2.2 Current State and Issue for Standardization and Quality Management

2.2.1 Standards related to the metalworking sector

Standards related to metalworking include those for dimensions and dimensional tolerance, sampling methods for chemical analysis and analytical methods, and metallic and alloy materials grade.

On the other hand, standards for metallic materials which are critical in the metalworking area are not included in TCVN. Take cast iron which the most basic and important material, for instance. Classification No. 77.080.10 sets forth standards for cast iron and pig iron, it only covers dimensional tolerances, the methods for preparation of samples for chemical analysis and determination of element content, and graphite classification. However, there are no standards specifying grades of cast iron.

TCVN, JIS, and ISO standards related to casting are compared in Table 2-2. In addition, standards for metallic materials are related to forging, press, and welding. In this area, TCVN fails to provide sufficient standards in terms of scope and depth. In particular, standards for products currently manufactured in the country, e.g., gray iron castings, spheroidal graphite iron castings, and carbon steel castings, need to be established in a systematic manner.

Comparison of TCVN and JIS in the area of "dimensional tolerance for iron castings" is shown in Table 2-3. TCVN 385-70, for instance, is based on GOST and appears to require much higher levels of dimensional accuracy than those for castings that can be expected from molding methods and equipment used by local enterprises.

Dimensional accuracy of iron castings is governed by a number of factors including, in addition to product size, product shape, molding method and equipment employed, the type of metal and alloy, and the type of pattern. In establishing and revising TCVN standards in future, therefore, efforts should be made to take into account these local factors and thereby develop standards which reflect technology levels in the country, in addition to the need for compliance with ISO and other internationally applicable standards.

It should be noted that, in the area of metalworking in Viet Nam, GOST is widely used because of familiarity due to a long use and a broad coverage to meet a variety of needs, as explained by various enterprises.

Large state enterprises opt to adopt ISO and other internationally acceptable standards, while TCVN is limited to domestic use.

2.2.2 Current use of standards by individual industries and enterprises

(1) Final product

For custom production, local enterprises carry out production and inspection according to drawings furnished and standards specified by the customer. In fact, this is a general practice seen in most of metalworking industries in the world. In the past, GOST has been primarily used for these purposes. As trade with West Europe and Japan grows with market opening, however, foreign standards such as JIS and DIN, and ISO are increasingly used. As a result, some confusion has occurred in standards related to metallic materials.

Standards used by industry are described as follows.

End user products which are shipped to the domestic market, such as hand tools and files, are made in compliance with TCVN.

Leading cast iron pipe manufacturers in the country adopt ISO as TC as they feel the need for using internationally acceptable standards when they seek opportunity in the international market. A state enterprise manufacturing bridges uses AASHTO (the American Association of State Highway and Transportation) ranging from design to manufacture and inspection.

Parts and materials used internally are made according to internal drawings and standards. Internal standards are based on a variety of original standards including GOST, internal standards of partners who provide technical assistance, and TCVN.

(2) Materials

Base materials purchased, such as pig iron and steel, are mainly foreign products which are made in compliance with foreign standards applied in suppliers' countries, such as JIS and GOST. Again, this is a general practice seen in any country when foreign materials are purchased.

(3) Testing and inspection

Metalworking products used as end user products, such as files, hand tools, and boilers, are made in accordance with TCVN. Metalworking parts and materials made on a contract basis are tested and inspected according to specifications furnished by customers. Inspection of materials used internally is limited to visual check.

In the case of gas cylinders, TCVN does not cover sufficient inspection items, and U.S. standards (DOT) are used instead.

2.2.3 Certification system

In the Vietnamese metalworking industry, the "product certification" system is rarely used. On the other hand, the "quality registration" system is used in the industry.

It should be noted that quality registration and product certification do not cover castings, forgings, and metallic press products which are used as machine parts. Rather they cover final products using metalworking products, metalworking products which are used as final products, such as cast iron pipes, files, boilers, gas cylinders, and hand tools, and construction materials such as bar steel and wire rod.

Thus, factories and work shops which make base materials to be used as machine parts are not required to have quality registration or produce certification, and in fact, they do not apply for them. On the other hand, manufacturers of metalworking products (e.g., cast iron pipes, files, hand tools) as well as bar steel and wire rod for construction register their products under the quality registration system. In addition, manufacturers of boilers and gas cylinders, which must meet strict safety requirements, have quality registration.

In reality, however, the certification system is not fully understood by enterprises. Many of them do not know how different "trademark registration," "quality registration," and "product registration" are.

According to our survey, enterprises cite various reasons for quality registration, including: 1) it helps obtain customer's confidence; and 2) it helps improve internal quality control. However, the present quality registration system is primarily designed to provide sufficient information on quality by requiring the manufacturer to indicate standards with which the product complies. Thus, it does not question the quality control system under which the product is manufactured. This is evidenced by the fact that manufacturers have their own quality control units (KCS), which perform inspection service only.

If "certification" and "quality registration" are to be used to ensure stable and improved quality, the focal point should be shifted to emphasize quality control of the production process, as one of basic TQM concepts says "quality is incorporated in the production process."

As for ISO 9000, many enterprises show interest as they send executive officers (e.g., president, chief engineer or KCS manager) to STAMEQ's seminars. However, most of them are still in the stage of careful consideration before they actually move to apply for certification.

Finally, ISO 14000 is not widely known, and most of enterprises do not show interest.

2.2.4 Current levels of quality control and need for improvement

There are significant differences between local enterprises and joint ventures having foreign partners/foreign companies operating in Viet Nam, which are described as follows.

(1) Local enterprises

Except for those receiving technical assistance from Japanese companies, local enterprises, regardless of size, have the following common elements in quality control practice:

1) All the enterprises visited by the study team have quality control sections (KCS), which are primarily responsible for product inspection and are different from QC departments seen in Japan.

2) Quality control techniques, such as control charts and cause and effect diagrams, are not used at all although some manufacturers record data.

3) Virtually no inspection is conducted between processes.

4) There is no equipment needed for quality control. Only three large state enterprises have spectrometers for chemical analysis of metallic materials. It is a case that the company can not purchase argon gas needed for spectrometer.

5) Quality control activity relies on workers' experience and intuitive judgment, and no measuring instruments are used. For instance, there is a few foundry which controls molten metal by using the CE meter or emulsion thermometer. Only a few foundries have optical pyrometers. Those having sand testers are limited in number, and those under procession are not in use. Many forging shops do not measure temperature in furnaces to heat materials.

6) Products and materials are placed all over the place and no safe passage is provided.

7) Many factories do not record inspection results. If taken, they are only kept as record and are not used as feedback information to production processes.

8) Foundries claim that the rejection rate is around 6% for raw materials and 3% at the time of machining. However, most of machinery manufacturers which process castings purchased from the foundries report the rejection rate of around 20% at the time of machining. Judging from equipment conditions and quality control practice observed, the latter figure seems to be closer to the actual situation.

In fact, rejection rates obtained for various products are invariable high: around 25% for lock bodies made in the floor molding process using green sand molds; 16% for hand pumps in the same process; 10% for cylinder liners made in the centrifugal casting process; and 15% for cylinder heads. Many defects are related to casting sand, including sand burning, sand inclusion, and blowholes, while alternate mold is observed caused by floor molding.

Molds are made without little consideration to material strength, and the focus should be placed on making mold patterns according to drawings. Judging from break surface of products observed many of them have chills or seem to have insufficient strength with rough surface. Those showing adequate break surface according to product use and shape are rarely seen.

Few factories record defect data, such as monthly rejection rates or rejection rate for each project, and quality control based on statistical data is not practiced.

Products accepted by these factories are not far form quality levels which are acceptable in Japan and other markets.

(2) Joint ventures with foreign partners and foreign companies operating in the country

Two mold manufacturers are adopting Japanese-style quality control practices in the future. The status of quality control in these companies are stated as follows:

1) Safe passages are clearly marked inside the factories, and shop floor is thoroughly cleaned, with products and materials being arranged in proper order.
2) Work standards translated to Vietnamese are kept beside workers.
3) A set of measuring instruments for quality control is provided and used.
4) Efforts are being made to promote small group activities, such as meetings of field workers held on Saturdays.
5) Necessary measuring instruments are provided between processes, and workers use them to check their own work.

On the other hand, a joint venture with a Japanese foundry manufacturer has just completed education on work standards and is now ready to introduce Japanese-style quality control, taking some time to produce the result.

(3) Need for improvement

As pointed out earlier, quality awareness among local enterprises generally remains at the level equating quality control with product inspection. They have still to understand and adopt the concept of "incorporating quality in the production process" by focusing on quality control practice on shop floor. The lack of understanding of the true quality control concept is a major cause for persistently high rejection rates and inhibits stable quality or quality improvement. The situation deprives manufacturers of competitiveness on one hand, and prevents them from exploring market opportunities on the other. To ensure sustainable growth of the metalworking industry in future, it is imperative to educate manufacturers with the true quality control concept and encourage them to put into practice.

The Japanese metalworking industry has previously emphasized quality inspection. It has successfully shifted its focus to quality control, then quality assurance. Accordingly, the inspection department has evolved to the quality control department, and the quality assurance department. To illustrate the process of evolution, the following section describes major functions of the inspection department, the quality control department, and the quality assurance department of Japanese metalworking companies.

1) Major functions of the inspection department

Major functions of the inspection department are to compare product quality with preset criteria, determine whether it is acceptable or not, and accept or reject a lot the product belongs to, thereby to prevent defective products from being shipped from the factory. The inspection department's major duties are as follows:

a) Product inspection
b) Acceptance inspection (raw materials and parts)
c) Maintenance of inspection and testing equipment

2) Major functions of the quality control department

Major functions of the quality control department are 1) promotion of quality control, and 2) provision of inspection service. The concept of quality control is based on recognition that the shipment of acceptable products by separating them from rejected products does not help prevent defect, resulting in higher cost. Promotion of quality control in 1) intends to manage the production process in terms of 4M (material, machine, method, and man) effectively to eliminate the occurrence of defect, thereby to achieve productivity improvement and cost reduction. In reality, however, it is very difficult to eliminate defects, no matter how the production process is well managed, so that inspection service in 2) is required as a safeguard to prevent any defective from being shipped. Major duties of the quality control department are as follows:

Activities related to promotion of quality control

a) QC education and advertisement/promotion activities
b) Fostering of QC circle
c) Development and maintenance of quality control-related standards and procedures, such as working standards and QC process chart
d) QC consultation and guidance for subcontractors

3) Major functions of the quality assurance department

The quality assurance department primarily serve three functions: 1) the establishment of the quality assurance system; 2) promotion of TQM; and 3) provision of inspection service. Quality control, with an aim to "produce a better product at a lower cost," has focused on effective management of the production process in order to prevent defect and has successfully accomplished productivity improvement and cost reduction. This approach is rather characterized as producer-oriented, i.e., based on perspective of the manufacturer. The new concept has evolved to change the orientation to the customer perspective, and the establishment of the quality assurance system in 1) is designed to provide a product which satisfies and is safe to the customer.

From the customer's perspective, quality control should not be limited to the manufacturing department. Rather it must be corporate-wide, systematic and continuous efforts, from the understanding of the customer's needs to after-sales service. This represents promotion of TQM in 2).

As quality assurance activity embraces a whole range of corporate activities, the quality assurance department is positioned as an key business unit reporting directly to the management.

Major duties of the quality assurance department are as follows:

a) Maintenance and reviewing of the TQM system

b) QA education and advertisement/promotion activities including PL (product liability) and CS (customer satisfaction)

c) Development and maintenance of quality assurance-related standards and procedures, including product claim handling and prevention of recurrence

d) QA audit of internal departments and subcontractors

2.2.5 Test, Inspection, and calibration

(1) Testing and inspection

QUATEST provides contract testing and inspection services for manufacturers. However, testing and inspection equipment at QUATEST is not sufficient for metallic materials, and manufacturers usually use laboratories of nearby universities and steel mills for these tests, unless they require a certificate of a public organization.

QUATEST's inspection takes 2 - 10 days before the test report is issued, which seems to be reasonable although some complain that it is too long.

(2) Measurement and calibration

VMI and QUATEST under STAMEQ provides calibration service for metallic material testers which are indispensable in the metalworking industry, such as tensile testers and hardness testers, measuring instruments such as micrometers and vernier calipers, and block gauge and pressure gauge used to check precision of measuring instruments.

2.2.6 Use of outside laboratory by individual enterprises

(1) Inspection and verification

Tests to determine chemical composition and mechanical properties of steel and other materials as well as castings are commissioned to QUATEST or laboratories of universities and steel mills. Generally, manufacturers use nearby laboratories including QUATEST, unless a certificate of a public organization is required, in which case QUATEST is used.

The frequency of using the third party laboratory varies greatly among enterprises, ranging from 5 - 6 times to 30 - 40 times annually. The inspection fee is 200,000 - 500,000 Dong per test piece.

Manufacturers expect pubic testing laboratories to strengthen the ability to examine and analyze mechanical properties of metallic materials as well as their chemical components.

As shown in Table A1-2 (Annex) QUATEST 1 does not have a required set of metallic material testing and non-destructive testing equipment, and some of existing ones are outdated and unsuitable for use. In particular, there is no analytical instrument for chemical composition of metal.

QUATEST 1's equipment procurement plan up to 2005 intends to add a variety of equipment including analytical instruments and X-ray inspection equipment as shown in Table 2-4.

QUATEST 3 has a standard set of mechanical testing and non-destructive testing machines for metallic materials, while there is only one analytical instrument capable of examining chemical composition, an atomic absorption spectrophotometer at its chemical laboratory. It reportedly plans to procure a vacuum emission spectrometer, and its early installation is desirable.

While it is desirable for an individual company to own testing and inspection equipment which is constantly required in quality control practice, it is not financially feasible for most of them, particularly small- and medium-sized enterprises. It is considered to be more effective, from the objective of fostering the machinery and metalworking industries, to establish "public testing facilities" in geographical areas where the industries are concentrated, which are capable of providing consultation service in the area of management and technology, in addition to inspection service. Such facility should possess a set of testing equipment which is generally used by the industries for quality control purposes, as shown in Table 2-5. However, special types of testing and inspection, such as fatigue, creep, twist, and corrosion, may be performed by university laboratories or similar facilities on a contract basis, when required.

(2) Metrology and calibration

Only a handful of companies have their material testing machines (e.g., tensile testing machine and hardness tester) calibrated by QUATEST's visiting service once per year, while most of them do not receive periodical calibration service.

Some of enterprises have dimensional measuring instruments such as micrometers calibrated by QUATEST and use them as internal standards to calibrate other instruments. Again, most of them do not have periodical calibration. Rather, they use standard bars attached to micrometers for internal checking.

There are not many enterprises which have block gauges, and they are mainly machining shops including manufacturers of machine tools. They are reportedly calibrated by QUATEST, but not likely on a periodical basis. At some factories, block gauges are left without greasing and have rust on surface.

QUATEST's calibration is verified by certificate, and few instruments are affixed with any certification label, so that it is difficult to determine whether an instrument has received calibration, or if so, how long calibration is valid. In fact, there are several cases where calibration has expired. It is important affix a label to a calibrated instrument indicating a period of validity.

Table 2-1: Production and Import of Metal Working Products

	Unit	Production				Import			
		1994	1995	1996	1997 (Estimated)	1994	1995	1996	1997 (Estimated)
Metal Working		4,619	4,645	4,576	4,682				
Castings	Tons								
Iron castings	Tons	6,875	2,427	3,016	2,910	754,000	1,116,225	1,505,230	1,000,000
Steel castings	Tons	288,044	470,122	510,003	652,641				
Aluminium castings	Tons	5,513	6,654	6,912	7,150	9,147	17,307	16,040	17,000
Forgings	Tons								
Stampings	Tons								

Source: General Statistical Office

Table 2-2 TCVN, JIS and ISO related to Castings (1/14)

	TCVN		JIS		ISO	
Vocabulary Glossary Terminology	1658-87	Metals and alloys. Vocabulary.	G 0203-84	Glossary of terms used in iron and Steel (products and quality)		
	1660-87	Metals and heat treatment. Terms and definitions.	G 0201-87	Glossary of terms used in iron and steel (heat treatment)	4885	Ferrous products (heat treatment). Vocabulary.
			G 0202-87	Glossary of terms used in iron and steel (testing)		
			Z 2300-91	Glossary of terms used in nondestructive testing		
	5112-90	Non-destructive testing. Ultrasonic test. Terms and definitions.				
	6105-1996 [ASTM E 596-90]	Non-destructive testing. Industrial radiology. Terminology.				
	6106-1996 [ASTM E 500-89]	Non-destructive testing. Ultrasonic examination. Terminology.				
	6107-1996 [ASTM E 425-90]	Non-destructive testing. Leak testing. Terminology.				
	6108-1996 [ASTM E 270-90a]	Non-destructive testing. Liquid penetrate examination. Terminology.				
	6109-1996 [ASTM E 269-88]	Non-destructive testing. Magnetic particle examination. Terminology.				
	6110-1996 [ASTM E 268-89]	Non-destructive testing. Electromagnetic testing. Terminology.				

Table 2-2 TCVN, JIS and ISO related to Castings (2/14)

	TCVN		JIS		ISO	
General	5016-89	Spheroidal graphite iron castings. Technical requirements.				
	385-70	Gray cast iron. Tolerances of dimensions and masses. Excess dimensions for mechanical treatment.	B 0403-95	Casting. System of dimensional tolerances and machining allowances.	8062	Castings. System of dimensional tolerances and machining allowances.
	2344-78	Steel casting. Tolerances on dimensions and masses. Residue for mechanical operations.				
	2511-1995	Surface roughness. Main parameters and values.	B 0601-94	Surface roughness. Definitions and designation.	0468	Surface roughness. Parameter, their values and general rules for specifying requirements.
					4287/1	Surface roughness. Terminology part 1 Surface and its parameters.
					4287/2	Surface roughness. Terminology part 2 Measurement of surface roughness parameters.
	5120-90	Surface roughness. Measurement of terms and definitions of parameters.				
			B 0703-87	Roundness of castings		
			G 0307-89	Steel castings. General technical requirements.	4990	Steel castings. General technical delivery requirements.
Classification of Material of Casting			G 5101-91	Carbon steel castings	3755	Cast steels for general engineering purposes
			G 5102-91	Steel castings for welded structure		
			G 5111-91	High tensile strength carbon steel castings and low alloy steel castings for structural purposes	9477	High strength cast steels for general engineering and structural purposes
			G 5121-91	Stainless steel castings		
			G 5122-91	Heat resisting steel castings		
			G 5131-91	High manganese steel castings		

Table 2-2 TCVN, JIS and ISO related to Castings (3/14)

	TCVN	JIS		ISO	
Classification of Material of Casting		G 5151-91	Steel castings for high temperature and high pressure service	4991	Steel castings for pressure purposes
		G 5152-91	Steel castings for low temperature and high pressure service	4991	Steel castings for pressure purposes
		G 5201-91	Centrifugal cast steel pipes for welded structure		
		G 5202-91	Centrifugal cast steel pipes for high temperature and high pressure service		
		G 5501-95	Grey iron castings	185	Grey cast iron. Classification.
		G 5502-95	Spheroidal graphite iron castings	1083	Spheroidal graphite cast iron. Classification.
		G 5503-95	Austempered sheroidal graphite iron castings	945	Cast iron. Designation of microstructure of graphite.
		G 5504-92	Heavy-walled ferritic spheroidal graphite iron castings for low temperature service		
		G 5510-87	Austenitic iron castings	2892	Austenitic cast iron
		G 5511-91	Low thermal expansive Fe-alloy castings		
		G 5702-88	Blackheart malleable iron castings	5922	Malleable casting
		G 5703-88	Whiteheart malleable iron castings	5922	Malleable casting
		G 5704-88	Pearlitic malleable iron castings	5922	Malleable casting
		H 5110-90	Copper castings	197	Copper and copper alloys. Terms and definitions: Part 4 casting.
		H 5101-88	Brass castings		
		H 5102-88	High strength brass castings		
		H 5111-88	Bronze castings		

Table 2-2 TCVN, JIS and ISO related to Castings (4/14)

	TCVN	JIS		ISO	
Classification of Material of Casting		H 5112-88	Silicon bronze castings		
		H 5113-88	Phosphor bronze castings		
		H 5114-88	Aluminium bronze castings		
		H 5115-88	Leaded bronze castings		
		H 5202-92	Aluminium alloy castings	2378	Aluminium alloy chill castings. Reference test bar.
				2379	Aluminium alloy sand castings. Reference test bar.
				7722	Aluminium alloy casting produced by gravity, sand, or chill by related processes
		H 5203-92	Magnesium alloy castings	121	Magnesium, Aluminium, Zinc alloy ingots and alloy casting. Chemical composition and mechanical properties of sand cast. Reference test bars.
				2377	Magnesium alloy sand casting. Reference test bars.
				3115	Castings in magnesium alloys containing zirconium. Chemical composition and mechanical properties.
		H 5301-90	Zinc alloy die castings	121	Magnesium, Aluminium, Zinc alloy ingots and alloy casting. Chemical composition and mechanical properties of sand cast. Reference test bars.
		H 5302-90	Aluminium alloys die castings	121	Magnesium. Aluminium, Zinc alloy ingots and alloy casting. Chemical composition and mechanical properties of sand cast. Reference test bars.

Table 2-2 TCVN, JIS and ISO related to Castings (5/14)

	TCVN		JIS		ISO	
Classification of Material of Casting			H 5303-91	Magnesium alloy die castings	121	Magnesium, Aluminium, Zinc alloy ingots and alloy casting. Chemical composition and mechanical properties of sand cast. Reference test bars.
			H 5601-90	Hard lead castings		
			H 5701-91	Nickel and nickel alloy castings		
			G 2201-76	Pig iron for steel making	9147	Pig-irons. Definition and classification.
Raw Material	2361-89	Foundry pig iron. Specifications.	G 2202-76	Foundry pig iron	9147	Pig-irons. Definition and classification.
			G 5901-74	Molding silica sand		
			G 5902-74	Molding natural sand		
			G 5903-75	Cast shot and grit		
			H 2118-90	Aluminium-base alloy in ingot for die castings		
			H 2201-57	Zinc alloy ingot for die castings	301	Zinc alloy ingots intended for casting
			H 2202-85	Brass ingots for castings		
			H 2203-85	Bronze ingots for castings		
			H 2204-85	Phosphor bronze ingots for castings		
			H 2205-85	High strength brass ingots for castings		
			H 2206-85	Aluminium bronze ingots for castings		
			H 2207-85	Leaded bronze ingots for castings		
			H 2211-92	Aluminium alloy ingots for castings	121	Magnesium, Aluminium, Zinc alloy ingots and alloy casting. Chemical composition and mechanical properties of sand cast. Reference test bars.
					3522	Cast aluminium alloys. Chemical composition and mechanical properties.

Table 2-2 TCVN, JIS and ISO related to Castings (6/14)

	TCVN		JIS		ISO	
Raw Material			H 2221-92	Magnesium alloy ingots for castings	121	Magnesium, Aluminium, Zinc alloy ingots and alloy casting. Chemical composition and mechanical properties of sand cast. Reference test bars.
					3115	Castings in magnesium alloys containing zirconium. Chemical composition and mechanical properties.
			H 2222-91	Magnesium alloy ingots for die castings	121	Magnesium, Aluminium, Zinc alloy ingots and alloy casting. Chemical composition and mechanical properties of sand cast. Reference test bars.
Products	2941-79	Cast iron pipes and fittings for water piping. Names and symbols on the schemes.				
	2942-1993	Grey iron pipes, special castings and grey iron parts for pressure main lines.			13	Grey iron pipes, special castings and grey iron parts for pressure main lines
	2943-79	Cast iron pipes and fittings for water piping. Cast iron socket pipes. Basic dimensions.				
	2944-79	Cast iron pipes and fittings for water piping. Cast iron sockets. Basic dimensions.				
	1292-72	Pipeline fittings. Malleable cast iron connectors with taper thread used for pipelines. Dimensions and general structures.			49	Malleable cast iron fittings threaded to ISO 7-1
	1293-72 ~ 1325-72	Pipeline fittings. Malleable cast iron connectors with taper thread used for pipelines. Elbows, Tees, Crosses, Sockets, Connector, Union nuts, Plugs, Covers, Fittings, Types.			49	Malleable cast iron fittings threaded to ISO 7-1

Table 2-2 TCVN, JIS and ISO related to Castings (7/14)

	TCVN		JIS		ISO	
Products	1326-72	Pipeline fittings. Malleable cast iron connectors with taper thread used for pipelines. Specifications.				
	2945-79 ~ 2978-79	Cast iron pipes and fittings for water piping. Cast iron flanges, tees, crosses, elbows, fittings, flanges, branches. Basic dimensions.				
			G 5526-89	Ductile iron pipes	2531	Ductile iron pipes, fittings and accessories for pressure pipelines
	4123-85	Pipeline fittings. Ductile cast iron fittings with cylindrical thread for pipelines. Specifications.				
	4125-85	Pipeline fittings. Ductile cast iron tees. Basic dimensions.	G 5527-89	Ductile iron fittings	2531	Ductile iron pipes, fittings and accessories for pressure pipelines
			G 5528-84	Epoxy-oower coating for interior of ductile iron pipes and fitting		
			G 5525-75	Cast-iron soil pipes and fittings		
Test Method			G 1201-92	General rules for chemical analysis of iron and steel		
			G 1204-78	General rules for fluorescent X-ray analysis of iron and steel		
			G 1253-95	Iron and steel. Method for spark discharge atomic emission spectrometric analysis		
			G 1256-82	Method for X-ray fluorescence spectrometric analysis of iron and steel		
			G 1257-94	Iron and steel. Method for atomic absorption spectrometric analysis.		
			G 1258-89	Method for inductively coupled plasma emission spectrochemical analysis of steel		

Table 2-2 TCVN, JIS and ISO related to Castings (8/14)

	TCVN		JIS		ISO	
Test Method	1811-76	Steel and cast iron. General rules. Method for preparation of samples for chemical analysis.				
	5055-90	Steel and iron. Sampling for the determination of chemical composition.			14284	Steel and iron. Sampling and preparation of samples for the determination of chemical composition.
	1821-76	Steel and cast iron. Chemical analysis. Determination of total carbon content.	G 1211-95	Iron and steel. Methods for determination of carbon content.	437	Steel and cast iron. Determination of total carbon content.
			Z 2615-96	General rules for determination of carbon in metallic materials	9556	Steel and iron. Determination of total carbon content.
	298 -85	Steel and cast iron. Determination of free carbon content.				
	1814-76	Steel and cast iron. Chemical analysis. Determination of silicon content.	G 1212-81	Methods for determination of silicon in iron and steel	439	Steel and cast iron. Determination of silicon content.
					4829-1	Steel and iron. Determination of total silicon content Part I (content 0.05 - 1.0)
					4829-2	Steel and iron. Determination of total silicon content Part II (content 0.01 - 0.05)
	1819-76	Steel and cast iron. Chemical analysis. Determination of manganese content.	G 1213-81	Methods for determination of manganese in iron and steel	R 629 10700	Chemical analysis of steels. Determination of manganese content. Determination of manganese content
	1815-76	Steel and cast iron. Chemical analysis. Determination of phosphorus content	G 1214-92	Methods for determination of phosphorus in iron and steel	2732	Steel and cast iron. Determination of phosphorus content.
	1820-76	Steel and cast iron. Chemical analysis. Determination of sulphur content.	G 1215-94	Iron and steel. Methods for determination of sulphur content.	4934 4935	Steel and cast iron. Determination of sulphur content.
					671	Steel and cast iron. Determination of sulphur content.
			Z 2615-96	General rules for determination of sulfur in metallic materials		

Table 2-2 TCVN, JIS and ISO related to Castings (9/14)

	TCVN		JIS		ISO	
Test Method	1812-76	Steel and cast iron. Chemical analysis. Determination of chrome content.	Z 1217-92	Methods for determination of chromium in iron and steel		
			G 1238-92	Steel and iron. Determination of chromium content.	4937 10138	Steel and iron. Determination of chromium content
	1813-76	Steel and cast iron. Chemical analysis. Determination of nickel content.	Z 1216-81	Methods for determination of nickel in iron and steel	4938	Steel and iron. Determination of nickel content.
					4939 4940	Steel and cast iron. Determination of nickel content.
	1816-76	Steel and cast iron. Chemical analysis. Determination of cobalt content.	Z 1222-81	Methods for determination of cobalt in iron and steel		
	1817-76	Steel and cast iron. Chemical analysis. Determination of molybdenum content.	Z 1218-94	Iron and steel. Methods for determination of molybdenum content.	4941	Steel and cast iron. Determination of molybdenum content.
	1818-76	Steel and cast iron. Chemical analysis. Determination of copper content.	Z 1219-81	Methods for determination of copper in iron and steel	4943 4946	Steel and cast iron. Determination of copper content.
	299 -89	Steel and cast iron. Determination of titanium content.	Z 1223-92	Methods for determination of titanium in iron and steel	10280	Steel and iron. Determination of titanium content.
	301 -89	Steel and cast iron. Determination of boron content.	Z 1227-92	Methods for determination of boron in iron and steel	10153	Steel. Determination of boron content.
	302 -85	Steel and cast iron. Determination of tungsten content.	Z 1220-94	Iron and steel. Methods for determination of tungsten content.		
	303 -89	Steel and cast iron. Determination of tantalum content.	Z 1236-92	Methods for determination of tantalum in steel		
	305 -85	Steel and cast iron. Determination of nitrogen content.	Z 1228-94	Iron and steel. Methods for determination of nitrogen content.	4945	Steel. Determination of nitrogen content.
	308 -89	Steel and cast iron. Determination of vanadium content.	Z 1221-92	Methods for determination of vanadium in iron and steel	4942 4947	Steel and iron. Determination of vanadium content.
	310 -89	Steel and cast iron. Determination of arsenic content.	Z 1225-92	Methods for determination of arsenic in iron and steel		

Table 2-2 TCVN, JIS and ISO related to Castings (10/14)

	TCVN		JIS		ISO	
Test Method	311 -89	Steel and cast iron. Determination of aluminium content.	Z 1224-81	Methods for determination of aluminium in iron and steel	9658	Steel. Determination of aluminium content.
			Z 1226-94	Iron and steel. Methods for determination of tin content.		
			Z 1229-94	Steel. Methods for determination of lead content.		
			Z 1232-80	Methods for determination of zirconium in steel		
			Z 1233-94	Steel. Methods for determination of selenium content.		
			Z 1234-81	Methods for determination of tellurium in steel		
			Z 1235-81	Methods for determination of antimony in steel	10698	Steel. Determination of antimony content.
			Z 1237-81	Methods for determination of niobium in steel	9441	Steel. Determination of niobium content.
	3902-84	Gray iron and spheroidal graphite iron casting. Microstructure and determination methods.				
	197 -85	Metals. Method of tractional test.	Z 2241-93	Method of tensile test for metallic materials	6892	Metallic materials. Tensile test.
			Z 2201-80	Test pieces for tensile test for metallic materials		
	5886-1995	Metallic materials. Tensile testing at elevated temperature.			783	Metallic materials. Tensile testing at elevated temperature.
	198-85	Metals. Method of bending test.	Z 2248-75	Method of bend test for metallic materials	7438	Metallic materials. Bend test.
			Z 2204-69	Bend test pieces for metallic materials		
			Z 2203-56	Flexure test pieces for metals		

Table 2-2 TCVN, JIS and ISO related to Castings (11/14)

	TCVN		JIS		ISO	
Test Method	256-85	Metals. Brinell hardness test.	Z 2243-92	Method of Brinell hardness test	6506	Metallic materials. Hardness test. Brinell test.
	5885-1995	Metallic materials. Hardness test. Tables of Brinell hardness values for use in test made on flat surfaces.			410	Metallic materials. Hardness test. Tables of Brinell hardness values for use in tests made on flat surfaces.
	257-85	Metals. Rockwell hardness test. A, B, C scales.	Z 2245-92	Method of Rockwell and Rockwell superficial hardness test	6508	Metallic materials. Hardness test. Rockwell test (scales A, B, C, D, E, F, G, H, K).
	4170-85	Metals. Rockwell hardness test. N and T scales.			1024	Metallic materials. Hardness test. Rockwell superficial test (scales N, T).
	258 -85	Metals. Vickers hardness test. Verification schedules.	Z 2244-92	Method of Vickers hardness test	6507/1-6507/3	Metallic materials. Hardness test. Vickers test. Part 1. - Part 3.
	5884-1995	Metallic materials. Hardness test. Tables of Vickers hardness values for use in test made on flat surfaces HV 5 to HV 100.			409/1	Metallic materials. Hardness test. Tables of Vickers hardness values for use in tests made on flat surfaces Part 1: HV 5 to HV 100.
	5888-1995	Metallic materials. Hardness test. Vickers test HV 5 to HV 100.				
			Z 2246-92	Method of Shore hardness test		
	5887-1995	Metallic materials. Hardness test. Knoop test.	Z 2251-92	Method of Knoop hardness test	4545	Metallic materials. Hardness test. Knoop test.
	312-84	Metals. Method for testing the impact strength at room temperature.	Z 2242-93	Method of impact test for metallic materials	83	Steel. Charpy impact test (U-notch).
					148	Steel. Charpy impact test (V-notch).
			Z 2202-80	Test pieces for impact test for metallic materials	83	Steel. Charpy impact test (U-notch).
					148	Steel. Charpy impact test (V-notch).
	313-85	Metals. Methods for twisting test.				

Table 2-2 TCVN, JIS and ISO related to Castings (12/14)

	TCVN		JIS		ISO	
Test Method	3939-84	Metals. Method for testing the impact strength at low temperature.				
	3940-84	Metals. Method of tension test at hight temperature.				
			Z 2273-78	General rules for fatigue testing of metals	R 377	General principles of fatigue testing of metals
					R1099	Axial lead fatigue testing
					R1143	Rotating bar bending fatigue testing
					DIS1352	Trosional stress fatigue testing
			Z 2274-78	Method of rotating bending fatigue testing of metals	R 377	General principles of fatigue testing of metals
					R1099	Axial lead fatigue testing
					R1143	Rotating bar bending fatigue testing
					DIS1352	Trosional stress fatigue testing
	4169-85	Metals. Method of multi-cycle and small-cycle fatigue testing.	Z 2279-92	Method of high temperature low cycle fatigue testing for metallic materials		
			G 0588-95	Visual examination and classification of surface quality for steel castings		
	5868-1995	Non-destructive testing. Qualification and certification of personnel.			9712	Non-destructive testing. Qualification and certification of personnel.
			G 0581-84	Methods of radiographic test and classification of radiographs for steel castings		
	5869-1995	Apparatus for gamma radiography. Specifications.	Z 4560-91	Industrial γ -ray apparatus for radiography	3999	Apparatus for gamma radiography. Specification.
			Z 4561-92	Viewing illuminators for industrial radiograph	5580	Non-destructive testing. Industrial radiographic illuminators. Minimum requirement.

Table 2-2 TCVN, JIS and ISO related to Castings (13/14)

	TCVN		JIS		ISO	
Test Method			Z 4606-95	Industrial X-ray apparatus for chest indirect radiography		
			Z 2344-93	General rule of ultrasonic testing of metals by pulse echo technique		
	5114-90	Non-destructive testing. Ultrasonic test. Calibration block No-1.	Z 2345-94	Standard test blocks for ultrasonic testing	2400	Welds in steel. Reference block for calibration of equipment for ultrasonic examination.
	5115-90	Non-destructive testing. Ultrasonic test. Calibration block No-2.			7963	Welds in steel. Calibration block No.2 for ultrasonic examination of welds.
			Z 2350-92	Method for measurement of performance characteristics of ultrasonic probes	DP10375	Non-destructive testing. Ultrasonic inspection. Characterization of search unit and sound field.
			Z 2353-91	Method for measurement on ultrasonic velocity of solid by pulse technique using reference test pieces		
			Z 2354-92	Method for measurement of ultrasonic attenuation coefficient of solid by pulse echo technique		
			Z 2355-94	Method for measurement of thickness by ultrasonic pulse echo technique		
	4396-86	Non-destructive testing. Magnetic particle method.			4986	Steel casting. Magnetic particle inspection.
			Z 2314-91	Test methods for performance characteristics of eddy current testing instruments		
			Z 2315-91	Test methods for performance characteristics of eddy current flaw detecting system		
			Z 2319-91	Methods for magnetic leakage flux testing		

Table 2-2 TCVN, JIS and ISO related to Castings (14/14)

	TCVN		JIS		ISO	
Test Method			Z 2321-93	AC yoke magnet for magnetic particle testing		
	5879-1995	Non-destructive testing. Aids to visual inspection. Selection of low-power magnifiers.				
	5880-1995	Non-destructive testing. Method for indirect assessment of black light sources.				
	4617-88	Non-destructive testing. Capillary method.				
	5870-1995	Non-destructive testing. Penetrative crack detectors. General technical requirements.	Z 2343	Method for liquid penetrate testing and classification of the indication	3452	Non-destructive testing. Penetrate inspection. General principles.
	6111-1996	Non-destructive testing radiographic examination of metallic materials by X and gamma rays. Basic rules.			5579	Non-destructive testing. Radiographic examination of metallic materials by X and gamma rays. Basic rules.
			Z 2306-91	Radiographic image quality indicators for non-destructive testing	1027	Radiographic image quality indicators for non-destructive testing. Principles and identification.
			Z 2601	Methods for determining foundry molding sand properties		

Table 2-3 Dimensional Tolerances of Castings (1/4)

(1) TCVN 385-70 Grey cast iron. Tolerances of dimensions and masses.
Excess dimensions for mechanical treatment.

1. Tolerances on lengths

Dimensional tolerances of castings I

Grade 1 (Unit: mm)

Largest dimension	Tolerances on nominal dimension								
	≦50	>50 ≦120	>120 ≦260	>260 ≦500	>500 ≦800	>800 ≦1,250	>1,250 ≦2,000	>2,000 ≦3,150	>3,150 ≦5,000
120 or under	±0.2	±0.3							
120 over 260 or under	±0.3	±0.4	±0.6						
260 over 500 or under	±0.4	±0.6	±0.6	±1.0					
500 over 1,250 or under	±0.6	±0.8	±1.0	±1.2	±1.4	±1.6			
1,250 over 3,150 or under	±0.8	±1.0	±1.2	±1.4	±1.6	±2.0	±2.5	±3.0	
3,150 over 5,000 or under	±1.0	±1.2	±1.5	±1.8	±2.0	±2.5	±3.0	±4.0	±5.0

Dimensional tolerances of castings II

Grade 2 (Unit: mm)

Largest dimension	Tolerances on nominal dimension									
	≦50	>50 ≦120	>120 ≦260	>260 ≦500	>500 ≦800	>800 ≦1,250	>1,250 ≦2,000	>2,000 ≦3,150	>3,150 ≦5,000	>5,000 ≦6,300
260 or under	±0.5	±0.8	±1.0							
260 over 500 or under	±0.8	±1.0	±1.2	±1.5						
500 over 1,250 or under	±1.0	±1.2	±1.5	±2.0	±2.5	±3.0				
1,250 over 3,150 or under	±1.2	±1.5	±2.0	±2.5	±3.0	±4.0	±5.0	±6.0		
3,150 over 6,300 or under	±1.5	±1.8	±2.2	±3.0	±4.0	±5.0	±6.0	±7.0	±9.0	±12.0

Dimensional tolerances of castings III

Grade 3 (Unit: mm)

Largest dimension	Tolerances on nominal dimension										
	≦50	>50 ≦120	>120 ≦260	>260 ≦500	>500 ≦800	>800 ≦1,250	>1,250 ≦2,000	>2,000 ≦3,150	>3,150 ≦5,000	>5,000 ≦6,300	>6,300 ≦10,000
500 or under	±1.0	±1.5	±2.0	±2.5							
500 over 1,250 or under	±1.2	±1.8	±2.2	±3.0	±4.0	±5.0					
1,250 over 3,150 or under	±1.5	±2.0	±2.5	±3.5	±5.0	±6.0	±7.0	±9.0			
3,150 over 6,300 or under	±1.8	±2.2	±3.0	±4.0	±5.5	±6.5	±8.0	±10.0	±12.0	±15.0	
6,300 over 10,000 or under	±2.0	±2.5	±3.5	±4.5	±6.0	±7.5	±9.0	±11.0	±14.0	±17.0	±20.0

Table 2-3 Dimensional Tolerances of Casting (2/4)

(1) TCVN 385-70 Grey cast iron. Tolerances of dimensions and masses.
Excess dimensions for mechanical treatment.

2. Tolerances on wall thickness

Tolerances on wall thickness where all not machined

(Unit: mm)

Largest dimension		Tolerances		
		I	II	III
500 or under	6 or under	±0.2	±0.4	±0.8
	6 over 10 or under	±0.3	±0.5	±1.0
	10 over 18 or under	±0.5	±0.8	±1.5
	18 over 30 or under	±0.8	±1.0	±1.5
	30 over 50 or under	±0.8	±1.2	±2.0
	50 over 80 or under	±1.0	±1.5	±2.5
	80 over 120 or under	±1.0	±1.8	±2.5
500 over 1,250 or under	10 or under	±0.3	±0.8	±1.2
	10 over 18 or under	±0.5	±1.2	±1.5
	18 over 30 or under	±0.8	±1.5	±2.0
	30 over 50 or under	±1.0	±1.8	±2.0
	50 over 80 or under	±1.2	±2.0	±2.5
	80 over 120 or under	±1.5	±2.5	±3.0
1,250 over 2,500 or under	10 or under	±0.5	±1.2	±1.5
	10 over 18 or under	±0.8	±1.5	±2.0
	18 over 30 or under	±1.0	±2.0	±2.5
	30 over 50 or under	±1.2	±2.5	±3.0
	50 over 80 or under	±1.8	±2.5	±3.0
	80 over 120 or under	±2.0	±3.0	±3.5
2,500 over 4,000 or under	18 or under	±1.0	±1.5	±2.0
	18 over 30 or under	±1.2	±2.0	±2.5
	30 over 50 or under	±1.5	±2.5	±3.0
	50 over 80 or under	±2.0	±3.0	±3.5
	80 over 120 or under	±2.5	±3.5	±4.0
4,000 over	18 or under		±2.0	±3.0
	18 over 30 or under		±2.5	±3.5
	30 over 50 or under		±3.0	±4.0
	50 over 80 or under		±3.5	±4.5
	80 over 120 or under		±4.0	±5.0

Table 2-3 Dimensional Tolerances of Castings (3/4)

2) JIS B 0403-1995 Castings – System of dimensional tolerances and machining allowances

1. Dimensional tolerances of castings

(Unit: mm)

Basic dimension of raw casting		Total casting tolerance															
		Casting tolerance grade CT															
over	or under	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
–	10	0.09	0.13	0.18	0.26	0.36	0.52	0.74	1.0	1.5	2.0	2.8	4.2	–	–	–	–
10	16	0.10	0.14	0.20	0.28	0.38	0.54	0.78	1.1	1.6	2.2	3.0	4.4	–	–	–	–
16	25	0.11	0.15	0.22	0.30	0.42	0.58	0.82	1.2	1.7	2.4	3.2	4.6	6.0	8.0	10.0	12.0
25	40	0.12	0.17	0.24	0.32	0.46	0.64	0.90	1.3	1.8	2.6	3.6	5.0	7.0	9.0	11.0	14.0
40	63	0.13	0.18	0.26	0.36	0.50	0.70	1.00	1.4	2.0	2.8	4.0	5.6	8.0	10.0	12.0	16.0
63	100	0.14	0.20	0.28	0.40	0.56	0.78	1.10	1.6	2.2	3.2	4.4	6.0	9.0	11.0	14.0	18.0
100	160	0.15	0.22	0.30	0.44	0.62	0.88	1.20	1.8	2.5	3.6	5.0	7.0	10.0	12.0	16.0	20.0
160	250		0.24	0.34	0.50	0.70	1.00	1.40	2.0	2.8	4.0	5.6	8.0	11.0	14.0	18.0	22.0
250	400			0.40	0.56	0.78	1.10	1.60	2.2	3.2	4.4	6.2	9.0	12.0	16.0	20.0	25.0
400	630				0.64	0.90	1.20	1.80	2.6	3.6	5.0	7.0	10.0	14.0	18.0	22.0	28.0
630	1,000					1.00	1.40	2.00	2.8	4.0	6.0	8.0	11.0	16.0	20.0	25.0	32.0
1,000	1,600						1.60	2.20	3.2	4.6	7.0	9.0	13.0	18.0	23.0	29.0	37.0
1,600	2,500							2.60	3.8	5.4	8.0	10.0	15.0	21.0	26.0	33.0	42.0
2,500	4,000								4.4	6.2	9.0	12.0	17.0	24.0	30.0	38.0	49.0
4,000	6,300									7.0	10.0	14.0	20.0	28.0	35.0	44.0	56.0
6,300	10,000										11.0	16.0	23.0	32.0	40.0	50.0	64.0

Notes: 1) The tolerance zone, unless otherwise stated, shall be symmetrically disposed with respect to a basic dimension, when agreed between manufacturer and purchaser for specific reasons, the tolerance zone may be asymmetric.

2) For wall thickness in grades CT1 to CT15, one grade coarser applies

3) For sizes up to 16mm, general tolerances from CT13 to CT16 are not available.
For these sizes, individual tolerances shall be indicated.

4) The grade CT16 exists only for wall thickness of castings generally specified to CT15.

Table 2-3 Dimensional Tolerances of Castings (4/4)

2) JIS B 0403-1995 Casting - System of dimensional tolerances and machining allowances

2. Annex A (informative): Casting tolerances

Tables A.1 and A.2 show tolerance grades which can normally be expected in casting processes

Table A.1 Tolerance grades for long-series production raw castings

Casting method	Tolerance grade CT								
	Cast steel	Grey cast iron	Spheroidal graphite cast iron	Malleable cast iron	Copper alloys	Zinc alloys	Light metal alloys	Nickel based alloys	Cobalt based alloys
Sand cast, hand moulded	11 - 14	11 - 14	11 - 14	11 - 14	10 - 13	10 - 13	9 - 12	11 - 14	11 - 14
Sand cast, machine moulded and shell moulding	8 - 12	8 - 12	8 - 12	8 - 12	8 - 10	8 - 10	7 - 9	8 - 12	8 - 12

Remarks: For metal mould casting (gravity method and low-pressure method), pressure die casting and investment casting, research and investigation are proceeding to establish appropriate data. Meanwhile, it should be preferable to be agreed between the manufacturer and purchaser.

Table A.2 Tolerance grades for short-series or single -production raw casting

Casting method	Moulding material	Tolerance grade CT							
		Cast steel	Grey cast iron	Spheroidal graphite cast iron	Malleable cast iron	Copper alloys	Light metal alloys	Nickel based alloys	Cobalt based alloys
Sand cast, hand-moulded	Green sand mould	13 - 15	13 - 15	13 - 15	13 - 15	13 - 15	11 - 13	13 - 15	13 - 15
	Self-curing mould	12 - 14	11 - 13	11 - 13	11 - 13	11 - 13	10 - 12	12 - 14	12 - 14

Remarks: The values in this Table apply generally to basic dimensions greater than 25mm. For smaller dimensions, finer tolerances can normally be economically and practically held as follows:

1) Basic dimension up to 10mm :3 grades finer;
2) Basic dimension 10mm to 16mm :2 grades finer;
3) Basic dimensions 16mm to 25mn :1 grade finer;

Table 2-4 List of Equipment for QUATEST 1, Mechanical and Material Testing Laboratory plan to procure up to 2005

No.	Name of Equipments	Application	Specification	Q'ty	Estimated Cost (US$)
1	Universal Testing Machine and Accessories	Testing for steel, alloy, etc.	1,000 KN capacity in tension	1	150,000
2	Emission Plasma Spectrophotometer or X-Ray Fluorescence Spectrometer	Analysis for metals	Analysis: ≧17 elements of steel and alloys, cast iron, Al- alloys, Cu- alloys etc.	1	120,000
3	X-Ray Equipment (X-Ray Radiography) and Accessories	Radiography for metals	300 – 320 kV	1	100,000
4	γ-Ray Equipment (γ-Ray Radiography) and Accessories	Radiography for metals	Iridium- 192 sources available	1	50,000
5	Compression Testing Machine & Accessories (Accessories: Moulds, Sump test, Electric poker vibrators, Cylinder capping, Windsor probe, Proformeter 4 rebar locator, Curing tank, Core drilling, Cutting ,etc.)	Testing for concrete (Compression and flexural)	Capacity with digital control; 2,000 KN compression and 100 – 200 KN flexural	1	80,000
6	Ultrasonic Cross-hole Pile Integrity Test System	Testing for concrete pile	Frequency range; 20 kHz – 1 MHz	1	30,000
7	Universal Testing Machine and Accessories	Testing for steel, alloy, etc.	100 KN capacity in tension	1	50,000
8	Impact Testing Machine	Testing for steel, alloy, etc. (Temperature in – 20 ℃)	30 kgm capacity in impact	1	10,000
9	Coating Thickness Meter	Measuring; Coating thickness for metal	0 – 2,000 μm	1	10,000
10	Hardness Tester	Measuring of hardness	Rockwell and Brinell	1	10,000
11	Portable Hardness Tester	Measuring of hardness	Rockwell and Vickers	1	6,000
12	Surface Roughness Tester	Measuring of surface roughness	Measuring range; Rz=320-10; 0.025-0.1 μm Ra=0.02 – 2.5 μm	1	7,000
				Total	623,000

Table 2-5 List of Equipment for Metalworking and Machinery Subsector needed in Public Testing Facilities (1/2)

Name of Equipments	Quantity
(1) Analysis Instrument of Chemical Composition for Metallic Materials	
1) Vacuum Emission Spectrometer or X-ray Fluorescence Spectrometer	1 unit
2) Grinding Equipment for Test Specimen	1 unit
3) Carbon and Sulphur Analyzer in Iron and Steel	1 unit
(2) Mechanical Testing Machine for Metallic Materials	
1) Universal Testing Machine; Amsler Type	1 unit
2) Hardness Tester:	
Brinell Hardness	1 unit
Rockwell Hardness	1 unit
Vickers Hardness	1 unit
Shore Hardness	1 unit
Micro Hardness	1 unit
3) Impact Testing Machine: Charpy Type	1 unit
4) Machine Tools for Test Pieces Preparation:	
Lathe	1 unit
Shaper	1 unit
Cutting Grinder	1 unit
Power Hacksaw	1 unit
(3) Metallographic Inspection Instruments for Metallic Materials	
1) Metallurgical Microscope with Camera	1 unit
2) Test Specimen Preparation Equipment:	
Sample Cutting Grinder	1 unit
Sample Mounting Press	1 unit
Rotary Grinding & Polishing Machine	1 unit
Sample Dryer	1 unit

Table 2-5 List of Equipment for Metalworking and Machinery Subsector needed in Public Testing Facilities (2/2)

Name of Equipments	Quantity
(4) Measuring Instrument for Dimension:	
1) Coordinate Measuring Machine	1 unit
2) Surface Roughness Tester	1 unit
3) Roundness Measuring Machine	1 unit
4) Precision Universal Profile Projector	1 unit
5) Coating Thickness Meter	1 unit
6) Miscellaneous Micrometer	1 lot
7) Miscellaneous Vernier Caliper	1 lot
8) Flat Table and Scribe Tools	1 set
(5) Non Destructive Testing Equipment	
1) Ultrasonic Flaw Detector	1 unit
2) Magnetic Particle Flaw Detector	1 unit
3) Radiographic Inspection Apparatus:	1 unit
X-ray Inspection Apparatus or	
γ-ray Inspection Apparatus	
(6) Molding Sand Test Equipment:	
Sand Sieve and Sieve Shaker	1 set
Sand Rammer	1 unit
Universal Sand Strength Tester	1 unit
Permeability Tester	1 unit
Infrared Rapid Moisture Tester	1 unit
Compactability Tester	1 unit
Laboratory Sand Mixer	1 unit
Sand Testing Washer	1 set
Total Clay Measuring Instrument	1 set
Active Clay Measuring Instrument	1 set

3 Electrical and Electronic Machinery and Equipment Industry[1]

3.1 Current State of Industry and Issue for Sectoral Development

3.1.1 Overseas trends in the electrical and electronic machinery and equipment industry

(1) Industrial electrical machinery industry

Demand for industrial electrical machinery and equipment in any country, particularly in less developed countries, grows proportional to investment in social capital led by public investment in the electrical energy sector and including other infrastructures including housing and industry. Thus, the market for industrial electrical machinery and equipment in any country emerges prior to the start of country-wide industrialization efforts. As a result, the industry often becomes a major target for import substitution.

Within the industrial electrical machinery and equipment industry in Japan, prime movers and boilers for power generation account for approximately 15% in terms of value of production, motors and generators 25%, transmission and distribution equipment 20%, and switchgears, control gears, and switching devices 40%.

The industry has fully matured in industrialized countries and major market expansion cannot be expected. In contrast, demand continues to grow appreciably in less developed countries due to ongoing investment in social capital. In these countries, local enterprises receiving technical assistance through license agreements with foreign counterparts in industrialized countries are operating, whereas direct investment is relatively small in number. Thus, industrial electrical machinery and equipment tend to be produced near the market, and imports account for relatively small portions compared to home appliances, with some variation among individual products. Notably, this is the worldwide trend. In the U.S. which is the largest importer of industrial electrical machinery and equipment, imports account for 10% - 25% of total demand. In particular, imports are dominated by products having small capacities, such as 400KVA or smaller generators and 500KVA or less distribution transformers.

Recently, parts and components for industrial electrical machinery and equipment are increasingly manufactured outside industrialized countries due to the rise in production cost.

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[1] Table 3-1 shows the classification of electrical/electronic machinery industry.

In the U.S., major industrial electrical machinery and equipment manufacturers include GE, Westinghouse Electric, Honeywell, and Emerson Electric. The U.S. companies have been making cost reduction efforts, such as the increasing use of imported parts and relocation of production bases to countries offering low labor costs. New production bases are mainly located in Mexico, Canada and Brazil. In Asia, they have been investing in the form of joint venture, acquisition of local companies, licensing, and the purchase of imported goods. The primary candidate for relocation in Asia is China because of its huge market size.

In Europe, many companies are struggling to survive in an increasingly competitive environment as a result of the unification of the EC and slow economic growth, through merger and restructuring. Among leading industrial electrical machinery and equipment manufacturers in Europe, Siemens of Germany and ABB of Sweden/Switzerland are active in Asian investment. They have been establishing joint ventures in ASEAN countries and China, entering into licensing arrangements.

Japanese industrial electrical machinery and equipment manufacturers have grown rapidly during the high growth period, as fueled by healthy growth of electricity demand. Then, they had to cope with sluggish demand after the oil crises by boosting exports, together with investment by power companies. Recently, however, they are losing competitiveness in export markets due to the appreciation of the yen. Through several setbacks, many Japanese industrial electrical machinery and equipment manufacturers have transformed themselves to integrated electrical and electronics manufacturers. Also, despite the investment spree by Japanese companies in ASEAN countries, direct investment in the industrial electrical machinery and equipment sector is much smaller than chemical, textile, electronics, and automobile.

Recently, ASEAN countries are facing a sharp rise in electricity demand due to economic development, which is accompanied by an expansion of the industrial electrical machinery and equipment market. In particular, Indonesia undergoes rapid growth in electricity demand that gives much more vigor to the industrial electrical machinery and equipment sector than its counterparts in Thailand and Malaysia. It should be noted, that these countries provide favorable treatment for local products in fostering the industry. Many industrial electrical machinery and equipment manufacturers in ASEAN countries and China are under technical assistance or license agreement with foreign companies. In particular, European manufacturers, particularly German companies are actively involved in technical assistance and licensing arrangement. Notable areas in licensing are generators and transformers.

(2) Electronic equipment industry

Overseas expansion of the electronic industry in industrialized nations was initially designed to secure and maintain the foreign markets. Then, the purpose gradually shifted to international deployment of foreign production bases (export bases).

The move for offshore production of electronic equipment was seen relatively long time ago, most of which focused on production of home appliances for the purpose of capturing local demand. At an initial stage, components were sent from parent companies and assembled locally to final products. Then, demand for localization heightened in host countries, prompting manufacturers to respond by increasing local contents. Today locally produced components are relatively diverse, depending upon the demand in each country.

In the late 1970s, offshore production was driven by a new force, trade friction. Color TVs became the first target. Production was transferred from Japan to overseas production bases, and domestic production plummeted.

The exodus of TV production from Japan caused the restructuring of electronics production structure in Japan, and particularly accelerated the development of VCRs. Suppliers changed their product items accordingly.

Key factors to consider in promoting overseas electronics production at that time were: 1) the intensification of trade friction, 2) the emergence of electronics industries in the NIEs, and 3) the need for the reorganization of global production systems in response to the opening of the Chinese market.

The appreciation of the yen after 1985 has been further urging offshore production of Japanese electronics companies, who are increasingly building overseas plants for a variety of electronic equipment for exports to Japan as well as for other foreign markets. Such overseas production bases are specialized in certain products and operated on a large scale to serve the export market.

This is the time during which manufacturers started to pursue horizontal division of labor on an international basis - the strategy to shift production of low-end products to ASEAN countries and NIEs, while making domestic production bases specialize in high-end products.

Take audio equipment, for instance. Mainstream products manufactured in Japan have been shifted from radio-cassette recorders to emerging products of onboard audio equipment for automobiles, digital audio disk players. Today, radio-cassette recorders are dominated by imports. The similar situation is observed in Taiwan, where production of cassette recorders has been gradually declining, whereas that of stereos and CD players is on the rise. In contrast, production of radio-cassette recorder increases in Singapore and Malaysia to replace production of radio sets. As for color TVs, 19-inch or smaller sets are increasingly produced in overseas production bases, and domestic bases are specialized in larger screen TVs and further high-grade products.

In industrialized countries including Japan, intensive competition has reduced product life cycle of electronic equipment considerably. In response, manufacturers have devised various measures. One of them is the reshuffling of product lines on an international basis. The primary effort above all, is the reduction of lead time which enables manufacturers to commercialize a new product quickly in response to market trends. This has been accomplished through, in addition to technological advancement such as CAD, the establishment of a joint development system between electronics companies and their suppliers by ensuring the involvement in research and development by related industries from the product development stage. More precisely, availability of suppliers having R&D capabilities is a prerequisite to the short time-to-market production system. Thus, it can be said that a product required to meet changing market needs in a flexible manner is unsuitable for overseas production.

Another factor encouraging the move is the advancement of mounting technology, which has automated many labor-intensive operations such as assembly of printed circuit boards, thus enabling manufacturers to effectively cope with the strong yen and the rise in labor cost.

At the same time, efforts are under way to reduce production costs by promoting overseas production of products which production technology is fairly established. In the initial stage of overseas production that focused on low-end products, the final assembly process was transferred to countries with low labor costs, to which component kits were exported. With the further rise in labor cost in Japan, however, together with the appreciation of the yen after 1985, export prices of component kits rose rapidly. That has made local manufacturers to look for cost reduction by boosting local contents.

To support such effort, Japanese suppliers have moved abroad with emigration of electronic equipment manufacturers and have complemented the general shortage of indigenous supporting industries.

The strategy to establish foreign production bases has recently evolved to procurement of necessary components for production in Japan and other countries (instead of importing from Japan).

3.1.2 Industry and market size in Viet Nam

Available statistical data on production, demand, and imports and exports are not reliable, prohibiting accurate estimates of the size of the electrical and electronic industry and market. Instead, production and consumption were estimated on the basis of information obtained from related industries and enterprises, as discussed below.

(1) Electrical equipment

1) Industrial equipment

For years, industrial equipment was manufactured by state enterprises, with little competition and no significant development (Table 3-2 to Table 3-5). Recently, however, the traditional industrial structure is gradually changing as an increasing number of foreign manufacturers start local production directly or through joint ventures with local enterprises.

Products manufactured by the subsector are listed in Table 3-6. Products such as generators, transformers, switches, and circuit breakers have not changed much due to the lack of innovation, and their markets are small. Previously, they were produced exclusively by a state enterprise (Vietnam Electro-Technical Equipment Corp. (VEC)). There was no competition and no entry of foreign companies. Product development, design, and manufacturing have been carried out by using indigenously technologies. Recently, joint ventures with foreign companies have started production of transformers, power transmission towers, and cable and wire.

Now that domestic demand grows steadily as the government encourages accelerated development of electricity and other infrastructures. In response, enterprises establish joint ventures, enter licensing agreement with foreign companies, and add production capacities.

Around 20 enterprises manufacture generators, with the combined capacity of 1,500 units annually. 5 enterprises manufacture motors, around 50,000 units annually. 8 manufacturers of transformers have the annual production capacity of around 10,000 units. One state enterprise and ABB hold a combined share of 60% - 70%. There are 15 enterprises manufacturing circuit breakers, power switchboards, and controllers, produced on a contract basis. Their markets are very small.

There are three manufacturers of cables and wires, which are relatively large in size and two of which are joint ventures, one Korean (Lucky Goldstar) and one Taiwanese (Daia). (another Korean joint venture with Daesung is planned) Several companies manufacture insulation parts.

Estimated market sizes for the above projects are shown in Table 3-6. They are not entirely reliable, however, due to the lack of accurate statistical data.

Most of local products are manufactured in obsolete ways, and the manufacturing cost per unit is invariably high, including labor, raw materials and energy. Quality is unstable and reliability is low to make them difficult to compete with imported products.

2) Consumer equipment

Electric fans account for major portions of this category. In addition, electric water heaters and rice cookers are produced in small quantities. Production does not grow much due to competition with imports.

In Viet Nam, electric fans are the most popular consumer electrical equipment, and the annual demand is estimated at 500,000 - 600,000 units. Local production was started three decades ago, and accounts for nearly one half of the local demand, amounting to 300,000 - 350,000 units annually, which are entirely sold in the domestic market. In 1990, there were around 50 manufacturers. After the adoption of market economy, many were dissolved due to intensified competition. The market is still highly competitive, and there are many factories which are not operated.

Now, local products are competing with those imported from China, which are cheap but have poor quality. On the other hand, Japanese products which are expensive and offer high performance, quality, and diverse functions are hitting the market. Although some of local enterprises fight back by offering new models based on their own design and technology, local production remains flat at a 300,000-unit level as shown in Table 3-7.

Local production of washing machines, with the domestic demand amounting to 70,000 units, has recently been started by a Japanese-affiliated company. It has the annual production capacity of 300,000 units and plans to export 80% of total production.

The domestic demand for refrigerators is estimated at around 130,000 units and is expected to grow more. A Korean manufacturer operates a factory within the country, but production data are unknown.

Air-conditioners and microwave ovens are not locally produced due to the small market size. No production for export has been started. Rice cookers are widely used because rice is the principal food in the country and cookers are relatively cheap. The domestic demand is around 300,000 units (according to a manufacturer's estimates). Because of simple construction and circuit design, local production is carried out by small- and medium-sized enterprises. However, local products are inferior to many of imports in a variety of models and features, while their prices are not competitive against Chinese products.

Small electric water heaters are widely displayed on the storefront, but the market size is unknown. Manufacturers of metallic tableware made simple models by combining a kettle with a sheathed heater. As in the case of the rice cooker, they are inferior to imports in terms of variety and performance.

Rapid economic development after the launching of the Doi Moi policy has led to notable growth of the domestic demand for electrical appliances. As seen in Table 3-7, however, the demand seems to have entered the moderate growth phase.

(2) Electronic equipment

In the former South Viet Nam, three Japanese electronics companies, Matsushita, Sanyo, and Sony, operated factories to produce black-and-white TVs and other products. They were requisitioned after the collapse of the Saigon government in 1975 and have been operated as state enterprises under the Ministry of Heavy Industry. Until very recently, little electronics production was made in the country, except for military application. Since 3-4 years ago, local assembly of consumer electronic equipment including TVs and audio equipment was started as the ownership of TVs grew rapidly, laying the foundation of the electronics industry in the country. Then Japanese manufacturers, including the companies which operated before the unification, have established joint ventures with local partners which operate the old facilities, and have supplied new production equipment. These factories are now doing assembly operation by using parts and components supplied by Japanese partners.

1) Industrial equipment

As shown in Table 3-8, the current market size is estimated at 15,000 units for PCs, and less than 3,000 units each or printers, floppy disk drives, and copiers. Any of them have not reached critical mass to justify local production. There are small shops which assemble PCs according to the customer's request by using purchased standard parts.

The government policy is now giving priority to proliferation and the tariff rate on PCs is set at 3%.

2) Consumer equipment and parts

Color TVs are the leading consumer electronic product in the country. Based on information obtained from the interview survey, the actual demand in 1996 is estimated at around 750,000 units. On the other hand, local production totaled

900,000 units and imports (including smuggled products) 300,000 units. With distribution stock of 400,000 units, local manufacturers cut back production this year. Total production capacity in the country is estimated at 2 million units annually. Ownership has exceeded 90% in Hanoi and Ho Chi Minh City, and no rapid growth can be expected. With the increased purchase in rural areas and replacement demand being anticipated, the annual growth of 10% is expected in future. Nevertheless, excess capacity, more than twice the demand, together with imports, creates fierce competition. In the meantime, the popular screen size will shift upward from 14-inch to 20-inch or 21-inch as considerable replacement demand is expected. The demand for black-and-white TVs, which has declined considerably with proliferation of color models, totals 100,000 units, which are mostly imported from China.

VCR demand grew rapidly in 1992 and is currently in the range of 30,000 units annually, which are mostly imported. Local production is not feasible for a while due to the small demand, the ease of handling, the difficulty to prevent smuggling, and the shortage of locally procurable parts.

As shown in Table 3-9, the demand for radio/cassette recorders, as estimated from local production and imports, amounts to 160,000 units. On the basis of the TV demand and other data, potential demand is estimated at around 1.2 million units. However, production remains unchanged at around 110,000 units in the recent few years due to strong competitive pressure from low-priced Chinese products. The demand for battery has reached 150 million units annually, and production has been growing steadily year after year (Table 3-9). At present, the volume of local production matches that of imports.

3.1.3 Procurement of parts, raw materials, and equipment

(1) Electrical equipment

Core in electrical equipment such as generators, motors, and transformers uses a variety of soft magnetic materials, including silicon steel sheet (Fe-Si), permalloy (Fe-Ni), ferrite, and pure iron. In addition, copper wire and insulation materials are used. Of the twelve enterprises visited, nine imported 90% or more of raw materials and parts consumed, two 50-90%, and one 50% or less, indicating high levels of dependency on imported parts and materials, which are imported from a variety of countries, including China, Russia, South Korea, Taiwan, the U.S., Japan, and Australia. Generally, most enterprises use parts made in China, Russia, and Korea, which are low-priced with inferior quality, while materials and parts made in Japan, high quality and expensive, are used as required.

Most factories use obsolete machinery and equipment made in Russia and Czechoslovakia, which are mostly idling due to the lack of order. Recently, an increasing number of enterprises, led by joint ventures, has begun to purchase new equipment from Japan, Korea, China, and the U.S. For instance, some of battery factories, which maintain brisk production, are actively replacing equipment.

(2) Electronic equipment

Of the twelve enterprises visited, five imported 90% or more of raw materials and parts consumed, six 50-90%, and one 50% or less, again indicating high levels of dependency on imported parts and materials. Major import sources are Korea, Taiwan, the U.S., Japan, Singapore and Malaysia.

As for color TVs, however, the government encourages localization of parts and components and have set differential tariff rates: 60% for finished products, 35% for SKD, 15% for CKD, and 5% for IKD[2].

In response, manufacturers are making efforts to procure local materials, and the local content is higher than other products. Now, a variety of parts including picture tubes (PIX tubes), deflection yokes (DYs), flyback transformers (FBT), plastic molds, and corrugated boxes is available, mainly manufactured by foreign-affiliated companies. Most importantly, production of PIX tubes was started last year by a joint venture of Daesung of Korea and HANEL. As the tube is the most expensive part of color TVs, and local production helps assembly manufacturers to meet IKD requirements.

Together with other costly parts such as tuners, DY, and FBT, the local content can exceed 60%.

On the other hand, production equipment including conveyors, soldering machines, and adjusters is entirely imported. Production equipment at TV assembly factories is fairly new as local production has started very recently. In particular, newly established joint ventures use latest production equipment. On the other hand, other assembly facilities do not have conveyors or use very simple configuration. Production equipment of dry battery and incandescent lamp factories has been entirely imported. It is mostly of old, semi-automatic type, requiring a lot of manual work and resulting in low productivity.

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[2] SKD: Knockdown products not using local materials
CKD: Knockdown products using less than 10% local materials
IKD: Knockdown products using 10% or more local materials

3.1.4 Industrial structure and production technology

(1) Electrical equipment

Factories producing electric fans, transformers, and circuit breakers manufacture large portions of parts and components internally. In particular, blades, bases, motor core, transformers, and metal cases of circuit breakers are made in-house by purchasing most of materials. Most of factories believe in virtue of integrated production. However, some have established a complementary production sharing system by selling certain parts to other factory and purchasing others.

No enterprise develops and manufactures its own production equipment, and there is no local manufacturer. As a result, all the equipment is imported, accompanied by necessary production technology. Large enterprises use equipment of 20 - 30 years old, many of which are not operated. Two companies, both joint venture, have new equipment. Some of state enterprises, which maintain a high operating rate, have invested in new equipment, which is operated side by side with older equipment. These companies show a future prospect. On the other hand, a factory which produced engine parts shifted to production of molds, switches, and switchboards as they have become unable to meet customer requirements due to old products and obsolete equipment.

Many enterprises improve product quality by obtaining technical assistance from foreign companies. Enterprises under Vietnam Electro-Technical Equipment (VEC) have foreign partners in Switzerland, Slovakia, Korea, and Japan.

(2) Electronic equipment

Unlike electrical equipment, no electronic equipment manufacturer make parts and components internally. Color TV production is essentially assembly operation using purchased parts.

As local production key TV parts and components has started, TV manufacturers are moving to use them as standard parts. They are not included in original designs to require design modification which is carried out in countries of parent companies, Locally produced parts are still inferior to imports in terms of quality.

Production equipment is all imported, accompanying production technology. Local enterprises are responsible only for their operation and maintenance. Joint ventures, newly established, have new factories and latest equipment comparable to those of parent companies. For instance, state enterprises use color adjustment lines based on visual inspection. On the other hand, joint ventures operate white balance meters and purity adjusters. While state enterprises seem to rely on low labor cost and dexterity of local people, a minimum set of equipment is required to ensure a sufficient level of accuracy.

3.1.5 Major Issues related to sectorial development

(1) Product development, design and merchandising capabilities

1) Electrical equipment

To ensure future development of the electrical equipment industry and production, education of product planers and designers is urgently required, as product development and design capabilities are the key to winning intensive competition in the industry.

Take electric fans, for instance. Imports grow faster than local products. Major differences are merchandising capability and product quality. In particular, local enterprises lack product development capability. They need engineers who have knowledge and skills in product development.

As for transformers, state enterprises are proud of their design capability and policy. However, they do not seem to have attained the ability to design products with international competitiveness.

Sockets, switches, and circuit breakers are obsolete in design.

Household appliance manufacturers completely lack development and design capabilities and have to rely on foreign designs for a while. The demand for washing machines, air-conditioners, and refrigerators is expected to grow in the country, but local enterprises do not have the ability to develop, design, and produce their own products.

2) Electronic equipment

The situation is even dreary in the electronics subsector, where local enterprises have little design and development capabilities.

Color TV designs are totally provided by foreign companies. Although locally produced parts and components are adopted, design modification to replace old parts needs to be done outside the country. Joint ventures also have to rely on technical support of parent companies. However, it is difficult to obtain the parent company's approval for design modification if the joint venture purchases designs, parts, and equipment all together. The parent company which supplies them is reluctant to agree with design modification for various reasons, including time and effort involved, the need for assuming the risk related to the quality of locally produced parts, and an inevitable decrease in parts sales. To ensure smooth adoption of local parts, therefore, the joint venture must have its own design capabilities.

On the other hand, it takes considerable time and cost to develop the ability to design original products, including competent designers and financial capabilities. It must be viewed from a long time span, not just five or ten years. Retaining and educating designers capable of design modification for parts replacement should be considered as the first step toward the final goal.

In addition to color TVs, all of electronic equipment industries lack product design and development capabilities, including PCs, radio/cassette recorders, dry batteries, and antenna. Education of designers and engineers should therefore be given of highest priority.

(2) Equipment and production technology

To ensure efficient production of electrical equipment at factory, well-designed tooling to match production volume and competent production engineers capable of maintaining and upgrading it are essential. In particular, production engineers must be trained to achieve continuous upgrading of factory layout, jigs and tools, and machinery and equipment which can effectively support productivity improvement.

Existing equipment is mostly 20-30 years old, made in the former Czechoslovakia and USSR. Their utilization rate is very low. Repair parts are manufactured internally. There is no production engineer capable of developing new machinery and equipment, which must be obtained from foreign countries. The lack of design capability must be tolerated for a while. Nevertheless, there are a plenty of opportunities to raise productivity at factory, which often start from small efforts, e.g., the improvement of jigs and tools, and the use of a portable conveyor. Thus, the belief should be spread first that productivity improvement must lead cost reduction. The major step to introduce production equipment and technology may have to follow the change in mindset of the management and factory workers.

The situation is similar in the electronics industry. There are few enterprises which have the ability to make or upgrade production equipment. To compete in the international markets by raising productivity, efforts should be made to build up the capability to upgrade production equipment and develop proprietary jigs and tools, particularly the development of a suitable organization and human resources, in addition to equipment maintenance capabilities.

(3) Industrial structure

At present, there are around 100 enterprises related to electrical and electronic equipment production, 90% of which are state enterprises. The percentage is extremely high compared to 25% in the entire industry. This reflects the fact that the industry requires large capital investment which makes private enterprises to enter. Major factors driving future growth of the industry are successful efforts to energize it, including the inducement of foreign capital, followed by market expansion. Thus, it is critical to foster the emerging industry by maintaining business environment which can fully leverage the market mechanism and leads to market expansion and localization of parts production, rather than direct promotion of localization.

Generally, electrical equipment manufacturers in the country maintain self-sufficient, integrated production systems, which have advantages and disadvantages. So long as the internal capacity to manufacture parts is fully utilized, the approach is proven to be highly economical by achieving significant cost reduction. Once the capacity utilization rate declines, however, idling machinery becomes a heavy financial burden on the factory and turns into a major economic disadvantage. At present, the latter is true in the electrical equipment industry and the integrated production system seems to be a major drag.

Taking color TV production as an example, while localization of parts is in the rapid progress, various parts such as tuners, DY, and BT are assembled from basic parts such as resistors, capacitors, and semiconductor devices, which are entirely imported.

To pursue cost reduction for the entire industry in future, manufacturers of these parts need to be attracted to the country so as to build industrial structure which allows local procurement of the key parts. For this purpose, it is important to encourage direct foreign investment and foster the industry under the market mechanism, thereby promoting market expansion.

3.2 Current State and Issue for Standardization and Quality Management

3.2.1 Standards in the electronic and electrical equipment subsector and development status within the country

(1) Electrical equipment

Many standards related to electrical equipment are very old and based on COMECON standards. The survey result shows that approximately 80% of standards in the electrical engineering field are ST-SEV based, while only 20% are based on ISO/IEC.

Most of electrical equipment manufacturing enterprises produce products according to old standards by using old equipment, and as new products are slow to be developed, no confusion is observed in the industry. Nevertheless, if the industry is to participate in the international market, a slow progress in development of ISO/IEC-based standards, including the updating of existing ones, is problematic.

Minimum required standards related to electrical equipment are those intended to protect consumers and prevent market disturbance such as radio interference. Particularly important are standards designed to protect consumers from fire, electric shock and injury. However, TCVN lacks product standards related to safety.

(2) Electronic equipment

Standards related to electronic equipment are mostly based on COMECON standards, more than those covering electrical equipment.

In fact, approximately 95% of standards related to electronic information imaging technology are based on ST-SEV, and ISO/IEC-based standards below 5%.

The electronics industry in Viet Nam has little proprietary technology, and most of technology used in all the areas including color TVs, radio/cassette recorders, VCRs, and black-and-white TVs has been introduced by foreign companies. While old standards remain in effect without updating, they are not used in practice. Instead, foreign standards are used under direction of the foreign manufacturer which designs a product and contracts its production to a Vietnamese company, or of the parent company of the joint venture.

(3) Need for promotion of standardization and development of the promotional system

Safety-related standards need to be made compulsory, both local products and import, with strict enforcement in the market. Renowned brands designed in foreign countries are designed and manufactured according to internal standards which are based on IEC, so that a safety problem rarely occurs. On the other hand, low-priced products, particularly those smuggled into the country, are very risky as they lack adequate safety measures.

To ensure complete enforcement of the essential standards, engineers of inspection bodies must have the ability to perform proper testing and inspection on electronic products, including color TVs and PCs. The development of such human resources will lead to higher levels of electrical engineering in the country as a whole.

On the other hand, performance requirements need not to be enforced and should be left to decision of individual consumers, provided that public efforts should be made to support educated selection of consumers. This can be accomplished by the use of a public organization which conducts comparison tests by purchasing products from the market and make objective data and information known to the public on a periodical and easily accessible basis. Finally, efforts should be made to replace the existing standards with ones complying with applicable IEC standards. At the same time, exception should be allowed to bring IEC closer to domestic standards, where industrial technology has not achieved required levels and does not present a serious threat to consumer safety.

3.2.2 Certification system

(1) Mandatory certification

At present, only two items of electrical equipment and parts are specified in MOSTE's list of mandatory certification, namely electric fans, and cables and wires. These products are to be inspected by QUATEST and must pass the specified tests before they are shipped to the market, with a certification label being affixed to each product.

In practice, however, many electric fans displayed at storefront do not bear the certification label, probably because the applicable standards do not specify penalty for incompliance and they are not strictly enforced in the form of crackdown by public power. These non-label products were presumably smuggled from neighboring countries or were manufactured locally but did not obtain certification.

Also, the mandatory certification system does not seem to be enforced properly for electrical cables and wires. Some electrical contractors complain that wires not conforming to applicable standards are supplied, probably because of strict cost requirements.

There is clear evidence that the current system is not effectively enforced. Safety-related mandatory standards must be strictly complied with by manufacturers. In particular, the current scope of mandatory certification covering only the two items is not sufficient to protect consumers. It is strongly recommended to add more products to the list and strengthen the enforcement to ensure that retail stores understand the need for the safety label. Naturally, these efforts entail additional manpower and equipment for testing and inspection. In fact, it is difficult for QUATEST to perform all the additional tests with its current staffing.

To effectively utilize limited human resources in the field of testing and inspection, the self-certification system can be a workable solution. Under the system, manufacturers will be responsible for safety verification of products for which manufacturers have demonstrated the ability to comply with safety standards over a long period of time, such as electric fans, and products with a small safety risk. This will allow STAMEQ inspectors to conduct tests on products which are newly designated in the list. This way, the certification system can increase its coverage significantly. At the same time, the new system will require STAMEQ engineers and technicians to have testing techniques and skills on a variety of products. These new skills and information on products and technologies will then be disseminated to help upgrade electrical engineering technology in the country as a whole.

While adding new products to the list, primary responsibility for products currently in the list is transferred to manufacturers who are required to check and declare the safety of their products. STAMEQ reviews and certify the products on the basis of documents submitted by respective manufacturers, while testing the products on market on a periodical basis to ensure their compliance. For instance, manufacturers of electric fans and cables are expected to have technical know-how in safety design as they have already undergone many tests and have made design modification to eliminate potential or existing problems found. Clearly, these products should be left to self-certification of manufacturers, while their compliance is monitored on market by stepping up activities. At the same time, testing equipment needs to be added in a planned manner to meet the changing needs.

In the field of electronics, no product is required to obtain certification. For instance, color TVs, which deal with high voltage and present a higher risk of fire and electric shock than electric fans, are only self-tested by manufacturers, due to the lack of testing skills and equipment as well as measuring instruments.

Again, it is recommended to identify products which have a high level of hazard and subject them to mandatory certification. If, however, the study finds that safety can be assured by local manufacturers and their testing practice for a product, it can be dropped from the list.

(2) Voluntary certification

The results of the on-site and questionnaire surveys indicate that few enterprises obtain voluntary certification partly because it requires considerable time and cost to apply for it, and partly because the certification does not produce any significant benefits for the manufacturer as the certification label is not widely recognized or relied on by consumers for their product choice.

Meanwhile, QUATEST does not have a necessary set of testing equipment and is only capable of performing simple tests on transformers. As a result, its service is rarely used in relation to electrical and electronic equipment, except for safety-related voluntary certification.

With an anticipated increase in joint venture activity which will likely result in export growth, efforts should be made to reinforce the voluntary certification system by encouraging manufacturers to obtain certification based on foreign standards which are acceptable in the export market[3].

(3) Quality system certification based on ISO 9000

One cable and wire manufacturer has already obtained ISO 9000 certification for its quality system, and so has an electronics manufacturer which is wholly owned by a foreign company. The former was audited by QUACERT and the latter by a French accreditation body. Other manufacturers do not seem to make application in near future and collect information by participating in STAMEQ seminars and other means. Although they have general interest in ISO 9000, they are not required to obtain certification urgently.

Large cable manufacturers having highly automated lines are expected to enjoy benefits from the ISO 9000 certification, as their product quality is governed by the success of the production control system. They also receive many requests from customers to obtain the certification so that they can be assured of product quality without performing the acceptance test on every product.

On the other hand, the ISO 9000 certification is not likely to produce significant quality impacts for small- and medium-sized enterprises as well as assembly manufacturers where manual operation accounts for large portions of production activity. To assist small enterprises in obtaining the certification when required by their customers, special guidelines need to be developed as part of public effort.

3.2.3 Current level of quality control and major Issues

Quality is roughly classified into design quality which represents a production target, and production quality which represents actual quality of a product upon completion. In Viet Nam, quality is generally understood as and is referred to the latter. In reality, however, quality is primarily governed by design. In this sense, production quality should include the design modification process to reflect feedback information from the

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3 Although Viet Nam has a certification scheme to verify compliance with foreign standards, there is no institutional setup to support its implementation.

production department and the market, especially any inadequacy or misfit. Most of manufacturers in the country fail to meet production quality in this aspect.

(1) Electrical equipment

1) Consumer equipment

Quality control of most manufacturers is mainly focused on efforts to prevent defectives from being shipped to the market by means of inspection on the basis of internal standards.

They collect rejection data in each process, but they fail to utilize and analyze them by QC circle activity or the seven QC tools.

Most of manufacturers do not understand the correlation between rejection rates in the market and within the factory. A high rejection rate at factory means that some of defectives can be undetected by inspection and shipped to the market. To prevent this, defects found in the process and the market must be provided and used as the basis of effective measures.

Another key factors for determining production quality are mechanization and automation. Quality can be improved significantly by installing machinery and automated systems in the production steps which are critical for quality control. However, manufacturers in the country are far behind in these aspects and even large state enterprises do not have conveyor.

2) Industrial equipment

While a variety of products has been locally produced over a long period of time, including large power transformers, small switches, circuit breakers, and plug sockets, they have rarely been improved over time. Many state enterprises still manufacture products of old types. Some enterprises have design capabilities and develop their own products, but the levels of their design techniques and development know-how are far behind those in industrialized countries. Even discounting the fact that the industry does not produce new models as frequently as consumer equipment, the lack of notable investment in design and R&D capabilities has clearly resulted in the technology gap.

To be ready for future competition with foreign products, they should not rely on steady orders from local power companies and should develop product design and development capabilities.

Quality control practice of industry equipment manufacturers seems to be in the same stage as consumer equipment, i.e., an emphasis is made on efforts to prevent the shipment of defective products by inspection. It should be noted that industrial equipment is generally produced on a contrast basis or in a small lot, not particularly adaptive to the TQM concept.

As seen in consumer equipment manufacturers, manufacturers collect rejection data in process but do not use them to identify the causes by QC circle activity. They do not understand how the 5S activity is associated with quality. Also, many of them feel that quality control involves large investment, including the upgrading of production and inspection equipment, and the reinforcement of the inspection process.

Again, mechanization and automation are considered to be important factors for determining production quality. Manufacturers of switches, circuit breakers, and other relatively large-lot products are generally small in size and their levels of mechanization and automation are very low. There are the lack of innovative efforts to improve productivity and quality, even if there are various ways to do so without much investment, e.g., the use of a manually operated conveyor. The familiar scene is that workers assemble various parts manually, pile them up around them, and carry them to the next process as the pile reaches a certain volume.

The cable and wire industry rarely develops new models, and quality is primarily governed by the production side, rather than the design side. In other words, production technology and equipment, and the quality control system - in particular, how well they are designed and maintained - basically determine product quality. In the industry, large enterprises plan to obtain the ISO 9000 certification partly because of customer's request. Some enterprises are in the documentation process and are scheduled to obtain it by the end of this year. There are enterprises making capital investment related to the certification process.

On the other hand, small- and medium-sized enterprises fully utilize old machinery and flexibly produce low-cost products in a small lot on a contract basis. They give priority to cost over quality and use low-cost materials and parts to meet customers' demand. Some products subject to mandatory certification are shipped without TCVN label.

(2) Electronic equipment

1) Consumer equipment

Generally, state enterprises manufacture consumer products for foreign companies on a contract basis. They have neither designer nor product planning department to ensure design quality.

They have established joint ventures with foreign TV manufacturers, each of which produces a different brand. At the same time, state enterprises produce other brands under license from foreign companies. This is considered to be wasteful from the viewpoint of quality assurance and standardization. To maintain quality of a product, it is important to produce it in accordance with the same designs and specifications over a long period of time. The practice is also critical in maintaining and building a technological base in a consistent and continuous manner. On the other hand, production of different brands requires additional spare parts, jigs and tools.

As seen in electrical equipment, quality control of state enterprises is still limited to a stage focusing on efforts to prevent the shipment of defectives to the market. Although rejection data are collected in the processes, no measures to improve quality, such as QC circle activity and analysis using the seven QC tolls, are taken. Japanese-affiliated joint ventures have introduced or are prepared to introduce the 5S and are making preparation to initiate QC circle activity.

Another determinant factor for production quality is the level of mechanization and automation. State enterprises are far behind in this area. For instance, most of their assembly lines are not equipped with automatic loaders. Given relatively low labor costs in the country, manual loading has a clear cost advantage at present. Nevertheless, the use of the automatic loader is essential in preventing incorrect loading and improving workability for soldering, which directly lead to quality assurance.

As for adjusting lines, there is a major gap between state enterprises and between state enterprises and joint ventures. Some state enterprises have manual white balance meters and purity adjusters. On the other hand, joint ventures have latest digitized equipment and the well-designed quality system, which seem to maintain the same level as production systems of parent companies.

State enterprises realize the need for quality education and actively participate in seminars, but they have not put it into practice. In particular, there is the lack of understanding on how to organize quality control practice and activity.

2) Industrial equipment

Products classified under the category include PCs, telephones, and FM transmitters In fact, these products are assembled by the designer or at a small shop employing a few workers, thus not suitable for analysis from the traditional viewpoint of manufacturing and quality.

Production quality is maintained in the form of acceptance test at the customer, i.e., a product is inspected by the customer before and after installation, including operational check. If any trouble occurs, the designer visits the customer and corrects it in consultation with him. Because of this, education of product designers is carried out extensively.

3) Parts and components

Dry battery and TV parts are major products of this subsector in Viet Nam. Dry battery is considered to be a century old from the viewpoint of design quality, as evidenced by the lack of R&D departments at manufacturers. Clearly, they are not in a position to compete in the international market. The bulk of products is still the manganese type, while alkaline battery remains at a minimal level, and more advanced batteries such as lithium ion are not produced. Batteries made in the country have poor performance, around 20% that of those imported from Japan and the U.S. (Figure 3-1). Unless performance (quality) is improved significantly, they will not be able to hold share in the domestic market.

As dry batter production is largely automated, production quality is governed by quality of production equipment and quality control system, i.e., how well they are designed, maintained, and managed. In this respect, manufacturers in the country clearly fall behind due to old equipment and poorly-executed quality system.

TV parts are produced by joint ventures, started very recently. At present, they are produced according to production technology and know-how transferred from parent companies, so that both design and production qualities are considered to be at satisfactory levels. For instance, a factory producing PIX tubes, only one in Viet Nam, is fully automated with efficient equipment layout according to product flow. The 5S seems to be thoroughly practiced, and the process percent defective remains at around 1%, more or less the same level as that of parent companies.

3.2.4 Testing, inspection, and calibration

(1) Internal testing and inspection system

1) Electrical equipment

Generally, there is a significant gap between state enterprises and joint ventures in their measuring instruments. State enterprises have much less instruments in terms of both quantity and variety, most of which are old and not suitable for the use in the mass production system.

Measuring instruments used in the production and shipment inspection processes of industrial equipment and parts are voltmeters, ammeters, resistance meters, power meters, length measuring instruments, thermometers, compression testers, and insulation resistance testers, which are kept by manufacturers according to their specific needs. On the other hand, few manufacturers have instruments which are required in the product development and design stages, including oscilloscopes, thermostatic ovens for aging, and tensile testers. Measuring instruments for high voltage are owned by some manufacturers, but they are rarely used.

As for measuring instruments used in the consumer equipment production process, there are many special instruments required to test a wide range of features peculiar to consumer products. For instance, inspection of refrigerators requires a heat exchange tester which costs a few million dollars, which is not owned by joint ventures that generally have a wide variety of equipment.

2) Electronic equipment

Measuring instruments used in the production and shipment inspection processes of industrial equipment and parts are voltmeters, ammeters, resistance meters, power meters, weighing machines, length measuring instruments, thermometers, compression testers, and insulation resistance testers, oscilloscopes, and thermostatic ovens for aging. Among them, manufacturers own an ordinary set of instruments required for process control, but not special instruments and those not frequently used.

As for measuring instruments for consumer equipment, mainly TV sets, there is a great variation among factories. Generally, there is a large gap between state enterprises and joint ventures in ownership of measuring instruments and adjusting lines. State enterprises are behind in variety and quantity, and most of instruments are old and not suitable for the use in the volume production process. On the other hand, joint ventures are equipped with latest instruments which are comparable to those used in industrialized countries. It should be noted, however, that joint ventures do not have special instruments required to test a wide range of features peculiar to consumer products, such as signal generators, vector scopes, luminance meters, measuring instruments for undesired radiation, and radio wave unechoic chambers.

(2) Use of outside testing laboratories by individual enterprises and industries

1) Electrical equipment

General measuring instruments used for products designed and produced in Viet Nam are in principle calibrated by STAMEQ (VMI or QUATEST in the south).

Among STAMEQ facilities, QUATEST 3 - designated testing laboratory for electric fans - is responsible for the measurement of electrical characteristics as well as air flow.

It only has a basic set of old instruments such as electric current, voltage, power, and frequency, as well as air flow meters, which are sufficient to test electric fans. QUATEST 3 handles 60 electric fans per month and calibrates 5-10 general instruments per day. In addition to QUATEST, laboratories under VEC are also used.

Because most products designed and manufactured in Viet Nam are destined to the domestic market and are mainly commodity products, they do not require testing and inspection by a third party organization, except for mandatory certification. For instance, if a manufacturer in Viet Nam designs, manufacturers, and exports washing machines, it has to ask a local laboratory to conduct tests on safety, environmental impacts, and performance, and submit test reports to importing countries. In practice, however, joint ventures manufacturers washing machines which are mostly designed by their parent companies, and various tests are conducted by them.

2) Electronic equipment

General measuring instruments used for products designed and produced in Viet Nam are calibrated by STAMEQ (VMI or QUATEST in the south).

Nearly one half of enterprises interviewed responded that they had measuring instruments calibrated. In Hanoi, no enterprise affix the calibration label to instruments, indicating the lack of proper control. In Ho Chi Minh City, enterprises which made a positive response affixed the label to only portions of instruments. Thus, few enterprises are properly calibrating their measuring instruments in a planned manner.

QUATEST 3 is only capable of calibrating instruments to measure basic items such as electric current, voltage, resistance, and frequency, while not covering special instruments such as oscilloscopes and signal generators. As a result, enterprises which have these instruments rely on calibration service of instrument suppliers located in foreign countries, or in the case of joint venture, sent them to parent companies for calibration.

Testing and verification facilities must meet technology levels of each country, and they have to maintain the level of accuracy to allow proper testing and inspection of products actually manufactured in the local industry. However, electronics companies in Viet Nam rely on foreign design and product development capabilities and are devoted to contract production, so that they do not require special testing inspection equipment peculiar to products they supply. If Vietnamese manufacturers are to control product quality on their own, however, they must have sufficient testing and inspection capabilities to at least monitor safety and performance of products which are sold to the domestic market.

Table 3-1 Classification of Electrical / Electronics Industry

Electrical Equipment	Electronic Equipment and Components
1) Electric Appliances *Example* – Electrical Fan – Rice Cooker – Refrigerator 2) Electrical Industrial Machinery and Equipment *Example* – Motor – Transformer – Switch board 3) Incandescent and Fluorescent Lamp 4) Wire and cable 5) Others	1) Consumer Equipment *Example* – Color and B/W TV – CD player – Radio/cassette tape recorder 2) Industrial Equipment *Example* – PCs – FM Transmitter 3) Part and components *Example* – Parts for TV – Dry cell battery

Table 3-2: Production and Import of Electrical and Eletronics Products

	Unit	Production				Import			
		1994	1995	1996	1997 (Estimated)	1994	1995	1996	1997 (Estimated)
Electric Machinery									
Electric motor	Units	28,789	29,390	36,871	40,296				
Transformer	Units	5,881	6,186	6,461	5,844				
Consumer Electric/Electronics Products									
Radio Cassete	Units	111,127	112,425	111,916	116,750	30,444	45,482	48,660	50,000
TV set (color & b/w)	Units	993,049	753,820	801,127	800,000	390,400	484,220	475,069	482,000
Electric Fan	1000u	334.1	370.0	317.2	340.6				
Air Conditioner	Units					82,276	82,435	82,900	83,000
Refregirator	Units					94,125	137,470	138,509	139,000
Other Elecric Products									
Wire and Cable	km	67,017	94,745	106,211	120,000				
Dry cell Battery	1000u	125,738	138,423	141,110	150,016				
Lamp	Units								
Fluorecent Lamp	Units								
Candecent Lamp	1000u	18,006	25,085	26,125	26,310				

Source: General Statistical Office

Table 3-3 Gross Output
(Electric and electronic products)

(Unit : Bill dongs at 1989 constant prices)

	1990	1991	1992	1993	1994	1995
Total gross output	272.3	277.6	300.3	409.2	492.8	514.0
State industry	208.1	194.7	220.0	323.0	385.2	404.0
Central industry	174.0	160.6	170.8	249.9	281.0	295.0
Local state industry	34.1	34.1	49.2	73.1	104.2	109.0
Non-state industry	64.2	82.9	80.3	86.2	107.6	110.0
Collective economy	27.2	10.7	12.2	5.8	1.0	
Individual & mixture economy	0.9	5.8	7.8	17.4	29.2	
Private household	36.1	66.4	60.3	63.0	77.4	

Source : General Statistical Office, "Statistical Yearbook, 1995"

Table 3-4 Number of Establishments (Electric and electronic products)

(Unit : Number)

	1990	1991	1992	1993	1994
Total	5,370	5,624	3,587	1,385	2,324
State industry	61	60	67	62	59
Central industry	24	25	27	27	27
Local state industry	37	35	40	35	32
Non-state industry	5,309	5,564	3,520	1,323	2,265
Collective economy	109	89	49	43	14
Individual & mixture economy	14	13	10	36	42
Private household	5,186	5,462	3,461	1,244	2,209

Source : General Statistical Office, "Statistical Yearbook, 1995"

Table 3-5 Gross Output per Establishment (Electric and electronic products)

(Unit : Mill dongs at 1989 constant prices)

	1990	1991	1992	1993	1994
Total	32	33	61	83	114
State industry	854	869	1,228	1,653	2,032
Central industry	1,739	1,793	2,135	2,557	3,121
Local state industry	494	464	712	1,009	1,239
Non-state industry	15	16	30	38	48
Collective economy	216	103	124	97	190
Individual & mixture economy	188	317	443	151	387
Private household	9	13	26	35	42

Source : General Statistical Office, "Statistical Yearbook, 1995"

Table 3-6 Outline of Electrical Machinery Industry in Viet Nam

Category	Product	Domestic Market		Domestic Production Yes / No	Remarks
		Estimated Size (thousand piece)	Forecast		
Industrial	Generator, Motor	n.a.	Increase	Yes	Market size is unknown due to no import data
	Transformer	n.a.	Slightly increase	Yes	Market size is unknown due to no import data
	Capacitor	n.a.	Increase	Yes	No data available
	Ballast	n.a.	Increase	Yes	No data available
	Switch	n.a.	Increase	Yes	No data available
	Breaker, Fuse	n.a.	Increase	Yes	No data available
	Switch board	n.a.	Increase	Yes	No data available
	Wattage meter	n.a.	Increase	Yes	No data available
Home appliance	Electrical fun	400 1)	Increase	Yes	Domestic product is stable
	Washing machine	16 1)	Increase	Yes 3)	
	Refrigerator	139 2)	Slightly increase	No 4)	
	Rice cooker, etc.	16 1)	Slightly increase	No 4)	
	Air conditioner	83 2)	Slightly increase	No 4)	
	Microwave oven	2 1)	Slightly increase	No 4)	
	Light bulb	26,000 2)	Increase	Yes	
	Fluorescent lamp	n.a.	Increase	Yes	
Parts	Wire, Cable	106 mil. km	Increase	Yes	
	Storage battery	n.a.	Increase	Yes	

Note: 1) According to "A Guide to the Ministry of Industry"
2) Central Statistical Bureau, 1997
3) The operation has just started and 80% of its production is for export
4) Small market size hinder producing the product locally

Table 3-7 Product and Import of Electrical Machinery

Product	Unit	Domestic Production 1994	1995	1996	1997	Import 1994	1995	1996	1997	Market trends in last 4 years
Motor	Piece	28,789	29,390	36,871	40,296	n.a.				Increase by 10% annually.
	(A)	100	102	128	140					
Transformer	Piece	5,881	6,186	6,461	5,844	n.a.				Increased by 5% annually except 1997 estimate.
	(A)	100	105	110	99					
Electrical fan	000' piece	334	370	312	340	n.a.				Production shows ups and downs.
	(A)	100	111	93	102					
Air conditioner	Piece	No production				82,276	82,435	82,900	83,000	Import increase slightly.
	(A)					100	100	101	101	
Refrigerator	Piece	No production				94,125	137,470	138,509	139,000	Import increase slightly except 1995.
	(A)					100	146	147	148	
Wire, Cable	km	67,017	94,745	106,211	120,000	n.a.				Production increase by 20–30% annually.
	(A)	100	141	158	179					

Notes: (A) 1994 = 100

Source: Central Statistical Bureau, 1997

Remarks: * Production of motor increases rapidly as construction and electric installment rise.

* Production of electrical fan increases slightly. Import from china including smuggling is increasing assumably although no proof data available.

* Market of air condition with 80,000 pieces and that of refrigerator with 140,000 pieces will increase slightly hereafter.

* Productions of wire and cable increase continually due to enforcement of electrical installation and construction boom.

Table 3-8 Outline of Electronics Industry in Viet Nam

Category	Product	Domestic Market		Domestic Production Yes / No	Remark
		Estimated Size (Thousand piece)	Forecast		
Industrial	PC, Printer	15 1)	Increase	Yes	
	FDD, PPC	<1 1)	Increase		Domestic production is unknown
Home appliance	Color TV	700 2)	Slightly Increase	Yes	Diffusion in major cities is 90%
	B&W TV	100 2)	Stable	Yes	Not reliable statistics
	Video	300	Slightly Increase	Yes	
	Radio cassette tape recorder	1,250	Slightly Increase	Yes	Diffusion is 70% in cities and 30% in local area
	Mini-stereo	30	Slightly Increase		Domestic production is unknown
Parts	Dry Cell Battery	83,000	Increase	Yes	
	TV parts, Antenna	800	Slightly Increase	Yes	

TV Parts	Domestic Production
PIX tube	Yes
FBT	Yes
DY	Yes
Tuner	Yes
PCB	Yes
Cabinet	Yes
Passive components (register, coil, capacitor)	No
Semi-conductor (TR, IC, D)	No
Small metal parts, molding parts	Yes
Telescoping antenna	Yes

Sources: 1) According to "A Guide to the Ministry of Industry"
2) Information from TV manufacture

Table 3-9 Production and Import of Electronics

Product	Unit	Domestic Production				Import				Market trends in last 4 years
		1994	1995	1996	1997	1994	1995	1996	1997	
Radio cassette tape recorder	Piece	111,127	112,425	111,916	116,750	30,444	45,482	48,660	50,000	Import increase 20% year due to cheap chinese products. Domestic product increase slightly.
	(A)	100	101	101	105	100	149	160	164	
TV (B/W + Color)	Piece	993,049	753,820	801,127	800,000	390,400	484,220	457,069	482,000	Import increases but domestic production decrease. TV with more than 25 inch are imported incrasingly.
	(A)	100	76	81	81	100	124	117	123	
Dry cell battery	000' piece	125,738	138,423	141,110	150,016					Incrase steadly by 5–10% annually.
	(A)	100	110	112	119					
Lighting bulb	000' piece	18,006	25,085	26,125	26,310					Production incrased in 1995 dramaticly, and became stable.
	(A)	100	139	145	146					

Notes: (A) 1994 = 100

Source: Central Statistical Bureau, 1997

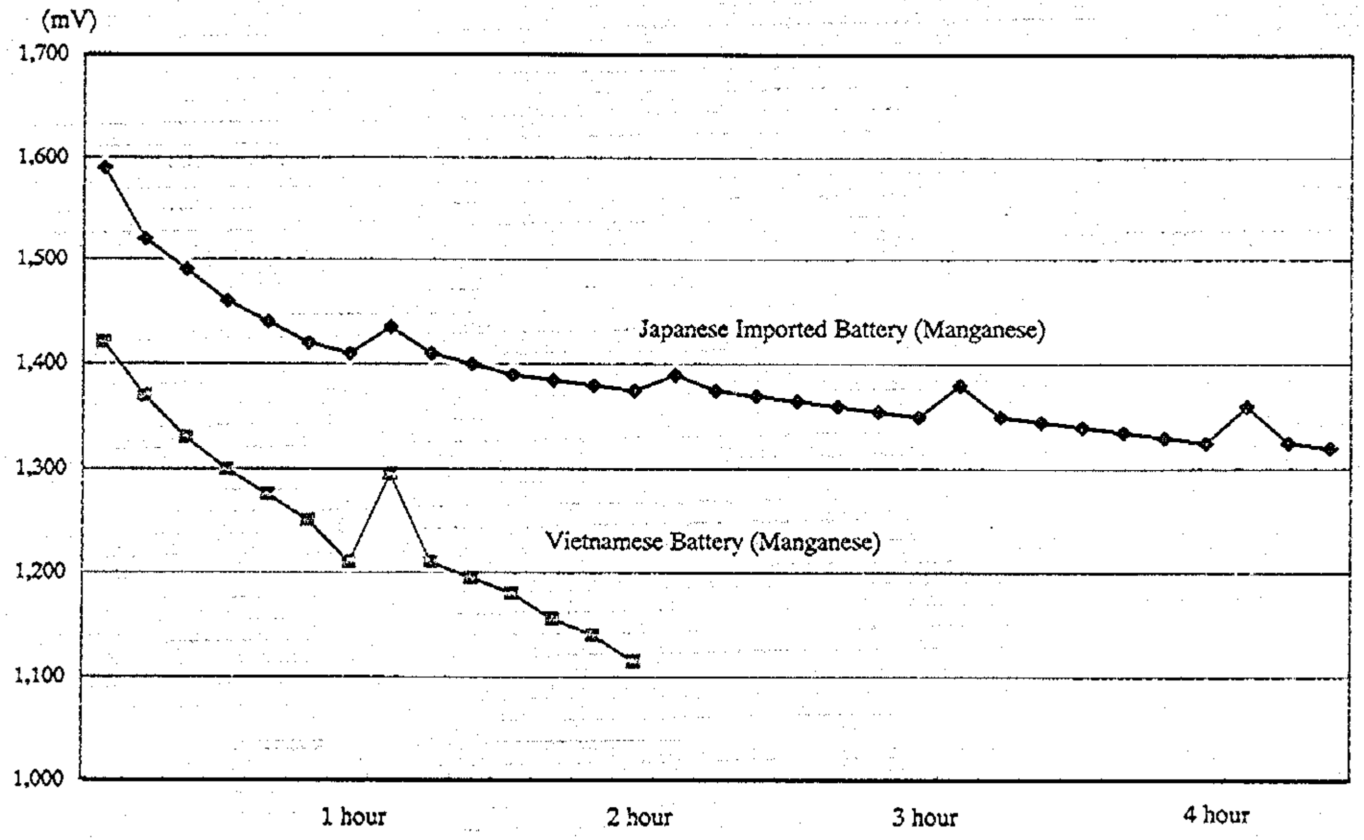
Remarks: *The competition of Radio casset with imported product will be severe, thus the domestic product needs to have more marchandizing with lower price.

*Present market size of CTV is 800,000. The market will be incrased slightly by diffusion to farm land and replacement.

* B/W TV will ramain to get certain demands due to low price

* Dry cell battery and light bulb will increase continually as it is seen in the table.

Figure 3-1 Durability Test for Battery



Note: Method; connect each batteries with one midget lamp for an hour and disconnect for half hour.

Repeat the same action and measure the voltage of batteries every 10 minuets.

4 Textile and Apparel Industries

4.1 Current State of Industry and Issue for Sectoreal Development

4.1.1 Size and structure of the Industry

The textile industry is divided into the following subsectors according to ISIC's classification:

1. Spinning, weaving and finishing of textile
2. Manufacture of other textile
3. Manufacture of knitted and crocheted fabrics and articles
4. Manufacture of wearing apparel except apparel

The second category includes the manufacture of carpets, ropes and nets, which are mainly produced by home manufacturers including craft shops. Also, the first and second categories often include the sewing process in the fourth category.

In Viet Nam, textile and apparel products are manufactured by state enterprises, private enterprises, and joint ventures. More precisely, there are 100 state enterprises, 165 cooperatives, 99 private enterprises, and more than 70,000 home manufacturers(as of January 1994). Note that home manufacturers include a large number of local craft shops and are not engaged in modern spinning, dyeing, fabrics and knit production which requires large investment. The total value of textile and apparel production in 1995 was 1,773 billion Dong (1989 price), approximately 60% of which was produced by state enterprises. On the other hand, cooperatives and private enterprises accounted for a combined share of 10% or less. The total value of production has steadily been on the rise, with 9% growth in 1995 (see Figure 4-1).

On the other hand, the sewing (apparel) industry consists of 101 state enterprises, 77 cooperatives, 383 private enterprises, and more than 32,0000 home manufacturers. Total output of apparel products reached 646 billion Dong in 1995, 58% of which was produced by state enterprises. Production has been increasing each year, with growth rate exceeding that of textile production. The growth rate in 1995 was 16% (see Figure 4-2).

Many state enterprises are under supervision of the Ministry of Industry, while others are controlled by People's Committee in provinces and municipalities. State enterprises originally under the former Ministry of Light Industry had been controlled under two general corporations, TEXTIMEX and CONFECTIMEX, which were merged to VINATEX in 1995. At present, VINATEX controls 28 textile manufacturers and 38 apparel manufacturers. Some of them are integrated manufacturers covering a whole range of process from spinning to sewing, employing 2,000 to 9,000 people and operating several factories each.

According to 1995 data published by International Textile Manufacturers' Federation (ITMF), spinning capacities in Viet Nam (1995) were approximately one million spindles for ring spinning and 1,600 rotors for open end spinning (see Table 4-1). On the other hand, China had 41 million spindles and 550,000 rotors, Taiwan 3.6 million spindles and 151,000 rotors, and Thailand 4.1 million spindles and 70,000 rotors, respectively, forming major concentrations in the region. Furthermore, ring spinning machines in the country include a large number of 20 years or older machines (more than 30%), and 80,000 - 85,000 spindles are actually operated.

Weaving machines consist of 11,000 shuttle looms and 4,000 shuttleless looms (see Table 4-1). The world trend is that the latter is replacing the former. In addition, there are as many as 20,000 hand looms in the non-factory sector throughout the country. Looms are mostly of old type, with operating rate of 60% - 70%. Weaving width is mainly 36 inches.

Most of dyeing and finishing machinery is owned by textile manufacturers, while there are few manufacturers specialized in dyeing, as seen in Japan. In the recent few years, textile manufacturers have been making investment in the dyeing process, which was lagged behind, but old machinery still dominates to result in a low operating rate and causes poor product quality.

Apparel manufacturers mainly rely on sewing machines and irons. As the industry requires a very small amount of capital spending compared to the textile industry, many companies have purchased new machines. In particular, manufacturers doing contract jobs for foreign customers use sewing machines furnished by customers or purchase automatic ironing machines and multiple-needle automatic embroidery machines.

Production capacities of the textile and apparel industry are as follows:

1) Spinning: 86,000 tons annually, 83% of which is pure cotton, and 17% mixed yarns
2) Plain weaving: 450 million m per year
3) Knitting: 15,000 tons

4) Acrylic wool: 1,500 tons annually
5) Clothing: 300 million pieces per year

As shown in Table 4-2, actual production of spun yarns and woven fabrics account for only 50% to 60% of production capacity due to low capacity utilization rates an shorter operating hours than other countries.

4.1.2 Procurement of parts, materials, and equipment

Cotton has previously been imported from the former USSR in large quantities, which declined dramatically in 1991. Present imports come from India, Pakistan, South Africa, the U.S., and Australia. The country produces cotton which represents only 10% of total demand. Also, polyester is imported from Taiwan, Korea, and Japan.

Fabrics and yarns used in the sewing process are mostly furnished by customers as contract jobs (CM) account for most of sewing operation, while integrated mills use their own fabrics and yarns. In the former case, only imported products are used. In the case of FOB job, most materials (fabrics and yarns) are imported from Korea, Hong Kong, and Taiwan These materials, imported or locally procured, are used for production only after the buyer has given approval. In the case of license production, the licenser checks raw materials.

According to the questionnaire survey[1], 29 textile and apparel companies obtain 27% of raw materials from local sources. In particular, The local content is particularly low for nine enterprises specialized in sewing, only 12%, indicating most of raw materials is imported.

Spinning machinery is mainly made in Italy or Japan, while there a large number of looms made in China or the former USSR, although some were imported from Korea.
Knitting machines are made in Taiwan or Japan, and embroidery machines are mostly made in Japan.

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[1] Of all the respondents to the questionnaire survey, 40 enterprises belonged to the textile and apparel industry. To depict characteristics by process, this section (4.1) classify them into enterprises which perform spinning, weaving, and finishing, those specialized in sewing, and other enterprises (manufacture of carpets, ropes, and nets)

4.1.3 Exports

Approximately 30% of total output and 70% of apparel products are exported. Before 1991, major destinations of textile and apparel exports were the former USSR and East European countries. Today, they have been replaced by EU countries, Japan, Korea, Taiwan, and Singapore. Upon conclusion of the Export Agreement on Apparel and Textile Products with EU (effective on January 1, 1993, valid for five years), 80% of exports bound Europe in 1993. Today, around 50% goes to Europe. As shown in Figure 4-2, exports of apparel products are rapidly growing. The value of textile and apparel exports in 1996 reached US$1,040 million.

According to the questionnaire survey, the average export ratio for the twenty nine textile and apparel manufacturers is 72%. In particular, the ratio among enterprises specialized in the sewing process is 94%.

4.1.4 Foreign Investment

Investment projects made by foreign companies between 1990 and March 1996 totaled 102 for the industry, 46 for textile and 56 for apparel. The aggregate amount of investment was US$967 million and US$140 million, respectively. Countries (regions) include Korea, Taiwan, Hong Kong, Japan, and France for both textile and apparel (see Table 4-3). One of major investment projects is made by Sumsong of Korea, which is building a polyester plant to make filaments and fibers. Regionally, many projects are seen in Dong Nai Province and Ho Chi Minh City. In addition, as it takes some time to establish a joint venture, many companies contracts with local enterprises for production commissioning. A Japanese company furnishes production equipment to a local manufacturer and provide technical assistance. In this case, materials are imported from Japan, Korea, and Taiwan.

4.1.5 Major Issues related to sectorial development

(1) Investment related to equipment modernization and rationalization

A majority of equipment in the textile industry is 25 years or older, and many machines are out of order, resulting in low productivity. Most spinning mills have the poor ability to clean spun yarns and less than world class spinning technology, resulting in poor product quality and high cost.

In the weaving sector, 80% of plain weaving machines are small. Looms other than plain weaving machinery account for 9% and are owned by state enterprises. Most of looms used by cooperatives and private enterprises are of wooden, old type. Old facilities and equipment are also used in knitting and dyeing processes. Despite the extensive deterioration of equipment, the lack of funds prevents them from introducing latest machinery and technology. At present, only a small number of textile products have exportable levels of quality and price, and can meet textile demand by apparel manufacturers who are export oriented.

(2) Competition with Chinese products

For the textile and apparel industries, competition with Chinese products is intense. In particular, local products cannot compete with Chinese products based on price in the domestic market. Now, some enterprises offer their own brands to appeal better quality to consumers. These brands begin to be recognized by consumer.

(3) Exploration of the U.S. market

Exports to the U.S., the world largest importer of apparel products, becomes the major challenge for the industry. While few exports are made today, the country plans to export 200 million clothes to the U.S. in 2005. To achieve this target, aggressive marketing is required. There are unfavorable factors, i.e., the U.S. has not granted the country the most-favored-nation status, and it shifts import sources from Asia to Mexico and the Caribbean countries.

4.2 Current State and Issue for Standardization and Quality Management

4.2.1 Development of standards

TCVN standards related to the textile and apparel industries consist of the following areas:

1. Textile production process
2. Fibers
2.1 Natural fibers
2.2 Man-made fibers
3. Textile products
3.1 General textile materials
3.2 Staples and yarns
3.3 Fabrics
3.4 Textiles for carpets
4. Weaving machinery

5. Apparel
6. Shoes

Note that the above standards include leather, furs, and shoes.

Compared to ISO, TCVN covers much less standards for spinning machines, looms, knitting machines, dyeing and finishing machines. Also, there are relatively a few standards related to testing and inspection methods for man-made fibers, while those for cotton and silk are more sufficient according to industry structure in Viet Nam. Compared to JIS, among other things, there is no standard covering the indication especially the method for indicating handling textile products. Note that, in addition to TCVN, the Ministry of Industry and the Ministry of Commerce issue TCN which set forth technical requirements and inspection standards for more than 30 products.

4.2.2 Use of standards by individual enterprises

The textile industry generally adopts TCVN as their product and material standards. For export purposes, many enterprises use internal standards which are based on buyer's standards and specifications. TCN is sometimes used for products shipped to the domestic market. Testing and inspection standards are ISO or ASTM for export products, and TCVN for locally distributed products. In particular, international standards are widely used for export products as many buyers require testing and inspection to check compliance with them.

According to the questionnaire survey, textile manufacturers use TCVN, TCN and TC. Standards for machinery and equipment are not used widely compared to products and raw materials (see Table 4-4). International and foreign standards such as ISO, ASTM, GOST, and JIS are used according to the customer's demand.

On the other hand, the apparel industry which mostly serves export demand manufacturers products according to internal standards and procedures prepared on the basis of buyers' specifications. In some cases, buyers require specific foreign standards. Among enterprises specialized in the sewing process which have responded to the questionnaire survey, only one (out of thirteen) used any standard except TC.

4.2.3 Expectation for promotion of standardization and major issues

In the standards development process, VINATEX (state enterprise) represents industrial needs by participating in the technical committee on drafting of standards. Nevertheless, there is a considerable gap in technology level among state enterprises, which serves as an impeding factor for agreement on technical requirements. Some enterprises believe that TCVN's technical standards are very low, while others want more detailed standards in addition to basic ones. As an increasing number of foreign companies join the industry and an increasing variety of products will be made in the country, it is imperative that standards for new materials will be demanded.

In the apparel industry, the need for standardization and development of standards is not as large as that in the textile industry, because it is dominated by enterprises specialized in contract sewing jobs and thus provide only labor, not doing product development, testing, and inspection on their own. On the other hand, the apparel industry uses a variety of foreign standards and there is the need for a library can supply technical data and information related these standards.

4.2.4 Need for Improvement of the certification System

There is small demand for the certification system because:

1) There is the lack of public recognition on the system itself
2) Export products do not require certification
3) Certification is generally not demanded to suppliers of materials

Since there is no standard or regulation on quality indication and marking, many products sold in the domestic market bear any mark. As consumers become concern about product quality, there will be the need for the quality indication system. Nevertheless, the current quality registration system, which is designed to ensure product quality as indicated, or the similar system to warrant product quality by marking does not have much impacts as the domestic market is dominated by imported products.

4.2.5 Current level of quality control

Quality control activities practiced in the country are summarized as follows:

1) 100% inspection or sample inspection on raw materials, in-process, and shipment;
2) Internal quality control section;
3) The inspection and repair group conducting inspection;

4) Testing laboratory at factory; and/or
5) Appointment of quality control managers or personnel.

Most of enterprises in the textile industry perform quality control practice in 1). While inspection using testing equipment is include, visual inspection covers most items. In fact, quality control in the industry centers on these activities. Some enterprises have quality control sections which are independent units led by testing laboratories and employ workers have relatively high levels of education. They are sent to seminars and training courses for continued education.

In the apparel industry, the quality control section is found in most of enterprises with many employees. In reality, however, it is mainly responsible for product inspection and repair, rather than quality control, and has not reached a level of statistical analysis. The quality control section's personnel performs in-process inspection as well as pre-shipment inspection, or field workers perform in-process inspection. Quality control staffs are often selected from skilled workers. If a major defect is found in the inspection process, the quality control section usually leads the problem-solving process or works with the buyer's technical staff to solve the problem.

Textile manufacturers and relatively large apparel companies maintain company standards (TC). If requirements in international standards or foreign standards are too high to achieve, company standards are developed to meet technology levels of each company. According to the questionnaire survey, 12 out of 18 manufacturers having the spinning process have company standards, and 2 are planning to develop them. The ratio is 5 out of 13 for apparel companies.

Large textile companies show interest in ISO 9000 and three companies which responded the questionnaire survey plan to implement the system. They have participated in ISO 9000 seminars conducted by STAMEQ. It should be noted, however, that the major motivation for obtaining ISO 9000 is to promote exports; they do not feel the need for improving their quality control systems. At present, they believe that the purchase of new equipment is an effective means of quality improvement, and few know or are interested in the Japanese 5S rules and small group activities.

Apparel manufacturers specialized in sewing work and exporting most of their products do not show much interest in ISO 9000. In the questionnaire survey, 9 out of 13 companies responded that they had no knowledge. On the other hand, the largest apparel manufacturer is preparing for ISO 9000 under assistance of an EU consultant.

4.2.6 Issues related to quality control and recommendations

(1) Need for education

There are a limited number of ways to attain high quality if the quality control system is primarily based on inspection, e.g., to increase the number of inspectors and to increase inspection items. These measures can lead to better quality in shipment, but require additional hours in process and labor costs.

Education is a major alternative to the solution focused on quantitative aspects of quality control by improving work skills and raising quality awareness. In this sense, education should include the creation of working environment, including improved work procedures, which stimulates workers to think about the ways to improve their work on a voluntary basis, in addition to product quality. In such working environment, workers should be trained and motivated to create ideas and make their suggestions. The quality control section leads these educational activities by preparing manuals and making training plans.

(2) Quality data management and the establishment of evaluation criteria

The current quality control system, although relying on inspection, fails to utilize data obtained from the inspection processes as the basis of feedback and future improvement. Also, evaluation criteria are based on verbal communication and/or experience, not documented. As visual inspection is extensively used, common standards are required to secure uniform quality. Also, inspection standards should not be kept by inspectors. Rather, they should be made in an easy-to-understand format including illustrations, photos and graphs and should be made available to workers as the basis of their own judgment.

4.2.7 Testing and Inspection system

(1) Internal testing and inspection systems

Textile mills, especially those having the spinning process, have their own testing laboratories. The laboratory is usually part of the quality control section and is staffed by technicians and engineers who can handle testing equipment. All the laboratories are equipped with testing equipment and measuring instruments related to strength, length, and density. Some of them have very old equipment, more than 30 years old, while those which export large portions of their products are equipped with western equipment including USTER's testing equipment.

On the other hand, textile mills only operating the knitting process generally lack testing equipment. They usually commission necessary tests to outside testing organizations or laboratories of other enterprises in the same group.

Very few apparel manufacturers have testing equipment, for they mainly perform contract sewing jobs by using materials furnished by customers, thus not requiring acceptance inspection on incoming materials. Also, they tend to invest in production equipment, and more importantly, buyers do not require testing and inspection.

(2) Third party testing services

According to the questionnaire survey, 17 out of 40 enterprises have used outside testing organizations. Of total, 11 were textile companies, 2 specialized apparel manufacturers, and 4 other categories.

Textile manufacturers often commission to outside testing organizations the tests which cannot be conducted by themselves. They usually do so when their customers demand test reports from third party testing organizations or when a defect or other problems related to the project occurs. In Viet Nam, there are several testing organizations including QUATEST and Textile Garment Research Institute (TRI). Major test items are shown below:

Fibers:	Length, fineness, tenacity, maturity, and moisture content
Staples and yarns:	Strength, elongation, lack of uniformity, length variation, and single staples and the number of strands
Cloth:	Texture, density (number of staples), tensile characteristics, tearing strength, bursting strength, and fastness of color

Finally, apparel manufacturers rarely use outside testing organizations, mainly because they use materials furnished by customers and do not require any test. Customers may test samples submitted by manufacturers. The need for outside inspection organizations is larger for inspection on process management than that for testing organizations.

Table 4-1 Number of Spinning and Weaving Machine in 1995

	Ring spinning	Open-end spinning
China	41,585,000	550,000
India	31,230,000	194,500
Indonesia	6,900,000	78,000
Japan	4,880,000	101,000
Pakistan	8,535,000	133,800
Taiwan	3,621,000	151,000
Thai	4,100,000	70,000
Russia	3,659,000	1,818,700
Vietnam	1,050,000	1,600
	Shuttleless loom	**Shuttle loom**
China	36,000	845,000
India	5,660	139,750
Indonesia	26,000	200,000
Japan	35,450	92,940
Korea	35,000	1,830
Taiwan	19,810	50,000
Uzbekistan	25,000	NA
Romania	20,000	5,000
Russia	120,440	11,330
Vietnam	4,000	11,000

Source: International Textile Manufacture Federation

Table 4-2 Production and Trade of Textile/Garment

	1991	1992	1993	1994	1995
Production					
Yarn ('000 tons)	40.3	44	38	44.4	50
Fabrics (mil. meters)	280.4	272	215	228.1	221
Import					
Raw Cotton ('000 tons)	32.5	8.3	16.4	19.9	
Yarn ('000 tons)	19.1	25	35.3	64.9	
Fabrics (mil. meters)	19.8	28.1	27.5	54.1	
Export					
Fabrics (mil. meters)	6.5	12.4	7.8	11.2	
Garment (mil.US$)	116.8	190.2	238.8	475.6	700

Source: Statistic Yearbook – Viet Nam 1995

Table 4-3 FDI in Textile and Garment Industry

(Unit: million US$)

	Total	1990	1991	1992	1993	1994	1995
Textile							
Number of projects	45	2	2	7	9	11	14
Capital	932.29	14.59	9.41	48.13	448.26	94.10	317.80
Average size of each project	20.7	7.2	4.7	6.8	49.8	8.5	22.7
Garment							
Number of projects	53	2	5	7	11	13	15
Invested capital	138.56	1.20	39.13	34.21	19.28	16.86	27.88
Average size of each project	2.6	0.6	7.8	4.8	1.7	1.2	1.8

Source: Viet Nam Economic Review

Table 4-4 Usage of Standards in Textile Industry

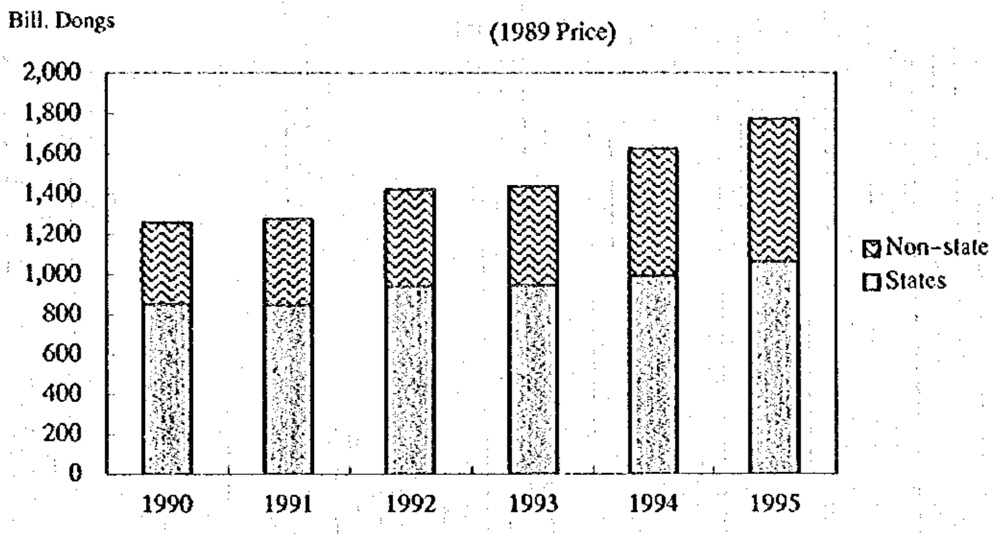
(Unit: number)

	TCVN	TCN	TC	Foreign/ International
Product for sell	13	8	10	5
Raw material	12	2	6	5
Machinery / equipment	3	0	2	2

Note: Data of 17 companies

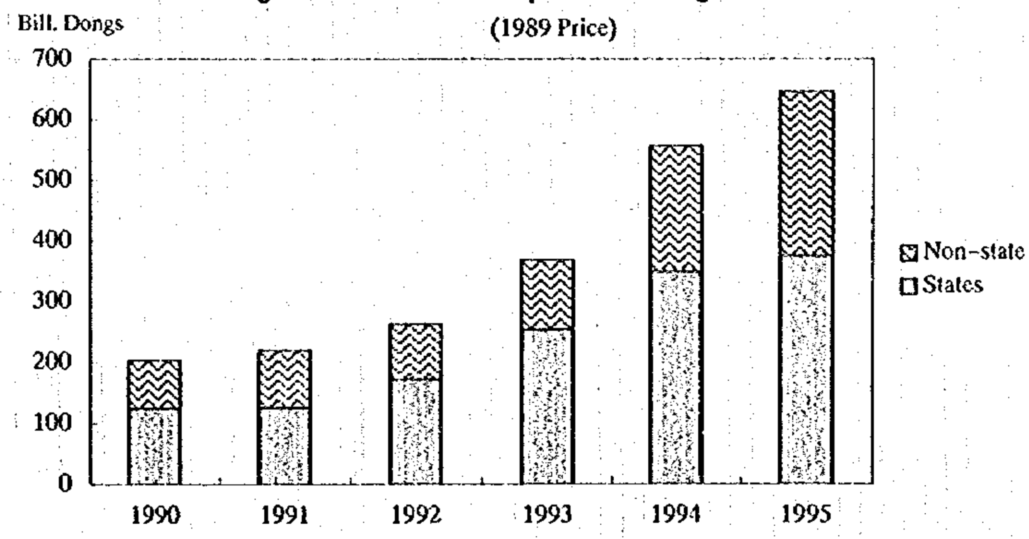
Source: Questionnaire by the JICA Study Team

Figure 4-1 Gross Output of Textile Product



Source: Statistic Yearbook – Viet Nam 1995

Figure 4-2 Gross Output of Sewing Product



Source: Statistic Yearbook – Viet Nam 1995