

DRILL PIPE ADVANCES

Colli Drill Pipes DDR represent an important innovation in the field of directional drilling pipes. The use of high performance steels, the advanced production technology, the precise and innovative hydraulic design and new types of tool joints permit intensive use. This has all been made possible by the efforts of a company which has always dedicated resources to research and to the engineering applied to the development of the product, thus creating new technologies.

MATERIALS

Directional drilling was conceived through the idea of having highly flexible drill pipes capable of creating holes with curvilinear profile. The curve radius that can be created with this drilling is one of the important parameters of this work technology. The smaller the curve radius that can be created in drilling, the greater the flexibility in the use of this technology, making it possible for it to be used in increasingly restricted conditions. Due to the increasingly widespread use of directional drilling, stronger drill pipes are being made, capable of carrying out drilling with ever greater diameters and pull-back distances. In many cases it has been the drill pipes which have been the limiting element in this technology as the use of inappropriate materials has brought about unsatisfactory results caused by the breaking of the pipes.

The material used in the manufacturing of the drill pipes is one of the elements which characterise them. Indeed for this particular purpose the classical steels of medium-high resistance and high toughness are not the best solution as they do not allow the extreme forces that are generated during directional drilling to be absorbed without causing permanent deformations or breaking. It is therefore necessary to use steels with high elasticity

Friction welding in the manufacture of Colli Drill Pipes.



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which are capable of a high mechanical resistance.

For the manufacture of the Colli Drill Pipe DDR a steel with well-known characteristics is employed: 42CrMo4 (AISI 4140, 42CD4). This is usually a quenched and tempered steel (European EN 10083), considered to be among the non-weldable steels because of its high carbon content and the alloy elements which are present in its chemical composition.

Its mechanical characteristics make it in any case extremely interesting, especially for its use in directional drilling. With its yield point of 900 N/mm² (Re), ultimate tensile strength of 1,100 N/mm² (Rm) and 30 J of minimum impact strength at room temperature, this steel allows the manufacture of drill pipes of mechanical characteristics capable of overcoming the limits present in the use of steels more easily employed technologically (easy weldability and low hardenability) but having lesser mechanical characteristics.

Despite its mechanical characteristics, many drill pipe manufacturers have not even attempted its use because of the tech-

nological difficulties and production costs imposed by the use of this material. Colli Drill have always adopted a production policy aiming for the maximisation of the performance of their own products, tending to regard production costs as a variable which can weigh only in part on the price paid by the client.

With this basic philosophy and an intense and continuous research, this company has developed a production process which has allowed the use of the 42CrMo4 to be extended to the entire range of drill pipes produced by Colli Drill. The inevitable initial failures have been important milestones in the perfection of this technology, finally achieving its current level of results both in terms of mechanical characteristics and joint technology (Re, Rm, KV and bend tests) as well as in terms of the metallographic characteristics of the welding areas. Furthermore, by carrying out standardised tests, the mechanical resistance of the joint is proved to be equal to if not greater than that of the base metal, with results in the bend tests and metallographic analysis that leave no doubts about the high quality of the production technology that has been developed.

PRODUCTION

As it is an extremely simple product, much of the production technology developed and employed by Colli Drill in the manufacture of drill pipes is covered by industrial secrecy, even though the company has always divulged a large part of the results obtained during the course of experiments carried out in product development, through the work of its consultants and the universities with whom the company has collaborated on the research.



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The gas nitriding furnace of the Colli Drill for the heat treatment of tool joints.

The production technology used by Colli Drill is on the surface similar to that used by other drill pipe manufacturers. The difference lies in the characteristics of the products manufactured which only a specific type of technology, the company's philosophy and not least the skills of those working in the company are able to guarantee.

The pipe is produced by welding a cut down tube to two threaded tool joints. In order to join the tool joints to the tube a friction welding technology is utilised. Friction welding is one of the most reliable non-conventional welding technologies, as it allows the conditions of the process to be repeated to an extremely high degree, which very few other welding methods can attain. In the welding of steels in particular, the friction welding technique allows thermally altered zones of extremely reduced size to be created, generally leading to an improvement of the mechanical characteristics of the welded joint compared to those of the base metal, due to the use of intense heat during the welding phases. One of the main characteristics of this welding technique is that the joint is formed without the steel ever melting and this, in a solely metallurgical aspect, is without doubt an advantage. It is in any case a technology which, especially with certain materials, requires careful and specific planning of the conditions of the process, without which any attempt to create reliable joints fails.

It is necessary to have an exhaustive knowledge of the metallurgy of the steel to be welded, being also thoroughly aware of the influence that each single variable of the process has on the final characteristics of the joint. It is easy to understand, even for those without an in-depth knowledge of metallurgy that, to create reliable joints with a steel like 42CrMo4, friction welding is not sufficient. There are in fact other steps in the production that back up and complete the technology developed by Colli Drill in the manufacture of its own drill pipes.

However the drill pipe possesses certain characteristics which go further than the technique used to weld tool joints to the tube, and it is in this that the production technology and the design of the components of the pipe play a determining role.

Thanks to a new friction welding technology applied in the manufacture of drill pipes, created and patented by Colli Drill



Macrographic controls on a threaded connections in the laboratory.

together with Friction Welding Associated Consultants (a consultancy firm for friction welding run by Ing. R. Chirulli - Italy) it has finally been possible to achieve an accurate internal hydraulic design of the drill pipes. In this way, a new generation of full O.D. type drill pipes, the new LIHR (low internal hydraulic resistance) series capable of supporting the mechanical performance with the new possibility of cost reduction by means of the reduction of internal hydraulic resistance has been created. Currently, for a full O.D. type rod, this result cannot be obtained by any other production technique. Not even with forged one-piece rods can such results be obtained, as all the internal surfaces of the new LIHR rods are obtained by turning on numerically controlled lathes made of solid steel bars, with the result that these surfaces are controlled, with regard to form and roughness, in order to obtain the decrease in internal hydraulic resistance which means having a greater useable energy of the circulation or pumping fluid, with considerable reductions in the drilling costs.

In order to fully appreciate the substantial difference between these products, it is sufficient to compare a cross-section of an LIHR rod to a normal type of friction welded rod or forged one-piece rod.

Another advantage offered by these rods made by welding the tool joints to the tube lies in the possibility of being able to carry out appropriate and efficient heat treatment against seizing of the threads, which is impossible for expense reasons for the forged one-piece rods.

The maximum surface hardness that can be measured on our tool joints in Vickers tests is equal to HV 850 0,1/30, with hard layers that do not exceed a tenth of a millimetre of depth with the evident advan-

tage of offering a resistance against seizing and exceptional utilisation possibilities without dangerously reducing the toughness of the material.

TYPE AND SIZE

Two main types of the Colli Drill Pipe DDR are produced: X-series (or standard friction welded drill pipe); and LIHR-series (or low internal hydraulic resistance drill pipe).

Mechanically, these two series have quite the same characteristics, but clearly they have different hydraulic characteristics. The LIHR rods can be used in all situations whereas the X-series rods are suitable only for applications where the cost of drilling is not very important and where the purchase cost of the actual rod, which is obviously less, prevails.

Both these series are produced for directional drilling in several standard sizes, but it is also possible to design and produce rods with diameters and thicknesses different from the standard ones, as long as the orders are placed according to the required minimum quantities

There are two types of threaded connections designed and produced by Colli Drill: RC - Resistant Connections, with taper-parallel fit of high resistance, suitable for use with down the hole hammers and when inverse rotation is used; and EB - Easy Break off, with taper thread, suitable only for one-verse rotation when the rapidity of the fitting and dechucking (coupling and uncoupling) operation is of great importance. Tool joints are added to these called: Custom - with thread according to the clients designs, suitable for the assembly technology of Colli Drill.

All the tool joints of the RC series have slots for the possible use of special spanners with spherical knobs which facilitate the phases of uncoupling of the rods.

Each tool joint is marked with a respective weld number which makes identification possible in case of incident.

QUALITY CONTROL

The company has a strict and complete ISO 9002 quality control system. The quality control begins as materials are received through the use of dimensional and laboratory controls, and it continues throughout all the phases of the production process. All the principal components of the plant are controlled by modern computers and complex software which are able to guarantee continuous monitoring of each phase of the production process.

by Dr. Ing. Renzo Chirulli
FWA Consultants



The new RC connection, designed and manufactured by Colli Drill. From left to right you can see: A - the taper thread, B - the parallel surface, C - the special slots of the RC connection.