

February 10, 1971

Mr. C. R. Carder, Jr.  
Engineering Department  
Union Carbide Corporation  
P.O. Box 8361  
South Charleston, West Virginia 25303

Dear Mr. Carder:

This is in answer to your letter of January 27, 1971, concerning the stress relieving temperature of nickel alloy steels.

The comments you submitted to Docket OPS-3A, Notice 70-1, were thoroughly reviewed and considered for adoption in the regulation on stress relieving. They could not be adopted at that time, since to do so would be requiring something substantially in addition to what was proposed. This is not permissible under the procedures under which Federal regulations are issued because the public must be given ample notice and a chance to comment on any new proposals.

We recognize that there is sufficient information to warrant reevaluation of the regulations in the area of stress relieving of certain ferritic alloy steels. The recommendation, as outlined by your submission, along with other recommended changes to the regulations are being evaluated and considered for a notice or a series of notices of proposed rulemaking.

Thank you for your latest submission. Please keep us informed of any new developments.

Sincerely,

\signed\

Joseph C. Caldwell  
Director, Acting  
Office of Pipeline Safety

March 31, 1970

Office of Pipeline Safety  
Department of Transportation  
400 Sixth Street, S.W.  
Washington, D.C. 20590

Gentlemen:

Subject: Docket OPS-3A, Notice 70-1, Subpart E, Par. 192.239(g) - Stress Relieving Temperatures for Ferritic Alloy Steels

The subject paragraph specifies a minimum stress relief temperature of 1200°F for ferritic alloy steels. That temperature is perhaps repeated from Article 827.6 of ANSI B31.8, the Gas Transmission Piping Code (1968 edition). We believe that the single-value minimum temperature should be replaced with a table of stress relief requirements to reflect the different effect of various alloying elements upon the transformation temperature of steel.

Both the ASME Boiler and Pressure Vessel Code and the ANSI Refinery Piping Code have such tabulations which specify different stress relief temperatures for each P-No. alloy group. However, prior to the 1959 edition, the Refinery Piping Code specified the same single minimum temperature, 1200°F, for stress relieving ferritic alloy steels that is current in the Gas Transmission Code and proposed for adoption in the Minimum Federal Safety Standards for Gas Pipelines.

A related matter pertaining to the proper stress relief temperature for a specific alloy, 3-1/2% Ni steel, was recently presented to the ASME Code Committee for consideration of a change. The attached excerpt from the change request indicates a reason why 1200°F is not acceptable as the minimum stress relief temperature for all ferritic alloy steels. The Code Committee has taken the subject under advisement but has not yet completed action.

The nickel steels currently present a very pertinent reason for checking stress relief requirements in the Gas Transmission Piping Code and the related minimum Federal Safety

Standards. With the increase of interest in pipelining in northern climes and the need to use brittle-fracture resistant materials, the nickel steels may well find their way into gas transmission lines. Pipe and piping components of steels meeting the requirements of ASTM A-333, Grades 3, 4, 7 and 9 would be suitable for such service, but would be better stress relieved at maximum temperatures somewhat below 1200°F.

Because of the probable relationship of the Federal Minimum Safety Standards to the Gas Transmission Piping Code, a copy of this letter is being sent to Mr. L.L. Elder, Chairman, B31.8 Committee. Since that group meets early in April, it may be possible to institute consideration of possible changes at that time. Such consideration would provide additional information for Office of Pipeline Safety personnel to include in their investigation of the matter.

Very truly yours,

UNION CARBIDE CORPORATION  
Chemicals and Plastics

\signed\

C. R. Carder, Jr.  
Engineering Department

December 17, 1969

ASME Boiler & Pressure Vessel Code Committee  
345 East 47th Street  
New York, New York 10017

Gentlemen:

Subject: Request for Ruling on Lowering of Temperature for PWHT of 3-1/2  
Percent Ni Steel

A vessel fabricator recently questioned the temperature range suggested for the stress-relief (PWHT) of 3-1/2 percent nickel steel in certain Company and ASTM standard specifications. The Company specifications were based on literature sources, ASTM specification, and service history and met Code requirements when originally prepared. A thorough review of the current Code and ASTM requirements for PWHT of 3-1/2 percent nickel steel has revealed the ... situation which leads to the attached proposed special ruling.

Carpenter and Floyd reported in *Welding Research*, February 1957, that 3-1/2 percent nickel steel should be stress relieved at not over 1175°F because of the effect of nickel on the  $A_{c1}$  temperature of steel. The same recommendation may be inferred from other literature sources

such as the iron-nickel equilibrium diagram in NBS Monograph 106, and Inco's Bulletin A-278 (March, 1964).

The equilibrium diagrams from the literature cited above show austenization beginning at about 1200°F which thus becomes the maximum temperature for postweld heat treatment of 3-1/2 percent nickel steels. Use of 1175°F as the Code maximum temperature for PWHT should leave a sufficient margin to allow for the temperature differentials which may be expected to occur at times. It has been stated by fabricators that even the 1200°F value does not leave enough range for furnace control when coupled with the UCS-56 required minimum of 1150°F.

Another probable reason for lowering the PWHT temperature for 3-1/2 percent nickel steels was described in a British publication in 1967. An article entitled "A Problem in Welding 3-1/2 Percent Nickel Steel" authored by H. Wormington appeared in the June 1967 issue of *Welding and Metal Fabrication*. Data were presented which indicate an embrittlement of 3-1/2 percent nickel weld metal heated in the range of 1292-1364°F which the British fabricator had encountered as the result of hot-spot heating of test plates during stress relieving of a vessel in the intended range of 1112-1202°F. The proximity of the ASME Code maximum PWHT temperature, 1250°F, to the embrittlement temperature of 1292° appears undesirable.

The preceding information leads to the suggestion that Table UCS-56 be revised to show a minimum PWHT temperature of 1100°F for P-9B materials and that Note 8 to the Table be revised to cite 1175°F as the maximum temperature for PWHT of P-9 materials. These changes combine to form a range of 1100-1175°F which is large enough to allow reasonable furnace control without encroaching upon the transformation range of the steel or approaching the potential embrittling temperature for weld metal.

While the lower end of that range conflicts with Table UCS-56, it agrees with the stress relief temperatures given in material specifications SA-203 for plate, SA-333 for pipe, and SA-350 for forgings. Thus these material specifications are also in conflict with Table UCS-56. Since plate and components will often be tested in accordance with the material specification requirements rather than those of Section VIII, it is probable that many impact test specimens will have been heat treated at 1100°F if stress relief is called for in the material order. (It is specifically known that one major manufacturer of forging does specify the 1100°F stress relief temperature for impact response qualification of his 3-1/2 percent nickel steel raw material.)

Yours very truly,

UNION CARBIDE CORPORATION  
Chemicals and Plastics

\signed\

Attachment

Proposed Case \_\_\_\_\_(Special Ruling)  
Postweld Heat Treatment Temperature for Pressure Vessels  
of 3-1/2% Ni Steel; Section VIII, Divisions 1 & 2

Inquiry: In view of the lowering effect of nickel upon the austenitizing temperature of low-alloy steels, may the minimum postweld heat treatment temperature for steels of P-No. 9B as shown in Tables UCS-56 and AF-402.1 be reduced from 1150°F to 1100°F. In addition, may the maximum PWHT temperature given in Note 8 of Table UCS-56 and Note 10 of Table AF-402.1 reduced from 1250°F to 1175°F.

Reply: It is the opinion of the Committee that the Table UCS-56 and Table AF-402.1 minimum temperature for postweld heat treatment of 3-1/2 percent nickel steel pressure vessels may be lowered to 1100°F and that the maximum PWHT temperature in Note 8 of Table UCS-56 and Note 10 of Table AF-402.1 should be lowered to 1175°F.

Attachment