addition to this, said test-piece shall be in certain cases subjected to a test, carried out by means of extensometers.

The aim of these tests is to classify the steel grades according to their transition temperature, this by using cylindrical test-pieces, which has not yet been done.

The results of the series of tests will provide the constructors with a valuable technical information. In fact, the development of the equipment working under pressure, entirely depends upon the state of our scientific knowledge as regards the passage to the plasticity state of the metal and the behaviour of the metal during its breaking. In fact, the criteria used to this purpose do not take into consideration the gradient of the stresses and should be improved. Besides, the brittleness of the metal at the low temperatures should be carefully studied because the extension of our knowledge about it is a thing in which the builders of cylindrical equipment and the builders in general are most interested.

Here is an example of a series of tests now in progress (table II). The values of the transition temperatures measured on one side, on a test-piece subjected to the notched bar impact test (Charpy V notch test) and on a cylindrical test-piece provided with the same type of notch are shown hereafter in tabular form.

Table II.

Test temperature °C	Rupture pressure kg/cm2	Brittle structure %
- 0	2 640	0
-10	2 660	2
-23	2 700	10
-33	2 760	27
-40	2 790	38
-50	2 810	45
-60	2 980	73
-70	3 100	85

B. IMPROVEMENT OF MANOMETERS.

In the course of these last ten years, we have considerably improved the metallic membrane and tube manometers. To this purpose, we have done a lot of research work in this field, which research has been the subject of numerous reports, published in the technical periodicals and leads to this result that the hysteresis phenomenon no more affects the measurement of the pressures and that the manometer can be used during its normal life without accertaining any displacement of its zero. Besides, our Institute has worked out precise methods for testing the manometers, which manometers have been consequently standardized and granted a quality mark distinguishing the manometers of the different types.

We became then aware of the fact that a lot of research had to be done, regarding other types of manometers particularly the manometers, used by the petroleum-industry and that we must endeavour to reduce to the minimum the troubles to which the mechanism of normal manometer is subjected when these manometers are normally used.

In fact, the manometers used by the petroleum-industry are subjected to very severe tests which consist in subjecting the tubes to be tested, to a pressure, which varies between zero and a predetermined value, the pressure changes occurring a very high number of times. According to the American standards, the number of said pressure changes amounted to 2 500 000. It has been ascertained in the U.S.A. as well as in the course of our carrying out appropriate tests, that these standards were really too severe. We have tried improving the American testing method so as to give satisfaction to the petroleum-industry. We were not successful in doing so because the testing cycle could not be defined with precision. This accounts for our observing variations in the quality of the tube, even breakages which occured under conditions which in the present state of the engineering science remain unexplained.

Therefore, we requested the cooperation of the Belgian manometers manufacturing industry with a view to more carefully studying the problem of the manometric tubes.

The elastic strain of the manometric tubes is expressed by different formulae, which appear to be contradictory, because the problem has to be simplified, owing to the complexity of the phenomena involved, which simplifications are such, that each formula suggested is applicable within very narrow bounds, which cannot be clearly defined.

Consequently a great number of experimental measurements have to be made with a view to condensing their results in one or several formulae, which would permit of predetermining the size of the tubes of which the use is most apt to solve the technical problems with which the industry is confronted.

Research work in this direction has been done in Great-Britain on a semi-theoretical and semi-empirical basis, but this work is too incomplete as regards the bounds within which the formula discovered is applicable. Without these bounds, the errors made by applying said formula are quite unacceptable.

We have however based on this British research work our own researches in the same field. We have measured and compared together a lot of manometric tubes, classed into several groups and for which the deformation laws are not to complex ones.

1. category : tubes of an elliptic section or of which the section is nearly an elliptic one.
2. category : tubes of an oval section or of which the section is nearly an oval one.

In each of these categories, we have distinguished the sections of which the size is bigger, from those of which the size is smaller:

a) 17 x 8 mm
b) 12 x 4,5 mm
c) 7 x 3,5 mm.

We have thus obtained six classes including all the types of tubes studied. In each class and by taking into consideration the maximum number of tubes, we have determined the four coefficients which are most appropriate for being introduced in the formula of which the use is recommended by author:

$$\varepsilon = K \frac{P}{E} \frac{R}{B}^{m} \frac{A}{B}^{n} \frac{A}{t}^{q}$$

that is to say K, m, n, q; A, B, R, t being used for determining certain dimensions of the tubes, p being the pressure and E the elasticity modulus of the material considered.

For each tube one has determined:

- the lift Z, the radius Ro, the angle Ø (which is necessary for obtaining ε) and the angle x between Z and the tangent of the tube;
- the shape of the section of the tube by optically plotting the coordinates of points belonging to half a section (symetry as to a vertical axis);
- the expansion of the small axis for a determined pressure with a view to distinguishing the strongly strained tubes from the little strained ones;
- the elasticity modulus E (some tubes have been used for measuring this coefficient E and verifying that its value is a constant one).