Report

to

The New York State Electric and Gas Corporation

on

EXAMINATION FOR GRAPHITIZATION OF WELD-PROBER SAMPLES FROM FOUR WELDS BETWEEN PIPE AND VALVES IN THE 12-INCH MAIN STEAM LINES OF THE GOUDEY STATION

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EXAMINATION FOR GRAPHITIZATION OF WELD-PROBER SAMPLES FROM FOUR WELDS BETWEEN PIPE AND VALVES IN THE 12-INCH MAIN STEAM LINES OF THE GOUDEY STATION

Eight weld-prober samples from four welds connecting pipe to valves in the 12-inch main steam line connecting Boilers 11 and 12 to the turbine in the Goudey Station of The New York State Electric and Gas Corporation were examined for graphitization. The welds were reported to have been in service for 82,481 hours at an average temperature of 856.5°F. The pipe was 0.5 Mo steel (ASTM A-206-40 Grade P-1) and the valves were cast 0.5 Mo steel (ASTM A-217 Grade WC-1).

The welds from which the samples were taken had not previously been examined. Three previous examinations (References 1, 2 and 3) had been carried out on samples from the eight-inch lines connecting Boilers 11 and 12 to the 12-inch line sampled for this report. The last examination of the eight-inch lines (Reference 3) had shown considerable graphite in the valve side heat-affected zones of the eight-inch boiler stop valves (welds W7-11B and W7-12B) after 72,800 hours of service.

SUMMARY AND CONCLUSIONS

No serious graphitization was found in any of the samples submitted. Slight nodular graphitization was found on the valve sides of the welds for the pipe to 12-inch turbine stop valve (weld W1-7T) and the pipe to the 6-inch x 10-inch pressure reducing valve (weld W2-PRV).

Any graphitization in the other samples or in the pipe sides of the welds was at most so slight that graphite could not be positively identified.

It appears that only the eight-inch boiler stop valves have shown considerable graphitization to date in the main steam piping of this system. The reasons for this are not apparent from available information.

HISTORY OF SPECIMENS

Eight weld-prober samples from four pipe to valve welds submitted under date of July 28, 1953 were described as follows:

Sample Number	Sample Code	Pipe	Valve
1 2	W1-7T-180° W1-7T-270°	12 3/4-inch O.D. x 0.850-inch wall ASTM A-206-40 Grade P-1	12-inch turbine stop valve ASTM A-217-40 Grade WC-1. R.P. and C. 900 psi gate valve
3 4	W2-7T-90° W2-7T-270°	12 3/4-inch O.D. x 0.850-inch wall ASTM A-206-40 Grade P-1	12-inch turbine throttle valve ASTM A-217 Grade WC-1 Westinghouse Special
5 6	W5-H-0° W5-H-270°	12-inch schedule 100 ASTM A-206-40 Grade P-1	6-inch pressure reducing station stop valve ASTM A-217-49T Grade WC-1. R.P. and C. Fig. No. 9004
7 8	W2-PRV-0° W2-PRV-270°	6-inch schedule 120 ASTM A-206-40 Grade P-1	6-inch x 10-inch 900 psi/ 400 psi pressure reducing valve Not specified but similar to ASTM A-217 Grade WC-1. Republic Flow Meters Spec.

The samples were removed during the week ending July 25, 1953 when the total service hours were 82,481, and the average service tempera-

ture was 856.5°F. The samples were taken from the 12-inch main steam line from Number 11 and 12 boilers to the turbine.

The details of the materials and location of the welds examined were extracted from New York State Electric and Gas Corporation Drawing Number B-133-2 included with the July 28, 1953 letter of transmittal for the samples. The degree designation included in the sample Code was established by: "With the observor looking downstream along the axial center line of the pipe, read clockwise with the top of the pipe specified as zero degress." Two samples, identified by the degree marking, were taken from each of the four welds sampled.

Both the pipe and castings were 0.5-per cent molybdenum steel.

PROCEDURE

Each weld-prober sample was cut lengthwise into two halves. One half was ground, macroetched and photographed. The other half was cut into metallographic samples permitting examination of the two base metals, both the upstream and downstream heat-affected zones of the weld and the weld deposited metal. A very thorough examination was carried out for graphite under the microscope. Typical photomicrographs were taken and included in the report for each heat-affected zone at the location where concentrated graphite tends to form in such welds.

RESULTS

The results of the careful microscopic examinations for graphite are given in Table I. Plate 1 shows the macrostructures of the samples,

and Plates 2 through 17 show the typical microstructures for the heat-affected zones for all samples. The results are summarized as follows:

1. The graphitization was very slight. Definitely identifiable nodules of graphite were found only in the heat-affected zone of the weld on the valve side of samples from the W1-7T and W2-PRV welds. These were very minor in extent. In neither case had graphitization developed far enough to even begin to outline the heat-affected zones.

2. Definitely identifiable graphite was not observed in the heat-affected zone of other samples, although there were extremely small nodules present which may be the beginning of graphitization.

3. No indication of graphite was observed in base materials or weld deposited metals.

4. The macroexamination showed usual structures for pipe and valves and welds joining the two. Specimen Number 4 macroetched in a somewhat different pattern on the valve side than the other samples. This, however, was not due to graphite, but mainly to the distribution of inclusions in the casting.

5. No particular difference between the two samples from the same weld was observed in any case.

DISCUSSION OF RESULTS

The degree of graphitization in the samples examined was very slight. Apparently graphitization is progressing very slowly and as yet is confined to the turbine stop valve and the 900 psi/400 psi pressure reducing valve.

The samples from the 12-inch line examined for this report had not previously been examined. The eight-inch lines from Boilers 11 and 12 to the 12-inch lines had previously been examined (References 1, 2 and 3). The last previous examination of samples from the eight-inch line had shown considerable graphite on the valve side of W7-12B and W7-11B welds. (See Reference 3.) These welds were between pipe and the eight-inch boiler stop valves and had been in service for 72,850 hours. The non-return valves in the same lines showed only slight amounts of nodular graphite. A very small amount of graphite was found in some of the pipe side heat-affected zones.

From these examinations, it would appear that for reasons not readily apparent graphitization has been very minor in all welds except those connecting the eight-inch lines from the boilers to the eight-inch boiler stop valves. Presumably the cause could be chemical composition, deoxidization practice, or service condition differences not shown by the information supplied.

REFERENCES

(1) Examination for Graphitization of Five Weld-Prober Sampled from the Carbon-Molybdenum Steel Steam Piping in the Westover Station of the New York State Electric and Gas Corporation. Project Number M771, Report Number 1, July 13, 1948.

(2) Examination for Graphitization of Six Weld-Prober Samples from the Carbon-Molybdenum Steam Piping in the Goudey Station. Project Number M771-A, Report Number 1, April 6, 1951.

(3) Examination for Graphitization of Eight Weld-Prober Samples from the Main Steam Lines of the Goudey Station. Project M771-2, Report Number 1, May 16, 1953.

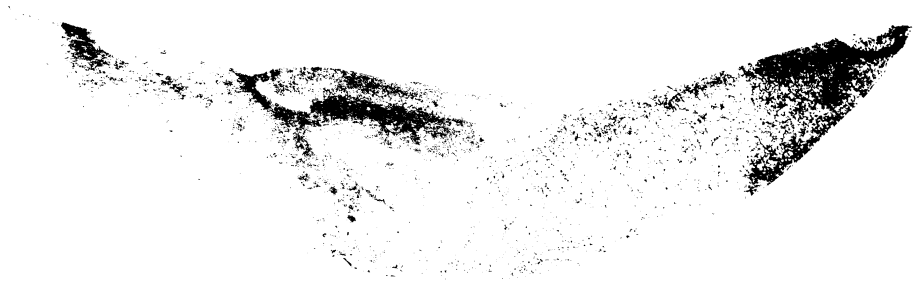
TABLE I

RESULTS OF MICROSCOPIC EXAMINATION OF HEAT-AFFECTED ZONES OF WELD-PROBER SAMPLES FOR GRAPHITE

Sample	Sample Code	Weld Location	Amount of Graphite Present in Heat-Affected Zones of Weld		Plates
			Valve Side	Pipe Side	
1 2	W1-7T-180° W1-7T-270°	Pipe to 12-inch turbine stop valve	Very few small nodules of graphite	No graphite	2, 3, 4 and 5
3 4	W2-7T-90° W2-7T-270°	Pipe to 12-inch turbine throttle valve	No graphite	No graphite	6, 7, 8 and 9
5 6	W5-H-0° W5-H-270°	Pipe to 6-inch pressure reducing station stop valve	No graphite	No graphite	10, 11, 12 and 13
7 8	W2-PRV-0° W2-PRV-270°	Pipe to 6-inch x 10-inch 900 psi/400 psi pressure reducing valve	Trace of graphite	No graphite	14, 15, 16 and 17

pipe side valve side

(No. 1): Sample W1-7T-180° -- 12-inch turbine stop valve to pipe weld.



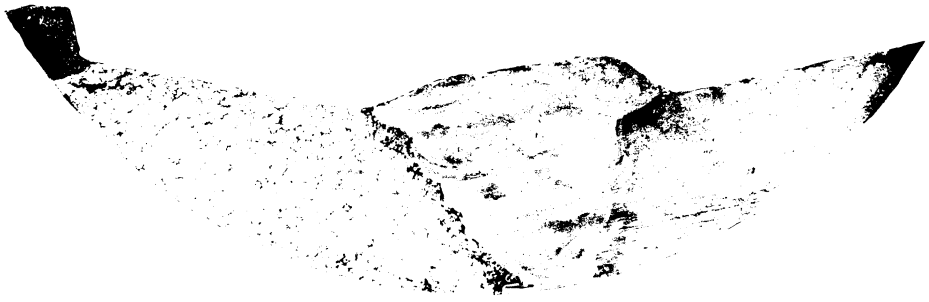
pipe side valve side

(No. 2): Sample W1-7T-270° -- 12-inch turbine stop valve to pipe weld.

valve side pipe side

(No. 3): Sample W2-7T-90° -- pipe to 12-inch turbine throttle valve weld.

Plate 1. Macrostructure of Weld-Prober Samples - XLD.

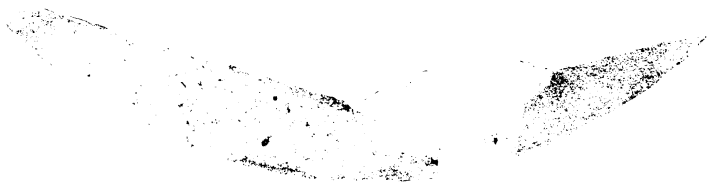


valve side pipe side

(No. 4): Sample W2-7T-270° -- pipe to 12-inch turbine throttle valve weld.

valve side pipe side

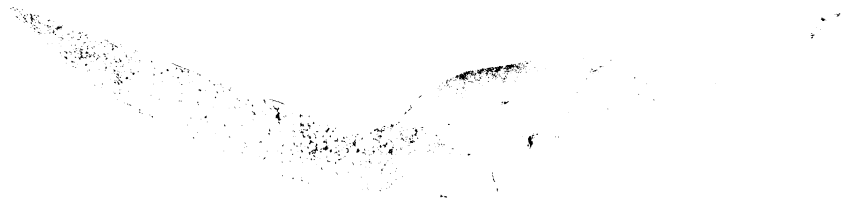
(No. 5): Sample W5-H-0° -- weld between pipe and 6-inch pressure reducing station stop valve.



valve side pipe side

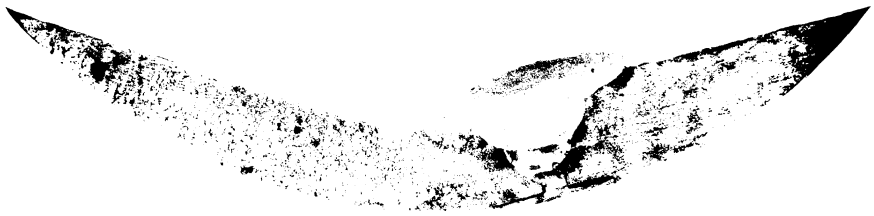
(No. 6): Sample W5-H-270° -- weld between pipe and 6-inch pressure reducing station stop valve.

Plate 1 (Continued). Macrostructures of Weld-Prober Samples - X1D.



valve side pipe side

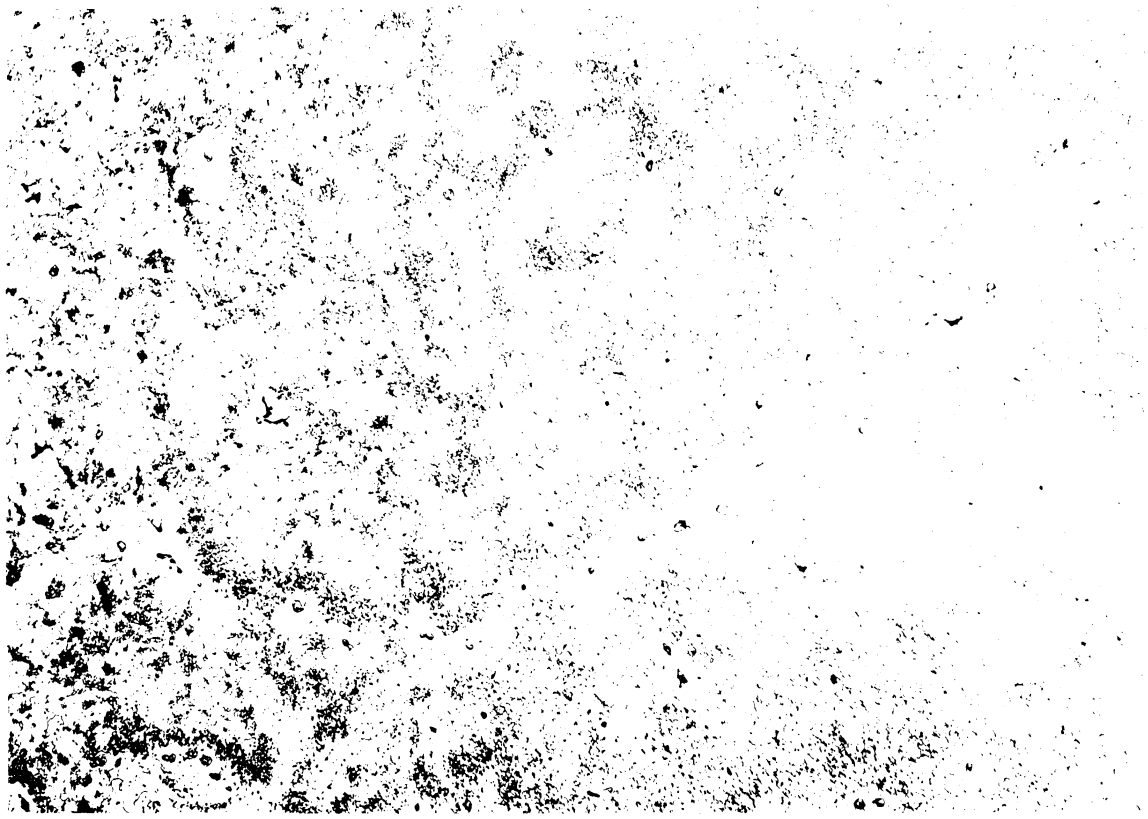
No. 7): Sample W2-PRV-0° -- weld between pipe and 6-inch x 10-inch pressure reducing valve



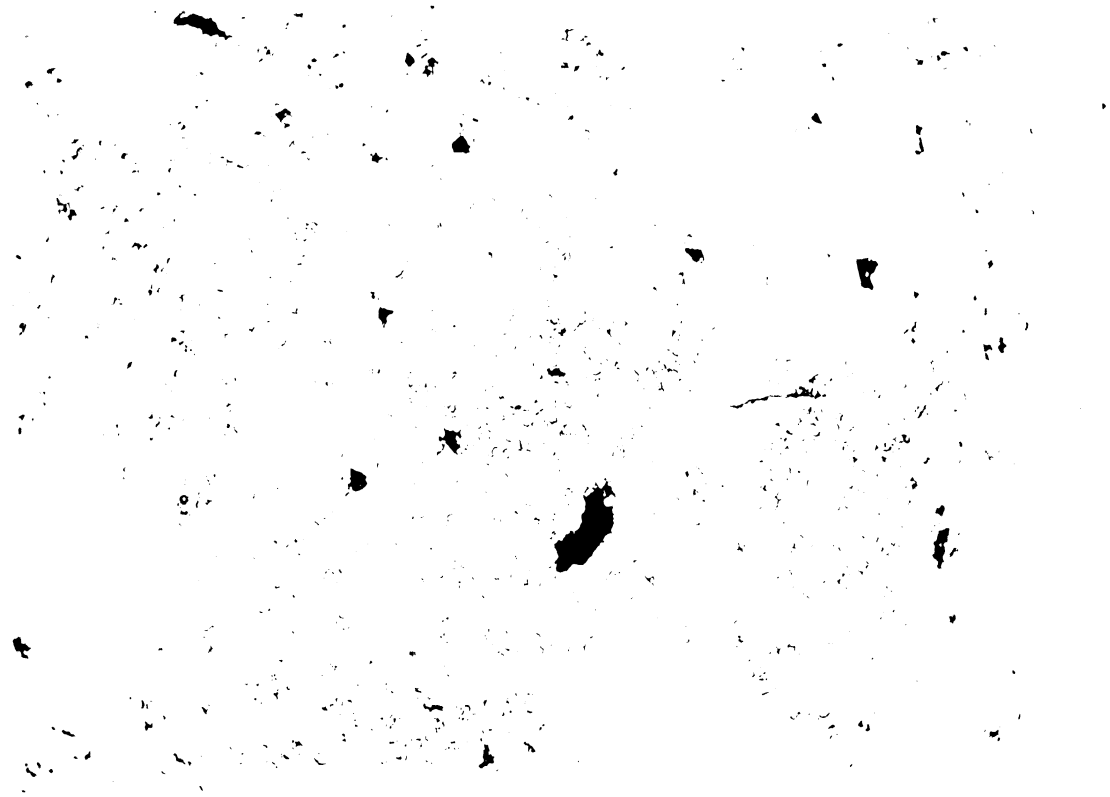
valve side pipe side

(No. 8): Sample W2-PRV-270° -- weld between pipe and 6-inch x 10-inch pressure reducing valve.

Plate 1, Concluded. Macrostructures of Weld-Prober Samples - X1D.



X100D



X1000D

Plate 2. Microstructure of the Upstream Heat-Affected Zone (Valve Side) of Sample W1-7T-180° (No. 1) -- 12-inch Turbine Stop Valve to Pipe Weld.

X100D

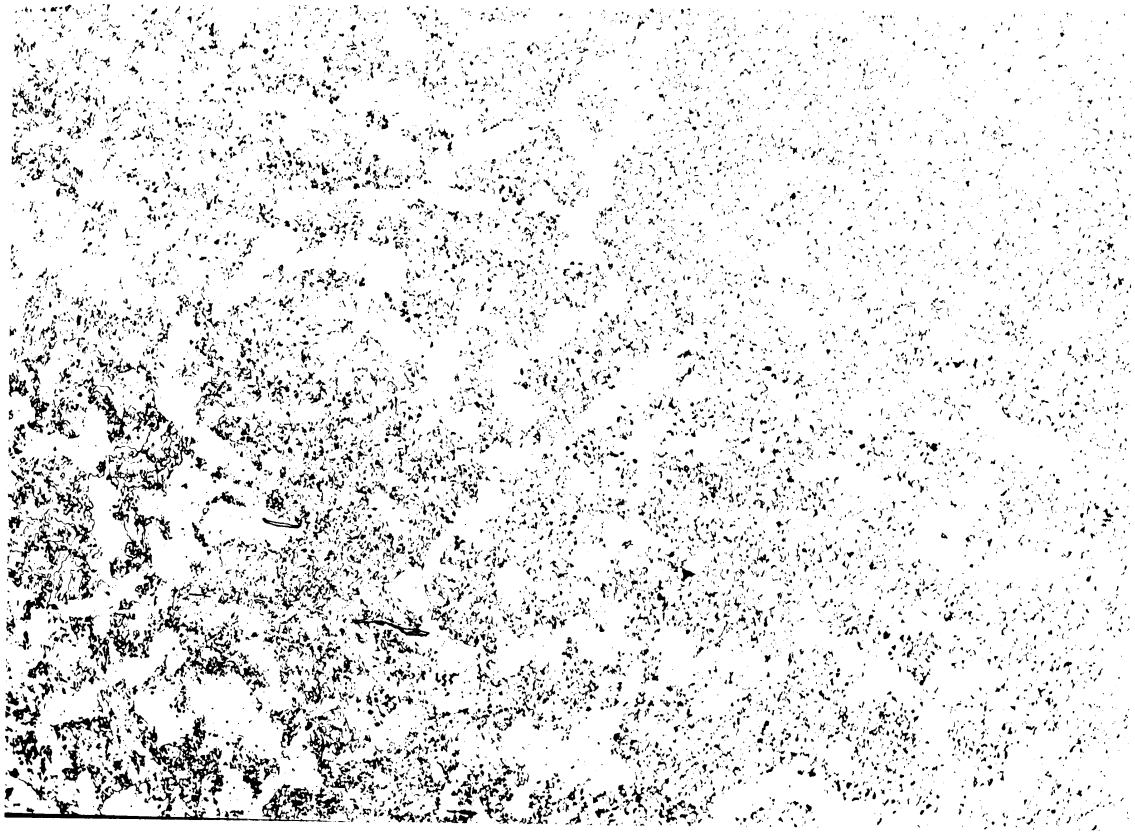
X1000D

Plate 3. Microstructure of the Downstream Heat-Affected Zone (Pipe Side) of Sample W1-7T-180° (No. 1) -- 12-inch Turbine Stop Valve to Pipe Weld.

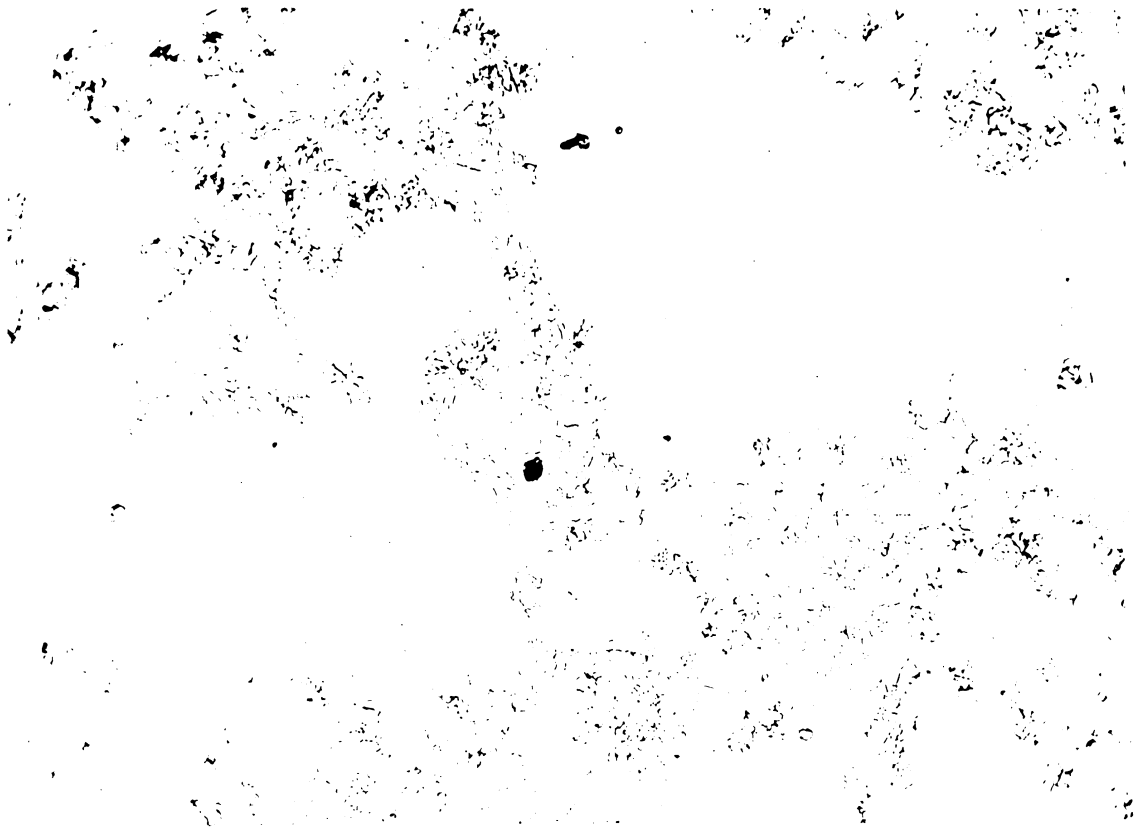
X100D

X1000D

Plate 4. Microstructure of the Upstream Heat-Affected Zone (Valve Side) of Sample W1-7T-270° (No. 2) -- 12-inch Turbine Stop Valve to Pipe Weld.

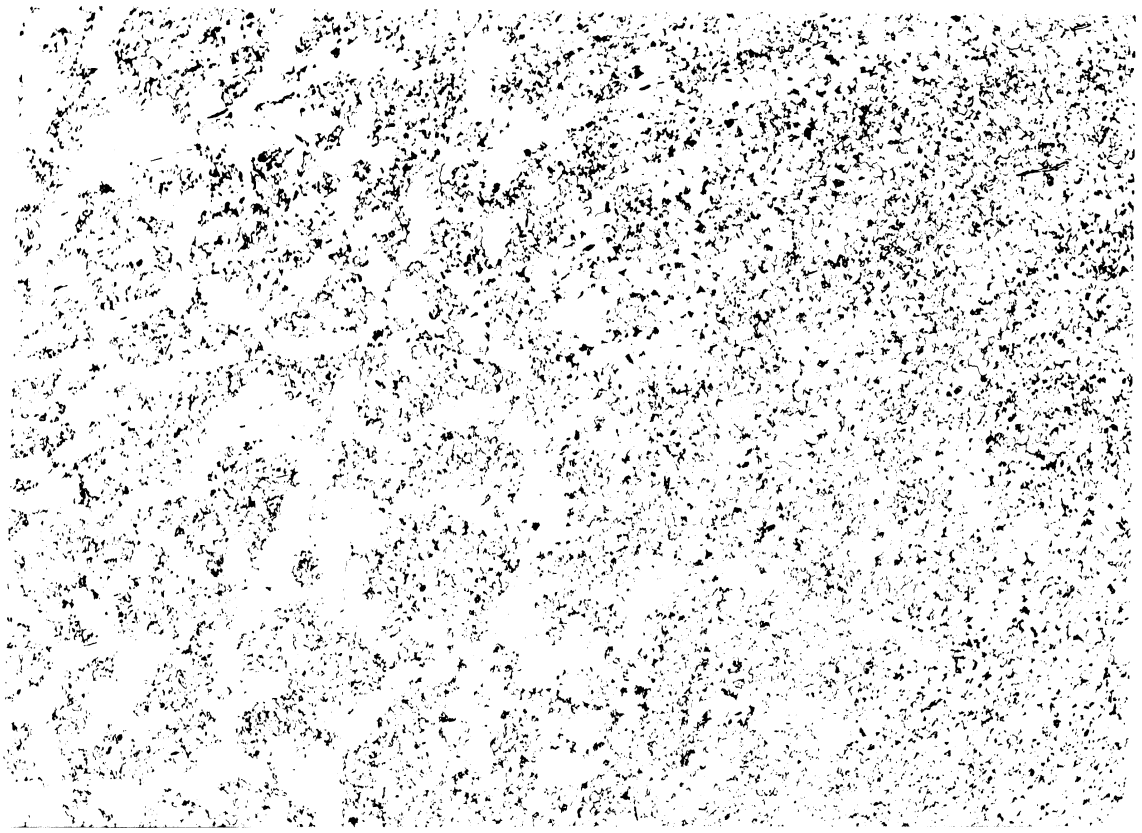


X100D

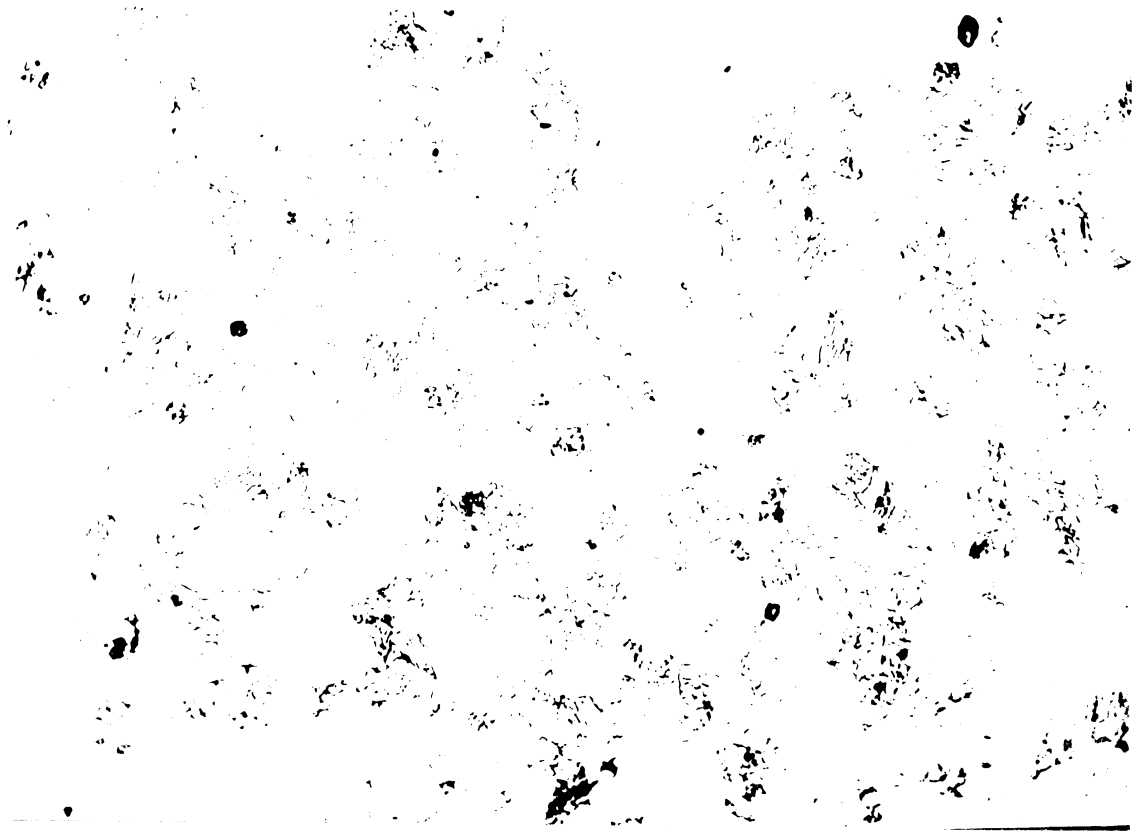


X1000D

Plate 5. Microstructure of the Downstream Heat-Affected Zone (Pipe Side) of Sample W1-7T-270° (No. 2) -- 12-inch Turbine Stop Valve to Pipe Weld.

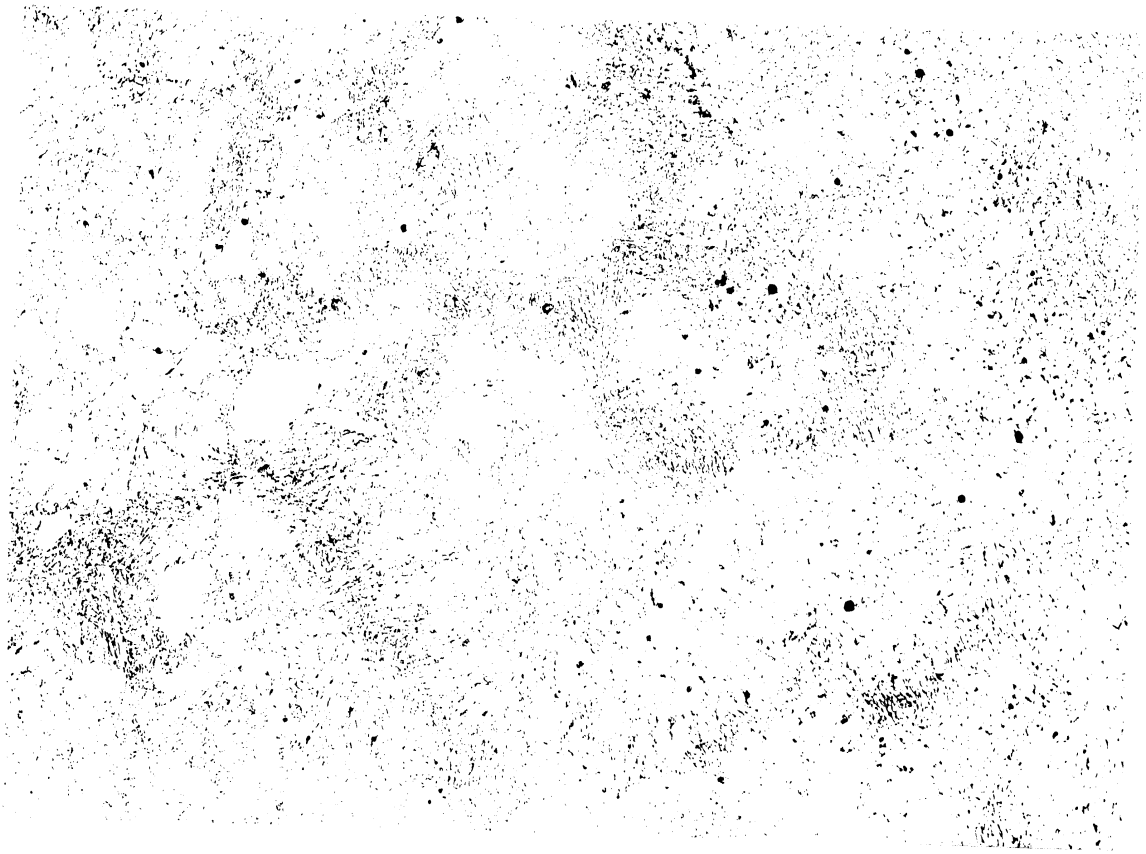


X100D

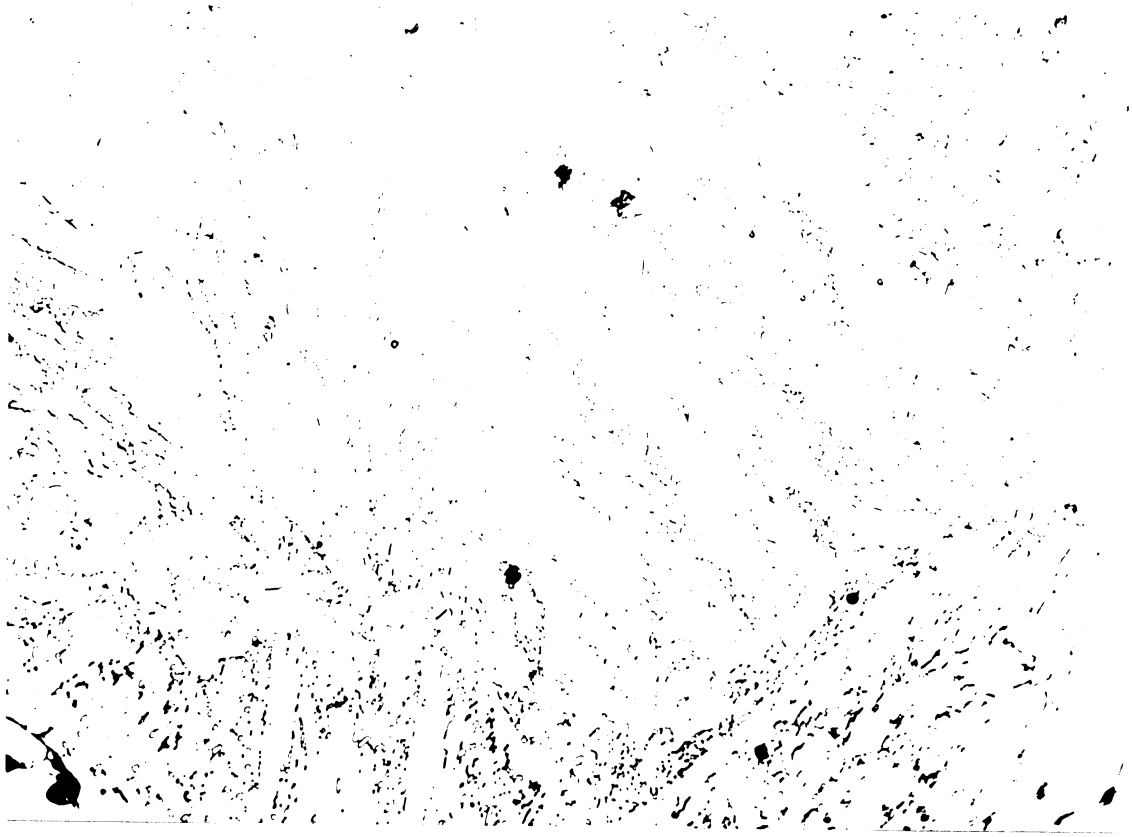


X1000D

Plate 6. Microstructure of the Upstream Heat-Affected Zone (Pipe Side) of Sample W2-7T-90° (No. 3) -- Pipe to 12-inch Turbine Throttle Valve Weld.

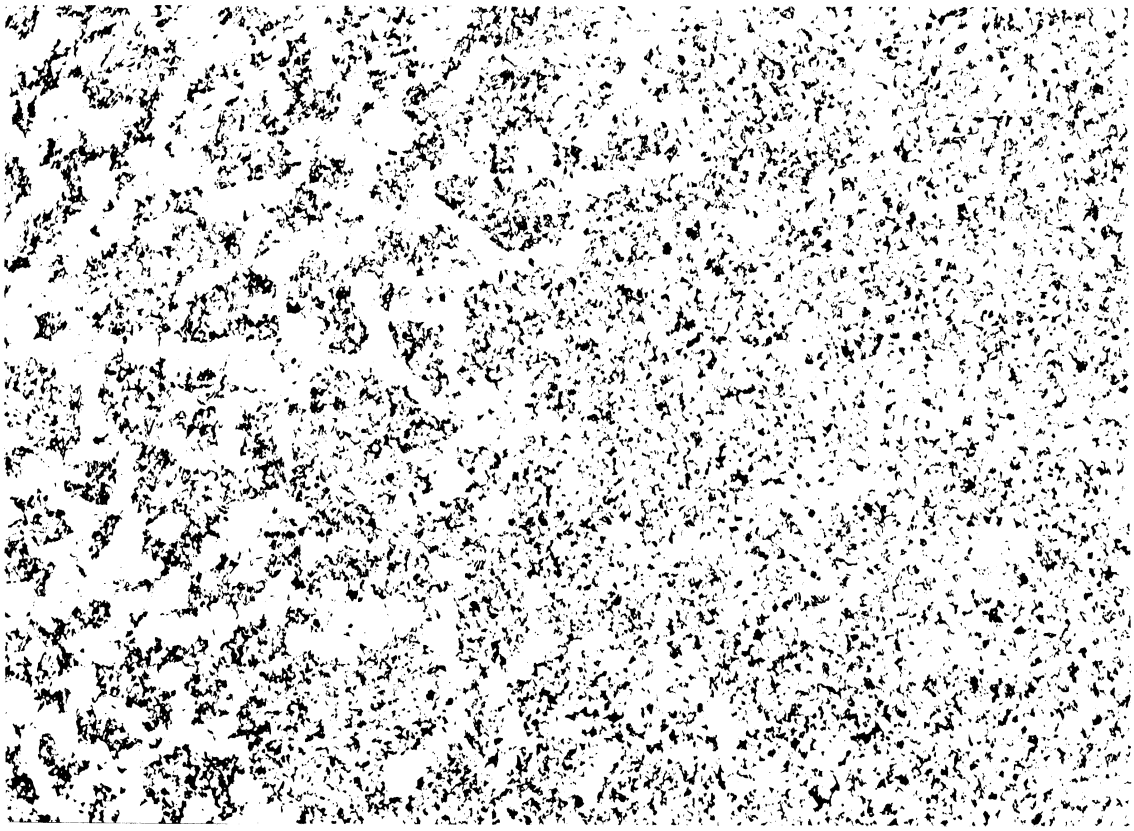


X100D

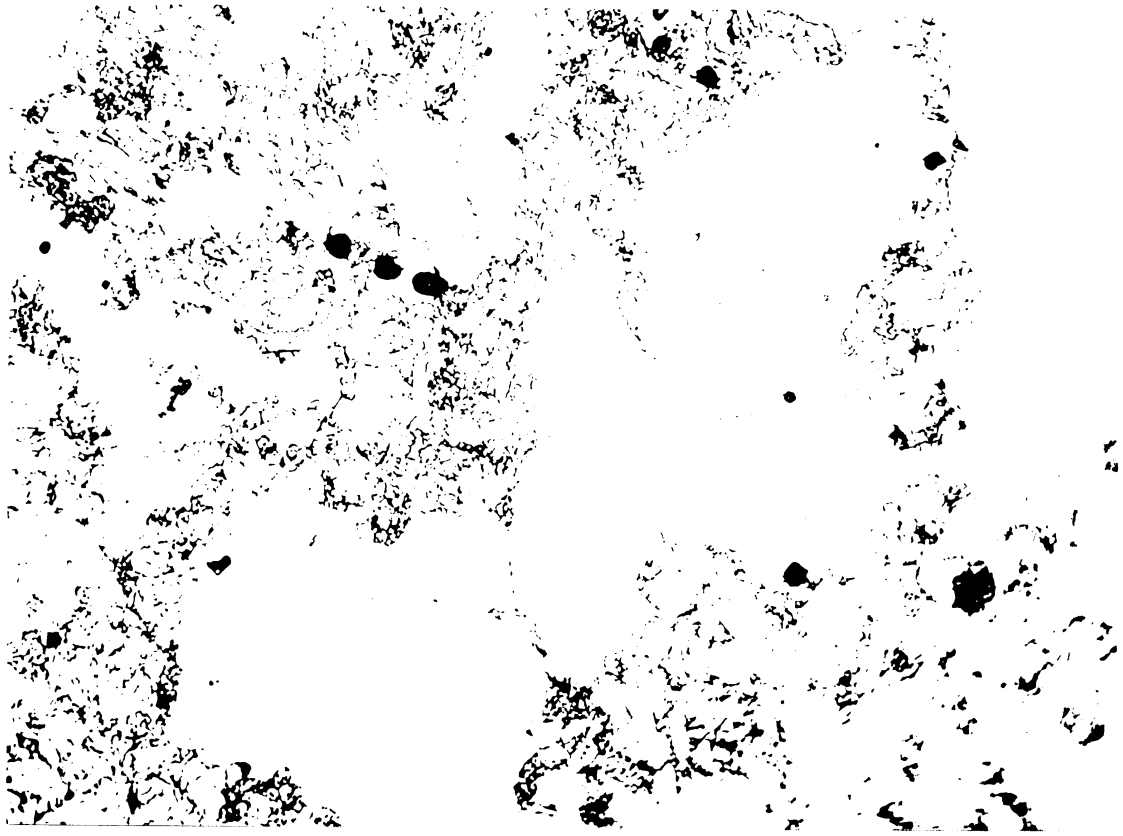


X1000D

Plate 7. Microstructure of the Downstream Heat-Affected Zone (Valve Side) of Sample W2-7T-90° (No. 3) -- Pipe to 12-inch Turbine Throttle Valve Weld.

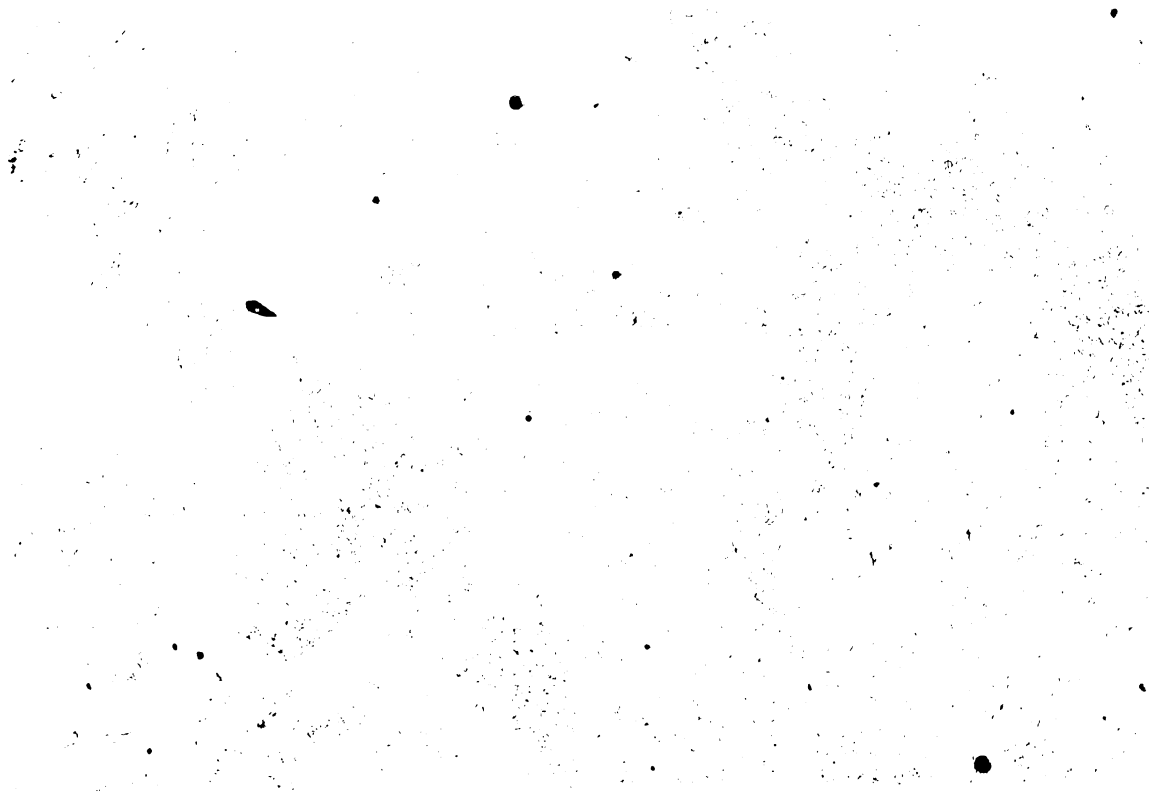


X100D

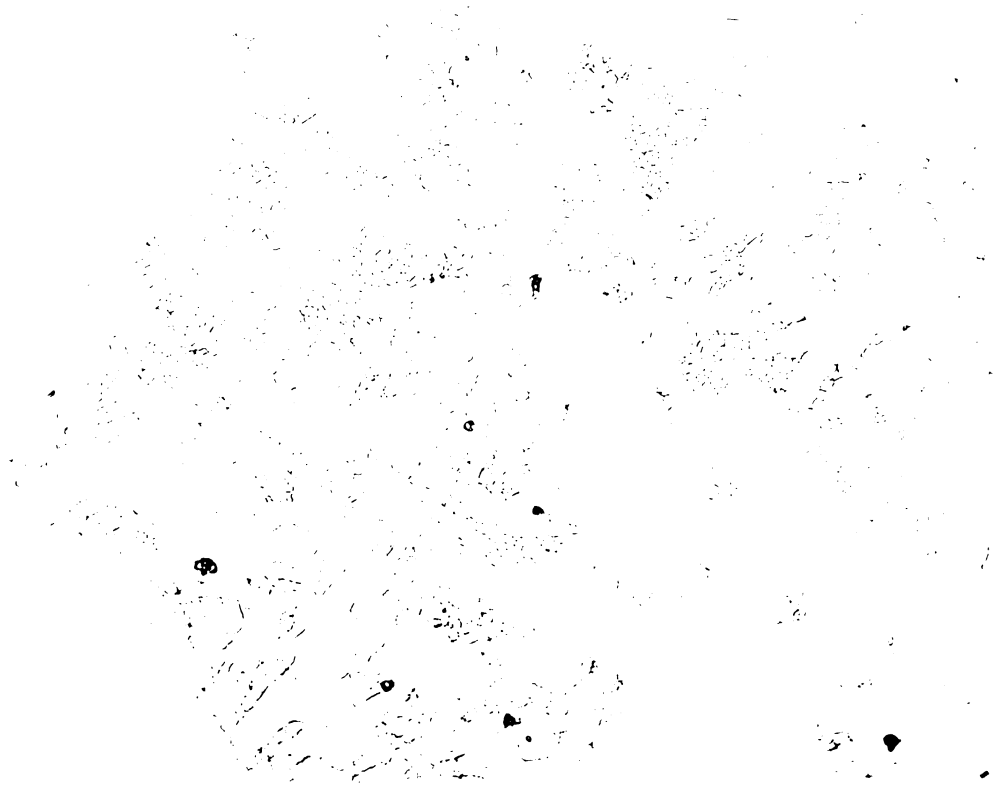


X1000D

Plate 8. Microstructure of the Upstream Heat-Affected Zone (Pipe Side) of Sample W2-7T-270° (No. 4) -- Pipe to 12-inch Turbine Throttle Valve Weld.



X100D



X1000D

Plate 9. Microstructure of the Downstream Heat-Affected Zone (Valve Side) of Sample W2-7T-270° (No. 4) -- Pipe to 12-inch Throttle Valve Weld.

X100D

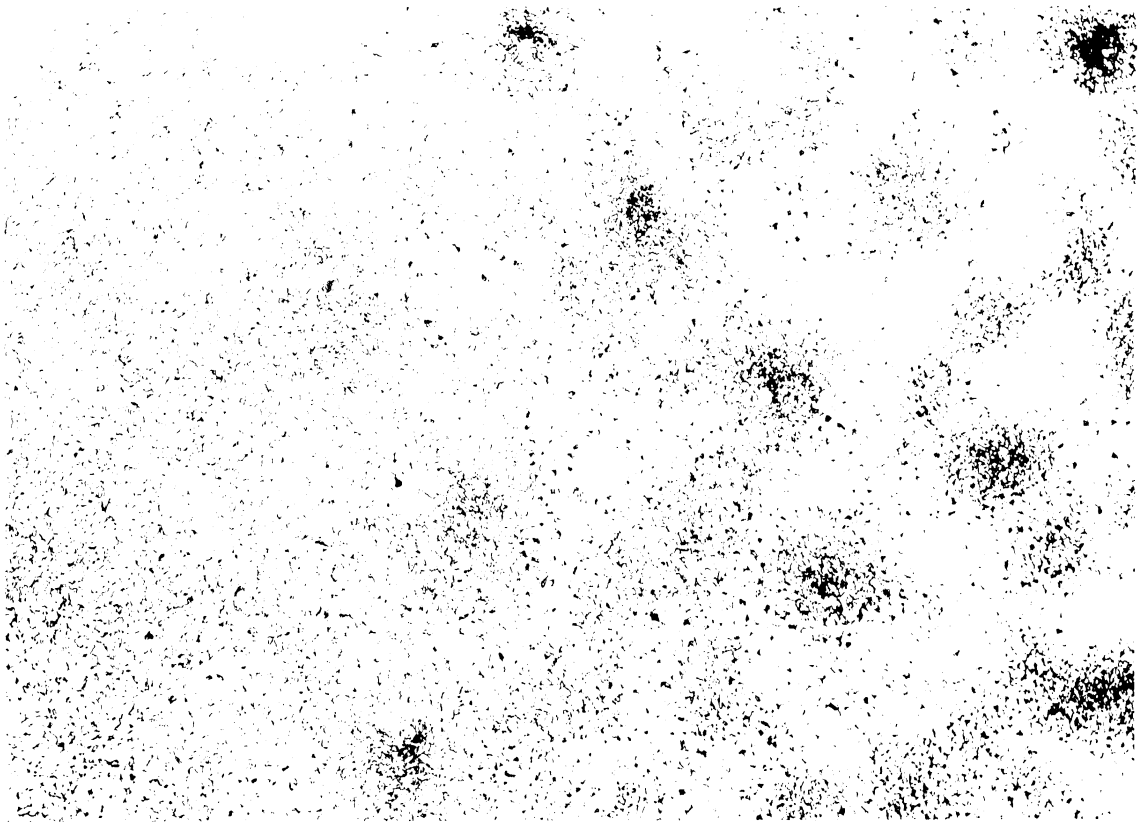
X1000D

Plate 10. Microstructure of the Upstream Heat-Affected Zone (Pipe Side) of Sample W5-H-0° (No. 5) -- Weld between Pipe and 6-inch Pressure Reducing Station Stop Valve.

X100D

X1000D

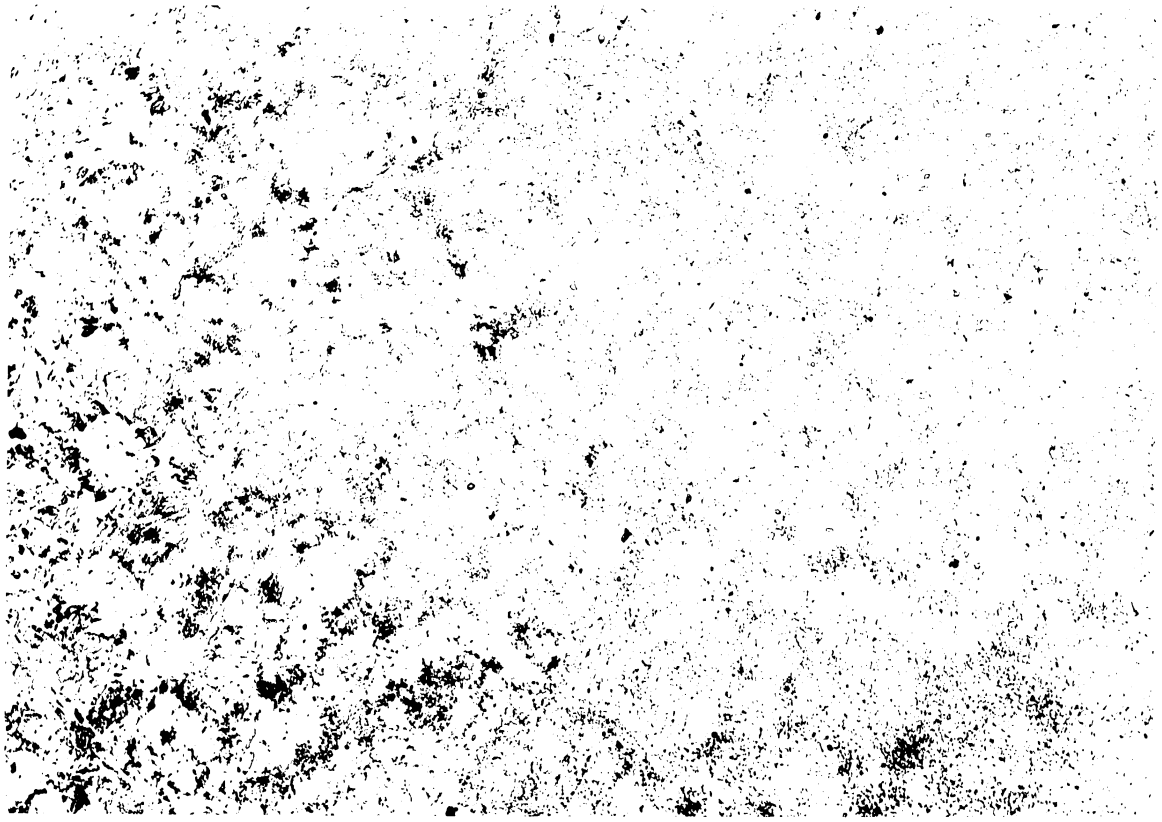
Plate 11. Microstructure of the Downstream Heat-Affected Zone (Valve Side) of Sample W5-H-0° (No. 5) -- Weld between Pipe and 6-inch Pressure Reducing Station Stop Valve.



X100D

X1000D

Plate 12. Microstructure of the Upstream Heat-Affected Zone (Pipe Side) of Sample W5-H-270° (No. 6) -- Weld between Pipe and 6-inch Pressure Reducing Station Stop Valve.



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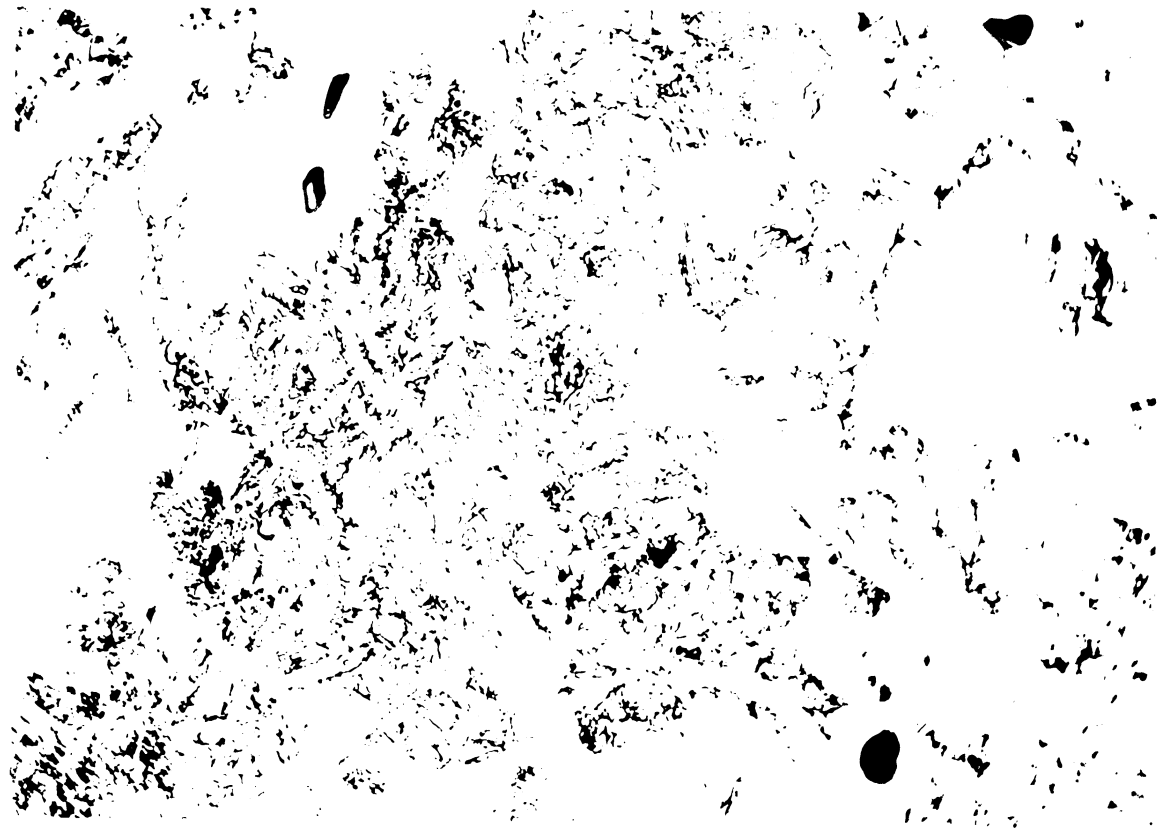
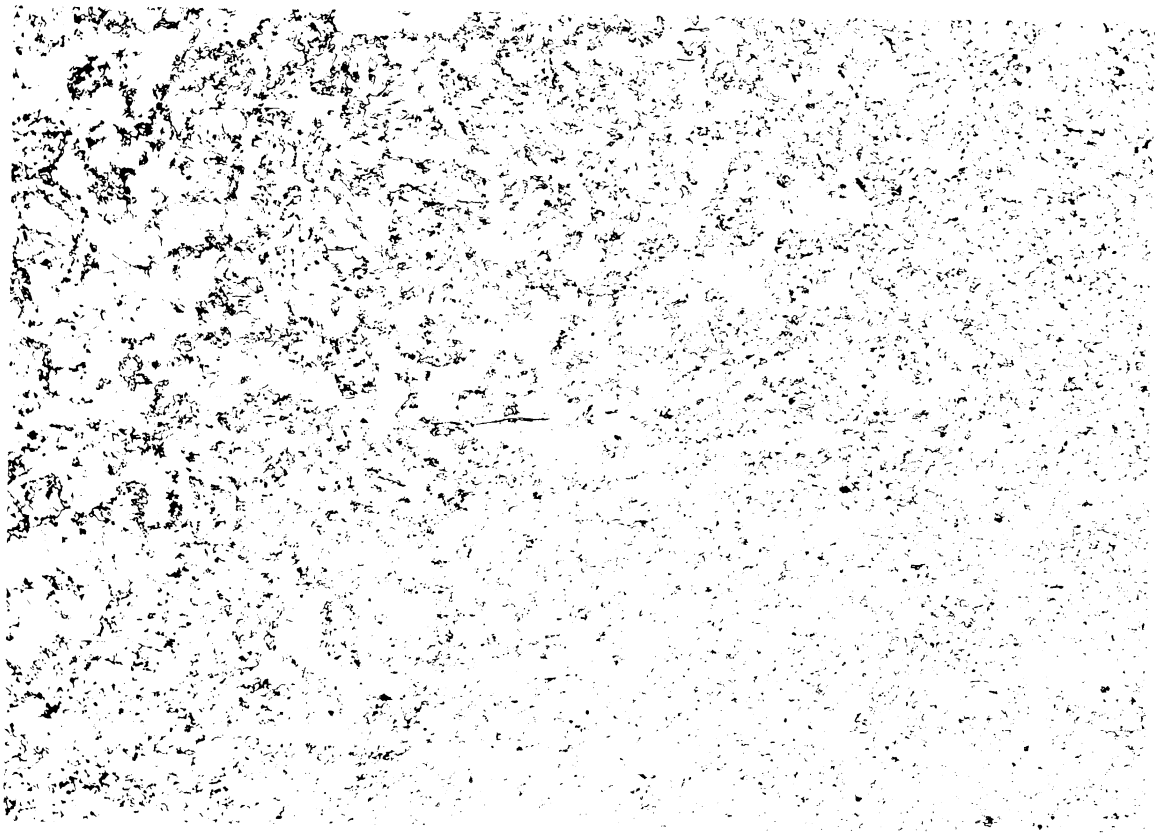
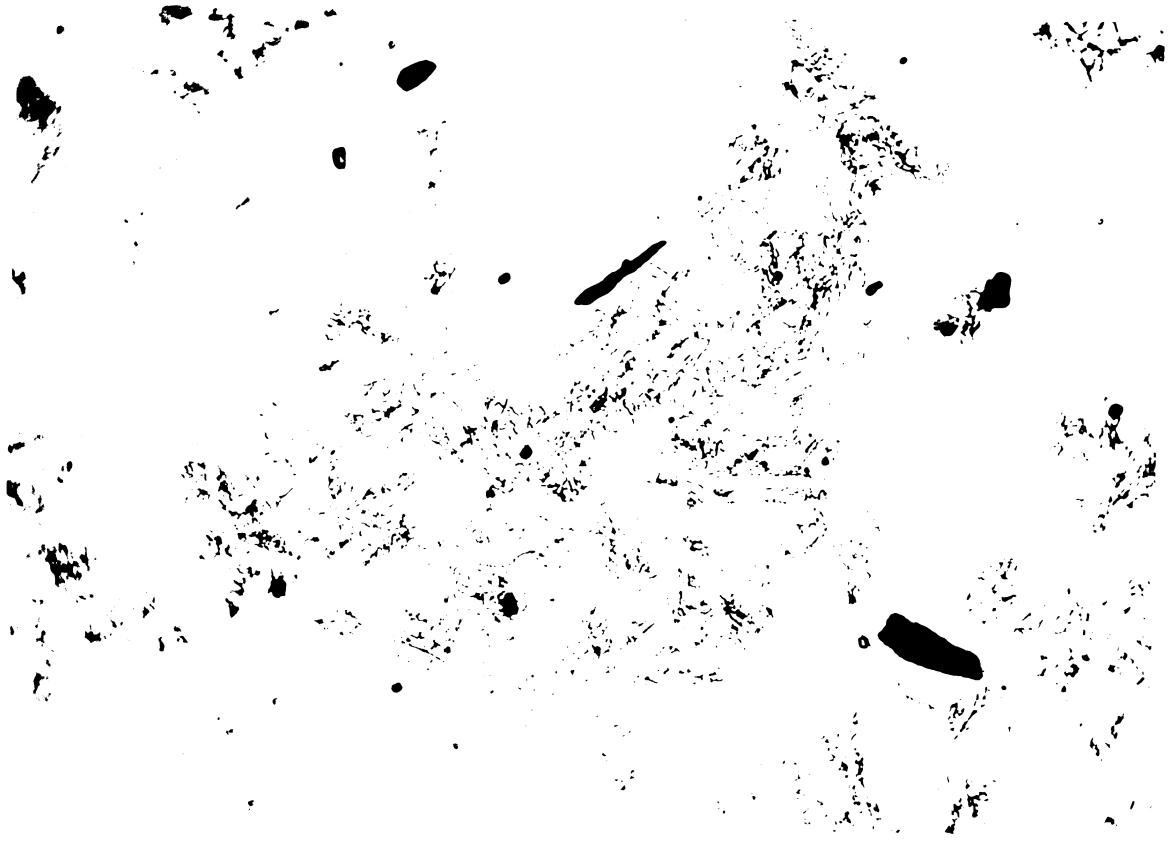


X1000D

Plate 13. Microstructure of the Downstream Heat-Affected Zone (Valve Side) of Sample W5-H-270° (No. 6) -- Weld between Pipe and 6-inch Pressure Reducing Station Stop Valve.

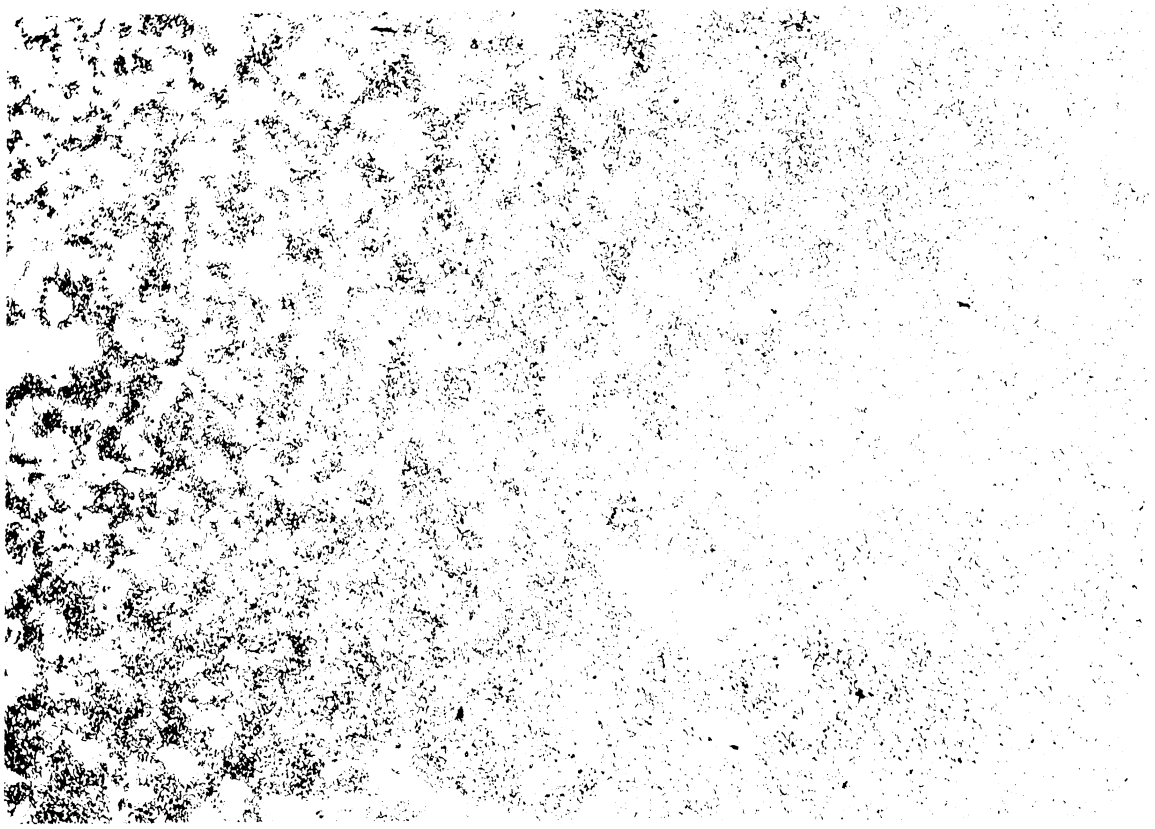


X100D



X1000D

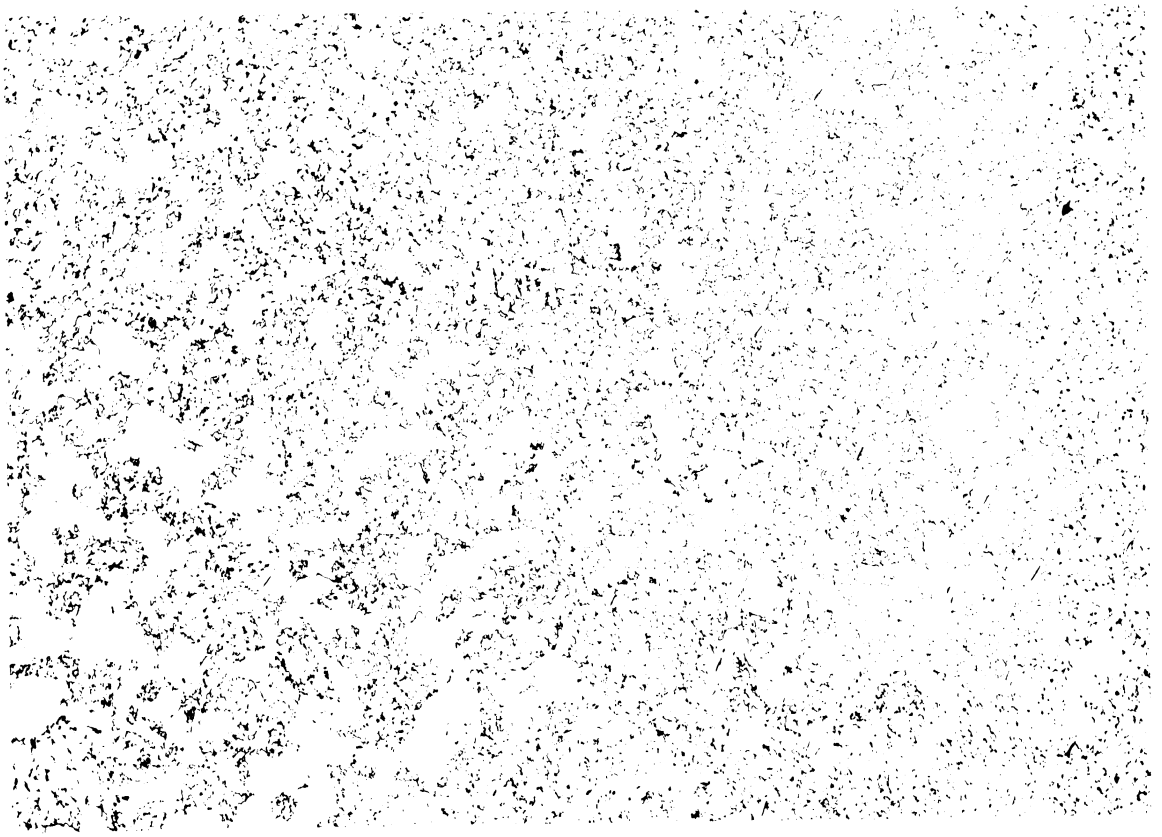
Plate 14. Microstructure of the Upstream Heat-Affected Zone (Pipe Side) of Sample W2-PRV-0° (No. 7) -- Weld between Pipe and 6-inch x 10-inch Pressure Reducing Valve.



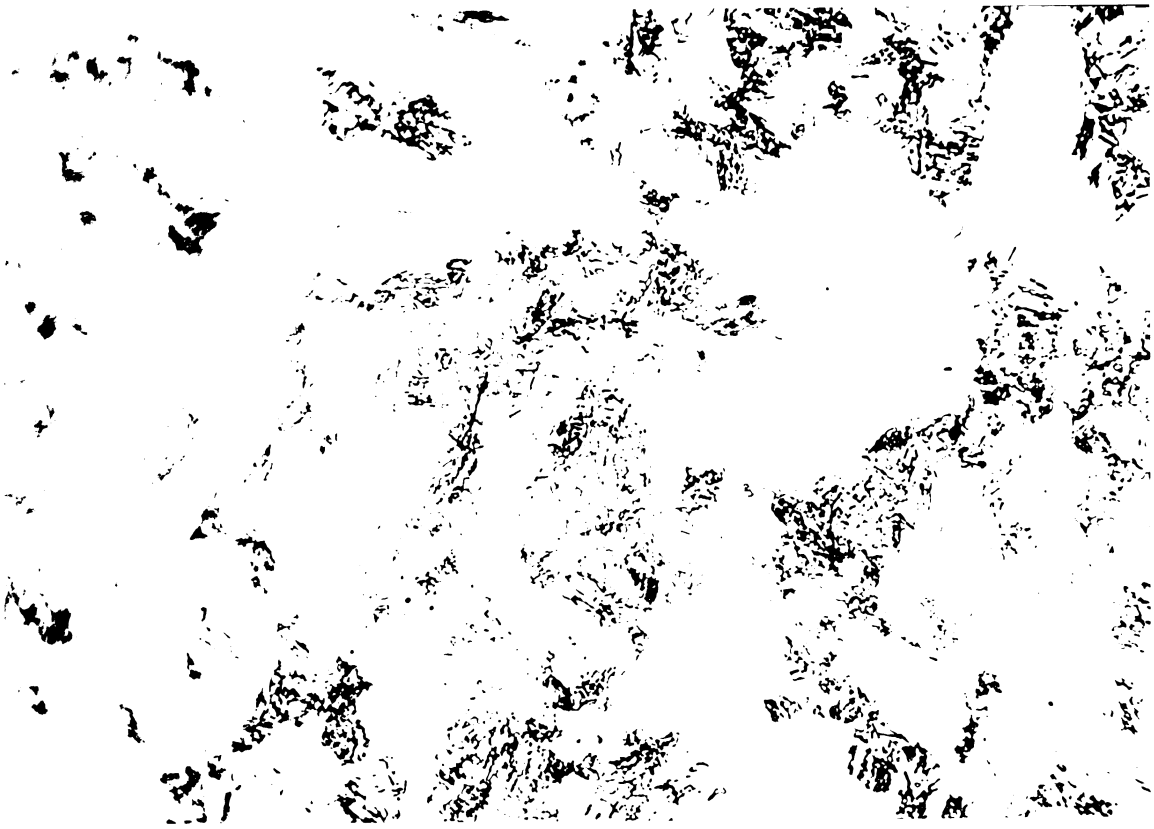
X100D

X1000D

Plate 15. Microstructure of the Downstream Heat-Affected Zone (Valve Side) of Sample W2-PRV-0° (No. 7) -- Weld between Pipe and 6-inch x 10-inch Pressure Reducing Valve.

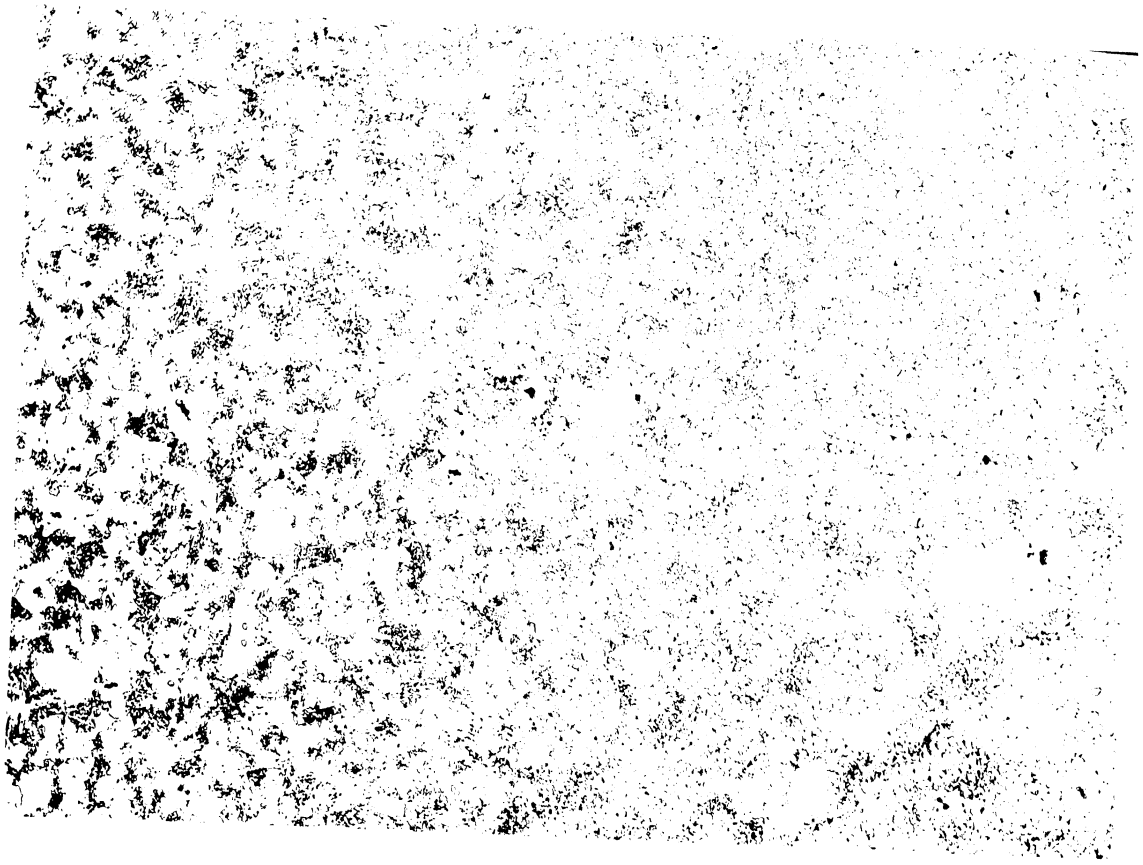


X100D

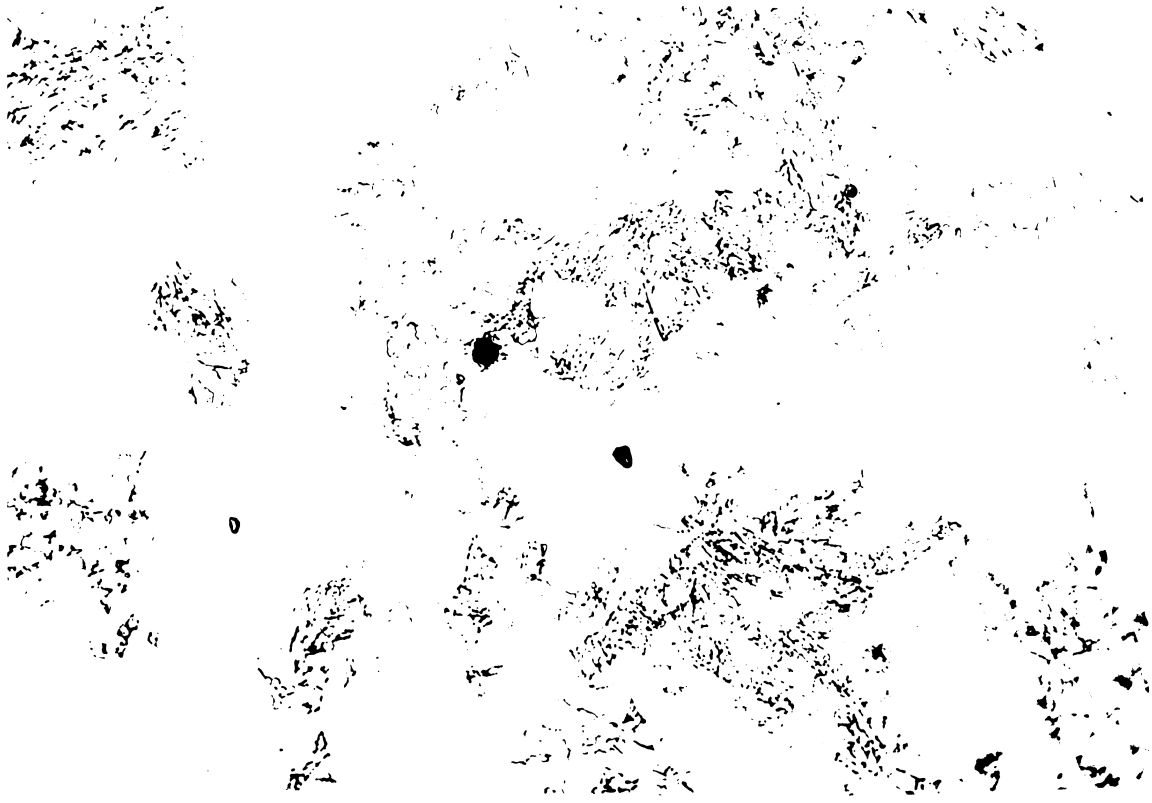


X100D

Plate 16. Microstructure of the Upstream Heat-Affected Zone (Pipe Side) of Sample W2-PRV-270° (No. 8) -- Weld between Pipe and 6-inch x 10-inch Pressure Reducing Valve.



X100D



X1000D

Plate 17. Microstructure of the Downstream Heat-Affected Zone (Valve Side) of Sample W2-PRV-270° (No. 8) -- Weld between Pipe and 6-inch x 10-inch Pressure Reducing Valve.