December 1985

SHIP PRODUCTION COMMITTEE
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INDUSTRIAL ENGINEERING FOR SHIPBUILDERS
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SURFACE PREPARATION AND COATINGS
FLEXIBLE AUTOMATION
EDUCATION AND TRAINING
WELDING

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

European Craft Training: A Trip Report

U.S. DEPARTMENT OF TRANSPORTATION
Maritime Administration
in cooperation with
The University of Michigan

European Craft Training
A Trip Report

Prepared for
National Shipbuilding Research Program

by

The Society of Naval Architects and Marine Engineers
Ship Production Committee
Education and Training Panel (SP-9)

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16. Abstract

A study was undertaken to identify training methods used to train shipbuilding craftsmen in Northern European countries. Information was gathered through European training literature and on-site inspection of shipyard training centers. It was found that institutional factors such as history of vocational training, educational systems, regulation, and the status of the shipbuilding industry significantly affect training in the shipbuilding industry. Apprenticeships continue to be the most important means of developing skilled craftsmen for the shipbuilding industry. Some traditional apprenticeships have been revised into formal, often regulated, comprehensive training programs: the British use a well defined modular training system, the Germans have developed national laws standardizing occupations and occupational training, Danish shipbuilding utilizes state-run colleges to train apprentices off-the-job, and Sweden currently does not have a national apprentice program--but does not hire many new workers. Training centers devoted to off-the-job training have been established to provide up-to-date training. Licensed training staff have a significant role in training. The apprentice programs, training centers, and trainers are charged with providing training to skill levels which can be tested and documented.

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The author of this report is Paul Vickers of the University of Michigan Transportation Research Institute (UMTRI). The editor is James Haney, Senior Science Writer of UMTRI. They were assisted by Howard Bunch of UMTRI, Stephen Sullivan of Bethlehem Steel Sparrows Point, and James Wallace of Newport News Shipbuilding.

The project was funded by the National Shipbuilding Research Program and administered under a contract with The University of Michigan--Professor Howard Bunch, Project Director.

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1.0 INTRODUCTION

This report describes a study conducted to identify craft training practices in Northern European shipyards. The project was supported by the Maritime Administration, U.S. Department of Transportation, through a contract with the Education Panel of the Ship Production Committee, The Society of Naval Architects and Marine Engineers.

The Education Panel of the Ship Production Committee is charged with conducting research on training methods and techniques and developing new training methods. As part of this effort, the panel funded a project to provide the means for on-site inspection and evaluation of craft training programs in Europe. In June of 1985, a four-person project team traveled to Northern Europe to meet with shipbuilding trainers and educators. This study presents the findings of that trip.

1.1 Overview

A four-person team spent two weeks in Europe visiting training centers in England, Sweden, Denmark, and West Germany. The team consisted of James Wallace, Director of Training and Development at Newport News Shipbuilding; Stephen Sullivan, Manager of Human Resources at Bethlehem Steel, Sparrows Point; and Howard Bunch and Paul Vickers of the University of Michigan. The project team

visited three training centers in England run by British Shipbuilders (Training, Education & Safety) Ltd; two Scandinavian shipyards (Kockums in Sweden and Burmeister & Wain Skipswerft in Denmark); and two shipyards in West Germany (Blohm + Voss AG and Howaldtswerke-Deutsche Werft--Kiel). One engineering organization, Borsig AG, in West Germany was also visited. Table 1 lists the sites visited. Throughout the trip, first-class trainers, educators, and managers were encountered. They patiently answered many questions, and they answered in English. The personnel included shipyard presidents, directors, managers, and trainers, as well as local education officials. The interest of shipyard presidents and directors indicates the importance training has in European countries.

TABLE 1

Organizations Visited by Project Team

Country	Organization	City
United Kingdom	British Shipbuilders (TES)	
	-------Hebburn Training Centre	Newcastle
	-------Barrow Training Centre	Barrow
	-------Birkenhead Centre	Birkenhead
Denmark	Burmeister & Wain	Copenhagen
Sweden	Kockums AB	Malmo
Federal Republic of Germany	Borsig AG	West Berlin
	Blohm + Voss AG	Hamburg
	Howaldtswerke-Deutsche Werft AG	Kiel

1.2 Organization of Report

The remainder of this report is divided into four sections. Sections 2 through 5 discuss vocational training in particular Northern European countries: the United Kingdom, Denmark, Sweden, and West Germany, respectively. Within each section the report describes the institutional factors affecting vocational training: history, general education, regulation, apprenticeships, training of trainers, and status of the shipbuilding industry. The last section contains conclusions and recommendations.

2.0 UNITED KINGDOM

The United Kingdom has a long history of shipbuilding craftsmanship. Today an independent, non-profit organization, British Shipbuilders, trains shipbuilding craftsmen for domestic and foreign shipyards. Before describing the training methods used by British Shipbuilders, this section discusses some institutional factors that affect training in the United Kingdom.

2.1 Vocational Education in the United Kingdom

2.1.1. History. Historically in the United Kingdom, vocational training has been the responsibility of industry, with minimal government intervention. The guilds controlled vocational training and apprenticeships from the Middle Ages through the sixteenth century and influenced vocational training until the Industrial Revolution in the eighteenth century. From then until the 1960's, vocational training was developed and controlled by industry and workers without state intervention. Apprenticeships continued to be an important component of training. Additional training in reading, writing, and arithmetic was provided through private institutes sponsored by industry and workers. The institutes began sponsoring examinations to test whether apprentices had learned the skills of their trade. Two organizations became instrumental in promoting vocational training and skill testing: The Royal Society of Arts, for commerce and trade, and the Guilds of London Institute for Technical Training.[34]

Since 1964, the state has become directly involved in training through the Industrial Training Act. The Act established Industrial Training Boards to oversee and promote vocational training in occupational areas. The Shipbuilding

Industry Training Board and the Engineering Industry Training Board became the dominating influences over vocational training for the British shipbuilding industry. Since that time, most of the industrial training boards, including the Shipbuilding Industry Training Board, have been dissolved, but the work of the training boards continues to guide vocational training.[19,20,24-29]

The 1973 Employment and Training Act created the Manpower Services Commission to coordinate the work of training boards, promote further adult training and retraining, and provide adequate vocational training for less qualified young people. Thus, the Manpower Services Commission has become directly involved in vocational training through financial support for private and public training institutions to train unemployed youth and retrain adults.[34]

2.1.2. Relation to General Education. Vocational education in the United Kingdom follows eleven years of compulsory education. Following compulsory education, some apprentices attend state-run polytechnic universities to receive theoretical training. However, each country in the United Kingdom has its own educational system, and those vary widely. Also, as previously stated, industry traditionally has been responsible for vocational education. In general, vocational training is not related to the general educational system and is more a matter of regulation and government sponsorship in an industrial setting.[34]

2.1.3. Regulation. Vocational training has only recently fallen under greater government regulation. Apprentice training traditionally has been monitored through union-industry agreements. Since passage of the Industrial Training Act in 1964, The Department of Employment and the Department of Education have taken a more significant role in shaping vocational training programs. The Industrial Trade Boards and the Manpower Services Commission work

to improve the quality of vocational education in the United Kingdom through cooperation between educational authorities, labor, and industry. These boards use a levy and grant system to pressure companies to make improvements in in-company vocational training. However, their ability to make changes is limited by the national labor-industry agreements on training. The Industry Trade Boards do operate training centers--training facilities for a regional industry--and can have and have had a significant impact on vocational training.[34] This is particularly true for the shipbuilding industry.[19,20,23-29]

In addition to government regulations, there are examination boards (such as the City and Guilds of London Institute, the Royal Society of Arts, and Technician Education Council) which influence vocational and polytechnic curricula by determining the criteria required for passing examinations leading to certification for various skill areas. The City and Guilds of London Institute is by far the most important examination board for shipbuilding trades training. The Technician Education Council is also important because of examination of technicians such as electronic technicians.[34]

2.1.4. Apprenticeships. In the United Kingdom, an apprenticeship is an in-company, basic training period of four to five years. The length of the apprenticeship is determined by national negotiations between the union and employer associations. Apprenticeships are heavily influenced by the Industrial Training Boards. The Training Board or a representative may operate a local or regional training center to provide classrooms and shops for teaching basic trade skills.[19,20,34]

The student apprentice is required to alternate study in a training center (off-the-job) with a planned on-the-job experience program. Over the course of

the apprenticeship, the student is required to progress from simple tasks to harder, more demanding, tasks.

An important component of apprentice training in the United Kingdom is the age of the apprentice. The national labor agreement which covers apprenticeships stipulates that the apprentice must begin the apprenticeship between the ages of fifteen and seventeen. Thus, apprentice training must be directed toward younger and less mature students than apprentices in the United States.

2.1.5. Training of Unskilled Workers. Entry to a skilled trade is primarily through an apprenticeship. However, given the large number of unemployed, the British government has developed programs through the Manpower Services Commission to provide training to unemployed unskilled workers in skill areas in demand or of interest to the trainee. The government provides financial support to the institutions providing the training as well as a modest stipend to the trainee. The programs are designed to impart marketable skills to the trainee, not to provide jobs after training. Training institutions in Britain use the funds provided by this program to level classroom and shop loads, provide continuous employment to instructors, and decrease the cost of training to the company (in the case of in-firm training) or to its customers (in the case of public institutions such as British Shipbuilders (Training, Education & Safety) Ltd.).

2.1.6. Trainers. There are three types of vocational trainers in the United Kingdom: teachers of theoretical vocational subjects, teachers of practical subjects, and in-firm apprentice instructors. The vocational trainer is typically an older, experienced man who has changed careers. For example, the average age of in-firm trainers exceeds fifty years. Teachers of theoretical subjects at the polytechnics are required to have passed a three-year technical

curriculum and have five years of on-the-job experience. They are not required to have undergone any "teacher" training. There are opportunities for continuing technical education and pedagogical training at teacher colleges and through institutions such as the City and Guilds of London. Practical or shop vocational trainers employed by the state or municipality are experienced craftsmen who have completed six weeks of training by the Manpower Services Commission following a series of qualifying examinations. In-firm shop vocational trainers are not required to complete pedagogical training, although most have done so.[31] The on-the-job apprentice instructors are not required to have any qualifications or to have undertaken any training. Frequently, they are supervisors. They provide the apprentice with work experience as determined by the work load. Some apprentice agreements require a planned work experience, but that is left to the discretion of the supervisor.[15,17]

2.1.7. Status of the Shipbuilding Industry. British Shipbuilders was formed in 1977 to run the nationalized shipbuilding industry in the United Kingdom (sans Northern Ireland). British Shipbuilders is composed of the largest shipbuilding and ship repair yards, marine engine builders, and offshore constructors in Britain.[5] A major subsidiary of British Shipbuilders is British Shipbuilders (Training, Education & Safety) Ltd. (BSTES). The role of BSTES in vocational training is discussed in the next section. Because shipbuilding is nationalized, there has been a great deal of central control and standardization of practices related to training in the United Kingdom. Despite the central control, diversity still exists in British craft training for shipbuilding.

2.2 Vocational Training in the Shipbuilding Industry

The responsibility for training shipyard employees falls squarely onto British Shipbuilders (Training Education & Safety) Ltd. (BSTES). BSTES, subsidiary of British Shipbuilders, is a non-profit, independent organization responsible for all facets of training and education in the British shipbuilding industry. BSTES trains craftsmen, office workers, and management at local and regional training centers as well as at special courses at shipyards or in secluded retreats. This section discusses the particular aspects of training these three groups of workers, with particular emphasis on craft training and craft apprenticeships.

A shipbuilding apprenticeship is a four-year training program with one year of off-the-job training followed by a three-year on-the-job planned work experience. The responsibility for apprentice training is shared by the sponsoring shipyard and the staff of the training center--who are employees of British Shipbuilders (Training, Education & Safety) Ltd. (BSTES).

Apprentices are selected by the shipyards--often with the help of BSTES. Applicants may be required to undergo a battery of tests administered by BSTES to determine mechanical aptitude, mathematical skills, and spatial recognition. The tests are used to determine an applicant's potential for successfully completing his apprenticeship.

The foundation for apprentice training, and craft retraining, is the modular training system.[15] The modular training system is a flexible yet well-defined training scheme designed to ensure that skills are learned and demonstrated by the trainee to a standard skill level. The modular training system consists of modules and elements. A module is the set of skills and

standards of workmanship required to work effectively in a given area of the shipyard. To complete the apprenticeship and receive a skilled worker certificate, an apprentice must complete three on-the-job modules. A module cannot be completed without a foundation--a set of skills to build on. The basic skills for various modules are developed at the training center during the first, off-the-job training year. Basic skills needed to successfully complete each module have been meticulously identified, defined, and assigned to elements as element levels. The process for completing elements and modules is illustrated in Figure 1.

The modular training system was developed, in part, by the Shipbuilding Industrial Training Board. The skills needed for various crafts were outlined in a series of information papers.[24-29] Portions of Information Paper No. 10, "The Training of Craftsmen: Metal Users," are reproduced in Appendix B.

The key to the system is the use of the standards of workmanship as the determining factor in completing an element or module. The defined standard of workmanship must be met in order for the trainee to receive a certificate which documents the given training.[1,15,17,19,20] Qualification in any area is recorded in Personal Work Records.[17] Tasks completed are described by the trainee in the work record. The work record and the test piece are checked by the foremen or instructor and his evaluation is recorded in the work record. An example of a completed element work record is shown in Figure 2. An example from a module work record is shown in Figure 3. Illustrative test pieces for a machinist are shown in Figure 4.

The modular skill system was designed to train apprentices. However, the modular system has proven to be an effective means of training skilled workers. Experienced workers can be given retraining or training in new skills needed on the job through additional elements and modules. Each time a module or element is completed by any trainee, a certificate of completion documents the given

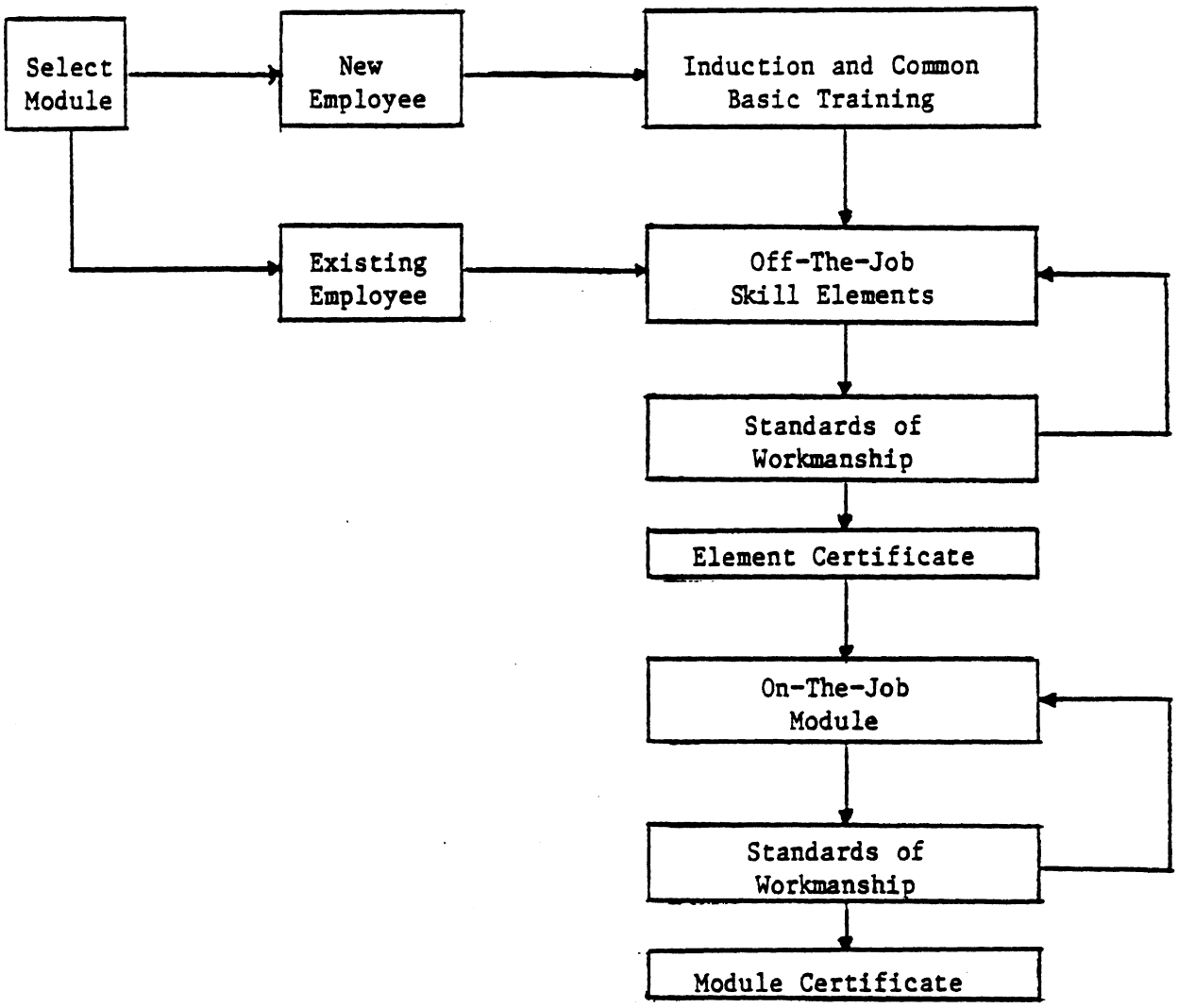

FIGURE 1. Modular skill training.

11-1-85 Mr Gilmore

Metal Users E.M.U. 25 Welding - Horizontal / Vertical Fillet

Level 1

Familiarisation Of Equipment

Trainee must be able to read and fully understand Instructions

Tools And Equipment

Transformer - supply point. Regulators.

Welding Leads (cables)

Welding Holder

Headscreen - (complete)

Safty Goggles

Chipping Hammer

Wire Brush

Protective Clothing

Exercise To Test Trainee

1. Check list of equipment.
2. Check equipment is in good order.
3. Set Up
4. Check earth and regulator lead.
5. Adjust regulator to required setting
6. Strike and establish Arc.
7. Break Arc
8. Repeat Operation to required standard is achieved.

ALL SAFTY PRECAUTIONS ADHERED TO

Material - Mild Steel plate 3mm and over 4mm electrodes.

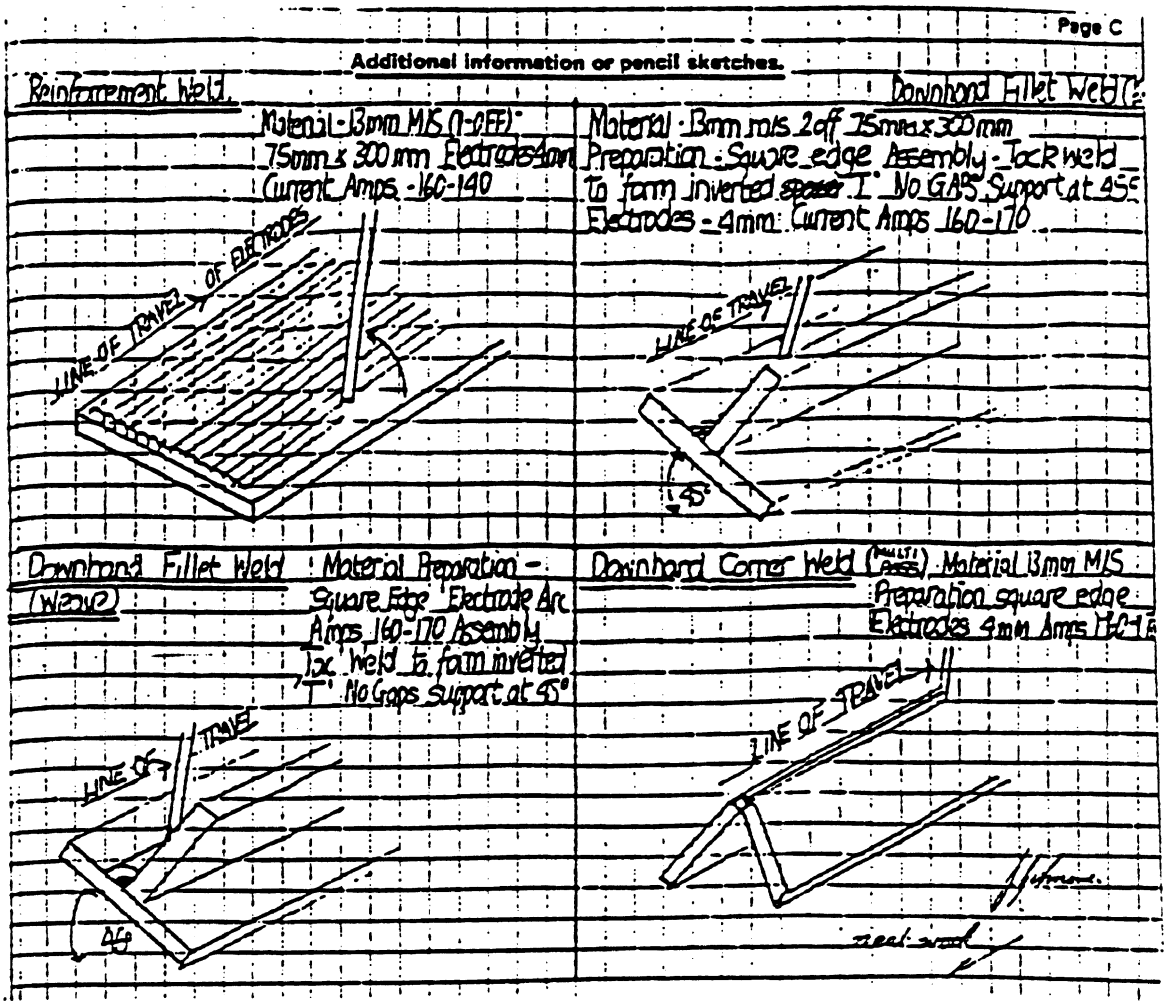

FIGURE 2. British Shipbuilding Apprentice's Workbook for Element Training

METAL USER

MODULE MU1 - PREFABRICATION PREREQ: EMU1:3:4:5:8:13

MODULE ASSESSMENT

I certify that ..... has completed the following jobs to the skill standards stated, and the time taken was that of a competent worker.

Signed ..... Date .....

Level 1.1 Prereq: EMU1:13 PREFABRICATION - Marking-off	
TRAINING SPECIFICATION	**SKILL STANDARD**
1. Interpret ships drawings and mark off items a) Brackets ☐ b) Stiffeners ☐ c) Girders ☐ d) Minor bulkheads ☐ e) Auxiliary seatings ☐ f) Deck panels ☐ g) Shell Panels ☐ h) Floors ☐	Transfer information from ship's drawings to job in accordance with relevant specification, with correct identification address. Mark plates and sections for regular and irregular shapes to within 2 mm. Relevant Specification 1. 2.
2. Make templates in: Wood ☐ (to within 1 mm) Cardboard ☐ Steel ☐	Templates made to within 1 mm

(continued)

METAL USER

MODULE MU1 - PREFABRICATION PREREQ: EMU1:3:4:5:8:13

(continued)

Level 1.1 Prereq: EMU1:13 PREFABRICATION - Marking-off	
TRAINING SPECIFICATION	**SKILL STANDARD**
3. Mark out plates on profiles/computer burning machine. ☐	Items marked to within 2 mm. Correct identification address clearly marked.

Level 1.1 ASSESSMENT

I certify that ..... has completed the jobs above, to the skill standards stated and the time taken was that of a competent worker.

Signed ..... Date .....

FIGURE 3. Modular skill training personal work record.

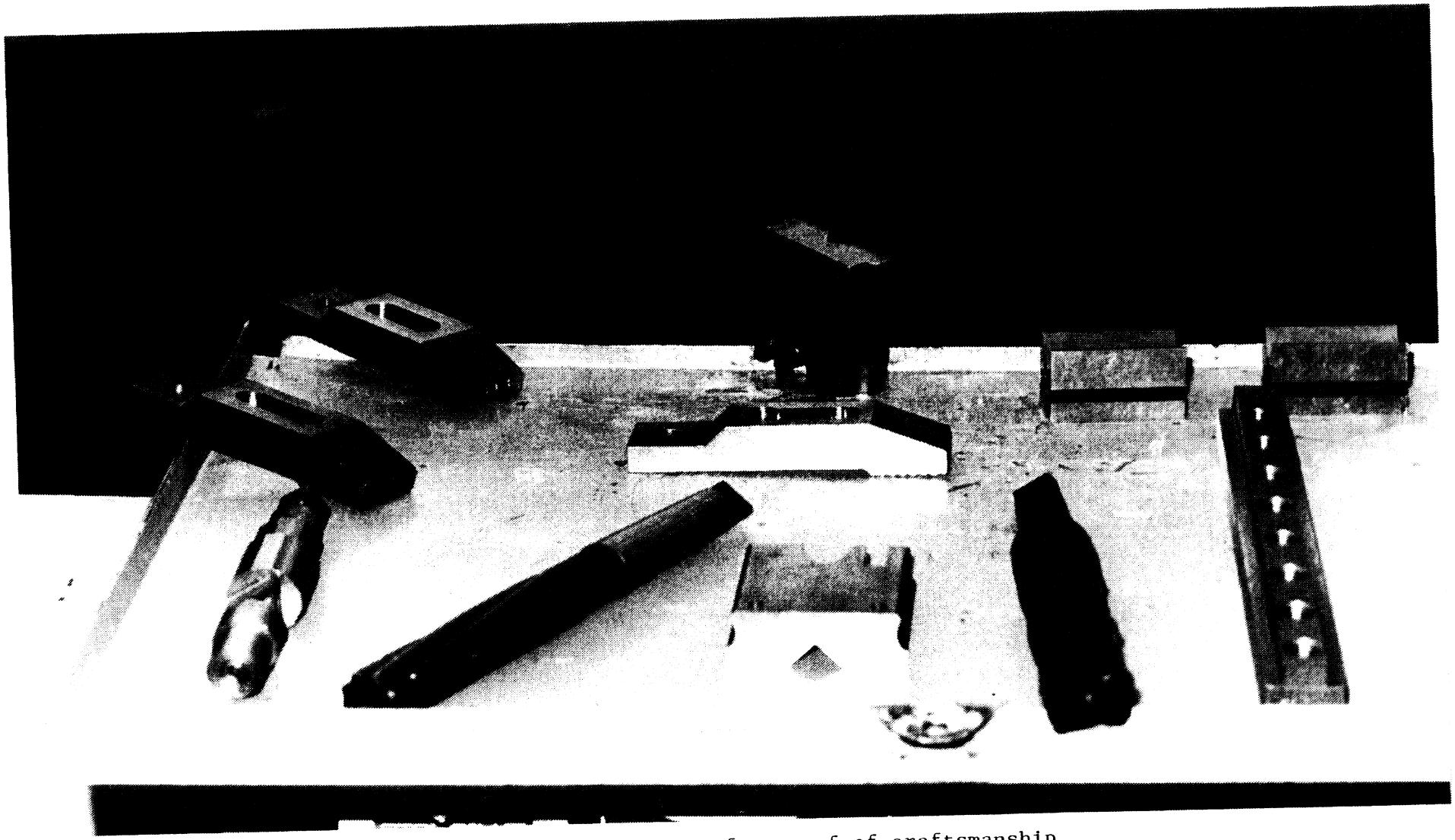

FIGURE 4. Apprentice test pieces for proof of craftsmanship.

training. In addition to BSTES record keeping, the trainee's certificate provides proof of training and craftsmanship.

2.2.1. Training Facilities. Apprentice training requires off-the-job instruction. Local training centers have been established in geographical shipbuilding centers. The BSTES centers are located outside shipyard boundaries and are completely separate from shipyard facilities. Some centers serve a number of shipyards. Others are located adjacent to a particular shipyard and are primarily responsible for the training of that shipyard's employees. Geography is the primary determinant in the location and number of shipyards a training center serves.

Training center facilities try to replicate shipyard working conditions. Many centers are located in abandoned shipyards. Thus, the trainees are able to work on platens, in graving docks, and in traditional training workshops such as the welding booth shown in Figure 5. When possible, shipboard conditions are realized through actual experience building small craft or rebuilding donated ships as shown in Figures 6 and 7. The training centers also utilize mock-ups of shipboard spaces to train electrical, HVAC, and piping installers. As shown in Figure 8, the mock-ups include structural work, shipboard lighting, and interferences from other outfitting systems. In addition, the training facilities are equipped with class rooms, work benches for mastering hand tools, and extensive machine shops--which only turn out test pieces. The types of facilities available for training are not uniform. All centers have the same basic equipment--classrooms, welding and cutting booths, platens for ship fitting, machine shops, and clerical training areas. Beyond the basics, the training centers vary in size and variety of training aids.

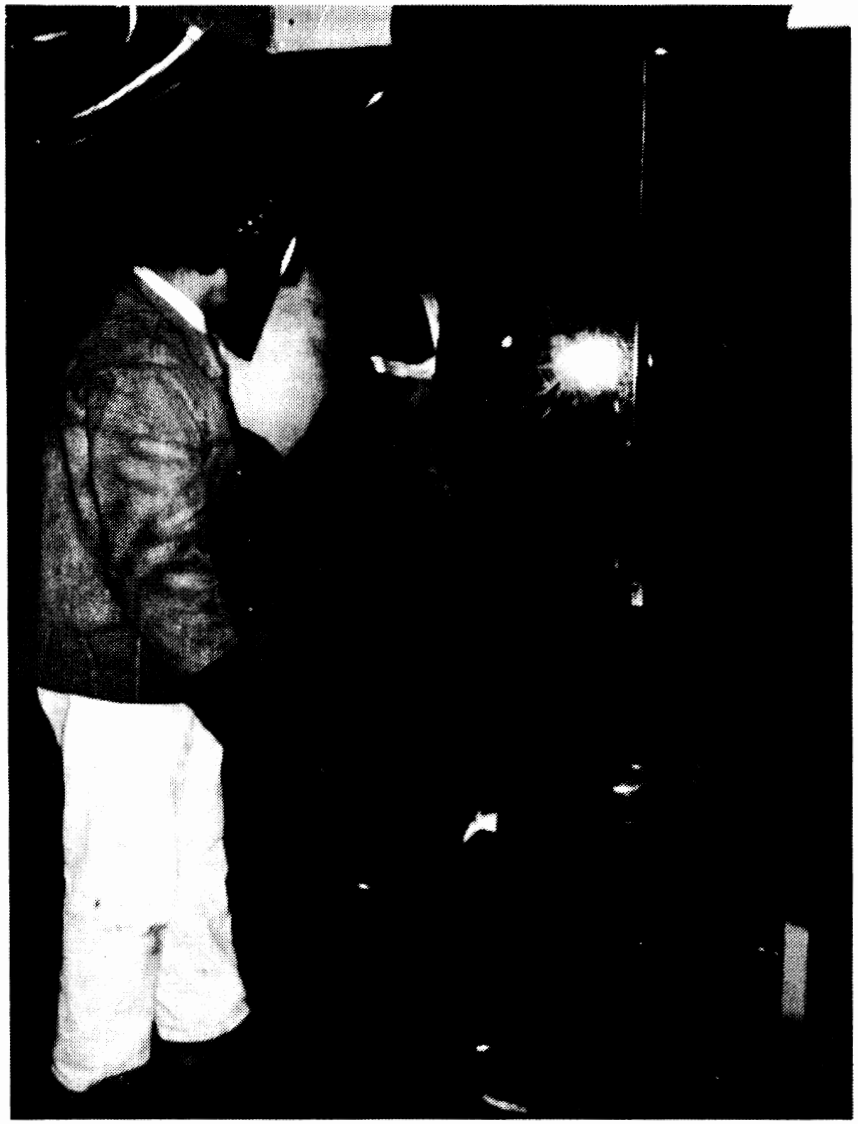

FIGURE 5. Welding training booth at Hebburn regional center.

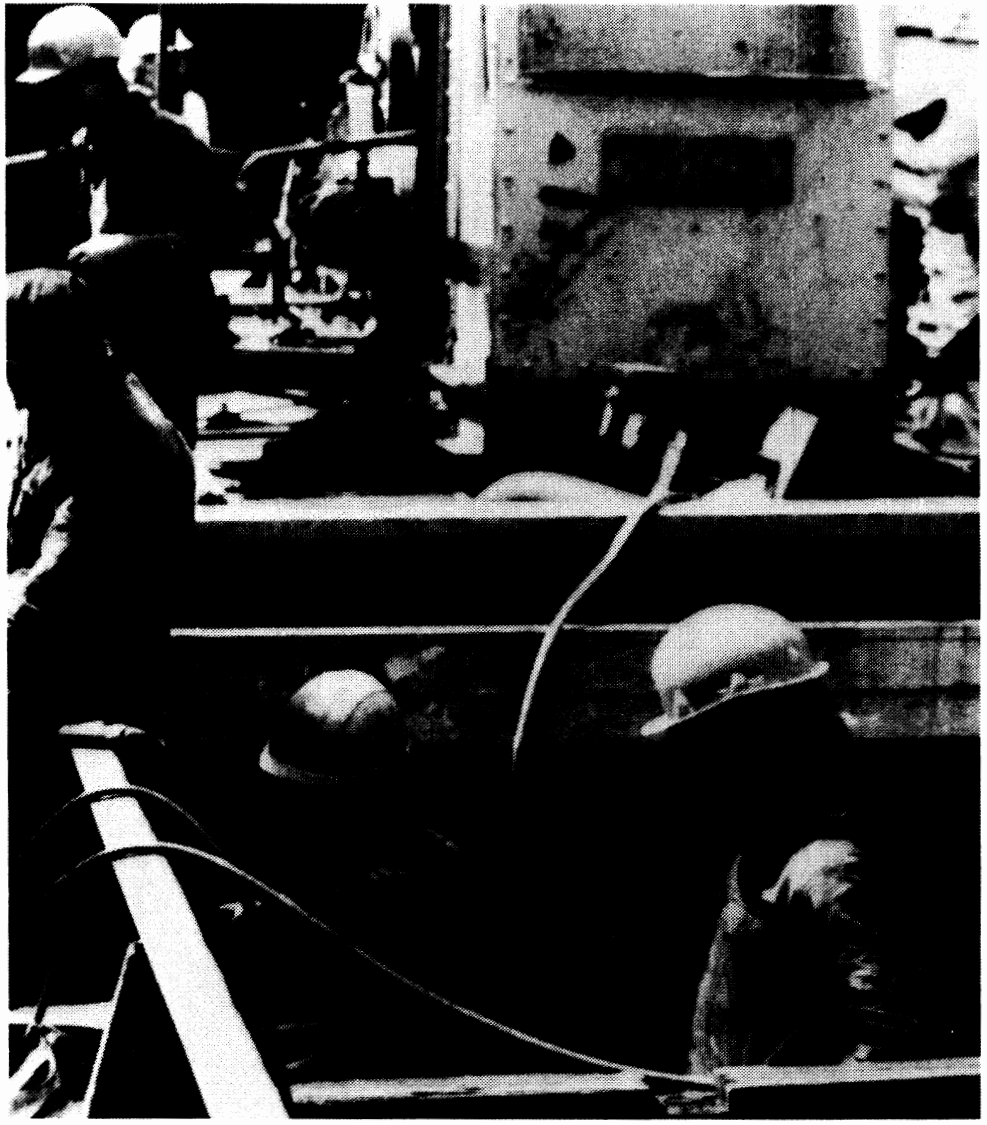

FIGURE 6. On-board ship repair at Birkenhead local training center.

FIGURE 7. On-board boiler repair at Birkenhead local training center.

FIGURE 8. Simulation of on-board conditions at Barrow local training center.

2.2.2. Non-Craft Training. British Shipbuilders (Training, Education & Safety) Ltd. is responsible for all facets of training for British Shipbuilders. Thus, BSTES trains clericals, draftsmen, computer programmers and operators, and management. The training centers and staff are equipped to handle different training needs. For example, the variety of training offered at the Hebburn Regional Training Center is shown in Table 2. [6]

TABLE 2

Training at Hebburn Regional Center

TECHNICAL & DESIGN	COMPUTER & ELECTRONICS	FABRICATION , PIPE & WELDING	ENGINEERING	CLERICAL
Computer-Aided-Design Design Principles Engineering Drawing Freehand Sketching Geometric Drawing Hull Definition Hull Structure Layouts & Ergonomics Piping Systems Plan Reading Structural Steelwork	Network Installation Electronic Office Computer Hardware Bureau Accounts Robotics Basic Electronics Microcomputer Repairs Word Processing	Ox-Gas Cutting Welding to International Standard Plating Sheetmetal Heat Line Bending Heat Treatment Drilling Tack Welding Burning Caulking Shipwrighting Plan Reading Marking Off	Shaping Milling Center Lathe Painting Woodwork Fitting Grinding	Keyboard Typing Telephone Filing Shorthand Accounts Writing

3.0 DENMARK

Danish shipyards remain competitive in markets dominated by Japan and Korea.[21] Despite the wage differential between the countries, Danish shipbuilders, particularly Burmeister & Wain Skipswerft of Copenhagen, have been able to secure contracts for long series of bulk carriers. Their competitive position is due, in part, to the highly skilled work force. This section discusses the training and training environment which produces those craftsmen.

3.1. Vocational Education in Denmark

In this section the institutional factors which influence shipbuilding training in Denmark are discussed.

3.1.1. History. The guilds strictly controlled vocational training through apprentice and master programs until 1857. At that time, the free trade movement caused the dissolution of the guilds and the end of apprentice training. This led to the development of technical training colleges run by industry associations. In the late nineteenth century, laws were passed making some form of occupational training mandatory. This has led to labor and industry association participation on state-sponsored boards which govern the training colleges. There is at least one college now for every occupation. Every student is guaranteed a training position for at last one-half year after completion of compulsory education.[34]

3.1.2. Relation to General Education. Vocational training begins after nine years of compulsory education and may take one of two forms: apprentice training or EFG training (basic vocational training). Apprentice training can be characterized by the student's choice of profession upon leaving school. The student signs an apprentice agreement with the firm. Apprentice training begins

with practical and theoretical course work at a technical college. The duration may vary depending on the craft (three months may be considered typical). Then the apprentice alternates between training and work in-company and block release to technical colleges for additional theoretical instruction. EFG training is characterized by the students choosing a craft following one year of instruction at a technical college in one of eight occupational groups: building, graphic trades, commerce and office work, iron and metal, agriculture, land transport, foodstuffs, or services. The instruction includes general studies (Danish, mathematics, occupations, civics, etc.), theoretical and practical training in the occupational area, and voluntary subjects such as the social sciences. Following the basic vocational year, the student and company will sign a training agreement providing alternate training in-company and at the technical college similar to the apprentice agreement.[34] The advantage of the EFG system is that the student can make a more informed career choice.

The vocational training is thus related to the general educational system through the technical colleges. Both apprentice training and EFG training provide an initial training period at the technical college followed by alternating periods in-company and in-school.

3.1.3. Regulation. The primary agency responsible for regulating vocational education and training is the Directorate for Vocational Training within the Ministry of Schools. The Ministry of Schools works with the Ministries of Industry and Labor to oversee the national apprentice and EFG training. The Center Council for Training was established to provide a coordinated approach to planning among the ministries.

The Council and Directorate are advised by the Council for Apprentices and Trade Committees. These advisory bodies are composed of representatives from employer and employee groups, education officials, and ministry officials. The

Council for Apprentices provides supervision of training at colleges. In conjunction with independent examining boards, the Council develops skilled-worker examinations. Trade committees are advisory boards.

Despite significant state financial support for training, much of the actual regulation for apprenticeships stays in the hands of the employers and unions. EFG training has led to an increased role for the Government but has not led to significant legislation concerning apprenticeships.

The training of unskilled workers and retraining of displaced workers has received considerable legislative action--primarily in the area of funding training schemes to provide training places for these types of workers.[34]

3.1.4. Apprenticeships. Danish apprentice and EFG programs provide two forms of vocational training with alternating periods in classrooms and on the job [see Section 3.2.2]. Danish apprentice programs are jointly managed by labor unions and management. Following a one-month training period in the shipyard training school, the apprentice alternates between periods in a state-run school and on-the-job experiences. Shop skills are taught at the training school. On-the-job experiences are determined by the apprentice's supervisor and are determined, in part, by the workload. After four years, the apprentice must pass a final examination to earn the title of skilled worker.

The EFG form of training is similar to apprenticeships. The student first completes a basic vocational year at a technical college in one of eight occupational groups: building, graphic trades, commerce and office work, iron and metal, agriculture, land transport, foodstuffs, or services. The instruction includes general studies, theoretical studies, and practical training. Following the basic vocational year, the student and company will sign a training agreement providing alternate training in-company and at the technical

college similar to the apprentice agreement. After three years the student is entitled to write the skilled worker's examination.

The Danish apprentice programs are not emphasized to the degree found in other European countries. There is greater emphasis placed on training unskilled workers. After four years of experience, an unskilled worker is entitled to test for the skilled worker certificate. Thus, there is significant emphasis placed on ensuring that the workers do have the skills a skilled worker is supposed to have.

3.1.5. Training of Unskilled Workers. Danish industries, including shipbuilding, employ significant numbers of unskilled workers. Twenty percent of Burmeister & Wain Skipswerft's work force is unskilled. Therefore, significant training resources must be employed in training these people to be productive workers. The training of unskilled workers, and the retraining of skilled but unemployed workers, is state-supported in the form of training grants and stipends for trainees. The trainees will alternate work in the training center at government expense with on-the-job work at company expense. This allows companies to reduce the cost of training its own workers.

3.1.6. Trainers. Danish vocational trainers are required to be skilled workers with five or more years of experience. Although some are master craftsmen, technological training is not a requirement for appointment as an instructor. Nor is teacher training required prior to appointment. Following the training appointment, instructors must take courses from the National Training Institute for Vocational Training Teachers. The courses are designed to teach instructional methods and prepare the instructor for a national examination on teaching skills. The Institute instruction includes both technical and teaching-method training. In addition to the compulsory teaching education,

trainers are given the opportunity to continue their education with courses in teaching or in changing technical areas.[31]

Craft trainers are typically older males. All have passed the licensing examination. Many are enrolled in supplemental education every year, learning new skills or updating old ones. An exception are the in-company apprentice instructors. There is no requirement for any pedagogical training for the in-company apprentice instructor. Therefore, most do not have any teacher training but many may continue to update their technical skills.

3.1.7. Status of the Shipbuilding Industry. Danish shipyards are independent, non-subsidized shipbuilders with a history of offering series construction of standardized vessels. The Danish shipbuilding industry is shrinking due to external pressures such as the dwindling tanker market, reduced North Sea construction, and high interest rates. Employment shrank from a high of 20,000 employees to fewer than 10,000 in 1983 [21]. Danish shipyards are unique in Europe, in that they are free to lay off employees as the workload decreases. Thus, the shipyard employment is not controlled by social and government pressures to the extent found in other European countries.

3.2. Vocational Training in the Shipbuilding Industry.

Danish shipbuilding trainers are concerned with training apprentices and EFG personnel, training unskilled workers to be skilled workers, and ensuring that workers in the yard have completed the necessary training for certification and qualification by external authorities such as shipbuilding classification societies. Each has its own unique requirements and demands on training personnel.

Apprentice and EFG training has been discussed in Section 3.1.4. The shipyard shares responsibility for training with the state-run schools. The primary responsibility of the shipyard training staff is to ensure that the apprentice receives on-the-job experiences which will impart the necessary skills to become a productive worker and pass the skilled worker examination. This task is complicated by the changing workload in the shops or on the ships. The training staff must work with the foremen to provide those experiences--even if it means making work.

A typical schedule for an EFG trainee is shown in Table 3. The trainee alternates between the shipyard and the state-run school. The work in school and on the job should be related, but there is no system or program to ensure that this occurs.

Unskilled worker training is a primary responsibility of the shipyard training staff. Unskilled workers do not undergo the alternating form of training. Thus, all off-the-job training for the unskilled is undertaken at the shipyard training center.

Qualification and certification of skilled workers for compliance with regulatory and classification societies is the responsibility of the shipyard. However, the shipyards typically do not train or certify their employees. Outside agencies such as the Danish Welding Institute are contracted to perform the necessary testing, retraining, and certification. This decreases the cost of training to the shipyard. Testing and training by agencies such as the Welding Institute may be given at the shipyard, or frequently the shipyard will send the worker to the training agency.

TABLE 3

Typical EFG Training Schedule

Year	Location	Duration
1	School	1 year
2	Shipyard Training School	1 month
	On-the-Job	8 months
	School	3 months
3	On-the-Job	1 year
4	School	3 months
	On-the-Job	9 months

4.0 SWEDEN

Shipbuilding has been an important component of the Swedish industrial base. Swedish shipbuilders, world renowned for their ability to construct and deliver complex vessels at competitive prices, must rely on a highly trained work force to assemble complex assemblies correctly. This section describes the vocational training system that produces skilled Swedish shipbuilders.

4.1 Vocational Education in Sweden

In this section the institutional factors which influence shipbuilding training in the Sweden are discussed.

4.1.1. Relation to General Education. State and municipally supported vocational education is performed in the integrated upper secondary school following nine years of compulsory education. The upper secondary school provides Swedish school-leavers an opportunity to enroll in a two-, three-, or four-year preparatory program for future employment or study. The secondary school has three main sectors: arts and social subjects, economics, and technical and scientific subjects. There are twenty-two educational lines and four hundred and fifty specialized courses within the three sectors. Vocational education for the shipbuilding industry typically is a two-year program within the scientific and technical sector.

Swedish vocational education has changed from specialized course work to a broader-based education. Students no longer concentrate on specific occupations. Each student receives a general education (including subjects such as English and Swedish, religion, psychology, mathematics, civics, and the arts) and a vocational education in his or her occupational block. There are twelve two-year occupational blocks or lines within the technical and science sector.

Within each line are alternatives for specialization. Seven lines are of primary interest to the shipbuilding industry. They are building and construction, operation and maintenance, electro-telecommunications, motor engineering, process engineering, woodwork, and workshop. The student does not have to choose the line or specialty until later in the program. Therefore, the student is better prepared for adapting to changes in the workplace.[18,23,32]

During the latter portion of the compulsory school years and throughout the secondary school years, the students are exposed to the national labor market as well as the local labor conditions. Thus, students in primary shipbuilding areas are exposed to other occupations. In fact, the shipyards work to promote their industry to students through school visits, shipyard tours, and lobbying local educators.

4.1.2. Regulation. The Swedish Parliament plays a central role in regulating all school activities, including vocational education. Through legislation and guideline development, the Parliament sets the stage for education in Sweden. The primary regulatory bodies are the National Board of Education and county and municipal school boards. Their duties include ensuring that the Parliamentary guidelines are met. However, each school does have considerable freedom to develop programs within those guidelines and legislation. The Act gives the teaching staff a strong voice in the decision-making process.[18]

At the state-owned shipyards, the training programs are relatively free of government intervention. The government does require Swedish language studies for foreigners. The government pays for that instruction as well as providing support for unskilled workers--who may or may not be hired upon completion of the training program. There is no apprentice regulation related to shipbuilding, because there are no national shipbuilding apprenticeships.

4.1.3. Apprenticeships. Apprenticeships are used in certain sectors of the Swedish economy but not in shipbuilding. Apprenticeships flourished at one time in shipbuilding, but current economic conditions have led to an emphasis on retraining experienced workers for new jobs rather than training new hires. Some school-leavers are hired and trained in an intensive program including nine months of basic training in welding, plating, and pipe work, followed by on-the-job training. But, upon completion of the program, they do not earn the title skilled worker.

4.1.4. Training of Unskilled Workers. Unskilled workers are trained under the auspices of government regulation and financing. The government actively promotes training of unskilled workers to improve the quality of the labor market. Unskilled workers may be trained at training centers within industry at government expense. The organization which does the training is under no obligation to hire the trainees upon completion of the program. Foreigners and the handicapped have been specifically identified as prime recipients of government sponsored training for the unskilled.[18]

4.1.5. Trainers. Vocational educators and trainers have different qualifications, dependent on their positions in the system. At the upper secondary schools, vocational teachers are craftsmen who have experience in their field and have completed a course of pedagogical training at a school of education. Vocational specialists have studied at special colleges. Their training is focused on teaching one particular trade or subject. At the shipyards, trainers are craftsmen who have received additional training in instruction and information transmittal. They are not licensed and are not required to undergo any form of certification.[18]

4.1.6. The Status of the Shipbuilding Industry. Swedish shipbuilding is dominated by the state-owned Swedyards Group, which controls the two largest new-building yards, Kockums and Ulddevallavarvet, and the offshore firm Arendal. The shipbuilding recession has caused a reduction in Swedish shipyard employment for new building of over fifty percent [21]. There has been a market shift from tankers and bulk carriers to more sophisticated and outfit-intensive craft such as passenger ships. North Sea construction has been able to keep some shipyards afloat but not prospering.

The state-owned Swedyards Group is subsidized by the government. However, with the exception of issues such as employment levels, the shipyards are able to act as independent organizations, including decisions regarding training. Decisions frequently are made by production management, training staff, and unions--not the government.

4.2 Vocational Training in the Shipbuilding Industry

The Swedish shipbuilding industry does not have a formal apprentice program. A small number of young people are hired from vocational schools at age sixteen. They must complete a vigorous program, including nine months of basic skill training in welding, plating, and pipe work. Upon completion, they are given further on-the-job training but do not earn a title such as skilled worker.

The world-wide decline in shipbuilding orders has had a significant effect on the number of new hires and, thus, on the training program emphasis. Swedish shipbuilding has been in a recession. Shipyards have been closing. Those that have stayed open have been forced to cut back on the number of employees and change their product lines. Thus, the training programs have changed to reflect

the need for skills in demand as determined by the order book. For example, welders and platers are being retrained to be joiners and plumbers to build outfit-intensive passenger ships instead of steel-work-intensive tankers. The training programs are oriented toward an older, experienced worker.

The training facility at Kockums illustrates the shift from training to retraining. The building is equipped with large work spaces and classrooms which are currently under-utilized. Welding training booths, as shown in Figure 9, now primarily are used for qualification testing. Little new welding training is given today. The electrical training uses simple fixtures, shown in Figure 10, to retrain welders and plumbers to be electricians. Considerably more activity can be found in the outfitting training areas. As shown in Figures 9, 10, and 11, the training facilities do not have sophisticated equipment. Rather, the emphasis is on providing the necessary basic skills to the trainee. Given Kockums's competitive position, this form of training works successfully.

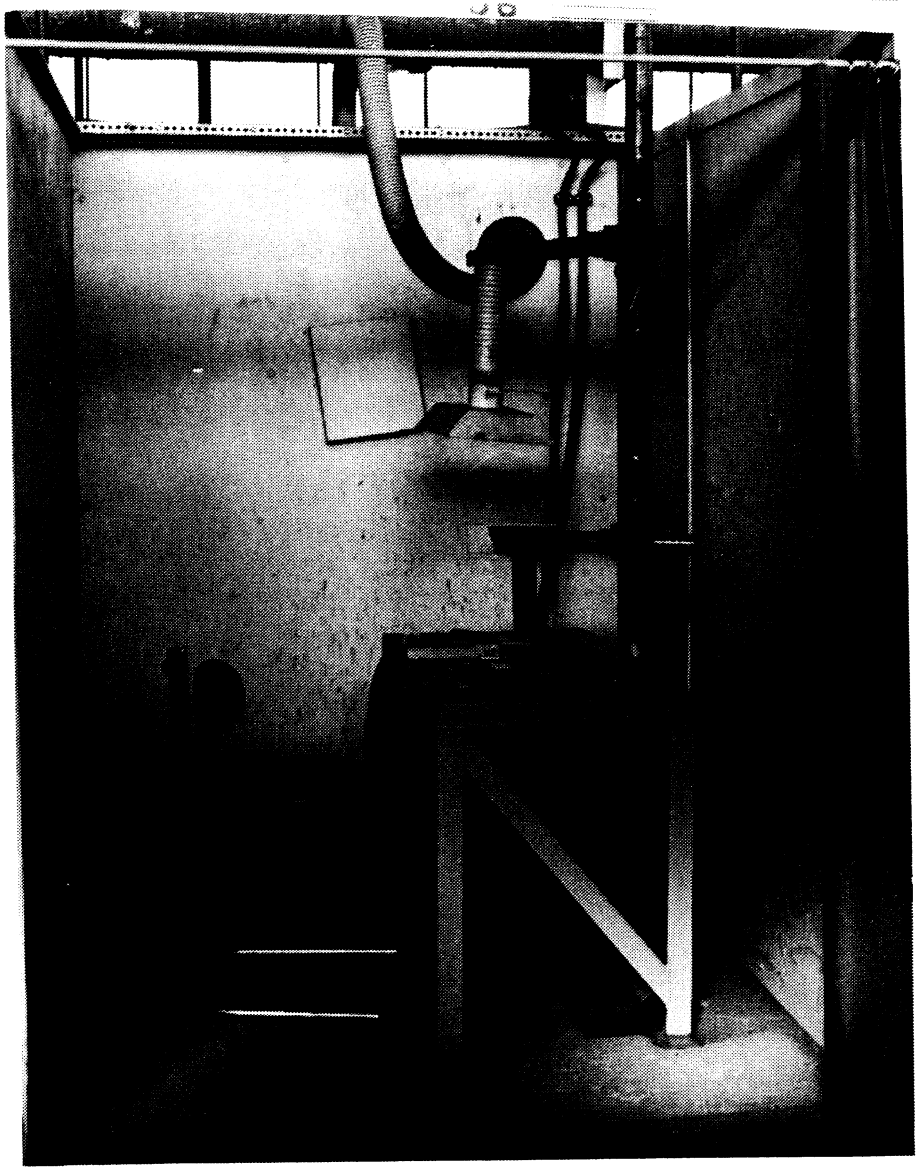

FIGURE 9. Welding training booth at Kockums AB.

FIGURE 10. Kockum's electrician trainee at practice board.

FIGURE 11. Kockums training center.

5.0 THE FEDERAL REPUBLIC OF GERMANY

German industry has been a world leader in the development of training methodologies to supply highly skilled workers for industrial plants. Government regulations and the use of the dual system have catapulted West Germany into the forefront of heavy industry training. The dual system of training is a highly developed, industry/government cooperative program that has become the main vocational education track for German youth. This section describes that system with special focus on its role within the shipbuilding industry.

5.1 Vocational Education in West Germany

In this section the institutional factors that influence shipbuilding training in the Federal Republic of Germany are discussed.

5.1.1. History. In-company vocational training has existed since the Middle Ages. Manual crafts were taught on-the-job under the influence of the guilds. Occupational training schools and the dual system were developed in the sixteenth century. The dual system provides training at two different places: on the job and in the classroom. In the nineteenth century, the Prussians developed training workshops at large firms to provide training for apprentices. It was not until the 20th century that vocational education resembled the systematic and regulated system that exists today. Early in the century, apprentice training laws were established--including the mandatory master craftsman (meister) certificate requirement for training apprentices. In 1939, strict occupational training regulations were introduced which shaped the current system. In 1969, today's systematic form of dual training was formally consolidated into a single regulation--the Law for Vocational Training of 1969--which provides a close

liaison between in-company vocational education and the system of general education.[34]

5.1.2. Relation to General Education. The dual system requires strong ties between industry and the school systems of the Federal States (Landers) as determined by the Law of Vocational Training. After nine to ten years of compulsory education, the student apprentice signs an apprentice training agreement with a company and the local chamber of commerce. Apprentices are required to work in-company and attend occupational training schools one or two days per week. Apprentices are also allowed to attend occupational training schools on block release for a period of several weeks. The occupational training school is charged with expanding the education of the apprentice to include general education in German, mathematics, social sciences, etc. and provide theoretical instruction in areas related to his chosen occupation. Students attend the occupational training school with students of the same or related occupations.[3,34]

In addition to the dual system, school-leavers are given the opportunity to attend craft training schools to replace in-company training with additional classroom and shop instruction. Craft training schools may be used for preparation for entry into a trade high school.

Trade high schools, former engineering schools, are two-year schools for practical and theoretical instruction. Upon completion, the student is awarded a trade college certificate. This certificate provides the necessary qualifications for entry into a university.

Meister training occurs in trade schools. Trade schools teach trade specialization, social science, bookkeeping, and pedagogical training to certified skilled workers. Pedagogical training includes methods for teaching practical crafts. Trade schools prepare the skilled worker for the meister

examination. Trade schools also provide the necessary qualifications for entry into trade high schools. Because many trade school students are fully employed, classes often are taught at night and require eighteen months to two years to complete.[3,31,34]

5.1.3. Regulation. Regulatory responsibility is shared by the federal government and the states or landers. Each federal state is responsible for developing and enforcing regulations concerning vocational education in the school systems. In-company training is regulated throughout the Republic by the Federal government through its power invested by the Law for Vocational Training of 1969. The federal government determines general training plans and examinations for each occupation. The state governments and the local chamber of commerce oversee training programs and examinations.[3,34]

The legal body of the federal level of government responsible for vocational education is the Federal Institute for Vocational Training (a branch of the Federal Ministry for Education and Science). The Institute is responsible for regulation, finance, research, and monitoring vocational training outside the educational system. Other ministries are required to work with the Institute and the Ministry of Education and Science to recognize occupations, develop regulations, and help finance vocational training.

The states are the primary agents for enforcing regulations and administering vocational education in accordance with federal vocational training laws and state education laws. The states are also responsible for financing much of the cost of education. Some funds are raised in local districts for construction and maintenance of school buildings.

Local authorities in conjunction with the private-sector Chamber of Commerce are legally responsible for training curricula and examination for apprentices. They also monitor meister training and practice.

West German vocational education is regulated at a variety of levels by the federal and state governments and the private sector. Each has the power to develop regulations. The federal law is the most important. Therefore, Committees for Vocational Training have been set up at the federal and state level to promote cooperation, avoid conflicts with federal law, and serve as advisory boards. The committees are composed of industry, labor, education, and government personnel.[34]

5.1.4. Apprenticeships. The German form of apprenticeship--the dual system--is a regulated, in-company, three-year basic training period. Apprenticeships are regulated by national laws concerning worker classification and are administered by the company and the local Chamber of Commerce. There are roughly 450 occupations or worker classifications. For each worker classification, the federal government sets general training plans and guidelines for apprentice examination. Upon completion of the apprenticeship, the trainee is tested by the local Chamber of Commerce to determine if the apprentice has reached a level of craftsmanship suitable to be awarded the title of facharbeiter, or skilled worker. Because of the national regulations and local testing, the German apprentice program is geared toward producing individuals who can pass that exam.

The first year of a German apprenticeship is conducted off the job in a company-run training center. The apprentice receives training ranging from basic hand tool skills to operation of sophisticated, state-of-the-art machinery. All apprentices in a given occupation are required by law to receive similar training--regardless of the companies' needs, facilities, or personnel. Small companies that cannot afford the cost of the training center or the cost of special training equipment contract with larger German firms to provide training for their apprentices.

A key to the success of the German system is the close ties to the public school system. The instruction, particularly for the non-university-bound students, has a definite and intentional industrial bias to prepare students for successful apprentice experiences.

5.1.5. Training of Unskilled Workers. German shipbuilding tradesmen primarily are skilled workers who have successfully completed their apprenticeships and passed the skilled worker examination. For example, Blohm + Voss AG's work force is over 80 percent skilled workers. Thus, training for unskilled workers is a low priority for industrial training staffs. No formal programs for unskilled workers have been identified.

5.1.6. Trainers. German vocational trainers can be divided into three categories: teachers of theoretical subjects, teachers of practical subjects, and the meisters or apprentice instructors. Each has unique regulated requirements and social standing in the Republic.

Teachers of theoretical subjects are recruited from the nation's colleges. A four-year curriculum is followed by eighteen months of practical training in the classroom. Additional technical training occurs on the job in an industrial setting. The typical theoretical trainer is trained to be a teacher.[31]

Teachers of practical subjects, shop teachers, are skilled craftsmen who have either received additional training at a technical school for one and one-half years or received a meister certificate and have undergone an eighteen-month training of trainers course. This is the recommended practice. Specific laws may vary from land to land. Therefore, all workshop trainers have not undergone this process.[31]

A key to the German system is the meister or master craftsman responsible for apprentice training. First and foremost, the meister is a certified skilled

worker--a facharbeiter. Second, the meister has completed a course of study to prepare for his role as an apprentice instructor. This course includes pedagogical training and course work in business and social sciences. Third, the meister has successfully completed a licensing examination.[3,31]

The meister is charged with teaching the apprentices the skills necessary to succeed in a given occupation--or at least pass the facharbeiter examination. The success, or failure, of the meister may be measured by his students' success rate in the facharbeiter examination. The apprentice contract guarantees the student the instruction needed to pass that examination. Failure to pass results in new training and testing for the apprentice and a review of the meister's credentials by the local Chamber of Commerce. But this is a rare event. The success rate for shipbuilding apprentices is very high.

5.1.7. Status of the Shipbuilding Industry. The German shipbuilding industry is composed of private enterprises and firms with the federal or local government as partners. The recent recession did not affect the German shipyards as much as the Scandinavian or British shipyards.[35] However, shipyards owned totally or in part by the Federal government did scale back their operations. Order books include a wide range of naval work, offshore construction, ship repair and conversion. Much of the German market--including naval work--is for export. Shipyards, unions, and government often act as social partners to determine the best course for activities such as training.

5.2 Vocational Training in the Shipbuilding Industry

Given the extensive influence of government regulation and industry panels (i.e., the Chamber of Commerce) it is not surprising that training in the shipbuilding industry closely follows the national vocational education system.

The primary entrance into a trade is through serving an apprenticeship under the dual system. Included in the national occupation classifications are traditional shipbuilding trades and other related crafts. Table 4 lists apprenticeships that are actively pursued in the German shipbuilding industry. Specific training requirements for the occupations are in Appendix C.

Apprentice selection begins approximately one year prior to the beginning of the apprenticeship. Shipyards and other industries work with school officials to introduce students to the myriad of occupations available for apprenticeships. A student is required to submit an application and his personal records for an initial screening. Selected applicants are then invited to take a battery of tests to determine their suitability for employment in a particular industry/occupation. The tests include mathematics, geometry, technical comprehension, and manual dexterity. The tests are evaluated immediately, the test results are discussed with the applicants (which allows the trainers to assess the character of the applicant), and an apprenticeship is offered or refused. If the student is offered an apprenticeship and accepts, an apprentice contract is signed.[2]

The contents of an apprentice contract are strictly determined by law and must include: occupation, duration, probationary period, wages and holidays, and the training plan to be followed. An example of a training plan for a Blohm + Voss welder is shown in Table 5.[2]

Like his counterpart in other industries, the shipbuilding meister is considered to be the mainstay of the training of craftsmen. Meisters work with the apprentices throughout the duration of the apprenticeship--particularly in the training centers and in preparation for the skilled worker examination. The meister is required to provide the trainee with feedback on his progress through the duration of the apprenticeship. A typical progress report or "rating chart" is shown in Figure 12.

In addition to the meisters, engineers play a significant role in the development of craftsmen at German shipyards. Top administrative positions in the training organization are typically held by engineers. Given the prominent role of apprenticeships in developing the work force, these positions are considered to be important steps in the careers of company engineers. Thus, people are an important component in shipyard training.

The training centers are a focal point in the shipyard training programs. Off-the-job training primarily occurs in the training centers. Initial training, intermediate training, and final preparation for the skilled worker examination take place at the training center. Thus, German shipyards have developed extensive training facilities to provide the classrooms, workshops, and capital equipment needed to meet the national standards for training. Workshops are supplied with state-of-the-art equipment to ensure that trainees are given instruction in all areas defined by the federal government and guaranteed by the apprenticeship contract.

TABLE 4
German Shipbuilding Apprenticeships

TRADE	TRADE	TRADE
Boilermaker/Smith	Joiner	Social Insurance
Boring Machine Operator	Fitter	Shipwright
Carpenter	Material Tester	Technical Draftsmen I
Commercial Employee	Milling Machinist	Technical Draftsman II
Data Processing	Office Worker	Turner
Electrician	Packer	Welder
Engine Fitter	Pipefitter	Woodworker

TABLE 5

Contract Timetable for Fusion Welder

Blohm+Voss

Timetable and subject matter content of training contract for trainees for the trade of fusion welder

1. Training workshop	Months
1.1 Acquisition of basic metal-working skills; introduction to accident prevention regulations	2,0
1.2 Electric welding practice: Acquisition of basic electric welding skills, weldability of materials, basic electrical principles, sources of welding current, welding procedure and arc striking; blast action; type of electrodes; welding seam forms (symbols); preparation of welding seams; welding faults; weld shrinkage. Accident prevention regulations. Acquisition of skills in: welding of plates, profiles and pipes in steel with various electrodes normally used at the shipyard, bead welding, fillet welding and butt welding in various welding positions (horizontal, horizontal (fillet welding), vertical, transverse, overhead) Take the EB II basic test	5,0
1.3 Cutting practice: Acquisition of knowledge and skills in hand and machine autogenous flame cutting; burning off and cutting out on various types of plate, cutting of profile and tube ends; introduction to accident prevention regulations for cutting gases and equipments.	1,0

TABLE 5 (continued)

		Months
2.	Electric welding practice - Production	2,0
	Employed in production fillet welding of components with various electrodes and in constrained positions; knowledge of working documents and the accident prevention regulations.	
3.	Training workshop - Gas fusion welding practice	3,0
	Acquisition of basic knowledge on autogenous welding: welding gases, cylinder gas, welding tools and accessories, materials and supplementary materials, welding seam forms (symbols), preparation of welding seams, welding procedure, welding process; accident prevention regulations: Practice in welding to the right and left of plates and pipes of steel and non-ferrous metal in various welding positions. Acquisition of knowledge and skills in hard and soft soldering.	
	Intermediate examination.	
4.	Welding practice - Pipe shop	1,5
	Employed in production welding of pipes in steel and non-ferrous metal using welding processes (Autogenous welding, MIG and TIG welding); knowledge of welding sequences, working documents and accident prevention regulations.	
5.	Electric welding practice - shipbuilding	1,0
	Knowledge of welding power supplies in shipbuilding; helping with the installation and servicing of welding power supplies in preliminary erection, erection on the slipways and for ship repair; acquisition of knowledge in the setting-up, operation and servicing of various automatic welding machines; accident prevention regulations.	

TABLE 5 (continued)

		Months
6.	Electric welding practice - production	
	Employed in production fillet and butt-welding of a high degree of difficulty in various production areas (shipbuilding, tank production and boiler production) both under instruction and unsupervised: acquisition of knowledge on material quality, supplementary materials, welding procedure and shrinkage	4,0
7.	Training workshop - protective gas welding	2,0
	Acquisition of knowledge and skills in protective gas welding using the MIG and TIG processes; exercises in bead, fillet and butt welding on plates and pipes of steel and non-ferrous metals; accident prevention regulations	
8.	Training workshop	1,0
	Revision and extension of skills learnt up to the present in autogenous and electric welding as a preparation for the skilled workers' test	
	6 weeks holiday per year of training	4,5
	13 weeks block instruction per year of training	9,0
	The sequence followed depends upon production factors; the training period can vary and is also dependent upon the learning capacity and cooperation of the trainee.	

Apprentice Rating Chart

(return to PA on completion of training period)

The following will be assigned for training to _____

for the period from _____ to _____

Pers. No. _____ Name _____ Christian name _____

Trade apprenticeship _____ year _____

Trade school _____

Safety instruction took place befor the start of the training period

on _____ _____ Apprentice signature _____

Training will take place in accordance with paragraph of the training plan overleaf.

The training plan was (tick where applicable)

completed ☐ partially completed ☐ not completed ☐

	very good	good	satisfactory	adequate	unsatisfactory
Standard of work: Quality of work carried out					
Speed of work: Time taken to complete work (training tasks)					
Behaviour: Uprightness, readiness to help others, ability to take criticism, sociability					
Attitude to work: Punctuality, carefulness orderliness energie					
Aptitude: Skill, learning capability, concentration, self-sufficiency					

Remarks: (e.g. Indications as to possible omissions in technical training

---

Signature: Assessor / Foreman

This rating chart has been discussed with the apprentice

on: _____ _____

Apprentice signature

FIGURE 12. Apprentice rating chart.

6.0 SUMMARY

The European shipyards stress the importance of developing and maintaining a highly skilled work force. Through apprentice training in the United Kingdom and Germany and the adult training programs in Denmark and Sweden, European shipbuilders learn the skills needed to produce ships at a competitive price. The Europeans have developed new techniques and modified traditional apprenticeships to produce high quality employees. Especially important topics for future consideration are the modular training program in the United Kingdom; the use of licensed meisters as instructors, as practiced in the Federal Republic of Germany; and the use of standard qualifications and examinations for earning the title of skilled worker.

The modular training system allows British Shipbuilders to provide flexible training alternatives to meet the demands of production. Through on-the-job modules and training elements, experienced workers and apprentices can be given training in different skill areas to the needed skill level. This allows production managers to specifically determine the training needs of their workers.

In the Federal Republic of Germany, the meister is a licensed apprentice instructor and a skilled worker. The meister must demonstrate a level of competence in his craft and instructional competence not normally required in the

United States. The meister is internationally recognized as a key component of the German training system.

The use of standard skill levels, qualification examinations, and certification provides solid documentation of worker skills and training. Documentation and certification allows management to better determine the best employee for a given job or supervisory position. Standards as well as documentation requires a well-defined training system with training centers, trainers, and training administrators. This means a significant investment of money, men, and facilities. But, as Herr Berg of Blohm + Voss Shipyards says, "I am not telling you any secrets, training is expensive. The only thing which can be more expensive for a company is: Do not train."

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APPENDIX A

LIST OF CONTACTS

LIST OF CONTACTS IN EUROPE

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LIST OF CONTACTS IN EUROPE
(Continued)

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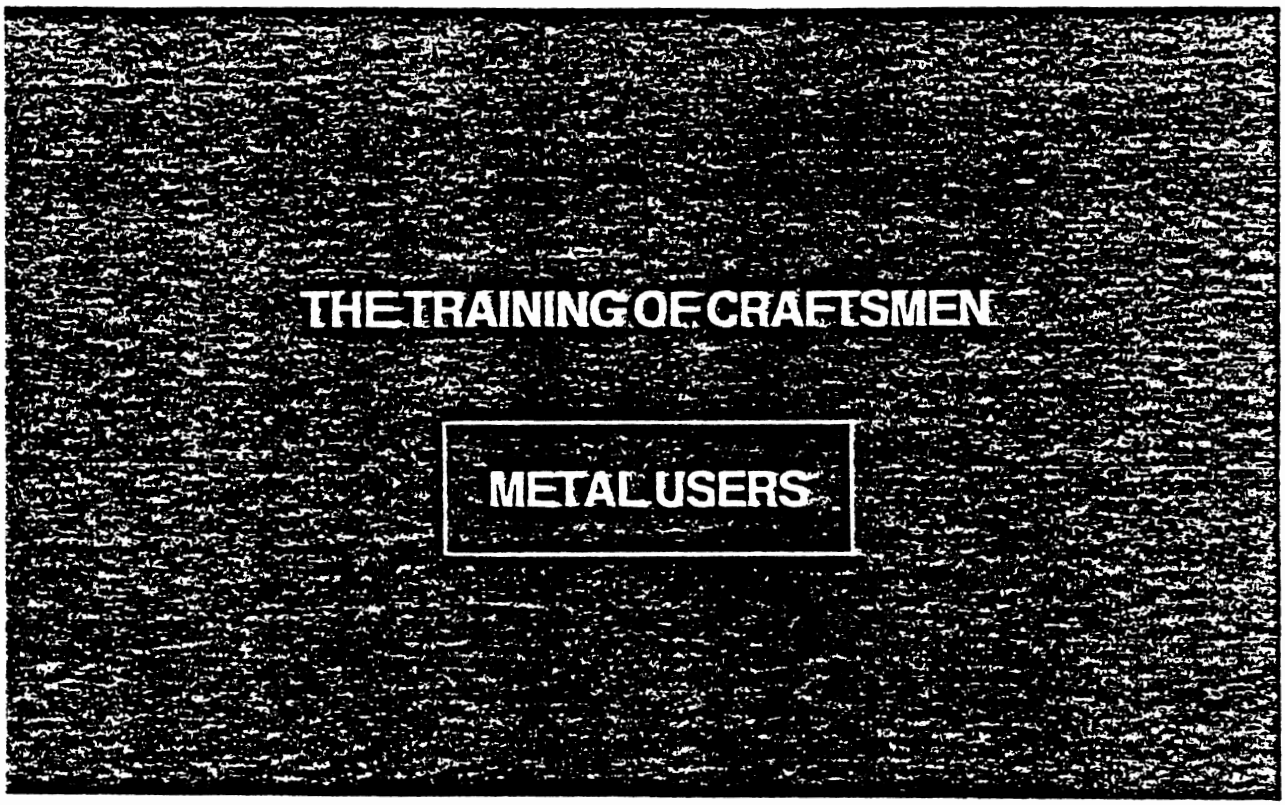
APPENDIX B

EXCERPTS OF INFORMATION PAPER NO. 10: METAL USERS, SHIPBUILDING INDUSTRIAL TRAINING BOARD

SHIPBUILDING INDUSTRY TRAINING BOARD



INFORMATION PAPER No. 10

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METAL USERS

General

1. In 1967 the Shipbuilding Industry Training Board published Training Policy Statements Nos. 2 and 3 which provided recommendations for the training of metal-using and shipyard outfitting craftsmen. These Policy Statements were reviewed in 1971 and revised recommendations were published in August 1972.

2. The recommendations reflected the need for the craftsman of the future to be versatile and adaptable and for training to facilitate the effective deployment of labour.

Survey of Craft Training

3. During the summer of 1980 the Board undertook a detailed survey of craft training by consulting representatives of all interested sections of the industry. It concluded that whilst the existing recommendations had produced significant improvements in craft training arrangements, a more flexible system was required to meet the present and future needs of the industry. In particular, the new arrangements should take account of technological change and the training and retraining of adults throughout their working lives.

Skill Review

4. Five working parties, fully representative of employers and trade unions, were formed to examine the present and future training requirements of the shipbuilding and shiprepair industry. This Information Paper provides recommendations for the training of **metal using craftsmen** (Caulker/Burner/ Driller/Riveter, Loftsman, Plater/Shipwright, Welder, Sheetmetal Worker).

5. The views of a cross-section of the industry in the merchant shipbuilding, warship building and shiprepair sectors were sought and the industry contacts have been listed in **Appendix E.**

Training Policy

6. The policy recommended has four main components:-

   (a) Induction and common basic training.

   (b) Off-the-job training in one or more elements of skill related to the modules to be taken. The elements can be taken singly or in groups.

   (c) Module training on-the-job in selected skills under controlled conditions. The skills would be selected from a range of modules, according to need.

   (d) Development of the acquired skills through experience, until the approved standard is reached.

Initial Training Structure

7. Trainee craftsmen entering the industry should start their training with a period of at least six weeks of induction and common basic training. This important period should provide a balanced programme of induction to the industry and the yard, combined with practical bench exercises of a simple nature, using hand tools common to the crafts employed in shipbuilding. The content of the Induction and Common Basic Programme recommended will be found in **Appendix A.**

Modular Training Structure

8. The structure recommended is designed to allow the trainee to progress up a ladder of skills moving from the simpler basic tasks to the more complex. It also allows a trainee to train for other jobs at a later date by taking optional modules. This structure provides a high degree of flexibility to meet individual and company requirements.

9. The structure is also designed to meet the requirement that trained craftsmen should be able to:-

   (a) adapt to technological and other change.

   (b) return to the training system at intervals throughout their careers to learn new skills and be brought up-to-date.

10. In addition, the system is believed to provide a sound basis for the future development of those craftsmen who change to work in other occupations or move to other E.E.C. countries. The modular structure which the Board recommends for the training of metal using craftsmen will be found in **Appendix B.**

Module Content

11. The identity and content of each module is related to the total skill requirements of a work area (e.g. fabrication area). Skill prerequisites have been established which a trainee must possess before undergoing training for a module. In some cases they are off-the-job elements and in others complete modules. The content of off-the-job elements will be found in **Appendix C.**

12. The content of each module has been set out in terms of a training specification (i.e. what the trainee should do) and the associated skill standard (i.e. how well the trainee should do it). The standards should be regarded as the minimum acceptable standards. Centres and yards should encourage trainees to exceed them and ensure that they have the opportunity to do so. The details of each module will be found in **Appendix D.**

Certificates of Craftsmanship

13. The length of training should be based on what has to be taught and the rate of learning of the individual, subject to sufficient time being allowed to acquire maturity. This means there is an incentive for trainees to become qualified as quickly as possible.

14. The number and types of module recommended to be completed successfully to qualify for the award of a Certificate of Craftsmanship have been included at the bottom of the page headed 'Modular Structure' in **Appendix B.**

Monitoring of Standards

15. The system recommended for assessing progress against the standards set is currently being investigated. A separate publication on this aspect will be available shortly.

Further Education
Craft Courses

16. The City & Guilds of London Institute is currently reviewing its policy for craft studies courses. The review should take account of these recommendations and that future further education courses will be of a modular type to match the modular training.

17. Until the new courses are available it is recommended that trainees should attend further education until they obtain a Part II Craft Studies Certificate. Exceptionally, a trainee can be allowed to cease attendance after three years if there is little possibility of his achieving Part II standard after a fourth year of study. On the other hand, trainees able to benefit should continue to study for Part III Craft Studies Certificate. The further education courses which are recommended are given below:

Occupation	Courses	Number
Caulker/Burner/ Driller/Riveter	Basic Engineering Craft Studies Pt I (Shipbuilding Metal Users)	200
	Shipbuilding Craft Studies Pt II	240
Loftsman and Plater/Shipwright	Basic Engineering Craft Studies Pt I (Shipbuilding Metal Users)	200
	Shipbuilding Craft Studies Pt II	240
	Shipbuilding Craft Studies Pt III	240
Welder	Basic Engineering Craft Studies Pt I (Shipbuilding Metal Users)	200
	Welding Craft Studies Pt II	215
	Welding Craft Studies Pt III	215
Sheetmetal Worker	Basic Engineering Craft Studies Pt I (Fabrication and Welding Bias)	200
	Sheet Metal and Thin Plate Craft Studies Pt II	216
	Fabrication, Welding and Shipbuilding Craft Studies Pt III	216

Technician Courses

18. In most cases, craft studies courses are appropriate for craft trainees. There may, however, be cases where a trainee is capable of taking a technician course. It is considered that a trainee should not be held back if this is so; and that certain technician courses should be accepted as being suitable in these circumstances. Such an arrangement calls for close liaison between employers and technical college and for a review of the trainee's practical training to ensure that it is relevant to technician activities.

Acknowledgements

19. The Board wishes to record its appreciation of the comprehensive and efficient manner in which the Working Party dealing with revised recommendations for the training of these craftsmen discharged their task within a limited time-scale. The membership of the Working Party is recorded in **Appendix F.**

Index to Appendices

Index to Appendices (continued)

INDUCTION AND COMMON BASIC TRAINING PROGRAMME

The Shipbuilding and Shiprepair Industry

Short history of shipbuilding and shipping — the wood, iron and steel ship era and progress in materials and propulsion machinery to date.

The industry — size, distribution, products and customers.

Future prospects. The new technology.

International competition.

The major associated industries, e.g. steel, engineering, marine equipment.

The Yard

History, organisation, layout.

Products, markets, main sub-contractors.

The skills used and the contribution of each trade to the end product.

Tour of the yard, shops and offices.

How wealth is created.

Trade Unions

The trade union movement — its history and role.

Joint consultation — Corporation/national, district and yard joint committees.

Shop stewards. Office representatives.

Note — A Trade Union representative should be invited to speak to groups of trainees as appropriate to the skill.

Conditions of Service

Hours, clocking, meal and tea-breaks, lateness, absenteeism.

Payment; sickness payments; management of personal money.

Holidays; canteen, sports and social facilities.

Work rules, discipline, behaviour, dress, smoking.

Training and further education opportunities; career opportunities.

Safety and Health

The Health and Safety at Work Act 1974.

The importance of safety, hygiene, safe working practices; accident prevention and good housekeeping.

The safety officer.

Fire precautions.

Factories Act. Offices, Shops and Railway Premises Act. Shipbuilding and Shiprepairing Regulations and associated codes of practice.

Ship Construction and Repair

Visits to ships under construction and repair. Instruction to include:-

Layout of ship.
Ship terms.
Sequence of building a ship from inception to completion.
Overhaul, drydocking and damage repairs.
Types of ship and their functions.
Plan reading.
Use of hand tools.

Hull Construction

Practice in simple caulking, burning and metal-arc welding.

Visits to ships under construction and to fabrication and other shops.

Procedure for erecting the hull of a ship.

The principal tools, machines and equipment, hand and power, used for hull construction in the shops and yard.

The principal materials used — their characteristics and uses.

Contribution of the various metal-using trades.

Safety precautions.

Launching

Visit to ship being prepared for launching and being launched.

Procedure for launching a ship.

Contribution made by rigger and plater/shipwright.

Methods used at home and abroad.

Outfitting

Measuring, marking out, joining and fashioning wood and metal including practice in simple operations therein.

Use of pipes and cables and practice in installation.
Use of templates.

Visits to outfitting workshops and ship fitting-out. Instruction to include:-

. Procedure for fitting-out a ship.
The principal materials used, e.g. metals, wood, laminates and plastics — their characteristics and uses.
The principal tools, machines and equipment, hand and power, used for outfitting in the shops and yard.
The contribution of the various outfitting trades.
Fittings and furnishings used.
Paint equipment and paints. Use and methods of application.
The principal equipment installed. The use of computers.

Safety precautions.

Machinery

Visits to engine works to see machinery under construction.

Visits to ships to see deck machinery, steering gear, etc.

Appreciation of engine room installations by use of plans, diagrams, or models. Instruction to include:-

Various types of marine diesel engines, steam turbine, reactor and nuclear propulsion.
Reasons for selection, e.g. cost, reliability, ease of maintenance, space, vibration.
Description of auxiliary machinery, function and layout.
Electric generators, compressors, pumps and lubrication methods.

Marking off	EMU 1
Lining off	EMU 2
Development	EMU 3
Manufacture	EMU 4
Assembly/Fairing	EMU 5
Erection	EMU 6
Alignment/Levelling	EMU 7
Machine Operation	EMU 8
Material Forming	EMU 9
Woodwork Tools/Machines	EMU 10
Woodwork on/under the ship	EMU 11
Glass Reinforced Plastic	EMU 12
Plan Reading	EMU 13
1/10 Scale Lofting	EMU 14
Computer Functions and Operations	EMU 15

Oxy Gas Cutting:	
Hand	EMU 16
Portable Machines	EMU 17
Profile/Computer	EMU 18
Caulking	EMU 19
Pneumatic/Electric Tools	EMU 20
Riveting	EMU 21
Arc Air Gouging	EMU 22
Heat Treatment	EMU 23
Drilling	EMU 24

GROUP 'A' MODULES

PR	Pre-Fabrication	MU 1
EMU 1, 13	Marking off	1.1
EMU 1, 3, 13	Development	1.2
EMU 1, 4, 8, 13	Manufacture	1.3
EMU 5, 13	Assembly/Fairing	1.4

PR	Machines	MU 2
EMU 8, 13	Machine Operation	2.1
EMU 8, 9, 13	Material Forming	2.2

PR	Building Berth/ Dock (Unit Assembly)	MU 3
EMU 2, 13	Lining off	3.1
EMU 7, 13	Levelling & Alignment	3.2
EMU 6, 13	Erection	3.3
EMU 5, 13	Assembly/Fairing	3.4

PR	Outfit	MU 4
EMU 2, 5, 7, 13	Steelwork	4.1
EMU 10, 11, 13	Woodwork	4.2

PR	Repair Work	MU 5
EMU 1, 5, 6, 8 11, 13	Manufacture	5.1
	Dry Docks	5.2
	Slipways	5.3

PR	Oxy-Gas Cutting	MU 6
EMU 16	Hand	6.1
EMU 16, 17	Portable Machines	6.2

PR	Pneumatic/Electric Tools	MU 7
EMU 20		

PR	Drilling	MU 8
EMU 24		

PR	Manual Metal Arc Welding	MU9
EMU 25	Down Hand Fillet	9.1
EMU 25, 26	Vertical Fillet	9.1

PR MU 9	Manual Metal Arc Welding	MU 10
EMU 27	Overhead Fillet	10.1
EMU 27, 28	Inclined Fillet	10.2

PR MU 9, 10	Manual Metal Welding	MU 11
EMU 29	Downhand Butt	11.1
EMU 29, 30	Vertical Butt	11.2
EMU 29, 30, 31	Overhead Butt	11.3

PR	Sheetmetal Manufacture I	MU 12
EMU 43, 44 45, 25, 32, 33	Non-critical Singular Items Sub-assembly	12.1
34, 21	Units	12.2

PR MU 12	Sheetmetal Multi Sub-assembly Units	MU 13

PR MU 12, 13	Sheetmetal Erect/Install	MU 14

RECOMMENDED MINIMUM NUMBER OF

Plater/Shipwright Group 'A' : MU 1 plus two modules from MU 2 - 5.

Loftsman Two modules from Group A : MU 1 - 5 plus one module from Group B : MU 15, 16, 17

or

One module from Group A : MU 1 - 5 plus two modules from Group B : MU 15, 16, 17.

STRUCTURE

ELEMENTS

Welding:	
Downhand Fillet	EMU 25
Vertical Fillet	EMU 26
Overhead Fillet	EMU 27
Inclined Fillet	EMU 28
Downhand Butt	EMU 29
Vertical Butt	EMU 30
Overhead Butt	EMU 31
Semi Automatic/Automatic Welding	
MIG/MAG	EMU 32
TIG	EMU 33
Oxy-gas	EMU 34
Pipe	EMU 35
Fusarc	EMU 36
Gravity Feed	EMU 37

Submerged Arc	EMU 38
Electrogas	EMU 39
Electroslag	EMU 40
Stud	EMU 41
Coded Welding	EMU 42
Marking	EMU 43
Hand Tools and Materials	EMU 44
Cutting and Forming Machines (fixed and portable)	EMU 45
Sketching	EMU 46

GROUP 'B' MODULES

PR	Full Size Lofting	MU 15
MU 1 or MU 3	Layout & lining off Development Template Making	15.1 15.2 15.3

PR	1/10 Scale Lofting	MU 16
MU 1 or MU 3	Parts Listing 1/10 Scale Drawing Development Lines Plan	16.1 16.2 16.3 16.4

PR	Computer Lofting	MU 17
MU 1 or MU 3		

PR	Launchways	MU 18
EMU 10, 11, 13		

PR	Door/Hand Squad	MU 19
EMU 2, 5, 6, 13, 25		

PR	Tank Testing	MU 20
EMU 6 EMU 7 EMU 13		

PR	Arc Air Gouging	MU 21
EMU 16 EMU 20 EMU 22		

PR	Profile/Computer	MU 22
EMU 18, 13	Burning	

PR	Riveting	MU 23
EMU 21		

PR	Boilerwork	MU 24

PR	Caulking	MU 25
MU 7 EMU 19		

PR	Heat Treatment	MU 26
EMU 23		

PR	GRP	MU 27
EMU 12		

PR	Coded Welding	MU 28
MU 9, 10, 11 EMU 42		

PR MU 9, 10, 11	Semi Automatic/ Automatic Welding	MU 29
EMU 32 EMU 33 EMU 34 EMU 35 EMU 36 EMU 37 EMU 38 EMU 39 EMU 40 EMU 41	MIG/MAG TIG Oxy gas Pipe Fusarc Gravity Feed Submerged Arc Electrogas Electroslag Stud	

PR	Sheetmetal Lining off	MU 30
EMU 2 EMU 46	Lining off Sketching	30.1 30.2

PR	Sheetmetal Manufacture 2	MU 31
EMU 12, 13		

PR	Sheetmetal	MU 32
MU 12, 13	Manufacture 3	

PR	Oxy gas/Cutting (Flame Planer)	MU 33
EMU 16, 17		

MODULES FOR CERTIFICATE OF CRAFTSMANSHIP

Caulker/Burner/ Driller/Riveter	Group 'A' : Modules MU 6, 7, 8	PR = Prerequsite
Welder	Group 'A' : Modules MU 9, 10, 11	

OFF-THE-JOB ELEMENTS

OFF-THE-JOB ELEMENT EMU 1 — MARKING OFF

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:- (a) Health and Safety at Work Act 1974. (b) Shipbuilding and Shiprepairing Regulations. (c) Use of protective clothing and equipment. (d) Safe handling of tools and equipment. (e) Safe method of manual lifing. (f) Correct use of mechanical handling equipment, including use of hand signals. (g) Protection of Eyes Regulations.	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials. Appropriate codes of practice and company safe working procedures complied with.
Use hand tools, hammer, centre punch, measuring tape/rule, dividers, trammels, chalk line, scriber.	Tools used safely and correctly. Appropriate standard achieved.
Identify, prepare and layout materials. Measure and mark material for regular and irregular shapes. Provide allowances for folding, bending and rolling.	Items marked to within 2mm. Correct identification address clearly marked.
Interpret and work to ships drawings.	Relevant information transferred correctly to job.
Interpret 1st and 3rd angle and isometric projection. Make templates in wood, cardboard and steel.	Templates made to within 2mm.
Types and methods of ship construction.	

OFF-THE-JOB ELEMENT EMU 2 — LINING OFF

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:- (a) Health and Safety at Work Act 1974. (b) Shipbuilding and Shiprepairing Regulations.	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials. Appropriate codes of practice and company safe working procedures complied with.

OFF-THE-JOB ELEMENT EMU 2 — LINING OFF (continued)

TRAINING SPECIFICATION	SKILL STANDARD
(c) Use of protective clothing and equipment.	
(d) Safe handling of tools and equipment.	
(e) Safe method of manual lifing.	
(f) Correct use of mechanical handling equipment, including use of hand signals.	
(g) Protection of Eyes Regulations.	
Use hand tools such as hammer, centre punch, measuring tape/rule, dividers, trammels, chalk line, scriber.	Tools used safely and correctly. Appropriate standard achieved.
Interpret and work to ships drawings.	Relevant information transferred correctly to job.
Position datum lines, water and buttock lines on ships components.	Dimensional accuracy to within 2mm.
Prepare and set up sights.	Keel sights levelled and set to within stated tolerance.
Line off moulded depth, freeboard draught marks, shell openings, paint lines and ships name.	Lining off to within stated tolerance.
Sheetmetalwork Option	
Line off simulated area from drawings incorporating the use of plumb bobs and bubble levels to accommodate for berth declivity, sheer and camber.	
Shipbuilding terminology.	

OFF-THE-JOB ELEMENT EMU 16 — OXY GAS CUTTING (HAND)

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:- (a) Health and Safety at Work Act 1974. (b) Shipbuilding and Shiprepairing Regulations. (c) Use of protective clothing and equipment. (d) Protection of Eyes Regulations. (e) Safe use of fuel gases, handling, storage, care of gas cylinders and identification of colour codes of pipes and cylinders. (f) Safe use of tools and equipment and fume control equipment where required. (g) Safe methods of manual lifting. (h) Correct use of mechanical handling equipment, including use of hand signals.	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials. Appropriate codes of practice and company safe working procedures complied with.
Cut mild steel plate using oxy gas cutting equipment in all relevant positions.	Plate edges cut by hand to 1.5mm of line; edges smooth, square and slag free.
Bevel mild steel plate edges using oxy gas cutting equipment in all relevant positions.	Plate prepared to specification, edges cut by hand to 1.5mm of line; smooth at correct angle and slag free.
Remove welds and rivets by burning process.	**Welds** Parent plates scar free; residue capable of removal in one pass with caulking machine. **Rivets** Rivets removed; countersinks and holes scar free.

OFF-THE-JOB ELEMENT EMU 17 — OXY GAS CUTTING (PORTABLE MACHINES)

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:- (a) Health and Safety at Work Act 1974. (b) Shipbuilding and Shiprepairing Regulations. (c) Use of protective clothing and equipment. (d) Protection of Eyes Regulations. (e) Safe use of fuel gases, handling, storage, care of gas cylinders and identification of colour codes of pipes and cylinders. (f) Safe use of tools and equipment and fume control equipment where required. (g) Safe methods of manual lifting. (h) Correct use of mechanical handling equipment, including use of hand signals.	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials. Appropriate codes of practice and company safe working procedures complied with.
Cut mild steel plate using oxy gas cutting equipment.	Plate edges cut to .75mm of line; edges smooth, square and slag free.
Bevel mild steel plate edges using oxy gas cutting equipment.	Plate edges prepared to specification, edges cut by machine to .75mm of line; edges smooth at correct angle and slag free.
Cut mild steel plates using machine burning aids, such as templates, trammels.	Plate edges cut to 1mm of line; edges smooth and slag free.
Recognise faults and defects i.e. laminations, speed of travel, heat control, correct nozzle sizes and gas pressures.	Faults and defects remedied on occurrence.

OFF-THE-JOB ELEMENT EMU 25 — WELDING — DOWNHAND FILLET

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:- (a) Health and Safety at Work Act 1974. (b) Shipbuilding and Shiprepairing Regulations. (c) Use of protective clothing and equipment. (d) Protection of Eyes Regulations. (e) Safe use of tools, machines and equipment including fume control equipment where required. (f) Safe earthing of equipment and job. (g) Safe methods of manual lifting. (h) Correct use of mechanical handling equipment, including use of hand signals.	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials. Appropriate codes of practice and company safe working procedures complied with.
Welding terms and symbols.	BS 499 (Part 2) symbols identified correctly.
Assemble and operate basic manual metal-arc welding equipment used in shipbuilding/shiprepair industry.	Shipbuilding and Shiprepairing Regulations 48 — 51, 59, 73 — 74 complied with.
Select appropriate electrode and current for type of job and fillet size.	Appropriate electrode and current used.
Weld mild steel in relevant position — downhand.	BS 1295 or Classification Society requirements complied with. Welds free of defects i.e. porosity, slag inclusion, undercut, spatter free and correct fillet size.
Follow specified welding procedures and sequence to minimise distortion.	Distortion controlled to yard standard.
Recognise weld defects and their causes and apply appropriate remedies.	Surface defects, porosity, undercut or lack of fusion remedied on occurrence.

OFF-THE-JOB ELEMENT EMU 26 — WELDING — VERTICAL FILLET

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:- (a) Health and Safety at Work Act 1974. (b) Shipbuilding and Shiprepairing Regulations. (c) Use of protective clothing and equipment. (d) Protection of Eyes Regulations. (e) Safe use of tools, machines and equipment including fume control equipment where required. (f) Safe earthing of equipment and job. (g) Safe methods of manual lifting. (h) Correct use of mechanical handling equipment, including use of hand signals.	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials. Appropriate codes of practice and company safe working procedures complied with.
Welding terms and symbols.	BS 499 (Part 2) symbols identified correctly.
Assemble and operate basic manual metal-arc welding equipment used in shipbuilding/shiprepair industry.	Shipbuilding and Shiprepairing Regulations 48 — 51, 59, 73 — 74 complied with.
Select appropriate electrode and current for type of job and fillet size.	Appropriate electrode and current used.
Weld mild steel in relevant position — vertical.	BS 1295 or Classification Society requirements complied with. Weld free of defects i.e. porosity, slag inclusion, undercut, spatter free and of correct fillet size.
Follow specified welding procedures and sequence to minimise distortion.	Distortion controlled to yard standards.
Recognise weld defects and their causes and apply appropriate remedies.	Surface defects, porosity, undercut or lack of fusion remedied on occurrence.

MODULE MU 2 — MACHINES (continued)

LEVEL 2.2

TRAINING SPECIFICATION	SKILL STANDARD
(f) Correct use of mechanical handling equipment, including use of hand signals.	
Material Forming	
Produce fore and aft shaped shell plates, bulbous bow dished plates, cones, square to round transformers using:-	Appropriate machine for job selected.
(a) Light/heavy rolls	Finished work within 5mm of dimensions or template.
(b) Plate flanger	
(c) Hydraulic press	
(d) Frame bender	

MODULE MU 3 — BUILDING BERTH/DOCK (UNIT ASSEMBLY)
PREREQUISITE:- EMU 2, EMU 13

LEVEL 3.1

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:-	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials.
(a) Health and Safety at Work Act 1974.	Appropriate codes of practice and company safe working procedures complied with.
(b) Shipbuilding and Shiprepairing Regulations.	
(c) Use of protective clothing and equipment.	
(d) Safe handling of tools and equipment.	
(e) Safe methods of manual lifting.	
(f) Correct use of mechanical handling equipment, including use of hand signals.	
Lining off	
Interpret and work to ships drawings.	Relevant information transferred correctly to job.

MODULE MU 3 — BUILDING BERTH/DOCK (UNIT ASSEMBLY) (continued)

LEVEL 3.1

TRAINING SPECIFICATION	SKILL STANDARD
Line off positions of deck and bulkhead openings, engine room seatings, sea valves, bulkheads.	Dimensional accuracy to within 2mm.
Position main datum lines, water and buttock lines on individual components.	Dimensional accuracy to within 2mm.
Establish ship's centre line, buttock lines and square lines to keel.	Best method to suit job requirements adapted. Dimensional accuracy to within 2mm.
Prepare and set up keel sights to correct height and declivity.	Keel sights levelled and set to within stated tolerance.
Line off moulded depth, freeboard draught marks, shell openings, paint lines and ship's name.	Classification Society or owner's requirements complied with.
Deck and shaft siting.	Deck and shaft sited to within given tolerance.

MODULE MU 3 — BUILDING BERTH/DOCK (UNIT ASSEMBLY)
PREREQUISITE:- EMU 7, EMU 13

LEVEL 3.2

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:-	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials.
(a) Health and Safety at Work Act 1974.	Appropriate codes of practice and company safe working procedures complied with.
(b) Shipbuilding and Shiprepairing Regulations.	
(c) Use of protective clothing and equipment.	
(d) Safe handling of tools and equipment.	
(e) Safe methods of manual lifting.	
(f) Correct use of mechanical handling equipment, including use of hand signals.	

MODULE MU 3 — BUILDING BERTH/DOCK (UNIT ASSEMBLY) (continued)

LEVEL 3.2

TRAINING SPECIFICATION	SKILL STANDARD
Levelling and Aligning Position main datum lines, water and buttock lines on ship, berth and in shop on individual items using:- (a) Dumpy level (b) Theodolite (c) Water level (d) Clinometer (e) Spirit level.	Instruments used and cared for in keeping with manufacturer's instructions. Completed work to within 1mm of tolerance in specification.

MODULE MU 3 — BUILDING BERTH/DOCK (UNIT ASSEMBLY)
PREREQUISITE:- EMU 6, EMU 13

LEVEL 3.3

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:- (a) Health and Safety at Work Act 1974. (b) Shipbuilding and Shiprepairing Regulations. (c) Use of protective clothing and equipment. (d) Safe handling of tools and equipment. (e) Safe methods of manual lifting. (f) Correct use of mechanical handling equipment, including use of hand signals.	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials. Appropriate codes of practice and company safe working procedures complied with.

MODULE MU 3 — BUILDING BERTH/DOCK (UNIT ASSEMBLY) (continued)

LEVEL 3.3

TRAINING SPECIFICATION	SKILL STANDARD
Erection	
Erect ships structures — double bottom units, deck and shell panels, hatch coamings, deckhouses.	Units placed and aligned to within 5mm of required dimensions.
Position and secure units by shoring, horning and tying.	Units positioned to within 5mm of required position and secured safely.
Use erection aids:- wire ropes, shackles, shorejack boxes, warricks and shores.	Aids used safely and to standard of company practice.

MODULE MU 3 — BUILDING BERTH/DOCK (UNIT ASSEMBLY)
PREREQUISITE:- EMU 5, EMU 13

LEVEL 3.4

TRAINING SPECIFICATION	SKILL STANDARD
Safe working practices, safety precautions and good housekeeping with particular reference to:-	Able to work safely i.e. without injury to self, other persons or damage to tools, machines or materials.
(a) Health and Safety at Work Act 1974.	Appropriate codes of practice and company safe working procedures complied with.
(b) Shipbuilding and Shiprepairing Regulations.	
(c) Use of protective clothing and equipment.	
(d) Safe handling of tools and equipment.	
(e) Safe methods of manual lifting.	
(f) Correct use of mechanical handling equipment, including use of hand signals.	
Assembly/Fairing	
Assemble and fair auxiliary seatings, tanks and minor bulkheads.	Correct material for job selected. Finished job within 3mm of specification.
Assemble, erect and fair sub-units, girders, transverses, frames, deck and shell panels and major bulkheads.	Correct units for job selected. Finished units within 3mm of specification.
Use fairing and levelling aids, including plumb board, plumb bob, spirit level and water pipes.	Assembly and fairing aids used minimally. Structures aligned and level to within 2mm.
Lift, transport and position materials.	Correct slings and techniques used.

APPENDIX C

TRAINING REQUIREMENTS FOR GERMAN SHIPBUILDING OCCUPATIONS

Job specification for vocational training

Boilermaker and tank construction worker

(in-plant training)

State-approved by decree of the Federal German Economics Minister — II A 4 — 2262/56 dated August 4, 1956

Duration of training: 3 years

Activities:

Marking out and machining of parts for pressureless and pressurized boilers, tanks and larger pipe systems, using non-alloy and alloy structural steels
Matching and fitting these parts and preparing boilers and tanks for dimensional checking and pressure testing
Care and maintenance of machinery, equipment and fittings

Skills and knowledge to be imparted during training:

Essential items:

Familiarization with main and auxiliary working materials, their characteristics and their machining and utilization potential
Basic metalworking skills:
Basic work in the following areas: measuring, scribing, center-punching, stamping, filing, sawing, boring, reaming, sinking, thread cutting by hand, forging and hardening simple tools, sharpening by grinding
Use of hand chisels, cross-cutting
Use of hand grinders
Straightening and bending by hand and mechanically
Flanging and neck forming
Transfer and marking out of simple involute curves, preparing sheet metal templates
Fitting elements of boilers, tanks and pipework together
Shrink fitting
Trimming sheet metal sections
Hammering (forge work)
Cold and hot riveting by hand and mechanically
Hand mortising
Inserting stay bolts
Pipe bending, flanging, internal rolling, opening out with mandrel, trimming
Fitting and sealing pipe fittings, assembling boilers, tanks and pipework
Preparing boilers and tanks for pressure testing
Tack welding — oxy-acetylene and electric
Oxy-acetylene flame cutting
Familiarization with the relevant accident protection and industrial safety regulations

Desired items:

Dishing bases of vessels
Assisting on shears and bending machines

W. Bertelsmann Verlag KG Bielefeld Bestell-Nr. 12 36 007 01
Berufsbild Kessel- und Behälterbauer, englisch

Job specification for vocational training

Lathe operator

State-approved by decree of the Federal German Economics Minister — II B 5 — 46 67 10 — dated March 1, 1962

Area of activity: Machining parts of machinery, tools and plant from steel, castings, non-ferrous metals, pressed materials and plastics on chip-removing machine tools, in particular various patterns of lathe

Duration of training: 3 years

Skills and knowledge to be imparted during in-company training:

Reading production drawings

Characteristics of main and ancillary materials, their uses and machining potential

Basic skills in the machining of materials

Simple work on shaping and milling machines

Work on the engine lathe in steel, on castings, in non-ferrous metals, pressed materials and plastics, and also with carbide metal tools up to the maximum precision limits and equivalent surface finishes, in various patterns of chuck, between centers, on the facing plate, with the steady and with special clamping fixtures

Measuring and marking out

Clamping and aligning workpieces

Setting up lathes

Grinding tools

Straight turning and facing

Facing

Boring, center-boring

Reaming

Taper turning

Slotting, rebating and recess turning

Pattern turning

Knurling and bordering

Turning and cutting single and multiple pitch internal and external threads of all customary patterns with threading tools, taps, dies, cutting heads and chasers

Care and maintenance of machines, tools, measuring gear and other working equipment

Knowledge of accident prevention regulations and first aid

Desirable items:

Work on the turret, facing and vertical turret lathes, the copying lathe, the grinding machine and on boring and milling machinery

Lapping and honing

Lathe turning with diamond and ceramic tipped tools

W. Bertelsmann Verlag KG Bielefeld Bestell-Nr. 12 36 004 01
Berufsbild Dreher, englisch

Job specification for vocational training

Mechanic

(practical training)

Duration of training: 3 1/2 years

Area of activity:

Roughing and finishing parts for small items of equipment and machinery, fitting prior to assembly

Assembling small items of equipment and machinery, testing and aligning

Making up simple tools and fixtures for the production of apparatus and machinery components

Repairs to small items of equipment and machines

Care and maintenance of working tools, machines and equipment

Skills and knowledge to be imparted during training:

Essential items:

Measuring, marking out, center-punching

Filing, chisel work, sawing

Fitting, scraping

Boring, reaming, sinking, thread cutting

Straightening, bending

Riveting

Spring winding

Forging simple workpieces and tools; hardening, grinding and sharpening

Soldering and brazing

Simple turning, planing and milling work

Simple sheet metal work

Draw-polishing

Assembly, testing and alignment of small items of equipment and machines

Care and maintenance of working tools, machines and equipment

Desirable items:

Simple grinding work

Production of simple parts by spinning

Pickling, painting, dyeing

Simple welding and flame cutting

Heat treatment of simple workpieces

Broaching

W. Bertelsmann Verlag KG Bielefeld Bestell-Nr. 12 36 002 01
Berufsbild Mechaniker, englisch

Job specification for vocational training

Mechanical fitter

(in-plant training)

Duration of training: 3 1/2 years

Activities:

Roughing and finishing parts of machinery and apparatus, fitting prior to assembly
Assembling, testing and starting up machinery and apparatus
Repairs to machinery and apparatus
Care and maintenance of working tools, machines and equipment

Skills and knowledge to be imparted during training:

Essential items:

Familiarization with the main process and ancillary materials, their characteristics, utilization and machining potential
Measuring, marking out
Filing, scraping, chiselling, sawing
Fitting
Boring, reaming, sinking, thread cutting
Straightening, bending
Riveting
Spring winding
Forging simple workpieces and tools
Soldering and brazing
Simple turning and planing work
Hardening and sharpening simple tools
Assembly
Care and maintenance of working tools, machines and equipment

Desirable items:

Simple milling and grinding work
Pipe bending, flanging and fitting
Simple welding work, flame cutting
Heat treatment of simple workpieces

W. Bertelsmann Verlag KG Bielefeld Bestell-Nr. 12 36 001 01
Berufsbild Maschinenschlosser, englisch

Job specification for vocational training

Woodworking-trade mechanic

Specific trade: seating and frame industry

Woodworking Trade Mechanics' Vocational Training Order dated June 28, 1974 (Federal German Gazette I, page 1412), §§ 1, 2 and 3

Duration of training, specialised trades

Vocational training lasts three years. Before the third year of training a choice can be made among the following specialised trades:

Furniture and cabinet-making

Interior finishing, building-accessory and shopfitting supply industries

Seating furniture and frame manufacturing industry

Box, crate and pallet industry

Moulding and frame industry

Parquet industry

(1) Shared vocational training for all these specialised trades must at least cover the following skills and knowledge:

1. Knowledge of the nature and properties of various types of timber, their processing and their uses, of wooden and plastic materials and of metals and other auxiliary substances
2. Interpreting and producing sketches and drawings
3. Processing and working wood and plastics by hand
4. Use of binders, in particular glues and adhesives
5. Processing veneers
6. Treating wood and plastic surfaces
7. Carrying out test work
8. Basic metalworking skills
9. Basic knowledge of mechanical, pneumatic, hydraulic and electrical processes on machines and equipment
10. Setting up, operating and maintaining machines, equipment and fixtures for woodworking and wood processing
11. Tracing and eliminating faults on machines, equipment and fixtures for woodworking and wood processing
12. Knowledge of the design and assembly of woodworking industry products

W. Bertelsmann Verlag KG Bielefeld Bestell-Nr. 12 36 021 02
Ausbildungsberufsbild Holzmechaniker, Fachrichtung Sitzmöbel- und Gestellindustrie, englisch
Also available in German: text of Woodworking Trade Mechanics' Vocational Training Order – Order No. 61 02 080 62

13. Production of parts
14. Assembly of prefabricated parts
15. Production of jigs and fixtures
16. Maintenance and repair of tools
17. Knowledge of work and company organization
18. Industrial safety and accident prevention

(2) Vocational training for the specialised trades must cover, in addition to extension and deepening of the skills and knowledge stated in Para. 1 No. 10, at least the following skills and knowledge:

For the specialised mechanic in the seating and frame industry:

a) Fine-finishing of surfaces
b) Assembly of parts to form seating furniture and frames
c) Knowledge of upholstery materials and techniques

Job specification for vocational training

Woodworking-trade mechanic

Specific trade: seating and frame industry

Woodworking Trade Mechanics' Vocational Training Order dated June 28, 1974 (Federal German Gazette I, page 1412), §§ 1, 2 and 3

Duration of training, specialised trades

Vocational training lasts three years. Before the third year of training a choice can be made among the following specialised trades:

Furniture and cabinet-making

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Seating furniture and frame manufacturing industry

Box, crate and pallet industry

Moulding and frame industry

Parquet industry

(1) Shared vocational training for all these specialised trades must at least cover the following skills and knowledge:

1. Knowledge of the nature and properties of various types of timber, their processing and their uses, of wooden and plastic materials and of metals and other auxiliary substances
2. Interpreting and producing sketches and drawings
3. Processing and working wood and plastics by hand
4. Use of binders, in particular glues and adhesives
5. Processing veneers
6. Treating wood and plastic surfaces
7. Carrying out test work
8. Basic metalworking skills
9. Basic knowledge of mechanical, pneumatic, hydraulic and electrical processes on machines and equipment
10. Setting up, operating and maintaining machines, equipment and fixtures for woodworking and wood processing
11. Tracing and eliminating faults on machines, equipment and fixtures for woodworking and wood processing
12. Knowledge of the design and assembly of woodworking industry products

W. Bertelsmann Verlag KG Bielefeld Bestell-Nr. 12 36 021 02
Ausbildungsberufsbild Holzmechaniker, Fachrichtung Sitzmöbel- und Gestellindustrie, englisch
Also available in German, text of Woodworking Trade Mechanics' Vocational Training Order — Order No. 81 02 080 62

13. Production of parts
14. Assembly of prefabricated parts
15. Production of jigs and fixtures
16. Maintenance and repair of tools
17. Knowledge of work and company organization
18. Industrial safety and accident prevention

(2) Vocational training for the specialised trades must cover, in addition to extension and deepening of the skills and knowledge stated in Para. 1 No. 10, at least the following skills and knowledge:

For the specialised mechanic in the seating and frame industry:

a) Fine-finishing of surfaces
b) Assembly of parts to form seating furniture and frames
c) Knowledge of upholstery materials and techniques

§§ | Para. | No. | Letter *)

Job specification for vocational training
Electronics mechanic — energy supply

16.—.—.—	**Vocational training must cover at least the following knowledge and skills, based on those stated in §§ 3 and 5 (for the electrical installation mechanic). (Training period: 1 1/2 years.)**
16.—. 1.—	**1. Extending knowledge of electrical plant construction:**
16.—. 1. a	Drawing up technical documentation
16.—. 1. b	Construction and operating characteristics of electrical machines
16.—. 1. c	Construction and operating principle of switchgear and distribution equipment, mains grids and protective devices in energy-supply engineering
16.—. 1. d	Basic principles and circuitry of electronics and their applications in switching systems
16.—. 1. e	Basic principles of control and regulating technology and their applications to electrical operating equipment
16.—. 1. f	Basic terms in lighting and illumination technology
16.—. 1. g	Industrial safety and accident prevention
16.—. 2.—	**2. Skills in and knowledge of assembly, installation, wiring and connecting procedures:**
16.—. 2. a	Further instruction in the assembly of electrical devices and operating equipment
16.—. 2. b	Further instruction in the wiring of energy supply circuits
16.—. 2. c	Further instruction in the production of conducting electrical joints

*) The §§, paragraphs, numbers and letters stated here and overleaf refer to the Federal German Order concerning Vocational Training in Electrical Engineering, dated December 12, 1972 (Fed. Ger. Gazette Part I, pages 2385—2440)

W. Bertelsmann Verlag KG Bielefeld Bestell-Nr. 12 36 016 02
Ausbildungsberufsbild Energieanlagenelektroniker, englisch
Also available in German: job descriptions, vocational training specifications, vocational training curricula and examination requirements (folder) for multi-stage training in electrical engineering — **Energy supply plant engineering** — Order No. 12 35 3106 44

16.—. 3.—	**3. Skill in and knowledge of measuring, testing and start-up procedures:**
16.—. 3. a	Further instruction in the measurement of electrical values
16.—. 3. b	Further instruction in the measurement of non-electrical values
16.—. 3. c	Further instruction in the checking of electrical functions
16.—. 3. d	Starting up devices and equipment for energy supply
16.—. 4.—	**4. Skill in and knowledge of the repair of electrical energy supply equipment**
16.—. 5.—	**5. Skill in and knowledge of the maintenance of electrical energy supply equipment**

Job specification for vocational training
Electrical installation mechanic

Duration of training: 2 years

3.—.—.—	**Vocational training must cover at least the following knowledge and skills:**
3.—. 1.—	**1. General knowledge**
3.—. 1. a	Working and auxiliary materials
3.—. 1. b	Interpreting technical drawings
3.—. 1. c	Using books of tables and reference books
3.—. 2.—	**2. Skill in and knowledge of materials processing:**
3.—. 2. a	Measuring and testing
3.—. 2. b	Marking out, centerpunching, applying identification marks
3.—. 2. c	Filing
3.—. 2. d	Sawing
3.—. 2. e	Drilling, sinking and reaming
3.—. 2. f	Thread cutting
3.—. 2. g	Sharpening by grinding
3.—. 2. h	Parting-off, using shears, perforating
3.—. 2. i	Straightening
3.—. 2. k	Bending
3.—. 2. l	Turning

*) The §§, paragraphs, numbers and letters stated here and on the following pages refer to the Federal German Order concerning Vocational Training in Electrical Engineering, dated December 12, 1972 (Fed. Ger. Gazette Part I, pages 2385—2440)

W. Bertelsmann Verlag KG Bielefeld Bestell-Nr. 12 36 014 04
Ausbildungsberufsbild Elektroanlageninstallateur, englisch
Also available in German: job descriptions, vocational training specifications, vocational training curricula and examination requirements (folder) for multi-stage training in electrical engineering —
Energy supply equipment technology — Order No. 12 35 3106 44

3.—. 3.—	**3. Skill in and knowledge of jointing techniques**
3.—. 3. a	Soft soldering
3.—. 3. b	Using adhesives
3.—. 3. c	Riveting
3.—. 3. d	Threaded connections
3.—. 4.—	**4. Knowledge of electrical engineering**
3.—. 4. a	Conducting and non-conducting materials
3.—. 4. b	Interpreting circuit diagrams
3.—. 4. c	Basic electrical theory
3.—. 4. d	Electrical and electromechanical components
3.—. 5.—	**5. Skill in and knowledge of electrical engineering**
3.—. 5. a	Processing and preparing electrical wiring
3.—. 5. b	Producing simple windings
3.—. 5. c	Preparing electrical components for installation
3.—. 6.—	**6. Skill in and knowledge of assembly work, wiring and connecting**
3.—. 6. a	Assembling components
3.—. 6. b	Wiring and connecting
3.—. 7.—	**7. Skill in and knowledge of measuring and testing procedures**
3.—. 7. a	Measuring electrical values
3.—. 7. b	Testing current flow paths and the continuity of wiring
3.—. 8.—	**8. Knowledge of industrial safety and accident prevention**
5.—. 1.—	**9. Extending knowledge of electrical engineering and its application electrical equipment construction:**
5.—. 1. a	Interpreting circuit diagrams
5.—. 1. b	Further study of electrical theory
5.—. 1. c	Electrical and electromechanical components
5.—. 1. d	Industrial safety and accident prevention
5.—. 2.—	**10. Extending knowledge of and skill in jointing techniques**
5.—. 2. a	Brazing
5.—. 2. b	Welding
5.—. 3.—	**11. Skill in and knowledge of assembly, setting-up and attachment work**
5.—. 3. a	Assembling electrical operating equipment
5.—. 3. b	Setting up and attaching electrical energy supply equipment

§§	Para. No.	Letter	*)	Electrical installation mechanic
5.—.	4.—			**12. Skill in and knowledge of wiring installation, circuitry and connecting methods**
5.—.	4.	a		Processing and preparing energy supply wiring and cables up to 1 kilovolt (kV) rating
5.—.	4.	b		Installing wiring and cables
5.—.	4.	c		Producing electrically conducting joints
5.—.	5.—			**13. Skill in and knowledge of measuring and testing procedures**
5.—.	5.	a		Measuring electrical values
5.—.	5.	b		Checking electrical functioning
5.—.	5.	c		Measuring non-electrical values
5.—.	6.—			**14. Skill in and knowledge of repair and maintenance work on electrical installations**
5.—.	6.	a		Repairing electrical installations
5.—.	6.	b		Maintenance work on electrical installations

Job specification for vocational training

Motor mechanic (repair work)

(for practical training)

Duration of training: 3 1/2 years

Activities:

Repair of motor vehicles (automobiles, trucks, motorcycles):
Identifying faults and damage on motor vehicles
Rough and final machining of parts
Assembling, fitting and installing all assemblies
Eliminating faults and damage on motor vehicles, including the electrical system
Testing motor vehicles, including road testing
Care and maintenance of working equipment, machinery and fittings

Skills and knowledge to be imparted during training:

Essential items:

Basic metalworking skills
Basic work in the following areas: measuring, marking out, filing, chiselling, sawing, scraping, fitting, boring, reaming, sinking, hand thread cutting, straightening, bending, hammering, riveting, stamping, soldering and brazing, cutting with shears, forging simple items, hardening, sharpening by grinding
Simple gas welding work
Simple lathe operation
Identifying faults and damage on motor vehicles (including accompanying the driver on road test runs)
Rectification of simple faults and damage on motor vehicles, including the electrical system:
Removing and stripping down parts and assemblies
Repairing parts and assemblies
Rough and finish machining of new parts
Assembling, fitting and installing parts and assemblies
Simple repair work on chassis and body
Maintenance of motor vehicles and their parts
Care and maintenance of working equipment, machinery and fittings

Desirable items:

Simple milling and planing work
Heat treatment of simple workpieces
Precision boring and honing of cylinders
Simple repair work on diesel-engined vehicles and vehicles operated on local fuels

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Berufsbild Kraftfahrzeugschlosser, englisch