2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32
4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32
5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32
6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32
7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32
8	8	50	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32
9	9	50	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32
10	10	48	10	10	50	10	10	53	10	10	32	10	10	32	10	10	32	10	10	32	10	10	32
11	11	44	11	11	47	11	11	51	11	11	32	11	11	32	11	11	58	11	11	61	11	11	32
12	12	42	12	12	44	12	12	49	12	12	52	12	12	55	12	12	55	12	12	32	12	12	58
13	13	44	13	13	41	13	13	43	13	13	45	13	13	49	13	13	53	13	13	32	13	13	55
14	14	37	14	14	38	14	14	41	14	14	42	14	14	50	14	14	50	14	14	56	14	14	32
15	15	36	15	15	42	15	15	39	15	15	41	15	15	32	15	15	48	15	15	49	15	15	32
16	16	34	16	16	35	16	16	38	16	16	39	16	16	41	16	16	45	16	16	47	16	16	51
17	17	32	17	17	33	17	17	37	17	17	38	17	17	40	17	17	41	17	17	44	17	17	50
18	18	31	18	18	33	18	18	34	18	18	35	18	18	39	18	18	41	18	18	40	18	18	47
19	19	31	19	19	32	19	19	34	19	19	33	19	19	38	19	19	37	19	19	40	19	19	40
20	20	31	20	20	31	20	20	31	20	20	32	20	20	34	20	20	36	20	20	38	20	20	40
21	21	31	21	21	31	21	21	31	21	21	31	21	21	32	21	21	34	21	21	37	21	21	37
22	22	25	22	22	26	22	22	30	22	22	31	22	22	32	22	22	32	22	22	35	22	22	36
23	23	23	23	23	25	23	23	28	23	23	31	23	23	31	23	23	31	23	23	33	23	23	35
24	24	18	24	24	21	24	24	27	24	24	28	24	24	31	24	24	31	24	24	31	24	24	33
25	25	18	25	25	18	25	25	21	25	25	23	25	25	26	25	25	27	25	25	31	25	25	31
26	26	16	26	26	13	26	26	19	26	26	19	26	26	21	26	26	24	26	26	31	26	26	31
27	27	32	27	27	11	27	27	12	27	27	21	27	27	17	27	27	21	27	27	24	27	27	30
28	28	32	28	28	32	28	28	9	28	28	17	28	28	15	28	28	18	28	28	20	28	28	23
29	29	32	29	29	5	29	29	32	29	29	32	29	29	11	29	29	14	29	29	19	29	29	18
30	30	32	30	30	32	30	30	32	30	30	32	30	30	11	30	30	12	30	30	14	30	30	18
31	31	32	31	31	32	31	31	4	31	31	7	31	31	8	31	31	32	31	31	10	31	31	15

TABLE 14 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 38

32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	6	32	1	10
33	2	32	33	2	32	33	2	32	33	2	32	33	2	3	33	2	32	33	2	3	33	2	7
34	3	32	34	3	32	34	3	32	34	3	32	34	3	32	34	3	32	34	3	32	34	3	7
35	4	32	35	4	32	35	4	32	35	4	32	35	4	32	35	4	32	35	4	32	35	4	32
36	5	32	36	5	32	36	5	32	36	5	32	36	5	32	36	5	32	36	5	32	36	5	32
37	6	32	37	6	32	37	6	32	37	6	32	37	6	32	37	6	32	37	6	32	37	6	32
38	7	53	38	7	32	38	7	32	38	7	32	38	7	32	38	7	32	38	7	32	38	7	32
39	8	52	39	8	32	39	8	32	39	8	32	39	8	32	39	8	32	39	8	32	39	8	32
40	9	32	40	9	32	40	9	32	40	9	32	40	9	32	40	9	32	40	9	32	40	9	32
41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	32
42	11	35	42	11	36	42	11	32	42	11	32	42	11	32	42	11	32	42	11	32	42	11	32
43	12	32	43	12	36	43	12	37	43	12	38	43	12	41	43	12	32	43	12	32	43	12	32
44	13	32	44	13	34	44	13	33	44	13	33	44	13	32	44	13	32	44	13	32	44	13	32
45	14	32	45	14	32	45	14	32	45	14	33	45	14	35	45	14	40	45	14	32	45	14	32
46	15	32	46	15	32	46	15	32	46	15	32	46	15	36	46	15	38	46	15	32	46	15	32
47	16	32	47	16	32	47	16	32	47	16	33	47	16	31	47	16	32	47	16	38	47	16	32
48	17	31	48	17	31	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32
49	18	28	49	18	31	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32
50	19	28	50	19	29	50	19	31	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32
51	20	25	51	20	28	51	20	29	51	20	31	51	20	31	51	20	32	51	20	32	51	20	32
52	21	22	52	21	26	52	21	26	52	21	29	52	21	31	52	21	31	52	21	32	52	21	32
53	22	20	53	22	22	53	22	25	53	22	28	53	22	29	53	22	31	53	22	31	53	22	32
54	23	17	54	23	22	54	23	20	54	23	25	54	23	32	54	23	29	54	23	30	54	23	32
55	24	17	55	24	18	55	24	22	55	24	24	55	24	24	55	24	26	55	24	29	55	24	31
56	25	14	56	25	32	56	25	32	56	25	21	56	25	22	56	25	24	56	25	28	56	25	29
57	26	10	57	26	32	57	26	17	57	26	32	57	26	20	57	26	25	57	26	26	57	26	27
58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	21	58	27	25	58	27	26
59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32
60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32
61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32
63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32

TABLE 14 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 38

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32
2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32
4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32
5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32
6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32
7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32
8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32
9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32
10	10	32	10	10	32	10	10	32	10	10	32	10	10	32	10	10	32	10	10	32
11	11	32	11	11	32	11	11	32	11	11	32	11	11	32	11	11	32	11	11	32
12	12	32	12	12	32	12	12	32	12	12	32	12	12	32	12	12	32	12	12	32
13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	32
14	14	32	14	14	61	14	14	32	14	14	32	14	14	32	14	14	32	14	14	32
15	15	55	15	15	32	15	15	62	15	15	32	15	15	32	15	15	32	15	15	32
16	16	54	16	16	32	16	16	32	16	16	32	16	16	32	16	16	32	16	16	32
17	17	52	17	17	56	17	17	57	17	17	57	17	17	32	17	17	32	17	17	32
18	18	48	18	18	52	18	18	51	18	18	57	18	18	32	18	18	32	18	18	32
19	19	46	19	19	51	19	19	52	19	19	32	19	19	58	19	19	32	19	19	32
20	20	32	20	20	44	20	20	47	20	20	32	20	20	54	20	20	56	20	20	32
21	21	39	21	21	41	21	21	48	21	21	49	21	21	50	21	21	56	21	21	32
22	22	38	22	22	40	22	22	43	22	22	45	22	22	48	22	22	53	22	22	57
23	23	37	23	23	39	23	23	41	23	23	43	23	23	45	23	23	49	23	23	52
24	24	34	24	24	35	24	24	39	24	24	42	24	24	43	24	24	47	24	24	48
25	25	32	25	25	33	25	25	36	25	25	40	25	25	42	25	25	43	25	25	46
26	26	31	26	26	32	26	26	34	26	26	37	26	26	37	26	26	40	26	26	44
27	27	28	27	27	31	27	27	33	27	27	33	27	27	36	27	27	39	27	27	43
28	28	24	28	28	30	28	28	28	28	28	32	28	28	34	28	28	37	28	28	37
29	29	20	29	29	26	29	29	28	29	29	29	29	29	32	29	29	36	29	29	37
30	30	18	30	30	22	30	30	26	30	30	27	30	30	29	30	30	31	30	30	33
31	31	16	31	31	19	31	31	20	31	31	23	31	31	25	31	31	31	31	31	32

TABLE 14 - CONCLUDED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 38

32	1	13	32	1	15	32	1	18	32	1	22	32	1	24	32	1	27	32	1	30
33	2	9	33	2	13	33	2	13	33	2	18	33	2	20	33	2	23	33	2	26
34	3	9	34	3	12	34	3	14	34	3	16	34	3	17	34	3	21	34	3	25
35	4	32	35	4	8	35	4	9	35	4	14	35	4	13	35	4	15	35	4	23
36	5	1	36	5	6	36	5	7	36	5	10	36	5	11	36	5	15	36	5	18
37	6	32	37	6	32	37	6	3	37	6	8	37	6	10	37	6	13	37	6	13
38	7	32	38	7	32	38	7	32	38	7	32	38	7	9	38	7	11	38	7	12
39	8	32	39	8	32	39	8	0	39	8	3	39	8	4	39	8	6	39	8	6
40	9	32	40	9	32	40	9	32	40	9	32	40	9	1	40	9	32	40	9	6
41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	3	41	10	5
42	11	32	42	11	32	42	11	32	42	11	32	42	11	32	42	11	32	42	11	0
43	12	32	43	12	32	43	12	32	43	12	32	43	12	32	43	12	32	43	12	32
44	13	32	44	13	32	44	13	32	44	13	32	44	13	32	44	13	32	44	13	32
45	14	32	45	14	32	45	14	32	45	14	32	45	14	32	45	14	32	45	14	32
46	15	32	46	15	32	46	15	32	46	15	32	46	15	32	46	15	32	46	15	32
47	16	32	47	16	32	47	16	32	47	16	32	47	16	32	47	16	32	47	16	32
48	17	32	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32
49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32
50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32
51	20	33	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32
52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32
53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32
54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32
55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32
56	25	30	56	25	31	56	25	32	56	25	32	56	25	31	56	25	32	56	25	32
57	26	30	57	26	31	57	26	31	57	26	32	57	26	32	57	26	32	57	26	32
58	27	27	58	27	30	58	27	31	58	27	32	58	27	32	58	27	31	58	27	32
59	28	26	59	28	26	59	28	27	59	28	31	59	28	31	59	28	32	59	28	32
60	29	32	60	29	32	60	29	27	60	29	30	60	29	31	60	29	31	60	29	31
61	30	32	61	30	24	61	30	22	61	30	26	61	30	29	61	30	31	61	30	31
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	28	62	31	31
63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	27	63	1	27

TABLE 15

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 39

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	31	0	1	32	0	1	37	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	31	1	1	35	1	1	32	1	1	36	1	1	32	1	1	32	1	1	32	1	1	32
2	2	31	2	2	32	2	2	33	2	2	32	2	2	37	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	33	3	3	34	3	3	38	3	3	32	3	3	41
4	4	31	4	4	31	4	4	32	4	4	31	4	4	33	4	4	34	4	4	36	4	4	39
5	5	31	5	5	32	5	5	31	5	5	32	5	5	31	5	5	33	5	5	35	5	5	35
6	6	30	6	6	31	6	6	31	6	6	31	6	6	31	6	6	34	6	6	35	6	6	35
7	7	32	7	7	32	7	7	32	7	7	32	7	7	31	7	7	32	7	7	32	7	7	34
8	8	32	8	8	32	8	8	32	8	8	32	8	8	31	8	8	31	8	8	32	8	8	32
9	9	32	9	9	32	9	9	31	9	9	31	9	9	31	9	9	31	9	9	31	9	9	32
10	10	32	10	10	32	10	10	32	10	10	31	10	10	31	10	10	31	10	10	31	10	10	31
11	11	32	11	11	32	11	11	32	11	11	31	11	11	30	11	11	29	11	11	31	11	11	31
12	12	32	12	12	32	12	12	32	12	12	32	12	12	32	12	12	31	12	12	32	12	12	31
13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	28	13	13	31
14	14	32	14	14	32	14	14	32	14	14	32	14	14	32	14	14	32	14	14	32	14	14	31
15	15	32	15	15	32	15	15	32	15	15	32	15	15	32	15	15	32	15	15	32	15	15	32
16	16	32	16	16	32	16	16	32	16	16	32	16	16	32	16	16	21	16	16	32	16	16	32
17	17	32	17	17	32	17	17	32	17	17	32	17	17	32	17	17	32	17	17	32	17	17	32
18	18	32	18	18	32	18	18	32	18	18	32	18	18	32	18	18	32	18	18	32	18	18	32
19	19	31	19	19	32	19	19	32	19	19	32	19	19	32	19	19	32	19	19	32	19	19	32
20	20	32	20	20	32	20	20	32	20	20	32	20	20	32	20	20	32	20	20	32	20	20	32
21	21	32	21	21	32	21	21	32	21	21	32	21	21	32	21	21	32	21	21	32	21	21	32
22	22	58	22	22	61	22	22	63	22	22	63	22	22	32	22	22	32	22	22	32	22	22	32
23	23	52	23	23	56	23	23	63	23	23	32	23	23	32	23	23	32	23	23	32	23	23	32
24	24	52	24	24	32	24	24	56	24	24	63	24	24	32	24	24	32	24	24	32	24	24	32
25	25	46	25	25	51	25	25	55	25	25	58	25	25	32	25	25	32	25	25	32	25	25	32
26	26	45	26	26	47	26	26	54	26	26	54	26	26	53	26	26	32	26	26	63	26	26	32
27	27	42	27	27	47	27	27	50	27	27	49	27	27	56	27	27	57	27	27	32	27	27	63
28	28	42	28	28	42	28	28	48	28	28	48	28	28	55	28	28	58	28	28	59	28	28	32
29	29	40	29	29	42	29	29	42	29	29	47	29	29	50	29	29	49	29	29	53	29	29	54
30	30	36	30	30	36	30	30	43	30	30	45	30	30	47	30	30	51	30	30	52	30	30	53
31	31	34	31	31	36	31	31	38	31	31	43	31	31	46	31	31	45	31	31	46	31	31	49

TABLE 15 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 39

32	1	30	32	1	32	32	1	38	32	1	39	32	1	40	32	1	44	32	1	47	32	1	51
33	2	27	33	2	31	33	2	32	33	2	32	33	2	35	33	2	39	33	2	42	33	2	40
34	3	22	34	3	31	34	3	31	34	3	33	34	3	36	34	3	35	34	3	40	34	3	40
35	4	26	35	4	25	35	4	29	35	4	30	35	4	31	35	4	33	35	4	33	35	4	41
36	5	20	36	5	22	36	5	25	36	5	29	36	5	31	36	5	32	36	5	31	36	5	32
37	6	15	37	6	17	37	6	19	37	6	27	37	6	30	37	6	31	37	6	31	37	6	31
38	7	13	38	7	19	38	7	21	38	7	23	38	7	25	38	7	30	38	7	31	38	7	31
39	8	15	39	8	17	39	8	17	39	8	19	39	8	24	39	8	28	39	8	26	39	8	31
40	9	11	40	9	12	40	9	14	40	9	18	40	9	21	40	9	23	40	9	24	40	9	29
41	10	6	41	10	9	41	10	9	41	10	13	41	10	13	41	10	22	41	10	23	41	10	25
42	11	7	42	11	7	42	11	11	42	11	13	42	11	14	42	11	18	42	11	21	42	11	25
43	12	32	43	12	32	43	12	6	43	12	9	43	12	16	43	12	19	43	12	20	43	12	22
44	13	32	44	13	3	44	13	32	44	13	32	44	13	12	44	13	14	44	13	19	44	13	18
45	14	32	45	14	5	45	14	32	45	14	32	45	14	10	45	14	10	45	14	12	45	14	13
46	15	32	46	15	32	46	15	32	46	15	32	46	15	6	46	15	7	46	15	13	46	15	32
47	16	32	47	16	32	47	16	32	47	16	32	47	16	32	47	16	7	47	16	9	47	16	16
48	17	32	48	17	32	48	17	32	48	17	32	48	17	1	48	17	4	48	17	32	48	17	9
49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32
50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	8
51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32
52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32
53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32
54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32
55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32
56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32
57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32
58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32
59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32
60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32
61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32
63	1	31	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32

TABLE 15 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 39

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32
2	2	32	2	2	32	2	2	47	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32
4	4	39	4	4	32	4	4	44	4	4	45	4	4	32	4	4	32	4	4	32	4	4	32
5	5	32	5	5	42	5	5	32	5	5	45	5	5	32	5	5	48	5	5	32	5	5	32
6	6	36	6	6	40	6	6	39	6	6	45	6	6	44	6	6	32	6	6	50	6	6	32
7	7	34	7	7	36	7	7	38	7	7	39	7	7	45	7	7	45	7	7	32	7	7	32
8	8	32	8	8	36	8	8	37	8	8	40	8	8	39	8	8	46	8	8	43	8	8	50
9	9	32	9	9	32	9	9	35	9	9	37	9	9	42	9	9	40	9	9	44	9	9	44
10	10	32	10	10	32	10	10	34	10	10	36	10	10	35	10	10	39	10	10	39	10	10	46
11	11	31	11	11	31	11	11	32	11	11	34	11	11	36	11	11	36	11	11	39	11	11	41
12	12	31	12	12	32	12	12	31	12	12	31	12	12	32	12	12	34	12	12	36	12	12	44
13	13	31	13	13	31	13	13	31	13	13	31	13	13	31	13	13	33	13	13	35	13	13	39
14	14	31	14	14	30	14	14	31	14	14	31	14	14	31	14	14	32	14	14	34	14	14	35
15	15	31	15	15	32	15	15	31	15	15	31	15	15	31	15	15	31	15	15	32	15	15	33
16	16	27	16	16	31	16	16	31	16	16	31	16	16	31	16	16	31	16	16	31	16	16	32
17	17	32	17	17	27	17	17	30	17	17	32	17	17	31	17	17	31	17	17	31	17	17	31
18	18	19	18	18	25	18	18	32	18	18	28	18	18	30	18	18	31	18	18	31	18	18	31
19	19	32	19	19	17	19	19	23	19	19	23	19	19	25	19	19	30	19	19	31	19	19	31
20	20	32	20	20	32	20	20	32	20	20	32	20	20	19	20	20	26	20	20	31	20	20	31
21	21	32	21	21	32	21	21	15	21	21	32	21	21	32	21	21	20	21	21	26	21	21	28
22	22	32	22	22	32	22	22	32	22	22	32	22	22	32	22	22	32	22	22	21	22	22	22
23	23	32	23	23	32	23	23	32	23	23	32	23	23	13	23	23	17	23	23	23	23	23	19
24	24	32	24	24	32	24	24	32	24	24	32	24	24	32	24	24	32	24	24	32	24	24	16
25	25	32	25	25	32	25	25	32	25	25	32	25	25	32	25	25	32	25	25	32	25	25	12
26	26	32	26	26	32	26	26	32	26	26	32	26	26	32	26	26	32	26	26	32	26	26	32
27	27	32	27	27	32	27	27	32	27	27	32	27	27	32	27	27	32	27	27	32	27	27	6
28	28	32	28	28	32	28	28	32	28	28	32	28	28	32	28	28	32	28	28	32	28	28	32
29	29	32	29	29	32	29	29	32	29	29	32	29	29	32	29	29	32	29	29	32	29	29	32
30	30	32	30	30	32	30	30	32	30	30	32	30	30	32	30	30	32	30	30	32	30	30	32
31	31	32	31	31	32	31	31	32	31	31	32	31	31	32	31	31	32	31	31	32	31	31	32

TABLE 15 - CONTINUED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 39

32	1	50	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32
33	2	49	33	2	52	33	2	50	33	2	55	33	2	32	33	2	32	33	2	32	33	2	32
34	3	43	34	3	48	34	3	32	34	3	52	34	3	53	34	3	56	34	3	32	34	3	32
35	4	42	35	4	41	35	4	44	35	4	46	35	4	32	35	4	55	35	4	54	35	4	32
36	5	33	36	5	40	36	5	45	36	5	45	36	5	47	36	5	32	36	5	32	36	5	32
37	6	37	37	6	35	37	6	41	37	6	41	37	6	44	37	6	45	37	6	49	37	6	51
38	7	32	38	7	32	38	7	34	38	7	40	38	7	41	38	7	40	38	7	32	38	7	32
39	8	31	39	8	31	39	8	31	39	8	32	39	8	34	39	8	39	39	8	41	39	8	42
40	9	28	40	9	31	40	9	32	40	9	31	40	9	31	40	9	32	40	9	34	40	9	32
41	10	29	41	10	28	41	10	32	41	10	32	41	10	32	41	10	32	41	10	34	41	10	37
42	11	23	42	11	28	42	11	31	42	11	32	42	11	32	42	11	31	42	11	31	42	11	31
43	12	27	43	12	27	43	12	30	43	12	31	43	12	32	43	12	32	43	12	32	43	12	32
44	13	23	44	13	24	44	13	28	44	13	31	44	13	30	44	13	31	44	13	32	44	13	32
45	14	21	45	14	25	45	14	24	45	14	28	45	14	29	45	14	30	45	14	31	45	14	32
46	15	18	46	15	32	46	15	22	46	15	24	46	15	28	46	15	30	46	15	31	46	15	31
47	16	13	47	16	16	47	16	17	47	16	24	47	16	23	47	16	29	47	16	30	47	16	30
48	17	10	48	17	13	48	17	18	48	17	18	48	17	19	48	17	25	48	17	25	48	17	29
49	18	9	49	18	10	49	18	16	49	18	12	49	18	20	49	18	32	49	18	26	49	18	25
50	19	32	50	19	7	50	19	14	50	19	16	50	19	32	50	19	16	50	19	23	50	19	24
51	20	9	51	20	32	51	20	32	51	20	12	51	20	32	51	20	14	51	20	32	51	20	19
52	21	32	52	21	32	52	21	32	52	21	12	52	21	17	52	21	17	52	21	16	52	21	18
53	22	32	53	22	32	53	22	7	53	22	32	53	22	32	53	22	32	53	22	14	53	22	18
54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	15
55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32
56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32	56	25	32
57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32	57	26	32
58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	32
59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32
60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32
61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32
63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32

TABLE 15 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 39

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32
2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32
4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32
5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32
6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32
7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32
8	8	50	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32
9	9	50	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32
10	10	48	10	10	50	10	10	53	10	10	32	10	10	32	10	10	32	10	10	32	10	10	32
11	11	44	11	11	47	11	11	51	11	11	32	11	11	32	11	11	58	11	11	61	11	11	32
12	12	41	12	12	44	12	12	49	12	12	52	12	12	55	12	12	55	12	12	32	12	12	58
13	13	44	13	13	41	13	13	42	13	13	45	13	13	49	13	13	52	13	13	32	13	13	55
14	14	36	14	14	38	14	14	41	14	14	42	14	14	50	14	14	50	14	14	56	14	14	32
15	15	36	15	15	42	15	15	38	15	15	41	15	15	32	15	15	48	15	15	49	15	15	32
16	16	34	16	16	34	16	16	39	16	16	39	16	16	40	16	16	45	16	16	46	16	16	51
17	17	32	17	17	33	17	17	37	17	17	38	17	17	39	17	17	40	17	17	44	17	17	50
18	18	31	18	18	33	18	18	33	18	18	34	18	18	37	18	18	41	18	18	38	18	18	47
19	19	31	19	19	31	19	19	34	19	19	33	19	19	38	19	19	36	19	19	38	19	19	39
20	20	31	20	20	31	20	20	31	20	20	32	20	20	34	20	20	34	20	20	38	20	20	39
21	21	30	21	21	31	21	21	31	21	21	31	21	21	32	21	21	33	21	21	36	21	21	36
22	22	22	22	22	26	22	22	31	22	22	31	22	22	32	22	22	32	22	22	33	22	22	35
23	23	23	23	23	24	23	23	28	23	23	31	23	23	31	23	23	31	23	23	33	23	23	35
24	24	17	24	24	19	24	24	30	24	24	29	24	24	31	24	24	31	24	24	28	24	24	33
25	25	18	25	25	18	25	25	20	25	25	23	25	25	26	25	25	26	25	25	31	25	25	31
26	26	16	26	26	13	26	26	18	26	26	19	26	26	21	26	26	21	26	26	31	26	26	31
27	27	32	27	27	11	27	27	12	27	27	17	27	27	17	27	27	21	27	27	21	27	27	31
28	28	32	28	28	32	28	28	9	28	28	17	28	28	15	28	28	18	28	28	18	28	28	22
29	29	32	29	29	5	29	29	32	29	29	32	29	29	11	29	29	14	29	29	19	29	29	16
30	30	32	30	30	32	30	30	32	30	30	32	30	30	11	30	30	8	30	30	14	30	30	18
31	31	32	31	31	32	31	31	4	31	31	7	31	31	8	31	31	32	31	31	10	31	31	15

TABLE 15 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITEEMACHINE OF EXP. 39

32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	32	32	1	6	32	1	9
33	2	32	33	2	32	33	2	32	33	2	32	33	2	3	33	2	32	33	2	3	33	2	7
34	3	32	34	3	32	34	3	32	34	3	32	34	3	32	34	3	32	34	3	32	34	3	7
35	4	32	35	4	32	35	4	32	35	4	32	35	4	32	35	4	32	35	4	32	35	4	32
36	5	32	36	5	32	36	5	32	36	5	32	36	5	32	36	5	32	36	5	32	36	5	32
37	6	32	37	6	32	37	6	32	37	6	32	37	6	32	37	6	32	37	6	32	37	6	32
38	7	53	38	7	32	38	7	32	38	7	32	38	7	32	38	7	32	38	7	32	38	7	32
39	8	52	39	8	32	39	8	32	39	8	32	39	8	32	39	8	32	39	8	32	39	8	32
40	9	32	40	9	32	40	9	32	40	9	32	40	9	32	40	9	32	40	9	32	40	9	32
41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	32
42	11	35	42	11	36	42	11	32	42	11	32	42	11	32	42	11	32	42	11	32	42	11	32
43	12	32	43	12	32	43	12	35	43	12	38	43	12	41	43	12	32	43	12	32	43	12	32
44	13	31	44	13	34	44	13	33	44	13	33	44	13	32	44	13	32	44	13	32	44	13	32
45	14	32	45	14	32	45	14	32	45	14	34	45	14	35	45	14	40	45	14	32	45	14	32
46	15	32	46	15	32	46	15	32	46	15	32	46	15	36	46	15	36	46	15	32	46	15	32
47	16	32	47	16	32	47	16	32	47	16	32	47	16	31	47	16	32	47	16	38	47	16	32
48	17	30	48	17	31	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32
49	18	29	49	18	31	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32
50	19	29	50	19	30	50	19	31	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32
51	20	26	51	20	28	51	20	29	51	20	31	51	20	31	51	20	32	51	20	32	51	20	32
52	21	20	52	21	26	52	21	26	52	21	30	52	21	31	52	21	31	52	21	32	52	21	32
53	22	20	53	22	22	53	22	25	53	22	28	53	22	29	53	22	31	53	22	31	53	22	32
54	23	16	54	23	22	54	23	20	54	23	25	54	23	32	54	23	29	54	23	30	54	23	32
55	24	17	55	24	18	55	24	22	55	24	24	55	24	24	55	24	26	55	24	29	55	24	31
56	25	14	56	25	32	56	25	32	56	25	20	56	25	21	56	25	24	56	25	28	56	25	28
57	26	10	57	26	32	57	26	17	57	26	32	57	26	20	57	26	25	57	26	26	57	26	27
58	27	32	58	27	32	58	27	32	58	27	32	58	27	32	58	27	21	58	27	26	58	27	22
59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32	59	28	32
60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32	60	29	32
61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32	61	30	32
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	32
63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	32

TABLE 15 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 39

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32	0	1	32
1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32	1	1	32
2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32	2	2	32
3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32	3	3	32
4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32	4	4	32
5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32	5	5	32
6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32	6	6	32
7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32	7	7	32
8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32	8	8	32
9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32	9	9	32
10	10	32	10	10	32	10	10	32	10	10	32	10	10	32	10	10	32	10	10	32
11	11	32	11	11	32	11	11	32	11	11	32	11	11	32	11	11	32	11	11	32
12	12	32	12	12	32	12	12	32	12	12	32	12	12	32	12	12	32	12	12	32
13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	32	13	13	32
14	14	32	14	14	61	14	14	32	14	14	32	14	14	32	14	14	32	14	14	32
15	15	55	15	15	32	15	15	62	15	15	32	15	15	32	15	15	32	15	15	32
16	16	54	16	16	32	16	16	32	16	16	32	16	16	32	16	16	32	16	16	32
17	17	51	17	17	56	17	17	57	17	17	57	17	17	32	17	17	32	17	17	32
18	18	48	18	18	51	18	18	51	18	18	56	18	18	32	18	18	32	18	18	32
19	19	46	19	19	51	19	19	52	19	19	32	19	19	58	19	19	32	19	19	32
20	20	32	20	20	44	20	20	45	20	20	32	20	20	52	20	20	56	20	20	32
21	21	38	21	21	41	21	21	48	21	21	49	21	21	50	21	21	55	21	21	32
22	22	38	22	22	37	22	22	43	22	22	45	22	22	48	22	22	53	22	22	57
23	23	35	23	23	36	23	23	41	23	23	40	23	23	43	23	23	49	23	23	52
24	24	34	24	24	35	24	24	39	24	24	42	24	24	45	24	24	45	24	24	48
25	25	32	25	25	33	25	25	35	25	25	40	25	25	42	25	25	43	25	25	46
26	26	31	26	26	31	26	26	34	26	26	37	26	26	37	26	26	40	26	26	44
27	27	26	27	27	31	27	27	33	27	27	33	27	27	36	27	27	39	27	27	43
28	28	24	28	28	31	28	28	27	28	28	32	28	28	34	28	28	36	28	28	37
29	29	20	29	29	27	29	29	28	29	29	28	29	29	31	29	29	34	29	29	35
30	30	19	30	30	22	30	30	26	30	30	25	30	30	31	30	30	31	30	30	32
31	31	13	31	31	19	31	31	20	31	31	24	31	31	24	31	31	31	31	31	32

TABLE 15 - CONCLUDED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 39

32	1	13	32	1	15	32	1	18	32	1	19	32	1	24	32	1	28	32	1	30
33	2	9	33	2	12	33	2	10	33	2	18	33	2	20	33	2	22	33	2	26
34	3	9	34	3	9	34	3	15	34	3	16	34	3	17	34	3	21	34	3	21
35	4	32	35	4	8	35	4	9	35	4	14	35	4	13	35	4	15	35	4	23
36	5	1	36	5	6	36	5	7	36	5	10	36	5	10	36	5	14	36	5	18
37	6	32	37	6	32	37	6	3	37	6	6	37	6	9	37	6	13	37	6	12
38	7	32	38	7	32	38	7	32	38	7	32	38	7	9	38	7	11	38	7	8
39	8	32	39	8	32	39	8	0	39	8	3	39	8	4	39	8	6	39	8	6
40	9	32	40	9	32	40	9	32	40	9	32	40	9	1	40	9	32	40	9	5
41	10	32	41	10	32	41	10	32	41	10	32	41	10	32	41	10	3	41	10	4
42	11	32	42	11	32	42	11	32	42	11	32	42	11	32	42	11	32	42	11	0
43	12	32	43	12	32	43	12	32	43	12	32	43	12	32	43	12	32	43	12	32
44	13	32	44	13	32	44	13	32	44	13	32	44	13	32	44	13	32	44	13	32
45	14	32	45	14	32	45	14	32	45	14	32	45	14	32	45	14	32	45	14	32
46	15	32	46	15	32	46	15	32	46	15	32	46	15	32	46	15	32	46	15	32
47	16	32	47	16	32	47	16	32	47	16	32	47	16	32	47	16	32	47	16	32
48	17	32	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32	48	17	32
49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32	49	18	32
50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32	50	19	32
51	20	33	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32	51	20	32
52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32	52	21	32
53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32	53	22	32
54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32	54	23	32
55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32	55	24	32
56	25	29	56	25	31	56	25	32	56	25	32	56	25	31	56	25	32	56	25	32
57	26	30	57	26	30	57	26	31	57	26	32	57	26	32	57	26	32	57	26	32
58	27	27	58	27	30	58	27	31	58	27	32	58	27	32	58	27	31	58	27	32
59	28	24	59	28	26	59	28	27	59	28	31	59	28	31	59	28	32	59	28	32
60	29	32	60	29	32	60	29	27	60	29	30	60	29	31	60	29	31	60	29	31
61	30	32	61	30	24	61	30	22	61	30	26	61	30	29	61	30	29	61	30	31
62	31	32	62	31	32	62	31	32	62	31	32	62	31	32	62	31	27	62	31	31
63	1	32	63	1	32	63	1	32	63	1	32	63	1	32	63	1	27	63	1	27

TABLE 16

SUMMARY OF EFFECT OF MACHINE SIZE UPON MODELING CAPABILITY WITH RESPECT TO THE HUMAN OPERATOR

Exp. No.	Time Interval In Sec.	No. of States	Scoring	Recall	Delay In Sec.	Aver. Error in Symbols	Adjusted Error in Percent
40	.15	15	Mag. of Diff.	4000	.0	3.5	5.5
43	.15	31	Average	4000	.30	3.7	5.7
44	.15	31	Mag. of Diff.	4000	.30	3.5	5.4
45	.15	31	Mag. of Diff.	4000	.15	2.6	4.0
46	.15	31	Mag. of Diff.	4000	.0	3.3	5.1
47	.15	31	Average	4000	.15	2.7	4.2

TABLE 17

RESULTS OF DIFFERENT COST MATRICES IN MODELING THE HUMAN OPERATOR IN HIS PERFORMANCE OF SINGLE AXIS TRACKING

Exp. No.	Description	Time Interval In Sec.	Delay In Sec.	Average Error in Symbols	Average Error in Percent
45	31 State 64 Symbols Magnitude of Error	.15	.15	2.55	3.96
47	31 State 64 Symbols Average Setting	.15	.15	2.67	4.16
60	31 State 64 Symbols All or Nothing	.15	.15	3.10	4.83
61	31 State 64 Symbols Zero Band Magnitude of Error	.15	.15	2.58	4.02

TABLE 18
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 45

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	36	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	37	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	34	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	34	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	34	6	6	15	6	6	15	6	6	15	6	6	53	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	39	7	7	15	7	7	44
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	36	8	8	15
9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	32	9	9	37
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	34	10	10	32	10	10	40
11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15
17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15
18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15
19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15
20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15
21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15
22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15
23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15
24	24	53	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15
25	25	51	25	25	53	25	25	63	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15
26	26	46	26	26	52	26	26	49	26	26	54	26	26	15	26	26	15	26	26	15	26	26	15
27	27	48	27	27	50	27	27	43	27	27	52	27	27	15	27	27	15	27	27	15	27	27	15
28	28	45	28	28	51	28	28	49	28	28	52	28	28	54	28	28	53	28	28	15	28	28	15
29	29	43	29	29	44	29	29	48	29	29	50	29	29	53	29	29	55	29	29	47	29	29	15
30	30	38	30	30	44	30	30	44	30	30	48	30	30	49	30	30	15	30	30	15	30	30	15
31	31	36	31	31	37	31	31	39	31	31	41	31	31	43	31	31	53	31	31	51	31	31	15

TABLE 18 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 45

32	1	31	32	1	35	32	1	34	32	1	37	32	1	41	32	1	44	32	1	50	32	1	46
33	2	30	33	2	31	33	2	32	33	2	33	33	2	34	33	2	36	33	2	40	33	2	47
34	3	25	34	3	29	34	3	30	34	3	32	34	3	32	34	3	34	34	3	36	34	3	43
35	4	20	35	4	24	35	4	29	35	4	33	35	4	30	35	4	31	35	4	31	35	4	33
36	5	19	36	5	21	36	5	23	36	5	27	36	5	28	36	5	30	36	5	31	36	5	34
37	6	16	37	6	17	37	6	20	37	6	23	37	6	27	37	6	30	37	6	30	37	6	31
38	7	19	38	7	16	38	7	20	38	7	17	38	7	23	38	7	27	38	7	29	38	7	30
39	8	12	39	8	13	39	8	16	39	8	21	39	8	18	39	8	25	39	8	27	39	8	28
40	9	7	40	9	10	40	9	20	40	9	13	40	9	14	40	9	18	40	9	19	40	9	27
41	10	15	41	10	9	41	10	8	41	10	10	41	10	15	41	10	15	41	10	22	41	10	21
42	11	15	42	11	15	42	11	9	42	11	11	42	11	15	42	11	15	42	11	16	42	11	21
43	12	15	43	12	15	43	12	15	43	12	1	43	12	7	43	12	13	43	12	13	43	12	17
44	13	15	44	13	15	44	13	15	44	13	15	44	13	13	44	13	11	44	13	15	44	13	14
45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	12	45	14	9
46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	14	46	15	8
47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15
48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15
49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15
50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15
54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	33	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	12	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 18 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 45

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	44	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	37	7	7	38	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	36	8	8	44	8	8	50	8	8	59	8	8	15	8	8	15	8	8	15	8	8	15
9	9	33	9	9	40	9	9	33	9	9	48	9	9	15	9	9	43	9	9	15	9	9	15
10	10	37	10	10	37	10	10	36	10	10	34	10	10	39	10	10	43	10	10	63	10	10	15
11	11	33	11	11	41	11	11	38	11	11	38	11	11	33	11	11	40	11	11	53	11	11	51
12	12	34	12	12	33	12	12	33	12	12	34	12	12	34	12	12	42	12	12	37	12	12	55
13	13	34	13	13	34	13	13	35	13	13	34	13	13	36	13	13	36	13	13	41	13	13	47
14	14	34	14	14	35	14	14	34	14	14	33	14	14	33	14	14	42	14	14	35	14	14	43
15	15	30	15	15	30	15	15	32	15	15	35	15	15	36	15	15	36	15	15	35	15	15	37
16	16	15	16	16	15	16	16	15	16	16	32	16	16	34	16	16	33	16	16	35	16	16	36
17	17	15	17	17	32	17	17	33	17	17	30	17	17	34	17	17	33	17	17	34	17	17	34
18	18	15	18	18	15	18	18	15	18	18	15	18	18	24	18	18	33	18	18	34	18	18	34
19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	31	19	19	34	19	19	34
20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	32
21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	28	21	21	24	21	21	34
22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	23	22	22	15
23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15
24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	25	24	24	15
25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	48
26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15
27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15
28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15
29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15
30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15
31	31	42	31	31	61	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15

TABLE 18 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 45

32	1	51	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15
33	2	49	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15
34	3	44	34	3	15	34	3	53	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15
35	4	35	35	4	15	35	4	47	35	4	43	35	4	15	35	4	15	35	4	15	35	4	15
36	5	33	36	5	35	36	5	35	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15
37	6	31	37	6	35	37	6	41	37	6	35	37	6	49	37	6	15	37	6	15	37	6	15
38	7	30	38	7	30	38	7	32	38	7	31	38	7	35	38	7	26	38	7	15	38	7	15
39	8	30	39	8	31	39	8	30	39	8	30	39	8	34	39	8	15	39	8	40	39	8	15
40	9	29	40	9	30	40	9	30	40	9	30	40	9	31	40	9	31	40	9	34	40	9	34
41	10	27	41	10	26	41	10	30	41	10	30	41	10	30	41	10	15	41	10	33	41	10	15
42	11	24	42	11	21	42	11	30	42	11	29	42	11	30	42	11	29	42	11	30	42	11	34
43	12	17	43	12	24	43	12	23	43	12	26	43	12	30	43	12	30	43	12	30	43	12	28
44	13	19	44	13	18	44	13	23	44	13	26	44	13	28	44	13	29	44	13	30	44	13	30
45	14	10	45	14	12	45	14	18	45	14	20	45	14	27	45	14	29	45	14	29	45	14	31
46	15	15	46	15	13	46	15	17	46	15	15	46	15	18	46	15	28	46	15	30	46	15	29
47	16	7	47	16	15	47	16	9	47	16	17	47	16	23	47	16	20	47	16	20	47	16	27
48	17	15	48	17	12	48	17	15	48	17	15	48	17	15	48	17	15	48	17	21	48	17	24
49	18	15	49	18	15	49	18	15	49	18	11	49	18	16	49	18	15	49	18	22	49	18	23
50	19	15	50	19	15	50	19	15	50	19	15	50	19	14	50	19	15	50	19	15	50	19	14
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	8	51	20	10	51	20	11
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	7	53	22	15
54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 18 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 45

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15
9	9	15	9	9	58	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15
11	11	15	11	11	15	11	11	61	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	57	12	12	15	12	12	60	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	49	13	13	51	13	13	41	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	45	14	14	48	14	14	15	14	14	43	14	14	57	14	14	15	14	14	53	14	14	15
15	15	36	15	15	41	15	15	60	15	15	53	15	15	15	15	15	15	15	15	57	15	15	62
16	16	38	16	16	41	16	16	37	16	16	46	16	16	49	16	16	53	16	16	54	16	16	15
17	17	37	17	17	39	17	17	38	17	17	37	17	17	45	17	17	37	17	17	55	17	17	60
18	18	35	18	18	35	18	18	37	18	18	41	18	18	46	18	18	48	18	18	38	18	18	55
19	19	34	19	19	35	19	19	36	19	19	37	19	19	40	19	19	35	19	19	46	19	19	52
20	20	34	20	20	35	20	20	34	20	20	35	20	20	42	20	20	40	20	20	42	20	20	48
21	21	34	21	21	33	21	21	35	21	21	34	21	21	35	21	21	38	21	21	41	21	21	44
22	22	33	22	22	31	22	22	32	22	22	34	22	22	34	22	22	35	22	22	38	22	22	41
23	23	30	23	23	33	23	23	33	23	23	33	23	23	33	23	23	34	23	23	36	23	23	38
24	24	28	24	24	26	24	24	25	24	24	31	24	24	34	24	24	34	24	24	34	24	24	34
25	25	15	25	25	21	25	25	31	25	25	30	25	25	32	25	25	32	25	25	33	25	25	34
26	26	15	26	26	15	26	26	22	26	26	21	26	26	25	26	26	32	26	26	32	26	26	33
27	27	15	27	27	15	27	27	15	27	27	23	27	27	28	27	27	21	27	27	28	27	27	32
28	28	15	28	28	15	28	28	15	28	28	15	28	28	23	28	28	20	28	28	22	28	28	27
29	29	15	29	29	15	29	29	15	29	29	15	29	29	25	29	29	20	29	29	23	29	29	23
30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	18	30	30	14
31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	7	31	31	18

TABLE 18 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 45

32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	14
33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15
34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	13
35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15
36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15
37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15
38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15
39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15
40	9	42	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15
41	10	15	41	10	35	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15
42	11	31	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15
43	12	30	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15
44	13	33	44	13	32	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15
45	14	30	45	14	23	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15
46	15	29	46	15	31	46	15	15	46	15	31	46	15	15	46	15	15	46	15	15	46	15	15
47	16	29	47	16	27	47	16	29	47	16	31	47	16	15	47	16	15	47	16	15	47	16	15
48	17	31	48	17	32	48	17	30	48	17	29	48	17	30	48	17	15	48	17	34	48	17	15
49	18	27	49	18	27	49	18	29	49	18	26	49	18	30	49	18	15	49	18	15	49	18	15
50	19	15	50	19	27	50	19	26	50	19	28	50	19	28	50	19	29	50	19	15	50	19	15
51	20	15	51	20	16	51	20	27	51	20	20	51	20	29	51	20	29	51	20	30	51	20	15
52	21	16	52	21	21	52	21	16	52	21	27	52	21	19	52	21	27	52	21	28	52	21	33
53	22	15	53	22	15	53	22	13	53	22	10	53	22	22	53	22	15	53	22	29	53	22	28
54	23	15	54	23	15	54	23	15	54	23	14	54	23	21	54	23	25	54	23	15	54	23	29
55	24	15	55	24	15	55	24	15	55	24	9	55	24	15	55	24	15	55	24	25	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	12	56	25	15	56	25	26
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	21	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 18 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 45

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15
9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15
11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15
17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15
18	18	51	18	18	58	18	18	15	18	18	15	18	18	59	18	18	15	18	18	15
19	19	56	19	19	47	19	19	63	19	19	58	19	19	15	19	19	15	19	19	15
20	20	50	20	20	47	20	20	54	20	20	58	20	20	61	20	20	15	20	20	15
21	21	47	21	21	44	21	21	45	21	21	52	21	21	61	21	21	15	21	21	15
22	22	34	22	22	45	22	22	48	22	22	52	22	22	47	22	22	15	22	22	56
23	23	39	23	23	49	23	23	48	23	23	47	23	23	51	23	23	57	23	23	55
24	24	40	24	24	44	24	24	45	24	24	46	24	24	49	24	24	53	24	24	54
25	25	38	25	25	35	25	25	43	25	25	44	25	25	48	25	25	51	25	25	49
26	26	33	26	26	34	26	26	40	26	26	39	26	26	45	26	26	45	26	26	47
27	27	32	27	27	34	27	27	35	27	27	38	27	27	41	27	27	42	27	27	49
28	28	31	28	28	33	28	28	34	28	28	33	28	28	38	28	28	37	28	28	44
29	29	26	29	29	31	29	29	31	29	29	33	29	29	34	29	29	35	29	29	39
30	30	19	30	30	25	30	30	31	30	30	31	30	30	32	30	30	32	30	30	35
31	31	16	31	31	23	31	31	24	31	31	24	31	31	28	31	31	31	31	31	33

TABLE 18 - CONCLUDED
FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 45

32	1	18	32	1	18	32	1	18	32	1	21	32	1	23	32	1	26	32	1	00
33	2	8	33	2	15	33	2	16	33	2	18	33	2	23	33	2	21	33	2	26
34	3	15	34	3	15	34	3	15	34	3	16	34	3	18	34	3	21	34	3	25
35	4	15	35	4	15	35	4	15	35	4	12	35	4	16	35	4	13	35	4	19
36	5	15	36	5	15	36	5	15	36	5	8	36	5	13	36	5	17	36	5	16
37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	14	37	6	14
38	7	15	38	7	15	38	7	15	38	7	15	38	7	20	38	7	16	38	7	3
39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	4
40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	9
41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15
42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15
43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15
44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15
45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15
46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15
47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15
48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15
49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15
50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15
54	23	29	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	32	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	19	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	12	63	1	15

TABLE 19

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 47

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	36	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	37	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	34	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	34	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	34	6	6	15	6	6	15	6	6	15	6	6	53	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	39	7	7	15	7	7	48
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	36	8	8	15
9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	34	9	9	36
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	34	10	10	32	10	10	40
11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15
17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15
18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15
19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15
20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15
21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15
22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15
23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15
24	24	52	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15
25	25	51	25	25	53	25	25	63	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15
26	26	48	26	26	53	26	26	56	26	26	54	26	26	15	26	26	15	26	26	15	26	26	15
27	27	48	27	27	51	27	27	49	27	27	52	27	27	15	27	27	15	27	27	15	27	27	15
28	28	46	28	28	49	28	28	50	28	28	52	28	28	54	28	28	55	28	28	15	28	28	15
29	29	42	29	29	43	29	29	50	29	29	49	29	29	54	29	29	56	29	29	47	29	29	15
30	30	38	30	30	43	30	30	43	30	30	48	30	30	51	30	30	15	30	30	15	30	30	15
31	31	36	31	31	40	31	31	38	31	31	44	31	31	43	31	31	54	31	31	51	31	31	15

TABLE 19 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 47

42	1	32	32	1	36	32	1	35	32	1	38	32	1	42	32	1	44	32	1	22	32	1	45
33	2	31	33	2	32	33	2	33	33	2	35	33	2	35	33	2	36	33	2	43	33	2	49
34	3	26	34	3	28	34	3	31	34	3	32	34	3	33	34	3	36	34	3	37	34	3	41
35	4	20	35	4	24	35	4	27	35	4	32	35	4	31	35	4	32	35	4	33	35	4	34
36	5	18	36	5	21	36	5	24	36	5	25	36	5	29	36	5	31	36	5	31	36	5	34
37	6	16	37	6	18	37	6	20	37	6	23	37	6	27	37	6	30	37	6	30	37	6	31
38	7	17	38	7	17	38	7	20	38	7	18	38	7	24	38	7	27	38	7	29	38	7	30
39	8	12	39	8	15	39	8	14	39	8	18	39	8	17	39	8	24	39	8	27	39	8	28
40	9	7	40	9	10	40	9	19	40	9	15	40	9	15	40	9	20	40	9	20	40	9	27
41	10	15	41	10	11	41	10	8	41	10	10	41	10	14	41	10	15	41	10	22	41	10	21
42	11	15	42	11	15	42	11	11	42	11	14	42	11	15	42	11	16	42	11	17	42	11	22
43	12	15	43	12	15	43	12	15	43	12	1	43	12	11	43	12	16	43	12	14	43	12	18
44	13	15	44	13	15	44	13	15	44	13	15	44	13	13	44	13	13	44	13	15	44	13	16
45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	12	45	14	9
46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	10
47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15
48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15
49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15
50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15
54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	33	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	23	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 19 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 47

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	44	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	37	7	7	38	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	36	8	8	44	8	8	52	8	8	59	8	8	15	8	8	15	8	8	15	8	8	15
9	9	34	9	9	40	9	9	42	9	9	48	9	9	15	9	9	43	9	9	15	9	9	15
10	10	37	10	10	42	10	10	39	10	10	34	10	10	42	10	10	46	10	10	63	10	10	15
11	11	34	11	11	41	11	11	38	11	11	46	11	11	35	11	11	44	11	11	53	11	11	52
12	12	34	12	12	34	12	12	33	12	12	34	12	12	36	12	12	42	12	12	37	12	12	55
13	13	34	13	13	34	13	13	35	13	13	34	13	13	36	13	13	38	13	13	40	13	13	47
14	14	34	14	14	35	14	14	35	14	14	33	14	14	34	14	14	40	14	14	37	14	14	43
15	15	30	15	15	31	15	15	32	15	15	35	15	15	37	15	15	36	15	15	36	15	15	38
16	16	15	16	16	15	16	16	15	16	16	33	16	16	35	16	16	33	16	16	35	16	16	37
17	17	15	17	17	32	17	17	33	17	17	30	17	17	34	17	17	32	17	17	34	17	17	34
18	18	15	18	18	15	18	18	15	18	18	15	18	18	29	18	18	33	18	18	34	18	18	35
19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	31	19	19	34	19	19	34
20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	33
21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	28	21	21	27	21	21	31
22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	23	22	22	15
23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15
24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	25	24	24	15
25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	48
26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15
27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15
28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15
29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15
30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15
31	31	42	31	31	61	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15

TABLE 19 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 47

32	1	51	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15
33	2	50	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15
34	3	42	34	3	15	34	3	53	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15
35	4	39	35	4	15	35	4	46	35	4	43	35	4	15	35	4	15	35	4	15	35	4	15
36	5	34	36	5	36	36	5	38	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15
37	6	31	37	6	33	37	6	41	37	6	36	37	6	49	37	6	15	37	6	15	37	6	15
38	7	31	38	7	30	38	7	32	38	7	32	38	7	35	38	7	26	38	7	15	38	7	15
39	8	30	39	8	31	39	8	31	39	8	32	39	8	34	39	8	15	39	8	40	39	8	15
40	9	28	40	9	30	40	9	30	40	9	31	40	9	31	40	9	34	40	9	44	40	9	34
41	10	28	41	10	27	41	10	30	41	10	30	41	10	30	41	10	15	41	10	33	41	10	15
42	11	22	42	11	23	42	11	28	42	11	30	42	11	30	42	11	29	42	11	30	42	11	33
43	12	18	43	12	23	43	12	23	43	12	27	43	12	30	43	12	30	43	12	29	43	12	30
44	13	18	44	13	19	44	13	24	44	13	26	44	13	26	44	13	29	44	13	30	44	13	30
45	14	12	45	14	13	45	14	18	45	14	21	45	14	25	45	14	28	45	14	30	45	14	30
46	15	15	46	15	15	46	15	17	46	15	16	46	15	21	46	15	27	46	15	30	46	15	29
47	16	7	47	16	15	47	16	13	47	16	18	47	16	19	47	16	22	47	16	23	47	16	27
48	17	15	48	17	12	48	17	13	48	17	15	48	17	15	48	17	15	48	17	21	48	17	25
49	18	15	49	18	15	49	18	15	49	18	11	49	18	17	49	18	14	49	18	21	49	18	22
50	19	15	50	19	15	50	19	15	50	19	15	50	19	17	50	19	15	50	19	15	50	19	18
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	9	51	20	10	51	20	11
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	7	53	22	15
54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 19 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 47

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15
9	9	15	9	9	58	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15
11	11	15	11	11	15	11	11	61	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	57	12	12	15	12	12	60	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	49	13	13	53	13	13	41	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	47	14	14	49	14	14	15	14	14	47	14	14	57	14	14	15	14	14	53	14	14	15
15	15	40	15	15	41	15	15	60	15	15	53	15	15	15	15	15	15	15	15	57	15	15	62
16	16	38	16	16	42	16	16	41	16	16	46	16	16	53	16	16	51	16	16	54	16	16	15
17	17	37	17	17	40	17	17	40	17	17	39	17	17	44	17	17	42	17	17	56	17	17	59
18	18	35	18	18	35	18	18	39	18	18	45	18	18	45	18	18	49	18	18	44	18	18	51
19	19	34	19	19	36	19	19	36	19	19	39	19	19	40	19	19	40	19	19	47	19	19	51
20	20	34	20	20	35	20	20	35	20	20	36	20	20	41	20	20	44	20	20	42	20	20	47
21	21	33	21	21	34	21	21	35	21	21	34	21	21	36	21	21	40	21	21	41	21	21	45
22	22	33	22	22	32	22	22	33	22	22	34	22	22	34	22	22	35	22	22	39	22	22	39
23	23	30	23	23	34	23	23	34	23	23	34	23	23	33	23	23	34	23	23	37	23	23	38
24	24	29	24	24	28	24	24	24	24	24	31	24	24	33	24	24	34	24	24	34	24	24	34
25	25	15	25	25	21	25	25	30	25	25	30	25	25	32	25	25	31	25	25	31	25	25	35
26	26	15	26	26	15	26	26	22	26	26	21	26	26	27	26	26	31	26	26	32	26	26	34
27	27	15	27	27	15	27	27	15	27	27	23	27	27	25	27	27	22	27	27	28	27	27	31
28	28	15	28	28	15	28	28	15	28	28	15	28	28	25	28	28	21	28	28	22	28	28	28
29	29	15	29	29	15	29	29	15	29	29	15	29	29	25	29	29	20	29	29	24	29	29	25
30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	21	30	30	13
31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	7	31	31	15

TABLE 19 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 47

32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	14
33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15
34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	13
35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15
36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15
37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15
38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15
39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15
40	9	42	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15
41	10	15	41	10	35	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15
42	11	34	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15
43	12	31	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15
44	13	32	44	13	32	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15
45	14	30	45	14	27	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15
46	15	29	46	15	31	46	15	15	46	15	33	46	15	15	46	15	15	46	15	15	46	15	15
47	16	30	47	16	29	47	16	29	47	16	32	47	16	15	47	16	15	47	16	15	47	16	15
48	17	31	48	17	32	48	17	30	48	17	30	48	17	31	48	17	15	48	17	34	48	17	15
49	18	27	49	18	28	49	18	29	49	18	26	49	18	31	49	18	15	49	18	15	49	18	15
50	19	15	50	19	24	50	19	25	50	19	28	50	19	28	50	19	29	50	19	15	50	19	15
51	20	17	51	20	21	51	20	27	51	20	23	51	20	28	51	20	31	51	20	30	51	20	15
52	21	16	52	21	21	52	21	16	52	21	25	52	21	24	52	21	25	52	21	29	52	21	33
53	22	15	53	22	15	53	22	16	53	22	10	53	22	25	53	22	20	53	22	29	53	22	28
54	23	15	54	23	15	54	23	15	54	23	14	54	23	24	54	23	25	54	23	15	54	23	29
55	24	15	55	24	15	55	24	15	55	24	9	55	24	15	55	24	15	55	24	27	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	12	56	25	15	56	25	26
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	21	57	26	15	57	26	15
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59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
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61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 19 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 47

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15
9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15
11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15
17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15
18	18	55	18	18	58	18	18	15	18	18	15	18	18	59	18	18	15	18	18	15
19	19	56	19	19	47	19	19	63	19	19	58	19	19	15	19	19	15	19	19	15
20	20	48	20	20	48	20	20	56	20	20	60	20	20	61	20	20	15	20	20	15
21	21	47	21	21	45	21	21	50	21	21	56	21	21	61	21	21	15	21	21	15
22	22	38	22	22	48	22	22	49	22	22	51	22	22	49	22	22	15	22	22	56
23	23	40	23	23	50	23	23	47	23	23	49	23	23	51	23	23	57	23	23	55
24	24	40	24	24	43	24	24	45	24	24	46	24	24	50	24	24	53	24	24	54
25	25	38	25	25	37	25	25	42	25	25	45	25	25	48	25	25	50	25	25	48
26	26	34	26	26	35	26	26	39	26	26	40	26	26	46	26	26	45	26	26	48
27	27	32	27	27	34	27	27	36	27	27	41	27	27	41	27	27	42	27	27	48
28	28	30	28	28	32	28	28	33	28	28	34	28	28	38	28	28	38	28	28	47
29	29	25	29	29	30	29	29	30	29	29	32	29	29	34	29	29	37	29	29	38
30	30	19	30	30	26	30	30	29	30	30	30	30	30	32	30	30	33	30	30	35
31	31	17	31	31	23	31	31	25	31	31	27	31	31	28	31	31	31	31	31	33

TABLE 19 - CONCLUDED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 47

32	1	19	32	1	19	32	1	17	32	1	21	32	1	24	32	1	26	32	1	30
33	2	11	33	2	15	33	2	16	33	2	17	33	2	23	33	2	21	33	2	26
34	3	15	34	3	15	34	3	14	34	3	17	34	3	19	34	3	22	34	3	24
35	4	15	35	4	15	35	4	15	35	4	12	35	4	16	35	4	15	35	4	19
36	5	15	36	5	15	36	5	15	36	5	9	36	5	13	36	5	17	36	5	17
37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	14	37	6	15
38	7	15	38	7	15	38	7	15	38	7	15	38	7	20	38	7	16	38	7	9
39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	4
40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	9
41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15
42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15
43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15
44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15
45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15
46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15
47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15
48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15
49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15
50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15
54	23	30	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	32	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	19	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	12	63	1	15

TABLE 20

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 60

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	36	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	37	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	34	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	34	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	34	6	6	15	6	6	15	6	6	15	6	6	53	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	39	7	7	15	7	7	44
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	56	8	8	15
9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	32	9	9	34
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	34	10	10	32	10	10	40
11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15
17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15
18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15
19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15
20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15
21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15
22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15
23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15
24	24	45	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15
25	25	55	25	25	53	25	25	63	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15
26	26	39	26	26	52	26	26	49	26	26	54	26	26	15	26	26	15	26	26	15	26	26	15
27	27	50	27	27	43	27	27	43	27	27	52	27	27	15	27	27	15	27	27	15	27	27	15
28	28	43	28	28	53	28	28	49	28	28	52	28	28	54	28	28	53	28	28	15	28	28	15
29	29	38	29	29	44	29	29	46	29	29	44	29	29	50	29	29	46	29	29	47	29	29	15
30	30	29	30	30	45	30	30	45	30	30	48	30	30	48	30	30	15	30	30	15	30	30	15
31	31	37	31	31	35	31	31	43	31	31	37	31	31	35	31	31	49	31	31	56	31	31	15

TABLE 20 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 60

32	1	30	32	1	30	32	1	31	32	1	44	32	1	32	32	1	37	32	1	50	32	1	46
33	2	27	33	2	31	33	2	32	33	2	34	33	2	31	33	2	32	33	2	40	33	2	45
34	3	24	34	3	30	34	3	29	34	3	32	34	3	32	34	3	34	34	3	32	34	3	36
35	4	20	35	4	24	35	4	29	35	4	33	35	4	29	35	4	30	35	4	31	35	4	33
36	5	17	36	5	19	36	5	21	36	5	23	36	5	28	36	5	30	36	5	31	36	5	31
37	6	16	37	6	17	37	6	18	37	6	20	37	6	29	37	6	30	37	6	30	37	6	30
38	7	21	38	7	16	38	7	15	38	7	21	38	7	21	38	7	23	38	7	28	38	7	30
39	8	12	39	8	13	39	8	16	39	8	21	39	8	18	39	8	25	39	8	27	39	8	30
40	9	7	40	9	7	40	9	10	40	9	13	40	9	14	40	9	17	40	9	19	40	9	30
41	10	15	41	10	9	41	10	8	41	10	10	41	10	15	41	10	14	41	10	19	41	10	15
42	11	15	42	11	15	42	11	9	42	11	11	42	11	7	42	11	15	42	11	19	42	11	21
43	12	15	43	12	15	43	12	15	43	12	1	43	12	7	43	12	13	43	12	9	43	12	13
44	13	15	44	13	15	44	13	15	44	13	15	44	13	13	44	13	11	44	13	15	44	13	13
45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	12	45	14	9
46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	14	46	15	13
47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15
48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15
49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15
50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15
54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	33	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	12	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 20 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 60

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	44	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	37	7	7	38	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	36	8	8	44	8	8	50	8	8	59	8	8	15	8	8	15	8	8	15	8	8	15
9	9	33	9	9	40	9	9	33	9	9	48	9	9	15	9	9	43	9	9	15	9	9	15
10	10	37	10	10	36	10	10	35	10	10	34	10	10	39	10	10	43	10	10	63	10	10	15
11	11	33	11	11	41	11	11	38	11	11	38	11	11	38	11	11	40	11	11	53	11	11	51
12	12	34	12	12	33	12	12	32	12	12	34	12	12	34	12	12	42	12	12	37	12	12	55
13	13	34	13	13	34	13	13	35	13	13	32	13	13	37	13	13	34	13	13	43	13	13	47
14	14	34	14	14	35	14	14	34	14	14	33	14	14	33	14	14	35	14	14	34	14	14	43
15	15	30	15	15	30	15	15	32	15	15	35	15	15	36	15	15	36	15	15	35	15	15	35
16	16	15	16	16	15	16	16	15	16	16	32	16	16	34	16	16	34	16	16	35	16	16	35
17	17	15	17	17	32	17	17	33	17	17	30	17	17	34	17	17	33	17	17	33	17	17	34
18	18	15	18	18	15	18	18	15	18	18	15	18	18	24	18	18	31	18	18	33	18	18	35
19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	27	19	19	35	19	19	35
20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	34
21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	28	21	21	24	21	21	34
22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	23	22	22	15
23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15
24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	25	24	24	15
25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	48
26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15
27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15
28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15
29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15
30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15
31	31	42	31	31	61	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15

TABLE 20 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 60

42	1	51	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15
33	2	41	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15
34	3	32	34	3	15	34	3	53	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15
35	4	32	35	4	15	35	4	47	35	4	43	35	4	15	35	4	15	35	4	15	35	4	15
36	5	33	36	5	34	36	5	35	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15
37	6	30	37	6	29	37	6	41	37	6	35	37	6	49	37	6	15	37	6	15	37	6	15
38	7	27	38	7	30	38	7	32	38	7	31	38	7	35	38	7	26	38	7	15	38	7	15
39	8	30	39	8	31	39	8	30	39	8	30	39	8	30	39	8	15	39	8	40	39	8	15
40	9	29	40	9	30	40	9	29	40	9	30	40	9	32	40	9	31	40	9	34	40	9	34
41	10	27	41	10	29	41	10	29	41	10	29	41	10	30	41	10	15	41	10	33	41	10	15
42	11	24	42	11	21	42	11	30	42	11	29	42	11	30	42	11	28	42	11	30	42	11	30
43	12	13	43	12	15	43	12	21	43	12	25	43	12	30	43	12	29	43	12	30	43	12	28
44	13	19	44	13	13	44	13	23	44	13	26	44	13	28	44	13	30	44	13	30	44	13	30
45	14	7	45	14	9	45	14	13	45	14	20	45	14	30	45	14	30	45	14	29	45	14	31
46	15	15	46	15	13	46	15	11	46	15	15	46	15	18	46	15	29	46	15	29	46	15	31
47	16	7	47	16	15	47	16	9	47	16	15	47	16	11	47	16	26	47	16	17	47	16	26
48	17	15	48	17	12	48	17	15	48	17	15	48	17	15	48	17	15	48	17	16	48	17	24
49	18	15	49	18	15	49	18	15	49	18	11	49	18	21	49	18	9	49	18	9	49	18	16
50	19	15	50	19	15	50	19	15	50	19	15	50	19	13	50	19	15	50	19	15	50	19	23
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	8	51	20	10	51	20	11
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	7	53	22	15
54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 20 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 60

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15
9	9	15	9	9	58	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15
11	11	15	11	11	15	11	11	61	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	57	12	12	15	12	12	60	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	49	13	13	51	13	13	41	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	42	14	14	44	14	14	15	14	14	43	14	14	57	14	14	15	14	14	53	14	14	15
15	15	36	15	15	41	15	15	60	15	15	53	15	15	15	15	15	15	15	15	57	15	15	62
16	16	33	16	16	46	16	16	35	16	16	54	16	16	49	16	16	53	16	16	54	16	16	15
17	17	35	17	17	39	17	17	33	17	17	30	17	17	49	17	17	37	17	17	54	17	17	55
18	18	34	18	18	36	18	18	37	18	18	38	18	18	46	18	18	43	18	18	38	18	18	55
19	19	34	19	19	35	19	19	36	19	19	37	19	19	34	19	19	33	19	19	40	19	19	40
20	20	33	20	20	34	20	20	34	20	20	35	20	20	34	20	20	36	20	20	37	20	20	42
21	21	34	21	21	32	21	21	33	21	21	34	21	21	35	21	21	38	21	21	38	21	21	44
22	22	33	22	22	30	22	22	32	22	22	34	22	22	34	22	22	34	22	22	35	22	22	41
23	23	30	23	23	33	23	23	33	23	23	33	23	23	32	23	23	33	23	23	36	23	23	35
24	24	28	24	24	24	24	24	20	24	24	34	24	24	34	24	24	33	24	24	33	24	24	33
25	25	15	25	25	21	25	25	26	25	25	28	25	25	32	25	25	32	25	25	33	25	25	34
26	26	15	26	26	15	26	26	22	26	26	21	26	26	25	26	26	34	26	26	32	26	26	33
27	27	15	27	27	15	27	27	15	27	27	23	27	27	28	27	27	24	27	27	20	27	27	33
28	28	15	28	28	15	28	28	15	28	28	15	28	28	19	28	28	16	28	28	15	28	28	30
29	29	15	29	29	15	29	29	15	29	29	15	29	29	25	29	29	20	29	29	23	29	29	20
30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	18	30	30	7
31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	7	31	31	8

TABLE 20 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 60

32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	14
33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15
34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	13
35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15
36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15
37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15
38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15
39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15
40	9	42	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15
41	10	15	41	10	35	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15
42	11	31	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15
43	12	30	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15
44	13	33	44	13	32	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15
45	14	30	45	14	23	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15
46	15	28	46	15	31	46	15	15	46	15	31	46	15	15	46	15	15	46	15	15	46	15	15
47	16	31	47	16	27	47	16	28	47	16	31	47	16	15	47	16	15	47	16	15	47	16	15
48	17	31	48	17	32	48	17	30	48	17	29	48	17	30	48	17	15	48	17	34	48	17	15
49	18	27	49	18	27	49	18	29	49	18	26	49	18	30	49	18	15	49	18	15	49	18	15
50	19	15	50	19	18	50	19	17	50	19	27	50	19	28	50	19	29	50	19	15	50	19	15
51	20	15	51	20	13	51	20	27	51	20	20	51	20	29	51	20	29	51	20	30	51	20	15
52	21	16	52	21	15	52	21	16	52	21	27	52	21	19	52	21	15	52	21	28	52	21	33
53	22	15	53	22	15	53	22	12	53	22	10	53	22	22	53	22	15	53	22	29	53	22	28
54	23	15	54	23	15	54	23	15	54	23	14	54	23	21	54	23	25	54	23	15	54	23	29
55	24	15	55	24	15	55	24	15	55	24	9	55	24	15	55	24	15	55	24	25	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	12	56	25	15	56	25	26
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	21	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 20 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 60

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15
9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15
11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15
17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15
18	18	51	18	18	58	18	18	15	18	18	15	18	18	59	18	18	15	18	18	15
19	19	56	19	19	47	19	19	63	19	19	58	19	19	15	19	19	15	19	19	15
20	20	40	20	20	47	20	20	53	20	20	58	20	20	61	20	20	15	20	20	15
21	21	48	21	21	43	21	21	45	21	21	51	21	21	59	21	21	15	21	21	15
22	22	34	22	22	45	22	22	43	22	22	52	22	22	47	22	22	15	22	22	56
23	23	38	23	23	49	23	23	48	23	23	43	23	23	51	23	23	53	23	23	51
24	24	40	24	24	47	24	24	41	24	24	39	24	24	49	24	24	45	24	24	48
25	25	38	25	25	33	25	25	45	25	25	44	25	25	48	25	25	42	25	25	50
26	26	33	26	26	34	26	26	41	26	26	39	26	26	43	26	26	42	26	26	44
27	27	32	27	27	34	27	27	34	27	27	37	27	27	44	27	27	41	27	27	53
28	28	33	28	28	33	28	28	33	28	28	33	28	28	40	28	28	24	28	28	44
29	29	26	29	29	29	29	29	31	29	29	33	29	29	32	29	29	35	29	29	33
30	30	17	30	30	22	30	30	31	30	30	32	30	30	33	30	30	32	30	30	33
31	31	14	31	31	23	31	31	30	31	31	24	31	31	25	31	31	31	31	31	34

TABLE 20 - CONCLUDED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 60

32	1	18	32	1	15	32	1	14	32	1	17	32	1	20	32	1	31	32	1	30
33	2	6	33	2	15	33	2	16	33	2	13	33	2	24	33	2	16	33	2	23
34	3	15	34	3	15	34	3	7	34	3	12	34	3	18	34	3	19	34	3	25
35	4	15	35	4	15	35	4	15	35	4	7	35	4	14	35	4	12	35	4	19
36	5	15	36	5	15	36	5	15	36	5	8	36	5	9	36	5	19	36	5	18
37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	12	37	6	14
38	7	15	38	7	15	38	7	15	38	7	15	38	7	20	38	7	16	38	7	3
39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	4
40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	9
41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15
42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15
43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15
44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15
45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15
46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15
47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15
48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15
49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15
50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15
54	23	29	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	32	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	19	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	12	63	1	15

TABLE 21

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 61

STATE 1			STATE 2			STATE 3			STATE 4			STATE 5			STATE 6			STATE 7			STATE 8		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	36	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	37	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	34	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	34	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	34	6	6	15	6	6	15	6	6	15	6	6	53	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	39	7	7	15	7	7	44
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	36	8	8	15
9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	32	9	9	37
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	34	10	10	32	10	10	40
11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15
17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15
18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15	18	18	15
19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	15
20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15
21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	15
22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15
23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15
24	24	53	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15
25	25	51	25	25	53	25	25	63	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15
26	26	46	26	26	52	26	26	49	26	26	54	26	26	15	26	26	15	26	26	15	26	26	15
27	27	49	27	27	53	27	27	43	27	27	52	27	27	15	27	27	15	27	27	15	27	27	15
28	28	45	28	28	52	28	28	48	28	28	52	28	28	54	28	28	53	28	28	15	28	28	15
29	29	43	29	29	44	29	29	48	29	29	50	29	29	53	29	29	55	29	29	47	29	29	15
30	30	38	30	30	44	30	30	44	30	30	48	30	30	49	30	30	15	30	30	15	30	30	15
31	31	36	31	31	36	31	31	39	31	31	44	31	31	43	31	31	53	31	31	51	31	31	15

TABLE 21 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 61

32	1	31	32	1	35	32	1	33	32	1	37	32	1	40	32	1	44	32	1	50	32	1	46
33	2	30	33	2	31	33	2	31	33	2	33	33	2	34	33	2	36	33	2	40	33	2	47
34	3	25	34	3	29	34	3	30	34	3	32	34	3	32	34	3	35	34	3	39	34	3	43
35	4	19	35	4	23	35	4	29	35	4	32	35	4	30	35	4	31	35	4	31	35	4	33
36	5	19	36	5	21	36	5	22	36	5	27	36	5	28	36	5	30	36	5	31	36	5	34
37	6	16	37	6	17	37	6	20	37	6	23	37	6	28	37	6	31	37	6	30	37	6	31
38	7	20	38	7	16	38	7	20	38	7	16	38	7	23	38	7	27	38	7	29	38	7	30
39	8	12	39	8	13	39	8	16	39	8	21	39	8	17	39	8	25	39	8	27	39	8	28
40	9	7	40	9	10	40	9	20	40	9	13	40	9	14	40	9	18	40	9	19	40	9	28
41	10	15	41	10	9	41	10	8	41	10	10	41	10	15	41	10	15	41	10	20	41	10	21
42	11	15	42	11	15	42	11	9	42	11	11	42	11	15	42	11	15	42	11	16	42	11	20
43	12	15	43	12	15	43	12	15	43	12	1	43	12	7	43	12	13	43	12	13	43	12	17
44	13	15	44	13	15	44	13	15	44	13	15	44	13	13	44	13	11	44	13	15	44	13	14
45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	12	45	14	9
46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	14	46	15	8
47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15
48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15
49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15
50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15
54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	33	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	12	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 21 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 61

STATE 9			STATE 10			STATE 11			STATE 12			STATE 13			STATE 14			STATE 15			STATE 16		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	44	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	37	7	7	38	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	36	8	8	44	8	8	50	8	8	59	8	8	15	8	8	15	8	8	15	8	8	15
9	9	33	9	9	40	9	9	33	9	9	48	9	9	15	9	9	43	9	9	15	9	9	15
10	10	37	10	10	37	10	10	36	10	10	34	10	10	39	10	10	43	10	10	63	10	10	15
11	11	33	11	11	41	11	11	38	11	11	38	11	11	33	11	11	40	11	11	53	11	11	51
12	12	34	12	12	34	12	12	33	12	12	34	12	12	34	12	12	42	12	12	57	12	12	55
13	13	34	13	13	34	13	13	35	13	13	34	13	13	36	13	13	36	13	13	41	13	13	47
14	14	34	14	14	35	14	14	34	14	14	33	14	14	34	14	14	42	14	14	45	14	14	44
15	15	30	15	15	30	15	15	32	15	15	35	15	15	36	15	15	35	15	15	35	15	15	38
16	16	15	16	16	15	16	16	15	16	16	32	16	16	34	16	16	33	16	16	45	16	16	35
17	17	15	17	17	32	17	17	33	17	17	30	17	17	34	17	17	33	17	17	34	17	17	34
18	18	15	18	18	15	18	18	15	18	18	15	18	18	24	18	18	33	18	18	34	18	18	34
19	19	15	19	19	15	19	19	15	19	19	15	19	19	15	19	19	31	19	19	34	19	19	34
20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	15	20	20	33
21	21	15	21	21	15	21	21	15	21	21	15	21	21	15	21	21	28	21	21	24	21	21	34
22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	15	22	22	23	22	22	15
23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15	23	23	15
24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	15	24	24	25	24	24	15
25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	15	25	25	48
26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15	26	26	15
27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15	27	27	15
28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15	28	28	15
29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15	29	29	15
30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15
31	31	42	31	31	61	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15

TABLE 21 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 61

32	1	51	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15
33	2	49	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15
34	3	44	34	3	15	34	3	53	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15
35	4	35	35	4	15	35	4	47	35	4	43	35	4	15	35	4	15	35	4	15	35	4	15
36	5	33	36	5	35	36	5	35	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15
37	6	31	37	6	35	37	6	41	37	6	35	37	6	49	37	6	15	37	6	15	37	6	15
38	7	31	38	7	30	38	7	32	38	7	31	38	7	35	38	7	26	38	7	15	38	7	15
39	8	31	39	8	30	39	8	30	39	8	31	39	8	36	39	8	15	39	8	40	39	8	15
40	9	29	40	9	30	40	9	30	40	9	30	40	9	31	40	9	31	40	9	34	40	9	34
41	10	27	41	10	26	41	10	30	41	10	30	41	10	30	41	10	15	41	10	33	41	10	15
42	11	24	42	11	22	42	11	30	42	11	30	42	11	30	42	11	29	42	11	30	42	11	34
43	12	17	43	12	24	43	12	23	43	12	26	43	12	29	43	12	30	43	12	30	43	12	29
44	13	19	44	13	18	44	13	23	44	13	25	44	13	28	44	13	29	44	13	30	44	13	30
45	14	10	45	14	12	45	14	18	45	14	19	45	14	27	45	14	29	45	14	29	45	14	30
46	15	15	46	15	13	46	15	17	46	15	15	46	15	18	46	15	28	46	15	30	46	15	30
47	16	7	47	16	15	47	16	9	47	16	17	47	16	23	47	16	26	47	16	20	47	16	27
48	17	15	48	17	12	48	17	15	48	17	15	48	17	15	48	17	15	48	17	21	48	17	25
49	18	15	49	18	15	49	18	15	49	18	11	49	18	16	49	18	15	49	18	22	49	18	23
50	19	15	50	19	15	50	19	15	50	19	15	50	19	14	50	19	15	50	19	15	50	19	14
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	8	51	20	10	51	20	11
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	7	53	22	15
54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 21 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 61

STATE 17			STATE 18			STATE 19			STATE 20			STATE 21			STATE 22			STATE 23			STATE 24		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15
9	9	15	9	9	58	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15
11	11	15	11	11	15	11	11	61	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	57	12	12	15	12	12	60	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	49	13	13	51	13	13	41	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	45	14	14	48	14	14	15	14	14	43	14	14	57	14	14	15	14	14	53	14	14	15
15	15	36	15	15	41	15	15	60	15	15	53	15	15	15	15	15	15	15	15	57	15	15	62
16	16	38	16	16	41	16	16	37	16	16	46	16	16	49	16	16	53	16	16	54	16	16	15
17	17	36	17	17	39	17	17	38	17	17	37	17	17	45	17	17	37	17	17	55	17	17	60
18	18	35	18	18	35	18	18	37	18	18	41	18	18	46	18	18	51	18	18	38	18	18	55
19	19	34	19	19	36	19	19	36	19	19	37	19	19	41	19	19	35	19	19	46	19	19	55
20	20	34	20	20	35	20	20	34	20	20	35	20	20	42	20	20	40	20	20	43	20	20	48
21	21	33	21	21	33	21	21	34	21	21	34	21	21	36	21	21	38	21	21	41	21	21	44
22	22	33	22	22	31	22	22	33	22	22	34	22	22	34	22	22	35	22	22	38	22	22	41
23	23	30	23	23	33	23	23	34	23	23	33	23	23	33	23	23	34	23	23	36	23	23	38
24	24	28	24	24	26	24	24	25	24	24	31	24	24	33	24	24	34	24	24	34	24	24	34
25	25	15	25	25	21	25	25	31	25	25	30	25	25	33	25	25	32	25	25	33	25	25	34
26	26	15	26	26	15	26	26	22	26	26	21	26	26	26	26	26	32	26	26	32	26	26	34
27	27	15	27	27	15	27	27	15	27	27	23	27	27	28	27	27	21	27	27	27	27	27	32
28	28	15	28	28	15	28	28	15	28	28	15	28	28	23	28	28	20	28	28	22	28	28	27
29	29	15	29	29	15	29	29	15	29	29	15	29	29	25	29	29	20	29	29	24	29	29	23
30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	15	30	30	18	30	30	14
31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	15	31	31	7	31	31	18

TABLE 21 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 61

32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	15	32	1	14
33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15	33	2	15
34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	15	34	3	13
35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15	35	4	15
36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15	36	5	15
37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	15
38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15	38	7	15
39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15
40	9	42	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15
41	10	15	41	10	35	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15
42	11	31	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15
43	12	30	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15
44	13	33	44	13	32	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15
45	14	30	45	14	23	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15
46	15	29	46	15	31	46	15	15	46	15	31	46	15	15	46	15	15	46	15	15	46	15	15
47	16	29	47	16	27	47	16	29	47	16	31	47	16	15	47	16	15	47	16	15	47	16	15
48	17	31	48	17	32	48	17	29	48	17	30	48	17	32	48	17	15	48	17	34	48	17	15
49	18	27	49	18	27	49	18	29	49	18	26	49	18	30	49	18	15	49	18	15	49	18	15
50	19	15	50	19	27	50	19	26	50	19	28	50	19	28	50	19	29	50	19	15	50	19	15
51	20	15	51	20	26	51	20	27	51	20	20	51	20	29	51	20	29	51	20	30	51	20	15
52	21	16	52	21	21	52	21	16	52	21	27	52	21	19	52	21	27	52	21	28	52	21	33
53	22	15	53	22	15	53	22	13	53	22	10	53	22	22	53	22	15	53	22	29	53	22	28
54	23	15	54	23	15	54	23	15	54	23	14	54	23	21	54	23	25	54	23	15	54	23	29
55	24	15	55	24	15	55	24	15	55	24	9	55	24	15	55	24	15	55	24	25	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	12	56	25	15	56	25	26
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	21	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	15

TABLE 21 - CONTINUED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 61

STATE 25			STATE 26			STATE 27			STATE 28			STATE 29			STATE 30			STATE 31		
IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU	IN	NS	OU
0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15	0	1	15
1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15	1	1	15
2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15	2	2	15
3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15	3	3	15
4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15	4	4	15
5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15	5	5	15
6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15	6	6	15
7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15	7	7	15
8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15	8	8	15
9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15	9	9	15
10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15	10	10	15
11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15	11	11	15
12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15	12	12	15
13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15	13	13	15
14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15	14	14	15
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15	16	16	15
17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15	17	17	15
18	18	51	18	18	58	18	18	15	18	18	15	18	18	59	18	18	15	18	18	15
19	19	56	19	19	47	19	19	63	19	19	58	19	19	15	19	19	15	19	19	15
20	20	51	20	20	47	20	20	54	20	20	58	20	20	61	20	20	15	20	20	15
21	21	47	21	21	44	21	21	45	21	21	52	21	21	61	21	21	15	21	21	15
22	22	34	22	22	45	22	22	48	22	22	52	22	22	47	22	22	15	22	22	56
23	23	39	23	23	49	23	23	48	23	23	47	23	23	51	23	23	57	23	23	55
24	24	39	24	24	44	24	24	45	24	24	47	24	24	50	24	24	53	24	24	54
25	25	37	25	25	35	25	25	43	25	25	43	25	25	47	25	25	51	25	25	49
26	26	34	26	26	35	26	26	40	26	26	40	26	26	45	26	26	44	26	26	47
27	27	32	27	27	34	27	27	35	27	27	38	27	27	43	27	27	42	27	27	51
28	28	31	28	28	33	28	28	34	28	28	34	28	28	39	28	28	37	28	28	44
29	29	26	29	29	30	29	29	31	29	29	32	29	29	34	29	29	35	29	29	39
30	30	19	30	30	25	30	30	30	30	30	31	30	30	32	30	30	33	30	30	36
31	31	16	31	31	24	31	31	23	31	31	24	31	31	28	31	31	32	31	31	33

TABLE 21 - CONCLUDED

FINAL EQUIVALENT 63 STATE FINITE MACHINE OF EXP. 61

32	1	18	32	1	18	32	1	18	32	1	21	32	1	23	32	1	26	32	1	30
33	2	14	33	2	15	33	2	15	33	2	18	33	2	23	33	2	24	33	2	26
34	3	15	34	3	15	34	3	16	34	3	16	34	3	18	34	3	20	34	3	24
35	4	15	35	4	15	35	4	15	35	4	13	35	4	16	35	4	13	35	4	19
36	5	15	36	5	15	36	5	15	36	5	8	36	5	13	36	5	18	36	5	16
37	6	15	37	6	15	37	6	15	37	6	15	37	6	15	37	6	14	37	6	14
38	7	15	38	7	15	38	7	15	38	7	15	38	7	20	38	7	16	38	7	3
39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	15	39	8	4
40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	15	40	9	9
41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15	41	10	15
42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15	42	11	15
43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15	43	12	15
44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15	44	13	15
45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15	45	14	15
46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15	46	15	15
47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15	47	16	15
48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15	48	17	15
49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15	49	18	15
50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15	50	19	15
51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15	51	20	15
52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15	52	21	15
53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15	53	22	15
54	23	29	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15	54	23	15
55	24	15	55	24	15	55	24	15	55	24	15	55	24	32	55	24	15	55	24	15
56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15	56	25	15
57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15	57	26	15
58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15	58	27	15
59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15	59	28	15
60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15	60	29	15
61	30	15	61	30	19	61	30	15	61	30	15	61	30	15	61	30	15	61	30	15
62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15	62	31	15
63	1	15	63	1	15	63	1	15	63	1	15	63	1	15	63	1	12	63	1	15

TABLE 22

EFFECT OF VARIOUS COST MATRICES ON ERROR DISTRIBUTION

Exp. No.	Description	Percent Correct	Percent One or Less	90 Percent Point in Symbols	Average Error in Symbols
45	Magnitude of Error	28.3	48.2	7	2.55
47	Average Setting	16.9	41.2	6	2.67
60	All or Nothing	32.9	47.6	9	3.10
61	Zero Band Magnitude of Error	25	51	7	2.58

TABLE 23

MATRIX REPRESENTATION OF 31 STATE AND 31 SYMBOL ALPHABET MACHINE OF EXP. 63.

POSITION	RATE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1																37				35											
2														33	34									41							
3																															
4												33			39	35	50	37	38		51	60								59		
5												32	33		38	36	39	40		48	49	43										
6										33	34		34	33	35	36	39	44	34	42	49	52	58	63		62						
7											34	34	33	34	34	36	37	39	43	45	47		52	49	58	61						
8								29	31	31		34	34	33	37	37	37	39	41	43	53	51	50		54	58	59					
9							31		31	32	32	32	35	34	35	35	37	39	41	42	42	46	48	54	58		60				60	
10									26	33	33	33	34	33	35	35	36	42	45	42	44	47	49	51	57	52	63	59				
11						27	22	26	33	32	32	34	33	33	34	36	38	40	41	43	47	46	52	48	54	62	61	57				
12					27		28	27	27	30	32	33	32	33	34	34	37	39	42	43	46	48	51	53	52	58	59	52				
13				23		23	19	31	23	31	31	31	33	33	34	36	39	43	41	46	46	47	50	51	52	52	59	55				
14						26	23	23	21	26	27	31	31	33	33	35	38	40	42	45	47	48	50	49	43	54	56					
15				24		14	18	18	19	25	25	29	30	30	32	33	35	37	42	41	45	51	48	51	54	50	59	47				
16					9	13	17	16	19	20	23	24	26	29	31	33	34	37	37	38	44	47	44	52	51	54	47		62			
17			11	5	13	11	15	15	15	20	21	23	24	28	29	30	32	32	35	36	35	40	40	44	51	58						
18					8	11	15	14	14	14	18	20	22	24	28	31	30	30	32	32	34	40	36	41	43	46						
19				17	13	12	12	15	14	17	16	20	22	27	27	29	29	30	31	30	33	32	34	31	41							
20				6	2	9	11	16	14	12	17	17	23	25	26	28	29	30	30	30	30	34	35	48	33		42					
21				7	11	9	8	11	16	13	19	19	22	23	25	28	29	29	29	30	30	32	33	36		34						
22					11	8	13	12	16	15	19	19	22	22	25	28	29	29	29	29	29	30	29	30								
23				14	11	3	9	8	11	14	18	17	22	24	26	29	29	28	29	32		29										
24					5	10	13	11	13	11	18	16	20	22	25	28	30	29	28	29	30			33								
25							11	15	14	13	16	20	26	22	26	28	29	27	27		32											
26							6	8		14	16	16	14	22	24	19	27	28	28		33											
27										14	10		22	24	19	28	29	27													
28											10			24	26							31									
29										19											32										
30										18																					
31												10		10			32														

TABLE 24

MATRIX REPRESENTATION OF 15 STATE AND 15 SYMBOL ALPHABET MACHINE OF EXP. 64

POSITION \ RATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1							34	37		35		44			
2						33		43	45	45	60				
3					33	33	35	36	39	46	51	61	62	59	
4				29	32	33	34	36	39	44	50	51	58		
5				29	31	33	34	36	39	43	47	54	59	60	60
6		23	25	28	31	32	33	35	40	44	48	53	56	55	
7			21	23	27	30	32	35	40	44	47	51	55	52	
8		12	14	15	20	25	29	32	36	40	46	50	50	62	
9		11	11	14	16	21	25	30	31	32	37	41	48		
10		9	9	13	16	18	25	28	30	30	32	37	38		
11		4	10	12	15	19	23	28	28	29	30	33			
12		14	6	13	15	17	23	28	28	30	29	33			
13			5	7	14	16	22	24	28		33				
14					12		25				31				
15					18	10	10		32	32					

TABLE 25

MATRIX REPRESENTATION OF 7 STATE AND 7 SYMBOL ALPHABET MACHINE OF EXP. 65

RATE

POSITION	1	2	3	4	5	6	7
1			33	40	46	44	59
2		31	33	37	43	55	54
3	23	26	32	36	45	52	59
4	1	16	25	32	39	49	52
5	8	13	19	28	30	36	
6	14	11	18	26	29	33	
7			12	28	32		

TABLE 26

TIME VARIANT ANALYSIS OF HUMAN PILOT (EXP. 65A)

POSITION \ RATE	1	2	3	4	5	6	7
1			33	39	44	44	59
2		30	33	36	41	53	
3		26	32	35	44	51	62
4	9	15	25	32	38	46	47
5	7	13	19	28	29	34	
6		10	18	26	28		
7			7	26			

POSITION \ RATE	1	2	3	4	5	6	7
1							
2		29	34	37	44	55	
3	23	24	33	36	44	54	
4	11	16	25	32	40	49	
5	7	12	18	27	30	40	
6		9	18	26	28		
7							

POSITION \ RATE	1	2	3	4	5	6	7
1				40	49		
2		33	33	36	42	54	54
3		26	33	36	45	49	56
4	24	17	26	33	40	49	48
5	13	14	20	28	31	37	
6	14	12	18	26	31	33	
7			13	29	32		

POSITION \ RATE	1	2	3	4	5	6	7
1							
2		32	33	37	45	56	
3		27	32	36	45	55	59
4	6	16	24	33	39	49	60
5	3	12	19	27	31	34	
6		9	17	26	29		
7			12	24			

TABLE 27

SUMMARY OF FLIGHT DATA EXPERIMENTS

State Size	Interval (Seconds)	Type of Prediction	Average Error in Symbols
31	0.2	Position-rate	3.95
15	0.2	Position-rate	4.84
64	0.2	Position-last output, Total recall	1.22
16	0.2	Position-last output, Total recall	2.85
8	0.2	Position-last output, Total recall	3.30
64	0.2	Position-last output, Current recall	3.53
8	0.2	Position-last output, Current recall	3.61
16	0.4	Position-last output, Current recall	6.13

TABLE 28

STATE-CHANGE RESPONSE OF A 16 STATE MACHINE

PRESENT INPUT	PREVIOUS OUTPUT															
	1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61
1	0		-2	-2	-1		2									
5			-1	0	0	-1	-1	-1	-4							
9	+1	-1	0	0	0	-1	-1	-2	-2	-1						
13	+1		-1	0	-1	-1	-1	-1	-1	-2		-2			-6	
17	0	+1	0	0	0	-1	-1	-1	-1	-2	-1	-2				
21	+1	+1	0	0	0	0	-1	-1	-1	-1	-2	-3	-4			-1
25		+1	0	0	0	0	0	-1	-1	-1	-2	-1				
29		+1	0	+1	0	0	-1	0	-1	0	0	-2	-2	+2		
33		+1	-2	0	0	0	0	0	-1	0	-1	0			-5	
37		0	+3	0	0	0	+1	0	0	0	0	-1				
41		+2	+1	+1	+1	0	0	0	+1	0	-1	0				-1
45		+2	+2	+1	0	+1	0	0	0	0	0					
49			+1	+1	+1	0	0	0	0	0	0		+3			
53					+1	0	0	0	+1	+1	-2					
57						0			0	0						
61							+2			0						

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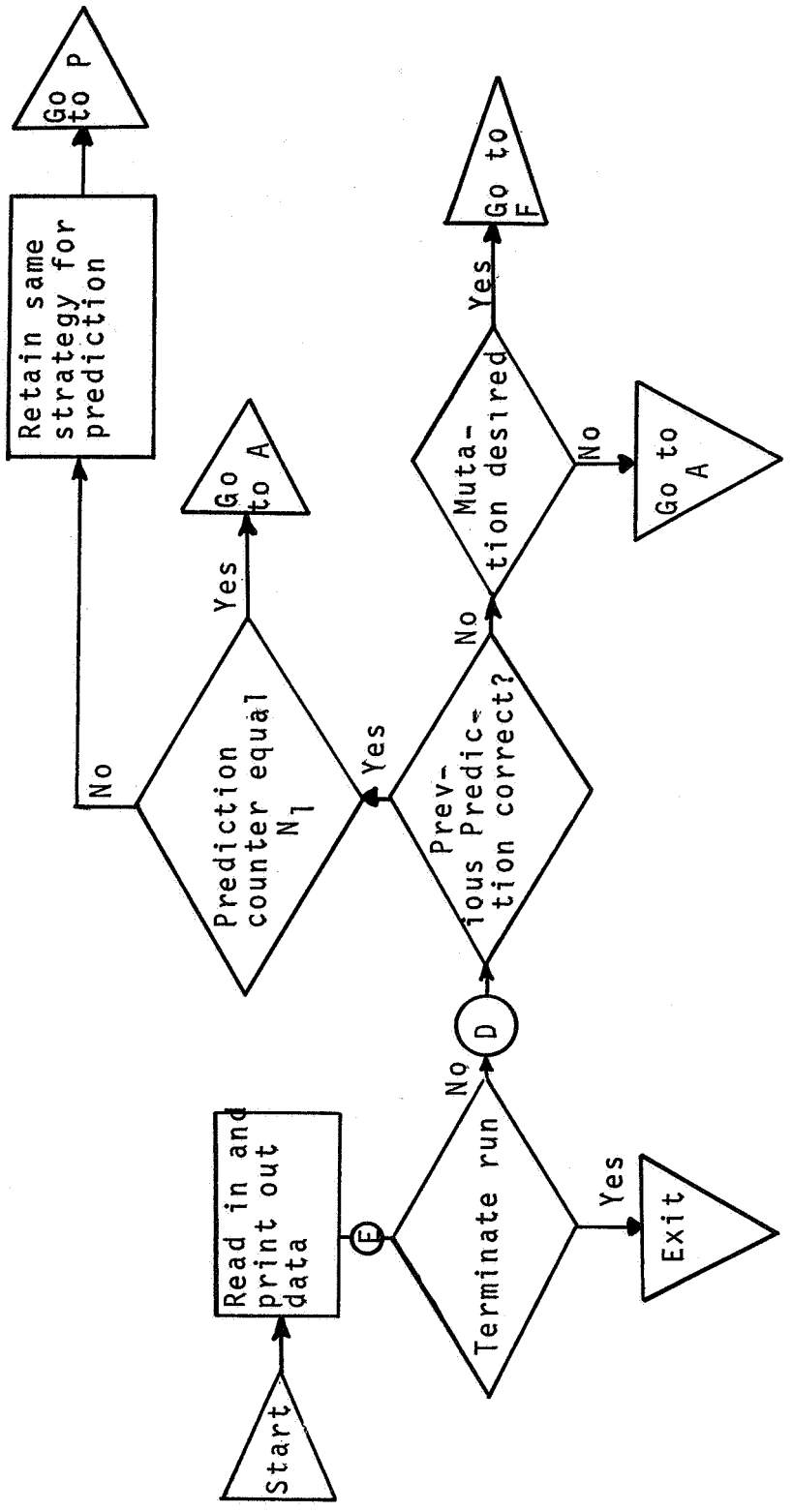


Fig. 1 Logical flow chart of a 64 symbol evolutionary program

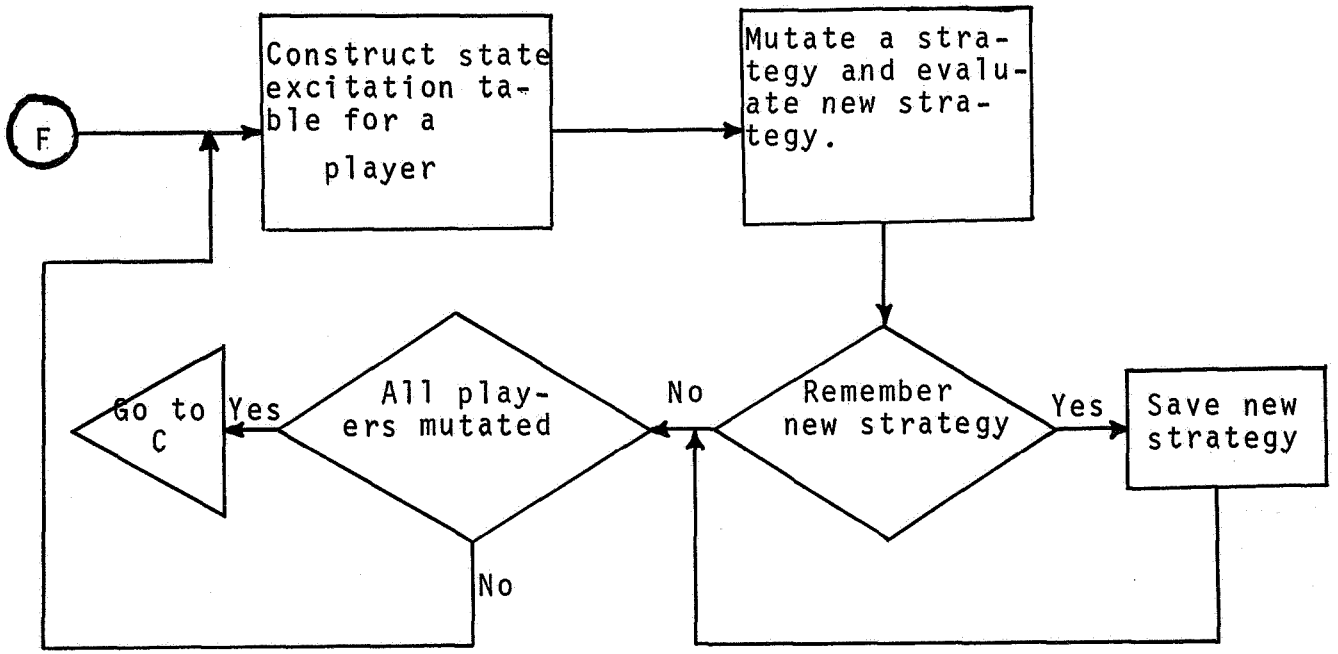


Fig. 1 Logical flow chart of a 64 symbol evolutionary program - continued

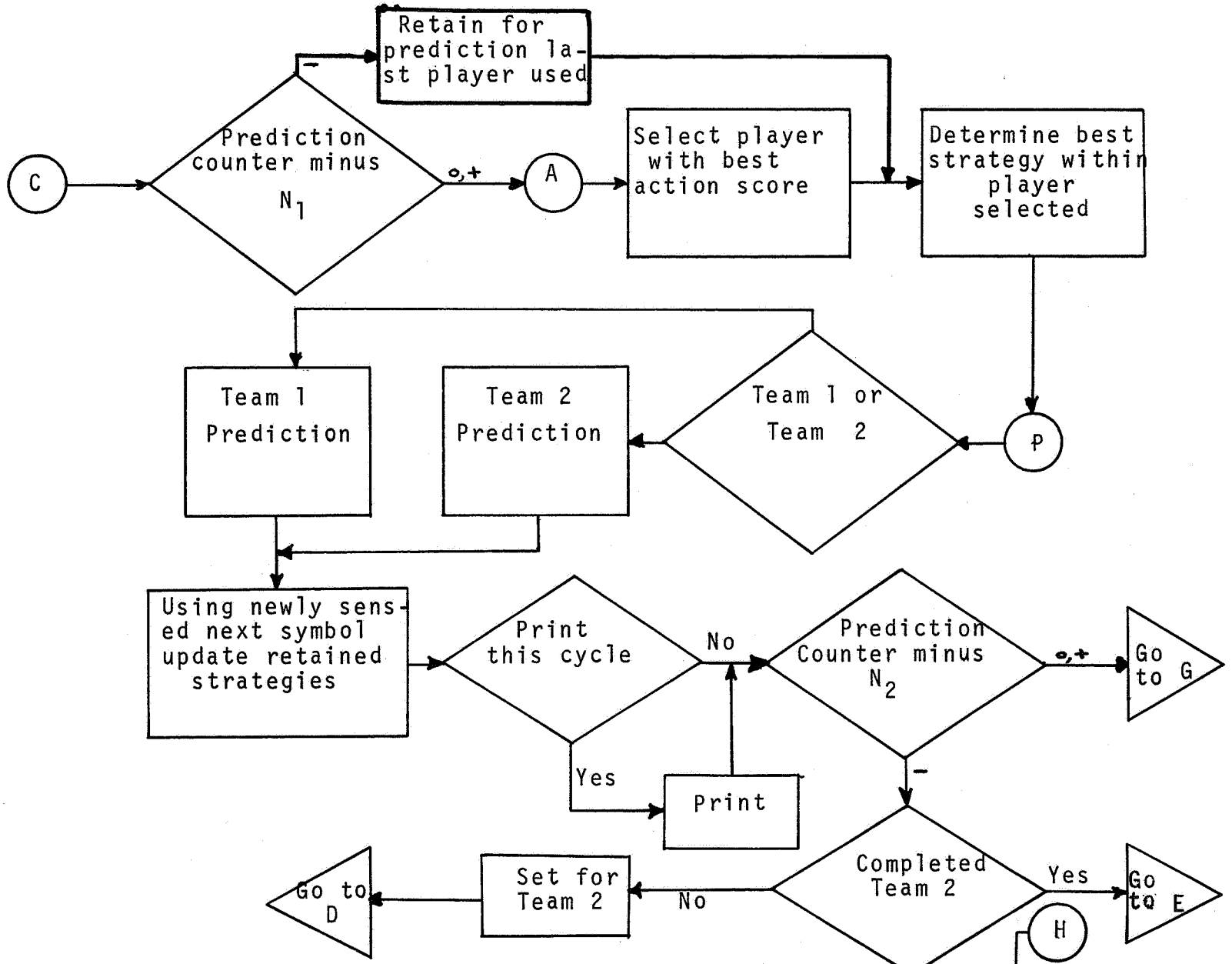


Fig. 1 Logical flow chart of a 64 symbol evolutionary program - continued

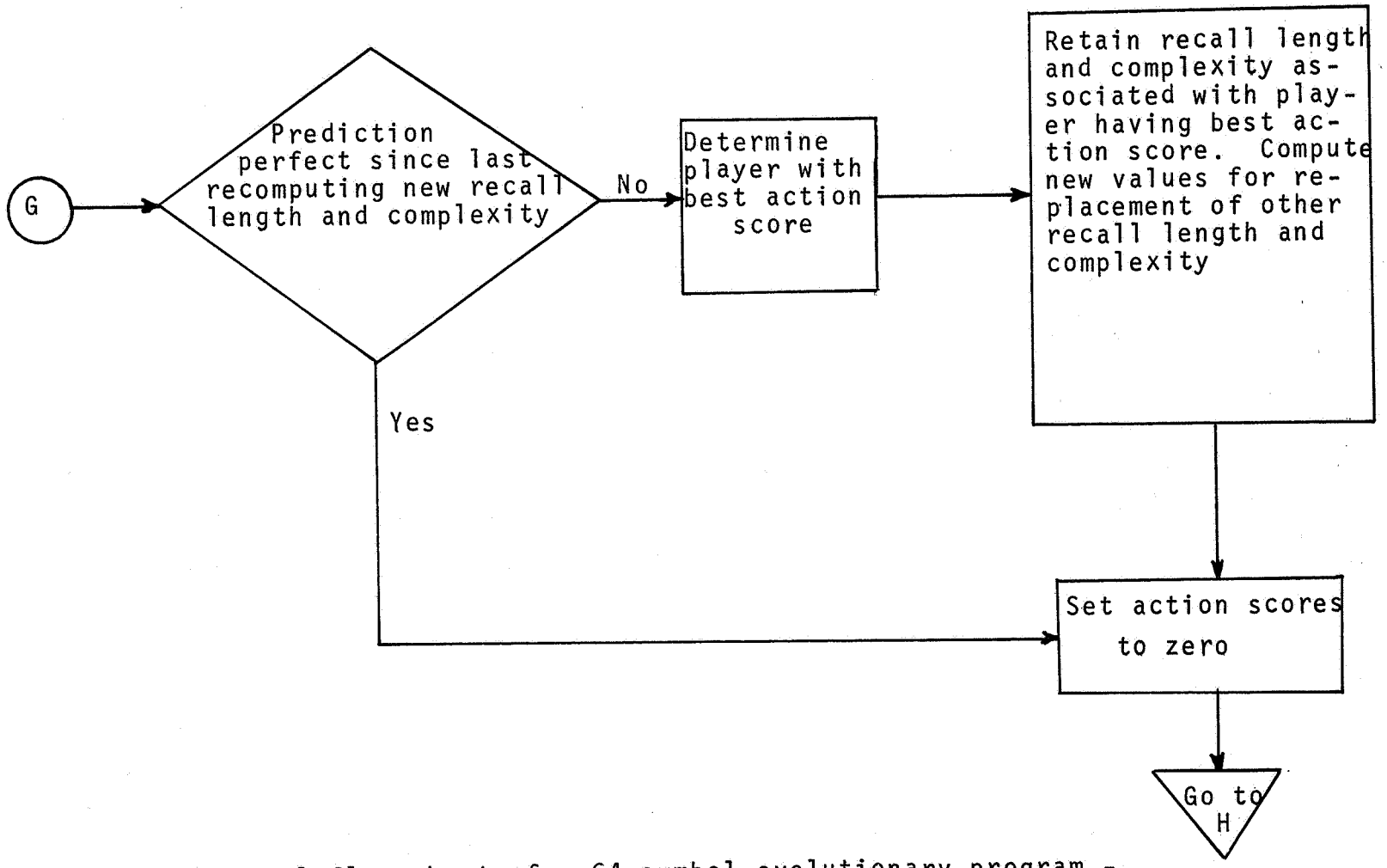


Fig. 1 Logical flow chart of a 64 symbol evolutionary program - concluded.

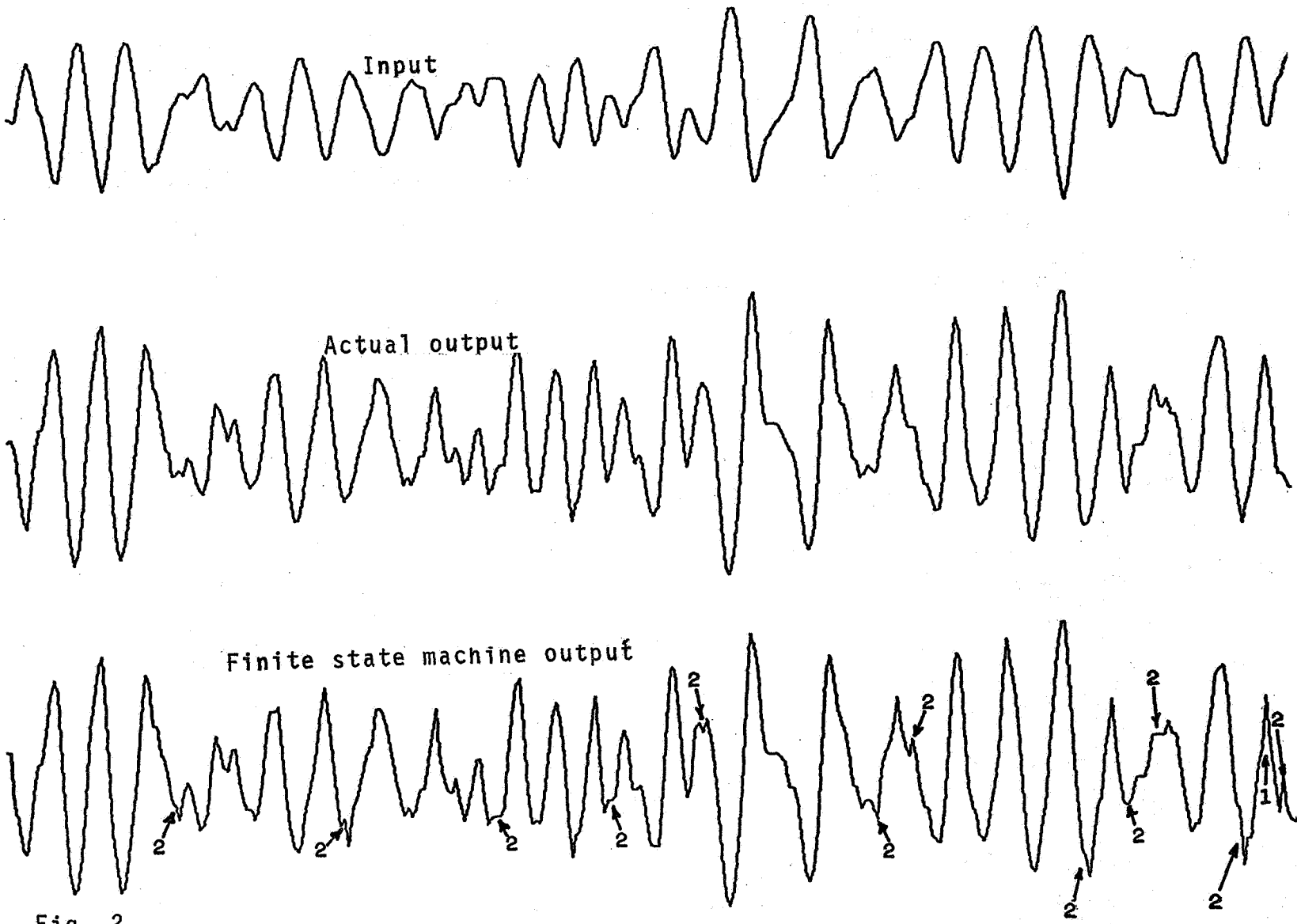


Fig. 2
Comparison of Linear Dynamic System with Final 15-State Machine of Exp. 1.

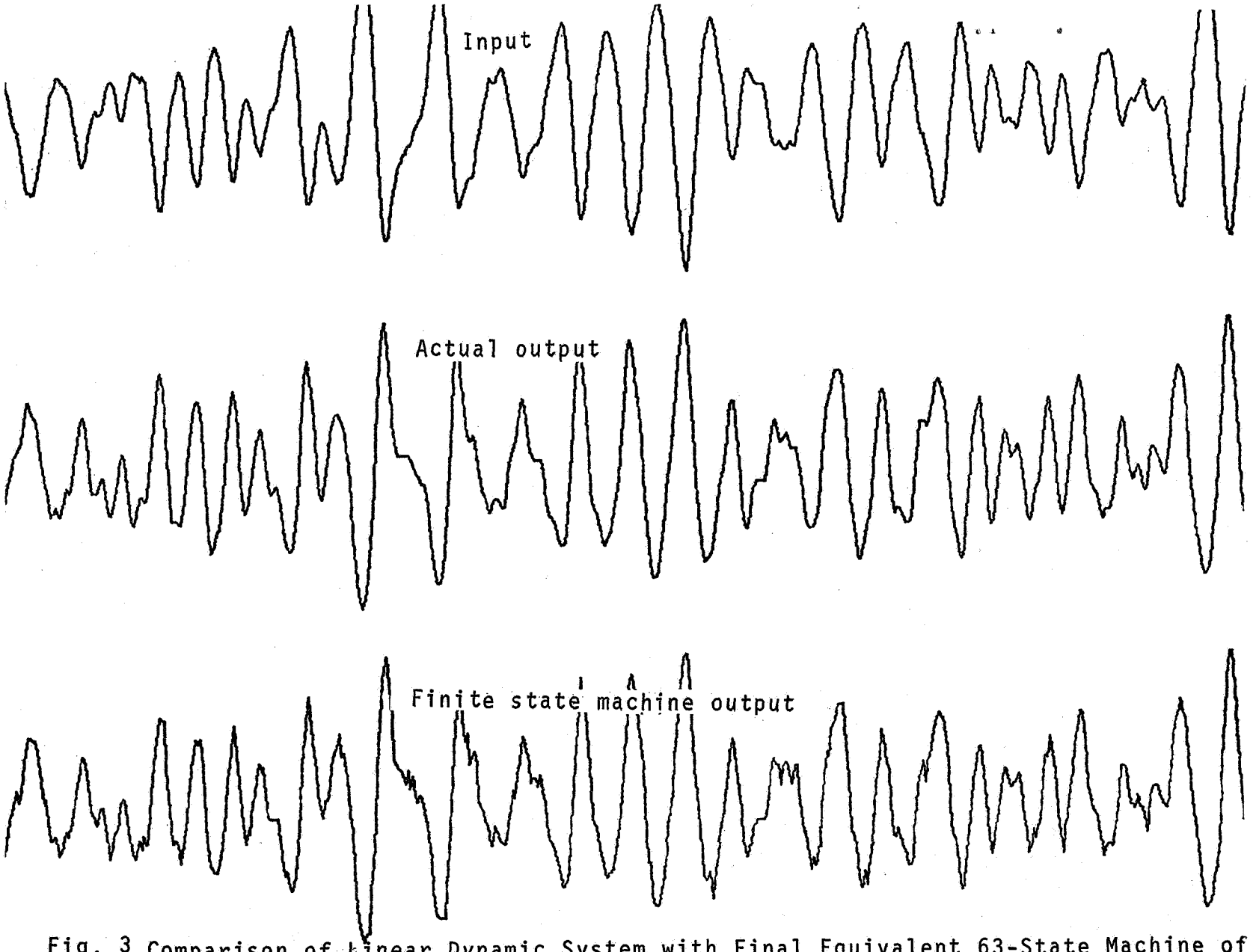


Fig. 3 Comparison of Linear Dynamic System with Final Equivalent 63-State Machine of Exp. 9.

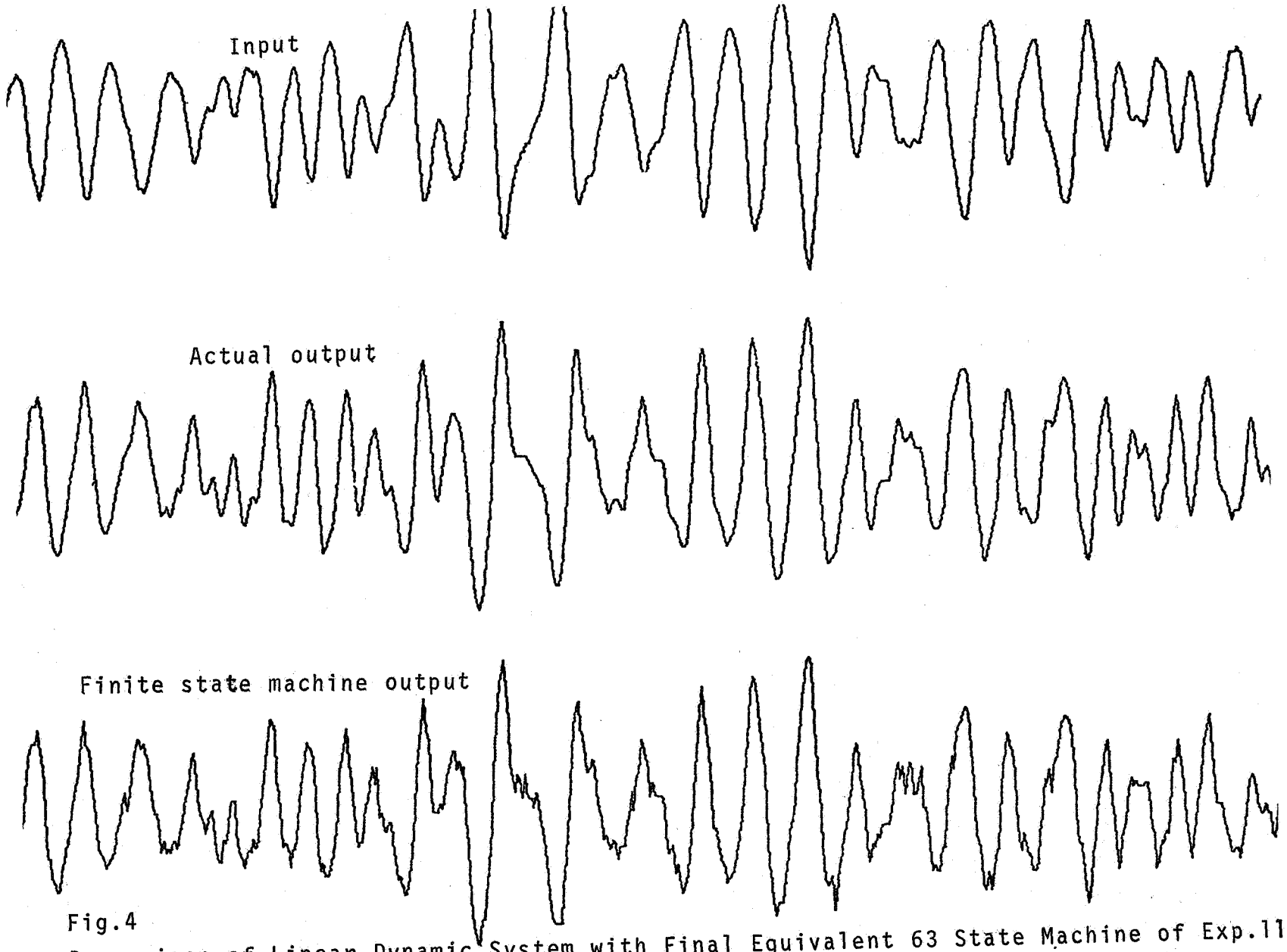


Fig.4
Comparison of Linear Dynamic System with Final Equivalent 63 State Machine of Exp.11.

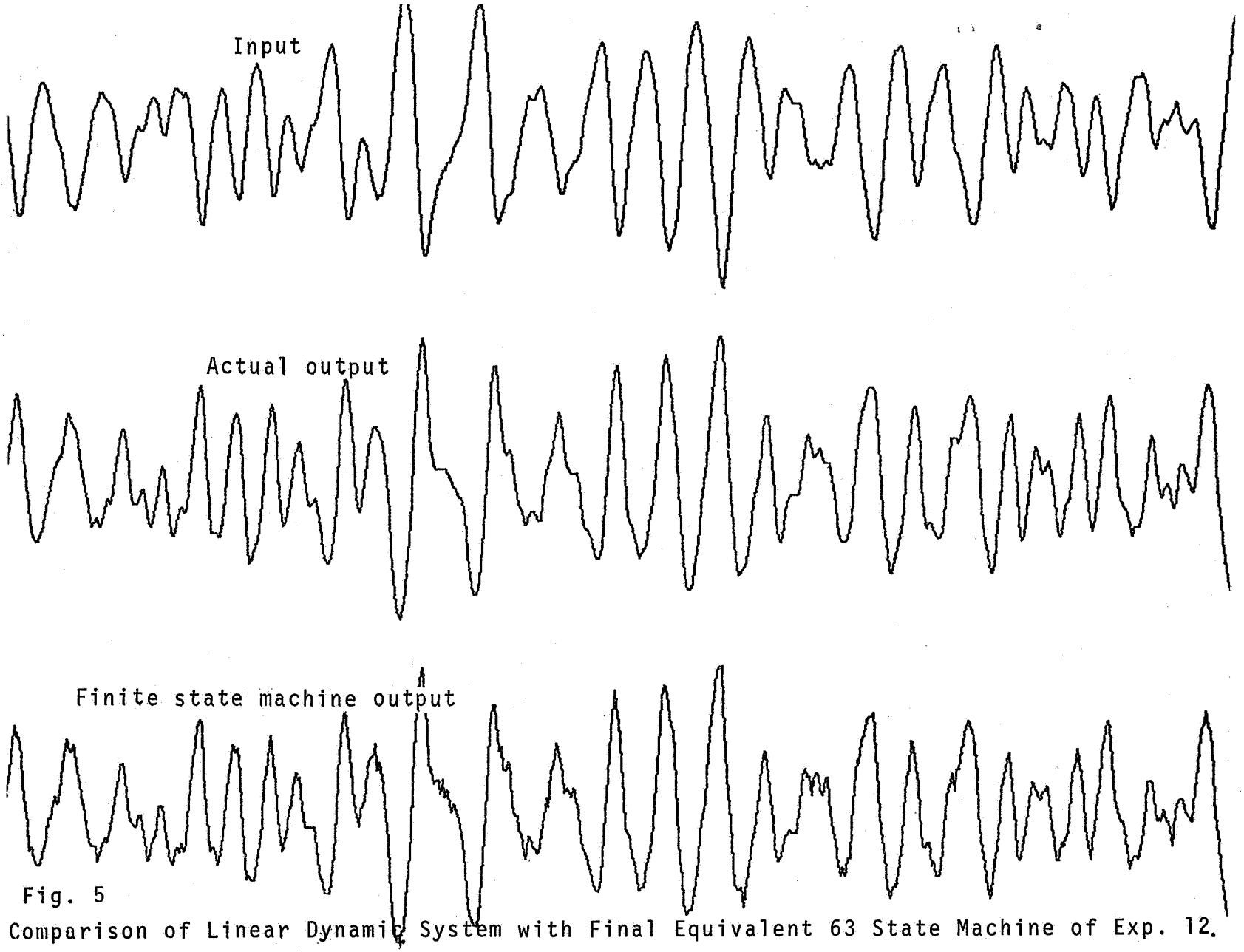


Fig. 5
Comparison of Linear Dynamic System with Final Equivalent 63 State Machine of Exp. 12.

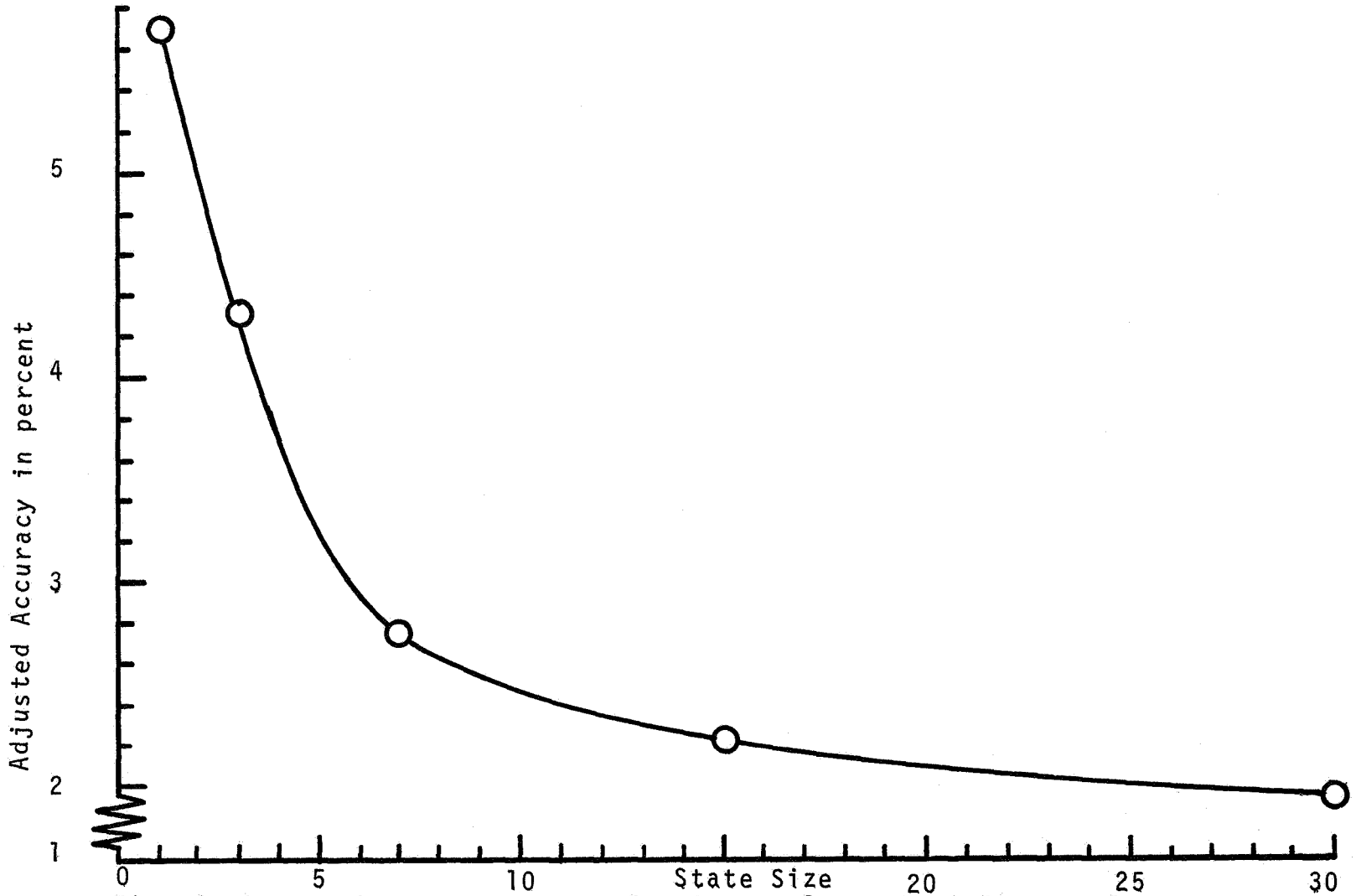


Fig. 6 State size vs. accuracy for input alphabet of 64 symbols and time step of .12 sec.

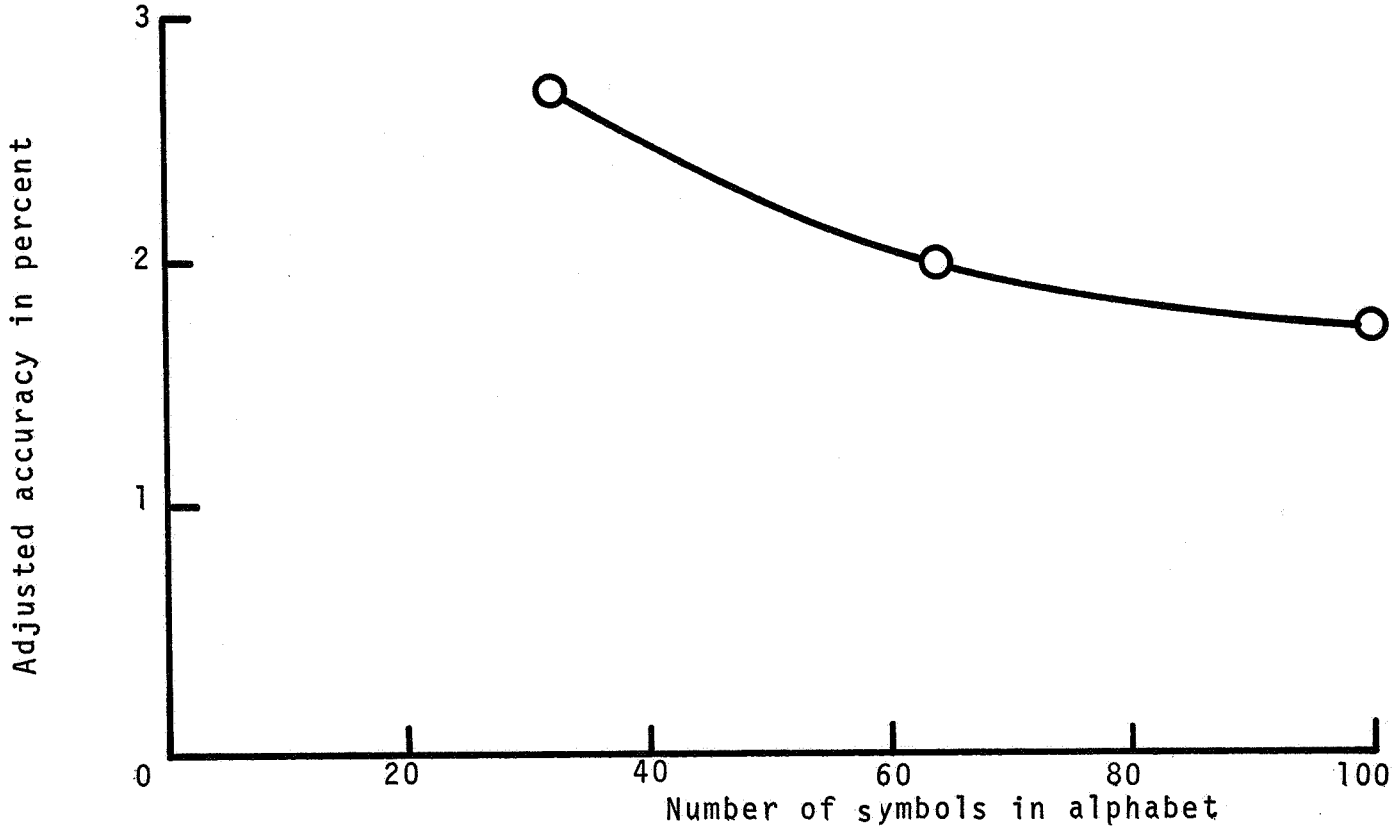


Fig. 7 Accuracy as a function of alphabet size

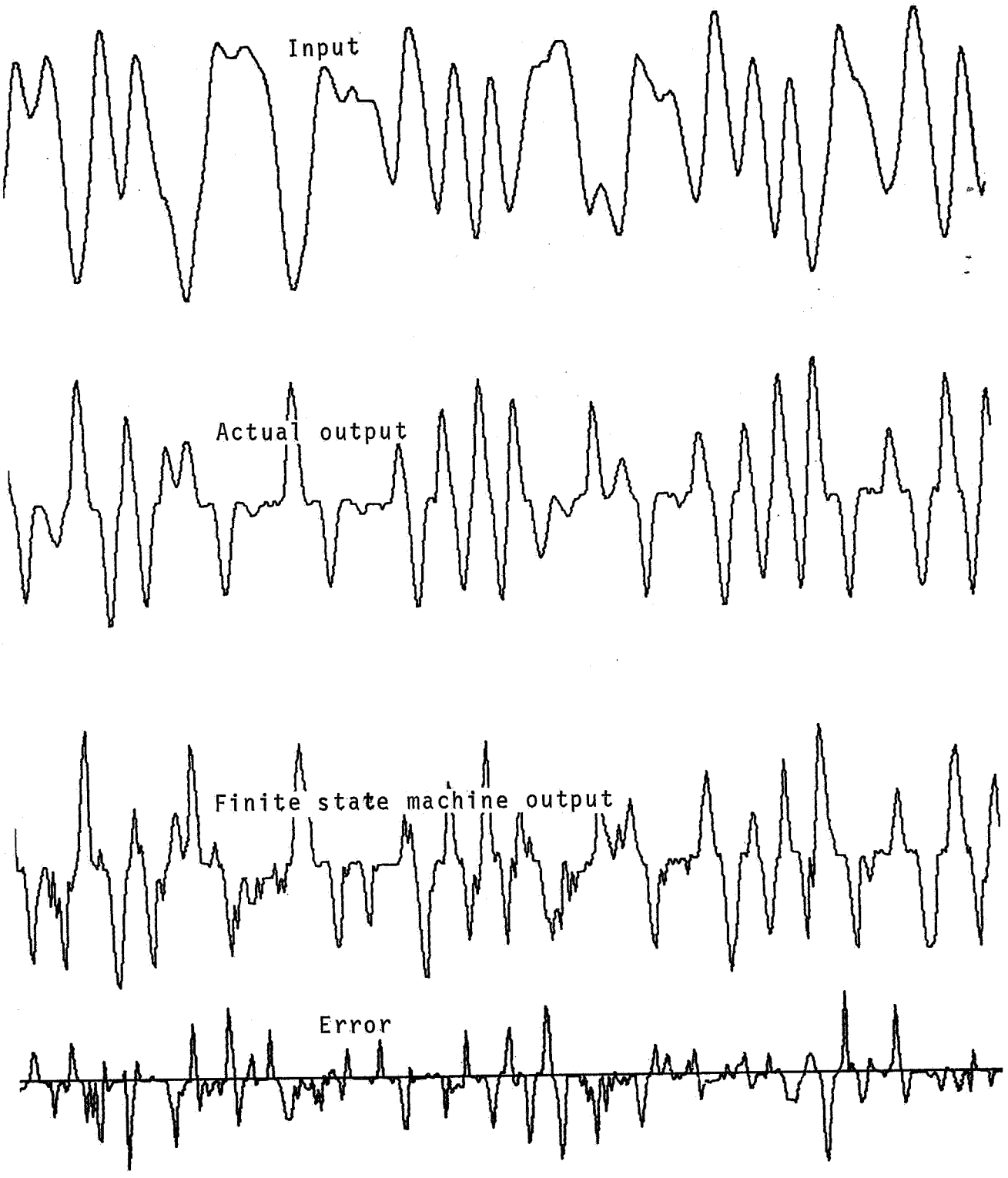


Fig. 8
Comparison of Non-Linear Dynamic System with Initial 31 State Machine using error display as input (Exp.20).

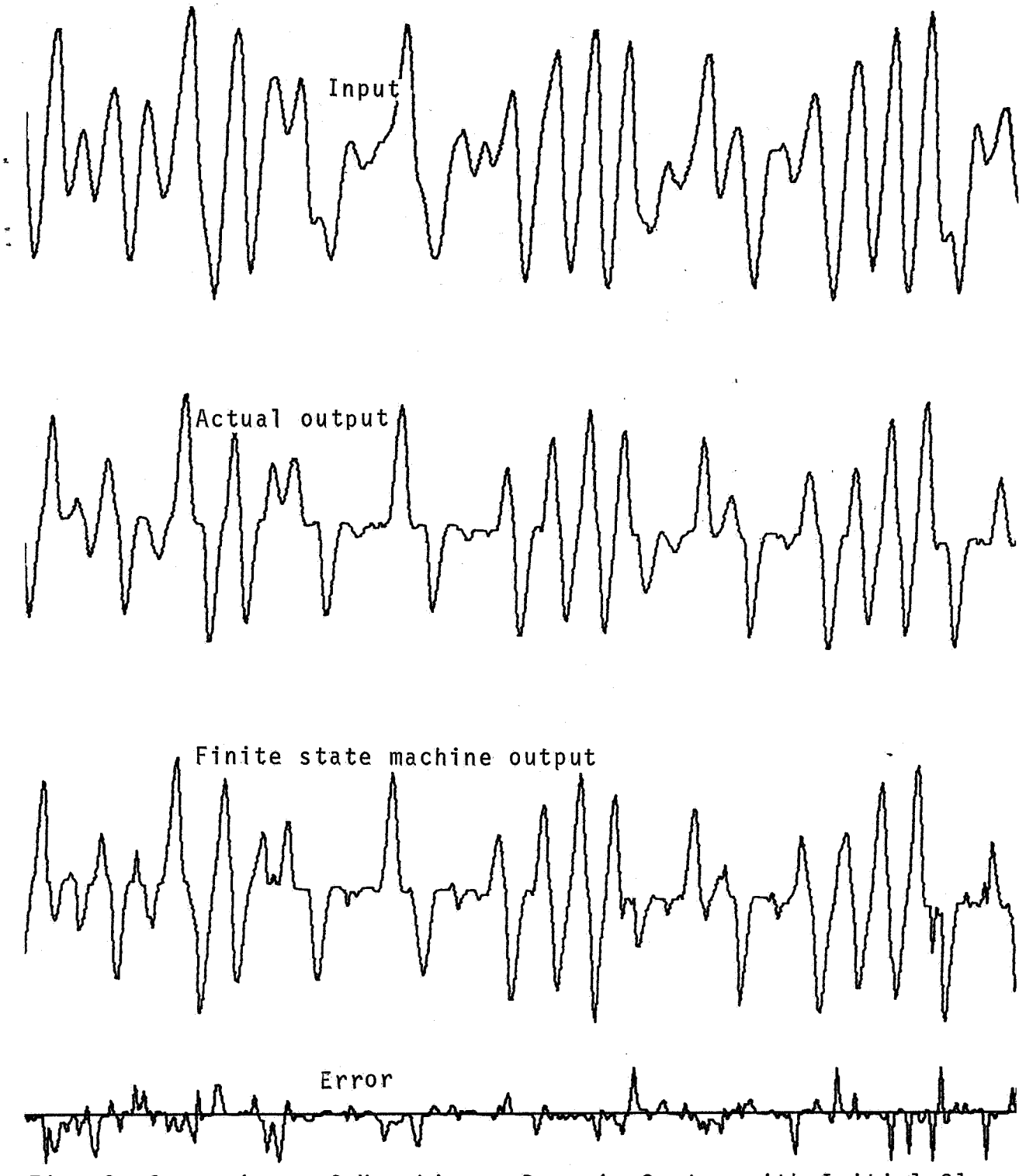


Fig. 9 Comparison of Non-Linear Dynamic System with Initial 31 State Machine using error rate as input (Exp. 21).

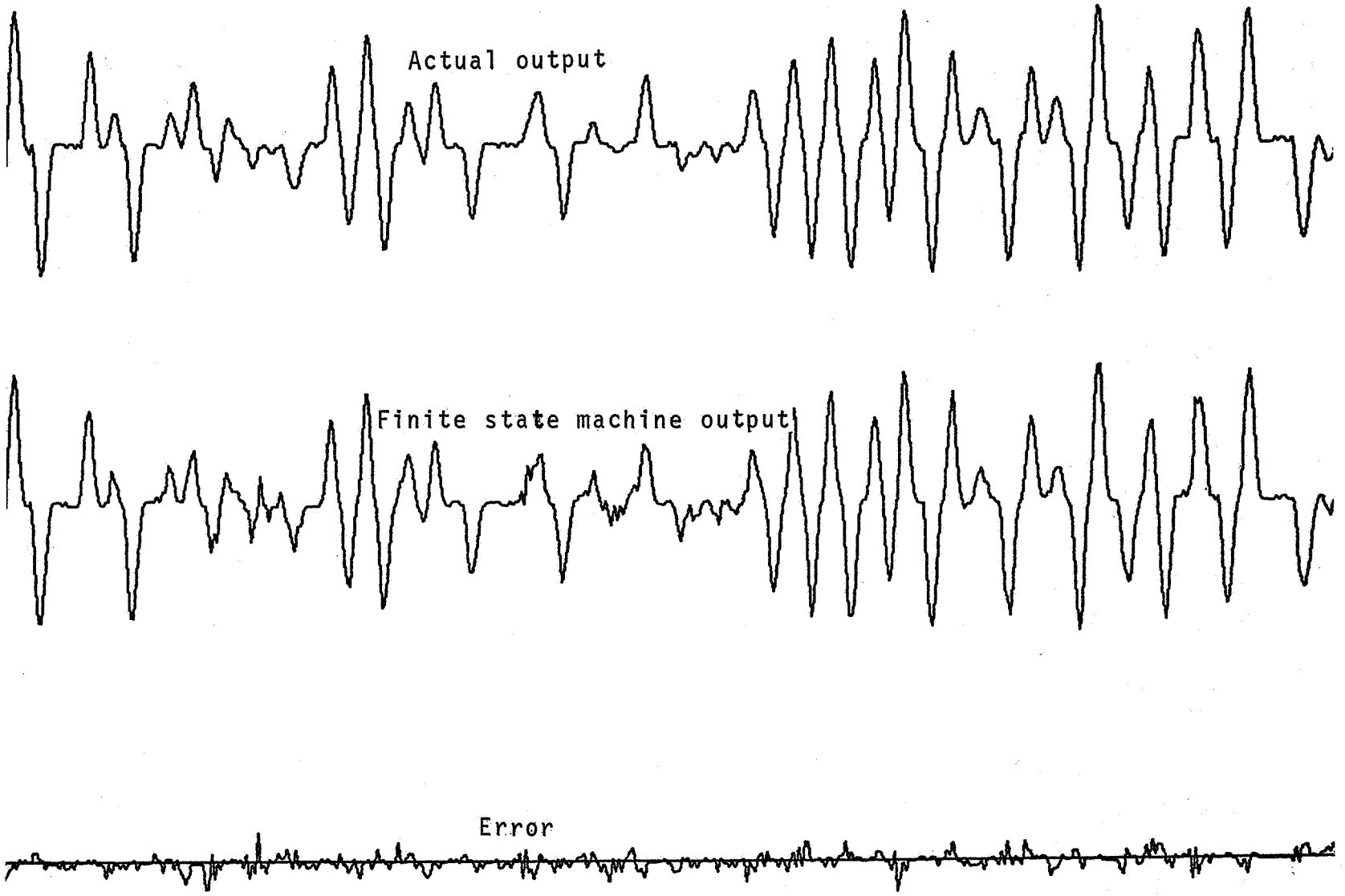


Fig. 10 Comparison of Non-Linear Dynamic System with Final Equivalent 63 State Machine using "Average" Scoring Method (Exp. 36).

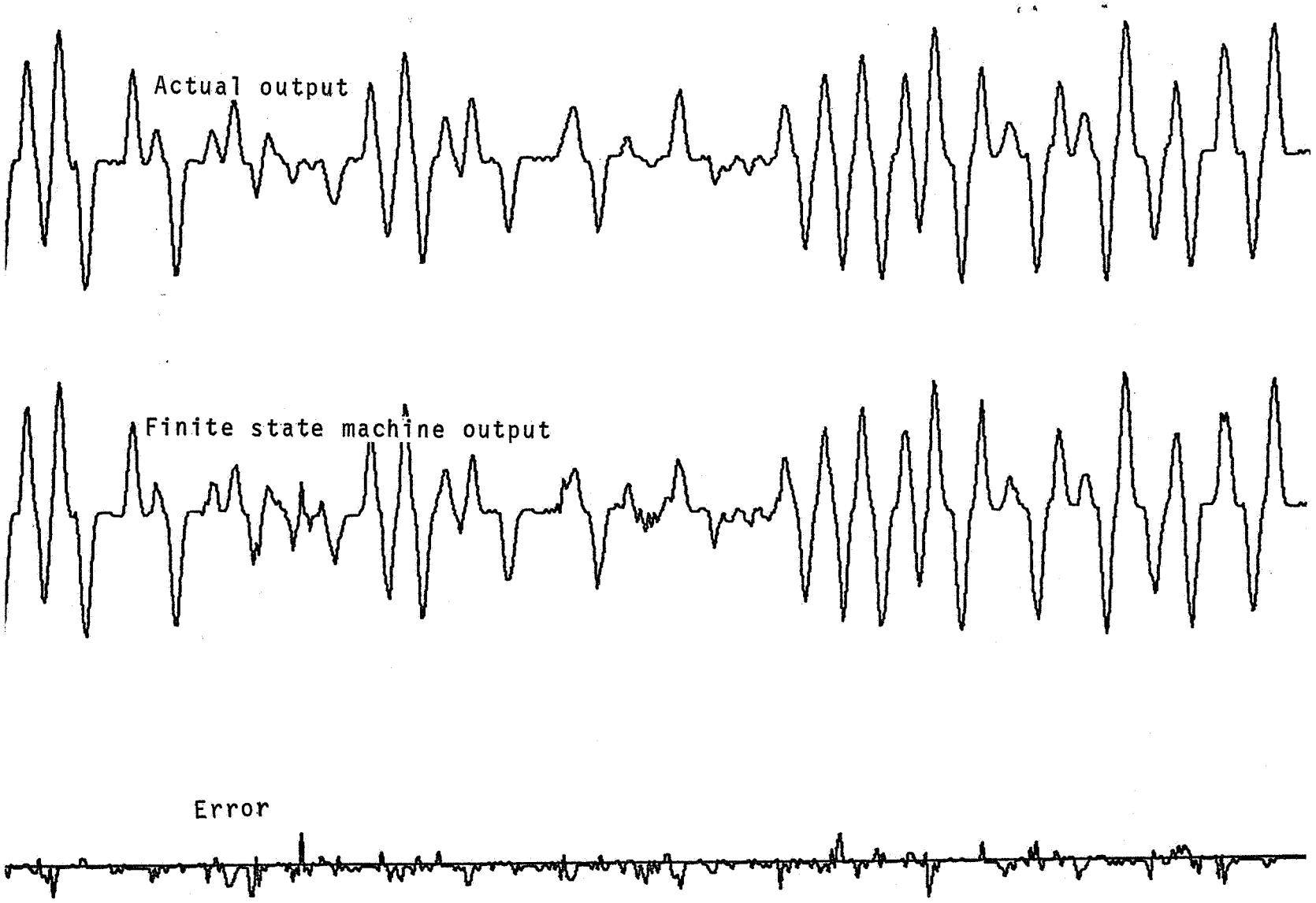


Fig. 11 Comparison of Non-Linear Dynamic System with Final Equivalent 63 State Machine using "Magnitude of the Difference" Scoring (Exp. 38).

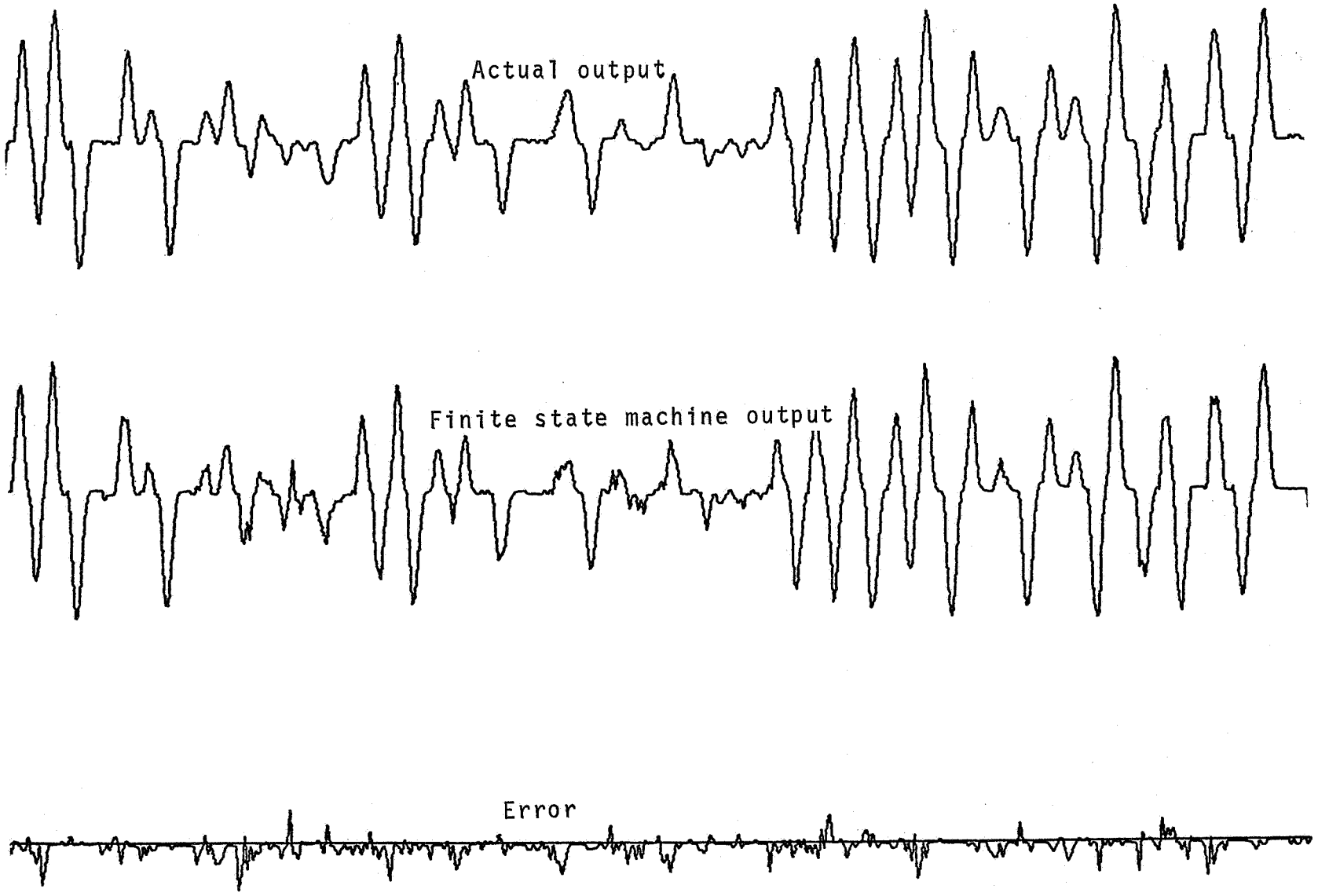


Fig. 12 Comparison of Non-Linear Dynamic System with Final Equivalent 63 State Machine using "All or Nothing" Scoring (Exp. 39).

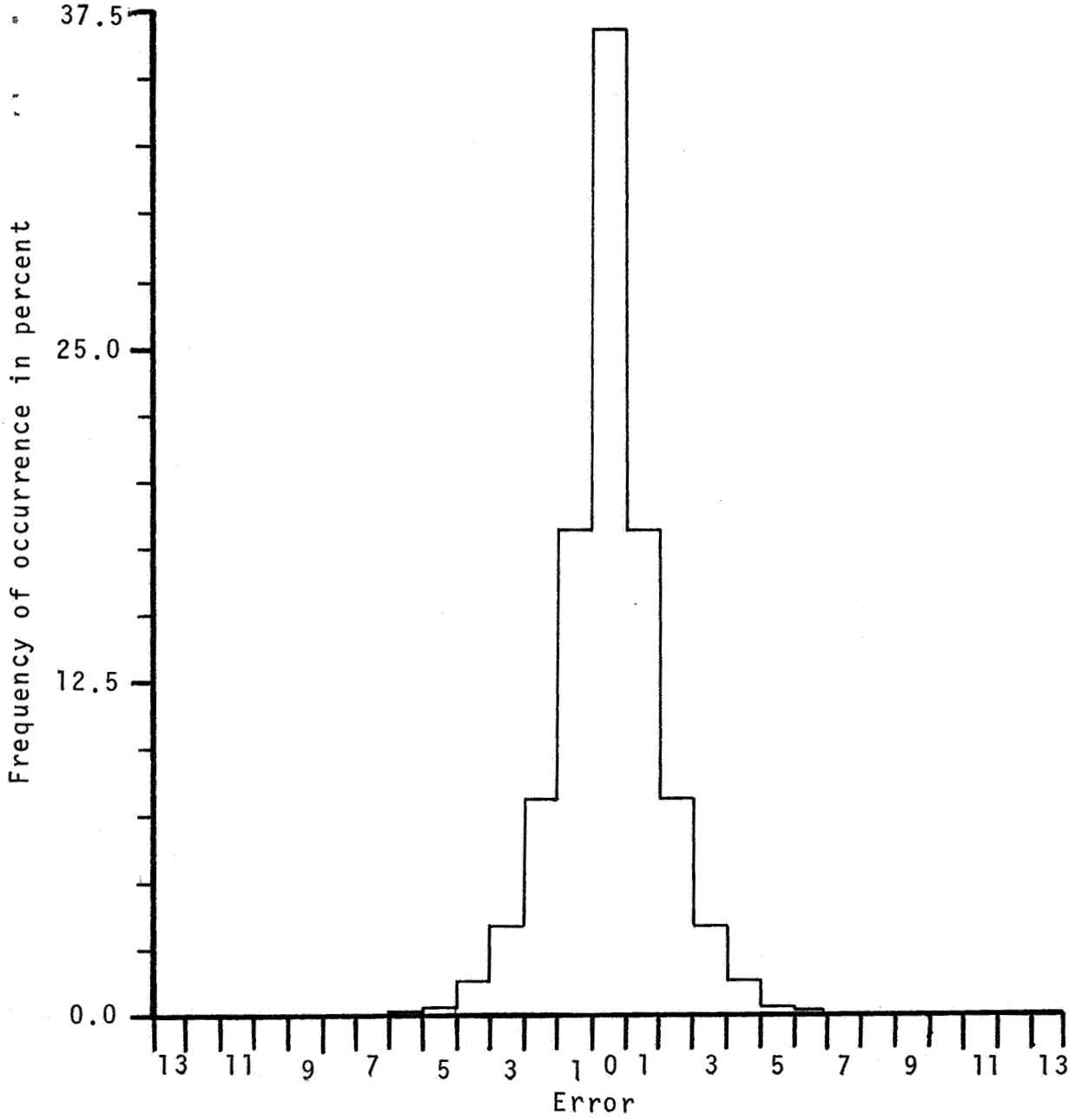


Fig. 13 Error distribution using "Average" Scoring Method (Exp. 36).

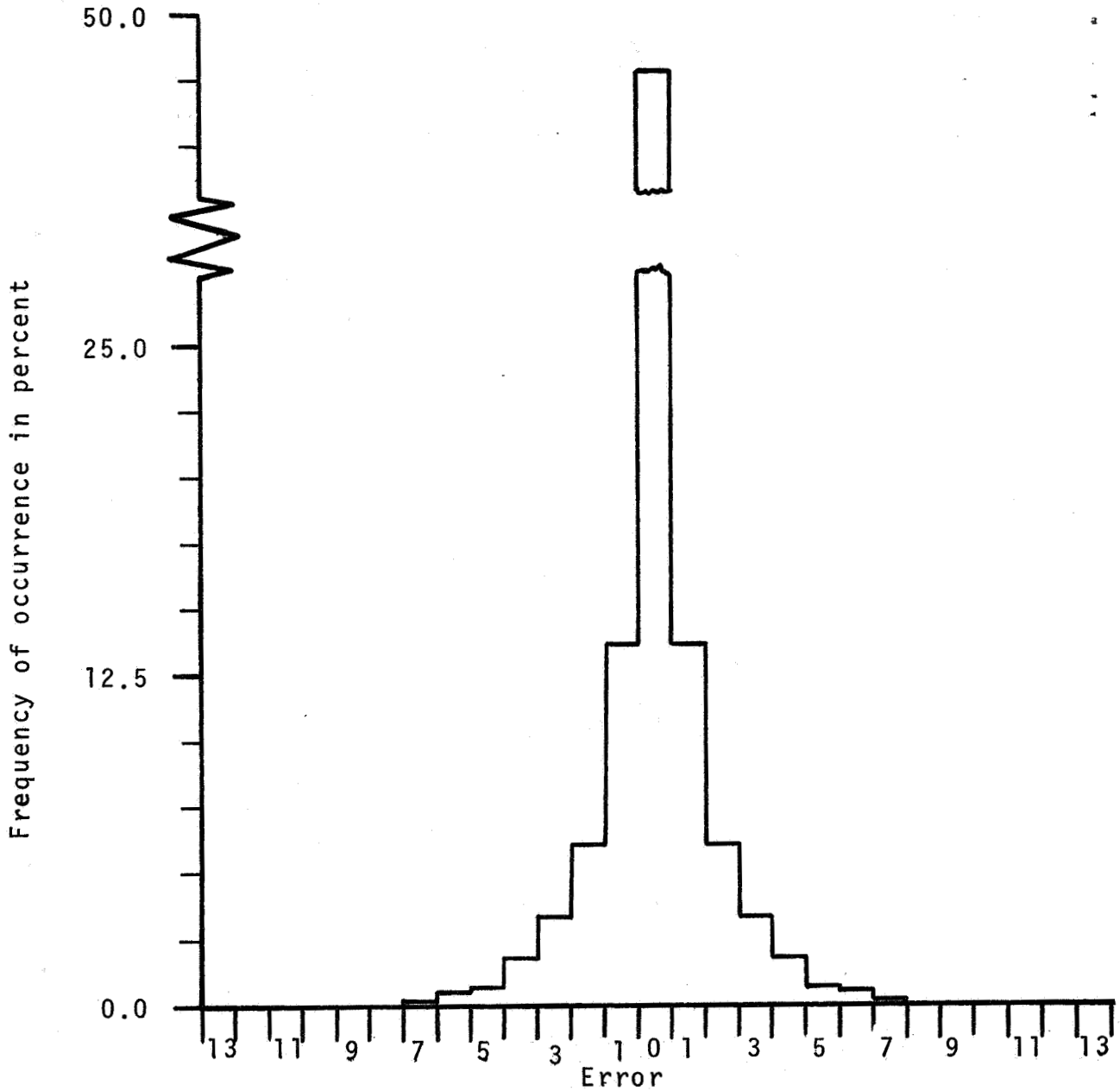


Fig. 14 Error distribution using "Magnitude of the Difference" Scoring Method (Exp. 38).

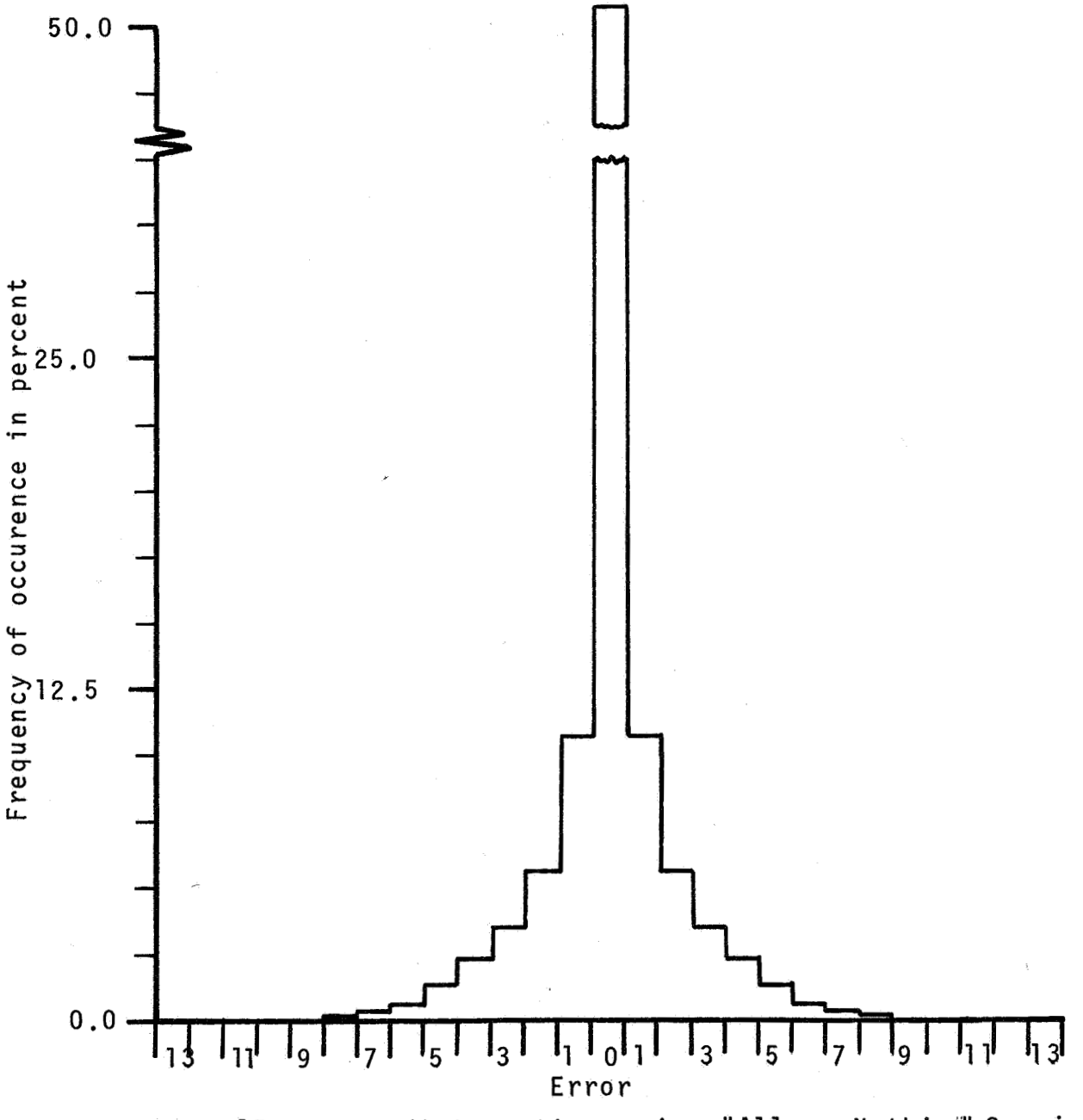


Fig. 15 Error distribution using "All or Nothing" Scoring Method (Exp. 39).

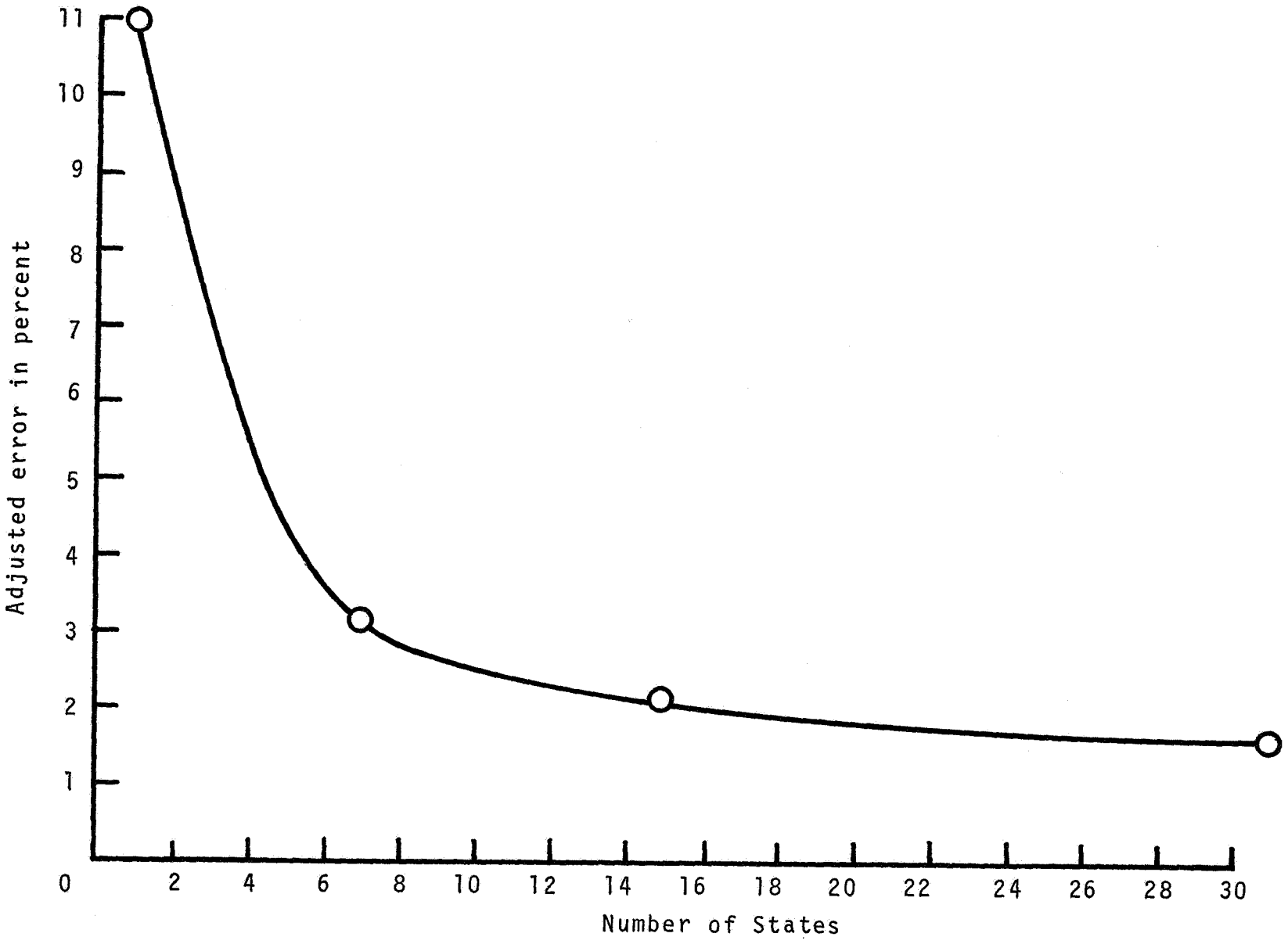


Fig. 16 Adjusted error as a function of machine size

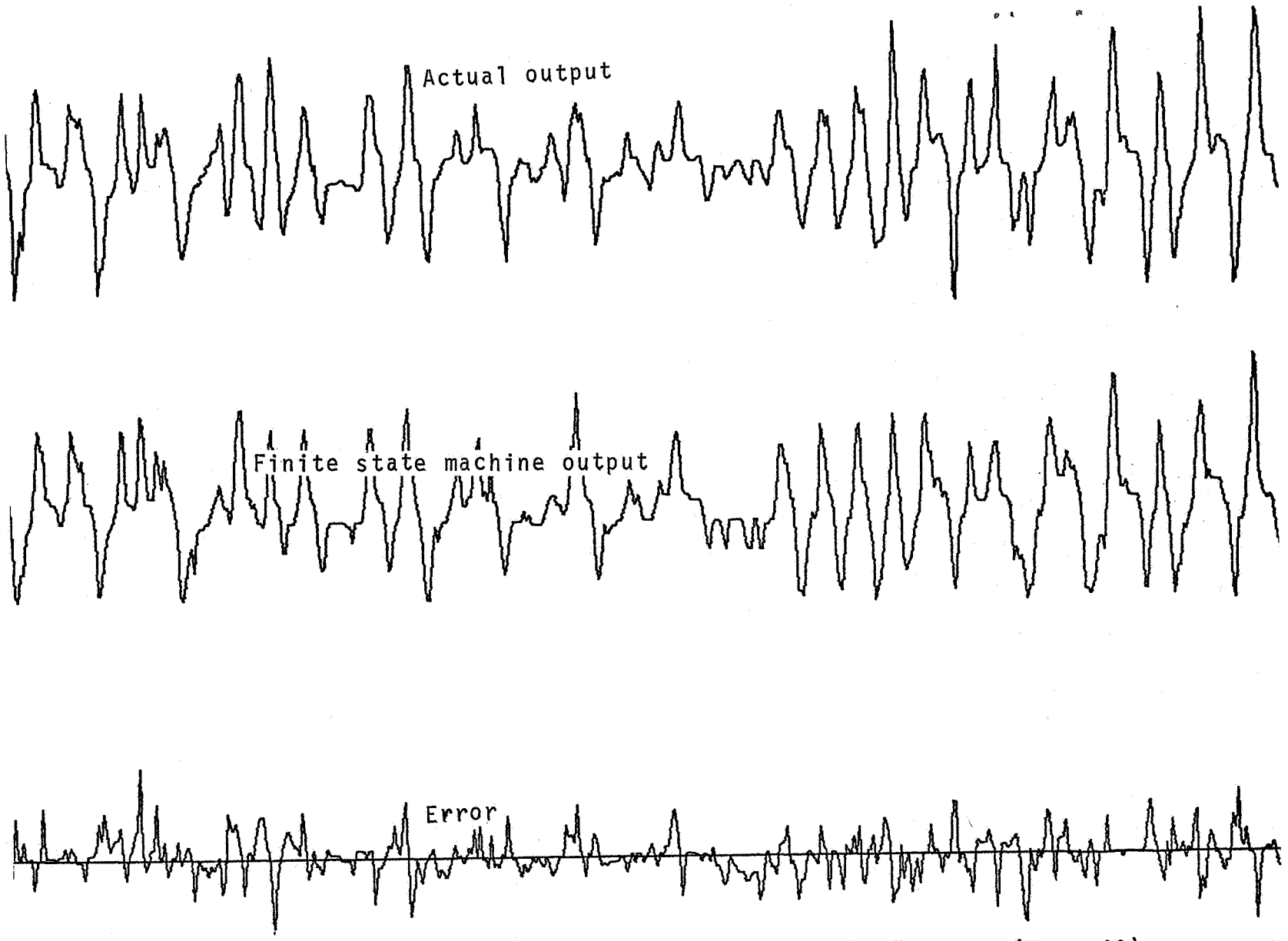


Fig. 17 Comparison of Human Operator with Final 15 State Machine (Exp. 40).

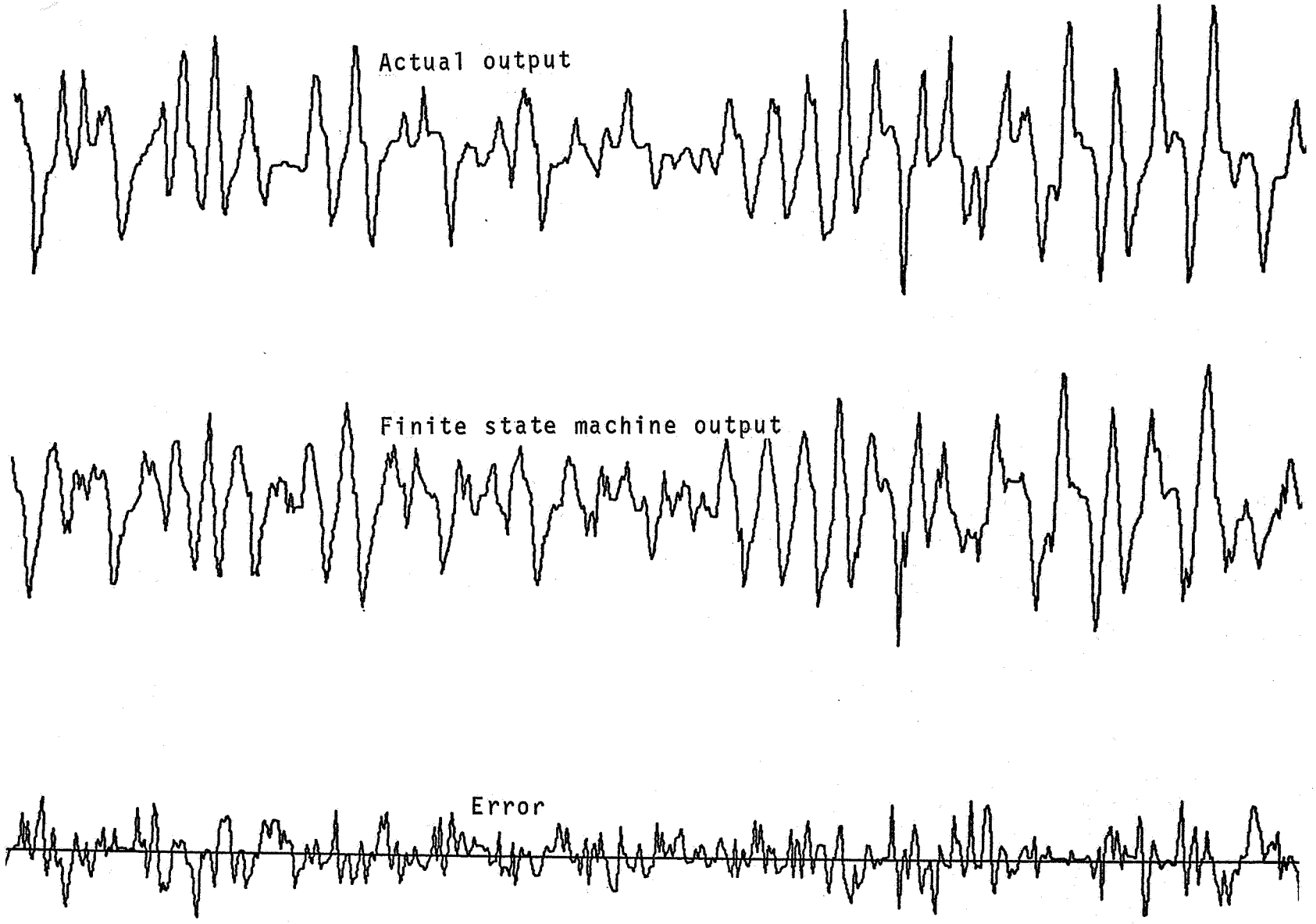


Fig. 18 Comparison of Human Operator with Final 31 State Machine (Exp. 43).

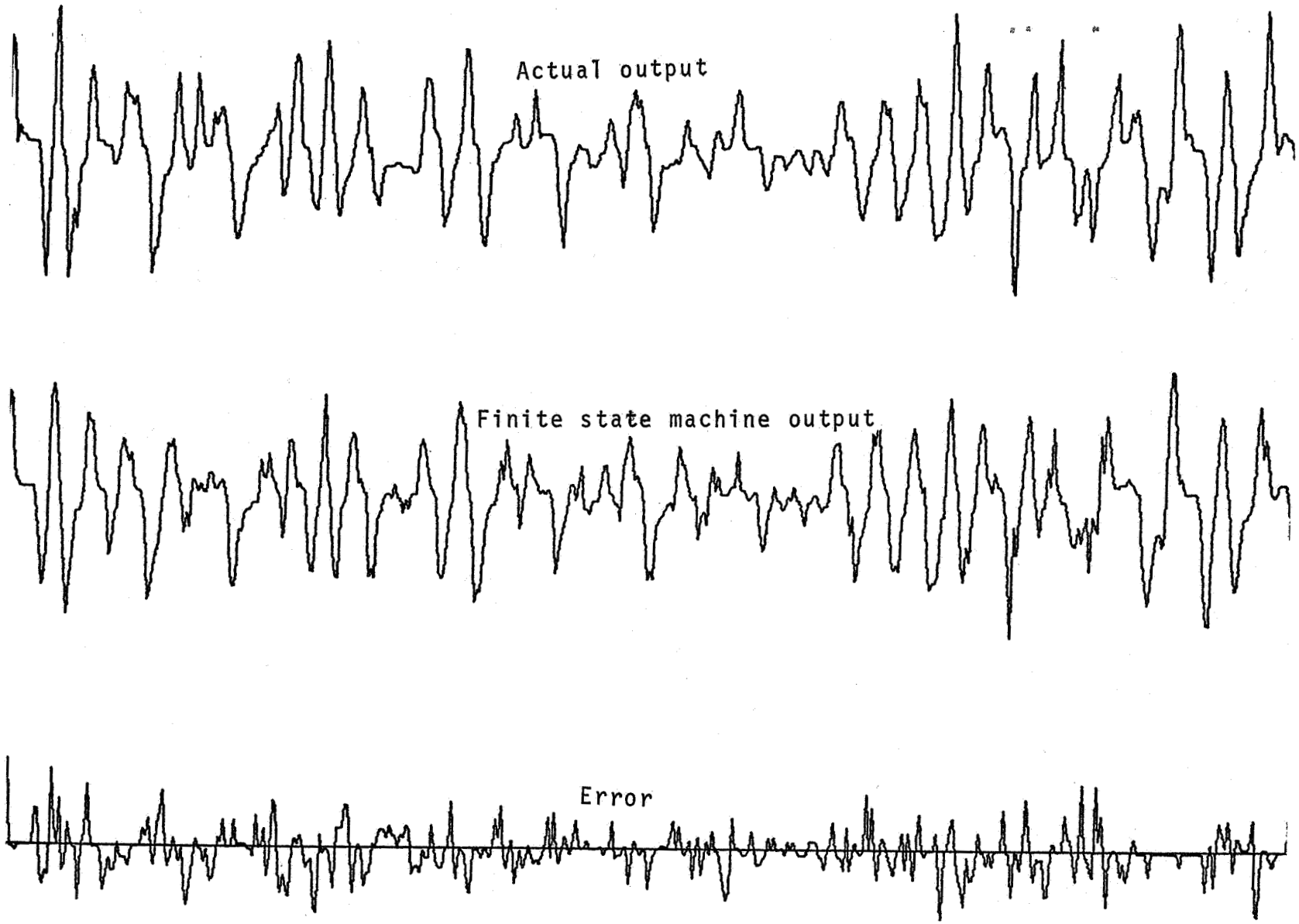


Fig. 19 Comparison of Human Operator with Final 31 State Machine (Exp. 44).

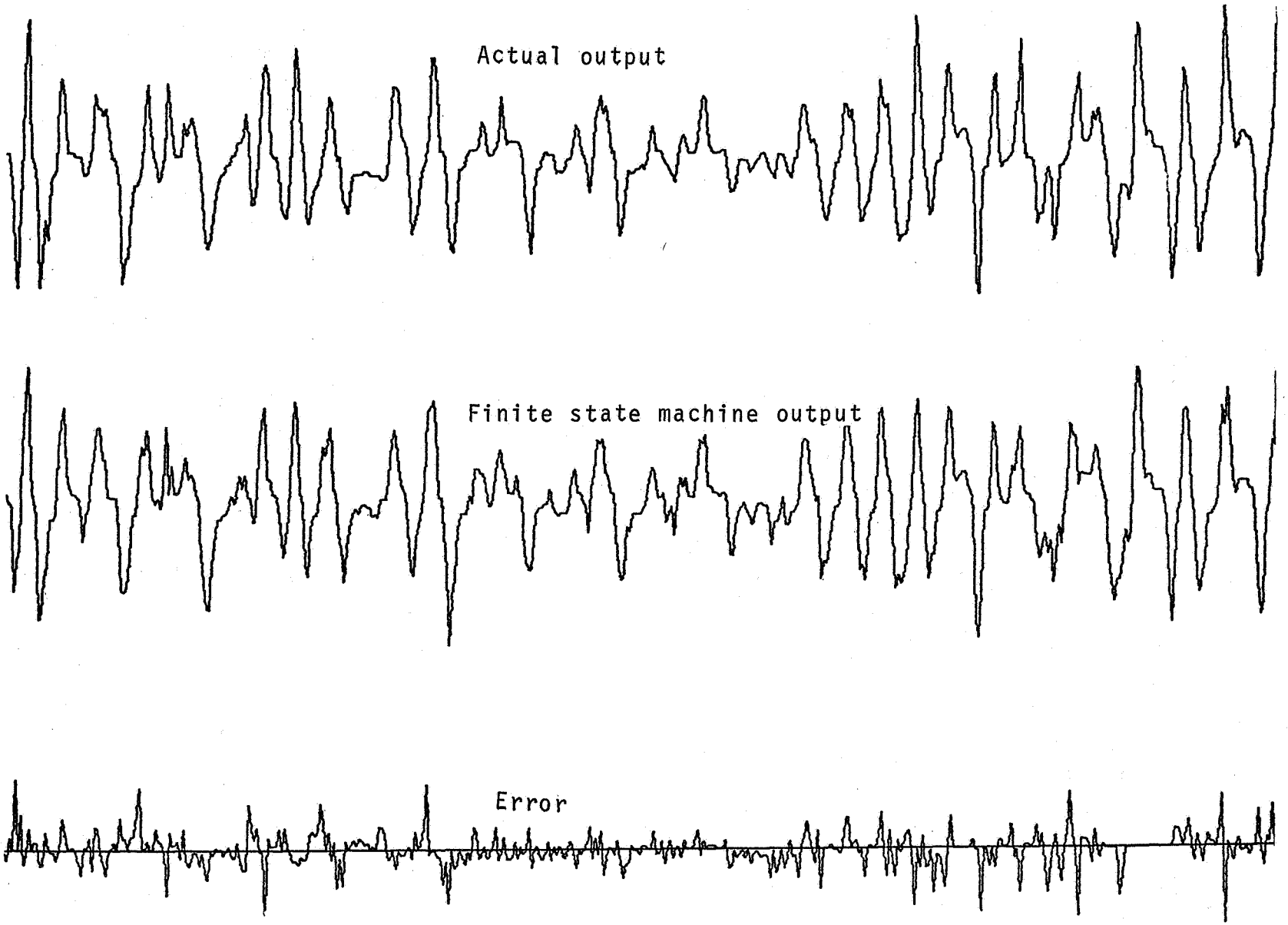


Fig. 20 Comparison of Human Operator with Final Equivalent 63 State Machine (Exp.45).

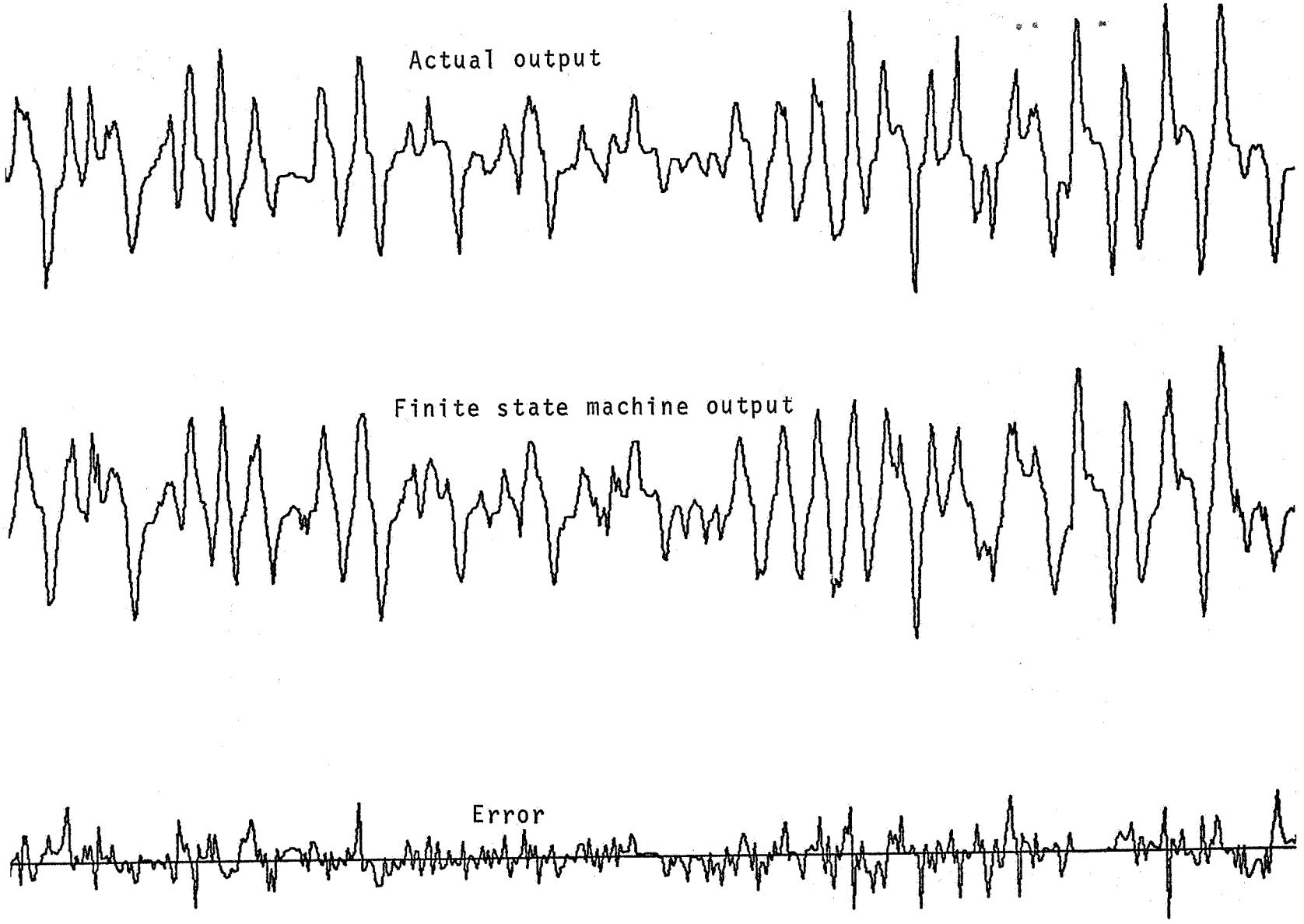


Fig. 21 Comparison of Human Operator with Final Equivalent 63 State Machine (Exp 47).

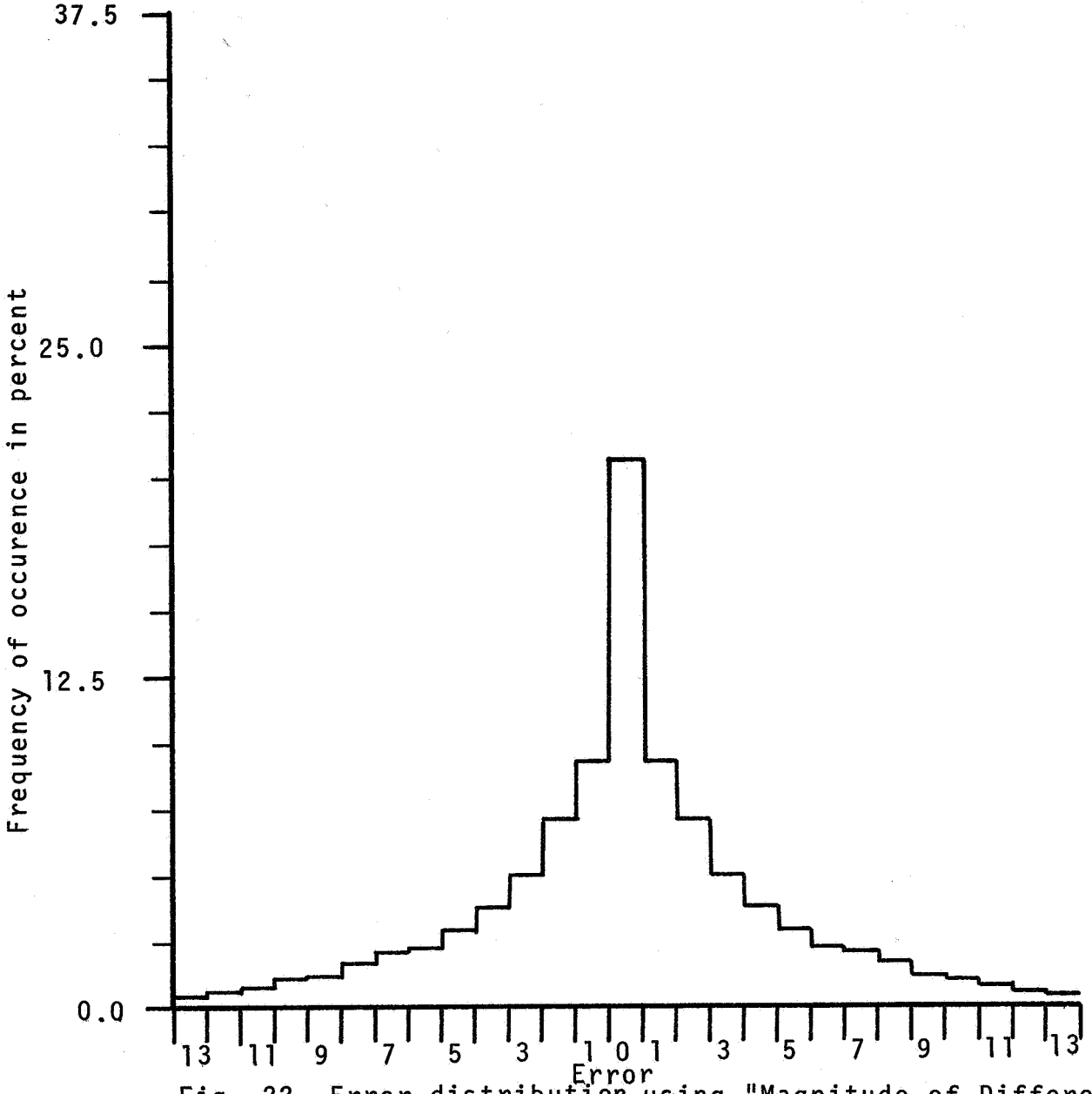


Fig. 22 Error distribution using "Magnitude of Difference" Scoring Method (Exp. 40).

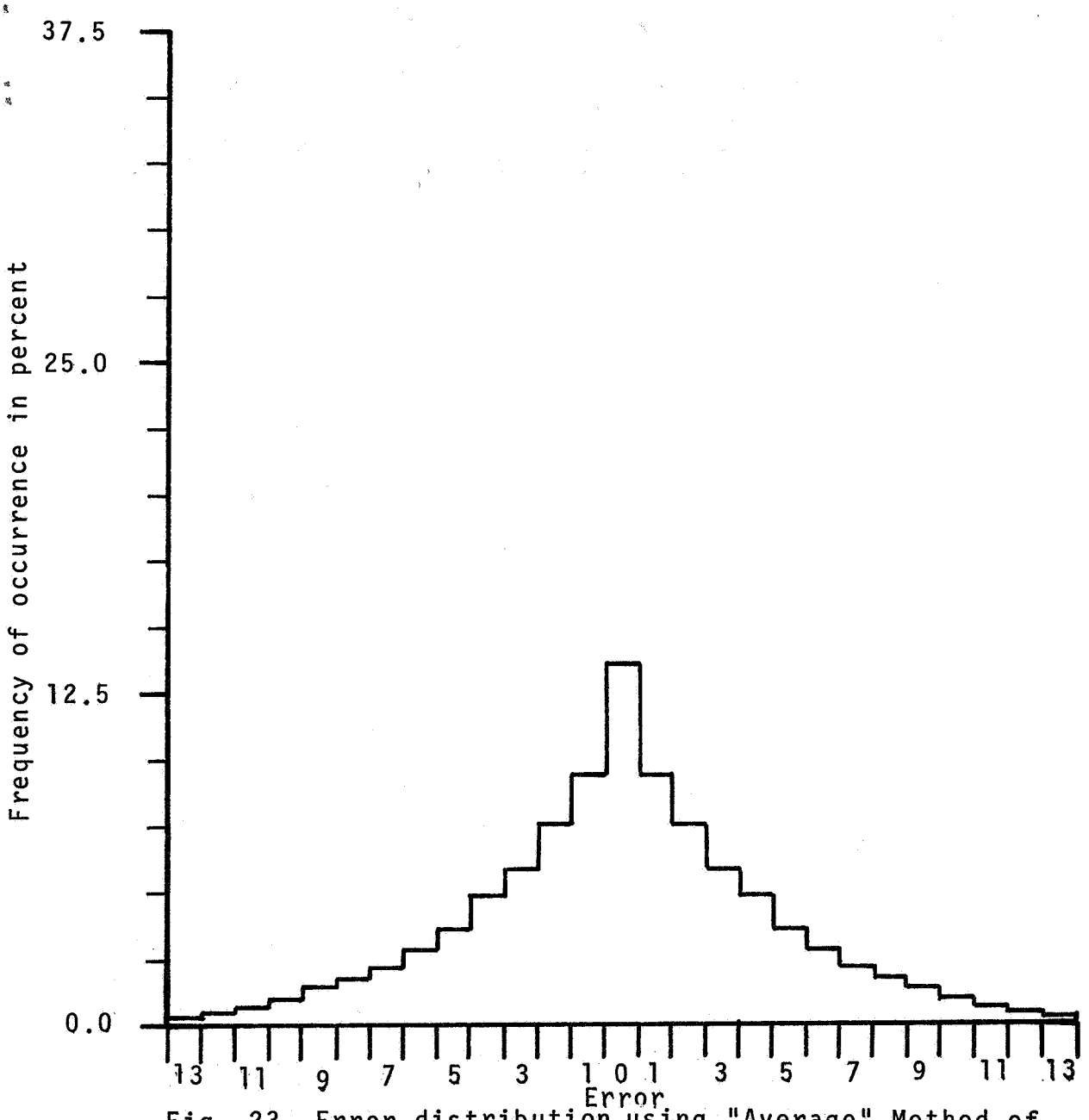


Fig. 23 Error distribution using "Average" Method of Scoring (Exp. 43).

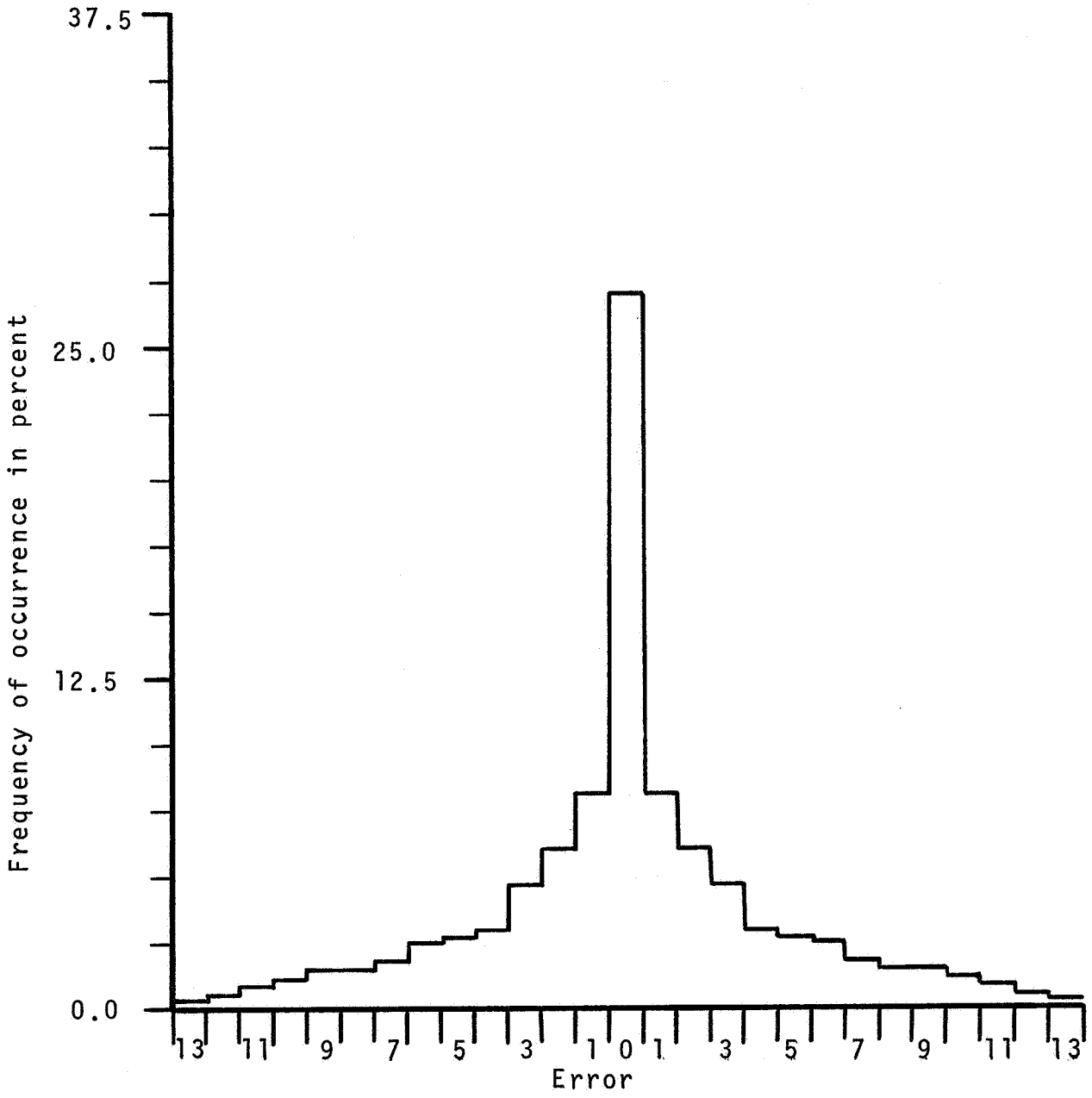


Fig. 24 Error distribution using "Magnitude of Difference" Scoring Method (Exp.44).

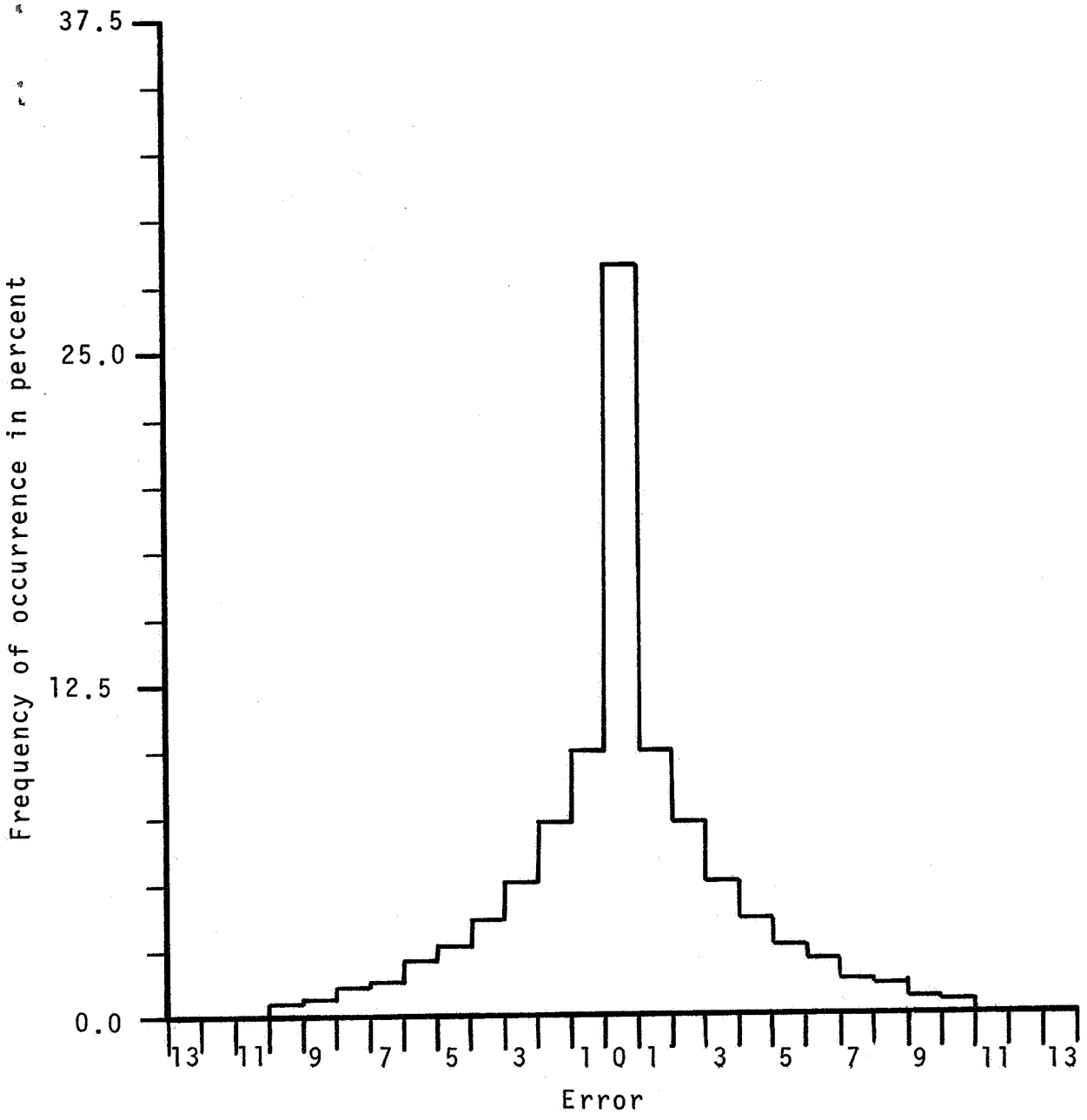


Fig. 25 Error distribution using "Magnitude of Difference" Scoring Method (Exp. 45).

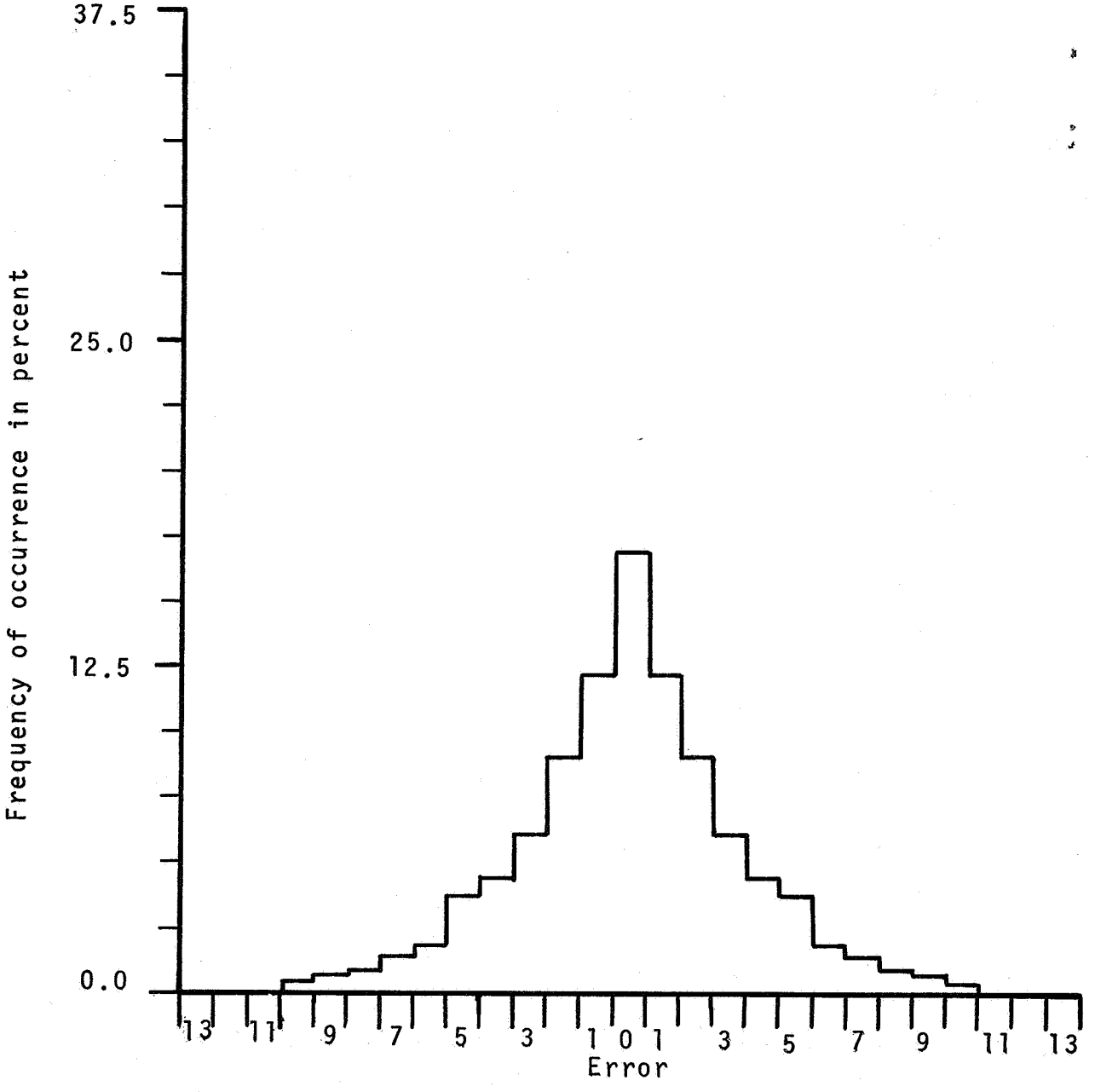


Fig. 26 Error distribution using "Average" Scoring Method (Exp. 47).

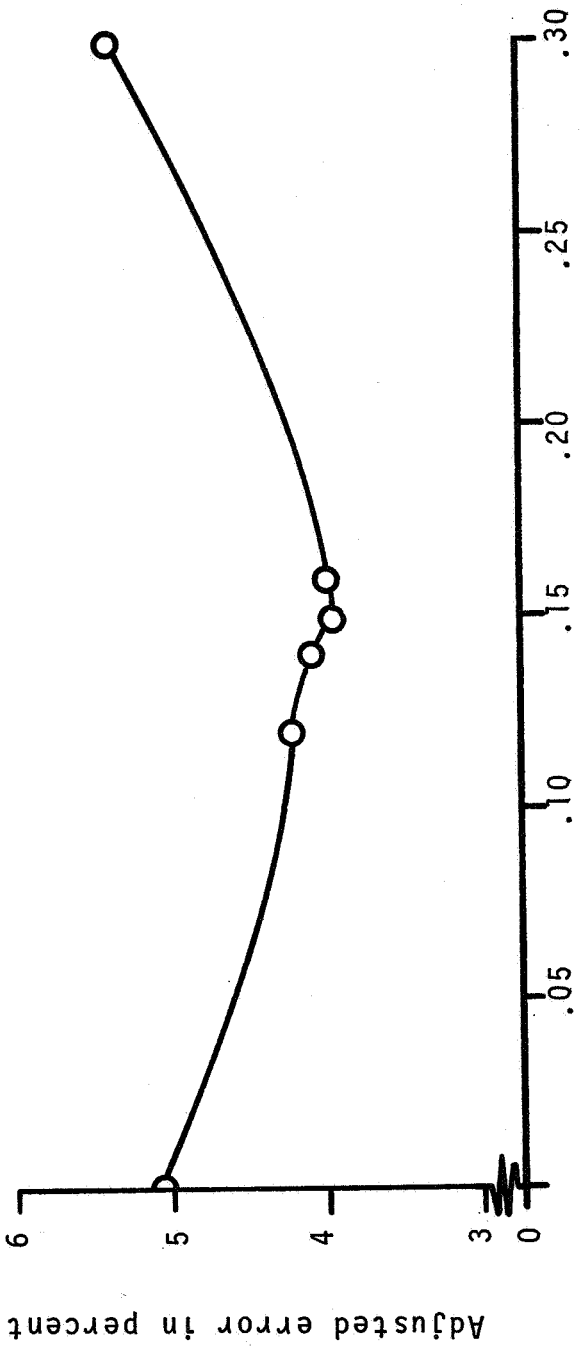


Fig. 27 Adjusted average error as a function of time delay

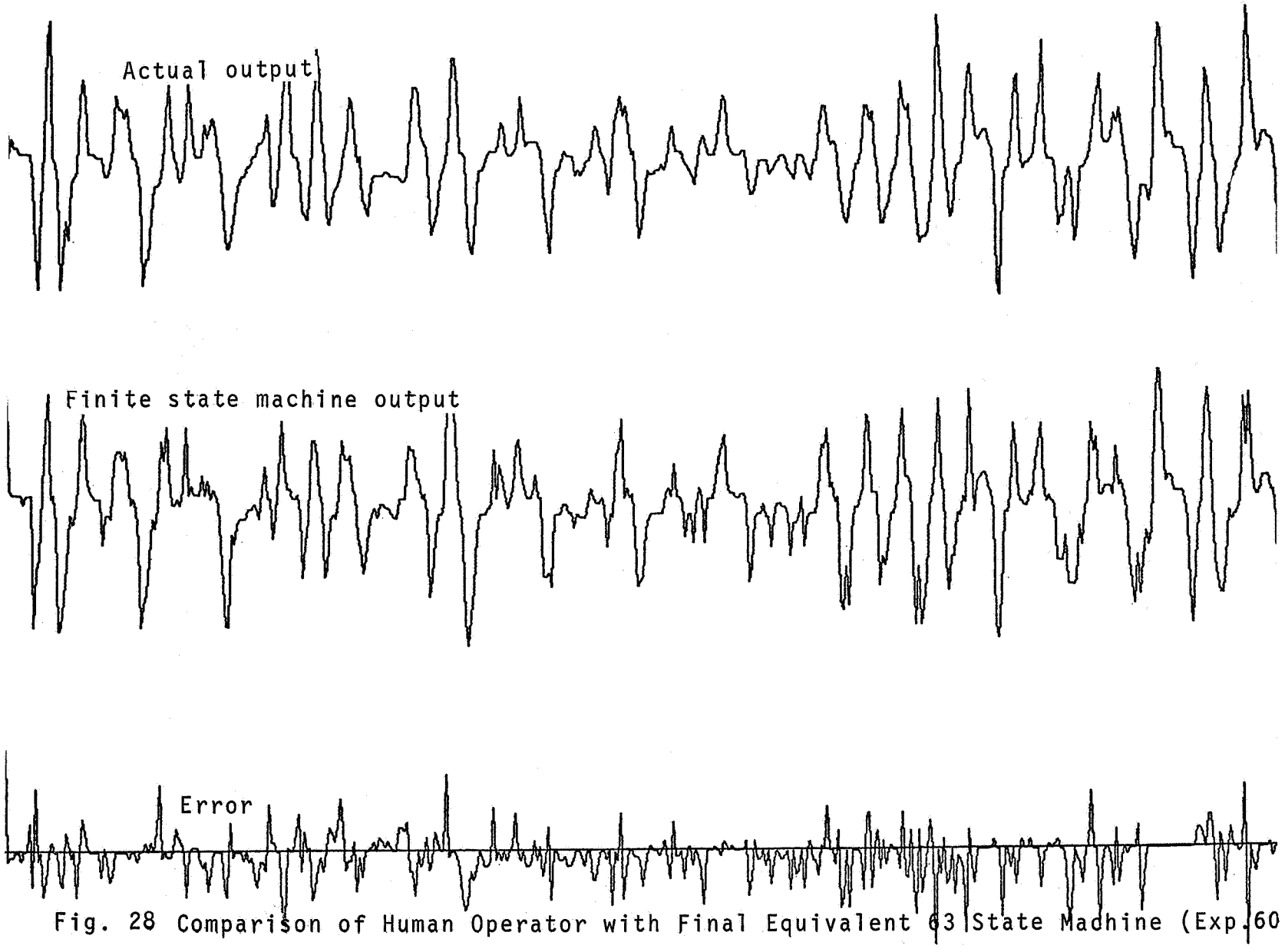


Fig. 28 Comparison of Human Operator with Final Equivalent 63 State Machine (Exp.60).

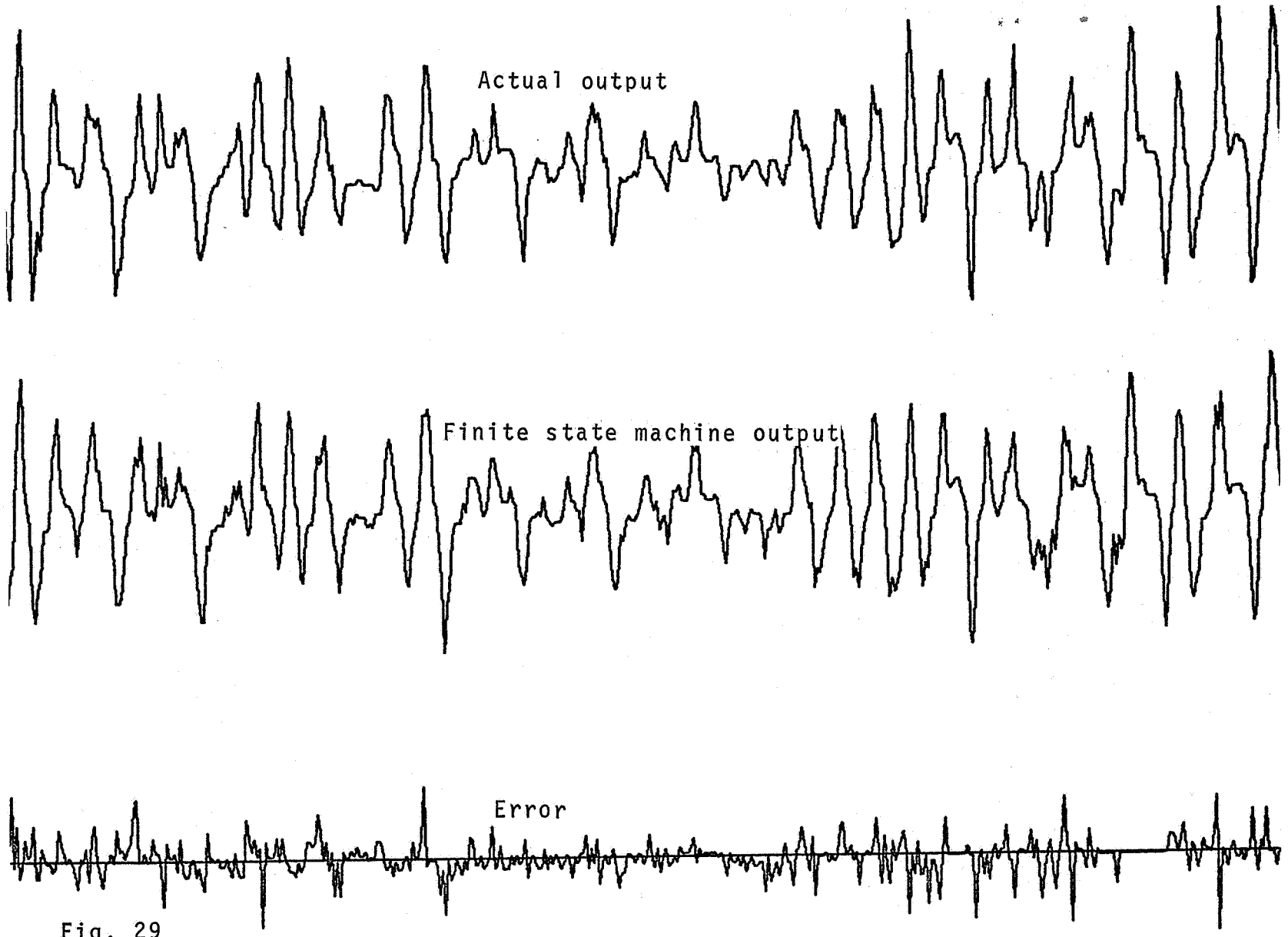


Fig. 29
Comparison of Human Operator with Final Equivalent 63 State Machine (Exp.61).

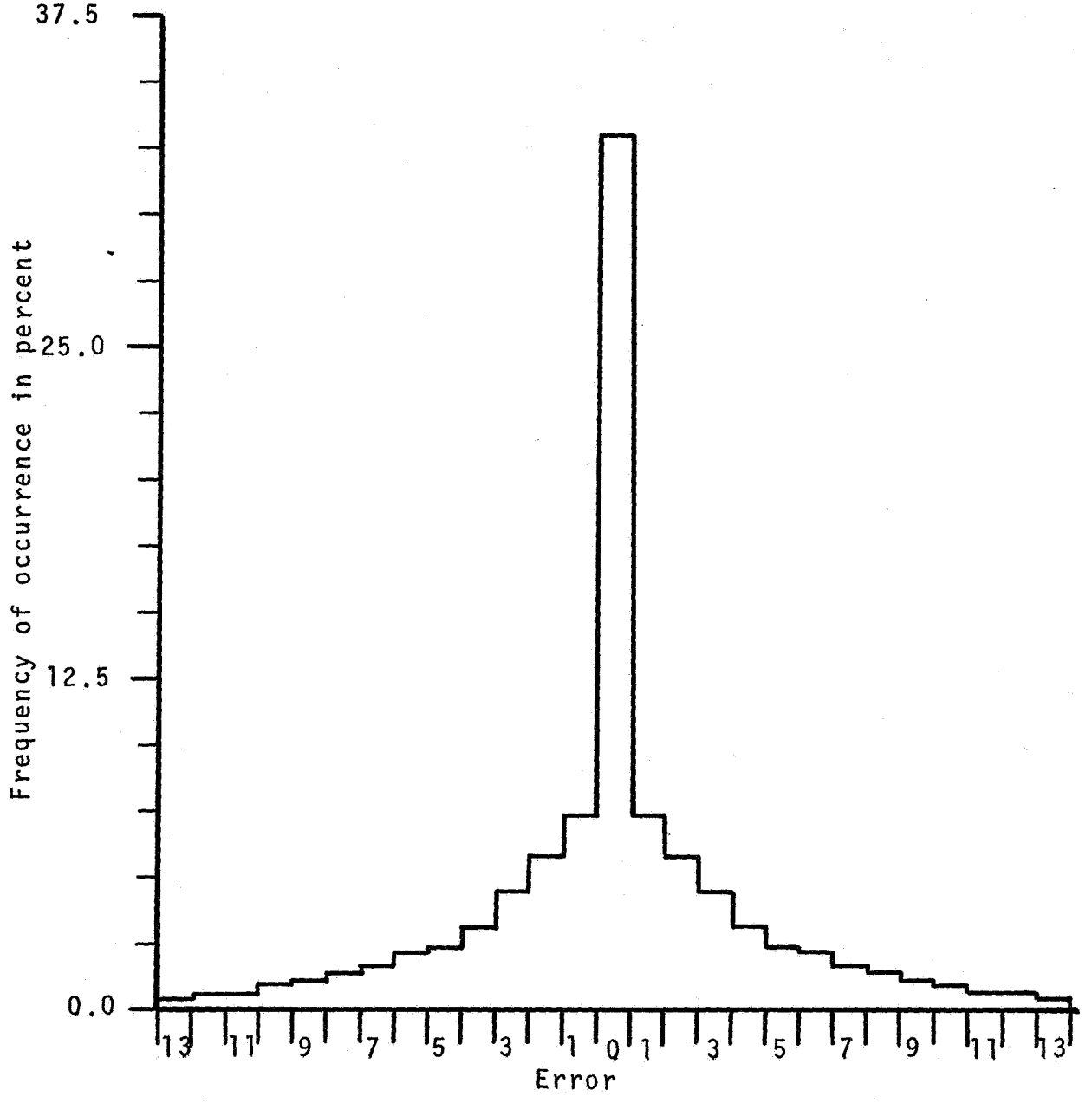


Fig. 30 Error distribution using "All or Nothing" Scoring Method (Exp.60).

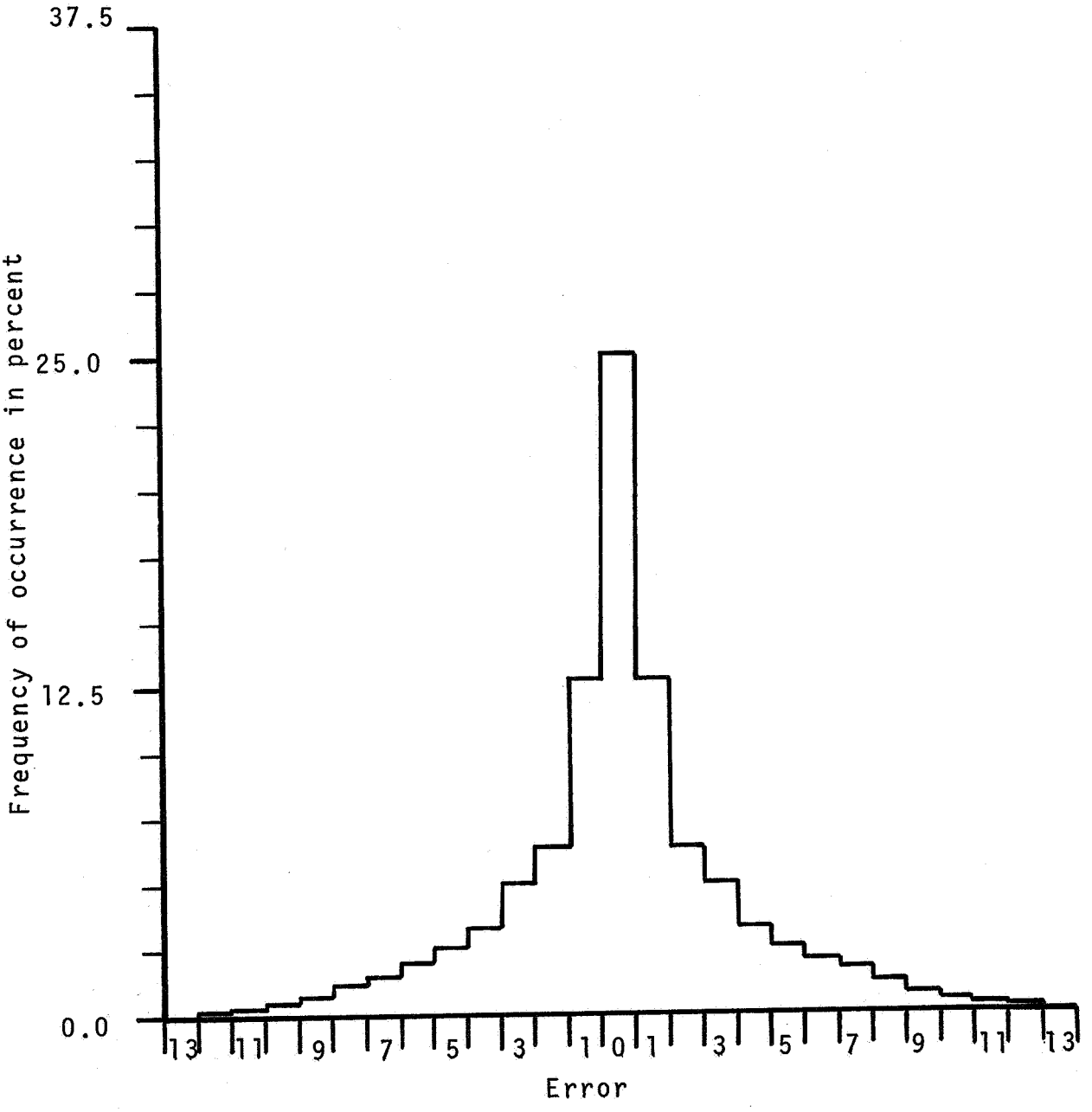


Fig. 31 Error distribution using "Zero Band Magnitude of Error" Scoring Method (Exp. 61).

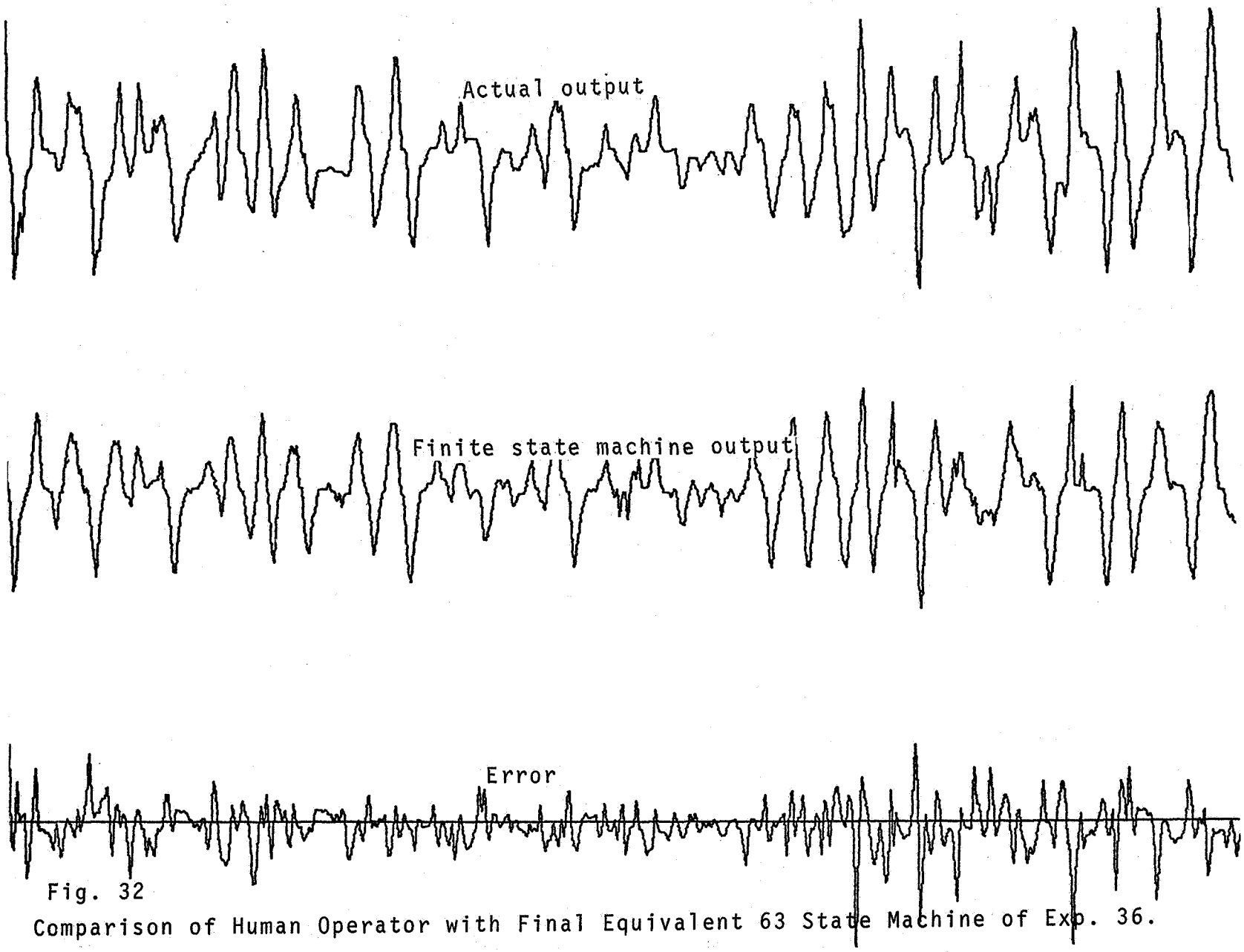


Fig. 32
Comparison of Human Operator with Final Equivalent 63 State Machine of Exp. 36.

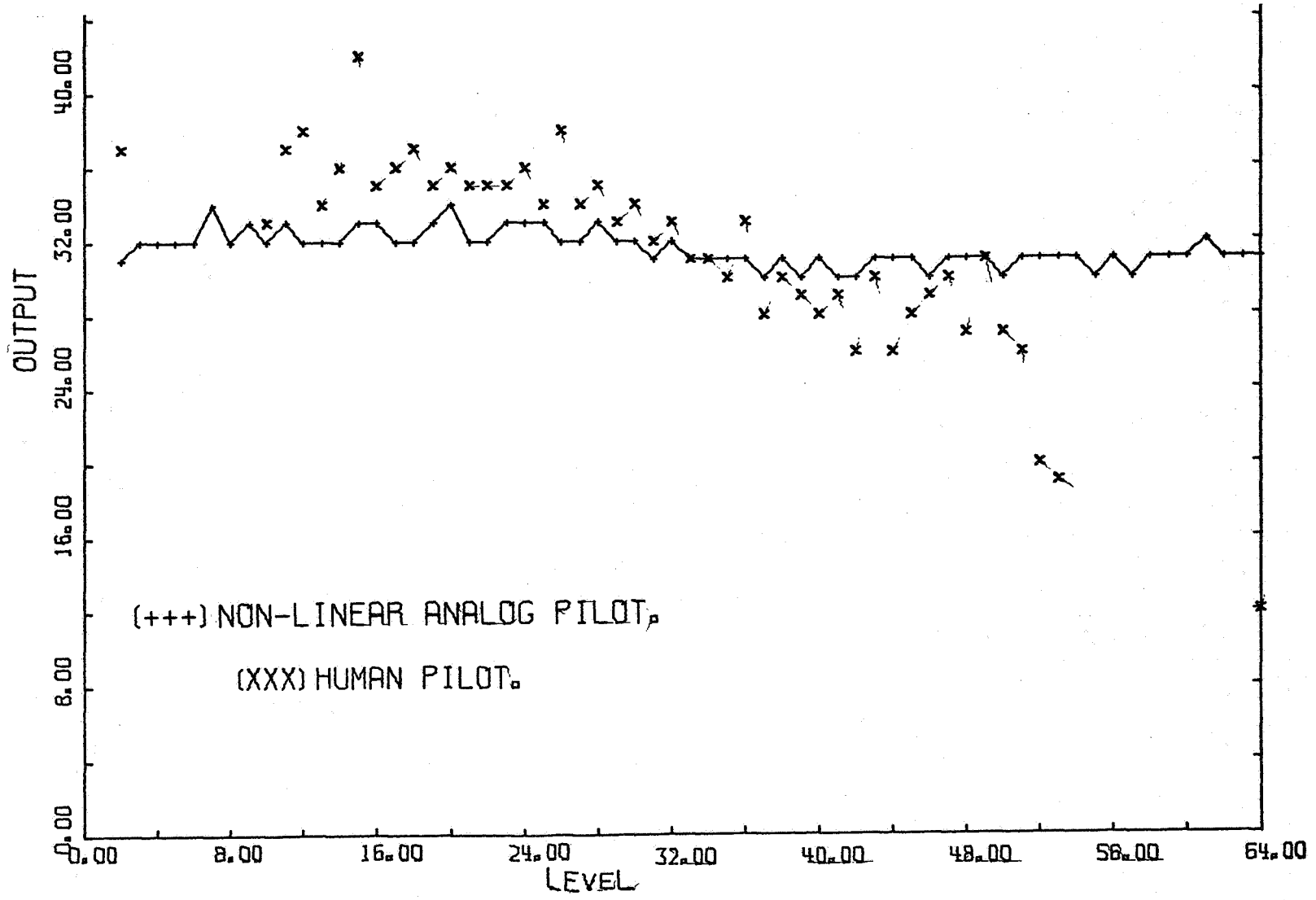


Fig. 33 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of Level for constant rate of zero.

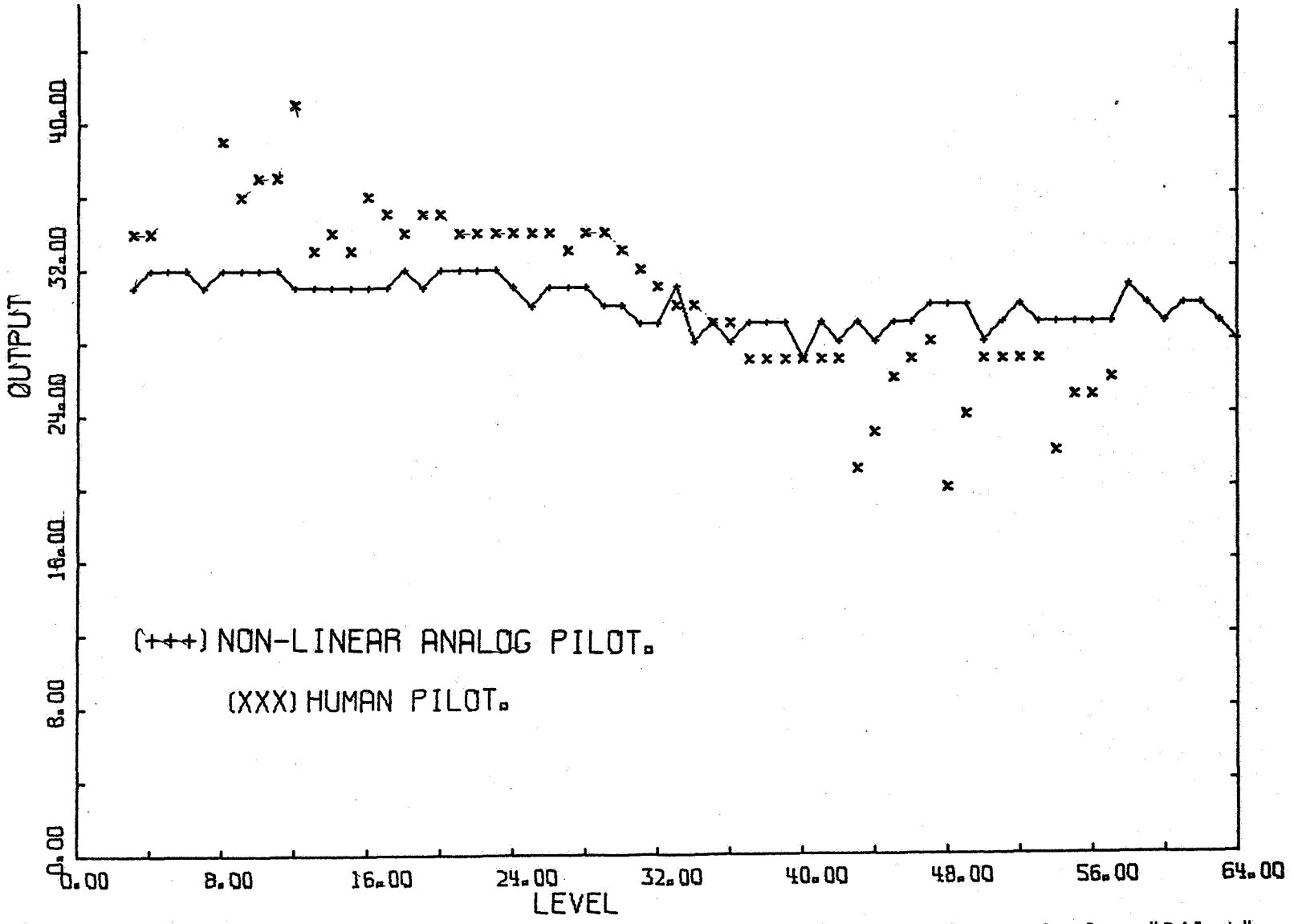


Fig. 34 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of Level for constant rate of +1.

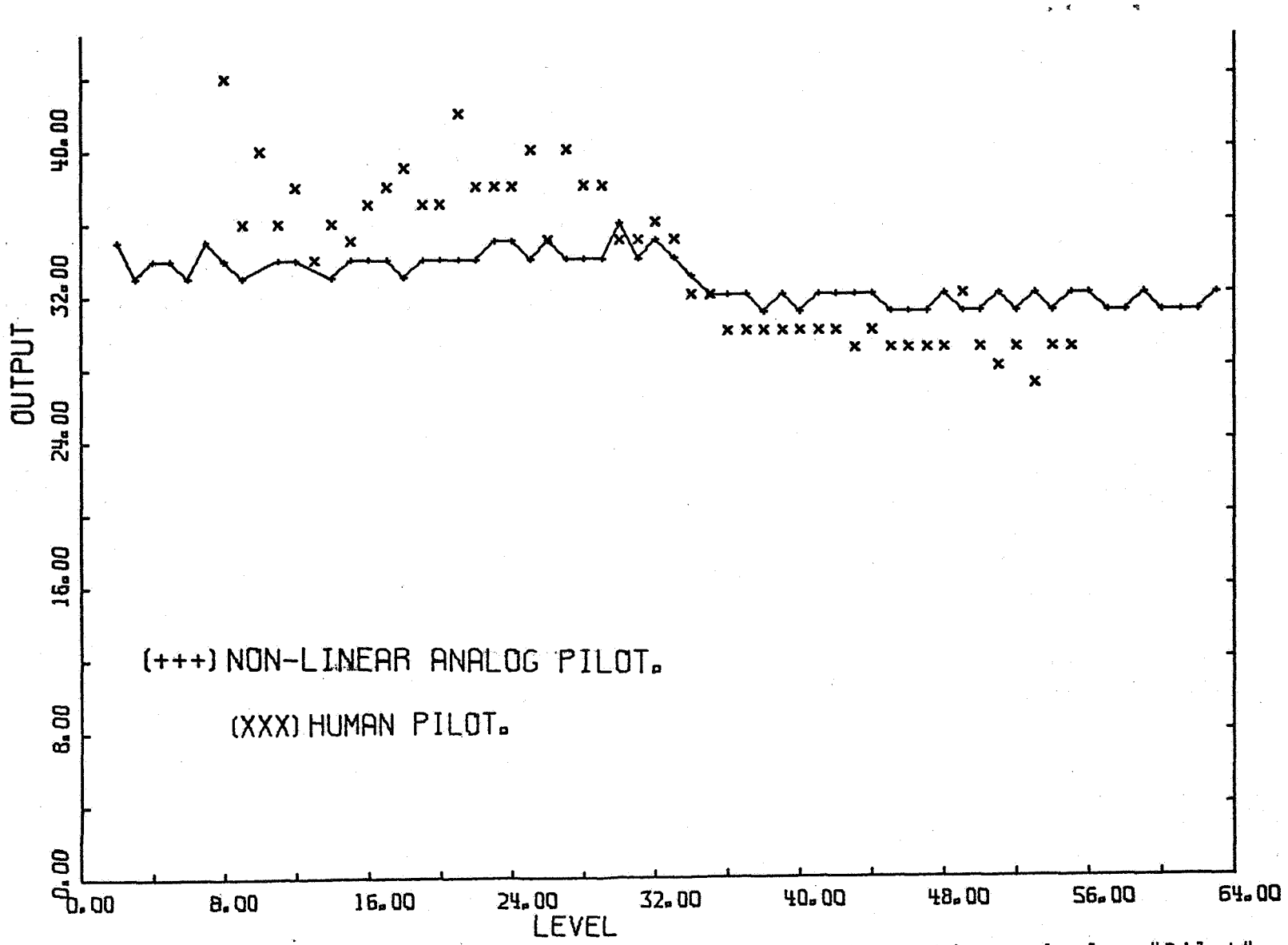


Fig. 35 Comparison of models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -1.

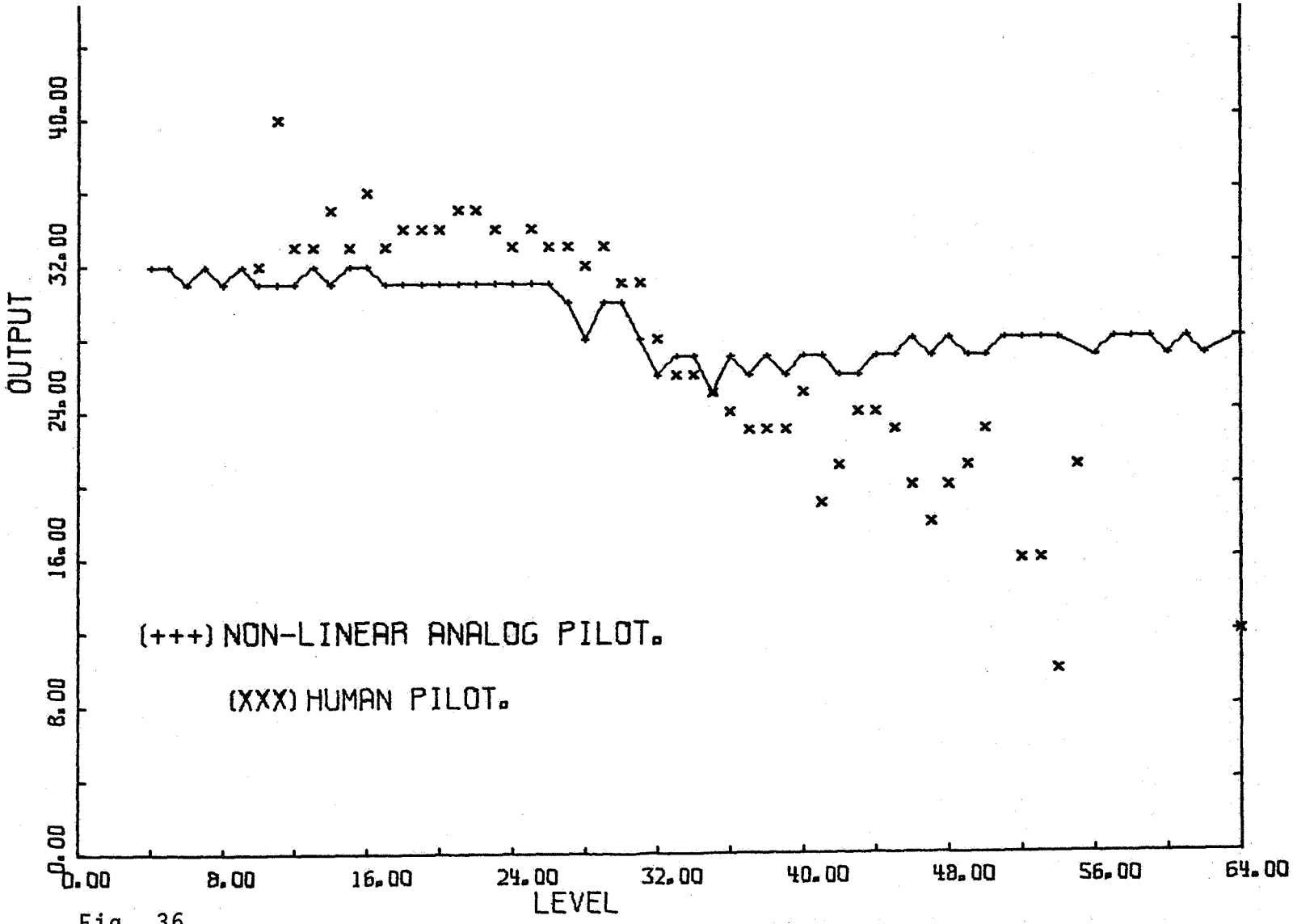


Fig. 36
Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of Level for constant rate of 2.

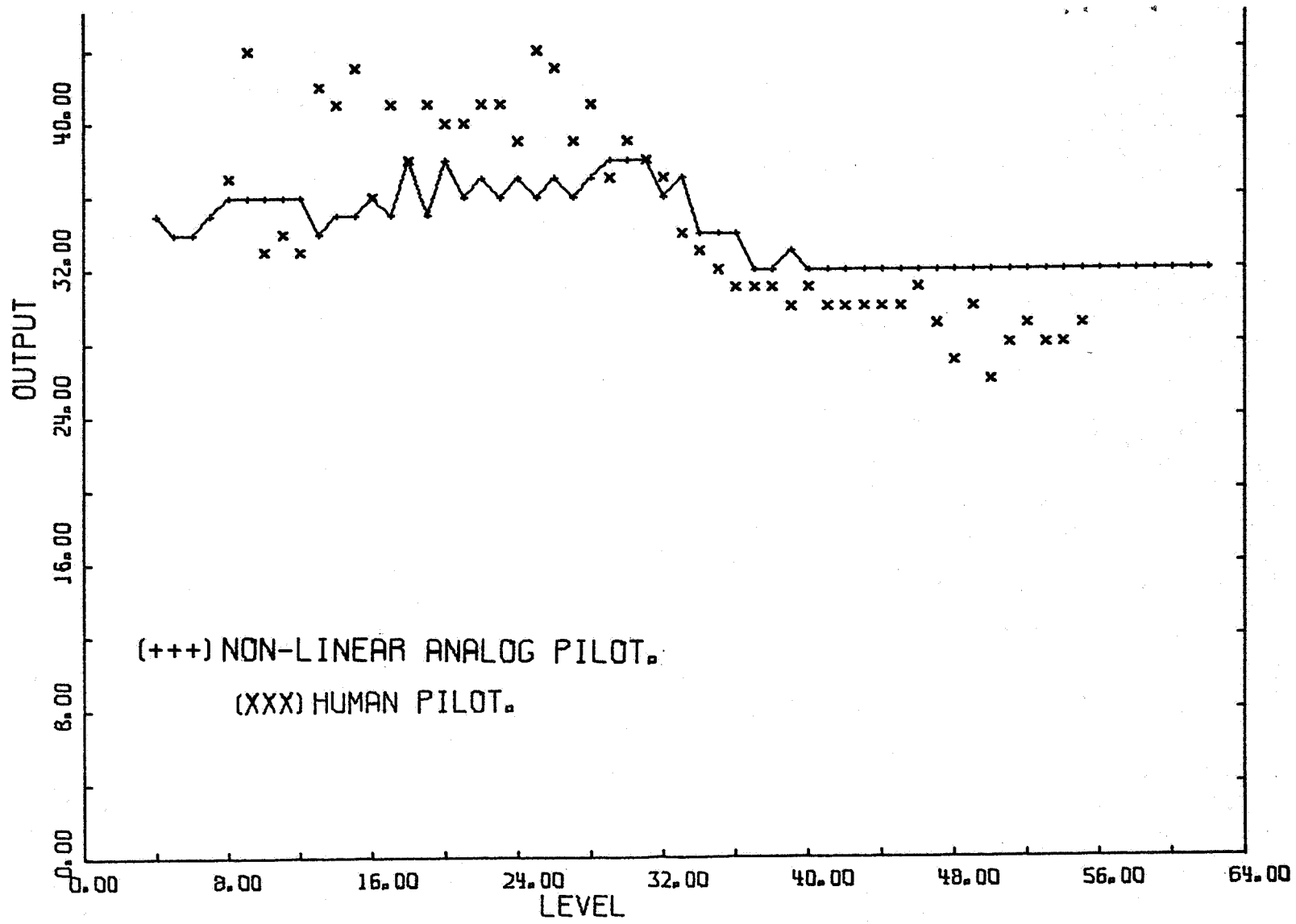


Fig. 37 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of Level for constant rate of -2.

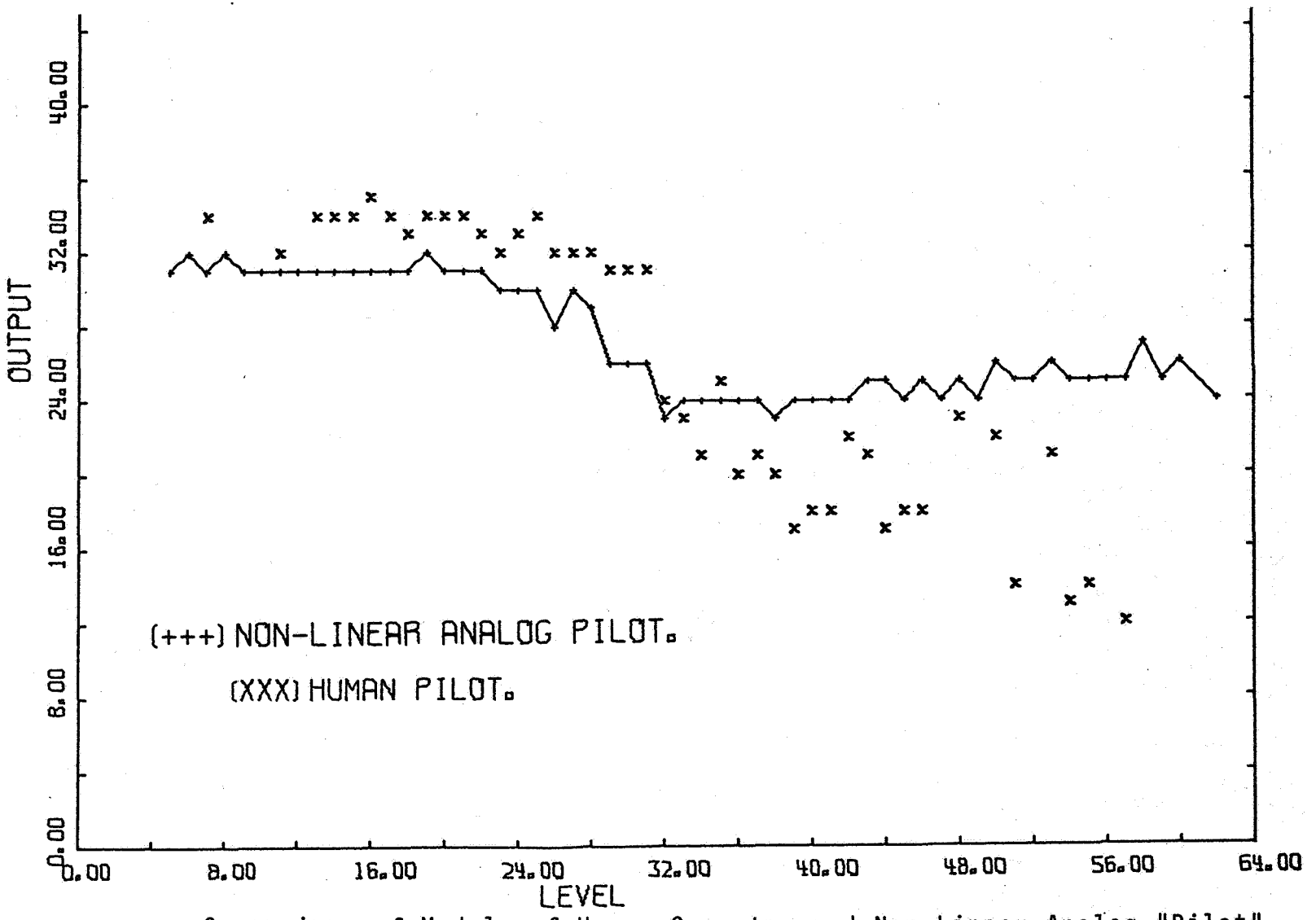


Fig. 38 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 3.

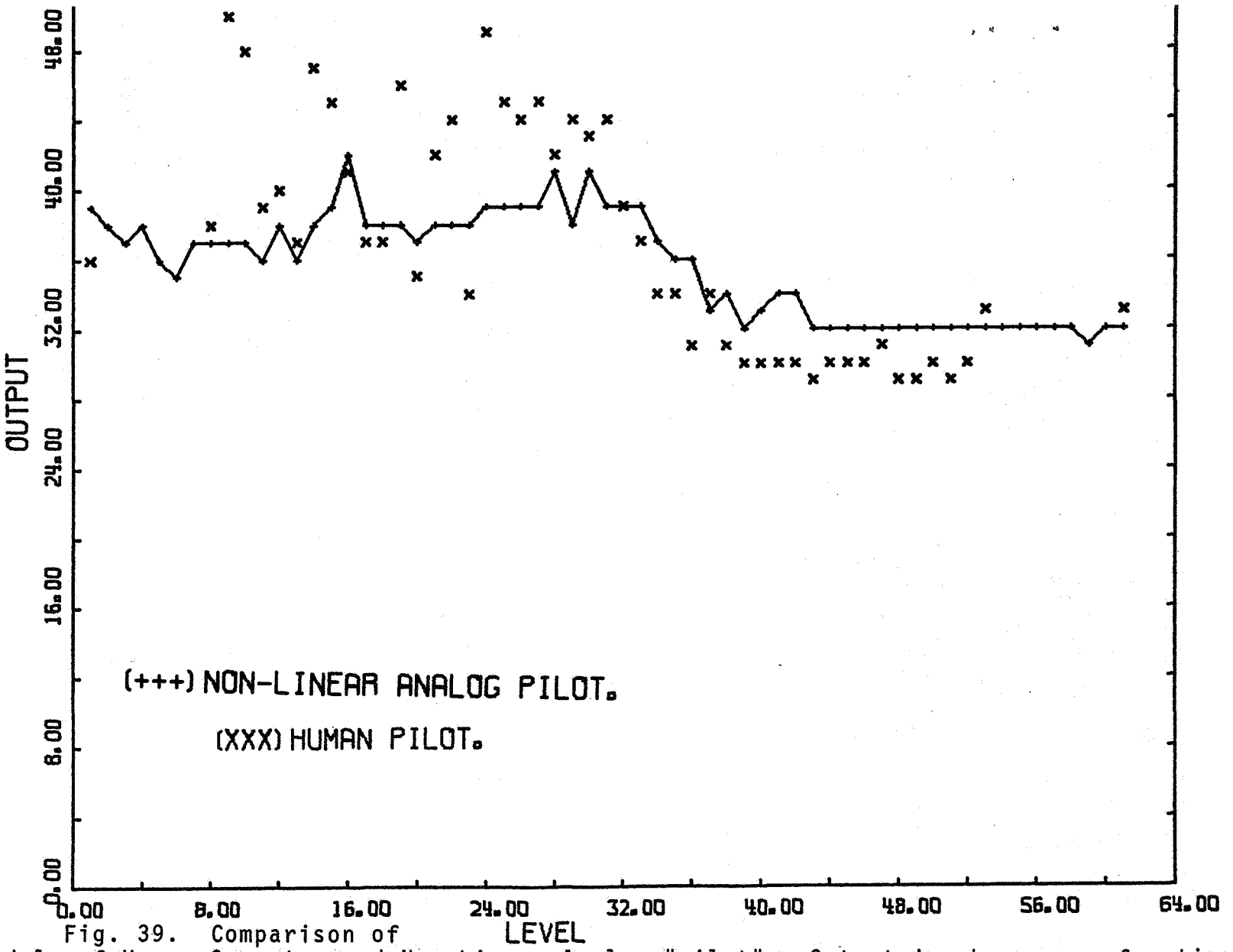


Fig. 39. Comparison of Models of Human Operator and Non-Linear Analog "pilot". Output is shown as a function level for constant rate of -3.

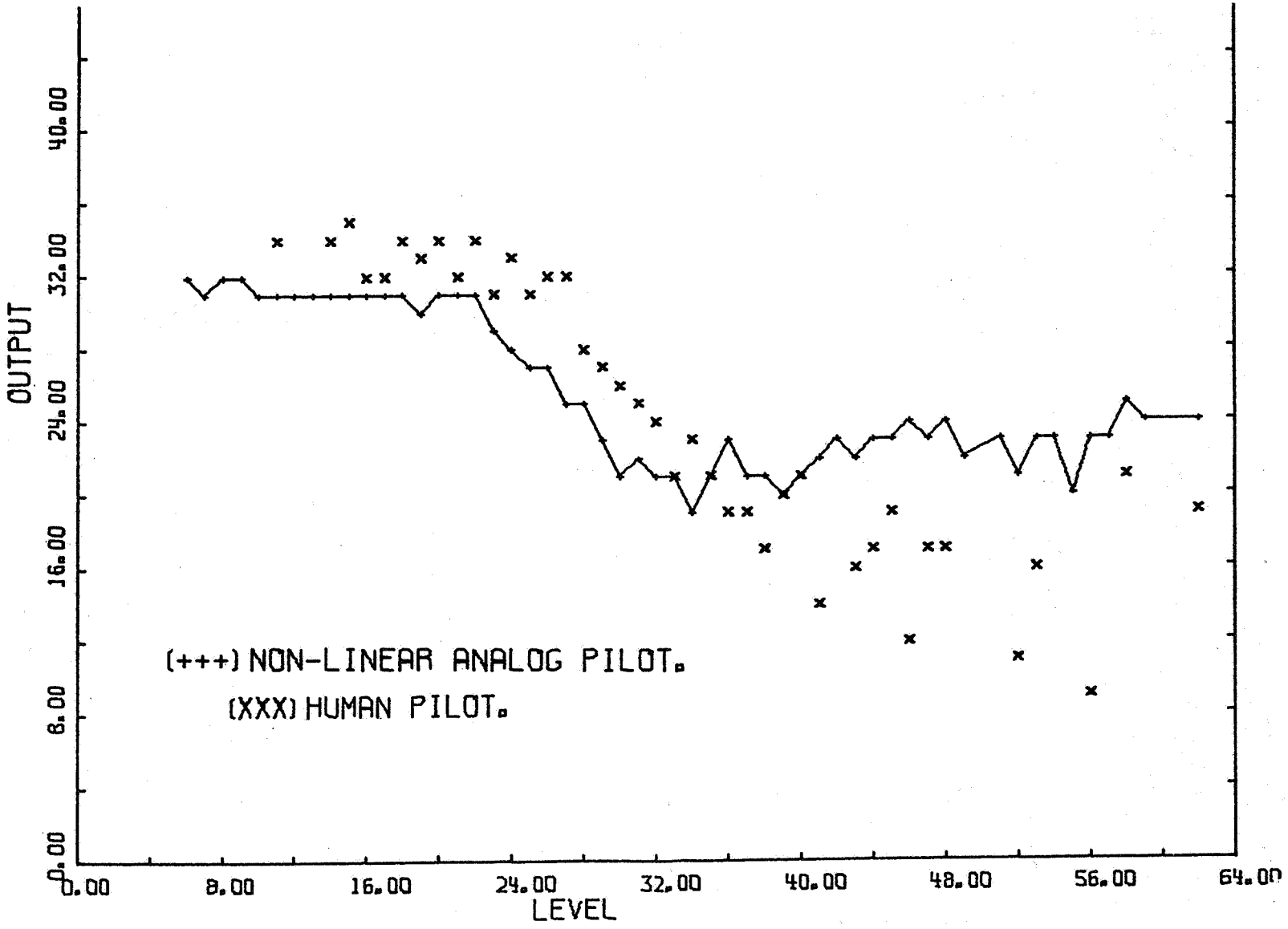


Fig. 40 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 4.

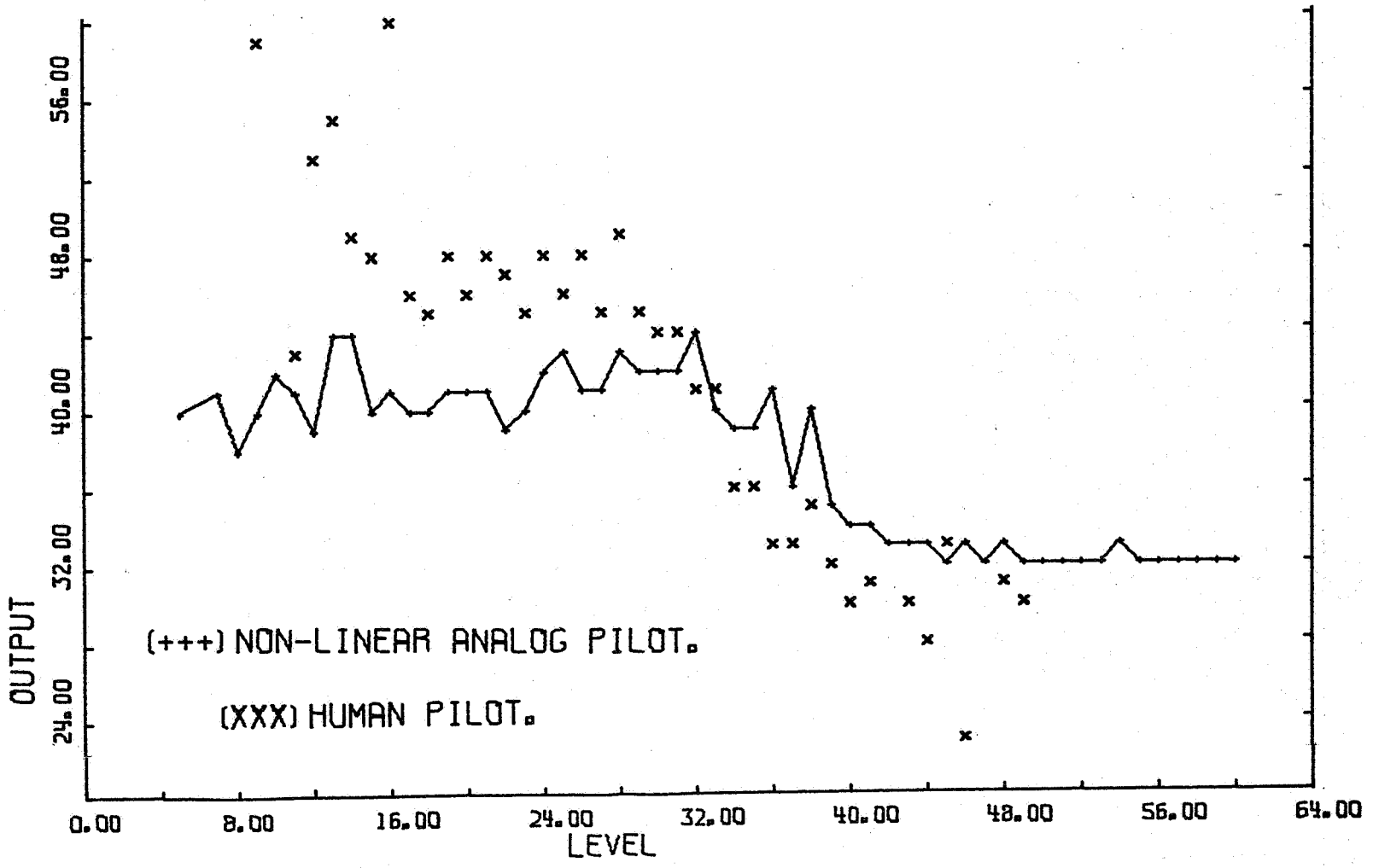


Fig. 41 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -4.

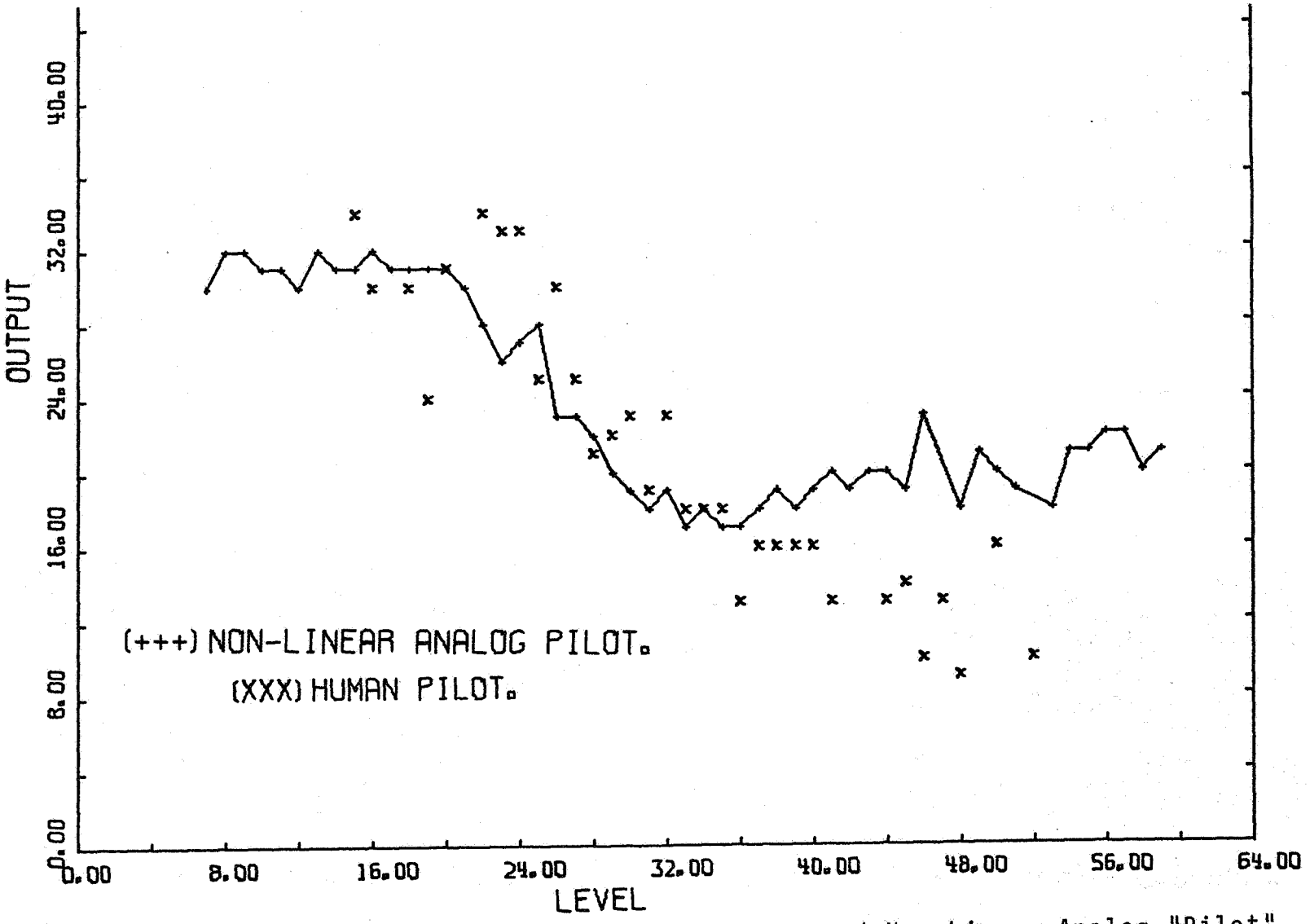


Fig. 42 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 5.

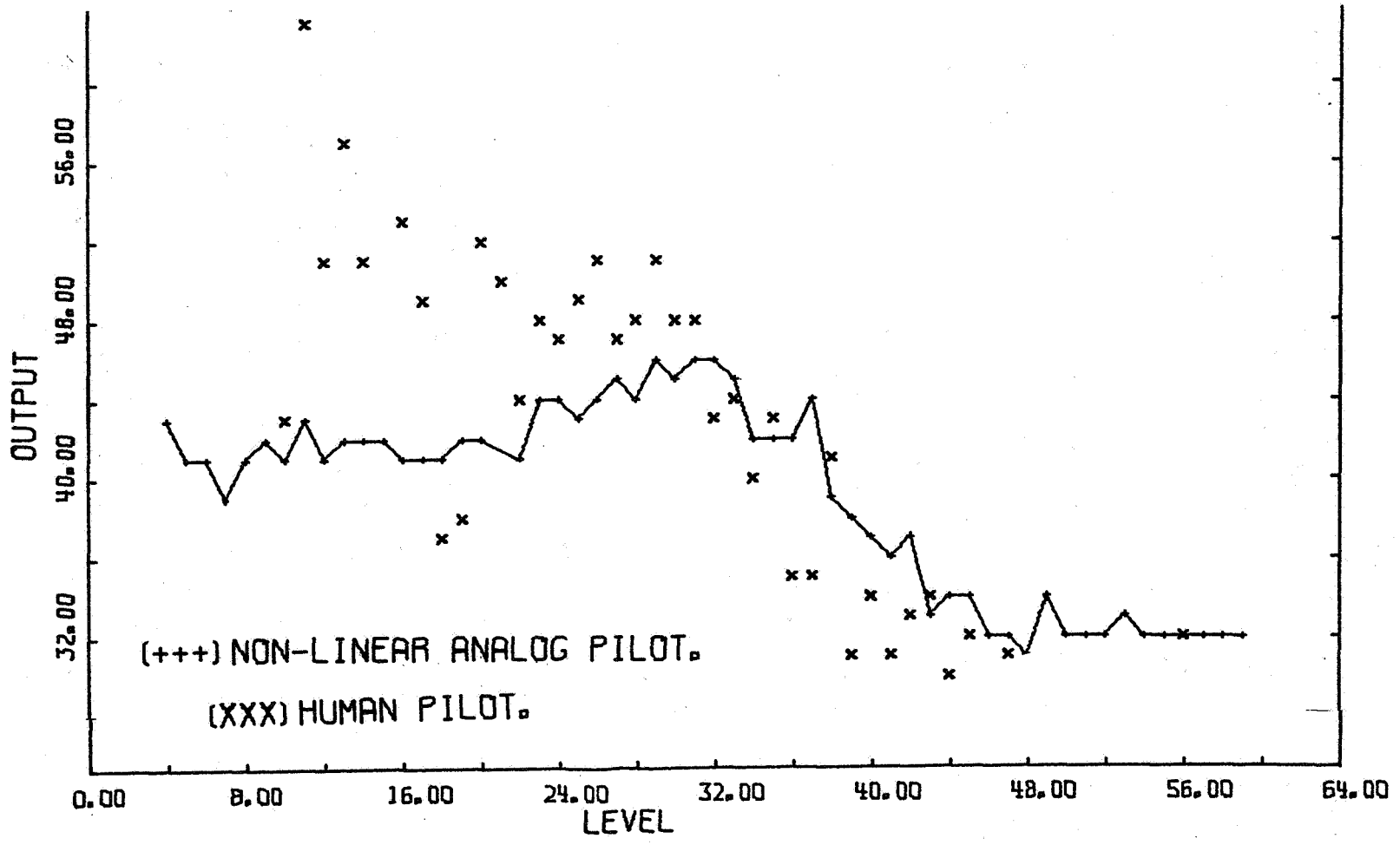


Fig. 43 Comparison of models of Human Behavior and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -5.

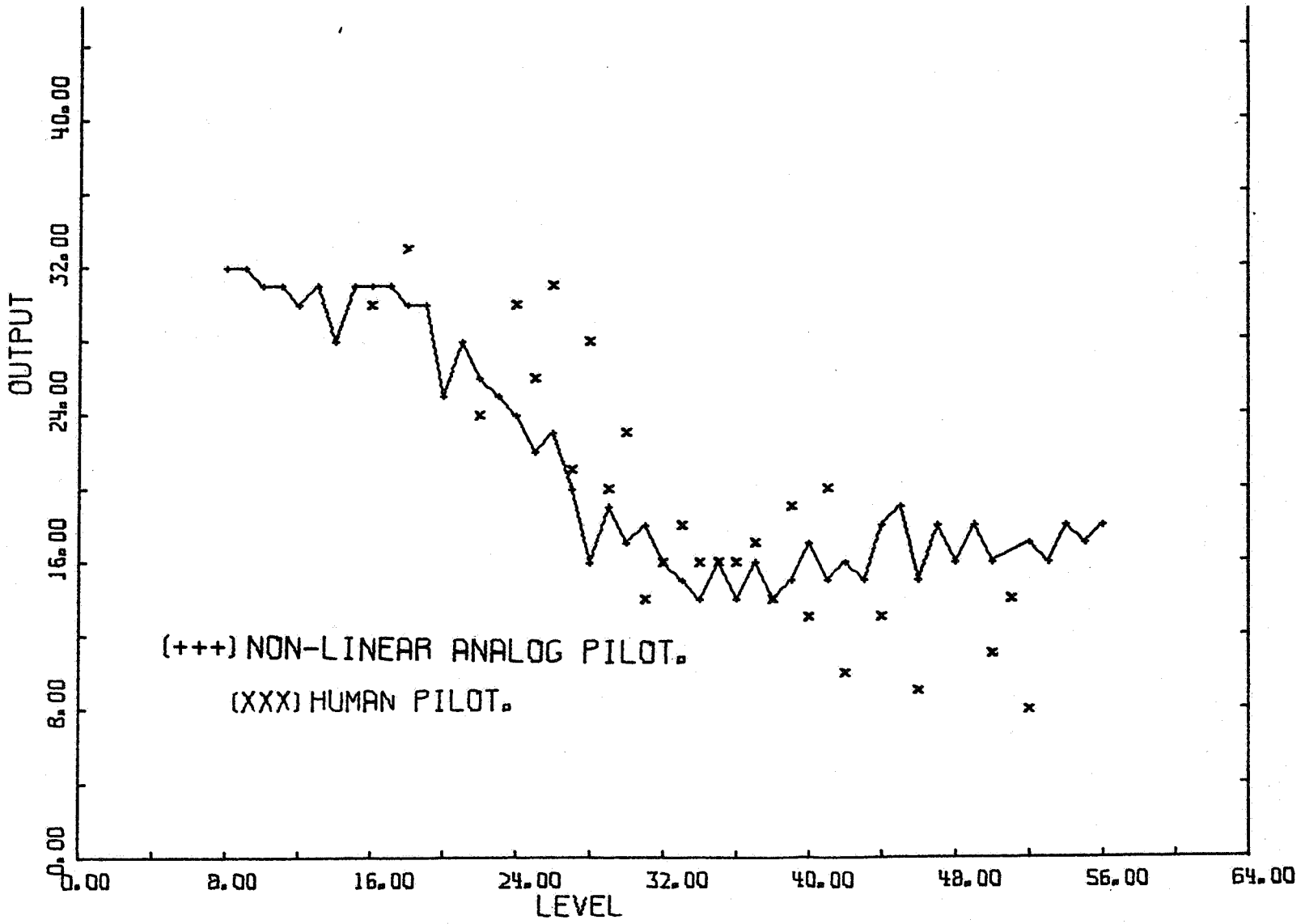


Fig. 44 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 6.

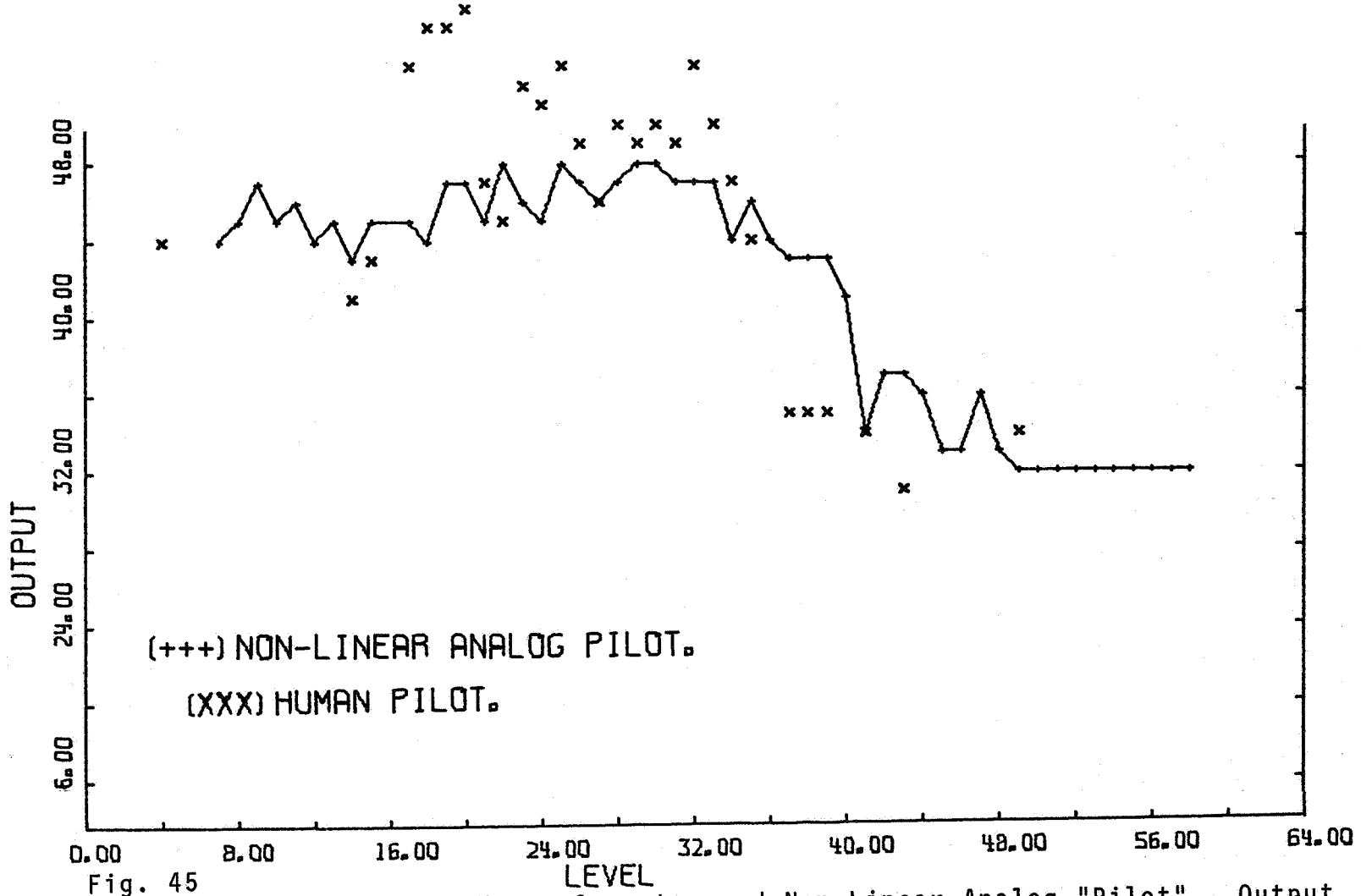


Fig. 45
Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -6.

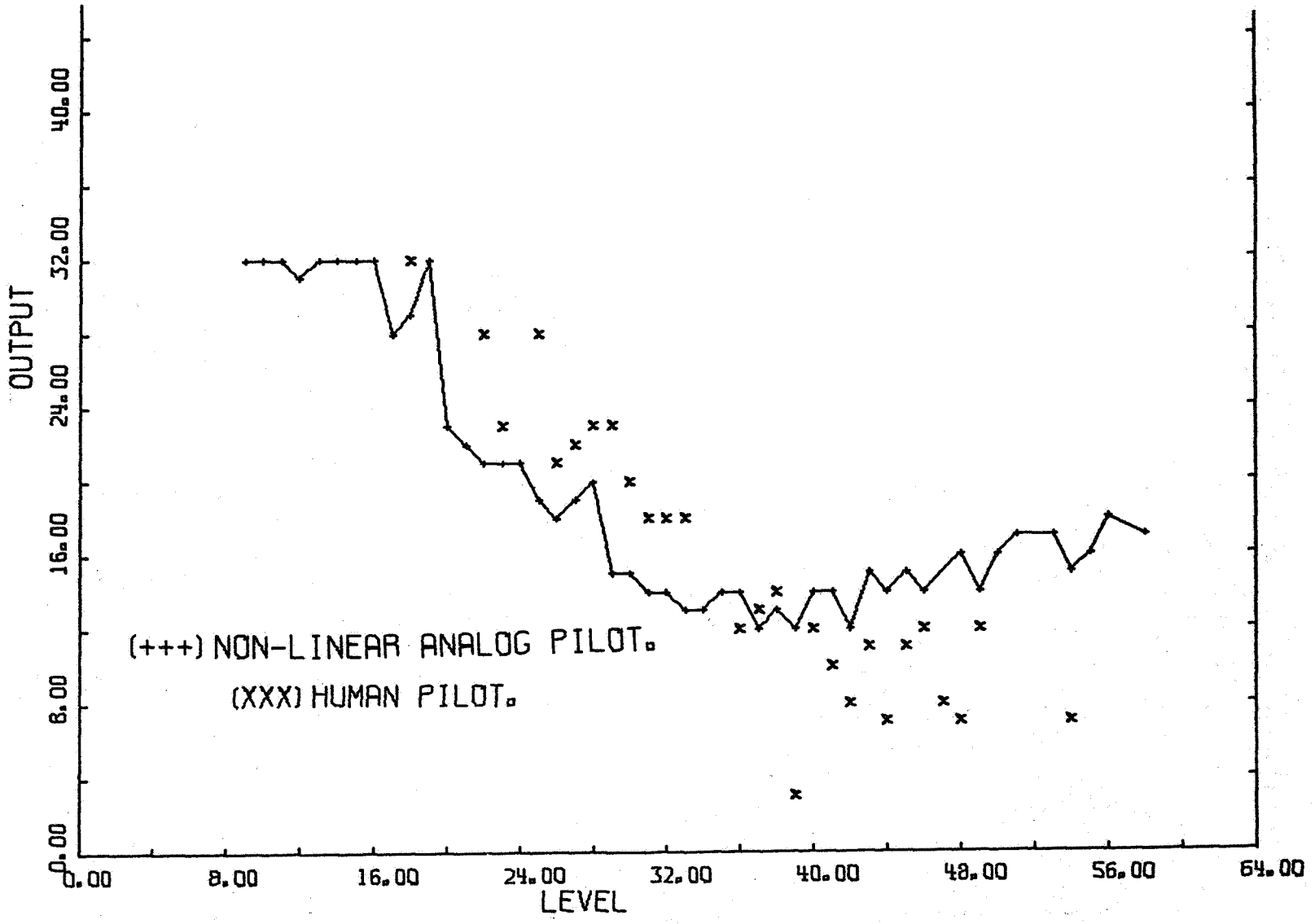


Fig. 46 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of 7.

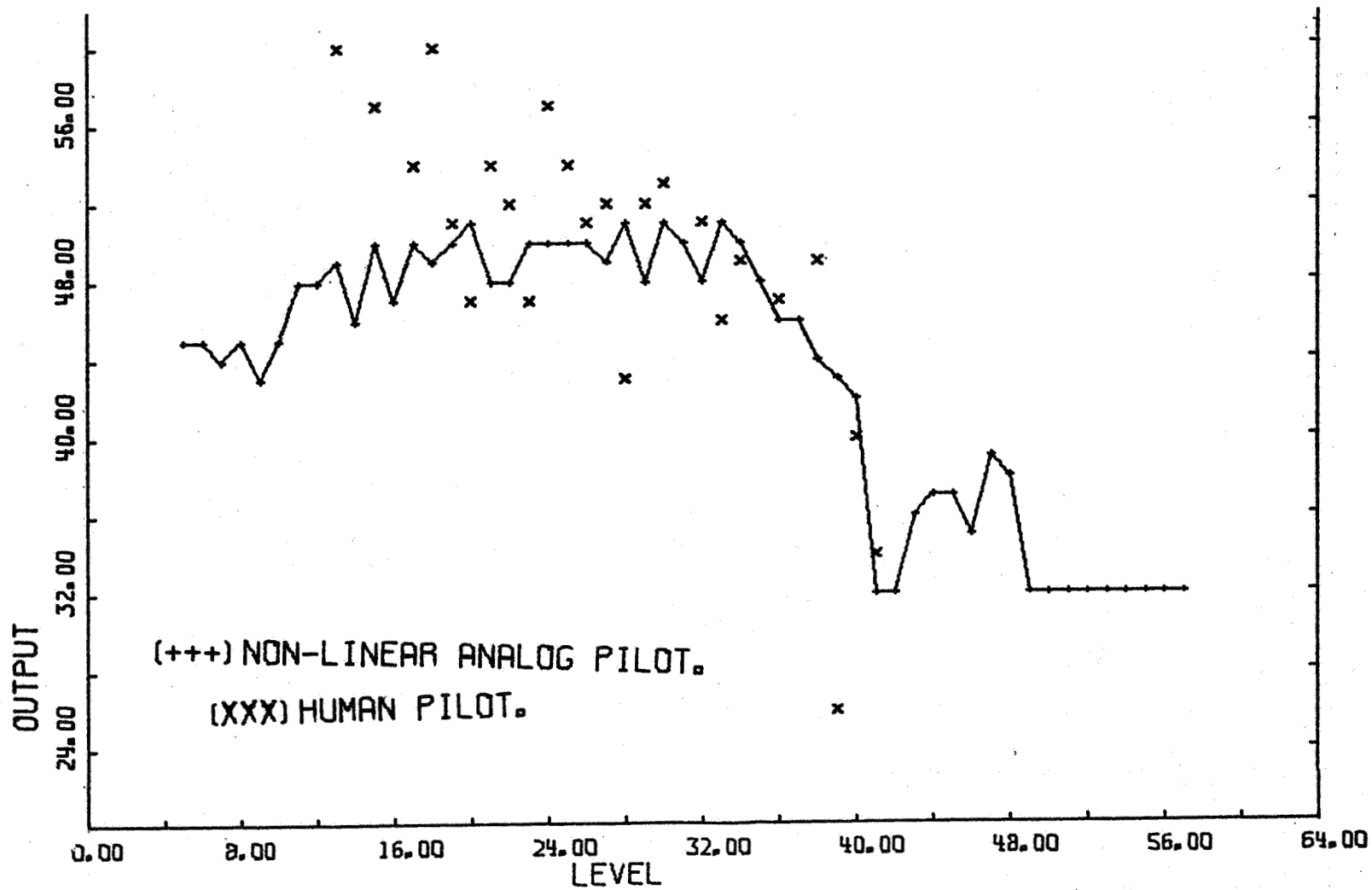


Fig. 47 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of level for constant rate of -7.

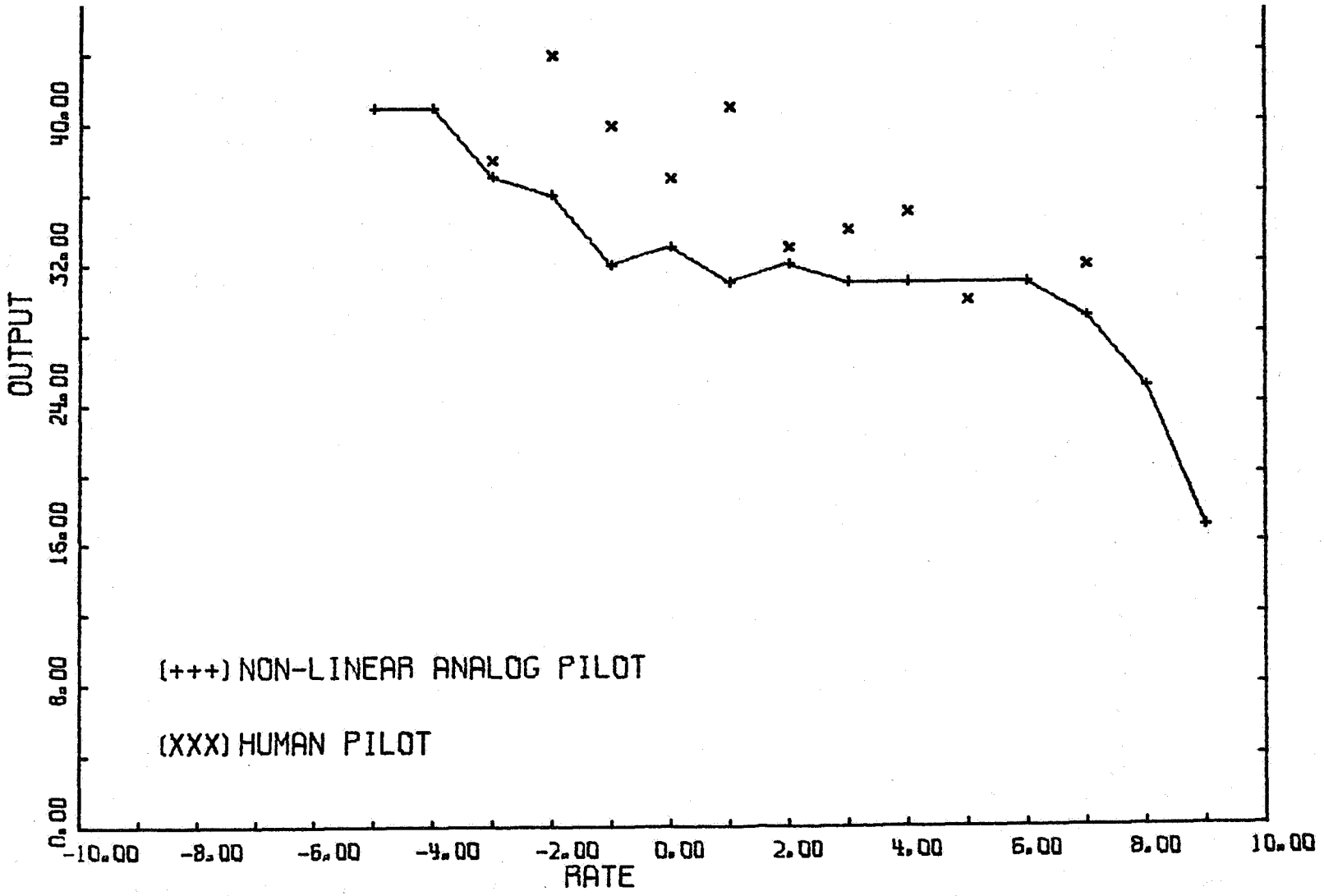


Fig. 48 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 10.

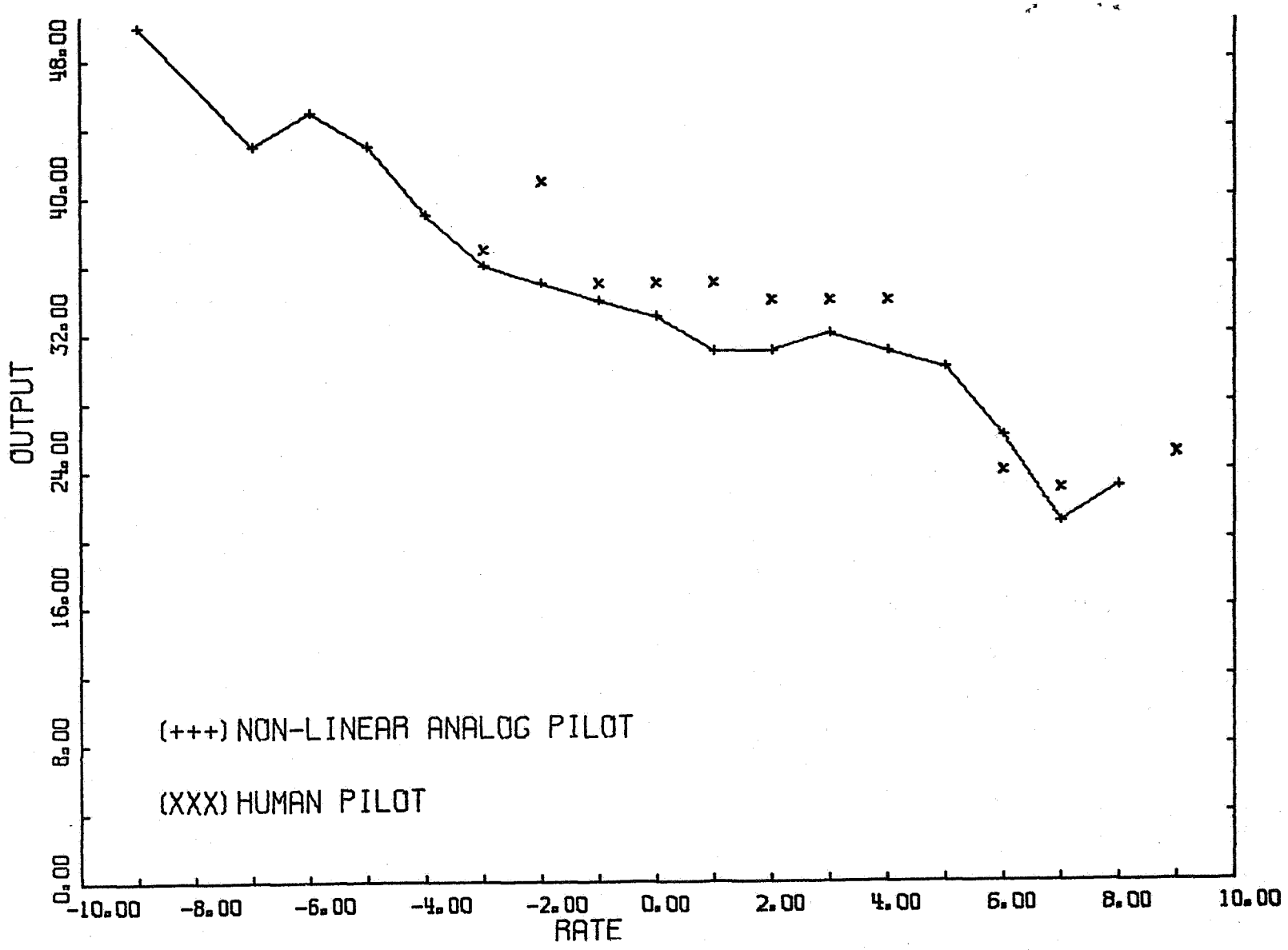


Fig.49 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 15

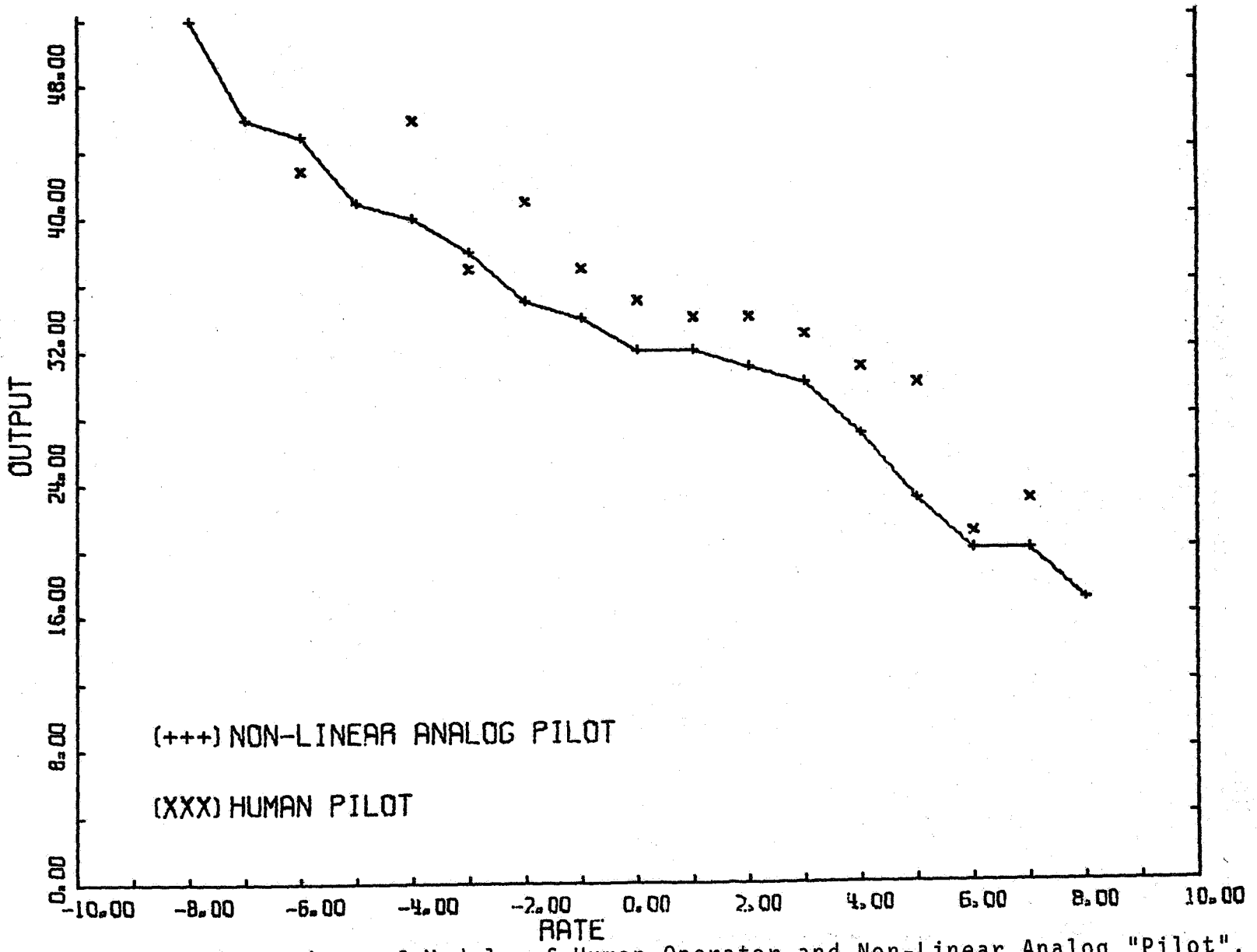


Fig. 50 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 20.

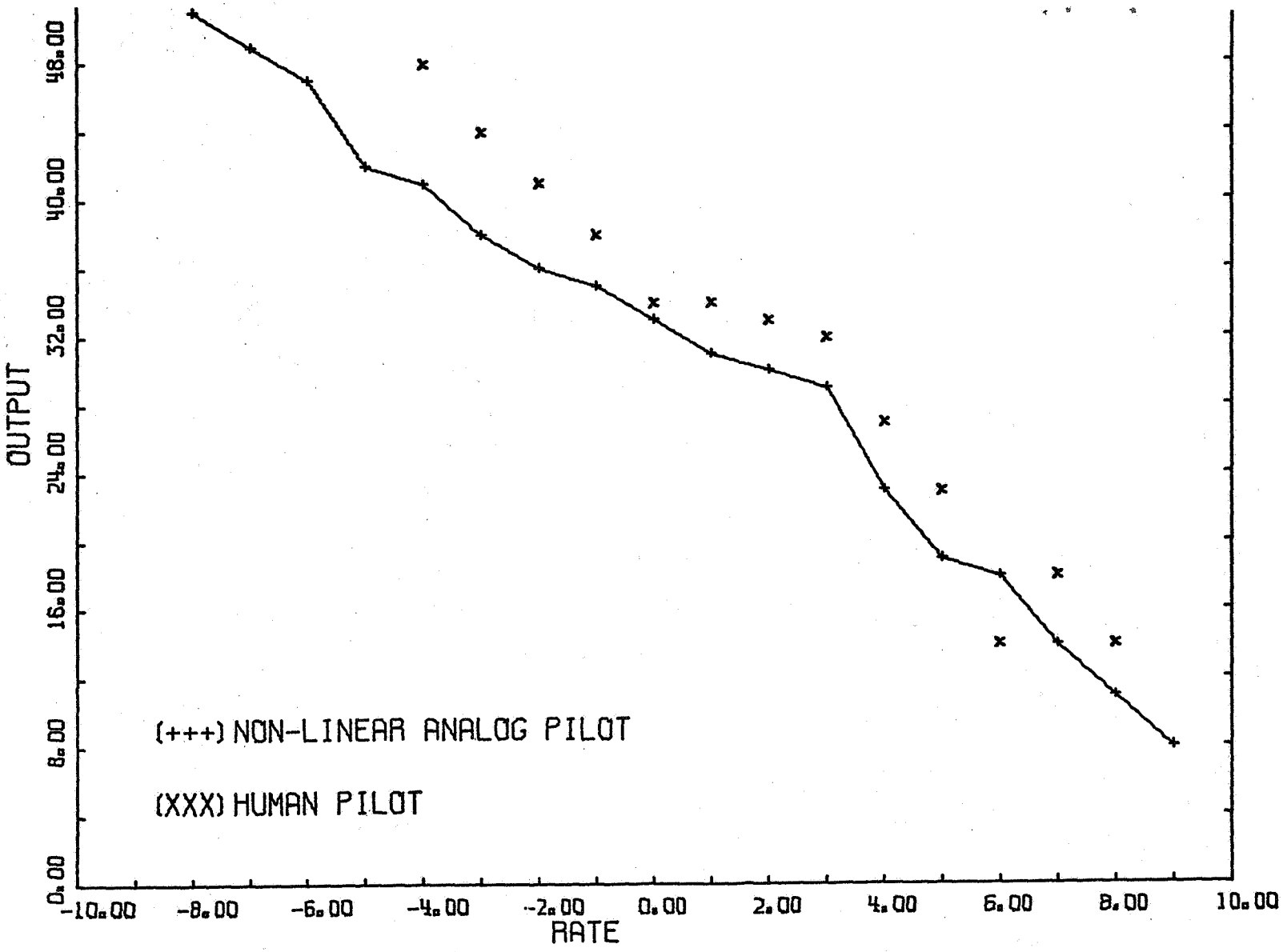


Fig. 51 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 24.

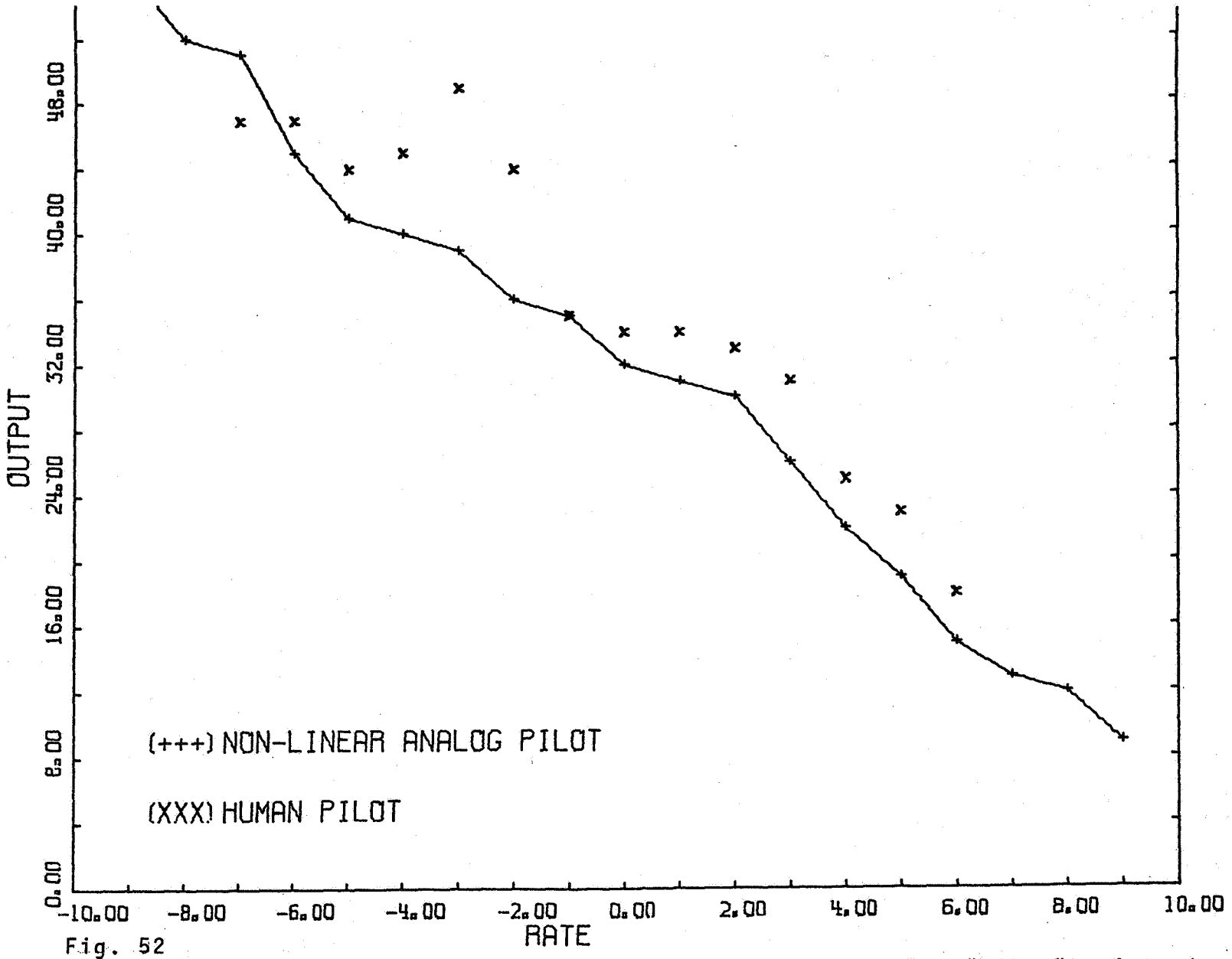


Fig. 52
Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 26.

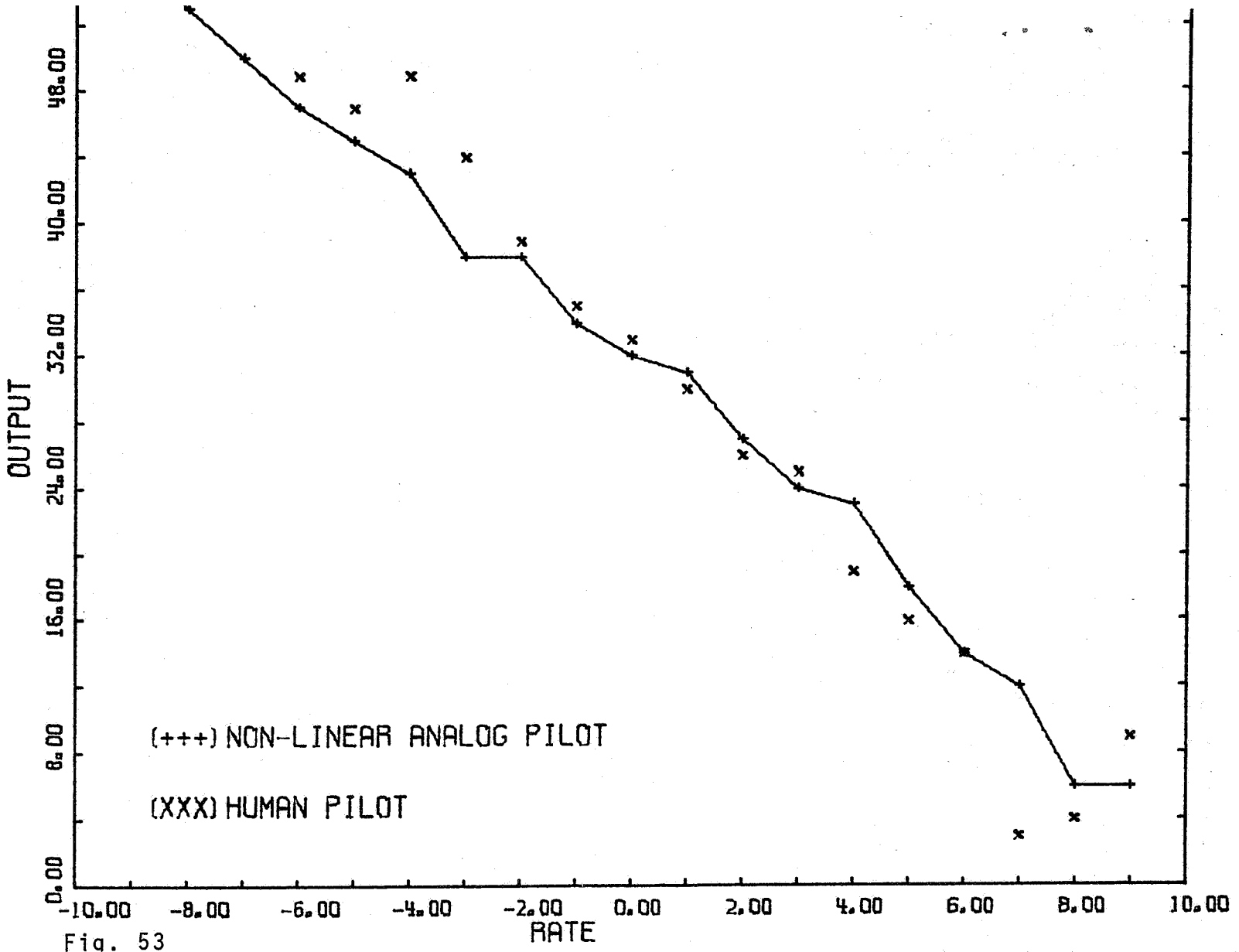


Fig. 53
Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 31.

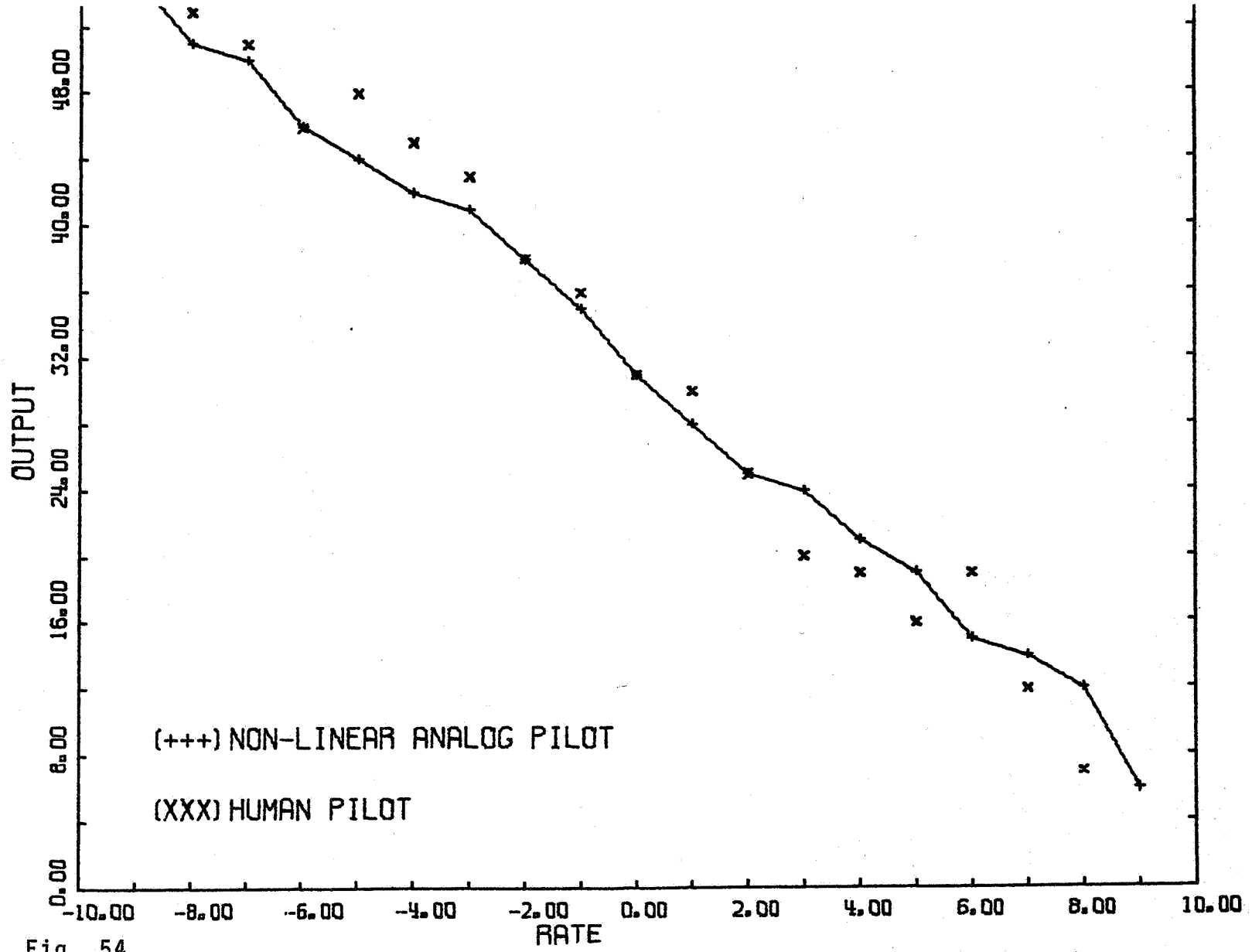


Fig. 54
Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 32.

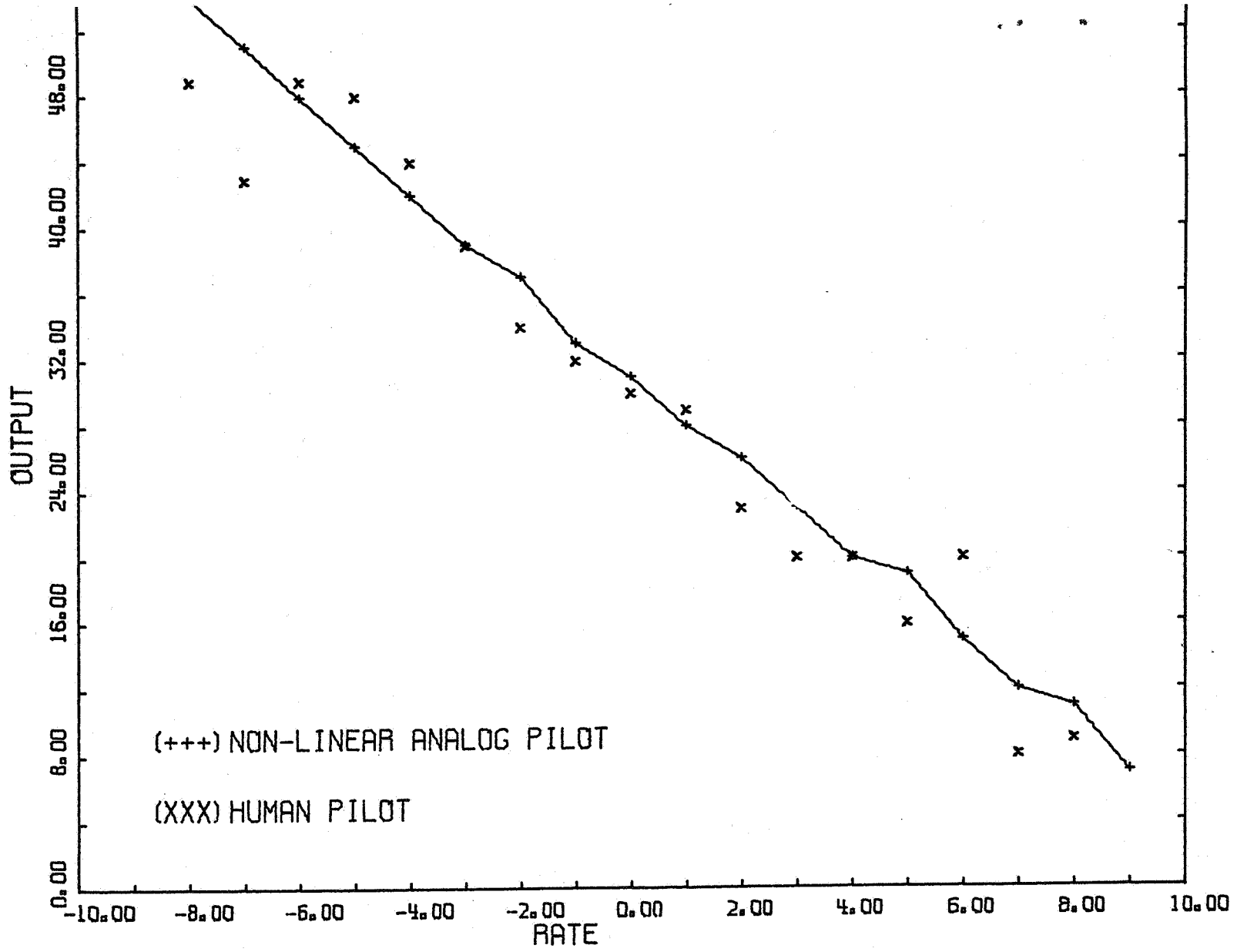


Fig. 55 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 34.

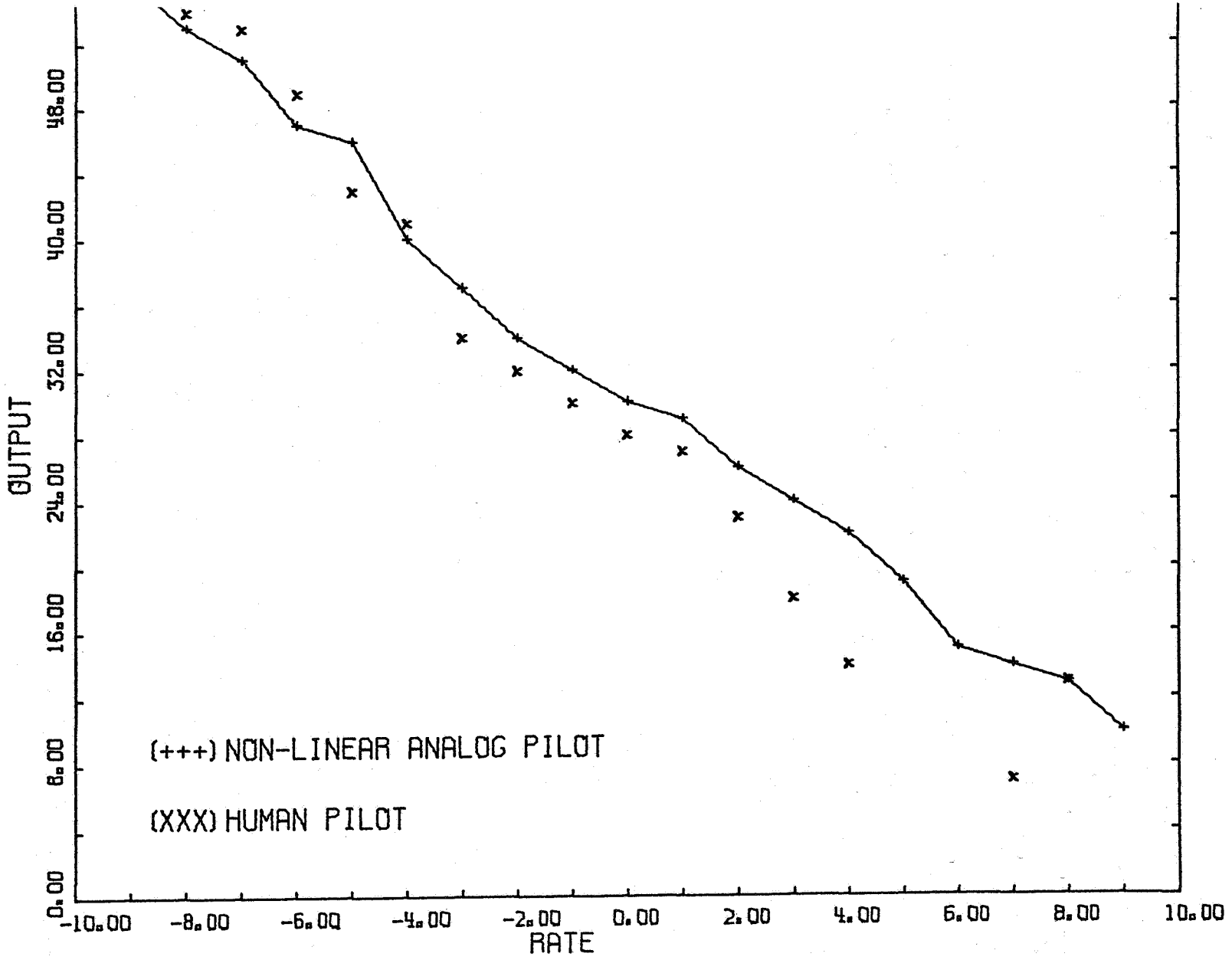


Fig. 56 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 36.

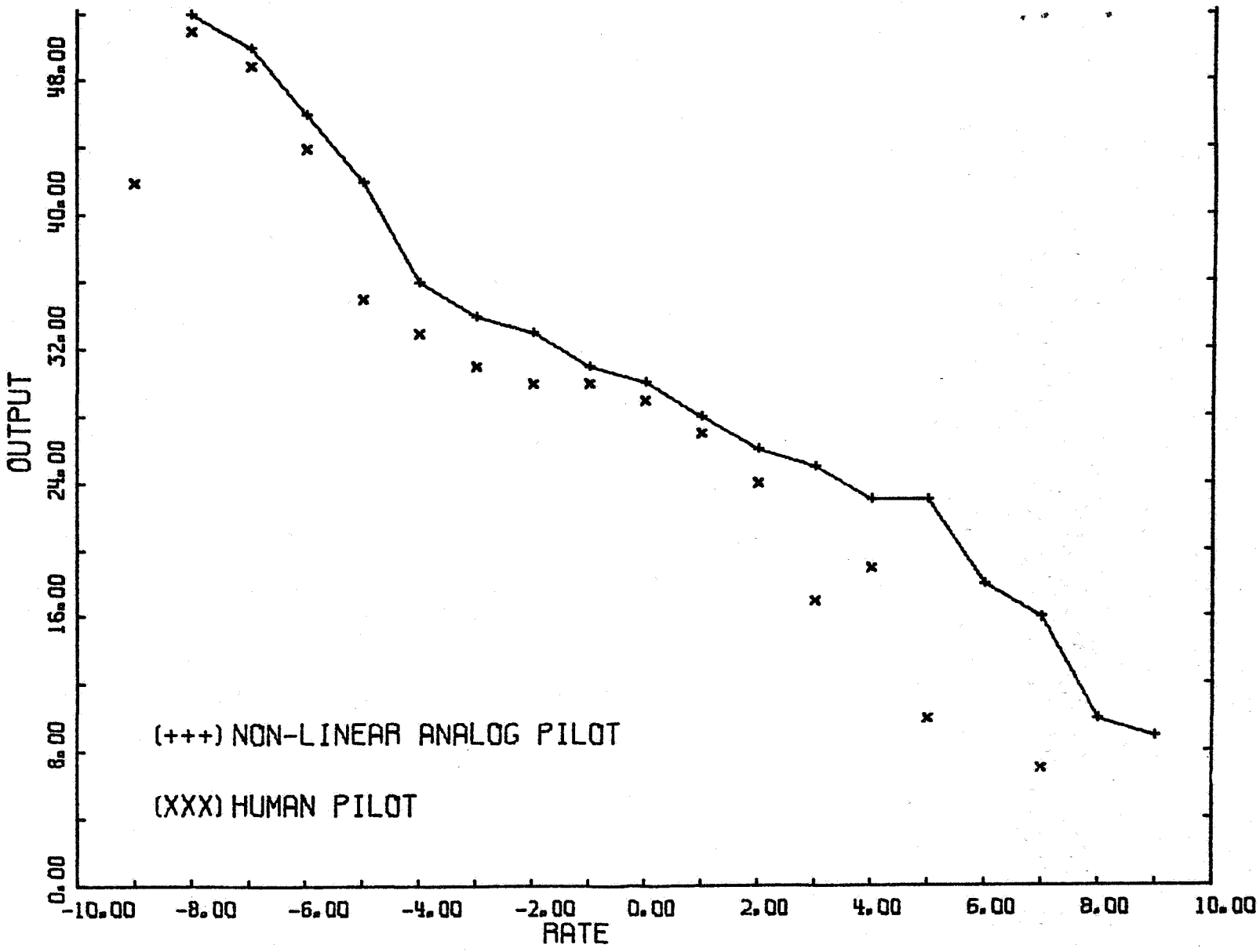


Fig. 57 Comparison of Models of Human OPerator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 40.

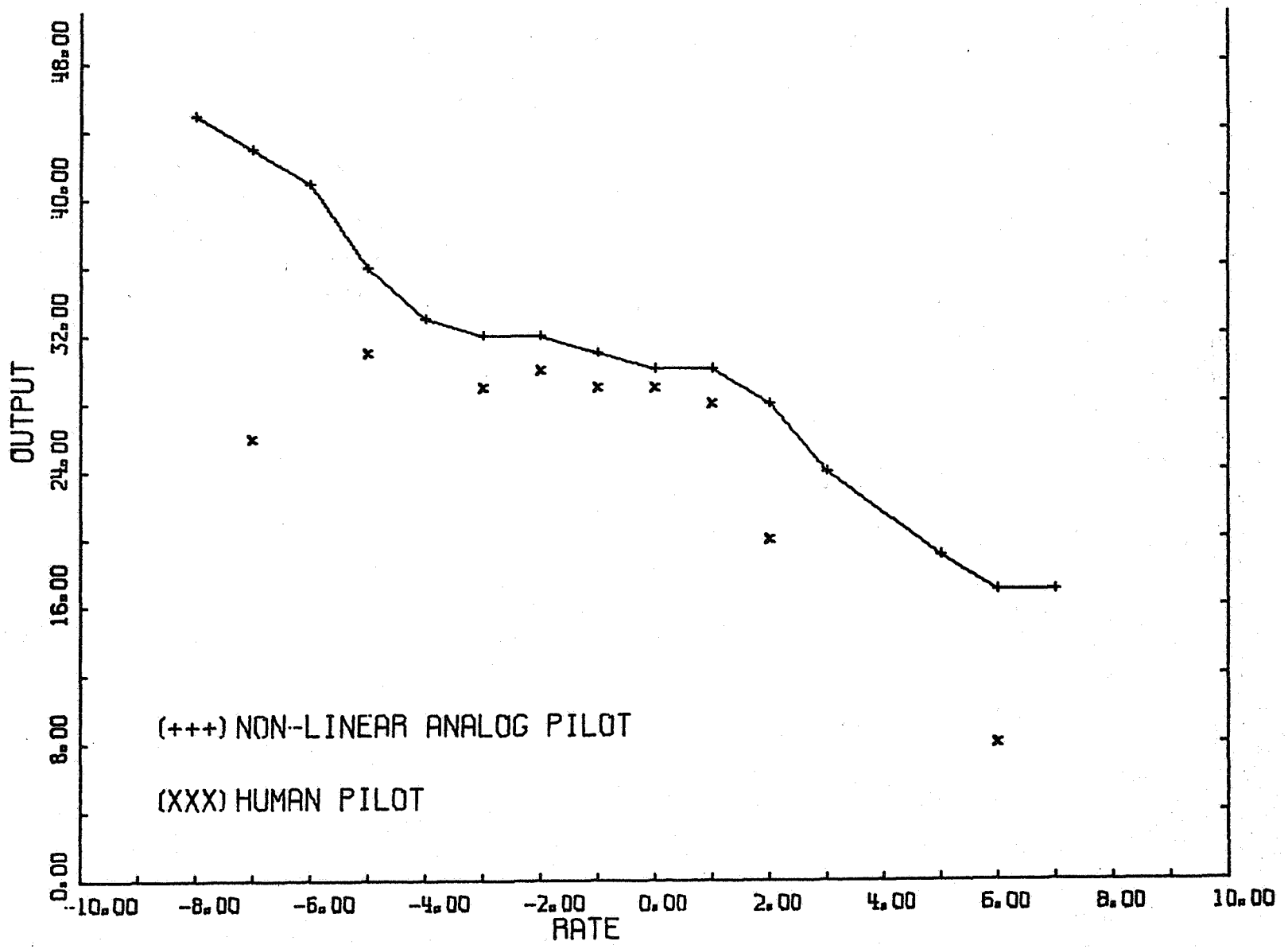


Fig. 58 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 45.

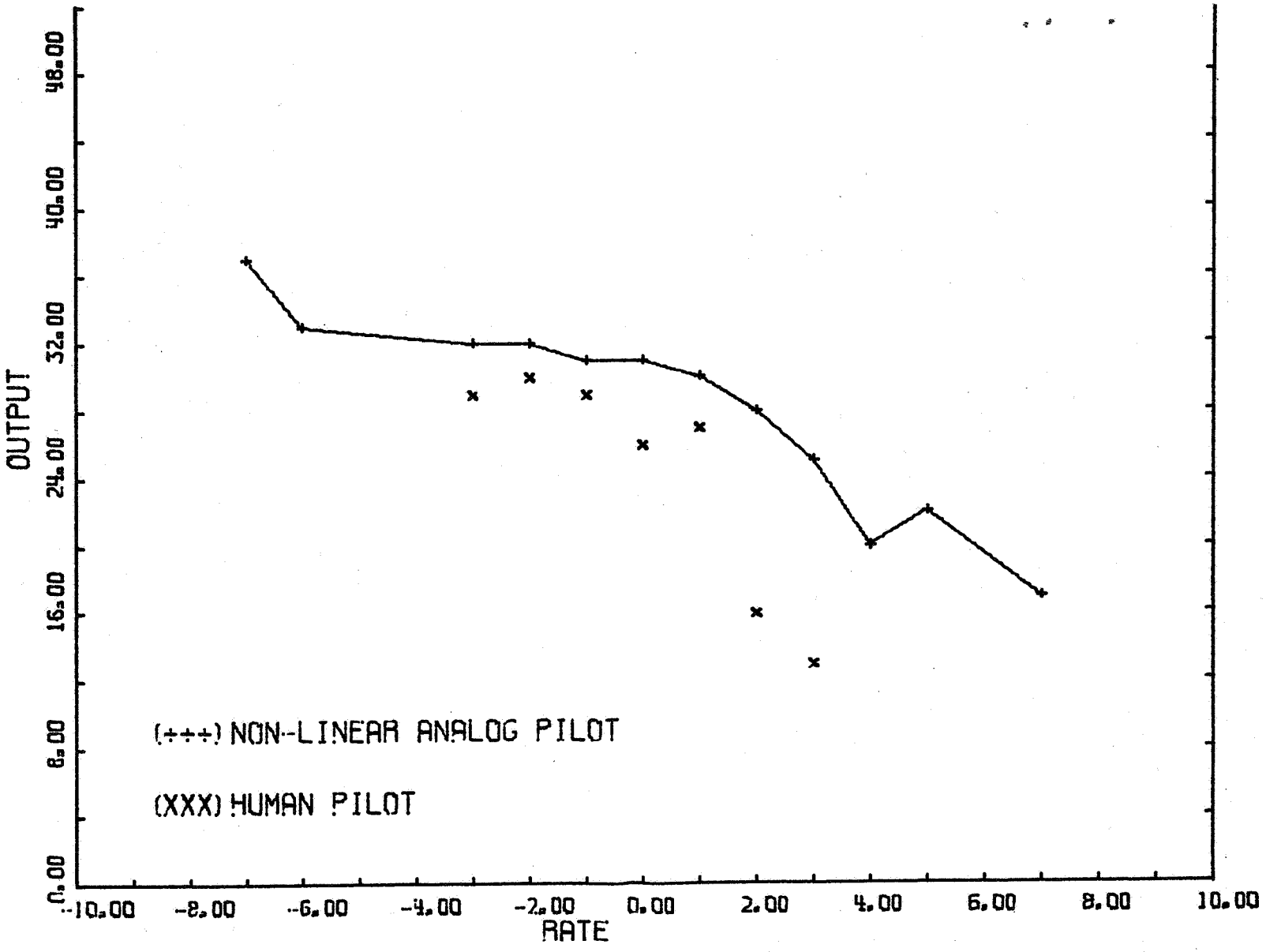


Fig. 59 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 50.

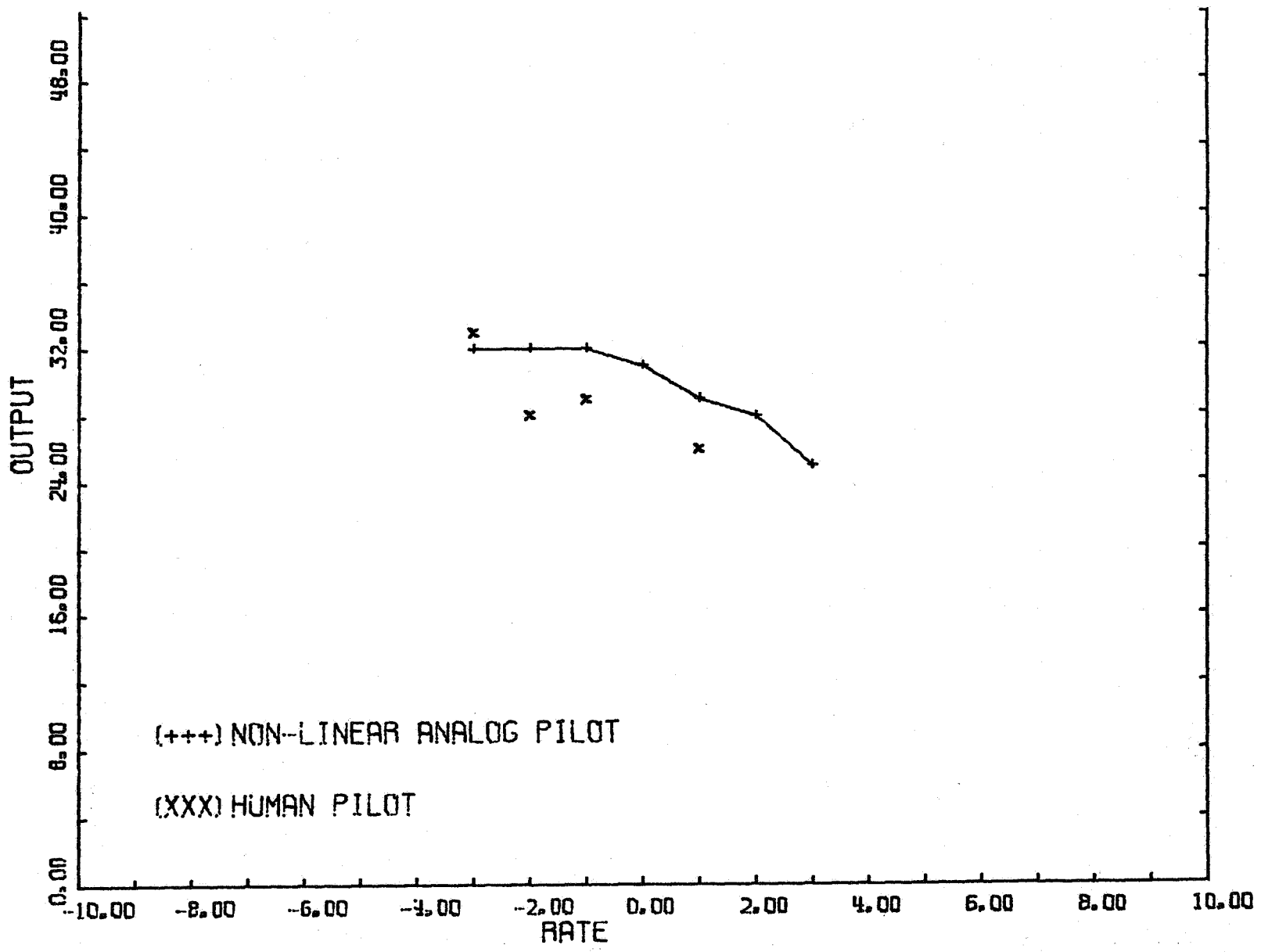


Fig. 60 Comparison of Models of Human Operator and Non-Linear Analog "Pilot". Output is shown as a function of rate for a constant level of 55.

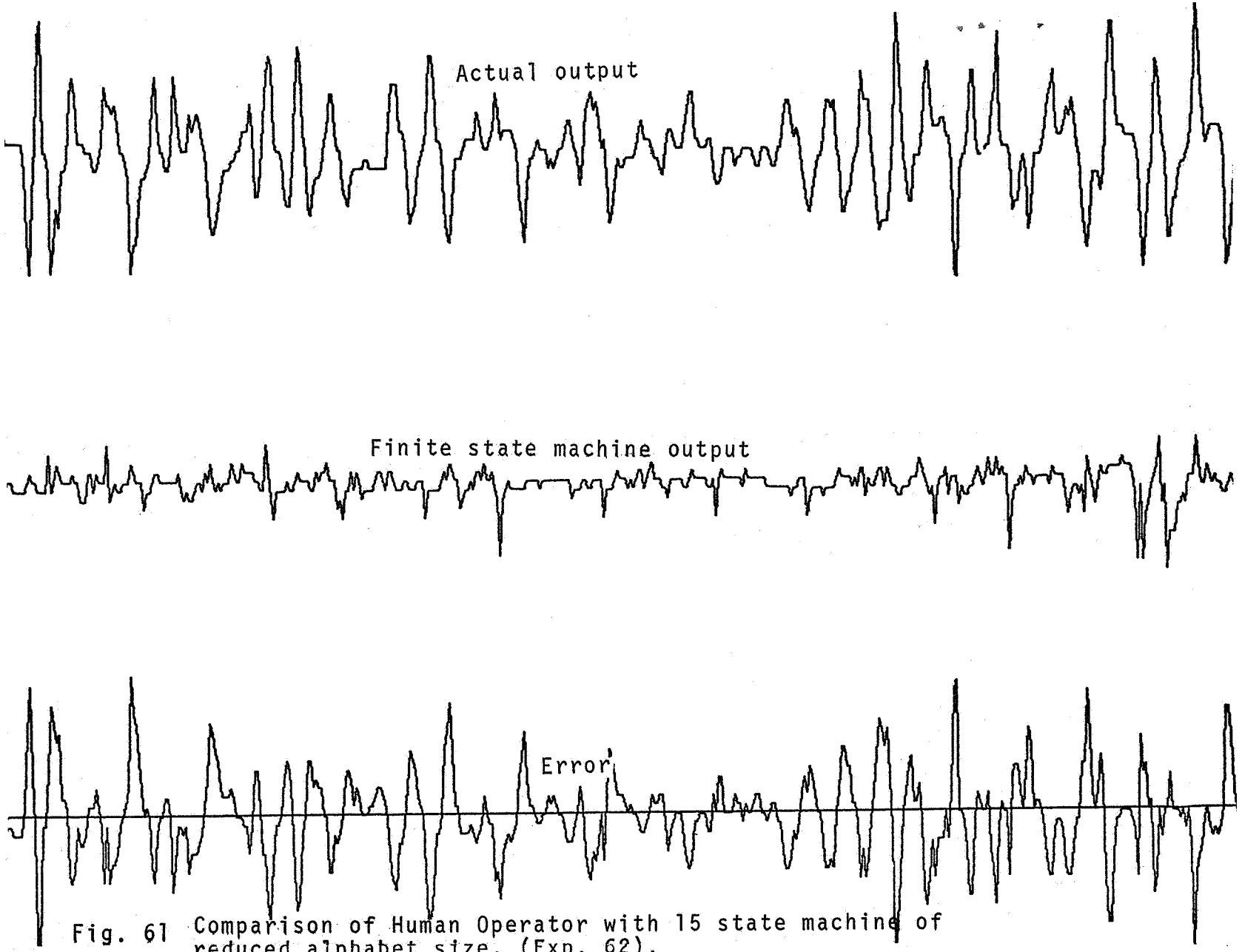


Fig. 61 Comparison of Human Operator with 15 state machine of reduced alphabet size. (Exp. 62).

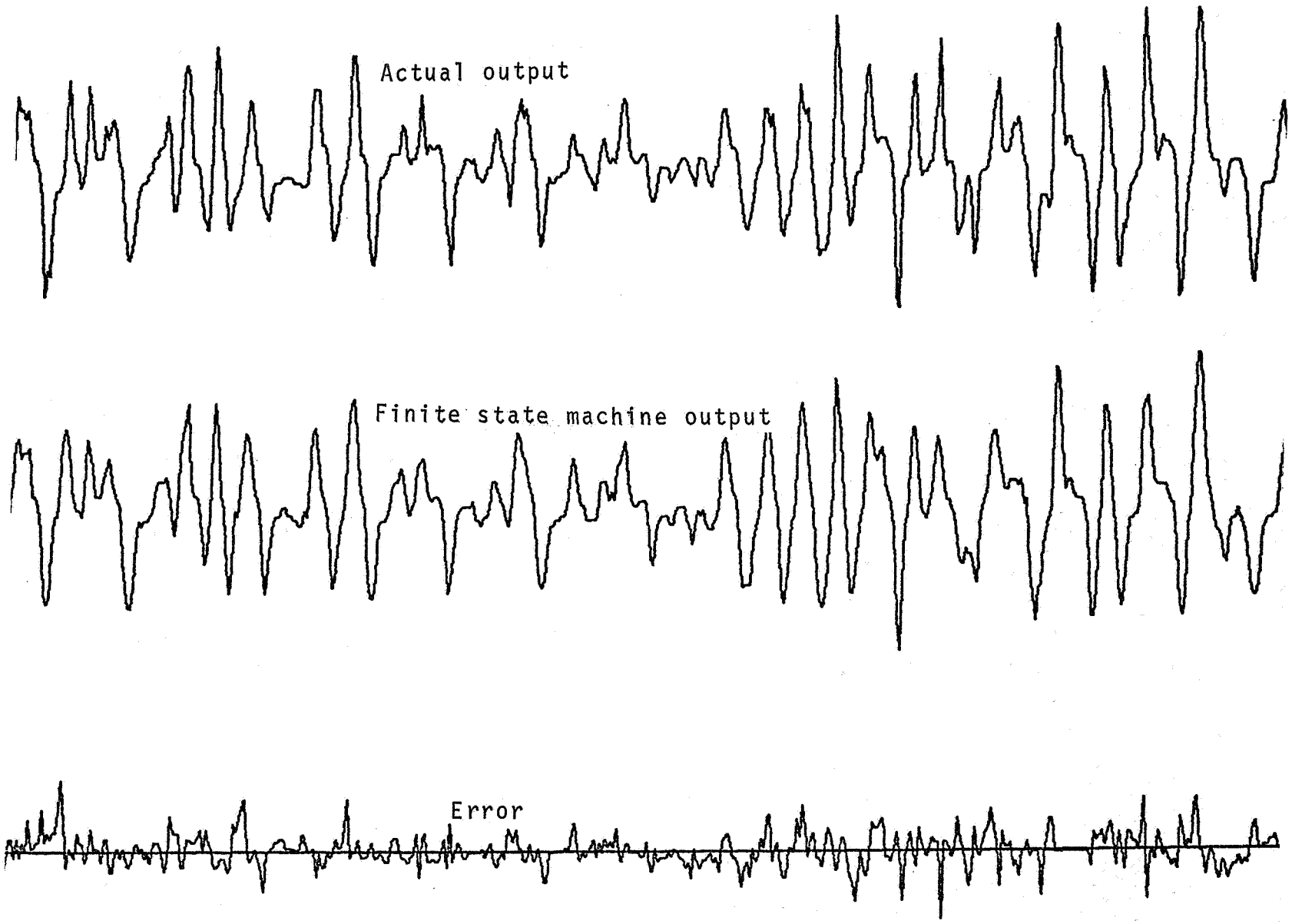


Fig. 62 Comparison of Human Operator with 31 state 31 symbol alphabet machine (Exp. 63).

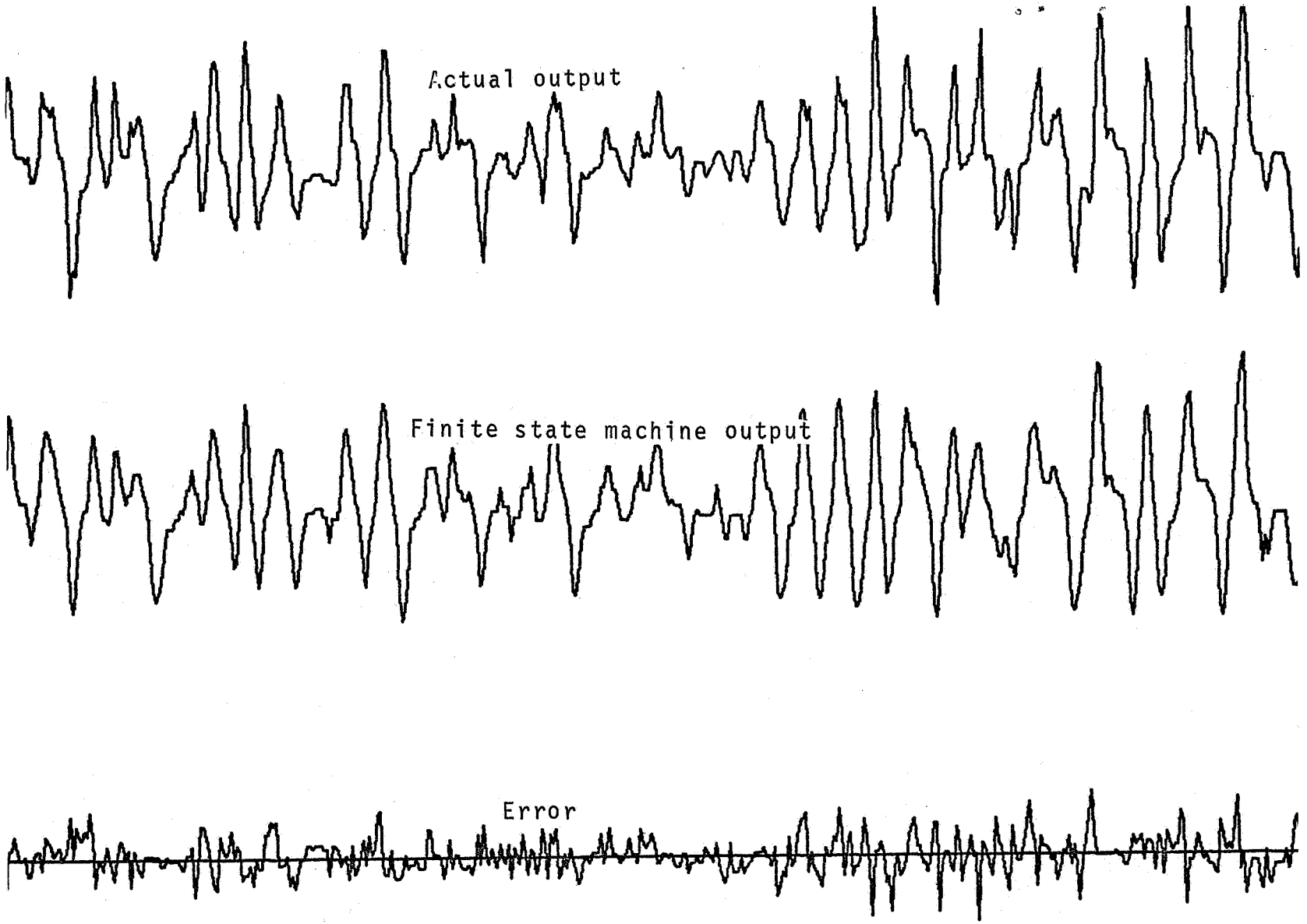


Fig. 63 Comparison of Human Operator with 15 state 15 symbol alphabet machine. (Exp. 64).

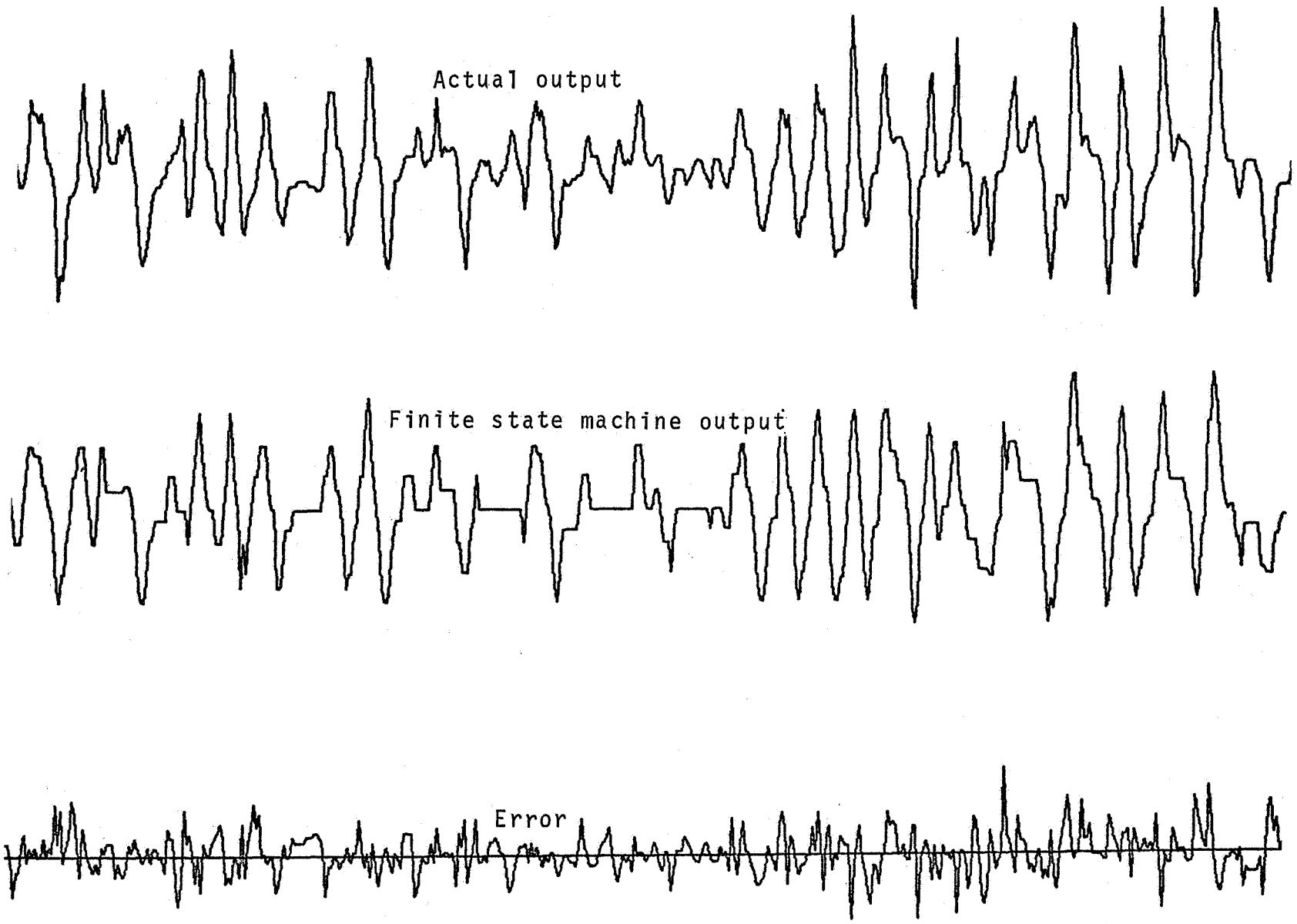


Fig. 64 Comparison of Human Operator with 7 state 7 symbol alpabet Machine. (Exp. 65).

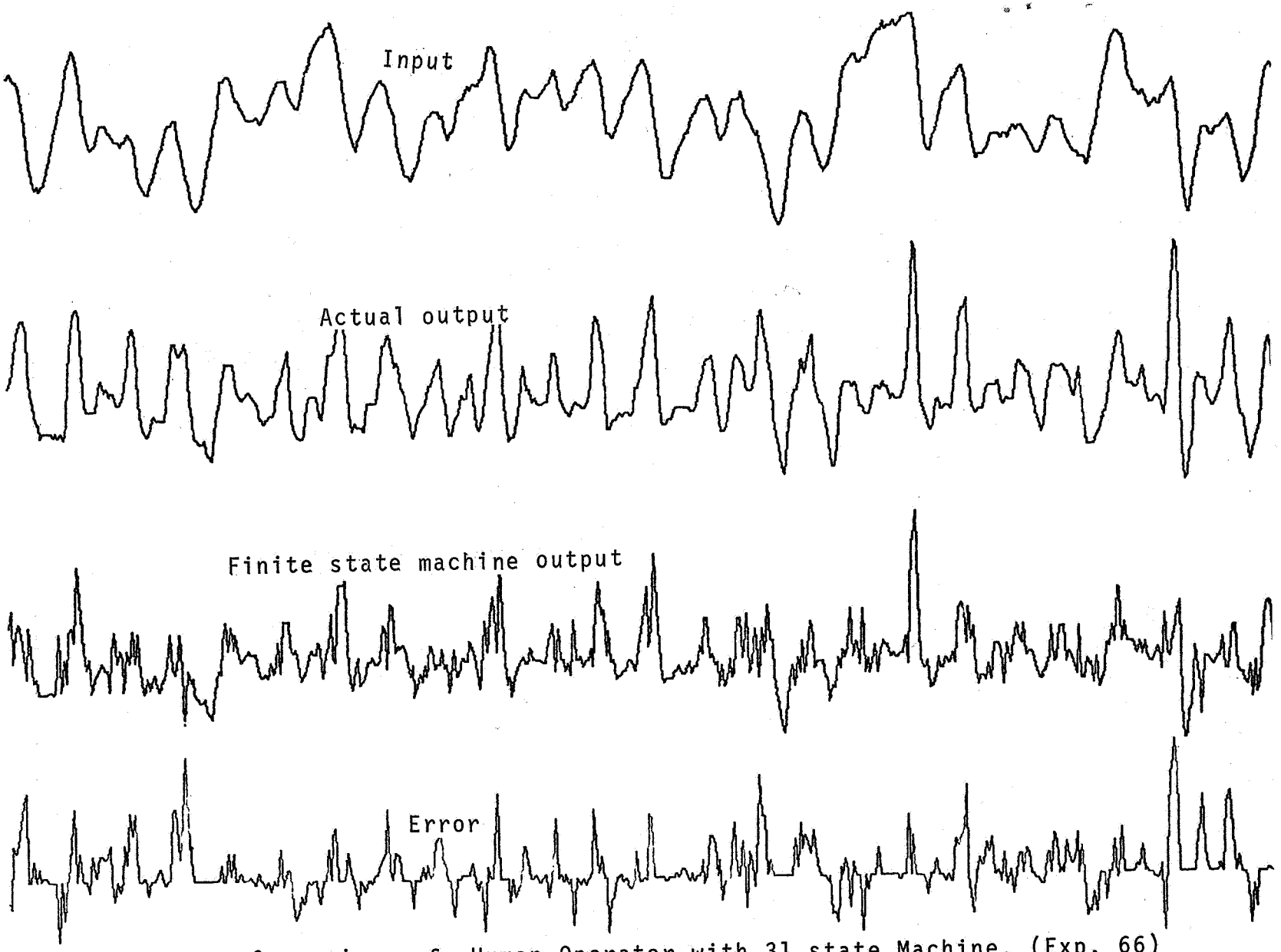


Fig. 65 Comparison of Human Operator with 31 state Machine. (Exp. 66)

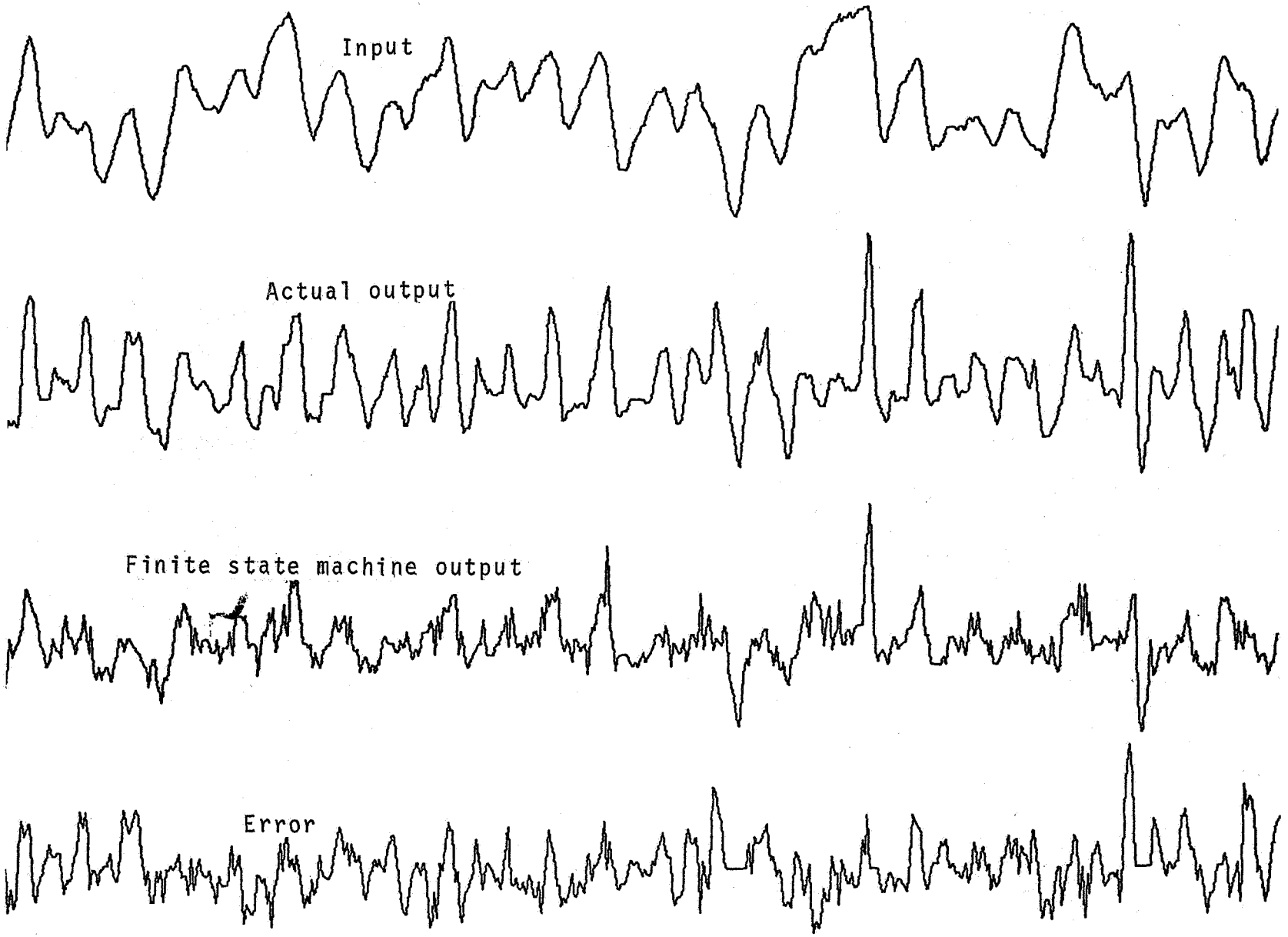


Fig. 66 Comparison of human operator with 15 state machine (Exp. 67)

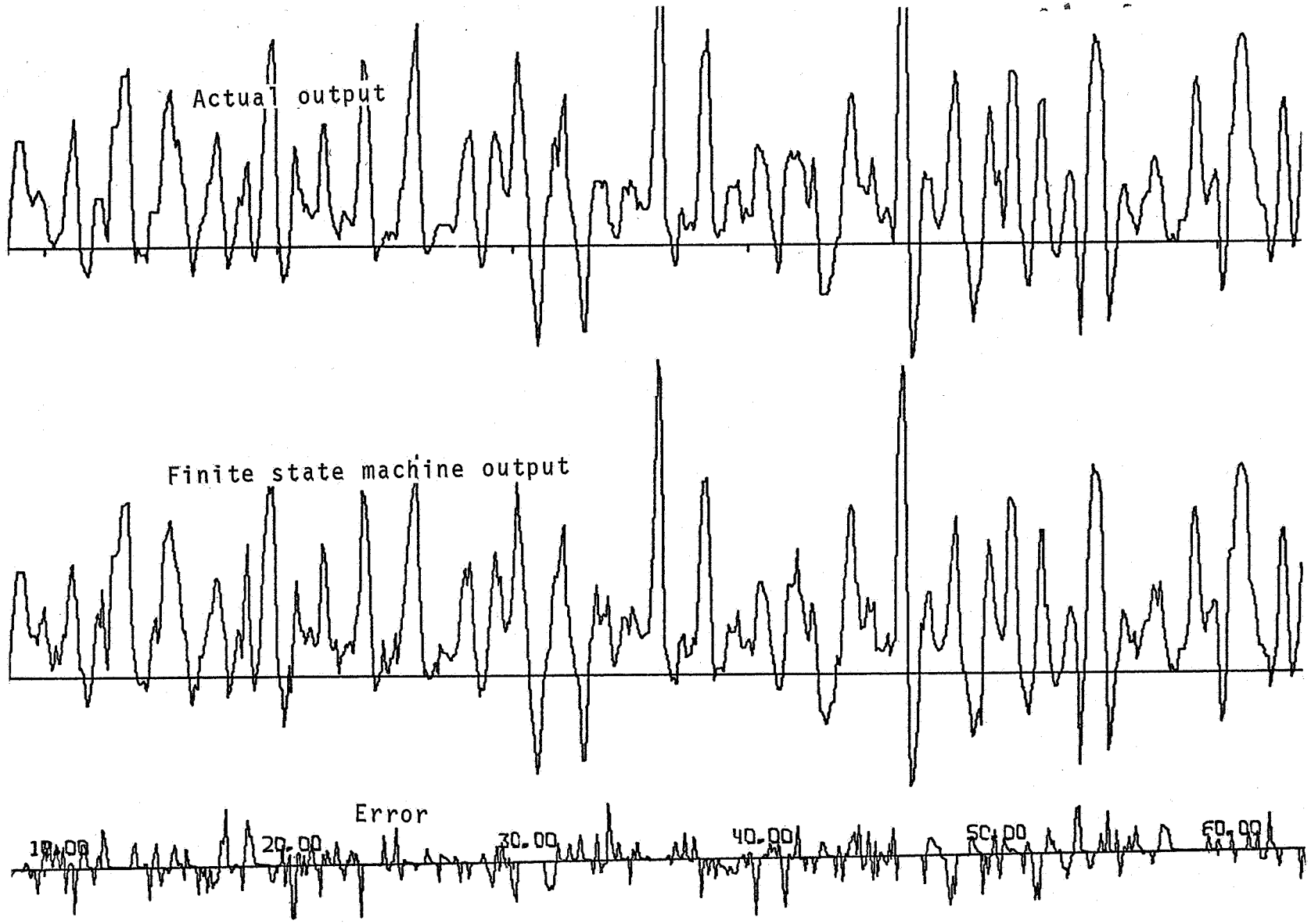


Fig. 67 Comparison of Human Operator with 64 state 64 symbol alphabet machine. (Exp.68)

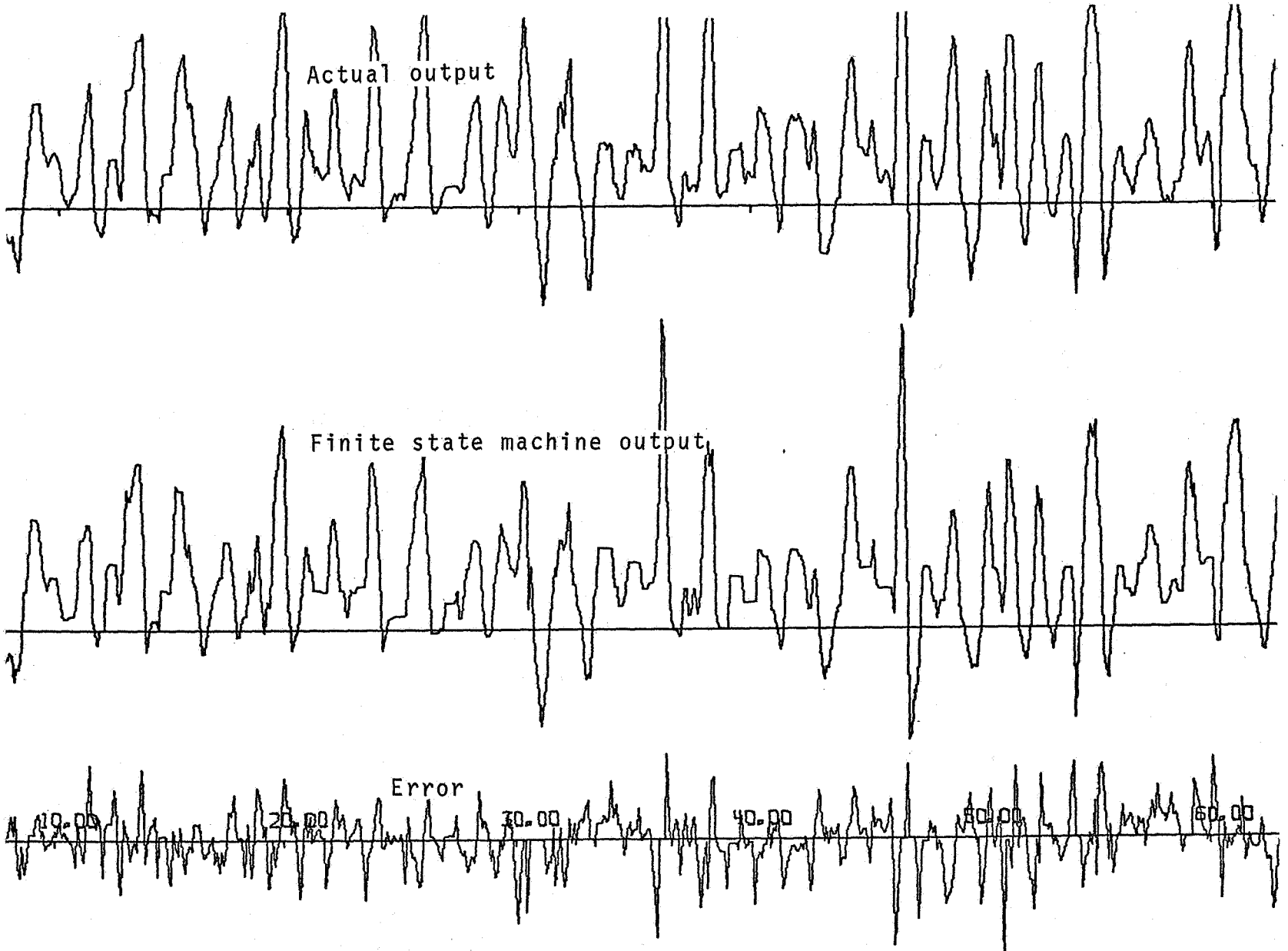


Fig. 68 Comparison of Human Operator with 16 state 16 symbol alphabet machine. (Exp. 69)

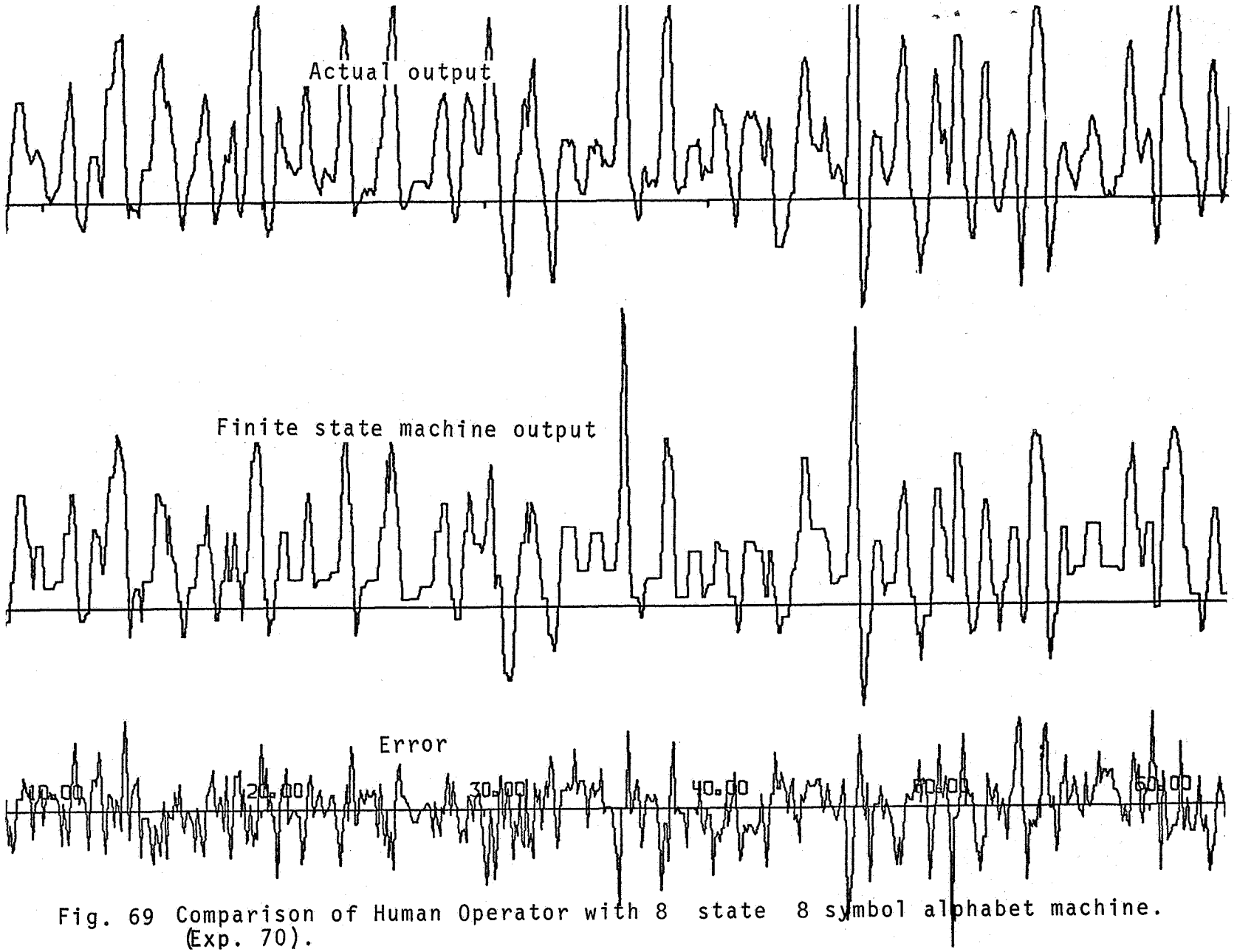


Fig. 69 Comparison of Human Operator with 8 state 8 symbol alphabet machine. (Exp. 70).

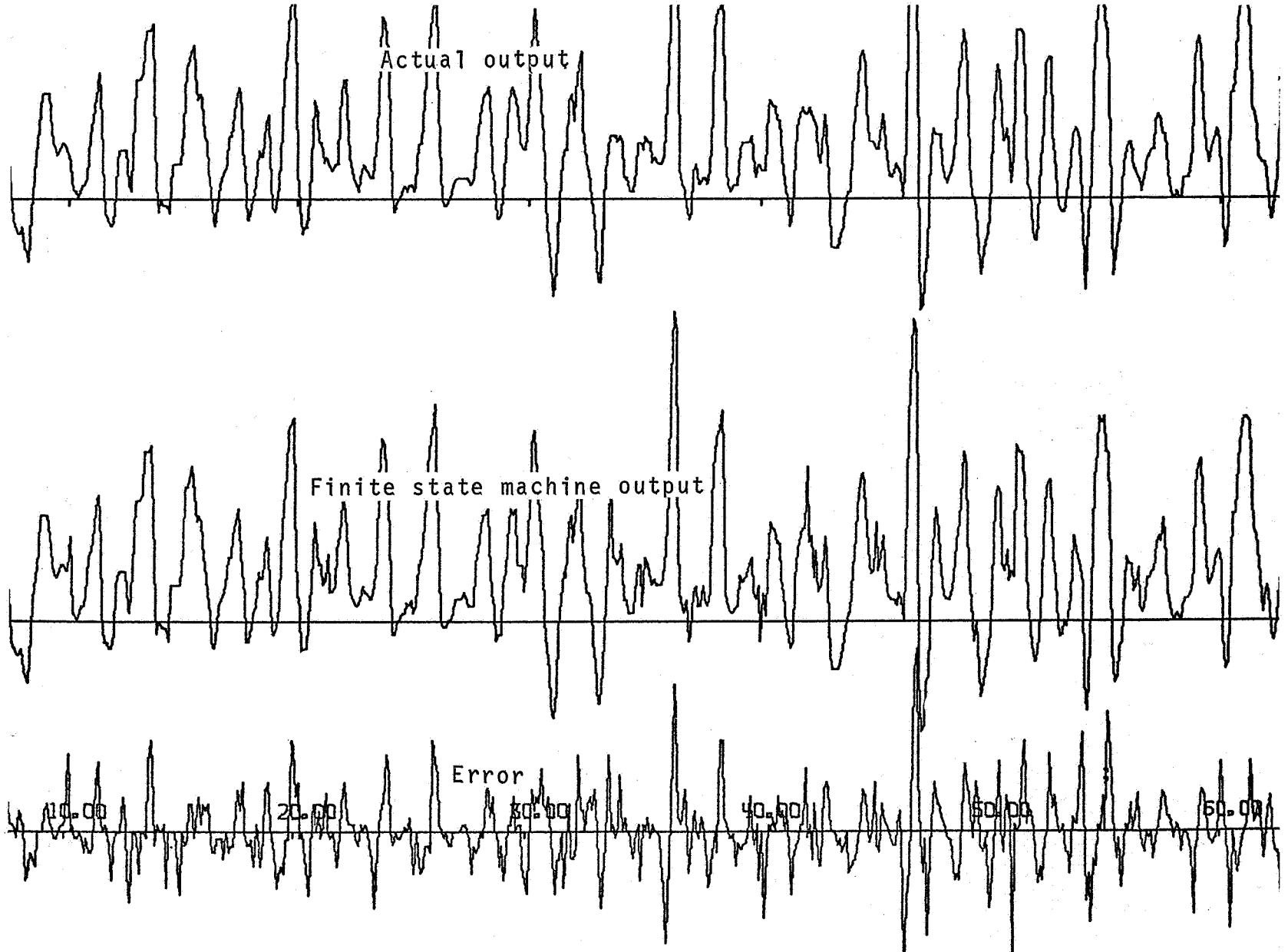


Fig. 70 Comparison of Human Operator with Current Recall (Exp. 71).

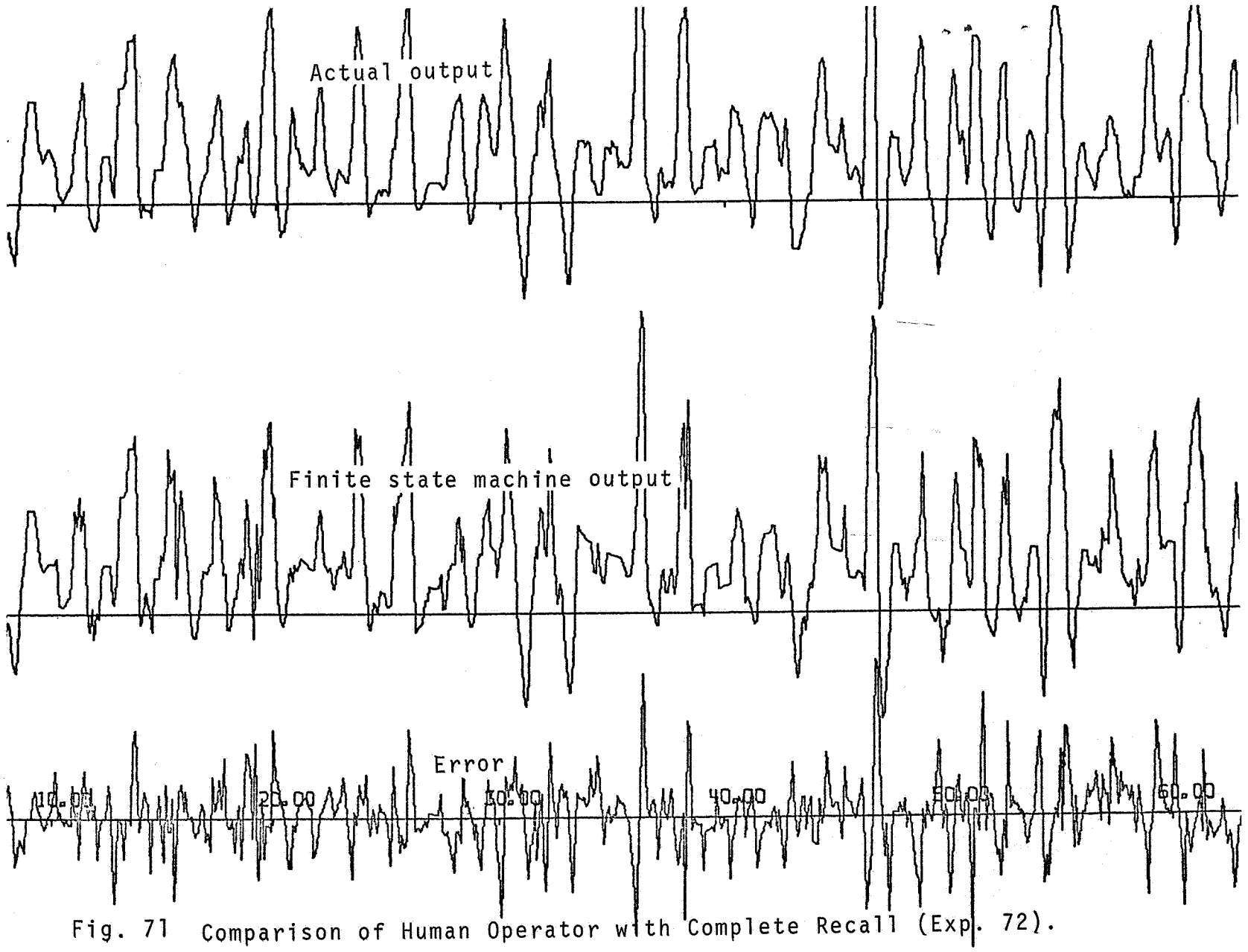


Fig. 71 Comparison of Human Operator with Complete Recall (Exp. 72).

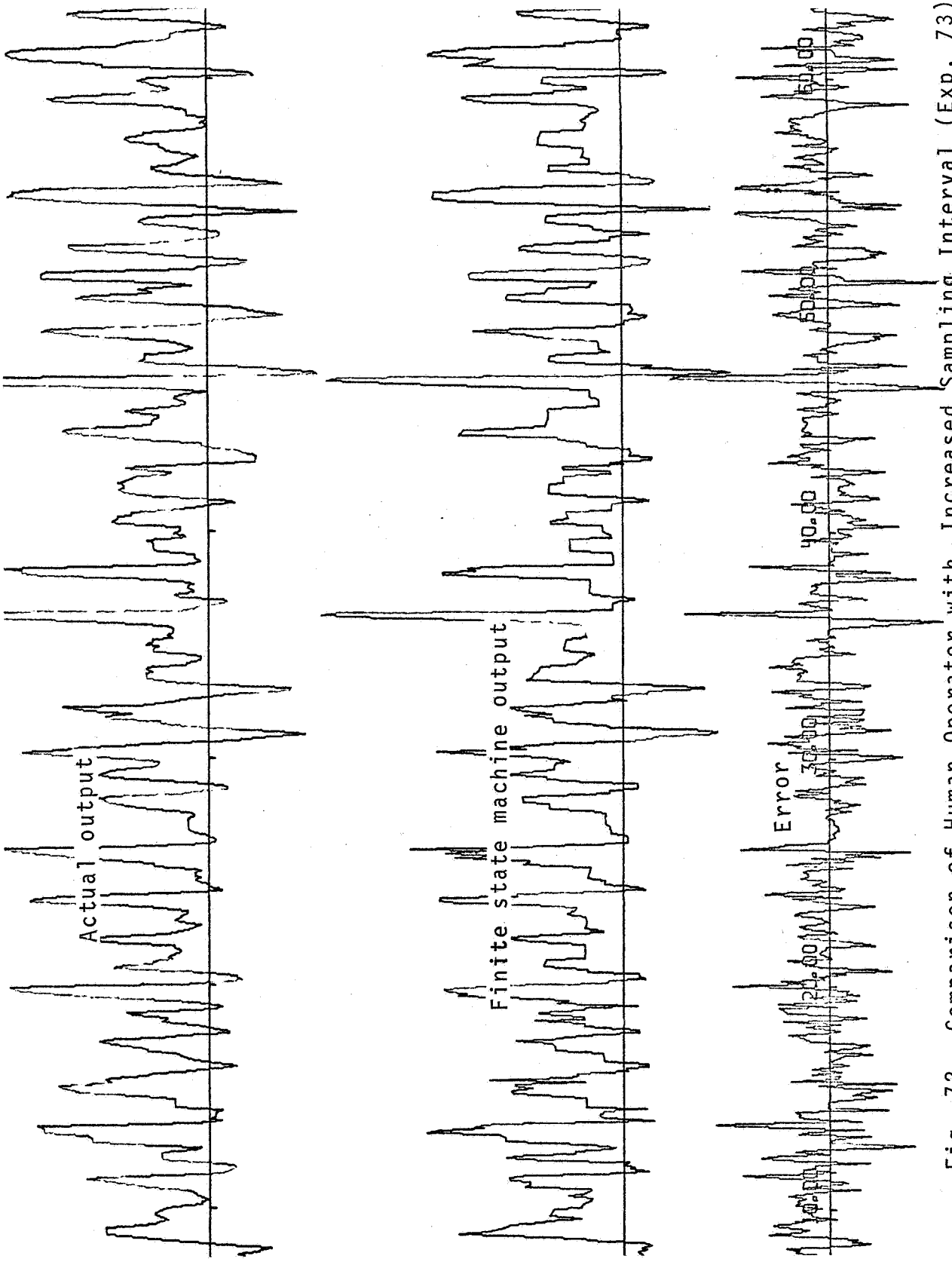


Fig. 72 Comparison of Human Operator with Increased Sampling Interval (Exp. 73).

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