Appendix A - Document Type Definitions (DTD)
ST32 US Patent Grant

```
<!--************************************************************************
ENTITY % patdoc PUBLIC "-//USPTO//DTD ST.32 US Patent Grant v1.0 1998-12-08//EN"
************************************************************************
Note: this DTD was developed by the USPTO in August of 1997 to support
the publishing of patent documents. It was derived from version 3.4 of the
WIPO Standard ST.32 DTD. The original DTD was modified to handle only those
elements used by the USPTO. It incorporates the CALS table and equation
models, and handles graphics as external entities. The last revision
occured on 03/09/1998.

Revised 1998 September 30, Bruce B. Cox
Revised 1998 November 20, Bruce B. Cox
Revised 1998 December 4, Bruce B. Cox
..revised to comply with latest revisions to Red Book and
....XML 1.0 (except empty tags and UNICODE)
..replaced CALS math with MathML
Revised 1998 December 8, Bruce B. Cox
..moved LST out of CWU definition
..changed P tag to PARA for CALS Table compatability
..changed ELE content model from PTEXT to STEXT
..added elements to SEQLST-US for old rules and embedded sequences
..removed bib tags from SEQLST-US (redundant) and tags for data not captured
..added SEQREF to PTEXT
..replaced special image tags in all CWUs with EMI
..fixed CWU empty tag attributes to add external file entities

-->
<!DOCTYPE PATDOC [
<!ENTITY % ISOAMSA PUBLIC "ISO 9573-13:1991//ENTITIES Added Math Symbols: Arrow Relations//EN">
%ISOAMSA;
<!ENTITY % ISOAMSB PUBLIC "ISO 9573-13:1991//ENTITIES Added Math Symbols: Binary Operators//EN">
%ISOAMSB;
<!ENTITY % ISOamsc PUBLIC "ISO 8879-1986//ENTITIES Added Math Symbols: Delimiters//EN"> %ISOamsc;
<!ENTITY % ISOamsn PUBLIC "ISO 8879-1986//ENTITIES Added Math Symbols: Negated Relations//EN">
%ISOamsn;
<!ENTITY % ISOamso PUBLIC "ISO 8879-1986//ENTITIES Added Math Symbols: Ordinary//EN"> %ISOamso;
<!ENTITY % ISOamsr PUBLIC "ISO 8879-1986//ENTITIES Added Math Symbols: Relations//EN"> %ISOamsr;
<!ENTITY % ISObox PUBLIC "ISO 8879-1986//ENTITIES Box and Line Drawing//EN"> %ISObox;
<!ENTITY % ISOCH PUBLIC "ISO 9573-11:1992//ENTITIES Chemistry//EN"> %ISOCH;
<!ENTITY % ISOCHEM PUBLIC "ISO 9573-13:1991//ENTITIES Chemistry//EN"> %ISOCHEM;
<!ENTITY % ISOcyr1 PUBLIC "ISO 8879-1986//ENTITIES Russian Cyrillic//EN"> %ISOcyr1;
<!ENTITY % ISOcyr2 PUBLIC "ISO 8879-1986//ENTITIES Non-Russian Cyrillic//EN"> %ISOcyr2;
<!ENTITY % ISOdia PUBLIC "ISO 8879-1986//ENTITIES Diacritical Marks//EN"> %ISOdia;
<!ENTITY % ISOgrk1 PUBLIC "ISO 8879-1986//ENTITIES Greek Letters//EN"> %ISOgrk1;
<!ENTITY % ISOgrk2 PUBLIC "ISO 8879-1986//ENTITIES Monotoniko Greek//EN"> %ISOgrk2;
<!ENTITY % ISOgrk3 PUBLIC "ISO 8879-1986//ENTITIES Greek Symbols//EN"> %ISOgrk3;
<!ENTITY % ISOgrk4 PUBLIC "ISO 8879-1986//ENTITIES Alternative Greek Symbols//EN"> %ISOgrk4;
<!ENTITY % ISOlat1 PUBLIC "ISO 8879-1986//ENTITIES Added Latin 1//EN"> %ISOlat1;
<!ENTITY % ISOlat2 PUBLIC "ISO 8879-1986//ENTITIES Added Latin 2//EN"> %ISOlat2;
<!ENTITY % ISOMFRK PUBLIC "ISO 9573-13:1991//ENTITIES Math Alphabets: Fraktur//EN"> %ISOMFRK;
<!ENTITY % ISOMOPF PUBLIC "ISO 9573-13:1991//ENTITIES Math Alphabets: Open Face//EN"> %ISOMOPF;
<!ENTITY % ISOMSCR PUBLIC "ISO 9573-13:1991//ENTITIES Math Alphabets: Script//EN"> %ISOMSCR;
<!ENTITY % ISOnum PUBLIC "ISO 8879-1986//ENTITIES Numeric and Special Graphic//EN"> %ISOnum;
<!ENTITY % ISOPUB PUBLIC "ISO 9573-13:1991//ENTITIES Publishing//EN"> %ISOPUB;
<!ENTITY % ISOTECH PUBLIC "ISO 9573-13:1991//ENTITIES General Technical//EN"> %ISOTECH;
<!ENTITY % uspto PUBLIC "-//USPTO//ENTITIES USPTO special character entities//EN"> %uspto;
<!ENTITY % tablepac PUBLIC "-//USA-DOD//DTD CALS MIL-M-28001 TABLEPAK 19981208 Red Book Mod //EN"
> %tablepac;
```

Appendix A - Document Type Definitions (DTD)
ST32 US Patent Grant

```
<!ENTITY % mathpac PUBLIC "-//W3C//DTD MATHML 19981208 Red Book Mod //EN" > %mathpac;

<!--Patent Document-->
<!ELEMENT PATDOC  - - (SDOBI,SDOAB,SDODE,SDOCL,SDODR?,SDOCR?) >

<!--cy = Country, organization (code from WIPO Standard ST.3)
dnum = Identification number
date = date of publication
file = file identification
kind = Kind of patent (code from WIPO Standard ST.16)
status = Status of the patent document
dtd = Version NUMBER of DTD-->
<!ATTLIST PATDOC
               CY  CDATA    #IMPLIED
               DNUM  CDATA    #IMPLIED
               DATE  NMTOKEN    #IMPLIED
               FILE  ENTITY    #REQUIRED
               KIND  CDATA    #IMPLIED
               STATUS  CDATA    #IMPLIED
               DTD  NMTOKEN    #IMPLIED  >

<!--Subdocument: Bibliographic information.-->
<!ELEMENT SDOBI  - - (B100,B200,B300*,B400?,B500,B600?,B700,B800?) >

<!--la = language (ISO 639)
cy = country code (WIPO Standard ST.3)
status = Status of the sub-doc.-->
<!ATTLIST SDOBI
               LA  NMTOKEN    #IMPLIED
               CY  NMTOKEN    #IMPLIED
               STATUS  CDATA    #IMPLIED  >

<!--Document identification-->
<!ELEMENT B100  - - (B110,B122US,(B130 | (CHG-S,B130,CHG-E)),B140,(B190 | (CHG-S,
               B190,CHG-E))) >

<!--Document number.-->
<!ELEMENT B110  - - (DNUM | (CHG-S,DNUM,CHG-E)) >

<!--Document, application, or publication number.-->
<!ELEMENT DNUM  - - (#PCDATA) >

<!--Start of changed content. Must be matched with a CHG-E.-->
<!ELEMENT CHG-S  - O  EMPTY  >

<!--date = Date of change text
status = add or delete
This tag cannot span other elements; bchg and echg (see below) can be used anywhere.-->
<!ATTLIST CHG-S
               DATE  NMTOKEN    #REQUIRED
               STATUS  CDATA    #REQUIRED
               ID  ID    #REQUIRED  >

<!--End of changed content. Must be matched with and refer to a CHG-S.-->
<!ELEMENT CHG-E  - O  EMPTY  >
```

```
<!ATTLIST CHG-E
               ID  IDREF    #IMPLIED  >

<!--Literal: "A statutory invention registration is not a patent. It has the defensive attributes
of a
patent but does not have the enforceable attributes of a patent. No article or advertisement
or the like may use the term patent, or any term suggestive of a patent, when referring to a
statutory invention registration. For more specific information on the rights associated with a
statutory invention registration see 35 U.S.C.157."
-->
<!ELEMENT B122US  - - (#PCDATA) >

<!--Document kind code from WIPO Standard ST.16.
For US documents:
A = Utility Patent
Bx = Reexamination Certificate, where x is an integer (e.g., B1, B3)
E = Reissue Patent
H = Statutory Invention Registration
P = Plant Patent
S = Design Patent-->
<!ELEMENT B130  - - (#PCDATA) >

<!--Document date (publication or issue).-->
<!ELEMENT B140  - - (DATE | (CHG-S,DATE,CHG-E)) >

<!--Date. YYYYMMDD: four-digit year, two-digit month
(leading zeros) and two-digit day (leading zeros).-->
<!ELEMENT DATE  - - (#PCDATA) >

<!--Publishing country or organization code from WIPO Standard ST.3.-->
<!ELEMENT B190  - - (#PCDATA) >

<!--Domestic filing data-->
<!ELEMENT B200  - - (B210,(B211US | (CHG-S,B211US,CHG-E)),B220,B221US?,B222US?) >

<!--Application number
For US documents: YYYYNNNNNN
(four-digit year, six-digit serial number with leading zeros)-->
<!ELEMENT B210  - - (DNUM | (CHG-S,DNUM,CHG-E)) >

<!--Series Code, two-digit, representing the following time periods and document types:
02 ..... up to ...1947-12-31
03 1948-01-01...1959-12-31
04 1960-01-01...1969-12-31
05 1970-01-01...1978-12-31
06 1979-01-01...1986-12-31
07 1987-01-01...1992-12-31
08 1993-01-01...1997-12-29
09 1997-12-30...and after
29 Design Application
60 Provisional Application
90 Reexamination Request-->
<!ELEMENT B211US  - - (#PCDATA) >

<!--Application filing date-->
<!ELEMENT B220  - - (DATE | (CHG-S,DATE,CHG-E)) >
```

```
<!--When present, signifies that the application was filed under Rule 47, indicating
the applicant(s) refused to execute the application or could not be found.-->
<!ELEMENT B221US  - O  EMPTY  >

<!--When present, signifies the prosecution of the application
includes the Continued Prosecution Application (CPA) procedure.-->
<!ELEMENT B222US  - O  EMPTY  >

<!--Foreign priority data-->
<!ELEMENT B300  - - (B310,B320,B330) >

<!--Priority application number-->
<!ELEMENT B310  - - (DNUM | (CHG-S,DNUM,CHG-E)) >

<!--Filing date of priority application.-->
<!ELEMENT B320  - - (DATE | (CHG-S,DATE,CHG-E)) >

<!--Publishing country or organization.-->
<!ELEMENT B330  - - (CTRY | (CHG-S,CTRY,CHG-E)) >

<!--Country. Use WIPO Standard ST.3 codes.-->
<!ELEMENT CTRY  - - (#PCDATA) >

<!--Public availability dates and term of protection-->
<!ELEMENT B400  - - (B450?,B472?) >

<!--Examined document with grant printed, need for reissue of reissue.-->
<!ELEMENT B450  - - (DOC | (CHG-S,DOC,CHG-E)) >

<!--Components of document identification-->
<!ELEMENT DOC  - - ((DNUM,DATE?,CTRY?,KIND?,BNUM?,DTXT*) | (CHG-S,DNUM,DATE?,CTRY?,
               KIND?,BNUM?,DTXT*,CHG-E)) >

<!--Document kind (WIPO Standard ST.16), or kind generally-->
<!ELEMENT KIND  - - (#PCDATA) >

<!--Bulletin number-->
<!ELEMENT BNUM  - - (#PCDATA) >

<!--Descriptive text-->
<!ELEMENT DTXT  - - (STEXT*) >

<!--Text including subscripts and superscripts.-->
<!ELEMENT STEXT  - - (FOR | PDAT | SB | SP) >

<!--Rreference to a footnote-->
<!ELEMENT FOR  - - (STEXT) >

<!--Footnote reference ID-->
<!ATTLIST FOR
               ID  IDREF    #REQUIRED  >

<!--Required for compatability with XML.
Use PDAT instead of #PCDATA to avoid mixed content models.-->
```

```
<!ELEMENT PDAT  - - (#PCDATA) >

<!--Subscript-->
<!ELEMENT SB  - - (PDAT | HIL)* >

<!--Highlighting: superscripts, subscripts, and floating accents-->
<!ELEMENT HIL  - - (LTL | SB | SP) >

<!--Literal text-->
<!ELEMENT LTL  - - (STEXT+) >

<!--Superscript-->
<!ELEMENT SP  - - (PDAT | HIL)* >

<!--Term of grant.-->
<!ELEMENT B472  - - ((B473?,B473US?,B474?,B474US?) | (CHG-S,B473?,B473US?,B474?,
               B474US?,CHG-E)) >

<!--Disclaimer date-->
<!ELEMENT B473  - - (DATE | (CHG-S,DATE,CHG-E)) >

<!--When present, this tag signifies that the patent is subject to a terminal disclaimer.-->
<!ELEMENT B473US  - O  EMPTY  >

<!--Term of Grant.
MANDATORY for US Design Patents only.-->
<!ELEMENT B474  - - (#PCDATA) >

<!--Term extension under 35 USC 154(b). Either "5 years", or the number of days (as an integer)
if the extension is less than five years.-->
<!ELEMENT B474US  - - (#PCDATA) >

<!--Technical information-->
<!ELEMENT B500  - - (B510,B520,B540,B560?,B570,B580,B590?) >

<!--International Patent Classification (IPC) data.-->
<!ELEMENT B510  - - ((B511,B512*,B516) | (CHG-S,B511,B512*,B516,CHG-E)) >

<!--International Patent Classification (IPC) Main classification
or Locarno Classification for Design patents-->
<!ELEMENT B511  - - (#PCDATA) >

<!--Further IPC classification-->
<!ELEMENT B512  - - (#PCDATA) >

<!--Edition, version of IPC-->
<!ELEMENT B516  - - (#PCDATA) >

<!--Domestic or national classification data-->
<!ELEMENT B520  - - ((B521,(B522 | B523)*) | (CHG-S,(B521,(B522 | B523)*),CHG-E)) >

<!--Domestic or National classification, Main classification.
US: Original classification (OR).-->
<!ELEMENT B521  - - (#PCDATA) >
```

```
<!--Further classification
US: Cross-reference classification-->
<!ELEMENT B522  - - (#PCDATA) >

<!--Unofficial classification-->
<!ELEMENT B523  - - (#PCDATA) >

<!--Title of invention-->
<!ELEMENT B540  - - (STEXT+ | (CHG-S,STEXT+,CHG-E)) >

<!--Citations-->
<!ELEMENT B560  - - (B561 | B562)+ >

<!--Citing a patent document-->
<!ELEMENT B561  - - ((PDAT | PCIT) | (CHG-S,(PDAT | PCIT),CHG-E)) >

<!--Patent citation-->
<!ELEMENT PCIT  - - (DOC,PARTY-US*,PIC*,PNC*,REL?) >

<!--Components of party-->
<!ELEMENT PARTY-US  - - ((NAM,ADR?,RESIDENCE?,DTXT?,RCTRY?,NCTRY?) | (CHG-S,NAM,ADR?,
               RESIDENCE?,DTXT?,RCTRY?,NCTRY?,CHG-E)) >

<!--Name of an individual or organization-->
<!ELEMENT NAM  - - ((TTL?,FNM,SNM,SFX?,IID?,IRF?) | (ONM,SYN*,OID?,(ODV,DID?)*)) >

<!--Title (e.g., Mr., Mrs.) applied to a name-->
<!ELEMENT TTL  - - (#PCDATA) >

<!--Given and middle name(s) or initials-->
<!ELEMENT FNM  - - (#PCDATA) >

<!--Family, last, surname or organisation-->
<!ELEMENT SNM  - - (STEXT+) >

<!--Suffix (e.g., II, Jr., Esq. et al.)-->
<!ELEMENT SFX  - - (#PCDATA) >

<!--Individual ID number (e.g., US SSSN)-->
<!ELEMENT IID  - - (#PCDATA) >

<!--Individual reference number (filing, etc.)-->
<!ELEMENT IRF  - - (#PCDATA) >

<!--Organization name-->
<!ELEMENT ONM  - - (STEXT+) >

<!--Synonym or cross reference-->
<!ELEMENT SYN  - - (#PCDATA) >

<!--Identifying number of organization-->
<!ELEMENT OID  - - (#PCDATA) >

<!--Division of organization-->
<!ELEMENT ODV  - - (STEXT+) >
```

```
<!--Identifying number of division-->
<!ELEMENT DID  - - (#PCDATA) >

<!--Components of an address-->
<!ELEMENT ADR  - - (OMC?,PBOX?,STR*,CITY?,CNTY?,STATE?,CTRY?,PCODE?,EAD*,TEL*,FAX*) >

<!--Organization mail code
US: use for military address, e.g., Unit 3400 Box 672 APO AE 09128.-->
<!ELEMENT OMC  - - (#PCDATA) >

<!--Post Office box number-->
<!ELEMENT PBOX  - - (#PCDATA) >

<!--Street, house number or house name-->
<!ELEMENT STR  - - (#PCDATA) >

<!--City or town-->
<!ELEMENT CITY  - - (#PCDATA) >

<!--County, parish, department, etc.-->
<!ELEMENT CNTY  - - (#PCDATA) >

<!--Region of country (state, province)-->
<!ELEMENT STATE  - - (#PCDATA) >

<!--Postal code or zip code-->
<!ELEMENT PCODE  - - (#PCDATA) >

<!--Electronic address (e.g., email)-->
<!ELEMENT EAD  - - (#PCDATA) >

<!--Telephone number-->
<!ELEMENT TEL  - - (#PCDATA) >

<!--Fax telephone number-->
<!ELEMENT FAX  - - (#PCDATA) >

<!--Inventor’s residence.-->
<!ELEMENT RESIDENCE  - - (MILS | (CITY,(STATE | CTRY))) >

<!--Military service where the applicant resides.
USN : US Navy
USA : US Army
USAF : US Air Force
USMC : US Marine Corp
USCG : US Coast Guard
etc.
-->
<!ELEMENT MILS  - - (#PCDATA) >

<!--Country of residence-->
<!ELEMENT RCTRY  - - (CTRY) >

<!--Country of nationality-->
```

```
<!ELEMENT NCTRY  - - (CTRY) >

<!--International classification of citation (IPC).-->
<!ELEMENT PIC  - - (#PCDATA) >

<!--National classificaiton of citation-->
<!ELEMENT PNC  - - (#PCDATA) >

<!--Identifies relevant spot in citation
(page numbers, paragraph numbers, relevant residues (in sequence listing), etc.)-->
<!ELEMENT REL  - - (STEXT+) >

<!--Citing non-patent literature-->
<!ELEMENT B562  - - ((PTEXT* | NCIT) | (CHG-S,(PTEXT* | NCIT),CHG-E)) >

<!--Contents of a paragraph-->
<!ELEMENT PTEXT  - - (B830 | CIT | CLREF | CRF | CWU | DFREF | DNUM | FGREF | FOO |
               FOR | HIL | LST | LSTREF | PDAT | SEQREF | TBLREF) >

<!--Microorganism deposit information-->
<!ELEMENT B830  - - (B831,B832?,B833?) >

<!--Deposit file number-->
<!ELEMENT B831  - - (#PCDATA) >

<!--Identificaiton of authority where deposit was made-->
<!ELEMENT B832  - - (#PCDATA) >

<!--Date of deposit-->
<!ELEMENT B833  - - (DATE) >

<!--Citation-->
<!ELEMENT CIT  - - (((DOC,B220,B140,NAM*,PIC*,PNC*) | NCIT),REL*)* >

<!--Components of a non-patent document citation-->
<!ELEMENT NCIT  - - (ARTCIT | BOOKCIT | DBASECIT | OTHCIT) >

<!--Components of a non-patent citation (NCIT)-->
<!ELEMENT ARTCIT  - - (AUTHGRP?,TI,SBT?,(JNL | CNG | BOOKID),PP?,ISSN?,CDN?) >

<!--Components of the author group-->
<!ELEMENT AUTHGRP  - - (AUTHOR | COAUTH | COLLAB)+ >

<!--Components of the author group (AUTHGRP) Author name and address-->
<!ELEMENT AUTHOR  - - (PARTY-US) >

<!--Co-author’s name and address-->
<!ELEMENT COAUTH  - - (PARTY-US) >

<!--Collaborator’s name and address-->
<!ELEMENT COLLAB  - - (PARTY-US) >

<!--Book title-->
<!ELEMENT TI  - - (STEXT+) >
```

```
<!--Article subtitle-->
<!ELEMENT SBT  - - (STEXT+) >

<!--Journal citation-->
<!ELEMENT JNL  - - (TI,SBT?,JABT?,PNM?,DATE,VID?,INO?,ANO?) >

<!--Journal abbreviated title-->
<!ELEMENT JABT  - - (STEXT+) >

<!--Publisher’s name and add.-->
<!ELEMENT PNM  - - (PARTY-US) >

<!--Journal volume identification-->
<!ELEMENT VID  - - (#PCDATA) >

<!--Journal issue number-->
<!ELEMENT INO  - - (#PCDATA) >

<!--Abstract number-->
<!ELEMENT ANO  - - (#PCDATA) >

<!--Conference group/citation-->
<!ELEMENT CNG  - - (CNM,DATE?,CNN?,CNP?,CNS?) >

<!--Conference name-->
<!ELEMENT CNM  - - (STEXT+) >

<!--Conference number-->
<!ELEMENT CNN  - - (#PCDATA) >

<!--Conference place-->
<!ELEMENT CNP  - - (#PCDATA) >

<!--Conference sponsor-->
<!ELEMENT CNS  - - (STEXT+) >

<!--Book identification-->
<!ELEMENT BOOKID  - - (TI,SBT?,EDN?,MSN?,MST?,ANO?,PNM?,DATE,VID?,NO?,ED?,ISBN?,CDN?) >

<!--Editor’s name and address-->
<!ELEMENT EDN  - - (PARTY-US) >

<!--Monographic series number-->
<!ELEMENT MSN  - - (#PCDATA) >

<!--Monographic series title-->
<!ELEMENT MST  - - (STEXT+) >

<!--Book number-->
<!ELEMENT NO  - - (#PCDATA) >

<!--Edition statement-->
<!ELEMENT ED  - - (#PCDATA) >

<!--ISBN, International Standard Book Number-->
```

```
<!ELEMENT ISBN  - - (#PCDATA) >

<!--CODEN (obsolete standard number for periodicals)-->
<!ELEMENT CDN  - - (#PCDATA) >

<!--Page numbers-->
<!ELEMENT PP  - - (PDAT | (PPF,PPL?)) >

<!--Page number, or starting page number-->
<!ELEMENT PPF  - - (#PCDATA) >

<!--Ending page number-->
<!ELEMENT PPL  - - (#PCDATA) >

<!--ISSN International Standard Serial Number-->
<!ELEMENT ISSN  - - (#PCDATA) >

<!--Book citation-->
<!ELEMENT BOOKCIT  - - (AUTHGRP,BOOKID,PART?,SECT?,PP?) >

<!--Part of book-->
<!ELEMENT PART  - - (#PCDATA) >

<!--Section of book-->
<!ELEMENT SECT  - - (#PCDATA) >

<!--Database citation-->
<!ELEMENT DBASECIT  - - (DBN,DBRECNO,PNM?,DBS?,SRT?,DATE?) >

<!--Name of database-->
<!ELEMENT DBN  - - (STEXT+) >

<!--Unique identification number of the database record cited.-->
<!ELEMENT DBRECNO  - - (#PCDATA) >

<!--Section of database-->
<!ELEMENT DBS  - - (#PCDATA) >

<!--Search terms-->
<!ELEMENT SRT  - - (STEXT+) >

<!--Other reference (paragraph form)-->
<!ELEMENT OTHCIT  - - (STEXT+) >

<!--Reference to a claim-->
<!ELEMENT CLREF  - O  EMPTY  >

<!ATTLIST CLREF
               ID  IDREF    #REQUIRED  >

<!--Reference to chemical expression-->
<!ELEMENT CRF  - O  EMPTY  >

<!ATTLIST CRF
               ID  IDREFS    #REQUIRED  >
```

Appendix A - Document Type Definitions (DTD)
ST32 US Patent Grant

```
<!--Complex work units-->
<!ELEMENT CWU  - - (TABLE-US | MATH-US | CHEM-US | SEQLST-US) >

<!--Table-->
<!ELEMENT TABLE-US  - - (TABLE-CALS,EMI) >

<!ATTLIST TABLE-US
               ID  ID    #REQUIRED  >

<!--Table in CALS markup-->
<!ELEMENT TABLE-CALS  - - (TABLE) >

<!--Embedded image-->
<!ELEMENT EMI  - O  EMPTY  >

<!--TI, type of image:
AD = abstract drawing
CF = chemical formulae
CI = clipped image
CP = computer program listings
DN = DNA sequences
DR = drawings
FF = undefined characters
FG = figures
GR = graphs
MF = mathematical formulae
PA = full-page facsimile image
PH = photograph
SR = search report form
TB = table or tabular data
TX = text character [deprecated in US documents]
UI = undefined image [deprecated in US documents]-->
<!ATTLIST EMI
               ID  ID    #REQUIRED
               HE  NMTOKEN    #IMPLIED
               WI  NMTOKEN    #IMPLIED
               FILE  ENTITY    #IMPLIED
               LX  NMTOKEN    #IMPLIED
               LY  NMTOKEN    #IMPLIED
               IMF (ST33 | TIFF)   #IMPLIED
               TI (AD | CF | CI | CP | DN | DR | FG | FF | GR | MF | PA | PH | SR |
               TB | TX | UI)   #IMPLIED  >

<!--Displayed and in-line math formulae-->
<!ELEMENT MATH-US  - - (MATHEMATICA,MATHML,EMI) >

<!ATTLIST MATH-US
               ID  ID    #REQUIRED  >

<!--Formula in Mathematica format-->
<!ELEMENT MATHEMATICA  - O  EMPTY  >

<!ATTLIST MATHEMATICA
               ID  ID    #REQUIRED
               FILE  ENTITY    #REQUIRED  >
```

```
<!--Formula in MathML format.-->
<!ELEMENT MATHML  - - (MATH) >

<!--Chemical Notation-->
<!ELEMENT CHEM-US  - - (CHEMCDX,CHEMMOL,EMI) >

<!ATTLIST CHEM-US
               ID  ID    #REQUIRED  >

<!--Chemical Notation in CDX4 Format-->
<!ELEMENT CHEMCDX  - O  EMPTY  >

<!ATTLIST CHEMCDX
               ID  ID    #IMPLIED
               FILE  ENTITY    #REQUIRED  >

<!--Chemical notation in MOL format-->
<!ELEMENT CHEMMOL  - O  EMPTY  >

<!ATTLIST CHEMMOL
               ID  ID    #REQUIRED
               FILE  ENTITY    #REQUIRED  >

<!--Sequence Listing-->
<!ELEMENT SEQLST-US  - - ((SEQ-LST,EMI) | (SEQ-EMBD,EMI)) >

<!ATTLIST SEQLST-US
               ID  ID    #REQUIRED  >

<!--Sequence Listing.
The following table shows the ST.25 Identifier followed by
the corresponding Red-Book tag: Bxxx elements are in SDOBI.
110.......B720
120.......B540
130.......S130
140.......B210
141.......B220
150.......B310
151.......B320
160.......S160
170.......S170
..............S200 (container for S2xx tags; not in ST.25)
210.......S210
211.......S211
212.......S212
213.......S213
220.......S220
221.......S221
222.......S222
223.......S223
300.......CIT
301.......AUTHGRP
302.......TI
303.......JTL
304.......VID
```

```
305.......INO
306.......PP
307.......DATE
308.......S308
309.......DATE
310.......DNUM
311.......B220
312.......B140
313.......S313
400.......S400
The following table shows the pre-ST.25 tags for which there is no corresponding ST.25
tag followed by the corresponding Red-Book tag.
(1)(v)................S-1-V
(1)(v)(A)..........S-1-V-A
(1)(v)(B)..........S-1-V-B
(1)(v)(C)..........S-1-V-C
(2)(i).................S-2-I
(2)(i)(C)...........S-2-I-C
(2)(i)(D)...........S-2-I-D
(2)(ii)................S-2-II
(2)(ii)(A)..........S-2-II-A
(2)(iii).............S-2-III
(2)(iv).............S-2-IV
(2)(v)..............S-2-V
(2)(vi)(B).......S-2-VI-B
(2)(vi)(C).......S-2-VI-B
(2)(vi)(D).......S-2-VI-D
(2)(vi)(E).......S-2-VI-E
(2)(vi)(F).......S-2-VI-F
(2)(vi)(G).......S-2-VI-G
(2)(vi)(H).......S-2-VI-H
(2)(vi)(I) .......S-2-VI-I
(2)(vii)...........S-2-VII
(2)(vii)(A).....S-2-VII-A
(2)(vii)(B).....S-2-VII-B
(2)(viii).........S-2-VIII
(2)(viii)(A) ...S-2-VII
(2)(viii)(B)....S-2-VII
(2)(viii)(C)....S-2-VII
(2)(ix)(C)......S-2-IX-C
-->
<!ELEMENT SEQ-LST  - - (S160,S-1-V?,S200+) >

<!--Number of sequence IDs.-->
<!ELEMENT S160  - - (#PCDATA) >

<!--Computer readable form-->
<!ELEMENT S-1-V  - - (S-1-V-A,S-1-V-B,S-1-V-C) >

<!--Medium type
Type of diskette/tape submitted-->
<!ELEMENT S-1-V-A  - - (#PCDATA) >

<!--Computer
Type of computer used with diskette/tape submitted-->
<!ELEMENT S-1-V-B  - - (#PCDATA) >
```

```
<!--Operating system-->
<!ELEMENT S-1-V-C  - - (#PCDATA) >

<!--Sequence information.-->
<!ELEMENT S200  - - (S210,S211,S212,S-2-I?,S-2-II?,S-2-III?,S-2-IV?,S-2-V?,S213,
               S-2-VI?,S-2-VII?,S-2-VIII?,S220*,CIT*,S400) >

<!--Sequence identification number.-->
<!ELEMENT S210  - - (#PCDATA) >

<!--Number of bases or amino acid residues-->
<!ELEMENT S211  - - (#PCDATA) >

<!--Presented sequence molecule is DNA or RNA or PRT (protein).
If a nucleotide sequence contains both DNA and RNA fragments,
the type shall be DNA. In addition, the combined DNA/RNA molecule
shall be further described in S220, S221, S222, and S223.-->
<!ELEMENT S212  - - (#PCDATA) >

<!--Sequence characteristics
-->
<!ELEMENT S-2-I  - - (S-2-I-C,S-2-I-D) >

<!--Strandedness. If nucleic acid, number of strands of source organism molecule,
i.e., whether single stranded, double stranded, both, or unknown to applicant.-->
<!ELEMENT S-2-I-C  - - (#PCDATA) >

<!--Topology. Whether source organism molecule is circular, linear, both, or
unknown to applicant.-->
<!ELEMENT S-2-I-D  - - (#PCDATA) >

<!--Molecule type: genomic RNA, genomic DNA, mRNA, tRNA, rRNA, snRNA,
scRNA, preRNA, cDNA to genomic RNA, cDNA to mRNAcDNA to tRNA, cDNA to rRNA,
cDNA to snRNA, cDNA to scRNA, other nucleic acid.
-->
<!ELEMENT S-2-II  - - (S-2-II-A) >

<!--Description (protein and peptide).-->
<!ELEMENT S-2-II-A  - - (#PCDATA) >

<!--Hypothetical? (yes, no)-->
<!ELEMENT S-2-III  - - (#PCDATA) >

<!--Anti-sense? (yes, no)-->
<!ELEMENT S-2-IV  - - (#PCDATA) >

<!--Gragment type. For proteins and peptides only, at least one of the following should be
included in the sequence listing: N-terminal fragment, C-terminal fragment,
and internal fragment.-->
<!ELEMENT S-2-V  - - (#PCDATA) >

<!--Organism's scientific name, i.e., genus/species, or 'unknown,' or 'artificial sequence.'
If 'unknown' or 'artificial sequence,' describe further in S220, S221, S222, S223.-->
<!ELEMENT S213  - - (#PCDATA) >

<!--Original source of molecule.-->
```

```
<!ELEMENT S-2-VI  - - (S-2-VI-B?,S-2-VI-C?,S-2-VI-D?,S-2-VI-E?,S-2-VI-F?,S-2-VI-G?,
               S-2-VI-H?,S-2-VI-I?) >

<!--Strain-->
<!ELEMENT S-2-VI-B  - - (#PCDATA) >

<!--Individual isolate-->
<!ELEMENT S-2-VI-C  - - (#PCDATA) >

<!--Developmental stage. Give developmental stage of source organism and indicate
whether derived from germ-line or rearranged developmental pattern.
-->
<!ELEMENT S-2-VI-D  - - (#PCDATA) >

<!--Haplotype-->
<!ELEMENT S-2-VI-E  - - (#PCDATA) >

<!--Tissue type-->
<!ELEMENT S-2-VI-F  - - (#PCDATA) >

<!--Cell type-->
<!ELEMENT S-2-VI-G  - - (#PCDATA) >

<!--Cell line-->
<!ELEMENT S-2-VI-H  - - (#PCDATA) >

<!--Organelle-->
<!ELEMENT S-2-VI-I  - - (#PCDATA) >

<!ELEMENT S-2-VII  - - (S-2-VII-A?,S-2-VII-B?) >

<!--Library (type and name)-->
<!ELEMENT S-2-VII-A  - - (#PCDATA) >

<!--Clone(s)-->
<!ELEMENT S-2-VII-B  - - (#PCDATA) >

<!--Position in genome-->
<!ELEMENT S-2-VIII  - - (S-2-VIII-A?,S-2-VIII-B?,S-2-VIII-C?) >

<!--Chromosome or segment name or number-->
<!ELEMENT S-2-VIII-A  - - (#PCDATA) >

<!--Map position-->
<!ELEMENT S-2-VIII-B  - - (#PCDATA) >

<!--Units for map position (genome percent, nucleotide number, etc.)-->
<!ELEMENT S-2-VIII-C  - - (#PCDATA) >

<!--Sequence feature; description a point of bilological significance in the sequence.-->
<!ELEMENT S220  - - (S221,S222,S-2-IX-C?,S223) >

<!--Name/Key. Appropriate identifier for this feature, preferably from
WIPO Standard ST.25 (1998), Appendix 2, tables 5 and 6.-->
<!ELEMENT S221  - - (STEXT+) >
```

```
<!--Location of the feature within the sequence. Where appropraite, state the number of the first
and last bases/amino acids in the feature.
Old rules: specify location according to syntax of DDBJ, EMBL, or GenBank feature tables
definition, including whether feature is on complement of presented sequence; where
appropriate, state number of first and last bases/amino acids in feature.-->
<!ELEMENT S222  - - (STEXT+) >

<!--Method by which the sequence was identified: experiment, similarity with known
sequence or to established consensus sequence or to some other pattern.-->
<!ELEMENT S-2-IX-C  - - (#PCDATA) >

<!--Other relevant information. Limited to approximately 288 characters of text.-->
<!ELEMENT S223  - - (STEXT+) >

<!--The sequence itself.-->
<!ELEMENT S400  - - (#PCDATA) >

<!--Sequence listing embedded in other text.-->
<!ELEMENT SEQ-EMBD  - - (#PCDATA) >

<!--Reference to formula (math)-->
<!ELEMENT DFREF  - O  EMPTY  >

<!ATTLIST DFREF
               ID  IDREFS    #REQUIRED  >

<!--Reference to a figure (drawing)-->
<!ELEMENT FGREF  - O  EMPTY  >

<!ATTLIST FGREF
               ID  IDREF    #REQUIRED  >

<!--Footnotes-->
<!ELEMENT FOO  - - (PTEXT+) >

<!--Footnote id.-->
<!ATTLIST FOO
               ID  ID    #REQUIRED  >

<!--List-->
<!ELEMENT LST  - - (DL | OL | SL | UL) >

<!ATTLIST LST
               ID  ID    #REQUIRED  >

<!--List, Definition-->
<!ELEMENT DL  - - (DT,DD)+ >

<!--tsize = Term size attribute
compact = Spacing between items-->
<!ATTLIST DL
               TSIZE  NMTOKEN    #IMPLIED
               COMPACT (COMPACT)   #IMPLIED  >
```

```
<!--List, Definition, Term-->
<!ELEMENT DT  - - (STEXT+) >

<!--Definition description-->
<!ELEMENT DD  - - (PTEXT | PARA)+ >

<!--Paragraph. Corresponds to P in ST.32. PARA name required for
compatability with CALS Table markup.-->
<!ELEMENT PARA  - - (PTEXT+) >

<!ATTLIST PARA
               ID  ID    #IMPLIED  >

<!--List, Ordered-->
<!ELEMENT OL  - - (LI+) >

<!--compact = Spacing between items
level = Nesting level of list
prefix = Prefix for each list item
numstyle = Numbering style-->
<!ATTLIST OL
               COMPACT (COMPACT)   #IMPLIED
               LEVEL  NMTOKEN    #IMPLIED
               PREFIX  CDATA    #IMPLIED
               NUMSTYLE  CDATA    #IMPLIED  >

<!--List item-->
<!ELEMENT LI  - - (PTEXT | PARA)+ >

<!--List, Simple-->
<!ELEMENT SL  - - (LI+) >

<!--compact = Spacing between items
level = Nesting level of list-->
<!ATTLIST SL
               COMPACT (COMPACT)   #IMPLIED
               LEVEL  NMTOKEN    #IMPLIED  >

<!--List, Unordered-->
<!ELEMENT UL  - - (LI+) >

<!--st = Ulist symbol
level = Nesting level of list
compact = Spacing between items-->
<!ATTLIST UL
               ST  CDATA    #REQUIRED
               LEVEL  NMTOKEN    #IMPLIED
               COMPACT (COMPACT)   #IMPLIED  >

<!--Reference to a list.-->
<!ELEMENT LSTREF  - O  EMPTY  >

<!ATTLIST LSTREF
               ID  IDREF    #REQUIRED  >

<!--Reference to a sequence listing.-->
```

```
<!ELEMENT SEQREF  - O  EMPTY  >

<!ATTLIST SEQREF
               ID  ID    #REQUIRED  >

<!--Reference to a table.-->
<!ELEMENT TBLREF  - O  EMPTY  >

<!--Table reference(s)-->
<!ATTLIST TBLREF
               ID  IDREFS    #IMPLIED  >

<!--Claims allowed or representative claim(s).-->
<!ELEMENT B570  - - ((B577,B578US*) | (CHG-S,B577,B578US*,CHG-E)) >

<!--Number of claims allowed.-->
<!ELEMENT B577  - - (#PCDATA) >

<!--Exemplary claim number.-->
<!ELEMENT B578US  - - (#PCDATA) >

<!--Field of search-->
<!ELEMENT B580  - - ((B581 | B582 | B583US) | (CHG-S,(B581 | B582 | B583US),CHG-E))+ >

<!--International patent classification (IPC)-->
<!ELEMENT B581  - - (#PCDATA) >

<!--National classification.
Use for structured US Classification information:
...Pos. 1 - 3 ... Class
3 alphanumeric characters, right justified; D for design classes,
followed by one or two right-justified digits; PLT for Plant classes
...Pos. 4 - ... Subclass
alphanumeric, variable length-->
<!ELEMENT B582  - - (#PCDATA) >

<!--US classification, unstructured. Could be any combination of classes, subclasses, ranges
of subclasses, etc.-->
<!ELEMENT B583US  - - (#PCDATA) >

<!--Specification and drawings-->
<!ELEMENT B590  - - ((B594US?,B595?,B595US?,B596) | (CHG-S,B594US?,B595?,B595US?,
               B596,CHG-E)) >

<!--If there is an optical microform (microfiche, microfilm, microcard, etc.) appendix,
the number of microforms and the number of pages imaged thereon (separated by a comma)
are shown here.-->
<!ELEMENT B594US  - - (#PCDATA) >

<!--Number of drawing sheets submitted by applicant-->
<!ELEMENT B595  - - (#PCDATA) >

<!--Number of drawing sheets submitted in color-->
<!ELEMENT B595US  - - (#PCDATA) >

<!--Number of figures-->
```

```
<!ELEMENT B596  - - (#PCDATA) >

<!--Related patents or applications-->
<!ELEMENT B600  - - (B610 | B620 | B630 | B640 | B641US | B645 | B645US | B660 |
               B680US)+ >

<!--Earlier document to which this is an addition-->
<!ELEMENT B610  - - (PARENT-US) >

<!--Parent/child relationship-->
<!ELEMENT PARENT-US  - - (CDOC,PDOC,B650?,(PSTA | (CHG-S,PSTA,CHG-E)),PPUB?) >

<!--Child document identification-->
<!ELEMENT CDOC  - - (DOC) >

<!--Parent document identification-->
<!ELEMENT PDOC  - - (DOC) >

<!--Previously-published document concerning the same application-->
<!ELEMENT B650  - - (DOC) >

<!--Parent status code.
00 ... Pending
01 ... Granted (Patent)
03 ... Abandoned
04 ... Statutory Invention Registration (SIR)-->
<!ELEMENT PSTA  - - (#PCDATA) >

<!--id of patent associated with parent-->
<!ELEMENT PPUB  - - (DOC) >

<!--Earlier application from which the present document has been divided out.-->
<!ELEMENT B620  - - (PARENT-US) >

<!--Continuations-->
<!ELEMENT B630  - - (B631 | B632 | B633)+ >

<!--Earlier application of which the present document is a continuation-->
<!ELEMENT B631  - - (PARENT-US) >

<!--Document of which this is a continuation-in-part-->
<!ELEMENT B632  - - (PARENT-US) >

<!--Document of which this is a continuing reissue-->
<!ELEMENT B633  - - (PARENT-US) >

<!--Reissue-->
<!ELEMENT B640  - - (PARENT-US) >

<!--Divisional resissue information of a related US document-->
<!ELEMENT B641US  - - (PARENT-US,SIBLING+) >

<!--Divisional reissue siblings-->
<!ELEMENT SIBLING  - - (CDOC,SDOC,SPUB) >
```

```
<!--Divisional reissue sibling application-->
<!ELEMENT SDOC  - - (DOC) >

<!--Divisional reissue sibling patent-->
<!ELEMENT SPUB  - - (DOC) >

<!--Reexamination-->
<!ELEMENT B645  - - (PARENT-US) >

<!--Present when a reissue application was merged with a reexamination proceeding.
The issuing document is a reissue patent which shows the following Reexamination results
statement on the reissue patent front page, immediately following the abstract.
NNNNN represents the Reexamination Request Number, and YYYYMMDD the filing date.
"The questions raised in reexamination request No.90/NNNNN, filed YYYYMMDD, have
been considered and the results thereof are reflected in this reissue patent which constitutes
the reexamination certificate required by 35 USC 307 as provided in 37 CFR 1.570(e)."
-->
<!ELEMENT B645US  - - (#PCDATA) >

<!--Document for which this is a substitute-->
<!ELEMENT B660  - - (PARENT-US) >

<!--US Provisional Application information-->
<!ELEMENT B680US  - - (DOC) >

<!--Parties concerned with the document-->
<!ELEMENT B700  - - (B720,B730?,B740?,B745) >

<!--Inventor information-->
<!ELEMENT B720  - - (B721+) >

<!--Inventor name, address, and residence.-->
<!ELEMENT B721  - - (PARTY-US) >

<!--Assignee-->
<!ELEMENT B730  - - (B731,(B732US | (CHG-S,B732US,CHG-E)))+ >

<!--Assignee name and address-->
<!ELEMENT B731  - - (PARTY-US) >

<!--Assignee type code:
01 Unassigned
02 United States company or corporation
03 Foreign company or corporation
04 United States individual
05 Foreign individual
06 United States government
07 Foreign government
08 County government (US)
09 State government (US)-->
<!ELEMENT B732US  - - (#PCDATA) >

<!--Attorney, agent, or representative.
US: Maximum of three.-->
<!ELEMENT B740  - - (B741+) >
```

```
<!--Attorney name and address-->
<!ELEMENT B741  - - (PARTY-US) >

<!--Persons acting upon the document-->
<!ELEMENT B745  - - (B746,B747*,(B748US | (CHG-S,B748US,CHG-E))) >

<!--Primary examiner name-->
<!ELEMENT B746  - - (PARTY-US) >

<!--Assistant examiner name-->
<!ELEMENT B747  - - (PARTY-US) >

<!--Technology Center, Industry Sector, Art Unit, or other grouping of US patent examiners.-->
<!ELEMENT B748US  - - (#PCDATA) >

<!--Data related to international conventions-->
<!ELEMENT B800  - - ((B860?,B870?) | (CHG-S,B860?,B870?,CHG-E))+ >

<!--PCT or regional authority filing information-->
<!ELEMENT B860  - - (B861,B862?,B863?,B864?) >

<!--PCT document identification. CTRY is always WO.-->
<!ELEMENT B861  - - (DOC) >

<!--Filing language (ISO 639)
US: English-->
<!ELEMENT B862  - - (#PCDATA) >

<!--35 USC 371 (PCT) date-->
<!ELEMENT B863  - - (DATE) >

<!--35 USC 102(e) date-->
<!ELEMENT B864  - - (DATE) >

<!--PCT or regional authority publication information-->
<!ELEMENT B870  - - (B871) >

<!--Document identification; CTRY is always WO.-->
<!ELEMENT B871  - - (DOC) >

<!--Subdocument: Abstract. All US patent types have an abstract;
for a Design patent, the abstract consists of a drawing only.-->
<!ELEMENT SDOAB  - - (BTEXT) >

<!--la = language (ISO 639)
cy = country code (WIPO Standard ST.3)
status = Status of the sub-doc.-->
<!ATTLIST SDOAB
              LA  NMTOKEN    #IMPLIED
              CY  NMTOKEN    #IMPLIED
              STATUS  CDATA    #IMPLIED  >

<!--Body text (container for many kinds of text).-->
<!ELEMENT BTEXT  - - ((H | PARA | CWU | IMG) | (CHG-S,(H | PARA | CWU | IMG),CHG-E))+ >
```

Appendix A - Document Type Definitions (DTD)
ST32 US Patent Grant

```
<!--Header-->
<!ELEMENT H  - - (STEXT | F)+ >

<!--lvl = level
align = Alignment-->
<!ATTLIST H
               LVL  NMTOKEN    #IMPLIED
               ALIGN (CENTER | LEFT | RIGHT)  "LEFT" >

<!--In-line formula-->
<!ELEMENT F  - - (MATH) >

<!--Image-->
<!ELEMENT IMG  - - (EMI | EMR | ELE | RTI) >

<!--Reference to emi-->
<!ELEMENT EMR  - O  EMPTY  >

<!ATTLIST EMR
               ID  IDREF    #REQUIRED  >

<!--Figure caption; embedded-image legend-->
<!ELEMENT ELE  - - (STEXT) >

<!ATTLIST ELE
               ID  ID    #REQUIRED  >

<!--Replace text with image-->
<!ELEMENT RTI  - - (#PCDATA) >

<!ATTLIST RTI
               ID  ID    #REQUIRED
               HE  NMTOKEN    #IMPLIED
               WI  NMTOKEN    #IMPLIED
               FILE  ENTITY    #IMPLIED
               LX  NMTOKEN    #IMPLIED
               LY  NMTOKEN    #IMPLIED
               IMF (ST33 | TIFF)   #IMPLIED  >

<!--Subdocument: Description of the invention.-->
<!ELEMENT SDODE  - - (RELAPP?,GOVINT?,BRFSUM?,DRWDESC?,DETDESC) >

<!--la = language (ISO 639)
cy = country code (WIPO Standard ST.3)
status = Status of the sub-doc.-->
<!ATTLIST SDODE
               LA  NMTOKEN    #IMPLIED
               CY  NMTOKEN    #IMPLIED
               STATUS  CDATA    #IMPLIED  >

<!--Other Patent Relations-->
<!ELEMENT RELAPP  - - (BTEXT) >

<!--Government Interest-->
<!ELEMENT GOVINT  - - (BTEXT) >
```

```
<!--Brief Summary-->
<!ELEMENT BRFSUM  - - (BTEXT) >

<!--Drawing Descriptions-->
<!ELEMENT DRWDESC  - - (BTEXT) >

<!ELEMENT DETDESC  - - (BTEXT) >

<!--Subdocument: Claims-->
<!ELEMENT SDOCL  - - ((H | CL) | (CHG-S,(H | CL),CHG-E))+ >

<!--la = language (ISO 639)
cy = country code (WIPO Standard ST.3)
status = Status of the sub-doc.-->
<!ATTLIST SDOCL
               LA  NMTOKEN    #IMPLIED
               CY  NMTOKEN    #IMPLIED
               STATUS  CDATA    #IMPLIED  >

<!--Ordered Claim list-->
<!ELEMENT CL  - - (CLM+) >

<!--A singular claim-->
<!ELEMENT CLM  - - (PTEXT | PARA)+ >

<!--Claim ID-->
<!ATTLIST CLM
               ID  ID    #REQUIRED  >

<!--Subdocument: Drawings-->
<!ELEMENT SDODR  - - (EMI* | (CHG-S,EMI*,CHG-E)) >

<!--la = language (ISO 639)
cy = country code (WIPO Standard ST.3)
status = Status of the sub-doc.-->
<!ATTLIST SDODR
               LA  NMTOKEN    #IMPLIED
               CY  NMTOKEN    #IMPLIED
               STATUS  CDATA    #IMPLIED  >

<!--Subdocument: OCR (optical character recognition) of first-page (bibliographic
information) contents. Where OCR failed to associate all content with elements,
the entire first page text is included in this element. Appears only in those US
documents which have been subjected to OCR processing.-->
<!ELEMENT SDOCR  - - (PDAT | (CHG-S,PDAT,CHG-E)) >

<!--la = language (ISO 639)
cy = country code (WIPO Standard ST.3)
status = Status of the sub-doc.-->
<!ATTLIST SDOCR
               LA  NMTOKEN    #IMPLIED
               CY  NMTOKEN    #IMPLIED
               STATUS  CDATA    #IMPLIED  >

]>
```

Appendix A - Document Type Definitions (DTD)
CALS - Table Markup Model

```
<!-- ***** CALS TABLE TAGS  -  ELEMENTS AND ATTRIBUTES *****         -->


     <!-- The following declarations may be referred to using a public
     entity as follows:

     <!ENTITY % tablepac PUBLIC
                  "-//USA-DOD//DTD CALS MIL-M-28001 TABLEPAK 950127 //EN">

     -->
<!ENTITY % paracon "(#PCDATA | ltl | sb | sp | emi | emr | ele | rti | dl | ol | sl | ul | table |
math)"                >
<!ENTITY % titles "(#PCDATA | ltl | sb | sp | emi | emr | ele | rti | dl | ol | sl | ul | table |
math)"                 >

<!ENTITY % bodyatt       "id            ID             #IMPLIED"  >

<!ENTITY % yesorno "NUMBER" >

<!-- ***** CALS TABLE TAGS  -  MAIN STRUCTURES *****          -->

<!ELEMENT (table )  - -       ((%titles;), tgroup+) -(table) >
<!ATTLIST (table)   tabstyle    NMTOKEN             #IMPLIED
                            tocentry    %yesorno;           "1"
                            shortentry  %yesorno;           #IMPLIED
                            frame       (top | bottom |
                                        topbot | all |
                                        sides | none)       #IMPLIED
                            colsep      %yesorno;           #IMPLIED
                            rowsep      %yesorno;           #IMPLIED
                            orient      (port | land)       #IMPLIED
                            pgwide      %yesorno;           #IMPLIED
                            %bodyatt;                               >

<!ELEMENT tgroup         - o       (colspec*,

                                    spanspec*,
                                   thead?, tfoot?,
                                   tbody) >
<!ATTLIST tgroup  cols        NUMBER              #REQUIRED
                  tgroupstyle NMTOKEN             #IMPLIED
                  colsep      %yesorno;           #IMPLIED
                  rowsep      %yesorno;           #IMPLIED
                  align       (left | right |
                              center | justify
                              | char )            "left"
                  charoff     NUTOKEN             "50"
                  char        CDATA               ""
                   >

<!ELEMENT colspec        - o       EMPTY>
<!ATTLIST colspec  colnum     NUMBER              #IMPLIED
                   colname    NMTOKEN             #IMPLIED
                   align      (left | right |
                              center | justify
                              | char)             #IMPLIED
                   charoff    NUTOKEN             #IMPLIED
```

```
                  char       CDATA              #IMPLIED
                  colwidth   CDATA              #IMPLIED
                  colsep     %yesorno;          #IMPLIED
                  rowsep     %yesorno;          #IMPLIED>

<!ELEMENT spanspec       - o       EMPTY >
<!ATTLIST spanspec  namest    NMTOKEN        #REQUIRED
                    nameend   NMTOKEN        #REQUIRED
                    spanname  NMTOKEN        #REQUIRED
                    align     (left|right|
                              center|justify
                              |char)         "center"
                    charoff   NUTOKEN        #IMPLIED
                    char      CDATA          #IMPLIED
                    colsep    %yesorno;      #IMPLIED
                    rowsep    %yesorno;      #IMPLIED>

<!ELEMENT (thead | tfoot)       - o       (colspec*, row+)    -(entrytbl) >
<!ATTLIST thead   valign  (top | middle | bottom) "bottom"  >
<!ATTLIST tfoot   valign   (top | middle | bottom) "top" >

<!ELEMENT tbody          - o       (row+) >
<!ATTLIST tbody   valign  (top | middle | bottom)  "top"  >

<!ELEMENT row            - o       (entry | entrytbl)+ >
 <!ATTLIST row   rowsep   %yesorno;   #IMPLIED >


<!ELEMENT entry          - o       (para | %paracon;)+>
<!ATTLIST entry   colname     NMTOKEN            #IMPLIED
             namest      NMTOKEN            #IMPLIED
                  nameend     NMTOKEN            #IMPLIED
                  spanname    NMTOKEN            #IMPLIED
                  morerows    NUMBER             "0"
                  colsep      %yesorno;          #IMPLIED
                  rowsep      %yesorno;          #IMPLIED
                  rotate      %yesorno;          "0"
                  valign      (top | bottom |
                              middle)            "top"
                  align       (left | right |
                              center | justify
                              | char )           #IMPLIED
                  charoff      NUTOKEN           #IMPLIED
                  char         CDATA             #IMPLIED  >

<!ELEMENT entrytbl    - -  (colspec*, spanspec*, thead?, tbody)+     -(entrytbl)>
<!ATTLIST entrytbl
       cols           NUMBER             #REQUIRED
               tgroupstyle    NMTOKEN            #IMPLIED
               colname        NMTOKEN            #IMPLIED
               spanname       NMTOKEN            #IMPLIED
               colsep         %yesorno;          #IMPLIED
               rowsep         %yesorno;          #IMPLIED
               align          (left | right |
                              center | justify
                              | char )           #IMPLIED
              charoff         NUTOKEN            #IMPLIED
              char            CDATA              #IMPLIED >
```

Appendix A - Document Type Definitions (DTD)
MathML - Mathematical Equation Markup Model

```
<!-- Content model for content and presentation        -->
<!--  and browser interface tags in MathML              -->
<!-- initial draft 9.May.1997          syntax = XML     -->
<!-- author = s.buswell sb@stilo.demon.co.uk            -->
<!--                                                    -->
<!-- revised 14.May.1997 by Robert Miner                -->
<!-- revised 29.June.1997 and 2.July.1997 by s.buswell  -->
<!--                                                    -->
<!-- revised 15.December.1997  by s.buswell             -->
<!-- revised 8.February.1998   by s.buswell             -->
<!-- revised 4.april.1998      by s.buswell             -->
<!--                                                    -->
<!-- W3C Recommendation      7 April 1998                          -->
<!-- ********************************************  -->

<!-- general attribute definitions for class & style & id & other -->
<!-- : attributes shared by all mathml elements        -->

<!ENTITY % att-globalatts      'class CDATA #IMPLIED
                                style CDATA #IMPLIED
                                id    ID    #IMPLIED
                                other CDATA #IMPLIED'  >

<!-- ********************************************  -->
<!-- Presentation element set                       -->

<!-- presentation attribute definitions -->

<!ENTITY % att-fontsize        'fontsize CDATA #IMPLIED'            >
<!ENTITY % att-fontweight      'fontweight (fwnormal | bold) #IMPLIED'  >
<!ENTITY % att-fontstyle       'fontstyle (fsnormal | italic) #IMPLIED' >
<!ENTITY % att-fontfamily      'fontfamily CDATA   #IMPLIED'        >
<!ENTITY % att-color           'color CDATA   #IMPLIED'             >

<!ENTITY % att-fontinfo      '%att-fontsize;
                              %att-fontweight;
                              %att-fontstyle;
                              %att-fontfamily;
                              %att-color;'  >

<!ENTITY % att-form        'form (prefix | infix | postfix) #IMPLIED' >
<!ENTITY % att-fence       'fence (aftrue | affalse ) #IMPLIED'    >
<!ENTITY % att-separator   'separator (true | false ) #IMPLIED'    >
<!ENTITY % att-lspace      'lspace CDATA  #IMPLIED'       >
<!ENTITY % att-rspace      'rspace CDATA  #IMPLIED'       >
<!ENTITY % att-stretchy    'stretchy (astrue | asfalse ) #IMPLIED'     >
<!ENTITY % att-symmetric   'symmetric (aytrue | ayfalse ) #IMPLIED'    >
<!ENTITY % att-maxsize     'maxsize CDATA #IMPLIED'       >
<!ENTITY % att-minsize     'minsize CDATA #IMPLIED'       >
<!ENTITY % att-largeop           'largeop (altrue | alfalse ) #IMPLIED' >
<!ENTITY % att-movablelimits     'movablelimits (amtrue | amfalse )
#IMPLIED' >
<!ENTITY % att-accent              'accent (aatrue | aafalse)  #IMPLIED'>

<!ENTITY % att-opinfo '%att-form;
                       %att-fence;
                       %att-separator;
```

```
                    %att-lspace;
                    %att-rspace;
                    %att-stretchy;
                    %att-symmetric;
                    %att-maxsize;
                    %att-minsize;
                    %att-largeop;
                    %att-movablelimits;
                    %att-accent;'        >

<!ENTITY % att-width            'width CDATA #IMPLIED'   >
<!ENTITY % att-height           'height CDATA #IMPLIED' >
<!ENTITY % att-depth            'depth CDATA #IMPLIED'   >

<!ENTITY % att-sizeinfo         '%att-width;
                                 %att-height;
                                 %att-depth;'          >

<!ENTITY % att-lquote             'lquote CDATA #IMPLIED'   >
<!ENTITY % att-rquote             'rquote CDATA #IMPLIED'   >

<!ENTITY % att-linethickness       'linethickness CDATA #IMPLIED' >

<!ENTITY % att-scriptlevel         'scriptlevel CDATA #IMPLIED'>
<!ENTITY % att-displaystyle        'displaystyle (dstrue | dsfalse)
#IMPLIED'>
<!ENTITY % att-scriptsizemultiplier 'scriptsizemultiplier CDATA
#IMPLIED'  >
<!ENTITY % att-scriptminsize       'scriptminsize CDATA #IMPLIED'>
<!ENTITY % att-background          'background CDATA #IMPLIED' >

<!ENTITY % att-open                'open CDATA #IMPLIED' >
<!ENTITY % att-close               'close CDATA #IMPLIED' >
<!ENTITY % att-separators          'separators CDATA #IMPLIED' >

<!ENTITY % att-subscriptshift      'subscriptshift CDATA #IMPLIED'>
<!ENTITY % att-superscriptshift    'superscriptshift CDATA #IMPLIED'    >

<!ENTITY % att-accentunder         'accentunder (aaytrue | aayfalse) #IMPLIED'>

<!ENTITY % att-align               'align CDATA #IMPLIED'          >
<!ENTITY % att-rowalign            'rowalign CDATA #IMPLIED'    >
<!ENTITY % att-columnalign         'columnalign CDATA #IMPLIED'   >
<!ENTITY % att-groupalign          'groupalign CDATA #IMPLIED'    >
<!ENTITY % att-alignmentscope      'alignmentscope CDATA #IMPLIED'  >

<!ENTITY % att-rowspacing          'rowspacing CDATA #IMPLIED'      >
<!ENTITY % att-columnspacing       'columnspacing CDATA #IMPLIED'   >
<!ENTITY % att-rowlines            'rowlines CDATA #IMPLIED'          >
<!ENTITY % att-columnlines         'columnlines CDATA #IMPLIED'        >
<!ENTITY % att-frame               'frame (none | solid | dashed)
#IMPLIED'  >
<!ENTITY % att-framespacing        'framespacing CDATA #IMPLIED'       >
<!ENTITY % att-equalrows           'equalrows CDATA #IMPLIED'         >
<!ENTITY % att-equalcolumns        'equalcolumns CDATA #IMPLIED'     >
```

```
<!ENTITY % att-tableinfo           '%att-align;
                                   %att-rowalign;
                                   %att-columnalign;
                                   %att-groupalign;
                                   %att-alignmentscope;
                                   %att-rowspacing;
                                   %att-columnspacing;
                                   %att-rowlines;
                                   %att-columnlines;
                                   %att-frame;
                                   %att-framespacing;
                                   %att-equalrows;
                                   %att-equalcolumns;
                                   %att-displaystyle;'        >

<!ENTITY % att-rowspan              'rowspan CDATA #IMPLIED'         >
<!ENTITY % att-columnspan           'columnspan CDATA #IMPLIED'      >

<!ENTITY % att-edge                  'edge (left | right)  #IMPLIED ' >

<!ENTITY % att-actiontype            'actiontype CDATA #IMPLIED' >
<!ENTITY % att-selection             'selection CDATA #IMPLIED ' >

<!-- presentation token schemata with content-->

<!ENTITY % ptoken "mi | mn | mo | mtext | ms" >

<!ATTLIST mi        %att-fontinfo;
                    %att-globalatts;    >

<!ATTLIST mn        %att-fontinfo;
                    %att-globalatts;    >

<!ATTLIST mo        %att-fontinfo;
                    %att-opinfo;
                    %att-globalatts;     >

<!ATTLIST mtext     %att-fontinfo;
                    %att-globalatts;     >

<!ATTLIST ms        %att-fontinfo;
                    %att-lquote;
                    %att-rquote;
                    %att-globalatts;          >

<!-- empty presentation token schemata -->

<!ENTITY % petoken  "mspace" >
<!ELEMENT mspace   - o EMPTY  >

<!ATTLIST mspace    %att-sizeinfo;
                    %att-globalatts;       >

<!-- presentation general layout schemata -->

<!ENTITY % pgenschema "mrow|mfrac|msqrt|mroot|
```

```
                    mstyle|merror|mpadded| mphantom|mfenced" >

<!ATTLIST mrow      %att-globalatts;   >

<!ATTLIST mfrac     %att-linethickness;
                    %att-globalatts; >

<!ATTLIST msqrt     %att-globalatts;   >

<!ATTLIST mroot     %att-globalatts;   >

<!ATTLIST mstyle    %att-fontinfo;
                    %att-opinfo;
                    %att-lquote;
                    %att-rquote;
                    %att-linethickness;
                    %att-scriptlevel;
                    %att-scriptsizemultiplier;
                    %att-scriptminsize;
                                        %att-background;
                                        %att-open;
                                        %att-close;
                                        %att-separators;
                    %att-subscriptshift;
                    %att-superscriptshift;
                    %att-accentunder;
                    %att-tableinfo;
                    %att-rowspan;
                    %att-columnspan;
                                        %att-edge;
                                        %att-actiontype;
                                        %att-selection;
                    %att-globalatts;          >

<!ATTLIST merror    %att-globalatts;   >

<!ATTLIST mpadded   %att-sizeinfo;
                    %att-lspace;
                    %att-globalatts;     >

<!ATTLIST mphantom  %att-globalatts;     >

<!ATTLIST mfenced   %att-open;
                    %att-close;
                    %att-separators;
                    %att-globalatts;     >

<!-- presentation  layout schemata : scripts and limits -->

<!ENTITY % pscrschema  "msub|msup|msubsup|
                    munder|mover|munderover|mmultiscripts" >

<!ATTLIST msub      %att-subscriptshift;
                    %att-globalatts;     >

<!ATTLIST msup      %att-superscriptshift;
```

```
                    %att-globalatts;          >

<!ATTLIST msubsup   %att-subscriptshift;
                    %att-superscriptshift;
                    %att-globalatts;          >

<!ATTLIST munder    %att-accentunder;
                    %att-globalatts;          >

<!ATTLIST mover     %att-accent;
                    %att-globalatts;           >

<!ATTLIST munderover %att-accent;
                     %att-accentunder;
                     %att-globalatts;      >

<!ATTLIST mmultiscripts
                    %att-subscriptshift;
                    %att-superscriptshift;
                    %att-globalatts;          >

<!-- presentation layout schemata: script empty elements -->

<!ENTITY % pscreschema "mprescripts|none" >

<!ELEMENT mprescripts  - o EMPTY          >
<!ATTLIST mprescripts   %att-globalatts;      >

<!ELEMENT none        - o EMPTY          >
<!ATTLIST none          %att-globalatts;      >

<!-- presentation layout schemata: tables -->

<!ENTITY % ptabschema "mtable|mtr|mtd" >

<!ATTLIST mtable    %att-tableinfo;
                    %att-globalatts;      >

<!ATTLIST mtr       %att-rowalign;
                    %att-columnalign;
                    %att-groupalign;
                    %att-globalatts; >

<!ATTLIST mtd       %att-rowalign;
                    %att-columnalign;
                    %att-groupalign;
                    %att-rowspan;
                    %att-columnspan;
                    %att-globalatts;   >

<!ENTITY % plschema  "%pgenschema;|%pscrschema;|%ptabschema;" >

<!-- empty presentation layout schemata -->

<!ENTITY % peschema "maligngroup | malignmark" >
```

```
<!ELEMENT  malignmark - o EMPTY          >

<!ATTLIST malignmark    %att-edge;
                        %att-globalatts;      >

<!ELEMENT maligngroup  - o EMPTY          >
<!ATTLIST maligngroup   %att-groupalign;
                        %att-globalatts;      >

<!-- presentation action schemata -->

<!ENTITY % pactions "maction" >
<!ATTLIST maction   %att-actiontype;
                    %att-selection;
                    %att-globalatts;     >

<!-- Presentation entity for substitution into content tag constructs -->
<!-- excludes elements which are not valid as expressions             -->

<!ENTITY % PresInCont    "%ptoken; | %petoken; |
                          %plschema; | %peschema; | %pactions;">

<!-- Presentation entity - all presentation constructs -->

<!ENTITY % Presentation  "%ptoken; | %petoken; | %pscreschema; |
                          %plschema; | %peschema; | %pactions;">

<!-- ***********************************************  -->
<!-- Content element set                              -->
<!-- attribute definitions                            -->

<!ENTITY % att-base              'base CDATA "10"'           >
<!ENTITY % att-closure           'closure CDATA "closed"'    >
<!ENTITY % att-definition        'definitionURL CDATA ""'    >
<!ENTITY % att-encoding          'encoding CDATA ""'         >
<!ENTITY % att-nargs             'nargs CDATA "1"'           >
<!ENTITY % att-occurence         'occurence CDATA "function-model"'  >
<!ENTITY % att-order             'order CDATA "numeric"'         >
<!ENTITY % att-scope             'scope CDATA "local"'         >
<!ENTITY % att-type              'type CDATA #IMPLIED'         >

<!-- content leaf token elements -->

<!ENTITY % ctoken "ci | cn" >

<!ATTLIST ci   %att-type;
               %att-globalatts;     >

<!ATTLIST cn   %att-type;
               %att-base;
               %att-globalatts;     >

<!-- content elements - specials -->
```

```
<!ENTITY % cspecial "apply | reln | lambda" >

<!ATTLIST apply   %att-globalatts;     >

<!ATTLIST reln    %att-globalatts;     >

<!ATTLIST lambda  %att-globalatts;     >

<!-- content elements - others -->

<!ENTITY % cother "condition | declare | sep" >

<!ATTLIST condition       %att-globalatts;     >

<!ATTLIST declare         %att-type;
                          %att-scope;
                          %att-nargs;
                          %att-occurence;
                          %att-definition;
                          %att-globalatts;     >

<!ELEMENT sep     - o EMPTY >
<!ATTLIST sep       %att-globalatts;     >

<!-- content elements - semantic mapping -->

<!ENTITY % csemantics "semantics | annotation | annotation-xml" >

<!ATTLIST semantics         %att-definition;
                            %att-globalatts;     >

<!ATTLIST annotation        %att-encoding;
                            %att-globalatts;     >

<!ATTLIST annotation-xml    %att-encoding;
                            %att-globalatts;     >

<!-- content elements - constructors -->

<!ENTITY % cconstructor "interval | list | matrix | matrixrow | set |
vector" >

<!ATTLIST interval     %att-closure;
                       %att-globalatts;     >

<!ATTLIST set          %att-globalatts;     >

<!ATTLIST list         %att-order;
                       %att-globalatts;     >

<!ATTLIST vector       %att-globalatts;     >

<!ATTLIST matrix       %att-globalatts;     >
```

```
<!ATTLIST matrixrow    %att-globalatts;     >

<!-- content elements - operators -->

<!ENTITY % cfuncop1ary "inverse | ident " >

<!ELEMENT inverse        - o EMPTY       >
<!ATTLIST inverse     %att-definition;
                      %att-globalatts;     >

<!ENTITY % cfuncopnary "fn |  compose" >

<!ATTLIST fn     %att-definition;
                 %att-globalatts;     >

<!ELEMENT ident     - o EMPTY       >
<!ATTLIST ident       %att-definition;
                      %att-globalatts;     >

<!ELEMENT compose   - o EMPTY       >
<!ATTLIST compose     %att-definition;
                      %att-globalatts;     >

<!ENTITY % carithop1ary "abs | conjugate | exp | factorial" >

<!ELEMENT exp       - o EMPTY       >
<!ATTLIST exp         %att-definition;
                      %att-globalatts;     >

<!ELEMENT abs       - o EMPTY       >
<!ATTLIST abs         %att-definition;
                      %att-globalatts;     >

<!ELEMENT conjugate - o EMPTY       >
<!ATTLIST conjugate   %att-definition;
                      %att-globalatts;     >

<!ELEMENT factorial - o EMPTY       >
<!ATTLIST factorial   %att-definition;
                      %att-globalatts;     >

<!ENTITY % carithop1or2ary "minus" >

<!ELEMENT minus     - o EMPTY       >
<!ATTLIST minus       %att-definition;
                      %att-globalatts;     >

<!ENTITY % carithop2ary "quotient | divide | power | rem" >

<!ELEMENT quotient     - o EMPTY       >
<!ATTLIST quotient       %att-definition;
                         %att-globalatts;     >

<!ELEMENT divide     - o EMPTY       >
<!ATTLIST divide       %att-definition;
```

```
                      %att-globalatts;     >

<!ELEMENT power        - o EMPTY       >
<!ATTLIST power       %att-definition;
                      %att-globalatts;     >

<!ELEMENT rem        - o EMPTY       >
<!ATTLIST rem        %att-definition;
                     %att-globalatts;     >

<!ENTITY % carithopnary "plus | times | max | min | gcd" >

<!ELEMENT plus        - o EMPTY       >
<!ATTLIST plus        %att-definition;
                      %att-globalatts;     >

<!ELEMENT max        - o EMPTY       >
<!ATTLIST max         %att-definition;
                      %att-globalatts;     >

<!ELEMENT min        - o EMPTY       >
<!ATTLIST min         %att-definition;
                      %att-globalatts;     >

<!ELEMENT times        - o EMPTY       >
<!ATTLIST times     %att-definition;
                    %att-globalatts;     >

<!ELEMENT gcd        - o EMPTY       >
<!ATTLIST gcd     %att-definition;
                  %att-globalatts;     >

<!ENTITY % carithoproot "root" >

<!ELEMENT root        - o EMPTY       >
<!ATTLIST root     %att-definition;
                   %att-globalatts;     >

<!ENTITY % clogicopquant "exists | forall" >

<!ELEMENT exists        - o EMPTY       >
<!ATTLIST exists     %att-definition;
                      %att-globalatts;     >

<!ELEMENT forall        - o EMPTY       >
<!ATTLIST forall     %att-definition;
                      %att-globalatts;     >

<!ENTITY % clogicopnary "and | or | xor" >

<!ELEMENT and        - o EMPTY       >
<!ATTLIST and     %att-definition;
                      %att-globalatts;     >

<!ELEMENT or        - o EMPTY       >
```

```
<!ATTLIST or     %att-definition;
                      %att-globalatts;     >

<!ELEMENT xor        - o EMPTY       >
<!ATTLIST xor     %att-definition;
                      %att-globalatts;     >

<!ENTITY % clogicop1ary "not" >

<!ELEMENT not        - o EMPTY       >
<!ATTLIST not     %att-definition;
                      %att-globalatts;     >

<!ENTITY % clogicop2ary "implies" >

<!ELEMENT implies        - o EMPTY       >
<!ATTLIST implies     %att-definition;
                      %att-globalatts;     >

<!ENTITY % ccalcop "log | int | diff | partialdiff" >

<!ELEMENT log        - o EMPTY       >
<!ATTLIST log     %att-definition;
                      %att-globalatts;     >

<!ELEMENT int        - o EMPTY       >
<!ATTLIST int     %att-definition;
                      %att-globalatts;     >

<!ELEMENT diff        - o EMPTY       >
<!ATTLIST diff     %att-definition;
                      %att-globalatts;     >

<!ELEMENT partialdiff        - o EMPTY       >
<!ATTLIST partialdiff     %att-definition;
                      %att-globalatts;     >

<!ENTITY % ccalcop1ary "ln" >

<!ELEMENT ln        - o EMPTY       >
<!ATTLIST ln     %att-definition;
                      %att-globalatts;     >

<!ENTITY % csetop2ary "setdiff" >

<!ELEMENT setdiff        - o EMPTY       >
<!ATTLIST setdiff     %att-definition;
                      %att-globalatts;     >

<!ENTITY % csetopnary "union | intersect" >

<!ELEMENT union        - o EMPTY       >
<!ATTLIST union     %att-definition;
                      %att-globalatts;     >
```

```
<!ELEMENT intersect        - o EMPTY       >
<!ATTLIST intersect     %att-definition;
                       %att-globalatts;     >

<!ENTITY % cseqop "sum | product | limit" >

<!ELEMENT sum        - o EMPTY       >
<!ATTLIST sum     %att-definition;
                      %att-globalatts;     >

<!ELEMENT product        - o EMPTY       >
<!ATTLIST product     %att-definition;
                      %att-globalatts;     >

<!ELEMENT limit        - o EMPTY       >
<!ATTLIST limit     %att-definition;
                      %att-globalatts;     >

<!ENTITY % ctrigop "sin | cos | tan | sec | csc | cot | sinh
                | cosh | tanh | sech | csch | coth
                | arcsin | arccos | arctan" >

<!ELEMENT sin        - o EMPTY       >
<!ATTLIST sin     %att-definition;
                      %att-globalatts;     >

<!ELEMENT cos        - o EMPTY       >
<!ATTLIST cos     %att-definition;
                      %att-globalatts;     >

<!ELEMENT tan        - o EMPTY       >
<!ATTLIST tan     %att-definition;
                      %att-globalatts;     >

<!ELEMENT sec        - o EMPTY       >
<!ATTLIST sec     %att-definition;
                      %att-globalatts;     >

<!ELEMENT csc        - o EMPTY       >
<!ATTLIST csc     %att-definition;
                      %att-globalatts;     >

<!ELEMENT cot        - o EMPTY       >
<!ATTLIST cot     %att-definition;
                      %att-globalatts;     >

<!ELEMENT sinh        - o EMPTY       >
<!ATTLIST sinh     %att-definition;
                      %att-globalatts;     >

<!ELEMENT cosh        - o EMPTY       >
<!ATTLIST cosh     %att-definition;
                      %att-globalatts;     >

<!ELEMENT tanh        - o EMPTY       >
<!ATTLIST tanh     %att-definition;
```

```
                    %att-globalatts;     >

<!ELEMENT sech        - o EMPTY       >
<!ATTLIST sech     %att-definition;
                    %att-globalatts;     >

<!ELEMENT csch        - o EMPTY       >
<!ATTLIST csch     %att-definition;
                    %att-globalatts;     >

<!ELEMENT coth        - o EMPTY       >
<!ATTLIST coth     %att-definition;
                    %att-globalatts;     >

<!ELEMENT arcsin        - o EMPTY       >
<!ATTLIST arcsin     %att-definition;
                     %att-globalatts;     >

<!ELEMENT arccos        - o EMPTY       >
<!ATTLIST arccos     %att-definition;
                     %att-globalatts;     >

<!ELEMENT arctan        - o EMPTY       >
<!ATTLIST arctan     %att-definition;
                     %att-globalatts;     >

<!ENTITY % cstatopnary "mean | sdev | var | median | mode" >

<!ELEMENT mean        - o EMPTY       >
<!ATTLIST mean     %att-definition;
                    %att-globalatts;     >

<!ELEMENT sdev        - o EMPTY       >
<!ATTLIST sdev     %att-definition;
                    %att-globalatts;     >

<!ELEMENT var        - o EMPTY       >
<!ATTLIST var     %att-definition;
                    %att-globalatts;     >

<!ELEMENT median        - o EMPTY       >
<!ATTLIST median     %att-definition;
                     %att-globalatts;     >

<!ELEMENT mode        - o EMPTY       >
<!ATTLIST mode     %att-definition;
                    %att-globalatts;     >

<!ENTITY % cstatopmoment "moment" >

<!ELEMENT moment        - o EMPTY       >
<!ATTLIST moment     %att-definition;
                     %att-globalatts;     >

<!ENTITY % clalgop1ary "determinant | transpose" >
```

```
<!ELEMENT determinant        - o EMPTY       >
<!ATTLIST determinant     %att-definition;
                      %att-globalatts;     >

<!ELEMENT transpose        - o EMPTY       >
<!ATTLIST transpose     %att-definition;
                      %att-globalatts;     >

<!ENTITY % clalgopnary "select" >

<!ELEMENT select        - o EMPTY       >
<!ATTLIST select     %att-definition;
                      %att-globalatts;     >

<!-- content elements -  relations  -->

<!ENTITY % cgenrel2ary "neq" >

<!ELEMENT neq        - o EMPTY       >
<!ATTLIST neq     %att-definition;
                      %att-globalatts;     >

<!ENTITY % cgenrelnary "eq | leq | lt | geq | gt" >

<!ELEMENT eq        - o EMPTY       >
<!ATTLIST eq     %att-definition;
                      %att-globalatts;     >

<!ELEMENT gt        - o EMPTY       >
<!ATTLIST gt     %att-definition;
                      %att-globalatts;     >

<!ELEMENT lt        - o EMPTY       >
<!ATTLIST lt     %att-definition;
                      %att-globalatts;     >

<!ELEMENT geq        - o EMPTY       >
<!ATTLIST geq     %att-definition;
                      %att-globalatts;     >

<!ELEMENT leq        - o EMPTY       >
<!ATTLIST leq     %att-definition;
                      %att-globalatts;     >

<!ENTITY % csetrel2ary "in | notin | notsubset | notprsubset" >

<!ELEMENT in        - o EMPTY       >
<!ATTLIST in     %att-definition;
                      %att-globalatts;     >

<!ELEMENT notin        - o EMPTY       >
<!ATTLIST notin     %att-definition;
                      %att-globalatts;     >
```

```
<!ELEMENT notsubset        - o EMPTY       >
<!ATTLIST notsubset     %att-definition;
                       %att-globalatts;     >

<!ELEMENT notprsubset        - o EMPTY       >
<!ATTLIST notprsubset     %att-definition;
                       %att-globalatts;     >

<!ENTITY % csetrelnary "subset | prsubset" >

<!ELEMENT subset        - o EMPTY       >
<!ATTLIST subset     %att-definition;
                       %att-globalatts;     >

<!ELEMENT prsubset        - o EMPTY       >
<!ATTLIST prsubset     %att-definition;
                       %att-globalatts;     >

<!ENTITY % cseqrel2ary "tendsto" >

<!ELEMENT tendsto        - o EMPTY       >
<!ATTLIST tendsto     %att-definition;
                       %att-type;
                       %att-globalatts;     >

<!-- content elements -  quantifiers  -->

<!ENTITY % cquantifier "lowlimit | uplimit | bvar | degree | logbase" >

<!ATTLIST lowlimit  %att-globalatts;     >

<!ATTLIST uplimit  %att-globalatts;     >

<!ATTLIST bvar     %att-globalatts;     >

<!ATTLIST degree   %att-globalatts;     >

<!ATTLIST logbase  %att-globalatts;     >

<!-- operator groups -->

<!ENTITY % cop1ary "%cfuncop1ary; | %carithop1ary; | %clogicop1ary;
                    | %ccalcop1ary; | %ctrigop; | %clalgop1ary; " >

<!ENTITY % cop2ary "%carithop2ary; | %clogicop2ary;| %csetop2ary; " >

<!ENTITY % copnary "%cfuncopnary; | %carithopnary; | %clogicopnary;
                    | %csetopnary; | %cstatopnary;  | %clalgopnary; " >

<!ENTITY % copmisc "%carithoproot; | %carithop1or2ary; | %ccalcop;
                    | %cseqop; | %cstatopmoment; | %clogicopquant;" >

<!-- relation groups -->

<!ENTITY % crel2ary "%cgenrel2ary;  | %csetrel2ary; | %cseqrel2ary;   " >
```

```
<!ENTITY % crelnary "%cgenrelnary; | %csetrelnary;" >

<!-- content constructs - all -->

<!ENTITY % Content "%ctoken; | %cspecial;  | %cother;  | %csemantics;
                   |%cconstructor; | %cquantifier;
                   |%cop1ary; |%cop2ary; |%copnary; |%copmisc;
                   |%crel2ary; |%crelnary;" >

<!-- content constructs for substitution in presentation structures -->

<!ENTITY % ContInPres "ci | cn  | apply  | fn | lambda | reln
                   | interval | list | matrix |matrixrow
                   | set | vector | semantics" > <!--dpc-->

<!-- *********************************************  -->

<!-- recursive definition for content of expressions             -->
<!-- include presentation tag constructs at lowest level         -->
<!-- so presentation layout schemata hold presentation or Content -->
<!-- include Content tag constructs at lowest level              -->
<!-- so Content tokens hold PCDATA or Presentation at leaf level -->
<!-- (for permitted substitutable elements in context)           -->

<!ENTITY % ContentExpression   "(%Content; | %PresInCont;)* "     >
<!ENTITY % PresExpression      "(%Presentation; | %ContInPres;)* "     >
<!ENTITY % MathExpression      "(%PresInCont; | %ContInPres;)* "     >

<!--  content token elements (may hold embedded presentation constructs)
-->

<!ELEMENT ci  - -     (#PCDATA | %PresInCont;)*   >
<!ELEMENT cn  - -     (#PCDATA | sep | %PresInCont;)*   >

<!--  content special elements    -->

<!ELEMENT apply   - -   (%ContentExpression;)   >
<!ELEMENT reln    - -   (%ContentExpression;)   >
<!ELEMENT lambda  - -   (%ContentExpression;)   >

<!--  content other elements    -->

<!ELEMENT condition  - -    (%ContentExpression;)   >
<!ELEMENT declare    - -    (%ContentExpression;)   >

<!--  content semantics elements    -->

<!ELEMENT semantics    - -          (%ContentExpression;)   >
<!ELEMENT annotation     - -        (#PCDATA)                >
<!ELEMENT annotation-xml  - -       (%ContentExpression;)   >

<!--  content constructor elements    -->

<!ELEMENT interval  - -     (%ContentExpression;)   >
```

```
<!ELEMENT set       - -     (%ContentExpression;)   >
<!ELEMENT list      - -     (%ContentExpression;)   >
<!ELEMENT vector    - -     (%ContentExpression;)   >
<!ELEMENT matrix    - -     (%ContentExpression;)   >
<!ELEMENT matrixrow - -     (%ContentExpression;)   >

<!--  content operator element (user-defined)    -->

<!ELEMENT fn   - -    (%ContentExpression;)   >

<!--  content quantifier elements    -->

<!ELEMENT lowlimit  - -     (%ContentExpression;)   >
<!ELEMENT uplimit   - -     (%ContentExpression;)   >
<!ELEMENT bvar      - -     (%ContentExpression;)   >
<!ELEMENT degree    - -     (%ContentExpression;)   >
<!ELEMENT logbase   - -     (%ContentExpression;)   >

<!-- ***********************************************  -->
<!-- presentation layout schema contain tokens, layout and content
schema  -->

<!ELEMENT mstyle     - -     (%PresExpression;)                    >
<!ELEMENT merror     - -     (%PresExpression;)                    >
<!ELEMENT mphantom   - -     (%PresExpression;)                    >
<!ELEMENT mrow       - -     (%PresExpression;)                    >
<!ELEMENT mfrac      - -     (%PresExpression;)                    >
<!ELEMENT msqrt      - -     (%PresExpression;)                    >
<!ELEMENT mroot      - -     (%PresExpression;)                    >
<!ELEMENT msub       - -     (%PresExpression;)                    >
<!ELEMENT msup       - -     (%PresExpression;)                    >
<!ELEMENT msubsup    - -     (%PresExpression;)                    >
<!ELEMENT mmultiscripts - -  (%PresExpression;)                    >
<!ELEMENT munder     - -     (%PresExpression;)                    >
<!ELEMENT mover      - -     (%PresExpression;)                    >
<!ELEMENT munderover - -     (%PresExpression;)                    >
<!ELEMENT mtable     - -     (%PresExpression;)                    >
<!ELEMENT mtr        - -     (%PresExpression;)                    >
<!ELEMENT mtd        - -     (%PresExpression;)                    >
<!ELEMENT maction    - -     (%PresExpression;)                    >
<!ELEMENT mfenced    - -     (%PresExpression;)                    >
<!ELEMENT mpadded    - -     (%PresExpression;)                    >

<!-- presentation tokens contain PCDATA or malignmark constructs -->

<!ELEMENT mi   - -  (#PCDATA | malignmark )*        >
<!ELEMENT mn   - -  (#PCDATA | malignmark )*        >
<!ELEMENT mo   - -  (#PCDATA | malignmark )*        >
<!ELEMENT mtext - - (#PCDATA | malignmark )*        >
<!ELEMENT ms   - -  (#PCDATA | malignmark )*        >

<!-- ***********************************************  -->
<!-- browser interface definition -->

<!-- attributes for top level math element -->
```

```
<!ENTITY  %     att-macros      'macros CDATA #IMPLIED' >
<!ENTITY  %     att-mode        'mode   CDATA #IMPLIED' >

<!ENTITY  %     att-topinfo    '%att-globalatts;
                                %att-macros;
                                %att-mode;'     >

<!-- attributes for browser interface element element -->

<!ENTITY  %     att-name        'name CDATA #IMPLIED' >
<!ENTITY  %     att-height      'height CDATA #IMPLIED' >
<!ENTITY  %     att-width       'width CDATA #IMPLIED' >
<!ENTITY  %     att-baseline    'baseline CDATA #IMPLIED' >
<!ENTITY  %     att-overflow    'overflow
(scroll|elide|truncate|scale) "scroll"' >
<!ENTITY  %     att-altimg      'altimg CDATA #IMPLIED' >
<!ENTITY  %     att-alttext     'alttext CDATA #IMPLIED' >

<!ENTITY  %     att-browif      '%att-type;
                                %att-name;
                                %att-height;
                                %att-width;
                                %att-baseline;
                                %att-overflow;
                                %att-altimg;
                                %att-alttext; '     >

<!-- the top level math  element      -->
<!-- math  contains MathML encoded mathematics -->
<!-- math has the browser info attributes iff it is the
    browser interface element also -->

<!ELEMENT math   - -    (%MathExpression;)    >

<!ATTLIST  math         %att-topinfo;
                        %att-browif;   >

<!-- end of DTD fragment -->
<!-- ********************************************  -->
```

Appendix A - Document Type Definitions (DTD)
MathML - Mathematical Equation Markup Model