DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
Transportation Laboratory
5900 Folsom Boulevard
Sacramento, California 95819-4612

METHOD OF TEST FOR SEAM QUALITY CONTROL OF HELICAL CONTINUOUSLY WELDED SEAM CORRUGATED METAL PIPE

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read "**SAFETY AND HEALTH**" in Section J of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed. Users of this method do so at their own risk.

A. SCOPE

This method describes the procedure to be followed in determining the quality of the seam of a helical continuously welded seam corrugated metal pipe. The procedure to be used involves physically distorting a short length of welded seam by using a 25 mm diameter hemispherical punch and a 38 mm inside diameter contoured die. The resulting distorted weld area will hereafter be called the "cup".

The fabricator may request approval of alternate method(s) for test. This must be accompanied with supporting data to the engineer for evaluation. The engineer has the prerogative to request additional tests if required.

In the event of a disagreement between the fabricator and engineer, the referee test described in Section H shall be performed.

B. APPARATUS

1. Die. A die having an inside diameter of 38 mm and machined to conform to the corrugation of the sample (see Figure 1) is required.

2. Punch. A punch consisting of a 25 mm steel ball (see Figure 1) is required.

C. TEST PREPARATION

1. Weld reinforcement may or may not be blended smooth on the automatically machine welded seam prior to the cup test.

2. Weld reinforcement shall be blended smooth on manually welded seam repairs if a cup test is required (see Section E-6).

D. TEST PROCEDURE

1. Position the punch on one side and centered over the welded seam at a distance of not less than 76 mm nor more than 450 mm from the end of the pipe (see Figure 2). This will normally be done near the trailing end of the pipe length.

2. Center the 25 mm diameter punch opposite the die (on the other side of the welded seam). Using a suitable loading device, force the punch into the welded seam to obtain a residual cup deflection of at least 3 mm (see Figure 3).

3. The direction of the cup shall be with the concavity of the corrugation (see Figure 3).

E. INSPECTION AND EVALUATION

1. For a length of a pipe to be acceptable, the sum of the lengths of cracks or other defects on either side of the cup shall not be more than 6 mm.

2. If the first cup indicates a failure, punch a second cup at another location on the weld not less than 76 mm nor more than 300 mm from the first cup (and in the direction of the center of the pipe). Evaluate the pipe again as described in Section E-1. If this second cup also indicates a failure, the pipe is not acceptable.

3. One cup will be the maximum required for evaluation of a standard 7 m pipe length or less where there are no seam repairs within 400 mm of the pipe end, measured along the weld, and provided the cup passes the requirements in Section E-1.

4. Helical welded seam corrugated metal pipe less than the standard 7 m length shall be required to meet the acceptance criteria of Sections E-1 or E-2.

5. It is the prerogative of the manufacturer to remove the defective portion of the length of pipe and retest, as per Sections E-1 or E-2.

6. It is the prerogative of the manufacturer to manually repair defects in the automatic weld seam, provided no single defect requires a repair exceeding 400 mm in length. If, however, a repair occurs within 400 mm of either end, measured along the weld, a satisfactory test, both on the manually repaired section and also on the immediately adjacent automatically welded section, must be conducted. If either test results in failure under the criteria of Sections E-1 or E-2, the pipe length shall be rejected.

7. Helical welded seam corrugated metal pipe of lengths greater than 7 m but less than 15 m shall be required to meet the criteria of Sections E-1 or E-2 at each end of the pipe. If either end is rejected, the entire length shall be rejected.

8. Helical welded seam pipe of diameter greater than 1220 mm shall be subject to the following additional requirements:

   When a length of pipe is rejected by the standard trailing end cup test (see Sections D-1, E-1, and E-2), test the following length of pipe on the leading end *in addition* to the standard trailing end cup test. If either of these two tests shows failure, reject the entire length.

9. The pipe seam shall exhibit continuous weld throughout the length of pipe with no visible indication of weld defects.

10. When a length of weld seam exhibits visible defects that would obviously fail the cup test requirements in Section E-1 if conducted over the defective area, the length of pipe is not acceptable. Corrective action may be taken as described in Section E-6.

F. WELD CORROSION

1. A welded seam with the spelter coat burned back more than 3t (three times the thickness of the pipe wall) will not be acceptable until corrective measures are taken as specified in the following paragraph.

2. Where spelter coat burn-back exceeds 3t, the weld and damaged area adjacent to the weld shall be cleaned and painted with zinc-rich paint in accordance with Section 55-3.28 of the California Standard Specifications.

G. REPORTING RESULTS

No formal test report will be made. This test will be part of the routine quality

control and plant inspection procedure for acceptance of the pipe, which is reported on Form R-29, Report of Inspection. Rejections will be reported verbally to the manufacturer.

H. REFEREE TEST

1. The referee test consists of a destructive test requiring two 610 mm x 610 mm samples of pipe of the diameter, gauge, and heat number of concern containing a 610 mm length of weld running through the center. The referee test may be requested by either the pipe manufacturer or the State Inspector.

2. Each sample shall contain physical test specimens and micro-etched specimens of the number and types as follows:

   No. Req. Type

3	Tensile tests across the weld.
3	Tensile tests of the base metal above the weld.
3	Tensile tests of the base metal below the weld.
3	Face bends.
3	Root bends.
3	Cup tests on the weld.
3	Cup tests on the base metal.
3	Micro-etched specimens of weld cross section.

3. The specimen layout on a pipe sample is as shown in Figure 4.

4. All tensile test specimens shall have 5.0 mm and 50.0 mm gage lengths on both sides across the weld area.

   The data resulting from the base metal and across the weld tensile tests shall be:

   a. Ultimate load accompanied with the ultimate stress.

   b. Percent elongation of both the 5.0 mm and the 50.0 mm gage lengths on both the face and root sides.

5. All face and root bend specimens shall have a 5.0 mm gage length on their appropriate sides across the weld area. The data resulting from the face bend test shall be the percent elongation of the gage length after having been guided around a 12.5 mm diameter mandrel. The data resulting from the root bend test shall be the percent elongation of the gage length after having been forced flat.

6. All cup tests shall have a 5.0 mm gage length on both sides of the cup, across the weld area, and located and measured at the crown of the cup. The data resulting from the cup tests shall be the percent elongation evaluated on both the face and root sides of the cup at increments of 1.0 mm cup depth to 6.0 mm. The direction of the cup shall be with the concavity of the corrugations.

7. All micro-etched specimens shall be mounted and viewed for weld joint defects such as lack of fusion or cracking.

8. The test conclusions shall be made by the engineer after having reviewed the sample test data.

I. NOTES

Figure 5 shows a gage recommended for use in measuring various dimensions in connection with the cup test and also for checking acceptable width of the area burned by welding. It is used in the following manner:

1. The projections at the top of the gage do not pertain to the cup test. They are dimensioned horizontally in accordance with the widths of burned area (3 times thickness of metal) acceptable under specifications for each indicated gage of metal. The indicated widths are based on specified gage thicknesses listed in AASHTO specification M-36 (see Figure 6).

2. The 76 mm overall length dimension is used to check the following requirements of the test method:
   a. The test shall be made not less than 76 mm from the end of the pipe (see Section D-1 and Figure 7).

b. The minimum distance between 2 cup tests is 76 mm (see Section E-2 and Figure 8).

3. When the gage is positioned on the pipe so that the bottom legs straddle the convex side of the cup, the 10.31 mm wide projection should always touch the cup. The interval corresponds to the minimum allowable cup deflection (3.18 mm). See Section D-2 and Figure 9.

4. The side projections (6.35 mm wide) can be used to check conformance to the limiting requirement of 6.35 mm maximum for weld defects (see Figure 10).

J. SAFETY AND HEALTH

Prior to handling, testing or disposing of any waste materials, testers are required to read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans Laboratory Safety Manual. Users of this method do so at their own risk.

REFERENCES:

AASHTO Designation M-36
California Standard Specifications

End of Text (California Test 665 contains 6 pages)

FIGURE 1 - DIE AND PUNCH

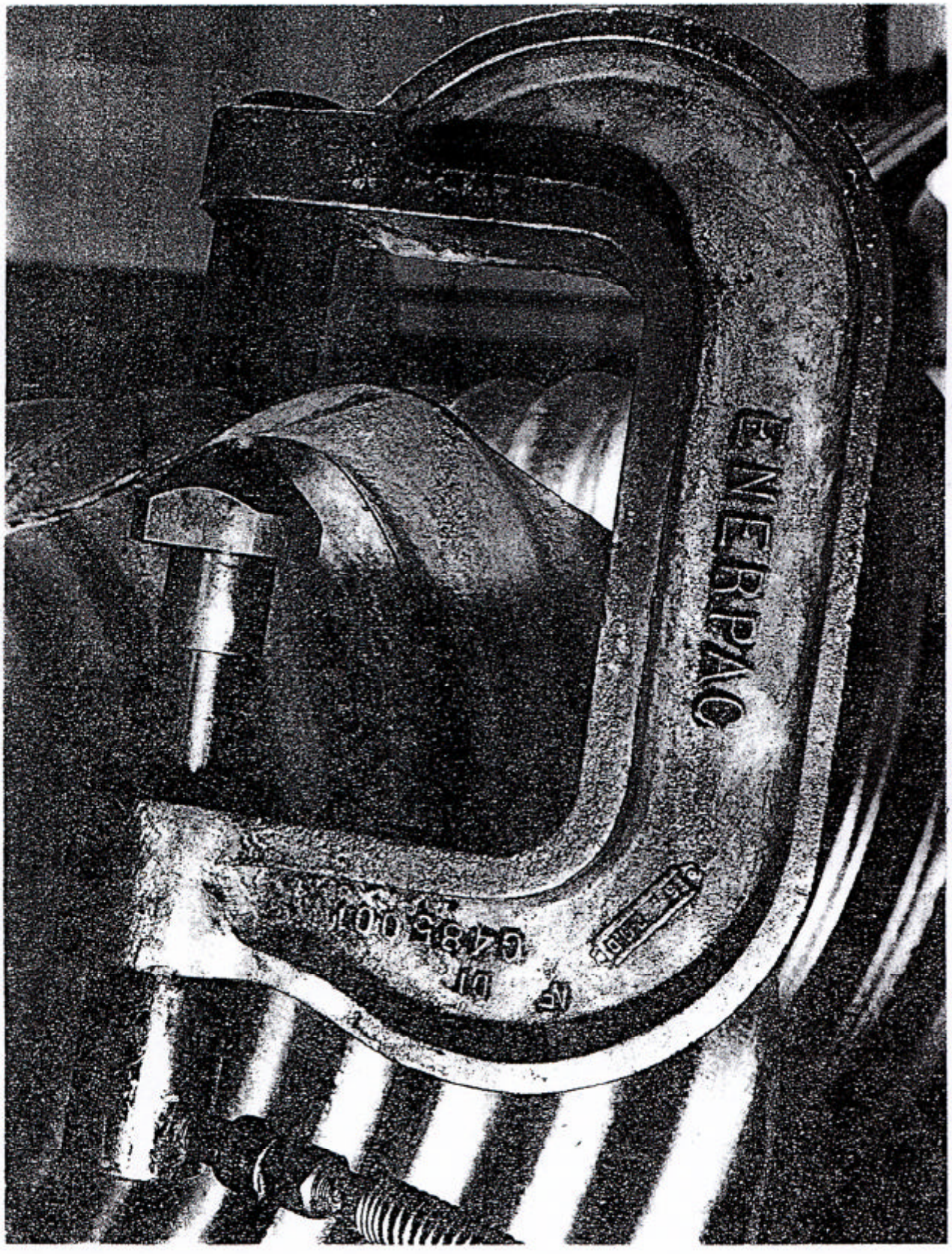


FIGURE 2 - POSITIONING THE DIE AND PUNCH

FIGURE 3 - CUP TEST WITH THE CONCAVITY OF THE CORRUGATION
216 mm x 140 mm BROADSIDE

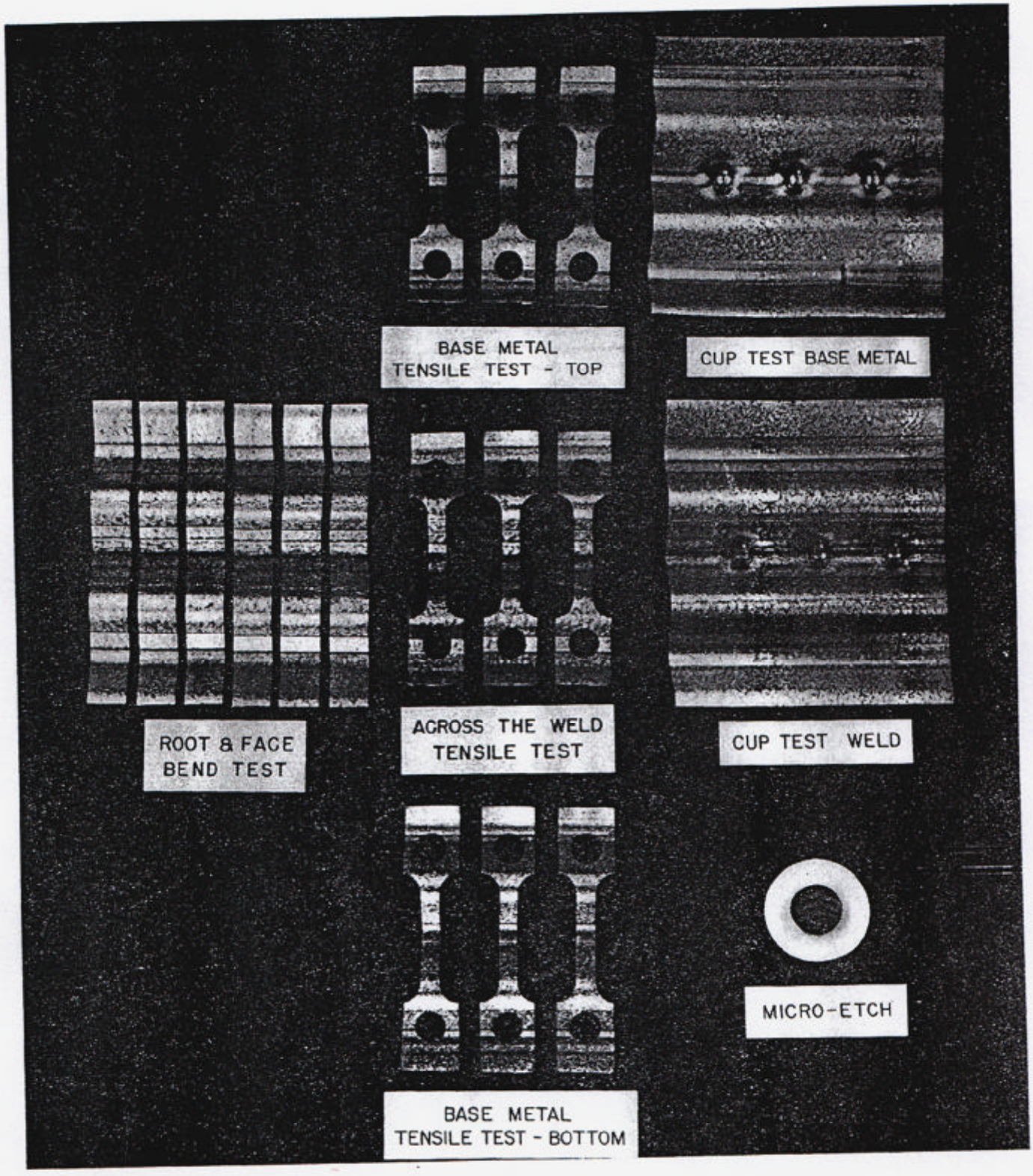
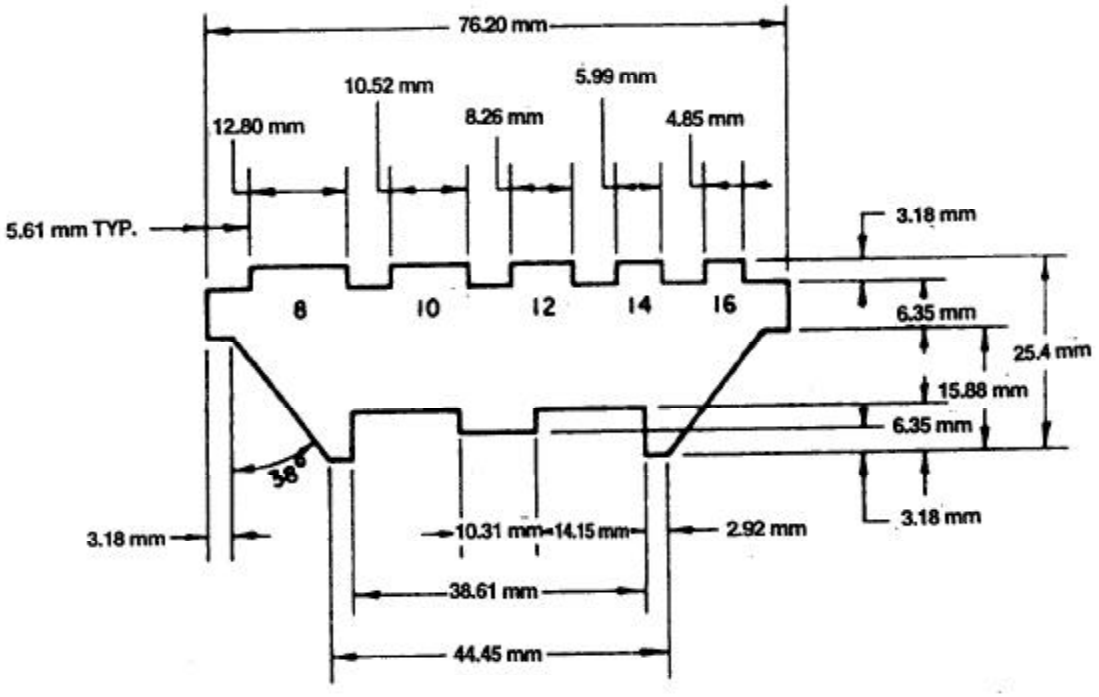


FIGURE 4- REFEREE TEST



MATERIAL - 2.38 mm STAINLESS STEEL

FIGURE 5 - CUP GAUGE

FIGURE 6 - MEASURING SPELTER COAT BURNED AREA

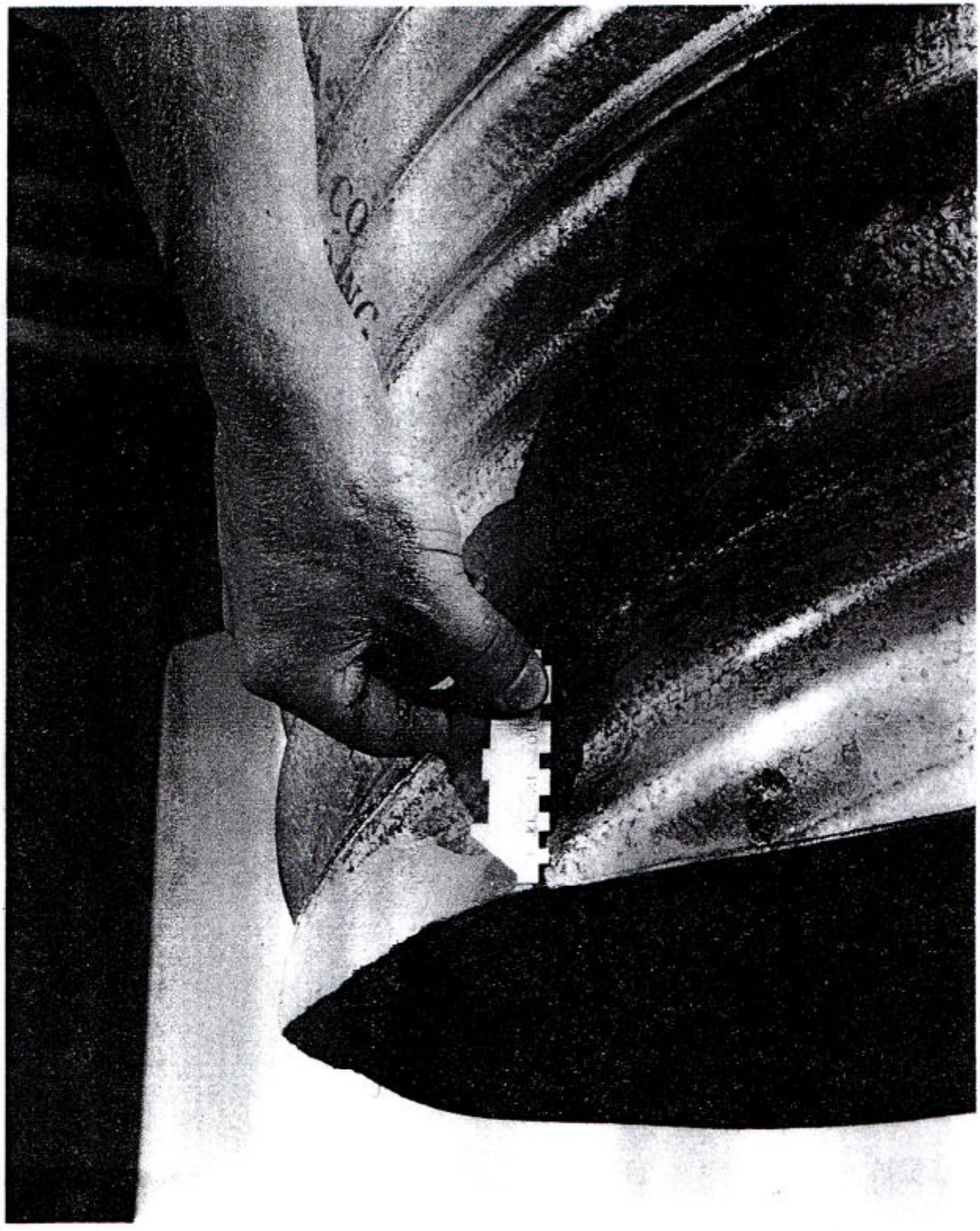


FIGURE 7 - MINIMUM ACCEPTABLE DISTANCE FROM THE END OF THE PIPE TO THE FIRST CUP TEST

FIGURE 8 - MINIMUM ACCEPTABLE DISTANCE BETWEEN CUP TESTS

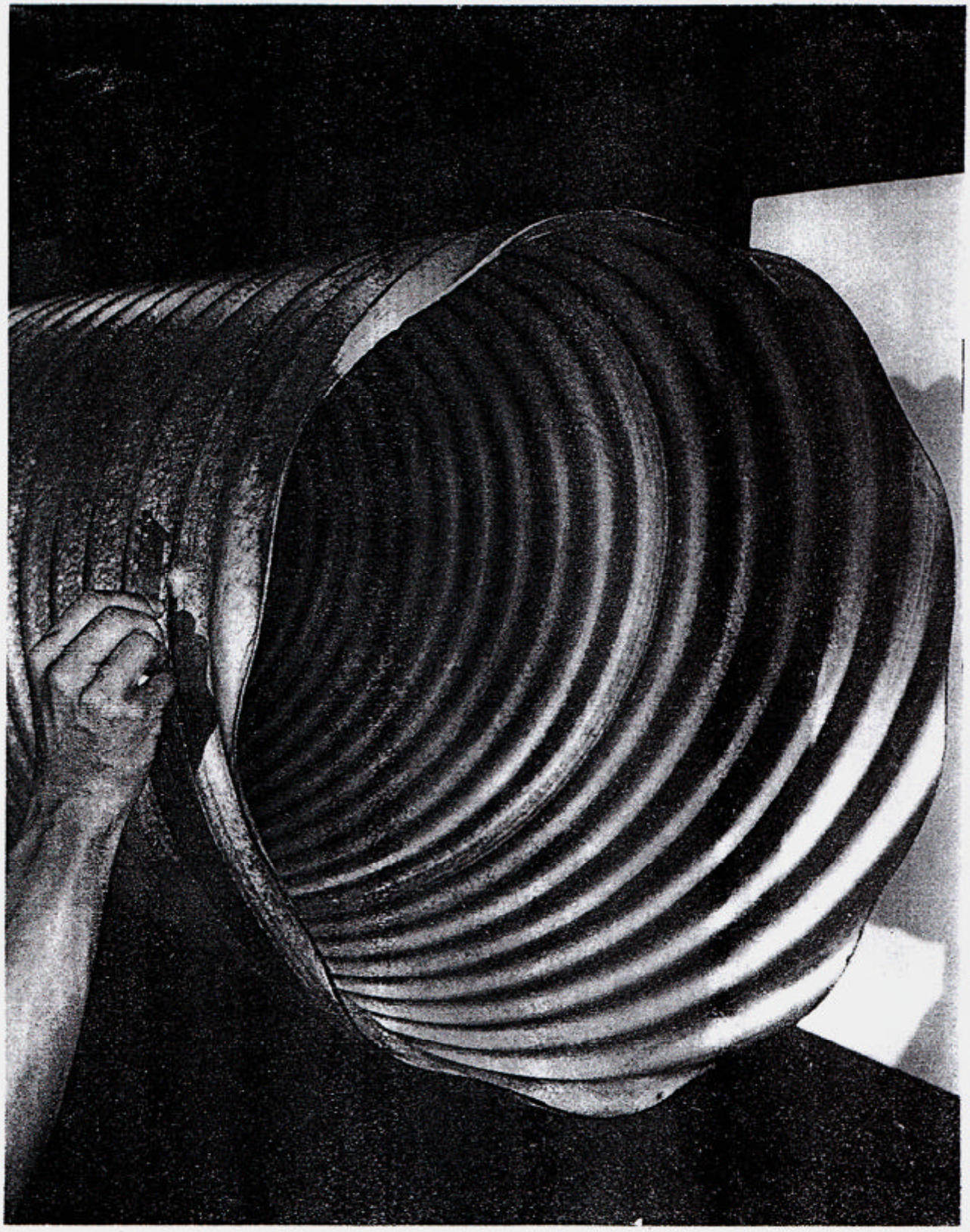


FIGURE 9 - CUP DEPTH ACCEPTANCE

FIGURE 10 - CUP TEST EXCEEDING 6.35 mm MAXIMUM DEFECT LENGTH -REJECTED -