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ABRASION TEST ACCORDING TO EN 295 - 3

Report No.:	**681Z / 08 (Pipe1)**
Type of pipe:	**ITALIANA CORRUGATI**
Pipe material:	**P P**
Nominal width:	**Ø 340, measured inner diameter of prepared test piece (Outer diameter: Ø 400)**
Manufacturer:	**ITALIANA CORRUGATI**
Request of:	**ITALIANA CORRUGATI asked for an abrasion test by confirmation of our quotation from 4th February 2008. The pipe to be tested was made of PE. The inner pipe diameter was 340mm.**

Results:

The test was made according to EN 295 part 3. The test method had been developed by our laboratory and is well known as "Darmstadt method". This corresponds to the tests which are required by national regulations for several kinds of plastic pipes, e.g. polyester, PVC or glass reinforced plastic pipes. The half pipe, supplied by ITALIANA CORRUGATI, was tested during 500.000 cycles to ensure reliable results. The test was interrupted at 25-, 50-, 75-, 100-, 150-, 200-, 300-, 400-, and 500-thousand cycles and the abrasion was measured (see annex).

Annex 3 shows a plot of the average abrasion a_m, measured during the tests, versus the number of cycles. For the tested pipe the average abrasion value was determined from abrasion values which were taken in intervals of 10mm along the inside of the pipe (method according to standard).

The measurements can be described by the following quadratic function:

$a_{m,\,(10mm)} = -3.5*10^{-7}*(cycles/1000)^2 + 0.0014*(cycles/1000)$ **mm.**

Fitting a straight line to the data yields the following formulation:

$a_{m,\,(straight\ line\ fit)} = 0.0013*(cycles/1000)$ **mm.**

Based on these formulations the calculated average abrasion depth after 100.000 load cycles is:

$a_{m,\,calculated\ (10mm)}{}^{100} =$ **0.14 mm (linear fit: 0.13 mm).**

The measured average value of abrasion (see annex 3-3) after 100.000 load cycles is:

$a_{m,\,measured\ (10mm)}{}^{100} =$ **0.13 mm.**

In addition to the average abrasion value the maximum and minimum abrasion values at the corresponding load cycle could be used to find a statement about the condition of the inner layer.

Such an interpretation is not required by the standard. Because of the higher dependency of minimum and maximum values on the kind of strain compared to the dependency of the average values, these values yield only limited information about the pipe material and the type of pipe.

In annex 3-3 the table with the maximum, minimum and average abrasion values is given. These values are nearly proportional to each other.

Photos of the pipe at the beginning, in the course and at the end of the abrasion test are given in the annexes 2-1 until 2-3. An abrasion effect is visible on the pictures.

A more detailed analysis is possible by a comparison of the abrasion values (see annex 3-3) to the reference thickness, to the wall structure and to common abrasion test results of other products of the same material

Darmstadt, 23th Mai 2008

(Dr.-Ing. P. Mewis)

<u>Annex:</u>

1. **Extract from EN 295 part 3, Measurement device**
2. **Pictures of the new pipe, during the test and after the completed test**
3. **Diagrams, abrasion and wall thickness as a function of cycles**

Extract of EN 295 part 3:

Prüfung der Abriebfestigkeit

Eine Rohrhalbschale von (1000 ± 10) mm Länge wird durch Stirnplatten seitlich abgeschlossen, mit einem Sand-Kies-Wasser-Gemisch gefüllt und mit einer weiteren Platte abgedeckt. Diese Halbschale wird wechselweise in Längsrichtung um ±22,5° geneigt, so dass durch die Bewegung des Prüfmaterials die zu prüfende Abriebwirkung erzeugt wird (siehe Anlage 1 / Blatt 1-2). Als Prüfmaterial ist natürlicher, ungebrochener, rundkörniger Quarzkies zu verwenden, dessen Sieblinie folgenden Anforderungen entspricht:

$M_p = d_{50} = 6$ mm

$d_{80} = 8{,}4$ mm

$d_{20} = 4{,}2$ mm

$U = d_{80}/d_{20} = 2$

wobei

M_p	die mittlere Korngröße in mm
U	der Ungleichförmigkeitsgrad
$d_{50}/d_{80}/d_{20}$	die Korngröße, die von 50/80/20% (Massenanteilen) des Materials unterschritten wird in mm

ist.

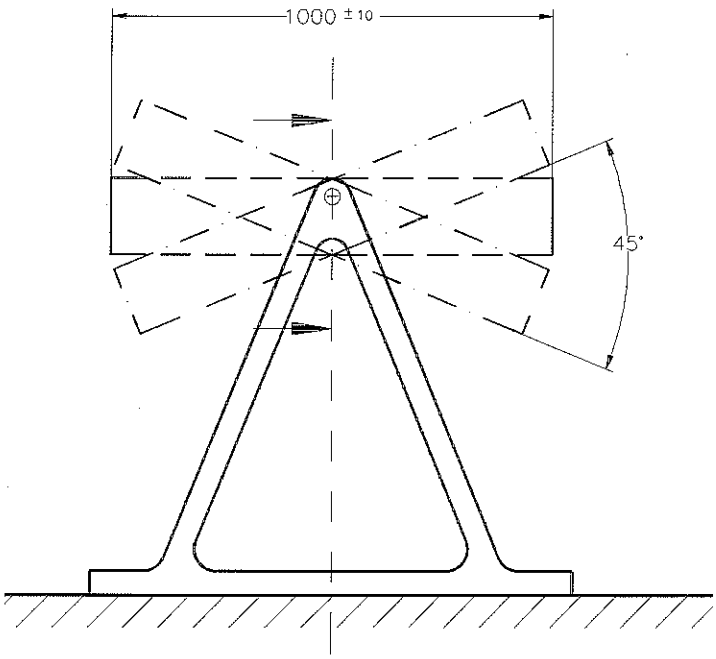
Die Prüfmaterialmenge nach Tabelle 29 (siehe Anlage 1/ Blatt 1-2) wird in die Prüfschale eingebracht, die anschließend bis zu einer Füllhöhe von (38 ± 2) mm mit Wasser aufgefüllt wird.

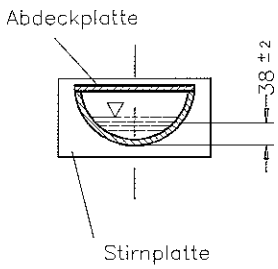
Die Prüfschale ist 100 000 Lastspielen (Abriebvorgängen durch Rutschen beim Kippvorgang) auszusetzen. Der Kippvorgang soll sinusförmigen Verlauf bei einer Frequenz von etwa 20 Lastspielen/min haben.

Die Abriebtiefe ist auf der Sohllinie über eine Prüflänge von 700 mm zu messen, wobei an beiden Enden der Halbschale 150mm unberücksichtigt bleiben. Die Messungen sind in Abständen von höchstens 10mm vorzunehmen, und anschließend ist die mittlere Tiefe zu berechnen. Dieser Wert ist der mittlere Abrieb.

Tabelle 3: Prüfmaterialmenge

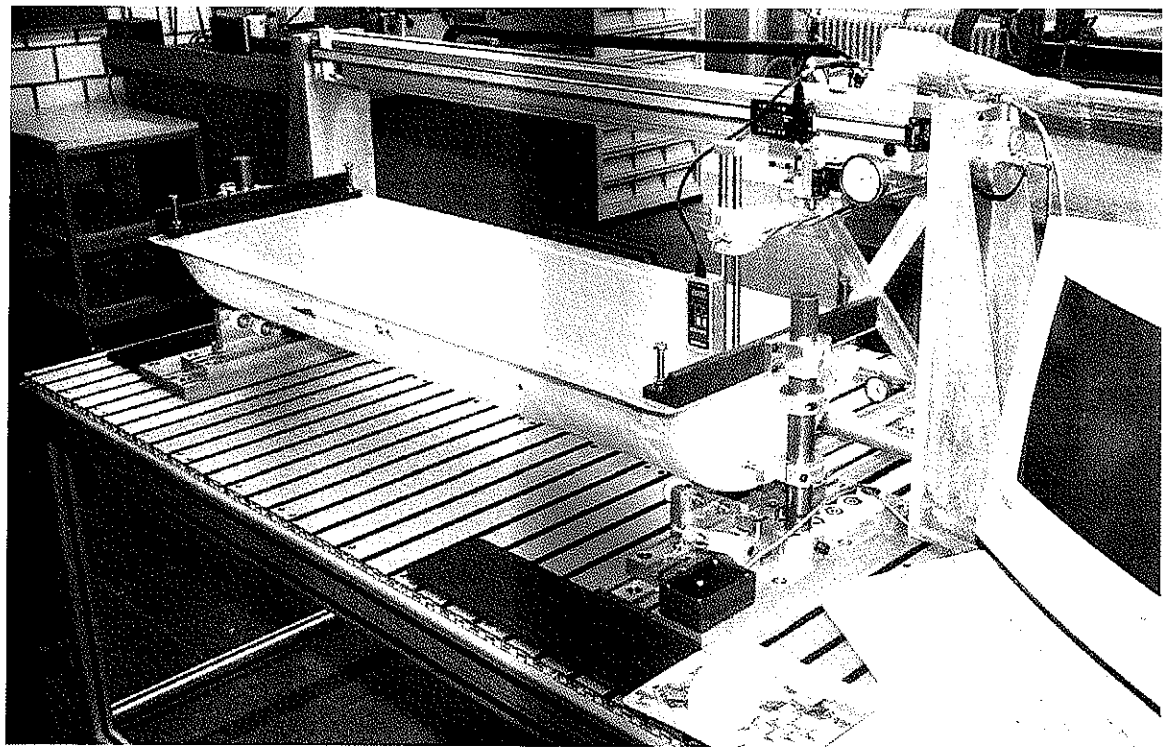
DN	Prüfmaterialmenge kg
100	2,8
125	3,1
150	3,4
200	4,0
250	4,5
300	5,0
400	5,8
500	6,5



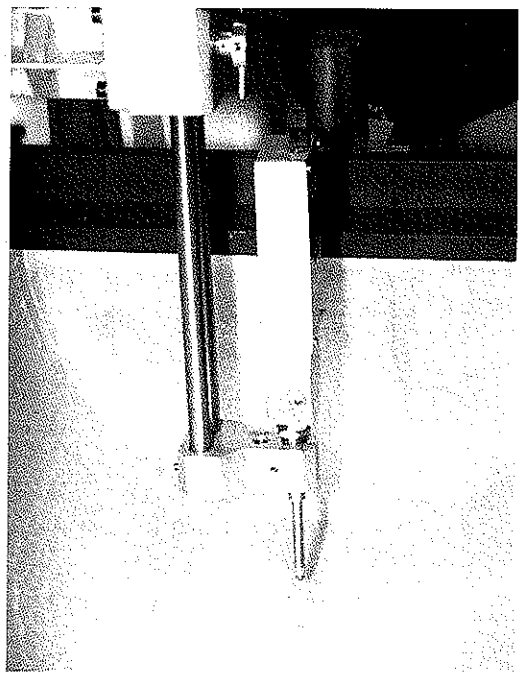


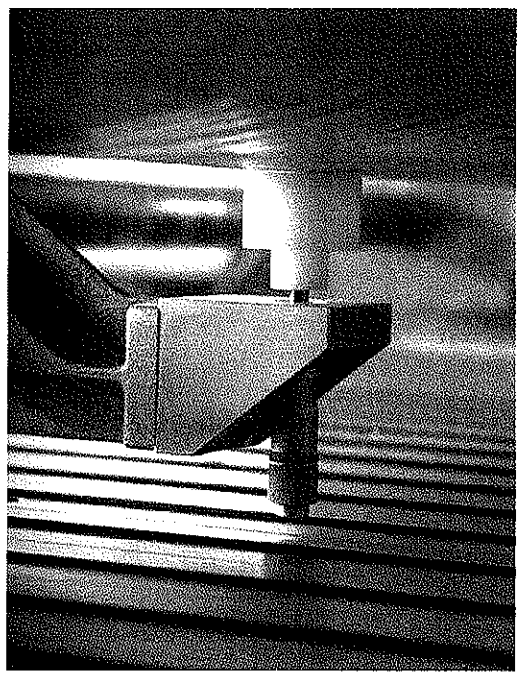
Versuchsanordnung für die Abriebprüfung

Measurement device



The pipe was removed after the mentioned numbers of load cycles and the wall thickness was measured by using a dial gauge. At regular intervals of 10mm the wall thickness of the pipe was measured along the inside in longitudinal direction.





With a resolution of 1/100mm the dial gauge yields the wall thickness values. Because of possible deformations of the pipe it is necessary to determine the wall thickness at different points along the inside of the pipe instead of measuring the distance to a fix reference level.

Pipe ITALIANA CORRUGATI Ø 400 after 0 Load Cycles

Pipe ITALIANA CORRUGATI Ø 400 after 100 000 Load Cycles

Pipe ITALIANA CORRUGATI Ø 400 after 500 000 Load Cycles

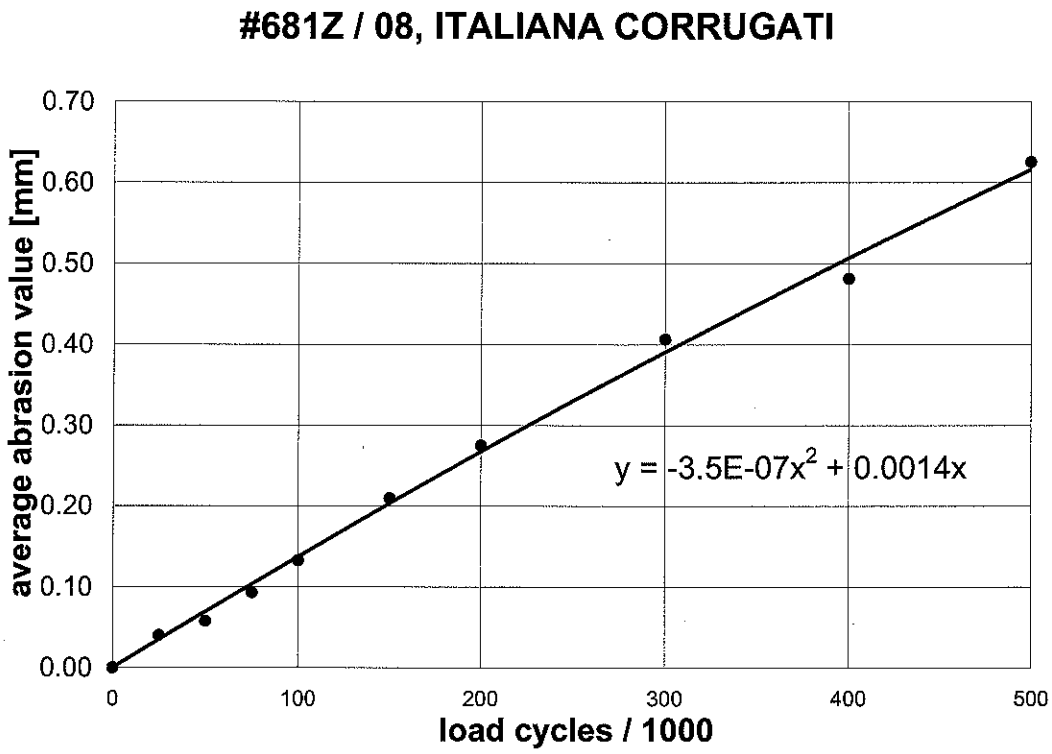


Diagram: Average abrasion versus load cycles (quadratic function fit)

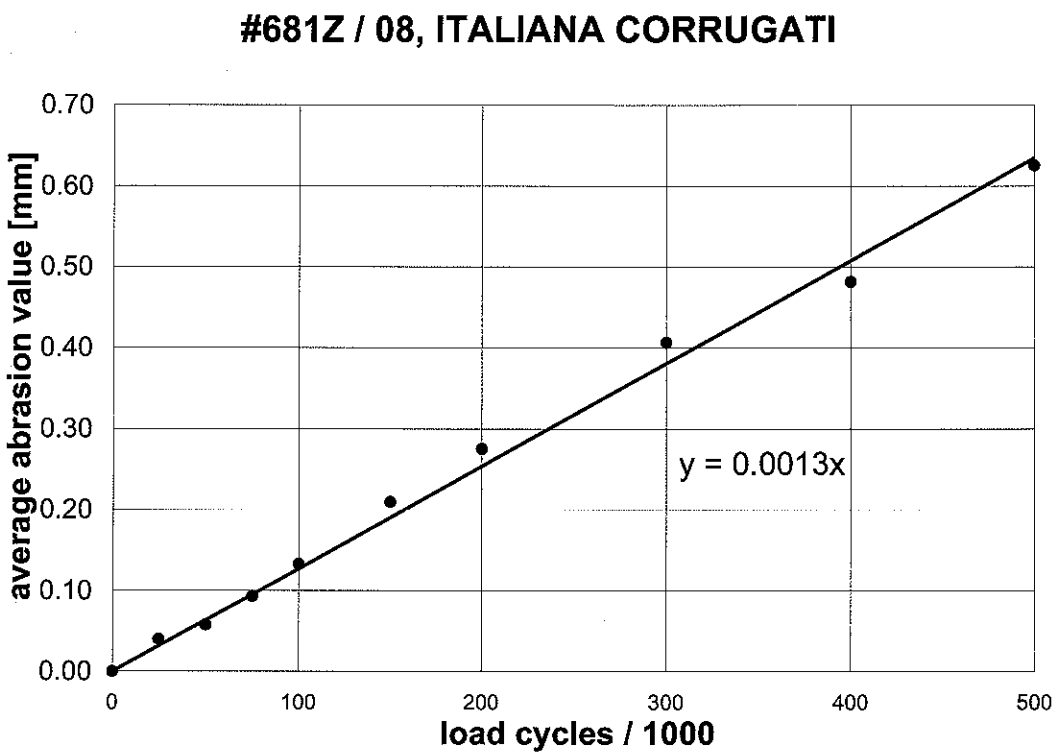


Diagram: Average abrasion versus load cycles (linear fit)

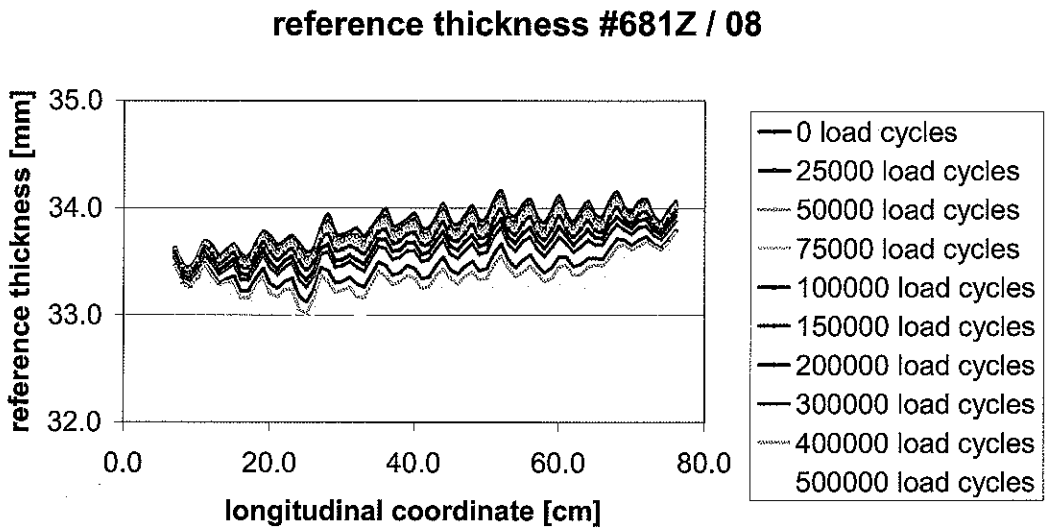


Diagram: Reference thickness

Italiana Corrugati-pipe abrasion values #681Z/08, pipe1

inner 70cm according to EN	25TLSP [mm]	50TLSP [mm]	75TLSP [mm]	100TLSP [mm]	150TLSP [mm]	200TLSP [mm]	300TLSP [mm]	400TLSP [mm]	500TLSP [mm]
minimum	0.02	0.01	0.03	0.04	0.09	0.11	0.17	0.17	0.24
average	0.04	0.06	0.09	0.13	0.21	0.28	0.41	0.48	0.63
maximum	0.06	0.09	0.14	0.19	0.29	0.38	0.57	0.66	0.84
total section length (81cm)	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
minimum	0.00	0.00	0.02	0.03	0.06	0.08	0.13	0.11	0.16
average	0.04	0.05	0.08	0.12	0.19	0.25	0.37	0.43	0.57
maximum	0.06	0.09	0.14	0.19	0.29	0.38	0.57	0.66	0.84

Table: Minimum, maximum and average values of abrasion for different numbers of load cycles