

**IEEE TP&C Winter Meeting**

**Albuquerque, NM**

**January 23, 2006**

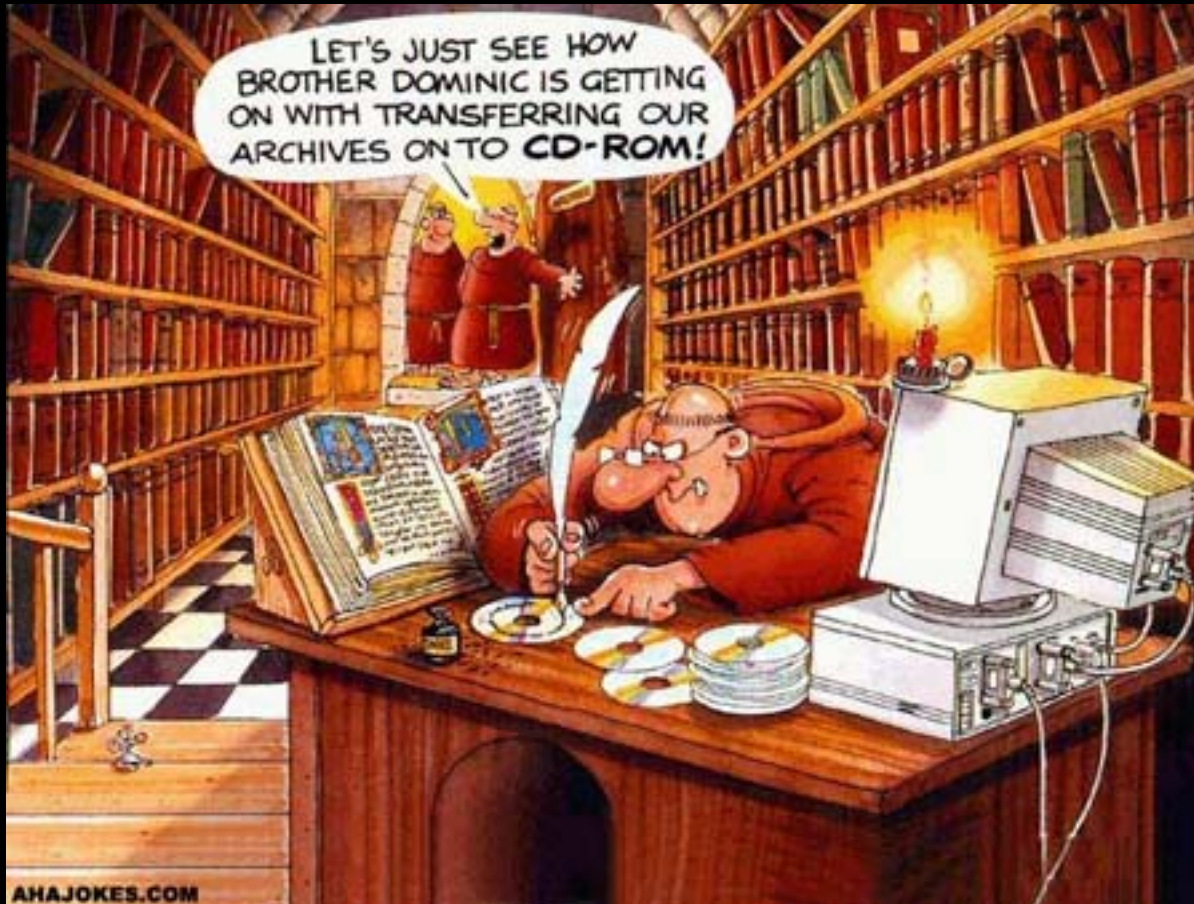
**Mini Tutorial**

**Bare Overhead Transmission Conductors,**

**Selection and Application**

**Chapter 3**

# Objectives



h them.

# *Conductor Properties*

- **Current Carrying Capacity**
- **Strength**
- **Weight**
- **Diameter**
- **Corrosion Resistance**
- **Creep Rate**
- **Thermal Coefficient of Expansion**
- **Fatigue Strength**
- **Operating Temperature**
- **Short Circuit Current/Temperature**
- **Thermal Stability**
- **Cost**



# *Categories of Overhead Conductors*

- **Others**

**VR**

**Vibration  
Resistant**

→ **Non-Specular**

→ **ACSR / SD**

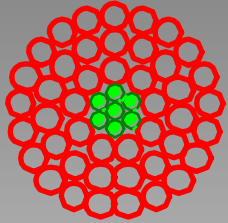
**Self  
Damping**

# *Why so many Choices?*

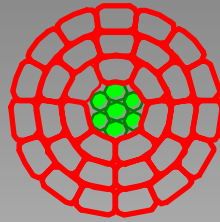
- ***Power Delivery Requirements***
  - Current Carrying Capacity*
  - Electrical Losses*
- ***Line Design Requirements***
  - Distances to be Spanned*
  - Sag and Clearance Requirements*
- ***Environmental Considerations***
  - Ice and Wind Loading*
  - Ambient Temperatures*

# Variety Of Conductor Designs Available

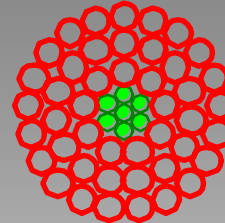
ACSR



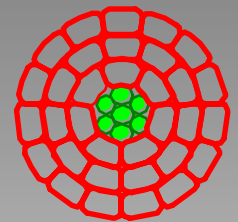
ACSR/TW



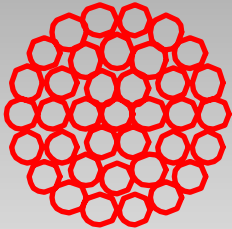
ACSS



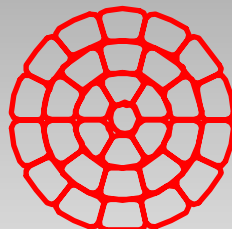
ACSS/TW



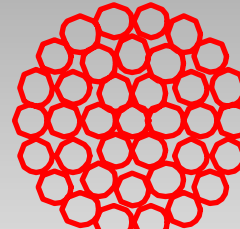
AAC



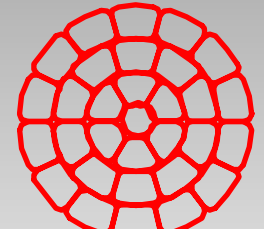
AAC/TW



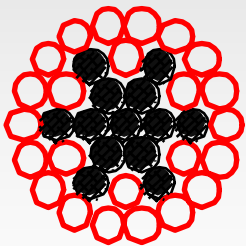
AAAC



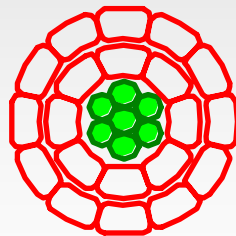
AAAC/TW



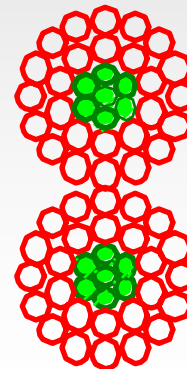
ACAR



ACSR/SD  
(SELF-DAMPING)

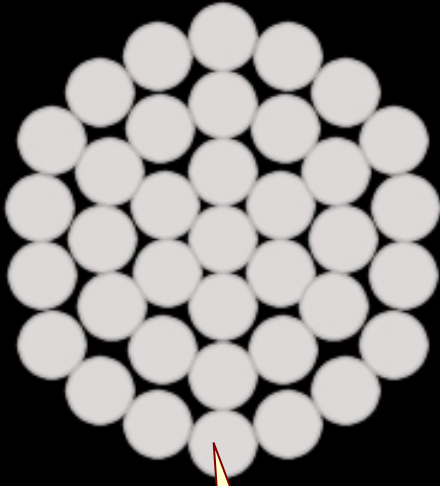


VIBRATION  
RESISTANT (VR)



# AAC

*(All Aluminum Conductor)*



- **Good Conductivity - 61.2% IACS**
- **Good Corrosion Resistance**
- **High Conductivity to Weight Ratio**
- **Moderate Strength**

## **Typical Application**

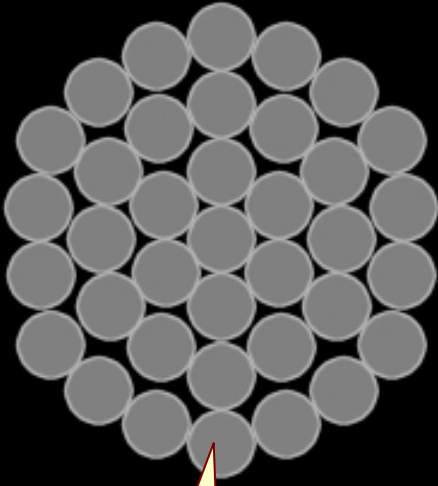
***Short spans where maximum current transfer is required.***

**1350-H19 Aluminum  
(24-28 ksi)**



# AAAC

*(All Aluminum Alloy Conductor)*



- **Higher Tensile Strength**
- **Excellent Corrosion Resistance**
- **Good Strength to Weight Ratio**
- **Lower Electrical Losses**
- **Moderate Conductivity – 52.5% IACS**

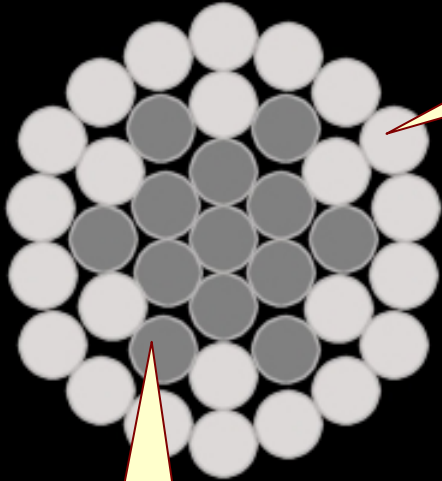
## **Typical Application**

**Transmission and Distribution applications in corrosive environments, ACSR replacement.**

**6201-T81 Aluminum Alloy  
(46-48 ksi)**

# ACAR

*(Aluminum Conductor Al. Alloy Reinforced)*



**1350-H19 Aluminum  
(24-28 ksi)**

- ***Balance of Mechanical & Electrical***
- ***Excellent Corrosion Resistance***
- ***Variable Strength to Weight Ratio***
- ***Higher Conductivity than AAAC***
- ***Custom Designed, diameter equivalent to ACSR most common.***

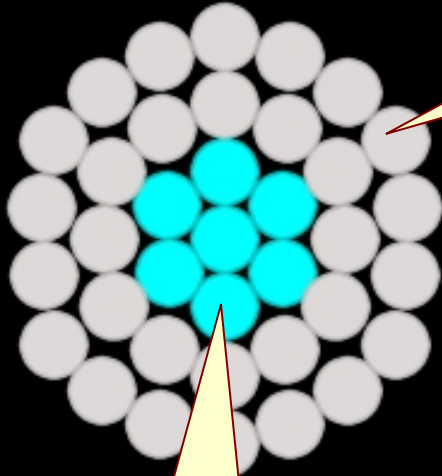
## **Typical Application**

***Used for both transmission and distribution circuits.***

**6201-T81 Aluminum Alloy  
(46-48 ksi)**

# ACSR

*(Aluminum Conductor Steel Reinforced)*



**1350-H19 Aluminum  
(24-28 ksi)**

- **Good Ampacity**
- **Good Thermal Characteristics**
- **High Strength to Weight Ratio**
- **Low sag**
- **High Tensile Strength**

**Typical Application**  
**Commonly used for both transmission and  
distribution circuits.**

**Coated Steel Core  
(Typically 11 – 18% by weight)  
(210-230 ksi)**

# ACSR

*(Aluminum Conductor Steel Reinforced)*

## **Typical Strandings (Aluminum / Steel)**

<b>3/4</b>	<b>8/7</b>	<b>48/7</b>
<b>4/3</b>	<b>12/7</b>	<b>54/7</b>
<b>5/1</b>	<b>20/7</b>	<b>72/7</b>
<b>6/1</b>	<b>22/7</b>	<b>30/19</b>
<b>7/1</b>	<b>24/7</b>	<b>54/19</b>
<b>8/1</b>	<b>26/7</b>	<b>76/19</b>
<b>18/1</b>	<b>30/7</b>	<b>84/19</b>
<b>36/1</b>	<b>42/7</b>	
<b>6/7</b>	<b>45/7</b>	

# *ACSR*

*(Aluminum Conductor Steel Reinforced)*

## ***Steel Core Coatings***

**Galvanized - (Zinc Coated)**

Class A, **Class B**, **Class C**

**AZ - Aluminum Coated**

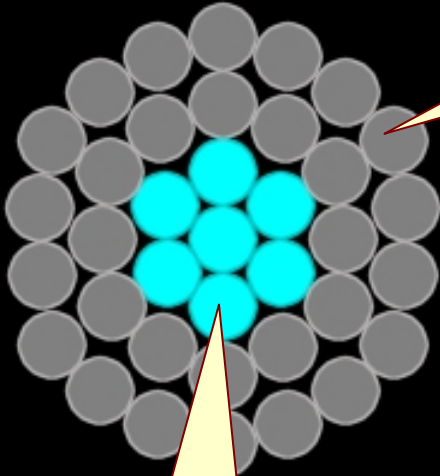
**AW - Aluminum Clad (or AC, or AS)**

**MA - Zinc-5% Aluminum-Mischmetal Alloy**  
**(Trade names: *Galfan* and *Bezinal*)**

**Equivalent to a Class C without  
corresponding loss of strength**

# AACSR

*(Aluminum Alloy Conductor Steel Reinforced)*



**6201-T81 Aluminum Alloy  
(46-48 ksi)**

- **Extra High Tensile Strength**
- **Good Thermal Characteristics**
- **High Strength to Weight Ratio**
- **Low sag**
- **Moderate Conductivity – 52.5% IACS**

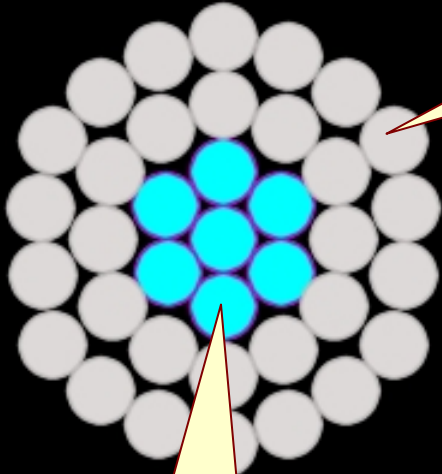
## **Typical Application**

***Long span and severe loading applications for both transmission and distribution circuits.***

**Coated Steel Core  
(Typically 11 – 18% by weight)  
(210-230 ksi)**

# ACSS

*(Aluminum Conductor Steel Supported)*



**1350-O Aluminum**  
**(~8.5 ksi)**

- **Excellent Conductivity – 63% IACS**
- **Excellent Thermal (250 °C)**
- **Low Sag – Improved with HS285**
- **Excellent Corrosion Resistance**
- **Excellent Self-Damping**

## Typical Application

**Applications requiring high power transfer for short periods of time.**

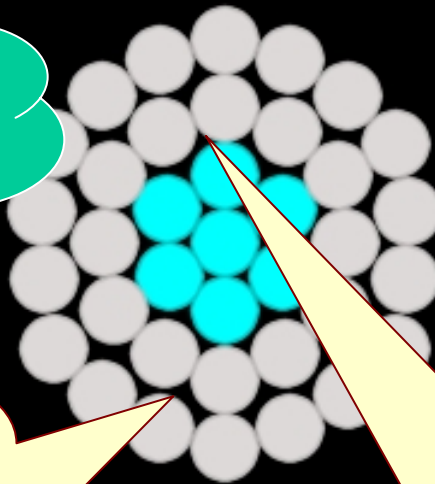
**Zinc-5% Aluminum Mischmetal  
Alloy Coated Steel Core  
210-285 ksi**

Hmmm...  
Where would  
that be???

- Capacity Limitations
- Emergency Loading

## Why use Trapezoidal Shaped Wires?

Roundwire: 1970  
Trapwire: Early '90s

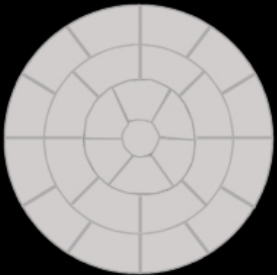


*Conductors made from round wires have “interstices”.*

*No interstices means more aluminum conductor in an equivalent diameter construction!*

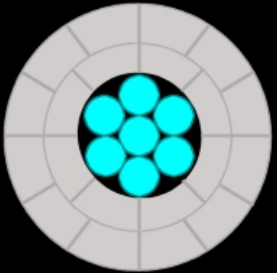


# *Trap Wire Constructions*



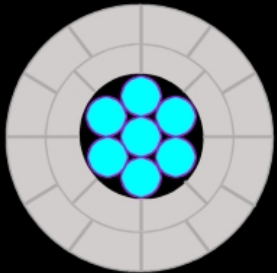
## **AAC/TW**

- Trapezoidal Shaped 1350-H19 Aluminum Strands



## **ACSR/TW**

- Trapezoidal Shaped 1350-H19 Aluminum Conductor
- Galvanized – Zinc or AW Coated Steel Core Wires

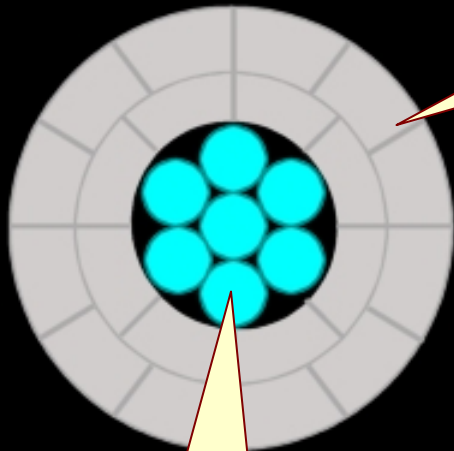


## **ACSS/TW**

- Trapezoidal Shaped 1350-O Aluminum Conductor
- Zinc – 5% Mischmetal Aluminum Alloy or AW Coated Steel Core wires, HS285 EHS Steel Cores.

# *ACSR - TW*

*(Al. Conductor Steel Reinforced – Trap Wire)*



**Trapezoidal Shaped  
1350-H19 Aluminum Strands**

***Two Types of Construction Available:***

- Equal Area (of Aluminum) to ACSR***
- Equal Diameter to ACSR (different code name)***

## **Typical Application**

***Used for both transmission and distribution circuits.***

**Galvanized Zinc Coated or AW  
Coated Steel Core**

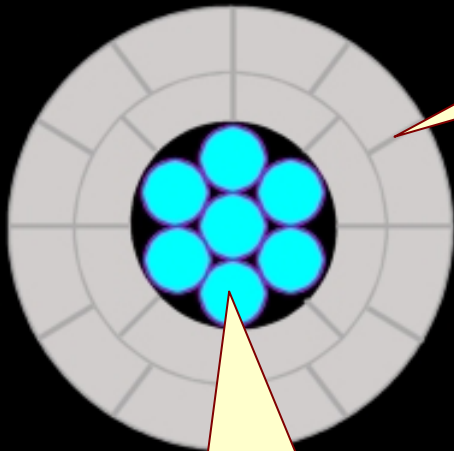
# *Comparison of ACSR/TW Type Number with Equivalent Stranding of ACSR*

Type Number	Conventional ACSR Stranding
3	36/1
5	42/7
6	18/1
→ 7	→ 45/7
8	84/19
10	22/7
13	54/7
13	54/49
13	24/7
16	26/7

The equivalent stranding is that stranding of conventional ACSR that has the same area of aluminum and steel as a given ACSR/TW type. The ACSR/TW type number is the approximate ratio of the area of steel to the area of aluminum in percent.

# ACSS - TW

*(Al. Conductor Steel Supported – Trap Wire)*



**Trapezoidal Shaped  
1350-O Aluminum Strands**

***Two Types of Construction Available:***

- Equal Area (of Aluminum) to ACSR***
- Equal Diameter to ACSR (different code name)***

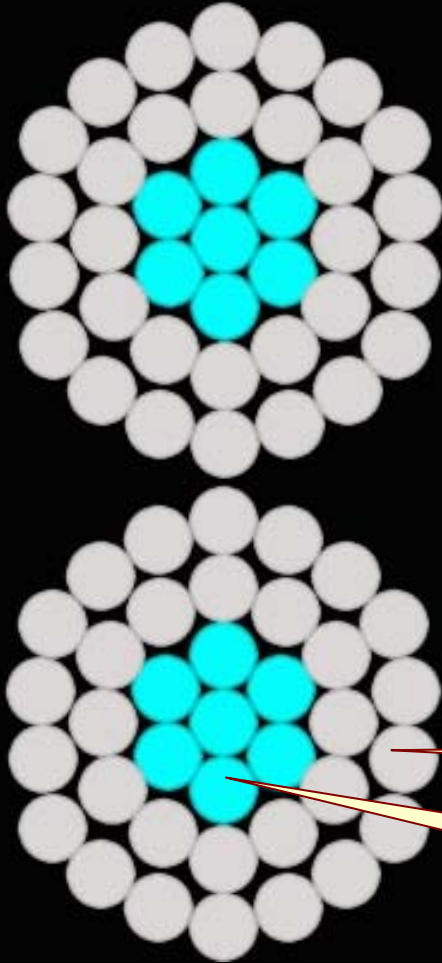
## **Typical Application**

***Re-conductoring and new applications to increase capacity and contingency ratings.***

**Zinc-5% Aluminum Mischmetal Alloy Coated,  
Alumoweld Coated and HS285 EHS MA Steel Core**

# *ACSR/TP Conductor*

*(VR - Vibration Resistant)*



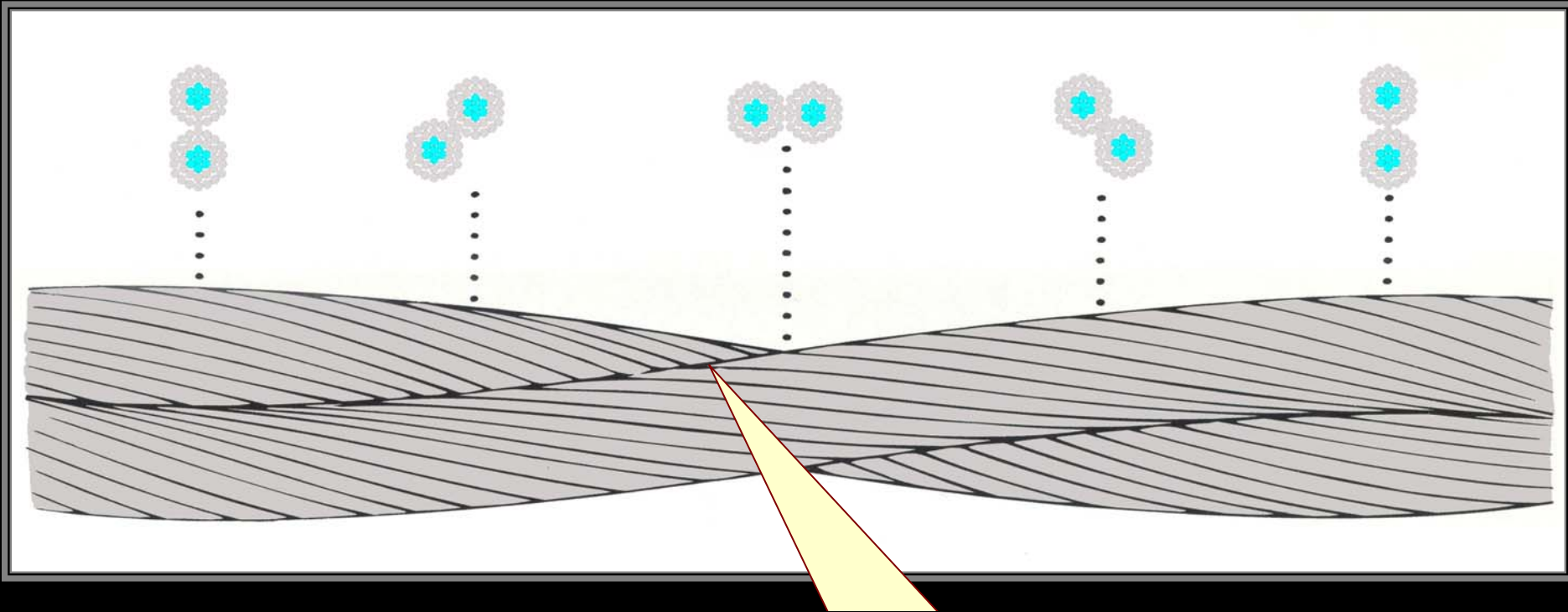
***Basically two ACSR  
conductors “plexed”  
(twisted) together.***

***Southwire Trade Name:  
VR Conductor***

**1350-H19 Aluminum**

**Galvanized or Alumoweld  
Coated Steel Core**

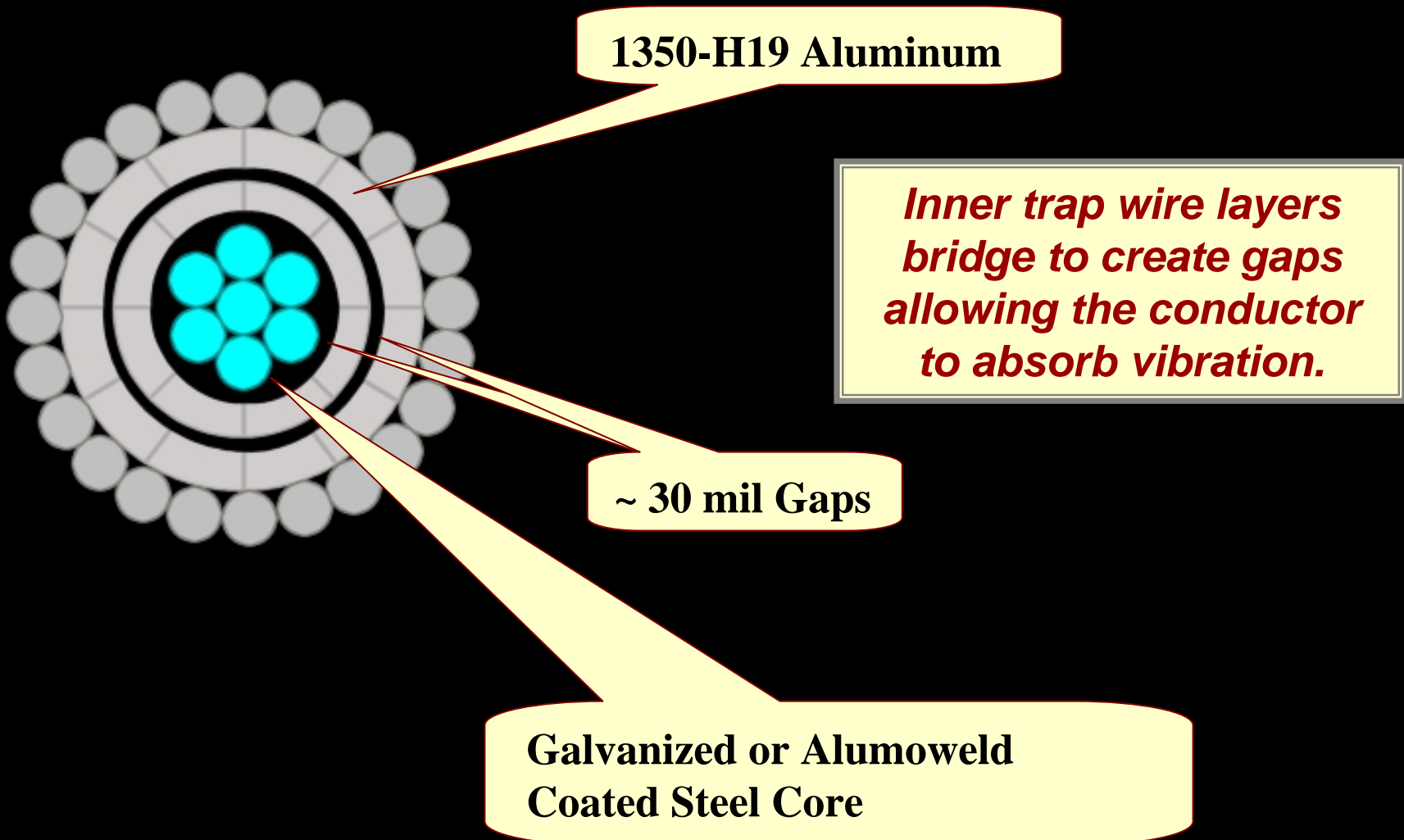
# *VR Conductor*



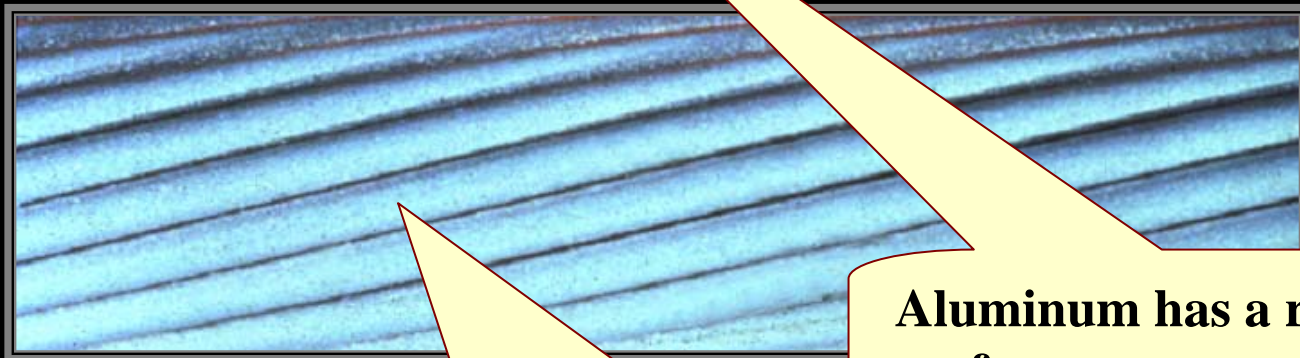
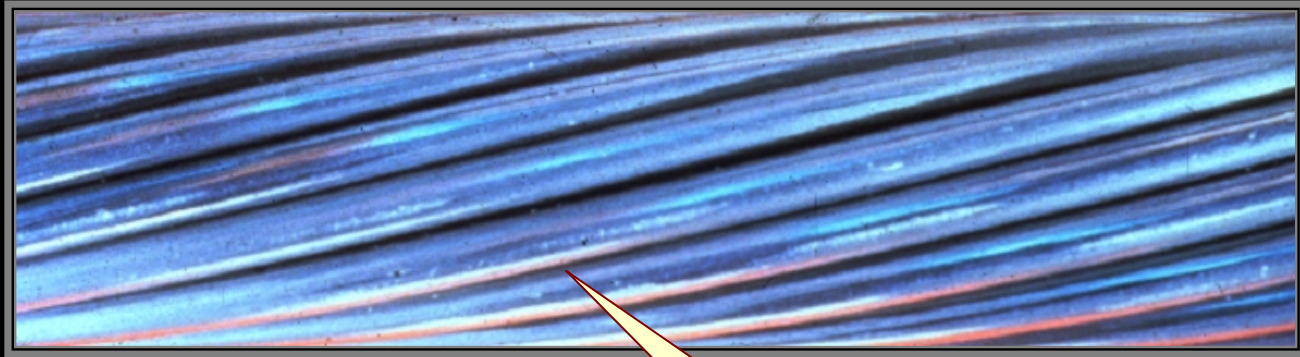
***Vibration Resistant*** Conductor presents a non-uniform profile to the wind which reduces the vortices that are formed compared to a uniform shaped conductor.

# *ACSR – SD*

## *Self Damping - Motion Resistant Conductor*



# *Non-Specular*



**Aluminum has a reflective surface.**

**Non-Specular conductors are treated to reduce the amount of light reflected .**



That's all Folks!

