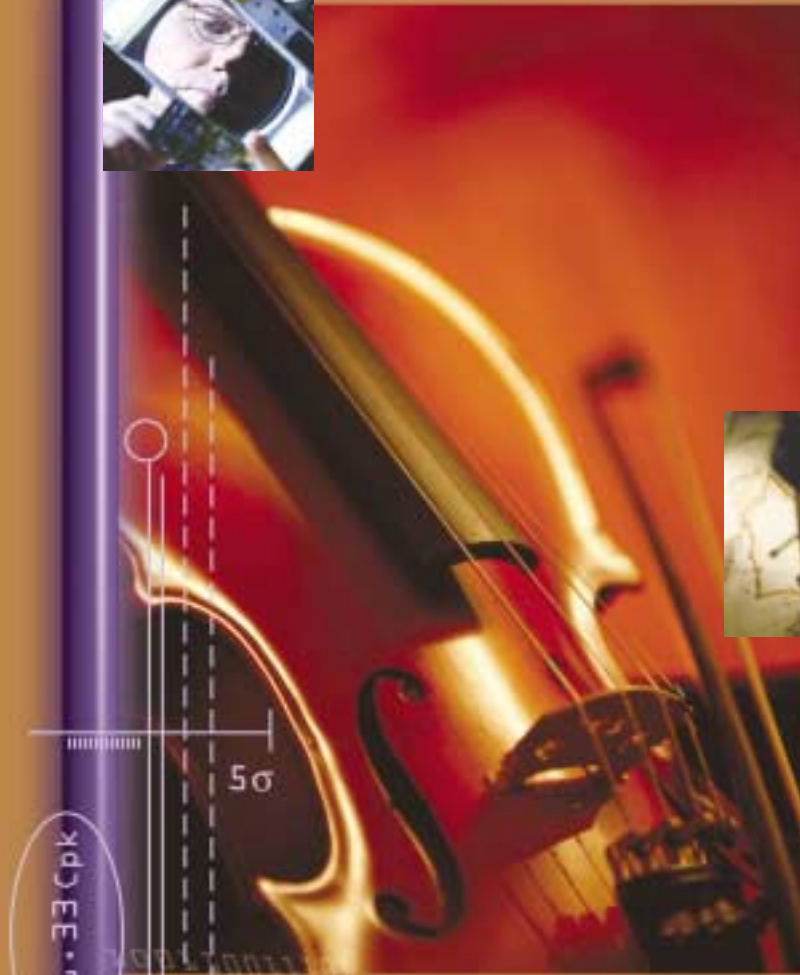




Quality



Setting The Standards Raising The Bar

HOW BELDEN SETS THE STANDARDS FOR
QUALITY IN THE WIRE AND CABLE INDUSTRY

Ensuring Cable Quality

1.33 Cpk

5 σ



What Works... What Doesn't...And Why

QUESTION: WHAT'S THE COST OF INSTALLING CABLE THAT DOESN'T MEET THE PERFORMANCE STANDARDS YOU EXPECT? IF IT NEEDS TO BE PULLED OUT OF THE WALL AND REINSTALLED, IT CAN BE EXTREMELY EXPENSIVE IN TERMS OF TIME, MONEY, AND HASSLES.

BUT INFERIOR CABLE THAT STAYS IN THE WALL CAN BE EVEN MORE EXPENSIVE DOWN THE ROAD. IT CAN LEAD TO LOST PRODUCTIVITY...INCREASED DOWNTIME...AND AN INABILITY TO HANDLE THE MORE DEMANDING NETWORK APPLICATIONS THE FUTURE WILL UNDOUBTEDLY BRING.

At Belden, we believe the cost of inferior cable is simply too high. You deserve superior quality cable that handles your requirements today and tomorrow, without compromise. We believe that the cable performance a manufacturer reports on the reel should be the performance you get when the cable is in the wall—a situation we have found not to be the case in a surprising number of experiences with cable other than Belden.

Fortunately, when you work with Belden, you get performance you can trust. That's because Belden has developed cable designs and manufacturing techniques that ensure that you realize the performance you expect and pay for. When you work with Belden, you get cable products that are easy to install and dependable, saving you time and money year after year.

HOW DO WE ENSURE CABLE QUALITY? FIRST, LET'S TAKE A LOOK AT TRADITIONAL QUALITY MEASURES AND WHY THEY DON'T WORK.

Sampling And Sorting

The first problem with traditional measures of quality is that they happen on the back end of the manufacturing process; that is, production personnel make the product, then quality is measured through inspection processes by quality control personnel, who eliminate products that don't meet specifications. This is inherently wasteful and expensive because it involves making products that may not be usable. More to the point, you simply cannot inspect quality into a product—it must be built in.

The traditional method to quality is known as lot acceptance sampling. In lot acceptance sampling, a sample of product is taken at random from the lot and tested. If the test passes, then the entire lot is assumed to be good. If it fails, then more samples in the lot may be tested, and pending the results of those tests, a decision is made on the lot. The main point of lot acceptance sampling, however, is to decide whether or not the lot is likely to be acceptable—not to estimate the quality of the lot.

In the wire and cable industry, one lot may consist of more than 200,000 feet of cable! Do you trust that the performance of one sample tested out of this amount of footage is indicative of the whole lot? Testing every reel in the lot (100% inspection) is not a viable option for the manufacturer. But even if it were, there would be problems.

What's wrong with 100% inspection? It sounds good, but can wire and cable truly be 100% inspected? Wrong decisions are always possible when samples are taken. For category cable such as Cat 5e and Cat 6, 100% inspection is not obtainable without destroying the cable. Cable reels are generally 1,000 feet, but the test length requirement

is 328 feet. With such a situation, the most inspection we could do would be to test 328 feet of cable between every 1,000-foot reel. This would constitute a 25% inspection rate (328 ft/1,328 ft = 25%); however, some manufacturers claim they inspect each and every reel. With the put-up being 1,000 feet and a test length of 328 feet, this still only constitutes a 33% inspection rate (328 ft/1,000 feet).

Another industry practice among some manufacturers is "sorting." Sorting is based upon the concept of lot acceptance sampling as described above. It is a process of segregating a production run of cable into groups, based upon performance. Once segregated, each group of cable is marketed as meeting a specific performance level (i.e.: one group is Category 5, another is Category 5e), even though they all came from the same cable design. By sorting, the cable manufacturer determines what performance level the cable will meet after it is produced instead of developing a cable design that consistently yields a specific performance level.

The bottom line is, backend quality inspections don't create quality cable. You have to start the quality process at the front end—which is exactly where Belden starts.

The Belden Approach To Cable Quality

IF SORTING AND SAMPLING AREN'T ACCURATE MEASURES OF ONGOING CABLE QUALITY, WHAT IS? AT BELDEN, WE KNOW THE ANSWER.

BELDEN'S COMMITMENT TO QUALITY BEGINS EVEN BEFORE ITS PRODUCTS LEAVE THE PRODUCT DEVELOPMENT PHASE. NOT ONLY DOES BELDEN DESIGN PRODUCTS TO ACHIEVE A GIVEN LEVEL OF PERFORMANCE, IT ALSO ENSURES THAT THESE PRODUCTS CAN BE MANUFACTURED IN A WAY THAT MAKES THAT PERFORMANCE POSSIBLE AND CONSISTENT.

THE MOST SIGNIFICANT DIFFERENCE BETWEEN PREVENTION AND INSPECTION IS THAT WITH PREVENTION, THE PROCESS – RATHER THAN SOLELY THE PRODUCT – IS MONITORED, CONTROLLED, AND ADJUSTED TO ENSURE

CORRECT PERFORMANCE. PREVENTION INVOLVES THE USE OF KEY INDICATORS OF PRODUCT PERFORMANCE AND STATISTICAL METHODS TO MONITOR THE PROCESS AND IDENTIFY CHANGES THAT AFFECT THE QUALITY OF THE PRODUCT—AND ADJUST THE PROCESS ACCORDINGLY. THE RESPONSIBILITY FOR QUALITY MOVES FROM THE INSPECTORS TO THE DESIGN AND MANUFACTURING DEPARTMENTS.

BUT PRODUCT QUALITY AT BELDEN BEGINS LONG BEFORE WE EVER MANUFACTURE A SINGLE FOOT OF CABLE. HERE'S A LOOK AT HOW WE DO IT:



Design For Manufacturability

Delivering a superior product means being sure you can *make* a superior product, day after day. Design for Manufacturability (DFM) seeks to identify and account for the challenges inherent in any manufacturing process and address them up front. It takes into account every aspect of manufacturing: materials, machines, operations, environmental factors, and more.

The purpose of DFM is to design products that are robust enough to stand up to the challenges of manufacturing to yield consistent, superior product quality. Unlike sorting or inspection, which focuses solely on an already-produced product, DFM is focused on the entire manufacturing process and how it can be monitored, controlled, and adjusted to achieve our quality goals.

The DFM process involves a wide range of personnel, from production, engineering, quality, and marketing, bringing together the entire team in a way that shortens the product development cycle and allows us to make better products with remarkable speed. But the real benefit to Belden customers is that our products achieve high performance standards that are both consistent and measurable.

Monitoring & Maintaining Quality

Before releasing any new products for production, all critical characteristics of Belden products are targeted to meet a capability index of $Cpk \geq 1.33$, which corresponds to a 99.997% passing rate. A Cpk is an index that quantifies the capability of a product's design and manufacturing process. The Cpk values are determined through capability studies, which represent the final product design and manufacturing set-ups. This includes statistically valid run times, footage, and sampling methods. The result is a Cpk value that corresponds to a predicted defect rate for the product.

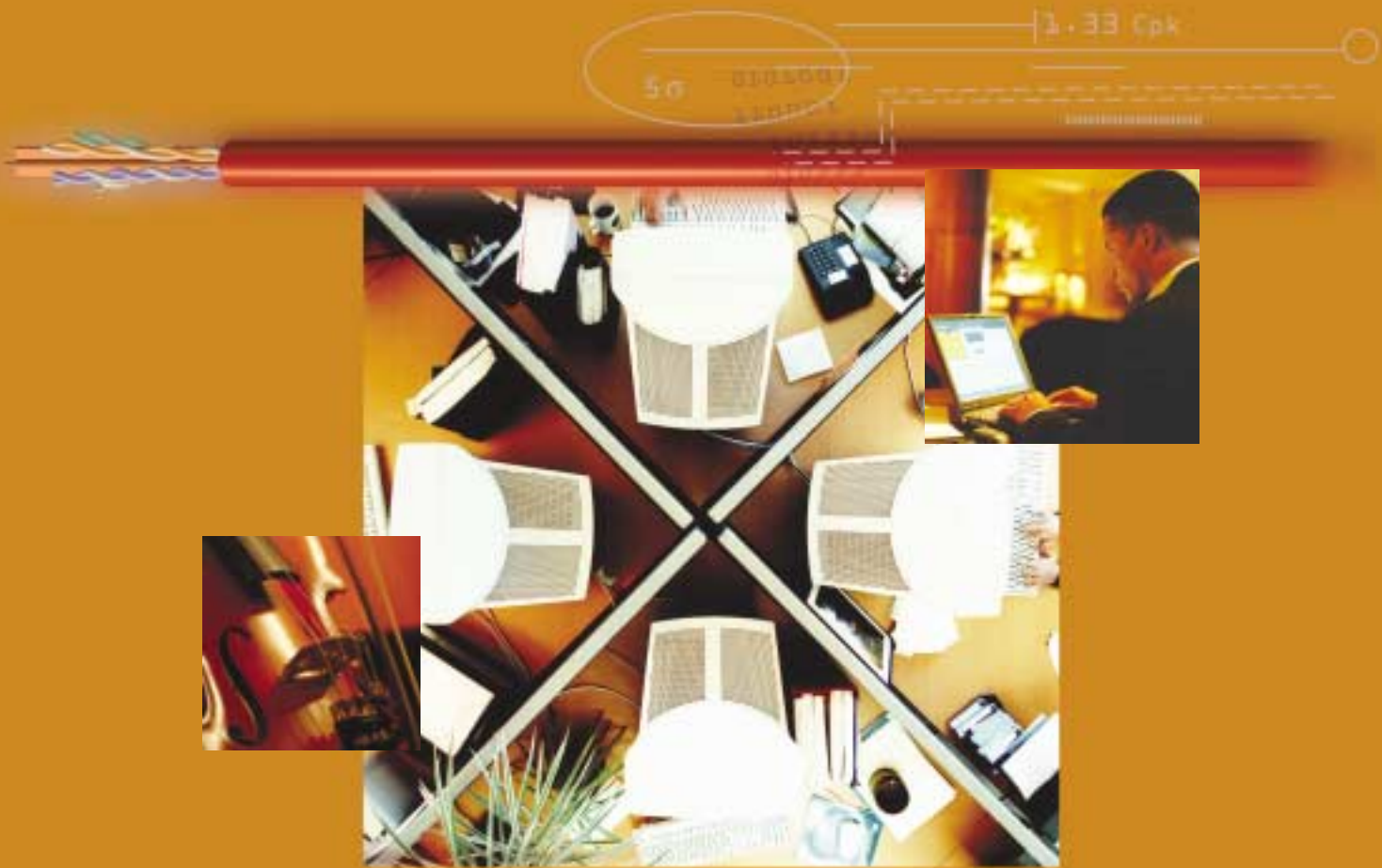
Belden's Cpk testing methods are actually more reliable than simple "pass/fail" testing on cable as it comes off the manufacturing line. Rather than merely testing batches of cable, Cpk testing allows Belden to monitor and control the long-term quality and performance of the cable we produce. It gives us an accurate measurement of quality over time, so that we can adjust our manufacturing processes in ways that ensure the production of high performance cable, day in and day out.

Our 5-Sigma Goal

A NUMBER OF YEARS AGO, IN AN EFFORT TO EVALUATE THE QUALITY OF OUR PRODUCTS, BELDEN ADOPTED THE "SIGMA" CONCEPT. IN TECHNICAL TERMS, SIGMA, ALSO KNOWN AS STANDARD DEVIATION FROM THE MEAN, MEASURES THE VARIABILITY IN A PROCESS. AT BELDEN, SIGMA IS A QUALITY TERM THAT ALLOWS US TO MEASURE THE EFFECTIVENESS OF OUR PROCESS IN PRODUCING DEFECT-FREE DESIGN, PRODUCT, DELIVERY, AND SERVICE - WITH A DEFECT BEING ANYTHING THAT RESULTS IN CUSTOMER DISSATISFACTION.

WE DERIVE OUR SIGMA LEVEL FROM CUSTOMER FEEDBACK WHICH WE CONVERT INTO SIGMA/PARTS PER MILLION:

$$\left(\frac{\text{The amount of cable footage identified by our customers as not meeting their expectations}}{\text{Total Footage Shipped}} \right) \times 1 \text{ Million}$$



As a company, Belden has set a 5-sigma goal, which translates to 233 defective parts per million. It's a goal we have not only achieved, but also exceeded, year after year. A good example of sigma at work at Belden is our networking cable product line. In 2001*, we achieved a 5.36-sigma level for our major premise product codes, which translates into a defect rate of less than 57 parts per million.

*YTD through October 2001

How does that compare? Industry studies indicate that most companies operate at 3-to 4-sigma quality levels. 3-sigma performance equates to 66,800 defects per million, or over 66 defective reels of cable out of every 1,000. The question any end user should be asking is, "Do I have one or more of those 66 reels installed in my building?" The following looks at what 3-sigma quality means when you apply it in other areas:

- MORE THAN 40,500 NEWBORN BABIES DROPPED BY DOCTORS OR NURSES EACH YEAR.
- UNSAFE DRINKING WATER FOR ABOUT TWO HOURS EACH MONTH.
- NO PHONE OR TV SERVICE FOR NEARLY 27 MINUTES EACH WEEK.
- FIVE SHORT OR LONG LANDINGS AT CHICAGO O'HARE AIRPORT EVERY DAY.
- NEARLY 1,350 INCORRECT SURGICAL OPERATIONS PER WEEK.

Will other cable manufacturers provide you with their sigma level goals? More important, do they actually achieve their goals? Does their relentless commitment to quality stack up to Belden's? According to one study, 75% of the leading networking cable manufacturers do not track the sigma level of the product they produce based upon customer feedback. What the manufacturers' sigma goals are and what sigma levels are actually attained are questions that need to be asked of the manufacturer. We invite you to compare. Without this information, the consumer does not know whether their concerns are being adequately addressed.

Quality Means More At Belden

Excellence in quality assurance is not about passing and failing product at the point of inspection. That is not why we test our products at Belden. Our quality level is such that we do not expect to find a failure in our inspection process. Rather, Belden quality assurance is about prevention and monitoring the process to ensure that the first reel of cable looks and performs like the one-millionth reel.

Belden has been in the business of manufacturing wire and cable products for nearly one hundred years. Not many

businesses in any industry can boast that kind of longevity. The Belden name has become synonymous with high-quality, high-performance cable products.

In the end, quality at Belden is not just a word tossed around because it sounds good in the annual report: quality is a commitment. We have built our name and reputation on quality, and it is the ongoing dedication to that principle that will continue to make us THE leader in wire and cable products in this century.