Do you know where the wire in your wireline cable came from? Camesa does.

When advertising the quality of their wireline cables, manufacturers justifiably go to great lengths to show their latest manufacturing processes, superior designs and operational performance. But what about the most basic element of the cables themselves, the raw materials? While there is no doubt that a wireline cable's performance in the oil well certainly relies on its design, manufacturing and operational use, most wireline manufacturers neglect to discuss the first essential "ingredient" in any wireline: the steel wire used to make the cable. This is tantamount to a baker advertising his loaf of bread that was kneaded by seasoned sous chefs, baked in the latest state-of-the-art oven and served with an expert's eye for presentation but neglecting to mention that the dough he used had subpar ingredients. This article attempts to explore the fascinating process of turning steel rod into the high strength carbon steel wires that allow a wireline cable to successfully deploy in and out of an oil and gas well repeatedly.

Raw Material Steel Rod Selection

The raw material for high carbon wire is steel rod (Figure 1). Steel rod is made of an iron and carbon alloy. An iron alloy that contains less than 2% of carbon is called steel whereas iron alloys which contain more than 2% of carbon are referred to as pig iron. Steel rod is manufactured all over the world at steel mills (Figure 2) and is used to create a multitude of wire products from piano wire to pre-stressed rebar used in highway and concrete foundation construction. Just like any raw material, not all steel rod is considered equal from a quality perspective. There are different grades of steel rod that relate to both the carbon content and the purity of the billet or raw semi-finished iron material steel mills use to manufacture the steel rod (Figure 3).


Figure 1


Figure 2

Alejandro Ruiz has been with Camesa for 20+ years and currently holds the title of Vice President for Procurement. He is directly responsible for the team that is in charge of purchasing all the raw steel rod Camesa uses in its finished wireline products. We asked him to describe the procurement process and how he ensures the highest quality rod is selected for Camesa's finished wireline products. Alejandro explains that, "Everything begins with the customer's specifications related to finished goods performance requirements. Our engineering group selects the raw material characteristics that are needed to cope with the harsh demand of our cables. Then they develop specs that are sent to vendors and those potential sources analyze compliance. If viable, in many cases manufacturing trials are performed to confirm processability.


Figure 3

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Those vendors' products that are deemed acceptable, in many cases, undergo field tests to assure the performance and operating conditions are met." Alejandro goes on to say, "Steel is the heaviest component and performs the critical feature of mechanical performance. So we rely on our best domestic vendor, Ternium, for the majority of our EM cables. Ternium, part of Techint Group, is a 9 million liquid tons company with several operations in America. We have worked with them for 40 years and they helped develop a high carbon rod supply in the early 1970s to supply Camesa so we have a strong partnership that stretches over time and market conditions. For really high tensile cables that require the 1090 grade steel required for our "EEHS" wirelines, we source abroad. EEHS wire grade steel is sourced currently with US-based Evraz group, using Canadian billet from Quebec Iron & Titanium, which is known in the industry as one of the purest and cleanest steel in the world. We have also worked with Nippon Steel and have access to Posco and Kobe Steel manufactured in Japan. We are proud of our EM cables. They are critical components in a very sophisticated marketthat demands products with superior quality. My role is to provide the best raw materials that meet the specs. We do not play games here."

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Wire Drawing and Galvanizing

Once an acceptable raw steel rod supplier has been selected, the next step in creating a wire for the EMC armor is to put the steel rod through a process called wire drawing. Before the wire drawing process can begin the coils of steel rod are submerged in a hydrochloric acid bath to clean and prepare the rod for drawing. The rod comes from the steel mill with a ¼ inch diameter and must therefore be drawn down to the final diameter required for the particular armor wire desired. This is done by pulling the rod through a wire drawing machine that contains multiple dies that are progressively smaller in diameter (Figure 4). Through this process the rod is effectively stretched as the diameter is decreased. This process along with the application of heat also has the added effect of annealing the steel, making it stronger. Once the rod has been drawn down to the desired diameter, the material is officially referred to as wire. The wire is now ready for the galvanizing process that will help protect the steel from corrosion. The wire is then run through a series of industrial ovens (Figure 5) that raise the temperature of the wire to approximately 842°F (450°C). Zinc ingots are then melted and applied to the steel wire coating the wire. This process is called galvanizing and the zinc acts as a sacrificial corrosive layer for the final product.

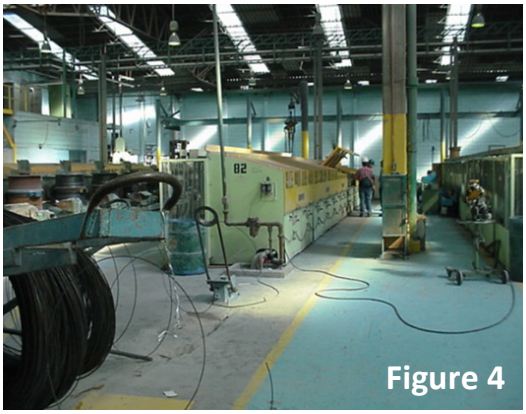
Figure 4

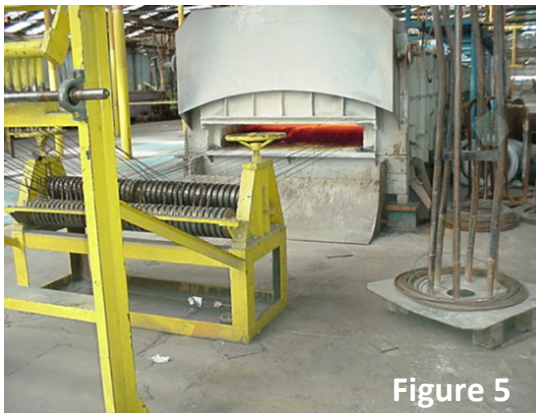
Figure 5

Quality Control and Testing

Samples of every batch of steel rod received at the wire drawing facility in Cuautitlan Mexico are subjected to spectral analysis with an electron microscope. The steel grain is inspected to ensure it is free of imperfections and the alloy mix and carbon content is verified against the order specifications. This process ensures that the steel used in the final wire meets the necessary quality and strength requirements.

The oil and gas industry is progressively moving towards full traceability of materials back to the manufacturer. We asked Marco Vilchiz, Camesa's Quality Director, how Camesa ensures that their customers can trace the quality of their products back to the source materials. "Since our Quality Management System is based on ISO 9001, we have established activities that allow us to assure the condition and identification of all materials during the different stages of production, as well as the traceability of our products across the whole process up to the finished product. These activities are mentioned and described in the P-14 Traceability and Identification Procedure and P-36 Rod and Material Receipt, Management and Storage Procedure." The rod wire tracing records are: a) Quality certificate, b) Packing List, c) Bar Code Label, d) Physical Test Report, and e) Rod Certificate.

Marco goes on to describe what happens if a Camesa material doesn't meet the internal specifications, "According to the P-31 Non Conformance Products Control Procedure, the material is identified by the "REJECTED" label and segregated to avoid its use or delivery. Camesa Mexico is always aware of the quality of our products and processes. We are convinced that the highest quality achieved will be translated into satisfaction and long term relationships with our final customers. We are aware that our products are used in very specific markets and a high quality guarantees savings in the long term."

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In addition to the steel rod quality control testing, the final drawn and galvanized wire is also tested in-house to make sure it meets the specifications required by Camesa's internal quality control processes. The testing includes tension, torsion and ductility tests of the wire. If the final quality control tests are passed, the finished wire is shipped to the EMC manufacturing plant in Vallejo, Mexico for armoring of the conductors. Camesa's Vallejo Superintendent, Ruben Gutiérrez, shares how the EMC plant performs another quality check on the finished wire they receive from the wire mill. "100% of Camesa EMC wires come from the Camesa Wire Mill in Cuautitlan where inspections for diameter, torsion, zinc coating, tensile strength, packaging and correct weight are performed. Every single reel has a tag so we can track the entire manufacturing process in the wire mill. Once the wire arrives at the EMC plant, we perform an inspection before unloading the raw material from the truck. We then send the wire to our warehouse where a wire operator measures the diameter against the QC tag data in order to be sure the correct wires are used in the manufacturing process. Camesa Mexico has been producing cables since 1975. The average seniority for our operators is 25 years. In order to assure the correct training for operation of all the machinery, we have an ILU Training Program each operator must complete to ensure they have all the necessary skills and knowledge to operate the machinery. This is how we make sure our operators are fully trained for their position. At Camesa we have a strong commitment with the customer; they require an excellent EM cable and our job is to produce the finished goods on time, meeting all the specifications. This is our main task for the Vallejo team."

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At Camesa we've been making wireline for more than 40 years which is why we understand how important it is to have as much control over the quality of the final product as possible. This starts with sourcing the highest quality raw materials available. At Camesa, we know where our wire came from because we make it in-house to ensure the highest quality in the industry. Do you know where your wire was sourced?