**CONTENT**
01/09, s/n 101 up

Page

## A. SCOPE

The TEXTEST FX 3750 Digital Elmendorf Tearing Tester is a microprocessor controlled falling-pendulum instrument with digital display for determination of the average force required to propagate a single-rip tongue-type tear starting from a cut in paper, cardboard, plastics, non-wovens and woven fabrics.

The instrument works in accordance with AFNOR G 07-149, ASTM D 689, ASTM D 1,424, ASTM D 1,922, ASTM D 5,734, BS 4,468, DIN 53,128, DIN 53,862, EN ISO 4,674-2, EN ISO 13,937-1, EN ISO 21,974, INDA IST 100.1, ISO 1,974, ISO 6,383-2/360A, ISO 9,290, Marks & Spencer P 29 (with modkit FX 3750-M&S), SCAN P 11, SNV 198,482, TAPPI T 414, WSP 100.1 and other standards.

The instrument covers an extremely wide measuring range from very low values to unusually high tearing forces. Therefore, it is perfectly suitable for *all* kinds of test specimens, from fine to heavy duty materials.

## B. FUNCTION

The instrument computes the average tearing force of a cut specimen from the energy loss of a falling pendulum. This test very well simulates the practical case where a test specimen is exposed to a sudden heavy load which causes the test specimen to tear, propagating an existing cut, such as a seam or a button hole.

The instrument digitally displays the average tearing force of a single test specimen in one out of seven switch selectable units of measure, rounded to the nearest three digits. The displayed test result automatically considers the selected pendulum weight and the number of test specimens, thus eliminating the need for retroactive conversion.

Test results falling into a portion of the measuring range which is declared invalid by some or all test standards cause an audible alarm and are clearly identified by a colored LED display.

Instead of a slave pointer, the instrument employs a digital optical encoder for measurement of the pendulum movement. This eliminates the usual friction, adjustment and maintenance problems and significantly improves the measuring accuracy of the instrument.

The instrument features an *automatic calibration* function which compensates for the pendulum friction and for any leveling error of the instrument. This further improves the measuring accuracy and eliminates the need for precise leveling of the instrument. Therefore, the instrument requires no spirit level.

The empty pendulum is completely balanced, so that the test result is solely determined by the weight of the pendulum weight(s) used. This eliminates the need for special calibration check weights. The periodic calibration check is reduced to a simple determination of the weight of the pendulum weights, which can easily be done with any suitable balance.

The instrument is supplied with an ISO conform calibration certificate.

The instrument has been designed for easy handling and for maximum operator safety:

- By means of unique specimen clamps the test specimen is loaded to the instrument quickly and without appreciable force by simply flipping over two levers. This eliminates the cumbersome and sometimes painful tightening of conventional sample clamps.
- During loading of the test specimen, the movable sample clamp is latched, so it cannot give way.
- For the higher measuring ranges two or four pendulum weights are used together on the twin pendulum. Therefore, in spite of the high capacity of the instrument, *none of the pendulum weights is heavier than 6 kgs (13 lbs)!*
- For changing of pendulum weights the pendulum can be locked in the horizontal position, and the pendulum weights can easily be pushed onto the pendulum and locked into place.
- To release the pendulum, *both* hands of the operator are required to prevent any interference with the swinging pendulum.
- In addition, a red safety bar keeps the head of the operator away from the swinging pendulum.

The instrument is equipped with a serial RS 232 data port.

## C. EVALUATION OF THE TEST RESULTS

The simplest method for evaluation of the test results is to read the test results from the digital display, to write them down and to evaluate them manually.

In order to eliminate all reading, writing and calculating tasks and related errors, the instrument can be connected to the L 5130 Strip Printer MINIPRINT, which documents the test results, including statistical analysis, on a 57 mm (2.25") wide paper strip.

Alternatively, the instrument can be connected to a PC with the L 5110 Evaluation Program LABODATA III. The PC prints a comprehensive test report, including statistical analysis of the test results. In addition, it stores the test results on disk and performs long-term evaluations based on various selection criterions.

Up to five different TEXTEST instruments can be connected to the PC at the same time. The test results from these instruments can be processed *simultaneously* and documented together on the same test report. The Evaluation Program LABODATA III turns the PC into a complete data processing system for the testing laboratory.

The program can be operated in five different languages: English, German, French, Italian and Spanish.

## D. TECHNICAL SPECIFICATIONS

- Individual measuring ranges (full scale):
  with weight set FX 3750-PAP: 200, 400 and 800 cN
  with weight set FX 3750-TEX: 1,600, 3,200, 6,800 and 13,600 cN
  with weight set FX 3750-TEX plus FX 3750-TX+: 1,600, 3,200, 6,800, 13,600 and 30,000 cN
- Total usable measuring range: 1.4 cN through 24,000 cN (0.003 through 53 lbs)
- Displayed unit of measure: mN, cN, N, g, kg, oz and lbs (switch selectable)
- Measuring accuracy: better than ± 2 % of the displayed value
- Resolution: 0.09 °
- Number of test specimens: 1 through 29
- Maximum test specimen thickness: 2.5 mm
- Tear length: 43 mm
- Cut length: 20 mm
- Data port: RS 232 C, asynchronous, bi-directional
- Power requirements: 100 through 240 V, 50 through 60 Hz, 40 W
- Dimensions (w x d x h): 35 x 65 x 62 cm
- Net/gross weight: 50 / 61 kgs.

The instrument is supplied with a die for *die* cutting of test specimens, a template with knife and cutting board for *manually* cutting of test specimens, a knife gauge, and an ISO-conform calibration certificate. The pendulum weights are not included with the base unit and must be ordered separately.

## E. ACCESSORIES

For the FX 3750 Digital Elmendorf Tearing Tester the following accessories are available:

**FX 3750-PAP Pendulum Weight Set "Paper"**
Set of three pendulum weights for measurements on paper, plastics and non-wovens.
- Measuring ranges (full scale): 200, 400 and 800 cN

**FX 3750-TEX Pendulum Weight Set "Textiles"**
Set of four pendulum weights for measurements on fabrics.
- Measuring ranges (full scale): 1,600, 3,200, 6,800 and 13,600 cN

**FX 3750-TX+ Augment Pendulum Weight Set "Textiles+"**
Set of two augment pendulum weights for measurements on high-tenacity fabrics. Works only in conjunction with the FX 3750-TEX Pendulum Weight Set "Textiles"
- Measuring range (full scale): 30,000 cN

**FX 3750-M&S Modkit "Marks & Spencer P 29"**
Modkit for tests in accordance with the Marks & Spencer Standard P 29. Comprising a knife, knife gauge, specimen template, and die.

**L 5130 Strip Printer MINIPRINT**
For documentation and statistical analysis of the test results from various TEXTEST instruments on a 57 mm (2.25") wide paper strip.

**L 5110 Evaluation Program LABODATA III for PC**
Program for documentation, statistical analysis, storage, and long-term evaluation of the test results from various TEXTEST instruments by means of a PC.

## F. TESTING

1. **Select test pieces**: Select the test pieces in such a manner that they are representative of the lot to be tested.

   - **Paper and non-wovens**: Sample the test piece in accordance with TAPPI T 400, DIN 53'101, ASTM D 5734 or any other appropriate standard. There shall be no folds, creases, or other visible defects in the area from which the test piece is cut and the test piece shall not include any part of the sample that is less than 15 mm from the edge of the sheet or reel. If watermarks are present, this should be stated in the test report. Cut sufficient test specimens to give a minimum of 10 valid test results in each required principal direction of the paper (e.g. a total of at least 40 specimens in each direction). Cut the test specimens with the die supplied with the instrument or with the template and the knife. In the latter case the dimensions of the test specimens are (63 ± 0,15) mm x (73 ± 1) mm. The edges of the test specimens shall run exactly parallel and perpendicular to the principal direction of the paper. Since the test specimens are torn perpendicularly to their longer side, the longer side must run parallel to the principal direction to be tested.
   - **Woven fabric**: Cut a test piece approximately 70 cm long across the full width of the material to be tested. There shall be no folds, creases, or other visible defects in the area from which the test piece is cut. Take no specimen nearer to the selvage than one tenth the width of the fabric. Take warp specimens that have different warp yarns in each specimen for a warp test and filling specimens which come from a different filling bobbin in each specimen for a filling test. Take five specimens in either directions or take as many specimens as necessary to achieve a 95 % confidence interval of the test result of not more than 4 %. Cut the test specimens with the die supplied with the instrument or with the template and the knife. In the latter case the dimensions of the test specimens are (63 ± 0,15) mm x (73 ± 1) mm. The edges of the test specimens shall run exactly parallel to the yarns. Since the test specimens are torn perpendicularly to their longer side, the longer side of warp specimens must run parallel to the warp direction and vice versa.

   For further details in regard to specimen preparation consult the appropriate test standard.

2. **Condition test specimens**: Prior to testing condition the test specimens in a standard atmosphere (20 °C ± 2 °C and 65 % ± 2 % relative humidity) in accordance with ASTM D 1776 or DIN 53,802 respectively.

3. **Switch on instrument**: Switch on the instrument with the power switch located at the rear of the instrument.

   The green signal lamp POWER comes on, indicating that power is present. A little later the green signal lamp READY comes on. It signals that the instrument is ready for testing or calibration.

   In addition, the message "CAL" appears on the digital display. This indicates that the calibration program has been started. After switch-on the calibration program is automatically started, because the instrument would not be functional without calibration. Therefore, at this point, the calibration program *cannot* be switched off.

4. **Enter number of specimens**: Enter into the thumb wheel switch NUMBER OF SPECIMENS the number of specimens to be torn simultaneously. The standard number for paper is 4 specimens, or alternatively, 1, 2, 8 or 16 specimens. Woven fabrics and non-wovens are always tested as single specimens. For further details regarding the number of specimens consult the appropriate test standard.

   The invalid entry "0" specimens causes an acoustic alarm and the error message "Err 4".

5. **Select unit of measure**: With the thumb wheel switch located at the right side of the digital display, select the desired unit of measure.

   For further details regarding the unit of measure consult the appropriate test standard. The table in chapter I gives a brief overview over the unit of measure prescribed by the different test standards.

6. **Determine measuring range**: Determine the required measuring range MR according to the following algorithm:

$$MR = 2.5 \cdot ATF \cdot NOS$$

It is:
ATF = expected average tearing force of a single test specimen
NOS = number of test specimens torn simultaneously.

Select the pendulum weight or the combination of pendulum weights, respectively, which comes closest to the required measuring range MR as determined by above algorithm. The FX 3750 Digital Elmendorf Tearing Tester offers the following measuring ranges: 200 cN, 400 cN, 800 cN, 1,600 cN, 3,200 cN, 6,800 cN, 13,600 cN and 30,000 cN. If the appropriate pendulum weight or combination of pendulum weights is already mounted to the pendulum, proceed to paragraph F 8.

7. **Change pendulum weight(s)**: In case the pendulum weight(s) must be changed, proceed in accordance with chapter G.

8. **Calibrate instrument**: In case the instrument has not yet been calibrated with the current pendulum weight(s), calibrate the instrument in accordance with chapter H.

9. **Load test specimen**: Load the test specimen(s) to the sample jaws and close the jaws by flipping the flaps to the outside. Always close the movable jaw first and the fixed jaw second.

   Carefully align the specimen(s) in the jaws with the bottom edge precisely set against the lower edge of the jaws. If more than one (paper) specimen is loaded, make sure all specimens are mounted in the same direction (machine direction or cross direction).

10. **Slit specimen**: Slit the test specimen(s) by pulling the knife lever (383) all the way down.

    The green signal lamp READY comes on, indicates that the instrument is ready for a test.

    If the knife is actuated more than once, an acoustic alarm sounds, and the digital display shows the error message "Err 3".

11. **Start test**: Release the pendulum by simultaneously pressing both buttons START.

> **Injury hazard!** Because both hands are required to release the pendulum, the hands are well protected. But make sure not to get with your head or arms into the path of the swinging pendulum! The red safety bar is there to prevent this!

    The pendulum will only be released if the green signal lamp READY is on. If the lamp is not on, an acoustic alarm sounds and the display shows the error message "Err 2": The test specimen has not been slit. In this case actuate the knife lever (383).

12. **Visually check the tear**: Visually check the test specimen(s) for proper tearing.

    If the test specimen is not completely torn, it is too strong for the pendulum weight(s) mounted to the pendulum. In this case, using the pendulum handles (322 and/or 360), return the pendulum to the start position, where it automatically latches. Repeat the test with heavier pendulum weight(s).

    - **Paper**: When testing paper, the path of the tear may deviate from the direction of the slit. If the mean deviation exceeds 10 mm in one or two of ten tests, reject these results and carry out further tests to bring the number of satisfactory tests up to 10. If in more than two of the test specimens the deviation exceeds 10 mm, include the results and state the fact in the test report. If, instead of tearing in the normal way, the paper of any test specimen peels apart so as to expose a wide band of torn surface ("skinning"), apply the above criteria to the mean center line of the torn band through the test specimen.
    - **Fabric**: When testing fabric, reject readings obtained where the specimen slips in the jaws or where the tear deviates more than 6 mm away from the projection of the original slit. Note whether puckering occurs during testing.

13. **Automatic check of test result**: The multicolor LED display to the left of the digital display indicates in which portion of the measuring range a test result was obtained. Each segment of the display represents 20 % of the full scale measuring range.

    - **Lower red segment** (0 to 20 % of the full scale measuring range): Test results obtained in this portion of the measuring range are not accepted by any test standard. They are to be rejected. The L 5130 Strip printer MINIPRINT and the L 5110 Evaluation Program LABODATA marks them with "*****". If, within a test series, several test results are obtained in the lower red segment, it is advisable to terminate the test series and to repeat the tests with the next smaller pendulum weight(s).
    - **Lower and upper green segment** (20 to 40 % and 40 to 60 % of the full scale measuring range): Test results obtained in this portion of the measuring range are accepted by all test standards. They may be used without restriction.
    - **Yellow segment** (60 to 80 % of the full scale measuring range): Test results obtained in this portion of the measuring range are not accepted by all test standards. Check the test standard you are using, to verify whether or not these test results are accepted. The table in chapter I gives a brief overview over the usable portions of the measuring range prescribed by the different test standards. The L 5130 Strip printer MINIPRINT and the L 5110 Evaluation Program LABODATA marks these test results with "o".
    - **Upper red segment** (80 to 100 % of the full scale measuring range): Test results obtained in this portion of the measuring range are not accepted by any test standard. They are to be rejected. The L 5130 Strip printer MINIPRINT and the L 5110 Evaluation Program LABODATA marks them with "*****". If, within a test series, several test results are obtained in the upper red segment, it is advisable to terminate the test series and to repeat the tests with the next larger pendulum weight(s).

14. **Read/record test result**: Read and record the test result displayed by the digital display. The instrument shows the average tearing force of the test specimen, rounded to the nearest three figures. If more than one test specimen was loaded into the jaws, the displayed value is the average tearing force of a *single* specimen.

    If the instrument is connected to a L 5130 Strip Printer MINIPRINT or to a PC with the L 5110 Evaluation Program LABODATA III, transmit the test result to the printer or PC, respectively.

15. **Load pendulum**: Using the pendulum handles (322 and/or 360), bring the pendulum into the start position, where it automatically latches.

    Alternatively, you may bring the pendulum with the right pendulum handle (322) into the start position and prop the left hand against the vertical handle (85) at the top of the instrument.

    **Note**: After loading of the pendulum, the test result disappears from the digital display, and it can no longer be read!

16. **Remove test specimen**: Open the sample jaws by flipping the flap completely to the front, and remove the torn test specimen(s).

    Make sure no residues from the test sample are left in the jaws. When testing fabrics, take particular care that no yarns are caught in the jaws or in the pendulum latch (510).

17. **Conduct additional tests**: Perform at least 10 tests with paper specimens or 5 tests with fabric specimens. Alternatively, select the number of tests so that a pre-determined confidence interval of the test result is achieved. Conduct all tests according to the same procedure.

18. **Prepare test report**: Document the test results in a test report with reference to the applied test standard and including the following information:
    - Type and designation of tested material
    - Test conditions:
        - Type of instrument (TEXTEST FX 3750 Digital Elmendorf Tearing Tester)
        - Measuring range
        - Number of test specimens
    - Tearing force:
        - Individual test results
        - Average value
        - Coefficient of variation
        - 95 % confidence interval including number of test results
    - Special observations made at the tested material or during tests
    - Test date.

    If the instrument is connected to a L 5130 Strip Printer MINIPRINT or to a PC with the L 5110 Evaluation Program LABODATA III, a hard copy test report is printed automatically at the end of each series of tests.

19. **Switch off instrument**: After the last test, switch off the instrument with the power switch located at the rear of the instrument.

    You may, however, leave the instrument switched on for extended periods of time between tests without problem. The power consumption is low, and you may save the calibration after switch on.

## G. CHANGE PENDULUM WEIGHTS

To change pendulum weights, proceed as follows:

1. **Activate pendulum latch**: Activate the pendulum latch (510), located at the top of the instrument by pulling down the black knob (516). The pendulum latch is spring loaded, and the spring will push it to the far right end of the connecting-link.

2. **Release pendulum**: Release the pendulum by simultaneously pressing both buttons START.

   > **Injury hazard!** Because both hands are required to release the pendulum, the hands are well protected. But make sure not to get with your head or arms into the path of the swinging pendulum! The red safety bar is there to prevent this!

   The pendulum will only be released if the green signal lamp READY is on. In the testing program the READY lamp will only be on after the test specimen has been slit. Otherwise an acoustic alarm sounds and the display shows the error message "Err 2" when both buttons START are pressed. In this case actuate the knife lever (383).

   In the calibration program no test specimen is loaded, and therefore there is no need to actuate the knife.

3. **Latch pendulum**: Carefully catch the swinging pendulum with one or both hands, and lift it into a horizontal position, where it automatically latches.

4. **Remove old pendulum weight(s)**: Turn the plastic knob in the center of the pendulum weight(s) slightly counter-clockwise, and simultaneously pull it out. Slide the pendulum weight(s) from the pendulum.

5. **Mount new pendulum weight(s)**: *Slowly* push the new pendulum weight(s) onto the pendulum. Guide the guide pin of the weight into the groove of the pendulum rod and *slowly* push the weight onto the rod until the guide pin locks in. Under light pressure, turn the plastic knob in the center of the pendulum weight slightly clockwise to firmly lock the pendulum weight in place. Check the proper locking of the pendulum weight!

   > **Important note:** It is important to push the pendulum weights *slowly* onto the pendulum rod. If this is done too quickly, the guide pin inside the pendulum weight may bend or break, particularly at the heavy weights!

   The correct configurations of the pendulum weights for the different measuring ranges is shown on the table, mounted to the front of the instrument:
   - All pendulum weights must be mounted to and locked in the *inner* lock position (near the pendulum hub). Only the pendulum weights "8,200 cN" are to be mounted in the *outer* lock position.
   - Single pendulum weights are always mounted to the *right* pendulum rod (seen from the operator's side).

6. **Unlatch and load pendulum**: Unlatch the pendulum and bring it via the home position into the start position:

   **For low measuring ranges up to 6,800 cN**:

   - **Withdraw pendulum latch**: Support the pendulum with the right hand and with the left hand push the black knob (516), located at the top of the instrument, into the extreme left position of the connecting-link, where it automatically latches.
   - **Load pendulum**: The pendulum is now free. With the right hand or with both hands carefully guide the pendulum into the home position. Using the right pendulum handle (322) bring the pendulum into the start position, where it automatically latches.

**For high measuring ranges over 6,800 cN**:

- **Unlock safety lock**: With the left hand push the red safety lock (519) to the left, and push the black knob (516) past the lock upwards, to the *first* stop, but not any further!!

> **Injury hazard!** If the black knob is pushed beyond the first stop position, the pendulum is released, and swinging heavy pendulums may cause injuries!
>
> At the first stop position the pendulum latch is unlocked, and the pendulum is released as soon as the pendulum is slightly lifted. Swinging heavy pendulums may cause injuries!

- **Release pendulum**: Slightly lift the pendulum with both hands, until the pendulum latch is released. The pendulum is now free. Carefully guide it into the neutral position. Do not let the pendulum fall freely!

> **Injury hazard!** The fully loaded pendulum has a weight of up to 24 kgs (53 lbs)! Prior to lifting and releasing the pendulum make sure you are able to support this weight!

- **Load pendulum**: Using both pendulum handles (322 and 360), bring the pendulum into the start position, where it automatically latches.

  Alternatively, you may bring the pendulum with the right pendulum handle (322) into the start position and prop the left hand against the vertical handle (85) at the top of the instrument.

- **Withdraw pendulum latch**: Guide the black knob (516), located at the top of the instrument, into the extreme left position of the connecting-link, where it automatically latches.

7. **Display**: After changing the pendulum weight(s), briefly look at the digital display of the instrument:

   - **Measuring range**: If the new pendulum weight(s) has/have already been calibrated, the digital display shows the actual measuring range of the mounted pendulum weight(s) in the selected unit of measure. The instrument is now ready for testing in accordance with chapter F.
   - **"CAL"**: If the new pendulum weight(s) has/have not yet been calibrated, the digital display shows the message "CAL" to indicate that the calibration program has been automatically started. Calibrate the instrument with the new pendulum weight(s) in accordance with chapter H.
   - **"Err 1"**: If an invalid combination of pendulum weights has been mounted to the pendulum, the digital display shows the error message "Err 1". In this case return to paragraph G 1 and mount a valid pendulum weight combination to the pendulum.

## H. CALIBRATION

The automatic calibration program determines the pendulum friction and the leveling error of the instrument and corrects the test results accordingly. This greatly improves the measuring accuracy of the instrument and eliminates the need for precise leveling. The instrument must be re-calibrated after it has been idle for extended periods of time and after each change of the operating position.

The calibration program is automatically started:
- after switch on of the instrument
- after each change of pendulum weights, provided the new pendulum weight(s) have not yet been calibrated.

In both cases the calibration program *cannot* be terminated.

Otherwise the calibration program can be started and terminated at any time by pushing the button CAL for approximately three seconds.

For calibration, proceed as follows:

1. **Mount pendulum weight(s)**: In accordance with chapter G mount the pendulum weight(s) to the pendulum rod(s) which are to be calibrated or to be used for the next test.

2. **Sample jaws**: Make sure the movable sample jaw (which is mounted to the pendulum) is empty and completely closed.

3. **Start calibration program**: Start the calibration program - if it has not yet been started automatically - by pushing the button CAL for approximately three seconds. The message "CAL" appears on the digital display.

4. **Release pendulum**: Release the pendulum by simultaneously pressing both buttons START. On the display the message "CAL" moves one position to the left.

   **Injury hazard!** Because both hands are required to release the pendulum, the hands are well protected. But make sure not to get with your head or arms into the path of the swinging pendulum! The red safety bar is there to prevent this!

5. **Let pendulum swing**: Let the pendulum perform one full swing. Upon completion of the swing the message "CAL" moves another position to the left.

6. **Dampen pendulum**: Carefully dampen the movement of the pendulum with the hand until it swings less than ± 15°. Release the pendulum and let it swing freely. The message "CAL" moves another position to the left.

   After three to approximately seven full swings - or when the pendulum has come to a complete stop in the resting position - the digital display shows the actual measuring range of the instrument, automatically taking into account the pendulum weight(s) mounted, the number of test specimens entered into the thumb wheel switch NUMBER OF SPECIMENS, the friction and any leveling error. The calibration is complete.

7. **Calibration error**: If the calibration is not possible, an acoustic alarm is sound, and the digital display shows an error message:
   - **"Err 7"**: The instrument is too far out of level or the sample jaw was not empty or not closed during calibration. In this case level the instrument or repeat the calibration with an empty and closed sample jaw, respectively.
   - **"Err 8"**: The pendulum friction is too high. In this case try to find the cause for the excessive friction. If this fails, it may be necessary to have the instrument repaired.

8. **Load pendulum**: Using the pendulum handles (322 and/or 360), bring the pendulum into the start position, where it automatically latches.

   Alternatively, you may bring the pendulum with the right pendulum handle (322) into the start position and prop the left hand against the vertical handle (85) at the top of the instrument.

   The instrument is now ready for testing.

# I. TEST STANDARDS AND CONVERSION TABLE

INTERNATIONAL TEST STANDARDS FOR TEARING STRENGTH

| Test standard | Country | Scope | Measuring range limits | Unit of measure |
|---|---|---|---|---|
| AFNOR G 07-149 | France | Woven fabric | 15 - 85 % | daN |
| ASTM D 1'424 | USA | Woven fabric | 20 - 60 % | g |
| ASTM D 5'734 | USA | Non-wovens | 20 - 80 % | mN |
| BS 4'468 | England | Paper | 20 - 80 % | mN |
| DIN 53'128 | Germany | Paper | 20 - 80 % | mN |
| DIN 53'862 | Germany | Woven fabric | 20 - 60 % | cN |
| EN ISO 4,674-2 | International | Rubber, coated fabrics | 15 - 85 % | N |
| EN ISO 13,937-1 | International | Woven fabrics | 15 - 85 % | N |
| INDA IST 100.1 | USA | Non-wovens | 20 - 80 % | g |
| ISO 1'974 | International | Paper | 20 - 80 % | mN |
| ISO 9'290 | International | Woven fabrics | 20 - 80 % | N |
| M&S P 29 | England | Woven fabrics | not specified | g |
| SNV 198'482 | Switzerland | Woven fabric | 20 - 60 % | cN |
| TAPPI T 414 | USA | Paper | 20 - 75 % | mN |
| WSP 100.1 | International | Non-wovens | 20 - 80 % | mN |

CONVERSION TABLE FOR VARIOUS UNITS OF MESURE FOR THE TEARING FORCE

| | mN | cN | N | daN | g | kg | oz | lbs |
|---|---|---|---|---|---|---|---|---|
| 1 mN = | 1,00 | 0,100 | 0,00100 | 0,000100 | 0,102 | 0,000102 | 0,00360 | 0,000225 |
| 1 cN = | 10,0 | 1,00 | 0,0100 | 0,00100 | 1,02 | 0,00102 | 0,0360 | 0,00225 |
| 1 N = | 1'000 | 100 | 1,00 | 0,1 | 102 | 0,102 | 3,60 | 0,225 |
| 1 daN = | 10'000 | 1'000 | 10,0 | 1,00 | 1'020 | 1,02 | 36,0 | 2,25 |
| 1 g = | 9,81 | 0,981 | 0,00981 | 0,000981 | 1,00 | 0,00100 | 0,0353 | 0,00221 |
| 1 kg = | 9'810 | 981 | 9,81 | 0,981 | 1'000 | 1,00 | 35,3 | 2,21 |
| 1 oz = | 278 | 27,8 | 0,278 | 0,0278 | 28,4 | 0,0284 | 1,00 | 0,0626 |
| 1 lbs = | 4450 | 445 | 4,45 | 0,445 | 454 | 0,454 | 16,0 | 1,00 |

## J. ERROR MESSAGES

The error messages displayed by the instrument have the following meanings:

**Err 1**: **Pendulum weight**: No pendulum weight or an invalid pendulum weight combination is mounted to the pendulum.

Mount a pendulum weight or a valid pendulum weight combination to the pendulum in accordance with chapter G. The correct pendulum weight configurations for the different measuring ranges are shown in a table at the front of the instrument.

**Err 2**: **No slit**: The instrument is not ready because the test specimen(s) has/have not yet been slit.

Slit the test specimen(s) by pulling the knife lever (383) all the way down.

**Err 3**: **Unnecessary slit**: The knife has already been actuated at least once.

Slit the test specimen(s) only once. During calibration the knife needs not to be actuated at all.

**Err 4**: **Invalid number of specimens**: The thumb wheel switch NUMBER OF SPECIMENS delivers an invalid value.

Set the thumb wheel switch NUMBER OF SPECIMENS to a valid number of test specimens (1 through 29). Make sure the switch latches securely.

**Err 5**: **Invalid unit of measure**: The thumb wheel switch for the unit of measure delivers an invalid value.

Set the thumb wheel switch for the unit of measure to a valid position. Make sure the switch latches securely.

**Err 6**: **Missing calibration**: The instrument has not yet been calibrated with the current pendulum weight(s).

Calibrate the instrument in accordance with chapter H.

**Err 7**: **Calibration error: Out of level**: The instrument is too far out of level or the sample jaw was not empty or not closed during calibration.

Level the instrument or repeat the calibration with an empty and closed sample jaw, respectively.

**Err 8**: **Calibration error: Excessive friction**: The pendulum friction is too high.

Try to find the cause for the excessive friction. If this fails, it may be necessary to have the instrument repaired.

## K. UNPACKING AND INSTALLATION

1. **Unpacking**: Unpack the instrument, and remove all foam pieces from it. Unscrew the instrument from the transportation board.

2. **Transportation damage**: When unpacking the instrument, inspect it for transportation damage. If any transportation damage is found, report it immediately to the forwarding agent and/or to the insurance company.

3. **Installation**: Clean the instrument from dust and install it on a rigid bench with an even and level surface.

   Slightly grease the pendulum weight rods (297 and 335).

   Adjust the adjustable feet of the instrument so that the instrument does not rock when the pendulum swings and that the instrument is approximately level. Lock the feet with the lock nuts. Perfect leveling is not required, because any leveling error is automatically compensated for when the instrument is calibrated. It is, however, important that the instrument does not rock when the pendulum swings!

   When using the FX 3750-TX+ pendulum weight set it may be necessary to firmly attach the instrument to the bench with the four screws supplied, thus avoiding movement of the instrument when the pendulum swings with the heavy weights.

4. **Room climate**: Install the instrument in a room with a controlled standard atmosphere of 20 °C ± 2 °C and 65 % ± 2 % relative humidity.

5. **Line voltage**: The instrument can be operated with any line voltage from 100 through 240 V and with any line frequency from 50 through 60 Hz. Therefore, it is not necessary to set up the instrument to the existing line voltage and frequency.

6. **Power plug**: If a power plug different from the one supplied is required, cut off the power plug from the power cord and mount the new plug instead. **Note**: The yellow/green wire is the ground wire!

7. **Power line**: Connect the instrument to power, and make sure it is properly grounded!

   > **Important note**: Proper grounding is imperative for safety reasons. It is also required for proper function of the instrument! Improper grounding represents a serious *safety hazard*!

8. **Accessories**: Place the knife gauge in the holder located at the rear side of the instrument, and store the Operating Instructions in the holder underneath the base plate of the instrument to have it handy at all times.

9. The instrument is now ready for use.

## L. HINTS FOR TROUBLE SHOOTING

**Important note**! When performing repair or maintenance work on the instrument with the cover taken off, be extremely cautious and aware of the electrical hazards! Always disconnect the instrument from power for such work. Only qualified personnel should work on the open instrument.

- **Problem**: Some test specimens are not very well clamped by the sample jaws, they slip in the jaws or are entirely pulled out.

  **Possible cause**: The sample jaws are dirty. Clean the sample jaws from dirt and lint in accordance to paragraph M 1.

  **Possible cause**: The sample jaws are misaligned or worn out. Take the jaws apart by opening the single screw (65) located at the front end of the large spring (63). The jaws can now be taken apart completely.

  If the problem occurs with *thin* test specimens only, remove one of the two washers (57-58), located in front of the sleeve (59), and re-assemble the jaws. This significantly improves the clamping force for thin test specimens.

  If the problem occurs with *all* test specimens, check the serrated jaw insert (14) located in the fixed jaw and the rubber coating (37) in the movable jaw (34). If the serrated jaw insert or the rubber coating is slippery or worn out, replace it.

- **Problem**: The test results obtained with the instrument differ clearly from the expected test results.

  **Possible cause**: The thumb wheel switch NUMBER OF SPECIMENS is set incorrectly. Enter into the thumb wheel switch NUMBER OF SPECIMENS the number of test specimens torn *simultaneously*. The standard number for paper is 4 specimens, or alternatively, 1, 2, 8 or 16 specimens. Woven fabrics and non-wovens are always tested as single specimens.

  **Possible cause**: The instrument has been calibrated with an open movable sample jaw. Re-calibrate the instrument in accordance with chapter H and make sure the movable sample jaw (which is mounted to the pendulum) is empty and completely closed.

  **Possible cause**: The pendulum weights are incorrectly recognized by the instrument. Check that the pendulum weights are correctly recognized by the instrument. Mount the pendulum weight or pendulum weight combination in question on the pendulum rod(s), and calibrate it/them. Bring the pendulum into the start position. The digital display must show a measuring range in cN approximately equal to the sum of the values shown on the mounted pendulum weight(s), divided by the pre-selected number of specimens. **Note**: The optical sensors do not only "see" the pendulum weight, but also any other object in their field of view (including your hand)! Therefore, make sure that no foreign object is in front of the sensors during the test!

  If at least one pendulum weight is incorrectly recognized, the instrument needs repair

- **Problem**: The digital display shows an (additional) decimal point in front of the test result.

  **Cause**: The service program is still on. Switch off the instrument for at least five seconds to terminate the service program.

## M. MAINTENANCE AND FUNCTION CHECKS

**Important note**! When performing repair or maintenance work on the instrument with the cover taken off, be extremely cautious and aware of the electrical hazards! Always disconnect the instrument from power for such work. Only qualified personnel should work on the open instrument.

1. **Maintenance:** The FX 3750 Digital Elmendorf Tearing Tester requires only very little maintenance:
   - **Sample jaws**: In regular intervals clean, with compressed air, the sample jaws from dirt and lint. For cleaning, the jaws can be taken apart by opening the single screw (65) located at the front end of the large spring (63). After cleaning, slightly grease the square shaft (62).
   - **Pendulum weight rod**: Keep the pendulum weight rods (297 and 335) slightly greased, so that the pendulum weights slide easily on these rods.

2. **Tare check:** To check the proper tare of the instrument proceed as follows:
   - **Release pendulum**: Release the pendulum by simultaneously pressing both buttons START.
   - **Remove pendulum weight(s)**: Remove the pendulum weight(s) from the pendulum.
   - **Close sample jaws**: Close the sample jaw, mounted to the pendulum, and make sure it is completely empty.
   - **Check tare**: The pendulum must now be balanced, i.e. it must remain stationary in any position it is moved to. A slight deviation from this ideal condition, i.e. a *slow* drift of the pendulum, can, however, be tolerated without problem, since its impact on the test result is negligible.

     If the tare is significantly off, limited corrections can be made by adjusting the right pendulum handle (322). After adjusting the handle, carefully lock the handle with the lock nut (321).
   - **Mount pendulum weight(s)**: Re-mount the pendulum weight(s) to the pendulum.
   - **Load pendulum**: Using the pendulum handles (322 and/or 360), bring the pendulum into the start position, where it automatically latches.

3. **Friction check:** To check the friction of the pendulum bearing, proceed as follows:
   - **Measuring range**: Mount the smallest pendulum weight available to the pendulum.
   - **Close sample jaw**: Close the sample jaw, mounted to the pendulum, and make sure it is completely empty.
   - **Start service program**: To start the service program, switch on the instrument while the button CAL is being depressed.
   - **Release pendulum**: Release the pendulum by simultaneously pressing both buttons START.
   - **Dampen pendulum**: Catch the swinging pendulum and dampen it until it comes to a complete stop in the home position. **Attention**: Touch the pendulum only after it has completed the first swinging cycle!
   - **Read correction angle**: The digital display shows the correction angle, i.e. the angle between the theoretical and the actual vertical direction. This angle must not exceed 0.7°.
   - **Determine friction angle**: Slowly displace the pendulum with the finger in both directions by 0.2°. When released, the pendulum must return to the original position with a maximum tolerance of 0.1°.

     The above mentioned tolerances are valid for *new* instruments. If during operation these values have more than doubled, the instrument has excessive friction. Although the friction is automatically compensated for during testing, the instrument should be repaired in this case.
   - **Load pendulum**: Using the pendulum handles (322 and/or 360), bring the pendulum into the start position, where it automatically latches.
   - **Quit service program**: To quit the service program, switch off the instrument for at least five seconds.

4. **Knife check**: To check the specimen knife, proceed as follows:

   - **Switch off**: For safety reasons switch off the instrument with the power switch located at the rear of the instrument.
   - **Load pendulum**: Using the pendulum handles (322 and/or 360), bring the pendulum into the start position, where it automatically latches.
   - **Load paper**: Clamp a piece of paper into the sample jaws and align the paper in the jaws with the bottom edge precisely set against the lower edge of the jaws, and close the jaws.
   - **Slit**: Slit the paper by pulling the knife lever (383) all the way down.
   - **Check slit**: Open the sample jaws, and remove the paper from the jaws. Check that the slit is clean and not fuzzy, and that it is rectangular to the paper edge.

     If this is not the case, the knife blade must be sharpened, replaced or aligned, respectively.
   - **Load knife gauge**: Clamp the knife gauge, supplied with the instrument, into the sample jaws. Carefully align the gauge in the jaws with the bottom edge precisely set against the lower edge of the jaws.
   - **Insert paper**: Cut a 2 mm wide strip of paper and hold it between the knife gauge and the specimen knife.
   - **Actuate knife**: Slowly and carefully pull down the knife lever (383). Make sure the knife blade is not pressed hard against the gauge, since this may cause serious damage to the blade!
   - **Check slit length**: Check that the paper strip is jammed between the gauge and the knife, but that it is not cut all the way through. Then the slit length is precisely 20 mm or 15 mm, respectively, if the instrument has been modified for the Marks & Spencer Standard P 29.

     If this is not the case, adjust the knife blade (373) in accordance with paragraph M 5.

5. **Adjust slit length**: To adjust the specimen knife for the proper slit length, proceed as follows:

   - **Switch on**: Switch on the instrument with the power switch located at the rear of the instrument.
   - **Release and latch pendulum**: Release the pendulum by simultaneously pressing both buttons START. Latch the pendulum in the horizontal position (which is normally used to change pendulum weights).
   - **Adjust knife**: *Very slightly only* loosen the two outer screws (380) which hold the knife blade (373). With the set screw (393) in the center adjust the knife blade. After adjustment, tighten the two screws (380).
   - **Check slit length**: Check the slit length in accordance with paragraph M 4. It may be necessary to repeat the adjustment several times until the slit length is ok.

6. **Pendulum weight check:** With a precision balance determine the weight of the pendulum weights. Owing to the construction of the instrument, the weight of each pendulum weight in grams must be as follows:

| Pendulum weight | Weight |
|---|---|
| "200 cN" | 181 g |
| "400 cN" | 361 g |
| "1600 cN" | 1'444 g |
| "6800 cN" | 6'138 g |
| "8200 cN" | 4'090 g |

   If a weight differs by more than 1 % from the nominal value, the pendulum weight in question must be replaced.

## N. DATA PORT

The FX 3750 Digital Elmendorf Tearing Tester is equipped with a bi-directional, asynchronous RS 232 data port for transmission of the test results to an external computer. The character code is ASCII, with 1 start bit, 8 data bits and 2 stop bits, without parity and without protocol. The baud rate is 9,600 Baud.

The pin layout of the female 9-pin Sub-D connector at the rear of the instrument is:
- pin 2: request for data RD
- pin 3: data line TD
- pin 5: ground.

When the instrument receives a "CR" character (Hexadecimal "0D") as request for data through pin 2 of the data port, a 60 character ASCII string is transmitted through pin 3. The format of this data string is as follows:

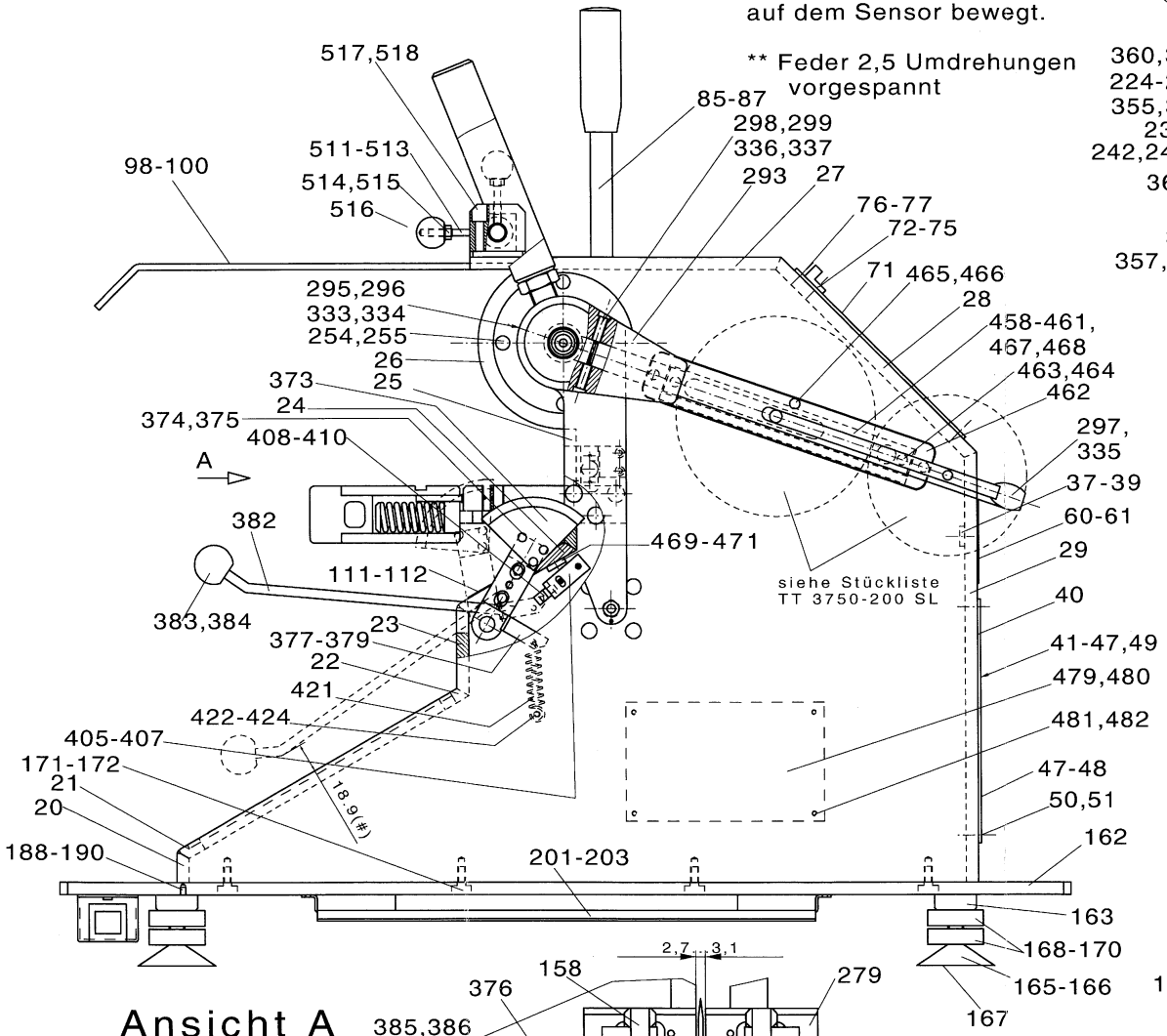
| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SZ | IT | IT | IT | IT | IT | IT | IT | SN | SN | SN | M | ZP1 | ZP1 | ZP1 | ZP1 | ZP1 |
| ZP1 | UP1 | ZP2 | ZP2 | ZP2 | ZP2 | ZP2 | ZP2 | UP2 | ZP3 | ZP3 | ZP3 | ZP3 | ZP3 | ZP3 | UP3 | ZP4 |
| ZP4 | ZP4 | ZP4 | ZP4 | ZP4 | UP4 | WS | ZE1 | ZE1 | ZE1 | ZE1 | ZE1 | ZE1 | UE1 | ZE2 | ZE2 | ZE2 |
| ZE2 | ZE2 | ZE2 | UE2 | RES | DLS | PS | EZ1 | EZ2 | | | | | | | | |

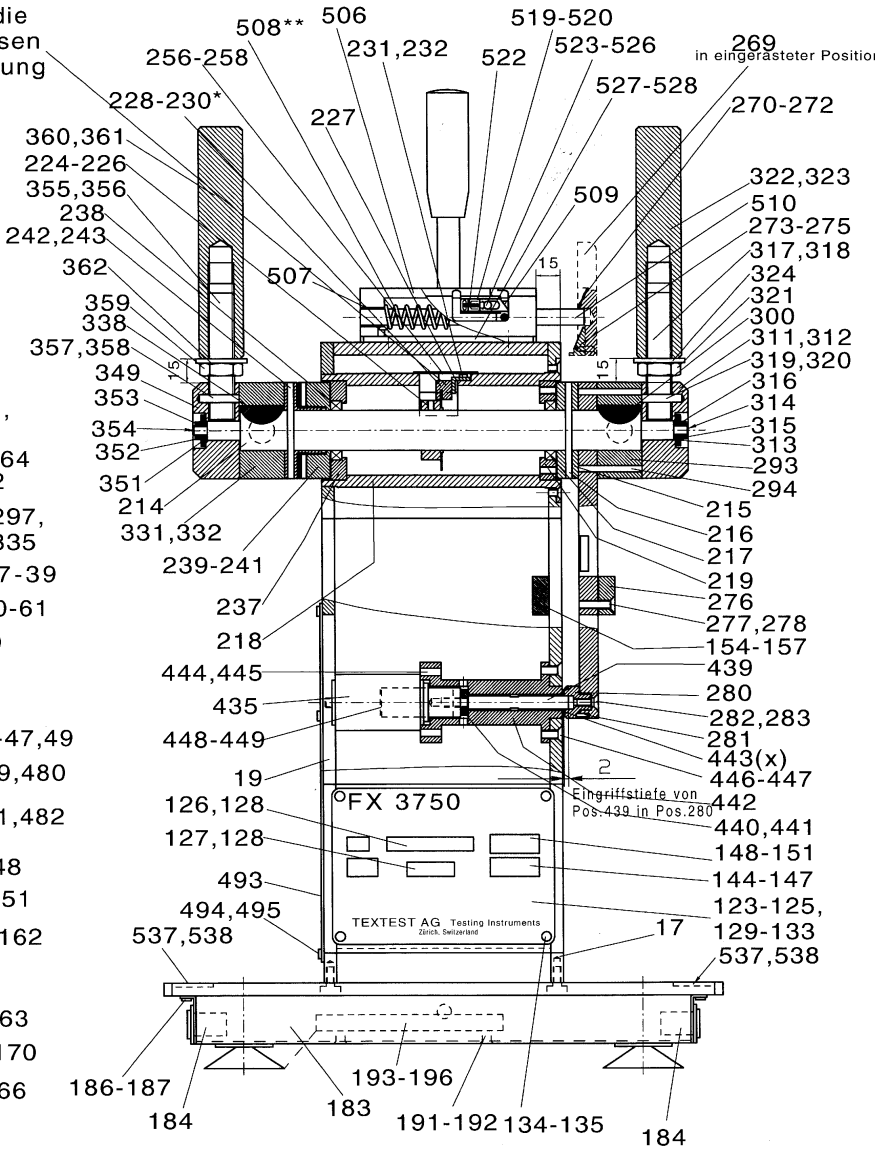
SZ = Start character: Hexadecimal "1E"
IT = Instrument identifier "FX 3750"
SN = Serial number of the instrument
M = Blank
ZP1 = Number of test specimens, right adjusted
UP1 = Blank
ZP2 = Nominal measuring range, right adjusted, with floating decimal point
UP2 = Unit of measure of the nominal measuring range "cN": Hexadecimal "37" = ASCII "7"
ZP3 = Blank
UP3 = Blank
ZP4 = Blank
UP4 = Blank
WS = Warning signal:
Test result is in the red range: Hexadecimal "2A" = ASCII "*"
Test result is in the yellow range: Hexadecimal "6F" = ASCII "o"
Test result is in the green range: Hexadecimal "20" = ASCII " "
ZE1 = Test result, right adjusted, with floating decimal point
UE1 = Unit of measure of the test result:
mN: Hexadecimal "36" = ASCII "6"
cN: Hexadecimal "37" = ASCII "7"
N: Hexadecimal "38" = ASCII "8"
g: Hexadecimal "3A" = ASCII ":"
kg: Hexadecimal "3B" = ASCII ";"
oz: Hexadecimal "3C" = ASCII "<"
lbs: Hexadecimal "3D" = ASCII "="
ZE2 = Blank
UE2 = Blank
RES = Blank
DLS = Data transfer flag:
Data have not yet been transferred: Hexadecimal "30" = ASCII "0"
Data have already been transferred: Hexadecimal "31" = ASCII "1"
PS = Check sum, consisting of the lower eight bits of the sum of byte 1 through byte 57 (both included)
EZ1 = End character 1: Hexadecimal "0D" = ASCII "CR"
EZ2 = End character 2: Hexadecimal "0A" = ASCII "LF".

(#) Schaltpunkt für Pos.408

Sensor so montieren,dass die Code - Scheibe beim Auslösen sich entgegen der Pfeilrichtung auf dem Sensor bewegt.

** Feder 2,5 Umdrehungen vorgespannt

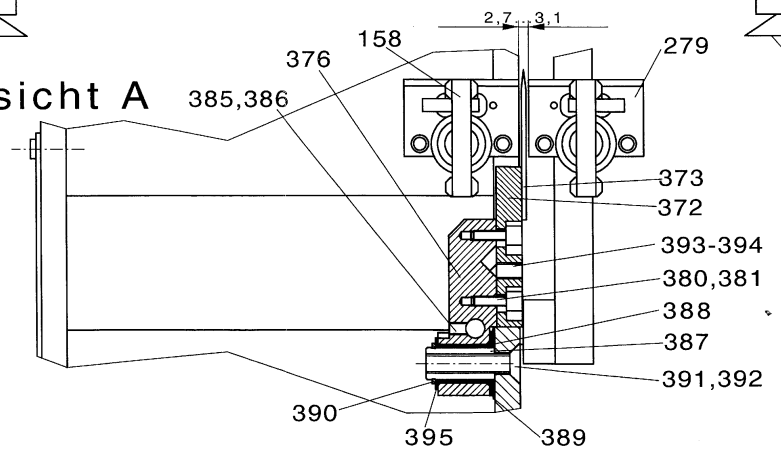


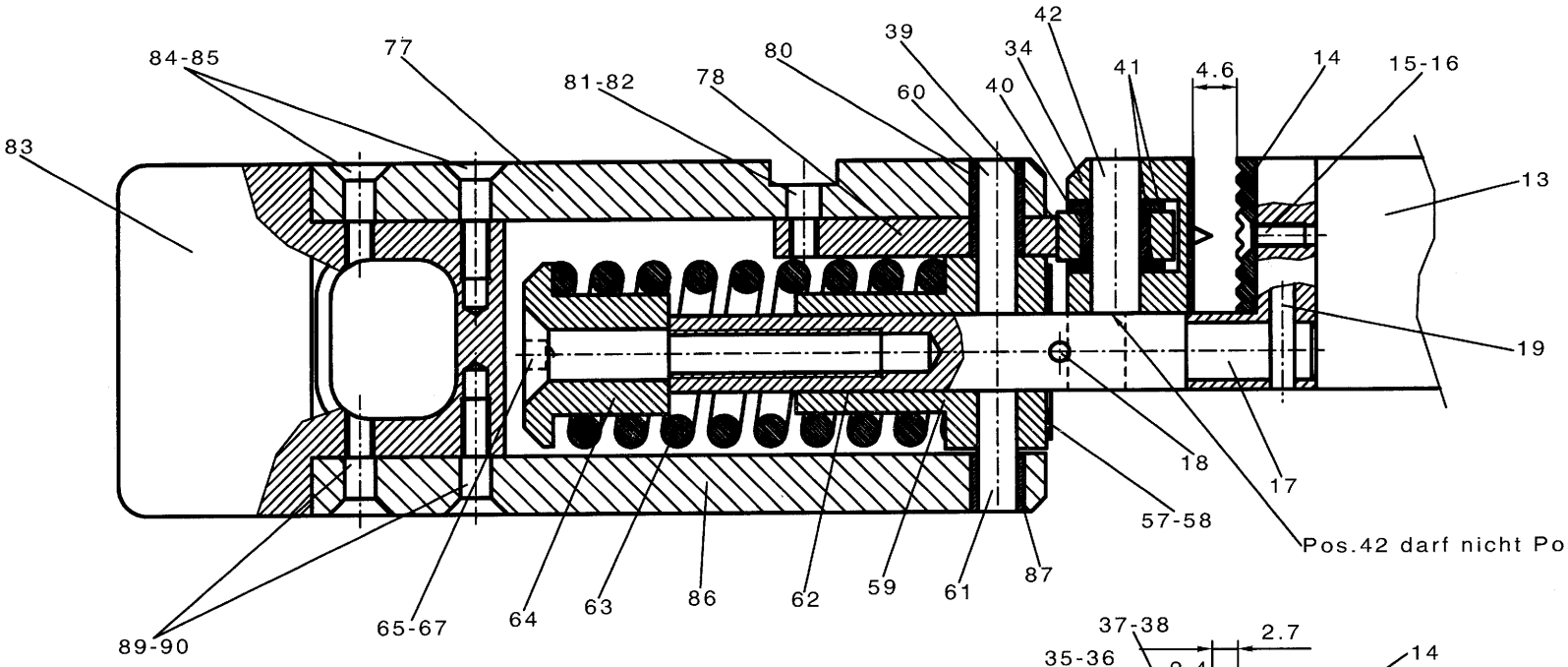

(x) Gleitlager für magnetbetätigten Verriegelungsstift: nach Montage aufreiben, bis Stift leichtgängig läuft

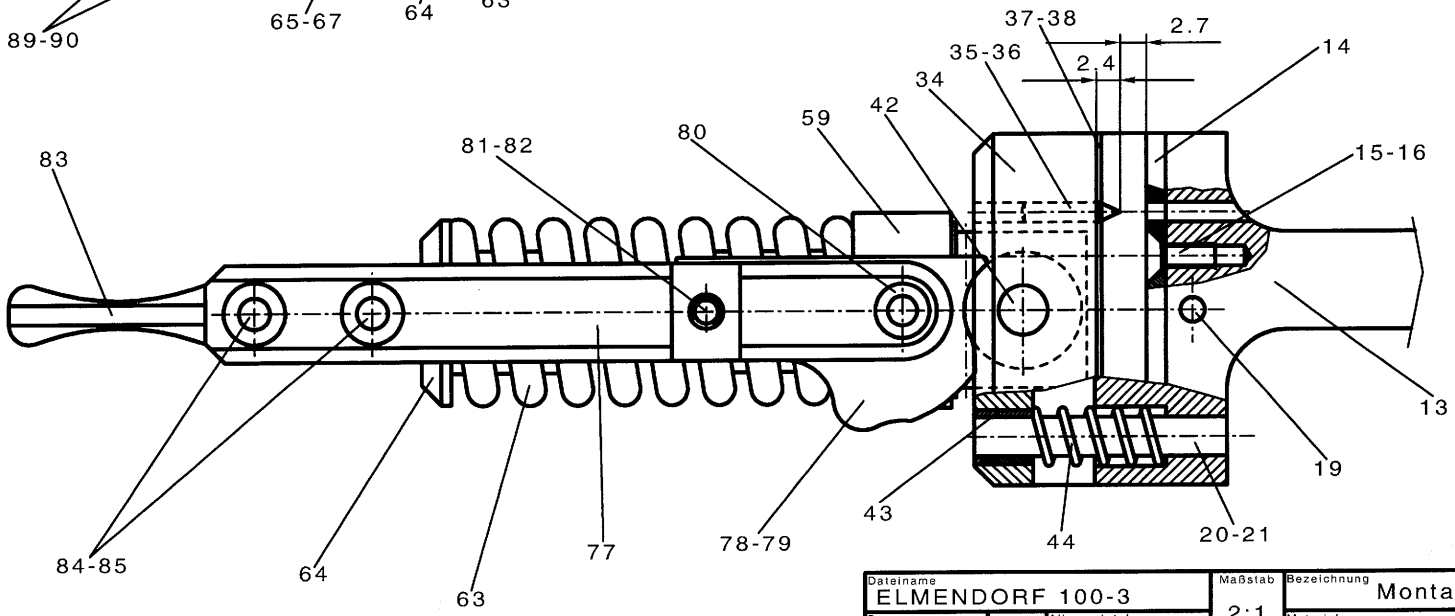
*Sensor so an Winkel anschrauben, dass die Sensorbeschriftung vom Winkel weg zeigt. ( Anschlusspins vom Winkel weg )

Ansicht A

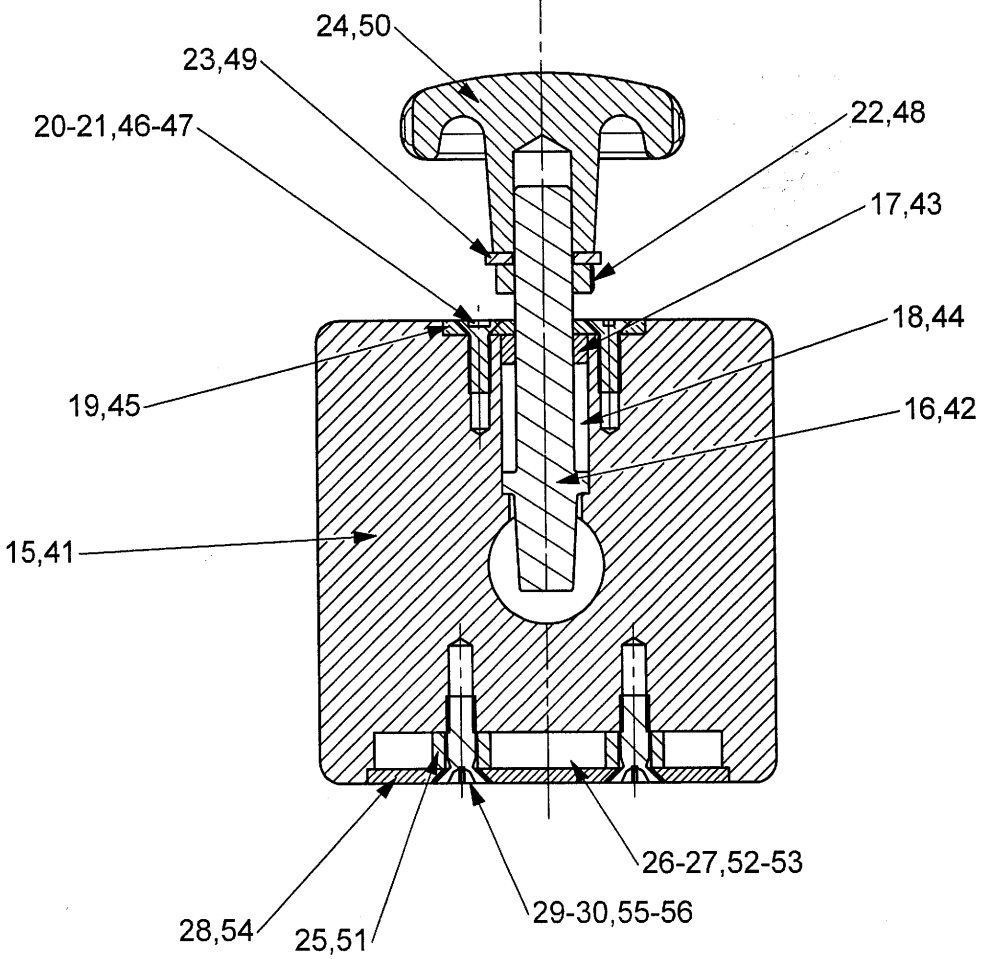


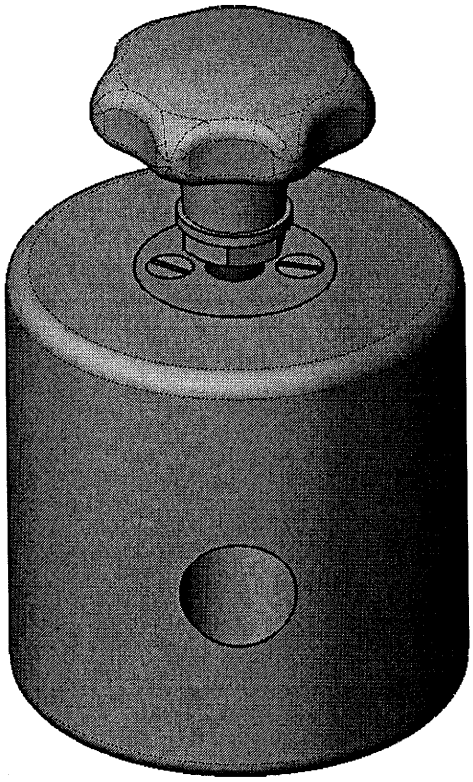

| | | | | | |
|---|---|---|---|---|---|
| Dateiname Elmendorf 100-3-BL1 | | gez. MC | Maßstab 0,3 | Bezeichnung Montagevorschrift | |
| Datum 28.11.03 | Allgemeintoleranzen ISO 2768-f | gepr. DR | | Material | |
| TEXTEST AG CH-8051 Zürich | | | | Oberfläche | |
| | | | | ZN TT 3750-1-100-01 | Gruppe 100 / Blatt 1/3 |



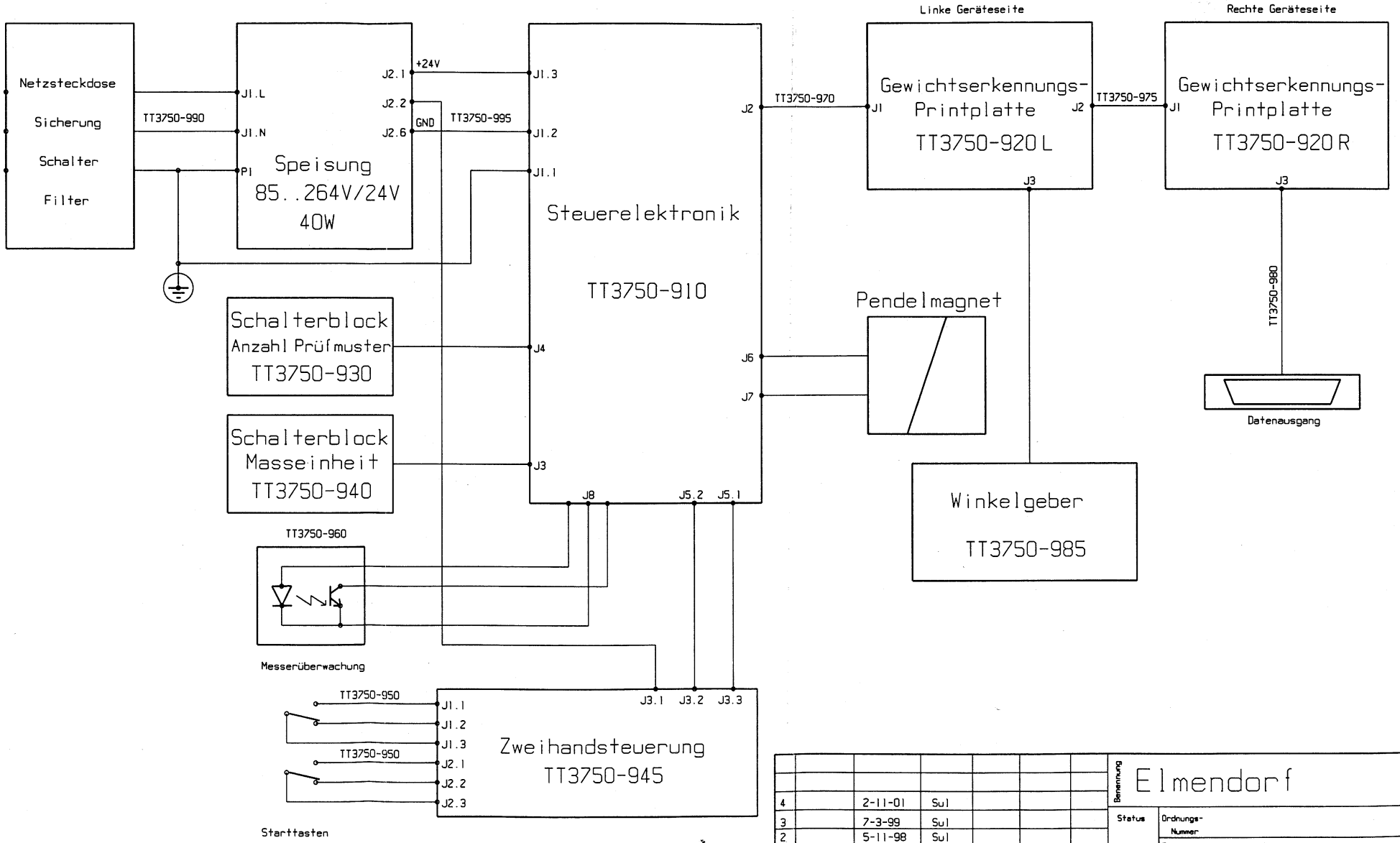




| | | | | | |
|---|---|---|---|---|---|
| Dateiname ELMENDORF 100-3 | | | Maßstab 2:1 | Bezeichnung Montageanweisung | |
| Datum 23.10.03 | gez. DR | Allgemeintoleranzen DIN 7168-f | | Material | |
| TEXTEST AG CH-8051 Zürich | | | | Oberfläche | |
| | | | | ZN TT 3700-4-100-3 | |



| Querreferenz | | | | Bezeichnung |
|---|---|---|---|---|
| | | | | Montagevorschrift |
| Datum | Allgemeintoleranzen | gez. | Maßstab | Material |
| 13.06.2007 | ISO 2768T1-f / 2768T2-H | DR | 1:1 | |
| TEXTEST INSTRUMENTS | TEXTEST AG<br>CH - 8603<br>Schwerzenbach | gepr. | Format | Oberfläche |
| | | | A4 | |
| | | ZN | TT 3750-1-201 | Stand 01b / Blatt 1/1 |




| Ausg. | Mitt. Nr | Datum | Bearbeiter | Geprueft | Normgepr. | Reg. |
|---|---|---|---|---|---|---|
| 4 | | 2-11-01 | Sul | | | |
| 3 | | 7-3-99 | Sul | | | |
| 2 | | 5-11-98 | Sul | | | |
| 1 | | 7-7-98 | Sul | | | |

Zugehoerige Unterlagen

Massstab

TEXTEST AG

Benennung: Elmendorf

Status

Ordnungs-Nummer

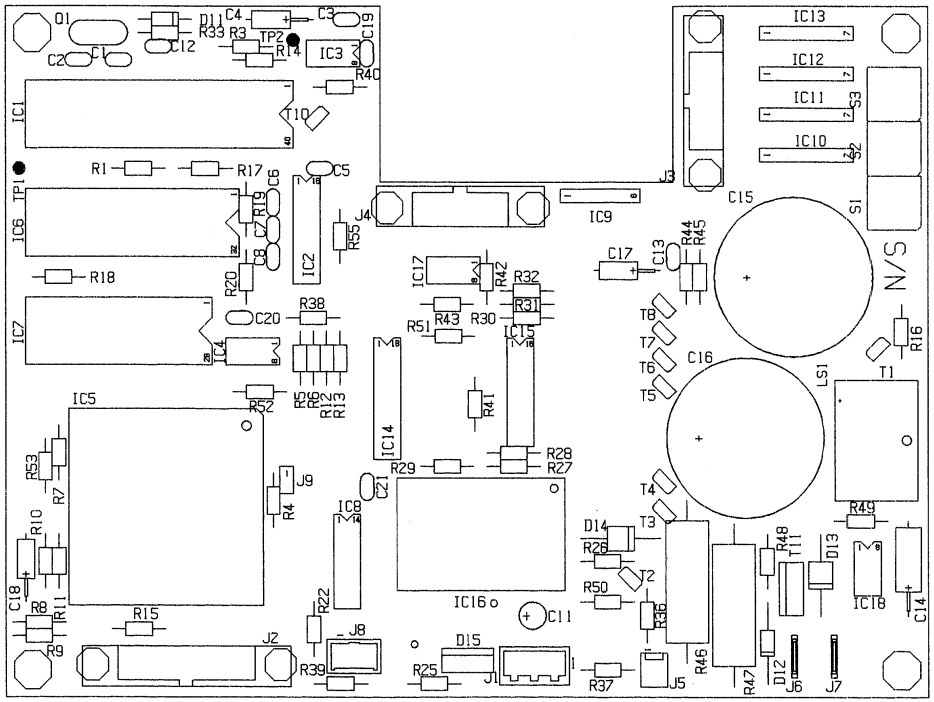
Erzeugnis-Nummer: gesamta.sch

Zeichnungs-Nummer: TT 3750-1-900

Ersatz fuer

# Elmendorf Printplatte "Steuerung"

TT3750-910-3 von Elementseite gesehen 29-4-99




Bestueckung Elementseite

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| 3 | | 29-4-99 | Sul | | | | |
| 2 | | 22-12-98 | Sul | | | | |
| Ausg. | Mitt. Nr | Datum | Bearbeiter | Gepruft | Normgepr. | Reg. | |
| 1 | | 7-7-98 | Sul | | | | |

Zugehoerige Unterlegen

Masstab 1 : 1

TEXTEST AG

Benennung: Steuerelektronik

Status

Ordnungs-Nummer

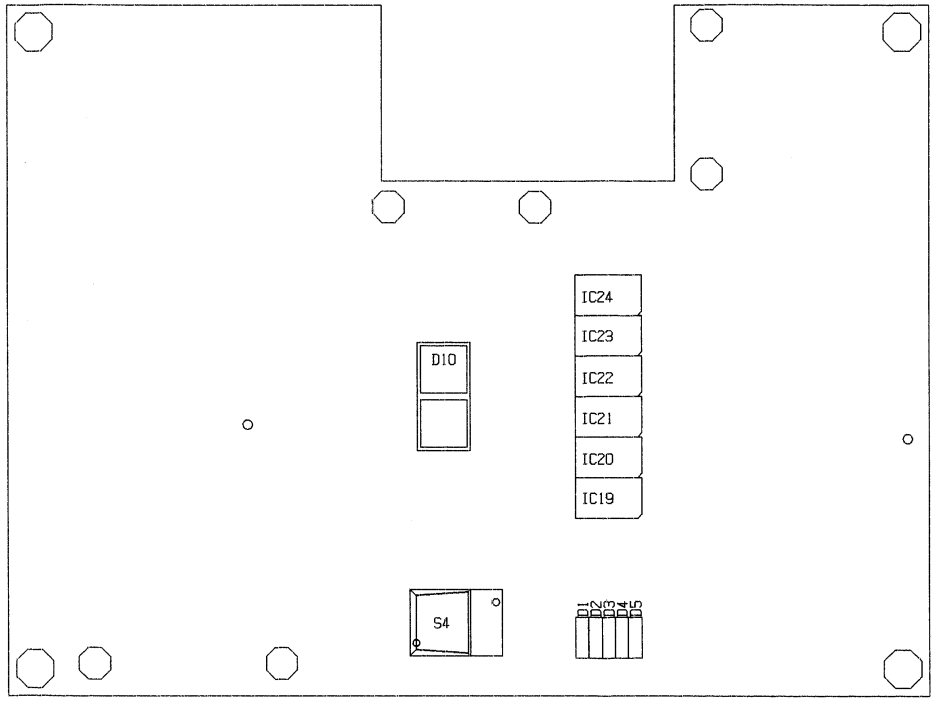
Erzeugnis-Nummer

Zeichnungs-Nummer: TT 3750-1-910 BE

Ersatz fuer

# Elmendorf Printplatte "Steuerung"

TT3750-910-3 von Elementseite gesehen 29-4-99




Bestueckung Loetseite

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | | 29-4-99 | Sul | | | |
| 2 | | 22-12-98 | Sul | | | |
| Ausg. | Mitt. Nr | Datum | Bearbeiter | Geprueft | Normgepr. | Reg. |
| 1 | | 7-7-98 | Sul | | | |

Zugehoerige Unterlagen

Masstab 1 : 1

TEXTEST AG

Benennung: Steuerelektronik

Status

Ordnungs-Nummer

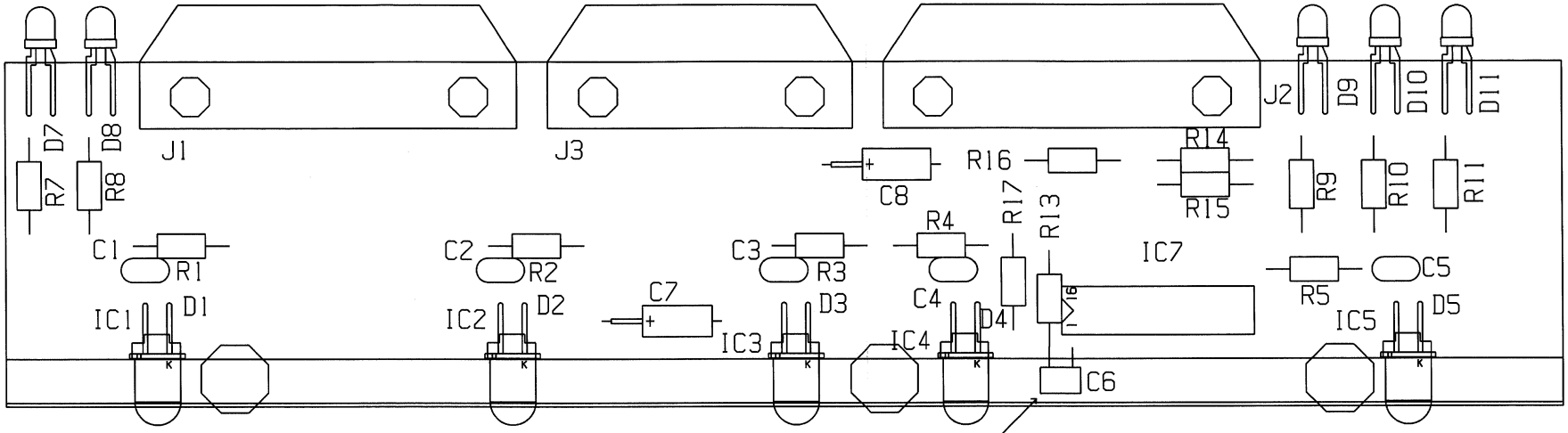
Erzeugnis-Nummer

Zeichnung Nummer: TT 3750-1-910 BL

Ersatz fuer

# Gewichtserkennung

TT3750-920-3 von Elementseite gesehen 19-10-98




Die Oberkante von IC1 bis IC5 muss 8,3 mm uber dem Print sein

Bestueckung Elementseite

C6 auf Rueckseite des Prints anloeten

| Ausg | Mitt. Nr | Datum | Bearbeiter | Geprueft | Normgepr. | Reg. |
|---|---|---|---|---|---|---|
| 5 | | 22-5-01 | Sul | | | |
| 4 | | 19-10-98 | Sul | | | |
| 3 | | 9-9-98 | Sul | | | |
| 2 | | 3-9-98 | Sul | | | |
| 1 | | 3-7-98 | Sul | | | |

Zugehoerige Unterlagen

Massstab 2 : 1

**TEXTEST AG**

Benennung: Gewichtserkennung

Status

Ordnungs-Nummer

Erzeugnis-Nummer

Zeichnungs-Nummer: TT 3750-1-920 BE

Ersatz fuer