| EUROMAP 26 | PROTOCOL FOR COMMUNICATION BETWEEN EXTRUSION LINES AND A CENTRAL COMPUTER APPLICATION |
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(33 pages)

This recommendation has been prepared by the Technical Commission of EUROMAP.

Contents

## 1 General Specifications

This part describes the requirements of the extrusion line application with respect to the communication between extrusion lines and a Central Computer Application, the used standardized communication network, the required communication functions and the data exchanged between the Central Computer Application and the extrusion lines.

## 2 Specification of EUROMAP 26 Topology and Communication Network

Extrusion lines are connected via a standardized communication network and with defined variables over EUROMAP 26 to a Central Computer Application in order to exchange data (machine data, job related data, production data, alarm data, process data). EUROMAP 26 contains the specification for the following extrusion lines:

1. extrusion lines for tubular film (blown film)
2. extrusion lines for flat sheets
3. extrusion lines for profiles
4. extrusion lines for pipes
5. extrusion lines for sheathing
6. extrusion lines for coating
7. extrusion lines for flat yarn
8. extrusion lines for granulating
9. extrusion lines for rubber

The topology of the EUROMAP 26 communication network is as shown in Figure 1

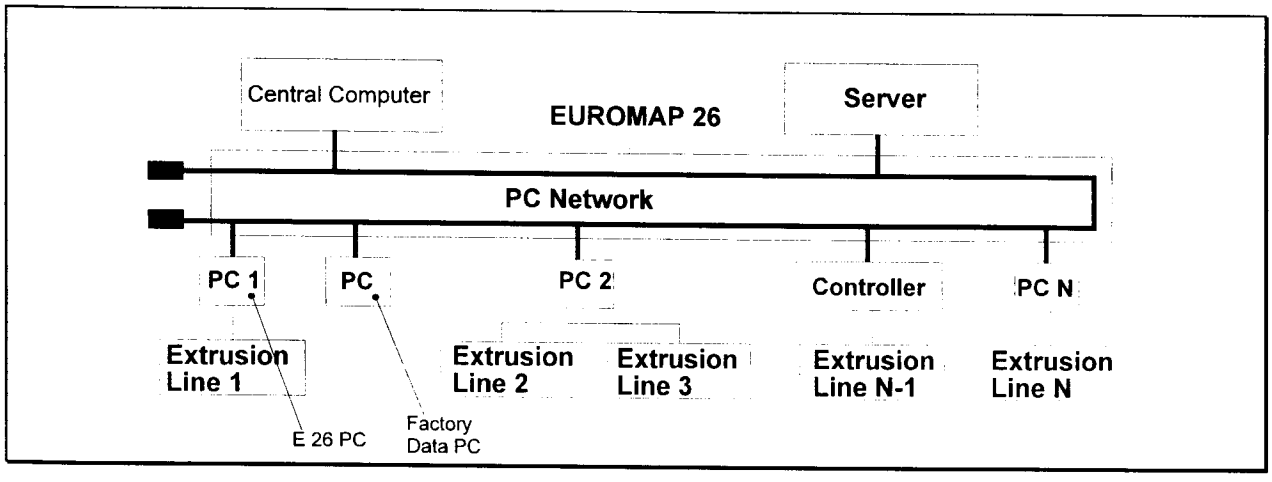


**Figure 1: Communication Network Topology**

The Central Computer Application and the extrusion lines are connected over a Personal Computer (PC) network with Ethernet IEEE 802.3 / ISO 8802-3 (10 Mbit/s, 50 Ohm, cheapernet RG 58) and a network operating sytem like Novell netware with a server or windows for workgroups etc.

As shown in Figure 1, every extrusion line is connected over its controller or an additional PC to the network. One PC can be used for one, or if possible for more extrusion lines. The PC is connected to the machine controller in a manufacturer-specific way. It is also possible to have more than 1 PC per extrusion line for different applications e.g.:

- 2 or more PC's at the extrusion line; one for collecting data and for communication with the Central Computer Application over EUROMAP 26, the other PC for production planning etc.

If there is only 1 PC at the extrusion line, it can be necessary to run a multi-tasking system on this PC for managing different applications.

All exchanged data between the machine control and the Central Computer Application is transmitted by file transfer to the Server. This method offers a cheap and easy way to connect different machine controls to a Central Computer Application. The Central Computer Application can contain 1 or more PC's for different applications like production control, production planning, quality control, data set transfer etc. . Therefore the following description contains Central Computer Application 1, 2, ... N.

## 3 Services and Data Exchange

The following services are available for communication between an extrusion line and one or more Central Computer Applications.

- **Read variable**, initiated by Central Computer Application
  The Central Computer Application requests for one or more variable values from the machine.

- **Write variable**, initiated by Central Computer Application
  The Central Computer Application writes one or more variable values to the machine control.

- **Information Report of variable**, initiated by machine
  The machine control sends variables to the Central Computer Application. The Information Report is either initiated by time (e.g. in sequence of 5 seconds, short cut: T) or by an event in the machine control (e.g. alarm, short cut: E).

## 3.1 Data Base Files

All variables are exchanged by data base files. The variables are defined according to data types of SQL (Standard Querry Language). SQL offers the simplest way to make a large number of usual data base software for EUROMAP 26 available. SQL is supported from the following data base software:
e.g. Dbase, Excel, Access, Foxpro, Paradox, DB2, Informix, Ingres, Oracle etc.

## 3.2 Definition of SQL Types

The following tables show the used SQL types for EUROMAP 26 communication and the used short cuts in the communication protocol.

### 3.2.1 Minimum SQL Data Types

Table 1 lists the minimum SQL data types from the X/Open and SQL Access Group SQL CAE specification (1992).

To determine which data types are supported by a data base software and the characteristics of those data types, the application must call SQLGetTypeInfo.

| SQL Name | SQL Data Type | Description |
|---|---|---|
| SQL_CHAR | CHAR(n) | Character string of fixed string length n (1 <= n <= 254). |
| SQL_VARCHAR | VARCHAR(n) | Variable-length character string with a maximum string length n (1 <= n <= 254). |
| SQL_LONGVARCHAR | LONG VARCHAR | Variable length character data. Maximum length is data source-dependent. |

**Table 1: Minimum SQL Data Types**

### 3.2.2 Core SQL Data Types

Table 2 lists the core SQL data types of the X/Open and SQL Access Group SQL CAE specification (1992).

In the table precision p refers to the total number of digits and scale n refers to the number of digits to the right of the decimal point.

To determine which data types are supported by a data base software and the characteristics of those data types, an application must call SQLGetTypeInfo.

| SQL Name | SQL Data Type | Description |
|---|---|---|
| SQL_DECIMAL | DECIMAL(p,s) | Signed, exact, numeric value with a precision p and scale s (1 <= p <= 15; 0 <= s <= p). |
| SQL_NUMERIC | NUMERIC(p,s) | Signed, exact, numeric value with a precision p and scale s (1 <= p <= 15; 0 <= s <= p). |
| SQL_SMALLINT | SMALLINT | Exact numeric value with precision 5 and scale 0 (signed: -32,768 <= n <= 32,767, unsigned: 0<= n <= 65,535) a. |
| SQL_INTEGER | INTEGER | Exact numeric value with precision 10 and scale 0 (signed: $-2^{31}$ <= n <= $2^{31}$ - 1, unsigned: 0 <= n <= $2^{32}$ - 1) a. |
| SQL_REAL | REAL | Signed, approximate, numeric value with a mantissa precision 7 (zero or absolute value $10^{-38}$ to $10^{38}$). |
| SQL_FLOAT | FLOAT | Signed, approximate, numeric value with a mantissa precision 15 (zero or absolute value $10^{-308}$ to $10^{308}$). |
| SQL_DOUBLE | DOUBLE PRECISION | Signed, approximate, numeric value with a mantissa precision 15 (zero or absolute value $10^{-308}$ to $10^{308}$). |

**Table 2: Core SQL Data Types**

**EUROMAP 26 uses the SQL Data Types: NUMERIC, SMALLINT, INTEGER, REAL, VARCHAR and LONG VARCHAR**

## 4 Mechanism of Data Transfer

The mechanism and synchronisation of data transfer between an extrusion line with its controller or an additional PC connected directly to the machine controller and the Central Computer Application is based on the following pattern as shown in Figure 2.

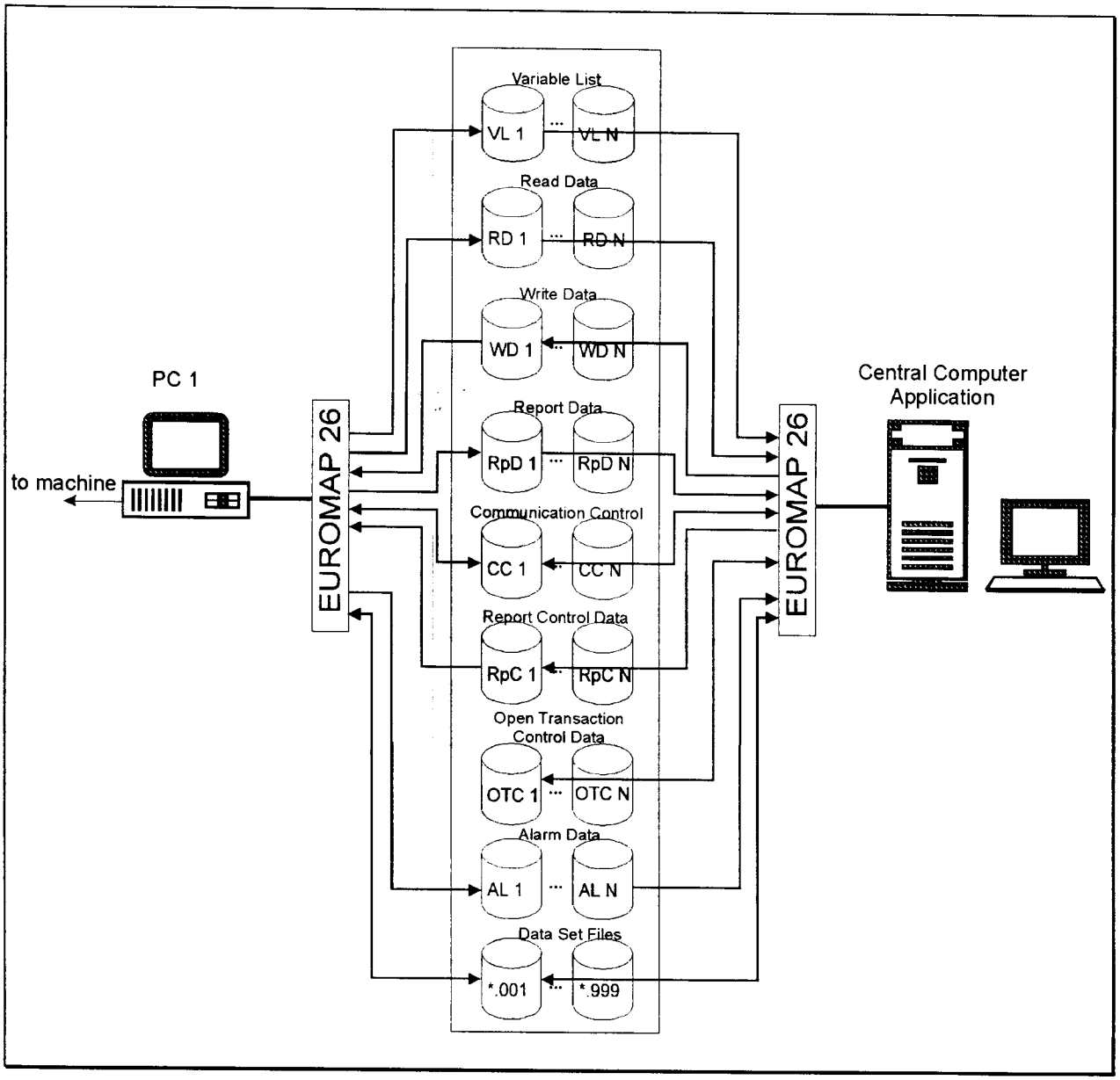


**Figure 2: Mechanism of data transfer**

This means that all exchanged data will be transmitted by reading and writing of data base files.
The data base files for communication and the data set files for up- and download of machine data sets are stored in the same directory on the file server or a dedicated PC of the network.
All reading, writing and reporting services and up- and downloads of machine data sets are made in this directory.
The meaning and structure of the different data base files is as follows:

## 4.1 Variable Names

All variables listed in the variable list in the annex of this document are named by an unequivocal variable name. The variable names are given according to the function of the variable.
E. g. the meaning of the variable **E_EX1T1AC** is as described in Table 3:

| Variable name components | Meaning |
|---|---|
| E_ | Starting Character for EUROMAP Variable |
| EX1 | Extruder 1 |
| T1 | Temperature Zone 1 |
| AC | Actual Value |

**Table 3: Meaning of Variable Names**

In the variable list, the variable for one Extrusion Line component is described. If it is necessary to use more than one Extrusion Line component, the variable name is built by using the component number.
E. g. the variable name for the Actual Value of Temperature Zone 3 of Extruder 5 is **E_EX5T3AC**.

## 4.2 Variable List 1 to N, VL 1 to VL N

This data base includes the variable list of each extrusion line.
It contains information about the machine's ability to exchange data according to the EUROMAP 26 protocol. When an extrusion line is started up, it gives information about the variables it is able to transmit or to receive. Extrusion line 1 stores this information in data base VL 1, extrusion line N in data base VL N. This file must be read by the Central Computer Application for having information about the machine's ability to exchange data.
The layout of the variable list is as shown in the appendix of this document.
The description of the different components is as follows:

All variable names of EUROMAP 26 start with "E_".
For manufacturer specific variables any other starting character can be used for the variable name. Thus a manufacturer specific extension of the variable list can be implemented.

- **BASECLASS** VARCHAR(30)
  represents the main class for extrusion lines. Different kind of extrusion plants can be recognized here. 30 Characters are allowed in this field.

- **SUBCLASS1** VARCHAR(40)
  The first subclass is able to contain 40 characters for specification.

- **SUBCLASS2** VARCHAR(30)
  The second and the following third subclass represent the next nesting levels in structuring the variable list. Both subclasses, 2 and 3, allow 30 characters.

- **SUBCLASS3** VARCHAR(30)
  same description as defined for subclass 2

- **DESCRIPT** LONG VARCHAR
  This field gives the possibility for explanation and description of the variables. The number of characters are limited by the data base system. E. g. Microsoft Excel allows up to 255 Characters per field.

- **VALTYPE** VARCHAR(2)
  This field specifies the type of a value. AC means Actual Value, SP means set point.

- **NUMSCALE** SMALLINT
  This field allows to enter the scale of the value. Scale refers to the number of digits to the right of the decimal point. (see also: Definition of SQL types)

- **NUMPRECS** SMALLINT
  The precision refers to the total number of digits.

- **UNIT** VARCHAR (10)
  10 characters can be inserted for the unit of the value. SI - units should be used.

- **SERVICE** VARCHAR(5)
  This means the service of data exchange: R=read; W=write; E=report event; T=report time.

- **COMAPPL** VARCHAR(2)
  COMAPPL gives Information about the Central Computer Application of the value. PD=production data; PR=process data; QD=part quality data; DC=setting data, recipe.

- **VARNAME** VARCHAR(16)
  This field contains the variable name. Up to 16 characters can be used here

- **SQL_TYPE** VARCHAR(1)
  This refers to the type of data of the variable. I=INTEGER; V=VARCHAR; R=REAL; S=SMALLINT

## 4.3 Read Data Bases, Write Data Bases, Report Data Bases

For communication between one or more Central Computer Applications and an extrusion line three data bases according to the services Read, Write and Information Report are necessary:

**Read Data Base 1 to N, RD 1 to RD N**

Read Data base (RD) means transferred data via the service Read. The exchanged values of the read variables of one extrusion line are stored in one data base file. Each extrusion line takes up one file. The file name is given according to the number of the extrusion line (e.g. extrusion line 1 uses data base RD 1; extrusion line N uses data base RD N)

**Write Data Base 1 to N, WD 1 to WD N**

Write Data base (WD) means transferred data via the service Write. The exchanged values of the written variables for one extrusion line are stored in one data base file. Each extrusion line takes up one file. The file name is given according to the number of the extrusion line (e.g. extrusion line 1 uses data base WD 1; extrusion line N uses data base WD N)

**Report Data Base 1 to N, RpD 1 to RpD N**

Report Data base (RpD) means transferred data via the service Information Report. The exchanged values of the reported variables of one extrusion line are stored in one data base file. Each extrusion line takes up one file. The file name is given according to the number of the extrusion line (e.g. extrusion line 1 uses data base RpD 1; extrusion line N uses data base RpD N)

The layout of each of the three data base files is as shown in Figure 3.

| VARNAME | V | S | I | R | N | TASKDONE | TRANSTIME | CENTRALNUM |
|---|---|---|---|---|---|---|---|---|
| VARCHAR(16) | LONG VARCHAR | SMALLINT | INTEGER | REAL | NUMERIC | VARCHAR(1) | VARCHAR(15) | SMALLINT |
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**Figure 3: Layout of the Read, Write and Report Data Bases**

This means that every data base (Read Data Base, Write Data Base, Report Data Base) consists of the same structure and contains the same components.
The description of the components of the variable data bases is as follows:

- **VARNAME** VARCHAR(16)
  This field contains the variable name. The length of the variable name is, as described in the Variable list, 16 characters

- **V** LONG VARCHAR
- **S** SMALLINT
- **I** INTEGER
- **R** REAL
- **N** NUMERIC
  The fields **V**, **S**, **I**, **R**, **N** are reserved for the variable values. The value will be stored in the field corresponding to the SQL data type.

- **TASKDONE** VARCHAR(1)
  The field TASKDONE gives information, if the data stored in this data base is already processed by the other communication partner.
  E. g. after the Central Computer Application was writing a variable into this data base, the machine has to read this variable. After reading the variable the machine has to mark this field by writing a "D" into TASKDONE.

- **TRANSTIME** VARCHAR(15)
  The transmission time of communication for every variable is stored here.
  The format is: year, month, day, hour, minute, second
  E.g. 19950120103045 means 20th January, 1995 10.30 and 45 sec.
  This field should be filled in at every transmission of variables.

- **CENTRALNUM** SMALLINT
  When communication with a Central Computer Application is running, the ID number of the Central Computer Application is stored here. The Central Computer Applications are numbered from Central Computer Application 1 to N.

## 4.4 Communication Control Data Base 1 to N, CC 1 to CC N

| CENTFRMACH | MACHTOCENT | CENTTOMACH | REPORT | TRANS_R | TRANS_W | TRANS_RP | CENTUP | CENTDOWN | MACHUP | MACHDOWN |
|---|---|---|---|---|---|---|---|---|---|---|
| INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER |
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**Figure 4: Layout of the Communication Control Data Bases**

The Communication Control data bases are the key for faultless communication.
The structure of the Communication Control Data Base is shown in Figure 4.
Each extrusion line takes up one file. The file name is given according to the number of the extrusion line (e.g. extrusion line 1 uses data base CC 1; extrusion line N uses data base CC N.
For realising communication the machine controller or the machine PC has to poll the data base file according to its number in a fixed period of time, e.g. 5 seconds.
The Central Computer Application itself has to poll all existing Communication Control Data Bases to detect communication activities.
The meaning of the fields is as follows:

- **CENTFRMACH** INTEGER
  This field is for realizing the service Read. The Central Computer Application has to enter the number of variables to be read.

- **MACHTOCENT** INTEGER
  This field is for realizing the service Read. The extrusion line has to enter the number of read variables after storing their values into the Read Data Base.

- **CENTTOMACH** INTEGER
  When the Central Computer Application is writing variables to the machine control, this field will be entered by the Central Computer Application for giving the extrusion line control or the extrusion line PC information about the number of variables to be written.

- **REPORT** INTEGER
  The extrusion line will have to enter the number of reported variables into this field.

- **TRANS_R** INTEGER
  **TRANS_W** INTEGER
  **TRANS_Rp** INTEGER
  These fields are named according to the services Read (R), Write (W) and Report (Rp) and give information about the position of the last written record in the read, write and report data bases. This information is important for realising ring buffering. This means each time a transmission is running the oldest entry will be overwritten by new values.

- **CENTUP** INTEGER
  **CENTDOWN** INTEGER
  These fields contain information about an up- or download of a machine data set, initiated by the Central Computer Application

  **MACHUP** INTEGER
  **MACHDOWN** INTEGER
  These fields contain information about an up- or download of a machine data set, initiated by the machine control.

## 4.5 Report Control Data Base 1 to N, RpC 1 to RpC N

| VARNAME | EVENT | TIME | ONOFF | CENTRALNUM |
|---|---|---|---|---|
| VARCHAR(16) | VARCHAR(1) | INTEGER | VARCHAR(3) | SMALLINT |
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**Figure 5: Layout of the Report Control Data Base**

This data base contains information about Information Report variables and has to be filled up by the Central Computer Application
According to this Data Base, the machine will know which variable must be transmitted to the Central Computer Application and in what period of time the variable will be transmitted.
The machine itself has to read this Data Base in a fixed period of time to consider changes of this Data Base.

- **VARNAME** VARCHAR(16)
  This field contains the variable name of the Report variable. The variable name refers to the name in the variable list, which is part of this document.

- **EVENT** VARCHAR(1)
  The event, when a machine initiates an Information Report, is stored in this field EVENT means e.g. alarms (A)

- **TIME** INTEGER
  For a continuous cyclic Information Report, the time period for transmission in ms can be entered in this field. This means, an Information Report is generated by the machine controller corresponding to the value in this field. This is useful to enter a user defined refresh rate of variables.

- **ONOFF** VARCHAR(3)
  ONOFF offers the possibility to enable or disable a variable for Information Report in an easy and quick way. "1" means ON; "0" means OFF.
  This field also contains the block name when using block transfer.

- **CENTRALNUM** SMALLINT
  The field CENTRALNUM contains the ID number of the Central Computer Application.

## 4.6 Open Transactions Data Base for Central Computer Application 1 to N, OTC 1 to OTC N

| CENTRALNUM | READ | WRITE | REPORT |
|---|---|---|---|
| SMALLINT | SMALLINT | SMALLINT | VARCHAR(1) |
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- **CENTRALNUM** SMALLINT
  The Central Computer Applications enter their identification number in this field.

- **READ** SMALLINT
  This field contains the number of Read Variables that are not processed by the Central Computer Application. The Central Computer Application has to keep this field up to date each time it reads a variable or finishes processing of a Read Variable.

- **WRITE** SMALLINT
  This field contains the number of Write Variables that are not processed by the Central Computer Application. The Central Computer Application has to keep this field up to date each time it writes a variable or finishes processing of a Write Variable.

- **REPORT** VARCHAR(1)
  This field gives information if a Central Computer Application will receive Report Variables or not. The field REPORT can be filled with 1 or 0.
  0 means: this Central Computer Application will not participate in any reporting activities
  1 means: this Central Computer Application will receive reported variables from 1 or more extrusion lines.
  The contents of the field REPORT is entered and changed by the Central Computer Application according to the contents of the Report Control Data Base (RpC).

## 4.7 Alarm Data Base 1 to N, AL 1 to AL N

| VARNAME | ERRNO | DESCRIPT |
|---|---|---|
| VARCHAR(16) | INTEGER | VARCHAR(254) |
| | | |
| | | |
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The Alarm Data Base contains machine manufacturer specific texts and definition for alarms.

- **VARNAME** VARCHAR(16)
  In VARNAME the 16 characters long variable name is stored.

- **ERRNO** INTEGER
  means error number. This number is stored in the alarm variable and helps the Central Computer Application to find the corresponding alarm description in the alarm data base.

- **DESCRIPT** VARCHAR(254)
  The DESCRIPTION field contains the manufacturer specific description of the occurred alarm. 255 characters for description are possible here.

## 4.8 Data Set Files *.001 to *.999

The data set files are for storage of machine data sets. The function of up- and download of data sets is described in this document.

## 4.9 Communication Synchronisation

### 4.9.1 Central Computer Application reads from Extrusion Line

The following data bases are used for the Read Service

Communication Control Data Base 1 to N , CC 1 to CC N

| CENTFRMACH | MACHTOCENT | CENTTOMACH | REPORT | TRANS_R | TRANS_W | TRANS_RP | CENTUP | CENTDOWN | MACHUP | MACHDOWN |
|---|---|---|---|---|---|---|---|---|---|---|
| INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER | INTEGER |
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Read Data Base 1 to N, RD 1 to RD N

| VARNAME | V | S | I | R | N | TASKDONE | TRANSTIME | CENTRALNUM |
|---|---|---|---|---|---|---|---|---|
| VARCHAR(16) | LONG VARCHAR | SMALLINT | INTEGER | REAL | NUMERIC | VARCHAR(1) | VARCHAR(15) | SMALLINT |
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Open Transactions Data Base 1 to N, OTC 1 to OTC N

| CENTRALNUM | READ | WRITE | REPORT |
|---|---|---|---|
| SMALLINT | SMALLINT | SMALLINT | VARCHAR(1) |
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