SYSPRO 8

Database Architecture

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SYSPRO™
Simplifying your Success

SYSPRO Help and Reference

Contents

Introduction

SYSPRO 8 is a powerful, scalable and feature rich Enterprise System.

A good understanding of its database architecture, together with how to configure SYSPRO to work effectively with SQL Server, can provide significant benefits to anyone working with SYSPRO.

The key topics covered by this document are:

- SYSPRO and Online Transaction Processing
- Supported versions of Microsoft SQL Server
- The SYSPRO 8 Database Architecture
- Guidelines for customizing the SYSPRO database
- Configuring SYSPRO to work with SQL Server
- SYSPRO and SQL Server Data Encryption
- Insight into SYSPRO Applications and their Interaction with SQL Server
- SQL Health Dashboard

This information is aimed at:

- SYSPRO System Administrators
- Database Administrators
- SYSPRO Implementers
- SYSPRO Support Personnel
- SYSPRO Developers
- Anyone else wanting an understanding of SYSPRO's database architecture

SYSPRO and Online Transaction Processing

A significant part of the SYSPRO ERP application is an Online Transaction Processing (OLTP) system and therefore its database design, data access, concurrency, performance and other issues relate directly to general OLTP guidelines.

The following is an extract from a Microsoft Technical Reference Guide on OLTP systems (http://technet.microsoft.com/en-us/library/hh393556.aspx):

"Operational, or online transaction processing (OLTP), workloads are characterized by small, interactive transactions that generally require sub-second response times. It is common for OLTP systems to have high concurrency requirements, with a read/write ratio ranging from 60/40 to as low as 98/2. Modifications are predominantly singleton statements, and most queries are constrained to simple joins. While limiting joins to as few tables as possible is desirable, a significant number of application systems do join many tables. Standard practices call for indexing strategies in OLTP systems to target an increase in concurrency versus query support; however, more indexes have to be created than is desired to reach acceptable query performance. The lower the proportion of write operations in the system, the higher the level of indexing that can be tolerated, unless the timing of specific write operations is critical. Database plans generally start with third normal form (3NF) enforced with referential integrity (RI) constraints, and then selectively deviate to second normal form (2NF) when necessary to enhance performance.

For OLTP systems, the middle tier plays an important role in defining the overall success of the system; while the database is important, it is not the only system component. When a new OLTP system is developed, the initial challenges in scalability and performance are often encountered in the middle tier. It is only after the challenges in the middle tier are addressed that the database tier scalability and performance issues are revealed. We recommend that you refer to the Technical Reference Guides included in the 'SYSPRO product' when gathering data points for operational considerations."

The only change made to the above extract was that the phrase 'SYSPRO Product' was used rather than generic product reference in the original text.

Note: Where this document quotes extracts from external resources they are shown in a blue font.

The remainder of this document serves as one of the **SYSPRO Product Technical Reference Guides** mentioned above.

Supported Versions of Microsoft SQL Server

SYSPRO 8 supports data storage using Microsoft SQL Server 2019, 2017, 2016, 2014, 2012, 2008 R2.

It is beyond the scope of this document to cover the various SQL Server editions. However, the vast majority of SYSPRO data functions are fully supported on all versions/editions of SQL Server from SQL Server 2008 R2 onwards.

Always see the SYSPRO Info Zone (https://infozone.syspro.com) for the latest information.

SQL Server 2019

All SYSPRO data functions are available when using SQL Server 2019.

SQL Server 2017

All SYSPRO data functions are available when using SQL Server 2017.

SQL Server 2016

All SYSPRO data functions are available when using SQL Server 2016.

SQL Server 2014

All SYSPRO data functions are available when using SQL Server 2014.

SQL Server 2012

All SYSPRO data functions are available when using SQL Server 2012.

SQL Server 2008 R2

All SYSPRO data functions are available when using SQL Server 2008 R2. However, see the note about end of support below.

SQL Server versions – optimization for later versions

The majority of SYSPRO code will work equally well with all supported versions of SQL Server listed above.

It should be mentioned that there are some selected functions where application code is further optimized to take account of new capabilities of one or more of the later SQL Server versions. In the case of specific optimization for later SQL Server versions we still automatically provide alternative code that will work on older versions not supporting the new capabilities. In this case there may be performance or other optimization benefits when using later SQL Server versions.

SQL Server versions – additional SYSPRO technologies

Whilst the core SYSPRO 8 ERP functions support the database versions listed above, some of the newer technologies introduced into recent versions of SYSPRO, have their own database version requirements. If you intend to introduce one or more of these technologies, you must consider their platform requirements over and above the core SYSPRO 8 ERP requirements.

These technologies include:

- SYSPRO Social ERP (Harmony)
- SYSPRO Bots
- SYSPRO IoT
- SYSPRO Connected Services

SQL Server 2008 R2 End of support

The following is a Microsoft statement regarding **SQL Server 2008** – it was copied as of November 2018 (https://www.microsoft.com/en-gb/sql-server/sql-server-2008):

Prepare for SQL Server 2008 end of support

On July 9, 2019, support for SQL Server 2008 and 2008 R2 will end. That means the end of regular security updates. Don't let your infrastructure and applications go unprotected. We're here to help you migrate to current versions for greater security, performance and innovation.

Due to this reason we advised that you DO NOT run SYSPRO on SQL Server 2008 R2.

SQL Server Express

SYSPRO 8 supports running on SQL Server Express (2019, 2017, 2016, 2014, 2012, 2008 R2) – a free version of SQL Server.

If you intend to use any version of SQL Server Express with SYSPRO you should make yourself fully aware of the capabilities and limits built-in to the SQL Server Express version you are considering.

These limitations include [SQL Server 2012-2019 comments in brackets]:

- Limited database size [10 GB]
- Limited use of server processor sockets and cores [Limited to lesser of 1 Socket or 4 cores]
- Limited access to server memory [Limited to using a maximum of 1 GB RAM]
- Limited tools to help with installation, configuration and database maintenance [Several tools are available including 'SQL Server Management Studio Express']
- Also, there are no Analysis Services, Integration Services or Notification Services.

There are many resources covering the various SQL Server editions and their capabilities. For example: Features Supported by the Editions of SQL Server 2019 at

https://www.microsoft.com/en-us/sql-server/sql-server-2019-comparison

Service Packs

It is good practice to ensure that you review, and where applicable apply, the latest Microsoft Service Packs and any other software patches or upgrades to ensure that you have the best security protection, bug fixes and other enhancements.

How to determine the Version, Edition and Service Packs of your SQL Server?

To determine the version and edition, including service packs, of your SQL Server system and components, see the following Microsoft information: http://support.microsoft.com/kb/321185

Note: The **SYSPRO SQL Health Dashboard** provides visibility to some of this version information.

SQL Server Compatibility Levels

When you create a database, it is assigned a compatibility level. Typically, the compatibility level is associated with the current version of SQL Server.

The compatibility level affects the SQL statements that can be issued against the database and the level of query optimization that is used to determine execution plans and ultimately performance.

The compatibility level of a database can be seen using SQL Server Management Studio:

Select the database, followed by **Properties** > **Options** > **Compatibility level**.

For example:

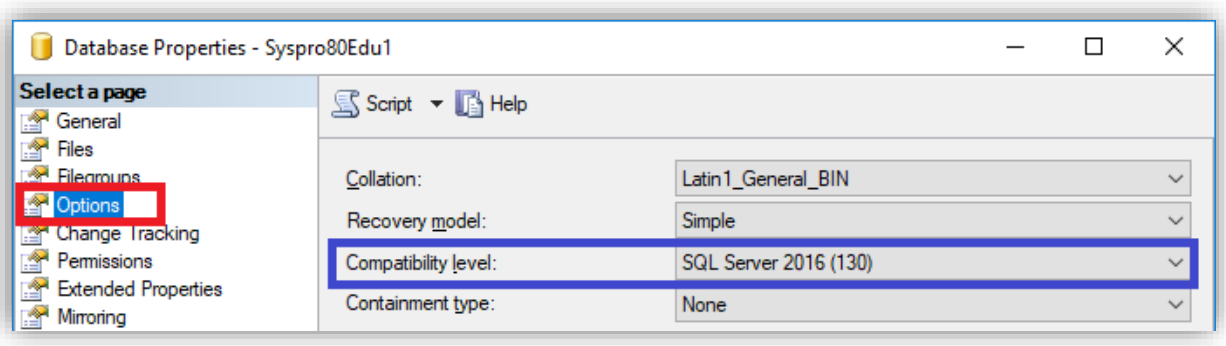


Figure 1 - SQL Server Compatibility Level

The following table lists compatibility levels, their associated version of SQL Server and SYSPRO 8 support:

Compatibility level	SQL Server Version	SYSPRO 8 Support
140	SQL Server 2017	Yes
130	SQL Server 2016	Yes
120	SQL Server 2014	Yes
110	SQL Server 2012	Yes
105*	SQL Server 2008 R2	Yes
100	SQL Server 2008	No
90	SQL Server 2005	No
80	SQL Server 2000	No

Note: You must have a compatibility level of '105' upwards when running SYSPRO 8.

* *Remember that we do NOT recommend running SYSPRO 8 on SQL Server 2008 R2 due to lack of Microsoft support.*

The **SYSPRO SQL Health Dashboard** provides visibility to the database compatibility level.

See the following examples.

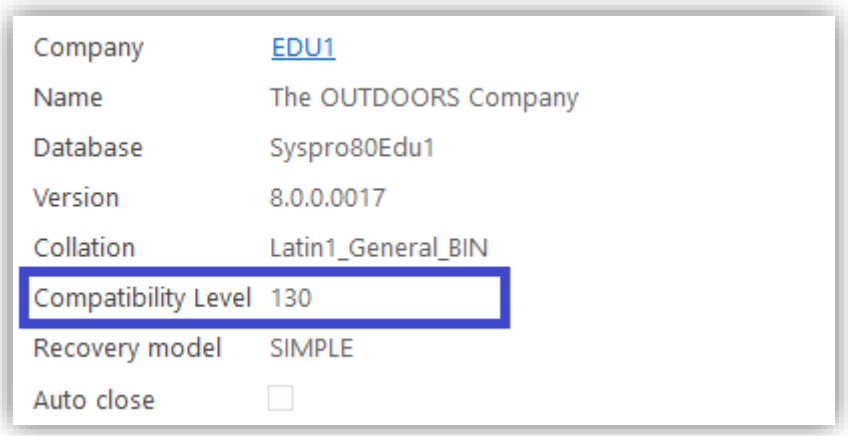


Figure 2 - Compatibility level set to same value as SQL Server version

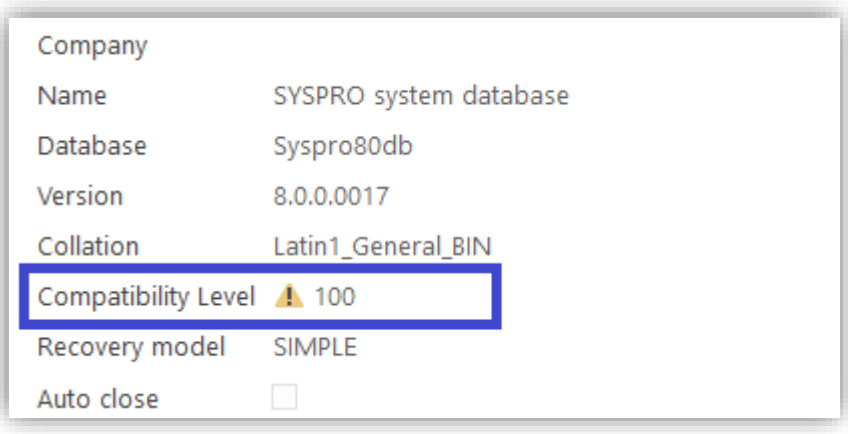


Figure 3 - Compatibility level warning

For more information about compatibility levels see the following link:

https://docs.microsoft.com/en-us/sql/t-sql/statements/alter-database-transact-sql-compatibility-level

Compatibility Levels when Upgrading SQL Server

When you upgrade your SQL Server software to a later version, each database's compatibility level remains at its original level number.

For example, if you originally created a SYSPRO 6.0 company using SQL Server 2008 - the company specific database compatibility level would be SQL Server 2008 (100). If you then upgraded your SQL Server installation to SQL Server 2012 the database compatibility level would remain as '100'. If you wished to upgrade to SYSPRO 8 then the compatibility level against the company database would have to be manually upped to SQL Server 2012 (110).

The 'compatibility level' property is just a flag to say to the Database Engine to evaluate SQL syntax and query optimization against this database according to the version of SQL Server specified.

For this reason, it is good practice to update the compatibility level against each SYSPRO database after upgrading your version of SQL Server. It is preferable to make the compatibility level match the version of SQL Server you are using.

Some of our partners and customers have reported that updating the compatibility level from older versions to the most current level can significantly improve the performance of SYSPRO running on SQL Server – this is probably because the later execution plan query optimizer is more efficient.

SYSPRO 8 Database Architecture

SYSPRO supports multiple companies where each company's data is contained within a single database. In addition, a single system-wide database is used to store information that is not specific to any individual company.

This is easiest to understand using the following examples:

- If a SYSPRO site has a single company then there will be two databases, one for the system-wide data and another for the single company-specific data.
- If the SYSPRO site has two companies then there will be three databases, one for the system-wide data and two more – one each for the two company-specific databases.
- Similarly, if the SYSPRO site has three companies there will be four databases etc.

All SYSPRO databases, both company specific databases and the system-wide database, must be located on a single instance of Microsoft SQL Server.

SYSTEM-WIDE DATABASE

In SYSPRO 8, the system-wide database contains many system-wide tables.

One important table in the system-wide database is named '**SysproAdmin**' – it contains a Company / Database / Collation cross-reference.

See the following example of a '**SysproAdmin**' table in the system-wide database.

In this example there are three SYSPRO companies, the first two have a 'Latin1_General_BIN' collation and the third has a 'Chinese_PRC_CS_AS' collation:

RUSSELLH.Syspro8...- dbo.SysproAdmin

	Company	DatabaseName	CollationName
	EDU1	Syspro80Edu1	Latin1_General_BIN
	EDU2	Syspro80Edu2	Latin1_General_BIN
	CHIN	Syspro80_China	Chinese_PRC_CS_AS

Figure 4 - Example System-wide SysproAdmin Table

The SYSPRO **System Setup** program allows you to define the name of the system-wide database. You are free to select any name for the system-wide database or retain the default.

See the following screen fragment from the **System Setup** – **Database** Tab:

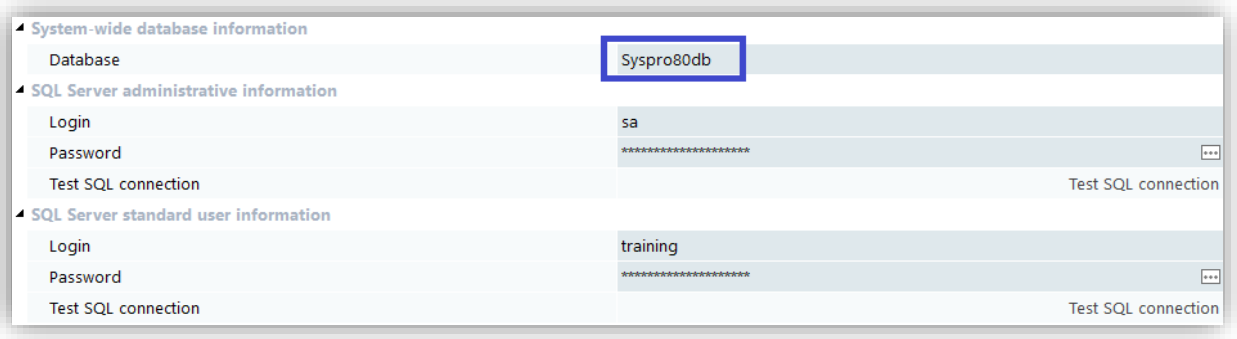


*Figure 5 - **System Setup** - **Database** Tab – **System-wide database information***

You should not add any additional tables in the system-wide database, nor should you change the '**SysproAdmin**' table structure (columns, data types, indexes, keys, constraints etc.)

The system-wide database name should be a maximum of 18 characters and only consist of uppercase and lowercase letters (A-Z and a-z), numeric digits (0-9), a dash ('-') or an underscore ('_').

Types of Data Stored in the System-wide Database

The system-wide database contains many tables that contain various types of data that are not related to a specific company.

The SYSPRO 8 system-wide database contains over 100 tables depending on the features installed.

These tables contain the following types of data:

- **Company database cross reference**
  This is the 'SysproAdmin' table described above and is used by SYSPRO to determine the relationship between SYSPRO companies and their databases.

- **Data dictionary data**
  This is a set of tables that describe the database structure.
  These tables begin with the characters 'Dds'.

- **Configuration data**
  This contains setup and configuration settings such as: Operators; License information; Authentication information; Notepad control; Role, Group and Operator security settings; eSignature configurations; Password control; Database version control and history; Printer configuration.

- **History, Journal and Audit data**
  This includes information providing historical journals and audit trails detailing the sequence of messages/transactions, who posted them and when. This includes: System audit log; Operator amendment journals.

- **SYSPRO User information**
  Contains information about each active user, the programs they are accessing, the Windows and SQL process ids etc.

- **e.net State information**
  Contains information about each e.net session.

- **Report Writer information**
  The SYSPRO Report Writer database and report definition information is stored in the system-wide database.
  These tables begin with the characters 'Rep'.

- **Espresso information**
  If you are using SYSPRO Espresso, then a set of tables used for the mobile application is defined in the system-wide database.
  These tables begin with the characters 'Esp'.

- **SYSPRO Avanti information**
  If you are using the SYSPRO Avanti user interface, then a set of tables used for these applications is defined in the system-wide database.
  These tables begin with the characters 'Avt'.

Company Specific Database

As mentioned previously each SYSPRO company has an associated database in SQL Server.

Types of Data Stored in a Company Specific Database

Each company specific database contains a relatively large number of tables that contain various types of data.

Each SYSPRO 8 company database contains approximately 1000 tables.

These tables contain the following types of data:

- **Master data**
  This includes information such as Customers, Suppliers, Stock codes, Banks, Prices, Branches and Work centers.

- **Transactional data**
  This includes transactional information such as Invoices, Sales orders, Purchase orders, Quotes, Jobs, Bank deposits and withdrawals.

- **History, Journal and Audit data**
  This includes information providing historical movements, journals and audit trails detailing the sequence of transactions, who posted them and when.

- **Configuration data**
  This contains setup and configuration settings such as the company setup containing: Configuration; Preferences; Financial periods; Tax; History; User-defined fields; Keys; Company and General Ledger Integration.

Static Database Structure per SYSPRO Release

New updates to SYSPRO 8 are published periodically (typically twice a year – but this is subject to change). Each release has a static database structure.

This is sometimes called a database schema, but we will call it the database structure as a 'schema' has a different meaning in SQL Server and will be discussed as a separate topic later.

By database structure we mean the list of tables, their column names, data types, sizes, defaults, constraints, primary keys, alternate indexes, foreign keys etc. This excludes the data that resides in each table.

The database structure is static (fixed) for each release of SYSPRO 8. For example, each of the following releases has its own database structure:

- SYSPRO 8 2018 R1
- SYSPRO 8 2018 R2
- SYSPRO 8 2019 R1
- SYSPRO 8 2019 R2
- SYSPRO 8 2020 R1

We make every effort not to change any part of the database structure during a software release, however it is possible that we may have to make changes to the database structure during a release in future (for example, for an unexpected legislative change).

Minor Database Updates

The database changes between SYSPRO 8 releases are called 'minor database updates' as they typically consist of new tables and/or new columns and/or new indexes.

This means that we generally do not remove, rename or alter existing tables or columns when new SYSPRO 8 releases are made available.

When an administrator logs in to a new SYSPRO 8 release for the first time the minor database update will be applied – this can add new tables, columns and indexes to both the system-wide database and each company database. All company databases that are linked to the same system-wide database will be updated and must be using the same database version.

Database Version

The current system-wide database version can be viewed by querying the **DatabaseVersion** column in the **AdmSysVersion** table – see the following example:

RUSSELLH.Syspro8...dbo.AdmSysVersion | Object Explorer Details

	CtlFlag	UpdateDate	DatabaseVersion	Description	SysproFullVersion
▶	CTL	2020-01-29 14:11:26.707	8.0.0.0017	SYSPRO 8 Avanti Version 0008 Update	8.0.0

Similarly, the current company specific database version can be viewed by querying the **DatabaseVersion** column in the **AdmVersion** table – see the following example:

RUSSELLH.Syspro80...- dbo.AdmVersion | Object Explorer Details

	CtlFlag	UpdateDate	DatabaseVersion	Description	SysproFullVersion
▶	CTL	2020-01-21 17:22:45.747	8.0.0.0017	SYSPRO 8 Minor Version 0017	8.0.0

The **DatabaseVersion** number is not directly related to the naming convention of the SYSPRO 8 release. This is an internal number that is incremented whenever the development team make database changes internally (i.e. these number may or may not run concurrently in a production environment).

As of March 2020, the database versions per release were:

SYSPRO Release	DatabaseVersion	Generally Available Release Date
SYSPRO 8 2018 R1	8.0.0.0008	July 2018
SYSPRO 8 2018 R2	8.0.0.0009	October 2018
SYSPRO 8 2019 R1	8.0.0.0010	February 2019
SYSPRO 8 2019 R2	8.0.0.0014	August 2019
SYSPRO 8 2020 R1	8.0.0.0017	March 2020

Data Dictionary and Database Updates

A set of data dictionary files defining the system-wide and company specific database structures are shipped as part of each SYSPRO 8 release.

When an administrator logs in to a new SYSPRO 8 release for the first time, the minor database update will be applied and the data dictionary (stored as a set of files in the BASE\DD folder on the server) is migrated to the system-wide database.

This consists of the following system-wide tables:

Data dictionary files in BASE\DD	Tables in system-wide database	Notes
DDSTAB	DdsTables	Table definitions
DDSCOL	DdsColumns	Column definitions
DDSCVL	DdsColumnValues	Column value text (describes column usage)
DDSIDX	DdsIndexes	Index definition (primary and alternate keys)
DDSFKY	DdsForeignKeys	Foreign key definitions (links between tables)

For this reason, you should treat the contents of these data dictionary tables in the system-wide database as 'read-only' as when the next release is installed their content will be removed and the new data dictionary information migrated to these tables.

Optional Tables

Although the majority of tables in SYSPRO 8 are static, there are a small set of tables that are optional and may only exist on specific conditions. These include:

- **Custom form data (ending '+')**
  SYSPRO 8 provides the ability to store custom data. Each custom form has an associated table in the database. These tables have the same name as the primary associated table and are suffixed with a '+'.
  For example, if you have defined custom form data against a Supplier (primary table name 'ApSupplier') then the custom form data will be stored in a table named 'ApSupplier+'.
  These tables are stored in the same database as the associated primary table.

- **Document archive tables (starting 'SrsArchive')**
  These tables are prefixed with 'SrsArchive' and are used to provide information about archived documents such as invoices, delivery notes, order acknowledgements, AR statements, factory documentation etc.
  The system administrator can define when to retain these archives (and hence whether the tables exist) and can configure an optional list of attributes that can be used to search the archive (and hence some of the columns are also optional).

- **SYSPRO Espresso**
  If you install and configure SYSPRO Espresso (our mobile solution) there are a set of tables beginning 'Esp' that will be created and maintained for Espresso. In this case they are stored in the system-wide database.

As other new technologies are introduced into the SYSPRO ERP product suite, other sets of tables can also be added as and when appropriate.

Table Names

SYSPRO table names start with a 2-5-character mnemonic representing the module to which they belong and then a short name describing the table contents. The name uses a camel case style with each 'word' starting with a capital letter followed by one or more lowercase characters.

SYSPRO table names have a maximum of 18 characters.

Table names only consist of uppercase and lowercase letters (A-Z and a-z) and numeric digits (0-9). No other characters are used in standard SYSPRO table names.

Example table names include:

Table name	Table description	Module prefix	Module description
ArCustomer	Customer	Ar	Accounts Receivable
ArInvoice	Customer Invoice	Ar	Accounts Receivable
ApSupplier	Supplier	Ap	Accounts Payable
ApBank	Bank	Ap	Accounts Payable
InvMaster	Inventory Master	Inv	Inventory Control
InvWarehouse	Inventory Warehouse	Inv	Inventory Control

In SYSPRO 8 Custom Form data is stored in separate tables – each table typically has the same name as its primary associated table with a '+' character as a suffix.

For example, custom form data associated with the customer table 'ArCustomer' is stored in a table named 'ArCustomer+'.

Note: Due to the '+' character at the end of Custom Form table names, you may wish to surround table names with square brackets [ ] when accessing them from third party applications. This avoids the SQL environment treating the '+' character as a concatenation or addition symbol.

Column Names

SYSPRO column names consist of a short name describing the column contents. The name uses a camel case style with one or more 'words' - each 'word' starting with a capital letter followed by one or more lowercase characters.

SYSPRO column names have a maximum of 18 characters.

Column names only consist of uppercase and lowercase letters (A-Z and a-z) and numeric digits (0-9). No other characters are used in standard SYSPRO column names.

Example column names from the Customer table ('ArCustomer') include:

Column name	SQL data type	Column description
Customer	varchar(15)	Customer code
Name	varchar(50)	Customer name
Telephone	varchar(20)	Telephone number
CreditLimit	decimal(12,0)	Credit limit
Salesperson	varchar(20)	Default assigned sales person
Branch	varchar(10)	Default branch
DateLastSale	datetime	Date last sale was made

Each column has several attributes, such as:

- Data type
- Precision, scale or length
- NULL or not NULL
- Default value
- Collation if data type is CHAR or VARCHAR
  The collation must default to <database default>.

More information about column attributes are described below.

Column Data types

SYSPRO columns have one of the following data types:

Data type	Notes	Example data type
char	Character data containing from 1 to 5 characters are stored using the 'char' data type.	char(1) char(5)
varchar	Character data containing 6 or more characters are stored using the 'varchar' data type. The maximum length of a SYSPRO column of type 'varchar' is 3000 characters. Trailing spaces are removed when SYSPRO programs store 'varchar' data.	varchar(6) varchar(15) varchar(255) varchar(1000)
varchar(max)	Character data containing potentially over 8000 characters. For example, can be used to store XML strings. Trailing spaces are removed.	varchar(max)

Data type	Notes	Example data type
varbinary	Binary data can be stored using the 'varbinary' datatype. This is preferred over 'varchar' when the data contains non-readable character data. The maximum length of a SYSPRO column of type 'varbinary' is 3000 characters.	varbinary(60)
varbinary(max)	Binary data containing a potentially large number of characters. For example, can be used to store encrypted strings.	varbinary(max)
decimal	Numeric data containing between 1 and 19 integers and from 0 to 6 decimals is stored in this exact precision numeric data type. In some cases, SYSPRO stores times as an 8-digit numeric field with a format of: HHMMSSFF - Hours, Minutes, Seconds, Fractions of a second (hundredths of a second)	decimal(1,0) decimal(8,0) decimal(12,0) decimal(15,0) decimal(8,5) decimal(14,2) decimal(18,6)
bit	Flags or indicators that can be yes/no or true/false can be stored using the bit datatype. Range: 0 or 1	bit
tinyint	Very small integers can be stored using the tinyint datatype. Range: 0 to 255	tinyint
smallint	Small integers can be stored using the smallint datatype. Range: -32,768 to +32,767	smallint
int	Large integers can be stored using the int datatype. Range: -2,147,483,648 to +2,147,483,647	int
bigint	Very large integers can be stored using the bigint datatype. Range: -9,223,372,036,854,775,808 to +9,223,372,036,854,775,807	bigint
uniqueidentifier	Globally Unique IDs (known as GUIDs) are stored as type 'uniqueidentifier'. In SYSPRO 8 these are used in various places such as for Contact Management 'ContactId' columns and in the eSignature log for storing GUIDs passed from a 3rd party application.	uniqueidentifier

Data type	Notes	Example data type
datetime	All dates are stored using the 'datetime' data type as this is compatible with all supported version of SQL Server. In some cases, SYSPRO stores the time portion in a separate column and only uses the 'datetime' column to store the date part. In this case the time is always stored using an 8-digit decimal field. Also, in this case, you must NOT place a non-zero value into the time part of the datetime column. Alternatively, SYSPRO can store both a date and time in the 'datetime' column. In this case the full precision of the time can be stored – this is to 1/1000th of a second where the last digit is limited to 0, 3 or 7. When not part of the primary key a 'datetime' column can be NULL indicating none or another special value.	datetime
timestamp	This is a database-wide unique number generated by SQL server and used for concurrency control. All SYSPRO tables have a column named 'TimeStamp' with this data type.	timestamp

NULL VALUES

The majority of SYSPRO 8 columns are defined as 'NOT NULL' – meaning that NULL values are not allowed.

The following list columns that are an exception to this general rule - where NULLs are allowed:

- **datetime** - where column is not in a primary key
  NULL means 'none' or another special value such as 'lowest' or 'highest' depending on context. For example, a stock obsolescence date field could use a NULL date to indicate that an item is not obsolete.

- **uniqueidentifier** – where column is not in a primary key
  NULL means 'none'.

- **Custom form columns** storing custom form fields that are not part of the primary key
  NULL means 'none' or 'no value supplied'.

Default Values

To simplify adding rows to SYSPRO tables a default constraint is configured against most columns.

This is useful when a 3rd party application is inserting rows into a table else you would have to supply a value for each NOT NULL column (which we have seen above is most columns).

The default values are configured 'by data type' – a selection of default values is shown below:

Data type	Default value	Comments
char	Spaces	Default always provided.
varchar	Single space	Default always provided.
varchar(max)	Single space	Default always provided.
decimal	Zero	Default always provided.
datetime	None as NULL is allowed	In cases where a 'datetime' column exists in the primary key, and therefore NULLs are not allowed, a default value of '1900-01-01' is used. It is recommended that you always provide a value to these 'datetime' columns in the primary key.
uniqueidentifier	None as NULL is allowed	In cases where a 'uniqueidentifier' column exists in the primary key, and therefore NULLs are not allowed, a default value of spaces is used. It is recommended that you always provide a value to these 'uniqueidentifier' columns in the primary key.
timestamp	None as value provided by SQL Server	No default provided as this field is updated by SQL Server whenever a row is inserted or changed.

In a SYSPRO 8 database, default constraints are named '`Syspro_DF_Table_Column`' where:

- 'Table' is the name of the SYSPRO table,
- 'Column' is the name of the column to which the default is applicable.

For example, the default constraint for the column 'Customer' in the 'ArCustomer' table is named:

```
Syspro_DF_ArCustomer_Customer
```

Indexes - Overview

There are two types of indexes applied to SYSPRO 8 tables:

- Primary Key (Clustered Index) - mandatory
- Alternate Indexes - optional

The following topics describe the difference between primary keys and alternate indexes and discusses performance implications and naming conventions.

Primary Key (Clustered Index)

All SYSPRO 8 tables have a primary key – usually known as a 'clustered index' in SQL Server documentation.

A primary key is one in which no two rows are permitted to have the same index key value. i.e. all values must be unique.

A primary key can consist of one or more columns. When multiple columns are specified the first column specified is the most important part of the sequence, the second column is the next most important part of the sequence, etc.

All SYSPRO primary keys have all components of the primary key in ascending sequence.

Primary Key (Clustered Index) - Performance

A clustered index is where the logical order of the key values determines the physical order of the corresponding rows in a table. The bottom, or leaf, level of the clustered index contains the actual data rows of the table. A table is allowed one clustered index at a time.

Each SYSPRO table has an appropriate clustered index allowing SYSPRO applications to retrieve a single row with optimal database access.

In addition, applications can retrieve multiple rows, with the best level or performance, by specifying the same sequence as the primary key.

Applications typically do not specify the clustered index name directly but simply specify a condition together with the sequence (ORDER BY) that the rows are to be retrieved. SQL Server determines, using a query optimizer, how to access the data required and will utilize the clustered index when appropriate.

Primary Key (Clustered Index) - Naming Conventions

SYSPRO 8 tables have their clustered keys named by concatenating the table name and the word 'Key'.

For example, the Customer table 'ArCustomer' has a clustered key named 'ArCustomerKey'.

Alternate Index

Selected SYSPRO 8 tables have alternate indexes - sometimes also known as 'nonclustered indexes' in SQL Server documentation.

An alternate index on SYSPRO 8 tables is one in which no two rows are permitted to have the same index key value. This is guaranteed by ensuring that alternate indexes always contain all the primary key parts which, as has already been mentioned, are always unique.

The alternate index can consist of just the primary key parts in a different sequence or it can contain additional columns as well as all the primary key parts.

All SYSPRO alternate indexes always have more than one column - the first column specified is the most important part of the sequence, the second column is the next most important part of the sequence, etc.

All SYSPRO alternate indexes have all components of the alternate index in ascending sequence.

Alternate Index – Performance

An alternate index specifies the logical ordering of a table. With an alternate index (nonclustered index), the physical order of the data rows is independent of their indexed order.

As mentioned previously, not all SYSPRO tables have alternate indexes, however when SYSPRO applications need to retrieve rows in a sequence other than the primary key sequence, an alternate index is usually provided as standard when the SYSPRO table was created.

Whilst not always quite as efficient as a clustered index, having an alternate index can provide significant performance benefits when SQL Server uses its query optimizer to determine the most efficient data access method to be used to retrieve data in a sequence other than the primary key sequence.

As for primary keys, applications typically do not specify the alternate index name directly but simply specify a condition together with the sequence that the rows are to be retrieved. SQL Server determines, using a query optimizer, how to access the data required and will utilize an alternate index when appropriate.

If all the columns to be queried by an application are defined as part of an alternate index the query optimizer may simply retrieve the values from the index instead of the underlying data (this is called a covering index). The query optimizer will always attempt to use the most efficient access method and depending on many factors this may provide additional performance benefits.

Alternate Index - Naming Conventions

When a SYSPRO 8 table has an alternate index the alternate index name is generated by concatenating the table name plus the phrase 'Idx', followed by a short mnemonic describing the index using a camel case convention.

As an example, the following lists the primary key and all alternate indexes for the Customer table 'ArCustomer':

Index name	Type	Description	Key parts
ArCustomerKey	Clustered	Primary key on Customer	Customer
ArCustomerIdxArea	Alternate	Index on Geographic area	Area Customer
ArCustomerIdxBranch	Alternate	Index on Branch	Branch Customer
ArCustomerIdxClass	Alternate	Index on Customer class	Class Customer
ArCustomerIdxEdi	Alternate	Index on EDI sender code	EdiSenderCode Customer
ArCustomerIdxFullName	Alternate	Index on Customer name	Name Customer
ArCustomerIdxName	Alternate	Index on Customer short name	ShortName Customer
ArCustomerIdxPhone	Alternate	Index on Telephone	Telephone Customer
ArCustomerIdxSlsp	Alternate	Index on Salesperson	Salesperson Customer

If you are considering adding custom indexes to a SYSPRO table, please see the topic: Guidelines when Adding User Indexes.

Foreign Keys

Foreign Keys allow a database to describe logical relationships between tables.

In SYSPRO 8, a Foreign Key is a link from a single source table to the Primary key of another related table.

For example, the Accounts Receivable Invoice table 'ArInvoice' has a column that stores the Customer. A Foreign Key between the 'Customer' column in the Invoice table and the 'Customer' column in the Customer table 'ArCustomer' ensures that this logical relationship is described in the database.

In SYSPRO 8 tables, the number of columns in the Primary key of the target table must match the number of columns in the source table when describing the Foreign Key Relationship.

Foreign Keys – WITH NOCHECK

In a SYSPRO 8 database all Foreign Key Relationships are created by specifying 'WITH NOCHECK'.

This means that the actual rows involved in the table relationship are not verified either at the time the table is created or as data is added, deleted or changed from either the source or target table.

The purpose of Foreign Keys in a SYSPRO database is purely to describe the relationship between tables, not between individual rows of data.

The SYSPRO business logic is used to ensure data integrity – not the Foreign Key Relationships described in the database.

Foreign Keys – Naming Conventions

When Foreign Keys are described in a SYSPRO 8 database the name of the Foreign Key is 'Syspro_FK_' followed by the source table and then an underscore and then the target table.

For example, the Foreign Key Relationship between the 'ArInvoice' table and the 'ArCustomer' table is named:

```
Syspro_FK_ArInvoice_ArCustomer
```

Foreign Keys – Database Diagrams (Entity Relationship Diagrams)

The definition of Foreign Keys in the SYSPRO database enables the use of tools such as the SQL Server Diagram tool.

These tools use Foreign Key Relationships as described in the database to understand the relationships between tables. This is more accurate than comparing column names for the relationships - as used in some database visualization tools.

It's relatively simple to create a new Diagram in SQL Server by selecting the Database > 'New Database Diagram' and then selecting two or more tables (e.g. 'ArCustomer' and 'ArInvoice') and viewing the resultant diagram. (It can take a few minutes to zoom in/out and re-organize the tables shown to best view the generated diagram – especially when there are many tables)

See the following example:

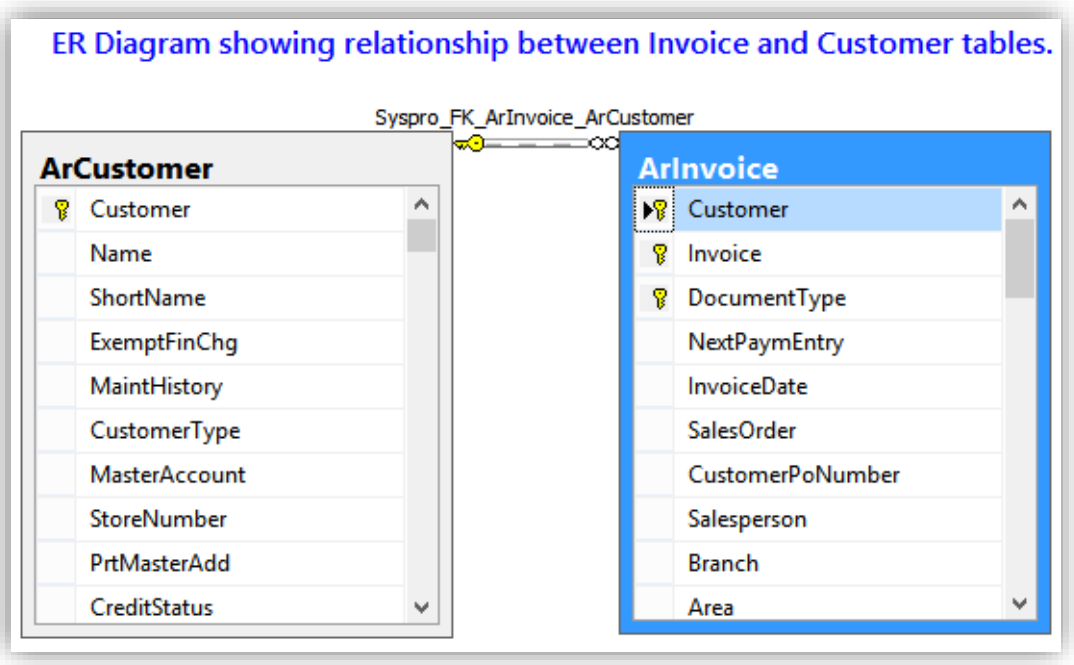


Figure 6 Simple Entity Relationship Diagram

When you exit after creating a new database diagram you will be prompted to give the diagram a name – this can be used to later retrieve and show and/or edit the diagram.

This diagram is interactive – i.e. you can use the context menu to view the relationships between tables, view keys, view check constraints and view column properties.

Warning: Take care when using the SQL Server Diagram tool to ensure that you only change the diagram and view the database structure, and not change the database in any way.

This is easiest accomplished by ensuring you do not access the Diagram tool when logged in as a system administrator.

Stored Procedures - None

SYSPRO does not use Stored Procedures in its database.

Stored Procedures are typically created by applications for one or more of the following reasons:

- They are used to provide standard functions with documented parameters that the application calls to perform a query or change the database. They can contain simple SQL statements or contain more sophisticated business logic. By documenting available Stored Procedures and their parameters third party developers are also able to take advantage of the standard functions provided.

- They are created to improve the performance of an application when it needs to make repetitive calls to the database engine.

- They are created to improve the performance of an application when many SQL statements are to be 'batched together' in a single transaction as the code is executed on the SQL Server and does require a roundtrip to the application server.

In SYSPRO, the first reason for having a Stored Procedure in a database (standardized and documented functions) is handled by SYSPRO Business Objects. A Business Object provides a simple, documented and extensible API layer into SYSPRO's business logic. Instead of placing business logic in a Stored Procedure SYSPRO places its business logic inside its own Business Objects.

The second reason for having Stored Procedures (performance) is handled by SYSPRO taking advantage of SQL Server's execution plan caching and reuse. When virtually identical SQL Queries are issued to SQL Server it generates an execution plan based on its query optimizer. This parameterized execution plan is cached in the 'execution plan' cache. SYSPRO programs are carefully developed to ensure that where relevant the same SQL parameterized statement is issued so that the performance benefit of not having to generate a new execution plan (but use one already cached) is taken advantage of.

This topic is explored further: http://technet.microsoft.com/en-us/library/ms181055(v=sql.105).aspx.

There are other reasons why some applications use Stored Procedures, such as by avoiding roundtrips. However, by making available appropriately coded SYSPRO Business Objects the level of performance, scalability, programmability and extensibility of the interface in most cases more than makes up for any lack of Stored Procedures.

Triggers - None

SYSPRO does not use SQL Triggers in its database.

End users can develop conditional actions in many ways in the SYSPRO software by making use of the following technologies:

- **eSignatures**
  - eSignatures can be configured to fire a trigger when a transaction occurs with a user-defined condition.
  - eSignatures can be configured by operator, role, group, company or system-wide.
  - eSignature triggers can call SYSPRO applications, call third party applications, run a VBScript and invoke a Business Object, send a notification email etc.

- **Events and Triggers**
  These two technologies also provide the ability to call applications, send email etc.

- **Workflow**
  This is a full-blown workflow engine that can provide very sophisticated abilities to detect transaction success or failure, prompt for authorization or approval, trigger virtually any sort of application or notification based on completely user-defined conditions.

Warning: The use of user defined (custom) triggers in SYSPRO databases has been found to be one of the leading causes of poor performance and unexpected software failures.

Views - None

SYSPRO does not create, maintain or use any SQL Server Views in the SYSPRO database.

In SYSPRO applications all database access is directly with base tables.

Check Constraints - None

SYSPRO does not create, maintain or rely on Check Constraints.

All business logic is encapsulated in the various SYSPRO Business Objects.

Collation and Case Sensitivity

SYSPRO requires that all its databases have a case sensitive collation. This includes collations known as 'Binary'.

The majority of SYSPRO 8 character data is stored in columns with a data type of CHAR or VARCHAR and these columns are affected by the collation when comparing data or sequencing results.

When you add a SYSPRO 8 database you should ensure that the database collation is either 'Binary' or 'Case Sensitive'.

See the following examples:

Collation name	Notes
Latin1_General_BIN	A Binary collation – providing high performance and covering English and many Western European languages. Used for backward compatibility between previous Binary collations.
Latin1_General_BIN2	A Binary collation – providing high performance and covering English and many Western European languages. A newer Binary collation available in more recent versions of SQL Server. It is recommended that the 'BIN2' collation is used rather than a 'BIN' collation – however if you have already created a database with a 'BIN' collation you do not need to consider changing the existing collation.
Latin1_General_CS_AS	A Case Sensitive and Accent Sensitive collation – covering English and many Western European languages.
Chinese_PRC_CS_AS	A Case Sensitive and Accent Sensitive collation – covers the simplified Chinese language used in mainland China and Chinese speaking territories. Can also store English data.

Collation and Sorting

The Collation not only affects comparison between items but also the sort order when retrieving items. The type of collation affects the sequence by which items are retrieved:

- **Binary collations**
  Typically returns all uppercase items before all lowercase ones.

- **Case Sensitive collations**
  Typically returns each item alphabetically regardless of case (within the same letter lowercase shows before uppercase).

To demonstrate this - assume you have the following items:

```
aa, AA, bb, BB, cc, CC, cat, Cat, dog, Dog
```

If the application selects all rows ordering them in ascending sequence, then the items will be returned as shown in the following table depending on the collation:

Latin1_General_BIN	Latin1_General_CS_AS
AA	aa
BB	AA
CC	bb
Cat	BB
Dog	cat
aa	Cat
bb	cc
cat	CC
cc	dog
dog	Dog

From this you may see that the 'Case Sensitive' collations are often preferable (and less confusing to operators) than the 'Binary' collations. However, 'Binary' collations can offer the best absolute performance.

Collation Names

There are several thousand available collations in SQL Server depending on the SQL Server version.

There are many variations to the style of collation names – in addition to the ones mentioned above some start 'SQL_' and some contain digits such as '90' or '100' in them.

You can select a required collation as long they are either 'Binary' or Case Sensitive and Accent Sensitive. If in doubt contact your SYSPRO support team for advice.

Important - You must not configure SYSPRO to run on a Case Insensitive collation else you may experience unexpected results. For similar reasons we suggest not using an Accent Insensitive collation. The letters 'CI' in the collation name mean 'Case Insensitive' and 'AI' means 'Accent Insensitive'. Therefore, avoid collations with 'CI' or 'AI' and rather use a collation that includes the letters 'CS_AS' (or 'BIN' or 'BIN2' for Binary).

Using Multiple Collations

The majority of SYSPRO sites have the same collation against all SYSPRO databases, whether they are the system-wide database or one of the company specific databases.

However, SYSPRO 8 does support one or more company databases having different collations from each other.

An earlier topic discussed the system-wide database and the 'SysproAdmin' table. If you recall the 'SysproAdmin' table contains a single row, one for each company. It not only contains the company id and database name, but it also contains the database collation. This is the mechanism by which SYSPRO 8 companies can have different collations.

Multiple Collations – Single Collation per Database

In a single SYSPRO database all columns containing character data must have the same collation.

Note: SYSPRO does not support some columns having one collation whilst other columns in the same database have a different collation.

If you have two or more company databases, then each can have a different collation. If you have Shared GL or Shared Inventory, see the following topics:

Multiple Collations – Shared GL Supported

The primary purpose of using Shared GL is to provide consolidated reporting across multiple companies.

For example, using the Financial Report Writer, it's possible to report on all GL data for a specific branch, department or account code across two or more companies. This can only be performed when the companies to be consolidated have the same Shared GL id.

The concept of Shared GL is that you can have two or more SYSPRO companies each storing their main General Ledger data in one of the company's databases. Each row in each of the Shared GL tables in the shared database have a company id in the key ensuring that all data is kept separately 'per company'. They just happen to be stored in a single database.

SYSPRO 8 does support two or more companies each having different collations but having a single Shared GL id.

To clarify further, consider the following example: Assume your site contains the three companies as defined in the following 'SysproAdmin' table:

RUSSELLH.Syspro8...- dbo.SysproAdmin

	Company	DatabaseName	CollationName
	EDU1	Syspro80Edu1	Latin1_General_BIN
	EDU2	Syspro80Edu2	Latin1_General_BIN
	CHIN	Syspro80_China	Chinese_PRC_CS_AS

Also assume that SYSPRO companies 'EDU1' and 'EDU2' have been defined as having a Shared GL id of 'CHIN', all General Ledger data will be stored in the 'CHIN' company's database named 'Syspro80_China'. Therefore company 'EDU1' (database 'Syspro80Edu1') will have most of its character data stored using the 'Latin1_General_BIN' collation.

Similarly, company 'EDU2' (database 'Syspro80Edu2') will have most of its character data also stored using the 'Latin1_General_BIN' collation.

Company 'CHIN' (database 'Syspro80_China') will have all character data stored using the 'Chinese_PRC_CS_AS' collation.

However, both companies 'EDU1' and 'EDU2' General Ledger data will be stored in company 'CHIN' (database 'Syspro80_China') and this will be stored using the 'Chinese_PRC_CS_AS' collation.

Remember that company 'EDU1' General Ledger data is stored with a company id of 'EDU1' recorded as a key item against each row in each of the General Ledger tables and therefore are separate from company 'EDU2' and 'CHIN'. Even though they are all stored in a single set of GL tables.

For the consolidated reporting purposes, you would also typically have consistency of GL code naming or numbering – often using numeric digits for your GL codes.

Multiple Collations – Shared Inventory Not Supported

SYSPRO 8 does not support Shared Inventory between companies that have databases of different collations.

Using the example 'SysproAdmin' above – Company 'EDU1' could have a Shared Inventory id 'EDU2' as they have the same collation.

However, company 'EDU1' could not have a Shared Inventory id of 'CHIN' as these have different collations.

The difference between Shared GL and Shared Inventory is that Shared GL stores the items from each company separately in the target database (by storing the source company id in each row) whereas Shared Inventory is using the same rows to store items (Inventory Master) and quantities (Inventory Warehouse, Bins, Lots, Serial's etc.)

Database Schema

SQL Server has a concept of a database schema.

This topic describes what this means, how it is typically used in SQL Server, and how SYSPRO should be configured and will reference the schema.

What is a Database Schema?

A Database Schema in SQL Server is a container of objects within a database.

Databases have a default schema named 'dbo' (database owner). In most cases when objects are created they are created under the 'dbo' schema.

It is possible to create other schemas against a database and then create objects in these schemas (instead of the 'dbo' schema). As the schema forms part of a full qualified object name (see below), you can have objects with the same name in different schema – i.e. the schema forms part of the uniqueness when naming objects.

The primary purpose of schemas is to simplify applying permissions to objects in SQL Server as it is relatively simple to assign a default schema to a SQL login and ensure that the login only has access (read, update, full etc.) against objects in that schema.

For this reason, it's often not recommended that you have objects with the same name in different schema. It can be confusing to all database users and developers.

Fully Qualified Object Names

All database objects can be uniquely identified by using a four part fully qualified object name.

The parts consist of:

1. Server name
2. Database name
3. Schema name
4. Object name

For example, the AR Customer table 'ArCustomer' stored on a server named 'SysproServer' in a database named 'SysproCompanyA' would be fully qualified as:

```
[SysproServer].[SysproCompanyA].[dbo].[ArCustomer]
```

The third part of the object definition is the schema name - in this case 'dbo'.

In this example all parts of the name have been surrounded by brackets []. This is optional when specifying objects unless there are special characters in the object name such as a space or '+'.

SYSPRO AND THE 'DBO' SCHEMA

Most SYSPRO applications do not explicitly reference the schema when accessing database objects. In this case SQL Server applies a default schema name inherited from the SQL login being used.

By default, most SQL logins have a default schema name of 'dbo'.

For this reason, all SYSPRO objects must reside in a single schema named 'dbo'. And all SQL logins used by the SYSPRO application must have a default schema of 'dbo'.

If you wish to create your own schema with you own objects, see the User Customization topics later in this document. However standard SYSPRO objects must all reside in a single schema named 'dbo'.

If you do decide to create your own schema in a SYSPRO database, it must NOT contain the word 'SYSPRO' in any case.

OTHER SYSPRO FEATURES THAT USE SQL SERVER

When installed and configured appropriately the following SYSPRO modules/technologies also store information in SQL Server - this includes:

- **SYSPRO Workflow Services**
  The SYSPRO Workflow Services (SWS) module creates its own database and tables that are separate from the database architecture explained in this document. They are not explained any further here.

- **SYSPRO Reporting Services**
  SYSPRO 8 allows SYSPRO Reporting Services (SRS) to use SQL Server as a temporary storage mechanism when producing reports.
  See the 'Reporting' Tab in the **System Setup** program for more information.
  These temporary tables are not explained further here.

DATA STORED IN THE FILE SYSTEM

A relatively small amount of configuration and setup data is stored in the file system. These files are not stored in the system-wide or company specific databases.

You should be aware when performing maintenance task that these files require regular backup.

Note that 'no transactional data' is stored in the file system – only configuration, setup and preference files. This means that full database transactional integrity will be maintained in the event of a system or other failure.

The information stored in the file system includes:

- **System configuration file**
  The `IMPACT.INI` file contains some system-wide licensing information and how to connect to SQL Server – this file is stored in the `WORK` folder.

- **Preference settings**
  Preferences and saved settings as users run applications can be persisted to files stored in the `BASE\SETTINGS` folder.

- **Rich text notes**
  Most notes in SYSPRO are stored as Rich Text (RTF) files. These are stored in the file system under an appropriate folder, such as:
  - `WORK\Notes`
  - `WORK\crm_xxxx\activity\body` *(where xxxx is the company)*

- **Custom reports**
  When designing custom reports using the SRS technology, they are stored in a folder named:
  - `BASE\ReportingCustomized`
- **Contact Management activity attachments**
  When posting or recording an Activity in Contact Management (such as receiving an email), there can be multiple attachments.
  Each attachment is stored with an appropriate name in a folder:
  - `WORK\crm_xxxx\activity\attach` *(where xxxx is the company)*

STATIC DATA SHIPPED WITH SYSPRO 8

A selection of files is shipped as part of the SYSPRO 8 application providing static lists, messages and other information used by the SYSPRO 8 applications.

These files are stored in the file system. They do not require backup as they are installed as part of the SYSPRO application.

In some cases, SYSPRO may upload selected files to SQL Server. In this case the SQL data must always be treated as read-only as the system may refresh this data when new versions of the files are loaded.

These include:

- **SYSPRO 8 data dictionary**
  This is a set of files that describe the database structure used by SYSPRO 8.
  Location: `BASE\DD`.
  Remember that parts of the data dictionary are uploaded to SQL Server each time a new SYSPRO release is installed.

- **Business object schema and sample XML**
  This is a set of schema and sample XML input and output for each business object available for e.net and VBScript developers.
  Location: `BASE\SCHEMAS`.

- **Various lists of items**
  These are several plain text files (typically ending with '`.IMP`') that contain information such as a list of all the:
  - SYSPRO programs
  - business objects
  - available modules,
  - available custom forms
  - configurable documents.

  Location: `BASE\Store`.

Guidelines: Customizing the SYSPRO Database

This set of topics provides guidelines for a database administrator, software implementer, SYSPRO support personnel, or anyone who is considering modifying the SYSPRO database in any way.

Adhering to the Guidelines and Future Upgrades to the SYSPRO Database

If you strictly adhere to all the guidelines documented in this Database Customization topic, then when you upgrade to a later version of SYSPRO (requiring an upgrade to the SYSPRO database) or a later release of SYSPRO 8 (requiring a minor database update) the conversion process will take account of your User Customization.

In some circumstances this may include:

- Saving and then dropping your User Customization
- Performing the database upgrade
- Reapplying your User Customization upon completion

Although not common, in some cases the upgrade process may rename some existing columns, or some columns may be relocated to different tables. You will be notified if any User Customization could not be re-applied due to these reasons.

Remember that the User Customization was saved prior to being dropped, so it is typically a relatively simple task to review the reason for the failure and then to manually re-apply the User Customization after making the necessary changes.

Typically, these types of issues are the only situations in which your User Customization will not be retained during a database upgrade.

To help you plan for an upgrade, we typically supply a 'readiness program' in the prior version of SYSPRO. This not only performs a health-check of your current database, but it also allows you to verify that any User Customization will be handled during the upgrade process.

Note: The 'minor database upgrade' that is performed when updating from one release of SYSPRO 8 to another (such as SYSPRO 8 2019 R2 to SYSPRO 8 2020 R1), typically applies only new tables, columns and indexes and therefore, (as long as you adhere to the guidelines in this topic) your User Customization will not be affected during the update process.

Ensure that Database User Customization is Necessary

Before considering any modification or addition to a SYSPRO database, we strongly suggest that you make yourself aware of the rich set of customization capabilities built-in to the SYSPRO application.

There are many types of configuration options, settings and parameters and other customizations, together with 'power tailoring' capabilities configurable at the system-wide, company, role, operator and/or other levels.

All these standard SYSPRO functions provide future-proofing as any customization will be handled in future versions and releases of software.

Some of these are listed below:

Business Objects and the SYSPRO Application

The SYSPRO application provides a rich set of Business Objects with an open and extensible application interface (API) accessible from any language.

These Business Objects encapsulate the SYSPRO business logic ensuring consistent application of configuration options, settings and other rules.

Wherever possible you should use the SYSPRO User Interface or use Business Objects to read, change or delete SYSPRO data or to post any transaction.

Power Tailoring – the SYSPRO User Interface

The SYSPRO user interface has a highly customizable 'power tailoring' capability.

You can configure the user interface from a cosmetic point of view or fully customize the user experience including using powerful VBScripts.

These VBScripts can be used to test and limit or highlight entry of values in single or multiple fields and lookup values against user tables. Messages can be shown to the operator when required.

You can also invoke Business Objects to lookup, validate or post values as required.

It is recommended that you use the 'power tailoring' capabilities rather than adding a User Check Constraint or User Trigger to the database.

eSignatures, Events and Triggers

SYSPRO provides a rich set of functions to fire triggers when transactions or other program specific functions occur.

These triggers can include:

- Sending email notifications
- Running applications
- Executing VBScripts
- Running pre-defined reports
- Logging information in summary and detail logs
- Creating a new entry in a message inbox

When using eSignatures you can provide additional authentication and even prevent transactions before they occur.

Custom Forms

The Custom Form system allows you to configure one or more user defined values against key fields.

For example, you could record three user defined fields related to your specific business rules whenever a sales order is captured. Each field can have a name, caption, data type, size and default specified together with various validation rules.

Custom Form fields are not only visible in Entry and Display Forms but can be included in list views, reports, printed on documents and used by the Report Writer.

Third party applications can add, change, delete and retrieve Custom Form fields using relevant Business Objects avoiding direct access to the SYSPRO database. All validation rules are honored.

Many SYSPRO sites use Custom Forms – often avoiding the requirement to add User Columns or even User Tables to the SYSPRO database.

General Notes about User Customization of the Database

You should only make changes to the SYSPRO database when necessary. Preferably after a full and detailed business case has been agreed by all stakeholders.

As a rule:

- We do not recommend that the SYSPRO database is accessed directly by any application
- We do not recommend that the SYSPRO database is modified or enhanced in any way

However, there are some business cases where modifying or adding to the standard SYSPRO database is the most practical way of providing the required business functionality.

The remainder of this 'User Customization' topic is designed to provide some guidelines to ensure that any User changes to the SYSPRO database cause the minimum of overhead or other problems to the SYSPRO application. Just as importantly, these guidelines help to ensure that any changes or additions made will have minimal effect with future upgrades to the SYSPRO application and its database.

Although this information is provided as a set of guidelines - any additional customization not explicitly approved here could lead to unexpected (or even intermittent behavior) by one or more parts of the SYSPRO application and is therefore not recommended. We have had many cases in the past where inappropriate database customization has caused poor performance, caused transactions to fail or other unexpected or unwanted behavior.

User Customization – Naming Conventions

Generally, any User Customization to a SYSPRO database should consider the fact that future upgrades to the SYSPRO database may add new objects that could conflict with your User Customization.

Each topic below, where user objects can be created, describes the naming conventions used in the standard SYSPRO database. One simple suggestion to avoid conflict with SYSPRO objects is to prefix any user objects with the string 'Usr_'.

For example, User Tables could be named 'Usr_Desks', 'Usr_Chairs' and 'Usr_Tables'. Similarly, User Columns could be named 'Usr_Count' and 'Usr_Notation'.

Instead of the prefix 'Usr_' you might consider using your company or product name together with an underscore. The reason for suggesting an underscore character is that it is a character not found in most objects (such as tables, indexes or column names) in a standard SYSPRO database.

If you intend to access your User Tables and User Columns from the SYSPRO Report Writer, or from some generic Business Objects, then we recommend that you keep the Table and Column names to a maximum of 18 characters. The Report Writer and SYSPRO data dictionary limit these object names to 18 characters.

User Customization – Documentation

As all User Customization should only be performed once a business case for the customization has been documented and approved by relevant stakeholders it is important to create and retain a document covering all User Customization of the SYSPRO databases together with the usage of these objects.

This should include a list of all applications that access the User Objects.

By authoring and maintaining this documentation administrators, developers and support personnel can quickly understand the extent of any customization to the standard SYSPRO database and the reasons for the changes.

User Customization - Common Database Objects

The following topics discuss the most common database objects and our guidelines as far as User Customization is concerned.

Dropping or Renaming of Standard Tables – Not Allowed

You must not drop or rename a standard SYSPRO table.

Dropping or Renaming of Standard Columns – Not Allowed

You must not drop or rename a standard SYSPRO column.

You also must not make any changes to the standard SYSPRO column attributes or properties. This includes:

- NULL and NOT NULL indicator
- Data type
- Length, precision or scale
- Default value (if any)
- Check constraints

Dropping or Renaming of Standard Keys/Indexes – Not Allowed

You must not drop, rename or change in any way a standard SYSPRO primary key or alternate index. This includes:

- Changing the columns that make up the key or index
- Changing the Ascending/Descending sequence of any key or index

User Tables - Allowed

User Tables describes the requirement to add additional tables, over and above standard SYSPRO tables.

Generally adding User Tables has no effect on the running of the SYSPRO application. However, this assumes that you have considered the following:

- The naming convention of any User Tables must not conflict with current or possible future SYSPRO table names. You could achieve this by reviewing the naming conventions for standard SYSPRO tables:
  - SYSPRO table names start with a mnemonic of one of the SYSPRO modules and then consist of a set of one or more words using a camel case style with initial capital letters.
  - SYSPRO table names only consist of uppercase and lowercase letter (A-Z and a-z) and digits (0-9).
  - Exceptions include custom form tables as they can be suffixed with a '+'.
  - In addition of our Harmony tracking tables can be suffixed by a '-'.

Guidelines When Adding User Tables

Due to the above, we recommend that any User Tables should have a different naming convention from the standard SYSPRO tables.

A suggestion could be that User Tables are prefixed with 'Usr_' followed by the name of the table.

By using a suitable naming convention (such as that described above) you can avoid possible future conflict with SYSPRO table names.

If you intend to access your User Table in the SYSPRO Report Writer or other standard SYSPRO applications, then you should ensure that the table name is no longer than 18 characters.

User Columns - Allowed

User Columns in SYSPRO tables describes the requirement to add additional columns, over and above standard SYSPRO columns, to a standard SYSPRO table.

Generally adding User Columns has no effect on the running of the SYSPRO application. However, this assumes that you have considered the following:

- The naming convention of any User Columns must not conflict with current or possible future SYSPRO column names. You could achieve this by reviewing the naming conventions for standard SYSPRO columns:
  - SYSPRO column names consist of a short name describing the column contents. The name uses a camel case style with one or more 'words' - each 'word' starting with a capital letter followed by one or more lowercase characters.
  - SYSPRO column names have a maximum of 18 characters.
  - Column names only consist of uppercase and lowercase letters (A-Z and a-z) and numeric digits (0-9). No other characters are used in standard SYSPRO column names.
- User Columns must be configured in such a way so that there is no effect on regular SYSPRO applications inserting, updating or deleting rows in any standard SYSPRO table.
- You should not add columns with the Identity property.

If you require to add a computed column see the later topic on this subject.

Guidelines When Adding User Columns

Due to the above, we recommend that any User Columns should have a different naming convention from the standard SYSPRO columns.

A suggestion could be that User Columns are prefixed with 'Usr_' followed by the name of the column.

By using a suitable naming convention (such as that described above) you can avoid possible future conflict with SYSPRO columns names.

If you intend to access your User Column in the SYSPRO Report Writer or other standard SYSPRO application, then you should ensure that the column name is no longer than 18 characters.

In addition to the above naming convention issues you should also be aware of the following before adding User Columns:

- User Columns must be configured in such a way so that there is no effect on regular SYSPRO applications inserting, updating or deleting rows in any standard SYSPRO table.
  - Issues could arise due to constraint validation and foreign keys.
  - The most common issue is defining a column as NOT NULL and not defining a default (see the next point).
- NULL and/or Default values
  - When a SYSPRO program inserts a row to a table it will not 'know' about your User Columns and will therefore not supply a value. It is up to you to either define the User Column as allowing NULLs or alternatively supply an appropriate default constraint.
  - We recommend allowing NULLs in User Columns.
  - Your User Column must not prevent standard SYSPRO applications from inserting rows into SYSPRO tables.

- Maximum row size
  - SQL Server allows a table to have a maximum of 8060 bytes per row. There are some exceptions depending on the data types of the columns in the row.
  - Always consider that in future versions of SYSPRO we may add a significant number of columns to any table and therefore you should not approach this limit when adding User Columns.
  - No standard SYSPRO 8 table currently approaches this 8060-byte maximum.

- Collation
  - When adding a User Column for alphanumeric data types (such as char, varchar, varchar(max)), we strongly suggest that your User Column has the same collation as the remainder of the alphanumeric columns in the SYSPRO database.
  - Failure to use the same collation may lead to unexpected results when attempting to access standard SYSPRO columns and your User Columns in the same SQL statement. This includes conditions, JOINs, string concatenation etc.

- User Columns should not be created with an Identity property
  - An Identity property means that a number is automatically generated (typically 1 upwards) when a row is added to the table. You should not add identify columns to SYSPRO tables.
  - One of the reasons for this is that database upgrades will not necessarily retain the generated Identity values and could cause an upgrade to fail.

User Computed Columns - Allowed

User Computed Columns in SYSPRO tables describes the requirement to add computed columns to a standard SYSPRO table.

A computed column is a virtual column that is not physically stored in the table, unless the column is marked PERSISTED. A computed column expression can use data from other columns to calculate a value for the column to which it belongs.

Generally adding User Computed Columns has no effect on the running of the SYSPRO application. However, this assumes that you have considered the following:

- The naming convention of any User Computed Columns must not conflict with current or possible future SYSPRO column names.
  You could achieve this by reviewing the naming conventions for standard SYSPRO columns. These are described against the previous topic 'User Columns' and will not be repeated here.

There are no standard computed columns in SYSPRO tables.

Guidelines When Adding User Computed Columns

Due to the above we recommend that any User Computed Columns should have a different naming convention from the standard SYSPRO columns. This is described against the subject 'User Columns' and will not be repeated here.

In addition, you should ensure that as standard columns are changed using SYSPRO applications that only valid User Computed Columns can be generated. In other words, the action of the system generating the User Computed Column must not cause any exception or error in the database.

Adding many User Computed Columns could affect the performance of regular SYSPRO applications and should be avoided.

User Indexes - Allowed

User Indexes on SYSPRO tables describes the requirement to add additional alternate indexes, over and above standard SYSPRO indexes, to a standard SYSPRO table.

When applied appropriately User Indexes are allowed and, unless an excessive number of indexes are added, should only have a small overhead when inserting or changing data on a table.

However, this assumes that you have considered the following:

- The naming convention of any User Indexes must not conflict with current or possible future SYSPRO primary key or index names. You could achieve this by reviewing the naming conventions for standard SYSPRO key and indexes:
  - Standard primary keys have a name that is generated by concatenating the table name and the word 'Key'.

- Standard alternate indexes have a name that is generated by concatenating the table name plus the phrase 'Idx', followed by a short mnemonic describing the index using a camel case convention.

- Unless constructed appropriately User indexes have the possible side effect of causing a duplicate when new data is inserted, or existing data is changed.
  - For example, if you added a User Index on the 'Name' column in the Customer table ('ArCustomer') the index may be applied successfully (as perhaps no duplicate names currently exist). However, at some time in the future you may attempt to add a customer with a duplicate name using a SYSPRO application. SQL Server would return a constraint violation on the insert statement. This could cause inadvertent errors to be returned to the user or cause other problems when using SYSPRO.
  - All User Indexes must be designed to ensure that duplicates are never generated.

- Custom form tables in SYSPRO 8 that end with a '+' are variable in nature
  - The column names in custom form tables are described by the end-user. As the custom form designer utility is used columns are added, changed or even deleted dynamically.
  - If you have added a User Index to a custom form table and you then use the custom form field designer to maintain or delete the custom field referenced by the User Index you may receive unexpected errors or problems.

Guidelines When Adding User Indexes

Due to the above we recommend that any User Indexes should have a different naming convention from the standard SYSPRO indexes.

As all SYSPRO primary key and alternate index names are prefixed with the table name and only consist of uppercase or lowercase characters a suggestion could be that User Indexes are added using the prefix 'Usr_' followed by the name of the table followed by the name of the index.

By using a suitable naming convention (such as that described above) you can avoid possible future conflict with SYSPRO indexes or other constraints.

In addition to the above naming convention issue, you should also be aware of the following before adding User Indexes:

- Must not cause duplicates
  - The columns that make up a User Index must ensure that it is always unique and that inserting or updating rows must never cause duplicates to be generated.
  - The simplest technique that can be used to guarantee uniqueness is one that standard SYSPRO indexes use. Each User Index should contain all columns from the standard SYSPRO primary key (and may optionally contain additional columns as required). As the Primary key is guaranteed to be unique, using this technique will ensure that your User Index is also unique.

- Failure to follow this guideline will almost certainly lead to application failures – it is your responsibility to ensure this does not occur.

- Keep User Indexes to the minimum number required
  - There is an overhead when you have added a User Index and a SYSPRO application inserts new rows or changes data on columns referenced by the User Index.
  - If you do add an excessive number of User Indexes (the exact definition of this will vary with the situation) then SYSPRO applications may be slowed significantly when data is inserted or updated. You should test your SYSPRO environment to ensure that the system has not been slowed excessively when adding many User Indexes to a single table. Note that this also affects Custom form tables.
  - Therefore, you should only add User Indexes when necessary and avoid an excessive number of User Indexes against a single table.
  - As a guideline, adding one or two User Indexes typically has little effect. If you add more than this, you should verify that the overhead does not slow SYSPRO applications significantly.

User Foreign Keys - Allowed

User Foreign Keys on SYSPRO tables describes the requirement to add additional foreign keys, over and above standard SYSPRO foreign keys, to a standard SYSPRO table.

When applied appropriately User Foreign Keys are allowed and should only have a minimal overhead when working with SYSPRO data.

In addition, you must always use the 'WITH NOCHECK' clause when adding User Foreign Keys as SYSPRO applications handle data integrity using business logic described in Business Objects and not using database constraints such as foreign keys.

There are basically two types of User Foreign Keys that are discussed here:

1. Foreign keys from a User Table into a standard SYSPRO table.
2. Foreign keys from a standard SYSPRO table into a User Table

In both cases you should consider the following:

- The naming convention of any User Foreign Keys must not conflict with current or possible future SYSPRO foreign key names. You could achieve this by reviewing the naming conventions for standard SYSPRO foreign keys:
  - Standard foreign keys have a name that is generated by concatenating 'Syspro_FK_' followed by the source table and then an underscore and then the target table.
  - A suggestion is to prefix User Foreign Keys with 'Usr_'.

- Foreign keys from a User Table to a standard SYSPRO table or the other way around must not enforce constraints – you must have a 'WITH NOCHECK' clause.

- Although both of the following are relative rare you should be aware of the following
  - In future versions of SYSPRO some columns may be renamed. We try and avoid this unless necessary hence it's relative rare.
  - In future versions of SYSPRO the columns that make up the construct of the primary key may change. Again, we only do this if necessary and hence it's relatively rare.

- Custom form tables end with a '+' and are variable in nature
  - The column names in custom form tables are described by the end-user.
  - Therefore, you should try and avoid referencing these columns in User Foreign Keys else using the custom form designer may give unexpected messages.

Guidelines When Adding User Foreign Keys

Due to the above we recommend that any User Foreign Keys should have a different naming convention from the standard SYSPRO foreign keys.

In addition to the above naming convention issue, you should also be aware of the following before adding User Foreign Keys:

- Must be defined with a 'WITH NOCHECK' clause
  - Foreign keys from a User Table to a standard SYSPRO table or the other way around must not enforce constraints – you must have a 'WITH NOCHECK' clause.
  - This means 'in effect' that User Foreign Keys into/out of standard SYSPRO tables are used purely to define the relationships between tables and not to enforce constraints on the actual rows in the tables.

- As it's possible for future versions of the SYSPRO database to rename columns and that the primary keys may change (however unlikely) you should be aware that in future your User Foreign Keys may not be applicable.

- Custom form tables that end with a '+' are variable in nature
  - The column names in custom form tables are described by the end-user.
  - Therefore, you should try and avoid referencing these columns in User Foreign Keys else using the custom form designer may give unexpected messages.

User Stored Procedures – Allowed

User Stored Procedures in SYSPRO tables describes the requirement to add stored procedures to a standard SYSPRO table.

There are no standard stored procedures in SYSPRO tables – as described earlier in this document SYSPRO Business Objects encapsulate all our business logic and provide an open and extensible programming interface. Wherever possible we suggest that you use Business Objects for any database access rather than accessing the database directly.

If you require to add User Stored Procedures, they will generally have no effect on the running of the SYSPRO application. However, this assumes that you have considered the following:

- The naming convention of any User Stored Procedures must not conflict with current or possible future SYSPRO database object names.

Guidelines When Adding User Stored Procedures

If you require to add a User Stored Procedure to a standard SYSPRO database, you should consider the following:

- To avoid potential problems with future SYSPRO application upgrades we recommend that any User Stored Procedures should have a different naming convention from any standard SYSPRO database objects.

- In future versions of SYSPRO some columns may be renamed. We try and avoid this unless necessary hence it's relative rare. However, User Stored Procedures based on SYSPRO tables may reference one or more renamed columns in future.

User Triggers - Allowed

User Triggers on SYSPRO tables describes the requirement to add a SQL TRIGGER to a standard SYSPRO table.

The standard SYSPRO database does not contain any SQL TRIGGERs.

Before you add a TRIGGER to the SYSPRO database you should consider the condition that will cause the trigger to be invoked together with the actions required and whether they can be performed by the standard SYSPRO application.

SYSPRO has a powerful and configurable set of capabilities for firing triggers of various types – many of which go way beyond the capability of a SQL Server TRIGGER. All built-in capabilities described here are designed to be future proof – allowing simple software upgrades in future.

These include:

- **eSignatures**
  - The eSignatures feature in SYSPRO combines three main capabilities:
    - **Authentication**
      Preventing a transaction unless authenticated.
    - **Logging**
      Summary and detail logging of each transaction including configuring which fields/variables are to be logged.
    - **Triggering**
      Upon successful completion of a SYSPRO transaction one or more triggers can be fired.

  - eSignature Triggers can include:
    - **Email**
      Send an email to one or more recipients. System-wide and Transaction specific variables are available.
    - **Run a VBScript**
      Allows a VBScript to be invoked. This can perform virtually any tasks including invoking Business Objects.
    - **Run any program**
      Allows developer code to be invoked with parameter passing.
    - **Write to message inbox**
      Allows you to write information to a special message inbox.
    - **Run an SRS report**
      Allows you to invoke any SYSPRO report. The report can physically print a document, send the report by email, export in a variety of formats (such as PDF or Excel) and can be archived.

  - eSignatures can be configured system-wide, by company, by role, by group or by operator

  - Multiple triggers can be fired for each environment, condition and transaction

  - eSignatures can be configured to be active on many user defined conditions

  - There are over 800 eSignature transactions that can be configured in SYSPRO 8

- **SYSPRO Triggers**
  - Various SYSPRO programs have 'trigger points' where an application can be invoked, or other actions performed.

These include:

- **Run a standard SYSPRO program**
  This can cause another SYSPRO program to be invoked allowing the operator to interact with a relevant program.
- **Run any program**
  Allows developer code to be invoked with parameter passing.
- **Run a customized report**
  Allows a Report Writer report to be invoked passing parameters about the cause of the trigger. These reports can produce physical reports, generate export files of various types and even update data in one or more tables.
- **Write to message inbox**
  Allows you to write information to a special message inbox.

- There are about 200 applications that have trigger points in SYSPRO 8.

- **SYSPRO Events**
  - Various events can be configured to fire triggers or actions.
    An event is something like 'Bank balance below a parameter'.
    Whenever the event occurs (regardless of the actual program making the change) one or more triggers can be fired.
    These include:
    - **Email**
      Send an email to one or more recipients. System-wide and Transaction specific variables are available.
    - **Run a standard SYSPRO program**
      This can cause another SYSPRO program to be invoked allowing the operator to interact with a relevant program.
    - **Run any program**
      Allows developer code to be invoked with parameter passing.
    - **Write to message inbox**
      Allows you to write information to a special message inbox.

  - There are over 50 different events that can be configured in SYSPRO 8

Guidelines When Adding User Triggers

If you require to add a User Trigger to a standard SYSPRO table, you should consider the following:

- To avoid potential problems with future SYSPRO application upgrades we recommend that any User Triggers should have a different naming convention from any standard SYSPRO database objects.

- In future versions of SYSPRO some columns may be renamed. We try and avoid this unless necessary hence it's relative rare. However, User Triggers based on SYSPRO tables may reference one or more renamed columns in future.

- User Triggers should be carefully developed to prevent exceptions being raised which could cause the SYSPRO transaction firing the SQL TRIGGER to be rolled back. This could cause confusion to end-users and may give unexpected messages.
  - Consider outputting a status or log to a separate table indicating the success or otherwise of a User Trigger – this can then be used to determine if there have been any problems.

- User Triggers should be carefully developed to avoid adding excessive overhead to regular SYSPRO transactions.
  - As a User Trigger can perform virtually any database access it's possible that a poorly developer SQL TRIGGER can cause excessive performance degradation to the SYSPRO application.

- User Triggers that in any way access data from standard SYSPRO tables may cause deadlocks or other contention issues.
  - In many cases a User Trigger reads data from a standard SYSPRO table and, based on the values returned, perform some other function. You should be careful when reading data from a User Trigger as the rows may be locked – either due to the SYSPRO transaction causing the trigger or another SYSPRO transaction initiated by a different user. When developing User Triggers, you should consider adding a 'WITH (NOLOCK)' clause to your SELECT statements causing a dirty read and preventing possible deadlocks.
  - Deadlocks caused by User Triggers have been found to be one of the most common problems caused by User Customization in SYSPRO databases.

- Custom form tables that end with a '+' are variable in nature
  - The column names in custom form tables are described by the end-user.
  - Therefore, you should try and avoid referencing these columns in User Triggers else using the custom form designer may give unexpected messages or if someone uses the custom form designer your User Trigger may fail unexpectedly.

User Views - Allowed

User Views on SYSPRO tables describes the requirement to add a View to a standard SYSPRO base table.

The standard SYSPRO database does not contain any views.

A User View creates a virtual table whose contents (columns and rows) are defined by a query. For example, a view can be used for the following purposes:

- To focus, simplify, and customize the perception each user has of the database.
- As a security mechanism by allowing users to access data through the view, without granting the users permissions to directly access the underlying base tables.
- To provide a backward compatible interface to emulate a table whose schema/structure has changed.

When applied appropriately User Views are allowed and should only have a minimal overhead when working with SYSPRO data. SYSPRO programs will not use or reference the User View. However, the Report Writer can be configured to report on a User View.

In some cases, a User View may be used by the SQL query optimizer even when not explicitly referenced so may even improve the performance of standard SYSPRO applications.

You should consider the following:

- The naming convention of any User View must not conflict with any other SYSPRO object whether now or into the future. You can achieve this by reviewing the current naming conventions and using a different naming convention for your User Views.
- In future versions of SYSPRO some columns may be renamed. We try and avoid this unless necessary hence it's relative rare. However, User Views based on SYSPRO tables may reference one or more renamed columns in future.
- Custom form tables that end with a '+' are variable in nature
  - The column names in custom form tables are described by the end-user.
  - Therefore, you should try and avoid referencing these columns in User Views else using the custom form designer may give unexpected messages.

Guidelines When Adding User Views

Due to the above we recommend that any User Views should have a different naming convention from any standard SYSPRO objects.

In addition to the naming convention issue, be aware of the following before adding User Views:

- SYSPRO applications do not reference User Views and therefore should only be created for third party database access to standard SYSPRO tables.
- In future versions of SYSPRO some columns may be renamed. We try and avoid this unless necessary hence it's relative rare. However, User Views based on SYSPRO tables may reference one or more renamed columns in future.

- When creating User Views, you should reference columns names explicitly rather than use an '*' to match all columns. This ensures that if the base table changes in future that your User View will remain unchanged.

- Custom form tables that end with a '+' are variable in nature
  - The column names in custom form tables are described by the end-user.
  - Therefore, you should try and avoid referencing these columns in User Views else using the custom form designer may give unexpected messages.

User Check Constraints – Allowed but Not Recommended

User Check Constraints on SYSPRO tables describes the requirement to add check constraints to a standard SYSPRO table.

The standard SYSPRO database does not contain any check constraints.

You should always consider using standard SYSPRO business logic encapsulated in Business Objects before making any changes to the SYSPRO database. The SYSPRO application uses Business Objects to provide business logic rather than using check constraints in the database.

A User Check Constraint on a standard SYSPRO column could be used to limit the possible values in a column. You may want to consider using a User Trigger instead of a User Check Constraint as this provides more control in the event of a check constraint violation.

When applied appropriately User Check Constraints are allowed (but not recommended) and should only have a minimal overhead when working with SYSPRO data.

Guidelines When Adding User Check Constraints

If you require to add a User Check Constraint to a standard SYSPRO table, consider the following:

- To avoid potential problems with future SYSPRO application upgrades we recommend that any User Check Constraints should have a different naming convention from any standard SYSPRO database objects.

- In future versions of SYSPRO some columns may be renamed. We try and avoid this unless necessary hence it's relative rare. However, User Check Constraints based on SYSPRO tables may reference one or more renamed columns in future.

- User Check Constraints (by definition) may cause standard SYSPRO applications to fail when inserting or changing data.
  - This may not be immediately obvious to the operator and it is completely your responsibility to ensure that any exceptions raised are understood by the operators using the software.
  - For this reason, it is recommended that you rather add a User Trigger and detect the constraint condition. Then, where relevant, you could log any exceptions (and reject the database insert/update if required).

- Alternatively, by appropriate use of a VBScript, the SYSPRO application could be changed to apply the same logic as the User Check Constraint. This is preferable to changes to the SYSPRO database.

- Custom form tables that end with a '+' are variable in nature
  - The column names in custom form tables are described by the end-user.
  - Therefore, you should try and avoid referencing these columns in User Check Constraints else using the custom form designer may give unexpected messages.

User Schemas – Allowed

A User Schema on SYSPRO tables describes the requirement to add additional schemas, over-and-above the 'dbo' schema used by SYSPRO, on one of the SYSPRO databases.

The topic about Database Schema earlier in this document - describes that a schema is a container for objects within the database. SYSPRO objects reside in the schema named 'dbo'. You can create User Schemas and add your own objects into your own schema.

However you should not 'move' standard SYSPRO objects into your schema as all standard SYSPRO objects must reside in a single schema named 'dbo'.

Guidelines When Adding User Schemas

If you require adding a User Schema to a standard SYSPRO table, consider the following:

- User Schema – Object naming conventions
  - Although you can create a User Schema and within that insert objects that have the same name as standard SYSPRO objects you should do this with caution.

  - The majority of SYSPRO applications will ignore the User Schema – and therefore any user objects within the User Schema. However, it is possible that one or more SYSPRO applications (such as utility programs) may not take account of the Schema Name when viewing or testing for the existence of objects with the same name as standard SYSPRO objects.

  - Another reason to avoid creating objects in your User Schema with the same name as standard SYSPRO objects is that this is often very confusing to administrators, developers and support personnel. Only use objects with the same name when you really intend to create this potential confusion.

  - You must not create a user schema that contains the word ‘SYSPRO’ in any case.

- All SQL Logins used when logging into SYSPRO must have a default schema of 'dbo'. This is to ensure that the User Schema is not accidently used in SYSPRO applications.

Configuring SYSPRO to work with SQL Server

This topic describes various options when setting up and configuring SYSPRO to work with SQL Server.

Most of these options are defined in the **System Setup** program under **System Setup** - **SQL**. See the example below:

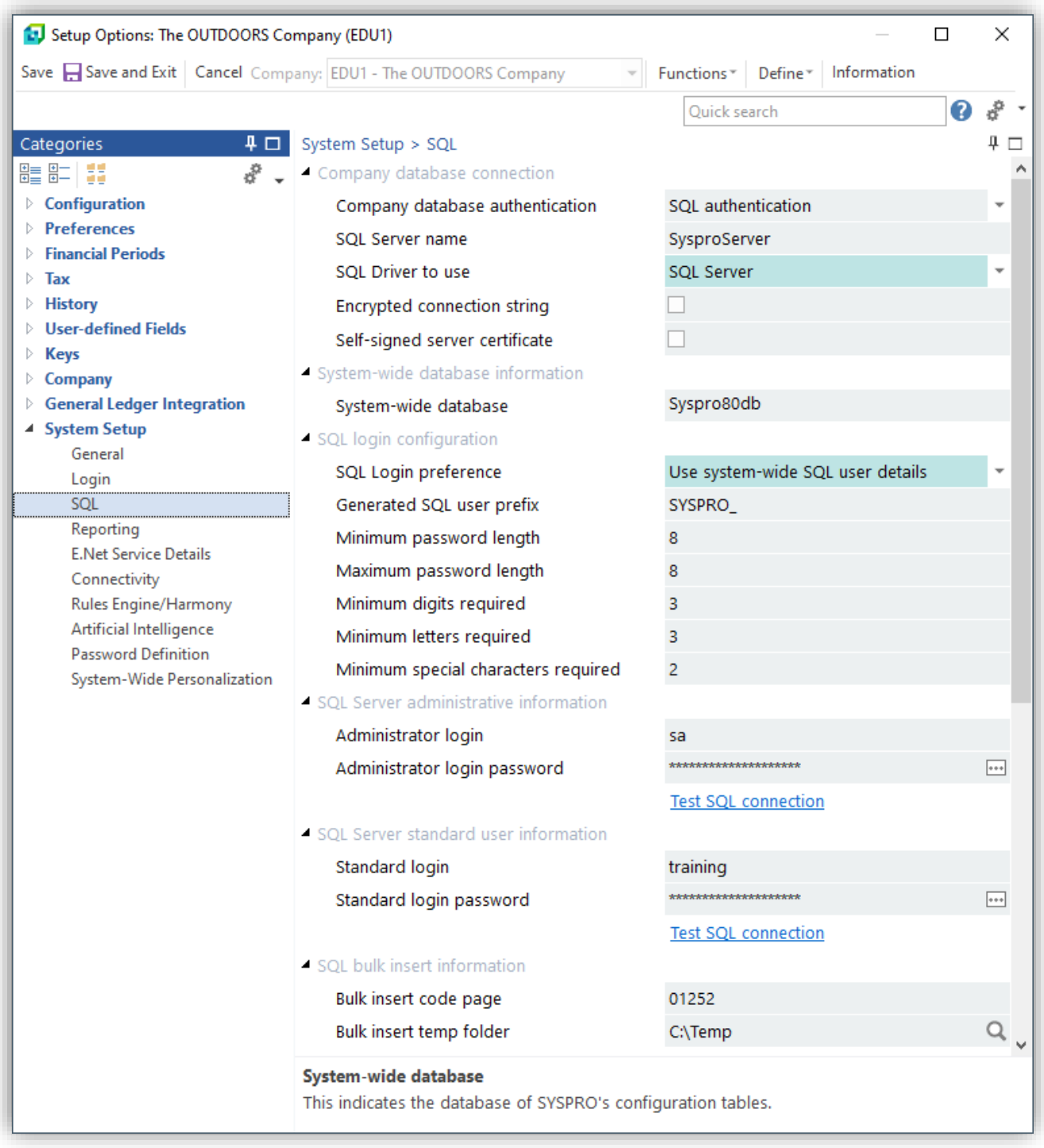


Figure 7 ***System Setup*** *-* ***SQL*** *Tab*

AUTHENTICATION

There are two main methods that applications can use to authenticate connections to SQL Server. SYSPRO can be configured to use either method.

The following information is taken from the Microsoft SQL Server documentation located at: http://msdn.microsoft.com/en-us/library/ms144284.aspx

The text shown with a blue font below is taken from the above-mentioned web page.

During setup of SQL Server, you must select an authentication mode for the Database Engine. There are two possible modes: Windows Authentication mode and Mixed mode. Windows Authentication mode enables Windows Authentication and disables SQL Server Authentication. Mixed mode enables both Windows Authentication and SQL Server Authentication. Windows Authentication is always available and cannot be disabled.

WINDOWS AUTHENTICATION

When a user connects through a Windows user account, SQL Server validates the account name and password using the Windows principal token in the operating system. This means that the user identity is confirmed by Windows. SQL Server does not ask for the password, and does not perform the identity validation.

Windows Authentication is the default authentication mode, and is much more secure than SQL Server Authentication. Windows Authentication uses Kerberos security protocol, provides password policy enforcement with regard to complexity validation for strong passwords, provides support for account lockout, and supports password expiration.

A connection made using Windows Authentication is sometimes called a trusted connection, because SQL Server trusts the credentials provided by Windows.

When you wish to use 'Windows authentication' to connect to SQL Server from SYSPRO, configure your **System Setup** program (**SQL** tab) to have the 'Company database authentication' set to 'Windows authentication'.

SQL SERVER AUTHENTICATION

When using SQL Server Authentication, logins are created in SQL Server that are not based on Windows user accounts. Both the user name and the password are created by using SQL Server and stored in SQL Server.

Users connecting using SQL Server Authentication must provide their credentials (login and password) every time that they connect.

When using SQL Server Authentication, you must set strong passwords for all SQL Server accounts.

When you wish to use 'SQL Server authentication' to connect to SQL Server from SYSPRO configure your **System Setup – SQL** tab to have the 'Company database authentication' set to 'SQL authentication'.

How does SYSPRO connect to SQL Server?

The following topic summarizes the process by which SYSPRO connects to SQL Server and how it determines the correct login method.

The fields in the **System Setup** program - **SQL** Tab – will be described more fully after this overview. We will simplify the phrase to **System Setup - SQL** Tab in the remainder of this document.

When you run SYSPRO, the initial application reads `IMPACT.INI` defined in your `WORK` folder.

See the following fragment from a sample `IMPACT.INI`:

The **`SQLLGN=`** entry contains the 'Company database authentication' setting as defined in the **System Setup - SQL** Tab.

The valid values are:

- SQLSERVER (uses SQL authentication)
- WINDOWS (uses Windows authentication)

If Windows authentication is selected, then the Windows user associated with the SYSPRO Communication Service will be used for all SQL Server access. This user must have SQL Server administrative privileges to the SYSPRO system-wide and company databases as the SYSPRO applications may need to maintain the database – for example when using the custom form designer or when applying a minor database update.

If SQL authentication is selected, then SYSPRO will proceed to login to SQL Server using the SQL Server standard user information as defined in the **System Setup - SQL** Tab. The standard SQL login will be used by the majority of SYSPRO applications and requires **db_datareader** and **db_datawriter** access to both the system-wide and company specific databases. If an administrative task is required (such as using the custom form designer where a new column may need to be created) the SQL Server administrative information will be used to elevate the privileges whilst the database maintenance is being performed. As soon as the task has completed the administrative SQL login will be disconnected – reverting to the standard SQL login as before.

If required, each SYSPRO operator can have their own SQL login, instead of using the SQL Server standard user information defined system-wide. This operator specific SQL login requires

db_datareader and **db_datawriter** access to both the system-wide and company specific databases - the same as the standard SQL login.

When you exit SYSPRO all SQL connections will be disconnected.

When an operator is viewing the Login Dialog in SYSPRO, the current database will be the system-wide database. In other words, the Windows authenticated user or SQL Server standard login (depending on the authentication method) will have the context of the system-wide database described in the **System Setup - SQL** Tab.

When the operator attempts to log into SYSPRO the 'SysproAdmin' table in the system-wide database is used to determine the company specific database name.

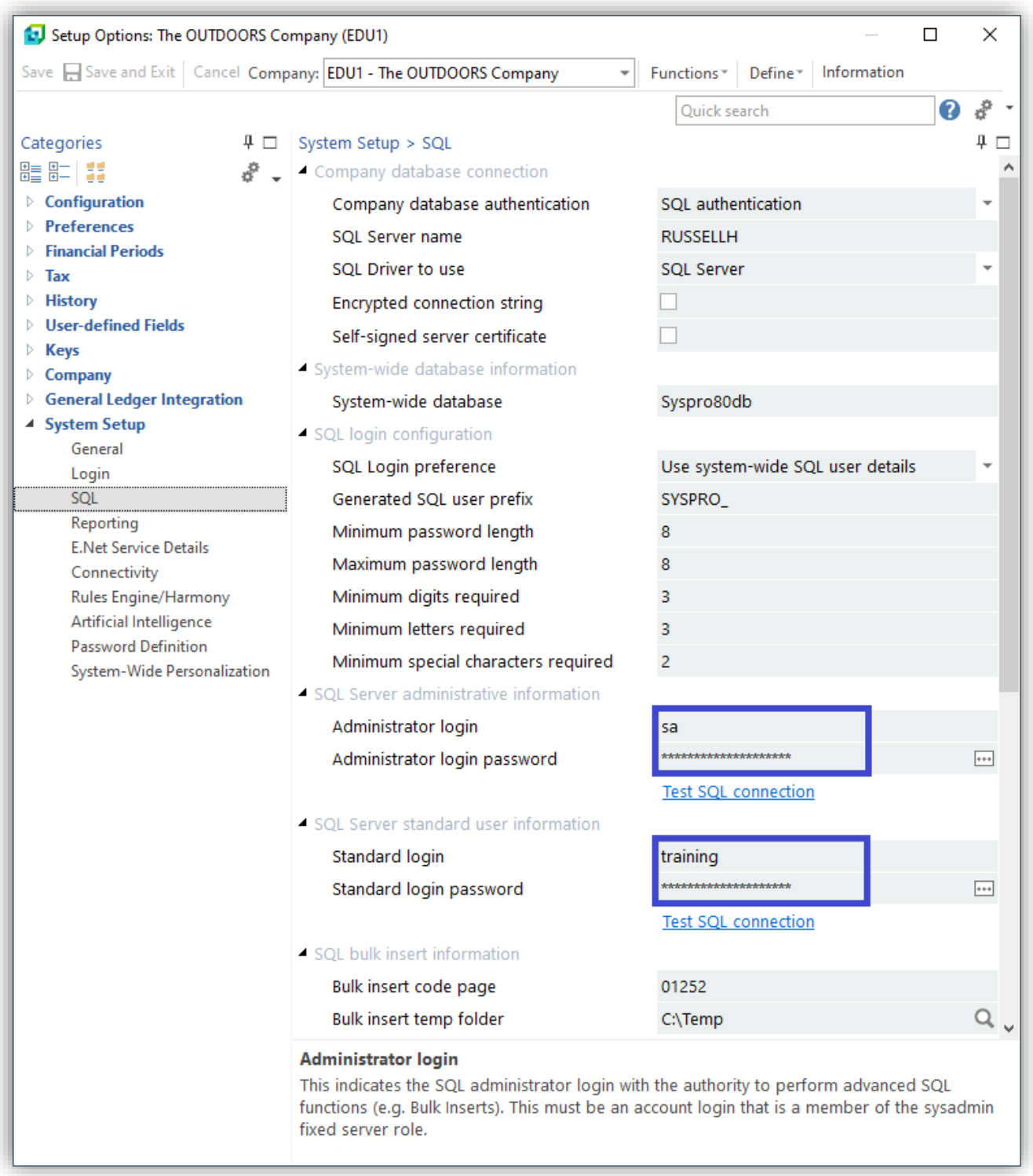
The context will be changed to the relevant company specific database and all SQL statements issued until you exit the company (or SYSPRO) will be relative to the company database.

If the operator uses the main menu option to return to the Login Dialog to allow another company to be entered the context is changed back to the system-wide database.

SYSTEM SETUP – SQL TAB REFERENCE

The following topic describes the **System Setup - SQL** Tab options and available values.

See the sample screen shot:



System Setup - Database Connection: Company database authentication

As described previously the 'Company database authentication' option allows you to configure how you wish SYSPRO to connect to SQL Server.

If the SQL Server instance has been configured to use only 'Windows authentication' then you must select 'Windows authentication' in the **System Setup – SQL** Tab. If your SQL Server instance allows SQL Server authentication, then you can also select Windows authentication in SYSPRO.

This means that all SQL Server access from within the SYSPRO application will use the Windows user defined against the SYSPRO Communication Service. This login must be assigned SQL Server administrative privileges.

If the SQL Server instance has been configured to allow 'Windows authentication and SQL Server authentication' then you can select 'SQL authentication' in the **System Setup – SQL** Tab. This means that the SQL Server login and password defined in the **System Setup** will be used to connect to SQL. SYSPRO requires a standard SQL Server user with **db_datareader** and **db_datawriter** access to both the system-wide and company specific databases. In addition, SYSPRO requires an administrative SQL Server user that will be used to perform administrative tasks.

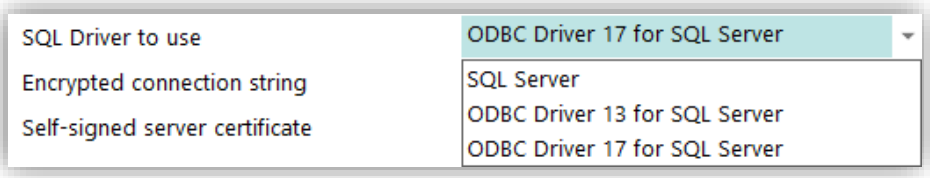
System Setup - Database Connection: SQL Server name

You must define the name of the SQL Server instance to which you wish to connect.

System Setup - Database Connection: SQL Driver to use

When using ODBC to connect to SQL Server you have a choice of which drivers to use. You will be presented with various options depending on your installed SQL Server environment.

See the following screen fragment:



If you wish to take advantage of **SQL Data Encryption in Motion**, then you must select one of the drivers that support this technology. In the example shown, you require to select one of drivers named: 'ODBC Driver 13 for SQL Server' or 'ODBC Driver 17 for SQL Server.

In addition, you should ensure that you set the next two options accordingly.

For more information about SQL Data Encryption in Motion and how to configure this environment see the topic: see Data Encryption in Motion.

System Setup - Database Connection: Encrypted connection string

Select this checkbox when configuring SQL Data Encryption in Motion.

For more information about SQL Data Encryption in Motion and how to configure this environment see the topic: see Data Encryption in Motion.

System Setup - Database Connection: Self-signed server certificate

Select this checkbox when configuring SQL Data Encryption in Motion and you wish to use a self-signed server certificate.

For more information about SQL Data Encryption in Motion and how to configure this environment see the topic: see Data Encryption in Motion.

System Setup – System-wide database information

You must define the name of the system-wide database. This is the database that contains system-wide tables including the 'SysproAdmin' table that contains the cross-reference between the company id and the database name and its collation.

System Setup – SQL Login configuration

There are three methods of connecting to SQL when using the 'SQL authentication' company authentication method. Making a selection here, provides a default when adding an operator using the **Operator Maintenance** program. In all cases you can override this default when maintain a specific operator.

Use system-wide SQL user details – This means that all normal access to SQL Server will use the SQL Server standard user information defined later in the **System Setup – SQL** Tab. This is the simplest method and many users have configured their system this way.

Use operator specific SQL user details – This means that each SYSPRO operator must have a SQL Login name and Password defined under the **Operator Maintenance** program – SQL Server authentication group. This SQL Login name and password defined against the operator will be used to connect to SQL Server. When using this method, it is very important to define a strong SQL password against each operator.

Use generated SQL user details – This means that when adding an operator using the Operator Maintenance program a SQL Login will be created in SQL Server with a generated (strong) password. In addition, the permissions of the generated SQL Login will be configured to provide the correct data reader and writer access. This provides a secure connection environment, together with the ability to trace individual operator's database access when using tools such as the SQL profiler. See the following prompts relating to SQL user prefix and password rules.

System Setup – SQL Login configuration – SQL user prefix and password rules

If you have selected the 'Use generated SQL user details' option above, then you should define a prefix that will be applied to all generated SQL Login's. For example, if you define a prefix of 'SYSPRO_' and the operator code is 'RUSS' then a SQL login named 'SYSPRO_RUSS' will be generated when using the Operator Maintenance program.

In addition, you should use the password rule fields defined here to ensure that the system will generate a strong password for each operator.

It is recommended that you use a minimum of at least 8 characters for generated passwords – preferably more. The generated password is never shown.

The individual password rule options are assumed to be self-explanatory.

System Setup – SQL Server administrative information

You must define the SQL Server login and password of a SQL Server account that has administrative privileges to both the system-wide and company specific databases.

This administrative account requires the following privileges:

- **DATABASE CREATE**
  Ability to add a new database, create and drop tables, columns, indexes, foreign keys etc.
- **BULK INSERT**
  Ability to execute a BULK INSERT statement to upload data to the database.

Examples where the administrative login is used:

- When using the Custom Forms Designer and a new Table or Column is to be added to the SYSPRO database or an existing column is to be deleted or renamed. All Custom Form tables affected by this are suffixed with '+'.
- When installing a new release of SYSPRO and performing a minor database update - this SQL login will be used to add additional Tables, Indexes, Columns or other objects as required.
- When using a SQL health dashboard or diagnostic program as these can require elevated permissions to query system and cross-database parameters.

You must set strong passwords for all SQL Server accounts.

You will often use a SQL Server account that has a fixed server 'sysadmin' role – such as 'sa' - but other accounts are acceptable if they have the correct privileges.

System Setup – SQL Server standard user information

You must define the SQL Server login and password of a SQL Server account that has data read and write privileges to both the system-wide and company specific databases.

This standard SQL account requires the following privileges:

- **db_datareader**
  Ability to read all rows from any table in the database.
- **db_datawriter**
  Ability to insert, change or delete any data in any row from any table in the database.

You must set strong passwords for all SQL Server accounts.

You may not use the same SQL Server account for both standard and administrative users.

SYSTEM SETUP – SQL BULK INSERT INFORMATION

You must define a bulk insert code page and temporary folder that will be used when SYSPRO applications require to perform BULK INSERT operations. For example:

- Refreshing the data dictionary when new software is installed uses the bulk insert SQL function to perform the update as quickly as possible.
- Running an MRP Requirement Calculation can require a bulk insert of large volumes of data into snapshot and suggested tables.

If you are using English or Western European languages, then leave the bulk insert code page as 01252. However, for other database collations you can select a relevant code page to be used during the BULK INSERT process.

The bulk insert process formats data into a plain text file with a Tab Separated format and then issues a BULK INSERT statement in SQL Server – in effect importing the data from the file system. This is very quick, hundreds or thousands of times time faster than inserting data row-by-row.

The bulk insert temp folder must be a folder that is accessible from both the SYSPRO application server and the server on which SQL Server is running. Often you will require entry of a UNC path to a temporary folder for this purpose – especially in a 3-tier environment.

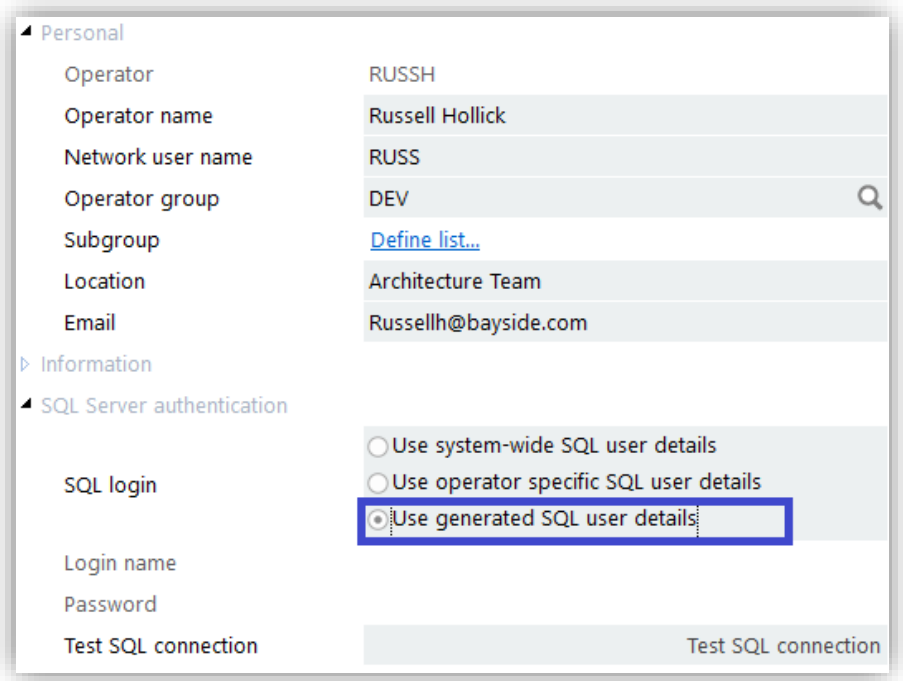
DEFINING A SQL SERVER LOGIN AGAINST EACH OPERATOR (*OPTIONAL*)

As mentioned previously, if you are using SQL Server authentication then you must define a standard and an administrative SQL login in the **System Setup** – **SQL** Tab.

In addition, as an operator logs into SYSPRO, you can override the standard SQL login and use an operator specific SQL Server login and password – this is defined against the operator code.

The following lists the advantages and disadvantages of having separate SQL Server login and password per operator:

- **Using a generated SQL Server login and password against each operator**
  - This means that the Operator Maintenance program will create a SQL Login with appropriate data reader and writer permissions.
  - The SQL Login name will be generated by combining the 'generated SQL user prefix' defined in the **System Setup – SQL** Tab and the operator code. For example, if you have a prefix of 'SYSPRO_' and are adding an operator code 'RUSS' then the generated SQL Login name will be 'SYSPRO_RUSS'.
  - It is important to note that the SQL Login will have a strong generated password based on the password rules defined in the **System Setup – SQL** Tab. The generated password is never shown.
  - When first setting this option, or adding a new operator with this option, the SQL Login will be created as described above.



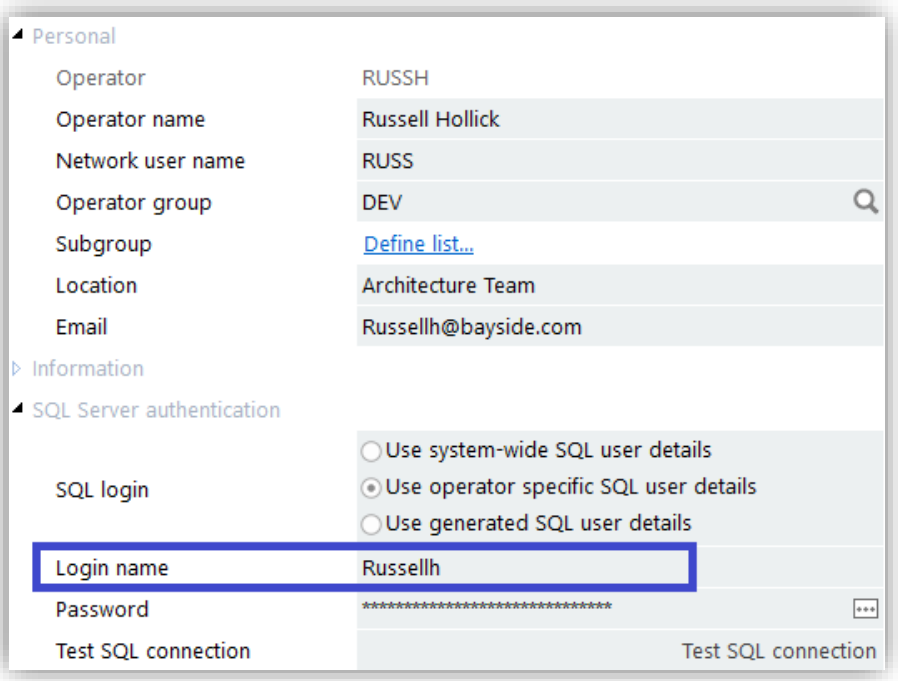
  - The advantage of this method is that each SYSPRO operator will be using a unique, consistently named SQL Server login and the password is generated, unique, strong and secure. This provides an improved diagnostic experience when tracing SQL Server access using the SQL profiler or similar tools.
  - The downside is that if you have many SYSPRO operators then your SQL Server environment will contain many SQL logins.

- **Defining a SQL Server login and password against each operator**
  - This means that you must have created a SQL Login for each SYSPRO operator and you will use this option to link the operator code to the SQL login.

  - It is up to you to define an appropriate SQL login name, a strong password (that will need to be captured in the Operator Maintenance program) and you must have assigned appropriate permissions using the data reader and writer access for both system-wide and company specific database.

  - The primary use of this option is when you have already configured SQL logins for this purpose.

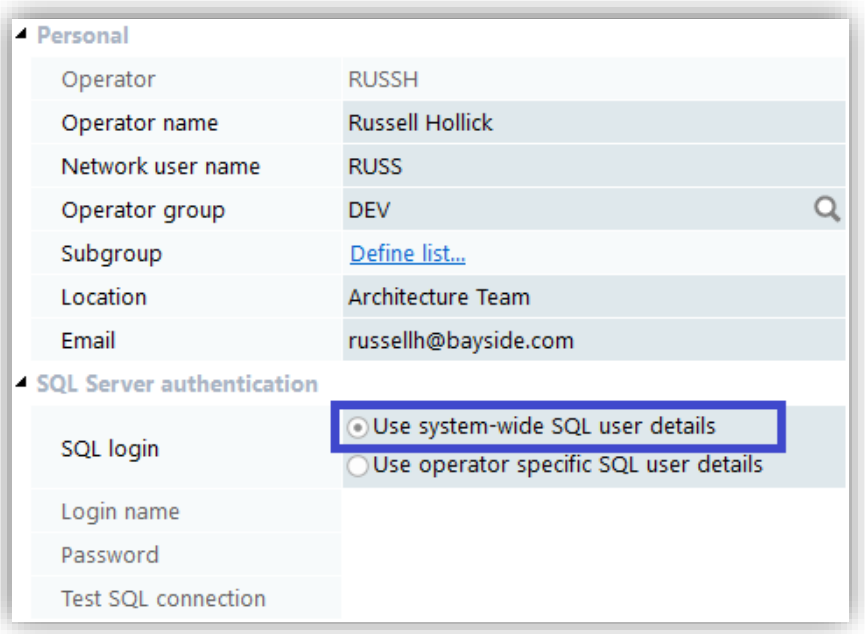
  - See the example below where the SQL login name 'Russellh' will be used to connect to SQL Server when this operator logs into SYSPRO.



  - The advantage of this method is that each SYSPRO operator can use a different SQL Server login and password (of your deciding). In addition, when tracing SQL Server access each operator's database access can be isolated – this can help when performing system diagnostics.

  - The downside is that if you have many SYSPRO operators then maintenance of all these SQL login and passwords (both in SQL Server and SYSPRO) can be a drain on administrative resources and can lead to less-than-ideal security unless strong passwords are always maintained. You should consider using the option to use a generated SQL login rather than this option.

- **Not defining a SQL login and password per operator**
  - The default is that all operators 'use system-wide SQL user details' – as shown below:



  - Selecting this option means that the SQL Server standard user information defined in the **System Setup** – **SQL** Tab – is used for all regular SQL Server access.

  - The advantage of this method is that you only require a single SQL login and password for all SYSPRO database access in SQL Server and you only need to define this single SQL login and password information once in the **System Setup** program. This considerably simplifies maintenance of both SQL Server and SYSPRO setup.

  - The only downside is that as you have a single SQL login for all SYSPRO access there is no way to differentiate between SYSPRO logins at the database level. For example, if you are using the SQL tracing facility to diagnose a problem you cannot easily correlate SQL users and SYSPRO operators.

  - However, SYSPRO is still using separate operator codes and all transactions and their logs/journals will still record the individual operators as normal (it's only at the database level where the same SQL login is being used).

  - Many sites use this method due to the simplicity of maintenance and therefore making it easier to ensure strong passwords are used.

SQL Connection Strings and ODBC

SYSPRO uses ODBC to connect to SQL Server.

Important: The following quote is from a Microsoft SQL Server resource (https://docs.microsoft.com/en-us/sql/connect/odbc/microsoft-odbc-driver-for-sql-server?view=sql-server-ver15):

> *"ODBC is the primary native data access API for applications written in C and C++ for SQL Server. There is an ODBC driver for most data sources. Other languages that can use ODBC include COBOL, Perl, PHP, and Python. ODBC is widely used in data integration scenarios."*

When SYSPRO connects to SQL Server it creates a connection string. This string requires the ODBC driver name, SQL Server name and the authentication method – this includes the SQL Server login and password if using SQL authentication.

A sample generated connection string is shown below (with the password hidden):

```
DRIVER={SQL Server}; UID=SysproLogin; PWD=********;
Trusted_Connection=no; Server=SysproServer;
```

ODBC Driver Information

SYSPRO communicates with SQL Server using ODBC drivers provided by Microsoft. These provide standardized, robust and high-performance interfaces to SQL Server.

SYSPRO 8 supports three different ODBC Drivers:

- SQL Server
- ODBC Driver 13 for SQL Server
- ODBC Driver 17 for SQL Server

The first driver (simply named **SQL Server**) ships as part of Windows and is known as a Windows Data Access Component (WDAC) – it has provided ODBC access to SQL Server for applications such as SYSPRO for many years. However, Microsoft have recently indicated that new software should no longer use this driver, partly because some features (e.g. relating to encryption) are not fully available with the **SQL Server** (WDAC) driver.

For this reason, SYSPRO 8 2020 R1 has been enhanced to allow more recent ODBC drivers to be specified in the **System Setup**.

The 'SQL Driver to use' option only shows ODBC drivers that have been installed on your SYSPRO application server. In addition, we will only show drivers that we have validated as working with SYSPRO. They are typically named 'ODBC Driver nn for SQL Server' where 'nn' represents the driver version.

Note: You may have to download and install the required ODBC driver if it is not currently installed on your SYSPRO application server.

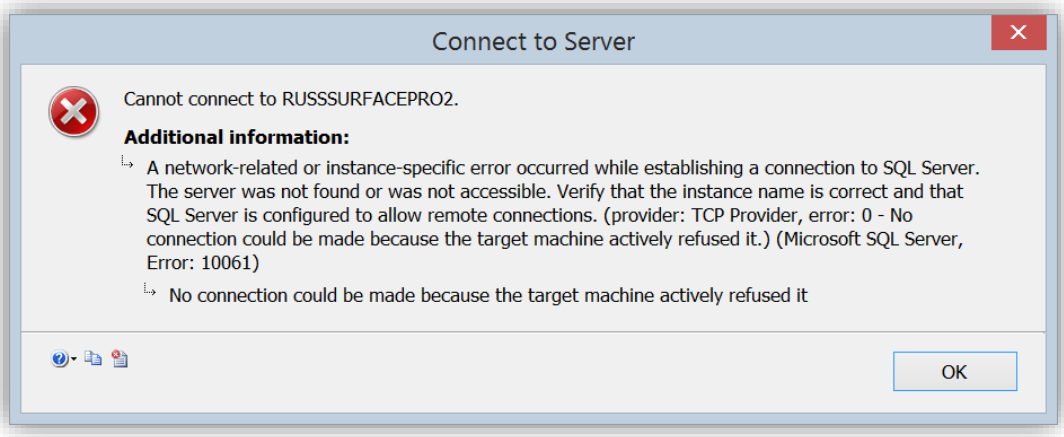
Due to the above, we recommend that you use the latest available ODBC driver presented in the **System Setup – SQL** Tab. If you intend to make use of the SQL Encryption in Motion, then you must use one of the later drivers.

NO CONNECTION COULD BE MADE BECAUSE THE TARGET MACHINE ACTIVELY REFUSED IT

When trying to login to SYSPRO you may receive a message from SQL Server indicating that it cannot connect to the instance of SQL server with a message saying:

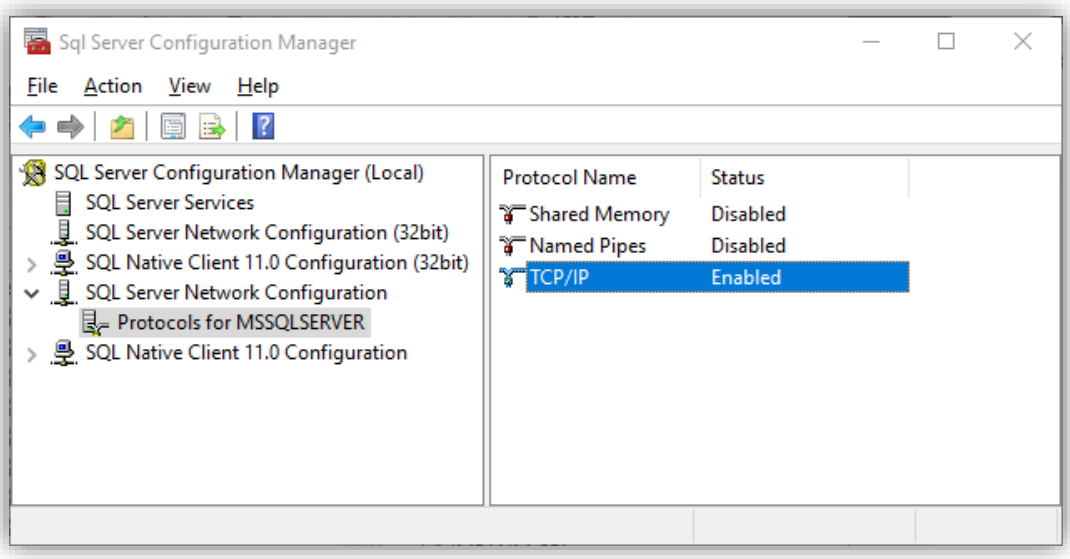
> **"No connection could be made because the target machine actively refused it"**

See an example below:



There are many possibilities that may cause this message. However, one of the common ones is where you are trying to use TCP/IP, but it has been disabled as a valid connection protocol.

To verify whether this is the cause: load the SQL Server Configuration Manager; open the 'SQL Server Network Configuration' node; click on Protocols for MSSQLSERVER.
See the following image:



Ensure the TCP/IP Protocol Name is 'Enabled'. The default on most installations is to disable this Protocol.

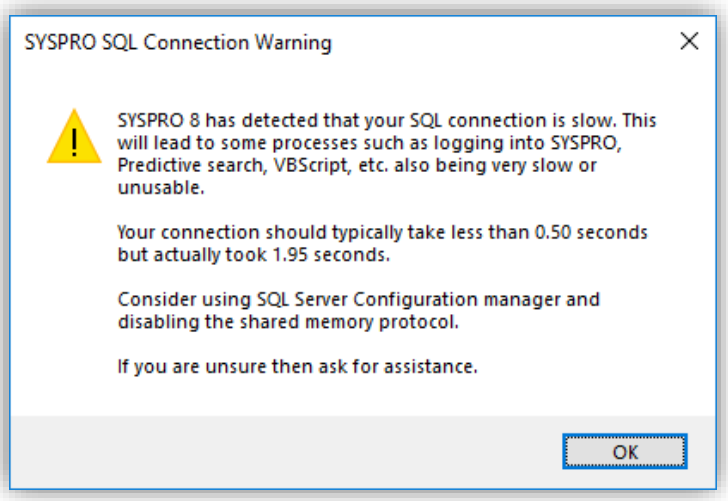
Once enabled then restart the MSSQLSERVER service – you can do this my clicking on 'SQL Server Services' and right-clicking on 'SQL Server (MSSQLSERVER)' and clicking 'Restart'.

Once enabled and the service restarted you should be able to login to SYSPRO without the message appearing.

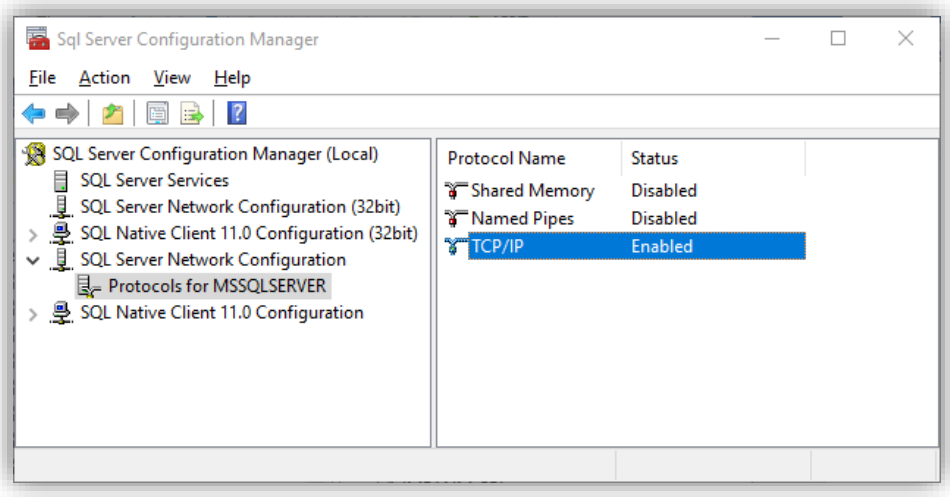
Connection to SQL Server is slow

When SYSPRO connects to SQL Server it detects the time that the connection took to connect. In a correctly configured and working system a connection to SQL Server should be much less than a 1/10th of a second (0.1 seconds or less).

If the login process detects that the connection is unusually slow (takes over 0.5 second) then you will receive a warning like the following:



As the message indicates this is often an indication that the SQL Server Configuration manager has not been setup appropriately. Ensure that the Shared Memory and Named Pipes protocols are **Disabled** as shown:



It is important to rectify this issue as many times within the SYSPRO application we may create a new connection to perform a specific task – if the connection takes an excessive time, then the application will perform poorly.

Creating a SYSPRO Database using Management Studio

When adding a new SYSPRO company, a wizard is invoked to create the company-specific database, create all the standard SYSPRO tables with appropriate columns and properties, each table's primary keys and alternate indexes together with foreign keys between all related tables.

The wizard then inserts an entry into the system-wide company/database/collation cross-reference table named 'SysproAdmin'.

Early on during this process the wizard allows you to choose whether you want to create the database yourself or have the wizard create the database for you.

In SYSPRO 8 we recommend that you create the database yourself.

There are several important properties against a database that the wizard does not currently allow you to configure. The ability to configure these properties may change in a later version of SYSPRO.

When adding a new database using SQL Server Management Studio there are many settings and options. The following sub-topics will discuss these.

New Database – General Tab

The General Tab is where you define the database name, initial data and transaction log file size and future growth together with their physical file locations. See below:

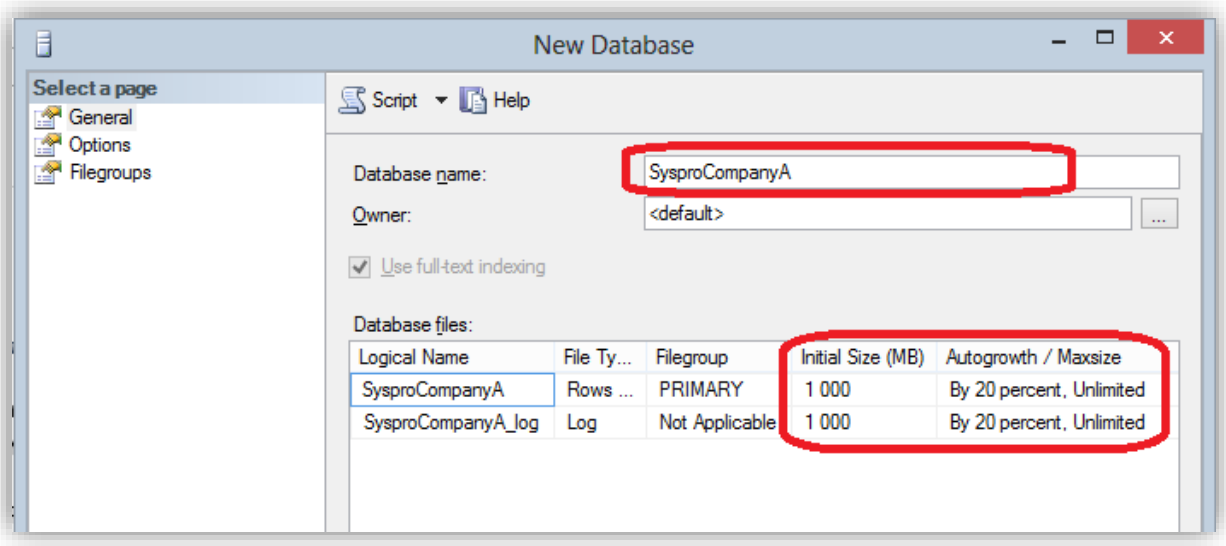


Figure 8 - Adding a Database - General Tab

SYSPRO database names must be 18 characters or less. You could consider a database name that describes the company or use the SYSPRO company id (a 1-4-character field consisting of A-Z or 0-9) as part of the database name.

For optimal performance it is important to change the 'Initial Size' and 'Autogrowth/Maxsize' of the data and transaction logs to appropriate values. The default values are typically an initial size of 10 MB with 10% growth.

However a real-world database will be considerably larger than 10 MB – usually at least 1000 MB (approximately 1 GB) and often much larger.

In the scenario where a database has an initial size of 10 MB and growth of 10% defined the following will occur. As SYSPRO inserts data into the database and the initial size of 10 MB is reached, SQL Server will autogrow the data file by 10%. This means that the data file will now be 11 MB. Quite quickly this will autogrow again by another 10% to 12.1 MB etc. There is an overhead when the autogrow feature enlarges the data file and each autogrow may cause disk fragmentation.

You can see that if the database started at 10 MB and was to grow to 1 GB, increasing by 10% at a time, it would have to autogrow hundreds or even thousands of times – this leads to excessive database resource usage, disk fragmentation and memory usage during the reorganization – all leading ultimately to reduced performance. This occurs not only during the database growth period but the system will continue to perform poorly due to disk fragmentation.

Consider changing the initial database size to something considerably larger than 10 MB. Unless you are creating a small development, test or training database, consider making the initial size 1000 MB (approximately 1 GB) or much more. You may want to change the autogrow percentage to a value larger than 10% - such as 50% or larger, or use a number of megabytes as the growth factor.

Data and Transaction Log Locations

Before you move from the General Tab, you should configure the path where the data and transaction log files reside.

See the topic: http://technet.microsoft.com/en-us/library/ms189563.aspx. This includes the following paragraph:

By default, the data and transaction logs are put on the same drive and path. This is done to handle single-disk systems. However, this may not be optimal for production environments. We recommend that you put data and log files on separate disks.

Note that you will need to use the slider to scroll to the right (from the database initial size and autogrow options). It's easy to not see the location options as they are initially out of sight.

Reasons for placing the data and transaction log files on different drives include:

- It allows optimal use of RAID configuration and other hardware optimizations.
- It provides resillience in the event of a disk crash or other disk corruption as an appropriate database backup model and backup regime will help you to restore the database quickly with minimal or even no loss of data.
- SYSPRO applications access the database (and therefore the associated data file) with a varied combination of random read, write and update operations, whereas the transaction log file is written sequentially by SQL Server. By locating the data and transaction log files on different physical disks you can gain maximum performance due to the differing types of file access and how they affect physical disk access and disk fragmentation.

The following shows a database being added – note the different disk drive (Path) of the data and transaction log files:

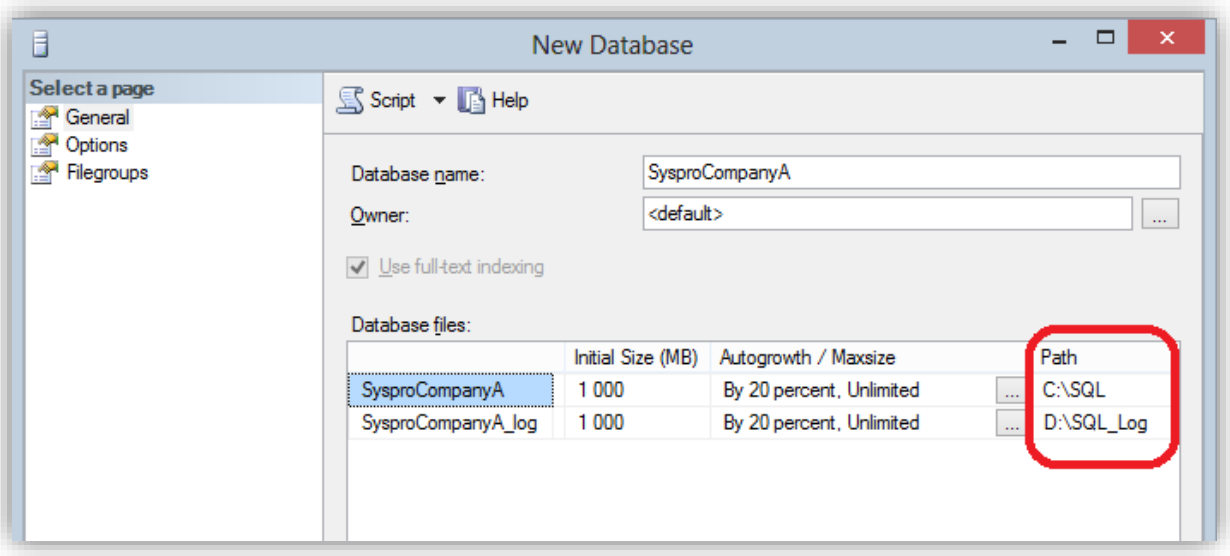


Figure 9 - Adding a Database - General Tab - Path

New Database – Options Tab

The Options Tab is where you define the Collation, Recovery model, Compatibility level and many other properties of the database:

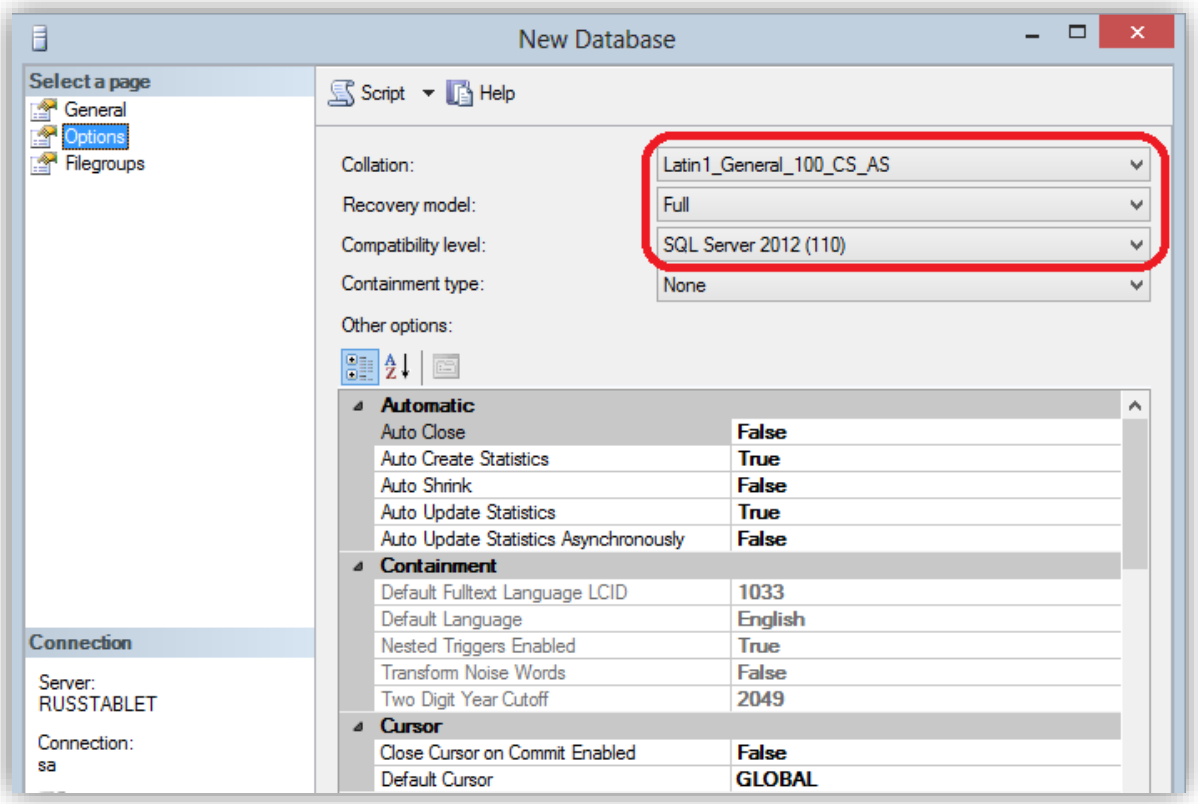


Figure 10 - Adding a Database - Options Tab

Collation

It is critical that you select a Case Sensitive and Accent Sensitive collation (or a Binary collation) when adding a SYSPRO database. This is described more fully earlier in this document under the topic Collation and Case Sensitivity.

Remember the suitable collations will either have 'CS_AS' (or 'BIN' or 'BIN2') as part of their name.

Recovery Model

Select an appropriate model after considering how you would like to backup and restore the database in the event of a failure.

SYSPRO sites typically use the 'Full' recovery model but this is not mandatory.

See the topic: http://msdn.microsoft.com/en-us/library/ms189275.aspx. This includes the following paragraph:

SQL Server backup and restore operations occur within the context of the recovery model of the database. Recovery models are designed to control transaction log maintenance. A recovery model is a database property that controls how transactions are logged, whether the transaction log requires (and allows) backing up, and what kinds of restore operations are available. Three recovery models exist: simple, full, and bulk-logged. Typically, a database uses the full recovery model or simple recovery model. A database can be switched to another recovery model at any time.

Compatibility Level

When adding a new database use a compatibility level that relates to the current version of SQL Server software. See the subject SQL Server Compatibility Levels earlier in this document for more information.

Other Options

The remainder of the database properties are typically left with their default values. If you decide to change any value from their defaults, then carefully consider if this will have any effect when running SYSPRO on this database. Some settings will prevent SYSPRO applications from performing optimally or at all. The remainder of these 'Other options' will not be covered in this document.

New Database – The model database

See the topic: http://technet.microsoft.com/en-us/library/ms186388.aspx. This includes the following paragraph:

The model database is used as the template for all databases created on an instance of SQL Server. Because tempdb is created every time SQL Server is started, the model database must always exist on a SQL Server system. The entire contents of the model database, including database options, are copied to the new database. Some of the settings of model are also used for creating a new tempdb during start up, so the model database must always exist on a SQL Server system.

Due to the above explanation, you might consider making changes to the 'model' database before you add several SYSPRO databases so that they 'inherit' the required defaults.

WHAT TO DO WHEN SYSPRO CANNOT CONNECT TO SQL SERVER

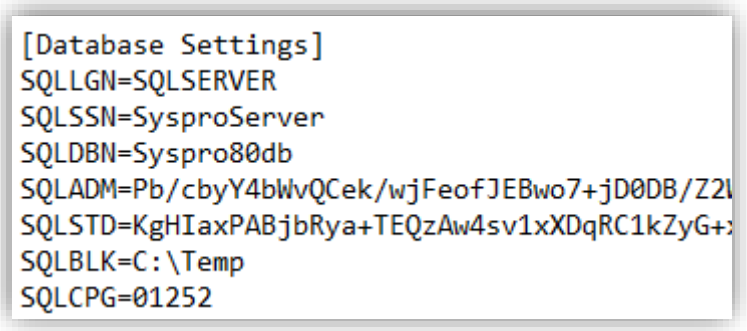
There may be situations where you are a support person, system administrator or developer and have been given a SYSPRO system to access, however you seem unable to connect to SQL Server.

As an example, perhaps the standard SQL login user and/or password is invalid for some reason.

As discussed earlier, when SYSPRO is loading it reads your `IMPACT.INI` file from the `WORK` folder and uses the entries that start 'SQL' to connect to SQL Server.

This includes two entries defining the standard and administrative SQL Server user name and password – these entries are both encrypted for obvious security reasons and therefore you cannot manually edit them to enter valid entries.

See the following fragment from an `IMPACT.INI` file:



Note: `SQLADM=` defines the administrative SQL user name and password (encrypted) and `SQLSTD=` defines the standard SQL user name and password (encrypted)

If either of the SQL login names are no longer valid or their SQL passwords are incorrect, lost or expired you may need an alternative way of getting your SYSPRO system up-and-running again.

SYSPRO 8 provides a 'SQL authentication reset mode' allowing to gain access to the initial SQL login process. This is explained in more detail below.

SETTING UP A STANDARD AND ADMINISTRATIVE SQL USER

Before using the 'reset' function you must ensure that you have two appropriately configured standard and administrative SQL users in SQL Server.

The administrative SQL user requires administrative rights to the SYSPRO system-wide and company specific databases. Typically requiring 'sysadmin' or appropriate CREATE DATABASE and BULK INSERT permissions.

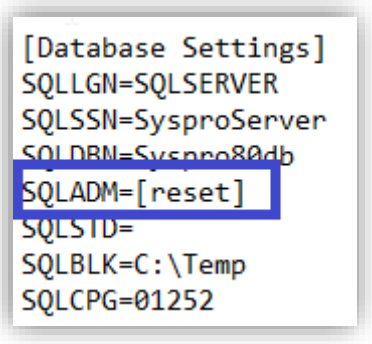
The standard SQL user requires **db_datareader** and **db_datawriter** rights to the SYSPRO system-wide and company specific databases.

Once you have the details to these two SQL logins you are ready to initiate the 'SQL authentication reset mode'.

INITIATING THE 'SQL AUTHENTICATION RESET MODE'

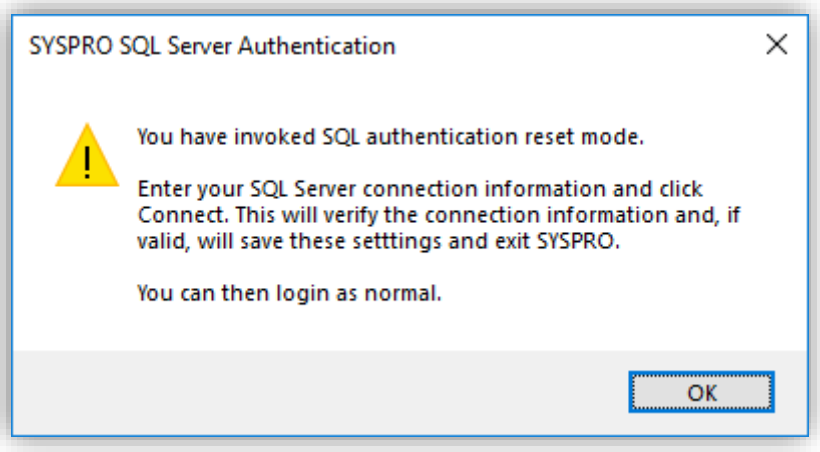
Save your `IMPACT.INI` before making any changes.

Edit `IMPACT.INI` using Notepad, or any other text editor, and change either the `SQLADM=` or `SQLSTD=` entry to the value '[reset]' (lower-case). For example:



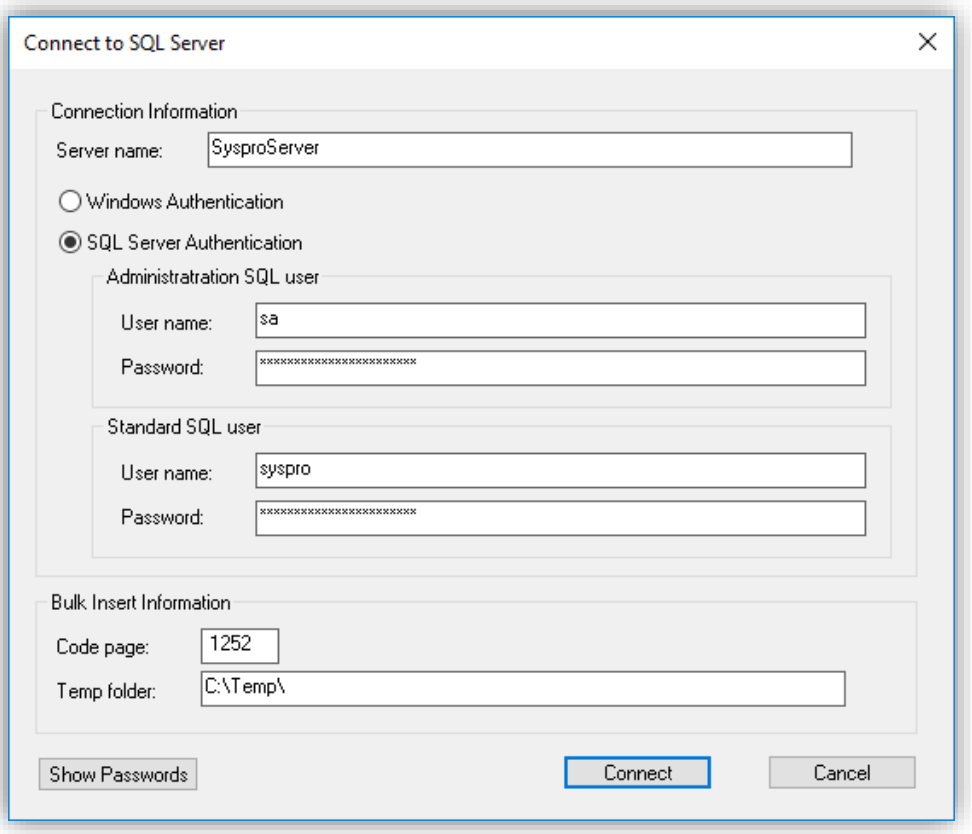
Now login to SYSPRO as normal.

SYSPRO will enter a 'SQL Authentication reset mode' – you will be presented with the following confirmation:



Once you click 'OK' you will be prompted for the information required for SYSPRO to connect to SQL Server.

See the following dialog:



You should then click 'Connect' – this will test the SQL connection information and if validated will update your `IMPACT.INI` and exit SYSPRO.

You are then ready to login to SYSPRO as normal.

NOTE ABOUT THE IMPORTANCE OF A RELIABLE SQL CONNECTION

Once a user has logged into SYSPRO, the system will have an active SQL connection open. This is used to perform queries, database updates and initiate transactions. If there is any break in the connection, then SYSPRO applications will not perform as expected.

In many cases they may report a missing item or other unexpected error.

If you then attempt to exit from the program, back to the menu, SYSPRO will also attempt to update a database table that stores a list of which programs are being used by each operator.

From SYSPRO 8 2020 R1 onwards we detect if this update fails and provide further information about the connection problem. Previous versions would often report the (slightly confusing) message: **You have been logged out by administrator**.

It is recommended that if a system is receiving these messages repeatedly that you consider your network connection reliability. As the SQL Server connection typically uses the TCP network protocol, if the network fails momentarily for any reason, or a network card is put in a sleep mode, or anything else that interrupts the network connection, this could explain the problems mentioned above.

SYSPRO and SQL Server Data Encryption

Introduction

This topic introduces data encryption relating to SYSPRO and SQL Server. It should be considered as part of your company's overall security and privacy policies.

The focus is on securing data from the SYSPRO ERP application when using Microsoft SQL Server and securing the communication *between* SYSPRO and SQL Server.

There are two relevant technologies known as **Data Encryption at Rest (TDE)** and **Data Encryption in Motion (TLS)**.

Why Data Encryption?

In today's highly regulated world, most companies operate in an environment where they must comply with one or more security and/or privacy regulations or government acts.

Examples include:

- EU citizens (GDPR - General Data Protection Regulation)
- Australia (OAIC - Privacy Act)
- Canada (PIPA, PIPEDA - Privacy Act)
- South Africa (POPI - Protection of Personal Information Act)
- USA (When this document was originally created (September 2019) the United States did not have any centralized, formal legislation at the federal level regarding this issue. However, it does ensure the privacy and protection of data through the United States Privacy Act, the Safe Harbor Act and the Health Insurance Portability and Accountability Act. Individual states may also have relevant acts that apply).

Failure to comply with these regulations can often incur heavy penalties and even criminal prosecution.

In the event of a data breach, there are typically prescribed reporting considerations to a regulatory body. In most cases the penalties for a breach can be largely mitigated if it can be shown that reasonable attempts were taken to protect your data.

For example, if you can show that you have encrypted the database then any network or other security breach will limit the damage and, consequently, penalties can be mitigated.

In addition, by encrypting data passed between SYSPRO and SQL Server you effectively remove the chance of eavesdroppers and hackers being able to gather or even change data.

Owing to these considerations, many companies should consider data encryption as part of their security and privacy data compliance strategy.

The following topics will be introduced, together with some information relating to the available technologies and some performance considerations:

- Data Encryption at Rest
- Data Encryption in Motion

DATA ENCRYPTION AT REST

Data Encryption at Rest describes the technique of configuring SQL Server so that the physical database files stored on the Windows file system are encrypted.

This ensures that, in the event of a network or other security breach, even if someone can access the physical database data or log files (or a backup of these files) the information remains secure.

The technique described here is known as **TDE - Transparent Data Encryption**.

Extract from: https://docs.microsoft.com/en-us/sql/relational-databases/security/encryption/transparent-data-encryption?view=sql-server-2017

Transparent Data Encryption (TDE) encrypts SQL Server, Azure SQL Database, and Azure SQL Data Warehouse data files, known as encrypting data at rest. You can take several precautions to help secure the database such as designing a secure system, encrypting confidential assets, and building a firewall around the database servers. However, in a scenario where the physical media (such as drives or backup tapes) are stolen, a malicious party can just restore or attach the database and browse the data. One solution is to encrypt the sensitive data in the database and protect the keys that are used to encrypt the data with a certificate. This prevents anyone without the keys from using the data, but this kind of protection must be planned in advance.

TDE performs real-time I/O encryption and decryption of the data and log files. The encryption uses a database encryption key (DEK), which is stored in the database boot record for availability during recovery. The DEK is a symmetric key secured by using a certificate stored in the master database of the server or an asymmetric key protected by an EKM module. TDE protects data "at rest", meaning the data and log files. It provides the ability to comply with many laws, regulations, and guidelines established in various industries. This enables software developers to encrypt data by using AES and 3DES encryption algorithms without changing existing applications.

RELEVANT SYSPRO VERSION – ALL VERSIONS

Data Encryption at Rest using TDE requires SQL Server configuration and does NOT require any additional configuration from within the SYSPRO application.

Therefore, Data Encryption at Rest using TDE is applicable to any SYSPRO version.

The technical details of how-to setup and configure SQL Server with TDE is available in a separate technical guide available from within the SYSPRO 8 Help (see: *SYSPRO Help* > *Resources* > *Technical Guides* > *SYSPRO and SQL Server Encryption Configuration*).

Data Encryption in Motion

Data Encryption in Motion describes the technique of configuring SYSPRO and SQL Server so that all communication between SYSPRO and SQL is encrypted. This includes initial connection information, SQL statements issued, and the actual data passed to-and-from SQL Server.

Data Encryption in Motion ensures that eavesdroppers and hackers can't see what is transmitted. This is particularly useful for private and sensitive information, but also for all information sent between SYSPRO and SQL Server.

It should be mentioned that if the SYSPRO Application server and SQL Server are running on the same server, then Data Encryption in Motion may add an unnecessary overhead with little or no benefit.

The technology described here is known as **TLS – Transport Layer Security**.

Extract from: https://blog.coeo.com/securing-connections-to-sql-server-with-tls

Fundamentally, TLS provides you with the ability to encrypt connections between SQL Server and calling client applications. When a client requests an encrypted connection to a SQL Server configured for TLS, an initial handshake takes place to negotiate the cipher suite from which further communication should take place. Once agreed, SQL Server then sends its TLS certificate to the client, which the client must then validate and trust against its copy of the Certification Authority (CA) certificate. Finally, providing the TLS certificate is trusted and it meets certain other requirements, a secure connection is established.

Warning: You must use TLS 1.2 (or higher) as earlier versions had known vulnerabilities. For your information, TLS supersedes its now deprecated predecessor – SSL - Secure Sockets Layer.

Relevant SYSPRO version – SYSPRO 8 2020 R1

SYSPRO 8 2020 R1 (released March 2020) has been enhanced to allow an administrator to configure SYSPRO and SQL Server using TLS, thus providing Data Encryption in Motion.

ODBC Driver Information

SYSPRO communicates with SQL Server using ODBC drivers provided by Microsoft. These provide standardized, robust and high-performance interfaces to SQL Server.

SYSPRO 8 2020 R1 supports three different ODBC Drivers:

- SQL Server
- ODBC Driver 13 for SQL Server
- ODBC Driver 17 for SQL Server

The first driver (simply named **SQL Server**) ships as part of Windows and is known as a Windows Data Access Component (WDAC) – it has provided ODBC access to SQL Server for applications such as SYSPRO for many years. However, Microsoft have recently indicated that new software should no longer use this driver, partly because some features (e.g. relating to encryption) are not fully available with the **SQL Server** (WDAC) driver.

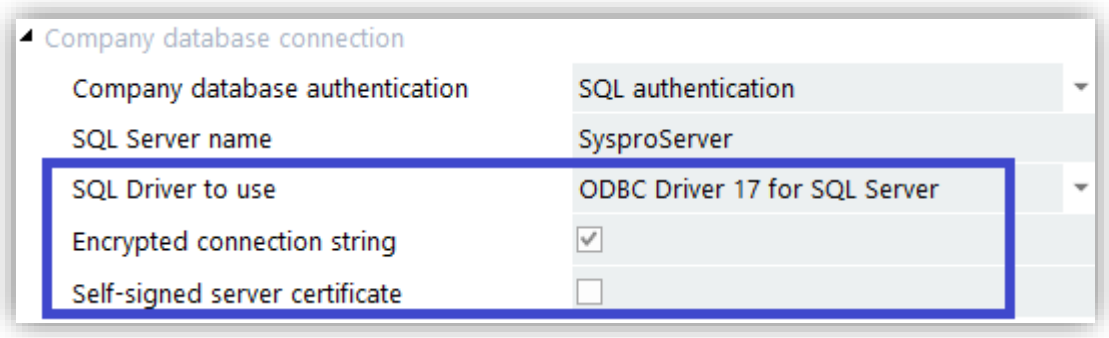
For this reason, SYSPRO 8 2020 R1 has been enhanced to allow more recent ODBC drivers to be specified in the **System Setup**.

The remainder of this topic assumes that **ODBC Driver 17 for SQL Server** is selected. If you use the older driver (ODBC Driver 13 for SQL Server) then substitute the driver name when appropriate.

Note: You may have to download and install the required ODBC driver if it is not currently installed on your SYSPRO application server.

Encrypted Connection String

Once you have chosen **ODBC Driver 17 for SQL Server** in the **System Setup**, you can select the **Encrypted connection string** checkbox and indicate whether you want a **Self-signed server certificate**.



Warning: Self-signed server certificates are, by their nature, less secure. The encrypted handshake is based on NT LAN Manager (NTLM). It is recommended that you provision a verifiable certificate on SQL Server for secure connectivity. Transport Layer Security (TLS) can only be secured with certificate validation.

Once you have saved these settings you should immediately configure SQL Server to work with TLS security. Alternatively, if you had already set up SQL Server to support TLS security then just login and the new Encryption in Motion technology is applied.

The technical details of how to set up and configure SQL Server with TLS is available in a separate technical guide available from within the SYSPRO 8 Help (*see: SYSPRO Help > Resources > Technical Guides > SYSPRO and SQL Server Encryption Configuration*).

Further Reading

There are two standalone documents published as part of the SYSPRO 8 Help providing additional content related to SYSPRO and SQL Server Encryption. This includes benchmarking comparison between systems with and without encryption.

See the following documents under: SYSPRO Help > Resources > Technical Guides

- *SYSPRO and SQL Server Encryption Overview*
- *SYSPRO and SQL Server Encryption Configuration*

Insight into SYSPRO Applications and their Interaction with SQL Server

This set of topics provides insight into how SYSPRO applications interact with SQL Server.

This includes:

- Database access using a connection string
- Generic database access
- Optimized database access and Diagnostics
- Transaction Processing
- Optimistic Concurrency Control and Timestamps

Whilst this document introduces these topics, developers will find significantly greater depth of information by using the Software Development Kit and related documentation.

SYSPRO USES A CONNECTION STRING TO CONNECT TO SQL SERVER

As mentioned under the topic 'configuring SYSPRO to work with SQL Server' SYSPRO uses ODBC to connect to SQL Server as Microsoft has adopted ODBC as the de-facto standard for many languages providing native access to SQL Server.

ODBC is a high-performance native API for connecting and communicating with SQL Server.

SYSPRO 8 uses a connection string to connect to SQL Server. This connection string is built automatically based on the SQL Server name and authentication methods configured in the **System Setup** – **Database** Tab.

SYSPRO APPLICATIONS HAVE TWO DATABASE ACCESS METHODS AVAILABLE

SYSPRO developers have two main sets of APIs that they can use to access SQL Server.

The two APIs are:

1. Generic database access logic
    - Useful for most common business logic
    - Used when inserting, updating or deleting single rows
    - Used to retrieve rows sequentially when reading via the primary key or alternate indexes – can be used to update row by row with complex business logic if required.

2. Optimized database access logic
    - Generally used when increased performance and scalability is critical
    - Provides set-based operations
      Updating and deleting multiple rows with single statements
    - Retrieving rows with complex WHERE conditions
    - Retrieving rows from multiple tables using JOINs
    - Customizing the database structure
      For example, the Custom Form designer can add, change or delete a column from the table holding the custom data.

Developers often use the Generic database access for most of their business logic, however they can also use the Optimized database access when required. These two sets of database access logic can be used as required in virtually any relevant combination.

GENERIC DATABASE ACCESS

The Generic database access logic has been available to SYSPRO developers for many years and provides a simple to code, robust and effective database access method. It is also designed to isolate many details of the underlying database from developers.

The performance is very good for most business logic.

The Generic database access makes use of a set of dedicated 'SQL file handlers' – one per table. These file handlers are statically built once 'per release' of SYSPRO so that they exactly match the SYSPRO data dictionary. The file handlers are in the application server BASE\FH and BASE\FH64 folders.

The SQL file handlers issue SQL statements that access all standard SYSPRO columns when selecting, inserting or updating rows in a table. This is 'by design' and part of the simplification process that makes using the generic database access simple for developers. Also, for this reason, any User Columns are never referenced by the Generic database access.

If you use a SQL trace facility you may notice that all the standard columns are being accessed when data is being queried, updated or inserted against a specific table. This typically indicates that Generic database access logic is being used.

Remember, most ERP transactions consist of singleton selects, updates and inserts – this lends itself to this generic database access logic.

OPTIMIZED DATABASE ACCESS

The Optimized database access logic requires the developer to have a more thorough understanding of SQL Server, the SYSPRO database architecture, the SQL Server query optimizer (including hints) and other performance considerations.

However effective use of Optimized database access can provide significant performance benefits for some business logic.

SYSPRO applications that wish to verify or modify the SYSPRO database architecture require to use the Optimized database access. The Generic database access method does not provide a method of modifying the database architecture. For example, the Custom Form designer uses Optimized database access.

If you use a SQL trace facility you may notice SQL commands that access a subset of the columns in a table, commands that access multiple tables with relevant JOINs, more sophisticated WHERE logic or even set based updates and deletes. This indicates that Optimized database access logic is being used.

Optimized database access - Diagnostics

Developers, Testers, Support personnel and others may find it useful to view the Optimized database access statements being issued by SYSPRO applications.

You can view the Optimized database access statements being issued against SQL Server by enabling the **System Setup** – **Diagnostics** option 'sql02' (exact case). See below:

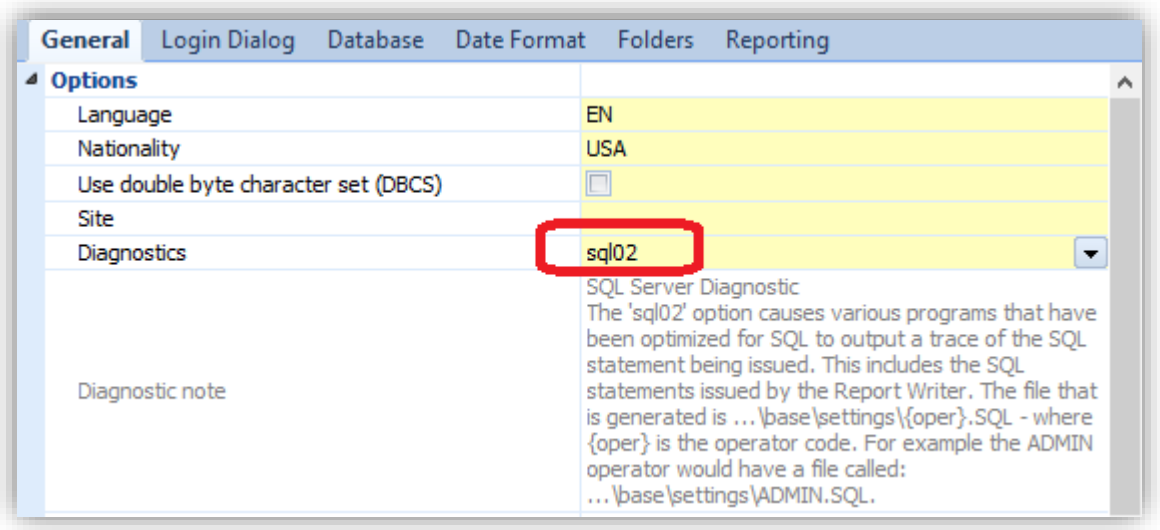


*Figure 11 - **System Setup** - **General** - **Diagnostics***

When configured all Optimized database access SQL statements are logged to a file on the application server named:

```
BASE\SETTINGS\ADMIN.SQL
```

Where '`ADMIN`' is the name of the operator.

Warning: You should only use this diagnostic on a development or test environment (or for very short periods in a live environment) as the diagnostic files add an overhead to the database access and can grow very quickly.

Also note that this diagnostic only logs Optimized database access - the Generic database access is NOT logged using this diagnostic. Therefore, you should be aware that when running a SYSPRO application that you may not be seeing the entire SQL Server interaction.

The 'sql02' diagnostic also includes information about each time a SYSPRO application connects and disconnects from the administration account configured in the **System Setup** program. For example, when you run the SQL Server Diagnostic program ('IMPDG6') you could see lines in the diagnostic log as shown below (in this case I just loaded and exited the diagnostic program).

```
-- Command generated 2018/10/24 17:15:20 Program: IMPSLG Called from: IMPDG6
Connected as user: sa

-- Command generated 2018/10/24 17:15:20 Program: IMPSLG Called from: IMPDG6
Issued: USE Syspro80db

-- Command generated 2018/10/24 17:15:21 Program: IMPSLG Called from: IMPDG6
Disconnected from current connection
```

The Report Writer also appends to this log when running a report (and when the 'sql02' diagnostic is enabled).

SQL Server Profiler

Sometimes when trying to diagnose performance or locking/blocking issues support personnel or database administrators may run the SQL Server Profiler. This is an interface to create and manage traces and analyze trace results.

The subject of configuring, setting up and/or replaying using the SQL Server Profiler utility is not covered in this document.

We have had several questions about the output of the trace. Some of which will be answered here.

I have repeated a part of the introduction about OLTP systems as it does have some relevance to the actual SQL statements being issued in SYSPRO applications (and these are visible in a trace created by the SQL Server Profiler).

The following is an extract from a Microsoft Technical Reference Guide on OLTP systems (http://technet.microsoft.com/en-us/library/hh393556.aspx):

"Operational, or online transaction processing (OLTP), workloads are characterized by small, interactive transactions that generally require sub-second response times. It is common for OLTP systems to have high concurrency requirements, with a read/write ratio ranging from 60/40 to as low as 98/2. Modifications are predominantly singleton statements, and most queries are constrained to simple joins. While limiting joins to as few tables as possible is desirable, a significant number of application systems do join many tables…"

SQL Server Profiler – Cursor vs Set based operations

As mentioned in the fragment included above, the majority of SYSPRO's interaction with SQL Server is small, interactive queries and/or transactions, both requiring quick response. Overall it is far more likely that a SYSPRO application will read data than write or change data.

Also, as mentioned earlier, SYSPRO applications have two sets of methods (APIs) to access SQL Server – these are known internally as 'generic' and 'optimized' access. It was also mentioned how you can distinguish between which method is being used.

When viewing a SQL trace, you may notice that simple procedures / batches are executed when viewing data – the results are fetched via a cursor. Depending on the application requirements it may access a single row (singleton SELECT) or, when required, multiple rows may be fetched and returned to the application. The rows to be fetched are selected using an appropriate WHERE clause and may optionally be sourced from multiple tables via an appropriate JOIN.

In some cases, complex business logic must be applied to each row as it is processed. The application may do this by fetching each row, performing the complex business logic (including sometimes inserting or changing rows in the same or a different table) and often updating the row to complete the logic – for example by decrementing a value or setting a status. The business logic is complex enough that a set-based operation is not suitable or desirable. Also, this processing often encompasses just a few rows but can scale when required. When performed inside a transaction appropriate locking – Update Intent locks and Exclusive locks will be used to ensure transaction integrity.

Examples include creating an invoice from a sale order. Each line must be processed, and different logic applied based on the order line type. Merchandised (stocked) items are handled differently to non-stocked lines, freight, miscellaneous charges and other line types. Stocked lines may require complex business logic to process associated lots, bins and/or serial numbers. All of this is further complicated by line and/or order discounting and sophisticated pricing policies together with local tax regulations. i.e. it's not a simple set-based operation.

Where possible, applications often do issue set based operations – for example: setting a flag for all items that match a specific condition; or deleting all rows that are obsolete and are ready to be purged etc.

Transaction Processing

Data integrity is one of the most significant reasons for using SQL Server to store and transact data. When correctly configured (and when appropriate backup models are in use) SYSPRO and SQL Server provide enterprise strength data integrity. SYSPRO applications use Transaction Processing concepts to help guarantee this data integrity.

This topic briefly introduces the subject of Transaction Processing and SYSPRO's use of this technology.

What is a Transaction?

A Transaction is a set of business logic that affects the database. It is a logical unit of database operations which are executed.

Transaction should have four properties. They should be Atomic, Consistent, Isolated and Durable. These properties of database transactions are often referred to by the acronym ACID.

Atomicity: A transaction is an indivisible unit. Either all its data modifications are performed, or none of them is performed.

Consistency: Transactions must keep the database from one consistent state to another consistent state. Consistency is closely related to atomicity.

Isolation: A transaction is implemented and cannot be interfered with by other transactions. That is, an internal operation of a transaction and the use of the data is isolated from other transactions, the concurrent implementation of all transactions cannot interfere with each other.

Durability: Also called permanence. It refers to a transaction which is submitted, and the data in the database it changes should be permanent. The next operation, or other faults, should not have any impact on them and cannot be undone. The modifications persist even in the event of a system failure.

For more information see: http://msdn.microsoft.com/en-us/library/aa480356.aspx

The classic example of a Transaction in the SYSPRO ERP product is where the General Ledger has a Debit posted to one account, in which case there must immediately be an equivalent Credit posted to a different account, ensuring that the ledger is 'in balance'.

In this case the Transaction must consist of both database changes (the Debit and the Credit) or it must have neither change. What you must never have is a Debit without a Credit or vice-versa.

Transaction Processing in SYSPRO Applications

Transaction Processing is implemented in SYSPRO applications by issuing a SQL Server BEGIN TRANSACTION statement before the Transaction starts and a COMMIT TRANSACTION after the Transaction has make its last database change.

If any unexpected problem occurs between the BEGIN and COMMIT, then a ROLLBACK TRANSACTION is issued. This tells SQL Server to undo all database changes (and releases any locks held) so that the database is in the same state as it was before the BEGIN TRANSACTION statement.

In most SYSPRO applications, if they encounter an 'unexpected problem' during a Transaction, they will show an appropriate message to the operator. Note that when the message has been shown the transaction has already been rolled back (undone).

See the following sample message (this specific message was generated for demonstration purposes only):

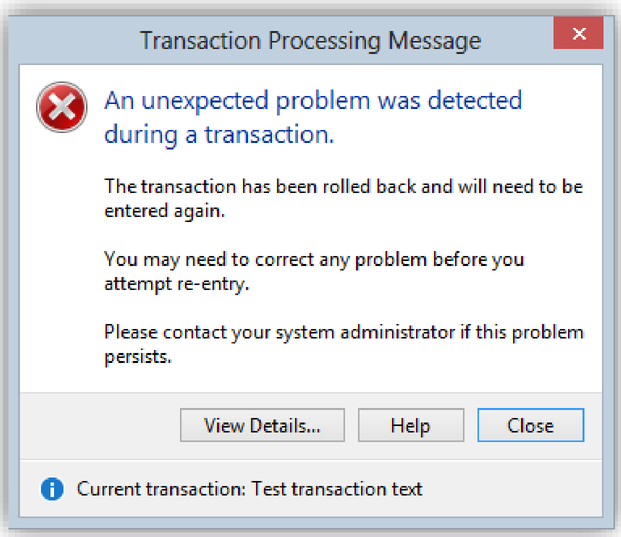


Figure 12 - Sample Transaction Failure Message

When this message has been shown the operator can click 'View Details...' and then 'Extended SQL Information...' to receive more information about the cause of the 'unexpected problem'.

See the example below:

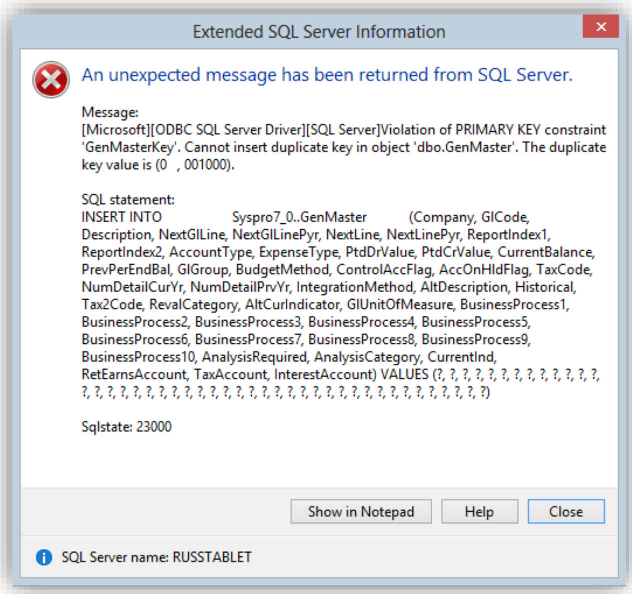


Figure 13 - Example Extended SQL Information

In this case the SYSPRO application attempted to insert a duplicate primary key – you can see that by the message: `Violation of PRIMARY KEY constraint 'GenMasterKey'.`

Database access performed between a BEGIN and its associated COMMIT causes locks to be acquired for each row being affected. If another application attempts to access any of these (locked) rows they will be 'blocked'. I.e. they will wait until the Transaction completes either via a COMMIT or ROLLBACK.

SYSPRO applications are designed to ensure that the database access performed between BEGIN and COMMIT occur as 'quickly as possible' to reduce contention and resource usage. This helps prevent excessive blocking (slowing of other applications as they wait for your transaction to complete).

SYSPRO applications never interact with the user while a Transaction is in progress as, depending on the speed of the operator's response, there could be excessive blocking.

It was mentioned earlier that 'most SYSPRO applications' show the messages discussed above. The alternative is when business objects are run in an e.net environment. In this case the transaction is also rolled back – however instead of a message 'being shown to the user' an exception message is returned to the calling application indicating that the rollback has occurred.

Transaction Processing and Job Logging

In the event of a Transaction being rolled back due to an 'unexpected problem' a Transaction status of 'Rolled back' will be inserted into the Job Logging system.

It's possible to filter on this Transaction condition so that you can see whether an excessive number of rollbacks are occurring.

See the following example Job Logging Query where a Transaction selection of 'Rolled back' has been selected.

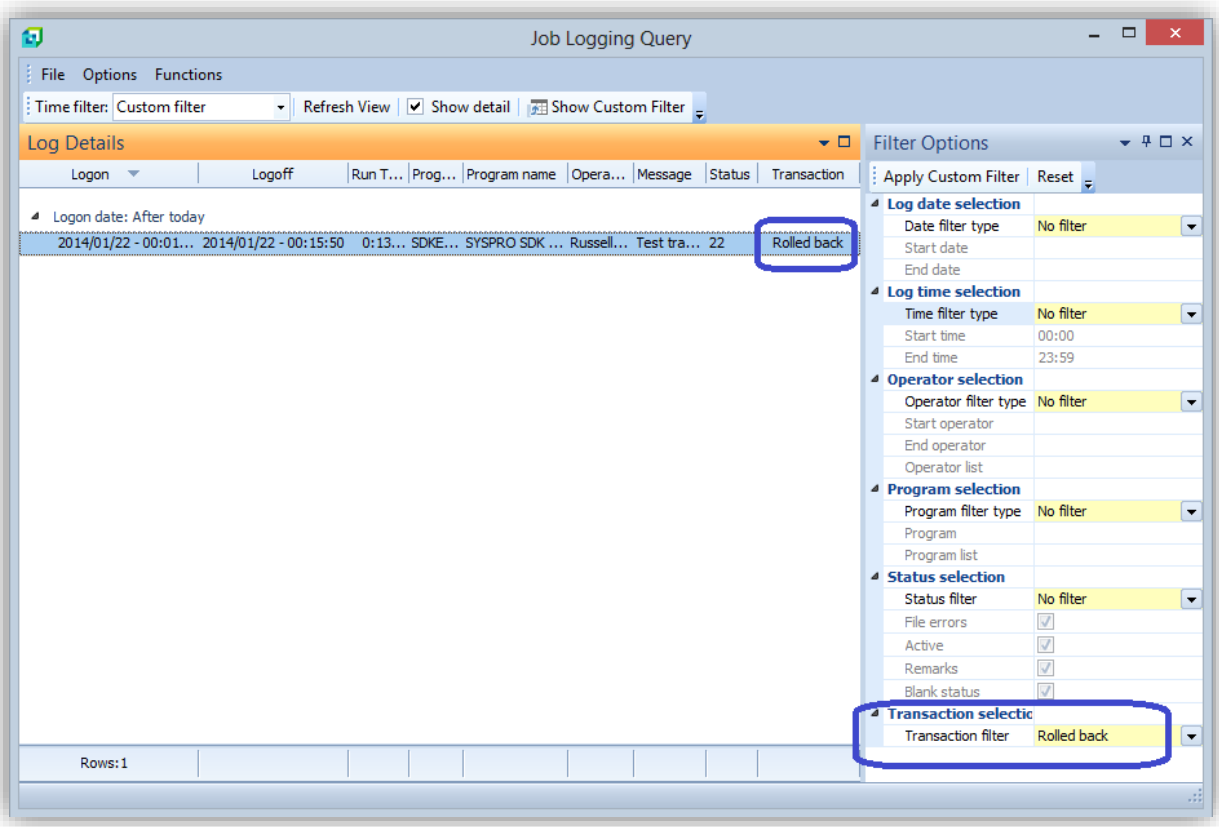


Figure 14 - Job Logging - Showing Rolled Back Transactions

In the event of an excessive number of Rolled-Back Transactions you should investigate the cause further.

If the Rollbacks are occurring from a single SYSPRO application, you should consider viewing the 'Program version' by adding this column to the list view using the Field Chooser. This may help you to identify whether this is a known issue and requires a software fix or whether there is some other reason for the contention.

Transaction Processing and Deadlocks

Occasionally you may experience deadlock problems. These can be difficult to understand and consequently solve. This topic is designed to explain a deadlock and what occurs when a deadlock is detected.

A deadlock can be described with the following example:

Suppose you have two rows in a table – item 'A' and item 'B'. Also suppose there are two operators using SYSPRO. The first operator starts a Transaction locking item 'A' and the second operator starts a Transaction and locks item 'B'.

Now the first operator (whilst still inside the same Transaction) attempts to lock item 'B'. The first operator will be 'blocked' as item 'B' is locked by the second operator. This is to be expected and correct. Typically, the second operator will complete their transaction, thus committing their changes and releasing the lock on item 'B' – in which case the first operator's request to access item 'B' is satisfied.

However, suppose that the second operator now attempts to access item 'A'. Now we have a deadlock (sometimes also known as a 'deadly embrace'). Each operator has locked one item and are attempting to access the item locked by the other operator. If both block indefinitely then both Transactions will appear to 'hang'.

This can be more serious than just these two Transactions not completing. In a real-world situation there are often other transactions that also start to be blocked as they wait for either of the first two to complete. This could escalate until a significant proportion of database users are unable to complete any Transactions.

Deadlock Detection

The SQL Server Database Engine has a deadlock detection scheme. Deadlock detection is performed by a lock monitor thread that periodically initiates a search through all the tasks in an instance of the Database Engine. Initially this is initiated approximately every 5 seconds. Once it detects a deadlock it continues to monitor deadlocks more frequently until it determines it can revert to the original time increment.

After a deadlock is detected, the Database Engine ends a deadlock by choosing one of the threads as a deadlock victim. The Database Engine terminates the current batch being executed for the thread, rolls back the transaction of the deadlock victim, and returns a 1205 error to the application.

Rolling back the transaction for the deadlock victim releases all locks held by the transaction. This allows the transactions of the other threads to become unblocked and continue.

For more information see: http://technet.microsoft.com/en-us/library/ms178104(v=sql.105).aspx

Due to the above Deadlock Detection mechanism you should not have the situation where a significant proportion of SYSPRO users are blocked, preventing them from continuing with their Transactions. However, you may find that an 'excessive' number of users are becoming the 'victim of a deadlock'. If this occurs, you should investigate the cause as described above against – 'Transaction Processing and Job Logging'.

Note: The 'User Triggers' topic earlier in this document provides some useful guidelines when a User Trigger appears to be causing an excessive number of Deadlocks or Rollbacks. We have found that this is often the most common cause of Deadlocks or Rollbacks on a SYSPRO database.

Optimistic Concurrency Control and Timestamps

OLTP systems like SYSPRO rely heavily on Transaction Processing to ensure data integrity.

Transaction Processing uses locks to ensure transaction isolation. With this comes the issues of blocking (and potentially deadlocks) as described earlier.

However, in SYSPRO there are many real-world situations where it is extremely unlikely that two or more operators will attempt to update the same information at the same time.

For example: 'AR invoice terms' provides a lookup table with a description, discount percentage and number of days within which an invoice discount may apply. In most companies these agreed AR invoice terms are subject to contracts and only change rarely. Therefore, it is extremely unlikely that two or more operators would use the AR invoice terms maintenance program to change a specific AR invoice terms code at the same time.

Introducing Optimistic Concurrency Control

SYSPRO supports an alternative technique of ensuring data integrity where it is unlikely that two or more operators are changing the same item at the same time.

The concept is known as Optimistic Concurrency Control and uses a special database capability to manage something called a Timestamp.

TIMESTAMPS

A Timestamp is a database-wide value that is incremented each time a row is inserted or changed in any table. If a table has a Timestamp column then the timestamp value is automatically updated by the database each time a row is updated or inserted.

All SYSPRO tables contain a Timestamp column for this purpose.

Important: In this context a Timestamp is not a date or time but is an integer that is incremented by the database engine each time a row is updated or inserted in the database. At any time, the database stores the current timestamp integer value. Sometimes a timestamp data type is also known as a 'rowversion'.

The following steps demonstrate how a Timestamp, together with appropriate code in a SYSPRO application, provides Optimistic Concurrency Control.

- Initially an operator starts to edit a row in a table. When the row is selected the application records the timestamp value stored against the row.
  - For this example, assume a timestamp value of 25.
  - Note there is no lock on the row.

- The operator then changes one or more values using the SYSPRO application user interface.
  - Again, note that there is no lock on the row.
  - The operator can work with the user interface and take as long as they like.

- Eventually, sometime later, the operator clicks 'Save'. Now, just before the row is updated, the SYSPRO application re-reads the timestamp value and if it is still the same (25) then the row is updated.
  - As the timestamp value has not changed the database has guaranteed that no one else has changed any value against the row since the row was first selected for editing.

- However, if the timestamp value has changed (for example has a value of 26) then the row is not updated, and a Timestamp Mismatch Message is shown to the operator indicating that someone else changed the row unexpectedly.
  - When the timestamp value has changed it indicates that some other process has made one or more changes to the row since the initial operator started the editing process. This could be a SYSPRO application or any application as it's the database that manages the Timestamp column and its value.
  - In most cases, once the Timestamp Mismatch Message is shown, the operator must re-start editing the item. The SYSPRO applications force a restart to the data entry process as it is expected that this is such a rare occurrence that there is no further logic required.
  - An example Timestamp Mismatch Message is shown below.

- If the operator does not 'Save' any changes but instead cancels out of the maintenance, then the program simply returns to the menu (or from where it was invoked).
  - As no lock was acquired there are no resources to unlock or clear.
  - Similarly, if the client application fails or is terminated or the server-side application fails or is terminated there was no lock acquired and therefore there is nothing to undo.
  - See the following sample Timestamp Mismatch Message (this specific message was generated for demonstration purposes only):

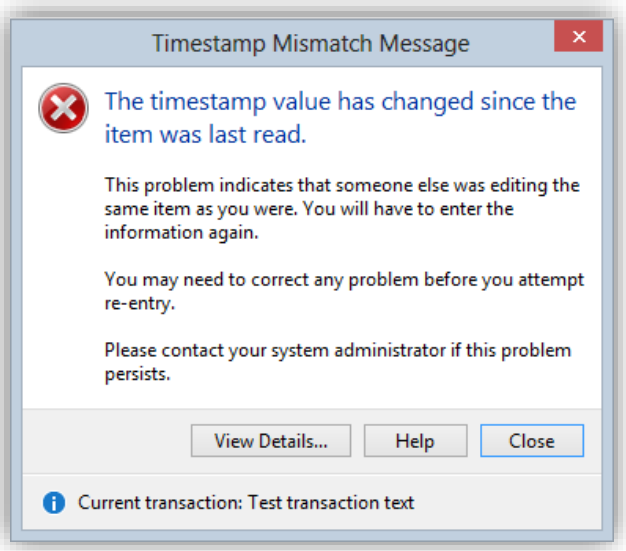


Figure 15 - Sample Timestamp Mismatch Message

The maintenance scenario described above applies to many of the simple maintenance applications in SYSPRO.

The advantages of using Optimistic Concurrency Control include:

- There are no locks involved and therefore there is no blocking and no chance of deadlocks.
- As there are no locks there are fewer resources used – improving performance and scalability.
- As Timestamps are managed by SQL Server this logic applies even if a third party attempts to change rows when an operator is using a SYSPRO application to change the same item.
- Similarly, third parties could use the same technique when changing data on SYSPRO tables.
- There are many simple maintenance applications where this logic works perfectly in a real-world business environment.

However, Optimistic Concurrency Control **cannot** be used in the following environments:

- Transactions
  Most Transactions require two or more rows to be updated in the same or different tables. Remember the classic Debit and Credit example.

- The reason that timestamps cannot be used in this instance is that the application would have to remember a timestamp for each affected row. Then, when a database change was about to be made on the first row the timestamp may not have changed and therefore the application would make the first update. The next row to be updated may detect a different timestamp from the originally saved timestamp and it would have to 'cancel' the process. However, the first update was performed. This means that there is no guarantee that all parts of the Transaction have been performed and therefore data integrity is not guaranteed.
- Similarly, if the SQL Server software, the server on which it is running or one of the physical disk drives crashes then there is also no guarantee of data integrity.
- Note that when using Transaction Processing on a correctly configured SQL Server environment using the BEGIN and COMMIT transaction logic SQL Server can guarantee the Transaction data integrity – even in the event of a system failure.

- Maintenance where multiple rows are affected
  - For the same reasons as the previous point, if a maintenance program requires to update two or more rows (in the same or different tables) then the same issues arise.
  - Due to this reason only relatively simple maintenance programs are suitable for Optimistic Concurrency Control using Timestamps.

Other uses of Timestamps – SYSPRO Analytics

Timestamps can be used for purposes other than for Optimistic Concurrency Control.

SYSPRO Analytics takes advantage of another use of Timestamps and is briefly described below.

Each time the SYSPRO Analytics 'extract job' is performed it requires to extract data from the SYSPRO database to a 'staging' database. This is a 'virtually exact copy' of the standard SYSPRO database.

It's important that the extract process is as quick and efficient as possible. The first time that the extract process is run, SYSPRO Analytics takes a copy of each SYSPRO table. Then it identifies and stores the highest timestamp found.

The next time the extract process runs it only copies rows from each table where the timestamp against the row is higher than the 'previously saved highest timestamp'. Once the extract is completed it then saves the new highest timestamp, ready for the next extract.

This technique ensures that only new rows, and rows that have been updated since the last extract, are copied to the staging database. This is a fast and efficient mechanism to minimize the amount of data copied.

SQL Health Dashboard

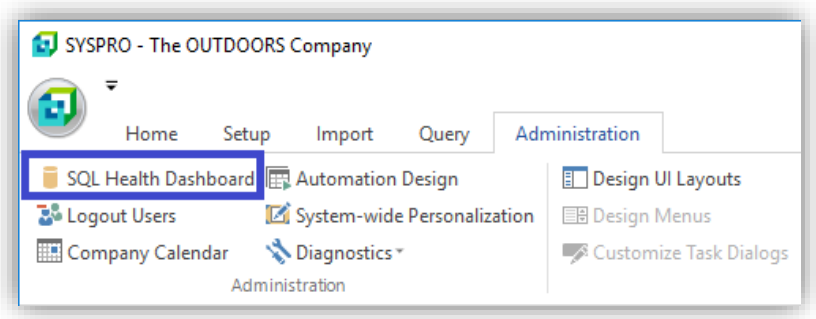
SYSPRO 8 includes a **SQL Health Dashboard** that provides a single place to monitor the key issues related to SYSPRO running on SQL Server.

It should be mentioned that there is no substitute for an expert system administrator and/or database administrator and/or SYSPRO support personnel when it comes to configuring, monitoring, diagnosing and correcting issues related to SYSPRO and SQL Server.

However, the **SQL Health Dashboard** is intended to provide some key information at-a-glance. The information shown, together with any highlighted items, is based on knowledge of our own software and how it interacts with SQL Server, together with input from our partners and customers about real-world issues that have been determined to have the most impact.

The SQL Health Dashboard is available from the ribbon bar:

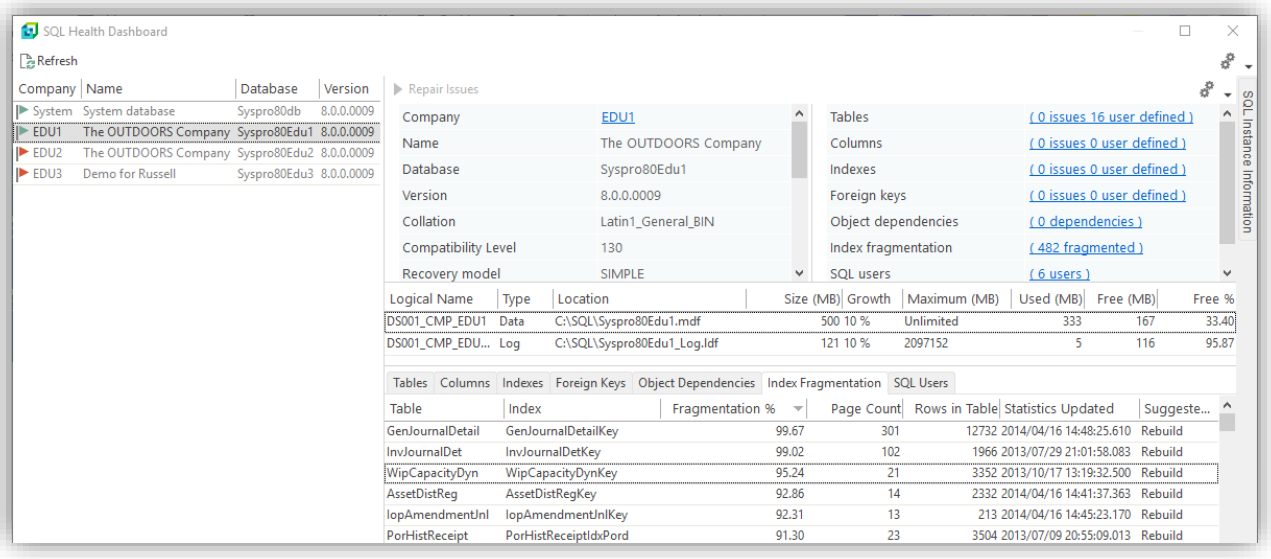
Administration > **SQL Health Dashboard**



When you run the **SQL Health Dashboard** program, it analyzes your system-wide database and each company specific database. For larger number of databases this could take a minute or so.

Note: From SYSPRO 8 2020 R1 the performance of the analyze process has been improved.

Once the analysis has completed the dashboard will be displayed - see the following example:



You can now select one of the databases shown in the left pane – this shows the system-wide database together with each company specific database.

When you select one of the databases, by clicking on the row, Database Details about the database are shown on the top right and a series of tab pages are available - bottom right. You can either click on the one of the hyperlinks shown in the top right pane or click directly on each tab page to see the relevant information.

The following topics provide additional insight to each of the types of information related to the currently selected database.

Database Details

The Database Details pane (shown top right) contains many properties and statistics relating to the currently selected database.

Highlights include:

- **Database version**
  You should ensure that the database version matches the SYSPRO version as described in the topic: Database Versions.
  If the SQL Health Dashboard finds any database that does not match the current database version it will not attempt to validate tables, columns, indexes or foreign keys.

- **Collation**
  You should ensure that the database collation conforms to the requirements of all SYSPRO databases – see the topic: Collation and Case Sensitivity.

- **Compatibility Level**
  You should ensure that the database compatibility level is set appropriately – see the topic: SQL Server Compatibility Levels.

- **Auto close**
  SYSPRO databases must not have the 'Auto close' property enabled – see the following link: https://docs.microsoft.com/en-us/sql/relational-databases/policy-based-management/set-the-auto-close-database-option-to-off?view=sql-server-2017.

- **Auto shrink**
  SYSPRO databases should not have the 'Auto shrink' property enabled as it can lead to performance degradation – see the following link: https://support.microsoft.com/en-us/help/315512/considerations-for-the-autogrow-and-autoshrink-settings-in-sql-server.

- **Status**
  This shows the status of the database at the time the query was executed. If the status is in anything but ONLINE then the checks on tables, indexes, etc. are not carried out.
  The database status can be:
  - ONLINE
  - RESTORING
  - RECOVERING
  - RECOVER_PENDING
  - SUSPECT
  - EMERGENCY
  - OFFLINE

  See the following link: https://docs.microsoft.com/en-us/sql/relational-databases/databases/database-states?view=sql-server-2017.

- **Read only**
  Live SYSPRO databases must never be set to 'read only'.

- **Last full backup**
  Ensure that the date of last full backup is as expected for your planned backup regime.

- **Last log backup**
  Ensure that the date of last full backup is as expected for your planned backup regime.

- **TDE encryption status**
  This shows the status of SQL Data Encryption at Rest using Transparent Data Encryption (TDE). If data encryption at rest has not been enabled you will see the message: **No database encryption key present, no encryption**. See the topic: Data Encryption at Rest.

- **Change data capture enabled**
  This shows whether you have enabled a technology known as Changed Data Capture (CDC) allowing SQL server to record insert, update and delete activity in the database. See the following information regarding CDC: https://docs.microsoft.com/en-us/sql/relational-databases/track-changes/about-change-data-capture-sql-server?view=sql-server-ver15

- **Change tracking enabled**
  This shows whether you have enabled a technology known as Change Tracking providing a lightweight solution that provides efficient change tracking mechanism for applications.
  See the following information regarding Change Tracking: https://docs.microsoft.com/en-us/sql/relational-databases/track-changes/about-change-tracking-sql-server?view=sql-server-ver15

Database and log backup are outside the scope of this document.

See the following information regarding the database recovery model:
https://docs.microsoft.com/en-us/sql/relational-databases/backup-restore/recovery-models-sql-server?view=sql-server-2017

Database Files

The Database File information is shown below the Database Details pane.

This shows the following information for each file used to store the database master and log information:

- **Logical name**
- **Type**
  This is the type of file – it can be either Data or Log.
- **Location**
  The physical locations of data and transaction logs can have a significant effect on the system data integrity and performance.
- **Size (MB)**
  This is the physical file size in megabytes in the file system.
- **Growth**
  This is the file growth property to be applied when free space is exhausted. It can be a percentage of the current file size or a number of megabytes. Setting this option too low can lead to excessive re-organization, disk fragmentation and poor performance.
  See the following link: https://blogs.msdn.microsoft.com/john_daskalakis/2013/11/25/sql-server-default-settings-that-you-might-want-to-change/.
- **Maximum (MB)**
  This is a configured maximum physical file size and can be a value in megabytes or 'unlimited'. On some versions of SQL Server, the default log can have a maximum value of 2097152 MB – this is just an 'arbitrary large' value and can be left 'as is'.
- **Used (MB)**
  Data usage in physical file.
- **Free (MB)**
  Free space in physical file.
- **Free %**
  This is the percentage of free space.
  This is the 'Free' space as a percentage of the file 'Size'.

The subject of setting up a new database, defining the file locations, size, free space and growth factors is complex. This is discussed in the topic about New Databases.

SQL Instance Information

There is an auto-hidden pane top right of the SQL Health Dashboard that shows information about the instance of SQL Server. This is the same regardless of the database selected.

Highlights include:

- **SQL version**
  This shows the SQL Server version, including sub-versions and service packs when relevant.

- **Collation**
  This is the collation defined when the SQL instance was installed and cannot be changed. It will be used for the system databases.
  It will govern the default collation. However, when you create SYSPRO databases you can override the collation when necessary.

- **Maximum server memory (MB)**
  It is important in a correctly configured system to fix the maximum SQL Server memory preventing it from taking all available server memory. Failure to limit the SQL Server memory will often lead to a very poorly performing system especially when SQL exists on the same server as the applications that use it.
  See the following topic: https://docs.microsoft.com/en-us/sql/database-engine/configure-windows/server-memory-server-configuration-options?view=sql-server-2017.

- **Connection time (seconds)**
  This shows how long it took to connect to SQL Server. Typically, this should be below 0.1 seconds. Any value above 0.5 seconds should be investigated. See the topic: Connection to SQL Server is Slow

- **Connection driver**
  This shows the current ODBC driver being used. See the topic: SQL Connection Strings and ODBC

- **Connection encrypted**
  This shows whether the SQL connection has been encrypted – i.e. whether you have SQL Data Encryption in Motion using Transport Layer Security (TLS). See the topic: Data Encryption in Motion

- **Connection protocol**
  This shows the current connection protocol being used. Ideally it should say 'TCP'. If it does not show TCP or you want to understand how to make a change, see the topic: Connection to SQL Server is Slow

- **Instant file initialization**
  This shows the status of the Instant file initialization option. For more information see: https://docs.microsoft.com/en-us/sql/relational-databases/databases/database-instant-file-initialization?view=sql-server-ver15

SQL Health Dashboard – Tables

The Tables tab shows information about standard SYSPRO tables that are missing. These should be treated as serious errors and will prevent parts of the SYSPRO application from running.

In addition, any user-defined tables are also shown. These are tables that do not appear to be standard SYSPRO tables. This could be due to one of the following reasons:

- The table is not defined in our standard data dictionary
- The table is not a custom form table (ends with a '+')
- The table is not a reporting archive table

If the dashboard lists any user-defined tables then it is worth investigating what, or who, has created these tables and whether they are still required and/or relevant.

Do not just delete tables that appear in this list. Ensure you have thoroughly investigated before deciding to delete user-defined tables. Typically, user defined tables have no effect on the running of standard SYSPRO applications.

Repair Issues

If there are missing tables then the 'Repair Issues' toolbar button (top right) can be selected.

This will automatically add missing tables using the correct definition as per the data dictionary.

Important: If you find that one or more tables are listed as missing, are re-added when using the repair function, but later are listed as missing again then you must investigate and prevent whatever (or whoever) is deleting these tables.

SQL Health Dashboard – Columns

The Columns tab shows information about standard SYSPRO columns that are missing from standard tables – these should be treated as serious errors and will prevent parts of the SYSPRO application from running.

Any standard SYSPRO column that does not conform to one-or more of the standard properties (such as datatype, length, collation, default, NULL indicator etc.) will be listed – these should be treated as serious errors and will prevent parts of the SYSPRO application from running.

In addition, any user-defined columns are also shown. These are columns in standard SYSPRO tables that do not appear to be standard SYSPRO columns. This includes user defined Computed Columns. This could be due to one of the following reasons:

- The column is not defined in our standard data dictionary
- The column is not a custom field defined using the custom form designer

If the dashboard lists any user-defined columns then it is worth investigating what, or who, has created these columns and whether they are still required and/or relevant.

Do not just delete columns that appear in this list. Ensure you have thoroughly investigated before deciding to delete user-defined columns. Typically, user defined columns have no effect on the running of standard SYSPRO applications.

Repair Issues

If there are missing columns and/or columns with incorrect properties, then the 'Repair Issues' toolbar button (top right) can be selected.

This will automatically add missing columns using the correct definition as per the data dictionary. It will also attempt to correct any incorrect properties – it is possible that inappropriate data may prevent the properties from being set to the standard values. Any errors will be shown and must be manually corrected.

Important: If you find that one or more columns are listed as missing, are re-added when using the repair function, but later are listed as missing again then you must investigate and prevent whatever (or whoever) is deleting these columns.

If user-defined columns are not defined as nullable and have no default value assigned, then the repair will set these columns as nullable.

SQL Health Dashboard – Indexes

The Indexes tab shows information about standard SYSPRO indexes that are missing from standard tables – these should be treated as serious errors and may degrade the performance of SYSPRO applications. Especially in tables with more than a few rows of data. In addition, if the primary clustered index is missing it may allow duplicates to be inserted into the table leading to data corruption and/or invalid data.

In addition, any user-defined indexes are also shown. These are indexes on standard SYSPRO tables that do not appear to be standard SYSPRO indexes. This could be due to one of the following reasons:

- The index is not defined in our standard data dictionary
- The index is not a primary clustered index on one of the custom form tables (ending with '+')

If the dashboard lists any user-defined indexes then it is worth investigating what, or who, has created these indexes and whether they are still required and/or relevant.

Do not just delete indexes that appear in this list. Ensure you have thoroughly investigated before deciding to delete user-defined indexes.

Please note that adding user defined indexes can have a negative effect on standard SYSPRO applications.

See the topic: Guidelines when adding User Indexes.

Repair Issues

If there are missing indexes or any standard index has incorrect properties, then the 'Repair Issues' toolbar button (top right) can be selected.

This will automatically add missing indexes using the correct definition as per the data dictionary. It will also attempt to correct any incorrect properties – it is possible that inappropriate data may prevent the properties from being set to the standard values. Any errors will be shown and must be manually corrected.

Important: If you find that one or more indexes are listed as missing, are re-added when using the repair function, but later are listed as missing again then you must investigate and prevent whatever (or whoever) is deleting these indexes.

SQL Health Dashboard – Foreign Keys

The Foreign Keys tab shows information about standard SYSPRO foreign keys that are missing from standard tables – this should be treated as relatively minor information as no SYSPRO applications rely on foreign keys - all data integrity is completely managed using SYSPRO business logic.

Any standard SYSPRO foreign key that does not conform to one-or-more of the standard properties (such as the list and sequence of columns and the 'NOCHECK' property etc.) will be listed.

In addition, any user-defined foreign keys are also shown. These are foreign keys linking to/from standard SYSPRO tables that do not appear to be standard SYSPRO foreign keys. This could be due to one of the following reasons:

- The foreign key is not defined in our standard data dictionary

If the dashboard lists any user-defined foreign key then it is worth investigating what, or who, has created these foreign keys and whether they are still required and/or relevant.

Do not just delete foreign keys that appear in this list. Ensure you have thoroughly investigated before deciding to delete user-defined foreign keys.

Repair Issues

If there are missing foreign keys, then the 'Repair Issues' toolbar button (top right) can be selected.

This will automatically add missing foreign keys using the correct definition as per the data dictionary.

Important: If you find that one or more foreign keys are listed as missing, are re-added when using the repair function, but later are listed as missing again then you must investigate and prevent whatever (or whoever) is deleting these foreign keys.

SQL Health Dashboard – Object Dependencies

The Object Dependencies tab shows information about links from third party objects into standard SYSPRO tables or columns. This includes custom form tables.

This can include:

- User Views
- User Stored Procedures
- User Computed Columns
- User Table and/or Scalar Functions
- User Triggers

If the dashboard lists any Object Dependencies then it is worth investigating what, or who, has created these dependencies and whether they are still required and/or relevant.

Do not just delete items that appear in this list. Ensure you have thoroughly investigated before deciding to delete user-defined objects or links from them to standard SYSPRO tables or columns.

Important: The column headed 'Updated' indicates that the user-defined object is updating a standard SYSPRO column.

We strongly advise against updating SYSPRO data directly, as any change may not follow the business rules associated with the data to be applied.

There are cases where custom form data may be updated directly – however you must ensure that any validation is honored.

Repair Issues

There is no repair related to Object Dependencies as these are 'by definition' user defined.

SQL Health Dashboard – Index Fragmentation

The Index Fragmentation tab shows information about the percentage fragmentation of each standard SYSPRO index. Only indexes where the fragmentation percentage is over 5%, or the index statistics have not been updated for at least 30 days, are included.

The list of indexes is shown in 'index fragmentation percentage' sequence with the highest fragmentation first.

General guidelines say that index fragmentation percentages above 30% can lead to performance degradation. However, it is very important to state that tables with very few rows are much less affected by the fragmentation percentages.

Therefore, if you use the Index Fragmentation tab and view indexes with large fragmentation percentages you should also consider the 'Rows in table' and 'Page Count' values. Only tables with high fragmentation percentages AND larger numbers in these columns should be considered for repair.

Some partners and customers have reported that when they have very high numbers in these fields and then repaired (rebuilt) their indexes, they noticed a considerable improvement in the performance of their SYSPRO systems.

Repair Issues

There is no automatic repair available in the SQL Health Dashboard relating to Index Fragmentation. This is because index rebuild, and reorganization functions should only be performed when the database is not being accessed.

Microsoft suggests the following guidelines:

Fragmentation %	Suggested action
Greater than 30%	Rebuild the index
Between 5% and 30%	Reorganize the index
Less than 5%	Indicates that the statistics are older than 30 days and you should consider updating them

See the following link describing how to perform index Reorganize and Rebuild functions: https://docs.microsoft.com/en-us/sql/relational-databases/indexes/reorganize-and-rebuild-indexes?view=sql-server-2017.

See the following link describing how to update your statistics: https://docs.microsoft.com/en-us/sql/t-sql/statements/update-statistics-transact-sql?view=sql-server-2017.

See the following link regarding auto creating statistics and the trade-off in performance vs improvements in the query optimizer: https://docs.microsoft.com/en-us/sql/relational-databases/statistics/statistics?view=sql-server-2017.

SQL Health Dashboard – SQL Users

The SQL Users tab shows information about each SQL user and/or login who have access to the selected database.

The list shows Users and/or Logins together with their type and the effective permissions into the database.

Typically, you should expect to see a SYSPRO administrator with Permissions such as **sysadmin** or **dbo** and standard SYSPRO logins with Permissions of **db_datareader** and **db_datawriter**.

You should review all SQL logins that have access to each SYSPRO database to ensure that not only each user has the minimum required permissions but also that additional logins that do not require access are not included.

When used effectively this helps reduce security access concerns.

There is a topic dedicated to SQL logins and user permissions in this document – see topic: Configuring SYSPRO to work with SQL Server

However, to briefly summarize here:

- If you are using Windows authentication, then you need to ensure that you have appropriate user permissions to administer each of the system-wide and company specific databases (typically 'sysadmin')

- If you are using SQL Server authentication the you need a minimum of two SQL users:
  - An administrative user that typically requires 'sysadmin' permissions on all the SYSPRO databases.
  - A standard user that typically requires **db_datareader** and **db_datawriter** permissions on all the SYSPRO databases.
  - In addition, you can configure that each SYSPRO operator has their own SQL login – in which case each of these SQL logins also requires **db_datareader** and **db_datawriter** permissions on all the SYSPRO databases.

If you notice one or more SQL users with permissions greater than summarized above, then you should investigate whether the SQL Users are required and whether their permissions are greater than required.

Repair Issues

There is no automatic repair available in the SQL Health Dashboard relating to SQL Users.

About the Author

This document was authored by Russell Hollick, Chief Software Architect, SYSPRO - Corporate.

Russell has been a member of the SYSPRO development team for over 30 years and is currently responsible for the SYSPRO Architecture team.

This team looks after:

- Database design and database access methods
- Client-Server architecture
- Security and authentication models
- eSignatures
- Custom forms
- Report Writer module

Russell was one of the key SYSPRO 8 architects responsible for the SYSPRO 8 scalability and performance improvements, data dictionary and database implementation, including the data conversion from earlier versions of SYSPRO.

Other areas that Russell is passionate about include:

- Agile development
- Code reviews
- Peer learning
- Helping developers and support personnel to get the most out of SYSPRO

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