AR-009-262

DSTO-TN-0010

Vibration Test on a Nomad N24A Aircraft Fitted with One Modified Aileron

P.A. Farrell, S.A. Dunn and C.D. Rider

DEPARTMENT OF DEFENCE

DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION

Vibration Test on a Nomad N24A Aircraft Fitted with One Modified Aileron

P.A. Farrell, S.A. Dunn and C.D. Rider

Airframes and Engines Division
Aeronautical and Maritime Research Laboratory

DSTO-TN-0010

ABSTRACT

Following doubt raised about the loads experienced on the flap and aileron of Nomad aircraft in flight, a flight test program was formulated to measure these loads. An aileron fitted with strain gauges and the associated wiring was installed on a Nomad N24A aircraft but this rendered the aircraft non-standard. To verify the aeroelastic stability of the aircraft when fitted with the instrumented aileron, a flight flutter trial was proposed. An abbreviated Ground Vibration Test (GVT) was conducted on the aircraft to support the flutter trial, and this report describes the GVT and presents the results.

Approved for public release

DEPARTMENT OF DEFENCE

DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION

Published by

DSTO Aeronautical and Maritime Research Laboratory
PO Box 4331
Melbourne Victoria 3001 Australia

Telephone: (03) 626 7000
Fax: (03) 626 7999

AR No. 009-262
June 1995

APPROVED FOR PUBLIC RELEASE

Vibration Test on a Nomad N24A Aircraft Fitted with One Modified Aileron

EXECUTIVE SUMMARY

Following an accident to Nomad A18-403 at RAAF Base Tindal on 17 September 1991, doubts were raised as to the adequacy of the Nomad ailerons to cope with the loads experienced in flight. Subsequent structural tests at AMRL showed that the ailerons were more than adequate for the theoretically-determined loads used by the manufacturer, Government Aircraft Factory (GAF), in the design of the aileron. However the aileron had failed at Tindal, so one possible explanation was that the flight loads experienced by the aileron were much higher than the design loads. Consequently the decision was made to initiate a flight test program to measure the flight loads acting on the aileron.

To this end an aileron was instrumented with strain gauges and associated wire looming, and calibrated at AMRL to measure loads; however the addition of the strain gauges and wiring to the aileron rendered it non-standard in terms of mass distribution, necessitating an evaluation of the effect of this modification on the flutter characteristics of the aircraft. The first step in this evaluation process is to conduct a Ground Vibration Test (GVT) wherein the natural frequencies and mode shapes of important structural modes are measured whilst the aircraft is on the ground. Such a test provides essential data to be used in the planning of a subsequent flight flutter trial and in interpreting its results.

This report describes the GVT carried out on Nomad A18-407, fitted with the instrumented aileron, at Edinburgh RAAF Base over the period 1-3 February 1995, and presents the results.

Contents

List of Tables

List of Figures

1. Introduction

Under Task 0154 ARDU is about to conduct a series of flight trials designed to measure the loads acting on a Nomad aileron during various manoeuvres at different flight conditions. To this end the starboard aileron on an ARDU Nomad aircraft has been replaced with one fitted with a number of strain gauges and associated wiring. Since this fitment renders the aircraft non-standard, a short vibration test was conducted on it prior to the flight trials. The purpose of this test was to provide information on the dynamic characteristics of the wing/aileron combination, to assist in the interpretation of data to be gathered during the planned flight trial. In particular the specific aims of the test were:

a) to demonstrate that the instrumented aileron has the same dynamic behaviour in the frequency range of interest (i.e. < 25 Hz) as the uninstrumented aileron

b) to determine the variation, if any, in the natural frequency of the fundamental wing bending and torsion modes with flap extension.

c) to determine which of the aileron strain gauges are most suitable for monitoring the dynamic behaviour of the aileron in the modes of interest

d) to determine the numerical relationships between the outputs of the selected strain gauges and the measured acceleration of the aileron when the wing was excited in various natural modes.

It was not the purpose of the test to determine the aeroelastic stability of the aircraft when fitted with the instrumented aileron.

2. Test Methodology

To satisfy these requirements it was not necessary to conduct a formal Ground Vibration Test (GVT) as would normally be conducted to obtain data for a structural model of the aircraft (Reference 1). Instead a simpler support system and a much reduced instrumentation set were adequate (Figure 1).

To obtain the first estimates of the aircraft natural frequencies it was excited by random input from an electromagnetic shaker attached to the aircraft at each of the first two locations listed in Table 1, and the response measured at each of the accelerometer locations listed in Table 2. The initial estimates of natural frequency were then determined from the transfer functions between each response and each force. A typical transfer function is shown in Figure 2.

Having obtained these initial estimates, four electromagnetic shakers were attached to the aircraft at the four locations listed in Table 1, and the frequency and force levels of sinusoidal excitation varied until an approximately monophase response, in quadrature to the excitation, was obtained at the "tuning" accelerometer locations (Table 2). The complex response of the structure was then measured by moving a single accelerometer to each of the "measuring" stations listed in Table 3. The normal mode was taken as the quadrature component of the measured response. No attempt was made to symmetrise the resulting mode shape.

An attempt was made to tune the mode at each of the peaks found in the transfer functions; however some modes involved large deformation of other sections of the aircraft (e.g. tailplane), and wing shakers alone were insufficient to tune the mode well. The inability to tune modes of other parts of the aircraft was not significant in the context of this test which was focused on wing/aileron behaviour.

Mode shapes and natural frequencies were measured with the flaps at both 0 and 38 degree settings.

3. Test Aircraft

The test was carried out at Edinburgh RAAF Base, Salisbury, South Australia, over the period 1-3 February 1995. The test aircraft was Nomad N24A-142, designated A18-407 by the ADF, and its modification status is given in Annex A. It was supported on its partially deflated tyres to lower the rigid body natural frequencies; however the geometry of its undercarriage is such that the rigid body modes are coupled. The highest frequency symmetric and anti-symmetric rigid body modes were measured to be:

symmetric (heave/pitch)	1.4 Hz
antisymmetric (roll/yaw)	2.6 Hz

The aircraft contained 1100lb of fuel held in the wing tanks (G99 tanks were not fitted). The control wheel was restrained in roll at the pilot's position to inhibit free rotation of the ailerons.

4. Natural Frequencies and Modes

A. Flap angle - 0 degrees

At zero flap angle, a total of nine modes were isolated, five symmetric and four antisymmetric. The modes isolated were:
Symmetric

1	Wing bending	6.6 Hz
2	Wing bending	8.8 Hz
3	Wing/tailplane bending	13.7 Hz
4	Tailplane bending	15.5 Hz
5	Aileron bending	23.6 Hz

Antisymmetric

6	Wing bending	6.8 Hz
7	Wing bending	10.5 Hz
8	Wing torsion	19.6 Hz
9	Aileron bending	22.4 Hz

The corresponding mode shapes are shown in Figures 3a to 3i.

B. Flap angle - 38 degrees

The flaps were lowered to 38 degrees and the following modes were then isolated:

Symmetric

10	Wing bending	6.7 Hz
11	Wing bending	8.8 Hz
12	Tailplane bending	15.7 Hz
13	Aileron bending / forward flap	19.6 Hz
14	Aileron bending / spoiler	21.4 Hz

Antisymmetric

15	Wing bending	6.5 Hz
16	Wing bending	10.0 Hz
17	Wing torsion	18.5 Hz
18	Aileron bending	21.0 Hz

The corresponding mode shapes are shown in Figures 3j to 3r.

5. Strain Gauge Outputs

This aircraft will be used in flight trials to measure aileron loads, so the aileron has been fitted with 15 strain gauges to measure bending torsion and shear at a number of locations. A further strain gauge has been fitted to the aileron actuator rod. The outputs of these 16 gauges will be recorded on an onboard recorder and as well as telemetered to a ground station. This system was energised during the vibration test of the aircraft at 38 degree flaps. While the wings were being excited in each of the relevant modes (modes 10 to 18 above), the output of each of the strain gauges was recorded on the onboard recorder. The output of each strain gauge was then compared which the acceleration measured at station 1E (Table 3).

The response of some of the strain gauges was less than a single quantisation step (count) of the ADC in the onboard data acquisition system. Table 4 shows the amplitude of the response of each data channel (in counts) when the aircraft was excited in each of the modes 10 to 18. For those gauges which were sensitive to deformation in the excited modes, a least squares process was used to obtain the amplitude of the response at the frequency of excitation for comparison with acceleration measures at station 1E. The resulting transfer functions for these gauges (in units of volts per g) are given in Table 5.

6. Results and Discussion

Natural frequencies and mode shapes were determined for the aircraft at two flap settings. Although excitation was applied only at the wing tips, some modes involved significant motion of other parts of the airframe; for example, modes 3 and 4 involved large tailplane deformations. In these cases the modes were less well isolated than when the mode involved basically only wing motion. Despite this, sufficient modes were tuned to enable a comparison of the dynamic characteristics of the port (standard) and starboard (instrumented) ailerons.

The array of measuring stations listed in Table 3 is a symmetric distribution on the port and starboard wings/ailerons. The numeral in their designation indicates the spanwise position, whereas the letter indicates the chordwise position. The stations marked 1 are near the starboard wing tip, while those marked 6 are in the symmetric position on the port wing. Similarly 2 and 5 indicate stations roughly mid-span of the aileron on the starboard and port sides respectively, while 3 and 4 indicate stations near the aileron inboard hinge, port and starboard respectively. The letter A indicates the wing front spar, B the wing rear spar, C the forward flap, D the aileron spar, and E the aileron trailing edge. All measurements were taken normal to the local surface.

The measured mode shapes (Figure 3) show a high degree of symmetry between the port and starboard sides, including the aileron motion. The aileron motion in each of the 18 measured modes is in general symmetric in terms of deformation, nodal position, and sense of rotation relative to the local wing motion. The amplitude of aileron motion on the port and starboard sides was not always equal as the applied forces were not always symmetrically balanced. There are however two modes in which the aileron deformation does not appear symmetric, namely modes 1 and 11. In both these modes the amplitude at the inboard end of the aileron trailing edge (measuring stations 3E and 4E) do not show the symmetry of the other measurements. However in both these cases it is the port (standard) aileron which has deformation inconsistent with that of adjacent modes, leading to the conclusion of experimental error in the measurement of the motion at the single point 4E in both modes.

Changing the flap angle from zero to 38 degrees did not in general have a great effect on the measured natural frequencies. The symmetric wing/tailplane bending mode (mode 3) measured at 13.7 Hz for zero flap, could not be tuned well enough at 38 degree flap to give a meaningful comparison. An interesting effect of flap extension was on the symmetric aileron bending mode (mode 5) measured at 23.6 Hz for zero flap. When the flap was extended this mode split into two, one involving aileron bending coupled with fore-and-aft motion of the forward flap (mode 13), the other being aileron bending coupled with spoiler rotation (mode 14). For the antisymmetric modes, the largest effect was on the two highest modes (modes 8 and 9), both of which dropped by about a hertz on flap extension.

Examination of the strain gauge counts in Table 4 shows that gauges 17.104 to 17.110, and gauge 17.115 are insensitive to deformation of the aileron in modes 10 to 18. The remaining gauges show reasonable sensitivity to deformation in the modes and are suitable for determining modal amplitude, using the transfer functions tabulated in Table 5; however the gains on these channels should be increased significantly.

7. Conclusions

a. The symmetry of the measured modes at both flap angles shows that the dynamic behaviour of the instrumented aileron is the same as that of the standard aileron in the frequency range up to 25 Hz.

b. The effect of flap extension on the measured natural frequencies is relatively small, with the greatest effect being a drop in frequency in the higher order modes.

c. The most suitable strain gauges for monitoring aileron motion are 17.111 and 17.202.

d. The numerical relationships between these strain gauge outputs as recorded on the onboard recorder, and the acceleration measured at station 1E is given in Table 5 for each of the modes 10 to 18, at the present gain settings.

8. Reference

1. Betty Emslie and P A Farrell. *Resonance test on N24 Nomad aircraft*. ARL/Struc Note 426, May 1976.

Annex A

Aircraft Modification Status

Aircraft Type G.A.F. Nomad Model N24A   Serial Number LS 142
Certificate of Type Approval 73-1

MODIFICATIONS INCORPORATED: N29, N64, N68, N108, N131, N207, N209, N220, N234, N237, N238, N261, N262, N263, N276, N286, N289, N290, N293, N294, N301, N307, N312, N313, N315, N316, N326, N331, N339, N345, N346, N354, N359, N361, N365, N366, N369, N373, N374, N376, N377, N385, N386, N389, N392, N393, N397, N398, N399, N400, N408, N411, N412, N415, N417, N419, N421, N422, N423, N426, N428, N430, N431, N435, N437, N439, N440, N443, N444, N447, N448, N452, N457, N458, N462, N463, N468, N470, N471, N475, N476, N477, N479, N481, N493, N495, N497, N502, N520, N521 Part, N522, N523, N524, N525, N527, N532, N535, N536, N537, N539, N540, N551, N553, N567, N568, N579.

Modifications incorporated by Engineering Notes: N354 to N339/G, N290 to N235/G, N301 to N245/G, N312 to N257/E, N316 to N254/G, N346 to N270/E, N373 to N364/B, N408 to N331/B.

CUSTOMER OPTIONS INCORPORATED: G9, G30A, G32-24, G44, R45, G46, G48FF, G50B, G65-24, G66, G68C, G70, G74, G75-24, G76-24, G83, G85, G86, G87, G206, G231A, G234, G240-24, G241, R246, G247, G278, G250, G251D, G252D, G288, G346B, G284.

Coordination Option: R1029

Service Bulletins Incorporated: SB.ANMD.61-4 and CEB 1111 Rev. 3

AIRWORTHINESS DIRECTIVES INCORPORATED DURING MANUFACTURE:

A.N.O. Part 105. AD/GENERAL/3A, AD/GENERAL/4B, AD/GENERAL/6A, AD/GENERAL/7E, AD/GENERAL/16B, AD/GENERAL/20, AD/GENERAL/31A, AD/GENERAL/33A, AD/GENERAL/37B, AD/GENERAL/38A, AD/GENERAL/51, AD/GENERAL/52, AD/GENERAL/54, AD/GENERAL/55B, AD/GENERAL/56A, AD/GAF-N22-2B, AD/GAF-N22-28B, AD/GAF-N22-31, AD/GAF-N22-42,

A.N.O. Part 106. AD/AL250-24C, AD/AL250-52 Amdt.1, AD/ENG-5.

A.N.O. Part 107. AD/ELECT-3A, AD/ELECT-26, AD/HOSE-2A, AD/HOSE-3 Amdt 2, AD/RADIO-21, AD/PROP-1 Amdt 2.

Table 1. Shaker locations

Shaker designation	Location
PLE	port wing tip, front spar
SLE	starboard wing tip, front spar
PTE	port wing tip, rear spar
STE	starboard wing tip, rear spar

Table 2. Location of "tuning" accelerometers

Accelerometer designation	Location
PLE	port wing tip, front spar
SLE	starboard wing tip, front spar
PTE	port wing tip, rear spar
STE	starboard wing tip, rear spar
PAIL	port aileron tip, spar
SAIL	starboard aileron tip, spar

Table 3. Location of measuring stations.

Station designation	Distance inboard from starboard wing tip (mm)	Distance aft of wing leading edge (mm)
1A	20	280
1B	20	1060
1C	20	1250
1D	20	1500
1E	20	1840
2A	1885	280
2B	1885	1060
2C	1885	1250
2D	1885	1500
2E	1885	1840
3A	2940	280
3B	2940	1060
3C	2940	1250
3D	2940	1500
3E	2940	1840
4A	13580	280
4B	13580	1060
4C	13580	1250
4D	13580	1500
4E	13580	1840
5A	14635	280
5B	14635	1060
5C	14635	1250
5D	14635	1500
5E	14635	1840
6A	16500	280
6B	16500	1060
6C	16500	1250
6D	16500	1500
6E	16500	1840

Table 4. Amplitude of response (in counts) of aileron strain gauges.

Strain gauge	Mode 10	Mode 11	Mode 12	Mode 13	Mode 14	Mode 15	Mode 16	Mode 17	Mode 18
17.101	-	8	5	9	8	3	5	10	9
17.102	1	7	5	9	8	3	5	10	9
17.103	-	3	2	4	4	<1	2	4	4
17.104	-	<1	<1	<1	<1	-	-	<1	1
17.105	-	-	<1	<1	<1	<1	<1	<1	<1
17.106	-	-	-	-	-	-	-	-	-
17.107	-	-	-	-	-	-	-	-	-
17.108	-	<1	<1	<1	<1	<1	-	<1	<1
17.109	-	-	-	-	-	-	-	-	-
17.110	-	-	-	-	-	-	-	-	-
17.111	2	16	12	22	15	3	14	22	10
17.112	4	10	7	6	5	3	5	8	7
17.113	4	10	6	7	5	2	5	8	5
17.114	5	11	7	6	4	2	5	7	5
17.115	<1	<1	-	1	1	-	<1	1	1
17.202	6	15	4	5	4	3	7	5	1

where - indicates a signal too small to evaluate

Table 5. Transfer functions (V/g) of the more responsive gauges relative to the acceleration at measurement station 1E.

Strain gauge	Mode 10	Mode 11	Mode 12	Mode 13	Mode 14	Mode 15	Mode 16	Mode 17	Mode 18
17.101	-	1.068	0.421	0.465	0.345	0.498	0.526	0.466	0.335
17.102	0.256	0.940	0.421	0.465	0.332	0.498	0.526	0.466	0.312
17.103	-	0.367	0.134	0.209	0.166	0.077	0.149	0.192	0.156
17.111	0.099	0.419	0.184	0.209	0.112	0.072	0.240	0.178	0.067
17.112	0.164	0.256	0.105	0.056	0.042	0.077	0.085	0.067	0.048
17.113	0.145	0.252	0.097	0.067	0.036	0.050	0.091	0.066	0.030
17.114	0.171	0.256	0.105	0.054	0.029	0.054	0.088	0.054	0.031
17.202	0.256	0.372	0.071	0.048	0.028	0.086	0.117	0.044	0.009

Figure 1. General view of test

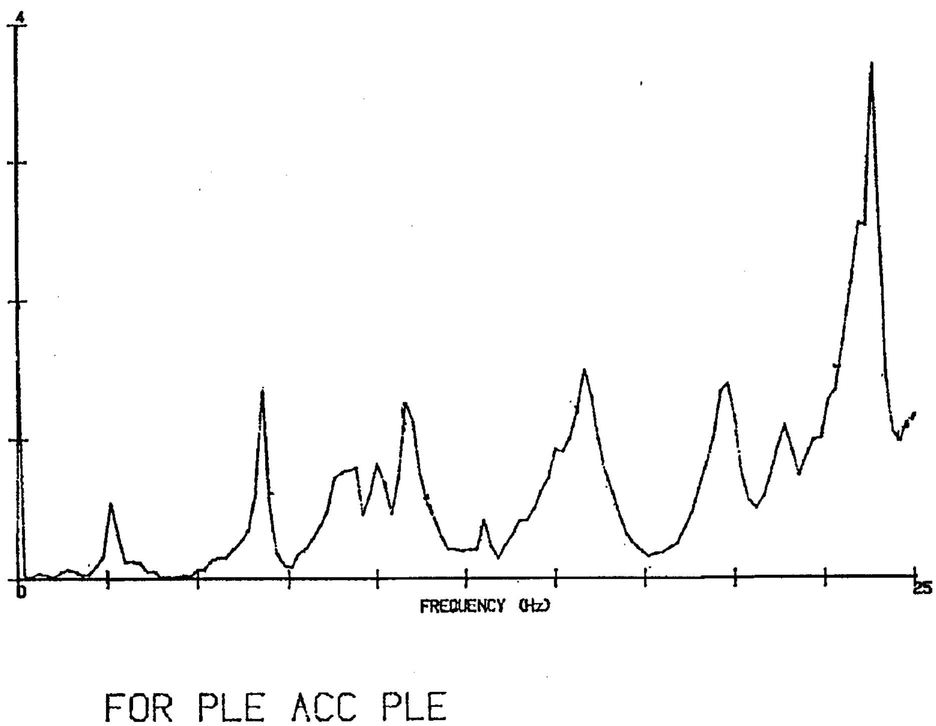

Figure 2. Typical measured Transfer Function

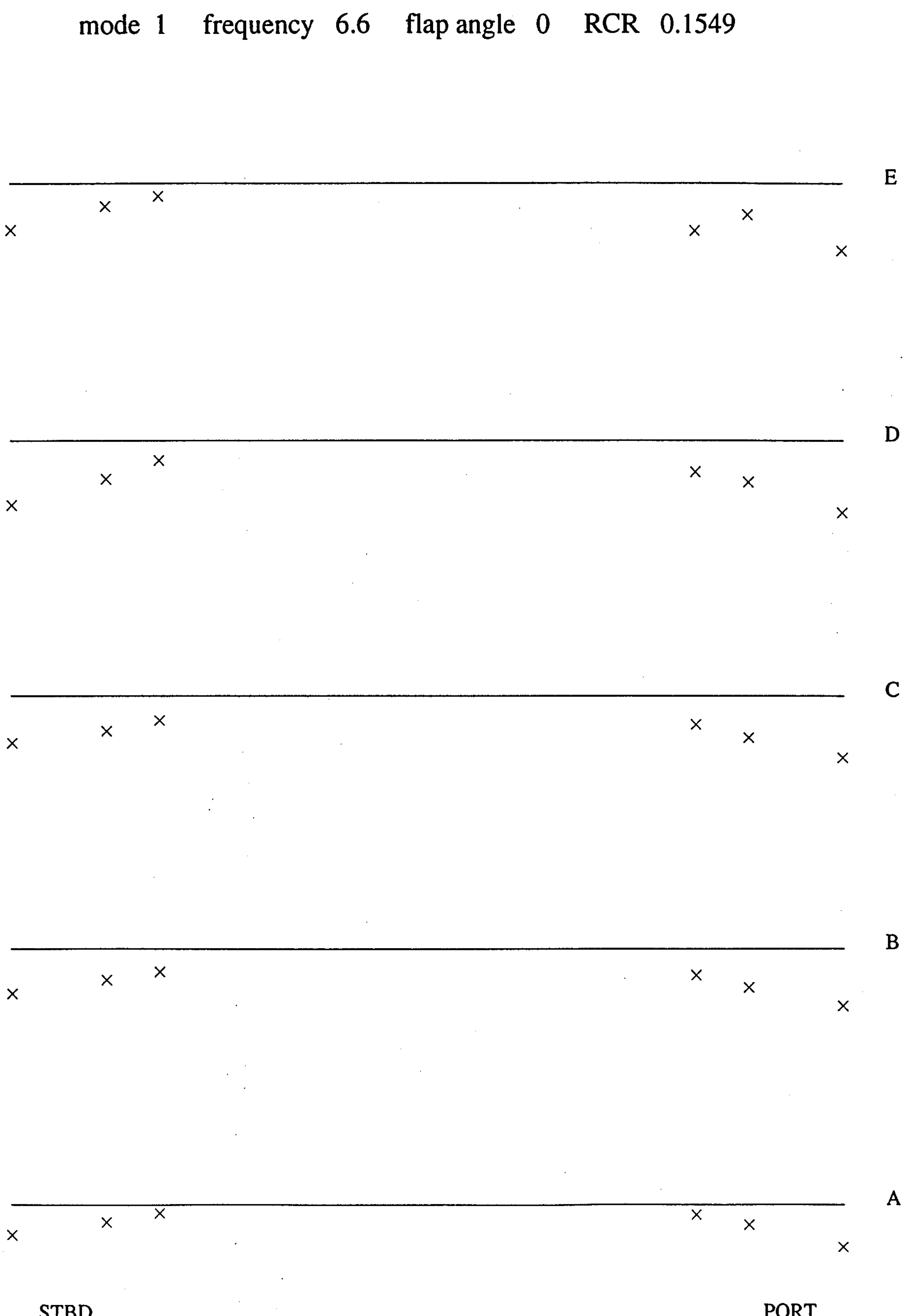

Figure 3a. Measured mode shape

mode 2 frequency 8.8 flap angle 0 RCR 0.1630

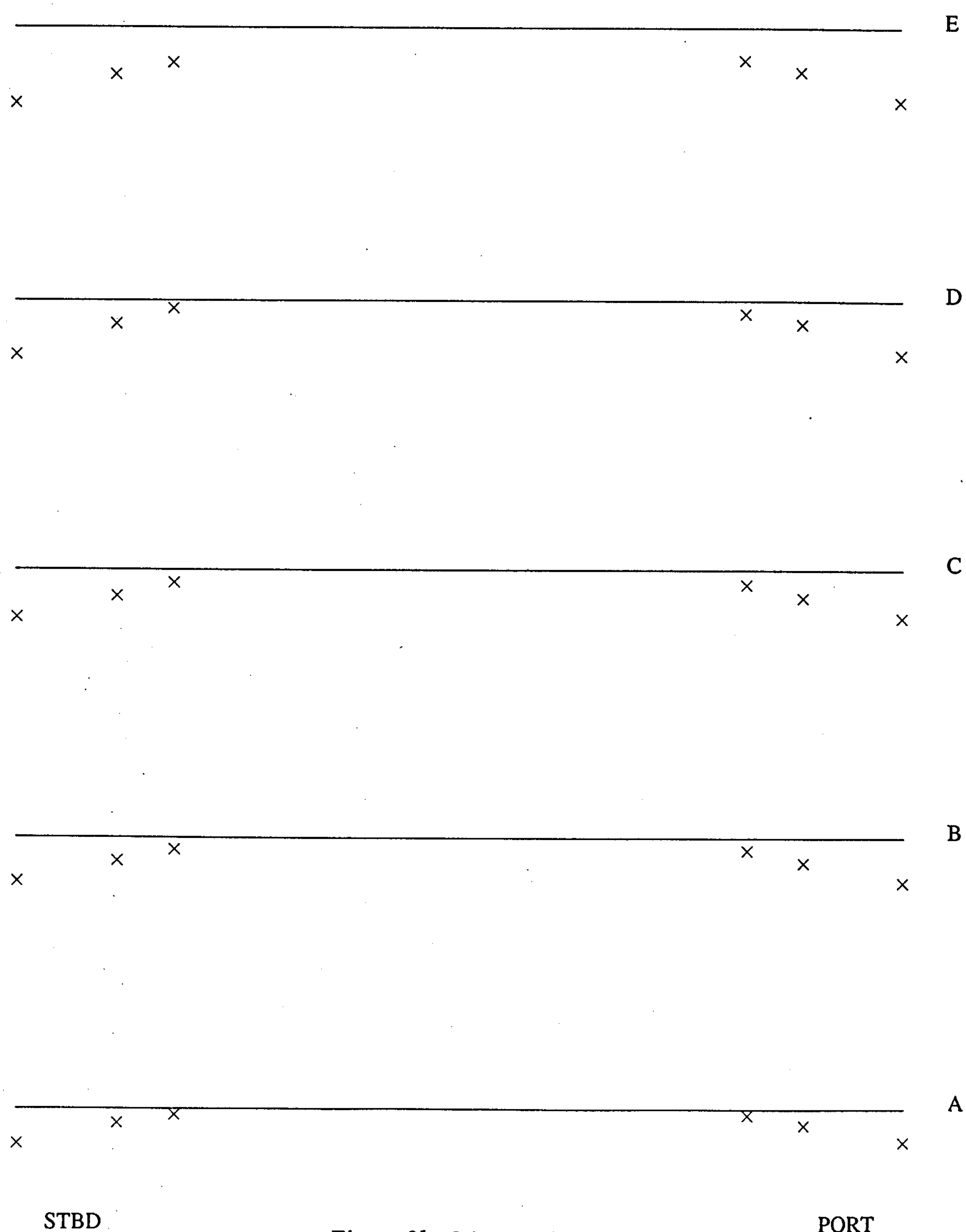

Figure 3b. Measured mode shape

mode 3 frequency 13.7 flap angle 0 RCR 1.3330

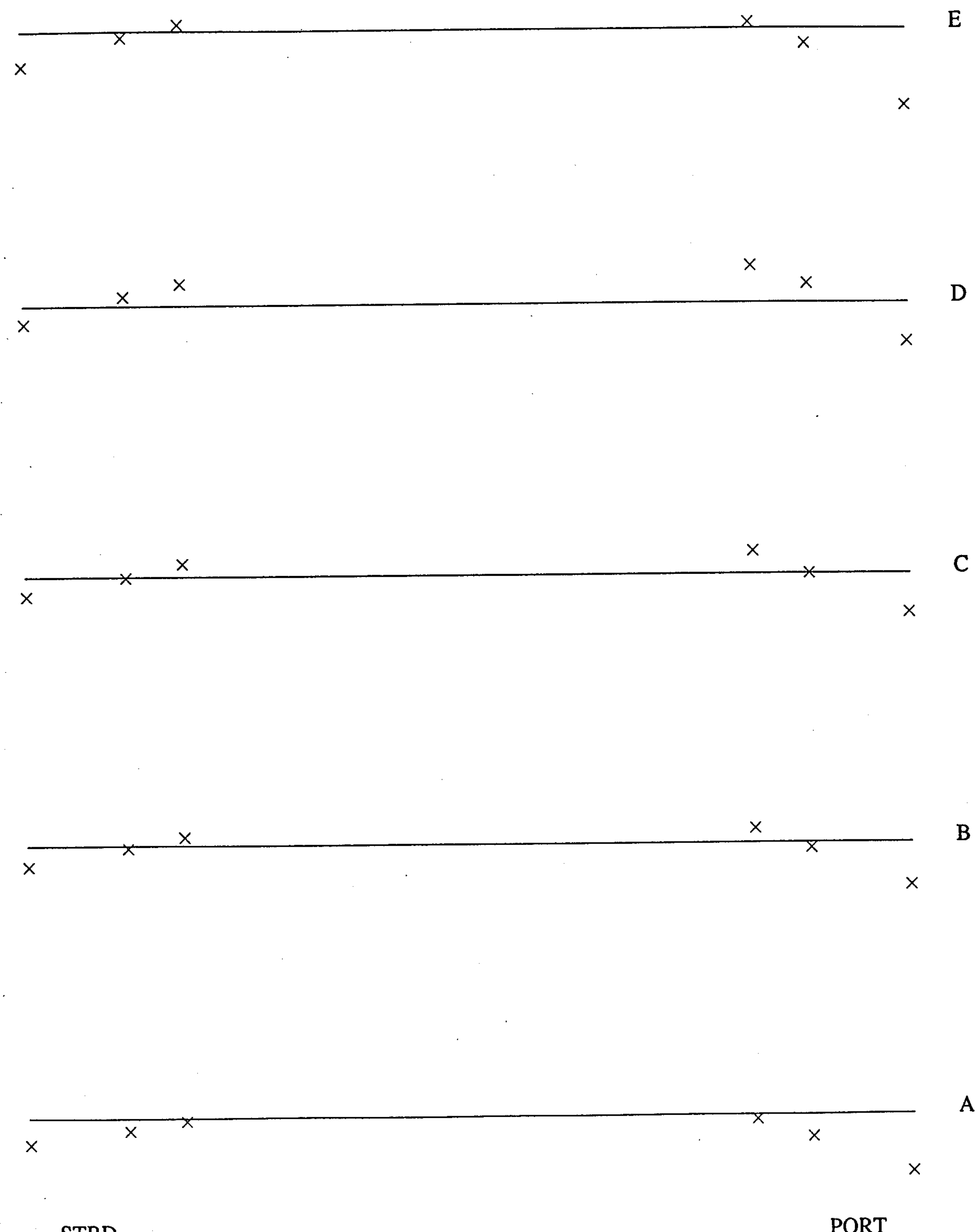

Figure 3c. Measured mode shape

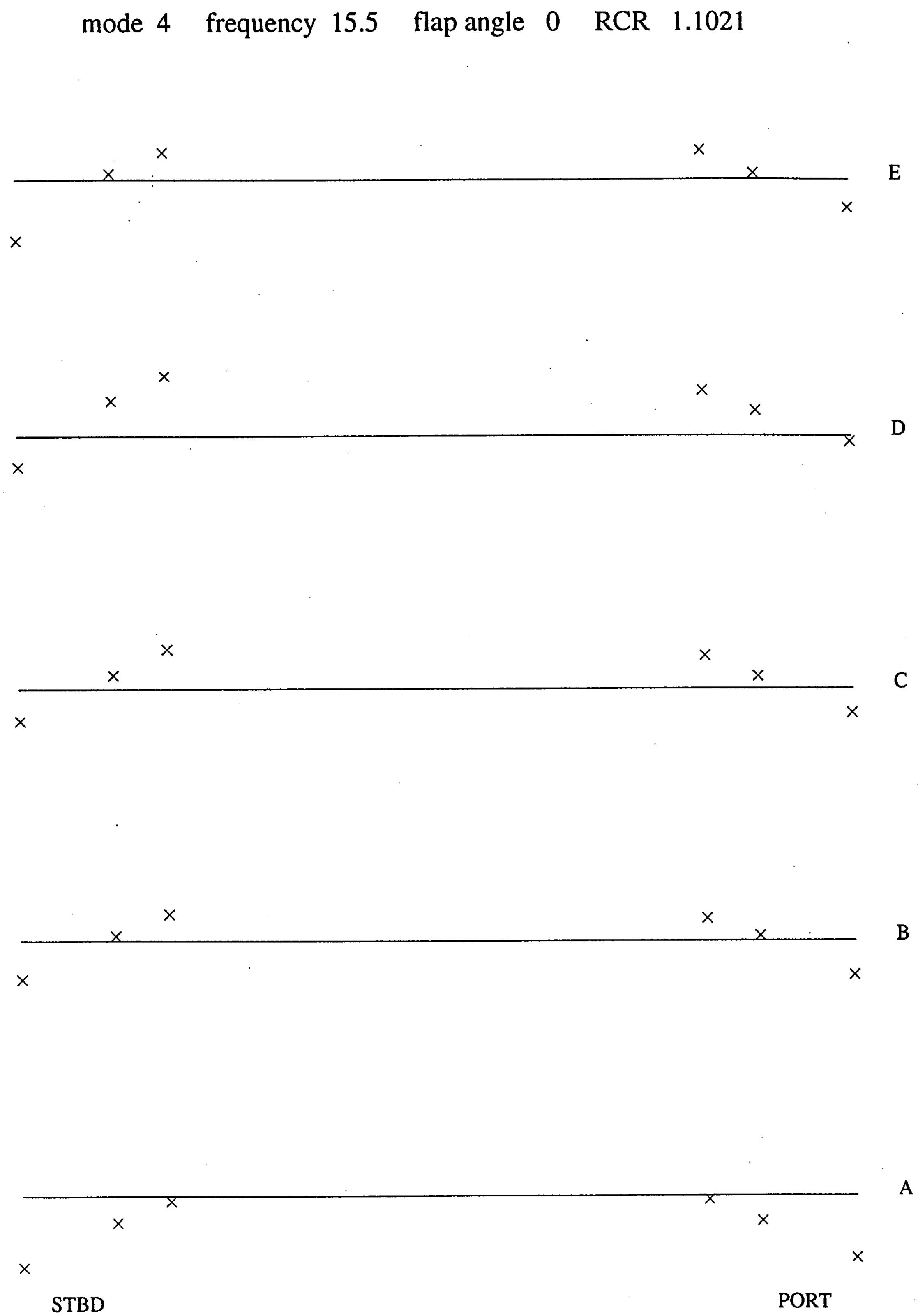

Figure 3d. Measured mode shape

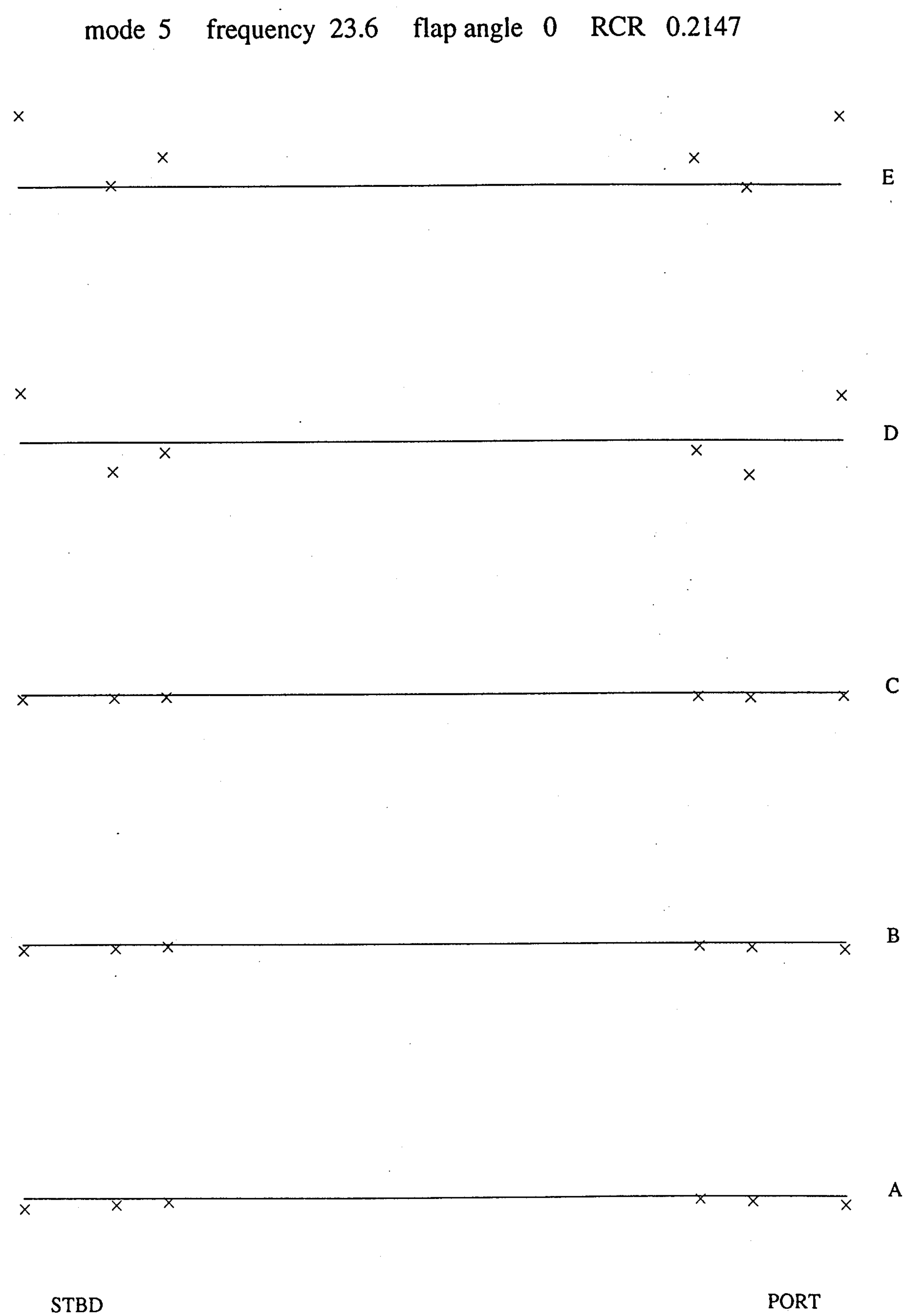

Figure 3e. Measured mode shape

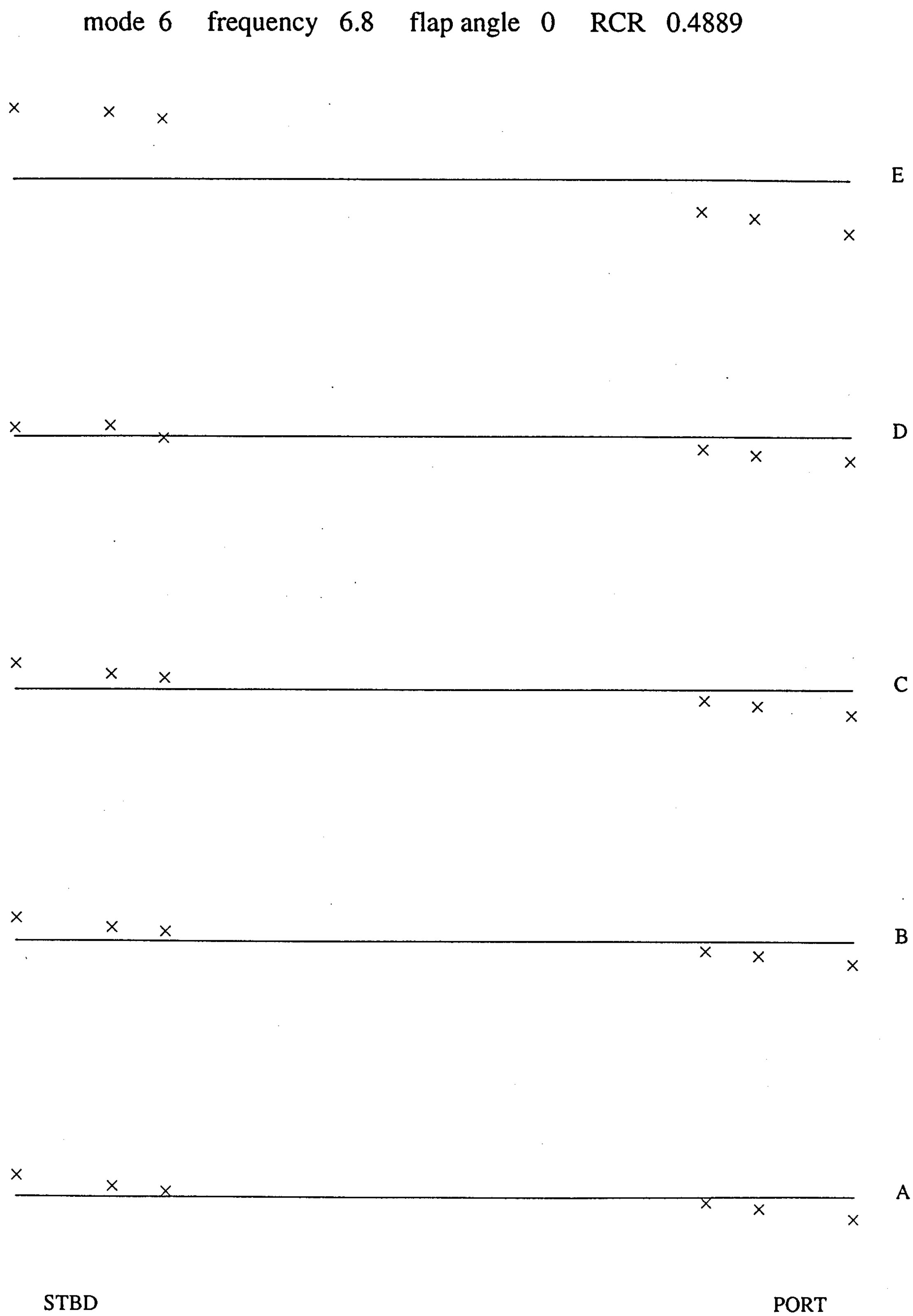

Figure 3f. Measured mode shape

mode 7 frequency 10.5 flap angle 0 RCR 0.1545

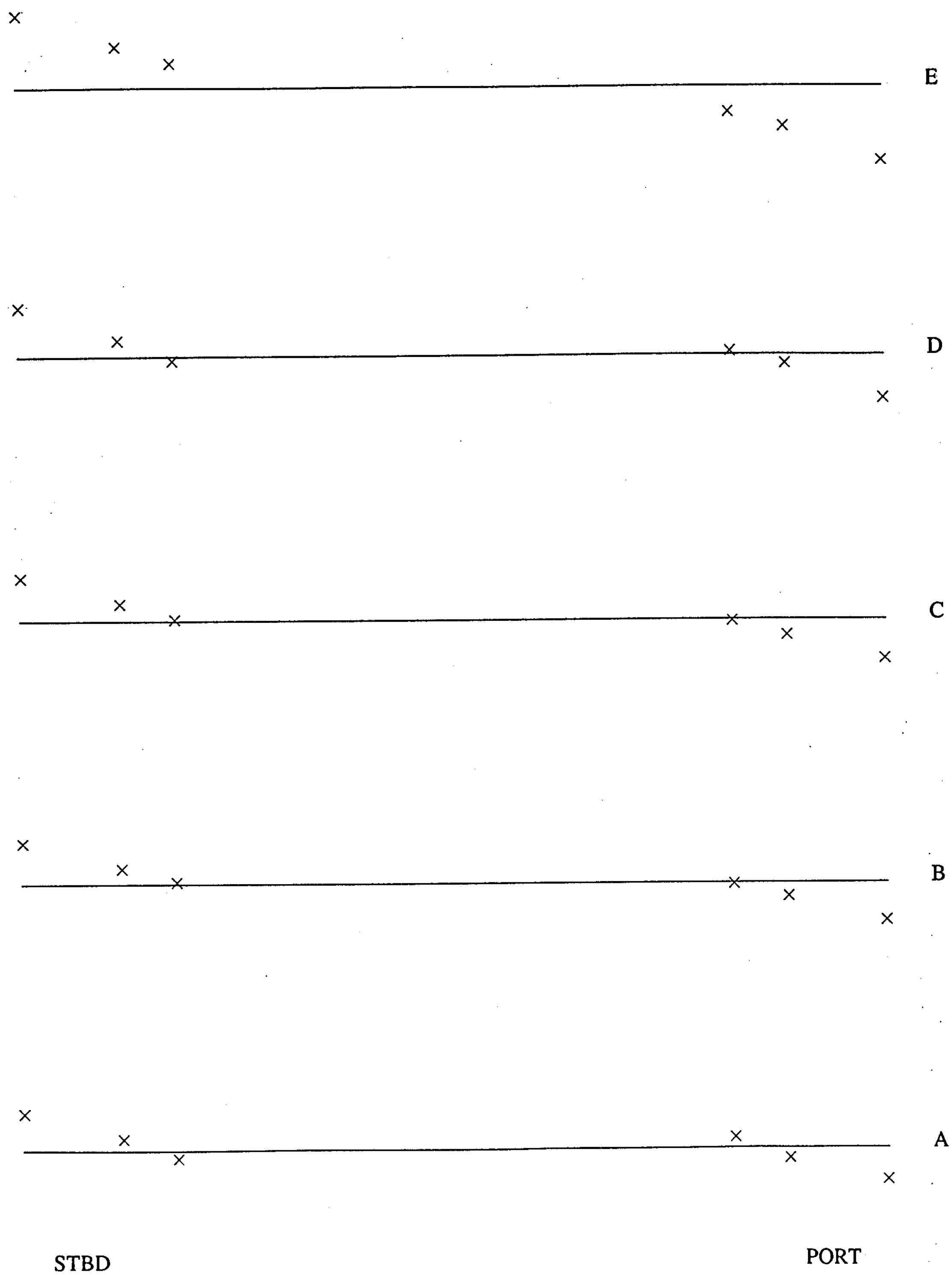

Figure 3g. Measured mode shape

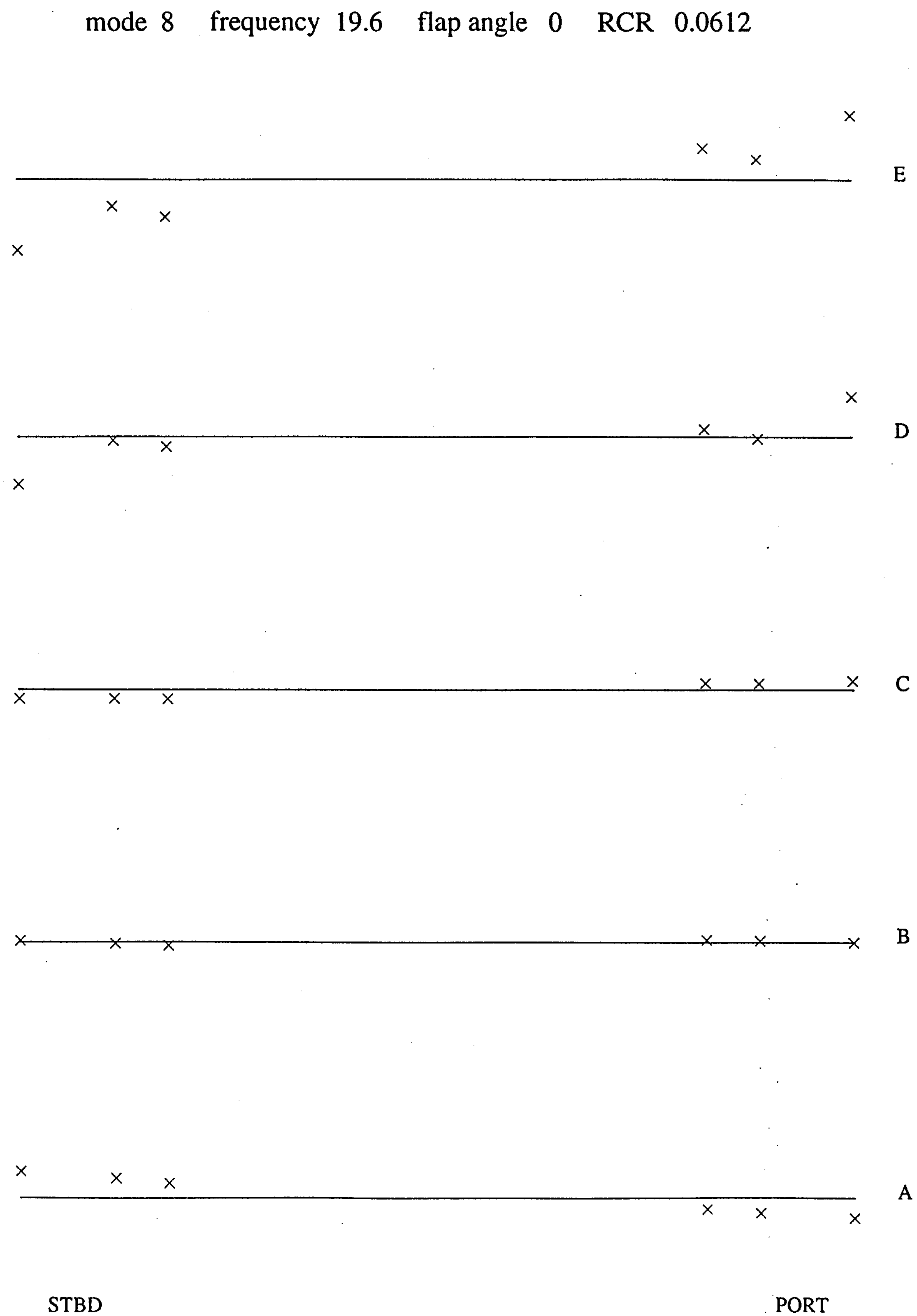

Figure 3h. Measured mode shape

mode 9 frequency 22.4 flap angle 0 RCR 0.2114

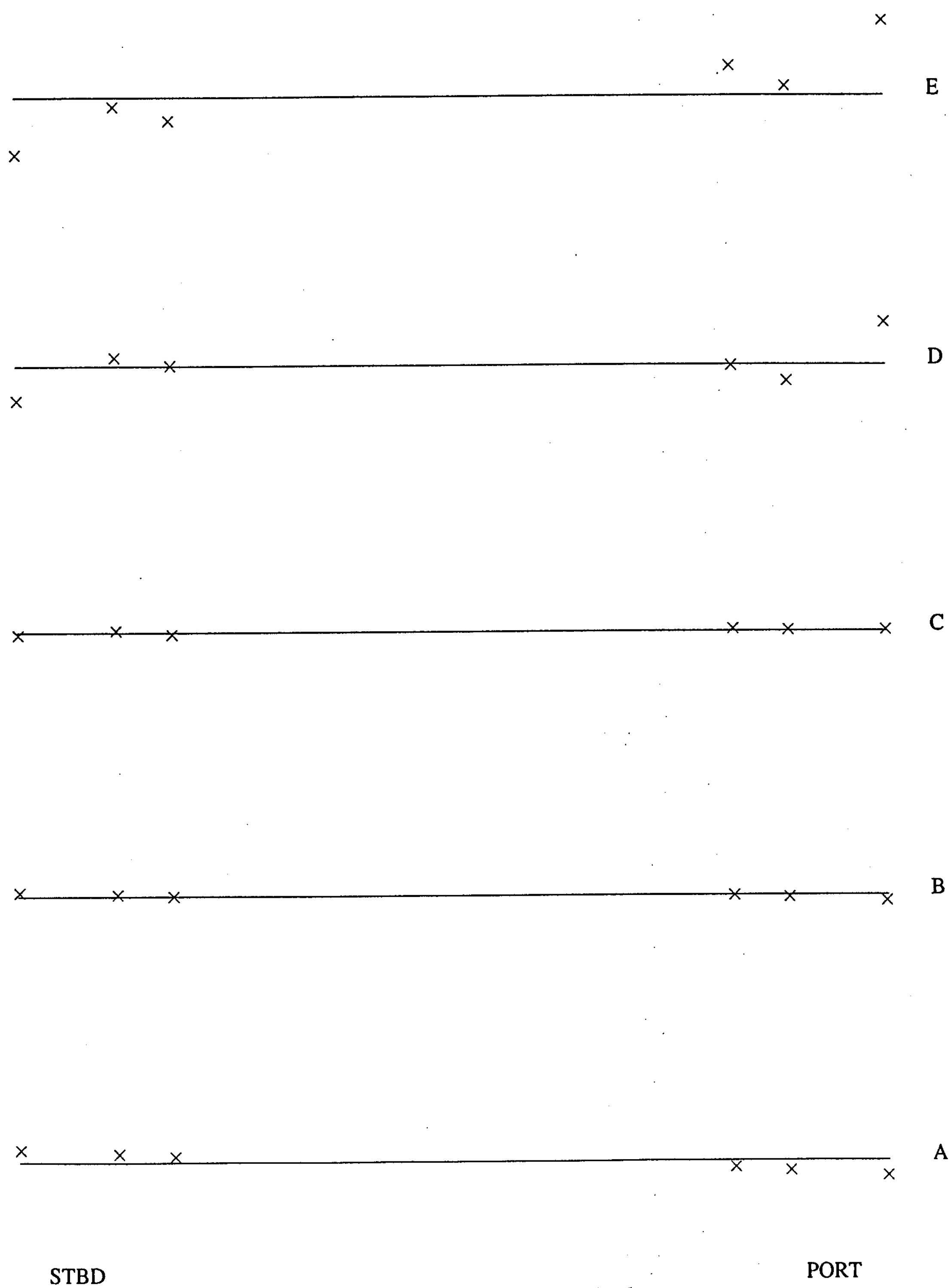

Figure 3i. Measured mode shape

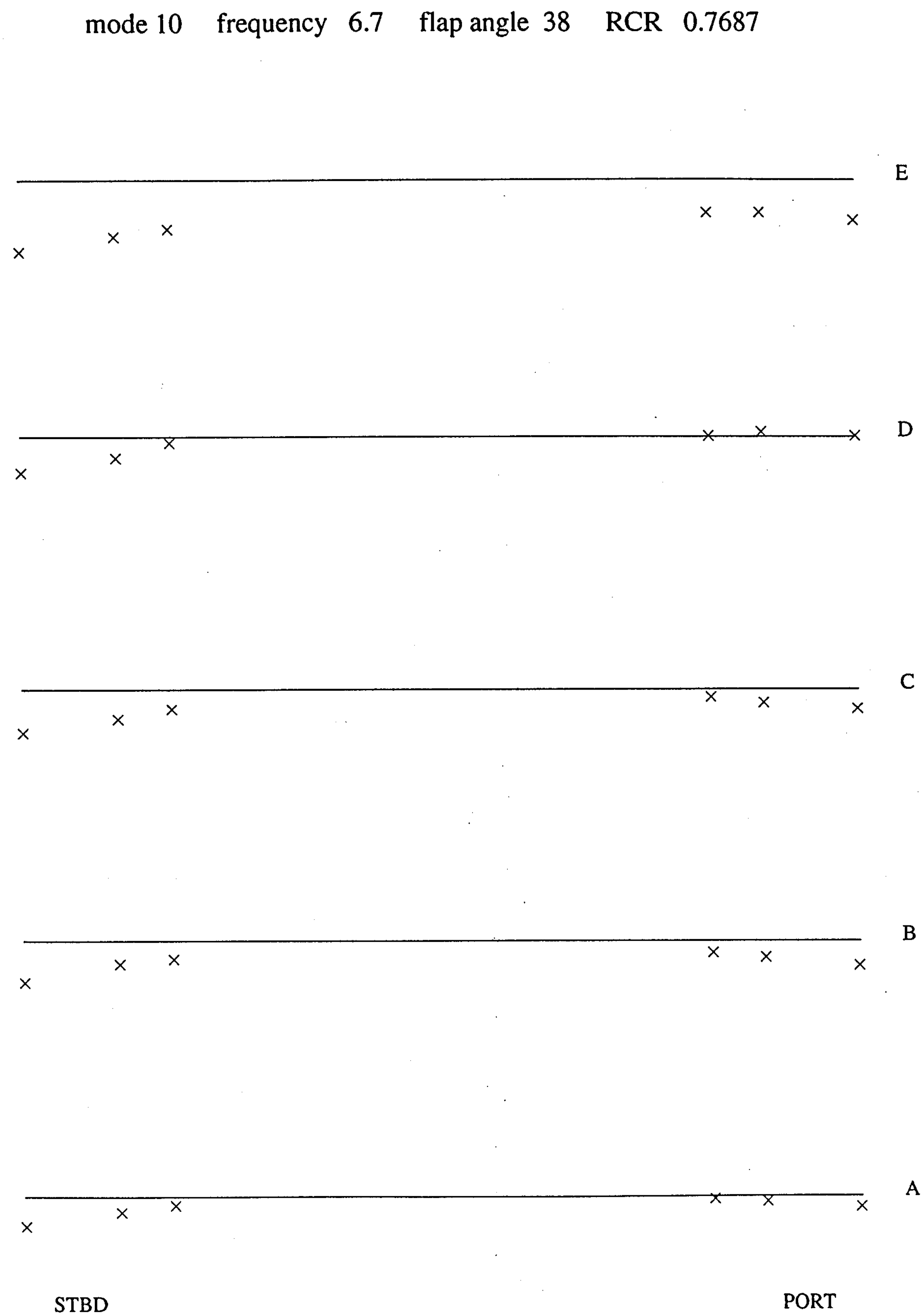

Figure 3j. Measured mode shape

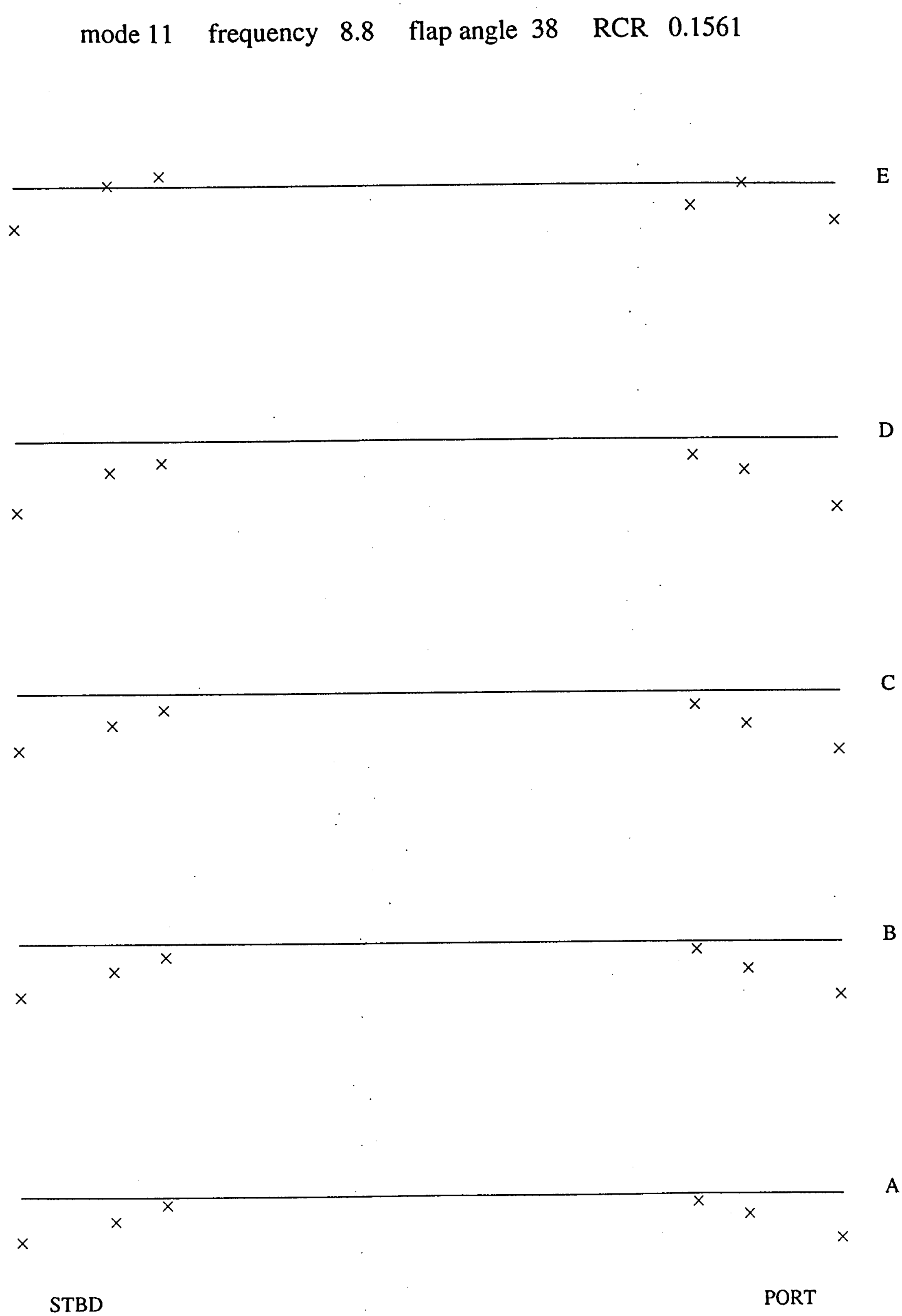

Figure 3k. Measured mode shape

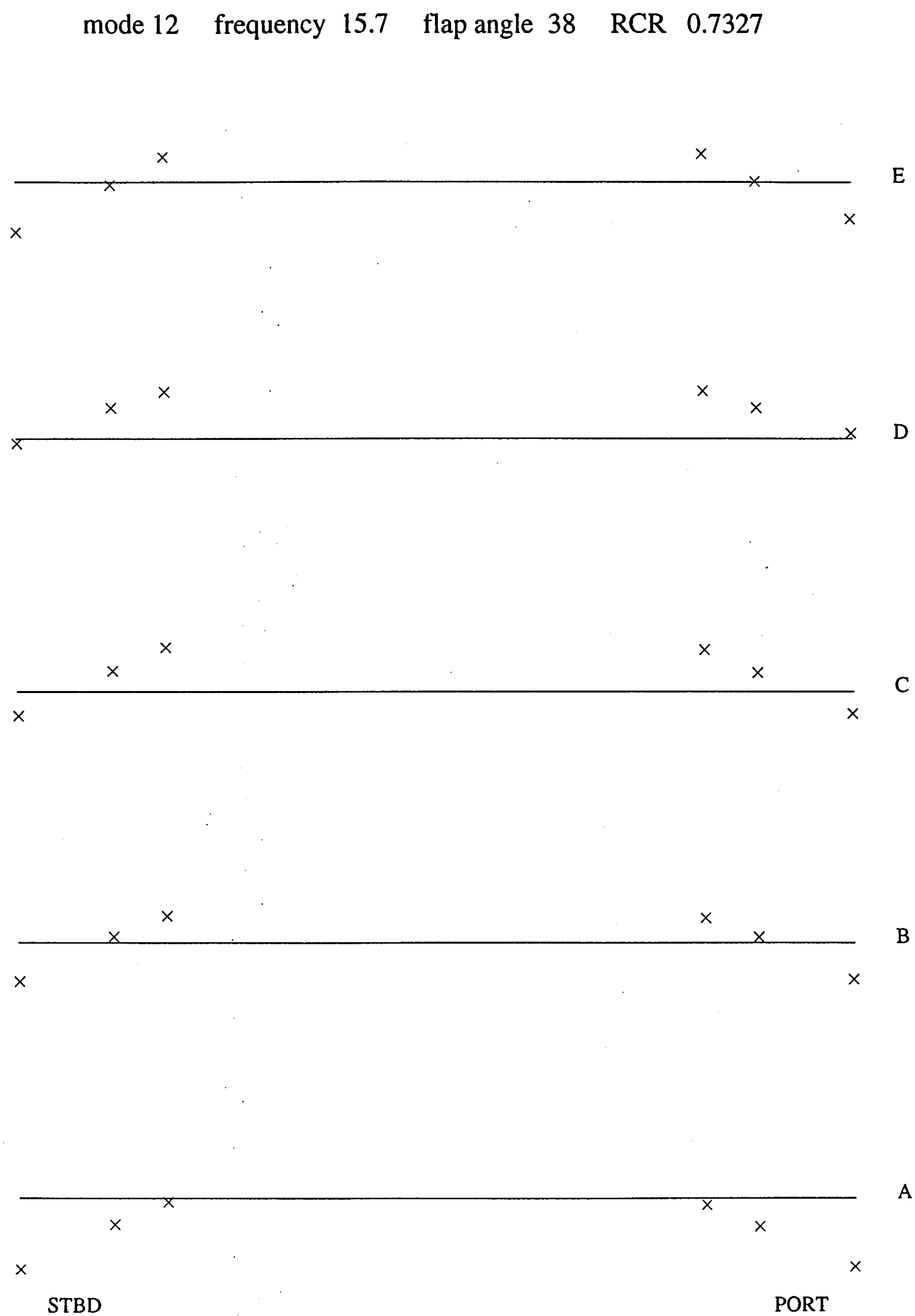

Figure 31. Measured mode shape

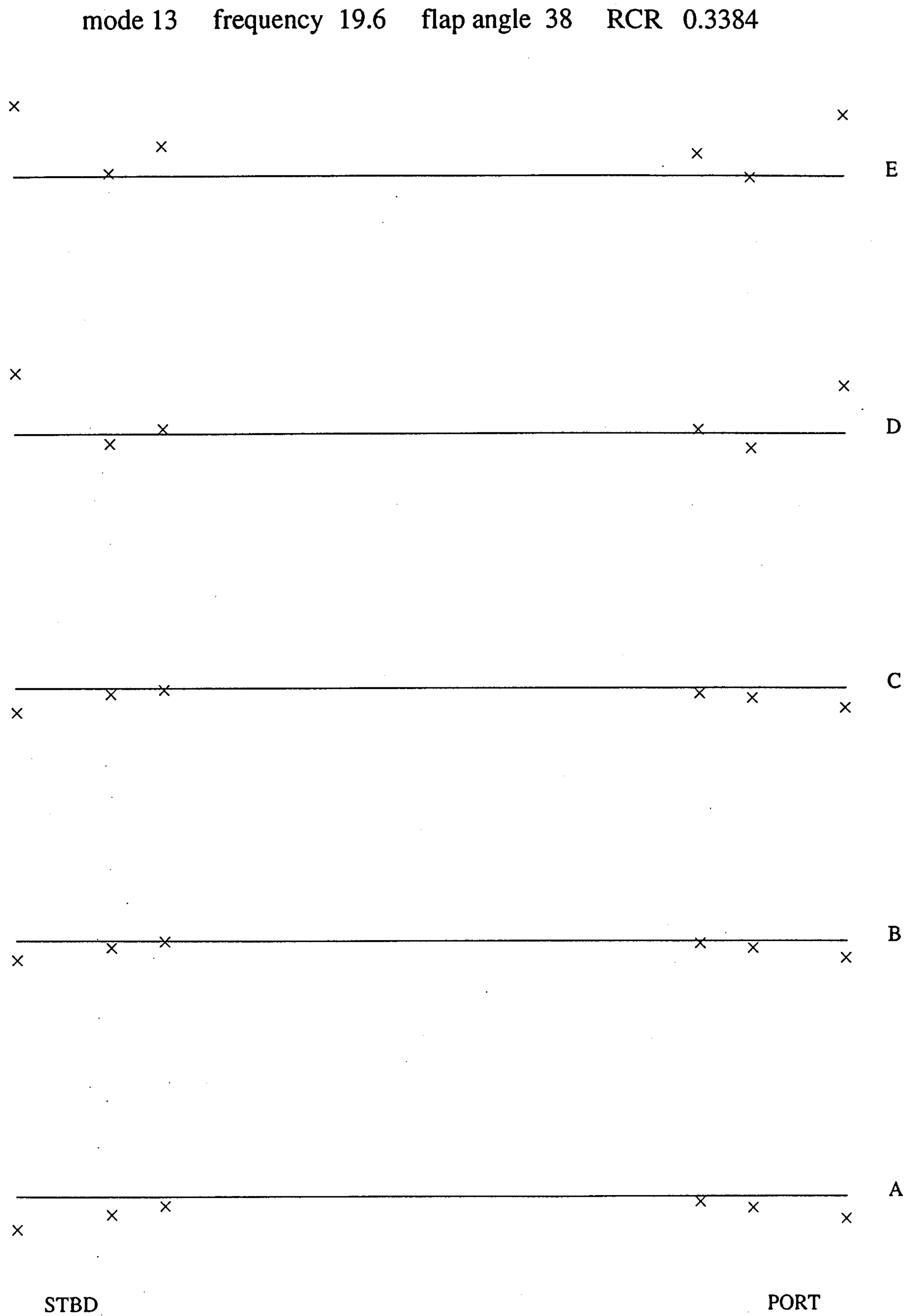

Figure 3m. Measured mode shape

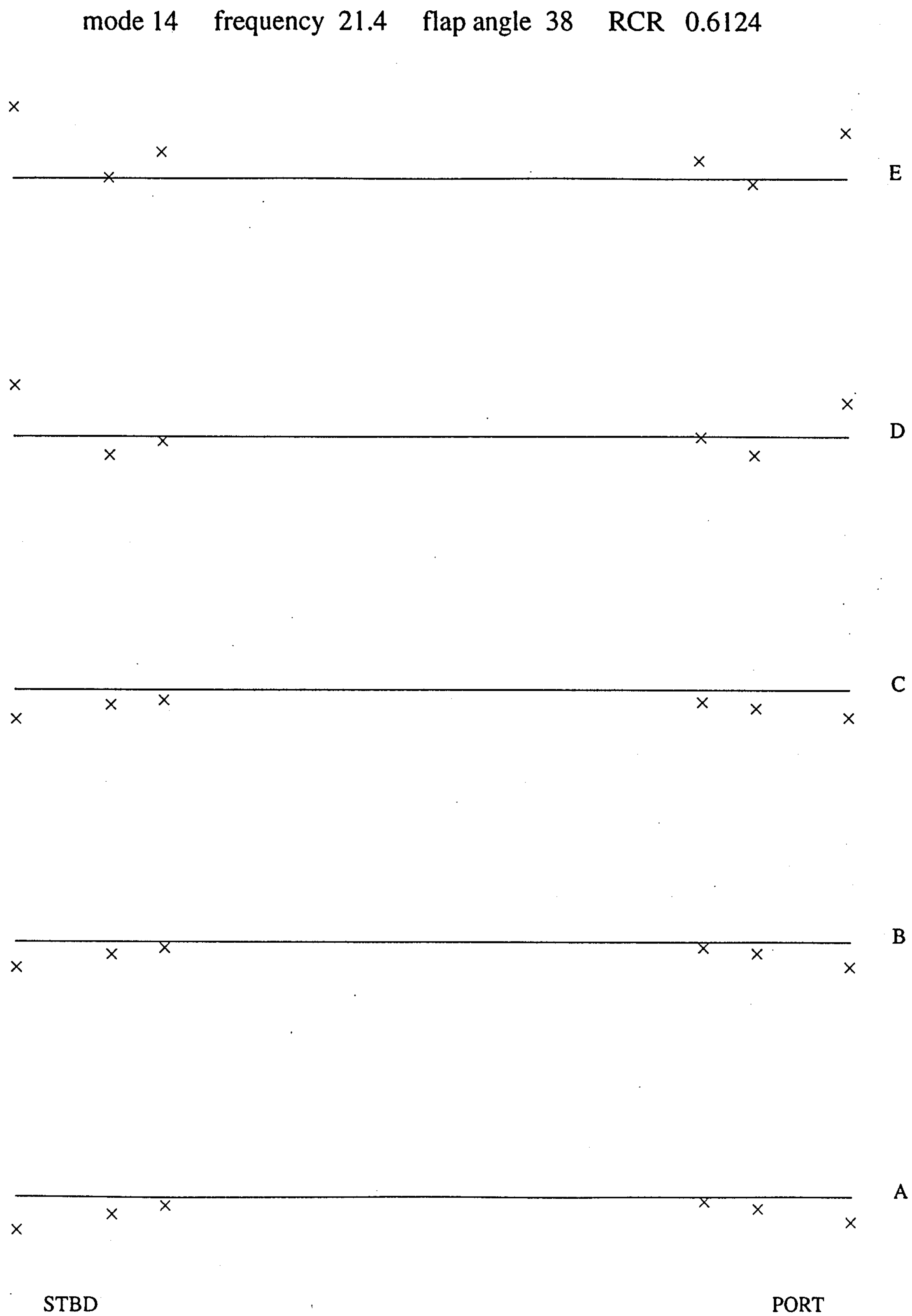

Figure 3n. Measured mode shape

mode 15 frequency 6.5 flap angle 38 RCR 0.2605

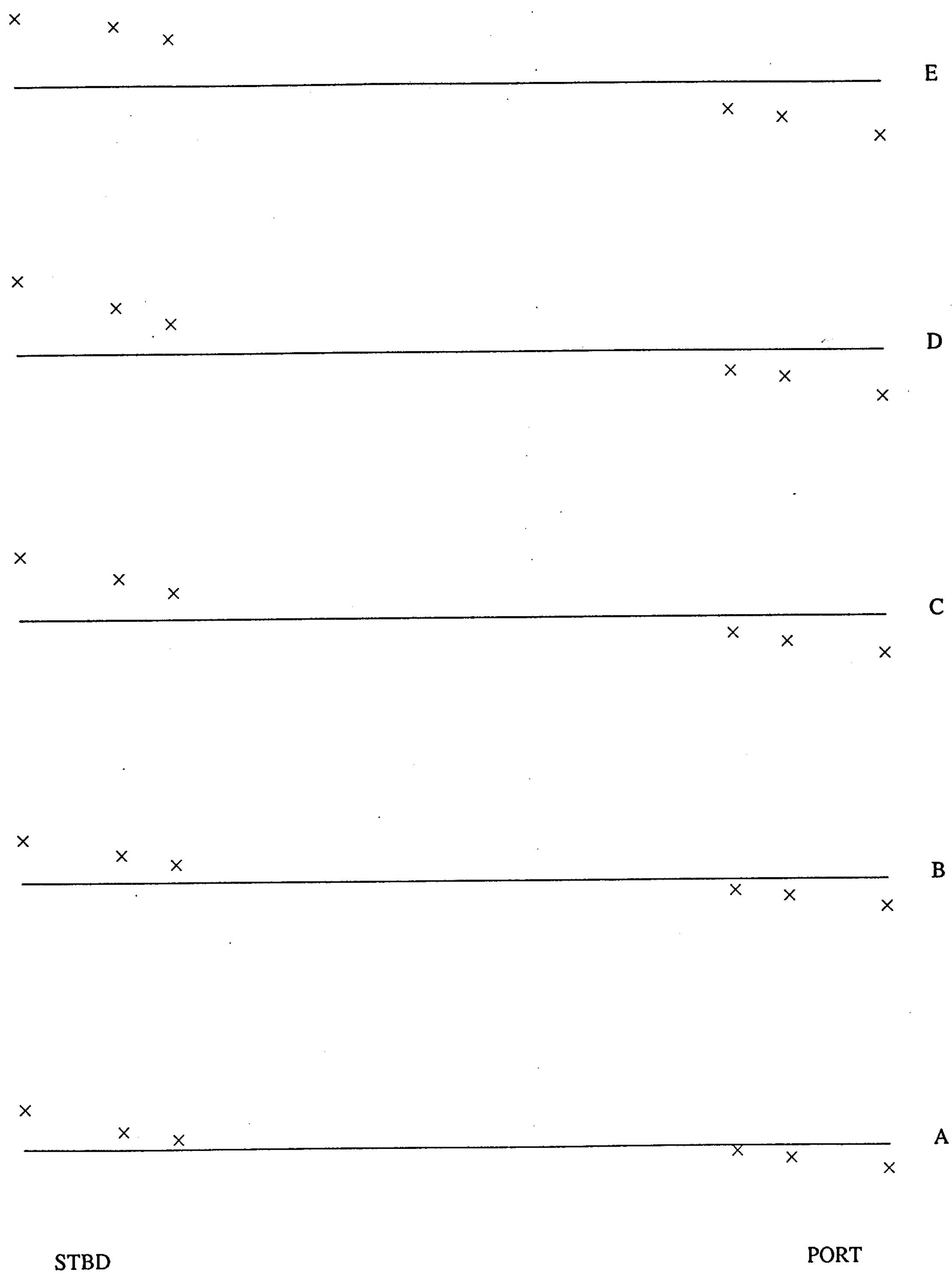

Figure 3o. Measured mode shape

mode 16 frequency 10.0 flap angle 38 RCR 0.2737

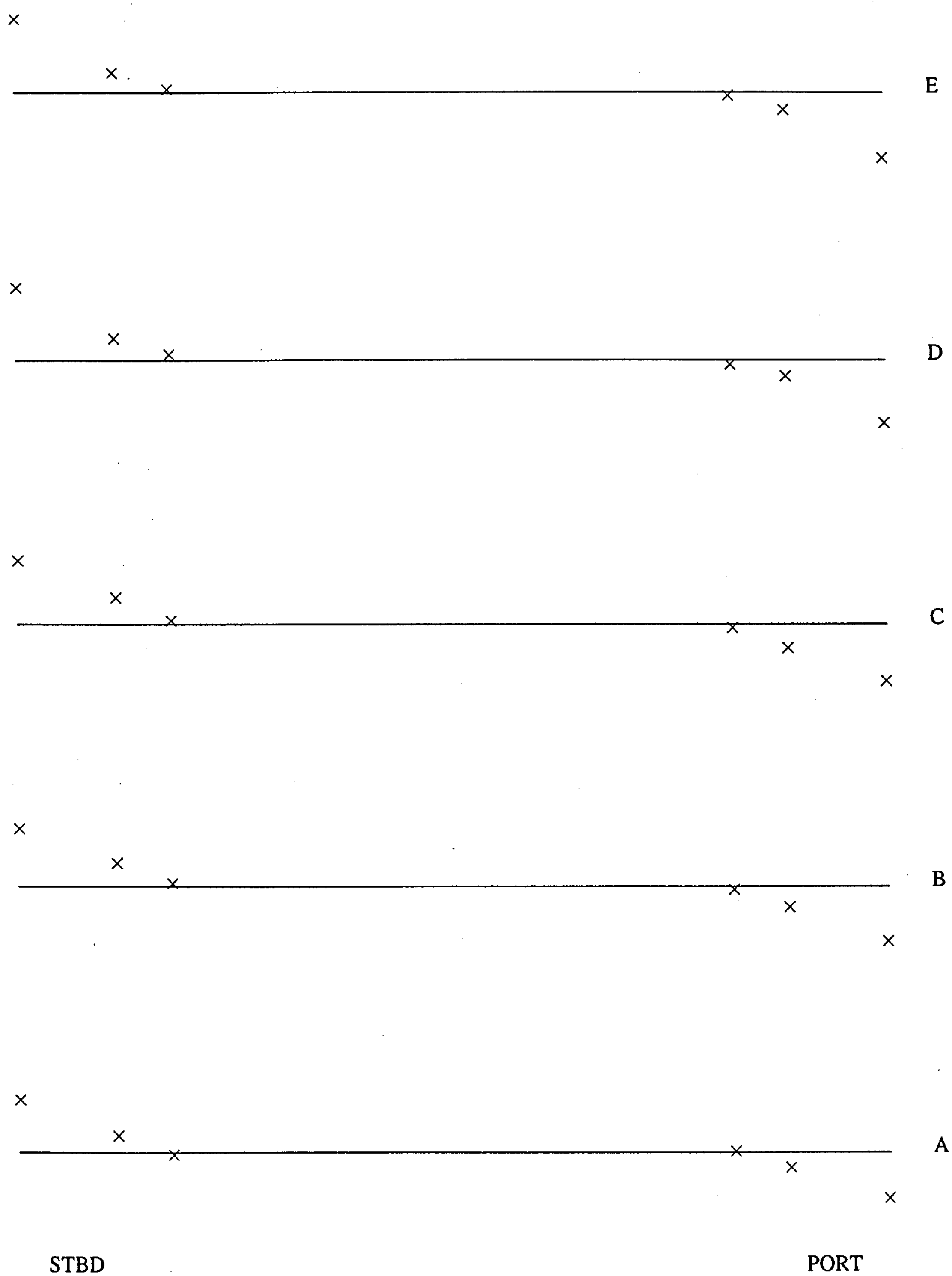

Figure 3p. Measured mode shape

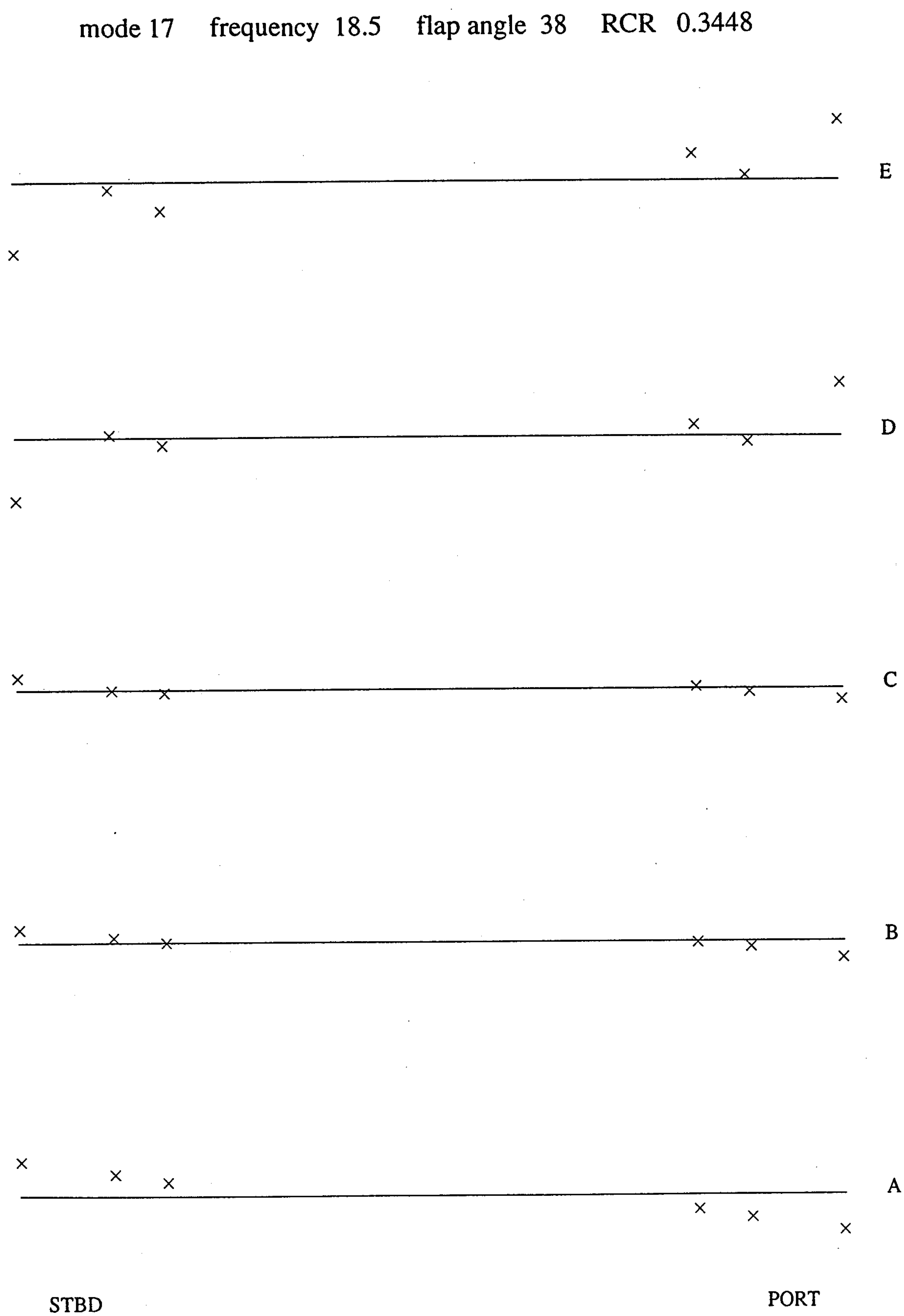

Figure 3q. Measured mode shape

mode 18 frequency 21.0 flap angle 38 RCR 0.3363

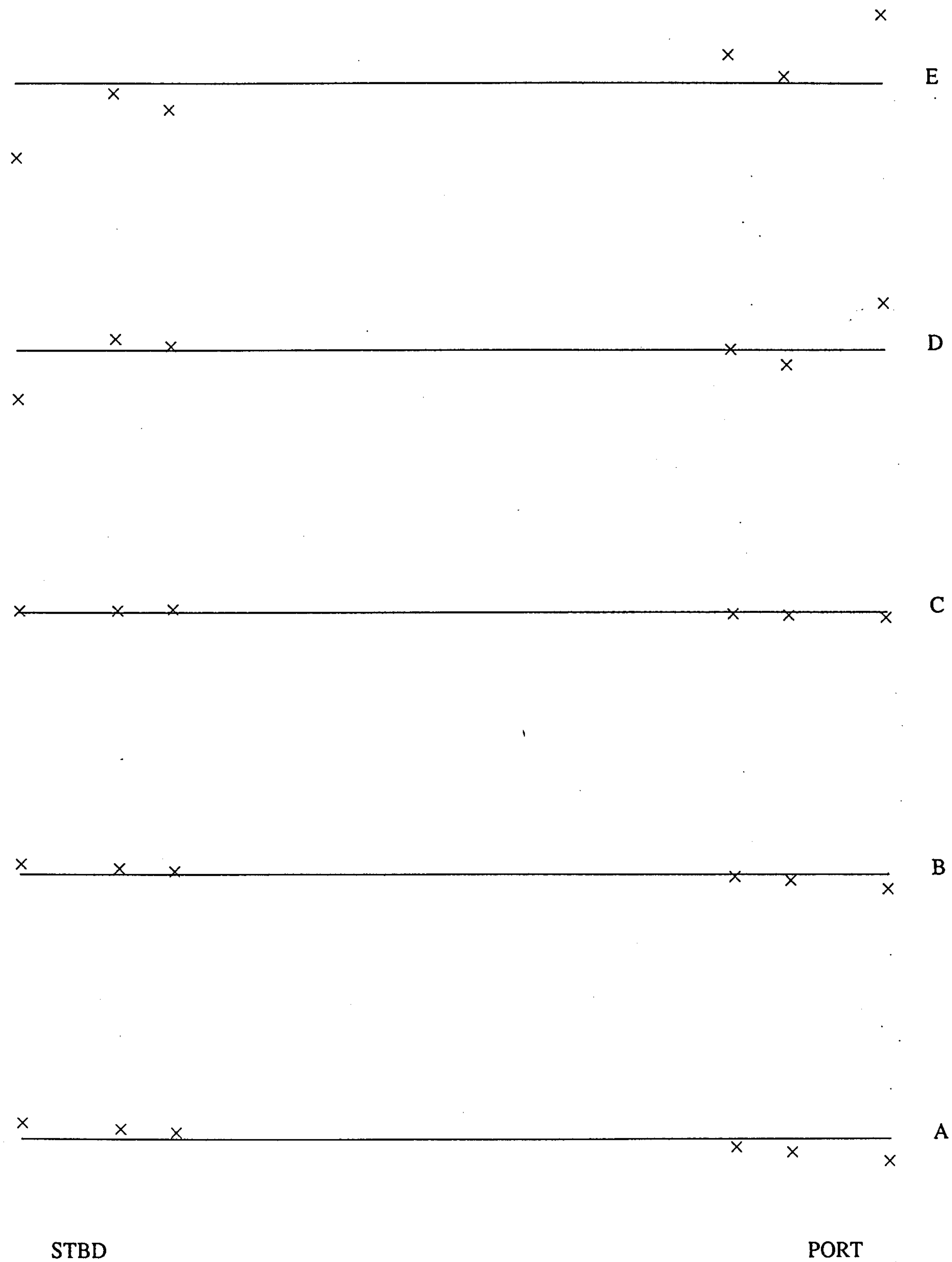

Figure 3r. Measured mode shape

Vibration Test on a Nomad N24A Aircraft Fitted with One Modified Aireron

P.A. Farrell, S.A. Dunn and C.D. Rider

DSTO-TN-0010

DISTRIBUTION

AUSTRALIA

DEFENCE ORGANISATION

Defence Science and Technology Organisation

Chief Defence Scientist
FAS Science Policy
AS Science Corporate Management
} shared copy
Counsellor Defence Science, London (Doc Data Sheet only)
Counsellor Defence Science, Washington (Doc Data Sheet only)
Senior Defence Scientific Adviser (Doc Data Sheet only)
Scientific Advisor Policy and Command (Doc Data Sheet only)
Navy Scientific Adviser (3 copies Doc Data Sheet only)
Scientific Adviser - Army
Air Force Scientific Adviser (Doc Data Sheet only)

Aeronautical and Maritime Research Laboratory
Director
Library Fishermens Bend
Library Maribyrnong
Chief Airframes and Engines Division
P.D. Hayes
Authors: P.A. Farrell
S.A. Dunn
C.D. Rider

Electronics and Surveillance Research Laboratory
Main Library - DSTO Salisbury

Defence Central

OIC TRS, Defence Central Library
Document Exchange Centre, DSTIC (8 copies)
Defence Intelligence Organisation
Library, Defence Signals Directorate (Doc Data Sheet Only)

Army

Army Technology and Engineering Agency
DESS-LC

Air Force

Aircraft Research and Development Unit
Tech Reports,CO Engineering Squadron,ARDU
OIC ATF, ATS, RAAFSTT, WAGGA (2 copies)

UNIVERSITIES AND COLLEGES

Australian Defence Force Academy
Library
Head of Aerospace and Mechanical Engineering

OTHER GOVERNMENT DEPARTMENTS AND AGENCIES

AGPS

OTHER ORGANISATIONS

NASA (Canberra)
ASTA Engineering, Document Control Office

SPARES (6 COPIES)

TOTAL (36 COPIES)

AL 149 DEPARTMENT OF DEFENCE

PAGE CLASSIFICATION
UNCLASSIFIED

PRIVACY MARKING

DOCUMENT CONTROL DATA

1a. AR NUMBER	1b. ESTABLISHMENT NUMBER	2. DOCUMENT DATE	3. TASK NUMBER
AR-009-262	DSTO-TN-0010	JUNE 1995	AIR 93/169

4. TITLE

VIBRATION TEST ON A NOMAD N24A AIRCRAFT FITTED WITH ONE MODIFIED AILERON

5. SECURITY CLASSIFICATION (PLACE APPROPRIATE CLASSIFICATION IN BOX(S) IE. SECRET (S), CONF. (C) RESTRICTED (R), LIMITED (L), UNCLASSIFIED (U)).

DOCUMENT	TITLE	ABSTRACT
U	U	U

6. NO. PAGES

35

7. NO. REFS.

1

8. AUTHOR(S)

P.A. FARRELL, S.A. DUNN AND C.D. RIDER

9. DOWNGRADING/DELIMITING INSTRUCTIONS

Not applicable.

10. CORPORATE AUTHOR AND ADDRESS

AERONAUTICAL AND MARITIME RESEARCH LABORATORY
AIRFRAMES AND ENGINES DIVISION
PO BOX 4331
MELBOURNE VIC 3001 AUSTRALIA

11. OFFICE/POSITION RESPONSIBLE FOR:

DESS - LC

SPONSOR

-

SECURITY

-

DOWNGRADING

CAED

APPROVAL

12. SECONDARY DISTRIBUTION (OF THIS DOCUMENT)

Approved for public release.

OVERSEAS ENQUIRIES OUTSIDE STATED LIMITATIONS SHOULD BE REFERRED THROUGH DOCUMENT EXCHANGE CENTRE, DIS NETWORK OFFICE, DEPT OF DEFENCE, CAMPBELL PARK OFFICES, CANBERRA ACT 2600.

13a. THIS DOCUMENT MAY BE ANNOUNCED IN CATALOGUES AND AWARENESS SERVICES AVAILABLE TO ....

No limitations.

14. DESCRIPTORS

Nomad aircraft
Vibration tests

15. DISCAT SUBJECT CATEGORIES

16. *ABSTRACT*

Following doubt raised about the loads experienced on the flap and aileron of Nomad aircraft in flight, a flight test program was formulated to measure these loads. An aileron fitted with strain gauges and the associated wiring was installed on a Nomad N24A aircraft but this rendered the aircraft non-standard. To verify the aeroelastic stability of the aircraft when fitted with the instrumented aileron, a flight flutter trial was proposed. An abbreviated Ground Vibration Test (GVT) was conducted on the aircraft to support the flutter trial, and this report describes the GVT and presents the results.

PAGE CLASSIFICATION
UNCLASSIFIED

PRIVACY MARKING

THIS PAGE IS TO BE USED TO RECORD INFORMATION WHICH IS REQUIRED BY THE ESTABLISHMENT FOR ITS OWN USE BUT WHICH WILL NOT BE ADDED TO THE DISTIS DATA UNLESS SPECIFICALLY REQUESTED.

16. ABSTRACT (CONT).		
17. IMPRINT AERONAUTICAL AND MARITIME RESEARCH LABORATORY, MELBOURNE		
18. DOCUMENT SERIES AND NUMBER DSTO Technical Note 0010	19. WA NUMBER 26257A	20. TYPE OF REPORT AND PERIOD COVERED
21. COMPUTER PROGRAMS USED		
22. ESTABLISHMENT FILE REF.(S) M1/9/83		
23. ADDITIONAL INFORMATION (AS REQUIRED)		