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Schema Reference Manual

Version 1.0

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PREFACE

The following document is patterned after (and much of it is copied directly from):

Technical Report C90-01
September 1990

Center for Seismic Studies
Version 3 Database:
Schema Reference Manual

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The present document, however, is derived directly from the schema file used by JSPC's software. Both this document and the schema differ somewhat from the original Technical Report from CSS.

This document differs in the following ways:

- Tables and attributes not used in the data set have been deleted.
- References to the ORACLE database representation are removed.

The schema differs in the following ways:

- The null values for belief and slores attributes in the assoc relation were changed since the original null value would not fit in the space reserved in the fixed format record.
- The *segtype* field in the wfdisc table, and the *rsptype* field in the instrument table have been perverted. Instead of their original meaning, these two fields are used to represent the "natural" units of the instrument, typically velocity instead of displacement. This field can take three legal values:

value	units
A	nm/s^2
V	nm/s
D	nm

Thus, a "V" in this field means that the units of the waveform (after *calib* is applied) are nm/s. For compatibility with the standard CSS database, if any other value (besides 'A', 'V', or 'D') appears, the units are assumed to be displacement (nm).

1.0 INTRODUCTION

This volume describes the schema of the JSPC Version 3.0 database. It is the current standard for data and software at JSPC. It derives directly from the Version 3.0 database at the Center for Seismic Studies.

The evolution of Version 3.0 and the philosophy motivating its design are briefly described in this first chapter, but the major objective of this volume is satisfied by the detailed descriptions of the Version 3.0 database structure, relations, and attributes which appear in chapters 2, 3 and 4.

1.1. HISTORICAL BACKGROUND

Application of relational database technology by the seismic monitoring community is now almost a decade old.[1] The initial work was done by Lawrence Berkeley Laboratory and the Discrimination Group at Lincoln Laboratories in the early 1980's. This work was continued by S-Cubed staff working at the Center for Seismic Studies in 1982-83, culminating with the release of Version 2.6[2] which was in general use at the Center for Seismic Studies by late-1983. Version 2.7, released in 1984, made some additions and changes to accommodate the needs of the 1984 GSE Technical Test.

When these early versions were designed, the emphasis was primarily on teleseismic events and most of the data were acquired and stored on tapes. Researchers did not interact directly with the database, but used standard utilities which copied the data of interest from the database into flat files. As far as software development was concerned, the major effect of the database structure was to standardize formats for data used by a wide variety of programs.

Version 2.8[3] was designed in 1987 to meet the needs of the Intelligent Array System (*IAS*). The *IAS* was a significant departure from previous systems in that it processed near real-time data automatically and used the database directly, accessing data with embedded SQL. The *IAS* performance requirements (particularly for interactive analysis) introduced some important new design considerations, and *IAS* operation in 1989 provided valuable practical experience with the issues involved.

The NMRD project began in 1989 with a comprehensive modernization of the Center database management system as an important objective. A new database structure was required to take advantage of past experience to support all classes of users (ranging from automated and interactive processing of near real-time data to database construction for off-line research projects). The new structure was also motivated by the need to handle regional and teleseismic data equally well. The initial version of the new structure was called Version 2.9. However, as the design matured, it became clear that this was a major upgrade that is more properly called Version 3.0

Some of the most important limitations of earlier versions that are addressed by Version 3.0 include:

- A simpler structure was needed to facilitate use by the scientific research community. Evolution over time had resulted in complex data structures not supported by the current ANSI SQL standard. This complicates access (particularly for interactive users) and maintenance.

- The most recent structure (Version 2.8) retained most of the relations used for teleseismic data and added new relations tailored specifically for arrays and *IAS* processing. Thus, there is significant duplication of information in different relations, and no convenient structures for supporting more general processing. Also, important features of three-component data are neglected.

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[1] For a review of the considerations motivating the original design, see "A Seismological Data Base Management System" by J. Berger, R.G. North, R.C. Goff, and M.A. Tiberio in *BSSA*, Vol. 74, pp. 1849-1862.

[2] J. Berger, R.C. Goff, R.G. North, W.E. Farrell, M.A. Tiberio, B. Shkoller, *Center for Seismic Studies: Prototype Design and Development*, S-Cubed Final Report, Task IV, Volume I, 1983.

[3] M.A. Brennan, *Center for Seismic Studies Database Structure Version 2.8*, Center for Seismic Studies Technical Report C87-04, September, 1987

- Earlier versions could not manage properly the temporally varying changes in instrument calibration.

In summary, Version 3.0 is designed to provide a database structure which facilitates the wide range of applications supported at the Center for Seismic Studies, including real-time and interactive processing, maintenance of a historical data archive, and support for seismological research. The objective is not to provide specific structures that support all applications, but to provide a framework that all applications can share.

1.2. DESCRIPTION OF VERSION 3.0

1.2.1. Design Philosophy

The major principles followed in the design of Version 3.0 are as follows:

Separate core tables which are of general interest from application-specific tables which store application-specific and/or intermediate results.

- Design the core relations to encourage interactive and embedded SQL access by the scientific community; that is, make them readable and compatible with seismological conventions.
- Complex data structures and relationships are to be limited to application-specific tables.

1.2.2. Basic Structure of Version 3.0

There are 21 relations in the core set in Version 3.0. These are separated into "Primary" and "Lookup" relations. The 11 Primary relations are dynamic and contain attributes used in automated and interactive processing (e.g., seismic arrivals, event locations). The 10 Lookup tables change infrequently and are used for auxiliary information used by the processing (e.g., station locations). In general terms, the information stored in the core relations includes:

- arrivals (seismic signals)
- events, origins, association of arrivals
- magnitude information
- station information (networks, site descriptions, instrument responses)
- pointers to disk and tape files storing waveform data
- attributes describing the contents of the dynamic relations
- administrative data (counters, seismic and geographic regions)

1.2.3. User Support for Version 3.0

The JSPC database is represented as a collection of plain files on a UNIX filesystem. JSPC provides a library of routines to simplify use of the database from within a program, as well as tools for inspection and manipulation of the data.

The library routines are available for both c and FORTRAN applications, and include functions for:

- reading and writing database fields, records and tables.
- joins, sorts, projections and views.
- error handling routines

This library is intended to limit the duplicate development of database access routines by many users. The library may be used by either C or FORTRAN applications.

The remainder of this volume consists of three Chapters:

Chapter 2 *Database Structure*
Each relation is defined.

Chapter 3 *Database Relations*
The logical design of the database is expressed in Entity-Relationship diagrams and each relation is described to identify the key fields and the links among the relations.

Chapter 4 *Database Attributes*
Each attribute is described.

In each chapter database relations are always printed boldface, and database attributes are always printed italicized.

2.0 DATABASE STRUCTURE

This chapter defines the physical structure of each table, in its flat file representation. The name of the relation appears in bold print at the top. Exactly one blank separates fields in these files, and one linefeed separates records. This improves readability and makes it easier for C programs to scan the records.

Each field has a an associated "type", recognized by the library routines. These basic data types, and their corresponding representation in C and FORTRAN library interfaces are shown below:

type	C	FORTRAN
string	char *	character *(*)
time	double	real *8
real	double	real *8
integer	int	integer
yearday	int	integer
date	char *	character *(*)

Fields of type *time* are represented as epoch times -- seconds since January 1, 1970. *Yearday* fields are of the form YYYYDDD. Eg. 1988080 represents day 80 of the year 1988, or February 29, 1988. *Date* fields are typically written as MM/DD/YYYY, but this format is not required. A library of routines which simplifies the conversions among these various representations of time is provided; see epoch(3) and epoch(3f).

All floating point values are represented in double precision by the db library.

The "print format" of each field is given in C printf style. All numeric entries are right justified and all character strings are left justified. Having the field number quickly accessible is useful when writing *awk* and shell scripts.

Relation:		**affiliation**			
Description:		Network station affiliations			
field name	no.	type	print format	character positions	attribute description
net	1	string	%-8s	1-8	unique network identifier
sta	2	string	%-6s	10-15	station
lddate	3	string	%-17s	17-33	load date

Relation:		**arrival**			
Description:		Summary information on a seismic arrival			
field name	no.	type	print format	character positions	attribute description
sta	1	string	%-6s	1-6	station
time	2	time	%17.5lf	8-24	epoch time of first sample in file
arid	3	integer	%8d	26-33	arrival id
jdate	4	yearday	%8d	35-42	julian date
stassid	5	integer	%8d	44-51	stassoc id
chanid	6	integer	%8d	53-60	channel operation id
chan	7	string	%-8s	62-69	channel
iphase	8	string	%-8s	71-78	reported phase
stype	9	string	%-1s	80-80	signal type
deltim	10	real	%6.3lf	82-87	delta time
azimuth	11	real	%7.2lf	89-95	observed azimuth
delaz	12	real	%7.2lf	97-103	delta azimuth
slow	13	real	%7.2lf	105-111	observed slowness (s/deg)
delslo	14	real	%7.2lf	113-119	delta slowness
ema	15	real	%7.2lf	121-127	emergence angle
rect	16	real	%7.3lf	129-135	rectilinearity
amp	17	real	%10.1lf	137-146	amplitude, instrument corrected, nm
per	18	real	%7.2lf	148-154	period
logat	19	real	%7.2lf	156-162	log(amp/per)
clip	20	string	%-1s	164-164	clipped flag
fm	21	string	%-2s	166-167	first motion
snr	22	real	%10.2lf	169-178	signal to noise ratio
qual	23	string	%-1s	180-180	signal onset quality
auth	24	string	%-15s	182-196	source/originator
commid	25	integer	%8d	198-205	comment id
lddate	26	string	%-17s	207-223	load date

Relation:		assoc			
Description:		Data associating arrivals with origins			
field name	no.	type	print format	character positions	attribute description
arid	1	integer	%8d	1-8	arrival id
orid	2	integer	%8d	10-17	origin id
sta	3	string	%-6s	19-24	station
phase	4	string	%-8s	26-33	associated phase
belief	5	real	%4.2lf	35-38	phase confidence
delta	6	real	%8.3lf	40-47	station to event distance
seaz	7	real	%7.2lf	49-55	station to event azimuth
esaz	8	real	%7.2lf	57-63	event to station azimuth
timeres	9	real	%8.3lf	65-72	time residual
timedef	10	string	%-1s	74-74	time = defining, non-defining
azres	11	real	%7.1lf	76-82	azimuth residual
azdef	12	string	%-1s	84-84	azimuth = defining, non-defining
slores	13	real	%7.2lf	86-92	slowness residual
slodef	14	string	%-1s	94-94	slowness = defining, non-defining
emares	15	real	%7.1lf	96-102	incidence angle residual
wgt	16	real	%6.3lf	104-109	location weight
vmodel	17	string	%-15s	111-125	velocity model
commid	18	integer	%8d	127-134	comment id
lddate	19	string	%-17s	136-152	load date

Relation:		event			
Description:		Event identification			
field name	no.	type	print format	character positions	attribute description
evid	1	integer	%8d	1-8	event id
evname	2	string	%-15s	10-24	event name
prefor	3	integer	%8d	26-33	preferred origin
auth	4	string	%-15s	35-49	source/originator
commid	5	integer	%8d	51-58	comment id
lddate	6	string	%-17s	60-76	load date

Relation:		instrument			
Description:		Generic (default) calibration information about a station			
field name	no.	type	print format	character positions	attribute description
inid	1	integer	%8d	1-8	instrument id
insname	2	string	%-50s	10-59	instrument name
instype	3	string	%-6s	61-66	instrument code
band	4	string	%-1s	68-68	frequency band
digital	5	string	%-1s	70-70	(d,a) analog
samprate	6	real	%11.7lf	72-82	sampling rate in samples/sec
ncalib	7	real	%16.6lf	84-99	nominal calibration
ncalper	8	real	%16.6lf	101-116	nominal calibration period
dir	9	string	%-64s	118-181	directory
dfile	10	string	%-32s	183-214	data file
rsptype	11	string	%-6s	216-221	response type
lddate	12	string	%-17s	223-239	load date

Relation:		lastid			
Description:		Counter values (Last value used for keys)			
field name	**no.**	**type**	**print format**	**character positions**	**attribute description**
keyname	1	string	%-15s	1-15	id name (arid, orid, etc.)
keyvalue	2	integer	%8d	17-24	last value used for that id
lddate	3	string	%-17s	26-42	load date

Relation:		netmag			
Description:		Network magnitude			
field name	**no.**	**type**	**print format**	**character positions**	**attribute description**
magid	1	integer	%8d	1-8	magnitude id
net	2	string	%-8s	10-17	unique network identifier
orid	3	integer	%8d	19-26	origin id
evid	4	integer	%8d	28-35	event id
magtype	5	string	%-6s	37-42	magnitude type (ml, ms, mb, etc.)
nsta	6	integer	%8d	44-51	number of stations used
magnitude	7	real	%7.2lf	53-59	magnitude
uncertainty	8	real	%7.2lf	61-67	magnitude uncertainty
auth	9	string	%-15s	69-83	source/originator
commid	10	integer	%8d	85-92	comment id
lddate	11	string	%-17s	94-110	load date

Relation:		network			
Description:		Network description and identification			
field name	**no.**	**type**	**print format**	**character positions**	**attribute description**
net	1	string	%-8s	1-8	unique network identifier
netname	2	string	%-80s	10-89	network name
nettype	3	string	%-4s	91-94	network type, array, local, world-wide, etc.
auth	4	string	%-15s	96-110	source/originator
commid	5	integer	%8d	112-119	comment id
lddate	6	string	%-17s	121-137	load date

Relation:	origerr				
Description:	Summary of confidence bounds in origin estimations				
field name	no.	type	print format	character positions	attribute description
orid	1	integer	%8d	1-8	origin id
sxx	2	real	%15.4lf	10-24	covariance matrix element
syy	3	real	%15.4lf	26-40	covariance matrix element
szz	4	real	%15.4lf	42-56	covariance matrix element
stt	5	real	%15.4lf	58-72	covariance matrix element
sxy	6	real	%15.4lf	74-88	covariance matrix element
sxz	7	real	%15.4lf	90-104	covariance matrix element
syz	8	real	%15.4lf	106-120	covariance matrix element
stx	9	real	%15.4lf	122-136	covariance matrix element
sty	10	real	%15.4lf	138-152	covariance matrix element
stz	11	real	%15.4lf	154-168	covariance matrix element
sdobs	12	real	%9.4lf	170-178	standard error of observation
smajax	13	real	%9.4lf	180-188	semi-major axis of error
sminax	14	real	%9.4lf	190-198	semi-minor axis of error
strike	15	real	%6.2lf	200-205	strike of the semi-major axis
sdepth	16	real	%9.4lf	207-215	depth error
stime	17	real	%8.2lf	217-224	origin time error
conf	18	real	%5.3lf	226-230	confidence
commid	19	integer	%8d	232-239	comment id
lddate	20	string	%-17s	241-257	load date

Relation:		origin			
Description:		Data on event location and confidence bounds			
field name	**no.**	**type**	**print format**	**character positions**	**attribute description**
lat	1	real	%9.4lf	1-9	estimated latitude
lon	2	real	%9.4lf	11-19	estimated longitude
depth	3	real	%9.4lf	21-29	estimated depth
time	4	time	%17.5lf	31-47	epoch time of first sample in file
orid	5	integer	%8d	49-56	origin id
evid	6	integer	%8d	58-65	event id
jdate	7	yearday	%8d	67-74	julian date
nass	8	integer	%4d	76-79	number of associated phases
ndef	9	integer	%4d	81-84	number of locating phases
ndp	10	integer	%4d	86-89	number of depth phases
grn	11	integer	%8d	91-98	geographic region number
srn	12	integer	%8d	100-107	seismic region number
etype	13	string	%-7s	109-115	event type
depdp	14	real	%9.4lf	117-125	estimated depth from depth phases
dtype	15	string	%-1s	127-127	depth method used
mb	16	real	%7.2lf	129-135	body wave magnitude
mbid	17	integer	%8d	137-144	mb magid
ms	18	real	%7.2lf	146-152	surface wave magnitude
msid	19	integer	%8d	154-161	ms magid
ml	20	real	%7.2lf	163-169	local magnitude
mlid	21	integer	%8d	171-178	ml magid
algorithm	22	string	%-15s	180-194	location algorithm used
auth	23	string	%-15s	196-210	source/originator
commid	24	integer	%8d	212-219	comment id
lddate	25	string	%-17s	221-237	load date

Relation:		remark			
Description:		Comments			
field name	**no.**	**type**	**print format**	**character positions**	**attribute description**
commid	1	integer	%8d	1-8	comment id
lineno	2	integer	%8d	10-17	comment line number
remark	3	string	%-80s	19-98	free format comment
lddate	4	string	%-17s	100-116	load date

Relation:		sensor			
Description:		Specific calibration information for physical channels			
field name	no.	type	print format	character positions	attribute description
sta	1	string	%-6s	1-6	station
chan	2	string	%-8s	8-15	channel
time	3	time	%17.5lf	17-33	epoch time of first sample in file
endtime	4	time	%17.5lf	35-51	last valid time for data
inid	5	integer	%8d	53-60	instrument id
chanid	6	integer	%8d	62-69	channel operation id
jdate	7	yearday	%8d	71-78	julian date
calratio	8	real	%16.6lf	80-95	calibration
calper	9	real	%16.6lf	97-112	nominal calibration period
tshift	10	real	%6.2lf	114-119	correction of data processing time
instant	11	string	%-1s	121-121	(y,n) discrete/continuing snapshot
lddate	12	string	%-17s	123-139	load date

Relation:		site			
Description:		Station location information			
field name	no.	type	print format	character positions	attribute description
sta	1	string	%-6s	1-6	station
ondate	2	integer	%8d	8-15	Julian start date
offdate	3	integer	%8d	17-24	Julian off date
lat	4	real	%9.4lf	26-34	estimated latitude
lon	5	real	%9.4lf	36-44	estimated longitude
elev	6	real	%9.4lf	46-54	elevation
staname	7	string	%-50s	56-105	station description
statype	8	string	%-4s	107-110	station type: single station, virt. array, etc.
refsta	9	string	%-6s	112-117	reference station for array members
dnorth	10	real	%9.4lf	119-127	offset from array reference (km)
deast	11	real	%9.4lf	129-137	offset from array reference (km)
lddate	12	string	%-17s	139-155	load date

Relation:		sitechan			
Description:		Station-channel information			
field name	no.	type	print format	character positions	attribute description
sta	1	string	%-6s	1-6	station
chan	2	string	%-8s	8-15	channel
ondate	3	integer	%8d	17-24	Julian start date
chanid	4	integer	%8d	26-33	channel operation id
offdate	5	integer	%8d	35-42	Julian off date
ctype	6	string	%-4s	44-47	channel type
edepth	7	real	%9.4lf	49-57	emplacement depth
hang	8	real	%6.1lf	59-64	horizontal angle
vang	9	real	%6.1lf	66-71	vertical angle
descrip	10	string	%-50s	73-122	channel description
lddate	11	string	%-17s	124-140	load date

Relation:	stamag				
Description:	Station magnitude				
field name	**no.**	**type**	**print format**	**character positions**	**attribute description**
magid	1	integer	%8d	1-8	magnitude id
sta	2	string	%-6s	10-15	station
arid	3	integer	%8d	17-24	arrival id
orid	4	integer	%8d	26-33	origin id
evid	5	integer	%8d	35-42	event id
phase	6	string	%-8s	44-51	associated phase
magtype	7	string	%-6s	53-58	magnitude type (ml, ms, mb, etc.)
magnitude	8	real	%7.2lf	60-66	magnitude
uncertainty	9	real	%7.2lf	68-74	magnitude uncertainty
auth	10	string	%-15s	76-90	source/originator
commid	11	integer	%8d	92-99	comment id
lddate	12	string	%-17s	101-117	load date

Relation:	stassoc				
Description:	Arrivals from a single station grouped into an event				
field name	**no.**	**type**	**print format**	**character positions**	**attribute description**
stassid	1	integer	%8d	1-8	stassoc id
sta	2	string	%-6s	10-15	station
etype	3	string	%-7s	17-23	event type
location	4	string	%-32s	25-56	apparent location description
dist	5	real	%7.2lf	58-64	estimated distance
azimuth	6	real	%7.2lf	66-72	observed azimuth
lat	7	real	%9.4lf	74-82	estimated latitude
lon	8	real	%9.4lf	84-92	estimated longitude
depth	9	real	%9.4lf	94-102	estimated depth
time	10	time	%17.5lf	104-120	epoch time of first sample in file
imb	11	real	%7.2lf	122-128	initial estimated mb
ims	12	real	%7.2lf	130-136	initial estimated ms
iml	13	real	%7.2lf	138-144	initial estimated ml
auth	14	string	%-15s	146-160	source/originator
commid	15	integer	%8d	162-169	comment id
lddate	16	string	%-17s	171-187	load date

Relation:	wfdisc				
Description:	Waveform file header and descriptive information				

field name	no.	type	print format	character positions	attribute description
sta	1	string	%-6s	1-6	station
chan	2	string	%-8s	8-15	channel
time	3	time	%17.5lf	17-33	epoch time of first sample in file
wfid	4	integer	%8d	35-42	waveform id
chanid	5	integer	%8d	44-51	channel operation id
jdate	6	yearday	%8d	53-60	julian date
endtime	7	time	%17.5lf	62-78	last valid time for data
nsamp	8	integer	%8d	80-87	number of samples
samprate	9	real	%11.7lf	89-99	sampling rate in samples/sec
calib	10	real	%16.6lf	101-116	nominal calibration
calper	11	real	%16.6lf	118-133	nominal calibration period
instype	12	string	%-6s	135-140	instrument code
segtype	13	string	%-1s	142-142	indexing method
datatype	14	string	%-2s	144-145	numeric storage
clip	15	string	%-1s	147-147	clipped flag
dir	16	string	%-64s	149-212	directory
dfile	17	string	%-32s	214-245	data file
foff	18	integer	%10d	247-256	byte offset
commid	19	integer	%8d	258-265	comment id
lddate	20	string	%-17s	267-283	load date

3.0 DATABASE RELATIONS

This chapter describes the relations that comprise the Version 3.0 Schema. The information given here, along with that in Chapter 4, *Database Attributes*, constitutes the data dictionary. There is an entry for each relation. Within the entry, the relation's name appears first, followed by a list of its key attributes. A brief description completes the entry. Key attributes link relations. The following tableau explains the format used in the entries.

Name: This is the name of the relation.

Keys: Primary. These are the attributes which, taken together, uniquely identify a row in the table.
Alternate. These are other attributes which also uniquely identify a row and may be used as primary keys.
Foreign. These attributes are primary keys in another table.

Description: This paragraph describes the relation.

Keys provide the links by which tables are joined. The following definitions explain the several types of keys.

A primary key (which often is the concatenation of several attributes) uniquely identifies a row in the table. For example, each **origin** record is unique by *lat, lon, depth*, and *time*.

An alternate key also uniquely identifies a row in the table and may be used as the primary key. For example, *orid* may also be used as the primary key for the **origin** table.

A foreign key is another table's primary key. Thus, *evid* is a foreign key in the **origin** table, but is the primary key in the **event** table. Similarly, *commid* is a foreign key in many of the tables and the primary key in **remark**.

Name:	**affiliation**	
Keys:	Primary:	sta
	Foreign:	net

Description: This is an intermediate relation by which seismic stations may be clustered into networks.

Name:	**arrival**	
Keys:	Primary:	sta time
	Alternate:	arid
	Foreign:	stassid chanid commid

Description: Information characterizing a 'seismic phase' observed at a particular station is saved here. Many of the attributes conform to seismological convention and are listed in earthquake catalogs.

Name:	**assoc**	
Keys:	Primary:	arid orid
	Foreign:	arid orid commid

Description: This table has information that connects arrivals (i.e., entries in the arrival relation) to a particular origin. It has a composite key made of arid and orid. There are two kinds of measurement data: three attributes are related to the station (delta, seaz, esaz), and the remaining measurement attributes are jointly determined by the measurements made on the seismic wave (arrival), and the inferred event's origin (origin). The attribute sta is intentionally duplicated in this table to eliminate the need for a join with arrival when doing a lookup on station.

Name:	**event**	
Keys:	Primary:	evid
	Foreign:	commid

Description: The purpose of this relation is to allow the connection of multiple origins to one event. Prefor points to the preferred origin.

Name:	**instrument**	
Keys:	Primary:	inid

Description: This table serves three purposes. It holds nominal one-frequency calibration factors for each instrument. It holds pointers to the nominal frequency-dependent calibration for an instrument. Finally, it holds pointers to the exact calibrations obtained by direct measurement on a particular instrument. See sensor.

Name:	**lastid**	
Keys:	Primary:	keyname
Description:	This relation is a reference table from which programs may retrieve the last sequential value of one of the numeric keys. Unique keys are required before inserting a record in numerous tables. The table has exactly one row for each keyname. In the core schema there are just 9 distinct identifier keys: arid, chanid, commid, evid, inid, magid, orid, stassid, wfid. This table will also support application-specific keys as needed. Users are encouraged to use the dbgetcounter library routine to obtain a counter value.	

Name:	**netmag**	
Keys:	Primary:	magid
	Foreign:	evid net orid commid
Description:	This table summarizes estimates of network magnitudes of different types for an event. Each network magnitude has a unique magid. Station magnitudes used to compute the network magnitude are in the relation stamag.	

Name:	**network**	
Keys:	Primary:	net
	Foreign:	commid
Description:	This relation gives general information about seismic networks. See affiliation.	

Name:	**origerr**	
Keys:	Primary:	orid
	Foreign:	commid
Description:	The error estimates associated with the parameters in the origin relation are saved in this table. The measurement attributes are the elements of the location covariance matrix. The descriptive attributes, which are more meaningful, describe the uncertainities in location, depth and origin time. These quantities are calculated from the covariance matrix, assuming gaussian errors and a confidence level conf.	

Name:	**origin**	
Keys:	Primary:	time lat lon depth
	Alternate:	orid
	Foreign:	evid commid
Description:	Information describing a derived or reported origin for a particular event is stored in this table.	

Name:	**remark**	
Keys:	Primary:	commid lineno
Description:	This relation may be used to store free-form comments that embellish records of other relations. The commid field in many relations refers to a tuple in the remark table. If commid is null (-1) in a tuple of any other relation, there are no comments stored for that tuple.	

Name:	**sensor**	
Keys:	Primary:	sta chan time endtime
	Foreign:	inid
Description:	This table provides a record of updates in the calibration factor or clock error of each instrument, and links a sta/chan/time to a complete instrument response in the relation instrument.	

Name:	**site**	
Keys:	Primary:	sta ondate offdate
Description:	Site names and describes a point on the earth where seismic measurements are made (e.g. the location of a seismic instrument or array). It contains information that normally changes infrequently, such as location. In addition, site contains fields to describe the offset of a station relative to an array reference location. Global data integrity implies that the sta/ondate in site be consistent with the sta/chan/ondate in sitechan.	

Name:	**sitechan**	
Keys:	Primary:	sta chan ondate offdate
	Alternate:	chanid
Description:	This relation describes the orientation of a recording channel at the site referenced by sta. This relation provides information about the various channels (e.g. sz, lz, iz) that are available at a station and maintains a record of the physical channel configuration at a site.	

Name:	**stamag**	
Keys:	Primary:	magid sta
	Foreign:	arid orid evid commid
Description:	This table summarizes station magnitude estimates based upon measurements made on specific seismic phases. See netmag.	

Name:	**stassoc**	
Keys:	Primary:	stassid
	Foreign:	commid
Description:	This table defines the group of phases seen at a single station from the same event.	

Name:	**wfdisc**	
Keys:	Primary:	sta chan time endtime
	Alternate:	wfid
	Foreign:	commid
Description:	This relation provides a pointer (or index) to waveforms stored on disk. The waveforms themselves are stored in ordinary disk files called wfdisc or.w files, containing only a sequence of sample values (usually in binary representation).	

4.0 DATABASE ATTRIBUTES

This chapter describes each of the attributes used in the Version 3.0 Schema. Descriptions of the relations are found in Chapter 3, *Database Relations.* Attributes are presented as follows:

Name:	*This is the name of the attribute.*
Relation:	**These are the database relations which contain the attribute.**
Description:	This paragraph describes the attribute.
NA Value:	This is a value used to indicate that information is not available for this attribute. Many attributes in this schema are optional. The NULL value is defined for these attributes and should be used when the actual value is not known. Essential attributes must always be given a value.
Units:	This lists the unit of measurement for the attribute, if applicable.
Range:	This is the range of permissible or recommended values for this attribute, if such a range exists. For most strings, the range indicates the recommended values, but is not restricted to those values.

The following conventions are applied throughout.

Dates and Times

The *time* attribute throughout the database is stored as epochal time, the number of seconds since January 1, 1970. Epochal time has a precision of 1 millisecond. Often *time* is matched by the more readable attribute, *jdate*. This so called "Julian date" represents a day in the form, for example, 1981231 where 1981 is the year (YYYY) and 231 is the day of year (DOY).

Units of Measurement

Attribute descriptions also include the unit of measurement, if applicable. Here are some quantities with their corresponding measurement units:

period, time	seconds	*calper*, *time*, *endtime*, etc.
julian date	YYYYDOY	*jdate*
amplitude	nanometers	Note that long-period measurements are frequently reported in microns so conversion is required.
angular measurements	degrees	*delta*, *azimuth*, etc.
depth, errors in location	kilometers	*deast*, *depdp*, *depth*, etc.

Range

Whenever possible, explicit ranges are defined for each attribute. The specified ranges are in the form of expressions which can be evaluated by the db library routines, to simplify automated validity checks of databases.

The style of these expressions closely follows standard c syntax, with an extension similar to awk, perl or the shell for regular expression matches. Typically, a numerical attribute may have an expression like:

lat >= -90. && lat <= 90.

  which means that lat must fall between -90 degrees and +90 degrees.

Some character attributes are can take on only a few legal values. The enumeration of these values is written like:

clip =~ /cn/

  which means that clip may either be "c" or "n". (The NULL value is a third possibility, in this case.)

Sometimes no information is available for an attribute. In that case, a NULL value is assigned. A NULL value is outside the range of permissible or recommended values for the attribute. This special NULL value alerts users and applications that the desired attribute was not available when the record was created. For example, in the origin relation, the attribute *ms*, surface wave magnitude, may be unknown for a given record, since it often can't be measured. Then the NULL value for magnitudes (-999.0) should be assigned to *ms* and *msid* should be set to -1, the NULL value for *msid*. Some attributes are essential to defining a meaningful record and they must be specified; the NULL value is not allowed. For example, the attribute *time* in arrival must be given a value in the valid range, not an NULL value.

Some general guidelines and specific examples of NULL values are given in the following table.

Representative NULL Values:

character fields	- (a dash)
non-negative integer numbers	-1
non-negative real numbers	-1.0
negative real numbers	-999.0
conf	0.0
deast, dnorth	0.0
endtime	+9999999999.999
time	-9999999999.999

In Versions 2.7 and 2.8 of the schema, the underscore "_" was used to denote an unavailable character string. Since the underscore "_" represents the ANSI SQL "match any single character" wildcard, Version 3.0 uses the dash "-" to denote an unknown character string.

Format of Character Data

Most character fields are mixed case, but *sta* and *chan* are normally uppercase only.

Name:	*algorithm*
Relation:	**origin**
Description:	This is a brief textual description of the algorithm used for computing a seismic origin.
NULL	-

Name:	*amp*
Relation:	**arrival**
Description:	This is the zero-to-peak amplitude of the earth's displacement for a seismic phase. Amp is assumed to be corrected for the response of the instrument.
NULL	-1.0
Units:	Nanometers
Range:	amp > 0.0

Name:	*arid*
Relation:	**arrival assoc stamag**
Description:	Each arrival is assigned a unique positive integer identifying it with a unique sta, chan and time. This number is used in the assoc relation along with the origin identifier to link arrival and origin.
NULL	-1
Range:	arid > 0

Name:	*auth*
Relation:	**arrival event netmag network origin stamag stassoc**
Description:	This records the originator of an arrival (in arrival relation) or origin (in origin relation). Possibilities include externally supplied arrivals identified according to their original source, such as WMO, NEIS, CAN(adian), UK(array), etc. This may also be an identifier of an application generating the attribute, such as an automated interpretation or signal processing program.
NULL	-

Name:	*azdef*
Relation:	**assoc**
Description:	This is a one character flag that indicates whether or not the azimuth of a phase was used to determine the event's origin. It is defining (azdef=d) if used to help locate the event or non-defining (azdef=n) if it is not used.
NULL	-
Range:	azdef =~ /dn/

Name: *azimuth*

Relation: **arrival stassoc**

Description: This is the estimated station-to-event azimuth measured clockwise from north. Azimuth is estimated from f-k or polarization analysis. In stassoc, the value may be an analyst estimate.

NULL -1.00

Units: Degrees

Range: azimuth >= 0.0 && azimuth < 360.0

Name: *azres*

Relation: **assoc**

Description: This is the difference between the measured station-to-event azimuth for an arrival and the true azimuth. The 'true' azimuth is the bearing to the inferred event origin.

NULL -999.0

Units: Degrees

Range: azres >= -180.0 && azres <= 180.0

Name: *band*

Relation: **instrument**

Description: This is a qualitative indicator of frequency pass-band for an instrument. Values should reflect the response curve rather than just the sample rate. Recommended values are s (short-period), m (mid-period), i (intermediate-period), l (long-period), b (broad-band), h (high frequency, very short-period), and v (very long-period). For a better notion of the instrument characteristics, see the instrument response curve.

NULL -

Range: band =~ /s|m|i|l|b|h|v/

Name: *belief*

Relation: **assoc**

Description: This is a qualitative estimate of the confidence that a seismic phase is correctly identified.

NULL 9.99

Range: belief >= 0.0 && belief <= 1.0

Name:	*calib*
Relation:	**wfdisc**
Description:	This is the conversion factor that maps digital data to displacement, velocity, or acceleration, depending on the value of segtype or rsptype. The factor holds true at the oscillation period specified by the attribute calper. A positive value means ground motion (velocity, acceleration) increasing in the component direction (up, north, east) is indicated by increasing counts. A negative value means the opposite. Calib generally reflects the best calibration information available at the time of recording, but refinement may be given in sensor reflecting a subsequent recalibration of the instrument. See calratio.
NULL	0.000000
Units:	Nanometers/digital count
Range:	calib > 0.0

Name:	*calper*
Relation:	**sensor wfdisc**
Description:	This gives the period for which calib, ncalib and calratio are valid.
NULL	-1.000000
Units:	Seconds
Range:	calper >= 0.0

Name:	*calratio*
Relation:	**sensor**
Description:	This is a dimensionless calibration correction factor which permits small refinements to the calibration correction made using calib and calper from the wfdisc relation. Often, the wfdisc calib contains the nominal calibration assumed at the time of data recording. If the instrument is recalibrated, calratio provides a mechanism to update calibrations from wfdisc with the new information without modifying the wfdisc relation. A positive value means ground motion increasing in component direction (up, north, east) is indicated by increasing counts. A negative value means the opposite. Calratio is meant to reflect the most accurate calibration information for the time period for which the sensor record is appropriate, but the nominal value may appear until other information is available.
NULL	1.000000

Name:	*chan*
Relation:	**arrival sensor sitechan wfdisc**
Description:	This is an eight-character code, which, taken together with sta, jdate and time, uniquely identifies the source of the seismic data, including the geographic location, spatial orientation, sensor and subsequent data processing.
NULL	-

Name:	*chanid*
Relation:	**arrival sensor sitechan wfdisc**
Description:	This is a surrogate key used to uniquely identify a specific recording. Chanid duplicates the information of the compound key sta, chan, time. As a single identifier it is often convenient. Chanid is very database dependent and is included only for backward compatibility with historical databases. Sta, chan and time is more appropriate to the human interface.
NULL	-1
Range:	chanid > 0

Name:	*clip*
Relation:	**arrival wfdisc**
Description:	This is a single-character flag to indicate whether (c) or not (n) the data were clipped. Typically, this flag is derived from status bits supplied with GDSN or RSTN data, but could also be supplied as a result of analyst review.
NULL	-
Range:	clip =~ /cn/

Name:	*commid*
Relation:	**arrival assoc event netmag network origerr origin remark stamag stassoc wfdisc**
Description:	This is a key used to point to free-form comments entered in the remark relation. These comments store additional information about a tuple in another relation. Within the remark relation, there may be many tuples with the same commid and different lineno, but the same commid will appear in only one other tuple among the rest of the relations in the database. See lineno.
NULL	-1
Range:	commid > 0

Name:	*conf*
Relation:	**origerr**
Description:	This attribute denotes the confidence attached to the event attributes smajax, sminax, sdepth and stime.
NULL	0.000
Range:	conf > 0.0 && conf <= 1.0

Name:	*ctype*
Relation:	**sitechan**
Description:	This attribute specifies the type of data channel: n (normal, a normal instrument response), b (beam, a coherent beam formed with array data), or i (an incoherent beam or energy stack).
NULL	-
Range:	ctype =~ /nbi/

Name:	*datatype*
Relation:	**wfdisc**
Description:	This attribute specifies the format of a data series in the file system. Datatypes t4, s4 and s2 are the allowed values. Datatype s4 denotes a 4-byte integer and t4 denotes a 32-bit real number in Sun format. Machine dependent formats are supported for common hardwares to allow data transfer in native machine binary formats. Note that the CSS standard defines many other formats, which are not supported by the JSPC software.
NULL	-
Range:	datatype =~ /t4|s4|s2/

Name:	*deast*
Relation:	**site**
Description:	This attribute gives the 'easting' or relative position of an array element, east of the location of the array center specified by the value of refsta. See dnorth.
NULL	0.0000
Units:	Kilometers
Range:	deast >= -20000.0 && deast <= 20000.0

Name:	*delaz*
Relation:	**arrival**
Description:	Delta azimuth. This attribute gives the standard deviation of the azimuth of a signal.
NULL	-1.00
Units:	Degrees
Range:	delaz > 0.0

Name:	*delslo*
Relation:	**arrival**
Description:	This attribute gives the standard deviation of the slowness of a signal.
NULL	-1.00
Units:	Seconds (of time)/degree
Range:	delslo > 0.0

Name:	*delta*
Relation:	**assoc**
Description:	This attribute is the arc length of the path the seismic phase follows from source to receiver. The location of the origin is specified in the origin record referenced by the attribute orid. The attribute arid points to the record in the arrival relation that identifies the receiver. The value of the attribute can exceed 180 degrees, it can even exceed 360 degrees. The geographic distance between source and receiver is delta mod(180).
NULL	-1.000
Units:	Degrees
Range:	delta >= 0.0

Name:	*deltim*
Relation:	**arrival**
Description:	This attribute gives the standard deviation of a detection time.
NULL	-1.000
Units:	Seconds
Range:	deltim > 0.0

Name:	*depdp*
Relation:	**origin**
Description:	This is a measure of event depth estimated from a depth phase or an average of several depth phases. Depth is measured positive in a downwards direction starting from the earth's surface. See ndp.
NULL	-999.0000
Units:	Kilometers
Range:	depdp >= 0.0 && depdp < 1000.0

Name:	*depth*
Relation:	**origin stassoc**
Description:	This attribute gives the depth of the event origin. In stassoc this may be an analyst estimate.
NULL	-999.0000
Units:	Kilometers
Range:	depth >= 0.0 && depth < 1000.0

Name:	*descrip*
Relation:	**sitechan**
Description:	This is a description of the data channel. For non-instrument channels (e.g. beams) this can be the only quantitative description of channel operations in the core tables.
NULL	-

Name:	*dfile*
Relation:	**instrument wfdisc**
Description:	In wfdisc, this is the file name of a disk-based waveform file. In instrument, this points to an instrument response file. See dir.
NULL	NONULL

Name:	*digital*
Relation:	**instrument**
Description:	This attribute is a single character flag denoting whether this instrument record describes an analog or digital recording system.
NULL	-
Range:	digital =~ /da/

Name:	*dir*
Relation:	**instrument wfdisc**
Description:	This attribute is the directory-part of a path name. Relative path names or '.' (dot), the notation for the current directory, may be used.
NULL	NONULL

Name:	*dist*
Relation:	**stassoc**
Description:	This attribute gives the approximate source-receiver distance as calculated from slowness (array measurements only), incident angle, or (S-P) times.
NULL	-1.00
Units:	Degrees
Range:	dist >= 0.0 && dist <= 180.0

Name:	*dnorth*
Relation:	**site**
Description:	This attribute gives the 'northing' or relative position of array element north of the array center specified by the value of refsta. See deast.
NULL	0.0000
Units:	Kilometers
Range:	dnorth >= -20000.0 && dnorth <= 20000.0

Name:	*dtype*
Relation:	**origin**
Description:	This single-character flag indicates the method by which the depth was determined or constrained during the location process. The recommended values are f (free), d (from depth phases), r (restrained by location program) or g (restrained by geophysicist). In cases r or g, either the auth field should indicate the agency or person responsible for this action, or the commid field should point to an explanation in the remark relation.
NULL	-
Range:	dtype =~ /f|d|r|g/

Name:	*edepth*
Relation:	**sitechan**
Description:	This attribute gives the depth at which the instrument is positioned, relative to the value of elev in the site relation.
NULL	NaN
Units:	Kilometers
Range:	edepth >= 0.0

Name:	*elev*
Relation:	site
Description:	This attribute is the elevation of a seismic station relative to mean sea level.
NULL	-999.0000
Units:	Kilometers
Range:	elev >= -10.0 && elev <= 10.0

Name:	*ema*
Relation:	arrival
Description:	This attribute is the emergence angle of an arrival, as observed at a three-component station or array. The value increases from the vertical direction towards the horizontal.
NULL	-1.00
Units:	Degrees
Range:	ema >= 0.0 && ema <= 90.0

Name:	*emares*
Relation:	assoc
Description:	This attribute is the difference between an observed emergence angle and the theoretical prediction for the same phase, assuming an event location as specified by the accompanying orid.
NULL	-999.0
Units:	Degrees
Range:	emares >= -90.0 && emares <= 90.0

Name:	*endtime*
Relation:	sensor wfdisc
Description:	In wfdisc, this attribute is the time of the last sample in the waveform file. Endtime is equivalent to time+(nsamp-1)/samprate. In sensor, this is the last time the data in the record are valid.
NULL	9999999999.99900
Units:	Epochal seconds
Range:	endtime == time+(nsamp-1)/samprate

Name:	*esaz*
Relation:	assoc
Description:	This attribute is the calculated event-to-station azimuth, measured in degrees clockwise from North.
NULL	-999.00
Units:	Degrees
Range:	esac >= 0.0 && esaz <= 360.0

Name:	*etype*
Relation:	**origin stassoc**
Description:	This attribute is used to identify the type of seismic event, when known. For etypes l, r, t the value in origin will be the value determined by the station closest to the event.
NULL	-
Range:	etype =~ /qb|eq|me|ex|o|l|r|t/

Name:	*evid*
Relation:	**event netmag origin stamag**
Description:	Each event is assigned a unique positive integer which identifies it in a database. It is possible for several records in the origin relation to have the same evid. This indicates there are several opinions about the location of the event.
NULL	-1
Range:	evid > 0

Name:	*evname*
Relation:	**event**
Description:	This is the common name of the event identified by evid.
NULL	-

Name:	*fm*
Relation:	**arrival**
Description:	This is a two-character indication of first motion. The first character describes first motion seen on short-period channels and the second holds for long-period instruments. Compression (dilation) on a short-period sensor is denoted by c(d) and compression (dilation) on a long-period sensor is denoted by u(r). Empty character positions will be indicated by dots (e.g., '.r').
NULL	-
Range:	fm =~ /[cd.][ur.]/

Name:	*foff*
Relation:	**wfdisc**
Description:	This is the byte offset of a waveform segment within a data file. It is used when data are multiplexed. See dir and dfile.
NULL	0
Range:	foff >= 0

Name: *grn*
Relation: **origin**
Description: This is a geographic region number, as defined by Flinn, Engdahl and Hill (Bull. Seism. Soc. Amer. vol 64, pp. 771-992, 1974). See grname.
NULL -1
Range: grn > 0

Name: *hang*
Relation: **sitechan**
Description: This attribute specifies the orientation of the seismometer in the horizontal plane, measured clockwise from North. For a North-South orientation with the seismometer pointing toward the north, hang=0.; for East-West orientation with the seismometer pointing toward the west, hang=270. See vang.
NULL NaN
Units: Degrees
Range: hang >= 0.0 && hang <= 360.0

Name: *imb*
Relation: **stassoc**
Description: This is an analyst's estimate of the body wave magnitude using data from a single station. See iml, ims, magnitude, magtype, mb, ml and ms.
NULL -999.00

Name: *iml*
Relation: **stassoc**
Description: This is an analyst's estimate of the local magnitude using data from a single station. See imb, ims, magnitude, magtype, mb, ml and ms.
NULL -999.00

Name: *ims*
Relation: **stassoc**
Description: This is an analyst's estimate of surface wave magnitude using data from a single station. See magnitude, magtype, mb, ml, ms, imb and iml.
NULL -999.00

Name: *inid*
Relation: **instrument sensor**
Description: This is a unique key to the instrument relation. Inid provides the only link between sensor and instrument.
NULL -1
Range: inid > 0

Name: *insname*
Relation: **instrument**
Description: This is a character string containing the name of the instrument.
NULL -

Name: *instant*
Relation: **sensor**
Description: When this attribute has the value instant = 'y', it means that the snapshot was taken at the time of a discrete procedural change, such as an adjustment of the instrument gain; n means the snapshot is of a continuously changing process, such as calibration drift. This is important for tracking time corrections and calibrations.
NULL N
Range: instant =~ /yn/

Name: *instype*
Relation: **instrument wfdisc**
Description: This character string is used to indicate the instrument type. Some examples are: SRO, ASRO, DWWSSN, LRSM, and S-750.
NULL -

Name: *iphase*
Relation: **arrival**
Description: This eight-character field holds the name initially given to a seismic phase. Standard seismological labels for the types of signals (or phases) are used (e.g., P, PKP, PcP, pP). Both upper and lower case letters are available and should be used when appropriate, for example, pP or PcP. See phase.
NULL -

Name: *jdate*
Relation: **arrival origin sensor wfdisc**
Description: This attribute is the date of an arrival, origin, seismic recording, etc. The same information is available in epoch time, but the Julian date format is more convenient for many types of searches. Dates B.C. are negative. Note: there is no year = 0000 or day = 000. Where only the year is known, day of year = 001; where only year and month are known, day of year = first day of month. Note: only the year is negated for BC, so Jan 1 of 10 BC is 0010001. See time.
NULL -1
Range: jdate == yearday(time)

Name: *keyname*

Relation: **lastid**

Description: This attribute contains the actual name of a key whose last assigned numeric value is saved in keyvalue.

NULL NONULL

Range: keyname =~ /arid|chanid|commid|evid|inid/

Name: *keyvalue*

Relation: **lastid**

Description: This attribute maintains the last assigned value (a positive integer) of the counter for the specified keyname. The number keyvalue is the last counter value used for the attribute keyname. Key values are maintained in the database to ensure uniqueness.

NULL 0

Range: keyvalue > 0

Name: *lat*

Relation: **origin site stassoc**

Description: This attribute is the geographic latitude. Locations north of the equator have positive latitudes.

NULL -999.0000

Units: Degrees

Range: lat >= -90.0 && lat <= 90.0

Name: *lddate*

Relation: **affiliation arrival assoc event instrument lastid netmag network origerr origin remark sensor site sitechan stamag stassoc wfdisc**

Description: This is the date and time the record was inserted into the database.

NULL -

Name: *lineno*

Relation: **remark**

Description: This integer attribute is assigned as a sequence number for multiple line comments. The combination of commid and lineno is unique.

NULL 0

Range: lineno > 0

Name: *location*

Relation: **stassoc**

Description: This character string describes the location of an event identified from data recorded at a single station. Two examples are Fiji-Tonga and Semipalatinsk.

NULL -

Name:	*logat*
Relation:	**arrival**
Description:	This measurement (logarithm of amplitude/period) of signal size is often reported instead of the amplitude and period separately. This attribute is only filled if the separate measurements are not available.
NULL	-999.00
Units:	Log (Nanometers/seconds)

Name:	*lon*
Relation:	**origin site stassoc**
Description:	This attribute is the geographic longitude in degrees. Longitudes are measured positive east of the Greenwich meridian.
NULL	-999.0000
Units:	Degrees
Range:	lon >= -180.0 && lon <= 180.0

Name:	*magid*
Relation:	**netmag stamag**
Description:	This key is assigned to identify a network magnitude in the netmag relation. It is required for every network magnitude. Magnitudes given in origin must reference a network magnitude with magid = mbid, mlid or msid, whichever is appropriate. See mbid, mlid, or msid.
NULL	0
Range:	magid > 0

Name:	*magnitude*
Relation:	**netmag stamag**
Description:	This gives the magnitude value of the type indicated in attribute magtype. It is derived in a variety of ways, which are not necessarily linked directly to an arrival. See imb, iml, ims, magtype, mb, ml and ms.
NULL	NaN

Name:	*magtype*
Relation:	**netmag stamag**
Description:	This character string is used to specify whether the magnitude value represents mb (body wave magnitude), ms (surface wave magnitude), ml (local magnitude) or other appropriate magnitude measure. See imb, iml, ims, magnitude, mb, ml, ms.
NULL	NONULL

Name:	*mb*
Relation:	origin
Description:	This is the body wave magnitude of an event. Associated with this attribute is the identifier mbid which points to magid in the netmag relation. The information in that record summarizes the method of analysis and data used. See imb, iml, ims, magnitude, magtype, ml and ms.
NULL	-999.00

Name:	*mbid*
Relation:	origin
Description:	This stores the magid for a record in netmag. Mbid is a foreign key joining origin to netmag where origin. mbid = netmag. magid. See magid, mlid and msid.
NULL	-1
Range:	mbid > 0

Name:	*ml*
Relation:	origin
Description:	This is the local magnitude of an event. Associated with this attribute is the identifier mlid, which points to magid in the netmag relation. The information in that record summarizes the method of analysis and the data used. See imb, iml, ims, magnitude, magtype, mb and ms.
NULL	-999.00

Name:	*mlid*
Relation:	origin
Description:	This stores the magid for a record in netmag. Mlid is a foreign key joining origin to netmag where origin. mlid = netmag. magid. See magid, sid and mbid.
NULL	-1
Range:	mlid > 0

Name:	*ms*
Relation:	origin
Description:	This is the surface wave magnitude for an event. Associated with this attribute is the identifier msid, which points to magid in the netmag relation. The information in that record summarizes the method of analysis and the data used. See imb, iml, ims, magnitude, magtype, mb and ml.
NULL	-999.00

Name:	*msid*
Relation:	**origin**
Description:	This stores the magid for a record in netmag. Msid is a foreign key joining origin to netmag where origin. msid = netmag. magid. See magid, mlid and mbid.
NULL	-1
Range:	msid > 0

Name:	*nass*
Relation:	**origin**
Description:	This attribute gives the number of arrivals associated with the origin.
NULL	-1
Range:	nass > 0

Name:	*ncalib*
Relation:	**instrument**
Description:	This is the conversion factor that maps digital data to earth displacement. The factor holds true at the oscillation period specified by ncalper. A positive value means ground motion increasing in component direction (up, north, east) is indicated by increasing counts. A negative value means the opposite. Actual calibration for a particular recording is determined using the wfdisc and sensor relations. See calratio.
NULL	NaN
Units:	Nanometers/digital count

Name:	*ncalper*
Relation:	**instrument**
Description:	This attribute is the period for which ncalib is valid.
NULL	-1.000000
Units:	seconds
Range:	ncalper >= 0.0

Name:	*ndef*
Relation:	**origin**
Description:	This attribute is the number of arrivals used to locate an event. See timedef.
NULL	-1
Range:	ndef >0 && ndef <= nass

Name:	*ndp*
Relation:	**origin**
Description:	This attribute gives the number of depth phases used in calculating depth and/or depdp. See depdp.
NULL	-1
Range:	ndp >= 0

Name:	*net*
Relation:	**affiliation netmag network**
Description:	This character string is the name of a seismic network. One example is WWSSN.
NULL	-

Name:	*netname*
Relation:	**network**
Description:	String containing the name of a network."
NULL	-

Name:	*nettype*
Relation:	**network**
Description:	This 4 character string specifies what type of network (ar = array), (lo = local area), (ww = world-wide) for the given value of net.
NULL	-

Name:	*nsamp*
Relation:	**wfdisc**
Description:	This quantity is the number of samples in a waveform segment.
NULL	0
Range:	nsamp > 0

Name:	*nsta*
Relation:	**netmag**
Description:	This quantity is the number of stations used to compute the magnitude of the event.
NULL	-1
Range:	nsta > 0

Name:	*offdate*
Relation:	**site sitechan**
Description:	This attribute is the Julian Date on which the station or sensor indicated was turned off, dismantled, or moved. See ondate.
NULL	-1
Range:	offdate >= 1970000 && offdate <= 2100000

Name:	*ondate*
Relation:	**site sitechan**
Description:	This attribute is the Julian Date on which the station or sensor indicated began operating. Offdate and ondate are not intended to accommodate temporary downtimes, but rather to indicate the time period for which the attributes of the station (lat, lon, elev) are valid for the given station code. Stations are often moved, but with the station code remaining unchanged.
NULL	0
Range:	ondate >= 1970000 && ondate <= 2100000

Name:	*orid*
Relation:	**assoc netmag origerr origin stamag**
Description:	Each origin is assigned a unique positive integer which identifies it in a data base. The orid is used to identify one of the many hypotheses of the actual location of the event.
NULL	0
Range:	orid > 0

Name:	*per*
Relation:	**arrival**
Description:	This attribute is the period of the signal described by the arrival record.
NULL	-1.00
Units:	Seconds
Range:	per > 0.0

Name:	*phase*
Relation:	**assoc stamag**
Description:	This field holds the identity of a seismic phase which has been associated to an event. Standard seismological labels for phases are used (e.g., P, PKP, PcP, pP, etc.). Both upper and lower case letters are available and should be used when appropriate, for example, pP or PcP. See iphase.
NULL	-

Name:	*prefor*
Relation:	**event**
Description:	This attribute holds the origin identifier, orid, that points to the preferred origin for a seismic event.
NULL	-1
Range:	prefor > 0

Name:	*qual*
Relation:	**arrival**
Description:	This single-character flag is used to denote the sharpness of the onset of a seismic phase. This relates to the timing accuracy as follows: i (impulsive) - accurate to +/ 0.2 seconds e (emergent) - accuracy between +/ (0.2 to 1.0 seconds) w (weak) - timing uncertain to > 1 second.
NULL	-
Range:	qual =~ /i|e|w/

Name:	*rect*
Relation:	**arrival**
Description:	This attribute is a measure of signal rectilinearity. The value is obtained from polarization analysis of 3-component data.
NULL	-1.000
Range:	rect >= 0.0 && rect <= 1.0

Name:	*refsta*
Relation:	**site**
Description:	This string specifies the reference station with respect to which array members are located. See deast, dnorth.
NULL	-

Name:	*remark*
Relation:	**remark**
Description:	This single line of text is an arbitrary comment about a record in the database. The comment is linked to its parent relation only by forward reference from commid in the tuple of the relation of interest. See commid and lineno.
NULL	-

Name:	*rsptype*
Relation:	**instrument**
Description:	Originally, this field characterized the response information specified by the neighboring attribute dir and dfile. However, in JSPC datasets, it is used to indicate the "natural" units for the instrument -- ie, 'A' (acceleration), 'V' (velocity) or 'D' (displacement).
NULL	NONULL

Name:	*samprate*
Relation:	**instrument wfdisc**
Description:	This attribute is the sample rate in samples/second. In the instrument relation this is specifically the nominal sample rate, not accounting for clock drift. In wfdisc, the value may vary slightly from the nominal to reflect clock drift.
NULL	NaN
Units:	1/seconds
Range:	samprate > 0.0

Name:	*sdepth*
Relation:	**origerr**
Description:	This is the maximum error of a depth estimate for a level of confidence given by conf. See smajax, sminax, stx.
NULL	-1.0000
Units:	Kilometers
Range:	sdepth > 0.0

Name:	*sdobs*
Relation:	**origerr**
Description:	This attribute is derived from the discrepancies in the arrival times of the phases used to locate an event. It is defined as the square root of the sum of the squares of the time residuals, divided by the number of degrees of freedom. The latter is the number of defining observations (ndef in origin) minus the dimension of the system solved (4 if depth is allowed to be a free variable, 3 if depth is constrained).
NULL	-1.0000
Range:	sdobs > 0.0

Name:	*seaz*
Relation:	**assoc**
Description:	This attribute is calculated from the station and event locations. It is measured clockwise from North.
NULL	-999.00
Units:	Degrees
Range:	seaz >= 0.0 && seaz < 360.0

Name:	*segtype*
Relation:	**wfdisc**
Description:	Originally, this attribute indicated if a waveform were o(original), v(virtual), s(segmented) or d(duplicate). However, in JSPC datasets, it indicates the "natural" units of the detector -- 'A' (acceleration), 'V' (velocity), or 'D' (displacement).
NULL	-
Range:	segtype =~ /A|V|D/

Name:	*slodef*
Relation:	assoc
Description:	This one-character flag indicates whether or not the slowness of a phase is d (defining), or n (non-defining) for the origin associated with this arrival. See azdef and timedef.
NULL	-
Range:	slodef =~ /dn/

Name:	*slores*
Relation:	assoc
Description:	This attribute gives the difference between an observed slowness and a theoretical prediction. The prediction is calculated for the related phase and event origin described in the record.
NULL	-999.00
Units:	Seconds/degree

Name:	*slow*
Relation:	arrival
Description:	This is the observed slowness of a wave as it sweeps across an array.
NULL	-1.00
Units:	Seconds/degree
Range:	slow >= 0.0

Name:	*smajax*
Relation:	origerr
Description:	This is the length of the semi-major axis of the location error ellipse. It is found by projecting the covariance matrix onto the horizontal plane. The level of confidence is specified by conf. See sdepth, sminax and stx.
NULL	-1.0000
Units:	Kilometers
Range:	smajax > 0.0

Name:	*sminax*
Relation:	origerr
Description:	This is the length of the semi-minor axis of the location error ellipse. It is found by projecting the covariance matrix onto the horizontal plane. The level of confidence is specified by conf. See sdepth, smajax and stx.
NULL	-1.0000
Units:	Kilometers
Range:	sminax > 0.0

Name:	*snr*
Relation:	**arrival**
Description:	This is an estimate of the size of the signal relative to that of the noise immediately preceding it.
NULL	-1.00
Range:	snr > 0.0

Name:	*srn*
Relation:	**origin**
Description:	This is a seismic region number, as given by Flinn, Engdahl and Hill (Bull. Seism. Soc. Amer. vol 64, pp 791-992, 1974). See grn, grname and srname.
NULL	-1
Range:	srn > 0

Name:	*sta*
Relation:	**affiliation arrival assoc sensor site sitechan stamag stassoc wfdisc**
Description:	This is the common code-name of a seismic observatory. Generally only three or four characters are used.
NULL	-

Name:	*staname*
Relation:	**site**
Description:	This is the full name of the station whose code-name is in sta. As an example, one record in the site relation connects sta = ANMO to staname = ALBUQUERQUE, NEW MEXICO (SRO).
NULL	-

Name:	*stassid*
Relation:	**arrival stassoc**
Description:	The wavetrain from a single event may be made up of a number of arrivals. A unique stassid joins those arrivals believed to have come from a common event as measured at a single station. Stassid is also the key to the stassoc relation, which contains additional signal measurements not contained within the arrival relation, such as station magnitude estimates and computed signal characteristics.
NULL	-1
Range:	stassid > 0

Name:	*statype*
Relation:	**site**
Description:	This character string specifies the station type. Recommended entries are ss (single station) or ar (array).
NULL	-
Range:	statype =~ /ss|ar/

Name:	*stime*
Relation:	**origerr**
Description:	This attribute denotes the time uncertainty that accompanies the location. The level of confidence is specified by conf. See smajax, sminax, and sdepth.
NULL	-1.00
Units:	Seconds
Range:	stime >= 0.0

Name:	*strike*
Relation:	**origerr**
Description:	This attribute is the strike of the semi-major axis of the location error ellipse, measured in degrees clockwise from North. See smajax.
NULL	-1.00
Units:	Degrees
Range:	strike >= 0.0 && strike < 360.0

Name:	*stt*
Relation:	**origerr**
Description:	This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.
NULL	-1.0000
Units:	seconds squared,
Range:	stt > 0.0

Name:	*stx*
Relation:	**origerr**
Description:	This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.
NULL	-1.0000
Units:	kilometer-second
Range:	stx > 0.0

Name: *sty*

Relation: **origerr**

Description: This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.

NULL -1.0000

Units: kilometer-second

Range: sty > 0.0

Name: *stype*

Relation: **arrival**

Description: This single-character flag indicates the event or signal type. The following event types are defined: l (local), r (regional), t (teleseismic), m (mixed or multiple), g (glitch), c (calibration activity upsets the date). l, r, and t are supplied by the reporting station, or as an output of post detection processing. g and c come from analyst comment or from the status bits from GDSN and RSTN data.

NULL -

Range: stype =~ /lrtmgc/

Name: *stz*

Relation: **origerr**

Description: This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.

NULL -1.0000

Units: kilometer-second

Name: *sxx*

Relation: **origerr**

Description: This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.

NULL -1.0000

Units: kilometers squared,

Name: *sxy*

Relation: **origerr**

Description: This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.

NULL -1.0000

Units: kilometers squared,

Name: *sxz*

Relation: **origerr**

Description: This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.

NULL -1.0000

Units: kilometers squared,

Name: *syy*

Relation: **origerr**

Description: This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.

NULL -1.0000

Units: kilometers squared,

Name: *syz*

Relation: **origerr**

Description: This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.

NULL -1.0000

Units: kilometers squared,

Name:	*szz*
Relation:	**origerr**
Description:	This is an element of the covariance matrix for the location identified by orid. The covariance matrix is symmetric (and positive definite) so that sxy = syx, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with sdobs, ndef and dtype) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.
NULL	-1.0000
Units:	kilometers squared,

Name:	*time*
Relation:	**arrival origin sensor stassoc wfdisc**
Description:	Epochal time given as seconds and fractions of a second since hour 0 January 1, 1970, and stored in a double precision floating number. Refers to the relation data object with which it is found. E.g., in arrival - arrival time; in origin - origin time; in wfdisc, - start time of data. Where date of historical events is known, time is set to the start time of that date; where the date of contemporary arrival measurements is known but no time is given, then the time attribute is set to the NA value. The double-precision floating point number allows 15 decimal digits. At 1 millisecond accuracy this is a range of 3 years. Where time is unknown, or prior to Feb. 10, 1653, set to the NA value.
NULL	-9999999999.99900
Units:	Seconds

Name:	*timedef*
Relation:	**assoc**
Description:	This one character flag indicates whether the time of a phase is d (defining), or n (non-defining) for this arrival. See azdef and slodef.
NULL	-
Range:	timedef =~ /dn/

Name:	*timeres*
Relation:	**assoc**
Description:	This attribute is a travel time residual, measured in seconds. The residual is found by taking the observed arrival time (saved in the arrival relation) of a seismic phase and subtracting the expected arrival time. The expected arrival time is calculated by a formula based on earth velocity model (attribute vmodel), an event location and origin time (saved in table origin), the distance to the station (attribute dist in table assoc), and the particular seismic phase (attribute phase in table assoc).
NULL	-999.000
Units:	Seconds

Name:	*tshift*
Relation:	**sensor**
Description:	This attribute is designed to accommodate discrepancies between actual time and the numerical time written by data recording systems. Actual time is the sum of the reported time plus tshift.
NULL	NaN
Units:	Seconds

Name:	*uncertainty*
Relation:	**netmag stamag**
Description:	This is the standard deviation of the accompanying magnitude measurement.
NULL	-1.00
Range:	uncertainty > 0.0

Name:	*vang*
Relation:	**sitechan**
Description:	This attribute measures the angle between the sensitive axis of a seismometer and the outward-pointing vertical direction. For a vertically oriented seismometer, vang = 0. For a horizontally oriented seismometer, vang =90. See hang.
NULL	NaN
Units:	Degrees
Range:	vang >= 0.0 && vang <= 90.0

Name:	*vmodel*
Relation:	**assoc**
Description:	This character string identifies the velocity model of the earth used to compute the travel times of seismic phases. These are required for event location (if phase is defining) or for computing travel-time residuals.
NULL	-

Name:	*wfid*
Relation:	**wfdisc**
Description:	The key field is a unique identifier for a segment of digital waveform data.
NULL	0
Range:	wfid > 0

Name:	*wgt*
Relation:	assoc
Description:	This attribute gives the final weight assigned to the allied arrival by the location program. It is used primarily for location programs that adaptively weight data by their residuals.
NULL	-1.000
Range:	wgt >= 0.0 && wgt < 1.0