

AD 740641

Index to the Shock and Vibration Bulletins 36 Through 41

JANUARY 1972

A publication of
**THE SHOCK AND VIBRATION
INFORMATION CENTER**
Naval Research Laboratory, Washington, D.C.



Office of
**The Director of Defense
Research and Engineering**

REPORT OF THE
**NATIONAL TECHNICAL
INFORMATION SERVICE**
1972-01-01

This document has been approved for public release and sale; its distribution is unlimited.

128

**Index to the
Shock and Vibration
Bulletins 36 Through 41**

JANUARY 1972

**A Publication of
THE SHOCK AND VIBRATION
INFORMATION CENTER
Naval Research Laboratory, Washington, D.C.**

**Prepared by
Rudolph H. Volin
and
Henry C. Pusey**

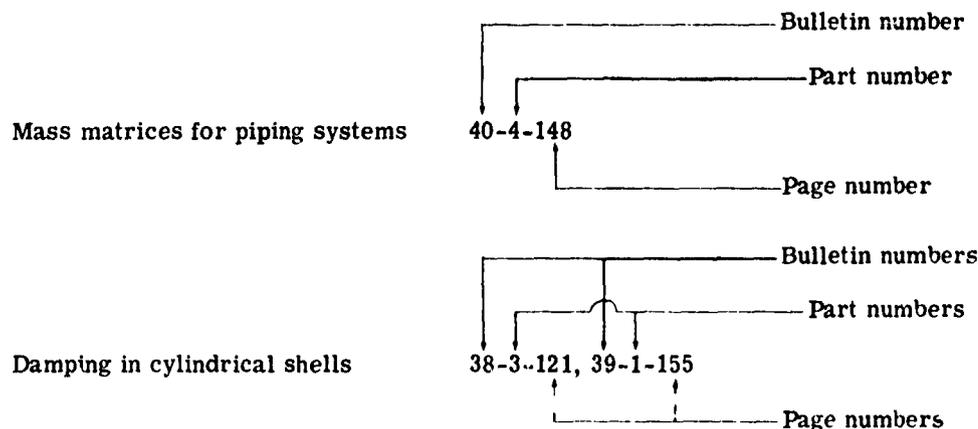
**Office of
The Director of Defense
Research and Engineering**

Preface

The "Index to Shock and Vibration Bulletin Nos. 1 through 24" was published in October 1957 and it was declassified and included as an appendix to the "Index to Shock and Vibration Bulletin 25 through 35". Bulletins 36 through 41 were published in 43 parts between January 1967 and December 1970 and this volume provides a complete index to these Bulletins.

This index is divided into three parts. In Part I subjects are compiled in alphabetical order. Part II consists of a list of authors in the same way. Part III contains a reproduction of the complete table of contents for each of the Bulletins by number and part.

Each entry in Parts I and II is followed by a basic three-number set. The first number identifies the Bulletin, the second number the part, and the third number the page. The appearance of more than one three-number set, is an indication of more than one reference for a single listing. The following examples will serve as illustrations:



Appendix A contains a complete list of Bulletin 36 through 41 with their DDC accession numbers where applicable. Instructions for ordering Bulletins are contained in the same appendix.

Acknowledgement

Appreciation is expressed to Mrs. Katherine G. Jahnel for typing the index cards and the author index, Mrs. Margaret Parker and Mrs. Evelyn Starrett for their typing the index cards and to Mrs. Barbara Szymanski, and Miss Patricia Fletcher for their typing of the manuscript.

Table of Contents

Preface	iii
Part I - Subject Index - Shock and Vibration Bulletins 36 through 41	1
Part II - Author Index - Shock and Vibration Bulletins 36 through 41	67
Part III - Tables of Contents - Shock and Vibration Bulletins 36 through 41	77
Appendix A - Listing of Shock and Vibration Bulletins 36 through 41	127

Part I
Subject Index

Shock and Vibration Bulletins
36 Through 41

SUBJECT INDEX

A

- A7 aircraft
 - gunfire environment, 40-6-27, 41-4-133
- Acceleration
 - analysis of data, 38-2-113
 - of beams with moving point loads, 41-6-55
 - in damping collar, 40-5-161
 - vs frequency
 - for electrohydraulic test system, 40-5-249
 - ground shock
 - hydraulic pressure pulse from, 41-5-144
 - gun setback
 - instrumentation for, 36-2-58
 - measurement of, 36-2-53
 - landing
 - attenuation of, 40-2-183
 - limitations
 - as shock severity criteria, 40-2-31
 - limiting
 - in vibration tests, 41-4-117
 - linear and angular
 - simultaneous tests, 41-3-155
 - measurements
 - on aircraft landings, 40-6-45
 - on catapult launched aircraft, 40-6-47
 - on railroad cars, 39-6-49, 41-4-154
 - on simulator for human head impact, 39-5-90
 - response
 - to air pulser impulse, 41-5-16
 - as criterion for selection of normal modes, 40-7-170
 - on railroad cars, 40-6-115
 - of scale model hull, 41-S-18
 - on tracked air cushion vehicles, 40-4-58
 - transfer function
 - for lumped parameter system, 38-2-108
 - use of, 36-3-20
 - and vibration, 36-3-119
- Acceleration probability density
 - for gunfire vibration in helicopters, 41-4-218
 - for vibration in helicopters, 41-4-230
- Acceleration pulse
 - definition of energy density of, 39-5-83
 - on electrodynamic vibration exciters, 40-2-176
- Acceleration spectral density
 - for vibration of aircraft, 40-6-49
 - for vibration of avionics equipment, 40-6-52
- Acceleration-time history
 - on drop test shock machines, 41-5-59
 - Fourier transform of predicted, 40-3-88
- for gunfire environment on aircraft, 41-4-134
- for gunfire environment on helicopter, 41-4-139
- at simulated launch vehicle spacecraft interface, 40-3-87
- for spherical structure, 41-7-97
- from underground explosion, 41-6-80
- Accelerometers
 - base-strain, 37-2-48
 - base-strain sensitivity tests on, 37-2-44
 - calibration of, 37-2-17, 41-3-1
 - using Fourier integral transforms, 37-2-17
 - shock test facilities for, 40-2-205
 - standards for, 41-3-1
 - compensation of data from, 40-7-125
 - copper ball
 - use of, 37-3-219
 - design of, 41-3-17
 - effect on structures, 41-3-6
 - for environment of eggs, 41-3-11
 - errors in, 37-2-43
 - using ferrofluid ultrasonic interferometer, 41-3-17
 - frequency response of, 41-3-1
 - high acceleration shock tests of, 40-2-205
 - for measurement of ground shock, 40-7-133
 - for measurement of mobility matrix of structures, 40-7-52
 - for measurement of transportation environments, 36-6-165
 - for natural frequencies of plates, 41-7-41
 - nonlinear inertial
 - affected by random vibration, 37-2-87
 - oil damping in piezoresistive, 41-3-7
 - ring
 - stress concentration in, 37-2-43
 - vibration test using, 37-2-48
- Acceptance tests, see Qualification tests and Quality Control Tests
- Acoustic data, see Acoustic environment
- Acoustic environment
 - of airborne weapons, 39-S-16, 40-6-18, 41-S-34, 41-S-37
 - of Apollo Applications Program payload, 39-3-61
 - of Apollo Lunar Module, 37-5-148, 40-3-163
 - effect of airspeed on, 37-S-100
 - on F-111B aircraft, 39-6-93
 - in-flight vs laboratory test, 37-5-31
 - instrumentation for, 36-7-90, 37-S-95
 - of launch vehicle, 36-5-97, 36-7-89
 - of OGO spacecraft, 36-7-91

Preceding page blank

- of Phoenix Missile, 39-6-93
 - prediction of, 36-5-97, 41-4-168
 - of RF-4C airplane, 37-S-95
 - of re-entry vehicles, 40-3-33
 - response of structural components to, 36-5-97
 - of Saturn V Launch Vehicle, 39-6-133
 - spacecraft, 40-3-52, 40-4-103
 - test facility for low pressure, 41-3-207
 - of UH-1F helicopter, 37-S-73
 - of VTOL Aircraft, 41-4-161
 - wind tunnel, 37-7-221
- Acoustic excitation**
- of aerospace structures, 37-5-55, 41-7-1
 - of airborne weapons, 39-S-15
 - of aircraft structures, 39-3-87
 - combined with airblast, 39-3-65
 - mathematical analysis of response to, 39-3-55
 - prediction of flight vibration from, 36-5-85
 - of re-entry vehicles, 40-3-31
 - response to
 - Apollo Lunar Module, 40-3-172
 - cylinders, 36-5-104
 - panel, 38-1-1, 40-3-57, 40-5-49
 - plates, 36-5-104
 - of rocket motors, 41-6-115
 - of shells, 40-3-23, 40-3-31
 - of solar panels, 40-3-49
 - during static firing tests, 39-6-135
 - and strain response, 36-5-77
 - structural damping during, 41-2-105
 - structural failure from, 39-3-65
 - of structures, 36-5-89, 39-3-65, 41-1-15, 41-6-211
 - vibration response to, 38-1-1
- Acoustic fatigue**
- of boron fiber reinforced panels, 39-4-101
 - of panels, 38-1-1
 - susceptibility areas for, 37-S-19
 - tests
 - on aircraft structures, 37-S-63
 - facility for, 37-S-17
 - instrumentation for, 40-7-17
 - procedures for, 37-S-43, 40-5-54
 - specimens for, 40-5-51
 - viscoelastically damped panels, 40-5-49
- Acoustic filter**
- helical coils, 41-2-77
- Acoustic generators, see Acoustic test facilities**
- Acoustic impedance**
- in shock analysis of fluid systems, 40-2-67
- Acoustic levels, see Boundary layer noise and Sound pressure levels.**
- Acoustic Mobility/Impedance Transducer (AMIT)**
- description of, 40-4-198
- Acoustic noise, see also Noise**
- attenuation of, 38-3-19C
 - prediction of response to, 41-4-87
- Acoustic power**
- prediction of
 - for VTOL Aircraft, 41-4-167
- Acoustic radiation**
- from aircraft, 41-4-161
 - resistance of cylindrical shells to, 40-3-23
- Acoustic spectra, see also Power spectra**
- shaping of, 37-S-64
 - for VTOL Aircraft, 41-4-164
- Acoustic test facilities**
- for acoustic fatigue tests, 37-S-63
 - for aerospace vehicles, 37-5-1
 - broad band random response for, 37-5-21
 - calibration of, 37-5-147
 - data analysis for, 37-S-35
 - definition of noise field in, 39-2-87
 - description of, 37-5-33
 - design of, 37-S-17
 - design of reverberation chamber for, 37-5-13
 - instrumentation for, 37-5-19, 37-5-42, 37-S-34
 - performance characteristics, 37-5-20, 37-S-17
 - performance of horn in, 37-5-46
 - scale model, 37-S-27
 - for simulation of inflight noise, 37-S-64
 - sound generators for, 37-S-30
 - for spacecraft, 37-5-25
 - vibration tests in, 37-5-8, 37-5-51
- Acoustic tests**
- of airborne weapons, 40-6-9
 - of aircraft structures, 37-S-43
 - amplitude distribution during, 38-1-4
 - of Apollo Lunar Module, 37-5-109
 - of Apollo spacecraft, 37-5-25, 37-5-93, 37-5-153
 - assembly level, 37-5-117
 - of boron fiber reinforced panels, 39-4-101
 - compared to vibration tests, 37-3-7, 37-3-21
 - comparison of spacecraft flight data with, 36-3-44, 37-3-23
 - of damped cantilever beams, 41-2-109
 - data analysis for, 37-5-77
 - derivation of spectra for, 41-3-46
 - of electronic equipment, 37-3-8, 40-S-78
 - establishing noise field for, 37-S-47
 - failures, 37-5-170
 - flight acoustic environment vs, 37-5-31

- instrumentation for, 37-S-53
- on Launch Phase Simulator, 37-3-182
- low level
 - to predict response at high levels, 41-4-97
 - at low pressures, 41-3-207
 - of models of spacecraft, 40-4-105
 - of OGO spacecraft, 37-3-21
 - of panels, 39-4-103, 40-5-54
 - prediction of response to, 41-4-87
 - of propellant system, 41-7-125
 - purpose of, 41-4-2
 - as qualification tests, 37-5-139, 37-5-167
 - response of cylinder to, 37-5-69
 - reverberation chamber for, 39-2-87, 41-3-207
 - simulation of vibration by, 37-5-1, 37-5-153
 - of spacecraft, 36-3-42, 37-5-1, 40-3-163
 - of spacecraft components, 36-3-39, 41-3-207
 - of upstage test vehicle, 41-6-19
 - vacuum tests combined with, 37-5-175
 - vibration to simulate, 38-1-115, 40-3-252
- Acoustic waves
 - from underwater explosions, 40-1-15
- Active vibration isolators, see also Shock isolators and Vibration isolators
 - attenuation of vibration in, 37-6-66
 - characteristics of, 37-6-29
 - design of, 37-6-32
 - electrohydraulic, 39-4-141
 - for helicopters, 37-6-63
 - performance of, 37-6-34
 - shock response of, 37-6-69
 - transmissibility of, 37-6-45
- Admittance, see Mechanical impedance
- Advanced Orbiting Solar Observatory Spacecraft (AOSO)
 - design for torsional shock, 36-7-63
 - qualification test requirements, 36-7-71
- Aerial delivery
 - impact during, 41-3-223
 - simulation of, 37-3-195, 41-3-223
- Aerodynamic drag
 - measurements of, 40-2-83
- Aerodynamic loads
 - simulation of, 40-5-2
- Aerodynamic noise
 - tests, 37-3-203
 - data analysis of, 37-5-209
 - results, 37-3-210
 - of scale model Titan, 37-3-203
- Aerospace structures
 - acoustic excitation of, 41-7-1
 - acoustic test facility for, 37-5-1
 - damping of, 40-5-1
 - prediction of vibration of, 41-7-1
- AH-1 Helicopter, 41-4-195
- AH-56 helicopter
 - ammunition conveyor system for, 40-4-115
 - response to blast of weapons, 40-1-70
- AIM-4D missile
 - captive flight environment, 37-1-125
 - data acquisition system for, 37-1-128
 - on F-4 aircraft, 39-1-195
 - flight test vs system test, 39-1-217
- Air
 - as a damping mechanism, 36-4-75
- Air blast, see also Blast
 - acoustic excitation combined with, 39-3-65
 - on aircraft, 40-2-123
 - characteristics of, 37-1-81
 - compared with underwater explosions, 36-1-13, 37-1-29
 - damage to structures from, 40-1-36
 - design for
 - of antennas, 37-5-1
 - of deck house, 39-1-107
 - drag loads from, 40-2-104
 - effects of
 - on aircraft carriers, 37-4-143
 - on antennas, 40-1-51, 40-1-45
 - on performance of prime movers, 37-4-127
 - on protective structures, 38-2-187
 - on ships, 36-1-13, 38-1-1
 - experimental vs predicted response to, 40-1-51, 40-1-83
 - field test on antennas, 37-4-153
 - hardness of vehicles to, 41-1-35
 - interaction with structures, 37-4-179
 - internal loading of structures by, 37-4-185
 - loads
 - on aircraft components, 40-2-123
 - on above ground structures, 41-1-35
 - on antenna mast structures, 40-2-101
 - on cylinders, 40-2-83
 - on deckhouse structure, 39-1-109
 - effects of sliding on, 37-4-193
 - on lattice type structures, 40-2-101
 - mathematical analysis of, 39-5-33
 - on ships, 39-1-95
 - on spheres, 39-5-29
 - on structures, 37-4-186, 37-4-193, 39-3-85, 40-1-31, 40-1-45
 - on vans, 37-4-194

nuclear
attenuation of ground shock from, 40-4-217
effects on above ground structures, 37-4-213
response spectra for, 41-S-4f
shock pulse for, 40-4-219
on open-frame structures, 38-2-177
plastic response of aircraft to, 40-2-128
pressure time history for, 37-4-18c
propagation into structures, 37-4-185
response to
of antennas, 37-4-151, 40-1-31, 40-1-45, 40-1-75, 40-2-101
of blast closures, 40-2-133
of gas turbines, 40-2-147
prediction of, 40-1-49
of re-entry vehicles, 39-1-223
of shell structures, 37-4-177
of ships, 37-1-77
of structures, 37-4-169, 40-1-31, 40-2-101, 41-1-35, 41-S-45
upper and lower bounds for, 37-4-169
test facilities
for SAFEGUARD, 40-2-243
shock tubes, 39-1-102, 39-5-41, 39-5-53
tests
on antennas, 37-S-14, 40-1-31, 40-1-45, 40-1-80, 40-2-105
on gas turbines, 40-2-147

Air cushion vehicles
response of guideways to, 41-6-4f
response to pressure loads, 41-6-55

Air drop, see Aerial delivery

Air guns, see Shock test facilities

Air jets, see Acoustic test facilities

Air springs, see Pneumatic springs

Airborne equipment
prediction of vibration of, 38-S-5

Airborne weapons, see also Captive flight
captive flight environment on propeller aircraft, 39-S-26
captive flight vibration, 39-S-15
cavity resonance in, 39-S-24
criteria for qualification tests, 39-S-33
gunfire environment for, 39-S-27
laboratory vs flight vibration response, 39-S-33

Aircraft, see also specific aircraft such as A-7, C-130, C-133, F-4, F-111, RF-4C, and XB-70A, etc.

airblast on, 40-2-123
elastic response to, 40-2-126
plastic response to, 40-2-128
catapult launchings of
acceleration measurements for, 40-6-47
compatibility with engine, 41-3-55
crash loads on, 36-3-165
mathematical analysis of, 38-3-166
response of mathematical model for, 38-3-169
simulation of, 41-3-133
damping of radar antenna for, 38-3-58
effect of flight parameters on captive flight vibration, 39-1-208
gunfire environment in
acceleration time history for, 41-4-134
isolation of recoil from, 39-4-251
simulation of, 41-4-37
gun system for
mathematical analysis of, 39-4-255
landings of
acceleration measurements for, 40-6-48
braking stops, 39-3-185
vibration of landing gear, 39-3-179
modal surveys of, 36-3-55, 39-2-63
mode tuning for, 36-3-67
suspension system for, 36-3-62
noise surveys of, 41-4-161
instrumentation for, 41-4-163
structures
acoustic excitation of, 39-3-87
air load on, 40-2-125
Clarkson's Method for prediction of stress in, 39-3-81
comparison of measured and predicted stress in, 39-3-91
shock analysis of, 40-2-123

Aircraft
vibration of, 41-4-133
vibration isolation in, 39-4-157

Aircraft carriers, see Ships

Aircraft seats
crash simulator for, 41-3-133

Amplitude, see Displacement

Amplitude control system
dynamic characteristics of, 36-3-10
response limitation of, 36-3-151

Amplitude distribution
during acoustic tests, 38-1-4

Analog computers, see also Computers, Digital Computers and Hybrid computers

for analysis
 of nonlinear systems, 36-3-43
 of scale model launch vehicle, 40-3-208
 of shock data, 36-6-37
 of shock spectra, 36-6-43
 calculation of response spectra by, 36-6-37
 for damping calculations, 40-3-151
 for estimation of fatigue damage, 41-3-60
 frequency stepping circuit for, 36-6-39
 for real-time analysis, 41-3-55
 for simulation of
 displacement, 39-6-53
 impact, 40-5-188
 motion of antenna booms, 36-6-197
 vacuum spring, 36-7-107
 vibration, 40-8-15

Analog/digital conversion
 data system, 36-6-56
 development of, 37-5-78

Analysis, see subject of analysis or specific analyses such as Dynamic analysis

Analyzers
 for digital analysis of shock, 36-6-21
 for vibration, 36-6-49

Anisotropic materials
 analysis of, 39-3-201

Antennas
 airblast tests of, 37-4-151, 37-8-14, 40-1-31, 40-1-45, 40-1-75, 40-2-101

Whip
 analysis of, 40-1-47
 criteria for materials for, 37-8-8
 damping of, 36-6-195, 39-4-1
 with extendible booms, 36-6-195
 design of simulated, 40-2-104
 dynamic analysis of, 37-4-159, 40-1-45, 40-1-75
 paraboloidal
 structural dynamics of, 41-6-103
 mathematical model of, 41-6-104
 natural frequencies of, 41-6-110
 predicted vs measured response to airblast, 40-1-39, 40-1-49, 40-1-83
 shipboard, 37-4-151, 40-1-31, 40-1-45, 40-1-75
 Shock hardening of, 37-8-1
 simulation of motion by analog computer, 36-6-197
 twang test on, 40-2-108
 wire rope
 stress analysis of, 40-1-76

Apollo spacecraft
 acoustic test facility for, 37-5-25
 acoustic test procedures for, 39-2-112

Command module
 impact attenuation for, 38-3-255
 dynamic test program, 37-5-89, 39-2-105
 equations of motion for, 37-5-59
 evaluation of flight vibration data for, 37-5-100
 flight vibration environment for, 37-5-90

Lunar module
 acoustic tests of, 37-5-109, 37-5-139
 acoustic and vibration environments, 37-5-139, 40-3-163
 engine induced vibration for, 37-5-107
 flight vibration vs ground test, 40-3-174
 launch environment for, 37-5-106
 mathematical analysis of, 39-3-55
 response to vibration and acoustic excitation, 40-3-172
 structural response of, 37-5-150
 vibration of, 40-3-166
 vibration tests, 37-5-105, 37-5-142
 random vibration criteria for, 39-2-107

Service Module
 response to pyrotechnic shock, 37-4-15
 shock spectra for, 37-4-23
 vibration test program for, 37-5-154
 vibroacoustic test of, 36-3-39

"Short-Stack"
 combined environments test program, 40-3-211, 40-7-99

Spacecraft Lunar Module Adapter (SLA)
 vibration characteristics of, 37-5-58
 structural analysis of, 39-3-55
 vibration qualification for components of, 37-5-153
 vibration test procedures for, 39-2-110

Apparent weight
 definition of, 37-3-62, 41-4-30, 41-4-110
 and input force spectrum, 41-4-113
 simulation of, 36-3-47, 37-3-64

Applications Technology Satellite (ATS)
 combined environment tests of, 37-5-175
 design and analysis of, 36-7-41
 natural frequencies of, 36-7-55
 qualification test levels for, 36-7-58
 response spectra for, 36-7-50
 vibration characteristics of, 36-7-48

Arches, see Hinged arch

Armament systems
 design of recoil adapters for, 39-4-251

Army equipment
 field tests of, 39-6-1

Asymptotic method
for determining response to vibration,
41-4-128

Atlas Booster
dynamic analysis of cannister tethered to,
40-4-225

Atlas/Agema-D launch vehicle
noise measurements on, 36-7-89

**Attenuation, see Shock isolation and Vibration
isolation**

Autocorrelation functions
from optical systems, 36-6-98
power spectra and, 37-2-90

Automobiles
crash hazards for, 38-3-327
dynamic tests of, 40-4-89
protective system for impacts of, 38-3-329
response to dynamic tests, 40-4-94
safety criteria for, 38-3-325
vibration isolation in, 38-3-317

Auxiliary vibration table
for electrohydraulic vibration exciter,
41-3-113

Averaging method of Ritz, 40-5-262

Averaging techniques
for control of vibration tests, 36-3-139,
37-3-75

B

Balancing
of shafts, 41-6-204

Ball peening tests, 37-2-41

Base strain sensitivity tests
on accelerometers, 37-2-44

Bayesian statistics
in structural reliability, 36-7-31

Beam-columns
stiffness matrix of, 40-4-187

Beams
Bernoulli-Euler
frequency parameter for, 37-3-49
bilinear hysteretic
mathematical model of, 41-5-28
propagation of yielding in, 40-4-81
response spectra for, 41-5-30

cantilever
dynamic analysis of, 39-3-130, 40-4-1
failure analysis of, 37-4-50
finite elements for, 41-7-53
influence coefficients for, 37-2-61
lumped mass mathematical models
for, 41-7-55
mechanical impedance of, 40-7-65
normal modes of, 39-3-134
stresses in, 40-4-1

clamped-clamped, 36-4-10

composite
damping of, 36-4-37, 38-3-13, 41-2-133
dynamic characteristics of, 36-4-28
flexural vibrations in, 38-3-18
with compound sidebranch resonator
dynamic analysis of, 41-6-211
computer programs for, 38-1-76

conical
mathematical model of, 37-2-177

crack detection in, 38-1-55

critical buckling loads for, 40-4-49

**cross-correlation analysis of cracks,
38-1-55**

damped
acoustic tests of, 41-2-109
analysis of errors in calculations,
41-2-135
dynamic analysis, 36-4-50
loss factors for, 38-3-8, 39-1-167
mechanical impedance analysis,
41-7-53
multilayer, 40-5-40, 41-2-121
symmetric and unsymmetric, 36-4-43
unconstrained layer, 40-5-47
vibration of, 39-4-53

design charts for, 39-3-52

discrete models of, 41-6-163

**dynamic analysis of, 38-1-67, 40-4-37,
40-4-81, 40-4-187, 41-6-47, 41-6-123,
41-6-133, 41-6-163, 41-7-51**

failure analysis for, 37-4-43

**finite element analysis of, 38-1-10,
41-6-123, 41-7-51**

as foundations for machinery, 39-1-124

free-free, 37-3-93, 38-1-67, 40-4-35

holography for shock analysis of, 40-7-38

holography in study of vibration of, 40-7-34

laminated
analysis of, 36-4-81
loss factors for, 36-4-83
mathematical analysis of, 39-3-6
modal density of, 39-3-1
vibrations of, 40-5-277

lumped mass matrix for, 41-6-123

lumped parameter analysis of, 36-6-117

mathematical model, 38-2-13

**mechanical impedance of, 38-2-222,
41-7-51**

- modal analysis of, 39-3-143, 40-4-50, 41-6-136
 - modal effective mass of, 39-3-145
 - mode numbers of, 36-4-86
 - mode shapes of, 38-3-122, 41-6-164, 41-6-211, 41-7-51
 - moment curvature relationship for, 41-6-147
 - with moving point loads
 - forced vibration of, 41-6-49
 - natural frequencies of, 39-3-49, 40-4-2, 40-4-49, 40-5-277, 41-6-164, 41-6-211, 41-7-51
 - nonlinear, 41-5-29
 - non-uniform, 38-1-69
 - pinned, 36-4-55
 - reinforced concrete, 38-2-133
 - resonant
 - high acceleration vibration tests using, 39-2-71
 - as tuned dampers, 39-4-19
 - response of
 - to moving pressure loads, 40-4-47
 - to shock, 40-4-3, 41-5-27
 - static, 38-2-158
 - root errors in frequencies for, 41-6-137
 - scale model, 39-3-39
 - shock loads on, 41-3-64, 41-6-147
 - simply-supported, 36-5-77, 37-4-53, 38-1-11
 - Timoshenko, 40-4-2
 - vibration of, 38-3-13, 39-3-49, 40-2-40, 40-4-47, 41-6-163
 - vibration analysis of, 40-5-277
 - viscoelastic sandwich, 38-3-13, 39-4-117
 - wedge shaped, 41-6-139
- Beam spring systems**
- coupled bending and torsional vibration of, 36-6-121
- Bearings**
- dynamic response of gas lubricated, 38-3-221, 40-3-275
 - instrumentation for dynamic tests of, 40-3-277
 - oil squeeze, 38-3-45
 - procedures for dynamic tests of, 40-3-280
 - test facility for, 38-3-222
- Belleville spring, 41-2-57**
- Bending frequencies**
- of non-uniform shafts, 36-2-169
 - of railroad cars, 40-6-115
- Bending modes, see also Modal characteristics and Normal modes**
- of beams, 38-1-67
 - comparison of test and theoretical, 39-2-139
- of frames, 38-2-220
- Bending moments**
- in beams with moving point loads, 41-6-55
- Bibliography**
- on vibration equivalence, 39-2-190
- Blast, see also Air blast**
- from weapons
 - effect on AH-56A helicopter, 40-1-70
 - effect on CH-47A helicopter, 40-1-67
 - effect on UH-1B helicopter, 40-1-63
 - helicopter response to, 40-1-61, 40-2-227
 - prediction of field of, 39-6-139
 - prediction of loads on helicopters, 40-2-231
 - scaling laws for, 39-6-141
- Blast closures**
- full-scale and model valves
 - comparison of overpressures for, 40-2-136
 - response to air blast, 40-2-133
- Blast loads**
- stress analysis of submerged structures, 40-7-203
 - on targets, 41-1-36
- Blast waves**
- characteristics of, 41-1-36
 - damage potential of, 41-5-17
 - drag coefficients for cylinders in, 40-2-83
 - interaction with helicopters, 40-2-228
- Bombs**
- low drag
 - flight vibration tests of, 41-8-33
- Boosters, see Launch vehicles and Missiles**
- Bond strength**
- of liquid squeeze-films, 39-2-77
- Boundary layer noise, see also Sound pressure levels**
- for Apollo spacecraft, 37-5-28
 - comparison of sources of, 37-7-78
 - correlation coefficients for, 37-5-63
 - joint acceptance for, 37-5-65
 - on launch vehicle, 36-5-97
 - predictions of, 39-6-105, 41-7-4
 - structural response to, 36-5-102, 40-3-63
 - in weapons bay of F-111B aircraft, 39-6-105
- Brake squeal**
- in aircraft landing gear, 39-3-179

- Bridges**
dynamic analysis of, 41-4-99
vibration tests of, 41-4-101
modal analysis of, 41-4-106
- Buckling loads**
on viscoelastic sandwich beams, 39-4-118
- Buffeting**
of Titan III models, 37-3-121
- Buildings**
mass-spring model of, 38-2-190
- Bullpup Missile**
rocket-propelled sled tests of, 39-1-179
- Bump tests**
of communications equipment, 39-6-15
design of machines for, 39-6-15
as a quality control tool, 39-6-18
- C**
- C-130 aircraft**
power spectral density on, 37-7-29
- C-133 aircraft**
power spectral density on, 37-7-32
- Calculator**
for critical damping, 38-3-89
- Calibration**
of accelerometers, 37-2-17, 41-3-1
of charge amplifiers, 36-6-212
by comparison, 36-6-193
of high-frequency microphone, 37-2-7
laser for, 37-2-1
for launch phase simulator, 36-6-207
shock test facilities for, 40-2-205
of vibration exciters, 36-6-183
- Cantilever beams, see Beams**
- Captive Air Space Craft (CASC)**
concept of, 41-1-1
- Captive airborne weapons, see Airborne weapons and Captive flight**
- Captive flight, see also Airborne weapons environment**
AIM-4D missile, 37-1-125
for airborne weapons, 39-S-15
data analysis of, 39-1-208
of FAE weapon, 40-S-56
of helicopter trap weapon, 40-S-54,
40-S-58
instrumentation for vibration test for,
40-6-15
measurement of, 37-1-178, 37-1-195
for Phoenix Missile, 39-6-77, 39-6-93
predicted vs measured, 39-6-80,
39-S-27
problems in simulation of, 40-6-61
on propeller aircraft, 39-S-26
simulation in wind tunnel, 40-3-9
specification of vibration tests for,
39-1-212
for Standard Antiradiation Missile
(AARM), 40-6-68
for SUU-35 munitions dispenser,
40-6-9
for SUU-38 munitions dispenser,
41-5-89
vibration test, 40-S-48
vibration
of airborne weapons, 40-6-9, 41-S-25,
41-S-33
effect of aircraft flight parameters
on, 39-1-208
of FAE weapons, 40-S-47
of helicopter trap weapons, 40-S-47
versus MIL-STD-810A, 37-S-115
of missiles, 39-1-195, 40-S-67
panel discussion on, 40-S-83
- Captive tests, see Static firing tests**
- Cargo, see Packaged equipment**
- Catenary horns, see Acoustic test facilities**
- Cavitation**
effects on response of hulls to underwater
explosions, 41-S-50
in underwater explosions, 41-S-49
- Cavity resonance**
in captive airborne weapons, 39-S-24,
40-6-11
- Centrifuges, see Launch-phase simulator**
- CH-47 helicopter**
distribution of induced velocity on, 37-6-6
reduction of vibration in, 40-5-191
response
to blast of weapons, 40-1-67
- CH-53 helicopter**
compatibility of turbine engine with
airframe, 39-3-17
- Chaparral missile**
transportation tests of, 39-2-37

- Charge amplifiers
calibration of, 36-C-212
- Chatter
in aircraft landing gear struts, 39-3-179
computer program for simulation of,
39-3-188
- Chladni figures
for vibrating panels, 39-3-11
- Clarkson's Method
for prediction of stress in aircraft
structures, 39-3-88
- Columns
mathematical analysis of, 39-3-248,
41-6-2
parametric response to shock loads,
40-2-115
parametric response spectra for, 39-3-247
parametric vibration of, 41-6-1
response to shock pulses, 40-2-117
unstable regions for, 41-6-5
- Combined environmental tests, see also Launch
Phase Simulator
of Apollo short stack, 40-3-211
data acquisition for, 40-7-99
facilities for, 36-3-119, 37-3-175, 40-2-51,
40-3-293
load control systems for, 40-3-225
use of regression analysis in, 36-6-83
of shipboard electronic equipment, 36-6-83
of spacecraft, 37-5-175
on subsystems of Orbiting Astronomical
Observatory, 40-3-189
of timers, 40-3-293
- Combined environments
effects on electronic equipment, 36-C-83
failure of structures from, 39-3-67
- Combustion instability tests
on the Saturn IB Saturn launch vehicle,
40-4-109
- Complex structures
analysis of mechanical impedance for,
38-2-271
dynamic analysis of, 39-3-153
stress waves in, 36-2-33
vibration analysis of, 39-3-99
- Component mode synthesis
theory of, 41-6-116
for vibration analysis of rocket motors,
41-6-115
- Components, see also Electronic components
criteria for vibration of, 37-7-200
qualification by acoustic tests, 37-5-153,
37-5-43
synthesis into mathematical model of
structure, 38-2-198
vibration tests of, 37-5-4, 38-1-87,
39-2-71
- Composite loss factor
for space-damped structures, 38-3-32
- Composite materials
acoustic tests of, 39-4-101
dynamic characteristics of, 36-4-95
predicted and experimental characteristics,
36-4-104
shock wave propagation in, 41-5-69
vibration of fiber-reinforced, 39-4-81,
39-4-93
- Composite structures
damping in, 38-3-24, 38-3-57
- Compressed air launchers, see Shock test
facilities
- Computer programs
for analysis of ground motion, SPECANAL,
41-6-79
for analysis of shipboard vibration,
36-6-115
for brake squeal simulation, 39-3-188
for chatter simulation, 39-3-188
for combined environments test, 40-7-107
for dynamic analysis
of antenna mast, 40-2-105
of gas turbines, 39-3-11
of shipboard equipment, 40-1R-2
of structures, 37-2-173, 40-7-178
Dynamic Design Analysis Method (DDAM),
36-6-101, 39-1-61
FAST
for evaluation of hardness of weapon
systems, 41-5-135
FORTRAN IV language, 36-6-105, 36-6-131
for line solution method, 38-2-167
MARS, 37-2-190
for mechanical receptance, 38-2-242
for modal combination, 38-2-139
NASTRAN, 39-1-62, 41-6-203
for normal mode analysis, 36-6-101
for on-line data analysis, 40-7-117
for perturbation analysis (PTL_{CRB}),
40-7-179
for propagation of shock waves, 40-4-135
for response of panels to boundary layer
noise, 40-3-63
for response of tower to ground shock
(1 DYNE), 41-6-82
for shock analysis, 36-6-131, 40-7-153

- for shock spectra, 36-2-12
- for structural analysis
 - of beams, 38-1-76
 - of helicopters, 40-2-238
 - of complex structures, 37-2-173
- Structural Analysis Matrix Interpretive System (SAMIS), 38-2-139, 41-6-115
- for study of isolation systems, 38-3-214, 38-3-295

- Computers, see also Analog computers
 - Digital computers and Hybrid computers
 - calibration of vibrational exciters using, 36-6-183
 - for dynamic analysis, 36-6-101
 - flow diagrams for stiffness analysis on, 37-6-22
 - graphic techniques in analysis of structures, 40-4-41
 - optimum shock isolators using, 39-4-185
 - vibration test of, 37-3-78

- Concrete
 - dynamic properties of, 39-4-201
 - properties of crushable, 39-4-202
 - for shock isolation, 39-4-199

- Cones
 - stress-time history for truncated, 40-4-131

- Consistent mass matrix
 - for beams, 41-6-123

- Contained equipment, see Packaged equipment

- Containers, see also Shipping containers
 - missile
 - shock test facility for, 37-4-137
 - suspension systems for, 39-6-57

- Continuous systems
 - transient response of, 38-2-112

- Control system
 - for transient waveforms on electrodynamic vibration exciters, 40-2-160

- Co-phasors
 - definition of, 37-2-77

- Co quad analysis
 - description of, 41-3-37
 - phase plotting for, 37-2-77

- Correlation, see also Cross correlation
 - Cook's theory of, 39-2-89
 - effect of chamber geometry on noise field, 39-2-93
 - of flight vehicle vibration response, 37-7-77
 - point-to-point
 - of sound pressure levels in reverberation chambers, 39-2-87
 - in projectile - target interaction analysis, 37-1-121

- Correlation analysis, 37-7-81

- Correlation coefficients
 - for boundary layer turbulence, 37-5-63
 - for reverberant acoustic field, 37-5-65

- Correlation functions
 - for panels, 40-3-59

- Coulomb damping, see Damping

- Coupling, see also Cross-coupling and Dynamic coupling
 - in statistical energy analysis, 38-5-11
 - theory of receptance, 38-2-240

- Crack detection
 - in beams, 38-1-50

- Crash
 - hazards for automobiles, 38-3-327
 - response of aircraft during, 38-3-165

- Crash energy dissipators, 39-4-236

- Crash injuries
 - design of an automobile for reduction of, 38-3-325

- Crash simulation
 - on scale model of aircraft fuselage, 38-3-171
 - scale models for, 39-4-230

- Crashworthiness
 - of automobiles, 38-3-325
 - test facility for aircraft seat, 41-3-133

- Creep
 - of composite materials, 36-4-95

- Critical damping
 - calculator for, 38-3-89

- Critical flutter, see Galloping

- Critical speeds
 - damping for control of, 38-3-45
 - of propeller shafts, 36-6-121
 - of shafts, 41-6-203

- Cross correlation, see also Correlation
 - analysis of cracks in beams, 38-1-55
 - coefficient

definition of, 39-2-90
 functions
 definition of, 39-2-89
 for optical systems, 36-6-98
 between random vibration inputs, 39-2-51

Cross-coupling
 between vibration exciters, 37-3-155

Cross-motion
 criteria
 in vibration tests, 40-6-64
 reduction of, 39-2-157

Cross-power spectral density, see also Power spectral density
 definition of, 39-2-90
 of generalized force, 40-3-60
 by recursive filtering, 36-6-65

Crosstalk, see Cross-motion

Crushable structures, see also Yielding structures and Honeycombs
 design criteria for, 41-2-95
 scale models in study of, 39-4-227
 as shock isolators, 39-4-129

Crystal accelerometers, see Accelerometers

Cyclic deformation
 energy absorption by, 38-3-255

Cylinders
 air blast tests of, 40-2-83
 analysis of multilayered, 40-4-127
 fluid induced vibrations in, 41-6-31
 flutter of, 40-3-308
 response of
 to acoustic excitation, 36-5-104
 to boundary layer noise, 36-5-102
 self-excited vibrations of, 40-3-303, 41-6-31
 stability analysis of, 41-6-33
 vibration analysis of, 36-5-107

Cylindrical shells
 Hamilton's Principle in dynamic analysis of, 40-3-134
 torsional vibration of, 36-5-115

D

Damage, see also Fatigue damage
 boundaries for packaged equipment, 40-6-127, 40-6-133
 to eggs during impact, 41-3-11
 prediction for or on frame structures, 38-2-177
 from pyrotechnic shock, 41-5-10

shock
 criteria for structures, 40-2-31
 mechanisms for, 37-4-71
 to shipboard equipment, 39-1-1
of structures
 probability for combined environments, 39-3-65
 from underwater explosions, 37-4-71

Damping
 in air versus a vacuum, 36-4-75
 analog computer simulation of, 40-5-151
 analysis of multifrequency, 38-3-74
 of antennas, 36-6-195, 39-4-1, 40-5-4, 40-5-147
 of beams
 by constrained layers, 38-3-5, 38-3-13, 39-4-53, 40-5-40, 41-2-121, 41-2-133
 errors in calculation of, 38-3-25
 mathematical analysis of, 41-2-133
 models for, 36-4-65
 by unconstrained layers, 36-4-37, 40-5-47
 calculator for, 38-3-39
 characteristics of thrust bearing, 40-3-222
 concept of single-particle impact, 39-4-1
 considerations for vibration test levels, 39-2-153
 for control of critical speeds, 38-3-45
 coulomb
 effect of system response, 36-1-47
 in cylindrical shells, 38-3-121, 39-1-155
 effect
 on dynamic load factors, 41-5-47
 of errors on measurements, 38-3-153
 on response of loose systems to vibration, 41-6-39
 on response of mechanical systems with gaps, 41-6-42
 on upper and lower bounds of shock spectra, 40-2-223
 evaluation of coefficient, 36-4-69
 extensional
 attenuation of acoustic noise using, 38-3-199
 dynamic properties of materials with, 38-3-202
 in flight configuration of Upstage vehicle, 41-6-23
 with grooved slider on rotating shaft, 38-3-112
 for helicopter rotor systems, 41-2-141
 at high temperatures, 36-4-25, 38-3-57
 impact, 39-4-3
 inelastic, 40-5-61
 of joints in structures, 36-4-1
 at low temperatures, 36-4-25, 38-3-57
 in machinery foundations, 36-4-81, 38-3-1, 39-1-143, 39-1-167

materials
 characteristics of, 40-5-1, 40-5-37
 composite, 36-4-95
 criteria for effectiveness, 38-3-200
 effect of test sample geometry on, 40-5-109
 evaluation of, 40-5-105
 stress-strain properties of, 40-5-62
 of multi-modal vibrations, 36-4-49
nonlinear
 absolute displacement transmissibility for, 40-5-32
 isolation of vibration with, 40-5-19
 in launch vehicle structures, 40-5-261
 shock isolation with, 41-2-21
 in pipes, 39-1-143
 use of oil for, 38-3-45, 41-3-7
 of plates, 39-4-63, 40-5-93, 41-2-106
 for reactor fuel assembly, 36-4-72
 relaxation, 40-5-203
 in scale models, 36-4-1
 in shim spring vibration isolator, 37-3-165
 in ships, 40-5-7
 for silencing of ships, 41-2-151
 single frequency, 38-3-72
 of sonar domes, 41-1-13
 spaced, 39-1-167
 of structures
 during acoustic excitation, 41-2-105
 aerospace, 40-5-1
 analysis of, 38-2-271
 comparison of evaluation systems for, 38-3-89
 using constrained layers, 38-3-71
 effect of air on, 36-4-75
 effects on mechanical impedance, 40-3-236
 at extreme temperatures, 38-3-57
 by impact, 39-4-1
 inelastic, 40-5-61
 in joints, 36-4-1
 by multi-layered treatments, 39-4-31, 39-4-53, 41-2-121
 resonant beams for, 39-4-19
 skin-stringer, 39-4-31
 for sonic fatigue resistance, 40-5-49
 with stiff members, 38-3-29
 using vibration absorber, 40-5-147
 viscoelastic materials for, 36-4-9, 36-4-25, 36-4-49, 38-3-121, 38-3-139
 of variable resonant vibration exciter, 38-5-3
 using vibration absorber, 37-6-57
 with viscoelastic materials
 of aerospace structures, 40-5-1
 using constrained layers, 38-3-37, 39-1-143, 39-4-53, 40-5-37, 40-5-93, 41-2-121, 41-2-133
 determination of properties, 36-4-37, 39-4-11, 41-2-133
 effects of frequency on, 38-3-156
 effects of temperature on, 38-3-156
 evaluation of effectiveness of, 40-5-105
 at extreme temperatures, 36-4-25, 38-3-57, 41-2-125
 of helicopter vibrations, 41-2-141
 measurements of, 38-3-151
 multifrequency response of, 38-3-71
 for multi-span structures with, 36-4-49
 of radar antenna, 38-3-58
viscous
 approximation of, 40-5-23
 using a mechanical system, 38-3-111

Data acquisition
 for air blast tests, 40-2-105
 of aircraft vibration, 37-1-154
 of captive flight environments, 37-1-125, 39-6-93, 40-5-47
 for combined environments tests, 40-7-99
 with constant bandwidth FM system, 37-2-109
 for helicopter ground vibration survey, 36-3-76
 on-line digital computers for, 40-7-99
 of transportation environments, 36-6-163, 40-7-45

Data analysis
 of acceleration data, 38-2-113
 for acoustic tests, 37-5-77, 37-5-35
 of aerodynamic noise, 37-3-208
 from air blast tests, 40-2-84
 of boundary layer noise, 39-6-106
 for combined environments tests, 40-7-99
 digital systems for, 40-7-115, 41-5-39
 of dynamic environments, 41-3-55
 equipment for mapping of mode shapes, 39-2-64
 of flight data, 37-1-139
 of gunfire environment, 37-7-206, 41-4-46, 41-4-203, 41-4-210
 of helicopter noise, 37-5-74
 for high-force vibration tests, 37-3-143
 of Mariner flight data, 37-4-5
 for mechanical impedance, 41-5-54
 on-line digital computers for, 36-6-57, 40-7-99, 40-7-115
 using optical systems, 36-6-91
 panel discussion on proposed standard, 39-6-7
 philosophy of, 41-3-81
 of shock
 automated system for, 36-6-21
 desiderata for, 36-6-22
 on gun set-back acceleration, 36-2-55
 pyrotechnic, 37-4-21
 on simulator for human head impact, 39-5-96

- of tests on munitions dispenser, 41-5-94
- of transportation environments, 37-7-19, 39-6-34
- of vibrations
 - assembly level tests, 37-5-129
 - during captive flight, 37-S-109, 39-1-208, 39-6-106, 40-S-47
 - flow chart for, 40-7-230
 - in helicopters, 37-S-74
 - from large electrohydraulic test system, 41-3-115
 - missiles, 37-7-98
 - with on-line digital computer, 36-6-57, 40-7-99
 - from pulsed random tests, 40-3-273
 - from Saturn tests, 36-6-55
 - of shells, 39-3-107
 - shipboard, 36-6-67
 - on spacecraft in flight, 37-7-176
 - techniques for, 36-6-47, 39-6-122
 - for wind tunnel test, 37-7-224
- Data reduction, see Data analysis
- Deceleration
 - of projectile during impact, 41-5-70
- Deceleration device
 - for protection of test specimen, 39-2-12
- Decks
 - effect of equipment mass on shock motion, 40-1-1
- Deckhouses
 - mathematical models of, 39-1-111
- Deflection, see Displacement
- Delta launch vehicle
 - noise measurements on, 36-7-89
- Design, see specific items being designed
- Design criteria
 - for active vibration isolators, 39-4-159
 - for Advanced Orbiting Solar Observatory (AOSO), 36-7-66
 - for ATS-B spacecraft, 36-7-41
 - for crushable structures, 41-2-95
 - for deckhouse structure, 39-1-111
 - for electronic components, 37-4-100
 - for focal isolation system, 38-3-268
 - for Hawk suspension system, 41-2-160
 - for impact limiters, 40-2-183
 - for inverting tube shock isolator, 41-2-89
 - for skid isolators, 39-4-180
 - for universal test fixture, 39-2-177
 - for unmanned spacecraft structures, 40-3-96
 - for vibration test fixtures, 36-3-102
- Design philosophy
 - for dynamic test facilities, 41-3-119
- Design procedure
 - for shock isolation system, 41-2-68
- Destroyers, see Ships
- Detonations, see Gas detonations and Nuclear detonations
- Digital computers, see also Analog computers, Computers, and Hybrid computers
 - in analysis of fatigue damage, 36-5-17
 - for analysis of mechanical impedance, 41-5-53
 - calculation of shock spectra by, 36-6-131
 - for control of waveforms of shock tests, 40-2-157
 - for design of shipboard equipment, 39-1-55, 39-S-55
 - for determining mini-max response, 36-5-71
 - in dynamic analysis of antennas, 40-1-75
 - in dynamic analysis of helicopter structures, 40-1-61
 - for Dynamic Design Analysis Method (DDAM), 36-6-101
 - dynamic programming for, 36-5-74
 - dynamic response of aircraft using, 38-3-169
 - for modal analysis of structures, 41-7-12
 - on-line application for data analysis, 36-6-57, 40-7-99, 40-7-115
 - in optimization of structures, 39-1-63
 - programs
 - for analysis of fatigue damage, 36-5-25
 - comparison of, 36-5-65
 - for dynamic analysis, 36-7-45, 39-1-59
 - in shock analysis, 40-7-153, 41-5-39
 - for simulation of overturning of structures, 37-4-193
 - for structural analysis, 38-2-139, 40-4-41, 40-4-63
 - for vibration analysis, 36-6-51, 36-6-115, 37-2-57, 38-3-295
- Digital recording systems
 - for transportation environments, 36-6-163
- Dimensional analysis
 - in scaling of performance of shock tubes, 39-5-55
- Dirac delta function, 36-5-119
- Direct stiffness method
 - for analysis of structures with rotating elements, 40-4-41

- for dynamic analysis of continuum bodies, 36-5-55
 - in finite element analysis, 36-5-56
 - in helicopter vibration analysis, 40-4-48
 - for prediction of vibration, 37-6-20
- Displacement**
- amplifier for shock, 41-3-149
 - bounds for rigid plastic structure, 37-4-74
 - calculation from random vibration data, 40-3-2
 - of composite panels, 39-3-191
 - differential across structures, 40-2-1
 - vs frequency for electrohydraulic test system, 40-5-249
 - of guideway structures for tracked air cushion vehicles, 40-4-57
 - of imperfect columns, 39-3-247
 - isometric representation of, 36-7-133
 - limiting device for vibration exciter, 39-2-11
 - mathematical analysis of railroad car, 39-6-52
 - measurement of
 - design of system for, 40-7-18
 - using holography, 41-3-63
 - using a multiple-beam interferometer, 37-2-13
 - proximity probes for, 40-7-17
 - of shells, 38-2-84, 40-3-46
 - test facility for simulation of large, 41-3-149
 - transfer functions for lumped parameter systems, 38-2-111
- Displacement-time history**
- during crash of vehicles, 39-4-231
 - for Partial Full Scale Test Machine, 39-4-222
 - for sonar transducers, 41-1-30
 - for spherical structures, 41-7-98
 - of tower, 41-6-84
- Displacement transmissibility**
- for nonlinear vibration isolation system, 40-5-32
- Distributed mass systems**
- response to base motion, 37-4-48
- Distributed parameter system**
- calculation of modal response suppression factor for, 38-2-277
- Drag coefficients**
- for cylinders in blast wave, 40-2-83
- Drag loads**
- from air blast, 40-2-104
- Dragon Missile**
- vibration tests of, 40-3-268
- Drop ball test**
- impulse by, 37-2-21
- Drop height**
- effect of package size on, 37-7-14
 - effect of package weight on, 37-7-13
 - recorder for packages, 39-6-19
 - during rough handling, 37-7-4
- Drop test machines, see Shock test facilities**
- Drop tests**
- on different surfaces, 36-6-175
 - rotational, 39-4-181
- Ducts**
- procedures for vibration tests of, 40-5-66
- Duhamel integral**
- calculation of spectra using, 36-2-12
- Dynamic analysis, see also Modal analysis, Shock analysis, Mathematical analysis, Structural analysis and Vibration analysis**
- of aerospace vehicles, 41-7-151
 - of ammunition conveyor systems, 40-4-115
 - of anisotropic materials, 38-2-201
 - of ballistic range models, 40-4-127
 - of beams, 41-6-211
 - component mode synthesis for, 41-6-115
 - computer flow diagrams for, 37-6-22, 40-1R-6
 - of conservative systems
 - Lagrange equations for, 41-6-87
 - Liapunov's functions for, 41-6-88
 - consideration of joints in, 37-2-182
 - cylinders, 41-7-93
 - digital computer programs for, 36-7-45, 40-1R-2, 40-4-63, 41-6-203, 41-6-115
 - by direct stiffness method, 36-5-55
 - of driver section for shock tube, 37-4-131
 - Dynamic Substructure Method in, 39-1-58
 - elasticity of launch rail in, 41-6-225
 - elastic-plastic, 37-1-25, 39-5-1, 40-4-67
 - of electronic equipment, 37-4-97, 38-2-11, 39-3-117
 - of equipment, 40-2-215
 - of equipment-foundation system, 38-2-210
 - finite element method, 38-1-7, 39-1-56, 39-3-129
 - flow path for, 41-6-179
 - of fluid-filled shells, 38-2-79
 - of fluid filled tubes, 41-7-144
 - of foundations, 39-1-123
 - of gas turbine, 39-3-21
 - of grillages for ships, 40-7-207

- of helicopter structures, 39-3-17, 40-1-61
- of hinged arches, 41-6-90
- improvement of mathematical model for, 36-5-1
- of inertial guidance, 40-3-257
- use of influence coefficients in, 36-6-101, 38-2-50
- interface between stress analysis and, 41-6-179
- of isolation system, 41-2-160, 41-5-129, 41-5-155
- of launch loads, 38-2-67
- of launch vehicles, 40-3-205
- of launch vehicles/spacecraft interface, 40-3-79
- line solution method, 38-2-163
- of lumped parameter systems, 38-2-57, 38-2-274, 39-3-153
- mass matrix in, 37-2-187
- mechanical impedance in, 38-2-8
- of nonconservative systems, 41-7-141
- of non-linear systems, 39-5-1
- normal mode method, 37-4-91, 41-2-105
- of partially filled shells, 41-7-151
- preliminary planning for, 38-2-1
- problems in, 41-2-1
- of railroad cars, 40-6-109
- of re-entry vehicles, 39-1-223
- of rotor bearings, 40-3-281
- of scale model automobiles, 40-4-89
- of shafts, 40-4-163
- of shipboard equipment, 36-7-129, 39-1-45, 39-1-84, 39-5-41, 40-7-165
- of shipping containers, 39-6-57
- of ship structures, 40-7-197
- of single-degree-of-freedom systems, 41-5-45
- solids immersed in fluids, 40-1R-11
- of sonar transducers, 41-1-21
- spheres, 41-7-91
- of spacecraft, 36-3-16
- of spring-mass ejection system, 41-6-93
- stiffness matrix in, 37-2-175
- for strain response, 36-5-79
- use of structural damping in, 38-2-271
- of structures, 37-2-173, 39-1-107, 39-3-99, 39-3-129, 39-3-153, 40-2-57, 40-2-123, 40-2-227, 40-2-243, 40-4-25, 40-4-41, 40-4-47, 40-4-63, 40-7-153, 41-5-27, 41-6-75, 41-7-9, 41-7-19, 41-7-81, 41-7-89, 41-7-123, 41-7-131
- symmetry in, 38-2-6
- of tethered systems, 40-4-225
- of towed cables, 41-6-61
- of vibration test specimens, 41-4-79
- of yielding structures, 36-2-10

Dynamic characteristics
of Advanced Orbiting Solar Observatory (AOSO), 36-7-66

- of control system for vibration tests, 36-3-150
- comparison of using lumped parameter method, 38-2-61
- of composite beams, 36-4-28
- of composite materials, 36-4-95
- of crushable materials, 41-2-98
- of gas turbine powered helicopters, 39-3-17
- measurement of
 - on equipment, 40-7-29
 - on structures, 40-7-51
- of shock isolators, 41-2-53
- of vibration test system with flexure guides, 39-2-164

Dynamic coupling
between translation and rotation, 36-7-135

Dynamic Design Analysis Method (DDAM), 39-1-55, 40-1R-1
for analysis of motion of immersed solids, 40-1R-17
derivation and implications of, 37-4-91
in design

- of foundations, 39-1-40
- of shipboard equipment, 39-1-13, 39-1-25, 39-1-74, 40-7-144

 digital computer programs for, 36-6-101, 40-7-153
use of dynamic substructure method for, 38-2-12
flow chart for, 39-1-57, 40-7-166
perturbation techniques for, 40-7-177
prediction versus full-scale shock test measurements, 36-1-1
review and approval of mathematical models for, 39-1-45
selection of normal modes for, 40-7-165
validation and derivation of inputs for, 39-1-13

Dynamic environments
during arrested landings, 40-6-37
for cargo

- on railroads, 39-6-47
- on trucks, 39-6-31

 criteria for simulation of weapon-mount interface, 41-5-53
data analysis for, 41-3-55
derivation for propellant storage module for Sky Lab, 41-7-195
effects of

- on field tests, 39-6-1
- on fragility of systems, 41-5-111
- on performance of gas lubricated bearings, 40-3-275

 of eggs, 41-3-11
for ejected missiles, 40-6-1
measurements of, 39-6-27

- prediction of
 - use of flight vibration data in, 41-4-189
 - of mechanical impedance in, 38-2-249
 - for spacecraft, 40-3-79
 - statistical energy analysis for, 41-6-9
 - of railroad cars, 41-4-141
 - for spacecraft, 41-4-3
 - Dynamic equivalence
 - of lumped parameter system, 39-3-157
 - Dynamic excitation
 - of damped structures, 38-3-71
 - of immersed solids, 40-1R-11
 - Dynamic loads
 - on Atlas booster and tethered cannister, 40-4-226
 - bounds for response of conservative systems to, 41-6-87
 - on space vehicles from flight vibration data, 40-4-171
 - Dynamic matrix
 - for structures, 37-2-190
 - Dynamic models, see also Mathematical models, Models, and Scale models
 - plastic materials for, 40-4-89
 - scaling laws for, 39-4-228, 40-4-89, 40-5-183
 - Dynamic modulus
 - of composite materials, 36-4-95
 - Dynamic overstress
 - criteria for in materials, 40-2-28
 - Dynamic response, see response
 - Dynamic similarity
 - criteria for scale model structures, 39-3-40
 - Dynamic stability
 - of columns, 41-6-1
 - of conservative systems, 41-6-87
 - of shells, 41-7-81
 - of structures, 40-2-57
 - Dynamic Substructures Method
 - in dynamic analysis, 38-2-14, 39-1-58
 - Dynamic systems
 - equations of motion for, 40-5-137
 - mechanical impedance of, 40-5-135
 - normal mode analysis of, 40-5-135
 - Dynamic stresses
 - in sonar transducers, 41-1-31
 - Dynamic tests
 - of gas lubricated roller bearings, 40-3-275
 - general purpose fixture, 39-2-175
 - of plastic scale models, 39-3-39
 - of vehicles, 41-3-127
 - Dynamics
 - discussion on, 41-2-1
 - of shock isolators, 39-4-213
 - of protective structures, 38-2-187
- E
- Earthquakes
 - vibration test systems for simulation of, 41-3-109
 - Effective mass
 - definition of, 36-6-123
 - Effective modulus theory
 - in analysis of laminated layers, 41-6-188
 - Effective weights
 - of reduced lumped parameter systems, 39-3-158
 - Eigenvalue problems
 - for fluid-filled shells, 38-2-86
 - solution of, 38-3-98
 - Eigenvector flowgraphs
 - for discrete systems, 38-1-104
 - Elastic materials
 - mechanical properties of, 38-3-251
 - Elastic medium
 - dynamic response in, 39-5-13
 - Elastic-plastic system
 - response to half sine pulse, 40-4-67
 - response to a sawtooth shock pulse, 39-5-1
 - Elastic skid mounts
 - as shock isolators, 39-4-179
 - Elastic strain energy
 - in damped skin-stringer structures, 39-4-35
 - Elastic wave
 - propagation in helical coil, 41-2-77
 - Elastomers, see also Viscoelastic materials
 - piezoelectric properties of, 38-2-1
 - as shock isolator, 41-2-57

- Elastoplastic response**
of shells to impulsive loads, 41-7-81
- Electrodynamic shakers, see** Vibration exciters
- Electromagnetic loudspeakers, see** Acoustic test facilities
- Electronic components, see also** Components
design criteria for, 37-4-100
vibration tests of, 40-5-111
- Electronic equipment**
acoustic tests of, 37-3-8
dynamic analysis of, 37-4-37, 39-3-117
effects of combined environments on, 36-6-83
internal vibration of, 37-3-7
qualifications of, 41-4-119
reliability testing of, 36-7-23
shock response of cabinet for, 36-7-129
shock tests of, 39-3-118, 39-5-79, 41-4-123
vibration tests of, 37-3-14, 40-5-63, 41-4-122
vibration tests for detecting loose parts, 36-6-73
- Energy**
equivalence in components of, 41-3-83
processing within a transducer, 41-3-92
- Energy-absorbing steering column**
characteristics of, 37-4-82
- Energy absorption**
by cyclic deformation, 38-3-255
in highway guard-rail structures, 40-5-115
inverting tube for, 41-2-89
materials for, 40-2-183
using modified concrete, 39-4-199
spherical crushable structures for, 41-2-95
in vehicle structures, 39-4-227
- Energy analysis**
of two coupled modes, 36-5-43
- Energy balance**
in multipanel structures, 37-2-101
- Energy density**
definition for transient acceleration pulse, 39-5-83
- Energy-flow method**
for shock analysis, 37-4-65
- Energy methods**
for vibration analysis of segmented rings, 39-1-144
- Energy spectral density**
for sum of two shock waves, 41-5-23
- Engine cutoff**
vibration tests for, 37-4-60
- Environmental data**
measurement and recording of, 36-6-163
for rocket engines, 37-2-135
from ships, 40-7-225
- Environmental factors**
affecting latent information parameters, 41-3-87
- Environmental tests**
definitions of, 39-2-124
of explosive weapons, 40-3-193
- Environments, see** specific environments such as Transportation environments, Vibration environments and so forth
- Equal annoyance contours**
for vibrating humans, 41-2-16
- Equalization**
analog system for, 36-3-49
with low-frequency phase compensation, 36-3-51
for random vibration tests, 41-4-79
- Equations of motion**
for cylindrical shells, 40-3-133
of helicopter structures, 41-7-134
for hemispherical shells, 38-2-82
for landing gear, 39-3-182
for lateral displacement of columns, 40-2-115
for lateral launch loads, 38-2-70
for multicore sandwich beams, 40-5-280
for non-uniform beams, 38-1-69
for open-frame structures, 38-2-183
for plates, 38-1-46, 40-3-119
of sandwich plates, 39-4-76
for sandwich shells, 40-3-70
for spherical shells, 40-3-75
for two-degree-of-freedom nonlinear systems, 39-3-162
for vibration isolators, 40-5-22
- Equipment, see** specific equipments such as Electronic equipment, Shipboard equipment and so forth
- Equivalence**
bibliography on vibration, 39-2-190
in energy components, 41-3-83
of measured and predicted strains, 36-5-77
of measured and predicted vibrations, 36-5-90

- in power components, 41-3-83
 - of test specimens, 36-2-63
 - of transients, 36-2-101
 - of vibration tests, 39-2-187
 - Error analysis**
 - algorithm, 39-3-102
 - in beam damping calculations, 38-3-25, 41-2-135
 - of damping calculations, 38-3-153
 - of instrumentation, 37-S-115
 - of measured properties of viscoelastic materials, 39-4-15
 - of mechanical impedance measurements, 39-1-128
 - of shock tube performance data, 39-5-59
 - Exploding wires**
 - simulation of shock waves by, 37-4-117
 - Explosions**
 - of liquid propellants, 38-2-177
 - Explosive shock, see Pyrotechnic shock**
 - Extensional damping, see Damping**
- F**
- F-4 Aircraft**
 - AIM-4D missile on, 39-1-195
 - F-111B aircraft**
 - environment measurements on Phoenix Missile in, 39-6-93
 - predicted vs measured environment for missile in, 39-C-117
 - vibration of Phoenix missile in, 39-6-77, 39-6-53
 - FAE weapon**
 - captive flight vibration on UH-1E helicopter, 40-S-59
 - Failure analysis**
 - of beams, 37-4-50
 - of shells, 39-5-21
 - Failure criteria**
 - for shipboard structures, 39-1-107
 - for structural members, 38-2-183
 - Failure modes**
 - in fatigue tests, 39-4-131
 - Failure rate tests**
 - for missiles, 39-2-99
 - Failures**
 - under acoustic test, 37-5-170, 37-5-63, 39-3-65
 - due to air blast after acoustic loading, 39-3-68
 - in aircraft gas turbines, 39-3-18
 - calculation of probability of, 41-5-141
 - from combined environment, 39-3-67
 - effect of qualification test levels on, 40-3-20
 - in electronic equipment, 36-6-73
 - of shell structures, 37-4-177
 - of spacecraft, 40-3-9
 - of weapon systems, 41-5-135
 - Fast Fourier Transform, see Fourier analysis and Fourier transform**
 - Fatigue, see also Acoustic fatigue**
 - of aircraft structures, 39-3-87, 40-5-49
 - in the design of electronic equipment, 40-4-97
 - Miner's Hypothesis for random vibration, 41-3-47
 - in shim spring vibration isolator, 37-3-168
 - of structural joints, 39-4-117
 - of structures, 40-5-61, 40-6-67
 - effect of air damping on, 36-4-75
 - Fatigue damage, see also Damage analog computer for, 41-3-60**
 - criteria for comparison of random vibration environments, 41-3-43
 - digital computer program for, 36-5-25
 - energy summation in, 40-3-139
 - gages for measurement of, 39-2-35
 - to a multi-modal system, 36-5-17
 - from random vibration, 40-3-1
 - Fatigue failures**
 - criteria for, 36-5-19
 - Palmgren-Miner hypothesis for, 40-4-99
 - reduction of, 40-4-97
 - due to vibration, 36-4-75
 - Fatigue gage**
 - description of, 39-2-35
 - Fatigue life**
 - effect of mean stress on, 40-4-99
 - prediction of, 39-3-87, 40-6-67
 - Fatigue tests**
 - for Chaparral missile, 39-2-37
 - failure modes of test specimens in, 39-4-131
 - of viscoelastic sandwich beams, 39-4-123
 - Ferrofluids**
 - definition of, 41-3-18
 - Field data, see specific data of interest such as Shock data and Vibration data**

- Field handling**
analysis for Polaris missile, 36-7-145
- Field of excitation**
definition of, 37-3-77
- Field tests**
of Army equipment, 39-6-1
- Finite Cosine transform**
definition of, 36-5-109
- Finite element method**
analysis by
of beams, 38-1-10, 41-6-123, 41-7-51
of grillages, 40-7-212
of helicopter structures, 41-7-132
of plates, 40-3-99, 41-7-41
of shells, 41-7-84
of structures, 41-7-123
for dynamic analysis, 39-1-56, 39-3-129
extension of, 36-5-55
mathematical analysis of sonar transducers, 41-1-21
model of solar panels for, 38-2-149
random vibration using, 38-1-7
for shock analysis, 38-2-11
- Fixed-base natural frequencies**
definition of, 38-2-209
of experimental structures, 38-2-263
measured vs calculated, 38-2-268
for shipboard equipment, 38-2-209
use in shock design, 38-2-261
- Fixtures**
accelerometer error
due to strain in, 37-2-47
due to stress in, 37-2-43
characteristics of multimodal, 40-3-233
design of
for floating shock platform, 37-4-85
for resonant beam vibration tests, 39-2-72, 39-2-221
for shock tests, 38-2-95
for vibration tests, 36-3-101, 39-3-31, 40-3-231
flexure guides for vibration tests, 39-2-157
general purpose, 39-2-175
parameters for selection of, 38-1-91
for vibration tests of composite panel, 39-3-192
for vibration tests of elastomers, 39-2-4
for vibration tests of Saturn S-IVB, 37-3-138
- Flat plates**
as underwater explosion model for hulls, 41-S-49
- Flexibility matrices**
for whip antennas, 40-1-49
- Flexible structures**
experimental study of very long, 36-6-195
- Flexural vibrations**
considerations in composite beams, 38-3-18
- Flight data**
acquisition, 37-1-137
for airborne electronic equipment, 40-S-66
for Apollo spacecraft, 37-5-90
comparison of acoustic test with, 37-3-23
comparison with vibration test criteria, 37-3-7
during launch of OGO, 37-3-21
Mariner, 37-4-5
measurement of, 40-S-63
for SNAP 10A, 36-7-75
for spacecraft, 37-7-182
- Flight test**
of helicopters with active isolator, 37-6-75
program for captive missile, 39-6-102
vs system test response data, 39-1-217
- Flight vibration**
vs acoustically induced vibration, 37-5-160
comparison of qualification test to, 41-3-47
data analysis for, 37-7-176, 37-S-109
dynamic loads on space vehicles from, 40-4-171
vs flight acceptance test requirements, 39-6-129
vs ground vibration test, 37-7-173
at low altitudes and high speed, 39-4-158
predicted
from acoustic excitation, 36-5-85
vs measured for spacecraft, 39-6-128
for missiles, 41-4-189
by statistical energy analysis, 41-6-9
probability of exceeding specified vibration test levels, 41-S-28
procedures for measurement of, 39-6-121
simulation of
for captive missile, 39-6-86
for helicopter, 41-3-121
for re-entry vehicle, 36-3-113
for spacecraft, 39-2-147
for spacecraft, 37-5-28, 39-6-119, 40-3-8, 40-3-163
vs static firing tests, 39-6-133
- Floating platforms, see also Shock test facilities**
for shock tests, 37-4-85, 40-2-1

- Floors**
shock isolated, 41-5-155
- Flow chart**
for method of indirect synthesis, 39-4-190
- Flow diagram**
for optimal design of shock isolators, 41-2-49
for vibration analysis of helicopters, 41-7-132
- Flowgraphs**
structural analysis using, 38-1-99
- Flow noise**
reduction in water tunnels, 41-2-151
- Fluctuating pressure, see Boundary layer noise**
- Fluid damping**
effect on motion of immersed solids, 40-1R-15
- Fluid films, see Oil films**
- Fluid systems**
shock analysis of, 40-2-67
- Flutter**
of aircraft wings, 41-7-109
in combined flexure-torsion system, 40-5-235
of cylinders, 40-3-308, 41-6-31
of hydrofoils, 41-7-205
mathematical analysis of, 41-7-111
of panels, 40-4-139
root locus equations for, 40-5-237, 41-7-113
of structures in fluid stream, 39-3-171
water tunnel facility for tests, 41-7-207
- FM multiplex system, 36-6-210**
- Foams, see specific foams such as Polyurethane foams and Polystyrene foams**
- Force-acceleration feedback**
for control of input, 39-4-11
- Force-controlled shock tests**
concept of, 39-5-63
- Force-controlled vibration tests**
feasibility of, 36-3-15
on spacecraft, 36-3-15
specification of, 36-3-1, 41-4-69
techniques for, 36-3-47, 37-3-61, 41-4-31
- Force-node method**
for lumped parameter system, 38-2-292
- Force transducers**
development of, 36-6-203
evaluation of, 36-3-7
for variable resonant vibration exciter, 38-S-3
- Force transfer functions**
for lumped parameter systems, 38-2-111
- Forcing functions**
for helicopters, 40-S-48
for hydraulic shock inputs, 41-1-23
for mathematical models of railroad cars, 40-6-112
for piping for steam systems, 39-1-155
for re-entry vehicles, 40-3-36
- FORTTRAN IV computer language, 36-6-105, 36-6-131**
- Foundations, see also Machinery foundations**
for antenna mast structures, 40-2-103
digital computers for design of, 39-1-55
inputs to, 40-7-188
motion of plates on, 40-4-220
for shipboard equipment, 39-1-39, 40-7-171
stresses and motions in, 40-4-219
yielding properties of distributed, 40-4-82
- Fourier analysis**
of acceleration response of scale model hull, 41-S-1b
for random vibration, 38-1-18
of shock data, 41-5-39
- Fourier spectra**
of complex shock transients, 36-6-9
derivation of, 41-5-21
using Duhamel integral, 36-2-12
effect of digitizing detail on accuracy, 36-6-1
for hulls of submarines, 39-S-44
for munitions ejection, 41-5-96
for shipboard equipment in submarines, 39-S-47
of shock pulses, 40-2-175
- Fourier transforms**
of acceleration-time histories, 40-3-87
of air pulser output, 41-S-12
calibration of accelerometers using, 37-2-17
for coherent optical systems, 36-6-96
definition of, 41-5-40
fast algorithm for computation of, 40-2-159

- generating shock pulses with modified, 40-7-92
 - in shock analysis of fluid systems, 40-2-67
 - for transient functions, 38-1-18
 - trigonometric terms for, 41-5-45
- Fragility**
- definitions of categories of, 41-5-112
 - in design of structures, 41-5-130
 - of equipment in hardened sites, 41-5-155
 - of equipment in silos, 41-5-161
 - of hydraulic systems, 41-5-143
 - of packaged equipment
 - procedures for determination of, 40-6-127, 40-6-133, 40-6-149
 - shock tests for, 40-6-127, 40-6-133
 - panel discussion on, 40-6-153
 - procedures for determination of, 41-5-119
 - of shock isolation systems, 41-5-129
 - standards for evaluation of, 41-5-111
 - of structures in hardened sites, 41-5-156
 - of systems
 - effect of dynamic environments on, 41-5-111
 - shock tests for, 41-5-121
 - vibration tests for, 41-5-123
- Fragmenting tubes**
- for attenuation of impact, 40-5-115
 - force-time histories for, 40-5-128
 - materials for, 40-5-117
 - shock tests of, 40-5-116
- Frames**
- mathematical models of, 39-3-34
 - mechanical impedance in analysis of, 38-2-219
 - mode shapes of, 38-2-225
 - natural frequencies of, 38-2-225, 39-3-31
 - Fraunhofer Diffraction pattern, 36-6-94
- Frequency**, see also Natural frequency
- of zero crossings, 40-3-2
 - errors in for beams, 41-6-126, 41-6-137
- Frequency analysis**
- of repetitive bursts of random vibration, 38-1-17
- Frequency correction equations for mechanical systems**, 38-2-295
- Frequency parameter**
- for Bernoulli-Euler beams, 39-3-50
 - for Timoshenko beams, 39-3-50
- Frequency response**
- of accelerometers, 41-3-1
 - of microminiature amplifier, 36-6-220
 - of nonlinear vibration isolation systems, 40-5-26
- of piping systems, 40-4-198
 - plotting of, 36-6-37
 - of printed circuit boards, 40-3-113
 - of prototype automobile, 40-4-94
 - of scale model automobile, 40-4-94
 - of vibration isolators, 40-6-40
- Frequency stepping circuit for analog computers**, 36-6-39
- Fresnel-Kirchoff Diffraction formula**, 36-6-94
- Friction**
- effect of balance weight on vibration absorber, 36-7-124
- Frustums**
- propagation of stresswaves in, 40-4-127
- Fuzes**, see Mechanical fuzes
- G**
- Galloping**
- of structures in fluid stream, 39-3-171
- Gas detonations**, see also Nuclear detonations
- for simulation of nuclear blast, 37-4-199
- Gas guns**, see Shock test facilities
- Gas springs**, see Pneumatic springs
- Gas turbines**
- air blast tests of, 40-2-147
 - compatibility with helicopter airframe, 39-3-17
- Gaussian pulse**
- properties of a, 37-2-21
- Geiger thick plate test method**, 40-5-105
- Gemini-Agena vehicle**
- structural analysis of, 37-2-117
 - test program for, 37-2-117
- Gemini-Titan vehicle**
- ground wind-induced vibrations of, 36-7-79
 - vibration tests on, 36-7-80
- General Bending Response Code**
- vibration analysis with, 39-S-60
- Generalized mass**
- definition of, 38-2-274
- Glass structures**
- shock analysis of, 40-5-176

Green's Theorem, 36-0-99

H

Grillages

dynamic analysis of ships, 40-7-207

Ground shock effect on protective structures 38-2-187

instrumentation for, 40-7-133

isolation of protective structures from,
39-4-199

parameters of soils for analysis of,
38-2-195

response of plates to, 40-4-217

response of tower to, 41-6-82

simulation of, 40-2-243, 41-3-149

Ground support equipment

shock isolation of, 37-4-218

Ground winds

during launch, 38-2-70

Guided missiles, see also Missiles

environmental test program for, 39-2-195

Guideways

response to air cushion vehicles, 41-6-47

Gunfire environments

acceleration probability density for,
41-4-218

on aircraft, 40-6-27, 41-4-123

for captive airborne weapons, 39-8-27

data analysis of, 41-4-46, 41-4-203,
41-4-210

field data, 37-2-32

free field blast overpressure, 39-6-142

free field side-on impulse, 39-6-146

on helicopters, 40-1-61, 40-2-227,
41-4-195, 41-4-209

of naval gun, 36-2-53

propagation of blast waves from, 39-6-139

for River Patrol Boat, 37-7-205

shock spectra for, 41-4-204

simulation of, 40-6-27, 41-4-37

Guns

dynamic analysis of recoil adapters,
39-4-251

isolation of recoil forces from, 39-4-211

simulation of recoil of, 41-3-187

Gust loads

on launch vehicles, 38-3-104

Gyroscopes

as synchronous vibration absorbers,
37-6-49

vibration isolators for, 38-3-285

Half-sine pulse, see Shock pulse

Hamilton's principle

in analysis of shells, 40-3-134, 41-7-152

in vibration analysis, 39-4-81, 39-4-93

Handling, see Rough handling

Hankel transform, 36-5-108

Hardened sites, see also Silos

analysis of, 38-2-187

fragility of equipment in, 41-5-155

hydraulic systems for, 41-5-143

shock isolators for, 41-5-129, 41-5-155

Hardening

criteria for ships, 39-1-65, 39-1-66

Harmonic motion, see Vibration

Harmonic spikes

energy summation for, 40-3-149

Hawk missile

dynamic analysis of isolation system for,
41-2-160

dynamic environments for, 41-2-159

Hawker-Siddeley P-1127 aircraft

acoustic environment of, 41-4-164

Heat shield

pyrotechnic shock in, 36-2-63

Helical coil

for dispersal of shock loads, 41-2-77

Helical coil spring

as shock isolators, 41-2-56

Helicopters, see also specific helicopters such as AH-1, AH-56, CH-47, CH-53, OH-4, and UH-1

active vibration isolator for, 37-6-63

ammunition conveyor system for, 40-4-115

balancing of rotors for, 36-7-113

compatibility of gas turbine with, 39-3-17

computer programs for structural
analysis of, 40-2-238

damping of vibration in, 41-2-141

data acquisition system for vibration of,
36-3-76

design of fuselage, 37-6-27

dynamic analysis of, 40-4-43

dynamic characteristics of gas turbine
powered, 39-3-17

- flight test of, 37-6-75
 - focal isolation system for, 38-3-263
 - ground vibration surveys of, 36-3-71, 39-3-23
 - gunfire environment of, 41-4-195, 41-4-209
 - mathematical model of, 38-3-282
 - noise in, 41-4-221
 - prediction of loads in rotor blades, 37-6-6
 - prediction of response to blast, 40-2-231
 - prediction of vibration in, 37-6-19
 - reduction of vibration in, 36-7-113, 37-6-5, 37-6-29, 37-6-33, 37-6-49, 37-6-63, 40-5-191, 38-3-263
 - response to blast of weapons, 40-1-61, 40-2-227
 - simulation of flight vibration, 41-3-121
 - transmission of vibration from rotors, 37-6-5
 - vibration in, 37-6-1, 39-3-17, 40-4-48, 40-5-191, 41-4-195, 41-4-209, 41-4-221, 41-7-131
 - vibration absorber for, 37-6-23, 40-5-191
- Helicopter Trap Weapon (HTW)
captive flight vibration of, 40-S-59
- High acceleration shock test facility, 40-2-205
- High impact, see also Impact
of shells, 39-5-21
- High-impact shock machines, see also Shock test machines
fixtures for, 38-2-95
mathematical model of, 38-2-97
modified, 38-2-226
- High polymers
effect on diffuser flow noise, 41-2-151
- High-shock loads
foundations for, 38-3-1
simulation of, 40-2-205
- High speed trains
measurement of vibration on Metroliner, 40-6-93
- High temperature
damping at, 36-4-25, 38-3-57
- Hinged arch
dynamic analysis of, 41-6-90
- HMS OBDURATE
shipboard shock on, 37-1-1
- Holography
description of, 39-2-41, 41-3-33
- for high frequency vibration studies of beams, 40-7-34
 - instrumentation using, 39-2-41, 41-3-64
 - for mode shapes of plates, 39-2-43, 41-7-38
 - in non-destructive tests, 41-3-63
 - for response to shock, 40-7-33
 - for vibration measurements, 39-2-41, 40-7-33, 41-3-63
- Honeycombs, see also Crushable structures and Yielding structures
pulsed lasers for observing defects in, 41-3-72
- Hopkinson's Law
for scaling of blast pressure, 39-6-139
- Horns
performance in acoustic test facility, 37-5-46
- Hulls
damage from underwater explosions, 39-1-95
influence of characteristics on response to air blast, 37-4-143
mathematical model for submarines, 40-7-186
mathematical model for vibrations, 38-1-126
response to underwater explosions, 38-3-244, 40-7-185, 41-S-49
vibration of, 38-S-1, 40-7-243
- Humans
effect of shock on, 37-4-80, 39-5-89, 41-2-5
effect of vibration on, 41-2-13
equal annoyance contours for vibration, 41-2-16
vibration isolators for, 39-4-157
- Humping, see Railroads
- Hybrid computers, see also Analog computers, Computers, and Digital computers
for high-speed analysis of vibration data, 36-6-55
for modal analysis, 41-3-25
for vibration analysis of helicopter structures, 41-7-131
- Hydraulic flow
for simulating recoil of guns, 41-3-187
- Hydraulic shock
forcing function for, 41-1-23
mathematical model for, 36-2-33

Hydrodynamic mass
definition of, 40-1R-11

Hydrofoils
flutter of, 41-7-205

Hygens-Fresnel Principle, 36-6-91

Hysteretic damping, see also **Damping**
in joints, 36-4-3

I

Ignition shock, see also **Shock**
versus temperature, 37-2-168

Impact, see also **High impact**
of airdropped material, 41-3-223
attenuation for Apollo Command module,
38-3-255
attenuation for spacecraft, 40-2-183
combined with spin, 41-3-164
copper ball accelerometer for measuring,
37-3-219
damage to eggs during, 41-3-11
damping by, 39-4-1
design criteria for limiters, 40-2-183
fragmenting tube for attenuation of,
40-5-115
human response to, 41-2-5
inverting tube response to, 41-2-91
lead targets for tests, 37-3-219
of nuclear fuel capsules, 40-2-193
pads for modified slingshot shock test
machine, 39-5-76
on piping, 40-S-3
of projectiles on armor, 41-5-69
protective system for automobiles,
38-3-329
pulse duration on different surfaces,
36-6-175
response to
of aircraft to ground, 38-3-165
of elastic half-space, 39-5-13
of helical coil, 41-2-80
of structures, 37-1-115, 38-2-38
of scale model vehicles, 39-4-227
sensitivity of radioactive materials to,
41-3-194
of shells, 39-5-21
of shipping containers, 39-6-65
simulation of human head, 39-5-89
tests on hard landing payloads, 40-2-185

Impedance, see **Mechanical impedance**

Impulse
calibration of accelerometers by, 37-2-21
design of exciter, 37-2-24

for determination of mechanical impedance,
41-5-54

by drop ball test, 37-2-21
from gunfire, 39-6-146
in vibration tests of ships, 41-S-1

Impulsive loads, see also **Shock loads**
elastoplastic response of shells to,
41-7-81
response of damped cylindrical shells to,
38-3-130
response of isolation system to, 40-5-206
vibration characteristics of ships from,
40-S-7

Indeterminate forms
evaluation of, 38-1-36

Indirect synthesis
definition of, 39-4-185
flow chart for, 39-4-190
of shock isolators, 39-4-185

Inertial guidance
dynamic analysis of, 40-3-257

Infinite stiffness
concept of, 37-2-184

Influence coefficients
for cantilever beams, 37-2-61
in dynamic analysis, 36-6-101, 38-2-50
quick check procedure for, 38-2-205
for truss, 38-2-62

Input control, see also **Force-controlled**
vibration tests
by monitoring response spectra, 37-3-47

Insertion factor
definition of, 38-S-20

Instrumentation
for acoustic environments, 36-7-90,
37-5-19, 37-5-42, 37-5-168, 37-S-31,
37-S-74, 37-S-95, 40-5-54, 40-7-17,
41-4-163, 41-4-221
for captive flight loads, 37-1-128, 40-6-15
for combined environments, 40-7-102,
41-3-164
for combustion instability tests, 40-4-110
for damping evaluation, 38-3-90
for dynamic tests, 37-2-132, 37-3-106,
37-4-3, 37-5-129, 38-3-221, 39-2-114
for egg damage, 41-3-11
for ejection tests, 40-6-4
error analysis in, 37-S-115
for fixed-base natural frequencies,
38-2-265

- for flutter of hydrofoils, 41-7-207
 - for force input measurement, 36-3-114
 - for gun setback acceleration, 36-2-58
 - for gunfire environment, 37-7-206, 41-4-198, 41-4-210
 - for handling of Polaris missile, 36-7-147
 - using holography, 39-2-41, 41-3-64
 - using a laser, 37-2-1
 - for launch phase simulator, 36-6-207, 37-3-184, 37-5-178
 - for mechanical impedance, 38-2-254, 40-4-200, 40-7-29, 40-7-65
 - for mechanical signature analysis, 36-6-74
 - for modal analysis, 36-3-86, 39-3-147
 - for model tests, 37-3-126, 40-4-93
 - for pyrotechnic shock, 37-4-17
 - for response of bridges, 41-4-100
 - for rocket sled, 37-3-199, 41-7-3
 - for shock, 37-4-106, 39-5-89, 40-1-10, 40-1-33, 40-5-256, 40-7-133, 40-S-22, 41-3-175, 41-5-93, 41-6-147
 - for shock spectra, 36-2-18
 - suppression of electrical noise in, 40-7-4
 - terminology, 41-3-82
 - for transportation environment, 37-7-19, 37-7-40, 40-6-91, 40-6-99, 41-4-142
 - for vibration, 37-2-118, 37-7-96, 37-7-176, 37-S-74, 37-S-95, 39-3-193, 40-7-79, 40-7-45, 40-7-225, 40-7-243, 40-S-66, 41-3-114, 41-4-221
 - for wind tunnel, 37-7-222
- Interface dynamic environments**
mechanical impedance in prediction of, 38-2-249
- Interferometer**
in accelerometer design, 41-3-17
measurement of displacement with, 37-2-13
- Isolation systems, see also Shock isolation and Vibration isolation**
for aircraft ground vibration survey, 36-3-62
for dynamic studies of launch vehicles, 40-3-205
for electronics cabinets, 40-S-29
mathematical analysis of, 38-3-286
for missile containers, 39-6-57
nonlinear springs for, 36-7-103
for railroad cars, 40-6-109
with relaxation damping, 40-5-203
for seismic mass, 41-3-110
for static firing tests, 37-3-99
- Isolators, see specific types such as Active vibration isolators, Shock isolators, and Vibration isolators**
- Isotopes**
shock test facility for, 41-3-194
- J**
- Jeep**
shock and vibration in M-151, 37-7-39
- Jet engine noise**
data analysis of, 41-3-55
- Joints**
in structural analysis, 37-2-182
structural damping in, 36-4-1
with viscoelastic materials, 39-4-117
- Joint acceptance**
for boundary layer turbulence, 37-5-65
transformation, 37-5-61
- K**
- Keel shock factor**
definition of, 39-1-8
fo. HMS OBDURATE, 37-1-5
for diverine craft, 37-1-48
- Kennedy-Pancu Method**
review of, 39-3-108
for vibration analysis of shells, 39-3-107
- Kinetic energy**
power dissipation of, 37-2-99
- L**
- Lagrange's equations**
in analysis of towed cables, 41-6-62
for dynamic analysis of conservative systems, 41-6-87
in launch dynamics analyzer, 41-6-220
- Landing gear**
dynamic analysis of, 39-3-179
- Lasers**
for observing defects in honeycombs, 41-3-72
for vibration analysis, 37-2-1
- Latent information parameters**
in measurements, 41-3-82
- Lateral dynamic loads**
analysis of, 38-2-69
- Launch environments**
for airborne weapons, 40-6-1
for Apollo Lunar Module, 37-5-106, 40-3-163

- lateral response to, 38-2-67
 - response of space vehicles to, 40-4-171
 - simulation of, 36-3-119
 - for SNAP 10A, 36-7-73
 - test facility for, 39-2-23
- Launch phase simulator, see also Combined environmental tests**
- acoustic tests on, 37-3-182
 - for combined acceleration and vibration tests, 36-3-119
 - hydraulic vibration exciter for, 39-2-23
 - instrumentation for, 36-6-207, 37-3-184
 - as qualification test facility, 40-3-183
 - for spacecraft, 37-5-175
- Launch vehicles, see also specific launch vehicles such as Titan launch vehicle, Saturn launch vehicle, and Scout launch vehicle**
- acoustic environment of, 36-5-97, 36-7-89
 - combustion instability tests, 40-4-111
 - criteria for scale models of, 40-3-205
 - dynamic tests of, 37-3-99, 37-5-117
 - flight vibration time history for, 39-6-136
 - ground vibration test of, 39-2-135
 - gust loads on, 38-3-104
 - high-force vibration tests of, 37-3-137
 - inelastic damping of ducts, 40-5-61
 - interaction of spacecraft with, 38-2-239
 - interface effects on subsystem response, 38-2-67
 - mechanical impedance at interface, 40-3-79
 - multimodal fixtures for, 40-3-231
 - nonlinear damping in structural analysis, 40-5-261
 - static firing tests, 39-6-133, 40-4-109
 - stiffness matrix for, 38-3-108
 - suspension system for dynamic studies of, 40-3-205
 - torsional shock from, 36-7-63
 - vibration analysis of, 38-3-95
- Lead targets**
- for impact tests, 37-3-219
- Legendre's Polynomial, 38-2-83**
- Liapunov's functions**
- for dynamic analysis, 41-6-88
- Lift-off, see Launch environments**
- Limits of allowable variation**
- definition of, 37-3-77
- Line solution method**
- for stability analysis, 38-2-163
 - for structural analysis, 38-2-157
- Linear systems**
- transfer functions for, 39-3-74
- Linearity**
- of measurement system, 40-7-18
- Liquid propellants**
- explosions of, 38-2-177
- Liquid spring**
- for shock isolation, 41-2-57
- Liquid squeeze-films**
- mechanical properties of, 39-2-82
 - for support of vibrating structures, 39-2-77
- Loading, see Dynamic excitation**
- Loss factors**
- for damped beams, 38-3-8
 - for laminated beams, 36-4-83
 - for segmented rings, 39-1-150
 - of spaced-damped beams, 39-1-167
 - in statistical energy analysis, 38-S-11
- Loudspeakers, see Acoustic test facilities**
- Low temperature**
- damping at, 36-4-25, 38-3-57
- Lumped parameter systems**
- analysis of, 38-2-57, 38-2-274, 39-3-153, 41-6-198
 - in beam analysis, 36-6-117, 41-5-28, 41-6-123
 - comparison of effective weights of, 39-3-158
 - comparison of natural frequencies of, 39-3-158
 - dynamic equivalence of, 39-3-157
 - force-node method for, 38-2-292
 - forced response of, 38-3-95
 - mobility matrix for, 40-5-137
 - reduction in mass points for, 38-2-57
 - transfer functions for, 38-2-109
- Lunar module, see Apollo spacecraft**
- Lunar Orbiter spacecraft**
- flight acceptance test, 39-6-120
 - flight vibration of, 39-6-119
 - flight vibration vs flight acceptance test, 39-6-129
 - vibration data analysis for, 39-6-122

M

- M-151 jeep**
vibration in, 37-7-39
- Mach number**
versus drag coefficients, 40-2-97
versus Reynolds number, 37-3-127
- Machinery**
gas-bearing, 38-3-221
wear in, 41-4-51
- Machinery foundations, see also Foundations**
design of damped, 36-4-81, 38-3-1, 39-1-143
mechanical impedance for, 38-S-19, 39-1-123
noise transmission of, 38-S-19
for shipboard equipment, 38-3-1, 38-3-19
spaced damping of, 39-1-167
in submarines, 39-1-123
tests of, 36-4-88
uniform beams as, 39-1 '23
vibration transmission of, 38-S-19
- Mariner spacecraft**
dynamic analysis of, 38-2-139
electronic assembly for, 36-3-27
instrumentation for, 37-4-3
Mars 1969, 38-2-139, 39-2-123
modal analysis for, 38-2-143
modal survey of, 39-2-123
shock spectra at separation, 37-4-8
transient response at separation, 37-4-1
vibration tests of, 36-3-27, 38-2-151
- Mass**
effect of concentration on vibrating plates, 38-1-37
- Mass matrices**
for beams, 38-1-12, 41-6-123
for bending of plates, 41-7-129
comparisons of consistent, 39-3-129, 40-4-1
generalized, 39-2-127
for piping system, 40-4-148
for plane stress, 41-7-126
in structural analysis, 37-2-187, 40-4-1
translational, 40-4-194
- Material damping, see Damping**
- Materials**
criteria for dynamic overstress in, 40-2-28
for energy absorption, 40-2-183, 41-2-98
with extensional damping, 38-3-199
- piezoelectric properties of rubberlike, 39-2-1
propagation of stress waves, 39-3-201
properties for scale models, 39-3-40
shock isolation properties of, 39-4-213
- Mathematical analysis, see also Dynamic analysis, Structural analysis, Vibration analysis and Shock analysis**
of acoustic excitation of solar panels, 40-3-49
of acoustic radiation resistance of shells, 40-3-24
of air blast on structures, 39-5-29
of ammunition conveyor feed system, 40-4-118
of combined flexure-torsion flutter, 40-5-236, 41-7-111
of combined torsional and translational vibration, 39-3-172
of damped beams, 38-3-14, 39-4-54, 40-5-278, 41-2-133
of damped shells, 38-3-121
of damping device for blade structures, 39-4-20
of deck vibration, 40-1-2
of ejection system, 41-6-94
of elastic-plastic system, 40-4-68
of fluid-filled shells, 38-2-79, 41-7-153
of forced vibration, 38-3-95
of foundations, 39-1-136, 40-4-82
of gun systems, 39-4-255
of impact of helical coil, 41-2-80
of inverting tube impact, 41-2-91
of isolators, 38-3-39, 38-3-286, 39-4-143, 40-5-204
of lumped parameter system, 39-3-154, 41-6-197
of modal coupling, 39-3-100
of nonconservative systems, 41-7-142
of nonlinear systems, 3 61, 40-5-263, 41-6-40
of panel flutter, 40-4-140
of paraboloidal antenna, 41-6-105
of piping system, 40-4-148
of plates, 39-3-206, 39-3-234, 39-4-65, 39-4-74, 39-4-81, 39-4-93, 40-4-218, 40-5-93, 41-7-30
of propulsion system for ships, 39-S-57
of protective structures, 39-4-208
of rail launching dynamics of missiles, 41-6-220
of scale model launch vehicle, 40-3-207
of segmented rings, 39-1-145
of shock bar, 40-2-211
of sonar transducers, 41-1-21
of stress propagation, 40-4-128
of torsional vibration, 40-4-163
of towed cables, 41-6-62

- of underwater explosions, 39-S-42, 40-7-186, 41-S-50
 - of vibration absorbers, 39-4-261
- Mathematical models, see also Dynamic models, Models, and Scale models**
- of aircraft carrier, 37-4-144
 - of aircraft structure, 40-2-123
 - of antennas, 37-4-151, 40-1-47, 41-6-104
 - for Apollo Applications Program structures, 39-3-57
 - of Apollo Lunar Surface Experiment Package, 38-2-47
 - of beams, 40-4-48, 41-5-28, 41-6-212, 41-7-55
 - of conical beam, 37-2-177
 - of deckhouse, 39-1-111
 - of electronic equipment cabinet, 36-7-130
 - of fluid-filled shells, 38-2-79
 - of foundations, 39-1-40, 39-1-136, 40-4-81
 - of heat shield, 36-2-64
 - of helicopter, 38-3-282, 40-2-236
 - of high-impact shock machine, 38-2-91
 - of isolation system, 40-5-204, 40-5-219
 - of lumped mass beam, 38-2-13
 - of missile container, 39-6-57
 - of missile handling system, 36-7-146
 - of open cell foams, 40-5-292
 - of open-frame structures, 38-2-181
 - of plates, 40-2-235, 41-5-102
 - of propellant tank, 41-7-174
 - of protective structures, 39-4-200, 40-2-244
 - of radio telescope, 40-4-155
 - of railroad cars, 40-6-110
 - of re-entry vehicles, 39-1-223, 40-3-34
 - of rigid frames, 39-3-34
 - of shock isolator, 36-2-92, 38-3-213, 39-4-218
 - of solar panels, 40-3-49
 - of sonar transducer, 36-2-33, 41-1-23
 - of spacecraft, 36-3-16, 36-7-42
 - of submarine hull, 40-7-186
 - of vibrating duct, 40-5-71
 - of weapons skid, 36-1-27
- Matrix, see Mass matrices and Stiffness matrices**
- Matrix analysis**
- of helicopters, 40-4-43
 - using mass and stiffness joiners, 40-1R-2
 - on a multi-modal system, 35-5-32
- Matrix flowgraphs, 38-1-100**
- Mean error**
- in vibration analysis, 37-2-90
- Mean square amplitude**
- derivation of, 38-1-28
- Mechanical amplifiers**
- as shock test facilities, 40-2-205
- Mechanical filter**
- for shock transducers, 37-2-37
- Mechanical fuzes**
- shock tests on, 37-3-219, 41-3-155
- Mechanical impedance**
- analysis of weapon-mount interface, 41-5-53
 - of beams, 38-2-222, 41-7-51
 - for calculating transmission of vibration, 38-2-231, 38-S-19
 - for complex structures, 38-2-271
 - for damping calculation, 38-3-89
 - data analysis for, 41-5-54
 - definition of point force, 40-3-231
 - for determining fixed-base natural frequencies, 38-2-209
 - in dynamic analysis, 40-2-215, 40-5-135
 - effects of damping on, 40-3-236
 - equivalence between modal shock parameters and, 41-7-59
 - of foundations, 39-1-123
 - of frames, 38-2-219
 - instrumentation for, 38-2-254, 40-7-29, 40-7-64, 41-5-53
 - of piping systems, 40-4-199
 - for prediction of dynamic environments, 37-6-27, 38-2-249, 40-3-79
 - of shells, 39-3-107
 - in shock tests, 39-5-63
 - simulation of, 40-3-233
 - of space-damped structures, 38-3-35
 - using structural equivalence, 36-2-63
 - for vehicle isolation, 38-3-319
 - for vibration input control, 37-3-89, 41-4-109
- Mechanical properties of elastic materials, 38-3-251**
- Mechanical receptance coupling**
- computer program for, 38-2-242
 - in spacecraft system, 38-2-239
 - theory of, 38-2-240
- Mechanical Signature Analysis**
- of bearings, 41-4-173
 - of electronic equipment, 41-4-173
 - instrumentation for, 36-6-74
 - of microelectronic devices, 41-4-180

- Mechanical systems**
 frequency correction equations for, 38-2-295
 response of, 38-2-107, 39-3-77
 vibration of, 39-3-73
 viscous damping in, 38-3-111
- Method of characteristics**
 for analysis of propagation of stress waves, 41-6-189
 for analysis of spalling of structures, 40-4-127
- Method of initial parameters, 38-2-157**
- Microminiature amplifiers**
 frequency response of, 36-6-220
 specifications for, 36-6-221
 for transducers, 36-6-215
- Microphones**
 calibration of, 37-2-7
 transfer function for, 37-2-9
- Miner's hypothesis**
 use for random vibration, 41-3-47
- Minuteman missile**
 measurement of vibration for, 37-7-93
 summary of vibration data for, 37-7-93
 vibration environment of, 37-7-98
- Missiles, see also specific missiles such as AIM-4D missile, Bullpup missile, etc.**
 bending of, 38-2-173
 captive flight environment of, 39-1-195, 39-6-77, 40-6-67
 components for
 reliability of, 39-1-175
 simulation of flight environment for, 40-3-293
 failure rate tests for, 39-2-99
 flight test program for, 39-6-102
 launch dynamics of, 41-6-219
 launch environment for, 40-6-1
 predicted vs measured environment, 39-6-117
 prediction of dynamic environments for, 41-4-189
 prediction of fatigue life in, 40-6-67
 response to ejection loads, 40-6-1
 response to ship loading, 37-7-68
 response to shock in tracked vehicles, 41-2-166
 rocket-propelled sled tests on, 39-1-175
 shipping containers for, 39-6-57
 shock in, 39-8-1, 40-2-1
 shock isolation of, 36-2-89, 39-4-213, 39-6-59
 shock spectra for shells, 38-2-43
 simulation of captive flight environment, 39-6-86
 test facility for simulation of launch environment, 40-6-1
 vibration in, 37-1-150, 37-7-93, 40-4-163, 41-4-190
 vibration-induced errors in guidance systems, 37-2-87
 vibration qualification tests of, 40-6-67
- Mobile shelters**
 shock isolators for, 39-4-179
- Mobility, see Mechanical impedance**
- Modal analysis, see also Modal characteristics, Dynamic analysis, Shock analysis, Structural analysis, and Vibration analysis**
 of aircraft carrier, 37-4-146
 automated system for, 41-3-25
 of bridges, 41-4-106
 of focal isolation system, 38-3-265
 of foundations for shipboard equipment, 40-7-171
 of frame structures, 40-7-172
 of helicopters, 36-3-71
 use of hybrid computers for, 41-3-25
 instrumentation for, 36-3-86
 of launch vehicle, 37-3-113
 phase separation techniques in, 36-3-89
 of re-entry vehicles, 36-3-83, 40-3-31
 of spacecraft, 38-2-143, 41-3-26
 of structures, 39-3-55, 39-3-99, 39-3-144, 41-7-10
 from test data, 38-2-271, 41-7-9
- Modal characteristics of structures, 39-4-33**
- Modal combination**
 computer program for, 38-2-139
- Modal coupling**
 for Apollo Applications mathematical model, 39-3-58
 mathematical analysis of, 39-3-100
- Modal damping**
 effects of tuning on, 37-6-60
 loss factor from modal mass, 38-2-271
 loss factor from vibration data, 38-2-289
- Modal density**
 of beams, 39-3-1
 of panels, 38-S-9, 39-3-1
 of printed circuit boards, 38-S-7
 of shells, 40-3-69
 of systems, 36-5-47
 of Upstage test vehicle, 41-6-15

- Modal displacement ratio**
versus mass ratio, 41-6-214
- Modal effective mass**
definition of, 39-3-143
measured vs calculated, 39-3-149
measurement of, 39-3-147
of structures, 39-3-143
- Modal mass**
for calculation of loss factor, 38-2-271
determination from vibration tests,
38-2-271
- Modal orthogonality**
discussion of, 41-3-38
- Modal response**
of elastic-plastic system, 37-4-73
of single resonator, 40-4-18
- Modal response suppression factor**
for distributed parameter system,
38-2-277
relationship to modal mass, 38-2-271
- Modal surveys**
correlation of analysis and test, 39-2-129
use of generalized mass matrix for,
39-2-127
of Mariner spacecraft, 39-2-123
of panels, 39-3-10
of Saturn I, 39-2-135
of scale models, 39-3-39
of shells, 38-1-89, 39-3-107
- Modal synthesis**
for mode shapes of rocket motor,
41-6-119
for natural frequencies of rocket motor,
41-6-119
of structures, 40-4-25
- Modal velocity**
as criterion of severity of shock, 40-2-31
- Modal weight criterion**
for selection of normal modes, 40-7-167
- Mode numbers**
of beams, 36-4-86
- Mode shapes**
of aircraft from ground vibration tests,
39-2-63
antennas, 41-6-110
for automobiles, 40-4-94
beams, 36-4-55, 38-2-166, 40-5-283,
41-6-163, 41-6-211, 41-7-51
data analysis equipment for mapping of,
39-2-64
of deck with simulated equipment, 40-1-4
for foundations, 39-3-172
of frames, 36-2-275
inertial reference unit, 40-3-260
from model tests, 37-3-128
of plates, 38-1-48, 39-2-43, 39-4-81,
39-4-93, 41-7-29, 41-7-37
of panels, 40-4-139
effect of cavity on, 40-4-142
of radio telescope, 40-4-156
of rings, 39-1-151
of rocket motors, 41-6-119
of Saturn I launch vehicle, 39-2-141
of Saturn V dynamic test vehicle, 40-5-268
of scale model hulls, 41-S-23
of shells, 38-2-79, 39-3-107
of sonar transducers, 41-1-28
of Standard ARM, 40-6-80
of structures, 40-4-25, 40-7-33,
40-7-207, 40-S-13, 41-7-9
from test data, 41-7-9
of tubes, 41-7-148
- Mode tuning**
for aircraft ground vibration survey,
36-3-67
- Model tests**
for determination of strain response,
36-5-78
instrumentation for, 37-3-126
mode shapes from, 37-3-128
Schlieren photographs from, 37-3-135
- Models, see also Dynamic models, Mathematical models, and Scale models**
of blast closure valves, 40-2-133
digitally simulated, 38-2-119
for dynamic analysis, 40-4-89
for evaluation of linear damping,
36-4-65
of focal isolation systems
vibration tests of, 38-3-268
lumped parameter, 39-3-153
mass-spring of building, 38-2-190
of shock isolation systems, 41-2-58
for spacecraft reliability, 36-7-4
of transducers, 41-3-91
for wind tunnel tests, 36-7-80, 37-3-121
- Modes, see Bending modes, Modal characteristics, and Normal modes**
- Modified Clarkson Method, 39-3-88**
- Modular concept for shock and noise isolation, 38-3-243**

Moment of inertia
 composite loss factor vs, 38-3-33

Moment technique
 for system identification, 38-2-119

Monte Carlo Method, 36-5-6

Moving loads
 response of structures to, 40-3-99,
 40-4-47

Multi-axis tests
 control of, 40-5-185, 41-4-34
 for transportation vibration, 41-3-119
 for vibration of spacecraft, 40-3-179

Multiple-degree-of-freedom simulator
 for railroad car environments, 41-3-120

Multi-degree-of-freedom systems
 dynamic analogies for, 37-2-59
 dynamic analysis of, 40-1R-1
 flutter in, 40-5-235
 mathematical analysis of, 41-6-93
 mathematical model of, 36-5-1
 mechanical impedance analysis of,
 40-2-216
 response characteristics of, 39-3-161
 Ritz averaging procedure for, 39-3-162
 shock spectra for, 40-4-17
 zeros and poles of transfer function for,
 40-2-219

Multimodal fixtures
 for vibration tests, 38-1-120

Multi-modal system
 fatigue damage to, 36-5-17
 matrix analysis of a, 36-5-32

Multi-point control
 of vibration tests, 37-3-75, 41-4-33

Munson road tests, 37-7-44

Myklestad's Method
 for coupled flexure-torsion vibration,
 41-7-109
 derivation of, 41-7-119

N

NASTRAN computer program
 for analysis of critical speeds of shafts,
 41-6-206

Natural frequency, see also Frequency
 of ammunition conveyor system, 40-4-120
 of anisotropic material, 39-3-201

of antenna, 41-6-110
 beams, 38-2-133, 40-4-2, 40-4-49,
 40-5-277, 41-6-163, 41-6-211, 41-7-51
 of box cars, 41-4-148
 calibration of accelerometers, 41-3-3
 of decks, 40-1-4
 of frames, 38-2-225, 39-3-35
 of inertial reference unit, 40-3-260
 of lumped parameter systems, 39-3-158
 of panels, 39-3-191, 40-3-59, 40-4-139
 of piping systems, 40-4-147
 of plates, 38-1-48, 39-4-73, 39-4-81,
 39-4-93, 40-5-97, 41-7-29, 41-7-37
 of printed circuit boards, 40-3-111
 of radio telescope, 40-4-156
 of re-entry vehicles, 40-3-40
 of rings, 39-1-150
 of rocket motors, 41-6-119
 of rotor bearings, 40-3-286
 of scale models, 38-3-42
 of shafts, 40-4-163, 41-6-208
 of shells, 38-2-79, 39-3-107, 40-3-131,
 40-4-209, 41-7-151
 of ships, 38-1-125
 of solar panels, 40-3-52
 of sonar transducers, 41-1-29
 of suspension systems, 39-6-59
 of structures, 40-4-25, 40-4-58, 40-7-207,
 40-8-13, 41-6-75, 41-6-103, 41-7-9
 of transmitters, 40-7-86
 tubes, 41-7-147

Naval guns
 environment from, 36-2-53

Navigation ratio
 as an indicator of performance mal-
 function, 39-2-100
 measurement of, 39-2-101

NERVA Nuclear reactor
 shock tests on, 38-1-50
 vibration analysis of, 36-1-45
 vibration tests on, 36-1-50

New York State Safety Sedan, 38-3-325

Natural vibration modes, see Modal analysis
 and Modal characteristics

Nike-X missile
 shock test facility for, 37-4-127

Nimbus Spacecraft
 vibration tests on, 40-3-243

Noise, see also Acoustic noise
 classification of sources, 36-5-97
 comparison with spacecraft vibration
 spectra, 36-7-97

- damping treatments for attenuation of, 39-1-159
 - definition of field in acoustic test facility, 37-S-47, 39-2-87
 - in helicopters, 41-4-221
 - interaction with structures, 36-5-48
 - isolation of, 38-3-243
 - liquid flow in water, 41-2-151
 - from machinery, 39-1-167
 - measurements of, 37-S-74
 - in piping systems, 39-1-155, 40-4-197
 - prediction levels of, 36-5-86
 - reduction of, 38-3-243, 40-4-103
 - response to, 36-5-99
 - simulation in acoustic test facility, 37-S-64
 - simulation at reduced pressures, 41-3-207
 - transmission through foundations, 38-S-19, 39-1-167
- Noise generators, see Acoustic test facilities
- Nomograph
for resonant frequencies of ducts, 40-5-72
for response of ducts, 40-5-77
- Non-destructive tests
holographic interferometry in, 41-3-63
- Nonlinear damping
transient response of mounting system with, 41-2-34
- Nonlinear springs
characteristics of, 36-7-105
in suspension systems, 36-7-103
- Nonlinear systems
analog computers in study of, 36-6-43
mathematical analysis of two degree of freedom, 39-3-161
shock in, 39-5-1
- Nonlinear vibration
of plates, 40-3-119
- Normalization
of structural mode shapes, 39-2-63
- Normal mode method
for shock analysis, 36-7-129, 37-4-91, 38-2-11
- Normal modes, see also Bending modes, and Modal characteristics
of beams, 38-1-69, 40-4-50, 40-7-34
computer program for analysis of, 36-6-101
of dynamic systems, 40-5-135
of panels, 40-3-60
- of plates
holography for identification of, 40-7-36
- of piping systems, 40-4-147
- of re-entry vehicles, 40-3-40
- selection of
for Dynamic Design Analysis Method (DDAM), 40-7-165
NRL criterion for, 40-7-166
- of shipboard equipment, 39-1-25, 39-1-55, 39-3-117, 39-8-41
- of solar panels, 40-3-49
- of shells, 39-1-155, 41-7-151
- of structures, 38-3-135, 39-3-99, 39-4-31, 40-3-49, 40-7-165, 41-2-105, 41-6-103, 41-7-135
- of tanks, 41-7-164
- Nuclear detonations, see also Gas detonations
effects on submarines, 39-1-98
simulation of shock loads from, 40-2-243, 41-5-167
free field environments for, 41-5-137
analysis of response of systems to, 41-5-140
- Nuclear fuel capsules
impact of, 40-2-193
shells for, 39-5-21
- Nuclear power plant
SNAP 10A, 36-7-73
- Nuclear weapons
simulation of effects of with detonable gas explosions, 37-4-199
shock environment for, 37-4-97, 39-1-93
- Nyquist plot
of co-quadrants, 37-2-80
- O
- OH-4A helicopter, 38-3-263
performance evaluation of vibration isolator for, 38-3-272
- OH-6 helicopter
response to gunfire, 40-1-66
- OV-10 aircraft
vibration of weapon, 40-S-47
- Oil film
as a mechanism for damping, 38-3-45
- Open cell foam
dynamic analysis of, 40-5-291
predicted vs experimental dynamic characteristics of, 40-5-303

prediction of force-time history for, 40-5-300
as shock isolator, 40-5-291
as vibration isolator, 40-5-291

Operation Prairie Flat, 40-1-31, 40-1-45,
40-1-75, 40-2-83, 40-2-101

Operation Sailor Hai
shear force measurements in deckhouse,
39-1-117

Optical systems
data analysis using, 36-6-91
Fourier transforms in, 36-6-96

Orbiting Astronomical Observatory (OAO),
40-3-179
analysis of flight dynamic loads, 40-3-181
combined environmental tests on,
40-3-189
criteria for dynamic environment for,
40-3-180
qualification tests of, 40-3-179
structural qualification loads for,
40-3-182
test facility for qualification of, 40-3-182

Orbiting Geophysical Observatory (OGO)
acoustic environment of, 36-7-91
acoustic tests of, 37-3-21
response to random vibration, 37-3-21
vibration absorber for, 37-6-57

Ordnance
specification for shock hardening of,
41-5-80

Overload protection
during vibration tests, 39-2-11

Overpressures
free field blast from gunfire, 39-6-142
for full-scale and model blast closure
valves, 40-2-136

Overtest
criteria for, 36-3-6
elimination of using force control, 36-3-5

P

Packaged equipment
damage boundaries for, 40-6-127,
40-6-133
design procedures for, 40-6-135
fragility of, 40-6-127, 40-6-133
repeated shock tests of, 39-6-15
simulated drop test of, 40-6-139

Packages

drop height recorder for, 39-6-19
effect of size on drop height, 37-7-14
effect of weight on drop height, 37-7-13
measurement of transportation
environments for, 39-6-19
rough handling environment of, 37-7-1
vibration environment within, 37-3-16

Palmgren-Miner hypothesis

for prediction of fatigue failure, 40-4-99

Panels

acoustic fatigue of, 38-1-1
acoustic excitation of, 40-3-57, 40-5-49
composite
acoustic tests of, 39-4-101
modal densities for, 39-3-12
natural frequencies of, 39-3-15,
39-3-191
properties of, 39-3-191
strain response, 39-4-104
structural analysis of, 39-3-1
vibration of, 39-3-1, 39-3-191
correlation functions for, 40-3-59
dynamic analysis of, 40-4-139
effect of cavity on vibration, 40-4-142
modal densities of, 38-S-9
natural frequencies of, 40-3-59, 40-4-139
normal modes of, 40-3-60, 40-4-139
prediction of flutter speeds in, 40-4-139
response of
to boundary layer noise, 40-3-63
to rocket propelled sled environments,
41-7-1
strain response of, 38-1-2
vibration of, 40-5-49

Paracril-BJ

properties of, 38-3-61, 38-3-157

Parametric analysis

of spacecraft, 39-2-149

Parametric excitation

of structures, 40-2-57

Parametric vibration

of columns, 39-3-247, 41-6-1
of plates, 40-3-119

Partial full scale shock test machine

displacement time history for, 39-4-222
as shock test facility, 39-4-216

Perissogyro

as vibration absorber, 37-6-49

Perturbation analysis

equations for, 40-7-178

for multi-mass systems, 40-7-177
PTURB computer program for, 40-7-179

Phase control system
dynamic characteristics of, 36-3-150
response limitation of, 36-3-151

Phase plotting
for vibration tests, 37-2-77

Phase separation techniques
in modal analysis, 36-3-89

Phoenix Missile
acoustic excitation of, 39-6-93
captive flight environment for, 39-6-77,
39-6-93
environmental measurements in F-111B
aircraft, 39-6-93
flight vibration of, 39-6-93
prediction of captive flight environment
for, 39-6-77
shock in, 39-6-93

Photography
for studying motion of structures,
36-6-197

Physiological effects
from shock, 41-2-5
from vibration, 41-2-16

Piezoelectric accelerometers, see
Accelerometers

Piezoelectric properties
of elastomers, 39-2-1
of polymers, 39-2-1

Piezoresistive accelerometers, see
Accelerometers

Piping
shock resistance in for ships, 40-S-1
shock tests of supports, 40-S-4
damping in, 39-1-143
dynamic analysis of, 40-4-147
effects of impact on, 40-S-3
fluid flow through, 40-2-70
fluid structure coupling in, 40-4-197
forcing functions for, 39-1-155
frequency response, 40-4-198
mass matrix for, 40-4-148
mechanical impedance for, 40-4-199
MIL-S-901C shock tests, 40-S-1
natural frequencies of, 40-4-147
noise in, 39-1-156, 40-4-197
normal modes of, 40-4-147
stiffness matrix for, 40-4-149
stress waves in, 40-5-157

vibration transmission for, 40-4-204
vibration of, 39-1-155, 40-4-197

Plastics
for scale models, 39-3-39

Plates
composite
damping of, 40-5-93
dynamic analysis of, 39-4-73,
39-4-81, 39-4-93, 40-5-93
mode shapes of, 39-4-81, 39-4-93
natural frequencies of, 39-4-73,
39-4-81, 39-4-93, 40-5-97
stresses in, 39-4-73
vibration of, 39-4-73, 39-4-81,
39-4-93, 40-5-93
damping in, 39-4-67, 40-5-93, 41-2-106
deformation by exploding projectile,
37-1-97
deformation as a function of thickness,
37-1-104
on distributed foundations, 41-5-102
dynamic analysis of, 38-1-45, 39-3-205,
39-4-73, 39-4-81, 39-4-67, 39-4-93,
40-3-99, 40-3-119, 40-5-93, 41-5-101,
41-7-29, 41-7-41
on elastic half space foundations, 40-4-216
on elastoplastic foundations, 40-4-221
finite elements of, 40-3-100
mass matrix for bending, 41-7-129
mathematical analysis of, 39-3-197,
39-3-206, 39-3-234, 39-4-65, 39-4-74
mathematical model of, 40-2-235
mode shapes of, 39-2-43, 39-4-81,
39-4-83, 41-7-29, 41-7-37
natural frequencies of, 39-4-73, 39-4-81,
39-4-93, 40-5-97, 41-7-29, 41-7-37
parametric response of, 39-3-205,
39-3-233, 40-3-119
response of
to acoustic excitation, 36-5-104
to boundary layer noise, 36-5-102
to moving loads, 39-3-233, 40-3-99
to shock, 39-4-63, 40-4-217,
41-3-64, 41-5-101
to traveling pressure pulses,
40-4-217
shock wave propagation in, 39-5-13
statistical energy analysis of, 36-5-46
stiffness matrix for bending, 41-7-126
stresses in, 39-4-73, 40-7-204
vibration of, 38-1-37, 38-1-45, 39-3-197,
39-3-205, 39-4-73, 39-4-81, 39-4-93,
40-3-119, 40-5-93, 41-7-31, 41-7-37
vibration tests of, 39-3-210

Pliers event
shock loads in tower during, 41-6-75

- Pneumatic springs**
 mathematical analysis of, 41-3-181
 as shock isolators, 41-2-57
 for testing of projectiles, 41-3-175
 for variable resonant vibration exciter, 38-S-3
- Polaris missile**
 field handling, 36-7-145
 shock during ship loading, 37-7-67
- Polyethylene foam**
 characteristics of, 38-3-177
- Polymers**
 piezoelectric properties of, 39-2-
- Polystyrene foam**
 characteristics of, 38-3-179
- Polyurethane foam**
 properties of, 36-2-90, 38-3-177
 shock isolation with, 36-2-89, 40-5-285
 vibration isolation with, 40-5-285
- Polyvinylchloride-acetate (PVC-A)**
 properties of, 40-4-90
- Polyvinylchloride foam**
 properties of, 38-3-179
- Poseidon missile**
 shock isolation system for, 39-4-214
- Potential flow model**
 for cylinders, 41-6-32
- Power**
 equivalence in components of, 41-3-83
- Power dissipation**
 of kinetic energy, 37-2-99
- Power spectra, see also Acoustic spectra and autocorrelation function, 37-2-90**
- Power spectral density, see also Cross-power spectral density**
 on air suspension trucks, 37-7-21
 definition of, 39-2-90
 versus dynamic pressure, 37-7-111
 of firing pulse of thruster, 40-3-269
 high speed computation of, 36-6-47
 for mechanical systems, 39-3-75
 for multiple square wave shock pulses, 39-5-85
 for railroad cars, 40-6-113
 in rocket engines, 37-2-121
 with selective bandwidth, 36-6-63
 for space vehicles, 40-4-171
 for STOL aircraft, 40-6-96
 for vibration of Metroliner, 40-6-95
- Power transmission lines**
 galling of, 39-3-175
- Prediction, see environment or effect predicted**
- Pressure pulses**
 in hydraulic systems, 41-5-143
- Pressures**
 acoustic tests at low, 41-3-207
- Pressure time history**
 for air blast, 37-4-188
 for underwater explosions, 39-1-4, 40-1-10
- Pressure vessels**
 shock analysis of, 40-1R-7
- Prime movers**
 shock tube facility for, 37-4-127
- Printed circuit boards**
 modal density of, 38-S-7, 38-S-11
 vibration response of, 38-S-5
- Project PYRO, 38-2-177**
- Project Sure Fire, 37-2-117**
- Projectiles**
 deformation of steel plates by, 37-1-97
 hard-wire instrumentation on, 41-3-175
 impact on armor, 41-5-69
 interaction with target, 37-1-116
 penetration of, 37-1-115
 pneumatic spring for testing of, 41-3-175
 simulation of firing, 41-3-175
 test facility for, 41-3-175
- Propeller shafts**
 critical speeds of, 36-6-121
- Protective structures**
 effects of air blast, 38-2-187
 effect of ground shock on, 38-2-187
 mathematical analysis of, 39-4-208, 40-2-243
 mathematical model of, 39-4-200, 40-2-244
 shock isolation systems for, 39-4-199
 shock loads for, 40-2-244
 shock tests of equipment in, 40-2-243
- Proximity probes**
 vs accelerometer, 40-7-22
 calibration of, 40-7-22
 for measurement of displacement, 40-7-17

Pulsed random vibration tests, 40-3-267
pulse gating, 36-6-40

Pyrotechnic devices
for ejection of munitions, 41-5-89
flight events by, 41-5-1
shock spectra for, 41-5-2
shock tests with, 41-5-11

Pyrotechnic shocks
attenuation of, 36-2-79, 37-5-40, 41-5-4
criteria for prediction of, 41-5-1
damage from, 41-5-10
data, 37-2-30, 41-5-1, 41-5-9
data analysis for, 37-4-21
definition of problem of, 40-2-21
in heat shield, 36-2-63
in honeycomb structures, 37-4-15
instrumentation for, 37-4-17
mass loading effects on, 41-5-13
in missiles, 39-S-1, 40-2-21
response spectra for, 36-2-73
shock spectra for, 41-5-2, 41-5-10
simulation of, 36-2-71, 41-5-9
in structures, 40-2-21, 41-5-9
in SUU-38 munitions dispenser, 41-5-89

Q

Quad phasors, 37-2-77

Qualification levels
for vibration tests, 37-7-176

Qualification tests, see also Quality Control tests
acoustic tests for, 37-5-139, 37-5-167
of captive airborne weapons, 39-S-33
comparison to flight vibration, 41-3-47
on missiles, 40-6-67
of solar panels, 39-2-127
on spacecraft, 36-7-1, 40-3-20, 40-3-179
vibration and structural reliability,
36-7-1

Quality control tests, see also Qualification tests
for missiles, 39-2-199

R

Radar antenna
of damping, 38-3-58

Radioactive materials
air gun for testing, 41-3-194
impact sensitivity of, 41-3-194

Radio Astronomy Explorer satellite, 36-6-195

Radomes
for antennas, 40-1-32

Railroad cars
dynamic analysis of, 39-6-52, 40-6-109
simulation of displacement of, 39-6-53
simulator for environments of, 41-3-120
suspension systems for, 40-C-109
vibration of, 40-6-109

Railroads
effect of track roughness on cargo, 39-6-47
transportability criteria for cargo, 40-6-85
transportation environment for, 39-6-47

Random vibration
of aircraft equipment, 41-S-25
analysis of, 37-2-89
by finite element method, 38-1-7
mean error in, 37-2-90
using optical systems, 36-6-91
of beams, 37-3-93
calculation of displacement, 40-3-2
computations of, 38-1-27
cross correlation between multiple inputs,
39-2-51
effects on humans, 41-2-13
energy summation for, 40-3-143
environments, 41-3-43
errors in guidance systems from, 37-2-87
fatigue damage from, 36-4-76, 40-3-1
of flight vehicles, 41-6-9
Fourier analysis of, 38-1-18
frequency analysis of repetitive bursts,
38-1-17
frequency of zero crossings, 40-3-2
identification of system parameters,
38-2-122
of inertial accelerometers, 37-2-87
of integrated systems, 37-3-151
isolation of, 38-3-285
kinetic energy of, 40-3-139
mechanical impedance for prediction of,
40-3-79
of missiles in captive flight, 39-1-195
non-stationary, 40-4-174
of panels, 40-5-49
parametric response of plates to, 40-3-119
of payloads in shells, 40-3-45
prediction of response to, 37-3-61
response
of plates, 39-3-205, 40-3-119
of isolation systems, 40-5-210
of linear systems, 37-3-89, 39-3-73
of mechanical systems, 39-3-77
of single-degree-of-freedom systems,
39-3-73
of shells, 40-3-45, 40-4-209
shock tests using, 39-5-83

- for simulation of engine cutoff, 37-4-62
 - versus sinusoidal vibration on humans, 41-2-16
 - of spacecraft, 39-6-119
 - specifications analysis, 38-2-52
 - stationary, 40-4-172
 - and strain response, 36-5-81
 - of structures, 39-3-55, 41-2-105, 41-6-197, 41-7-195
 - system identification under, 38-2-120
 - tests
 - control of, 36-3-15, 36-3-47, 37-3-47, 37-3-81, 37-3-89, 41-4-77
 - mechanical impedance for control of, 37-3-89
 - with multiple shakers, 36-3-92, 36-3-153, 37-3-89, 37-3-151, 39-2-51
 - specification of, 41-4-109
 - transfer function for, 36-5-88
 - transmission through structures, 38-2-231
- Range of variation
definition of, 37-3-77
- Rayleigh distribution
to derive peak exceedance curve, 41-3-44
- Rayleigh's Principle
in vibration analysis, 40-7-210
- Rayleigh-Ritz Method, 38-2-169
- RC averaging error, 41-4-93
- Reactor fuel assembly
damping model for, 36-4-72
- Real-time analysis
analog computer for, 41-3-55
- Reciprocity calibration
of probe for vibration, 40-7-50
of vibration exciters, 36-6-185
recoil simulation of, 41-3-187
in small arms, 41-5-53
- Re-entry vehicles
acoustic excitation of, 40-3-31
aerodynamic loads for, 39-1-223
flight vibration tests of, 36-3-113
modal analysis of, 36-3-83, 40-3-31
natural frequencies of, 40-3-40
pyrotechnic shock tests of, 36-2-71
resonance tests of, 36-3-83
structural model of, 37-4-67
- Regression analysis
in combined environment tests, 36-6-83
for prediction of vibration, 37-7-81, 39-6-122
- Reliability
of components, 39-1-175
determination of, 36-7-9, 36-7-29
improvement of, 41-2-141
of spacecraft,
analysis of, 40-3-11
effect of qualification tests on, 36-7-1, 40-3-20
model for, 36-7-4
tests
of electronic equipment, 36-7-23, 41-4-123
of propulsion systems, 36-7-21
of warheads, 39-1-177
- Residual thrust oscillation
definition of, 40-4-171
- Resonance
of composite panels, 39-3-15, 39-3-195
of ducts, 40-5-72
of reinforced concrete beams, 38-2-133
tests of re-entry vehicles, 36-3-83
- Resonant frequency, see Natural frequency
- Resonant systems
effect of sweep rate on, 41-4-95
- Response
to acoustic excitation
of beams, 36-5-77
measurement of, 37-5-53
of panels, 38-1-1, 39-4-101
prediction of, 41-4-87
of re-entry vehicles, 40-3-38
of solar panels, 40-3-49
of spacecraft, 36-3-42
of structures, 36-5-89, 36-5-97, 36-4-49, 39-3-55, 40-3-57
to aerodynamic loads
of re-entry vehicles, 39-1-223
to air blast
of antenna, 37-4-151, 40-1-31, 40-1-45
of gas turbines, 40-2-147
of hulls, 37-4-143
of re-entry vehicles, 39-1-223
of shells, 37-4-177
of structures, 37-4-169, 37-4-177
of target, 41-1-40
upper and lower bounds for, 37-4-169
of aircraft to crash loads, 38-3-165
characteristics of two-degree-of-freedom systems, 39-3-161
comparison of shock and vibration, 36-7-66
digital computers for determining mini-max, 36-5-71
to dynamic loads
of beams, 36-3-39
of stiffened plates, 39-3-233, 40-3-102

- of structural elements, 38-2-157
 - of two degree of freedom nonlinear systems, 39-3-161
- effect of Coulomb damping on, 36-1-47
- effect of temperature on, 40-5-4
- errors in prediction of, 36-1-7
- of helicopter structures to gunfire, 41-4-195
- to launch environments, 38-2-67
- limitation of amplitude control system, 36-3-151
- limitation of phase control system, 36-3-151
- of missiles to ship loading, 37-7-68
- optimization for railroad cars, 40-6-117
- to shock
 - of bilinear system, 36-6-45
 - of columns, 40-2-115
 - of continuous systems, 38-2-112
 - of crash energy dissipators, 39-4-236
 - of cylinders, 36-5-106
 - distributed mass systems, 37-4-48
 - of elastic half-space, 39-5-13
 - of electronic equipment, 36-7-129, 37-4-98
 - of fluid in gauge system, 40-2-67, 41-7-192
 - of forced draft blower, 38-2-103
 - of fragmenting tubes, 40-5-128
 - of glass structures, 40-5-175
 - of hard landing payloads, 40-2-187
 - of humans, 41-2-5
 - of isolation systems, 40-5-206, 41-2-27
 - of liquid filled tubes, 41-7-149
 - of mechanical systems, 38-2-107
 - of missile stowage system, 40-2-8
 - of missiles, 37-1-115
 - of nuclear reactor
 - of optimum isolation system, 40-5-208
 - of plates, 36-5-106, 39-4-63
 - of protective structures, 38-2-187, 39-4-199
 - of resonators, 40-4-20
 - of rotor bearings, 40-3-286
 - of second-order systems, 36-6-37
 - of shells, 38-3-121
 - of ship decks, 40-1-1
 - of ships, 39-1-21
 - of single-degree-of-freedom systems, 39-5-1, 41-S-46
 - of sonar transducer, 36-2-31, 37-1-67
 - of spacecraft, 37-4-1
 - of structures, 38-2-38, 39-4-5, 40-2-1, 40-5-175
- of shock isolator to foundation velocity, 38-3-216
- of small arms to recoil, 41-5-53
- of spacecraft from subsystem characteristics, 38-2-239

- of structures
 - calculations for, 38-2-3, 38-2-157, 40-3-1
 - digital computer for analysis of, 37-4-171
 - upper and lower bounds of total impulse, 37-4-173
- to vibration,
 - of airborne weapons, 37-S-107, 39-S-27, 40-6-9, 40-S-59
 - of boron-epoxy plates, 39-3-205, 39-4-81, 39-4-93, 41-7-30
 - of bridges, 41-4-99
 - of damped structures, 36-6-115, 41-2-105, 41-4-99
 - of ducts, 40-5-61
 - of dynamic systems, 36-5-69
 - of elastomers, 39-2-1
 - of flight vehicle, 37-7-77
 - of focal isolation systems, 38-3-265, 39-4-144, 40-5-205
 - of humans, 41-2-13
 - of hydrophones, 37-2-52
 - of inertial reference unit, 40-3-260
 - of launch vehicles, 38-3-104
 - of linear systems, 37-3-89, 39-3-73
 - of lumped parameter systems, 38-3-95
 - of mechanical systems, 41-4-130, 41-6-42
 - of payload in shells, 40-3-45
 - of printed circuit boards, 38-S-5, 40-3-111
 - of propellant gauge system, 41-7-190
 - of rectangular plates, 39-3-205
 - of reinforced concrete beams, 38-2-133
 - of rotor bearings, 40-3-283
 - of shafts in water, 39-2-217
 - of shells, 38-3-121
 - of spacecraft, 36-5-50
 - of target acquisition system, 40-S-63
 - of test specimens, 36-3-48, 38-1-136
 - of viscoelastic dampers, 38-3-71
- to underwater explosions
 - of shells, 40-1-15
 - of shipboard equipment, 39-1-55
 - of structures, 41-7-89
 - of submarine equipment, 39-S-41

Response functions
 transformation of, 36-4-105

Response spectra
 of airborne weapons dispenser, 40-5-11
 for bilinear hysteretic beam, 41-5-50
 for blade-like structures, 39-4-26
 calculation by analog computer, 36-6-37
 for columns, 39-3-247, 40-2-115
 concept of, 36-7-64

- in control of vibration tests, 37-3-47
 - of cylinder during acoustic test, 37-5-69
 - for nuclear airblast, 41-S-46
 - for pyrotechnic shock, 36-2-71
 - from random inputs, 39-2-51
 - for remote compass transmitter, 40-5-14
 - for shock in plates, 41-5-101
 - of spacecraft electronic assembly, 36-3-30
 - of structures excited by underwater explosions, 40-7-190
 - for swept sinusoidal vibration, 38-1-133
 - for torsional shock, 36-7-64
 - for torsional vibration, 36-7-65
- Reverberant acoustic field
 - correlation coefficients for, 37-5-65
- Reverberation chamber
 - acoustic tests in, 39-2-87, 41-3-207
- Reynold's number
 - critical, 39-2-217
 - versus Mach number, 37-3-127
- RF-4C aircraft
 - vibration and acoustic environments for, 37-S-95
 - vibration of equipment in, 37-S-103
- Rigid body
 - damped vibration of elastically-supported, 36-7-135
- Rigid body modes
 - for helicopter structures, 41-7-135
- Ring spring, 41-2-56
- Rings
 - composite loss factor for, 39-1-150
 - mode shapes of, 39-1-151
 - natural frequencies of, 39-1-150
 - vibration analysis of, 39-1-144
- Ritz averaging procedure
 - for multi-degree-of-freedom systems, 39-3-162
- Ritz Method
 - in vibration analysis, 39-4-81, 39-4-93
- Riverine craft
 - shock data for, 37-1-48
 - shock hardening of, 37-1-35
 - shock isolation for equipment, 37-1-55
 - shock isolation for personnel, 37-1-56
- River Patrol Boat
 - dynamic environment for, 37-7-205
- Road tests
 - simulated for tracked vehicle, 41-3-124
- Road vehicles
 - vibration isolation of, 38-3-317
 - vibration tests of, 41-3-124
- Rocket engines
 - acoustic excitation of, 41-6-115
 - combustion instability in, 40-4-110
 - environmental data for, 37-2-135
 - power spectral density for, 37-2-121
 - shock test of, 37-2-129
 - vibration tests of, 37-2-129
 - vibration analysis of, 41-6-115
- Rocket Motors, see Rocket engines
- Rocket Propelled sleds
 - instrumentation for tests, 37-3-199, 41-7-3
 - test data for prediction of response of panels, 41-7-1
 - tests on missiles, 39-1-175
- Rocket vehicles, see Missiles
- Rods
 - longitudinal vibrations of, 40-2-39
 - lumped parameter mathematical models of, 41-7-62
- Root locus equations
 - for binary flutter, 41-7-113
- Root locus method
 - in extension of binary flutter models, 41-7-109
 - mathematical analysis of, 41-7-120
- Rotary inertia
 - definition of, 39-3-49
 - effects on vibrating beams, 38-3-13, 39-3-49
- Rotating shaft
 - damping of, 38-3-112
- Rotor blades
 - balancing of, 36-7-113
 - mathematical model of, 40-2-237
 - vibration isolation of, 38-3-263
- Rough handling
 - drop height during, 37-7-4
 - effect of distribution system on, 37-7-8
 - environments for cargo, 37-7-1
 - during loading of ships, 37-7-67
 - measurement of, 36-6-173
 - shock recorder for, 39-6-19

- shock spectra for, 37-7-16
- transportation environments during, 37-7-1
- Rough road tests
 - comparison to MIL-STD-810A, 37-7-63
- S**
- Safeguard facility equipment
 - shock tests on, 40-2-243
- Safety criteria for automobiles, 38-3-325
- Safety factors
 - derivation for spacecraft equipment, 40-3-94
 - for design of spacecraft structures, 40-3-89
- SAM-D Missile
 - rail launch dynamics of, 41-6-219
- Sandwich panels, see Panels
- Sandwich plates, see Plates
- Satellites, see Spacecraft
- Saturn launch vehicles
 - acoustic environment of, 39-6-133
 - dynamic test vehicle, 40-5-261
 - fixture for component vibration tests, 38-1-87
 - prediction of dynamic characteristics, 40-5-268
 - S-IB stage
 - bending modes for, 37-3-113
 - combustion instability tests, 40-4-109
 - data from dynamic tests, 37-3-115
 - dynamic tests, 37-3-99
 - isolation system for dynamic test stand, 37-3-101
 - measured versus predicted modes, 39-2-139
 - modal survey, 39-2-135
 - structural analysis, 39-2-136
 - S-IC stage
 - acoustic tests on fin structures, 37-5-167
 - engine cutoff vibration, 37-4-59
 - reliability program for, 36-7-19
 - S-II stage
 - acoustic vs mechanical excitation for, 37-5-135
 - analysis of data from, 36-6-47, 36-6-55
 - assembly level vibration tests, 37-5-121
 - launch vibration environment, 37-5-117
- S-IVB stage
 - assembly level vibration tests, 37-5-121
 - data analysis for vibration tests, 37-2-109
 - high force vibration tests, 37-3-137
 - test criteria for vibration, 37-3-139
 - vibration of propellant in, 41-7-169
 - vibration environment of, 39-6-133
 - vibration tests of scale models, 38-2-25
- Sawtooth pulse, see Shock pulse
- Scalar flowgraphs, 38-1-100
- Scale models, see also Dynamic models and Mathematical models, and Models
 - correlation factors for natural frequencies, 39-3-42
 - for crash simulation, 39-4-230
 - in crash tests of aircraft fuselages, 38-3-171
 - in crashworthiness studies of vehicles, 39-4-227
 - data from wind tunnels, 37-7-221
 - for dynamic analysis of structures, 40-4-89
 - for dynamic studies of launch vehicles, 40-3-205
 - properties of materials for, 39-3-40
 - for shock analysis of structures, 40-1-1
 - for stress in blast closures, 40-2-138
 - vibration of beams, 39-3-39
- Scaling
 - for blast of weapons, 39-6-141
 - of damping, 36-4-1
 - for dynamic models, 39-4-228
 - for shock tests, 39-5-41
 - for shock tubes, 39-5-41, 39-5-53
 - for Titan III models, 37-3-125
 - of vibration data, 36-5-85
- Schlieren photographs
 - from model tests, 37-3-135
- Scout launch vehicle
 - prediction of flight vibration, 36-5-85
- Seismic mass
 - isolation system for, 41-3-110
 - for variable resonant vibration exciter, 38-S-3
- Self synchronization
 - of vibrating machinery, 41-6-159
- Sensitivity analysis
 - of shock isolators, 41-2-51

Sensitivity of humans to vibration, 41-2-13

Separation shock, see Pyrotechnic shock

Shafts

critical speeds of, 38-3-45, 41-6-203
in studies of bending vibrations of
missiles, 38-2-169
in studies of torsional vibrations of
missiles, 40-4-163
torsional natural frequencies of, 40-4-164
vibration analysis of, 39-2-217
vortex shedding of towed, 39-2-218

Shakers, see Vibration exciters

Shear deformation effects on vibrating beams,
38-3-13, 39-3-49

Shear modulus
measurement of, 36-4-85

Shells

acoustic excitation of, 40-3-23, 40-3-31
attenuation of noise in, 39-1-159
correspondence theorem for, 38-3-122
criterion for impact failure, 39-5-21
damping of, 38-3-121, 39-1-155
dynamic stability of, 41-7-81
eigenvalue distributions in, 40-4-209
eigenvalue problem for, 38-2-86
elasto-plastic response to impulse loads,
41-7-81
equations of motion for, 40-3-75
finite element analysis of, 41-7-84
Hamilton's principle in modal analysis,
41-7-152
Kennedy-Pancu Method for vibration
studies of, 39-3-107
impact of, 39-5-21
kinetic energy of, 40-3-134
mathematical analysis of, 38-3-123
mathematical model of, 38-2-79
mechanical impedance of, 39-3-107
modal densities of, 40-3-69
mode shapes of, 38-2-79, 39-1-161,
39-3-107, 40-3-31, 40-3-131, 41-7-151
mode surveys of, 39-3-107
natural frequencies of, 38-2-79, 39-3-107,
40-4-209, 41-7-151
for nuclear fuel capsules, 39-5-21
optimized damping treatments for,
39-1-163
radial motion of spherical, 36-5-114
response to underwater explosions,
40-1-15
shock spectra for, 38-2-43
stress waves in, 38-2-38
stresses in, 40-3-43

structural analysis of, 38-1-87, 38-2-79,
39-3-107, 39-5-21, 40-3-23, 40-3-31,
40-3-69, 40-3-131, 40-4-209, 41-7-151
vibration of, 39-1-155, 39-3-107, 40-3-31,
40-3-69, 40-3-131, 40-4-209
as vibration test fixtures, 38-1-87

Shillelagh Missile

shock test facility for components,
37-4-103, 37-4-111

Shipboard environment

simulation of, 40-2-51
versus floating platform shock tests and,
37-1-71

Shipboard equipment

analysis of response to underwater
explosions, 39-S-41
combined environment tests of, 36-6-83,
40-2-51
criteria for shock inputs to, 39-1-80
damage of, 37-1-2, 39-1-1, 39-1-96
DDAM prediction versus response, 36-1-1
design for underwater explosions, 39-1-65
dynamic analysis of, 36-7-129, 38-2-11,
39-1-13, 39-1-25, 39-1-33, 39-1-45,
39-1-74, 39-1-80, 39-3-117, 39-3-41,
40-1R-1, 40-7-165, 40-7-177, 40-7-197
Dynamic Design Analysis Method (DDAM)
for, 39-1-13, 39-1-25
effect on shock response of decks, 40-1-1
fixed-base natural frequencies for,
38-2-209
foundations for, 38-3-1, 39-1-39, 40-7-171
Fourier spectra for, 39-S-47
information needs for dynamic analysis
of, 40-7-141
mathematical models of, 39-1-45, 39-1-86,
40-1R-5
normal mode analysis of, 39-1-13,
39-1-25, 39-1-55, 39-S-41
problems in application of DDAM,
40-7-144
shock environment, 37-1-1, 40-S-29
shock hardness, 39-1-1, 39-1-13, 39-1-25,
40-7-143
shock isolated vs hard mounted, 40-S-40
shock isolation of, 37-1-25, 39-1-83,
40-7-233, 40-S-29
shock response, 40-2-1
shock spectra for, 39-1-15
shock tests of, 37-1-69, 38-2-95,
38-3-221, 39-1-70, 39-1-84, 40-7-145
sources of shock data for, 36-1-2
stress analysis of, 39-1-42
two-stage isolators for, 40-7-233
velocity spectra for, 39-S-48
vibration isolation of, 40-7-233

Shipboard personnel
shock isolation of, 37-4-79

Shipboard shock
effect on humans, 41-2-5
elastic-plastic analysis of, 37-1-25
evolution of design techniques for, 37-1-23
on HMS OBDURATE, 37-1-1
information needs for design requirements,
40-7-141
motions of decks, 40-1-1
protection of equipment from, 39-1-100
response of missile stowage system to,
40-2-8
shock isolators for, 38-3-246
survey of progress in, 37-1-15
tests on shock isolators, 40-S-35
on 21B weapons skid, 36-1-23

Shipboard vibration
automated recorder for, 40-7-225
computer program for analysis of, 36-6-115
data analysis of, 36-6-67
instrumentation for, 40-7-243
response of structures to, 36-6-115
vibration exciter for, 38-S-1

Shipping containers, see also Containers
dynamic analysis of, 39-6-57
for missiles, 39-6-57
recorder to measure drop height, 36-6-173
shock during handling, 37-7-2
shock tests of, 39-6-65
simulation of tipover, 39-6-65

Ships
airblast environment for, 36-1-16, 39-1-95
aircraft carriers
analog computer program for
vibration, 40-S-16
catapult excited vibrations on, 40-S-13
effects of air blast on, 37-4-143
mathematical model of, 37-4-144,
40-S-16
modal analysis for, 37-4-145
antennas for, 37-4-151, 40-1-31, 40-1-45,
40-1-75
balanced protection for, 39-1-97
calculations of natural frequencies for,
38-1-125
CVAN 65
capsize boundaries for, 37-1-87
criteria for shock hardening, 39-1-65,
39-1-93
damping from anchor drop tests, 40-S-8
damping of foundations for machinery,
39-1-171
damping treatments for silencing, 41-2-151
damping from vibration generator tests,
40-S-9

DD421
capsize boundaries of, 37-1-87
design of machinery for, 39-1-33
design of propulsion systems, 39-S-55
DLG-16, 39-1-107
capsize boundaries of, 37-1-87
dynamic analysis of boilers, 39-1-26
effects of airblast on, 36-1-13, 37-1-77,
37-4-143, 39-1-1
effect of underwater explosions on,
36-1-13, 37-1-1, 39-1-1, 39-1-65
on shipboard humans, 41-2-5
electronic equipment for, 39-3-117
environmental data from, 40-7-225
foundations for machinery, 38-S-19
HMS OBDURATE, 37-1-1
use of keel shock factor for, 39-1-8
predicted vs measured shock response,
39-1-21
rough handling during loading, 37-7-67
shock analysis for, 40-1-1, 40-7-65
shock data for, 36-1-14, 37-1-1
shock loads on, 39-1-3, 39-1-13, 39-1-33,
39-1-65, 39-1-93, 40-7-141, 40-7-153,
40-S-1, 41-1-1
shock resistance of piping, 40-S-1
shock tests of boilers, 39-1-30
specifications for shock inputs, 39-1-13
underwater explosions tests on, 39-1-67,
41-1-1
USS ATLANTA, 36-1-3, 36-1-13
USS FULLAM, 36-1-3
velocity time histories at different deck
levels, 39-1-7
vibration in, 38-1-125, 39-S-55, 40-S-13
vibration analysis of, 36-6-67, 36-6-115,
38-S-1, 39-S-55
vibration characteristics from impulse
loads, 40-S-7
vibration tests of, 41-S-1

Shock, see also specific types such as Ground
shock and Pyrotechnic shock
as criteria for severity acceleration,
40-2-31
attenuation of
in glass structures, 40-5-175
in missiles, 39-S-1
by yielding structures, 38-2-255
in avionics during arrested landings,
40-6-37
challenging problems in, 36-2-1
complexity of, 36-2-5
criteria for shipboard structures, 39-1-39
damage to eggs, 41-3-11
damage mechanisms for, 37-4-71
design
of electronic equipment, 37-4-98
use of fixed-base natural frequencies
in, 38-2-261

- of shipboard equipment, 39-1-13, 39-1-25, 39-1-77
- of shipboard structures, 39-1-39
- of ship boilers, 39-1-25
- in submarines, 38-3-243
- use of vibration for, 41-4-119
- displacement amplifier for, 41-3-149
- in electronic equipment, 40-7-85, 40-S-73
- environment
 - from guns, 39-6-139
 - isolation of gunfire, 39-4-251
 - for nuclear weapons, 37-4-97, 39-1-93
- equivalence with vibration, 41-4-124
- from 5 in./54 Naval gun, 36-2-53
- during handling of shipping containers, 37-7-2
- human tolerance to, 37-4-80, 41-2-5
- inputs for shipboard equipment, 39-1-50
- in M-151 jeep, 37-7-39
- measurements
 - on ships, 39-1-5
 - on structures, 40-2-3
- in missiles, 39-S-1
 - during shiploading, 37-7-67
- modal velocity as criteria for severity, 40-2-31
- in nonlinear structures, 41-5-27
- in non-linear system, 39-5-1
- parametric response to, 40-2-115
- performance of gas bearings during, 38-3-221
- physiological effects from, 41-2-5
- prediction of transmission, 37-4-65
- protection of spacecraft during landing, 41-2-89
- protection of above-ground structures, 37-4-213
- response to
 - of beams, 40-4-3, 41-5-27
- of bearings, 40-3-275
 - of electronic equipment to, 37-4-98
 - of fluid systems, 40-2-67
 - of fragmenting tubes, 40-5-128
 - of glass structures, 40-5-175
 - holography for, 40-7-33
 - of hulls, 40-7-185
 - of missiles on tracked vehicle, 41-2-166
 - of multi-degree-of-freedom systems, 40-4-17
 - of plates, 39-4-67, 41-5-101
 - of ship decks, 40-1-1
 - of shipboard equipment, 40-2-1
- response spectra
 - for columns, 40-2-115
 - for plates, 41-5-101
- rough handling, 37-7-16
- on shipboard equipment, 37-1-1, 40-S-29
- on shipboard machinery, 39-1-34

- in ships, 39-1-1, 39-1-13, 39-1-33, 39-1-65, 39-1-93, 40-7-141, 40-7-153, 40-S-1, 41-1-1
 - problems in dissemination of information, 39-1-81
 - sources in structures, 40-2-22
- spectral analysis of, 36-6-2
- in submarines, 39-1-93, 39-S-41, 41-S-49
- transient waveform control of, 40-2-164
- in trucks, 39-6-31
- velocity spectra as descriptor of, 40-2-32

Shock analysis, see also Dynamic analysis, Mathematical analysis, Modal analysis, Structural analysis, and Vibration analysis

- of aircraft during ground impact, 38-3-166
- analog computers in, 36-6-37
- computer programs for, 36-6-131
- of cylindrical shells, 40-1-17
- digital computers in, 40-7-153
- of elastic-plastic systems, 39-5-2, 40-4-67
- of elastomeric shock isolators, 39-4-216
- of electronic equipment, 39-3-117, 40-7-85, 40-S-31
- energy-flow method for, 37-4-65
- finite element method for, 38-2-11
- of fluid systems, 40-2-67
- of force transmitted to armor, 41-5-72
- of gas spring, 41-3-181
- of high-impact shock machine, 38-2-95
- of impact damping, 39-4-3
- of impact limiters, 40-2-185
- of inverting tube for, 41-2-89
- of machinery for ships, 39-1-35
- mathematical models for, 36-6-131
- normal mode method for, 38-2-11
- of open cell foams, 40-5-291
- of pressure vessels, 40-1R-7
- of propagation of shock wave, 39-5-14
- of propagation of stress waves, 38-2-34
- of rotational drop test, 39-4-182
- of shipboard equipment, 39-1-33, 39-1-45, 39-3-117, 40-1R-1, 40-7-177
- of ships, 39-1-13, 40-7-165
- of ship's decks, 40-1-1
- shock spectra in, 37-4-43
- of shock tubes, 39-5-42
- of sonar transducers, 41-1-21
- of structures, 36-6-131, 40-1-1, 40-2-31, 40-2-123, 40-5-176, 40-7-185, 40-7-197, 41-7-89
- of suspension systems, 39-6-60, 40-5-218, 41-2-60
- of test facility for damping collar, 40-5-166
- time sharing computer program for, 40-7-153
- of tipover of shipping containers, 39-6-68
- of vacuum tube launchers, 40-2-194

- Shock analyzer**
 design of, 37-2-65
 digital, 36-6-21
- Shock barges, see Floating shock platforms**
- Shock data**
 analysis of, 36-2-55, 40-7-115
 automated system for, 36-6-21
 desiderata for, 36-6-22
 digital, 36-6-21
 fast Fourier transforms in, 41-5-39
 proposed standard for, 39-6-7
 comparison for full-scale and model blast closures, 40-2-143
 interpretation from ship shock tests, 40-2-1
 presentation of, 39-6-7
 for riverine craft, 37-1-48
 during rough handling, 37-7-2
 sampling and digitalization of, 41-5-10
 on ships, 37-1-1
 from air blasts, 36-1-16
 from underwater explosions, 36-1-14, 40-1-11
 on simulated ship structures, 40-2-10
 sources for shipboard equipment, 36-1-2
 on submarines, 36-1-4
- Shock design numbers**
 comparison of, 39-3-117
- Shock effects**
 on isotopes, 41-3-194
 on sonar transducers, 36-2-31
- Shock hardening**
 of antennas, 37-S-1
 of hydraulic systems, 41-5-143
 of ordnance, 41-5-77
 of riverine craft, 37-1-35
 of shipboard equipment, 39-1-1, 39-1-13, 39-1-25, 40-2-147, 40-7-143, 41-5-35
 of shipboard structures, 39-1-107
 of sonar transducers, 37-1-65
 of submarines, 39-1-93
 of weapon systems, 41-5-135
- Shock inputs**
 for shipboard equipment, 39-1-80
- Shock isolation**
 for aircraft crashes, 41-3-133
 of avionics components, 40-5-285
 of ballistic missiles, 36-2-89, 39-4-213
 combined with ship silencing, 38-3-243
 computer-aided design, 39-4-185
 concepts, 37-4-214
 concrete for, 39-4-199
 crushable structures for, 41-2-95
 design of attenuator strut for, 38-3-256
 of equipment in mobile shelters, 39-4-179
 of ground support equipment, 37-4-218
 from high frequency effects, 41-2-53
 for impact on structures, 40-5-115
 with nonlinear damping, 41-2-21
 open cell foams for, 40-5-291
 with polyurethane foam, 36-2-89
 properties of elastomeric materials, 39-4-213
 of recoil forces from guns, 39-4-251
 for riverine craft equipment, 37-1-55
 for riverine craft personnel, 37-1-56
 of shipboard equipment, 37-1-25
 of shipboard personnel, 37-4-79
 systems
 analysis of, 40-5-218, 41-2-60, 41-5-129
 design of, 41-2-55, 41-2-68, 41-5-155
 for equipment in hardened sites, 41-5-155
 for equipment platforms, 41-5-129
 fragility of, 41-5-129
 interactive optional design of, 41-2-47
 modeling of, 40-5-218, 41-2-58
 for protective structures, 39-4-199
 viscoelastic materials for, 40-5-175
 yielding structures for, 41-2-89
 of weapons skid 21B, 36-1-23
- Shock isolators, see also Active vibration isolators and Vibration isolators**
 annular
 dynamics of, 39-4-213
 effect of air flow on spring rate of, 39-4-226
 mathematical model of, 39-4-218
 for avionics equipment
 during arrested landing, 40-6-37
 polyurethane foams as, 40-5-285
 computer-aided design of, 41-2-47
 crushable structures as, 39-4-199
 damped, 38-3-215
 dynamic characteristics of, 41-2-53
 double acting
 analysis of, 38-3-214
 performance of, 38-3-213
 elastic skid mounts as, 39-4-179
 elastomeric, 41-2-57
 analysis of airflow in, 39-4-216
 properties of, 39-6-58
 for electronics equipment, 40-S-31
 energy-absorber steering columns as, 37-4-79
 for equipment in hardened sites, 41-5-129
 failure models for, 41-5-130
 flow diagram for, 41-2-49
 gas dynamic effects in, 39-4-213
 high performance, 41-2-53
 high rate loading of, 40-5-218

- data acquisition for, 40-5-256
 - test facility for, 40-5-245
 - tests of, 40-5-233
 - indirect synthesis of, 39-4-185
 - inverting tube as, 41-2-89
 - linear versus nonlinear, 41-2-34
 - load deflection characteristics of, 40-7-235, 40-8-31
 - mathematical models of, 38-3-213, 41-2-65
 - for missile stowage system, 40-2-10
 - for mobile shelters, 39-4-179
 - optimum, 36-5-73, 39-4-185
 - open cell foams as, 40-5-291
 - performance of
 - conventional, 40-7-234
 - of crushable, 39-4-23.
 - polyurethane foam, 36-2-92
 - relaxation damping for, 40-5-203
 - sensitivity analysis of, 41-2-51
 - for shipboard equipment, 38-3-246, 39-1-83, 40-7-233, 40-8-29
 - shock tests on, 40-5-171, 40-5-246, 40-7-235, 40-8-35
 - shortcomings of conventional, 38-3-213
 - soil as, 37-4-182
 - specifications for, 41-2-54
 - stress waves in, 40-5-157
 - surging in, 40-5-217
 - system identification in design of, 39-4-188
 - transmissibility of, 41-5-157
 - vacuum spring as, 36-7-103
- Shock loads, see also Impulsive loads
 - on beams, 41-6-147
 - on blast closure valves, 40-2-135
 - on composite materials, 41-5-69
 - design for high intensity, 40-7-85
 - dispersal of, 41-2-77
 - measurement of, 41-3-64
 - parametric response of columns to, 40-2-115
 - in plates, 41-5-101
 - response of second-order systems to, 36-6-37
 - on scale models, 38-4-261
 - ships, 39-1-3
 - simulation of, 40-2-243
 - on structures, 40-2-3, 40-2-57, 40-2-115, 40-2-243, 41-6-75, 41-6-187, 41-7-89
 - for tests of spacecraft, 36-2-97
 - vibration absorbers for, 39-4-261
- Shock pulse
 - analog analysis of, 38-1-19
 - compensation for haversine, 40-7-126
 - editing of, 36-6-23
 - on electrodynamic vibration exciters
 - procedures for generating, 40-7-96
 - synthesis of multiple, 39-5-83
 - Fourier spectra for, 40-2-175
- from guns, 36-2-85
- half sine
 - crushable honeycomb response to, 40-4-74
 - elastic-plastic system response to, 40-4-67
 - on electrodynamic vibration exciters, 36-2-21
 - shock spectra for, 36-2-23, 37-2-73
 - yielding structures response to, 40-4-81
- input for microphone, 37-2-7
- rectangular
 - compensation for, 40-7-130
 - response of bilinear system to, 36-6-45
 - response of columns to, 40-2-119
 - requirements for full-sine, 40-2-178
 - response of columns to longitudinal, 40-2-115
- sawtooth
 - compensation for, 40-7-130
 - on electrodynamic vibration exciters, 36-2-24, 40-7-94
 - response of elastic-plastic system to, 39-5-1
 - response of resonator to, 40-4-20
 - shock spectra for, 36-2-22, 37-2-74
- shaping
 - by drop test techniques, 41-5-65
- shock spectra for triangular, 37-2-75
- square wave,
 - power spectrum for, 39-5-85
- synthesis of, 39-5-69
- trapezoidal,
 - response to, 36-5-119
 - shock spectra for, 36-5-124
- Shock recorders
 - design requirements for, 36-6-175
 - for rough handling of packages, 36-6-173, 39-6-19
 - test shipments with, 39-6-30
 - for transportation environments, 36-6-163, 36-6-173, 39-6-19, 40-3-99
- Shock response, see response
- Shock spectra
 - analysis of, 37-4-43, 41-3-75
 - by analog computer, 36-6-43
 - analyzers for, 37-2-66, 41-3-78
 - calculation of
 - by digital computer, 36-6-131
 - using Duhamel integral, 36-2-12
 - comparison for various pulse shapes, 40-6-134
 - of complex shock transients, 36-6-9
 - computer program for, 36-2-12
 - definition of, 41-3-75, 41-5-18

derivation of, 41-5-19
 in design of equipment, 40-2-215
 for dynamic analysis of shipboard
 equipment, 39-1-15
 effect
 of damping on, 40-2-223
 of digitizing detail on accuracy,
 36-6-1
 of separation of frequencies on dip,
 40-2-225
 of signal error on analysis, 37-2-38
 of gunfire on helicopters, 41-4-207
 for half-sine pulse, 36-2-23, 37-2-73
 instrumentation for, 36-2-18
 lower and upper bounds to, 40-2-220
 for missile shells, 38-2-43
 as a measure of damage potential, 41-5-17
 for munitions ejection, 41-5-96
 practical upper frequency limit of, 37-4-43
 for pyrotechnic shock, 41-5-2
 requirements for transmitter, 40-7-86
 for rough handling shocks, 37-6-16
 for sawtooth pulse, 36-2-22, 37-2-74
 for shock isolated equipment, 41-5-167
 using sinusoidal pulse technique, 38-3-211
 for slow sweep vibration tests, 38-3-208
 for spacecraft, 39-5-67
 in specifications, 39-5-85, 40-2-245
 for structures, 40-4-17
 for trapezoidal shock pulse, 36-5-124
 for triangular pulse, 37-2-75
 for underwater explosions, 39-S-41
 for weapons skid 21B, 36-1-26
 yielding effects on, 36-2-9

Shock test facilities

air guns as, 37-2-32, 37-3-219, 37-4-103,
 37-4-111, 41-3-194
 for calibration of accelerometers,
 40-2-205
 compressed air launchers as, 40-S-21
 detonable gas explosions as, 37-4-199
 electrodynamic vibration exciters as,
 39-5-67, 39-5-83, 40-2-157, 40-2-173
 exploding wires as, 37-4-121
 floating shock platform as, 37-1-69,
 37-4-85, 39-1-82, 40-2-1
 gas guns as, 41-3-155
 mechanical amplifiers as, 40-2-205
 for missile containers, 37-4-137
 partial full scale test machine as, 39-4-216
 for prime movers, 37-4-127
 for qualification to MIL-S-901C, 37-4-85,
 39-1-71
 for repeated shocks, 39-6-15
 Servo-hydraulic vibration exciters as,
 40-2-243
 shock tubes as, 37-4-127, 39-5-41,
 39-5-53, 40-2-133, 40-2-147
 shock tunnel as, 37-3-203

for simulation of
 air blast, 39-1-102
 human head impacts, 39-5-89
 underwater explosions, 37-4-137
 solid-propellant guns as, 36-2-83
 for submarine hull penetrations, 39-1-73
 vacuum tube launchers as, 40-2-193
 for zero impedance tests, 39-5-64

Shock test machines, see also High-impact shock machines

capabilities of modified slingshot, 39-5-76
 drop test, 37-2-32
 acceleration-time histories on,
 41-5-59
 shock tests on, 39-5-73, 41-5-59
 dual mode, 37-4-137
 for simulation of container tipover,
 39-6-65

Shock tests

of aerial-delivered material, 41-3-223
 of attenuator struts, 38-3-257
 of beams, 41-6-147
 of bearings, 40-3-280
 by directional, 37-2-33
 on blast closure valves, 40-2-133
 of boilers for ships, 39-1-30
 compared to normal mode structural
 analysis, 39-3-117
 with compressed air launchers, 40-S-21
 control of waveforms by digital computers.
 40-2-157
 for design of equipment, 40-2-215
 on drop test shock machines, 39-5-73,
 41-5-59
 versus Dynamic Design Analysis Method
 (DDAM), 36-1-1
 with electrodynamic shakers, 36-2-17,
 36-3-91, 39-5-67, 39-5-83, 40-2-157,
 40-2-173, 40-7-93, 41-3-149
 of electronic equipment, 39-3-118,
 39-5-79, 40-7-85, 41-4-123
 of equipment in protective structures.
 40-2-243, 41-5-167
 using exploding wires, 37-4-119
 for failure loads on railroad cargo,
 40-6-87
 floating shock platform versus shipboard
 environment, 37-1-71
 fixtures for, 38-2-95, 39-2-175
 force-controlled, 39-5-63
 on foundations, 38-3-2
 for fragility
 of packaged equipment, 40-6-127,
 40-6-133
 of systems, 41-5-121
 of fragmenting tubes, 40-5-116
 on fuzes, 41-3-155
 of gas-bearing machinery, 38-3-221

- with gas guns, 41-3-155
 - of glass spheres, 40-5-178
 - on gas turbines, 40-2-152
 - with head impact simulator, 39-5-96
 - of helical coils, 41-2-79
 - high acceleration, 40-2-205
 - of humans, 41-2-5
 - on hydraulic systems, 41-5-145
 - of isolation systems, 41-2-61
 - limitations on present methods, 39-5-63
 - mechanical amplifications of stress waves for, 40-2-205
 - mechanical impedance in, 39-5-63
 - on modified floating shock platform, 37-1-69
 - with modified slingshot shock test machine, 39-5-73
 - of nuclear fuel capsules, 40-2-193
 - of packaged equipment, 39-6-15
 - of piping, 40-S-1
 - pyrotechnic
 - with explosive charges, 36-2-71
 - of a re-entry vehicle, 36-2-71
 - with pyrotechnic devices, 41-5-11
 - for railroad transportability of cargo, 40-6-86
 - on rocket engines, 37-2-129
 - on scale model vehicles, 39-4-227
 - shipboard, 37-1-21, 37-1-69
 - interpretation of data from, 40-2-1
 - of a missile stowage system, 40-2-5
 - of shipboard equipment, 37-1-69, 38-2-95, 38-3-221, 39-1-70
 - panel discussion on, 39-1-77
 - problems in, 39-1-94, 40-7-145
 - of shipping containers, 39-6-65
 - of shock isolators, 39-4-217, 40-5-171, 40-5-246
 - with shock tubes, 39-5-41, 39-5-53
 - with solid-propellant-powered guns, 36-2-83
 - on sonar transducers, 37-1-63
 - on spacecraft, 39-5-67
 - specialized facilities for, 37-4-103, 37-4-111,
 - specifications for, 36-2-107, 39-5-63, 39-5-67, 39-5-85, 40-2-164, 40-2-246, 41-5-77
 - vacuum tube launchers for, 40-2-193
 - to verify mathematical model of foams, 40-5-300
 - of weapon ejection mechanisms, 41-5-89
 - zero impedance, 39-5-63
 - design of shock test facilities for, 39-5-65
- Shock transients**
- Fourier spectra of, 36-6-9
 - shock spectra of, 36-6-9
- Shock tubes, see Shock test facilities**
- Shock velocity**
- from scaled data, 39-5-56
- Shock waves, see also Blast waves**
- fluid-structure interaction, 39-1-63
 - propagation of
 - in composite materials, 41-5-69
 - in elastic half-space, 39-5-14
 - in elastic plates, 39-5-13
 - kinetic energy absorbed in, 40-7-135
 - measurement of, 40-7-134
 - through structures, 40-2-21
 - in soils
 - pulse x-rays for study of, 36-6-225
 - in structures, 36-2-66, 39-5-13, 40-2-21
- Sidewinder Missile (AIM-9D)**
- power spectral density vs dynamic pressure, 37-S-111
- Signal error**
- effect on shock spectra analysis, 37-2-38
 - sources in transducers, 37-2-29
- Silencing, see Submarines**
- Silicones**
- characteristics of, 38-3-177
 - damping properties of, 38-3-64
- Silos, see also Hardened sites**
- fragility of equipment in, 41-5-161
 - hydraulic systems for, 41-5-143
 - shock isolators for equipment in, 41-5-129, 41-5-155
 - shock tests of equipment in, 41-5-167
- Simulation, see effect or environment simulated**
- Simultane**
- in shock tubes, 39-5-57
- Single-degree of-freedom systems**
- dynamic analogies for, 37-2-58
 - dynamic analysis of, 40-4-67, 41-S-45
 - response of
 - to random vibration, 39-3-73
 - to sawtooth shock pulses, 39-5-1
 - to trapezoidal shock pulses, 36-5-119
 - shock in non-linear, 39-5-1
 - transfer functions for, 39-3-75
- Sinusoidal pulse**
- shock spectra using, 38-3-211
 - for vibration tests, 38-3-207
- Sinusoidal vibration**
- calibration for, 37-2-23

- damping in plates during, 41-2-106
 - error as a function of amplitude, 37-2-88
 - fatigue damage from, 36-4-76, 36-5-17
 - fragility of resolver for, 41-5-114
 - isolation of, 38-3-285
 - kinetic energy of, 40-3-139
 - resonant response to swept-notched, 41-4-130
 - response to
 - of damped cylindrical shells, 38-3-132
 - of humans, 41-2-13
 - of spacecraft, 41-4-127
 - response spectra for swept, 38-1-133
 - to simulate engine cutoff, 37-4-60
 - to simulate spacecraft flight loads, 39-2-147
 - and strain response, 36-5-81
 - transmission through structures, 38-2-231
- Skids**
- design criteria for, 39-4-180
 - load-deflection characteristics of, 39-4-180
- Sky Lab**
- dynamic environment, 41-7-195
- Slosh**
- modes, 41-7-181
 - in propellant tanks, 41-7-169, 41-7-185
 - in rigid tanks, 41-7-164
 - of propellant
 - equivalent mathematical model of, 41-7-169
 - predicted vs experimental, 41-7-176
 - scaling laws in equivalent models for, 41-7-170
- Snap buckling**
- of structures, 41-6-89
- Snap 10A**
- criteria for structural design of, 36-7-74
 - flight vibration data for, 36-7-75
- Soil**
- analysis of ground shock in, 38-2-195
 - as isolator of stress waves, 37-4-182
 - pulse x-rays for study, 36-6-225
- Solar panels**
- finite element models of, 38-2-149
 - normal modes analysis for, 40-3-49
 - qualification tests of, 39-2-127
 - response to acoustic excitation, 40-3-49
- Sonar System AN/BQS-6B, 39-3-117**
- Sonar transducers**
- mathematical models of, 36-2-33
 - shock in, 36-2-1, 37-1-67
- Sonic fatigue, see Acoustic fatigue**
- Sound generators, see Acoustic test facilities**
- Sound pressure levels, see also Boundary layer noise**
- contours for VTOL Aircraft, 41-4-165
 - point-to-point correlation of, 39-2-87
- Spacecraft, see also specific spacecraft such as Apollo spacecraft, Mariner spacecraft, and Lunar Orbiter spacecraft**
- acoustic environment for, 40-3-52
 - acoustic excitation of solar panels, 40-3-49
 - acoustic test facility for, 37-5-25
 - acoustic tests of, 37-5-1, 40-4-105, 41-3-207
 - components, 36-3-39
 - application of mechanical impedance to, 38-2-239, 38-2-249, 40-3-86
 - attenuation of impact for, 40-2-183
 - combined environment tests on, 37-3-188
 - criteria for vibration of, 37-7-202
 - design criteria for, 40-3-96
 - dynamic environments of, 40-3-12, 41-4-3
 - flight data versus acoustic tests, 36-3-44
 - flight vibration of, 37-7-173, 40-3-9
 - interaction with launch vehicles, 38-2-239
 - launch induced failures, 40-3-9
 - launch phase simulator for, 37-5-175
 - mathematical model of, 36-3-16
 - modal analysis of, 41-3-26
 - noise reduction in, 40-4-103
 - notched random test spectra for, 36-3-15
 - parametric analysis of, 39-2-149
 - prediction of dynamic environments for, 40-3-79
 - protection during landing shock, 41-2-89
 - reliability of, 40-3-11
 - analysis of, 40-3-11
 - effect of qualification tests on, 36-7-1
 - model for, 36-7-4
 - response of
 - to sinusoidal vibration, 41-4-127
 - from subsystem characteristics, 38-2-239
 - safety factors for, 40-3-89
 - shock loads in, 36-2-97
 - shock spectra for, 39-5-67
 - shock tests on, 39-5-67
 - structural analysis of, 36-3-16
 - structural qualification, 39-2-147
 - synthesis of analytical model of, 39-2-153
 - transient loads in, 36-2-97
 - transportation environment for, 37-7-19
 - vibration analysis of, 41-4-128
 - using the statistical energy method, 36-5-41
 - vibration tests of, 40-3-9
 - fixtures for, 40-3-231

- force-control, 36-3-15
to simulate flight loads, 39-2-147
- Spaced-damping**
application of, 38-3-34
of structures, 38-3-31
- Spalling**
of structures, 40-4-127
- Specifications, see also Standards**
analysis of, 38-2-52, 39-6-151
of combined environmental tests, 37-5-176
for microminiature amplifiers, 36-6-221
MIL-E-5400, 40-6-37
MIL-S-901C, 37-1-69, 38-2-95, 41-5-77
MIL-STD-810B
for shock tests, 40-2-173
for vibration tests, 40-3-151
MIL-T-5422, 40-6-27
safety factors for spacecraft structures,
40-3-89
for shock hardening of ordnance, 41-5-30
of shock inputs to ships, 39-1-13
for shock isolators, 41-2-54
of shock tests, 36-2-107, 39-5-63, 40-2-45
using shock spectra, 39-5-85
shock and vibration
review of panel discussions on,
39-6-151
versus standards, 39-6-151
for vibration tests, 41-4-30, 41-4-69
41-4-109
force and motion in, 38-1-109
shortcomings of, 37-3-1
for zero impedance shock tests, 39-5-66
- Spectral analysis**
of gunfire, 41-4-135
for input control of vibration tests, 37-3-53
of shock, 36-6-2
- Spectral analyzer**
optical, 36-6-98
for shock, 37-2-65
- Spheres**
air blast loads on, 39-5-29
shock tests on glass, 40-5-178
structural analysis of, 39-5-29
vibration analysis of, 36-5-107
- Spring mass systems**
effect of looseness on performance,
41-6-39
- Sprint Missile**
shock data for, 39-S-3
vibration data for, 39-S-7
- Stability**
of active vibration isolation systems,
39-4-165
- Standard Antiradiation Missile (ARM)**
captive flight environment for, 40-5-68
spectral analysis of bending moment for,
40-6-81
- Standards, see also specifications**
for calibration of accelerometers, 41-3-1
for evaluation of fragility, 41-5-111
- Static analysis**
of anisotropic material, 39-3-201
- Static firing tests**
for launch vehicles, 37-3-99, 39-6-133,
40-4-109
isolation system for, 37-3-99
- Statistical analysis**
of multi-degree of freedom systems,
40-4-17
- Statistical energy analysis**
coupling factors in, 38-S-11
fundamentals of, 38-6-2, 41-6-10
loss factors in, 36-S-11
of multipanel structures, 37-2-99
for vibration analysis of spacecraft,
36-5-41
for prediction of dynamic environments,
38-S-5, 41-6-9
- Statistical shock analysis**
of missile on transporter, 41-2-167
- Stiffness matrix**
for beams, 38-1-11, 40-4-187
for columns, 40-4-187
computation of, 39-3-130
joiner matrix for, 40-1R-4
for landing gear, 39-3-190
for launch vehicles, 38-3-108
for mechanical shock model, 36-2-47
for piping system, 40-4-149
for plane stress, 41-7-124
for plates, 41-7-126
reduced, 40-4-2
in structural analysis, 37-2-175,
40-7-177
for triangular elements, 41-7-123
- STOL aircraft**
vibration environment of, 40-6-91
- Stowage system**
shock tests of, 40-2-5

- Strain**
in beams, 36-5-77
in panels, 38-1-2, 39-4-108
- Strain gage**
as bending moment transducer, 36-6-199
as fatigue gage, 39-2-35
microminiature amplifier for, 36-6-218
- Stranded wire spring**, 41-2-56
- Stress**
in aircraft structures, 39-3-87
in beams, 39-4-120, 40-4-1
Clarkson's method for prediction of, 39-3-88
combination of modal, 40-4-3
correlation with velocity, 40-2-38
determination from random vibration data, 40-3-1
distribution from vibration, 36-7-6
measured versus predicted, 39-3-90
in plates, 39-4-73
in scale model blast closures, 40-2-138
in shells, 40-3-43
of antennas, 40-1-76
of electronics equipment, 39-3-118
of glass structures, 40-5-183
of plates, 40-7-204
of shipboard equipment, 39-1-42
of stratified medium, 41-6-187
- Stress concentration under ring accelerometers**, 37-2-43
- Stress-strength concept**
in structural reliability, 36-7-2
- Stress-time history**
for cones, 40-4-131
- Stress waves**
attenuation of, 40-5-157
mechanical amplifications of 40-2-205
in piping, 40-5-157
propagation of
through anisotropic materials, 39-3-201
analysis of, 38-2-34
cylinders, 40-4-127
in frustums, 40-4-127
mathematical analysis of, 40-4-128
method of characteristics for, 41-6-183
in shells, 38-2-38
in shock isolators, 40-5-157
use of soil as isolator, 37-4-182
in solids, 41-6-139
in structures, 38-2-33, 41-6-187
- Strouhal number**
definition of, 40-3-303
for vortex shedding about cylinders, 41-6-31
- Structural analysis**, see also Dynamic analysis, Mathematical analysis, Modal analysis, Shock analysis, and Vibration analysis
of air blast resistance structures, 37-4-180
of antennas, 37-4-159, 40-1-45, 40-1-76, 41-6-103
of Apollo Lunar Surface Experiment Package (ALSEP), 38-2-50
automated, 39-3-31
of beams, 36-4-50, 37-4-50, 38-1-67, 39-3-1, 40-4-1, 40-4-81, 40-5-277, 41-6-47, 41-6-123, 41-6-133, 41-6-134, 41-7-51
of bridges, 41-4-99
of columns, 39-3-247, 40-2-115, 41-6-1
consistent mass matrices for, 40-4-1
digital computers in, 38-2-139, 40-4-163
digital computer programs for, 36-7-45, 38-2-139, 40-2-105, 40-2-238
using dynamic substructures, 38-2-14
of fixtures, 38-2-95, 39-2-158
of frames, 38-2-219
of grillages
by folded plate method, 40-7-216
by orthotropic plate method, 40-7-208
Rayleigh's Principle in, 40-7-210
of guideways, 41-6-47
of hardened sites, 38-2-187
of helicopters, 40-2-238
line solution method for, 38-2-157
lumped parameter method in, 38-2-57, 39-3-153
mechanical impedance in, 38-2-219
of missiles, 38-2-173
of panels, 39-3-1, 40-4-139
of piping system, 40-4-147
of plates, 36-5-46, 38-1-45, 39-3-205, 39-3-233, 39-4-73, 39-4-81, 39-4-93, 40-3-99, 40-3-119, 41-5-101, 41-7-29
of radio telescope, 40-4-155
of recoil adapters, 39-4-251
of re-entry vehicles, 39-1-223
of shells, 36-5-109, 37-4-178, 38-1-87, 39-3-107, 39-5-21, 40-3-23, 40-3-31, 40-3-69, 40-3-131, 40-4-209
of spheres, 39-5-29
of submarine hulls, 36-6-115
of trusses, 38-2-1, 39-3-157, 41-6-197
- Structural Analysis Matrix Interpretive System (SAMIS)** computer program, 38-2-139
- Structural damping**, see Damping

- Structural damage, see Damage of structures
- Structural design
 loads for
 analytical versus experimental, 36-7-56
 of machinery foundations, 36-4-88
 mini-max response problems in, 36-5-69
 viscoelastic materials in, 36-4-9, 33-3-37
- Structural dynamics
 of Apollo Lunar Surface Experimental Package (ALSEP), 38-2-47
 philosophy of tests, 41-4-1
- Structural equivalence
 using mechanical impedance, 36-2-63
- Structural fatigue, see Fatigue of structures
- Structural members
 criteria for failures of, 38-2-183
 dynamic response of, 38-2-157
 reduction of vibration in, 38-3-71
 vibration analysis of, 38-2-219
- Structural models
 of re-entry vehicles, 37-4-67
 synthesized, 38-2-201
 for vibration tests, 38-2-26
- Structural relationships
 in dynamic analysis, 38-2-2
- Structural reliability
 analysis of, 36-7-29
 Bayesian statistics in, 36-7-31
 difficulties in determining, 36-7-27
 panel discussion on, 36-7-27
 of spacecraft, 36-7-1
 stress-strength concept in, 36-7-2
 vibration qualification tests for, 36-7-1
- Structural synthesis
 fundamentals of, 39-3-32
- Structures, see also specific types such as Aircraft structures, Bridges, Hardened sites, Protective structures, and Shipboard structures
 above-ground
 shock protection techniques in 37-4-213
 acoustic excitation of, 37-5-167 43,
 39-3-55, 39-3-65, 40-3-57, 41-7-195
 acoustic fatigue of, 40-5-49
 aerospace
 design of, 41-6-179
 air blast loads on, 37-4-169, 37-4-185,
 38-2-177, 39-1-109, 37-4-193, 39-3-65,
 39-5-29, 40-1-31, 40-1-45, 40-2-101,
 41-1-35
 air blast propagation into, 37-4-185
- Structures
 air blast resistant, 37-4-180
 air blast shock tests on, 39-5-41
 aircraft
 acoustic tests of, 37-S-43
 fatigue resistance of, 40-5-49
 prediction of stress in, 39-3-88
 aircraft carriers
 cardboard models in studies of, 40-S-14
 antennas
 air blast loads in, 40-2-101
 design of foundation for, 40-2-103
 design of masts, 40-2-104
 impact damping of, 39-4-1
 attenuation of impact on, 40-5-115
 beam-plate, 37-4-67
 blade-like
 damping of, 39-4-19
 response spectra for, 39-4-26
 vibration of, 39-4-19
 class of loadings for, 37-4-170
 combined environmental tests of, 40-3-211
 computer graphic techniques for, 40-4-41
 cylindrical, 41-7-93
 damage from air blast, 40-1-36
 damping of, 36-4-49, 36-4-75, 38-3-29,
 38-3-121, 38-3-133, 39-1-167, 39-4-1,
 39-4-19, 39-4-31, 39-4-53, 40-5-2,
 40-5-49, 40-5-61, 40-5-147, 40-5-261,
 41-1-13, 41-2-105, 41-2-121
 deck, 40-7-218
 deckhouse
 air blast environment for, 39-1-109
 design criteria for, 39-1-111
 degradation in, 39-2-35
 differential displacement across, 40-2-1
 digital computers in analysis of, 37-4-171,
 37-4-193, 40-1-61, 40-4-41
 dynamic analysis of, 36-5-41, 36-7-130,
 37-2-173, 38-2-1, 38-2-11, 38-2-57,
 39-1-107, 39-3-129, 40-1-66, 40-2-57,
 40-2-123, 40-2-227, 40-3-99, 40-3-257,
 40-4-1, 40-4-31, 40-4-41, 40-4-47,
 40-5-183, 40-7-153, 40-7-197, 41-5-27,
 41-3-75, 41-6-197, 41-7-9, 41-7-19,
 41-7-81, 41-7-89, 41-7-123, 41-7-131
 computer programs for, 36-6-105,
 40-4-64, 40-7-178
 scale models for, 40-4-89
 stiffness matrix in, 40-7-177
 dynamic characteristics of, 40-7-51
 dynamic response of, 38-2-157

- to air blast, 41-1-35
- calculations of, 38-2-3
- to transient loads, 41-7-19
- dynamic stability of, 40-2-57
- effect of accelerometers on, 41-3-6
- effect of phase shift on response, 41-5-22
- equivalent static loads for, 41-6-197
- externally redundant, 36-6-105
- failure of
 - due to acoustic excitation, 39-3-65
 - from combined environments, 39-3-67
- fatigue of, 39-3-87, 40-5-49, 40-5-161
- fin, 37-5-167
- finite element analysis of, 41-7-123, 41-7-132
- fixed-base natural frequencies of, 38-2-209, 38-2-263
- flutter of, 39-3-171, 40-5-235, 41-7-109
- fragility of, 41-5-129
- frame
 - air blast on, 38-2-177
 - effect of liquid propellant explosions on, 38-2-179
 - mathematical analysis of, 38-2-183, 40-7-172
 - mathematical models of, 38-2-181
- free-free, 40-4-31
- future requirements for, 41-2-1
- galloping of, 39-3-171
- glass
 - analysis of stress in, 40-5-183
 - attenuation of shock in, 40-5-175
- for helicopters, 40-1-161, 40-2-227, 41-7-131
 - gunfire vibration of, 41-4-195
- highway guard-rail
 - energy absorption of, 40-5-115
- honeycomb
 - pyrotechnic shock loads in, 37-4-15
 - response to half sine pulse, 40-4-74
- ideal size of, 36-7-32
- identification of complex, 38-2-23
- impact damped, 39-4-1
- inertial reference unit, 40-3-260
- interaction of control system with, 40-3-205
- interaction of noise with, 36-5-48
- linear elastic, 36-6-131
- load restraint for, 40-3-221
- mathematical analysis of, 38-3-121, 39-3-55, 39-3-172, 40-3-257
- mathematical models of, 36-6-131, 39-3-57, 41-7-19
- mechanical impedance of, 38-2-285, 38-3-35, 39-3-143, 39-1-123, 40-3-236, 40-7-51
- missile
 - response to high impact, 37-1-115
- modal analysis of, 39-3-55, 39-3-99
 - flow charts for, 41-7-12
 - from test data, 41-7-9
- modal characteristics of, 39-4-33
- modal effective mass of, 39-3-143
- modal enrichment of, 40-3-236
- modal synthesis of, 40-4-25
- mode shapes of, 40-4-25, 40-7-207, 41-7-9
- multipanel, 37-2-99
- multi-span, 36-4-49, 38-3-139
- natural frequencies of, 38-2-209, 38-2-261, 40-4-25, 40-7-207, 41-6-75, 41-6-103, 41-7-9, 41-7-21
- near resonant vibration tests, 38-2-23
- normal modes of, 39-3-99, 40-3-49, 40-7-165, 41-6-103
- optimization of, 39-1-63
- parametric excitation of, 40-2-57
- prediction of response
 - to blast of weapons, 40-2-234
 - scale models for, 40-4-89
- pyrotechnic shock in, 40-2-21, 41-5-4, 41-5-9
- radio telescope, 40-4-158
- reduction of vibration in, 38-3-57

Structures

- reliability of warhead, 39-1-177
- response
 - to acoustic excitation, 39-3-55, 40-3-57
 - to air blast, 37-4-169, 40-1-31, 40-2-101
 - to blast from weapons, 40-1-61, 40-2-227, 41-1-195
 - to blast waves, 40-2-229, 41-5-17
 - to combined environments, 39-3-65
 - to dynamic excitation, 38-3-71
 - to moving loads, 40-3-99, 40-4-47
 - to transient loads, 41-7-22
 - to underwater explosions, 40-1-15, 40-7-197, 41-7-89
 - upper and lower bounds, 37-4-173
- rigid plastic, 37-4-75
- Ritz averaging method for, 40-5-262
- with rotating elements, 40-4-41
- safety factors for, 40-3-93
- scale model
 - dynamic similarity criteria for, 39-3-40
 - vibration tests of, 40-4-89
- shell
 - air blast loads on, 37-4-177
 - failure of, 37-4-180
 - modal survey of, 38-1-89
 - shock in, 39-5-29, 40-2-1, 41-6-75
 - shock analysis of, 36-6-131, 40-2-31, 40-7-185, 41-7-89
 - shock loads on, 41-6-187
 - shock measurement on, 40-2-3
 - shock response of, 40-2-10

shock wave propagation in, 36-2-66,
 40-2-21
 shock spectra for, 40-4-17
 shipboard
 dynamic analysis of, 40-7-197
 failure criteria for, 39-1-107
 shock criteria for, 39-1-39
 shock hardness of, 39-1-107
 simulation of capsize of, 37-4-193
 on single non-rigid supports, 38-2-261
 skin-stringer
 analysis of energy in, 39-4-35
 normal mode analysis of, 39-4-31
 slosh modes of, 41-7-181
 snap buckling of, 41-6-89
 spacecraft
 safety factors for, 40-3-91
 test program for, 39-2-147
 spheres
 dynamic analysis of, 41-7-91
 sources of shock in, 40-2-22
 static vs dynamic loads in, 41-6-197
 statistical energy analysis of, 37-2-99
 stiffened plate, 41-2-105
 stress analysis of, 41-6-191
 stress wave propagation in, 41-6-187
 submerged
 pressure loads on, 40-7-199
 shock analysis of, 40-7-197
 shock loads in, 41-7-89
 system identification of, 38-2-23
 torsional and translational vibration of,
 39-3-171
 transmission of loads through, 37-4-65,
 38-2-231
 underground
 shock isolation systems for, 39-4-199
 vehicle
 energy absorption in, 39-4-227
 vibra-acoustic transfer function for,
 40-3-63
 vibration of, 38-1-99, 39-4-19, 40-4-41,
 40-7-207, 41-6-1, 41-6-47, 41-6-103,
 41-7-19, 41-7-131, 41-7-195
 vibration analysis of, 36-5-41, 39-3-55,
 40-4-25, 40-5-277, 41-6-197
 vibration tests of, 38-1-115, 39-4-41,
 40-4-89, 41-7-95
 fixtures for, 39-2-157, 40-3-221
 with viscoelastic materials, 39-4-117
 yielding, 36-2-10, 40-4-81

Submarines

damage from underwater explosions,
 39-1-99
 foundations for machinery in, 39-1-123
 hulls
 Fourier spectra for, 39-S-44
 structural analysis, 36-6-115

isolated modules for, 38-3-243
 replenishment of Polaris missiles for,
 36-7-145
 shock in, 36-1-4, 39-1-93, 39-S-41,
 41-S-49
 shock hardness of, 38-3-243, 39-1-93
 shock test facilities for, 39-1-73
 silencing, 38-3-243
 USS George Washington, 36-6-115
 velocity spectra for bulkheads of, 39-S-44

Subsystems

dynamic analysis of, 38-2-67
 modal coupling of, 39-3-99

Surging

in hydraulic systems, 41-5-143
 in shock isolators, 40-5-217

Suspension systems, see Isolation systems

SUU 36 munitions dispenser
 captive flight of, 40-6-9

SUU-38 munitions dispenser
 shock tests of, 41-5-93

SV-5D re-entry vehicle, 36-3-83, 36-3-113

Sweep rate

effect on resonant systems, 41-4-95

Symmetry

in structural analysis, 38-2-6

Synthesis

in designing isolators, 39-4-186

System identification

in design of shock isolators, 39-4-188
 moment technique for, 38-2-119
 of structures, 38-2-23
 theory of, 38-2-24, 38-2-121
 vibration tests for, 38-2-27, 38-2-120
 identification of
 for digitally simulated models,
 38-2-119
 from random vibration input, 38-2-122
 from sinusoidal vibration input,
 38-2-126

Systems, see also specific systems such as Multi-degree-of-freedom systems and Isolation systems

for analysis of vibration data, 36-6-47,
 37-2-109
 for dynamic phase plotting, 37-2-77
 elastic-plastic, 37-4-73
 equipment-foundation, 38-2-210

for generating and measuring combined environments, 40-3-297
lumped parameter, 39-3-153
modal coupling of, 39-3-100
nonconservative, 41-7-141

T

TALOS missile
flight vibration of, 41-4-189

Tanks
gun recoil on, 41-3-187

TAT/Agema-D launch vehicle
noise measurements on, 36-7-89

Temperature
effect
on damping, 38-3-156, 41-2-125,
41-2-145
on high polymer viscoelastic materials,
38-3-175
ignition shock versus, 37-2-168

Test criteria
development of, 39-2-196

Test facilities, see also Acoustic test facilities,
and Shock test facilities
air drop, 41-3-223
for aircraft seat crashworthiness, 41-3-133
for combined environmental tests,
37-3-175, 40-2-51, 40-3-293
for cross-country tests of vehicles,
41-3-215
design of, 40-2-52, 40-5-245, 41-3-119
displacement amplifier as, 41-3-149
electrohydraulic vibration exciters as,
41-3-109
for elements of shock isolators, 40-5-245
for explosive weapons, 40-3-201
for fuzes, 41-3-155
for gas bearings, 38-3-222
for high rate loads on shock isolators,
40-5-245
for impact tests of isotope fuels, 41-3-195
for large displacements, 41-3-149
for launch environments of missiles, 40-6-1
for launch environments of spacecraft,
39-2-23, 40-3-183
Launch Phase Simulator, 40-3-183
for launching and recovering projectiles,
41-3-175
for low pressure acoustic environments,
41-3-207
for noise reduction studies in spacecraft,
40-4-105
for recoil simulation, 41-3-187
resonant beam, 39-2-72

transonic wind tunnel as, 37-3-123
for tri-axial vibration, 41-3-121
for wheel/rail dynamic studies, 41-3-127

Test fixtures, see also fixture
for combined acceleration and vibration
tests, 40-3-293
design criteria for, 39-2-177

Test programs
for missile environments, 37-2-117,
39-2-195
for verifying integrity of spacecraft
structures, 39-2-147

Test specimens
equivalence of, 36-2-63
protection of, 39-2-11

Test system
definition of, 37-3-77

Test techniques
for simulation of earthquakes, 41-3-116

Tests, see also specific types such as Acoustic
tests, Dynamic tests, Environmental tests,
Shock tests, Vibration tests
combined environment for shipboard
equipment, 40-2-51
cross-country, 41-2-163
of gun recoil on tanks, 41-3-187
handling of Polaris missiles, 36-7-147
laboratory vs field, 39-2-35
of machinery foundations, 36-4-88
in shock tubes, 39-5-58
simultaneous linear and angular
accelerations, 41-3-155

Thunderpipe tests, 36-5-2

Time-sharing computers
calibration of vibration exciters using,
36-6-183

Timoshenko beams
frequency parameters for, 39-3-50

Tipoff
mathematical analysis of, 41-6-224

Tipover
of shipping containers, 39-6-65

Titan launch vehicle
scale models of
aerodynamic noise test on, 37 203
wind tunnel acoustic data on,
37-7-221
wind tunnel tests of, 37-3-121

- wind-induced vibration tests of, 36-7-81
- TNT
 - for simulation of propellant explosions, 38-2-179
- Torpedoes
 - underwater explosion tests on, 40-1-9
- Torsional natural frequencies
 - upper and lower bounds for shafts, 40-4-164
- Torsional shock
 - design of spacecraft for, 36-7-63
 - prediction of response to, 36-7-67
- Torsional vibration
 - coupled bending and, 36-6-121
 - of missiles, 40-4-163
 - response spectra for, 36-7-65
 - of shells, 36-5-115
- Total impulse
 - upper and lower bounds from air blast, 37-4-173
- TOW missile
 - effect on UH-1B helicopter, 40-1-64
 - transportation environment for, 37-7-39
- Towers
 - response to ground shock, 41-6-75
 - TDYNE computer program for, 41-6-82
- Tracked air cushion vehicles
 - response of guideway structures to, 40-4-47
- Tracked vehicles
 - cross-country tests of, 41-2-163
 - simulated road tests of, 41-3-124
 - vibration isolation for, 41-2-159
- Tracking filter
 - for averaging, 36-3-142
- Transducers, see also Accelerometers and Force transducers
 - calibration
 - accelerometers, 41-3-1
 - by comparison, 36-6-193
 - laser for, 37-2-1
 - compensation for distortion, 40-7-123
 - curve fitting technique for, 40-7-124
 - conceptual models of, 41-3-91
 - energy processing within, 41-3-92
 - errors in, 37-2-29
 - factors influencing response, 40-7-2
 - influence of environment on, 40-7-3
 - for measurement of
 - bending moment, 36-6-199
 - egg damage, 41-3-11
 - force, 36-6-203
 - ground shock, 40-7-136
 - of shock, 37-2-29
 - vibration, 40-7-244
 - microminiature amplifiers for, 36-6-215
 - response to environment, 40-7-1
 - seismic, 40-7-123
 - sonar
 - finite element analysis of, 41-1-21
 - mathematical models for, 36-2-33, 36-2-39
 - optimization of design, 36-2-41
 - response to shock, 36-2-31, 37-1-67
 - shock hardening of, 37-1-65
 - shock tests on, 37-1-63
 - vibration requirements for, 37-2-51
- Transfer functions
 - for active vibration isolation systems, 39-4-170
 - development of, 38-2-115
 - Fourier transform for, 38-1-18
 - for linear systems, 39-3-74
 - for lumped parameter systems, 38-2-109
 - for microphones, 37-2-9
 - for nonlinear vibration isolation systems, 40-5-27
 - for prediction of flight vibration, 36-5-85
 - for single-degree-of-freedom systems, 39-3-75
 - for two-degree-of-freedom systems, 40-2-216
 - vibra-acoustic, 40-3-63
- Transfer impedance, see Mechanical impedance
- Transfer matrix method, 36-2-157
- Transforms, see Fourier transforms
- Transient data
 - to improve mathematical models, 36-5-1
- Transient loads, see Shock loads
- Transient response, see Response
- Transient tests
 - for fragility of systems, 41-5-121
- Transients
 - simulation with vibration tests, 36-3-207
- Transmissibility
 - of active vibration isolators, 37-6-40, 37-6-45
 - effect of looseness in mechanical systems on, 41-6-42

- of foam materials, 38-3-193
 - of foundations, 39-1-123
 - of isolators with nonlinear damping, 40-5-22
 - of missile suspension systems, 39-6-60
 - of pneumatic active isolators, 40-7-241
 - for railroad cars, 40-6-112
 - of shock isolated floors, 41-5-157
 - of shock isolators, 40-7-234, 41-5-157
 - of two stage isolators, 40-7-238
 - of vibration isolators, 37-3-167, 40-5-28, 40-7-236
 - of viscoelastic isolators, 38-3-40
- Transmission matrices**
- definition of, 41-7-61
 - derivation from continuum theory, 41-7-76
 - power series expansion of, 41-7-73
 - theory of, 41-6-133
- Transportation environments**
- criteria for, 40-6-85
 - data for, 37-6-19
 - data acquisition for, 36-6-163, 40-7-45
 - data analysis of, 37-7-19, 39-6-36
 - instrumentation for, 37-7-19, 37-7-40, 39-6-31
 - for loose cargo on trucks, 39-6-18
 - on M-151 Jeep, 37-7-39
 - for packages, 39-6-19
 - of railroad cars, 39-6-47, 40-6-91
 - recorders for measurement of, 36-6-163, 36-6-173, 39-6-19, 40-6-99, 40-7-45
 - during rough handling, 37-7-1
 - simulation of, 39-6-15, 41-3-119, 41-3-215
 - for spacecraft, 37-7-19
 - for STOL aircraft, 40-6-91
 - survey of, 37-7-1
 - for trucks, 39-6-31
- Traveling waves**
- analysis of, 36-2-66
- Trucks**
- transportation environments for, 37-7-1, 37-7-19, 39-6-31
- Truncated cones**
- response to strain pulse, 40-4-130
- Trusses**
- dynamic analysis of, 38-2-61, 39-3-157, 41-6-199
- Tuning**
- effects on modal damping, 37-6-60
- Twang test**
- on antenna masts, 40-2-106
- Two mass systems**
- perturbation analysis for, 40-7-180
- U
- UH-1 helicopter**
- acoustic environment on, 37-S-73
 - distribution of induced velocity on, 37-6-7
 - environment for on-board weapons, 40-S-47
 - response to TOW missile overpressures, 40-1-64
 - vibration of, 37-S-73
 - weapons blast effects on structure of, 40-1-62
- Underground explosions**
- acceleration-time history from, 41-6-80
 - response of tower to, 41-6-75
- Underground structures, see Hardened sites and silos**
- Underwater explosions**
- acoustic wave-shell interaction theory for, 40-1-15
 - airblast compared with, 36-1-13, 37-1-29
 - cavitation in, 41-S-49
 - correlation of velocity change with forcing function for, 40-1-9
 - damage
 - analysis of, 37-4-71
 - to shipboard equipment, 39-1-96
 - to submarine equipment, 39-1-99
 - design of shipboard equipment for, 39-1-33, 39-1-65
 - dip in shock spectrum for, 39-S-41, 40-7-185
 - effect on humans, 41-2-5
 - environment, 39-1-65, 37-2-30, 39-1-4, 40-7-99
 - equivalent static pressure from, 40-7-198
 - instrumentation for, 40-1-10
 - pressure data from, 40-1-10
 - pressure-time history for, 39-1-4, 40-7-99
 - response to
 - of nulls, 38-3-244, 40-7-185, 41-S-49
 - of cylindrical shells, 40-1-22
 - of shipboard equipment, 39-1-55, 39-S-41
 - of ships, 36-1-13, 37-1-1, 39-1-1
 - of structures, 40-1-15, 40-7-197, 41-7-89
 - Royal Canadian Navy criteria for, 40-S-30
 - shock data from, 40-1-11
 - shock test facility for, 37-4-137
 - tests
 - on decks, 40-1-5

- on scale model captive air spacecraft, 41-1-6
 - on ships, 39-1-67, 41-1-1
 - on torpedoes, 40-1-9
 - velocity change from, 40-1-9
 - velocity response spectra for, 41-S-58
 - velocity time-history for hulls, 41-S-52
 - Unit impulse function
 - properties of, 38-2-107
 - Upstage test vehicle
 - acoustic test of, 41-6-19
 - flight vibration of, 41-6-9
 - modal density for, 41-6-15
 - sources of vibration for, 41-6-24
 - U. S. Army Combat Development Command
 - mission of, 39-6-1
- V
- Vacuum
 - damping in, 36-4-75
 - Vacuum spring
 - as a shock and vibration isolator, 36-7-103
 - simulation on analog computer, 36-7-107
 - Vacuum tests
 - combined with acoustic tests, 37-5-175
 - Vacuum tube launchers
 - for shock tests, 40-2-193
 - Vans
 - air blast loads on, 37-4-194
 - Variation spectra, 36-6-9
 - Vehicles
 - active isolation of, 38-3-317
 - crash environment, 39-4-231
 - crashworthiness of, 39-4-227
 - cross-country tests of, 41-3-215
 - crushable shock isolators for, 39-4-231
 - dynamic tests of, 41-3-127
 - response of bridges to, 41-4-102
 - scale model
 - impact of, 39-4-227
 - prediction of response to impact for, 39-4-242
 - stabilization system for, 38-3-317
 - Velocity
 - correlation of stress with, 40-2-38
 - as criteria for
 - measurement of wear, 41-4-53
 - severity of shock, 40-2-23
 - severity of vibration, 40-2-27, 41-4-53
 - distribution of
 - in CH-47 helicopter, 37-6-8
 - in UH-1 helicopter, 37-6-7
 - measurements of human head impact, 39-5-93
 - recorder to measure impact, 36-6-173
 - Velocity change
 - correlation with underwater explosion forcing function, 40-1-9
 - Velocity gages
 - for measurement of ground shock, 40-7-133
 - Velocity response
 - in selection of normal modes, 40-7-169
 - Velocity spectra
 - for bulkheads of submarines, 39-S-44
 - cavitation effects on, 41-S-58
 - as descriptor of shock, 40-2-32
 - for equipment in submarines, 39-S-48
 - Velocity-time history
 - for spherical structures, 41-7-98
 - Velocity transfer functions
 - for lumped parameter systems, 38-2-111
 - Vibra-acoustic environment
 - criteria for simulation of, 37-5-1
 - of external aircraft stores, 41-S-33
 - Vibrating beam test method
 - for damping in materials, 40-5-106
 - Vibration, see also specific types such as Flight vibration, Random vibration, and Shipboard vibration
 - and acceleration, 36-3-119
 - acoustically induced
 - flight vibration vs, 37-5-160
 - in aerospace vehicles, 37-5-2
 - aircraft, 37-7-35, 41-4-133
 - acceleration spectral density curves for, 40-6-49
 - from gunfire, 40-6-27
 - from motion of towed cables, 41-6-61
 - power spectral density for STOL, 40-6-96
 - sources of, 37-S-97
 - versus airspeed, 37-S-100
 - on aircraft carriers, 40-S-13
 - of aircraft landing gear, 39-3-179
 - amplitude by optical method, 37-2-13
 - asymptotic method for determining response to, 41-4-128
 - automated recorder for, 40-7-225
 - of automobiles, 40-4-94

of avionics equipment, 40-6-37, 40-S-63
 acceleration spectral density curves
 for, 40-6-52
 of beams, 38-3-13, 39-3-49, 39-4-53,
 40-2-40, 40-4-47, 40-5-277, 41-6-133,
 41-6-163
 identification of damping models in,
 36-4-65
 with moving point loads, 41-6-49
 of blade-like structures, 29-4-19
 of bearings, 38-3-221, 40-3-275
 of bombs, 41-S-34
 of box cars, 41-4-155
 of captive airborne weapons, 37-S-107,
 39-6-78, 39-S-15
 challenging problems in, 36-2-1
 of columns, 39-3-247
 complexity of, 36-2-5
 criteria
 for helicopters, 40-5-194
 for severity, 40-2-27
 for spacecraft, 37-7-202
 damage potential of, 41-3-43
 damping
 of elastically-rigid bodies, 36-7-135
 in helicopters, 41-2-141
 in pipes, 39-1-143
 in plates, 39-4-63, 40-5-93
 in structures, 36-4-49, 38-3-1,
 38-3-57, 38-3-71, 39-4-1, 39-4-19,
 39-4-31, 40-5-49, 40-5-61
 of deck structures, 40-1-2, 40-7-218
 as a diagnostic tool for shock design,
 41-4-119
 in multipanel structures, 37-2-99
 of ducts, 40-5-71
 effects
 on fatigue damage to structures,
 36-5-17
 on humans, 41-2-13
 electrically generated in elastomers,
 39-2-1
 of electronic equipment, 37-3-7
 environment
 for captive airborne weapons, 39-S-16
 of high speed trains, 40-6-91
 of STOL aircraft, 40-6-91
 of equipment
 in aircraft, 37-S-103
 from gunfire, 40-6-27
 equivalence of
 energy summation in, 40-3-139
 measured and predicted, 36-5-90
 shock with, 41-4-124
 failures of spacecraft from, 40-3-9
 feedback control signal averaging of,
 36-3-139
 of fiber-reinforced composite materials,
 39-4-81, 39-4-93
 fixtures for amplification of, 39-2-221,
 41-3-149
 flow-induced
 in cylinders, 40-3-304, 41-6-31
 of shafts, 39-2-217
 of structures, 41-7-205
 of fluids, 41-7-181
 of grillages for ships, 40-7-207
 of guideways, 41-6-48
 in helicopters, 37-6-1, 37-6-7, 39-3-17,
 40-4-43, 41-4-195, 41-4-209, 41-4-221
 high-speed analyzer for, 36-6-49
 of hulls
 code for measurements of, 40-7-243
 characteristics of, 38-S-1
 mathematical model for, 38-1-126
 as indicator of wear, 41-4-51
 of launch vehicles, 39-6-135
 of loose mechanical systems, 41-6-39
 mathematical analysis of
 forced, 38-3-95
 torsional and translational, 39-3-172
 of mechanical systems, 39-3-73
 in missiles, 38-2-74, 39-S-1, 39-2-196
 multi-axis tests for, 41-4-34
 multi-modal, 36-4-49
 of munitions dispenser, 41-S-37
 use of Myklestad's method for, 41-7-109
 of nonconservative systems, 41-7-141
 nonlinear
 of panels, 39-3-191
 of spring-mass systems, 41-6-39
 of two-degree-of-freedom systems,
 39-3-161
 of one-dimensional continuum, 41-7-61
 in packages, 37-3-16
 of panels, 39-3-1, 39-3-13, 39-3-191
 parametric, 39-3-205
 physiological effects from, 41-2-16
 of piping, 39-1-143, 39-1-155, 40-4-197
 of plates, 38-1-37, 38-1-45, 39-3-197,
 39-3-206, 39-4-63, 39-4-73, 39-4-81,
 39-4-93, 40-5-93, 41-7-29, 41-7-37
 prediction
 for aerospace structures, 36-5-41,
 36-5-85, 36-5-97, 38-S-5, 39-6-77,
 39-6-119, 40-6-67, 41-6-9, 41-7-1,
 41-7-195
 for airborne equipment, 38-S-5
 direct stiffness method for, 37-6-20
 for helicopters, 37-6-5, 37-6-19
 for missiles, 39-6-77
 mobility in, 37-6-27
 for propellant storage module shelf,
 41-7-196
 regression analysis technique for,
 39-6-122
 statistical energy method for,
 36-5-41, 38-S-5, 41-6-9

of propellant, 41-7-169
 of propellant storage module
 sources of, 41-7-195
 proposed standard for data analysis of,
 39-6-1
 of radio telescopes, 40-4-155
 of railroad cars, 40-6-95, 40-6-109,
 41-4-141
 reduction
 by active isolators, 37-6-66
 in helicopters, 36-7-113, 37-6-5,
 37-6-49, 37-6-63, 40-5-191,
 41-1-141
 with viscoelastic materials, 36-4-9,
 36-4-49, 37-3-19, 38-3-1, 38-3-13,
 38-3-29, 38-3-37, 38-3-57,
 38-3-71, 38-3-175, 39-4-19,
 39-4-31, 39-4-53, 39-4-63, 39-4-73,
 40-5-1, 40-5-37, 40-5-49, 40-5-93,
 41-5-105, 41-5-121, 41-5-141
 response
 of bearings, 40-3-275
 of bridges, 41-4-99
 of ducts, 40-5-61
 effect of sinusoidal sweep on, 38-1-134
 of focal isolation system, 38-3-265
 of helicopters, 41-7-131
 of hydrophones, 37-2-52
 of plates, 38-1-37, 38-1-45, 39-3-197,
 39-3-206, 39-4-75, 39-4-81,
 39-4-93, 40-5-93, 41-7-29, 41-7-37
 of printed circuit boards to, 38-S-5,
 40-3-111
 of shells, 39-1-155, 39-3-107, 40-3-69,
 40-3-131
 of River patrol boat, 37-7-205
 of rocket motors, 41-6-115
 of rods, 40-2-39
 rotor-induced, 36-7-113
 of rotors, 41-6-159
 of scale models, 39-3-39
 self-excited, 40-3-303, 41-4-194, 41-6-31
 sensitivity of humans to, 41-2-13
 of shafts in analysis of missile bending,
 38-2-169
 with NASTRAN analysis, 41-6-203
 of shells, 39-1-155, 39-3-107, 40-3-69,
 40-3-131
 in ships, 38-1-125, 39-S-55, 40-S-13
 simulation of, 41-4-29
 by acoustic tests, 37-5-1, 37-5-153
 analog computers in, 40-S-15
 vs flight of captive missiles,
 39-6-86
 gunfire induced, 41-4-37
 during launch, 39-2-23
 short bursts, 40-3-267
 of sonar transducers, 37-2-51
 of spacecraft, 37-7-176, 40-3-179
 stress distribution from, 36-7-6

Vibration

of structures, 37-2-99, 38-1-99, 38-2-57,
 39-3-171, 39-4-19, 39-4-31, 40-4-41,
 40-4-155, 40-5-49, 40-7-207, 40-S-13,
 41-6-1, 41-6-47, 41-6-103, 41-7-19,
 41-7-131, 41-7-205
 as a substitute for acoustic tests, 38-1-115,
 40-3-252
 of systems with self synchronized rotors,
 41-6-159
 techniques for data analysis of, 36-6-47
 torsional and translational, 39-3-171
 transient
 of multi degree of freedom systems,
 40-4-17
 for simulation of engine cutoff,
 37-4-59
 for simulation of nuclear detonation
 shock, 41-5-167
 transmission
 in foundations, 38-S-19, 39-1-123
 from helicopter rotors, 37-6-5
 mechanical admittance for calculating,
 38-2-231
 by polyurethane isolator, 40-5-288
 through structure, 39-6-135
 of trucks, 37-7-28, 39-6-31
 of two degree of freedom systems,
 39-3-161, 39-3-171
 walking, 40-4-160
 of weapons
 on aircraft, 40-S-47, 41-S-33
 on helicopters, 40-S-47

Vibration absorbers

active, 38-3-235
 analysis of synchronous, 37-6-49
 for attenuation of brake squeal, 39-3-186
 damping using, 37-6-57, 40-5-147
 definition of, 38-3-235
 dynamic mounting requirements for,
 36-7-122
 flight tests of, 40-5-199
 gyroscopes as synchronous, 37-6-49
 for helicopters, 36-7-113, 37-6-23,
 40-5-191
 mathematical analysis of, 39-4-261,
 41-7-135
 performance of, 36-7-116, 38-3-237
 for spacecraft antennas, 40-5-148
 for transient shock loads, 39-4-261
 tuning of, 39-4-265, 40-5-191

Vibration analysis, see also Dynamic analysis,
 Mathematical analysis, Modal analysis,
 Shock analysis, and Structural analysis
 of aircraft braking sweep, 39-3-185
 of beams, 38-3-13
 of columns, 39-3-248
 co-quad, 37-2-77

- of cross correlation effects on test results, 39-2-51
- of cylinders, 36-5-107
- digital computers in, 38-3-295
- of ducts, 40-5-71
- of eigenvector errors, 39-3-102
- flowgraphs in, 38-1-99
- of gas turbines for helicopters, 39-3-17
- General bending response code for, 39-S-60
- Hamilton's principle in, 39-4-81, 39-4-93
- for helicopters, 37-6-7, 41-7-131
- hybrid computers in, 41-7-131
- of inertial reference units, 40-3-257
- isolation systems, 37-6-44, 38-3-285
- of landing gear, 39-3-179
- of launch vehicles, 38-3-95
- of liquid squeeze-films, 39-2-78
- for mini-max response, 36-5-69
- of nuclear reactors, 36-1-45
- of panels, 39-3-191
- of plates, 39-3-197
- of propellant quantity gauge system, 41-7-182
- of propulsion systems for ships, 39-S-55
- of railroad cars, 39-6-52
- of resonant fixtures, 39-2-221
- Ritz method in, 39-4-81, 39-4-93
- of self synchronization of rotors, 41-6-160
- of shafts, 39-2-217, 41-6-203
- of shells, 39-3-107
- of spacecraft, 36-5-41, 41-4-128
- of specifications for random vibration, 38-2-52
- of spheres, 36-5-107
- of stabilization systems for vehicles, 38-3-319
- statistical energy method for, 36-5-41
- of structures, 36-5-41, 38-2-23, 39-3-39, 41-6-197, 41-7-131
- survey of techniques for, 41-4-1
- of synchronous vibration absorbers, 37-6-49
- of systems with dynamic coupling, 36-7-135
- of traveling waves, 36-2-66
- of vibration absorber for spacecraft antenna, 40-5-148
- of viscoelastic dampers, 38-3-72
- of wear in machinery, 41-4-65

Vibration data

- analysis of, 40-7-115
 - facility for, 36-6-47
 - hybrid computer for, 36-6-55
 - one-third octave vs narrow filter bandwidth, 41-S-30
- determination of stress from, 40-3-1
- modal damping loss factor from, 38-2-289
- modal response suppression factor from, 38-2-271

- presentation of, 39-6-7
- scaling of, 36-5-85
- for spacecraft, 37-7-173
- in structural analysis, 38-2-271

Vibration distribution
measurement of, 37-2-102

Vibration equivalence
monograph on, 39-2-189

Vibration exciters

- air pulser as, 41-S-1
 - force-time history for, 41-S-11
 - amplification of output of, 39-2-221, 41-S-149
- calibration of
 - by reciprocity method, 36-6-185
 - with a time-sharing computer, 36-6-183
- for calibration of accelerometers, 41-3-3
- for combined environment test facilities, 40-2-51
- cross-coupling between, 37-3-155
- displacement limiting device for, 39-2-11
- driving by prerecorded tapes, 37-3-152
- electrodynamic
 - control techniques for, 40-2-157, 41-4-183
 - protection of test specimens on, 39-2-11
 - shock testing by, 36-2-17, 39-5-67, 39-5-83, 40-2-157, 40-2-173, 40-7-93, 41-7-149
 - for simulation of control forces of launch vehicle, 40-3-206
- electrohydraulic, 41-3-109
 - control system for, 39-2-26
 - on launch phase simulator, 36-3-119, 39-2-23
- flexure-guided, 39-2-159
- for launch phase simulator, 36-3-119, 37-3-182, 39-2-23
- multiple
 - control stabilization of, 37-3-155
 - random vibration tests with, 39-2-51
- servo-hydraulic
 - as shock test facility, 40-2-243
- for shipboard tests, 38-S-1, 41-S-1
- variable resonant, 38-S-1

Vibration isolation

- active systems for, 37-6-29
- displacement mobility of, 39-4-174
- dynamic response of, 39-4-166
- performance tests of, 39-4-163
- response to shock, 37-6-69
- stability of, 39-4-165
- transfer functions for, 39-4-170
- vehicles, 38-3-317

active-passive systems for, 37-5-39
 in aircraft, 39-4-157
 of avionic components, 40-5-285
 computer programs for, 38-3-295
 electrohydraulic systems for, 37-6-32,
 39-4-141
 local systems for, 38-3-263
 in helicopters, 37-6-29, 37-6-39, 38-3-263
 hybrid systems, 37-6-44
 hypothesized gyroscope for, 38-3-289
 on M-754 tracked vehicle, 41-2-159
 nonlinear systems for damping in, 40-5-19
 frequency response for, 40-5-26
 resonance characteristics of, 40-5-31
 transfer functions of, 40-5-27
 parametric analysis of systems for,
 38-3-235
 of road vehicles, 38-3-317
 of systems with relaxation damping,
 40-5-205

**Vibration isolators, see also Active vibration
 isolators and Shock isolators**
 active, 38-3-317, 39-4-141, 39-4-157
 design criteria for, 39-4-159
 development of, 39-4-160
 active-passive, 37-6-76
 for avionics equipment, 40-6-37
 polyurethane foams as, 40-5-285
 for combined shock and vibration isolation,
 40-7-233
 effects on safe levels for rotor bearings,
 40-3-290
 electrohydraulic, 39-4-141
 characteristics of, 39-4-146
 mathematical analysis of, 39-4-143
 force-deflection characteristics for,
 40-7-236
 frequency response of, 40-6-40
 for gyroscope, 38-3-285
 for helicopters, 37-6-39, 37-6-69, 38-3-263
 hysteresis loop characteristics for,
 40-5-21
 nonlinear
 performance of, 40-5-19
 transmissibility for, 40-5-22
 open cell foams as, 40-5-291
 performance of conventional, 40-7-236
 polyurethane, 40-5-286
 for protection of humans, 39-4-157
 relaxation damping for, 40-5-203
 response to shipboard shock, 40-7-236
 shim spring as, 37-3-163
 for shipboard equipment, 40-7-233
 static load characteristics of, 40-3-287
 vacuum spring as, 36-7-103

**Vibration measurements, see also Vibration
 data**
 on aircraft, 37-7-28, 37-S-95

on avionics equipment, 40-S-63
 data analysis for, 37-S-74
 on captive airborne weapons, 37-S-107,
 40-S-47, 39-1-195, 39-6-93
 on engines, 37-2-118
 on freight cars, 41-4-141
 on helicopters, 37-S-73, 41-4-209,
 41-4-221
 on high speed trains (Metroliner), 40-6-93
 instrumentation for, 37-2-118, 37-S-74,
 37-S-95, 40-7-45, 40-7-225
 lasers for, 37-2-1
 holography for, 39-2-41, 40-7-33
 on M-151 (jeep), 37-7-39
 on missiles, 37-7-93
 on munitions dispenser, 40-6-21
 on printed circuit boards, 38-S-5, 40-3-111
 probe for, 40-7-29
 on River patrol boats, 37-7-205
 on ships, 40-7-231
 on sonar transducers, 37-2-51
 on STOL aircraft, 40-6-95
 on trucks, 37-7-21, 39-6-31
 on vehicles, 40-7-48
 velocity transducers for, 40-7-244

Vibration modes, see Modal analysis

Vibration response, see Response

Vibration spectra
 for antennas, 40-5-4
 for helicopters, 41-4-228
 for missiles, 41-4-190
 for spacecraft, 36-7-97

Vibration tests
 acceleration limiting in, 41-4-117
 acoustically-induced, 36-3-39
 of aircraft equipment, 41-S-25
 allowable cross-motion in, 40-6-64
 for Apollo lunar surface experiment,
 38-2-52
 areas of controversy on equivalence of,
 39-2-188
 assembly-level, 36-3-27
 control of, 37-3-49
 data analysis for, 37-5-129
 of launch vehicles, 37-5-117
 of avionics equipment, 40-S-63, 40-6-32
 qualification levels for components,
 40-S-76
 of bearings, 40-3-280
 of bombs, 41-S-33
 of bridges, 41-4-101
 of calibration propellant storage modules,
 41-7-200
 for captive flight environment,
 39-1-212, 40-S-48
 combined with temperature and humidity,
 36-6-83

compared with
 acoustic tests, 37-3-7, 37-3-21
 field data, 37-3-1
 flight vibration, 37-7-173
 vibration analysis, 36-1-45
 comparison of fatigue damage potential
 of, 40-3-153
 of components
 problems in, 37-5-4
 qualification levels for, 37-7-176
 of computer programme * 37-3-78
 control of
 averaging techniques for, 36-3-139,
 37-3-47, 37-3-75
 assembly-level, 37-3-49
 base-strain in accelerometers,
 37-2-48
 for multiple vibration exciters,
 36-3-147, 41-4-183
 criteria, 41-S-25
 for captive airborne weapons, 39-S-15
 comparison of flight data with, 37-3-7
 for launch vehicles, 37-5-119
 design for shock, 41-4-119
 for detecting loose parts, 36-6-73,
 41-4-173
 determination of modal mass from,
 38-2-271
 determination of bond strength of liquid
 squeeze-films from, 39-2-80
 of ducts, 40-5-66, 40-5-75, 40-5-88
 dynamic analysis of systems for, 41-4-79
 for earthquakes, 41-3-109
 of elastomers, 39-2-4
 of electronic components, 40-3-111
 of electronic equipment, 37-3-14,
 41-4-122
 energy summation in, 40-3-151
 equivalence of, 37-3-1, 39-2-187
 of explosive weapons, 40-3-196
 for fixed-base natural frequencies,
 38-2-209, 38-2-261
 fixtures for, 36-3-101, 38-1-120, 39-3-31,
 39-2-72, 39-2-157, 39-2-175, 39-3-192,
 40-3-231
 flexure guides as fixtures for, 39-2-157
 focal isolation systems, 38-3-268
 for fragility of systems, 41-5-123
 of gas-bearing machinery, 38-3-221
 on helicopters, 36-3-71, 39-3-23
 high acceleration, 39-2-71
 high-force
 control of, 37-3-139
 data analysis for, 37-3-143
 on humans, 41-2-13
 on immersed solids, 40-1R-17
 of impact damped structures, 39-4-4
 instrumentation for, 41-3-114
 of isolation systems, 38-3-268, 40-6-40
 of isolators, 40-6-39

 of launch vehicles, 36-7-80, 37-2-109,
 39-2-135
 of scale models of, 38-2-25, 41-7-171
 levels for, 39-2-153
 of a LOX vent duct, 36-3-91
 mechanical impedance in, 38-2-234,
 41-4-109
 for mechanical signature analysis,
 36-6-73, 41-4-174
 of missiles, 39-2-197, 40-3-268
 for modal surveys of aircraft, 36-3-55
 monitoring of, 36-3-1
 multimodal fixtures for, 40-3-231, 38-1-120
 multiple-axis, 39-2-23, 41-3-119
 with multiple vibration exciters, 36-3-55,
 36-3-71, 36-3-91, 38-1-115
 control techniques for, 36-3-147,
 41-4-183
 importance of cross correlation in,
 39-2-51
 of large structures, 38-1-115
 multi-point control of, 37-3-75, 41-4-33
 of munitions dispensers, 41-S-37
 wind tunnel vs laboratory excitation
 for, 40-6-22
 near resonant
 for identification of complex
 structures, 38-2-23
 on nuclear reactors, 36-1-50
 of oil squeeze bearing damper, 38-3-48
 outer loop control for, 41-4-183
 overload protection during, 39-2-11
 phase plotting for, 37-2-77
 of plates, 39-2-197, 39-3-210, 39-4-83
 practical approach to, 37-3-4
 probabilistic approach to, 41-S-25
 pulsed random, 40-3-267
 control system for, 40-3-270
 analysis of data for, 40-3-273
 as quality assurance tool, 36-6-73,
 41-4-173
 realism of, 37-3-2, 39-2-195, 41-4-29
 reduction of spectrum levels for, 41-S-27
 of re-entry vehicles, 36-3-113
 response limiting in control of, 41-4-183
 response outside of sweep range during,
 38-1-136
 ring accelerometers for, 37-2-48
 of road vehicles, 41-3-124
 of rocket engines, 37-2-129
 of scale model hulls, 41-S-3
 of segmented shells, 38-1-87
 of shafts, 41-6-207
 sinusoidal pulse technique for, 38-3-207
 sinusoidal sweep in, 36-2-102, 38-1-133,
 38-3-207
 for slosh modes in propellant tanks,
 41-7-169
 of spacecraft, 36-3-27, 37-3-21, 38-2-151,
 40-3-9, 40-3-183

criteria for, 37-5-156
fixtures for, 40-3-231
 procedures for, 39-2-110
 programs for, 37-5-109, 37-5-154
 qualification levels for, 37-7-175
 of scale models of, 40-3-243
specifications for, 36-3-1, 38-1-109,
 40-6-42, 40-6-62, 41-4-30, 41-4-69
of structures, 38-1-115, 39-4-41, 41-7-195
 of scale models of, 40-4-89
survey of techniques for, 41-4-1
sweep rate effects in, 41-4-95
for system identification, 38-2-27
tracking filters in, 40-6-64
of viscoelastic damper, 38-3-76
of viscoelastic foam materials, 38-3-190
of weapons, 40-3-267
wind-induced, 36-7-81

Viscoelastic materials, see also Elastomers
for attenuation of shock, 40-5-175
chemorheological study of, 38-3-175
complex stiffness of, 39-4-11
damping with, 36-4-25, 36-4-49, 38-3-37,
 38-3-71, 41-2-121
at extreme temperatures, 38-3-57
of plates, 39-4-63, 40-5-93
 of structures, 40-5-1, 40-5-37
 of vibration, 41-2-141
dynamic modulus versus temperature,
 36-4-33
effect on fatigue of joints, 39-4-117
effects of specimen geometry on Young's
 modulus, 38-3-154
endurance life of, 41-2-147
high polymer, 38-3-175
load carrying capacity of structures with,
 39-4-117
loss factor versus temperature, 36-4-30
for machinery foundations, 38-3-1
mathematical analysis of test system for,
 39-4-13
performance at extreme temperatures,
 36-4-25
properties of, 36-4-37, 38-3-1, 38-3-151,
 38-3-175, 39-4-11, 39-4-67, 40-5-38,
 40-5-50, 40-5-105, 41-2-125, 41-2-133
 Geiger thick plate test for, 40-5-112
 techniques for determining, 39-4-15
 from vibrating composite beam test,
 40-5-112
for reduction of shock in plates, 39-4-63
for reduction of vibration, 36-4-9,
 36-4-49, 37-3-19, 38-3-1, 38-3-13,
 38-3-29, 38-3-37, 38-3-57, 38-3-71,
 38-3-175, 39-4-19, 39-4-31, 39-4-53,
 39-4-63, 39-4-73, 40-5-1, 40-5-37,
 40-5-49, 40-5-93, 41-5-105, 41-5-121,
 41-5-141
response to vibration, 39-4-11

strength characteristics of joints with,
 39-4-117
for structural damping, 36-4-9, 36-4-25,
 36-4-49, 38-3-121, 38-3-139
in structural design, 36-4-9, 38-3-37
for tuned damping, 38-3-151
vibration parameters for, 38-3-75

Vortex shedding
for cylinders, 40-3-303, 41-6-31
for towed shafts, 39-2-218

W

Walleye missile
dynamic analysis of shipping container,
 39-6-57

Waterhammer
in fluid systems, 40-2-67

Water tunnels
measurement of flow noise in, 41-2-152

Waveform synthesizers
shock pulse shaping by, 39-5-67

Waveforms
control of transient, 40-2-157
reproduction of, 36-3-47

Weapons skid, 21B
analysis of, 36-1-23
design shock spectra for, 36-1-26

Weber transform, 36-5-108

Wind tunnels
acoustic data from, 37-7-221
captive flight vibration tests in, 40-6-12
data from scale model in, 37-7-221
instrumentation for tests in, 37-7-222
tests of missiles in, 36-7-80, 37-3-121
transonic, 37-3-123

Wings
flutter of aircraft, 41-7-109

X

XB-70A aircraft
modal survey on, 36-3-55

X-rays
experiments with, 36-6-230
field emission type, 36-6-233
for research in soils, 36-6-225
in soil dynamics, 36-6-228

Y

Yielding
effects on shock spectra, 36-2-9

propagation in beams, 40-4-81
Yielding structures, see also Crushable
structures and Honeycombs
shock attenuation by, 38-3-255, 41-2-89

Part II
Author Index

Shock and Vibration Bulletins
36 Through 41

AUTHOR INDEX

A

Abdulahadi, F., 39-4-73,
40-5-93, 41-2-133
Ablowitz, M., 39-3-73
Abstein, H. T., Jr., 41-4-37
Ach, J. T., 37-S-73, 41-4-221
Addonizio, N. R., 39-1-39
Agnew, D. R., 39-6-65
Agrawal, B. N., 41-4-127
Alcone, J. M., 41-2-89
Ali, H. B., 38-1-125
Allen, H. C., 41-7-195
Alley, T. L., 40-4-225
Alma, H. F., 38-1-125,
40-S-7
Ames, V. G., 40-3-293
Andersen, W. F., 39-4-213
Anderson, J. D., 39-4-81
Anderson, R. H., 37-4-151
Anderson, T. L., 40-2-115
Angelopoulos, N., 37-2-117
Apgar, J. W., 37-1-97
Arahamian, R., 41-3-63
Arcas, N., 39-3-87
Arcilesi, C. J., 37-3-175
Arone, R. A., 36-3-147,
41-3-119
Arthur, W. E., 40-5-285
Arthurs, T. D., 38-2-139
Arya, S. C., 39-4-199
Ashley, C., 41-2-13
Ashton, J. E., 39-4-81,
39-4-93
Avila, J. H., 36-6-101
Avis, A. J., 36-7-145
Avre, R. S., 41-5-27

B

Bachman, R. E., 41-6-75
Baganoff, D., 38-1-55
Baganoff, F., 38-1-55
Bahn, M. M., 38-2-47
Baird, E. F., 37-5-105
Bajan, R. L., 39-3-99
Baker, W. E., 36-5-55,
37-1-77, 40-2-227, 40-1-61
41-7-19
Baker, W. J., 36-6-225
Balcerzak, M. J., 37-4-189
Balke, R. W., 38-3-263
Bangs, W. F., 41-5-9
Baran, A. S., 36-2-17
Baratono, J. R., 37-7-221
Barclay, R. G., 40-5-147
Barnett, P., 37-4-1
Barnoski, R. L., 38-1-37
Barrett, S., 39-2-157
Basdekas, N. L., 41-7-29
Basye, C. B., 40-4-115
Bathke, E. A., 41-5-59
Baum, C., 41-6-123
Beck, C. J., Jr., 37-5-167,
39-6-133
Beckett, R. E., 41-6-39
Beecher, W. C., 39-2-175
Bell, A. W., 38-2-57,
39-3-153
Bell, R. L., 40-2-205
Belsheim, R. O., 36-1-1
39-1-13
Benson, A. S., 41-7-151
Benson, D. A., 37-S-1
Benton, M. D., 37-2-173

Berge, G. E., 39-2-99
Berkman, H. R., 37-3-75
Bernstein, M., 37-5-105
Berry, E., Jr., 41-7-123
Bert, C. W., 39-3-107,
39-3-191, 40-5-277
Bezler, P., 40-4-147
Bhuta, P. G., 41-3-63
Bickle, L. W., 39-5-41
Biehl, F. A., 39-3-179
Bies, D. A., 37-6-39
Binder, R. C., 37-2-7,
37-4-117, 39-2-99,
39-3-171, 40-2-67,
40-5-235, 41-2-151,
41-7-205
Bishop, G. W., 38-2-205,
39-1-33
Blasingame, W., 36-4-81,
39-1-143
Blenner, D. R., 38-3-199,
40-5-105
Bliven, D. O., 40-2-123
Block, D. L., 38-2-33
Boers, B. L., 36-4-65
Bohs, C., 39-5-73
Bolds, P. G., 41-4-221
Bort, R. L., 39-1-13
Bost, R. B., 36-5-85
Bouche, R. R., 41-3-1
Bouclm, P., 40-S-63
Bowie, G. E., 40-5-61
Bozich, D. J., 36-6-55,
37-5-77, 39-4-227
Brammeier, G. F.,
40-5-261
Bratkowski, W. V.,
36-6-215
Brauchli, H., 41-6-87

Preceding page blank

Britt, F. A., 37-4-151
Britton, W. R., 36-2-71
Brock, P. A., 36-3-147
Brown, C. R., 36-7-145,
37-7-67
Brunnemer, R. D., 37-7-39
Bruns, G. H., 36-4-49
Burack, R. D., 36-1-45
Burnett, R. R., 37-7-93
Burton, B. E., 41-5-27
Butt, L. T., 37-4-71

C

Caba, D. W., 39-6-133
Calcaterra, P. C., 37-6-29,
39-4-157, 40-5-203
Campos, P. E., 38-2-67
Cannon, C. M., 38-3-151,
39-4-31
Carlson, A. D., 36-2-31
Carrell, T., 40-5-285
Carter, D. A. E., 40-3-193
Carter, R. R., 37-2-1
Catherines, J. J., 40-6-91
Cerasuolo, D., 41-3-149
Chajes, A., 37-4-143
Chalmers, R. H., 40-2-31
Chandiramani, K. L.,
36-5-97
Chaump, L. E., 40-3-31
Chen, S., 41-7-141
Chi, M., 41-7-29
Childs, W., 39-6-15
Chin, J., 41-3-149
Chirby, A. E., 39-2-105,
41-7-195
Christiansen, H. N., 39-3-31
41-6-115
Chung, T. J., 41-7-81
Cinelli, G., 36-5-107
Citipitioglu, E., 39-6-57
Clevenson, S. A., 39-6-119
Coalson, C. G., 41-3-223
Coffey, C. G., 40-2-147
Cohen, E., 37-4-213
Cole, H. M., 40-S-21
Collopy, F. H., 36-7-13
Colonna, R. A., 37-5-89
Colt, J. G., 37-3-151
Compton, W. A., 40-5-61
Conley, W. R., 40-1-75
Conticelli, V. M., 38-2-177
Cook, L. L., Jr., 39-2-11
Cornelius, K. T., 36-1-13,
38-3-213
Corrao, P., 41-2-5
Cost, T. B., 39-2-35
Courtney, W. J., 41-3-187
Covert, M., 41-2-95
Cox, P. A., Jr., 40-2-227
40-1-61
Crist, S. A., 41-6-61
Critchfield, M., 36-4-95
Crites, R. C., 41-3-55
Cronin, D. L., 38-1-133,
41-7-9
Cronkrite, J. D., 41-7-131
Crum, J., 41-5-167
Cunniff, P. F., 36-2-9
Curciack, H. D., 41-3-155
Curreri, J. R., 39-2-51,
39-3-161, 40-4-147
Curtis, A. J., 37-3-47,
39-6-77, 41-4-37
Curwen, P. W., 38-3-221,
40-3-275
Cyphers, H. D., 36-6-207,
39-2-23

D

Daly, J. M., 36-5-55
Damle, S. K., 40-3-99
Davidson, L. C., 40-4-197

Davis, H. J., 37-3-219
Davis, S., 36-7-63, 38-3-325
Deckard, C. E., 41-3-119
DeClue, T. K., 41-3-119
Delchamps, T. B., 39-6-151
Della Rocca, R. J., 39-1-39
Demas, L. J., 37-5-175
Dembo, M. M., 40-2-243
Denton, K. D., 41-5-89
Derby, T. F., 40-5-19,
40-5-203
DeVost, V. F., 37-2-29
Dick, A. F., 36-1-1
Dickerson, J. R., 37-2-173
DiTaranto, R. A., 36-4-81,
39-1-143
Dodge, F. T., 41-7-169
Doll, R. W., 39-4-179
Donaghy, R. G., 37-4-127
Dorland, W. D., 37-5-25,
37-5-139, 40-3-163
Douglas, B. E., 38-3-89,
39-1-155
Downing, B. N., 40-6-67
Dreher, J. F., 37-S-95,
39-S-15, 41-S-25,
41-S-33
Drischler, J. A., 36-5-77
Dudek, T. J., 38-3-199,
40-5-105
Dunham, T. D., 38-3-235
Durling, B. J., 40-6-109
DuWaldt, F. A., 37-6-5
Dzialo, F. J., 37-4-143

E

Earls, D. L., 38-S-5
41-S-25
Ebner, S. G., 41-6-1
Eckblad, D. M., 41-5-143
Edelberg, A. Y., 40-3-9
Edelman, S., 39-2-1

- Egle, D. M., 38-3-235,
39-3-107
- Eidson, R. L., 41-7-81
- Eldred, K. McK., 37-5-1,
37-5-25, 37-5-139
- Elliott, W. A., 40-4-89
- Ellison, J. A., 36-6-203
- Elmore, N., 41-1-1
- Elsen, W. G., 37-3-21
- Engblom, J. J., 40-5-135
- Epstein, H., 40-5-291
- Erickson, L. L., 39-3-1
- Eshleman, R. L., 40-5-217,
41-2-53
- Everett, W. D., 37-4-137
- Everitt, J. M., 37-5-117
- F
- Fagan, J. R., 36-2-17,
36-4-75, 39-5-83
- Favour, J. D., 37-2-17,
40-2-157
- Feeser, L. J., 39-3-233,
40-3-99
- Feng, C. C., 38-1-99,
39-3-99
- Fine, R. A., 41-5-69
- Fischer, E. G., 37-7-67
- Fitzgerald, E. A., 38-3-139
- Fitzgerald, T. E., 37-4-59
- Flannery, W. G., 37-6-63,
38-3-111
- Floyd, C. J., 39-3-117,
41-4-119
- Fluent, S. L., 41-3-175
- Fogelson, S., 36-5-17
- Foley, J. T., 39-6-31
- Foster, W. P., 40-5-7
- Fotieo, G., 39-3-1
- Foxwell, V. M., Jr., 40-6-37
- Franken, P. A., 36-3-27
- Freeland, R. E., 39-2-123
- Frericks, D. E., 41-5-53
- Fritz, R. J., 40-1R-11
- Frohrib, D. A., 38-3-37
- Frost, A., 38-3-221
- Fuss, R. E., 36-1-13
- G
- Gaberson, H. A., 40-2-31,
41-5-39
- Gaffney, J. S., 38-2-67
- Galef, A. E., 41-7-9
- Gambucci, B. J., 40-3-205
- Gardner, L. B., 41-5-53
- Garner, D., 40-2-173
- Garza, L. R., 41-7-169
- Gaugh, W. J., 38-2-139,
39-2-123
- Gebhart, C. E., 37-4-193
- Gelman, A. P., 36-7-73
- Geminicar, R., 40-2-101
- Gerks, I. F., 39-2-217
- Gertel, M., 36-6-1, 37-4-43
- Gesswein, J., 41-2-5
- Gilbert, W. E., 40-1-45
- Go, J. Chi-Dian, 39-5-13
- Godino, V. D., 41-1-21
- Goff, J. W., 40-6-127
- Goldberg, J. L., 37-2-13
- Goldman, R. J., 36-2-63
- Gordon, L. A., 39-1-45
- Gossard, M. L., 41-6-103
- Grant, R. L., 41-5-155,
41-5-167
- Gray, D. M., 39-1-25
- Gray, H. P., 41-5-45
- Grisham, L. R., 39-2-1
- Grootenhuus, P., 40-5-37
- Grundy, A. H., 41-4-51
- Guordo, A. F., 37-5-1
- H
- Hagen, A., 40-5-13
- Hagglund, R. R., 41-5-69
- Haile, W. B., Jr., 41-6-103
- Hammer, J. G., 41-7-89
- Hancock, R. N., 40-6-27
- Hanks, B. R., 36-4-1,
39-2-77
- Hanners, R. J., 39-1-123
- Hart, F. D., 40-3-23,
40-4-209
- Haskell, D. F., 39-5-21
- Hasselmann, T. K., 36-7-129
- Hawkins, J. T., 37-4-79
- Hayek, S. I., 40-3-131
- Hayes, C. D., 37-2-7
- Healy, J. J., 37-4-127
- Hedrick, W. L., 41-5-143
- Heer, E., 38-2-239
- Heinrichs, J. A., 36-3-15
- Heise, R., Jr., 39-1-1
- Hellweg, R. D., 41-6-9
- Helmuth, J. G., 37-3-155,
41-4-183
- Henderson, F. M., 36-6-115,
41-6-163
- Henderson, J. P., 39-4-31,
40-5-1
- Henley, C. E., Jr., 37-2-43
- Henricks, W., 41-4-1
- Henry, A. S., 38-1-27
- Herrera, J. G., 37-3-47
- Herrmann, G., 40-2-57
- Hershfield, D. J., 36-6-195
- Herzberg, R. J., 41-4-1
- Herzing, K. A., 40-6-9,
41-5-89
- Heymann, F. J., 37-4-91
- Hieken, M. H., 41-3-207
- Higginbotham, R. R., 37-1-69
- Higham, C., 40-3-193
- Higney, J. T., 41-6-123
- Hill, L. R., Jr., 40-1-31
- Himmelblau, H., 37-4-15

- Hinegardner, W. D., 37-S-95
Hines, D. E., 41-6-9
Hirsch, A. E., 37-4-79
Hobbs, G. K., 37-2-173
Hofer, K. E., 40-5-245
Hoffman, D., 41-5-77
Holbeck, H. J., 38-2-139
Holland, R., 36-6-1, 37-4-43,
41-4-195
Holley, F. J., 36-6-163,
36-6-207
Hollis, W. W., 39-6-1
Holt, H. L., 39-2-195
Hooper, W. E., 36-7-113
Hord, J. E., 39-2-135
Hornbuckle, J. C., 41-7-109
Hou, S., 40-4-25, 40-4-171
Houston, A. D., 37-3-7
Howard, E. P., 36-5-1,
38-1-7
Howlett, J. T., 36-2-97,
38-3-207, 40-2-183
Huang, C. C., 40-2-243
Huang, H., 40-1-15
Huffington, N. J., Jr., 36-2-63
Hughes, P. S., 36-2-53,
37-2-29
Humphrey, P. W., 40-5-147
Hunter, N. F., Jr., 36-3-47,
37-3-61, 37-3-155
Hupton, J. R., 39-1-167
Hurt, D. M. C., 40-S-1
Hutchinson, J. A., 40-6-27,
41-4-133
Hwang, C., 38 1-87
Hwang, C. M., 36-7-129
- I
- Ip, C., 36-5-1, 36-6-91,
38-1-7
Irick, J. T., 37-1-77
Isaacson, C. C., 39-2-63
- Isada, N. M., 40-2-123,
40-3-111, 41-3-215, 41-3-133
Ishino, B. M., 40-3-257,
41-2-151
- J
- Jackman, K. R., 39-2-195
Jacobs, B. R., 37-3-99
Janetzko, L. G., 40-S-63
Janza, F. J., 36-6-225
Jaszlics, L. J., 39-3-99
Jenkins, J. F., 41-7-81
Jenks, A., 41-6-123
Jensen, F. R., 41-6-115
Jewell, R. E., 39-3-55
Johnson, C. D., 37-1-63,
39-2-41
Johnson, M. R., 37-4-199
Johnson, R. L., 41-3-63
Johnston, J. D., Jr., 37-5-25
40-3-163
Jones, D. I. G., 36-4-9,
36-4-49, 38-3-139,
38-3-151, 39-4-19, 39-4-31,
40-5-1, 41-2-105
Jones, G. K., 36-2-71,
37-6-57, 40-3-79
Jones, I. W., 39-4-63
Jones, P. J., 38-3-285,
41-6-197
Jones, R., 37-6-63
Jones, T. B., Jr., 40-2-51
- K
- Kacena, W. J., III, 41-6-197
Kachadourian, G., 37-7-173
Kadman, Y., 39-3-65
Kalinowski, A. J., 39-4-185
Kampfe, W. R., 37-3-193
Kao, G. C., 38-2-177,
39-4-227
Kaplan, S. M., 36-7-41,
39-2-147, 40-3-89
- Kapur, K. K., 38-1-7
Kartman, A. E., 41-4-189
Kazmierczak, F. F., 41-3-43
Keeffe, R. E., 41-5-59
Keegan, W. B., 40-3-179
Kennedy, D. R., 37-5-167
Kennedy, R., 40-6-85
Kennedy, R. P., 41-6-75
Kimsey, R. D., 39-1-175
Kipp, W. I., 39-5-89
Kirchman, E. J., 37-3-175
Kirsch, A., 39-1-223
Kiwior, T. M., 39-6-93
Klepl, M. J., 40-5-235
Knauer, C. D., Jr., 37-1-125,
37-4-15
Koegler, R. K., 40-2-123
Kohler, B. A., 39-2-71
Kolb, A. W., 37-S-17
Koronaos, N., 37-2-99
Kozin, C. H., 38-2-119
Kozin, F., 38-2-119
Krach, F. G., 38-2-133
Kraft, D. C., 38-3-71
Krajcinovic, D., 40-2-57
Kula, L. C., 37-4-59
Kulasa, L. V., 39-3-39
Kulina, M. R., 38-3-45,
40-1R-1
Kunieda, H., 40-3-69
- L
- LaBarge, W. L., 39-4-117,
40-5-49
Laier, R. L., 39-4-179
Laird, W. M., 39-3-39
Lake, R. M., 41-3-11
Lakin, E. D., 39-S-15
Lambert, W. H., 36-7-79
Lamoree, M. D., 39-4-117,
40-5-49

LeBrun, J. M., 40-2-157
Lee, H., 41-7-51
Lee, K., 37-4-65
Lee, R. H., 41-1-35
Lee, S. E., 36-6-67, 38-S-1
Lee, S. K., 39-3-201
Lee, T. N., 40-3-57
Leifer, N. A., 37-2-87
Lemley, C. E., 40-4-139
Lester, G., 41-4-183
Liang, S. T. W., 39-S-55
Liber, T., 40-5-291
Lifer, C. E., 38-1-87
Lipeles, J. L., 41-5-77
Loewy, R. G., 36-2-1
Long, B. R., 38-1-45
Long, J. V., 40-5-61
Luebke, R. W., 41-4-141
Lund, D. M., 39-1-65
Lutes, L. D., 38-2-239
Lyon, R. H., 36-5-97, 40-4-17

M

Macinante, J. A., 40-4-155
MacIntosh, A. M., 37-1-1
Mack, T. H., 36-3-27
Macy, M. J., 39-1-45
Maddux, G. E., 41-7-37
Magrath, H. A., 37-S-17
Maguire, A. F., 36-1-45
Mains, R. M., 38-2-1,
39-3-129, 40-4-1, 41-4-79
Mair, R. W., 37-S-1
Mandich, R. P., 39-1-195
39-6-93
Manning, J. E., 37-4-65
Marcus, D., 41-4-195
Mard, K. C., 39-3-17
Marsh, E. G., 37-2-51
Martin, D. J., 38-3-207,
41-6-203

Masri, S. F., 39-4-1
Massey, G. A., 37-2-1
Masters, A. E., 41-7-81
Mahur, P. N., 40-4-217,
41-1-35
Matrullo, M., 36-3-113
Maurer, O. F., 37-S-43
Mayberry, B. L., 39-3-191
Mayer, G. M., 37-1-63,
37-2-51, 39-2-41
Mays, J. R., 40-4-81, 41-5-101
McCaa, R., 36-3-113
McCafferty, R. M., 41-3-109
McCann, R. F., 36-3-71
McCarty, J. L., 40-2-183
McConnell, K. G., 39-4-11,
40-S-13
McCoy, R. G., 40-2-133
McFarland, S. L., 41-4-161
McGrath, M. B., 41-5-1
McGrattan, R. J., 36-2-31
McHorney, P. E., 37-1-125,
37-4-15
McIntosh, V. C., 41-4-209
McNabb, J. W., 36-1-23
Mebane, W. W., 37-2-65
Melichar, J. F., 37-4-185
Mellsen, S. B., 40-2-83
Melodia, A. C., 36-6-131
Mentzer, W. R., Jr., 36-2-9
Merchant, J. K., 40-3-31
Merkel, R. W., 39-2-63
Meyer, E. B., 38-2-231
Miller, D. F., 36-1-45
Miller, D. K., 40-4-209
Miller, H. T., 38-3-29,
39-1-167
Mok, Chi-Hung, 40-2-215
Molnar, A. J., 37-7-67
Monahan, J., 41-7-37
Moody, M. L., 39-3-247,
40-2-115, 41-6-1

Morrow, C. T., 39-2-87,
39-5-63, 41-5-17
Morse, R. E., 37-7-93
Moser, J. R., 40-2-173
Mueller, A. W., 40-4-103
Muirhead, J. C., 40-2-147
Mullen, J. F., 38-3-45
Murdock, J. W., 41-1-35
Murfin, W. B., 36-6-21,
37-4-177, 38-1-109
Murray, F. M., 37-5-13
Muskat, R., 41-6-93
Musson, B. G., 41-4-133

N

Nagy, J. A., 37-2-43
Nashif, A. D., 36-4-9,
36-4-37, 38-3-57, 38-3-151,
39-4-19, 39-4-53, 40-5-1,
41-2-121
Naylor, R., 40-2-147
Nelson, F. C., 38-3-5
Nelson, J. E., 41-5-101
Nemergut, P. J., 41-7-37
Neubert, V. H., 41-6-147,
41-7-51
Nevrincean, G., 40-2-133
Newbrough, D. E., 37-5-89,
37-5-105
Newman, R. K., 38-3-71
Nicholas, T., 38-3-13,
39-4-53, 41-2-121
Nielsen, R., 38-2-157,
40-4-63
Nirschl, J., 40-5-285
Nissel, N. B., 38-3-325
Noiseux, D. U., 38-2-231
Nokes, D. S., 38-3-5
Noonan, W. E., 37-3-89,
38-1-17
North, R. G., 36-3-55
Novak, M. E., 40-4-41
Nunez, H. W., 40-2-193

O

Oden, J. T., 41-7-81
 Oedy, R. J., 39-6-93
 O'Hara, G. J., 38-2-209,
 39-1-13, 39-3-143
 Ohno, J. M., 38-3-175
 O'Leary, J. J., 40-5-191
 Oleson, M. W., 40-2-1
 Olmsted, G. W., 41-3-207
 Olsen, J. R., 37-4-15
 Olson, J. N., 41-3-207
 On, F. J., 38-2-249, 40-3-79
 O'Neill, J. P., 40-5-157
 Osgood, C. C., 40-3-1
 Ostrem, F. E., 37-7-1
 O'Sullivan, D. J., Jr., 39-6-19
 Ottis, J. V., 36-3-47, 37-3-61,
 41-4-29
 Owens, F. S., 36-4-25

P

Paovich, R. J., 37-2-57
 Padovan, J. A., 39-3-161
 Painter, G. W., 36-3-1
 Pakstys, M., Jr., 38-2-11,
 38-3-243, 39-1-55
 Pal, D., 41-5-39
 Pan, K. C., 41-6-39
 Parker, G. R., 41-6-9
 Parker, W. S., 40-4-109
 Parks, J. G., 41-3-17
 Parmenter, W. W., 37-S-107,
 40-S-47
 Parrish, R. V., 40-6-109
 Parrott, T. L., 36-5-77
 Patel, M. C., 40-3-131
 Payne, B. F., 36-6-183
 Paz, M., 39-6-57, 41-6-159,
 41-7-123
 Pearson, J., 40-3-205
 Peete, W. F., Jr., 40-1-9
 Penrod, D. D., 41-6-39

Peoples, J. R., 41-S-1
 Perry, C. R., 40-6-1
 Perry, E. S., 39-4-199
 Petak, L. P., 38-2-209
 Peters, F. W., 37-3-121
 Pettit, E. A., Jr., 39-3-31
 Peverley, R. W., 36-3-39,
 37-5-153
 Phelps, H. N., Jr., 41-1-13
 Phelps, W. D., 37-7-19
 Pierce, S. R., 40-6-127
 Pilkey, W. D., 36-5-69,
 37-4-169, 38-2-157,
 39-4-185, 40-4-63, 41-2-47
 Pittman, P. F., 36-6-215
 Platus, D. L., 38-3-255
 Pollard, W. G., 41-3-75
 Pomonik, G. M., 37-7-39
 Poppitz, J. V., 38-2-187
 Port, R. J., 41-5-129
 Porter, O. H., 37-1-35
 Potter, J. L., 41-2-141
 Powell, A., 36-2-5
 Prendergast, F. X., 36-6-37
 Prothro, B. E., 39-6-47
 Pulgrano, L. J., 39-3-73
 Pursifull, L. J., 39-6-47,
 40-6-99
 Putman, T. H., 38-3-317
 Putukian, J. H., 37-4-97

Q

Quinn, T. L., 39-4-251

R

Rader, W. P., 41-5-9
 Raftopoulos, D. D., 41-S-49
 Rao, P. N., 40-5-217,
 40-5-245
 Ranney, J. P., 36-2-97,
 38-2-23
 Ravenscraft, J. R., 41-6-211
 Rav, J. D., 39-3-107
 Razziano, A., 39-2-51
 Reade, R., 41-3-187
 Redford, D. F., 36-3-91,
 37-2-109
 Reed, R. S., 37-7-205
 Regillo, D. A., 39-5-67
 Remmers, G. M., 38-2-261,
 39-3-143
 Rich, H. L., 37-1-15, 39-1-93
 Rich, R. L., 36-7-19,
 Rigger, C. L., 36-3-83
 Rimer, M., 41-7-181
 Riparbelli, C., 37-1-115
 Roach, C. D., 37-6-1
 Robb, E. A., 36-7-73
 Roberts, J. A., 36-7-19
 Roberts, P. V., 40-S-29,
 41-2-159
 Roberts, W. H., 37-7-77,
 39-S-1, 40-2-21
 Robertson, K. D., 36-7-103
 Robinson, F., 36-6-83
 Rocke, R. D., 39-4-1,
 41-6-133, 41-7-61
 Rodeman, R., 41-4-109
 Rodkin, S., 37-4-103
 Rodriguez, A. M., 40-4-217
 Rogers, D. M., 41-1-35
 Roos, C. H., 41-4-173
 Root, L. W., 38-1-27,
 39-2-187, 39-5-73, 40-4-97
 Rosenberg, G. S., 36-4-65
 Rosenfield, M. J., 38-2-177
 Roske, V. P., Jr., 40-5-277
 Ross, D. H., 37-3-203
 Rossmiller, R., 41-3-187
 Roth, S. C., 39-2-1
 Rountree, R. C., 41-5-111
 Rowan, W. H., 41-5-135
 Roy, R., 41-6-133
 Rubinstein, N., 38-2-169,
 40-4-163
 Rucker, C. E., 38-1-1

- Ludder, F. F., Jr., 39-3-49
 Runkle, C. J., 40-3-23
 Rupert, C. L., 39-4-101
 Ruzicka, J. E., 39-4-141,
 40-5-19
- S
- Safford, F. B., 37-4-117,
 41-5-111
 Sallet, D. W., 39-4-261,
 40-3-393, 41-6-31
 Salter, J. P., 37-3-1
 Salyer, R. A., 41-3-25
 Sanchez, L., 37-4-213
 Sapetta, L. P., 39-4-73
 Sardella, G., 36-3-83
 Saunders, H., 36-5-119,
 39-1-223, 40-4-187
 Saunders, P. D., 38-2-95
 Scavazzo, R. J., 39-S-41,
 41-S-49
 Scharton, T. D., 36-3-27,
 36-5-41, 38-1-115, 40-3-231
 Schell, E. H., 40-6-153
 Scheller, B. R., 40-4-115
 Schock, R. W., 37-5-117
 Schlue, J. W., 37-7-19
 Schoessow, T. D., 38-1-37
 Schrader, C. G., 37-4-85
 Schubert, D. W., 37-6-29,
 39-4-141, 39-4-157
 Schulz, M. W., 36-6-73
 Schwantes, S. N., 40-6-9
 41-5-89
 Sciarra, J. J., 37-6-19
 Seamons, L. O., 36-2-83,
 41-3-195
 Seat, J. R., 37-5-117
 Seigel, A. E., 40-4-127
 Sellers, W. H., 37-2-57
 Sevin, E., 36-5-69, 37-4-169,
 39-4-185
 Sevy, R. W., 38-S-5
- Sewall, J. L., 40-6-109
 Sharma, M. G., 36-4-95
 Shear, J. C., 40-3-111
 Shipway, G. D., 40-3-211
 Shupe, W. L., 41-3-11
 Shurtleff, W. W., 36-3-139
 Shyu, T. P., 40-3-119
 Sierakowski, R. L., 41-7-109
 Sigillito, V. G., 38-2-169,
 40-4-163
 Silver, R. L., 39-3-205
 Silverman, S., 37-1-77,
 40-2-227, 40-1-51
 Simmons, D. R., 39-4-31
 Sincavage, J., 39-5-83
 Singhvi, G. M., 39-3-233
 Skolka, E. J., 36-3-119
 Smallwood, D. O., 41-4-87
 Smart, T. E., 37-2-77
 Smith, A., 40-S-29
 Smith, D. L., 41-4-161
 Smith, E. F., 41-6-
 Smith, F. A., 37-7-221,
 38-3-285, 39-3-55
 Smith, J. E., 39-1-123,
 40-4-197
 Smith, L. G., 37-3-137
 Snowdon, J. C., 41-2-21
 Soifer, M. T., 38-2-57,
 39-3-153
 Somerset, J. H., 39-3-205,
 40-3-119
 Soroka, A. J., 39-2-147
 Soulant, H., 38-S-1
 Sowers, J. D., 38-3-95
 Spalthoff, W. G., 39-1-195
 Spencer, P. R., 40-3-275
 Srinivasan, A. V., 37-6-49
 Stadter, J. T., 38-2-169,
 40-4-163
 Stahle, C. V., Jr., 36-7-1
- Steier, M., 40-4-63
 Stein, P. K., 41-3-81
 Stephens, D. G., 36-1-1,
 41-7-181
 Sterk, M. W., 36-6-203
 Stevens, R. A., 39-2-105,
 41-7-185
 Stevens, R. W., 37-4-111
 Stevenson, J. R., 36-3-55
 Stewart, H. L., 40-3-267
 St. Lawrence, W. F., 36-4-95
 Strickland, G. E., Jr.,
 39-5-29
 Stroeve, A., 40-3-49
 Sugarman, R. C., 41-3-215
 Suh, N. P., 41-2-77
 Sullivan, J. R., 39-1-65
 Sussman, E. D., 41-3-215
 Sutphin, H. C., 41-6-219
 Sutton, J. F., 39-2-23
 Swanson, W. L., 40-3-27
 Sylvester, R. J., 36-5-1
- T
- Tai, C. L., 38-2-79
 Tait, J. N., 40-3-139
 Terentak, W. B., 36-7-89
 Terkun, V., 36-7-41
 Thomas, C. F., 37-S-73,
 41-4-209
 Thomas, E. V., 36-4-81,
 38-3-1, 38-S-19, 39-1-155
 Thompson, J. N., 39-4-199
 Thornton, E. A., 40-1-1
 Timmerman, K. M., 37-3-193
 Tinling, N. G., 39-6-77,
 41-4-37
 Tirman, C. J., 40-5-157
 Toile, E. A., 39-S-15
 Tolleth, F. C., 36-3-101
 Tomassoni, J. E., 36-7-79

Trull, R. V., 41-4-95
Tryon, H. B., 40-3-275
Tuckerman, R. G., 36-6-67
Tustin, W., 40-6-61

U

Uchiyama, J. T., 37-3-121
Uchiyama, S., 28-2-79
Ungar, E. E., 36-5-41,
37-2-99, 39-3-65, 41-7-1

V

Vagnoni, L. A., 36-2-53
Van Bibber, V. H., 41-1-1
van der Heyde, R. C. W.,
37-S-63
Van Gulick, L. A., 41-6-219
Varney, R. F., 41-4-99
Vatz, I. P., 38-2-271,
41-6-179
Venetos, M. A., 36-6-173
Verga, J., 38-2-219,
39-2-221
Vigil, M. G., 39-5-41,
39-5-53
Viner, J. G., 41-4-99, 41-S-1
Vogel, W., 41-6-147
Volz, W. A., 36-2-89
von Hardenberg, P. W.,
39-3-17

W

Wallerstein, L., Jr.,
37-3-163

Walton, W. C., Jr., 41-6-203
Wambeganss, M. W., Jr.,
36-4-65
Wang, E. H., 36-6-225
Wang, Shou-ling, 39-1-107
Wang, Y. F., 40-1-15
Ward, H. H., 39-1-65
Ward, T. M., 41-7-205
Warkulwiz, V. P., 38-2-107
Warnaka, G. E., 39-1-167
Warner, R. W., 41-2-95
Waters, D., 37-S-1
Weatherstone, J. D., 36-6-47
Weber, J. D., 38-3-165
Weinberger, F., 37-1-35,
39-1-1
Weissman, S., 37-4-213
Welch, W. P., 38-2-95
Wells, C. R., 39-2-135
West, J. R., Jr., 37-4-15,
37-5-89
Westine, P. S., 39-6-139,
40-1-61
White, M. P., 37-4-143
White, R. P., Jr., 37-6-5
White, R. W., 37-5-55
Whitehill, A. S., 39-4-251
Wiland, J., 41-4-195
Williams, L. A., 36-7-89
Wilson, J. F., 40-4-47,
41-6-47
Wilson, J. P., 40-1R-1

Winqvist, A. A., 40-2-67
Witt, E. F., 40-2-133
Witte, A. F., 38-1-67,
41-4-109, 41-4-69
Wohlmann, M., 39-5-1,
40-4-67, 41-6-219
Wood, W. R., Jr., 39-2-105,
41-7-195
Woolam, W. E., 40-5-115
Wren, R. J., 37-5-25,
37-5-139
Wrenn, B. G., 41-4-1
Wright, P. M., 38-1-99

Y

Yang, J. C. S., 40-4-127,
40-5-175, 41-6-187
Yang, T. M., 37-6-39,
38-1-115
Yorgiadis, A., 39-2-157
Young, D., 40-2-227,
Young, J. P., 40-2-157
Young, R. K., 41-5-53

Z

Ziegra, G. A., 38-3-243,
41-1-21
Zimmerman, N. H., 40-4-139
Zonars, D., 41-2-1
Zwibel, H. S., 41-7-89

Part III
Tables of Contents

Shock and Vibration Bulletins
36 Through 41

Bulletin 36

Part I

DYNAMIC DESIGN ANALYSIS METHOD PREDICTION VERSUS TEST MEASUREMENT OF SHIPBORNE EQUIPMENT RESPONSE	1
R. O. Belsheim and A. F. Dick, Naval Research Laboratory, Washington, D.C.	
COMPARISON OF SHOCK MOTIONS INDUCED BY AIR BLAST AND UNDERWATER EXPLOSIONS	13
Robert E. Fuss and Kenneth T. Cornelius, David Taylor Model Basin, Washington, D.C.	
ANALYSIS OF 21B WEAPONS SKID FOR VERTICAL SHOCK	23
John W. McNabb, Northern Ohio University, Ada, Ohio	
NERVA NUCLEAR REACTOR VIBRATION ANALYSIS AND TEST PROGRAM WITH EMPHASIS ON NONLINEAR RESPONSES	45
R. D. Burack, D. F. Miller, and A. F. Maguire, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania	
RECENT SOVIET RESEARCH IN SHOCK, VIBRATION, AND NONLINEAR MECHANICS	*
David B. Singer, Aerospace Corporation, San Bernardino, California	
DISTRIBUTION	55

Bulletin 36

Part II

Opening Session

THE CHALLENGE OF THE SECOND HALF OF THE DECADE	1
R. G. Loewy, University of Rochester, Rochester, New York	
SHOCK AND VIBRATION - A PERSPECTIVE	5
Alan Powell, David Taylor Model Basin, Washington, D.C.	

Shock

YIELDING EFFECTS ON SHOCK SPECTRA	9
William R. Mentzer, Jr., Bowles Engineering Corporation, Silver Spring, Maryland, and Patrick F. Cunniff, University of Maryland, College Park, Maryland	
SHOCK SPECTRA OF PRACTICAL SHAKER SHOCK PULSES	17
John R. Fagan and Anthony S. Baran, Radio Corporation of America, Princeton, New Jersey	
TRANSDUCER SHOCK STUDY	31
Arthur D. Carlson and Robert J. McGrattan, General Dynamics, Electric Boat Division, Groton, Connecticut	
DIRECT MEASUREMENT OF 5"/54 GUN SETBACK ACCELERATION	53
Peter S. Hughes and Luigi A. Vagnoni, Naval Ordnance Laboratory, Silver Spring, Maryland	

*This manuscript was not available at the time this part of the Bulletin went to press. It is hoped that the paper will be published at a later date.

SIMULATION OF HEAT SHIELD PYROTECHNIC SHOCK IMPEDANCE	63
Norris J. Huffington, Jr., and Robert J. Goldman, The Martin Company, Baltimore, Maryland	
PYROTECHNIC SHOCK TESTING OF A FULL-SCALE REENTRY VEHICLE	71
W. R. Britton and G. K. Jones, The Martin Company, Baltimore, Maryland	
SHOCK TESTING WITH SOLID-PROPELLANT-POWERED GUNS	83
Larry O. Seamons, Sandia Corporation, Albuquerque, New Mexico	
APPLICATION OF POLYURETHANE FOAM TO SHOCK ISOLATION OF LARGE SILO-BASED MISSILES	89
W. A. Volz, Westinghouse Electric Corporation, Sunnyvale, California	
NEW APPROACH FOR EVALUATING TRANSIENT LOADS FOR ENVIRONMENTAL TESTING OF SPACECRAFT	97
James T. Howlett and John P. Raney, NASA Langley Research Center, Hampton, Virginia	
SPECIFICATION OF SHOCK TESTS - PANEL SESSION	107
DISTRIBUTION	121

Bulletin 36

Part III

Vibration Testing

USE OF FORCE AND ACCELERATION MEASUREMENTS IN SPECIFYING AND MONITORING LABORATORY VIBRATION TESTS	1
G. W. Painter, Lockheed-California Company, Burbank, California	
FEASIBILITY OF FORCE-CONTROLLED SPACECRAFT VIBRATION TESTING USING NOTCHED RANDOM TEST SPECTRA	15
Joseph A. Heinrichs, The Martin Company, Baltimore, Maryland	
COMPARISON OF MARINER ASSEMBLY-LEVEL AND SPACECRAFT-LEVEL VIBRATION TESTS	27
Peter A. Franken and Terry D. Scharton, Bolt Beranek and Newman Inc., Van Nuys, California, and Thomas H. Mack, Jet Propulsion Laboratory, Pasadena, California	
ACOUSTICALLY INDUCED VIBRATION TESTING OF SPACECRAFT COMPONENTS	39
Richard W. Peverley, General Electric Company, Houston, Texas	
REPRODUCTION OF COMPLEX AND RANDOM WAVEFORMS AT VARIOUS POINTS ON A TEST ITEM	47
John V. Otts and Norman F. Hunter, Jr., Sandia Corporation, Albuquerque, New Mexico	
MULTIPLE SHAKER GROUND VIBRATION TEST SYSTEM DESIGNED FOR XB-70A	55
R. G. North and J. R. Stevenson, North American Aviation, Inc., Los Angeles, California	
THE HOW OF HELICOPTER VIBRATION TESTING	71
Ronald F. McCann, The Boeing Company, Morton, Pennsylvania	
RESONANCE TESTING OF A LIFTING BODY REENTRY VEHICLE	83
G. Sardella and C. L. Ruggen, The Martin Company, Baltimore, Maryland	
SHOCK AND VIBRATION TESTING USING FOUR-SHAKER SYSTEM	91
Dean F. Redford, Thiokol Chemical Corporation, Brigham City, Utah	

DESIGN TECHNIQUES FOR HORIZONTAL DRIVERS	10
Fred C. Tolleth, North American Aviation, Inc., Autonetics Division, Anaheim, California	
FLIGHT LEVEL VIBRATION TESTING OF A LIFTING BODY REENTRY VEHICLE	11
R. McCaa and M. Matrullo, The Martin Company, Baltimore, Maryland	
HYDRAULIC EXCITER COMBINED ENVIRONMENT TESTS	11
Edwin J. Skolka, NASA Goddard Space Flight Center, Greenbelt, Maryland	
AVERAGING FUNDAMENTAL VIBRATION CONTROL SIGNALS: A THEORETICAL STUDY	12
W. W. Shurtleff, Sandia Corporation, Albuquerque, New Mexico	
CONTROL TECHNIQUES FOR MULTI-SHAKER VIBRATION SYSTEMS	14
Richard A. Arone, Wyle Laboratories, Huntsville, Alabama, and Paul A. Brock, Sine Engineering Company, Granada Hills, California	

Bulletin 36

Part IV

Damping

MECHANISMS AND SCALING OF DAMPING IN A PRACTICAL STRUCTURAL JOINT	1
Brantley R. Hanks and David G. Stephens, NASA Langley Research Center, Hampton, Virginia	
DAMPING OF STRUCTURES BY VISCOELASTIC LINKS	9
David I. G. Jones, Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio, and Ahid D. Nashif, University of Dayton, Dayton, Ohio	
ELASTOMERS FOR DAMPING OVER WIDE TEMPERATURE RANGES	25
F. S. Owens, Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio	
NEW METHOD FOR DETERMINING DAMPING PROPERTIES OF VISCOELASTIC MATERIALS	37
Ahid D. Nashif, University of Dayton, Dayton, Ohio	
EFFECT OF TUNED VISCOELASTIC DAMPERS ON RESPONSE OF MULTI-SPAN STRUCTURES	49
David I. G. Jones and George H. Bruns, Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio	
METHOD FOR IDENTIFYING AND EVALUATING LINEAR DAMPING MODELS IN BEAM VIBRATIONS	65
M. W. Wambsganss, Jr., B. L. Boers, and G. S. Rosenberg, Argonne National Laboratory, Argonne, Illinois	
EFFECT OF AIR DAMPING ON STRUCTURAL FATIGUE FAILURE	75
John R. Fagan, Radio Corporation of America, Princeton, New Jersey	
DEVELOPMENT OF DAMPED MACHINERY FOUNDATIONS	81
W. Blasingame and E. V. Thomas, Navy Marine Engineering Laboratory, Annapolis, Maryland, and R. A. DiTaranto, Pennsylvania Military Colleges, Chester, Pennsylvania	
DYNAMIC MECHANICAL STUDIES OF A COMPOSITE MATERIAL	85
M. G. Sharma, M. Critchfield, and W. F. St. Lawrence, The Pennsylvania State University, University Park, Pennsylvania	

Bulletin 36

Part V

Analysis and Prediction

METHOD FOR IMPROVING A DYNAMIC MODEL USING EXPERIMENTAL TRANSIENT RESPONSE DATA	1
Ching-u Ip, Eli P. Howard, and Richard J. Syivester, Aerospace Corporation, San Bernardino, California	
DIGITAL ANALYSIS OF FATIGUE DAMAGE TO A MULTI-MODAL SYSTEM SUBJECTED TO LOGARITHMICALLY SWEPT SINUSOIDAL VIBRATION SPECTRA	17
Seymour Fogelson, The Marquardt Corporation, Van Nuys, California	
ANALYSIS OF VIBRATION DISTRIBUTIONS IN COMPLEX STRUCTURES	41
Eric E. Ungar, Bolt Beranek and Newman Inc., Cambridge, Massachusetts, and Terry D. Scharon, Bolt Beranek and Newman Inc., Van Nuys, California	
DYNAMIC ANALYSIS OF CONTINUUM BODIES BY THE DIRECT STIFFNESS METHOD . . .	55
W. E. Baker, Rocketdyne, Division of North American Aviation, McGregor, Texas, and J.M. Day, Arde Engineering Company, Asheville, North Carolina	
MIN-MAX RESPONSE PROBLEMS OF DYNAMIC SYSTEMS AND COMPUTATIONAL SOLUTION TECHNIQUES	69
Eugene Sevin and Walter Pilkey, IIT Research Institute, Chicago, Illinois	
STRAIN RESPONSE OF SIMPLY SUPPORTED BEAMS TO POINT AND ACOUSTIC LOADING	77
Tony L. Parrott and Joseph A. Driechler, NASA Langley Research Center, Langley Station, Hampton, Virginia	
PREDICTION OF FLIGHT VIBRATION LEVELS FOR THE SCOUT LAUNCH VEHICLE . . .	85
Robert B. Bost, LTV Aerospace Corporation, LTV Astronautics Division, Dallas, Texas	
RESPONSE OF STRUCTURAL COMPONENTS OF A LAUNCH VEHICLE TO IN-FLIGHT ACOUSTIC AND AERODYNAMIC ENVIRONMENTS	97
Khushi L. Chandiramani and Richard H. Lyon, Bolt Beranek and Newman Inc., Cambridge, Massachusetts	
DYNAMIC VIBRATIONS OF THICK-WALLED ELASTIC ANISOTROPIC CYLINDERS AND SPHERES WITH INTERNAL DAMPING	107
Gabriel Cinelli, Argonne National Laboratory, Argonne, Illinois	
EFFECT OF ASYMMETRICAL TRAPEZOIDAL PULSE ON SINGLE-DEGREE-OF-FREEDOM SYSTEMS	119
H. Saunders, General Electric Company, Philadelphia, Pennsylvania	

Bulletin 36

Part VI

Data Analysis and Instrumentation

EFFECT OF DIGITIZING DETAIL ON SHOCK AND FOURIER SPECTRUM COMPUTATION OF FIELD DATA	1
M. Gertel and R. Holland, Allied Research Associates, Inc., Concord, Massachusetts	
AUTOMATED DIGITAL SHOCK DATA REDUCTION SYSTEM,	21
Walter B. Murfin, Sandia Corporation, Albuquerque, New Mexico	

AUTOMATED ANALOG METHOD OF SHOCK ANALYSIS	37
F. X. Prendergast, Bell Telephone Laboratories, Whippany, New Jersey	
VIBRATION DATA REDUCTION TECHNIQUES AS APPLIED TO SATURN S-II VEHICLE	47
Joseph D. Weatherstone, North American Aviation, Downey, California	
DIGITAL ANALYSIS OF SATURN ENVIRONMENTAL TEST RESPONSE DATA	55
Daniel J. Bozich, Wyle Laboratories, Huntsville, Alabama	
USE OF A LOW-FREQUENCY SPECTRUM ANALYZER	67
S. E. Lee and R. G. Tuckerman, David Taylor Model Basin, Washington, D.C.	
DETECTION OF LOOSE PARTS AND FREE OBJECTS IN SEALED CONTAINERS	73
M. W. Schulz, General Electric Research and Development Center, Schenectady, New York	
COMBINED ENVIRONMENT TESTING OF SHIPBOARD ELECTRONIC EQUIPMENT AND UTILIZATION OF REGRESSION ANALYSIS	83
F. Robinson, Navy Electronics Laboratory, San Diego, California	
ANALYSIS OF RANDOM VIBRATION WITH AID OF OPTICAL SYSTEMS	91
Ching-u Ip, Aerospace Corporation, San Bernardino, California	
COMPUTER PROGRAM FOR DYNAMIC DESIGN ANALYSIS METHOD	101
John H. Avila, David Taylor Model Basin, Washington, D.C.	
COMPUTER PROGRAM FOR GENERAL SHIP VIBRATION CALCULATIONS	115
Francis M. Henderson, David Taylor Model Basin, Washington, D.C.	
MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR TRANSIENT SHOCK ANALYSIS	131
Anthony C. Melodia, David Taylor Model Basin, Washington, D.C.	
TRANSPORTATION ENVIRONMENTAL MEASUREMENT AND RECORDING SYSTEM	163
Frank J. Holley, NASA Goddard Space Flight Center, Greenbelt, Maryland	
DEVELOPMENT OF VELOCITY SHOCK RECORDER FOR MEASUREMENT OF SHIPPING ENVIRONMENTS	173
Matthew A. Venetos, U.S. Army Natick Laboratories, Natick, Massachusetts	
ABSOLUTE CALIBRATION OF VIBRATION GENERATORS WITH TIME-SHARING COMPUTER AS INTEGRAL PART OF SYSTEM	183
B. F. Payne, National Bureau of Standards, Washington, D.C.	
EXPERIMENTAL TECHNIQUES FOR OBSERVING MOTION OF EXTENDIBLE ANTENNA BOOMS	195
Donald J. Hermsfeld, NASA Goddard Space Flight Center, Greenbelt, Maryland	
DEVELOPMENT OF LOW-COST FORCE TRANSDUCER	203
Marlyn W. Sterk, Sandia Corporation, Albuquerque, New Mexico, and James A. Ellison, California Institute of Technology, Pasadena, California	
AUTOMATIC CALIBRATION AND ENVIRONMENTAL MEASUREMENT SYSTEM FOR LAUNCH PHASE SIMULATOR	207
Harry D. Cyphers and Frank J. Holley, NASA Goddard Space Flight Center, Greenbelt, Maryland	
MICROMINIATURE INSTRUMENTATION AMPLIFIERS	215
W. V. Bratkowski and P. F. Pittman, Westinghouse Research and Development Center, Pittsburgh, Pennsylvania	
INVESTIGATION OF PULSE X-RAY TECHNIQUES FOR STUDY OF SHOCK-WAVE- INDUCED EFFECTS IN SOIL	225
Warren J. Baker, Frank J. Janza, and Eric H. Wang, Civil Engineering Research Facility, University of New Mexico, Albuquerque, New Mexico	

DISTRIBUTION	237
------------------------	-----

Bulletin 36

Part VII

Structural Reliability

ESTIMATE OF EFFECT OF SPACECRAFT VIBRATION QUALIFICATION TESTING ON RELIABILITY	1
Clyde V. Stahle, Jr., The Martin Company, Baltimore, Maryland	
S-IC RELIABILITY PROGRAM FROM STRUCTURAL LIFE VIEWPOINT	19
Roy L. Rich and James A. Roberts, The Boeing Company, New Orleans, Louisiana	
STRUCTURAL RELIABILITY - PANEL SESSION	27

Design Data and Methods

DYNAMIC ANALYSIS OF ATS-B SPACECRAFT	41
Saul M. Kaplan and Victor Terkun, Hughes Aircraft Company, El Segundo, California	
SPACECRAFT DESIGN FOR ATLAS TORSIONAL SHOCK TRANSIENT	63
Sol Davis, Fairchild Hiller, Republic Aviation Division, Farmingdale, Long Island, New York	
COMPARISON OF PREDICTED AND MEASURED LAUNCH LOADS FOR SNAP 10A	73
Everett A. Robb and A. P. Gelman, Atomics International, Canoga Park, California	
GROUND-WIND-INDUCED OSCILLATIONS OF GEMINI-TITAN AIR VEHICLE AND ITS ERECTOR	79
John E. Tomassoni and William H. Lambert, The Martin Company, Baltimore, Maryland	
NOISE LEVEL MEASUREMENTS FOR IMPROVED DELTA, ATLAS/AGENA-D, AND TAT/AGENA-D LAUNCH VEHICLES	89
Lloyd A. Williams and William B. Tereniak, NASA Goddard Space Flight Center, Greenbelt, Maryland	
THE "VACUUM SPRING"	103
K. D. Robertson, U.S. Army Materials Research Agency, Watertown, Massachusetts	
SELF-ADAPTIVE VIBRATION BALANCING DEVICE FOR HELICOPTERS	113
W. Euan Hooper, The Boeing Company, Morton, Pennsylvania	
SHOCK RESPONSE OF ELECTRONIC EQUIPMENT CABINETS BY NORMAL MODE METHOD	129
T. K. Hasselman and C. M. Hwang, TRW Systems, Redondo Beach, California	
DAMPED VIBRATIONS OF ELASTICALLY SUPPORTED RIGID BODY WITH COUPLING BETWEEN TRANSLATION AND ROTATION	135
Francis H. Collopy, ITEK Corporation, Lexington, Massachusetts	
MISSILE HANDLING ANALYSIS	145
C. R. Brown and Alex J. Avis, Westinghouse Electric Corporation, Sunnyvale, California	
DISTRIBUTION	153

Bulletin 37

Part I

RECENT WORK ON SHOCK AT N.C.R.E.	1
A. M. MacIntosh, Naval Construction Research Establishment, Dunfermline, Fife, Scotland	
STATE OF SHOCK IN THE NAVY, 1967	15
H. L. Rich, Naval Ship Research and Development Center, Washington, D. C.	
NAVY DYNAMIC DESIGN ANALYSIS METHOD -- PANEL SESSION	33
SHOCK HARDENING RIVERINE WARFARE CRAFT FOR VIETNAM	35
O. H. Porter and F. Weinberger, Naval Ship Research and Development Center, Washington, D. C.	
SHOCK TESTING OF SONAR TRANSDUCERS -- A STATUS REPORT	63
C. M. Mayer and C. D. Johnson, Navy Underwater Sound Laboratory, New London, Connecticut	
AN EXPLOSION SHOCK-TESTING METHOD FOR SHIPBOARD EQUIPMENT	69
R. R. Higginbotham, Naval Ship Research and Development Center, Portsmouth, Virginia	
RIGID BODY RESPONSE OF NAVAL SURFACE VESSELS TO AIR BLAST	77
J. T. Irick, AVCO Corporation, Lowell, Massachusetts, S. Silverman and W. E. Baker, Southwest Research Institute, San Antonio, Texas	
REACTION OF MILD STEEL TARGETS TO EXPLODING MUNITIONS	97
J. W. Apgar, Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland	
RESPONSE OF A MISSILE STRUCTURE UNDER HIGH VELOCITY IMPACT	115
C. Riparbelli, General Dynamics/Pomona, Pomona, California	
AIM4D/F4 CAPTIVE-FLIGHT VIBRATION LOADS AND ENVIRONMENTAL MEASUREMENTS PROGRAM	125
C. D. Knauer, Jr. and P. E. McHorney, Hughes Aircraft Company, El Segundo, California	

Bulletin 37

Part II

Instrumentation and Analysis

PORTABLE LASER INSTRUMENT FOR VIBRATION ANALYSIS AND TRANSDUCER CALIBRATION	1
G. A. Massey and R. K. Carter, Sylvania Electronic Systems, Mountain View, California	
HIGH-FREQUENCY MICROPHONE CALIBRATION USING A SUPERSONIC FREE-FLIGHT RANGE	7
C. D. Hayes, Jet Propulsion Laboratory, Pasadena, California, and R. C. Binder University of Southern California, Los Angeles, California	
METHOD OF MEASURING VIBRATORY DISPLACEMENTS IN TERMS OF A LIGHT WAVELENGTH	13
J. L. Goldberg, National Standards Laboratory, Sydney, Australia	

CALIBRATION OF ACCELEROMETERS BY IMPULSE EXCITATION AND FOURIER INTEGRAL TRANSFORM TECHNIQUES	17
J. D. Favour, The Boeing Company, Seattle, Washington	
BIDIRECTIONAL SHOCK AND HIGH-IMPACT EFFECTS ON SHOCK TRANSDUCERS	29
V. F. DeVost and P. S. Hughes, Naval Ordnance Laboratory, Silver Spring, Maryland	
INFLUENCE OF FIXTURE STRESS CONCENTRATIONS ON RING ACCELEROMETERS . .	43
J. A. Nagy and C. E. Henley, Jr., NASA Goddard Space Flight Center, Greenbelt, Maryland	
SONAR TRANSDUCER VIBRATION REQUIREMENTS AND MEASUREMENT TECHNIQUES.	51
G. M. Mayer and E. G. Marsh, Navy Underwater Sound Laboratory, New London, Connecticut	
AUTOMATED VIBRATION ANALYSIS	57
R. J. Pabich and W. H. Sellers, Raytheon Company, Bedford, Massachusetts	
A COMPACT, LOW-COST SHOCK-SPECTRUM ANALYZER	65
W. W. Mebane, Naval Ordnance Laboratory, Silver Spring, Maryland	
DYNAMIC PHASE PLOTTING	77
T. E. Smart, Sandia Corporation, Albuquerque, New Mexico	
RANDOM-VIBRATION-INDUCED ERRORS IN A MISSILE CAUSED BY NONLINEAR INERTIAL ACCELEROMETERS	87
N. A. Leifer, Bell Telephone Laboratories, Inc., Whippany, New Jersey	
VIBRATION DISTRIBUTIONS IN MULTIPANEL STRUCTURES: COMPARISON OF MEASUREMENTS WITH STATISTICAL ENERGY PREDICTIONS	99
E. F. Ungar and N. Koronaios, Bolt Beranek and Newman Inc., Cambridge, Massachusetts	
CONSTANT BANDWIDTH FM DATA SYSTEM DESIGNED FOR SATURN S-IVB/V VIBRATION TESTS	109
D. F. Redford, Thiokol Chemical Corporation, Brigham City, Utah	
DYNAMICS PORTION OF GEMINI AGENA TARGET VEHICLE ENGINE MODIFICATION AND TEST PROGRAM (PROJECT SURE FIRE)	117
N. Angelopoulos, Lockheed Missiles & Space Company, Sunnyvale, California	
DYNAMIC ANALYSIS OF COMPLEX STRUCTURES	173
M. D. Benton, G. K. Hobbs, Hughes Aircraft Company, El Segundo, California, and J. R. Dickerson, University of Texas, Austin, Texas	

Bulletin 37

Part III

Reproduced from
best available copy. 

Vibration Testing

ADVANCES IN NUMEROLOGY	1
J. P. Salter, Royal Armaments Research and Development Establishment, Fort Halstead, Sevenoaks, Kent, England	
INTERNAL VIBRATION OF ELECTRONIC EQUIPMENT RESULTING FROM ACOUSTIC SHAKER INDUCED EXCITATION	7
A. D. Houston, Lockheed Missiles & Space Company, Sunnyvale, California	
RANDOM-VIBRATION RESPONSE DATA FOR ORBITING GEOPHYSICAL OBSERVA- TORY: FLIGHT, ACOUSTIC, AND VIBRATION TEST	21
W. G. Elsen, NASA Goddard Space Flight Center, Greenbelt, Maryland	

RANDOM-VIBRATION TEST LEVEL CONTROL USING INPUT AND TEST ITEM RESPONSE SPECTRA	47
A. J. Curtis and J. G. Herrera, Hughes Aircraft Company, Culver City, California	
RANDOM-FORCE VIBRATION TESTING	61
J. V. Otts and N. F. Hunter, Jr., Sandia Corporation, Albuquerque, New Mexico	
CONTROL POINT AVERAGING FOR LARGE SPECIMEN VIBRATION TESTS	75
H. R. Berkman, Litton Systems, Inc., Van Nuys, California	
VIBRATION METHODS FOR MULTIPLE RANDOM EXCITATION	89
W. E. Noonan, McDonnell Company, St. Louis, Missouri	
DYNAMIC TESTING OF FULL-SCALE SATURN LAUNCH VEHICLES	99
B. R. Jacobs, Northrop Nortronics, Huntsville, Alabama	
BUFFET RESPONSE MEASUREMENTS OF A SEVEN PERCENT AEROELASTICALLY SCALED MODEL OF VARIOUS TITAN III CONFIGURATIONS	121
J. T. Uchiyama and F. W. Peters, Martin-Marietta Corporation, Denver, Colorado	
HIGH-FORCE VIBRATION TESTING OF THE SATURN S-IVB STAGE	137
L. G. Smith, McDonnell Douglas Corporation, Huntington Beach, California	
SIMPLIFIED METHOD OF CONDUCTING A DUAL RANDOM-VIBRATION INTEGRATED SYSTEM TEST	151
J. G. Colt, Radio Corporation of America, Burlington, Massachusetts	
CONTROL STABILIZATION FOR MULTIPLE SHAKER TESTS	155
N. F. Hunter, Jr., Sandia Corporation, Albuquerque, New Mexico, and J. G. Helmuth, Chadwick-Helmuth Company, Inc., Monrovia, California	
THE SHM SPRING ISOLATOR	163
L. Wallerstein, Jr., Lord Manufacturing Company, Erie, Pennsylvania	

Test Facilities

ADVANCED COMBINED ENVIRONMENTAL TEST FACILITY	175
E. J. Kirchman and C. J. Arcilesi, NASA Goddard Space Flight Center, Greenbelt, Maryland	
DEVELOPMENT OF SIMULATED AIRCRAFT DELIVERY USING A ROCKET SLED	193
W. R. Kampfe and K. M. Timmerman, Sandia Corporation, Albuquerque, New Mexico	
AERODYNAMIC NOISE INVESTIGATION IN A SHORT-DURATION SHOCK FUNNEL	203
D. H. Ross, Aerospace Corporation, El Segundo, California	
IMPACT TESTING WITH A FOUR-INCH AIR GUN AND LEAD TARGETS	219
H. J. Davis, Harry Diamond Laboratories, Washington, D. C.	

Bulletin 37

Part IV

Shock Analysis and Simulation

MEASUREMENT AND ANALYSIS OF SPACECRAFT SEPARATION TRANSIENT RESPONSE FOR MARINER-TYPE SPACECRAFT	1
P. Barnett, Jet Propulsion Laboratory, Pasadena, California	
MECHANICAL SHOCK OF HONEYCOMB STRUCTURE FROM PYROTECHNIC SEPARATION	15
J. R. Olsen, J. R. West, Jr., H. Himmelblau, North American Rockwell Corporation, Los Angeles, California, C. D. Knauer, Jr., and P. E. McHorney, Jr., Hughes Aircraft Company, El Segundo, California	

SIMPLE STRENGTH CONCEPT FOR DEFINING PRACTICAL HIGH-FREQUENCY LIMITS OF SHOCK SPECTRUM ANALYSIS	43
M. Gertel and R. Holland, Allied Research Associates, Concord, Massachusetts	
TRANSIENT VIBRATION SIMULATION	59
T. E. Fitzgerald and L. C. Kula, The Boeing Company, New Orleans, Louisiana	
PREDICTING MECHANICAL SHOCK TRANSMISSION	65
J. E. Manning and K. Lee, Bolt Beranek and Newman Inc., Cambridge, Massachusetts	
SHOCK DAMAGE MECHANISM OF A SIMPLE STRUCTURE	71
L. T. Butt, Naval Ship Research and Development Center, Portsmouth, Virginia	
GENERAL MOTORS ENERGY-ABSORBING STEERING COLUMN AS A COMPONENT OF SHIPBOARD PERSONNEL PROTECTION	79
J. T. Hawkins and A. E. Hirsch, Naval Ship Research and Development Center, Washington, D. C.	
DESIGN OF HEAVY WEIGHT SHOCK TEST FACILITIES	85
C. G. Schrader, San Francisco Bay Naval Shipyard, San Francisco, California	
DERIVATION AND IMPLICATIONS OF THE NAVY SHOCK ANALYSIS METHOD	91
F. J. Heymann, Westinghouse Electric Corporation, Lester, Pennsylvania	
DYNAMIC ANALYSIS OF A TYPICAL ELECTRONIC EQUIPMENT CABINET SUBJECTED TO NUCLEAR-WEAPON-INDUCED SHOCK	97
J. H. Putukian, Kaman Avidyne, Burlington, Massachusetts	
DEVELOPMENT OF A ZERO-G COAST PHASE AIR GUN	103
S. Rodkin, General Electric Company, Philadelphia, Pennsylvania	
DEVELOPMENT OF A MISSILE LAUNCH SHOCK TEST FACILITY FOR SHILLELAGH . . .	111
R. W. Stevens, Martin-Marietta Corporation, Orlando, Florida	
USE OF EXPLODING WIRE APPARATUS FOR LABORATORY SIMULATION OF SHOCK WAVES	117
F. B. Safford, Mechanics Research Inc., El Segundo, California, and R. C. Binder, University of Southern California, Los Angeles, California	
NIKE-X SHOCK TUBE FACILITY	127
R. G. Donaghy and J. J. Szaly, Office of the Chief of Engineers, Department of the Army, Washington, D. C.	
DESIGN AND PERFORMANCE OF DUAL MODE SHOCK MACHINE	137
W. D. Everett, Naval Missile Center, Point Mugu, California	

Air Blast and Ground Shock

INFLUENCE OF SHIP MOBILITY ON INTERNAL FORCES PRODUCED BY BLAST	143
A. Chajes, F. J. Dzialo, and M. P. White, Department of Civil Engineering, University of Massachusetts, Amherst, Massachusetts	
DYNAMIC BEHAVIOR OF SHIPBOARD ANTENNA MASTS SUBJECTED TO BLAST- GENERATED OVERPRESSURES	151
F. A. Britt and R. H. Anderson, Mechanics Research, Inc., El Segundo, California	
*HARDENED ANTENNA TECHNOLOGY	
D. A. Benson, A. F. Gurdo, R. W. Mair and D. J. Waters, Rome Air Development Center, Griffiss AFB, New York	
ABSOLUTE UPPER AND LOWER BOUNDS FOR THE CRITICAL BLAST LOADING ENVIRONMENT OF TARGET ELEMENTS AND SYSTEMS	169
E. Sevin and W. D. Pilkey, IIT Research Institute, Chicago, Illinois	

*This paper appears in Shock and Vibration Bulletin 37, Supplement.

ELASTIC-PLASTIC COLLAPSE OF STRUCTURES SUBJECTED TO A BLAST PULSE	177
W. B. Murfin, Sandia Corporation, Albuquerque, New Mexico	
INTERNAL LOADING OF STRUCTURES BY BLAST WAVES	185
J. F. Melichar, Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland	
EFFECTS OF SLIDING ON BLAST LOADS REQUIRED TO OVERTURN STRUCTURES	193
C. E. Gebhart, IIT Research Institute, Chicago, Illinois	
USE OF DETONABLE GAS EXPLOSIONS FOR BLAST AND SHOCK STUDIES	199
M. R. Johnson and M. J. Balcerzak, General American Research Division, Niles, Illinois	
INCORPORATION OF SHOCK PROTECTION IN EXISTING ABOVEGROUND CYLINDRICAL STRUCTURES SUBJECTED TO NUCLEAR BLAST	213
E. Cohen, S. Weissman and L. Sanchez, Ammann and Whitney, New York, New York	

Bulletin 37

Part V

Large Vibroacoustic Test Facilities

VIBROACOUSTIC ENVIRONMENTAL SIMULATION FOR AEROSPACE VEHICLES	1
K. McK. Eldred, Wyle Laboratories, El Segundo, California	
*RTD SONIC FATIGUE FACILITY, DESIGN AND PERFORMANCE CHARACTERISTICS	
A. W. Kolb and H. A. Magrath, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio	
OPERATIONAL CHARACTERISTICS OF A 100,000-CUBIC-FOOT ACOUSTIC REVER- BERATION CHAMBER	13
F. M. Murray, Wyle Laboratories, Huntsville, Alabama	
CONCEPT, DESIGN, AND PERFORMANCE OF THE SPACECRAFT ACOUSTIC LABORATORY	25
R. J. Wren, W. D. Dorland, J. D. Johnston, Jr., NASA Manned Spacecraft Center, Houston, Texas, and K. McK. Eldred, Wyle Laboratories, El Segundo, California	
THEORETICAL STUDY OF ACOUSTIC SIMULATION OF IN-FLIGHT ENVIRONMENTS	55
R. W. White, Wyle Laboratories, Huntsville, Alabama	
DATA HANDLING METHODS FOR LARGE VEHICLE TESTING	77
D. J. Bozich, Wyle Laboratories, Huntsville, Alabama	
DEVELOPMENT AND VERIFICATION OF THE VIBRATION TEST REQUIREMENTS FOR THE APOLLO COMMAND AND SERVICE MODULES	89
D. E. Newbrough, General Electric Company, Houston, Texas, R. A. Colonna, NASA Manned Spacecraft Center, Houston, Texas, and J. K. West, Jr., North American Rockwell Corporation, Downey, California	
DEVELOPMENT AND VERIFICATION OF THE APOLLO LUNAR MODULE VIBRATION TEST REQUIREMENTS	105
D. E. Newbrough, General Electric Company, Houston, Texas, M. Bernstein and E. F. Baird, Grumman Aircraft Engineering Company, Bethpage, New York	

*This paper appears in Shock and Vibration Bulletin 37, Supplement.

SATURN S-II, S-IVB, AND INSTRUMENT UNIT SUBASSEMBLY AND ASSEMBLY VIBRATION AND ACOUSTIC EVALUATION PROGRAMS	117
R. W. Schoc, J. M. Everitt, NASA Marshall Space Flight Center, Huntsville, Alabama, and J. R. Seat, Brown Engineering Company, Huntsville, Alabama	
DEVELOPMENT OF ACOUSTIC TEST CONDITIONS FOR APOLLO LUNAR MODULE FLIGHT CERTIFICATION	139
W. D. Dorland, R. J. Wren, NASA Manned Spacecraft Center, Houston, Texas, and K. McK. Eldred, Wyle Laboratories, El Segundo, California	
*FACILITY SONIC FATIGUE PROOF TESTING O. F. Maurer, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio	
VIBROACOUSTIC TEST METHODS FOR VIBRATION QUALIFICATION OF APOLLO FLIGHT HARDWARE	153
R. W. Peverley, General Electric Company, Houston, Texas	
ACOUSTICAL QUALIFICATION OF S-IC FIN STRUCTURES	167
C. J. Beck, Jr., The Boeing Company, Huntsville, Alabama, and D. R. Kennedy, Brown Engineering Company, Huntsville, Alabama	
*SIMULATION OF ACOUSTIC FATIGUE FAILURE IN THE WIDEBAND NOISE TEST FACILITY OF THE AIR FORCE FLIGHT DYNAMICS LABORATORY R. C. W. van der Heyde, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio	
REAL-TIME COMBINED ACOUSTIC-VACUUM TESTING OF SPACECRAFT	175
L. J. Demas, NASA Goddard Space Flight Center, Greenbelt, Maryland	

Bulletin 37

Part VI

Helicopter Environments

HELICOPTER VIBRATIONS	1
C. D. Roach, U. S. Army Aviation Materiel Laboratories, Fort Eustis, Virginia	
HELICOPTER VIBRATION -- A MAJOR SOURCE, ITS PREDICTION AND AN APPROACH TO ITS CONTROL	5
R. P. White, Jr., and F. A. DuWaldt, Cornell Aeronautical Laboratory, Inc., Buffalo, New York	
*IN-FLIGHT VIBRATION AND ACOUSTIC STUDY ON THE UH-1F HELICOPTER C. E. Thomas and J. T. Ach, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio	
HELICOPTER FUSELAGE VIBRATION PREDICTION BY STIFFNESS MOBILITY METHODS	19
J. J. Sciarra, The Boeing Company, Morton, Pennsylvania	
ISOLATION OF HELICOPTER ROTOR-INDUCED VIBRATIONS USING ACTIVE ELEMENTS	29
P. C. Calcatera and D. W. Schubert, Barry Research & Development, Watertown, Massachusetts	
HYBRID VIBRATION-ISOLATION SYSTEM FOR HELICOPTERS	39
D. A. Bies and T. M. Yang, Bolt Beranek and Newman Inc., Los Angeles, California	

*This paper appears in Shock and Vibration Bulletin 37, Supplement.

RECENT ADVANCES IN THE STUDY OF SYNCHRONOUS VIBRATION ABSORBERS	49
A. V. Srinivasan, Kaman Corporation, Bloomfield, Connecticut	
OPTIMIZING THE DYNAMIC ABSORBER TO INCREASE SYSTEM DAMPING	57
G. K. Jones, NASA Goddard Space Flight Center, Greenbelt, Maryland	
APPLICATION OF THE DYNAMIC ANTIRESONANT VIBRATION ISOLATOR TO HELICOPTER VIBRATION CONTROL	63
R. Jones and W. G. Flannelly, Kaman Corporation, Bloomfield, Connecticut	

Bulletin 37

Part VII

Environmental Data

SURVEY OF THE CARGO-HANDLING SHOCK AND VIBRATION ENVIRONMENT	1
F. E. Ostrem, General American Research Division, Niles, Illinois	
A NEW LOOK AT TRANSPORTATION VIBRATION STATISTICS	19
J. W. Schlue and W. D. Phelps, Jet Propulsion Laboratory, Pasadena, California	
RECENT SHOCK AND VIBRATION MEASUREMENTS ON THE M-151 (JEEP) VEHICLE	39
R. D. Brunner and G. M. Pomonik, Hughes Aircraft Company, Canoga Park, California	
LATERAL IMPACT SHOCK DURING SHIP LOADING OF THE A3 POLARIS MISSILE	67
E. G. Fischer, C. R. Brown, and A. J. Molnar, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania	
*FF-4C VIBRATION AND ACOUSTIC ENVIRONMENT STUDY	
J. F. Dreher, Air Force Flight Dynamics Laboratory, and W. D. Hinegardner, Systems Engineering Group, Wright-Patterson AFB, Ohio	
EMPIRICAL CORRELATION OF FLIGHT VEHICLE VIBRATION RESPONSE	77
W. H. Roberts, Martin-Marietta Corporation, Orlando, Florida	
VIBRATION DATA SUMMARY OF MINUTEMAN WING VI FLIGHT TEST MISSILES	93
R. R. Burnett and R. E. Morse, TRW Systems, Redondo Beach, California	
SPACECRAFT VIBRATION: COMPARISON OF FLIGHT DATA AND GROUND TEST DATA	173
G. Kachadourian, General Electric Company, Philadelphia, Pennsylvania	
MEASUREMENT AND ANALYSIS OF GUN FIRING AND VIBRATION ENVIRONMENTS OF THE RIVER PATROL BOAT	205
R. S. Reed, Naval Ordnance Laboratory, Silver Spring, Maryland	
*RESPONSE OF THE AIM-9D (SIDEWINDER) MISSILE TO CAPTIVE-FLIGHT VIBRATION	
W. W. Parmenter, Naval Weapons Center, China Lake, California	
SCALE-MODEL WIND-TUNNEL ACOUSTIC DATA	221
J. R. Baratono and J. A. Smith, Martin-Marietta Corporation, Denver, Colorado	

 *This paper appears in Shock and Vibration Bulletin 37, Supplement.

Bulletin 38

Part I

Vibration Analysis

VIBRATION RESPONSES OF SIMPLE CURVED PANELS TO HIGH INTENSITY RANDOM AND DISCRETE FREQUENCY NOISE	1
C. E. Rucker, NASA Langley Research Center, Hampton, Virginia	
RANDOM VIBRATION USING FINITE ELEMENT APPROACH	7
K. K. Kapur, Ching-U Ip and E. P. Howard, Aerospace Corporation, San Bernardino, California	
FREQUENCY ANALYSIS OF REPETITIVE BURSTS OF RANDOM VIBRATION	17
W. E. Noonan, McDonnell Company, St. Louis, Missouri	
SIMPLIFIED RANDOM VIBRATION COMPUTATIONS	27
LaVerne W. Root and A. S. Henry, Collins Radio Company, Cedar Rapids, Iowa	
CONCENTRATED MASS EFFECTS ON THE VIBRATION OF CORNER SUPPORTED RECTANGULAR PLATES	37
R. L. Barnoski, Measurement Analysis Corporation, Los Angeles, California, and T. D. Schoessow, Aerospace Corporation, El Segundo, California	
VIBRATION OF ECCENTRICALLY STIFFENED PLATES	45
B. R. Long, Defence Research Establishment Suffield, Ralston, Alberta, Canada	
CRACK DETECTION IN A STRUCTURAL BEAM THROUGH CROSS- CORRELATION ANALYSIS	55
F. Baganoff, Baganoff Associates, Inc., St. Louis, Missouri, and D. Baganoff, Stanford University, Stanford, California	
A THEORETICAL MODAL STUDY FOR THE LATERAL VIBRATIONS OF BARS HAVING VARIABLE CROSS SECTION AND FREE END CONDITION	67
A. F. Witte, Sandia Corporation, Albuquerque, New Mexico	
*VARIABLE RESONANT VIBRATION GENERATOR FOR EXPERIMENTAL VIBRATIONAL ANALYSIS OF STRUCTURES	
H. Soulant and S. Lee, Naval Ship Research and Development Center, Washington, D.C.	
*THE PREDICTION OF INTERNAL VIBRATION LEVELS OF FLIGHT VEHICLE EQUIPMENT	
R. W. Sevy and D. L. Earls, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio	
SATURN V COMPONENT VIBRATION TESTS USING SEGMENTED SHELL SPECIMENS	87
C. Hvang, Northrop Corporation, Norair Division, Hawthorne, California, and C. E. Lifer, NASA, Marshall Space Flight Center, Huntsville, Alabama	
AN APPLICATION OF FLOWGRAPHS TO THE FREE VIBRATION OF STRUCTURES	99
P. M. Wright, University of Toronto, Toronto, Canada, and C. C. Feng, University of Colorado, Boulder, Colorado	
DUAL SPECIFICATIONS IN VIBRATION TESTING	109
W. B. Murfin, Sandia Corporation, Albuquerque, New Mexico	
SUBSTITUTE ACOUSTIC TESTS	115
T. D. Scharon and T. M. Yang, Bolt Beranek and Newman Inc., Van Nuys, California	

*This paper appears in Shock and Vibration Bulletin 38, Supplement.

SIMPLIFIED METHOD OF CALCULATING NATURAL FREQUENCIES AND NORMAL MODES OF VIBRATION FOR SHIPS	125
H. B. Ali and H. F. Alms, Naval Ship Research and Development Center, Washington, D.C.	
RESPONSE SPECTRA FOR SWEEPING SINUSOIDAL EXCITATIONS	133
D. L. Cronin, TRW Systems Group, Redondo Beach, California	

Bulletin 38

Part II

Structural Analysis

AN OVERALL VIEW OF STRUCTURAL DYNAMICS	1
R. M. Mains, Washington University, St. Louis, Missouri	
DYNAMIC SUBSTRUCTURES METHOD FOR SHOCK ANALYSIS	11
M. Pakstys, Jr., General Dynamics, Electric Boat Division, Groton, Connecticut	
IDENTIFICATION OF COMPLEX STRUCTURES USING NEAR-RESONANCE TESTING	23
J. P. Raney, NASA Langley Research Center, Hampton, Virginia	
PROPAGATION OF LONGITUDINAL STRESS WAVES IN A COMPLEX BAR-TYPE STRUCTURE	33
D. L. Block, Martin Marietta Corporation, Orlando, Florida	
ALSEP SYSTEM STRUCTURAL DYNAMICS STUDY	47
M. M. Bahn, Aerospace Systems Division, The Bendix Corporation, Ann Arbor, Michigan	
REDUCING THE NUMBER OF MASS POINTS IN A LUMPED PARAMETER SYSTEM	57
M. T. Soifer and A. W. Bell, Dynamic Science, Menlo Park, California	
LATERAL DYNAMIC RESPONSE OF LARGE SUBSYSTEMS DURING LAUNCH TRANSIENT CONDITIONS	67
J. S. Gaffney and P. E. Campos, Atlantic Research Corporation, Costa Mesa, California	
A NEW APPROACH TO THE INTERACTION PROBLEMS OF FLUID-FILLED ELASTIC MEMBRANE SHELLS	79
C. L. Tai and S. Uchiyama, Space Division, North American Rockwell Corporation, Downey, California	
STRUCTURAL AND VIBRATION ANALYSIS OF NAVY CLASS HIGH IMPACT, MEDIUM WEIGHT SHOCK TESTS	95
W. P. Welch and P. D. Saunders, Westinghouse Electric Corporation, Sunnyvale, California	
TRANSIENT RESPONSES OF A LINEAR MECHANICAL SYSTEM BY USE OF EXPERIMENTALLY DETERMINED UNIT IMPULSE RESPONSES	107
V. P. Warkulwiz, General Electric Company, Valley Forge Space Technology Center, Pennsylvania	
A MOMENT TECHNIQUE FOR SYSTEM PARAMETER IDENTIFICATION	119
F. Kozin and C. H. Kozin, Midwest Applied Science Corporation, West Lafayette, Indiana	
REINFORCED CONCRETE BEAM RESONANCES	133
F. G. Krach, Barry Controls Division, Barry Weight Corporation, Watertown, Massachusetts	

STRUCTURAL DYNAMIC ANALYSIS OF THE MARINER MARS '69 SPACECRAFT	139
H. J. Holbeck, Jet Propulsion Laboratory, Pasadena, California, and T. D. Arthur and W. J. Gaugh, Northrop Systems Laboratory, Northrop Corporation, Hawthorne, California	
LINE SOLUTION TECHNOLOGY AS A GENERAL ENGINEERING APPROACH TO THE STATIC, STABILITY, AND DYNAMIC RESPONSE OF STRUCTURAL MEMBERS AND MECHANICAL ELEMENTS	157
W. D. Pilkey, IIT Research Institute, Chicago, Illinois, and R. Nielsen, Jr., Department of Transportation, Washington, D.C.	
UPPER AND LOWER BOUNDS TO BENDING FREQUENCIES OF NONUNIFORM SHAFTS, AND APPLICATIONS TO MISSILES	169
N. Rubinstein, V. G. Sigillito and J. T. Stadter, Applied Physics Laboratory, The Johns Hopkins University, Silver Spring, Maryland	
DAMAGE PREDICTION FOR OPEN-FRAME STRUCTURES SUBJECT TO LIQUID PROPELLANT EXPLOSIONS	177
G. C. Kao and V. M. Conticelli, Wyle Laboratories, Huntsville, Alabama, and M. J. Rosefield, U.S. Army Corps of Engineers, Ohio River Division Laboratories, Cincinnati, Ohio	
SIMPLIFIED DYNAMICS OF HARDENED BURIED BUILDINGS	187
J. V. Poppitz, Bell Telephone Laboratories, Inc., Whippany, New Jersey	
INFLUENCE COEFFICIENT MATRIX QUICK-CHECK PROCEDURE	205
G. W. Bishop, Bishop Engineering Company, Princeton, New Jersey	

Mechanical Impedance

DETERMINATION OF FIXED BASE NATURAL FREQUENCIES OF DUAL FOUNDATION SHIPBOARD EQUIPMENTS BY SHAKE TESTS	209
L. P. Petak and G. J. O'Hara, Naval Research Laboratory, Washington, D.C.	
*VIBRATION TRANSMISSION METHODS FOR FOUNDATION STRUCTURES	
E. V. Thomas, Annapolis Division, Naval Ship Research and Development Center, Annapolis, Maryland	
VIBRATION ANALYSIS OF A STRUCTURAL FRAME USING THE METHOD OF MOBILITY	219
J. Verga, Hazeltine Corporation, Little Neck, New York	
APPLICABILITY OF MECHANICAL ADMITTANCE TECHNIQUES	231
D. U. Noiseux and E. B. Meyer, Bolt Beranek and Newman Inc., Cambridge, Massachusetts	
APPLICATION OF THE MECHANICAL RECEPTANCE COUPLING PRINCIPLE TO SPACECRAFT SYSTEMS	239
E. Heer, Jet Propulsion Laboratory, Pasadena, California, and L. D. Lutes, Rice University, Houston, Texas	
A VERIFICATION OF THE PRACTICALITY OF PREDICTING INTERFACE DYNAMICAL ENVIRONMENTS BY THE USE OF IMPEDANCE CONCEPTS	249
F. J. On, NASA, Goddard Space Flight Center, Greenbelt, Maryland	
EXPERIMENTAL TECHNIQUE FOR DETERMINING FIXED-BASE, NATURAL FREQUENCIES OF STRUCTURES ON SINGLE NONRIGID ATTACHMENT POINTS	261
G. M. Remmers, Naval Research Laboratory, Washington, D.C.	
DETERMINATION OF MODAL MASS FROM TEST DATA	271
I. P. Vatz, Brown Engineering, A Teledyne Company, Huntsville, Alabama	

*This paper appears in Shock and Vibration Bulletin 38, Supplement.

Bulletin 38

Part III

Damping and Isolation

DESIGN OF A DAMPED MACHINERY FOUNDATION FOR HIGH-SHOCK LOADING	1
E. V. Thomas, Annapolis Division, Naval Ship Research and Development Center, Annapolis, Maryland	
CONSTRAINED LAYER DAMPING WITH PARTIAL COVERAGE	5
D. S. Nokes and F. C. Nelson, Tufts University, Medford, Massachusetts	
THE EFFECTS OF ROTATORY INERTIA AND SHEAR DEFORMATION ON THE FLEXURAL VIBRATIONS OF A TWO-LAYERED VISCOELASTIC-ELASTIC BEAM	13
T. Nicholas, Air Force Materials Laboratory, Wright-Patterson AFB, Ohio	
METHODS OF DAMPING VERY STIFF STRUCTURAL MEMBERS	29
H. T. Miller, Lord Manufacturing Company, Erie, Pennsylvania	
THE OPTIMUM DESIGN OF FIVE-PLY VISCOELASTIC ISOLATION FLEXURES FOR POINT-INERTIA LOADING	37
C. A. Frohrib, University of Minnesota, Minneapolis, Minnesota	
APPLICATION OF DAMPING DEVICE FOR CRITICAL SPEED CONTROL	45
J. F. Mullen and M. R. Kulina, Curtiss-Wright Corporation, Wood-Ridge, New Jersey	
DEVELOPMENT OF PRACTICAL TUNED DAMPERS TO OPERATE OVER A WIDE-TEMPERATURE RANGE	57
A. D. Nashif, University of Dayton Research Institute, Dayton, Ohio	
MULTIFREQUENCY RESPONSE OF VISCOELASTIC DAMPERS	71
R. K. Newman and D. C. Kraft, University of Dayton, Dayton, Ohio	
THE CRITICAL DAMPING CALCULATOR AND A COMPARISON OF SELECTED STRUCTURAL DAMPING EVALUATION SYSTEMS	89
B. E. Douglas, Annapolis Division, Naval Ship Research and Development Center, Annapolis, Maryland	
FORCED RESPONSE OF LUMPED-PARAMETER SYSTEM WITH APPLICATIONS TO MISSILE DYNAMICS	95
J. D. Sowers, Chrysler Corporation Space Division, New Orleans, Louisiana	
A NONFLUID VELOCITY DAMPER	111
W. G. Flannelly, Kaman Aircraft Division, Kaman Corporation, Bloomfield, Connecticut	
THE DYNAMIC RESPONSE OF LINEARLY VISCOELASTIC CYLINDRICAL SHELLS TO PERIODIC OR TRANSIENT LOADING	121
E. A. Fitzgerald, Missile and Space Systems Division, McDonnell Douglas Corporation, Santa Monica, California	
DAMPING OF MULTISPAN STRUCTURES BY MEANS OF VISCOELASTIC LINKS	139
D. I. G. Jones, Air Force Materials Laboratory, Wright-Patterson AFB, Ohio	
DAMPING MEASUREMENTS ON SOFT VISCOELASTIC MATERIALS USING A TUNED DAMPER TECHNIQUE	151
C. M. Cannon and A. D. Nashif, University of Dayton, Dayton, Ohio, and D. I. G. Jones, Air Force Materials Laboratory, Wright-Patterson AFB, Ohio	
AIRCRAFT STRUCTURAL RESPONSE DUE TO GROUND IMPACT	165
J. D. Weber, Convair Division of General Dynamics, San Diego, California	

EFFECT OF TEMPERATURE ON THE VISCOELASTIC HIGH POLYMER MATERIALS	175
J. M. Ohno, Aerospace Systems Division, The Bendix Corporation, Ann Arbor, Michigan	
BROADBAND EXTENSIONAL DAMPING MATERIALS	199
D. R. Blenner and T. J. Dudek, Lord Manufacturing Company, Erie, Pennsylvania	
A SINUSOIDAL PULSE TECHNIQUE FOR ENVIRONMENTAL VIBRATION TESTING	207
J. T. Howlett and D. J. Martin, NASA, Langley Research Center, Hampton, Virginia	

Isolation

A STUDY OF THE PERFORMANCE OF AN OPTIMUM SHOCK MOUNT	213
K. T. Cornelius, Naval Ship Research and Development Center, Washington, D.C.	
AN INVESTIGATION OF THE PERFORMANCE OF GAS-BEARING MACHINERY SUBJECTED TO LOW-FREQUENCY VIBRATION AND SHOCK	221
P. W. Curwen and A. Frost, Mechanical Technology Inc., Latham, New York	
AN EXPERIMENTAL INVESTIGATION OF AN ACTIVE VIBRATION ABSORBER	235
T. D. Dunham, Southwest Research Institute, San Antonio, Texas, and D. M. Egle, University of Oklahoma, Norman, Oklahoma	
INTEGRATED SHOCK AND ACOUSTIC MODULAR DESIGN CONCEPT FOR SUBMARINES	243
M. Pakstys, Jr. and G. A. Ziegra, Electric Boat Division of General Dynamics, Groton, Connecticut	
CYCLIC DEFORMATION CREW ATTENUATOR STRUTS FOR THE APOLLO COMMAND MODULE	255
D. L. Platus, Mechanics Research, Inc., El Segundo, California	
DEVELOPMENT OF THE KINEMATIC FOCAL ISOLATION SYSTEM FOR HELICOPTER ROTORS	263
R. W. Balke, Bell Helicopter Company, Fort Worth, Texas	
A TOOL FOR PARAMETRIC ANALYSIS OF COMPLEX ISOLATION SYSTEMS	285
P. J. Jones and F. A. Smith, Martin Marietta Corporation, Denver, Colorado	
AN ACTIVE STABILIZATION SYSTEM FOR VEHICLES AND OTHER MASSIVE BODIES	317
T. H. Putman, Westinghouse Research Laboratories, Pittsburgh, Pennsylvania	
CRASH CONSIDERATIONS IN THE DESIGN OF THE NEW YORK STATE SAFETY SEDAN . . .	325
S. Davis and N. B. Nissel, Fairchild Hiller, Republic Aviation Division, Farmingdale, L.I., New York	

Bulletin 39

Part I

AN INTRODUCTION TO THE BASIC SHOCK PROBLEM	1
F. Weinberger and R. Heise, Jr., Naval Ship Research and Development Center, Washington, D.C.	
DESIGN INPUT DERIVATION AND VALIDATION	13
R. O. Belsheim, G. J. O'Hara and R. L. Bort, Naval Research Laboratory, Washington, D.C.	
SHOCK DESIGN OF NAVAL BOILERS	25
D. M. Gray, Combustion Engineering, Inc., Windsor, Connecticut	

MACHINERY DESIGN FOR SHIPBOARD UNDERWATER SHOCK	33
G. W. Bishop, Bishop Engineering Company, Princeton, New Jersey	
SHOCK DESIGN OF SHIPBOARD STRUCTURES	39
R. J. Della Rocca and N. R. Addonizio, Gibbs and Cox, Inc., New York, New York	
REVIEW AND APPROVAL OF DYNAMIC ANALYSIS	45
M. J. Macy and L. A. Gordon, Supervisor of Shipbuilding, Conversion and Repair, USN, Brooklyn, New York	
COMPUTER AIDED DESIGN - ANALYSIS FOR SHIPBOARD UNDERWATER SHOCK . . .	55
M. Pakstys, Jr., General Dynamics, Electric Boat Division, Groton, Connecticut	
CURRENT NAVY SHOCK HARDENING REQUIREMENTS AND POLICY.	65
J. R. Sullivan, H. H. Ward and D. M. Lund, Department of the Navy, Naval Ship Systems Command Headquarters, Washington, D.C.	
SHOCK DESIGN AND TEST QUALIFICATION OF SHIPBOARD SYSTEMS/ COMPONENTS—PANEL SESSION	77
*HARDENING OF SURFACE SHIPS AND SUBMARINES FOR ADVANCED SEA- BASED DETERRENCE	93
H. L. Rich, Naval Ship Research and Development Center, Washington, D.C.	
TOWARD A MORE RATIONAL BLAST-HARDENED DECKHOUSE DESIGN	107
Shou-ling Wang, Naval Ship Research and Development Center, Washington, D.C.	
COMPUTATION OF THE MOBILITY PROPERTIES OF A UNIFORM BEAM FOUNDATION.	123
J. E. Smith and R. J. Harners, Naval Ship Research and Development Center, Annapolis, Maryland	
AN ANALYTICAL INVESTIGATION OF THE DAMPING OF RADIAL VIBRATIONS OF A PIPE BY CONSTRAINED VISCOELASTIC LAYERS USING AXIAL STAVES . . .	143
R. A. DiTaranto, PMC Colleges, Chester, Pennsylvania, and W. Blasingame, Naval Ship Research and Development Center, Annapolis, Maryland	
*DAMPED CYLINDRICAL SHELLS AND DYNAMIC SYSTEMS EFFECTS	155
B. E. Douglas and E. V. Thomas, Naval Ship Research and Development Center, Annapolis, Maryland	
APPLICATION OF SPACED DAMPING TO MACHINERY FOUNDATIONS	167
J. R. Hupton, General Dynamics, Electric Boat Division, Groton, Connecticut, H. T. Miller and G. E. Warnaka, Lord Manufacturing Company, Erie, Pennsylvania	
*ROCKET SLED TESTS OF THE AGM-12 "BULLPUP" MISSILE	175
Robert D. Kimsey, Naval Missile Center, Point Mugu, California	
AIM-4D FLIGHT MEASUREMENT PROGRAM	195
R. P. Mandich and W. G. Spalthoff, Hughes Aircraft Company, Canoga Park, California	
*AEROELASTIC ANALYSIS OF A FLEXIBLE RE-ENTRY VEHICLE	223
H. Saunders and A. Kirsch, General Electric Company, Re-Entry Systems Department, Philadelphia, Pennsylvania	

*This paper not presented at Symposium.

Bulletin 39

Part II

Vibration

ELECTRICAL GENERATION OF MOTION IN ELASTOMERS	1
S. Edelman, S. C. Roth and L. R. Grisham, National Bureau of Standards, Washington, D.C.	
CONTROLLED DECELERATION SPECIMEN PROTECTION SYSTEMS FOR ELECTRODYNAMIC VIBRATION SYSTEMS	11
Lawrence L. Cook, Jr., NASA Goddard Space Flight Center, Greenbelt, Maryland	
CONTROL TECHNIQUES FOR SIMULTANEOUS THREE-DEGREE-OF-FREEDOM HYDRAULIC VIBRATION SYSTEM	23
H. D. Cyphers and J. F. Sutton, NASA Goddard Space Flight Center, Greenbelt, Maryland	
*INITIAL REPORT ON EQUIVALENT DAMAGE MEASUREMENT BY UTILIZING S/N FATIGUE GAGES	35
Thomas B. Cost, Naval Weapons Center, China Lake, California	
HOLOGRAM INTERFEROMETRY AS A PRACTICAL VIBRATION MEASUREMENT TECHNIQUE	41
Cameron D. Johnson and Gerald M. Mayer, Navy Underwater Sound Laboratory, Fort Trumbull, New London, Connecticut	
RESPONSE OF AN ELASTIC STRUCTURE INVOLVING CROSS CORRELATIONS BETWEEN TWO RANDOMLY VARYING EXCITATION FORCES	51
A. Razziano, Grumman Aircraft Engineering Corporation, Bethpage, New York, and J. R. Curreni, Polytechnic Institute of Brooklyn, Brooklyn, New York	
AUTOMATIC NORMALIZATION OF STRUCTURAL MODE SHAPES	63
C. C. Isaacson and R. W. Merkel, Engineering Laboratories, McDonnell Aircraft Company, St. Louis, Missouri	
*RESONANT BEAM HIGH "G" VIBRATION TESTING	71
B. A. Kohler, International Business Machines Corporation, Federal Systems Division, Owego, New York	
THE USE OF LIQUID SQUEEZE-FILMS TO SUPPORT VIBRATING LOADS	77
Brantley R. Hanks, NASA Langley Research Center, Langley Station, Hampton, Virginia	
POINT-TO-POINT CORRELATION OF SOUND PRESSURES IN REVERBERATION CHAMBERS	87
Charles T. Morrow, LTV Research Center, Western Division, Anaheim, California	
ENVIRONMENTAL LABORATORY MISSILE FAILURE RATE TEST WITH AERODYNAMIC FUNCTION SIMULATION	99
Raymond C. Binder and Gerald E. Berge, Naval Missile Center, Point Mugu, California	
APOLLO CSM DYNAMIC TEST PROGRAM	105
A. E. Chirby, R. A. Stevens and W. R. Wood, Jr., North American Rockwell Corporation, Downey, California	
MODAL SURVEY RESULTS FROM THE MARINER MARS 1969 SPACECRAFT	123
R. E. Freeland, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, and W. J. Gaugh, Northrop Systems Laboratories, Northrop Corporation, Hawthorne, California	

*This paper not presented at Symposium.

UPRATED SATURN I FULL SCALE DYNAMIC TEST CORRELATION	135
Charles R. Wells and John E. Hord, Chrysler Corporation Space Division, New Orleans, Louisiana	
AN APPROACH FOR DUPLICATING SPACECRAFT FLIGHT-INDUCED BODY FORCES IN A LABORATORY	147
S. M. Kaplan and A. J. Soroka, General Electric Company, Philadelphia, Pennsylvania	
FLEXURE GUIDES FOR VIBRATION TESTING	157
Alexander Yorgiadis and Stanley Barrett, North American Rockwell Corporation, Downey, California	
A COMPRESSION-FASTENED GENERAL-PURPOSE VIBRATION AND SHOCK FIXTURE	175
Warren C. Beecher, Instrument Division, Lear Siegler, Inc., Grand Rapids, Michigan	
VIBRATION EQUIVALENCE: FACT OR FICTION?	187
LaVerne Root, Collins Radio Company, Cedar Rapids, Iowa	
PROVIDING REALISTIC VIBRATION TEST ENVIRONMENTS TO TACTICAL GUIDED MISSILES	195
K. R. Jackman and H. L. Holt, General Dynamics, Pomona, California	
*THE REDUCTION OF THE VIBRATION LEVEL OF A CIRCULAR SHAFT MOVING TRANSVERSELY THROUGH WATER AT THE CRITICAL REYNOLDS NUMBER	217
Irvin F. Gerks, Honeywell Inc., Seattle, Washington	
*ANALYSIS AND DESIGN OF RESONANT FIXTURES TO AMPLIFY VIBRATOR OUTPUT	221
J. Verga, Hazeltine Corporation, Little Neck, New York	

Bulletin 39

Part III

Structural Analysis

MODAL DENSITIES OF SANDWICH PANELS: THEORY AND EXPERIMENT.	1
Larry L. Erickson, NASA Ames Research Center, Moffett Field, California	
TURBINE ENGINE DYNAMIC COMPATIBILITY WITH HELICOPTER AIRFRAMES	17
Kenneth C. Mard and Paul W. von Hardenberg, Sikorsky Aircraft Division of United Aircraft Corporation, Stratford, Connecticut	
SYNTHESIS OF RIGID FRAMES BASED ON DYNAMIC CRITERIA	31
Henry N. Christiansen, Associate Professor, Department of Civil Engineering Science, Brigham Young University, Provo, Utah, and E. Alan Pettit, Jr., Engineer, Humble Oil Company, Benicia, California	
DYNAMIC RESPONSE OF PLASTIC AND METAL SPIDER BEAMS FOR 1/9TH SCALE SATURN MODEL	39
L. V. Kulasa, KPA Computer Techniques, Inc., Pittsburgh, Pennsylvania, and W. M. Laird, University of New York, Fredonia, New York	
*CHARTS FOR ESTIMATING THE EFFECT OF SHEAR DEFORMATION AND ROTARY INERTIA ON THE NATURAL FREQUENCIES OF UNIFORM BEAMS.	49
F. F. Rudder, Jr., Aerospace Sciences Research Laboratory, Lockheed-Georgia Company, Marietta, Georgia	

*This paper not presented at Symposium.

ACOUSTIC RESPONSE ANALYSIS OF LARGE STRUCTURES	55
F. A. Smith, Martin Marietta Corporation, Denver Division, Denver, Colorado, and R. E. Jewell, NASA Marshall Space Flight Center, Huntsville, Alabama	
*ESTIMATION OF PROBABILITY OF STRUCTURAL DAMAGE FROM COMBINED BLAST AND FINITE-DURATION ACOUSTIC LOADING	65
Eric E. Ungar and Yoram Kadman, Bolt Beranek and Newman Inc., Cambridge, Massachusetts	
*THE RESPONSE OF MECHANICAL SYSTEMS TO BANDS OF RANDOM EXCITATION	73
L. J. Pulgrano and M. Ablowitz, Grumman Aircraft Engineering Corporation, Bethpage, New York	
*PREDICTION OF STRESS AND FATIGUE LIFE OF ACOUSTICALLY-EXCITED AIRCRAFT STRUCTURES	87
Noe Arcas, Grumman Aircraft Engineering Corporation, Bethpage, New York	
VIBRATION ANALYSIS OF COMPLEX STRUCTURAL SYSTEMS BY MODAL SUBSTITUTION	99
R. L. Bajan, C. C. Feng, University of Colorado, Boulder, Colorado, and I. J. Jaszlics, Martin Marietta Corporation, Denver, Colorado	
THE APPLICATION OF THE KENNEDY-PANCU METHOD TO EXPERIMENTAL VIBRATION STUDIES OF COMPLEX SHELL STRUCTURES	107
John D. Ray, Charles W. Bert and Davis M. Egle, School of Aerospace and Mechanical Engineering, University of Oklahoma, Norman, Oklahoma	
*NORMAL MODE STRUCTURAL ANALYSIS CALCULATIONS VERSUS RESULTS	117
Culver J. Floyd, Raytheon Company, Submarine Signal Division, Portsmouth, Rhode Island	
COMPARISONS OF CONSISTENT MASS MATRIX SCHEMES	129
R. M. Mains, Department of Civil and Environmental Engineering, Washington University, St. Louis, Missouri	
MEASUREMENT OF A STRUCTURE'S MODAL EFFECTIVE MASS	143
G. J. O'Hara and G. M. Remmers, Naval Research Laboratory, Washington, D.C.	
SIMPLIFYING A LUMPED PARAMETER MODEL	153
Martin T. Soifer and Arlen W. Bell, Dynamic Science, a Division of Marshall Industries, Monrovia, California	
STEADY STATE BEHAVIOR OF TWO DEGREE OF FREEDOM NONLINEAR SYSTEMS . .	151
J. A. Padovan and J. R. Curreri, Polytechnic Institute of Brooklyn, Brooklyn, New York, and M. B. Electronics, New Haven, Connecticut	
THE FLUTTER OR GALLOPING OF CERTAIN STRUCTURES IN A FLUID STREAM	171
Raymond C. Binder, University of Southern California, Los Angeles, California	
*AIRCRAFT LANDING GEAR BRAKE SQUEAL AND STRUT CHATTER INVESTIGATION . .	179
F. A. Biehl, McDonnell Douglas Corporation, Long Beach, California	
EXPERIMENTAL INVESTIGATION OF NONLINEAR VIBRATIONS OF LAMINATED ANISOTROPIC PANELS	191
Bryon L. Mayberry and Charles W. Bert, School of Aerospace and Mechanical Engineering, University of Oklahoma, Norman, Oklahoma	
*STRUCTURAL DYNAMICS ANALYSIS OF AN ANISOTROPIC MATERIAL	201
S. K. Lee, General Electric Company, Syracuse, New York	
*EXPERIMENTS ON THE LARGE AMPLITUDE PARAMETRIC RESPONSE OF RECTANGULAR PLATES UNDER IN-PLANE RANDOM LOADS	205
R. L. Silver and J. H. Somerset, Department of Mechanical and Aerospace Engineering, Syracuse University, Syracuse, New York	

*This paper not presented at Symposium.

*RESPONSE OF STIFFENED PLATES TO MOVING SPRUNG MASS LOADS	233
Ganpat M. Singhvi, Schutte Mochon, Inc., Milwaukee, Wisconsin, and Larry J. Feeser, University of Colorado, Boulder, Colorado	
*PARAMETRIC RESPONSE SPECTRA FOR IMPERFECT COLUMNS	247
Martin L. Moody, University of Colorado, Boulder, Colorado	

Bulletin 39

Part IV

Damping

*APPLICATION OF A SINGLE-PARTICLE IMPACT DAMPER TO AN ANTENNA STRUCTURE	1
R. D. Rocke, Hughes Aircraft Company, Fullerton, California, and S. F. Masri, University of Southern California, Los Angeles, California	
A PROPOSED EXPERIMENTAL METHOD FOR ACCURATE MEASUREMENTS OF THE DYNAMIC PROPERTIES OF VISCOELASTIC MATERIALS	11
Kenneth G. McConnell, Associate Professor of Engineering Mechanics, Iowa State University, Ames, Iowa	
DAMPING OF BLADE-LIKE STRUCTURES	19
David I. G. Jones, Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio, and Ahid D. Nashif, University of Dayton, Dayton, Ohio	
MULTI-LAYER ALTERNATELY ANCHORED TREATMENT FOR DAMPING OF SKIN-STRINGER STRUCTURES	31
Captain D. R. Simmons, Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio, J. P. Henderson, D. I. G. Jones, Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio, and C. M. Cannon, University of Dayton, Dayton, Ohio	
AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF A TWO-LAYER DAMPING TREATMENT	53
A. D. Nashif, University of Dayton, Dayton, Ohio, and T. Nicholas, Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio	
DAMPING OF PLATE VIBRATIONS BY MEANS OF ATTACHED VISCOELASTIC MATERIAL	63
I. W. Jones, Applied Technology Associates, Inc., Ramsey, New Jersey	
VIBRATIONS OF SANDWICH PLATES WITH ORTHOTROPIC FACES AND CORES	73
Fakhruddin Abdulhadi, Reliability Engineering, IBM Systems Development Division, Rochester, Minnesota, and Lee P. Sapetta, Department of Mechanical Engineering, University of Minnesota, Minneapolis, Minnesota	
THE NATURAL MODES OF VIBRATION OF BORON-EPOXY PLATES	81
J. E. Ashton and J. D. Anderson, General Dynamics, Fort Worth, Texas	
NATURAL MODES OF FREE-FREE ANISOTROPIC PLATES	93
J. E. Ashton, General Dynamics, Fort Worth, Texas	
ACOUSTIC TEST OF BORON FIBER REINFORCED COMPOSITE PANELS CONDUCTED IN THE AIR FORCE FLIGHT DYNAMICS LABORATORY'S SONIC FATIGUE TEST FACILITY	101
Carl L. Rupert, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio	

*This paper not presented at Symposium.

STRENGTH CHARACTERISTICS OF JOINTS INCORPORATING VISCOELASTIC MATERIALS	117
W. L. LaBarge and M. D. Lamoree, Lockheed-California Company, Burbank, California	

Isolation

RECENT ADVANCES IN ELECTROHYDRAULIC VIBRATION ISOLATION	141
Jerome E. Ruzicka and Dale W. Schubert, Barry Controls, Division of Barry Wright Corporation, Watertown, Massachusetts	
ACTIVE ISOLATION OF HUMAN SUBJECTS FROM SEVERE AIRCRAFT DYNAMIC ENVIRONMENTS	157
Peter C. Calcaterra and Dale W. Schubert, Barry Controls, Division of Barry Wright Corporation, Watertown, Massachusetts	
ELASTIC SKIDMOUNTS FOR MOBILE EQUIPMENT SHELTERS	179
R. W. Doil and R. L. Laier, Barry Controls, Division Barry Wright Corporation, Burbank, California	
COMPUTER-AIDED DESIGN OF OPTIMUM SHOCK-ISOLATION SYSTEMS	185
E. Sevin, W. D. Pilkey and A. J. Kalinowski, IIT Research Institute, Chicago, Illinois	
ANALYTIC INVESTIGATION OF BELOWGROUND SHOCK-ISOLATING SYSTEMS SUBJECTED TO DYNAMIC DISTURBANCES	199
J. Neils Thompson, Ervin S. Perry and Suresh C. Arya, The University of Texas at Austin, Austin, Texas	
GAS DYNAMICS OF ANNULAR CONFIGURED SHOCK MOUNTS	213
W. F. Andersen, Westinghouse Electric Corporation, Sunnyvale, California	
A SCALE MODEL STUDY OF CRASH ENERGY DISSIPATING VEHICLE STRUCTURES	227
F. J. Bozich and G. C. Kao, Research Staff, Wyle Laboratories, Huntsville, Alabama	
DESIGN OF RECOIL ADAPTERS FOR ARMAMENT SYSTEMS	251
A. S. Whitehill and T. L. Quinn, Lord Manufacturing Company, Erie, Pennsylvania	
*A DYNAMIC VIBRATION ABSORBER FOR TRANSIENTS	261
Dirse W. Sallet, University of Maryland, College Park, Maryland and Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland	

Bulletin 39

Part V

Shock

DYNAMIC RESPONSE OF A SINGLE-DEGREE-OF-FREEDOM ELASTIC-PLASTIC SYSTEM SUBJECTED TO A SAWTOOTH PULSE	1
Martin Wohltmann, Structures and Mechanics Department, Martin Marietta Corporation, Orlando, Florida	
*TRANSIENT DYNAMIC RESPONSES IN ELASTIC MEDIUM GENERATED BY SUDDENLY APPLIED FORCE	13
Dr. James Chi-Dian Go, The Boeing Company, Seattle, Washington	
IMPACT FAILURE CRITERION FOR CYLINDRICAL AND SPHERICAL SHELLS	21
Donald F. Haskell, Hittman Associates, Inc., Columbia, Maryland	

*This paper not presented at Symposium.

*THE EXCITATION OF SPHERICAL OBJECTS BY THE PASSAGE OF PRESSURE WAVES	29
Gordon E. Strickland, J., Lockheed Missiles and Space Company, Palo Alto, California	
THE PERFORMANCE CHARACTERISTICS OF CONCENTRATED-CHARGE, EXPLOSIVE-DRIVEN SHOCK TUBES	41
L. W. Bickle and M. G. Vigil, Sandia Laboratories, Albuquerque, New Mexico	
*PRIMACORD EXPLOSIVE-DRIVEN SHOCK TUBES AND BLAST WAVE PARAMETERS IN AIR, SULFURHEXAFLUORIDE AND OCTOFLUOROCYCLOBUTANE (FREON-C318)	53
M. G. Vigil, Sandia Laboratories, Albuquerque, New Mexico	
ZERO IMPEDANCE SHOCK TESTS, A CASE FOR SPECIFYING THE MACHINE	63
Charles T. Morrow, LTV Research Center, Western Division, Anaheim, California	
SHOCK TESTING WITH AN ELECTRODYNAMIC EXCITER AND WAVEFORM SYNTHESIZER	67
Dana A. Regillo, Massachusetts Institute of Technology, Lincoln Laboratory, Lexington, Massachusetts	
SLINGSHOT SHOCK TESTING	73
LaVerne Rust and Carl Bohs, Collins Radio Company, Cedar Rapids, Iowa	
SHOCK TESTING AND ANALYSIS: A NEW LABORATORY TECHNIQUE	83
J. Fagan and J. Sincavage, RCA Astro-Electronics Division, Princeton, New Jersey	
*INSTRUMENTATION FOR A HUMAN OCCUPANT SIMULATION SYSTEM	89
W. I. Kipp, Monterey Research Laboratory, Inc., Monterey, California	

Bulletin 39

Part VI

Introductory Papers

THE IMPACT OF A DYNAMIC ENVIRONMENT ON FIELD EXPERIMENTATION	1
Walter W. Hollis, U.S. Army Combat Development Command, Experimentation Command, Fort Ord, California	
TRANSCRIPT OF PANEL DISCUSSION ON PROPOSED USASI STANDARD ON METHODS FOR ANALYSIS AND PRESENTATION OF SHOCK AND VIBRATION DATA	7
Julius S. Bendat, Measurement Analysis Corporation, Los Angeles, California, and Allen J. Curtis, Hughes Aircraft Corporation, Culver City, California	

Transportation and Packaging

THE BUMP TESTING OF MILITARY SIGNALS EQUIPMENT IN THE UNITED KINGDOM	15
W. Chiids, Signals Research and Development Establishment, Ministry of Technology, United Kingdom	
LABS SHIPPING HAZARDS RECORDER STATUS AND FUTURE PLANS	19
Dennis J. O'Sullivan, Jr., U.S. Army Natick Laboratories, Natick, Massachusetts	

*This paper not presented at Symposium.

NORMAL AND ABNORMAL DYNAMIC ENVIRONMENTS ENCOUNTERED IN TRUCK TRANSPORTATION	31
J. T. Foley, Sandia Laboratories, Albuquerque, New Mexico	
DEVELOPMENT OF A RAILROAD ROUGHNESS INDEXING AND SIMULATION PROCEDURE	47
L. J. Pursifull and B. E. Prothro, U.S. Army Transportation Engineering Agency, Military Traffic Management and Terminal Service, Fort Eustis, Virginia	
AN APPROXIMATE METHOD OF DYNAMIC ANALYSIS FOR MISSILE CONTAINER SYSTEMS	57
Mario Paz, Associate Professor, and Ergin Citipitioglu, Associate Professor, University of Louisville, Louisville, Kentucky	
SIMULATED MECHANICAL IMPACT TEST EQUIPMENT	65
D. R. Agnew, Naval Air Development Center, Johnsville, Warminster, Pennsylvania	

Environmental Measurements

SUCCESS AND FAILURE WITH PREDICTION AND SIMULATION OF AIRCRAFT VIBRATION	77
A. J. Curtis and N. G. Tinling, Hughes Aircraft Company, Culver City, California	
PHOENIX ENVIRONMENTAL MEASUREMENTS IN F-111B WEAPONS BAY	93
T. M. Kiwior, R. P. Mandich and R. J. Oedy, Hughes Aircraft Company, Canoga Park, California	
LUNAR ORBITER FLIGHT VIBRATIONS WITH COMPARISONS TO FLIGHT ACCEPTANCE REQUIREMENTS AND PREDICTIONS BASED ON A NEW GENERALIZED REGRESSION ANALYSIS	119
S. A. Clevenson, NASA Langley Research Center, Langley Station, Hampton, Virginia	
VIBRATION AND ACOUSTIC ENVIRONMENT CHARACTERISTICS OF THE SATURN V LAUNCH VEHICLE	133
Clark J. Beck, Jr. and Donald W. Caba, The Boeing Company, Huntsville, Alabama	
THE BLAST FIELD ABOUT THE MUZZLE OF GUNS	139
Peter S. Westine, Southwest Research Institute, San Antonio Texas	
SPECIFICATIONS: A VIEW FROM THE MIDDLE	151
T. B. Delchamps, Bell Telephone Laboratories, Inc., Whippany, New Jersey	

SUPPLEMENT

SHOCK AND VIBRATION CHARACTERISTICS OF AN ADVANCED HYPERSONIC MISSILE INTERCEPTOR	1
George Foteo and William H. Roberts, Structures and Mechanics Department, Martin Marietta Corporation, Orlando, Florida	
VIBRACOUSTIC ENVIRONMENT AND TEST CRITERIA FOR AIRCRAFT STORES DURING CAPTIVE FLIGHT	15
J. F. Dreher, Air Force Flight Dynamics Laboratory; E. D. Lakin, Aeronautical Systems Division, and E. A. Tolle, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio	
SPECTRUM DIP IN SUBMARINE UNDERWATER SHOCK	41
R. J. Scavuzzo, The University of Toledo, Toledo, Ohio	
*DESIGN AND VIBRATION ANALYSIS OF A NAVAL SHIP PROPULSION SYSTEM WITH A DIGITAL COMPUTER	55
Stephen T. W. Liang, Naval Ship Research and Development Center, Washington, D.C.	

*This paper not presented at Symposium.

Bulletin 40

Part I

EFFECT OF EQUIPMENT MASS ON THE SHOCK MOTIONS OF DECKS.	1
E. A. Thornton, Naval Ship Research and Development Center, Portsmouth, Virginia	
CORRELATION OF A RESULTANT VELOCITY CHANGE TO AN UNDERWATER EXPLOSION FORCING-FUNCTION	9
W. F. Peete, Jr., Naval Undersea Research and Development Center, Pasadena, California	
PREDICTION OF THE TRANSIENT RESPONSE OF A CYLINDRICAL ELASTIC SHELL TO SPHERICAL UNDERWATER SHOCK WAVES BY THE ACOUSTIC WAVE-SHELL INTERACTION THEORY.	15
H. Huang and Y. F. Wang, Naval Ship Research and Development Laboratory, Annapolis, Maryland	
STRUCTURAL EVALUATION OF SHIPBOARD WEAPON SYSTEMS—NSRDC PARTICIPATION IN OPERATION PRAIRIE FLAT	31
L. R. Hill, Jr., Naval Ship Research and Development Center, Washington, D.C.	
THE RESPONSE OF WHIP ANTENNAS TO AIR BLAST	45
W. E. Gilbert, Naval Ship Research and Development Center, Washington, D.C.	
SHOCK LOADING AND RESPONSE OF HELICOPTER STRUCTURES DUE TO WEAPON BLAST.	61
P. A. Cox, W. E. Baker, S. Silverman, and P. S. Westine, Southwest Research Institute, San Antonio, Texas	
THE RESPONSE OF LONG WIRE ROPE ANTENNAS TO AIR BLAST	75

Bulletin 40

Part II

Shock

AN EXPERIMENTAL APPROACH TO UNDERSTANDING SHOCK RESPONSE	1
M. W. Oleson, Naval Research Laboratory, Washington, D. C.	
EXPLOSIVE SHOCK	21
W. H. Roberts, Martin Marietta Corporation, Orlando, Florida	
MODAL VELOCITY AS A CRITERION OF SHOCK SEVERITY.	31
H. A. Gaberson, Naval Civil Engineering Laboratory, Pt. Hueneme, California, and R. H. Chalmers, Naval Electronics Laboratory Center, San Diego, California	
THE SIMULTANEOUS APPLICATION OF TRANSIENT AND STEADY STATE DYNAMIC EXCITATIONS IN A COMBINED ENVIRONMENT TEST FACILITY SIMULATING SHIPBOARD ENVIRONMENTS	51
T. B. Jones, Jr., Hughes Aircraft Company, Fullerton, California	

*PERIODIC SHOCK EXCITATION OF ELASTIC STRUCTURES	57
D. Krajcinovic, Ingersoll-Rand Research Inc., Princeton, New Jersey, and G. Herrmann, Northwestern University, Evanston, Illinois	
SHOCK ANALYSIS OF FLUID SYSTEMS USING ACOUSTIC IMPEDANCE AND THE FOURIER TRANSFORM: APPLICATION TO WATERHAMMER PHENOMENA	67
A. A. Winquist, Norton AFB, San Bernardino, California, and R. C. Binder, University of Southern California, Los Angeles, California	
DRAG ON FREE FLIGHT CYLINDERS IN A BLAST WAVE.	83
S. B. Mellaen, Defense Research Establishment Suffield, Alberta, Canada	
ANALYTICAL AND EXPERIMENTAL RESULTS OF LATTICE TYPE STRUCTURES SUBJECTED TO A BLAST LOADING	101
R. Geminder, Mechanics Research, Inc., Los Angeles, California	
*LATERAL RESPONSE OF SLIGHTLY CURVED COLUMNS UNDER LONGITUDINAL PULSE LOAD	115
T. L. Anderson, University of Idaho, Moscow, Idaho, and M. L. Moody, University of Colorado, Denver, Colorado	
RESPONSES OF AIRCRAFT STRUCTURES SUBJECTED TO BLAST LOADING	123
N. M. Isada, R. K. Koegler and D. O. Bliven, Cornell Aeronautical Laboratory, Inc., Buffalo, New York	
PREDICTION OF BLAST-VALVE RESPONSE USING MODELS	133
R. G. McCoy, G. Nevrincean and E. F. Witt, Bell Telephone Laboratories, Whippany, New Jersey	
*TESTING THE RESPONSE OF GAS TURBINES TO AIR BLAST	147
J. C. Muirhead, R. Naylor and C. G. Coffey, Defense Research Establishment Suffield, Alberta, Canada	
TRANSIENT WAVEFORM CONTROL OF ELECTROMAGNETIC VIBRATION TEST EQUIPMENT.	157
J. D. Favour and J. M. LeBrun, The Boeing Company, Seattle, Washington, and J. P. Young, NASA Goddard Space Flight Center, Greenbelt, Maryland	
AN IMPROVED ELECTRODYNAMIC SHAKER SHOCK TECHNIQUE	173
J. R. Moser and D. Garner, Texas Instruments Inc., Dallas, Texas	
PROTUBERANCE EFFECTS ON LIMITER-EQUIPPED HARD LANDING PAYLOADS	183
J. L. McCarty and J. T. Howlett, NASA Langley Research Center, Hampton, Virginia	
IMPACT TESTS OF NUCLEAR FUEL MATRICES USING A VACUUM TUBE LAUNCHER	193
H. W. Nunez, Sandia Corporation, Albuquerque, New Mexico	
DEVELOPMENT OF 100,000 G TEST FACILITY	205
R. L. Bell, Endevco Corporation, Pasadena, California	
*ON THE INTERPRETATION AND APPLICATION OF SHOCK TEST RESULTS IN ENGINEERING DESIGNS	215
Chi-Hung Mok, General Electric Company, Philadelphia, Pennsylvania	

*This paper not presented at Symposium.

METHODS OF COMPUTING STRUCTURAL RESPONSE OF HELICOPTERS TO WEAPONS' MUZZLE AND BREECH BLAST	227
W. E. Baker, S. Silverman, P. A. Cox, Jr., and D. Young, Southwest Research Institute, San Antonio, Texas	

SHOCK TESTING FOR EQUIPMENT IN PROTECTIVE STRUCTURES	243
M. M. Dembo and C. C. Huang, U. S. Army Engineer Division, Huntsville, Alabama	

Bulletin 40

Part III

Vibration

ANALYSIS OF RANDOM RESPONSES FOR CALCULATION OF FATIGUE DAMAGE	1
C. C. Osgood, RCA Astro-Electronics Division, Princeton, New Jersey	
VIBRATION TRENDS ANALYSIS	9
A. Y. Edelberg, The Boeing Company, Washington, D. C.	
THE RADIATION RESISTANCE OF CYLINDRICAL SHELLS EXHIBITING AXISYMMETRIC MODE SHAPES	23
C. J. Runkle, Chertstrand Research Center, Durham, North Carolina, and F. D. Hart, North Carolina State University, Raleigh, North Carolina	
MODAL SENSITIVITY STUDY OF A CONICAL REENTRY VEHICLE TO AERODYNAMICALLY INDUCED ACOUSTIC LOADING	31
L. E. Champ and J. K. Merchant, General Electric Company, Philadelphia, Pennsylvania	
ACOUSTIC RESPONSE OF A SPACECRAFT SOLAR PANEL USING NORMAL MODE METHOD	49
A. Stroeve, TRW Systems Group, Redondo Beach, California	
COMPUTER PROGRAMS FOR PREDICTION OF STRUCTURAL VIBRATIONS DUE TO FLUCTUATING PRESSURE ENVIRONMENTS	57
T. N. Lee and W. L. Swanson, Chrysler Corporation Space Division, Huntsville, Alabama	
MODAL DENSITIES OF SPHERICAL SHELLS	69
H. Kunieda, NASA Ames Research Center, Moffett Field, California	
PREDICTION OF INTERFACE RANDOM AND TRANSIENT ENVIRONMENTS THROUGH THE USE OF MECHANICAL IMPEDANCE CONCEPTS	79
G. K. Jones and F. J. On, NASA Goddard Space Flight Center, Greenbelt, Maryland	
*FACTORS OF SAFETY FOR UNMANNED SPACECRAFT STRUCTURES	89
S. M. Kaplan, General Electric Company, Philadelphia, Pennsylvania	
*RESPONSE OF RECTANGULAR PLATES TO MOVING LOADS BY A FINITE ELEMENT PROCEDURE	99
S. K. Damle, University of Baroda, Baroda, India, and L. J. Feiser, University of Colorado, Boulder, Colorado	

*This paper not presented at Symposium.

*VIBRATORY RESPONSE OF PRINTED CIRCUIT BOARDS	111
N. M. Isada, State University of New York, Buffalo, New York, and J. C. Shear, Eastman Kodak Company, Rochester, New York	
*NONLINEAR PARAMETRIC RESPONSE OF PLATES UNDER RANDOM LOADS	119
T. P. Shyu and J. H. Somerset, Syracuse University, Syracuse, New York	
*VIBRATION OF CELLULAR CYLINDRICAL SHELLS	131
M. C. Patel, Brown Engineering Company, Huntsville, Alabama, and S. I. Hayek, Pennsylvania State University, University Park, Pennsylvania	
*ANALYSIS OF SINUSOIDAL AND RANDOM VIBRATION ENERGIES	139
J. N. Tait, Naval Air Development Center, Johnsville, Pennsylvania	
APOLLO LUNAR MODULE VIBRATIONS DURING FLIGHT AND GROUND TESTS	163
W. D. Dorland and J. D. Johnston, Jr., NASA Manned Spacecraft Center, Houston, Texas	
STRUCTURAL QUALIFICATION OF THE ORBITING ASTRONOMICAL OBSERVATORY . .	179
W. B. Keegan, NASA Goddard Space Flight Center, Greenbelt, Maryland	
THE ENVIRONMENTAL TESTING OF EXPLOSIVE STORES IN THE UNITED KINGDOM	193
C. Higham, Ordnance Board, London England, and D. A. E. Carter, Environmental Test Center, Foulness, England	
A UNIQUE MODEL, SUSPENSION, AND EXCITATION SYSTEM FOR LAUNCH VEHICLE DYNAMICS STUDIES	205
J. Pearson and B. J. Gambucci, NASA Ames Research Center, Moffett Field, California	
LOAD APPLICATION AND CONTROL SYSTEMS UTILIZED TO SIMULATE COMBINED LOADS ENVIRONMENT FOR SATURN V - APOLLO SPACECRAFT	211
G. D. Shipway, Wyle Laboratories, Norco, California	
IMPEDANCE SIMULATION VIBRATION TEST FIXTURES FOR SPACECRAFT TESTS . . .	231
T. D. Scharton, Bolt Beranek and Newman Inc., Van Nuys, California	
VIBRATION ANALYSIS OF AN INERTIAL REFERENCE UNIT	257
B. M. Ishino, Autonetics, Anaheim, California	
*PULSED-RANDOM VIBRATION TESTING	267
H. L. Stewart, McDonnell Aircraft Company, St. Louis, Missouri	
*AXIAL RESPONSE OF A HIGH-SPEED, GAS-LUBRICATED, ROTOR-BEARING ASSEMBLY TO SHOCK AND VIBRATION	275
P. R. Spencer and P. W. Curwen, Mechanical Technology, Inc., Latham, New York, and H. B. Tryon, NASA Lewis Research Center, Cleveland, Ohio	
MULTI-ENVIRONMENT TEST SYSTEM FOR SEQUENTIAL TIMERS	297
V. G. Ames, U. S. Army Frankford Arsenal, Philadelphia, Pennsylvania	
*ON THE SELF EXCITED VIBRATIONS OF A CIRCULAR CYLINDER IN UNIFORM FLOW	303
D. W. Sallet, University of Maryland, College Park, Maryland	

*This paper not presented at Composium.

Bulletin 40

Part IV

Dynamics

FURTHER COMPARISONS OF CONSISTENT MASS MATRIX SCHEMES	1
R. M. Mains, Washington University, St. Louis, Missouri	
SHOCK SPECTRA FOR STATISTICALLY MODELLED STRUCTURES	17
R. H. Lyon, Bolt Beranek and Newman Inc., Cambridge, Massachusetts	
REVIEW OF MODAL SYNTHESIS TECHNIQUES AND A NEW APPROACH	25
S. Hou, Bellcomm, Inc., Washington, D. C.	
ROTATING ELEMENTS IN THE DIRECT STIFFNESS METHOD OF DYNAMIC ANALYSIS WITH EXTENSIONS TO COMPUTER GRAPHICS	41
M. E. Novak, The Boeing Company, Vertol Division, Philadelphia, Pennsylvania	
DYNAMIC RESPONSE OF BEAMS TO MOVING PRESSURE LOADS AS RELATED TO TRACKED AIR CUSHION VEHICLES	47
J. F. Wilson, Duke University, Durham, North Carolina	
*THE DESIGN OF A STRUCTURAL MEMBER ANALYSIS PROGRAM FOR AN INTERACTIVE COMPUTER SYSTEM	63
W. D. Pilkey, University of Virginia, Charlottesville, Virginia, and R. Nielsen and M. Steier, COM/CODE Corporation, Washington, D. C.	
*DYNAMIC RESPONSE OF A SINGLE-DEGREE-OF-FREEDOM ELASTIC-PLASTIC SYSTEM SUBJECTED TO A HALF SINE PULSE	67
M. Wohltmann, Martin Marietta Corporation, Orlando, Florida	
*PROPAGATION OF YIELDING IN A BILINEAR HYSTERETIC BEAM AND DISTRIBUTED FOUNDATION UNDER DYNAMIC PULSE LOADING	81
J. R. Mays, University of Colorado, Denver, Colorado	
PLASTIC MODELS FOR DYNAMIC STRUCTURAL ANALYSIS	89
W. A. Elliott, Chevrolet Division, GMC, Detroit, Michigan	
OPTIMUM DESIGN OF ELECTRONIC EQUIPMENT	97
L. W. Root, Collins Radio Company, Cedar Rapids, Iowa	
MODEL STUDIES TO DETERMINE LOW-FREQUENCY NOISE REDUCTION OF SPACECRAFT	103
A. W. Mueller, NASA Langley Research Center, Hampton, Virginia	
*COMBUSTION INSTABILITY TESTS OF THE SATURN IB FIRST STAGE	109
W. S. Parker, Chrysler Corporation, New Orleans, Louisiana	
DYNAMIC ANALYSIS OF A HIGH-SPEED LINKLESS AMMUNITION CONVEYOR SYSTEM	115
C. B. Basye and B. R. Scheller, Emerson Electric Company, St. Louis, Missouri	
STRESS WAVES IN MULTILAYERED CYLINDERS AND CONICAL FRUSTUMS	127
J. C. S. Yang and A. F. Seigel, Naval Ordnance Laboratory, Silver Spring, Maryland	

*This paper not presented at Symposium

CAVITY EFFECT ON PANEL FLUTTER - JUST HOW SIGNIFICANT?	139
N. H. Zimmerman and C. E. Lemley, McDonnell Aircraft Company, St. Louis, Missouri	
AN EIGENVALUE PROBLEM SOLUTION OF A THREE-DIMENSIONAL PIPING SYSTEM	147
P. Bezler, Brookhaven National Laboratory, Upton, New York, and J. R. Curreri, Polytechnic Institute of Brooklyn, Brooklyn, New York	
DESIGN MODEL BASED ON OBSERVED MODES OF VIBRATION OF AUSTRALIAN CSIRO 210-FT RADIO TELESCOPE	155
J. A. Macinante, CSIRO, National Standards Laboratory, Sydney, Australia	
UPPER AND LOWER BOUNDS TO TORSIONAL FREQUENCIES OF NONUNIFORM SHAFTS AND APPLICATIONS TO MISSILES	163
N. Rubinstein, V. G. Sigillito and J. T. Stadter, Applied Physics Laboratory, JHU, Silver Spring, Maryland	
*DETERMINATION OF DYNAMIC LOADS AND RESPONSE OF A SPACE VEHICLE USING FLIGHT DATA	171
S. Hou, Bellcomm, Inc., Washington, D. C.	
*STIFFNESS MATRIX OF A BEAM-COLUMN INCLUDING SHEAR DEFORMATION	187
H. Saunders, General Electric Company, Philadelphia, Pennsylvania	
*LIQUID-STRUCTURE COUPLING IN CURVED PIPES	197
L. C. Davidson and J. E. Smith, Naval Ship Research and Development Laboratory, Annapolis, Maryland	
*DISTRIBUTION OF EIGENVALUES IN CONICAL SHELLS	209
D. K. Miller and F. D. Hart, North Carolina State University, Raleigh, North Carolina	
*DYNAMIC RESPONSE OF STRUCTURAL SHIELD TO A TRAVELING PRESSURE PULSE	217
A. M. Rodriguez and P. N. Mathur, Aerospace Corporation, San Bernardino, California	
*ANALYSIS OF THE RELATIVE MOTION OF THE PEM MOD-IV TETHERED CANISTER AND THE ATLAS BOOSTER	225
T. L. Alley, Aerospace Corporation, San Bernardino, California	

Bulletin 40

Part V

Damping and Isolation

REDUCTION OF VIBRATIONS IN AEROSPACE STRUCTURES BY ADDITIVE DAMPING	1
D. I. G. Jones and J. P. Henderson, Air Force Materials Laboratory, Wright- Patterson AFB, Ohio, and A. D. Nashif, University of Dayton, Dayton, Ohio	
VIBRATION ISOLATION WITH NONLINEAR DAMPING	19
J. E. Ruzicka and T. F. Derby, Barry Controls, Watertown, Massachusetts	

*This paper not presented at Symposium.

THE CONTROL OF VIBRATIONS WITH VISCOELASTIC MATERIALS	37
P. Grootenhuis, Imperial College of Science and Technology, London, England	
SONIC FATIGUE RESISTANCE OF STRUCTURES INCORPORATING A CONSTRAINED VISCOELASTIC CORE	49
M. D. Lamoree and W. L. LaBarge, Lockheed-California Company, Burbank, California	
EXPERIMENTS ON INELASTIC DAMPING OF SPACE VEHICLE DUCTS	61
G. E. Bowie, W. A. Compton and J. V. Long, Solar Division of International Harvester Company, San Diego, California	
TRANSVERSE VIBRATIONS OF LAMINATED PLATES WITH VISCOELASTIC LAYER DAMPING	93
F. Abdulhadi, IBM Corporation, Rochester, Minnesota	
COMPARISON OF THE GEIGER THICK PLATE TEST AND THE VIBRATING COMPOSITE BEAM TEST FOR THE EVALUATION OF THE EFFECTIVENESS OF VIBRATION DAMPING MATERIALS	105
D. R. Blenner, Lord Manufacturing Company, Erie, Pennsylvania, and T. J. Dudek, General Tire and Rubber Company, Akron, Ohio	
AN AEROSPACE ENERGY ABSORBER APPLIED TO HIGHWAY SAFETY	115
W. E. Woolam, Southwest Research Institute, San Antonio, Texas	
*DETERMINATION OF THE COMPLEX MOBILITY AND IMPEDANCE MATRICES FOR DAMPED LUMPED PARAMETER LINEAR DYNAMIC SYSTEMS.	135
J. J. Engblom, Hughes Aircraft Company, Culver City, California	
'WAGGING TAIL' VIBRATION ABSORBER	147
R. G. Barclay and P. W. Humphrey, NASA Goddard Space Flight Center, Greenbelt, Maryland	
A SIMPLE DEVICE FOR ATTENUATION OF LONGITUDINAL ELASTIC STRESS WAVES	157
J. P. O'Neill and C. J. Tirman, TRW Systems Group, Redondo Beach, California	
ANALYSIS OF SHOCK MITIGATION FOR GLASS SUBMERSIBLES	175
J. C. S. Yang, Naval Ordnance Laboratory, Silver Spring, Maryland	
REDUCTION IN VIBRATION OF THE CH-47C HELICOPTER USING A VARIABLE TUNING VIBRATION ABSORBER	191
J. J. O'Leary, The Boeing Company, Philadelphia, Pennsylvania	
RESPONSE AND OPTIMIZATION OF AN ISOLATION SYSTEM WITH RELAXATION TYPE DAMPING	203
T. F. Derby and P. C. Calcaterra, Barry Controls, Watertown, Massachusetts	
THE RESPONSE OF MECHANICAL SHOCK ISOLATION ELEMENTS TO HIGH RATE INPUT LOADING	217
R. L. Eshleman and P. N. Rao, IIT Research Institute, Chicago, Illinois	
RATIONAL ANALYSIS OF A TWO-DEGREE-OF-FREEDOM FLEXURE-TORSION SYSTEM FOR REDUCTION OF CERTAIN TYPES OF FLUTTER	235
M. J. Kleip, North American Rockwell Corporation, Los Angeles, California, and R. C. Binder, University of Southern California Los Angeles, California	

*This paper not presented at Symposium.

DESIGN AND DEVELOPMENT OF A SHOCK ISOLATION EVALUATION SYSTEM FOR HIGH RATE INPUT LOADING	245
P. N. Rao and K. E. Hofer, IIT Research Institute, Chicago, Illinois	
*A STUDY OF AMPLITUDE FREQUENCY PLOTS WITH NONLINEAR DAMPING	261
G. F. Brammeler, Brown Engineering Company, Huntsville, Alabama	
VIBRATIONS OF MULTICORE SANDWICH BEAMS	277
V. P. Roske, Jr., Air Force Missile Development Center, Holloman AFB, New Mexico, and C. W. Bert, University of Oklahoma, Norman, Oklahoma	
*THE USE OF POLYURETHANE FOAM FOR SHOCK AND VIBRATION ISOLATION OF AVIONICS COMPONENTS	285
W. E. Arthur and T. Carrell, North American Rockwell Corporation, Los Angeles, California, and J. Nirschl, U. S. Army Electronics Command, Ft. Monmouth, New Jersey	
*THE ANALYTIC MODELING OF OPEN-CELL FOAMS AS SHOCK AND VIBRATION ELEMENTS	291
T. Liber, IIT Research Institute, Chicago, Illinois, and H. Epstein, University of Minnesota, Minneapolis, Minnesota	

Bulletin 40

Part VI

Transportation

SIMULATION OF DYNAMIC LOADS ON EJECTED MISSILES	1
C. R. Perry, The Boeing Company, Seattle, Washington	
WIND TUNNEL SIMULATION OF FLIGHT VIBRATION AND ACOUSTIC LEVELS ON AN EXTERNAL STORE	9
K. A. Herzing and S. N. Schwantes, Honeywell Inc., Hopkins, Minnesota	
A METHOD TO SIMULATE GUNFIRE INDUCED VIBRATION ENVIRONMENT	27
J. A. Hutchinson and R. N. Hancock, LTV Aerospace Corporation, Dallas, Texas	
THE SHOCK AND VIBRATION EXPERIENCED BY NAVAL AVIONICS DURING ARRESTED LANDING	37
V. M. Foxwell, Jr., Westinghouse Aerospace Division, Baltimore, Maryland	
A SURVEY OF PRACTICAL PROBLEMS ENCOUNTERED IN REPRODUCING THE CAPTIVE FLIGHT ENVIRONMENT BY MEANS OF SHAKERS AND SHOCK TEST MACHINES	61
W. Tustin, Tustin Institute of Technology, Inc., Santa Barbara, California	
STANDARD ARM CAPTIVE CARRY LIFE EXPECTANCY PREDICTION AND VIBRATION QUALIFICATION TESTING	67
B. N. Downing, General Dynamics Corporation, Pomona, California	
RAILROAD TRANSPORTABILITY CRITERIA	85
R. Kennedy, U. S. Army Transportation Engineering Agency, Ft. Eustis, Virginia	

*This paper not presented at Symposium.

MEASURED VIBRATION RIDE ENVIRONMENTS OF A STOL AIRCRAFT AND A HIGH-SPEED TRAIN	91
J. J. Catherines, NASA Langley Research Center, Hampton, Virginia	
THRESHOLD-TYPE RECORDERS	99
L. J. Pursifull, U. S. Army Transportation Engineering Agency, Ft. Eustis, Virginia	
RAIL VEHICLE DYNAMIC STUDIES	109
J. L. Sewall, R. V. Parrish and B. J. Durling, NASA Langley Research Center, Hampton, Virginia	
A PROCEDURE FOR DETERMINING DAMAGE BOUNDARIES	127
J. W. Goff and S. R. Pierce, Michigan State University, School of Packaging, East Lansing, Michigan	
EVALUATION OF A FRAGILITY TEST METHOD AND SOME PROPOSALS FOR SIMPLIFIED METHODS	133
E. H. Schell, Shock and Vibration Information Center, Washington, D. C.	
PANEL DISCUSSION ON FRAGILITY	153

Bulletin 40

Part VII

Instrumentation and Data Analysis

THE RESPONSE OF TRANSDUCERS TO THEIR ENVIRONMENT: THE PROBLEM OF SIGNAL AND NOISE	1
P. K. Stein, Arizona State University, Tempe, Arizona	
A SIMPLIFIED METHOD FOR MEASURING STATIC AND DYNAMIC DISPLACEMENT OF VIBRATING SYSTEMS	17
P. T. JaQuay, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio	
INSTRUMENTATION FOR MEASUREMENT OF VIBRATORY MOTION AND MECHANICAL IMPEDANCE WITHIN ASSEMBLED AEROSPACE EQUIPMENT	29
C. T. Morrow, LTV Research Center, Anaheim, California	
APPLICATIONS OF HOLOGRAPHY TO HIGH-FREQUENCY VIBRATIONS AND TRANSIENT RESPONSE	33
R. Apvahamian and D. A. Evensen, TRW Systems Group, Redondo Beach, California	
LOW-FREQUENCY PORTABLE VIBRATION MEASURING AND RECORDING SYSTEM	45
S. A. Clevenson, D. J. Martin and A. C. Dibble, NASA Langley Research Center, Hampton, Virginia	
MEASUREMENT OF THE TOTAL STRUCTURAL MOBILITY MATRIX	51
J. E. Smith, Naval Ship Research and Development Laboratory, Annapolis, Maryland	

*DEVELOPMENT OF A SMALL TRANSMITTER FOR HIGH INTENSITY SHOCK ENVIRONMENT	85
E. L. Kirkley, Radiation Inc., Melbourne, Florida	
PREDICTABLE SHOCK PULSE BY MODIFIED FOURIER TRANSFORMS	93
C. W. Young, Johnson-Williams Division, Bacharach Instrument Company, Mountain View, California	
ON-LINE COMPUTER APPLICATIONS FOR THE APOLLO 'SHORT-STACK' COMBINED ENVIRONMENTS TEST PROGRAM	99
D. J. Bozich, Wyle Laboratories, Huntsville, Alabama	
DYNAMIC DATA ANALYSIS SYSTEM	115
M. O. Michellich, The Boeing Company, Seattle, Washington	
*A DYNAMIC DATA COMPENSATION TECHNIQUE FOR SEISMIC TRANSDUCERS	123
G. L. Schulz and W. E. Baker, University of New Mexico, Albuquerque, New Mexico	
AIR DAMPED HIGH-G ACCELEROMETER AND WIDE BAND VELOCIMETER FOR SHOCK STUDY IN FREE MASS UNDER SEVERE AIR BLAST	133
Y. T. Li and S. Y. Lee, Massachusetts Institute of Technology, Cambridge, Massachusetts	
<u>Ship Shock</u>	
A SURVEY OF THE INFORMATION NEEDS OF INDUSTRY IN DESIGNING TO MEET NAVY SHIPBOARD SHOCK REQUIREMENTS	141
H. C. Pusey, Shock and Vibration Information Center, Washington, D. C.	
A CONVERSATIONAL TIME SHARING COMPUTER PROGRAM FOR DYNAMIC SHOCK ANALYSIS	153
B. A. Bott, General Electric Company, Groton, Connecticut, and R. G. Gauthier, General Dynamics Corporation, Groton, Connecticut	
CRITERIA FOR MODE SELECTION IN THE DDAM PROCEDURE	165
M. Pakstys, Jr., General Dynamics Corporation, Groton, Connecticut	
APPLICATION OF PERTURBATION TECHNIQUES TO THE NAVY'S DYNAMIC DESIGN ANALYSIS METHOD	177
J. T. Higney, Gibbs & Cox, Inc., New York, New York	
AN ANALYSIS OF SPECTRUM DIP IN UNDERWATER SHOCK	185
R. J. Scavuzzo and D. D. Raftopoulos, The University of Toledo, Toledo, Ohio	
DYNAMIC ANALYSIS OF SUBMERGED SHIP STRUCTURE AND EQUIPMENT	197
D. B. Ehrenpreis, David Ehrenpreis Consulting Engineers, New York, New York	
DYNAMIC BEHAVIOR OF PARTIALLY CONSTRAINED SHIP GRILLAGES	207
C. S. Smith, Naval Construction Research Establishment, Dunfermline, Fife, Scotland, and D. Faulkner, British Navy Staff, Washington, D. C.	
*AN ENVIRONMENTAL VIBRATION RECORDER	225
R. E. Schauer and W. P. Foster, Naval Ship Research and Development Center, Washington, D. C.	

*This paper not presented at Symposium.

*2K SYSTEM APPROACH FOR VIBRATION AND SHOCK PROTECTION FOR SHIPBOARD EQUIPMENTS	233
C. M. Salerno, Barry Controls, Watertown, Massachusetts	
*PORTABLE INSTRUMENTS FOR USE IN CONNECTION WITH SHIPBOARD VIBRATION CODES	243
R. K. Brown and A. Hagen, Naval Ship Research and Development Center, Washington, D. C.	

SUPPLEMENT

RIGID AND RESILIENT SHIPBOARD PIPING SYSTEMS: WHAT CONSTITUTES ACCEPTABLE SHOCK PERFORMANCE/QUALIFICATION?	1
D. M. C. Hurt, Naval Ship Engineering Center, Hyattsville, Maryland	
DAMPING VALUES OF NAVAL SHIPS OBTAINED FROM IMPULSE LOADINGS	7
W. P. Foster and H. F. Alma, Naval Ship Research and Development Center, Washington, D. C.	
CATAPULT-EXCITED MAST-ISLAND VIBRATION ON AN AIRCRAFT CARRIER	13
A. Hagen and K. McConnell, Naval Ship Research and Development Center, Washington, D. C.	
COMPRESSED-AIR LAUNCHERS	21
H. M. Cole, Naval Ordnance Laboratory, Silver Spring, Maryland	
EQUIPMENT CABINET MOUNTING FOR SHIPBOARD SHOCK	29
P. V. Roberts, Raytheon Company, Bedford, Massachusetts, and A. Smith, Canadian Naval Engineering Test Establishment, Montreal, Canada	
RESPONSE OF THE LOW SPEED FAE AND HELICOPTER TRAP WEAPONS (HTW) TO CAPTIVE-FLIGHT VIBRATION	47
W. W. Parmenter, Naval Weapons Center, China Lake, California	
RESPONSE OF TIAS MECHANICAL MODEL DURING LABORATORY SINE AND RANDOM VIBRATION COMPARED TO INFLIGHT AND VIBROACOUSTIC RESPONSES	63
P. Bouclin and L. G. Janetzko, Naval Weapons Center, China Lake, California	
PANEL DISCUSSION ON CAPTIVE FLIGHT DESIGN AND TEST CRITERIA	83

Bulletin 41
Part I

CASC (CAPTIVE AIR SPACE CRAFT) - A POSSIBLE CONCEPT FOR RIVERINE BOAT DESIGN	1
V. H. Van Bluser, Naval Ship Research and Development Laboratory, Panama City, Florida, and N. Elmore, Naval Ship Research and Development Center, Portsmouth, Va.	
PROBLEMS OF DAMPING THE WINDOW AREAS OF SONAR DOMES	13
Howard N. Phelps, Jr., Naval Underwater Systems Center, New London, Connecticut	

*This paper not presented at Symposium.

APPLICATION OF THE FINITE ELEMENT METHOD TO THE SHOCK AND SONAR TRANSDUCERS	21
Vincent D. Godino and George A. Ziegler, General Dynamics/Electric Groton, Connecticut	
DYNAMIC RESPONSE OF ABOVE-GROUND TARGETS TO A BLAST WAVE	35
P. N. Mathur, D. M. Rogers, R. H. Lee, and J. W. Murdock, The Aerospace Corporation, San Bernardino, California	

Bulletin 41

Part II

Keynote Talk

THE DYNAMIC CENTURY	1
D. Zonars, Air Force Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio	

Physiological Effects

TESTING AND MODELING STANDING MAN'S RESPONSE TO IMPACT	5
Joseph Gesswein and Paul Corrao, Naval Ship Research and Development Center, Washington, D.C.	
EQUAL ANNOYANCE CONTOURS FOR THE EFFECT OF SINUSOIDAL VIBRATION ON MAN	13
C. Ashley, Mechanical Engineering Department, University of Birmingham, England	

Isolation

ISOLATION FROM MECHANICAL SHOCK WITH A MOUNTING SYSTEM HAVING NONLINEAR DUAL-PHASE DAMPING	21
J. C. Snowdon, Ordnance Research Laboratory, The Pennsylvania State University, University Park, Pennsylvania	
INTERACTIVE OPTIMAL DESIGN OF SHOCK ISOLATION SYSTEMS	47
W. D. Pilkey, University of Virginia, Charlottesville, Virginia	
DESIGN OF HIGH-PERFORMANCE SHOCK ISOLATION SYSTEMS	53
Ronald L. Eshleman, IIT Research Institute, Chicago, Illinois	
ELASTIC WAVE PROPAGATION IN A HELICAL COIL WITH VARYING CURVATURE AND ITS APPLICATION AS AN IMPACT LOAD DISPERSER	77
Nam P. Suh, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts	
ANALYSIS OF THE INVERTING TUBE ENERGY ABSORBER	89
J. M. Alcone, Sandia Laboratories, Livermore, California	
THE EFFECTS OF PAYLOAD PENETRATION AND VARIOUS ANALYTICAL MODELS ON THE DESIGN OF A SPHERICAL CRUSHABLE CASING FOR LANDING ENERGY ABSORPTION	95
Robert W. Warner and Margaret Covert, NASA Ames Research Center	

Damping

EFFECT OF FREE LAYER DAMPING ON RESPONSE OF STIFFENED PLATE STRUCTURES	105
David I. G. Jones, Air Force Materials Laboratory, Wright-Patterson AFB, Ohio	
VIBRATION CONTROL BY A MULTIPLE-LAYERED DAMPING TREATMENT	121
A. D. Nashif, University of Dayton Research Institute, Dayton, Ohio and T. Nicholas, Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio	
DETERMINATION OF DAMPING PROPERTIES OF SOFT VISCOELASTIC MATERIALS	133
Fakhruddin Abdulhadi, IBM General Systems Division, Rochester, Minnesota	
IMPROVING RELIABILITY AND ELIMINATING MAINTENANCE WITH ELASTOMERIC DAMPERS FOR ROTOR SYSTEMS	141
J. L. Potter, Lord Manufacturing Company, Erie, Pennsylvania	
EFFECT OF HIGH POLYMER ADDITIVES ON DIFFUSER FLOW NOISE	151
B. M. Ishino, California State College, Fullerton, California and R. C. Binder, University of Southern California, Los Angeles, California	
HAWK SUSPENSION SYSTEM PERFORMANCE ON M754 TRACKED VEHICLE	159
Paul V. Roberts, Raytheon Company, Missile Systems Division, Bedford, Massachusetts	

Bulletin 41

Part III

Instrumentation

A PRACTICAL APPLICATION OF ACCELEROMETER CALIBRATIONS	1
R. R. Bouche, Endevco, Dynamic Instrument Division, Pasadena, California	
DESIGNING AN INSTRUMENTED TEST EGG FOR DETECTING IMPACT BREAKAGE	11
William L. Shupe, USDA, Agricultural Research Service, Transportation and Facilities Research Div., University of California, Davis, California and Robert M. Lake, Mayo Clinic, Rochester, Minnesota	
AN ACCELEROMETER DESIGN USING FERROFLUID ULTRASONIC INTERFEROMETRY	17
Jack G. Parks, U.S. Army Tank-Automotive Command, Warren, Michigan	
HYBRID TECHNIQUES FOR MODAL SURVEY CONTROL AND DATA APPRAISAL	25
Robert A. Salyer, TRW Systems, Inc., Redondo Beach, California	
OBJECTIVE CRITERIA FOR COMPARISON OF RANDOM VIBRATION ENVIRONMENTS	43
F. F. Kazmierczak, Lockheed Missiles and Space Company, Sunnyvale, California	
THE APPLICATION OF ANALOG TECHNIQUES TO REAL TIME ANALYSIS AND SCREENING OF DYNAMIC DATA	55
Roger C. Crites, McDonnell Aircraft Co., St. Louis, Mo.	
SHOCK LOADING AND HOLOGRAPHIC INTERFEROMETRY IN NDT	63
R. L. Johnson, R. Aprahamian and P. G. Bhuta, TRW Systems Group, Redondo Beach, California	

Data Analysis

A NEW SYNTHESIS TECHNIQUE FOR SHOCK SPECTRUM ANALYSIS	75
William G. Pollard, Spectral Dynamics Corporation of San Diego, San Diego, California	
THE ROLE OF LATENT INFORMATION IN INFORMATION PROCESSING IN MEASURING SYSTEMS.	81
Peter K. Stein, Arizona State University, Tempe, Arizona	

Test Facilities

USBR VIBRATION TEST SYSTEM.	109
R. M. McCafferty, U.S. Bureau of Reclamation, Denver, Colorado	
MULTI-DEGREE OF FREEDOM MOTION SIMULATOR SYSTEMS FOR TRANSPORTATION ENVIRONMENTS.	119
T. K. DeClue, R. A. Arone and C. E. Deckard, Wy'e Laboratories, Huntsville, Alabama	
DESIGN AND FABRICATION OF AN AIRCRAFT SEAT CRASH SIMULATOR	133
Nelson M. Isada, State University of New York at Buffalo, Buffalo, New York	
DESCRIPTION OF A SHOCK AND VIBRATION DISPLACEMENT AMPLIFIER	149
D. Cerasuolo and J. Chin, Raytheon Company, Sudbury, Massachusetts	
ARTILLERY SIMULATOR FOR FUZE EVALUATION.	155
H. D. Curchack, Harry Diamond Laboratories, Washington, D.C.	
GAS SPRING FIRING AND THE SOFT RECOVERY OF A HARD-WIRE INSTRUMENTED 155 MM PROJECTILE.	175
S. L. Fluent, Heat, Plasma, Climatic, Towers Division, Sandia Laboratories, Albuquerque, New Mexico	
FULL-SCALE RECOIL MECHANISM SIMULATOR (FORCED FLUID FLOW THROUGH A CONCENTRIC ORIFICE).	87
W. J. Courtney, IIT Research Institute, Chicago, Illinois and R. Rossmiller and R. Reade, U.S. Army Weapons Command, Rock Island, Illinois	
ISOTOPE FUEL IMPACT FACILITY	195
Larry O. Seamon, Sandia Laboratories, Albuquerque, New Mexico	
A REVERBERATION CHAMBER FOR USE AT REDUCED PRESSURES	207
M. H. Hieken, J. N. Olson, and G. W. Olmsted, McDonnell Aircraft Company, St. Louis, Missouri	
DESIGN OF AN OFF ROAD VEHICLE MOTION SIMULATOR	215
Nelson M. Isada, Cornell Aeronautical Laboratory, Inc., and State University of New York at Buffalo, Buffalo, New York and Robert C. Sugarman, and E. Donald Sussman, Cornell Aeronautical Laboratory, Inc., Buffalo, New York	
AN AERIAL CABLE TEST FACILITY USING ROCKET POWER	223
C. G. Coalson, Sandia Laboratories, Albuquerque, New Mexico	

Bulletin 41

Part IV

Vibration

SURVEY OF SPACE VEHICLE VIBRATION ANALYSIS AND TEST TECHNIQUES	1
W. Henricks, R. J. Herzberg, B. G. Wrenn, Lockheed Missiles and Space Company, Sunnyvale, California	
METHODS USED TO REALISTICALLY SIMULATE VIBRATION ENVIRONMENTS	29
J. V. Otts, Centrifuge, Vibration, and Acoustics Division, Sandia Laboratories, Albuquerque, New Mexico	
SIMULATION OF COMPLEX-WAVE PERIODIC VIBRATION	37
A. J. Curtis, H. T. Abstein, Jr., and N. G. Tinling, Hughes Aircraft Company, Culver City, California	
RATIONALES APPLYING TO VIBRATION FOR MAINTENANCE.	51
A. H. Grunig, Canadian Forces Headquarters, Ottawa, Canada	
SPECIFICATION OF SINE VIBRATION TEST LEVELS USING A FORCE-ACCELERATION PRODUCT TECHNIQUE	69
A. F. Witte, Vibration and Acoustics Test Division Sandia Laboratories, Albuquerque, New Mexico	
SOME EFFECTS OF EQUALIZATION WITH A SINGLE MASS VS AN ELASTIC SYSTEM ON ACCELERATIONS AND STRESSES	79
R. M. Mains, Washington University	
A METHOD FOR PREDICTING STRUCTURAL RESPONSES FROM LOWER LEVEL ACOUSTIC TESTS	87
D. O. Smallwood, Centrifuge, Vibration, Acoustics Division, Sandia Laboratories, Albuquerque, New Mexico	
SWEEP SPEED EFFECTS IN RESONANT SYSTEMS	95
Ronald V. Trull, USAF, 4750th Test Squadron, Tyndall AFB, Florida	
THE DYNAMIC RESPONSE OF A STEEL EYEBAR CHAIN SUSPENSION BRIDGE OVER THE OHIO RIVER TO VARIOUS EXCITATIONS	99
R. F. Varney, J. G. Viner, Federal Highway Administration, Department of Transportation, Washington, D.C.	
DUAL SPECIFICATIONS IN RANDOM VIBRATION TESTING, AN APPLICATION OF MECHANICAL IMPEDANCE.	109
A. F. Witte, Vibration and Acoustics Test Division, Sandia Laboratories, Albuquerque, New Mexico and R. Rodeman, Applied Mechanics Division, Sandia Laboratories, Albuquerque, New Mexico	
VIBRATION - A DIAGNOSTIC TOOL FOR SHOCK DESIGN	119
Culver J. Floyd, Raytheon Company, Submarine Signal Division, Portsmouth, Rhode Island	
THE RESONANT RESPONSE OF A MECHANICAL SYSTEM SUBJECTED TO LOG ARITHMICALLY SWEEPED AND NOTCHED BASE EXCITATION, USING ASYMPTOTIC EXPANSION	127
B. N. Agrawal, COMSAT Laboratories, Clarksburg, Maryland	

EFFECTS OF FLIGHT CONDITIONS UPON GUNFIRE INDUCED VIBRATION ENVIRONMENT	133
J. A. Hutchinson and B. G. Musson, LTV Aerospace Corporation, Vought Aeronautics Division, Dallas, Texas	
THE BOX CAR DYNAMIC ENVIRONMENT	141
Robert W. Luebke, C and O/B and O Railroad Companies, Baltimore, Maryland	
THE NOISE ENVIRONMENT OF A DEFLECTED-JET VTOL AIRCRAFT	161
S. L. McFarland and D. L. Smith, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio	
VIBRATION SIGNATURE ANALYSIS OF BEARINGS AND ELECTRONIC PACKAGES	173
Charles H. Roos, General Electric Company, Aerospace Electronic Systems, Utica, New York	
OUTER LOOP CONTROL FOR VIBRATION TESTING	183
Gordon Lester, Perkin-Elmer Corporation, Danbury, Connecticut and James Gay Helmuth, Chadwick-Helmuth Company, Inc., Monrovia, California	
EMPIRICAL PREDICTION OF MISSILE FLIGHT RANDOM VIBRATION	189
A. E. Kartman, The Bendix Corporation, Mishawaka, Indiana	
STRUCTURAL VIBRATIONS IN THE BELL AH-1G HELICOPTER DURING WEAPON FIRING	195
R. Holland, Kinetic Systems, Inc., Boston, Massachusetts and D. Marcus and J. Wiland, U.S. Army Frankford Arsenal, Philadelphia, Pennsylvania	
CHARACTERISTICS OF GUNFIRE INDUCED VIBRATION IN HELICOPTERS	209
C. E. Thomas and V. C. McIntosh, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio	
INFLIGHT VIBRATION AND NOISE STU L OF THREE HELICOPTERS	221
Phyllis G. Bolds and John T. Ach, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio	

Bulletin 41

Part V

Shock

A DISCUSSION OF PYROTECHNIC SHOCK CRITERIA	1
M. B. McGrath, Martin Marietta Corporation, Denver, Colorado	
A SUMMARY OF PYROTECHNIC SHOCK IN THE AEROSPACE INDUSTRY	9
W. P. Rader, Martin Marietta Corporation, Denver, Colorado and William F. Bangs, Goddard Space Flight Center, Greenbelt, Maryland	
MEASURES OF BLAST WAVE DAMAGE POTENTIAL	17
C. T. Morrow, LTV Research Center, Western Division, Anaheim, California	
SHOCK RESPONSE OF A BILINEAR, HYSTERETIC BEAM AND SUPPORT SYSTEM	27
Bruce E. Burton, Ohio Northern University and Robert S. Ayre, University of Colorado, Boulder, Colorado	

DIGITAL FOURIER ANALYSIS OF MECHANICAL SHOCK DATA.	39
H. A. Gaberson, and D. Pal, Naval Civil Engineering Laboratory, Port Hueneme, California	
THE COMPUTER DETERMINATION OF MECHANICAL IMPEDANCE FOR SMALL ARMS FROM THE RESPONSE TO RECOIL	53
L. B. Gardner, R. K. Young, and D. E. Frericks, U.S. Army Weapons Command, Rock Island, Illinois	
SHOCK PULSE SHAPING USING DROP TEST TECHNIQUES	59
R. E. Keeffe and E. A. Bathke, Kaman Sciences Corporation, Colorado Springs, Colorado	
ANALYSIS OF PROJECTILE IMPACT ON COMPOSITE ARMOR	69
Richard A. Fine, IBM Corporation, Rochester, Minnesota and Raymond R. Hagglund, Worcester Polytechnic Institute, Worcester, Massachusetts	
A SYSTEMATIC APPROACH TO SHOCK HARDENING	77
J. L. Lipeles, Littleton Research and Engineering Corporation, Littleton, Massachusetts and D. Hoffman, Naval Ammunition Depot, Crane, Indiana	
THE DEVELOPMENT OF SHOCK TEST CRITERIA FOR AIRCRAFT DISPENSER WEAPON EJECTION MECHANISMS	89
K. D. Denton, K. A. Herzing, and S. N. Schwantes, Honeywell, Inc., Ordnance Division, Hopkins, Minnesota	
SHOCK LOAD RESPONSE OF AN ELASTIC ANNULAR PLATE ON A DISTRIBUTED FOUNDATION	101
John R. Mays, Department of Civil and Environmental Engineering, University of Colorado, Denver, Colorado and James E. Nelson, Space Systems Dynamics, Martin Marietta Corporation, Denver, Colorado	
<u>Fragility</u>	
METHODOLOGY AND STANDARDIZATION FOR FRAGILITY EVALUATION.	111
R. C. Rountree, Logicon, San Pedro, California and F. B. Safford, TRW Systems Group, Redondo Beach, California	
CONTROLLING PARAMETERS FOR THE STRUCTURAL FRAGILITY OF LARGE SHOCK ISOLATION SYSTEMS	129
Robert J. Port, Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico	
HARDNESS EVALUATION	135
W. H. Rowan, TRW Systems Group, Redondo Beach, California	
FRAGILITY TESTING FOR HYDRAULIC SURGE EFFECTS.	143
D. M. Eckblad, The Boeing Company, Seattle, Washington and W. L. Hedrick, TRW Systems Group, Redondo Beach, California	
INITIAL DESIGN CONSIDERING STATISTICAL FRAGILITY ASSESSMENT.	155
R. L. Grant, the Boeing Company, Seattle, Washington	
TRANSIENT PULSE DEVELOPMENT	167
J. Crum and R. L. Grant, The Boeing Company, Seattle, Washington	

Bulletin 41

Part VI

Dynamics

PARAMETRIC RESPONSE OF MONOSYMMETRIC IMPERFECT THIN-WALLED COLUMNS UNDER SINUSOIDAL LOADING	1
Stanley G. Ebner, USAF Academy, Colorado and Martin L. Moody, University of Colorado, Denver, Colorado	
PREDICTION OF UPSTAGE RANDOM VIBRATION ENVIRONMENT USING A STATISTICAL ENERGY APPROACH	9
D. E. Hines, G. R. Parker, and R. D. Hellweg, McDonnell Douglas Astronautics Company-West, Santa Monica, California	
ON THE REDUCTION AND PREVENTION OF THE FLUID-INDUCED VIBRATIONS OF CIRCULAR CYLINDERS OF FINITE LENGTH.	31
Dirse W. Sallet, Department of Mechanical Engineering, University of Maryland College Park, Maryland and U.S. Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland	
EFFECTS OF LOOSENESS ON DYNAMIC BEHAVIOR.	39
R. E. Beckett, K. C. Pan, U.S. Army Weapons Command, Rock Island, Illinois and D. D. Penrod, The University of Iowa, Iowa City, Iowa	
DYNAMIC DEFLECTIONS OF MULTIPLE-SPAN GUIDEWAYS UNDER HIGH SPEED, AIR CUSHION VEHICLES.	47
James F. Wilson, Duke University, Durham, North Carolina	
ANALYSIS OF THE MOTION OF A LONG WIRE TOWED FROM AN ORBITING AIRCRAFT	61
S. A. Crist, Department of Engineering Mechanics, USAF Academy, Colorado	
A POSTSHOT STUDY OF THE DYNAMIC RESPONSE OF THE LASL MOBILE TOWER DURING THE PLIERS EVENT	75
R. E. Bachman, E. F. Smith, Holmes and Narver, Inc., Las Vegas, Nevada and R. P. Kennedy, Holmes and Narver, Inc., Los Angeles, California	
BOUNDS FOR THE RESPONSE OF A CONSERVATIVE SYSTEM UNDER DYNAMIC LOADING	87
H. Brauchli, The University of Alabama in Huntsville, Huntsville, Alabama	
THREE DEGREE OF FREEDOM SPRING MASS EJECTION SYSTEM	93
R. Muskat, Aerospace Corporation, San Bernardino, California	
STRUCTURAL DYNAMICS OF A PARABOLOIDAL ANTENNA	103
Myron L. Gossard and William B. Halle, Jr., Lockheed Missiles and Space Company, Sunnyvale, California	
AN APPLICATION OF COMPONENT MODE SYNTHESIS TO ROCKET MOTOR VIBRATION ANALYSIS	115
F. R. Jensen, Hercules Inc., and H. N. Christiansen, Brigham Young University	
COMPARISON OF CONSISTENT AND LUMPED MASS MATRIX SOLUTIONS WITH THE EXACT SOLUTION FOR A SIMPLY-SUPPORTED TIMOSHENKO BEAM	123
C. Baum, J. T. Higney, Gibbs and Cox, Inc., New York, New York and A. Jenks, Tso International Inc., New York, New York	

APPLICATION OF APPROXIMATE TRANSMISSION MATRICES TO DESCRIBE TRANSVERSE BEAM VIBRATIONS	133
R. D. Rocke and Ranjit Roy, University of Missouri-Rolla, Rolla, Missouri	
MEASUREMENT OF MOMENT-CURVATURE RELATIONSHIP FOR STEEL BEAMS	147
V. H. Neubert and W. Vogel, The Pennsylvania State University, University Park, Pennsylvania	
SELF-SYNCHRONIZATION OF TWO ECCENTRIC ROTORS ON A BODY IN PLANE MOTION	159
Mario Paz, Associate Professor, University of Louisville, Louisville, Kentucky	
PROPAGATION OF THE ERROR IN COMPUTED FREQUENCIES AND MODE SHAPES RESULTING FROM A DISCRETE MASS REPRESENTATION OF UNIFORM, SLENDER BEAMS WITH VARYING HEIGHT-TO-LENGTH RATIOS	163
Francis M. Henderson, Naval Ship Research and Development Center, Washington, D. C.	

Dynamic Stress Analysis

A DISCUSSION ON THE ANALYTICAL DYNAMICS, STRESS, AND DESIGN INTERFACES	179
Irvin P. Vatz, Teledyne Brown Engineering, Huntsville, Alabama	
DYNAMIC STRESS ANALYSIS IN A STRATIFIED MEDIUM	187
Jackson C.S. Yang, Ames Research Center, NASA, Moffett Field, California	
COMPARISON OF STRUCTURAL LOADS: STATIC VERSUS DYNAMIC	197
Paul J. Jones and William J. Kacena, III, Martin Marietta Corporation, Denver, Colorado	
EGGSHELLING AND VIBRATIONS OF A HIGH SPEED SHAFT WITH NASTRAN ANALYSIS	203
Dennis J. Martin and William C. Walton, Jr., NASA Langley Research Center, Hampton, Virginia	
PARAMETRIC STUDY OF A BEAM WITH A COMPOUND SIDE-BRANCH RESONATOR AS A DEVICE TO EVALUATE PRELIMINARY DESIGN LOADS	211
J. Roger Ravenscraft, Teledyne Brown Engineering, Huntsville, Alabama	
RAIL LAUNCHING DYNAMICS OF THE SAM-D SURFACE-TO-AIR MISSILE	219
Martin Wohltmann, Leonard A. Van Gulick, H. Carlton Sutphin, Martin Marietta Corporation, Orlando, Florida	

Bulletin 41

Part VII

Mathematical Analysis

ROCKET-SLED MODEL STUDY OF PREDICTION TECHNIQUES FOR FLUCTUATING PRESSURES AND PANEL RESPONSE	1
Eric E. Ungar, Bolt Beranek and Newman Inc., Cambridge, Massachusetts	
DETERMINATION OF STRUCTURAL PROPERTIES FROM TEST DATA	9
A. E. Galef and D. L. Cronin, TRW Systems Group, Redondo Beach, California	

VALIDITY OF MATHEMATICAL MODELS OF DYNAMIC RESPONSE OF STRUCTURES TO TRANSIENT LOADS	19
Wilfred E. Baker, Southwest Research Institute, San Antonio, Texas	
DYNAMIC RESPONSE OF PLATES WITH CUT-OUTS	29
Nicholas L. Basdekas, Office of Naval Research, Arlington, Virginia and Michael Chi, Catholic University of America, Washington, D. C.	
NATURAL FREQUENCIES AND MODE SHAPES OF PLATES WITH INTERIOR CUT-OUTS	37
Jon Monahan, P. J. Nemergut, USAF Air Force Institute of Technology, G.E. Maddux, Air Force Flight Dynamics Laboratory Wright-Patterson AFB, Ohio	
FINITE BEAM ELEMENTS FOR DYNAMIC ANALYSIS	51
V. H. Neubert, The Pennsylvania State University, State College, Pennsylvania and H. Lee, Westinghouse Research Laboratory, Pittsburgh, Pennsylvania	
EVALUATION OF MODELS FOR ONE-DIMENSIONAL VIBRATION SYSTEMS	61
R. D. Rocke, University of Missouri-Rolla, Rolla, Missouri	
DYNAMIC ELASTOPLASTIC RESPONSE OF GEOMETRICALLY NONLINEAR ARBITRARY SHELLS OF REVOLUTION UNDER IMPULSIVE AND THERMAL LOADINGS	81
T. J. Chung, J. T. Oden, R. L. Eldson, J. F. Jenkins, and A. E. Masters, Research Institute, The University of Alabama in Huntsville, Huntsville, Alabama	
RIGID BODY MOTIONS OF ELASTICALLY RESTRAINED UNDERWATER STRUCTURES FROM DETONATION-INDUCED SHOCK	89
H. S. Zwibel and J. G. Hammer, Naval Civil Engineering Laboratory, Fort Hueneme, California	
EXTENSION OF CLASSICAL BINARY FLUTTER MODEL USING ROOT LOCUS	109
J. C. Hornbuckle, and R. L. Sierakowski, University of Florida, Gainesville Florida	
STIFFNESS AND MASS MATRICES FOR A TRIANGULAR ELEMENT	123
Mario Paz, Associate Professor, Civil Engineering Department, University of Louisville, Louisville, Kentucky and Earl Berry, Jr., Graduate Student, University of Louisville, Louisville, Kentucky	
HELICOPTER FUSELAGE VIBRATION RESPONSE ANALYSIS USING THE HYBRID COMPUTER	131
James D. Cronkhite, Bell Helicopter Company, Fort Worth, Texas	
VIBRATION OF A CLASS OF NONCONSERVATIVE SYSTEMS WITH TIME-DEPENDENT BOUNDARY CONDITIONS	141
Shoel-sheng Chen, Argonne National Laboratory, Argonne, Illinois	
Fluid-Structure Interactions	
A VARIATIONAL APPROACH TO THE FLUID-SHELL DYNAMIC INTERACTION PROBLEM	151
A. S. Benson, Lockheed Missiles and Space Company, Sunnyvale, California	
EQUIVALENT MECHANICAL MODEL OF PROPELLANT FREE-SURFACE VIBRATIONS IN THE SATURN S-IVB WORKSHOP CONFIGURATION	169
Franklin T. Dodge and Luis R. Garza, Southwest Research Institute, San Antonio, Texas	

THE EFFECT OF LIQUID OSCILLATIONS ON THE LM PROPELLANT QUANTITY GAUGE SYSTEM	181
M. Rimer, Grumman Aerospace Corporation, Bethpage, New York and D. G. Stephens, NASA Langley Research Center, Hampton Virginia	
DERIVATION OF SKYLAB PROPELLANT STORAGE MODULE RANDOM VIBRATION ENVIRONMENT	195
A. E. Chirby, R. A. Stevens, H.C. Allen and W.R. Wood, Jr., North American Rockwell Corporation, Space Division, Downey, California	
THE FLUTTER OF A HYDROFOIL	205
Thomas M. Ward, California Institute of Technology, Pasadena, California and Raymond C. Binder, University of Southern California, Los Angeles, California	

SUPPLEMENT

AN AIR PULSER FOR VIBRATION TESTING	1
J. R. Peoples, Naval Ship Research and Development Center, Washington, D.C. and J. G. Viner, Federal Highway Administration, Washington, D. C.,	
STATISTICAL APPROACH TO OPTIMIZE RANDOM VIBRATION TEST SPECTRA	25
David L. Earls and John F. Dreher, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio	
THE EFFECT OF TAILFINS ON THE VIBRACOUSTIC ENVIRONMENT OF EXTERNALLY CARRIED AIRCRAFT STORES	33
John F. Dreher, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio	
THE EFFECTS OF VISCOUS DAMPING ON DYNAMIC LOAD FACTORS FOR SINGLE DEGREE-OF-FREEDOM SYSTEMS	45
Harry Price Gray, Naval Ship Research and Development Center, Washington, D.C.	
THE EFFECT OF CAVITATION ON THE FLAT PLATE HULL UNDERWATER SHOCK MODEL	49
R. J. Scavuzzo, Rensselaer Polytechnic Institute, Hartford Graduate Center, East Windsor Hill, Connecticut, and D. D. Raftopoulos, The University of Toledo, Toledo, Ohio	

Appendix A

Preceding page blank

APPENDIX A

**Shock and Vibration Bulletins
36 through 41**

Bulletin No.	Part No.	Date	DDC
36	1	Mar. 1967	AD 381 304
	2	Feb. 1967	AD 647 644
	3	Jan. 1967	AD 646 982
	4	Jan. 1967	AD 647 645
	5	Jan. 1967	AD 646 983
	6	Feb. 1967	AD 651 403
	7	Feb. 1967	AD 651 404
37	1	Apr. 1968	AD 390 496L
	2	Jan. 1968	AD 667 227
	3	Jan. 1968	AD 667 228
	4	Jan. 1968	AD 667 229
	5	Jan. 1968	AD 668 246
	6	Jan. 1968	AD 668 328
	7 Supplement	Jan. 1968	AD 668 230 AD 831 154
38	1	Aug. 1968	AD 682 201
	2	Aug. 1968	AD 683 313
	3	Nov. 1968	AD 683 314
	Supplement	Aug. 1968	AD 847 594
39	1	Apr. 1969	AD 502 850L
	2	Feb. 1969	AD 688 445
	3	Jan. 1969	AD 684 065
	4	Apr. 1969	AD 688 788
	5	Dec. 1968	AD 684 066
	6 Supplement	Mar. 1969 Apr. 1969	AD 688 789 AD 853 161
40	1	Dec. 1969	*
	1-R	Dec. 1969	*
	2	Dec. 1969	*
	3	Dec. 1969	*
	4	Dec. 1969	*
	5	Dec. 1969	*
	6 Supplement	Dec. 1969	*
41	1	Dec. 1970	*
	2	Dec. 1970	*
	3	Dec. 1970	*
	4	Dec. 1970	*
	5	Dec. 1970	*
	6	Dec. 1970	*
	" Supplement	Dec. 1970	*

*Not available through either DDC or NTIS see availability statement.

Availability

Bulletins 36 Part 1, 37, Part 1 and Supplement, 38 Supplement, and 39 Part 1 and Supplement should be ordered from the Defense Documentation Center (DDC), Cameron Station, Alexandria, Virginia 22314.

Bulletins 36 Parts 2-7, 37 Parts 2-7, 38 Parts 1-3, and 39 Parts 2-6, should be ordered from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, Virginia 22151.

Bulletins 40 and 41 should be ordered from the Navy Publication and Printing Service Office, Naval District Washington, Bldg 157-2, Washington Navy Yard, Washington, D.C. 20390. The price for either the 40th or the 41st Bulletin is \$15.00 for the complete set. A check or money order payable to the Treasurer of the United States must accompany the order.