WIRE REINFORCEMENT INSTITUTE®

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Technical Blog

Welded Wire Reinforcement Deformation Requirements

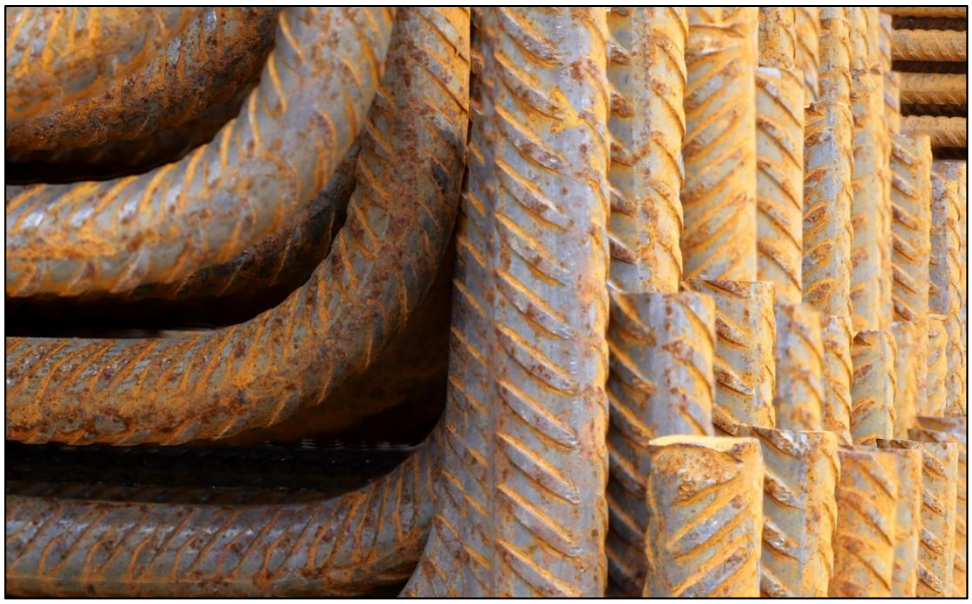
ASTM A1064 / A1064M – 18a *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete* defines all physical and mechanical properties required for welded wire reinforcement used to reinforce concrete structures. For welded wire reinforcement comprised of deformed wires, there are strict geometric criteria outlined therein to ensure that deformed wire surfaces are able to provide a reliable means of developing bond strength and anchorage within the surrounding hardened concrete.

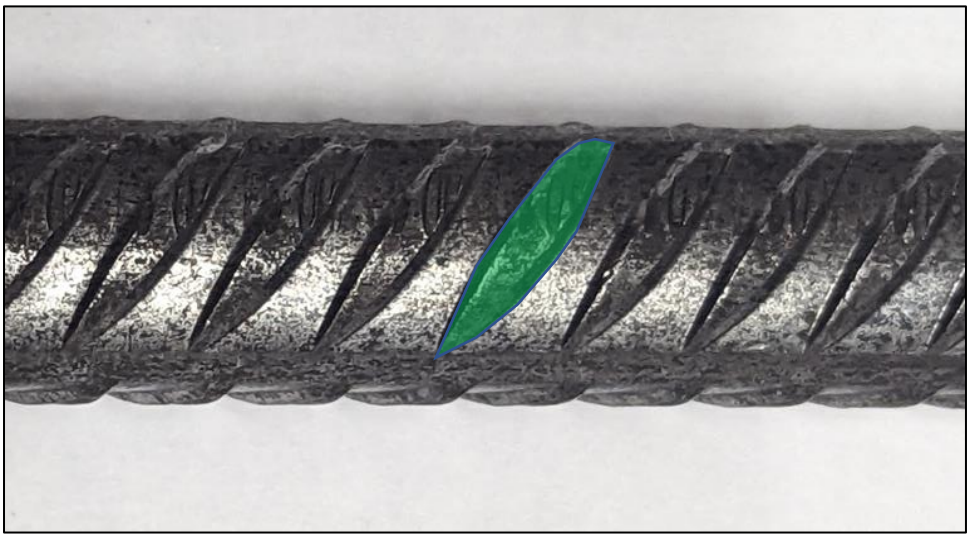
This month's Technical Blog highlights these deformation requirements, with italicized excerpts from ASTM A1064 and accompanying WRI illustrations and figures.

Deformation Type

Article 3.1.2.1
Deformations can be either indented or raised transverse ribs (protrusions).

Indentations are known as "negative deformation".



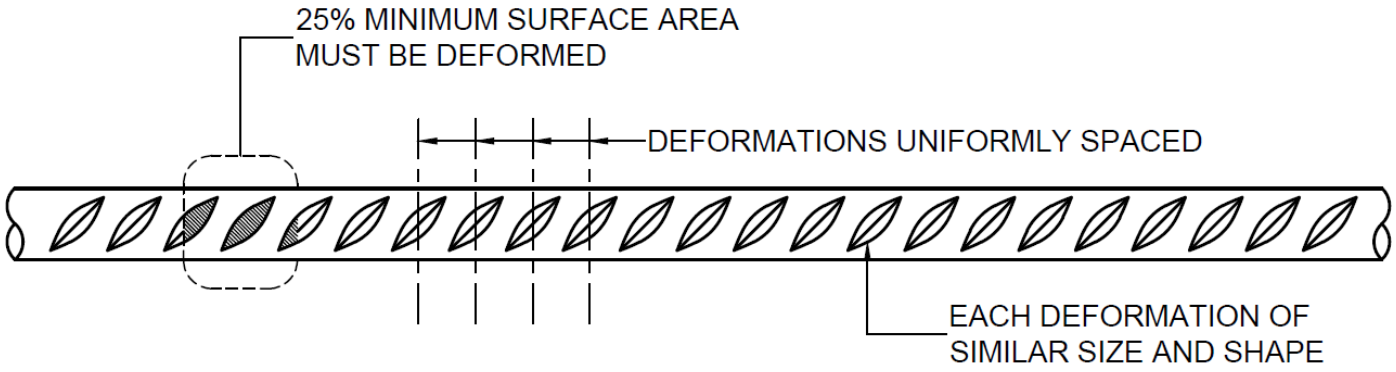


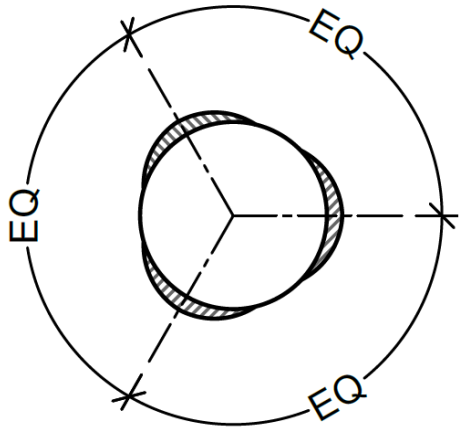
Protrusions ("ribs") are known as "positive deformation".

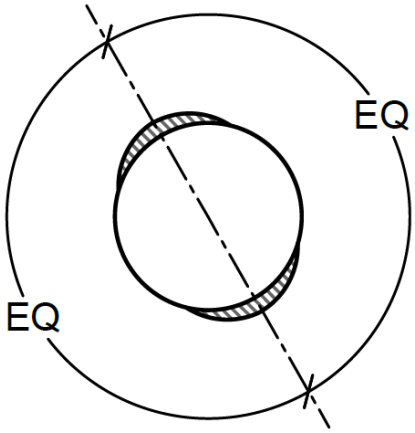
Deformation Arrangement

Articles 7.2.4.1 & 7.2.4.2

- *Deformations shall be spaced along the wire at a substantially uniform distance and shall be symmetrically dispersed around the perimeter.*
- *The deformations on all longitudinal lines of the wire shall be similar in size and shape.*
- *A minimum of 25% of the total surface area shall be deformed by measurable deformations.*
- *Deformed wire shall have two or more lines of deformations.*





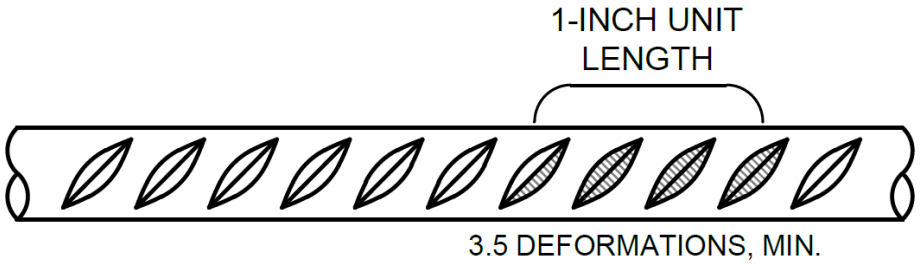


TWO OR MORE LINES OF DEFORMATIONS ARE REQUIRED. THREE AND FOUR LINES ARE MOST COMMON.

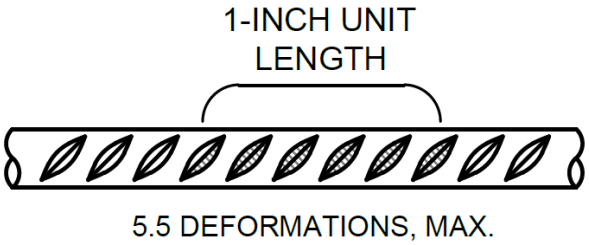
Deformation Spacing

Article 7.2.4.3
The average longitudinal spacing of deformations shall be not less than 3.5 nor more than 5.5 deformations per inch in each line of deformations on the wire.

Article 7.2.4.6
The average spacing of deformations shall be determined by dividing a measured length (10 in. [250 mm] min) of the wire specimen by the number of individual deformations in any one row of deformations on any side of the wire specimens. A measured length of the wire specimen shall be considered the distance from a point on a deformation to a corresponding point on any other deformation in the same line of deformations on the wire.



In practice, the verification of deformations per inch is on a minimum 10-inch specimen length. 1-inch equivalent lengths are illustrated here for visual reference.



Deformation Height

Article 7.2.4.4
The minimum average height of the center of typical deformations based on the nominal wire diameters shall be as follows:

Wire Sizes	Minimum Average Height of Deformations as Percent of Nominal Wire Diameter
D3.0 and smaller	4.0
D3.0 < Size ≤ D10.0	4.5
Size > D10.0	5.0

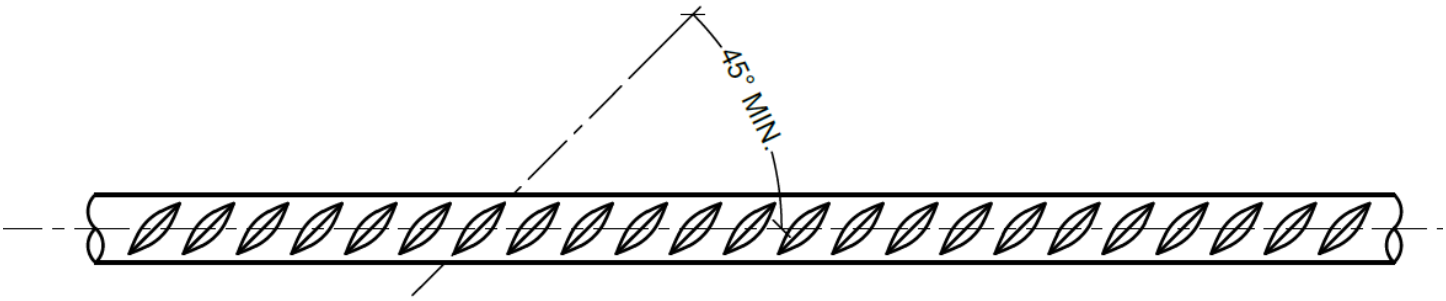
Article 7.2.4.7
The minimum average height of deformations shall be determined from measurements made on not less than two typical deformations from each line of deformations on the wire. Measurements shall be made at the center of indentations or raised ribs.

As a geometric frame of reference, the minimum average heights for #3, #4, and #5 rebar deformations are 4.0%, 4.0%, and 4.5% respectively as outlined in ASTM A615-20.

Deformation Orientation

Article 7.2.4.5

The deformations shall be placed with respect to the axis of the wire so that the included angle is not less than 45°; or if deformations are curvilinear, the angle formed by the transverse axis of the deformation and the wire axis shall be not less than 45°. Where the line of deformations forms an included angle with the axis of the wire from 45° to 70° inclusive, the deformations shall alternately reverse in direction on each side, or those on one side shall be reversed in direction from those on the opposite side. Where the included angle is over 70°, a reversal in direction is not required.



FOR INCLUDED ANGLES FROM 45° TO 70° INCLUSIVE, THE DEFORMATIONS SHALL ALTERNATELY REVERSE DIRECTION. OPTION SHOWN HERE IS DIRECTION REVERSAL FROM ONE ROW (NEAR SIDE) RELATIVE TO AN OPPOSING ROW (FAR SIDE, SHOWN WITH HIDDEN LINES).

FOR INCLUDED ANGLES FROM 45° TO 70° INCLUSIVE, THE DEFORMATIONS SHALL ALTERNATELY REVERSE DIRECTION. OPTION SHOWN HERE IS RIB DIRECTION REVERSAL ON EACH SIDE (OPPOSITE SIDE NOT VISIBLE).

Author's Note: Simplified side views presented herein utilize "single visible rows" of deformations for ease of illustration. In production, given most deformed wires are comprised of three or four rows of deformations, there is a circumferential wrapping effect that results in more than a single row of deformations being visible when viewed on any given side. Illustrations here do not reflect this wrapping effect.