
ELPRESS
ELPRESS

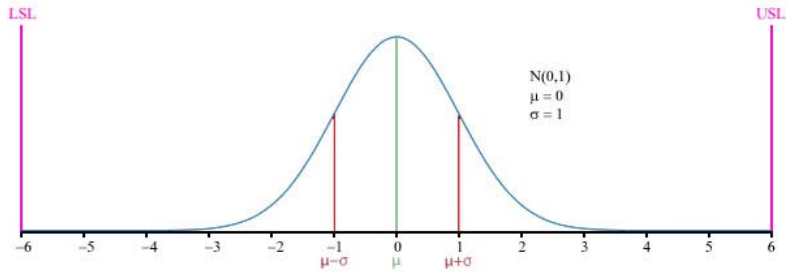
Crimp Quality Assurance
&
Statistical Process Control

Elpress Analyzer Software

Statistical Process Control

Basic SPC theory

- What is Statistical Process Control?
- Control methods:
  - Target value control
  - Tolerance value control
- C_{mk}> Machine Capability Index
- C_{pk} > Process Capability Index
- Standard deviation, σ
- Six sigma > Normal distribution chart



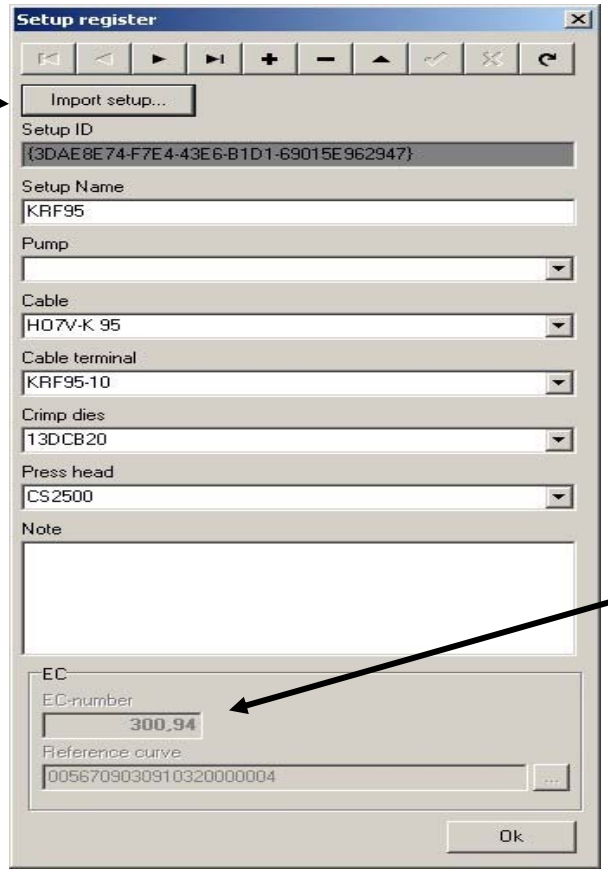
Elpress Analyzer – SPC tool

- A target value control by use of the EC value
- The target value is determined as the mean value of 30 crimp characteristics
- The value of the EC number is the target value for each crimp process
- Minimizing errors:
  - Capability of machine and process
  - Calibrated system
  - Education of operator
- High machine capability index, C_{mk}
- The process capability, C_{pk}, is influenced by the tool, terminal and conductor

Setup register

Setup register

Import of a unique setup



The setup is a tested combination of dies, terminal and conductor.

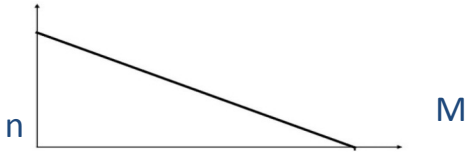
The EC- number is the numerical value representing the unique crimp combination.

Analyze of crimps

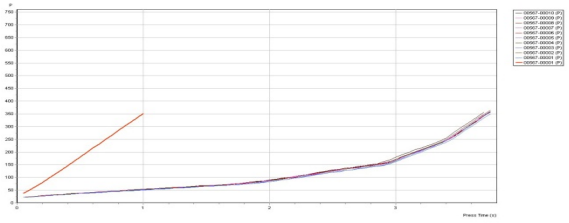
Crimping work definition:

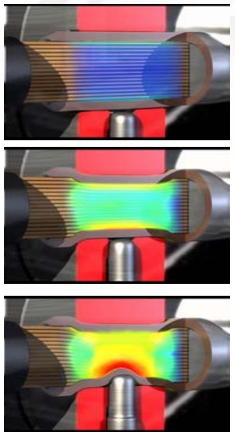
Crimping force x crimping distance, for a certain previous crimp combination

- **Hydraulic pressure prop. force.**
- **Force prop. material cross section + hardness.**
- **Motor torque prop. pressure.**
- **Motor speed prop. motor torque.**
- **Hydraulic flow prop. motor speed.**
- **Crimp time prop. flow.**



DC motor characteristics





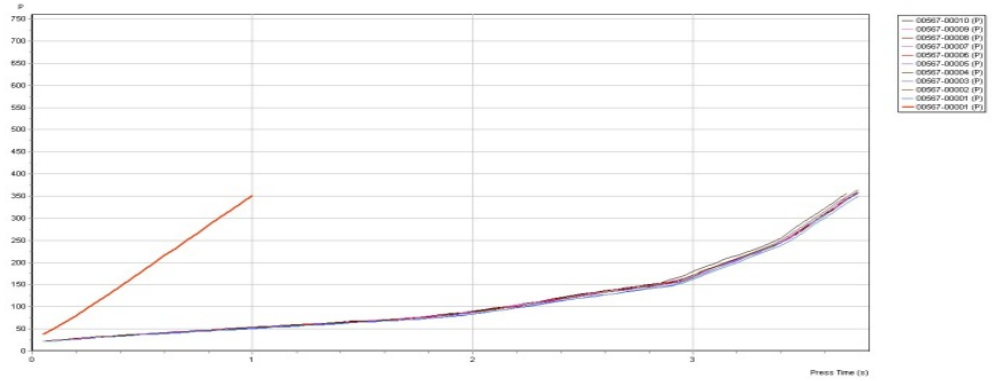
EC number:

”The numerical mean value of area from the pressure-time graph for an amount of crimp data based on a tested crimp combination reduced with the area coming from a calibration crimp cycle is named EC, crimp work or energy.”

Analyze of crimps

How is the crimp monitored?

- **The control system logs the hydraulic pressure with a frequency of 20 Hz.**
- **The measurement starts at 15 bar.**



What can be analyzed?

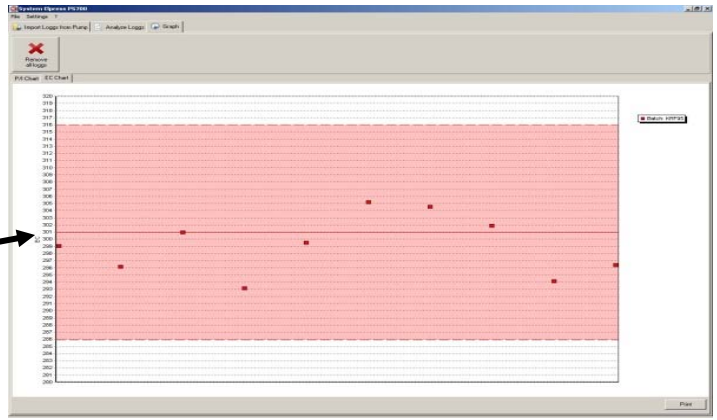
- **Variation of process**
- **Cross section variations**
- **Hardness of material**
- **Crimp component combinations**

Control chart

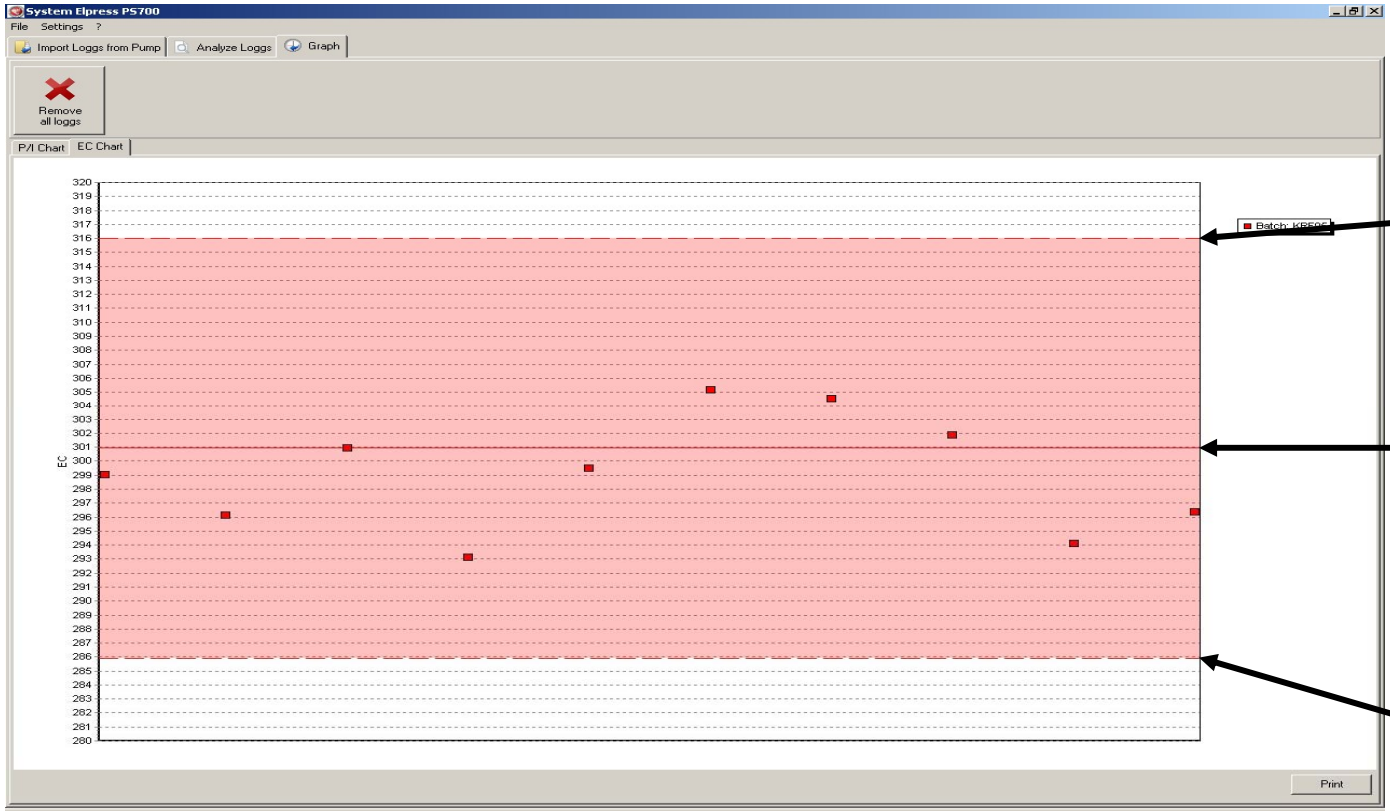
The control chart consists of the following:

- **Measurements of crimp characteristics taken from the crimp process at different times.**
- **A target line, the EC- value for each unique setup.**
- **Upper and lower control limits calculated from the standard deviation of the process.**

Target line



Control chart



Upper control limit

EC value

Lower control limit

Example

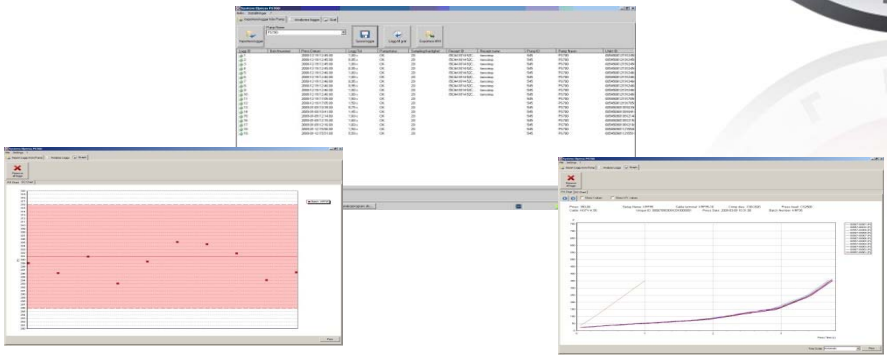
- Tensile strength test demand of 5500 N
- Customer demand C_{pk} value: 1,67
- Test method: Tensile test
- Lower control limit: 5500 N
- Tensile test result >
- Customer example

Tensile test (N)
6130
6035
6080
5935
6230
6130
6080
6130
6030
6380
6180
6130
6030
5935
6280
6180
6030
6030
6330
6080
6118
119
1,73

The System – Quality assurance

The Crimping System

The Analyzer Software



A High Quality Solution

Introduction to the software

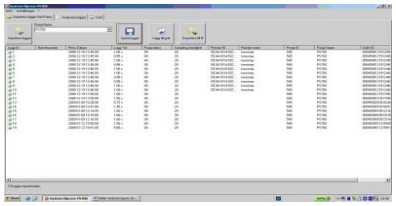
Software - main properties

- Enables statistical analyze of the crimping process.
- Each crimp is monitored by the control system.
- Each crimp characteristics are saved.
- Each crimp is given a unique identification number in the database.
- Equipment calibration by export and import of crimp files.
- Possibility to print different reports.

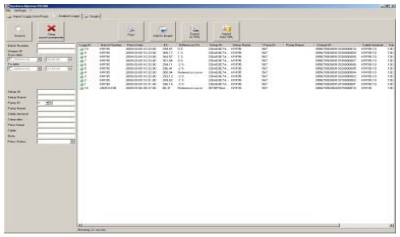
Software – work process

Registration of pump.

Start window: From this window import and save crimps from the pump unit into the database.

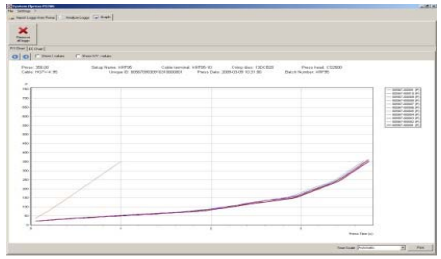


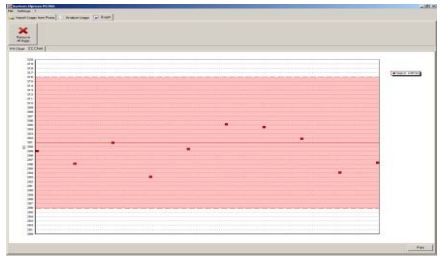
The database: From this window name a batch, connect a crimp/batch to a setup, make selections of crimps/batches, analyze crimps/batches, import/export files.



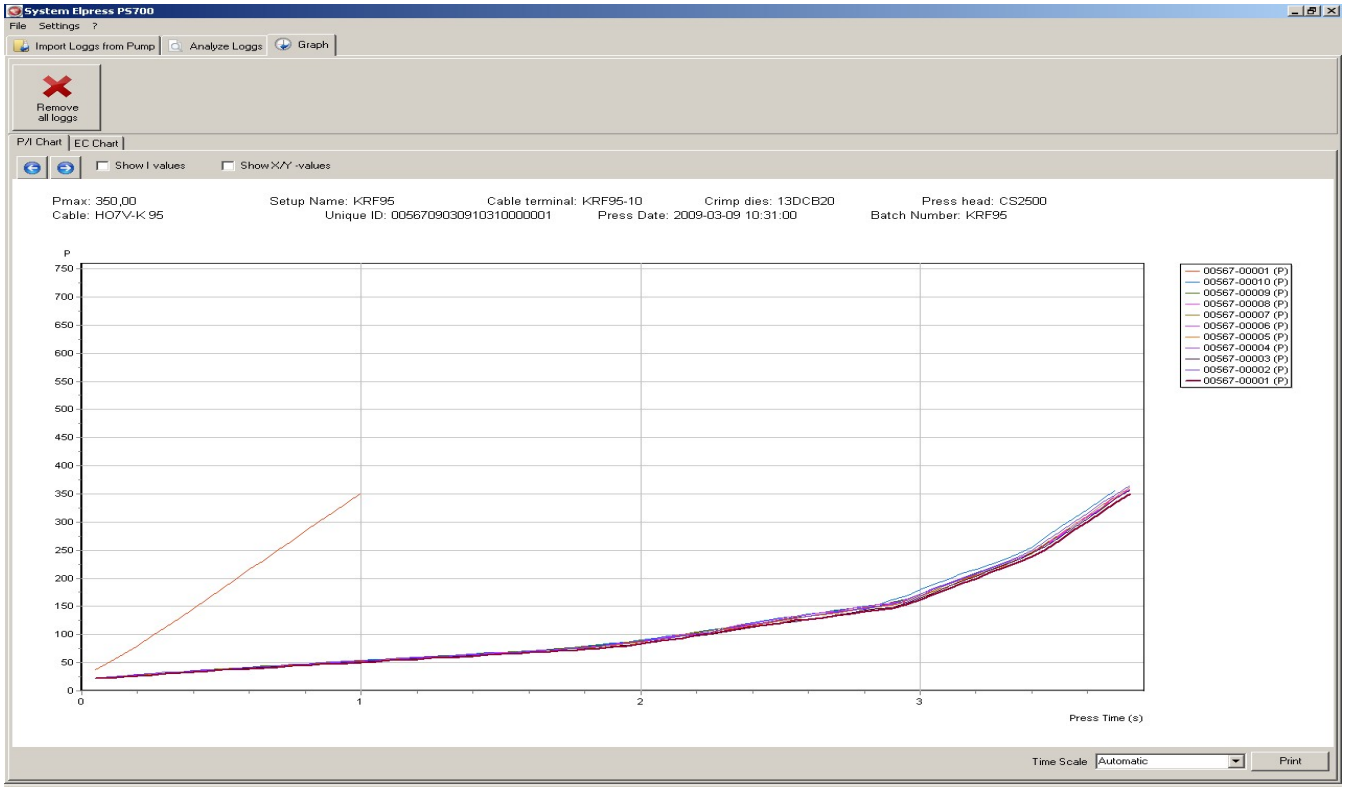
Print of press report

Graph/chart window: Study/print crimp graphs, study/print control chart

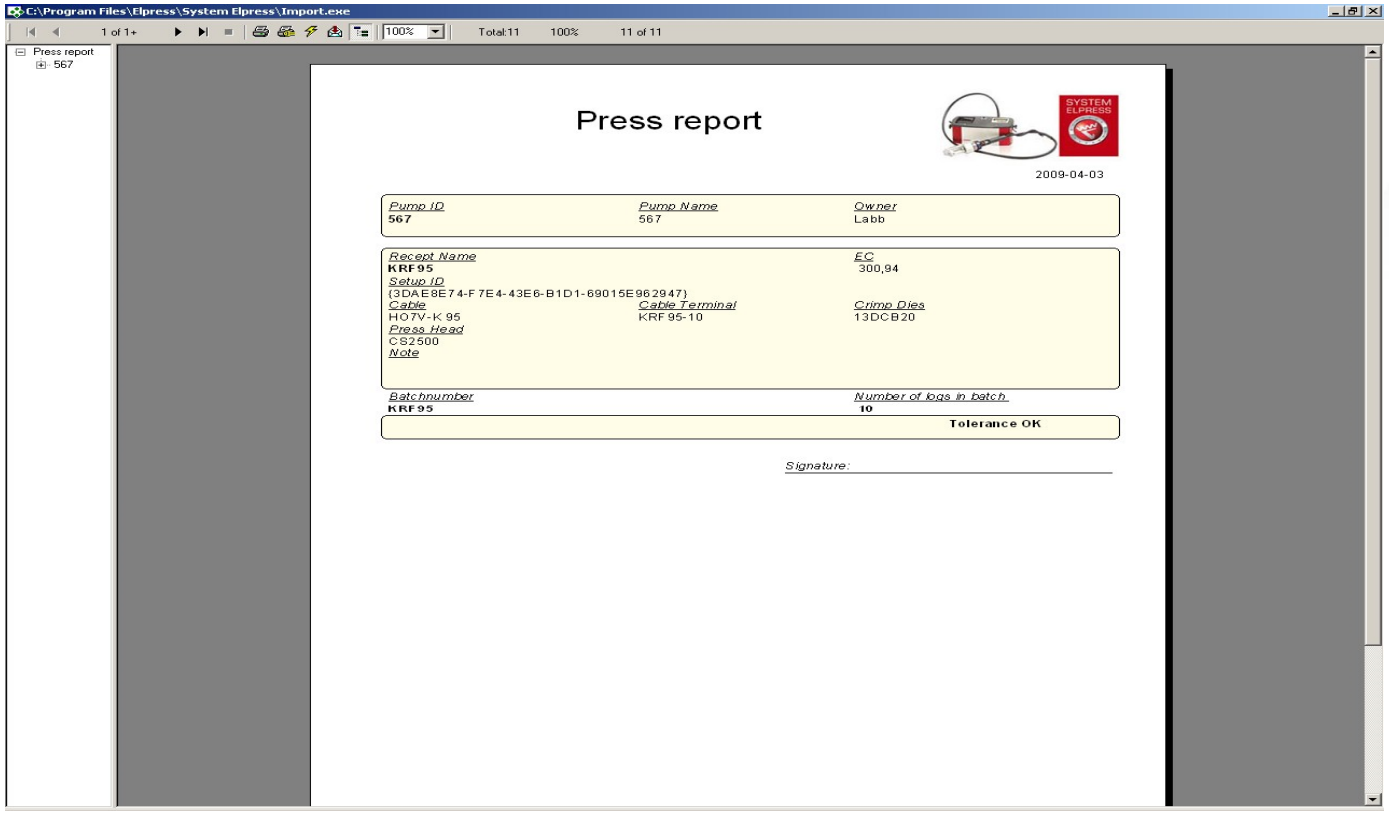




The crimp graph



Printing of press report



Export/import of crimp