

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS	0-1
INTRODUCTION	1-1
CHRONOLOGICAL HISTORY.....	1-1
1989-1990	1-3
1991-1992	1-4
1993-1994	1-5
1995	1-6
950	1-9
960	1-13
970	1-17
971	1-23
971R6.....	1-31
971R6.1	1-37
R7.0.....	1-42
R7.1	1-57
R8.0.....	1-73
R9.0.....	1-96
R10.....	1-151
R11	1-200
R12.....	1-256
R13.....	1-316
R14.....	1-316
R15.....	1-316
MATERIAL MODELS.....	1-316
SPATIAL DISCRETIZATION.....	1-318
CONTACT-IMPACT INTERFACES	1-321
INTERFACE DEFINITIONS FOR COMPONENT ANALYSIS.....	1-322
PRECISION	1-323
GETTING STARTED.....	2-1
DESCRIPTION OF KEYWORD INPUT	2-1
SUMMARY OF COMMONLY USED OPTIONS	2-10
EXECUTION SYNTAX	2-12
SENSE SWITCH CONTROLS	2-17

TABLE OF CONTENTS

Procedure for LS-DYNA/MPP	2-18
FILES.....	2-19
RESTART ANALYSIS	2-21
VDA/IGES DATABASES	2-23
LS-PrePost®	2-24
EXECUTION SPEEDS	2-25
UNITS	2-26
GENERAL CARD FORMAT	2-27
 *AIRBAG	 3-1
*AIRBAG	3-2
Core Cards	3-3
*AIRBAG_SIMPLE_PRESSURE_VOLUME	3-9
*AIRBAG_SIMPLE_AIRBAG_MODEL	3-12
*AIRBAG_ADIABATIC_GAS_MODEL	3-17
*AIRBAG_WANG_NEFSKE	3-20
JETTING models	3-30
CM option	3-35
*AIRBAG_LOAD_CURVE	3-38
*AIRBAG_LINEAR_FLUID	3-40
*AIRBAG_HYBRID	3-44
*AIRBAG_HYBRID_JETTING	3-44
*AIRBAG_HYBRID_CHEMKIN	3-54
*AIRBAG_FLUID_AND_GAS	3-60
*AIRBAG_ALE	3-65
*AIRBAG_CPG	3-81
*AIRBAG_INTERACTION	3-89
*AIRBAG_PARTICLE	3-91
*AIRBAG_REFERENCE_GEOMETRY	3-115
*AIRBAG_SALE	3-118
*AIRBAG_SHELL_REFERENCE_GEOMETRY	3-127
 *ALE	 4-1
*ALE_AMBIENT_HYDROSTATIC	4-5
*ALE_BURN_SWITCH_MMG	4-9
*ALE_COUPLING_NODAL_CONSTRAINT	4-15
*ALE_COUPLING_NODAL_DRAG	4-18
*ALE_COUPLING_NODAL_PENALTY	4-21

TABLE OF CONTENTS

*ALE_COUPLING_RIGID_BODY	4-24
*ALE_ESSENTIAL_BOUNDARY	4-26
*ALE_FAIL_SWITCH_MMG	4-28
*ALE_FRAGMENTATION	4-30
*ALE_FSI_PROJECTION	4-32
*ALE_FSI_SWITCH_MMG	4-35
*ALE_FSI_TO_LOAD_NODE	4-40
*ALE_INJECTION	4-42
*ALE_MAPPING	4-52
*ALE_MAPPING_FROM_LAGRANGIAN	4-63
*ALE_MESH_INTERFACE	4-67
*ALE_MULTI-MATERIAL_GROUP	4-70
*ALE_PRESCRIBED_MOTION	4-74
*ALE_REFERENCE_SYSTEM_CURVE	4-77
*ALE_REFERENCE_SYSTEM_GROUP	4-80
*ALE_REFERENCE_SYSTEM_NODE	4-88
*ALE_REFERENCE_SYSTEM_SWITCH	4-90
*ALE_REFINE	4-92
*ALE_SMOOTHING	4-93
*ALE_STRUCTURED_FSI	4-96
*ALE_STRUCTURED_MESH	4-102
*ALE_STRUCTURED_MESH_CONTROL_POINTS	4-106
*ALE_STRUCTURED_MESH_JOIN	4-113
*ALE_STRUCTURED_MESH_MOTION	4-114
*ALE_STRUCTURED_MESH_REFINE	4-117
*ALE_STRUCTURED_MESH_TRIM	4-120
*ALE_STRUCTURED_MESH_VOLUME_FILLING	4-124
*ALE_STRUCTURED_MULTI-MATERIAL_GROUP	4-130
*ALE_STRUCTURED_POINT_SOURCE	4-133
*ALE_SWITCH_MMG	4-135
*ALE_TANK_TEST	4-142
*ALE_UP_SWITCH	4-146
*BOUNDARY	5-1
*BOUNDARY_ACOUSTIC_COUPLING	5-4
*BOUNDARY_ACOUSTIC_COUPLING_SPECTRAL	5-7
*BOUNDARY_ACOUSTIC_FREE_SURFACE	5-8

TABLE OF CONTENTS

*BOUNDARY_ACOUSTIC_IMPEDANCE	5-9
*BOUNDARY_ACOUSTIC_IMPEDANCE_COMPLEX	5-10
*BOUNDARY_ACOUSTIC_IMPEDANCE_MECHANICAL	5-11
*BOUNDARY_ACOUSTIC_INTERFACE	5-12
*BOUNDARY_ACOUSTIC_MAPPING	5-13
*BOUNDARY_ACOUSTIC_NON_REFLECTING	5-14
*BOUNDARY_ACOUSTIC_PRESCRIBED_MOTION	5-16
*BOUNDARY_ACOUSTIC_PRESSURE_SPECTRAL	5-17
*BOUNDARY_ALE_MAPPING	5-18
*BOUNDARY_AMBIENT	5-25
*BOUNDARY_AMBIENT_EOS	5-28
*BOUNDARY_CONVECTION	5-30
*BOUNDARY_COUPLED	5-33
*BOUNDARY_CYCLIC	5-35
*BOUNDARY_DE_NON_REFLECTING	5-38
*BOUNDARY_FLUIDM	5-39
*BOUNDARY_FLUIDM_BOTTOM	5-41
*BOUNDARY_FLUIDM_FREE_SURFACE	5-42
*BOUNDARY_FLUIDM_INTERIOR	5-43
*BOUNDARY_FLUX	5-46
*BOUNDARY_FLUX_TRAJECTORY	5-50
*BOUNDARY_MCOL	5-58
*BOUNDARY_NON_REFLECTING	5-60
*BOUNDARY_NON_REFLECTING_2D	5-62
*BOUNDARY_PAP	5-64
*BOUNDARY_PORE_FLUID	5-66
*BOUNDARY_PRECRACK	5-68
*BOUNDARY_PRESCRIBED_ACCELEROMETER_RIGID	5-69
*BOUNDARY_PRESCRIBED_FINAL_GEOMETRY	5-73
*BOUNDARY_PRESCRIBED_MOTION	5-75
*BOUNDARY_PRESCRIBED_ORIENTATION_RIGID	5-88
*BOUNDARY_PRESSURE_OUTFLOW	5-97
*BOUNDARY_PWP	5-98
*BOUNDARY_PZEPOT	5-106
*BOUNDARY_RADIATION	5-107
*BOUNDARY_RADIATION_ENCLOSURE	5-109
*BOUNDARY_RADIATION_SEGMENT	5-115

TABLE OF CONTENTS

*BOUNDARY_RADIATION_SEGMENT_VF	5-118
*BOUNDARY_RADIATION_SET	5-120
*BOUNDARY_RADIATION_SET_VF	5-123
*BOUNDARY_SALE_MESH_FACE	5-126
*BOUNDARY_SLIDING_PLANE	5-129
*BOUNDARY_SPC	5-130
*BOUNDARY_SPC_SYMMETRY_PLANE	5-133
*BOUNDARY_SPH_FLOW	5-136
*BOUNDARY_SPH_NON_REFLECTING	5-139
*BOUNDARY_SPH_NOSLIP	5-140
*BOUNDARY_SPH_PERIODIC	5-142
*BOUNDARY_SPH_SYMMETRY_PLANE	5-144
*BOUNDARY_SYMMETRY_FAILURE	5-145
*BOUNDARY_TEMPERATURE	5-146
*BOUNDARY_TEMPERATURE_PERIODIC_SET	5-148
*BOUNDARY_TEMPERATURE_RSW	5-150
*BOUNDARY_TEMPERATURE_TRAJECTORY	5-155
*BOUNDARY_THERMAL_BULKFLOW	5-160
*BOUNDARY_THERMAL_BULKNODE	5-161
*BOUNDARY_THERMAL_WELD	5-163
*BOUNDARY_THERMAL_WELD_TRAJECTORY	5-167
*BOUNDARY_USA_SURFACE	5-175
*BOUNDARY_ELEMENT_METHOD	5-1
*BOUNDARY_ELEMENT_METHOD_CONTROL	6-2
*BOUNDARY_ELEMENT_METHOD_FLOW	6-4
*BOUNDARY_ELEMENT_METHOD_NEIGHBOR	6-6
*BOUNDARY_ELEMENT_METHOD_SYMMETRY	6-10
*BOUNDARY_ELEMENT_METHOD_WAKE	6-11
*CASE	7-1
*COMMENT	7-1
*COMPONENT	9-1
*COMPONENT_GEBOD	9-2
*COMPONENT_GEBOD_JOINT	9-4
*COMPONENT_HYBRIDIII	9-7
*COMPONENT_HYBRIDIII_JOINT	9-10

TABLE OF CONTENTS

*CONSTRAINED.....	10-1
*CONSTRAINED_ADAPTIVITY.....	10-3
*CONSTRAINED_BEAM_IN_SOLID.....	10-5
*CONSTRAINED_BUTT_WELD.....	10-13
*CONSTRAINED_COORDINATE	10-16
*CONSTRAINED_EULER_IN_EULER	10-20
*CONSTRAINED_EXTRA_NODES	10-22
*CONSTRAINED_GENERALIZED_WELD	10-24
Spot Weld Card	10-27
Fillet Weld Card.....	10-29
Butt Weld Card	10-31
Cross Fillet Weld Card	10-34
Combined Weld Cards.....	10-36
*CONSTRAINED_GLOBAL	10-38
*CONSTRAINED_IMMERSSED_IN_SPG	10-40
*CONSTRAINED_INTERPOLATION.....	10-41
*CONSTRAINED_INTERPOLATION_SPOTWELD	10-47
*CONSTRAINED_JOINT	10-61
*CONSTRAINED_JOINT_COOR	10-79
*CONSTRAINED_JOINT_STIFFNESS.....	10-88
Flexion-Torsion Joint Stiffness Cards.....	10-92
Generalized Joint Stiffness Cards	10-97
Translational Joint Stiffness Cards	10-102
Cylindrical Joint Stiffness Cards.....	10-106
*CONSTRAINED_JOINT_USER_FORCE	10-111
*CONSTRAINED_LAGRANGE_IN_SOLID	10-112
*CONSTRAINED_LINEAR_GLOBAL	10-134
*CONSTRAINED_LINEAR_LOCAL.....	10-137
*CONSTRAINED_LOCAL	10-140
*CONSTRAINED_MULTIPLE_GLOBAL	10-142
*CONSTRAINED_NODAL_RIGID_BODY	10-145
*CONSTRAINED_NODE_INTERPOLATION.....	10-159
*CONSTRAINED_NODE_SET	10-161
*CONSTRAINED_NODE_TO_NURBS_PATCH.....	10-164
*CONSTRAINED_POINTS.....	10-166
*CONSTRAINED_RIGID_BODIES	10-168

TABLE OF CONTENTS

*CONSTRAINED_RIGID_BODY_INSERT	10-170
*CONSTRAINED_RIGID_BODY_STOPPERS	10-172
*CONSTRAINED_RIVET	10-176
*CONSTRAINED_SHELL_IN_SOLID	10-178
*CONSTRAINED_SHELL_TO_SOLID	10-181
*CONSTRAINED_SOIL_PILE	10-183
*CONSTRAINED_SOLID_IN_SOLID	10-205
*CONSTRAINED_SPLINE	10-208
*CONSTRAINED_SPOTWELD	10-210
*CONSTRAINED_SPR2	10-214
*CONSTRAINED_TIE-BREAK	10-222
*CONSTRAINED_TIED_NODES_FAILURE	10-224
*CONTACT	11-1
*CONTACT	11-3
Introduction	11-3
Options for *Contact keyword	11-8
ID Card	11-18
MPP Cards	11-19
Mandatory Card 1	11-24
Mandatory Card 2	11-27
Mandatory Card 3	11-33
Card 4: AUTOMATIC_..._TIEBREAK	11-35
Card 4: AUTOMATIC_..._SURFACE_TO_SURFACE_TIEBREAK_USER_...	11-43
Card 4: AUTOMATIC_SURFACE_TO_SURFACE_COMPOSITE/LUBRICATION	11-46
Card 4: AUTOMATIC_SINGLE_SURFACE_TIED	11-48
Card 4: AUTOMATIC_SURFACE_TO_SURFACE_..._TIED_WELD	11-49
Card 4: CONSTRAINT_..._TO_SURFACE	11-52
Card 4: DRAWBEAD	11-53
Card 4: ERODING_..._SURFACE	11-65
Card 4: SURFACE_INTERFERENCE	11-67
Card 4: RIGID_TO_RIGID	11-69
Card 4: TIEBREAK_NODES	11-71
Card 4: TIEBREAK_SURFACE	11-73
Card 4: CONTRACTION_JOINT	11-75
THERMAL	11-77
THERMAL_FRICTION	11-80

TABLE OF CONTENTS

ORTHO_FRICTION	11-84
Optional Card A	11-90
Optional Card B	11-102
Optional Card C	11-106
Optional Card D	11-111
Optional Card E.....	11-115
Optional Card F.....	11-119
Optional Card G	11-122
General Remarks	11-123
Contact Examples.....	11-140
*CONTACT_ADD_WEAR.....	11-143
*CONTACT_AUTO_MOVE	11-147
*CONTACT_COUPLING.....	11-153
*CONTACT_ENTITY	11-155
*CONTACT_EXCLUDE_INTERACTION	11-165
*CONTACT_FORCE_TRANSDUCER.....	11-167
*CONTACT_GEBOD	11-172
*CONTACT_GUIDED_CABLE	11-175
*CONTACT_INTERIOR.....	11-177
*CONTACT_RIGID_SURFACE	11-179
*CONTACT_SPG.....	11-183
*CONTACT_1D.....	11-185
*CONTACT_2D.....	11-187
*CONTACT_2D_[SLIDING, TIED, & PENALTY].....	11-190
*CONTACT_2D_[AUTOMATIC & FORCE_TRANSDUCER]	11-196
*CONTACT_2D_NODE_TO_SOLID.....	11-206
*CONTROL.....	12-1
*CONTROL_ACCURACY	12-8
*CONTROL_ACOUSTIC.....	12-14
*CONTROL_ACOUSTIC_COUPLING	12-15
*CONTROL_ACOUSTIC_SPECTRAL	12-16
*CONTROL_ADAPSTEP	12-18
*CONTROL_ADAPTIVE	12-19
*CONTROL_ADAPTIVE_CURVE	12-43
*CONTROL_AIRBAG.....	12-50
*CONTROL_ALE	12-51

TABLE OF CONTENTS

*CONTROL_BULK_VISCOSITY	12-60
*CONTROL_CHECK_SHELL.....	12-62
*CONTROL_COARSEN.....	12-64
*CONTROL_CONSTRAINED	12-66
*CONTROL_CONTACT	12-67
*CONTROL_COUPLING	12-85
*CONTROL_CPG	12-87
*CONTROL_CPM	12-89
*CONTROL_CPU	12-93
*CONTROL_DEBUG	12-94
*CONTROL_DISCRETE_ELEMENT	12-95
*CONTROL_DYNAMIC_RELAXATION.....	12-102
*CONTROL_EFG	12-108
*CONTROL_ENERGY	12-110
*CONTROL_EOS_USER_LIBRARY	12-112
*CONTROL_EXPLICIT_THERMAL	12-114
*CONTROL_EXPLICIT_THERMAL_ALE_COUPLING	12-115
*CONTROL_EXPLICIT_THERMAL_BOUNDARY	12-116
*CONTROL_EXPLICIT_THERMAL_CONTACT	12-117
*CONTROL_EXPLICIT_THERMAL_INITIAL	12-118
*CONTROL_EXPLICIT_THERMAL_OUTPUT.....	12-119
*CONTROL_EXPLICIT_THERMAL_PROPERTIES	12-121
*CONTROL_EXPLICIT_THERMAL_SOLVER	12-124
*CONTROL_EXPLOSIVE_SHADOW	12-125
*CONTROL_FORMING	12-127
*CONTROL_FORMING_AUTO_NET	12-129
*CONTROL_FORMING_AUTOCHECK	12-133
*CONTROL_FORMING_AUTOPOSITION_PARAMETER	12-142
*CONTROL_FORMING_BESTFIT	12-150
*CONTROL_FORMING_HOME_GAP	12-156
*CONTROL_FORMING_INITIAL_THICKNESS	12-157
*CONTROL_FORMING_MAXID	12-160
*CONTROL_FORMING_ONESTEP	12-162
*CONTROL_FORMING_OUTPUT	12-180
*CONTROL_FORMING_PARAMETER_READ	12-189
*CONTROL_FORMING_POSITION.....	12-192
*CONTROL_FORMING_PRE_BENDING	12-194

TABLE OF CONTENTS

*CONTROL_FORMING_PROJECTION.....	12-199
*CONTROL_FORMING_REMOVE_ADAPTIVE_CONSTRAINTS	12-201
*CONTROL_FORMING_SCRAP_FALL.....	12-203
*CONTROL_FORMING_SHELL_TO_TSHELL	12-216
*CONTROL_FORMING_STONING	12-221
*CONTROL_FORMING_STRAIN_RATIO_SMOOTH.....	12-228
*CONTROL_FORMING_TEMPLATE.....	12-230
*CONTROL_FORMING_TIPPING	12-236
*CONTROL_FORMING_TRAVEL	12-243
*CONTROL_FORMING_TRIM_MERGE	12-245
*CONTROL_FORMING_TRIM_SOLID_REFINEMENT	12-248
*CONTROL_FORMING_TRIMMING	12-250
*CONTROL_FORMING_UNFLANGING	12-252
*CONTROL_FORMING_USER.....	12-262
*CONTROL_FREQUENCY_DOMAIN.....	12-266
*CONTROL_HOURLASS.....	12-268
*CONTROL_IMPLICIT	12-272
*CONTROL_IMPLICIT_AUTO	12-274
*CONTROL_IMPLICIT_BUCKLE.....	12-282
*CONTROL_IMPLICIT_CONSISTENT_MASS	12-284
*CONTROL_IMPLICIT_DYNAMICS	12-285
*CONTROL_IMPLICIT_EIGENVALUE.....	12-291
*CONTROL_IMPLICIT_FORMING	12-304
*CONTROL_IMPLICIT_GENERAL	12-319
*CONTROL_IMPLICIT_INERTIA_RELIEF.....	12-323
*CONTROL_IMPLICIT_JOINTS	12-325
*CONTROL_IMPLICIT_MODAL_DYNAMIC.....	12-326
*CONTROL_IMPLICIT_MODAL_DYNAMIC_DAMPING	12-330
*CONTROL_IMPLICIT_MODAL_DYNAMIC_MODE	12-333
*CONTROL_IMPLICIT_MODES	12-335
*CONTROL_IMPLICIT_ORDERING	12-340
*CONTROL_IMPLICIT_RESIDUAL_VECTOR	12-342
*CONTROL_IMPLICIT_ROTATIONAL_DYNAMICS	12-346
*CONTROL_IMPLICIT_SOLUTION	12-351
*CONTROL_IMPLICIT_SOLVER	12-364
*CONTROL_IMPLICIT_SSD_DIRECT	12-376
*CONTROL_IMPLICIT_STABILIZATION	12-378

TABLE OF CONTENTS

*CONTROL_IMPLICIT_STATIC_CONDENSATION	12-380
*CONTROL_IMPLICIT_TERMINATION	12-384
*CONTROL_LSDA.....	12-386
*CONTROL_MAPPING_SHIFT_BY_DT.....	12-387
*CONTROL_MAT	12-388
*CONTROL_MPP	12-389
*CONTROL_MPP_CONTACT_GROUPABLE	12-391
*CONTROL_MPP_DECOMPOSITION_ADJUST_MTYPE_COST	12-393
*CONTROL_MPP_DECOMPOSITION_ADJUST_PART_COST	12-394
*CONTROL_MPP_DECOMPOSITION_ARRANGE_PARTS.....	12-395
*CONTROL_MPP_DECOMPOSITION_AUTOMATIC	12-397
*CONTROL_MPP_DECOMPOSITION_BAGREF	12-398
*CONTROL_MPP_DECOMPOSITION_CHECK_SPEED	12-399
*CONTROL_MPP_DECOMPOSITION_CONTACT_DISTRIBUTE	12-400
*CONTROL_MPP_DECOMPOSITION_CONTACT_ISOLATE.....	12-401
*CONTROL_MPP_DECOMPOSITION_DEFORMED_GEOMETRY.....	12-402
*CONTROL_MPP_DECOMPOSITION_DISABLE_UNREF_CURVES	12-403
*CONTROL_MPP_DECOMPOSITION_DISTRIBUTE_ALE_ELEMENTS.....	12-404
*CONTROL_MPP_DECOMPOSITION_DISTRIBUTE_SPH_ELEMENTS.....	12-405
*CONTROL_MPP_DECOMPOSITION_ELCOST	12-406
*CONTROL_MPP_DECOMPOSITION_FILE	12-407
*CONTROL_MPP_DECOMPOSITION_FLAG_STRESS_STRAIN_CURVE	12-408
*CONTROL_MPP_DECOMPOSITION_METHOD	12-409
*CONTROL_MPP_DECOMPOSITION_NODISTRIBUTE_DES_ELEMENTS.....	12-410
*CONTROL_MPP_DECOMPOSITION_NUMPROC	12-411
*CONTROL_MPP_DECOMPOSITION_OUTDECOMP	12-412
*CONTROL_MPP_DECOMPOSITION_PARTS_DISTRIBUTE	12-413
*CONTROL_MPP_DECOMPOSITION_PARTSET_DISTRIBUTE	12-414
*CONTROL_MPP_DECOMPOSITION_RCBLOG	12-415
*CONTROL_MPP_DECOMPOSITION_REDECOMPOSITION.....	12-416
*CONTROL_MPP_DECOMPOSITION_SCALE_CONTACT_COST	12-418
*CONTROL_MPP_DECOMPOSITION_SCALE_FACTOR_SPH.....	12-419
*CONTROL_MPP_DECOMPOSITION_SHOW	12-420
*CONTROL_MPP_DECOMPOSITION_TRANSFORMATION	12-421
*CONTROL_MPP_IO_LSTC_REDUCE	12-423
*CONTROL_MPP_IO_NOBEAMOUT.....	12-424
*CONTROL_MPP_IO_NOD3DUMP	12-425

TABLE OF CONTENTS

*CONTROL_MPP_IO_NODUMP	12-426
*CONTROL_MPP_IO_NOFULL	12-427
*CONTROL_MPP_IO_NOTIEDIO	12-428
*CONTROL_MPP_IO_SWAPBYTES	12-429
*CONTROL_MPP_MATERIAL_MODEL_DRIVER	12-430
*CONTROL_MPP_PFILE	12-431
*CONTROL_MPP_REBALANCE	12-432
*CONTROL_NONLOCAL	12-434
*CONTROL_OUTPUT	12-435
*CONTROL_PARALLEL	12-448
*CONTROL_PORE_AIR	12-451
*CONTROL_PORE_FLUID	12-452
*CONTROL_PZELECTRIC	12-459
*CONTROL_REFERENCE_CONFIGURATION	12-461
*CONTROL_REFINE_ALE	12-465
*CONTROL_REFINE_ALE2D	12-471
*CONTROL_REFINE_MPP_DISTRIBUTION	12-477
*CONTROL_REFINE_SHELL	12-479
*CONTROL_REFINE_SOLID	12-485
*CONTROL_REMESHING	12-490
*CONTROL_REQUIRE_REVISION	12-495
*CONTROL_RIGID	12-497
*CONTROL_SEGMENTS_IN_ALE_COUPLING	12-502
*CONTROL_SHELL	12-505
*CONTROL_SOLID	12-520
*CONTROL_SOLUTION	12-527
*CONTROL_SPH	12-530
*CONTROL_SPH_INCOMPRESSIBLE	12-538
*CONTROL_SPOTWELD_BEAM	12-540
*CONTROL_STAGED_CONSTRUCTION	12-543
*CONTROL_START	12-547
*CONTROL_STEADY_STATE_ROLLING	12-548
*CONTROL_STRUCTURED	12-550
*CONTROL_SUBCYCLE	12-551
*CONTROL_TERMINATION	12-553
*CONTROL_THERMAL_EIGENVALUE	12-555
*CONTROL_THERMAL_FORMING	12-556

TABLE OF CONTENTS

*CONTROL_THERMAL_NONLINEAR.....	12-566
*CONTROL_THERMAL_SOLVER	12-568
*CONTROL_THERMAL_TIMESTEP	12-575
*CONTROL_TIMESTEP	12-578
*CONTROL_UNITS	12-586
*CONTROL_2D_REMESHING_REGION	12-588
*CONTROLLER	13-1
*CONTROLLER_PLANT	13-2
*COSIM	14-1
*COSIM_FMI_CONTROL	14-2
*COSIM_FMI_INTERFACE	14-9
*DAMPING	15-1
*DAMPING_FREQUENCY_RANGE	15-2
*DAMPING_GLOBAL	15-8
*DAMPING_PART_MASS	15-10
*DAMPING_PART_STIFFNESS	15-12
*DAMPING_PART_STRUCTURAL.....	15-14
*DAMPING_RELATIVE	15-15
*DAMPING_STRUCTURAL	15-17
*DATABASE	16-1
*DATABASE	16-4
*DATABASE_ACEOUT	16-19
*DATABASE_ADAMS.....	16-20
*DATABASE_ALE	16-22
*DATABASE_ALE_MAT.....	16-25
*DATABASE_ALE_OPERATION.....	16-26
*DATABASE_BINARY	16-31
*DATABASE_BINARY_D3PROP	16-41
*DATABASE_CPM_SENSOR.....	16-42
*DATABASE_CROSS_SECTION.....	16-46
*DATABASE_DEFRAGMENT	16-52
*DATABASE_D3FTG.....	16-53
*DATABASE_D3MAX	16-54
*DATABASE_EXTENT	16-57
*DATABASE_EXTENT_AVS	16-58

TABLE OF CONTENTS

*DATABASE_EXTENT_BINARY	16-62
*DATABASE_EXTENT_D3PART	16-77
*DATABASE_EXTENT_INTFOR	16-80
*DATABASE_EXTENT_MOVIE	16-84
*DATABASE_EXTENT_MPGS.....	16-85
*DATABASE_EXTENT_SSSTAT	16-86
*DATABASE_FATIGUE_STRESS_CYCLE	16-87
*DATABASE_FATXML.....	16-88
*DATABASE_FORMAT	16-89
*DATABASE_FREQUENCY_ASCII.....	16-91
*DATABASE_FREQUENCY_BINARY.....	16-94
*DATABASE_FSI	16-102
*DATABASE_FSI_SENSOR.....	16-107
*DATABASE_HISTORY	16-110
*DATABASE_HISTORY_ACOUSTIC	16-116
*DATABASE_ISPHHTC	16-117
*DATABASE_MASSOUT	16-118
*DATABASE_MAX.....	16-119
*DATABASE_NODAL_FORCE_GROUP.....	16-121
*DATABASE_PAP_OUTPUT	16-122
*DATABASE_PBLAST_SENSOR	16-123
*DATABASE_PROFILE.....	16-125
*DATABASE_PWP_FLOW.....	16-128
*DATABASE_PWP_OUTPUT	16-129
*DATABASE_RCFORC_MOMENT	16-131
*DATABASE_RECOVER_NODE.....	16-132
*DATABASE_RVE.....	16-134
*DATABASE_SALE.....	16-135
*DATABASE_SPRING_FORWARD	16-136
*DATABASE_SUPERPLASTIC_FORMING	16-137
*DATABASE_TRACER	16-138
*DATABASE_TRACER_ALE	16-141
*DATABASE_TRACER_GENERAL	16-144
*DATABASE_TRACER_GENERATE.....	16-148
*DEFINE.....	17-1
*DEFINE_ADAPTIVE_SOLID_TO_DES.....	17-7

TABLE OF CONTENTS

*DEFINE_ADAPTIVE_SOLID_TO_SPH	17-11
*DEFINE_BEAM_SOLID_COUPLING.....	17-15
*DEFINE_BOX	17-16
*DEFINE_BOX_ADAPTIVE	17-19
*DEFINE_BOX_COARSEN	17-25
*DEFINE_BOX_DRAWBEAD	17-28
*DEFINE_BOX_NODES_ADAPTIVE	17-30
*DEFINE_BOX_SPH	17-35
*DEFINE_CABLE	17-39
*DEFINE_CONNECTION_PROPERTIES	17-42
*DEFINE_CONSTRUCTION_STAGES	17-52
*DEFINE_CONTACT_EXCLUSION	17-54
*DEFINE_CONTACT_VOLUME	17-56
*DEFINE_CONTROL_VOLUME.....	17-59
*DEFINE_CONTROL_VOLUME_FLOW_AREA	17-63
*DEFINE_CONTROL_VOLUME_INTERACTION	17-65
*DEFINE_COORDINATE_NODES	17-67
*DEFINE_COORDINATE_SYSTEM	17-69
*DEFINE_COORDINATE_VECTOR	17-75
*DEFINE_CPG_GAS_PROPERTIES.....	17-77
*DEFINE_CPG_REGION	17-79
*DEFINE_CPM_BAG_INTERACTION.....	17-81
*DEFINE_CPM_CHAMBER.....	17-83
*DEFINE_CPM_GAS_PROPERTIES	17-86
*DEFINE_CPM_NPDATA	17-89
*DEFINE_CPM_SWITCH_REGION	17-91
*DEFINE_CPM_VENT.....	17-92
*DEFINE_CURVE.....	17-97
*DEFINE_CURVE_BOX_ADAPTIVITY	17-102
*DEFINE_CURVE_COMPENSATION_CONSTRAINT	17-106
*DEFINE_CURVE_DRAWBEAD	17-112
*DEFINE_CURVE_DUPLICATE	17-115
*DEFINE_CURVE_ENTITY	17-116
*DEFINE_CURVE_FEEDBACK.....	17-118
*DEFINE_CURVE_FLC	17-121
*DEFINE_CURVE_FLD_FROM_TRIAXIAL_LIMIT	17-124
*DEFINE_CURVE_FUNCTION	17-127

TABLE OF CONTENTS

*DEFINE_CURVE_SMOOTH	17-146
*DEFINE_CURVE_STRESS	17-148
*DEFINE_CURVE_TRIAXIAL_LIMIT_FROM_FLD	17-151
*DEFINE_CURVE_TRIM	17-154
*DEFINE_DE_ACTIVE_REGION	17-173
*DEFINE_DE_BOND	17-175
*DEFINE_DE_BOND_OVERRIDE	17-183
*DEFINE_DE_BY_PART	17-186
*DEFINE_DE_COHESIVE	17-188
*DEFINE_DE_FLOW_DRAG	17-190
*DEFINE_DE_HBOND	17-196
*DEFINE_DE_INJECT_BONDED	17-200
*DEFINE_DE_INJECT_SHAPE	17-204
*DEFINE_DE_INJECTION	17-207
*DEFINE_DE_INTERNAL_SKIP	17-212
*DEFINE_DE_MASSFLOW_PLANE	17-213
*DEFINE_DE_MESH_BEAM	17-214
*DEFINE_DE_MESH_SURFACE	17-216
*DEFINE_DE_MESH_VOLUME	17-218
*DEFINE_DE_PARTS_INTERACTION	17-220
*DEFINE_DE_PATTERN_OUTPUT	17-221
*DEFINE_DE_TEMP	17-223
*DEFINE_DE_TO_BEAM_COUPLING	17-224
*DEFINE_DE_TO_CPM_COUPLING	17-226
*DEFINE_DE_TO_SURFACE_COUPLING	17-227
*DEFINE_DE_TO_SURFACE_TIED	17-232
*DEFINE_DEATH_TIMES	17-234
*DEFINE_DRIFT_REMOVE	17-237
*DEFINE_ELEMENT_DEATH	17-239
*DEFINE_ELEMENT_EROSION	17-241
*DEFINE_ELEMENT_GENERALIZED_SHELL	17-243
*DEFINE_ELEMENT_GENERALIZED_SOLID	17-248
*DEFINE_FABRIC_ASSEMBLIES	17-251
*DEFINE_FIBERS	17-253
*DEFINE_FIELD	17-257
*DEFINE_FILTER	17-260
*DEFINE_FORMING_ADAPTIVE_PART_INITIAL	17-262

TABLE OF CONTENTS

*DEFINE_FORMING_BLANKMESH	17-263
*DEFINE_FORMING_CLAMP	17-269
*DEFINE_FORMING_CONTACT	17-273
*DEFINE_FORMING_ONESTEP_PRIMARY	17-275
*DEFINE_FP_TO_SURFACE_COUPLING	17-277
*DEFINE_FRICTION	17-279
*DEFINE_FRICTION_ORIENTATION	17-282
*DEFINE_FRICTION_SCALING	17-288
*DEFINE_FUNCTION	17-290
*DEFINE_FUNCTION_TABULATED	17-293
*DEFINE_GROUND_MOTION	17-295
*DEFINE_HAZ_PROPERTIES	17-296
*DEFINE_HAZ_TAILOR_WELDED_BLANK	17-299
*DEFINE_HEX_SPOTWELD_ASSEMBLY	17-300
*DEFINE_ISPG_TO_SURFACE_COUPLING	17-302
*DEFINE_LANCE_SEED_POINT_COORDINATES	17-305
*DEFINE_MATERIAL_HISTORIES	17-306
*DEFINE_MULTI_DRAWBEADS_IGES	17-321
*DEFINE_MULTI_SHEET_CONNECTORS	17-323
*DEFINE_MULTISCALE	17-326
*DEFINE_NURBS_CURVE	17-327
*DEFINE_PART_FROM_LAYER	17-330
*DEFINE_PARTICLE_BLAST	17-333
*DEFINE_PBLAST_AIRGEO	17-338
*DEFINE_PBLAST_GEOMETRY	17-341
*DEFINE_PLANE	17-344
*DEFINE_POINT_CLOUD	17-346
*DEFINE_POROUS	17-349
*DEFINE_PRESSURE_TUBE	17-352
*DEFINE_QUASAR_COUPLING	17-362
*DEFINE_REGION	17-365
*DEFINE_SALEAB_PARAMETERS	17-370
*DEFINE_SD_ORIENTATION	17-372
*DEFINE_SET_ADAPTIVE	17-374
*DEFINE_SPG_TO_SURFACE_COUPLING	17-375
*DEFINE_SPH_ACTIVE_REGION	17-377
*DEFINE_SPH_AMBIENT_DRAG	17-382

TABLE OF CONTENTS

*DEFINE_SPH_DE_COUPLING	17-384
*DEFINE_SPH_INJECTION	17-386
*DEFINE_SPH_INJECTION_SIMPLIFIED	17-388
*DEFINE_SPH_MASSFLOW_PLANE	17-391
*DEFINE_SPH_MESH_BOX	17-392
*DEFINE_SPH_MESH_OBJ	17-394
*DEFINE_SPH_MESH_SURFACE	17-395
*DEFINE_SPH_TO_SPH_COUPLING	17-396
*DEFINE_SPH_VICINITY_SENSOR	17-399
*DEFINE_SPOTWELD_FAILURE	17-400
*DEFINE_SPOTWELD_FAILURE_RESULTANTS	17-405
*DEFINE_SPOTWELD_MULTISCALE	17-407
*DEFINE_SPOTWELD RUPTURE_PARAMETER	17-408
*DEFINE_SPOTWELD RUPTURE_STRESS	17-411
*DEFINE_STAGED_CONSTRUCTION_PART	17-413
*DEFINE_STOCHASTIC_ELEMENT	17-415
*DEFINE_STOCHASTIC_VARIATION	17-416
*DEFINE_STOCHASTIC_VARIATION_PROPERTIES	17-422
*DEFINE_TABLE	17-427
*DEFINE_TABLE_2D	17-430
*DEFINE_TABLE_3D	17-432
*DEFINE_TABLE_{X}D	17-434
*DEFINE_TABLE_COMPACT	17-436
*DEFINE_TABLE_MATRIX	17-443
*DEFINE_TARGET_BOUNDARY	17-447
*DEFINE_TRACER_PARTICLES_2D	17-449
*DEFINE_TRANSFORMATION	17-450
*DEFINE_TRIM_SEED_POINT_COORDINATES	17-455
*DEFINE_VECTOR	17-457
*DEFINE_VECTOR_NODES	17-458
EXAMPLES	17-459
*DEFORMABLE_TO_RIGID	18-1
*DEFORMABLE_TO_RIGID	18-2
*DEFORMABLE_TO_RIGID_AUTOMATIC	18-3
*DEFORMABLE_TO_RIGID_INERTIA	18-9
*ELEMENT	19-1

TABLE OF CONTENTS

*ELEMENT_BEAM.....	19-3
*ELEMENT_BEAM_PULLEY	19-18
*ELEMENT_BEAM_SOURCE.....	19-20
*ELEMENT_BEARING	19-22
*ELEMENT_BLANKING.....	19-27
*ELEMENT_DIRECT_MATRIX_INPUT	19-28
*ELEMENT_DISCRETE	19-31
*ELEMENT_DISCRETE_SPHERE	19-34
*ELEMENT_GENERALIZED_SHELL	19-40
*ELEMENT_GENERALIZED_SOLID.....	19-42
*ELEMENT_INERTIA	19-44
*ELEMENT_INTERPOLATION_SHELL.....	19-47
*ELEMENT_INTERPOLATION_SOLID	19-50
*ELEMENT_LANCING	19-53
*ELEMENT_MASS.....	19-64
*ELEMENT_MASS_MATRIX.....	19-65
*ELEMENT_MASS_PART.....	19-67
*ELEMENT_PLOTEL	19-69
*ELEMENT_SEATBELT	19-70
*ELEMENT_SEATBELT_ACCELEROMETER.....	19-73
*ELEMENT_SEATBELT_PRETENSIONER.....	19-75
*ELEMENT_SEATBELT_RETRACTOR.....	19-81
*ELEMENT_SEATBELT_SENSOR	19-87
*ELEMENT_SEATBELT_SLIPRING.....	19-92
*ELEMENT_SHELL.....	19-98
*ELEMENT_SHELL_NURBS_PATCH	19-107
*ELEMENT_SHELL_SOURCE_SINK.....	19-117
*ELEMENT_SOLID	19-118
*ELEMENT_SOLID_NURBS_PATCH.....	19-126
*ELEMENT_SOLID_PERI	19-133
*ELEMENT_SOLID_REFERENCE	19-135
*ELEMENT_SPH	19-136
*ELEMENT_TRIM	19-138
*ELEMENT_TSHELL.....	19-139
*END.....	20-144
*EOS.....	21-1

TABLE OF CONTENTS

*FATIGUE	22-2
*FATIGUE	22-3
*FATIGUE_FAILURE.....	22-8
*FATIGUE_LOADSTEP.....	22-9
*FATIGUE_MEAN_STRESS_CORRECTION	22-10
*FATIGUE_MULTIAXIAL.....	22-12
*FATIGUE_SUMMATION	22-14
*FREQUENCY_DOMAIN	23-1
*FREQUENCY_DOMAIN_ACCELERATION_UNIT	23-2
*FREQUENCY_DOMAIN_ACOUSTIC_BEM	23-4
*FREQUENCY_DOMAIN_ACOUSTIC_DIRECTIVITY.....	23-18
*FREQUENCY_DOMAIN_ACOUSTIC_FEM.....	23-20
*FREQUENCY_DOMAIN_ACOUSTIC_FREQUENCY	23-28
*FREQUENCY_DOMAIN_ACOUSTIC_FRINGE_PLOT	23-31
*FREQUENCY_DOMAIN_ACOUSTIC_INCIDENT_WAVE.....	23-37
*FREQUENCY_DOMAIN_ACOUSTIC_SOUND_SPEED.....	23-39
*FREQUENCY_DOMAIN_FRF.....	23-41
*FREQUENCY_DOMAIN_LOCAL	23-56
*FREQUENCY_DOMAIN_MODE.....	23-57
*FREQUENCY_DOMAIN_PATH.....	23-61
*FREQUENCY_DOMAIN_RANDOM_VIBRATION.....	23-63
*FREQUENCY_DOMAIN_RESPONSE_SPECTRUM	23-80
*FREQUENCY_DOMAIN_SEA_CONNECTION.....	23-93
*FREQUENCY_DOMAIN_SEA_INPUT.....	23-96
*FREQUENCY_DOMAIN_SEA_SUBSYSTEM.....	23-98
*FREQUENCY_DOMAIN_SSD	23-104
*HASH	24-117
*HASH	24-118
*HASH_END	24-119
*HOURLASS	25-1
*IGA	26-1
*IGA_1D_BREP	26-3
*IGA_1D_NURBS_UVW	26-4
*IGA_1D_NURBS_XYZ.....	26-8
*IGA_2D_BASIS_TRANSFORM_XYZ.....	26-11

TABLE OF CONTENTS

*IGA_2D_BEZIER_XYZ.....	26-12
*IGA_2D_BREP	26-13
*IGA_2D_NURBS_UVW	26-14
*IGA_2D_NURBS_XYZ.....	26-19
*IGA_3D_BASIS_TRANSFORM_XYZ.....	26-24
*IGA_3D_BEZIER_XYZ.....	26-25
*IGA_3D_NURBS_XYZ.....	26-26
*IGA_EDGE_UVW.....	26-32
*IGA_EDGE_XYZ.....	26-36
*IGA_FACE_UVW	26-39
*IGA_FACE_XYZ	26-43
*IGA_INCLUDE_BEZIER	26-47
*IGA_INTEGRATION_SHELL_REDUCE	26-49
*IGA_INTEGRATION_SOLID_REDUCE.....	26-50
*IGA_MASS	26-51
*IGA_POINT_UVW.....	26-53
*IGA_REFINE_SHELL.....	26-55
*IGA_REFINE_SOLID	26-58
*IGA_SHELL	26-61
*IGA_SOLID.....	26-63
*IGA_TIED_EDGE_TO_EDGE.....	26-65
*IGA_VOLUME_XYZ.....	26-66
*INCLUDE.....	27-1
*INCLUDE.....	27-3
*INCLUDE_AUTO_OFFSET.....	27-9
*INCLUDE_COMPENSATION	27-12
*INCLUDE_COMPENSATION_BEFORE_SPRINGBACK.....	27-15
*INCLUDE_COMPENSATION_BLANK_AFTER_SPRINGBACK	27-16
*INCLUDE_COMPENSATION_BLANK_BEFORE_SPRINGBACK	27-17
*INCLUDE_COMPENSATION_COMPENSATED_SHAPE	27-18
*INCLUDE_COMPENSATION_COMPENSATED_SHAPE_NEXT_STEP	27-19
*INCLUDE_COMPENSATION_CURRENT_TOOLS	27-20
*INCLUDE_COMPENSATION_CURVE	27-21
*INCLUDE_COMPENSATION_DESIRED_BLANK_SHAPE	27-22
*INCLUDE_COMPENSATION_NEW_RIGID_TOOL	27-23
*INCLUDE_COMPENSATION_ORIGINAL_DYNAIN	27-24

TABLE OF CONTENTS

*INCLUDE_COMPENSATION_ORIGINAL_RIGID_TOOL	27-25
*INCLUDE_COMPENSATION_ORIGINAL_TOOL	27-26
*INCLUDE_COMPENSATION_SPRINGBACK_INPUT	27-27
*INCLUDE_COMPENSATION_SYMMETRIC_LINES	27-28
*INCLUDE_COMPENSATION_TANGENT_CONSTRAINT	27-30
*INCLUDE_COMPENSATION_TRIM_CURVE	27-31
*INCLUDE_COMPENSATION_TRIM_NODE	27-32
*INCLUDE_COMPENSATION_UPDATED_BLANK_SHAPE	27-33
*INCLUDE_COMPENSATION_UPDATED_RIGID_TOOL	27-34
*INCLUDE_COSIM	27-35
*INCLUDE_ISPG	27-42
*INCLUDE_MULTISCALE	27-44
*INCLUDE_MULTISCALE_SPOTWELD	27-47
*INCLUDE_PATH	27-50
*INCLUDE_STAMPED	27-52
*INCLUDE_STAMPED_PART_SOLID_TO_SOLID	27-62
*INCLUDE_TRIM	27-67
*INCLUDE_UNITCELL	27-69
*INCLUDE_WD	27-73
*INCLUDE_WD_FINAL_PART	27-74
*INCLUDE_WD_INITIAL_BLANK	27-75
*INCLUDE_WD_WELDING_CURVE	27-76
*INITIAL	28-1
*INITIAL_AIRBAG_PARTICLE_POSITION	28-4
*INITIAL_ALE_MAPPING	28-5
*INITIAL_AXIAL_FORCE_BEAM	28-10
*INITIAL_CONTACT_WEAR	28-13
*INITIAL_CPG	28-15
*INITIAL_CRASHFRONT	28-17
*INITIAL_DETONATION	28-18
*INITIAL_DETONATION_GEOMETRY	28-22
*INITIAL_EOS_ALE	28-29
*INITIAL_FATIGUE_DAMAGE_RATIO	28-31
*INITIAL_FIELD_SOLID	28-36
*INITIAL_FOAM_REFERENCE_GEOMETRY	28-38
*INITIAL_GAS_MIXTURE	28-40

TABLE OF CONTENTS

*INITIAL_HISTORY_NODE	28-42
*INITIAL_HYDROSTATIC_ALE	28-45
*INITIAL_IMPULSE_MINE	28-49
*INITIAL_INTERNAL_DOF_SOLID	28-53
*INITIAL_LAG_MAPPING	28-55
*INITIAL_MOMENTUM	28-59
*INITIAL_PWP_DEPTH	28-60
*INITIAL_PWP_NODAL_DATA	28-61
*INITIAL_SOLID_VOLUME	28-62
*INITIAL_STRAIN_BEAM	28-63
*INITIAL_STRAIN_IGA_SHELL	28-64
*INITIAL_STRAIN_SHELL	28-67
*INITIAL_STRAIN_SHELL_NURBS_PATCH	28-70
*INITIAL_STRAIN_SOLID	28-73
*INITIAL_STRAIN_SOLID_NURBS_PATCH	28-75
*INITIAL_STRAIN_TSHELL	28-77
*INITIAL_STRESS_BEAM	28-79
*INITIAL_STRESS_DEPTH	28-85
*INITIAL_STRESS_DES	28-87
*INITIAL_STRESS_IGA_SHELL	28-88
*INITIAL_STRESS_SECTION	28-91
*INITIAL_STRESS_SHELL	28-95
*INITIAL_STRESS_SHELL_NURBS_PATCH	28-100
*INITIAL_STRESS_SOLID	28-103
*INITIAL_STRESS_SOLID_NURBS_PATCH	28-108
*INITIAL_STRESS_SPH	28-111
*INITIAL_STRESS_TSHELL	28-112
*INITIAL_TEMPERATURE	28-115
*INITIAL_VAPOR_PART	28-117
*INITIAL_VEHICLE_KINEMATICS	28-118
*INITIAL_VELOCITY	28-121
*INITIAL_VELOCITY_GENERATION	28-124
*INITIAL_VELOCITY_GENERATION_START_TIME	28-128
*INITIAL_VELOCITY_NODE	28-129
*INITIAL_VELOCITY_RIGID_BODY	28-130
*INITIAL_VOID	28-131
*INITIAL_VOLUME_FRACTION	28-132

TABLE OF CONTENTS

*INITIAL_VOLUME_FRACTION_GEOMETRY	28-136
*INTEGRATION	29-1
*INTEGRATION_BEAM	29-2
*INTEGRATION_SHELL	29-16
*INTERFACE.....	30-1
*INTERFACE_ACOUSTIC	30-3
*INTERFACE_BLANKSIZE	30-4
Card Set for *INTERFACE_BLANKSIZE_DEVELOPMENT	30-5
Card Set for *INTERFACE_BLANKSIZE_INITIAL_TRIM	30-10
Card Set for *INTERFACE_BLANKSIZE_INITIAL_ADAPTIVE.....	30-13
Card Set for *INTERFACE_BLANKSIZE_SCALE_FACTOR.....	30-15
Card Set for *INTERFACE_BLANKSIZE_SYMMETRIC_PLANE.....	30-16
Remarks and Examples	30-17
*INTERFACE_COMPENSATION_3D.....	30-34
*INTERFACE_COMPONENT_FILE.....	30-61
*INTERFACE_COMPONENT.....	30-63
*INTERFACE_DE_HBOND	30-66
*INTERFACE_LINKING_DISCRETE_NODE	30-69
*INTERFACE_LINKING_EDGE	30-70
*INTERFACE_LINKING_FILE	30-71
*INTERFACE_LINKING_FORCES	30-72
*INTERFACE_LINKING_NODE	30-73
*INTERFACE_LINKING_SEGMENT	30-77
*INTERFACE_SPG_1	30-78
*INTERFACE_SPG_2	30-79
*INTERFACE_SPRINGBACK	30-80
*INTERFACE_SSI	30-90
*INTERFACE_SSI_AUX	30-95
*INTERFACE_SSI_AUX_EMBEDDED	30-96
*INTERFACE_SSI_STATIC.....	30-98
*INTERFACE_THICKNESS_CHANGE_COMPENSATION	30-100
*INTERFACE_WELDLINE_DEVELOPMENT.....	30-102
*ISPG.....	31-1
*ISPG_ASCII_CPL	31-3
*ISPG_ASCII_SUMFORC	31-4
*ISPG_BOUNDARY_CONVECTION_SET	31-5

TABLE OF CONTENTS

*ISPG_BOUNDARY_SYMMETRY	31-7
*ISPG_CONTROL_ADAPTIVITY	31-8
*ISPG_CONTROL_D3ISPG	31-12
*ISPG_CONTROL_IMPLICIT	31-14
*ISPG_CONTROL_MPP	31-16
*ISPG_CONTROL_SOLUTION	31-17
*ISPG_DAMPING_SURF	31-18
*ISPG_DEFINE_MERGER_MPP	31-19
*ISPG_INITIAL_TEMPERATURE_SET	31-20
*ISPG_LOAD_GRAVITY	31-21
*KEYWORD	32-1
*LOAD	33-1
*LOAD_ACOUSTIC_SOURCE	33-4
*LOAD_ALE_CONVECTION	33-7
*LOAD_BEAM	33-9
*LOAD_BLAST	33-11
*LOAD_BLAST_CLEARING	33-14
*LOAD_BLAST_ENHANCED	33-16
*LOAD_BLAST_SEGMENT	33-23
*LOAD_BLAST_SEGMENT_SET	33-24
*LOAD_BODY	33-25
*LOAD_BODY_GENERALIZED	33-31
*LOAD_BODY_POROUS	33-35
*LOAD_BRODE	33-38
*LOAD_DENSITY_DEPTH	33-40
*LOAD_EDGE_UVW	33-42
*LOAD_ERODING_PART_SET	33-43
*LOAD_EXPANSION_PRESSURE	33-46
*LOAD_EXTERNAL_VARIABLE	33-49
*LOAD_FACE_UVW	33-55
*LOAD_FACE_XYZ	33-56
*LOAD_GRAVITY_PART	33-57
*LOAD_HEAT_CONTROLLER	33-59
*LOAD_HEAT_EXOTHERMIC_REACTION	33-60
*LOAD_HEAT_GENERATION	33-67
*LOAD_MASK	33-69

TABLE OF CONTENTS

*LOAD_MOTION_NODE	33-71
*LOAD_MOVING_PRESSURE	33-73
*LOAD_NODE.....	33-78
*LOAD_NURBS_SHELL	33-82
*LOAD_POINT_UVW	33-89
*LOAD_PYRO_ACTUATOR.....	33-90
*LOAD_PZE.....	33-93
*LOAD_REMOVE_PART.....	33-94
*LOAD_RIGID_BODY	33-96
*LOAD_SEGMENT	33-99
*LOAD_SEGMENT_ALE_INI.....	33-104
*LOAD_SEGMENT_CONTACT_MASK	33-105
*LOAD_SEGMENT_FILE	33-107
*LOAD_SEGMENT_FSILNK	33-109
*LOAD_SEGMENT_NONUNIFORM.....	33-112
*LOAD_SEGMENT_SET	33-115
*LOAD_SEGMENT_SET_ANGLE	33-117
*LOAD_SEGMENT_SET_NONUNIFORM	33-119
*LOAD_SEISMIC_SSI.....	33-122
*LOAD_SEISMIC_SSI_AUX.....	33-127
*LOAD_SHELL	33-129
*LOAD_SPCFORC	33-132
*LOAD_SSA.....	33-133
*LOAD_STEADY_STATE_ROLLING	33-137
*LOAD_STIFFEN_PART	33-141
*LOAD_SUPERPLASTIC_FORMING	33-143
*LOAD_SURFACE_STRESS	33-149
*LOAD_THERMAL.....	33-151
*LOAD_THERMAL_BINOUT	33-153
*LOAD_THERMAL_CONSTANT	33-155
*LOAD_THERMAL_CONSTANT_ELEMENT	33-157
*LOAD_THERMAL_CONSTANT_NODE	33-158
*LOAD_THERMAL_D3PLOT	33-159
*LOAD_THERMAL_LOAD_CURVE	33-160
*LOAD_THERMAL_RSW	33-161
Node defining the tail of the orientation vector (axis of rotation of the ellipsoidal region) and the base for positioning of the nugget. See Remarks 1 and 2.....	33-162

TABLE OF CONTENTS

*LOAD_THERMAL_TOPAZ	33-167
*LOAD_THERMAL_VARIABLE	33-168
*LOAD_THERMAL_VARIABLE_BEAM	33-170
*LOAD_THERMAL_VARIABLE_ELEMENT	33-173
*LOAD_THERMAL_VARIABLE_NODE	33-174
*LOAD_THERMAL_VARIABLE_SHELL	33-175
*LOAD_VOLUME_LOSS	33-177
*MODULE	34-179
*MODULE_LOAD	34-180
*MODULE_PATH	34-182
*MODULE_USE	34-183
*NODE	35-1
*NODE	35-2
*NODE_MERGE_SET	35-4
*NODE_MERGE_TOLERANCE	35-5
*NODE_REFERENCE	35-6
*NODE_RIGID_SURFACE	35-7
*NODE_SCALAR	35-8
*NODE_THICKNESS	35-10
*NODE_TO_TARGET_VECTOR	35-12
*NODE_TRANSFORM	35-13
*PARAMETER	36-1
*PARAMETER	36-2
*PARAMETER_DUPLICATION	36-6
*PARAMETER_EXPRESSION	36-7
*PARAMETER_TYPE	36-11
*PART	37-1
*PART	37-2
*PART_ADAPTIVE_FAILURE	37-16
*PART_ANNEAL	37-17
*PART_COMPOSITE	37-18
*PART_DUPLICATE	37-30
*PART_MODES	37-33
*PART_MOVE	37-38
*PART_SENSOR	37-41

TABLE OF CONTENTS

*PART_STACKED_ELEMENTS	37-42
*PERTURBATION	38-1
*PERTURBATION	38-2
*RAIL	39-1
*RAIL_TRACK	39-2
*RAIL_TRAIN	39-8
*RIGIDWALL	40-1
*RIGIDWALL_FORCE_TRANSDUCER	40-2
*RIGIDWALL_GEOMETRIC	40-4
*RIGIDWALL_PLANAR	40-16
*SECTION	41-1
*SECTION_ALE1D	41-2
*SECTION_ALE2D	41-6
*SECTION_BEAM	41-8
*SECTION_BEAM_AISC	41-32
*SECTION_DISCRETE	41-36
*SECTION_FPD	41-39
*SECTION_IGA_SHELL	41-42
*SECTION_IGA_SOLID	41-46
*SECTION_ISPG	41-47
*SECTION_POINT_SOURCE	41-49
*SECTION_POINT_SOURCE_MIXTURE	41-52
*SECTION_SEATBELT	41-58
*SECTION_SHELL	41-60
*SECTION_SOLID	41-83
*SECTION_SOLID_PERI	41-106
*SECTION_SPH	41-108
*SECTION_TSHELL	41-112
*SENSOR	42-1
*SENSOR_CONTROL	42-4
*SENSOR_CPM_AIRBAG	42-10
*SENSOR_DEFINE_CALC-MATH	42-12
*SENSOR_DEFINE_ELEMENT	42-15
*SENSOR_DEFINE_FORCE	42-21
*SENSOR_DEFINE_FUNCTION	42-25

TABLE OF CONTENTS

*SENSOR_DEFINE_MISC	42-27
*SENSOR_DEFINE_NODE	42-31
*SENSOR_SWITCH.....	42-35
*SENSOR_SWITCH_CALC-LOGIC.....	42-36
*SENSOR_SWITCH_SHELL_TO_VENT	42-38
*SET.....	43-1
*SET_BEAM	43-3
*SET_BEAM_ADD	43-7
*SET_BEAM_INTERSECT	43-8
*SET_BOX	43-9
*SET_DISCRETE	43-10
*SET_DISCRETE_ADD	43-14
*SET_IGA_EDGE	43-15
*SET_IGA_FACE.....	43-19
*SET_IGA_POINT_UVW	43-23
*SET_MODE	43-27
*SET_MULTI.....	43-29
*SET_MULTI-MATERIAL_GROUP_LIST	43-29
*SET_NODE.....	43-31
*SET_NODE_ADD	43-39
*SET_NODE_INTERSECT	43-41
*SET_PART	43-42
*SET_PART_ADD	43-48
*SET_PART_TREE.....	43-50
*SET_PERI_LAMINATE	43-52
*SET_SEGMENT	43-53
*SET_SEGMENT_ADD	43-61
*SET_SEGMENT_INTERSECT	43-62
*SET_SHELL	43-63
*SET_SHELL_ADD	43-70
*SET_SHELL_INTERSECT	43-71
*SET_SOLID	43-72
*SET_SOLID_ADD.....	43-78
*SET_SOLID_INTERSECT.....	43-79
*SET_TSHELL	43-80
*SET_2D_SEGMENT	43-84

TABLE OF CONTENTS

*RVE	44-1
*RVE_ANALYSIS_FEM	44-2
*TERMINATION	45-1
*TERMINATION_BODY	45-2
*TERMINATION_CONTACT	45-3
*TERMINATION_CURVE	45-4
*TERMINATION_DELETED_SHELLS	45-5
*TERMINATION_DELETED_SOLIDS	45-6
*TERMINATION_NODE	45-7
*TERMINATION_SENSOR	45-8
*TITLE	46-1
*UNIT	47-1
*UNIT_DEFAULTS	47-2
*UNIT_DERIVED	47-5
*UNIT_AMOUNT	47-7
*UNIT_ANGLE	47-8
*UNIT_ELECTRIC_CURRENT	47-9
*UNIT_LENGTH	47-10
*UNIT_LUMINOUS_INTENSITY	47-11
*UNIT_MASS	47-12
*UNIT_SYSTEM	47-13
*UNIT_TEMPERATURE	47-14
*UNIT_TIME	47-15
*USER	48-1
*USER_GET_HISTORY	48-2
*USER_INTERFACE	48-5
*USER_LOADING	48-9
*USER_LOADING_SET	48-10
*USER_NONLOCAL_SEARCH	48-13
Restart Input Data	49-1
*CHANGE	49-4
BOUNDARY_CONDITION	49-4
CONTACT_SMALL_PENETRATION	49-5
CURVE_DEFINITION	49-5
OUTPUT	49-6

TABLE OF CONTENTS

<i>RIGIDWALL_GEOMETRIC</i>	49-6
<i>RIGIDWALL_PLANAR</i>	49-6
<i>RIGID_BODY_CONSTRAINT</i>	49-6
<i>RIGID_BODY_INERTIA</i>	49-7
<i>RIGID_BODY_STOPPERS</i>	49-8
<i>STATUS_REPORT_FREQUENCY</i>	49-10
<i>THERMAL_PARAMETERS</i>	49-11
<i>VELOCITY</i>	49-12
<i>VELOCITY_GENERATION</i>	49-13
<i>VELOCITY_NODE</i>	49-13
<i>VELOCITY_RIGID_BODY</i>	49-14
<i>VELOCITY_ZERO</i>	49-15
*CONTROL_DYNAMIC_RELAXATION	49-16
*CONTROL_SHELL	49-18
*CONTROL_TERMINATION	49-20
*CONTROL_TIMESTEP	49-21
*DAMPING_GLOBAL	49-23
*DATABASE	49-24
*DATABASE_BINARY	49-26
*DELETE	49-27
*INTERFACE_SPRINGBACK_LSDYNA	49-29
*RIGID_DEFORMABLE	49-31
*RIGID_DEFORMABLE_CONTROL	49-32
*RIGID_DEFORMABLE_D2R	49-33
*RIGID_DEFORMABLE_R2D	49-34
*STRESS_INITIALIZATION	49-35
*TERMINATION	49-37
*TITLE	49-40
REFERENCES	50-1
APPENDIX A: User-Defined Materials	51-1
Getting Started with User-Defined Features	51-1
Download	51-1
Static or dynamic linking	51-1
Compiler and compiling	51-2
Execution	51-3
Coding	51-4

TABLE OF CONTENTS

Module concept	51-4
General Overview of User-Defined Materials	51-6
Additional Features	51-11
Load curves and tables	51-11
Local coordinate system.....	51-12
Temperature.....	51-13
Failure.....	51-13
Deformation gradient	51-13
Implicit analysis.....	51-18
User-defined materials with equations-of-state	51-21
Post-processing a user-defined material	51-23
APPENDIX B: User-Defined Equation-of-State	52-1
General overview	52-1
Example and Discussion.....	52-2
APPENDIX C: User-Defined Element Interface for Solids and Shells	53-1
Algorithm Outline	53-1
Invoking User-Defined Elements	53-2
Integrated Elements.....	53-2
Resultant/Discrete Elements	53-5
Additional Features of User-Defined Elements	53-6
Nodal Fiber Vectors	53-6
Extra Degrees-Of-Freedom	53-6
Section Keywords	53-8
The *SECTION_SHELL Card.....	53-8
The *SECTION_SOLID Card	53-10
Sample User Shell Element 101 (Belytschko-Tsay shell)	53-11
Sample User Solid Element 101 (constant stress solid).....	53-14
Examples.....	53-18
APPENDIX D: User Defined Airbag Sensor	54-1
APPENDIX E: User Defined Solution Control	55-1
APPENDIX F: User Defined Interface Control.....	56-1
APPENDIX G: User Defined Interface Friction and Conductivity	57-1
APPENDIX H: User-Defined Thermal Material Model.....	58-1
APPENDIX I: Occupant Simulation Including the Coupling to the CAL3D and MADYMO programs....	59-1

TABLE OF CONTENTS

INTRODUCTION	59-1
THE LS-DYNA/OCCUPANT SIMULATION PROGRAM LINK.....	59-1
AIRBAG MODELING	59-2
COMMON ERRORS.....	59-3
APPENDIX J: Interactive Graphics Commands.....	60-1
APPENDIX K: Interactive Material Model Driver	61-1
INTRODUCTION	61-1
INPUT DEFINITION	61-1
INTERACTIVE DRIVER COMMANDS	61-2
APPENDIX L: VDA Database	62-1
APPENDIX M: Commands for Two-Dimensional Rezoning	63-1
APPENDIX N: Rigid-Body Dummies.....	64-1
APPENDIX O: LS-DYNA MPP User Guide	65-1
Supported Features	65-1
Contact Interfaces.....	65-1
Output Files and Post-Processing.....	65-2
Parallel Specific Options.....	65-4
PFILE.....	65-4
Execution of MPP/LS-DYNA	65-15
APPENDIX P: Implicit Solver.....	66-1
Introduction	66-1
Nonlinear Implicit Analysis	66-2
Linear Equation Solver	66-12
Elements and Materials.....	66-16
Contacts.....	66-17
Troubleshooting Convergence Problems	66-22
Checklist	66-25
APPENDIX Q: User Defined Weld Failure	67-1
APPENDIX R: User Defined Cohesive Model	68-1
APPENDIX S: User Defined Boundary Flux	69-1
APPENDIX T: Metal Forming Glossary	70-1
A Typical DRAW DIE engineering PROCESS	70-1
Types of draw dies.....	70-3

TABLE OF CONTENTS

Types of flanging dies.....	70-4
Types of hemming dies.....	70-4
APPENDIX U: RESERVED VARIABLE NAMES.....	71-1
Appendix V: How to Read Card Summaries	73-1
Motivation for Introducing the Card Summary Section.....	73-2
“Optional” Cards (How LS-DYNA Parses Blank Lines).....	73-3
The Structure of Manual Entries.....	73-4
Summary Table Format	73-5
Example 1.....	73-6
Example 2.....	73-7
Example 3.....	73-8
Default Values for Data Cards.....	73-9
Appendix W: Acoustic Volume Element and Spectral Element Solvers	74-1
Explicit Transient Acoustic Spectral Element Solutions.....	74-2
Implicit Direct Steady State Acoustic FE Solutions.....	74-4
Appendix X: Multistage Analysis.....	75-1
Why Use Stages.....	75-1
Example of Splitting into Stages.....	75-2
The “dynain” approach	75-3
Formats	75-4
LSDA format.....	75-4
Exporting Data	75-7
Outputting Data with *INTERFACE_SPRINGBACK_LSDYNA.....	75-7
PSID = 999.....	75-7
NSHV = 999	75-8
FTYPE = 3	75-9
NDFLAG = 1	75-9
CFLAG = 1	75-9
HFLAG = 1	75-11
Boundary Conditions	75-12
Importing data.....	75-12
Excluding Parts in Subsequent Stages	75-12
Changing Element and Material Types.....	75-14
Inertia Properties of Rigid Bodies	75-15
Deformation Gradient and Stress Update	75-17

TABLE OF CONTENTS

Contact	75-17
Stabilization Forces.....	75-20
Cases	75-20
APPENDIX Y: LS-DYNA HYBRID User Guide	76-1
INTRODUCTION	76-1
LS-DYNA HYBRID Version	76-2
Performance and Scalability	76-2
Output Consistency	76-3
Supported Features	76-4
Contact Interfaces.....	76-4
Output Files and Post-Processing.....	76-4
Parallel Specific Options.....	76-4
PFILE.....	76-4
Execution of LS-DYNA HYBRID	76-4

