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## IIIc 6

### Examination of weld-seams.

### Prüfung der Schweißnähte.

### Essai et contrôle des cordons de soudure.

Dr. Ing. h. c. M. Roš,

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The examination includes:

- 1) Weld-rods (Electrodes),
- 2) Welders,
- 3) Welding-seams in the finished structure.

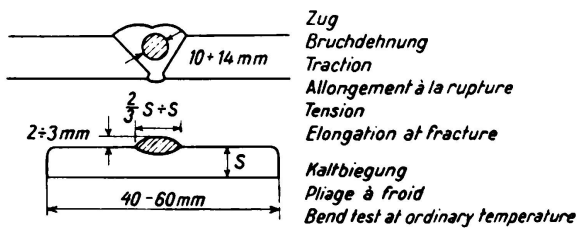


Fig. 1.

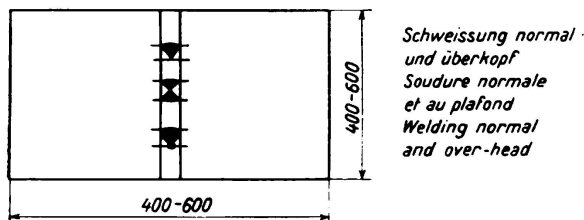


Fig. 2.

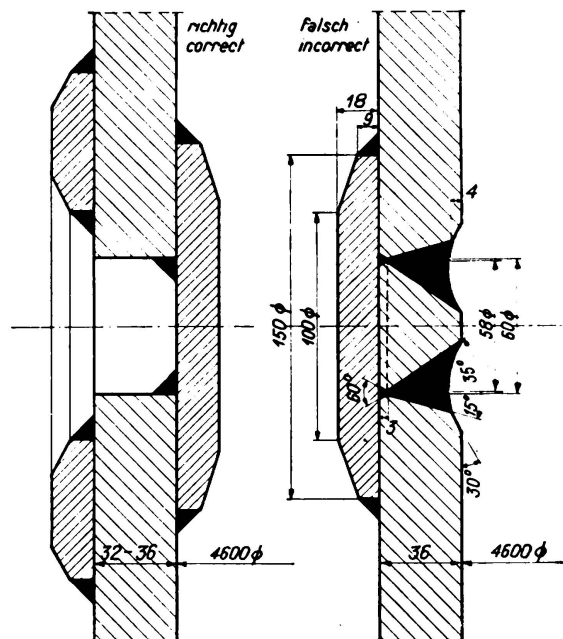


Fig. 3.

Correct and incorrect closure of place whence specimen has been removed, by welding.

1) *Weld-rods (Electrodes)*. The melted weld-material is tested as regards strength, deformation-properties and sensibility with respect to quenching.

Test-piece taken from weld: — Weld material —

*Required values:*

Brinell-hardness  $H = 115$  to  $160$

Tensile-strength for steel as normally used in construction

( $\beta_z = 36 - 44$  kg/mm<sup>2</sup>,  $C \leq 0,15$  %):  $\beta_z = 40 - 55$  kg/mm<sup>2</sup>,

elongation after rupture  $\lambda_{10} = 15 - 25$  %.

Welding-“cords” laid down in thin layers — Sensibility with respect to quenching —

Flexure numeral:  $K = 50 \cdot \frac{s}{r} = 32 - 48$ .

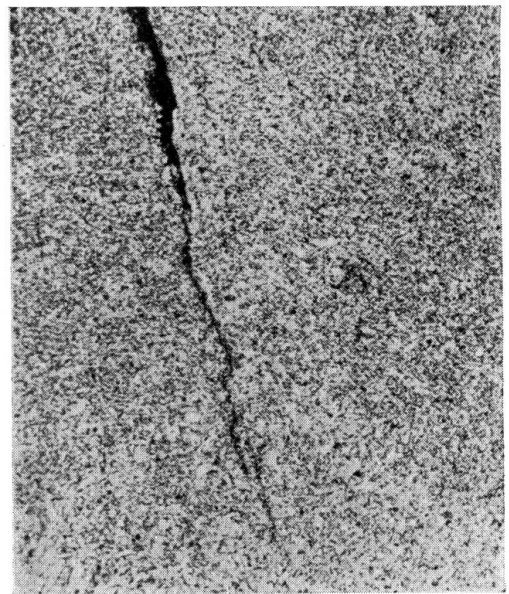
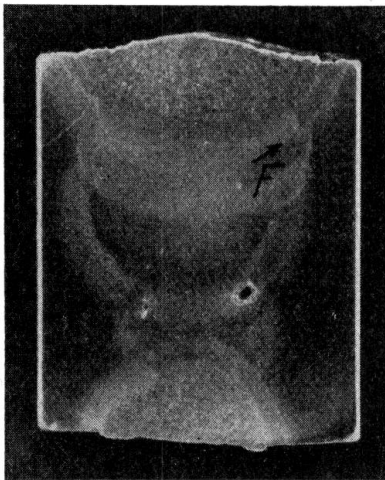
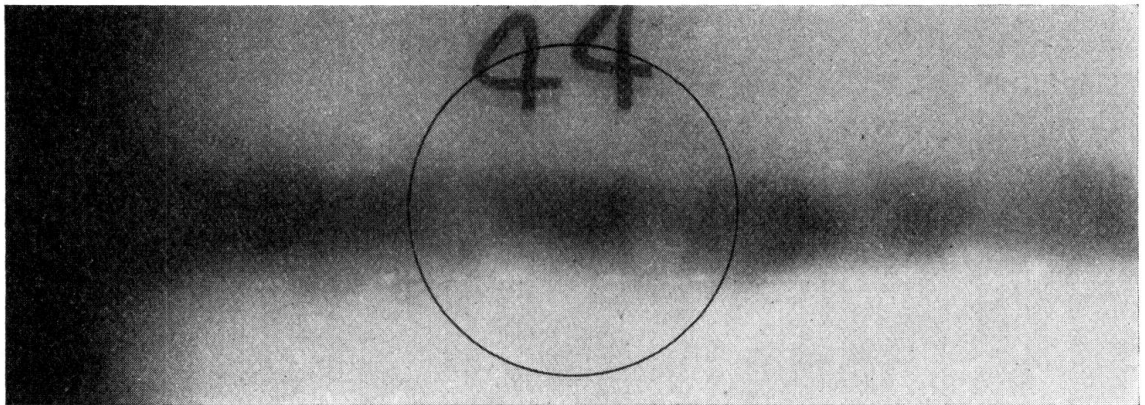


Fig. 4.

Microscopic crack in structure of weld metal, not detectable by x-rays.

*Not compelling values:*

Yield-point  $\delta_s = 25 - 35$  kg/mm<sup>2</sup>

notch-tenacity of small normalised test-pieces EMPA  $x \geq 4$  mkg/cm<sup>2</sup>.

For high-grade steels separate agreements.

2) *Welder. — Workshop.* Plates and bars, of very small and large thickness as used in construction, welded in form of butt- and cruciform joints in normal as well as overhead position were examined by means of X-rays and afterwards subjected to the following tests: coarse-(macro) and fine-(micro)-structure, hardness, tensile-strength, folding-flexure capacity, repeated stress-strength and — by way of exception — to notch — tenacity. The selection of the test-pieces is carried out according to the results of the X-ray examination.

Failures of bond are not admissible. The structure must be free from cracks. For steel as normally used in construction the following is required: Hardness numbers of cross-section  $H = 115 - 160 \text{ kg/mm}^2$ , surface  $H \leq 180 \text{ kg/mm}^2$ ; tensile-strength — butt-joint — equal to that of the steel,  $\beta_z = 36 - 44 \text{ kg/mm}^2$ , tensile-strength — cruciform — joint average value  $\beta_z = 25 \text{ kg/mm}^2$ , minimum  $22,5 \text{ kg/mm}^2$ ; folding-flexure capacity  $K = 20 - 28$  (plate thickness  $\delta < 12 \text{ mm}$ ),  $K = 16 - 20$  ( $\delta = 12 - 20 \text{ mm}$ ) and  $K = 12 - 16$  ( $\delta > 20 \text{ mm}$ );

Repeated stress-strength — blunt-joint —  $\sigma_U \geq 15 \text{ kg/mm}^2$  — normal position —  
 $\sigma_U \geq 12 \text{ kg/mm}^2$  — overhead —

Repeated stress-strength — cross-joint  $\sigma_U \geq 6 \text{ kg/mm}^2$ .

For high-grade and special-steels, requirements ad hoc.

3) *Welding-seams. — Finished structure.* Discs or bars of suitable shapes (round, oval), are be taken from the finished structure or structural element at suitable points and tested in a similar manner, to comply with the same requirements as regards strength and deformation, as described in the preceding paragraph under „welders“. The characteristic values obtained must be within the same limits; only very slight differences are admissible. The places from which the test-pieces are taken must be made good with particular care to avoid accumulations of weld-metal and to minimise internal and shrinkage stresses (Fig. 3).

X-ray examinations serve to disclose nonconnected spots, pores, slag inclusions and cracks, but they do not reveal the presence of very fine hair cracks which are often undesirable — Fig. 4. Frequently the X-ray examination must be carried out twice, firstly on the weld-seams after completion of the welding, secondly after removal (by shaping, grinding, cutting) of the unevenness of the top-layers. This applies also to places whence test pieces have been removed.