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HARDWARE CONSIDERATIONS IN THE INTERNATIONAL MARKETING OF ELECTRONIC DATA PROCESSING EQUIPMENT

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BY

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Introduction The international electronic data processing (EDP) equipment market is roughly divided into four parts: one third of the world's supply is sold in the U.S., one third in Europe, one sixth in Japan, and the remaining one sixth in the rest of the world. Because of the large market potential in Europe and Japan, and the desirability of retaining the economies of scale necessary to compete not only internationally but also here in the U.S., it is becoming increasingly necessary for the EDP vendor or system integrator to design or procure equipment for the international market instead of just for the U.S. One of the largest minicomputer companies just replaced a popular computer before the end of its life cycle because it did not comply with European wiring regulations, and the company needed to ship the computer internationally to stay competitive.

While it is obvious that software is country specific because of both language and application differences, this paper will discuss only the hardware considerations. Hardware changes are necessitated not only because of differences in language and electrical power, but also to insure compliance with different countries' safety and telephone regulatory bodies (in the U.S. it might be the U.L. or F.C.C.). Some devices common in the U.S. are not suited for international usage (for example, the new breed of terminals containing plug-in, self-dialing, intelligent modems are illegal in most of the world). EDP vendors must also consider where to procure the various components of an EDP system and who will service the equipment once it is installed.

Electrical Power Differences To work, the EDP equipment must connect to the local power supply. The characteristics of the electric current -- type (alternating or direct current), number of phases, frequency (hertz per second), and voltage -- must be considered, as well as the physical plug connecting the equipment to the power source.

Attachment plugs used throughout the world come in a bewildering variety of forms, dimensions, and configurations. The variations are too numerous to delineate, but there are a few basic types that represent the majority of plugs used.[1] The most basic forms include the American system's two flat parallel blades, the European type with two or three round pins (i.e., circular blades), and the British square pins types. Attachment plugs are fairly easy to attach to the end of the power cord. Some countries, such as Switzerland, specify that the local government must provide the power cord and attachment plugs.

Frequency differences are the most important factor in the operation of timing-sensitive equipment such as EDP equipment. At least two different power supplies, generally either 50 or 60 HZ,must be supplied. Frequencies tend to be fairly rigid country wide (most of Europe is 220V, 50HZ; the U.S., Korea, and Taiwan are 110V, 60HZ). There are exceptions, such as Japan. As a legacy of the post-WW2 occupation, there is a north/south dividing line through Japan; the northern part has European-like power (100V, 50HZ) and the southern part U.S.-like power (100V, 60HZ).

While most countries have AC power only, some have both AC and DC. These are generally available in either one or three phases. Nominal voltages change from country to country (and often from city to city). There are, however, some general rules that can apply. Direct current nominal voltages are available in two voltages (for example 110/220 and 120/240), the lower voltage always one half of the higher. Normally, direct current is not used for EDP equipment.

Alternating current is normally distributed through either three-phase; wye (star) -- for example, 110/190, 120/208, 220/380, 230/400; or delta (triangle) -- for example, 110/220, 230/460 systems. The wye system's higher voltage is 1.732 (the square root of 3) times the lower; the delta system's higher voltage is twice the lower.[2] Differences in voltage are much easier to deal with than differences frequency; usually a small transformer board or switch can be put in the equipment.

Safety and Electrical Regulations The next big obstacle to overcome is approval of the EDP equipment by the local government regulatory bodies. Most of the regulations have to do with two main categories: safety, and electro-magnetic (EMI) and radio frequency (RFI) interference. The regulations tend to be very strict. One of the main reasons for this is, that outside the U.S., the power companies are owned by the state, and the state is therefore liable (or at least responsible) for any mishap. For example, in Europe, with 220V power, a short in the circuit could easily kill someone.

The variety in regulations from country to country used to be even greater than it is today. Countries tend to be suspicious of other countries' regulations (especially since those regulations have been used to achieve competitive advantage), so there has not been much cooperation in developing a standard. Generally, however, most countries recognized Germany's Verband Deutscher Electrotechniker (VDE) standards as being among the most strict. Vendors have a definite advantage in getting equipment approved in another country if it already has VDE approval.

The International Electrotechnical Commission (IEC) has sought to create international standards that are comprised of elements of various countries' local standards. Currently, the IEC-issued standards for safety are essentially the same as those of the VDE; for example, IEC 435 and IEC 380 are equivalent to VDE 805/79 and VDE 806/8.81.[3] The Japanese Industrial Standards (JIS) are closely aligned with the IEC standards, and other countries are following suit.

There is usually more than one category of safety standards. For example, the VDE has a Class A for data processing and a Class B for office equipment. The differences in the two lie mainly in two areas: the requirements of in-depth training (for which professional training is a prerequisite) for the DP equipment against minimal training for OE, and the portability of equipment (which makes it usable in close proximity to the domestic environment and implies simplicity of operation). The VDE as defines "portable" equipment that weighs less than 25 kg and hence can easily be moved.

Equipment can be categorized under the regulations as having official approval, as being under compliance, or as being under noncompliance. Approval means that an official, or sanctioned, testing agency has tested the product and the manufacturer may affix a label on the product so stating. Compliance means that a vendor is in such a position that, if challenged, the product in question can be shown to comply with the standards by a letter from an official testing agency or an outside consultant, or by using the vendor's own testing facilities.[4]

The procedure for getting equipment officially approved is so time-consuming and filled with red tape that most vendors tend to test their equipment first at TUV (Technischer Uberwachungs-Verien) or VDE consultants to insure compliance. Then they can seek the "approval mark" after completion of the compliance test. Approval and compliance both require that the same technical standards be met; the approval is an additional administrative act with follow-up, sample retesting, and factory supervision to ensure and verify continuing compliance.

Even though there is an attempt to establish international standards, an attempt that will get stronger over time, the local rules do not go away. There are thousands of local regulations, many more than can be discussed here. Sperry Univac put out a book entitled <u>World of EDP Standards</u>. The book covers only safety, EMI, and RFI standards in various countries -- yet it is over 150 pages long. However for safety standards, vendors generally choose to have their equipment comply with the requirements of IEC380 or IEC435 (depending on the type of equipment, DP/OE). Additionally, equipment manufactured for sale in the U.K. must meet the British standards: BSI 3861 and BSI 3535.

Similar rules apply to EMI and RFI. Although not as many universal standards apply, it looks as if the CISPR/B (translated from the French--Internal Special Committee on Radio Interference) will become the international standard. The VDE 871 is the toughest current standard. The new FCC standards that go into effect in October 1983 closely resemble these two standards.

The VDE also classifies DP and OE equipment into two categories (not to be confused with the two classes of safety standards) for EMI and RFI: class "A" and class "B". Class "A" would have a measure of better isolation between the receiver to be protected (victim) and DP or OE equipment. Class "B" could occur in close proximity to the domestic environment. Interestingly enough, once a vendor goes through all of the tests and receives class "A" aproval (or claims compliance), "type" approval (in other words, a blanket approval for any of that kind of equipment) can be granted. Class "A" equipment, however, has to be tested at each individual location.

Approval is the same as for the safety standards. Compliance means the vendor has reason to believe that if challenged the product in question can be shown to comply with the standards. Sometimes the "reason" is a letter from the official testing agency. For example, if country X specs closely resemble VDE and country X laws do not require "official" testing unless a complaint is filed, VDE approval is sufficient. Vendors tend to comply with CISPR/B, VDE 871 and TEIL 100/80 (equivalent to CISPR/B but extending to lower frequencies), and VDE 875.

Legal Ramifications The vendor must decide what standards to design for, and in what countries to seek approval. Approval and compliance with the regulatory standards, along with the applicable local safety laws, determine a vendor's legal risk. Since the standards and laws are different in every country, this paper cannot hope to cover every case. However, since the German standards and laws are generally accepted as "worst case," the legal considerations in Germany will be discussed as an example.

Is VDE approval for safety, RFI, and EMI required? Approval is not strictly required by law. Legal liability under German law is based not only on the general civil and criminal prohibitions against negligently and/or intentionally injuring a person and/or an other's property, but on the technical standards and rules (VDE) as well as "the accepted rules of electrical engineering for the state of the art." Potential defendants are the manufacturer, the importer, any dealer, and their directly responsible employees.

In order to avoid legal liabilities under the general provisions for damage or injury caused by technical devices, it must be shown that the technical standards or the state of the art were adhered to. Only adherence is equivalent to the exercise of due care and diligence. German insurance companies and occupational cooperatives also tend to accept the results of the VDE as determining the "accepted rules of electrical engineering."

Currently, the only way to ensure compliance is to have the equipment approved (although no sticker is necessary).[5]

The state of the art (in Germany, the VDE standards) represents the minimum but sufficient standard of care to be used in the development and construction of products. If it is not adhered to, the liability arises from negligent (or even intentional) conduct. The generally recognized rules of the art need not be adhered to if it can be shown that the standard of care which applies instead is at least equivalent to the generally recognized rules. A vendor who takes the standards into account in going beyond the state of the art fulfills his duty of care and does not act negligently.[6]

It may be very difficult to show that a novel or alternative solution is equivalent to VDE standards, and hence a vendor has a high risk of liability for negligence. Problems can arise when the recognized worldwide "state of the art" does not coincide with the local "state of the art." For example, about eight years ago the VDE ruled that power supplies could not be of the then new switching regulator power types (they generally would have to fall into the transformer category). When companies began to need a less expensive, lighter power supply for use in the new portable terminals, great improvements were made in the design and implementation of the switching regulators. Now these power supplies are safer, more reliable, less expensive, and have the added advantage of being able to be used on a variety of voltages. Most data terminals have been made with this type of power supply only for the last five years. The VDE has still not approved this type of power supply because it is "intuitively" unsafe. What this means, of course, is that a vendor supplies out-of-date technology or accepts the risk of liability. Both alternatives increase costs.

Every employer in Germany is a mandatory member of the occupational safety authority. The statutory function of this authority is to insure all employees against accidents at work and to ensure the observance of the safety standards laid down and issued or accepted by the authority (including ergometric standards).[7]

The authority holds the employers (the vendor's potential customers) directly responsible for safety at work by denying insurance coverage in the case of noncompliance with its provisions and by imposing of fines on employers who violate the authority's safety rules. The authority also has the power to inspect and audit the employment conditions. It obligates all employers to get assurance from their vendors that they comply with the applicable safety rules.

The state of the art will rarely be mentioned explicitly as a specific requirement in an agreement. However, equipment always has to be complying, otherwise it would be considered defective or faulty. This applies to established standards as well as advanced technical solutions which go beyond the state of the art but are not yet fully evaluated as to the safety hazards they present.

Ergonomics Besides the safety and communications regulations, many countries are initiating regulations governing the ergometrics of the data-processing equipment. The equipment must be easy to use, have nonglare screens, and be nonfatiguing. The screen cannot flicker and the characters must be large and easy to read. Keys cannot be too close together or too far apart (which causes problems, because Orientals' hands are smaller, so differently spaced keyboards might be necessary), and the keyboard must be low profile (or have palm rests provided). Screens may also have to be tiltable and keyboards removable. Occupational safety authorities (as discussed above) can enforce these standards.

These regulations are often not laws but "guidelines" set down by the local unions. Union members will not use equipment that does not follow the guidelines. In many countries, the labor unions are powerful enough that these guidelines carry the force of law. In many other countries, the guidelines have become law. In Sweden, any data processing equipment sold to the government must pass union-sponsored ergometric laws; in Denmark, any data-processing equipment that is imported must pass similar laws.

Language Requirements Language-induced changes in the internals of the EDP equipment are minimal, since most of the high-level languages that run on the computers are in English (most of the standard languages -- COBOL, Basic, Pascal, Fortran, C, RPGII, etc. -- were developed in English-speaking countries). This makes software and technical documentation generally transferable between countries (except France, where there is a government committee that takes English programming terms -- such as "GO TO" in Basic -- and changes them to French).

The layout of the keyboard varies considerably, being mainly dependent on the country of origin and the application for which the machine is designed (of course, there are manufacturers like Hazeltine who just swap the keys around -- the 1500 and 1420). The main reasons for the differences are: the need for different character sets (Latin, Greek, Russian, Japanese); the allocation of common characters to different positions on the keyboard for historical reasons, even on keyboards using the same basic alphabet; and the need to include in a character set, in addition to the basic alphabet, some characters typical of the language, country, or application (these characters could be new ones or could be obtained by the combination of a character of the basic alphabet and a diacritical mark).[8]

It has been recognized that there should be a practical minimum on the various configurations so that operators can easily transfer from one machine to another with a minimum loss of efficiency. For this reason, there are various world standards (ISO/R 2126 and ISO 3243) that can help countries set up their own layouts. Within the countries using keyboards based on the Latin alphabet, there is an even greater commonality in character positioning.

Not only are the keyboard changes necessary in order to make the machine really functional; they may also be necessary to avoid liability. In Germany, if your name is "Müller" and you get a bill with your name spelled "Muller," then you don't owe the bill because it was not sent to you, it was sent to "Muller."

Most EDP vendors make a variety of different keyboards for international use. The most commonly used are: German/Austrian, Norwegian/Danish, Swedish/Finnish, U.S./Italian/Dutch, British (same as U.S. except with a pound sign), French word processing, French data processing (the French do not like dual-purpose keys), Swiss, Spanish, Katakana (one of the Japanese alphabets), and Arabic. Only a few keys vary on the European keyboards . For example, on the standard typewriter keyboard in the U.S., the keys right of "L" are ;/:, '/", {/}. On the Danish keyboard, the keys right of "L" are æ/Æ, ø/Ø, ;/:. The '/" key is moved to an upper right position, and the {/} key is not used at all.

Where one has to be careful, with respect to both the keyboard and the printers, is in the code assignments of the various characters. Using the ASCII code, for example, the binary code for the # symbol in the U.S./Italian keyboard is the same as the £ symbol in the U.K. version. The more complex the changes in the keyboard, the more changes there are in the code. In the Swiss character set, the £ symbol has the same code representation and replaces the #, the a replaces the @, the é replaces the [, the ç replaces the /, the è replaces the], the ä replaces the {, the ö replaces the |, the ü replaces the }, and the ¨ replaces the ~. The rule is that the most common characters with diacritical marks are represented on the keyboard, while the less common have to be represented by two characters, the alphabetic character and the diacritical mark. Some of the countries have tried to make their language more conducive to being represented in print. The Greek alphabet has ten diacritical marks that can be used with seven different vowels. Since the seventy resulting characters are too many to manage, the printing and computing industries have led the way in replacing all of the diacritical marks with one (a single dot over the vowel -- for example, "ὀ"). As one might expect, all of this plays havoc with software that uses the special characters to mean special functions.[9]

The hardest keyboards to accommodate are some of the non-Latin ones. The Japanese hieroglyphic language Kangi has thousands of characters. Keyboards that use Kangi are incredibly complex; the best typists average only 5 to 6 words per minute. Fortunately, most of the Japanese keyboards use the Katakana alphabet. Katakana has 51 instead of 26 characters (which is still no small task to design for). Where the Latin characters must also be put on the same keyboard, they can be engraved on the keytops beside the non-Latin characters. On stepped keyboards, it is possible to put the non-Latin characters on the front of the keys and the Latin characters on top, or the other way around. This solution requires more tooling and is therefore more expensive.

There is also a subtle change in the numeric keypads. Most European countries use commas instead of decimal points to delineate between whole currency units and subunits, so a comma has to be substituted on the numeric keypad.

Printers have to be able to recognize the various codes and print the appropriate characters. Dot matrix printers can be programmed to form almost any character and are therefore very flexible. Printers that use a type font must have the appropriate number and type of fonts available. A large number of fonts are necessary if the system requires both Latin and non-Latin characters. For example, a Japanese printer may be required to print, in addition to Latin characters, Kangi, Katakana, and Hiragana. (Hiragana is another Japanese alphabet and has a one-to-one correspondence with Katakana. The two have the same code representations, and are usually differentiated by a preceding symbol like an "escape" key.)

The printer markets can be affected by the complexity of the language. In Japan, most interoffice correspondence is hand-written rather than typed or twxed. There is a much larger demand for facsimile transmission and optical scanning equipment. While most computer systems in the U.S. are fitted with continuous roll (tractor) feeders, systems in Japan and Europe do not use automatic printouts as much, and printers have to be fitted with sheet feeders. This means that different types of special equipment could be necessary in different parts of the world.

Data Communications and Interfacing Differences in this category are represented by direct-connect cabling requirements, and by a host of regulations from the local countries governing data communications over telephone lines.

When it comes to interfacing cable standards, U.S. standards (EIA RS232 or RS244 and IEEE) are just what they imply -- U.S. standards, and are not generally recognized beyond our shores. Europe and Japan have really combined to set the world standards (perhaps precipitated by joint ventures in the computer field à la

Siemons/Fujitsu) and it looks as if the French CCITT standards will win out. The JIS are very similar to the European standards. Communications standards for networking and packet switching have been similarly affected; IBM's SNA/SDLC have not become the world standard that IBM hoped they would, while the European-developed X.25 has, even in the U.S.

There are real problems in the communications systems in many countries. Phone lines are not insulated, and the switching is done by mechanical, and in some cases human, switchers. This can make transmissions, especially to remote locations very dificult. Care must be taken to maintain data integrity, especially to insure that computer-initiated calls do not go through a human switchboard operator (France is one of many countries which have "solved" this problem by simply making it against the law for any computer to initiate a call). Often private leased lines are necessary.

The telephone lines themselves are not the main obstacle; rather, it is the limitations placed on the hardware vendors by the government-owned telephone companies. These regulations govern what equipment can be placed on the line for the "protection" of the telephone company's equipment, and also include laws governing transmission of data.

The Carterphone decision which led to the proliferation of direct-connect modems in the U.S. is not in effect in the rest of the world. The local phone company is usually a government-run monopoly, often part of the Postal/Telegraph Department. Many countries ban direct connect modems and internal modems altogether; in the countries that do allow them, they are rarely seen and approval is extremely difficult to obtain. The modems that do get approved require the local equivalent of a Data Access Arrangement (DAA). In England, a separate black box barrier circuit from the British Post Office (BPO) is also required. (Most modems already contain this circuit.) So, most communication is done through acoustic couplers. Either way, there is always a buffer between the modem (or acoustic coupler) and the telephone line.

The laws governing what can and cannot be attached to the lines are very strict. In Germany, a vendor must certify that equipment will not put out a sound pressure to the telephone of more than one newton per square inch. In Japan, a vendor must successively short out every connection in the equipment while it is connected to a test line to prove that it will not exceed the one newton per square inch limit. Sometimes the rules are excessive. For example, the above rules are intended to protect a 50 cent microphone in the telephone handset, although a raised human voice exceeds this limit.

The frequencies used on the telephone lines are different in different countries. The acoustic couplers must be set accordingly.

Telephone headsets are different throughout the world, and the muffs on the acoustic couplers must be made to accommodate them. Sometimes it is not practical to manufacture all of the different muffs, so straps must be provided to keep the headsets in. In Germany, the straps are required so the telephone handset won't fall out and damage the government's telephone.

Interesting "Catch 22s" sometimes arise. The Postal, Telephone, Telegraph (PTT) Department will usually not approve equipment for use on the line until it has received the equivalent of VDE approval. The VDE does not currently have a category for battery-powered equipment, and consequently won't examine it. But the German PTT won't examine a battery-powered machine until the VDE approves it -- Catch 22.

Limitations arise with telephone usage rules. Many countries restrict computer-to-computer calls, or restrict the speed at which communications can occur (some countries claim that 9600 baud ties up the telephone lines too much in case of an "emergency"). Many countries control what information can be sent out of the country, and therefore are very strict as to which companies with "sensitive" data bases can have communication equipment. Since the telephone companies are government-owned, countries can restrict the data traffic by regulating the cost of phone calls (Nippon Telephone and Telegraph (NTT) has a policy of very expensive call rates). NTT also has regulations covering where and through whom companies can transfer information.

Coping with Selling Internationally Many components of EDP equipment are not made by the vendor, but are purchased on an OEM (Original Equipment Manufacturer) contract. A manufacturer of minicomputer equipment, for example, may make the CPU and the VDTs, but may procure the high speed printers and disk drives. A hardware integrator may buy the computer systems from one source, a plotter or other specialized equipment from another, add his ownsoftware, and sell a turnkey solution. There are other questions that arise.

First of all, does a company buy or make components for foreign markets? The hardware differences may be too great to justify manufacturing every variation. For example, it might not be economical to develop a Katakana keyboard for the Japanese marketplace, so the VDT may be procured instead of manufactured.

Tariffs also affect a company's choice of components. In Australia, there is a high tariff on terminals (to protect local manufacturers), and almost none on computers (no local manufacturers exist). In cases like this, it often makes sense to buy local terminals for the system. Countries like Brazil, which have tried to develop their own local manufacturers, will allow only certain EDP equipment into the country at all. Tariffs on the equipment Brazil does allow in often approach 300 percent. In cases like this, the only alternative is to manufacture locally. Many countries are requiring that higher and higher percentages of EDP equipment be manufactured locally, especially EDP equipment that fills "routine" applications (data entry, accounting, payroll, etc.).

The most important question is whether service and support are available in all of the countries where one wants to market. Companies with their own service organizations face fewer problems. Hardware integrators, on the other hand, have to make sure their vendors or their vendors' distributors will service all of the equipment. Many problems arise from distributors not honoring agreements to service special equipment (such as plotters and paper tape equipment), or demanding lost commission premiums on equipment not bought directly from them.

This leads to the question of where to procure. A lot of theequipment made in other countries is technically superior and less expensive than comparable products made in the U.S. (for example,the recent explosion of inexpensive Japanese printers). Many integrators are considering procuring component equipment in Europe or Japan for international distribution. The same issues are pertinent here: can that vendor support equipment in the rest of the world, including the U.S.? Another issue to consider is the OEM agreements of the various component vendors. Some may require that products be bought in the local country (sometimes the equipment is priced very uncompetitively by the local sales offices, and alternate equipment must be procured for that country).

Conclusion How does the medium-sized company that believes it has a product with international appeal, but doesn't have an international marketing department, go about selling its product internationally? First, it has to be aware of the considerations discussed in this paper. Unfortunately, this information is not easily available. Much information is available from the ISO, CCITT, IEC, or even the U.S. Department of Commerce.

In the past, vendors often simply claimed that equipment met safety and other standards, and shipped whatever equipment they wanted to other countries. However, the risks are much greater now. Countries are enforcing the standards more strictly, and so are insurance companies and occupational safety councils. Public awareness is forcing a closer look at safety (especially in the area of VDT radiation). Also, more vendors that do meet the standards are appearing on the scene. Therefore, it makes sense to design for the most severe standards, especially since the coming "world standards" will approximate the most severe standards. It should be noted that the more "state of the art" the application, the less the regulations and limitations apply.

Japan, one country that has been extremely successful inexporting its products to the rest of the world, has relied on giant international trading companies to help the medium-sized companies break the international barriers. Often this is done by allocating different markets to different companies (company A takes Europe, company B takes the Arab states, etc.). Japanese companies have built a base of business by designing EDP equipment (especially printers and home computers) for both the Japanese and the European market. This has given them the economies of scale necessary to effectively penetrate the U.S. market.

The giant international trading companies are currently against the antitrust laws of the U.S. (particularly the ones that allocate markets). Currently there is legislation in Congress to relax the laws for international trading companies, and this might make the expertise of an international marketing organization more available. This would make it easier for smaller companies to design and plan for the international EDP marketplace.

Appendix A
Some Applicable Standards and Laws

Safety Standards

IEC 435	Safety of data processing equipment.
VDE 805/79	Safety of data processing equipment (draft document, revision of IEC 435).
IEC 380	Safety of electrically energized office machines.
VDE 806/8.81	Safety of electrically energized office machines (revision of IEC 380 publication).
VDE 160/79	Specifications for outfitting power installation with electronic apparatus -- equipment containing electronic apparatus for information processing in power installations.
VDE 160/81	Specifications for the erection and hand operation of telecommunication installations including data processing equipment -- general requirements.
VDE 804/80	Specifications for telecommunication apparatus including information processing equipment.
BSI 3861	Electrical safety of office machines.
BSI 3535	Safety isolating transformers.

EMI/RFI Standards

CISPR/B	Interfacing from ISM apparatus -- data processing equipment and electronic office machines.
VDE 871/6.77 & TIEL 100/80	Radio interference suppression of data processing equipment and electronic office machines.
VDE 875/6.77 & amend. 1/79	Specifications for the radio interference suppression of appliances, machines, and installations for rated frequencies 0 to 10 KHz.

Product Safety Laws

Energiewirtschaftgesetz (energy distribution law)
Machinenschutwgesetz (appliance safety law)
Fernmeldegaraetegesetz (telecommunications appliance law)

Component level standards

VDE 110	Creepage distances.
VDE 281	PVC insulated power cords.
VDE 282	Rubber insulated power cords.
VDE 283	Color code for power cords.
VDE 471	Fire prevention rules for electronic components.
VDE 550 & 551	Safety transformers.
VDE 607 & 608	Terminal blocks.
VDE 620 & 625	Power plugs.
VDE 630 & 632	Power switches.
VDE 820	Fuseholders.

Acknowledgements and References

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U.S. Department of Commerce, issued May 1975
Office of Business Research and Analysis

ISO International Standard #3243
"Keyboards for countries whose languages have alphabetic extenders -- Guidelines for harmonization."
First edition, 1975

Specification Guide for International Products, Volume 8, International Keyboards and Character Sets
Texas Instuments publication by EDSD engineering, originally issued March 1980, revised November 1981.

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Footnotes

1 *Electric Current Abroad*, U.S. Department of Commerce. See for more information.

2 Ibid.

3 See Appendix A for a listing of standards.

4 Confidential internal company documents.

5 Ibid.

6 Ibid.

7 Ibid.

8 ISO International Standard #3243.

9 *Specifications Guide for Internal Products*. A complete listing of all the keyboard and ASCII standards can be obtained from the ISO.