

From: Hansraj Ashar
To: Heedong, Park
Date: 5/31/01 4:22PM
Subject: Re: Questions for a guidance in REGULATORY GUIDE 1.136 (Yellow Ticket No. 020010081)

Dear Mr. Park:

Regulatory Guide (RG) 1.136 was developed to endorse the use of ASME Section III, Division 2, Subsection CC, "Code for Concrete containments (the Code)." As explained in the discussion of the regulatory position on CC-2433.2.3, "Experience with the use of alloy steel materials for anchor blocks and wedge blocks (such as AISI 4140) indicates that a high degree of hardness of these materials is a factor in causing (presumably stress corrosion) cracking under certain inevitable environment. Also, it is necessary to control the uniformity of hardness of these materials."

AISI 4140 material was the choice of the manufacturer of the prestressing tendon hardware. Thus, the RG position was focussed towards the use of this material. Neither the RG, nor the Code restrict the use of other softer materials.

Reponses to your Questions:

Q1. What is the purpose/reason to maintain uniformity in hardness HRC +/-2 ?

R1. Anchor heads (buttonheaded tendons) and wedge blocks (wedge-friction tendons) are subjected to very high triaxial stresses. Difference in the hardness of the material for the anchor heads of the same tendon sets up field of stress concentrations, which is suspected as one of the factors in cracking the anchor heads. U.S vendors of the prestressing hardware have not identified any problems in meeting this provision.

Q2. What is the specific meaning of a designated hardness number?

R2. A designated hardness number is the one a manufacturer is striving to meet. It has to be less than Rockwell C40. During qualification testing, the tolerance is applied to this designated hardness.

Q3(1). Should all hardness test results for 10% random sample of all anchor heads for one containment building be within HRC +/-2 if the material for the anchor heads come from the same furnace load ?

R3(1). Yes. The RG position is to be applied to the hardness testing requirements of CC-2433.2.1(b) and CC-2433.2.2(b).

Q3(2). Should all hardness test results for a minimum of one sample of all anchor heads from every furnace loads for one containment building be within HRC +/-2 if the material

for the anchor heads come from different furnace load as shown in table below ? (Table is not reproduced here).

R3(2). To maintain uniformity of hardness, the RG position requires the users to follow the requirements of CC-2433.2.1(b), CC-2433.2.2(b), and ASTM A-370. It is not the purpose of the position to provide guidance for the manufacturing process.

Q4. The existing anchor heads for our anchorage system had been fabricated with the range of HB(Brinell Hardness) 190-HB 230 in hardness which is relatively low hardness.

(The material for our anchor heads is AISI 1026 and it is normalized and quenching and tempering.)

Since it is not appropriate to conduct Rockwell C-scale hardness test for above range of HB 190-HB 230, we conduct Brinell Hardness test. Rockwell C-scale is proper to the material hardened to the range of HRC20-HRC70.

For the material under the hardness of HRC20, it is common to conduct other hardness test method as Brinell Hardness. Since HRC20 can be converted to HB226, it is not proper to conduct Rockwell C-scale hardness test for our anchor heads material. Accordingly, may you please give a guidance for uniformity in hardness with Brinell Hardness number(HB) instead of Rockwell C-scale(HRC) ?

R4. At the time the RG was developed, the vendors of prestressing system were using high strength (high hardness) materials for anchor heads and wedge blocks. Thus, the guidance is provided for such materials. For soft (low strength) steels having hardness number less than HRC20, there is no need to have a RG position. The stress corrosion cracking that is associated with the material hardness is not a concern. However, the requirements of CC-2433.2.1(b), CC-2433.2.2(b), and ASTM A-370 have to be met.

Cordially,
Hans Ashar

>>> "Heedong, Park" <parkhd@doosanheavy.com> 05/21 4:30 AM >>>

With regard to one of the guidance in REGULATORY GUIDE 1.136 revised June, 1981, we would like to ask you as follows.

We have found that REGULATORY POSITION for CC-2433.2.3(Acceptance Standards) specifies the following guidance should be used additionally.

"The maximum hardness for material of anchor head assemblies and wedge block shall not exceed that of

Rockwell C40. To maintain uniformity in hardness, the tolerance on a designated hardness

number shall not exceed +/-2. "

Inquiry :

1. What is the purpose/reason to maintain uniformity in hardness HRC +/-2 ?

2. What is the specific meaning of a designated hardness number ?

3. In accordance with the hardness test requirement specified in ASME Section III Div.2 CC-2433.2, we conduct a

hardness test for a minimum 10% random sample of all anchor heads for heat of steel but not less than one sample from each furnace load.

In this case, we would like to ask you the following quires for maintenance of uniformity in hardness, HRC +/-2.

1) Should all hardness test results for 10% random sample of all anchor heads for one containment building be within HRC +/-2 if the material for the anchor heads come from the same furnace load ?

2) Should all hardness test results for a minimum of one sample of all anchor heads from every furnace loads

for one containment building be within HRC +/-2 if the material for the anchor heads come from different furnace load as shown in table below ?

(If we have six different furnace loads as shown in table below, should all hardness test results

(A1,A2,A3,A4,A5,A6) from each furnace loads be within HRC+/-2 ?)

| Lot No Bar (Heat Treatment) | Hardness | Quantity (Pieces of Round Bar) | Length of Round (Unit : mm) |
|-----------------------------------|----------|-----------------------------------|--------------------------------|
| A 2500,2200,2800,3200 | A1 | 3 | 3700,4600,4480 |
| B | A2 | 4 | |
| C | A3 | 3 | 3500,2800,3100 |
| D | A4 | 2 | 2800,2100 |
| E 2900,3500,2600,2400 | A5 | 4 | |
| F | A6 | 3 | 2900,3500,3600 |

* We purchase the long round bars and cut to 150mm of length for a fabrication of anchor heads.

In addition, we need approximately 30 tons of round bar for anchor heads per one containment building.

Due to the capacity of furnace load, we have various heat treatments(Lot No.) for the anchor heads for one containment building.

4. The existing anchor heads for our anchorage system had been fabricated with the range of HB(Brinell

Hardness) 190-HB 230 in hardness which is relatively low hardness.

(The material for our anchor heads is AISI 1026 and it is normalized and quenching and tempering.)

Since it is not appropriate to conduct Rockwell C-scale hardness test for above range of HB 190-HB 230, we

conduct Brinell Hardness test.

Rockwell C-scale is proper to the material hardened to the range of HRC20-HRC70.

For the material under the hardness of HRC20, it is common to conduct other hardness test method as Brinell

Hardness. Since HRC20 can be converted to HB226, it is not proper to conduct Rockwell C-scale hardness

test for our anchor heads material.

Accordingly, may you please give a guidance for uniformity in hardness with Brinell Hardness number(HB)

instead of Rockwell C-scale(HRC) ?

We will appreciate your detail & prompt reply on above quires..

CC: <afb@nrc.gov>; Bill Bateman; David Terao; Gene Imbro; George Georgiev; James Davis; Michael Mayfield; Tajuan Carter; Victor Dricks